OMRON

Machine Automation Controller
Industrial PC Platform

NJ/NY-series

NC Integrated Controller

User's Manual

NJ501-5300
NY532-5400

CPU Unit
Industrial Panel PC

SYSMAC
always in control

O030-E1-03

Introduction

Thank you for purchasing an NJ/NY-series NC Integrated Controller. ("NJ/NY-series NC Integrated Controller" is sometimes abbreviated as "NC Integrated Controller".)

This manual contains information that is necessary to use the NC Integrated Controller. Please read this manual and make sure you understand the functionality and performance of the NC Integrated Controller 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.

This manual only describes functions that are added to NJ501-5300 or NY532-5400.

When you use NJ501-5300, also consult manuals for the NJ-series listed in *Related Manuals* on page 25 for functions common to NJ501-□□□□ Series including NJ501-1□□□.

When you use NY532-5400, also consult manuals for the NY-series listed in *Related Manuals* on page 25 for functions common to NY532-□□□□ Series including NY532-1□□□.

Intended Audience

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

- Personnel in charge of 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

This manual is also intended for personnel who understand the following contents.

- For programming, this manual is intended for personnel who understand the programming language specifications in international standard IEC 61131-3 or Japanese standard JIS 3503.
- For NC programming, this manual is intended for personnel who understand the programming language specifications in international standard ISO 6983-1 or Japanese standard JIS 6315.

Applicable Products

This manual covers the following products.

- NJ-series NC Integrated Controller
  NJ501-5300
- NY-series NC Integrated Controller
  NY532-5400

Relevant Manuals

The following table lists the relevant manuals for this product. Read all of the manuals that are relevant to your system configuration and application before you use this product.

Most operations are performed from the Sysmac Studio and CNC Operator Automation Software.

Refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for information on the Sysmac Studio, and *CNC Operator Operation Manual* (Cat. No. O032) for the CNC Operator.

Relevant Manuals for NJ Series

Purpose of use	Manual									
	Basic information									
	NJ-series CPU Unit Hardware User's Manual	NJ/NX-series CPU Unit Software User's Manual	NJ/NX-series Instructions Reference Manual	NJ/NX-series CPU Unit Motion Control User's Manual	NJ/NX-series Motion Control Instructions Reference Manual	NJ/NX-series CPU Unit Built-in EtherCAT® Port User's Manual	NJ/NX-series CPU Unit Built-in EtherNet/IP™ Port User's Manual	NJ/NY-series NC Integrated Controller User's Manual	NJ/NY-series G code Instructions Reference Manual	NJ/NX-series Troubleshooting Manual
Introduction to NJ-series Controllers	●									
Setting devices and hardware	●									
Using motion control				●						
Using EtherCAT						●				
Using EtherNet/IP							●			
Software settings		●								
Using motion control				●						
Using EtherCAT						●				
Using EtherNet/IP							●			
Using numerical control								●		
Writing the user program		●	●							
Using motion control				●	●					
Using EtherCAT						●				
Using EtherNet/IP							●			
Using numerical control								●	●	
Programming error processing										●
Testing operation and debugging		●								
Using motion control				●						
Using EtherCAT						●				
Using EtherNet/IP							●			
Using numerical control								●		

Purpose of use	Manual									
	Basic information									
	NJ-series CPU Unit Hardware User's Manual	NJ/NX-series CPU Unit Software User's Manual	NJ/NX-series Instructions Reference Manual	NJ/NX-series CPU Unit Motion Control User's Manual	NJ/NX-series Motion Control Instructions Reference Manual	NJ/NX-series CPU Unit Built-in EtherCAT® Port User's Manual	NJ/NX-series CPU Unit Built-in EtherNet/IP™ Port User's Manual	NJ/NY-series NC Integrated Controller User's Manual	NJ/NY-series G code Instructions Reference Manual	NJ/NX-series Troubleshooting Manual
Learning about error management and corrections*1	△	△		△		△	△	△		●
Maintenance	●									
Using motion control				●						
Using EtherCAT						●				
Using EtherNet/IP							●			

*1. Refer to the *NJ/NX-series Troubleshooting Manual* (Cat. No. W503) for error management concepts and an overview of the items subject to errors. Refer to the manuals that are indicated with triangles for details on errors for the corresponding Units.

Relevant Manuals for NY Series

Purpose of use	Manual											
	Basic information											
	NY-series Industrial Panel PC Hardware User's Manual	NY-series Industrial Box PC Hardware User's Manual	NY-series Industrial Panel PC / Industrial Box PC Setup User's Manual	NY-series Industrial Panel PC / Industrial Box PC Software User's Manual	NY-series Instructions Reference Manual	NY-series Industrial Panel PC / Industrial Box PC Motion Control User's Manual	NY-series Motion Control Instructions Reference Manual	NY-series Industrial Panel PC / Industrial Box PC Built-in EtherCAT Port User's Manual	NY-series Industrial Panel PC / Industrial Box PC Built-in EtherNet/IP Port User's Manual	NJ/NY-series NC Integrated Controller User's Manual	NJ/NY-series G code Instructions Reference Manual	NY-series Troubleshooting Manual
Introduction to NY-series Panel PCs	○											
Introduction to NY-series Box PCs		○										
Setting devices and hardware	○	○										
Using motion control						○						
Using EtherCAT								○				
Using EtherNet/IP									○			
Making setup*1			○									
Making initial settings												
Preparing to use Controllers												
Software settings				○								
Using motion control						○						
Using EtherCAT								○				
Using EtherNet/IP									○			
Using numerical control										○		
Writing the user program				○	○							
Using motion control						○	○					
Using EtherCAT								○				
Using EtherNet/IP									○			
Using numerical control										○	○	
Programming error processing												○
Testing operation and debugging				○								
Using motion control						○						
Using EtherCAT								○				
Using EtherNet/IP									○			
Using numerical control										○		
Learning about error management and corrections*2										△		○
Maintenance	○	○										
Using motion control						○						
Using EtherCAT								○				
Using EtherNet/IP									○			

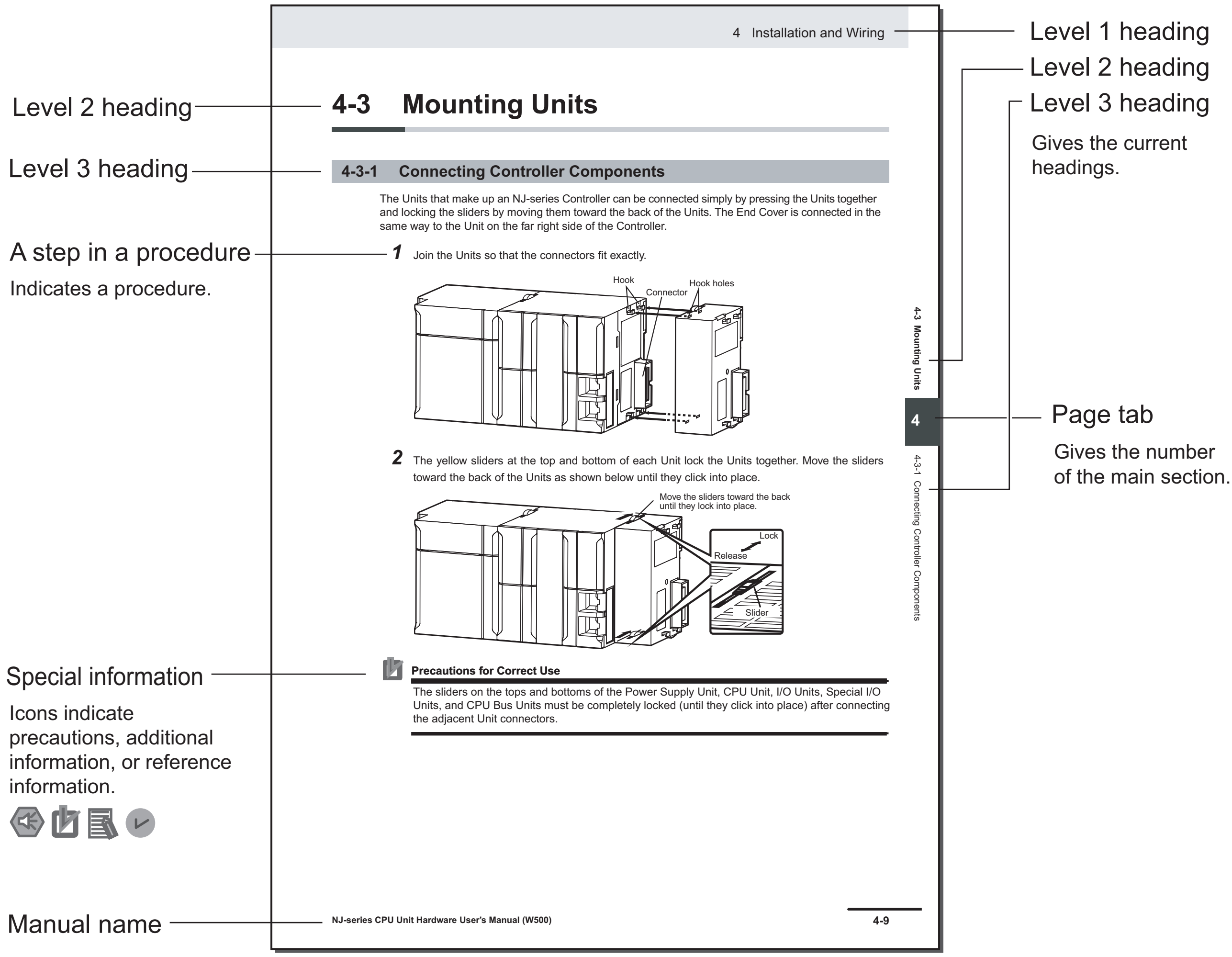
*1. Refer to the *NY-series Industrial Panel PC / Industrial Box PC Setup User's Manual* (Cat. No. W568) for how to set up and how to use the utilities on Windows.

*2. Refer to the *NY-series Troubleshooting Manual* (Cat. No. W564) for the error management concepts and an overview of the items subject to errors.

Manual Structure

Page Structure and Symbols

The following page structure and symbols are used in this manual.



Note This illustration is only provided 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 and ease of operation.

Version Information

Information on differences in specifications and functionality for NC Integrated Controller with different unit versions and for different versions of the Sysmac Studio and the CNC Operator are given.

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.
- Some of the instructions described in this manual are common to NJ/NY-series as well. Therefore, note the following conditions.

(a) NJ-series enables you to connect a computer that runs the Support Software directly to the CPU Unit with a USB connection. However, NY-series has no peripheral USB port. For details, refer to the *NJ/NX-series CPU Unit Software User's Manual* (Cat. No. W501) or the *NY-series Industrial Panel PC / Industrial Box PC Software User's Manual* (Cat. No. W558).

(b) NY-series Controllers have no SD Memory Card slots. Instead, they provide the Virtual SD Memory Card function that uses the Windows shared folder. Therefore, replace the term SD Memory Card with Virtual SD Memory Card. For details on the Virtual SD Memory Card, refer to the *NY-series Industrial Panel PC / Industrial Box PC Software User's Manual* (Cat. No. W558) or the *NY-series Industrial Panel PC / Industrial Box PC Setup User's Manual* (Cat. No. W568).

Sections in this Manual

CONTENTS

Section 2 CNC System Configuration and Principles

Section 3 Configuring CNC Motors and CNC Coordinate Systems

Section 4 CNC Parameters

Section 5 CNC Program

Section 6 Realization of CNC Machines

Section 7 Manual Operation

Section 8 Homing

Section 9 Control Functions for CNC Motor and CNC Coordinate System Operations

Section 10 CNC Instructions

Section 11 Variables and Instructions

Section 12 CNC Coordinate System Instructions

Section 13 Common Command Instructions

Section 14 System Control Instructions

Section 15 Troubleshooting

Appendices

Terms and Conditions Agreement

Warranty, Limitations of Liability

Warranties

- **Exclusive Warranty**

Omron's exclusive warranty is that the Products will be free from defects in materials and workmanship for a period of twelve months from the date of sale by Omron (or such other period expressed in writing by Omron). Omron disclaims all other warranties, express or implied.

- **Limitations**

OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, ABOUT NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OF THE PRODUCTS. BUYER ACKNOWLEDGES THAT IT ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE.

Omron further disclaims all warranties and responsibility of any type for claims or expenses based on infringement by the Products or otherwise of any intellectual property right.

- **Buyer Remedy**

Omron's sole obligation hereunder shall be, at Omron's election, to (i) replace (in the form originally shipped with Buyer responsible for labor charges for removal or replacement thereof) the non-complying Product, (ii) repair the non-complying Product, or (iii) repay or credit Buyer an amount equal to the purchase price of the non-complying Product; provided that in no event shall Omron be responsible for warranty, repair, indemnity or any other claims or expenses 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. Return of any Products by Buyer must be approved in writing by Omron before shipment. Omron Companies shall not be liable for the suitability or unsuitability or the results from the use of Products in combination with any electrical or electronic components, circuits, system assemblies or any other materials or substances or environments. Any advice, recommendations or information given orally or in writing, are not to be construed as an amendment or addition to the above warranty.

See http://www.omron.com/global/ or contact your Omron representative for published information.

Limitation on Liability; Etc

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

Further, in no event shall liability of Omron Companies exceed the individual price of the Product on which liability is asserted.

Application Considerations

Suitability of Use

Omron Companies shall not be responsible for conformity with any standards, codes or regulations which apply to the combination of the Product in the Buyer's application or use of the Product. At Buyer's request, Omron will provide applicable third party certification documents identifying ratings and limitations of use which apply to the Product. This information by itself is not sufficient for a complete determination of the suitability of the Product in combination with the end product, machine, system, or other application or use. Buyer shall be solely responsible for determining appropriateness of the particular Product with respect to Buyer's application, product or system. Buyer shall take application responsibility in all cases.

NEVER USE THE PRODUCT FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY OR IN LARGE QUANTITIES WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCT(S) IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

Programmable Products

Omron Companies shall not be responsible for the user's programming of a programmable Product, or any consequence thereof.

Disclaimers

Performance Data

Data presented in Omron Company websites, catalogs and other materials 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 user must correlate it to actual application requirements. Actual performance is subject to the Omron's Warranty and Limitations of Liability.

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 part numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the Product may be changed without any notice. When in doubt, special part numbers may be assigned to fix or establish key specifications for your application. Please consult with your Omron's representative at any time to confirm actual specifications of purchased Product.

Errors and Omissions

Information presented by Omron Companies has been checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical or proofreading errors or omissions.

Safety Precautions

Refer to the following manuals for safety precautions.

- *NJ-series CPU Unit Hardware User's Manual* (Cat. No. W500)
- *NY-series Industrial Box PC Hardware User's Manual* (Cat. No. W556)
- *NY-series Industrial Panel PC Hardware User's Manual* (Cat. No. W557)
- *CNC Operator Operation Manual* (Cat. No. O032)

Precautions for Safe Use

Refer to the following manuals for precautions for safe use.

- *NJ-series CPU Unit Hardware User's Manual* (Cat. No. W500)
- *NY-series Industrial Box PC Hardware User's Manual* (Cat. No. W556)
- *NY-series Industrial Panel PC Hardware User's Manual* (Cat. No. W557)
- *CNC Operator Operation Manual* (Cat. No. O032)

Numerical Control

- When you have changed CNC motor compensation table values with CNC Operator, be sure to save the values to the retained memory or to a file and load them when the power is turned ON again. If the CNC motor compensation table values are not saved, the previous condition will be restored when the power is turned ON thus possibly causing the machine to operate unexpectedly.
- When you execute feed hold reset, the tool automatically returns to the feed hold stop position with rapid feed. For this reason ensure that there are no obstacles in the way of the execution of feed hold reset.

Precautions for Correct Use

Refer to the following manuals for precautions for correct use.

- *NJ-series CPU Unit Hardware User's Manual* (Cat. No. W500)
- *NY-series Industrial Box PC Hardware User's Manual* (Cat. No. W556)
- *NY-series Industrial Panel PC Hardware User's Manual* (Cat. No. W557)
- *CNC Operator Operation Manual* (Cat. No. O032)

Numerical Control

- Use the system-defined variable in the user program to confirm that EtherCAT communications are established before you attempt to execute CNC instructions. CNC instructions are not executed normally if EtherCAT communications are not established.

Regulations and Standards

Refer to the following manuals for regulations and standards.

- *NJ-series CPU Unit Hardware User's Manual* (Cat. No. W500)
- *NY-series Industrial Box PC Hardware User's Manual* (Cat. No. W556)
- *NY-series Industrial Panel PC Hardware User's Manual* (Cat. No. W557)

Versions

Hardware revisions and unit versions are used to manage the hardware and software in NJ/NY-series Units and EtherCAT slaves. The hardware revision or unit version is updated each time there is a change in hardware or software specifications. Even when two Units or EtherCAT slaves have the same model number, they will have functional or performance differences if they have different hardware revisions or unit versions.

Checking Versions

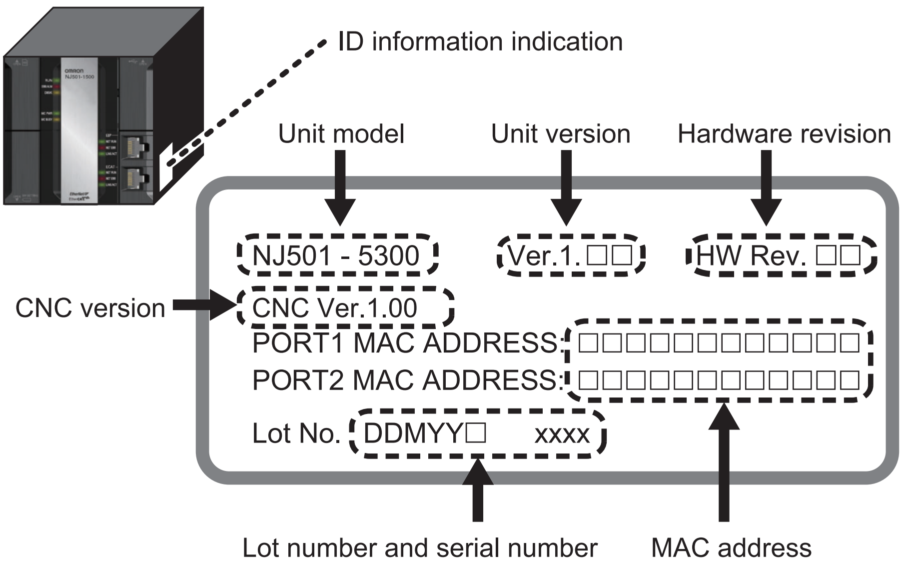
You can check versions on the ID information indications or with the Sysmac Studio.

Checking Unit Versions on ID Information Indications

The unit version is given on the ID information indication on the side of the product.

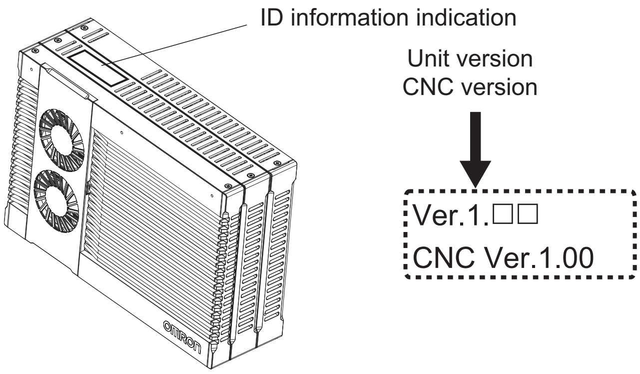
● Checking the Unit Version of an NJ-series CPU Unit

The ID information on the NJ501-5300 is shown below.



● Checking the Unit Version of an NY-series Controller

The ID information on an NY-series NY5□2-1□□□ Controller is shown below.



Checking Unit Versions with the Sysmac Studio

You can use the Sysmac Studio to check unit versions. The procedure is different for Units and for EtherCAT slaves.

● Checking the Unit Version of an NJ-series CPU Unit

You can use the Production Information while the Sysmac Studio is online to check the unit version of a Unit. You can do this for the CPU Unit, CJ-series Special I/O Units, and CJ-series CPU Bus Units. You cannot check the unit versions of CJ-series Basic I/O Units with the Sysmac Studio.

Use the following procedure to check the unit version.

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.

2 Right-click any open space in the Unit Editor and select **Production Information**.

The Production Information Dialog Box is displayed.

● Checking the Unit Version of an NY-series Controller

You can use the Production Information while the Sysmac Studio is online to check the unit version of a Unit. You can only do this for the Controller.

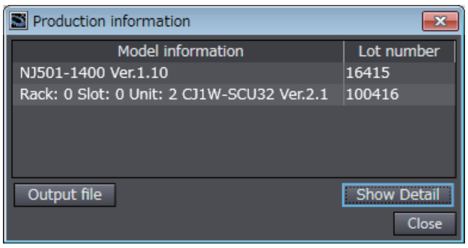
1 Right-click **CPU Rack** under **Configurations and Setup** - **CPU/Expansion Racks** in the Multiview Explorer and select **Production Information**.

The Production Information Dialog Box is displayed.

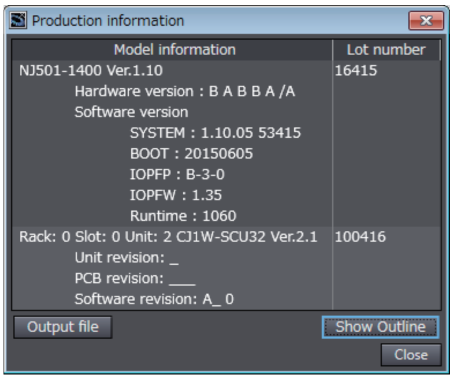
● Changing Information Displayed in Production Information Dialog Box

1 Click the **Show Detail** or **Show Outline** Button at the lower right of the **Production Information** Dialog Box.

The view will change between the production information details and outline.



Outline View



Detail View

The information displayed is different for the Outline View and Detail View. The Detail View displays the unit version, hardware version, and software version. The Outline View displays only the unit version.

Note The hardware revision is separated by "/" and displayed on the right of the hardware version.

● Checking the Unit Version of an EtherCAT Slave

You can use the Production Information while the Sysmac Studio is online to check the unit version of an EtherCAT slave. Use the following procedure to check the unit version.

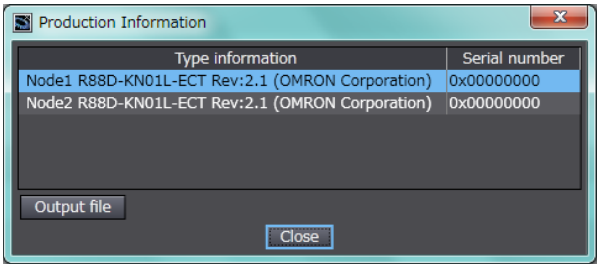
1 Double-click **EtherCAT** under **Configurations and Setup** in the Multiview Explorer. Or, right-click **EtherCAT** under **Configurations and Setup** and select **Edit** from the menu.

The EtherCAT Tab Page is displayed.

2 Right-click the master on the EtherCAT Tab Page and select **Display Production Information**.

The Production Information Dialog Box is displayed.

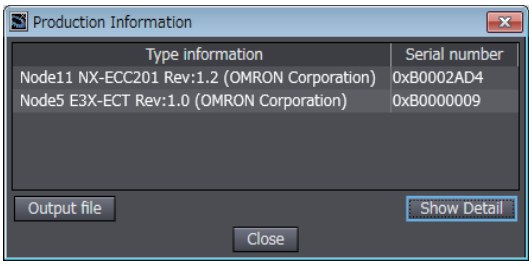
The unit version is displayed after “Rev.”



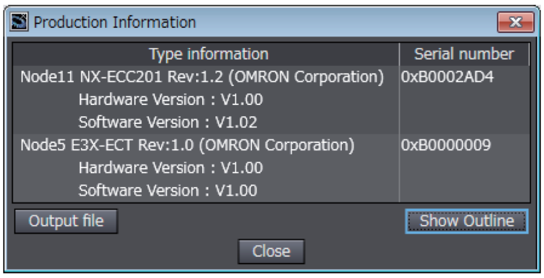
● Changing Information Displayed in Production Information Dialog Box

1 Click the **Show Detail** or **Show Outline** Button at the lower right of the **Production Information** Dialog Box.

The view will change between the production information details and outline.



Outline View



Detail View

Related Manuals

The following manuals are related. Use these manuals for reference.

Manual name	Cat. No.	Model numbers	Application	Description
NJ-series CPU Unit Hardware User’s Manual	W500	NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	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. • Features and system configuration • Introduction • Part names and functions • General specifications • Installation and wiring • Maintenance and inspection
NJ/NX-series CPU Unit Software User’s Manual	W501	NX701-□□□□ NX1P2-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	Learning how to program and set up an NJ/NX-series CPU Unit. Mainly software information is provided.	The following information is provided on a Controller built with an NJ/NX-series CPU Unit. • CPU Unit operation • CPU Unit features • Initial settings • Programming based on IEC 61131-3 language specifications
NJ/NX-series Instructions Reference Manual	W502	NX701-□□□□ NX1P2-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	Learning detailed specifications on the basic instructions of an NJ/NX-series CPU Unit.	The instructions in the instruction set (IEC 61131-3 specifications) are described.
NJ/NX-series CPU Unit Motion Control User's Manual	W507	NX701-□□□□ NX1P2-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	Learning about motion control settings and programming concepts.	The settings and operation of the CPU Unit and programming concepts for motion control are described.
NJ/NX-series Motion Control Instructions Reference Manual	W508	NX701-□□□□ NX1P2-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	Learning about the specifications of the motion control instructions.	The motion control instructions are described.
NJ/NX-series CPU Unit Built-in EtherCAT® Port User’s Manual	W505	NX701-□□□□ NX1P2-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	Using the built-in EtherCAT port on an NJ/NX-series CPU Unit.	Information on the built-in EtherCAT port is provided. This manual provides an introduction and provides information on the configuration, features, and setup.
NJ/NX-series CPU Unit Built-in EtherNet/IP™ Port User's Manual	W506	NX701-□□□□ NX1P2-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	Using the built-in EtherNet/IP port on an NJ/NX-series CPU Unit.	Information on the built-in EtherNet/IP port is provided. Information is provided on the basic setup, tag data links, and other features.
NJ/NY-series NC Integrated Controller User's Manual	O030	NJ501-5300 NY532-5400	Performing numerical control with NJ/NY-series Controllers.	Describes the functionality to perform the numerical control. Use this manual together with the *NJ/NY-series G code Instructions Reference Manual* (Cat. No. O031) when programming.
NJ/NY-series G code Instructions Reference Manual	O031	NJ501-5300 NY532-5400	Learning about the specifications of the G code/M code instructions.	The G code/M code instructions are described. Use this manual together with the *NJ/NY-series NC Integrated Controller User's Manual* (Cat. No. O030) when programming.
NJ/NX-series Troubleshooting Manual	W503	NX701-□□□□ NX1P2-□□□□ NJ501-□□□□ NJ301-□□□□ NJ101-□□□□	Learning about the errors that may be detected in an NJ/NX-series Controller.	Concepts on managing errors that may be detected in an NJ/NX-series Controller and information on individual errors are described.

Manual name	Cat. No.	Model numbers	Application	Description
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.
CNC Operator Operation Manual	O032	SYSMAC-RTNC0□□□D	Learning an introduction of the CNC Operator and how to use it.	An introduction of the CNC Operator, installation procedures, basic operations, connection operations, and operating procedures for main functions are described.
NY-series IPC Machine Controller Industrial Panel PC Hardware User's Manual	W557	NY532-1□□□	Learning the basic specifications of the NY-series Industrial Panel PCs, including introductory information, designing, installation, and maintenance. Mainly hardware information is provided.	An introduction to the entire NY-series system is provided along with the following information on the Industrial Panel PC. • Features and system configuration • Introduction • Part names and functions • General specifications • Installation and wiring • Maintenance and inspection
NY-series IPC Machine Controller Industrial Box PC Hardware User's Manual	W556	NY512-1□□□	Learning the basic specifications of the NY-series Industrial Box PCs, including introductory information, designing, installation, and maintenance. Mainly hardware information is provided.	An introduction to the entire NY-series system is provided along with the following information on the Industrial Box PC. • Features and system configuration • Introduction • Part names and functions • General specifications • Installation and wiring • Maintenance and inspection
NY-series IPC Machine Controller Industrial Panel PC / Industrial Box PC Setup User's Manual	W568	NY532-1□□□ NY512-1□□□	Learning the initial settings of the NY-series Industrial PCs and preparations to use Controllers.	The following information is provided on an introduction to the entire NY-series system. • Two OS systems • Initial settings • Industrial PC Support Utility • NYCompolet • Industrial PC API • Backup & recovery
NY-series IPC Machine Controller Industrial Panel PC / Industrial Box PC Software User's Manual	W558	NY532-1□□□ NY512-1□□□	Learning how to program and set up the Controller functions of an NY-series Industrial PC.	The following information is provided on the NY-series Controller functions. • Controller operations • Controller functions • Controller settings • Programming based on IEC 61131-3 language specifications
NY-series Instructions Reference Manual	W560	NY532-1□□□ NY512-1□□□	Learning detailed specifications on the basic instructions of an NY-series Industrial PC.	The instructions in the instruction set (IEC61131-3 specifications) are described.
NY-series IPC Machine Controller Industrial Panel PC / Industrial Box PC Motion Control User's Manual	W559	NY532-1□□□ NY512-1□□□	Learning about motion control settings and programming concepts of an NY-series Industrial PC.	The settings and operation of the Controller and programming concepts for motion control are described.
NY-series Motion Control Instructions Reference Manual	W561	NY532-1□□□ NY512-1□□□	Learning about the specifications of the motion control instructions of an NY-series Industrial PC.	The motion control instructions are described.

Manual name	Cat. No.	Model numbers	Application	Description
NY-series IPC Machine Controller Industrial Panel PC / Industrial Box PC Built-in EtherCAT® Port User's Manual	W562	NY532-1□□□ NY512-1□□□	Using the built-in EtherCAT port in an NY-series Industrial PC.	Information on the built-in EtherCAT port is provided. This manual provides an introduction and provides information on the configuration, features, and setup.
NY-series IPC Machine Controller Industrial Panel PC / Industrial Box PC Built-in EtherNet/IP™ Port User's Manual	W563	NY532-1□□□ NY512-1□□□	Using the built-in EtherNet/IP port in an NY-series Industrial PC.	Information on the built-in EtherNet/IP port is provided. Information is provided on the basic setup, tag data links, and other features.
NY-series Troubleshooting Manual	W564	NY532-1□□□ NY512-1□□□	Learning about the errors that may be detected in an NY-series Industrial PC.	Concepts on managing errors that may be detected in an NY-series Controller and information on individual errors are described.

Terminology

Term	Description
NJ501-1□□□	Represents NJ501-1300/-1400/-1500.
NJ-series NJ NC Integrated Controller	Represents NJ501-5300. It may also be described as NJ501-5□□□.
NY-series NY NC Integrated Controller	Represents NY532-5400. It may also be described as NY5□□-5400.
Axis Coordinate System (Axis Coordinate System)	Indicates a rotational coordinate system or orthogonal coordinate system unique to each axis. It is abbreviated as ACS.
Machine Coordinate System (Machine Coordinate System)	Indicates an orthogonal coordinate system unique to a machine. It is abbreviated as MCS.
User Coordinate System (User Coordinate System)	Indicates an orthogonal coordinate system that the user can define arbitrarily. It is abbreviated as UCS.
Tool Coordinate System (Tool Coordinate System)	Indicates an orthogonal coordinate system having TCP as the origin. It is abbreviated as TCS.
TCS0 (Tool Coordinate System 0)	Indicates the default TCS. The origin is TCP0.
TCSi (Tool Coordinate System i)	Indicates the TCS that the robot is currently selecting. It represents the TCS whose ToolID is i, where i is a number 1 to 16.
TCP (Tool Center Point)	Indicates the end with which the machine (robot) works. Specify this TCP to set positioning in an orthogonal coordinate system.
TCP0 (Tool Center Point 0)	Indicates the default TCP.

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. O030-E1-03

Revision code

Revision code	Date	Revised content
01	October 2017	Original production
02	October 2017	Corrected mistakes.
03	July 2018	• Made changes accompanying release of unit version 1.01 of the CNC. • Corrected mistakes.

1

Introduction to the CNC Function Module

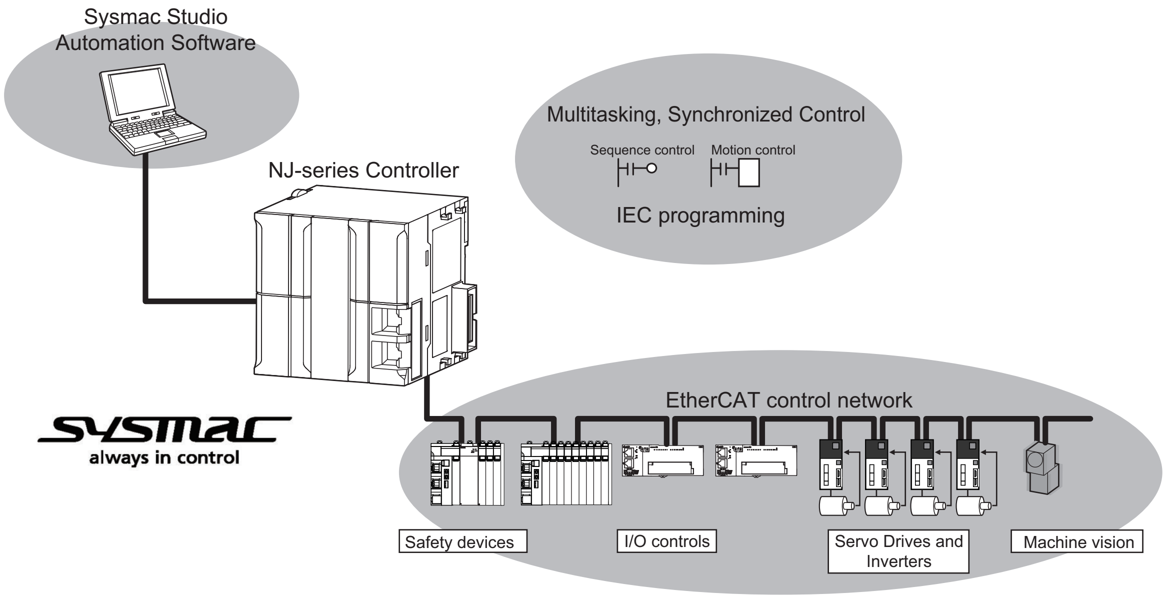
This section describes the features, system configuration, and application flow for the CNC Function Module.

1-1 Features

The NJ/NY-series Controllers are the machine automation controllers of the next generation. They provide various functionality and high-speed performance required for machine control, as well as safety, reliability, and maintainability required as industrial controllers.

In addition to the functionality given by conventional OMRON PLCs, the NJ/NY-series Controllers, as the integrated controllers, are equipped with multiple functionality required for numeric control, and can control input and output devices such as safety, vision, motion devices, and I/O Units synchronously via high-speed EtherCAT.

OMRON offers Sysmac devices that are control devices built with unified communications and user interface specifications. The NJ/NY-series Controllers are designed to realize the optimum functionality and operability when they are used with the Sysmac devices such as EhtherCAT slaves and the Sysmac Studio Automation Software. In a system configured with Sysmac devices, you can improve connectability and operability as the devices share the consistent usability concept.



CNC Function Module

The CNC Function Module is a software function module that is built into the NC Integrated Controller.

The CNC Function Module can control CNC coordinate systems via the EtherCAT port that is built into the NC Integrated Controller. Up to four CNC coordinate systems can be controlled with the NJ-series NC Integrated Controller, and up to eight with the NY-series NC Integrated Controller.

Cyclic communications are performed with Servo Drives and other devices that are connected to the EtherCAT port to enable high-speed and high-precision numerical control.

NC Program

NC programs for numerical control of the CNC Function Module use languages dedicated to the NC program, represented by G codes. By using NC programs, you can easily machine complex shapes and change machining drawings.

NC programs enable to use the interpolation function that specifies target positions and feed rate, the function of spindle axis that specifies cutting feed rate, and the tool functions such as compensating tool length and radius.

Synchronization with sequence control programs (ladder and ST) is possible by using M codes.

Sequence Control Program

Sequence control programs use CNC instructions to control the CNC Function Module.

In addition to the function block used to start an NC program, the sequence control program has other function blocks used to perform jogging, deceleration stop, and maintenance operation that reads and writes parameters.

Data Transmission Using EtherCAT Communications

The CNC Function Module can be combined with OMRON 1S-series Servo Drives with built-in Ether-CAT communications or G5-series with built-in EtherCAT communications to enable exchange of all control information by using high-speed data communications.

Various control commands are transmitted via data communications. This means that the Servomotor's operational performance is maximized without being limited by interface specifications, such as the response frequency of encoder feedback pulses.

You can use the Servo Drive's various control parameters and monitor data on a host controller to unify system information management.

Additional Information

What is EtherCAT?

EtherCAT is an open ultrahigh-speed industrial network system that conforms to Ethernet (IEEE802.3). Each node achieves a short communication cycle time by transmitting Ethernet frames at a high speed. The mechanism that shares clock information enables high-precision synchronized control with low communications jitter.

1-2 System Configuration

The CNC Function Module receives sensor signal status from devices and control panels. It receives commands from the CNC instructions that are executed in the NC program or sequence control program. It uses both of them to control Servo Drives and spindle drivers as well as to perform precise numerical control and spindle axis control.

CNC System Configuration

The CNC Function Module uses the EtherCAT network configuration, the Slave Terminal configurations for EtherCAT Coupler Units, Sysmac Studio, and CNC Operator.

● EtherCAT Network Configuration

The CNC Function Module controls Servo Drives and the spindle driver by using the EtherCAT communications master port that is built into the NC Integrated Controller.

The EtherCAT network configuration is used to perform precise numerical control in a fixed period with very little deviation.

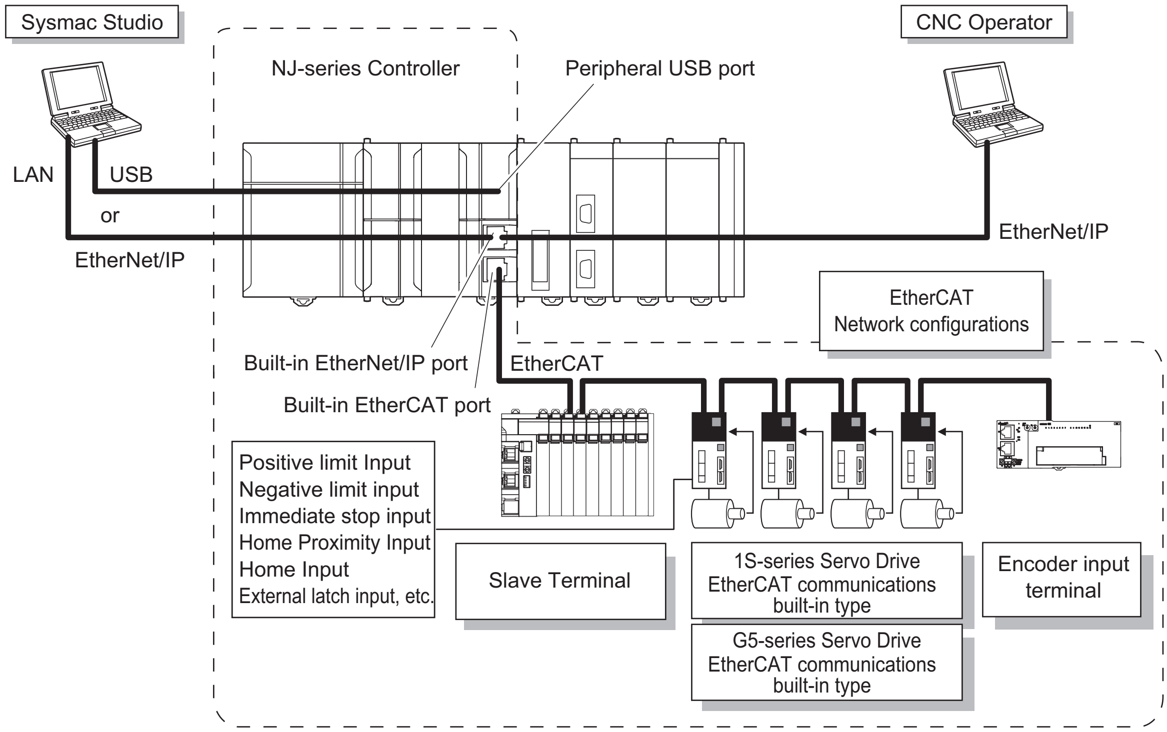
● Slave Terminal Configurations of EtherCAT Coupler Units

The CNC Function Module uses the Pulse Encoder Unit and Digital Input Unit that are mounted under an EtherCAT Coupler Unit to load the MPG and Jog switch.

You can also use this configuration to perform numerical control for maintenance operation that can be carried out from a user program.

● Sysmac Studio

Sysmac Studio is connected to the peripheral USB port on the NC Integrated Controller using a commercially available USB cable. You can also connect it through an Ethernet cable that is connected to the EtherNet/IP port built into the NC Integrated Controller.



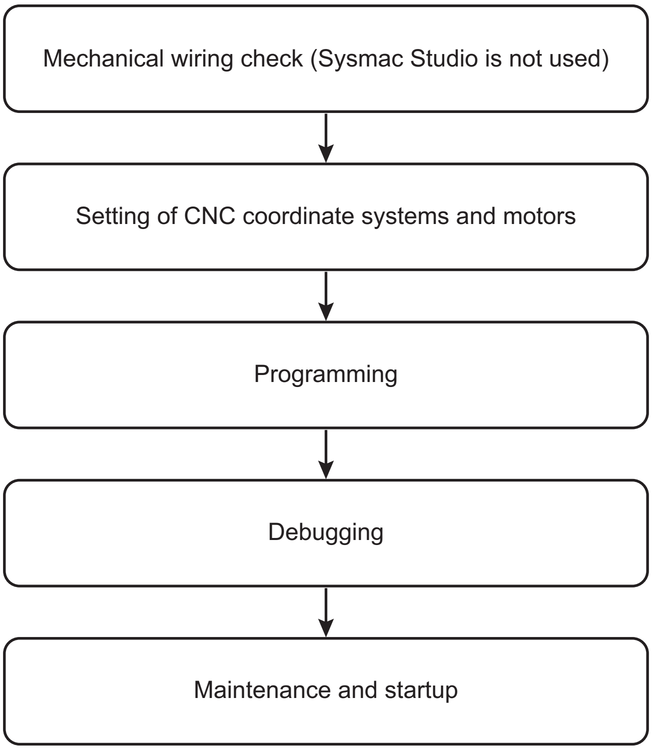
* The NY-series NC Integrated Controller is not equipped with peripheral USB ports.

● CNC Operator

In this system, NC programs are transferred from CNC Operator that is running on a Windows computer. To establish a connection to a Windows computer, connect an Ethernet cable to the EtherNet/IP port that is built into the NC Integrated Controller. You cannot use a USB cable to establish the connection.

1-3 Basic Flow of Operation

This section describes the basic procedure to perform numerical control using the CNC Function Module.



1-4 Specifications

This section describes the specifications of the CNC Function Module.

1-4-1 General Specifications

General specifications conform to the general specifications of each series of the Controllers.

For details, refer to the *NJ-series CPU Unit Hardware User's Manual* (Cat. No. W500) or *NY-series Industrial Panel PC Hardware User's Manual* (Cat. No. W557).

1-4-2 Performance Specifications

The following table describes the performance specifications for each NC Integrated Controller.

Item			Specifications	
			NJ501-5300	NY532-5400
Task period	Primary period	Setting value	500 µs to 4 ms	500 µs to 8 ms
		Default	1 ms	1 ms
	CNC Planner Service period	Setting value	500 µs to 16 ms*1	500 µs to 16 ms*1
		Default	2 ms	2 ms
System service monitoring settings	System service execution time ratio	Setting value	5% to 50%	---
		Default	30%	---
	System service execution interval	Setting value	10 ms to 1 s	---
		Default	10 ms	---
Number of CNC motors	Maximum number of CNC motors*2		16	32
CNC coordinate system	Maximum number of CNC coordinate systems		4	8
	Maximum number of composition CNC motors in a CNC coordinate system (excluding spindle axes)		8	8
	Number of spindle axes in a CNC coordinate system		1	1
Number of simultaneous interpolation axes			4	4

Item		Specifications	
		NJ501-5300	NY532-5400
NC Program[*3]	Program buffer size[*4,*5]	16 MB	64 MB
	Maximum number of programs[*4]	Main program - Upper limit of registrations: 512 - Range of program numbers For Sysmac Studio: 0001 to 0299 For CNC Operator: 0300 to 0999 Subprogram - Upper limit of registrations: 512 - Range of program numbers For Sysmac Studio: 1000 to 2999 For CNC Operator: 3000 to 9999	Main program - Upper limit of registrations: 512 - Range of program numbers For Sysmac Studio: 0001 to 0299 For CNC Operator: 0300 to 0999 Subprogram - Upper limit of registrations: 512 - Range of program numbers For Sysmac Studio: 1000 to 2999 For CNC Operator: 3000 to 9999
NC program variables[*3]	P variable	Long reals 65536 variables	Long reals 65536 variables
	Q variable	Long reals 8192 variables	Long reals 8192 variables
	L variable	Long reals 256 variables	Long reals 256 variables
CNC motor compensation table	Maximum number of CNC motor compensation tables	32	64
	Maximum size of all compensation tables	1 MB	2 MB

*1. They satisfy the following conditions: *Primary periodic task ≤ CNC Planner Service period,* and *Integer multiples of primary periodic task*.

*2. The number of controlled axes of the MC Control Function Module is included.

*3. Some parts of the area are reserved by the system.

*4. This is the number of programs or their capacities that can be loaded into the NC Integrated Controller at the same time.

*5. The program capacity is the maximum size available. As fragmentation will occur, the size that is actually available will be smaller than the maximum size. As a guideline, limit the size to be used to approximately half the capacity.

Precautions for Correct Use

To run the CNC Function Module, approximately 150 μs must be secured for system service execution time. Adjust the system service execution time ratio, so that the above system service execution time can be secured.

1-4-3 Function Specifications

The following table shows the functions that are supported when the Controller is connected to OMRON control devices.

Item					NJ501-5300
Numerical control	CNC coordinate system	Axis type			Positioning axis, spindle axis
		Control modes	Positioning axis		Position control
			Spindle axis		Velocity control
		Positions that can be managed			Absolute position (command), absolute position (feedback), program position, remaining travel distance
		NC program execution	Execute		Executes the NC program.
			Reset		Interrupts the NC program.
			Single block execution		Executes the NC program by block.
			Back trace		Executes back trace of interpolation path.
			Feed hold, and feed hold reset		Temporarily stops the NC program, and restarts it.
			Optional stop		Stops the NC program with optional signal.
			Option block skip		Skips one block of the NC program with optional signal.
			Dry run		Runs from the NC program.
			Machine lock		Locks each axis operation during execution of the NC program.
			Auxiliary function lock		Locks M code output.
			Override		Overrides the feed rate and spindle velocity.
		G code	Positioning function	Rapid positioning	Rapid feed of each CNC motor according to the motor setting
				Linear interpolation	Interpolates linearly.
				Circular interpolation	Interpolates circularly, helically, spirally, or conically.
				Skip function	Rapid feed until an external signal is input
			Return to reference point		Returns to a specified position on the machine.
			Fixed cycle	Rigid tap	Performs tapping machining.
			Feed function	Exact stop	Temporarily prevents blending of positioning operations before and after an exact stop command.
				Exact stop mode	Mode in which anteroposterior positioning operations are not blended
				Continuous-path mode	Mode in which anteroposterior positioning operations are blended
				Dwell	Waits for the specified period of time.
			Coordinate system selection	Dimension Shift Cancel	The coordinate system uses the machine home position as the home of the system.
				Zero Shift	The coordinate system has work offset for the Machine Coordinate System.
				Local Coordinate System Set	The coordinate system has additional offset for the Work Coordinate System.

Item					NJ501-5300
Numerical control	CNC coordinate system	G code	Auxiliary for coordinate system	Absolute or relative selection	Switches the manipulated variable specification method between absolute and relative ones.
				Metric or inch selection	Selects metric or inch as the orthogonal axes unit system.
				Scaling	Scales up or down the current coordinates of the orthogonal axes.
				Mirroring	Mirrors the current coordinates against the specified orthogonal axes.
				Rotation	Rotates the current coordinates around the coordinates of the specified orthogonal axis.
			Tool functions	Cutter compensation	Compensation of the tool edge path according to the tool radius
				Tool offset	Compensation of tool center point path according to the tool length
		M Code	M code output and reset		Outputs M codes, and interlocks with sequence control program using reset.
			Spindle axis	CW, CCW, or OFF	Outputs and stops velocity commands in velocity loop control mode.
				Orientation	Stops spindle axes to the specified phase by setting up feedback loop.
			Subroutine call		Calls a subroutine of the NC program.
		NC Programming	Arithmetic calculation		Performs a calculation in the NC program.
			Branch control		Branches on conditions in the NC program.
			NC program variables		Memory area in the NC program used for data processing and so on
				P variable	Global memory area commonly used by CNC coordinate systems
				Q variable	Global memory area unique to each CNC coordinate system
				L variable	Memory area that can be used as the primary area during execution of the NC program
		Auxiliary control functions	Error reset		Clears errors for CNC coordinate system and CNC motors.
			Immediate stop		Immediately stops all CNC motors in the CNC coordinate system.
	CNC motor	Positions that can be managed			Command positions and feedback positions
		Position control	Absolute positioning		Positioning to target positions specified by absolute coordinates.
			Relative positioning		Positioning by specifying travel distances from command current positions.
			Cyclic positioning		Outputs a command position in each control cycle of position control mode.
		Spindle control	CW rotation, CCW rotation, or stop		Outputs and stops velocity commands in velocity control mode.
		Manual operation	Powering the Servo		The Servo in the Servo Drive is turned ON to enable CNC motor operation.
			Jogging		Jogs a CNC motor at a specified target velocity.
		Auxiliary control functions	Homing		Defines home by operating a CNC motor and using limit signals, home proximity signal and home signal.
			Immediate stop		Stops the CNC motor immediately.
		Compensation table	Ball screw compensation		Compensates the pitch errors for one-dimensional ball screw.
			Cross-axis compensation		Compensates one-dimensional cross-axis.
			Edit of compensation table		Edits (reads and writes) compensation tables from using sequence control program.

Item					NJ501-5300
Numerical control	CNC motor	Auxiliary function	In-position Check		You can set an in-position range and in-position check time to confirm when positioning is completed.
			Stop method selection		You can set the stop method to the immediate stop input signal or limit input signal.
			Monitoring functions	Software limits	Monitors the movement range of a CNC motor.
				Following error	Monitors the positional error between the command current value and the feedback current value for a CNC motor.
			Absolute encoder support		You can use an OMRON G5-series Servo Drive or 1S-series Servomotor with an Absolute Encoder to eliminate the need to perform homing at startup.
			Input signal logic inversion		You can inverse the logic of immediate stop input signal, positive limit input signal, negative limit input signal, or home proximity input signal.
		External interface signals			The Servo Drive input signals given below are used. Home signal, home proximity signal, positive limit signal, negative limit signal, immediate stop signal, and interrupt input signal
	Common items	Parameters	Changing CNC coordinate system parameters and CNC motor parameters		References and changes CNC coordinate system parameters and CNC motor parameters from the user program.

1-4-4 NC Program Specifications

Refer to the *NJ/NY-series G code Instructions Reference Manual* (Cat. No. O031) for NC program specifications.

2

CNC System Configuration and Principles

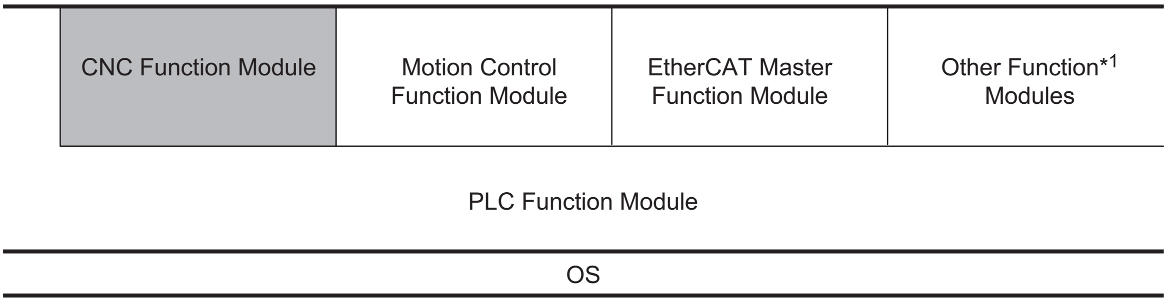
This section outlines the internal structure of the NC Integrated Controller and describes the configuration and principles of the CNC Function Module.

2-1 Internal Structure of NC Integrated Controller

This section provides an overview of the internal mechanisms of the NJ/NY-series NC Integrated Controller.

The NC Integrated Controller has the following software configuration.

The CNC Function Module is a software module that performs numerical control.



*1. For information on other Function Modules, refer to the *NJ/NX-series CPU Unit Software User's Manual* (Cat. No. W501) or the *NY-series Industrial Panel PC/Industrial Box PC Software User's Manual* (Cat. No. W558).

The PLC Function Module runs on top of the OS. The other Function Modules run on top of the PLC Function Module.

A description of each Function Module is given in the following table.

Function module name	Abbreviation	Description
PLC Function Module	PLC	This module manages overall scheduling, executes the user program, sends commands to the CNC Function Module, and interfaces with USB[*1] and an SD Memory Card[*2].
CNC Function Module	CNC	This module performs numerical control according to the commands from CNC instructions that are executed in the user program. It sends data to the EtherCAT Master Function Module. The module is primarily used to perform numerical control.
Motion Control Function Module	MC	This module performs motion control according to the commands from motion control instructions that are executed in the user program. It sends data to the EtherCAT Master Function Module. The module is primarily used to perform general motion controls such as conveyance and press, which are different from numerical control.
EtherCAT Master Function Module	ECAT	As the EtherCAT master, this module communicates with the EtherCAT slaves.

*1. On the NY-series Controllers, this module interfaces with virtual SD Memory Cards.

*2. The NY-series Controllers is not equipped with USB.

Precautions for Correct Use

For information on other Function Modules, refer to the *NJ/NX-series CPU Unit Software User's Manual* (Cat. No. W501) or the *NY-series Industrial Panel PC/Industrial Box PC Software User's Manual* (Cat. No. W558).

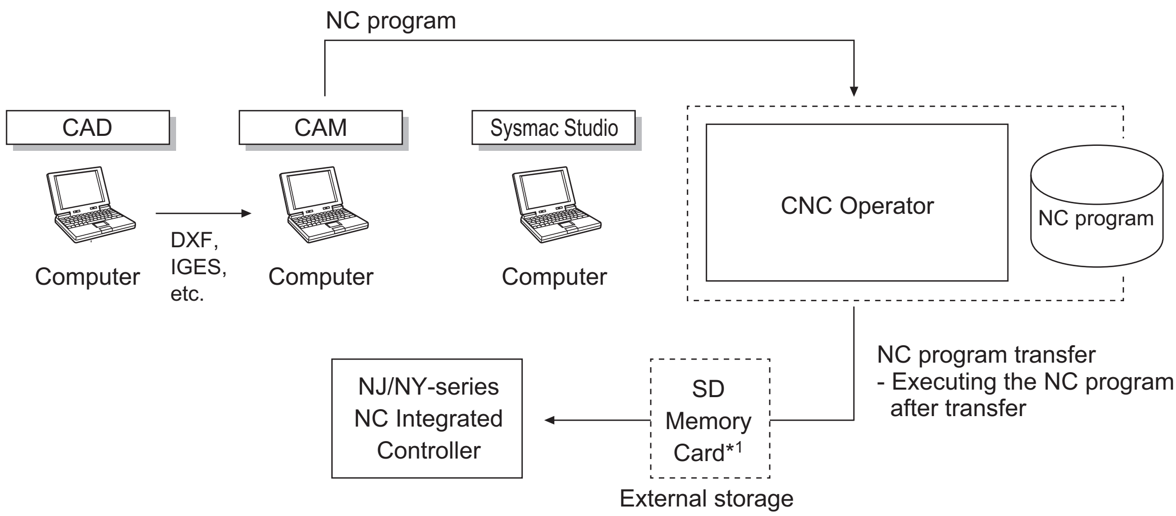
2-2 CNC System Configuration

A CNC system consists of the following two system elements:

- A system for which coordination with CNC Operator is required. Such coordination includes creation, execution, and stop of NC programs (refer to *2-2-1 Configuration of CNC Operator and the NC Integrated Controller* on page 2-4).
- A system that performs numerical control and controls Servomotors with instructions received from CNC Operator (refer to *2-2-2 Configuration of NC Integrated Controller and Drive Control* on page 2-5).

2-2-1 Configuration of CNC Operator and the NC Integrated Controller

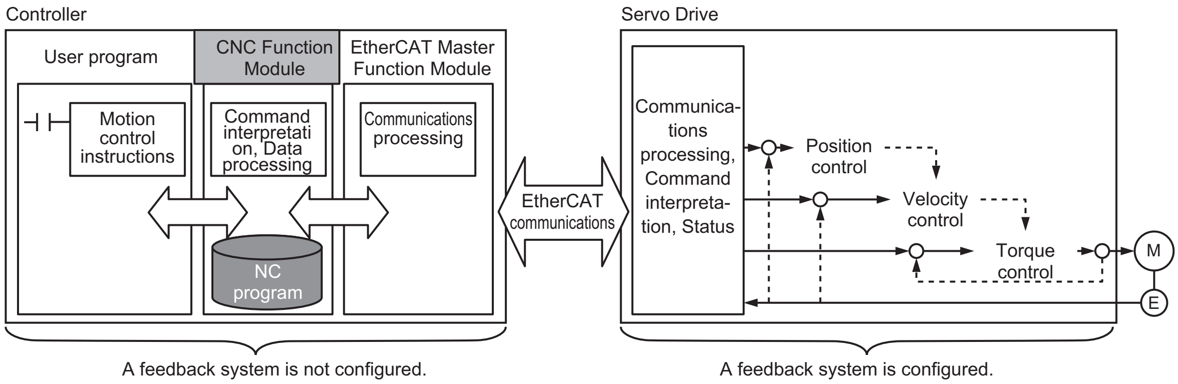
- NC programs are created using CAD/CAM software, or directly created on CNC Operator.
- The created NC program is transferred from CNC Operator to the NC Integrated Controller.
- When executing the CNC_CoordControl (CNC Coordinate System NC Control) instruction in the user program, according to NC program execution processing by CNC Operator, the NC program transferred from CNC Operator is interpreted to perform numerical control.



*1 On the NY-series NC Integrated Controller, this is a virtual SD Memory Card.

2-2-2 Configuration of NC Integrated Controller and Drive Control

- When the CNC_CoordControl instruction in the user program is executed, the CNC Function Module interprets the NC program.
- The CNC Function Module executes path calculation in a fixed cycle based on the results of the NC program interpretation, and generates and sends the command values to Servo Drives.
- The command values are sent by using PDO communications during each process data communications cycle of EtherCAT communications.
- The Servo Drive performs position control, velocity control, and torque control based on the command values received during each process data communications cycle of EtherCAT communications.
- The encoder's current value and the Servo Drive status are sent to the NC Integrated Controller during each process data communications cycle of EtherCAT communications.

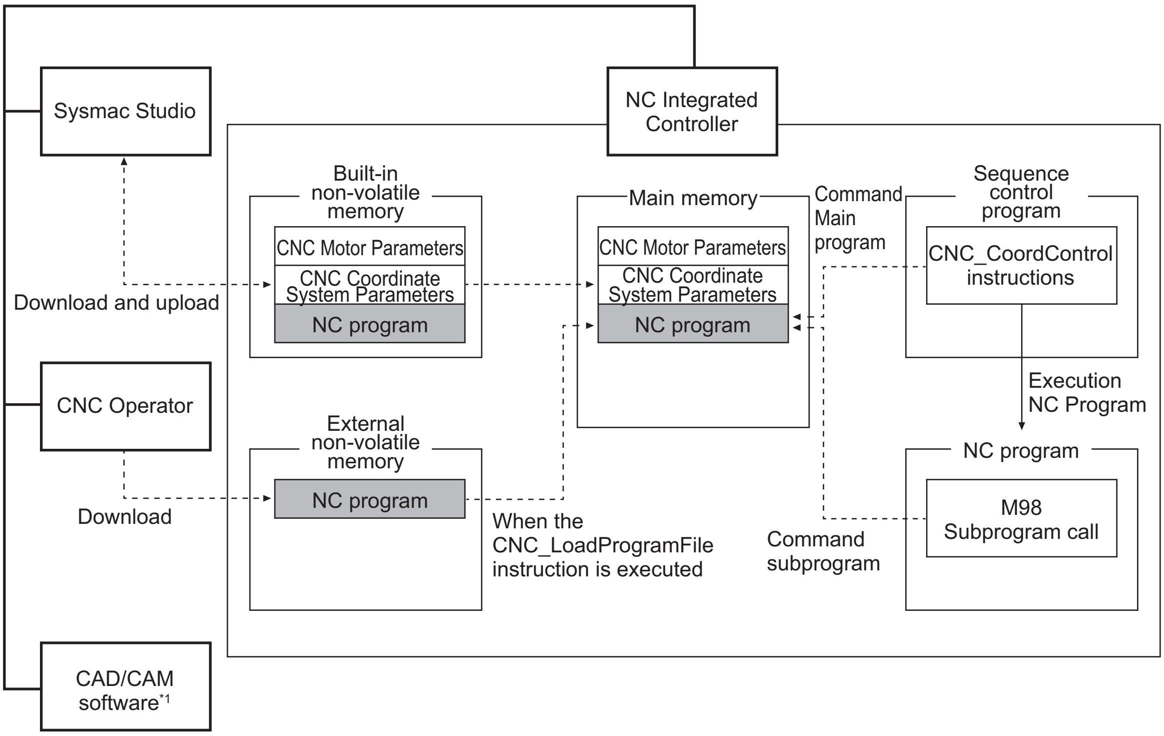


2-2-3 Configuration of NC Program

The NC program is a program used to perform numerical control.

NC Program Configuration

The following diagram describes the configuration of the NC program.



*1. The NC program that was created using CAD/CAM software conforms to the grammar of CNC Function Module when the program is parsed with Sysmac Studio or CNC Operator.

Precautions for Correct Use

- If you have transferred the same NC program number more than once, the program transferred last is enabled. Arrange the user program so that duplication of NC program numbers does not occur.

How to Transfer an NC Program

The following three methods are available to transfer an NC program to the NC Integrated Controller.

- Transferring an NC program from Sysmac Studio to the non-volatile memory in the NC Integrated Controller. The NC program that is transferred to the non-volatile memory of the NC Integrated Controller is read into the main memory when the power is turned ON or the download process is completed. This method is typically used to download subprograms provided by a machining equipment manufacturer.
- Using FTP or other protocols or methods to transfer intermediate codes, generated by CNC Operator, from the computer to the SD Memory Card. They are transferred from the SD Memory Card into the main memory by executing the dedicated program read instruction. This method is typically used to change recipes more easily by only operating HMI.
- Transferring the NC program from CNC Operator into the main memory by temporarily using an SD Memory Card

Additional Information

To expand the NC program into the main memory via an SD Memory Card, insert the SD Memory Card in advance.

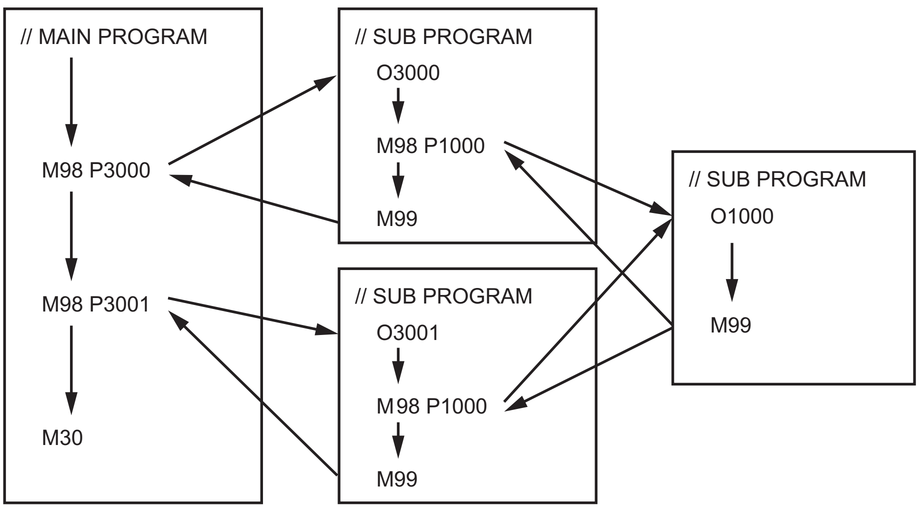
For an NY-series Controller, enable the virtual SD Memory Card.

Main Program and Subprogram

An NC program executed from CNC instructions of a user program is called the main program. Programs that pick up and summarize similar parts of the main programs, such as machining in the same pattern, are called subprograms.

If the Subprogram Call (M98) instruction is read during execution of the main program, the subprogram is executed. After the execution of the subprogram is completed, the process returns to the main program and executes the remaining part of the main program.

The following shows an image of the relationship between the main program and the subprogram.

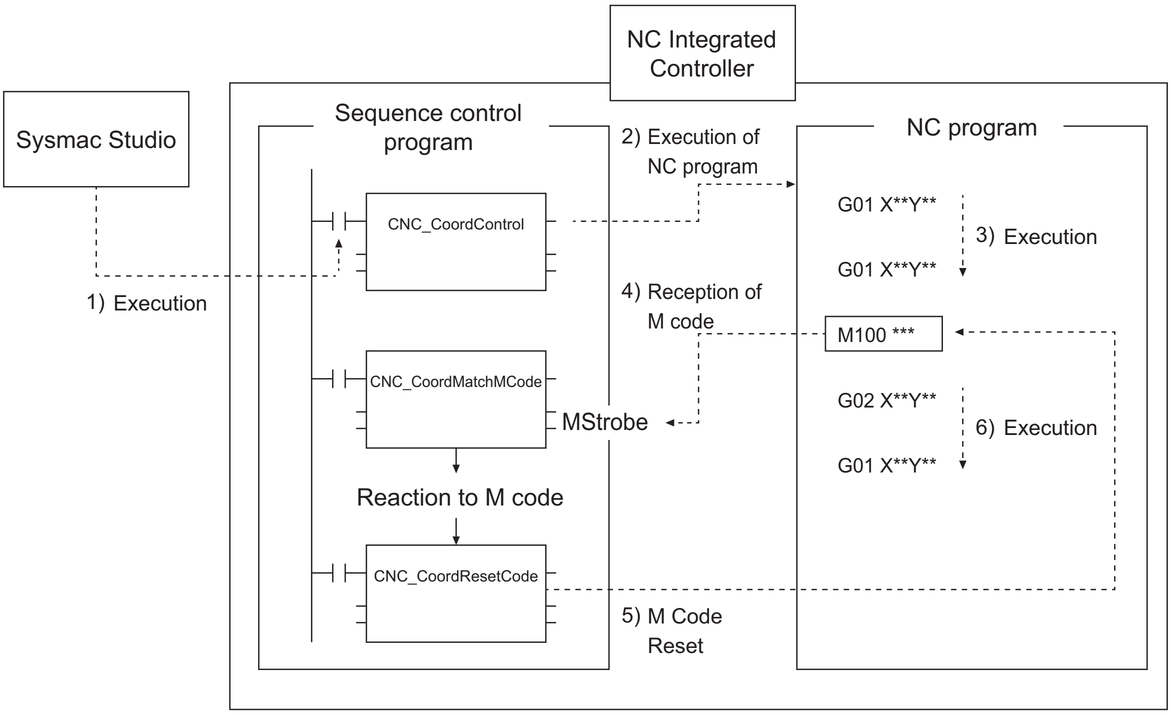


2-3 Relationship between Sequence Control Program and NC Program

The section describes the relationship between the sequence control program and the NC program of the NC Integrated Controller.

Relationship between Sequence Control Program and NC Program

The following diagram describes the relationship between the sequence control program and the NC program.



Start and Stop of NC Program

- The CNC_CoordControl instruction in the sequence control program is executed when the NC program start command is received from CNC Operator, etc.
- The CNC Function Module starts to interpret the NC program after the CNC_CoordControl instruction is executed.
- The CNC Function Module executes path calculation in a fixed cycle based on the results of the NC program interpretation, and generates and sends the command values to Servo Drives.
- The CNC Function Module continues to run the NC program until it executes the End of Program (M30) instruction, or until it receives the reset by the CNC_CoordControl instruction or a program abort by the CNC_CoordStop instruction of the sequence control program.

Feed Hold and Feed Hold Reset of NC Program

- When the *FeedHold* input variable under the *ControlInputs* in-out variable for the CNC_CoordControl (CNC Coordinate System NC Control) instruction is changed to TRUE, the NC program currently under execution is temporarily stopped.
- When the *CycleStart* input variable under the *ControlInputs* in-out variable for the CNC_CoordControl (CNC Coordinate System NC Control) instruction is changed to TRUE, the NC program execution is resumed.

M-code and M-code Reset of NC Program

- If the CNC Function Module finds an M code during execution of the NC program, the module sends the M code to the sequence control program.
- The sequence control program executes the CNC_CoordCatchMCode (Catch M Code) instruction to receive the M code.
- The sequence control program executes peripheral controls (conveyance control, valve ON/OFF, etc.) corresponding to the received M code.
- After completing peripheral controls, the sequence control program executes the CNC_CoordReset-MCode (Reset M code) instruction to send M code reset.
- The CNC Function Module, after receiving the M code reset signal, clears the waiting status for a M code reset, and moves on to the next block.

2-4 Configuration of Variables

This section describes variables provided for the NC Integrated Controller that is equipped with the CNC Function Module.

As is the case with standard CPU Units, the NC Integrated Controller has variables used for the sequence control program to access I/O and information inside the CPU Unit.

In addition, the NC Integrated Controller particularly has variable areas called NC program variables used for data calculations and other processing in NC program.

In this section, user-defined variables and system-defined variables refer to variables that can be accessed from the sequence control program. On the other hand, NC program variables and system-defined NC program variables refer to variables that can be accessed from the NC program.

2-4-1 What is the NC Program Variable?

The NC program variables refer to variable areas used for data calculations and other processing in NC program.

There are the system global variables (P variables) that are common to CNC coordinate systems, global variables (Q variables) that are unique to individual CNC coordinate systems, and local variables (L variables) that can be used as the primary area during program execution.

Some NC program variable areas are reserved for system definitions. They are called system-defined NC program variables.

The NC program variables are provided as variable areas with which data can be read and written from the NC program. Some of them can be read and written from the sequence control program.

The variables are classified into the following categories.

Category				Limited to CNC package	Remarks
Variables[1]	User-defined variables				-
	Semi-user-defined variables	Device variable	EtherCAT slaves device variable		-
			CJ-series Unit device variable[2]		-
		Cam data variable			-
		CNC motor compensation table variable		Yes	-
	System-defined variable	System-defined variable for PLC Function Module			-
		Motion control system-defined variable	MC common variable		-
			Axis variable		-
			Axes group variable		-
		CNC system-defined variable	CNC common variable	Yes	-
			CNC motor variable	Yes	-
			CNC coordinate system variable	Yes	-
			NC program variable monitoring	Yes	Among the NC program variables, user areas are monitored
		System-defined variable for EtherNet/IP			-
		System-defined variable for EtherCAT master			-
NC program variables[3]	System Global Variables (P Variables)			Yes	P0 to P65535
		System-defined variables		Yes	P32768 to P65535
	CNC coordinate system global variables (Q variables)			Yes	Q0 to Q8191
		System-defined variables		Yes	Q4096 to Q8191
	Local Variables (L Variables)			Yes	L0 to L255

*1. Can be accessed from the sequence control program.

*2. You can use CJ-series Units only with NJ-series CPU Units.

*3. Can be accessed from NC program

2-4-2 NC Program Variable Types

System Global Variables (P Variables)

They refer to system global variable areas that are common to CNC coordinate systems. They are used for waiting and data exchange between CNC coordinate systems.

The system global variable is double-precision real type. The CNC Function Module has 65,536 system global variables (P0 to P65535). Among them, P0 to P32767 are used for user areas and P32768 to P65535 are for system-defined areas. User areas can be read and written from the sequence control program as they are displayed by the *_CNC_ComNCVar* system-defined variable.

In NC program, a number is specified after P. This number is specified as a constant right after the letter P. Examples are provided below.

```
P17=3.14159
P200=P100+1
```

In the system areas of P variables, there is no system-defined NC program variable that is made public to users.

CNC Coordinate System Global Variables (Q Variable)

They refer to global variable areas that are unique to each CNC coordinate system. While the same NC program can be executed in multiple CNC coordinate systems, this type of variable enables independent program operation to each CNC coordinate system.

The CNC coordinate system global variable is double-precision real type. For each CNC coordinate system, there are 8,192 CNC coordinate system global variables (Q0 to Q8191). Among them, Q0 to Q4095 are used for user areas, and Q4096 to Q8191 are for system-defined areas. User areas can be read and written from the sequence control program as they are displayed by the *_CNC_CoordNCVarX* system-defined variable (where X is a CNC coordinate system number).

In NC program, a number is specified after Q. This number is specified as a constant right after the letter Q. Examples are provided below.

```
Q17=3.14159
Q200=Q100+1
```

The following system-defined NC program variables are declared in the system area of the Q variable. They can be accessed from NC program.

System defined	Remarks	Description
Auxiliary Function Output Reset Return Value	_CNC_MCodeResetRetValue0	Stores a value specified by Inputs[0] of CNC_CoordResetM-Code.
	_CNC_MCodeResetRetValue1	Stores a value specified by Inputs[1] of CNC_CoordResetM-Code.
	_CNC_MCodeResetRetValue2	Stores a value specified by Inputs[2] of CNC_CoordResetM-Code.
	_CNC_MCodeResetRetValue3	Stores a value specified by Inputs[3] of CNC_CoordResetM-Code.
	_CNC_MCodeResetRetValue4	Stores a value specified by Inputs[4] of CNC_CoordResetM-Code.
	_CNC_MCodeResetRetValue5	Stores a value specified by Inputs[5] of CNC_CoordResetM-Code.
	_CNC_MCodeResetRetValue6	Stores a value specified by Inputs[6] of CNC_CoordResetM-Code.
	_CNC_MCodeResetRetValue7	Stores a value specified by Inputs[7] of CNC_CoordResetM-Code.
Skip Function (G31) Capture Position	_CNC_CapturedPosition0	Logical motor 0 capture position
	_CNC_CapturedPosition1	Logical motor 1 capture position
	_CNC_CapturedPosition2	Logical motor 2 capture position
	_CNC_CapturedPosition3	Logical motor 3 capture position
	_CNC_CapturedPosition4	Logical motor 4 capture position
	_CNC_CapturedPosition5	Logical motor 5 capture position
	_CNC_CapturedPosition6	Logical motor 6 capture position
	_CNC_CapturedPosition7	Logical motor 7 capture position

Local Variables (L Variables)

They refer to variable areas that can be used as the primary area during execution of an NC program.

The local variable values are saved to the stack when program execution jumps to a subprogram, and restored from the stack when it returns from the subprogram. The local variable values that are changed in an NC program will be cleared when program execution returns from a subprogram.

The local variable is double-precision real type. There are 256 local variables (L0 to L255).

In NC program, a number is specified after L. This number is specified as a constant right after the letter L. Examples are provided below.

```
L17=3.14159
L200=L100+1
```

2-5 Principle of Task Processing

This section provides information on the NC Integrated Controller tasks and how they relate to numerical control.

For details, refer to the *NJ/NX-series CPU Unit Motion Control User's Manual* (Cat No. W507) or the *NY-series Industrial Panel PC/Industrial Box PC Motion Control User's Manual* (Cat. No. W559).

NC Integrated Controller Tasks and Services

Tasks are the attributes of a user program, etc. that determine execution conditions and the sequence of executions. The NJ/NY-series NC Integrated Controller supports the following tasks. Besides the tasks, three types of services are supported: Tag Data Link Service, System Service, and CNC Planner Service.

Task or service type	Task or service name
Tasks that execute programs at regular intervals	Primary periodic task
	Priority 16, 17, and 18 periodic tasks
Tasks that execute programs only once when the execution conditions for the tasks are met	Event tasks (execution priority 8 and 48)
Service that plans NC program execution, calculates the interpolation path for a coordinate system, or performs other processing.	CNC Planner Service (execution priority 6)

Precautions for Correct Use

- CNC instructions can be used in a primary periodic task.
- If CNC instructions are used in any other tasks, an error will occur when the user program is built using Sysmac Studio.

Basic Operation of Tasks

● Overall Task Operation

The primary periodic task includes operations such as system common processing, motion control, and the servo processing of the CNC Function Module in addition to I/O refreshing and user program execution.

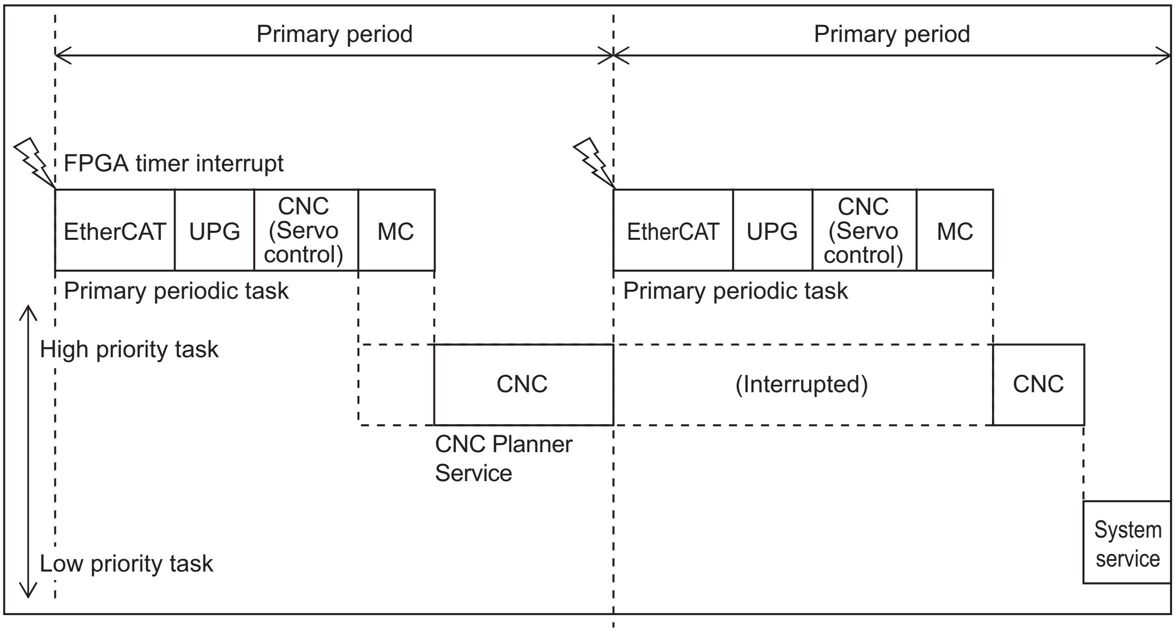
The CNC instruction included in the sequence control program is executed during the next servo control period after the END instruction is executed for the task.

The following diagram shows the operation for NJ501-5300.

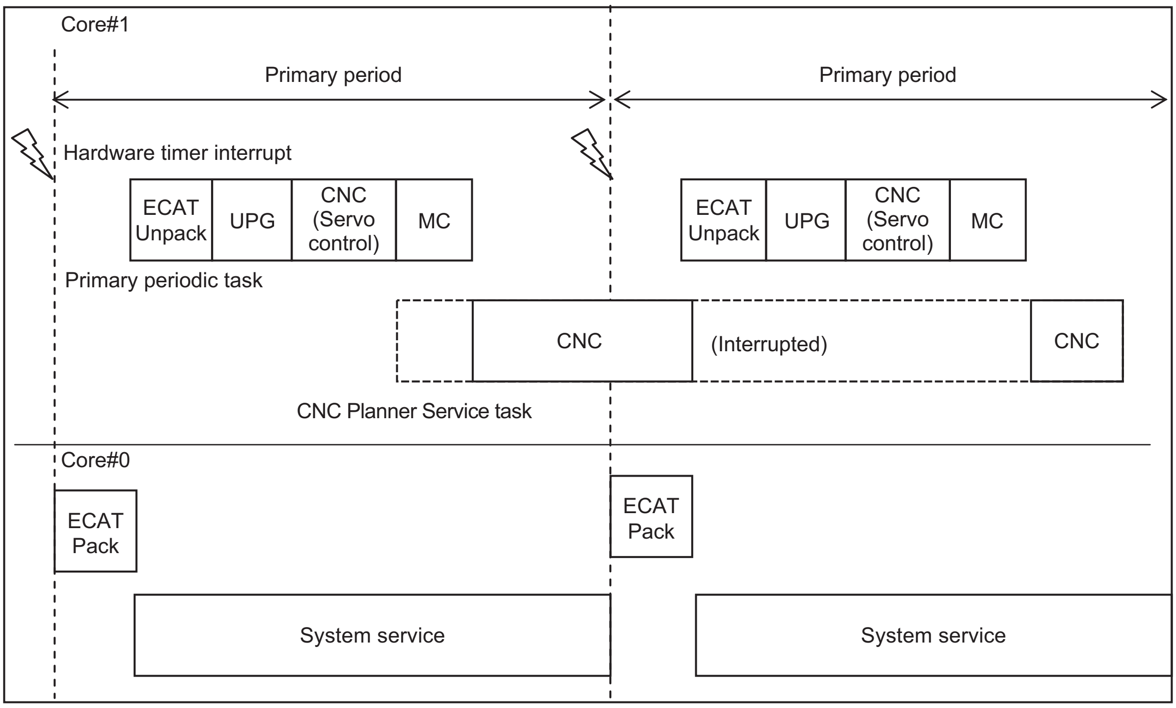
The CNC Planner Service (execution priority 6) is executed after execution of the primary periodic task is completed.

The Priority 16, 17, and 18 periodic tasks have lower execution priorities than the CNC Planner Service task, so they are executed when the CNC Planner Service is not being executed.

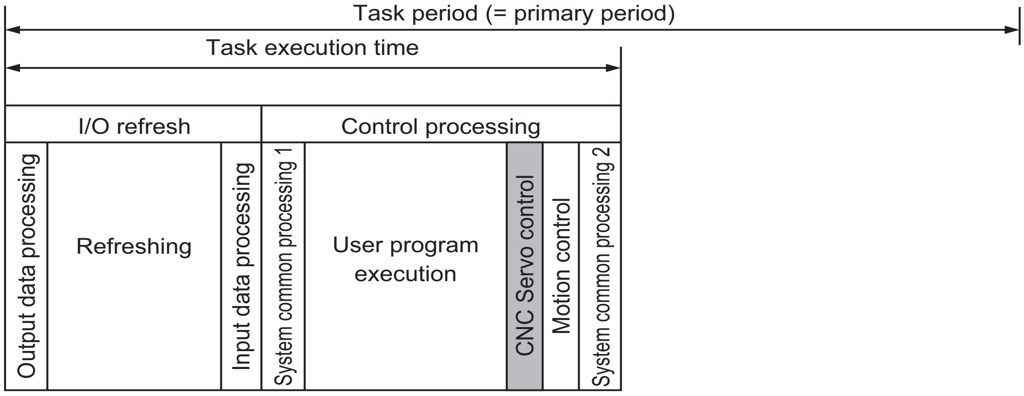
System services are executed in the unused time between execution of tasks.



The following diagram shows the operation for NY532-5400.



● Operation of the Primary Periodic Task



For details, refer to the NY-series Industrial Panel PC/Industrial Box PC Motion Control User's Manual (Cat. No. W559).

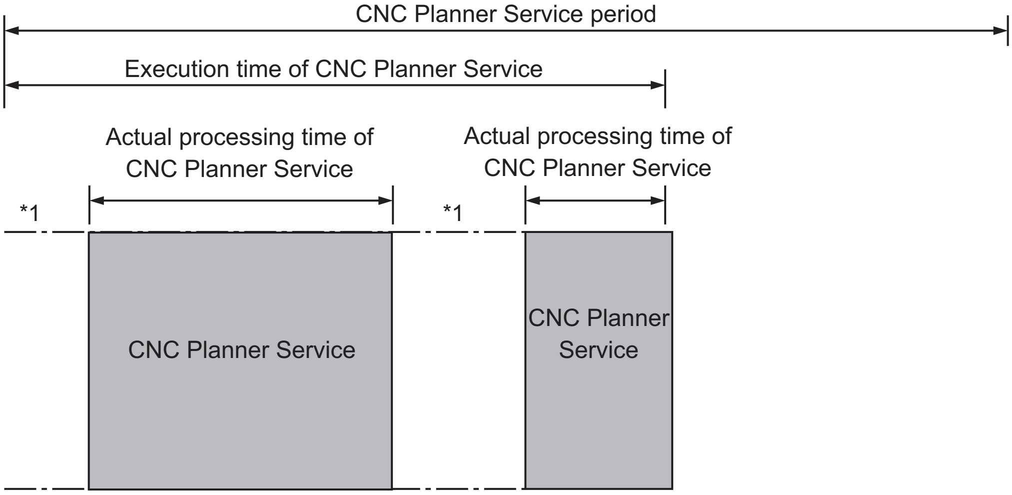
Processing	Processing contents
Output data processing	• Output refresh data is generated for Output Units that execute I/O refreshing. • If forced refreshing is set, the forced refreshing values are reflected in the output refresh data.
Refreshing	• Data exchange with I/O is executed.
Input data processing	• Whether or not the condition expression for event task execution is met is determined. • Input refresh data is loaded from Input Units that have executed I/O refresh. • If forced refreshing is set, the forced refreshing value (input) is reflected on the input refresh data that has been loaded.
System common processing 1	Processing for exclusive control of variables in tasks is performed (when accessing tasks are set). • Motion input processing is performed.*1 • Data trace processing (sampling and trigger checking) is performed.
Execution of user program	• Programs assigned to tasks are executed in the order that they are assigned.
CNC servo control	Software tasks that are driven at the control period of Servo Drives include: • Encoder conversion • Distribution calculation from interpolation path to motor position • Updating CNC motor compensation tables • Closed loop processing for positions • Equation calculation for CNC motor command travel • Checking CNC motor status and errors: Deviation, commanded velocity zero, in-position
Motion control	• The motion control commands from the motion control instructions in the user programs in the primary periodic task and the priority-16 periodic task are executed. • Motion output processing is performed.*2

Processing	Processing contents
System common processing 2	Processing for exclusive control of variables in tasks is performed (when refreshing tasks are set). • Processing for variables accessed from outside of the Controller is performed to maintain concurrency with task execution (executed for the variable access time that is set in Task Settings). • If there is processing for EtherNet/IP tag data links and refreshing tasks are set for the tags (i.e., variables with a Network Publish attribute), variable access processing is performed.

*1. The Servo Drive status, axis current values, and other motion control system-defined variables are updated based on data received from Servo Drives, etc.

*2. Data is sent to the Servo Drives during I/O refreshing in the next primary periodic task.

● Operation of CNC Planner Service



*1. The CPU Unit temporarily interrupts the execution of a task in order to execute a task that has a higher execution priority.

Processing	Processing contents

CNC Planner Service	Services that are driven at the CNC Planner Service period include:
	• NC program operation planning
	• Interpolation path calculation for the coordinate system
	• CNC motor safety and status check
	  •Software limit check during execution of the NC program
	  •Monitoring servo lock, driver errors, and driver warning
	  •Processing external latch signals for the G31 command
	• Updating the status of coordinate systems

● CNC Planner Service period

CNC Planner Service is repeated periodically.

Set the CNC Planner Service period to the integral multiple of task period of the primary periodic task.

For example, if the primary period is 1 ms and the CNC Planner Service period is 4 ms, CNC Planner Service is executed once at every fourth execution of the primary periodic task.

● CNC Planner Service Period Exceeded

If CNC Planner Service processing is not finished within two periods, a CNC Planner Service Period Exceeded error occurs.

This is a controller error of observation information level. Operation continues even when this error occurs.

If CNC Planner Service processing is not completed within the period, information is output to the *_CNC_ServiceExceeded* (CNC Planner Service Period Exceeded Flag) and *_CNC_ServiceExceedCount* (CNC Planner Service Exceeded Count) the system-defined variable as well as to the event log.

2-6 Relationship with EtherCAT Communications

The CNC Function Module controls Servo Drives through PDO communications of the EtherCAT Master Function Module in the NC Integrated Controller.

This section describes EtherCAT communications and other items related to the CNC Function Module.

2-6-1 CAN Application Protocol over EtherCAT (CoE)

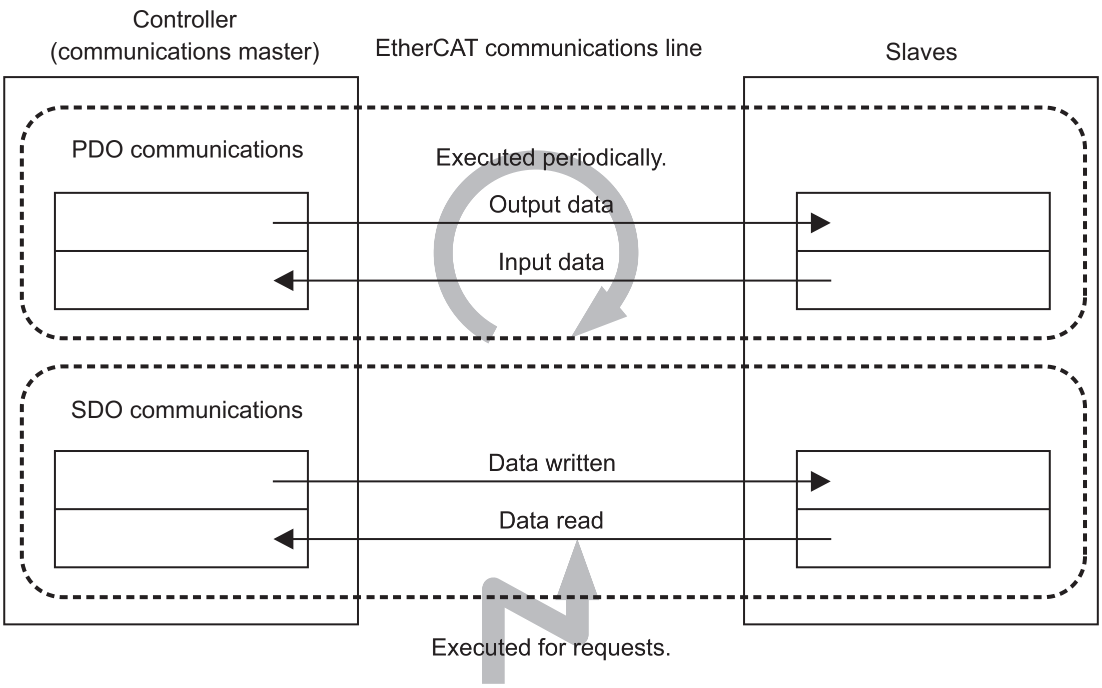
The CNC Function Module exchanges data with the slaves on EtherCAT using the CAN application protocol over EtherCAT (CoE).

With CoE, the parameters and control information held by the slaves are specified according to data specifications of the object dictionary (OD).

There are two methods that can be used to communicate data between the Controller (communications master) and slaves. One is Process Data Objects (PDO) that are used to periodically exchange data in real time. The other is Service Data Objects (SDO) that are used to exchange data when required.

The CNC Function Module uses PDO communications for commands to refresh I/O data, such as data for Servomotor position control, on a fixed control period.

It uses SDO communications for commands to read and write data at specified times, such as when parameter transfer occurs.



2-6-2 Relationship between EtherCAT Master Function Module and CNC Function Module

The NC Integrated Controller can perform sequence control, motion control, and numerical control through connections to EtherCAT slaves.

Sequence Control

- I/O ports for configuration slaves are automatically created when you create the EtherCAT configuration in EtherCAT Tab Page in Sysmac Studio.
- You can use the I/O Map Tab Page in Sysmac Studio to assign device variables.
- Perform sequence control through instructions other than CNC instructions.

CNC or Numerical Control

- I/O ports for configuration slaves are automatically created when you create the EtherCAT configuration in EtherCAT Tab Page in Sysmac Studio.
- Create CNC motor variables in the CNC Setup View and assign the EtherCAT slaves for which numerical control is performed.
- Perform numerical control through CNC instructions and the NC program.

Devices that can be assigned to CNC motor variables are EtherCAT slave Servo Drives.

Additional Information

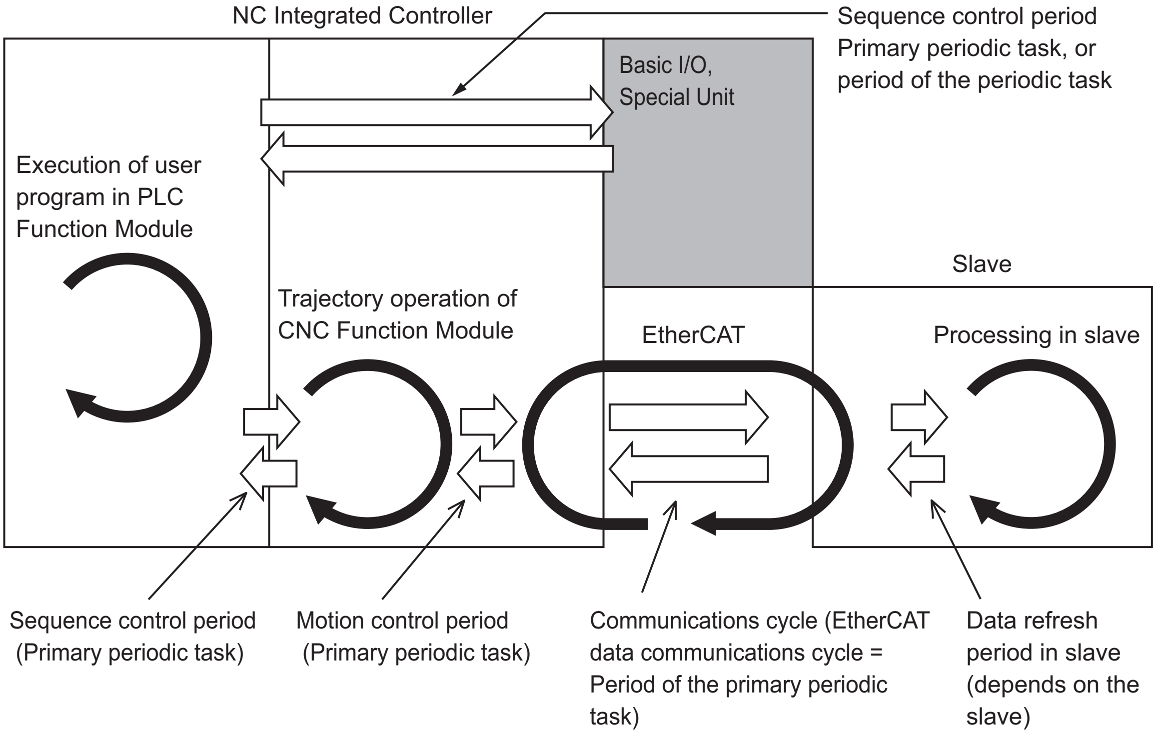
In instructions other than CNC instructions, commands cannot be sent directly from the sequence control program to RxPDO of EtherCAT slaves assigned to CNC motors. On the other hand, the RxPDO data that was not assigned to CNC motors can be changed from the sequence control program.

2-6-3 Relationship between Process Data Communications Cycle and the Control Period for Servo Drive

The PLC Function Module sends numerical control commands to the CNC Function Module when CNC instructions are executed in the user program. The CNC Function Module then performs servo processing based on those commands and sends the results of processing as commands to the EtherCAT's Servo Drive or other devices.

This type of data exchange is updated in the following processing period.

Primary period = Control period for Servo Drive = Process data communications cycle for EtherCAT communications



3

Configuring CNC Motors and CNC Coordinate Systems

This section outlines CNC motors and CNC coordinate systems.

3-1 CNC Motors

This section describes CNC motors that are used in a CNC Function Module.

CNC Motors

In the NC Integrated Controller, CNC motors are elements of the CNC coordinate system.

Typically, CNC motors are assigned one-to-one to logical axes (X, Y, Z, A, B and C axes) of the CNC coordinate system.

It is also possible to assign multiple CNC motors to one logical axis of the CNC coordinate system. Using this assignment process, you can more easily construct a Gantry system.

3-2 CNC Coordinate System

This section outlines the CNC coordinate system of the CNC Function Module.

3-2-1 Configuration of CNC Coordinate System

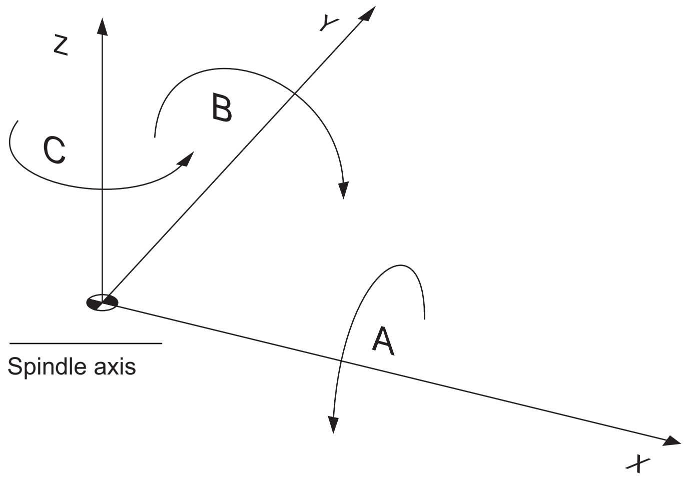
The following describes the configuration of the CNC coordinate system.

CNC Coordinate System

The CNC coordinate system is a control group or object to be controlled mainly by the NC program in the CNC Function Module.

The CNC coordinate system consists of logical axes and a spindle axis.

In the following figure, the direction indicated by the arrow is the positive direction.



Logical Axes

Logical axes mean the X-, Y-, and Z-axis that represent Cartesian coordinates of the CNC coordinate system, and the A-, B-, and C-axis that represent rotation coordinates.

Spindle Axis

A spindle axis is a CNC coordinate system tool. It is a rotation axis that is parallel to the Z-axis of Cartesian coordinates.

3-2-2 Types of Coordinate Systems

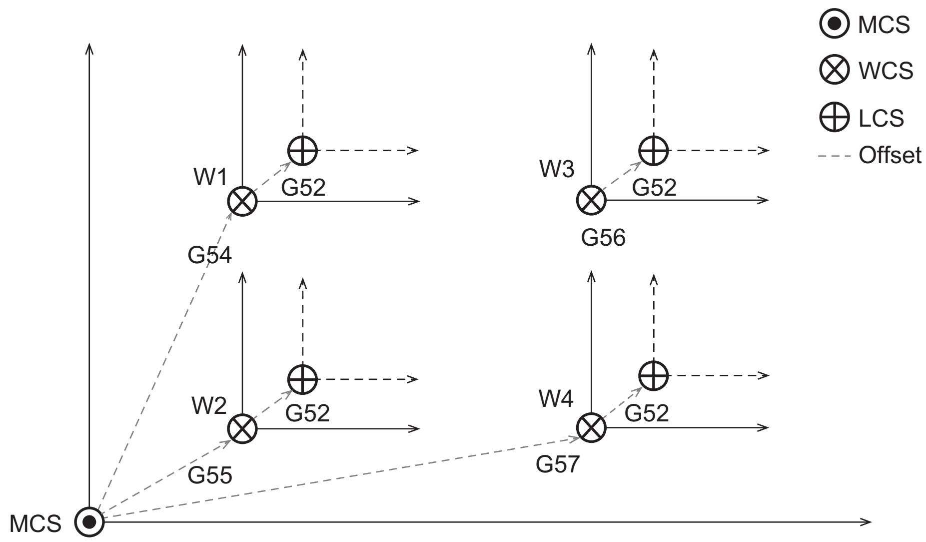
In the CNC Function Module, the coordinate values can be specified in the following three types of coordinate systems.

The position of the tool center point is handled as a coordinate value.

a) Machine Coordinate System (MCS)
b) Workpiece Coordinate System (WCS)
c) Local Coordinate System (LCS)

Relationship between Machine Coordinate System, Work Coordinate System, and Local Coordinate System

The following figure describes the relationship between the Machine Coordinate System, Work Coordinate System, and Local Coordinate System. With reference to the Machine Coordinate System, a Work Coordinate System possesses work offset to the Machine Coordinate System. With reference to a Work Coordinate System, a Local Coordinate System possesses work offset to the Work Coordinate System.



Machine Coordinate System (MCS)

The point unique to a machine, that is, the reference point for the machine is called the home. A coordinate system that references the home as its home position is called the Machine Coordinate System. When homing is completed after the power is turned on, or when communications with the Drive is established while an absolute encoder is used, the Machine Coordinate System is established.

Work Coordinate System (WCS)

A coordinate system used to machine workpieces is called Work Coordinate System. Up to six work coordinate systems can be configured in one CNC coordinate system.

With reference to the Machine Coordinate System, a Work Coordinate System processes offset to the Machine Coordinate System.

Configure six Work Coordinate Systems in advance as parameters of the CNC coordinate system. Then you can select Work Coordinate Systems to use, by NC program commands G54 to G59.

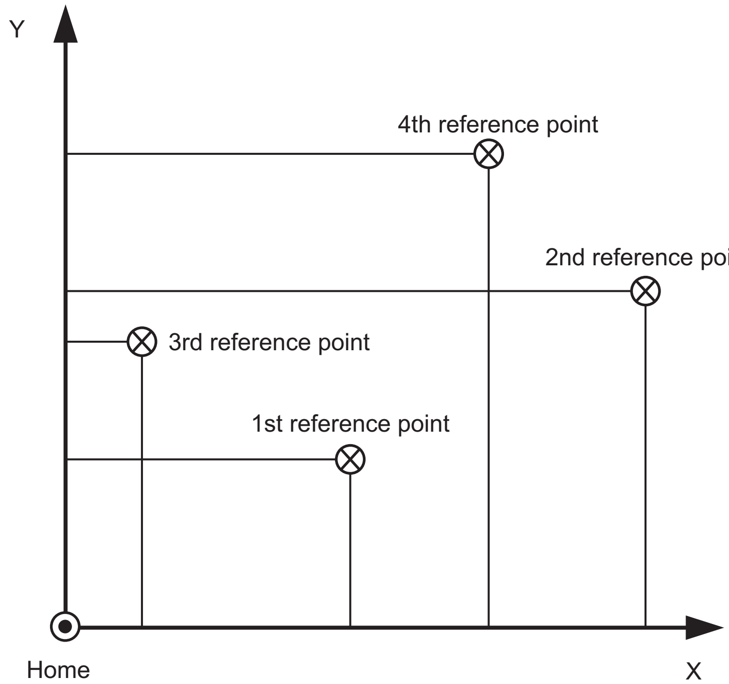
Local Coordinate System (LCS)

A Local Coordinate System is created on a Work Coordinate System to help create programs easier. A Local Coordinate System (G52) is valid on a specified coordinate system of the Work Coordinate System (G54 to G59).

3-2-3 Reference Point

For a machine tool, specific positions on the machine are defined. These positions are called reference points.

Typically, reference points are used as positions to be referenced when changing tools or for other purposes. Up to four reference points can be assigned to CNC coordinate system parameters by using coordinate values of the Machine Coordinate System.



4

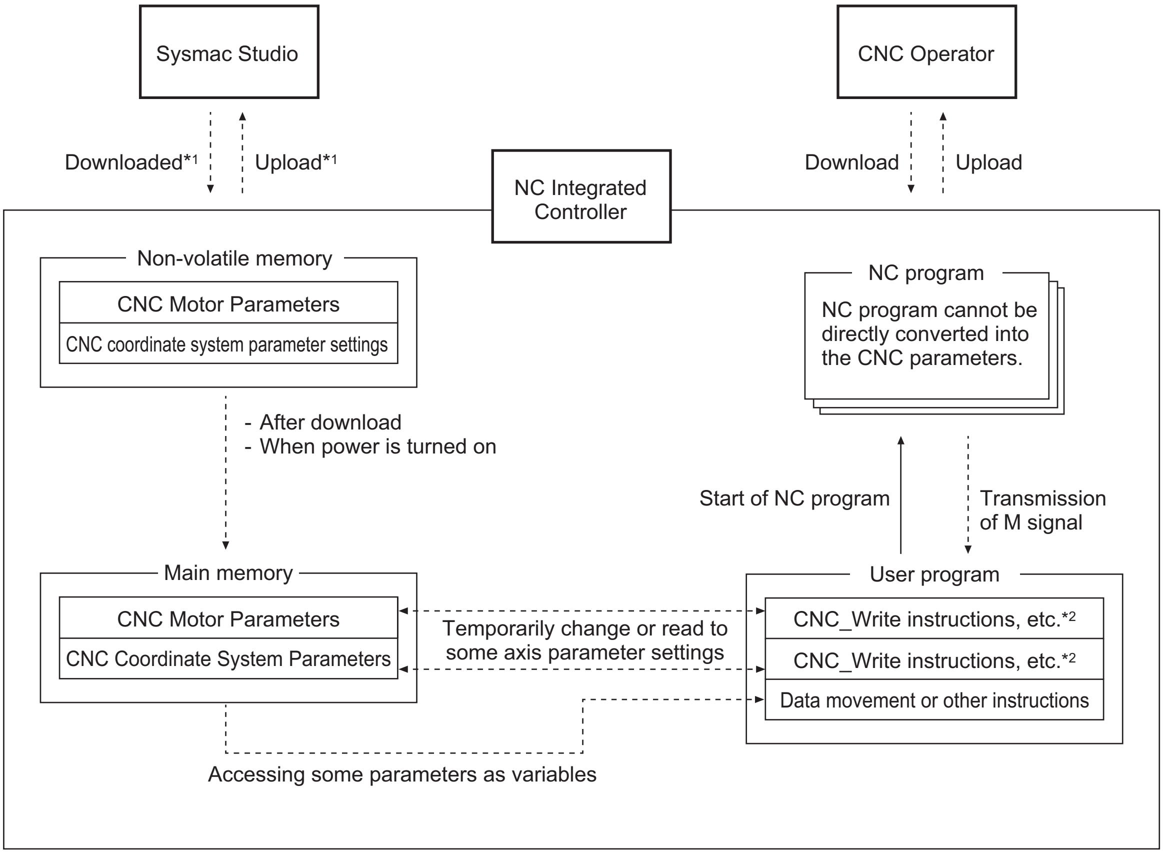
CNC Parameters

This section describes the parameter settings to be configured in the CNC Function Module.

4-1 Introduction

With the CNC Function Module of this Controller, you can perform the numerical control of a CNC coordinate system with NC programs. You can also operate CNC motors of the CNC coordinate system with CNC instructions of the sequence control program. The CNC motor parameters and CNC coordinate system parameters are set to determine these operations.

In order to run the NC program for a CNC coordinate system, you must set CNC coordinate system parameters, and CNC motor parameters that compose the CNC coordinate system. If you want to operate the system in units of a CNC motor, you must only set CNC motor parameters. These parameters are called CNC parameters.



*1. Use the synchronization function of Sysmac Studio to upload and download the project.

*2. The NC Integrated Controller and Sysmac Studio version 1.20 or higher are required to use CNC instructions such as CNC_Write.

Precautions for Correct Use

- If the CNC parameters are changed by CNC instructions, they are saved to the main memory in the NC Integrated Controller. They are not saved in the non-volatile memory in the NC Integrated Controller. The parameter settings stored in the non-volatile memory are restored when the power is recycled, or when settings are downloaded from Sysmac Studio. You cannot upload these data by using Sysmac Studio.

  If you need to save settings to the non-volatile memory, use Sysmac Studio to change the parameter settings and then download the settings to the NC Integrated Controller.
- The CNC_Write instruction can change the CNC parameters.
- Some CNC parameter settings are expressed by floating point reals. Precautions for using them are provided. Refer to *A-2 Cancellation of Digits of Real Type Data* on page A-7.

Data Flow for CNC Parameters

- Download your CNC Parameter Settings to the NC Integrated Controller using Sysmac Studio to save those settings to the non-volatile memory in the NC Integrated Controller. When you upload the CNC Parameter Settings to the Sysmac Studio, the CNC Parameter Settings that were saved in the non-volatile memory are uploaded.
- The settings that were saved in the non-volatile memory are applied to the main memory after you download them or when the power is turned ON.
- If there are no problems with the saved settings, the CNC Function Module executes control based on the settings in the main memory.
- The settings of some parameters can be accessed as CNC system-defined variables in the user program.
- You can upload and download CNC parameter settings regardless of the NC Integrated Controller mode or the status of the CNC Function Module.
- When you start the download process, all CNC motors in motion will stop immediately.

  You can also continue sending commands to I/O devices during the download process. Refer to the *NJ/NX-series CPU Unit Software User's Manual* (Cat. No. W501) for how to set to stop or continue sending commands to the I/O devices when the download process starts.

● Stopping Sending Commands to I/O Devices

During download process, CNC motors enter the Servo OFF state.

● Continuing Sending Commands to I/O Devices

During download process, the Servo ON state resulted from the CNC_Power instruction immediately before the download is maintained. The Servo ON state and torque limit are maintained even if the CNC_Power instruction is deleted from the user program after the program is updated by downloading. Depending on the item to download, however, they may not be able to be maintained. Refer to the following table.

Item to download	Behavior of CNC Function Module
Sequence control program	Continues sending commands to I/O devices.
NC program	Stops sending commands to I/O devices.
CNC coordinate system parameters, CNC motor parameters, CNC motor compensation table	Stops sending commands to I/O devices.
Others	Conforms to the device output hold setting function

Overwriting CNC Parameters with CNC Instructions

- You can use the CNC instruction CNC_Write (Write CNC Setting) to change the settings of some of the CNC parameters in the main memory while the sequence control program is running.
- If the specified set value is outside the value range, the *Error* output variable from the instruction changes to TRUE and the CNC parameter setting is not changed.
- All changes to the parameters for CNC coordinate systems and CNC motors that compose the CNC coordinate system become valid.
- Changes of some parameters are applied immediately, and changes of others are applied when an operation instruction is executed. Refer to the list of each parameter for the application timing of the parameter.

Relationship between NC Program and CNC Parameters

- You cannot read or change CNC parameters directly from an NC program.
- To change CNC parameters, rewrite the parameters directly from a sequence control program, or write a sequence control program with which the parameters can be changed indirectly by using M codes.

4-2 CNC Common Parameter Settings

The CNC Common Parameters set the CNC Planner Service period and other settings for the CNC Function Module.

One CNC common parameter is provided for each NC Integrated Controller.

4-2-1 List of CNC Common Parameters

Use Sysmac Studio to set the CNC common parameters for each CNC motor.

Classification	Parameter name	Temporary changes			Reading variables
		Support	Update timing	Applica-ble instruc-tion	
CNC Planner Service Settings	CNC Planner Service Period	---	---	---	---

4-2-2 CNC Planner Service Settings

Select **Configurations and Setup - Controller Setup - Task Settings** from the Sysmac Studio to set the CNC Planner Service Period.

Parameter name	Function	Setting range	Default
CNC Planner Service Period*1	Sets the period of Planner Service.	Refer to *1-4-2 Performance Specifications* on page 1-7.	2 ms

*1. Set the CNC Planner Service period to an integer multiple of the task period of the primary periodic task. If the least common multiple of the CNC Planner Service period and a primary task period exceeds 600 ms, you cannot use the two in combination.

4-3 CNC Coordinate System Parameter Settings

The CNC Coordinate System Parameters set composition CNC motor, the maximum feed rate, and configure other settings for the CNC coordinate system controlled by the CNC Function Module.

The number of CNC coordinate system parameters provided is the same as the maximum number of controlled CNC coordinate systems for each model. For NJ501-5300, parameters are provided for four CNC coordinate systems. For NY532-5400, parameters are provided for eight coordinate systems.

The same parameter settings are applied to all CNC coordinate systems. This section describes the parameters for one CNC coordinate system.

4-3-1 List of CNC Coordinate System Parameters

Use Sysmac Studio to set the CNC coordinate system parameters for each CNC coordinate system.

Classification	Parameter name	Temporary changes			Reading variables
		Support	Update timing	Applicable instruction	
CNC Coordinate System Basic Settings	CNC Coordinate System Number				OK
	CNC Coordinate System Use				OK
	Positioning Axis Assignment				OK
	Spindle Axis Assignment				OK
	Unit of Cartesian Axes				
CNC Coordinate System Operation Settings	Maximum Feedrate				
	Rotary Axis Velocity	OK	Immediate	CNC_Write	
	Dry Run Velocity	OK	Immediate	CNC_Write	
	Immediate Stop Input Stop Method				
	Limit Input Stop Method				
	Feed Hold Acceleration/Deceleration Time	OK	When an operation instruction is executed	CNC_Write	
	In-position Check Time	OK	When an operation instruction is executed	CNC_Write	
	Software Overtravel Limit Operation Control	OK	When an operation instruction is executed	CNC_Write	
NC Program Default Settings	Acceleration Time				
	Deceleration Time				
	Jerk Time				
Tool Compensation Settings	Tool Radius	OK	Immediate	CNC_Write	
	Tool Length	OK	Immediate	CNC_Write	
	Overcut Mode	OK	Immediate	CNC_Write	
	Circular Feed Rate Mode	OK	Immediate	CNC_Write	

Classification	Parameter name	Temporary changes			Read-ing vari-ables
		Sup-port	Update timing	Applicable instruction	
Work Coordinate System Settings	1st Work Coordinate System Offset	OK	Immediate	CNC_Write	
	2nd Work Coordinate System Offset	OK	Immediate	CNC_Write	
	3rd Work Coordinate System Offset	OK	Immediate	CNC_Write	
	4th Work Coordinate System Offset	OK	Immediate	CNC_Write	
	5th Work Coordinate System Offset	OK	Immediate	CNC_Write	
	6th Work Coordinate System Offset	OK	Immediate	CNC_Write	
Reference Point Settings	1st Reference Point	OK	Immediate	CNC_Write	
	2nd Reference Point	OK	Immediate	CNC_Write	
	3rd Reference Point	OK	Immediate	CNC_Write	
	4th Reference Point	OK	Immediate	CNC_Write	
M Code Settings	M Code Output Timing[*1]				
Spindle Axis Operation Settings	Orientation Position	OK	Immediate	CNC_Write	
	Orientation Velocity	OK	Immediate	CNC_Write	
	Orientation Accelera-tion/Deceleration	OK	Immediate	CNC_Write	

*1. M codes can be set individually for each M code address. However, M0, M1, M2, M30, M98, and M99 are fixed.

4-3-2 CNC Coordinate System Basic Settings

These parameters are used to set whether or not to enable the CNC coordinate system. To enable the system, set CNC motors to be assigned.

Parameter name	Function	Setting range	Default
CNC Coordinate System Number*1	Set the logical number of the CNC coordinate system. The numbers set by this parameter will be applied to the numeric values of the _CNC_Coord[0-7] system-defined variable.	0 to (Maximum number of CNC coordinate systems)	---
CNC Coordinate System Use*2	Set whether to enable or disable the CNC coordinate system. 0: Undefined CNC coordinate system*3 1: Unused CNC coordinate system 2: Used CNC coordinate system	0 to 2	---

*1. You cannot use the same CNC coordinate system number more than once.

*2. Except for 2: Used CNC coordinate system, parameter settings other than the CNC coordinate system number are not required.

*3. When a CNC instruction is executed in an undefined or unused CNC coordinate system, *Busy* (Executing) changes to TRUE.

Busy (Executing) changes to FALSE when *Execute* or *Enable* changes to FALSE.

If you select Undefined coordinate system, you do not need to delete the program for the unused axes even if one user program is shared among devices that have different axis configurations.

Composition CNC Motor

Select the CNC motors to be used in the CNC coordinate system. CNC motors used in the CNC coordinate system are called composition CNC motors. Set the axis of the CNC coordinate system to which each composition CNC motor is assigned.

The axis types are: X/Y/Z-axes that constitute the orthogonal axes and A/B/C-axes that are rotational axes. These axes are called the positioning axes as they determine the position of a tool or work object of a machine tool.

Other than positioning axes, an axis is provided to control rotational speed by installing a cutting tool such as a drill or milling cutter used to machine the object. This axis is called the spindle axis.

The CNC motor assigned to the spindle axis must be different from CNC motors assigned to the positioning axes.

Precautions for Correct Use

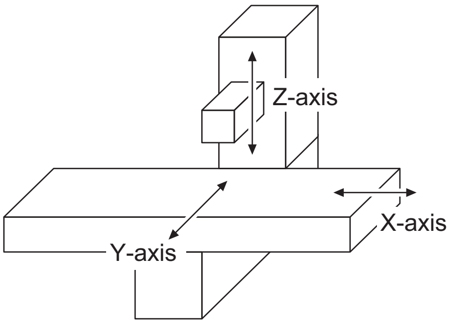
- If you change the axis assignment for a CNC motor that is set to Positioning Axis Assignment or Spindle Axis Assignment, the command unit of the axis to which the CNC motor is assigned may be different. Accordingly, you must review the unit conversion settings for the CNC motor.
- Refer to *Axis and Motor Command Unit* on page 4-13 for information on the axis and motor command unit.
- Refer to *4-4-3 Unit Conversion Settings* on page 4-26 for information on the unit conversion settings.

CNC Motors Used to Configure Positioning Axes

Set the CNC motors to be assigned to the positioning axes.

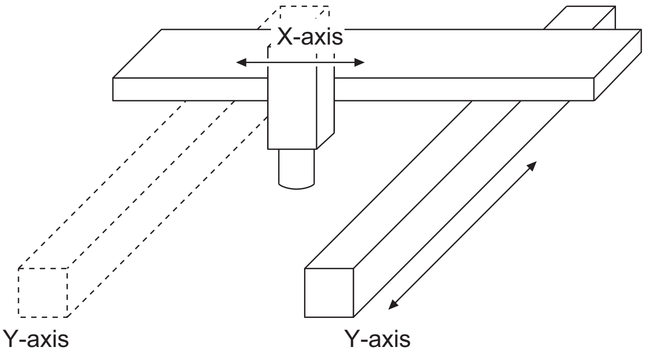
In most cases, one CNC motor is assigned to one positioning axis.

Example 1: Using the X-, Y-, and Z-axes, and assigning a CNC motor to each of the three axes.



However, a one-to-two setting can also be configured for a positioning axis and CNC motors as shown in the following figure.

Example 2: Assigning two CNC motors to the Y-axis to use Gantry Control.



Version Information

Gantry settings were added in the CNC with unit version of 1.01 or later. When you use the gantry control, enable the gantry settings of the CNC motor that is used as a gantry slave axis. For details on the gantry settings, refer to *4-4-11 Gantry Settings* on page 4-36.

If commands are issued or the status is obtained separately for each CNC motor of the CNC coordinate system, the positioning axis composition motor number may be used instead of the CNC motor number in order to increase the reusability of the program.

A composition CNC motor sets the assignment of positioning axis composition motor numbers and the CNC motor numbers belonging to the CNC coordinate system.

Use Sysmac Studio to set the CNC motors in the order from positioning axis composition motor number P0.

Even when you create two or more CNC coordinate systems, you must set the CNC motors in the order of positioning axis composition motor number P0 for each CNC coordinate system.

Parameter name	Function	Setting range	Default
Position Axis Composition Motor Number	Set CNC motor numbers to use for the positioning axes of the CNC coordinate system.	0 to (Maximum CNC motor number) -1	No assignment

Precautions for Correct Use

- The positioning axis composition motor numbers must be filled from the top.
  For example, you cannot set P2 to No Assignment and P3 to CNC Motor 5 at the same time.
- For a CNC coordinate system which is set to 2: Used CNC coordinate system in CNC Coordinate System Use, you cannnot specify CNC motor numbers that are undefined or unused.
- If CNC Coordinate System Use is set to anything other than 2: Used CNC coordinate system, all composition CNC motors are identified as undefined or unused.
- You cannot use the same CNC motor number more than once.
- CNC motors specified for Spindle Axis Assignment (described later) cannot be set.
- You cannot specify CNC motor numbers that have been set to the composition CNC motors for other CNC coordinate systems.

Example 1: Assigning CNC motor numbers 1, 3, 5, 6, and 8 as positioning CNC motor configurations

Positioning axis composition motor number	CNC motor number
P0	1
P1	3
P2	5
P3	6
P4	8
P5	(No assignment)
P6	(No assignment)
P7	(No assignment)

Example 2: Assigning CNC motor numbers 7, 2, and 4 as positioning CNC motor configurations

Positioning axis composition motor number	CNC motor number
P0	7
P1	2
P2	4
P3	(No assignment)
P4	(No assignment)
P5	(No assignment)
P6	(No assignment)
P7	(No assignment)

● Positioning Axis Assignment

Set which CNC motors that are assigned to positioning axes correspond to the axes in the CNC coordinate system.

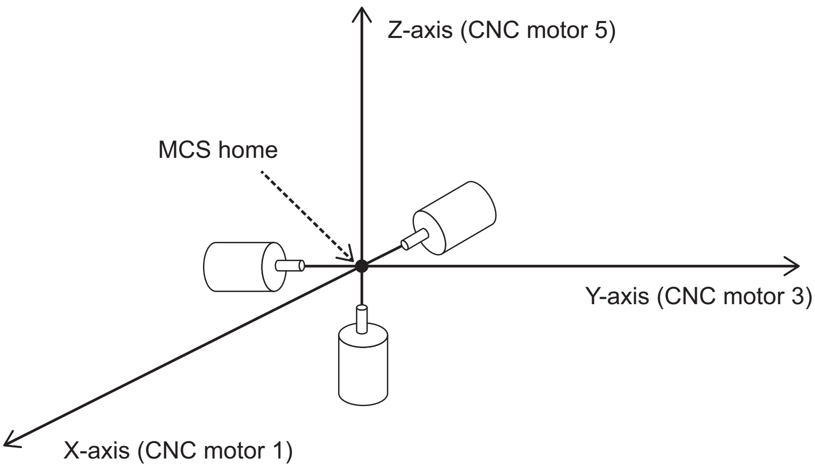
Set the positioning axis assignment, for each positioning axis composition motor number.

Parameter name	Function	Setting range	Default
Positioning Axis Assignment*1	Select the positioning axis to which a CNC motor is assigned. 0: X-axis 1: Y-axis 2: Z-axis 3: A-axis 4: B-axis 5: C-axis 200: X gantry slave axis 201: Y gantry slave axis 202: Z gantry slave axis	0 to 5, 200 to 202	P0 ... 0: X-axis P1 ... 1: Y-axis P2 ... 2: Z-axis P3 ... 5: C-axis P4 ... 0: X-axis P5 ... 0: X-axis P6 ... 0: X-axis P7 ... 0: X-axis * Settings of positioning axis composition motor numbers to which no CNC motor is assigned are invalid.

*1. Only two to four types of positioning axes can be set for each CNC coordinate system. However, gantry slave axes are not counted for this assignment restriction.

For information on the setting of Positioning Axis Assignment for each positioning axis composition motor number, refer to the following example.

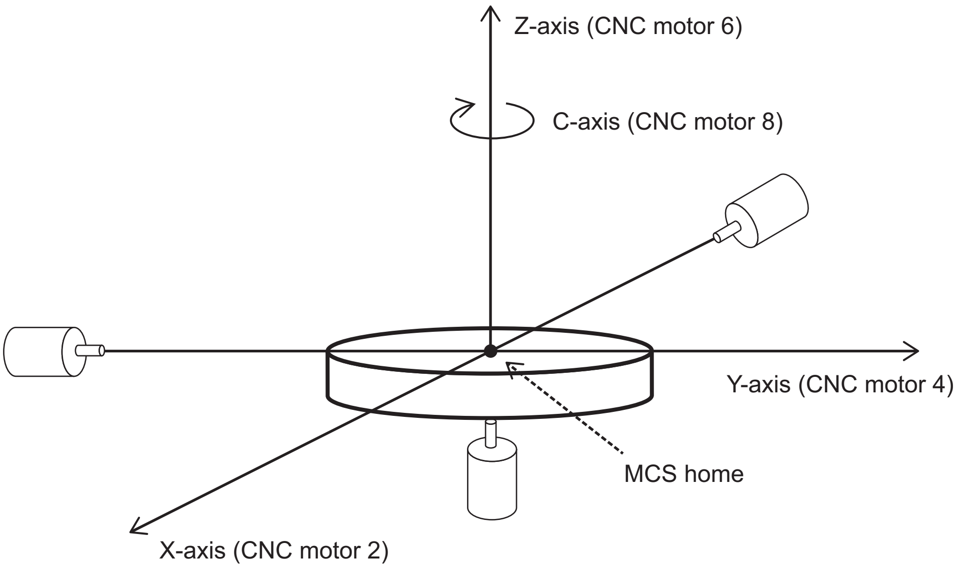
Example 1: Assigning CNC motors 1, 3, and 5 respectively to the X-, Y-, and Z-axes.



Positioning axis composition motor*1	Positioning axis assignment
P0 (1)	0: X-axis
P1 (3)	1: Y-axis
P2 (5)	2: Z-axis

*1. The number in the parentheses is a CNC motor number.

Example 2: Assigning CNC motors 2, 4, and 6 respectively to the X-, Y-, and Z-axes, and a CNC motor 8 to the C-axis.



Positioning axis composition motor*1	Positioning axis assignment
P0 (2)	0: X-axis
P1 (4)	1: Y-axis
P2 (6)	2: Z-axis
P3 (8)	5: C-axis

*1. The number in the parentheses is a CNC motor number.

● Spindle Axis Assignment

Select a CNC motor to assign to the spindle axis. Specify one CNC motor number.

No CNC motor needs to be assigned to the spindle axis for tool machines that do not rotate cutting tools.

Example: If you do not use the spindle axis in the CNC coordinate system, specify No assignment.

Precautions for Correct Use

- You cannot set CNC motor numbers of undefined or unused CNC motors.
- You cannot set CNC motor numbers that are set to composition CNC motors for other CNC coordinate systems.
- You cannot set CNC motors that are set to positioning axes composition motors.

Parameter name	Function	Setting range	Default
Spindle Axis Assignment	Set a CNC motor number to use for the spindle axis of the CNC coordinate system.	0 to (Maximum number of CNC motors) - 1	No assignment

Axis and Motor Command Unit

The command unit of each axis is shown in the following table. In particular, the unit of position is called the axis command unit.

Axis type	Unit of position (axis command unit)		Unit of velocity		Unit of acceleration and deceleration rates	
	metric	inch	metric	inch	metric	inch
X	mm	inch	mm/min	inch/min	mm/s^2	inch/s^2
Y						
Z						
A	degree		degree/min		degree/s^2	
B						
C						
Spindle	rev		rev/min		rev/s^2	

The axis command unit for orthogonal axes X, Y, and Z can be selected from metric and inch by using Unit of Cartesian Axes.

Parameter name	Function	Setting range	Default
Unit of Cartesian Axes	Set the command unit for the X-, Y-, and Z-orthogonal axes and the unit for CNC motors assigned to these axes collectively. 0: Metric (mm) 1: inch (inch)	0 to 1	0

The command unit system for composition CNC motors assigned to the X-, Y-, and Z-axes also conform to the Unit of Cartesian Axes settings.

This command unit for the CNC motors is called the motor command unit.

Basically, the axis command unit of the CNC coordinate system is equal to the motor command unit.

However, only for the orthogonal axes of the CNC coordinate system, the command unit can be changed between metric and inch by G codes G20 and G21.

As only the axis command unit is changed at this time and the motor command unit retains the Unit of Cartesian Axes settings, the axis command unit is not equal to the motor command unit.

4-3-3 CNC Coordinate System Operation Settings

Set operations of the CNC coordinate system such as the maximum feedrate and immediate stop method. Set them according to the specifications of the device to be controlled.

Parameter name	Function	Setting range	Default
Maximum Feedrate	Set the maximum feed rate of a path. Value 0 means there is no limit to the feed rate. If a target speed exceeding the maximum feed rate is specified using a CNC coordinate system operation instruction, the specified maximum feed rate is applied.*1 (Unit: Axis command units/min)	Positive long reals or 0	0
Rotary Axis Velocity	Set the speed of feeding the A-, B-, and C-axes using linear interpolation (G01) for a non-dry run. (Unit: degree/min)	Positive long reals	2,160
Dry Run Velocity*2	Specify the speed for a dry run. (Unit: mm, inch, degree/min)	Positive long reals	3,000
Immediate Stop Input Stop Method	Set the stopping method for CNC motors when immediate stop input is enabled in any of the composition CNC motor. Composition CNC motors without any error are immediately stopped. 0: Immediate stop 2: Immediate stop and error counter reset 3: Immediate stop and Servo OFF	0, 2, or 3	0
Limit Input Stop Method	Set the stopping method for CNC motors when positive limit input or negative limit input is enabled in any of the composition CNC motor. Composition CNC motors without any error are immediately stopped. 0: Immediate stop 3: Immediate stop and Servo OFF	0 or 3	0
Feed Hold Acceleration Deceleration Time	The time taken until operation stops when the override value changes from 100% to 0% at execution of feed hold. This parameter is also used for the acceleration time when override returns to 100% after operation resumes from the feed hold stop.*3 (Unit: ms)	1 to 10,000	1,000
In-position Check Time*4	An error occurs if all positioning axis composition CNC motors in a coordinate system are not in-positioned within this time period at the completion of the travel command while an execution of a CNC instruction. Set this check time in milliseconds.*5 However, the in-position check is not performed for the blending operation. The in-position check is also not performed if 0 is set. (Unit: ms)	0 to 10,000	0
Software Overtravel Limit Operation Control	Set the operation when the software overtravel limit of the CNC motor is reached while the CNC coordinate system is operating. 0: An error occurs. Each CNC motor stops immediately. 1: No error occurs. The command position of the CNC motor is limited by software overtravel limit, and the operation continues without observing the path.	0 or 1	0

*1. This parameter limits the specified feed rate. If the feedrate override value is set to 100% or more, the rate to be output is not limited by this parameter.

*2. Set a value less than or equal to the maximum feedrate if the maximum feedrate is not 0.

*3. If feed hold is executed while Multi-block Acceleration/Deceleration Rate Enable (G500) is enabled, operation does not stop according to this parameter. A sudden stop takes place within the range of maximum acceleration/deceleration rate of composition motors.

*4. Set a value larger than the number of in-position continuance cycles for the positioning axis composition CNC motor.
Example: Suppose that the control cycle time of a primary periodic task is 2 milliseconds, and that the largest number of the in-position check continuance cycles of the composition CNC motors is 100 control cycles. Then the in-position check time must be set to a value larger than 200 milliseconds. Cases where the in-position check time is 0 milliseconds or it is smaller than the CNC Planner Service period are excluded.

*5. The result of an in-position check of the CNC coordinate system is determined by the CNC Planner Service. Actually, therefore, the accuracy of the in-position check time is rounded down to the unit of the CNC Planner Service period. If the in-position check time is smaller than the CNC Planner Service period, it is rounded down to be 0, and the in-position check is not executed.

Example: Suppose that the in-position check time is 6 milliseconds and that the CNC Planner Service period is 4 milliseconds. Then normal operation is performed when the in-position check of all the positioning axis composition CNC motors is completed within one CNC Planner Service period (4 milliseconds) from the CNC Planner Service that has actually finished the travel command. An error occurs if the in-position check takes longer than the period.

4-3-4 NC Program Default Settings

Set the default values for the parameters and modal values that can be changed from the NC program, for each CNC coordinate system.

Default values are restored when modal reset is executed.

Parameter name	Function	Setting range	Default
Acceleration Time	Set the default acceleration time. (Unit: ms)	Positive long reals or 0	100
Deceleration Time	Set the default deceleration time. (Unit: ms)	Positive long reals or 0	100
Jerk Time*1	Set the default jerk time. (Unit: ms)	Positive long reals or 0	0

*1. Refer to the *NJ/NY-series G code Instructions Reference Manual* (Cat. No. O031) for Jerk Time.

4-3-5 Tool Compensation Settings

Set parameters relevant to compensation of tool radius and length.

Parameter name	Function	Setting range	Default
Tool Radius	Set the tool radius for 2D tool system compensation. (Unit: Axis command units)	Positive long reals or 0	0
Tool Length	Set the tool length (offset in the Z-axis direction) for tool length compensation. (Unit: Axis command units)	Negative or positive long reals or 0	0
Overcut Mode	Specify the overcut mode for tool radius compensation control. 0: Overcut error At the instant when an over-cut is detected, the program operation stops in an error state. 1: Overcutting avoidance In an attempt to avoid overcuts, the corrected path between the first and second intersection points is eliminated. As the result, the entry path and outgoing path at the intersection points are connected directly. This operation mode is normally used for rough machining by large tools which cannot go into detailed profiles of any components. 2: Overcutting ignorance Continues program operation without detecting overcuts. 3: Overcutting test avoidance Attempts to avoid an overcut. If the overcut cannot be avoided, it is ignored to continue program operation.	Enumerator 0 to 3	0
Circular Feed Rate Mode	Specify the circular feed rate mode to be applied for tool radius compensation control. FALSE: The tool center moves at the programmed feedrate. The velocity of tool edge along the programmed path becomes lower when tool radius compensation is outside the arc. The velocity becomes higher when tool radius compensation is inside the arc. TRUE: The tool edge along the programmed path moves at the programmed feedrate. The tool center becomes faster when tool radius compensation is outside the arc. It becomes slower when tool radius compensation is inside the arc.	TRUE or FALSE	FALSE

4-3-6 Work Coordinate System Offset Settings

Set the offset value for each axis in the first to sixth Work Coordinate Systems.

As shown in the table below, you can set a total of six work coordinate system offset values for each of first to sixth Work Coordinate System.

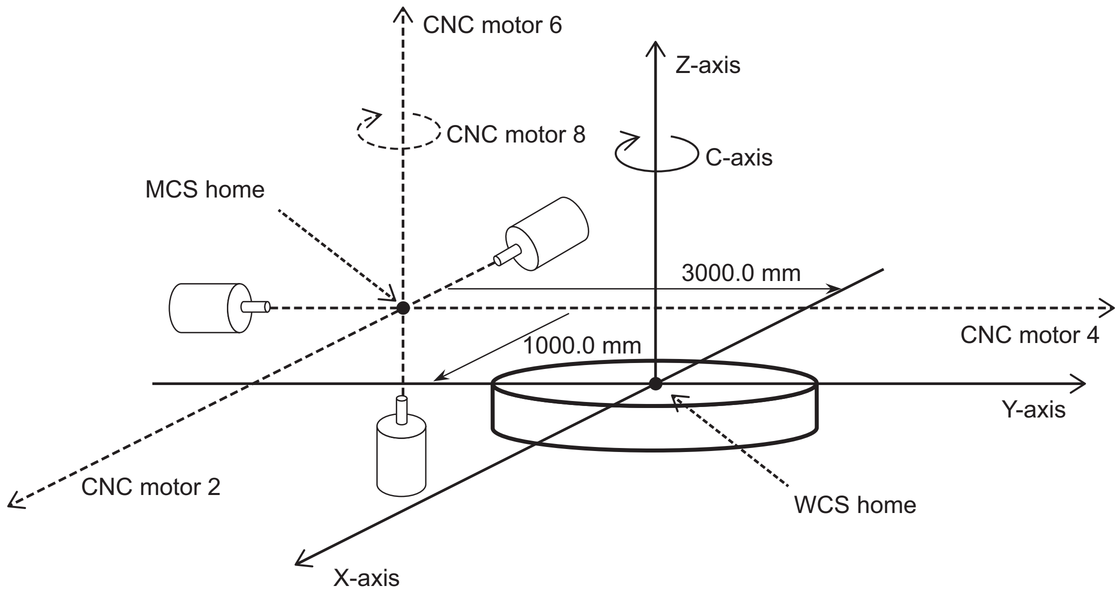
Parameter name	Function	Setting range	Default
Work Coordinate System Offset X Value*1	Set the offset of a Work Coordinate System against the Machine Coordinate System of each axis. (Unit: Axis command units)	Negative or positive long reals or 0	0
Work Coordinate System Offset Y Value*1			
Work Coordinate System Offset Z Value*1			
Work Coordinate System Offset A Value*1			
Work Coordinate System Offset B Value*1			
Work Coordinate System Offset C Value*1			

*1. Values for positioning axes that are not used are invalid.

Example: Assigning CNC motors 2, 4, and 6 respectively to the X-, Y-, and Z-axes

Assign CNC motor 8 to the C-axis.

The homes of the Z-axis and C-axis in the Machine Coordinate System are the same as the home of the Work Coordinate System. However, if you want to set the homes of the X-axis and Y-axis in the Work Coordinate System to the center of the circular table, it must be offset against the home in the Machine Coordinate System.



Axis type	X	Y	Z	A	B	C
Work Coordinate System Offset Value	1000.0	3000.0	0	0	0	0

4-3-7 Reference Point Settings

The position of each axis that constitutes the reference point can be set.

Parameter name	Function	Setting range	Default
Reference Point X*1	Set the positions of reference points for each axis. (Unit: Axis command units)	Negative or positive long reals or 0	0
Reference Point Y*1			
Reference Point Z*1			
Reference Point A*1			
Reference Point B*1			
Reference Point C*1			

*1. Values for positioning axes that are not used are invalid.

You can set the first to fourth reference points.

However, you do not have to set reference points for unused positioning axes.

Example: Using the X-, Y-, Z-, and C-axes.

Reference point	X-axis	Y-axis	Z-axis	A-axis	B-axis	C-axis
1st Reference Point	Supported	Supported	Supported	Unnecessary	Unnecessary	Supported
2nd Reference Point	Supported	Supported	Supported	Unnecessary	Unnecessary	Supported
3rd Reference Point	Supported	Supported	Supported	Unnecessary	Unnecessary	Supported
4th Reference Point	Supported	Supported	Supported	Unnecessary	Unnecessary	Supported

4-3-8 M Code Settings

Select the output timing of M codes.

Parameter name	Function	Setting range	Default
M Code Output Timing	Select the output timing of M codes. 0: Synchronous 1: Immediate	0 to 1	0

The timing can be set individually for each M code address. However, M0, M1, M2, M30, M98, and M99 are fixed.

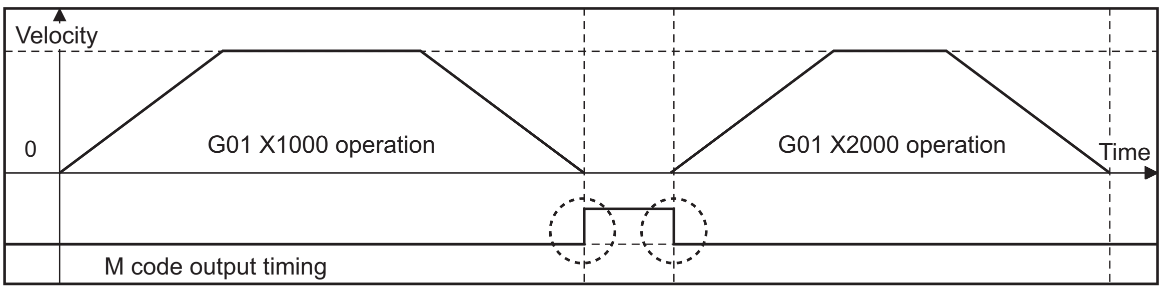
M code address	Parameters
0	(No output)
1	(No output)
2	(No output)
3	0 or 1
...	0 or 1
29	0 or 1
30	Always 0
31	0 or 1
...	0 or 1
98	(No output)
99	(No output)
...	0 or 1
191	0 or 1

The following is an example of controlling M code output timing using an NC program.

```
(Sample of NC Program)
N10 G01 X1000
N20 M10
N30 G01 X2000
```

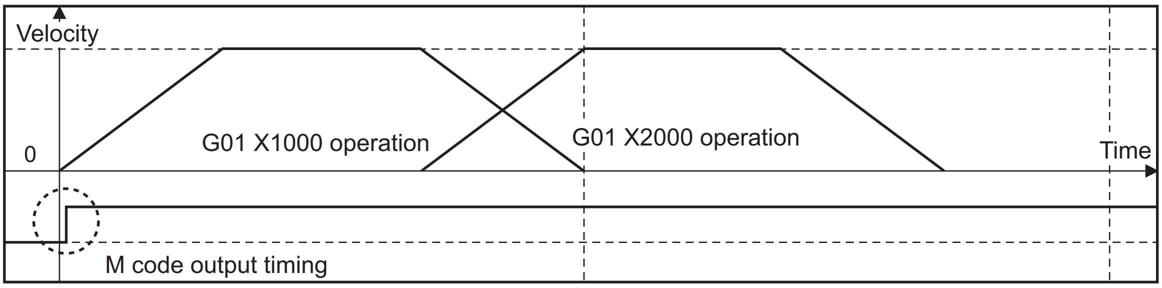
● 0: Synchronous

- The M10 signal is output when the G01 X1000 travel is completed.
- The next axis motion is not executed until the M10 signal is reset by the sequence control program.



- **1: Immediate**

The M10 signal is output at the timing when the line N20 M10 in the NC program is interpreted. It does not synchronize with the operation.



4-3-9 Spindle Axis Operation Settings

Set orientation operation for the spindle axis assigned to the coordinate system.

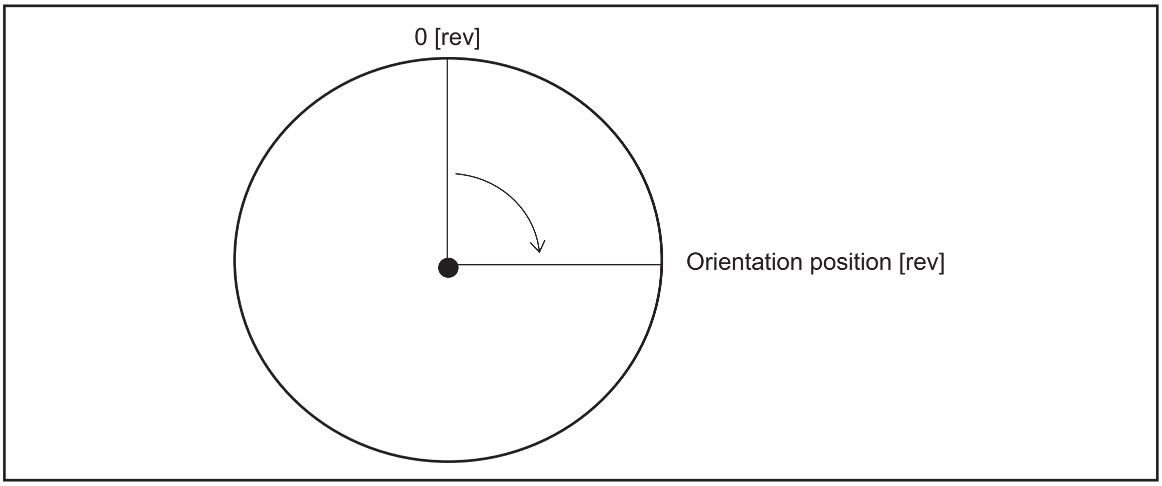
Parameter name	Function	Setting range	Default
Orientation Position	Specify the stop position [rev] within one spindle axis rotation at Spindle Orientation (M19).	Long reals $0 \leq x < 1$	0
Orientation Velocity*1	Specify the target velocity [rev/min] in the constant velocity section at Spindle Orientation (M19).	Single-precision reals Positive number	600.0
Orientation Acceleration/Deceleration*2	Specify an acceleration/deceleration rate [rev/s^2] at Spindle Orientation (M19).	Single-precision reals Positive number, 0	0

*1. Set a value less than or equal to the maximum velocity of the CNC motor assigned to the spindle axis.

*2. Set a value less than or equal to the maximum acceleration of the CNC motor assigned to the spindle axis, if the maximum acceleration is not 0.

Orientation operation is a function to be performed for tool replacement. Orientation operation enables to stop the spindle axis at a specific phase and replace tools.

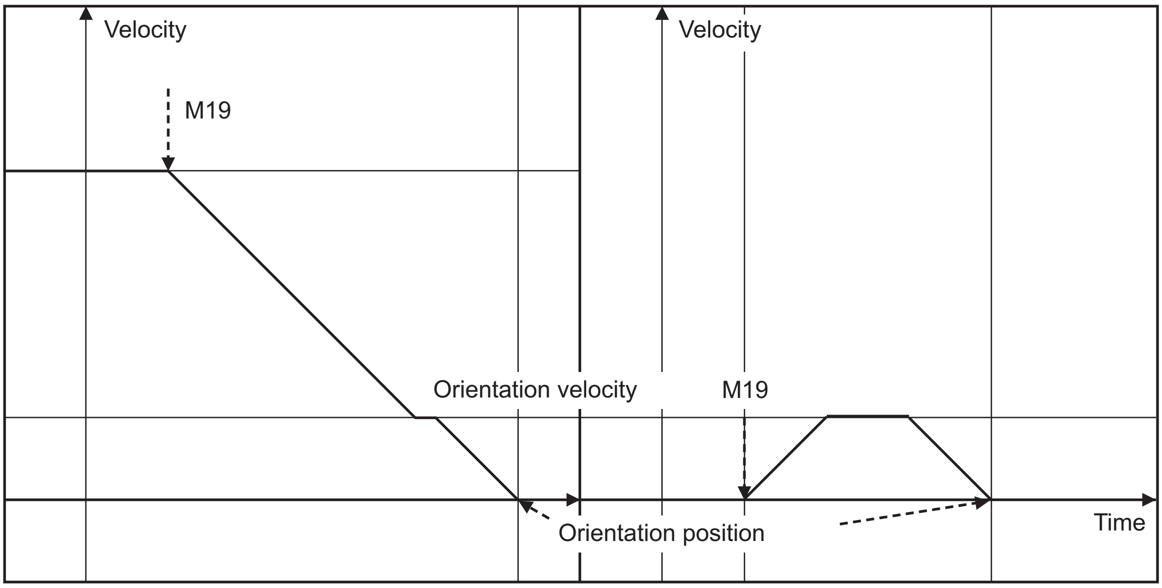
As shown in the following figure, the orientation position is specified for an offset position within one rotation from position 0.



For the orientation velocity, specify a speed in the constant velocity section during orientation operation of the spindle axis.

For the orientation acceleration/deceleration, specify an acceleration/deceleration rate until the orientation velocity or speed 0 is reached.

The figure to the left shows the operation when M19 (Spindle Orientation) is executed during positive rotation (CW) or negative rotation (CCW) of the spindle axis. The figure to the right shows the operation when M19 (Spindle Orientation) is executed when the spindle axis in standby status.



Precautions for Correct Use

If M19 is executed during CW or CCW rotation of the spindle axis, the spindle axis status switches from open loop to closed loop. This makes the rotation speed temporarily discontinuous. Therefore, you need to reduce the rotation speed of the spindle axis to an adequately low level before executing M19.

4-4 CNC Motor Parameter Settings

The CNC motor parameters set CNC motor operation such as the maximum velocity, homing, and other settings related to CNC motors controlled by the CNC Function Module.

The number of CNC motor parameters provided is the same as the maximum number of controlled CNC motors for each model. For NJ501-5300, the parameters are provided for 16 axes. For NY532-5400, they are provided for 32 axes.

The same parameter settings are applied to each CNC motor. This section describes the parameters for one CNC motor.

4-4-1 List of CNC Motor Parameters

Use Sysmac Studio to set the CNC motor parameters for each CNC motor.

Classification	Parameter name	Temporary changes			Reading variables
		Support	Update timing	Applicable instruction	
CNC Motor Basic Settings	CNC Motor Number				OK
	CNC Motor Use				OK
	Virtual CNC Motors				OK
	Coordinate System Number				OK
	Axis Assignment Type				
	Input/Output Device				
Unit Conversion Settings	Command Pulse Count Per Motor Rotation				
	Travel Distance Per Work Rotation				
	Work Gear Ratio				
	Motor Gear Ratio				
Operation Settings	Maximum Velocity				
	Maximum Acceleration/Deceleration				
	Rapid Feed Acceleration/Deceleration	OK	Immediate	CNC_Write	
	In-position Range	OK	Immediate	CNC_Write	
	Number of In-position Continuance Cycles	OK	Immediate	CNC_Write	
	Skip Velocity	OK	Immediate	CNC_Write	
Other Operation Parameters	Driver Error Reset Monitoring Time				
	Immediate Stop Input Logic Inversion				
	Positive Limit Input Logic Inversion				
	Negative Limit Input Logic Inversion				
	Home Proximity Input Logic Inversion				

Classification	Parameter name	Temporary changes			Read-ing vari-ables
		Sup-port	Update timing	Applicable instruction	
Limit Settings	Software Overtravel Limit	OK	When an operation instruction is executed	CNC_Write	
	Positive Software Overtravel Limit	OK	When an operation instruction is executed	CNC_Write	
	Negative Software Overtravel Limit	OK	When an operation instruction is executed	CNC_Write	
	Following Error Over Value	OK	Immediate	CNC_Write	
	Following Error Warning Value	OK	Immediate	CNC_Write	
Position Count Parameters	Encoder Type				
Servo Drive Types	PDS Status Control Method				
Homing Settings	Homing Operation Mode				
	Home Input Signal				
	Homing Start Direction				
	Home Input Detection Direction				
	Operation Selection at Positive Limit Input				
	Operation Selection at Negative Limit Input				
	Homing Velocity				
	Homing Approach Velocity				
	Homing Acceleration/Deceleration				
	Home Input Mask Distance				
	Home Offset				
	Homing Holding Time				
	Homing Compensation Value				
	Homing Compensation Velocity				
Servo Gain Settings	Position Loop Gain	OK	Immediate	CNC_Write	
	Velocity Feedforward Gain	OK	Immediate	CNC_Write	
Gantry Settings	Gantry Enable				
	CNC Motor Number for Gantry Master Axis				
	Alignment Velocity				
	Position Deviation Between Axes Over Value				
	Position Deviation Between Axes Warning Value				

4-4-2 CNC Motor Basic Settings

Set whether to use CNC motors, and to use real or virtual CNC motors, as well as the node addresses of the EtherCAT slave devices.

Parameter name	Function	Setting range	Default
CNC Motor Number[*1]	Set the logical number of the CNC motor. The number specified with this parameter will be the numeric value in *_CNC_Motor[0-15]* system-defined variable.	0 to (Largest CNC motor number)-1	---
CNC Motor Use[*2]	Set whether to use the CNC motor. 0: Undefined CNC motor 1: Unused CNC motor 2: Used CNC motor	0 to 2	---
Virtual CNC Motor	Select whether to enable or disable the virtual CNC motor. I/O wiring is not required for virtual CNC motors. 0: Disable (Real CNC motor) 1: Enable (Virtual CNC motor)	0 to 1	1
Coordinate System Number[*3, *4]	Display the number of the assigned CNC coordinate system.	0 to (Largest CNC coordinate system number)-1	---[*5]
Axis Assignment Type[*3, *6]	Display whether the axis is a positioning axis (orthogonal or rotational) or the spindle axis, and the purpose of axis use. 0: Positioning orthogonal axis 1: Positioning rotational axis 2: Spindle axis	0, 1, or 2	---
Input/Output Device[*7]	Specify the node address of the EtherCAT slave device that is assigned to the CNC motor.	0 to 65,535	---

*1. You cannot use the same CNC motor number more than once.

*2. These settings are determined in association with the setting for the CNC Coordinate System Use in the CNC Coordinate System Basic Settings of the CNC coordinate system parameters. They cannot be set as CNC motor parameters.

*3. These settings are determined when CNC motors are assigned in the CNC Coordinate System Basic Settings of the CNC coordinate system parameters. They cannot be set as CNC motor parameters.
The CNC motor parameter setting screen is shown on the Sysmac Studio, but they cannot be set from the Sysmac Studio.

*4. A CNC motor must be assigned to any CNC coordinate system.

*5. When you add a CNC motor on Sysmac Studio, the coordinate system number changes to - (none) and an error occurs. Assign it to any CNC coordinate system before transferring the parameter to the NC Integrated Controller.

*6. This parameter is automatically set from Positioning Axis Assignment or Spindle Axis Assignment of the coordinate system to which the CNC motor is assigned.

*7. This setting is not required when a virtual CNC motor is enabled.

Precautions for Correct Use

When absolute encoders are used, the absolute encoder home offset for each CNC motor is associated with a CNC motor number and saved to the battery-backup memory. For the NY-series Controllers, it is saved to the non-volatile memory. If the CNC motor number is changed, the saved offset will be lost. If you change the CNC motor number, set the Homing Settings again.

CNC Motor Number

You can set the numbers for CNC motors up to the maximum number of CNC motors.

Item	NJ501-5300	NY532-5400
Settable CNC motor numbers	0 to 15	0 to 31
Maximum number of CNC motors	16	32

Virtual CNC Motors

Virtual CNC motors are provided in the CNC Function Module. Set to enable or disable the virtual CNC motors.

If the virtual CNC motors are enabled, the EtherCAT slave Servo Drives and EtherCAT spindle driver are not used. By enabling the virtual CNC motors, you can create programs even if you have not yet obtained actual CNC motors and drivers to use when starting up a machine tool.

The virtual CNC motors do not have physical encoders or external I/O signals.

When the virtual CNC motors are enabled, the following points differ from when they are disabled.

- As the feedback current position, the command position that is rounded down to the precision in pulse will be replicated.
- The feedback current velocity is derived from the difference of the feedback current position.
- External input signals cannot be used.
- If the CNC_Home (Homing) or CNC_HomeWithParameter (Home with Parameters) instruction is executed, the instruction is processed as a zero position preset regardless of the setting of the Homing Method of the CNC motor parameter.
- Errors do not occur for immediate stop inputs or positive/negative limit inputs because the input signals do not exist for them.

Input Device/Output Device

When the virtual CNC motors are disabled, specify the node address of the EtherCAT slave device that is assigned to the axis.

The node address parameter cannot be selected when the virtual CNC motors are enabled.

Precautions for Correct Use

- OMRON 1S-series Servo Drives and G5-series Servo Drives can be set to specific node addresses by using the node address switches on the front panel. If the node address switches are set to 00, the node address will be determined by the settings set in the EtherCAT Editor of Sysmac Studio.

  If the node address switches are set to 00 for all connected Servo Drives, errors will not occur even if the Servo Drive's connection position is changed. Set the node addresses on the node address switches to assign specific Servo Drives for each machine control.
- The value set on the Servo Drive's node address switches is loaded only once when the Servo Drive's control power is turned ON.

  Such changes are enabled only after the power supply is turned ON again.

  Do not change the setting on the node address switches after the power supply has been turned ON.
- An error occurs if the same node address is used more than once.

4-4-3 Unit Conversion Settings

Set the units for positions, and determine the electronic gear ratio (unit conversion).

Parameter name	Function	Setting range	Default
Command Pulse Count Per Motor Rotation*1	Set the number of pulses per motor rotation for commanded positions according to the encoder resolution. The command value is converted to a number of pulses based on the electronic gear ratio.	1 to 4,294,967,295	10,000
Travel Distance Per Work Rotation*2,*3	Set the work travel distance per work rotation at the commanded position. This parameter can only be set when Axis Assignment Type is *0: Positioning orthogonal axis*. The unit used for this parameter is the orthogonal axis command unit set by the CNC Coordinate System Basic Settings to which the CNC motor is assigned.	Positive long reals	10.0
Work Gear Ratio*2	Set the gear ratio for the workpiece.*4	1 to 4,294,967,295	1
Motor Gear Ratio2	Set the gear ratio of the CNC motor.*4	1 to 4,294,967,295	1

*1. For example, if the encoder resolution is 10,000 pulses/rotation, specify 10,000.

*2. There is a condition to be satisfied for these settings. Refer to *Condition for Unit Conversion Settings* on page 4-28 for the condition.

*3. This parameter can only be set when Axis Assignment Type is *0: Positioning orthogonal axis*.
If Axis Assignment. Type is *1: Positioning rotational axis*, the setting is fixed to 360.0 degrees, and if it is *2: Spindle axis*, the setting is fixed to 1.0 rev.

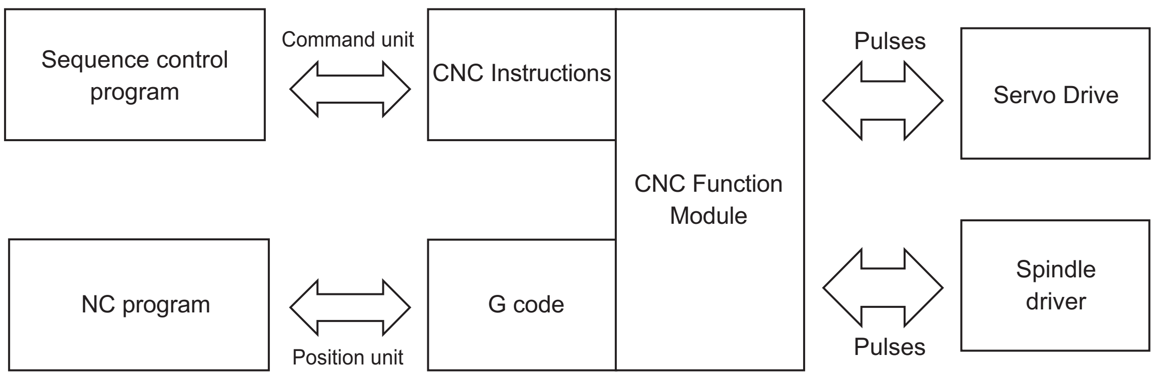
*4. When you do not use a reducer or other gears, do not change the default value 1.

Precautions for Correct Use

When you make a change in the unit conversion settings, there are some differences between the physical position of the machine and the command current position of the CNC Function Module. Therefore, if you made a change in the unit conversion settings, execute the Home instruction to define the home again.

Positions are generally given in pulses between the CNC Function Module and Servo Drives or spindle driver.

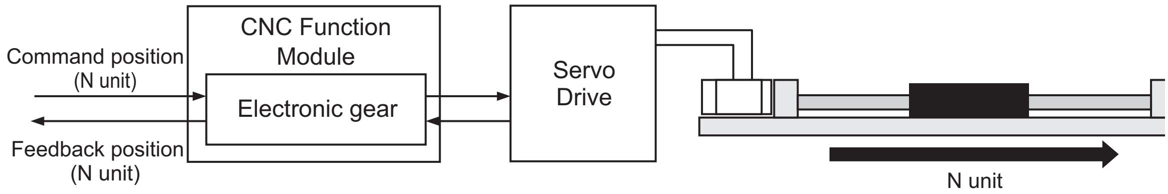
For positions used to control a machine tool, use the motor command units such as millimeter, inch, degree, and revolution for easier understanding of actual operations.



Electronic Gear Ratio (Unit Conversion Formula)

Use the electronic gear to set the relationship between the command unit and pulse unit in the CNC Function Module.

Use Sysmac Studio and set the electronic gear ratio.



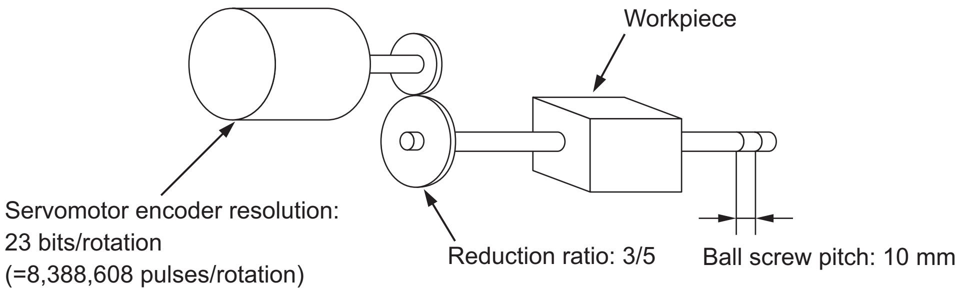
Commanded position value (pulses) = Commanded position (N units) × Electronic gear ratio

$$\text{Electronic gear ratio} = \frac{\text{Command Pulse Count Per Motor Rotation} \times \text{Motor Gear Ratio}}{\text{Travel Distance Per Work Rotation} \times \text{Work Gear Ratio}}$$

In this example, an OMRON 1S-series Servomotor with a 23-bit absolute encoder is used.

The CNC motor is assigned to the CNC coordinate system as a positioning orthogonal axis, and the metric unit (millimeter) is used as the orthogonal axis command unit of the CNC coordinate system.

Mechanically, the reduction ratio of the reducer is 3/5 and the workpiece moves 10 mm for each rotation of the ball screw.



The Command Pulse Count Per Motor Rotation is set to the resolution of the encoder on the Servomotor.

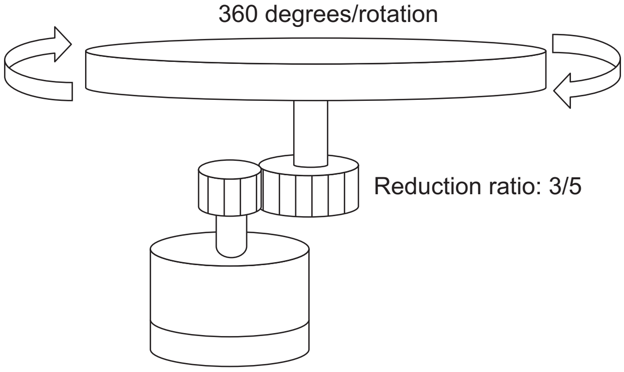
The Travel Distance Per Work Rotation is set to 10 mm, which is equivalent to the ball screw pitch.

A reducer with a reduction ratio of 3/5 is used, so the ball screw turns three times for every five rotations of the Servomotor. For this reduction ratio setting, the work gear ratio is set to 3 and the motor gear ratio is set to 5.

Parameter name	Setting
CNC Coordinate System Number	The number of the CNC coordinate system whose orthogonal axis command unit is 0: metric.
Axis Assignment Type	0: Positioning orthogonal axis
Command Pulse Count Per Motor Rotation	8,388,608
Travel Distance Per Work Rotation	10
Work Gear Ratio	3
Motor Gear Ratio	5

In this example, an OMRON G5-series Servomotor with a 17-bit absolute encoder is used as a positioning rotational axis.

Mechanically, the reduction ratio of the reducer is 3/5 and the workpiece moves 360 degrees for every rotation of the turntable.



The Command Pulse Count Per Motor Rotation is set to the resolution of the encoder on the Servomotor.

The Travel Distance Per Work Rotation is automatically set to 360.

A reducer with a reduction ratio of 3/5 is used, so the turntable (or workpiece) turns three times for every five rotations of the Servomotor. For this reduction ratio setting, the work gear ratio is set to 3 and the motor gear ratio is set to 5.

Parameter name	Setting
Axis Assignment Type	1: Positioning rotational axis
Command Pulse Count Per Motor Rotation	131,072
Travel Distance Per Work Rotation	Always 360
Work Gear Ratio	3
Motor Gear Ratio	5

Condition for Unit Conversion Settings

The unit conversion settings must satisfy the following condition:

- The result of the following calculation must be equal to or between 0.000000001 and 65,535: Travel Distance Per Work Rotation × Work Gear Ratio ÷ Motor Gear Ratio.

4-4-4 Operation Settings

These parameters set items for the operation of CNC motor, such as the maximum velocity and maximum acceleration/deceleration rate. Set them according to the specifications of the device you are controlling.

Parameter name	Function	Setting range	Default
Maximum Velocity[*1]	Set the maximum velocity for the CNC motor.[*2] This parameter is also used as the rapid feed rate. Do not set a value that exceeds the maximum speed of the motor that you are using. (Unit: Motor command units/min)	Positive single-precision reals[*3]	30000.0
Maximum Acceleration/Deceleration	Set the maximum acceleration/deceleration rate for a CNC motor operation command. Value 0 means there is no limit to the acceleration/deceleration rate. (Unit: Motor command units/s^2)[*4]	Positive single-precision reals or 0	0
Rapid Feed Acceleration/Deceleration[*5]	Set the acceleration and deceleration rates of the rapid feed command. (Unit: Motor command units/s^2)	Positive single-precision reals or 0	0
In-position Range[*6,*7]	Set the in-position width.[*8] When the value is set to 0, positioning is complete when the position command is completed. (Unit: Motor command units)	0 or larger single-precision real type value	10
Number of In-position Continuance Cycles[*9]	Set the time for checking completion of positioning in units of control periods. (Unit: Control period)	0 to 255	0
Skip Velocity	Set the velocity of the rapid feed command in Skip Function (G31). (Unit: Motor command units/min)	Positive single-precision reals	600.0

*1. Parameters related to the following velocities must be set to a value less than or equal to the maximum velocity.
- Homing velocity
- Homing approach velocity
- Homing compensation velocity
- Skip velocity
- Alignment velocity

*2. The maximum velocity is used as the command velocity if you specify a velocity command value that is greater than the maximum velocity. This parameter also applies to CNC coordinate system operation.

*3. The maximum value that can be specified for the maximum velocity is 128,849,018,820 pulses/min, a value converted into long reals, then into pulses.

*4. The limitations set by the Maximum Acceleration/Deceleration become valid when acceleration/deceleration rate is enabled by the CNC_MoveJog or CNC_Move instruction, or in NC program operation and Multi-block Acceleration/Deceleration Rate Enable (G500). This function does not work in Multi-block Acceleration/Deceleration Rate Disable (G501)

*5. Set a value less than or equal to the maximum acceleration/deceleration rate.

*6. The in-position check is processed by the CNC Function Module. Servo Drive functions are not used.

*7. In-position check does not function when Continuous-path mode (G64) is enabled.

*8. The maximum value that you can set for the in-position range is 1,099,511,627,775 pulses, a value converted into long reals, then into pulses.

*9. Set a value less than the In-position Check Time of the CNC coordinate system to which the CNC motor is assigned.

Example: Suppose that the control period of the primary periodic task is 2 ms and that the in-position check time of the CNC coordinate system is set to 100 ms.

Then the in-position check time must be set to a value less than 50 control periods.

Precautions for Correct Use

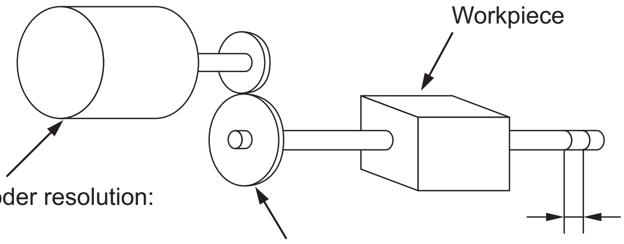
The Maximum Velocity parameter is also used as the speed of the rapid feed command for the CNC coordinate system. Be sure to set a value that is supported by the machine.

Maximum Velocity

The following provides a setting example for the maximum velocity.

● Setting Example for the Maximum Velocity

This is an example for orthogonal axis and a Servomotor with a maximum speed of 1,000 r/min.



When calculating from a maximum speed of 1,000 r/min., a reduction ratio of 3/5, and a ball screw pitch of 20 mm, the formula 1,000 r/min × 3/5 × 20 mm yields 1,200 mm/min. Accordingly, specify 1200 for the maximum velocity.

The default setting of 30,000 exceeds the maximum speed of the CNC motor, so you must change the setting.

4-4-5 Other Operation Settings

Set the input logic inversion, etc. of each signal.

Parameter name	Function	Setting range	Default
Driver Error Reset Monitoring Time	Set the monitor time for a driver error reset. (Unit: ms) After the monitor time has elapsed, reset processing will end even if the drive error is not yet reset.	1 to 1000	200
Immediate Stop Input Logic Inversion	Set whether to reverse the logic of the immediate stop input signal. FALSE: Do not reverse. TRUE: Reverse.	TRUE or FALSE	FALSE
Positive Limit Input Logic Inversion	Set whether to reverse the logic of the positive limit input signal. FALSE: Do not reverse. TRUE: Reverse.	TRUE or FALSE	FALSE

Parameter name	Function	Setting range	Default
Negative Limit Input Logic Inversion	Specify whether to invert the logic of the negative limit input signal. FALSE: Do not reverse. TRUE: Reverse.	TRUE or FALSE	FALSE
Home Proximity Input Logic Inversion	Set whether to reverse the logic of the home proximity input signal. FALSE: Do not reverse. TRUE: Reverse.	TRUE or FALSE	FALSE

4-4-6 Limit Settings

Use the following parameters to select functions for limiting the following error and for software limits.

Parameter name	Function	Setting range	Default
Software Overtravel Limit*1	Enable or disable the software overtravel limit. The stop method is an immediate stop for the command position (stop using remaining pulses). 0: Disabled 1: Enable	0 or 1	0
Positive Software Overtravel Limit*2,*3,*4	Set the software overtravel limit in the positive direction. (Unit: Motor command units)	Positive single-precision reals	10,000
Negative Software Overtravel Limit*2,*4,*5	Set the software overtravel limit in the negative direction. (Unit: Motor command units)	Negative single-precision reals	-10,000
Following Error Over Value*6	Set the excessive following error check value. Set 0 to disable the excessive following error check. (Unit: Motor command units)	Positive long reals or 0	0
Following Error Warning Value*7	Set the following error warning check value. Set 0 to disable the following error warning check. (Unit: motor command units)	Positive long reals or 0	0

*1. This function is activated only when the home is defined.

*2. If the software overtravel limit is disabled, the value does not need to be input.

*3. The value obtained through a conversion into a pulse value using the unit conversion setting must be less than or equal to 549755813887.

*4. When assigned to the spindle axis, the software limit does not work.

*5. The value obtained through a conversion into a pulse value using the unit conversion setting must be equal to or larger than -549755813888.

*6. The value obtained through a conversion into a pulse value using the unit conversion setting must be less than or equal to 1099511627775.

*7. When the Following Error Over Value is not 0, a value that is less than or equal to the Following Error Over Value must be set to this parameter.

4-4-7 Position Count Settings

Set the count mode for the position.

Parameter name	Function	Setting range	Default
Encoder Type	Set the encoder type.*1,*2 0: Incremental encoder 1: Absolute encoder	0 to 1	0

*1. If you use any of the following products, set the encoder type to 1: Absolute encoder.

When an OMRON 1S-series or G5-series Servomotor/Servo Drive with an absolute encoder is used

When an OMRON 1S-series or G5-series Servomotor/Servo Drive with an absolute external scale for fully-closed control is used

When an OMRON 1S-series or G5-series Linear Motor Type Servomotor/Servo Drive with built-in EtherCAT communications is used with an absolute external scale

*2. The settings are as follows when you use an OMRON 1S-series or G5-series Servomotor/Servo Drive with an external scale for fully-closed control, or when you use an OMRON 1S-series or G5-series Linear Motor Type Servomotor/Servo Drive with built-in EtherCAT communications.

0: Incremental external scale

1: Absolute external scale

4-4-8 Servo Drive Settings

Set the value that is set on the Servo Drive that is connected.

Parameter name	Function	Setting range	Default
PDS Status Control Method*1	Set the status to which PDS status changes when Servo is turned OFF by the CNC_Power instruction.*1 0: Switched on by Servo OFF 1: Ready to switch on by Servo OFF	0 to 1	0

*1. If you set this parameter to 1, the Servo Ready (Switched on) status of OMRON 1S-series Servo Drives or G5-series Servo Drives cannot be used. To use the Servo Ready (Switched on) status, set this parameter to 0.

4-4-9 Homing Settings

Set the CNC motor operation to use to determine home.

Parameter name	Function	Setting range	Default
Homing Operation Mode	Set the homing operation. 0: Proximity reverse turn/home proximity input OFF 1: Proximity reverse turn/home proximity input ON 4: Home proximity input OFF 5: Home proximity input ON 8: Limit input OFF 9: Proximity reverse turn/home input mask distance 11: Limit inputs only 12: Proximity reverse turn/holding time 13: No home proximity input/holding home input 14: Zero position preset	0, 1, 4, 5, 8, 9, or 11 to 14	14
Home Input Signal	Select the input to use for the home input signal. 0: Use the Z-phase input as home. 1: Use external home input*1	0 or 1	0
Homing Start Direction	Set the start direction for when homing is started. 0: Positive direction 2: Negative direction	0 or 2	0
Home Input Detection Direction	Set the home input detection direction of the homing operation. 0: Positive direction 2: Negative direction	0 or 2	0
Operation Selection at Positive Limit Input	Set the stopping method when the positive limit input turns ON during homing. 0: No reverse turn, minor fault stop (Stop according to Limit Input Stop Method parameter.) 1:Reverse turn/immediate stop 2: Reverse turn/deceleration stop	0 to 2	1
Operation Selection at Negative Limit Input	Set the stopping method when the negative limit input turns ON during homing. 0: No reverse turn/minor fault stop (Stop according to Limit Input Stop Method parameter.) 1:Reverse turn/immediate stop 2: Reverse turn/deceleration stop	0 to 2	1
Homing Velocity*2	Set the homing velocity. (Unit: Motor command units/min)	Positive single-precision reals	600.0
Homing Approach Velocity*3	Set the velocity to use after the home proximity input turns ON. (Unit: Motor command units/min)	Positive single-precision reals	60.0

Parameter name	Function	Setting range	Default
Homing Acceleration/Deceleration*4	Specify the acceleration and deceleration rates for homing. If the homing acceleration/deceleration rate is set to 0, the homing velocity, homing approach velocity or other target velocity is used without any acceleration/deceleration rate. (Unit: Motor command units/s^2)	Positive single-precision reals or 0	0
Home Input Mask Distance*5	Set the home input mask distance to be applied when the homing operation mode is set to the proximity reverse turn/home input mask distance. (Unit: Motor command units)	Positive long reals or 0	10.0
Home Offset*6	Preset the actual position for the value that is set after homing. (Unit: Motor command units)	Single-precision real type negative, positive, or 0	0
Homing Holding Time	Set the holding time when you set the Homing Operation Mode to the proximity reverse turn/holding time. (Unit: ms)	0 to 10,000	100
Homing Compensation Value*7, *8, *9	Set the homing compensation value that is applied after the home is defined. (Unit: Motor command units)	Negative or positive long reals or 0	0
Homing Compensation Velocity	Set the velocity to use for homing compensation. (Unit: Motor command units/min)	Positive single-precision reals	60

*1. This setting can be used for an OMRON 1S-series Servo Drive or G5-series Servo Drive. The input allocated to latch 1 for the Servo Drive is used as the external home input. In the default setting of the OMRON 1S-series Servo Drives or G5-series Servo Drives, the external latch input 1 is allocated to latch 1.
For details, refer to the *AC Servomotors/Servo Drives 1S-series with Built-in EtherCAT Communications User's Manual* (Cat. No. I586), *AC Servomotors/Servo Drives G5-series with Built-in EtherCAT Communications User's Manual* (Cat. No. I576) or the *AC Servomotors/Servo Drives G5-series with Built-in EtherCAT Communications Linear Motor Type User's Manual* (Cat. No. I577).

*2. Set a value less than or equal to the maximum velocity.

*3. Set a value less than or equal to the homing velocity.

*4. Set a value less than or equal to the maximum acceleration/deceleration rate if the maximum acceleration/deceleration rate is not 0.

*5. The settable maximum value is 1,099,511,627,775 pulses when the value is converted into pulses.

*6. The settable values are -549,755,813,888 to 549,755,813,887 pulses when the value is converted to pulses.

*7. The settable values are -549,755,813,888 to 549,755,813,887 pulses when the value is converted to pulses.

*8. These parameters are for homing operation. Refer to *Section 8 Homing* for details.

*9. You cannot map the Z-phase input to a PDO for an OMRON G5-series Linear Motor Type Servo Drive. Therefore, if you set the Homing Operation Mode to No home proximity input/holding home input, which can use a Z-phase input mapped to a PDO, do not select the Z-phase input for the home input signal.

4-4-10 Servo Gain Settings

Set the servo gain parameters of the CNC motor. The setting values are used to calculate the output command based on the command position and feedback position.

These parameters must be set only when you position the CNC motor assigned to the spindle axis with the closed-loop control.

Precautions for Safe Use

- Before adjusting this parameter, adjust the gain on the spindle driver to ensure normal operation of the following functions that perform spindle open-loop control.
  - CNC_SpindleGo
  - Spindle CW (M03)
  - Spindle CCW (M04)
- When adjusting the gain, take sufficient measures to ensure safety.
- If oscillation (abnormal noise or vibration) occurs, immediately turn OFF the power to the driver or turn the Servo OFF.

Parameter name	Function	Setting range	Default
Position Loop Gain	Set the value of Position Loop Gain (K_p). (Unit: 1/s)	0 to 3,000 Single-precision reals	40
Velocity Feedforward Gain	Set the value of Velocity Feedforward Gain (K_vff) (Unit: %)	0 to 100 Single-precision reals	0

Refer to *9-2-2 Position Loop by Cyclic Velocity Control* on page 9-7 for details on the meaning of each parameter and how to adjust the parameter.

4-4-11 Gantry Settings

Set the operation of the gantry slave axis that configure the gantry system.

Parameter name	Function	Setting range	Default
Gantry Enable[*1 *2]	Specify whether to use the CNC motor as the gantry slave axis. 0: Not used as the gantry slave axis 1: Used as the gantry slave axis	0/1	0
CNC Motor Number for Gantry Master Axis[*3]	Specify a CNC motor number of the CNC motor used as the gantry master axis.	0 to maximum motor number	0
Alignment Velocity[*4]	Set the velocity to use for alignment. (Unit: Motor command units/min)	Positive single-precision reals	60.0
Position Deviation Between Axes Over Value[*5]	Specify a value to check the position deviation over value between gantry axes. Set *0* to disable the check for the position deviation over between gantry axes. (Unit: Motor command units)	Positive long reals or 0	0
Position Deviation Between Axes Warning Value[*5 *6]	Specify a value to check the position deviation warning between gantry axes. Set *0* to disable the following error warning check. (Unit: motor command units)	Positive long reals or 0	0

*1. Any other gantry settings parameters are enabled when *1: Used as the gantry slave axis* is selected for this setting.

*2. The CNC motor used as the gantry slave axis must be assigned to *Auxiliary Axis* under *Positioning Axis Assignment* in the CNC Coordinate System Basic Settings.

*3. The CNC motor used as the gantry master axis must satisfy the following conditions. If the conditions are not satisfied, the Sysmac Studio will detect a setting error.
- The motor must be assigned to the same CNC coordinate system where the CNC motor used as the gantry slave axis is assigned.
- The CNC motor number is smaller than the CNC motor used as the gantry slave axis.
- The motor is not used as a gantry master or slave axis of another gantry system.
- The encoder type and the unit conversion settings are consistent with those for the gantry slave axis.

*4. The value must be less than or equal to the parameter setting for the maximum velocity.

*5. The value obtained through a conversion into a pulse value using the unit conversion setting must be less than or equal to 1099511627775.

*6. When the Position Deviation Between Axes Over Value is not 0, a value that is less than or equal to the Position Deviation Between Axes Over Value must be set to this parameter.

Precautions for Correct Use

- The gantry master and salve axes must be set the same value specified for *Operation Settings* and *Limit Settings* in the CNC motor parameter settings.
- If you set the *encoder type* to *0: Incremental encoder*, you must also set the slave to use an incremental encoder. For an OMRON 1S-series Servo Drive, you can set this by the *Absolute Encoder Operation Selection* parameter.

4-5 CNC Motor Compensation Table Parameter Settings

The CNC motor compensation table parameters are provided to set data tables which are used to correct CNC motors controlled in the CNC Function Module.

The number of CNC motor compensation table parameter set is the same as the maximum number of CNC motor compensation tables for each model.
For NJ501-5300, the parameter sets are provided for 32 tables. For NY532-5400, they are provided for 64 tables.

The same parameter settings are applied to each CNC motor compensation table. This section describes the parameters for one table.

● List of CNC Motor Compensation Table Parameters

Use Sysmac Studio to set the compensation table parameters for each CNC motor compensation table.

Classification	Parameter name	Temporary changes			Reading variables
		Support	Update timing	Applicable instruction	
CNC Motor Compensation Table Basic Parameters	CNC Motor Compensation Table Number	---	---	---	---
	Source CNC Motor Number	---	---	---	---
	Target CNC Motor Number	---	---	---	---
	Compensation Scaling	OK	Immediate	CNC_Write	---
	Source Compensation Start Position	---	---	---	---
	Source Compensation Section Distance	---	---	---	---
	Number of Compensation Table Point Sections	---	---	---	---
	Source Reference Position	---	---	---	---
	Compensation Output Method	---	---	---	---
	Repetition Mode	---	---	---	---
	Table Point Interpolation Method	---	---	---	---
CNC Motor Compensation Table Data	Source Compensation Point	---	---	---	---
	Target Compensation Value	OK	Immediate	Write as a variable	OK

Refer to *5-4 CNC Motor Compensation Table* on page 5-21 for information on each setting and how to edit the setting.

5

CNC Program

This section describes CNC programs.

5-1 Sequence Control Program

CNC instructions are used in a sequence control program to execute CNC functions. These instructions are defined as function blocks (FBs).

The CNC Function Module controls CNC motors and CNC coordinate systems. The CNC motor corresponds to axis used in the MC Function Module. The CNC coordinate system of the CNC Function Module corresponds to an axes group used in the MC Function Module.

This section describes an overview of the CNC instructions used in the CNC Function Module, and gives the specifications of the CNC Function Module.

For basic information on the function block (FB), refer to the *NJ/NX-series CPU Unit Software User's Manual* (Cat. No. W501) or the *NY-series Industrial Panel PC/Industrial Box PC Software User's Manual (Cat. No. W558)*.

For information on MC Function Module programs, refer to the *NJ/NX-series CPU Unit Motion Control User's Manual* (Cat. No. W507) or *NY-series Industrial Panel PC/Industrial Box PC Motion Control User's Manual* (Cat. No. W559).

● CNC Instructions

The procedure for executing CNC instructions conforms to that for executing motion control instructions of the MC Function Module. For this reason, user programs can be more easily reused without hardware dependence.

Costs of training and support can also be reduced.

Refer to *Section 10 CNC Instructions* for details.

5-2 Status Transitions

The status transitions of CNC coordinate systems caused by the execution of CNC instructions of the CNC Function Module conform to those of the MC Function Module.

The status transitions of CNC instructions are affected by the composition CNC motor status, start and stop of an NC program, and other factors.

This section describes the statuses and status transitions including those of the overall CNC Function Module.

5-2-1 Status of the CNC Function Module

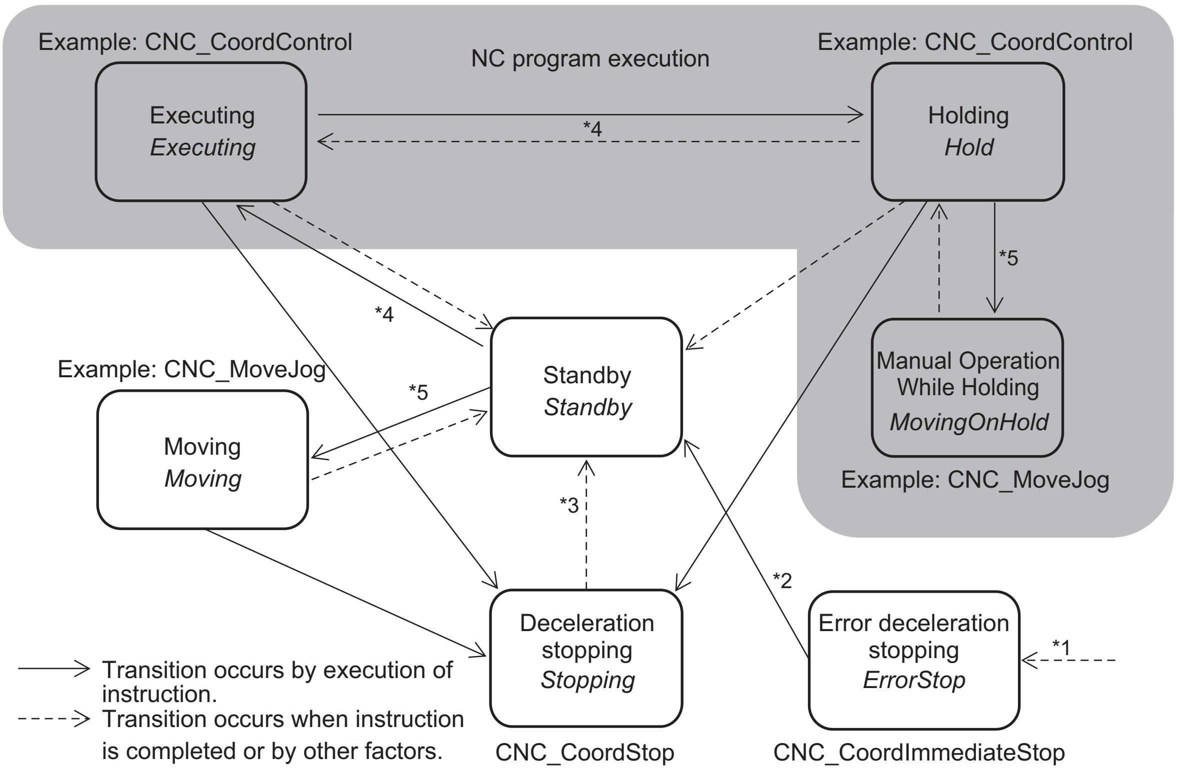
The status of the overall CNC Function Module are described in the following table.

Status name	Definition
CNC Run Mode*1	CNC instructions are enabled. The CNC instructions in the user program are interpreted to perform numerical control. You can enable CNC Run Mode regardless of the operating mode of the NC Integrated Controller.

*1. This status can be monitored with the CNC Common Variable *_CNC_COM.Status.RunMode*.

5-2-2 Statuses of CNC Coordinate System

The status transitions of a CNC coordinate system are shown in the following figure.



*1. Transition into this status occurs from any status when an error occurs in the CNC coordinate system.

*2. Transition into this status occurs when the error is reset by the CNC_CoordReset or ResetCNCError instruction.

*3. Transition into this status occurs when the *Done* output from the CNC_CoordStop instruction changes to TRUE and the *Execute* input is FALSE.

*4. Transition into this status occurs according to the status of executing the NC program by the CNC_CoordControl instruction. Refer to *Section 8 Homing* for details.

*5. Transition into this status occurs when a certain CNC coordinate system motion instruction is executed. Refer to *A-4 Instructions for Which Multi-execution Is Supported* on page A-15 for details.

Status name	Definition
Standby	In this status, no CNC coordinate system motion instruction is executed. The status where the NC program is executed to a specific block line and stopped at a program point is also included.
Moving	In this status, a CNC coordinate system motion instruction is running. Transition into the *Standby* status occurs when the instruction is completed or interrupted.
Executing	In this status, an NC Program is being executed by the CNC_CoordControl instruction. However, the status where the process stops because of the held NC program is not included.
Holding	In this status, the NC program is held and being stopped.
Manual Operation While Holding	In this status, the NC program is held and being stopped or a CNC coordinate system operation instruction is being executed. Transition into the *Hold* status occurs when the instruction is completed or interrupted.
Deceleration Stopping	In this status, the CNC_CoordStop (CNC Coordinate System Stop) instruction is executing. The includes when *Execute* is TRUE after the coordinate system is stopped due to the CNC_CoordStop (CNC Coordinate System Stop). In this state, it is not possible to execute a CNC instruction. If one is executed, *CommandAborted* (Command Aborted) will change to TRUE.
Error Deceleration Stopping	In this status, an error has occurred in the CNC coordinate system. This included during execution of CNC_CoordImmediateStop (CNC Coordinate System Immediate Stop) instruction, and when the CNC coordinate system is decelerating to stop due to an error on the coordinate system. It is not possible to execute CNC coordinate system instruction in this status. If an attempt is made to execute one of them, *CommandAborted* (Command Aborted) will change to TRUE.

5-3 CNC System-defined Variables

This section describes variables that belong to the CNC Function Module.

5-3-1 Overview of CNC System-defined Variables

The NJ/NY-series NC Integrated Controller is compliant with the IEC 61131-3 standard. Parameter settings, status information, and other data are handled as variables in the user program in the NJ/NY-series Controller.

Of these, system-defined variables that belong to the CNC Function Module are called CNC system-defined variables.

Types of CNC System-defined Variables

The following table lists the types of CNC system-defined variables.

Level 1	Level 2	Level 3	Description
System-defined Variables	CNC System-defined Variables	CNC Common Variables	Monitor the common status of the CNC Function Module.
		CNC Motor Variables	Monitor the status of each CNC motor and settings of part of CNC motor parameters.
		CNC Coordinate System Variables	Monitor the status of each CNC coordinate system and the setting of part of CNC coordinate system parameters.

● CNC Common Variables

You can monitor the overall status of the CNC Function Module with the CNC Common Variable. The variable name is *_CNC_COM*.

● CNC Motor Variables

Use these variables to handle EtherCAT slaves, Servo Drives (including spindle drives) and virtual CNC motors. You can use either the system-defined variables or the variables that are set on Sysmac Studio in the user program.

You can change any of the CNC Motor Variables names that you create on Sysmac Studio.

- Variable names in the system-defined variable: _CNC_Motor[0] to _CNC_Motor[31]
- Variable names created using Sysmac Studio: CNC_Motor000 to CNC_Motor031 (default)

● CNC Coordinate System Variables

Use these variables to handle a CNC coordinate system composed of multiple CNC motors.

You can use either the system-defined variables or the variables that are set on Sysmac Studio in the user program.

You can change any of the CNC Coordinate System Variable names that you create on Sysmac Studio.

- Variable names in the system-defined variable: _CNC_Coord[0] to _CNC_Coord[7]
- Variable names created using Sysmac Studio: CNC_Coord000 to CNC_Coord007 (default)

Data Types Used for CNC System-defined Variables

The types of CNC system-defined variables are basic data types and derivative data types.

● Basic Data Types

Category	Data type	Size	Range of values	Notation
Boolean	BOOL	2*1	TRUE or FALSE	TRUE or FALSE
Integer	UINT	2	0 to +65,535	Binary expression: "2#" is prefixed to the number.*2 Octal notation: "8#" is prefixed to the number.*3 Decimal notation: "10#" is prefixed to the number.*4 Hexadecimal notation: "16#" is prefixed to the number.*5 If you do not prefix any notation to a number, that number is treated as a decimal number.
	UDINT	4	0 to +4,294,967,295	
Real numbers	LREAL	8	-1.79769313486231e+308 to -2.22507385850721e-308, 0, 2.22507385850721e-308 to 1.79769313486231e+308, positive infinity, or negative infinity	Written as (sign) + integer_part + (decimal_point) + (decimal_part) + (exponent).*6 You can omit items in parentheses.
Duration*7, *8	TIME	8	T#-9223372036854.775808ms (T#-106751d_23h_47m_16s _854.775808ms) to T#+9223372036854.775807ms (T#+106751d_23h_47m_16s _854.775807ms)	T#12d3h3s T#3s56ms TIME#6d_10m TIME#16d_5h_3m_4s T#12d3.5h T#10.12s T#61m5s (same as T#1h1m5s) TIME#25h_3m

*1. BOOL data is only 1 bit in size but it takes up 2 bytes of memory.

*2. Example of binary expression: 2#1111_1111, 2#1110_0000

*3. Example of octal notation: 8#377, 8#340

*4. Example of decimal notation: -12, 0, 123_456, +986, 10#1234

*5. Example of hexadecimal notation: 16#FF, 16#ff, 16#E0, 16#e0

*6. Example: 2, -12.0, 0.0, 0.4560, 3.14159_26, -1.34E-12, -1.34e-12, 1.0E+6, 1.0e+6, 1.234E6, 1.234e6

*7. Use the NanoSecToTime and TimeToNanoSec instructions for conversion between durations and integer data.

For details on instruction specifications, refer to the *NJ/NX-series Instructions Reference Manual* (Cat. No. W502), or the *NY-series Instructions Reference Manual* (Cat. No. W560).

*8. Variables are compared with nanosecond precision for comparison instructions. To change the precision for comparison, use the TruncTime, TruncDt, or TruncTod instruction. For details on instruction specifications, refer to the *NJ/NX-series Instructions Reference Manual* (Cat. No. W502), or the *NY-series Instructions Reference Manual* (Cat. No. W560).

● **Derivative Data Types**

Type	Description
Enumerated data type	This data type uses one item from a prepared name list as its value. Variables of this data type starts with "_e".
Structure data type	This data type consists of multiple data types placed together into a single layered structure. Variables with this data type start with "_s".

Attributes of CNC System-defined Variables

The attributes that are shown in the following table are the same for all CNC system-defined variables.

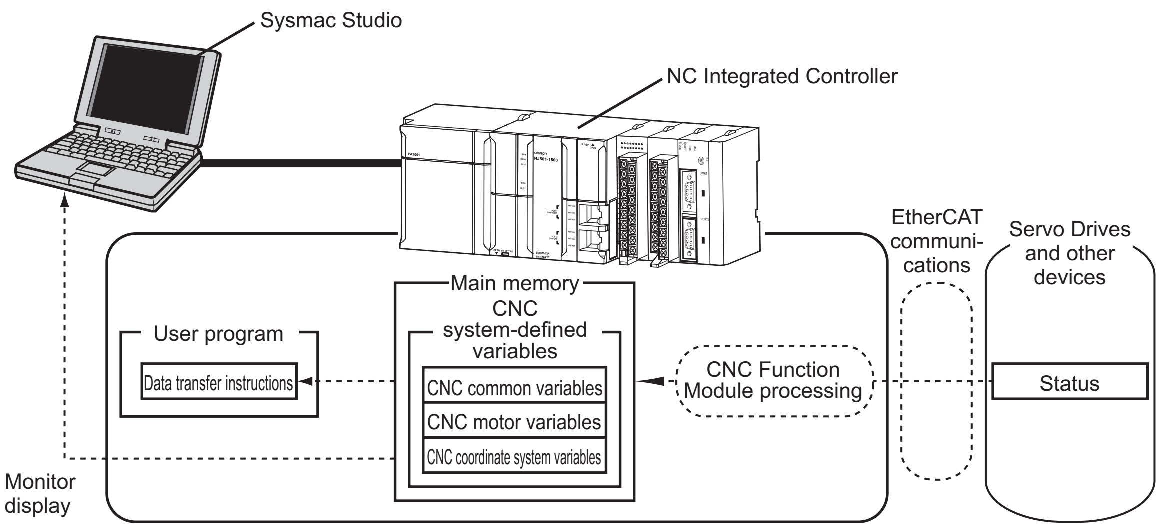
Attribute type	Attributes of CNC system-defined variables
Global/local	Global variable
R/W access	• _CNC_ComNCVar, _CNC_CoordNCVarX: Read/Write • Other CNC system-defined variables: Read only
Retain	Non-retain
Network publish	Publish*1
Usage in user program	Available

*1. Variables are published on the network using the names of the system-defined variables. The variable names that are created when CNC motors or CNC coordinate systems were created on the Sysmac Studio are not published on the network.

5-3-2 Mechanism of CNC System-defined Variables

CNC system-defined variables consist of information indicating the status of the CNC Function Module, status information on slave devices connected via EtherCAT communications, and some settings of the CNC motor parameters that are used to perform numerical control.

You can access the CNC system-defined variables as variables in a user program. You can also monitor them from Sysmac Studio.



Update Timing of CNC System-defined Variables

CNC system-defined variables are updated every primary task period.

5-3-3 Lists of CNC System-defined Variables

CNC Common Variable

The variable name _CNC_COM is used for CNC Common Variable. The data type is _sCNC_COM_REF, which is a structure variable.

This section describes the configuration of the CNC Common Variable and provides details on the members.

Variable name	Data type	Meaning	Function
_CNC_COM	_sCNC_COM_REF	CNC Common Variable	
Status	_sCNC_COM_STA	CNC Common Status	
RunMode	BOOL	CNC Run	TRUE during CNC Function Module operation.
PFaultLvl	_sCNC_REF_EVENT	CNC Common Partial Fault	
Active	BOOL	CNC Common Partial Fault Occurrence	TRUE while there is a CNC common partial fault.
Code	WORD	CNC Common Partial Fault Code	Contains the code for a CNC common partial fault. This is the same value as the upper four digits of the event code.
MFaultLvl	_sCNC_REF_EVENT	CNC Common Minor Fault	
Active	BOOL	CNC Common Minor Fault Occurrence	TRUE while there is a CNC common minor fault.
Code	WORD	CNC Common Minor Fault Code	Contains the code for a CNC common minor fault. This is the same value as the upper four digits of the event code.
Obsr	_sCNC_REF_EVENT	CNC Common Observation	
Active	BOOL	CNC Common Observation Occurrence	TRUE while there is a CNC common observation.
Code	WORD	CNC Common Observation Code	Contains the code for a CNC common observation. This is the same value as the upper four digits of the event code.

The attributes of the CNC Common Variable are shown in the following table.

Attribute type	Attributes of CNC system-defined variables
Global/local	Global variable
R/W access	Read only
Retain	Non-retain
Network publish	Publish
Usage in user program	Available

CNC Coordinate System Variables

The variable name _*CNC_Coord* is used for CNC coordinate system variables. The data type is _sCNC_COORD_REF, which is a structure variable.

This section describes the configuration of the CNC coordinate system variable and provides details on the members.

Variable name	Data type	Meaning	Function
_CNC_Coord[0..7]	_sCNC_COORD_REF	CNC Coordinate System Variable	
Status	_sCNC_COORD_STA	CNC Coordinate System Status	
Ready	BOOL	CNC Coordinate System Ready-to-execute	TRUE if the composition CNC motor satisfies all of the following conditions: • The home is defined for the positioning axis CNC motor. • The Servo is locked for the positioning axis CNC motor. • The Servo is locked for the spindle axis CNC motor. • The CNC coordinate system is in a Standby status.
Standby	BOOL	CNC Coordinate System Ready	TRUE when a CNC coordinate system motion instructions and the NC program stop, and when CNC coordinate system operations and the NC program are ready to start. The following CNC coordinate system statuses are mutually exclusive. Only one of them can be TRUE at a time. *Standby, Moving, Executing, Hold, MovingOnHold, Stopping, or ErrorStop*
Moving	BOOL	CNC Coordinate System Moving	TRUE while a CNC operation instruction is executed from a Standby status. This also includes the in-position waiting status.
Executing	BOOL	CNC Coordinate System Execution	TRUE during execution of the NC program. This also includes the in-position waiting status, a stop occurs due to dwelling, deceleration due to Hold, and acceleration after resuming operation from Hold.
Hold	BOOL	CNC Coordinate System Holding	TRUE when operation stops due to Hold during execution of the NC program. This changes to FALSE when the NC Program is resumed or interrupted.
MovingOnHold	BOOL	CNC Coordinate System Operation Holding	TRUE when a CNC coordinate system motion instruction is executed from a status where the NC program has stopped due to Hold. This also includes the in-position waiting status.
Stopping	BOOL	Deceleration Stopping	TRUE until the CNC coordinate system stops for the CNC_CoordStop instruction. This includes a status where *Execute* is TRUE after the CNC coordinate system stopped for the CNC_CoordStop instruction. No CNC coordinate system motion instruction can be executed in this state. (*CommandAborted* is TRUE.)

Variable name			Data type	Meaning	Function
		ErrorStop	BOOL	Error Deceleration Stopping	TRUE while the CNC coordinate system is stopping or stopped for the CNC_CoordImmediateStop instruction or a CNC coordinate system minor fault occurrence (when *_CNC_Coord[*].MFaultLvl.Active* is TRUE). No CNC coordinate system motion instruction can be executed in this state. (*CommandAborted* is TRUE.)
	Spindle		_sCNC_SPINDLE_STA	Spindle Axis Status	
		Standby	BOOL	Standby	TRUE when the spindle axis stopped and is waiting for start-up from the NC program or a CNC instruction. TRUE also when the spindle axis is not assigned to the CNC coordinate system.
		CW	BOOL	Forward	TRUE when the spindle axis rotates clockwise (CW).
		CCW	BOOL	Reverse	TRUE when the spindle axis rotates counterclockwise (CCW).
		Orientation	BOOL	Orientation	TRUE when the spindle axis is in Spindle Orientation (M19).
		Tapping	BOOL	Tapping	TRUE when the spindle axis is in tapping cycle (G74, G84).
		Moving	BOOL	Spindle Axis Operating	TRUE when the spindle axis is operating, activated by CNC_Move or CNC_Home.
		Stopping	BOOL	Spindle Axis Stopping	TRUE until the CNC coordinate system stops for the CNC_CoordStop instruction. This includes a status where *Execute* is TRUE after the CNC coordinate system stopped for the CNC_CoordStop instruction. No CNC coordinate system motion instruction can be executed in this state. (*CommandAborted* is TRUE.)
		ErrorStop	BOOL	Error Stop	TRUE while the CNC coordinate system is stopping or stopped for the CNC_CoordImmediateStop instruction or a CNC coordinate system minor fault occurrence (when *_CNC_Coord[*].MFaultLvl.Active* is TRUE). No CNC coordinate system motion instruction can be executed in this state. (*CommandAborted* is TRUE.)

Variable name			Data type	Meaning	Function
	Details		_sCNC_COORD_DET	CNC Coordinate System Control Status	
		Idle	BOOL	Standby	TRUE when processing is not currently performed for the command value, except when waiting for in-position state. Processing status include operation at velocity 0, stop processing when an error occurs, and operating status of the CNC coordinate system.
		Homed	BOOL	Home Defined	TRUE when the homes of all the CNC motors assigned to positioning axes are defined.
		InPos	BOOL	In-position Completed	TRUE when all the CNC motors assigned to positioning axes satisfy the in-position conditions.
	Feedrate		_sCNC_FEEDRATE	CNC Coordinate System Interpolation Velocity	
		CmdVel	LREAL	Current Command Interpolation Velocity	Contains the current value of the command interpolation velocity for the X-, Y-, and Z-axes.
		ActVel	LREAL	Feedback Current Interpolation Velocity	Contains the current value of the feedback interpolation velocity for the X-, Y-, and Z-axes.
	AxCmdPos		_sCNC_COORD_AX_DATA	Command Position for CNC Coordinate System	
		X	LREAL	X-axis Position	Shows the command position (tool center point) of each axis according to the currently valid CNC coordinate system parameters.*1 This also shows a position offset from the center of the tool during tool radius compensation. Unit: Axis command units
		Y	LREAL	Y-axis Position	
		Z	LREAL	Z-axis Position	
		A	LREAL	A-axis Position	
		B	LREAL	B-axis Position	
		C	LREAL	C-axis Position	
	AxProgPos		_sCNC_COORD_AX_DATA	Target Position for CNC Coordinate System	
		X	LREAL	X-axis Position	Shows the target program position on each axis of an NC program execution block. Unit: Axis command units
		Y	LREAL	Y-axis Position	
		Z	LREAL	Z-axis Position	
		A	LREAL	A-axis Position	
		B	LREAL	B-axis Position	
		C	LREAL	C-axis Position	
	AxDistanceToGo		_sCNC_COORD_AX_DATA	Remaining Travel Distance in the CNC Coordinate System	
		X	LREAL	Remaining Travel Distance in X-axis	Shows the remaining travel distance to the target position on each axis of an NC program execution block.*2 Unit: Axis command units
		Y	LREAL	Remaining Travel Distance in Y-axis	
		Z	LREAL	Remaining Travel Distance in Z-axis	
		A	LREAL	Remaining Travel Distance in A-axis	
		B	LREAL	Remaining Travel Distance in B-axis	
		C	LREAL	Remaining Travel Distance in C-axis	

Variable name		Data type	Meaning	Function
AxActPos		_sCNC_COORD_AX_DATA	Feedback Current Position for CNC Coordinate System	
	X	LREAL	X-axis Position	Shows the feedback current position (tool center point) of each axis according to the current CNC coordinate system parameters.*1 Unit: Axis command units
	Y	LREAL	Y-axis Position	
	Z	LREAL	Z-axis Position	
	A	LREAL	A-axis Position	
	B	LREAL	B-axis Position	
	C	LREAL	C-axis Position	
AxCmdVel		_sCNC_COORD_AX_DATA	Command Current Velocity for CNC Coordinate System	
	X	LREAL	X-axis Velocity	Shows the current value of the command velocity of each axis according to the current CNC coordinate system parameters. Unit: Axis command units 0 is output if no CNC motor is assigned to the axis.
	Y	LREAL	Y-axis Velocity	
	Z	LREAL	Z-axis Velocity	
	A	LREAL	A-axis Velocity	
	B	LREAL	B-axis Velocity	
	C	LREAL	C-axis Velocity	
AxActVel		_sCNC_COORD_AX_DATA	Feedback Current Velocity for CNC Coordinate System	
	X	LREAL	X-axis Velocity	Shows the current velocity of each axis according to the current CNC coordinate system settings. Unit: Axis command units
	Y	LREAL	Y-axis Velocity	
	Z	LREAL	Z-axis Velocity	
	A	LREAL	A-axis Velocity	
	B	LREAL	B-axis Velocity	
	C	LREAL	C-axis Velocity	
MFaultLvl		_sCNC_REF_EVENT	CNC Coordinate System Minor Fault	
	Active	BOOL	CNC Coordinate System Minor Fault Occurrence	TRUE while there is a CNC coordinate system minor fault.
	Code	WORD	CNC Coordinate System Minor Fault Code	Contains the code for a CNC coordinate system minor fault. This is the same value as the upper four digits of the event code.
Obsr		_sCNC_REF_EVENT	CNC Coordinate System Observation	
	Active	BOOL	CNC Coordinate System Observation Occurrence	TRUE while there is a CNC coordinate system observation.
	Code	WORD	CNC Coordinate System Observation Code	Contains the code for CNC coordinate system observation. This is the same value as the upper four digits of the event code.
Cfg		_sCNC_COORD_CFG	CNC Coordinate System Basic Parameters	
	CoordNo	UINT	CNC Coordinate System Number	Shows the logical number of the CNC coordinate system.
	CoordEnable	_eCNC_COORD_USE	Using CNC Coordinate System	Shows whether to use the CNC coordinate system. 0: _cncNoneCoord (Undefined CNC coordinate system) 1: _cncUnusedlCoord (Unused CNC coordinate system) 2: _cncUsedCoord (Used CNC coordinate system)
	PosMotorNum	UINT	Number of Positioning Axis Composition CNC Motors	Shows the number of CNC motors that are assigned to positioning axes.

Variable name			Data type	Meaning	Function
	PosAxes		_ ARRAY [0..15] OF _sCNC_AXIS_ASSIGN	Positioning Axis Composition CNC Motor Assignment	Shows the assignment of CNC motors to respective positioning axes of the CNC coordinate system.
		MotorNo	UINT	Positioning Axis Composition CNC Motor Number	Shows the CNC motor numbers that are assigned to positioning axes. 65535: No assignment
		AxType	_eCNC_AXIS_TYPE	Positioning Axis Composition CNC Motor Assignment Type	Shows the assigned axis type. The value is 0 for no assignment. _cncAxisX = 0 _cncAxisY = 1 _cncAxisZ = 2 _cncAxisA = 3 _cncAxisB = 4 _cncAxisC = 5 _cncAxisGantrySlaveX := 200 _cncAxisGantrySlaveY := 201 _cncAxisGantrySlaveZ := 202
	SpindleAxes		ARRAY [0..3] OF _sCNC_AXIS_ASSIGN	Spindle Axis CNC Motor Assignment	Shows the assignment of a CNC motor to the spindle axis of the CNC coordinate system.
		MotorNo	UINT	Spindle Axis CNC Motor Number	Shows the number of the CNC motor that is assigned as the spindle axis. 65535: No assignment
		AxType	_eCNC_AXIS_TYPE	Spindle Axis CNC Motor Assignment Type	Shows the assigned axis type. The value is 100 for no assignment. _cncAxisSpindle = 100

*1. When two or more CNC motors are assigned to the same axis, the value of each current position is calculated on the basis of the current position of CNC motor with the lowest motor number.

*2. *AxDistanceToGo* (Remaining Travel Distance in the CNC Coordinate System) is derived from the difference between *AxProgPos* (Target Position for CNC Coordinate System) and *AxCmdPos* (Command Position for CNC Coordinate System). When you execute a G code for converting the coordinate system such as mirroring, rotation, or work offset, the coordinate system to be referenced is different between the target program position on each axis and the commanded position on each axis. Consequently, no correct value will be output from immediately after the coordinate system conversion is executed until the next target program position on each axis is determined.

The attributes of the CNC coordinate system variables are shown in the following table.

Attribute type	Attributes of CNC system-defined variables
Global/local	Global variable
R/W access	Read only
Retain	Non-retain
Network publish	Publish*1
Usage in user program	Available

*1. Variables are published on the network using the names of the system-defined variables. The variable names that are created when the CNC coordinate system was created on Sysmac Studio are not published on the network.

CNC Motor Variables

The variable name *_CNC_Motor* is used for CNC motor variables. The data type is _sCNC_MOTOR_REF, which is a structure.

This section describes the configuration of the CNC motor variables and provides details on the members.

Variable name	Data type	Meaning	Function
_CNC_Motor[0..31]	_sCNC_MOTOR_REF	CNC Motor Variables	
Details	_sCNC_MOTOR_DET	CNC Motor Control Status	
Homed	BOOL	Home Defined	TRUE when the home is defined. FALSE: Home not defined. TRUE: Home is defined.
SoftLimitPosi	BOOL	Positive Software Overtravel Limit	TRUE when exceeding the positive software overtravel limit of the commanded position is detected.*1
SoftLimitNega	BOOL	Negative Software Overtravel Limit	TRUE when exceeding the negative software overtravel limit of the commanded position is detected.*1
InPos	BOOL	In-position Completed	TRUE when the in-position conditions are satisfied.
InPosTimer	UINT	In-position Check Timer	Shows the number of remaining cycles of in-position monitoring. The default is the setting number of in-position continuance cycles. When the following four conditions are satisfied at the same time, in-position monitoring starts and this value is decremented by one every control period. (1) The Servo of the CNC motor is being locked. (2) The CNC motor commanded velocity is 0. (3) No operation and dwell commands are given to the CNC motor. (4) The absolute value of difference between the commanded position and current position of the CNC motor is within or below the in-position check range. InPos is TRUE if this value is 0 and conditions (1) to (4) are satisfied.
Dir	_sCNC_MOTOR_DIR	Command Direction	
Posi	BOOL	Positive Direction	TRUE when there is a command in the positive direction.
Nega	BOOL	Negative Direction	TRUE when there is a command in the negative direction.

Variable name			Data type	Meaning	Function
	DrvStatus		_sCNC_MOTOR_STA_DRV	Servo Drive Status	
		ServoOn	BOOL	Servo ON	TRUE when the Servomotor is powered.
		Ready	BOOL	Servo Ready	TRUE when the Servo is ready[*2].
		MainPower	BOOL	Main Power	TRUE when the Servo Drive main power is ON.
		P_OT	BOOL	Positive Limit Input	TRUE when the positive limit input is enabled.
		N_OT	BOOL	Negative Limit Input	TRUE when the negative limit input is enabled.
		HomeSw	BOOL	Home Proximity Input	TRUE when the home proximity input is enabled.
		ImdStop	BOOL	Immediate Stop Input	TRUE when the immediate stop input is enabled.
		Latch1	BOOL	External Latch Input 1	TRUE when latch input 1 is enabled.
		Latch2	BOOL	External Latch Input 2	TRUE when latch input 2 is enabled.
		DrvAlarm	BOOL	Driver Error Input	TRUE while there is a Servo Drive error.
		DrvWarning	BOOL	Driver Warning Input	TRUE while there is a driver warning.
		ILA	BOOL	Driver Internal Limiting	TRUE when the Servo Drive limiting function actually limits the axis. This corresponds to one of the following limits in the G5-series Servo Drive.[*3] Torque limits, velocity limit, drive prohibit inputs, software limits
	Cmd		_sCNC_MOTOR_CMD _DATA	CNC Motor Command Value	
		Pos	LREAL	Command Current Position	Contains the current value of the commanded position. This variable contains the feedback current position while the Servo is OFF. (Unit: Motor command units)[*4]
		Vel	LREAL	Command Current Velocity	Contains the current value of the commanded velocity. (Unit: Motor command units/min)
		CompPos	LREAL	Current Compensation Position	Contains the current compensation position. (Unit: Motor command units/min)
	Act		_sCNC_MOTOR_ACT_DATA	CNC Motor Current Value	
		Pos	LREAL	Feedback Current Position	Contains the feedback current position. (Unit: Motor command units)
		Vel	LREAL	Feedback Current Velocity	Contains the feedback current position. (Unit: Motor command units/min^2)
		Trq	LREAL	Feedback Current Torque	Contains the current value of the feedback torque. (Unit: %) A plus sign is added during travel in the positive direction, and a minus sign during travel in the negative direction.
	MFaultLvl		_sCNC_REF_EVENT	CNC Motor Minor Fault	
		Active	BOOL	CNC Motor Minor Fault Occurrence	TRUE while there is a CNC motor minor fault.
		Code	WORD	CNC Motor Minor Fault Code	Contains the code for a CNC motor minor fault. This is the same value as the upper four digits of the event code.

Variable name			Data type	Meaning	Function
	Obsr		_sCNC_REF_EVENT	CNC Motor Observation	
		Active	BOOL	CNC Common Observation Occurrence	TRUE while there is a CNC motor observation.
		Code	WORD	CNC Motor Observation Code	Contains the code for a CNC motor observation. This is the same value as the upper four digits of the event code.
	Cfg		_sCNC_MOTOR_CFG	CNC Motor Basic Settings	Gives the settings of the CNC motor basic parameters.
		MotorNo	UINT	CNC Motor Number	Shows the logical number of the CNC motor.
		MotorEnable	_eCNC_MOTOR_USE	CNC Motor Use	Shows whether to use the CNC motor. 0: _cncNoneMotor (Undefined CNC motor) 1: _cncUnusedMotor (Unused CNC motor) 2: _cncUsedMotor (Used CNC motor)
		Virtual	BOOL	Virtual CNC Motor	Shows whether the CNC motor is virtual.
		CoordNo	UINT	CNC Coordinate System Number to which CNC Motors are Assigned	Shows the logical number of the CNC coordinate system.

*1. In *Executing*, the CNC motor commanded position does not exceed the software overtravel limit. The path is limited or stopped on the software overtravel limit. However, the *SoftLimitPosi* and *SoftLimitNega* change to TRUE in that status.
When it is not *Executing* while the *SoftLimitPosi* and *SoftLimitNega* are TRUE, they change to FALSE.

*2. This variable is TRUE when the PDS state of the Servo Drive is either *Ready to switch on*, *Switched on* or *Operation enabled* and the main circuit power supply (voltage enabled) is ON.
For details on the PDS status, refer to the *NJ/NX-series CPU Unit Motion Control User's Manual* (Cat. No. W507) or *NY-series Industrial Panel PC/Industrial Box PC Motion Control User's Manual* (Cat. No. W559).

*3. This variable gives the status of bit 11 (internal limit enabled) in the Status Word (6041 hex) that is mapped to a PDO. The conditions for this variable to change to TRUE depend on the specifications of the Servo Drive. Refer to the manual for the connected Servo Drive for details.

*4. If the Axis Assignment Type is set to *2: Spindle axis* and open loop control is applied with the following functions, the feedback current position is replicated for the commanded position. For a virtual motor, however, the commanded position is output as is the case when CNC_Move is used for operation.
- CNC_SpindleGo
- Spindle CW (M03)
- Spindle CCW (M04)

The attributes of the CNC motor variable are shown in the following table.

Attribute type	Attributes of CNC system-defined variables
Global/local	Global variable
R/W access	Read only
Retain	Non-retain
Network publish	Publish*1
Usage in user program	Available

*1. Variables are published on the network using the names of the system-defined variables. The variable names that are defined when the CNC motors were created on Sysmac Studio are not published on the network.

● Relationship between CNC Motor Variables and Enabled Virtual CNC Motors

CNC motor variables are enabled or disabled depending on the virtual CNC motor settings.

Disabled members are FALSE or 0.

Variable name			Data type	Meaning	Physical CNC motor	Virtual CNC Motor
_CNC_Motor[0..31]			_sCNC_MOTOR_REF	CNC Motor Variables		
	Details		_sCNC_MOTOR_DET	CNC Motor Control Status		
		Homed	BOOL	Home Defined	Enabled	Enabled
		SoftLimitPosi	BOOL	Positive Software Overtravel Limit	Enabled	Enabled
		SoftLimitNega	BOOL	Negative Software Overtravel Limit	Enabled	Enabled
		InPos	BOOL	In-position Completed	Enabled	Enabled
		InPosTimer	UINT	In-position Check Timer	Enabled	Enabled
	Dir		_sCNC_MOTOR_DIR	Command Direction	Enabled	
		Posi	BOOL	Positive Direction	Enabled	Enabled
		Nega	BOOL	Negative Direction	Enabled	Enabled
	DrvStatus		_sCNC_MOTOR_STA_DRV	Servo Drive Status		
		ServoOn	BOOL	Servo ON	Enabled	Enabled
		Ready	BOOL	Servo Ready	Enabled	Always TRUE
		MainPower	BOOL	Main Power	Enabled	Always TRUE
		P_OT	BOOL	Positive Limit Input	Enabled	
		N_OT	BOOL	Negative Limit Input	Enabled	
		HomeSw	BOOL	Home Proximity Input	Enabled	
		ImdStop	BOOL	Immediate Stop Input	Enabled	
		Latch1	BOOL	External Latch Input 1	Enabled	
		Latch2	BOOL	External Latch Input 2	Enabled	
		DrvAlarm	BOOL	Driver Error Input	Enabled	
		DrvWarning	BOOL	Driver Warning Input	Enabled	
		ILA	BOOL	Driver Internal Limiting	Enabled	
	Cmd		_sCNC_MOTOR_CMD_DATA	CNC Motor Command Value		
		Pos	LREAL	Command Current Position	Enabled	Enabled
		Vel	LREAL	Command Current Velocity	Enabled	Enabled
		CompPos	LREAL	Current Compensation Position	Enabled	Enabled
	Act		_sCNC_MOTOR_ACT_DATA	CNC Motor Current Value		
		Pos	LREAL	Feedback Current Position	Enabled	Enabled
		Vel	LREAL	Feedback Current Velocity	Enabled	Enabled
		Trq	LREAL	Feedback Current Torque	Enabled	
	MFaultLvl		_sCNC_REF_EVENT	CNC Motor Minor Fault		
		Active	BOOL	CNC Motor Minor Fault Occurrence	Enabled	Enabled
		Code	WORD	CNC Motor Minor Fault Code	Enabled	Enabled
	Obsr		_sCNC_REF_EVENT	CNC Motor Observation		
		Active	BOOL	CNC Common Observation Occurrence	Enabled	Enabled
		Code	WORD	CNC Motor Observation Code	Enabled	Enabled
	Cfg		_sCNC_MOTOR_CFG	CNC Motor Basic Settings		
		MotorNo	UINT	CNC Motor Number	Enabled	Enabled
		MotorEnable	_eCNC_MOTOR_USE	CNC Motor Use	Enabled	Enabled
		Virtual	BOOL	Virtual CNC Motor	Enabled	Enabled
		CoordNo	UINT	CNC Coordinate System Number to which CNC Motors are Assigned	Enabled	Enabled

Other System-defined Variables for CNC Function Module

This section describes other system-defined variables other than CNC common variables, CNC coordinate system variables, and CNC motor variables.

● Variable for Monitoring CNC Planner Service Execution Time

Variable name	Data type	Meaning	Function
_CNC_ServiceLastExecTime*1	TIME	Previous CNC Planner Service Execution Time	Shows the last execution time of the CNC Planner Service.*2
_CNC_ServiceMaxExecTime*1	TIME	Maximum CNC Planner Service Execution Time	Contains the maximum value of the task execution time.*2
_CNC_ServiceMinExecTime*1	TIME	Minimum CNC Planner Service Execution Time	Contains the minimum value of the task execution time.*2
_CNC_ServiceExecCount*1	UDINT	CNC Planner Service Execution Count	Contains the number of executions of the task. If 4,294,967,295 is exceeded, the value returns to 0 and counting is continued.
_CNC_ServiceExceeded*1	BOOL	CNC Planner Service Period Exceeded Flag	TRUE if the task period was exceeded. FALSE if task execution was completed within the task period.
_CNC_ServiceExceedCount*1	UDINT	CNC Planner Service Exceeded Count	Stores the number of times that the task period is exceeded. If the current value exceeds 4,294,967,295, the value returns to 0 and counting continues.

*1. These variables can be reset from the Task Execution Time Monitor on Sysmac Studio. The variables are also reset when NC Integrated Controller Mode is changed.

*2. The TIME data type can express time in units of nanoseconds, however, the effective accuracy of this variable is in units of one microsecond.

The attributes of the variable for Monitoring CNC Planner Service Execution Time are shown in the following table.

Type	Attributes of CNC system-defined variables
Global/local	Global variable
R/W access	Read only
Retain	Non-retain
Network publish	Publish
Usage in user program	Available

NC Program Variable Monitoring

These system-defined variables are for monitoring variables used in NC programs. For a CNC with unit version of 1.01 or later, these variables can be written from the sequence control program.

Variable name	Data type	Meaning	Function
_CNC_ComNCVar	ARRAY[0.32767] OF LREAL	P variable monitor	Displays the areas made public to users (P0 to P32767) for P variables.
_CNC_CoordNCVar0	ARRAY[0..4095] OF LREAL	Q Variable Monitor for CNC coordinate system No0	Displays the areas made public to users (Q0 to Q4095) for Q variables.
_CNC_CoordNCVar1	ARRAY[0..4095] OF LREAL	Q Variable Monitor for CNC Coordinate System No1	
_CNC_CoordNCVar2	ARRAY[0..4095] OF LREAL	Q Variable Monitor for CNC Coordinate System No2	
_CNC_CoordNCVar3	ARRAY[0..4095] OF LREAL	Q Variable Monitor for CNC Coordinate System No3	
_CNC_CoordNCVar4	ARRAY[0..4095] OF LREAL	Q Variable Monitor for CNC Coordinate System No4	
_CNC_CoordNCVar5	ARRAY[0..4095] OF LREAL	Q Variable Monitor for CNC Coordinate System No5	
_CNC_CoordNCVar6	ARRAY[0..4095] OF LREAL	Q Variable Monitor for CNC Coordinate System No6	
_CNC_CoordNCVar7	ARRAY[0..4095] OF LREAL	Q Variable Monitor for CNC Coordinate System No7	

Type	Attributes of CNC system-defined variables
Global/local	Global variable
R/W access	CNC Ver.1.00: Read only CNC Ver.1.01 and later: Read/Write
Retain	Non-retain
Network publish	Publish
Usage in user program	Available

Precautions for Correct Use

- For a CNC with unit version of 1.00, use this system-defined variable for the purpose of monitoring debugs such as Watch Tab Page and data racing.
- For a CNC with unit version of 1.01 or later, these variables can be written from the sequence control program. While the NC program execution is in progress, you need to interlock the NC program and the sequence control program with M codes and control the write timing in order to prevent data from writing from both programs at the same time.
- The execution priority differs between the CNC Planner Service where NC programs are processed and the primary periodic task where the sequence control program is running. For this reason, writing multiple blocks may not be updated at the same timing when they are referenced from the sequence control program. To maintain the concurrency, make sure to interlock the sequence control program with M codes. Refer to *6-1 M Codes* on page 6-2 for details on the interlock procedure with M codes.

Version Information

- For a CNC with unit version of 1.01 or later, these variables can be written from the sequence control program. It is useful for writing multi-point data such as a point table from the sequence control program all at once before executing the NC program.

● CNC Error Status Variables

Variable name	Data type	Meaning	Function
_CNC_ErrSta	WORD	CNC Function Module Error Status	Shows the status of errors that are detected in the CNC Function Module.
_CNC_ComErrSta	WORD	CNC Common Error Status	Shows the status of errors that are detected by common processing in the CNC Function Module.
_CNC_CoordErrSta	ARRAY [0..7] OF WORD	CNC Coordinate System Error Status	Shows the status of errors that are detected for each CNC coordinate system. Up to eight coordinate systems are displayed.
_CNC_MotorErrSta	ARRAY [0..31] OF WORD	CNC Motor Error Status	Shows the status of errors that are detected for each CNC motor. Up to 32 CNC motors are displayed.

The attributes of the CNC error status variable are shown in the following table.

Type	Attributes of CNC system-defined variables
Global/local	Global variable
R/W access	Read only
Retain	Non-retain
Network publish	Publish
Usage in user program	Available

5-4 CNC Motor Compensation Table

This section describes the CNC motor compensation table.

The CNC Function Module uses the CNC motor compensation table parameter settings that you created using the CNC Motor Compensation Table Editor of Sysmac Studio as CNC motor compensation tables.

The CNC motor compensation table data is handled as data variables for CNC motor compensation table in the NJ/NX-series Controller.

5-4-1 Editing the CNC Motor Compensation Table

The CNC motor compensation table function compensates geometrical inclinations, bends, and deviations of individual machine tools. The CNC motor compensation table can be edited in Sysmac Studio and CNC Operator.

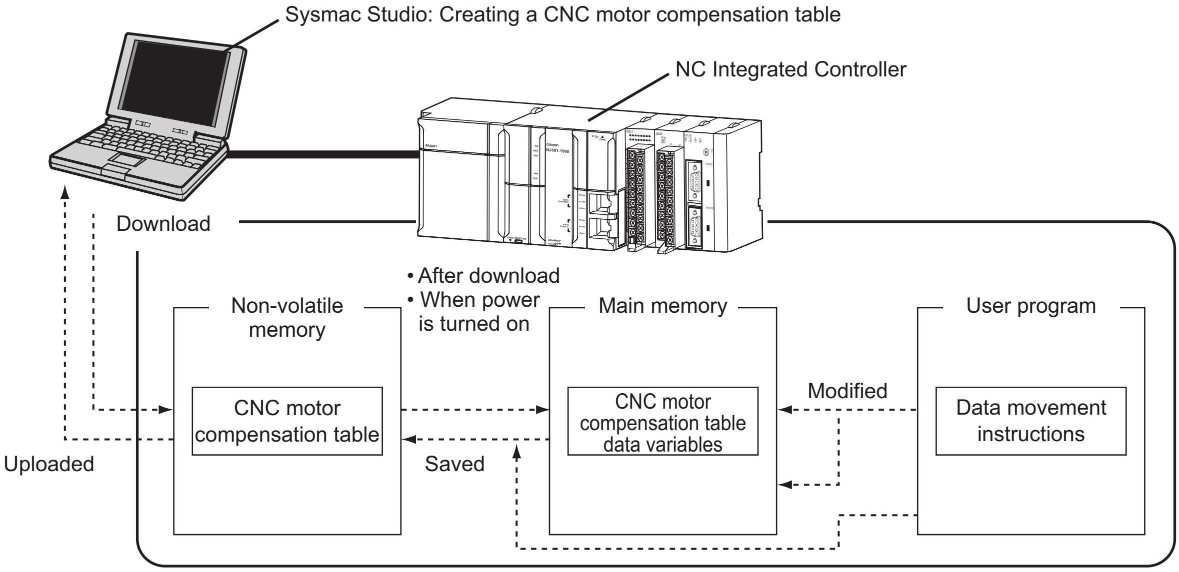
According to a CNC motor compensation table that you created on Sysmac Studio, data variables for CNC motor compensation table are generated. The data variables for CNC motor compensation table only represent data columns of the CNC motor compensation table. The data variables for CNC motor compensation table are global, which can be edited from the sequence control program.

Variable Definition

Configuration element	Description
Variable name	User-defined on Sysmac Studio
Variable type	REAL array type[*1]
Variable scope	Global
Network publish	Read and write

*1. The array size is variable.

Creating and Saving CNC Motor Compensation Table



5-4-2 Edit

CNC motor compensation table variables that can referenced from the sequence control program are generated. However, the variables only contain data columns and do not include settings such as source motor numbers and target motor numbers.

Typically, geometrical differences are obtained by using an external measuring instrument, and the CNC motor compensation table is output as a file in CSV or another format. For the NJ series, the CSV file is placed on the SD Memory Card. It is placed on the virtual SD Memory Card for the NY-series. Then the differences are read from the sequence control program, and the file is transferred to CNC motor compensation table data.

Precautions for Correct Use

- Editing the CNC motor compensation table while a CNC motor is running will cause a critical problem. Disable the CNC motor compensation table once if you want to edit it.
- When cycle the power supply, or when data is downloaded from Sysmac Studio, CNC motor compensation table data that you edited by the sequence control program is overwritten by the data stored in the non-volatile memory. You cannot upload these data by using Sysmac Studio.

5-4-3 Enabling/Disabling CNC Motor Compensation Table

When you created a CNC motor compensation table on the Sysmac Studio and transferred it, the table is automatically enabled. If you want to disable the CNC motor compensation table, rewrite the compensation scale to 0 with the CNC_Write instruction. To enable it again, rewrite it to 1 with the CNC_Write instruction.

Refer to *5-4-8 Basic Settings* on page 5-26 for information about the compensation scale.

Refer to the *Section 13 Common Command Instructions* for how to use the CNC_Write instruction.

When the compensation scale is rewritten, the compensation value is reflected on the position the slave is commanded in the control period. For example, if the compensation value is 100 mm, the command position moves 100 mm per control period. It is recommended that you rewrite the scale with values incremented or decremented step-by-step over several periods if the target value is not minute.

5-4-4 Saving

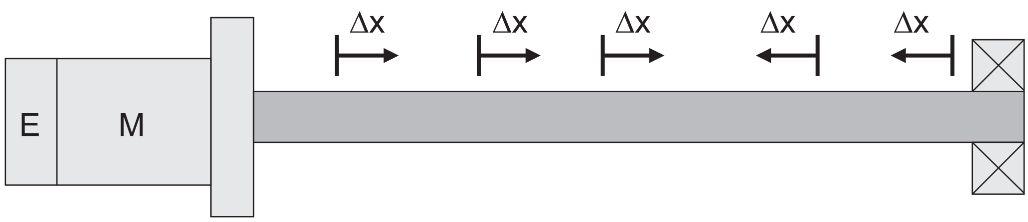
The CNC Function Module does not include a function of automatically saving the CNC motor compensation table. Create a user program that makes a CSV file then saves it to the SD Memory Card, and reads the file from the SD Memory Card when cycling the power supply.

5-4-5 Functions and Purposes of CNC Motor Compensation Table

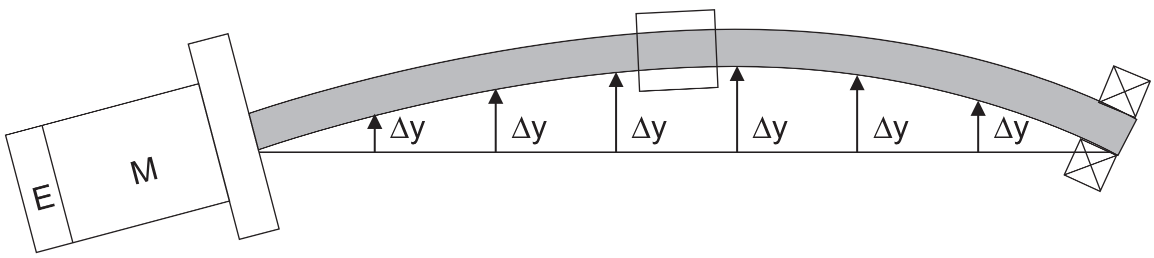
The compensation table function compensates the travel distance of a specific CNC motor or other CNC motors according to the commanded position of the CNC motor.

If there is a position-related error between an actual machine tool and a program, the function compensates the mechanical error as shown in the following figures.

Example of error 1: Shows a mechanical error generated when the rotation of a ball screw assigned to the X-axis is converted into translatory movement.



Example of error 2: Shows a mechanical error caused by a deflection in the Y-axis.



5-4-6 Terminology

Term	Description
CNC motor compensation table	A data table on which compensation table points are aligned in equal intervals from the source compensation point that is set to current position 0, the initial point. It is represented as a two-dimensional array of the target compensation value and the source compensation point of compensation table points. This is often referred to as Compensation table.
Source CNC motor	A CNC motor of input source for determining the compensation value by the compensation table.
Target CNC motor	A CNC motor to be compensated with the source data and CNC motor compensation table. The source CNC motor can also be the target CNC motor.
Source compensation section	Shows a section in which to perform compensation on the source CNC motor.
Source compensation point	Shows a relative distance from the start position of the source compensation section. This is a value set in the motor command unit system of the source CNC motor.
Target compensation value	Shows a compensation value of the target CNC motor position at the source compensation point. This is a value set in the motor command unit system of the target CNC motor.
Compensation table point	Data on a set of the source compensation point and target compensation value. This shows the target compensation value of a position on the source CNC motor.
Compensation table point span	Shows an interval between the compensation table points that are adjacent to each other. The compensation table point spans are equally aligned.
Motor current compensation position	A value that stores the compensation amount internally for each CNC motor based on the compensation table. The value is edited from multiple CNC motor compensation tables when the multiple CNC motor compensation tables are used to compensate a single CNC motor as the target.

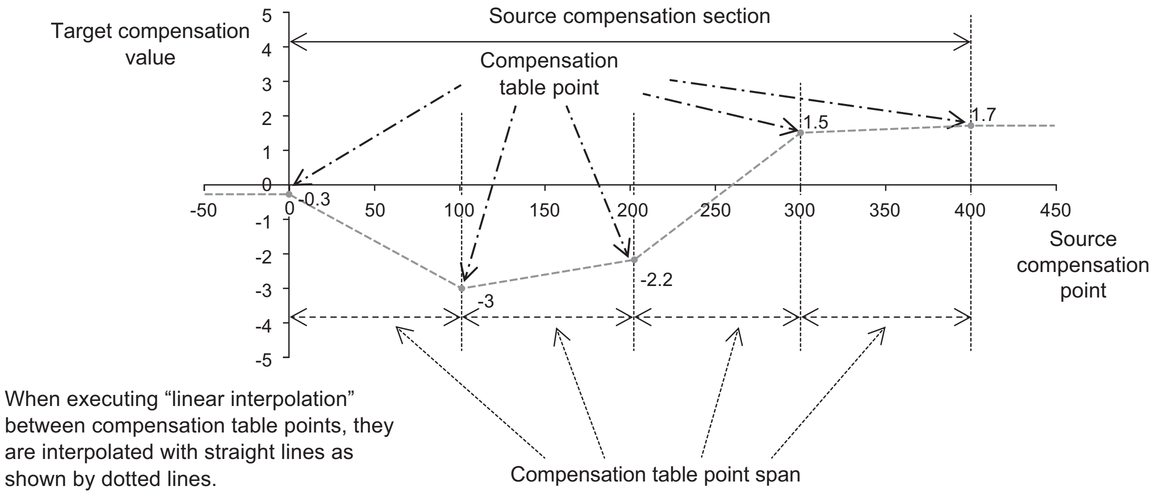
5-4-7 Outline

In the CNC Function Module of CNC motor compensation table points, a compensation table point is the combination of a source compensation point and target compensation value.

The CNC motor compensation table is represented by a data table as shown in the following.

Source compensation point	Target compensation value
0.0	-0.3
100.0	-3.0
200.0	-2.2
300.0	1.5
400.0	1.7

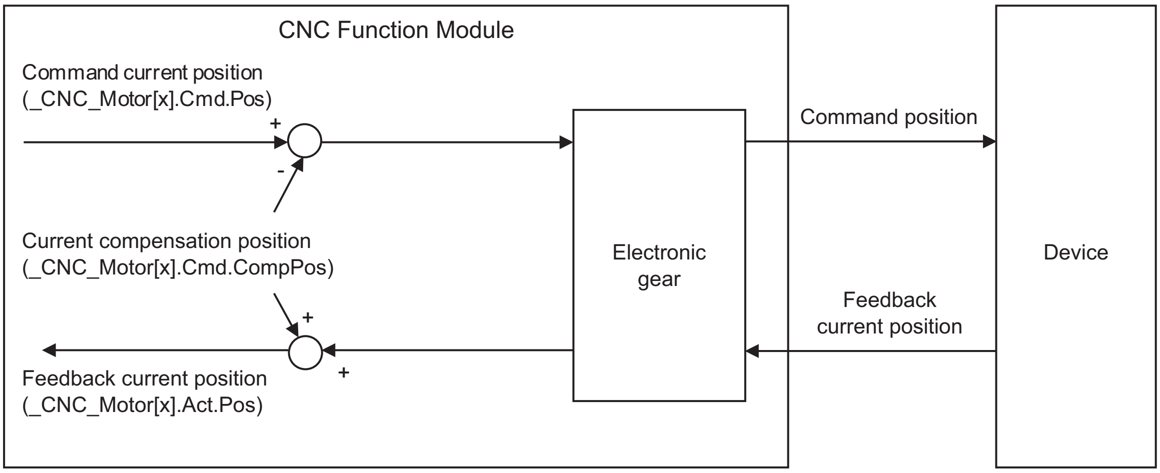
The following graph shows a CNC motor compensation table in which the horizontal axis represents the source compensation point, and the vertical axis the target compensation value.



The target compensation value is calculated from the source CNC motor position and compensation table value every control period, and output to the CNC motor current compensation position of each CNC motor.

In the control period, the value of feedback position in the CNC motor variable (*_CNC_Motor[x].Cmd.Pos*) does not make any noticeable changes. To the Servo Drive and spindle drive, however, the commanded position is output as a value subtracted by the CNC motor current compensation position.

The value of the feedback position of CNC motor variable (*_CNC_Motor[x].Act.Pos*) is a value output from the actual Servo Drive and spindle driver to which the CNC motor current compensation position is added.



The processing enables you to match the position of CNC motor in the program with that of the actual machine.

Precautions for Correct Use

To calculate the target compensation value, the current position value specified for the source position is used as it is. Accordingly, edit and enable the CNC motor compensation table after home is determined.

5-4-8 Basic Settings

Create a CNC motor compensation table with the CNC Motor Compensation Table Editor of Sysmac Studio.

After you create a CNC motor compensation table, configure the basic settings of the CNC compensation table before inputting a compensation value. This section describes the basic setting items.

Parameter name	Description	Setting range	Default
CNC Motor Compensation Table Number	A logical number of a CNC motor compensation table. It must not be duplicated with a number used for another CNC motor compensation table.	0 to (Maximum number of CNC motor compensation tables)-1	---
Source CNC Motor Number	A CNC motor of input source for determining the compensation value by the CNC motor compensation table. Only one can be selected.	Number of CNC motors created	---
Target CNC Motor Number	A CNC motor to be compensated with the source data and compensation data table. The source CNC motor can also be the target CNC motor. Only one can be selected.	Number of CNC motors in the same CNC coordinate system.	---
Compensation Scaling	Specify a coefficient that multiplies the compensation value calculated in the CNC motor compensation table. Specifying 0 disables compensation.	0 to 2.0	1.0
Source Compensation Start Position	Shows the absolute start position of a source compensation section. (Unit: Source motor command units)	Positive long reals or 0	0

Parameter name	Description	Setting range	Default
Source Compensation Section Distance	Shows a relative distance between the source compensation start position and the absolute position at which the source compensation section ends. (Unit: Source motor command units)	Positive long reals or 0	100
Number of Compensation Table Point Sections	Shows the number of source compensation points generated by dividing a source section distance. The number of arrays for the CNC motor compensation table is calculated in the following formula. (Source section distance/Number of compensation table point sections)+1	1 to 65,534	4
Source Reference Position	Select whether to reference the commanded position or the feedback position for the source CNC motor.	0: Command position 1: Feedback position	0
Compensation Output Method	Select whether to Overwrite or Add the CNC motor current compensation position. Select Overwrite in most cases. However, when compensating a single target CNC motor by using multiple CNC motor compensation tables, you can: Select Overwrite for Compensation Output Mode of the least compensation table number, and select Add for that of remaining tables, so that multiple compensations are possible.	0: Overwrite 1: Add	0
Repetition Mode	Select a compensation mode for outside of the source compensation section. • No repetition Retains the target compensation value of both ends for outside of the source compensation section.*1 • Repetition Repeats compensation according to the CNC motor compensation table for each source compensation section distance, for outside of the source compensation section.	0: No repetition 1: Repetition	0
Table Point Interpolation Method	Select whether to set the interpolation between CNC motor compensation table points to the 1st-order or 3rd-order. If the 1st-order interpolation is selected, liner interpolation applies to CNC motor compensation table data items. This makes the compensation positions continuous, however, the velocities are discontinuous. If the 3rd-order interpolation is selected, the tertiary interpolation applies to CNC motor compensation table data items. This makes the compensation positions continuous and velocity variation smooth. However, this interpolation will take approximately double the calculation time that is required for the Primary interpolation.	0: 1st-order interpolation 1: 3rd-order interpolation	0

*1. If No repetition and 3rd-order interpolation are set, there are sections where the target compensation value varies before and after the source compensation section to make the velocities continuous.

Precautions for Correct Use

When Add is selected for Compensation Output Mode, make sure that multiple CNC motor compensation tables are used for a single target CNC motor, and that the CNC motor compensation table number is not the least value.

If Add is selected in other conditions, the compensation value continues to be added every control period. Consequently, the compensation value becomes excessively large and an unintended motion may result.

Setting basic settings determines the size of the CNC motor compensation table array, and the value of source compensation point for each CNC motor compensation table point.

Source compensation point	Target compensation value
0.0	0.0
Source Compensation Section[*1]	0.0
Source Compensation Section[*1]	0.0
...	0.0
Source Compensation Section Distance	0.0

*1. Source section range = Source compensation section distance/Number of compensation table point sections

Then set the target compensation value in each CNC motor compensation table point.

Parameter name	Description	Setting range	Default
Target Compensation Value	Shows a compensation value of the target CNC motor position at the source compensation point. This is a value set in the motor command unit system of the target CNC motor.	Range of single-precision reals[*1]	0.0

*1. -∞ and +∞ are excluded.

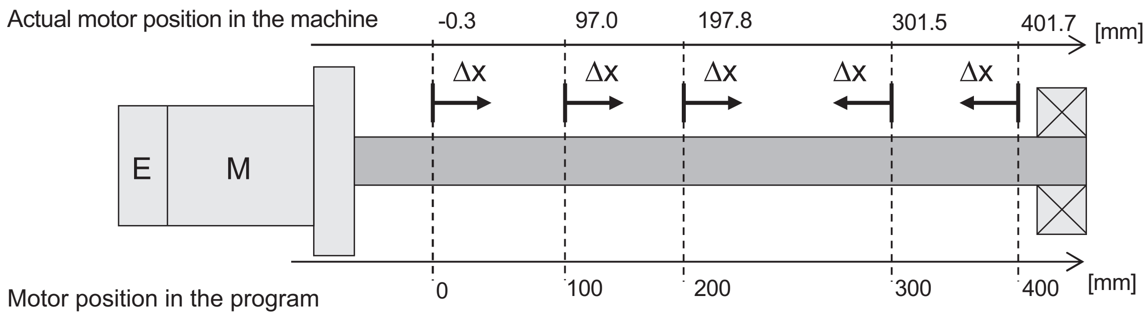
5-4-9 Setting Example

This section describes the method to set the CNC motor compensation table.

Examples of Ball Screw Pitch Compensation, Ball Screw Deflection, and Rotary Table Compensation are provided.

Ball Screw Pitch Compensation

Suppose that you executed the operation command for five points on the X-axis from absolute position 0 mm to 400 mm at 100 mm intervals, and measured X-axis positions of the actual machine tool. As a result, you obtained the following reproducible errors caused by displacement of the ball screw pitch.

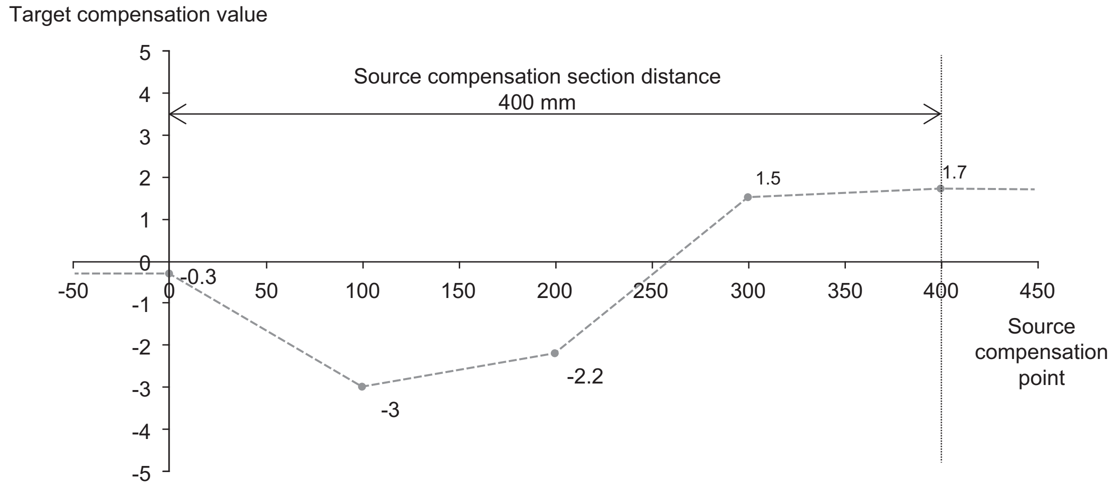


Use the CNC motor compensation table to cancel the error and match the positions in the program with those of the actual machine.

First, input the basic settings.

Setting	Value
Source CNC Motor Number	1 (CNC_Motor001)
Target CNC Motor Number	1 (CNC_Motor001)
Compensation Scaling	1.0
Source Compensation Start Position	0 (mm)
Source Compensation Section Distance	400 (mm)
Number of Compensation Table Point Sections	4
Source Reference Position	0: Command position
Compensation Output Method	0: Overwrite
Repetition Mode	0: No repetition
Table Point Interpolation Method	0: 1st-order interpolation

Then set the displacement of each measurement point (Measured position - Position in the program) for each target compensation value.



Source compensation point [mm]	Target compensation value [mm]
0.0	-0.3
100.0	-3.0
200.0	-2.2
300.0	1.5
400.0	1.7

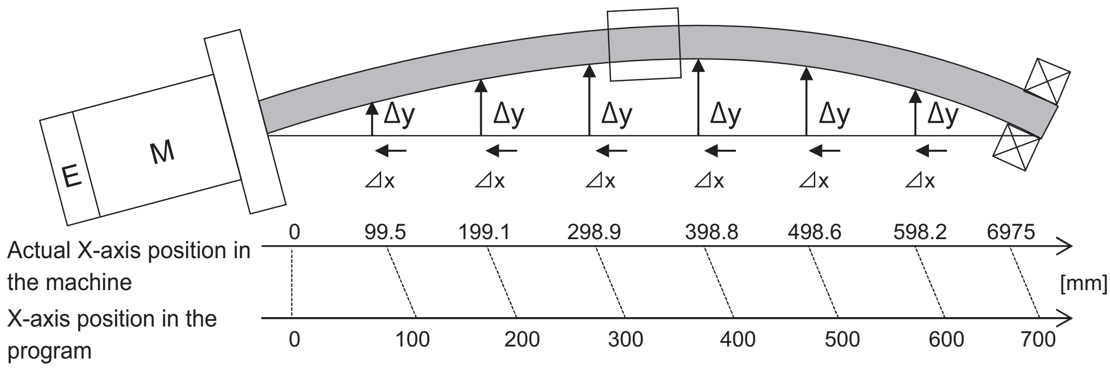
Ball Screw Deflection Compensation

Suppose that CNC motor 0 is assigned to the X-axis, and CNC motor 1 to the Y-axis. The CNC motor in the X-axis direction deflects in the Y-axis direction.

In this case, use two CNC motor compensation tables. The first one compensates the deflection in the X-axis direction. The second one compensates the deflection in the Y-axis direction.

● Compensation in the X-axis direction

Suppose that, without moving the Y-axis from 0 mm, you executed the operation command for eight points on the X-axis from absolute position 0 mm to 700 mm at 100 mm intervals, and measured the X-axis position of the actual tool machine at each point. As a result, you obtained the following reproducible errors caused by displacement of the ball screw pitch.



The following table shows the basic settings of the first CNC motor compensation table (number 0) and CNC motor compensation table data.

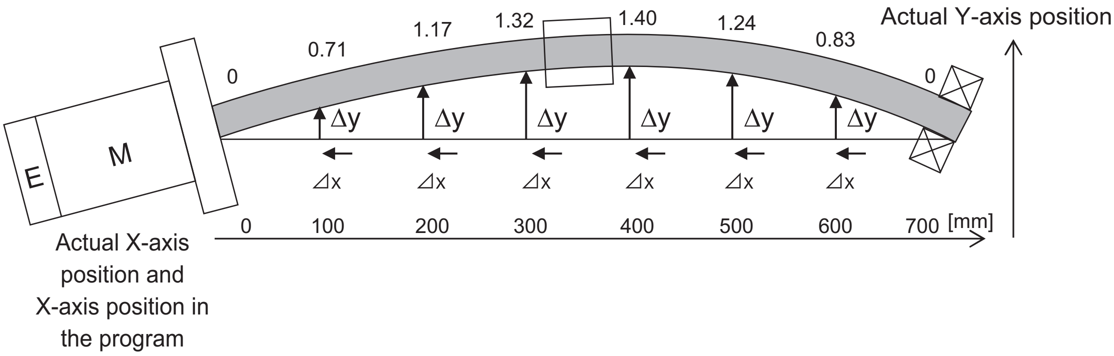
The settings must be set in the same way as you did for Ball Screw Pitch Compensation as described in the previous section.

Setting	Value
CNC Motor Compensation Table Number	0
Source CNC Motor Number	0 (CNC_Motor000)
Target CNC Motor Number	0 (CNC_Motor000)
Compensation Scaling	1.0
Source Compensation Start Position	0 (mm)
Source Compensation Section Distance	700 (mm)
Number of Compensation Table Point Sections	7
Source Reference Position	0: Command position
Compensation Output Method	0: Overwrite
Repetition Mode	0: No repetition
Table Point Interpolation Method	1: 3rd-order interpolation

Source compensation point [mm]	Target compensation value [mm]
0.0	0
100.0	-0.5
200.0	-0.9
300.0	-1.1
400.0	-1.2
500.0	-1.4
600.0	-1.8
700.0	-2.5

Compensation in the Y-axis direction

Measure eight points with CNC motor compensation table number 0 enabled, and obtain the following errors in the Y-axis direction.



Set the basic settings and compensation table data settings for the second CNC motor compensation table (number 1).

This table differs from the first CNC motor compensation table in the following two points:

- The source CNC motor and the target CNC motor are different.
- The source reference position is set to "1: Feedback position".

Setting	Value
CNC Motor Compensation Table Number	1
Source CNC Motor Number	0 (CNC_Motor000)
Compensation Scaling	1.0
Target CNC Motor Number	1 (CNC_Motor001)
Source Compensation Start Position	0 (mm)
Source Compensation Section Distance	700 (mm)
Number of Compensation Table Point Sections	7
Source Reference Position	1: Feedback position
Compensation Output Method	0: Overwrite
Repetition Mode	0: No repetition
Table Point Interpolation Method	1: 3rd-order interpolation

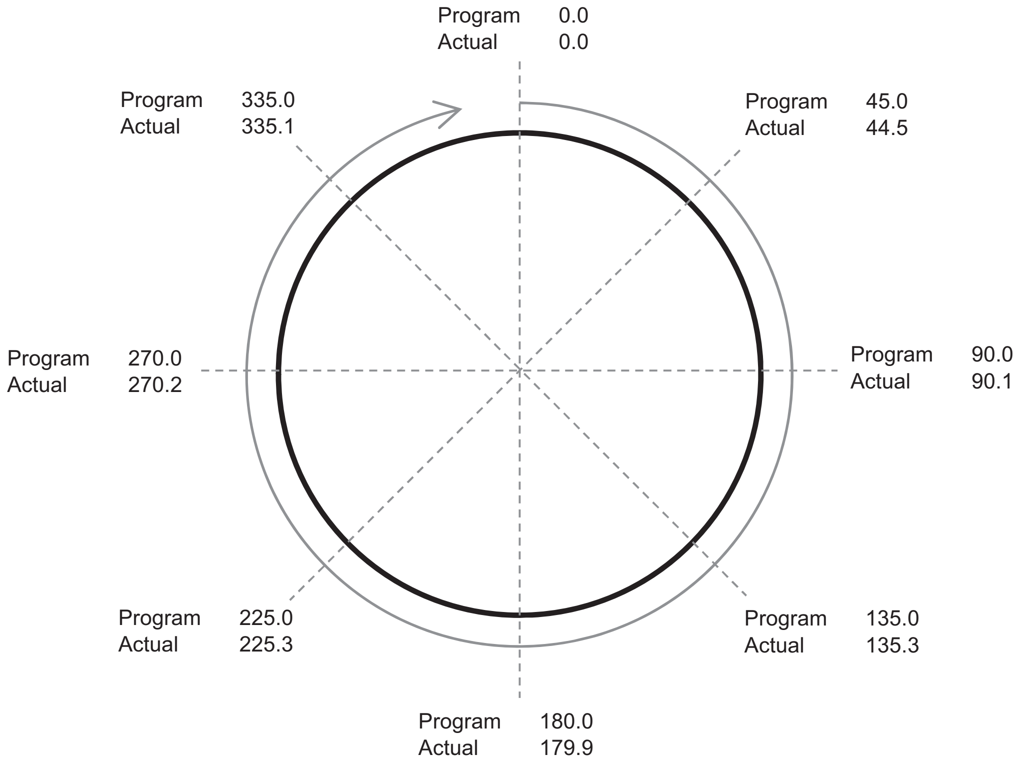
Source compensation point [mm]	Target compensation value [mm]
0.0	0.0
100.0	0.71
200.0	1.17
300.0	1.32
400.0	1.40
500.0	1.24
600.0	0.83
700.0	0.0

With these settings, the position set to the input source in the second CNC motor compensation table is the X position, a position of the actual machine that was compensated in the first CNC motor compensation table.

When you move the X-axis in the positive direction without moving the Y-axis from 0 mm, the operation actually moves CNC motor 1 on the Y-axis in the negative direction to disable the error.

Rotary Table Compensation

Suppose that you assigned CNC motor 1 to the rotary table of the C-axis, rotated it from 0 degrees at intervals of 45.0 degrees, and measured the actual rotation angle. As a result, you obtained the following reproducible errors.



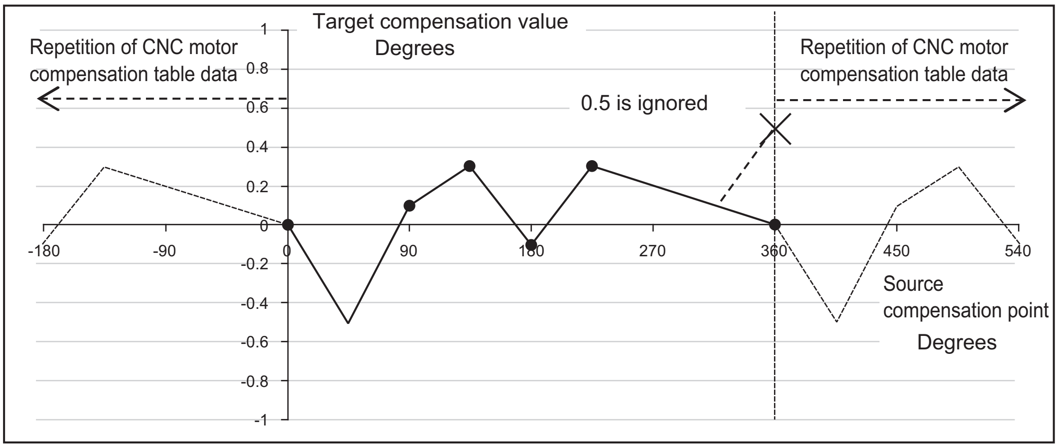
Input the basic settings and the target compensation value of each point.

In this example, the Repetition setting is selected as similar errors must be compensated every time the rotary table is rotated.

Setting	Value
CNC Motor Compensation Table Number	0
Source CNC Motor Number	1 (CNC_Motor001)
Target CNC Motor Number	1 (CNC_Motor001)
Compensation Scaling	1.0
Source Compensation Start Position	0 (degree)
Source Compensation Section Distance	360 (degree)
Number of Compensation Table Point Sections	8
Source Reference Position	0: Command position
Compensation Output Method	0: Overwrite
Repetition Mode	1: Repetition
Table Point Interpolation Method	0: 1st-order interpolation

Source compensation point degrees	Target compensation value degrees
0.0	0.0
45.0	-0.5
90.0	0.1
135.0	0.3
180.0	-0.1
225.0	0.3
270.0	0.2
315.0	0.1
360.0	0.5 -> 0.0 (The setting value is ignored.)

If 1: Repetition is selected, the target compensation value of the first point is used for that of the last point. The following graph shows the compensation value to be used when 0.5 is set.



5-4-10 CNC Motor Compensation Table Specifications

This section describes specifications of the CNC motor compensation table.

Item	Description
Maximum number of compensation table points per CNC motor compensation table	65,535
Upper limit of the size of all CNC motor compensation tables	Maximum size of all compensation tables varies depending on the model. Refer to *1-4-1 General Specifications* on page 1-7 for details. Size of a CNC motor compensation table = 100 + CNC motor compensation table points x 4 bytes
Upper limit of the number of CNC motor compensation tables	The upper limit of the maximum number of compensation tables varies depending on the model. Refer to *1-4-1 General Specifications* on page 1-7 for details.
Changing a CNC motor compensation table	CNC motor compensation table data can be edited from a user program.
Saving a CNC motor compensation table	The file read/write instruction enables you to use this function.
Timing to reflect CNC motor compensation tables on main memory	• At power ON • At synchronous download of Sysmac Studio

6

Realization of CNC Machines

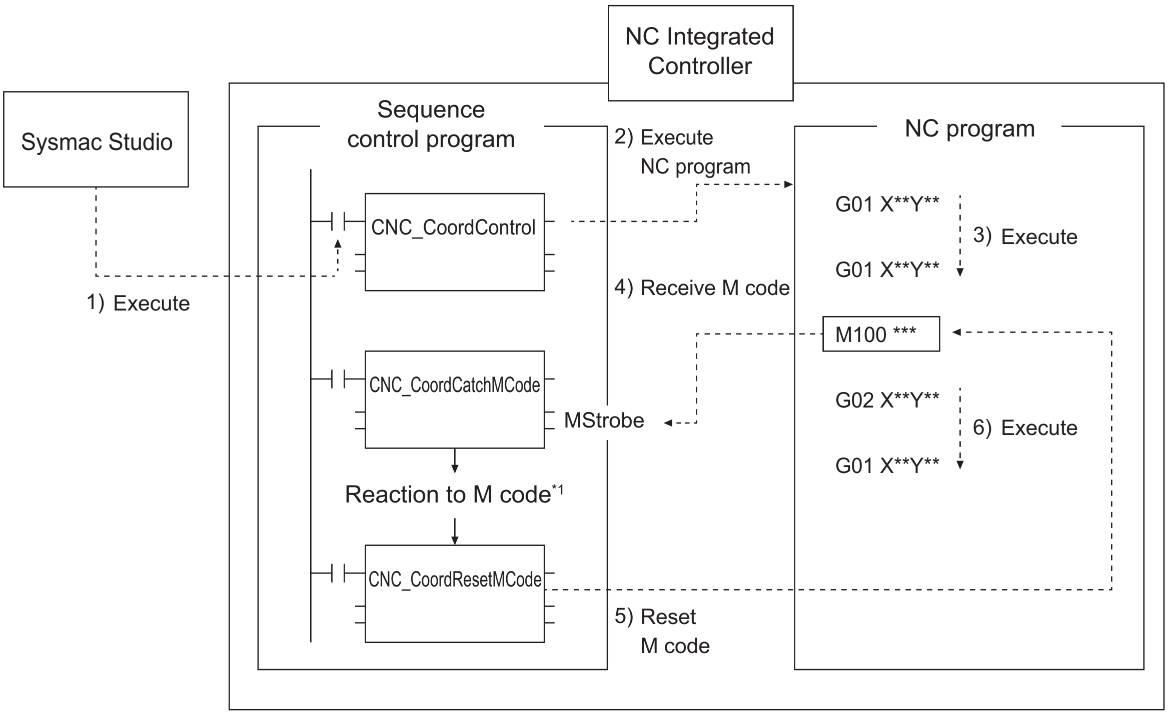
This section describes the functions and means of producing CNC machine applications with the aid of sequence control programs, NC programs, and CNC functions.

6-1 M Codes

This section describes procedures to interlock the sequence control program with an NC program to construct CNC machine applications, by using M codes.

You can transmit M codes to the sequence control program with the CNC_CoordCatchMCode instruction. Up to 192 (M0 to M191) M codes to output from the NC program can be specified for each CNC coordinate system. M code numbers (0 to 191) are used to specify the M codes to accept with the CNC_CoordCatchMCode instruction. A different M code can be programmed for each M code number. The CNC_CoordCatchMCode instruction can also place multiple instances. Accordingly, there is no limit to the number of M codes that can be output simultaneously. After performing processing according to M codes, such as coolant control and ATC control, the sequence control program executes the CNC_CoordResetMCode instruction to send M code reset to the NC program.

● Relationship between Sequence Control Program and NC Program



*1. Processing must be programmed according to M codes. For specific applications, refer to the following examples.

- Coolant, spindle, and other I/O controls.
- ATC control and tool data writing. Refer to *6-2 Tool Functions* on page 6-3 for details.
- Writing and reading NC program variable monitor. Refer to *NC Program Variable Monitoring* on page 5-19 for details.

6-2 Tool Functions

This section describes the tool change function and tool data management function.

6-2-1 Method for Realizing Tool Data Management

Tool data includes the tool radius and length used for tool compensation, as well as the usage frequency and time recorded for managing the tool life. This Controller does not have a function that manages the tool data. Realize the tool data management function with the aid of the sequence control program, which is capable of saving the data to the hold memory inside the program.

Tool data management can be realized, for example, by defining global variables (shown in the following table) and constructing the following logics using the sequence control program and CNC Operator.

Tool Shape Data Management

Procedure to manage tool shape data is as follows.

1 Create a CNC Operator screen used to input the tool length and tool radius for each tool ID.

2 Create a logic that initializes the tool life data.

Tool Life Data Management

Procedure for managing tool life data is as follows.

1 Create a logic that accumulates the usage frequency, usage time, and abrasion of a tool when the tool is used.

2 Set the thresholds for the usage frequency, usage time, and abrasion, and create a logic that detects errors.

Example : The following table shows an example of tool data management.

Variable name	Data type	Name	Function
ToolManagementData	Array[N] of User Define Struct	Tool Data	Tool data (for each tool ID)
ShapeData	User Define Struct	Tool Shape Data	A data group related to tool compensation
Offset	LREAL	Tool Length	A value used for tool length compensation
Radius	LREAL	Tool Radius	A value used for tool radius compensation
LifecycleData	User Define Struct	Tool Life Data	A data group related to tool life.
UsageCount	UDINT	Usage Frequency	A value indicating the frequency of tool usage
OperationTime	Time	Usage Time	A value indicating the elapsed time of tool usage
LengthWear	LREAL	Abrasion	A value indicating the abrasion of tool length
RadiusWear	LREAL	Abrasion	A value indicating the abrasion of tool radius

6-2-2 Method for Realizing Tool Change

Refer to the description in *6-1 M Codes* on page 6-2 for tool change.

The following example shows how to realize tool change.

When the NC program requests that the tool be replaced, the sequence control program executes automatic tool change. After completing the automatic tool change, the sequence control program transmits the information to the NC program.

● Prior Conditions

a) M code is M100 for tool replacement.

b) Use the tool ID as an argument of M code output (ID 0 to 2)

● Example (Replace with Tool ID #1)

a) Output M06 VA1 from the NC program.

b) Receive M06 with the CNC_CoordCatchMCode instruction in the sequence control program.

c) Check the Tool ID that has been output to MCodeRef.Outputs[0].

d) Execute the tool change operation according to the Tool ID.

e) Execute the CNC_Write instruction to change the tool length and radius.

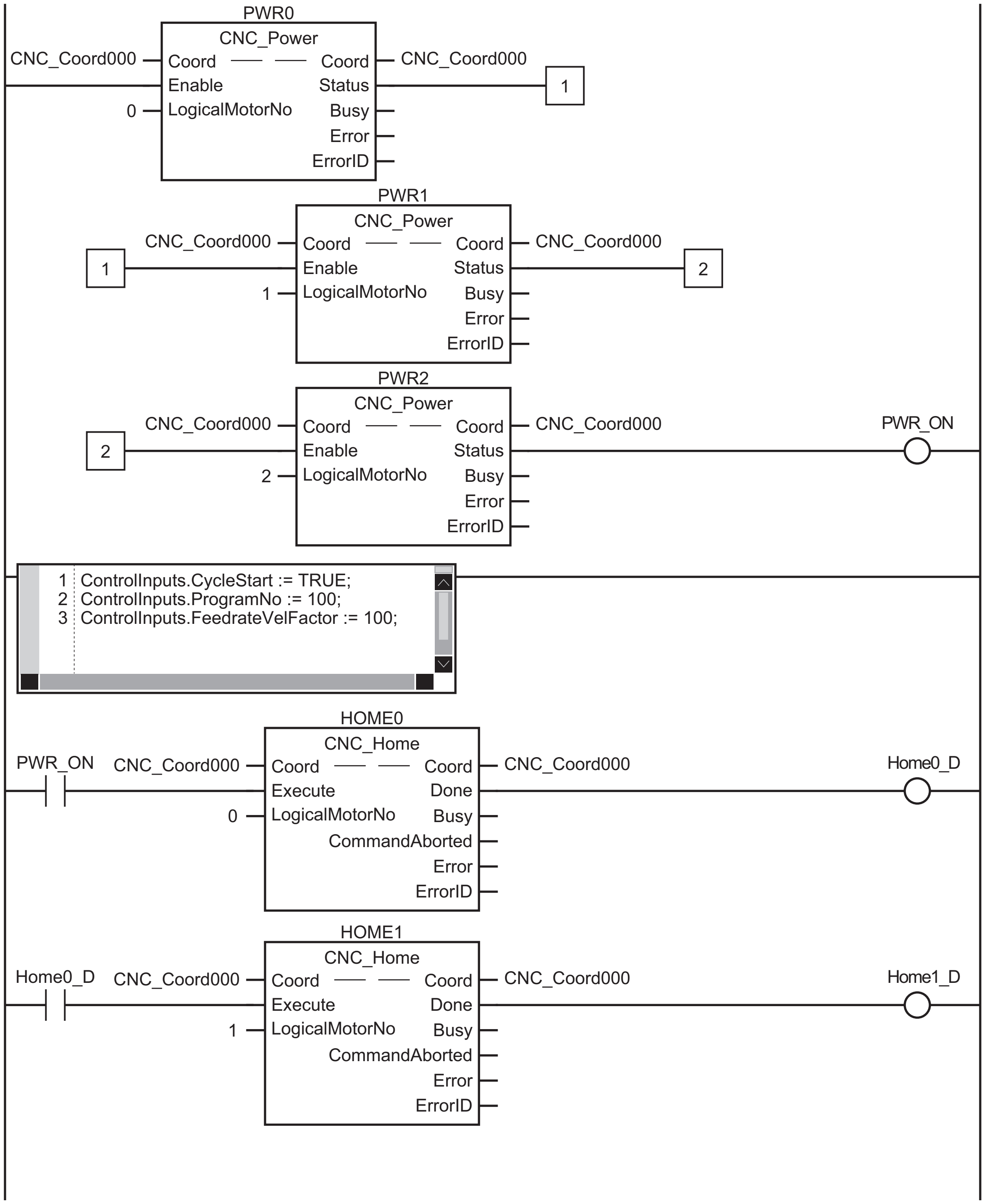
f) After the tool change is completed, execute the CNC_CoordResetMCode instruction and restart the NC program.

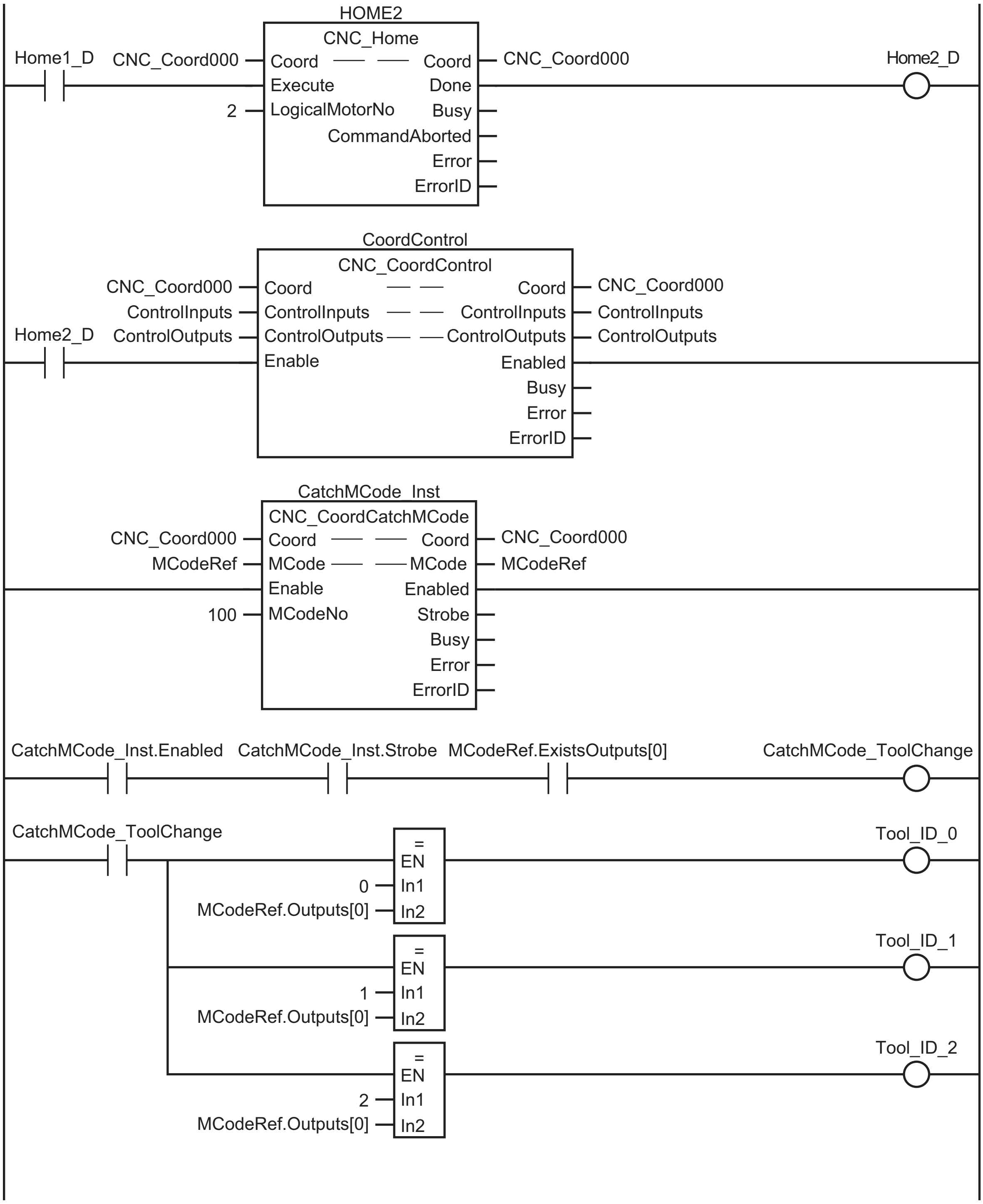
g) Enable tool radius compensation and tool length compensation from the NC program.

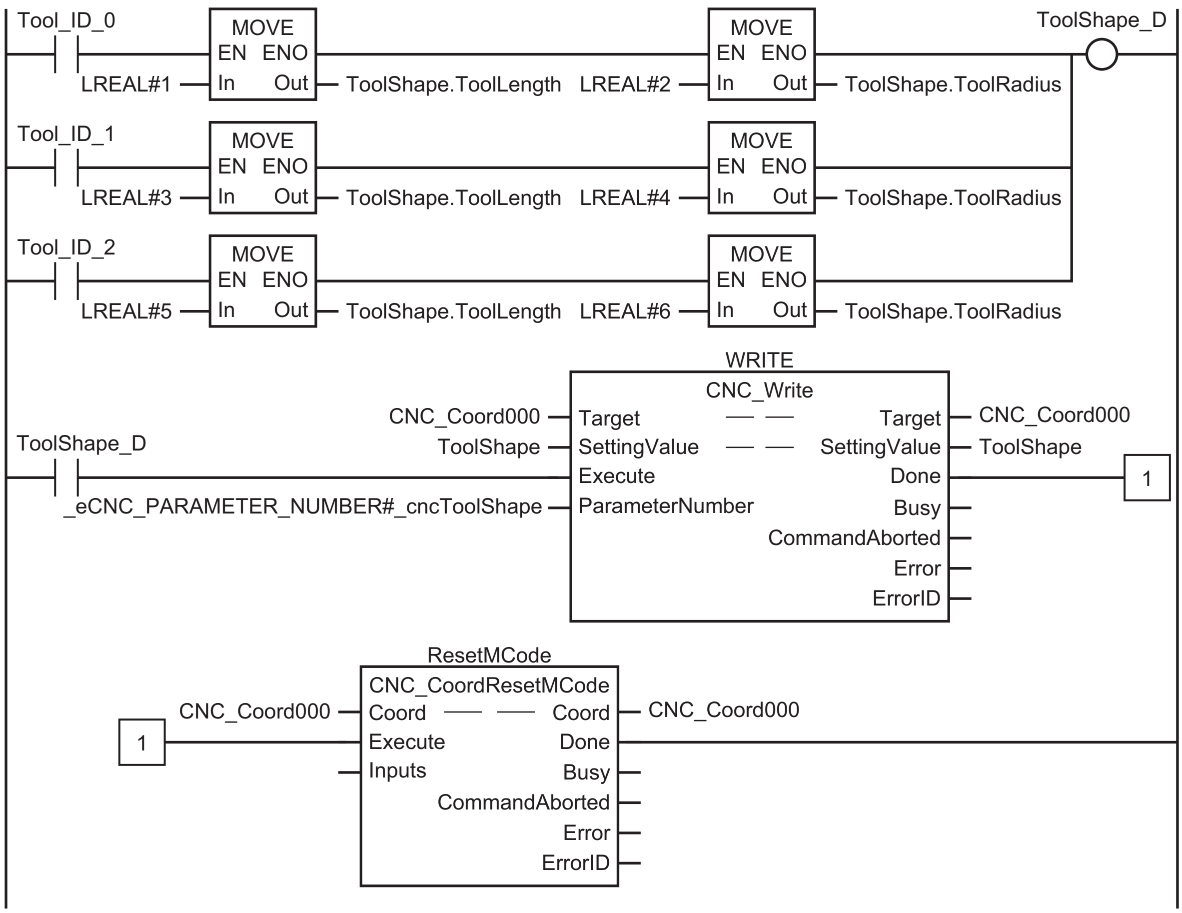
● NC Program

```
G90 G17 F100
G28          // Return to reference point
M06 VA1      //M06 (tool change) Tool ID #1
G41 X10 Y10  // Enables cutter compensation
G04 P5000
X20 Y20
G04 P5000
G40 X0 Y0
G04 P5000
G43 X10 Z10  // Enables tool length compensa-
        tion
G04 P5000
G49 X0 Z0
M30
```

- **Sequence Control Program**




HOME2
CNC_Home
Home1_D
CNC_Coord000
Coord
Coord
CNC_Coord000
Home2_D
Execute
Done
2
LogicalMotorNo
Busy
CommandAborted
Error
ErrorID
CoordControl
CNC_CoordControl
CNC_Coord000
Coord
Coord
CNC_Coord000
ControlInputs
ControlInputs
ControlInputs
ControlInputs
Home2_D
ControlOutputs
ControlOutputs
ControlOutputs
ControlOutputs
Enable
Enabled
Busy
Error
ErrorID
CatchMCode_Inst
CNC_CoordCatchMCode
CNC_Coord000
Coord
Coord
CNC_Coord000
MCodeRef
MCode
MCode
MCodeRef
Enable
Enabled
100
MCodeNo
Strobe
Busy
Error
ErrorID
CatchMCode_Inst.Enabled
CatchMCode_Inst.Strobe
MCodeRef.ExistsOutputs[0]
CatchMCode_ToolChange
CatchMCode_ToolChange
=
EN
Tool_ID_0
0
In1
MCodeRef.Outputs[0]
In2
=
EN
Tool_ID_1
1
In1
MCodeRef.Outputs[0]
In2
=
EN
Tool_ID_2
2
In1
MCodeRef.Outputs[0]
In2


Tool_ID_0
MOVE
EN ENO
LREAL#1
In Out
ToolShape.ToolLength
MOVE
EN ENO
LREAL#2
In Out
ToolShape.ToolRadius
ToolShape_D
Tool_ID_1
MOVE
EN ENO
LREAL#3
In Out
ToolShape.ToolLength
MOVE
EN ENO
LREAL#4
In Out
ToolShape.ToolRadius
Tool_ID_2
MOVE
EN ENO
LREAL#5
In Out
ToolShape.ToolLength
MOVE
EN ENO
LREAL#6
In Out
ToolShape.ToolRadius
WRITE
CNC_Write
CNC_Coord000
Target
Target
CNC_Coord000
ToolShape
SettingValue
SettingValue
ToolShape
ToolShape_D
Execute
Done
1
_eCNC_PARAMETER_NUMBER#_cncToolShape
ParameterNumber
Busy
CommandAborted
Error
ErrorID
ResetMCode
CNC_CoordResetMCode
CNC_Coord000
Coord
Coord
CNC_Coord000
1
Execute
Done
Inputs
Busy
CommandAborted
Error
ErrorID

6-3 Realization of the Function of Spindle Axis

This section describes the function of spindle axis. There are two methods to realize the function of spindle axis. One is to use the CNC Function Module, and the other is to use the I/O control or MC Function Module.

Refer to *6-3-3 When No Spindle Axis is Assigned* on page 6-12 if spindle axis assignment is not required.

6-3-1 Realization of the Function of Spindle Axis with CNC Function Module

This section describes how to realize the function of spindle axis with the CNC Function Module.

Spindle Axis Assignment

If you control spindle axis with the CNC Function Module, assign a CNC motor to the spindle axis in the CNC coordinate system. The spindle axis must conform to CiA402, and support CSV (Cyclic Synchronous Velocity) mode by default.

Positive, Negative, and Stop Operations

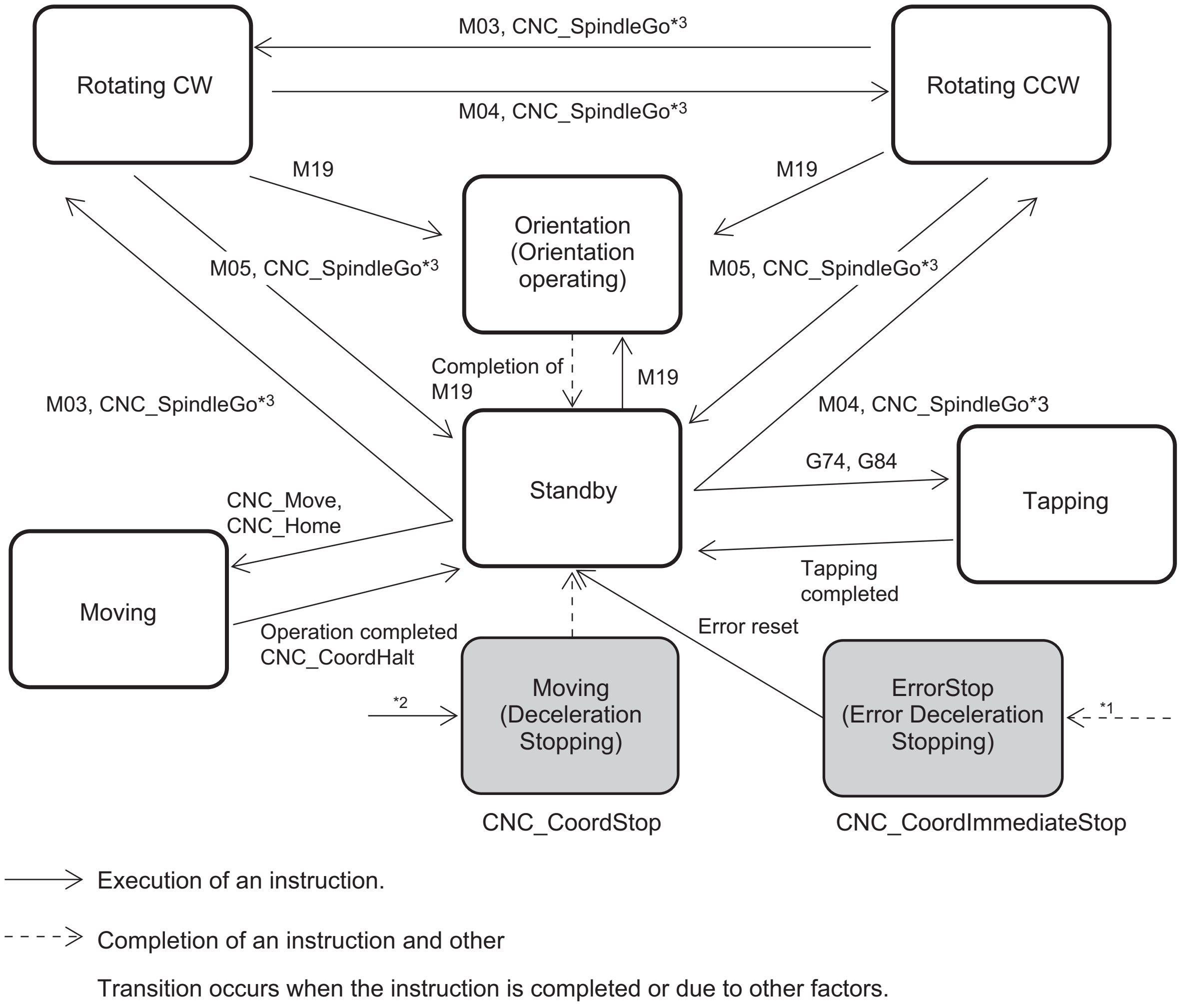
While the NC program is running, the spindle axis is automatically controlled from the CNC Function Module. The user program does not need to receive Positive (M03), Negative (M04), and Stop (M05). If you want to operate the spindle axis in manual mode, use the CNC_SpindleGo instruction.

Orientation of Spindle Axis

The orientation of the spindle axis is automatically controlled from the CNC Function Module. The user program does not need to be used to receive Orientation of Spindle axis (M19). Unlike CW and CCW operations, Orientation of Spindle axis cannot be executed in manual mode.

Spindle Axis States

The status transitions of the spindle axis are shown in the following diagram. The states correspond to respective variables for CNC_Coord[*].Status.Spindle of CNC coordinate system variables.



*1. An error stop event occurs.

*2. A sop event occurs.

*3. If Velocity of CNC_SpindleGo is set to 0, transition takes place in the standby state.

Status	Status name	Definition
Standby	Standby	A state where the spindle motor stops.
CW	Rotating in CW direction	Spindle CW (M03), a state where the spindle axis is rotating in the CW direction with CNC_SpindleGo.
CCW	Rotating in CCW direction	Spindle CCW (M04), a state where the spindle axis is rotating in the CCW direction with CNC_SpindleGo.
Orientation	Orientation operating	A state where the spindle axis is positioned to the orientation position with Spindle Orientation (M19).
Tapping	Tapping	A state where the spindle axis is tapping with Left-handed Tapping cycle (G74) and Tapping cycle (G84).
Moving	Moved by instruction	A state where the spindle axis is being moved with CNC_Move or CNC_Home
Stopping	Deceleration Stopping	A state until the CNC coordinate system stops for the CNC_CoordStop instruction.

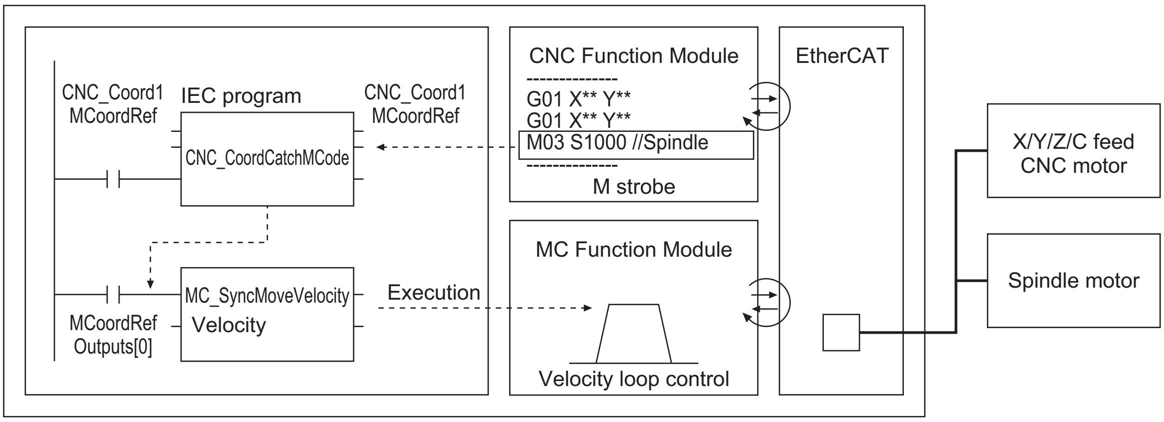
Status	Status name	Definition
ErrorStop	Error Deceleration Stopping	A state until the CNC coordinate system stops or a state where it stops for the CNC_CoordImmediateStop instruction or a CNC coordinate system minor fault.

6-3-2 Realization of the Function of Spindle Axis with General-purpose I/O Control or MC Function Module

Besides assigning the spindle axis to a CNC coordinate system, the function of spindle axis can also be realized by using I/O control or the MC Function Module. This section describes how to determine the function of the spindle axis with the MC Function Module.

Spindle Axis Assignment

The spindle axis is controlled by the axis assigned to the Motion Control Function Module. Spindle axis operation is realized by programming the transmission of commands from the CNC Function Module to the Motion Control Function Module via an M code and the sequence control program.



Precautions for Correct Use

- When an error occurs for the spindle motor, an appropriate remedy must be programmed so that the sequence control program detects errors and stops the operation of the CNC coordinate system.
- In the same way, when an error occurs in the CNC coordinate system, an appropriate remedy must be programmed so that the sequence control program detects the error and stops the operation of the spindle motor.

Positive, Negative, and Stop Operations

By receiving M03, M04, and M05 using the user program, the following instruction is executed:

MC_SyncMoveVelocity instruction is used for positive/negative operation.

MC_Stop instruction is used for stop operation.

Orientation of Spindle Axis

The sequence control program and MC Function Module are used for the orientation of the spindle axis.

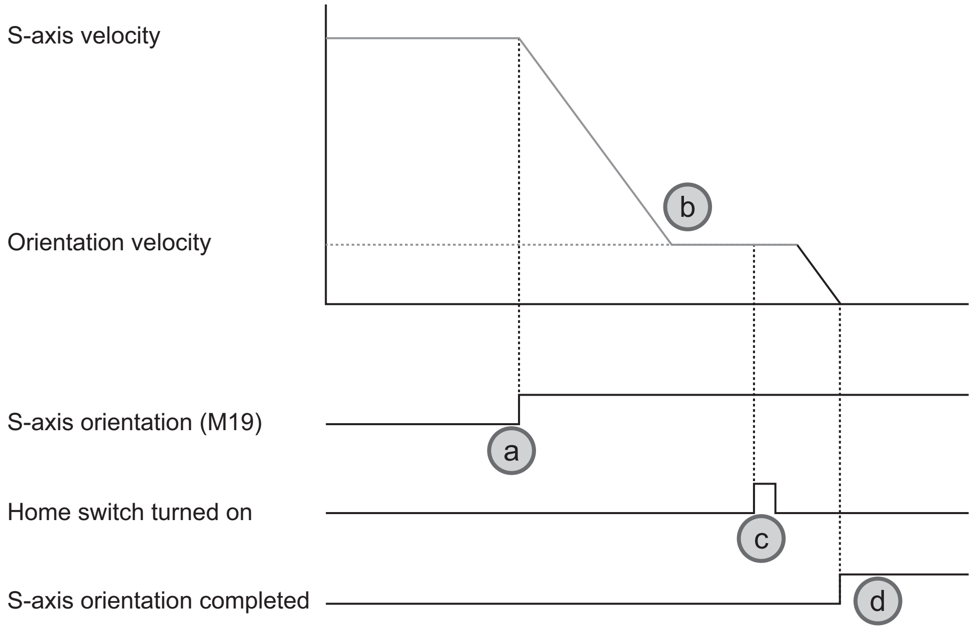
● Example

a) Receive the M19 (Spindle Orientation) command.

b) Gradually reduce the velocity instructed for MC_SyncMoveVelocity instruction to the orientation velocity.

c) Detect the Z-phase position with MC_TouchProbe instruction.

d) Consider the Z-phase position and orientation position offset, and perform the positioning to the orientation position with MC_MoveAbsolute instruction.



6-3-3 When No Spindle Axis is Assigned

If no spindle axis is assigned to the CNC coordinate system, CNC instructions and G codes/M codes behave differently.

Behavior of the Spindle Axis Instruction

If you execute the instruction without assigning a spindle axis to the CNC coordinate system, an error occurs due to the instruction.

Behaviors of G codes and M Codes for Spindle Axis

If you execute G codes/M codes without assigning a spindle axis to the CNC coordinate system, they behave differently as shown in the following table.

G/M code		Difference of behavior
M03	Spindle CW	Converts into general M code
M04	Spindle CCW	Converts into general M code
M05	Spindle OFF	Converts into general M code
M19	Spindle Orientation	Converts into general M code
G74	Left-handed Tapping Cycle	X/Y/Z/A/B/C operation only (Soft tapping)
G84	Tapping Cycle	X/Y/Z/A/B/C operation only (Soft tapping)

6-4 Connect with MPG

Signals from a manual pulse generator (MPG) or other external input devices are handled as device variables in the sequence control program via EtherCAT slaves such as NX units.

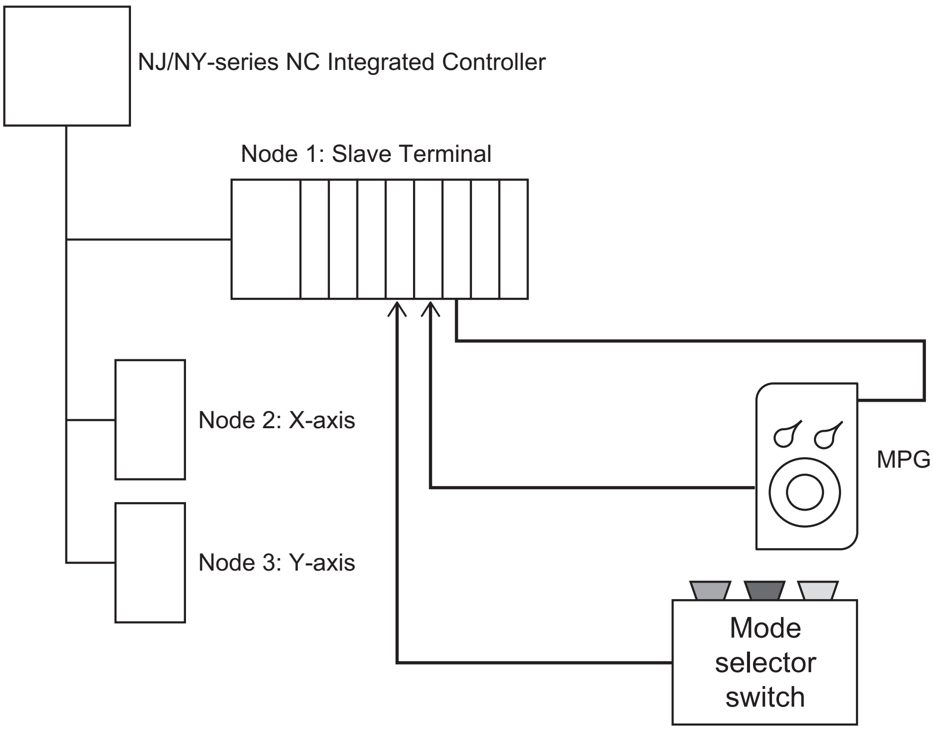
This enables you to connect multiple MPGs without physical limitations, and control the CNC Function Module.

This section provides an example of how to connect an MPG.

Signals from the MPG are received by the NX unit and treated as device variables, and thereby you can control the MPG.

System Configuration

● Configuration Diagram



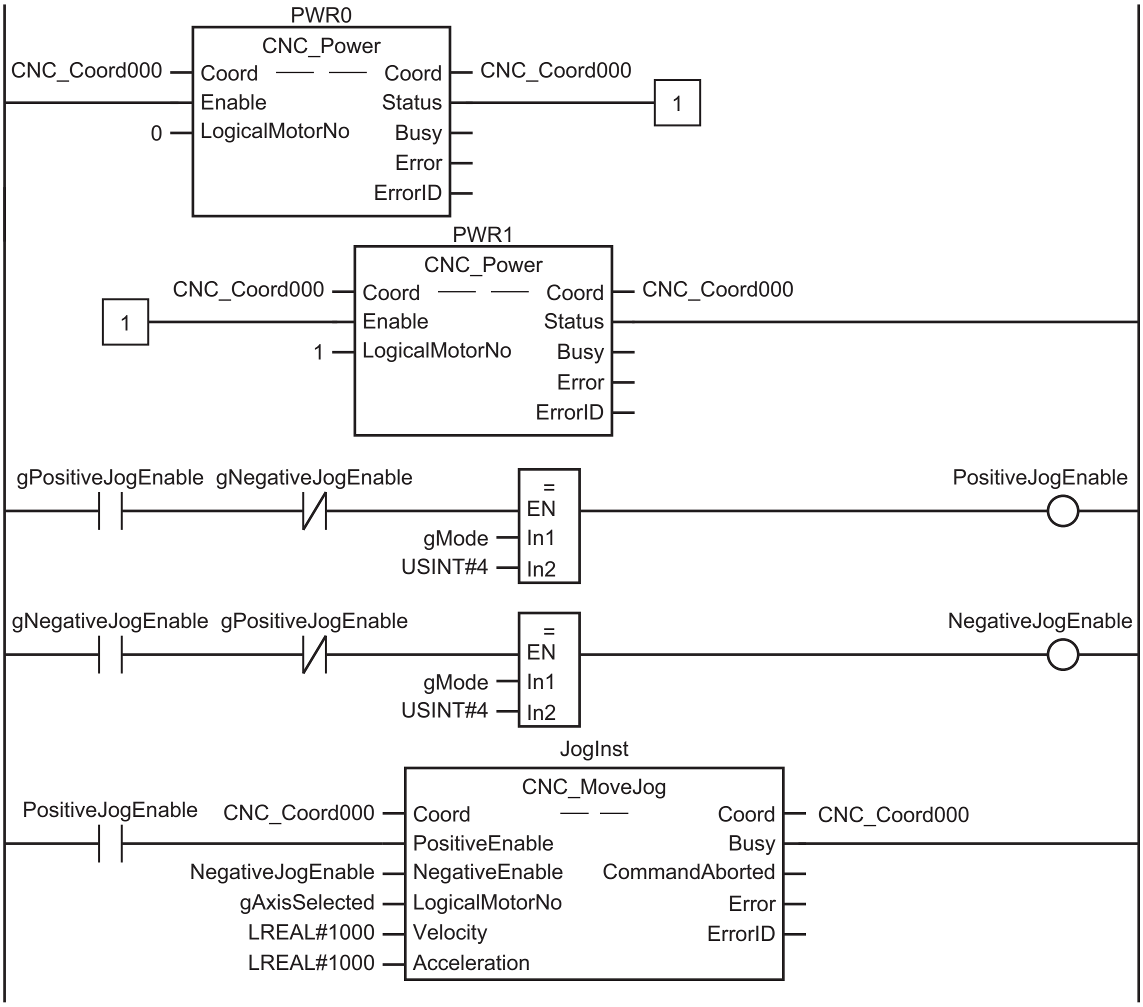
Example of Function List

The following table lists the functions of general MPG. Variables described in the table are the variables used in sample programs of each functions.

Function name	Function	Variables		
		Device variables	Variable name	Data type
Mode Selection	Switch for selecting jog operation/MPG mode	Mode selection switch input	gMode 0: Edit mode 1: Auto mode 2: MDI mode 3: MPG mode 4: Jog mode 5: Home mode	USINT
Axis Selection	Switch for selecting the X/Y-axis	Axis selection input	gAxisSelected 0: X, 1: Y	USINT
Positive/Negative Direction Jog Switch	Switch for jog operation of the selected axis	Positive direction jog switch input	gPositiveJogEnable	BOOL
		Negative direction jog switch input	gNegativeJogEnable	BOOL
MPG	Operation of the MPG for the selected axis	MPG pulse input	gPulseInput	DINT
Magnification Ratio Selection	Magnification ratio setting for MPG operation and jog operation	Magnification ratio selection switch input	gRatioSelection 0: 1 time, 1: 10 times, 2: 100 times	USINT

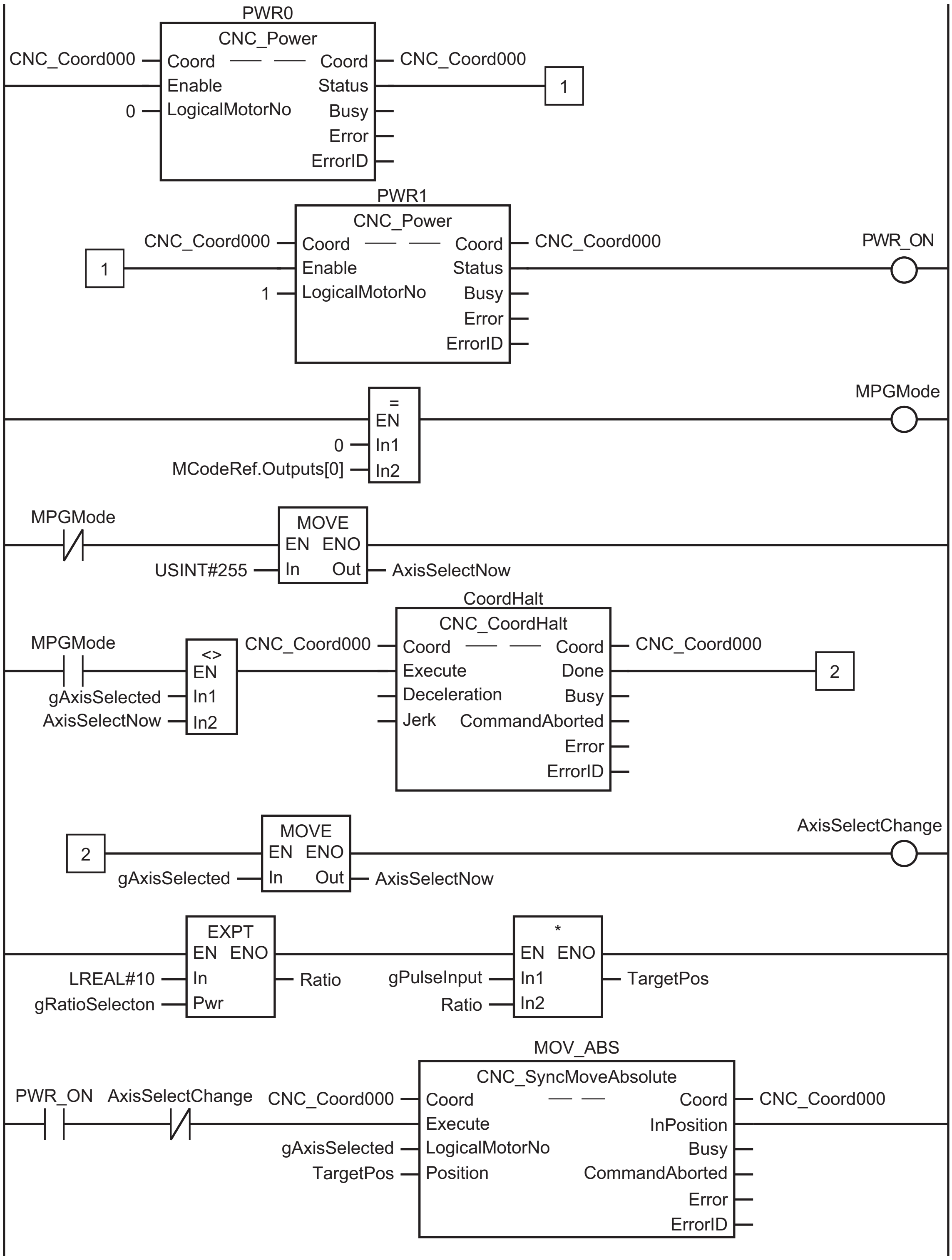
Application of Jogging

- **Sample Program of Jogging**



Application of MPG Operations

- **Sample Program of MPG**



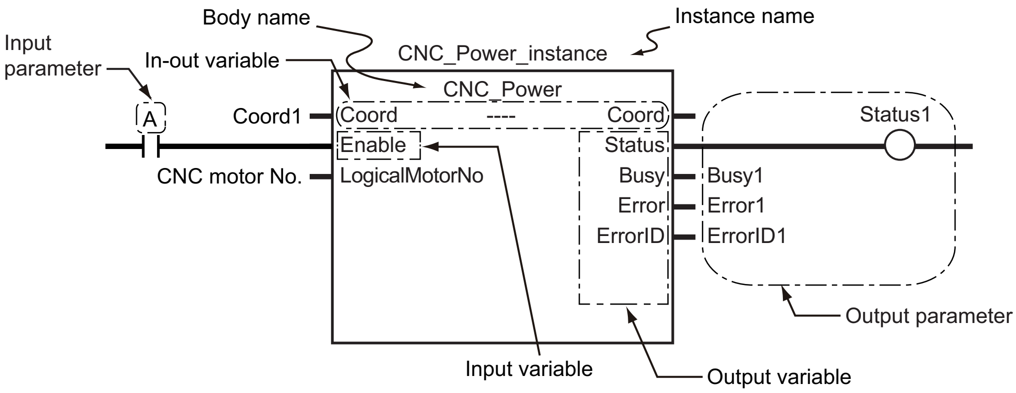
7

Manual Operation

This section describes functions related to manual operation.

7-1 Turning ON the Servo

You can turn the Servo ON or OFF to enable or disable sending operation commands to the Servo Drive. Use the CNC instruction CNC_Power (Power Servo).



Specify the motors to operate with the *Coord* (CNC Coordinate System Variable)) and *LogicalMotorNo* (Logical CNC Motor Number) in-out variables. Change the *Enable* input variable for CNC_Power to TRUE to turn ON the Servo. Change *Enable* to FALSE to turn OFF the Servo.

Precautions for Correct Use

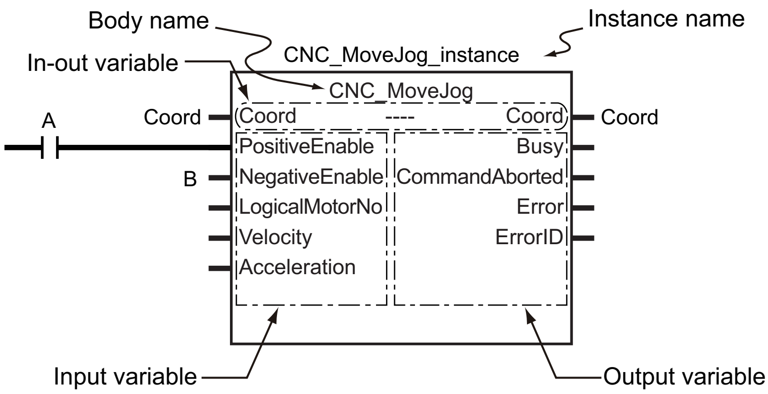
Manual operation requires CNC coordinate system or CNC motor settings.

Additional Information

- If a Servo Drive with an absolute encoder is used, home is defined when EtherCAT process data communication transitions from the non-established status to the established status.
- If a Servo Drive with an absolute encoder is used, home is defined when the *Enable* input variable to the CNC_Power instruction changes to TRUE.

7-2 Jogging

For jogging, use the CNC instruction CNC_MoveJog (Jog).



Specify the axis to jog with the *Coord* (CNC Coordinate System Variable) and *LogicalMotorNo* (Logical CNC Motor Number) in-out variables.

Change the *PositiveEnable* input variable to TRUE to start the axis with the specified positive *Velocity* (Target Velocity) and *Acceleration* (Acceleration/Deceleration Rate). Change *PositiveEnable* to FALSE to decelerate and stop the axis at the specified *Acceleration* (Acceleration/Deceleration Rate).

Similarly, if you change the *NegativeEnable* input variable to TRUE, the axis will start in the negative direction. Change *NegativeEnable* to FALSE to stop the axis.

You can perform jogging even if the home has not yet been defined.

7-2-1 Jogging Procedure

1 Adding and Setting a CNC Coordinate System and CNC Motors

Add and set a CNC coordinate system and CNC motor from Sysmac Studio.

Refer to *Section 4 CNC Parameters* for details.

2 Setting the CNC Coordinate System and CNC Motor Parameters

Set the CNC coordinate system and CNC motor parameters from Sysmac Studio.

Refer to *Section 4 CNC Parameters* for details.

3 Writing the User Program

Create the user program from Sysmac Studio.

4 Downloading the CNC Coordinate System Parameters, and CNC Motor Parameters, and User Program

Download the CNC coordinate system and CNC motor parameters you have set, and the user program to the CPU Unit.

Use the Synchronization menu command of the Sysmac Studio to download the project to the CPU Unit.

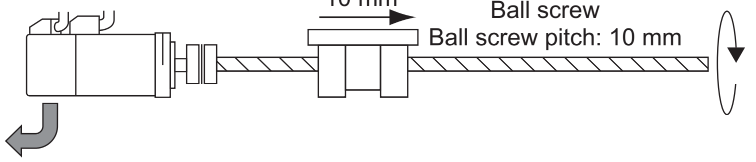
5 Executing the User Program

Execute the user program and change the Enable input variable for CNC_Power to TRUE to change the Servo Drive to the Servo ON state.

Set either the *PositiveEnable* or *NegativeEnable* input variable of the CNC_MoveJog (Jog) instruction to TRUE to start jogging.

7-2-2 Setting CNC Parameters

Set the following CNC parameters if you want to jog when home is not defined. The following setting example is for a one-axis device.



Parameter name	Setting
CNC Motor Variable Name	Motor1*1
CNC Motor Number	1*2
CNC Motor Use	CNC motor in use
Axis Assignment Type	X-axis
Input/Output Device	1*3
Command Pulse Count Per Motor Rotation	8,388,608*4
Travel Distance Per Work Rotation	10*4
Unit of Display	mm
Maximum Velocity	30,000*5
Maximum Acceleration/Deceleration Rate	5,000*6

*1. If there is more than one axis, a different variable name is set for each CNC motor.
*2. If there is more than one axis, a different value is set for each CNC motor.
*3. Set the node address to the same value as the node address that is set on the Servo Drive. If there is more than one axis, a different value is set for each CNC motor.
*4. The position command unit is 1 (mm).
*5. The maximum velocity will be 3,000 r/min = 30 m/min =30,000 mm/min.
*6. The maximum acceleration/deceleration rate is 5000mm/s^2. The acceleration time to the maximum velocity (3,000 r/min) is 0.1s.

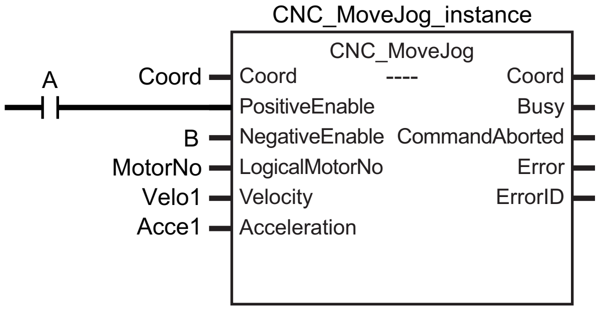
7-2-3 Input Variable Setting Example

This section describes the settings for *Velocity* (Target Velocity) and *Acceleration* (Acceleration/Deceleration Rate) input variables of the CNC_MoveJog (Jog) instruction.

- For example, set *Velocity* to 6000 to jog at a velocity of 6,000 mm/min.
- Set *Acceleration* to 500 to accelerate and decelerate at 0.5 m/s^2.

7-2-4 Programming Example

The following programming example jogs a CNC motor named Motor1 in the positive direction for the value of bit A and in the negative direction for the value of bit B.



At this time, *MotorNo* (Logical CNC Motor Number) is the logical motor number that indicates Motor1, *Velocity* (Target Velocity) is Velo1, and *Acceleration* (Acceleration/Deceleration Rate) is Acce1.

Set the values for each variable in the user program in advance to operate the axis with the example input variable settings.

- Coord=CNC_Coord000
- MotorNo = 0
- Velo1 = 1000
- Acce1 = 500

Refer to *CNC_MoveJog* on page 12-83 for details on the CNC_MoveJog (Jog) instruction.

8

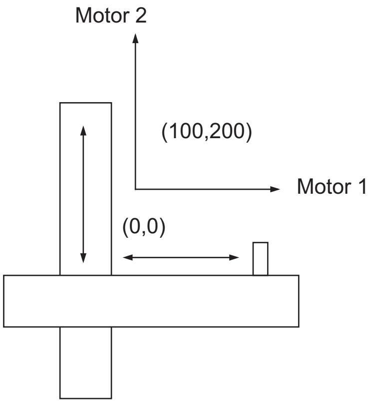
Homing

This section describes homing.

8-1 Outline

To perform positioning to absolute positions in a positioning system, you first need to define the home.

For example, if you want to position at (Motor 1, Motor 2) = (100 mm, 200 mm) on the XY stage shown below, you must define the home position (0, 0). The process of defining home is called homing.



In the CNC Function Module, use the CNC instruction CNC_Home (Home) or CNC_HomeWithParameter (Home with Parameters) to define home.

Additional Information

- If a Servo Drive with an absolute encoder is used, home is defined when EtherCAT process data communication transitions from the non-established status to the established status.
- If a Servo Drive with an absolute encoder is used, home is defined when the *Enable* input variable to the CNC_Power instruction changes to TRUE.
- No NC program can be executed when the home is not defined.
- The software limit function is disabled when the home is not defined.

8-2 Homing Procedure

This section describes the procedure to perform homing.

1 Adding and Setting a CNC Coordinate System and CNC Motor

Add and set a CNC motor and a CNC coordinate system from the Sysmac Studio.

2 Setting CNC Motor Parameters

Set the homing method with the homing parameters.

3 Writing the User Program

Create the user program from Sysmac Studio.

4 Downloading the CNC Parameters and the User Program

Download the CNC motor parameters and CNC coordinate system parameters you have set, and the user program to the NC Integrated Controller.

Use the Synchronization menu command of Sysmac Studio to download the project to the NC Integrated Controller.

5 Executing the User Program

Execute the user program and change the *Enable* input variable for CNC_Power instruction to TRUE to change the Servo Drive to the Servo ON state.

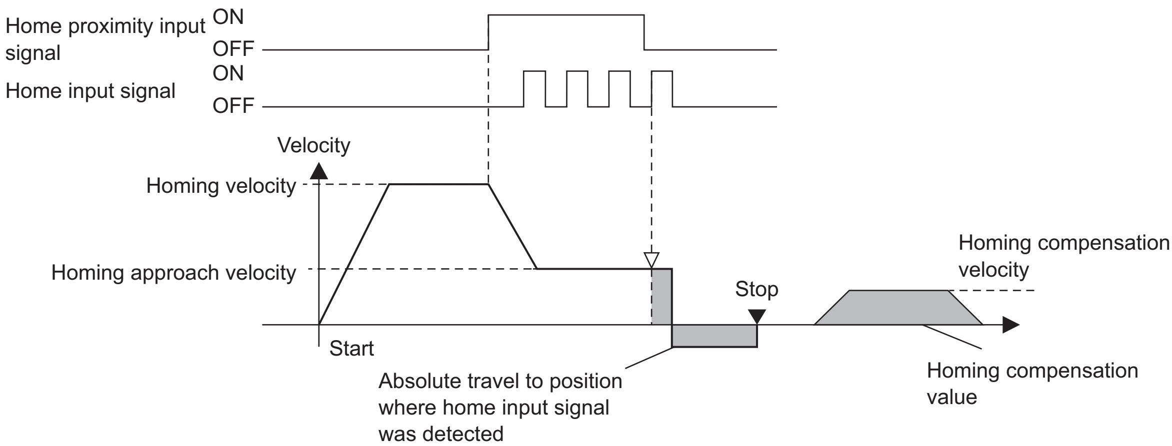
Homing is performed when the *Execute* input variable of the CNC_Home instruction changes to TRUE.

8-2-1 Setting Homing Parameters

Set the homing parameters to specify the homing procedure.

Set the homing parameters from Sysmac Studio.

Setting	Description
Homing Operation Mode	Select a homing method.
Home Input Signal	Select the input to use for the home input signal.
Homing Start Direction	Set the start direction for when homing is started.
Home Input Detection Direction	Set the home input detection direction for homing.
Operation Selection at Positive Limit Input	Set the stopping method when the positive limit input turns ON during homing.
Operation Selection at Negative Limit Input	Set the stopping method when the negative limit input turns ON during homing.
Homing Velocity	Set the homing velocity. (Unit: command units/min)
Homing Approach Velocity	Set the velocity to use after the home proximity input turns ON. (Unit: command units/min)
Homing Acceleration/Deceleration	Specify the acceleration and deceleration rates for homing. If the homing acceleration is set to 0, the homing velocity is reached without any acceleration. (Unit: command units/s^2)
Home Input Mask Distance	Set the home input mask distance to be applied when the homing operation mode is set to the proximity reverse turn/home input mask distance. (Unit: command units)
Home Offset	Preset the actual position for the value that is set after homing. (Unit: command units)
Homing Holding Time	Set the holding time when you set the homing operation mode to the proximity reverse turn/holding time. (Unit: ms)
Homing Compensation Value	Set the homing compensation value that is applied after the home is defined. (Unit: command units)
Homing Compensation Velocity	Set the velocity to use for homing compensation. (Unit: command units/min)



The homing parameters are described individually below.

Homing Operation Mode

You can select any of the ten operations to define home.

- Proximity reverse turn/home proximity input OFF
- Proximity reverse turn/home proximity input ON
- Home proximity input OFF
- Home proximity input ON
- Limit input OFF
- Proximity reverse turn/home input mask distance
- Limit inputs only
- Proximity reverse turn/holding time
- No home proximity input/holding home input
- Zero position preset

The following table shows the homing parameters that are used for each Homing Operation Mode.

(Yes: Parameter is used, No: Parameter is not used.)

	Homing parameters												
Homing Operation Mode	Home Input Signal	Homing Start Direction	Home Input Detection Direction	Operation Selection at Positive Limit Input	Operation Selection at Negative Limit Input	Homing Velocity	Homing Approach Velocity	Homing Acceleration/Deceleration	Home Input Mask Distance	Home Offset	Homing Holding Time	Homing Compensation Value	Homing Compensation Velocity
Proximity reverse turn/home proximity input OFF	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes
Proximity reverse turn/home proximity input ON	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes
Home proximity input OFF	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes
Home proximity input ON	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes
Limit input OFF	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes
Proximity reverse turn/home input mask distance	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Limit inputs only	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes
Proximity reverse turn/holding time	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
No home proximity input/holding home input	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes
Zero position preset	No	No	No	No	No	No	No	No	No	Yes	No	No	No

Homing Input Signal

In a Homing Operation Mode that uses the home input signal, select either the Z-phase signal of the Servo Drive or an external home signal as the signal to define the home.

Precautions for Correct Use

This parameter can be used to set a home input signal only when an OMRON 1S-series Servo Drive or G5-series Servo Drive is connected.

Homing Start Direction

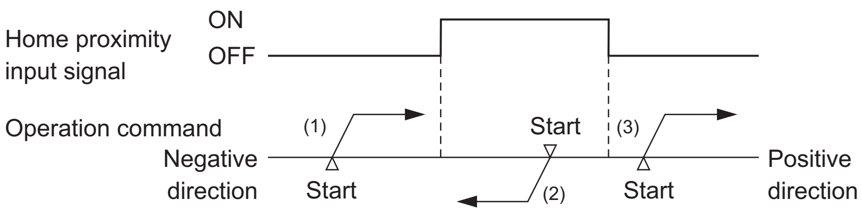
Select the direction (positive or negative) in which the axis starts moving when homing is started.

If homing starts while the home proximity signal is ON in a Homing Operation Mode that includes reversal operation for a proximity reverse turn, the axis starts motion in the direction opposite to the home input detection direction (regardless of the setting of the homing start direction).

There are four Homing Operation Modes that include reversal operation for a proximity reverse turn. These are listed below.

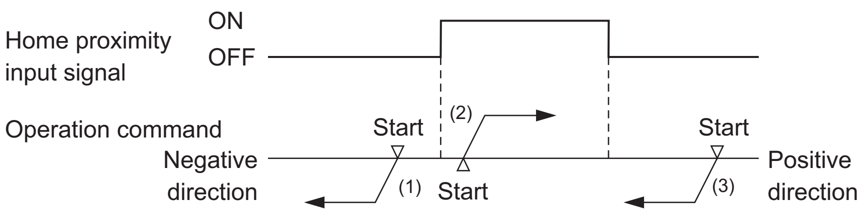
- 0: Proximity reverse turn/home proximity input OFF
- 1: Proximity reverse turn/home proximity input ON
- 9: Proximity reverse turn/home input mask distance
- 12: Proximity reverse turn/holding time

Homing start direction: Positive
Home input detection direction: Positive



(1), (3): The home proximity signal is OFF, so the axis starts moving in the homing start direction.
(2): The home proximity signal is ON, so the axis starts moving in the direction opposite to the home input detection direction.

Homing start direction: Negative
Home input detection direction: Negative



(1), (3): The home proximity signal is OFF, so the axis starts moving in the homing start direction.
(2): The home proximity signal is ON, so the axis starts moving in the direction opposite to the home input detection direction.

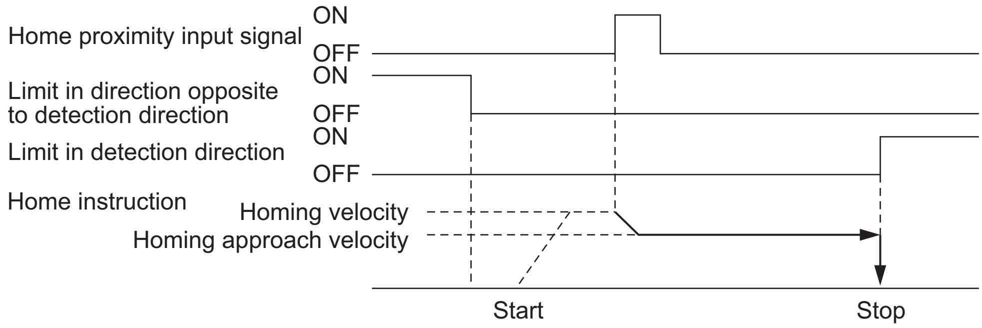
Home Input Detection Direction

Select the direction (positive or negative) in which to detect home.

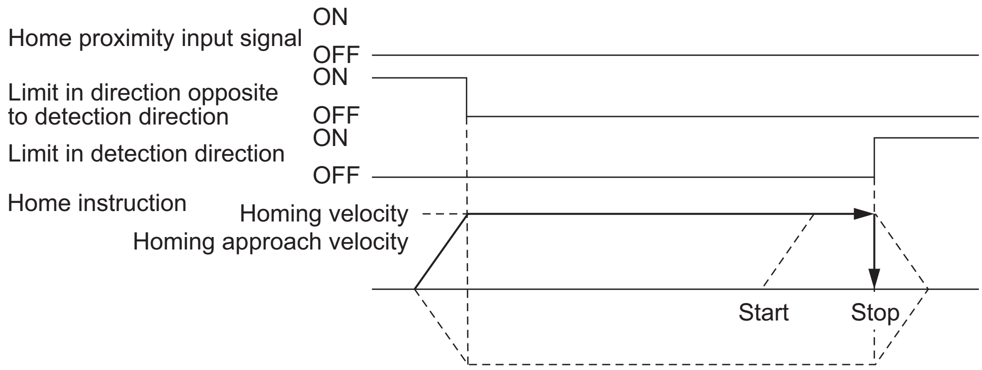
Refer to *Homing Start Direction* on page 8-6 for the relationship between the home detection method and the initial direction in which the machine moves when homing starts.

Operation Selection at Positive Limit Input and Operation Selection at Negative Limit Input

- Select the operation when the axis reaches a limit input in the operating direction during homing: reverse the axis and continue with homing, or do not reverse the axis, create an error, and stop the axis. When you have decided to reverse the direction, also select the method to stop the motor.
- When the motor is set to reverse the direction, an error occurs and the motor stops if the limit signal in the home input detection direction turns ON while the motor travels at the homing approach velocity. However, if the Homing Operation Mode is 13: no home proximity input/holding home input, which does not use proximity signals, no error will occur and the axis will not stop.



When the limit input operations for both directions are set to reverse the directions, an error occurs and the motor stops if home cannot be detected even after the motor moves from one limit input of the home detection direction to the other limit input of the opposite direction.



Homing Velocity

Set the homing velocity in command units/min.

Homing Approach Velocity

Set the velocity after the home proximity input turns ON in command units/min.

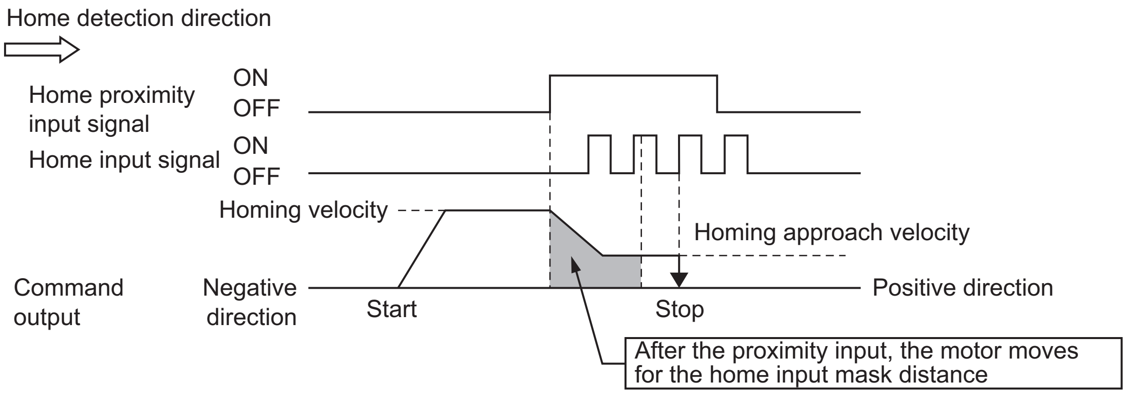
Homing Acceleration/Deceleration

Set the homing acceleration and deceleration rates in command units/s^2.

If the homing acceleration and deceleration rates is set to 0, the homing velocity and other target velocities are reached without any acceleration.

Homing Input Mask Distance

Set the home input mask distance in command units when you set the homing operation mode to 9: proximity reverse turn/home input mask distance. This is the distance from the position at which the home proximity input signal is set to OFF to the position at which the home proximity input signal is set to ON to start deceleration.



Home Offset

When the home is defined and the homing compensation value is set, the current value is preset to the specified value after the homing compensation operation is completed.

This function is used when you set home to any specified value rather than to 0.

For systems with absolute encoders, the absolute encoder home offset value is calculated automatically and saved in the battery-backup memory in the NC Integrated Controller.

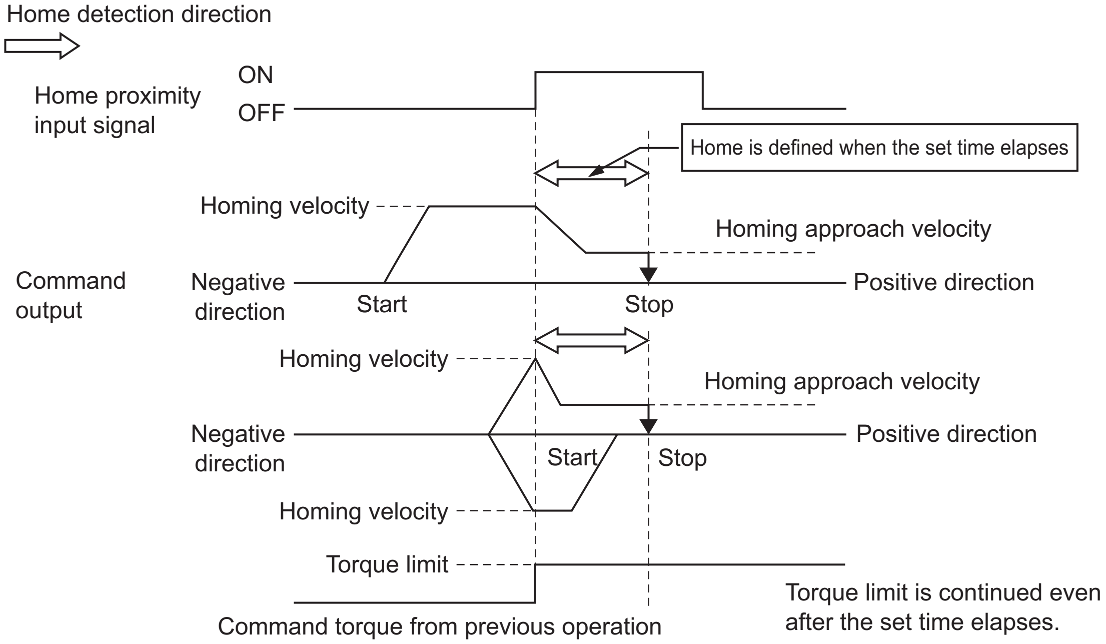
Additional Information

If the target position of the Home Offset overflows or underflows, a Target Position Setting Out of Range (5607 0000 hex) error is output.

Homing Holding Time

Set the holding time in milliseconds to be applied when you set the homing operation mode to 12: proximity reverse turn/holding time.

This is the period from the time when the home proximity input signal is set to OFF to the time when the home proximity input signal is set to ON to start deceleration.



Homing Compensation Value

After home is defined, relative positioning is performed at the set value to adjust the position of home. This homing compensation is performed at the homing compensation velocity.

Adjusting the workpiece is sometimes difficult after home is defined. The homing compensation can be used to fine-tune the position of home after it is first determined.

This is useful when you cannot easily replace the home proximity sensor or when home has moved after a motor replacement.

Additional Information

If the target position of the homing compensation value overflows or underflows, a Target Position Setting Out of Range (5607 0000 hex) error is output.

Homing Compensation Velocity

If you set a homing compensation value, set the velocity to use for the compensation in command units/min.

8-2-2 Monitoring the Homing Operation

You can read CNC motor variables from the user program to monitor the homing status and the input signal status.

Variable name	Data type	Name	Function
_CNC_Coord[*].Status.Moving	BOOL	CNC Coordinate System Moving	TRUE when homing for the CNC_Home or CNC_HomeWithParameter instruction is in progress.
_CNC_Motor[*].Details.Homed	BOOL	Home Defined	TRUE when the home is defined. FALSE: Home is not defined. TRUE: Home is defined.
_CNC_Motor[*].DrvStatus.P_OT	BOOL	Positive Limit Input	TRUE when the positive limit input is enabled.
_CNC_Motor[*].DrvStatus.N_OT	BOOL	Negative Limit Input	TRUE when the negative limit input is enabled.
_CNC_Motor[*].DrvStatus.HomeSw	BOOL	Home Proximity Input	TRUE when the home proximity input is enabled.

8-3 Homing Operation

Select the home definition method based on the configuration of the positioning system and its purpose.

There are ten homing operation modes supported by the CNC Function Module.

You can also fine-tune the home that was once determined with a homing compensation value.

Additional Information

- The most suitable mode depends on the configuration of the positioning system and the application.

  Proximity reverse turn /home proximity input OFF is normally used for a machine that is equipped with home proximity sensor, positive limit input, and negative limit input.
- The in-position check will follow the in-position check settings only for the completion of the home definition and homing compensation motions.

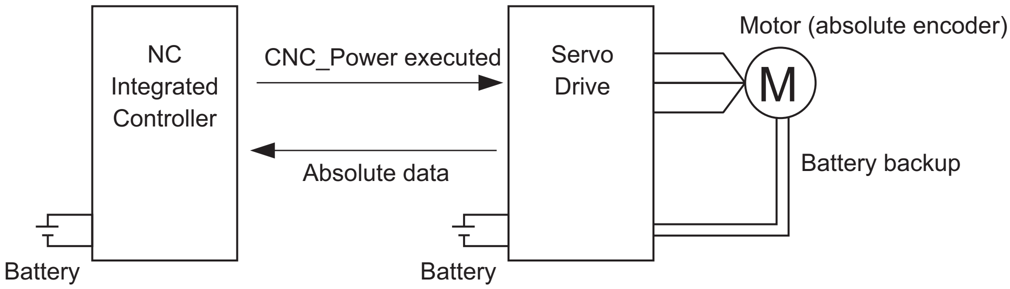
Refer to *CNC Instructions* on page 10-1 for details on homing.

8-4 Homing with an Absolute Encoder

This section describes how to use an OMRON 1S-series Servomotor/Servo Drive with built-in EtherCAT communications.

If you use an absolute encoder, the absolute data can be retained by the battery backup function of the encoder even when the power supply to the NC Integrated Controller is turned OFF. When you execute the CNC_Power (Power Servo) instruction or an EtherCAT communication is established, the position is determined by reading the actual position from the absolute encoder.

Unlike the case where an incremental encoder is used, once the home is defined, you do not need to perform the homing operation again.



Precautions for Correct Use

- When using the NJ-series NC Integrated Controller with an OMRON 1S-series Servo Drive, connect the NC Integrated Controller battery to the Servo Drive.
- If you use an absolute encoder in combination with the NJ-series NC Integrated Controller and OMRON G5-series Servo Drive, connect each of the CNC Controller battery and the backup battery of the absolute encoder for the Servo Drive.
- Always execute the CNC_Home or CNC_HomeWithParameter instruction to define home when you use the absolute encoder for the first time, after you replace the motor, when you use an OMRON G5-series Servo Drive, when the battery in the absolute encoder expires, or at any other time when the absolute value data is lost.
- If there is an error for the battery of the NC Integrated Controller, when the power supply to the NC Integrated Controller is turned ON, an Absolute Encoder Home Offset Read Error (event code: 1781 0000 hex) occurs. In this case, you can use the ResetCNCError (Reset CNC Error) instruction to reset the error and turn the Servo Drive ON.

Additional Information

If you use an OMRON G5-series Linear Motor Type Servomotor/Servo Drive with built-in EtherCAT communications, you can set the absolute encoder home position. If you use a Linear Motor Type, observe the followings points when reading this section.

- A Linear Motor Type does not use an encoder. It uses an external scale, which functions in a similar way.
- "Absolute encoder" in this section can be read as an absolute external scale.
- An absolute external scale does not have the rotation data of an absolute encoder. Any rotation data setting procedures that are required for an absolute encoder are not required. A battery to back up the rotation data is also not required.
- Refer to the *AC Servomotors/Servo Drives G5-series with Built-in EtherCATR® Communications Linear Motor Type User's Manual* (Cat. No. I577) for the specification of Linear Motor Type.

8-4-1 Outline of Functions

To define the home of an absolute encoder system, absolute encoder offset compensation is performed when the CNC_Power (Power Servo) instruction is executed or when EtherCAT process data communications changes from non-established to established state.

The home can be defined by performing the homing operation in the same way as for an incremental encoder. After the home has been defined, the difference between the commanded position and the absolute value data read from the absolute encoder is saved to **Absolute Encoder Home Offset** in the battery-backup memory of the NC Integrated Controller as an offset.

When the actual position is preset with the CNC_Home (Home) or CNC_HomeWithParameter (Home with Parameters) instruction, the difference between the commanded position and absolute value data after home is defined is also saved to **Absolute Encoder Home Offset** as an offset.

The CNC Function Module saves **Absolute Encoder Home Offset** in the battery-backup memory inside the NC Integrated Controller when the power supply is interrupted. For the NY-series Controllers, it is saved to the non-volatile memory.

Precautions for Correct Use

- When you replace the NC Integrated Controller or the battery of the NC Integrated Controller, be sure to back up **Absolute Encoder Home Offset** with the home defined before you start the replacement procedure.
- When absolute encoders are used, the **Absolute Encoder Home Offset** for each CNC motor is saved to the battery-backup memory along with the CNC motor number. For the NY-series Controllers, it is saved to the non-volatile memory. If the CNC motor number is changed, the saved offset will be lost. If you change the CNC motor number, set the Homing Settings again.
- By restoring the backup data after the replacement has been completed, you can use the home defined before the replacement was carried out.
- To back up or restore data, use Sysmac Studio. Refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for details on the operation procedure.

8-4-2 Setting Procedure

This section describes the procedure to set the home of an absolute encoder system.

1 Setting the Absolute Encoder

Refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for the setup procedures.

2 Setting the CNC Motor Parameters

Select **1: Absolute encoder** for **Encoder Type** of **Position Count Parameters** in the CNC motor parameter of the CNC Function Module. Refer to *4-4-7 Position Count Settings* on page 4-32 for details.

3 Executing Homing

Set the **Homing Operation Mode** in **Homing Settings** in the CNC motor parameter of the CNC Function Module.

After home is defined, the difference between the command position and the absolute value data read from the absolute encoder is saved to **Absolute Encoder Home Offset** in the battery-backup memory when the power supply is interrupted.

Absolute Encoder Setup

The absolute encoder must be set up when it is used for the first time, when you want to initialize the rotation data to 0, when the absolute encoder is left for an extended period of time without the battery connected, or in other cases.

Refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for details on the setup procedures.

Precautions for Correct Use

After the absolute encoder is set up, the power supply to the OMRON 1S-series Servo Drive or G5-series Servo Drive must be cycled. When setup processing for the absolute encoder is completed, an Absolute Value Clear Error (A27.1) will occur in the Servo Drive. Cycle the control power supply to the Servo Drive to clear this error and complete the absolute encoder setup procedure.

9

Control Functions for CNC Motor and CNC Coordinate System Operations

This section describes the control functions for CNC motor and CNC coordinate system operations.

9-1 CNC Motor Position Control

Position control can be used for the CNC motor assigned to a logical axis. Position control and velocity control can be used for the CNC motor assigned to the spindle axis.

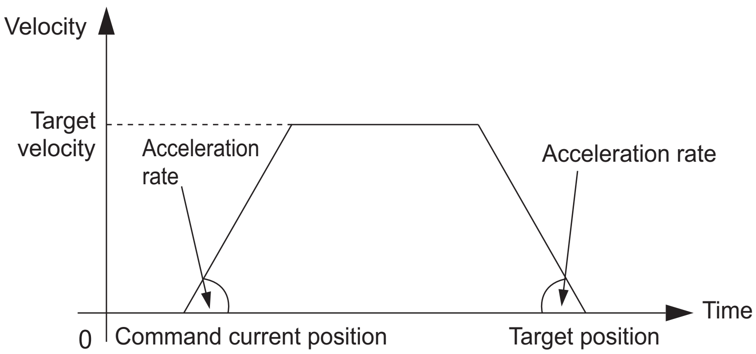
This section describes CNC motor positioning operations.

9-1-1 Outline of Operations

The CNC motor control function of the CNC Function Module supports the PTP operation, manual operations such as jogging, and the homing operation.

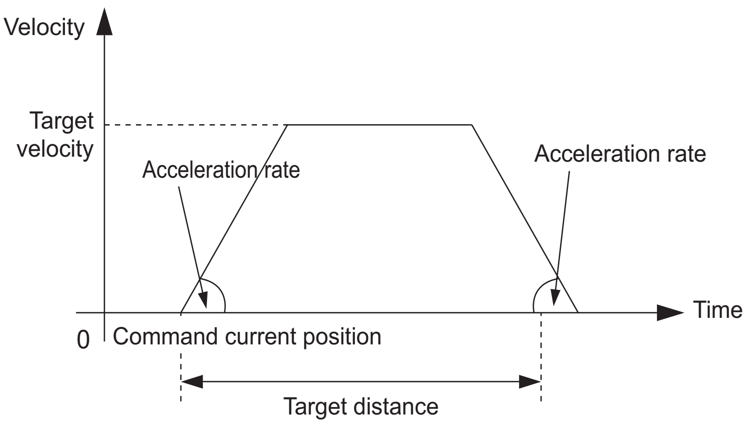
9-1-2 Absolute Positioning

Absolute positioning specifies the absolute coordinates of the target position in relation to home.



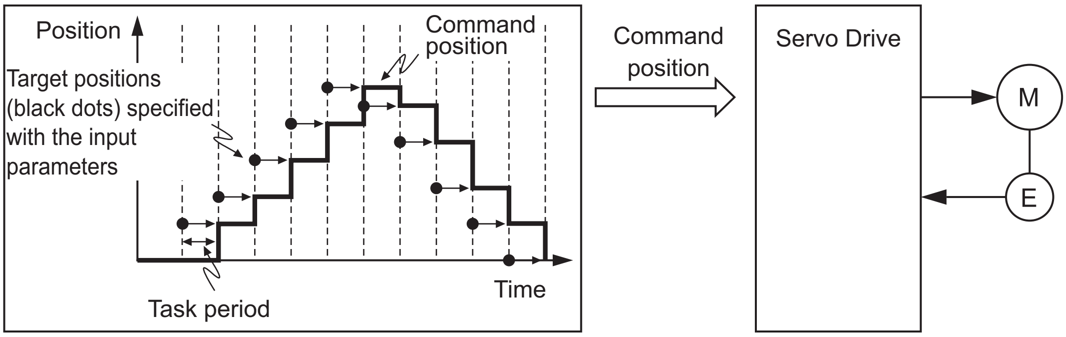
9-1-3 Relative Positioning

Relative positioning specifies the distance from the actual position.



9-1-4 Cyclic Synchronous Positioning

Cyclic synchronous positioning is used to output a target position to a specified CNC coordinate system in each task period. The target position is specified as an absolute position. This function is used to perform MPG feeding and other operations.



9-1-5 Stopping

Functions to stop CNC motor operation include immediate stop input signal and limit input signals connected to the Servo Drive, stop functions of CNC instructions in the user program, and stopping due to errors.

Stopping for Servo Drive Input Signals

CNC motor motion is stopped for the immediate stop input signal or a limit input signal from the Servo Drive.

You can select the stop method with the Sysmac Studio.

● Immediate Stop Input

Stop processing in the CNC Function Module is executed according to the state of the Servo Drive input signals. You can select one of the following stopping methods for the CNC Function Module.

- Immediate stop
- Immediate stop and error counter reset
- Immediate stop and Servo OFF

Precautions for Correct Use

The immediate stop input for the OMRON 1S-series Servo Drive or G5-series Servo Drive also causes an error and executes stop processes in the Servo Drive itself.

Limit Input (Positive Limit Input or Negative Limit Input)

Stop processing in the CNC Function Module is executed according to the state of the Servo Drive input signals.

The CNC motor stop method can be selected from the following based on the Limit Input Stop Method of the CNC motor.

- Immediate stop
- Immediate Stop and Servo OFF

Other CNC motors of the CNC coordinate system stop immediately.

Precautions for Correct Use

If a limit input signal turns ON, do not execute an instruction for CNC coordinate system command in the same direction as the limit input signal.

Stopping for a CNC Instruction

For information about stopping for a CNC instruction, refer to *CNC_CoordStop* on page 12-68, *CNC_CoordImmediateStop* on page 12-72, and *CNC_CoordHalt* on page 12-76 in *Section 12 CNC Coordinate System Instructions*.

Stopping Due to Errors or Other Problems

Stopping for Errors during CNC Motor Operation

When an error occurs during a CNC motor operation, the motor will stop immediately depending on the error.

Stopping for a Software Limit

When **Software Overtravel Limit Operation Control** is set to *0: An error occurs* and the software limit is judged to be exceeded during execution of an NC program, each CNC motor stops immediately. In other cases, adjust the path or target position so that the software limit is not exceeded.

Errors That Cause the Servo to Turn OFF

An immediate stop is performed if an error occurs that causes the Servo to turn OFF. The operation of Servo Drive during Servo OFF state depends on the settings in the Servo Drive.

While an NC program is running, all other CNC motors in the CNC coordinate system will decelerate to stop at their maximum deceleration rate. In other cases, the other CNC motors are not affected.

● Stopping Due to Change in the NC Integrated Controller Mode

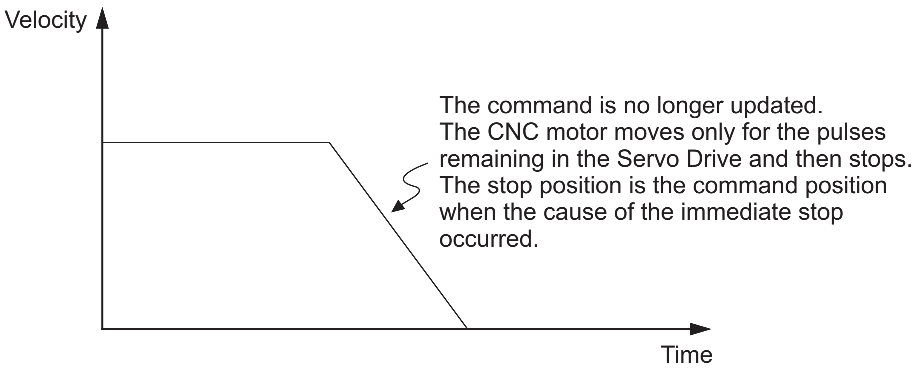
All CNC motors will immediately stop if the NC Integrated Controller operating mode changes.

Additional Information

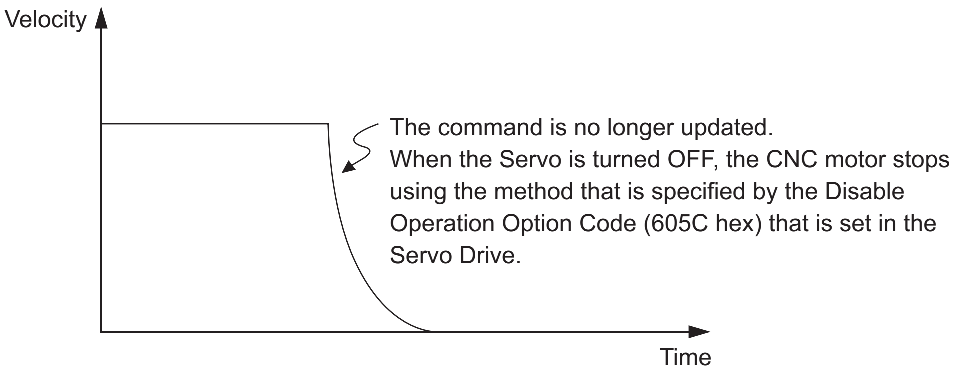
- When RUN mode changes to PROGRAM mode, any CNC instructions that are currently in execution are aborted. *CommandAborted* output variable from the instructions remains FALSE. The Servo ON/OFF status is maintained after the mode has been switched to the PROGRAM mode.
- If the operating mode returns to RUN mode while a immediate stop is in progress after the operating mode changes from RUN to PROGRAM mode, the output variables from CNC instructions are cleared. The *CommandAborted* output variables from the CNC instructions therefore remain FALSE.

Stop Methods

● Immediate Stop



● Immediate Stop and Servo OFF



Stop Priorities

The priorities for each stop method are listed in the following table. If a stop with a higher priority stop method occurs while stopping, the stop method will switch to the higher priority method.

Stop method	Priority (higher numbers mean higher priority)
Immediate stop and Servo OFF	3
Immediate stop and error counter reset	2
Immediate stop	1

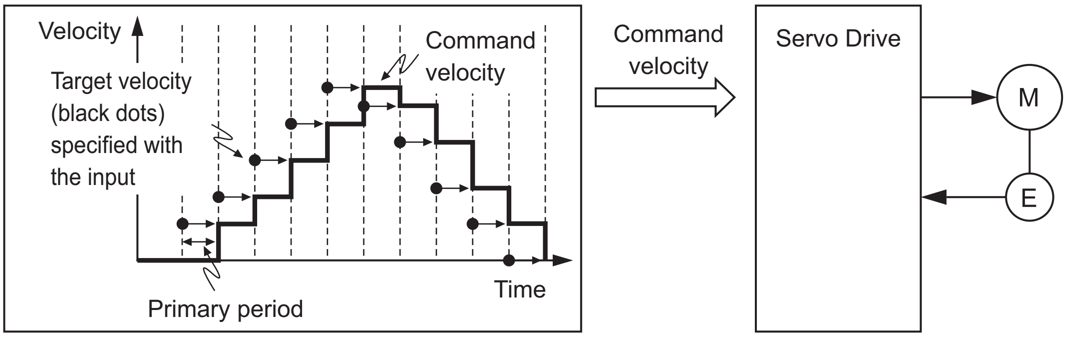
9-2 CNC Motor Velocity Control

Velocity control can be used for the CNC motor assigned to the spindle axis.

This section describes the CNC motor velocity control functions.

9-2-1 Cyclic Velocity Control

The control mode of the Servo Drive is set to Velocity Control Mode and a command speed is output every control period.

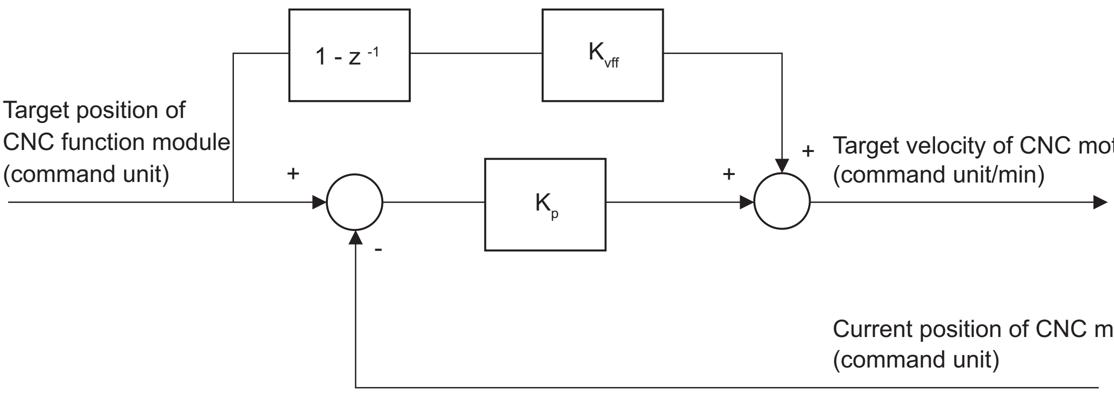


Additional Information

The open loop control is set during velocity control processing.

9-2-2 Position Loop by Cyclic Velocity Control

The CNC Function Module controls the spindle axis using the velocity command. However, the positioning is required for some spindle functions. Therefore, the CNC Function Module has a position loop for each CNC motor that is assigned to the spindle axis. To adjust the responsiveness of the position loop, you can set the Position Loop Gain (K_p) and Velocity Feedforward Gain (K_vff) parameters.



Precautions for Safe Use

- Before adjusting this parameter, use the following methods to control the spindle in open-loop and adjust the gain on the spindle driver to ensure normal operation.
  - CNC_SpindleGo
  - Spindle CW (M03)
  - Spindle CCW (M04)
- When adjusting the gain, take sufficient measures to ensure safety.
- If oscillation (abnormal noise or vibration) occurs, immediately turn OFF the power to the Drive or turn the Servo OFF.

Position Loop Gain

The Position Loop Gain (K_p) parameter gives the main gain for servo loop, and it provides control outputs that are proportional to the position error (i.e. difference between the command position and the current position) of the CNC motor.

Velocity Feedforward Gain

Velocity Feedforward Gain K_vff adds the control amount that is proportional to the command velocity of the CNC motor to the control output. This parameter is used to reduce following errors caused by physical damping effects.

If you need adjustments using this parameter, make sure that both adjustments of spindle driver and position loop gain are completed. Increase the setting value gradually from zero. Overshooting will increase if an excessively large value is set at once.

9-3 Common Functions for CNC Motor Control

This section describes the common functions of CNC motor control.

9-3-1 Positions

Types of Positions

The CNC Function Module uses the following two types of positions.

Type of position	Definition
Command position	This is the command position of the CNC motor.
Feedback current position	This is the feedback position of the CNC motor.

Position Parameters

Parameter name	Function	Setting range	Default
In-position Range*1	Set the in-position width.*2 (Unit: motor command units) When the value is set to 0, positioning is completed when the positioning command is completed.	0 or larger single-precision real value	10
In-position Check Time*3	While a CNC instruction is executed, an error occurs if CNC motors for all of the positioning axes in the coordinate system are not in-positioned within this time period at the completion of the travel command. Set this check time in milliseconds.*4 However, the in-position check is not performed for the blending operation. The in-position check is also not performed if 0 is set. (Unit: ms)	0 to 10,000	0
Software Overtravel Limit*5	Set the operation when the software overtravel limit of the CNC motor is reached while the CNC coordinate system is operating. 0: An error occurs. Each CNC motor stops immediately. 1: No error occurs. The commanded position of the CNC motor is limited by software overtravel limit, and the operation continues without observing the path.	0 or 1	0
Positive Software Overtravel Limit	Set the software overtravel limit in the positive direction. (Unit: motor command units)	Positive single-precision reals	10,000

Parameter name	Function	Setting range	Default
Negative Software Overtravel Limit	Set the software overtravel limit in the negative direction. (Unit: motor command units)	Negative single-precision reals	-10,000
Following Error Over Value	Set the excessive following error check value. Set 0 to disable the excessive following error check. (Unit: motor command units)	Positive single-precision reals or 0	0
Following Error Warning Value	Set the following error warning check value. Set 0 to disable the following error warning check. (Unit: motor command units)	Positive single-precision reals or 0	0

*1. The in-position check is processed by the CNC Function Module. The function in the Servo Drive is not used.

*2. The maximum value that you can set for the in-position range is 1,099,511,627,775 pulses, a value converted into long reals, then into pulses.

*3. Set a value larger than the number of in-position check continuance cycle of the positioning axis composition CNC motor.
Example: Suppose that the control cycle time of a primary periodic task is 2 milliseconds, and that the largest value of the in-position check continuance cycle for the composition CNC motor is 100 control periods. Then the in-position check time must be set to a value larger than 200 milliseconds.

*4. The result of an in-position check of the CNC coordinate system is determined with the CNC Planner Service. Actually, therefore, the accuracy of the in-position check time is rounded down to the unit of the CNC Planner Service period. If the in-position check time is smaller than the CNC Planner Service period, it becomes 0 after being rounded down and the in-position check is not executed.

Example: Suppose that the in-position check time is 6 milliseconds and that the CNC Planner Service period is 4 milliseconds. Then normal operation is performed when the in-position check for all of the positioning axis CNC motors is completed within one period (4 milliseconds) of the CNC Planner Service that has actually finished the travel command. An error occurs if it takes longer than this period.

*5. This function is enabled only when the home has been determined.

Monitoring Positions

You can read CNC Motor variables in the user program to monitor positions.

Variable name	Data type	Name	Function
_CNC_Motor[*].Cmd.Pos	LREAL	Command Current Position	This is the current value of the command position. When the Servo is OFF and the mode is not the position control mode, the feedback current position is output.
_CNC_Motor[*].Act.Pos	LREAL	Feedback Current Position	This is the feedback current position.

Count Mode

The count mode is the linear mode that has a finite axis feed range. The linear mode has the following features:

- The linear mode is centered around 0.
- When the CNC motor is assigned to the feed axis, the range is set using a 40-bit signed integer (0x8000000000 to 7FFFFFFFFF) after pulse unit conversion has been completed.
- If the CNC motor is assigned to the spindle axis, the range when the value is converted to pulses is 54-bit signed integer ($-2^{53} \leq$ Position $< +2^{53} - 1$).
- For positioning that specifies target positions, such as relative and absolute positioning, you cannot assign targets that exceed the specified range.
- A Command Position Overflow/Underflow observation will occur if the specified range is exceeded. Command position outputs will continue, but the actual position is not updated and is fixed to either the upper limit or the lower limit.
- In a state where the current position is fixed, positioning used to specify the target position can be executed when a position within the operating range is specified (CNC_Move, CNC_SyncMoveAbsolute). Any operation that does not specify the target position can be performed when a direction within the operating range is specified (CNC_MoveJog). Any command that specifies a direction away from the range will cause an error on execution of the instruction. (CNC_Move, CNC_SyncMoveAbsolute, CNC_MoveJog)
- During home definition, velocity control, and stop operation, the status in which the value of the current position is fixed is not determined as an error. (CNC_HomeWithParameter, CNC_Home, CNC_SpindleGo, CNC_CoordHalt, CNC_CoordImmediateStop, CNC_CoordStop)
- During multi-axis coordinated control operation (execution control of NC program), the status in which the current position is fixed is determined as an error when an instruction is executed regardless of the direction. Note that a spindle axis is not included in axes that perform the coordinated operation. (CNC_CoordControl)
- The current position is not updated until a command position overflow or underflow observation status is cleared.

9-3-2 Velocity

Types of Velocities

The CNC Function Module uses the following two types of velocities.

Type of velocity	Definition
Command velocity	This is the velocity that the CNC Function Module outputs to control a CNC motor.
Feedback velocity	This is the velocity calculated in the CNC Function Module based on the feedback position that is input from the Servo Drive or counter.

Velocity Unit

A velocity is given in command units/min. The command unit is the value obtained from unit conversion of the position display unit and the electronic gear.

Parameters That Are Related to Velocities

Refer to *4-4-4 Operation Settings* on page 4-29.

Monitoring Velocities

You can read CNC Motor Variables in the user program to monitor velocities.

Variable name	Data type	Name	Function
_CNC_Motor[*].Cmd.Vel	LREAL	Command Current Velocity	This is the current value of the command velocity. A plus sign is added during travel in the positive direction, and a minus sign is added during travel in the negative direction.
_CNC_Motor[*].Act.Vel	LREAL	Feedback Current Velocity	This is the feedback current velocity. A plus sign is added during travel in the positive direction, and a minus sign is added during travel in the negative direction.

9-3-3 Acceleration Control

The acceleration and deceleration characteristics at the CNC motor position control are determined by the acceleration/deceleration rate settings.

Acceleration/Deceleration Rate Control

Specify the acceleration/deceleration rate in motor command units/s^2. The target velocity does not determine acceleration/deceleration rate. The required acceleration/deceleration time also differs for some target velocities. The target velocity may not be reached with some combination of specifications for travel distance, target velocity, and acceleration/deceleration rate.

Acceleration Parameters

Refer to *4-4-4 Operation Settings* on page 4-29.

9-3-4 Gantry Control

Gantry control is a special control function for the gantry system.

The CNC motor that is set to the slave axis for the gantry axis in the *Gantry Settings* of the CNC motor settings is called a gantry slave axis. In addition, the CNC motor specified at *CNC Motor Number for Gantry Master Axis* is called a gantry master axis.

The gantry slave axis automatically follows the command position of the gantry master axis. This makes it easier to realize the gantry system only by specifying absolute positioning, jog operation and linear interpolation for the gantry master axis.

CNC_Power (Power Servo), CNC_Write (Write CNC Setting), and CNC_Read (Read CNC Setting) are the only CNC instructions that can be issued to the gantry slave axis individually.

If you instruct CNC_Move (Positioning), CNC_MoveJog (Jog), CNC_SyncMoveAbsolute (Cyclic Synchronous Absolute Positioning), CNC_Home (Home), or CNC_HomeWithParameter (Home with Parameters) for the gantry slave axis, the *Unassigned Logical CNC Motor Number Specified* (5605 0000 hex) will occur.

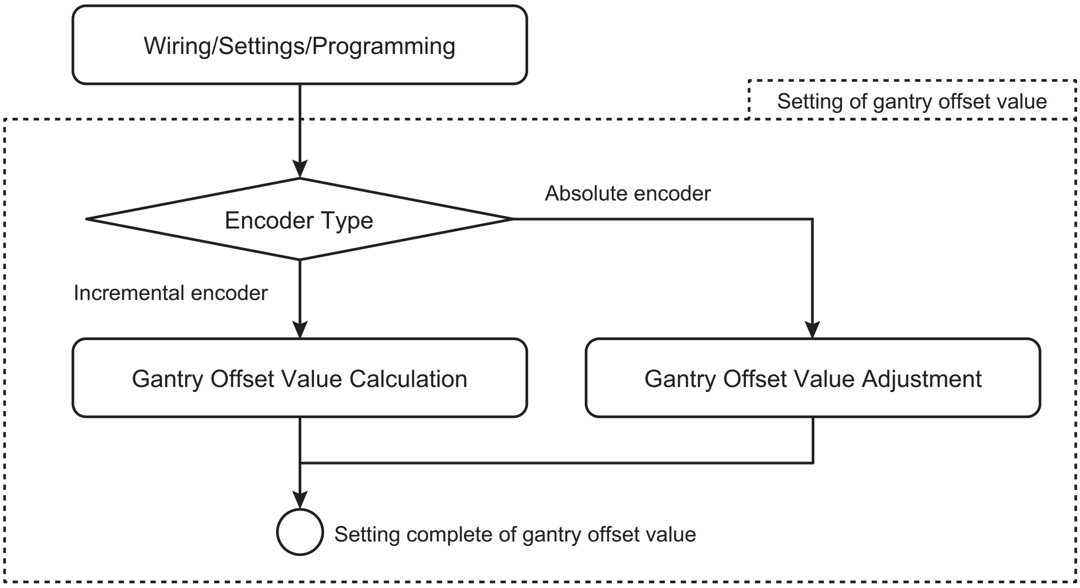
Other than a function that follows a command position, the gantry control also has the following functions to control the gantry system:

- Gantry offset
- Gantry homing
- Alignment compensation
- Gantry monitor function

The initial setup and start for devices that have a gantry system are implemented by the following procedure.

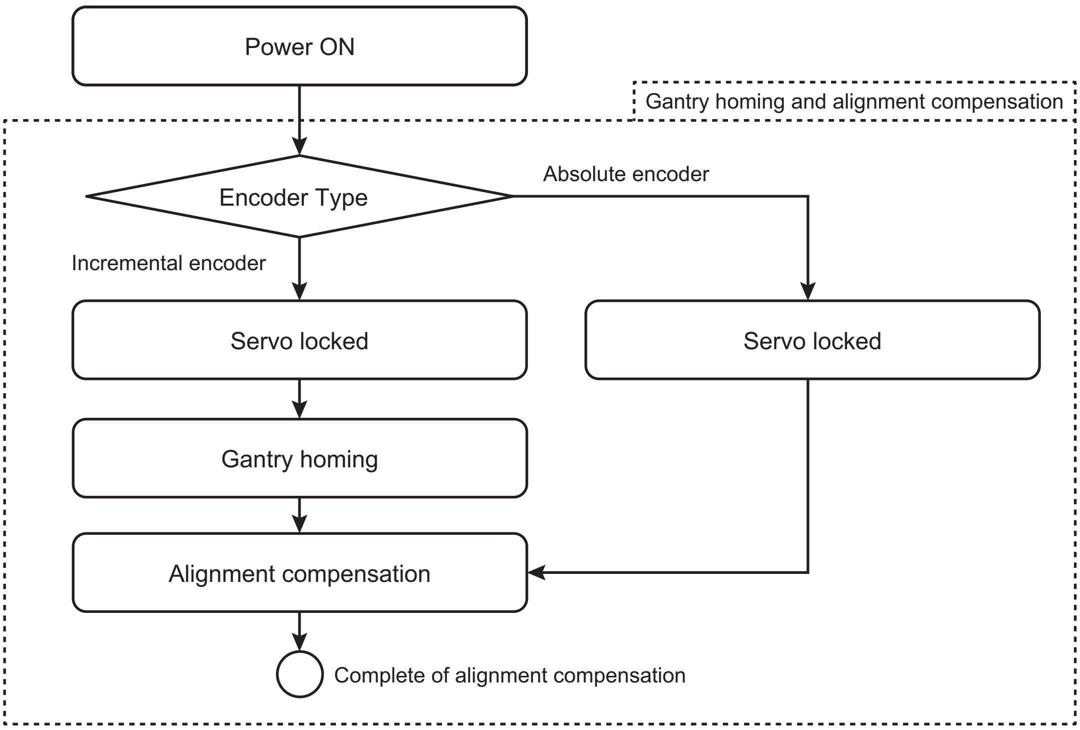
- **Initial Setup Procedure for Devices That Have a Gantry System**

The initial setup for devices that have a gantry system is implemented by the following chart.



- **Start Procedure for Devices That Have a Gantry System**

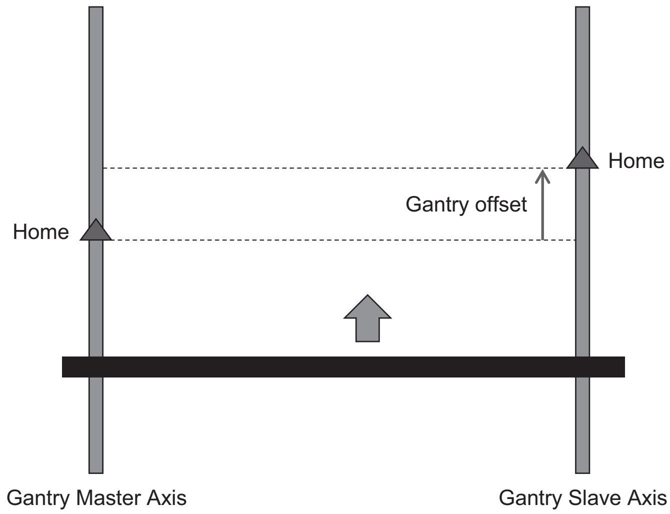
The start for devices that have a gantry system is implemented by the following chart.



Gantry Offset

A displacement from the home exists between the gantry axes. The value that compensates this displacement is called a gantry offset. Before starting up the gantry system machine, you need to calculate the gantry offset and adjust the value at first.

The CNC_GantrySkewControl (Gantry Skew Control) instruction is used to calculate and adjust the gantry offset. Refer to *CNC_GantrySkewControl* on page 12-130 for details.



The CNC Function Module updates the gantry offset value when the CNC_SkewControl execution completes, and it saves the value in the battery-backup memory inside the NC Integrated Controller when the power supply is interrupted.

Precautions for Correct Use

The **Absolute Encoder Home Offset** area of each CNC motor is used for the gantry offset. As with the case of the **Absolute Encoder Home Offset**, note the following conditions.

- For the NY-series Controllers, the gantry offset for each CNC motor is saved to the non-volatile memory along with the CNC motor number. If the CNC motor number is changed, the saved offset will be lost. If you change the CNC motor number, calculate the gantry offset again.
- If there is an error for the battery of the NC Integrated Controller, when the power supply to the NC Integrated Controller is turned ON, an *Absolute Encoder Home Offset Read Error* (event code: 17810000 hex) occurs. In this case, note that a read error for the gantry offset value also occurs.
- When you replace the NC Integrated Controller or the battery of the NC Integrated Controller, be sure to back up **Absolute Encoder Home Offset** with the gantry home defined before you start the replacement procedure.
- By restoring the backup data after the replacement has been completed, you can use the home defined before the replacement was carried out.

Gantry Homing

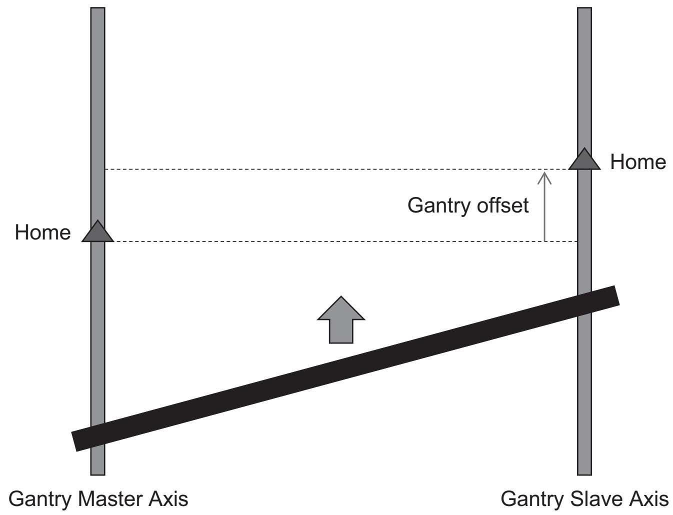
When homing is executed for the gantry master axis with the CNC_Home (Home) instruction or the CNC_HomeWithParameter (Home with Parameters) instruction, homing is executed for the gantry master axis first and then for the gantry slave axis next.

In addition, based on the position of the home of each axis and the gantry offset, the skew between the axes is measured and compensated automatically. This operation is called alignment compensation.

Example of gantry homing

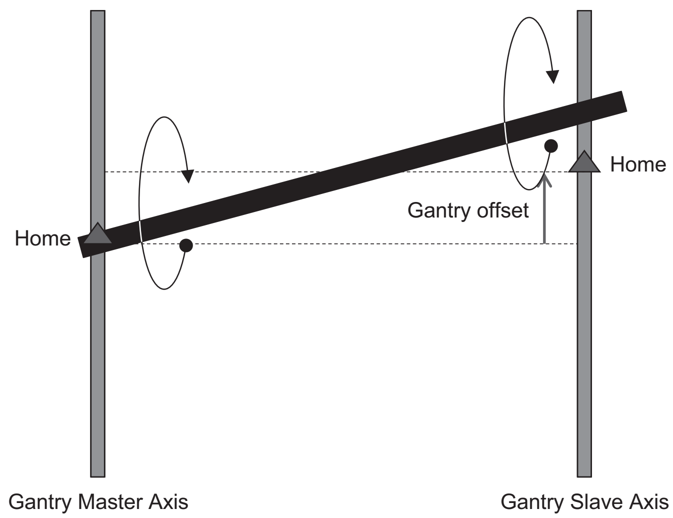
Status 1: Power ON

A skew exists between the gantry axes.



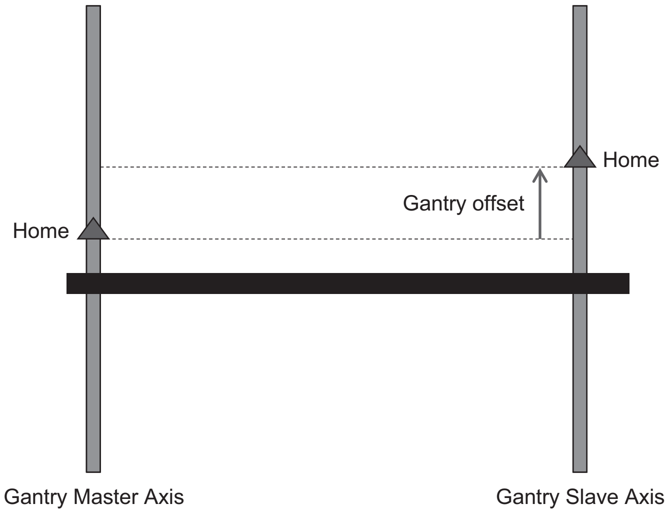
Status 2: Homing

Homing operation is executed sequentially for the gantry master axis and the gantry salve axis.



Status 3: Alignment compensation

Alignment compensation executes with the gantry offset.



By performing the gantry homing, the value of *Home Defined* (Homed) system-defined variable changes to TRUE.

Precautions for Correct Use

For the alignment compensation after gantry homing, the gantry offset must be calculated correctly. Always execute gantry homing after the calculation of the gantry offset.

Additional Information

- When *1: Absolute encoder* is set for the encoder type of the gantry master and slave axes, the home is defined when communications are established or when the CNC_Power (Power Servo) instruction is executed.
- When the CNC_Home (Home) instruction is used, values specified for the gantry master axis are used for the homing parameters of the gantry master axis and values specified for the gantry slave axis are used for the homing parameters of the gantry slave axis.
- When the CNC_HomeWithParameter (Home with Parameters) instruction is used, values specified for the gantry slave axis are used for the homing parameters of the gantry slave axis.
- *Home Offset* is not used the setting value for the gantry slave axis. Instead, it is preset based on the current position for the gantry master axis.
- By setting Homing Operation Mode for the gantry slave axis to *14: Zero position preset*, you can use the homing method where the current position for the gantry master axis is preset to the gantry slave axis without inputting home signal for the gantry slave axis.
- Gantry homing is not necessary for the gantry system that uses the absolute encoder. Alignment compensation executes automatically when the servo is locked.

Alignment Compensation

When any of the following conditions are met, alignment compensation executes automatically depending on the *Alignment Velocity* in Gantry Settings.

- Right after the gantry home is defined
- When the Servo is locked for the CNC motor assigned to the gantry slave axis with its home defined
- When the gantry offset is adjusted with CNC_GantrySkewControl (Gantry skew control)

Precautions for Correct Use

When the absolute encoder is used, the home is defined for the CNC motor since the initial power is ON. To avoid unexpected behavior of alignment compensation, make sure to check the monitor value of the current position and the actual machine position before the Servo is locked when the initial power is ON.

Gantry Monitor Function

This function automatically monitors the status between the gantry axes. This function is further classified into the following two functions.

● Position Deviation between Axes Monitor Function

This function monitors a difference of the feedback position between the gantry axes. This function allows you to stop the gantry axes operation automatically in case the axes have a displacement from each other due to an error with one of the axes or other reasons.

Once the deviation exceeds *Position Deviation Between Axes Warning Value* in the gantry slave axis settings, the *Position Deviation between Axes Limit Warning* (679A0000 hex) will occur. Furthermore, if the deviation exceeds *Position Deviation between Axes Over Value*, the *Position Deviation between Axes Limit Exceeded* (679B0000 hex) will occur.

Additional Information

The position deviation between axes monitor function is enabled when the gantry slave axis is in the servo lock state. In the following cases, the gantry home is not defined. Therefore, this function monitors the difference of the current position of each Servo Drive for the master axis and the slave axis.

- When the gantry home is undefined
- When the gantry homing operation is in progress

● Gantry Master Axis Status Monitor Function

This function automatically turns the Servo OFF for the gantry slave axis when a Servo OFF state is detected for the gantry master axis.

Note that the relationship between the master axis and slave axis in the gantry system is switched internally during the homing operation of the gantry slave axis. Therefore, the monitoring target by this function is switched accordingly.

Effects on System-defined Variables

Some of the system-defined variables that are related to the gantry master and slave axes will behave differently from the standard functions.

Details are given below.

● CNC Motor Variables

The following statuses affect the CNC motor variables for the gantry master axis.

Variable name	Data type	Name	Changes to the function
_CNC_Motor[0..31].Details.Homed	BOOL	Home Defined	TRUE when *Home Defined* is specified for the gantry master and slave axes.
_CNC_Motor[0..31].Details.SoftLimitPosi	BOOL	Positive Software Overtravel Limit	TRUE when *Positive Software Overtravel Limit* is specified for the gantry master or slave axis.
_CNC_Motor[0..31].Details.SoftLimitNega	BOOL	Negative Software Overtravel Limit	TRUE when *Negative Software Overtravel Limit* is specified for the gantry master or slave axis.
_CNC_Motor[0..31].Details.InPos	BOOL	In-position Completed	TRUE when *In-position Completed* is specified for the gantry master and slave axes.

● NC Program Variables

The following variable affects the NC program variables that are related to the gantry slave axis.

Variable name	Name	Function
_CNC_CapturedPosition@*1	Logical motor @ capture position	This function does not work. The capture function for the gantry slave axis does not work. It only works for the master axis.*2

*1. @ indicates the logical motor number from 0 to 7.

*2. The capture function for the gantry slave axis does not work. No value is assigned to the variable for the capture position.

9-4 CNC Coordinate System Position Control

This section describes the operation of multi-axes coordinated control. With the CNC Function Module, you can set a CNC coordinate system in advance from Sysmac Studio to perform interpolation control for multiple axes.

9-4-1 Outline of Operations

Multi-axes coordinated control performs a motion with multiple related CNC motors together as a single group to control the path of the target control object such as tool center points.

The CNC Function Module treats all CNC motors that perform coordinated operation as a CNC coordinate system. CNC coordinate system are set from the Sysmac Studio. The NC program is used to control the path of the tool center point in the CNC coordinate system.

In the user program, each of the composition CNC motors for a CNC coordinate system are set to Servo ON status and to complete homing. Then, the CNC instruction to start the NC program and path operation is executed. If any error occurs on any CNC motor in the CNC coordinate system, all other CNC motors in the CNC coordinate system stop immediately.

Precautions for Correct Use

You cannot execute NC programs to a coordinate system if a CNC motor that composes the coordinate system is manually operated. In the same way, the manual operation cannot be executed during execution of the NC program except for the *Hold* (Holding) status.

Resetting CNC Coordinate System Errors

If an error occurs in a CNC coordinate system, you can use the CNC_CoordReset (CNC Coordinate System Error Reset) instruction to remove the error once you have eliminated the cause.

9-4-2 Preparatory Function (G code)

Refer to the *NJ/NY-series G code Instructions Reference Manual* (Cat. No. O031).

9-5 Common Functions for CNC Coordinate System Position Control

For information about position, feedrate, acceleration time, deceleration time, and override, refer to the *NJ/NY-Series G code Instruction Reference Manual* (Cat. No. O031).

9-6 Other Functions

This section describes other functions of the CNC Function Module.

9-6-1 Latching

Latching is used to control positioning based on the position where a trigger signal occurs, such as a signal from a sensor input. The position of the CNC motor is recorded (i.e., latched) when the trigger signal occurs.

Latching is required for G31 (Skip Function).

9-6-2 Software Limit

The positive and negative software limit parameters are provided for each CNC motor.

When **Software Overtravel Limit Operation Control** is set to *0: An error occurs* and the software limit is judged to be exceeded during execution of an NC program, each CNC motor stops immediately. In other cases, the path or target position is adjusted so that the software limit is not exceeded.

The software limit is valid only when the home is defined. The software limit is invalid during homing.

9-6-3 In-position Check

In-position Check for CNC Motors

For the in-position range, specify the maximum position error value so that the CNC motor can be assumed in the in-position status when any command operations are not executed. For the number of in-position continuance cycles, specify the number of consecutive repetitions during which the in-position status must be true so that the CNC motor can be assumed in the in-position status.

If the number of in-position continuance cycles is greater than 0, the in-position status must continue to be true for the period specified by the additional number of consecutive check times. The NC Integrated Controller checks these conditions in each primary period for all the active CNC motors. If any of these additional checks detects that any of these conditions is not true, the count must be started again from zero.

Additional Information

- The following five conditions must be satisfied in order that the CNC motor is assumed to be in the in-position status:
  - The CNC motor is in a closed-loop control state.
  - The command velocity of the CNC motor is set to 0.
  - The CNC motor is not running or dwell processing is not executed for the specified period of time.
  - The magnitude of the error is less than or equal to the in-position range.
  - The above four conditions are satisfied in the consecutive primary period (i.e., the number of continuous in-position cycles + 1).
- When the number of in-position continuance cycles is set to the default value, if the in-position conditions (closed-loop, commanded velocity zero, and error less than or equal to the in-position range) are satisfied at the first check, the *InPos* (in-position completion) CNC motor variable is set.

In-position Check for CNC Coordinate Systems

When the in-position check time of the CNC coordinate system parameters is set to a positive value and blending is disabled between programs, this Controller is specified to check the in-position conditions before all axes on the coordinate system start the next motions by the NC program. In this case, specify the in-position check timeout time to the in-position check time. The timeout time is indicated by the number of CNC Planner Service periods (CNC Planner Service Period + 1 servo cycle). If all axes in the coordinate system are not set in the in-position status within this time before the start of the next travel, the NC Program Execution Error (6799 0000 hex) occurs and the program stops.

When the in-position check time of CNC coordinate system parameter is set to 0 and blending is disabled, this Controller instantaneously stops the command position before the next travel is started. However, this does not mean that the actual position of any axis reaches the end point.

When all the CNC motors in the CNC coordinate system are judged to be in the in-position status, the in-position status *bit* of the CNC coordinate system is set. After the in-position check is completed, a dwell time wait operation is inserted before the next programmed travel is executed.

10

CNC Instructions

This section describes CNC instructions.

Overview of CNC Instructions

This section provides an overview of CNC instructions.

Types of CNC Instructions

The following table shows the types and descriptions of CNC instructions.

Type	Category	Functional group	Outline
Common commands	Common administration instructions	Parameters	These instructions are used to control the common statuses of the CNC Function Module, and to manipulate or monitor various data items.
CNC coordinate system commands	CNC coordinate system motion instructions	CNC coordinate system control	These instructions perform coordinated motion of the CNC coordinate system.
	CNC coordinate system administration instructions	Auxiliary functions for CNC coordinate system control	These instructions are used to control or monitor the CNC coordinate system status.

State Transitions

State transitions are defined for the CNC coordinate system and instruction execution.

Execution and Status of CNC Instructions

Variables that start instruction execution or that indicate the execution status are defined as common rules for the instructions.

There are two input variables that start instruction execution: *Execute* and *Enable*.

The output variables that indicate the execution status of an instruction include *Busy*, *Done*, *CommandAborted*, and *Error*.

Error Processing

You execute CNC instructions to implement numerical control with the CNC Function Module. When CNC instructions are executed, input parameters and instruction processing are checked for errors.

If an error occurs in an instruction, the *Error* output variable from the instruction changes to TRUE and an error code is output to *ErrorID* (Error Code) output variable.

There are two ways that you can use to program processing of errors for CNC instructions.

● Error Processing for Individual Instructions

You can use the *Error* (Error) and *ErrorID* (Error Code) output variables from the instruction to process errors that occur for each instruction.

● Error Processing for Different Types of Errors

You can use the error status that is provided by the CNC system-defined variables to process each type of error separately.

Changing Input Variables during Execution of CNC Instruction (Restarting Instructions)

If the input variable *Execute* of the same instruction instance is changed to TRUE again while the CNC instruction is under execution, an error occurs.

Multi-execution of CNC Instructions

Unlike the Motion Control Function Module, CNC instructions do not have functions for buffer modes.

Whether the multi-execution of instructions is supported in the CNC Function Module depends on by the current status of CNC coordinate system and the instruction to execute. Refer to *A-4 Instructions for Which Multi-execution Is Supported* on page A-15 for details.

Basic Information on CNC Instructions

This section describes the basic specifications and restrictions for programming with CNC instructions for the CNC Function Module built into the NC Integrated Controller.

CNC Instruction Names

All the CNC instructions for the CNC Function Module begin with “CNC_”.

Languages for CNC Instructions

The CNC instructions of the CNC Function Module can be used in the programming languages shown below.

- Ladder diagram (LD)
- Structured text (ST)

CNC Instruction Locations

This section describes what task a CNC instruction can be assigned to, and the relationship between the location of the task in a program and the resultant operation.

Task Types

CNC instructions can be used in the primary periodic task. If you use CNC instructions in any other task, an error will occur when you build the program.

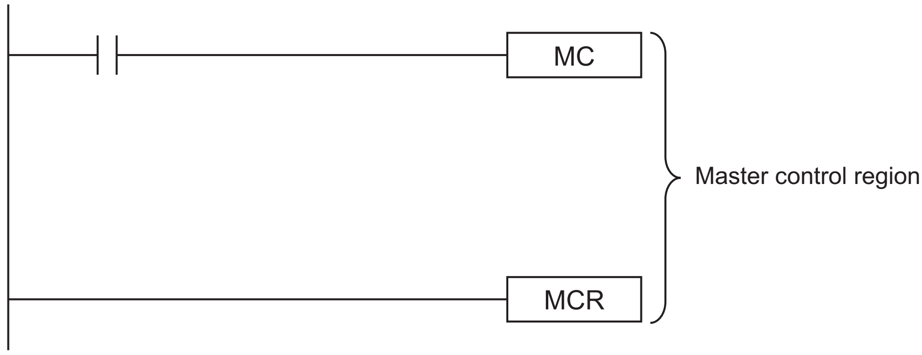
Task Type	Applicable
Primary periodic task	Yes
Periodic task (execution priority: 16)	No
Periodic task (execution priority: 17)	No
Periodic task (execution priority: 18)	No
Event task (execution priority: 8)	No
Event task (execution priority: 48)	No

In Function Block Definitions

You can also use CNC instructions in the function block definitions that user creates.

Master Control Regions

The area in a ladder diagram between the Master Control Start instruction (MC) and the Master Control End instruction (MCR) is the master control region.

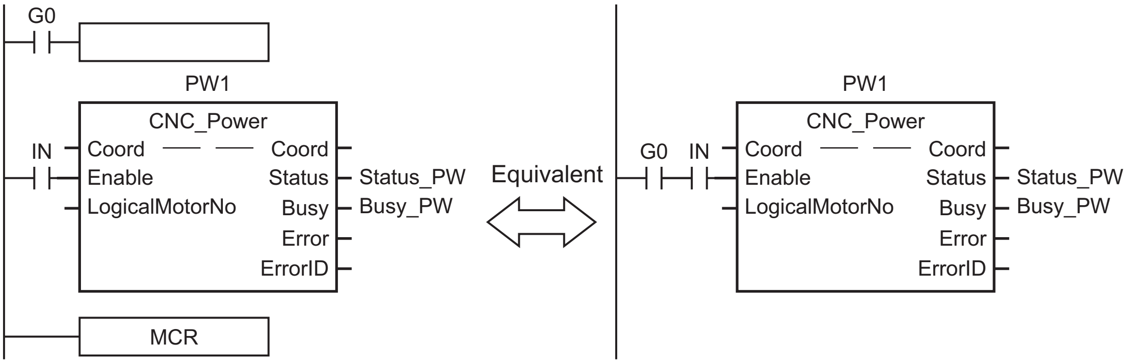


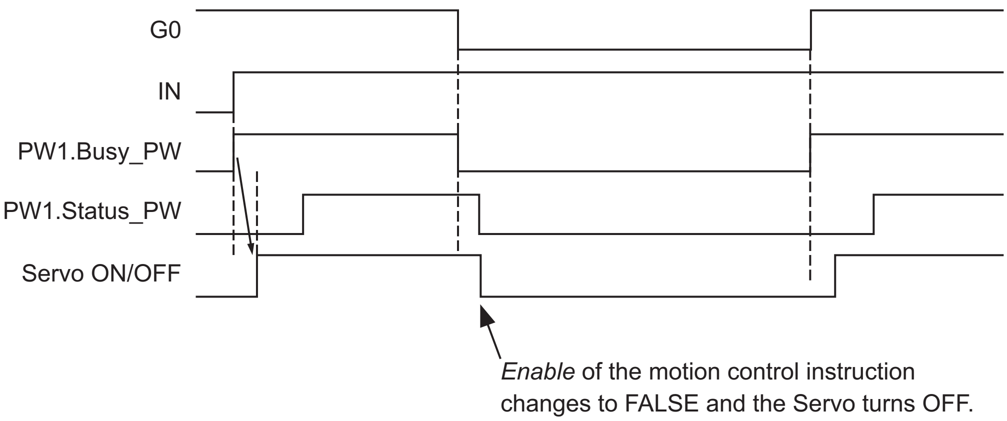
If a CNC instruction is located in the master control region, and the MC input condition is FALSE, the following will occur.

- When the CNC instruction is directly input from the left bus bar to the *Enable* or *Execute* input variable of the CNC instruction, the *Enable* or *Execute* input variable is FALSE.
- Inline ST sections are executed normally.
- The values of the output parameters are updated as normal even when the *Enable* or *Execute* input variables to the CNC instructions are FALSE.

● Enable-type CNC Instructions

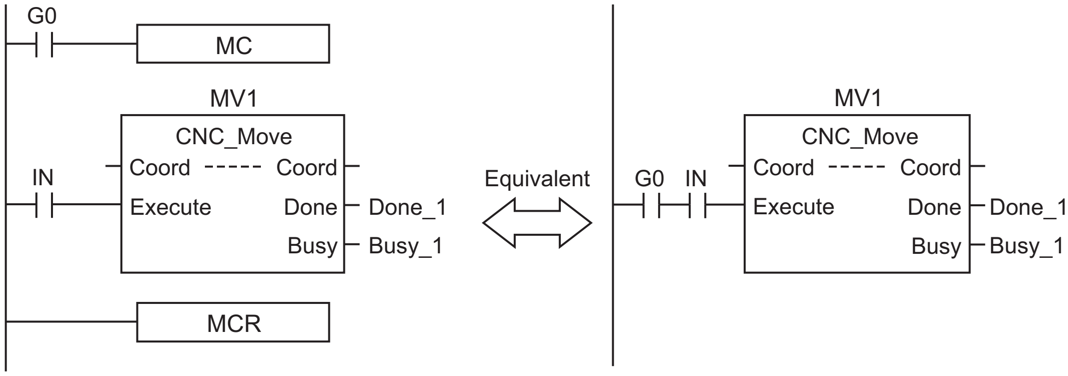
- Instructions located in master control regions are equivalent to the programming shown on the right in the following figure.
- When G0 is TRUE, the CNC_Power is executed normally.
- When G0 is FALSE, the CNC_Power is executed as if the *Enable* input variable was FALSE.

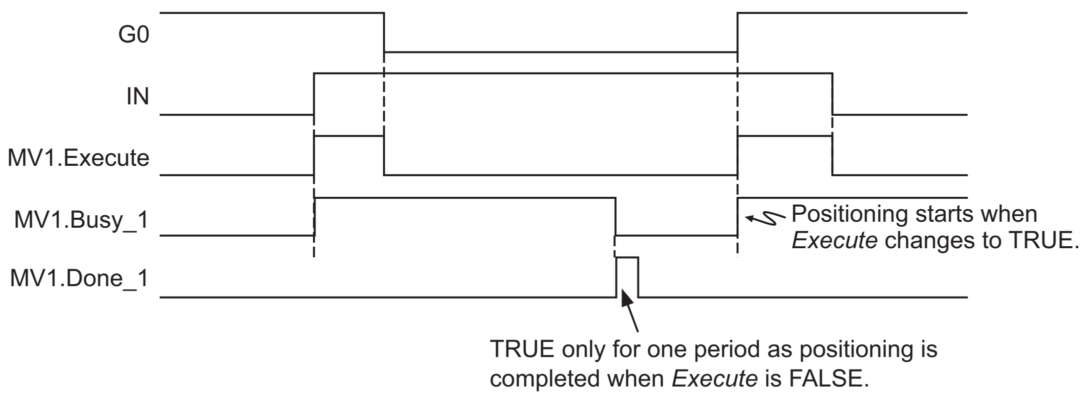




● Execute-type CNC Instructions

- Instructions located in master control regions are equivalent to the programming shown on the right in the following figure.
- When G0 is TRUE, the CNC_Move is executed normally.
- When G0 is FALSE, the CNC_Move is executed as if the *Execute* input variable was FALSE.
- Instructions executed when G0 is TRUE continue operation until completion, even if G0 changes to FALSE during operation. The values of output parameters are also updated in the normal way.





CNC Instructions in ST Statement Instructions

This section describes the operation of CNC instructions when they are located in ST statement instructions, such as IF, CASE, WHILE, or REPEAT instructions.

When the evaluation result for the condition expression of an ST statement instruction is FALSE, the CNC instructions within the structure are not executed. Also, the values of the output variables are not updated.

If execution of an execute-type instruction is started and then the evaluation result changes to FALSE, processing is continued until it is completed. In that case, however, the values of the output variables are not updated.

Precautions for Correct Use

The execution status of an execute-type instruction in an ST statement instructions will not be clear if the evaluation result of the condition expression changes to FALSE during execution of the instruction, therefore, we do not recommend using execution-type instructions in ST statement instructions.

If they must be used, be careful of the operation.

Treatment of REAL and LREAL Data

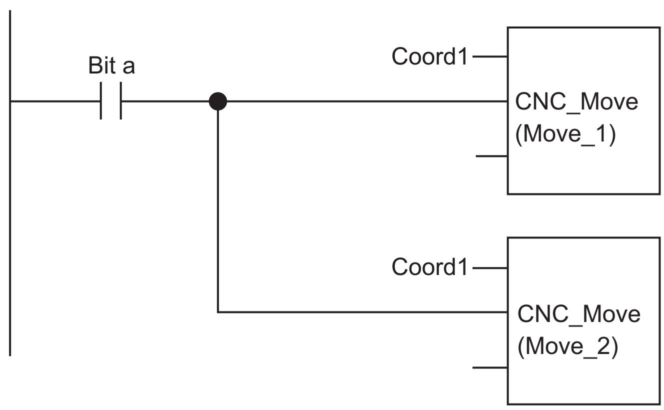
REAL and LREAL are floating-point decimal data types.

Refer to the *NJ/NX-series Motion Control Instructions Reference Manual* (Cat. No. W508) or *NY-series Motion Control Instructions Reference Manual* (Cat. No. W561).

Simultaneous Execution of CNC Instructions

This section describes operations to execute multiple CNC instructions for the same CNC coordinate system in the same task period.

- In the following programming, instruction instances **Move_1** and **Move_2** start in the same task period when Bit a turns ON.
- Instructions in a program are executed from the top. Therefore **Move_1** is started first, and then **Move_2** is started before **Move_1** is finished.
- This is considered as the multi-execution of CNC instructions. In this example, **Move_2** is executed multiple times in relation to **Move_1**.



Online Editing of CNC Instructions

You can perform the following online editing operations for CNC instructions from the Sysmac Studio.

Online editing operations
Deleting CNC instructions
Adding CNC instructions
Adding input variables, output variables, and in-out variables to CNC instructions
Changing input variables, output variables, and in-out variables for CNC instructions
Deleting input variables, output variables, and in-out variables for CNC instructions

Changes the Operation Mode of the NC Integrated Controller

The NJ/NY-series NC integrated controller has two operation modes: PROGRAM mode and RUN mode.

This section describes the operation of the CNC Function Module when the operating mode changes.

Changes from RUN Mode to PROGRAM Mode

- The CNC instruction that is under execution will be aborted. The *CommandAborted* (Command Aborted) output variable remains FALSE, but the operation is the same as when *CommandAborted* (Command Aborted) is TRUE.
- If the axis is moving, it will perform an immediate stop. The Servo ON/OFF status will continue.

Changes from PROGRAM Mode to RUN Mode

- The output variables of the CNC instructions are cleared.
- The axis performs an immediate stop when the mode changes from RUN mode to PROGRAM mode. If the operating mode is changed back to RUN mode while the axis performs an immediate stop, the output variables from the CNC instruction are cleared. Therefore, *CommandAborted* (Command Aborted) of the CNC instruction that was under execution remains FALSE.

11

Variables and Instructions

This section describes the variables and instructions for the CNC Function Module.

11-1 Variables

There are two types of variables for the CNC Function Module.

The first type is system-defined variables, which you use to monitor the CNC coordinate system status and some of the parameter settings. System-defined variables that are used by the CNC Function Module are called CNC system-defined variables.

The second type is variables that are used to input arguments to CNC instructions and to output execution status from CNC instructions. Some input variables to CNC instruction are enumerated variables. With enumerated variables, selections are made from a set of enumerators.

This section describes the variable types, the valid ranges of CNC instruction input variables, and the enumerated variables. Refer to *5-3 CNC System-defined Variables* on page 5-5 for details.

11-1-1 Input Variables for CNC Instructions

The following tables list the input variables and the valid ranges for CNC instructions, and the valid ranges of enumerations.

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Execute	Execute	BOOL	TRUE or FALSE	FALSE	Other input variables are input when *Execute* changes to TRUE. To update the input value, change the value, and *Execute* changes to TRUE again. The output variables are valid as long as *Execute* remains TRUE even after the instruction is completed. Then, all output variables except for *Error* and *ErrorID* are disabled when *Execute* changes to FALSE. If *Execute* changes to FALSE before the instruction is completed, output variables are enabled for at least one period.
Enable	Enable	BOOL	TRUE or FALSE	FALSE	The instruction function is enabled when *Enable* changes to TRUE and disabled when it changes to FALSE. While *Enable* is TRUE, the other input variables are input every period. If *Enable* changes to FALSE, all output variables except for *Error* and *ErrorID* are disabled.

Valid Range of Input Variables

This section describes the valid ranges of input variables to CNC instructions.

Refer to individual instruction descriptions for the valid ranges for each instruction.

● BOOL Input Variables

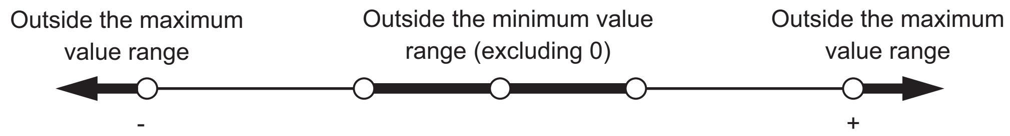
Any value other than FALSE is treated as TRUE. For this reason, out-of-range errors do not occur.

● Enumerated (ENUM) Input Variables

Values that are outside of the valid range will result in an error.

● Input Variables Given as Full Range, Positive Number, or Negative Number

Operation when an input variable is set inside or outside the valid range is described in the following table.



Name	Meaning	Valid range	Outside maximum value range	Outside the minimum value range (excluding 0)
Velocity	Target Velocity	0, (-1 ≤ and ≤ -Maximum velocity) or (1 ≤ and ≤ Maximum velocity)*1	Fixed to the maximum velocity for a positive number, and to the −maximum velocity for a negative number.	Set to 1 pulse/s when positive number, and -1 pulse/s when negative number.*2
Acceleration	Acceleration/Deceleration Rate	0 or (0.004 ≤ and ≤ Maximum acceleration/deceleration rate)*3	Maximum Acceleration/Deceleration Rate If the acceleration/deceleration time*4 is less than 125 μs, it is always fixed at 125 μs.	Fixed to 0.004pulse/s^2 when positive number. If the acceleration/deceleration time is greater than 250 s, it will always be fixed at 250 s. Error when negative number.
Position (Feed axis specification)	Command Position (ABS specification)	(0xFFFFFF8000000000) ≤ and <(0x0000007FFFFFFFFF+1)*5	Error	Values outside of the minimum value range do not occur.
	Travel Distance (INC specification)	(0xFFFFFF0000000001) ≤ and ≤ (0x000000FFFFFFFFFF)	Error	Values outside of the minimum value range do not occur.
Position (Spindle specification)	Command Position (ABS specification)	-2^{53} ≤ and < 2^{53}*-1*6	Error	Values outside of the minimum value range do not occur.
	Travel Distance (INC) specification	(0xFFFFFF0000000001) ≤ and ≤ (0x000000FFFFFFFFFF)	Error	Values outside of the minimum value range do not occur.

*1. The upper limit of the Maximum Velocity in the CNC motor parameter is 128,849,018,820 pulses/min.

*2. If a negative number or 0 is specified when a negative number or 0 is not included in the valid range, an error occurs.

*3. The upper limit of the Maximum Acceleration/Deceleration Rate in the CNC motor parameter is 3,200,000,000,000 pulses/s.

*4. Calculated as follows: Acceleration/deceleration time = (| Target velocity - Current command velocity |)/Acceleration/deceleration rate

*5. Position must be an absolute value in pulses and within a signed 40-bit range.

*6. Position must be an absolute value in pulses and within a signed 54-bit range. Additionally, one travel distance must be less than a signed 40-bit.

Enumerations

This is a list of ENUM data used by input variables to CNC instructions.

An enumeration input variable is not actually set to the number, but to the enumerator.

Data type	Valid range	Description	Variable of appropriate instruction (Variable name)
_eCNC_PARAMETER_NUMBER	_cncRotaryVel := 0 _cncDryRunVel := 1 _cncFeedholdTime := 2 _cncInPosTime := 3 _cncSwLmtCtrl := 4 _cncToolShape := 5 _cncToolRadiusCompCtrl := 6 _cncSpindleOrientation := 7 _cncSingleBlockOption := 8 _cncWorkOffset1 := 20 _cncWorkOffset2 := 21 _cncWorkOffset3 := 22 _cncWorkOffset4 := 23 _cncWorkOffset5 := 24 _cncWorkOffset6 := 25 _cncRefPoint1 := 30 _cncRefPoint2:= 31 _cncRefPoint3 := 32 _cncRefPoint4 := 33 _cncFELmt := 50 _cncChkFELmt := 51 _cncSwLmt := 52 _cncPosiSwLmt := 53 _cncNegaSwLmt := 54 _cncInPosCycle := 55 _cncInPosRange := 56 _cncRapidFeedAcc := 57 _cncSkipVel := 58 _cncPIDCtr := 59 _cncCompScaling := 100	Specifies the parameter to write. 0: Rotary Axis Velocity 1: Dry Run Velocity 2: Feed Hold Acceleration Deceleration Time 3: In-position Check Time 4: Software Overtravel Limit Operation Control 5: Tool Shape Data 6: Tool Radius Compensation Control 7: Spindle Axis Orientation Operation 8: Single Block Execution Option 20: 1st Work Coordinate System Offset 21: 2nd Work Coordinate System Offset 22: 3rd Work Coordinate System Offset 23: 4th Work Coordinate System Offset 24: 5th Work Coordinate System Offset 25: 6th Work Coordinate System Offset 30: 1st Reference Point 31: 2nd Reference Point 32: 3rd Reference Point 33: 4th Reference Point 50: Following Error Over Value 51: Following Error Warning Value 52: Software Overtravel Limit 53: Positive Software Overtravel Limit 54: Negative Software Overtravel Limit 55: Number of In-position Continuance Cycles 56: In-position Range 57: Rapid Feed Acceleration/Deceleration 58: Skip Velocity 59: PID Control 100: Compensation Scaling	ParameterNumber (Parameter Number)
_eCNC_MOVE_MODE	_cncAbsolute := 0 _cncRelative := 1	Selects the travel method. 0: Absolute positioning 1: Relative positioning	MoveMode (Travel Mode)

Data type	Valid range	Description	Variable of appropriate instruction (Variable name)
_eCNC_SWLMT _MODE	_cncNonSwLmt := 0 _cncCmdImmediateStop := 1	Enable or disable the software overtravel limit. 0: Disable software limits. 1: Enable software limits and perform immediate stop for command position. (stop using remaining pulses)	-
_eCNC_SWLMT_ CONTROL	_cncSwLmtOTErr := 0 _cncSwLmtTrajSaturation := 1	Set the operation when the software overtravel limit of the CNC motor is reached while the CNC coordinate system is operating. 0: Error 1: No error (Path saturation)	-
_eCNC_HOMING_MODE	_cncHomeSwTurnHomeSwOff := 0 _cncHomeSwTurnHomeSwOn := 1 _cncHomeSwOff := 4 _cncHomeSwOn := 5 _cncLimitInputOff := 8 _cncHomeSwTurnHomeMask := 9 _cncLimitInputOnly := 11 _cncHomeSwTurnHoldingTime := 12 _cncNoHomeSwHoldingHomeInput := 13 _cncHomePreset := 14	Specify the new setting of the Homing Operation Mode. 0: Proximity reverse turn/home proximity input OFF 1: Proximity reverse turn/home proximity input ON 4: Home proximity input OFF 5: Home proximity input ON 8: Limit input OFF 9: Proximity reverse turn/home input mask distance 11: Limit inputs only 12: Proximity reverse turn/holding time 13: No home proximity input/holding home input 14: Zero position preset	-
_eCNC_HOME _INPUT	_cncZPhase := 0 _cncExternalSignal := 1	Select the input to use for the home input signal. 0: Use the Z-phase input as home. 1: Use external home input	-
_eCNC_LIMIT _REVERSE _MODE	_cncErrorStop := 0 _cncRevImmediateStop := 1 _cncRevDecelerationStop := 2	Set the stopping method when the limit input turns ON during homing. 0: No reverse turn/minor fault stop 1: Reverse turn/immediate stop 2: Reverse turn/deceleration stop	-
_eCNC _DIRECTION	_cncPositiveDirection := 0 _cncShortestWay := 1 _cncNegativeDirection := 2 _cncCurrentDirection := 3 _cncNoDirection := 4	Specifies the direction of motion. 0: Positive direction 1: Shortest way 2: Negative direction 3: Current direction 4: No direction specification	-
_eCNC _OVERCUT _MODE	_cncOvercutErr := 0 _cncOvercutAvoid := 1 _cncOvercutIgnore := 2 _cncOvercutTestAvoid := 3	Specifies the Overcut Mode. 0: Over-cut detection error 1: Overcutting avoidance 2: Overcutting ignorance 3: Overcutting test avoidance	-
_eCNC _DELETE_PRG	_cncNotDelPrg := 0 _cncDelLoadedPrg := 1	Specifies the program deletion option. 0: Do not delete. 1: Delete all the loaded program.	DeletePrg (Program Deletion Option)

Data type	Valid range	Description	Variable of appropriate instruction (Variable name)
_eCNC_SINGLE_BLOCK_OPTION	_cncSingleBlockOptionDisable := 0 _cncSingleBlockOptionEnable := 1	Specifies the Single block execution option. 0: Disabled Single block execution option. 1: Enabled Single block execution option.	-
_eCNC_SKEW_MODE	_cncCalcOffset := 0 _cncAlignOffset := 1 _cncWriteOffset := 2 _cncReadOffset := 3	Specifies the operating mode of the gantry skew control. • _cncCalcOffset: Calculates the gantry offset value. • _cncAlignOffset: Changes the gantry offset value and adjusts the slave axis position. • _cncWriteOffset: Changes the gantry offset value. • _cncReadOffset: Reads the gantry offset value that is currently valid.	SkewMode (Skew Control Mode)

11-1-2 Output Variables for CNC Instructions

The following table lists the output variables for CNC instructions.

Name	Meaning	Data type	Valid range	Description
Done	Done	BOOL	TRUE or FALSE	TRUE when the instruction is completed. At this time, output variables *Error*, and *CommandAborted* are FALSE. *Done* will be TRUE for at least one period if the input variable *Execute* is FALSE when the instruction is completed. If *Execute* is TRUE, *Done* remains TRUE until *Execute* changes to FALSE.
Busy	Executing	BOOL	TRUE or FALSE	TRUE when an instruction is acknowledged.
Enabled	Enabled	BOOL	TRUE or FALSE	TRUE when busy.
CommandAborted	Command Aborted	BOOL	TRUE or FALSE	TRUE when an instruction could not be executed or when it was aborted during execution. If an error occurs in the target CNC coordinate system, the instruction cannot be executed. Also, the instruction cannot be executed while the CNC coordinate system is decelerating to a stop. The instruction is aborted when another instruction is executed, or if an error other than for this instruction occurs. At this time, the *Done* and *Error* output variables are set to FALSE. If the instruction is aborted while the input variable *Execute* is FALSE, *CommandAborted* will be TRUE for at least one period. If *Execute* or *Enable* is TRUE, *CommandAborted* remains TRUE until *Execute* or *Enable* changes to FLASE. If *Execute* or *Enable* is TRUE, *CommandAborted* remains TRUE until Execute or *Enable* changes to FALSE.
Error	Error	BOOL	TRUE or FALSE	TRUE when there is an error caused by a mistake in an input variable or instruction processing.
ErrorID	Error Code	WORD		Contains the error code when an error occurs. 16#0000 indicates normal operation.

11-1-3 In-Out Variables for CNC Instructions

The following table lists the in-out variables for CNC instructions.

Name	Meaning	Data type	Valid range	Description
Coord	CNC Coordinate System	_sCNC_COORD_REF	---	Specifies the CNC coordinate system.
GantryOffset	Gantry Offset	LREAL	---*1	Input: Specify a gantry offset value to change. It is used when the skew control mode is _cncAlignOffset or _cncWriteOffset.*1 Output: When the execution of an instruction is completed, the currently valid gantry offset value is stored.

*1. When the skew control mode is either _cncAlignOffset or _cncWriteOffset, the valid range is same as that for travel distance, which is between 0xFFFFFF0000000001 and 0x000000FFFFFFFFFF after it is converted into pulses.

11-2 List of CNC Instructions

CNC instructions are classified into the following two types.

Type	Outline
Common commands	Common instructions of CNC Function Module
CNC coordinate system commands	Instructions for CNC Function Module to control and monitor the CNC coordinate system.

11-2-1 Common Commands

This section describes the common instructions for the CNC Function Module.

In the Classification column, Administration indicates a non-motion system instruction, and Motion indicates a motion system instruction.

Instruction	Instruction name	Outline	Classification
CNC_Write	Write CNC Setting	Overwrites CNC parameters.	Administration
CNC_Read	Read CNC Setting	Reads CNC parameters.	Administration
CNC_LoadProgramFile	Load NC Program	The CNC_LoadProgramFile instruction loads an NC program from an external non-volatile memory into the main memory.	Administration

11-2-2 CNC Coordinate System Commands

This section describes instructions to perform multi-axis coordinated control for the CNC Function Module.

In the Classification column, Administration indicates a non-motion system instruction, and Motion indicates a motion system instruction.

Instruction	Instruction name	Outline	Classification
CNC_CoordControl	CNC Coordinate System NC Control	Executes the NC program, and starts controlling the specified CNC coordinate system.	Administration
CNC_CoordCatchMCode	Catch M Code	Receives the M code output from the NC program using the sequence control program.	Administration
CNC_CoordResetMCode	Reset M Code	Resets the M code output from the NC program.	Administration
CNC_CoordReset	CNC Coordinate System Error Reset	The CNC_CoordReset instruction clears the error detected in the specified CNC coordinate system.	Administration
CNC_CoordStop	CNC Coordinate System Stop	The CNC_CoordStop instruction decelerates all the currently running CNC motors in the specified CNC coordinate system to a stop.	Motion

Instruction	Instruction name	Outline	Classifica-tion
CNC_CoordImmediateStop	CNC Coordinate System Immediate Stop	The CNC_CoordImmediateStop instruction immediately stops all the currently running CNC motors in the specified CNC coordinate system.	Motion
CNC_CoordHalt	CNC Coordinate System Halt	Stops the currently running CNC motors assigned to the positioning axes in the specified CNC coordinate system.	Motion
CNC_Power	Power Servo	Switches the driver status to the Run Enable status.	Administration
CNC_MoveJog	Jog	Performs jogging according to the specified target velocity.	Motion
CNC_Home	Home	The CNC_Home instruction operates the Servomotor to determine home using the limit signals, home proximity signal, and home signal.	Motion
CNC_HomeWithParameter	Homing with Parameters	Sets the homing parameter and operates the Servomotor to determine home. It uses the limit signals, home proximity signal, and home signal.	Motion
CNC_Move	Positioning	Performs absolute positioning or relative positioning.	Motion
CNC_SyncMoveAbsolute	Cyclic Synchronous Absolute Positioning	Outputs the specified target position cyclically.	Motion
CNC_SpindleGo	Spindle Control	Starts running the CNC motor assigned to the spindle axis.	Motion
CNC_GantySkewControl	Gantry Skew Control	Controls the skew of the gantry axes.	Motion

11-3 PDO Mapping

You need to map the objects required for the CNC functions you will use on process data communications.

The PDO map lists all of the objects that are registered in advance.

11-3-1 Required Objects

There are objects that are required for Positioning axes and objects required for Spindle axis of CNC motor type.

If even one of the required objects is not set, a Required Process Data Object Not Set error (error code: 3780 hex) occurs.

Positioning Axis

The following object settings must be set to use instructions of the CNC Function Module for the positioning axis:

Input/output	Function	Process data
Output	Control word	6040 hex
	Target position	607A hex
Input	Status word	6041 hex
	Current position	6064 hex

Spindle Axis

The following object settings must be set to use instructions of the CNC Function Module for the spindle axis:

Input/output	Function	Process data
Output	Control word	6040 hex
	Target velocity	60FF hex
Input	Status word	6041 hex
	Current position	6064 hex

11-3-2 Objects Required for Specific Instructions

There are objects that you must set to use specific instructions for the CNC motor.

There are settings required for the CNC motors that is assigned for each Positioning axes and Spindle axis.

If an object that is required for each instruction is not set, a Process Data Object Setting Missing error (error code: 3781 hex) occurs.

CNC Motor

There are instructions that require the object setting to operate the CNC motor.

Refer to the following table and set the required objects.

Any instructions that are not listed in the following table only require to set required objects for the CNC motor operation.

Output Settings

Instruction name/G code name	Function name
	Touch Probe Function 60B8 hex
CNC_Home, CNC_HomeWithParameter CNC_GantrySkewControl*1	Conditionally required*2
G31	Required

*1. When Gantry Offset Value Calculation is specified for the skew control mode, same restrictions as those for CNC_Home apply.

*2. Setting is required, excluding Homing Operation Mode, 11, 12, and 14.

Input Settings

Instruction name/G code name	Function name		
	Touch probe status 60B9 hex	Touch probe pos1 pos value 60BA hex	Touch probe pos2 pos value 60BC hex
CNC_Home, CNC_HomeWithParameter CNC_GantrySkewControl*1	Conditionally required*2	Conditionally required*2	Conditionally required*2
G31	Required		Required

*1. When Gantry Offset Value Calculation is specified for the skew control mode, same restrictions as those for CNC_Home apply.

*2. Setting is required, excluding Homing Operation Mode, 11, 12, and 14.

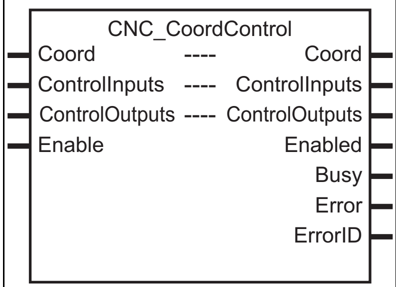
12

CNC Coordinate System Instructions

This section describes the instructions for the CNC Function Module to perform the control of the CNC coordinate system or the CNC motors.

CNC_CoordControl

Executes the NC program, and starts controlling the specified CNC coordinate system.

Instruction	Name	FB/FUN	Graphic expression	ST expression
CNC_CoordControl	CNC Coordinate System NC Control	FB	CNC_CoordControl_instance  	CNC_CoordControl_instance (Coord :=*parameter*, ControlInputs :=*parameter*, ControlOutputs :=*parameter*, Enable :=*parameter*, Enabled =>*parameter*, Busy =>*parameter*, Error =>*parameter*, ErrorID =>*parameter*);

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Enable	Execute	BOOL	TRUE or FALSE	FALSE	Executes the instruction while this variable is TRUE.

Output Variables

Name	Meaning	Data type	Valid range	Description
Enabled	Enable	BOOL	TRUE or FALSE	TRUE when the CNC coordinate system is being controlled.
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error Code	WORD	*1	Contains the error code when an error occurs. A value of 16#0000 indicates normal execution.

*1. Refer to *Section 15 Troubleshooting*.

● Output Variable Update Timing

Name	Timing for changing to TRUE	Timing for changing to FALSE
Enabled	When the instruction is started.	• After one period when *Enable* is FALSE. • When *Error* changes to TRUE.
Busy	When Enable changes to TRUE.	• When *Error* changes to TRUE. • When *Enable* changes to FALSE.
Error	When there is an error in the execution conditions or input parameters for the instruction.	When the error is cleared.

In-Out Variables

Name	Meaning	Data type	Valid range	Description
Coord	CNC Coordinate System	_sCNC _COORD_REF	---	Specifies the CNC coordinate system.
ControlInputs	Numerical Control Input	_sCNC_CTR_ INPUTS_REF	---	Specifies the interface from the PLC to the NC. Create a user-defined variable with a data type of _sCNC_CTR_INPUTS_REF.
ControlOutputs	Numerical Control Output	_sCNC_CTR_ OUTPUTS_REF	---	Specifies the interface from the NC to the PLC. Create a user-defined variable with a data type of _sCNC_CTR_OUTPUTS_REF.

● _sCNC_CTR_INPUTS_REF

Name	Meaning	Data type	Valid range	Function
CycleStart	Cycle Start	BOOL	TRUE or FALSE	Starts the execution of the NC program when this variable changes to TRUE.*1
SingleBlock	Single Block Valid	BOOL	TRUE or FALSE	Executes the NC program on a block-by-block basis if this variable changes to TRUE when the execution of the NC program starts.*2,*3
MachineLock	Machine Lock Valid	BOOL	TRUE or FALSE	Executes the NC program in *MachineLock* if this variable changes to TRUE when the execution of the NC program starts.* 2
DryRun	Dry Run Valid	BOOL	TRUE or FALSE	Executes the NC program in *DryRun* if this variable changes to TRUE when the execution of the NC program starts.*2
AuxiliaryLock	M Code Lock Valid	BOOL	TRUE or FALSE	Executes the NC program in *AuxiliaryLock* if this variable changes to TRUE when the execution of the NC program starts.*2
FeedHold	Feed Hold	BOOL	TRUE or FALSE	Interrupts the NC program when this variable changes to TRUE.*1
Reset	Reset	BOOL	TRUE or FALSE	Interrupts the NC program that is currently being executed, and initializes its status when this variable changes to TRUE.*1
BackTrace	Back Trace Enabled	BOOL	TRUE or FALSE	Traces the NC program in *Hold* backward when this variable changes to TRUE and *CycleStart* (Cycle Start) is started.*3
OptionalInputs	Optional Input	ARRAY [0..31] OF BOOL	TRUE or FALSE	Inputs an optional signal to the NC program. 0 bit: Signal for Optional Stop (M01) 1 to 31 bit: Signal for Option block skip
ProgramNo	NC Program Number	UINT	1 to 9999	Specifies the NC program number.*2

Name	Meaning	Data type	Valid range	Function
FeedrateVelFactor	Feedrate Override Factor	LREAL	0 to 500	Specifies the feedrate override factor. The valid range of the override factor is 0.01 to 500.00. Values of 500.00 or more are treated as 500 and values less than 0.01 (including negative values) are treated as 0.01. The override factor is 0 only when 0 is specified. The unit is [%].
FeedrateVelFac-torChangeRate	Feedrate Override Change Rate	LREAL	0 to 500	Specifies the feedrate override change rate. The valid range of the override change rate is 0.01 to 500.00. Values of 500.00 or more are treated as 500 and values less than 0.01 (including negative values) are treated as 0.01. The override change rate is 0 only when 0 is specified. The unit is [%/s].
SpindleVelFactor	Spindle Velocity Override Factor	LREAL	0 to 500	Specifies the spindle velocity override factor. The valid range of the override factor is 0.01 to 500.00. Values of 500.00 or more are treated as 500 and values less than 0.01 (including negative values) are treated as 0.01. The override factor is 0 only when 0 is specified. The unit is [%].

*1. The inputs to send a command for CNC Coordinate System NC Control are *CycleStart*, *Reset*, and *FeedHold*. If these variables are input simultaneously, the priority order conforms to *Reset* > *FeedHold* > *CycleStart*.

*2. *SingleBlock*, *MachineLock*, *AuxiliaryLock*, *DryRun*, and *ProgramNo* are *CycleStart* input options in *Standby*. The NC program runs in accordance with these options while Operating.

*3. *SingleBlock* and *BackTrace* are *CycleStart* input options in *Hold*.

● _sCNC_CTR_OUTPUTS_REF

Variable	Meaning	Data type	Valid range	Description
CycleStartReady	Cycle Start Ready	BOOL	TRUE or FALSE	TRUE when the NC program is ready to accept cycle start.
ManualIntervention-Ready	Manual Inter-vention Ready	BOOL	TRUE or FALSE	TRUE when the NC program is ready to accept the manual inter-vention.
BackTraceReady	Back Trace Ready	BOOL	TRUE or FALSE	TRUE when the NC program is ready to accept the back trace.
ProgramEnd	Program Completed	BOOL	TRUE or FALSE	TRUE when the NC program ter-minates normally, or FALSE when the NC program starts.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error Code	WORD	Refer to *Error Lists* on page 15-13.	Contains the error code when an error occurs. A value of 16#0000 indicates normal execution.
ExecutingStatus	NC Program Execution Status	ENUM _eCNC _EXECUTING _STATE	0: _cncStandby 1: _cncExecuting 2: _cncHold	Outputs the execution status of the NC program.
CurrentProgramNo	Executing Program Number	UINT	0 to 9,999	Outputs the program number of the program that is currently being executed. Default: 0*1
CurrentBlockNo	Executing Block Number	UDINT	0 to 4,294,967,295	Outputs the block number of the block that is currently being exe-cuted. Default: 0*1
CurrentLookahead BlockNo	Look-ahead Block Number	UDINT	0 to 4,294,967,295	Outputs the block number of the block that is currently being read ahead. Default: 0*1
ModalStatus	Modal Status	_sCNC _MODAL_REF	-	Outputs the status of the modal that is currently being read ahead.*1

*1. The value is initialized when the NC program terminates normally or when the reset is executed.
The previous value is retained when the NC program is aborted by CNC_CoordStop or Error Stop and the val-ue is initialized when the NC program is executed by the reset execution or Cycle Start.

_sCNC_MODAL_REF

Variable	Meaning	Data type	Valid range	Description
NonModal	NonModal State	DWORD	0 to FFFFFFFF	Outputs the G code modal status that is currently being executed. Default: 0*1 Bit0: G04 Bit1: G28 Bit2: G30 Bit3: G31 Bit4: G52 Bit5: G53
Motion	Motion	USINT	0 to 3	Outputs the G code modal status that is currently being executed. Default: 1*1 0: G00 1: G01 2: G02 3: G03
Plane	Plane	USINT	0 to 2	Outputs the G code modal status that is currently being executed. Default: 0*1 0: G17 1: G18 2: G19
Distance	Distance	USINT	0 to 1	Outputs the G code modal status that is currently being executed. Default: 0*1 0: G90 1: G91
Units	Unit	USINT	0 to 1	Outputs the G code modal status that is currently being executed. The default value follows the cartesian axis command unit of the CNC coordinate system parameter.*1 0: G20 1: G21
ToolRadius	Tool Compensation	USINT	0 to 2	Outputs the G code modal status that is currently being executed. Default: 0*1 0: G40 1: G41 2: G42

Variable	Meaning	Data type	Valid range	Description
ToolLengthOffset	Tool Length Compensation	USINT	0 to 2	Outputs the G code modal status that is currently being executed. Default: 2*1 0: G43 1: G44 2: G49
CannedCycle	Fixed Cycle	USINT	0 to 2	Outputs the G code modal status that is currently being executed. Default: 1*1 0: G74 1: G80 2: G84
ReturnLevel	Return Point Specification	USINT	0 to 1	Outputs the G code modal status that is currently being executed. Default: 0*1 0: G98 1: G99
Scaling	Scaling	USINT	0 to 1	Outputs the G code modal status that is currently being executed. Default: 0*1 0: G50 1: G51
CsSelection	Coordinate System Selection	USINT	0 to 6	Outputs the G code modal status that is currently being executed. Default: 0*1 0: Work coordinate system disable 1: G54 2: G55 3: G56 4: G57 5: G58 6: G59
PathControl	Path Control	USINT	0 to 1	Outputs the G code modal status that is currently being executed. Default: 1*1 0: G61 1: G64
Rotation	Rotation	USINT	0 to 1	Outputs the G code modal status that is currently being executed. Default: 1*1 0: G68 1: G69

Variable	Meaning	Data type	Valid range	Description
Mirroring	Mirroring	USINT	0 to 1	Outputs the G code modal status that is currently being executed. Default: 0*1 0: G50.1 1: G51.1
MultiBlockAcc	Multi-block Accelera-tion/Decelera-tion	USINT	0 to 1	Outputs the G code modal status that is currently being executed. Default: 0 0: G500 1: G501
S	S Code	LREAL	0 min.	Outputs the S code that is currently being executed. Default: 0*2
F	F Code	LREAL	0 min.	Outputs the F code that is currently being executed. Default: 0*1
Ta	Ta Code	LREAL	0 min.	Outputs the Ta code that is cur-rently being executed. The default value is the Accelera-tion Time of the CNC coordinate system parameters.*1
Td	Td Code	LREAL	0 min.	Outputs the Td code that is cur-rently being executed. The default value is the Decelera-tion Time of the CNC coordinate system parameters.*1
Ts	Ts Code	LREAL	0 min.	Outputs the Ts code of the modal that is currently being executed. The default value is the Jerk Time of the CNC coordinate system parameters.*1

*1. The value is initialized when the NC program terminates normally or when the reset is executed. The previous value is retained when the NC program is aborted by CNC_CoordStop or Error Stop and the value is initialized when the NC program is executed by the reset execution or Cycle Start.

*2. The value is retained, not initialized when the NC program terminates normally or when the reset is executed. If the NC program is aborted by CNC_CoordStop or Error Stop, the value is initialized when the spindle axis assignment is performed. The value is retained when the spindle axis assignment is not performed.

Precautions for Correct Use

Each actual structure includes Reserved areas. Do not create a sequence control program that refers to Reserved areas.

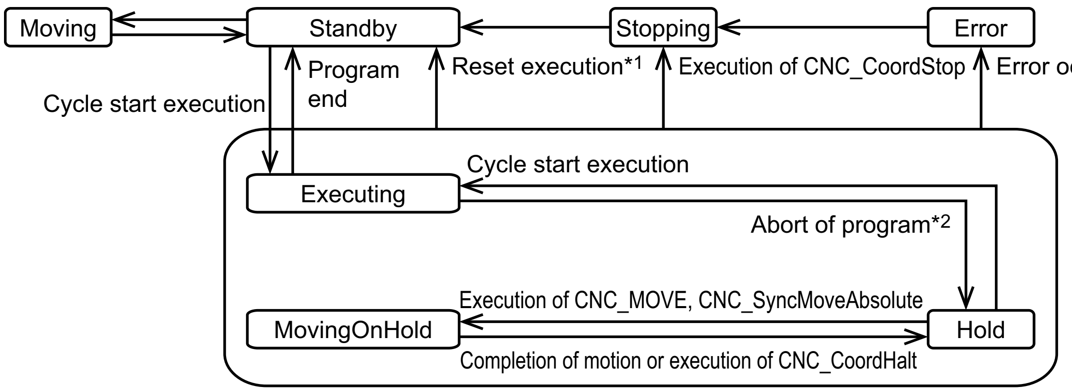
Functions

This instruction updates the values of *ControlInputs* (Numerical Control Inputs) and *ControlOutputs* (Numerical Control Outputs) in-out variables that are used to control NC programs in the CNC coordinate system. When *Enabled* is TRUE, the values of *ControlInputs* (Numerical Control Inputs) and *ControlOutputs* (Numerical Control Outputs) are updated with this instruction.

The instruction can execute the NC program loaded into the NC program buffer. To load data in the NC program buffer, download the NC program created with Sysmac Studio in advance, or load the NC program saved in the SD Memory Card using the CNC_LoadProgramFile instruction.

Only one NC program can be executed simultaneously in a CNC coordinate system.

The figure below shows the relationships between this instruction's operations and the CNC coordinate system status.



*1. Except *MovingOnHold* status and when G74, G84, or M19 is executing. If *Reset* is TRUE when G74, G84, or M19 is completed, the program is reset at that timing.

*2. Program abort refers to any one of the following states.

- *FeedHold* execution*3
- M00 or M01 execution
- 1-row execution completion by single block
- Back trace completion

*3. Except when G74, G84, or M19 is executing. If *FeedHold* (Feed Hold) is TRUE when G74, G84, or M19 is completed, the program is set to Feed Hold at that timing.

- When *CycleStart* (Cycle Start) is TRUE while *Standby* and *CycleStartReady* (Cycle Start Ready) is TRUE, the status transitions to Executing, which starts executing the NC program based on *ProgramNo* (Program Number). However, the transition is not performed when *Reset* or *FeedHold* is TRUE.
- When Execute NC program is completed or *Reset* is changed to TRUE, the status transitions to *Standby*.
- When *FeedHold* (Feed Hold) is changed to TRUE during the execution of NC program or when another program is interrupted due to an event, the status transitions to *Hold*.
- When the status is *Hold* and *ManualInterventionReady* (Manual Intervention Ready) is TRUE, the manual intervention is available. Refer to the explanation of *Manual Intervention* on page 12-11 for details.
- When the *Hold* and *BackTraceReady* (Back Trace Ready) is TRUE, *BackTrace* is available. Refer to the explanation of *Back Trace of NC Program* on page 12-13 for details.
- When *CycleStart* (Cycle Start) is TRUE while the status is *Hold* and *CycleStartReady* (Cycle Start Ready) is TRUE, the status transitions to *Executing* again, which restarts *Execute* NC program.

Additional Information

- The execution of NC Program is available when *CycleStartReady* (Cycle Start Ready) is TRUE. All the following conditions must be satisfied.
  a) All the positioning axes and the spindle axis in the CNC coordinate system are set to Servo ON.
  b) All the positioning axes in the CNC coordinate system have the home defined. (Excluding the spindle)
  c) The CNC coordinate system is in *Standby* or *Hold*, and axes other than the spindle axis are stopped.
- When the status transitions to *Executing*, operation starts after in-position check was completed.
- When deceleration stop is set by *FeedHold*, only all the positioning axes in the CNC coordinate system decelerate to a stop. If the multi-block acceleration/deceleration is disabled, deceleration stop are performed based on the feed hold acceleration/deceleration time of the CNC coordinate system parameter. If the multi-block acceleration/deceleration is disabled, deceleration stop are performed based on the maximum acceleration/deceleration rate of each CNC motor parameter.
- When immediate stop is set by *Reset*, only all the positioning axes in the CNC coordinate system stop immediately. When immediate stop is set by CNC_CoordStop or error detection, all the positioning axes and spindle axis in the CNC coordinate system stop immediately.

Instruction Details

Override

This is a function to change the override of the feedrate or spindle velocity in the execution of an NC program.

Changing the override value changes the velocity during the execution of an NC program.

For feedrate override, the override change rate during moving can be controlled by modifying the feedrate override change rate. Setting the feedrate override change rate to a positive value changes the override gradually to the target feedrate override value. Setting the feedrate override change rate to 0 changes the override immediately to the target override value.

When the instruction is not operating at feedrate, the override immediately changes to the target override value regardless of the feedrate override change rate.

Precautions for Correct Use

- The feedrate override is an override value for the feed rate (F). Therefore, for example, the feedrate override does not operate for the G code instructions such as G00 that operates at a rapid feedrate.
- When the feedrate override value is changed while the Multi-block Acceleration/Deceleration is enabled (G500 is enabled), the changed value does not apply to the operations that have been read ahead at the time of change. When the override value is changed, the value applies to the operations that have not been read ahead.
- The override value is disabled for the tapping operation (G74, G84) and the tapping operation is performed at an override value of 100%.

● Manual Intervention

If *FeedHold* changes to TRUE during execution of an NC program, the NC program decelerates to a stop. When the deceleration stop is completed, the status changes to *Hold*.

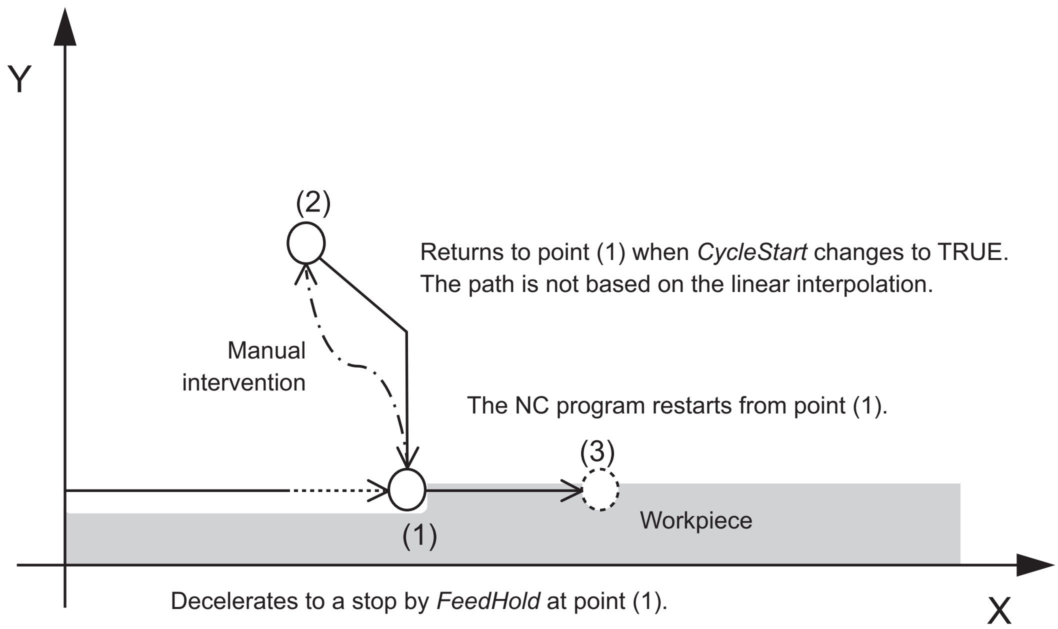
In the *Hold* status, you can execute some of the other CNC instructions. This is called a manual intervention.

Refer to *A-4 Instructions for Which Multi-execution Is Supported* on page A-15 for the instructions that enable the manual intervention.

Manual intervention is a function used to temporarily stop the NC program for troubleshooting purposes when machine troubles occurred during the processing operation by NC program.

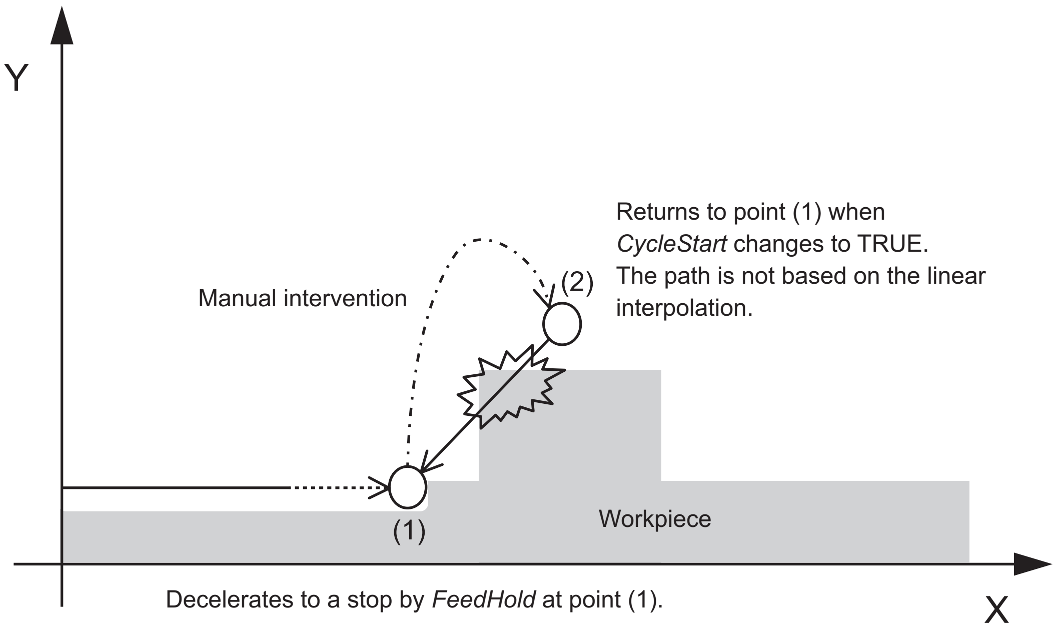
Also, troubleshooting is performed, and continuation is executed by *CycleStart*. Continuation refers to restarting the execution of the NC program after the CNC coordinate system returned to the position at which the CNC coordinate system stopped by *FeedHold*.

Executing continuation performs first to return to the position at which the CNC coordinate system stopped by *FeedHold* when *CycleStart* (Cycle Start) is changed to TRUE after manual intervention was completed. It then restarts the execution of the NC program. The return operation is performed independently for each CNC motor, therefore, the tool is positioned in the CNC coordinate system based on a non-linear interpolation manner. The maximum velocity is applied to each CNC motor for the return operation.



Precautions for Safe Use

Be sure to correctly perform manual intervention depending on the working direction and workpiece shape. Otherwise, the workpiece, machine, or tools may be damaged.



Precautions for Correct Use

To execute the manual intervention, all of the following conditions must be satisfied.

- The Multi-block Acceleration/Deceleration is enabled (G500 is enabled).
- The feed hold is stopped while G01, G02, or G03 is being executed.

  Additionally, the above conditions are satisfied when *ManualInterventionReady* (Manual Intervention Ready) of *ControlOutputs* (Numerical Control Outputs) is TRUE. The manual intervention program is interlocked using *ManualInterventionReady* (Manual Intervention Ready). When the CNC instruction for the manual intervention is started if *ManualInterventionReady* (Manual Intervention Ready) is FALSE, the CNC instruction changes to *CommandAborted* (Command Aborted).

● Back Trace of NC Program

If *FeedHold* changes to TRUE during execution of an NC program, the NC program decelerates to a stop. When the deceleration stop is completed, the status transitions to the *Hold* (Holding) status.

If *BackTrace* (Back Trace) changes to TRUE and *CycleStart* (Cycle Start) changes from FALSE to TRUE in the *Hold* (Holding) status, the back trace can be executed. The back trace function executes the NC program in backward direction from the stop position. The status transitions to *Executing* while the back trace is being executed.

However, back trace cannot be executed for the G00 (Positioning) operation of the NC program. When the NC program contains the G00 operation, it stops before the G00 operation.

If the back trace is executed in a status in which the operation is performed using an instruction that enables the manual intervention after the *Hold* (Holding) status, the back trace execution is disabled.

BackTrace is available only for operations of the positioning axis. It is not available for operations of the spindle axis.

The G or M code that is previous executed is not re-executed; therefore, *ModalStatus* holds the status that is set at *BackTrace* execution, and read-ahead processing is stopped.

However, only *CurrentBlockNo* is updated (rewound).

When the NC program returns to the point at which *BackTrace* was re-executed by *CycleStart* after *BackTrace* was executed once, the update of *ModalStatus* restarts.

Precautions for Correct Use

To execute the backtrace, all of the following conditions must be satisfied.

- The Multi-block Acceleration/Deceleration is enabled (G500 is enabled).
- The feedhold is stopped while G01, G02, or G03 is being executed.
- The manual intervention is never executed in the *Hold* status.

  Additionally, when *BackTraceReady* (Back Trace Ready) of *ControlOutputs* (Numerical Control Outputs) is TRUE, the above conditions are satisfied. The back trace execution program is interlocked using *BackTraceReady* (Back Trace Ready). If the back trace is executed when *BackTraceReady* (Back Trace Ready) is FALSE, the execution is disabled.

  The execution of back trace is not applied to the single block execution.

● Test of NC Program

Created NC program may be checked whether it can operate the machine as intended by executing the NC program before machining workpieces.

You can check the program either by actually operating the machine or, or by displaying the current position without operating the machine.

- Dry run

  This is a test run to operate the machine with workpieces removed to check tool operations.

  The machine runs at the dry run velocity specified using the relevant CNC coordinate system parameter regardless of the velocity specified by the NC program.

  If *DryRun* (Dry Run Enable) changes to TRUE when the execution of the NC program starts, the dry run is executed.

- Machine lock

  This is a test run to check the changes shown on the position indicator without operating the machine.

  If *MachineLock* (Machine Lock Enable) changes to TRUE when the execution of the NC program starts, the machine lock is executed. The NC program is executed as specified and the position indicator changes, however, the axes do not move.

  When the status transitions to the *Standby* status, the machine lock is released, and then the position indicator returns to the machine position.

  MachineLock applies to all of positioning axes and the spindle axis in the CNC coordinate system. When the machine lock is specified while the spindle axis performs the CW/CCW operation and the cycle start is executed, the spindle axis status is maintained, but the output is cut (a speed of 0 is output). Additionally, when the status of the CNC coordinate system transitions from *Executing* to *Standby* during machine lock, the status of the spindle axis transitions to *Standby*.

- M code lock

  This function is used to lock M codes for test running.

  If *AuxiliaryLock* (M Code Lock Valid) changes to TRUE when the execution of an NC program starts, the M code lock is executed. The M code does not run.

- Optional Input

  This function outputs an optional input signal to the NC program. This signal can be detected as an input signal in the NC program by setting each bit of *OptionalInputs* (Optional Input) to TRUE.

  Bit 0 of Optional Input is an input signal for Optional Stop (M01) that stops the NC program by detecting the input signal.

  Bits 1 to 31 of Optional Input are input signals for a command (/N*) that skips one block of the NC program by detecting the input signal.

  * N is a constant between 1 to 31.

- Single block

  When the NC program is started while *SingleBlock* (Single Block) changes to TRUE, step execution is performed. A row in which a block number (N**) is not described is not recognized as one block in the parsed NC program. The program is executed until the next block number is found.

  The NC program loaded from Sysmac Studio cannot be applied to single block execution. However, the single block execution of the NC program loaded from Sysmac Studio can be performed by rewriting the setting value of the single block execution option. To rewrite the setting value of the single block execution option, use the CNC_Write instruction. Specify _cncSingleBlockOption := 8 for *ParameterNumber* (Parameter Number) and set _cncSingleBlockOptionEnable := 1 to *SettingValue* (Setting Value).

● Modal Status

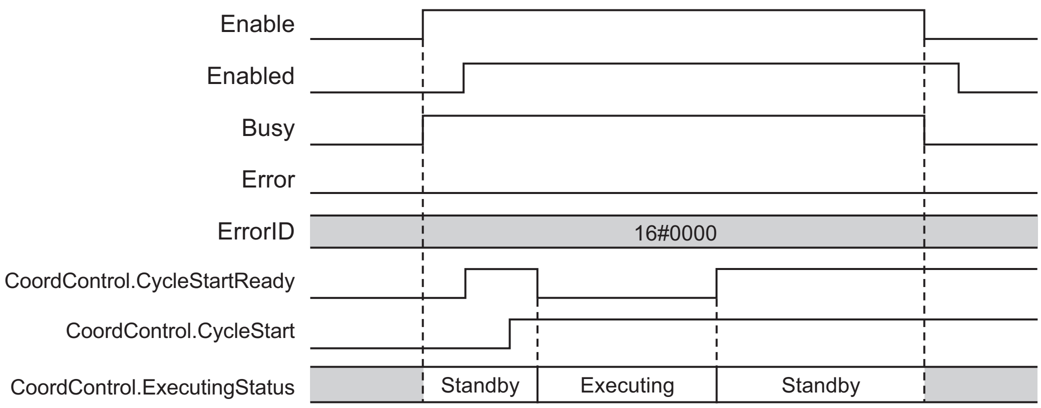
The valid modal status during execution of the NC program is output to *ModalStatus* (Modal Status) of *ControlOutputs* (Numerical Control Outputs). *ModalStatus* is maintained even while *Standby* is set by *FeedHold*. *ModalStatus* is reset at the timing shown below.

- *Reset* (Reset) is executed.
- *CycleStart* is executed in the *Standby* (Standby) status.
- The program that is currently executing changes to the end of program (M02/M30/M99).

When the program is stopped by CNC_CoordStop or CNC_ImmedieateStop or when the program is stopped as an error is detected during operation, *ModalStatus* is not reset.

Timing Chart

A timing chart for the operation of the CNC_CoordControl instruction is shown below.



While *Enabled* is TRUE, *CoordControl* is updated.

Re-execution of CNC Instructions

You cannot re-execute CNC instructions with enable-type inputs.

Multi-execution of CNC Instructions

Only one instance can enable this instruction in the CNC coordinate system.

When this instruction already has an instance enabled in the CNC coordinate system, if an attempt is made to enable this instruction of another instance in the same CNC coordinate system, the instruction is enabled for the subsequent instance.

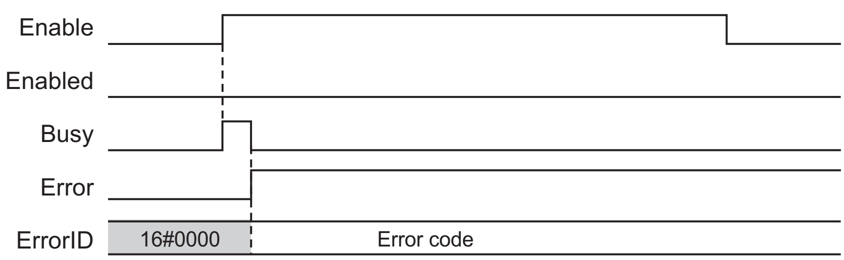
Refer to *A-4 Instructions for Which Multi-execution Is Supported* on page A-15 for details on multi-execution of CNC instructions.

Error

If this instruction cannot be executed, an error occurs, and *Error* will change to TRUE.

You can find out the cause of the error by referring to the value output by *ErrorID* (Error Code).

● Timing Chart When Error Occurs



● Error Code

Refer to *Section 15 Troubleshooting* for errors that occur in instructions.

Sample Programming

This section shows sample programming about the NC program execution control method.

Parameter Settings

The minimum settings required for this sample programming are given below.

● CNC Coordinate System Settings

Logical CNC motor configuration

CNC coordinate system	Logical CNC motor configuration
CNC coordinate system 0	3

Positioning axis configuration

CNC coordinate system	Positioning axis CNC motor number	Positioning axis configuration CNC motor	Positioning axis assignment
CNC coordinate system 0	CNC motor P0	CNC motor 0	X-axis
CNC coordinate system 0	CNC motor P1	CNC motor 1	Y-axis
CNC coordinate system 0	CNC motor P2	CNC motor 2	Z-axis

Spindle axis use CNC motor

CNC coordinate system	Spindle axis use CNC motor
CNC coordinate system 0	CNC motor 3

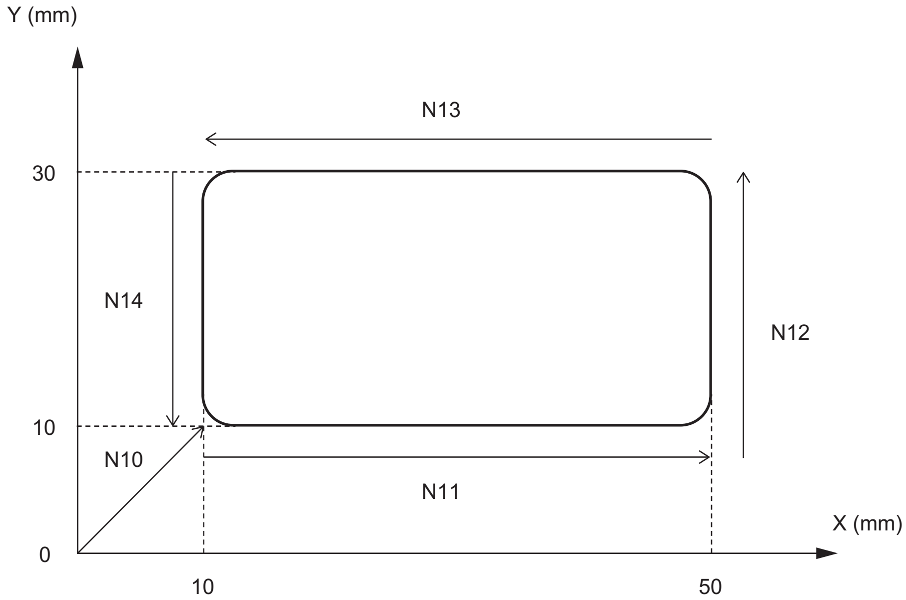
Operation Example

Use the CNC_CoordControl (CNC Coordinate System NC Control) instruction to execute the following NC program that has been loaded using the CNC_LoadProgramFile (Load NC Program) instruction.

● NC Program

```
// File name: NCProg1.txt
// Program number: 300
N00 G17 G91 F500
N10 G00 X10 Y10
N11 G01 X40
N12 Y20
N13 X-40
N14 Y-20
N15 M30
```

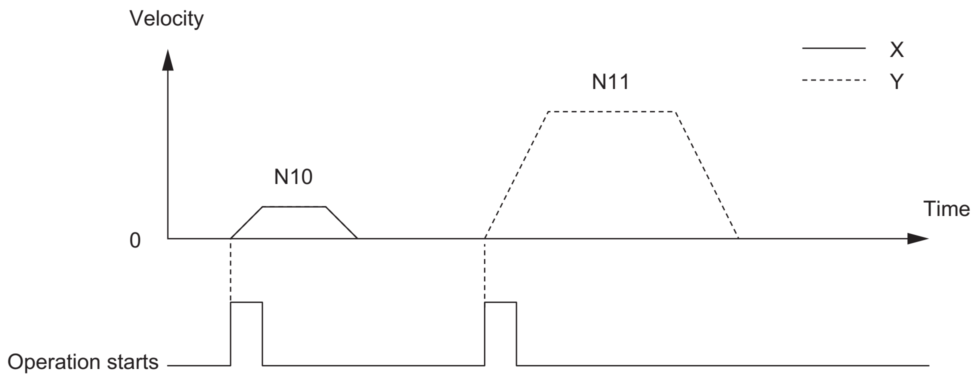
- **Operation Pattern 1 (NC Program Execution)**



1 Turning ON the Operation Start Switch

When you turn ON the operation start switch, CNC coordinate system 0 operates in accordance with the NC program.

- **Operation Pattern 2 (Single Block Execution)**



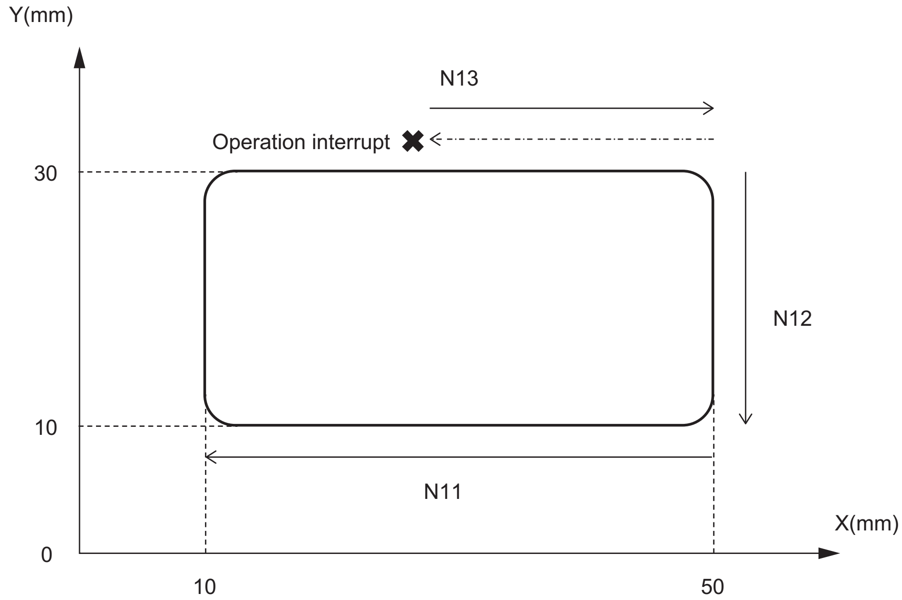
1 Turning ON the Single Block Enable Switch

Turn ON the single block enable switch.

2 Turning ON the Operation Start Switch

Every time you turn ON the operation start switch, CNC coordinate system 0 operates block by block in accordance with the NC program.

- **Operation Pattern 3 (Back Trace Execution)**



1 **Turning ON the Operation Start Switch**

When you turn ON the operation start switch, CNC coordinate system 0 operates in accordance with the NC program.

2 **Turning ON the Operation Interrupt Switch**

When you turn ON the operation interrupt switch, the executing NC program pauses.

3 **Turning ON the Back Trace Enable Switch**

When you turn ON the operation start switch in the back trace enable switch ON status, CNC coordinate system 0 rewinds the NC program to run operations.

- **Operation Pattern 4 (Dry Run Execution)**

1 **Turning ON the Dry Run Enable Switch**

Turn ON the dry run enable switch.

2 **Turning ON the Operation Start Switch**

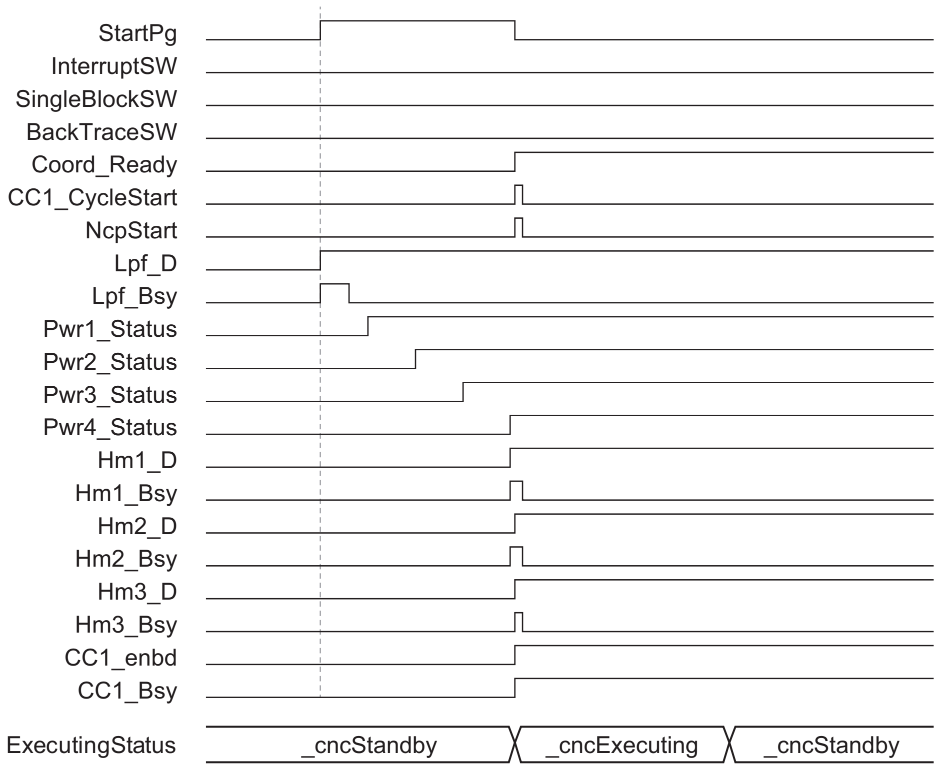
When you turn ON the operation start switch, the machine lock and auxiliary function lock are enabled, and then CNC coordinate system 0 runs the NC program in the dry run mode. At this time, the command position moves, but the feedback position does not change from the machine position. The velocity also becomes the dry run velocity and the auxiliary function output does not operate.

Ladder Diagram

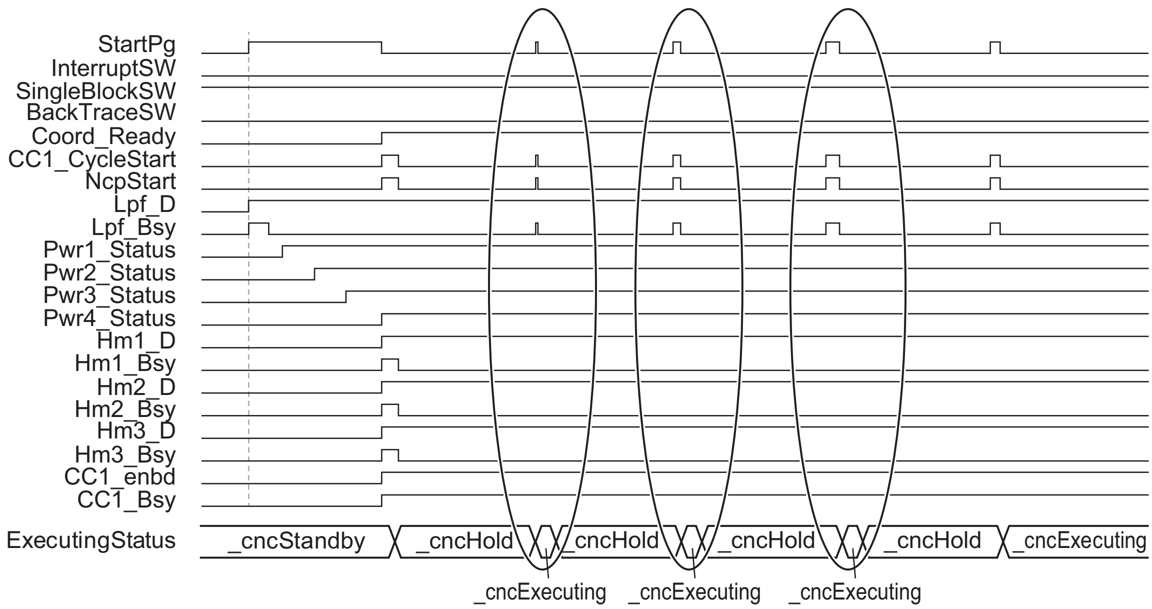
● Main Variables

Name	Data type	Default	Comment
CNC_Coord000	_sCNC_COORD_REF	---	CNC coordinate system variable of CNC coordinate system 0.
CNC_Motor000	_sCNC_MOTOR_REF	---	CNC motor variable of CNC motor 0.
StartPg	BOOL	FALSE	Indicates the operation start switch. The Servo is turned ON when this variable is TRUE and EtherCAT process data communications are established.
Coord_Ready	BOOL	FALSE	Indicates the execution ready completion in the NC program. TRUE when the NC program execution conditions are satisfied.
NcpStart	BOOL	FALSE	When this variable is TRUE and the cycle start ready is completed, the NC program is executed.
InitFlg	BOOL	FALSE	Indicates the input parameter setting completion. Input parameters are set when this variable is FALSE. When the input parameter setting is completed, this variable changes to TRUE.
InterruptSW	BOOL	FALSE	Indicates the operation interrupt switch. When this variable is TRUE, the execution of the NC program pauses.
SingleBlockSW	BOOL	FALSE	Indicates the single block enable switch. When this variable is TRUE, the single block execution is enabled.
BackTraceSW	BOOL	FALSE	Indicates the back trace enable switch. When this variable is TRUE, the back trace is enabled.
DryRunSW	BOOL	FALSE	Indicates the dry run enable switch. When this variable is TRUE, the dry run, machine lock, and auxiliary function lock are enabled.

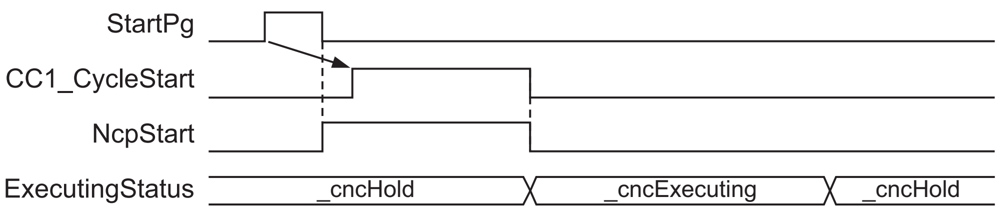
● **Timing Chart 1 (NC Program Execution)**



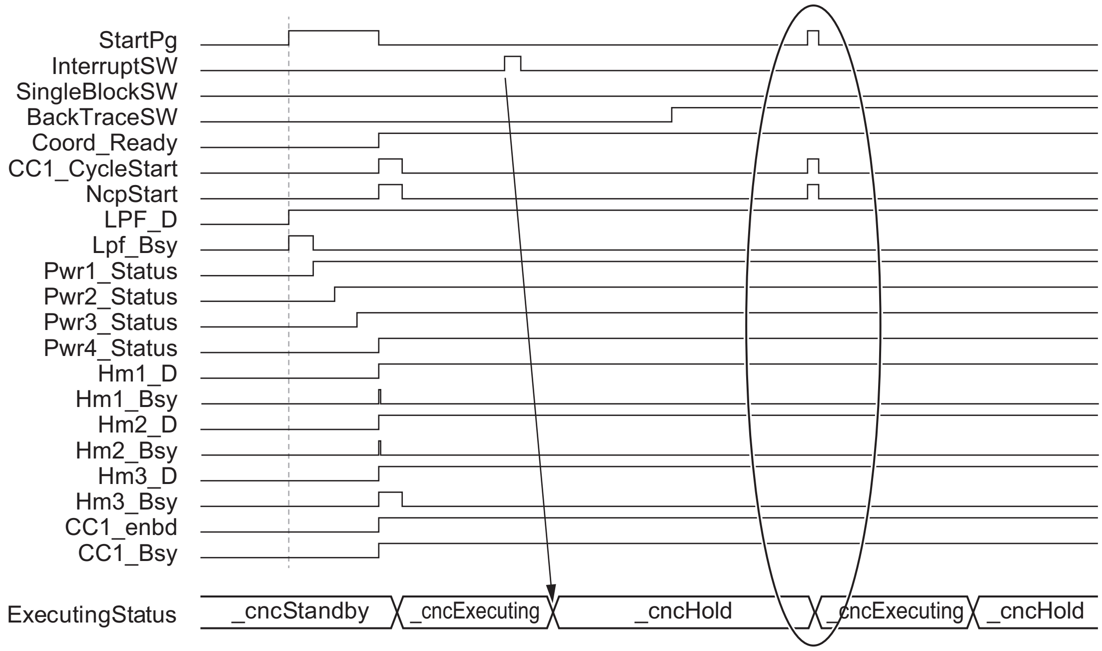
● **Timing Chart 2 (Single Block Execution)**



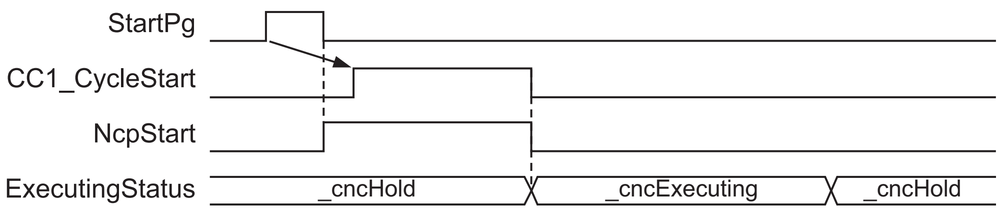
The details of the circle marked portions are shown below.



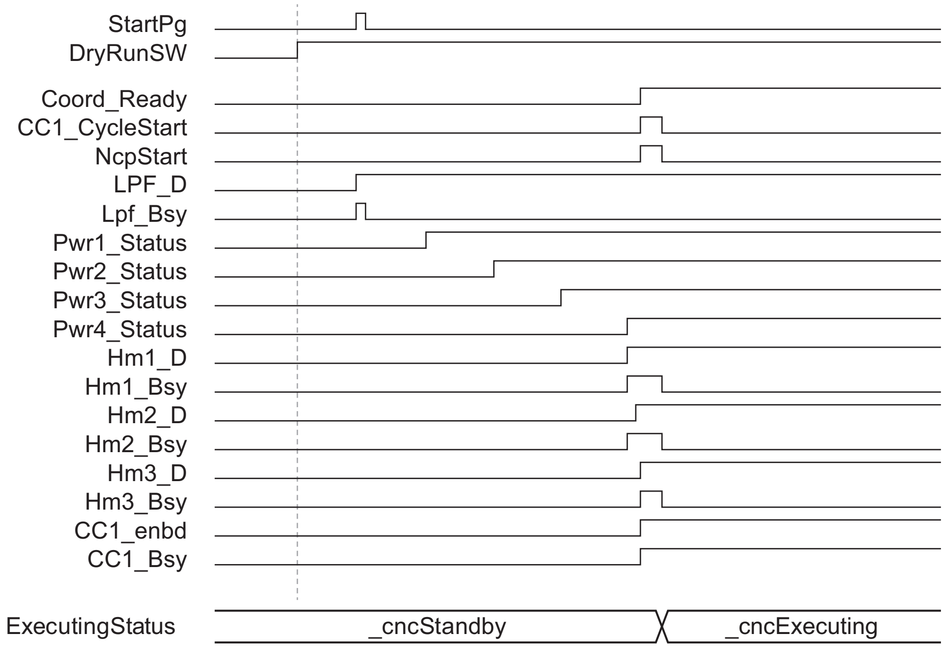
● Timing Chart 3 (Back Trace Execution)



The details of the circle marked portions are shown below.



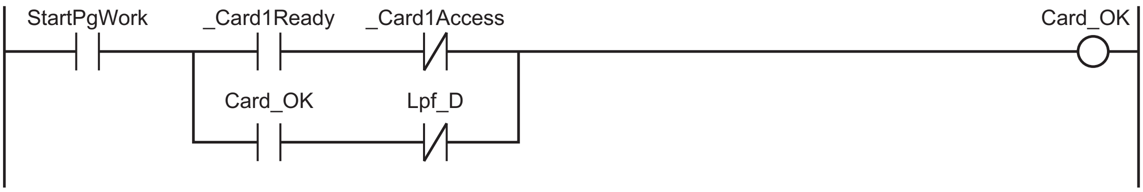
● Timing Chart 4 (Dry Run Execution)



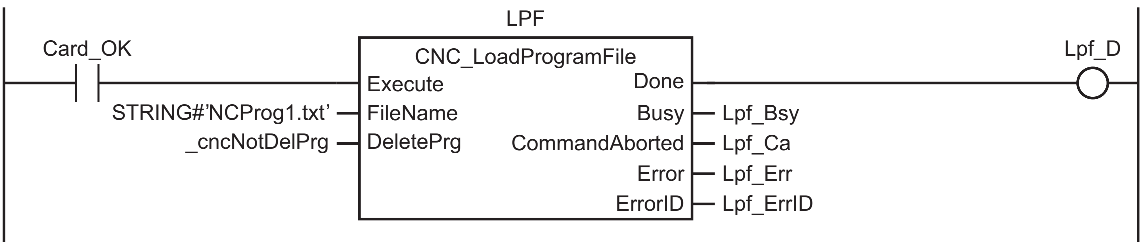
● Sample Programming (NC Program Execution/Single Block Execution/Back Trace Execution)

When contact *StartPg* is TRUE, the first pressing process of the operation start switch is executed.

When contact *StartPgWork* is TRUE, check that an SD Memory Card is inserted.



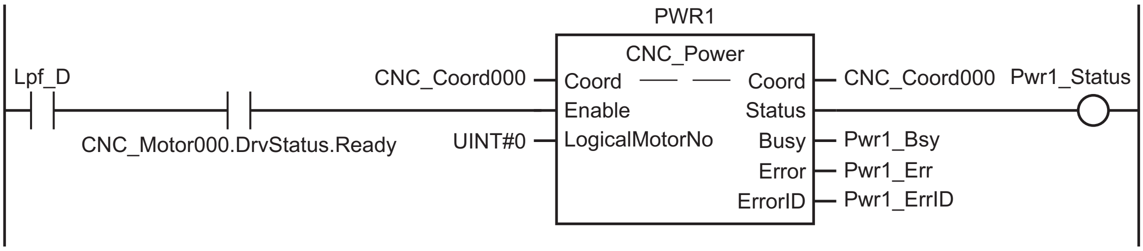
After checking that an SD Memory Card is inserted, start the Load NC Program to load the NC program.



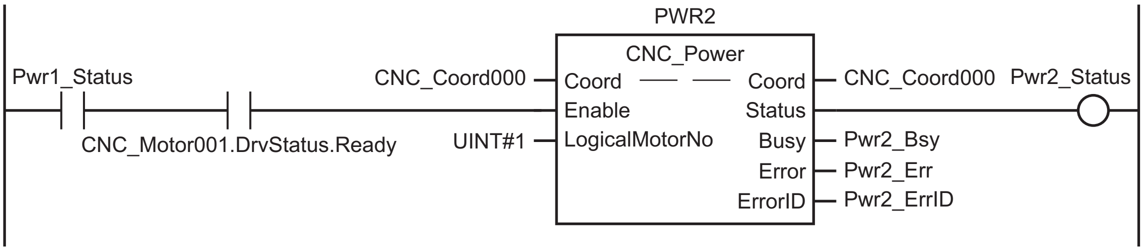
If a monitoring information error occurs during loading of the NC program, the error handler for the device (FaultHandler) is executed.

Program the FaultHandler according to the device.

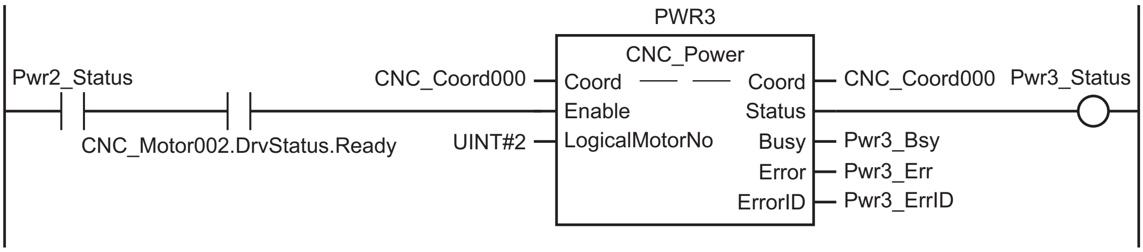
When the Load NC Program is completed, check that the Servo Drive is in the servo ready status and set the X-axis to the Servo ON status.



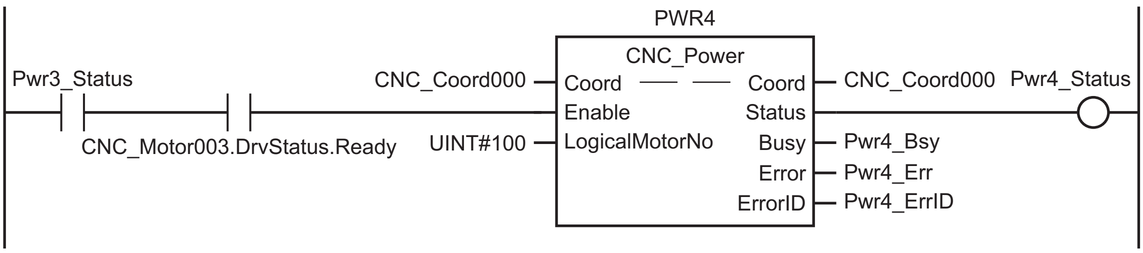
When the X-axis is in the Servo ON status, check that the Servo Drive is in the servo ready status and set the Y-axis to the Servo ON status.



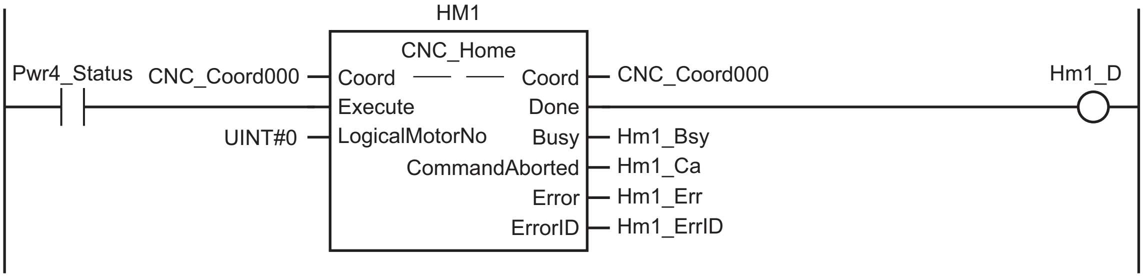
When the Y-axis is in the Servo ON status, check that the Servo Drive is in the servo ready status and set the Z-axis to the Servo ON status.



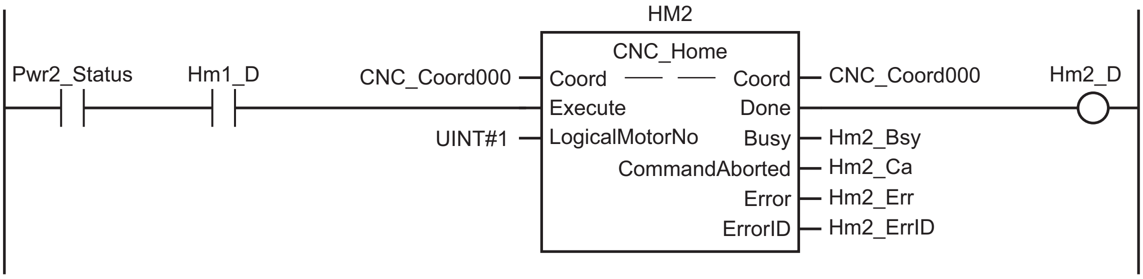
When the Z-axis is in the Servo ON status, check that the Servo Drive is in the servo ready status and set the spindle axis to the Servo ON status.



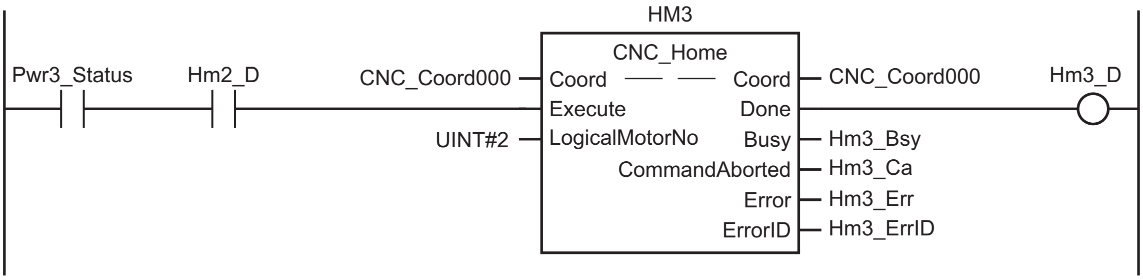
When the positioning axis and spindle axis are in the Servo ON status, execute homing of the X-axis.



After the home of the X-axis is defined, execute homing of the Y-axis.

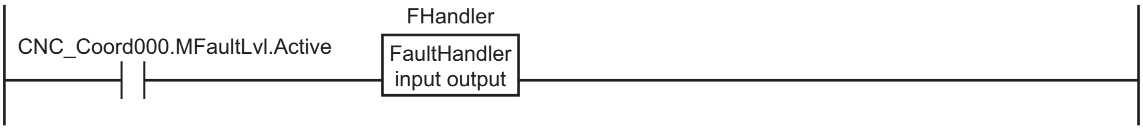


After the home of the Y-axis is defined, execute homing of the Z-axis.

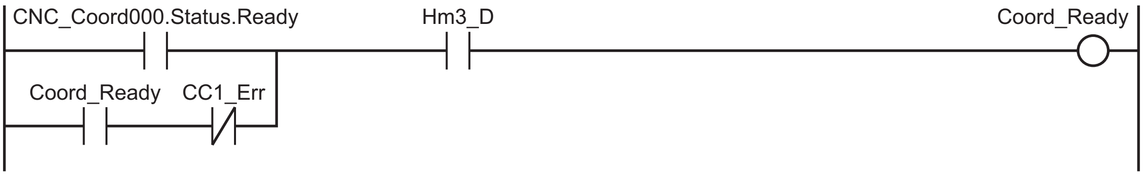


If a minor fault level error occurs in CNC coordinate system 0, the error handler for the device (FaultHandler) is executed.

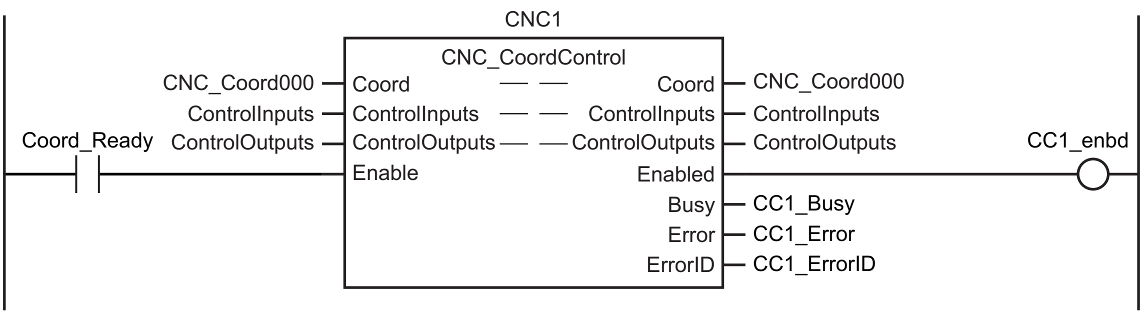
Program the FaultHandler according to the device.



When the NC program execution ready is completed, Coord_Ready changes to TRUE.



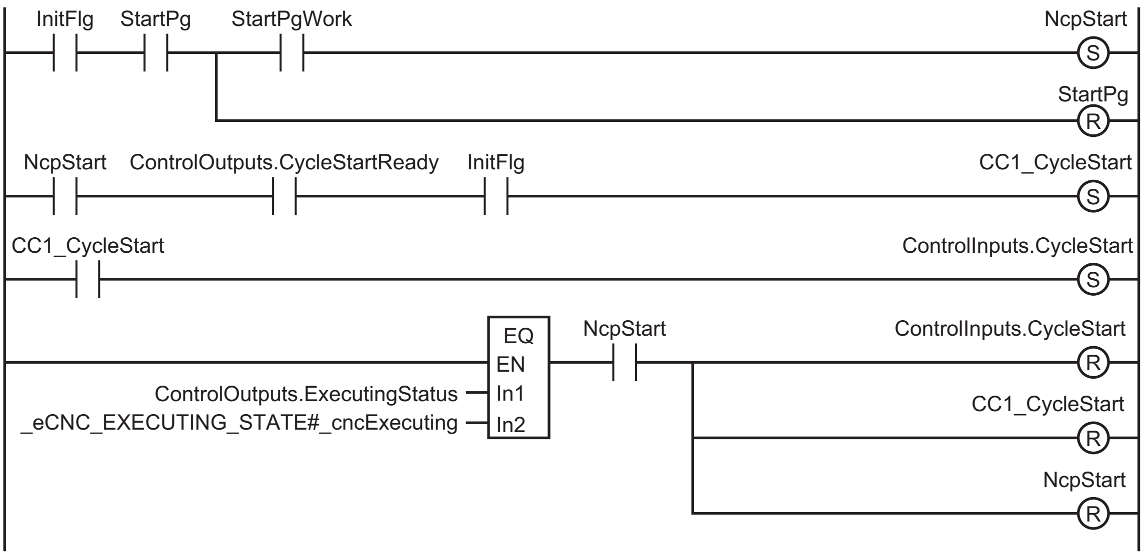
When Coord_Ready is TRUE, start the execution control of the NC program.



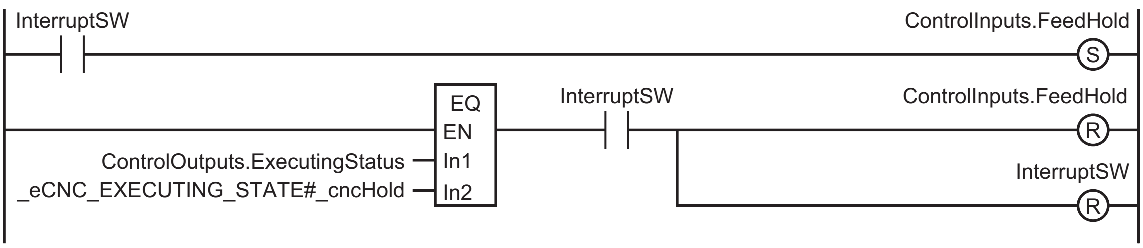
When the execution control of the NC program is started, set the parameters of the CNC_Coord-Control (CNC Coordinate System NC Control) instruction.

```
// CNC_CoordControl parameter
// Specify the NC program (No.300) that was loaded with the CNC_LoadProgramFile
(Load NC Program) instruction.
ControlInputs.ProgramNo :=UINT#300;
ControlInputs.FeedrateVelFactor:=LREAL#300.0;
ControlInputs.SpindleVelFactor:=LREAL#100.0;
ControlInputs.AuxiliaryLock:=FALSE;
ControlInputs.BackTrace :=FALSE;
ControlInputs.DryRun    :=FALSE;
ControlInputs.FeedHold  :=FALSE;
ControlInputs.MachineLock:=FALSE;

// Change InitFlag to TRUE after setting the input parameters.
InitFlg := TRUE;

// Start the NC program.
NcpStart:=TRUE;
```

When contact *StartPg* is TRUE, check that the cycle start ready is completed and start the execution of the NC program.



When contact *InterruptSW* is TRUE, stop the execution of the NC program.



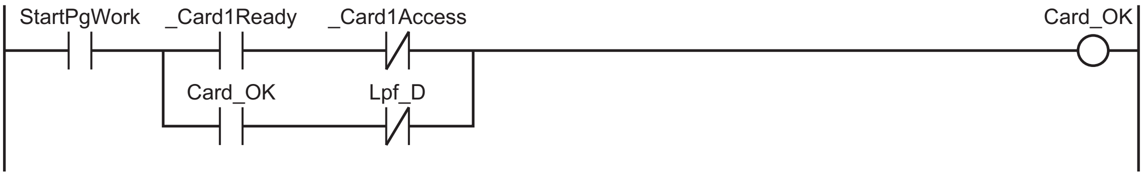
When contact *BackTraceSW* is TRUE, enable the back trace.

When contact *SingleBlockSW* is TRUE, enable the single block execution.

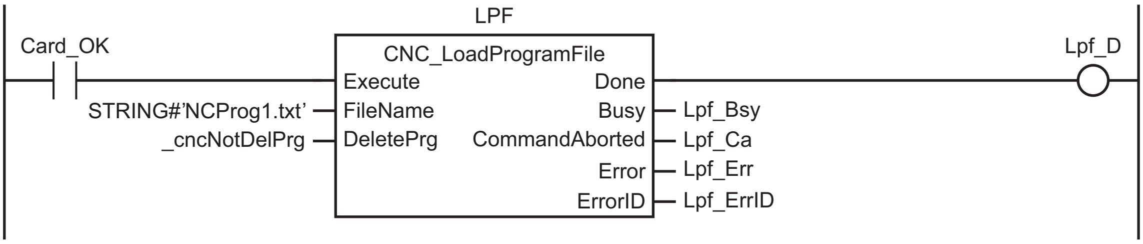
- **Sample Programming (Dry Run Execution)**

When contact *StartPg* is TRUE, the first pressing process of the operation start switch is executed.

When contact *StartPgWork* is TRUE, check that an SD Memory Card is inserted.



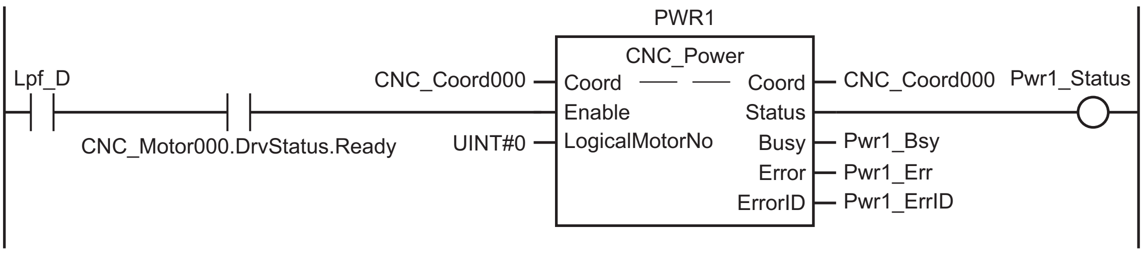
After checking that an SD Memory Card is inserted, start the Load NC Program to load the NC program.



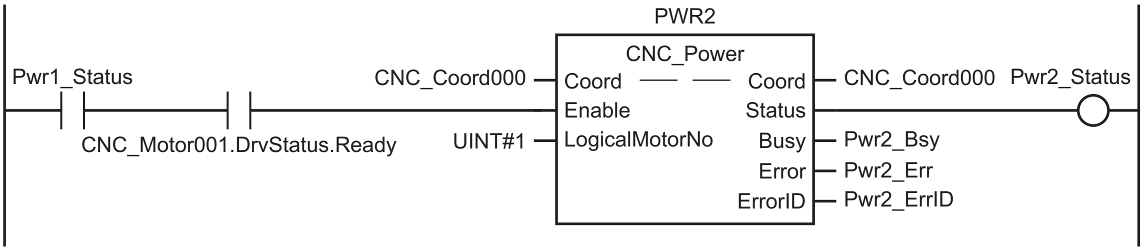
If a monitoring information error occurs during loading of the NC program, the error handler for the device (FaultHandler) is executed.

Program the FaultHandler according to the device.

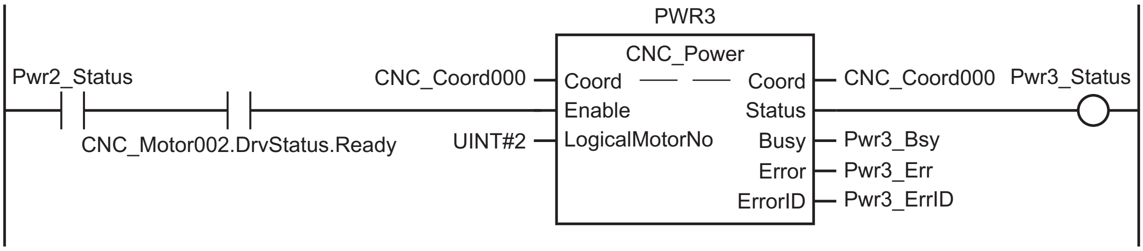
When the Load NC Program is completed, check that the Servo Drive is in the servo ready status and set the X-axis to the Servo ON status.



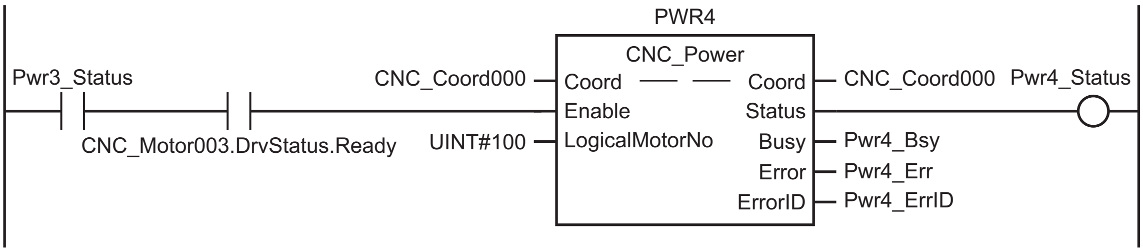
When the X-axis is in the Servo ON status, check that the Servo Drive is in the servo ready status and set the Y-axis to the Servo ON status.



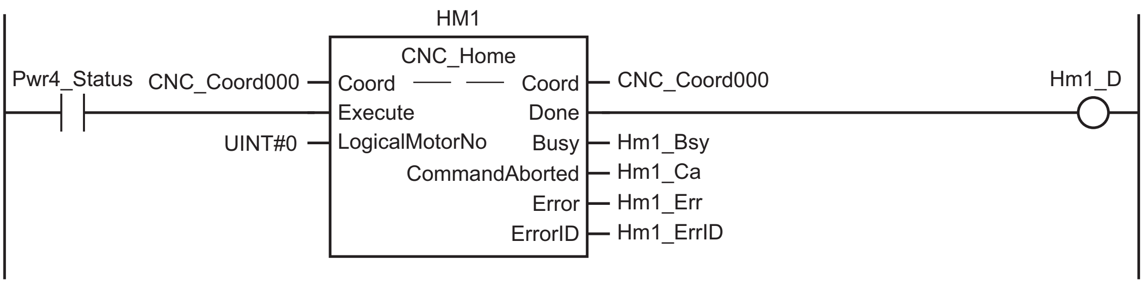
When the Y-axis is in the Servo ON status, check that the Servo Drive is in the servo ready status and set the Z-axis to the Servo ON status.



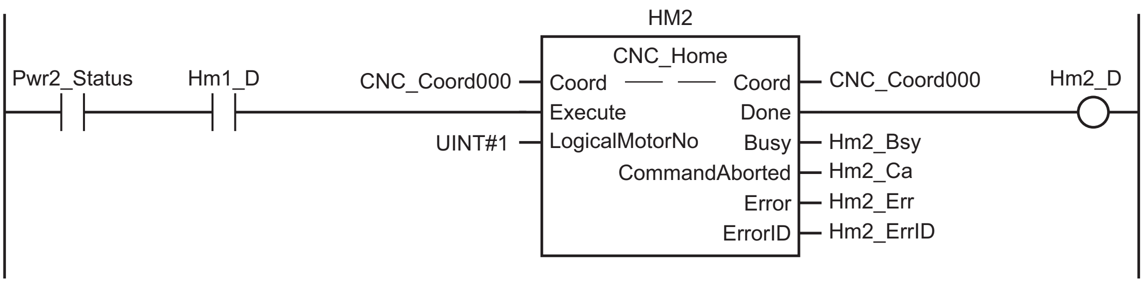
When the Z-axis is in the Servo ON status, check that the Servo Drive is in the servo ready status and set the spindle axis to the Servo ON status.



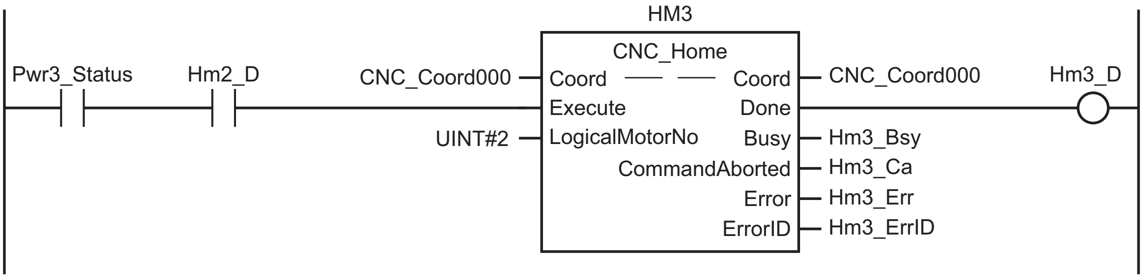
When the positioning axis and spindle axis are in the Servo ON status, execute homing of the X-axis.



After the home of the X-axis is defined, execute homing of the Y-axis.

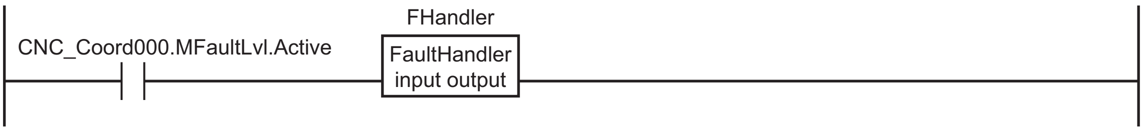


After the home of the Y-axis is defined, execute homing of the Z-axis.

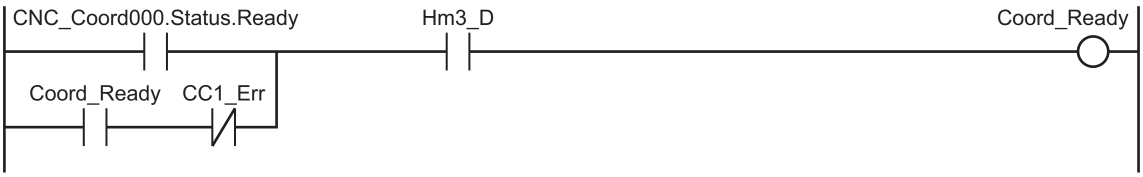


If a minor fault level error occurs in CNC coordinate system 0, the error handler for the device (FaultHandler) is executed.

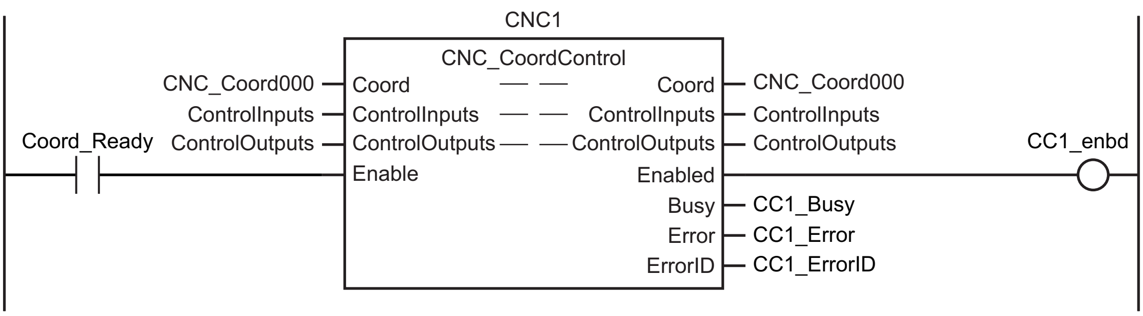
Program the FaultHandler according to the device.



When the NC program execution ready is completed, *Coord_Ready* changes to TRUE.



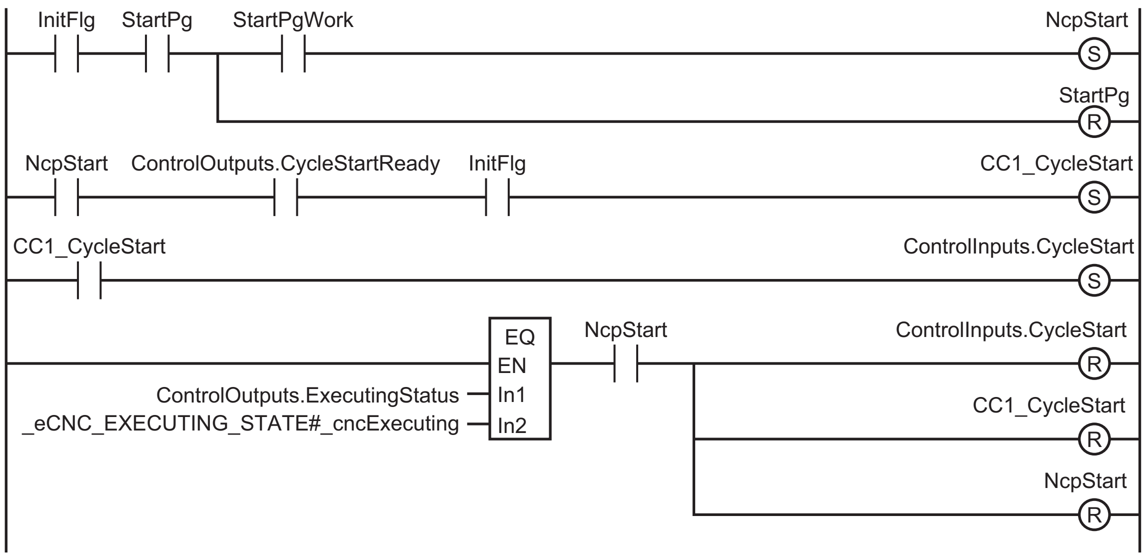
When *Coord_Ready* is TRUE, start the execution control of the NC program.



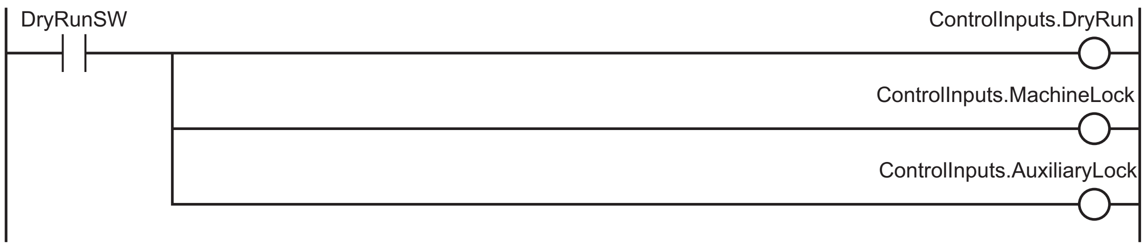
When the execution control of the NC program is started, set the parameters of the CNC_Coord-Control (CNC Coordinate System NC Control) instruction.

```
// CNC_CoordControl parameter
// Specify the NC program (No.300) that was loaded with the CNC_LoadProgram-
File (Load NC Program) instruction.
ControlInputs.ProgramNo :=UINT#300;
ControlInputs.FeedrateVelFactor:=LREAL#300.0;
ControlInputs.SpindleVelFactor:=LREAL#100.0;
ControlInputs.AuxiliaryLock:=FALSE;
ControlInputs.BackTrace :=FALSE;
ControlInputs.DryRun    :=FALSE;
ControlInputs.FeedHold  :=FALSE;
ControlInputs.MachineLock:=FALSE;

// Change InitFlag to TRUE after setting the input parameters.
InitFlg := TRUE;

// Start the NC program.
NcpStart:=TRUE;
```

When contact *StartPg* is TRUE, check that the cycle start ready is completed and start the execution of the NC program.



When contact *DryRunSW* is TRUE, enable the dry run, machine lock, and auxiliary function lock.

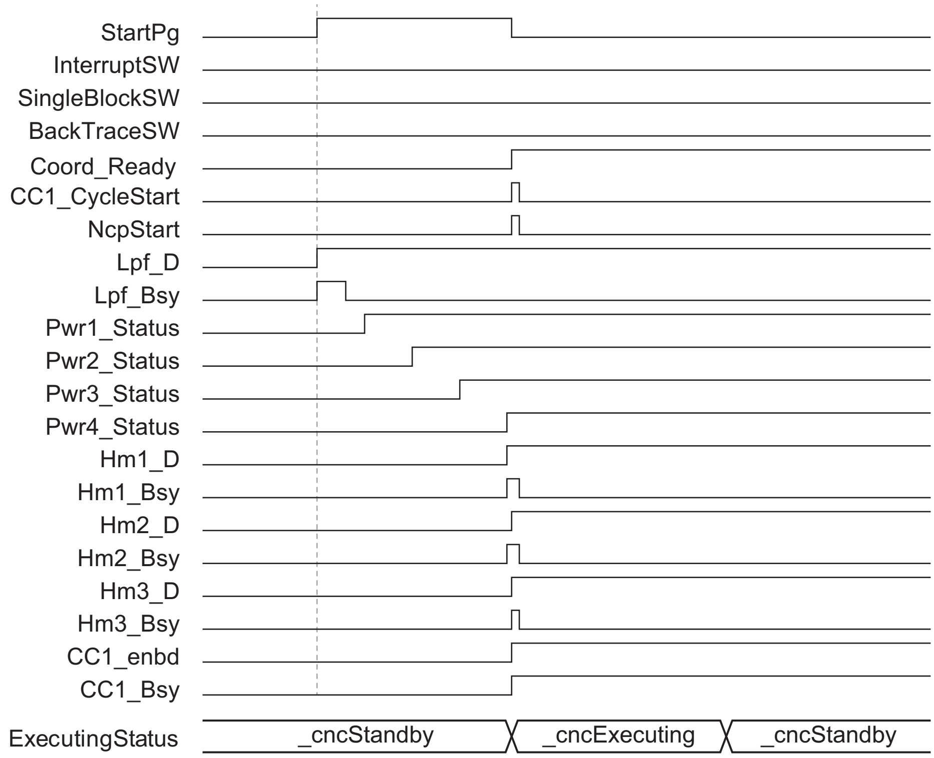


Structured Text (ST)

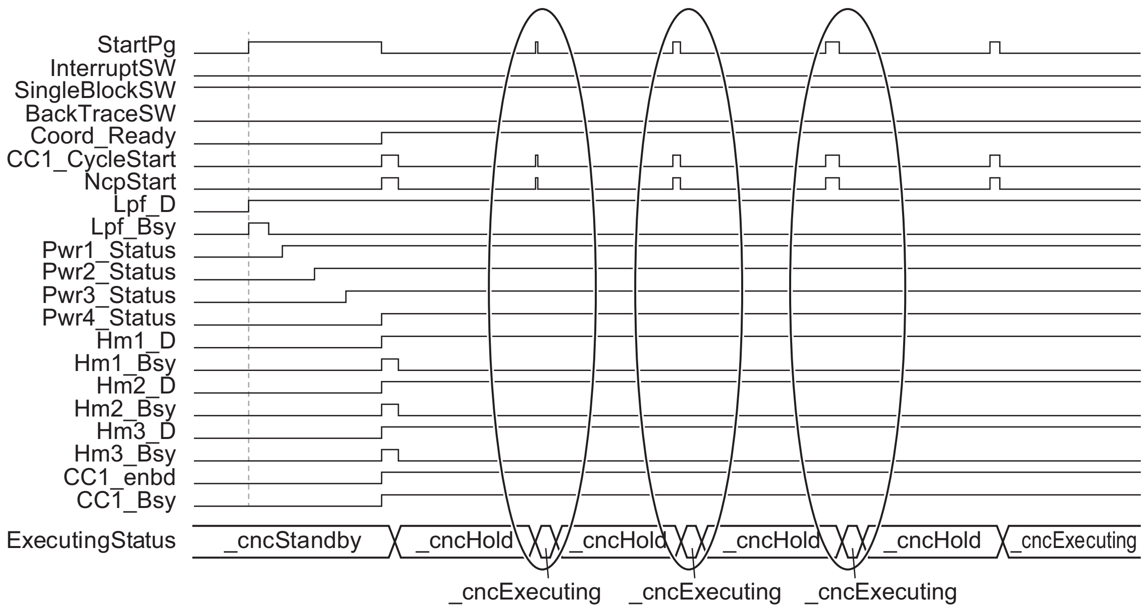
Main Variables

Name	Data type	Default	Comment
CNC_Coord000	_sCNC_COORD_REF	---	CNC coordinate system variable of CNC coordinate system 0.
CNC_Motor000	_sCNC_MOTOR_REF	---	CNC motor variable of CNC motor 0.
StartPg	BOOL	FALSE	Indicates the operation start switch. The Servo is turned ON when this variable is TRUE and EtherCAT process data communications are established.
Coord_Ready	BOOL	FALSE	Indicates the execution ready completion the NC program. TRUE when the NC program execution conditions are satisfied.
NcpStart	BOOL	FALSE	When this variable is TRUE and the cycle start ready is completed, the NC program is executed.
InitFlg	BOOL	FALSE	Indicates the input parameter setting completion. Input parameters are set when this variable is FALSE. When the input parameter setting is completed, this variable changes to TRUE.
InterruptSW	BOOL	FALSE	Indicates the operation interrupt switch. When this variable is TRUE, the execution of the NC program pauses.
SingleBlockSW	BOOL	FALSE	Indicates the single block enable switch. When this variable is TRUE, the single block execution is enabled.
BackTraceSW	BOOL	FALSE	Indicates the back trace enable switch. When this variable is TRUE, the back trace is enabled.
DryRunSW	BOOL	FALSE	Indicates the dry run enable switch. When this variable is TRUE, the dry run, machine lock, and auxiliary function lock are enabled.

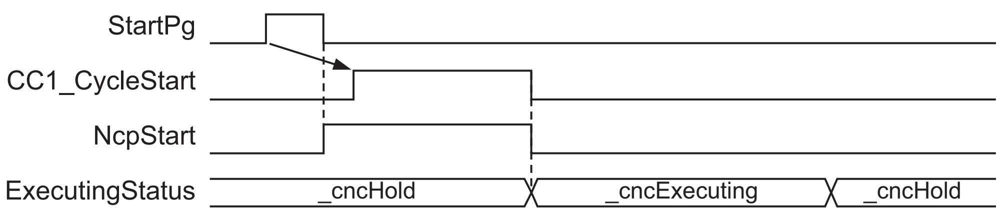
● Timing Chart 1 (NC Program Execution)



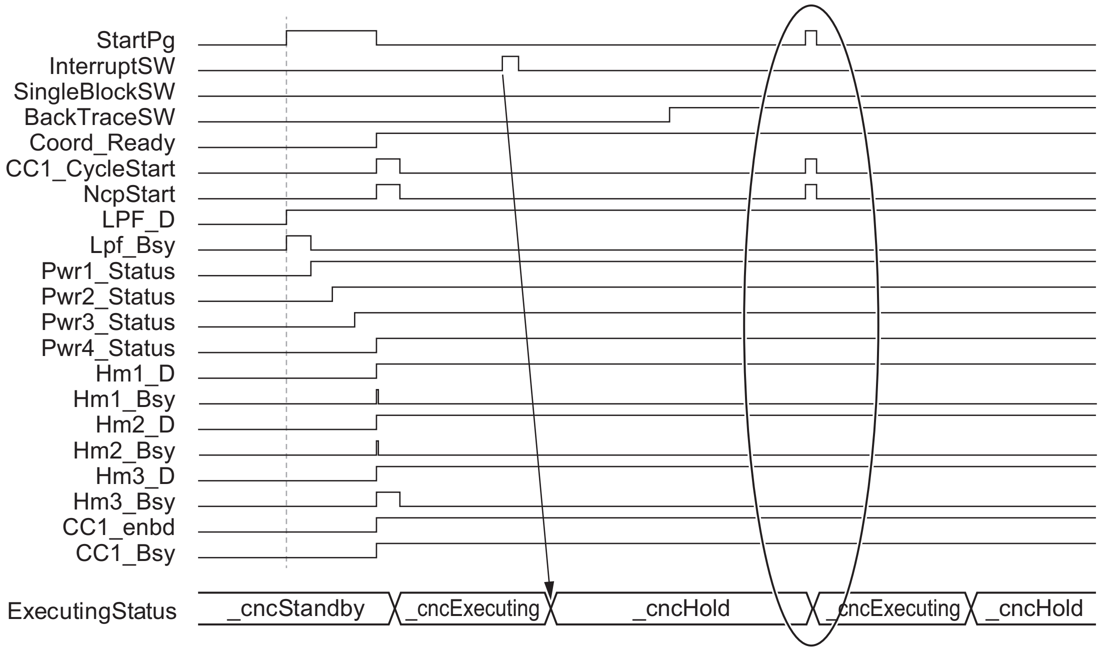
● Timing Chart 2 (Single Block Execution)



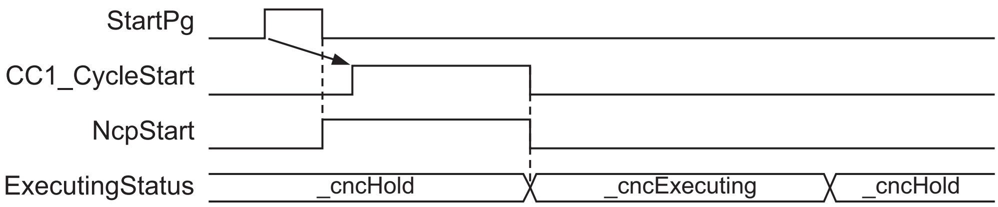
The details of the circle marked portions are shown below.



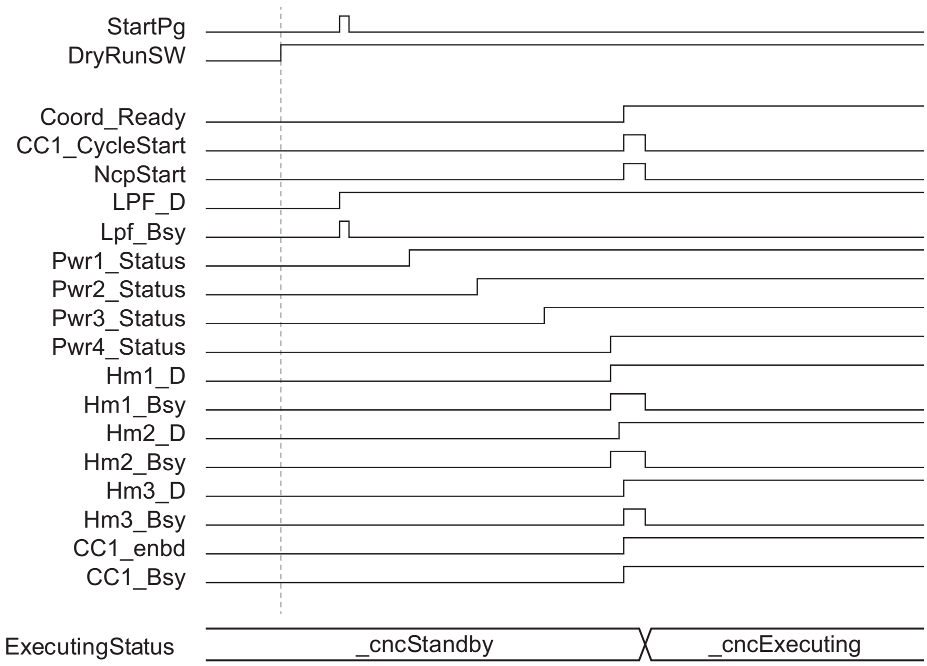
● Timing Chart 3 (Back Trace Execution)



The details of the circle marked portions are shown below.



● Timing Chart 4 (Dry Run Execution)



- **Sample Programming (NC Program Execution/Single Block Execution/Back Trace Execution)**

```
// When StartPg is TRUE, execute the first pressing process of the operation start
switch.
IF (StartPg = TRUE) AND (StartPgWork=FALSE) THEN
        StartPgWork:=TRUE;
END_IF;

// When StartPgWork is TRUE, check that an SD Memory Card is inserted.
IF (StartPgWork = TRUE) THEN
        IF ( _Card1Access=FALSE ) AND ( _Card1Ready =TRUE) THEN
                LPF_Ex:=TRUE;
        END_IF;
END_IF;

// If a monitoring information error occurs during loading of the NC program, exe-
cute the error handler for the device (FaultHandler).
// Program the FaultHandler according to the device.
IF (_CNC_COM.Obsr.Active=TRUE) THEN
        FaultHandler();
END_IF;

// When the Load NC Program is completed, check that the Servo Drive is in the servo
ready status and set the X-axis to the ON status.
IF (LPF_Dn = TRUE) AND (CNC_Motor000.DrvStatus.Ready=TRUE) THEN
                Pwr1_En:=TRUE;
        ELSE
                Pwr1_En:=FALSE;
END_IF;

// When the X-axis is in the Servo ON status, check that the Servo Drive is in the
servo ready status and set the Y-axis to the Servo ON status.
IF (Pwr1_Status = TRUE) AND (CNC_Motor001.DrvStatus.Ready=TRUE) THEN
        Pwr2_En:=TRUE;
ELSE
        Pwr2_En:=FALSE;
END_IF;

// When the Y-axis is in the Servo ON status, check that the Servo Drive is in the
servo ready status and set the Z-axis to the Servo ON status.
IF (Pwr2_Status = TRUE) AND (CNC_Motor002.DrvStatus.Ready=TRUE) THEN
        Pwr3_En:=TRUE;
ELSE
        Pwr3_En:=FALSE;
END_IF;

// When the Z-axis is in the Servo ON status, check that the Servo Drive is in the
servo ready status and set the spindle axis to the Servo ON status.
IF (Pwr3_Status = TRUE) AND (CNC_Motor003.DrvStatus.Ready=TRUE) THEN
        Pwr4_En:=TRUE;
ELSE
        Pwr4_En:=FALSE;
END_IF;
```

```
// When the positioning axis and spindle axis are in the Servo ON status, execute
homing of the X-axis.
IF (Pwr4_Status=TRUE) THEN
        Hm1_Ex:=TRUE;
END_IF;

// After the home of the X-axis is defined, execute homing of the Y-axis.
IF (Pwr2_Status=TRUE) AND (Hm1_D=TRUE) THEN
        Hm2_Ex:=TRUE;
END_IF;

// After the home of the Y-axis is defined, execute homing of the Z-axis.
IF (Pwr3_Status=TRUE) AND (Hm2_D=TRUE) THEN
        Hm3_Ex:=TRUE;
END_IF;

// If a minor fault level error occurs in coordinate system 0, execute the error
handler for the device (FaultHandler).
// Program the FaultHandler according to the device.
IF (CNC_Coord000.MFaultLvl.Active=TRUE) THEN
        FaultHandler();
END_IF;

// When the NC program execution ready is completed, Coord_Ready changes to TRUE.
IF (Hm3_D =TRUE) AND (CNC_Coord000.Status.Ready=TRUE) THEN
        Coord_Ready :=TRUE;
ELSIF(CC1_Err = TRUE) THEN
        Coord_Ready :=FALSE;
END_IF;

// When Coord_Ready is TRUE, start the execution control of the NC program.
IF (Coord_Ready=TRUE)THEN
        CC1_En:=TRUE;
ELSE
        CC1_En:=FALSE;
END_IF;

// Processing when input parameters are not set
IF(CC1_enbd= TRUE)AND( InitFlg=FALSE) THEN
        // CNC_CoordControl parameter
        // Specify the NC program (No.300) that was loaded with the CNC_LoadPro-
gramFile (Load NC Program) instruction.
        ControlInputs.ProgramNo:=UINT#300;
        ControlInputs.FeedrateVelFactor:=LREAL#300.0;
        ControlInputs.SpindleVelFactor:=LREAL#100.0;
        ControlInputs.AuxiliaryLock:=FALSE;
        ControlInputs.BackTrace:=FALSE;
        ControlInputs.DryRun:=FALSE;
        ControlInputs.FeedHold:=FALSE;
        ControlInputs.MachineLock:=FALSE;
        // Change InitFlag to TRUE after setting the input parameters.
        InitFlg := TRUE;
        // Start the NC program.
        NcpStart:=TRUE;
END_IF;
```

```
// Check that the cycle start ready is completed and start the execution of the NC
program.
IF (InitFlg=TRUE) AND (ControlOutputs.CycleStartReady=TRUE) AND (NcpStart=TRUE)
THEN
        CC1_CycleStart:=TRUE;
END_IF;
IF( CC1_CycleStart =TRUE) THEN
                ControlInputs.CycleStart:=TRUE;
END_IF;

// When the NC program is executed, CC1_CycleStart and NcpStart change to FALSE.
IF (ControlOutputs.ExecutingStatus = _eCNC_EXECUTING_STATE#_cncExecuting) THEN
        NcpStart:=FALSE;
        CC1_CycleStart:=FALSE;
        ControlInputs.CycleStart:=FALSE;
END_IF;

// Pressing the operation start switch again re-executes the NC program.
IF (StartPg = TRUE) THEN
        StartPg := FALSE;
        IF (StartPgWork = TRUE) AND (InitFlg=TRUE)THEN
                NcpStart:=TRUE;
        END_IF;
END_IF;

// When InterruptSW is TRUE, the execution of the NC program pauses.
IF (InterruptSW = TRUE) THEN
        ControlInputs.FeedHold :=TRUE;
        // Check that the NC program stops and set the FeedHold flag to OFF.
        IF (ControlOutputs.ExecutingStatus= _eCNC_EXECUTING_STATE#_cncHold)THEN
                ControlInputs.FeedHold :=FALSE;
                InterruptSW:=FALSE;
        END_IF;
END_IF;

// When BackTraceSW is TRUE, determine whether the back trace can be used. When the
back trace can be used, enable the back trace.
IF (BackTraceSW = TRUE) THEN
        IF (ControlOutputs.BackTraceReady=TRUE) THEN
                ControlInputs.BackTrace:=TRUE;
        END_IF;
ELSE
        ControlInputs.BackTrace:=FALSE;
END_IF;

// When SingleBlockSW is TRUE, enable the single block execution.
IF (SingleBlockSW = TRUE) THEN
        ControlInputs.SingleBlock:=TRUE;
ELSE
        ControlInputs.SingleBlock:=FALSE;
END_IF;
```

```
// CNC_Power of X-axis
PWR1(
        Coord:= CNC_Coord000,
        Enable:=Pwr1_En,
        LogicalMotorNo:=UINT#0,
        Status=>Pwr1_Status,
        Busy => Pwr1_Bsy,
    Error => Pwr1_Err,
    ErrorID => Pwr1_ErrID
);
// CNC_Power of Y-axis
PWR2(
        Coord:= CNC_Coord000,
        Enable:=Pwr2_En,
        LogicalMotorNo:=UINT#1,
        Status=>Pwr2_Status,
        Busy => Pwr2_Bsy,
    Error => Pwr2_Err,
    ErrorID => Pwr2_ErrID
);
// CNC_Power of Z-axis
PWR3(
        Coord:= CNC_Coord000,
        Enable:=Pwr3_En,
        LogicalMotorNo:=UINT#2,
        Status=>Pwr3_Status,
        Busy => Pwr3_Bsy,
    Error => Pwr3_Err,
    ErrorID => Pwr3_ErrID
);
// CNC_Power of spindle axis
PWR4(
        Coord:= CNC_Coord000,
        Enable:=Pwr4_En,
        LogicalMotorNo:=UINT#100,
        Status=>Pwr4_Status,
        Busy => Pwr4_Bsy,
    Error => Pwr4_Err,
    ErrorID => Pwr4_ErrID
);
// CNC_Home of X-axis
HM1(
  Coord := CNC_Coord000,
  Execute := Hm1_Ex,
  LogicalMotorNo :=UINT#0,
  Done => Hm1_D,
  Busy => Hm1_Bsy,
  CommandAborted=> Hm1_Ca,
  Error => Hm1_Err,
  ErrorID => Hm1_ErrID
);
```

```
// CNC_Home of Y-axis
HM2(
  Coord := CNC_Coord000,
  Execute := Hm2_Ex,
  LogicalMotorNo :=UINT#1,
  Done => Hm2_D,
  Busy => Hm2_Bsy,
  CommandAborted=> Hm2_Ca,
  Error => Hm2_Err,
  ErrorID => Hm2_ErrID
);
// CNC_Home of Z-axis
HM3(
  Coord := CNC_Coord000,
  Execute := Hm3_Ex,
  LogicalMotorNo :=UINT#2,
  Done => Hm3_D,
  Busy => Hm3_Bsy,
  CommandAborted=> Hm3_Ca,
  Error => Hm3_Err,
  ErrorID => Hm3_ErrID
);

//      CNC_CoordControl
CC1(
        Coord:= CNC_Coord000,
        ControlInputs:=ControlInputs,
        ControlOutputs:=ControlOutputs,
        Enable:=CC1_En,
        Enabled=>CC1_enbd,
        Busy=>CC1_Bsy,
        Error=>CC1_Err,
        ErrorID=>CC1_ErrID
);

// CNC_LoadProgramFile
LPF(
        Execute:=LPF_Ex,
        FileName:=STRING#'NCProg1.txt',
        DeletePrg:=_eCNC_DELETE_PRG#_cncNotDelPrg,
        Done=>LPF_D,
        Busy=>LPF_Bsy,
        CommandAborted=>LPF_Ca,
        Error=>LPF_Err,
        ErrorID=>LPF_ErrID
);
```

- **Sample Programming (Dry Run Execution)**

```
// When StartPg is TRUE, execute the first pressing process of the operation start
switch.
IF (StartPg = TRUE) AND (StartPgWork=FALSE) THEN
        StartPgWork:=TRUE;
END_IF;

// When StartPgWork is TRUE, check that an SD Memory Card is inserted.
IF (StartPgWork = TRUE) THEN
        IF ( _Card1Access=FALSE ) AND ( _Card1Ready =TRUE) THEN
                LPF_Ex:=TRUE;
        END_IF;
END_IF;

// If a monitoring information error occurs during loading of the NC program, exe-
cute the error handler for the device (FaultHandler).
// Program the FaultHandler according to the device.
IF (_CNC_COM.Obsr.Active=TRUE) THEN
        FaultHandler();
END_IF;

// When the Load NC Program is completed, check that the Servo Drive is in the servo
ready status and set the X-axis to the ON status.
IF (LPF_Dn = TRUE) AND (CNC_Motor000.DrvStatus.Ready=TRUE) THEN
                Pwr1_En:=TRUE;
        ELSE
                Pwr1_En:=FALSE;
END_IF;

// When the X-axis is in the Servo ON status, check that the Servo Drive is in the
servo ready status and set the Y-axis to the Servo ON status.
IF (Pwr1_Status = TRUE) AND (CNC_Motor001.DrvStatus.Ready=TRUE) THEN
        Pwr2_En:=TRUE;
ELSE
        Pwr2_En:=FALSE;
END_IF;

// When the Y-axis is in the Servo ON status, check that the Servo Drive is in the
servo ready status and set the Z-axis to the Servo ON status.
IF (Pwr2_Status = TRUE) AND (CNC_Motor002.DrvStatus.Ready=TRUE) THEN
        Pwr3_En:=TRUE;
ELSE
        Pwr3_En:=FALSE;
END_IF;

// When the Z-axis is in the Servo ON status, check that the Servo Drive is in the
servo ready status and set the spindle axis to the Servo ON status.
IF (Pwr3_Status = TRUE) AND (CNC_Motor003.DrvStatus.Ready=TRUE) THEN
        Pwr4_En:=TRUE;
ELSE
        Pwr4_En:=FALSE;
END_IF;

// When the positioning axis and spindle axis are in the Servo ON status, execute
homing of the X-axis.
IF (Pwr4_Status=TRUE) THEN
        Hm1_Ex:=TRUE;
END_IF;
```

```
// After the home of the X-axis is defined, execute homing of the Y-axis.
IF (Pwr2_Status=TRUE) AND (Hm1_D=TRUE) THEN
        Hm2_Ex:=TRUE;
END_IF;

// After the home of the Y-axis is defined, execute homing of the Z-axis.
IF (Pwr3_Status=TRUE) AND (Hm2_D=TRUE) THEN
        Hm3_Ex:=TRUE;
END_IF;

// If a minor fault level error occurs in coordinate system 0, execute the error
handler for the device (FaultHandler).
// Program the FaultHandler according to the device.
IF (CNC_Coord000.MFaultLvl.Active=TRUE) THEN
        FaultHandler();
END_IF;

// When the NC program execution ready is completed, Coord_Ready changes to TRUE.
IF (Hm3_D =TRUE) AND (CNC_Coord000.Status.Ready=TRUE) THEN
        Coord_Ready :=TRUE;
ELSIF(CC1_Err = TRUE) THEN
        Coord_Ready :=FALSE;
END_IF;

// When Coord_Ready is TRUE, start the execution control of the NC program.
IF (Coord_Ready=TRUE)THEN
        CC1_En:=TRUE;
ELSE
        CC1_En:=FALSE;
END_IF;

// Processing when input parameters are not set
IF(CC1_enbd= TRUE)AND( InitFlg=FALSE) THEN
        // CNC_CoordControl parameter
        // Specify the NC program (No.300) that was loaded with the CNC_LoadPro-
gramFile (Load NC Program) instruction.
        ControlInputs.ProgramNo:=UINT#300;
        ControlInputs.FeedrateVelFactor:=LREAL#300.0;
        ControlInputs.SpindleVelFactor:=LREAL#100.0;
        ControlInputs.AuxiliaryLock:=FALSE;
        ControlInputs.BackTrace:=FALSE;
        ControlInputs.DryRun:=FALSE;
        ControlInputs.FeedHold:=FALSE;
        ControlInputs.MachineLock:=FALSE;
        // Change InitFlag to TRUE after setting the input parameters.
        InitFlg := TRUE;
        // Start the NC program.
        NcpStart:=TRUE;
END_IF;

// Check that the cycle start ready is completed and start the execution of the NC
program.
IF (InitFlg=TRUE) AND (ControlOutputs.CycleStartReady=TRUE) AND (NcpStart=TRUE)
THEN
        CC1_CycleStart:=TRUE;
END_IF;
IF( CC1_CycleStart =TRUE) THEN
                ControlInputs.CycleStart:=TRUE;
END_IF;
```

```
// When the NC program is executed, CC1_CycleStart and NcpStart change to FALSE.
IF (ControlOutputs.ExecutingStatus = _eCNC_EXECUTING_STATE#_cncExecuting) THEN
        NcpStart:=FALSE;
        CC1_CycleStart:=FALSE;
        ControlInputs.CycleStart:=FALSE;
END_IF;

// Pressing the operation start switch again re-executes the NC program.
IF (StartPg = TRUE) THEN
        StartPg := FALSE;
        IF (StartPgWork = TRUE) AND (InitFlg=TRUE)THEN
                NcpStart:=TRUE;
        END_IF;
END_IF;

// When DryRunSW is TRUE, enable the dry run, machine lock, and auxiliary function
lock.
IF (DryRunSW = TRUE) THEN
        ControlInputs.DryRun:=TRUE;
        ControlInputs.MachineLock:=TRUE;
        ControlInputs.AuxiliaryLock:=TRUE;
ELSE
        ControlInputs.DryRun:=FALSE;
        ControlInputs.MachineLock:=FALSE;
        ControlInputs.AuxiliaryLock:=FALSE;
END_IF;

// CNC_Power of X-axis
PWR1(
        Coord:= CNC_Coord000,
        Enable:=Pwr1_En,
        LogicalMotorNo:=UINT#0,
        Status=>Pwr1_Status,
        Busy => Pwr1_Bsy,
    Error => Pwr1_Err,
    ErrorID => Pwr1_ErrID
);
// CNC_Power of Y-axis
PWR2(
        Coord:= CNC_Coord000,
        Enable:=Pwr2_En,
        LogicalMotorNo:=UINT#1,
        Status=>Pwr2_Status,
        Busy => Pwr2_Bsy,
    Error => Pwr2_Err,
    ErrorID => Pwr2_ErrID
);
// CNC_Power of Z-axis
PWR3(
        Coord:= CNC_Coord000,
        Enable:=Pwr3_En,
        LogicalMotorNo:=UINT#2,
        Status=>Pwr3_Status,
        Busy => Pwr3_Bsy,
    Error => Pwr3_Err,
    ErrorID => Pwr3_ErrID
);
```

```
// CNC_Power of spindle axis
PWR4(
        Coord:= CNC_Coord000,
        Enable:=Pwr4_En,
        LogicalMotorNo:=UINT#100,
        Status=>Pwr4_Status,
        Busy => Pwr4_Bsy,
    Error => Pwr4_Err,
    ErrorID => Pwr4_ErrID
);
// CNC_Home of X-axis
HM1(
  Coord := CNC_Coord000,
  Execute := Hm1_Ex,
  LogicalMotorNo :=UINT#0,
  Done => Hm1_D,
  Busy => Hm1_Bsy,
  CommandAborted=> Hm1_Ca,
  Error => Hm1_Err,
  ErrorID => Hm1_ErrID
);
// CNC_Home of Y-axis
HM2(
  Coord := CNC_Coord000,
  Execute := Hm2_Ex,
  LogicalMotorNo :=UINT#1,
  Done => Hm2_D,
  Busy => Hm2_Bsy,
  CommandAborted=> Hm2_Ca,
  Error => Hm2_Err,
  ErrorID => Hm2_ErrID
);
// CNC_Home of Z-axis
HM3(
  Coord := CNC_Coord000,
  Execute := Hm3_Ex,
  LogicalMotorNo :=UINT#2,
  Done => Hm3_D,
  Busy => Hm3_Bsy,
  CommandAborted=> Hm3_Ca,
  Error => Hm3_Err,
  ErrorID => Hm3_ErrID
);

//      CNC_CoordControl
CC1(
        Coord:= CNC_Coord000,
        ControlInputs:=ControlInputs,
        ControlOutputs:=ControlOutputs,
        Enable:=CC1_En,
        Enabled=>CC1_enbd,
        Busy=>CC1_Bsy,
        Error=>CC1_Err,
        ErrorID=>CC1_ErrID
);
```

```
// CNC_LoadProgramFile
LPF(
        Execute:=LPF_Ex,
        FileName:=STRING#'NCProg1.txt',
        DeletePrg:=_eCNC_DELETE_PRG#_cncNotDelPrg,
        Done=>LPF_D,
        Busy=>LPF_Bsy,
        CommandAborted=>LPF_Ca,
        Error=>LPF_Err,
        ErrorID=>LPF_ErrID
);
```

CNC_CoordCatchMCode

The CNC_CoordCatchMCode instruction receives the M code output from the NC program using the sequence control program.

Instruction	Name	FB/FUN	Graphic expression	ST expression
CNC_CoordCatchMCode	Catch M Code	FB	CNC_CoordCatchMCode_instance CNC_CoordCatchMCode Coord ---- Coord MCode ---- MCode Enable — Enabled MCodeNo — Strobe Busy Error ErrorID	CNC_CoordCatchMCode_instance (Coord :=*parameter*, MCode :=*parameter*, Enable :=*parameter*, MCodeNo. :=*parameter*, Enabled =>*parameter*, Strobe =>*parameter* Busy =>*parameter*, Error =>*parameter*, ErrorID =>*parameter*,);

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Enable	Execute	BOOL	TRUE or FALSE	FALSE	The instruction is executed when *Enable* is TRUE.
MCodeNo	M Code Number	UINT	0 to 191	0	Specify an M code number to be received. This value is applied only when Enable changes to TRUE.

Output Variables

Name	Meaning	Data type	Valid range	Description
Enabled	Enable	BOOL	TRUE or FALSE	TRUE when the CNC coordinate system is being controlled.
Strobe	Strobe	BOOL	TRUE or FALSE	TRUE when the M code output specified in an M code is received from the CNC coordinate system.
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error Code	WORD	*1	Contains the error code when an error occurs. A value of 16#0000 indicates normal execution.

*1. Refer to *Section 15 Troubleshooting*.

Output Variable Update Timing

Name	Timing for changing to TRUE	Timing for changing to FALSE
Enabled	When *Enable* changes to TRUE.	• When *Enable* changes to FALSE. • When *Error* changes to TRUE.
Busy	When *Enable* changes to TRUE.	• When *Error* changes to TRUE. • When *Enable* changes to FALSE.
Error	When there is an error in the execution conditions or input parameters for the instruction.	When the error is cleared.
Strobe	When the M code output specified in an M code is received from the CNC coordinate system.	When the M code output is reset by CNC_CoordResetMCode.

In-Out Variables

Name	Meaning	Data type	Valid range	Description
Coord	CNC Coordinate System	_sCNC_COORD_REF	---	Specifies the CNC coordinate system.
MCode	M code attached information	_sMCODE_REF	---	Outputs the information attached to the M code output. (*) Create a user-defined variable of the _sMCODE_REF type.

_sMCODE_REF

Name	Meaning	Data type	Valid range	Function
ExistsOutputs	Attached information output existence	ARRAY[0..7] OF BOOL	TRUE or FALSE	Outputs whether *Outputs* exists or not when an M code is received. The element numbers (0..7) in the array correspond to the arguments (VA..VH) in the M code. 0=VA, 1=VB, 2=VC, 3=VD, 4=VE, 5=VF, 6=VG, 7=VH
Outputs	Attached information output	ARRAY[0..7] OF LREAL	---	Outputs the *Outputs* when an M code is received. The element numbers in the array correspond to the arguments (VA..VH) in the M code. 0=VA, 1=VB, 2=VC, 3=VD, 4=VE, 5=VF, 6=VG, 7=VH

Functions

The CNC_CoordCatchMCode instruction receives the M code output of the NC program as an interface to execute the M codes provided by the sequence control program from the NC program.

This instruction receives (Strobe changes to TRUE) the M code output of the CNC coordinate system specified using *Coord* (CNC Coordinate System) in accordance with *MCodeNo* (M Code Number).

When the M code output is received, information about whether there is the argument specified in MCode is output to *ExistsOutputs* using the sequence control program, and if the argument exists, its value is output to *Outputs*.

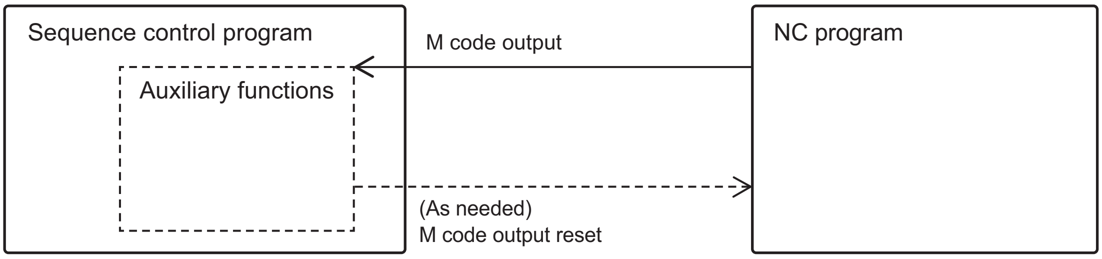
The *ExistsOutputs* and *Outputs* argument values are retained until the M code output is received again using the instance of the same CNC_CoordCatchMCode instruction.

If the M code is set to 0 (synchronization) or the M code output has an argument, this instruction continues to wait for block stepping of the NC program until the M code output is reset.

Instruction Details

This instruction realizes to acknowledge the calls for the auxiliary functions from the NC program in the sequence control program.

For example, the auxiliary functions of the processing machine include ATC control, coolant ON/OFF, and spindle control. These auxiliary functions depend on the processing machine, and they can be deployed using various commands of the NJ/NX series.



Up to 192 of M codes outputs output from the NC program can be specified for each CNC coordinate system.

M code numbers (0 to 191) are used to specify the M codes outputs accepted by the CNC_CoordCatchMCode instruction. A different auxiliary function can be programmed for each M code number of the auxiliary functions.

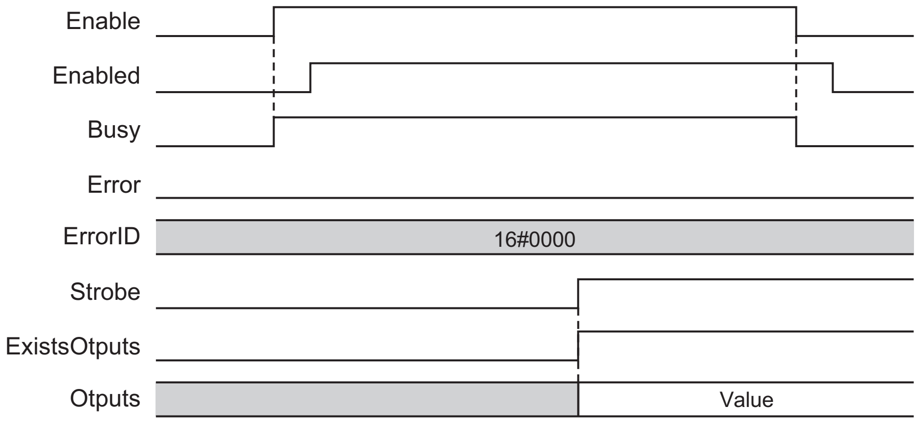
Also, you can pass up to eight arguments to each M code output that is to be output from the NC program. This can be used when setting the parameter specified from an NC program to the M codes, for example, when specifying a tool number for the tool exchange auxiliary function.

When the M code output is enabled in the NC program, its argument that is specified for M code output is output to *ExistsOutputs* (Argument Existence/Non-existence) and *Outputs* (Argument Value).

If the argument is specified using an NC program to enable the M code output, the NC program must retain the argument value until the argument value is loaded by the sequence control program. Therefore, the NC program continues to wait for a reset from the sequence control program. In the sequence control program, be sure to execute the CNC_CoordResetMCode (Reset M Code) instruction after receiving an M code output that is specified for the argument.

Timing Chart

A timing chart for the operation of the CNC_CoordCatchMCode instruction is shown below.



While *Enabled* is TRUE, *Strobe* is updated.

ExistsOutputs and *Outputs* are updated at the timing when *Strobe* is updated from FALSE to TRUE. *ExistsOutputs* and *Outputs* are not updated at other timings.

Re-execution of CNC Instructions

You cannot re-execute CNC instructions with enable-type inputs.

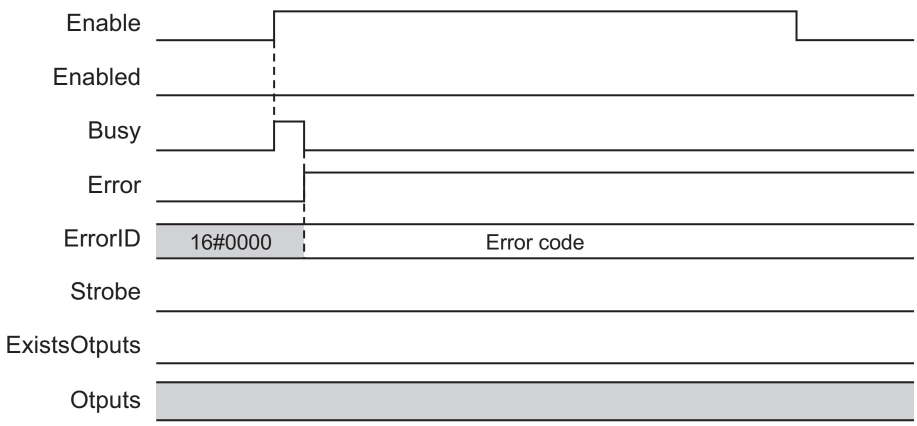
Multi-execution of CNC Instructions

This instruction operates independently for each instruction, therefore it is not affected by the restriction of CNC instruction multi-execution processing.

Errors

If this instruction cannot be executed, an error occurs, and *Error* will change to TRUE.

You can find out the cause of the error by referring to the value output by *ErrorID* (Error Code).



Sample Programming

This section shows sample programming to receive the auxiliary function output and perform the reset.

Parameter Settings

The minimum settings required for this sample programming are given below.

● CNC Coordinate System Settings

Logical CNC motor configuration

CNC coordinate system	Logical CNC motor configuration
CNC coordinate system 0	3

Positioning axis configuration

CNC coordinate system	Positioning axis CNC motor number	Positioning axis configuration CNC motor	Positioning axis assignment
CNC coordinate system 0	CNC motor P0	CNC motor 0	X-axis
CNC coordinate system 0	CNC motor P1	CNC motor 1	Y-axis
CNC coordinate system 0	CNC motor P2	CNC motor 2	Z-axis

Spindle axis use CNC motor

CNC coordinate system	Spindle axis use CNC motor
CNC coordinate system 0	CNC motor 3

M code settings

M code number	Setting value
M101	0 (Synchronous)

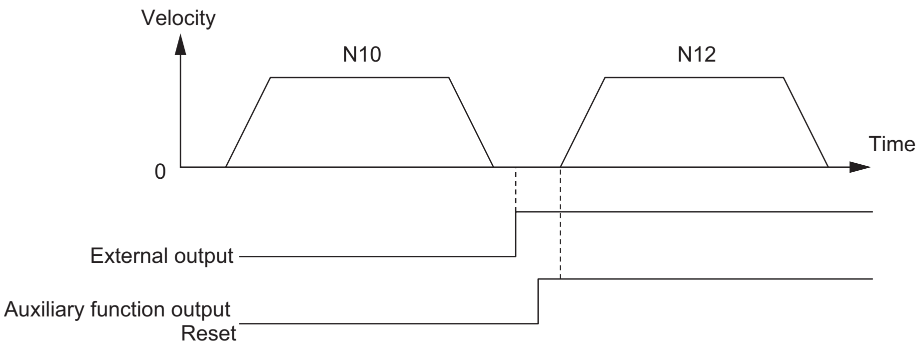
Operation Example

Set 101 for MCodeNo (M Code Number) using the CNC_CoordCatchMCode (Catch M Code) instruction and run the sequence control program that turns ON the external output using the N11 block of the NC program shown below. After the external output turned ON, the execution of the NC program is continued using the CNC_CoordResetMCode (Reset M Code) instruction.

● NC Program

```
N10 G91 F1000 G01 X10
N11 M101
N12 X20
M30
```

● Operation Patterns



1 Turning ON the Operation Start Switch

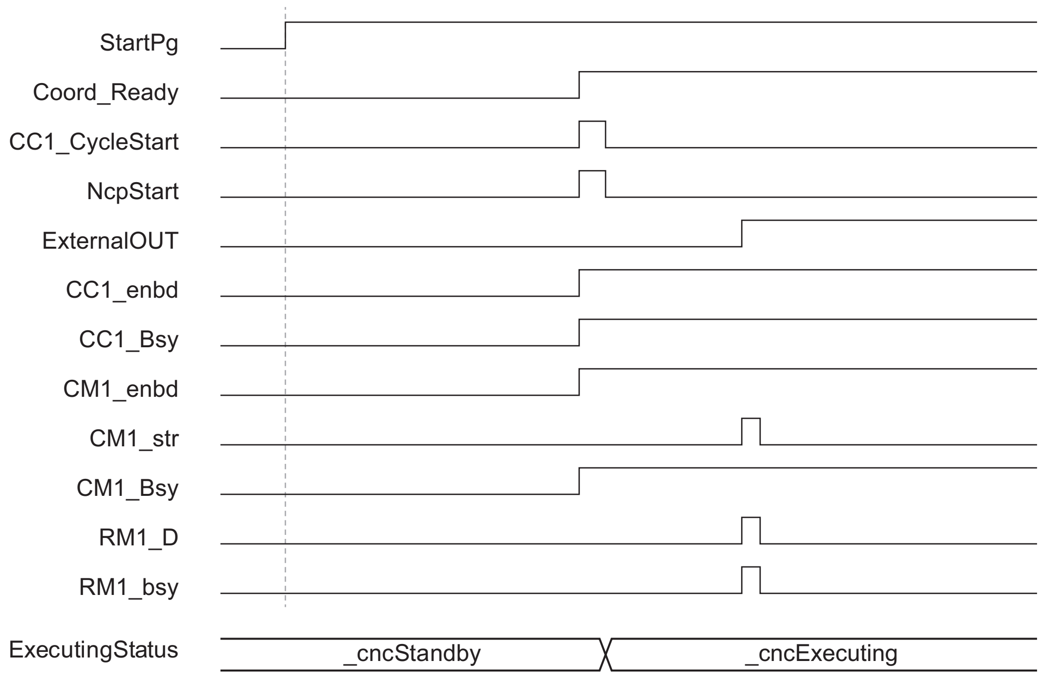
When you turn ON the operation start switch at the home, CNC motor 0 assigned to the X-axis is positioned to 10.00 mm in the positive direction and the external output turns ON. After that, CNC motor 1 is positioned to 20.00 mm in the positive direction.

Ladder Diagram

● Main Variables

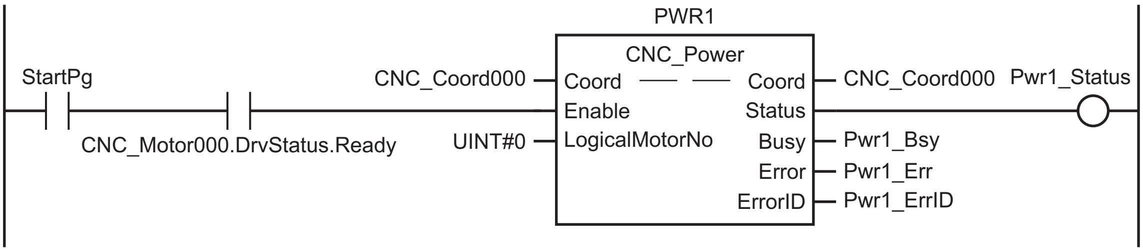
Name	Data type	Default	Comment
CNC_Coord000	_sCNC_COORD_REF	---	CNC coordinate system variable of CNC coordinate system 0.
CNC_Motor000	_sCNC_MOTOR_REF	---	CNC motor variable of CNC motor 0.
StartPg	BOOL	FALSE	Indicates the operation start switch. The Servo is turned ON when this variable is TRUE and EtherCAT process data communications are established.
Coord_Ready	BOOL	FALSE	Indicates the execution ready completion status of the NC program. This variable changes to TRUE when the NC program execution conditions are satisfied.
NcpStart	BOOL	FALSE	When this variable is TRUE and the cycle start ready is completed, the NC program is executed.
InitFlg	BOOL	FALSE	Indicates the input parameter setting completion. Input parameters are set when this variable is FALSE. When the input parameter setting is completed, this variable changes to TRUE.
ExternalOUT	BOOL	FALSE	Indicates the external output.

● Timing Chart

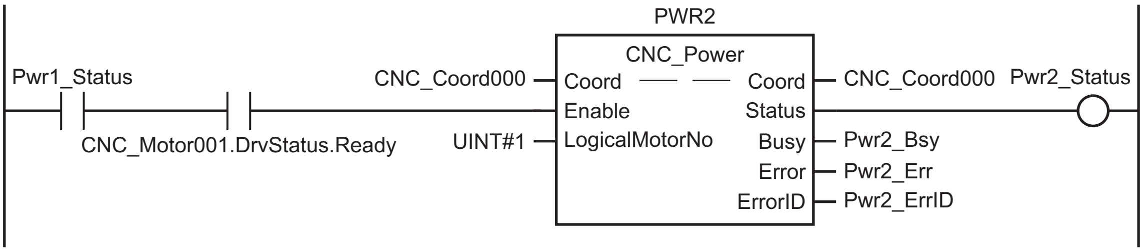


● Sample Programming

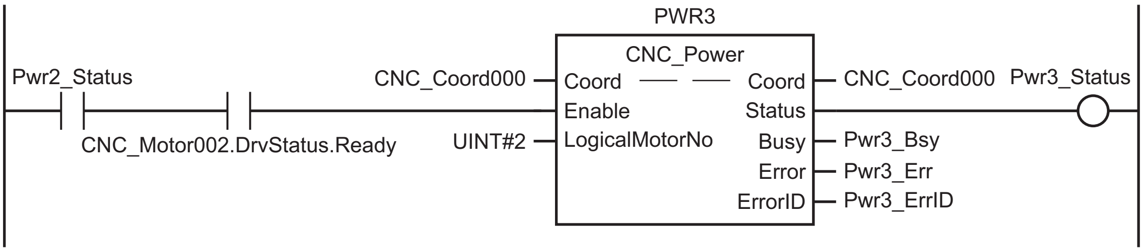
When contact *StartPg* is TRUE, check that the Servo Drive is in the servo ready status and set the X-axis to the Servo ON status.



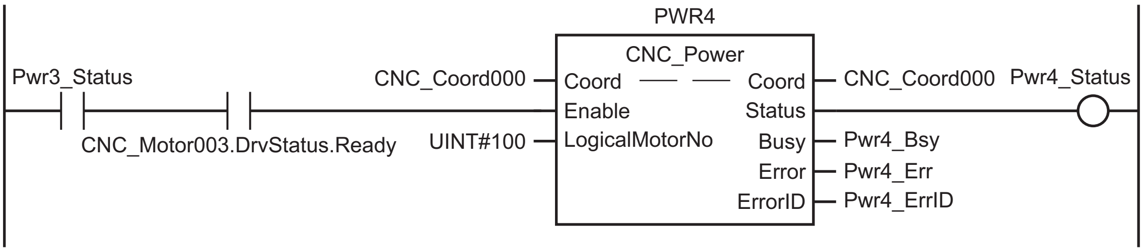
When the X-axis is in the Servo ON status, check that the Servo Drive is in the servo ready status and set the Y-axis to the Servo ON status.



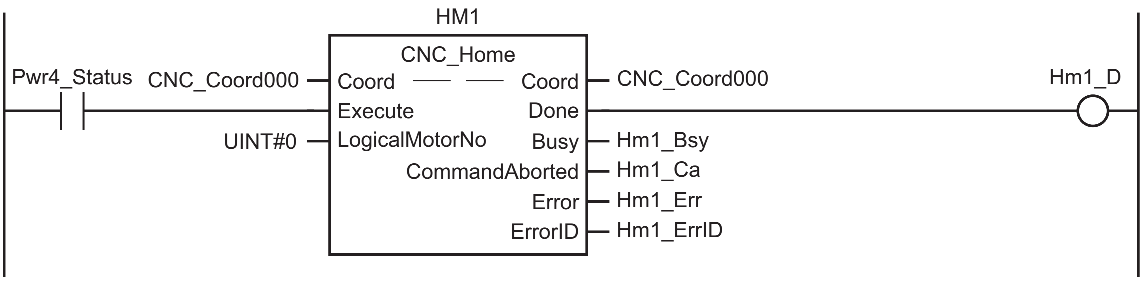
When the Y-axis is in the Servo ON status, check that the Servo Drive is in the servo ready status and set the Z-axis to the Servo ON status.



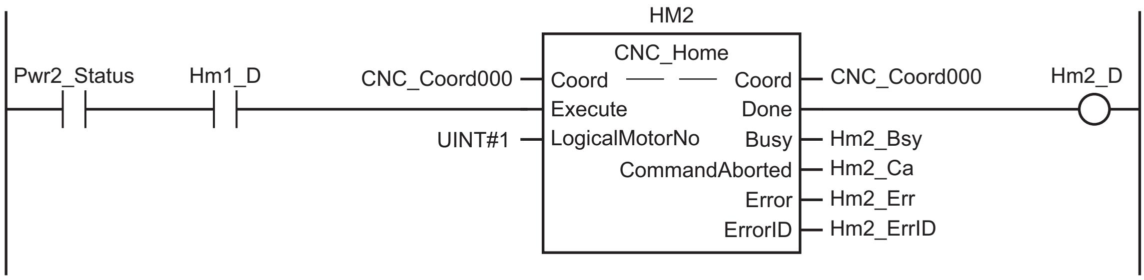
When the Z-axis is in the Servo ON status, check that the Servo Drive is in the servo ready status and set the spindle axis to the Servo ON status.



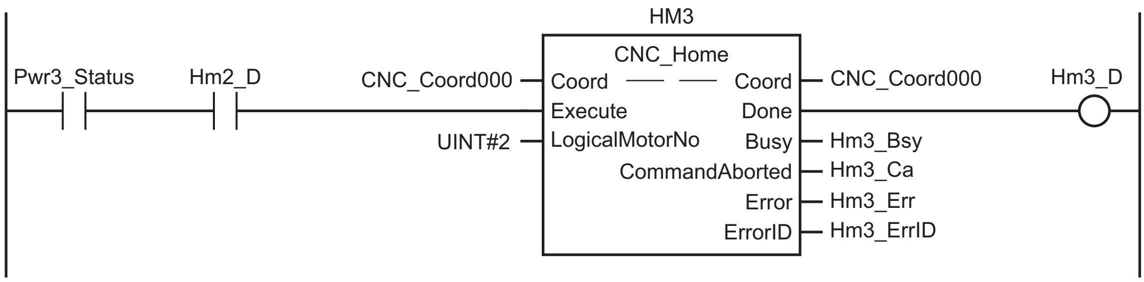
When the positioning axis and spindle axis are in the Servo ON status, execute homing of the X-axis.



After the home of the X-axis is defined, execute homing of the Y-axis.

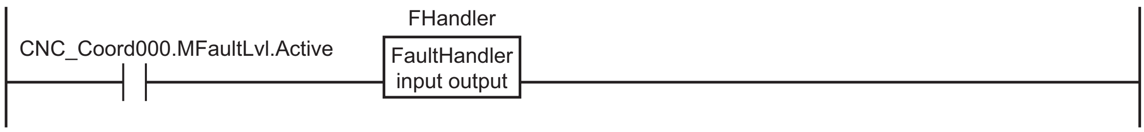


After the home of the Y-axis is defined, execute homing of the Z-axis.

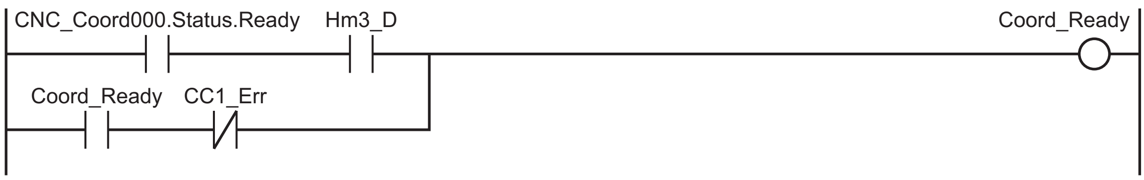


If a minor fault level error occurs in CNC coordinate system 0, the error handler for the device (FaultHandler) is executed.

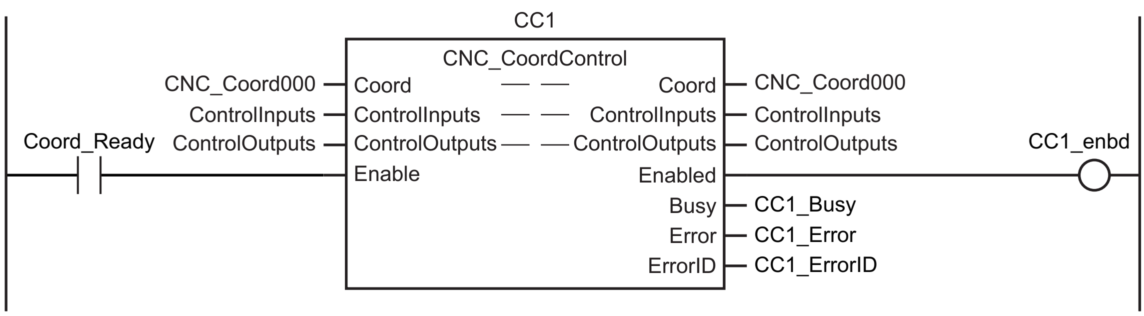
Program the FaultHandler according to the device.



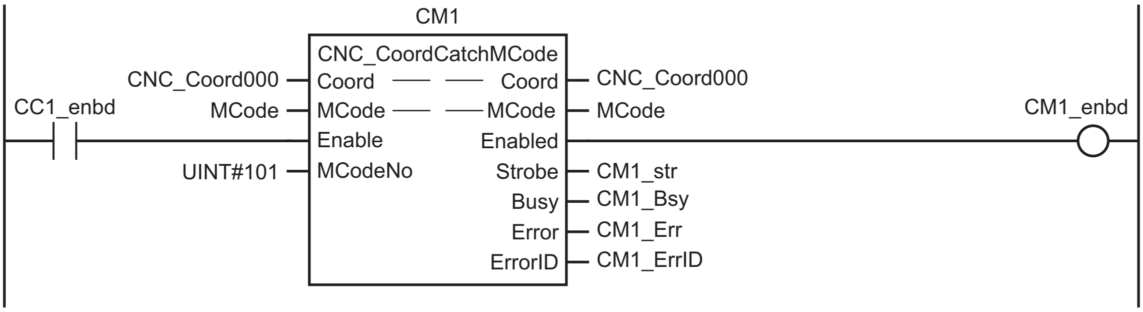
When the NC program execution ready is completed, change Coord_Ready to TRUE.



When Coord_Ready changes to TRUE, start the execution control of the NC program.



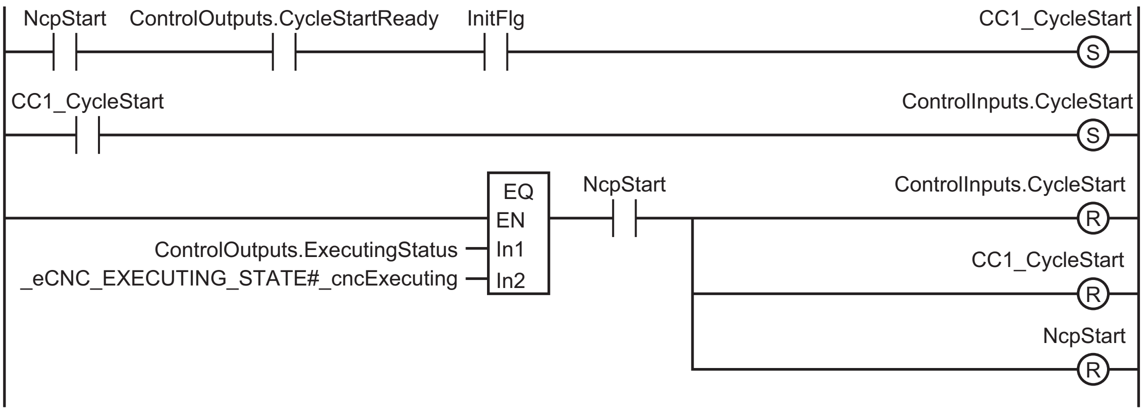
When the execution control of the NC program is started, start the auxiliary function output received.



When the auxiliary function output received is started, set the parameters of the CNC_CoordControl (CNC Coordinate System NC Control) instruction.

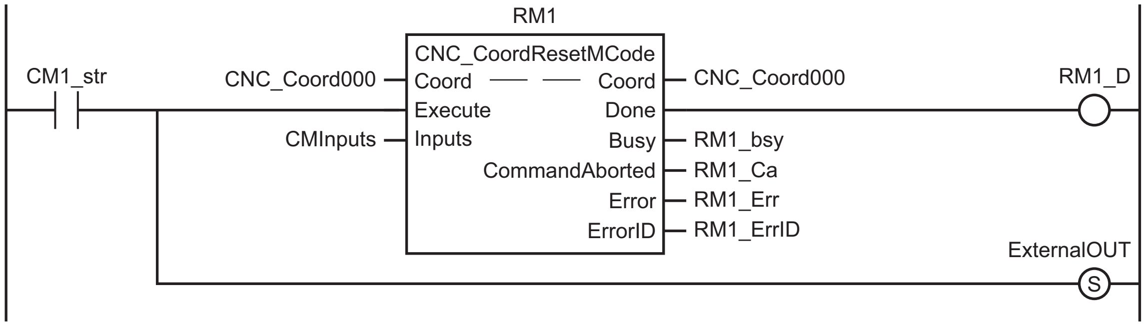
```
// CNC_CoordControl parameter
// Specify the NC program (No. 1) that was created on the Sysmac Studio.
ControlInputs.ProgramNo :=UINT#1;
ControlInputs.FeedrateVelFactor:=LREAL#100.0;
ControlInputs.SpindleVelFactor:=LREAL#100.0;
ControlInputs.AuxiliaryLock:=FALSE;
ControlInputs.BackTrace :=FALSE;
ControlInputs.DryRun    :=FALSE;
ControlInputs.FeedHold  :=FALSE;
ControlInputs.MachineLock:=FALSE;

// Change InitFlag to TRUE after setting the input parameters.
InitFlg := TRUE;

// Start the NC program.
NcpStart:=TRUE;
```

Check that the cycle start ready is completed and start the execution of the NC program.



When the auxiliary function output is received, turn ON the external output and start the auxiliary function output reset.

Continue the NC program after the auxiliary function output of the NC program is reset.

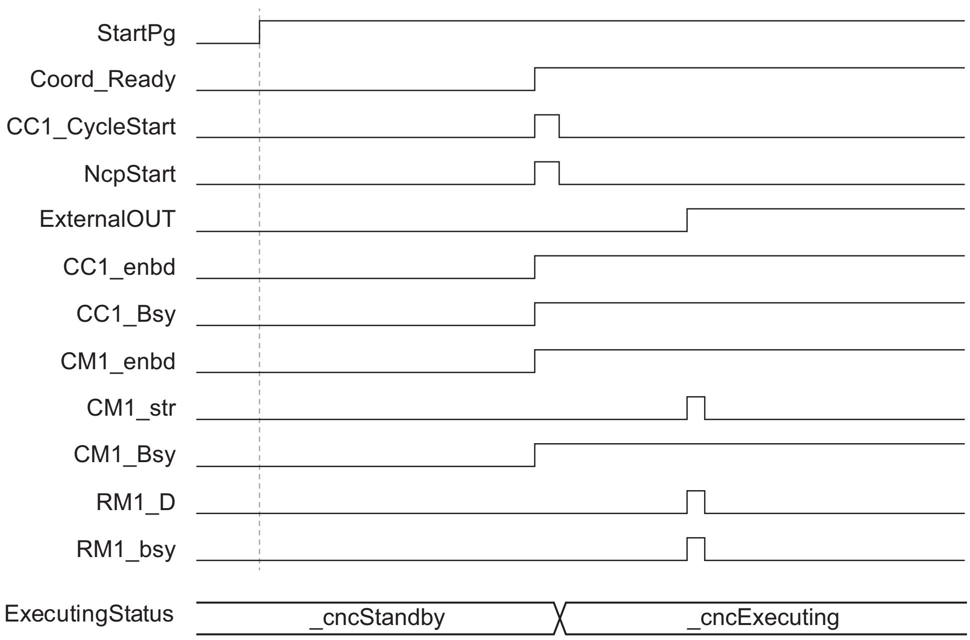


Structured Text (ST)

● Main Variables

Name	Data type	Default	Comment
CNC_Coord000	_sCNC_COORD_REF	---	CNC coordinate system variable of CNC coordinate system 0.
CNC_Motor000	_sCNC_MOTOR_REF	---	CNC motor variable of CNC motor 0.
StartPg	BOOL	FALSE	Indicates the operation start switch. The Servo is turned ON when this variable is TRUE and EtherCAT process data communications are established.
Coord_Ready	BOOL	FALSE	Indicates the execution ready completion of the NC program. This variable changes to TRUE when the NC program execution conditions are satisfied.
NcpStart	BOOL	FALSE	When this variable is TRUE and the cycle start ready is completed, the NC program is executed.
InitFlg	BOOL	FALSE	Indicates the input parameter setting completion. Input parameters are set when this variable is FALSE. When the input parameter setting is completed, this variable changes to TRUE.
ExternalOUT	BOOL	FALSE	Indicates the external output.

● Timing Chart



Sample Programming

```
// When StartPg is TRUE, check that the Servo Drive is in the servo ready status and
set the X-axis to the Servo ON status.
IF (StartPg = TRUE)AND (CNC_Motor000.DrvStatus.Ready=TRUE) THEN
        Pwr1_En:=TRUE;
ELSE
        Pwr1_En:=FALSE;
END_IF;

// When the X-axis is in the Servo ON status, check that the Servo Drive is in the
servo ready status and set the Y-axis to the Servo ON status.
IF (Pwr1_Status = TRUE) AND (CNC_Motor001.DrvStatus.Ready=TRUE) THEN
        Pwr2_En:=TRUE;
ELSE
        Pwr2_En:=FALSE;
END_IF;

// When the Y-axis is in the Servo ON status, check that the Servo Drive is in the
servo ready status and set the Z-axis to the Servo ON status.
IF (Pwr2_Status = TRUE) AND (CNC_Motor002.DrvStatus.Ready=TRUE) THEN
        Pwr3_En:=TRUE;
ELSE
        Pwr3_En:=FALSE;
END_IF;

// When the Z-axis is in the Servo ON status, check that the Servo Drive is in the
servo ready status and set the spindle axis to the Servo ON status.
IF (Pwr3_Status = TRUE) AND (CNC_Motor003.DrvStatus.Ready=TRUE) THEN
        Pwr4_En:=TRUE;
ELSE
        Pwr4_En:=FALSE;
END_IF;

// When the positioning axis and spindle axis are in the Servo ON status, execute
homing of the X-axis.
IF (Pwr4_Status=TRUE) THEN
        Hm1_Ex:=TRUE;
END_IF;

// After the home of the X-axis is defined, execute homing of the Y-axis.
IF (Pwr2_Status=TRUE) AND (Hm1_D=TRUE) THEN
        Hm2_Ex:=TRUE;
END_IF;

// After the home of the Y-axis is defined, execute homing of the Z-axis.
IF (Pwr3_Status=TRUE) AND (Hm2_D=TRUE) THEN
        Hm3_Ex:=TRUE;
END_IF;

// If a minor fault level error occurs in coordinate system 0, execute the error
handler for the device (FaultHandler).
// Program the FaultHandler according to the device.
IF (CNC_Coord000.MFaultLvl.Active=TRUE) THEN
        FaultHandler();
END_IF;
```

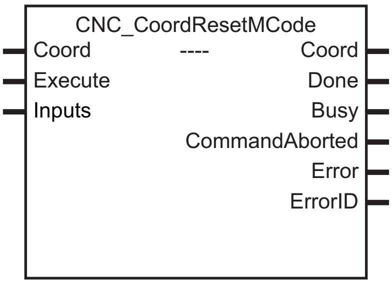
```
// When the NC program execution ready is completed, change Coord_Ready to TRUE.
IF (Hm3_D =TRUE) AND (CNC_Coord000.Status.Ready=TRUE) THEN
        Coord_Ready :=TRUE;
ELSIF(CC1_Err = TRUE) THEN
        Coord_Ready :=FALSE;
END_IF;

// When Coord_Ready changes to TRUE, start the execution control of the NC program.
// Also, start the auxiliary function output received to receive the auxiliary
function output from the NC program.
IF (Coord_Ready=TRUE)THEN
        CC1_En:=TRUE;
        CM1_En:=TRUE;
ELSE
        CC1_En:=FALSE;
END_IF;

// Processing when input parameters are not set
IF (CM1_enbd=TRUE) AND (InitFlg=FALSE) THEN
        // CNC_CoordControl parameter
        // Specify the NC program (No. 1) that was created on the Sysmac Studio.
        ControlInputs.ProgramNo:=UINT#1;
        ControlInputs.FeedrateVelFactor:=LREAL#100.0;
        ControlInputs.SpindleVelFactor:=LREAL#100.0;
        ControlInputs.AuxiliaryLock:=FALSE;
        ControlInputs.BackTrace:=FALSE;
        ControlInputs.DryRun:=FALSE;
        ControlInputs.FeedHold:=FALSE;
        ControlInputs.MachineLock:=FALSE;

        // Change InitFlag to TRUE after setting the input parameters.
        InitFlg := TRUE;
        // Start the NC program.
        NcpStart:=TRUE;
END_IF;

// Check that the cycle start ready is completed and start the execution of the NC
program.
IF (InitFlg=TRUE) AND (ControlOutputs.CycleStartReady=TRUE) AND (NcpStart=TRUE)
THEN
        CC1_CycleStart:=TRUE;
END_IF;
IF( CC1_CycleStart =TRUE) THEN
                ControlInputs.CycleStart:=TRUE;
END_IF;

// When the NC program is executed, change CC1_CycleStart and NcpStart to FALSE.
IF (ControlOutputs.ExecutingStatus = _eCNC_EXECUTING_STATE#_cncExecuting) THEN
        NcpStart:=FALSE;
        CC1_CycleStart:=FALSE;
        ControlInputs.CycleStart:=FALSE;
END_IF;

// When the auxiliary function output is received, turn ON the external output and
start the auxiliary function output reset.
// After the auxiliary function output of the NC program is reset, continue the NC
program.
IF CM1_str=TRUE THEN
        ExternalOUT:=TRUE;
        RM1_Ex:=TRUE;
END_IF;
```

```
// Check that the NC program is restarted.
IF RM1_D=TRUE THEN
        RM1_Ex:=FALSE;
END_IF;

// CNC_Power of X-axis
PWR1(
        Coord:= CNC_Coord000,
        Enable:=Pwr1_En,
        LogicalMotorNo:=UINT#0,
        Status=>Pwr1_Status,
        Busy => Pwr1_Bsy,
    Error => Pwr1_Err,
    ErrorID => Pwr1_ErrID
);
// CNC_Power of Y-axis
PWR2(
        Coord:= CNC_Coord000,
        Enable:=Pwr2_En,
        LogicalMotorNo:=UINT#1,
        Status=>Pwr2_Status,
        Busy => Pwr2_Bsy,
    Error => Pwr2_Err,
    ErrorID => Pwr2_ErrID
);
// CNC_Power of Z-axis
PWR3(
        Coord:= CNC_Coord000,
        Enable:=Pwr3_En,
        LogicalMotorNo:=UINT#2,
        Status=>Pwr3_Status,
        Busy => Pwr3_Bsy,
    Error => Pwr3_Err,
    ErrorID => Pwr3_ErrID
);
// CNC_Power of spindle axis
PWR4(
        Coord:= CNC_Coord000,
        Enable:=Pwr4_En,
        LogicalMotorNo:=UINT#100,
        Status=>Pwr4_Status,
        Busy => Pwr4_Bsy,
    Error => Pwr4_Err,
    ErrorID => Pwr4_ErrID
);
// CNC_Home of X-axis
HM1(
  Coord := CNC_Coord000 ,
  Execute := Hm1_Ex,
  LogicalMotorNo :=UINT#0 ,
  Done => Hm1_D,
  Busy => Hm1_Bsy,
  CommandAborted=> Hm1_Ca,
  Error => Hm1_Err,
  ErrorID => Hm1_ErrID
);
// CNC_Home of Y-axis
HM2(
```

```
  Coord := CNC_Coord000 ,
  Execute := Hm2_Ex,
  LogicalMotorNo :=UINT#1 ,
  Done => Hm2_D,
  Busy => Hm2_Bsy,
  CommandAborted=> Hm2_Ca,
  Error => Hm2_Err,
  ErrorID => Hm2_ErrID
);
// CNC_Home of Z-axis
HM3(
  Coord := CNC_Coord000 ,
  Execute := Hm3_Ex,
  LogicalMotorNo :=UINT#2 ,
  Done => Hm3_D,
  Busy => Hm3_Bsy,
  CommandAborted=> Hm3_Ca,
  Error => Hm3_Err,
  ErrorID => Hm3_ErrID
);

//      CNC_CoordControl
CC1(
        Coord:= CNC_Coord000,
        ControlInputs:=ControlInputs,
        ControlOutputs:=ControlOutputs,
        Enable:=CC1_En,
        Enabled=>CC1_enbd,
        Busy=>CC1_Bsy,
        Error=>CC1_Err,
        ErrorID=>CC1_ErrID
);

// CNC_CoordCatchMCode
CM1(
        Coord:=CNC_Coord000,
        MCode:=MCode,
        Enable:=CM1_En,
        MCodeNo:=UINT#101,
        Enabled=>CM1_enbd,
        Strobe=>CM1_str,
        Busy=>CM1_Bsy,
        Error=>CM1_Err,
        ErrorID=>CM1_ErrID
);

// CNC_CoordResetMCode
RM1(
        Coord:=CNC_Coord000,
        Execute:=RM1_Ex,
        Inputs:=CMInputs,
        Done=>RM1_D,
        Busy=>RM1_bsy,
        CommandAborted=>RM1_Ca,
        Error=>RM1_Err,
        ErrorID=>RM1_ErrID
);
```

CNC_CoordResetMCode

The CNC_CoordResetMCode instruction resets the M code output from the NC program.

Instruction	Name	FB/FUN	Graphic expression	ST expression
CNC_CoordResetMCode	Reset M Code	FB	CNC_CoordResetMCode_instance 	CNC_CoordResetMCode_instance (Coord :=*parameter*, Execute :=*parameter*, Inputs :=*parameter,* Done =>*parameter*, Busy =>*parameter*, CommandAborted =>*parameter*, Error =>*parameter*, ErrorID =>*parameter*);

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Execute	Execute	BOOL	TRUE or FALSE	FALSE	The instruction is executed when *Execute* changes to TRUE.
Inputs	Reset input	ARRAY [0..7] OF LREAL	---	0	Outputs the *Inputs* when the auxiliary function is reset. The element numbers in the array correspond to the auxiliary function output reset return value of the auxiliary function output.

Output Variables

Name	Meaning	Data type	Valid range	Description
Done	Done	BOOL	TRUE or FALSE	TRUE when the instruction is completed.
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Command-Aborted	Command Aborted	BOOL	TRUE or FALSE	TRUE when the instruction is aborted.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error Code	WORD	*1	Contains the error code when an error occurs. A value of 16#0000 indicates normal execution.

*1. Refer to *Section 15 Troubleshooting*.

Output Variable Update Timing

Variable	Timing for changing to TRUE	Timing for changing to FALSE
Done	When the M code is reset.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Busy	When *Execute* changes to TRUE.	• When *Done* changes to TRUE. • When *Error* changes to TRUE. • When *CommandAborted* changes to TRUE.
Command-Aborted	When this instruction is canceled due to an error.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Error	When there is an error in the execution conditions or input parameters for the instruction.	When the error is cleared.

In-Out Variables

Name	Meaning	Data type	Valid range	Description
Coord	CNC Coordinate System	_sCNC_COORD_REF	---	Specifies the CNC coordinate system.

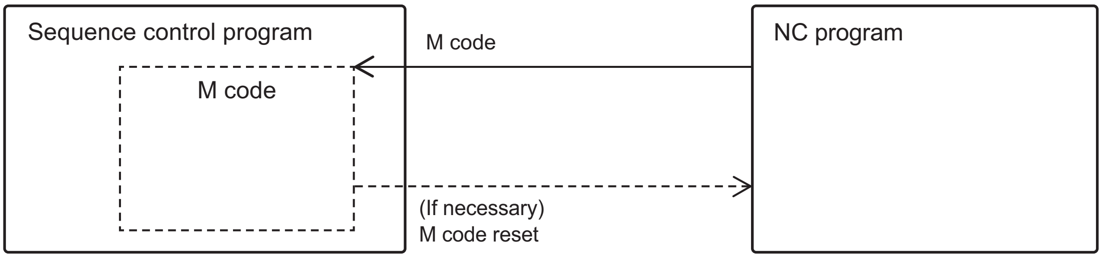
Functions

The CNC_CoordResetMCode instruction resets the M code output of the NC program.

You can specify the CNC coordinate system to reset M code by specifying the CNC coordinate system.

Instruction Details

The M code outputs are enabled (TRUE) in the NC program, and this instruction resets (FALSE) the M code outputs that accepted TRUE for IO refresh of the task for the sequence control program to be executed.



The result of the reset execution is applied to Strobe of the CNC_CoordCatchMCode (Catch M Code) instruction in the next and subsequent cycles. (When this reset instruction is executed at the beginning of the sequence control program, the following sequence control program accepts M codes if this occurred in the same scan.)

If an M code output with arguments is reset, the values (8 pieces of LREAL data) can be passed from the sequence control program to NC program. The NC Program stores the received values to NC program system variable *_CNC_MCodeResetRetValueX* (where X is a digit from 0 to 7).

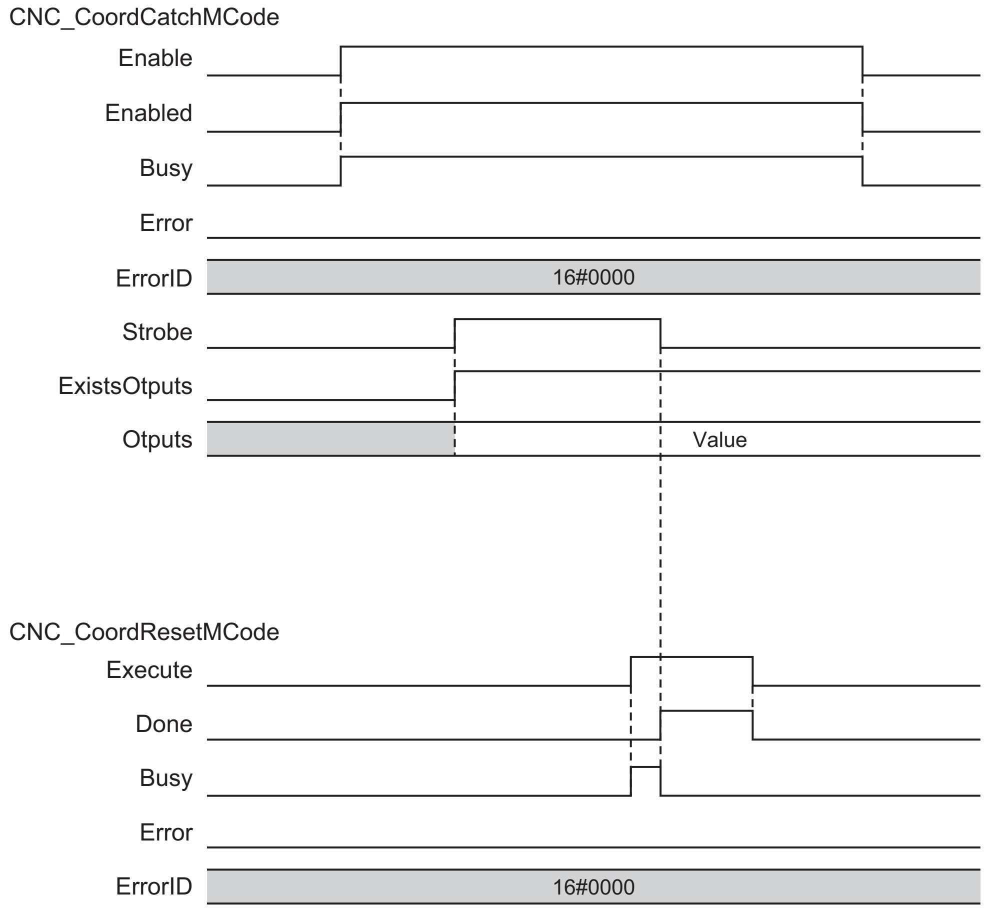
For example, an NC program is written as follows,

P0 = _CNC_MCodeResetRetValue0

You can load the inputs[0] value of CNC_CoordResetMCode, executed lastly for the same CNC coordinate system, to P0.

Timing Charts

A timing chart for the execution of the CNC_CoordResetMCode instruction is shown below.



Re-execution of CNC Instructions

This instruction cannot be re-executed. A CNC Instruction Re-execution Disabled error (5603 0000 hex) occurs if re-execution is attempted.

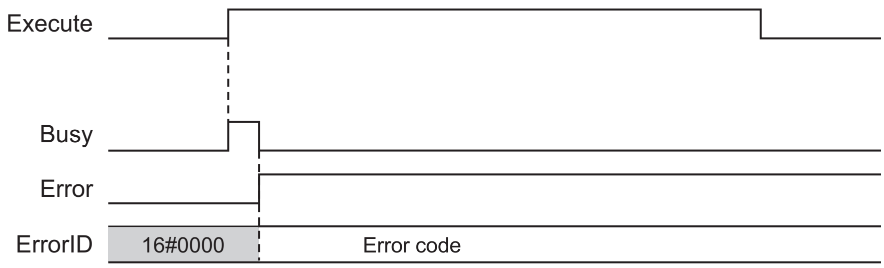
Multi-execution of CNC Instructions

Refer to *A-4 Instructions for Which Multi-execution Is Supported* on page A-15 for details on multi-execution of CNC instructions.

Errors

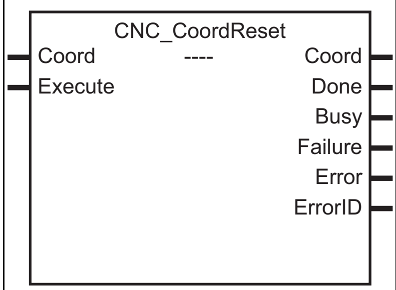
If this instruction cannot be executed, an error occurs, and *Error* will change to TRUE.

You can find out the cause of the error by referring to the value output by *ErrorID* (Error Code).



CNC_CoordReset

The CNC_CoordReset instruction clears the error in the specified CNC coordinate system.

Instruction	Name	FB/FUN	Graphic expression	ST expression
CNC_CoordReset	CNC Coordinate System Error Reset	FB	CNC_CoordReset_instance  	CNC_CoordReset_instance (Coord :=*parameter*, Execute :=*parameter*, Done =>*parameter*, Busy =>*parameter*, Failure =>*parameter*, Error =>*parameter*, ErrorID =>*parameter*);

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Execute	Execute	BOOL	TRUE or FALSE	FALSE	The instruction is executed when *Execute* changes to TRUE.

Output Variables

Name	Meaning	Data type	Valid range	Description
Done	Done	BOOL	TRUE or FALSE	TRUE when the instruction is completed.
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Failure	Failure End	BOOL	TRUE or FALSE	TRUE when the instruction was not executed normally.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error Code	WORD	*1	Contains the error code when an error occurs. A value of 16#0000 indicates normal execution.

*1. Refer to *Section 15 Troubleshooting*.

Output Variable Update Timing

Name	Timing for changing to TRUE	Timing for changing to FALSE
Done	When the M code is reset.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Busy	When *Execute* changes to TRUE.	• When *Done* changes to TRUE. • When *Error* changes to TRUE. • When *CommandAborted* changes to TRUE.
Failure	• When this instruction is executed while the CNC coordinate system decelerated to a stop due to an error. • When this instruction is executed while a CNC coordinate system error occurred due to a CNC common error.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Error	When there is an error in the execution conditions or input parameters for the instruction.	When the error is cleared.

In-Out Variables

Name	Meaning	Data type	Valid range	Description
Coord	CNC Coordinate System	_sCNC_COORD_REF	---	Specifies the CNC coordinate system.

Functions

This instruction clears an error that is detected in the CNC coordinate system specified in *Coord* (CNC coordinate system) when *Execute* changes to TRUE. You can clear minor faults detected in the CNC coordinate system, monitoring information errors and drive errors.

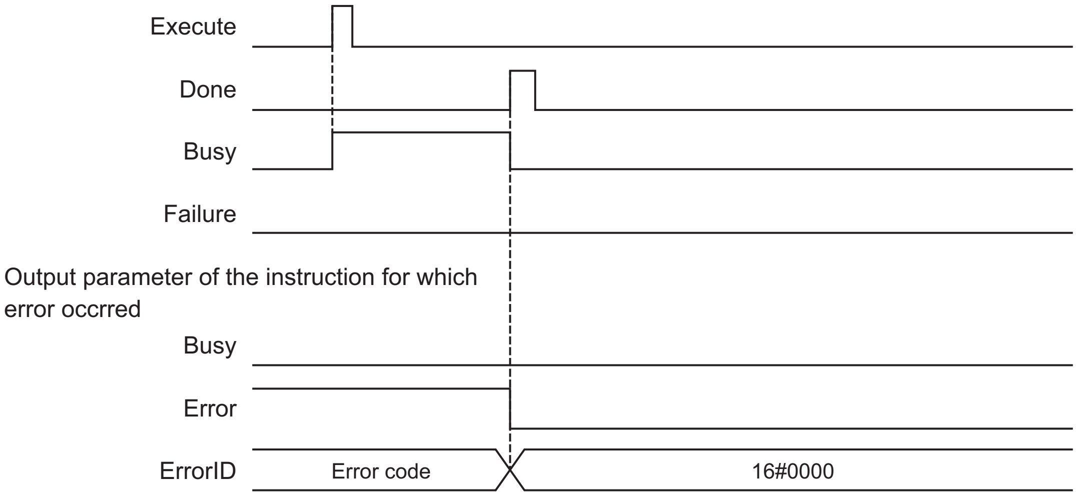
- Error clear processing is performed regardless of whether the CNC motor is set to the Servo ON or Servo OFF status.
- If a driver error occurs on the CNC motor, driver error reset processing is executed first, and then error reset processing is executed.
- Driver error reset processing continues until the driver error is cleared or during the period specified in Driver Error Reset Monitoring Time of the CNC motor parameter. Driver error reset processing is simultaneously performed for the CNC motors in the CNC coordinate system.
- Errors that are detected at the timing when *Execute* changes to TRUE will be reset.
- Errors that are detected during reset processing will not be reset.
- If an attempt is made to execute this instruction while the CNC coordinate system is decelerated to a stop due to an error, the instruction is not executed, and *Failure* (Failure End) changes to TRUE. This processing is performed to prevent error reset processing from being started before the target CNC motor stops.

  Also, CNC common errors cannot be reset by executing this instruction, therefore, *Failure* (Failure End) changes to TRUE.

Precautions for Correct Use

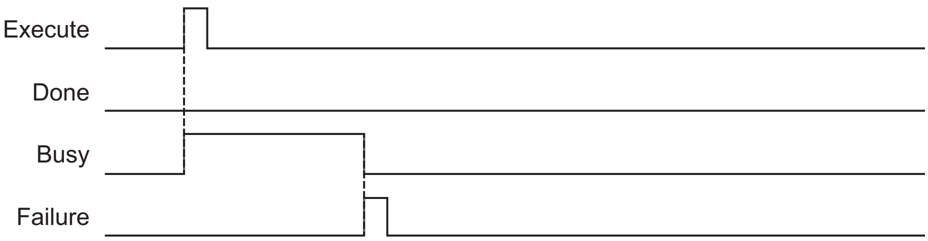
- Error reset processing initiated by this instruction may span multiple control cycles.
- If the CNC motor is active even when this instruction has been executed, the *Failure* (Failure End) output variable of this instruction changes to TRUE.
- Eliminate the cause of the error, and execute retry processing until *Done* changes to TRUE.
- Before eliminating the cause of the error, always check that each CNC motor stopped completely.
- When using this instruction for the OMRON G5-series Servo Drive, perform exclusive processing to prevent the *ResetECError* (Reset EtherCAT Error) instruction from being executed simultaneously.

Timing Chart



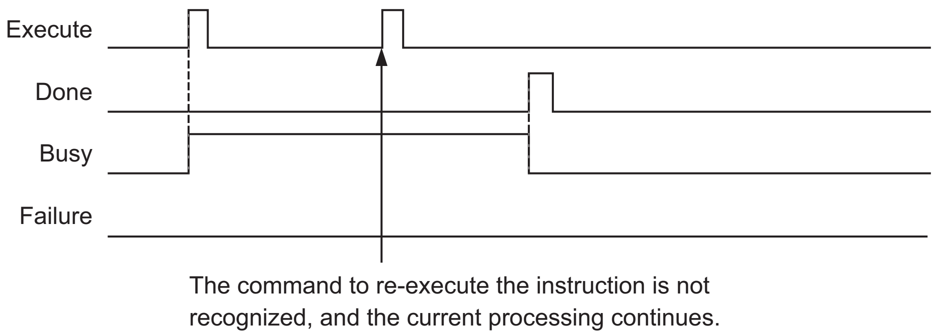
Aborting the Instruction

The instruction is aborted if it is not possible to clear errors that occur when the CNC coordinate system is decelerating to a stop for an error or errors that occur during CNC coordinate system errors resulting from CNC common errors.



Re-execution of CNC Instructions

If the instruction is re-executed by changing *Execute* to TRUE again, the re-executed instruction is ignored and error clear processing is continued.



Multi-execution of CNC Instructions

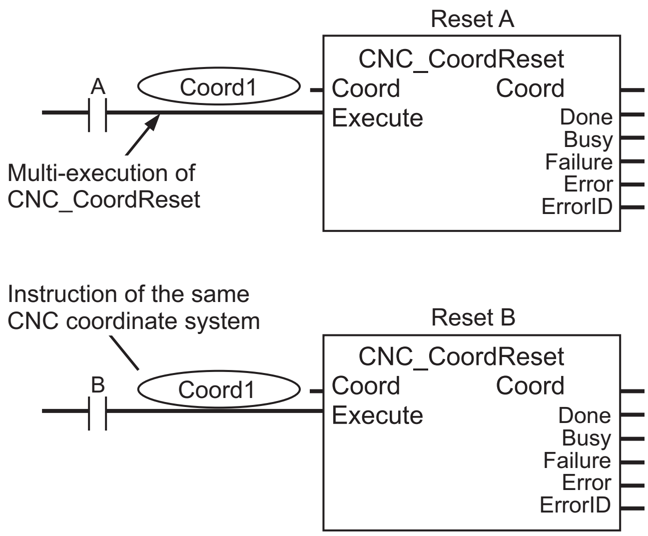
Refer to *A-4 Instructions for Which Multi-execution Is Supported* on page A-15 for details on multi-execution of CNC instructions.

● Execution of Other Instructions during Instruction Execution

If another instance of the CNC_CoordReset (CNC Coordinate System Error Reset) instruction is executed for the same CNC coordinate system, both instructions are executed.

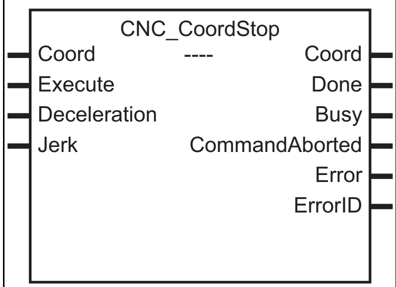
If a slave error occurs, processing may wait until the Drive Error Reset Monitoring Time for the CNC motor parameters expires.

The elapsed time is also counted for each instruction instance.



CNC_CoordStop

The CNC_CoordStop instruction performs an immediate stop for all the currently running CNC motors in the specified CNC coordinate system.

Instruction	Name	FB/FUN	Graphic expression	ST expression
CNC_CoordStop	CNC Coordinate System Stop	FB	CNC_CoordStop_instance  	CNC_CoordStop_instance (Coord :=*parameter*, Execute :=*parameter*, Deceleration :=*parameter*, Jerk :=*parameter*, Done =>*parameter*, Busy =>*parameter*, CommandAborted =>*parameter*, Error =>*parameter*, ErrorID =>*parameter*);

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Execute	Execute	BOOL	TRUE or FALSE	FALSE	The instruction is executed when *Execute* changes to TRUE.
Deceleration (Reserved)	Deceleration Rate	ARRAY[0..2] OF LREAL	0	0	Specifies the deceleration rate. The unit is command units/s^2.
Jerk (Reserved)	Jerk	LREAL	0	0	Specify jerk. The unit is command units/s^3.

Output Variables

Name	Meaning	Data type	Valid range	Description
Done	Done	BOOL	TRUE or FALSE	TRUE when the instruction is completed.
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Command-Aborted	Command Aborted	BOOL	TRUE or FALSE	TRUE when the instruction is aborted.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error Code	WORD	*1	Contains the error code when an error occurs. A value of 16#0000 indicates normal execution.

*1. Refer to *Section 15 Troubleshooting*.

● Output Variable Update Timing

Name	Timing for changing to TRUE	Timing for changing to FALSE
Done	When this instruction is completed.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Busy	When *Execute* changes to TRUE.	• When *Done* changes to TRUE. • When *Error* changes to TRUE. • When *CommandAborted* changes to TRUE.
Command-Aborted	• When this instruction is canceled due to an error. • When this instruction is executed while there is an error.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Error	When there is an error in the execution conditions or input parameters for the instruction.	When the error is cleared.

In-Out Variables

Name	Meaning	Data type	Valid range	Description
Coord	CNC Coordinate System	_sCNC_COORD_REF	---	Specifies the CNC coordinate system.

Functions

- This function performs an immediate stop for all the currently operating CNC motors in the specified CNC coordinate system.
- *CommandAborted* (Command Aborted) changes to TRUE for the instruction that is currently in operation when this instruction is executed.
- When *Execute* changes to TRUE, the operation of stopping starts.

Precautions for Correct Use

If you want to stop the operation of the CNC motor when *ErrorStop* (Error Deceleration Stopping) is TRUE for the CNC coordinate system, use the CNC_CoordImmediateStop (CNC Coordinate System Immediate Stop) instruction.

Instruction Details

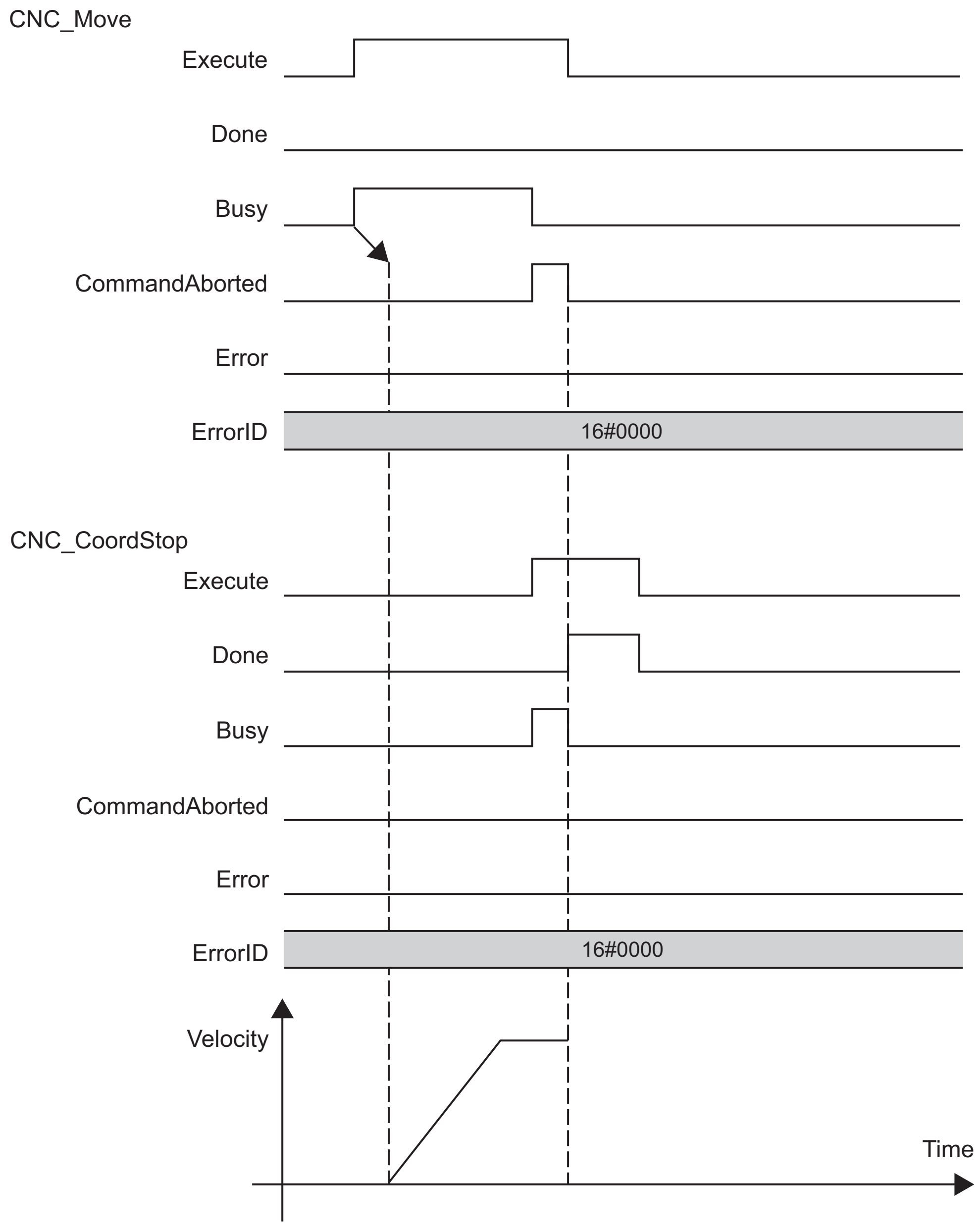
● In-position Check

An in-position check is not performed when stopping for this instruction.

Timing Chart

- *Busy* (Executing) changes to TRUE at the same time as *Execute* changes to TRUE.
- *Done* changes to TRUE when a velocity of 0 is reached.

  The following timing chart shows operations to stop the CNC motor during positioning. *Command-Aborted* (Command Aborted) for the positioning instruction that is currently in operation will change to TRUE when this instruction is executed.



Re-execution of CNC Instructions

This instruction cannot be re-executed. A CNC Instruction Re-execution Disabled error (5603 0000 hex) occurs if re-execution is attempted.

Multi-execution of CNC Instructions

Refer to *A-4 Instructions for Which Multi-execution Is Supported* on page A-15 for details on multi-execution of CNC instructions.

Errors

If this instruction cannot be executed, an error occurs, and *Error* will change to TRUE.

You can find out the cause of the error by referring to the value output by *ErrorID* (Error Code).

CNC_CoordImmediateStop

The CNC_CoordImmediateStop instruction immediately stops all the currently running CNC motors in the specified CNC coordinate system.

Instruction	Name	FB/FUN	Graphic expression	ST expression
CNC_CoordImmediateStop	CNC Coordinate System Immediate Stop	FB	CNC_CoordImmediate_instance CNC_CoordImmediateStop Coord ---- Coord Execute Done Busy CommandAborted Error ErrorID	CNC_CoordImmediateStop_instance (Coord :=*parameter*, Execute :=*parameter*, Done =>*parameter*, Busy =>*parameter*, CommandAborted =>*parameter*, Error =>*parameter*, ErrorID =>*parameter*);

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Execute	Execute	BOOL	TRUE or FALSE	FALSE	The instruction is executed when *Execute* changes to TRUE.

Output Variables

Name	Meaning	Data type	Valid range	Description
Done	Done	BOOL	TRUE or FALSE	TRUE when the instruction is completed.
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Command-Aborted	Command Aborted	BOOL	TRUE or FALSE	TRUE when the instruction is aborted.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error Code	WORD	*1	Contains the error code when an error occurs. A value of 16#0000 indicates normal execution.

*1. Refer to *Section 15 Troubleshooting*.

● Output Variable Update Timing

Name	Timing for changing to TRUE	Timing for changing to FALSE
Done	When the immediate stop is completed.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Busy	When *Execute* changes to TRUE.	• When *Done* changes to TRUE. • When *Error* changes to TRUE. • When *CommandAborted* changes to TRUE.
Command-Aborted	When this instruction is aborted due to an error.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Error	When there is an error in the execution conditions or input parameters for the instruction.	When the error is cleared.

In-Out Variables

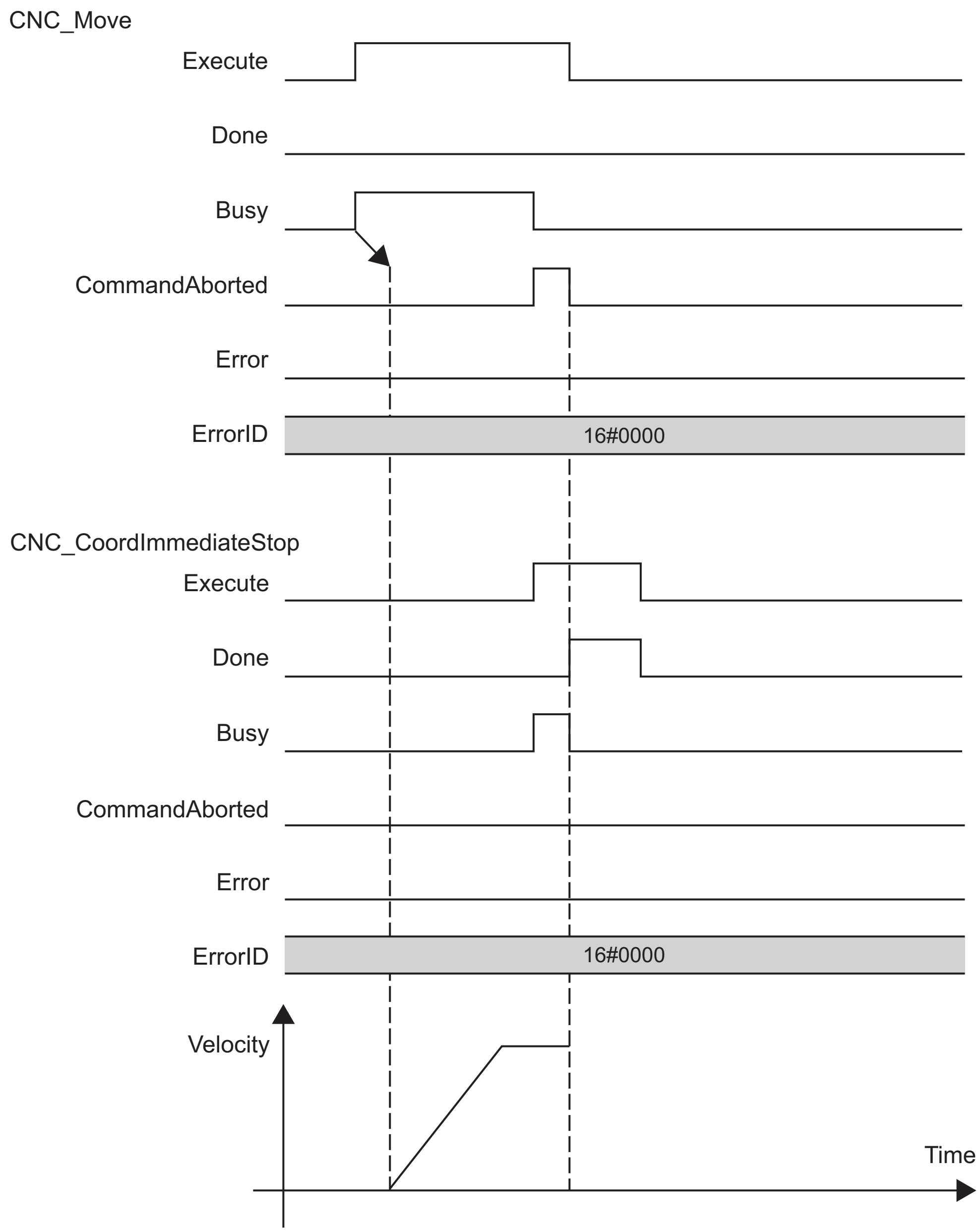
Name	Meaning	Data type	Valid variable	Description
Coord	CNC Coordinate System	_sCNC_COORD_REF	---	Specifies the CNC coordinate system.

Functions

- This instruction can be executed for the CNC coordinate system that is in motion.
- When this instruction is executed, all the composition CNC motor stops immediately according to the setting of the **Immediate Stop Method** of CNC coordinate system parameter. *CommandAborted* (Command Aborted) changes to TRUE for the instruction that is currently in operation.
- When this instruction is executed, *ErrorStop* (Error Deceleration Stopping) changes to TRUE in the CNC coordinate system, and the Immediate Stop Instruction Executed error (560C0000 hex) occurs.

Timing Chart

- *Busy* (Executing) changes to TRUE at the same time as *Execute* changes to TRUE.
- *Done* changes to TRUE when processing of this instruction is completed.



Re-execution of CNC Instructions

This instruction cannot be re-executed. A CNC Instruction Re-execution Disabled error (5603 0000 hex) occurs if re-execution is attempted.

Multi-execution of CNC Instructions

Refer to *A-4 Instructions for Which Multi-execution Is Supported* on page A-15 for details on multi-execution of CNC instructions.

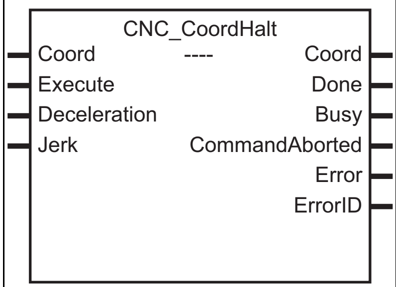
Errors

If this instruction cannot be executed, an error occurs, and *Error* will change to TRUE.

You can find out the cause of the error by referring to the value output by *ErrorID* (Error Code).

CNC_CoordHalt

The CNC_CoordHalt instruction stops the currently running CNC motor assigned to the positioning axis in the specified CNC coordinate system.

Instruction	Name	FB/FUN	Graphic expression	ST expression
CNC_CoordHalt	CNC Coordinate System Halt	FB	CNC_CoordHalt_instance 	CNC_CoordHalt_instance (Coord :=*parameter*, Execute :=*parameter*, Deceleration :=*parameter*, Jerk :=*parameter*, Done =>*parameter*, Busy =>*parameter*, CommandAborted =>*parameter*, Error =>*parameter*, ErrorID =>*parameter*);

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Execute	Execute	BOOL	TRUE or FALSE	FALSE	The instruction is executed when *Execute* changes to TRUE.
Deceleration (Reserved)	Deceleration Rate	ARRAY[0..1] OF LREAL	0	0	Specifies the deceleration rate of the CNC motor in the CNC coordinate system. The unit is command units/s^2.
Jerk (Reserved)	Jerk	LREAL	0	0	Specify jerk. The unit is command units/s^3.

Output Variables

Name	Meaning	Data type	Valid range	Description
Done	Done	BOOL	TRUE or FALSE	TRUE when the instruction is completed.
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Command-Aborted	Command Aborted	BOOL	TRUE or FALSE	TRUE when the instruction is aborted.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error Code	WORD	*1	Contains the error code when an error occurs. A value of 16#0000 indicates normal execution.

*1. Refer to *Section 15 Troubleshooting*.

● Output Variable Update Timing

Name	Timing for changing to TRUE	Timing for changing to FALSE
Done	When this instruction is completed.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Busy	When *Execute* changes to TRUE.	• When *Done* changes to TRUE. • When *Error* changes to TRUE. • When *CommandAborted* changes to TRUE.
Command-Aborted	• When this instruction is canceled due to an error. • When this instruction is executed while there is an error.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Error	When there is an error in the execution conditions or input parameters for the instruction.	When the error is cleared.

In-Out Variables

Name	Meaning	Data type	Valid range	Description
Coord	CNC Coordinate System	_sCNC_COORD_REF	---	Specifies the CNC coordinate system.

Functions

- This function immediately stops the currently operating CNC motors in the specified CNC coordinate system.
- When this instruction starts, the instructions that are currently being executed are aborted by *CommandAborted* (Command Aborted).
- When *Execute* changes to TRUE, the stop processing starts.
- The in-position check is not performed when the CNC motor is stopped by this instruction.
- When this instruction starts, the CNC coordinate system is not changed to the *Stopping* (Deceleration Stopping) status. The CNC coordinate system transitions to *Standby* or *Hold* (Holding). This instruction is mainly used to abort CNC_SyncMoveAbsolute from *Hold* (Holding) during manual intervention.

- If this instruction is executed while the CNC coordinate system is set to the *Executing* status, a multi-execution error occurs.

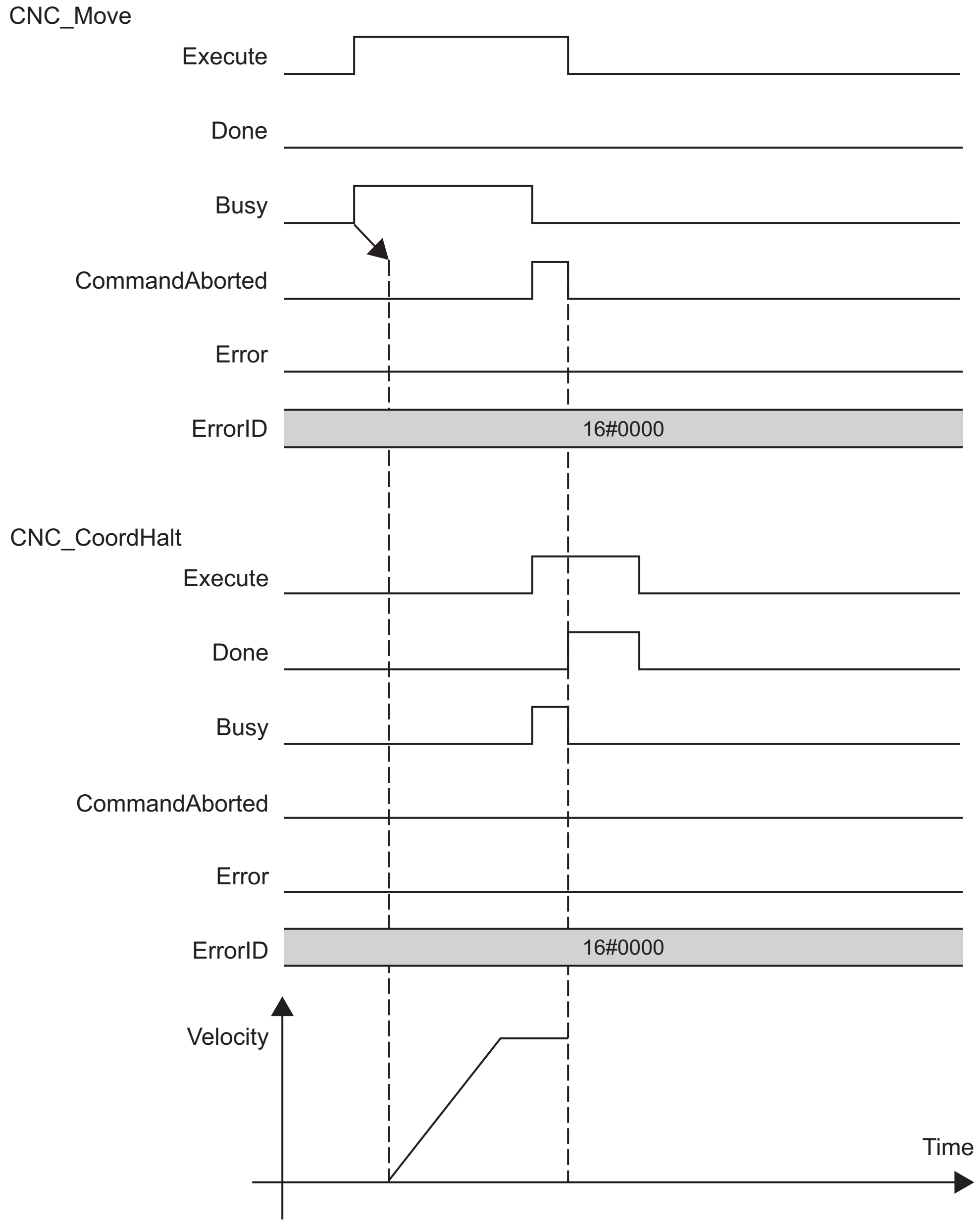
Precautions for Correct Use

When stopping all the CNC motor configurations including the spindle axis, use the CNC_CoordStop instruction.

Timing Chart

- *Busy* (Executing) changes to TRUE at the same time as *Execute* changes to TRUE.
- *Done* changes to TRUE when a velocity of 0 is reached.

  The following timing chart shows operations to stop the CNC motor during positioning. *CommandAborted* (Command Aborted) for the positioning instruction that is currently in operation will change to TRUE when this instruction is executed.



Re-execution of CNC Instructions

This instruction cannot be re-executed. A CNC Instruction Re-execution Disabled error occurs if re-execution is attempted.

Multi-execution of CNC Instructions

Refer to *A-4 Instructions for Which Multi-execution Is Supported* on page A-15 for details on multi-execution of CNC instructions.

Errors

If this instruction cannot be executed, an error occurs, and *Error* will change to TRUE.

You can find out the cause of the error by referring to the value output by *ErrorID* (Error Code).

CNC_Power

The CNC_Power instruction makes a Servo Drive ready to operate.

Instruction	Name	FB/FUN	Graphic expression	ST expression
CNC_Power	Power Servo	FB	CNC_Power_instance CNC_Power Coord ---- Coord Enable Status LogicalMotorNo Busy Error ErrorID	CNC_Power_instance (Coord :=*parameter*, Enable :=*parameter*, LogicalMotorNo :=*parameter*, Status :=*parameter*, Busy =>*parameter*, Error =>*parameter*, ErrorID =>*parameter*);

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Enable	Enable	BOOL	TRUE or FALSE	FALSE	The device is ready for operation when *Enable* is TRUE, and not ready when it is FALSE.
Logical MotorNo	Logical CNC Motor Number	UINT	0 to (Maximum Positioning Logical CNC Motor Number - 1), 100	0	Specify the logical CNC motor number. When the CNC motor is assigned to the positioning axis, specify the Positioning Logical CNC Motor Number. When it is assigned to the spindle axis, specify 100.

Output Variables

Name	Meaning	Data type	Valid range	Description
Status	Servo ON	BOOL	TRUE or FALSE	TRUE when the device is ready for operation.
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error Code	WORD	*1	Contains the error code when an error occurs. A value of 16#0000 indicates normal execution.

*1. Refer to *Section 15 Troubleshooting*.

Output Variable Update Timing

Name	Timing for changing to TRUE	Timing for changing to FALSE
Status	When the specified CNC motor is ready for operation.	When operation ready status for the specified CNC motor is cleared.
Busy	When *Enable* changes to TRUE.	• When *Enable* changes to FALSE. • When *Error* changes to TRUE.
Error	When there is an error in the execution conditions or input parameters for the instruction.	When the error is cleared.

In-Out Variables

Name	Meaning	Data type	Valid range	Description
Coord	CNC Coordinate System	_sCNC_COORD_REF	---	Specifies the CNC coordinate system.

Functions

- When *Enable* changes to TRUE, the CNC motor specified in *LogicalMotorNo* is made ready to operate. You can control the CNC motor when it is ready to operate.
- When *Enable* changes to FALSE, the ready status is cleared for the CNC motor specified by *LogicalMotorNo*. You cannot control the CNC motor after the ready status is cleared because it will not acknowledge operation commands. Also, an error occurs if a motion command is executed for a CNC motor for which the ready status is cleared. You can execute the CNC_Power (Power Servo) and CNC_CoordReset (CNC Coordinate System Error Reset) instructions even for CNC motor that are not ready.
- You can use this instruction to disable the operation of CNC motors while they are in motion. In this case, *CommandAborted* (Command Aborted) will change to TRUE. Output of the operation command will stop and the CNC motor will no longer be ready for operation.
- If home is not defined for a Servomotor with an absolute encoder, compensation is performed using the absolute encoder home offset to define home when the CNC motor is ready to operate. Home is also defined when I/O refresh communications with the I/O device assigned to the CNC motor change from a non-established to an established state.

Instruction Details

Relation to CPU Unit Operating Modes

If a CNC motor is placed in ready status during RUN mode, ready status will continue even if the operating mode changes to PROGRAM mode.

Deleting Instruction with Online Editing

If a CNC motor is placed in ready status, ready status will continue even if the instruction is deleted during online editing.

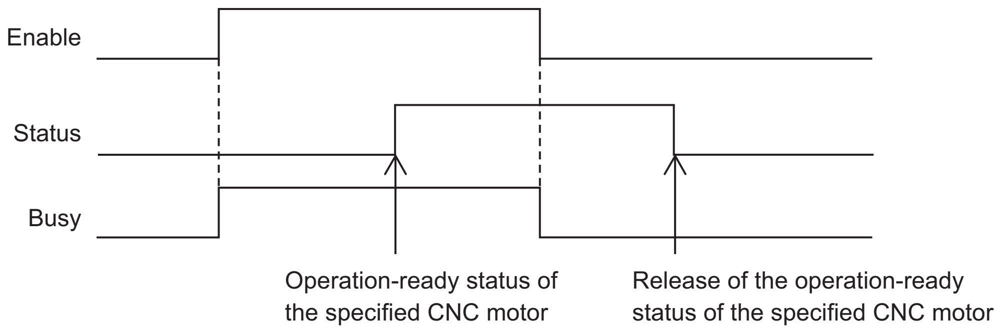
Timing Chart

- When *Enable* changes to TRUE, *Busy* (Executing) changes to TRUE to indicate that the instruction was acknowledged.

  After the CNC motor becomes ready for operation, *Status* (Servo ON) changes to TRUE.
- When *Enable* changes to FALSE, *Busy* (Executing) changes to FALSE. *Status* (Servo ON) changes to FALSE when ready status is cleared. *Status* (Servo ON) outputs the CNC motor ready status regardless of whether *Enable* is TRUE or FALSE.

Precautions for Correct Use

Status (Servo ON) will not change to TRUE until *Enable* changes to TRUE and the processing is finished at the CNC motor. Make sure that *Status* (Servo ON) changes to TRUE before moving the CNC motor.



Re-execution of CNC Instructions

You cannot re-execute CNC instructions with enable-type inputs.

Multi-execution of CNC Instructions

Refer to *A-4 Instructions for Which Multi-execution Is Supported* on page A-15 for details on multi-execution of CNC instructions.

Precautions for Correct Use

Do not create a program that starts the CNC_Power instruction of another instance for the CNC motor for which the CNC_Power instruction is currently being executed. Basically, assign a CNC_Power instruction to each CNC motor.

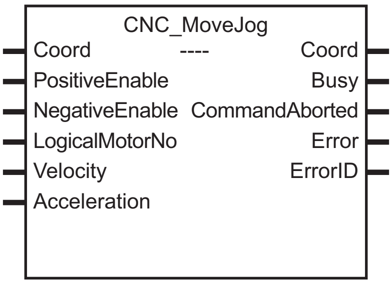
Errors

If this instruction cannot be executed, an error occurs, and *Error* will change to TRUE.

You can find out the cause of the error by referring to the value output by *ErrorID* (Error Code).

CNC_MoveJog

The CNC_MoveJog instruction jogs a CNC coordinate system according to the specified target velocity.

Instruction	Name	FB/FUN	Graphic expression	ST expression
CNC_MoveJog	Jog	FB	CNC_MoveJog_instance 	CNC_MoveJog_instance (Coord :=*parameter*, PositiveEnable :=*parameter*, NegativeEnable :=*parameter*, LogicalMotorNo :=*parameter*, Velocity :=*parameter*, Acceleration :=*parameter*, Busy =>*parameter*, CommandAborted =>*parameter*, Error =>*parameter*, ErrorID =>*parameter*);

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Positive Enable	Positive Direction Enable	BOOL	TRUE or FALSE	FALSE	When this variable changes to TRUE, the CNC motor starts moving in the positive direction. When it changes to FALSE, the CNC motor stops moving.
Negative Enable	Negative Direction Enable	BOOL	TRUE or FALSE	FALSE	When this variable changes to TRUE, the CNC motor starts moving in the positive direction. When it changes to FALSE, the CNC motor stops moving.
Logical MotorNo	Logical CNC Motor Number	UINT	0 to (Maximum Positioning Logical CNC Motor Number - 1)	0	Specify the logical CNC motor number. When the CNC motor is assigned to the positioning axis, specify the Positioning Logical CNC Motor Number.
Velocity	Target Velocity	LREAL	Positive number, 0	0	Specify the target velocity. The unit is command units/min.
Acceleration	Acceleration/Deceleration Rate	LREAL	Positive number, 0	0	Specify the acceleration/deceleration rate. The unit is command units/s^2.

Output Variables

Name	Meaning	Data type	Valid range	Description
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Command-Aborted	Command Aborted	BOOL	TRUE or FALSE	TRUE when the instruction is aborted.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error Code	WORD	*1	Contains the error code when an error occurs. A value of 16#0000 indicates normal execution.

*1. Refer to *Section 15 Troubleshooting*.

● Output Variable Update Timing

Name	Timing for changing to TRUE	Timing for changing to FALSE
Busy	When *PositiveEnable* or *NegativeEnable* changes to TRUE.	• When the CNC motor stops. • When *Error* changes to TRUE. • When *CommandAborted* changes to TRUE.
Command-Aborted	• When this instruction is aborted because another motion control instruction was multi-executed (*Aborting*). • When this instruction is aborted due to an error. • When this instruction is executed while there is an error. • When you start this instruction during CNC_CoordStop instruction execution.	• When *PositiveEnable* changes to FALSE if *PositiveEnable* is TRUE. • When *NegativeEnable* changes to FALSE if *NegativeEnable* is TRUE. • After one period when *PositiveEnable* and *NegativeEnable* are both FALSE.
Error	When there is an error in the execution conditions or input parameters for the instruction.	When the error is cleared.

In-Out Variables

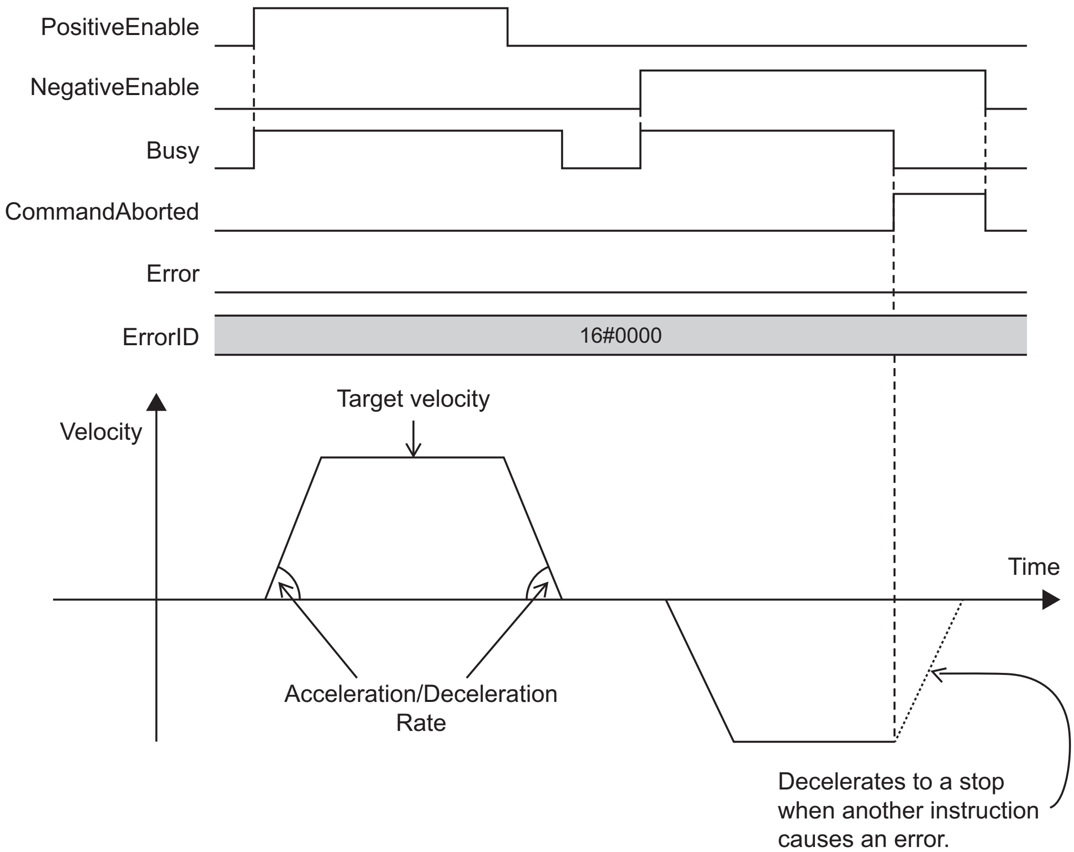
Name	Meaning	Data type	Valid range	Description
Coord	CNC Coordinate System	_sCNC_COORD_REF	---	Specifies the CNC coordinate system.

Functions

- The CNC_MoveJog instruction performs jogging according to the specified *Velocity* (Target Velocity).
- To jog in the positive direction, change *PositiveEnable* (Positive Direction Enable) to TRUE. To jog in the negative direction, change *NegativeEnable* (Negative Direction Enable) to TRUE.
- If *PositiveEnable* (Positive Direction Enable) and *NegativeEnable* (Negative Direction Enable) are changed to TRUE at the same time, *PositiveEnable* (Positive Direction Enable) takes priority. As a result, the CNC motor will jog in the positive direction.
- If the command velocity of the CNC_MoveJog (Jog) instruction exceeds the maximum jog velocity that is set in the CNC motor parameters, the maximum jog velocity is used.
- This instruction can be executed even if home is not defined.

Timing Chart

- *Busy* (Executing) changes to TRUE as soon as *PositiveEnable* (Positive Direction Enable) or *NegativeEnable* (Negative Direction Enable) changes to TRUE.
- The axis starts deceleration as soon as *PositiveEnable* (Positive Direction Enable) or *NegativeEnable* (Negative Direction Enable) changes to FALSE and *Busy* (Executing) changes to FALSE when the axis stops completely.
- If another instruction aborts this instruction, *CommandAborted* (Command Aborted) changes to TRUE and *Busy* (Executing) changes to FALSE.

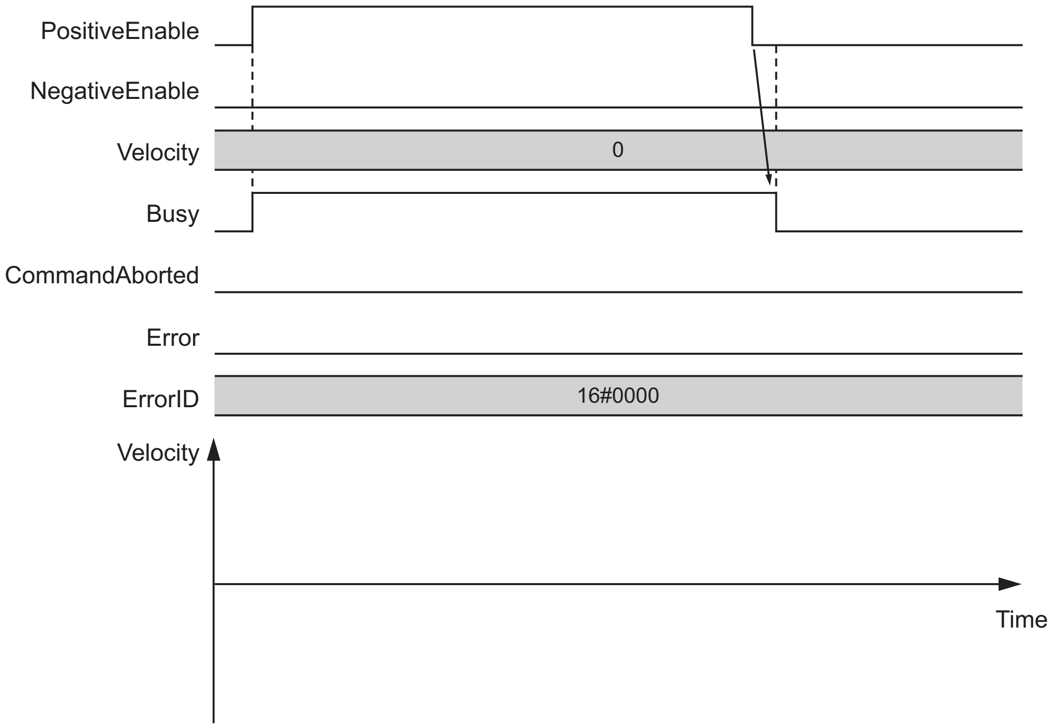


You can specify *Velocity* (Target Velocity) and *Acceleration* (Acceleration/Deceleration Rate) as the input variables. The *Velocity* (Target Velocity) and *Acceleration* (Acceleration/Deceleration Rate) input variables are updated operations only when *PositiveEnable* (Positive Direction Enable) or *NegativeEnable* (Negative Direction Enable) rises. Therefore, the velocity will not change even if *Velocity* (Target Velocity) changes while *PositiveEnable* (Positive Direction Enable) or *NegativeEnable* (Negative Direction Enable) remains TRUE.

Timing Chart When Target Velocity Is 0

When the *Velocity* (Target Velocity) is 0 and you start jogging the motor, the CNC motor does not move, however, the CNC coordinate system changes to *Moving* status.

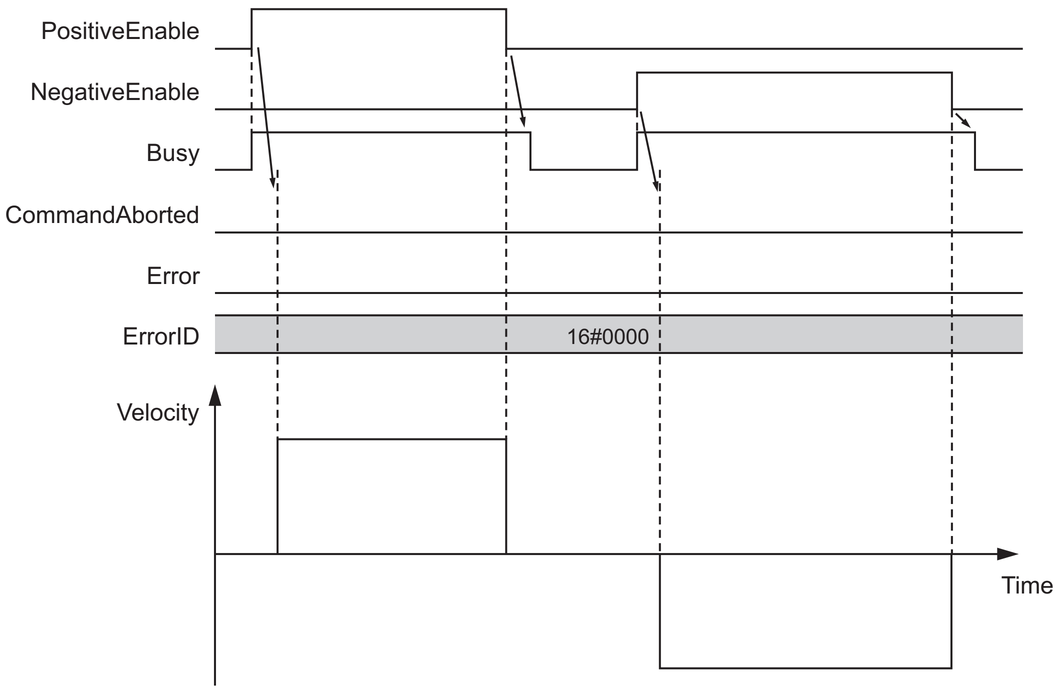
The following timing chart shows an example when the *Velocity* (Target Velocity) is 0 and you start jogging the CNC motor.



Timing Chart When Acceleration/Deceleration Rate Is 0

When the *Acceleration* (Acceleration/Deceleration Rate) is 0 and you start jogging the motor, the motor will reach the target velocity without accelerating or decelerating.

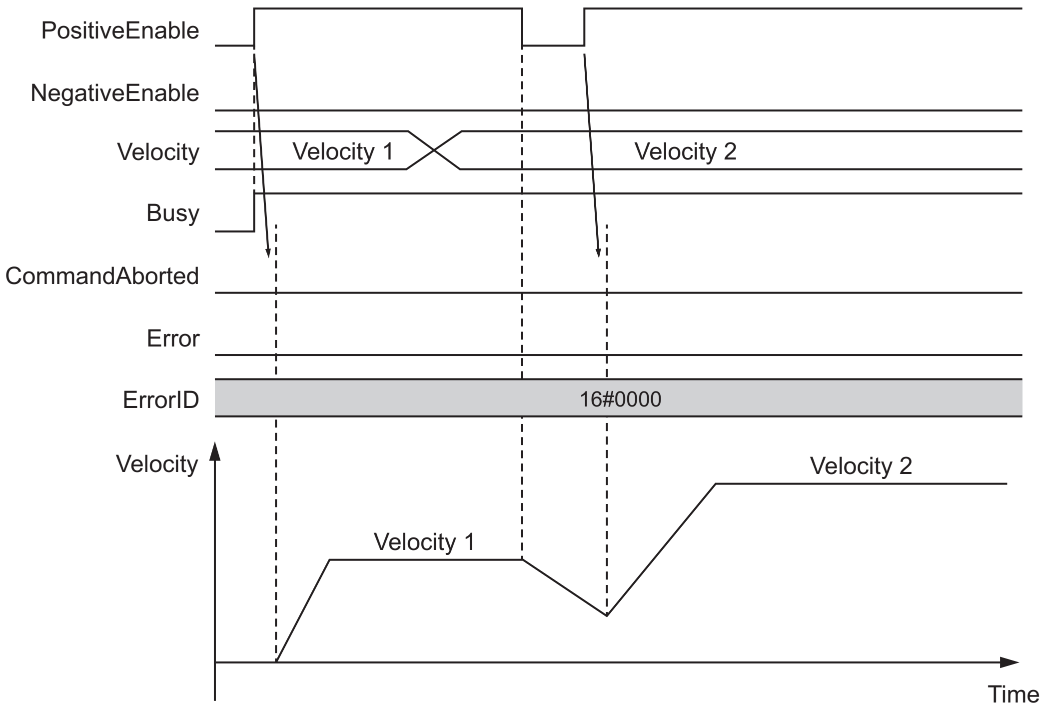
The timing chart below shows an example when the *Acceleration* (Acceleration/Deceleration Rate) are 0.



Re-execution of CNC Instructions

● Restarting with *Enable* in the Same Direction

If you change *PositiveEnable* (Positive Direction Enable) or *NegativeEnable* (Negative Direction Enable) to TRUE when it is FALSE and the axis is decelerating, the axis will begin to accelerate/decelerate towards the target velocity. If you change the *Velocity* (Target Velocity) or *Acceleration* (Acceleration/Deceleration Rate) at this time, the new value of the input parameter is used in operation. The axis is not stopped, and *Busy* (Executing) does not change to FALSE. The following example shows operation when *PositiveEnable* (Positive Direction Enable) changes to TRUE during deceleration.

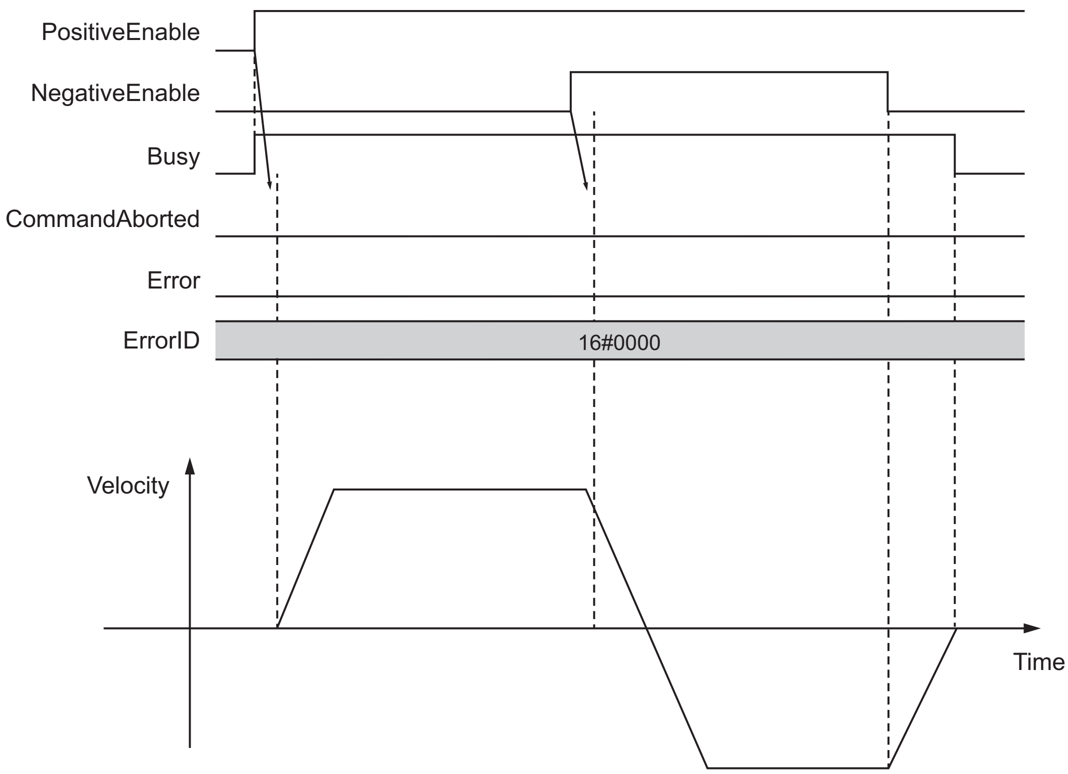


● Restarting with *Enable* in the Opposite Direction

If you change *NegativeEnable* (Negative Direction Enable) to TRUE when *PositiveEnable* (Positive Direction Enable) is TRUE and the axis is jogging in the positive direction, the axis will reverse its direction and start jogging in the negative direction. When this happens, you can jog the axis with the input variables for when *NegativeEnable* (Negative Direction Enable) changes to TRUE. The input variables are *Velocity* (Target Velocity) and *Acceleration* (Acceleration/Deceleration Rate).

The deceleration rate before the axis direction is reversed and the acceleration rate after it is reversed follow the input variables for when *NegativeEnable* (Negative Direction Enable) changes to TRUE. When *NegativeEnable* (Negative Direction Enable) is TRUE and the axis is jogging in the negative direction, the same operation occurs when *PositiveEnable* (Positive Direction Enable) changes to TRUE. If *NegativeEnable* (Negative Direction Enable) changes to TRUE while *PositiveEnable* (Positive Direction Enable) is TRUE, the axis starts jogging in the negative direction. In this case, the axis will not jog in the positive direction even if *NegativeEnable* (Negative Direction Enable) changes to FALSE. To jog the axis in the positive direction, change *PositiveEnable* (Positive Direction Enable) to FALSE, and then back to TRUE again.

The same operation applies to the opposite case.



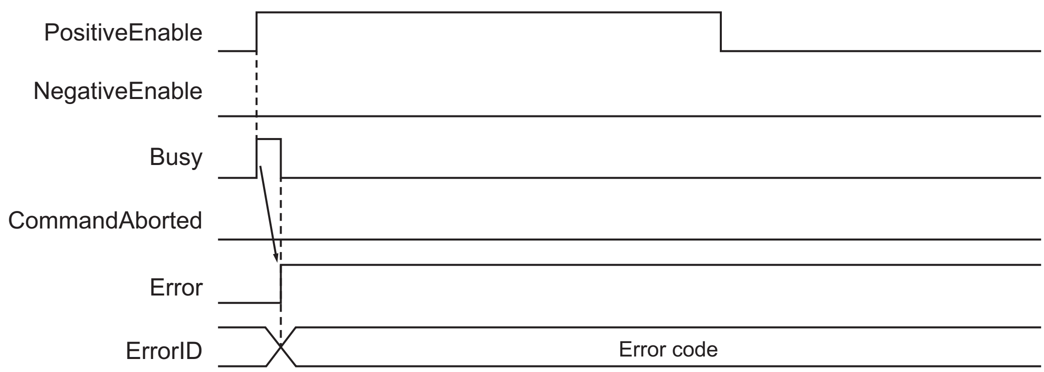
Multi-execution of CNC Instructions

Refer to *A-4 Instructions for Which Multi-execution Is Supported* on page A-15 for details on multi-execution of CNC instructions.

Errors

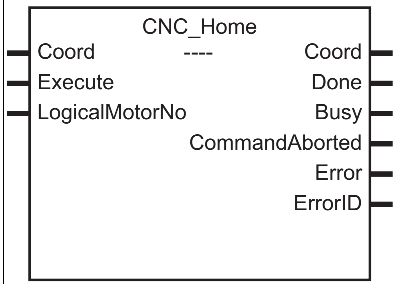
If this instruction cannot be executed, an error occurs, and *Error* will change to TRUE.

You can find out the cause of the error by referring to the value output by *ErrorID* (Error Code).



CNC_Home

The CNC_Home instruction operates the Servomotor to determine home using the limit signals, home proximity signal, and home signal.

Instruction	Name	FB/FUN	Graphic expression	ST expression
CNC_Home	Home	FB	CNC_Home_instance  	CNC_Home_instance (Coord :=*parameter*, Execute :=*parameter*, LogicalMotorNo :=*parameter*, Done =>*parameter*, Busy =>*parameter*, CommandAborted =>*parameter*, Error =>*parameter*, ErrorID =>*parameter*);

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Execute	Execute	BOOL	TRUE or FALSE	FALSE	The instruction is executed when *Execute* changes to TRUE.
Logical MotorNo	Logical CNC Motor Number	UINT	0 to (Maximum Positioning Logical CNC Motor Number - 1), 100	0	Specify the logical CNC motor number. When the target CNC motor is assigned to the positioning axis, specify the Positioning Logical CNC Motor Number.

Output Variables

Name	Meaning	Data type	Valid range	Description
Done	Done	BOOL	TRUE or FALSE	TRUE when the instruction is completed.
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Command-Aborted	Command Aborted	BOOL	TRUE or FALSE	TRUE when the instruction is aborted.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error Code	WORD	*1	Contains the error code when an error occurs. A value of 16#0000 indicates normal execution.

*1. Refer to *Section 15 Troubleshooting*.

Output Variable Update Timing

Name	Timing for changing to TRUE	Timing for changing to FALSE
Done	When this instruction is completed.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Busy	When *Execute* changes to TRUE.	• When *Done* changes to TRUE. • When *Error* changes to TRUE. • When *CommandAborted* changes to TRUE.
Command-Aborted	• When this instruction is aborted because another motion control instruction was multi-executed (*Aborting*). • When this instruction is aborted due to an error. • When this instruction is executed while there is an error. • When you start this instruction during CNC_CoordStop instruction execution.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Error	When there is an error in the execution conditions or input parameters for the instruction.	When the error is cleared.

In-Out Variables

Name	Meaning	Data type	Valid range	Description
Coord	CNC Coordinate System	_sCNC_COORD_REF	---	Specifies the CNC coordinate system.

Functions

Refer to the description of MC_Home in the *NJ/NX-series Motion Control Instructions Reference Manual* (Cat. No. W508) or *NY-series Motion Control Instructions Reference Manual* (Cat. No. W561).

The following describes differences from the MC_Home specifications.

Homing Acceleration / Deceleration

You can specify the homing acceleration/deceleration rate as a homing parameter.

The homing acceleration rate and homing deceleration rate cannot be specified individually.

Homing Jerk

You cannot specify the Homing Jerk.

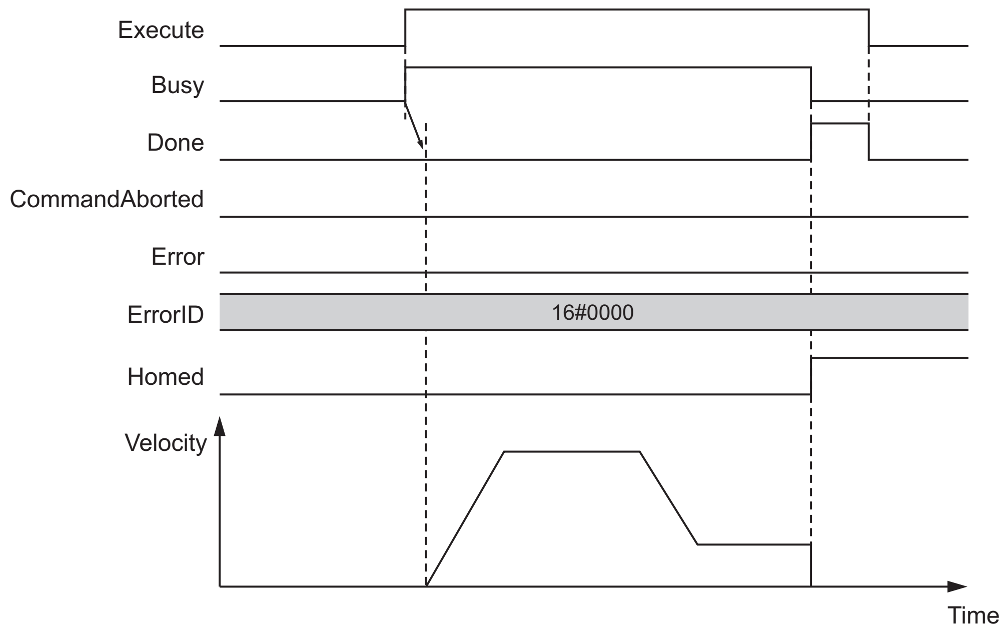
Instruction Details

Refer to the description of MC_Home in the *NJ/NX-series Motion Control Instructions Reference Manual* (Cat. No. W508) or *NY-series Motion Control Instructions Reference Manual* (Cat. No. W561).

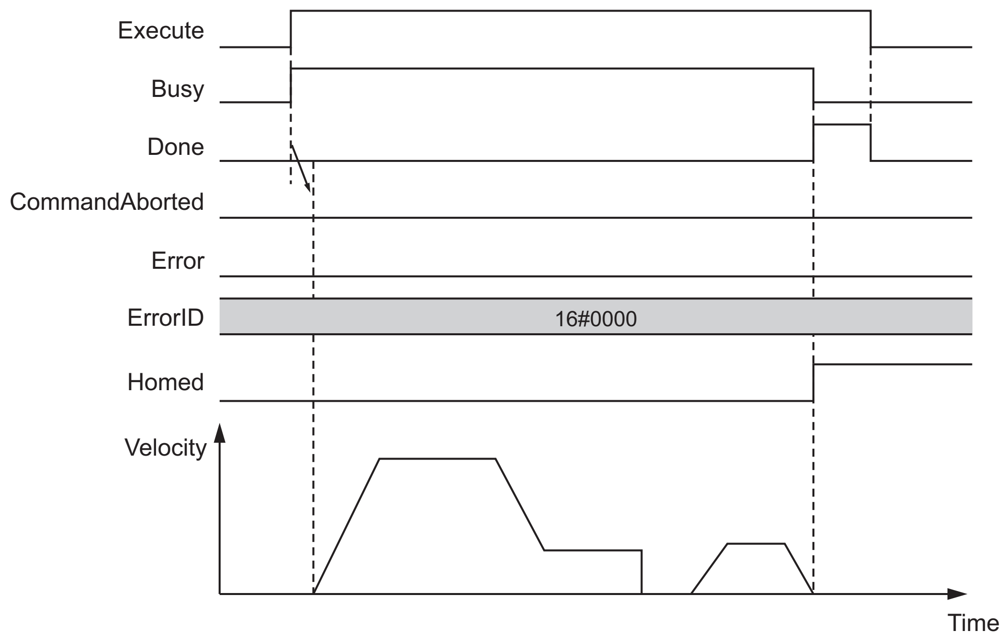
Timing Chart

A timing chart for the operation of the CNC_Home instruction is shown below.

● No Homing Compensation



● Homing Compensation



Re-execution of CNC Instructions

This instruction cannot be re-executed. A CNC Instruction Re-execution Disabled error occurs if re-execution is attempted.

Multi-execution of CNC Instructions

Refer to *A-4 Instructions for Which Multi-execution Is Supported* on page A-15 for details on multi-execution of CNC instructions.

Errors

If this instruction cannot be executed, an error occurs, and *Error* will change to TRUE.

You can find out the cause of the error by referring to the value output by *ErrorID* (Error Code).

CNC_HomeWithParameter

The CNC_HomeWithParameter instruction sets the homing parameter and operates the Servomotor to determine home using the limit signals, home proximity signal, and home signal.

Instruction	Name	FB/FUN	Graphic expression	ST expression
CNC_HomeWithParameter	Home with Parameters	FB	CNC_HomeWithParameter_instance CNC_HomeWithParameter Coord ---- Coord HomingParameter HomingParameter Execute Done LogicalMotorNo Busy CommandAborted Error ErrorID	CNC_HomeWithParameter_instance (Coord :=*parameter*, HomingParameter :=*parameter*, Execute :=*parameter*, LogicalMotorNo :=*parameter*, Done =>*parameter*, Busy =>*parameter*, CommandAborted =>*parameter*, Error =>*parameter*, ErrorID =>*parameter*);

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Execute	Execute	BOOL	TRUE or FALSE	FALSE	The instruction is executed when Execute changes to TRUE.
LogicalMo-torNo	Logical CNC Motor Number	UINT	0 to (Maximum Positioning Log-ical CNC Motor number) - 1,100	0	Specify the logical CNC motor num-ber. When the CNC motor is assigned to the positioning axis, specify the Positioning Logical CNC Motor Number.

Output Variables

Name	Meaning	Data type	Valid range	Description
Done	Done	BOOL	TRUE or FALSE	TRUE when the instruction is completed.
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Command-Aborted	Command Aborted	BOOL	TRUE or FALSE	TRUE when the instruction is aborted.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error Code	WORD	*1	Contains the error code when an error occurs. A value of 16#0000 indicates normal execution.

*1. Refer to *Section 15 Troubleshooting*.

Output Variable Update Timing

Name	Timing for changing to TRUE	Timing for changing to FALSE
Done	When this instruction is completed.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Busy	When *Execute* changes to TRUE.	• When *Done* changes to TRUE. • When *Error* changes to TRUE. • When *CommandAborted* changes to TRUE.
Command-Aborted	• When this instruction is aborted because another motion control instruction was multi-executed (*Aborting*). • When this instruction is aborted due to an error. • When this instruction is executed while there is an error. • When you start this instruction during CNC_CoordStop instruction execution.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Error	When there is an error in the execution conditions or input parameters for the instruction.	When the error is cleared.

In-Out Variables

Name	Meaning	Data type	Valid range	Description
Coord	CNC Coordinate System	_sCNC_COORD_REF	---	Specifies the CNC coordinate system.
HomingParameter	Homing Parameter	_sCNC_HOMING_REF	---	Specifies a homing parameter.

Functions

Refer to the description of MC_Home in the *NJ/NX-series Motion Control Instructions Reference Manual* (Cat. No. W508) or *NY-series Motion Control Instructions Reference Manual* (Cat. No. W561).

The following describes differences from the MC_HomeWithParameter specifications.

- **Homing Acceleration/Deceleration Rate**

  The user can specify the acceleration/deceleration rate as a homing parameter.

  _sCNC_HOMING_REF.Acc is used to specify the homing acceleration/deceleration rate.

  There is no parameter that is equivalent to the Homing Deceleration (_sHOMING_REF.Dec).

- **Homing Jerk**

  You cannot specify the Homing Jerk.

  There is no parameter that is equivalent to the Homing Jerk (_sHOMING_REF.Jerk).

Instruction Details

Refer to the description of MC_HomeWithParameter in the *NJ/NX-series Motion Control Instructions Reference Manual* (Cat. No. W508) or *NY-series Motion Control Instructions Reference Manual* (Cat. No. W561).

Timing Chart

The timing chart is the same as that for the CNC_Home instruction. Refer to the timing chart shown in *CNC_Home* on page 12-90.

Re-execution of CNC Instructions

This instruction cannot be re-executed. A CNC Instruction Re-execution Disabled error occurs if re-execution is attempted.

Multi-execution of CNC Instructions

Refer to *A-4 Instructions for Which Multi-execution Is Supported* on page A-15 for details on multi-execution of CNC instructions.

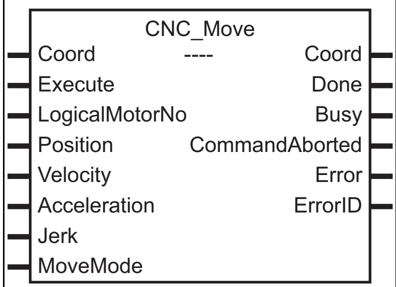
Errors

If this instruction cannot be executed, an error occurs, and *Error* will change to TRUE.

You can find out the cause of the error by referring to the value output by *ErrorID* (Error Code).

CNC_Move

The CNC_Move instruction performs absolute positioning or relative positioning.

Instruction	Name	FB/FUN	Graphic expression	ST expression
CNC_Move	Positioning	FB	CNC_Move_instance 	CNC_Move_instance(Coord :=*parameter*, Execute :=*parameter*, LogicalMotorNo :=*parameter*, Position :=*parameter*, Velocity :=*parameter*, Acceleration :=*parameter*, Jerk :=*parameter*, MoveMode :=*parameter*, Done =>*parameter*, Busy =>*parameter*, CommandAborted =>*parameter*, Error =>*parameter*, ErrorID =>*parameter*);

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Execute	Execute	BOOL	TRUE or FALSE	FALSE	The instruction is executed when *Execute* changes to TRUE.
LogicalMotorNo	Logical CNC Motor Number	UINT	0 to (Maximum Positioning Logical CNC Motor number) - 1	0	Specify the logical CNC motor number. When the CNC motor is assigned to the positioning axis, specify the Positioning Logical CNC Motor Number. To specify the spindle axis, specify 100.
Position	Target Position	LREAL	Negative number, positive number, or 0	0	Specify the target position. The unit is command units.
Velocity	Target Velocity	LREAL	Positive number	0	Specify the target velocity. The unit is command units/min.
Acceleration	Acceleration/Deceleration	LREAL	Positive number, 0	0	Specify the acceleration/deceleration rate. The unit is command units/s^2.
Jerk (Reserved)	Jerk	LREAL	0	0	Specify jerk. The unit is command units/s^3.
MoveMode	Travel Mode	_eCNC_MOVE_MODE	0: _cncAbsolute 1: _cncRelative	0	Select the travel method 0: Absolute positioning 1: Relative positioning

Output Variables

Name	Meaning	Data type	Valid range	Description
Done	Done	BOOL	TRUE or FALSE	TRUE when the instruction is completed.
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Command-Aborted	Command Aborted	BOOL	TRUE or FALSE	TRUE when the instruction is aborted.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error Code	WORD	*1	Contains the error code when an error occurs. A value of 16#0000 indicates normal execution.

*1. Refer to *Section 15 Troubleshooting*.

● Output Variable Update Timing

Name	Timing for changing to TRUE	Timing for changing to FALSE
Done	When positioning is completed.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Busy	When *Execute* changes to TRUE.	• When *Done* is set to TRUE. • When *Error* changes to TRUE. • When *CommandAborted* changes to TRUE.
Command-Aborted	• When this instruction is aborted because another motion control instruction was multi-executed (*Aborting*). • When this instruction is aborted due to an error. • When this instruction is executed while there is an error. • When you start this instruction during CNC_CoordStop instruction execution.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Error	When there is an error in the execution conditions or input parameters for the instruction.	When the error is cleared.

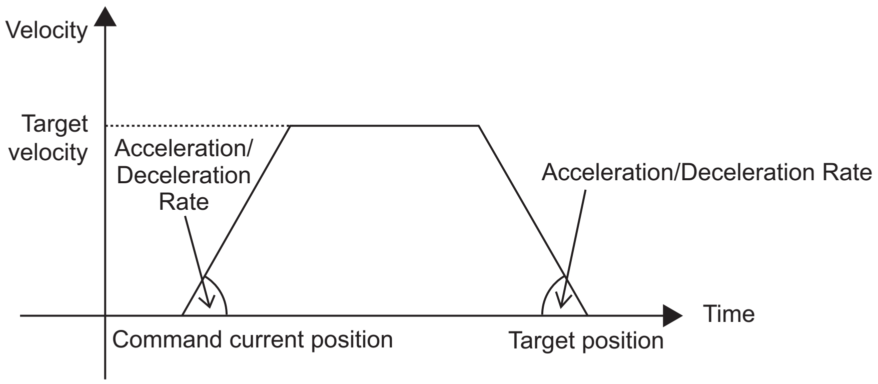
In-Out Variables

Name	Meaning	Data type	Valid range	Description
Coord	CNC Coordinate System	_sCNC_COORD_REF	---	Specifies the CNC coordinate system.

Functions

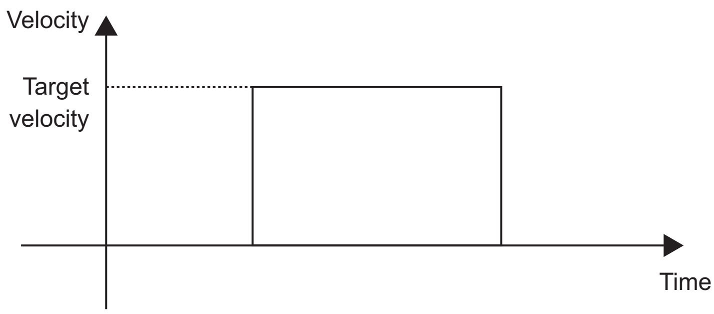
- This instruction performs absolute positioning or relative positioning for the CNC motor.
- When *Execute* changes to TRUE, the operation of absolute positioning starts.
- This instruction can be executed when the CNC coordinate system status is *Standby* (Stopping) or *Hold* (Holding). However, if the spindle axis is specified, this instruction can only be executed in *Standby*.
- This instruction can be executed even if home is not defined.
- You can specify *Velocity* (Target Velocity) and *Acceleration* (Acceleration/Deceleration Rate) as input variables.

The following chart shows an operation example of absolute positioning.



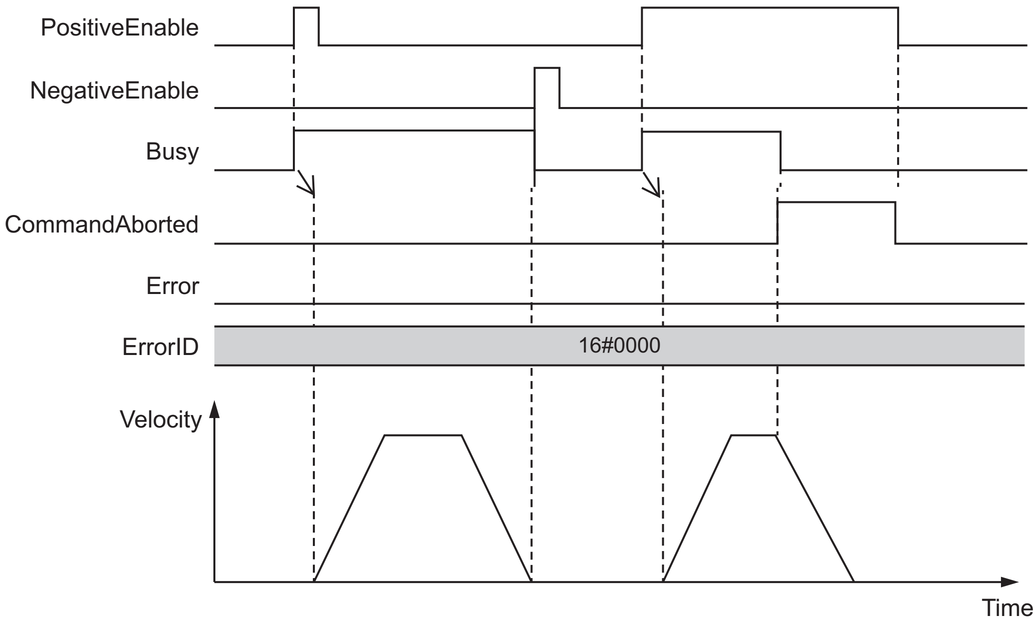
When *Acceleration* (Acceleration/Deceleration Rate) is 0, this instruction can be executed. The CNC motor can reach the target velocity without acceleration or deceleration.

The following chart shows an operation example of an absolute positioning when the acceleration/deceleration rate is 0.



Timing Chart

- *Busy* (Executing) changes to TRUE at the same time as *Execute* changes to TRUE.
- When the CNC motor reaches the target position specified in *Position* (Target Position) and positioning is completed, Done changes to TRUE.
- If another instruction aborts this instruction, *CommandAborted* (Command Aborted) changes to TRUE and *Busy* (Executing) changes to FALSE.



Re-execution of CNC Instructions

This instruction cannot be re-executed. A CNC Instruction Re-execution Disabled error occurs if re-execution is attempted.

Multi-execution of CNC Instructions

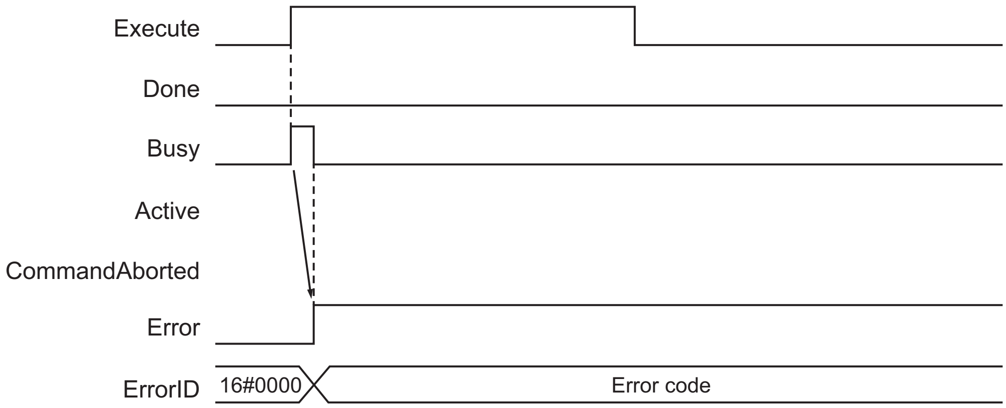
Refer to *A-4 Instructions for Which Multi-execution Is Supported* on page A-15 for details on multi-execution of CNC instructions.

Errors

If this instruction cannot be executed, an error occurs, and *Error* will change to TRUE.

You can find out the cause of the error by referring to the value output by *ErrorID* (Error Code).

● Timing Chart When Error Occurs



Sample Programming

This section shows sample programming about absolute positioning.

Parameter Settings

The minimum settings required for this sample programming are given below.

● CNC Coordinate System Settings

Logical CNC motor configuration

CNC coordinate system	Logical CNC motor configuration
CNC coordinate system 0	3

Positioning axis configuration

CNC coordinate system	Positioning axis CNC motor number	Positioning axis configuration CNC motor	Positioning axis assignment
CNC coordinate system 0	CNC motor P0	CNC motor 0	X-axis
CNC coordinate system 0	CNC motor P1	CNC motor 1	Y-axis
CNC coordinate system 0	CNC motor P2	CNC motor 2	Z-axis

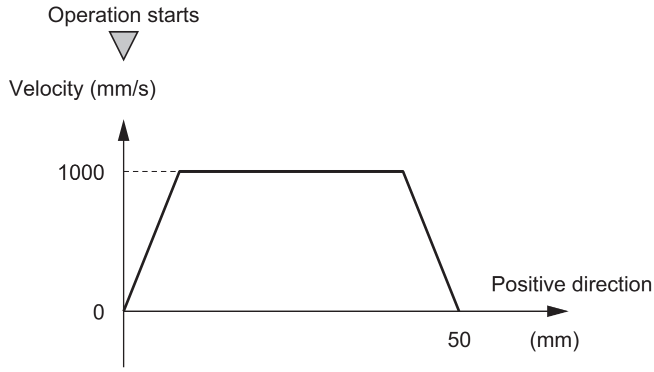
Spindle axis use CNC motor

CNC coordinate system	Spindle axis use CNC motor
CNC coordinate system 0	CNC motor 3

Operation Example

MoveMode (Travel Mode) of the CNC_Move (Positioning) instruction is set to Absolute positioning to move to the target position.

● Operation Patterns



1 Turning ON the Operation Start Switch

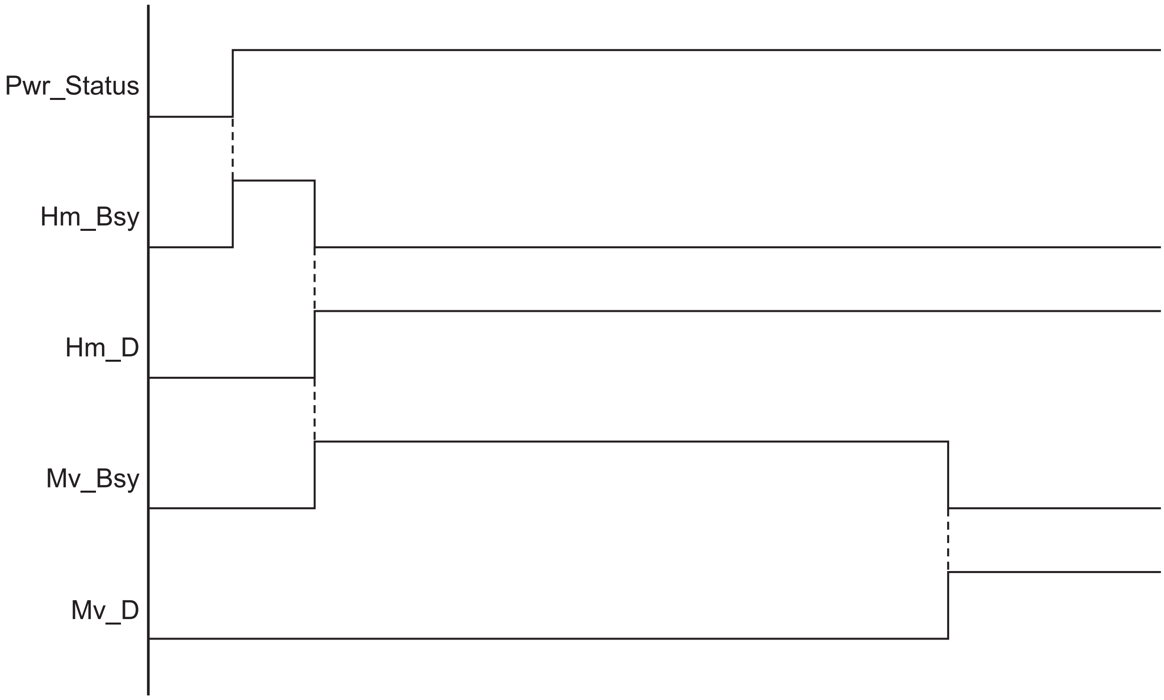
When you turn ON the operation start switch at the home, CNC motor 0 assigned to the X-axis is positioned to 50.00 mm in the positive direction.

Ladder Diagram

● Main Variables

Name	Data type	Default	Comment
CNC_Coord000	_sCNC_COORD_REF	---	CNC coordinate system variable of CNC coordinate system 0.
CNC_Motor000	_sCNC_MOTOR_REF	---	CNC motor variable of CNC motor 0.
CNC_Motor000.MFaultLvl.Active	BOOL	FALSE	TRUE when a minor fault level error occurs in CNC motor 0.
StartPg	BOOL	FALSE	Indicates the operation start switch. The Servo is turned ON when this variable is TRUE and EtherCAT process data communications are established.

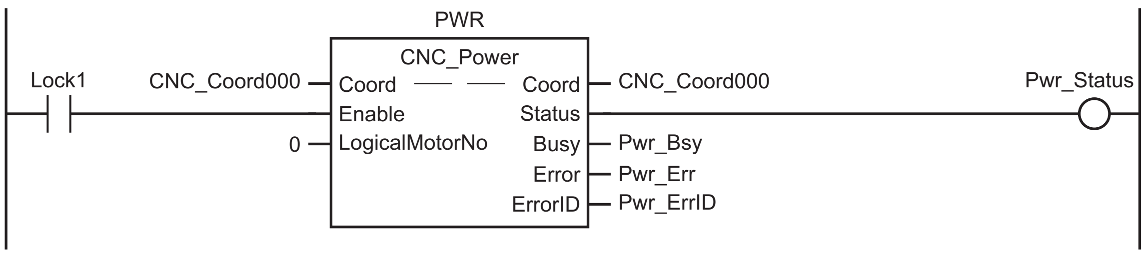
● Timing Chart



● Sample Programming

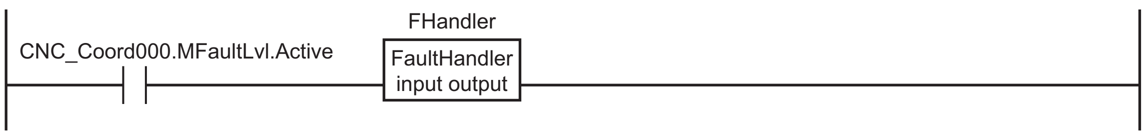
When contact *StartPg* is TRUE, check that the Servo Drive is in the servo ready status.

When the Servo Drive is in the servo ready status, turn ON the Servo.

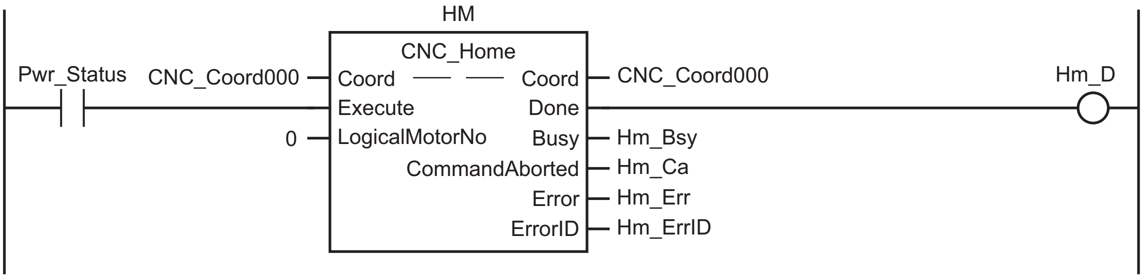


If a minor fault level error occurs in CNC motor 0 assigned to the X-axis, the error handler for the device (FaultHandler) is executed.

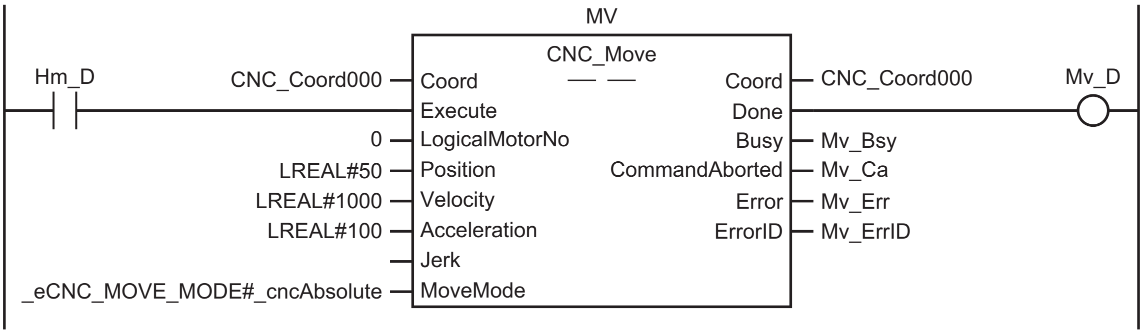
Program the FaultHandler according to the device.



When the Servo is ON, the Home instruction is executed.



After the home is defined, start the absolute positioning.

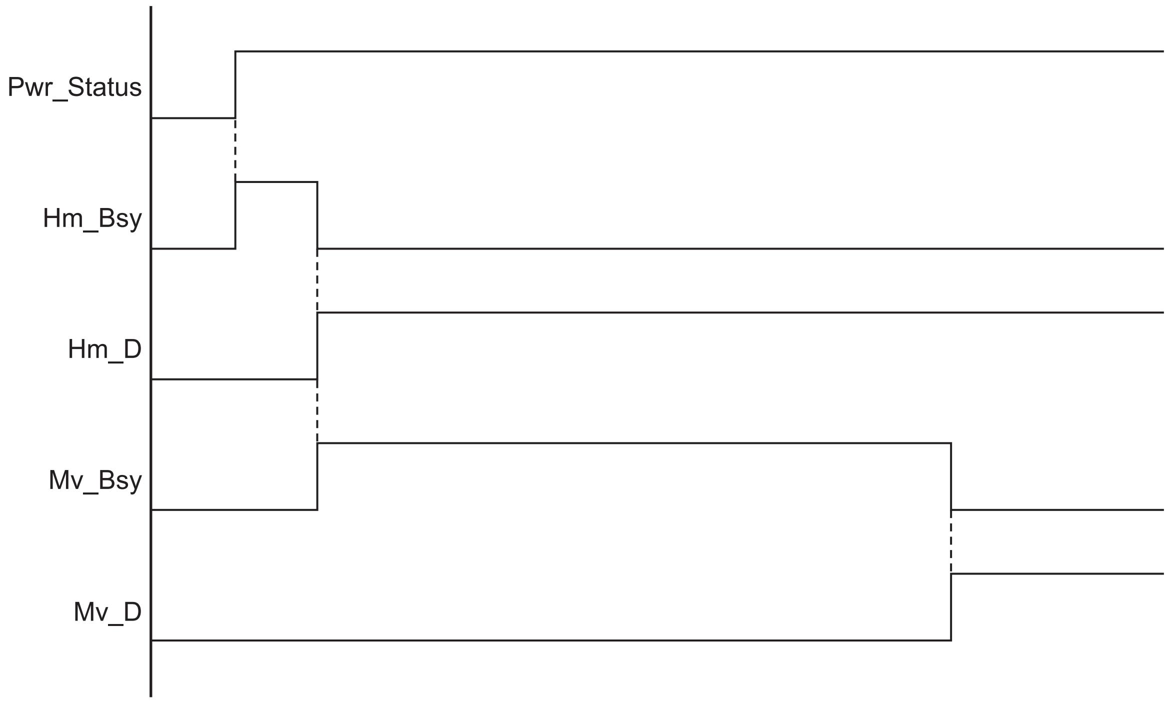


Structured Text (ST)

● Main Variables

Name	Data type	Default	Comment
CNC_Coord000	_sCNC_COORD_REF	---	CNC coordinate system variable of CNC coordinate system 0.
CNC_Motor000	_sCNC_MOTOR_REF	---	CNC motor variable of CNC motor 0.
CNC_Motor000.MFaultLvl.Active	BOOL	FALSE	TRUE when a minor fault level error occurs in CNC motor 0.
StartPg	BOOL	FALSE	Indicates the operation start switch. The Servo is turned ON when this variable is TRUE and EtherCAT process data communications are established.

● Timing Chart



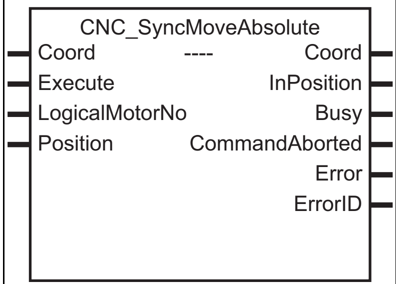
Sample Programming

```
// When StartPg changes to TRUE, check that the Servo Drive is in the servo ready
status and turn ON the Servo.
// If the Servo is not ready, turn OFF the Servo.
IF (StartPg=TRUE) AND (CNC_Motor000.DrvStatus.Ready=TRUE) THEN
  Pwr_En:=TRUE;
ELSE
  Pwr_En:=FALSE;
END_IF;

// If a minor fault level error occurs in CNC motor 0 assigned to the X-axis, the
error handler for the device (FaultHandler) is executed.
// Program the FaultHandler according to the device.
IF CNC_Motor000.MFaultLvl.Active=TRUE THEN
  FaultHandler();
END_IF;

// When the Servo is ON, the Home instruction is executed.
IF Pwr_Status=TRUE THEN
  Hm_Ex:=TRUE;
END_IF;

// After the home is defined, start the absolute positioning.
IF Hm_D=TRUE THEN
  Mv_Ex:=TRUE;
END_IF;

//CNC_Power
PWR(
  Coord := CNC_Coord000 ,
  Enable := Pwr_En ,
  LogicalMotorNo := 0 ,
  Status => Pwr_Status ,
  Busy => Pwr_Bsy ,
  Error => Pwr_Err ,
  ErrorID => Pwr_ErrID
);

//CNC_Home
HM(
  Coord := CNC_Coord000 ,
  Execute := Hm_Ex ,
  LogicalMotorNo :=0 ,
  Done => Hm_D ,
  Busy => Hm_Bsy ,
  CommandAborted=> Hm_Ca ,
  Error => Hm_Err ,
  ErrorID => Hm_ErrID
);
```

```
//CNC_Move
MV(
  Coord := CNC_Coord000 ,
  Execute := Mv_Ex ,
  LogicalMotorNo := 0 ,
  Position := LREAL#50 ,
  Velocity := LREAL#1000 ,
  Acceleration := LREAL#100 ,
  Jerk := LREAL#0 ,
  MoveMode := _eCNC_MOVE_MODE#_cncAbsolute ,
  Done => Mv_D ,
  Busy => Mv_Bsy ,
  CommandAborted=> Mv_Ca ,
  Error => Mv_Err ,
  ErrorID => Mv_ErrID
);
```

CNC_SyncMoveAbsolute

The CNC_SyncMoveAbsolute outputs the specified target position cyclically.

Instruction	Name	FB/FUN	Graphic expression	ST expression
CNC_SyncMoveAbsolute	Cyclic Synchronous Absolute Positioning	FB	CNC_SyncMoveAbsolute_instance 	CNC_SyncMoveAbsolute_instance(Coord :=*parameter*, Execute :=*parameter*, LogicalMotorNo :=*parameter*, Position :=*parameter*, InPosition =>*parameter*, Busy =>*parameter*, CommandAborted =>*parameter*, Error =>*parameter*, ErrorID =>*parameter*);

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Execute	Execute	BOOL	TRUE or FALSE	FALSE	The instruction is executed when *Execute* changes to TRUE.
Logical MotorNo	Logical CNC Motor Number	UINT	0 to (Maximum Positioning Logical CNC Motor number) - 1	0	Specify the logical CNC motor number. When the target CNC motor is assigned to the positioning axis, specify the Positioning Logical CNC Motor Number.
Position	Target Position	LREAL	Negative number, positive number, or 0	0	Specify the target position of the absolute coordinates. The unit is command units.

Output Variables

Name	Meaning	Data type	Valid range	Description
InPosition	In-position	BOOL	TRUE or FALSE	TRUE when the feedback current positions for all composition axes are within the in-position range of their target positions.
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Command-Aborted	Command Aborted	BOOL	TRUE or FALSE	TRUE when the instruction is aborted.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error Code	WORD	*1	Contains the error code when an error occurs. A value of 16#0000 indicates normal execution.

*1. Refer to *Section 15 Troubleshooting*.

● Output Variable Update Timing

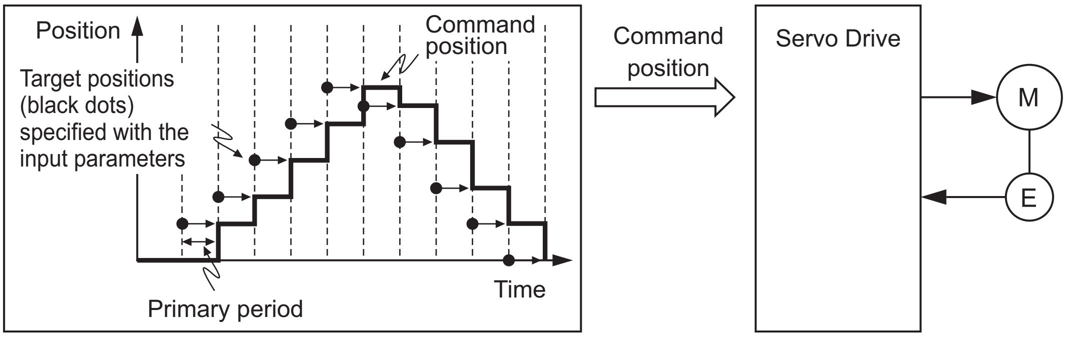
Variable	Timing for changing to TRUE	Timing for changing to FALSE
InPosition	When the feedback current positions for all composition axes are within the in-position range of their target positions.	• When the feedback current position has been placed out of the in-position range. • When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Busy	When *Execute* changes to TRUE.	• When *Error* is set to TRUE. • When *CommandAborted* changes to TRUE.
Command-Aborted	• When this instruction is aborted because another motion control instruction was multi-executed (*Aborting*). • When this instruction is aborted due to an error. • When this instruction is executed while there is an error. • When you start this instruction during CNC_CoordStop instruction execution.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Error	When there is an error in the execution conditions or input parameters for the instruction.	When the error is cleared.

In-Out Variables

Name	Meaning	Data type	Valid range	Description
Coord	CNC Coordinate System	_sCNC_COORD_REF	---	Specifies the CNC coordinate system.

Functions

- This instruction outputs the target position from the user program every task period to the Servo Driver or other device in Cyclic Synchronous Position (CSP) Control Mode. The target positions are given as absolute positions.
- The upper limit of the velocity is the value that is set in the Maximum Velocity CNC motor parameter. The maximum acceleration and deceleration are not used.
- If this instruction is executed in the primary periodic task, the target position that is specified in the input parameters is output to the Servo Drive in the next task period. The following timing charts show an example of the operation for when this instruction is executed in the primary periodic task.



Instruction Details

In-position Check

If *Position* (Target Position) is not changed, *InPosition* changes to TRUE when the difference between the target position and the feedback position is within the range that is set for the In-position Range CNC motor parameter. Even if the target position is changed while *InPosition* is TRUE, it will remain TRUE for the remainder of the period and change to FALSE the next period. The setting of the CNC motor parameter, Number of In-position Continuance Cycle is disabled.

Stop Processing

This section describes the methods that are used to stop operations of the CNC coordinate system. To stop operations, use the CNC_CoordHalt (CNC Coordinate System Halt) instruction, CNC_CoordStop (CNC Coordinate System Stop) instruction, or CNC_CoordImmediateStop (CNC Coordinate System Immediate Stop) instruction. Executing any of these instructions changes *CommandAborted* (Command Aborted) of this instruction to TRUE.

- Stopping with the CNC_CoordHalt (CNC Coordinate System Halt) instruction

  An immediate stop is performed. The CNC coordinate system does not transition to the Stopping status.
- Stopping with the CNC_CoordStop (CNC Coordinate System Stop) instruction

  An immediate stop is performed.
- Stopping with the CNC_CoordImmediateStop (CNC Coordinate System Immediate Stop) instruction

  An immediate stop is performed in accordance with the setting of the **Immediate Stop Method** parameter of each CNC coordinate system.

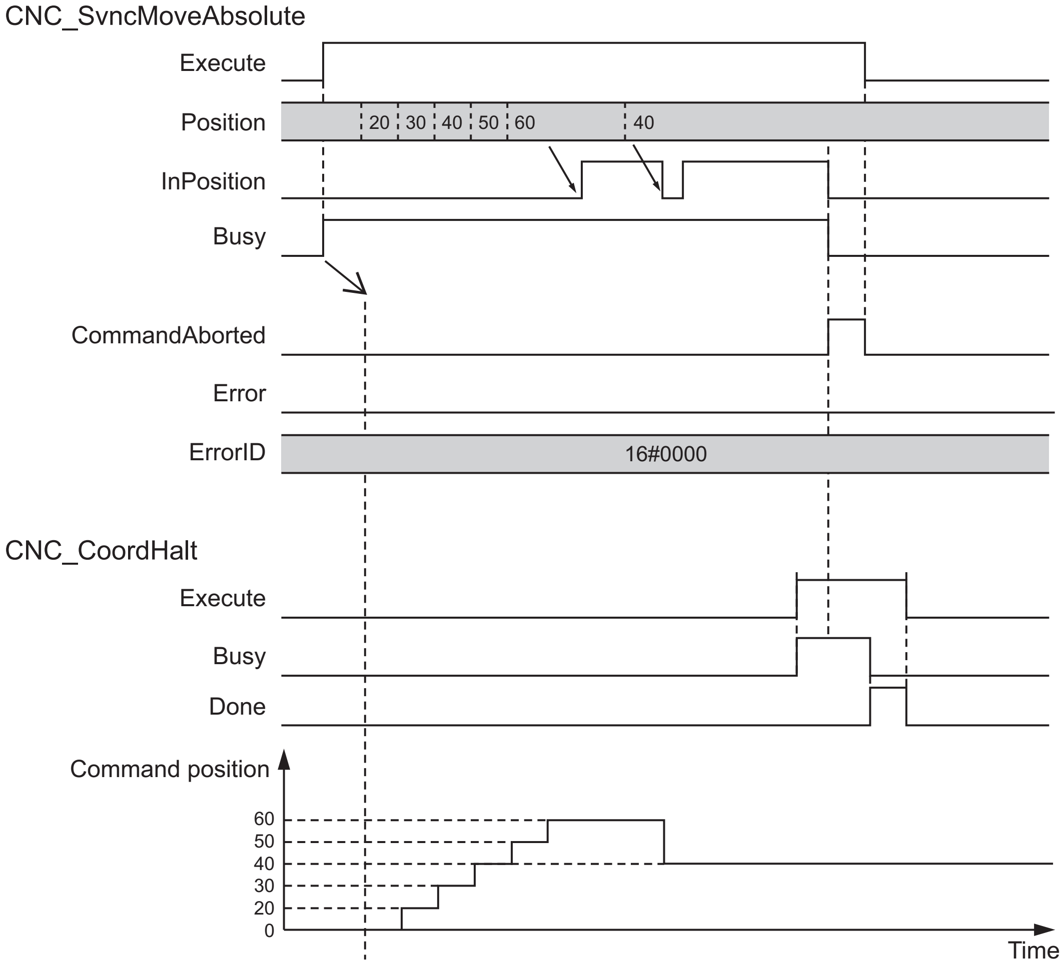
Stopping Due to Error

If an error that causes the CNC motor to stop occurs, an immediate stop is performed regardless of any settings.

Timing Chart

- *Busy* (Executing) changes to TRUE at the same time as *Execute* changes to TRUE.
- *InPosition* changes to TRUE when the feedback current positions for all composition axes are within the in-position range from *Positions* (Target Positions).
- If another instruction aborts this instruction, *CommandAborted* (Command Aborted) changes to TRUE and *Busy* (Executing), *Active* (Controlling), and *InPosition* change to FALSE.
- The CNC_CoordHalt (CNC Coordinate System Halt) instruction is used to stop this instruction.

The following timing charts show an example of an operation for when this instruction is executed in the primary periodic task.



Re-execution of CNC Instructions

This instruction cannot be re-executed. A CNC Instruction Re-execution Disabled error (5603 0000 hex) occurs if re-execution is attempted.

Multi-execution of CNC Instructions

Refer to *A-4 Instructions for Which Multi-execution Is Supported* on page A-15 for details on multi-execution of CNC instructions.

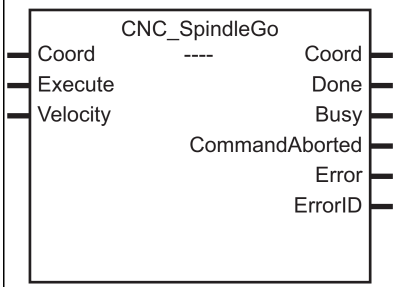
Errors

If this instruction cannot be executed, an error occurs, and *Error* will change to TRUE.

You can find out the cause of the error by referring to the value output by *ErrorID* (Error Code).

CNC_SpindleGo

The CNC_SpindleGo instruction controls the normal rotation, reverse rotation, and stop for the CNC motor assigned to the spindle axis.

Instruction	Name	FB/FUN	Graphic expression	ST expression
CNC_SpindleGo	Spindle Control	FB	CNC_SpindleGo_instance 	CNC_SpindleGo_instance(Coord :=*parameter*, Execute :=*parameter*, Velocity :=*parameter*, Done =>*parameter*, Busy =>*parameter*, CommandAborted =>*parameter*, Error =>*parameter*, ErrorID =>*parameter*);

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Execute	Execute	BOOL	TRUE or FALSE	FALSE	The instruction is executed when *Execute* changes to TRUE.
Velocity	Target Velocity	LREAL	Negative number, positive number, or 0	0	Specify the target velocity. The unit is command units/min.

Output Variables

Name	Meaning	Data type	Valid range	Description
Done	Done	BOOL	TRUE or FALSE	TRUE when the instruction is completed.
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Command-Aborted	Command Aborted	BOOL	TRUE or FALSE	TRUE when the instruction is aborted.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error Code	WORD	*1	Contains the error code when an error occurs. A value of 16#0000 indicates normal execution.

*1. Refer to *Section 15 Troubleshooting*.

Output Variable Update Timing

Name	Timing for changing to TRUE	Timing for changing to FALSE
Done	When this instruction is completed.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Busy	When *Execute* changes to TRUE.	• When *Error* changes to TRUE. • When *CommandAborted* changes to TRUE.
Command-Aborted	• When this instruction is aborted because another motion control instruction was multi-executed (*Aborting*). • When this instruction is aborted due to an error. • When this instruction is executed while there is an error. • When you start this instruction during CNC_CoordStop instruction execution.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Error	When there is an error in the execution conditions or input parameters for the instruction.	When the error is cleared.

In-Out Variables

Name	Meaning	Data type	Valid range	Description
Coord	CNC Coordinate System	_sCNC_COORD_REF	---	Specifies the CNC coordinate system.

Functions

- This instruction outputs the target velocity specified from the user program to the spindle axis in the specified CNC coordinate system.
- This instruction is completed when the command is reported to the spindle axis.
- If *Execute* (Start Up) changes to TRUE when the spindle axis does not exist in the specified CNC coordinate system, only *Busy* (Executing) changes to TRUE. When *Execute* (Start Up) changes to FALSE, *Busy* (Executing) changes to FALSE.

Instruction Details

Target Velocity

The *Velocity* (Target Velocity) input variable can be set to LREAL data in reference to 0. The axis moves in the positive direction for a positive value and in the negative direction for a negative value. If 0 is set, the command velocity is 0. However, the spindle axis maintains *Moving* (Spindle Moving). You can set *Velocity* (Target Velocity) from the user program. When the target velocity different from the current velocity is specified and *Execute* (Start Up) is turned ON again, the new target velocity is applied.

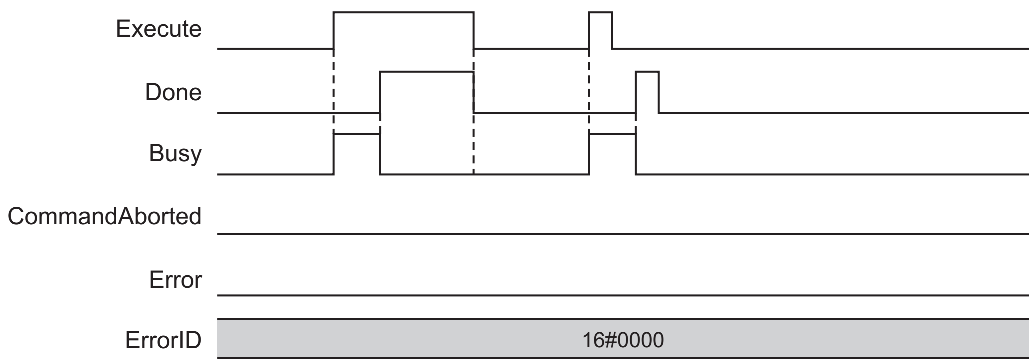
● Stop Processing

This section describes the control mode and command velocity used to stop axis operations.

- Stopping with the CNC_CoordImmediateStop (CNC Coordinate System Immediate Stop) instruction
  Set the command velocity to 0.
- Stopping by setting the velocity of the CNC_SpindleGo (Spindle Control) instruction to 0.
  Set the command velocity to 0.
- Stopping by a minor fault level error
  Set the command velocity to 0.
- Stopping by a major fault level error and a partial fault level error
  Set the command velocity to 0.
- Stopping by Servo OFF
  Set the command velocity to 0 using the specified method.
- Stopping by changing the operating mode of the NC Integrated Controller to the PROGRAM mode
  Set the command velocity to 0 using the specified method.

Timing Chart

- *Busy* (Executing) changes to TRUE at the same time as *Execute* changes to TRUE.
- *Done* (Done) changes to TRUE when a command is acknowledged. If another instruction aborts this instruction, *CommandAborted* (Command Aborted) changes to TRUE and *Busy* (Executing) and *Done* (Done) change to FALSE.
- To stop the spindle axis, set *Velocity* (Target Velocity) of the CNC_SpindleGo (Spindle Control) instruction to 0, and re-execute.
  The following timing chart shows an example of an operation for when this instruction is executed in the primary periodic task.



Re-execution of CNC Instructions

This instruction cannot be re-executed. A CNC Instruction Re-execution Disabled error (5603 0000 hex) occurs if re-execution is attempted.

Multi-execution of CNC Instructions

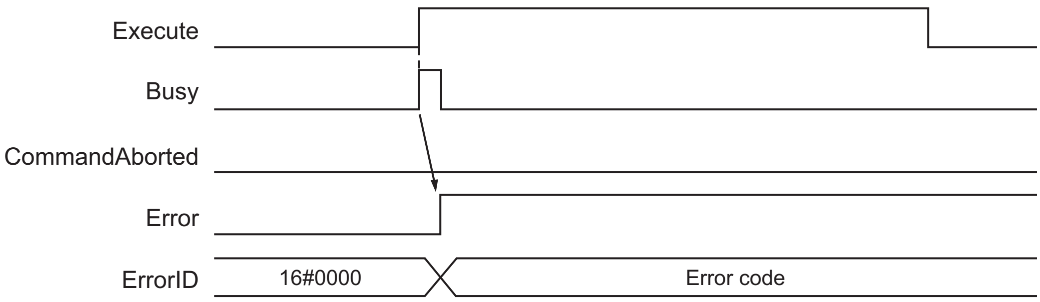
Refer to *A-4 Instructions for Which Multi-execution Is Supported* on page A-15 for details on multi-execution of CNC instructions.

Errors

If this instruction cannot be executed, an error occurs, and *Error* will change to TRUE.

You can find out the cause of the error by referring to the value output by *ErrorID* (Error Code).

- **Timing Chart When Error Occurs**



Sample Programming

This section shows sample programming to control the spindle.

Parameter Settings

The minimum settings required for this sample programming are given below.

● CNC Coordinate System Settings

Logical CNC motor configuration

CNC coordinate system	Logical CNC motor configuration
CNC coordinate system 0	3

Positioning axis configuration

CNC coordinate system	Positioning axis CNC motor number	Positioning axis configuration CNC motor	Positioning axis assignment
CNC coordinate system 0	CNC motor P0	CNC motor 0	X-axis
CNC coordinate system 0	CNC motor P1	CNC motor 1	Y-axis
CNC coordinate system 0	CNC motor P2	CNC motor 2	Z-axis

Spindle axis use CNC motor

CNC coordinate system	Spindle axis use CNC motor
CNC coordinate system 0	CNC motor 3

M code settings

M code number	Setting value
M03	1 (Immediate)

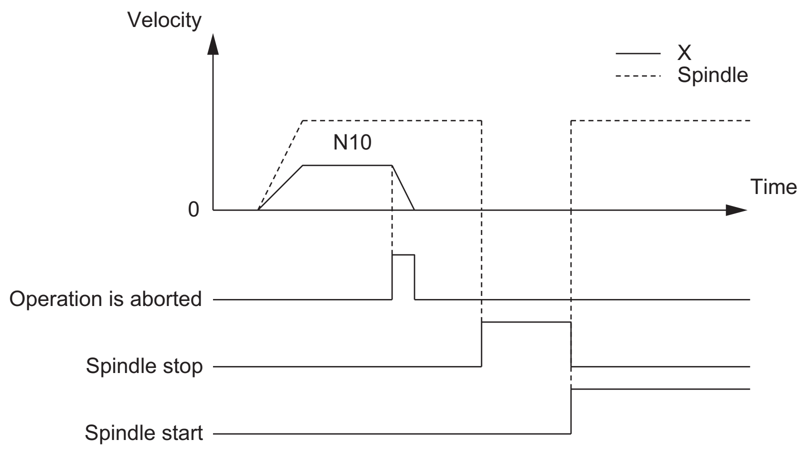
Operation Example

The spindle axis in feed hold is stopped or restarted with the CNC_SpindleGo (Spindle Control) instruction.

● NC Program

```
N10 M03 S100
N20 G91 G01 X100 F50
N21 M30
```

● Operation Patterns



1 Turning ON the Operation Start Switch

When you turn ON the operation start switch at the home, CNC motor 0 assigned to the X-axis is positioned to 100.00 mm in the positive direction.

2 Turning ON the Operation Interrupt Switch

When you turn ON the operation interrupt switch, the executing NC program pauses.

3 Turning ON the Spindle Stop Switch

When you turn ON the spindle stop switch, CNC motor 3 assigned to the spindle axis stops the rotation.

4 Turning ON the Spindle Start Switch

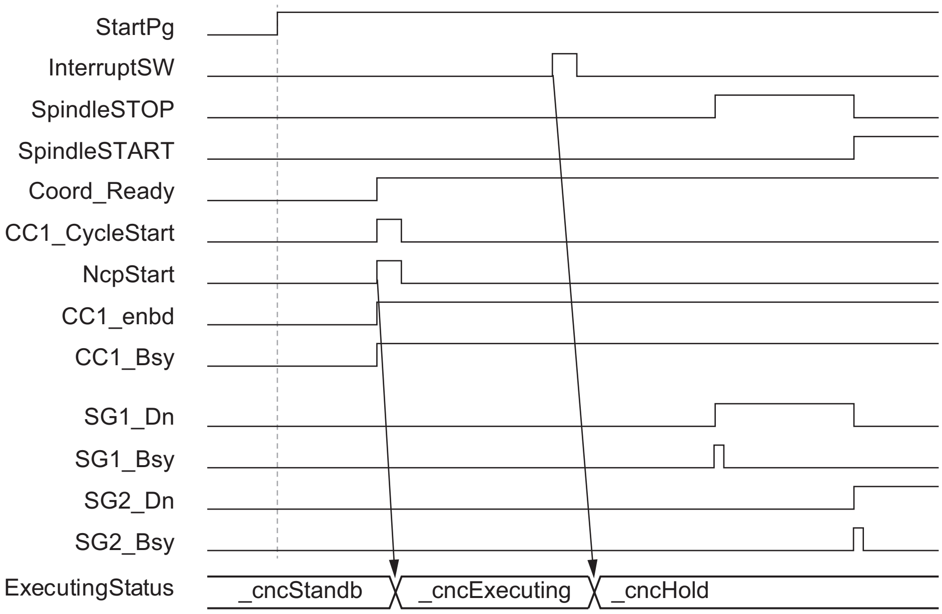
When you turn ON the spindle start switch, CNC motor 3 assigned to the spindle axis starts the rotation. At this time, the spindle stop switch turns OFF.

Ladder Diagram

● Main Variables

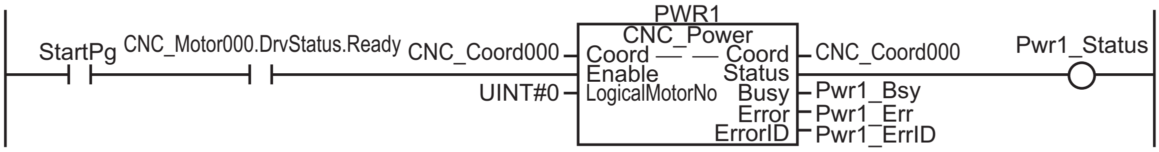
Name	Data type	Default	Comment
CNC_Coord000	_sCNC_COORD_REF	---	CNC coordinate system variable of CNC coordinate system 0.
CNC_Motor000	_sCNC_MOTOR_REF	---	CNC motor variable of CNC motor 0.
StartPg	BOOL	FALSE	Indicates the operation start switch. The Servo is turned ON when this variable is TRUE and EtherCAT process data communications are established.
Coord_Ready	BOOL	FALSE	Indicates the execution ready completion status of the NC program. This variable changes to TRUE when the NC program execution conditions are satisfied.
NcpStart	BOOL	FALSE	When this variable is TRUE and the cycle start ready is completed, the NC program is executed.
InitFlg	BOOL	FALSE	Indicates the input parameter setting completion. Input parameters are set when this variable is FALSE. When the input parameter setting is completed, this variable changes to TRUE.
InterruptSW	BOOL	FALSE	Indicates the operation interrupt switch. When this variable is TRUE, the execution of the NC program pauses.
SpindleSTOP	BOOL	FALSE	Indicates the spindle stop switch. When this variable is TRUE, the rotation of the spindle axis stops.
SpindleSTART	BOOL	FALSE	Indicates the spindle start switch. When this variable is TRUE, the rotation of the spindle axis starts.

● Timing Chart

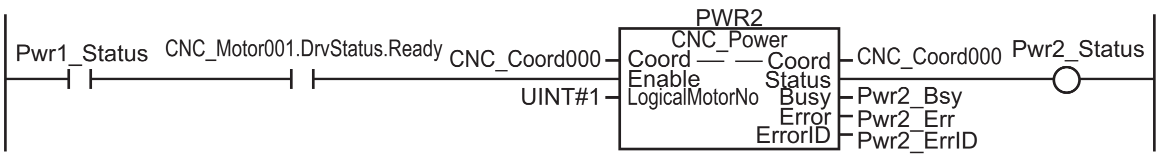


● Sample Programming

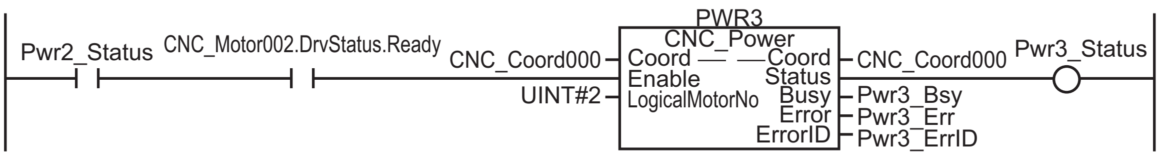
When contact *StartPg* changes to TRUE, check that the Servo Drive is in the servo ready status and set the X-axis to the Servo ON status.



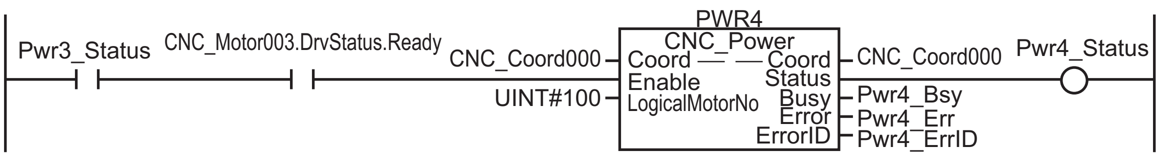
When the X-axis is in the Servo ON status, check that the Servo Drive is in the servo ready status and set the Y-axis to the Servo ON status.



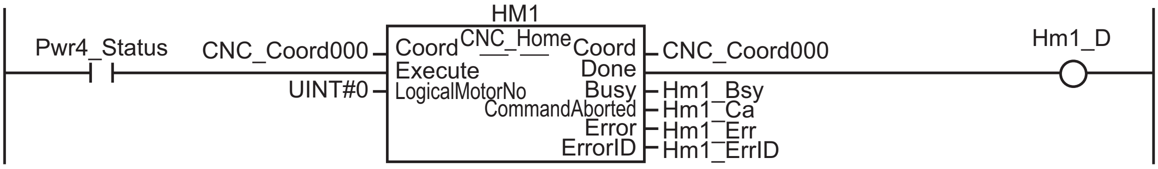
When the Y-axis is in the Servo ON status, check that the Servo Drive is in the servo ready status and set the Z-axis to the Servo ON status.



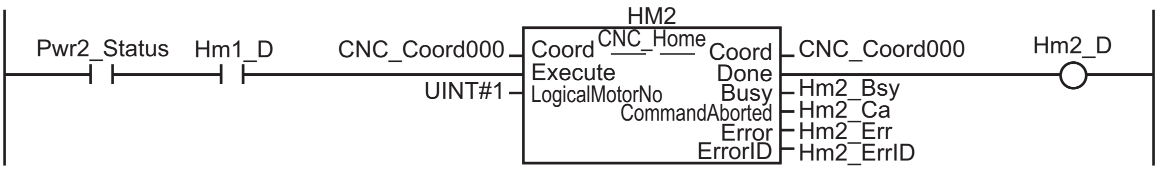
When the Z-axis is in the Servo ON status, check that the Servo Drive is in the servo ready status and set the spindle axis to the Servo ON status.



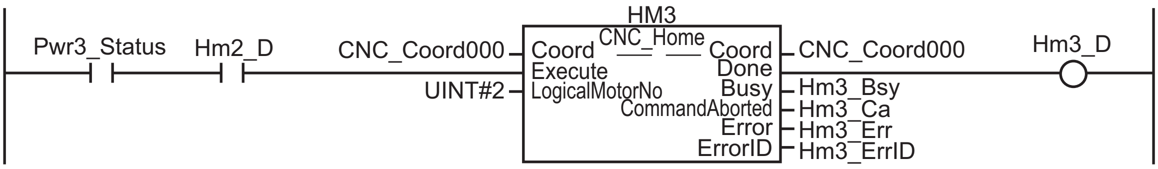
When the positioning axis and spindle axis are in the Servo ON status, execute homing of the X-axis.



After the home of the X-axis is defined, execute homing of the Y-axis.

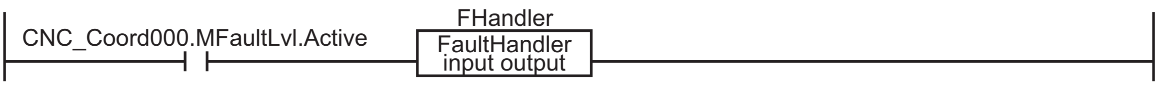


After the home of the Y-axis is defined, execute homing of the Z-axis.



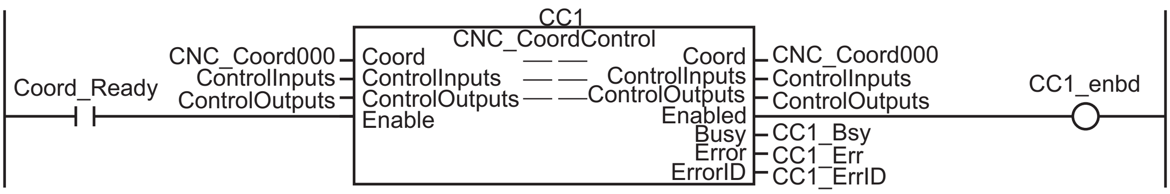
If a minor fault level error occurs in CNC coordinate system 0, the error handler for the device (FaultHandler) is executed.

Program the FaultHandler according to the device.



When the NC program execution ready is completed, change Coord_Ready to TRUE.

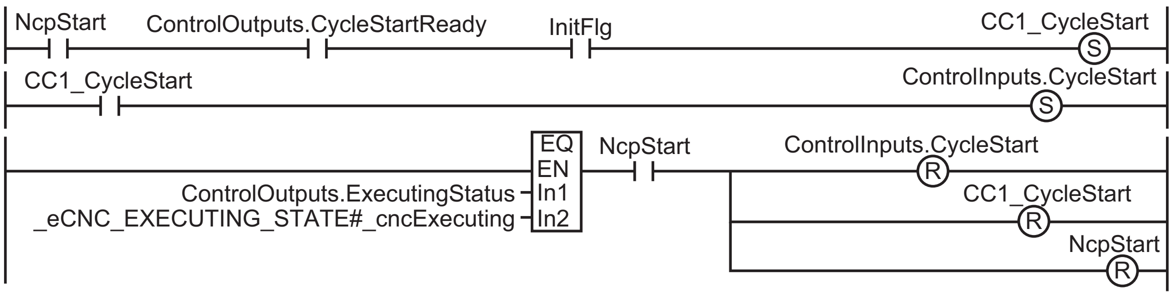
When Coord_Ready changes to TRUE, start the execution control of the NC program.



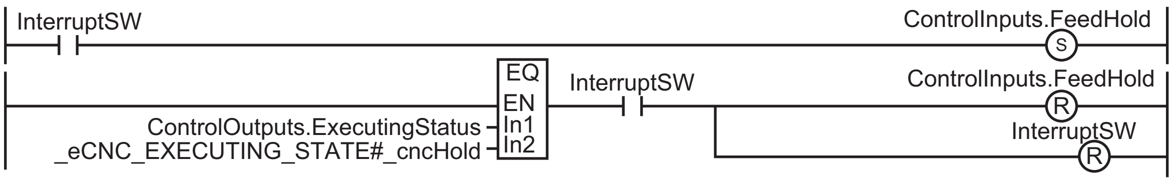
When the execution control of the NC program is started, set the parameters of the CNC_CoordControl (CNC Coordinate System NC Control) instruction.

```
// CNC_CoordControl parameter
// Specify the NC program (No. 1) that was created on the SysmacStudio.
ControlInputs.ProgramNo :=UINT#1;
ControlInputs.FeedrateVelFactor:=LREAL#100.0;
ControlInputs.SpindleVelFactor:=LREAL#100.0;
ControlInputs.AuxiliaryLock:=FALSE;
ControlInputs.BackTrace :=FALSE;
ControlInputs.DryRun    :=FALSE;
ControlInputs.FeedHold  :=FALSE;
ControlInputs.MachineLock:=FALSE;

// Change InitFlag to TRUE after setting the input parameters.
InitFlg := TRUE;

// Start the NC program.
NcpStart:=TRUE;
```

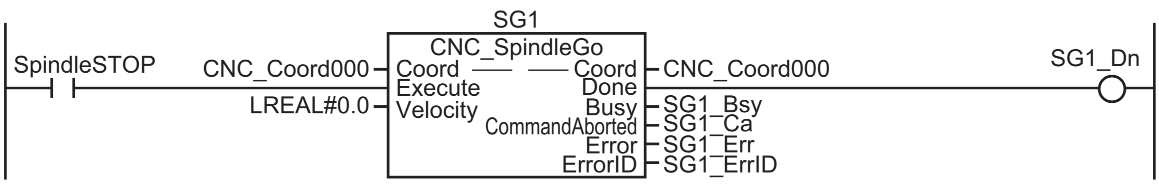
Check that the cycle start ready is completed and start the execution of the NC program.



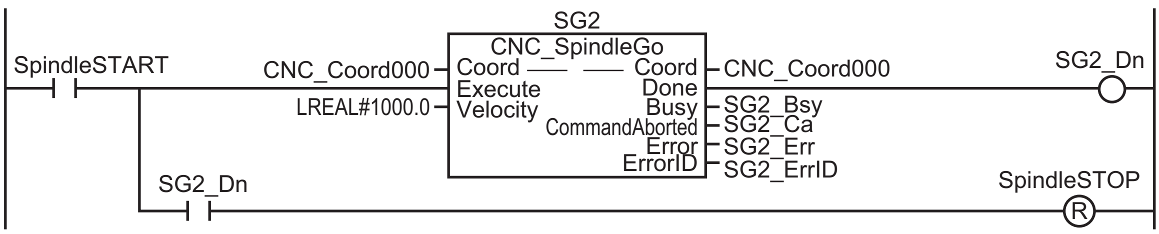
When contact *InterruptSW* is TRUE, the execution of the NC program stops.



When contact *SpindleSTOP* is TRUE, start the spindle control to stop the rotation of the spindle axis.



When contact *SpindleSTART* is TRUE, start the spindle control to start the rotation of the spindle axis.

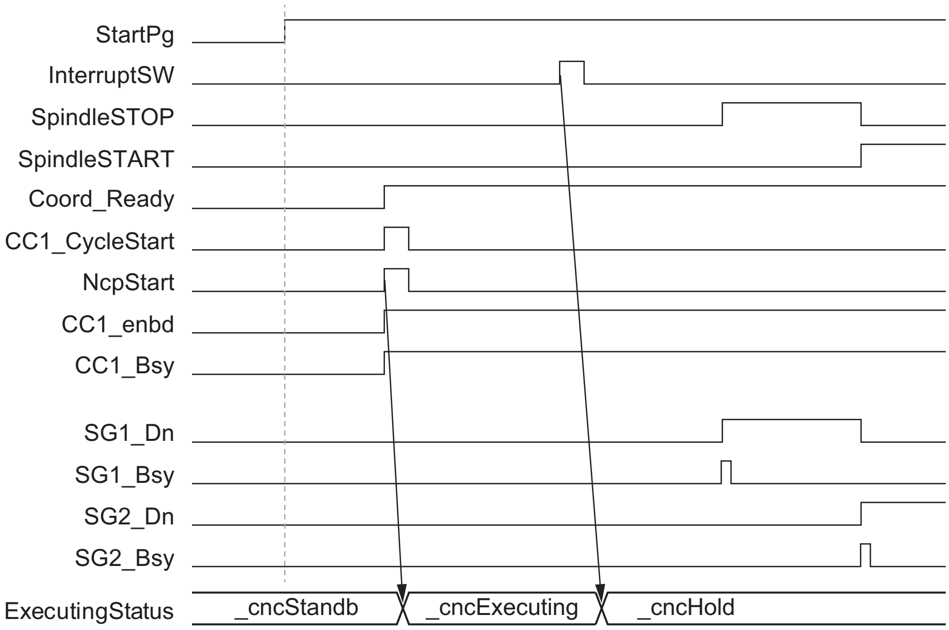


Structured Text (ST)

Main Variables

Name	Data type	Default	Comment
CNC_Coord000	_sCNC_COORD_REF	---	CNC coordinate system variable of CNC coordinate system 0.
CNC_Motor000	_sCNC_MOTOR_REF	---	CNC motor variable of CNC motor 0.
StartPg	BOOL	FALSE	Indicates the operation start switch. The Servo is turned ON when this variable is TRUE and EtherCAT process data communications are established.
Coord_Ready	BOOL	FALSE	Indicates the execution ready completion status of the NC program. This variable changes to TRUE when the NC program execution conditions are satisfied.
NcpStart	BOOL	FALSE	When this variable is TRUE and the cycle start ready is completed, the NC program is executed.
InitFlg	BOOL	FALSE	Indicates the input parameter setting completion. Input parameters are set when this variable is FALSE. When the input parameter setting is completed, this variable changes to TRUE.
InterruptSW	BOOL	FALSE	Indicates the operation interrupt switch. When this variable is TRUE, the execution of the NC program pauses.
SpindleSTOP	BOOL	FALSE	Indicates the spindle stop switch. When this variable is TRUE, the rotation of the spindle axis stops.
SpindleSTART	BOOL	FALSE	Indicates the spindle start switch. When this variable is TRUE, the rotation of the spindle axis starts.

Timing Chart



Sample Programming

```
// When StartPg is TRUE, check that the Servo Drive is in the servo ready status and
set the X-axis to the Servo ON status.
IF (StartPg = TRUE)AND (CNC_Motor000.DrvStatus.Ready=TRUE) THEN
        Pwr1_En:=TRUE;
ELSE
        Pwr1_En:=FALSE;
END_IF;

// When the X-axis is in the Servo ON status, check that the Servo Drive is in the
servo ready status and set the Y-axis to the Servo ON status.
IF (Pwr1_Status = TRUE) AND (CNC_Motor001.DrvStatus.Ready=TRUE) THEN
        Pwr2_En:=TRUE;
ELSE
        Pwr2_En:=FALSE;
END_IF;

// When the Y-axis is in the Servo ON status, check that the Servo Drive is in the
servo ready status and set the Z-axis to the Servo ON status.
IF (Pwr2_Status = TRUE) AND (CNC_Motor002.DrvStatus.Ready=TRUE) THEN
        Pwr3_En:=TRUE;
ELSE
        Pwr3_En:=FALSE;
END_IF;

// When the Z-axis is in the Servo ON status, check that the Servo Drive is in the
servo ready status and set the spindle axis to the Servo ON status.
IF (Pwr3_Status = TRUE) AND (CNC_Motor003.DrvStatus.Ready=TRUE) THEN
        Pwr4_En:=TRUE;
ELSE
        Pwr4_En:=FALSE;
END_IF;

// When the positioning axis and spindle axis are in the Servo ON status, execute
homing of the X-axis.
IF (Pwr4_Status=TRUE) THEN
        Hm1_Ex:=TRUE;
END_IF;

// After the home of the X-axis is defined, execute homing of the Y-axis.
IF (Pwr2_Status=TRUE) AND (Hm1_D=TRUE) THEN
        Hm2_Ex:=TRUE;
END_IF;

// After the home of the Y-axis is defined, execute homing of the Z-axis.
IF (Pwr3_Status=TRUE) AND (Hm2_D=TRUE) THEN
        Hm3_Ex:=TRUE;
END_IF;

// If a minor fault level error occurs in coordinate system 0, execute the error
handler for the device (FaultHandler).
// Program the FaultHandler according to the device.
IF (CNC_Coord000.MFaultLvl.Active=TRUE) THEN
        FaultHandler();
END_IF;
```

```
// When the NC program execution ready is completed, change Coord_Ready to TRUE.
IF (Hm3_D =TRUE) AND (CNC_Coord000.Status.Ready=TRUE) THEN
        Coord_Ready :=TRUE;
ELSIF(CC1_Err = TRUE) THEN
        Coord_Ready :=FALSE;
END_IF;

// When Coord_Ready is TRUE, start the execution control of the NC program.
IF (Coord_Ready=TRUE)THEN
        CC1_En:=TRUE;
ELSE
        CC1_En:=FALSE;
END_IF;

// Processing when input parameters are not set
IF (InitFlg=FALSE) AND (CC1_enbd=TRUE) THEN
        // CNC_CoordControl parameter
        // Specify the NC program (No. 1) that was created on the SysmacStudio.
        ControlInputs.ProgramNo:=UINT#1;
        ControlInputs.FeedrateVelFactor:=LREAL#100.0;
        ControlInputs.SpindleVelFactor:=LREAL#100.0;
        ControlInputs.AuxiliaryLock:=FALSE;
        ControlInputs.BackTrace:=FALSE;
        ControlInputs.DryRun:=FALSE;
        ControlInputs.FeedHold:=FALSE;
        ControlInputs.MachineLock:=FALSE;

        // Change InitFlag to TRUE after setting the input parameters.
        InitFlg := TRUE;
        // Start the NC program.
        NcpStart:=TRUE;
END_IF;

// Check that the cycle start ready is completed and start the execution of the NC
program.
IF (InitFlg=TRUE) AND (ControlOutputs.CycleStartReady=TRUE) AND (NcpStart=TRUE)
THEN
        CC1_CycleStart:=TRUE;
END_IF;
IF( CC1_CycleStart =TRUE) THEN
                ControlInputs.CycleStart:=TRUE;
END_IF;

// When the NC program is executed, change CC1_CycleStart and NcpStart to FALSE.
IF (ControlOutputs.ExecutingStatus = _eCNC_EXECUTING_STATE#_cncExecuting) THEN
        NcpStart:=FALSE;
        CC1_CycleStart:=FALSE;
        ControlInputs.CycleStart:=FALSE;
END_IF;

// When InterruptSW is TRUE, the execution of the NC program pauses.
IF (InterruptSW=TRUE)  THEN
        ControlInputs.FeedHold:=TRUE;
END_IF;

// When pausing of the NC program is completed, change InterruptSW to FALSE.
IF (ControlOutputs.ExecutingStatus = _cncHold) THEN
        InterruptSW:=FALSE;
END_IF;
```

```
// When SpindleSTOP is TRUE, stop the rotation of the spindle axis.
IF SpindleSTOP=TRUE THEN
        SG1_Ex:=TRUE;
ELSE
        SG1_Ex:=FALSE;
END_IF;

// When SpindleSTART is TRUE, start the rotation of the spindle axis.
IF SpindleSTART=TRUE THEN
        SG2_Ex:=TRUE;
END_IF;

// Check that the Spindle Control instruction is completed.
IF SG2_Dn=TRUE THEN
        SpindleSTOP:=FALSE;
END_IF;

// CNC_Power of X-axis
PWR1(
        Coord:= CNC_Coord000,
        Enable:=Pwr1_En,
        LogicalMotorNo:=UINT#0,
        Status=>Pwr1_Status,
        Busy => Pwr1_Bsy,
    Error => Pwr1_Err,
    ErrorID => Pwr1_ErrID
);
// CNC_Power of Y-axis
PWR2(
        Coord:= CNC_Coord000,
        Enable:=Pwr2_En,
        LogicalMotorNo:=UINT#1,
        Status=>Pwr2_Status,
        Busy => Pwr2_Bsy,
    Error => Pwr2_Err,
    ErrorID => Pwr2_ErrID
);
// CNC_Power of Z-axis
PWR3(
        Coord:= CNC_Coord000,
        Enable:=Pwr3_En,
        LogicalMotorNo:=UINT#2,
        Status=>Pwr3_Status,
        Busy => Pwr3_Bsy,
    Error => Pwr3_Err,
    ErrorID => Pwr3_ErrID
);
// CNC_Power of spindle axis
PWR4(
        Coord:= CNC_Coord000,
        Enable:=Pwr4_En,
        LogicalMotorNo:=UINT#100,
        Status=>Pwr4_Status,
        Busy => Pwr4_Bsy,
    Error => Pwr4_Err,
    ErrorID => Pwr4_ErrID
);
```

```
// CNC_Home of X-axis
HM1(
  Coord := CNC_Coord000 ,
  Execute := Hm1_Ex,
  LogicalMotorNo :=UINT#0 ,
  Done => Hm1_D,
  Busy => Hm1_Bsy,
  CommandAborted=> Hm1_Ca,
  Error => Hm1_Err,
  ErrorID => Hm1_ErrID
);
// CNC_Home of Y-axis
HM2(
  Coord := CNC_Coord000 ,
  Execute := Hm2_Ex,
  LogicalMotorNo :=UINT#1 ,
  Done => Hm2_D,
  Busy => Hm2_Bsy,
  CommandAborted=> Hm2_Ca,
  Error => Hm2_Err,
  ErrorID => Hm2_ErrID
);
// CNC_Home of Z-axis
HM3(
  Coord := CNC_Coord000 ,
  Execute := Hm3_Ex,
  LogicalMotorNo :=UINT#2 ,
  Done => Hm3_D,
  Busy => Hm3_Bsy,
  CommandAborted=> Hm3_Ca,
  Error => Hm3_Err,
  ErrorID => Hm3_ErrID
);

//      CNC_CoordControl
CC1(
        Coord:= CNC_Coord000,
        ControlInputs:=ControlInputs,
        ControlOutputs:=ControlOutputs,
        Enable:=CC1_En,
        Enabled=>CC1_enbd,
        Busy=>CC1_Bsy,
        Error=>CC1_Err,
        ErrorID=>CC1_ErrID
);

// CNC_SpindleGo (for the spindle axis stop)
SG1(
        Coord:=CNC_Coord000,
        Execute:=SG1_Ex,
        Velocity:=LREAL#0.0,
        Done=>SG1_Dn,
        Busy=>SG1_Bsy,
        CommandAborted=>SG1_Ca,
        Error=>SG1_Err,
        ErrorID=>SG1_ErrID
);
```

```
// CNC_SpindleGO (for the spindle axis operation)
SG2(
        Coord:=CNC_Coord000,
        Execute:=SG2_Ex,
        Velocity:=LREAL#100.0,
        Done=>SG2_Dn,
        Busy=>SG2_Bsy,
        CommandAborted=>SG2_Ca,
        Error=>SG2_Err,
        ErrorID=>SG2_ErrID
);
```

CNC_GantrySkewControl

The CNC_GantrySkewControl instruction controls the skew of the gantry axes.

Instruction	Name	FB/FUN	Graphic expression	ST expression
CNC_GantrySkewControl	Gantry skew control	FB	CNC_GantrySkewControl_instance CNC_GantrySkewControl Coord ---- Coord OffsetValue ---- OffsetValue Execute Done LogicalMotorNo Busy SkewMode CommandAborted Error ErrorID	CNC_GantrySkewControl_instance(Coord :=*parameter*, OffsetValue :=*parameter*, Execute :=*parameter*, LogicalMotorNo :=*parameter*, SkewMode :=*parameter*, Done =>*parameter*, Busy =>*parameter*, CommandAborted =>*parameter*, Error =>*parameter*, ErrorID =>*parameter*);

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Execute	Execute	BOOL	TRUE or FALSE	FALSE	The instruction is executed when *Execute* changes to TRUE.
LogicalMotorNo	Logical Motor Number	UINT	0 to (Maximum positioning logical CNC motor number) - 1	0	Specifies a logical motor number. Specify a logical motor number of the CNC motor assigned to the gantry master axis.
SkewMode	Skew Control Mode	_eCNC_SKEW_MODE	0: _cncCalcOffset 1: _cncAlignOffset 2: _cncWriteOffset 3: _cncReadOffset	0	Specifies the operating mode of the gantry skew control. _cncCalcOffset: Calculates the gantry offset value. _cncAlignOffset: Changes the gantry offset value and adjusts the slave axis position. _cncWriteOffset: Changes the gantry offset value. _cncReadOffset: Reads the gantry offset value that is currently valid.

Precautions for Correct Use

- If a motor that is not assigned to the gantry master axis is specified for the *LogicalMotorNo* (Logical Motor Number) input variable, the *Unassigned Logical CNC Motor Number Specified* (56050000 hex) error is output.
- If the *SkewMode* (Skew Control Mode) input variable is either *1: _cncAlignOffset* or *2: _cncWriteOffset*, check if the *OffsetValue* (Offset Value) in-out variable is appropriate when this instruction is executed. If the value is invalid, the *Offset Value Setting Out of Range* (562B0000 hex) error is output. The value is not checked when *SkewMode* (Skew Control Mode) is set to *0: _cncCalcOffset* or *3: _cncReadOffset*.

Output Variables

Name	Meaning	Data type	Valid range	Description
Done	Done	BOOL	TRUE or FALSE	TRUE when the instruction is completed.
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Command-Aborted	Command Aborted	BOOL	TRUE or FALSE	TRUE when the instruction is aborted.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error Code	WORD	*1	Contains the error code when an error occurs. A value of 16#0000 indicates normal execution.

*1. Refer to *Section 15 Troubleshooting*.

● Output Variable Update Timing

Name	Timing for changing to TRUE	Timing for changing to FALSE
Done	When this instruction is completed.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Busy	When *Execute* changes to TRUE.	• When *Error* changes to TRUE. • When *CommandAborted* changes to TRUE.
Command-Aborted	• When this instruction is aborted because another motion control instruction was multi-executed (*Aborting*). • When this instruction is aborted due to an error. • When this instruction is executed while there is an error. • When you start this instruction during CNC_CoordStop instruction execution.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Error	When there is an error in the execution conditions or input parameters for the instruction.	When the error is cleared.

In-Out Variables

Name	Meaning	Data type	Valid range	Description
Coord	CNC Coordinate System	_sCNC_COORD_REF	---	Specifies the CNC coordinate system.
OffsetValue	Offset Value	LREAL	---	Input: Specify a gantry offset value to change. It is used when the skew control mode is _cncAlignOffset or _cncWriteOffset. Output: When the execution of an instruction is completed, the currently valid gantry offset value is stored.

Functions

A displacement from the home exists between the gantry axes. The value that compensates this displacement is called a gantry offset. Before starting up the gantry system machine, you need to calculate the gantry offset and adjust the value at first.

This instruction is used to calculate and adjust the gantry offset.

Instruction Details

This instruction allows you to switch the operation according to your purposes with *SkewMode* (Skew Control Mode).

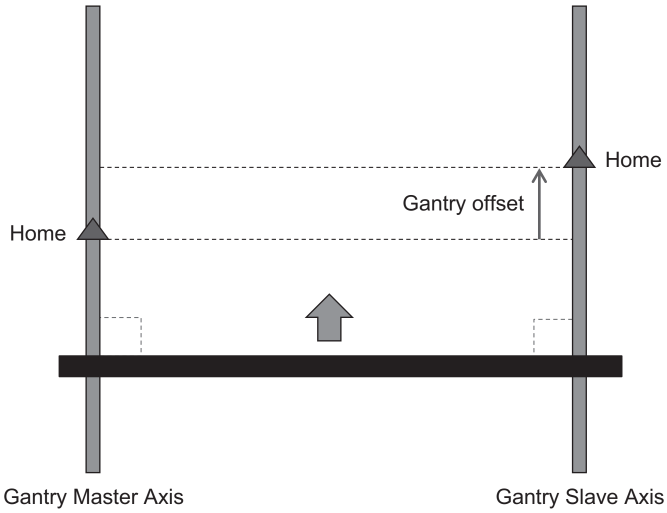
Additional Information

The CNC Function Module saves the gantry offset value changed by this instruction in the battery-backup memory inside the NC Integrated Controller when the power supply is interrupted. For the NY-series Controllers, it is saved to the non-volatile memory.

● _cncCalcOffset (Gantry Offset Value Calculation)

This mode is used to perform homing operation for the gantry master axis and the gantry slave axis in sequence and calculate the offset value between the gantry axes.

This is a general method for calculating the gantry offset value if the gantry system uses an incremental encoder. When you start the system, you must use this mode first and calculate the gantry offset.



- To perform homing operation for the calculation of the gantry offset, use the homing settings that is set in the each CNC motor settings for the gantry master and slave axes.
- Before executing this instruction, make sure that the gantry axes are positioned in parallel as shown in the figure. If you execute the instruction while the axes are skewed, the gantry offset value will not be calculated correctly.
- When this instruction completes successfully, the gantry offset value is stored in *OffsetValue* (Offset Value) in-out variable.
- When this instruction completes successfully, homes are defined for the gantry master and slave axes. In addition, the current position of the gantry slave axis will be preset so that it is placed at the same current position as the gantry master axis.

● _cncAlignOffset (Gantry Offset Value Adjustment)

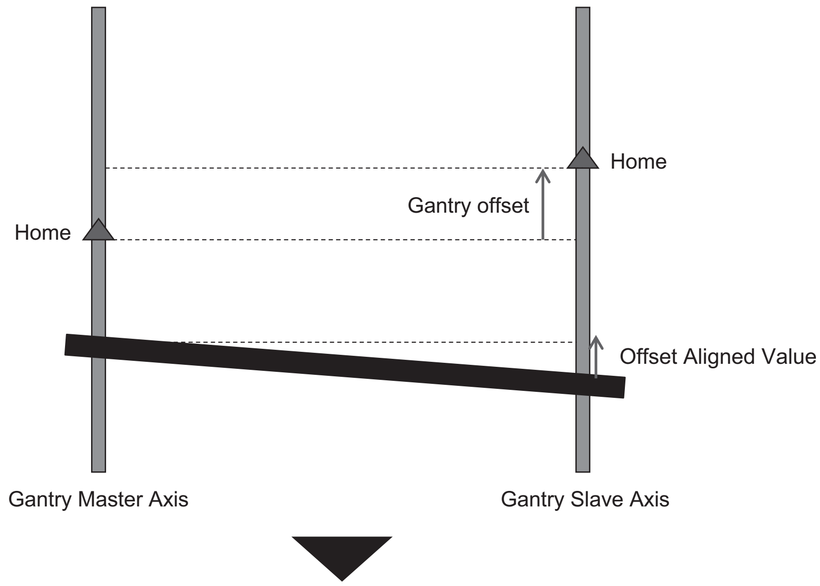
This mode is used to change the specified value to the currently valid gantry offset value and move the gantry slave axis depending on the distance relative to the offset value change.

_cncAlignOffset is used for fine-tuning the position after the calculation of the gantry offset value by measuring the parallelism between the axes. This is also used for setting an offset value without using the gantry offset value calculation mode for the gantry system that uses the absolute encoder.

Example of offset value adjustment

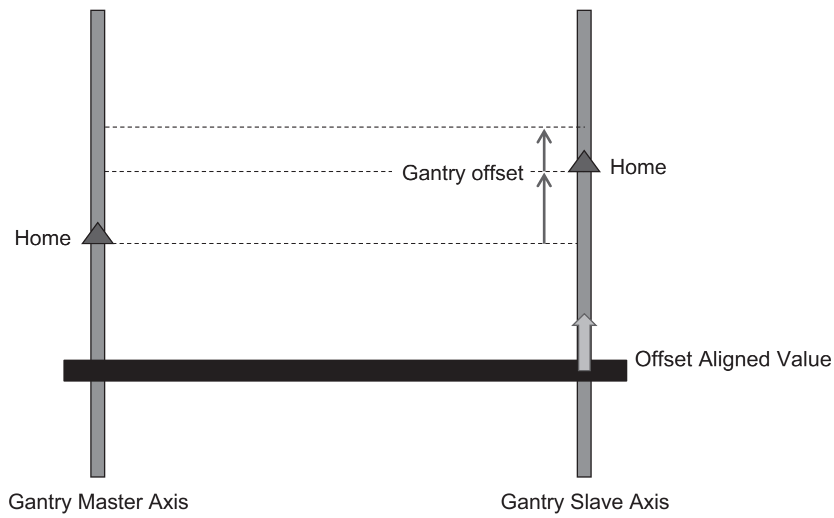
Status 1: Before adjustment

Axes are Skewed



Status 2: After adjustment

Axes are positioned in parallel after they adjust the offset



- Set the *OffsetValue* (Offset Value) in-out variable according to the following formula:
  OffsetValue (Offset Value): = currently valid offset value + offset aligned value
- Use *Alignment Velocity* for the velocity of adjustment operation.

_cncWriteOffset (Gantry Offset Value Write)

This mode is used to change the currently valid gantry offset value to the specified value. The difference from _cncAlignOffset (Gantry Offset Value Adjustment) is that minor adjustment is not performed after the value is changed.

In addition, this mode can be executed in the servo unlock state.

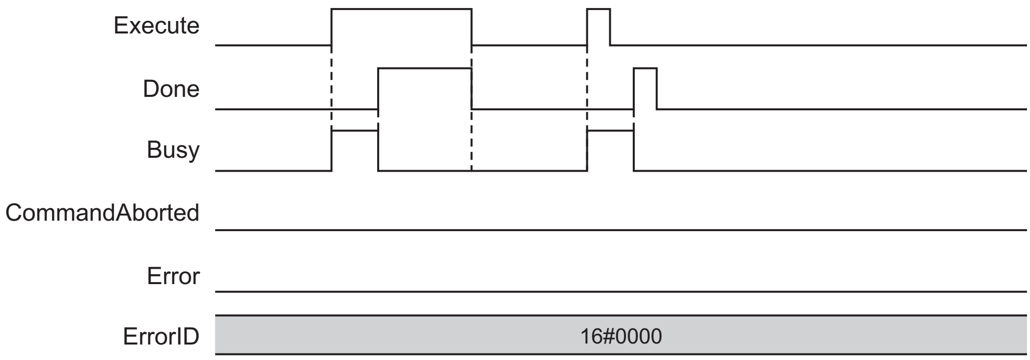
_cncReadOffset (Gantry Offset Value Read)

This mode is used to read the currently valid gantry offset value.

In addition, this mode can be executed in the servo unlock state.

Timing Chart

- *Busy* (Executing) changes to TRUE at the same time as *Execute* changes to TRUE.
- *Done* (Done) changes to TRUE when the skew control completes.
- If another instruction aborts this instruction, *CommandAborted* (Command Aborted) changes to TRUE and *Busy* (Executing) and *Done* (Done) change to FALSE.



Re-execution of CNC Instructions

This instruction cannot be re-executed. A CNC Instruction Re-execution Disabled error (56030000 hex) occurs if re-execution is attempted.

Multi-execution of CNC Instructions

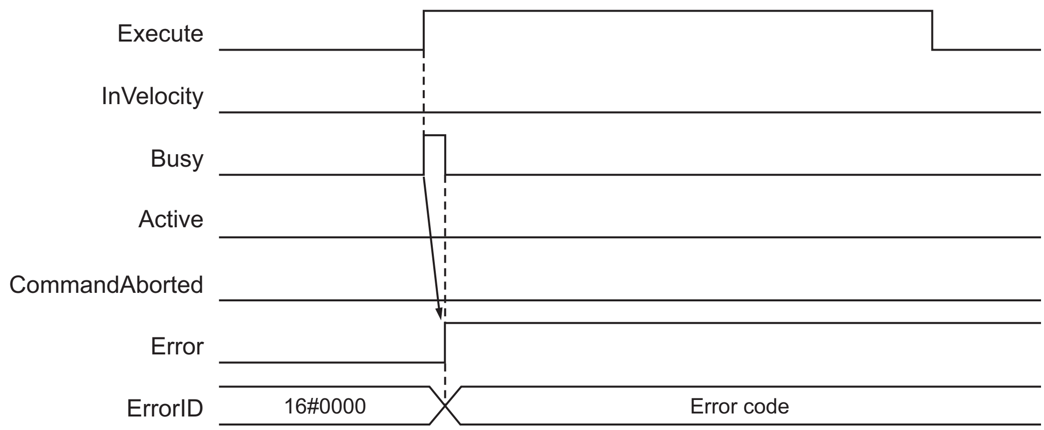
Refer to *A-4 Instructions for Which Multi-execution Is Supported* on page A-15 for details on multi-execution of CNC instructions.

Error

If this instruction cannot be executed, an error occurs, and *Error* will change to TRUE.

You can find out the cause of the error by referring to the value output by *ErrorID* (Error Code).

● Timing Chart When Error Occurs



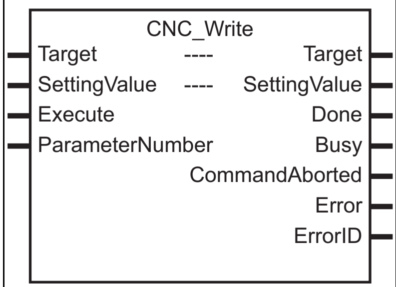
13

Common Command Instructions

This section describes the instructions that are used for both CNC motors and CNC coordinate systems.

CNC_Write

The CNC_Write instruction overwrites CNC parameters.

Instruction	Name	FB/FUN	Graphic expression	ST expression
CNC_Write	Write CNC Setting	FB	CNC_Write_instance  	CNC_Write_instance (Target :=*parameter*, SettingValue :=*parameter*, Execute :=*parameter*, ParameterNumber :=*parameter*, Done =>*parameter*, Busy =>*parameter*, CommandAborted =>*parameter*, Error =>*parameter*, ErrorID =>*parameter*);

Precautions for Correct Use

The values that are written by this instruction are not saved in the non-volatile memory in the NC integrated controller. Any written values are lost when the power supply to the Controller is turned OFF, when settings are downloaded, or when the CNC Function Module is restarted. They return to the values that were set from the Sysmac Studio.

Use the Sysmac Studio and transfer the parameters to save them to the non-volatile memory.

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Execute	Execute	BOOL	TRUE or FALSE	FALSE	The instruction is executed when *Execute* changes to TRUE.
Parameter Number	Parameter Number	_eCNC _PARAME-TER_NUMBER	0: _cncRotaryVel 1: _cncDryRunVel 2: _cncFeedholdTime 3: _cncInPosTime 4: _cncSwLmtCtrl 5: _cncToolShape 6: _cncToolRadiusCompCtrl 7: _cncSpindleOrientation 8: _cncSingleBlockOption 20: _cncWorkOffset1 21: _cncWorkOffset2 22: _cncWorkOffset3 23: _cncWorkOffset4 24: _cncWorkOffset5 25: _cncWorkOffset6 30: _cncRefPoint1 31: _cncRefPoint2 32: _cncRefPoint3 33: _cncRefPoint4 50: _cncFELmt 51: _cncChkFELmt 52: _cncSwLmt 53: _cncPosiSwLmt 54: _cncNegaSwLmt 55: _cncInPosCycle 56: _cncInPosRange 57: _cncRapidFeedAcc 58: _cncSkipVel 59: _cncPIDCtr 100: _cncCompScaling	0*1	Specify the parameter to write. 0: Rotary Axis Velocity 1: Dry Run Velocity 2: Feed Hold Acceleration Deceleration Time 3: In-position Check Time 4: Software Overtravel Limit Operation Control 5: Tool Shape Data 6: Tool Radius Compensation Control 7: Spindle Axis Orientation Operation 8: Single Block Execution Option*2 20: 1st Work Coordinate System Offset 21: 2nd Work Coordinate System Offset 22: 3rd Work Coordinate System Offset 23: 4th Work Coordinate System Offset 24: 5th Work Coordinate System Offset 25: 6th Work Coordinate System Offset 30: 1st Reference Point 31: 2nd Reference Point 32: 3rd Reference Point 33: 4th Reference Point 50: Following Error Over Value 51: Following Error Warning Value 52: Software Overtravel Limit 53: Positive Software Overtravel Limit 54: Negative Software Overtravel Limit 55: Number of In-position Continuance Cycles 56: In-position Range 57: Rapid Feed Acceleration/Deceleration 58: Skip Velocity 59: PID Control 100: Compensation Scailing

*1. The default value for an enumeration variable is actually not the number, but the enumerator.

*2. The single block execution option is a parameter that can only be changed with CNC_Write.

Parameter Data Types and Setting Ranges

The table below shows the valid range of each parameter. However, this valid range is available for this instruction, and it varies depending on the value of the correlative parameter.

Parameter	Data type	Valid range	Comments
CNC Coordinate System Parameters			
Rotation Axis Velocity	LREAL	Positive number	
Dry-Run Speed	LREAL	Positive number	
Feed Hold Acceleration Deceleration Time	UDINT	1 to 10,000 [ms]	
In-position Check Time	UINT	0 to 10,000 [ms]	
Software Overtravel Limit Operation Control	_eCNC_SWLMT_-CONTROL	_cncSwLmtOTErr := 0 _cncSwLmtTraj Saturation := 1	0: Error 1: No error (Path saturation)
Tool Shape Data	_sCNC_TOOL _SHAPE	Refer to _sCNC_TOOL _SHAPE.	Refer to _sCNC_TOOL_SHAPE.
Tool Radius Compensa-tion Control	_sCNC_TOOL _RADIUS_COMP	Refer to _sCNC_TOOL _RADIUS_COMP.	Refer to _sCNC_TOOL_RADIUS_-COMP.
Orientation of Spindle Axis Setting	_sSPINDLE _ORIENTATION	Refer to _sSPIN-DLE _ORIENTATION.	Refer to _sSPINDLE_ORIENTATION.
Single Block Execution Option	_eCNC_SINGLE _BLOCK_OPTION	_cncSingleBlockOp-tionDisable = 0 _cncSingleBlockOp-tionEnable = 1	0: The single block execution option is disabled. 1: The single block execution option is enabled.
1st Work Coordinate System Offset	_sCNC_COORD _AX_DATA	Negative number, positive number, or 0	
2nd Work Coordinate System Offset	_sCNC_COORD _AX_DATA	Negative number, positive number, or 0	
3rd Work Coordinate System Offset	_sCNC_COORD _AX_DATA	Negative number, positive number, or 0	
4th Work Coordinate System Offset	_sCNC_COORD _AX_DATA	Negative number, positive number, or 0	
5th Work Coordinate System Offset	_sCNC_COORD _AX_DATA	Negative number, positive number, or 0	
6th Work Coordinate System Offset	_sCNC_COORD _AX_DATA	Negative number, positive number, or 0	
1st Reference Point	_sCNC_COORD _AX_DATA	Negative number, positive number, or 0	
2nd Reference Point	_sCNC_COORD _AX_DATA	Negative number, positive number, or 0	

Parameter		Data type	Valid range	Comments
	3rd Reference Point	_sCNC_COORD _AX_DATA	Negative number, positive number, or 0	
	4th Reference Point	_sCNC_COORD _AX_DATA	Negative number, positive number, or 0	
CNC Motor Parameters				
	Following Error Over Value	LREAL	0.0 min.	
	Following Error Warning Value	LREAL	0.0 min.	
	Software Overtravel Limit	_eCNC_SWLMT _MODE	_cncNonSwLmt := 0 _cncCmdImmediateStop := 1	0: Disable software limits. 1: Immediate stop for command position (stop using remaining pulses)
	Positive Software Overtravel Limit	LREAL	Positive number	
	Negative Software Overtravel Limit	LREAL	Negative numbers	
	Number of In-position Continuance Cycles	UINT	0 to 255	
	In-position Range	LREAL	0.0 min.	
	Rapid Feed Acceleration/Deceleration	LREAL	0 min.	
	Skip Velocity	LREAL	Positive number	
	PID Control	_sCNC_PID _CONTROL	Refer to _sCNC_PID_CONTROL	Refer to _sCNC_PID_CONTROL
CNC Motor Compensation Table Parameters				
	Compensation Scaling	LREAL	0 to 2.0	

● _sCNC_COORD_AX_DATA

Name	Meaning	Data type	Valid range	Function
X	X-axis Position	LREAL	Positive, negative, 0	X-axis value
Y	Y-axis Position	LREAL	Positive, negative, 0	Y-axis value
Z	Z-axis Position	LREAL	Positive, negative, 0	Z-axis value
A	A-axis Position	LREAL	Positive, negative, 0	A-axis value
B	B-axis Position	LREAL	Positive, negative, 0	B-axis value
C	C-axis Position	LREAL	Positive, negative, 0	C-axis value

● _sCNC_TOOL_SHAPE

Name	Meaning	Data type	Valid range	Function
ToolRadius	Tool Radius	LREAL	0.0 min.	Tool radius to be compensated
ToolLength	Tool Length	LREAL	Positive, negative, 0	Tool length to be compensated

_sCNC_TOOL_RADIUS_COMP

Name	Meaning	Data type	Valid range	Function
OvercutMode	Over-cut Mode	_eCNC_OVER-CUT_MODE	_cncOvercutErr := 0 _cncOvercutAvoid := 1 _cncOvercutIgnore := 2 _cncOvercutTestAvoid := 3	Over-cut mode setting
ArcFeedrateMode	Circular Feed Rate Mode	BOOL	TRUE or FALSE	Feedrate compensation setting for circular interpolation with compensation

_sSPINDLE_ORIENTATION

Name	Meaning	Data type	Valid range	Function
OrientationPos	Orientation Position	LREAL	0 ≤ x < 1	Orientation position setting
OrientationVel	Orientation Velocity	LREAL	Positive number	Orientation velocity setting
OrientationAcc	Orientation Acceleration/Deceleration	LREAL	0.0 min.	Orientation acceleration/deceleration setting

_sCNC_PID_CONTROL

Name	Meaning	Data type	Valid range	Function
Kp	Position Loop Gain	REAL	0 to 3000	Position loop gain setting
Kvff	Velocity Feedforward Gain	REAL	0 to 100	Velocity feedforward setting
Ki	Integral Gain	REAL	0	Integral gain setting (Reserved)
Kvfb	Velocity Feedback Gain	REAL	0	Velocity feedback gain setting (Reserved)
Kvifb	Velocity Feedback Gain (before integrator)	REAL	0	Velocity feedback gain (before integrator) setting (Reserved)
Kviff	Velocity Feedforward Gain (before integrator)	REAL	0	Velocity feedforward gain (before integrator) setting (Reserved)
Kaff	Acceleration Feedforward Gain	REAL	0	Acceleration feedforward gain setting (Reserved)

Output Variables

Name	Meaning	Data type	Valid range	Description
Done	Done	BOOL	TRUE or FALSE	TRUE when the instruction is completed.
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Command-Aborted	Command Aborted	BOOL	TRUE or FALSE	TRUE when the instruction is aborted.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error Code	WORD	*1	Contains the error code when an error occurs. A value of 16#0000 indicates normal execution.

*1. Refer to *Section 15 Troubleshooting*.

● Output Variable Update Timing

Name	Timing for changing to TRUE	Timing for changing to FALSE
Done	When this instruction is completed.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Busy	When *Execute* changes to TRUE.	• When *Done* changes to TRUE. • When *Error* changes to TRUE. • When *CommandAborted* changes to TRUE.
CommandAborted	When another instruction causes an error and aborts this instruction.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Error	When there is an error in the execution conditions or input parameters for the instruction.	When the error is cleared.

In-Out Variables

Name	Meaning	Data type	Valid range	Description
Target	Write Target	_sCNC_COORD_REF, _sCNC_MOTOR_REF, ARRAY[0..N] OF REAL	---	Specify the CNC motor, CNC coordinate system, or CNC compensation table data variable for which to write a parameter. N in the array variable is set automatically by the Sysmac Studio. Specify the CNC motor compensation table data variable created with the CNC motor compensation table editor of Sysmac Studio.
SettingValue	Setting Value	*1	---	Specify the value to write. The valid range follows the CNC parameter that is specified by *ParameterNumber* (Parameter Number). It is set to 0 by default.

*1. Depends on the data type of the variable specified.

● In-Out Variable Update Timing

Name	Write timing
SettingValue	When *Done* changes to TRUE.

Functions

The CNC_Write instruction writes the SettingValue (Setting Value) to the CNC parameter specified by *Target* (Write Target) and *ParameterNumber* (Parameter Number) when *Execute* changes to TRUE. To specify the change target, combine the *ParameterNumber* (Parameter Number) with the *Target* (Write Target). If the combination you specified is invalid, it causes the CNC Parameter Setting Read/Write Target Out of Range error (560F 0000 hex).

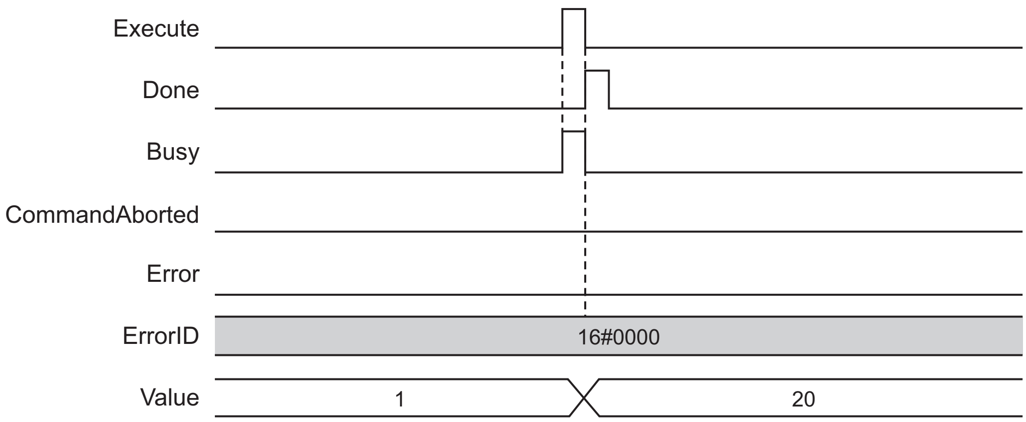
Precautions for Correct Use

The values that are written by this instruction are not saved in the non-volatile memory in the NC integrated controller. Any written values are lost when the power supply to the Controller is turned OFF, when settings are downloaded, or when the CNC Function Module is restarted. They return to the values that were set from the Sysmac Studio.

Use the Sysmac Studio and transfer the parameters to save them to the non-volatile memory.

Timing Chart

A timing chart is shown below when data 20 is written to _cncInPosRange (In-position Range) in the CNC motor parameter settings.



Re-execution of CNC Instructions

If *Execute* for the same instance of this instruction changes to TRUE while *Busy* (Executing) is TRUE, the instruction is re-executed. At this time, the instruction overwrites the previous values of the *Target* (Write Target), *ParameterNumber* (Parameter Number), and *SettingValue* (Setting Value) with the values that are specified when Execute rises.

Multi-execution of CNC Instructions

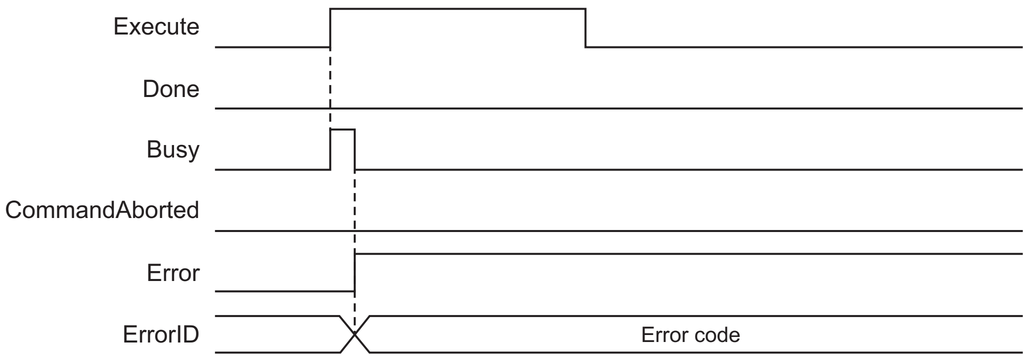
Refer to *A-4 Instructions for Which Multi-execution Is Supported* on page A-15 for details on multi-execution of CNC instructions.

Errors

If an error occurs during instruction execution, *Error* will change to TRUE and the parameter is not changed. The previous values are retained.

You can find out the cause of the error by referring to the value output by *ErrorID* (Error Code).

● Timing Chart When Error Occurs

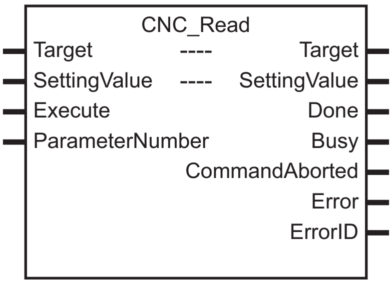


● Error Code

Refer to *Section 15 Troubleshooting* for details on error codes.

CNC_Read

The CNC_Read instruction reads CNC parameters.

Instruction	Name	FB/FUN	Graphic expression	ST expression
CNC_Read	Read CNC Setting	FB	CNC_Read_instance 	CNC_Read_instance (Target :=*parameter*, SettingValue :=*parameter*, Execute :=*parameter*, ParameterNumber :=*parameter*, Done =>*parameter*, Busy =>*parameter*, CommandAborted =>*parameter*, Error =>*parameter*, ErrorID =>*parameter*);

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Execute	Execute	BOOL	TRUE or FALSE	FALSE	The instruction is executed when Execute changes to TRUE.
Parameter Number	Parameter Number	_eCNC _PARAME-TER_NUM-BER*1	0: _cncRotaryVel 1: _cncDryRunVel 2: _cncFeedholdTime 3: _cncInPosTime 4: _cncSwLmtCtrl 5: _cncToolShape 6: _cncToolRadiusCompCtrl 7: _cncSpindleOrientation 8: _cncSingleBlockOption 20: _cncWorkOffset1 21: _cncWorkOffset2 22: _cncWorkOffset3 23: _cncWorkOffset4 24: _cncWorkOffset5 25: _cncWorkOffset6 30: _cncRefPoint1 31: _cncRefPoint2 32: _cncRefPoint3 33: _cncRefPoint4 50: _cncFELmt 51: _cncChkFELmt 52: _cncSwLmt 53: _cncPosiSwLmt 54: _cncNegaSwLmt 55: _cncInPosCycle 56: _cncInPosRange 57: _cncRapidFeedAcc 58: _cncSkipVel 59: _cncPIDCtr 100: _cncCompScaling	0*2	Specify the parameter to read. 0: Rotary Axis Velocity 1: Dry Run Velocity 2: Feed Hold Acceleration Deceleration Time 3: In-position Check Time 4: Software Overtravel Limit Operation Control 5: Tool Shape Data 6: Tool Radius Compensation Control 7: Spindle Axis Orientation Operation 8: Single Block Execution Option 20: 1st Work Coordinate System Offset 21: 2nd Work Coordinate System Offset 22: 3rd Work Coordinate System Offset 23: 4th Work Coordinate System Offset 24: 5th Work Coordinate System Offset 25: 6th Work Coordinate System Offset 30: 1st Reference Point 31: 2nd Reference Point 32: 3rd Reference Point 33: 4th Reference Point 50: Following Error Over Value 51: Following Error Warning Value 52: Software Overtravel Limit 53: Positive Software Overtravel Limit 54: Negative Software Overtravel Limit 55: Number of In-position Continuance Cycles 56: In-position Range 57: Rapid Feed Acceleration/Deceleration 58: Skip Velocity 59: PID Control 100: Compensation Scailing

*1. Refer to the CNC_Write instruction for _eCNC_PARAMETER_NUMBER.

*2. The default value for an enumeration variable is actually not the number, but the enumerator.

Output Variables

Name	Meaning	Data type	Valid range	Description
Done	Done	BOOL	TRUE or FALSE	TRUE when the instruction is completed.
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Command-Aborted	Command Aborted	BOOL	TRUE or FALSE	TRUE when the instruction is aborted.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error Code	WORD	*1	Contains the error code when an error occurs. A value of 16#0000 indicates normal execution.

*1. Refer to *Section 15 Troubleshooting*.

● Output Variable Update Timing

Name	Timing for changing to TRUE	Timing for changing to FALSE
Done	When this instruction is completed.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Busy	When *Execute* changes to TRUE.	• When *Done* changes to TRUE. • When *Error* changes to TRUE. • When *CommandAborted* changes to TRUE.
CommandAborted	When another instruction causes an error and aborts this instruction.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Error	When there is an error in the execution conditions or input parameters for the instruction.	When the error is cleared.

In-Out Variables

Name	Meaning	Data type	Valid range	Description
Target	Read Target	_sCNC_COORD_REF or _sCNC_MOTOR_REF or ARRAY[0..N] OF REAL	---	Specify a CNC motor, CNC coordinate system, or CNC motor compensation table data variable from which to read a parameter. N in the array variable is set automatically by the Sysmac Studio. Specify the CNC motor compensation table data variable created with the CNC motor compensation table editor of Sysmac Studio.
SettingValue	Setting Value	*1	---	Stores the read values. The valid range follows the CNC parameter that is specified by *ParameterNumber* (Parameter Number).

*1. Depends on the data type of the variable specified.

In-Out Variable Update Timing

Name	Write timing
SettingValue	When *Done* changes to TRUE.

Functions

The CNC_Read instruction reads the CNC parameter specified by *Target* (Read Target) and *ParameterNumber* (Parameter Number) to the *SettingValue* (Setting Value) when *Execute* changes to TRUE.

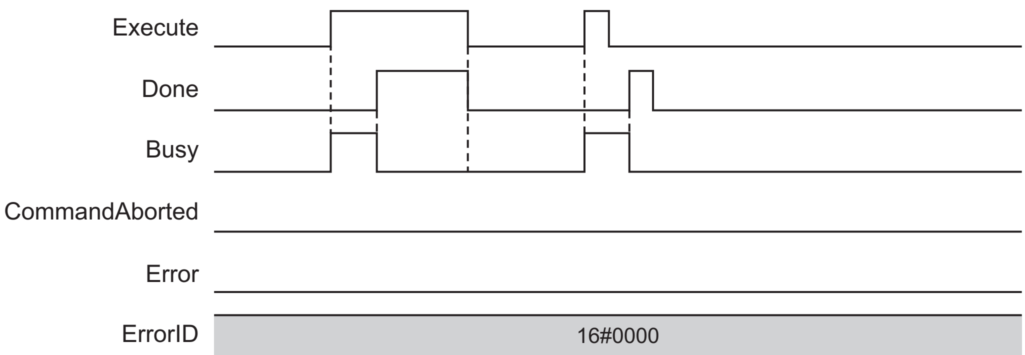
Precautions for Correct Use

The parameter values that can be read by this instruction are not those saved in the non-volatile memory in the NC integrated controller but those that is enabled at the timing when this instruction was executed.

For example, if you wrote parameters with the CNC_Write (Write CNC Setting) instruction, the written parameters are read.

Timing Chart

A timing chart for execution of the CNC_Read (Read CNC Setting) instruction is shown below.



Re-execution of CNC Instructions

If *Execute* for the same instance of this instruction changes to TRUE while *Busy* (Executing) is TRUE, the instruction is re-executed. The CNC_Read instruction reads the parameter specified by *Target* (Read Target) and *ParameterNumber* (Parameter Number) when the last *Execute* changes to TRUE.

Multi-execution of CNC Instructions

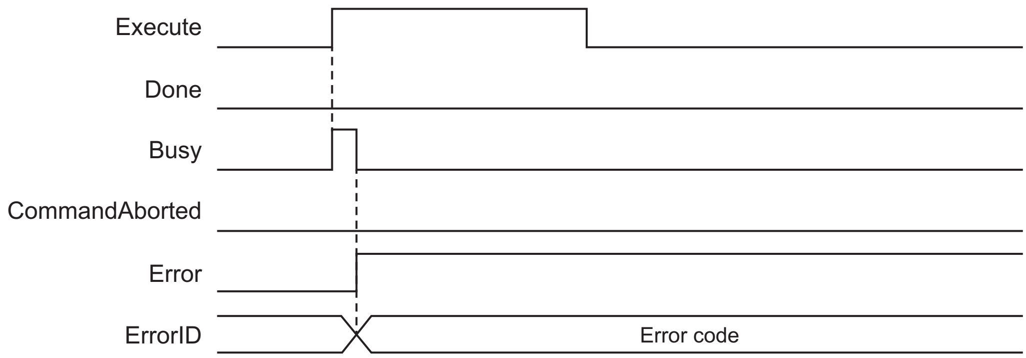
Refer to *A-4 Instructions for Which Multi-execution Is Supported* on page A-15 for details on multi-execution of CNC instructions.

Errors

If an error occurs during instruction execution, *Error* will change to TRUE and the parameter is not changed. The previous values are retained.

You can find out the cause of the error by referring to the value output by *ErrorID* (Error Code).

● Timing Chart When Error Occurs

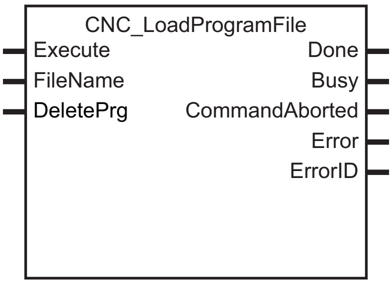


● Error Code

Refer to *Section 15 Troubleshooting* for details on error codes.

CNC_LoadProgramFile

The CNC_LoadProgramFile instruction loads an NC program from an external non-volatile memory into the main memory.

<table>
<tr><th>Instruction</th><th>Name</th><th>FB/FUN</th><th>Graphic expression</th><th>ST expression</th></tr>
<tr><td>CNC_LoadProgramFile</td><td>NC program load</td><td>FB</td><td>CNC_LoadProgramFile_instance
</td><td>CNC_LoadProgramFile_instance (
Execute :=parameter,
FileName :=parameter,
DeletePrg :=parameter,
Done =>parameter,
Busy =>parameter,
CommandAborted =>parameter,
Error =>parameter,
ErrorID =>parameter
);</td></tr>
</table>

Variables

Input Variables

Name	Meaning	Data type	Valid range	Default	Description
Execute	Execute	BOOL	TRUE or FALSE	FALSE	The instruction is executed when *Execute* changes to TRUE.
FileName	File Name	STRING	*1		File name to be loaded
DeletePrg	Program Deletion Option	_eCNC_DELETE_PRG	_cncNotDelPrg (0) _cncDelLoadedPrg (1)	_cncNotDelPrg (0)	Specify whether to delete the NC program loaded by this instruction. _cncNotDelPrg: Do not delete NC program _cncDelLoadedPrg: Delete all the loaded NC programs

*1. Up to 66 bytes (65 bytes + NULL)

Output Variables

Name	Meaning	Data type	Valid range	Description
Done	Done	BOOL	TRUE or FALSE	TRUE when the instruction is completed.
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Command-Aborted	Command Aborted	BOOL	TRUE or FALSE	TRUE when the instruction is aborted.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error Code	WORD	*1	Contains the error code when an error occurs. A value of 16#0000 indicates normal execution.

*1. Refer to *Section 15 Troubleshooting*.

● Output Variable Update Timing

Output variable	Timing for changing to TRUE	Timing for changing to FALSE
Done	When this instruction is completed.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Busy	When *Execute* changes to TRUE.	• When *Done* changes to TRUE. • When *Error* changes to TRUE. • When *CommandAborted* changes to TRUE.
CommandAborted	When another instruction causes an error and aborts this instruction.	• When *Execute* is TRUE and changes to FALSE. • After one period when *Execute* is FALSE.
Error	When there is an error in the execution conditions or input parameters for the instruction.	When the error is cleared.

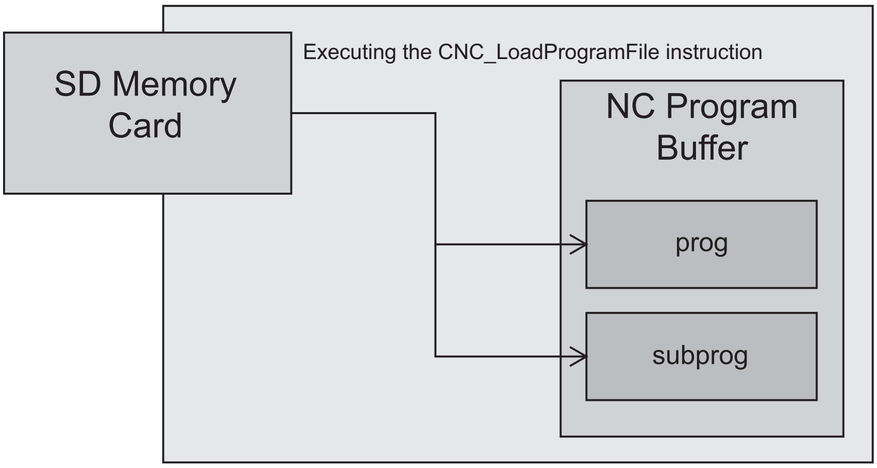
Functions

In order to execute an NC program, it must be loaded into the NC program buffer. This instruction loads the NC program stored in the file (on the SD Memory Card) specified by *FileName*, in the NC program buffer.

Two types of NC program buffers are provided: prog for main programs, and subprog for sub programs. Specify the NC program buffer used to load the NC program in the program file. Up to 512 programs can be loaded into each of the buffers.

NC programs are identified according to the program numbers. If you load a program that has the same program number, the program will be overwritten. The program number must be specified in the program file.

When loading programs, make sure that the NC programs in all the CNC coordinate systems are stopped. Otherwise, a CNC Multi-execution Disabled error (5604 0000 hex) will occur when the programs are loaded during execution of NC program.

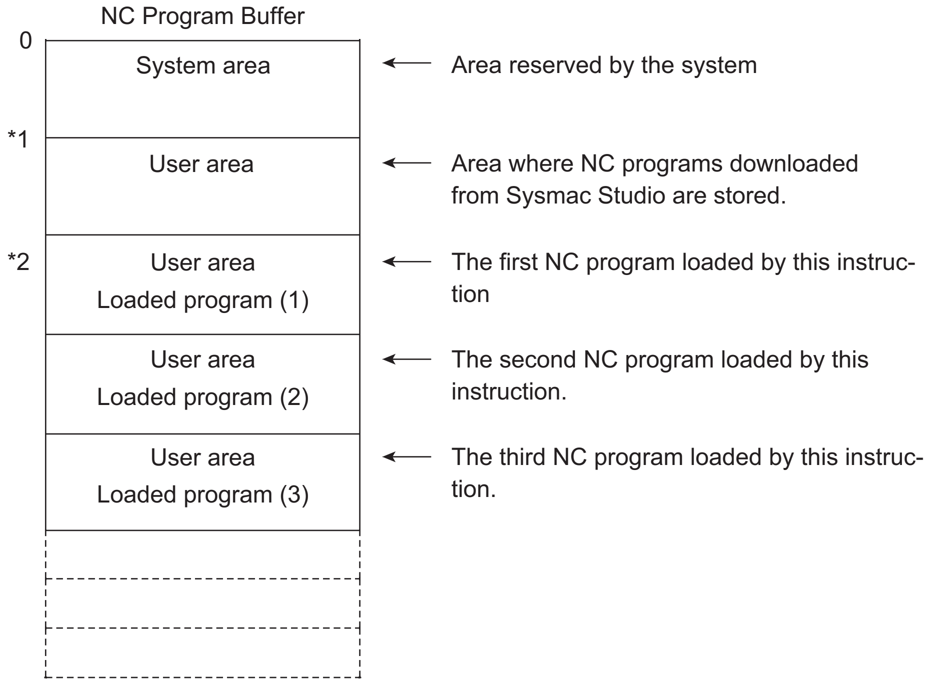


Program area	Maximum number of programs that can be registered	Range of program numbers		Program capacity
Main program	512 programs (Total number including the programs downloaded from Sysmac Studio)	Sysmac Studio	No.0001 to 0299	In the total number of main and sub programs, the NJ5 series has a capacity of 16 MB, and the NY5 series has a capacity of 64 MB. The system area also uses this area.
		CNC_loadProgram-File	No.0300 to 0999	
Sub program	512 programs (Total number including the programs downloaded from Sysmac Studio)	Sysmac Studio	No.1000 to 2999	
		CNC_loadProgram-File	No.3000 to 9999	

NC Program Buffer Configuration and Program Deletion

The CNC Function Module provides a program buffer. Main and sub programs are stored in the same buffer. NC programs are placed in the following sequence from the head address of the buffer: first the system area reserved for the system and next the area that contains the NC programs downloaded from Sysmac Studio.

The NC programs loaded by this instruction are placed in the areas following the NC program area downloaded from Sysmac Studio in the order in which they are loaded.

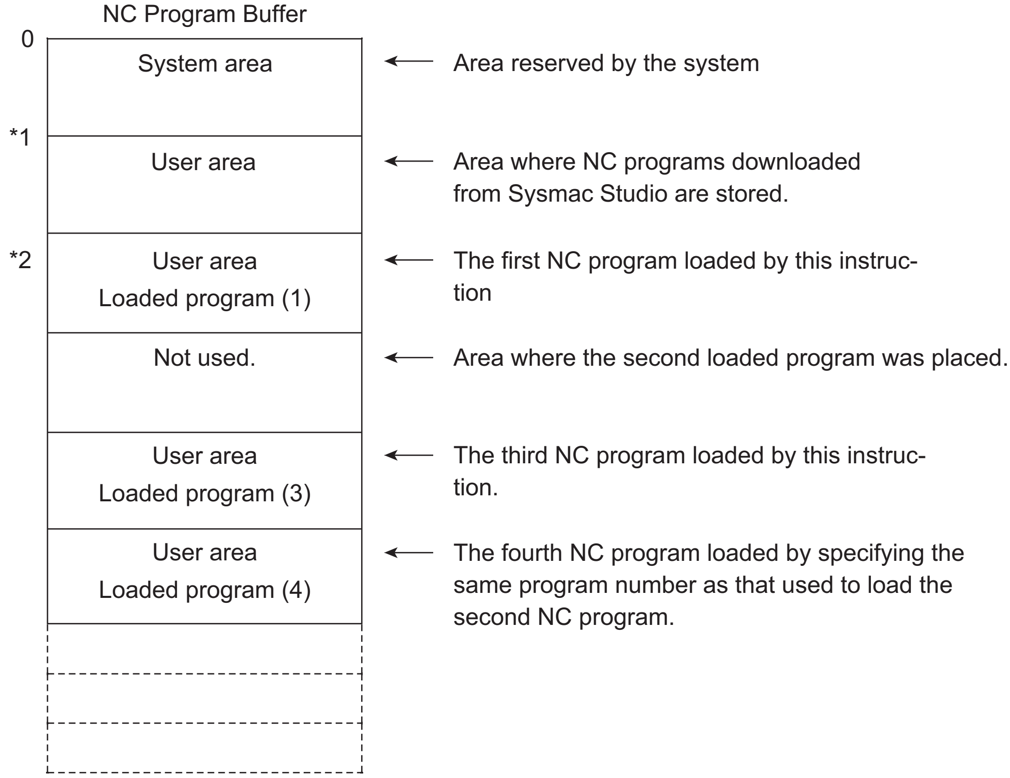


*1. The available size of the system area is approximately 1 MB.

*2. The available size of the device manufacturer's area varies depending on the size of the NC programs downloaded from Sysmac Studio.

When a program that has the same program number is loaded, it will be placed at the bottom of the area. An area in which an overwritten NC program exists is not reused and it becomes free space.

Therefore, if NC programs are repeatedly loaded using this instruction, the NC program buffer runs out, and a Load NC Program Size Over error (5623 0000 hex) is output.

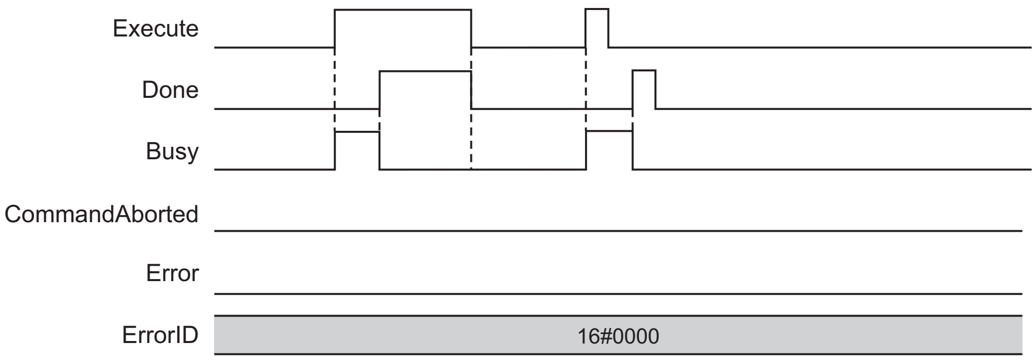


To solve buffer shortage, specify DeletePrg (Program Deletion Option) to _cncDelLoadedPrg (Delete all the loaded NC programs), and execute this instruction at the timing of a setup change. After the loaded NC programs are deleted by this instruction, a new program is loaded.

Even if this *DeletePrg* (Program Deletion Option) instruction is executed, the NC programs placed in the system area and the NC programs loaded from Sysmac Studio are not deleted.

Timing Chart

A timing chart for the execution of the CNC_LoadProgramFile instruction is shown below.



Re-execution of CNC Instructions

This instruction does not detect re-execution. When a CNC instruction is restarted, the system continues the currently executed NC program without a new input value. Also, output variables is not changed due to re-execution.

Multi-execution of CNC Instructions

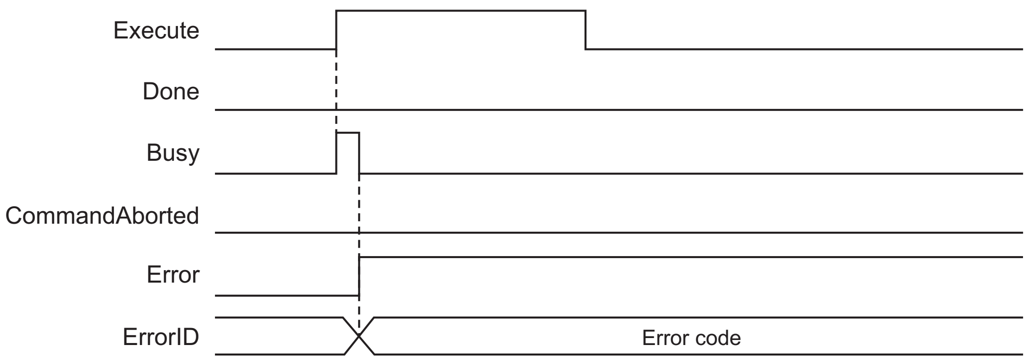
This instruction does not support the multi-execution function. Therefore, more than one instance cannot be executed multiply. If multiple instances are executed, it causes a Too Many Files Open error (5620 0000 hex).

Errors

If an error occurs during instruction execution, *Error* will change to TRUE and the parameter is not changed. The previous values are retained.

You can find out the cause of the error by referring to the value output by *ErrorID* (Error Code).

● Timing Chart When Error Occurs



● Error Code

Refer to *Section 15 Troubleshooting* for details on error codes.

Related System-defined Variables

Name	Meaning	Data type	Description
_Card1Ready	SD Memory Card Ready Flag	BOOL	This flag indicates whether or not the SD Memory Card is physically inserted and whether the mount process is completed successfully, and thus it is now accessible by instructions and communication commands. TRUE: The card can be used. FALSE: The card cannot be used.
_Card1Protect	SD Memory Card Write Protected Flag	BOOL	This flag indicates whether or not the SD Memory Card, which has been mounted and is ready, is write-protected. TRUE: Writing is not possible. FALSE: Writing is possible.
_Card1Err	SD Memory Card Error Flag	BOOL	This flag indicates whether or not an out-of-specification SD Memory Card (e.g. SDHC card) is mounted, or whether or not the card has a format error (the format is not FAT16 or the system file is damaged). TRUE: Writing is not possible. FALSE: Writing is possible.
_Card1Access	SD Memory Card Access Flag	BOOL	This flag indicates whether the SD Memory Card is currently being accessed. TRUE: The card is accessed. FALSE: The card is not accessed.
_Card1PowerFail	SD Memory Card Power Interruption Flag	BOOL	This flag indicates whether an error occurred during processing when power was interrupted while the SD Memory Card was accessed. This flag is not cleared automatically. TRUE: An error occurred. FALSE: No error occurred.

Additional Information

The root directory in a file name indicates the first layer of the SD Memory Card.

Precautions for Correct Use

- This instruction continues the processing to the end even when *Execute* changes to FALSE and execution time exceeds the task period. Whether the process has terminated successfully can be checked by confirming that the Done value has changed to TRUE.
- If the size of the specified file is larger than that of the CNC program buffer, an error occurs.
- Do not access the same file simultaneously with this instruction and SD Memory Card instruction. In the user program, perform exclusive control between this instruction and SD Memory Card instruction.
- For an NC program file to be loaded with this instruction, specify the file (extension: pmc) that is created after the NC program was parsed by CNC Operator. If parse processing is not performed, an NC program file cannot be loaded properly or does not run normally.
- In the following cases, *Error* changes to TRUE:
  - The SD Memory Card is not ready for use.
  - The file specified by *FileName* does not exist.
  - The *FileName* value is not valid as a file name.
  - The *FileName* value exceeds the number of bytes that can use for a file name.
  - An error occurred while the SD Memory Card was being accessed, and the card is not accessible.
  - An attempt was made to load main and sub programs over the respective maximum numbers of programs that can be registered.
  - An attempt was made to load programs over the specified program buffer size.
  - This instruction was started while any CNC coordinate system was *Executing* or *Hold*.
  - A failure such as a syntax error was detected in the loaded NC program.
  - One row in the loaded NC program exceeds 1,020 bytes.
  - Multiple instances of this instruction were executed multiply.

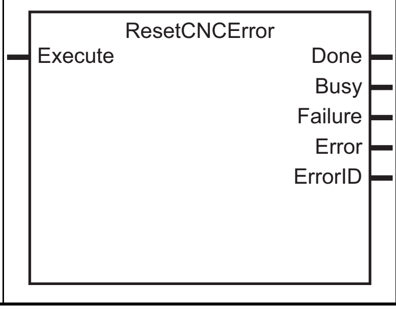
14

System Control Instructions

This section describes instructions that are used for system control.

ResetCNCError

The ResetCNCError instruction resets Controller errors in the CNC Function Module.

Instruction	Name	FB/FUN	Graphic expression	ST expression
ResetCNCError	CNC Error Reset	FB	ResetCNCError_instance 	ResetCNCError_instance (Execute :=*parameter*, Done =>*parameter*, Busy =>*parameter*, Failure =>*parameter*, Error =>*parameter*, ErrorID =>*parameter*);

Variables

Input Variables

Name	Meaning	Data type	Valid range	Description
Execute	Execute	BOOL	TRUE or FALSE	The instruction is executed when *Execute* changes to TRUE. The default is FALSE.

Output Variables

Name	Meaning	Data type	Valid range	Description
Done	Done	BOOL	TRUE or FALSE	TRUE when the instruction is completed.
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged.
Failure	Failure End	BOOL	TRUE or FALSE	TRUE when the instruction was not executed correctly.
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error.
ErrorID	Error Code	WORD	*1	Contains the error code when an error occurs. A value of 16#0000 indicates normal execution.

*1. Refer to *Section 15 Troubleshooting*.

Functions

The ResetCNCError instruction resets Controller errors in the CNC Function Module.

If the reset fails, *Failure* (Failure End) changes to TRUE.

The ResetCNCError instruction applies to all the CNC coordinate systems even if the program that ResetCNCError instruction is executed is written in any task.

Related System-defined Variables

Name	Meaning	Data type	Description
_CNC_ErrSta	CNC Error Status	WORD	Contains the error status of the CNC Function Module.

Precautions for Correct Use

- Errors are not necessarily reset immediately after the execution of this instruction. Check the GetCNCError instruction to confirm whether the error is reset.
- When you use this instruction for the OMRON G5-series Servo Drive, perform exclusive control to prevent the ResetECError instruction from being executed simultaneously.

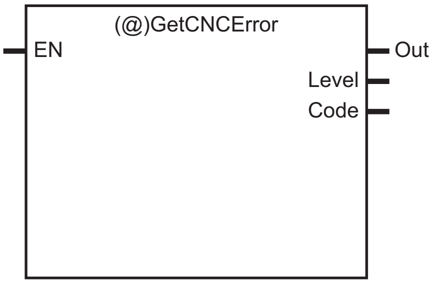
  If this instruction is executed simultaneously with ResetECError instruction, the G5-series Servo Drive may not be able to accept subsequent SDOs.

Sample Programming

Refer to the sample programming of the ResetMCError instruction described in the *NJ/NX-series Instructions Reference Manual* (Cat. No. W502).

GetCNCError

The GetCNCError instruction obtains the highest level status (partial fault or minor fault) and highest level event code of the current Controller errors in the CNC Function Module.

Instruction	Name	FB/FUN	Graphic expression	ST expression
GetCNCError	Get CNC Error Status	FUN		Out:=GetCNCError(Level,Code);

Variables

Output Variables

Name	Meaning	Data type	Valid range	Description
Out	Error Flag	BOOL	*1	TRUE: Controller error exists. FALSE: No Controller error
Level	Highest Level Status	UINT	0, 2, and 3	The highest level status of the current Controller errors that exist in the CNC Function Module 0: No Controller error 2: Partial fault level 3: Minor fault level
Code	Highest Level Event Code	DWORD	16#00000000 16#00070000 to 16#FFFFFFFF	The highest level event code of the current Controller errors that exist in the CNC Function Module 16#0000_0000: No Controller error 16#0007_0000 to 16#FFFF_FFFF: Event code

*1. Depends on the data type of the variable specified.

Functions

This instruction obtains *Level* (Highest Level Status) and *Code* (Highest Level Event Code) of the current *Controller* errors that exist in the CNC Function Module.

If there are no current *Controller* errors, the *Out* (Error Flag) value changes to FALSE.

If there are two or more Controller errors of the highest level event code, *Code* takes as its value the event code of the *Controller* error that occurred first.

Related System-defined Variables

Name	Meaning	Data type	Description
_CNC_ErrSta	CNC Error Status	WORD	Contains the error status of the CNC Function Module.

Sample Programming

Refer to the sample programming of the ResetMCError instruction described in the *NJ/NX-series Instructions Reference Manual* (Cat. No. W502).

15

Troubleshooting

This section describes errors (events) that may occur in the CNC Function Module and measures used to correct those errors.

15-1 Errors Related to the CNC Function Module

This section describes the errors that are related to the CNC Function Module.

Additional Information

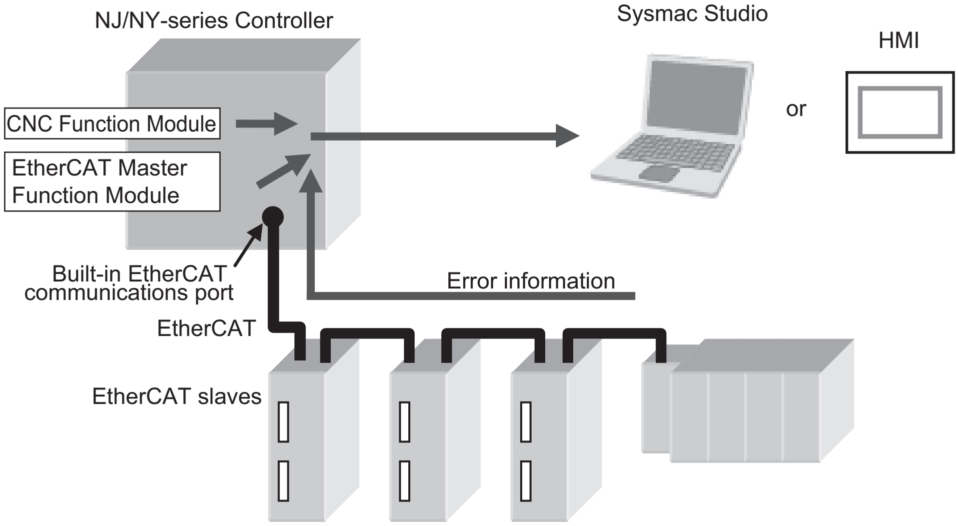
Refer to the *NJ/NX-series Troubleshooting Manual* (Cat. No. W503) for the NJ-series troubleshooting.

Refer to the *NY-series Troubleshooting Manual* (Cat. No. W564) for the NY-series troubleshooting.

15-1-1 Error Locations Related to the CNC Function Module

In addition to errors that occur in the CNC Function Module, there are errors caused by EtherCAT communication that is used for connection with the Servo Drive.

- Inside of CNC Function Module
- EtherCAT Master Function Module
- Built-in EtherCAT communications port hardware
- EtherCAT slaves



You can check the sources and causes of the errors in the system-defined variables or from the Sysmac Studio or an HMI.

Precautions for Correct Use

Refer to the appendices of the *NJ/NX-series Troubleshooting Manual* (Cat. No. W503) or *NY-series Troubleshooting Manual* (Cat. No. W564) for the applicable range of the HMI Troubleshooter.

15-1-2 Types

The following three sources of errors in the CNC Function Module exist.

Classification	Description
CNC common errors	If an error is detected in the common part of the CNC Function Module, the relevant bit of _CNC_ComErrSta (CNC common error status) is set to TRUE.
CNC motor errors	If an error is detected in the CNC motor, the relevant bit of _CNC_MotorErrSta (CNC motor error status) is set to TRUE.*1
CNC coordinate system errors	If an error is detected in the CNC coordinate system, the relevant bit of _CNC_CoordErrSta (CNC coordinate system error status) is set to TRUE.

*1. If a CNC motor error over the minor fault level is detected, the CNC coordinate system, which includes the CNC motor with the error detected in the composition CNC motor, also cannot be operated.

Additional Information

If an error is detected in a CNC instruction, it causes an error for which the error source is PLC Function Module and the source details is Instruction.

15-1-3 Event Levels

The following table shows the event levels concerning the CNC Function Module.

Event level	Operation
Major Fault	All NJ/NY-series Controller control operations stop for errors in this event level.
Partial fault	All control operations for one of the function modules in the NJ/NY-series Controller stop for errors in this event level. If this error occurs in the CNC Function Module, the relevant CNC motor or CNC coordinate system stops.
Minor fault	Some of the control operations for one of the function modules in the NJ/NY-series Controller stop for errors in this event level. If this error occurs in the CNC Function Module, the relevant CNC motor or CNC coordinate system stops.
Observation	Errors in the observation level do not affect NJ/NY-series Controller control operations. Observations are reported in order to prevent them from developing into errors at the minor fault level or higher.
Information	The user is notified of information, excluding errors.

15-1-4 Errors for each Source in CNC Function Module

The following tables list the errors in each event level that can occur for each source.

CNC Common Errors

The table below shows errors detected in the CNC common part for each level.

Level	Error name
Major fault	• CNC Parameter Setting Invalid
Partial Fault	• CNC Parameter Setting Error • Absolute Encoder Home Offset Read Error • CNC Motor Compensation Table Read Error • Required Process Data Object Not Set • Network Configuration Information Missing for CNC Motor Slave • CNC Initialization Error • CNC Control Period Exceeded
Minor fault	• Illegal CNC Coordinate System Specification • CNC Instruction Re-execution Disabled • Parameter Selection Out of Range • CNC Parameter Setting Read/Write Setting Value Out of Range • CNC Parameter Setting Read/Write Target Out of Range • Illegal NC Program • Illegal CNC Motor Specification • Illegal CNC Motor Compensation Table Specification • NC Program Capacity Exceeded
Observation	• SD Memory Card Access Failure • File Does Not Exist • Illegal Load NC Program Number Specification • Too Many Files Open • File or Directory Name Is Too Long • SD Memory Card Access Failed • Load NC Program Capacity Exceeded • Number of NC Program Exceeded • Illegal Load NC Program • CNC Planner Service Period Exceeded
Information	• CNC Function System Information

CNC Motor Errors

The table below shows errors detected in the CNC motor for each level.

Level	Error name
Major fault	None
Partial fault	None
Minor fault	• Immediate Stop Input • Positive Limit Input Detected • Negative Limit Input Detected • Positive Software Limit Exceeded • Negative Software Limit Exceeded • In-position Check Time Exceeded • Following Error Limit Exceeded • Illegal Following Error • Absolute Encoder Current Position Calculation Failed • Servo Main Circuit Power OFF • Slave Error Detected • Slave Disconnection during Servo ON • EtherCAT Slave Communications Error • Homing Opposite Direction Limit Input Detected • Homing Direction Limit Input Detected • Homing Limit Inputs Detected in Both Directions • Home Proximity/Homing Opposite Direction Limit Input Detected • Home Proximity/Homing Direction Limit Input Detected • Home Input/Homing Opposite Direction Limit Input Detected • Home Input/Homing Direction Limit Input Detected • Invalid Home Input Mask Distance • No Home Input • No Home Proximity Input • Position Deviation between Axes Limit Exceeded
Observation	• Following Error Warning • Command Position Overflow • Command Position Underflow • Actual Position Overflow • Actual Position Underflow • Slave Observation Detected • Software Limit Path Limited • Velocity Control Command Value Saturated • Position Deviation between Axes Limit Warning
Information	• Slave Error Code Report

CNC Coordinate System Errors

The table below shows errors detected in the CNC coordinate system for each level.

Level	Error name
Major fault	None
Partial fault	None
Minor fault	• Process Data Object Setting Missing • Deceleration Setting Out of Range • Jerk Setting Out of Range • CNC Instruction Re-execution Disabled • CNC Multi-execution Disabled • Unassigned Logical CNC Motor Number Specified • Logical CNC Motor Number Out of Range • Target Position Setting Out of Range • Impossible CNC Motor Operation Specified when the Servo is OFF • Target Velocity Setting Out of Range • Acceleration/Deceleration Setting Out of Range • Travel Mode Selection Out of Range • Immediate Stop Instruction Executed • Cycle Start Error with Undefined Home • Homing Parameter Setting Out of Range • M Code Number Out of Range • CNC Instruction Re-execution Disabled (CNC Coordinate System Specification) • CNC Instruction Re-execution Disabled (Logical CNC Motor Number) • Cycle Start Multi-execution Disabled • Impossible CNC Motor Cycle Start Specified when the Servo is OFF • Illegal NC Program Number Specification • Illegal Back Trace Specification • Target Position Positive Software Limit Exceeded • Target Position Negative Software Limit Exceeded • Command Position Overflow/Underflow • Positive Limit Input • Negative Limit Input • Home Undefined during Coordinated Motion • Cycle Start Specified during Positive Software Limit Exceeded • Cycle Start Specified during Negative Software Limit Exceeded • Cycle Start Specified during Command Position Overflow (Underflow) • Cycle Start Specified during Positive Limit Input • Cycle Start Specified during Negative Limit Input • NC Program Execution Error • CNC Coordinate System Composition CNC Motor Error • CNC Common Error Occurrence • Servo Main Circuits OFF • Skew Control Mode Out of Range • Offset Value Setting Out of Range
Observation	None
Information	None

15-1-5 EtherCAT Communication, EtherCAT Slave, and NX Unit Errors

The following errors occur in the CNC Function Module due to an EtherCAT communication, EtherCAT slave, or NX unit error.

Error name	Event code	Cause	Operation at error detection
EtherCAT Slave Communications Error	8780 0000 hex	An error occurred in a communication with the EtherCAT slave or NX unit assigned to the CNC motor of the CNC Function Module.*1	SERVO OFF is performed for the CNC motor with the error detected, and an operation other than error reset is rejected.*2
Slave Error Detected	7786 0000 hex	The EtherCAT slave or NX unit assigned to the CNC motor of the CNC Function Module has detected an error.	SERVO OFF is performed for the CNC motor with the error detected, and an operation other than error reset is rejected.

*1. When an error occurs in communications with an EtherCAT slave, an error also occurs in the EtherCAT Master Function Module. While multiple devices are assigned to a single CNC motor, if a communication error occurs in even one device, the CNC motor results in a communication error.

*2. If a slave communication error occurs, the CNC motor is placed in the home undefined state.

15-1-6 Servo Drive Errors

This section describes error occurrence notifications in the OMRON 1S-series Servo Drive or G5-series Servo Drive.

There is a time lag between the timing when the CNC Function Module detects a Servo Drive error and the timing when the error code is acquired from the Servo Drive.

Therefore, the CNC Function Module notifies Servo Drive error detection and error code in different events.

● Error Notification

If the CNC Function Module detects a Servo Drive error, it causes minor fault level, Slave Error Detection (7786 0000 hex).

At this point, the MC Function Module performs the error operation (i.e., it turns OFF the Servo).

● Error Code Notification

When the Servo Drive reports the error code, the MC Function Module generates a Slave Error Code Report information event (9780 0000 hex). The error code (the main part of the error display number) from the Servo Drive is included in the lower two digits of the attached information of the Slave Error Code Report event.

For example, if the attached information is displayed as FF13, the error with display number 13 (Main Circuit Power Supply Undervoltage) occurred in the Servo Drive.

Precautions for Correct Use

You must change the settings to receive notification of the Slave Error Code Report event.

Map object 603F hex (Error Code) in the PDO Edit Pane.

15-1-7 NX Unit Errors

If an error occurs in the OMRON NX series position interface unit, the error detection and error code are notified in the same way as for the OMRON 1S-series Servo Drive or G5-series Servo Drive.

However, NX-series Position Interface Units do not have an object that corresponds to object 603F hex (Error Code), so 0000 hex is given for the Slave Error Code Report (9780 0000 hex) in the attached information.

Refer to the *NX-series Position Interface Units User's Manual* (Cat. No. W524) and *NX-series EtherCAT Coupler Units User's Manual* (Cat. No. W519) for details on the errors detected in the NX-series position interface unit.

15-2 Troubleshooting

This section describes how to check and reset an error detected in the CNC Function Module.

The detected CNC Function Module error is retained until the controller is turned off or reset.

To reset a Controller error, it is necessary to eliminate the cause of the error. The same error will occur again if you reset the error, but do not eliminate the cause of the error.

15-2-1 How to Check Errors

An error detected in the CNC Function Module can be checked using the following methods.

- Controller body's LED
- Sysmac Studio troubleshooting function
- HMI troubleshooter
- CNC Operator troubleshooter
- Error status acquirement instruction
- System-defined variable

Refer to the *NJ/NX-series Troubleshooting Manual* (Cat. No. W503) or *NY-series Troubleshooting Manual* (Cat. No. W564) for details on how to check errors using the controller body's LED, Sysmac Studio troubleshooting function, HMI troubleshooter, error status acquirement instruction, or system-defined variable.

Refer to the *CNC Operator Operation Manual* (Cat. No. O032) for details on how to check errors using the CNC Operator troubleshooter.

Instructions to Get Error Detected in the CNC Function Module

The error (event) detected in the CNC Function Module can be acquired using the following instructions. Refer to the explanation of each instruction for details.

Instruction name	Instruction	Function
Get CNC Error Status	GetCNCError	The GetCNCError instruction obtains the highest level status (partial fault or minor fault) and highest level event code of the current Controller errors that exist in the CNC Function Module.

System-Defined Variables Related to the Error Detected in the CNC Function Module

The error (event) detected in the CNC Function Module can be checked using the following system-defined variables. Refer to the explanation of each variable for details.

Name	Variable	Function
CNC Function Module Error Status	_CNC_ErrSta	Shows the status of errors that are detected in the CNC Function Module.
CNC Common Error Status	_CNC_ComErrSta	Shows the status of errors that are detected by common processing in the CNC Function Module.
CNC Coordinate System Error Status	_CNC_CoordErrSta	Shows the status of errors that are detected for each CNC coordinate system. Up to eight coordinate systems are displayed.
CNC Motor Error Status	_CNC_MotorErrSta	Shows the status of errors that are detected for each CNC motor. Up to 32 CNC motors are displayed.
CNC Common Partial Fault Occurrence	_CNC_COM.PFaultLvl.Active	TRUE while there is a CNC common partial fault.
CNC Common Partial Fault Code	_CNC_COM.PFaultLvl.Code	Contains the code for a CNC common partial fault. This is the same value as the upper four digits of the event code.
CNC Common Minor Fault Occurrence	_CNC_COM.MFaultLvl.Active	TRUE while there is a CNC common minor fault.
CNC Common Minor Fault Code	_CNC_COM.MFaultLvl.Code	Contains the code for a CNC common minor fault. This is the same value as the upper four digits of the event code.
CNC Common Observation Occurrence	_CNC_COM.Obsr.Active	TRUE while there is a CNC common observation.
CNC Common Observation Code	_CNC_COM.Obsr.Code	Contains the code for a CNC common observation. This is the same value as the upper four digits of the event code.
CNC Coordinate System Minor Fault Occurrence	_CNC_Coord[*].MFaultLvl.Active	TRUE while there is a CNC coordinate system minor fault.
CNC Coordinate System Minor Fault Code	_CNC_Coord[*].MFaultLvl.Code	Contains the code for a CNC coordinate system minor fault. This is the same value as the upper four digits of the event code.
CNC Coordinate System Observation Occurrence	_CNC_Coord[*].Obsr.Active	TRUE while there is a CNC coordinate system observation.
CNC Coordinate System Observation Code	_CNC_Coord[*].Obsr.Code	Contains the code for CNC coordinate system observation. This is the same value as the upper four digits of the event code.
CNC Motor Minor Fault Occurrence	_CNC_Motor[*].MFaultLvl.Active	TRUE while there is a CNC motor minor fault.
CNC Motor Minor Fault Code	_CNC_Motor[*].MFaultLvl.Code	Contains the code for a CNC motor minor fault. This is the same value as the upper four digits of the event code.

Name	Variable	Function
CNC Common Observation Occurrence	_CNC_Motor[*].Obsr.Active	TRUE while there is a CNC motor observation.
CNC Motor Observation Code	_CNC_Motor[*].Obsr.Code	Contains the code for a CNC motor observation. This is the same value as the upper four digits of the event code.

15-2-2 How to Reset Error

An error detected in the CNC Function Module can be reset using the following methods.

- Commands from Sysmac Studio
- Commands from an HMI
- Commands from CNC Operator
- Commands from the user program

Refer to the *NJ/NX-series Troubleshooting Manual* (Cat. No. W503) or *NY-series Troubleshooting Manual* (Cat. No. W564) for details on the commands from Sysmac Studio, HMI, and user program.

The error (event) detected in the CNC Function Module can be reset using the following instructions.
Refer to the explanation of each instruction for details.

Instruction name	Instruction	Function
CNC Error Reset	ResetCNCError	The ResetCNCError instruction resets Controller errors in the CNC Function Module.
CNC Coordinate System Error Reset	CNC_CoordReset	The CNC_CoordReset instruction clears the error detected in the specified CNC coordinate system.

Refer to the *CNC Operator Operation Manual* (Cat. No. O032) for details on how to check errors using the CNC Operator troubleshooter.

15-3 Error Lists

This section shows lists of errors (events) that may occur in the CNC Function Module.

Refer to the *NJ/NX-series Troubleshooting Manual* (Cat. No. W503) for all the NJ-series event codes.

Refer to the *NY-series Troubleshooting Manual* (Cat. No. W564) for all the NY-series event codes.

● Replacing the Event Explanation in Use of the NY-Series Controller

To describe the events displayed by Sysmac Studio, the events detected commonly in the NY-series Controller and NJ/NX-series Controller are explained as the events detected in the NJ/NX-series Controller. Therefore, it is necessary to interpret the displayed contents when your use an NY-series Controller. Note the following conditions.

- You cannot connect a CJ-series Unit with NY-series Controllers. In the instructions, skip items related to CJ-series Units.
- In explanation of the errors, replace the term CPU Unit with NY-series Controller or NY-series Industrial PC.
- NY-series Controllers have no SD Memory Card slots. Instead, they provide the Virtual SD Memory Card function that uses the Windows shared folder. Therefore, replace the term SD Memory Card with Virtual SD Memory Card. Refer to the NY-series Industrial Panel PC / Industrial Box PC Setup User's Manual (Cat. No. W568) for details on the Virtual SD Memory Card function.
- NY-series Controllers do not have the SD PWR LED and SD BUSY LED indicators. In the instructions, skip items related to the SD PWR LED and SD BUSY LED indicators.
- NY-series Controllers do not have the RUN LED, ERR LED, and LINK/ACT LED indicators for EtherCAT. Skip the items that describe EtherCAT’s RUN LED, ERR LED, and LINK/ACT LED.
- Replace the NJ/NX-series manuals with the NY-series manuals in the *Reference* column.

15-3-1 Interpreting Error Descriptions

The contents of the error tables are described below.

Item	Description
Event code	An error (event) detected in the NJ/NY-series CPU unit is given. The codes are given in eight hexadecimal digits.*1
Event name	The name of the event is given
Description	A short description of the error is given.
Assumed cause	The assumed cause of the error is given
Level	The level of influence on control is given. The abbreviations have the following meanings. Maj: Major fault level Prt: Partial fault level Min: Minor fault level Obs: Observation information Info: Information The symbols have the following meanings. ○: Level defined by the system ⊙: Level that can be changed by the user*2
Reference	Shows the number of the manual that describes the detail of the relevant error (event). The manual name that corresponds to the manual number is given before each error table.

*1. When the CPU unit with the event detected is limited, its version is indicated in parentheses ( ) of the event code column.

*2. This symbol appears only for events for which the user can change the event level.

15-3-2 Error Lists

CNC Function Errors

The list below shows the errors related to common part of the CNC Function Module, CNC motor, and CNC coordinate system.

Event code	Event name	Description	Assumed cause	Level: Maj	Prt	Min	Obs	Info	Reference
4781 0000 hex	CNC Parameter Setting Invalid	A fatal error was detected during setting of the CNC Function Module.	• The system failed to transfer the CNC parameter setting. Otherwise, an error occurred in the software.	✓					P. 15-38
1780 0000 hex	CNC Parameter Setting Error	The CNC parameters that were saved in non-volatile memory are missing.	• The power supply to the Controller was interrupted or communications with the Sysmac Studio were disconnected while downloading the CNC parameter settings or clearing memory. • Non-volatile memory failure		✓				P. 15-39
1781 0000 hex	Absolute Encoder Home Offset Read Error	The absolute encoder current position that is retained during power interruptions was lost.	• When the retained variables are backed up with a battery, this event indicates that the life of the battery in the CPU Unit has expired. • Backup memory failure		✓				P. 15-40
1782 0000 hex	CNC Motor Compensation Table Read Error	The CNC motor compensation table that was saved in non-volatile memory is missing.	• The power supply to the Controller was interrupted or communications with the Sysmac Studio were disconnected while downloading the CNC parameter settings or clearing memory. • Non-volatile memory failure		✓				P. 15-41
3780 0000 hex	Required Process Data Object Not Set	The object that is required for the assigned axis type in the CNC motor parameter settings is not allocated to PDO.	• The required PDOs are not mapped when the assigned axis type in the CNC motor parameter settings is set to a positioning axis or spindle axis. • Non-volatile memory failure		✓				P. 15-42

Event code	Event name	Description	Assumed cause	Level					Refer-ence
				Maj	Prt	Min	Obs	Info	
4780 0000 hex	CNC Initialization Error	A fatal error occurred in the system and prevented initialization of the CNC Function Module.	• Hardware failure		✓				P. 15-42
7780 0000 hex	CNC Control Period Exceeded	The primary periodic task processing has not been completed within two control cycles.	• The processing load in the primary periodic task is too heavy.		✓				P. 15-43
3781 0000 hex	Process Data Object Setting Missing	The PDO mapping is not correct.	• The PDOs that are required for the CNC instruction are not mapped. • The relevant instruction was executed for a device that does not have an object that supports the instruction.			✓			P. 15-43
5600 0000 hex	Illegal CNC Coordinate System Specification	The CNC coordinate system specified for the *Coord* in-out variable to a CNC instruction does not exist.	• CNC coordinate system does not exist for the variable specified for the *Coord* in-out variable to the instruction.			✓			P. 15-44
5601 0000 hex	Deceleration Setting Out of Range	The parameter specified for the *Deceleration* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable.			✓			P. 15-44
5602 0000 hex	Jerk Setting Out of Range	The parameter specified for the *Jerk* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable.			✓			P. 15-45
5603 0000 hex	CNC Instruction Re-execution Disabled	A CNC instruction that cannot be re-executed was re-executed.	• A CNC instruction that cannot be re-executed was re-executed.			✓			P. 15-45
5604 0000 hex	CNC Multi-execution Disabled	Multiple functions that cannot be executed simultaneously were executed for the same target (CNC coordinate system).	• Multiple functions that cannot be executed simultaneously were executed for the same target (CNC coordinate system). • The CNC_LoadProgramFile instruction was executed when any of CNC coordinate system was *Executing* (Executing) or *Hold* (Holding).			✓			P. 15-46

Event code	Event name	Description	Assumed cause	Level					Refer-ence
				Maj	Prt	Min	Obs	Info	
5605 0000 hex	Unassigned Logical CNC Motor Number Specified	The CNC motor of the parameter specified for the *LogicalMotorNo* input variable to the CNC instruction is not assigned.	• The logical CNC motor number for which the CNC motor is not assigned to the *LogicalMotorNo* input variable to the CNC instruction was specified, and the instruction was executed.			✓			P. 15-46
5606 0000 hex	Logical CNC Motor Number Out of Range	The parameter specified for the *LogicalMotorNo* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable.			✓			P. 15-47
5607 0000 hex	Target Position Setting Out of Range	The parameter specified for the *Position* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable. Or, there was an overflow/underflow in the target position.			✓			P. 15-47
5608 0000 hex	Impossible CNC Motor Operation Specified when the Servo is OFF	An operation instruction was executed for the CNC motor for which the Servo is OFF.	• Home was preset with the CNC_Home or CNC_HomeWithParameter instruction for an axis for which EtherCAT process data communications are not established.			✓			P. 15-48
5609 0000 hex	Target Velocity Setting Out of Range	The parameter specified for the *Velocity* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable.			✓			P. 15-49
560A 0000 hex	Acceleration/Deceleration Setting Out of Range	The parameter specified for the *Acceleration* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable.			✓			P. 15-49
560B 0000 hex	Travel Mode Selection Out of Range	The parameter specified for the *MoveMode* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable.			✓			P. 15-50
560C 0000 hex	Immediate Stop Instruction Executed	An Immediate Stop (CNC_CoordImmediateStop) instruction was executed.	• An Immediate Stop instruction was executed.			✓			P. 15-50

Event code	Event name	Description	Assumed cause	Level					Refer-ence
				Maj	Prt	Min	Obs	Info	
560D0000 hex	Parameter Selection Out of Range	The parameter specified for the *ParameterNumber* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable.			✓			P. 15-51
560E0000 hex	CNC Parameter Setting Read/Write Setting Value Out of Range	The parameter specified for the *SettingValue* in-out variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the in-out variable.			✓			P. 15-51
560F0000 hex	CNC Parameter Setting Read/Write Target Out of Range	The parameter specified for the *Target* in-out variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the in-out variable.			✓			P. 15-52
56100000 hex	Cycle Start Error with Undefined Home	A cycle start was executed for a CNC coordinate system including the positioning axis with no defined home.	• A cycle start was executed for a CNC coordinate system including the positioning axis with no defined home.			✓			P. 15-52
56110000 hex	Homing Parameter Setting Out of Range	The parameter specified for the *HomingParameter* in-out variable of the CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the in-out variable.			✓			P. 15-53
56120000 hex	M Code Number Out of Range	The parameter specified for the *MCodeNo* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable.			✓			P. 15-53
56130000 hex	CNC Instruction Re-execution Disabled (CNC Coordinate System Specification)	An attempt was made to change the parameter for the *Coord* in-out variable when re-executing a CNC instruction. (This in-out variable cannot be changed when re-executing an instruction.)	• A parameter for an in-out variable that cannot be changed for re-execution was changed.			✓			P. 15-54

Event code	Event name	Description	Assumed cause	Level					Refer-ence
				Maj	Prt	Min	Obs	Info	
5614 0000 hex	CNC Instruction Re-execution Disabled (Logical CNC Motor Number)	An attempt was made to change the parameter for the *LogicalMotorNo* input variable when re-executing a CNC instruction. (This input variable cannot be changed when re-executing an instruction.)	• A parameter for an input variable that cannot be changed for re-execution was changed.			✓			P. 15-54
5615 0000 hex	Illegal NC Program	An error was detected in the NC program transferred from Sysmac Studio.	• NC program transfer processing failed.			✓			P. 15-55
5616 0000 hex	Cycle Start Multi-execution Disabled	A cycle start was executed multiple times for the same target (CNC coordinate system).	• A cycle start was executed while the CNC coordinate system is *Executing* (Executing), *MovingOnHold* (Manual Operation While Holding), or *Moving* (Moving).			✓			P. 15-55
5617 0000 hex	Impossible CNC Motor Cycle Start Specified when the Servo is OFF	A cycle start was executed for a CNC coordinate system including the CNC motor for which the Servo is OFF.	• A cycle start was executed for the CNC motor for which Servo is turned OFF.			✓			P. 15-56
5618 0000 hex	Illegal NC Program Number Specification	The NC program specified for *ProgramNo* in the *ControlInputs* in-out variable to the CNC_CoordControl instruction is not loaded.	• A cycle start was executed after an unloaded NC program is specified for *ProgramNo* in the *ControlInputs* in-out variable to the CNC_CoordControl instruction.			✓			P. 15-56
5619 0000 hex	Illegal Back Trace Specification	A cycle start was executed when the CNC coordinate system is *Standby* (Standby) while *BackTrace* in the *ControlInputs* in-out variable to the CNC_CoordControl instruction is set to TRUE.	• A cycle start was executed when the CNC coordinate system is *Standby* (Standby) while *BackTrace* in the *ControlInputs* in-out variable to the CNC_CoordControl instruction is set to TRUE.			✓			P. 15-57

Event code	Event name	Description	Assumed cause	Level: Maj	Prt	Min	Obs	Info	Reference
5625 0000 hex	Illegal CNC Motor Specification	The CNC motor specified for the *Target* in-out variable to a CNC instruction does not exist.	• A CNC motor does not exist for the variable specified for the *Target* input variable to the instruction.			✓			P. 15-57
5626 0000 hex	Illegal CNC Motor Compensation Table Specification	The CNC motor compensation table specified for the *Target* input variable to a CNC instruction does not exist.	• A CNC motor compensation table does not exist for the variable specified for the *Target* input variable to the instruction.			✓			P. 15-58
5629 0000 hex	NC Program Capacity Exceeded	Loading failed because the NC program downloaded from Sysmac Studio exceeded the maximum capacity.	• The NC program that has a capacity above the maximum was downloaded from Sysmac Studio.			✓			P. 15-58
562A 0000 hex	Skew Control Mode Out of Range	The parameter specified for the *SkewMode* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable.			✓			P. 15-59
562B 0000 hex	Offset Value Setting Out of Range	The parameter specified for the *OffsetValue* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable.			✓			P. 15-59
6780 0000 hex	Immediate Stop Input	The immediate stop input turned ON.	• An immediate stop input signal was detected. • The immediate stop input signal is not connected correctly or the logic setting for the immediate stop input is wrong.			✓			P. 15-60
6781 0000 hex	Positive Limit Input Detected	The positive limit input turned ON.	• A positive limit input signal was detected. • The positive limit input signal is not connected correctly or the logic setting for the positive limit input is wrong.			✓			P. 15-61
6782 0000 hex	Negative Limit Input Detected	The negative limit input turned ON.	• A negative limit input signal was detected. • The negative limit input signal is not connected correctly or the logic setting for the negative limit input is wrong.			✓			P. 15-62

Event code	Event name	Description	Assumed cause	Level: Maj	Prt	Min	Obs	Info	Reference
6783 0000 hex	Target Position Positive Software Limit Exceeded	The specified position exceeds the positive software limit.	• The parameter specified for the *Position* input variable to the instruction is beyond the positive software limit. • The first position is beyond the positive software limit and an instruction that specifies motion in the opposite direction of the software limit was executed.			✓			P. 15-63
6784 0000 hex	Target Position Negative Software Limit Exceeded	The specified position exceeds the negative software limit.	• The parameter specified for the *Position* input variable to the instruction is beyond the negative software limit. • While the starting position is out of the negative software limit, an operation was specified in the opposite direction of the software limit.			✓			P. 15-63
6785 0000 hex	Command Position Overflow/Underflow	Positioning, an instruction in the underflow/overflow direction, or an instruction for which the direction is not specified was executed when there was an underflow/overflow in the command position.	• One of the following was executed when there was a command position overflow/underflow. •A positioning instruction •A continuous control instruction in the underflow/overflow direction •An instruction for which the direction is not specified (syncing)			✓			P. 15-64
6786 0000 hex	Positive Limit Input	An instruction was executed for a motion in the positive direction when the positive limit input was ON.	• An instruction for a motion in the positive direction was executed when the positive limit input was ON, or an instruction for a motion with no direction specification was executed when the positive limit input was ON.			✓			P. 15-65
6787 0000 hex	Negative Limit Input	While the negative limit input is set to ON, an instruction that runs in the negative direction was executed.	• While the negative limit input is set to ON, an instruction that runs in the negative direction was executed, or an instruction with no direction specified was executed.			✓			P. 15-66

Event code	Event name	Description	Assumed cause	Level: Maj	Prt	Min	Obs	Info	Reference
67880000 hex	Positive Software Limit Exceeded	The position exceeded the positive software limit while the CNC motor was running.	• The position exceeded the positive software limit.			✓			P. 15-66
67890000 hex	Negative Software Limit Exceeded	The position exceeded the negative software limit while the CNC motor was running.	• The position exceeded the negative software limit.			✓			P. 15-67
678A0000 hex	In-position Check Time Exceeded	The in-position check was not completed within the monitoring time.	• Time is required to complete positioning.			✓			P. 15-67
678B0000 hex	Following Error Limit Exceeded	The error between the command current position and actual current value exceeded the Following Error Over Value.	• The positioning operation has poor following performance and the actual motion is slower than the command.			✓			P. 15-68
67910000 hex	Illegal Following Error	The difference between the command position and the actual current position exceeds the range of 30-bit data when converted to pulses.	• The command current position was restricted so that the velocity of the CNC motor would not exceed the maximum velocity for the specified travel distance. • The CNC motor's positioning operation has poor following performance and the actual motion is slower than the command.			✓			P. 15-68
67920000 hex	Absolute Encoder Current Position Calculation Failed	It was not possible to correctly restore the current position from the absolute encoder information that was saved when power was interrupted.	• The position to restore when converted to pulses exceeded the range of signed 40-bit data.			✓			P. 15-69

Event code	Event name	Description	Assumed cause	Level					Refer- ence
				Maj	Prt	Min	Obs	Info	
6793 0000 hex	Home Undefined during Coordi- nated Motion	Home of the CNC motor became undefined while the status of CNC coordinate system is *Executing* (Exe- cuting), *Hold* (Hold- ing), *MovingOnHold* (Manual Operation While Holding).	• The command position or actual position over- flowed or underflowed for a CNC motor while the status of CNC coor- dinate system is *Execut- ing* (Executing), *Hold* (Holding), or *MovingOn- Hold* (Manual Opera- tion While Holding), and the home definition was lost. • A slave communications error occurred in the CNC motor and the home become unde- fined while the status of CNC coordinate system is *Executing* (Execut- ing), *Hold* (Holding), or *MovingOnHold* (Manual Operation While Hold- ing). • A slave for a logical axis left the network or was disabled and home became undefined while the status of CNC coor- dinate system is *Execut- ing* (Executing), *Hold* (Holding), or *MovingOn- Hold* (Manual Opera- tion While Holding).			✓			P. 15-70
6794 0000 hex	Cycle Start Specified during Posi- tive Soft- ware Limit Exceeded	The first position exceeds the posi- tive software limit.	• The command current position of the position- ing cartesian axis or positioning rotational axis in the CNC coordi- nate system is out of range of the positive software limit.			✓			P. 15-71
6795 0000 hex	Cycle Start Specified during Neg- ative Soft- ware Limit Exceeded	The first position exceeds the nega- tive software limit.	• The command current position of the position- ing cartesian axis or positioning rotational axis in the CNC coordi- nate system is out of range of the negative software limit.			✓			P. 15-71
6796 0000 hex	Cycle Start Specified during Command Position Overflow (Underflow)	The cycle start was executed when there was a com- mand position overflow/underflow.	•The cycle start was executed when there was a command posi- tion overflow/underflow.			✓			P. 15-72

Event code	Event name	Description	Assumed cause	Level					Reference
				Maj	Prt	Min	Obs	Info	
6797 0000 hex	Cycle Start Specified during Positive Limit Input	A cycle start was executed when the positive limit input was ON.	• A cycle start was executed when the positive limit input was ON.			✓			P. 15-73
6798 0000 hex	Cycle Start Specified during Negative Limit Input	A cycle start was executed when the negative limit input was ON.	• A cycle start was executed when the negative limit input was ON.			✓			P. 15-73
6799 0000 hex	NC Program Execution Error	An error was detected while the NC program was running.	An error was detected in the running NC program. • Refer to the Error Codes in Attached information for the error contents.			✓			P. 15-74
679B 0000 hex	Position Deviation between Axes Limit Exceeded	The deviation of the feedback current position between the gantry master axis and the gantry slave axis exceeded the Position Deviation Between Axes Over Value.	• The gantry slave axis is moving slower than the gantry master axis due to poor following performance of the slave axis.			✓			P. 15-75
7782 0000 hex	CNC Coordinate System Composition CNC Motor Error	An error occurred for a composition CNC motor in a CNC coordinate system.	• An error occurred for a composition CNC motor in a CNC coordinate system while it was moving.			✓			P. 15-76
7783 0000 hex	CNC Common Error Occurrence	A CNC common error occurred.	• Partial fault level CNC common error occurred.			✓			P. 15-76
7784 0000 hex	Servo Main Circuits OFF	An attempt was made to turn ON the Servo when the main circuit power supply to the Servo Drive was OFF.	• An attempt was made to turn ON the Servo when the main circuit power supply to the Servo Drive was OFF.			✓			P. 15-77
7785 0000 hex	Servo Main Circuit Power OFF	The main circuit power of the Servo Drive turned OFF while the Servo was ON.	• The main circuit power of the Servo Drive was interrupted while the Servo was ON.			✓			P. 15-77
7786 0000 hex	Slave Error Detected	An error was detected for the EtherCAT slave or NX Unit that is allocated to the CNC motor.	• An error was detected for the EtherCAT slave or NX Unit that is allocated to the CNC motor.			✓			P. 15-78

Event code	Event name	Description	Assumed cause	Level					Refer-ence
				Maj	Prt	Min	Obs	Info	
7788 0000 hex	Slave Disconnection during Servo ON	An EtherCAT slave or NX Unit that is allocated to the CNC motor was disconnected, replaced, or disabled while the Servo was ON.	• An EtherCAT slave or NX Unit that is allocated to the CNC motor was disconnected, replaced, or disabled while the Servo was ON.			✓			P. 15-78
7789 0000 hex	Homing Opposite Direction Limit Input Detected	The limit signal in the direction opposite to the homing direction was detected during a homing operation.	• The Operation Selection at Negative Limit Input or Operation Selection at Positive Limit Input parameter is set to No reverse turn. • The location of the homing input signal sensors, homing settings, and homing start position cause a limit input to be reached. • The input signal sensor wiring is incorrect or the sensor is faulty.			✓			P. 15-79
778A 0000 hex	Homing Direction Limit Input Detected	The limit signal in the homing direction was detected during a homing operation.	• The Operation Selection at Negative Limit Input or Operation Selection at Positive Limit Input parameter is set to No reverse turn. • The location of the homing input signal sensors, homing settings, and homing start position cause a limit input to be reached. • The input signal sensor wiring is incorrect or the sensor is faulty.			✓			P. 15-80
778B 0000 hex	Homing Limit Inputs Detected in Both Directions	The limit signals in both directions were detected during a homing operation.	• The wiring of the limit signal is incorrect. • The limit sensor is installed in the wrong location. • The contact logic of the limit signal is not correct. • The limit sensor failed.			✓			P. 15-80

Event code	Event name	Description	Assumed cause	Level					Refer- ence
				Maj	Prt	Min	Obs	Info	
778C0000 hex	Home Proximity/Homing Opposite Direction Limit Input Detected	The home proximity input and the limit signal in the direction opposite to the homing direction were detected at the same time during a homing operation.	• The wiring of the home proximity signal or limit signal is incorrect. • The home proximity sensor or limit sensor is installed in the wrong location. • The contact logic of the home proximity signal or limit signal is not correct. • The home proximity sensor or limit sensor failed.			✓			P. 15-81
778D0000 hex	Home Proximity/Homing Direction Limit Input Detected	The home proximity input and the limit signal in the homing direction were detected at the same time during a homing operation.	• The wiring of the home proximity signal or limit signal is incorrect. • The home proximity sensor or limit sensor is installed in the wrong location. • The contact logic of the home proximity signal or limit signal is not correct. • The home proximity sensor or limit sensor failed.			✓			P. 15-82
778E0000 hex	Home Input/Homing Opposite Direction Limit Input Detected	The home input and the limit signal in the direction opposite to the homing direction were detected at the same time during a homing operation.	• The wiring of the home input signal or limit signal is incorrect. • The home input sensor or limit sensor is installed in the wrong location. • The contact logic of the home input signal or limit signal is not correct. • The home input signal output device or limit sensor failed.			✓			P. 15-83

Event code	Event name	Description	Assumed cause	Level					Reference
				Maj	Prt	Min	Obs	Info	
778F0000 hex	Home Input/Homing Direction Limit Input Detected	The home input and the limit signal in the homing direction were detected at the same time during a homing operation.	• The wiring of the home input signal or limit signal is incorrect. • The home input sensor or limit sensor is installed in the wrong location. • The contact logic of the home input signal or limit signal is not correct. • The home input signal output device or limit sensor failed.			✓			P. 15-84
77900000 hex	Invalid Home Input Mask Distance	The setting of the home input mask distance is not suitable for the CNC_Home or CNC_HomeWithParameter instruction.	• The set value of the home input mask distance when the operating mode of the MC_Home instruction is set to Proximity Reverse Turn/Home Input Mask Distance is insufficient to decelerate from the homing velocity to the homing approach velocity.			✓			P. 15-85
77910000 hex	No Home Input	There was no home signal input during the homing operation. Or, a limit signal was detected before there was a home input.	• There was no home signal input during the homing operation. • A limit signal was detected before there was a home input.			✓			P. 15-85
77920000 hex	No Home Proximity Input	There was no home proximity signal input during the homing operation.	• There was no home proximity signal input during the homing operation when a home proximity input signal was specified.			✓			P. 15-86
87800000 hex	EtherCAT Slave Communications Error	A communications error occurred for the EtherCAT slave or NX Unit that is allocated to a CNC motor.	• A communications error occurred for the EtherCAT slave or NX Unit that is allocated to the CNC motor.			✓			P. 15-86
561D0000 hex	SD Memory Card Access Failure	SD Memory Card access failed when an instruction was executed.	• An SD Memory Card is not inserted. • The SD Memory Card is damaged. • The SD Memory Card slot is broken.				✓		P. 15-87
561E0000 hex	File Does Not Exist	The file specified for an instruction does not exist.	• The specified file does not exist.				✓		P. 15-87

Event code	Event name	Description	Assumed cause	Level					Reference
				Maj	Prt	Min	Obs	Info	
561F 0000 hex	Illegal Load NC Program Number Specification	Loading has failed because an attempt was made to load the NC program with an invalid program number specified.	• An attempt was made to load the NC program with an invalid program number specified.				✓		P. 15-88
5620 0000 hex	Too Many Files Open	The maximum number of open files was exceeded when opening a file for an instruction.	• The maximum number of open files was exceeded when opening a file for an instruction.				✓		P. 15-88
5621 0000 hex	File or Directory Name Is Too Long	The file name or directory name that was specified for an instruction is too long.	• The file name or directory name that was specified for the instruction to create is too long.				✓		P. 15-89
5622 0000 hex	SD Memory Card Access Failed	SD Memory Card access failed.	• The SD Memory Card is damaged. • The SD Memory Card slot is broken.				✓		P. 15-89
5623 0000 hex	Load NC Program Capacity Exceeded	Loading has failed because an attempt was made to load the NC program that has a capacity above the maximum.	• An attempt was made to load the NC program that has a capacity above the maximum.				✓		P. 15-90
5624 0000 hex	Number of NC Program Exceeded	Loading failed because an attempt was made to load NC programs over the maximum number of NC programs.	• A new NC program was loaded while the number of loaded NC programs reaches the maximum.				✓		P. 15-90
5628 0000 hex	Illegal Load NC Program	An error was detected in the loaded NC program.	• A syntax error was detected in the NC program you attempted to load.				✓		P. 15-91
678C 0000 hex	Following Error Warning	The following error exceeded the Following Error Warning Value.	• The positioning operation has poor following performance and the actual motion is slower than the command.				✓		P. 15-92
678D 0000 hex	Command Position Overflow	The number of pulses for the command position overflowed.	• When the command position was converted to the pulse unit for the positioning cartesian axis or positioning rotational axis, the specified value exceeded the upper limit of the signed 40-bit data (signed 54-bit data for the spindle axis).				✓		P. 15-92

Event code	Event name	Description	Assumed cause	Level					Refer-ence
				Maj	Prt	Min	Obs	Info	
678E 0000 hex	Command Position Underflow	The number of pulses for the command position exceeded the valid range. (It underflowed.)	• When the command position was converted to the pulse unit for the positioning cartesian axis or positioning rotational axis, the specified value exceeded the lower limit of the signed 40-bit data (signed 54-bit data for the spindle axis).				✓		P. 15-93
678F 0000 hex	Actual Position Overflow	The number of pulses for the actual position overflowed.	• When the command position was converted to the pulse unit for the positioning cartesian axis or positioning rotational axis, the specified value exceeded the upper limit of the signed 40-bit data (signed 54-bit data for the spindle axis).				✓		P. 15-93
6790 0000 hex	Actual Position Underflow	The number of pulses for the actual position underflowed.	• When the command position was converted to the pulse unit for the positioning cartesian axis or positioning rotational axis, the specified value exceeded the lower limit of the signed 40-bit data (signed 54-bit data for the spindle axis).				✓		P. 15-94
679A 0000 hex	Position Deviation between Axes Limit Warning	The deviation of the feedback current position between the gantry master axis and the gantry slave axis exceeded the Position Deviation Between Axes Warning Value.	• The gantry slave axis is moving slower than the gantry master axis due to poor following performance of the slave axis.				✓		P. 15-94
7781 0000 hex	CNC Planner Service Period Exceeded	CNC planner service processing was not finished within two periods.	• The processing load of the NC program in a period of the CNC planner service is too heavy.				✓		P. 15-95
7787 0000 hex	Slave Observation Detected	A warning was detected for an EtherCAT slave or NX Unit.	• A warning was detected for the EtherCAT slave or NX Unit that is allocated to a CNC motor.				✓		P. 15-95

Event code	Event name	Description	Assumed cause	Level					Refer-ence
				Maj	Prt	Min	Obs	Info	
9781 0000 hex	Software Limit Path Limited	The path exceeded the software limit was specified during *Executing* (Executing). Therefore, the path was limited within the software limit range.	• The path exceeded the software limit was specified during *Executing* (Executing).				✓		P. 15-96
9783 0000 hex	Velocity Control Command Value Saturated	The velocity control command value for the servo drive is saturated.	• The output value by feedback loop calculation exceeded Maximum Velocity defined in the CNC motor parameter, or the actual operation is slower than the commanded one because of the poor following performance of the positioning operation. • The spindle rotation velocity (S) or spindle velocity override value was commanded over the Maximum Velocity defined in the CNC motor parameter.				✓		P. 15-96
9780 0000 hex	Slave Error Code Report	The error code was reported by the slave when a Slave Error Detected error occurred.	• The error code was reported by the slave when a Slave Error Detected error (7786 0000 hex) occurred.					✓	P. 15-97
9782 0000 hex	CNC Function System Information	This event provides internal information from the CNC Function Module.	• This event provides internal information from the CNC Function Module. It is recorded to provide additional information for another event.					✓	P. 15-97

CNC Instruction Errors

This section shows lists of errors (events) that may occur in CNC instructions. The lower four digits of the event code represents the error code for the instruction. For descriptions of an error code, refer to the description of the corresponding event code. For example, when the error code of the target instruction is 16#3781, refer to the explanation of event code, 5401 3781 hex.

Event code	Event name	Description	Assumed cause	Level					Reference
				Maj	Prt	Min	Obs	Info	
5401 3781 hex	Process Data Object Setting Missing	The PDO mapping is not correct.	• The PDOs that are required for the CNC instruction are not mapped. • The relevant instruction was executed for a device that does not have an object that supports the instruction.				✓		P. 15-98
5401 5600 hex	Illegal CNC Coordinate System Specification	The CNC coordinate system specified for the *Coord* in-out variable to a CNC instruction does not exist.	• CNC coordinate system does not exist for the variable specified for the *Coord* in-out variable to the instruction.				✓		P. 15-99
5401 5601 hex	Deceleration Setting Out of Range	The parameter specified for the *Deceleration* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable.				✓		P. 15-99
5401 5602 hex	Jerk Setting Out of Range	The parameter specified for the *Jerk* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable.				✓		P. 15-100
5401 5603 hex	CNC Instruction Re-execution Disabled	A CNC instruction that cannot be re-executed was re-executed.	• A CNC instruction that cannot be re-executed was re-executed.				✓		P. 15-101
5401 5604 hex	CNC Multi-execution Disabled	Multiple functions that cannot be executed simultaneously were executed for the same target (CNC coordinate system).	• Multiple functions that cannot be executed simultaneously were executed for the same target (CNC coordinate system). • The CNC_LoadProgramFile instruction was executed when any of CNC coordinate system was *Executing* (Executing) or *Hold* (Holding).				✓		P. 15-102

Event code	Event name	Description	Assumed cause	Level					Reference
				Maj	Prt	Min	Obs	Info	
54015605 hex	Unassigned Logical CNC Motor Number Specified	The CNC motor of the parameter specified for the *LogicalMotorNo* input variable to the CNC instruction is not assigned.	• The logical CNC motor number for which the CNC motor is not assigned to the *LogicalMotorNo* input variable to the CNC instruction was specified, and the instruction was executed.				✓		P. 15-103
54015606 hex	Logical CNC Motor Number Out of Range	The parameter specified for the *LogicalMotorNo* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable.				✓		P. 15-104
54015607 hex	Target Position Setting Out of Range	The parameter specified for the *Position* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable. Or, there was an overflow/underflow in the target position.				✓		P. 15-104
54015608 hex	Impossible CNC Motor Operation Specified when the Servo is OFF	An operation instruction was executed for the CNC motor for which the Servo is OFF.	• An operation instruction was executed for the CNC motor for which the Servo is OFF. • Home was preset with the CNC_Home or CNC_HomeWithParameter instruction for an axis for which EtherCAT process data communications are not established.				✓		P. 15-105
54015609 hex	Target Velocity Setting Out of Range	The parameter specified for the *Velocity* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable.				✓		P. 15-106
5401560A hex	Acceleration/Deceleration Setting Out of Range	The parameter specified for the *Acceleration* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable.				✓		P. 15-106
5401560B hex	Travel Mode Selection Out of Range	The parameter specified for the *MoveMode* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable.				✓		P. 15-107

Event code	Event name	Description	Assumed cause	Level					Refer-ence
				Maj	Prt	Min	Obs	Info	
5401 560D hex	Parameter Selection Out of Range	The parameter specified for the *ParameterNumber* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable.				✓		P. 15-107
5401 560E hex	CNC Parameter Setting Read/Write Setting Value Out of Range	The parameter specified for the *SettingValue* in-out variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the in-out variable.				✓		P. 15-108
5401 560F hex	CNC Parameter Setting Read/Write Target Out of Range	The parameter specified for the *Target* in-out variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the in-out variable.				✓		P. 15-108
5401 5611 hex	Homing Parameter Setting Out of Range	The parameter specified for the *HomingParameter* in-out variable of the CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the in-out variable.				✓		P. 15-109
5401 5612 hex	M Code Number Out of Range	The parameter specified for the *MCodeNo* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable.				✓		P. 15-109
5401 5613 hex	CNC Instruction Re-execution Disabled (CNC Coordinate System Specification)	An attempt was made to change the parameter for the *Coord* in-out variable when re-executing a CNC instruction. (This in-out variable cannot be changed when re-executing an instruction.)	• A parameter for an in-out variable that cannot be changed for re-execution was changed.				✓		P. 15-110
5401 5614 hex	CNC Instruction Re-execution Disabled (Logical CNC Motor Number)	An attempt was made to change the parameter for the *LogicalMotorNo* input variable when re-executing a CNC instruction. (This input variable cannot be changed when re-executing an instruction.)	• A parameter for an input variable that cannot be changed for re-execution was changed.				✓		P. 15-111

Event code	Event name	Description	Assumed cause	Level					Refer- ence
				Maj	Prt	Min	Obs	Info	
5401561D hex	SD Memory Card Access Failure	SD Memory Card access failed when an instruction was executed.	• An SD Memory Card is not inserted. • The SD Memory Card is damaged. • The SD Memory Card slot is broken.				✓		P. 15-112
5401561E hex	File Does Not Exist	The file specified for an instruction does not exist.	• The specified file does not exist.				✓		P. 15-113
5401561F hex	Illegal Load NC Program Number Specification	Loading has failed because an attempt was made to load the NC program with an invalid program number specified.	• An attempt was made to load the NC program with an invalid program number specified.				✓		P. 15-113
54015620 hex	Too Many Files Open	The maximum number of open files was exceeded when opening a file for an instruction.	• The maximum number of open files was exceeded when opening a file for an instruction.				✓		P. 15-114
54015621 hex	File or Directory Name Is Too Long	The file name or directory name that was specified for an instruction is too long.	• The file name or directory name that was specified for the instruction to create is too long.				✓		P. 15-114
54015622 hex	SD Memory Card Access Failed	SD Memory Card access failed.	• The SD Memory Card is damaged. • The SD Memory Card slot is broken.				✓		P. 15-115
54015623 hex	Load NC Program Capacity Exceeded	Loading has failed because an attempt was made to load the NC program that has a capacity above the maximum.	• An attempt was made to load the NC program that has a capacity above the maximum.				✓		P. 15-116
54015624 hex	Number of NC Program Exceeded	Loading failed because an attempt was made to load NC programs over the maximum number of NC programs.	• A new NC program was loaded while the number of loaded NC programs reaches the maximum.				✓		P. 15-117
54015625 hex	Illegal CNC Motor Specification	The CNC motor specified for the *Target* in-out variable to a CNC instruction does not exist.	• A CNC motor does not exist for the variable specified for the *Target* input variable to the instruction.				✓		P. 15-117

Event code	Event name	Description	Assumed cause	Level					Refer-ence
				Maj	Prt	Min	Obs	Info	
5401 5626 hex	Illegal CNC Motor Compensation Table Specification	The CNC motor compensation table specified for the *Target* input variable to a CNC instruction does not exist.	• A CNC motor compensation table does not exist for the variable specified for the *Target* input variable to the instruction.				✓		P. 15-118
5401 5628 hex	Illegal Load NC Program	An error was detected in the loaded NC program.	• A syntax error was detected in the NC program you attempted to load.				✓		P. 15-119
5401 562A hex	Skew Control Mode Out of Range	The parameter specified for the *SkewMode* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable.				✓		P. 15-120
5401 562B hex	Offset Value Setting Out of Range	The parameter specified for the *OffsetValue* input variable to a CNC instruction is out of range.	• Instruction input parameter exceeded the valid range of the input variable.				✓		P. 15-120
5401 6783 hex	Target Position Positive Software Limit Exceeded	The specified position exceeds the positive software limit.	• The parameter specified for the *Position* input variable to the instruction is beyond the positive software limit. • The first position is beyond the positive software limit and an instruction that specifies motion in the opposite direction of the software limit was executed.				✓		P. 15-121
5401 6784 hex	Target Position Negative Software Limit Exceeded	The specified position exceeds the negative software limit.	• The parameter specified for the *Position* input variable to the instruction is beyond the negative software limit. • While the starting position is out of the negative software limit, an operation was specified in the opposite direction of the software limit.				✓		P. 15-122

Event code	Event name	Description	Assumed cause	Level					Refer- ence
				Maj	Prt	Min	Obs	Info	
54016785 hex	Command Position Over- flow/Under- flow	Positioning, an instruction in the underflow/over- flow direction, or an instruction for which the direction is not specified was executed when there was an underflow/over- flow in the com- mand position.	• One of the following was executed when there was a command position overflow/under- flow. •A positioning instruc- tion •A continuous control instruction in the under- flow/overflow direction •An instruction for which the direction is not spec- ified (syncing)				✓		P. 15-123
54016786 hex	Positive Limit Input	An instruction was executed for a motion in the posi- tive direction when the positive limit input was ON.	• An instruction for a motion in the positive direction was executed when the positive limit input was ON, or an instruction for a motion with no direction specification was exe- cuted when the positive limit input was ON.				✓		P. 15-124
54016787 hex	Negative Limit Input	While the negative limit input is set to ON, an instruction that runs in the negative direction was executed.	• While the negative limit input is set to ON, an instruction that runs in the negative direction was executed, or an instruc- tion with no direction specified was executed.				✓		P. 15-125
54017784 hex	Servo Main Circuits OFF	An attempt was made to turn ON the Servo when the main circuit power supply to the Servo Drive was OFF.	• An attempt was made to turn ON the Servo when the main circuit power supply to the Servo Drive was OFF.				✓		P. 15-126

15-4 Error Descriptions

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

15-4-1 How to Check Error Contents

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**	Level affected by control*1	**Recovery method**	Recovery method*2	**Log category**	Type of stored log*3
Effects	**User program**	User program execution status*4	**Operation**	Provides special information on the operation that results from the error.		
LED/Status	This status can be checked using the built-in EtherCAT port LED or Industrial PC Support Utility of the built-in EtherNet/IP port. Indicator status is given only for errors in the EtherCAT Master Function Module and the EtherNet/IP Function Module.					
System -defined variable	**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 HMI.*5					
Precautions/ Remarks	Provides precautions, restrictions, and supplemental information. If the user can set the event level, the event levels that can be set, the recovery method, operational information, and other information is also provided.					

*1. One of the following:
Major fault: Major fault level
Partial fault: Partial fault level
Minor fault: Minor fault level
Observation
Information

*2. After the correction is performed, one of the following methods is used to reset the Controller error state:
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.
Turn-on again: After the cause was remedied, turn the controller on again to return to the normal state.
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.

*5. Refer to the *NJ/NX-series Troubleshooting Manual* (Cat. No. W503) or *NY-series Troubleshooting Manual* (Cat. No. W564) for the applicable range of the HMI Troubleshooter.

15-4-2 Error Descriptions

CNC Function Errors

This section describes the meanings of the errors related to common parts of the CNC Function Module, CNC motor, and CNC coordinate system.

<table>
<tr><th>Event name</th><td colspan="3">CNC Parameter Setting Invalid</td><th>Event code</th><td colspan="2">47810000 hex</td></tr>
<tr><th>Meaning</th><td colspan="6">A fatal error was detected during setting of the CNC Function Module.</td></tr>
<tr><th>Source</th><td colspan="2">CNC Function Module</td><th>Source details</th><td>CNC common</td><th>Detection timing</th><td>At power ON, at Controller reset, or when downloading</td></tr>
<tr><th>Error attributes</th><th>Level</th><td>Major fault</td><th>Recovery</th><td>Cycle the power supply.</td><th>Log category</th><td>System</td></tr>
<tr><th>Effects</th><th>User program</th><td>Stops.</td><th>Operation</th><td colspan="3">It will not be possible to perform CNC motor control. The Controller will stop.</td></tr>
<tr><th rowspan="2">System-defined variables</th><th colspan="2">Variable</th><th colspan="2">Data type</th><th colspan="2">Name</th></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><th rowspan="2">Cause and correction</th><th colspan="2">Assumed cause</th><th colspan="2">Correction</th><th colspan="2">Prevention</th></tr>
<tr><td colspan="2">The system failed to transfer the CNC parameter setting. Otherwise, an error occurred in the software.</td><td colspan="2">Clear all of memory and then download the project from the Sysmac Studio.
If you cannot perform a Clear All Memory operation from the Sysmac Studio, transfer the project to the Controller with a restore operation from an SD Memory Card.
If this error recurs after you took the above correction, contact your OMRON representative.</td><td colspan="2">None</td></tr>
<tr><th>Attached information</th><td colspan="6">Attached information 1: System information</td></tr>
<tr><th>Precautions/ Remarks</th><td colspan="6">None</td></tr>
</table>

<table>
<tr><td>Event name</td><td colspan="4">CNC Parameter Setting Error</td><td>Event code</td><td colspan="2">17800000 hex</td></tr>
<tr><td>Meaning</td><td colspan="7">The CNC parameters that were saved in non-volatile memory are missing.</td></tr>
<tr><td>Source</td><td colspan="2">CNC Function Module</td><td>Source details</td><td>CNC common</td><td>Detection timing</td><td colspan="2">At power ON, at Controller reset, or when downloading</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Partial fault</td><td>Recovery</td><td>Cycle the power supply or reset the Controller.</td><td>Log category</td><td colspan="2">System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="4">It will not be possible to perform CNC motor control.</td></tr>
<tr><td rowspan="2">System-defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="3">Name</td></tr>
<tr><td colspan="2">_CNC_COM.PFaultLvl.Active</td><td colspan="2">BOOL</td><td colspan="3">CNC Common Partial Fault Occurrence</td></tr>
<tr><td rowspan="3">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="3">Prevention</td></tr>
<tr><td colspan="2">The power supply to the Controller was interrupted or communications with the Sysmac Studio were disconnected while downloading the CNC parameter settings or clearing memory.</td><td colspan="2">Download the CNC parameters from the Sysmac Studio.</td><td colspan="3">Do not turn OFF the power supply during save processing for the CNC parameters.</td></tr>
<tr><td colspan="2">Non-volatile memory failure</td><td colspan="2">If the error occurs even after the above correction is performed, non-volatile memory has failed. After you replace the CPU Unit, download all settings including the CNC Parameter Settings from the Sysmac Studio.</td><td colspan="3">None</td></tr>
<tr><td>Attached information</td><td colspan="7">None</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="7">None</td></tr>
</table>

Event name	Absolute Encoder Home Offset Read Error		**Event code**	17810000 hex	
Meaning	The absolute encoder current position that is retained during power interruptions was lost.				
Source	CNC Function Module	**Source details**	CNC common	**Detection timing**	At power ON, at Controller reset, or when downloading
Error attributes	**Level**	Partial fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	It will not be possible to perform CNC motor control.	
System-defined variables	**Variable**	**Data type**		**Name**	
	_CNC_COM.PFaultLvl.Active	BOOL		CNC Common Partial Fault Occurrence	
Cause and correction	**Assumed cause**	**Correction**		**Prevention**	
	When the retained variables are backed up with a battery, this event indicates that the life of the battery in the CPU Unit has expired.	Replace the Battery in the CPU Unit, reset the error, and perform homing to define home.		When the retained variables are backed up with a battery, periodically replace the battery in the CPU Unit. For the Battery life, refer to the *NJ-series CPU Unit Hardware User's Manual* (Cat. No. W500).	
	Backup memory failure	If the error occurs even after the above correction is performed, CPU Unit backup memory failed. Replace the CPU Unit and perform homing to define home.		None	
Attached information	None				
Precautions/ Remarks	None				

Event name	CNC Motor Compensation Table Read Error			**Event code**	17820000 hex	
Meaning	The CNC motor compensation table that was saved in non-volatile memory is missing.					
Source	CNC Function Module		**Source details**	CNC common	**Detection timing**	At power ON, at Controller reset, or when down-loading
Error attri-butes	**Level**	Partial fault	**Recovery**	Cycle the power supply or reset the Controller.	**Log category**	System
Effects	**User program**	Continues.	**Operation**	It will not be possible to perform CNC motor control.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_COM.PFaultLvl.Active		BOOL		CNC Common Partial Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	The power supply to the Controller was interrupted or communica-tions with the Sysmac Studio were disconnected while downloading the CNC parameter settings or clearing memory.		Download the CNC parameters from the Sysmac Studio.		Do not turn OFF the power supply during save processing for the CNC parameters.	
	Non-volatile memory failure		If the error occurs even after the above correction is performed, non-volatile memory has failed. After you replace the CPU Unit, download all settings including the CNC Parameter Settings from the Sysmac Studio.		None	
Attached information	None					
Precautions/ Remarks	None					

Event name	Required Process Data Object Not Set			Event code	3780 0000 hex	
Meaning	The object that is required for the assigned axis type in the CNC motor parameter settings is not allocated to PDO.					
Source	CNC Function Module		Source details	CNC common	Detection timing	At power ON, at Controller reset, or when downloading
Error attributes	Level	Partial fault	Recovery	Cycle the power supply or reset the Controller.	Log category	System
Effects	User program	Continues.	Operation	It will not be possible to perform CNC motor control.		
System-defined variables	Variable		Data type		Name	
	_CNC_COM.PFaultLvl.Active		BOOL		CNC Common Partial Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	The required PDOs are not mapped when the assigned axis type in the CNC motor parameter settings is set to a positioning axis or spindle axis.		Map the PDOs that are required for the relevant assigned axis type.		Map the PDOs that are required for the assigned axis type to be used.	
	Non-volatile memory failure		If the error occurs even after the above correction is performed, non-volatile memory has failed. After you replace the CPU Unit, download all settings including the CNC Parameter Settings from the Sysmac Studio.		None	
Attached information	None					
Precautions/ Remarks	None					

Event name	CNC Initialization Error			Event code	4780 0000 hex	
Meaning	A fatal error occurred in the system and prevented initialization of the CNC Function Module.					
Source	CNC Function Module		Source details	CNC common	Detection timing	At power ON, at Controller reset, or when downloading
Error attributes	Level	Partial fault	Recovery	Cycle the power supply.	Log category	System
Effects	User program	Continues.	Operation	It will not be possible to perform CNC motor control. It will not be possible to execute CNC motor control instructions.		
System-defined variables	Variable		Data type		Name	
	None		---		---	
Cause and correction	Assumed cause		Correction		Prevention	
	Hardware has failed.		Replace the CPU Unit.		None	
Attached information	None					
Precautions/ Remarks	None					

Event name	CNC Control Period Exceeded			Event code	77800000 hex	
Meaning	Processing for the primary periodic task was not finished within two control periods.					
Source	CNC Function Module		Source details	CNC common	Detection timing	Continuously
Error attributes	Level	Partial fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	Operation is not possible for all the CNC coordinate systems. CNC coordinate systems in motion stop immediately.		
System-defined variables	Variable		Data type		Name	
	_CNC_COM.PFaultLvl.Active		BOOL		CNC Common Partial Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	The processing load in the primary periodic task is too heavy.		Reduce the amount of processing in the primary periodic task or set the control period to a value that is long enough not to cause operation problems. Check the task period in the *Task Period Monitor* of the Sysmac Studio.		Write the programs for the primary periodic task so that they perform only the processes required in the specified period. Or, set the period of the primary periodic task to be long enough to complete all required processing.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Process Data Object Setting Missing			Event code	37810000 hex	
Meaning	The PDO mapping is not correct.					
Source	CNC Function Module		Source details	CNC coordinate system	Detection timing	At instruction execution
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	Operation is not possible for the relevant CNC coordinate systems.		
System-defined variables	Variable		Data type		Name	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	The PDOs that are required for the CNC instruction are not mapped.		Map the PDOs that are required for the instruction.		Map the PDOs that are required for the instructions that are used.	
	The relevant instruction was executed for a device that does not have an object that supports the instruction.		Some devices do not support the relevant instruction. Refer to the manual for the device, check to see if the relevant instruction is supported, and correct the program so that unsupported instructions are not executed.		Refer to the manual for the device and write the program so that unsupported instructions are not executed.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Illegal CNC Coordinate System Specification			**Event code**	5600 0000 hex	
Meaning	The CNC coordinate system specified for the *Coord* in-out variable to a CNC instruction does not exist.					
Source	CNC Function Module		**Source details**	CNC common	**Detection timing**	At instruction execution
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction is not executed.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_COM.MFaultLvl.Active		BOOL		CNC Common Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	CNC coordinate system does not exist for the variable specified for the *Coord* in-out variable to the instruction.		Correct the instruction so that the variable exists for the CNC coordinate system that was specified for the instruction.		Specify a variable that exists when specifying a variable for an input parameter to an instruction.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Deceleration Setting Out of Range			**Event code**	5601 0000 hex	
Meaning	The parameter specified for the *Deceleration* input variable to a CNC instruction is out of range.					
Source	CNC Function Module		**Source details**	CNC coordinate system	**Detection timing**	At instruction execution
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction is not executed. The relevant CNC coordinate system immediately stops while moving.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	Instruction input parameter exceeded the valid range of the input variable.		Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Jerk Setting Out of Range			**Event code**	56020000 hex	
Meaning	The parameter specified for the *Jerk* input variable to a CNC instruction is out of range.					
Source	CNC Function Module		**Source details**	CNC coordinate system	**Detection timing**	At instruction execution
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction is not executed. The relevant CNC coordinate system immediately stops while moving.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	Instruction input parameter exceeded the valid range of the input variable.		Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.	
Attached information	None					
Precautions/ Remarks	None					

Event name	CNC Instruction Re-execution Disabled			**Event code**	56030000 hex	
Meaning	A CNC instruction that cannot be re-executed was re-executed.					
Source	CNC Function Module		**Source details**	CNC common/CNC coordinate system	**Detection timing**	At instruction re-execution
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction is not executed. The relevant CNC coordinate system immediately stops while moving.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_COM.MFaultLvl.Active		BOOL		CNC Common Minor Fault Occurrence	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	A CNC instruction that cannot be re-executed was re-executed.		Correct the program so that the *Execute* input variable does not change to TRUE until the *Busy* output variable from the instruction changes to FALSE.		When using instructions that cannot be re-executed, include a condition for the *Execute* input variable so that it does not change to TRUE unless the *Busy* output variable for the previous instruction is FALSE. Or, stop the instruction before executing it again.	
Attached information	None					
Precautions/ Remarks	None					

Event name	CNC Multi-execution Disabled			Event code	5604 0000 hex	
Meaning	Multiple functions that cannot be executed simultaneously were executed for the same target (CNC coordinate system).					
Source	CNC Function Module		Source details	CNC common/ CNC coordinate system	Detection timing	At instruction execution
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The relevant instruction is not executed. The relevant CNC coordinate system immediately stops while moving.		
System -defined variables	Variable		Data type		Name	
	_CNC_COM.MFaultLvl.Active		BOOL		CNC Common Minor Fault Occurrence	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	• Multiple functions that cannot be executed simultaneously were executed for the same target (CNC coordinate system). • The CNC_LoadProgramFile instruction was executed when any of CNC coordinate system was *Executing* (Executing) or *Hold* (Holding).		Check the specifications of multi-execution of instructions for this instruction and correct the program so that instructions that cannot be executed at the same time are not executed simultaneously.		Check the specifications for multi-execution of instructions for the instruction and do not execute instructions that cannot be executed at the same time.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Unassigned Logical CNC Motor Number Specified			Event code	5605 0000 hex	
Meaning	The CNC motor of the parameter specified for the *LogicalMotorNo* input variable to the CNC instruction is not assigned.					
Source	CNC Function Module		Source details	CNC coordinate system	Detection timing	At instruction execution
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The relevant instruction is not executed. The relevant CNC coordinate system immediately stops while moving.		
System -defined variables	Variable		Data type		Name	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	The logical CNC motor number for which the CNC motor is not assigned to the *LogicalMotorNo* input variable to the CNC instruction was specified, and the instruction was executed.		Correct the parameter so that the specified value does not exceed the range of the logical CNC motor number for which the CNC motor is assigned to the *LogicalMotorNo* input variable to the instruction.		Specify the appropriate parameter so that the *LogicalMotorNo* input variable to the instruction does not exceed the range of *Positioning Axis Assignment* or *Spindle Axis Assignment* in the CNC coordinate system parameter settings.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Logical CNC Motor Number Out of Range			Event code	56060000 hex	
Meaning	The parameter specified for the *LogicalMotorNo* input variable to a CNC instruction is out of range.					
Source	CNC Function Module		Source details	CNC coordinate system	Detection timing	At instruction execution
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The relevant instruction is not executed. The relevant CNC coordinate system immediately stops while moving.		
System -defined variables	Variable		Data type		Name	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	Instruction input parameter exceeded the valid range of the input variable.		Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Target Position Setting Out of Range			Event code	56070000 hex	
Meaning	The parameter specified for the *Position* input variable to a CNC instruction is out of range.					
Source	CNC Function Module		Source details	CNC coordinate system	Detection timing	At instruction execution
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The relevant instruction is not executed. The relevant CNC coordinate system immediately stops while moving.		
System -defined variables	Variable		Data type		Name	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	Instruction input parameter exceeded the valid range of the input variable. Or, there was an overflow/underflow in the target position.		Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Impossible CNC Motor Operation Specified when the Servo is OFF			Event code	56080000 hex		
Meaning	An operation instruction was executed for the CNC motor for which the Servo is OFF.						
Source	CNC Function Module		Source details	CNC coordinate system	Detection timing	At instruction execution	
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System	
Effects	User program	Continues.	Operation	The relevant instruction is not executed. The relevant CNC coordinate system immediately stops while moving.			
System-defined variables	Variable		Data type		Name		
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence		
Cause and correction	Assumed cause		Correction		Prevention		
	An operation instruction was executed for the CNC motor for which the Servo is OFF.		Correct the program so that the instruction is executed after the Servo is turned ON.		Make sure to execute the operation instruction after the Servo is turned ON.		
	Home was preset with the CNC_Home or CNC_HomeWithParameter instruction for an axis for which EtherCAT process data communications are not established.		If the *_EC_PDSlavTbl* (Process Data Communicating Slave Table) system-defined variable for the EtherCAT master of the master axis is FALSE, remove the cause and execute the CNC_Home or CNC_HomeWithParameter instruction to preset home after *_EC_PDSlavTbl* changes to TRUE.		If you execute the CNC_Home or CNC_HomeWithParameter instruction to preset home immediately after you turn ON the power supply to the Controller, download data, reset a slave communications error, disconnect the slave, reconnect the slave, or disable or enable the slave, write the program to make sure that the *_EC_PDSlavTbl* (Process Data Communicating Slave Table) system-defined variable for the EtherCAT master is TRUE before you execute CNC_Home or CNC_HomeWithParameter.		
Attached information	Attached information 1: Logical CNC motor number where the error occurred						
Precautions/ Remarks	None						

Event name	Target Velocity Setting Out of Range			Event code	56090000 hex	
Meaning	The parameter specified for the *Velocity* input variable to a CNC instruction is out of range.					
Source	CNC Function Module		Source details	CNC coordinate system	Detection timing	At instruction execution
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The relevant instruction is not executed. The relevant CNC coordinate system immediately stops while moving.		
System -defined variables	Variable		Data type		Name	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	Instruction input parameter exceeded the valid range of the input variable.		Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Acceleration/Deceleration Setting Out of Range			Event code	560A0000 hex	
Meaning	The parameter specified for the *Acceleration* input variable to a CNC instruction is out of range.					
Source	CNC Function Module		Source details	CNC coordinate system	Detection timing	At instruction execution
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The relevant instruction is not executed. The relevant CNC coordinate system immediately stops while moving.		
System -defined variables	Variable		Data type		Name	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	Instruction input parameter exceeded the valid range of the input variable.		Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Travel Mode Selection Out of Range			**Event code**	560B0000 hex	
Meaning	The parameter specified for the *MoveMode* input variable to a CNC instruction is out of range.					
Source	CNC Function Module		**Source details**	CNC coordinate system	**Detection timing**	At instruction execution
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction is not executed. The relevant CNC coordinate system immediately stops while moving.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	Instruction input parameter exceeded the valid range of the input variable.		Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Immediate Stop Instruction Executed			**Event code**	560C0000 hex	
Meaning	An Immediate Stop (CNC_CoordImmediateStop) instruction was executed.					
Source	CNC Function Module		**Source details**	CNC coordinate system	**Detection timing**	At instruction execution
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant CNC coordinate system immediately stops according to the setting of the *Immediate Stop Input Stop Method* parameter when it is moving.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	An Immediate Stop instruction was executed.		---		---	
Attached information	None					
Precautions/ Remarks	None					

<table>
<tr><td>Event name</td><td colspan="3">Parameter Selection Out of Range</td><td>Event code</td><td colspan="2">560D0000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">The parameter specified for the ParameterNumber input variable to a CNC instruction is out of range.</td></tr>
<tr><td>Source</td><td colspan="2">CNC Function Module</td><td>Source details</td><td>CNC common</td><td>Detection timing</td><td>At instruction execution</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Minor fault</td><td>Recovery</td><td>Error reset</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The relevant instruction is not executed.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">_CNC_COM.MFaultLvl.Active</td><td colspan="2">BOOL</td><td colspan="2">CNC Common Minor Fault Occurrence</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">Instruction input parameter exceeded the valid range of the input variable.</td><td colspan="2">Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.</td><td colspan="2">Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.</td></tr>
<tr><td>Attached information</td><td colspan="6">None</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">None</td></tr>
</table>

<table>
<tr><td>Event name</td><td colspan="3">CNC Parameter Setting Read/Write Setting Value Out of Range</td><td>Event code</td><td colspan="2">560E0000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">The parameter specified for the SettingValue in-out variable to a CNC instruction is out of range.</td></tr>
<tr><td>Source</td><td colspan="2">CNC Function Module</td><td>Source details</td><td>CNC common</td><td>Detection timing</td><td>At instruction execution</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Minor fault</td><td>Recovery</td><td>Error reset</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The relevant instruction is not executed.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">_CNC_COM.MFaultLvl.Active</td><td colspan="2">BOOL</td><td colspan="2">CNC Common Minor Fault Occurrence</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">Instruction input parameter exceeded the valid range of the in-out variable.</td><td colspan="2">Correct the parameter so that the valid range of the in-out variable is not exceeded for the relevant instruction.</td><td colspan="2">Set the input parameter to the instruction so that the valid range of the in-out variable is not exceeded.</td></tr>
<tr><td>Attached information</td><td colspan="6">None</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">None</td></tr>
</table>

Event name	CNC Parameter Setting Read/Write Target Out of Range			**Event code**	560F0000 hex	
Meaning	The parameter specified for the *Target* in-out variable to a CNC instruction is out of range.					
Source	CNC Function Module		**Source details**	CNC common	**Detection timing**	At instruction execution
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction is not executed.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_COM.MFaultLvl.Active		BOOL		CNC Common Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	Instruction input parameter exceeded the valid range of the in-out variable.		Correct the parameter so that the valid range of the in-out variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the in-out variable is not exceeded.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Cycle Start Error with Undefined Home			**Event code**	56100000 hex	
Meaning	A cycle start was executed for a CNC coordinate system including the positioning axis with no defined home.					
Source	CNC Function Module		**Source details**	CNC coordinate system	**Detection timing**	At Cycle Start
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The cycle start is not executed. The relevant CNC coordinate system immediately stops while moving.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	A cycle start was executed for a CNC coordinate system including the positioning axis with no defined home.		Perform homing to define home for all positioning axes before executing the cycle start.		Perform homing to define home for all positioning axes before executing the cycle start.	
Attached information	Attached information 1: Logical CNC motor number where the error occurred					
Precautions/ Remarks	None					

Event name	Homing Parameter Setting Out of Range			Event code	56110000 hex	
Meaning	The parameter specified for the *HomingParameter* in-out variable to a CNC instruction is out of range.					
Source	CNC Function Module		Source details	CNC coordinate system	Detection timing	At instruction execution
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The relevant instruction is not executed. The relevant CNC coordinate system immediately stops while moving.		
System -defined variables	Variable		Data type		Name	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	Instruction input parameter exceeded the valid range of the in-out variable.		Correct the parameter so that the valid range of the in-out variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the in-out variable is not exceeded.	
Attached information	Attached information 1: Error Details 1:Homing Method out of range, 2: Home Input Signal out of range, 3: Homing Start Direction out of range, 4: Home Input Detection Direction out of range, 5: Operation Selection at Positive Limit Input out of range, 6: Operation Selection at Negative Limit Input out of range, 7: Homing Velocity out of range, 8: Homing Approach Velocity out of range, 9: Homing Acceleration out of range, 12: Home Input Mask Distance out of range, 13: Absolute Encoder Home Offset out of range, 14: Homing Holding Time out of range, 15: Homing Compensation Value out of range, 16: Homing Compensation Velocity out of range, 100: Home Input Mask Distance exceeded 40-bit range when converted to pulses, 102: Homing Compensation Value exceeded 40-bit range when converted to pulses, 104: Home Offset exceeded 40-bit range (54-bit range for spindle axis) when converted to pulses, 106: Homing Velocity exceeded maximum velocity, 107: Homing Approach Velocity exceeded maximum velocity, 108: Homing Approach Velocity was not less than or equal to Homing Velocity, 109: Homing Compensation Velocity was not less than or equal to Homing Velocity, 110: Homing Acceleration exceeded maximum acceleration rate					
Precautions/ Remarks	None					

Event name	M Code Number Out of Range			Event code	56120000 hex	
Meaning	The parameter specified for the *MCodeNo* input variable to a CNC instruction is out of range.					
Source	CNC Function Module		Source details	CNC coordinate system	Detection timing	At instruction execution
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The relevant instruction is not executed. The relevant CNC coordinate system immediately stops while moving.		
System -defined variables	Variable		Data type		Name	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	Instruction input parameter exceeded the valid range of the input variable.		Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.	
Attached information	None					
Precautions/ Remarks	None					

Event name	CNC Instruction Re-execution Disabled (CNC Coordinate System Specification)			**Event code**	56130000 hex	
Meaning	An attempt was made to change the parameter for the *Coord* in-out variable when re-executing a CNC instruction. (This in-out variable cannot be changed when re-executing an instruction.)					
Source	CNC Function Module		**Source details**	CNC coordinate system	**Detection timing**	At instruction re-execution
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction is not executed. The relevant CNC coordinate system immediately stops while moving.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	A parameter for an in-out variable that cannot be changed for re-execution was changed.		Correct the program so that the parameter for the relevant in-out variable does not change when the relevant instruction is re-executed.		Check the manual to see if each in-out variable to the relevant CNC instruction can be changed by re-execution. Write the program so that the input parameters for any in-out variable that cannot be changed do not change upon re-execution.	
Attached information	None					
Precautions/ Remarks	None					

Event name	CNC Instruction Re-execution Disabled (Logical CNC Motor Number)			**Event code**	56140000 hex	
Meaning	An attempt was made to change the parameter for the *LogicalMotorNo* input variable when re-executing a CNC instruction. (This input variable cannot be changed when re-executing an instruction.)					
Source	CNC Function Module		**Source details**	CNC coordinate system	**Detection timing**	At instruction re-execution
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction is not executed. The relevant CNC coordinate system immediately stops while moving.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	A parameter for an input variable that cannot be changed for re-execution was changed.		Correct the program so that the parameter for the relevant input variable does not change when the relevant instruction is re-executed.		Check the manual to see if each input variable to the relevant CNC instruction can be changed by re-execution. Write the program so that the input parameters for any input variable that cannot be changed do not change upon re-execution.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Illegal NC Program			Event code	56150000 hex	
Meaning	An error was detected in the NC program transferred from Sysmac Studio.					
Source	CNC Function Module		Source details	CNC common	Detection timing	At power ON, at Controller reset, or when downloading
Error attributes	Level	Minor fault	Recovery	Cycle the power supply or reset the Controller.	Log category	System
Effects	User program	Continues.	Operation	Not affected.		
System-defined variables	Variable		Data type		Name	
	_CNC_COM.MFaultLvl.Active		BOOL		CNC Common Minor Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	NC program transfer processing failed.		Download the NC program from Sysmac Studio again. If this error recurs after you took the above correction, contact your OMRON representative.		None	
Attached information	None					
Precautions/ Remarks	None					

Event name	Cycle Start Multi-execution Disabled			Event code	56160000 hex	
Meaning	A cycle start was executed multiple times for the same target (CNC coordinate system).					
Source	CNC Function Module		Source details	CNC coordinate system	Detection timing	At cycle start
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The cycle start is not executed. The relevant CNC coordinate system immediately stops while moving.		
System-defined variables	Variable		Data type		Name	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	A cycle start was executed while the CNC coordinate system is *Executing* (Executing), *MovingOnHold* (Manual Operation While Holding), or *Moving* (Moving).		A cycle start cannot be executed multiple times. Correct the program so that a cycle start is not executed while the CNC coordinate system is *Executing* (Executing), *MovingOnHold* (Manual Operation While Holding), or *Moving* (Moving).		A cycle start cannot be executed multiple times. Write the program so that a cycle start is not executed while the CNC coordinate system is *Executing* (Executing), *MovingOnHold* (Manual Operation While Holding), or *Moving* (Moving).	
Attached information	None					
Precautions/ Remarks	None					

Event name	Impossible CNC Motor Cycle Start Specified when the Servo is OFF		Event code	5617 0000 hex		
Meaning	A cycle start was executed for a CNC coordinate system including the CNC motor for which the Servo is OFF.					
Source	CNC Function Module		Source details	CNC coordi-nate system	Detection timing	At cycle start
Error attri-butes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The cycle start is not executed. The relevant CNC coordinate system immediately stops while moving.		
System -defined variables	Variable		Data type		Name	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	A cycle start was executed for the CNC motor for which Servo is turned OFF.		Correct the program so that a cycle start is executed after the Servo is turned ON.		Execute a cycle start after the Servo is turned ON.	
Attached information	Attached information 1: Logical CNC motor number where the error occurred					
Precautions/ Remarks	None					

Event name	Illegal NC Program Number Specification		Event code	5618 0000 hex		
Meaning	The NC program specified for *ProgramNo* in the *ControlInputs* in-out variable to the CNC_CoordControl instruction is not loaded.					
Source	CNC Function Module		Source details	CNC coordi-nate system	Detection timing	At cycle start
Error attri-butes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The cycle start is not executed. The relevant CNC coordinate system immediately stops while moving.		
System -defined variables	Variable		Data type		Name	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	A cycle start was executed after an unloaded NC program is speci-fied for *ProgramNo* in the *Con-trolInputs* in-out variable to the CNC_CoordControl instruction.		Transfer the relevant NC program using Sysmac Studio. Or, use the CNC_LoadProgram-File instruction to load the relevant NC program from the SD Memory Card.		Specify the NC program trans-ferred by Sysmac Studio or the NC program loaded from the SD Memory Card with the CNC_-LoadProgramFile instruction for *ProgramNo* in the *ControlInputs* in-out variable to the CNC_Co-ord-Control instruction.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Illegal Back Trace Specification			**Event code**	56190000 hex	
Meaning	A cycle start was executed when the CNC coordinate system is *Standby* (Standby) while *BackTrace* in the *ControlInputs* in-out variable to the CNC_CoordControl instruction is set to TRUE.					
Source	CNC Function Module		**Source details**	CNC coordinate system	**Detection timing**	At cycle start
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The cycle start is not executed. The relevant CNC coordinate system immediately stops while moving.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	A cycle start was executed when the CNC coordinate system is *Standby* (Standby) while *BackTrace* in the *ControlInputs* in-out variable to the CNC_CoordControl instruction is set to TRUE.		Correct the program so that a cycle start is not executed when the CNC coordinate system is *Standby* (Standby) while *BackTrace* in the *ControlInputs* in-out variable to the CNC_CoordControl instruction is set to TRUE.		Do not execute the cycle start when the CNC coordinate system is *Standby* (Standby) while *BackTrace* in the *ControlInputs* in-out variable to the CNC_CoordControl instruction is set to TRUE.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Illegal CNC Motor Specification			**Event code**	56250000 hex	
Meaning	The CNC motor specified for the *Target* in-out variable to a CNC instruction is not exist.					
Source	CNC Function Module		**Source details**	CNC common	**Detection timing**	At instruction execution
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction is not executed.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_COM.MFaultLvl.Active		BOOL		CNC Common Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	A CNC motor does not exist for the variable specified for the *Target* input variable to the instruction.		Correct the instruction so that the variable exists for the CNC motor that was specified for the instruction.		Specify a variable that exists when specifying a variable for an input parameter to an instruction.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Illegal CNC Motor Compensation Table Specification			**Event code**	56260000 hex
Meaning	The CNC motor compensation table specified for the *Target* input variable to a CNC instruction is not exist.				
Source	CNC Function Module	**Source details**	CNC common	**Detection timing**	At instruction execution
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction is not executed.	
System -defined variables	**Variable**	**Data type**	**Name**		
	_CNC_COM.MFaultLvl.Active	BOOL	CNC Common Minor Fault Occurrence		
Cause and correction	**Assumed cause**	**Correction**	**Prevention**		
	A CNC motor compensation table does not exist for the variable specified for the *Target* input variable to the instruction.	Correct the instruction so that the variable exists for the CNC motor compensation table that was specified for the instruction.	Specify a variable that exists when specifying a variable for an input parameter to an instruction.		
Attached information	None				
Precautions/ Remarks	None				

Event name	NC Program Capacity Exceeded			**Event code**	56290000 hex
Meaning	Loading failed because the NC program downloaded from Sysmac Studio exceeded the maximum capacity.				
Source	CNC Function Module	**Source details**	CNC common	**Detection timing**	At power ON, at Controller reset, or when downloading
Error attributes	**Level**	Minor fault	**Recovery**	Cycle the power supply or reset the Controller.	**Log category**	System
Effects	**User program**	Continues.	**Operation**	Not affected.	
System -defined variables	**Variable**	**Data type**	**Name**		
	_CNC_COM.MFaultLvl.Active	BOOL	CNC Common Minor Fault Occurrence		
Cause and correction	**Assumed cause**	**Correction**	**Prevention**		
	The NC program over the maximum capacity was downloaded from Sysmac Studio.	Correct the program so that the NC program downloaded from Sysmac Studio does not exceed the maximum capacity.	Write the program so that the NC program downloaded from Sysmac Studio does not exceed the maximum capacity.		
Attached information	None				
Precautions/ Remarks	None				

Event name	Skew Control Mode Out of Range			Event code	562A0000 hex	
Meaning	The parameter specified for the *SkewMode* input variable to a CNC instruction is out of range.					
Source	CNC Function Module		Source details	CNC coordinate system	Detection timing	At instruction execution
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	Stops.		
System-defined variable	Variable		Data type		Name	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	Instruction input parameter exceeded the valid range of the input variable.		Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Offset Value Setting Out of Range			Event code	562B0000 hex	
Meaning	The parameter specified for the *OffsetValue* input variable to a CNC instruction is out of range.					
Source	CNC Function Module		Source details	CNC coordinate system	Detection timing	At instruction execution
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	Stops.		
System-defined variable	Variable		Data type		Name	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	Instruction input parameter exceeded the valid range of the input variable.		Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Immediate Stop Input			**Event code**	67800000 hex	
Meaning	The immediate stop input turned ON.					
Source	CNC Function Module		**Source details**	CNC motor	**Detection timing**	Continuously
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant CNC coordinate system immediately stops according to the setting of the *Immediate Stop Input Stop Method* parameter when it is moving.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Motor[*].MFaultLvl.Active		BOOL		CNC Motor Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	An immediate stop input signal was detected.		Turn OFF the immediate stop input signal.		(The goal is to detect the immediate stop input. Preventative measures are not required.)	
	The immediate stop input signal is not connected correctly or the logic setting for the immediate stop input is wrong.		If the error occurs even when the immediate stop input signal is OFF, correct the immediate stop signal connection and logic setting for the immediate stop input. Check the logic settings both in the CNC motor parameters and in the slave settings.		Make sure that the immediate stop signal connection and logic setting for the immediate stop input are correct. Check the logic settings both in the CNC motor parameters and in the slave settings.	
Attached information	None					
Precautions/ Remarks	You must turn OFF the immediate stop input signal before you reset the error.					

<table>
<tr><td>Event name</td><td colspan="3">Positive Limit Input Detected</td><td>Event code</td><td colspan="2">67810000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">The positive limit input turned ON.</td></tr>
<tr><td>Source</td><td colspan="2">CNC Function Module</td><td>Source details</td><td>CNC motor</td><td>Detection timing</td><td>Continuously</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Minor fault</td><td>Recovery</td><td>Error reset</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The relevant CNC coordinate system immediately stops according to the setting of the Limit Input Stop Method parameter when it is moving.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">_CNC_Motor[*].MFaultLvl.Active</td><td colspan="2">BOOL</td><td colspan="2">CNC Motor Minor Fault Occurrence</td></tr>
<tr><td rowspan="3">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">A positive limit input signal was detected.</td><td colspan="2">Reset the error and move the axis back in the negative direction before it exceeds the limit in the positive direction.
Find the reason the limit was exceeded and make suitable corrections.</td><td colspan="2">The goal is to detect the positive limit input. Preventative measures are not required. However, be sure not to exceed the positive limit input when making programs.</td></tr>
<tr><td colspan="2">The positive limit input signal is not connected correctly or the logic setting for the positive limit input is wrong.</td><td colspan="2">If a positive limit input signal does not occur, correct the connection of the positive limit signal and the logic setting for the positive limit input.
Check the logic settings both in the CNC motor parameters and in the slave settings.</td><td colspan="2">Make sure that the positive limit signal connection and logic setting for the positive limit input are correct.
Check the logic settings both in the CNC motor parameters and in the slave settings.</td></tr>
<tr><td>Attached information</td><td colspan="6">None</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">None</td></tr>
</table>

<table>
<tr><td>Event name</td><td colspan="3">Negative Limit Input Detected</td><td>Event code</td><td colspan="2">67820000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">The negative limit input turned ON.</td></tr>
<tr><td>Source</td><td colspan="2">CNC Function Module</td><td>Source details</td><td>CNC motor</td><td>Detection timing</td><td>Continuously</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Minor fault</td><td>Recovery</td><td>Error reset</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The relevant CNC coordinate system immediately stops according to the setting of the Limit Input Stop Method parameter when it is moving.</td></tr>
<tr><td rowspan="2">System-defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">_CNC_Motor[*].MFaultLvl.Active</td><td colspan="2">BOOL</td><td colspan="2">CNC Motor Minor Fault Occurrence</td></tr>
<tr><td rowspan="3">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">A negative limit input signal was detected.</td><td colspan="2">Reset the error and move the axis back in the positive direction before it exceeds the limit in the negative direction.
Find the reason the limit was exceeded and make suitable corrections.</td><td colspan="2">The goal is to detect the negative limit input. Preventative measures are not required. However, be sure not to exceed the negative limit input when making programs.</td></tr>
<tr><td colspan="2">The negative limit input signal is not connected correctly or the logic setting for the negative limit input is wrong.</td><td colspan="2">If a negative limit input signal does not occur, correct the connection of the negative limit signal and the logic setting for the negative limit input.
Check the logic settings both in the CNC motor parameters and in the slave settings.</td><td colspan="2">Make sure that the negative limit signal connection and logic setting for the negative limit input are correct.
Check the logic settings both in the CNC motor parameters and in the slave settings.</td></tr>
<tr><td>Attached information</td><td colspan="6">None</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">None</td></tr>
</table>

Event name	Target Position Positive Software Limit Exceeded				**Event code**	67830000 hex
Meaning	The specified position exceeds the positive software limit.					
Source	CNC Function Module		**Source details**	CNC coordinate system	**Detection timing**	At instruction execution
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction is not executed. The relevant CNC coordinate system immediately stops while moving.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	The parameter specified for the *Position* input variable to the instruction is beyond the positive software limit.		Correct the parameter specified for the *Position* input variable to the instruction so that it is within the positive software limit.		Set the parameter specified for the *Position* input variable to the instruction so that it is within the positive software limit.	
	The first position is beyond the positive software limit and an instruction that specifies motion in the opposite direction of the software limit was executed.		Correct the program so that the travel direction for the instruction is towards the positive software limit.		If the first position is beyond the positive software limit, write the program so that the travel direction is in the direction of the positive software limit.	
Attached information	Attached information 1: Logical CNC motor number where the error occurred					
Precautions/ Remarks	None					

Event name	Target Position Negative Software Limit Exceeded				**Event code**	67840000 hex
Meaning	The specified position exceeds the negative software limit.					
Source	CNC Function Module		**Source details**	CNC coordinate system	**Detection timing**	At instruction execution
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction is not executed. The relevant CNC coordinate system immediately stops while moving.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	The parameter specified for the *Position* input variable to the instruction is beyond the negative software limit.		Correct the parameter specified for the *Position* input variable to the instruction so that it is within the negative software limit.		Set the parameter specified for the *Position* input variable to the instruction so that it is within the negative software limit.	
	The first position is beyond the negative software limit and an instruction that specifies motion in the opposite direction of the software limit was executed.		Correct the program so that the travel direction for the instruction is towards the negative software limit.		If the first position is beyond the negative software limit, write the program so that the travel direction is in the direction of the negative software limit.	
Attached information	Attached information 1: Logical CNC motor number where the error occurred					
Precautions/ Remarks	None					

<table>
<tr><td>Event name</td><td colspan="3">Command Position Overflow/Underflow</td><td>Event code</td><td colspan="2">67850000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">Positioning, an instruction in the underflow/overflow direction, or an instruction for which the direction is not specified was executed when there was an underflow/overflow in the command position.</td></tr>
<tr><td>Source</td><td colspan="2">CNC Function Module</td><td>Source details</td><td>CNC coordinate system</td><td>Detection timing</td><td>At instruction execution</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Minor fault</td><td>Recovery</td><td>Error reset</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The relevant instruction is not executed. The relevant CNC coordinate system immediately stops while moving.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">_CNC_Coord[*].MFaultLvl.Active</td><td colspan="2">BOOL</td><td colspan="2">CNC Coordinate System Minor Fault Occurrence</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">One of the following was executed when there was a command position overflow/underflow.
• A positioning instruction
• A continuous control instruction in the underflow/overflow direction
• An instruction for which the direction is not specified (syncing)</td><td colspan="2">Execute an error reset and then clear the overflow or underflow state by executing homing.</td><td colspan="2">Make sure that overflow or underflow does not occur.</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached information 1: Logical CNC motor number where the error occurred</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">None</td></tr>
</table>

Event name	Positive Limit Input			**Event code**	67860000 hex	
Meaning	An instruction was executed for a motion in the positive direction when the positive limit input was *ON*.					
Source	CNC Function Module		**Source details**	CNC coordinate system	**Detection timing**	At instruction execution
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction is not executed.		
System-defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	An instruction for a motion in the positive direction was executed when the positive limit input was *ON*, or an instruction for a motion with no direction specification was executed when the positive limit input was *ON*.		Execute an error reset and then perform a recovery operation in the negative direction. If this error occurs again, check the connection of the positive limit signal, the logic setting for the positive limit input, and the execution conditions for the start command, and correct any mistakes. Check the logic settings both in the CNC motor parameters and in the slave settings.		Check to make sure there are no problems with the positive limit signal connection, the logic setting for the positive limit input, and the execute conditions for the instruction. Check the logic settings both in the CNC motor parameters and in the slave settings.	
Attached information	Attached information 1: Logical CNC motor number where the error occurred					
Precautions/ Remarks	None					

<table>
<tr><td>Event name</td><td colspan="3">Negative Limit Input</td><td>Event code</td><td colspan="2">6787 0000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">An instruction for a motion in the negative direction was executed when the negative limit input was ON.</td></tr>
<tr><td>Source</td><td colspan="2">CNC Function Module</td><td>Source details</td><td>CNC coordinate system</td><td>Detection timing</td><td>At instruction execution</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Minor fault</td><td>Recovery</td><td>Error reset</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The relevant instruction is not executed.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">_CNC_Coord[*].MFaultLvl.Active</td><td colspan="2">BOOL</td><td colspan="2">CNC Coordinate System Minor Fault Occurrence</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">An instruction for a motion in the negative direction was executed when the negative limit input was ON, or an instruction for a motion with no direction specification was executed when the negative limit input was ON.</td><td colspan="2">Execute an error reset and then perform a recovery operation in the positive direction. If this error occurs again, check the connection of the negative limit signal, the logic setting for the negative limit input, and the execution conditions for the start command, and correct any mistakes.
Check the logic settings both in the CNC motor parameters and in the slave settings.</td><td colspan="2">Check to make sure there are no problems with the negative limit signal connection, the logic setting for the negative limit input, and the execute conditions for the instruction.
Check the logic settings both in the CNC motor parameters and in the slave settings.</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached information 1: Logical CNC motor number where the error occurred</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">None</td></tr>
</table>

<table>
<tr><td>Event name</td><td colspan="3">Positive Software Limit Exceeded</td><td>Event code</td><td colspan="2">6788 0000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">The position exceeded the positive software limit while the CNC motor is in motion.</td></tr>
<tr><td>Source</td><td colspan="2">CNC Function Module</td><td>Source details</td><td>CNC motor</td><td>Detection timing</td><td>During instruction execution</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Minor fault</td><td>Recovery</td><td>Error reset</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">Follows the setting of the Software Limit Function Selection.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">_CNC_Motor[*].MFaultLvl.Active</td><td colspan="2">BOOL</td><td colspan="2">CNC Motor Minor Fault Occurrence</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">The position exceeded the positive software limit.</td><td colspan="2">Find the reason that the software limit was exceeded and make suitable corrections.</td><td colspan="2">(The goal is to enable detecting the software limits when they are exceeded due to unanticipated causes. Preventative measures are not required.)</td></tr>
<tr><td>Attached information</td><td colspan="6">None</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">Whenever you change the positive software limit setting, make sure that the new setting is safe.</td></tr>
</table>

Event name	Negative Software Limit Exceeded		Event code	67890000 hex	
Meaning	The position exceeded the negative software limit while the CNC motor is in motion.				
Source	CNC Function Module	Source details	CNC motor	Detection timing	During instruction execution
Error attributes	Level: Minor fault	Recovery	Error reset	Log category	System
Effects	User program: Continues.	Operation	Follows the setting of the *Software Limit Function Selection*.		
System-defined variables	**Variable**	**Data type**	**Name**		
	_CNC_Motor[*].MFaultLvl.Active	BOOL	CNC Motor Minor Fault Occurrence		
Cause and correction	**Assumed cause**	**Correction**	**Prevention**		
	The position exceeded the negative software limit.	Find the reason that the software limit was exceeded and make suitable corrections.	(The goal is to enable detecting the software limits when they are exceeded due to unanticipated causes. Preventative measures are not required.)		
Attached information	None				
Precautions/ Remarks	Whenever you change the negative software limit setting, make sure that the new setting is safe.				

Event name	In-position Check Time Exceeded		Event code	678A0000 hex	
Meaning	The in-position check was not completed within the monitoring time.				
Source	CNC Function Module	Source details	CNC motor	Detection timing	During instruction execution
Error attributes	Level: Minor fault	Recovery	Error reset	Log category	System
Effects	User program: Continues.	Operation	The relevant CNC coordinate system immediately stops while moving.		
System-defined variables	**Variable**	**Data type**	**Name**		
	_CNC_Motor[*].MFaultLvl.Active	BOOL	CNC Motor Minor Fault Occurrence		
Cause and correction	**Assumed cause**	**Correction**	**Prevention**		
	Time is required to complete positioning.	Determine the cause of the slow positioning and remove the cause of the error. Or, adjust the Servo Drive or adjust the In-position Check Time or In-position Range. Increase the loop gain if you adjust the Servo Drive. However, make sure that you keep the loop gain low enough so that the control does not oscillate.	Remove the cause of poor following performance or oscillation/vibration in the positioning operation as much as possible.		
Attached information	None				
Precautions/ Remarks	None				

Event name	Following Error Limit Exceeded			**Event code**	678B0000 hex	
Meaning	The error between the command current position and actual current value exceeded the Following Error Over Value.					
Source	CNC Function Module		**Source details**	CNC motor	**Detection timing**	During instruction execution
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant CNC coordinate system immediately stops while moving.		
System-defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Motor[*].MFaultLvl.Active		BOOL		CNC Motor Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	The positioning operation has poor following performance and the actual motion is slower than the command.		Remove the cause of poor following performance in the positioning operation. Or increase the *Following Error Over Value* within the range that will not create problems.		Remove the cause of poor following performance in the positioning operation as best you can.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Illegal Following Error			**Event code**	67910000 hex	
Meaning	The difference between the command position and the actual current position exceeds the range of 30-bit data when converted to pulses.					
Source	CNC Function Module		**Source details**	CNC motor	**Detection timing**	Continuously
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The Servo for the relevant CNC motor is turned OFF.		
System-defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Motor[*].MFaultLvl.Active		BOOL		CNC Motor Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	The command current position was restricted so that the velocity of the CNC motor would not exceed the maximum velocity for the specified travel distance.		Correct the program or correct the electronic gear ratio so that the CNC motor does not exceed the maximum velocity.		Write the program or set the electronic gear ratio so that the CNC motor does not exceed the maximum velocity.	
	The CNC motor positioning operation has poor following performance and the actual motion is slower than the command.		Remove the cause of poor following performance in the CNC motor positioning operation.		Remove the cause of poor following performance in the CNC motor positioning operation as best you can.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Absolute Encoder Current Position Calculation Failed			**Event code**	67920000 hex	
Meaning	It was not possible to correctly restore the current position from the absolute encoder information that was saved when power was interrupted.					
Source	CNC Function Module		**Source details**	CNC motor	**Detection timing**	At power ON, at Controller reset, when downloading, or when starting Servo ON status
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	Operation is not possible for relevant CNC motors.		
System-defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Motor[*].MFaultLvl.Active		BOOL		CNC Motor Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	The position to restore when converted to pulses exceeded the range of signed 40-bit data.		Reset the error and perform homing. Perform homing near the position where the absolute encoder is set up so that the position to restore does not exceed the range of signed 40-bit data.		Perform homing again if you changed any parameters related to position. Perform homing near the position where the absolute encoder is set up so that the position to restore does not exceed the range of signed 40-bit data. Also, do not execute the CNC_Power (Power Servo) instruction or cycle the power supply when the encoder position exceeds the range of signed 40-bit data.	
Attached information	None					
Precautions/ Remarks	None					

<table>
<tr><td>Event name</td><td colspan="3">Home Undefined during Coordinated Motion</td><td>Event code</td><td colspan="2">67930000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">Home of the CNC motor became undefined while the status of CNC coordinate system is Executing (Executing), MovingOnHold (Manual Operation While Holding), or Moving (Moving).</td></tr>
<tr><td>Source</td><td colspan="2">CNC Function Module</td><td>Source details</td><td>CNC coordinate system</td><td>Detection timing</td><td>During instruction execution</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Minor fault</td><td>Recovery</td><td>Error reset</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The relevant CNC coordinate system immediately stops while moving.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">_CNC_Coord[*].MFaultLvl.Active</td><td colspan="2">BOOL</td><td colspan="2">CNC Coordinate System Minor Fault Occurrence</td></tr>
<tr><td rowspan="4">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">The command position or actual position overflowed or underflowed for a CNC motor while the status of CNC coordinate system is Executing (Executing), MovingOnHold (Manual Operation While Holding), or Moving (Moving) and the home definition was lost.</td><td colspan="2">Correct the program so that the axis operates within ranges that do not cause overflows or underflows in the command position or actual position.</td><td colspan="2">Write the program so that the axis operates within ranges that do not cause overflows or underflows in the command position or actual position.</td></tr>
<tr><td colspan="2">A slave communications error occurred in the CNC motor and the home become undefined while the status of CNC coordinate system is Executing (Executing), MovingOnHold (Manual Operation While Holding), or Moving (Moving).</td><td colspan="2">Correct the slave communications error and define home.</td><td colspan="2">None</td></tr>
<tr><td colspan="2">A slave for a logical axis left the network or was disabled and home became undefined while the status of CNC coordinate system is Executing (Executing), MovingOnHold (Manual Operation While Holding), or Moving (Moving).</td><td colspan="2">Connect the disconnected or disabled slave to the network again and define home.</td><td colspan="2">Do not disconnect or disable the slave of the logical axis while the status of CNC coordinate system is Executing (Executing), MovingOnHold (Manual Operation While Holding), or Moving (Moving).</td></tr>
<tr><td>Attached information</td><td colspan="6">None</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">None</td></tr>
</table>

Event name	Cycle Start Specified during Positive Software Limit Exceeded		Event code	67940000 hex	
Meaning	The first position exceeds the positive software limit.				
Source	CNC Function Module	Source details	CNC coordinate system	Detection timing	At cycle start
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The cycle start is not executed. The relevant CNC coordinate system immediately stops while moving.	
System -defined variables	Variable	Data type	Name		
	_CNC_Coord[*].MFaultLvl.Active	BOOL	CNC Coordinate System Minor Fault Occurrence		
Cause and correction	Assumed cause	Correction	Prevention		
	The command current position of the positioning cartesian axis or positioning rotational axis in the CNC coordinate system is out of range of the positive software limit.	Reset the error, and perform homing so that the CNC motor outside the software limit returns in the range of the software limit.	Write the program so that a cycle start is executed while the positioning cartesian axis or positioning rotational axis in the CNC coordinate system is in the range of the software limit.		
Attached information	Attached information 1: Logical CNC motor number where the error occurred				
Precautions/ Remarks	None				

Event name	Cycle Start Specified during Negative Software Limit Exceeded		Event code	67950000 hex	
Meaning	The first position exceeds the negative software limit.				
Source	CNC Function Module	Source details	CNC coordinate system	Detection timing	At cycle start
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The cycle start is not executed. The relevant CNC coordinate system immediately stops while moving.	
System -defined variables	Variable	Data type	Name		
	_CNC_Coord[*].MFaultLvl.Active	BOOL	CNC Coordinate System Minor Fault Occurrence		
Cause and correction	Assumed cause	Correction	Prevention		
	The command current position of the positioning cartesian axis or positioning rotational axis in the CNC coordinate system is out of range of the negative software limit.	Reset the error, and perform homing so that the CNC motor outside the software limit returns in the range of the software limit.	Write the program so that a cycle start is executed while the positioning cartesian axis or positioning rotational axis in the CNC coordinate system is in the range of the software limit.		
Attached information	Attached information 1: Logical CNC motor number where the error occurred				
Precautions/ Remarks	None				

<table>
<tr><td>**Event name**</td><td colspan="3">Cycle Start Specified during Command Position Overflow/Underflow</td><td>**Event code**</td><td colspan="2">67960000 hex</td></tr>
<tr><td>**Meaning**</td><td colspan="6">The cycle start was executed when there was a command position overflow/underflow.</td></tr>
<tr><td>**Source**</td><td colspan="2">CNC Function Module</td><td>**Source details**</td><td>CNC coordinate system</td><td>**Detection timing**</td><td>At cycle start</td></tr>
<tr><td>**Error attributes**</td><td>**Level**</td><td>Minor fault</td><td>**Recovery**</td><td>Error reset</td><td>**Log category**</td><td>System</td></tr>
<tr><td>**Effects**</td><td>**User program**</td><td>Continues.</td><td>**Operation**</td><td colspan="3">The cycle start is not executed. The relevant CNC coordinate system immediately stops while moving.</td></tr>
<tr><td rowspan="2">**System -defined variables**</td><td colspan="2">**Variable**</td><td colspan="2">**Data type**</td><td colspan="2">**Name**</td></tr>
<tr><td colspan="2">_CNC_Coord[*].MFaultLvl.Active</td><td colspan="2">BOOL</td><td colspan="2">CNC Coordinate System Minor Fault Occurrence</td></tr>
<tr><td rowspan="2">**Cause and correction**</td><td colspan="2">**Assumed cause**</td><td colspan="2">**Correction**</td><td colspan="2">**Prevention**</td></tr>
<tr><td colspan="2">• The cycle start was executed when there was a command position overflow/underflow.</td><td colspan="2">Execute an error reset and then clear the overflow/underflow state by executing homing.</td><td colspan="2">Make sure that overflow or underflow does not occur.</td></tr>
<tr><td>**Attached information**</td><td colspan="6">Attached information 1: Logical CNC motor number where the error occurred</td></tr>
<tr><td>**Precautions/ Remarks**</td><td colspan="6">None</td></tr>
</table>

<table>
<tr><td>Event name</td><td colspan="3">Cycle Start Specified during Positive Limit Input</td><td>Event code</td><td colspan="2">6797 0000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">A cycle start was executed when the positive limit input was ON.</td></tr>
<tr><td>Source</td><td colspan="2">CNC Function Module</td><td>Source details</td><td>CNC coordinate system</td><td>Detection timing</td><td>At cycle start</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Minor fault</td><td>Recovery</td><td>Error reset</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The cycle start is not executed. The relevant CNC coordinate system immediately stops while moving.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">_CNC_Coord[*].MFaultLvl.Active</td><td colspan="2">BOOL</td><td colspan="2">CNC Coordinate System Minor Fault Occurrence</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">A cycle start was executed when the positive limit input was ON.</td><td colspan="2">Execute an error reset and then perform a recovery operation in the negative direction. If this error occurs again, check the connection of the positive limit signal and the logic setting for the positive limit input, and correct any mistakes.
Check the logic settings both in the CNC motor parameters and in the slave settings.</td><td colspan="2">Check to make sure there are no problems with the positive limit signal connection and the logic setting for the positive limit input.
Check the logic settings both in the CNC motor parameters and in the slave settings.</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached information 1: Logical CNC motor number where the error occurred</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">None</td></tr>
</table>

<table>
<tr><td>Event name</td><td colspan="3">Cycle Start Specified during Negative Limit Input</td><td>Event code</td><td colspan="2">6798 0000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">A cycle start was executed when the negative limit input was ON.</td></tr>
<tr><td>Source</td><td colspan="2">CNC Function Module</td><td>Source details</td><td>CNC coordinate system</td><td>Detection timing</td><td>At cycle start</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Minor fault</td><td>Recovery</td><td>Error reset</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The cycle start is not executed. The relevant CNC coordinate system immediately stops while moving.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">_CNC_Coord[*].MFaultLvl.Active</td><td colspan="2">BOOL</td><td colspan="2">CNC Coordinate System Minor Fault Occurrence</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">A cycle start was executed when the negative limit input was ON.</td><td colspan="2">Execute an error reset and then perform a recovery operation in the positive direction. If this error occurs again, check the connection of the negative limit signal and the logic setting for the negative limit input, and correct any mistakes.
Check the logic settings both in the CNC motor parameters and in the slave settings.</td><td colspan="2">Check to make sure there are no problems with the negative limit signal connection and the logic setting for the negative limit input.
Check the logic settings both in the CNC motor parameters and in the slave settings.</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached information 1: Logical CNC motor number where the error occurred</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">None</td></tr>
</table>

<table>
<tr><td>Event name</td><td colspan="3">NC Program Execution Error</td><td>Event code</td><td colspan="2">67990000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">An error was detected while the NC program is running.</td></tr>
<tr><td>Source</td><td colspan="2">CNC Function Module</td><td>Source details</td><td>CNC coordinate system</td><td>Detection timing</td><td>Executing (Executing)</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Minor fault</td><td>Recovery</td><td>Error reset</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The relevant CNC coordinate system immediately stops while moving.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">_CNC_Coord[*].MFaultLvl.Active</td><td colspan="2">BOOL</td><td colspan="2">CNC Coordinate System Minor Fault Occurrence</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">An error was detected while the NC program is running.
Refer to error codes in the following attached information for details on errors.</td><td colspan="2">Identify the NC program error from the attached information, and take the appropriate correction for the NC program.</td><td colspan="2">Check the manual for the syntax and instructions available in the NC program, and write the NC program so that no error is detected.</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached information 1: Error codes caused by CNC coordinate system when you use G codes.
0: No error
• An error caused by CNC coordinate system does not occur.
3: Execution instruction error when tool radius compensation is active
• An instruction (G00, G28, G30, G31, G74, or G84) that you cannot execute was executed when tool radius compensation was active.
5: Illegal cancel move for tool radius compensation
• Cancel move used by G02 or G03, or travel distance of cancel move is less than tool radius.
6: Illegal startup move for tool radius compensation
• Startup move used by G02 or G03, or travel distance of startup move is less than tool radius.
7: Too many instructions to the next intersection at tool radius compensation
• There are too many instructions to the next intersection during tool radius compensation move. (Next in-plane move cannot be detected.)
10: Overcut detection error at tool radius compensation
• An overcut error was detected during tool radius compensation move. (Interference condition)
13: Cannot resolve overcut
• Overcut used by cancel move cannot be resolved.
15: No move for tool radius compensation error
• More than one compensation move is not performed between startup move and cancel move.
16: Not enough calculation time for CNC planner service
• There is not enough calculation time for CNC planner service.
17: In-position check time exceeded error
• CNC coordinate system is not in-position state within the specified check time.
21: Illegal feedrate specification
• Feedrate (F) specified in NC program is illegal.
32: Software limit error
• CNC coordinate system is stopped from exceeding software limit.
64: Illegal radius specification of circular interpolation
• Radius specifications of circular interpolation on the X/Y/Z plane are illegal.
Attached information 2: Error codes that are occurred when NC program is loaded or started
0: No error
• An error does not occur when NC program is loaded or started.
20: Illegal command
• An illegal instruction is executed.
22: Invalid program number
• The specified NC program number is not existed.</td></tr>
</table>

	Attached information 3: Error codes that are occurred during execution of NC program 0: No error • An error does not occur during execution of NC program. 4: Illegal NC Program • NC program is stopped due to illegal syntax, instructions, or other reasons. 7: Invalid NC program number • NC program is stopped because the subprogram number that is not loaded is specified.
Precautions/ Remarks	None

Event name	Position Deviation between Axes Limit Exceeded		**Event code**	679B0000 hex		
Meaning	The deviation of the feedback current position between the gantry master axis and the gantry slave axis exceeded the Position Deviation Between Axes Over Value.					
Source	CNC Function Module		**Source details**	CNC motor	**Detection timing**	Whenever Servo is ON
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	Stops.		
System -defined variable	**Variable**		**Data type**		**Name**	
	_CNC_Motor[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	The gantry slave axis is moving slower than the gantry master axis due to poor following performance of the slave axis.		Eliminate the cause of making the gantry slave axis move slower than it should. Alternatively, increase the Position Deviation Between Axes Over Value within the range that will not create problems.		Eliminate the cause of making the gantry slave axis move slower than it should as much as possible.	
Attached information	None					
Precautions/ Remarks	None					

Event name	CNC Coordinate System Composition CNC Motor Error			**Event code**	77820000 hex	
Meaning	An error occurred for a composition CNC motor in a CNC coordinate system.					
Source	CNC Function Module		**Source details**	CNC coordinate system	**Detection timing**	Continuously
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant CNC coordinate system immediately stops while moving.		
System-defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	An error occurred for a composition CNC motor in a CNC coordinate system while it is moving.		Check the error code of the CNC motor in the CNC coordinate system, and remove the cause of the error.		None	
Attached information	None					
Precautions/ Remarks	When a CNC motor error occurs, the CNC coordinate system including the CNC motor will not operate.					

Event name	CNC Common Error Occurrence			**Event code**	77830000 hex	
Meaning	A CNC common error occurred.					
Source	CNC Function Module		**Source details**	CNC coordinate system	**Detection timing**	Continuously
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	Operation is not possible for relevant CNC motors.		
System-defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	Partial fault level CNC common error occurred.		Check the CNC common error that occurred and remove the cause of the error.		None	
Attached information	None					
Precautions/ Remarks	When a partial fault level CNC common error occurs, the CNC coordinate system do not operate.					

Event name	Servo Main Circuits OFF			Event code	7784 0000 hex	
Meaning	An attempt was made to turn ON the Servo when the main circuit power supply to the Servo Drive was *OFF*.					
Source	CNC Function Module		Source details	CNC coordinate system	Detection timing	At instruction execution
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The Servo for the relevant CNC motor is turned OFF. The relevant CNC coordinate system immediately stops while moving.		
System -defined variables	Variable		Data type		Name	
	_CNC_Coord[*].MFaultLvl.Active		BOOL		CNC Coordinate System Minor Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	An attempt was made to turn ON the Servo when the main circuit power supply to the Servo Drive was *OFF*.		Turn ON the Servo after turning *ON* the main circuit power supply of the Servo Drive for the CNC motor where the error occurred.		Turn ON the Servo after turning *ON* the main circuit power supply to the Servo Drive.	
Attached information	Attached information 1: Logical CNC motor number where the error occurred					
Precautions/ Remarks	None					

Event name	Servo Main Circuit Power OFF			Event code	7785 0000 hex	
Meaning	The main circuit power of the Servo Drive turned OFF while the Servo was ON.					
Source	CNC Function Module		Source details	CNC motor	Detection timing	Whenever Servo is ON
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The Servo for the relevant CNC motor is turned OFF.		
System -defined variables	Variable		Data type		Name	
	_CNC_Motor[*].MFaultLvl.Active		BOOL		CNC Motor Minor Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	The main circuit power of the Servo Drive was interrupted while the Servo was ON.		Turn ON the main circuit power of the Servo Drive for the axis where the error occurred, reset the error, and then turn ON the Servo.		Turn OFF the Servo, then turn OFF the main circuit power of the Servo Drive.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Slave Error Detected			Event code	77860000 hex	
Meaning	An error was detected for the EtherCAT slave or NX Unit that is allocated to the CNC motor.					
Source	CNC Function Module		Source details	CNC motor	Detection timing	Continuously
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The Servo for the relevant CNC motor is turned OFF.		
System -defined variables	Variable		Data type		Name	
	_CNC_Motor[*].MFaultLvl.Active		BOOL		CNC Motor Minor Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	An error was detected for the EtherCAT slave or NX Unit that is allocated to the CNC motor.		Check the error at the slave and check the slave error code reported in *Slave Error Code Report* (97800000 hex) and perform the required corrections.		None	
Attached information	None					
Precautions/ Remarks	None					

Event name	Slave Disconnection during Servo ON			Event code	77880000 hex	
Meaning	An EtherCAT slave or NX Unit that is allocated to the CNC motor was disconnected, replaced, or disabled while the Servo was ON.					
Source	CNC Function Module		Source details	CNC motor	Detection timing	Whenever Servo is ON
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The Servo for the relevant CNC motor is turned OFF.		
System -defined variables	Variable		Data type		Name	
	_CNC_Motor[*].MFaultLvl.Active		BOOL		CNC Motor Minor Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	An EtherCAT slave or NX Unit that is allocated to the CNC motor was disconnected, replaced, or disabled while the Servo was ON.		Reconnect the EtherCAT slave or NX Unit that is allocated to the CNC motor to the network.		Turn OFF the Servo before you disconnect, replace, or disable a slave.	
Attached information	None					
Precautions/ Remarks	None					

<table>
<tr><th>Event name</th><td colspan="3">Homing Opposite Direction Limit Input Detected</td><th>Event code</th><td colspan="2">77890000 hex</td></tr>
<tr><th>Meaning</th><td colspan="6">The limit signal in the direction opposite to the homing direction was detected during a homing operation.</td></tr>
<tr><th>Source</th><td colspan="2">CNC Function Module</td><th>Source details</th><td>CNC motor</td><th>Detection timing</th><td>During instruction execution</td></tr>
<tr><th>Error attributes</th><th>Level</th><td>Minor fault</td><th>Recovery</th><td>Error reset</td><th>Log category</th><td>System</td></tr>
<tr><th>Effects</th><th>User program</th><td>Continues.</td><th>Operation</th><td colspan="3">The axis stops with the stop method for the homing execution status.</td></tr>
<tr><th rowspan="2">System -defined variables</th><th colspan="2">Variable</th><th colspan="2">Data type</th><th colspan="2">Name</th></tr>
<tr><td colspan="2">_CNC_Motor[*].MFaultLvl.Active</td><td colspan="2">BOOL</td><td colspan="2">CNC Motor Minor Fault Occurrence</td></tr>
<tr><th rowspan="4">Cause and correction</th><th colspan="2">Assumed cause</th><th colspan="2">Correction</th><th colspan="2">Prevention</th></tr>
<tr><td colspan="2">The Operation Selection at Negative Limit Input or Operation Selection at Positive Limit Input parameter is set to No reverse turn.</td><td colspan="2">To prevent errors at the limit inputs, set the Operation Selection at Negative Limit Input and Operation Selection at Positive Limit Input parameters to Reverse turn.</td><td colspan="2" rowspan="3">Check to see if any of the conditions that are given as causes exist in advance.</td></tr>
<tr><td colspan="2">The location of the homing input signal sensors, homing settings, and homing start position cause a limit input to be reached.</td><td colspan="2">Correct the location of the input signal sensors, homing settings, and homing start position so that a limit input is not reached.</td></tr>
<tr><td colspan="2">The input signal sensor wiring is incorrect or the sensor is faulty.</td><td colspan="2">Correct the wiring of the input signal sensor or replace the sensor.</td></tr>
<tr><th>Attached information</th><td colspan="6">None</td></tr>
<tr><th>Precautions/ Remarks</th><td colspan="6">None</td></tr>
</table>

Event name	Homing Direction Limit Input Detected			**Event code**	778A0000 hex	
Meaning	The limit signal in the homing direction was detected during a homing operation.					
Source	CNC Function Module		**Source details**	CNC motor	**Detection timing**	During instruction execution
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The axis stops with the stop method for the homing execution status.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Motor[*].MFaultLvl.Active		BOOL		CNC Motor Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	The Operation Selection at Negative Limit Input or Operation Selection at Positive Limit Input parameter is set to *No reverse turn*.		To prevent errors at the limit inputs, set the Operation Selection at Negative Limit Input and Operation Selection at Positive Limit Input parameters to *Reverse turn*.		Check to see if any of the conditions that are given as causes exist in advance.	
	The location of the homing input signal sensors, homing settings, and homing start position cause a limit input to be reached.		Correct the location of the input signal sensors, homing settings, and homing start position so that a limit input is not reached.			
	The input signal sensor wiring is incorrect or the sensor is faulty.		Correct the wiring of the input signal sensor or replace the sensor.			
Attached information	None					
Precautions/ Remarks	None					

Event name	Homing Limit Inputs Detected in Both Directions			**Event code**	778B0000 hex	
Meaning	The limit signals in both directions were detected during a homing operation.					
Source	CNC Function Module		**Source details**	CNC motor	**Detection timing**	During instruction execution
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The axis stops with the stop method for the homing execution status.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Motor[*].MFaultLvl.Active		BOOL		CNC Motor Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	The wiring of the limit signal is incorrect.		Correct the wiring of the limit signal.		Check to see if any of the conditions that are given as causes exist in advance.	
	The limit sensor is installed in the wrong location.		Correct the installation locations of the limit sensors so that they do not turn *ON* at the same time.			
	The contact logic of the limit signal is not correct.		Correct the contact logic (N.C./N.O.) of the limit signal.			
	The limit sensor failed.		Replace the limit sensor.			
Attached information	None					
Precautions/ Remarks	None					

<table>
<tr><td>Event name</td><td colspan="3">Home Proximity/Homing Opposite Direction Limit Input Detected</td><td>Event code</td><td colspan="2">778C0000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">The home proximity input and the limit signal in the direction opposite to the homing direction were detected at the same time during a homing operation.</td></tr>
<tr><td>Source</td><td colspan="2">CNC Function Module</td><td>Source details</td><td>CNC motor</td><td>Detection timing</td><td>During instruction execution</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Minor fault</td><td>Recovery</td><td>Error reset</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The axis stops with the stop method for the homing execution status.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">_CNC_Motor[*].MFaultLvl.Active</td><td colspan="2">BOOL</td><td colspan="2">CNC Motor Minor Fault Occurrence</td></tr>
<tr><td rowspan="5">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">The wiring of the home proximity signal or limit signal is incorrect.</td><td colspan="2">Correct the wiring of the home proximity signal or limit signal.</td><td colspan="2" rowspan="4">Check to see if any of the conditions that are given as causes exist in advance.</td></tr>
<tr><td colspan="2">The home proximity sensor or limit sensor is installed in the wrong location.</td><td colspan="2">Correct the installation location of the home proximity sensor or limit sensor so that they do not turn ON at the same time.</td></tr>
<tr><td colspan="2">The contact logic of the home proximity signal or limit signal is not correct.</td><td colspan="2">Correct the contact logic (N.C./N.O.) of the home proximity sensor or limit sensor.</td></tr>
<tr><td colspan="2">The home proximity sensor or limit sensor failed.</td><td colspan="2">Replace the home proximity sensor or limit sensor.</td></tr>
<tr><td>Attached information</td><td colspan="6">None</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">None</td></tr>
</table>

Event name	Home Proximity/Homing Direction Limit Input Detected			**Event code**	778D0000 hex	
Meaning	The home proximity input and the limit signal in the homing direction were detected at the same time during a homing operation.					
Source	CNC Function Module		**Source details**	CNC motor	**Detection timing**	During instruction execution
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The axis stops with the stop method for the homing execution status.		
System-defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Motor[*].MFaultLvl.Active		BOOL		CNC Motor Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	The wiring of the home proximity signal or limit signal is incorrect.		Correct the wiring of the home proximity signal or limit signal.		Check to see if any of the conditions that are given as causes exist in advance.	
	The home proximity sensor or limit sensor is installed in the wrong location.		Correct the installation location of the home proximity sensor or limit sensor so that they do not turn *ON* at the same time.			
	The contact logic of the home proximity signal or limit signal is not correct.		Correct the contact logic (N.C./N.O.) of the home proximity sensor or limit sensor.			
	The home proximity sensor or limit sensor failed.		Replace the home proximity sensor or limit sensor.			
Attached information	None					
Precautions/ Remarks	None					

<table>
<tr><td>Event name</td><td colspan="3">Home Input/Homing Opposite Direction Limit Input Detected</td><td>Event code</td><td colspan="2">778E0000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">The home input and the limit signal in the direction opposite to the homing direction were detected at the same time during a homing operation.</td></tr>
<tr><td>Source</td><td colspan="2">CNC Function Module</td><td>Source details</td><td>CNC motor</td><td>Detection timing</td><td>During instruction execution</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Minor fault</td><td>Recovery</td><td>Error reset</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The axis stops with the stop method for the homing execution status.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">_CNC_Motor[*].MFaultLvl.Active</td><td colspan="2">BOOL</td><td colspan="2">CNC Motor Minor Fault Occurrence</td></tr>
<tr><td rowspan="5">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">The wiring of the home input signal or limit signal is incorrect.</td><td colspan="2">Correct the wiring of the home input signal or limit signal.</td><td colspan="2" rowspan="4">Check to see if any of the conditions that are given as causes exist in advance.</td></tr>
<tr><td colspan="2">The home input sensor or limit sensor is installed in the wrong location.</td><td colspan="2">Correct the installation location of the home input sensor or limit sensor so that they do not turn ON at the same time.</td></tr>
<tr><td colspan="2">The contact logic of the home input signal or limit signal is not correct.</td><td colspan="2">Correct the contact logic (N.C./N.O.) of the home input signal or limit sensor.</td></tr>
<tr><td colspan="2">The home input signal output device or limit sensor failed.</td><td colspan="2">Replace the home input signal output device or limit sensor.</td></tr>
<tr><td>Attached information</td><td colspan="6">None</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">None</td></tr>
</table>

<table>
<tr><td>Event name</td><td colspan="3">Home Input/Homing Direction Limit Input Detected</td><td>Event code</td><td colspan="2">778F0000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">The home input and the limit signal in the homing direction were detected at the same time during a homing operation.</td></tr>
<tr><td>Source</td><td colspan="2">CNC Function Module</td><td>Source details</td><td>CNC motor</td><td>Detection timing</td><td>During instruction execution</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Minor fault</td><td>Recovery</td><td>Error reset</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The axis stops with the stop method for the homing execution status.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">_CNC_Motor[*].MFaultLvl.Active</td><td colspan="2">BOOL</td><td colspan="2">CNC Motor Minor Fault Occurrence</td></tr>
<tr><td rowspan="5">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">The wiring of the home input signal or limit signal is incorrect.</td><td colspan="2">Correct the wiring of the home input signal or limit signal.</td><td colspan="2" rowspan="4">Check to see if any of the conditions that are given as causes exist in advance.</td></tr>
<tr><td colspan="2">The home input sensor or limit sensor is installed in the wrong location.</td><td colspan="2">Correct the installation location of the home input sensor or limit sensor so that they do not turn ON at the same time.</td></tr>
<tr><td colspan="2">The contact logic of the home input signal or limit signal is not correct.</td><td colspan="2">Correct the contact logic (N.C./N.O.) of the home input signal or limit sensor.</td></tr>
<tr><td colspan="2">The home input signal output device or limit sensor failed.</td><td colspan="2">Replace the home input signal output device or limit sensor.</td></tr>
<tr><td>Attached information</td><td colspan="6">None</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">None</td></tr>
</table>

Event name	Invalid Home Input Mask Distance			**Event code**	7790 0000 hex	
Meaning	The setting of the home input mask distance is not suitable for the CNC_Home or CNC_HomeWithParameter instruction.					
Source	CNC Function Module		**Source details**	CNC motor	**Detection timing**	During instruction execution
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The axis stops with the stop method for the homing execution status.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Motor[*].MFaultLvl.Active		BOOL		CNC Motor Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	The set value of the home input mask distance when the operating mode of the MC_Home instruction is set to *Proximity Reverse Turn/Home Input Mask Distance* is insufficient to decelerate from the homing velocity to the homing approach velocity.		Check the home input mask distance, homing velocity, and homing approach velocity. Change the settings so that they provide sufficient travel distance to decelerate based on the operating specifications of the CNC_Home or CNC_HomeWithParameter instruction.		Check the operating specifications for the CNC_Home or CNC_HomeWithParameter instruction, then set the home input mask distance, homing velocity, and homing approach velocity so that they provide sufficient travel distance to decelerate.	
Attached information	None					
Precautions/ Remarks	None					

Event name	No Home Input			**Event code**	7791 0000 hex	
Meaning	There was no home signal input during the homing operation. Or, a limit signal was detected before there was a home input.					
Source	CNC Function Module		**Source details**	CNC motor	**Detection timing**	During instruction execution
Error attributes	**Level**	Minor fault	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The axis stops with the stop method for the homing execution status.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_Motor[*].MFaultLvl.Active		BOOL		CNC Motor Minor Fault Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	• There was no home signal input during the homing operation. • A limit signal was detected before there was a home input.		Check the home input settings and wiring and correct them so that the home signal is input during homing based on the operation specifications of the CNC_Home or CNC_HomeWithParameter instruction. Also, set the system so that the home signal is detected before the limit signals.		Set the system so that the home signal is input during the homing operation. Make sure that the home signal is detected before a limit signal. Also check to make sure there are no wiring problems with the home input.	
Attached information	None					
Precautions/ Remarks	None					

Event name	No Home Proximity Input			Event code	77920000 hex	
Meaning	There was no home proximity signal input during the homing operation.					
Source	CNC Function Module		Source details	CNC motor	Detection timing	During instruction execution
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The axis stops with the stop method for the homing execution status.		
System -defined variables	Variable		Data type		Name	
	_CNC_Motor[*].MFaultLvl.Active		BOOL		CNC Motor Minor Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	There was no home proximity signal input during the homing operation when a home proximity input signal was specified.		Check the home proximity input settings and wiring and correct them so that the home proximity signal is input during homing based on the operation specifications of the CNC_Home or CNC_HomeWithParameter instruction.		Set the system so that the home proximity signal is input during the homing operation. Also check to make sure there are no wiring problems with the home proximity input.	
Attached information	None					
Precautions/ Remarks	None					

Event name	EtherCAT Slave Communications Error			Event code	87800000 hex	
Meaning	A communications error occurred for the EtherCAT slave or NX Unit that is allocated to a CNC motor.					
Source	CNC Function Module		Source details	CNC motor	Detection timing	Continuously
Error attributes	Level	Minor fault	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The Servo for the relevant CNC motor is turned OFF.		
System -defined variables	Variable		Data type		Name	
	_CNC_Motor[*].MFaultLvl.Active		BOOL		CNC Motor Minor Fault Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	A communications error occurred for the EtherCAT slave or NX Unit that is allocated to a CNC motor.		Check the event log for the EtherCAT error that occurred. Remove the cause of the error and clear the relevant error.		None	
Attached information	None					
Precautions/ Remarks	Even if this error is reset, the error in the EtherCAT Master Function Module is not reset. This error can be reset without resetting the error in the EtherCAT Master Function Module, but the CNC motor will still set in Servo OFF.					

Event name	SD Memory Card Access Failure			**Event code**	561D0000 hex	
Meaning	SD Memory Card access failed when an instruction was executed.					
Source	CNC Function Module		**Source details**	CNC common	**Detection timing**	At instruction execution
Error attributes	**Level**	Observation	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications. The operation of the Unit is not affected.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_COM.Obsr.Active		BOOL		CNC Common Observation Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	An SD Memory Card is not inserted.		Insert an SD Memory Card.		Insert an SD Memory Card.	
	The SD Memory Card is damaged.		If none of the above causes applies, replace the SD Memory Card.		Do not remove the SD Memory Card or interrupt the power supply while the SD BUSY indicator is lit. Or, replace the SD Memory Card periodically according to the write life of the SD Memory Card.	
	The SD Memory Card slot is broken.		If this error recurs after you took the two actions mentioned above, replace the Controller.		None	
Attached information	None					
Precautions/ Remarks	None					

Event name	File Does Not Exist			**Event code**	561E0000 hex	
Meaning	The file specified for an instruction does not exist.					
Source	CNC Function Module		**Source details**	CNC common	**Detection timing**	At instruction execution
Error attributes	**Level**	Observation	**Recovery**	Error reset	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications. The operation of the Unit is not affected.		
System -defined variables	**Variable**		**Data type**		**Name**	
	_CNC_COM.Obsr.Active		BOOL		CNC Common Observation Occurrence	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	The specified file does not exist.		Make sure that the filename that is specified for the instruction exists. Or, modify the filename so that it matches the filename specified for the instruction.		Make sure that the filename that is specified for the instruction exists.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Illegal Load NC Program Number Specification		**Event code**	561F0000 hex	
Meaning	Loading failed because an attempt was made to load the NC program with an invalid program number specified.				
Source	CNC Function Module	**Source details**	CNC common	**Detection timing**	At instruction execution
Error attributes	**Level** Observation	**Recovery**	Error reset	**Log category**	System
Effects	**User program** Continues.	**Operation**	The relevant instruction will end according to specifications. The operation of the Unit is not affected.		
System-defined variables	**Variable**	**Data type**		**Name**	
	_CNC_COM.Obsr.Active	BOOL		CNC Common Observation Occurrence	
Cause and correction	**Assumed cause**	**Correction**		**Prevention**	
	An attempt was made to load the NC program with an invalid program number specified.	Correct the parameter so that the NC program number does not exceed the specified range.		Correct the parameter so that the NC program number does not exceed the specified range.	
Attached information	Attached information 1: Row number with error detected (Indicates the row number after parsing processing.) Attached information 2: File name of the NC program with error detected (Last 15 characters when the file name length exceeds 16 characters)				
Precautions/ Remarks	None				

Event name	Too Many Files Open		**Event code**	56200000 hex	
Meaning	The maximum number of open files was exceeded when opening a file for an instruction.				
Source	CNC Function Module	**Source details**	CNC common	**Detection timing**	At instruction execution
Error attributes	**Level** Observation	**Recovery**	Error reset	**Log category**	System
Effects	**User program** Continues.	**Operation**	The relevant instruction will end according to specifications. The operation of the Unit is not affected.		
System-defined variables	**Variable**	**Data type**		**Name**	
	_CNC_COM.Obsr.Active	BOOL		CNC Common Observation Occurrence	
Cause and correction	**Assumed cause**	**Correction**		**Prevention**	
	The maximum number of open files was exceeded when opening a file for an instruction.	Correct the program to reduce the number of open files.		Decrease the number of files. Or, write the program so that files that no longer need to be open are closed in order to prevent too many files from being open at once.	
Attached information	None				
Precautions/ Remarks	None				

Event name	File or Directory Name Is Too Long			Event code	56210000 hex	
Meaning	The file name or directory name that was specified for an instruction is too long.					
Source	CNC Function Module		Source details	CNC common	Detection timing	At instruction execution
Error attributes	Level	Observation	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The relevant instruction will end according to specifications. The operation of the Unit is not affected.		
System-defined variables	Variable		Data type		Name	
	_CNC_COM.Obsr.Active		BOOL		CNC Common Observation Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	The file name or directory name that was specified for the instruction to create is too long.		Correct the program so that the file name or directory name specified for the instruction is within FAT16/FAT32 restrictions.		Write the program so that the specified file names and directory names are within FAT16/FAT32 restrictions.	
Attached information	None					
Precautions/ Remarks	None					

Event name	SD Memory Card Access Failed			Event code	56220000 hex	
Meaning	SD Memory Card access failed.					
Source	CNC Function Module		Source details	CNC common	Detection timing	At instruction execution
Error attributes	Level	Observation	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The relevant instruction will end according to specifications. The operation of the Unit is not affected.		
System-defined variables	Variable		Data type		Name	
	_CNC_COM.Obsr.Active		BOOL		CNC Common Observation Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	The SD Memory Card is damaged.		Replace the SD Memory Card.		Do not remove the SD Memory Card or interrupt the power supply while the SD BUSY indicator is lit. Or, replace the SD Memory Card periodically according to the write life of the SD Memory Card.	
	The SD Memory Card slot is broken.		If this error recurs after you took the above correction, replace the Controller.		None	
Attached information	None					
Precautions/ Remarks	None					

Event name	Load NC Program Capacity Exceeded			Event code	56230000 hex	
Meaning	Loading failed because an attempt was made to load the NC program over the maximum capacity.					
Source	CNC Function Module		Source details	CNC common	Detection timing	At instruction execution
Error attributes	Level	Observation	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The relevant instruction will end according to specifications. The operation of the Unit is not affected.		
System -defined variables	Variable		Data type		Name	
	_CNC_COM.Obsr.Active		BOOL		CNC Common Observation Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	An attempt was made to load the NC program over the maximum capacity.		Set *1: _cncDelLoadedFile* to the *DeleteFile* input variable for the relevant instruction, and delete the loaded NC program once.		Set *1: _cncDelLoadedFile* to the *DeleteFile* input variable for the relevant instruction when changing the setup so that the NC program loaded at the same time does not exceed the maximum capacity, and write the program to delete the loaded NC program.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Number of NC Program Exceeded			Event code	56240000 hex	
Meaning	Loading failed because an attempt was made to load NC programs over the maximum number of NC programs.					
Source	CNC Function Module		Source details	CNC common	Detection timing	At instruction execution
Error attributes	Level	Observation	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The relevant instruction will end according to specifications. The operation of the Unit is not affected.		
System -defined variables	Variable		Data type		Name	
	_CNC_COM.Obsr.Active		BOOL		CNC Common Observation Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	A new NC program was loaded while the number of loaded NC programs reaches the maximum.		Correct the program to reduce the number of NC programs to be loaded.		Write the program so that the program numbers of unused NC programs are reused to prevent too many NC programs from being loaded.	
Attached information	Attached information 1: Row number with error detected (Indicates the row number after parsing processing.) Attached information 2: File name of the NC program with error detected (Last 15 characters when the file name length exceeds 16 characters)					
Precautions/ Remarks	None					

Event name	Illegal Load NC Program			Event code	5628 0000 hex	
Meaning	An error was detected in the loaded NC program.					
Source	CNC Function Module		Source details	CNC common	Detection timing	At instruction execution
Error attributes	Level	Observation	Recovery	Error reset	Log category	System
Effects	User program	Continues.	Operation	The relevant instruction will end according to specifications. The operation of the Unit is not affected.		
System-defined variables	Variable		Data type		Name	
	_CNC_COM.Obsr.Active		BOOL		CNC Common Observation Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	A syntax error was detected in the NC program you made an attempt to load.		• Perform parsing processing with CNC Operator, and specify the NC program that was transferred to the SD Memory Card. • The file name and row number of the NC program with the error detected are shown in the attached information. Make sure that the syntax and instruction are correct. • If this error recurs after you took the above correction, contact your OMRON representative.		Do not edit the file of the NC program that was parsed with CNC Operator and transferred to the SD Memory Card.	
Attached information	Attached information 1: Row number with error detected (Indicates the row number after parsing processing.) Attached information 2: File name of the NC program with error detected (Last 15 characters when the file name length exceeds 16 characters) Attached information 3: System information					
Precautions/ Remarks	None					

<table>
<tr><td>Event name</td><td colspan="3">Following Error Warning</td><td>Event code</td><td colspan="2">678C0000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">The following error exceeded the Following Error Warning Value.</td></tr>
<tr><td>Source</td><td colspan="2">CNC Function Module</td><td>Source details</td><td>CNC motor</td><td>Detection timing</td><td>At instruction execution</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Observation</td><td>Recovery</td><td>Cycle the power supply or reset the Controller.</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">Not affected.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">_CNC_Motor[*].Obsr.Active</td><td colspan="2">BOOL</td><td colspan="2">CNC Common Observation Occurrence</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">The positioning operation has poor following performance and the actual motion is slower than the command.</td><td colspan="2">Remove the cause of poor following performance in the positioning operation.
Or increase the Following Error Warning Value within the range that will not create problems.</td><td colspan="2">Remove the cause of poor following performance in the positioning operation as best you can.</td></tr>
<tr><td>Attached information</td><td colspan="6">None</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">None</td></tr>
</table>

<table>
<tr><td>Event name</td><td colspan="3">Command Position Overflow</td><td>Event code</td><td colspan="2">678D0000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">The number of pulses for the command position overflowed.</td></tr>
<tr><td>Source</td><td colspan="2">CNC Function Module</td><td>Source details</td><td>CNC motor</td><td>Detection timing</td><td>Continuously</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Observation</td><td>Recovery</td><td>---</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The position is not updated, but motion continues.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">_CNC_Motor[*].Obsr.Active</td><td colspan="2">BOOL</td><td colspan="2">CNC Common Observation Occurrence</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">When the command position was converted to the pulse unit for the positioning cartesian axis or positioning rotational axis, the specified value exceeded the upper limit of the signed 40-bit data (signed 54-bit data for the spindle axis).</td><td colspan="2">Correct the program so that the input value for the command position does not exceed the pulse number limit for the instruction. Or, change the electronic gear ratio settings.
To recover from the overflow, perform the homing operation.</td><td colspan="2">Check the gear ratio setting and the target position setting value, and make sure that the converted number of pulses does not exceed the specified range.</td></tr>
<tr><td>Attached information</td><td colspan="6">None</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">None</td></tr>
</table>

Event name	Command Position Underflow			Event code	678E0000 hex	
Meaning	The number of pulses for the command position exceeded the valid range. (It underflowed.)					
Source	CNC Function Module		Source details	CNC motor	Detection timing	Continuously
Error attributes	Level	Observation	Recovery	---	Log category	System
Effects	User program	Continues.	Operation	The position is not updated, but motion continues.		
System -defined variables	Variable		Data type		Name	
	_CNC_Motor[*].Obsr.Active		BOOL		CNC Common Observation Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	When the command position was converted to the pulse unit for the positioning cartesian axis or positioning rotational axis, the specified value exceeded the lower limit of the signed 40-bit data (signed 54-bit data for the spindle axis).		Correct the program so that the input value for the command position does not exceed the pulse number limit for the instruction. Or, change the electronic gear ratio settings. To recover from the underflow, perform the homing operation.		Check the gear ratio setting and the target position setting value, and make sure that the converted number of pulses does not exceed the specified range.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Actual Position Overflow			Event code	678F0000 hex	
Meaning	The number of pulses for the actual position overflowed.					
Source	CNC Function Module		Source details	CNC motor	Detection timing	Continuously
Error attributes	Level	Observation	Recovery	---	Log category	System
Effects	User program	Continues.	Operation	The position is not updated, but motion continues.		
System -defined variables	Variable		Data type		Name	
	_CNC_Motor[*].Obsr.Active		BOOL		CNC Common Observation Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	When the command position was converted to the pulse unit for the positioning cartesian axis or positioning rotational axis, the specified value exceeded the upper limit of the signed 40-bit data (signed 54-bit data for the spindle axis).		Correct the program so that the target position is well within the pulse number limit so that the actual position does not exceed the pulse number limit for the instruction. Or, change the electronic gear ratio settings. To recover from the overflow, perform the homing operation.		Check the gear ratio setting and the target position setting value, and make sure that the converted number of pulses does not exceed the specified range. Allow some leeway.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Actual Position Underflow			Event code	67900000 hex	
Meaning	The number of pulses for the actual position underflowed.					
Source	CNC Function Module		Source details	CNC motor	Detection timing	Continuously
Error attributes	Level	Observation	Recovery	---	Log category	System
Effects	User program	Continues.	Operation	The position is not updated, but motion continues.		
System-defined variables	Variable		Data type		Name	
	_CNC_Motor[*].Obsr.Active		BOOL		CNC Common Observation Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	When the command position was converted to the pulse unit for the positioning cartesian axis or positioning rotational axis, the specified value exceeded the lower limit of the signed 40-bit data (signed 54-bit data for the spindle axis).		Correct the program so that the target position is well within the pulse number limit so that the actual position does not exceed the pulse number limit for the instruction. Or, change the electronic gear ratio settings. To recover from the underflow, perform the homing operation.		Check the gear ratio setting and the target position setting value, and make sure that the converted number of pulses does not exceed the specified range. Allow some leeway.	
Attached information	None					
Precautions/ Remarks	None					

Event name	Position Deviation between Axes Limit Warning			Event code	679A0000 hex	
Meaning	The deviation of the feedback current position between the gantry master axis and the gantry slave axis exceeded the Position Deviation Between Axes Warning Value.					
Source	CNC Function Module		Source details	CNC motor	Detection timing	Whenever Servo is ON
Error attributes	Level	Observation	Recovery	---	Log category	System
Effects	User program	Continues.	Operation	Not affected.		
System-defined variable	Variable		Data type		Name	
	_CNC_Motor[*].Obsr.Active		BOOL		CNC Common Observation Occurrence	
Cause and correction	Assumed cause		Correction		Prevention	
	The gantry slave axis is moving slower than the gantry master axis due to poor following performance of the slave axis.		Eliminate the cause of making the gantry slave axis move slower than it should. Alternatively, increase the Position Deviation Between Axes Warning Value within the range that will not create problems.		Eliminate the cause of making the gantry slave axis move slower than it should as much as possible.	
Attached information	None					
Precautions/ Remarks	None					

<table>
<tr><td>Event name</td><td colspan="3">CNC Planner Service Period Exceeded</td><td>Event code</td><td colspan="2">77810000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">CNC planner service processing was not finished within two periods.</td></tr>
<tr><td>Source</td><td colspan="2">CNC Function Module</td><td>Source details</td><td>CNC common</td><td>Detection timing</td><td>Continuously</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Observation</td><td>Recovery</td><td>---</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">Not affected.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">_CNC_COM.Obsr.Active</td><td colspan="2">BOOL</td><td colspan="2">CNC Common Observation Occurrence</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">The processing load of the NC program in a period of the CNC planner service is too heavy.</td><td colspan="2">Reduce the amount of processing of the NC program in a period of the CNC planner service, or set the CNC planner service period to a greater value within the range that does not adversely affect operation.
Check the CNC planner service period in the Task Period Monitor of the Sysmac Studio.</td><td colspan="2">Set the CNC planner service period to be long enough to complete all required processing.</td></tr>
<tr><td>Attached information</td><td colspan="6">None</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">None</td></tr>
</table>

<table>
<tr><td>Event name</td><td colspan="3">Slave Observation Detected</td><td>Event code</td><td colspan="2">77870000 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">A warning was detected for an EtherCAT slave or NX Unit.</td></tr>
<tr><td>Source</td><td colspan="2">CNC Function Module</td><td>Source details</td><td>CNC motor</td><td>Detection timing</td><td>Continuously</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Observation</td><td>Recovery</td><td>---</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">Not affected.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">_CNC_Motor[*].Obsr.Active</td><td colspan="2">BOOL</td><td colspan="2">CNC Common Observation Occurrence</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">A warning was detected for the EtherCAT slave or NX Unit that is allocated to a CNC motor.</td><td colspan="2">Check the warning code for the EtherCAT slave and remove the cause of the warning.</td><td colspan="2">None</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached information 1: Drive warning code</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">None</td></tr>
</table>

Event name	Software Limit Path Limited		Event code	97810000 hex	
Meaning	The path exceeded the software limit was specified during *Executing* (Executing). Therefore, the path was limited within the software limit range.				
Source	CNC Function Module	Source details	CNC motor	Detection timing	During *Executing*
Error attributes	Level	Observation	Recovery	---	Log category: System
Effects	User program	Continues.	Operation	Not affected.	
System-defined variables	Variable		Data type	Name	
	_CNC_Motor[*].Obsr.Active		BOOL	CNC Common Observation Occurrence	
Cause and correction	Assumed cause		Correction	Prevention	
	The path exceeded the software limit was specified during *Executing* (Executing).		Correct the NC program so that the path specified by the NC program does not exceed the software limit, or change *Positive Software Overtravel Limit* or *Negative Software Overtravel Limit* of the Limit Settings to the appropriate setting.	Set the appropriate path and software limit specified for the NC program.	
Attached information	None				
Precautions/ Remarks	To detect a minor fault error, set the *Software Overtravel Limit Operation Control* operation parameter in the CNC coordinate system to *0: Error.*				

Event name	Velocity Control Command Value Saturated		Event code	97830000 hex	
Meaning	The velocity control command value for the servo drive is saturated.				
Source	CNC Function Module	Source details	CNC motor	Detection timing	Whenever Servo is ON
Error attributes	Level	Observation	Recovery	---	Log category: System
Effects	User program	Continues.	Operation	Not affected.	
System-defined variables	Variable		Data type	Name	
	_CNC_Motor[*].Obsr.Active		BOOL	CNC Common Observation Occurrence	
Cause and correction	Assumed cause		Correction	Prevention	
	The output value for Feedback loop calculation exceeded the *Maximum Velocity* for the CNC motor parameter setting, or the positioning operation has poor following performance and the actual motion is slower than the command.		Remove the cause of poor following performance in the positioning operation.	Remove the cause of poor following performance in the positioning operation as best you can.	
	The commanded master axis rotation rate (S) or master axis velocity override factor exceeded the *Maximum Velocity* for the CNC motor parameter setting.		Check the command value of the master axis rotation rate (S) and the master axis velocity override factor, and correct the program so that the value does not exceed the *Maximum Velocity* for the CNC motor parameter setting.	Check to see if any of the conditions that are given as causes exist in advance.	
Attached information	None				
Precautions/ Remarks	None				

Event name	Slave Error Code Report			Event code	9780 0000 hex	
Meaning	The error code was reported by the slave when a *Slave Error Detected* error occurred.					
Source	CNC Function Module		Source details	CNC motor	Detection timing	After *Slave Error Detected* error (77860000 hex)
Error attributes	Level	Information	Recovery	---	Log category	System
Effects	User program	Continues.	Operation	Not affected.		
System-defined variables	Variable		Data type		Name	
	None		---		---	
Cause and correction	Assumed cause		Correction		Prevention	
	The error code was reported by the slave when a *Slave Error Detected* error (77860000 hex) occurred.		This error accompanies a *Slave Error Detected* error (77860000 hex). Check the slave error code in the attached information and make the required corrections.		None	
Attached information	Attached information 1: Slave error code					
Precautions/ Remarks	For the OMRON 1S-series Servo Drive or G5-series Servo Drive, the error code (the main part of the error display number) from the Servo Drive is included in the lower two digits of the attached information. For example, if the attached information is displayed as *FF13*, the error with display number 13 (Main Circuit Power Supply Undervoltage) occurred in the Servo Drive.					

Event name	CNC Function System Information			Event code	9782 0000 hex	
Meaning	This event provides internal information from the CNC Function Module.					
Source	CNC Function Module		Source details	CNC common	Detection timing	Continuously
Error attributes	Level	Information	Recovery	---	Log category	System
Effects	User program	Continues.	Operation	Not affected.		
System-defined variables	Variable		Data type		Name	
	None		---		---	
Cause and correction	Assumed cause		Correction		Prevention	
	This event provides internal information from the CNC Function Module. It is recorded to provide additional information for another event.		None		None	
Attached information	Attached information 1: System information Attached information 2: System information Attached information 3: System information Attached information 4: System information					
Precautions/ Remarks	None					

CNC Instruction Errors

This section provides a table of errors (events) that occur for CNC instructions. The lower four digits of the event code give the error code for the instruction. For descriptions of the error codes, refer to the descriptions of the corresponding event codes. For example, if the error code of the instruction is 16#3781, refer to the description of the event with event code 54013781 hex.

<table>
<tr><td>Event name</td><td colspan="4">Process Data Object Setting Missing</td><td>Event code</td><td colspan="2">54013781 hex</td></tr>
<tr><td>Meaning</td><td colspan="7">The PDO mapping is not correct.</td></tr>
<tr><td>Source</td><td colspan="2">PLC Function Module</td><td>Source details</td><td>Instruction</td><td>Detection timing</td><td colspan="2">At instruction execution</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Observation</td><td>Recovery</td><td>---</td><td>Log category</td><td colspan="2">System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="4">The relevant instruction will end according to specifications.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="3">Name</td></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="3">---</td></tr>
<tr><td rowspan="3">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="3">Prevention</td></tr>
<tr><td colspan="2">The PDOs that are required for the CNC instruction are not mapped.</td><td colspan="2">Map the PDOs that are required for the instruction.</td><td colspan="3">Map the PDOs that are required for the instructions that are used.</td></tr>
<tr><td colspan="2">The relevant instruction was executed for a device that does not have an object that supports the instruction.</td><td colspan="2">Some devices do not support the relevant instruction.
Refer to the manual for the device, check to see if the relevant instruction is supported, and correct the program so that unsupported instructions are not executed.</td><td colspan="3">Refer to the manual for the device and write the program so that unsupported instructions are not executed.</td></tr>
<tr><td>Attached information</td><td colspan="7">Attached Information 1: Error Location
Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given.
Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified.
Attached Information 4: Expansion Error Code (ErrorIDEx)</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="7">If a program is changed after an error occurs, the attached information that is displayed may not be correct.</td></tr>
</table>

Event name	Illegal CNC Coordinate System Specification			**Event code**	54015600 hex	
Meaning	The CNC coordinate system specified for the *Coord* in-out variable to a CNC instruction does not exist.					
Source	PLC Function Module		**Source details**	Instruction	**Detection timing**	At instruction execution
Error attributes	**Level**	Observation	**Recovery**	---	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.		
System-defined variables	**Variable**		**Data type**		**Name**	
	None		---		---	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	CNC coordinate system does not exist for the variable specified for the *Coord* in-out variable to the instruction.		Correct the instruction so that the variable exists for the CNC coordinate system that was specified for the instruction.		Specify a variable that exists when specifying a variable for an input parameter to an instruction.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

Event name	Deceleration Setting Out of Range			**Event code**	54015601 hex	
Meaning	The parameter specified for the *Deceleration* input variable to a CNC instruction is out of range.					
Source	PLC Function Module		**Source details**	Instruction	**Detection timing**	At instruction execution
Error attributes	**Level**	Observation	**Recovery**	---	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.		
System-defined variables	**Variable**		**Data type**		**Name**	
	None		---		---	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	Instruction input parameter exceeded the valid range of the input variable.		Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

<table>
<tr><th>Event name</th><td colspan="3">Jerk Setting Out of Range</td><th>Event code</th><td colspan="2">54015602 hex</td></tr>
<tr><th>Meaning</th><td colspan="6">The parameter specified for the Jerk input variable to a CNC instruction is out of range.</td></tr>
<tr><th>Source</th><td colspan="2">PLC Function Module</td><th>Source details</th><td>Instruction</td><th>Detection timing</th><td>At instruction execution</td></tr>
<tr><th>Error attributes</th><th>Level</th><td>Observation</td><th>Recovery</th><td>---</td><th>Log category</th><td>System</td></tr>
<tr><th>Effects</th><th>User program</th><td>Continues.</td><th>Operation</th><td colspan="3">The relevant instruction will end according to specifications.</td></tr>
<tr><th rowspan="2">System -defined variables</th><th colspan="2">Variable</th><th colspan="2">Data type</th><th colspan="2">Name</th></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><th rowspan="2">Cause and correction</th><th colspan="2">Assumed cause</th><th colspan="2">Correction</th><th colspan="2">Prevention</th></tr>
<tr><td colspan="2">Instruction input parameter exceeded the valid range of the input variable.</td><td colspan="2">Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.</td><td colspan="2">Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.</td></tr>
<tr><th>Attached information</th><td colspan="6">Attached Information 1: Error Location
Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given.
Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified.
Attached Information 4: Expansion Error Code (ErrorIDEx)</td></tr>
<tr><th>Precautions/ Remarks</th><td colspan="6">If a program is changed after an error occurs, the attached information that is displayed may not be correct.</td></tr>
</table>

Event name	CNC Instruction Re-execution Disabled			Event code	5401 5603 hex	
Meaning	A CNC instruction that cannot be re-executed was re-executed.					
Source	PLC Function Module		Source details	Instruction	Detection timing	At instruction execution
Error attributes	Level	Observation	Recovery	---	Log category	System
Effects	User program	Continues.	Operation	The relevant instruction will end according to specifications.		
System-defined variables	Variable		Data type		Name	
	None		---		---	
Cause and correction	Assumed cause		Correction		Prevention	
	A CNC instruction that cannot be re-executed was re-executed.		Correct the program so that the *Execute* input variable does not change to TRUE until the *Busy* output variable from the instruction changes to FALSE.		When using instructions that cannot be re-executed, include a condition for the *Execute* input variable so that it does not change to TRUE unless the *Busy* output variable for the previous instruction is FALSE. Or, stop the instruction before executing it again.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

Event name	CNC Multi-execution Disabled			**Event code**	54015604 hex	
Meaning	Multiple functions that cannot be executed simultaneously were executed for the same target (CNC coordinate system).					
Source	PLC Function Module		**Source details**	Instruction	**Detection timing**	At instruction execution
Error attributes	**Level**	Observation	**Recovery**	---	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.		
System -defined variables	**Variable**		**Data type**		**Name**	
	None		---		---	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	• Multiple functions that cannot be executed simultaneously were executed for the same target (CNC coordinate system). • The CNC_LoadProgramFile instruction was executed when any of CNC coordinate system was *Executing* (Executing) or *Hold* (Holding).		Check the specifications of multi-execution of instructions for this instruction and correct the program so that instructions that cannot be executed at the same time are not executed simultaneously.		Check the specifications for multi-execution of instructions for the instruction and do not execute instructions that cannot be executed at the same time.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

Event name	Unassigned Logical CNC Motor Number Specified			**Event code**	54015605 hex	
Meaning	The CNC motor of the parameter specified for the *LogicalMotorNo* input variable to the CNC instruction is not assigned.					
Source	PLC Function Module		**Source details**	Instruction	**Detection timing**	At instruction execution
Error attributes	**Level**	Observation	**Recovery**	---	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.		
System -defined variables	**Variable**		**Data type**		**Name**	
	None		---		---	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	The logical CNC motor number for which the CNC motor is not assigned to the *LogicalMotorNo* input variable to the CNC instruction was specified, and the instruction was executed.		Correct the parameter so that the specified value does not exceed the range of the logical CNC motor number for which the CNC motor is assigned to the *LogicalMotorNo* input variable to the instruction.		Specify the appropriate parameter so that the *LogicalMotorNo* input variable to the instruction does not exceed the range of *Positioning Axis Assignment* or *Spindle Axis Assignment* in the CNC coordinate system parameter settings.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

<table>
<tr><td>Event name</td><td colspan="3">Logical CNC Motor Number Out of Range</td><td>Event code</td><td colspan="2">54015606 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">The parameter specified for the LogicalMotorNo input variable to a CNC instruction is out of range.</td></tr>
<tr><td>Source</td><td colspan="2">PLC Function Module</td><td>Source details</td><td>Instruction</td><td>Detection timing</td><td>At instruction execution</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Observation</td><td>Recovery</td><td>---</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The relevant instruction will end according to specifications.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">Instruction input parameter exceeded the valid range of the input variable.</td><td colspan="2">Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.</td><td colspan="2">Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached Information 1: Error Location
Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given.
Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified.
Attached Information 4: Expansion Error Code (ErrorIDEx)</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">If a program is changed after an error occurs, the attached information that is displayed may not be correct.</td></tr>
</table>

<table>
<tr><td>Event name</td><td colspan="3">Target Position Setting Out of Range</td><td>Event code</td><td colspan="2">54015607 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">The parameter specified for the Position input variable to a CNC instruction is out of range.</td></tr>
<tr><td>Source</td><td colspan="2">PLC Function Module</td><td>Source details</td><td>Instruction</td><td>Detection timing</td><td>At instruction execution</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Observation</td><td>Recovery</td><td>---</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The relevant instruction will end according to specifications.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">Instruction input parameter exceeded the valid range of the input variable. Or, there was an overflow/underflow in the target position.</td><td colspan="2">Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.</td><td colspan="2">Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached Information 1: Error Location
Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given.
Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified.
Attached Information 4: Expansion Error Code (ErrorIDEx)</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">If a program is changed after an error occurs, the attached information that is displayed may not be correct.</td></tr>
</table>

<table>
<tr><td>Event name</td><td colspan="3">Impossible CNC Motor Operation Specified when the Servo is OFF</td><td>Event code</td><td colspan="2">54015608 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">An operation instruction was executed for the CNC motor for which the Servo is OFF.</td></tr>
<tr><td>Source</td><td colspan="2">PLC Function Module</td><td>Source details</td><td>Instruction</td><td>Detection timing</td><td>At instruction execution</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Observation</td><td>Recovery</td><td>---</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The relevant instruction will end according to specifications.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><td rowspan="3">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">An operation instruction was executed for the CNC motor for which the Servo is OFF.</td><td colspan="2">Correct the program so that the instruction is executed after the Servo is turned ON.</td><td colspan="2">Make sure to execute the operation instruction after the Servo is turned ON.</td></tr>
<tr><td colspan="2">Home was preset with the CNC_Home or CNC_HomeWithParameter instruction for an axis for which EtherCAT process data communications are not established.</td><td colspan="2">If the _EC_PDSlavTbl (Process Data Communicating Slave Table) system-defined variable for the EtherCAT master of the master axis is FALSE, remove the cause and execute the CNC_Home or CNC_HomeWithParameter instruction to preset home after _EC_PDSlavTbl changes to TRUE.</td><td colspan="2">If you execute the CNC_Home or CNC_HomeWithParameter instruction to preset home immediately after you turn ON the power supply to the Controller, download data, reset a slave communications error, disconnect the slave, reconnect the slave, or disable or enable the slave, write the program to make sure that the _EC_PDSlavTbl (Process Data Communicating Slave Table) system-defined variable for the EtherCAT master is TRUE before you execute CNC_Home or CNC_HomeWithParameter.</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached Information 1: Error Location
Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given.
Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified.
Attached Information 4: Expansion Error Code (ErrorIDEx)</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">If a program is changed after an error occurs, the attached information that is displayed may not be correct.</td></tr>
</table>

Event name	Target Velocity Setting Out of Range			Event code	5401 5609 hex	
Meaning	The parameter specified for the *Velocity* input variable to a CNC instruction is out of range.					
Source	PLC Function Module		Source details	Instruction	Detection timing	At instruction execution
Error attributes	Level	Observation	Recovery	---	Log category	System
Effects	User program	Continues.	Operation	The relevant instruction will end according to specifications.		
System -defined variables	Variable		Data type		Name	
	None		---		---	
Cause and correction	Assumed cause		Correction		Prevention	
	Instruction input parameter exceeded the valid range of the input variable.		Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

Event name	Acceleration/Deceleration Setting Out of Range			Event code	5401 560A hex	
Meaning	The parameter specified for the *Acceleration* input variable to a CNC instruction is out of range.					
Source	PLC Function Module		Source details	Instruction	Detection timing	At instruction execution
Error attributes	Level	Observation	Recovery	---	Log category	System
Effects	User program	Continues.	Operation	The relevant instruction will end according to specifications.		
System -defined variables	Variable		Data type		Name	
	None		---		---	
Cause and correction	Assumed cause		Correction		Prevention	
	Instruction input parameter exceeded the valid range of the input variable.		Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

Event name	Travel Mode Selection Out of Range			**Event code**	5401560B hex	
Meaning	The parameter specified for the *MoveMode* input variable to a CNC instruction is out of range.					
Source	PLC Function Module		**Source details**	Instruction	**Detection timing**	At instruction execution
Error attributes	**Level**	Observation	**Recovery**	---	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.		
System -defined variables	**Variable**		**Data type**		**Name**	
	None		---		---	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	Instruction input parameter exceeded the valid range of the input variable.		Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

Event name	Parameter Selection Out of Range			**Event code**	5401560D hex	
Meaning	The parameter specified for the *ParameterNumber* input variable to a CNC instruction is out of range.					
Source	PLC Function Module		**Source details**	Instruction	**Detection timing**	At instruction execution
Error attributes	**Level**	Observation	**Recovery**	---	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.		
System -defined variables	**Variable**		**Data type**		**Name**	
	None		---		---	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	Instruction input parameter exceeded the valid range of the input variable.		Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

Event name	CNC Parameter Setting Read/Write Setting Value Out of Range			**Event code**	5401560E hex	
Meaning	The parameter specified for the *SettingValue* in-out variable to a CNC instruction is out of range.					
Source	PLC Function Module		**Source details**	Instruction	**Detection timing**	At instruction execution
Error attributes	**Level**	Observation	**Recovery**	---	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.		
System-defined variables	**Variable**		**Data type**		**Name**	
	None		---		---	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	Instruction input parameter exceeded the valid range of the in-out variable.		Correct the parameter so that the valid range of the in-out variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the in-out variable is not exceeded.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

Event name	CNC Parameter Setting Read/Write Target Out of Range			**Event code**	5401560F hex	
Meaning	The parameter specified for the *Target* in-out variable to a CNC instruction is out of range.					
Source	PLC Function Module		**Source details**	Instruction	**Detection timing**	At instruction execution
Error attributes	**Level**	Observation	**Recovery**	---	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.		
System-defined variables	**Variable**		**Data type**		**Name**	
	None		---		---	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	Instruction input parameter exceeded the valid range of the in-out variable.		Correct the parameter so that the valid range of the in-out variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the in-out variable is not exceeded.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

Event name	Homing Parameter Setting Out of Range			Event code	54015611 hex
Meaning	The parameter specified for the *HomingParameter* in-out variable to a CNC instruction is out of range.				
Source	PLC Function Module	Source details	Instruction	Detection timing	At instruction execution
Error attributes	Level: Observation	Recovery	---	Log category	System
Effects	User program: Continues.	Operation	The relevant instruction will end according to specifications.		
System-defined variables	Variable	Data type		Name	
	None	---		---	
Cause and correction	Assumed cause	Correction		Prevention	
	Instruction input parameter exceeded the valid range of the in-out variable.	Correct the parameter so that the valid range of the in-out variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the in-out variable is not exceeded.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)				
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.				

Event name	M Code Number Out of Range			Event code	54015612 hex
Meaning	The parameter specified for the *MCodeNo* input variable to a CNC instruction is out of range.				
Source	PLC Function Module	Source details	Instruction	Detection timing	At instruction execution
Error attributes	Level: Observation	Recovery	---	Log category	System
Effects	User program: Continues.	Operation	The relevant instruction will end according to specifications.		
System-defined variables	Variable	Data type		Name	
	None	---		---	
Cause and correction	Assumed cause	Correction		Prevention	
	Instruction input parameter exceeded the valid range of the input variable.	Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)				
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.				

<table>
<tr><td>Event name</td><td colspan="3">CNC Instruction Re-execution Disabled (CNC Coordinate System Specification)</td><td>Event code</td><td colspan="2">54015613 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">An attempt was made to change the parameter for the Coord in-out variable when re-executing a CNC instruction. (This in-out variable cannot be changed when re-executing an instruction.)</td></tr>
<tr><td>Source</td><td colspan="2">PLC Function Module</td><td>Source details</td><td>Instruction</td><td>Detection timing</td><td>At instruction execution</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Observation</td><td>Recovery</td><td>---</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The relevant instruction will end according to specifications.</td></tr>
<tr><td rowspan="2">System-defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">A parameter for an in-out variable that cannot be changed for re-execution was changed.</td><td colspan="2">Correct the program so that the parameter for the relevant in-out variable does not change when the relevant instruction is re-executed.</td><td colspan="2">Check the manual to see if each in-out variable to the relevant CNC instruction can be changed by re-execution. Write the program so that the input parameters for any in-out variable that cannot be changed do not change upon re-execution.</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached Information 1: Error Location
Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given.
Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified.
Attached Information 4: Expansion Error Code (ErrorIDEx)</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">If a program is changed after an error occurs, the attached information that is displayed may not be correct.</td></tr>
</table>

Event name	CNC Instruction Re-execution Disabled (Logical CNC Motor Number)			**Event code**	54015614 hex	
Meaning	An attempt was made to change the parameter for the *LogicalMotorNo* input variable when re-executing a CNC instruction. (This input variable cannot be changed when re-executing an instruction.)					
Source	PLC Function Module		**Source details**	Instruction	**Detection timing**	At instruction execution
Error attributes	**Level**	Observation	**Recovery**	---	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.		
System-defined variables	**Variable**		**Data type**		**Name**	
	None		---		---	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	A parameter for an input variable that cannot be changed for re-execution was changed.		Correct the program so that the parameter for the relevant input variable does not change when the relevant instruction is re-executed.		Check the manual to see if each input variable to the relevant CNC instruction can be changed by re-execution. Write the program so that the input parameters for any input variable that cannot be changed do not change upon re-execution.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

<table>
<tr><td>Event name</td><td colspan="3">SD Memory Card Access Failure</td><td>Event code</td><td colspan="2">5401561D hex</td></tr>
<tr><td>Meaning</td><td colspan="6">SD Memory Card access failed when an instruction was executed.</td></tr>
<tr><td>Source</td><td colspan="2">PLC Function Module</td><td>Source details</td><td>Instruction</td><td>Detection timing</td><td>At instruction execution</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Observation</td><td>Recovery</td><td>---</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The relevant instruction will end according to specifications.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><td rowspan="4">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">An SD Memory Card is not inserted.</td><td colspan="2">Insert an SD Memory Card.</td><td colspan="2">Insert an SD Memory Card.</td></tr>
<tr><td colspan="2">The SD Memory Card is damaged.</td><td colspan="2">Replace the SD Memory Card already confirmed that it operates normally.</td><td colspan="2">Do not remove the SD Memory Card or interrupt the power supply while the SD BUSY indicator is lit. Or, replace the SD Memory Card periodically according to the write life of the SD Memory Card.</td></tr>
<tr><td colspan="2">The SD Memory Card slot is broken.</td><td colspan="2">If this error recurs after you took the two actions mentioned above, replace the Controller.</td><td colspan="2">None</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached Information 1: Error Location
Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given.
Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified.
Attached Information 4: Expansion Error Code (ErrorIDEx)</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">If a program is changed after an error occurs, the attached information that is displayed may not be correct.</td></tr>
</table>

Event name	File Does Not Exist			Event code	5401561E hex		
Meaning	The file specified for an instruction does not exist.						
Source	PLC Function Module		Source details	Instruction		Detection timing	At instruction execution
Error attributes	Level	Observation	Recovery	---		Log category	System
Effects	User program	Continues.	Operation	The relevant instruction will end according to specifications.			
System -defined variables	Variable		Data type		Name		
	None		---		---		
Cause and correction	Assumed cause		Correction		Prevention		
	The specified file does not exist.		Make sure that the filename that is specified for the instruction exists. Or, modify the filename so that it matches the filename specified for the instruction.		Make sure that the filename that is specified for the instruction exists.		
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)						
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.						

Event name	Illegal Load NC Program Number Specification			Event code	5401561F hex		
Meaning	Loading failed because an attempt was made to load the NC program with an invalid program number specified.						
Source	PLC Function Module		Source details	Instruction		Detection timing	At instruction execution
Error attributes	Level	Observation	Recovery	---		Log category	System
Effects	User program	Continues.	Operation	The relevant instruction will end according to specifications.			
System -defined variables	Variable		Data type		Name		
	None		---		---		
Cause and correction	Assumed cause		Correction		Prevention		
	An attempt was made to load the NC program with an invalid program number specified.		Correct the parameter so that the NC program number does not exceed the specified range.		Correct the parameter so that the NC program number does not exceed the specified range.		
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)						
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.						

Event name	Too Many Files Open			**Event code**	54015620 hex	
Meaning	The maximum number of open files was exceeded when opening a file for an instruction.					
Source	PLC Function Module		**Source details**	Instruction	**Detection timing**	At instruction execution
Error attributes	**Level**	Observation	**Recovery**	---	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.		
System -defined variables	**Variable**		**Data type**		**Name**	
	None		---		---	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	The maximum number of open files was exceeded when opening a file for an instruction.		Correct the program to reduce the number of open files.		Decrease the number of files. Or, write the program so that files that no longer need to be open are closed in order to prevent too many files from being open at once.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

Event name	File or Directory Name Is Too Long			**Event code**	54015621 hex	
Meaning	The file name or directory name that was specified for an instruction is too long.					
Source	PLC Function Module		**Source details**	Instruction	**Detection timing**	At instruction execution
Error attributes	**Level**	Observation	**Recovery**	---	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.		
System -defined variables	**Variable**		**Data type**		**Name**	
	None		---		---	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	The file name or directory name that was specified for the instruction to create is too long.		Correct the program so that the file name or directory name specified for the instruction is within FAT16/FAT32 restrictions.		Write the program so that the specified file names and directory names are within FAT16/FAT32 restrictions.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

Event name	SD Memory Card Access Failed			Event code	54015622 hex	
Meaning	SD Memory Card access failed.					
Source	PLC Function Module		Source details	Instruction	Detection timing	At instruction execution
Error attributes	Level	Observation	Recovery	---	Log category	System
Effects	User program	Continues.	Operation	The relevant instruction will end according to specifications.		
System-defined variables	Variable		Data type		Name	
	None		---		---	
Cause and correction	Assumed cause		Correction		Prevention	
	The SD Memory Card is damaged.		Replace the SD Memory Card.		Do not remove the SD Memory Card or interrupt the power supply while the SD BUSY indicator is lit. Or, replace the SD Memory Card periodically according to the write life of the SD Memory Card.	
	The SD Memory Card slot is broken.		If this error recurs after you took the above correction, replace the Controller.		None	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

<table>
<tr><td>Event name</td><td colspan="3">Load NC Program Capacity Exceeded</td><td>Event code</td><td colspan="2">54015623 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">Loading failed because an attempt was made to load the NC program over the maximum capacity.</td></tr>
<tr><td>Source</td><td colspan="2">PLC Function Module</td><td>Source details</td><td>Instruction</td><td>Detection timing</td><td>At instruction execution</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Observation</td><td>Recovery</td><td>---</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The relevant instruction will end according to specifications.</td></tr>
<tr><td rowspan="2">System-defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">An attempt was made to load the NC program over the maximum capacity.</td><td colspan="2">Set 1: _cncDelLoadedFile to the DeleteFile input variable for the relevant instruction, and delete the loaded NC program once.</td><td colspan="2">Set 1: _cncDelLoadedFile to the DeleteFile input variable for the relevant instruction when changing the setup so that the NC program loaded at the same time does not exceed the maximum capacity, and write the program to delete the loaded NC program.</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached Information 1: Error Location
Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given.
Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified.
Attached Information 4: Expansion Error Code (ErrorIDEx)</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">If a program is changed after an error occurs, the attached information that is displayed may not be correct.</td></tr>
</table>

Event name	Number of NC Program Exceeded			Event code	54015624 hex	
Meaning	Loading failed because an attempt was made to load NC programs over the maximum number of NC programs.					
Source	PLC Function Module		Source details	Instruction	Detection timing	At instruction execution
Error attributes	Level	Observation	Recovery	---	Log category	System
Effects	User program	Continues.	Operation	The relevant instruction will end according to specifications.		
System-defined variables	Variable		Data type		Name	
	None		---		---	
Cause and correction	Assumed cause		Correction		Prevention	
	A new NC program was loaded while the number of loaded NC programs reaches the maximum.		Correct the program to reduce the number of NC programs to be loaded.		Write the program so that the program numbers of unused NC programs are reused to prevent too many NC programs from being loaded.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

Event name	Illegal CNC Motor Specification			Event code	54015625 hex	
Meaning	The CNC motor specified for the *Target* in-out variable to a CNC instruction is not exist.					
Source	PLC Function Module		Source details	Instruction	Detection timing	At instruction execution
Error attributes	Level	Observation	Recovery	---	Log category	System
Effects	User program	Continues.	Operation	The relevant instruction will end according to specifications.		
System-defined variables	Variable		Data type		Name	
	None		---		---	
Cause and correction	Assumed cause		Correction		Prevention	
	A CNC motor does not exist for the variable specified for the *Target* input variable to the instruction.		Correct the instruction so that the variable exists for the CNC motor that was specified for the instruction.		Specify a variable that exists when specifying a variable for an input parameter to an instruction.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

<table>
<tr><td>Event name</td><td colspan="3">Illegal CNC Motor Compensation Table Specification</td><td>Event code</td><td colspan="2">54015626 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">The CNC motor compensation table specified for the Target input variable to a CNC instruction is not exist.</td></tr>
<tr><td>Source</td><td colspan="2">PLC Function Module</td><td>Source details</td><td>Instruction</td><td>Detection timing</td><td>At instruction execution</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Observation</td><td>Recovery</td><td>---</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The relevant instruction will end according to specifications.</td></tr>
<tr><td rowspan="2">System-defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">A CNC motor compensation table does not exist for the variable specified for the Target input variable to the instruction.</td><td colspan="2">Correct the instruction so that the variable exists for the CNC motor compensation table that was specified for the instruction.</td><td colspan="2">Specify a variable that exists when specifying a variable for an input parameter to an instruction.</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached Information 1: Error Location
Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given.
Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified.
Attached Information 4: Expansion Error Code (ErrorIDEx)</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">If a program is changed after an error occurs, the attached information that is displayed may not be correct.</td></tr>
</table>

Event name	Illegal Load NC Program			Event code	54015628 hex	
Meaning	An error was detected in the loaded NC program.					
Source	PLC Function Module		Source details	Instruction	Detection timing	At instruction execution
Error attributes	Level	Observation	Recovery	---	Log category	System
Effects	User program	Continues.	Operation	The relevant instruction will end according to specifications.		
System-defined variables	Variable		Data type		Name	
	None		---		---	
Cause and correction	Assumed cause		Correction		Prevention	
	A syntax error was detected in the NC program you made an attempt to load.		• Perform parsing processing with CNC Operator, and specify the NC program that was transferred to the SD Memory Card. • The file name and row number of the NC program with the error detected are shown in the attached information. Make sure that the syntax and instruction are correct. • If this error recurs after you took the above correction, contact your OMRON representative.		Do not edit the file of the NC program that was parsed with CNC Operator and transferred to the SD Memory Card.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

Event name	Skew Control Mode Out of Range			Event code	5401562A hex	
Meaning	The parameter specified for the *SkewMode* input variable to a CNC instruction is out of range.					
Source	PLC Function Module		**Source details**	Instruction	**Detection timing**	At instruction execution
Error attributes	**Level**	Observation	**Recovery**	---	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.		
System-defined variable	**Variable**		**Data type**		**Name**	
	None		---		---	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	Instruction input parameter exceeded the valid range of the input variable.		Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

Event name	Offset Value Setting Out of Range			Event code	5401562B hex	
Meaning	The parameter specified for the *OffsetValue* input variable to a CNC instruction is out of range.					
Source	PLC Function Module		**Source details**	Instruction	**Detection timing**	At instruction execution
Error attributes	**Level**	Observation	**Recovery**	---	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.		
System-defined variable	**Variable**		**Data type**		**Name**	
	None		---		---	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	Instruction input parameter exceeded the valid range of the input variable.		Correct the parameter so that the valid range of the input variable is not exceeded for the relevant instruction.		Set the input parameter to the instruction so that the valid range of the input variable is not exceeded.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

Event name	Target Position Positive Software Limit Exceeded			**Event code**	54016783 hex	
Meaning	The specified position exceeds the positive software limit.					
Source	PLC Function Module		**Source details**	Instruction	**Detection timing**	At instruction execution
Error attributes	**Level**	Observation	**Recovery**	---	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.		
System -defined variables	**Variable**		**Data type**		**Name**	
	None		---		---	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	The parameter specified for the *Position* input variable to the instruction is beyond the positive software limit.		Correct the parameter specified for the *Position* input variable to the instruction so that it is within the positive software limit.		Set the parameter specified for the *Position* input variable to the instruction so that it is within the positive software limit.	
	The first position is beyond the positive software limit and an instruction that specifies motion in the opposite direction of the software limit was executed.		Correct the program so that the travel direction for the instruction is towards the positive software limit.		If the first position is beyond the positive software limit, write the program so that the travel direction is in the direction of the positive software limit.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

<table>
<tr><td>Event name</td><td colspan="3">Target Position Negative Software Limit Exceeded</td><td>Event code</td><td colspan="2">54016784 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">The specified position exceeds the negative software limit.</td></tr>
<tr><td>Source</td><td colspan="2">PLC Function Module</td><td>Source details</td><td>Instruction</td><td>Detection timing</td><td>At instruction execution</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Observation</td><td>Recovery</td><td>---</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The relevant instruction will end according to specifications.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><td rowspan="3">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">The parameter specified for the Position input variable to the instruction is beyond the negative software limit.</td><td colspan="2">Correct the parameter specified for the Position input variable to the instruction so that it is within the negative software limit.</td><td colspan="2">Set the parameter specified for the Position input variable to the instruction so that it is within the negative software limit.</td></tr>
<tr><td colspan="2">The first position is beyond the negative software limit and an instruction that specifies motion in the opposite direction of the software limit was executed.</td><td colspan="2">Correct the program so that the travel direction for the instruction is towards the negative software limit.</td><td colspan="2">If the first position is beyond the negative software limit, write the program so that the travel direction is in the direction of the negative software limit.</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached Information 1: Error Location
Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given.
Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified.
Attached Information 4: Expansion Error Code (ErrorIDEx)</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">If a program is changed after an error occurs, the attached information that is displayed may not be correct.</td></tr>
</table>

<table>
<tr><td>Event name</td><td colspan="3">Command Position Overflow/Underflow</td><td>Event code</td><td colspan="2">54016785 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">Positioning, an instruction in the underflow/overflow direction, or an instruction for which the direction is not specified was executed when there was an underflow/overflow in the command position.</td></tr>
<tr><td>Source</td><td colspan="2">PLC Function Module</td><td>Source details</td><td>Instruction</td><td>Detection timing</td><td>At instruction execution</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Observation</td><td>Recovery</td><td>---</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The relevant instruction will end according to specifications.</td></tr>
<tr><td rowspan="2">System-defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">One of the following was executed when there was a command position overflow/underflow.
• A positioning instruction
• A continuous control instruction in the underflow/overflow direction
• An instruction for which the direction is not specified (syncing)</td><td colspan="2">Execute an error reset and then clear the overflow or underflow state by executing homing.</td><td colspan="2">Make sure that overflow or underflow does not occur.</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached Information 1: Error Location
Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given.
Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified.
Attached Information 4: Expansion Error Code (ErrorIDEx)</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">If a program is changed after an error occurs, the attached information that is displayed may not be correct.</td></tr>
</table>

<table>
<tr><td>Event name</td><td colspan="3">Positive Limit Input</td><td>Event code</td><td colspan="2">54016786 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">An instruction was executed for a motion in the positive direction when the positive limit input was ON.</td></tr>
<tr><td>Source</td><td colspan="2">PLC Function Module</td><td>Source details</td><td>Instruction</td><td>Detection timing</td><td>At instruction execution</td></tr>
<tr><td>Error attributes</td><td>Level</td><td>Observation</td><td>Recovery</td><td>---</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The relevant instruction will end according to specifications.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">An instruction for a motion in the positive direction was executed when the positive limit input was ON, or an instruction for a motion with no direction specification was executed when the positive limit input was ON.</td><td colspan="2">Execute an error reset and then perform a recovery operation in the negative direction. If this error occurs again, check the connection of the positive limit signal, the logic setting for the positive limit input, and the execution conditions for the start command, and correct any mistakes.
Check the logic settings both in the CNC motor parameters and in the slave settings.</td><td colspan="2">Check to make sure there are no problems with the positive limit signal connection, the logic setting for the positive limit input, and the execute conditions for the instruction.
Check the logic settings both in the CNC motor parameters and in the slave settings.</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached Information 1: Error Location
Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given.
Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified.
Attached Information 4: Expansion Error Code (ErrorIDEx)</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">If a program is changed after an error occurs, the attached information that is displayed may not be correct.</td></tr>
</table>

Event name	Negative Limit Input			**Event code**	54016787 hex	
Meaning	An instruction for a motion in the negative direction was executed when the negative limit input was *ON*.					
Source	PLC Function Module		**Source details**	Instruction	**Detection timing**	At instruction execution
Error attributes	**Level**	Observation	**Recovery**	---	**Log category**	System
Effects	**User program**	Continues.	**Operation**	The relevant instruction will end according to specifications.		
System -defined variables	**Variable**		**Data type**		**Name**	
	None		---		---	
Cause and correction	**Assumed cause**		**Correction**		**Prevention**	
	An instruction for a motion in the negative direction was executed when the negative limit input was *ON*, or an instruction for a motion with no direction specification was executed when the negative limit input was *ON*.		Execute an error reset and then perform a recovery operation in the positive direction. If this error occurs again, check the connection of the negative limit signal, the logic setting for the negative limit input, and the execution conditions for the start command, and correct any mistakes. Check the logic settings both in the CNC motor parameters and in the slave settings.		Check to make sure there are no problems with the negative limit signal connection, the logic setting for the negative limit input, and the execute conditions for the instruction. Check the logic settings both in the CNC motor parameters and in the slave settings.	
Attached information	Attached Information 1: Error Location Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given. Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified. Attached Information 4: Expansion Error Code (*ErrorIDEx*)					
Precautions/ Remarks	If a program is changed after an error occurs, the attached information that is displayed may not be correct.					

<table>
<tr><td>Event name</td><td colspan="3">Servo Main Circuits OFF</td><td>Event code</td><td colspan="2">54017784 hex</td></tr>
<tr><td>Meaning</td><td colspan="6">An attempt was made to turn ON the Servo when the main circuit power supply to the Servo Drive was OFF.</td></tr>
<tr><td>Source</td><td colspan="2">PLC Function Module</td><td>Source details</td><td>Instruction</td><td>Detection timing</td><td>At instruction execution</td></tr>
<tr><td>Error attri-butes</td><td>Level</td><td>Observation</td><td>Recovery</td><td>---</td><td>Log category</td><td>System</td></tr>
<tr><td>Effects</td><td>User program</td><td>Continues.</td><td>Operation</td><td colspan="3">The relevant instruction will end according to specifi-cations.</td></tr>
<tr><td rowspan="2">System -defined variables</td><td colspan="2">Variable</td><td colspan="2">Data type</td><td colspan="2">Name</td></tr>
<tr><td colspan="2">None</td><td colspan="2">---</td><td colspan="2">---</td></tr>
<tr><td rowspan="2">Cause and correction</td><td colspan="2">Assumed cause</td><td colspan="2">Correction</td><td colspan="2">Prevention</td></tr>
<tr><td colspan="2">An attempt was made to turn ON the Servo when the main circuit power supply to the Servo Drive was OFF.</td><td colspan="2">Turn ON the Servo after turning ON the main circuit power supply of the Servo Drive for the CNC motor where the error occurred.</td><td colspan="2">Turn ON the Servo after turning ON the main circuit power supply to the Servo Drive.</td></tr>
<tr><td>Attached information</td><td colspan="6">Attached Information 1: Error Location
Attached Information 2: Error Location Details (Rung Number). For a program section, the rung number from the start of the section is given. For ST, the line number is given.
Attached Information 3: Names of the Instruction and Instruction Instance Where the Error Occurred. If there is more than one possible instruction, information is given on all of them. Nothing is given if the instruction cannot be identified.
Attached Information 4: Expansion Error Code (ErrorIDEx)</td></tr>
<tr><td>Precautions/ Remarks</td><td colspan="6">If a program is changed after an error occurs, the attached information that is displayed may not be correct.</td></tr>
</table>

A

Appendices

A-1 Valid Range of CNC Parameter Settings

Some real-type CNC parameters have their valid range in addition to a setting range. The valid range is within the setting range and handled as internally effective. If a setting value is within the setting range but outside the valid range, it is not handled as an error but corrected to a value within the valid range so that it can be used for calculation purposes.

Valid Ranges for Real-type CNC Coordinate System Parameters

Category	Real number point parameter	Setting range	Valid range	Within the setting range but outside the valid range
CNC Coordinate System Operation Settings	Maximum Feedrate	Positive number, 0	0.0000001 to upper limit*1	Not handled as an error. 0: Set to the upper limit defined to the left. Larger than 0 and less than 0.0000001: Set to 0.0000001. Larger than the upper limit defined to the left: Set to the upper limit.
	Rotary Axis Velocity	Positive number	0.0000001 to upper limit*1	Not handled as an error. Larger than 0 and less than 0.0000001: Set to 0.0000001. Larger than the upper limit defined to the left: Set to the upper limit.
	Dry Run Velocity	Positive number	0.0000001 to upper limit*1	Not handled as an error. Larger than 0 and less than 0.0000001: Set to 0.0000001. Larger than the upper limit defined to the left: Set to the upper limit.
NC Program Default Settings	Acceleration Time	Positive number, 0	- *2	-
	Deceleration Time	Positive number, 0	- *2	-
	Jerk Time	Positive number, 0	- *2	-

Category	Real number point parameter	Setting range	Valid range	Within the setting range but outside the valid range
Tool Compensation Settings	Tool Radius	Positive number, 0	0, or 0.0000001 to 1,000,000	Not handled as an error. Larger than 0 and less than 0.0000001: Set to 0.0000001. Larger than 1,000,000: Set to 1,000,000.
	Tool Length	Negative number, positive number, or 0	-1,000,000 to -0.0000001 0 +0.0000001 to +1,000,000	Not handled as an error. The absolute value is larger than 0 and less than 0.0000001: Set to 0.0000001 of the absolute value. The absolute value is larger than 1,000,000: Set to 1,000,000 of the absolute value.
Work Coordinate System Settings	1st Work Coordinate System Offset 2nd Work Coordinate System Offset 3rd Work Coordinate System Offset 4th Work Coordinate System Offset 5th Work Coordinate System Offset 6th Work Coordinate System Offset	Negative number, positive number, or 0 at each of X-, Y-, Z-, A-, B-, and C-axis.	-1,000,000 to -0.0000001 0 +0.0000001 to +1,000,000	Not handled as an error. The absolute value is larger than 0 and less than 0.0000001: Set to 0.0000001. The absolute value is larger than 1,000,000: Set to 1,000,000.
Reference Point Settings	1st Reference Point 2nd Reference Point 3rd Reference Point 4th Reference Point	Negative number, positive number, or 0 at each of X-, Y-, Z-, A-, B-, and C-axis.	-1,000,000 to -0.0000001 0 +0.0000001 to +1,000,000	Not handled as an error. The absolute value is larger than 0 and less than 0.0000001: Set to 0.0000001. The absolute value is larger than 1,000,000: Set to 1,000,000.
Spindle Axis Operation Settings	Orientation Position	$0 \le x < 1$	-	-
	Orientation Velocity	Positive number	The value converted into pulses based on the setting of the motor assigned to the spindle is 60 pulses/min or more	Not handled as an error. Larger than 0 and less than 60 pulses/min: Set to 60 pulses/min.
	Orientation Acceleration/Deceleration	Positive number, 0	The value converted into pulses based on the setting of the motor assigned to the spindle is 0 or 0.004 to 3200000000000 pulses/s^2	Not handled as an error. Larger than 0 and less than 0.004 pulses/s^2: Set to 0.004 pulses/s^2. Larger than 3200000000000 pulses/s^2: Set to 3200000000000 pulses/s^2.

*1. Double the Maximum Velocity value among the CNC motors assigned to positioning axes in the CNC coordinate system.

*2. This parameter has no valid range, but a recommended usage range. Refer to the *NJ/NY-series G code Instructions Reference Manual* (Cat. No. O031).

Valid Ranges for Real-type CNC Motor Parameters

Category	Real number point parameter	Setting range	Valid range	Within the setting range but outside the valid range
Unit Conversion Settings	Travel Distance Per Work Rotation	Positive number	-	-
Operation Settings	Maximum Velocity	Positive number	The value after conversion into pulses is 60 pulses/min or more.	Not handled as an error. Larger than 0 and less than 60 pulses/min: Set to 60 pulses/min.
	Maximum Acceleration/Deceleration	Positive number, 0	The value after conversion into pulses is 0 or 0.004 to 3200000000000 pulses/s^2.	Not handled as an error. Larger than 0 and less than 0.004 pulses/s^2: Set to 0.004 pulses/s^2. Larger than 3200000000000 pulses/s^2: Set to 3200000000000 pulses/s^2.
	Rapid Feed Acceleration/Deceleration	Positive number, 0	The value after conversion into pulses is 0 or 0.004 pulses/s2 or more.	Not handled as an error. Larger than 0 and less than 0.004 pulses/s^2: Set to 0.004 pulses/s^2.
	In-position Range	Positive number, 0	-	-
	Skip Velocity	Positive number	The value after conversion into pulses is 60 pulses/min or more.	Not handled as an error. Larger than 0 and less than 60 pulses/min: Set to 60 pulses/min.
Limit Settings	Positive Software Overtravel Limit	Positive number	-	-
	Negative Software Overtravel Limit	Negative number	-	-
	Following Error Over Value	Positive number, 0	-	-
	Following Error Warning Value	Positive number, 0	-	-

Category	Real number point parameter	Setting range	Valid range	Within the setting range but outside the valid range
Homing Settings	Homing Velocity	Positive number	The value after conversion into pulses is 60 pulses/min or more.	Not handled as an error. Larger than 0 and less than 60 pulses/min: Set to 60 pulses/min.
	Homing Approach Velocity	Positive number	The value after conversion into pulses is 60 pulses/min or more.	Not handled as an error. Larger than 0 and less than 60 pulses/min: Set to 60 pulses/min.
	Homing Acceleration/Deceleration	Positive number, 0	The value after conversion into pulses is 0 or 0.004 pulses/s^2 or more.	Not handled as an error. Larger than 0 and less than 0.004 pulses/s^2: Set to 0.004 pulses/s^2.
	Home Input Mask Distance	Positive number, 0	-	-
	Home Offset	Positive number, negative number, or 0	-	-
	Homing Compensation Value	Positive number, negative number, or 0	-	-
	Homing Compensation Velocity	Positive number	The value after conversion into pulses is 60 pulses/min or more.	Not handled as an error. Larger than 0 and less than 60 pulses/min: Set to 60 pulses/min.
Servo Gain Settings	Position Loop Gain	0 to 3000	0, or 0.01 to 3000.0	Larger than 0 and less than 0.01: Not handled as an error but set to 0.01.
	Velocity Feedforward Gain	0 to 100	0, or 0.01 to 100.0	Larger than 0 and less than 0.01: Not handled as an error but set to 0.01.
Gantry Settings	Alignment Velocity	Positive number	The value after conversion into pulses is 60 pulses/min or more.	Not handled as an error. Larger than 0 and less than 60 pulses/min: Set to 60 pulses/min.
	Position Deviation Between Axes Over Value	Positive number, 0	-	-
	Position Deviation Between Axes Warning Value	Positive number, 0	-	-

Valid Ranges for Real-type CNC Motor Compensation Table Settings

Category	Real number point parameter	Setting range	Valid range	Within the setting range but outside the valid range
Basic Settings	Compensation Scailing	0 to 2.0	-	-
	Source Compensation Start Position	Positive number, 0, or negative number	-1,000,000 to -0.0000001 0, +0.0000001 to +1,000,000	Not handled as an error. The absolute value is larger than 0 and less than 0.0000001: Set to 0.0000001. The absolute value is larger than 1,000,000: Set to 1,000,000.
	Source Compensation Section Distance	Positive number	+0.0000001 to +1,000,000	Not handled as an error. Larger than 0 and less than 0.0000001: Set to 0.0000001. Larger than 1,000,000: Set to 10,00,000.

For information about the valid ranges of input variables for CNC instruction function blocks, refer to *11-1-1 Input Variables for CNC Instructions* on page 11-2.

A-2 Cancellation of Digits of Real Type Data

The CNC Function Module mixes single-precision real type data and double-precision real type data for its calculation. For this reason, cancellation of digits occurs when data is converted from double-precision reals into single-precision reals.

Example:

The mantissa part of single-precision reals (REAL) is 23-bit. The number of digits of numbers that can be expressed by the 23-bit mantissa part is maintained. On the other hand, information loss from overflowed lower bits occurs when a number that cannot be expressed by the 23-bit mantissa part is handled.

In the following program example, the Data2 value is 16777216.

Variable name	Data type
Data1	LREAL
Data2	LREAL
Data3	REAL

(ST Program)

```
Data1 := 16777217; // 2^23 + 1
Data3 := Data1;    // Deceased conversion from LREAL to REAL
Data2 := Data3;    // Increased conversion from REAL to LREAL
```

Parameters

The following parameters use single-precision reals (REAL).

Set the parameter by considering the following effects.

Parameter	Effect
CNC Common Parameters	
N/A	---
CNC Coordinate System Parameters	
N/A	---
CNC Motor Parameters	
Maximum Velocity	If a value that cannot be expressed by the 23-bit mantissa part is set in Sysmac Studio, the function restricted by the maximum velocity works with a user-set value from which overflowed lower bit information is lost.
Maximum Acceleration/Deceleration Rate	If a value that cannot be expressed by the 23-bit mantissa part is set in Sysmac Studio, the function restricted by the maximum acceleration works with a user-set value from which overflowed lower bit information is lost.
Rapid Feed Acceleration/Deceleration	If a value that cannot be expressed by the 23-bit mantissa part is set in Sysmac Studio, the function restricted by the maximum acceleration works with a user-set value from which overflowed lower bit information is lost.
In-position Range	An In-position state may occur in a range different from the defined In-position due to the following two reasons: • If a value that cannot be expressed by the 23-bit mantissa part is set in Sysmac Studio, a use-set value from which overflowed lower bit information is lost is used for operation. • If a deviation of CNC motor (value obtained by deducting the current position from the commanded position) turns to a value that cannot be expressed by the 23-bit mantissa part, a use-set value from which overflowed lower bit information is lost is used for operation.
Skip Velocity	If a value that cannot be expressed by the 23-bit mantissa part is set in Sysmac Studio, a user-set value from which overflowed lower bit information is lost is used for operation.
Positive Software Overtravel Limit	If a value that cannot be expressed by the 23-bit mantissa part is set in Sysmac Studio, a user-set value from which overflowed lower bit information is lost is used for software limit.
Negative Software Overtravel Limit	If a value that cannot be expressed by the 23-bit mantissa part is set in Sysmac Studio, a user-set value from which overflowed lower bit information is lost is used for software limit.
Homing Velocity	If a value that cannot be expressed by the 23-bit mantissa part is set in Sysmac Studio, a user-set value from which overflowed lower bit information is lost is used for operation.
Homing Approach Velocity	If a value that cannot be expressed by the 23-bit mantissa part is set in Sysmac Studio, a user-set value from which overflowed lower bit information is lost is used for operation.
Homing Acceleration/Deceleration	If a value that cannot be expressed by the 23-bit mantissa part is set in Sysmac Studio, a user-set value from which overflowed lower bit information is lost is used for operation.
Home Offset	If a value that cannot be expressed by the 23-bit mantissa part is set in Sysmac Studio, a user-set value from which overflowed lower bit information is lost is used for preset.
Homing Compensation Velocity	If a value that cannot be expressed by the 23-bit mantissa part is set in Sysmac Studio, a user-set value from which overflowed lower bit information is lost is used for operation.
Position Loop Gain	If a value that cannot be expressed by the 23-bit mantissa part is set in Sysmac Studio, a user-defined value from which overflowed lower bit information is lost is used for position loop gain.

Parameter		Effect
	Velocity Feedforward Gain	If a value that cannot be expressed by the 23-bit mantissa part is set in Sysmac Studio, a user-defined value from which overflowed lower bit information is lost is used for velocity feedforward gain.
	Alignment Velocity	If a value that cannot be expressed by the 23-bit mantissa part is set in Sysmac Studio, a user-set value from which overflowed lower bit information is lost is used for operation.
CNC Motor Compensation Table Parameters		
	N/A	---

Retained Variables

The following retained variables use single-precision reals (REAL).

Parameter		Effect
CNC Motor Retained Variables		
	Absolute Encoder Home Offset	When a value that cannot be expressed by the 23-bit mantissa part is restored to the ABS current position, it is restored with the value from which overflowed lower bit information is lost.
	Gantry Offset	When a value that cannot be expressed by the 23-bit mantissa part is restored to the gantry offset, it is restored with the value from which overflowed lower bit information is lost.

Precautions for Correct Use

You cannot execute NC programs to a coordinate system if a CNC motor that composes the coordinate system is manually operated. In the same way, the manual operation cannot be executed during execution of the NC program except for the *Hold* (Holding) status.

Input Variables for CNC Instructions

To ensure visibility, double-precision reals (LREAL) data is used in PLC program. However, the following variables use single-precision reals (REAL) data for the internal use.

Input variable		Effect
CNC_MoveJog		
	Velocity	When a value that cannot be expressed by the 23-bit mantissa part is specified, a user-set value from which the information is lost is used for the velocity.
	Acceleration	When a value that cannot be expressed by the 23-bit mantissa part is specified, a user-set value from which the information is lost is used for the acceleration/deceleration rate.
CNC_Move		
	Velocity	When a value that cannot be expressed by the 23-bit mantissa part is specified, a user-set value from which the information is lost is used for the velocity.
	Acceleration	When a value that cannot be expressed by the 23-bit mantissa part is specified, a user-set value from which the information is lost is used for the acceleration/deceleration rate.
CNC_HomeWithParameter		
	HomingParameter. Vel	Refer to Homing Velocity
	HomingParameter. ApproachVel	Refer to Homing Approach Velocity
	HomingParameter. Acc	Refer to Homing Acceleration/Deceleration
	HomingParameter. Offset	Refer to Home Offset
	HomingParameter. CompensationVel	Refer to Homing Compensation Velocity
CNC_SpindleGo		
	Velocity	If a value that cannot be expressed by the 23-bit mantissa part is specified, a user-set value from which overflowed lower bit information is lost is used for operation.
CNC_CoordControl		
	ControlOutputs. FeedrateVelFactor	If a value that cannot be expressed by the 23-bit mantissa part is specified, a user-set value from which overflowed lower bit information is lost is used for operation.
	ControlOutputs. FeedrateVelFactorChangeRate	If a value that cannot be expressed by the 23-bit mantissa part is specified, a user-set value from which overflowed lower bit information is lost is used for operation.
CNC_GantrySkewControl		
	GantryOffset	If a value that cannot be expressed by the 23-bit mantissa part is specified, a user-set value from which overflowed lower bit information is lost is used for operation.

A-3 Connecting to 1S-series Servo Drives

This section describes connections to an OMRON 1S-series Servo Drive with built-in EtherCAT communications.

Basically, the connections are the same as for the Motion Control Function Module. This section, therefore, describes only the differences. For details, refer to the *NJ/NX-series CPU Unit Motion Control User's Manual* (Cat. No. W507).

A-3-1 Wiring the Servo Drive

Refer to the *NJ/NX-series CPU Unit Motion Control User's Manual* (Cat. No. W507).

A-3-2 Servo Drive Settings

Assigning External Input Signals

Refer to the *NJ/NX-series CPU Unit Motion Control User's Manual* (Cat. No. W507).

Backlash Compensation

Refer to the *NJ/NX-series CPU Unit Motion Control User's Manual* (Cat. No. W507).

PDO Mapping

Refer to the *NJ/NX-series CPU Unit Motion Control User's Manual* (Cat. No. W507).

Relationships between CNC Function Module and Process Data

This function changes from the MC Function Module.

The functions of the CNC Function Module are related to the information in the process data objects.

Depending on the EtherCAT slave configuration and functions that are used by the CNC Function Module, you may sometimes need to change the relationships.

To access the settings, click the **Detailed Settings** Button on the CNC Motor Basic Setting Display in Sysmac Studio.

Output Settings (Controller to Servo Drive)

The settings apply to the command data that is sent from the CNC Function Module to the Servo Drive.

The default settings in Sysmac Studio are listed in the following table. (The ○ mark indicates a required object for positioning axis assignment/The △ mark indicates a required object for spindle axis assignment

Function name	Process data	Description
○△ Control Word	6040 hex-00.0 (Controlword)	This data is used to control the status of the Servo Drive. Set *6040 hex: Controlword.*
○ Target Position	607A hex-00.0 (Target position)	The target position for position control. This is used by the positioning axis. Set *607A hex: Target position*. It is not used by the spindle axis. 0 is always output.
△ Target Velocity	60FF hex-00.0 (Target velocity)	The target velocity for velocity control. This is used by the spindle axis. Normally set *60FF hex: Target velocity*. It is not used by the positioning axis. 0 is always output.
Target Torque	6071 hex-00.0 (Target torque)	The target torque for torque control. This is not used by the CNC Function Module. 0 is always output.
Max Profile Velocity	607F hex-00.0 (Max profile velocity)	The velocity limit value for torque control. This is not used by the CNC Function Module. The maximum motor velocity is always output.
△ Operation Mode	6060 hex-00.0 (Modes of operation)	This data is required to change the control mode. Normally set *6060 hex: Modes of operation*.*1 For the positioning axis, always CSP mode (8) is output. For the spindle axis, always CSV mode (9) is output.
Positive Torque Limit Value	60E0 hex-00.0 (Positive torque limit value)	This is the torque limit value in the positive direction. This is not used by the CNC Function Module. 3000 is always output.
Negative Torque Limit Value	60E1 hex-00.0 (Negative torque limit value)	This is the torque limit value in the negative direction. This is not used by the CNC Function Module. 3000 is always output.
Touch Probe Function	60B8 hex-00.0 (Touch probe function)	This data is used to control the touch probe function. It is required for the touch probe functions such as the CNC_Home instruction, CNC_HomeWithParameter instruction, and G31 (Skip Function). Normally set *60B8 hex: Touch probe function*.

*1. If you set 6060 hex (Modes of operation), also set 6061 hex (Modes of operation display). Normal operation is not possible if only one of these two is set.

Precautions for Correct Use

- If you change the settings, make sure that the desired operations are performed for the CNC Function Module and process data settings.
- If you are not using an OMRON 1S-series Servo Drive with built-in EtherCAT communications or G5-series Servo Drive with built-in EtherCAT communications, always set the Modes of Operation (6060 hex).

● Input Settings (Servo Drive to Controller)

This is the status data settings from the Servo Drive to the CNC Function Module.

The default settings in Sysmac Studio are listed in the following table. (The ○ mark indicates a required object for positioning axis assignment/The △ mark indicates a required object for spindle axis assignment

Function name	Process data	Description
○△ Status Word	6041 hex-00.0 (Statusword)	The status of the Servo Drive. Set *6041 hex: Statusword*.
○△ Position Actual Value	6064 hex-00.0 (Position actual value)	Shows the actual position. Set *6064 hex: Position actual value*.
Actual velocity	Not set. *1	Shows the actual velocity. This is not used by the CNC Function Module.
Torque Actual Value	6077 hex (Torque actual value)	Shows the actual torque. Normally set *6077 hex: Torque actual value*.
△ Modes of Operation Display	6061 hex-00.0 (Modes of operation display)	Shows the operation mode. Normally set *6061 hex: Modes of operation display.* *2
Touch probe status	60B9 hex-00.0 (Touch probe status)	Shows the status of the touch probe function. It is required for the touch probe functions such as the CNC_Home instruction, CNC_HomeWithParameter instruction, and G31 (Skip Function). Normally set *60B9 hex: Touch probe status*.
Touch probe pos1 pos value	60BA hex-00.0 (Touch probe pos1 pos value)	The latched position for touch probe 1. It is required for the touch probe functions of the CNC_Home instruction and CNC_HomeWithParameter instruction. Normally set *60BA hex: Touch probe pos1 pos value.*
Touch probe pos2 pos value	60BC hex-00.0 (Touch probe pos2 pos value)	The latched position for touch probe 2. This is required for G31 (skip function). Normally set *60BC hex: Touch probe pos2 pos value.*
Error Code	603F hex-00.0 (Error code)	The error code in the Servo Drive. Normally set *603F hex: Error code*.

*1. If required, map the selected process data to a PDO before setting it.
The standard setting is 606C hex-00.0 (Velocity actual value).

*2. If you set 6061 hex (Modes of operation display), also set 6060 hex (Modes of operation).
Normal operation is not possible if only one of these two is set.

Precautions for Correct Use

- If you change the settings, make sure that the desired operations are performed for the CNC Function Module and process data settings.
- If you are not using an OMRON 1S-series Servo Drive with built-in EtherCAT communications or G5-series Servo Drive with built-in EtherCAT communications, always set the Modes of Operation Display (6061 hex).

● Digital Input Settings

Refer to the *NJ/NX-series CPU Unit Motion Control User's Manual* (Cat. No. W507).

A-3-3 Object Settings

Refer to the *NJ/NX-series CPU Unit Motion Control User’s Manual* (Cat. No. W507).

A-4 Instructions for Which Multi-execution Is Supported

Whether multi-execution of CNC instructions is supported depends on the current status of the CNC motor or CNC coordinate system, and on the type of instruction to execute. This section describes the relationships among them.

The following table gives the instructions for which multi-execution is supported and the state transitions for instructions when the instructions are executed for a positioning axis or CNC coordinate system.

The color of the cell in the table shows you if multi-execution of the instruction is supported.

White	:	Multi-execution of the instruction is supported.
Gray	:	Multi-execution of the instruction is not supported. An error will occur.
Yellow	:	Multi-execution of the instruction is not supported. CommandAborted changes to TRUE and execution of the instruction is disabled.

The letters in the table give the state of transition as follows.

A : Standby
B : Moving
C : Executing
D : Hold
E : MovingOnHold
F : Stopping
G : ErrorStop
H : CW/CCW

- **Operations for Positioning Axis States in CNC Coordinate System when Instructions are Executed**

Positioning axis state		Spindle axis state, and servo lock/unlock state of logical motor number											
		A			B			C	D	E	F	G	
		Standby			Moving			Executing	Hold	MovingOnHold	Stopping	ErrorStop	
Instruction	Servo lock/unlock state	Lock		Unlock	Lock		Unlock					Lock	Unlock
	CNC Coordinate System axis state	Standby	CW/ CCW	---	Standby CW/CCW	Moving	---					---	---
CNC_Power (Enable=TRUE)		A			B			C	D	E	F	G	G
CNC_Power (Enable=FALSE)		A			A or B*1			A	A	A	F	G	
CNC_MoveJog		B		G	G			G	E	G	F	G	
CNC_Home (Positioning axis)		B		G*2	G			G	G	G	F	G	
CNC_Home (Spindle axis)		B	G		G			G	G	G	F	G	
CNC_HomeWithParameter (Positioning axis)		B		G*2	G			G	G	G	F	G	
CNC_HomeWithParameter (Spindle axis)		B	G		G			G	G	G	F	G	
CNC_GantrySkewControl *3		B		G*2	G			G	G		F	G	
CNC_GantrySkewControl *4		B			G			G	G		F	G	
CNC_Move (Positioning axis)		B		G	G			G	E	G	F	G	
CNC_Move (Spindle axis)		B	G		G			G	G	G	F	G	
CNC_SyncMoveAbsolute		B		G	G			G	E	G	F	G	
CNC_SpindleGo		A		G	B*5	G*5		G	D	E	F	G	
CNC_CoordControl *6*7		A			B			C	D	E	F	G	
CNC_CoordReset		A			B			C	D	E	F	A	
CNC_CoordHalt		A			A			G	D	D	F	G	
CNC_CoordStop		F			F			F	F	F	F	G	
CNC_CoordImmdiateStop		G			G			G	G	G	G	G	
CNC_CoordCatchMCode		A			B			C	D	E	F	G	
CNC_CoordResetMCode		A			B			C	D	E	F	G	
ResetCNCError		A			B			C	D	E	F	A	
CNC_Write		A			B			C	D	E	F	G	
CNC_Read		A			B			C	D	E	F	G	
CNC_LoadProgramFile		A			B			C *8	D *8	E *8	F	G	

*1. A when the target motor is operating. Otherwise, B.

*2. This instruction can be executed only in *PresetMode*, even when the Servo is unlocked.

*3. If SkewMode is set to any of the following:

- _cncCalcOffset (Gantry Offset Value Calculation)
- _cncAlignOffset (Gantry Offset Value Adjustment)

*4. If SkewMode is set to any of the following:

- _cncWriteOffset (Gantry Offset Value Write)
- _cncReadOffset (Gantry Offset Value Read)

*5. Multi-execution of CNC_SpindleGo instruction is not possible while the spindle axis is in *Moving*.

*6. *CycleStart* can be accepted in *Standby* only if the Servo of all the CNC motors assigned to the coordinate system are locked and home is defined for all the CNC motors of positioning axes. If the conditions for the acceptance are not met, an error occurs.

*7. *CycleStart* cannot be executed while CNC_LoadProgramFile instruction is running.

*8. Multi-execution of CNC_LoadProgramFile instruction is not possible while an NC program is running, or in *Hold*.

● Operations for Spindle Axis States in the CNC Coordinate System when Instructions are Executed

Spindle axis state	Spindle axis state, and servo lock/unlock state of logical motor number																
	A						H						B		F	G	
	Standby						CW/CCW						Moving		Stopping	ErrorStop	
Instruction / Servo lock/unlock state	Lock					Unlock	Lock					Unlock	Lock	Unlock		Lock	Unlock
Instruction / CNC Coordinate System axis state	Standby	Moving	Executing	Hold	MovingOnHold	---	Standby	Moving	Executing	Hold	MovingOnHold	---	---	---		---	---
CNC_Power (Enable=TRUE)	A						H						B		F	G	
CNC_Power (Enable=FALSE)	A						A or H*1						A or B*2		F	G	
CNC_MoveJog	A	G	G	A	G	G	H	G	G	H	G	G	G		F	G	
CNC_Home (Positioning axis)	A	G	G	G	G	G*3	H	G	G	G	G	G	G		F	G	
CNC_Home (Spindle axis)	B	G	G	G	G	G	G	G	G	G	G	G	G		F	G	
CNC_HomeWithParameter (Positioning axis)	A	G	G	G	G	G*3	H	G	G	G	G	G	G		F	G	
CNC_HomeWithParameter (Spindle axis)	B	G	G	G	G	G	G	G	G	G	G	G	G		F	G	
CNC_GantrySkewControl *4	A	G	G	G	G	G*3	B	G	G	G	G	G*3	G		F	G	
CNC_GantrySkewControl *5	A	G	G	G	G	A	B	G	G	G	G	B	G		F	G	
CNC_Move (Positioning axis)	A	G	G	A	G	G	H	G	G	H	G	G	G		F	G	
CNC_Move (Spindle axis)	B	G	G	G	G	G	G	G	G	G	G	G	G		F	G	
CNC_SyncMoveAbsolute	A	G	G	A	G	G	H	G	G	H	G	G	G		F	G	
CNC_SpindleGo	H *6	H *6	G	H *6	H *6	G	H *6	H *6	G	H *6	H *6	G	G*6		F	G	
CNC_CoordControl *7*8	A						H						B		F	G	
CNC_CoordReset	A						H						B		F	A	
CNC_CoordHalt	A	A	G	A	A	A	H	H	G	H	H	H	A		F	G	
CNC_CoordStop	F						F						F		F	G	
CNC_CoordImmdiateStop	G						G						G		G	G	
CNC_CoordCatchMCode	A						H						B		F	G	
CNC_CoordResetMCode	A						H						B		F	G	
ResetCNCError	A						H						B		F	A	
CNC_Write	A						H						B		F	G	
CNC_Read	A						H						B		F	G	
CNC_LoadProgramFile	A	A	A*9			A	H	H	H*9			H	B		F	G	

*1. A when the target motor is operating. Otherwise, H.

*2. A when the target motor is operating. Otherwise, B.

*3. This instruction can be executed only in *PresetMode*, even when the Servo is unlocked.

*4. If SkewMode is set to any of the following:

- _cncCalcOffset (Gantry Offset Value Calculation)
- _cncAlignOffset (Gantry Offset Value Adjustment)

*5. If SkewMode is set to any of the following:
  •_cncWriteOffset (Gantry Offset Value Write)
  •_cncReadOffset (Gantry Offset Value Read)

*6. Multi-execution of CNC_SpindleGo instruction is not possible while the spindle axis is in *Moving*.

*7. *CycleStart* in *Standby* and *CW/CCW* can be accepted only if the Servo of all the CNC motors assigned to the coordinate system are locked and home is defined for all the CNC motors of positioning axes. If the conditions for the acceptance are not met, an error occurs.

*8. *CycleStart* cannot be executed while CNC_LoadProgramFile instruction is running.

*9. Multi-execution of CNC_LoadProgramFile instruction is not possible while an NC program is running, or in *Hold*.

OMRON Corporation **Industrial Automation Company**
Kyoto, JAPAN

Contact: www.ia.omron.com

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

OMRON ASIA PACIFIC PTE. LTD.
No. 438A Alexandra Road # 05-05/08 (Lobby 2),
Alexandra Technopark,
Singapore 119967
Tel: (65) 6835-3011/Fax: (65) 6835-2711

OMRON ELECTRONICS LLC
2895 Greenspoint Parkway, Suite 200
Hoffman Estates, IL 60169 U.S.A.
Tel: (1) 847-843-7900/Fax: (1) 847-843-7787

OMRON (CHINA) CO., LTD.
Room 2211, Bank of China Tower,
200 Yin Cheng Zhong Road,
PuDong New Area, Shanghai, 200120, China
Tel: (86) 21-5037-2222/Fax: (86) 21-5037-2200

Authorized Distributor:

Cat. No. O030-E1-03 0718