**Right choice for ultimate yield**

**LSIS strives to maximize customers' profit in gratitude of choosing us for your partner.**

Programmable Logic Controller

# Motion Control Module

XGT Series

**User's Manual**

**XGF-M32E**

## Safety Instructions

- Read this manual carefully before installing, wiring, operating, servicing or inspecting this equipment.
- Keep this manual within easy reach for quick reference.

LSIS

**http://www.lsis.com**

## Before using the product …

For your safety and effective operation, please read the safety instructions thoroughly before using the product.

► Safety Instructions should always be observed in order to prevent accident or risk with the safe and proper use the product.

► Instructions are divided into "Warning" and "Caution", and the meaning of the terms is as follows.

⚠ **Warning** This symbol indicates the possibility of serious injury or death if some applicable instruction is violated

⚠ **Caution** This symbol indicates the possibility of severe or slight injury, and property damages if some applicable instruction is violated

Moreover, even classified events under its caution category may develop into serious accidents relying on situations. Therefore we strongly advise users to observe all precautions properly just like warnings.

► The marks displayed on the product and in the user's manual have the following meanings.

⚠ Be careful! Danger may be expected.

⚠ Be careful! Electric shock may occur.

► The user's manual even after read shall be kept available and accessible to any user of the product.

## Safety Instructions for design process

### ⚠ Warning

- **Please install a protection circuit on the exterior of PLC so that the whole system may operate safely regardless of failures from external power or PLC.** Any abnormal output or operation from PLC may cause serious problems to safety in whole system.
  - Install protection units on the exterior of PLC like an interlock circuit that deals with opposite operations such as emergency stop, protection circuit, and forward/reverse rotation or install an interlock circuit that deals with high/low limit under its position controls.
  - If any system error (watch-dog timer error, module installation error, etc.) is detected during CPU operation in PLC, all output signals are designed to be turned off and stopped for safety. However, there are cases when output signals remain active due to device failures in Relay and TR which can't be detected. Thus, you are recommended to install an addition circuit to monitor the output status for those critical outputs which may cause significant problems.
- **Never overload more than rated current of output module nor allow to have a short circuit**. Over current for a long period time may cause a fire .
- **Never let the external power of the output circuit to be on earlier than PLC power**, which may cause accidents from abnormal output operation.
- **Please install interlock circuits in the sequence program for safe operations in the system when exchange data with PLC or modify operation modes using a computer or other external equipments** Read specific instructions thoroughly when conducting control operations with PLC.

## Safety Instructions for design process

**⚠ Caution**

- **I/O signal or communication line shall be wired at least 100mm away from a high-voltage cable or power line.** Fail to follow this

## Safety Instructions on installation process

**⚠ Caution**

- **Use PLC only in the environment specified in PLC manual or general standard of data sheet.** If not, electric shock, fire, abnormal operation of the product may be caused.
- **Before install or remove the module, be sure PLC power is off.** If not, electric shock or damage on the product may be caused.
- **Be sure that every module is securely attached after adding a module or an extension connector.** If the product is installed loosely or incorrectly, abnormal operation, error or dropping may be caused. In addition, contact failures under poor cable installation will be causing malfunctions as well.
- **Be sure that screws get tighten securely under vibrating environments.** Fail to do so will put the product under direct vibrations which will cause electric shock, fire and abnormal operation.
- **Do not come in contact with conducting parts in each module**, which may cause electric shock, malfunctions or abnormal operation.

# Safety Instructions for wiring process

## Warning

- **Prior to wiring works, make sure that every power is turned off.** If not, electric shock or damage on the product may be caused.
- **After wiring process is done, make sure that terminal covers are installed properly before its use.** Fail to install the cover may cause electric shocks.

## Caution

- **Check rated voltages and terminal arrangements in each product prior to its wiring process.** Applying incorrect voltages other than rated voltages and misarrangement among terminals may cause fire or malfunctions.
- **Secure terminal screws tightly applying with specified torque.** If the screws get loose, short circuit, fire or abnormal operation may be caused. Securing screws too tightly will cause damages to the module or malfunctions, short circuit, and dropping.
- **Be sure to earth to the ground using Class 3 wires for FG terminals which is exclusively used for PLC**. If the terminals not grounded correctly, abnormal operation or electric shock may be caused.
- **Don't let any foreign materials such as wiring waste inside the module while wiring,** which may cause fire, damage on the product or abnormal operation.
- **Make sure that pressed terminals get tighten following the specified torque. External connector type shall be pressed or soldered using proper equipments.**

## Safety Instructions for test-operation and maintenance

### Warning

- **Don’t touch the terminal when powered**. Electric shock or abnormal operation may occur.
- **Prior to cleaning or tightening the terminal screws, let all the external power off including PLC power.** If not, electric shock or abnormal operation may occur.
- **Don’t let the battery recharged, disassembled, heated, short or soldered**. Heat, explosion or ignition may cause injuries or fire.

### Caution

- **Do not make modifications or disassemble each module.** Fire, electric shock or abnormal operation may occur.
- **Prior to installing or disassembling the module, let all the external power off including PLC power.** If not, electric shock or abnormal operation may occur.
- **Keep any wireless equipment such as walkie-talkie or cell phones at least 30cm away from PLC**. If not, abnormal operation may be caused.
- **When making a modification on programs or using run to modify functions under PLC operations, read and comprehend all contents in the manual fully.** Mismanagement will cause damages to products and accidents.
- **Avoid any physical impact to the battery and prevent it from dropping as well.** Damages to battery may cause leakage from its fluid. When battery was dropped or exposed under strong impact, never reuse the battery again. Moreover skilled workers are needed when exchanging batteries.

# Safety Instructions for waste disposal

**⚠ Caution**

- **Product or battery waste shall be processed as industrial waste.** The waste may discharge toxic materials or explode itself.

# Revision History

| Version | Date | Remark | Revised position |
|---|---|---|---|
| V 1.0 | ’13.9 | First Edition | - |

※ The number of User’s manual is indicated right part of the back cover.

Thank you for purchasing PLC of LSIS Co., Ltd.
Before use, make sure to carefully read and understand the User's Manual about the functions, performances, installation and programming of the product you purchased in order for correct use and importantly, let the end user and maintenance administrator to be provided with the User's Manual.

The User's Manual describes the product. If necessary, you may refer to the following description and order accordingly. In addition, you may connect our website (http://eng.lsis.biz/) and download the information as a PDF file.

Relevant User's Manuals

| Title | Description |
|---|---|
| XG5000 User's Manual (for XGK, XGB) | XG5000 software user manual describing online function such as programming, print, monitoring, debugging by using XGK, XGB CPU |
| XG5000 User's Manual (for XGI, XGR) | XG5000 software user manual describing online function such as programming, print, monitoring, debugging by using XGI, XGR CPU |
| XGK/XGB Instructions & Programming User's Manual | User's manual for programming to explain how to use instructions that are used PLC system with XGK, XGB CPU. |
| XGI/XGR/XEC Instructions & Programming User's Manual | User's manual for programming to explain how to use instructions that are used PLC system with XGI, XGR,XEC CPU. |
| XGK CPU User's Manual (XGK-CPUA/CPUE/CPUH/CPUS/CPUU) | XGK-CPUA/CPUE/CPUH/CPUS/CPUU user manual describing about XGK CPU module, power module, base, IO module, specification of extension cable and system configuration, EMC standard |
| XGI CPU User's Manual (XGI-CPUU/CPUH/CPUS) | XGI-CPUU/CPUH/CPUS user manual describing about XGI CPU module, power module, base, IO module, specification of extension cable and system configuration, EMC standard |
| XGR redundant series User's Manual | XGR- CPUH/F, CPUH/T user manual describing about XGR CPU module, power module, extension drive, base, IO module, specification of extension cable and system configuration, EMC standard |
| XG-PM User's Manual | XG-PM software user manual describing online function such as motion programing, monitoring, debugging by using Motion Control Module |

Current XGF-M32E manual is written based on the following version.

Related OS version list

| **Product name** | **OS version** |
|---|---|
| XGK-CPUH, CPUS, CPUA, CPUE, CPUU | V4.1 |
| XGI-CPUU, CPUH, CPUS | V3.7 |
| XGR-CPUH/F, CPUH/T | V2.5 |
| XG5000(XG-PM) | V3.67 |

# ◎ Table of Contents ◎

# Chapter 1 Overview

This user's manual describes the standard of Motion Control module, installation method, the method to use each function, programming and the wiring with external equipment.

## 1.1 Characteristics

The characteristics of Motion Control module are as follows.

(1) The Motion Control module is available for XGK/I/R Series.

(2) Various Motion Control function
It has various functions needed for motion control system such as position control, speed control etc.

(a) It supports various motion control commands.
1) It supports a number of function blocks.
2) It supports a number of motion function blocks compliant to PLCopen standards.
3) Motion programs are supported in the form of LD or ST by using XG-PM.

(b) It can control actual axis of up to 32 axes, virtual axis of 4 axes and VO (up to 256 points) of four units, and supports I/O of input 8 points and output 8 points and encoder input of two channels.

(c) Various sing-axis operations are available.
1) Position control
2) Speed control
3) Synchronous control
4) Multi-axis simultaneous start

(d) Various multi-axis group operations are available.
1) Circular arc interpolation
2) Linear interpolation
3) Helical interpolation
4) Group homing / Changes group position

(e) Switching control in operation is available.
1) Position/Speed control switching
2) Position/Torque control switching
3) Speed/Torque control switching

(f) Cam Control is available.
It is available to create up to 32 kinds of cam data with various cam profile of XG-PM.

(g) Various Homing Control Function.
As for a homing method, you can use Homing method supported by each servo drive model.
(Refer to the instruction manual of each servo drive for more detailed homing methods and servo parameter settings)

(h) For the Acceleration/Deceleration method, trapezoidal acceleration/deceleration and S-shaped acceleration/deceleration is supported, and S-shaped acceleration/deceleration can be implemented by setting jerk on a motion function block.

(3) Speed-up of execution of the motion program
Through realization of speed-up of processing at the time of start-up operation, the motion program set as main task can be performed at up to 1ms intervals. In addition, there is no delay time between axes in Simultaneous start and interpolation start.

(4) Connection with the servo driver through EtherCAT[*1]
  (a) Direct connection to servo drives of up to 32 units and EtherCAT I/O of up to 4 units can be achieved through EtherCAT.
  (b) Since the connection between motion control module and servo drive is made using Ethernet cables. So wiring is simple.
  (c) You can easily check and set up the servo driver information and parameter at the Motion Control module
  (d) Max. connection distance is 100m.

(5) Able to realize the absolute position system
You can realize the absolute position system just by connecting to the servo drive using the absolute position encoder and in case of ON/OFF, it can know the current position of the motor without homing.

(6) Easy maintenance
As retain registers, parameters, cam data and location data are stored in MRAM (Magnetoresistive Random Access Memory) within the Motion Control module, data can be stored without delay, and there is no limited number of writes.

(7) There are no restrictions in the quantity of the Motion Control module used in the base of XGK/I system. (However, they have to be used within the capacity of power module. The XGR system is limited to two units.)

(8) Self-diagnosis, monitoring and test are available with strong software package, XG-PM.
  (a) Monitoring function (Module & Servo driver)
  (b) Trace function
  (c) Trend function
  (d) Reading and saving module program/parameter
  (e) Reading and saving servo parameter
  (f) Creation of CAM data
  (g) Providing details about errors and the solution for it
  (h) Print function of various forms

(9) Applicable XGK/I/R CPU version for Motion Control module.

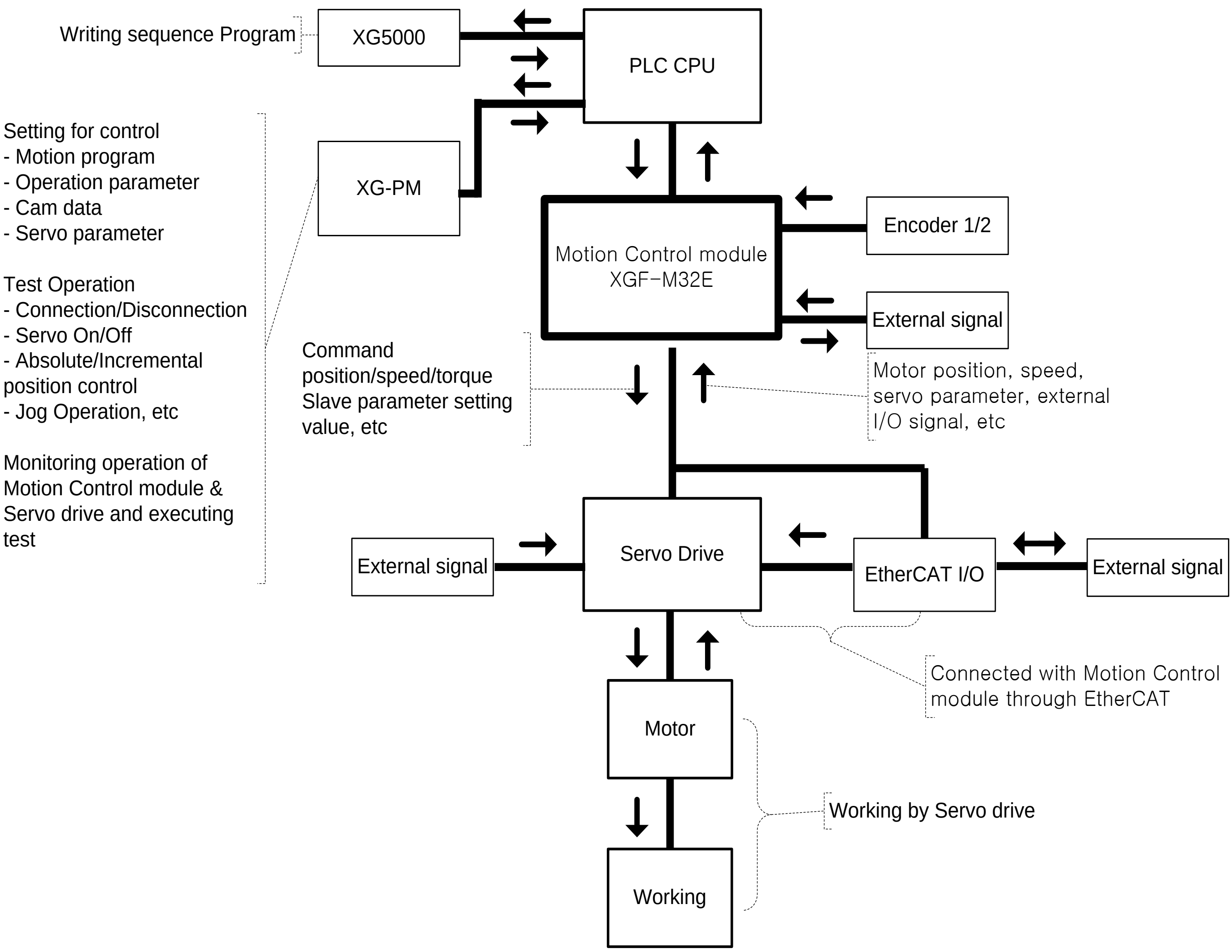
| XGT CPU Module Type | Version |
|---|---|
| XGK CPU Module | V4.10 or above |
| XGI CPU Module | V3.70 or above |
| XGR CPU Module | V2.50 or above |

**Note**

1. What is EtherCAT?
EtherCAT, Open Industrial Ethernet Solution, is developed by Beckhoff at 2002 and at 2003, November EtherCAT Technology Group (ETG-http://www.ethercat.org) is organized and it opens its technology. At 2005, February, that is authorized as IEC standard specification. Because of fast control speed and easiness for use and maintenance, it is widely used in the industrial field and conforming its performance
In our positioning module, data communication with service driver is done with master-slave method through EtherCAT, and electric Ethernet Cable is used.

## 1.2 Signal Flow of Positioning Module

The flow of PLC system using the Motion Control module is as follows.



# 1.3 Function overview of Motion Control module

Describe Representative functions of Motion Control module (Coordinate & Linear Interpolation, Circular Interpolation & Stop) briefly.

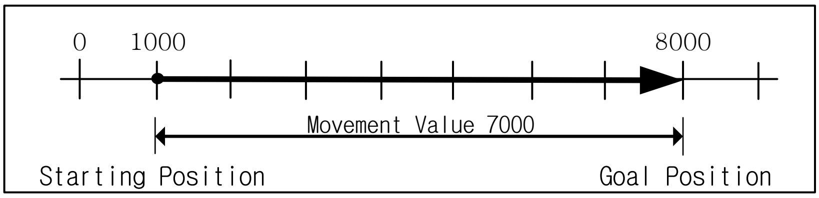
## 1.3.1 Position Control

Execute positioning control for the designated axis from starting position(current position) to goal position(the position to move to).

### (1) Control by Absolute coordinates

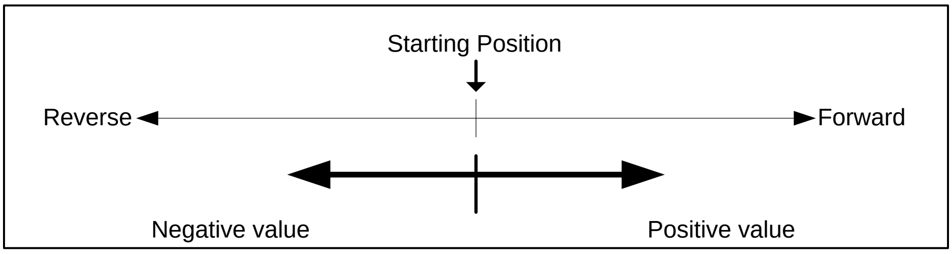
(a) Execute positioning control from starting position to goal position designated in motion function block
(b) Positioning control is executed based on home position designated in homing
(c) Moving direction is decided by starting position and goal position.
 1) Starting Position < Goal Position : Forward Positioning Operation
 2) Starting Position > Goal Position : Reverse Positioning Operation

[ Example ]
 1) Starting Position : 1000
 2) Goal Position : 8000
 Value of Forward movement is 7000 (7000=8000-1000)

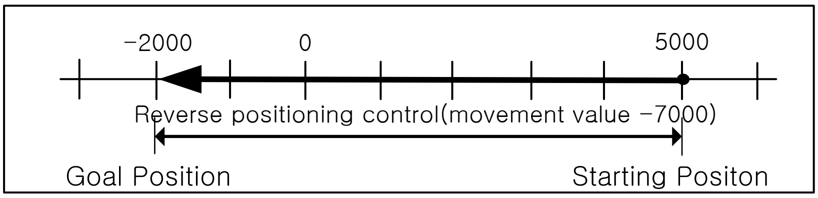



### (2) Control by Incremental Coordinates

(a) Execute positioning control from starting position as much as goal movement value.
The difference from absolute coordinates control is that the goal position is movement value, not position value.
(b) Moving direction depends on sign of movement value.
 1) Positive value (+ or 0) : Positioning operation with forward direction
 2) Negative value (-) : Positioning operation with reverse direction



[ Example ]
1) Starting Position : 5000
2) Goal Position : -7000
In this condition, it moves reversely and stops at -2000.

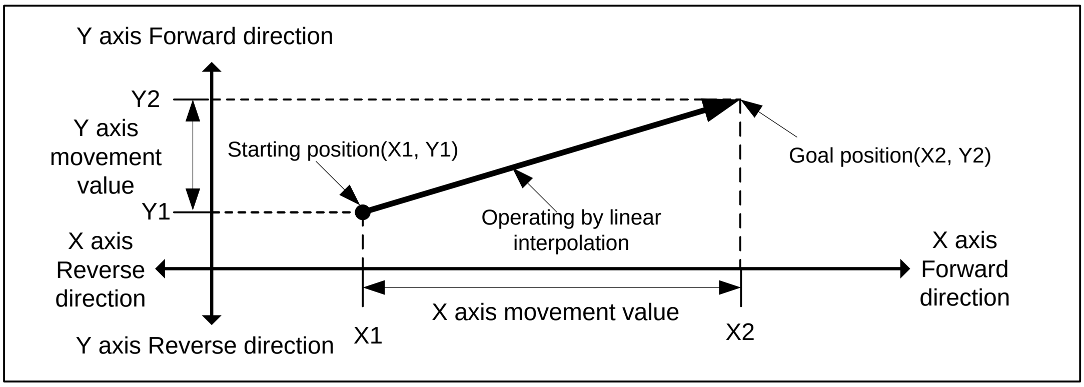



## 1.3.2 Interpolation Control

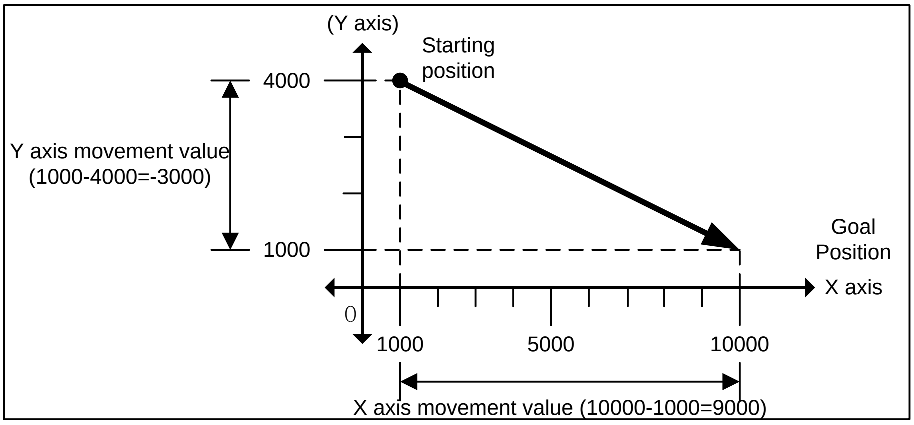
### (1) Linear Interpolation Control

Execute Linear interpolation control with designated axis at start position (Current position).
Combination of interpolation axis is unlimited and it is available to execute max. 4 axis Linear interpolation control.

(a) Linear interpolation by absolute coordinates
1) Execute Linear interpolation from starting position to goal position designated by positioning data.
2) Positioning control is executed based on home position designated in homing.
3) Movement direction is designated by starting position & goal position of each axis.
a) Starting position < Goal position : Positioning operation with forward direction
b) Starting position > Goal position : Positioning operation with reverse direction

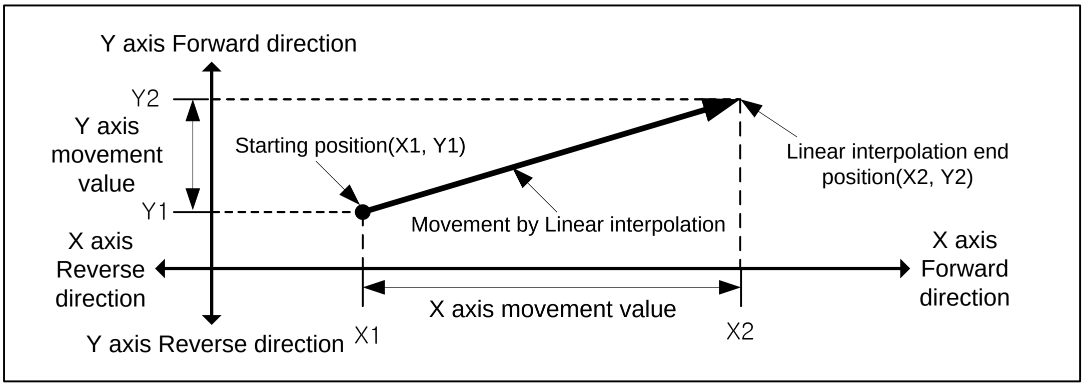



[ Example ]
a) Starting Position (1000, 4000)
b) Goal Position (10000, 1000)
In this condition, operation is as follows.



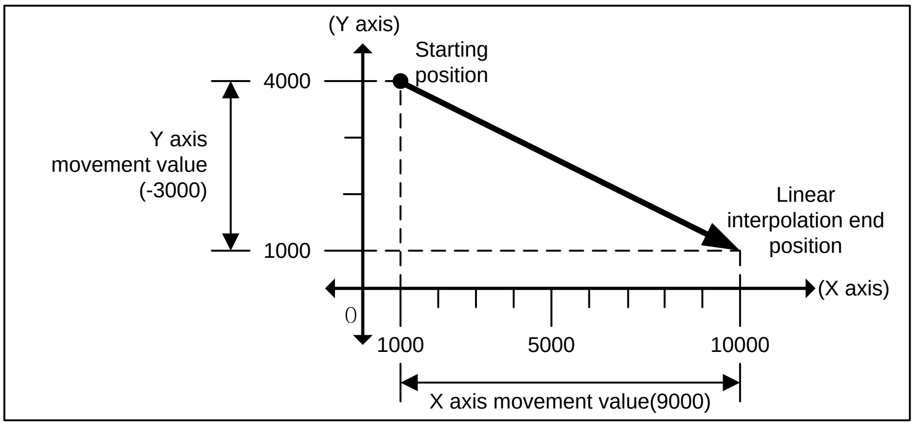

(b) Linear Interpolation by incremental coordinates

1) Goal value becomes movement value
2) Moving direction depends on movement value is positive or negative.
   a) Positive value (+ or 0) : Positioning operation with forward direction
   b) Negative value (-) : Positioning operation with reverse direction




[ Example ]

a) Starting position (1000, 4000)
b) Goal position (9000, -3000)
   In this condition, operation is as follows.



**(2) Circular Interpolation Control**

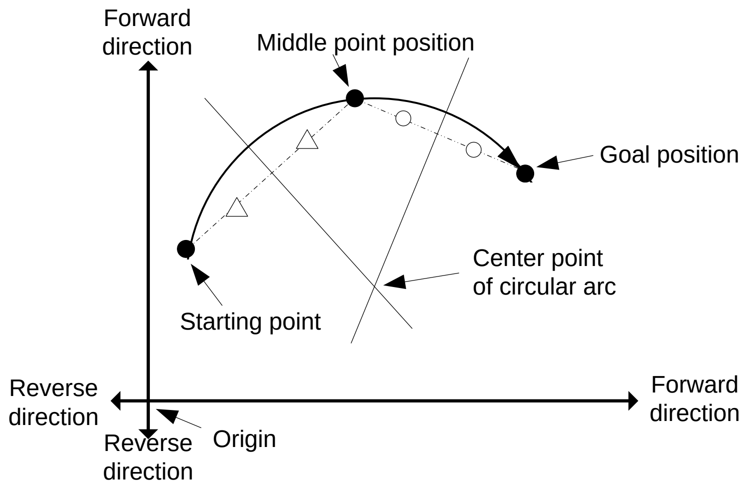
Execute interpolation operation along the trace of circle with 2 axes in forward direction that already designated for each axis.

Circular interpolation has 3 types according to auxiliary point, Middle point method passing auxiliary point, Center point method using auxiliary point as center of circle and Radius method using auxiliary point as radius of circle.

The combination of 2 axes that used in circular interpolation is unlimited. Any of the two axes from the actual axes (1-axis to 32-axis) or virtual axes (37-axis to 40-axis) can be used.)

(a) Middle Point Specified Circular interpolation

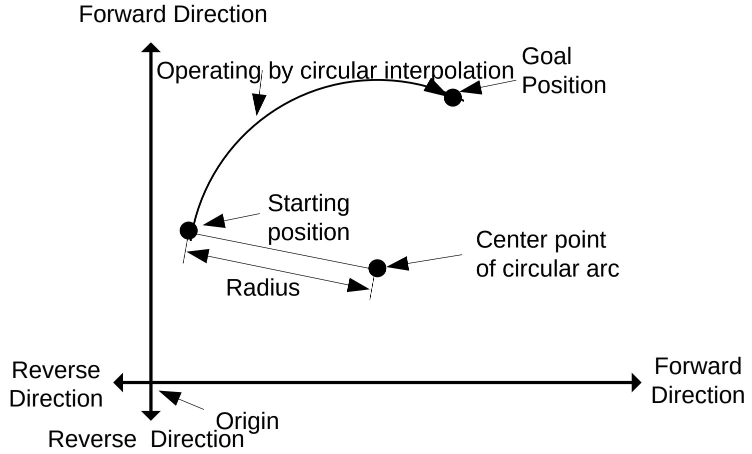
1) Starts operating at starting position and executes circular interpolation through the designated middle point.
2) There will be a circular arc whose center point is crossing point of perpendicular bisection between starting position and middle point or middle point and goal position.



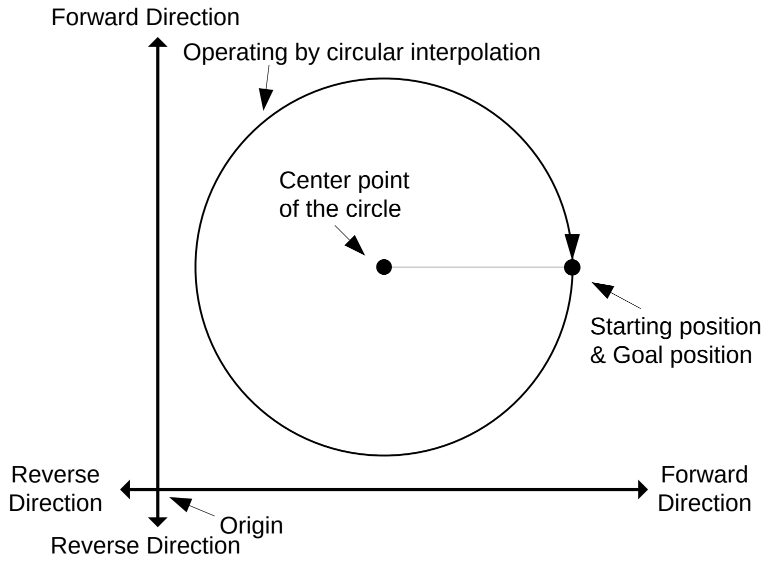

3) Movement direction is automatically designated by goal position and auxiliary point of circular interpolation.

(b) Center Point Specified Circular interpolation

1) Starts operating from starting position and execute circular interpolation along trace of circle that has distance from starting point to designated center point as radius.



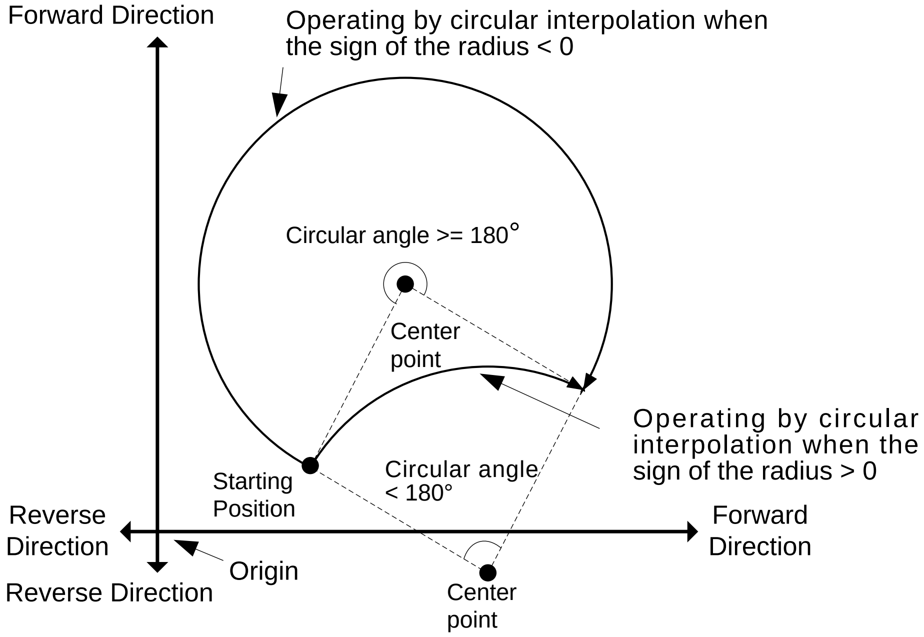
2) If the goal position is same as starting position, it is available to have an operation like a circle that has distance from starting point to auxiliary point as its radius.




3) The direction of movement is determined according to the selection of paths (CW, CCW) to be set at the time of motion function block.

**(3) Radius Specified Circular interpolation**

(a) Starts operating from starting position and execute circular interpolation along trace of circular arc that has value designated in auxiliary point of main axis as it radius. An arc whose central point varies depending on the sign of the radius is drawn.



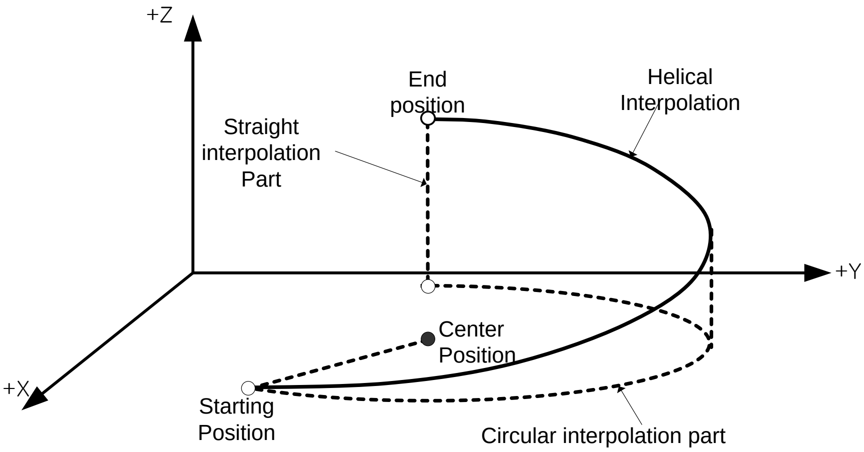

(b) In radius designation form, goal position can not be set the same as starting position.

(c) The operational directions and the size of the arc are determined by the path selection (CW, CCW) of circular interpolation commands and the sign of the radius.

**(4) Helical Interpolation**

(a) Moves along the designated trace of circular arc depending on circular arc interpolation setting and executes Linear interpolation synchronously.

(b) There is no limit to the combination of axes to be used in helical interpolation, and three axes from actual axis (1 axis to 32 axes) or virtual axis (37 axes to 40 axes) are used.




## 1.3.3 Speed Control

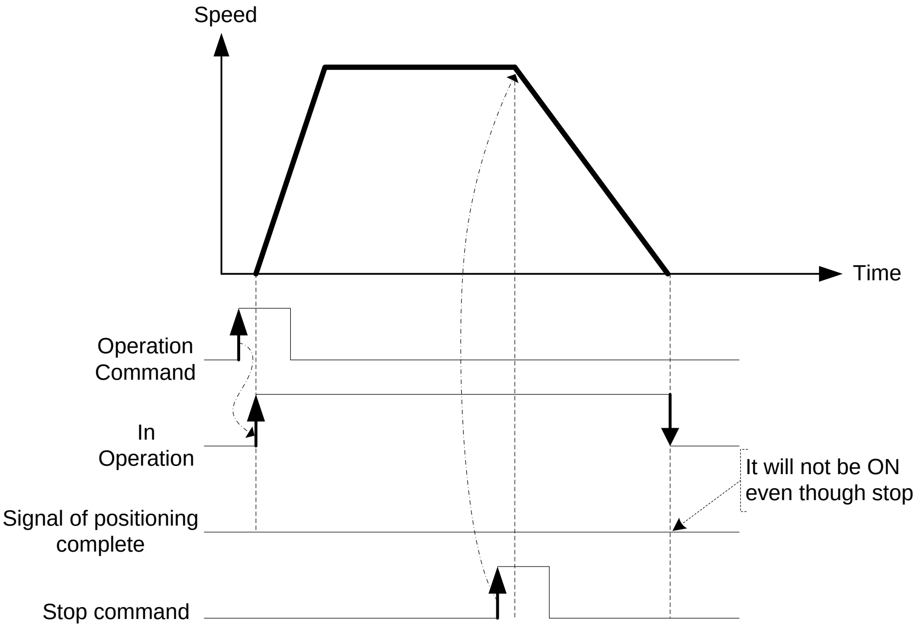
(1) Execution is made by speed control commands, and the operation proceeds at the established rate until buffer commands are executed, or stop commands are entered.

(2) Speed control has forward operation and reverse operation.

(a) Forward run: In case of velocity > 0 and forward direction, or velocity < 0 and reverse direction

(b) Reverse run: In case velocity > 0 and reverse direction, or velocity < 0 and reverse direction.

(3) Operating Timing



# Chapter 2 Specifications

## 2.1 General Specifications

The following table shows the general specification of XGT series.

<table>
<tr><th>No.</th><th>Item</th><th colspan="4">Specifications</th><th>Related specifications</th></tr>
<tr><td>1</td><td>Ambient temperature</td><td colspan="4">0 ℃ ~ +55℃</td><td>-</td></tr>
<tr><td>2</td><td>Storage temperature</td><td colspan="4">-25 ℃ ~ +70℃</td><td>-</td></tr>
<tr><td>3</td><td>Ambient humidity</td><td colspan="4">5 ~ 95%RH (Non-condensing)</td><td>-</td></tr>
<tr><td>4</td><td>Storage humidity</td><td colspan="4">5 ~ 95%RH (Non-condensing)</td><td>-</td></tr>
<tr><td rowspan="8">5</td><td rowspan="8">Vibration resistance</td><td colspan="3">Occasional vibration</td><td>-</td><td>-</td></tr>
<tr><td>Frequency</td><td>Acceleration</td><td>Amplitude</td><td>How many times</td><td rowspan="7">IEC61131-2</td></tr>
<tr><td>5 ≤ f < 8.4 Hz</td><td>-</td><td>3.5 mm</td><td rowspan="6">10 times each directions (X, Y and Z)</td></tr>
<tr><td>8.4 ≤ f ≤ 150 Hz</td><td>9.8 $m/s^2$ (1G)</td><td>-</td></tr>
<tr><td colspan="3">For continuous vibration</td></tr>
<tr><td>Frequency</td><td>Acceleration</td><td>Amplitude</td></tr>
<tr><td>5 ≤ f < 8.4 Hz</td><td>-</td><td>1.75 mm</td></tr>
<tr><td>8.4 ≤ f ≤ 150 Hz</td><td>4.9 $m/s^2$ (0.5G)</td><td>-</td></tr>
<tr><td>6</td><td>Shock resistance</td><td colspan="4">• Peak acceleration: 147 $m/s^2$(15G)<br>• Duration: 11ms<br>• Half-sine, 3 times each direction per each axis</td><td>IEC61131-2</td></tr>
<tr><td rowspan="5">7</td><td rowspan="5">Noise resistance</td><td>Square wave Impulse noise</td><td colspan="3">AC: ± 1,500V<br>DC: ± 900V</td><td>LSIS standard</td></tr>
<tr><td>Electrostatic discharge</td><td colspan="3">Voltage : 4kV (contact discharging)</td><td>IEC 61131-2, IEC 61000-4-2</td></tr>
<tr><td>Radiated electromagnetic field noise</td><td colspan="3">80 ~ 1,000 MHz, 10V/m</td><td>IEC 61131-2, IEC 61000-4-3</td></tr>
<tr><td rowspan="2">Fast transient /bust noise</td><td>Segment</td><td>Power supply module</td><td>Digital/analog input/output communication interface</td><td rowspan="2">IEC 61131-2, IEC 61000-4-4</td></tr>
<tr><td>Voltage</td><td>2kV</td><td>1kV</td></tr>
<tr><td>8</td><td>Environment</td><td colspan="4">Free from corrosive gasses and excessive dust</td><td>-</td></tr>
<tr><td>9</td><td>Altitude</td><td colspan="4">Up to 2,000 ms</td><td>-</td></tr>
<tr><td>10</td><td>Pollution degree</td><td colspan="4">Less than equal to 2</td><td>-</td></tr>
<tr><td>11</td><td>Cooling</td><td colspan="4">Air-cooling</td><td>-</td></tr>
</table>

**Note**

1. IEC (International Electrotechnical Commission):
   An international nongovernmental organization which promotes internationally cooperated standardization in electric/electronic field, publishes international standards and manages applicable estimation system related with.
2. Pollution degree:
   An index indicating pollution degree of the operating environment which decides insulation performance of the devices. For instance, Pollution degree 2 indicates the state generally that only non-conductive pollution occurs. However, this state contains temporary conduction due to dew produced.

## 2.2 Performance Specifications

The following table shows the performance specifications of XGT Positioning Module.

### 2.2.1 Function Specifications

| Items | | Specification |
|---|---|---|
| No. of control axis | | 32 axis(Real axis), 4 axis(Virtual axis), 4 axis(EtherCAT I/O) |
| Communication | | EtherCAT (CoE: CANopen over EtherCAT) |
| Communication period | | 1ms, 2ms, 4ms (Same with main task period) |
| Servo drive | | Servo drive to support EtherCAT CoE |
| Control period | | 1ms, 2ms, 4ms (Same with main task period) |
| Control unit | | pulse, mm, inch, degree |
| I/O | Internal | Input 8 point, Output 8 point |
| | External | EtherCAT I/O 4 EA(Maximum 256 point) |
| Motion program | No. of program | Maximum 256 EA |
| | Capacity | Maximum 2MB |
| | Language | LD(FB), ST |
| | Position data | Specifying available (6400 Point/All axis) |
| Control method | | Position, Velocity, Torque(Servo drive support) control, Synchronous control, Interpolation control |
| Range of position | | ± LREAL, 0 |
| Range of velocity | | ± LREAL, 0 |
| Torque unit | | Rated torque % designation |
| Acc./Dec. process | | Trapezoid type, S-type<br>(Setting to specify the Jerk at function block) |
| Rage of Acc./Dec. | | ± LREAL, - |
| Manual operation | | JOG operation |
| CAM operation | | 32 blocks |
| Absolute System | | Available (When using absolute encoder type servo drive) |
| Encoder input | Channel | 2 channels |
| | Max. input | 500 Kpps |
| | Input method | Line drive input (RS-422A IEC specification)<br>Open collector output type encoder |
| | Input type | CW/CCW, Pulse/Dir, Phase A/B |
| Max. distance | | 100m |

| Items | Specification |
|---|---|
| Communication cable | Over CAT.5 STP(Shielded Twisted-pair) cable |
| Error indication | Indicated by LED |
| Communication status indication | Indicated by LED |
| Occupied point I/O | Variable: 16points, Fixed: 64points |
| Consumable current | 900mA |
| Weight | 122g |

**Note**

1. LREAL range: -1.7976931348623157e+308 ~ -2.2250738585072014e-308 or 0 or 2.2250738585072014e-308 ~ 1.7976931348623157e+308
2. Jerk: Change rate of acceleration, which is index, how fast acceleration increasing or decreasing

## 2.2.2 Communication specifications

| Item | Specification |
|---|---|
| Communication protocol | EtherCAT |
| Support specification | CoE(CANopen over EtherCAT) |
| Physical layer | 100BASE-TX |
| Communication speed | 100Mbps |
| Topology | Daisy Chain |
| Communication cable | Over Cat. 5 STP(Shielded Twisted-pair) cable |
| No. of maximum slave | 36 |
| Communication period | 1ms/2ms/4ms |
| Synchronous Jitter | Within 1 ㎲ |
| Synchronous communication | PDO(Process Data Object) Mapping through CoE |
| Non-synchronous communication | SDO(Service Data Object) communication through CoE |
| Communication setting | Set the communication configuration using XG-PM |

### 2.2.3 Internal input/output specifications

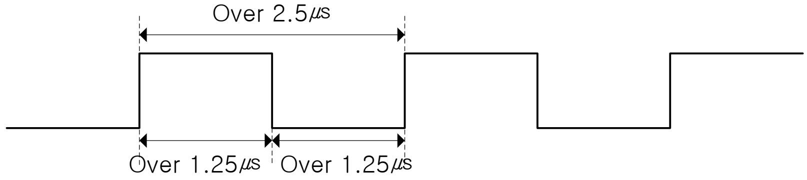
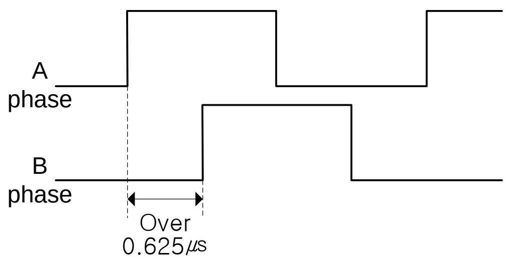
1. **Input specifications (source/sink type)**

| Item | Specification |
|---|---|
| Input point | 8 point |
| Insulation method | Photo-coupler insulation |
| Rated input voltage | 24V |
| Rated output voltage | About 4mA |
| Used voltage range | DC20.4V~28.8V(within ripple rate 5%) |
| On voltage/On current | DC19V or above / 3mA or above |
| Off voltage/Off current | DC11V or less / 1.7mA or less |
| Input resistance | About 5.6 ㏀ |
| Response time | 1ms or less |
| Working voltage | AC560Vrms/3 Cycle (Altitude 2000m) |
| Insulation resistance | Insulation resistance 10 ㏁ or more |
| COMM method | 8point / COM |

2. **Output specifications (sink type)**

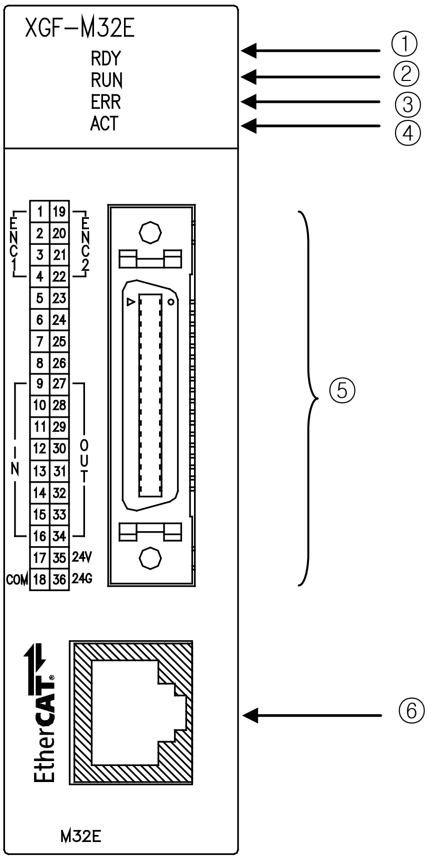
| Item | | Specification |
|---|---|---|
| Output point | | 8 point |
| Insulation method | | Photo-coupler insulation |
| Rated load voltage | | DC 12V / 24V |
| Used load voltage range | | DC10.2V~26.4V |
| Maximum load current | | 0.5A / 1 point, 2A / 1COM |
| Off leakage current | | 0.1mA or less |
| Maximum inrush current | | 4A / 10ms or less |
| Maximum voltage drop(On) | | DC 0.3V or less |
| Surge absorber | | Zener diode |
| Response time | Off→On | 1ms or less |
| | On→Off | 1ms or less(Rated load, resistive load) |
| COM method | | 8 point /1COM |
| External power | Voltage | DC 12/24V ±10% (ripple voltage 4Vp-p or less) |
| | Current | 10mA or less (DC 24V connection) |

## 2.2.4 Encoder Input Specification

<table>
<tr><th>Item</th><th colspan="2">Specification</th></tr>
<tr><td>Input voltage</td><td>5V (4.5V ~ 5.5V)</td><td rowspan="4">In accordance with RS-422A Line Driver Level</td></tr>
<tr><td>Input current</td><td>7 ㎃ ~ 11 ㎃</td></tr>
<tr><td>Min. On guarantee voltage</td><td>4.1V</td></tr>
<tr><td>Max. Off guarantee voltage</td><td>1.7V</td></tr>
<tr><td>Input pulse</td><td colspan="2">1) Pulse width<br><br><br>2) Phase difference<br><br><br>When A phase input pulse is ahead of B phase input pulse<br>: Position value increases<br><br>When B phase input pulse is ahead of A phase input pulse<br>: Position value decreases</td></tr>
</table>

# 2.3 The Name of Each Part

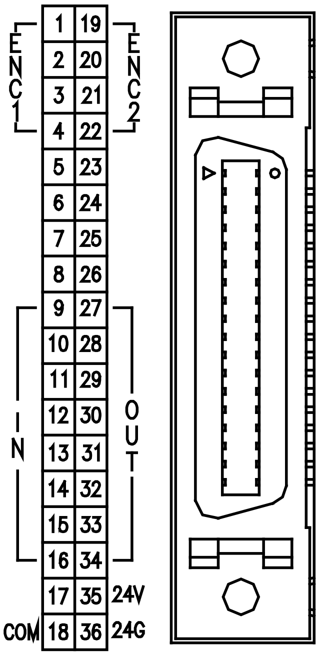
## 2.3.1 The name of each part



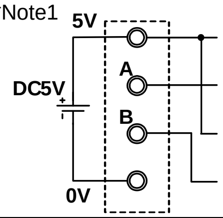
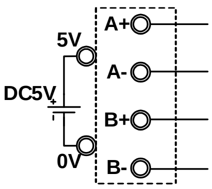

| No. | Name | Description |
|---|---|---|
| ① | Module ready(RDY) | On: Positioning module normal status<br>Off: Power OFF or CPU module reset status |
| ② | RUN/STOP indicator | On: Run user program<br>Off: Stop user program<br>Flicker: Write user program |
| ③ | Error display | Off: User program normal execution status<br>Flicker: Error occurs during user program executing/communiting wih servo drive |
| ④ | TRX status LED(ACT) | On: Wiring with servo driver is done<br>Off: Wiring with servo driver is not done<br>Flicker: communicating with servo driver |
| ⑤ | Wiring connector for encoder and internal input/output | Connector to connect with encoder and internal I/O signal |
| ⑥ | RJ-45 connector | RJ-45 connector to connect with servo drive |

## 2.3.2 Specification of interface with external device

### 1. Pin arrangement of connector

| Pin arrangement | Pin no. | Signal name | | Signal direction |
|---|---|---|---|---|
|   | 1 | ENC1A+ | Encoder 1A+ input | Input |
| | 2 | ENC1A- | Encoder 1A- input | |
| | 3 | ENC1B+ | Encoder 1B+ input | |
| | 4 | ENC1B- | Encoder 1B- input | |
| | 5 – 8 | - | N.C | - |
| | 9 | IN0 | Input signal 0 | Input |
| | 10 | IN1 | Input signal 1 | |
| | 11 | IN2 | Input signal 2 | |
| | 12 | IN3 | Input signal 3 | |
| | 13 | IN4 | Input signal 4 | |
| | 14 | IN5 | Input signal 5 | |
| | 15 | IN6 | Input signal 6 | |
| | 16 | IN7 | Input signal 7 | |
| | 17 | - | N.C | - |
| | 18 | COM | Input signal Common | Input |
| | 19 | ENC2A+ | Encoder 2 A+ input | Input |
| | 20 | ENC2A- | Encoder 2 A- input | |
| | 21 | ENC2B+ | Encoder 2 B+ input | |
| | 22 | ENC2B- | Encoder 2 B- input | |
| | 23 – 26 | - | N.C | - |
| | 27 | OUT0 | Output signal 0 | Output |
| | 28 | OUT1 | Output signal 1 | |
| | 29 | OUT2 | Output signal 2 | |
| | 30 | OUT3 | Output signal 3 | |
| | 31 | OUT4 | Output signal 4 | |
| | 32 | OUT5 | Output signal 5 | |
| | 33 | OUT6 | Output signal 6 | |
| | 34 | OUT7 | Output signal 7 | |
| | 35 | 24V | DC 24V | Input |
| | 36 | GND | DC 24V GND | |

2.　**Encoder internal circuit**

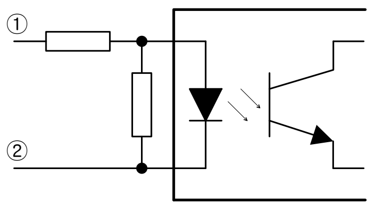
| Item | Pin No. | Signal | |
|---|---|---|---|
| *Note1  | 1 | ENC1A+ | Encoder 1A+ input |
| | 2 | ENC1A- | Encoder 1 A- input |
| | 3 | ENC1B+ | Encoder 1 B+ input |
| | 4 | ENC1B- | Encoder 1 B- input |
| *Note2  | 19 | ENC2A+ | Encoder 2 A+ input |
| | 20 | ENC2A- | Encoder 2 A- input |
| | 21 | ENC2B+ | Encoder 2 B+ input |
| | 22 | ENC2B- | Encoder 2 B- input |

**Note**

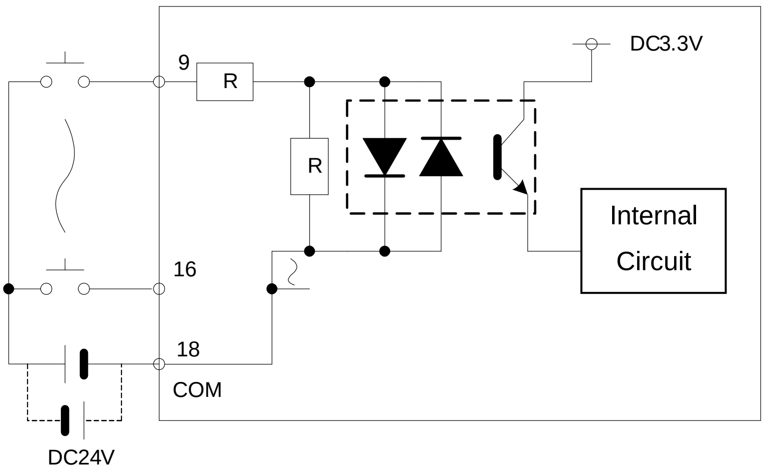
*Note1
Wiring of encoder 1 is example about 5V voltage output type (open collector). When using 12V, 24V type MPG, change the input voltage from 5V to 12V or 24V and in case of 12V, connect 910Ω resistor to ENC1 A+(pin 1), ENC1 B+ (pin3), in case of 24V, 2.4㏀ resistor, before connecting the power source (adding PULL-UP resistor is needed)

*Note2
Wiring of encoder 2 is example about 5V voltage output type (line driver)

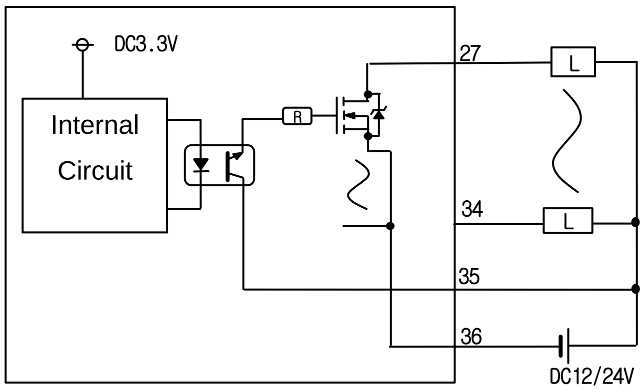
This describes the internal circuit of the module when connecting the encoder.

| Item | Internal circuit | No. | Terminal | Pin number | | Signal name |
|---|---|---|---|---|---|---|
| | | | | Encoder 1 | Encoder 2 | |
| Input |  | ① | A+ | 1 | 7 | A phase pulse input + |
| | | ② | A- | 2 | 8 | A phase pulse input - |
| | | ① | B+ | 3 | 9 | B phase pulse input + |
| | | ② | B- | 4 | 10 | B phase pulse input - |

### 3. Input internal circuit




### 4. Output internal circuit



# Chapter 3 Operation Order and Installation

## 3.1 Operation Order

▶ Here describes the Operation order of Motion Control module.

Start

1. Specify motion control operation method and control unit
2. Specify the number of axis to be connected
3. Specify the servo type and capacity
4. Install the XG5000 and XG-PM on the PC
5. Mount the Motion Control module on the base
6. Connect the motor and external signal to the servo
   - External emergency stop signal
   - External upper limit signal
   - External lower limit signal
   - Home signal
   - DOG signal
7. Connect Ethernet communication cable between positioning module and servo, and between servos
   - Max. Communication distance: 100m
   - Communication cable: STP cable
8. Turn the Servo on
9. Turn the PLC on
   - Check whether RDY LED is ON or not
10. Connect the communication cable between USB ports (RS-232C) of PC and PLC CPU module
11. Write the motion program and parameter of Motoin Control module in the XG-PM and download it to the module
    - Basic parameter, axis group parameter, master parameter, common parameter, motion program
12. Set up the servo axis and establish communication between Servo and Motion Control module
    - Allocate the axis number to each servo by using XG-PM
13. Write the servo parameter in the XG-PM and download it to servo
    - Reading/Writing servo parameter and servo tuning are available by XG-PM
14. Execute a test run by using XG-PM
    - Check the operation status and modify the module parameter and servo parameter
15. Write the program for motion control operation through XG5000
16. Start the motion control operation

End

## 3.2 Installation

### 3.2.1 Installation Environment

This machine has a good reliability regardless of installation environment but cares should be taken in the following items to guarantee the reliability and safety of the system.

**1. Environment Condition**

(1) Install the control panel available for water-proof, anti-vibration.
(2) The place free from continuous impact or vibration.
(3) The place not exposed to direct rays.
(4) The place with no dew phenomena by rapid temperature change.
(5) The place where surrounding temperature maintains 0-55℃.

**2. Installation Construction**

(1) In case of processing the screw hole or wiring, cares should be taken not to put the wiring remnants to PLC inside.
(2) Install on the good place to operate.
(3) Do not install the high voltage machine on the same Panel.
(4) The distance from duct or surrounding module shall be more than 50mm.
(5) Ground to the place where surrounding noise environment is good enough.

### 3.2.2 Notices in Handling

Here describes the notices in handling the positioning module from opening to installation.

(1) Do not fall down or apply the strong impact.
(2) Do not remove PCB from the case. It may cause the failure.
(3) In wiring, cares should be taken not to put the wiring remnants or foreign materials to the upper part of module. If something entered, it should be removed.
(4) The removal of module in the status of power ON is prohibited.

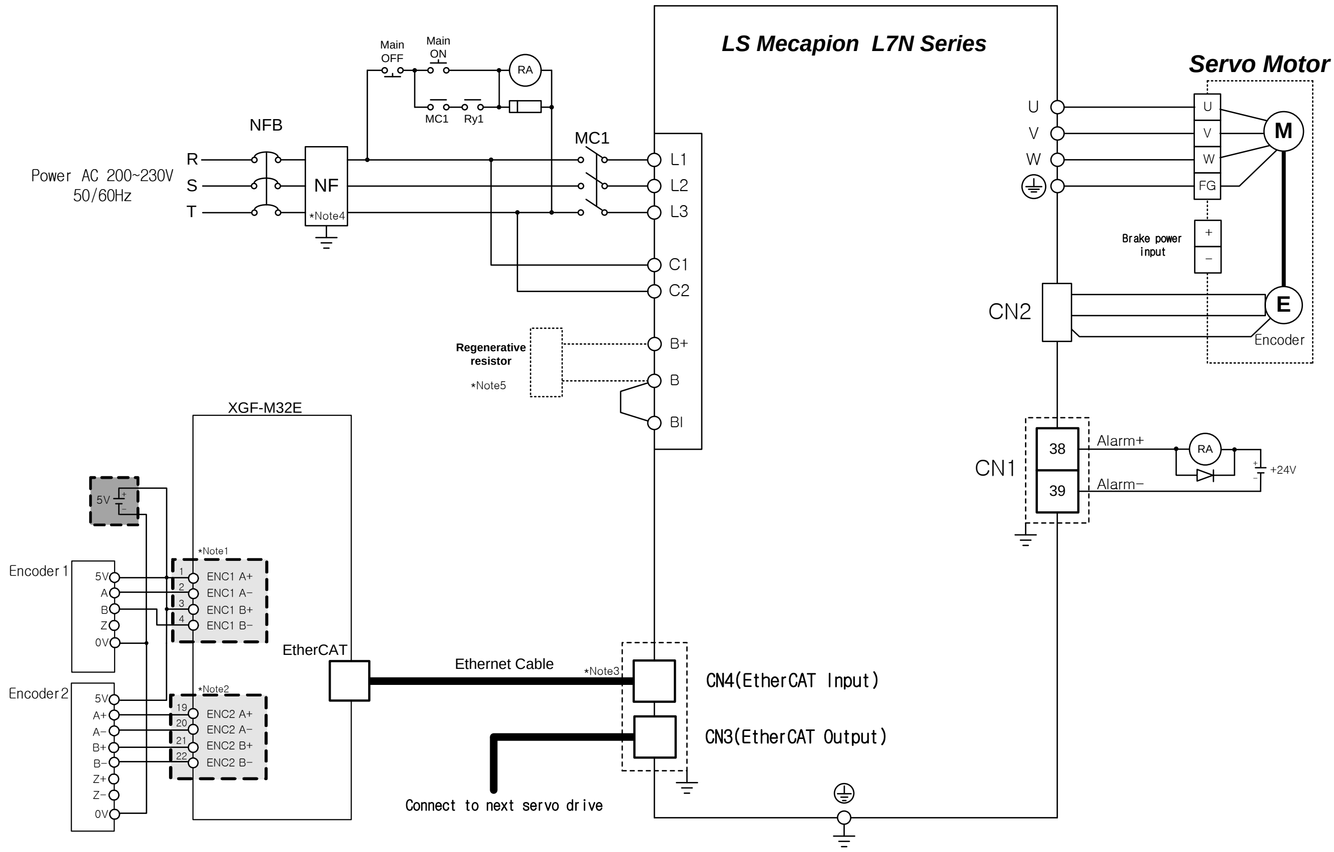
## 3.3 Notices in Wiring

### 3.3.1 Notices in Wiring

(1) The length of connecting cable between positioning module and drive machine shall be as short as possible. (Max. length: 2m and 10m).
(2) For alternating current and external I/O signal of positioning module, it is required to use the separate cables to avoid the surge or induction noise generated from the alternating current.
(3) The wires should be selected considering surrounding temperature, allowable current and it is recommended to be more than max. size AWG22(0.3㎟).
(4) In wiring, if it is too close to the high temperature machine or material or it is directly contacted to the oil for a long time, the short-circuit will occur that may cause the damage or malfunction.
(5) Make sure to check the polarity before applying the external contact signal to the terminal board.
(6) In case of wiring the high voltage cable and power cables together, the induction noise occurs that may cause the malfunction or failure.
(7) In case of wiring by the pipe, the grounding of pipe is required.
(8) Connect the line between motion control module and EtherCAT slave device by using more than STP CAT-5 in wiring between motion control module and drive unit.
(9) When a communication error(0x0F50, 0x0F51, 0x1F00, 0x1011, 0x2011, etc.) occurs in operation of motion control module, attach Ferrite Core to communication cable connecting motion control module to EtherCAT slave device and run the module because it may be caused by noise interference in wiring between motion control module and EtherCAT slave device.
(10) When using the wiring connector for encoder signal and external I/O signal, install it on the place where there is no dust or corrosive gas.

## 3.3.2 Connection Example of Servo and Stepping Motor Drive Machine

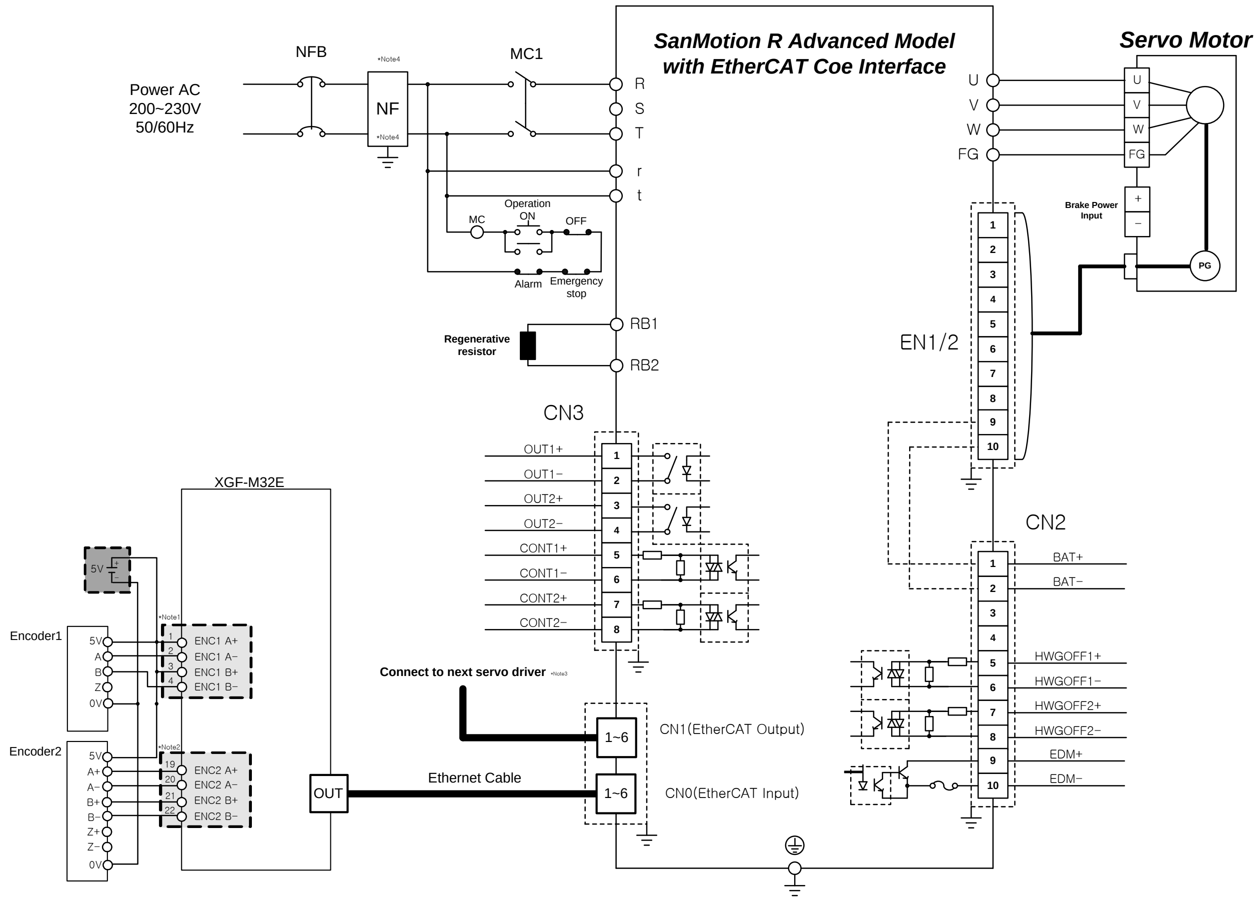
(1) This is an example of wiring which connects EtherCAT servo drive/motor, the L7N Model of LS Mecapion, in motion control module (XGF-M32E). Refer to manual of each drive for details on installation and wiring.




**Note**

*Note1
Wiring of encoder 1 is an example about 5V voltage output (open collector) type.
*Note2
Wiring of encoder 2 is an example about 5V voltage output (line driver) type.
*Note3
When connecting more than 2 servo drivers, connect first servo driver's IN to the positioning module's OUT and for other servo drivers, connect previous servo driver's OUT to next servo driver's IN. last servo driver's OUT doesn't need to be connected. And connection order is not related with axis order.
*Note4
NF is abbreviation of Noise Filer. It is necessary to prevent the noise from coming in.
*Note 5
Use after making a short circuit between terminals B and BI as regenerative resistor of L7NA001B~L7NA004B (50[W], 100[Ω]), L7NA008B ~L7NA010B(100[W], 40[Ω]), L7NA020B~ L7NA035B(150[W], 13[Ω]) is contained inside. In case of a high regeneration capacity due to frequent acceleration/deceleration, open the shorting pin(B, BI) and connect external resistor to B and BI to use.

(2) This is wiring example connecting SanMotion R Advanced Model EtherCAT servo drive/motor to Motion Control module(XGF-M32E). For detail on installation and wiring, refer to the driver manual.




**Note**

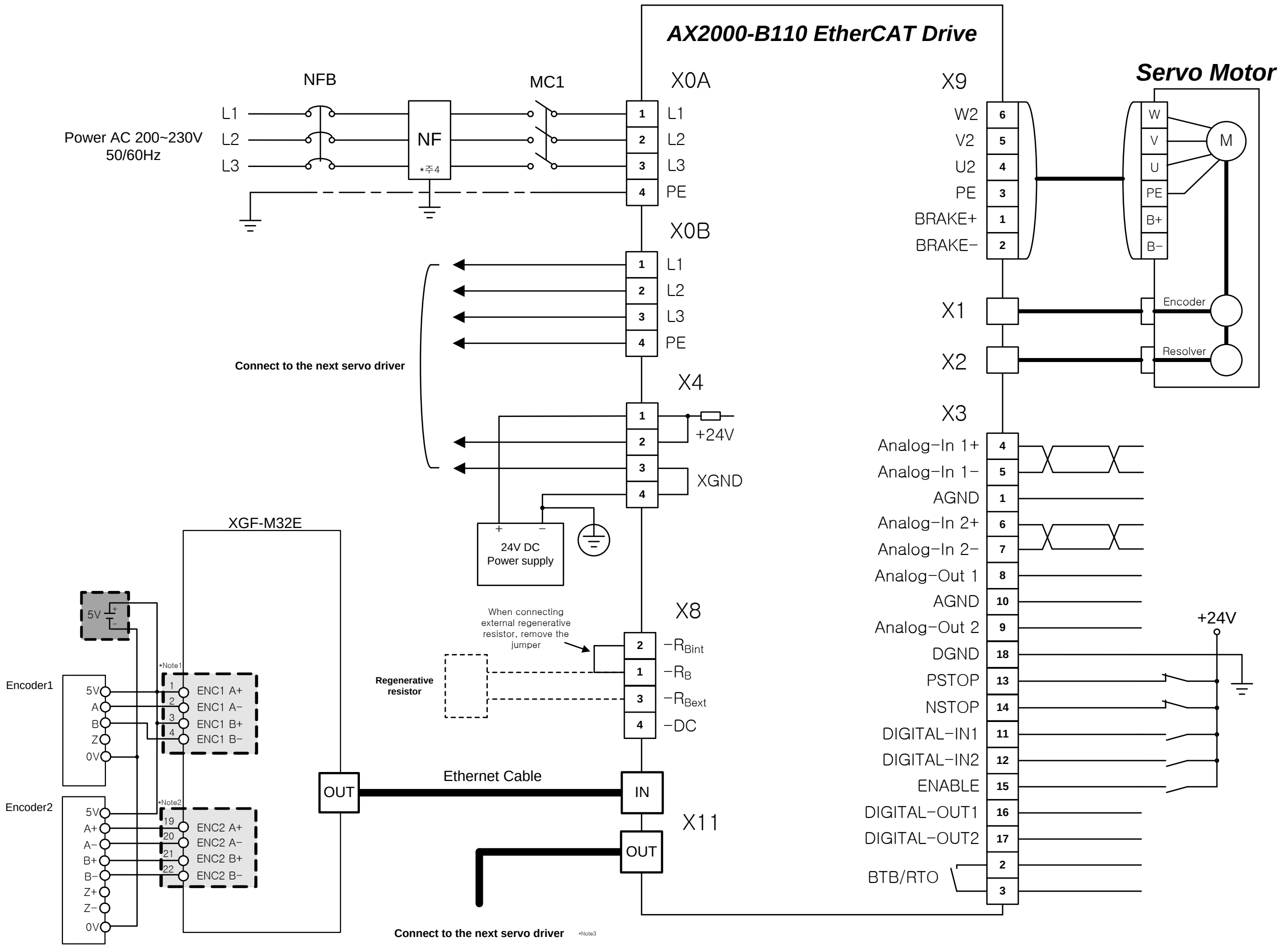
*Note1
Wiring of encoder 1 is an example about 5V voltage output (open collector) type.

*Note2
Wiring of encoder 2 is an example about 5V voltage output (line driver) type.

*Note3
When connecting more than 2 servo drivers, connect first servo driver’s IN to the positioning module’s OUT and for other servo drivers, connect previous servo driver’s OUT to next servo driver’s IN. last servo driver’s OUT doesn’t need to be connected. And connection order is not related with axis order.

*Note4
NF is abbreviation of Noise Filer. It is necessary to prevent the noise from coming in.

(3) This is wiring example connecting BeckHoff AX2000 servo drive/motor to Motion Control module (XGF-M32E). For detail on installation and wiring, refer to the driver manual.



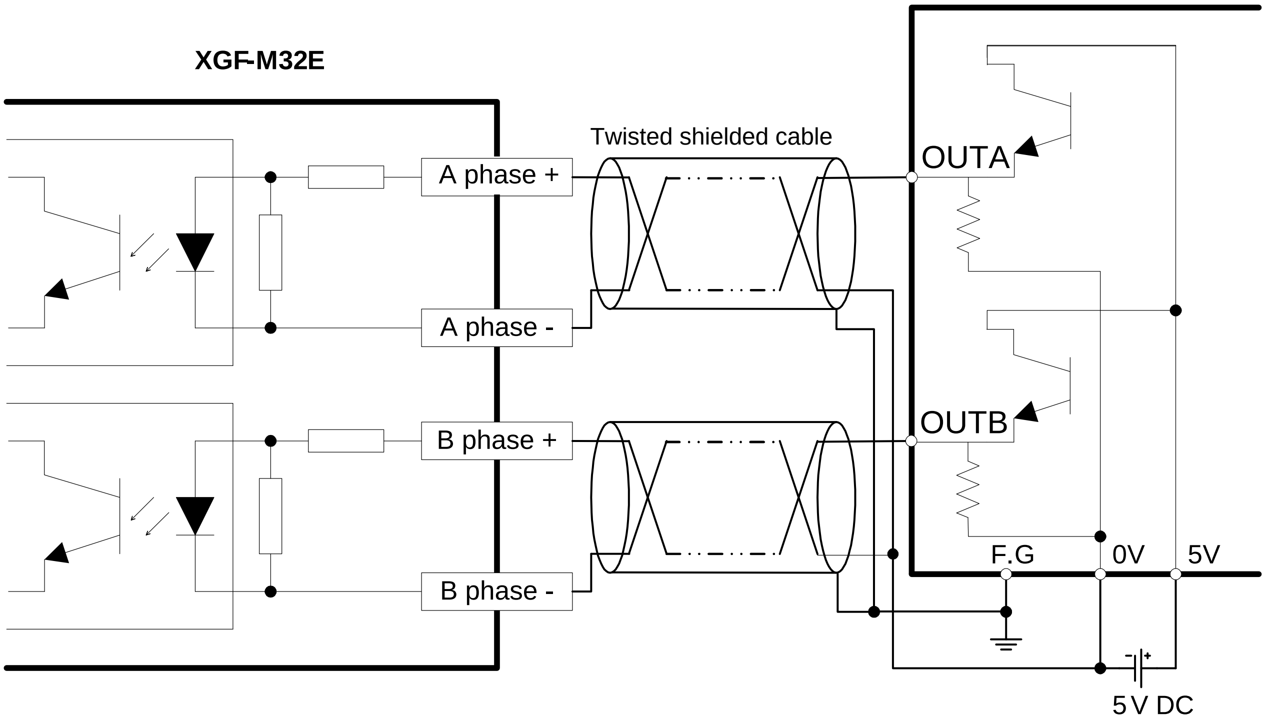

**Note**

*Note1
Wiring of encoder 1 is an example about 5V voltage output (open collector) type.
*Note2
Wiring of encoder 2 is an example about 5V voltage output (line driver) type.
*Note3
When connecting more than 2 servo drivers, connect first servo driver’s IN to the positioning module’s OUT and for other servo drivers, connect previous servo driver’s OUT to next servo driver’s IN. last servo driver’s OUT doesn’t need to be connected. And connection order is not related with axis order.
*Note4
NF is abbreviation of Noise Filer. It is necessary to prevent the noise from coming in.

### 3.3.3 Encoder Input (DC 5V Voltage Output) Wiring Example

When Pulse Generator is a Voltage Output type, wiring example of positioning module and Encoder input part is as follows.

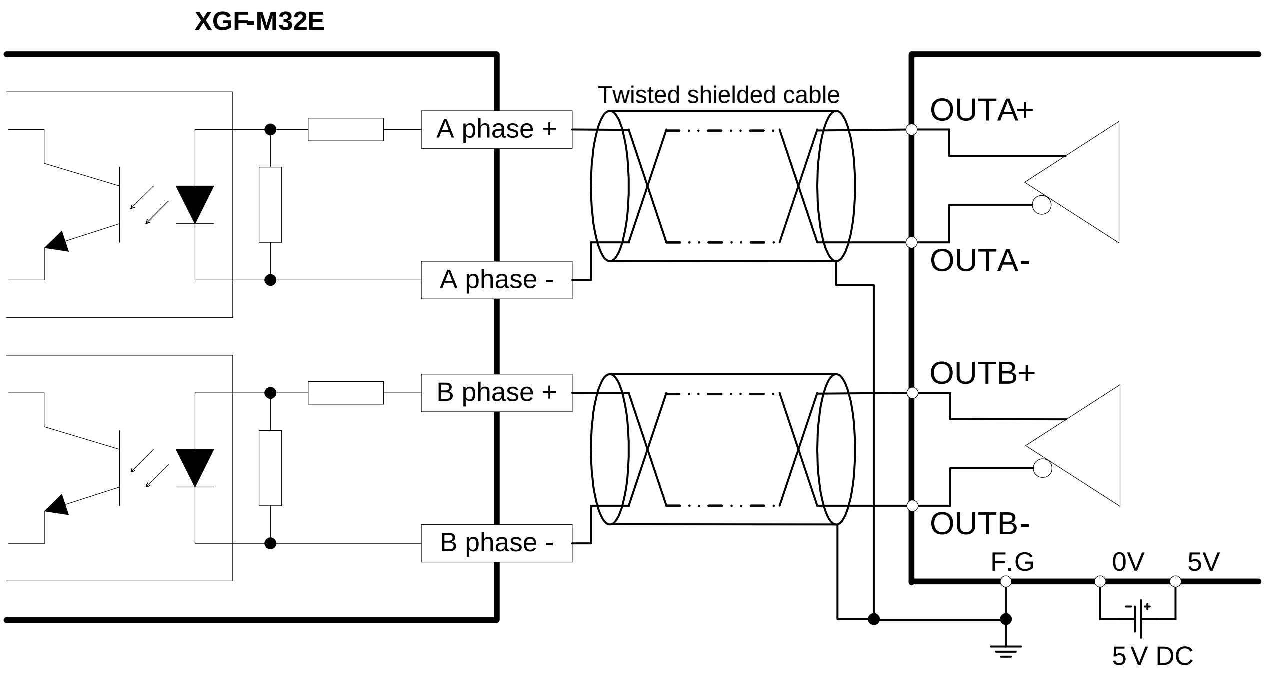
In case pulse generator is totem-pole output and used as voltage output style, wiring is equal.




**Notes**

Before Wiring, please consider maximum output distance of pulse generator.

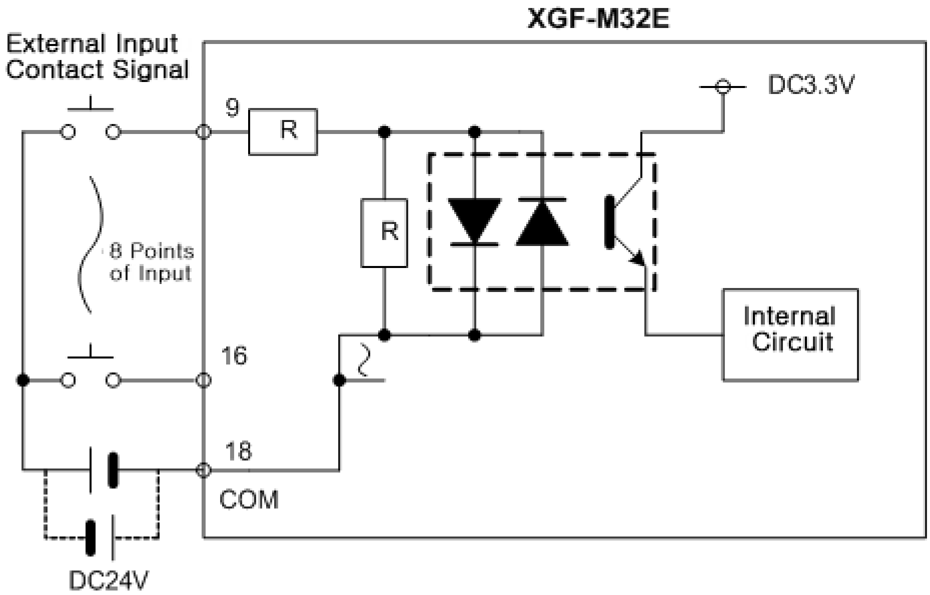
### 3.3.4 Encoder Input (5V Line Driver Output) Wiring Example



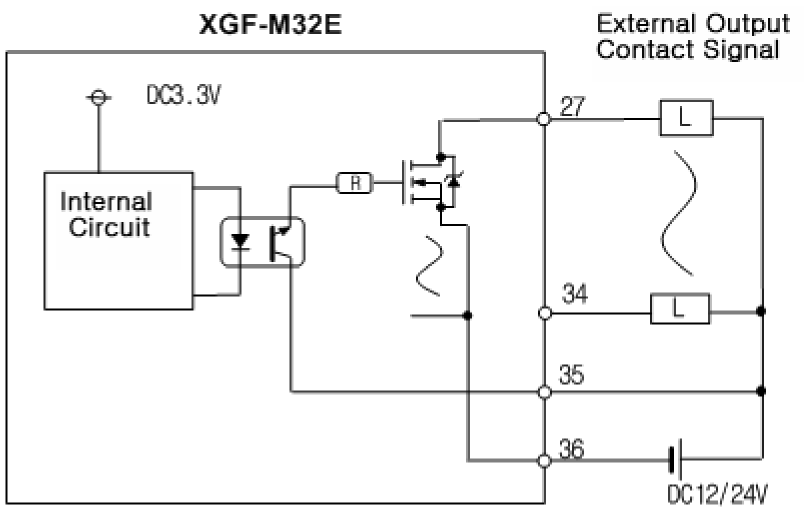

**Notes**

Before Wiring, please consider maximum output distance of pulse generator.

### 3.3.5 External Input Signal Wiring Example




### 3.3.6 External Output Signal Wiring Example

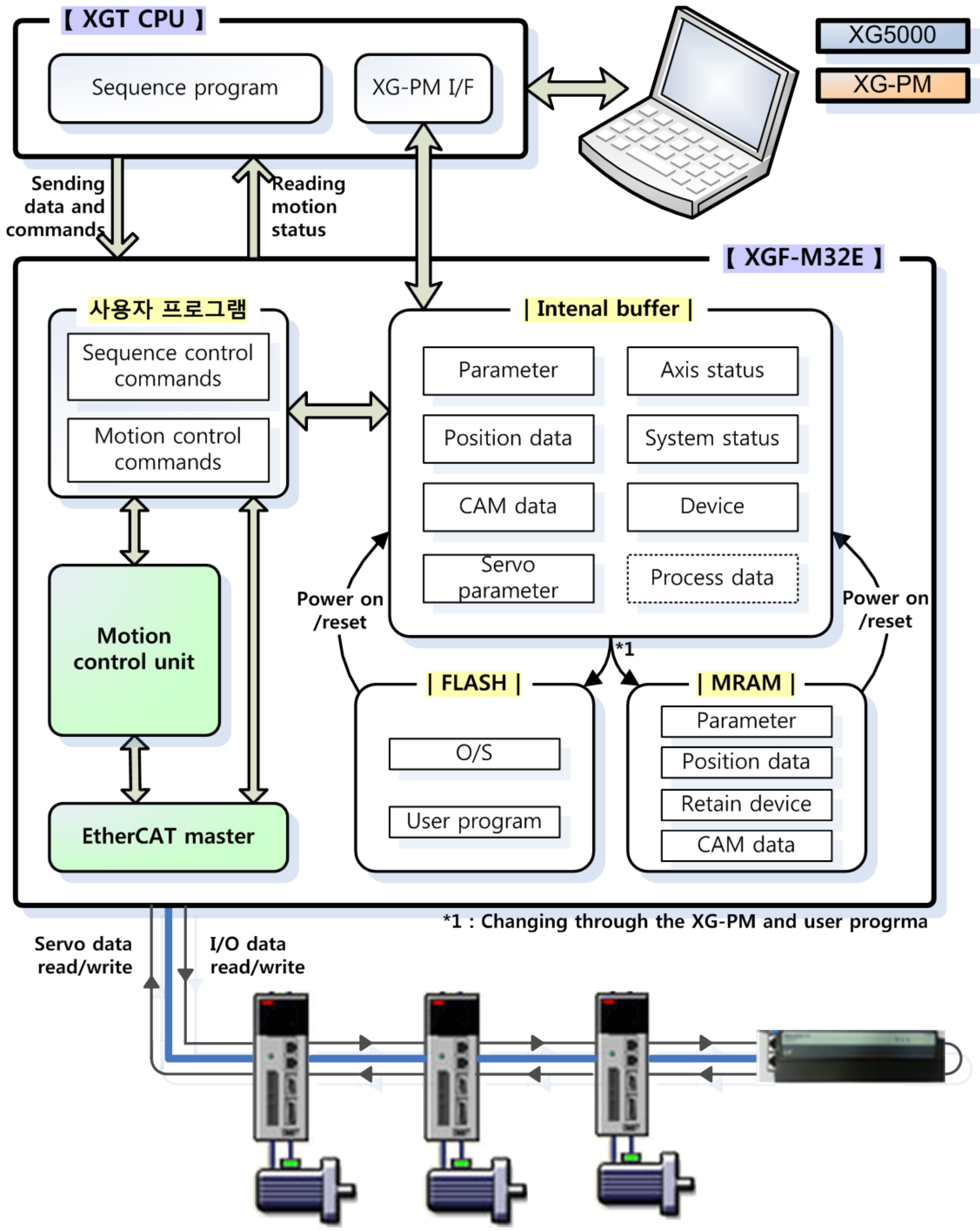


# Chapter 4 Motion Control Operation

This chapter describes structure, parameter and device of Motion Control module.

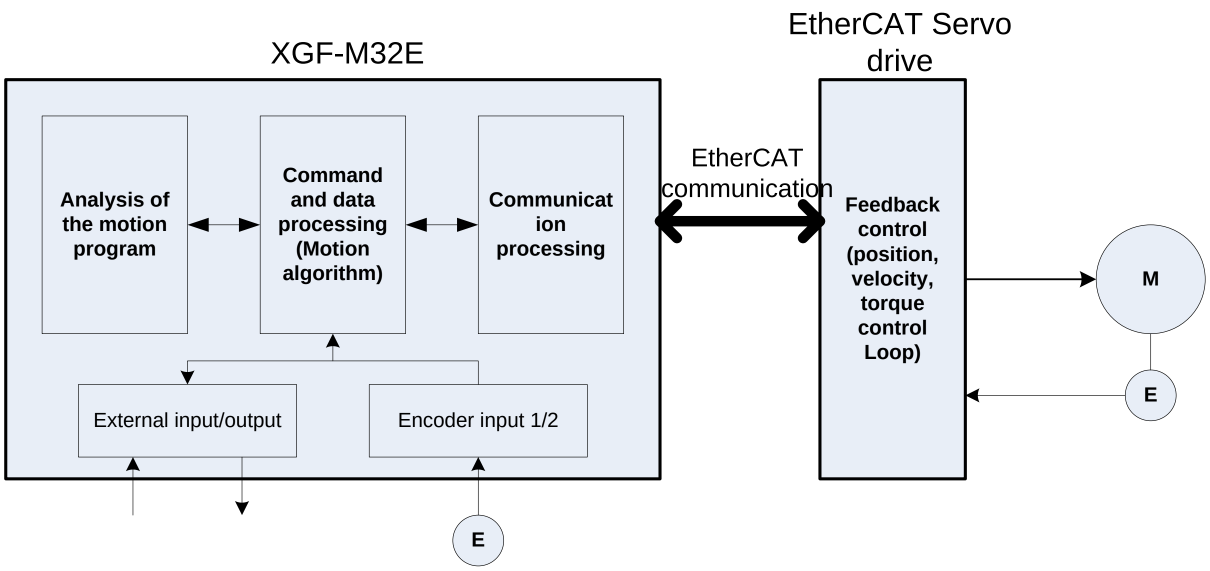
## 4.1 Structure of Motion Control Module

This picture describes process of parameter and operation data saved in the module.



## 4.2 Configuration of Motion Control

XGF-M32E is motion control module of XGK/I/R series; it can control up to 32 axes of actual motor axis and 4 virtual axes through EtherCAT. Also, it can control up to 4 EtherCAT I/Os besides 8 points of input and 8 points of output included inside. Motion control block diagram of motion control module is shown below.




## 4.3 Motion Control Tasks

The following describes tasks of the motion control module.

### 4.3.1 Types of Tasks

There are 3 types of motion control tasks: main task, periodic task and initialization task.

The main task completes the motion within the period set by the user, and it performs I/O refresh, program process, motion control and processes EtherCAT synchronous communication. The set period of the main task is 1/2/4ms, and it can be set in the basic parameter of the motion control module.

The period of the periodic task can be set in multiples of the main task's period set by the user, and the periodic task is processed in the remaining time after the main task is completed during the period of each task.

Therefore, the periodic task can be performed over a number of main task periods.

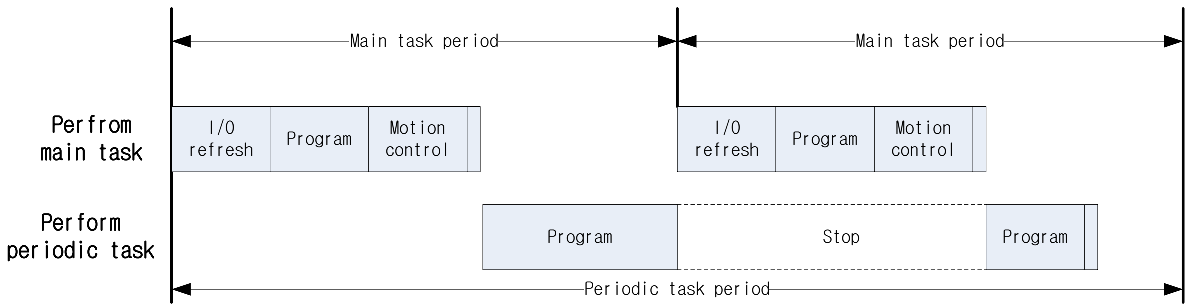
The initialization task is only performed once at the beginning when the motion control module is entering the RUN mode, and it is normally used for setting the initial data of the system and the parameter.

| Types of Tasks | Number of Programs | Motions |
|---|---|---|
| Main task | Up to 256 | · It performs I/O refresh, processing of programs assigned to main task and motion control.<br>· It performs the above tasks at a time for each of the established control period (main task cycle).<br>· It has higher priority than periodic task.<br>· It uses programs that require synchronized control and high-speed operation processing through allocation since it is possible to process program fast.<br>· Period possible to be set: 1ms, 2ms, 4ms |
| Periodic task | | · It performs processing of programs assigned to main task.<br>· It is performed for the remaining time after implementation of main task operation within the control period, and can be performed over multiple cycles.<br>· Since it has lower priority than main task in the execution of motion control commands within main task program, the motion control commands executed in the main task program are processed first.<br>· It uses programs of processing other monitoring data and control of device that doesn't require high-speed processing through allocation.<br>· Period possible to be set: 1ms ~ 100ms (Set to a multiple of the main task cycle) |
| Initialization task | | · It performs processing of programs assigned to the initialization task after implementing I/O refresh.<br>· It is performed only once at the time of entering the RUN mode. |

## 4.3.2 Task Operation

### 1. Overall task operation

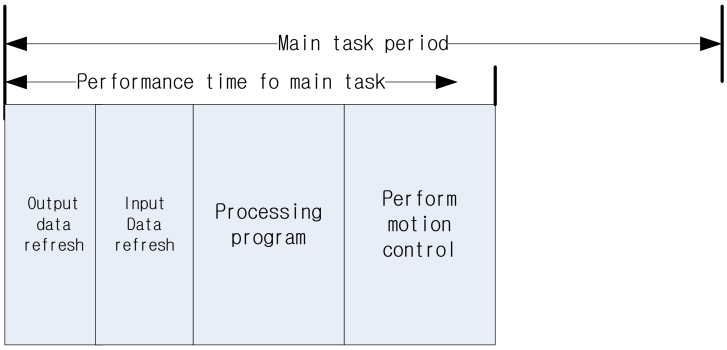
The task is composed of the main task and periodic task. The main task performs I/O refresh and processes program as well as motion control motion according to the processing of the program during the control period. The periodic task is performed in the control period in the remaining time after the main task is completed and it can be completed after going through many control periods.



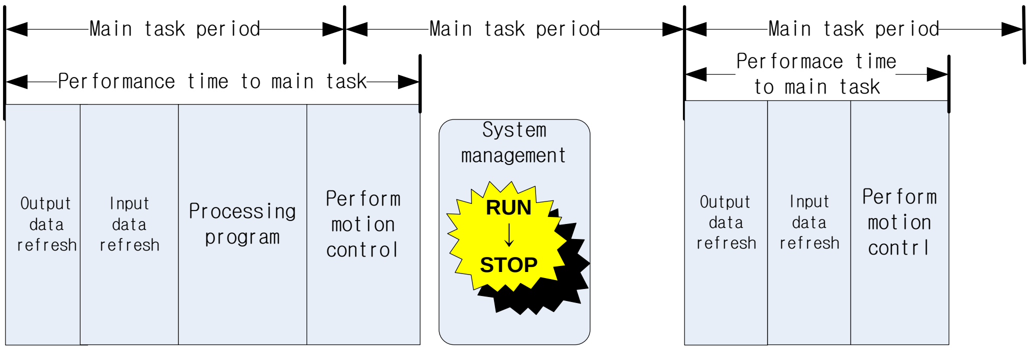
## 2. Main task operation

The main task must be performed in the set task period, and if the performance of the main task exceeds the set main task period, an error occurs and if motion control module is in RUN state, it is changed to STOP state.

(1) Performance time of main task ≤ Main task period



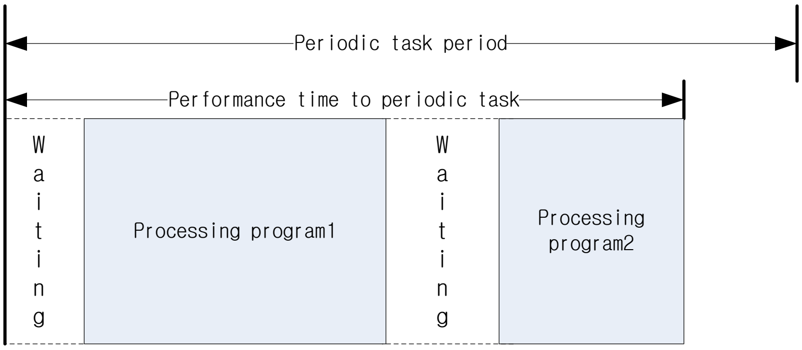

(2) Performance time of main task > Main task period



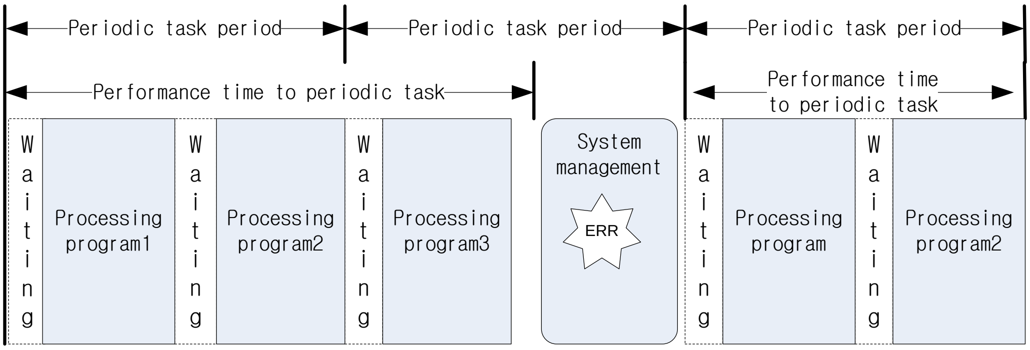

## 3. Periodic task operation

The periodic task is performed in the remaining time after performing the main task in the set control period and it can be performed over many control periods depending on the performance time of the task. An error will occur if the performance of the periodic task exceeds the set period of the periodic task, but it does not change the RUN/STOP state of the motion control module.

(1) Performance time of periodic task ≤ Periodic task period




(2) Performance time of periodic task > Periodic task period



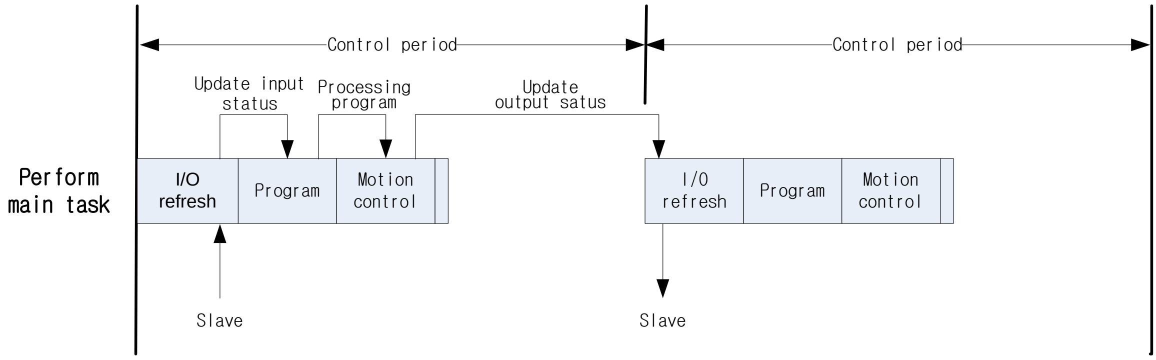

**4. Initialization task operation**

The initialization task is a task performed only once at the beginning when motion control module is entering the RUN mode. It is mainly used to set the initial data of the system and the parameter. The initialization task must be also performed in the set task period like the main task, and an error will occur if the performance of the initialization task exceeds the set period of the main task, and it is changed to stop state. When using the basic function block and motion function block in the initialization task program, the function of the relevant function block may be limited. This is because it is only performed once when it enters the RUN mode due to the characteristic of the initialization task, and in the case of function block, the output parameter is not updated. Therefore, when using the basic function block and motion function block in the initialization task program, the output of the relevant function block may be different to its real function, so please take caution when in use.

## 4.3.3 Execution of Motion Commands

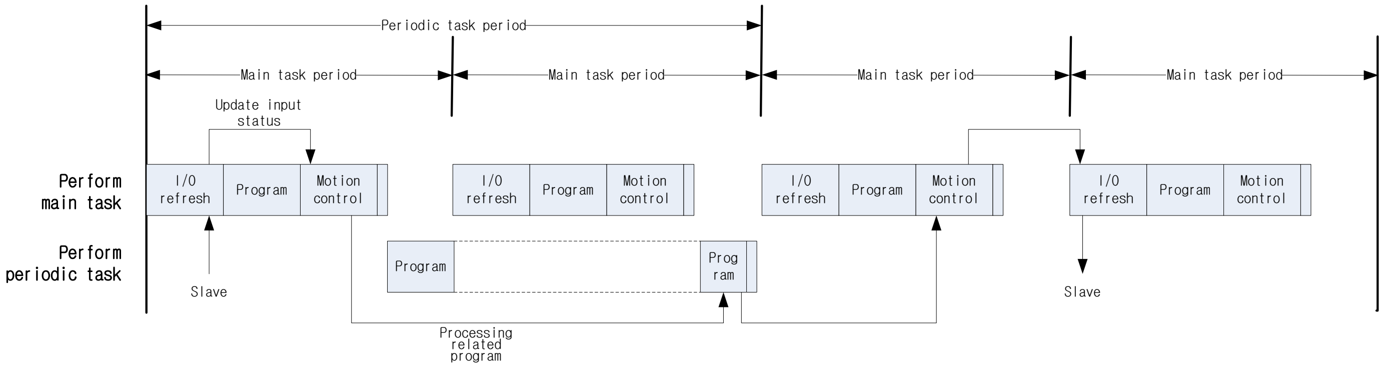
### 1. Execution of motion commands in the main task

Execution of motion instruction of the main task is shown in the figure below. The input value of the slave and the system parameters are updated by the I/O refresh motion of the main task, and based on this information, the program is processed and motion control motion is performed. The outcome of the performance is output in slave module at the I/O refresh time of the next control period.




### 2. Execution of motion commands in the periodic task

Execution of motion instruction in the periodic task is shown in the figure below. According to the I/P refresh motion of the main task, the input value of slave and the system parameters are updated and motion control is performed in the main task based on this information. The program of the periodic task is performed by this result, and motion control is performed with this result while the main task is being performed in the control period after the performance of the periodic task. Also the outcome of this motion control performance is output in slave at the I/O refresh time of the next control period

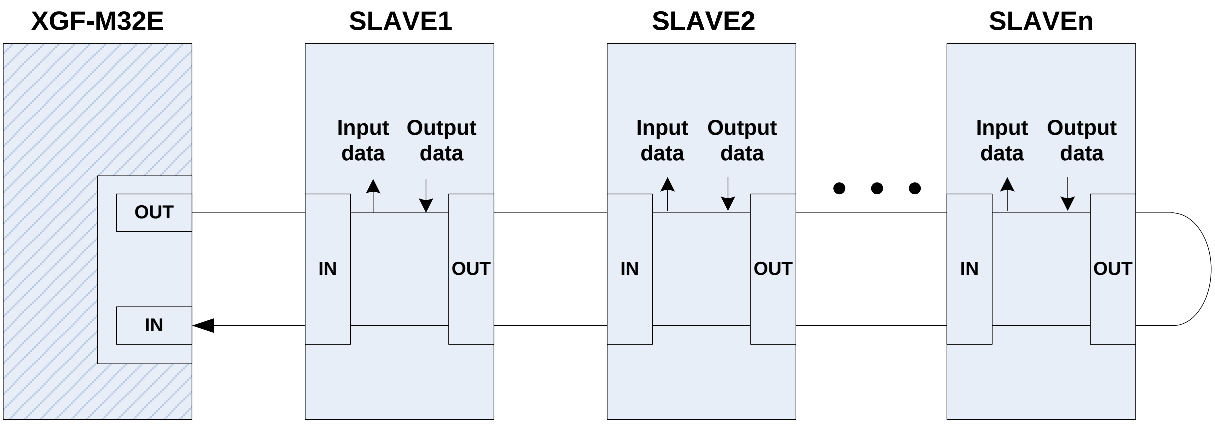


## 4.4 EtherCAT Communication

The communication of EtherCAT(Ethernet for Control Automation Technology) is explained here.

### 4.4.1 What is EtherCAT

EtherCAT is a high-performance industrial network system which uses Real-Time Ethernet based on the Ethernet developed by Beckhoff Company in Germany. EhterCAT is a communication between the master and the slave, and it provides a short communication cycle time by transmitting Ethernet Frame at a high speed between each nodes. When data Frame transmitted from the master to the slave passes through the slave, EtherCAT communication sends the received data to the relevant data Frame at the same time as the slave receives the transmission data. In other words, EtherCAT does not transmit data to each slave nodes of the network but passes one communication Frame to every slave in order, and each slave reads and writes Data in its relevant area in the Frame when the communication Frame passes through each slave. The communication Frame performs high speed data transmission with a structure where after going through the last slave, it turns back and passes through every slave and is transmitted to the master.




### 4.4.2 CoE(CANopen over EtherCAT)

Motion control module uses the slave and EtherCAT to communicate and uses CoE(CANopen over EtherCAT) as the protocol for information exchange.

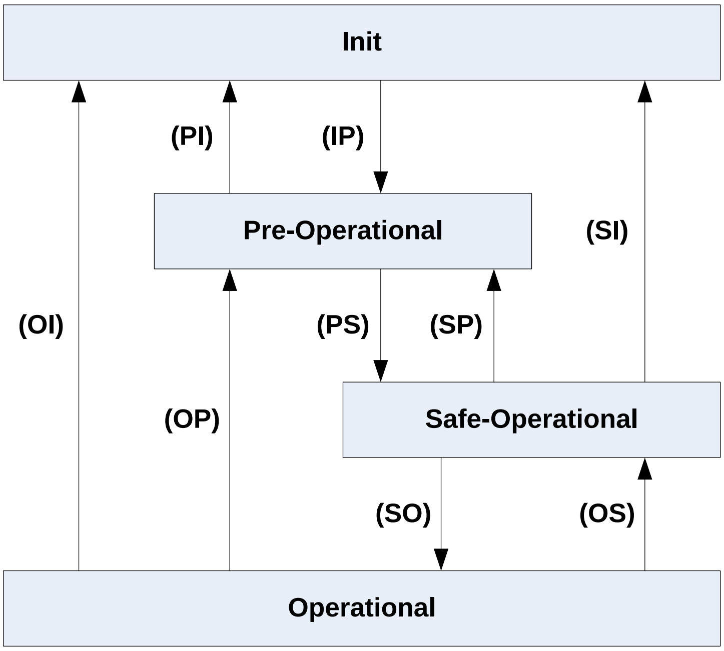
In CoE, parameter and data information of the slave are composed of Object Dictionary. Object Dictionary contains the information used in the configuration of the device and communication, and it is a group of the object (parameter) which can be accessed through the network. In the communication between master-slave using CoE, there are a communication which uses Process Data Object (PDO) and synchronously transmits information, and a Service Data Object (SDO) communication which occurs asynchronously.

Motion control module regularly performs process data communication to receive and send input/output signal and to control the position of EtherCAT slave (servo drive). It also performs service data communication in terms of an error state in the slave and the parameter reading/writing whenever there is a request.

| Types of communication | Communication time | Contents |
|---|---|---|
| Process Data Communication (PDO Communication) | Synchronous (main task period) | servo drive position control data, input/output of data, etc. |
| Service Data Communication (SDO Communication) | Asynchronous (in request) | servo parameter reading/writing, servo error information reading, etc. |

### 4.4.3 EtherCAT State Machine

The state and motion between states of EtherCAT communication are shown in the figure below.




The communication between the master-slave of EtherCAT communication begins from the Initial state and progresses to the Operational state. In the motion control module, the slave servo drive can be controlled with a normal process data communication when it is in operational state.
If a communication error occurs while the motion control module performs the slave and EhterCAT communication at operational state, the communication state is changed to the Initial state and the communication between the slaves is discontinued. In this case, the factor of communication error should be removed and reconnect with the slave to restart the communication.

### 4.4.4 EtherCAT Process Data Objective(PDO)

The synchronous data communication in EtherCAT communication of motion control module occurs through process data object (PDO). There are two types of process data: TxPDO which is transmitted from the slave to motion control module, and RxPDO which is transmitted from motion control module to the slave. In RxPDO and TxPDO, data which are going to be synchronous communication can be put together to be set as the example of the figure below shows among the data defined in the Object Dictionary.

**Object Dictionary**

| Index | Sub-Index | Description | Type |
|---|---|---|---|
| 0x6040 | - | Control Word | UINT |
| | ⋮ | | |
| 0x6060 | - | Mode of Operation | BYTE |
| | ⋮ | | |
| 0x607A | - | Target Position | DINT |

**RxPDO**

| Index | Sub-Index |
|---|---|
| 0x6040 | 0x00 |
| 0x6060 | 0x00 |
| 0x607A | 0x00 |

**Object Dictionary**

| Index | Sub-Index | Description | Type |
|---|---|---|---|
| 0x6041 | - | Status  Word | UINT |
| | ⋮ | | |
| 0x6061 | - | Operation Display | BYTE |
| | ⋮ | | |
| 0x6064 | - | Actual Position | DINT |

**TxPDO**

| Index | Sub-Index |
|---|---|
| 0x6040 | 0x00 |
| 0x6064 | 0x00 |
| 0x6061 | 0x00 |

Slave manufacturers sometimes set many RxPDO and TxPDO in advance and provide Slave Information File including this information in xml format. When initially setting and test operating this slave information file, it should be transmitted to the motion control module using the XG-PM. This slave information file should be analyzed and communicated to the PDO data which is optimized for controlling.

### 4.4.5 Specification of Motion Control Module EtherCAT Communication

| Item | Specification |
|---|---|
| Communication protocol | EtherCAT |
| Support specification | CoE(CANopen over EtherCAT) |
| Physical layer | 100BASE-TX |
| Communication speed | 100Mbps |
| Topology | Daisy Chain |
| Communication cable | Over Cat. 5 STP(Shielded Twisted-pair) cable |
| No. of maximum slave | 36 |
| Communication period | 1ms/2ms/4ms |
| Synchronous Jitter | Within 1 ㎲ |
| Synchronous communication | PDO(Process Data Object) Mapping through CoE |
| Non-synchronous communication | SDO(Service Data Object) communication through CoE |
| Communication setting | Set the communication configuration using XG-PM |

# 4.5 Motion Control Program

## 4.5.1 Program Execution

**1. Configuration of the program**

Motion control program is composed of functional elements needed in performing certain controls and it is performed in the internal RAM of motion control module. The program is backed up in the flash memory.
Programs with these functional elements are classified as follows.

| Program | Processing information |
|---|---|
| Main task program | Process the command which is executed in every 'main task period'. |
| Periodic task program | Process the command which is executed in every 'periodic task period'. |
| Initialization task program | Execute the command which is executed once in case of motion control module RUN. |

## 4.5.2 Operation Modes

**1. RUN mode**

This is a mode which normally performs the motion program calculation.

(1) Processing when changing the mode

Initialization is performed in the data area at the beginning, and possibility of performance is decided by examining the validity of the motion program.

(2) The contents of calculation processing

Motion program, motion command calculation, input/output data processing, and EtherCAT communication are performed.

**2. STOP mode**

This is a mode in stop state which does not perform the motion program calculation.

(1) Processing when changing the mode

Every output data is in Off state.

(2) The contents of operation processing

This performs EtherCAT communication.

**3. TEST mode**

This is a mode which does not perform the motion program calculation but executes the command performed in command window.

(1) Processing when changing the mode
STOP mode is changed to TEST mode, and every output data is maintained in Off state.

(2) The contents of operation processing
This executes the command performed in command window and performs EtherCAT communication.

### 4. Change in operation modes

Operation mode of motion control module can be changed as follows.

| PLC CPU Operation Mode | Motion Control Module Operation Mode | Remarks |
|---|---|---|
| In RUN | RUN or STOP | Motion control module can be made to perform RUN/STOP/TEST using PLC program or XG-PM.(However, TEST mode is possible only in case motion control mode is in STOP mode in XG-PM.) |
| STOP → RUN | RUN | If PLC CPU changes from STOP mode to RUN mode, motion control module is also changed from STOP mode to RUN mode. |
| RUN → STOP | STOP | If PLC CPU changes from RUN mode to STOP mode, motion control module is also changed from RUN mode to STOP mode. |
| In STOP | STOP | In case PLC CPU is in STOP mode, motion control module maintains STOP state. TEST mode can be switched only in case motion control module is in STOP mode in XG-PM. |

# Chapter 5 Memory and Parameter, I/O Signal

## 5.1 Memory

### 5.1.1 Flag

**1. Types of flags**

(1) System flag

This flag indicates the motion, state, and information of motion control module.

| Variable | Data Type | Address | Description |
|---|---|---|---|
| _RUN | BOOL | %FX0 | RUN mode |
| _STOP | BOOL | %FX1 | STOP mode |
| _ERROR | BOOL | %FX2 | ERROR mode |
| _RUN_EDIT_ST | BOOL | %FX5 | Downloading program during online editing |
| _RUN_EDIT_CHK | BOOL | %FX6 | Processing during online editing |
| _RUN_EDIT_DONE | BOOL | %FX7 | Complete during online editing |
| _RUN_EDIT_NG | BOOL | %FX8 | Abnormally complete during online editing |
| _FLASH_BUSY | BOOL | %FX9 | Writing to FLASH |
| _FLASH_FAIL | BOOL | %FX10 | Failed to write to FLASH |
| _FORCE_IN | BOOL | %FX11 | Forced input status |
| _FORCE_OUT | BOOL | %FX12 | Forced output status |
| _PB1 | BOOL | %FX14 | Select program code 1 |
| _PB2 | BOOL | %FX15 | Select program code 2 |
| _BPRM_ER | BOOL | %FX35 | Basic parameter error |
| _COMPRM_ER | BOOL | %FX36 | Common parameter error |
| _AXISPRM_ER | BOOL | %FX37 | Axis parameter error |
| _AXESPRM_ER | BOOL | %FX38 | Axis group parameter error |
| _NETPRM_ER | BOOL | %FX39 | Network parameter error |
| _SDPRM_ER | BOOL | %FX40 | Shared variable parameter error |
| _PGM_ER | BOOL | %FX41 | Program error |
| _CODE_ER | BOOL | %FX42 | Program code error |
| _SWDT_ER | BOOL | %FX45 | Module abnormal termination error |
| _AB_SD_ER | BOOL | %FX64 | Stop from abnormal operation |
| _PTASK_CYCLE_ER | BOOL | %FX67 | Main task period error |
| _CTASK_CYCLE_ER | BOOL | %FX68 | Periodic task period error |
| _T20MS | BOOL | %FX96 | 20ms cycle clock |

| Variable | Data Type | Address | Description |
|---|---|---|---|
| _T100MS | BOOL | %FX97 | 100ms cycle clock |
| _T200MS | BOOL | %FX98 | 200ms cycle clock |
| _T1S | BOOL | %FX99 | 1s cycle clock |
| _T2S | BOOL | %FX100 | 2s cycle clock |
| _T10S | BOOL | %FX101 | 10s cycle clock |
| _T20S | BOOL | %FX102 | 20s cycle clock |
| _T60S | BOOL | %FX103 | 60s cycle clock |
| _ON | BOOL | %FX104 | All time on bit |
| _OFF | BOOL | %FX105 | All time off bit |
| _1ON | BOOL | %FX106 | The only first scan on bit |
| _1OFF | BOOL | %FX107 | The only first scan off bit |
| _STOG | BOOL | %FX108 | Reversal at every scanning |
| _ERR | BOOL | %FX112 | Operation error flag |
| _LER | BOOL | %FX113 | Operation error latch flag |
| _ARY_IDX_ERR | BOOL | %FX114 | Out of arrangement array index error flag |
| _ARY_IDX_LER | BOOL | %FX115 | Out of arrangement array index latch error flag |
| _OS_VER | DWORD | %FD4 | OS version |
| _OS_DATE | DWORD | %FD5 | OS distribution date |
| _OS_VER_PATCH | DWORD | %FD6 | OS patch version |
| _SCAN_MAX | WORD | %FW14 | Main task – Maximum scan time |
| _SCAN_MIN | WORD | %FW15 | Main task – minimum scan time |
| _SCAN_CUR | WORD | %FW16 | Main task – Current scan time |
| _CTASK_SCAN_MAX | WORD | %FW17 | Periodic task – Maximum scan time |
| _CTASK_SCAN_MIN | WORD | %FW18 | Periodic task – minimum scan time |
| _CTASK_SCAN_CUR | WORD | %FW19 | Periodic task – Current scan time |
| _PLC_TIME | ARRAY[0..7] OF BYTE | %FB20 | Current RTC time |
| _PLC_DATE | DATE | %FW24 | Current RTC date |
| _PLC_TOD | TIME_OF_DAY | %FD13 | Current time of RTC(ms unit) |
| _FLASH_WR_RATIO | WORD | %FW28 | FLASH writing ratio |
| _FLASH_WR_CNT | DWORD | %FD16 | Flash write count |
| _SCAN_WR | BOOL | %FX464 | Initialize scan value |
| _CTASK_SCAN_WR | BOOL | %FX465 | Periodic task – Initialize scan value |

(2) Motion flag

The flag displayed following are as follows. It displays the state and data of the Motion Control.

The flag related to axis is displayed as "_AXxx_..."(xx indicates the relevant axis No.) and the flag related to axis group is displayed as "_AGxx_..."(xx indicates the axis group No.: 01 ~ 40).

| Variable | Type | Address | Comment |
|---|---|---|---|
| _RUN_MODE | BOOL | %JX0.0 | RUN mode |
| _STOP_MODE | BOOL | %JX0.1 | STOP mode |
| _TEST_MODE | BOOL | %JX0.2 | TEST mode |
| _WARNING | BOOL | %JX0.3 | Warning state |
| _ALARM | BOOL | %JX0.4 | Alarm state |
| _LINKUP_INFO | BOOL | %JX0.5 | Link up / down information |
| _COMM | BOOL | %JX0.6 | Communication connecting state |
| _COMM_ERR | BOOL | %JX0.7 | Communication timeout error |
| _COM_ERR | BOOL | %JX0.8 | Common error exist |
| _ERR_CODE | WORD | %JW0.1 | Axis error code |
| _AX_RDY | ARRAY[0..32] OF BOOL | %JX0.32 | Axis ready |
| _IO_RDY | ARRAY[0..4] OF BOOL | %JX0.64 | IO ready |
| _AX_NUM | BYTE | %JB0.10 | The number of connected axes |
| _IO_NUM | BYTE | %JB0.11 | The number of connected I/O |
| _AX_SDO_BUSY | ARRAY[0..32] OF BOOL | %JX0.96 | Axis SDO processing busy |
| _AX_SDO_ERR | ARRAY[0..32] OF BOOL | %JX0.128 | Axis SDO processing error |
| _IO_SDO_BUSY | ARRAY[0..4] OF BOOL | %JX0.160 | I/O SDO processing busy |
| _IO_SDO_ERR | ARRAY[0..4] OF BOOL | %JX0.176 | I/O SDO processing error |
| _AXxx_RDY | BOOL | %JXxx.0 | Axis xx ready |
| _AXxx_WARNING | BOOL | %JXxx.1 | Axis xx warning state |
| _AXxx_ALARM | BOOL | %JXxx.2 | Axis xx alarm state |
| _AXxx_SV_ON | BOOL | %JXxx.3 | Axis xx servo on/off state |
| _AXxx_SV_RDY | BOOL | %JXxx.4 | Axis xx servo ready state |
| _AXxx_AX_TYPE | BOOL | %JXxx.5 | Axis xx main axis/sub. axis state |
| _AXxx_MST_INFO | BYTE | %JBxx.1 | Axis xx main axis information |

| Variable | Type | Address | Comment |
|---|---|---|---|
| _AXxx_SVON_INCMPL | BOOL | %JXxx.16 | Axis xx servo on incomplete |
| _AXxx_COMM_WARN | BOOL | %JXxx.17 | Axis xx communication warning |
| _AXxx_DEV_WARN | BOOL | %JXxx.18 | Axis xx abnormal deviation warning |
| _AXxx_SV_ERR | BOOL | %JXxx.32 | Axis xx servo drive error |
| _AXxx_HW_POT | BOOL | %JXxx.33 | Axis xx upper limit detection |
| _AXxx_HW_NOT | BOOL | %JXxx.34 | Axis xx lower limit detection |
| _AXxx_SW_POT | BOOL | %JXxx.35 | Axis xx S/W upper limit detection |
| _AXxx_SW_NOT | BOOL | %JXxx.36 | Axis xx S/W lower limit detection |
| _AXxx_SV_OFF | BOOL | %JXxx.37 | Axis xx execution error of operation command in servo-off state |
| _AXxx_POS_OVR | BOOL | %JXxx.38 | Axis xx exceeds the set range of positioning movement amount |
| _AXxx_VEL_OVR | BOOL | %JXxx.39 | Axis xx exceed the speed limit |
| _AXxx_DEV_ERR | BOOL | %JXxx.40 | Axis xx deviation error alarm |
| _AXxx_HOME_INCMPL | BOOL | %JXxx.41 | Axis xx execution of absolute position operation command in the origin indetermination status |
| _AXxx_COMM_ERR | BOOL | %JXxx.42 | Axis xx communication alarm |
| _AXxx_BUSY | BOOL | %JXxx.48 | Axis xx motion command busy state |
| _AXxx_PAUSE | BOOL | %JXxx.49 | Axis xx state of motion commands pause (velocity is zero) |
| _AXxx_STOP | BOOL | %JXxx.50 | Axis xx stop state by the stop command |
| _AXxx_FAIL | BOOL | %JXxx.51 | Axis xx end state by command error |
| _AXxx_CMPL | BOOL | %JXxx.52 | Axis xx command execution complete |
| _AXxx_DIR | BOOL | %JXxx.53 | Axis xx operation direction |
| _AXxx_JOG | BOOL | %JXxx.54 | Axis xx JOG operating |
| _AXxx_HOME | BOOL | %JXxx.55 | Axis xx Home return operating |
| _AXxx_P_CTRL | BOOL | %JXxx.56 | Axis xx position control operating |
| _AXxx_V_CTRL | BOOL | %JXxx.57 | Axis xx velocity control operating |
| _AXxx_T_CTRL | BOOL | %JXxx.58 | Axis xx torque control operating |
| _AXxx_LINTP | BOOL | %JXxx.59 | Axis xx linear interpolation operating |
| _AXxx_CINTP | BOOL | %JXxx.60 | Axis xx circular interpolation operating |
| _AXxx_POS_CMPL | BOOL | %JXxx.64 | Axis xx positioning complete |
| _AXxx_INPOS | BOOL | %JXxx.65 | Axis xx inposition detection |
| _AXxx_LATCH_CMPL | BOOL | %JXxx.66 | Axis xx latch operation complete |
| _AXxx_HOME_CMPL | BOOL | %JXxx.67 | Axis xx Home return complete |

| Variable | Type | Address | Comment |
|---|---|---|---|
| _AXxx_Disabled | BOOL | %JXxx.80 | Axis xx Disabled state |
| _AXxx_Standstill | BOOL | %JXxx.81 | Axis xx Standstill state |
| _AXxx_Discrete | BOOL | %JXxx.82 | Axis xx Discrete state |
| _AXxx_Continuous | BOOL | %JXxx.83 | Axis xx Continuous state |
| _AXxx_Synchronized | BOOL | %JXxx.84 | Axis xx Synchronized state |
| _AXxx_Homing | BOOL | %JXxx.85 | Axis xx Homing state |
| _AXxx_Stopping | BOOL | %JXxx.86 | Axis xx Stopping state |
| _AXxx_Errorstop | BOOL | %JXxx.87 | Axis xx Errorstop state |
| _AXxx_TPOS | LREAL | %JLxx.2 | Axis xx target position |
| _AXxx_CPOS | LREAL | %JLxx.3 | Axis xx command position of current scan |
| _AXxx_CVEL | LREAL | %JLxx.4 | Axis xx command velocity |
| _AXxx_ACCDEC | LREAL | %JLxx.5 | Axis xx command acc./dec. |
| _AXxx_CJERK | LREAL | %JLxx.6 | Axis xx command jerk |
| _AXxx_CTRQ | LREAL | %JLxx.7 | Axis xx command torque |
| _AXxx_POS | LREAL | %JLxx.8 | Axis xx current position |
| _AXxx_VEL | LREAL | %JLxx.9 | Axis xx current velocity |
| _AXxx_TRQ | LREAL | %JLxx.10 | Axis xx current torque |
| _AXxx_POS_DEV | LREAL | %JLxx.11 | Axis xx position deviation |
| _AXxx_ALM | BOOL | %JXxx.768 | Axis xx alarm state |
| _AXxx_SV_ON_STS | BOOL | %JXxx.770 | Axis xx servo on status |
| _AXxx_POT | BOOL | %JXxx.771 | Axis xx upper limit input |
| _AXxx_NOT | BOOL | %JXxx.772 | Axis xx lower limit input |
| _AXxx_HOME_INPUT | BOOL | %JXxx.773 | Axis xx home input |
| _AXxx_LATCH1 | BOOL | %JXxx.774 | Axis xx LATCH1 input |
| _AXxx_LATCH2 | BOOL | %JXxx.775 | Axis xx LATCH2 input |
| _AXxx_SVPARAM_BUSY | BOOL | %JXxx.776 | Axis xx read/write operation of the servo parameters |
| _AXxx_DRV_IN | DWORD | %JDxx.25 | Axis xx servo drive input |
| _AXxx_AX_ERR | WORD | %JWxx.52 | Axis xx error code |
| _AXxx_DRV_ERR | WORD | %JWxx.53 | Axis xx servo drive error code |
| _AGyy_RDY | BOOL | %CXyy.0 | Axis group xx ready to execute |
| _AGyy_WARNING | BOOL | %CXyy.1 | Axis group xx warning state |
| _AGyy_SV_ON | BOOL | %CXyy.3 | Axis group xx servo on/off state |
| _AGyy_SV_RDY | BOOL | %CXyy.4 | Axis group xx servo ready state |
| _AGyy_BUSY | BOOL | %CXyy.16 | Axis group xx motion command busy state |

| Variable | Type | Address | Comment |
|---|---|---|---|
| _AGyy_PAUSE | BOOL | %CXyy.17 | Axis group xx state of motion commands pause(velocity is zero) |
| _AGyy_STOP | BOOL | %CXyy.18 | Axis group xx stop state by the stop command |
| _AGyy_FAIL | BOOL | %CXyy.19 | Axis group xx command error exit status |
| _AGyy_CMPL | BOOL | %CXyy.20 | Axis group xx command execution complete |
| _AGyy_LINTP | BOOL | %CXyy.21 | Axis group xx linear interpolation operating |
| _AGyy_CINTP | BOOL | %CXyy.22 | Axis group xx circular interpolation operating |
| _AGyy_POS_CMPL | BOOL | %CXyy.32 | Axis group xx positioning complete |
| _AGyy_Disabled | BOOL | %CXyy.48 | Axis group xx Disabled state |
| _AGyy_Standby | BOOL | %CXyy.49 | Axis group xx Standby state |
| _AGyy_Moving | BOOL | %CXyy.50 | Axis group xx Moving state |
| _AGyy_Homing | BOOL | %CXyy.51 | Axis group xx Homing state |
| _AGyy_Stopping | BOOL | %CXyy.52 | Axis group xx Stopping state |
| _AGyy_ErrorStop | BOOL | %CXyy.53 | Axis group xx ErrorStop state |
| _AGyy_CMD_VEL | LREAL | %CLyy.1 | Axis group xx target velocity |
| _AGyy_CMD_ACCDEC | LREAL | %CLyy.2 | Axis group xx command acc./dec. |
| _AGyy_ACT_VEL | LREAL | %CLyy.3 | Axis group xx current velocity |
| _AGyy_AX_NUM | WORD | %CWyy.17 | Axis group xx number of axes |
| _AGyy_AX1 | BYTE | %CByy.36 | Axis group xx composition axis number for Axis1 |
| _AGyy_AX2 | BYTE | %CByy.37 | Axis group xx composition axis number for Axis2 |
| _AGyy_AX3 | BYTE | %CByy.38 | Axis group xx composition axis number for Axis3 |
| _AGyy_AX4 | BYTE | %CByy.39 | Axis group xx composition axis number for Axis4 |

(3) I/O Flag

The input/output flag indicates the embedded digital input and output values with embedded encoder values. In add, it indicates the PDO Data that is connected to the Motion Control Module under fixed-time communication. The below example displays the synchronized communication data flag when it is connected to L7N Servo Drive.

| Variable | Data Type | Address | Comment |
|---|---|---|---|
| _IN | ARRAY[0..7] OF BOOL | %IX0.0 | Internal digital input |
| _ENC1 | LREAL | %IL0.1 | Encoder1 input |
| _ENC2 | LREAL | %IL0.2 | Encoder2 input |
| _OUT | ARRAY[0..7] OF BOOL | %QX0.0 | Internal digital output |
| _SLx_Controlword | UINT | %QWx.0 | Control word |
| _SLx_Target_Torque | INT | %QWx.1 | Target torque |
| _SLx_Target_Position | DINT | %QDx.1 | Target position |
| _SLx_Mode_of_Operation | USINT | %QBx.8 | Operation mode |
| _SLx_Touch_Probe_Function | UINT | %QWx.5 | Touch probe function |
| _SLx_Statusword | UINT | %IWx.0 | Statusword |
| _SLx_Torque_Actual_Value | INT | %IWx.1 | Actual torque value |
| _SLx_Position_Actual_Value | DINT | %IDx.1 | Actual position value |
| _SLx_Following_Error_Actual_Value | DINT | %IDx.2 | Positioning error's actual value |
| _SLx_Digital_Inputs | UDINT | %IDx.3 | Digital input |
| _SLx_Mode_of_Operation_Display | USINT | %IBx.16 | Operation mode display |
| _SLx_Command_Speed(rpm) | INT | %IWx.9 | Commanded speed |
| _SLx_Current_Speed(rpm) | INT | %IWx.10 | Operating speed |
| _SLx_Touch_Probe_Status | UINT | %IWx.11 | Touch probe status |
| _SLx_Touch_Probe_1_Positive_Edge_Position_Value | DINT | %IDx.6 | Touch probe 1 forward's position value |

## 5.1.2 Device

### 1. Types of devices

Types of device supported in motion control module are shown in the Table below.

| Type | Size | Description |
|---|---|---|
| Automatic variable (A) | 512KB | This is assigned when adding symbolic variable to automatic variable area.<br>(able to set a maximum 64KB of retain) |
| Direct variable (G) | 128KB | This is a global variable which can set 64KB of retain by selecting in the area of basic variable. |
| Input variable (I) | 1B (input contact)<br>8B (encoder)<br>4.5KB (slave) | This assigns digital input contact.<br>input value of 2ch encoder<br>This assigns the slave TxPDO data. |
| Output variable (Q) | 1B<br>4.5KB (slave) | This assigns digital output setting.<br>This assigns the slave RxPDO data. |
| System variable (F) | - | State variable of the motion control state and module motion |
| Shared variable (D, M) | 1MB each | The area for data sharing and CPU module<br>CPU→module : 2,048words, CPU←module : 2,048words |
| Position data (P) | 25KB | Position data used when moving to certain position<br>6400points |

(1) Automatic variable

- This is a variable to be automatically assigned the position of variables by compiler; user does not need to specify the position of internal variable. The variables, which user sets but does not assign specific position, are assigned to automatic variable.
- Automatic variable is initialized to 0 when turning Off the power..

(2) Direct variable

- This is a variable which user forces the position of memory to be assigned by using the name and number of a device directly.
- The range of address assignment where direct variable is available is as follows.

| Size of Variable | Designated range of Variable address |
|---|---|
| X(Bit) | %GX0 ~ %GX1048575 |
| B(Byte) | %GB0 ~ %GB131071 |
| W(Word) | %GW0 ~ %GW65535 |
| D(Double Word)) | %GD0 ~ %GD32767 |
| L(Long Word)) | %GL0 ~ %GL16383 |

(3) Input variable

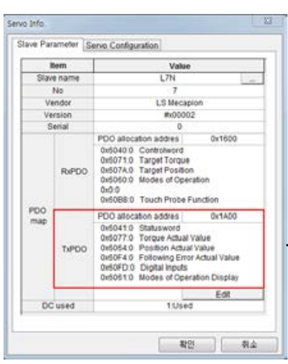
- This is a variable assigned to internal digital input and encoder input.
- Internal digital input is 8 points.
- Encoder input is the LREAL data and 2 channels are assigned.
- Input variable is expressed as follows.
  %I[size prefix]n1.n2

| Number | Description |
|---|---|
| Size prefix | X(1 bit), B(1 byte), W(1 word), D(1 double word), L(1 long word) |
| n1 | 0: internal input and internal encoder input<br>1~36: slave number (TxPDO of n1 slave parameter is mapped) |
| n2 | n2 data based on [size prefix] among n1 data |

- Device depending on the input variable expression is assigned as follows.

| Address | Description |
|---|---|
| %IX0.0 | Internal Digital input 0 |
| %IX0.1 | Internal Digital input 1 |
| %IX0.2 | Internal Digital input 2 |
| %IX0.3 | Internal Digital input 3 |
| %IX0.4 | Internal Digital input 4 |
| %IX0.5 | Internal Digital input 5 |
| %IX0.6 | Internal Digital input 6 |
| %IX0.7 | Internal Digital input 7 |
| %IL0.1 | Encoder1 input |
| %IL0.2 | Encoder2 input |
| %IW1.0 ~ %IW1.63 | TxPDO Mapping Data of Servo Drive 01 |
| : | : |
| %IW32.0 ~ %IW32.63 | TxPDO Mapping Data of Servo Drive 32 |
| %IW33.0 ~ %IW33.63 | Input Data of EtherCAT IO Station 01(TxPDO Mapping Data) |
| : | : |
| %IW36.0 ~ %IW36.63 | Input Data of EtherCAT IO Station 04(TxPDO Mapping Data) |

For example, when the slave parameter of 3-axis servo drive is as follows, input flag is automatically assigned as follows.



| Index | Name | Data Type | Size(Bytes) |
|---|---|---|---|
| 0x6041:0 | Statusword | UINT | 2 |
| 0x6077:0 | Actual torque value | INT | 2 |
| 0x6064:0 | Actual position value | DINT | 4 |
| 0x60F4:0 | Positioning error's actual value | DINT | 4 |
| 0x60FD:0 | Digital input | UDINT | 4 |
| 0x6061:0 | Operation mode display | SINT | 1 |
| 0x2601:0 | Commanded speed | INT | 2 |
| 0x2600:0 | Operating speed | INT | 2 |
| 0x60B9:0 | Touch probe status | UINT | 2 |
| 0x60BA:0 | Touch probe 1 forward's position value | DINT | 4 |

| Variable | Data Type | Address | Description |
|---|---|---|---|
| _SL3_Statusword | UINT | %IW3.0 | Statusword |
| _SL3_Torque_Actual_Value | INT | %IW3.1 | Actual torque value |
| _SL3_Position_Actual_Value | DINT | %ID3.1 | Actual position value |
| _SL3_Following_Error_Actual_Value | DINT | %ID3.2 | Positioning error's actual value |
| _SL3_Digital_Inputs | UDINT | %ID3.3 | Digital input |
| _SL3_Mode_of_Operation_Display | SINT | %IB3.16 | Operation mode display |
| _SL3_Command_Speed(rpm) | INT | %IW3.9 | Commanded speed |
| _SL3_Current_Speed(rpm) | INT | %IW3.10 | Operating speed |
| _SL3_Touch_Probe_Status | UINT | %IW3.11 | Touch probe status |

(4) Output variable

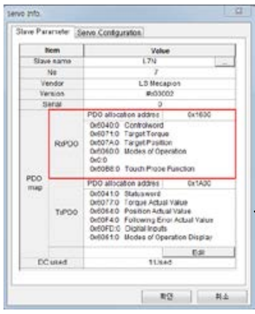
- This is a variable which is assigned to built-in digital output.
- Internal digital output is 8 points.
- Output variable is expressed as follows.
  %I[size prefix]n1.n2

| Number | Description |
|---|---|
| Size prefix | X(1 bit), B(1 byte), W(1 word), D(1 double word), L(1 long word) |
| n1 | 0: internal output<br>1~36: slave number (TxPDO of n1 slave parameter is mapped) |
| n2 | n2 data based on [size prefix] among n1 data |

- Device depending on the output variable expression is assigned as follows.

| Address | Description |
|---|---|
| %QX0.0 | Internal Digital output 0 |
| %QX0.1 | Internal Digital output 1 |
| %QX0.2 | Internal Digital output 2 |
| %QX0.3 | Internal Digital output 3 |
| %QX0.4 | Internal Digital output 4 |
| %QX0.5 | Internal Digital output 5 |
| %QX0.6 | Internal Digital output 6 |
| %QX0.7 | Internal Digital output 7 |
| %QW1.0 ~ %QW1.63 | TxPDO Mapping Data of Servo Drive 01 |
| : | : |
| %QW32.0 ~ %QW32.63 | TxPDO Mapping Data of Servo Drive 32 |
| %QW33.0 ~ %QW33.63 | Output Data of EtherCAT IO Station 01(TxPDO Mapping Data) |
| : | : |
| %QW36.0 ~ %QW36.63 | Output Data of EtherCAT IO Station 04(TxPDO Mapping Data) |

For example, when the slave parameter of 3-axis servo drive is as follows, input flag is automatically assigned as follows. .



| Index | Name | Data Type | Size(Bytes) |
|---|---|---|---|
| 0x6040:0 | Controlword | UINT | 2 |
| 0x6071:0 | Target torque | INT | 2 |
| 0x607A:0 | Target position | DINT | 4 |
| 0x6060:0 | Operation mode | SINT | 1 |
| 0x0:0 | | | 1 |
| 0x60B8:0 | Touch probe function | UINT | 2 |

| Variable | Data Type | Address | Description |
|---|---|---|---|
| _SLx_Controlword | UINT | %QWx.0 | Controlword |
| _SLx_Target_Torque | INT | %QWx.1 | Target torque |
| _SLx_Target_Position | DINT | %QDx.1 | Target position |
| _SLx_Mode_of_Operation | USINT | %QBx.8 | Operation mode |
| _SLx_Touch_Probe_Function | UINT | %QWx.5 | Touch probe function |

(5) Shared variable

- This is an area for data sharing between PLC CPU module and motion control module.
- The data input to motion control module from PLC CPU module is up to 2,048 words. Common input variable is only available for reading.
- The data output to PLC CPU from the motion control module is up to 2,048 words. Common output variable is available for reading/writing.
- The range of address assignment where shared variable is available is as follows.

| Size of Variable | Designated range of D Variable address | Designated range of M Variable address |
|---|---|---|
| X(Bit) | %DX0 ~ %DX8388607 | %MX0 ~ %MX8388607 |
| B(Byte) | %DB0 ~ %DB1048575 | %MB0 ~ %MB1048575 |
| W(Word) | %DW0 ~ %DW524287 | %MW0 ~ %MW524287 |
| D(Double Word) | %DD0 ~ %DD262143 | %MD0 ~ %MD262143 |
| L(Long Word) | %DL0 ~ %DL131071 | %ML0 ~ %ML131071 |

(6) Positioning data

- This is an area of position data which can be referred when wanting to operate to specific position by using motion control module.
- This is not divided by each axis, and 6400 points can be assigned to every axis in common.
- Data are maintained even when turning Off the power.
- The range of address assignment where position data variable is available is as follows

.

| Type of Variable | Designated range of Variable address |
|---|---|
| LREAL | %PL0 ~ %PL6399 |

**2. Retain setting**

Default (automatic) variable retain is used when wanting to keep and use the data that occurs while operating or the data required for an operation even in the case of restarting after the motion control module has stopped, and a certain part of the device in G area can be used as retain area by setting the basic parameter.

Characteristic table of the device which is available to set retain is shown below.

| Device | Retain setting | Characteristic |
|---|---|---|
| Default | O | Enable retain setting when adding variable to automatical variable area |
| G | O | It is internal contact area and enable retain setting at parameter |
| I | X | Internal digital input contact and internal encoder input contact |
| Q | X | Internal digital output contact |
| D | X | Available area for sharing data between PLC CPU and motion control module |
| M | X | |
| P | X(Retain) | Available for position data and maintain data value when power off(Always maintain retain, No user setting) |

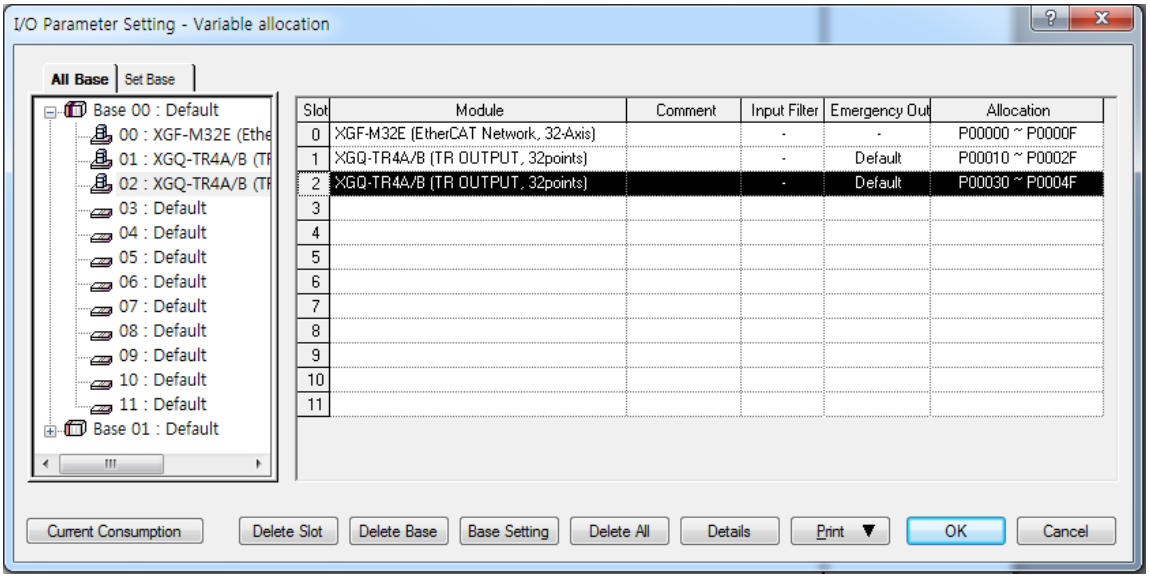
**3. Data sharing with PLC CPU**

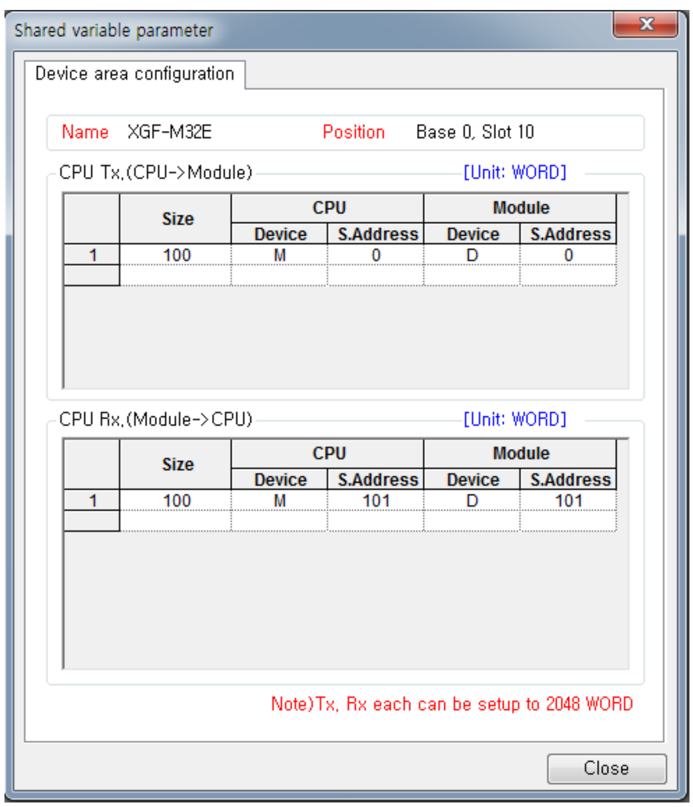
(1) Sequence

(a) Data are shared between CPU and motion control module by using the exclusive shared variable.

(b) User can set the size of reading/writing by parameter, and the maximum setting size is 2,048 words each.

(c) User can select and set motion control module in I/O parameter of XG5000.



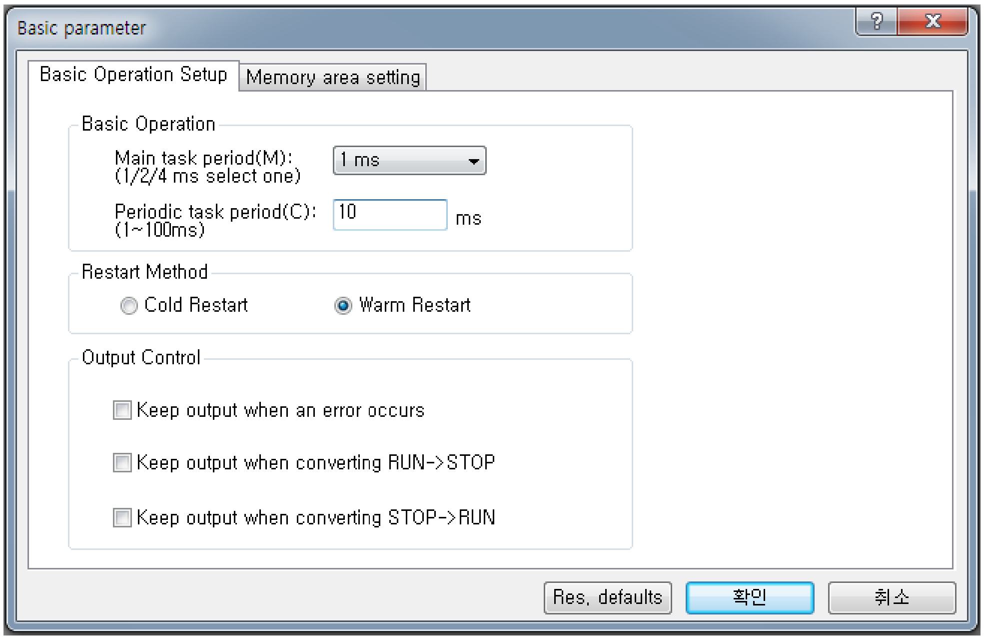

(d) Shared variable set is transmitted to motion control module when running PLC CPU, and it can be identified by reading the shared variable parameter of motion control module in XG-PM.

### 5.1.3 Parameter

**1. Basic parameter**

Explain Basic parameter of the motion control module.

(1) Basic motion setting




(a) Main task cycle

- Set the motion period of the main task. The period can be set by selecting one in 1ms/2ms/4ms.
- Set the control time of performing in the main task of motion control module considering the execution timeof program.
- When the execution time of the main task exceeds the main task period, an error occurs and if motion control module is in RUN state, it is changed to STOP state.

(b) Periodic task cycle

- Set the motion period of the periodic task. The period can be set in multiples of the main task between 1 ~ 100ms.
- The periodic task is performed in the remaining time after performing the main task in the control period, and therefore, it can be performed through a number of control periods.

(c) Restart mode

Restart by PLC CPU reset or turning on the power after turning off is divided into cold restart and warm restart. With regard to restart mode, variables can be set in 3 different types such as default, initialization, and retain; and the initialization of variables set by restart mode is as follows.

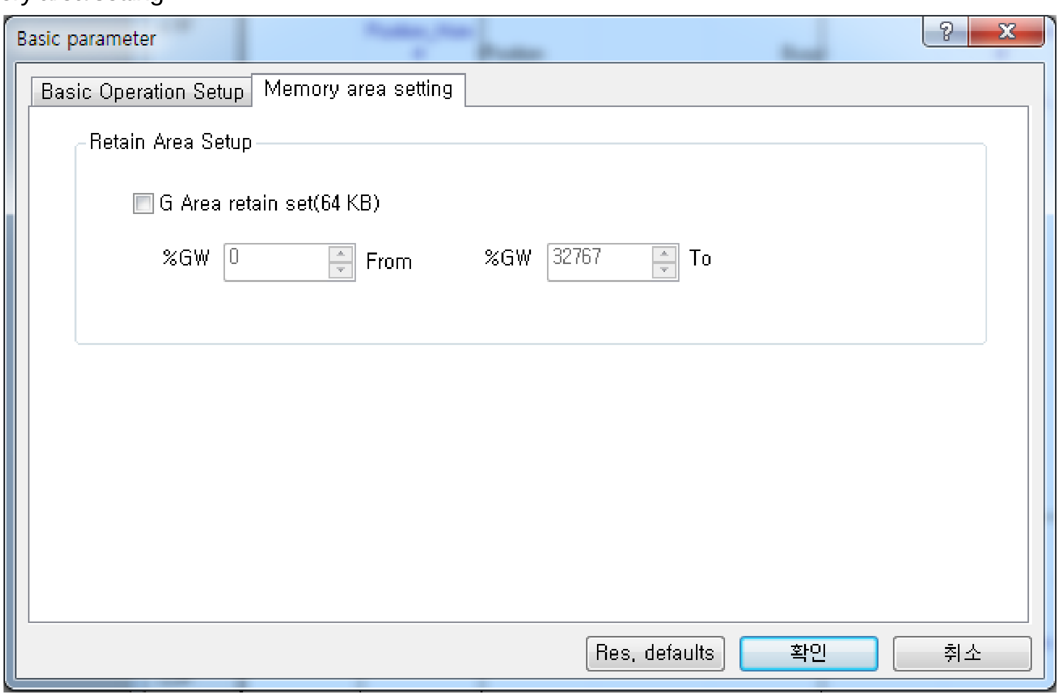
| | Cold Restart | Warm Restart |
|---|---|---|
| Default | Initialize with ‘0’ | ‘Initialize with ‘0’ |
| Retain | Initialize with ‘0’ | Maintain previous value |
| Initialization | Initialize with user setting value | Initialize with user setting value |
| Retain & Initialization | Initialize with user setting value | Maintain previous value |

(d) Output control setting

When an error occurs in module or changing the motion mode of module, decide whether to maintain the data output or not.

| Selection | Operation |
|---|---|
| Maintain the output in the event of an error | Decide whether to output the data normally when an error or certain input occurs in the module. |
| Maintain the output when switching from RUN to STOP | Decide whether to output the data normally during the operation mode of the motion control module is switching from RUN to STOP. |
| Maintain the output when switching from STOP to RUN | Decide whether to output the data normally during the operation mode of motion control module is switching from STOP to RUN. |

(2) Memory area setting




This is a parameter item which sets the retain area. Retain area can be set by checking the “G Area retain set" to activate retain setting. Retain can be set up to 64Kbyte, and if the beginning and ending addresses are set to be retain in G area, the value of relevant area is maintained even when turning off the power.

**(2) Common parameter**

Common parameter is explained as follows.

| Item | Description | Settings | Initialize value |
|---|---|---|---|
| Encoder1 Unit | Set display unit of encoder position. | 0: pulse<br>1: mm<br>2: inch<br>3:degree | 0: pulse |
| Encoder1 Pulses per rotation | Set Encoder1 pulses per rotation | 1 ~ 4294967295 | 8192 pls |
| Encoder1 Travel per rotation | Set the movement amount of the load side moved per encoder 1 rotation. | 0.000000001 ~ 4294967295 | 10 pls |
| Encoder1 Pulse input | Set the input mode in accordance with the output shape of encoder. | 0: CW/CCW (x1)<br>1: PULSE/DIR (x1)<br>2: PULSE/DIR (x2)<br>3: PHASE A/B (x1)<br>4: PHASE A/B (x2)<br>5: PHASE A/B (x4) | 3: PHASE A/B (x1) |
| Encoder2 Unit | Set display unit of encoder position. | 0: pulse<br>1: mm<br>2: inch<br>3:degree | 0: pulse |
| Encoder2 Pulses per rotation | Set Encoder2 pulses per rotation | 1 ~ 4294967295 | 8192 pls |
| Encoder2 Travel per rotation | Set the movement amount of the load side moved per encoder 2 rotation. | 0.000000001 ~ 4294967295 | 10 pls |
| Encoder2 Pulse input | Set the input mode in accordance with the output shape of encoder. | 0: CW/CCW (x1)<br>1: PULSE/DIR (x1)<br>2: PULSE/DIR (x2)<br>3: PHASE A/B (x1)<br>4: PHASE A/B (x2)<br>5: PHASE A/B (x4 | 3: PHASE A/B (x1) |
| Encoder1 Max. value | Set position display range of encoder. | Long Real(LREAL) | 2147483647 pls |
| Encoder1 Min. value | | | -2147483648 pls |
| Encoder2 Max. value | | | 2147483647 pls |
| Encoder2 Min. value | | | -2147483648 pls |
| Override | Set the application method of the input value when executing override command. | 0: Specified by ratio<br>1: Specified by unit | 0: Specified by ratio |

(1) Encoder unit

This is to set the display unit of encoder position, and each control target can be set by pulse, mm, inch, and degree. In case of the synchronous operation having the encoder as a center, the unit must be set by the same unit with it of the synchronous operation axis.

(2) Encoder Pulses per rotation

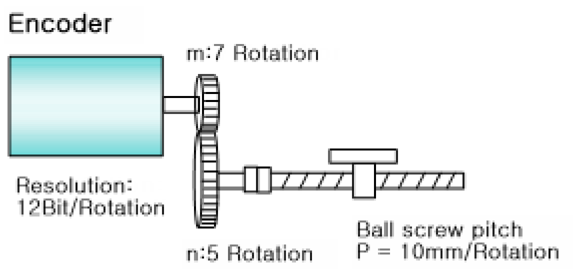
When using mm, inch, and degree for the encoder unit, set the number of purses per encoder rotation.

(3) Encoder Travel per rotation

When using mm, inch, and degree for the encoder unit, set the amount of movement of the load side moved per encoder rotation.

**[Setting Example]**

When the machine which is moved by ball screw is connected to the encoder with gear, the setting of the encoder unit / Encoder Pulses per rotation / Encoder Travel per rotation is as follows.




· Encoder unit: mm

· Encoder Pulses per rotation = Encoder resolution x Encoder side gear ratio

= 4096 x 7

= 28672 pls

· Encoder Travel per rotation = Ball screw pitch x Machine side gear ratio

= 10.0 mm x 5

= 50.0 mm

(4) Input encoder pulse

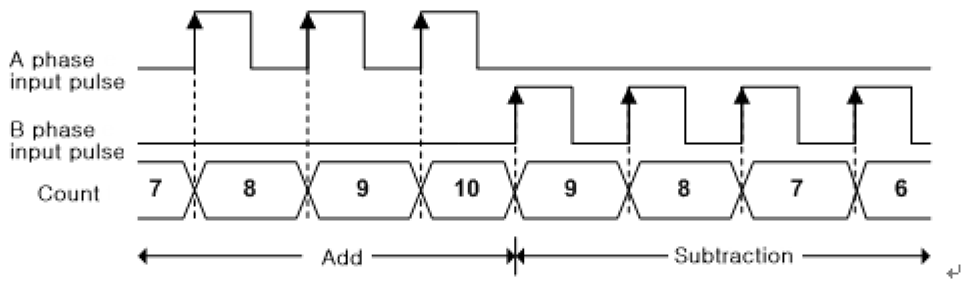
When wanting to use the encoder signal of servo drive or manual pulse generator as an input, the signal, which is right to the output form of the encoder or manual pulse generator, can be selected to be used.

One among CW/CCW (x1), PULSE/DIR (x1), PULSE/DIR (x2), PHASE A/B (x1), PHASE A/B (x2), and PHASE A/B (x4) must be selected and set for the encoder input signal.

(a) CW/CCW (x1)

Count operation is performed when A phase input pulse increases or B phase input pulse increases; and adding operation is performed when A phase input pulse increases in the Low input of B phase input pulse; and subtraction operation is performed when B phase input pulse increases in the Low input of A phase input pulse.

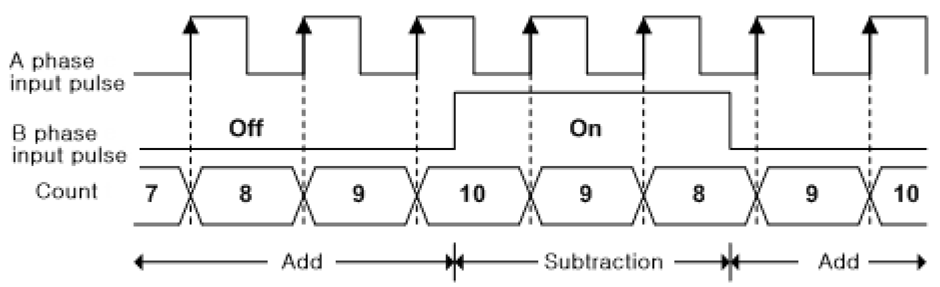
| Add/Subtraction | A phase input pulse High | A phase input pulse Low |
|---|---|---|
| B phase input pulse High | - | Subtraction count |
| B phase input pulse Low | Add count | - |




(b) PULSE/DIR (x1)

Count operation is performed when A phase input pulse increases, whether to be added or subtracted is decided by B phase.

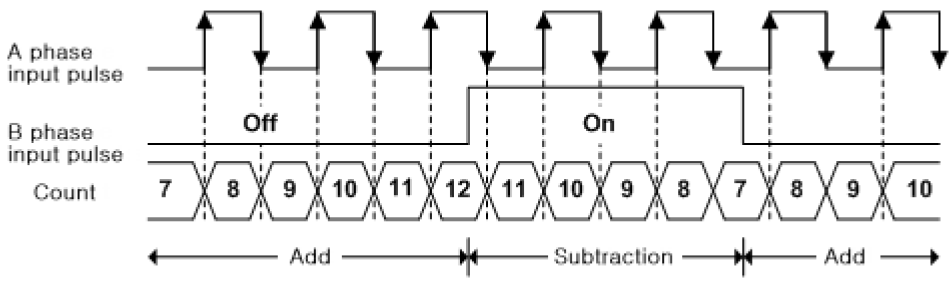
| Add/Subtraction | A phase input pulse High | A phase input pulse Low |
|---|---|---|
| B phase input pulse Off | Add count | - |
| B phase input pulse On | Subtraction count | - |




(c) PULSE/ DIR (x2)

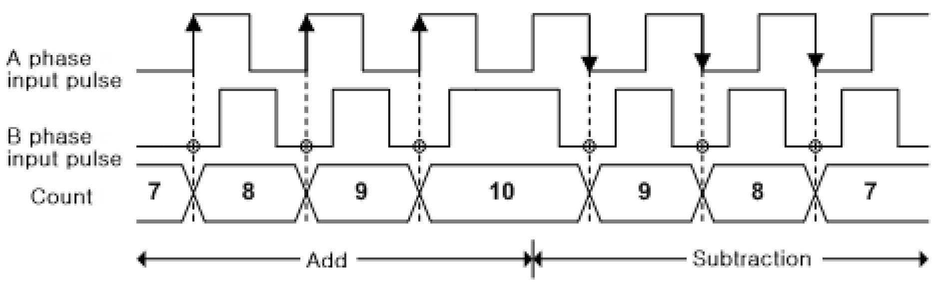
Count operation is performed when A phase input pulse increases and decreases, and whether to be added or subtracted is decided by B phase.

| Add/Subtraction | A phase input pulse High | A phase input pulse Low |
|---|---|---|
| B phase input pulse Off | Add count | Add count |
| B phase input pulse On | Subtraction count | Subtraction count |



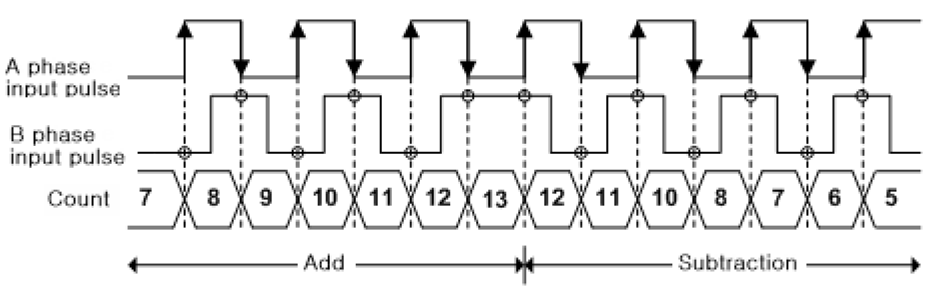

(d) PHASE A/B (x1)

Add operation is performed in case of the increase in A phase pulse when the phase of A phase input pulse is ahead of B phase input pulse, and subtraction operation is performed in case of the decrease in A phase pulse when the phase of B phase input pulse is ahead.



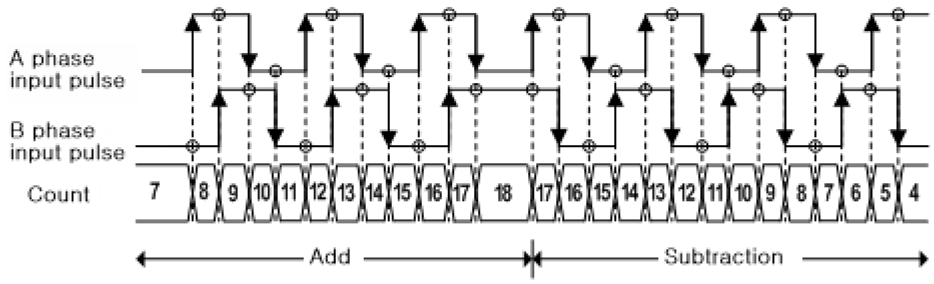

(e) PHASE A/B (x2)

Count operation is performed when both increase and decrease in A phase input pulse. Add operation is performed when the phase of A phase is input ahead of B phase, and subtraction operation is performed when the phase of B phase is input ahead of A phase.



(f) PHASE A/B (x4)

Count operation is performed in case of the increase/decrease in A phase input pulse and the increase/decrease in B phase; and add operation is performed when the phase of A phase is input ahead of B phase; and subtraction operation is performed when the phase of B phase is input ahead of A phase.

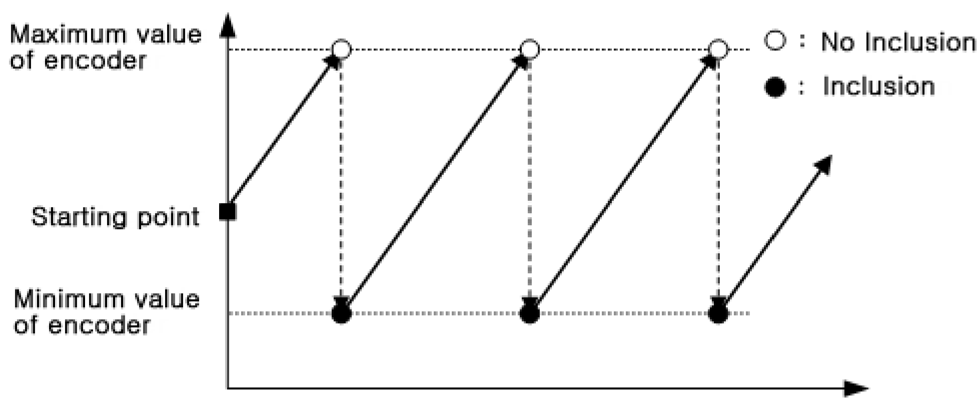



(5) Maximum and minimum values of encoder

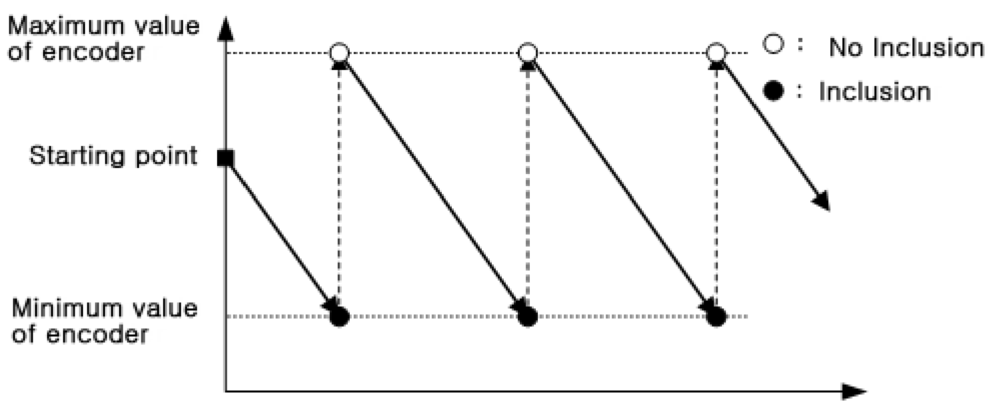
(a) The range of the encoder value is set to the maximum and minimum values of encoder when counting the input pulse from the encoder signal of servo drive or manual pulse generator and indicating it to encoder value.

(b) Operations are as shown in the figure below.

- In case of the increase in the encoder value




- In case of the decrease in the encoder value



## 3. Operation parameter

(1) Basic parameter

Basic parameter among operation parameters is explained as follows.

| Item | Description | Settings | Initial value |
|---|---|---|---|
| Unit | Set the command position unit of the axis. | 0: pulse<br>1: mm<br>2: inch<br>3:degree | 0: pulse |
| Pulses per rotation | Set the number of pulses per rotation of motor which corresponds encoder resolution. | 1 ~ 4294967295 | 524288 pls |
| Travel per rotation | Set the movement amount of the load side moved per rotation of motor. | 0.000000001 ~<br>4294967295 | 10 pls |
| Speed command unit | Set the command speed unit of the axis. | 0: Unit/Time<br>1: rpm | 0: Unit/Time |
| Speed limit | Set the maximum speed in case of the speed command of each axis. | Long real(LREAL)<br>Positive number | 20000000 pls/s |
| Emergency stop deceleration | Set the deceleration used in the sudden stop conditions. | 0 or Long real(LREAL)<br>Positive number | 0 pls/s$^2$ |
| Encoder select | Set the type of encoder to be used. | 0: Incremental Encoder<br>1: Absolute Encoder | 0: Incremental Encoder |
| Gear ratio(Motor) | Set the gear ratio between motor and load. | 1~65535 | 1 |
| Gear ratio(Machine) | | 1~65535 | 1 |
| Operation mode of the reverse rotation | Specify the operation method in case operation direction is reversed in the input conditions of newly executed command. | 0: E.Stop<br>1: Stop | 0: E.Stop |

(a) Unit

This is used to set the command unit during motion control, and depending on the control target, the unit of pulse, mm, inch, and degree can be set for each axis.

When changing the setting of the unit, other parameters or variable values are not changed. Therefore, when changing the units, the relevant parameters must be reset so that they can be adjusted to the setting range of the relevant unit.

(b) Pulses per rotation

When using mm, inch, and degree for the motion control command units and indicating the speed in rpm, the number of pulses required per motor rotation is set to be used.

(c) Travel per rotation

Set the movement amount of the load side per motor rotation when using mm, inch and degree for motion control command unit.

How the machine moves from a rotation of motor is determined by the structure of the machine.

(d) Gear ratio(Motor, Machine)

Set gear ratio between the motor and the load. If it is a structure that the load side rotates n times when the motor side rotates m times, set the gear ratios as below.

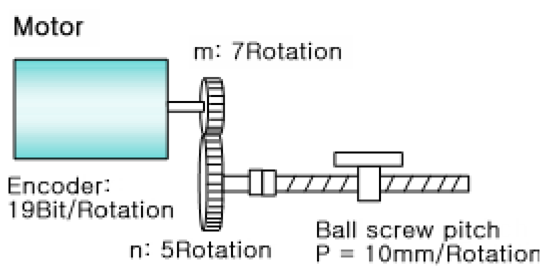
• Motor side gear ratio = m

• Machine side gear ratio = n

If the 「unit」 setting is '0: pulse', this parameter is invalid.

**[Setting Example]**

When the machine which is moved by ball screw is connected to the encoder with gear, the setting of the encoder unit/ Pulses per rotation/ travel per rotation is as follows.




· Unit: mm
· Pulses per rotation = 524288 (19Bit Encoder)
· Travel per rotation = Ball screw pitch
  = 10.0 mm
· Gear ratio(Motor) = 7
· Gear ratio(Machine) = 5

(e) Speed command unit

The base unit of the value of the speed used for the motion control command is set.

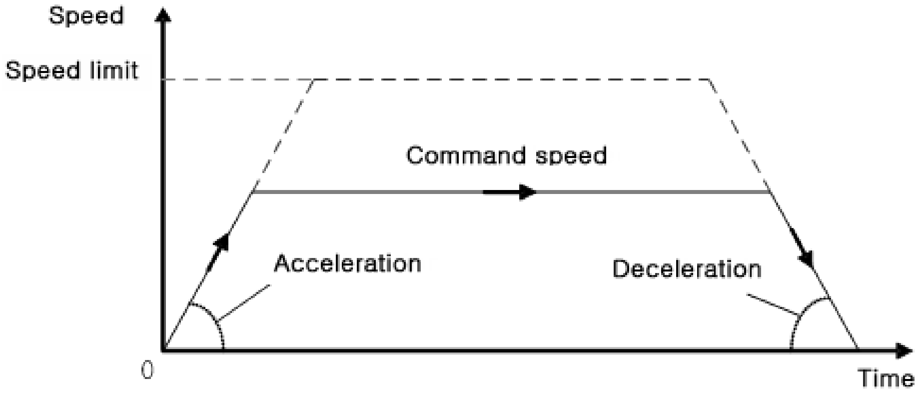
If it is set to '0: unit/time', it is applied by the rate of change per second form the position of the relevant unit set in the 「unit」 parameter. For example, if the setting of the 「unit」 is in mm, the unit of the speed command is 'mm/s'.

If it is set to '1: rpm', rpm is applied to the speed command unit. If the speed command unit is rpm and it is internally changed to the unit speed, values set in the 「Pulses per rotation」 and 「Travel per rotation」 parameters are used. When changing the setting of the speed command unit, other parameters or variable values are not changed. Therefore, the related parameters must also be reset according to the setting range of the relevant unit.

(f) Speed limit

Speed limit refers to the maximum rate of the available setting of motion control operation.

When operating the relevant axis, the operation speed should be set below the speed limit set.




(g) Emergency stop deceleration

Deceleration in the event of a sudden stop sets the deceleration for situations where a sudden stop needs to be made while operating the axis due to internal or external factors.

Conditions for a emergency stop are as follows.

- In case the software upper limit/lower limit is detected
- In case the operation speed of the serve axis exceeds the speed limit in synchronized operation (gear, cam)
- In case the setting for「error level of tracking error」is '1: alarm' and the error of tracking error occurs
- In case the emergency stop command is executed during the test operation in XG-PM
- In case an error occurs in the command executed while axis is currently operating during the checking of execution conditions
  (Except for occasions when restarting the command or ContinuousUpdate is activated.)

(h) Encoder select

Set the type of encoder that is going to be used. When using the absolute position system, select 1: absolute encoder. The following shows the setting of "Encoder select"

| Item | Settings | Description |
|---|---|---|
| Encoder select | 0: Incremental Encoder | After power on/off, the previous location of servo motor is not maintained.<br>After power of/off, origin fix state is off. |
| | 1: Absolute Encoder | The absolute position system is activated.<br>After power on/off, the previous location of servo motor is maintained.<br>Origin fix state maintain last condition before power on/off. |

(i) Operation mode of the reverse rotation

Specify the method of motion when the operation direction is reversed in the input conditions of newly executed commands.

When starting or restarting the command which the BufferMode is Aborting, or activating ConinuousUpdate, in case where the command condition and the current operating direction are in reverse of each other, stop it by following the method set in the parameter, and start operation in the set speed.

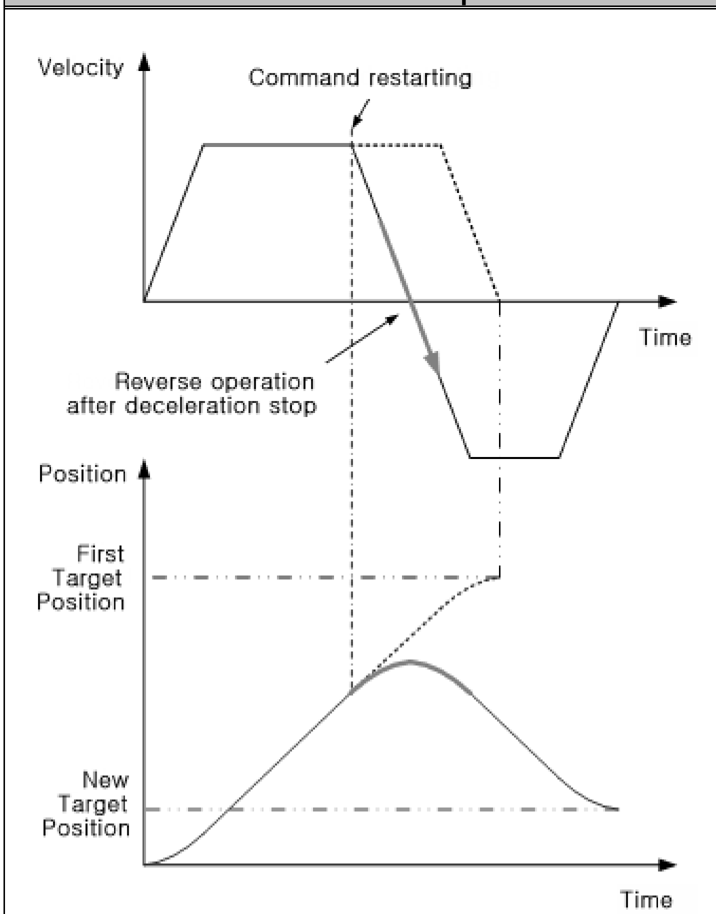
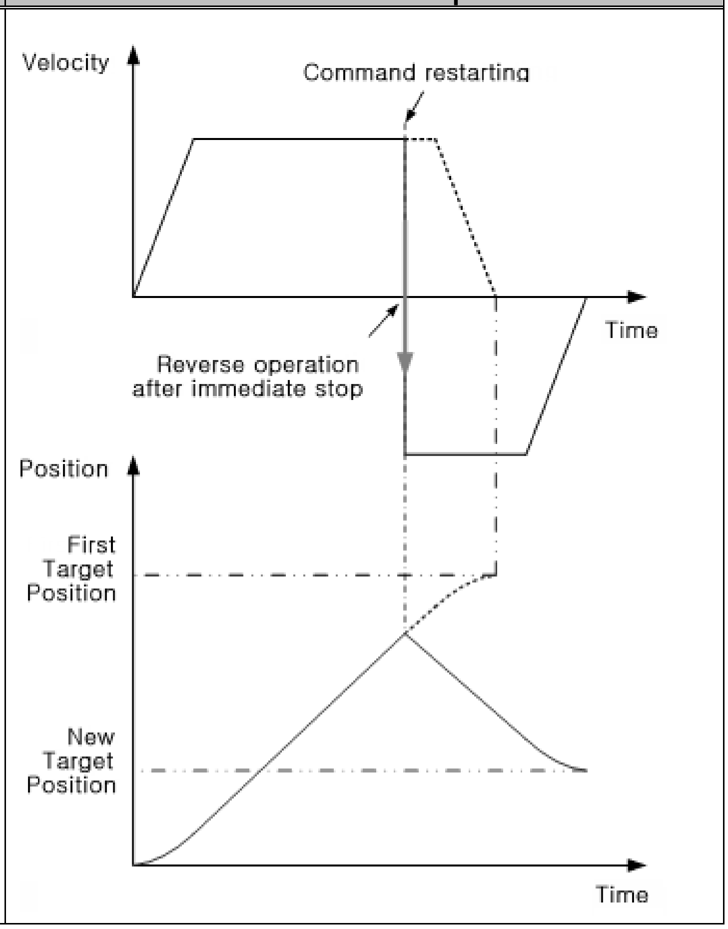
If the BufferMode is not Aborting, it is run in the specified continuous running method in the BufferMode rather than the method set in the parameter.

- '0: Deceleration stop'

  When the operation direction is reversed by the condition of newly executed command, make a deceleration pause to 0 speed and continue accelerating to the target position or operate at the targeted speed.

- '1: Immediate stop'

  When the operation direction is reversed by the condition of newly executed command, stop immediately and continue operating in the opposite direction in the same operation speeds to the target position or at the targeted speed.

| 0: Deceleration stop' | 1: Immediate stop |
| --- | --- |
|  |  |

(2) Extended parameter

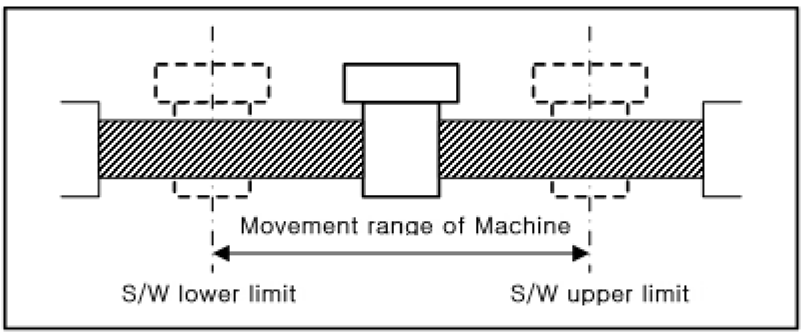
The following explains extended parameter of operation parameter

| Item | Description | Settings | Initial value |
|---|---|---|---|
| S/W upper limit | Set the range of the software limit functions. | Long real(LREAL) | 2147483647 pls |
| S/W lower limit | | | -2147483648 pls |
| Infinite running repeat position | Set the value of the repetitive position range in case infinite running repeat mode is used. | Long real(LREAL)<br>Positive number | 360 pls |
| Infinite running repeat | Set the allowable status of infinite length repetitive operation functions. | 0: Disable<br>1: Enable | 0: Disable |
| Command inposition range | Set the range where inposition signal is On before completion of positioning. | 0 or<br>Long real(LREAL)<br>Positive number | 0 pls |
| Tracking error over-range value | Set the value to detect more than position deviation. | 0 or<br>Long real(LREAL)<br>Positive number | 0 |
| Current position compensation amount | Set the compensation threshold to indicate the current position value as the target position value. | 0 or<br>Long real(LREAL)<br>Positive number | 0 |
| Current speed filter time constant | Set the time to calculate movement average of the current speed. | 0 ~ 100 | 0 |
| Error reset monitoring time | Set the monitoring time when resetting error occurred in servo drive. | 1 ~ 1000 | 100 |
| S/W limit during speed control | Set whether the soft limit is detected during the speed control. | 0: Don't detection<br>1: Detect | 0: Don't detection |
| Tracking error level | Set the error level more than deviation. | 0: Warning<br>1: Alarm | 0: Warning |
| JOG high speed | Set the values of speed / acceleration / deceleration / jerk which is referred in jog operation command | Long real(LREAL)<br>Positive number | 100000 pls/s |
| JOG low speed | | | 10000 pls/s |
| JOG Acceleration | | 0 or<br>Long real(LREAL)<br>Positive number | 100000 pls/$s^2$ |
| JOG Deceleration | | | 100000 pls/$s^2$ |
| JOG Jerk | | | 0 pls/$s^3$ |

(a) Software upper limit / Software lower limit

This is a function which sets the available range of the movement of the machine in the way of software by setting the upper limit & lower limit and allows the machine not to be operated beyond the set range. In other words, this is used to prevent a breakaway due to an error from setting the operation position and false operation that occurs from the user program error.

Set the external input upper limit and lower limit beyond the range of the software upper limit and the software lower limit.




The range check of the software upper limit and lower limit is conducted at the beginning of operation and during the operation.

If the soft upper limit and lower limit is detected, an error occurs and the module suddenly stops a motor. Therefore, check the cause of the error and use it after resetting the error when restarting the operation.

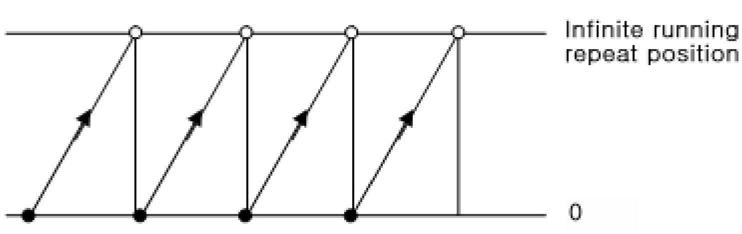
If you set the software upper limit and lower limit to be the initial value (upper limit: 2,147,483,647, lower limit: -2,147,483,648) or the same value, the soft upper limit and lower limit is not be detected.

(b) Infinite running repeat position

When using in infinite running repeat mode, set the position value which is repeated.

This is applied when the setting of extended parameter, 「Infinite running repeat」 parameter, is '1:Enable'.

When the 「Infinite running repeat」 parameter is '1:Enable', the command position and current position is indicated as "0~ (infinite running repeat position of -1). (「Unit」 = 0: pulse based)




(c) Infinite running repeat

Set the function availability of infinite running repeat operation.

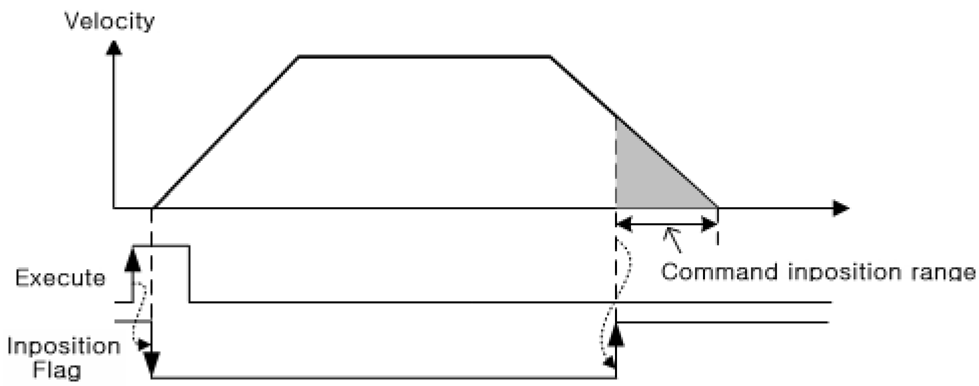
If this parameter is set to '1: Enable', the display of the command position and current position is updated periodically and automatically in the range set in the infinite length repetition position.

You must set it to '0: Disable' when you are not using the infinite running repeat operation function.

(d) Command inposition range

This item sets the distance to the target position where inposition flag (_AXxx_INPOS) is On.

When starting up the motion control, the in-position flag (_AXxx_INPOS) is Off, and it is On when the current position goes inside the「Command inposition range」from the target position. In-position flag can be used as a trigger when executing other assistant work before completing the position control.




(e) Exceeding value of tracking error

Set the value which will detect the value over position deviation. If a value exceeds this range, the 「Over deviation warning (_AXxx_DEV_WARN)」 or 「Over deviation alarm(_AXxx_DEV_ERR)」flag is On.

If this set value is 0, it won't detect the value over the deviation. You can set whether you want it to be a warning or an alarm for over deviation in the 「Error level of tracking error」of the expanded parameter.

(f) Tracking error level

Set whether to make it a warning or an alarm when the value over deviation is detected.

Operations according to the set values are as follows.

–'0: Warning'

When an error occurs in tracking error, the 「Over deviation warning (_AXxx_DEV_WARN)」flag is On, and warning error of tracking error (error code: 0x101D)) occurs. The axis does not stop and keeps operation.

–'1: Alarm'

When an error occurs in tracking error, the 「Over deviation alarm (_AXxx_DEV_ERR)」flag is On, and the alarm error of tracking error (error code: 0x101C) occurs. The axis suddenly stops at the「Emergency stop deceleration」of basic parameter.

In the following situations, the error in tracking error is not examined.

- In case the「Tracking error over-range value」is 0
- In case of the operation in homing or torque control

- In case the 「Tracking error over-range value」is 0
- In case of the operation in homing or torque control

(g) Current position compensation amount

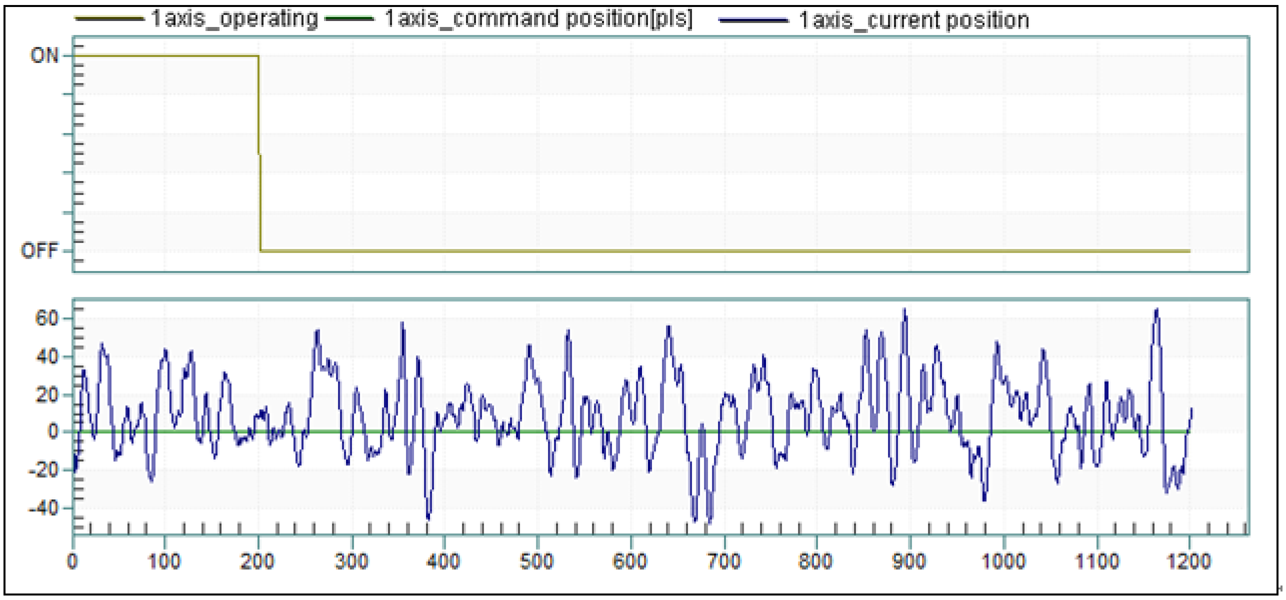
Current position compensation amount is a parameter unit used to display the current position value as the command position when the servo motor's current position value is not displayed as a fixed value but changed slightly depending on the personal setting of the user application and the servo drive.

When it is not in operation and if the difference of the command position and the current position is within the amount of compensation in displaying current position, the current position value is displayed as a command position value. When it is in operation, Current position compensation amount is not reflected, and the actual position value is displayed.

The following is an example of application of Current position compensation amount according to the value of Current position compensation amount when the command position is '0'.

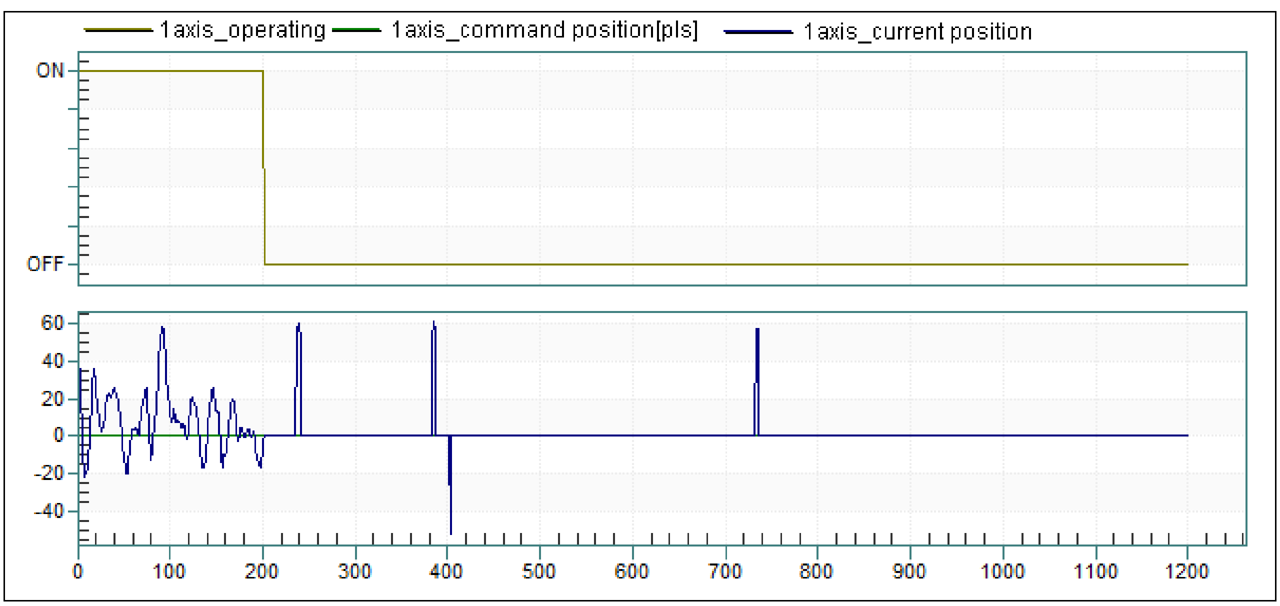
① Current position compensation amount = 0 pls

Position value of the actual motor is displayed as the current position value even after the end of operation.



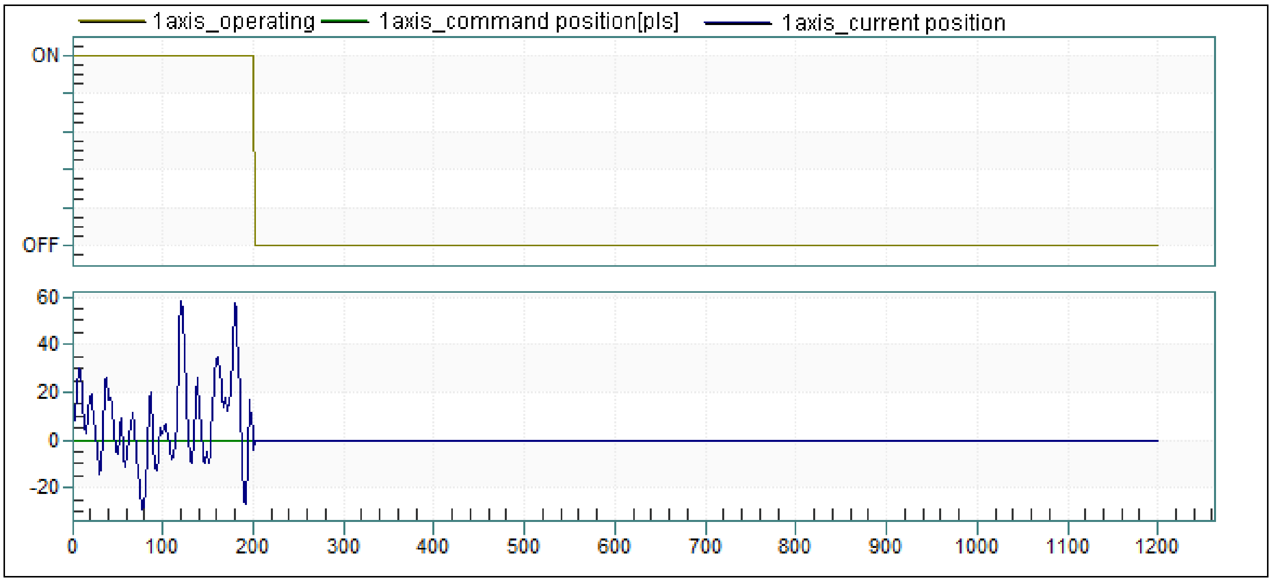

② Current position compensation amount = 50 pls

If the current position value is within ±50 of command position after the end of operation, it is displayed as the command position value. .



③ Current position compensation amount = 100 pls

If the current position value is within ±100 of command position after the end of operation, it is displayed as the command position value.



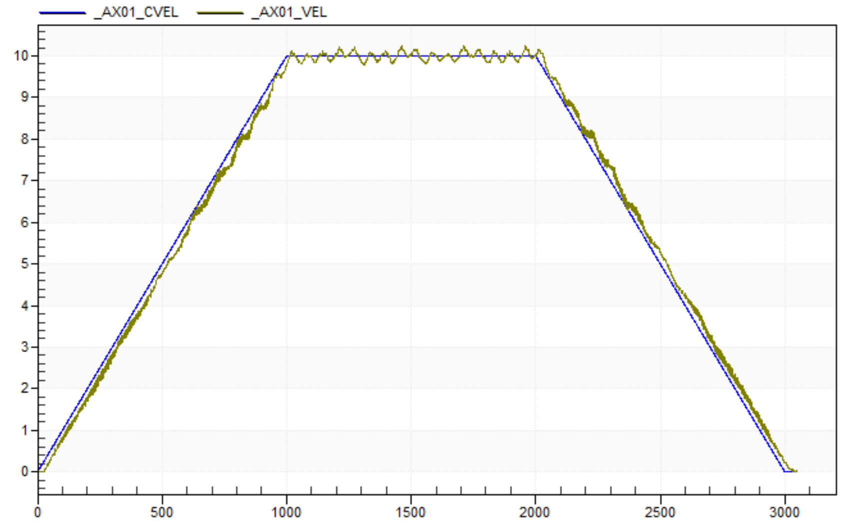

(g) Current speed filter time constant

Set the time to calculate the average of movement at current speed. (unit: ms) Current speed filter time constant is not applied if it is set to '0'.

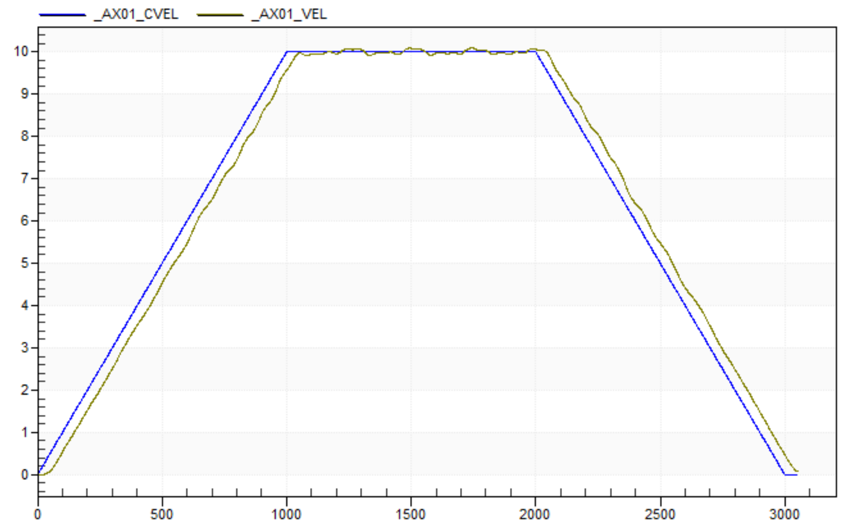
When the speed of axis is slow or there are wide variations in current speed (ex. 「unit」 setting is '0: pulse', stable speed can be achieved by applying the average of movement to the current speed.

You can check the differences in current speed depending on the value of Current speed filter time constant in the list below which traces command speed and current speed at 10 mm/s of command speed.

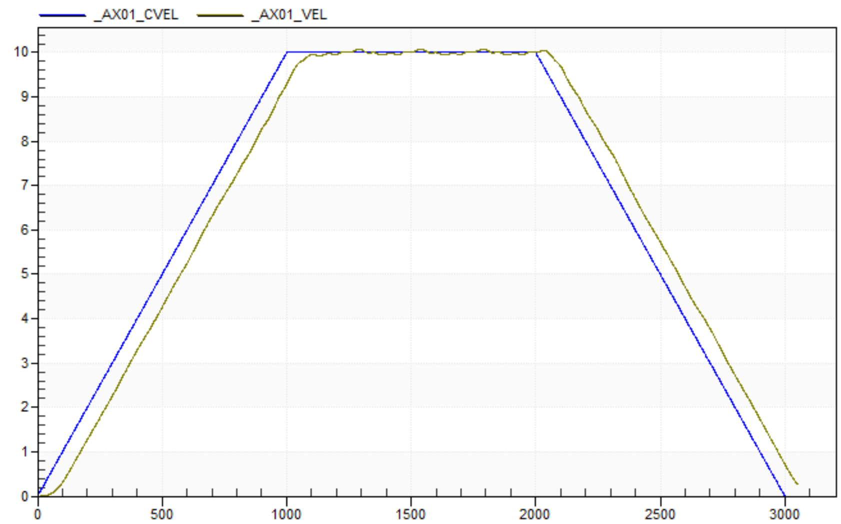
① Current speed filter time constant = 0 ms




② Current speed filter time constant = 50 ms




③ Current speed filter time constant = 100 ms



(h) Error reset monitoring time

Set the monitoring time in the event of error reset occurred in the servo drive. (unit: ms) If the error which occurred in the servo drive within the error reset monitoring time, error reset monitoring is terminated and error reset time out error of servo drive (error code: 0x1070) is occurred.

(i) S/W limit during speed control

When software limit is detected during the operation at fixed speed by speed control, this is used to stop the motor. Operations according to the set values are as follows.

- ‘0: Don’t detect’

If it is under the speed control even when the software limit function is activated, software limit is not detected.

- ‘1: Detect’

If it is under the speed control even when the software limit function is activated, software limit is detected.

Even when the parameter value is set to '1: detect', if the software upper limit/lower limit is set to the initial value (upper limit: 2,147,483,647, lower limit: -2,147,483,648) or the same value, software limit is not detected.

(j) JOG high speed / JOG low speed

Jog speed is related to the speed when operating jog which is a type of manual operation. Jog operation is divided into JOG high speed and JOG low speed.

Jog is operated in the pattern with the areas of acceleration, fixed speed, and deceleration. Therefore, the acceleration area is controlled by jog acceleration time and the deceleration area is controlled by jog deceleration time.

Setting range of JOG high speed cannot exceed the speed limit. Also, JOG high speed must be the same with or bigger than JOG low speed.

(k) JOG acceleration, JOG deceleration, JOG jerk

Set the values of acceleration, deceleration, and jerk which are applied in the case of JOG high speed and JOG low speed operation.

If JOG acceleration is 0, it is operated immediately at JOG set speed without acceleration area at the beginning of JOG operation.

If JOG deceleration is 0, it is stopped immediately at 0 without deceleration area at the stop of JOG operation.

If JOG jerk is 0, the form of acceleration/deceleration is in a linear as acceleration is fixed

## 4. Axis group parameter

Axis group parameter item is explained as follows.

| Item | Description | Settings | Initial value |
|---|---|---|---|
| Axis1 | Set the axis which form axis group. | None,<br>1Axis ~ 32Axis(real axis),<br>37Axis ~ 40Axis(virtual axis) | None |
| Axis 2 | | | None |
| Axis 3 | | | None |
| Axis 4 | | | None |
| Interpolation speed max | Set max speed of operation about axis group. | Long Real(LREAL)<br>Positive number | 20000000 u/s |

(1) Configuration axis setting

Set the number of each axis which belongs to the relevant axis group. Each axis group can include up to 4 axes.

Virtual axis can also be set in the axis group parameter.

Axis setting must be set in order in axis group which executes circular interpolation or helical interpolation command. In other words, 「axis setting 1」 is X-axis of the arc, 「axis setting 2」 is Y-axis of the arc, and 「axis setting 3」 is Z-axis of helical interpolation.

Therefore, if circular interpolation command is executed when setting the axis group, errors occur as follows.

- In case the axis group is comprised of 4 axes (error code: 0x20A9)
- In case the set value of 「axis setting 1」 or 「axis setting 2」 is ‘none’ (error code: 0x20AA)
- In case the set value of「axis setting 3」is 'none' and the remaining axes are set (error code: 0x20AA)

(2) Interpolation speed max

This refers to the configurable maximum speed of interpolation control operation when controlling interpolation with axes which belongs to the relevant axis group.

In case of interpolation operation of the relevant axis group, interpolation speed must be set below the set Interpolation speed max.

## 5. Network parameter

The items related to EtherCAT network setting are explained here.

(1) Master parameter

Set master function related to EtherCAT slave connection when connecting network.

Master parameter setting items are as follows.

| Item | Description | Settings | Initial value |
| --- | --- | --- | --- |
| Slave Revision Check | Specify whether to check Revision information of parameter matches the Revision value of actual slave at the time of network connection. | 0: Don’t check<br>1: Check | 0: Don’t check |
| Slave Serial Number Check | Specify whether to check serial number information of parameter matches the serial number value of actual slave at the time of network connection. | 0: Don’t check<br>1: Check | 0: Don’t check |
| Periodic communication time-out count | Specify the number of criteria that periodic communication time-out occurs. | 1 ~ 8 | 2 |

(a) Slave Revision check

Whether to proceed with the connection is determined by comparing the revision information set in the slave parameters at the time of network connection with that possessed by the slave which is actually connected.

Motions according to the set values are as follows.

- ‘0:Don’t check’

  The communication connection process is continued while not comparing the Revision information set in the slave parameter and the Revision information which the slave has.
- ‘1: Check’

  Compare the Revision information set in the slave parameter and the Revision information which the connected slave has, and if it does not correspond, a network configuration mismatch error (error code: 0x0F1F) occurs and ends the communication connection process.

It may not operate normally if the Revision of the slave parameter and a slave with no compatibility are connected in case that you set the check standard of slave Revision to ‘0: Don’t check’. Therefore, use it after checking the availability of the compatibility between the Revisions

(b) Slave Serial Number Check

When connecting to the network, decide whether or not to continue the connection process by comparing the serial number information set in the slave parameter and the serial number information which actually connected slave has.

Motions according to the set values are as follows.

- '0: Don't check'
  The communication connection process is continued while not comparing the serial number information set in the slave parameter and the serial number information which the slave has.
- '1: Check'
  Compare the serial number information set in the slave parameter and the serial number information which the connected slave has, and if it does not correspond, a network configuration mismatch error (error code: 0x0F1F) occurs and ends the communication connection process.

If the slave's serial number check is set to '1: Check', you are able to know the changes made to the network when the network configuration order is changed or when the slave is replaced, which is useful for maintaining and repairing such as resetting the slave parameter. Resetting of the serial number in XG-PM is required to connect to the changed network configuration.

(c) Periodic communication time-out count

The standard number occurring time-out error is specified when it cannot receive the periodic data during execution of periodic communication between the motion control module and the slave device.
When the communication time-out error occurs frequently from various noise environments (power surges, induction noise or noise interference between the motion control module and the wiring of the slave device), set the set value high.
The available setting range is between 1 to 8 times.

(2) Slave parameter

Set the information of EtherCAT slave used when connecting to the network. The slave parameter can be identified in the slave information window which is displayed when adding the slave by executing [Slave data] – [Add item] – [Slave] in the XG-PM project tree. Or you can check it in the slave information window which is displayed after executing each slave's 'Properties' linked to the sub-tree of the [Slave data] on the XG-PM project tree
The setting items for the slave parameter are as follows.

| Item | | Description | Settings | Initial value |
|---|---|---|---|---|
| Slave name | | Select the slave and displays the name of selected slave. | XML | L7N |
| Number | | Set the number of station which is applied to the selected slave. | 1 ~ 32<br>33 ~ 36 | 1<br>(Increase automatically when adding the slave) |
| Vendor | | The name of the selected slave supplier is automatically displayed. | Setting is not available | LS Mecapion |
| Version | | Revision of the selected slave is automatically displayed. | Setting is not available | #x00002 |
| PDO Map | RxPDO | RxPDO mapping information of the slave is automatically displayed. | XML | 0x1600 PDO map information |
| | TxPDO | TxPDO mapping information of the slave is automatically displayed. | XML | 0x1A00 PDO map information |
| DC Used | | Set the DC use of the slave. | 0: Unused<br>1: Used | 1: Used |

(a) Slave name

Select the slave you want to connect to the motion control module, and display the name of the selected slave.
L7N servo drive is selected for the initial value when adding the slave to the slave data.
Display the supportable list by bringing the slave information from XML file which is in the folders below.

- Korean version: 'XG-PM setting folder' > \l.kor\DriveInfo, \l.kor\IOInfo folder
- English version: 'XG-PM setting folder' > \l.eng\DriveInfo, \l.eng\IOInfo folder

When wanting to add new slave, copy the relevant XML file to the folders above and restart XG-PM.

(b) The number of station

Set the number of station which is applied to the selected slave. The set number of station is the slave number and IO device number.
Setting ranges are as follows.

- Servo drive: 1 ~ 32
- EtherCAT I/O device: 33 ~ 36

In the event of connecting servo drive automatically, axis order is automatically set in accordance with connection order.

(c) Supplier

The name of the selected slave supplier is automatically displayed. User cannot arbitrarily change it.

(d) Version

Revision information of the selected slave is automatically displayed. User cannot arbitrarily change it.

(e) RxPDO

Set the synchronous data which is transmitted from the motion control module to the slave in every communication period. RxPDO item supported by the relevant slave is automatically set when selecting a slave.
Object that the user wants can be added or deleted by using the editing function.
When editing the PDO object, the following objectives must be included as they are essential items used in the motion control module.

- 0x6040:0 Controlword
- 0x607A:0 Target position

The synchronous data assigned here is automatically registered as input/output flag and it can be referred in the user program.
For example, 'Controlworld' object from RxPDO synchronous data of L7N servo drive which is linked to the slave 1 is registered as I/O flag, _SL1_Controlword (%QW1.0).

(f) TxPDO

Set the synchronous data which is read from the slave in the motion control module every communication period. When selecting the slave, the TxPDO item which is supported by the relevant slave is set automatically. Object that the user wants can be added or deleted by using the editing function.
When editing the PDO object, the following objects must be included as they are essential items used in the motion control module.

- 0x6041:0 Statusword
- 0x6064:0 Position Actual Value

The synchronous data assigned here is automatically registered as I/O flag and it can be referred in the user program.
For example, 'Statusword' object from TxPDO synchronous data of L7N servo drive which is linked to the slave 2 is registered as I/O flag, _SL1_Statusword (%IW1.0).

(g) DC Used

If the slave supports the DC function, it is automatically set form the XML file. If you do not want to use the DC function, select it to 0: Unused.
DC(Distributed Clock) is a function used to synchronize the EtherCAT master and the EtherCAT slave, and it allows high-definition synchronous control between the Ethercat slaves.
DC shares the time information between the EtherCAT master and EtherCAT slave; and adjusts the synchronization between each slave. In order to share the time information, the first slave that is connected to the motion control module provides the Reference Clock. The Reference Clock distributes time information to each slave every communication period.

## 5.2 I/O signal

Explain about the contents and functions of the I/O signal for data exchange of Motion control module and XGK CPU module.

### 5.2.1 Contents of I/O Signal

1. I/O Signal of Motion control module use input 48Bit, output 16bit.

2. The operation preparation signal (Uxx.00.F) of motion control module is a signal which always remains On when the module is in a normal state by the way of hardware, and the module recognition process is completed normally by CPU.
   If PLC CPU operation mode is RUN and there is the initialization task program when turning the initial power On, the operation preparation signal is On after the initialization task program has ended.
   When an error related to the hardware occurs during the operation of motion control module, the operation preparation signal is Off.

3. The relevant Bit is On in only the connected axis when the operation preparation signal for each axis of the motion control module is connected with EtherCAT communication between the motion control module and servo drive regardless of the operation mode of motion control module.

4. Output signal
   The signal delivers from PLC CPU to Motion control module.

| Axis | Signal direction: PLC CPU → Motion Control Module | |
|---|---|---|
| | Output Signal | Description |
| Common | Uxx.03.0 | RUN/STOP Command (0:RUN, 1:STOP) |
| - | Uxx.03.1 | Unused |
| - | Uxx.03.2 | Unused |
| - | Uxx.03.3 | Unused |
| - | Uxx.03.4 | Unused |
| - | Uxx.03.5 | Unused |
| - | Uxx.03.6 | Unused |
| - | Uxx.03.7 | Unused |
| - | Uxx.03.8 | Unused |
| - | Uxx.03.9 | Unused |
| - | Uxx.03.A | Unused |
| - | Uxx.03.B | Unused |
| - | Uxx.03.C | Unused |
| - | Uxx.03.D | Unused |
| - | Uxx.03.E | Unused |
| - | Uxx.03.F | Unused |

5. Input signal

The signal delivers from Motion control module to PLC CPU.

| Signal direction: Motion Control Module → PLC CPU | | |
|---|---|---|
| **Axis** | **Output Signal** | **Description** |
| Common | Uxx.00.0 | RUN/STOP state (0:RUN, 1:STOP) |
| Common | Uxx.00.1 | Error state |
| Common | Uxx.00.2 | Communication state |
| - | Uxx.00.3 | Unused |
| - | Uxx.00.4 | Unused |
| - | Uxx.00.5 | Unused |
| - | Uxx.00.6 | Unused |
| - | Uxx.00.7 | Unused |
| - | Uxx.00.8 | Unused |
| - | Uxx.00.9 | Unused |
| - | Uxx.00.A | Unused |
| - | Uxx.00.B | Unused |
| - | Uxx.00.C | Unused |
| - | Uxx.00.D | Unused |
| Common | Uxx.00.E | Link up/down information |
| Common | Uxx.00.F | Operation ready of Motion control module |

| Signal direction: Motion Control Module → PLC CPU | | |
|---|---|---|
| **Axis** | **Output Signal** | **Description** |
| 1 Axis | Uxx.01.0 | 1Axis operation ready |
| 2 Axis | Uxx.01.1 | 2 Axis operation ready |
| 3 Axis | Uxx.01.2 | 3 Axis operation ready |
| 4 Axis | Uxx.01.3 | 4 Axis operation ready |
| 5 Axis | Uxx.01.4 | 5 Axis operation ready |
| 6 Axis | Uxx.01.5 | 6 Axis operation ready |
| 7 Axis | Uxx.01.6 | 7 Axis operation ready |
| 8 Axis | Uxx.01.7 | 8 Axis operation ready |
| 9 Axis | Uxx.01.8 | 9 Axis operation ready |
| 10 Axis | Uxx.01.9 | 10 Axis operation ready |
| 11 Axis | Uxx.01.A | 11 Axis operation ready |
| 12 Axis | Uxx.01.B | 12 Axis operation ready |
| 13 Axis | Uxx.01.C | 13 Axis operation ready |
| 14 Axis | Uxx.01.D | 14 Axis operation ready |
| 15 Axis | Uxx.01.E | 15 Axis operation ready |
| 16 Axis | UXX.01.F | 16 Axis operation ready |

| Signal direction: Motion Control Module → PLC CPU | | |
|---|---|---|
| **Axis** | **Output Signal** | **Description** |
| 17 Axis | Uxx.02.0 | 17 Axis operation ready |
| 18 Axis | Uxx.02.1 | 18 Axis operation ready |
| 19 Axis | Uxx.02.2 | 19 Axis operation ready |
| 20 Axis | Uxx.02.3 | 20 Axis operation ready |
| 21 Axis | Uxx.02.4 | 21 Axis operation ready |
| 22 Axis | Uxx.02.5 | 22 Axis operation ready |
| 23 Axis | Uxx.02.6 | 23 Axis operation ready |
| 24 Axis | Uxx.02.7 | 24 Axis operation ready |
| 25 Axis | Uxx.02.8 | 25 Axis operation ready |
| 26 Axis | Uxx.02.9 | 26 Axis operation ready |
| 27 Axis | Uxx.02.A | 27 Axis operation ready |
| 28 Axis | Uxx.02.B | 28 Axis operation ready |
| 29 Axis | Uxx.02.C | 29 Axis operation ready |
| 30 Axis | Uxx.02.D | 30 Axis operation ready |
| 31 Axis | Uxx.02.E | 31 Axis operation ready |
| 32 Axis | UXX.02.F | 32 Axis operation ready |

### 5.2.2 Use of I/O Signal

**1. Ready signal of axis operation**

(1) Ready signal of axis operation use EtherCAT communication to motion control module. Signal related to the connected axis is on when connecting servo drive.

(2) Can check the axis which is accessed to motion control module and performs EtherCAT communication.

(3) When Disconnectiong the communication between the motion control module and servo drive by using the motion function block, "LS_Disconnect", in the motion control program, the operation preparation signals of every axis become Off.

(4) “Uxx.00.zz” indicate signal. ‘U’ is U of PLC CPU, ‘xx’ is installed position of motion control module, ‘zz’ is Bit of input signal.

**2. Link up/down information**

(1) Link up/down information is on when network cable is physically connected at motion control module.
Link up/down information is off when network cable is physically disconnected at motion control module.

(2) Can check the factor that causes an error by checking whether the network cable is connected.

**3. RUN/STOP Command, RUN/STOP State**

(1) RUN/STOP command (Uxx.03.0) is a signal which changes the state of the motion control module into RUN or STOP.
When PLC CPU is RUN, the motion control module is RUN for the relevant signal 0 and STOP for the signal 1.

(2) RUN/STOP state (Uxx.00.0) is a signal which communicates the current state of motion control module to PLC CPU.
If motion control module is RUN, this is 0 and if the module is STOP, this is 1.

.

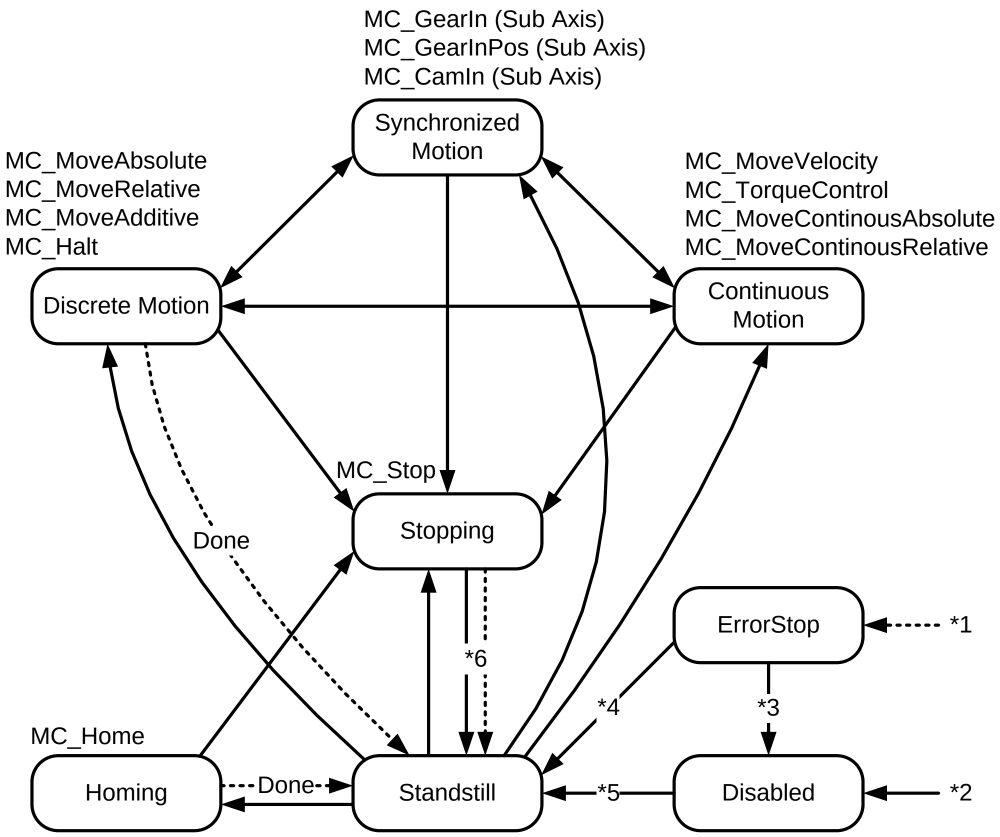
# Chapter 6 Function Blocks

This chapter describes the basic function block library mentioned in the previous chapter and other application function block library.

## 6.1 Common Elements of Motion Function Blocks

### 6.1.1 The State of axis

Each axis in the motion control module is changed to the relevant state depending on the situation and command. The changing structure of each situation is shown in the figure below.




*1 ErrorStop: in case axis error occurs regardless of the current state of axis

*2 Disabled: in case MC_Power.Enable input is Off when axis error does not occur

*3 ErrorStop → Disabled: in case MC_Reset command has issued when MC_Power.Status output is Off

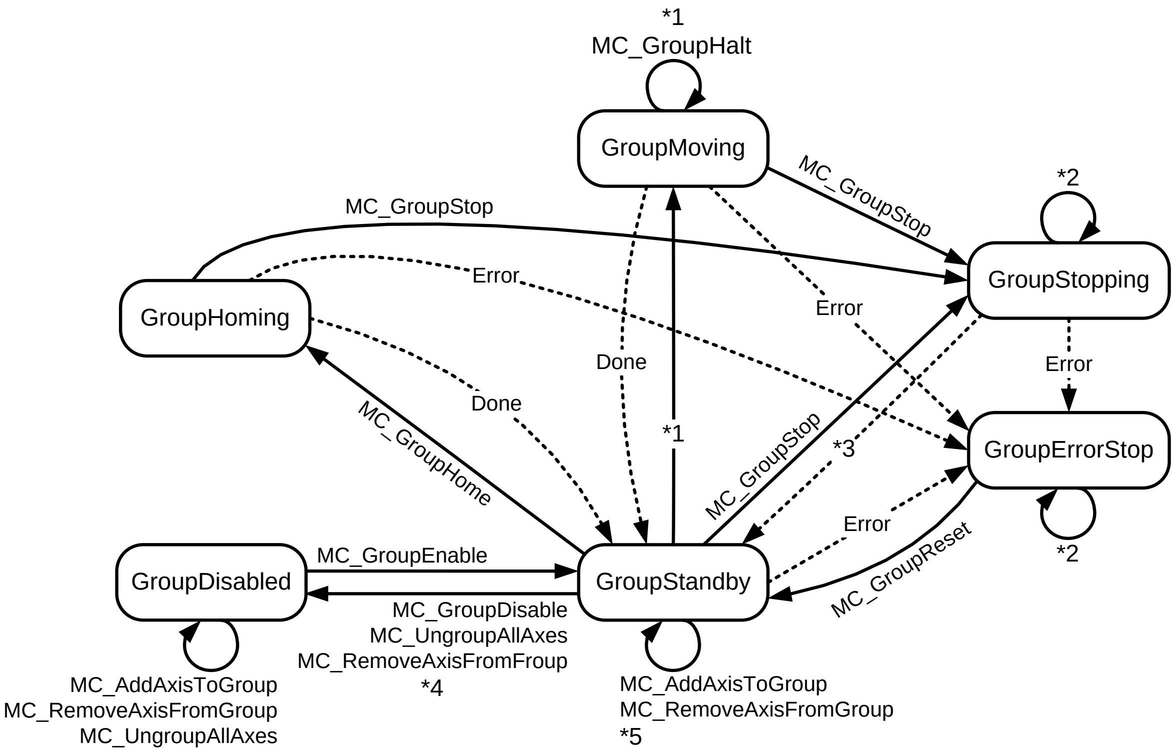
*4 ErrorStop → Standstill: in case MC_Reset command has issued when MC_Power.Status output is on and MC_Power.Enable input is On

*5 Disabled → Standstill: in case of turning On MC_Power.Enable input when MC_Power.Status output is On
*6 Stopping → Standstill: in case of turning Off MC_Stop.Execute input when MC_Stop.Done output is On

| The state of axis | Description |
|---|---|
| **Disabled** | Disabled state indicates the state in which no command is given to a single axis, and no error occurs. In case there is no motion control module at the time of first operation, each axis begins in the disabled state. Afterwards, axis status is changed to standstill state in case servo-on status emerges when Enable input of servo On/Off (MC_Power) motion function block is On. The axis becomes disabled state when Enable input of serve On/Off (MC_Power) motion function block is Off in case of not being in ErrorStop state. In case there is motion function block which is currently being performed, the command is interrupted.(The CommandAborted output of the motion block function is On) |
| **ErrorStop** | No matter which state the current axis is in, it is changed to ErrorStop state when axis error occurs, and the axis decelerates to stop. In the state where error occurs, ErrorStop state is maintained even though servo On/Off (MC_Power) motion function block is executed. The motion axis which is in ErrorStop state maintains stationary state, and any command except for error reset is not executed. |
| **StandStill** | When the power of axis is activated, there is no error in the axis and any command is not made, the axis state indicates StandStill state. |
| **Homing** | Homing state indicates the axis is in homing operation. |
| **Stopping** | In case emergency stop (MC_Stop) function block is executed, the axis state is changed to stopping state. When the axis is in stopping state, other motion commands cannot be given to the axis until the Stop is completed (until Done output is activated). If Done output is On, and Execute input is On, the state is switched to Standstill status. |
| **Continuous Motion** | It indicates state where operation continues until the current axis becomes operation stop status. |
| **Discrete Motion** | It indicates reduced operating status with target position. |
| **Synchronized Motion** | Synchronized motion indicates axis is in synchronized operation. |

### 6.1.2 The State of Group

Each group in motion control module is changed to the relevant state depending on the situation and command.
The changing structure of each state is shown in the figure below.




*1 GroupMoving: in case of performing the motion function block of general group operation

*2 GroupStopping, GroupErrorStop

: The relevant motion function block is not performed when different motion function block is performed in GroupStopping or GroupErrorStop state, and when MC_GroupReset function block is performed in GroupErrorStop state, the state of the relevant group is changed to GroupStandby.

*3 GroupStopping → GroupStandby

: when MC_GroupStop.DONE output is On and MC_SroupStop.EXECUTE input is Off

*4 GroupStandby → GroupDisabled

: in case there is no axis belonging to the group when performing the axis remove command (MC_RemoveAxisFromGroup, MC_UnGroupAllAxes)

*5 GroupStandby

: in case more than one axis belongs to the group when performing the axis add or remove command in group (MC_AddAxisToGroup, MC_RemoveAxisFromGroup)

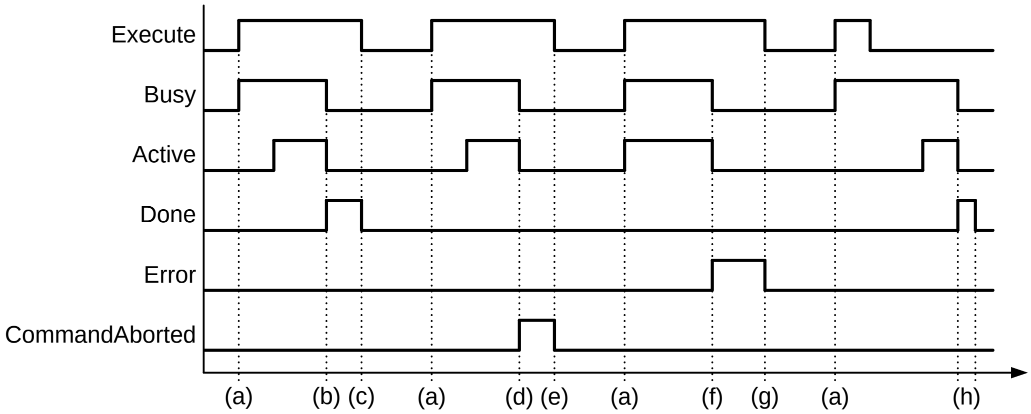
*6 GroupDisabled

: When performing MC_GroupDisable or MC_UnGroupAllDisable function block, the relevant group is changed to GroupDisabled state regardless of its current state.

### 6.1.3 Basic I/O Variable

**1. Edge operation motion function block**

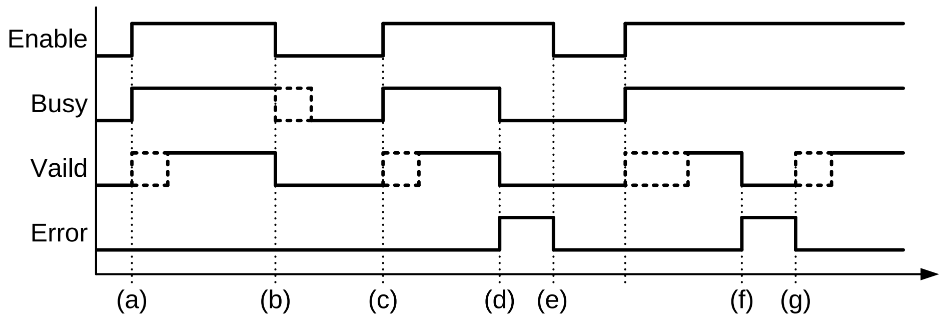
Relationships of the basic I/O parameter in the Edge operation motion function block are as below.




| Variable | Description |
|---|---|
| **Execute** | This is an input to run the relevant function block in Edge operation function block. Function block is executed in the rising Edge. (Figure a state) |
| **Busy** | This is an output to indicate the relevant motion function block is currently running (= not completed), and this indicates the output of motion function block can be changed.<br>Busy output is On in the rising Edge of Execute input (Figure a state), and it is Off when Done output is On (Figure b state), CommandAborted output is On (Figure d state), or Error output is On (Figure f state). |
| **Active** | This indicates the relevant motion function block is actually controlling axis.<br>When running many motion function block to one axis (in case only one motion function block is controlling and other notion function blocks are Buffered), Active output is On in only one motion function block which is controlling, and in motion function blocks which are Buffered, Busy output is On. |
| **Done** | This is an output to indicate operation of the relevant motion function block has been successfully completed.<br>If Done output is On, Busy and Active output is Off. (Figure d state)<br>Done output is Off when Execute input is Off (Figure e state), if Execute output was Off when Done output became On, it remains On only during 1 scan (Figure h state). |
| **Error** | This is an output to indicate an error occurs while running motion function block.<br>Error output is Off when Execute input is Off (Figure f state). If Execute output was Off when Error output became On, it remains On only during 1 scan (Figure h state). |

| Variable | Description |
|---|---|
| **ErrorID** | This outputs error code regarding the relevant error when an error occurs while running motion function block. ErrorID output and elimination time are same with Error output. |
| **CommandAborted** | This indicates the relevant motion function block is interrupted by the other motion function block. CommandAborted output is Off when Execute input is Off (Figure g state). If Execute output was Off when Done output became On, it remains On only during one scan. |
| ※ When Execute input is On in Edge operation(Execute input) motion function block, depending on the state of axis, one output in Busy, Done, Error, and CommandAborted output is On. Busy, Done, Error, and CommandAborted output are available to be On one at a time, and if one output in four is On, other three outputs become Off. | |

**2. Motion function block for level motion**




| Variable | Description |
|---|---|
| **Enable** | This is an input to run function block for level operation motion.<br>This runs motion function block in the rising Edge (Figure a state), and stops it in the falling Edge(Figure b state). |
| **Busy** | This is an output to indicate the relevant motion function block is currently running ((= not completed), and it indicates the output of motion function block can be changed. Busy output is On in the rising Edge of Enable input (Figure b state), and it remains on while motion function is in operation. |
| **Valid** | This is an output to indicate the relevant motion function block is successfully performed and output & motion are valid.<br>Valid output is Off when Enable input is Off (Figure b state). |

| Variable | Description |
|---|---|
| **Error** | This is an output to indicate an error occurs while running motion function block.<br>If an error which cannot be automatically restored occurs while motion function block is in operation, Error output is On, Busy & Valid output is Off (Figure d state), and motion function block stops operating.<br>Error output is Off when Enable input is Off (Figure e state).<br>If an error which can be automatically restored occurs while function block is in operation, Error output is On and Valid input is Off (Figure f state).<br>When the error in the relevant motion function block is restored, Error output is Off, and operation is resumed (Figure g state). |
| **ErrorID** | This outputs error code regarding the relevant error when an error occurs while running motion function block. ErrorID output and elimination time are same with Error output. |
| ※ Valid and Error outputs are not On at the same time. | |

3. **Axis input**

Each motion function block can be specified by Axis input to the axis which is subject to the relevant command. Motion control module can control 1-32 actual axes and 37~40 virtual axes, and 41-41 encoders can be used as main axis depending on motion function block. Therefore, values of 1~32, 37~40, and 41~42 can be input in Axis input depending on motion function block. When it is out of the range which is available to set in each motion function block, "error 0x0006"occurs.

### 6.1.4 BufferMode Input

This is an input which can specify whether to wait until the existing command is completed or to cancel the existing motion function block and execute the command in case the axis is already running other motion function block when running motion function block in a certain axis. The number between 0-5 can be specified, and if it is out of the range, "error 0x101A" occurs in the axis command and "error 0x201A" occurs in the axis group command. The values which are available to be set in BufferMode are as below.

| Number | Buffer Mode | Explanation |
|---|---|---|
| **0** | **mcAborting** | Execute the command immediately. The existing command in operation is interrupted. |
| **1** | **mcBuffered** | Execute the command after the existing command in operation is completed. |
| **2** | **mcBlendingLow** | Do combined operation to combine the speeds of the existing command and command issuing to the low speed by comparing. |
| **3** | **mcBlendingPrevious** | Do combined operation to combine the speeds of the existing command. |
| **4** | **mcBlendingNext** | Do combined operation to combine the speeds of the command issuing. |
| **5** | **mcBlendingHigh** | Do combined operation to combine the speeds of the existing command and command giving to the high speed by comparing. |

### 6.1.5 Changes in Parameters during Execution of Motion Function Block

The parameter of the relevant command can be changed at the time motion function block is running, and the detailed operations are as below.

(1) When executing Edge operation motion function block in the Off state of ContinuousUpdate input (turn On the Execute input), the relevant motion function block is operated by application of the parameter at the time when Execute input was On (rising Edge). In this case, the change of the parameter input value in the middle of execution of motion function block does not affect operation.
When wanting to change the parameter while the relevant motion function block is in operation, change the parameter and turn On Execute input again.

(2) When executing Edge operation motion function block in the On state of ContinuousUpdate input (turn On the Execute input), the parameter of the time when Execute input was On (rising Edge) is applied at first.
When changing the parameter while ContinuousUpdate input is On, the relevant motion function block operates reflecting the every change in parameter.
But, if you change the parameter at the completion or after the stop of the operation of the relevant motion function block (Busy output is Off), the change is not reflected any more. (Parameter changing operation using ContinuousUpdate does not rerun the motion function block which is completed or interrupted, In other words, ContinuousUpdate operation is applied only to the motion function block which is currently running.)

(3) As for level operation motion function block, it is operated by the application of the parameter at the time when Enable input was On (rising Edge), and continuous change of parameter is available while Enable input is On.

### 6.1.6 Group Operation Route Change Settings

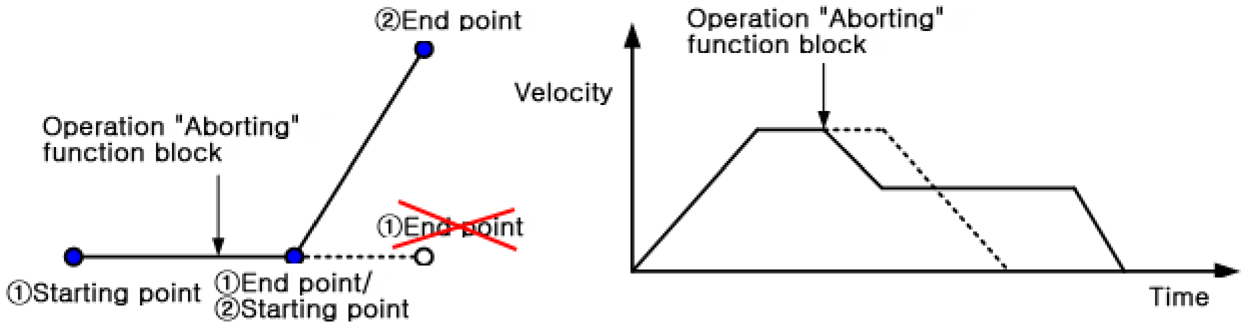
When the axis group of the current motion control module is executing a command, other command can be issued to the relevant axis group. At this point, the path, which the next command will achieve, can specify how the existing command will be connected to the existing path. The parameter of connection track is specified in TransitionParameter input.

| Number | TRANSITION Mode | Explanation |
|---|---|---|
| **0** | **TMNone** | Do not generate a connection track. |
| **3** | **TMCornerDistance** | Generate a connection track which specifies the corner distance of a connection track and draws circular arcs at the specified corner distance. |

**1. TransitionMode “TMNone”**

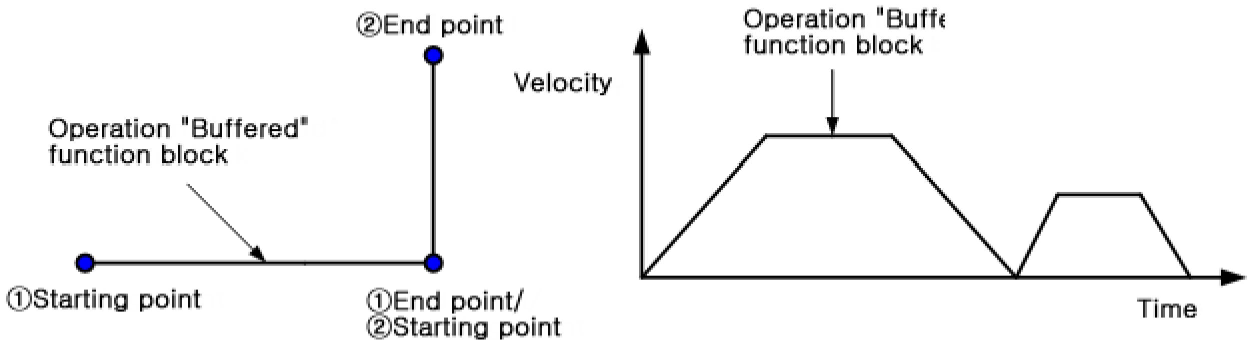
Connection track is not generated. TransitionMode input is available only to “TMNone” in case BufferMode input of motion function block is “Aborting” or “Buffered”.

The Figure below shows the case when running BufferMode of motion function block in the setting of ‘Aborting’. The Figure in the left shows that motion function block ② is executed in the setting of ‘Aborting’ while motion function block ① is running. Motion function block ① is forced to be terminated at 'end point ① / starting point ②' without reaching 'end point ①'. The Figure in the right shows that deceleration pause is performed at the moment of the execution of 'Aborting' function block, and the next motion function block is executed.




<In case BufferMode is specified as "Aborting">

The Figure below shows that the case when running BufferMode of motion function block in the setting of 'Buffered'. The Figure in the left shows that motion function block ② is executed in the setting of 'Buffered' while motion function block ① is running. Motion function block ② is executed after motion function block ① has reached target position. The Figure in the right shows that when 'Buffered' function block is executed, the next motion function block is executed after it reaches original target position.




<In case BufferMode is specified as "Buffered">

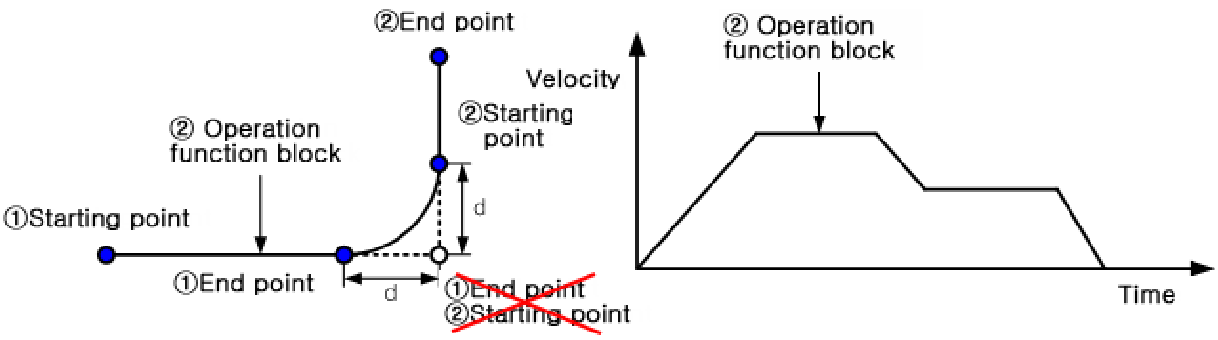
## 2. TransitionMode "TMCornerDistance"

The radius of a connection track is specified and the connection track which draws a circle having specified radius is output. This mode is operated only when BufferMode is "BlendingXXXX", and it is operated in "TMNone" when BufferMode is "Aborting" or "Buffered".

When drawing a connection track, the maximum speed of the path complies with the specified speed in BufferMode, and the length of radius complies with the value specified in TransitionParameter.

The Figure below shows the generation of a connection track which draws radius circle in two linear interpolation commands. The Figure in the left shows that motion function block ② is executed in the setting of “TMcornerDistance” while motion function block ① is running. The original target position of motion function block ① was end point ① / starting point ②, but straight-line motion is stopped and circular motion is started at the point ahead as far as radius 'd' (end point ①). Circular operation starts at end point ① and finishes at starting point ②, and executes motion function block ②.

The Figure in the right shows that the speed does not stop in the middle of two function blocks and continues.




<In case BufferMode is specified as “BlendingLow” and TransitionMode is specified as “TMCornerDistance”>

### 6.1.7 Motion Function Block Errors

Errors occurring in ErrorID variable of motion function block are as follows.

| STAT | Content | Detailed Description |
|---|---|---|
| 0x0000 | Normal | In case motion function block is normally executed, “O” is displayed on ErrorID. |
| 0x0005 | The current motion module does not support the motion function block. | The motion function block is not executed in the version of current module. Check the version in which the motion function block can be executed. |
| 0x0006 | Axis number of motion function block (Axisinput) exceeded allowable range. | Check the axis that can implement allocation by motion function block, and set axis number to the areas of 1~32 and 37~40. |
| 0x0007 | Axis group number of motion function block (AxisGroup input) exceeded allowable range. | Set axis group number to a value between 1 and 16. |
| 0x0012 | Internal execution error of motion function block occurred during the execution of the motion function block. | Check the version of XG-PM and XGF-M32E. |
| 0x0013 | Motion response error occurred during the execution of motion function block. | Check the version of XG-PM and XGF-M32E. |
| 0x0020<br>:<br>0x0FFF | It indicates a common error of the motion control module.<br>For more details, refer to ‘error information and measures in APPENDIX 1’. | |
| 0x1000<br>:<br>0x1FFF | It indicates error that occurs in relation to axis control of motion control module.<br>For more details, refer to ‘error information and measures in APPENDIX 1’. | |
| 0x2000<br>:<br>0x2FFF | It indicates error that occurs in relation to axis control of motion control module.<br>For more details, refer to ‘error information and measures in APPENDIX ‘. | |

## 6.2 Motion Function Block

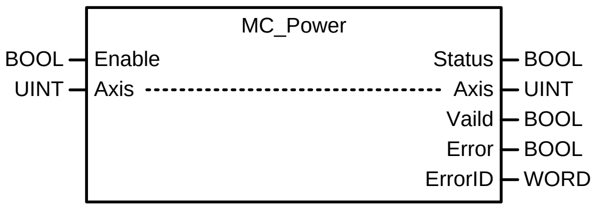
| | Name | Description | Movement Condition |
|---|---|---|---|
| **Single-axis Motion Command** | | | |
| 1 | MC_Power | Servo On/OFF | Level |
| 2 | MC_Home | Perform the search home | Edge |
| 3 | MC_Stop | Stop immediately | Edge |
| 4 | MC_Halt | Stop | Edge |
| 5 | MC_MoveAbsolute | Absolute positioning operation | Edge |
| 6 | MC_MoveRelative | Relative positioning operation | Edge |
| 7 | MC_MoveAdditive | Additive positioning operation | Edge |
| 8 | MC_MoveVelocity | Specified velocity operation | Edge |
| 9 | MC_MoveContinuousAbsolute | Absolute position operation ending with specified velocity operation | Edge |
| 10 | MC_MoveContinuousRelative | Relative position operation ending with specified velocity operation | Edge |
| 11 | MC_TorqueControl | Torque control | Edge |
| 12 | MC_SetPosition | Setting the current position | Edge |
| 13 | MC_SetOverride | Velocity/Acceleration override | Level |
| 14 | MC_ReadParameter | Read Parameter | Level |
| 15 | MC_WriteParameter | Write Parameter | Edge |
| 16 | MC_Reset | Reset axis error | Edge |
| 17 | MC_TouchProbe | Touch probe | Edge |
| 18 | MC_AbortTrigger | Abort trigger events | Edge |
| **Multi-axis Command** | | | |
| 19 | MC_CamIn | Camming run | Edge |
| 20 | MC_CamOut | Camming stop | Edge |
| 21 | MC_GearIn | Electrical gearing run | Edge |
| 22 | MC_GearOut | Electrical gearing disengage | Edge |
| 23 | MC_GearInPos | Electrical gearing by specifying the position | Edge |
| **Gourp Command** | | | |
| 24 | MC_AddAxisToGroup | Adds one axis to a group in a structure AxesGroup | Edge |

| | Name | Description | Movement Condition |
|---|---|---|---|
| 25 | MC_RemoveAxisFromGroup | Removes one axis to a group in a structure AxesGroup | Edge |
| 26 | MC_UngroupAllAxes | Removes all axes from the group AxesGroup | Edge |
| 27 | MC_GroupEnable | Changes the state for a group from GroupDisabled to GroupEnable | Edge |
| 28 | MC_GroupDisable | Changes the state for a group to GroupDisabled | Edge |
| 29 | MC_GroupHome | The AxesGroup to perform the search home sequence | Edge |
| 30 | MC_GroupSetPosition | Sets the Position of all axes in a group without moving | Edge |
| 31 | MC_GroupStop | Stop a Group immediately | Edge |
| 32 | MC_GroupHalt | Stop a Group | Edge |
| 33 | MC_GroupReset | Reset a group error | Edge |
| 34 | MC_MoveLinearAbsolute | Absolute positioning linear interpolation operation | Edge |
| 35 | MC_MoveLinearRelative | Relative positioning linear interpolation operation | Edge |
| 36 | MC_MoveCircularAbsolute | Absolute positioning circular interpolation operation | Edge |
| 37 | MC_MoveCircularRelative | Relative positioning circular interpolation operation | Edge |
| **LS Command** | | | |
| 38 | LS_Connect | Connect servo drives | Edge |
| 39 | LS_Disconnect | Disconnect servo drives | Edge |
| 40 | LS_ReadServoParemeter | Read servo parameters | Edge |
| 41 | LS_WriteServoParameter | Write servo parameters | Edge |
| 42 | LS_EncoderPreset | Encoder preset | Edge |
| 43 | LS_Jog | JOG operation | Level |

## 6.3 Single-Axis Motion Function Block

### 6.3.1 Servo on/off (MC_Power)

Motion Function Block




| | | |
|---|---|---|
| **Input-Output** | | |
| UINT | Axis | Specify the axis to be commanded (1~32: real axis, 37~40: virtual axis) |
| **Input** | | |
| BOOL | Enable | Servo motor of the relevant axis is servo On while input is activated. |
| **Output** | | |
| BOOL | Status | Indicate the power permission status of the relevant axis. |
| BOOL | Valid | Indicate the validity of motion function block output. (same with Status output here) |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

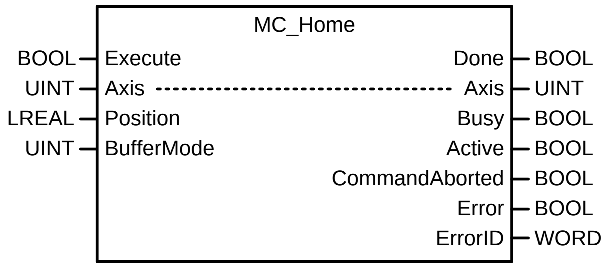
(1) This motion function block is to give servo On/Off command to the relevant axis.

(2) When Enable input is On, Servo On command is given to the relevant axis, and when it is Off, servo Off command is given.

(3) If servo On command is executed when the axis is in 'Disable' state, the axis state is 'StandStill', and failure in servo On brings 'ErrorStop' state.

### 6.3.2 Perform the search home(MC_Home)

Motion Function Block




| | | |
|---|---|---|
| **Input-Output** | | |
| UINT | Axis | Specify the axis to be commanded (1~32: real axis, 37~40: virtual axis) |
| **Input** | | |
| BOOL | Execute | Start the homing operation in rising Edge. |
| LREAL | Position | Specify the absolute position of axis when reference signal is detected. |
| UINT | BufferMode | Specify the sequential operation setting of motion function block.<br>(Refer to 10.1.4.BufferMode) |
| **Output** | | |
| BOOL | Done | Indicate the completion state of motion function block. |
| BOOL | Busy | Indicate that execution of motion function block is not completed. |
| BOOL | Active | Indicate that the current motion function block is controlling the relevant axis. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted by other command. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

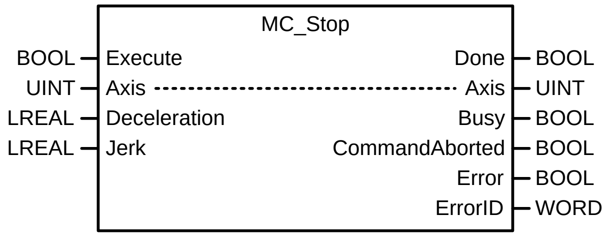
(1) This motion function block is to give a homing command to the relevant axis.

(2) Homing method is operated as specified in the operation parameter of the relevant axis in advance.

(3) As for Position input, absolute position of axis is specified when Reference Signal is detected or homing is completed.

(4) While this motion function block is running, the axis is 'Homing' state, and when the command is completed, it is switched to 'Standstill'.

### 6.3.3 Stop immediately(MC_STOP)

| | | |
|---|---|---|
| Motion Function Block | | |
|   | | |
| Input-Output | | |
| UINT | Axis | Specify the axis to be commanded (1~32: real axis, 37~40: virtual axis) |
| Input | | |
| BOOL | Execute | Give immediate stop command to the relevant axis in the rising Edge. |
| LREAL | Deceleration | Specify deceleration in time of stop. [u/$s^2$] |
| LREAL | Jerk | Specify the change rate of acceleration/deceleration. [u/$s^3$] |
| Output | | |
| BOOL | Done | Indicate that the speed of the relevant axis reaches 0. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted while it is running. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is to give an emergency stop command to the relevant axis.

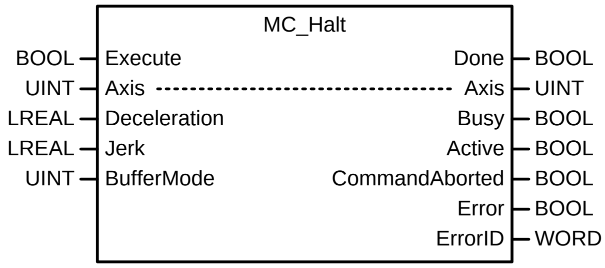
(2) When executing immediate stop (MC_Stop) motion function block, the existing motion function block being executed in the relevant axis is stopped, and the axis state changed to 'Stopping'. When the relevant axis is in 'Stopping' state, other motion function block cannot be executed in the relevant axis until the stopping is completed (until the Done output is activated).

(3) CommandAborted output indicates that the current motion function block is interrupted while it is running. Other motion function block cannot interrupt immediate stop (MC_Stop) motion function block while immediate stop (MC_Stop) motion function block is running, therefore, CommandAborted output is On in general when the power of servo is blocked or servo Off command is executed.

(4) If Execute input is On or the speed of axis is not 0, the axis is in 'Stopping' state, and when Done output is On and Execute input is Off, it is switched to 'Standstill' state.

## 6.3.4 Stop(MC_Halt)

| Motion Function Block | | |
|---|---|---|

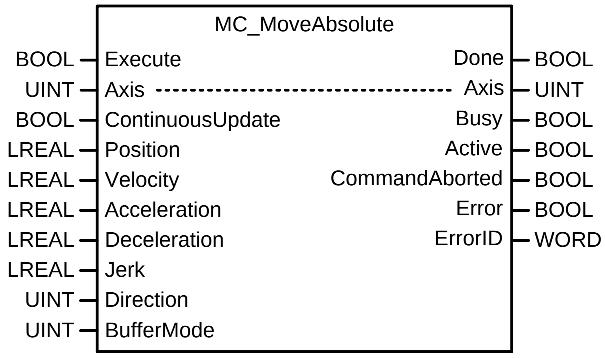



| | | |
|---|---|---|
| **Input-Output** | | |
| UINT | Axis | Specify the axis to be commanded (1~32: real axis, 37~40: virtual axis) |
| **Input** | | |
| BOOL | Execute | Give stop command to the relevant axis in the rising Edge. |
| LREAL | Deceleration | Specify deceleration in time of stop. [u/s$^2$] |
| LREAL | Jerk | Specify the change rate of acceleration/deceleration. [u/s$^3$] |
| UINT | BufferMode | Specify the sequential operation setting of motion function block.<br>(Refer to 10.1.4.BufferMode) |
| **Output** | | |
| BOOL | Done | Indicate that the speed of the relevant axis reaches 0. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Active | Indicate that the current motion function block is controlling the relevant axis. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted while it is running. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is to give a stop command to the relevant axis.

(2) The axis is 'DiscreteMotion' state while this motion function block is running, and when the speed of the relevant axis is 0, ‘Done’ output is On and changed to 'Standstill' state.

### 6.3.5 Absolute positioning operation (MC_MoveAbsolute)

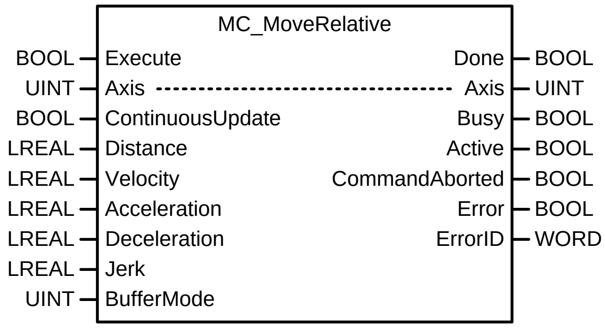
| | | |
|---|---|---|
| Motion Function Block | | |
|   | | |
| Input-Output | | |
| UINT | Axis | Specify the axis to be commanded (1~32: real axis, 37~40: virtual axis) |
| Input | | |
| BOOL | Execute | Give an absolute position operation command to the relevant axis in the rising Edge. |
| BOOL | ContinuousUpdate | Specify the update setting of input value.<br>(Refer to 10.1.5.Changes in Parameters during Execution of Motion Function Block) |
| LREAL | Position | Specify the target position. |
| LREAL | Velocity | Specify the maximum speed. [u/s] |
| LREAL | Acceleration | Specify the acceleration. [u/$s^2$] |
| LREAL | Deceleration | Specify the deceleration. [u/$s^2$] |
| LREAL | Jerk | Specify the change rate of acceleration/deceleration. [u/$s^3$] |
| UINT | Direction | Specify the operation direction.<br>(0~4: 0-Not specified, 1-Forward direction, 2-Shortest distance, 3-Reverse direction, 4-Current direction) |
| UINT | BufferMode | Specify the sequential operation setting of motion function block.<br>(Refer to 10.1.4.BufferMode) |

| Output | | |
|---|---|---|
| BOOL | Done | Indicate whether to reach the specified distance. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Active | Indicate that the current motion function block is controlling the relevant axis. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted while it is running. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is to give the relevant absolute position operation commands.
(2) Operation direction of the axis in Infinite length repetition operation is set in Direction input, and if Infinite length repetition operation is set to Prohibited, Direction input is ignored. When Direction input is the shortest distance(=2), the relevant axis doing Infinite length repetition operation automatically selects the direction which allows the shortest distance. The available range is 0-4 (0-Not specified, 1-Forward direction, 2-Shortest distance, 3-Reverse direction, 4-Current direction), and "error 0x1017" occurs in case of excess of the range.
(3) On condition that there is no motion function block is on standby after the current motion function block, If the speed is 0 after reaching the target point, operation is completed and Done output is On.
(4) The axis is in 'DiscreteMotion' state while this motion function block is running, and it is switched to 'Standstill' state when operation is completed.

### 6.3.6 Relative positioning operation(MC_MoveRelative)

Motion Function Block




| | | |
|---|---|---|
| **Input-Output** | | |
| UINT | Axis | Specify the axis to be commanded (1~32: real axis, 37~40: virtual axis) |
| **Input** | | |
| BOOL | Execute | Give an absolute position operation command to the relevant axis in the rising Edge. |
| BOOL | ContinuousUpdate | Specify the update setting of input value.<br>(Refer to 10.1.5.Changes in Parameters during Execution of Motion Function Block) |
| LREAL | Distance | Specify the target distance. |
| LREAL | Velocity | Specify the maximum speed. [u/s] |
| LREAL | Acceleration | Specify the acceleration. [u/$s^2$] |
| LREAL | Deceleration | Specify the deceleration. [u/$s^2$] |
| LREAL | Jerk | Specify the change rate of acceleration/deceleration. [u/$s^3$] |
| UINT | BufferMode | Specify the sequential operation setting of motion function block.<br>(Refer to 10.1.4.BufferMode) |
| **Output** | | |
| BOOL | Done | Indicate whether to reach the specified distance. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Active | Indicate that the current motion function block is controlling the relevant axis. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted while it is running. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is to give relative position operation command to the relevant axis.

(2) Relative position motion (MC_MoveRelative) is the motion function block which moves as far as the target distance specified in Distance input from the current position.

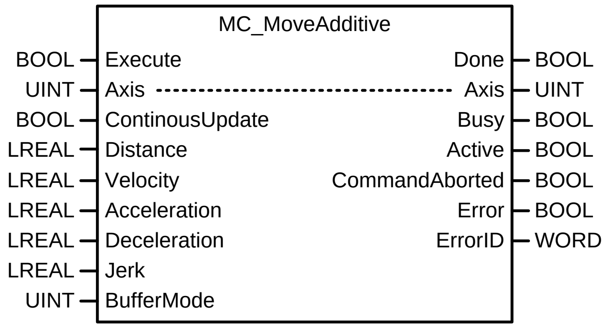
(3) Moving direction is decided depending on the sign of the target distance specified in Distance input, and positive (+ or No sign) moving direction leads to the forward direction, and negative (-) moving direction leads to the reverse direction.

(4) If there is no motion function block is on standby after the current motion function block and the speed is 0 after moving to the target distance, operation is completed and Done output is On.

(5) The axis is in "DiscreteMotion" state when this motion function block is running, and it is switched to "StandStill" state when operation is completed.

### 6.3.7 Additive positioning operation(MC_MoveAdditive)

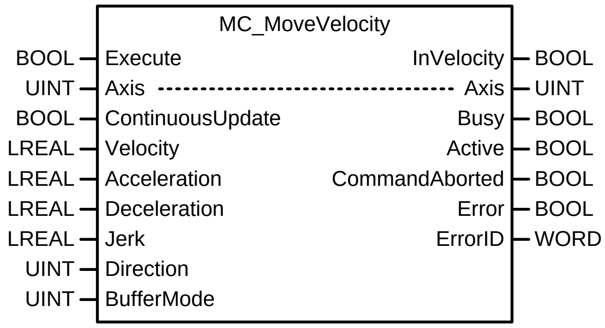
Motion Function Block




| | | |
|---|---|---|
| **Input-Output** | | |
| UINT | Axis | Specify the axis to be commanded (1~32: real axis, 37~40: virtual axis) |
| **Input** | | |
| BOOL | Execute | Give an absolute position operation command to the relevant axis in the rising Edge. |
| BOOL | ContinuousUpdate | Specify the update setting of input value.<br>(Refer to 10.1.5.Changes in Parameters during Execution of Motion Function Block) |
| LREAL | Distance | Specify the target distance. |
| LREAL | Velocity | Specify the maximum speed. [u/s] |
| LREAL | Acceleration | Specify the acceleration. [u/$s^2$] |
| LREAL | Deceleration | Specify the deceleration. [u/$s^2$] |
| LREAL | Jerk | Specify the change rate of acceleration/deceleration. [u/$s^3$] |
| UINT | BufferMode | Specify the sequential operation setting of motion function block.<br>(Refer to 10.1.4.BufferMode) |
| **Output** | | |
| BOOL | Done | Indicate whether to reach the specified distance. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Active | Indicate that the current motion function block is controlling the relevant axis. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted while it is running. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is to give the relevant additive position operation commands.
(2) Additive position motion (MC_MoveAdditive) is the motion function block which additionally moves as far as the position specified in Distance input from the final target position of the currently running motion function block or the latest motion function block executed in 'DiscreteMotion' state. If the current axis is executing motion function block ‘ContinuousMotion’ state, it executes operation based on the position where additive position motion (MC_MoveAdditve) is executing.
(3) Moving direction is decided depending on the sign of the specified target distance in Distance input, and positive (+ or No sign) moving direction leads to forward direction, and negative (-) moving direction leads to reverse direction.
(4) When reaching the target position without motion function block on standby after the current motion function block, 'Done' output is On.
(5) The axis is in 'DiscreteMotion' state while this motion function block is running, and it is switched to 'Standstill' state when operation is completed.

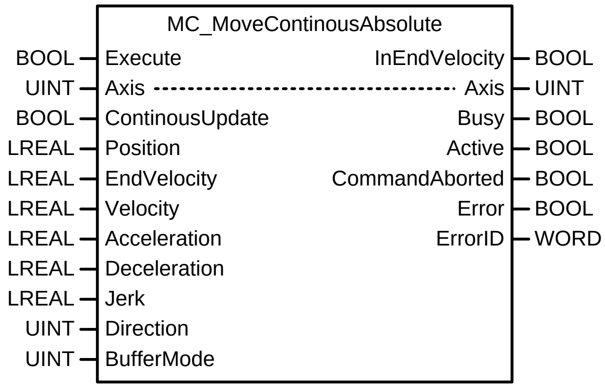
### 6.3.8 Specified velocity operation(MC_MoveVelocity)

| Motion Function Block | | |
|---|---|---|
|  | | |
| **Input-Output** | | |
| UINT | Axis | Specify the axis to be commanded (1~32: real axis, 37~40: virtual axis) |
| **Input** | | |
| BOOL | Execute | Give an absolute position operation command to the relevant axis in the rising Edge. |
| BOOL | ContinuousUpdate | Specify the update setting of input value.<br>(Refer to 10.1.5.Changes in Parameters during Execution of Motion Function Block) |
| LREAL | Velocity | Specify the maximum speed. [u/s] |
| LREAL | Acceleration | Specify the acceleration. [u/$s^2$] |
| LREAL | Deceleration | Specify the deceleration. [u/$s^2$] |
| LREAL | Jerk | Specify the change rate of acceleration/deceleration. [u/$s^3$] |
| UINT | Direction | Specify the operation speed. (1 ~ 3 : 1-Forward direction, 2-Reverse direction, 3-Current direction) |
| UINT | BufferMode | Specify the sequential operation setting of motion function block.<br>(Refer to 10.1.4.BufferMode) |
| **Output** | | |
| BOOL | InVelocity | Indicate whether to reach the specified speed. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Active | Indicate that the current motion function block is controlling the relevant axis. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted while it is running. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is to give specified velocity operation command to the relevant axis.
(2) Giving a stop command or execution of other motion function block allow to interrupt specified velocity motion.
(3) Specify the operation speed in Velocity input. Positive sign (+ or No sign) of the operation speed value leads to forward direction, and negative (-) sign leads to reverse direction.
(4) Specify the operation direction in Direction input. But, the operation direction is affected by the sign of the specified speed value by Velocity input. For example, if you specify the negative number for the Velocity value and reverse direction for Direction input, the relevant axis lastly does forward direction operation.
(5) Output InVelocity is On when the relevant axis reaches the specified speed, and it is Off when the specified speed operation is interrupted.
(6) The axis is in 'ContinuousMotion' state when this motion function block is running.

### 6.3.9 Absolute position operation ending with specified velocity operation(MC_MoveContinuousAbsolute)

Motion Function Block

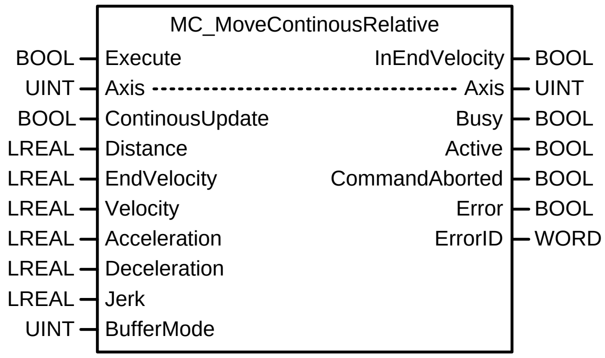



| | | |
|---|---|---|
| **Input-Output** | | |
| UINT | Axis | Specify the axis to be commanded (1~32: real axis, 37~40: virtual axis) |
| **Input** | | |
| BOOL | Execute | Give an absolute position operation command to the relevant axis in the rising Edge. |
| BOOL | ContinuousUpdate | Specify the update setting of input value.<br>(Refer to 10.1.5.Changes in Parameters during Execution of Motion Function Block) |
| LREAL | EndVelocity | Specify the operation speed after reaching the target position. [u/s] |
| LREAL | Velocity | Specify the maximum speed to reach the target position. [u/s] |
| LREAL | Acceleration | Specify the acceleration. [u/s$^2$] |
| LREAL | Deceleration | Specify the deceleration. [u/s$^2$] |
| LREAL | Jerk | Specify the change rate of acceleration/deceleration. [u/s$^3$] |
| UINT | Direction | Specify the operation direction.<br>(0~4: 0-Not specified, 1-Forward direction, 2-Shortest distance, 3-Reverse direction, 4-Current direction) |
| UINT | BufferMode | Specify the sequential operation setting of motion function block.<br>(Refer to 10.1.4.BufferMode) |

| Output | | |
|---|---|---|
| BOOL | InEndVelocity | Indicate the operation at the specified speed after reaching the target position. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Active | Indicate that the current motion function block is controlling the relevant axis. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted while it is running. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is to give Specified velocity operation after relative position operation command to the relevant axis.
(2) When executing MC_MoveContinuousAbsolute, the relevant axis moves to the position specified in Position and operates at the specified speed in EndVelocity if there is no motion function block is on standby.
(3) Giving a stop command or execution of other motion function block allow to interrupt speed operation.
(4) Set the operation direction of the axis in infinite length repetition operation in Direction input, and if infinite length repetition operation is set to Prohibited, Direction input is ignored. When Direction input is the shortest distance (=2), the relevant axis selects the direction which allows the shortest distance and operates if it does infinite length repetition operation. The range can be set to 0~4(0-No specified, 1-Forward direction, 2-Shortest distance, 3-Reverse direction, 4-Current direction), if the value outside the range is set and motion function block is executed, Error is On and “0x1017” occurs in ErrorID.
(5) Output InEndVelocity is on when the relevant axis starts speed operation after reaching the specified position, and when the specified operation is interrupted, it is Off.
(6) The axis is in 'ContinuousMotion' state while this command is executing.

## 6.3.10 Relative position operation ending with specified velocity operation(MC_MoveContinuousRelative)

| Motion Function Block | | |
|---|---|---|
|  | | |
| Input-Output | | |
| UINT | Axis | Specify the axis to be commanded (1~32: real axis, 37~40: virtual axis) |
| Input | | |
| BOOL | Execute | Give an absolute position motion command to the relevant axis in the rising Edge. |
| BOOL | ContinuousUpdate | Specify the update setting of input value.<br>(Refer to 10.1.5.Changes in Parameters during Execution of Motion Function Block) |
| LREAL | Distance | Specify the target distance. |
| LREAL | EndVelocity | Specify the operation speed after reaching the target position. [u/s] |
| LREAL | Velocity | Specify the maximum speed to reach the target position. [u/s] |
| LREAL | Acceleration | Specify the acceleration. [u/s$^2$] |
| LREAL | Deceleration | Specify the deceleration. [u/s$^2$] |
| LREAL | Jerk | Specify the change rate of acceleration/deceleration. [u/s$^3$] |
| UINT | BufferMode | Specify the sequential operation setting of motion function block.<br>(Refer to 10.1.4.BufferMode) |
| Output | | |
| BOOL | InEndVelocity | Indicate the operation at the specified speed after reaching the target position. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Active | Indicate that the current motion function block is controlling the relevant axis. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted while it is running. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block gives MC_MoveContinuousRelative command to the relevant axis.

(2) When executing MC_MoveContinuousRelative, the relevant axis operates at the speed specified in EndVelocity after moving the distance specified in Distance if there is no motion function block is on standby.

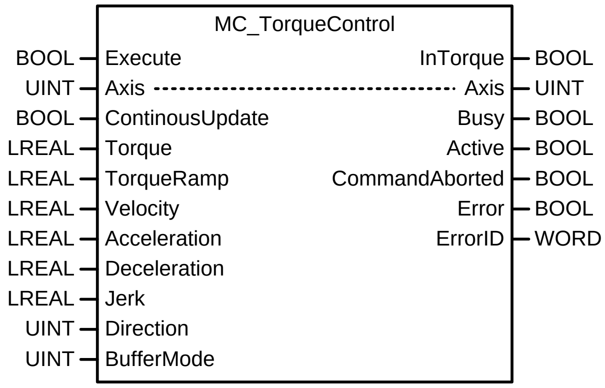
(3) Giving a stop command or operation of other motion function block allow to interrupt specified velocity motion.

(4) Output InEndVelocity is On when the relevant axis starts speed operation and reaches the specified speed after moving the specified distance, and when specified velocity motion is interrupted, it is Off.

(5) The axis is in 'ContinuousMotion' state while this motion function block is running.

### 6.3.11 Torque control(MC_TorqueControl)

Motion Function Block

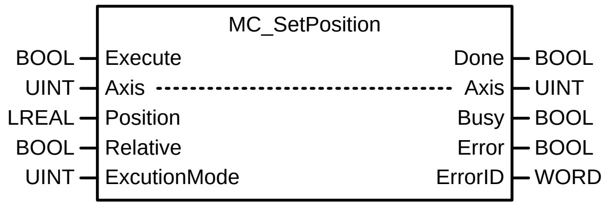



| | | |
|---|---|---|
| Input-Output | | |
| UINT | Axis | Specify the axis to be commanded (1~32: real axis) |
| Input | | |
| BOOL | Execute | Give an absolute position operation command to the relevant axis in the rising Edge. |
| BOOL | ContinuousUpdate | Specify the update setting of input value.<br>(Refer to 10.1.5.Changes in Parameters during Execution of Motion Function Block) |
| LREAL | Torque | Specify the target torque. [u] |
| LREAL | TorqueRamp | Specify the ascending slope of torque. [u/s] |
| LREAL | Velocity | Unused |
| LREAL | Acceleration | Unused |
| LREAL | Deceleration | Unused |
| LREAL | Jerk | Unused |
| UINT | Direction | Specify the operation direction.<br>(1~2 : 1-Forward direction, 2-Reverse direction) |
| UINT | BufferMode | Specify the sequential operation setting of motion function block.<br>(Refer to 10.1.4.BufferMode) |

| Output | | |
|---|---|---|
| BOOL | InTorque | Indicate that the input torque value and currently operating torque value are same. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Active | Indicate that the current motion function block is controlling the relevant axis. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted while it is running. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is to give torque control command to the relevant axis.
(2) When executing torque control (MC_Torque), the relevant axis performs the control to keep the torque value specified in Torque input.
(3) Giving a stop command or operation of other motion function block allow to interrupt specified velocity motion.
(4) Specify the gradient to reach the target torque value in TorqueRamp input.
(5) Specify the maximum speed in torque control operation in Speed input, and the value in negative number is not allowed. Rotation direction is decided depending on the size of load in torque and the relative axis.
(6) Specify the operation direction in Direction input. When setting the value outside the range and executing motion function block, Error is On and “0x1017” occurs in ErrorID.
(7) Output InTorque is On when the relevant axis reaches the specified torque, and when torque control operation is interrupted, it is Off.
(8) The axis is in 'ContinuousMotion' state when this motion function block is running.

### 6.3.12 Setting the current position(MC_Setposition)

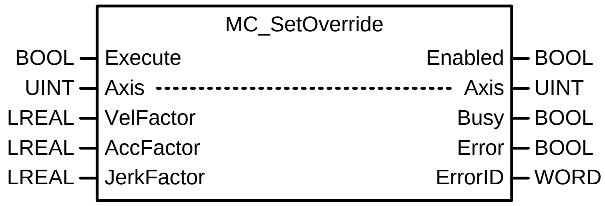
| Motion Function Block | | |
|---|---|---|
|   | | |
| **Input-Output** | | |
| UINT | Axis | Specify the axis to be commanded (1~32: real axis, 37~40: virtual axis) |
| **Input** | | |
| BOOL | Execute | Specify the current position of the relevant axis in the rising Edge. |
| LREAL | VelFactor | Specify the override rate of speed. |
| LREAL | AccFactor | Specify the override rate of acceleration/deceleration. |
| LREAL | JerkFactor | Specify the override rate of the change rate of acceleration. |
| **Output** | | |
| BOOL | Enabled | Indicate that override rate is successfully applied. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is to set the current position of the relevant axis.
(2) Specify the position in Position input. When executing motion function block, if Relative input is Off, the position of the relevant axis is replaced by the value of Position input, and if Relative input is On, the value of Position input is added to the current position of the relevant axis.
(3) ExcutionMode input specifies the setting point. 0 means to be set immediately after motion function block, and 1 means to be set at the same point with ‘Buffered’ in sequential operation setting. The value unable to be set causes "error0x101B”.

0 (mcImmediately): Change the parameter value immediately after executing function block (rising Edge in Execute input). If the relevant axis is in running, operation can be affected.

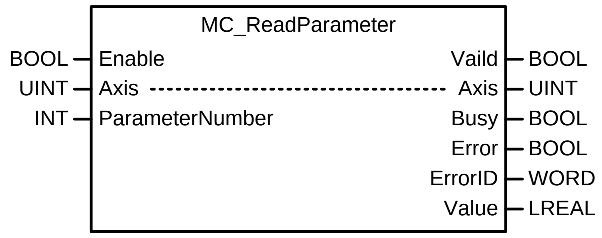
1 (mcQueued): Changed at the same point with ‘Buffered’ in Buffermode. (**Error! Reference Source Not Found.** Refer to input)

### 6.3.13 Velocity/Acceleration override(MC_Setoverride)

| Motion Function Block | | |
|---|---|---|
|  | | |
| Input-Output | | |
| UINT | Axis | Specify the axis to be commanded (1~32: real axis, 37~40: virtual axis) |
| Input | | |
| BOOL | Enable | Execute override operation in the relevant axis while input is activated. |
| LREAL | VelFactor | Specify the override rate of speed. |
| LREAL | AccFactor | Specify the override rate of acceleration/deceleration. |
| LREAL | JerkFactor | Specify the override rate of the change rate of acceleration. |
| Output | | |
| BOOL | Enabled | Indicate that override rate is successfully applied. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is to override the speed of the relevant axis, acceleration, and the change rate of acceleration.
(2) Override rate which is applied to the relevant axis can be specified and changed while Enable input is On. If Enable input is Off, override rate right before the Off is maintained.
(3) Speed override rate is specified in VelFactor input. If the specified value is 0.0, the relevant axis stops but it is not changed to 'StandStill' state.
(4) Specify acceleration/deceleration and override rate of jerk (change rate of acceleration) in AccFactor and JerkFactor input respectively.
(5) Negative number cannot be input in each Facotr, and if it is input, "error 0x10C1" occurs.
(6) Default of each override rate is 1.0, and it means 100% of the command speed of function block currently running.
(7) Override operation does not affect the serve axis of the relevant axis.

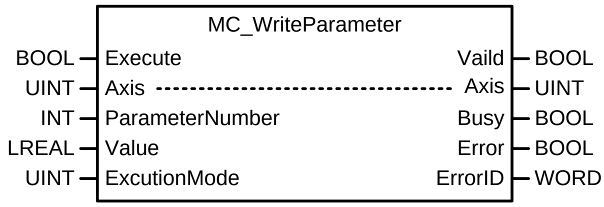
### 6.3.14 Read Parameter(MC_ReadParameter)

| Motion Function Block | | |
|---|---|---|
|   | | |
| Input-Output | | |
| UINT | Axis | Specify the axis to be commanded (1~32: real axis, 37~40: virtual axis) |
| Input | | |
| BOOL | Enable | Execute override operation in the relevant axis while input is activated. |
| INT | ParameterNumber | Specify the number of parameter to read. (0 ~ 25) |
| Output | | |
| BOOL | Vaild | Indicate whether the output of the current motion function block is valid. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |
| LREAL | Value | Output the value of parameter. |

(1) This command is a motion function block which outputs parameter of the relevant axis.
(2) The value of the relevant parameter is continuously output in Value while Enable input is On.
(3) Specify the number of parameter to read in ParameterNumber input.
(4) The numbers of parameter are as below.

| 번호 | 파라미터 | 항목 | 비고 |
|---|---|---|---|
| 0 | Basic Parameter | Unit | 0:pulse,1:mm,2:inch,3:degree |
| 1 | | Purses per rotation | 1 ~ 4,294,967,295 [pulse] |
| 2 | | Travel per rotation | 0.000000001 ~ 4,294,967,295 [Unit] |
| 3 | | Speed command unit | 0:Unit/Time, 1:rpm |
| 4 | | Speed limit | LREAL Positive number [Unit/s, rpm]<br>(Change according to Unit, Pulses per rotation, Travel per rotation, Speed command unit) |
| 5 | | Emergency stop deceleration | 0 or LREAL Positive number [Unit/$s^2$] |
| 6 | | Encoder select | 0:Incremental Encoder,1:Absolute Encoder |
| 7 | | Gear ratio(Motor) | 1 ~ 65,535 |
| 8 | | Gear ratio(Machine) | 1 ~ 65,535 |
| 9 | | Operating mode of the reverse rotation | 0:E.Stop, 1:Stop |
| 10 | Extented Parameter | S/W upper limit | LREAL [Unit] |
| 11 | | S/W lower limit | LREAL [Unit] |
| 12 | | Infinite running repeat position | LREAL Positive number [Unit] |
| 13 | | Infinite running repeat | 0:Disable, 1:Enable |
| 14 | | Command Inposition range | 0 or LREAL Positive number [Unit] |
| 15 | | Tracking error over-range value | 0 or LREAL Positive number [Unit] |
| 16 | | Current position compensation amount | 0 or LREAL Positive number [Unit] |
| 17 | | Current speed filter time constant | 0 ~ 100 |
| 18 | | Error reset monitoring time | 1 ~ 1000 [ms] |
| 19 | | S/W limit during speed control | 0:Don't detect, 1:Detect |
| 20 | | Tracking error level | 0:Warning, 1:Alarm |
| 21 | | JOG high Speed | LREAL Positive number [Unit]<br>(Jog low speed ~speed limit ) [Unit/s] |
| 22 | | JOG low Speed | LREAL Positive number [Unit]<br>( < Jog high speed) [Unit/s] |
| 23 | | JOG acceleration | 0 or LREAL Positive number [Unit/ $s^2$] |
| 24 | | JOG deceleration | 0 or LREAL Positive number [Unit/ $s^2$] |
| 25 | | JOG jerk | 0 or LREAL Positive number [Unit/ $s^2$] |

### 6.3.15 Write Parameter(MC_WriteParameter)

| Motion Function Block | | |
|---|---|---|
|   | | |
| Input-Output | | |
| UINT | Axis | Specify the axis to be commanded (1~32: real axis, 37~40: virtual axis) |
| Input | | |
| BOOL | Execute | Rising Edge corresponding parameters of input is written. . |
| INT | ParameterNumber | Specify the number of parameter to write. (0 ~ 25) |
| LREAL | Value | Specify the value of parameter to write. |
| UINT | ExecutionMode | Specify the time when parameter is written. |
| Output | | |
| BOOL | Vaild | Indicate whether parameter is successfully written. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is to write the value specified in parameter of the relevant axis.
(2) Parameter is written in the rising Edge of Execute input.
(3) Specify the number of parameter to write in ParameterNumber input. The value unable to be set causes "error 0x10F0".
(4) Specify the value to write in parameter for Value input.
(5) In ExecutionMode, correct the time when parameter is written and the values below can be set. The value unable to be set causes "error 0x101B".

0 (mcImmediately): Change the parameter value immediately after executing function block (rising Edge in Execute input). If the relevant axis is in running, operation can be affected.

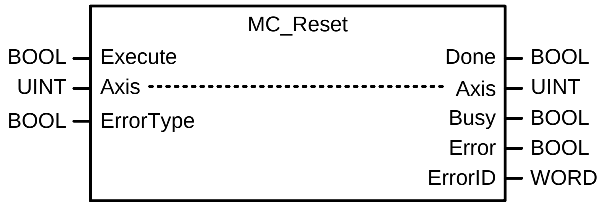
1 (mcQueued): Changed at the same point with 'Buffered' in Buffermode. (**Error! Reference Source Not Found**. Refer to input )

(6) The numbers of parameter are as below.

| No. | Parameter | Item | Description |
|---|---|---|---|
| 0 | Basic Parameter | Unit | 0:pulse,1:mm,2:inch,3:degree |
| 1 | | Purses per rotation | 1 ~ 4,294,967,295 [pulse] |
| 2 | | Travel per rotation | 0.000000001 ~ 4,294,967,295 [Unit] |
| 3 | | Speed command unit | 0:Unit/Time, 1:rpm |
| 4 | | Speed limit | LREAL Positive number [Unit/s, rpm]<br>(Change according to Unit, Pulses per rotation, Travel per rotation, Speed command unit) |
| 5 | | Emergency stop deceleration | 0 or LREAL Positive number [Unit/$s^2$] |
| 6 | | Encoder select | 0:Incremental Encoder,1:Absolute Encoder |
| 7 | | Gear ratio(Motor) | 1 ~ 65,535 |
| 8 | | Gear ratio(Machine) | 1 ~ 65,535 |
| 9 | | Operating mode of the reverse rotation | 0:E.Stop, 1:Stop |
| 10 | Extented Parameter | S/W upper limit | LREAL [Unit] |
| 11 | | S/W lower limit | LREAL [Unit] |
| 12 | | Infinite running repeat position | LREAL Positive number [Unit] |
| 13 | | Infinite running repeat | 0:Disable, 1:Enable |
| 14 | | Command Inposition range | 0 or LREAL Positive number [Unit] |
| 15 | | Tracking error over-range value | 0 or LREAL Positive number [Unit] |
| 16 | | Current position compensation amount | 0 or LREAL Positive number [Unit] |
| 17 | | Current speed filter time constant | 0 ~ 100 |
| 18 | | Error reset monitoring time | 1 ~ 1000 [ms] |
| 19 | | S/W limit during speed control | 0:Don't detect, 1:Detect |
| 20 | | Tracking error level | 0:Warning, 1:Alarm |
| 21 | | JOG high Speed | LREAL Positive number [Unit]<br>(Jog low speed ~speed limit ) [Unit/s] |
| 22 | | JOG low Speed | LREAL Positive number [Unit]<br>( < Jog high speed) [Unit/s] |
| 23 | | JOG acceleration | 0 or LREAL Positive number [Unit/ $s^2$] |
| 24 | | JOG deceleration | 0 or LREAL Positive number [Unit/ $s^2$] |
| 25 | | JOG jerk | 0 or LREAL Positive number [Unit/ $s^2$] |

### 6.3.16 Reset axis error(MC_Reset)

Motion Function Block



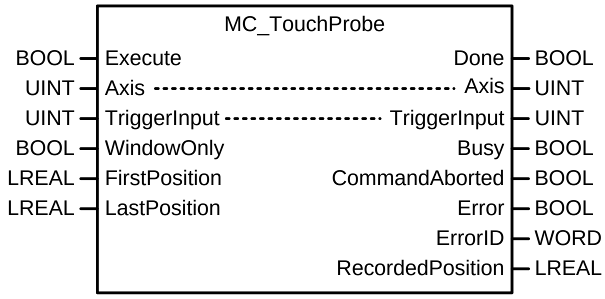

| | | |
|---|---|---|
| **Input-Output** | | |
| UINT | Axis | Specify the axis to be commanded (1~32: real axis, 37~40: virtual axis) |
| **Input** | | |
| BOOL | Execute | Reset the axis error in the rising Edge of input. |
| BOOL | ErrorType | The types of error to be reset (0: Axis error, 1: Common error) |
| **Output** | | |
| BOOL | Done | Indicate whether the axis error is successfully reset. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is to reset the error of the relevant axis. When setting ErrorType to '0' and executing motion function block in case the relevant axis is in ' ErrorStop' state, every axis error is reset and the axis state is switched to 'StandStill' or 'Disabled' state.

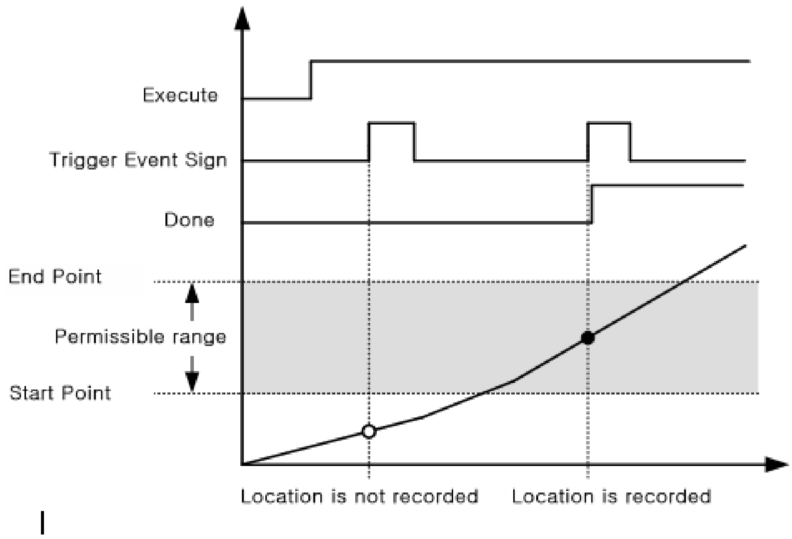
(2) If ErrorType is set to ‘1’ and motion function block is executed, common error occurred in the relevant module is reset.

(3) Motion function block is executed in the rising Edge of Execute input.

### 6.3.17 Touch Probe(MC_TouchProbe)

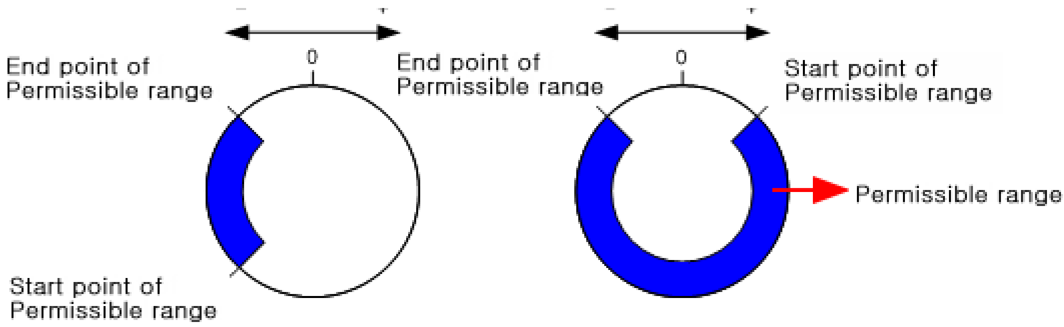
| Motion Function Block | | |
|---|---|---|
|  | | |
| Input-Output | | |
| UINT | Axis | Specify the axis to be commanded (1~32: real axis) |
| UINT | TriggerInput | Specify the signal to be used as a trigger. (0: TouchProbe 1, 1: TouchProbe 2) |
| Input | | |
| BOOL | Execute | TouchProbe function starts at the rising Edge of input. |
| BOOL | WindowOnly | Activate the window mode. |
| LREAL | FirstPosition | Specify the starting position of allowable area in the window mode. |
| LREAL | LastPosition | Specify the end position of allowable area in the window mode. |
| Output | | |
| BOOL | Done | Indicate that the trigger signal is successfully recorded. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted by other command. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |
| REAL | RecordedPosition | Output the axis position where the trigger occurs. |

(1) This motion function block is to execute 'TouchProbe' function which records the axis position at the time when the trigger event occurs.
(2) TouchProbe function starts at the rising Edge of Execute input.
(3) Specify the signal to be used as a trigger in TriggerInput. The value unable to be set causes "error 0x10E1".
(4) When activating the window mode, allowable area where accepts the trigger signal of axis can be set. Operation timing of each signal when the window mode is activated is as below.

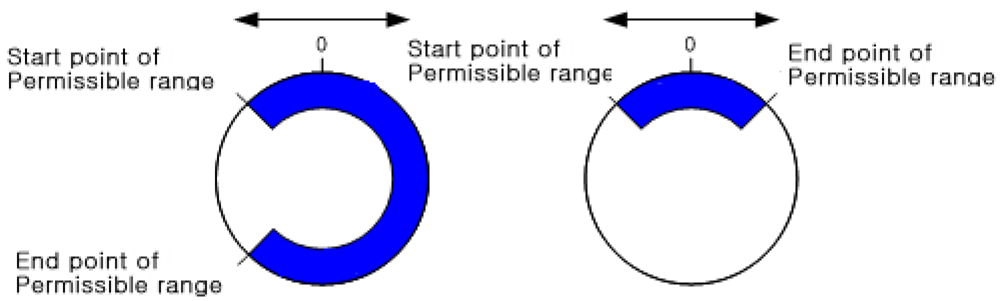



< In case TouchProbe function is the window mode, Operation timing >

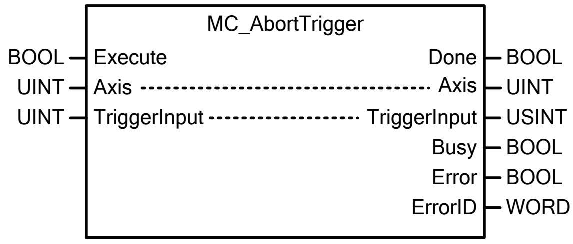
● In case of Permissible range start point < Permissible range end point




● In case of Permissible range start point > Permissible range end point



### 6.3.18 Abort trigger events(MC_AbortTrigger)

| Motion Function Block | | |
|---|---|---|
|  | | |
| Input-Output | | |
| UINT | Axis | Specify the axis to be commanded (1~32: real axis) |
| UINT | TriggerInput | Specify the trigger signal to be disengaged. (0: TouchProbe 1, 1: TouchProbe 2) |
| Input | | |
| BOOL | Execute | The trigger on standby in the relevant axis in the rising Edge is disengaged. |
| Output | | |
| BOOL | Done | Indicate the state of motion function block completion. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

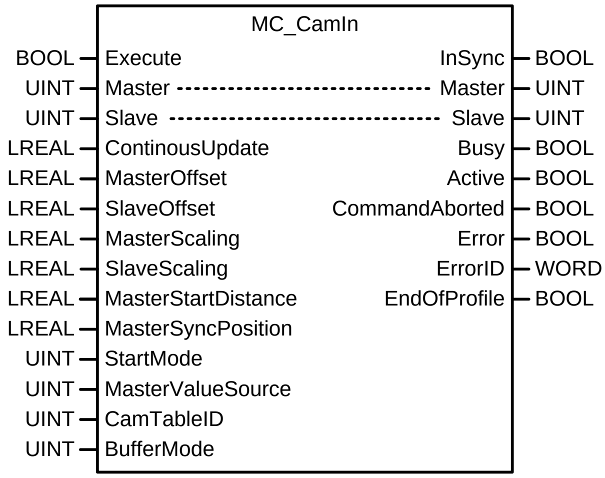


(1) This motion function block is to disengage the trigger which is on standby in the relevant axis.
(2) Specify the trigger signal to be disengaged in TriggerInput. The value unable to be set causes "error 0x10E1".

## 6.4 Multi-Axis Motion Function Block

### 6.4.1 Camming run(MC_CamIn)

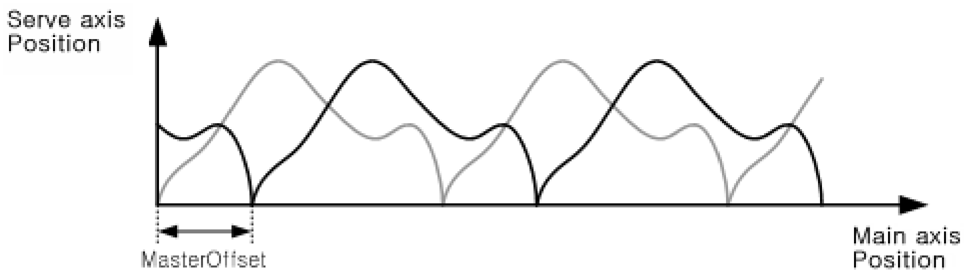
Motion Function Block

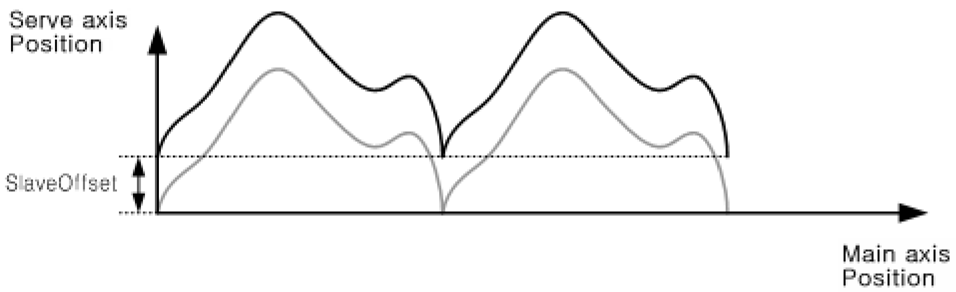



| | | |
|---|---|---|
| **Input-Output** | | |
| UINT | Master | Set the main axis. (1~32: Actual axes, 37~40: Virtual axes, 41~42: Encoders) |
| UINT | Slave | Set the the serve axis. (1~32: Actual axes, 37~40: Virtual axes) |
| **Input** | | |
| BOOL | Execute | Give cam operation command to the relevant axis in the rising Edge. |
| BOOL | ContinuousUpdate | Specify the update setting of input value.<br>(Refer to 10.1.5.Changes in Parameters during Execution of Motion Function Block) |
| LREAL | MasterOffset | Set the offset value of the main axis. |
| LREAL | SlaveOffset | Set the offset value of the the serve axis cam table. |
| LREAL | MasterScaling | Specify the magnification of the main axis. |
| LREAL | SlaveScaling | Specify the magnification of the serve axis cam table. |
| LREAL | MasterStartDistance | Specify the position of the main axis where cam operation of the slave. |
| LREAL | MasterSyncPosition | Specify the starting point at cam table when cam operation starts. |
| UINT | StartMode | Set the cam operation mode.<br>0 : Cam table is applied as an absolute value (mcAbsolute) |

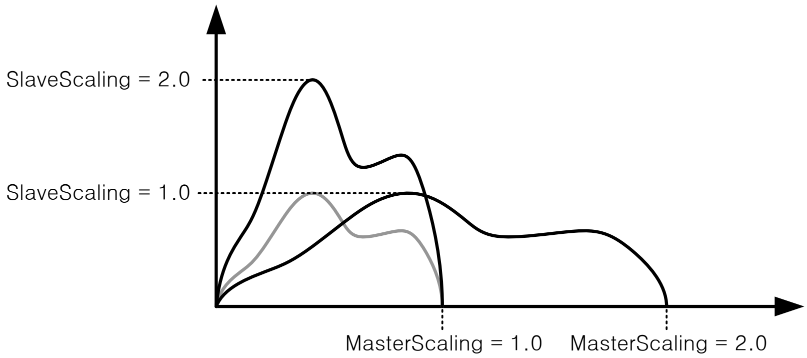
| | | |
|---|---|---|
| | | 1: Cam table is applied as a relative value based on the command starting point (mcRelative) |
| UINT | MasterValueSource | Select the source of the main axis for cam operation.<br>0 : Synchronized in the target value of the main axis.<br>1 : Synchronized in the current value of the serve axis. |
| UINT | CamTableID | Specify the cam table to operate. |
| UINT | BufferMode | Specify the sequential operation setting of motion function block.<br>(Refer to 10.1.4.BufferMode) |
| Output | | |
| BOOL | InSync | Indicate that cam operation is normally being fulfilled.<br>(Indicate that the serve axis is following the cam table.) |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Active | Indicate that the current motion function block is controlling the relevant axis. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted while it is running. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is to operate the serve axis cam depending on the main axis.
(2) Cam operation command can be given to the serve axis even if the main axis is in stop state.
(3) You must give cam operation abort (MC_CamOut) command to the serve axis or operate other motion function block to stop cam operation.
(4) The axis is in 'Synchronized Motion' while this motion function block is running.
(5) Set the offset of cam table to be applied in MasterOffset and SlaveOffset. MasterOffset sets the offset with the starting point of the main axis, and SlaveOffset sets the offset with the starting point of the serve axis. Refer to the Figure below.

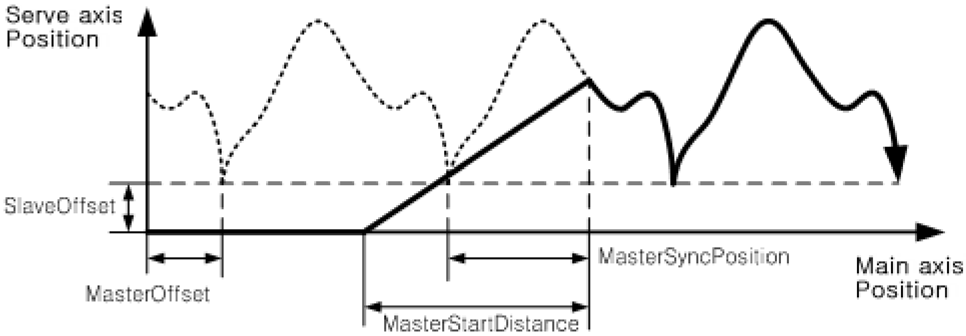


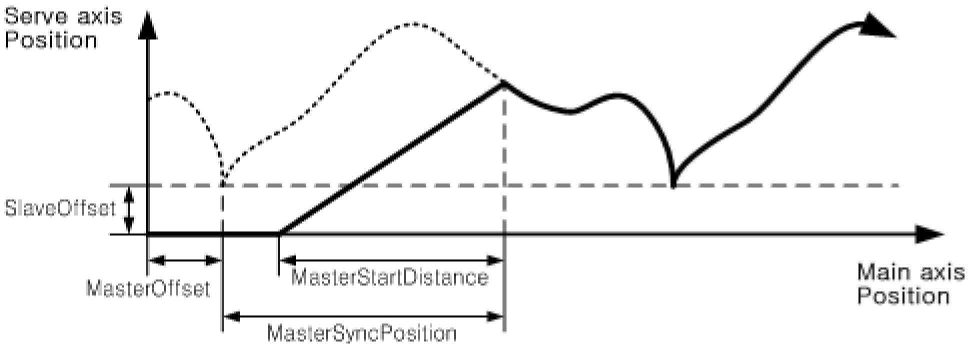
(6) Set the magnification of cam data to be applied in MasterScaling and SlaveScaling. Set the magnification of the main axis data in MasterScaling, and set the magnification of the the serve axis data. Refer to the Figure below.




(7) MasterSyncPosition input specifies the position of the main axis within the table where the synchronization of actual cam operation is completed, and MasterStartDistane input specifies the relative position of the main axis where the synchronization starts.




In case MasterScaling is 1.0



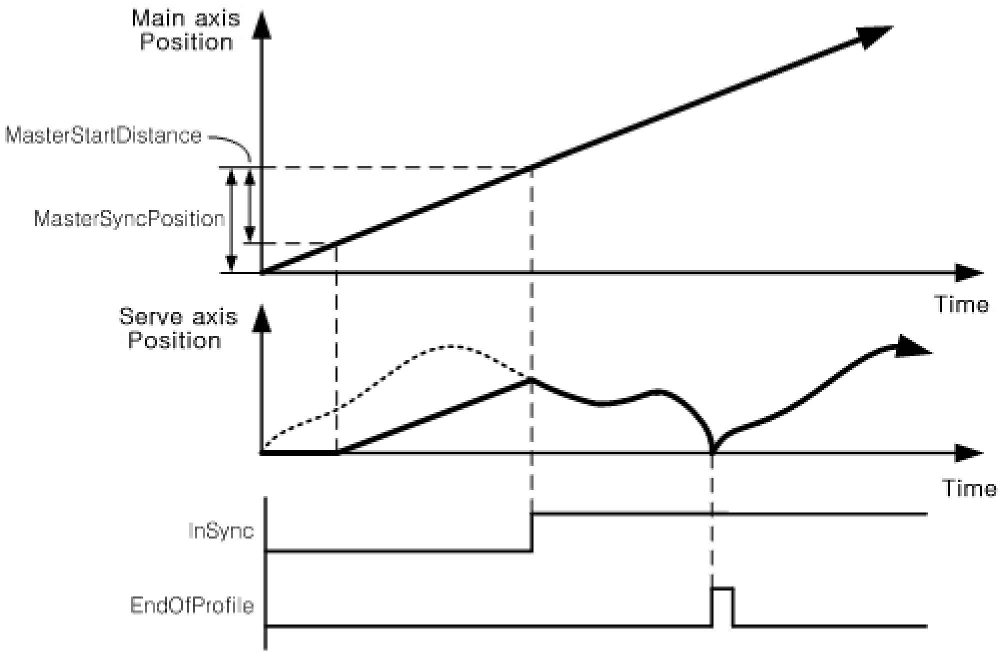

In case MasterScaling is 2.0

MasterSyncPosition position is based on the position within the cam table, and actual synchronization position is decided by considering MasterOffset and MasterScale parameters.

The serve axis starts moving to the synchronization position from the distance of the input value away based on the position where MasterSyncPosition is actually applied. If it is before starting moving, the serve axiss waits at the relevant position in stop state, and if the serve axis is already in the section to move to the synchronization position at the beginning of the command, take back the position of the synchronization starting point by the length of a table until it escapes the MasterStartDistance range.

Actual synchronization position can vary depending on MasterScaling and SlaveScaling because MasterSyncPosition is a value based on the inside of cam table, but MasterOffset and MasterStartDistance value remain unaffected.

(8) Once cam operation starts normally, InSync output is On, and EndOfProfile output is 1 scan On every time one cam table operation is completed.



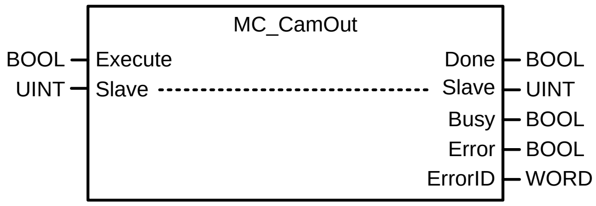

(9) Cam operation mode is set in StartMode. Setting range is 0 or 1, and the input value outside the setting range causes an error.

(10) MasterValueSource selects the source of the main axis to be synchronized. If it is set to 0, the serve axis performs cam operation based on the command position of the main axis which is calculated in motion control module, and if it is set to 1, the serve axis performs cam operation based on the current position which is received by communication in servo drive of main axis.

(11) CamTableID sets the number of cam table to be applied to cam operation. Setting range is 1~32 , and the input value outside the setting range causes error "0x1115" in motion function block.

(12) The relevant axis is in "SynchronizedMotion" state while this motion function block is running.

### 6.4.2 Camming stop(MC_CamOut)

| | | |
|---|---|---|
| Motion Function Block | | |
|  | | |
| Input-Output | | |
| UINT | Slave | Set the the serve axis. (1~32: Actual axes, 37~40: Virtual axes) |
| Input | | |
| BOOL | Execute | Give cam operation stop command to the relevant axis in the rising Edge. |
| Output | | |
| BOOL | Done | Indicate the state of motion function block completion. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |



(1) This motion function block immediately disengages cam operation running in the serve axis.

(2) If motion function block of which BufferMode is Aborting in the serve axis where cam operation is running, cam operation is automatically disengaged and the relevant motion function block is executed. To execute cam operation abort (MC_CamOut) motion function block, the relevant axis do operation which keeps the speed at the time when cam operation is disengaged. If you want to completely stop the serve axis, use stop (MC_Halt) or immediate stop (MC_Stop) motion function block.

### 6.4.3 Electrical gearing run(MC_GearIn)

**Motion Function Block**

```
                         MC_GearIn
   BOOL ─ Execute                          InGear ─ BOOL
   UINT ─ Master ---------------------------- Master ─ UINT
   UINT ─ Slave ------------------------------ Slave ─ UINT
   BOOL ─ ContinousUpdate                    Busy ─ BOOL
    INT ─ RatioNumerator                    Active ─ BOOL
   UINT ─ RatioDenominator        CommandAborted ─ BOOL
   UINT ─ MasterValueSource                  Error ─ BOOL
  LREAL ─ Acceleration                     ErrorID ─ WORD
  LREAL ─ Deceleration
  LREAL ─ Jerk
   UINT ─ BufferMode
```

**Input-Output**

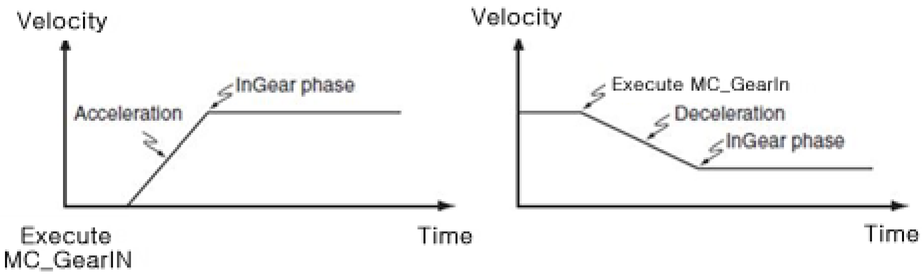
| | | |
|---|---|---|
| UINT | Master | Set the main axis. (1~32: Actual axes, 37~40: Virtual axes, 41~42: Encoders) |
| UINT | Slave | Set the the serve axis. (1~32: Actual axes, 37~40: Virtual axes) |

**Input**

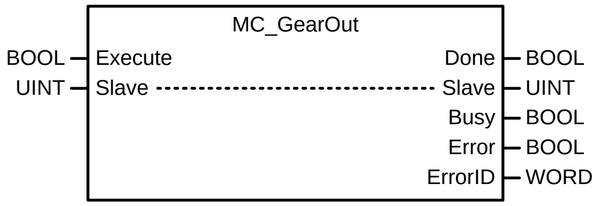
| | | |
|---|---|---|
| BOOL | Execute | Give gear operation command to the relevant axis in the rising Edge. |
| BOOL | ContinuousUpdate | Specify the update setting of input value.<br>(Refer to 10.1.5.Changes in Parameters during Execution of Motion Function Block) |
| INT | RatioNumerator | Specify the numerator of gear ratio. (-32768 ~ 32767) |
| UINT | RatioDenominator | Specify the denominator of gear ratio. (0 ~ 65535) |
| UINT | MasterValueSource | Select data of the main axis to be synchronized.<br>0: Synchronize in the command position of the main axis.<br>1: Synchronize in the current position of the main axis. |
| LREAL | Acceleration | Specify the acceleration at the beginning of gear operation synchronization. [u/$s^2$] |
| LREAL | Deceleration | Specify the deceleration at the beginning of gear operation synchronization. [u/$s^2$] |
| LREAL | Jerk | Specify the change rate of acceleration/deceleration. [u/$s^3$] |
| UINT | BufferMode | Specify the sequential operation setting of motion function block.<br>(Refer to 10.1.4.BufferMode) |

| Output | | |
|---|---|---|
| BOOL | InGear | Indicate that gear operation is running by applying gear ration. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Active | Indicate that the current motion function block is controlling the relevant axis. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted while it is running. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is an operation to synchronize the speed of the main axis and the serve axis depending on gear ratio which is set.
(2) Giving gear operation abort (MC_GearOut) commands to the relevant axis or execution of other motion function block allow to disengage gear operation.
(3) RatioNumerator and RatioDenominator set the numerator and denominator to be applied to the serve axis respectively. If the numerator is set to negative number, the rotation direction of the serve axis is the opposite of the main axis.
(4) MasterValueSource select the data of the main axis which is a standard of synchronization. If it is set to 0, synchronization operation is based on the command position of the main axis of motion control module, and if it is set to 1, synchronization operation is based on the current position. Other values set besides these two make Error of motion function block On and cause “0x1114” in ErrorID.
(5) When this motion function block is executed, the serve axis is synchronized with the main axis through acceleration/deceleration at the speed in synch with the relevant gear ratio.
(6) The serve axis is in 'SynchronizedMotion' while this motion function block is running.



### 6.4.4 Electrical gearing disengage(MC_GearOut)

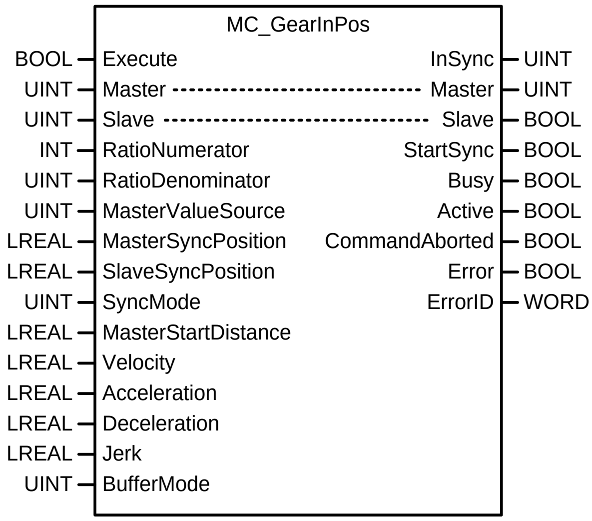
| Motion Function Block | | |
|---|---|---|
|  | | |
| **Input-Output** | | |
| UINT | Slave | Set the the serve axis. (1~32: Actual axes, 37~40: Virtual axes) |
| **Input** | | |
| UINT | BufferMode | Specify the sequential operation setting of motion function block.<br>(Refer to 10.1.4.BufferMode) |
| **Output** | | |
| BOOL | Done | Indicate the state of motion function block completion. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block immediately disengages gear operation running in the spindle.

(2) If motion function block of which BufferMode is Aborting in the spindle where cam operation is running, gear operation is automatically disengaged and the relevant motion function block is executed. If gear operation abort (MC_GearOut) motion function block is only to be executed, the relevant axis performs operation to maintain the speed at the time when gear operation is disengaged. To completely stop the spindle, use stop (MC_Halt) or immediate stop (MC_Stop) motion function block.

### 6.4.5 Electrical gearing by specifying the position(MC_GearInPos)

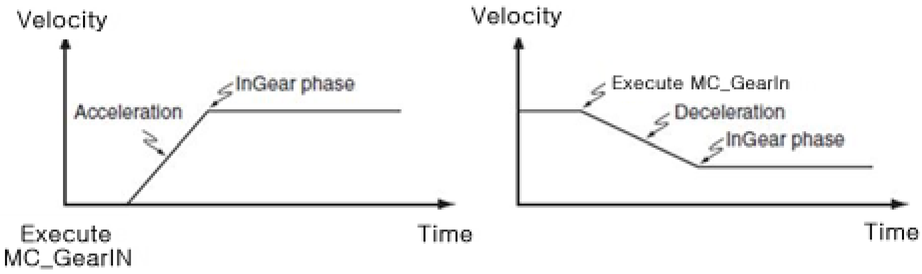
Motion Function Block

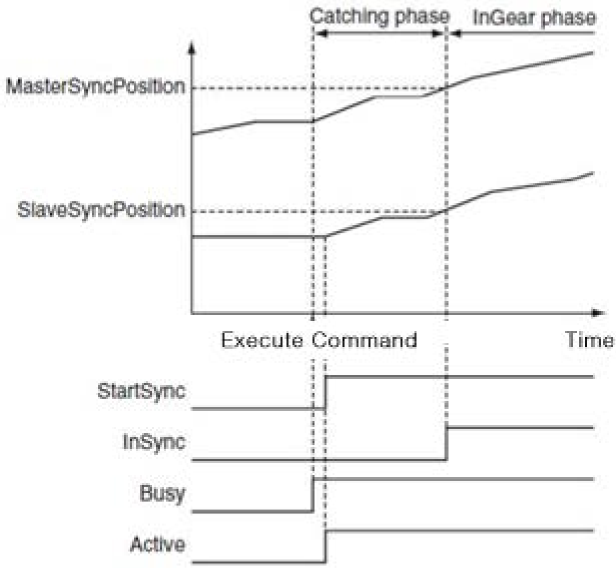


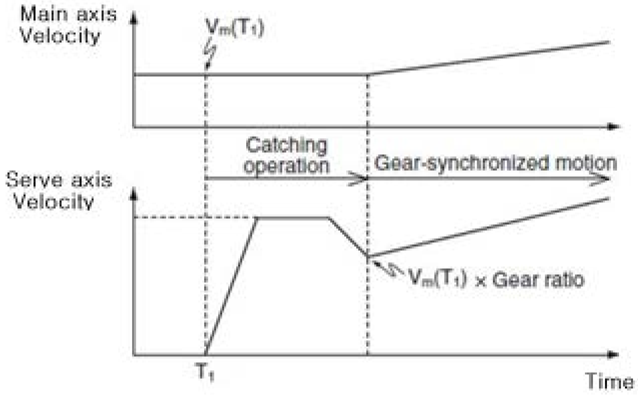

| Input-Output | | |
|---|---|---|
| UINT | Master | Set the main axis. (1~32: Actual axes, 37~40: Virtual axes, 41~42: Encoders) |
| UINT | Slave | Set the the serve axis. (1~32: Actual axes, 37~40: Virtual axes) |
| **Input** | | |
| BOOL | Execute | Give a gear operation command to the relevant axis in the rising Edge. |
| INT | RatioNumerator | Specify the numerator of gear ratio. (-32768~32767) |
| UINT | RatioDenominator | Specify the denominator of gear ratio. (0~65535) |
| UINT | MasterValueSource | Select the standard of the main axis value to be synchronized.<br>0(mcSetValue): Synchronize in the target position of the main axis.<br>1(mcActualValue): Synchronize in the current position of the main axis. |
| LREAL | MasterSyncPosition | Specify the position of the main axis where gear operation starts. |
| LREAL | SlaveSyncPosition | Specify the position of the spindle where gear operation starts. |
| LREAL | MasterStartDistance | Specify the distance of the main axis where synchronization starts. |
| LREAL | Velocity | Specify the maximum speed of the spindle at the beginning of synchronization. [u/s] |
| LREAL | Acceleration | Specify the maximum acceleration of the spindle at the beginning of synchronization. [u/$s^2$] |
| LREAL | Deceleration | Specify the maximum deceleration of the spindle at the beginning of synchronization. [u/$s^2$] |

| | | |
|---|---|---|
| LREAL | Jerk | Specify the change rate of acceleration/deceleration. [u/s$^3$] |
| UINT | BufferMode | Specify the sequential operation setting of motion function block.<br>(Refer to 10.1.4.BufferMode) |
| Output | | |
| BOOL | InSync | Indicate that gear operation is normally being fulfilled as the specified gear ratio is applied. |
| BOOL | StartSync | Indicate synchronization is starting. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Active | Indicate that the current motion function block is controlling the relevant axis. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted while it is running. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is an operation to synchronize the speed of the main axis and the spindle in the set position depending on gear ratio which is set in the specific position.
(2) Giving gear operation abort (MC_GearOut) commands to the spindle or operation of other motion function block allow to stop gear operation.
(3) RatioNumerator and RatioDenominator set the numerator and denominator of gear ratio to be applied to the spindle respectively. If the numerator is set to negative number, the rotation direction of the spindle goes into reverse of the main axis.
(4) MasterValueSource selects the source of the main axis to be synchronized. If it is set to 0 (mcSetValue), synchronization is performed by putting the target position of the main axis in the current motion control period as a source, and if it is set to 1(mcActualValue), synchronization is performed by putting the current position of the main axis got feedback from the current motion control period as a source. Other values set besides these two cause "error 0x10D1".
(5) Input the positions of the main axis and the spindle where gear operation is completed synchronization in MasterSyncPosition input and SlaveSyncPosition input respectively. Input the distance where the spindle starts synchronization in MasterStartDistance input, and the spindle starts synchronization at the position away the distance set in MasterStartDistance input from the position set in MasterSyncPosition input.
(6) Once synchronization starts, StartSync output is On. When synchronization is completed and gear operation starts, StartSync output is Off and InSync output is On.
(7) The spindle is in 'SynchronizedMotion' while this motion function block is running.


Velocity
InGear phase
Acceleration
Execute MC_GearIN
Time
Velocity
Execute MC_GearIn
Deceleration
InGear phase
Time

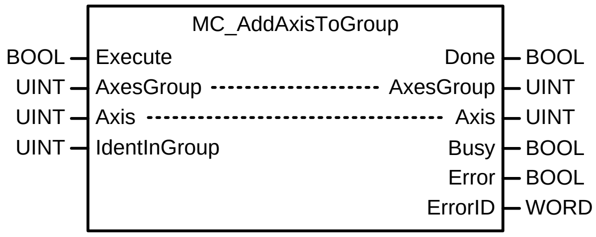

Catching phase
InGear phase
MasterSyncPosition
SlaveSyncPosition
Execute Command
Time
StartSync
InSync
Busy
Active


Main axis Velocity
Vm(T1)
Catching operation
Gear-synchronized motion
Serve axis Velocity
Vm(T1) × Gear ratio
T1
Time

## 6.5 Group Motion Function Blocks

### 6.5.1 Adds one axis to a group in a structure AxesGroup(MC_AddAxisToGroup)

Motion Function Block

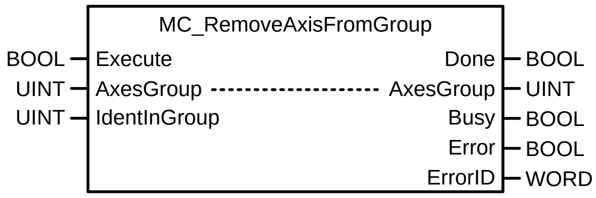



| | | |
|---|---|---|
| Input-Output | | |
| UINT | AxesGroup | Set the group where the relevant axis is added. (1 ~ 16 : Group 1 ~ Group 16) |
| UINT | Axis | Set the axis to be added to the relevant group. (1~32: Actual axes, 37~40: Virtual axes) |
| Input | | |
| BOOL | Execute | Give group axis addition command to the relevant axis in the rising Edge. |
| UINT | IdentInGroup | Set the ID of the relevant axis to be used in the relevant group. (1 ~ 4) |
| Output | | |
| BOOL | Done | Indicate the state of motion function block completion. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block adds Axis specified axis to the axis group specified in AxesGroup input.

(2) ID in the axis group specified to IdentInGroup must have unique value for each axis. (ID of each axis must be different.) Maximum 4 axes can be included in each axis group, axis ID can be specified in the range of 1-4. If the specified axis number is outside the range, “error 0x0006” occurs, and if numbers in the axis group overlap, “error 0x2051” occurs.

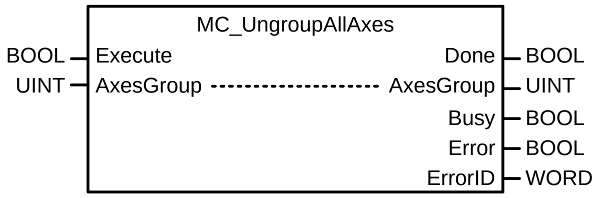
### 6.5.2 Removes one axis to a group in a structure AxesGroup(MC_RemoveAxisFromGroup)

| Motion Function Block | | |
|---|---|---|
|  | | |
| Input-Output | | |
| UINT | AxesGroup | Set the group where the relevant axis is removed. (1 ~ 16 : Group1 ~ Group 16) |
| Input | | |
| BOOL | Execute | Give group axis exclusion command to the relevant group in the rising Edge. |
| UINT | IdentInGroup | Set the axis number in the relevant group to be removed from the relevant group. |
| Output | | |
| BOOL | Done | Indicate the state of motion function block completion. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block removes the axis which is specified to IdentInGroup in the axis group specified in AxesGroup input.

(2) If the execution of group axis exclusion is tried when the axis group is not in GroupDisabled, GroupStandBy, and GroupErrorStop state, "error 0x2003 or 0x2004 or 0x2005" occurs and the axis is not removed. In other words, the axis cannot be removed when the axis group does not completely stop.

### 6.5.3 Removes all axes from the group AxesGroup(MC_UngroupAllAxes)

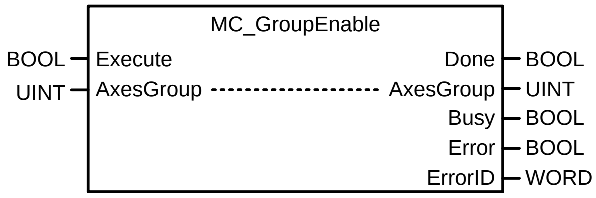
| Motion Function Block | | |
|---|---|---|
|   | | |
| Input-Output | | |
| UINT | AxesGroup | Set the group where every axis is to be removed. (1 ~ 16 : Group 1 ~ Group 16) |
| Input | | |
| BOOL | Execute | Give MC_UngroupAllAxes command to the relevant group in the rising Edge. |
| UINT | IdentInGroup | Set the axis number in the relevant group to be removed from the relevant group. |
| Output | | |
| BOOL | Done | Indicate the state of motion function block completion. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block removes every axis which belongs to the axis group specified in AxesGroup input.

(2) If this motion function block is executed when the axis group is not in GroupDisabled, GroupStandBy, and GroupErrorStop state, "error 0x2003 or 0x2004 or 0x2005" occurs and the axis is not removed. In other words, the axis cannot be removed when the axis group does not completely stop.

(3) When the axis which belongs to the group is successfully removed, the relevant group is switched to GroupDisabled state.

### 6.5.4 Changes the state for a group from GroupDisabled to GroupEnable(MC_GroupEnable)

| Motion Function Block | | |
|---|---|---|
|  | | |
| **Input-Output** | | |
| UINT | AxesGroup | Set the group to be activated. (1 ~ 16 : Group 1 ~ Group 16) |
| **Input** | | |
| BOOL | Execute | Give group activation command to the relevant group in the rising Edge. |
| **Output** | | |
| BOOL | Done | Indicate the state of motion function block completion. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

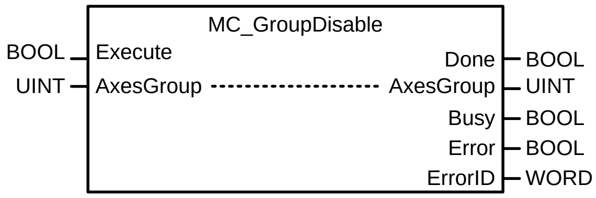


(1) This motion function block is to activate the axis group specified in AxesGroup input.

(2) When giving this command to the axis group in GroupDisable state, the relevant axis group is switched to GroupStandby state.

(3) This motion function block does not affect the power state of each axis in the relevant group.

### 6.5.5 Changes the state for a group to GroupDisabled(MC_GroupDisable)

| Motion Function Block | | |
|---|---|---|
|   | | |
| **Input-Output** | | |
| UINT | AxesGroup | Set the group to be deactivated. (1 ~ 16 : Group 1 ~ Group 16) |
| **Input** | | |
| BOOL | Execute | Give group disablement command to the relevant group in the rising Edge. |
| **Output** | | |
| BOOL | Done | Indicate the state of motion function block completion. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

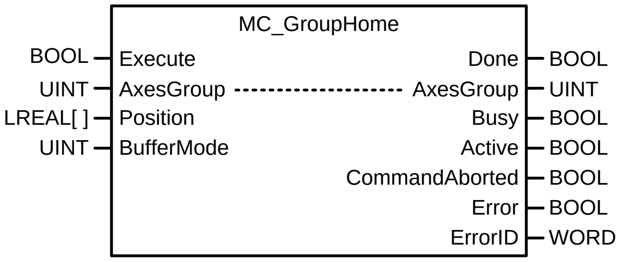
(1) This motion function block is to deactivate the axis group specified in AxesGroup input.

(2) The axis group which executes this motion function block is switched to GroupDisabled.

(3) This motion function block does not affect the power state of each axis in the relevant group.

### 6.5.6 The AxesGroup to perform the search home sequence(MC_GroupHome)

| | | |
|---|---|---|
| Motion Function Block | | |




| | | |
|---|---|---|
| Input-Output | | |
| UINT | AxesGroup | Set the group returning to home. (1 ~ 16 : Group 1 ~ Group 16) |
| Input | | |
| BOOL | Execute | Give group homing command to the relevant group in the rising Edge. |
| LREAL[ ] | Position | Specify the absolute position of each axis when reference signal is detected. |
| UINT | BufferMode | Specify the sequential operation setting of motion function block.<br>(Refer to 10.1.4.BufferMode) |
| Output | | |
| BOOL | Done | Indicate the state of motion function block completion. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Active | Indicate that the current motion function block is controlling the relevant axis. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted while it is running. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is to give homing command to the axis group specified in AxesGroup input.

(2) Homing method is operated as specified in servo parameter of the relevant axis in advance.

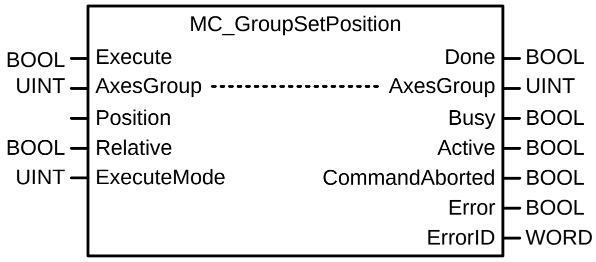
(3) In Position input, specify the absolute position to the array to be set when homing is completed or Reference Signal is detected. Values in the array and the axis in the group correspond in the order of [1, 2, 3, 4]. (1~4 are the axis ID in the axis group)

(4) The axis group is in 'GroupHoming' state while this motion function block is running, and it is switched to 'GroupStandby' state when motion function block is completed.

### 6.5.7 Sets the Position of all axes in a group without moving(MC_GroupSetPosition)

| **MC_GroupSetPosition** | **Availability** |
|---|---|
| **Sets the Position of all axes in a group without moving** | **XGF-M32E** |

Motion Function Block




| | | |
|---|---|---|
| **Input-Output** | | |
| UINT | AxesGroup | Select the group to set the current position. (1 ~ 16 : Group 1 ~ Group 16) |
| **Input** | | |
| BOOL | Execute | Give group current position setting command to the relevant group in the rising Edge. |
| LREAL[ ] | Position | Specify the position. |
| BOOL | Relative | 0: Position value=Absolute position, 1: Position value=Relative position |
| UINT | ExecuteMode | 0: Immediately applied the position value,<br>1: Applied at the same point with 'Buffered' of Buffermode |
| **Output** | | |
| BOOL | Done | Indicate the state of motion function block completion. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Active | Indicate that the current motion function block is controlling the relevant axis. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted while it is running. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block sets the current position of the relevant axis group.

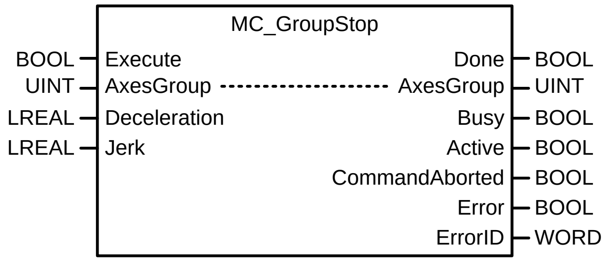
(2) Specify the position of each axis in the group to the array. When executing this motion function block, if Relative input is Off, the position of the relevant axis is replaced by the Position input value, and if Relative input is On, the Position input value is added to the current position of the relevant axis. Values in the array and the axis in the group correspond in the order of [1, 2, 3, 4]. (1~4 are the axis ID in the axis group)

(3) ExcutionMode input specifies the setting point. If it is 0, it is set immediately after the execution of a command, If it is 1, it is set at the same point with ‘Buffered’ of sequential operation setting. The value unable to be set causes "error 0x201B”.

0 (mcImmediately): Change the value of parameter immediately after the execution of motion function block (rising Edge in Execute input). If the relevant axis is running, the operation can be affected.

1 (mcQueued): Changed at the same point of ‘Buffered’ of Buffermode (**Error! Reference Source Not Found**. Refer to input).

### 6.5.8 Stop a Group immediately(MC_GroupStop)

| Motion Function Block | | |
|---|---|---|
|  | | |
| **Input-Output** | | |
| UINT | AxesGroup | Set the group to stop immediately. (1 ~ 16 : Group 1 ~ Group 16) |
| **Input** | | |
| BOOL | Execute | Give group immediate stop command to the relevant group in the rising Edge. |
| LREAL | Deceleration | Specify the deceleration in time of stop. [u/s$^2$] |
| LREAL | Jerk | Specify the change rate of acceleration/deceleration. [u/s$^3$] |
| **Output** | | |
| BOOL | Done | Indicate the state of motion function block completion. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Active | Indicate that the current motion function block is controlling the relevant axis. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted while it is running. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |



(1) This motion function block is to give an emergency stop command to the relevant axis group.

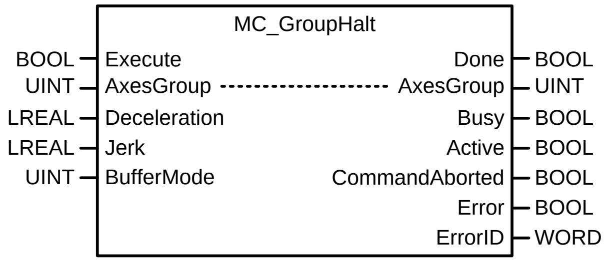
(2) The relevant axis group moves on the route which it was following until it completely stops.

(3) When executing group immediate stop (MC_GroupStop) motion function block, motion function block which the relevant axis group is performing is interrupted, and the axis is changed to 'GroupStopping'. When the relevant axis group is in ‘GroupStopping’ state, other motion function block cannot be given to the relevant axis until the stop is completed (until Done output is On).

(4) CommandAborted output indicates that the current motion function block is interrupted while it was executed. Because other motion function block cannot interrupt group immediate stop (MC_GroupStop) command while group immediate stop (MC_GroupStop) command is being executed, CommandAborted output is On when the power of servo is cut, servo Off command is executed, or servo connection is disconnected.

(5) If Execute input is On or the speed of the axis is not 0, the axis is in ' GroupStopping' state, and if Done output is On and Execute input is Off, the axis is switched to ' GroupStandBy' state.

### 6.5.9 Stop a Group(MC_GroupHalt)

| Motion Function Block | | |
|---|---|---|
|  | | |
| **Input-Output** | | |
| UINT | AxesGroup | Set the group to stop. (1 ~ 16 : Group 1 ~ Group 16) |
| **Input** | | |
| BOOL | Execute | Give group stop command to the relevant group in the rising Edge. |
| LREAL | Deceleration | Specify the deceleration in the time of stop. [u/s$^2$] |
| LREAL | Jerk | Specify the change rate of acceleration/deceleration. [u/s$^3$] |
| UINT | BufferMode | Specify the sequential operation setting of motion function block.<br>(Refer to 10.1.4.BufferMode) |
| **Output** | | |
| BOOL | Done | Indicate the state of motion function block completion. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Active | Indicate that the current motion function block is controlling the relevant axis. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted while it is running. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

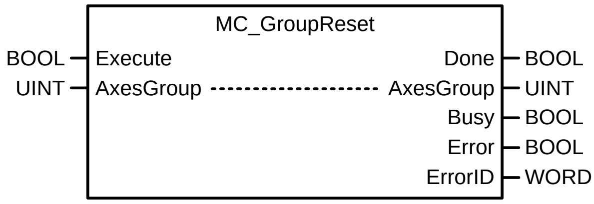


(1) This motion function block is to give a stop command to the relevant axis.

(2) The relevant axis group moves on the route which it was following until it completely stops.

(3) The axis is in 'GroupMoving' state while this motion function block is running, and if the axis group completely stops, 'Done' output is On and the group state is changed to 'GroupStandBy' state.

### 6.5.10 Reset a group error(MC_GroupReset)

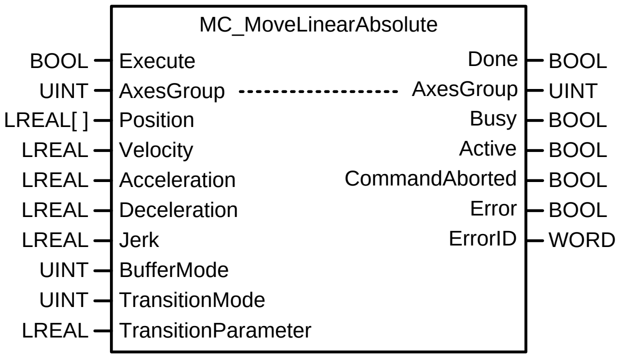
| Motion Function Block | | |
|---|---|---|
|  | | |
| **Input-Output** | | |
| UINT | AxesGroup | Set the group to do error reset. (1 ~ 16 : Group 1 ~ Group 16) |
| **Input** | | |
| BOOL | Execute | Give group error reset command to the relevant group in the rising Edge. |
| **Output** | | |
| BOOL | Done | Indicate the state of motion function block completion. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |



(1) This motion function block is to reset the error of the relevant axis group. When the relevant axis is in 'GroupErrorStop', the execution of motion function block resets the error occurred in the current relevant axis and switches the axis group to 'GroupStandBy' state.

(2) When executing this motion function block, every error occurred in each axis in the group is reset. (This has the same effect with when executing the axis error reset (MC_Reset) command in each axis.)

### 6.5.11 Absolute positioning linear interpolation operation(MC_MoveLinearAbsolute)

| | | |
|---|---|---|
| Motion Function Block | | |
|  | | |
| Input-Output | | |
| UINT | AxesGroup | Set the group to perform absolute position linear interpolation operation. (1 ~ 16: Group 1 ~ Group 16) |
| Input | | |
| BOOL | Execute | Give absolute position linear interpolation operation command to the relevant group in the rising Edge. |
| LREAL[ ] | Position | Specify the target position of each axis. |
| LREAL | Velocity | Specify the maximum speed of the route. [u/s] |
| LREAL | Acceleration | Specify the maximum acceleration. [u/$s^2$] |
| LREAL | Deceleration | Specify the maximum deceleration. [u/$s^2$] |
| LREAL | Jerk | Specify the change rate of acceleration/deceleration. [u/$s^3$] |
| UINT | BufferMode | Specify the sequential operation setting of motion function block. (Refer to 10.1.4.BufferMode) |
| UINT | TransitionMode | Specify the route change mode of group operation. (Refer to 10.1.6.TransitionMode ) |
| LREAL | TransitionParameter | Specify the parameter of the route change setting of group operation.. (Refer to 10.1.6.TransitionMode ) |
| Output | | |
| BOOL | Done | Indicate whether to reach the specified position. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Active | Indicate that the current motion function block is controlling the relevant axis. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted while it is running. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is to give an absolute position linear interpolation command to the axis group specified in AxesGroup input.

(2) When this motion function block is executed, interpolation control is performed in a linear path from the current position to the target position of each axis, and the moving direction is decided by the starting point and the target point of each axis.

Beginning position < Target position: Forward direction operation

Beginning position > Target position: Reverse direction operation

(3) In Position input, specify the target position of each axis in the group as matrix. The values in the array and the axis in the group correspond in the order of [1, 2, 3, 4].(1~4 are axis ID in the axis group).

(4) Specify the speed, acceleration, deceleration, and the change rate of acceleration/deceleration of interpolation route in Velocity, Acceleration, Deceleration, and Jerk inputs respectively.

(5) Velocity is to set the interpolation speed of the axis group, and it indicates the integrated speed of each axis. Operation speeds of each configuration axis are calculated as follows.

$$\text{Interpolation speed (F)} = \text{Target speed specified in the Velocity}$$

$$\text{Interpolation movement amount (S)} = \sqrt{S_1{}^2 + S_2{}^2 + S_3{}^2 + S_4{}^2}$$

$$\text{Configuration axis 1 speed } (V_1) = \text{Interpolation speed (F)} \times \frac{\text{Configuration axis 1 movement amount } (S_1)}{\text{Interpolation movement amount (S)}}$$

$$\text{Configuration axis 2 speed } (V_2) = \text{Interpolation speed (F)} \times \frac{\text{Configuration axis 2 movement amount } (S_2)}{\text{Interpolation movement amount (S)}}$$

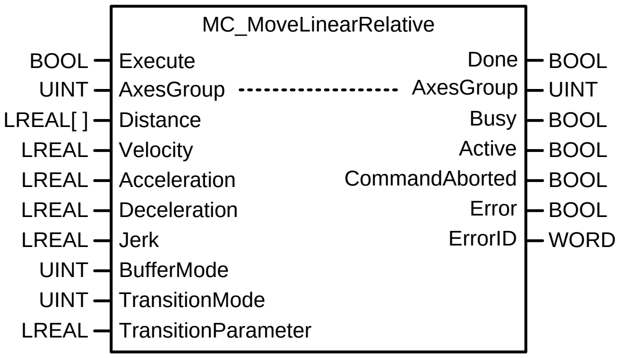
$$\text{Configuration axis 3 speed } (V_3) = \text{Interpolation speed (F)} \times \frac{\text{Configuration axis 3 movement amount } (S_3)}{\text{Interpolation movement amount (S)}}$$

$$\text{Configuration axis 4 speed } (V_4) = \text{Interpolation speed (F)} \times \frac{\text{Configuration axis 4 movement amount } (S_4)}{\text{Interpolation movement amount (S)}}$$

(6) Refer to linear interpolation control part in motion control module’s manual for more details.

### 6.5.12 Relative positioning linear interpolation operation(MC_MoveLinearRelative)

| Motion Function Block | | |
|---|---|---|




| | | |
|---|---|---|
| **Input-Output** | | |
| UINT | AxesGroup | Set the group to do relative position linear interpolation operation. (1 ~ 16: Group 1 ~ Group 16) |
| **Input** | | |
| BOOL | Execute | Give relative position linear interpolation operation command to the relevant group in the rising Edge. |
| LREAL[ ] | Distance | Set the target distance of each axis. |
| LREAL | Velocity | Specify the maximum speed of the route. [u/s] |
| LREAL | Acceleration | Specify the maximum acceleration. [u/$s^2$] |
| LREAL | Deceleration | Specify the maximum deceleration. [u/$s^2$] |
| LREAL | Jerk | Specify the change rate of acceleration/deceleration. [u/$s^3$] |
| UINT | BufferMode | Specify the sequential operation setting of motion function block.<br>(Refer to 10.1.4.BufferMode) |
| UINT | TransitionMode | Specify the route change mode of group operation.<br>(Refer to 10.1.6.TransitionMode ) |
| LREAL | TransitionParameter | Specify the parameter of the route change setting of group operation..<br>(Refer to 10.1.6.TransitionMode ) |
| **Output** | | |
| BOOL | Done | Indicate whether to reach the specified position. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Active | Indicate that the current motion function block is controlling the relevant axis. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted while it is running. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is to give a relative position linear interpolation command to the axis group specified in AxesGroup input.

(2) When this motion function block is executed, interpolation control performed in a linear path from the current position to the target position of each axis, and the moving direction is decided by the sign of the target distance of each axis.

Target distance > 0: Forward direction operation

Target distance < 0: Reverse direction operation

(3) In Distance input, specify the target distance of each axis in the group as array. The specified array and the axis in the group correspond in the order of specified axis ID [ID1 target distance, ID2 target distance, …].

(4) Set the speed, acceleration, deceleration, and the change rate of acceleration/deceleration of interpolation route in Velocity, Acceleration, Deceleration, and Jerk inputs respectively.

(5) Velocity is to set the interpolation speed of the axis group, and it indicates the integrated speed of each axis. Operation speeds of each configuration axis are calculated as follows.

$$\text{Interpolation speed (F)} = \text{Target speed specified in the Velocity}$$

$$\text{Interpolation movement amount (S)} = \sqrt{S_1{}^2 + S_2{}^2 + S_3{}^2 + S_4{}^2}$$

$$\text{Configuration axis 1 speed } (V_1) = \text{Interpolation speed (F)} \times \frac{\text{Configuration axis 1 movement amount } (S_1)}{\text{Interpolation movement amount (S)}}$$

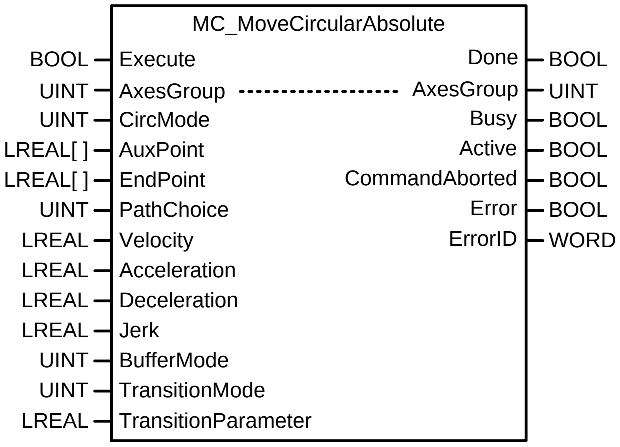
$$\text{Configuration axis 2 speed } (V_2) = \text{Interpolation speed (F)} \times \frac{\text{Configuration axis 2 movement amount } (S_2)}{\text{Interpolation movement amount (S)}}$$

$$\text{Configuration axis 3 speed } (V_3) = \text{Interpolation speed (F)} \times \frac{\text{Configuration axis 3 movement amount } (S_3)}{\text{Interpolation movement amount (S)}}$$

$$\text{Configuration axis 4 speed } (V_4) = \text{Interpolation speed (F)} \times \frac{\text{Configuration axis 4 movement amount } (S_4)}{\text{Interpolation movement amount (S)}}$$

(6) Refer to linear interpolation control part in motion control module's manual for more details.

### 6.5.13 Absolute positioning circular interpolation operation(MC_MoveCircularAbsolute)

| Motion Function Block | | |
|---|---|---|
|  | | |
| **Input-Output** | | |
| UINT | AxesGroup | Set the group to do absolute position circular interpolation operation. (1 ~ 16: Group 1 ~ Group 16) |
| **Input** | | |
| BOOL | Execute | Give absolute position circular interpolation operation command to the relevant group in the rising Edge. |
| UINT | CirMode | Circular interpolation method setting [0: Midpoint, 1: Central point, 2: Radius] |
| LREAL[ ] | AuxPoint | Specify the position of auxiliary point depending on the circular interpolation method in an absolute coordinate. |
| LREAL[ ] | EndPoint | Specify the end point of circular arc in an absolute coordinate. |
| BOOL | PathChoice | Circular route selection<br>0: Clockwise, 1: Counterclockwise |
| LREAL | Velocity | Specify the maximum speed of the route. [u/s] |
| LREAL | Acceleration | Specify the maximum acceleration. [u/s$^2$] |
| LREAL | Deceleration | Specify the maximum deceleration. [u/s$^2$] |
| LREAL | Jerk | Specify the change rate of acceleration/deceleration. [u/s$^3$] |
| UINT | BufferMode | Specify the sequential operation setting of motion function block.<br>(Refer to 10.1.4.BufferMode) |
| UINT | TransitionMode | Unused |
| LREAL | TransitionParameter | Unused |

| Output | | |
|---|---|---|
| BOOL | Done | Indicate whether to reach the specified position. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Active | Indicate that the current motion function block is controlling the relevant axis. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted while it is running. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is to give an absolute position circular interpolation command to the axis group specified in AxesGroup input.

(2) When this motion function block starts, each axis performs circular path interpolation control which refers to the set auxiliary point, and the movement direction is decided by PathChoice input. When setting PathChoice input to 0, circular interpolation operation is done clockwise, and when setting it to 1, circular interpolation operation is done counterclockwise.

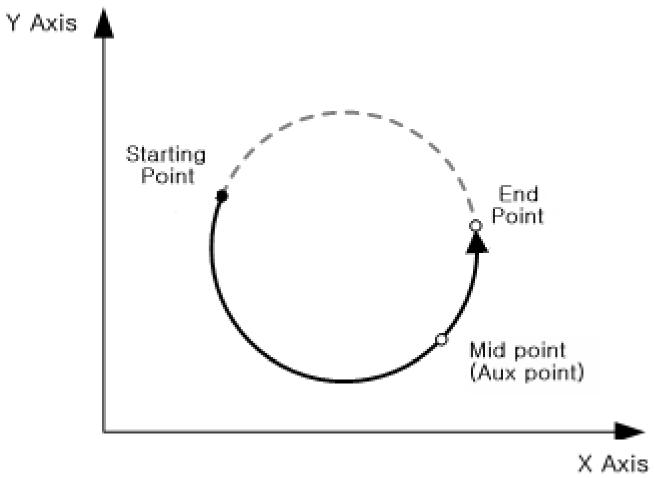
(3) Specify the absolute position of the auxiliary point to refer when doing circular interpolation of each axis in AuxPoint and EndPoint inputs as array. The entered array and the axis in the group correspond in the order of the specified axis ID [ID1, ID2, ID3, ··· ]. (The 3 LEAL type sized array should be entered in Position input as there are 3 axes which comprise the group to give a circular interpolation operation command.)

(4) Specify the speed, acceleration, deceleration, and the change rate of acceleration of interpolation route in Velocity, Acceleration, Deceleration, and Jerk inputs respectively.

(5) Set the circular interpolation method in CircMode input. The circular interpolation methods which are different from the value specified in CircMode are as below.

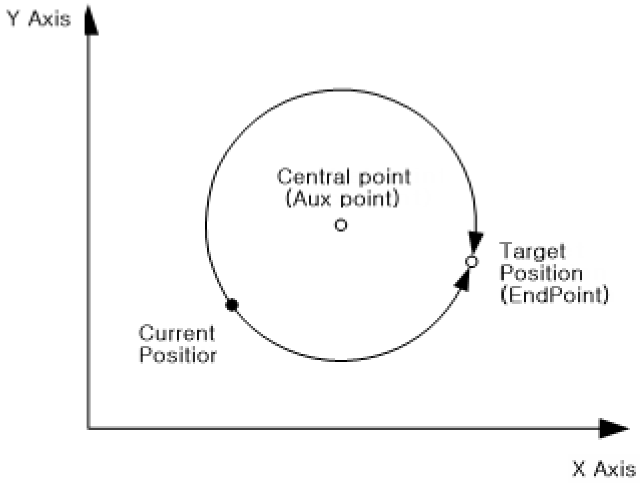
(a) Circular interpolation of midpoint specifying method (BORDER, CircMode = 0)

In this method, operation starts at the starting point and it does circular interpolation through the specified position of the central point to the target position. The Figure below shows that the coordinate of the axis group at the beginning of a command corresponds to the starting point, the coordinate entered in AuxPoint corresponds to the central point, and the coordinate entered in EndPoint corresponds to the target position in an absolute value.



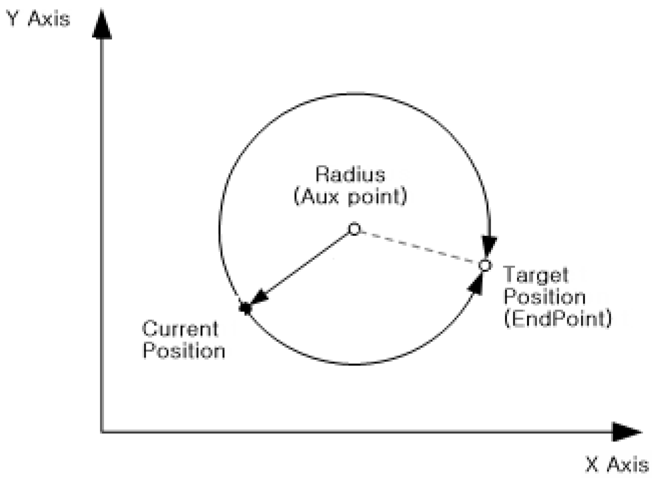
(b) Circular interpolation of central point specifying method

In this method, operation starts at the current position, and it does circular interpolation to the target position along the circular path, which has a radius of the distance to the specified central position. The Figure below shows that the coordinate of the axis group at the beginning of a command corresponds to the current position, the coordinate entered in AuxPoint corresponds to the central point, and the coordinate entered in EndPoint corresponds to the target point as an absolute value.




(c) Circular interpolation using the radius specifying method

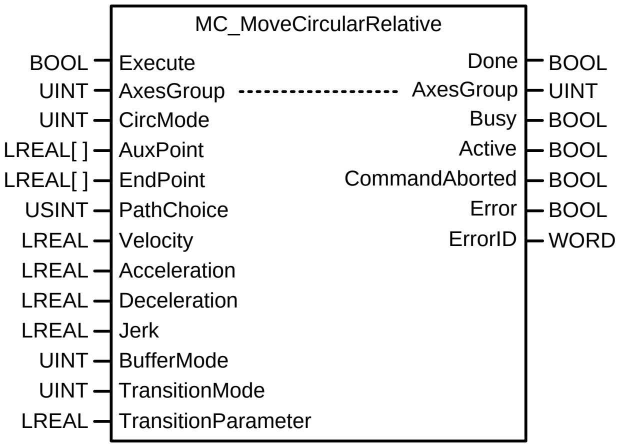
In this method, operation starts at the current position, and it does circular interpolation to the target position along the circular path which has a radius of the value specified in the radius. The Figure below shows that the coordinate of the axis group at the beginning of a command corresponds to the current position, the value entered in X-axis of AuxPoint corresponds to the radius, and the coordinate entered in EndPoint corresponds to the target point in an absolute value.




(6) Refer to linear interpolation control part in motion control module’s manual for more details.

### 6.5.14 Relative positioning circular interpolation operation(MC_MoveCircularRelative)

Motion Function Block




| Input-Output | | |
|---|---|---|
| UINT | AxesGroup | Set the group to do absolute position circular interpolation operation. (1 ~ 16: Group 1 ~ Group 16) |
| **Input** | | |
| BOOL | Execute | Give relative position circular interpolation operation command to the relevant group in the rising Edge. |
| UINT | CirMode | Circular interpolation method setting [0: Midpoint, 1: Central point, 2: Radius] |
| LREAL[ ] | AuxPoint | Specify the position of auxiliary point depending on the circular interpolation method as the relative coordinate based on the starting point. |
| LREAL[ ] | EndPoint | Specify the end point of circular arc as the relative coordinate based on the starting point. |
| BOOL | PathChoice | Circular route selection<br>0: Clockwise, 1: Counterclockwise |
| LREAL | Velocity | Specify the maximum speed of the route. [u/s] |
| LREAL | Acceleration | Specify the maximum acceleration. [u/$s^2$] |
| LREAL | Deceleration | Specify the maximum deceleration. [u/$s^2$] |
| LREAL | Jerk | Specify the change rate of acceleration/deceleration. [u/$s^3$] |
| UINT | BufferMode | Specify the sequential operation setting of motion function block.<br>(Refer to 10.1.4.BufferMode) |
| UINT | TransitionMode | Unused |
| LREAL | TransitionParameter | Unused |

| Output | | |
|---|---|---|
| BOOL | Done | Indicate whether to reach the specified position. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Active | Indicate that the current motion function block is controlling the relevant axis. |
| BOOL | CommandAborted | Indicate that the current motion function block is interrupted while it is running. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is to give a relative position circular interpolation command to the axis group specified in AxesGroup input.

(2) When this motion function block starts, each axis performs circular path interpolation control which refers to the set auxiliary point, and the movement direction is decided by PathChoice input. When setting PathChoice input to 0, circular interpolation operation is done clockwise, and when setting it to 1, circular interpolation operation is done counterclockwise.

(3) Specify the relative position of the auxiliary point to refer when doing circular interpolation of each axis in AuxPoint and EndPoint inputs as array. The entered array and the axis in the group correspond in the order of the specified axis ID [ID1, ID2, ID3, ··· ]. (The 3 LEAL type sized array should be entered in Position input as there are 3 axes which comprise the group to give a circular interpolation operation command.)

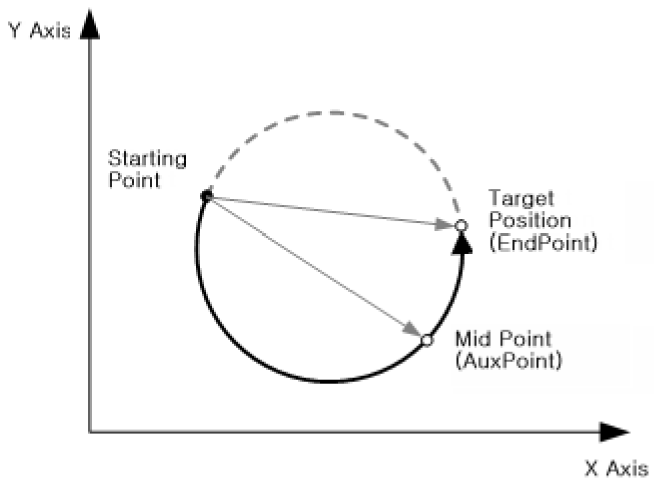
(4) Specify the speed, acceleration, deceleration, and the change rate of acceleration of interpolation route in Velocity, Acceleration, Deceleration, and Jerk inputs respectively.

(5) Set the circular interpolation method in CircMode input. The circular interpolation methods which are different from the value specified in CircMode are as below.

(a) Circular interpolation of midpoint specifying method (BORDER, CircMode = 0)

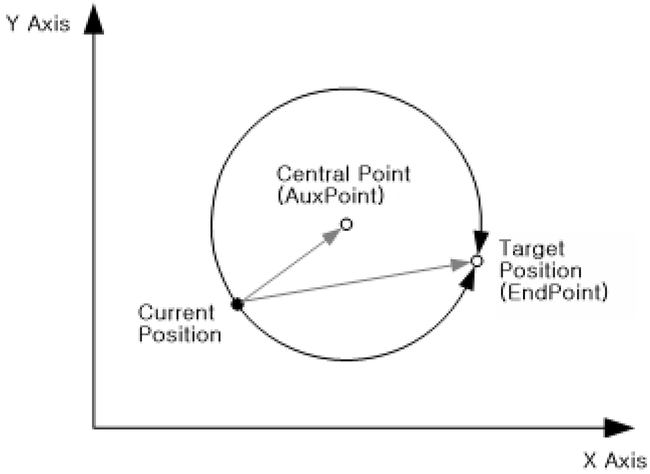
In this method, operation starts at the current position and it does circular interpolation through the specified position of the central point to the target position.

The Figure below shows that the coordinate of the axis group at the beginning of a command corresponds to the current position, the coordinate entered in AuxPoint corresponds to the central point, and the coordinate entered in EndPoint corresponds to the target position in a relative value.



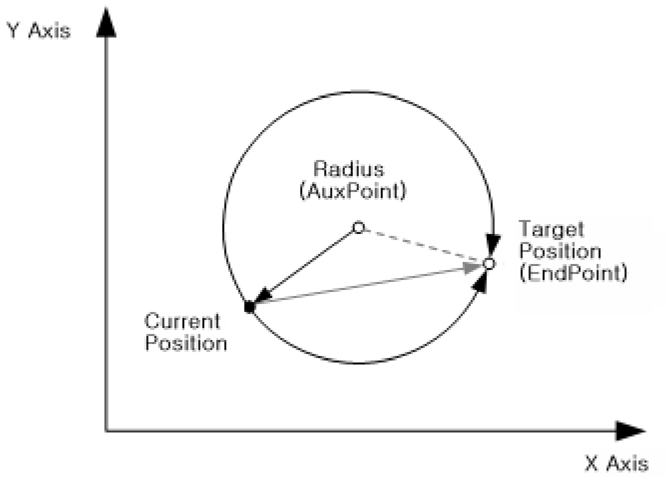
(b) Circular interpolation of central point specifying method

In this method, operation starts at the current position, and it does circular interpolation to the target position along the circular path, which has a radius of the distance to the specified central position. The Figure below shows that the coordinate of the axis group at the beginning of a command corresponds to the current position, the coordinate entered in AuxPoint corresponds to the central point, and the coordinate entered in EndPoint corresponds to the target point as a relative value.




(c) Circular interpolation using the radius specifying method

In this method, operation starts at the current position, and it does circular interpolation to the target position along the circular path which has a radius of the value specified in the radius. The Figure below shows that the coordinate of the axis group at the beginning of a command corresponds to the current position, the value entered in X-axis of AuxPoint corresponds to the radius, and the coordinate entered in EndPoint corresponds to the target point in a relative value.

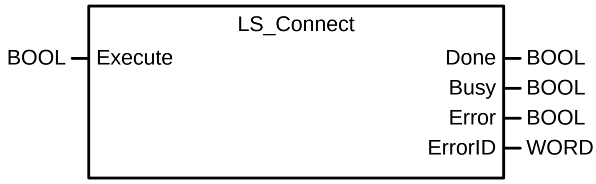



(6) Refer to linear interpolation control part in motion control module's manual for more details.

# 6.6 Exclusive Function Blocks

## 6.6.1 Connect servo drives(LS_Connect)

Motion Function Block




| | | |
|---|---|---|
| **Input** | | |
| BOOL | Execute | Give communication connection command to the relevant module in the rising Edge. |
| **Output** | | |
| BOOL | Done | Indicate whether to complete communication connection. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

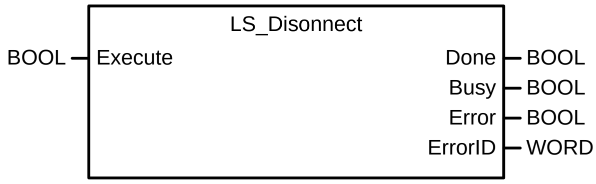
(1) This motion function block is to give a command to connect communication with servo drive or external input/output apparatus to the module.

(2) When slave devicees are normally connected, Done is On and Busy is Off.

(3) If an error occurs during the communication connection, Error is On and error number is output in ErrorID according to the cause.

### 6.6.2 Disconnect servo drives(LS_Disconnect)

Motion Function Block




| Input | | |
|---|---|---|
| BOOL | Execute | Give communication disconnection command to the relevant module in the rising Edge. |
| **Output** | | |
| BOOL | Done | Indicate whether to complete communication disconnection. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

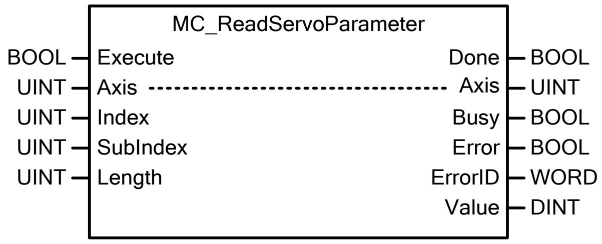
(1) This motion function block gives a command which orders the module to disconnect the communication with servo drive or external input/output apparatuses.

(2) If communication slave is disconnected, Done is On and Busy is off.

(3) If an error occurs during the execution of communication disconnection, Error is On and error number is output in ErrorID according to the error situation.

### 6.6.3 Read servo parameters(LS_ReadServoParameter)

**Motion Function Block**




| | | |
|---|---|---|
| **Input-Output** | | |
| UINT | Axis | Set the axis to be given a command. (1~32: Actual axes) |
| **Input** | | |
| BOOL | Execute | Give servo parameter reading command to the relevant axis in the rising Edge. |
| UINT | Index | Set the Index of servo parameter Object to be read. (0x0000~0x9FFF) |
| UINT | SubIndex | Set the SubIndex of servo parameter Object to be read. (0 ~ 255) |
| UINT | Length | Set the distance of servo parameter Object to be read by Byte. (1 ~ 4) |
| **Output** | | |
| BOOL | Done | Indicate that servo parameter is successfully read. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |
| LREAL | Value | Output the value of servo parameter. |

(1) This motion function block is to read the parameter (CoE Object) value of servo drive in the relevant axis, and reads the servo parameter value of the position specified in Index and SubIndex of the axis specified by Axis input as much as the size of Length and indicates it on Value output.

(2) Value output is eliminated to 0 when motion function block is running, and it is output as the read value when the running is completed (Done output is On).

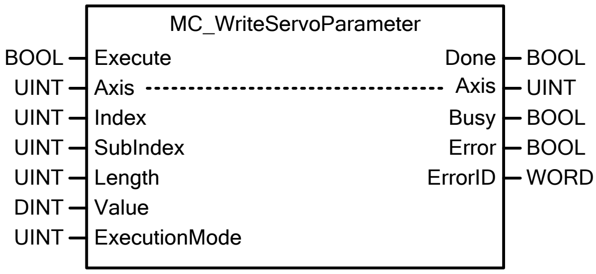
(3) Index input can be set as below. If the value is set outside the range, "error 0x1F12" occurs.

| Variable | Description |
|---|---|
| 16#0000 ~ 16#0FFF | Data Type Description |
| 16#1000 ~ 16#1FFF | Communication objects |
| 16#2000 ~ 16#5FFF | Manufacturer Specific Profile Area |
| 16#6000 ~ 16#9FFF | Standardized Device Profile Area |

(4) The value between 0~255 can be entered in SubIndex, and if the value is set outside the range, "error 0x1F12" occurs.

(5) The value between 1~4 can be set in Length, which means 1~4 Byte. If the value is set outside the range, “error 0x1F12” occurs.

### 6.6.4 Write servo parameters(LS_WriteServoParameter)

| Motion Function Block | | |
|---|---|---|
|  | | |
| **Input-Output** | | |
| UINT | Axis | Set the axis to be given a command. (1~32: Actual axes) |
| **Input** | | |
| BOOL | Execute | Give servo parameter writing command to the relevant axis in the rising Edge. |
| UINT | Index | Set the Index of servo parameter Object to be written. (0x0000~0x9FFF) |
| UINT | SubIndex | Set the SubIndex of servo parameter Object to be written. (0 ~ 255) |
| UINT | Length | Set the distance of servo parameter Object to be written by Byte. (1 ~ 4) |
| DINT | Value | Set the value to be written in servo parameter. |
| UINT | ExecuteMode | Specify the time when performing servo parameter writing.<br>0: Immediately executed<br>1: Applied at the same time with 'Buffered' of BufferMode. |
| **Output** | | |
| BOOL | Done | Indicate that servo parameter is successfully read. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |



(1) This motion function block is to write the parameter (CoE Object) value of the relevant axis servo drive, and it writes the value entered in Value as the size of the Length in servo parameter of the position specified as Index and SubIndex of the axis specified in Axis input.

(2) Index input can be set as below. When it is set to the value besides the set value, "error 0x1F12" occurs.

| Value | Description |
|---|---|
| 16#0000 ~ 16#0FFF | Data Type Description |
| 16#1000 ~ 16#1FFF | Communication objects |
| 16#2000 ~ 16#5FFF | Manufacturer Specific Profile Area |
| 16#6000 ~ 16#9FFF | Standardized Device Profile Area |

(3) The value between the range of 0~255 can be entered in SubIndex, and if the value outside the range is set, “error 0x1F12” occurs.

(4) The value between the range of 1~4 can be entered in Length, which means 1~4 Byte. If the value outside the range is set, "error 0x1F12” occurs.

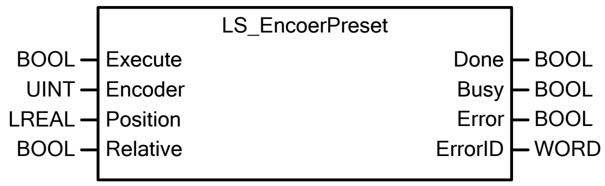
(5) The time when parameter is written is set in ExecutionMode, and values can be set as below. The value unable to be set causes "error0x101B”.

(6) 0 (mcImmediately): Change the parameter value immediately after the execution of motion function block(rising Edge in Execute input) If the relevant axis is running, operation can be affected.

(7) 1 (mcQueued): Changed at the same time with‘Buffered’of BufferMode. (Refer to 10.1.4. BufferMode input)

### 6.6.5 Encoder preset(LS_EncoderPreset)

Motion Function Block



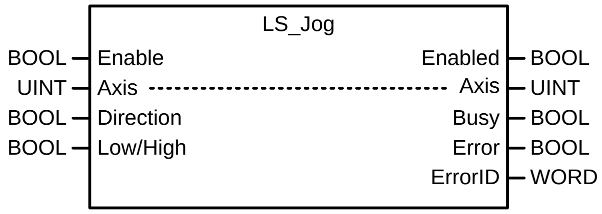

| | | |
|---|---|---|
| **Input** | | |
| BOOL | Execute | Specify the position of the relevant encoder in the rising Edge. |
| UINT | Encoder | Set the encoder to set the position. (1~2: Encoder 1~Encoder 2) |
| LREAL | Position | Specify the position to set. [u] |
| BOOL | Relative | 0: Absolute coordinate position<br>1: Relative coordinate position |
| **Output** | | |
| BOOL | Done | Indicate the state of motion function block completion. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is to set the current position of the relevant encoder.

(2) Specify the position in Position input. When executing motion function command, if Relative input is Off, the position of the current axis is replaced with the Position input value, and if the Relative input is On, the Position input value is added to the current position of the relevant axis.

### 6.6.6 JOG operation(LS_Jog)

Motion Function Block




| | | |
|---|---|---|
| **Input-Output** | | |
| UINT | Axis | Set the axis to be given a command. (1~32: Actual axes) |
| **Input** | | |
| BOOL | Enable | Give jog command to the relevant axis while input is On. |
| BOOL | Direction | Set the rotation direction in jog (0: Forward direction, 1: Reverse direction) |
| BOOL | Low/High | Set the jog speed in jog.<br>(0: Jog low speed operation, 1: Jog high speed operation) |
| **Output** | | |
| BOOL | Enabled | Indicate that the relevant axis is in jog. |
| BOOL | Busy | Indicate that the execution of motion function block is not completed. |
| BOOL | Error | Indicate whether an error occurs or not. |
| WORD | ErrorID | Output the number of error occurred while motion function block is running. |

(1) This motion function block is to make the relevant axis perform jog operation.

(2) Jog is a manual operation function for test and is used to confirm the position address for system operation, wiring condition check, and teaching. Jog can be used by dividing the speed into high speed and low speed.

(3) When Enable input is On (in jog), if the value set in Low/High is changed, speed change occurs without stop in jog, and if the value set in JOG_DIR is changed, Jog is continued by changing the direction after the deceleration pause.

# Chapter7 Program

## 7.1 Structure of the Program

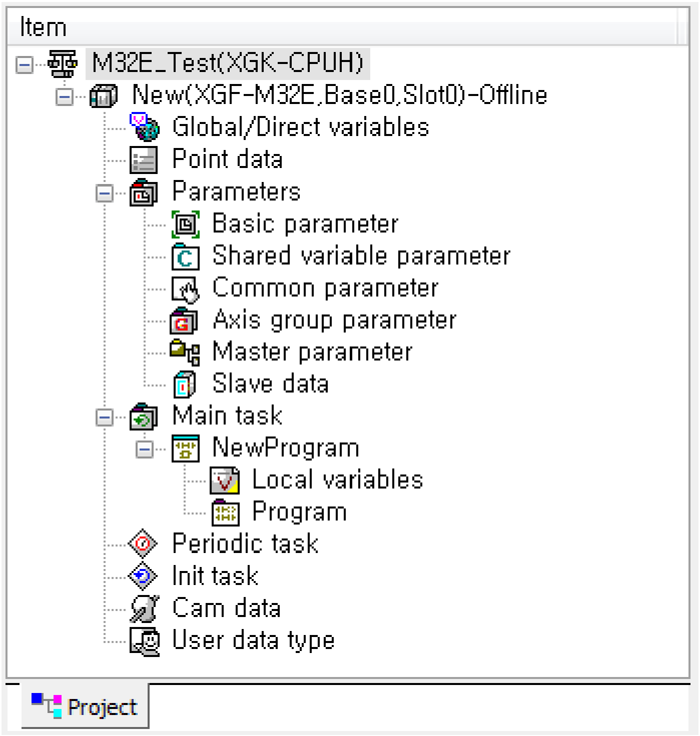
The program of the motion control module is divided into main task program, periodic task program and initialization task program. The features of each program in execution are as follows.

(1) Initialization task program: It is executed only once when motion control module enters the RUN.

(2) Main task program: It is executed in every main task cycle set in the motion control module.
The main task cycle can be set in "main task period" of the basic parameters, and a period can be set through section among 1ms, 2ms, and 4ms.
In case the execution time of main task program exceeds the set main task period, error occurs.

(3) Periodic task program: It is executed in every periodic task period set in the motion control module.
The cycle of the periodic task can be set "periodic task period" of the basic parameters, and a multiple of the set main task period is to be set.
The periodic task program is executed the remaining time after executing main task program by main task period in motion control module, and it is executed repeatedly in every periodic task period.

For information about the execution of main task program and periodic task program, refer to "4.3 motion control task".



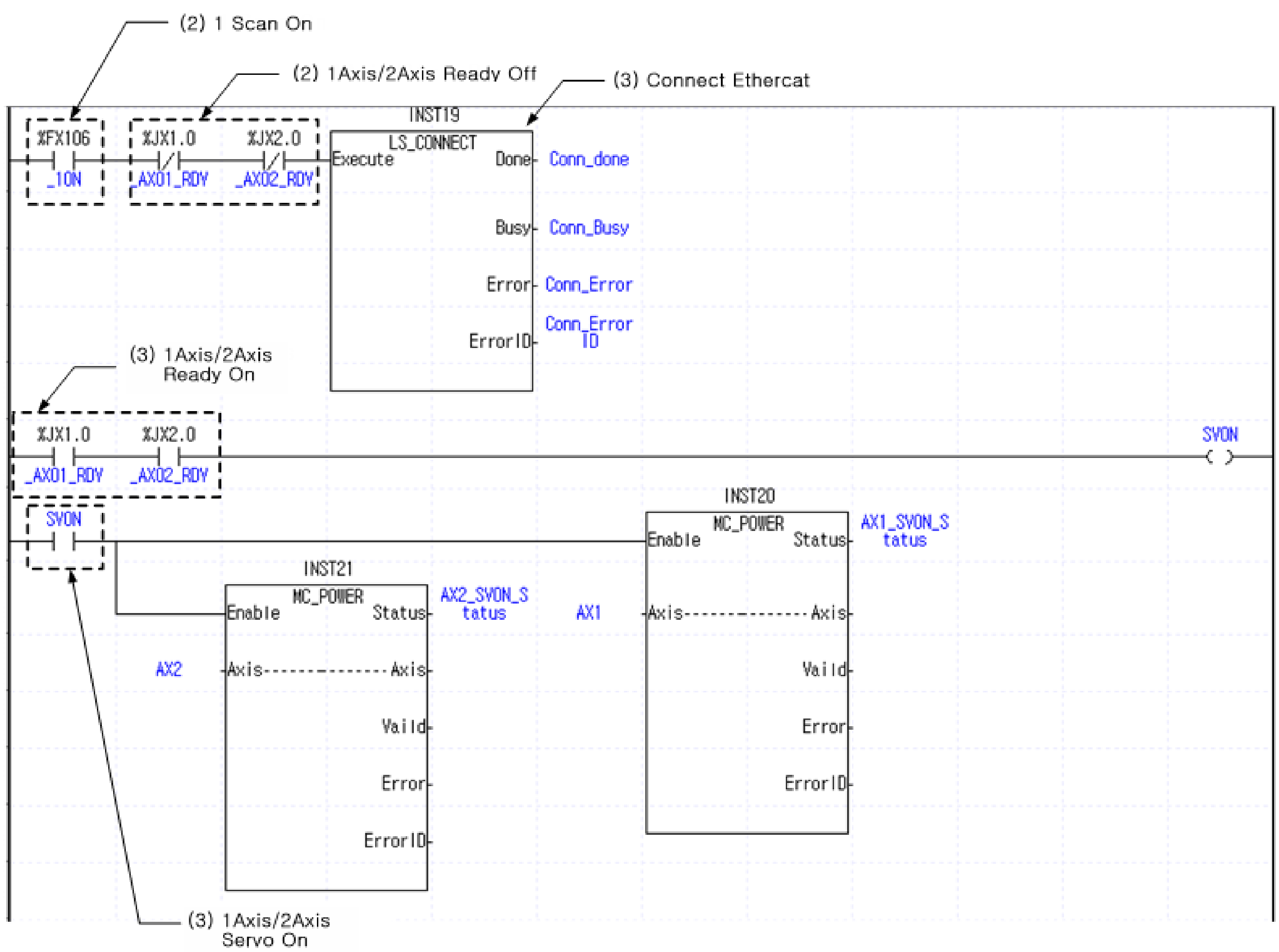
## 7.2 Status Information Reading

In the program of motion control modules, each axis, status of axis group and operating status of the motion control module can be checked with the flag.
Most of the program examples of chapter 7 is created using flags that indicate axis and status of axis group.
Flags that indicate the status information can be used directly in the program, and can be delivered to PLC CPU by being assigned to a shared device of the motion control module.
For more information on the types and functions of flags, refer to “5.1.1 flag”.

## 7.3 Discrete Motion Program

### 7.3.1 Preparation for operation

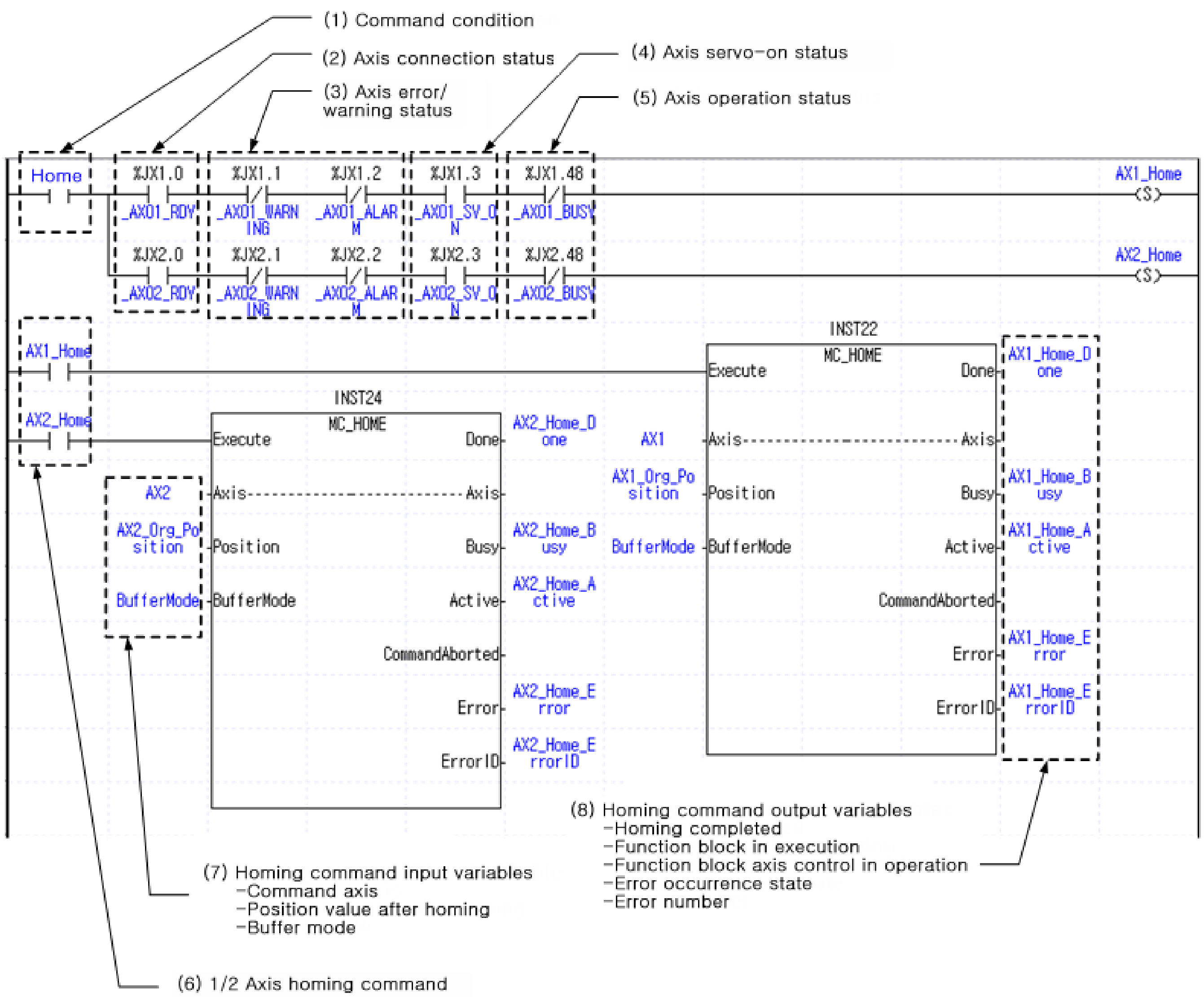
These are example programs that make access to servo drive connected with Ethernet cable and get the connected servo drive to be On to operate EtherCAT servo drive.



(1) The above examples assume situation in which two axes of 1-axis and 2-axis are connected to the motion control module.
(2) In case 1-axis and 2-axis are not connected when the motion control module enters the RUN, start the connection of EtherCAT communication between motion control module and servo drive using motion function block for communication connection (LS_CONNECT).
(3) If the connection of EtherCAT communication between motion control modules and servo drives is normally performed, servo On/Off (MC_Power) command is issued to each axis by getting “SVON” contact to be On.
(4) In case there is no error in servo drive of the connected 1-axis and 2-axis, the servo is normally On, and it is ready to operate 1-axis and 2-axis.

### 7.3.2 Homing operation

Homing is carried out to set the origin of the machine after the power is applied. Since homing is performed in the servo drive, homing methods may vary depending on servo drive manufacturers. In motion control module, the completion of homing command and error situation is monitored, and the position of the origin after homing is applied to control.




(1) Command condition

: It is a condition to make the axis perform homing operation.

(2) Axis connection state flag

: In case the axis to be operated is connected to motion control module, and EtherCAT communication with motion control module is normally performed, it is On.

(3) Axis error/Warning status flag

: If there are errors and warnings in the axis, it is On.

(4) Axis servo-on status flag

: If the axis is in servo-on state, it is On, and servo-off state, it becomes Off.

(5) Axis operation status flag

: If the axis is in operation, it is On.

(6) 1/2 axis homing command

: In example programs, homing (MC_Home) motion function block is performed under the following conditions.

- Homing condition is On
- The axis is normally connected
- There should be no errors and warnings
- Servo-on state
- Not in operation

Conditions to perform motion function block may vary depending on systems.

(7) Homing command input variables

: These are input variables to perform homing (MC_Home) motion function block.

- Command-axis: It sets the axis in which motion function block is performed.
- Position value after homing: It sets the position value when homing is completed.
- Buffer mode: It sets the point of time when motion function block is executed. That is, it sets whether to execute immediately or execute after the completion of commands which are currently being performed. For more details on Function Block execution mode, refer to “6.1.4 Buffer Mode input”.

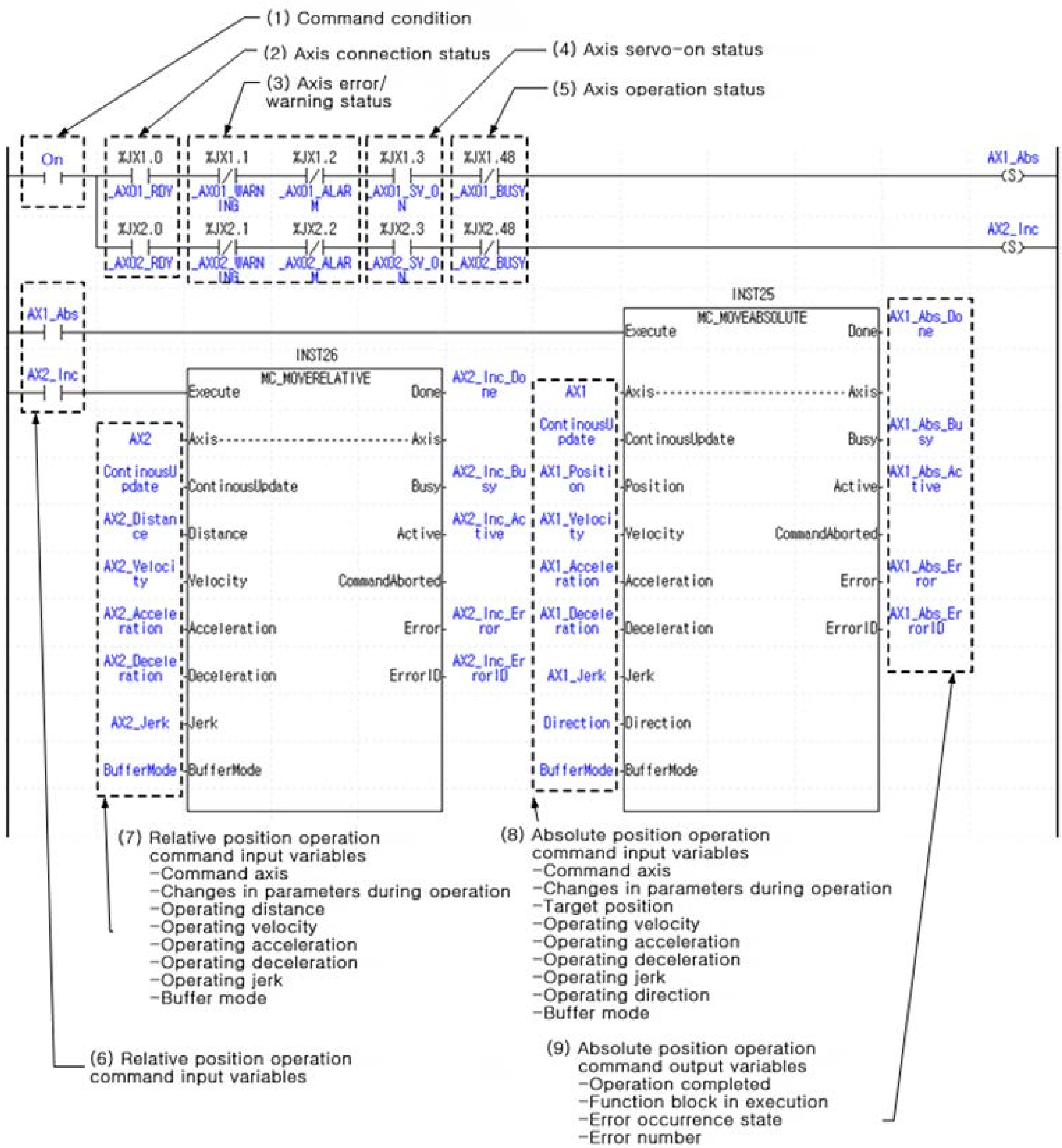
(8) Homing command output variable

: It is a variable to store output value generated when homing (MC_Home) motion function block is executed.

- Homing completed: If homing operation is completed, it is On.
- Function Block in execution: If motion function block is being performed, it is On, and homing completion is On, it is Off.
- Function Block axis control in operation: In case motion function block controls the axis, it is On.
- Error occurrence state: In case error occurs while motion function block is being executed, it is On.
- Error number: In case error occurs, the number that corresponds to error is generated.
- For more details on the output of motion function block, refer to “Edge operation motion function block” of “6.1.3 basic I/O variable”.

### 7.3.3 Absolute Position/Relative Position Operation

It is a program for absolute position and relative position operation using motion control module. The absolute positon is based on the origin and, and relative position the current position.



(1) Command condition
: It is a condition to make the axis perform position control operation.

(2) Axis connection state flag
: If the axis to be operated is connected to motion control module, and EtherCAT communication with motion control module is normally performed, it is On.

(3) Axis error/Warning status flag
: If there are errors and warnings in the axis, it is On.

(4) Axis servo-on status flag
: If the axis is in servo-on state, it is On, and servo-off state, it becomes Off.

(5) Axis operation status flag
: If the axis is in operation, it is On.

(6) 1-axis absolute position operation / 2-axis relative position operation commands
: In example programs, absolute position operation (MC_MoveAbsolute) is performed in 1-axis, and relative position operation (MC_MoveRelative) in 2-aixs under the following conditions.
- The axis operation condition is On.
- The axis is normally connected.
- There should be no errors and warnings.
- Servo-on state
- Not in operation.

Conditions to perform motion function block may vary depending on systems.

(7) Relative position operation command input variables
: These are input variables to perform relative position operation (MC_MoveRelative) motion function block.
- Command-axis: It sets the axis in which motion function block is performed.
- Changes in parameters during operation: It sets whether to apply to the operation by changing the input variables of motion function block.
  For more information, refer to “6.1.5 Changes in parameters during execution of motion function block”.
- Operating distance: It sets distance to perform relative coordinate operation. Based on the current position, + value means forward direction, and – value means reverse direction value.
- Operating velocity: It sets velocity to perform relative coordinate operation.
- Operating acceleration, operating deceleration, operating jerk: It sets values to be applied in relative coordinate operation respectively.
- Buffer mode: It sets the point of time when motion function block is executed. That is, it sets whether to execute immediately or execute after the completion of commands which are currently being performed. For more details, refer to “6.1.4 Buffer Mode input”.

(8) Absolute position operation command input variables
: These are input variables to perform absolute position operation (MC_MoveAbsolute) motion function block.
- Command-axis: It sets the axis in which motion function block is performed.
- Changes in parameters during operation: It sets whether to apply to the operation by changing the input variables of motion function block.
  For more information, “6.1.5 Changes in parameters during execution of motion function block”.
- Target position: It sets the position that moves to absolute coordinate operation.
- Operating velocity: It sets the velocity when absolute position operation is performed to the target position.
- Operating acceleration, operating deceleration, operating jerk: It sets values to be applied in absolute coordinate operation respectively.
- Operating direction: It sets direction when moving to the target position. In case of 1, movement to the target position is made through forward direction operation, in case of 2, operation is made in the direction that can reach the target area in the shortest distance based on the current position, in case of 3, reverse direction, and in case of 4, movement to the target position is made through operation in the direction of the current operation.

- Buffer mode: It sets the point of time when motion function block is executed. That is, it sets whether to execute immediately or execute after the completion of commands which are currently being performed. For more details, refer to “6.1.4 Buffer Mode input”.

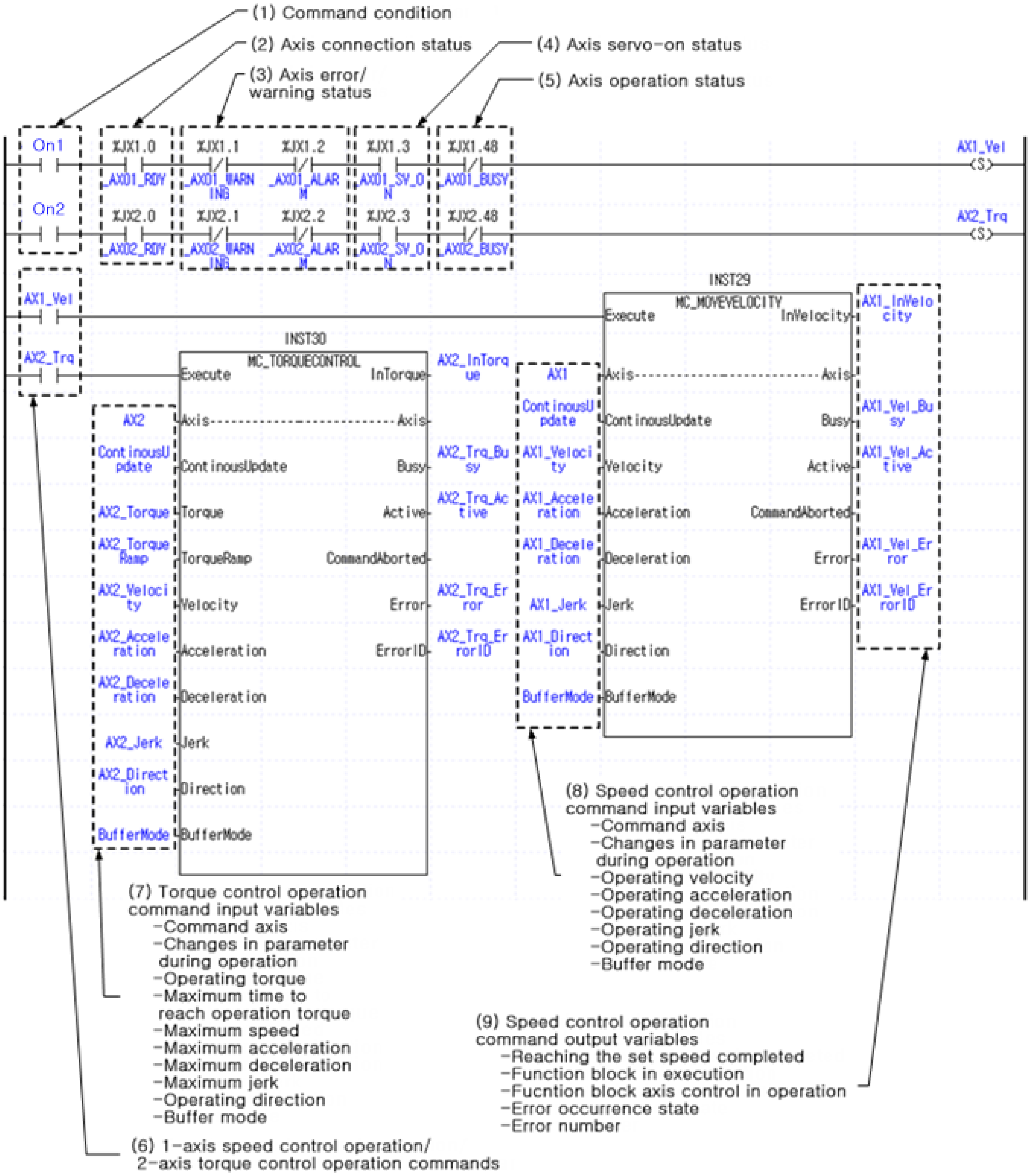
(9) Absolute position operation command output variable

: It is a variable to store output values generated when absolute position operation (MC_MoveAbsolute) motion function block is executed.

- Operation completed: When absolute coordinate operation is completed, it is On.
- Function Block in execution: When motion function block is executed, it is On, and if operation completed is On, it is Off.
- Function Block axis control in operation: In case motion function block is controlling the axis, it is On.
- Error occurrence state: In case error occurs when motion function block is executed, it is On.
- Error number: In case error occurs, the number that corresponds to error is generated.
- For more details on the output of motion function, refer to “Edge operation motion function block” of “6.1.3 basic input and output variables”.

### 7.3.4 Speed/Torque Control Operation

These are example programs for speed control and torque control operation using motion control modules. In case of the torque control, torque control of servo drive is used, and in motion control module, command for executing torque control is issued, and execution completion and status is monitored.



(1) Command condition

: It is a condition to make the axis perform speed control/torque control operations.

(2) Axis connection state flag

: In case the axis to be operated is connected to motion control module, and EtherCAT communication with motion control module is normally performed, it is On.

(3) Axis error/Warning status flag

: If there are errors and warnings in the axis, it is On.

(4) Axis servo-on status flag

: If the axis is in servo-on state, it is On, and servo-off state, it becomes Off.

(5) Axis operation status flag

: If the axis is in operation, it is On.

(6) 1-axis speed control operation/ 2-axis torque control operation commands

: In example programs, specified velocity operation (MC_MoveVelocity) motion function block is executed in 1-axis, and toque control operation (MC_TorqueControl) motion function block is executed in 2-axis under the following conditions.

- The axis operation condition is On.
- The axis is normally connected.
- There should be no errors and warnings.
- Servo-on state
- Not in operation

Conditions to perform motion function block may vary depending on systems.

(7) Torque control operation command input variables

: These are input variables to execute torque control operation (MC_TorqueControl) motion function block.

- Command axis: It sets the axis in which motion function block is executed.
- Changes in parameters during operation: It sets whether to apply to the operation by changing input variable values of the motion function block. For details, refer to “6.1.5 Changes in parameters during the execution of motion function block”.
- Operation torque: It sets torque values in torque control operation.
- The maximum time to reach operation torque: It sets the maximum slope from the current torque until changed to the set torque. Its unit is [Unit/s].
- Maximum speed, maximum acceleration, maximum deceleration, maximum jerk: It sets values to be applied to respective torque control operation.
- Operating direction: It sets direction to be operated with torque control. In case of 1, it operates in forward direction, in case of 3, in reverse direction, and in case of 4, it operates in current operation direction.
- Buffer mode: It sets the point of time when motion function block is executed. That is, it sets whether to execute immediately or execute after the completion of commands which are currently being performed. For details, refer to “6.1.4 Buffer Mode input”.

(8) Speed control operation command input variables

: These are input variables to execute specified velocity operation (MC_MoveVelocity) motion function block.

- Command axis: It sets the axis in which motion function block is executed.
- Changes in parameters during operation: It sets whether to apply to the operation by changing input variable values of the motion function block. For details, refer to “6.1.5 Changes in parameters during execution of motion function block”.
- Operating velocity: It sets velocity in speed control operation.
- Operating acceleration, operating deceleration, operating jerk: It sets values to be applied in speed control operation respectively.
- Operating direction: It sets directions in speed control operation. In case of 1, it operates in forward direction, in case of 3, in reverse direction, and in case of 4, it operates in direction of the current operation.
- Buffer mode: It sets the point of time when motion function block is executed. That is, it sets whether to execute immediately or execute after the completion of commands which are currently being performed. For details, refer to “6.1.4 Buffer Mode input”.

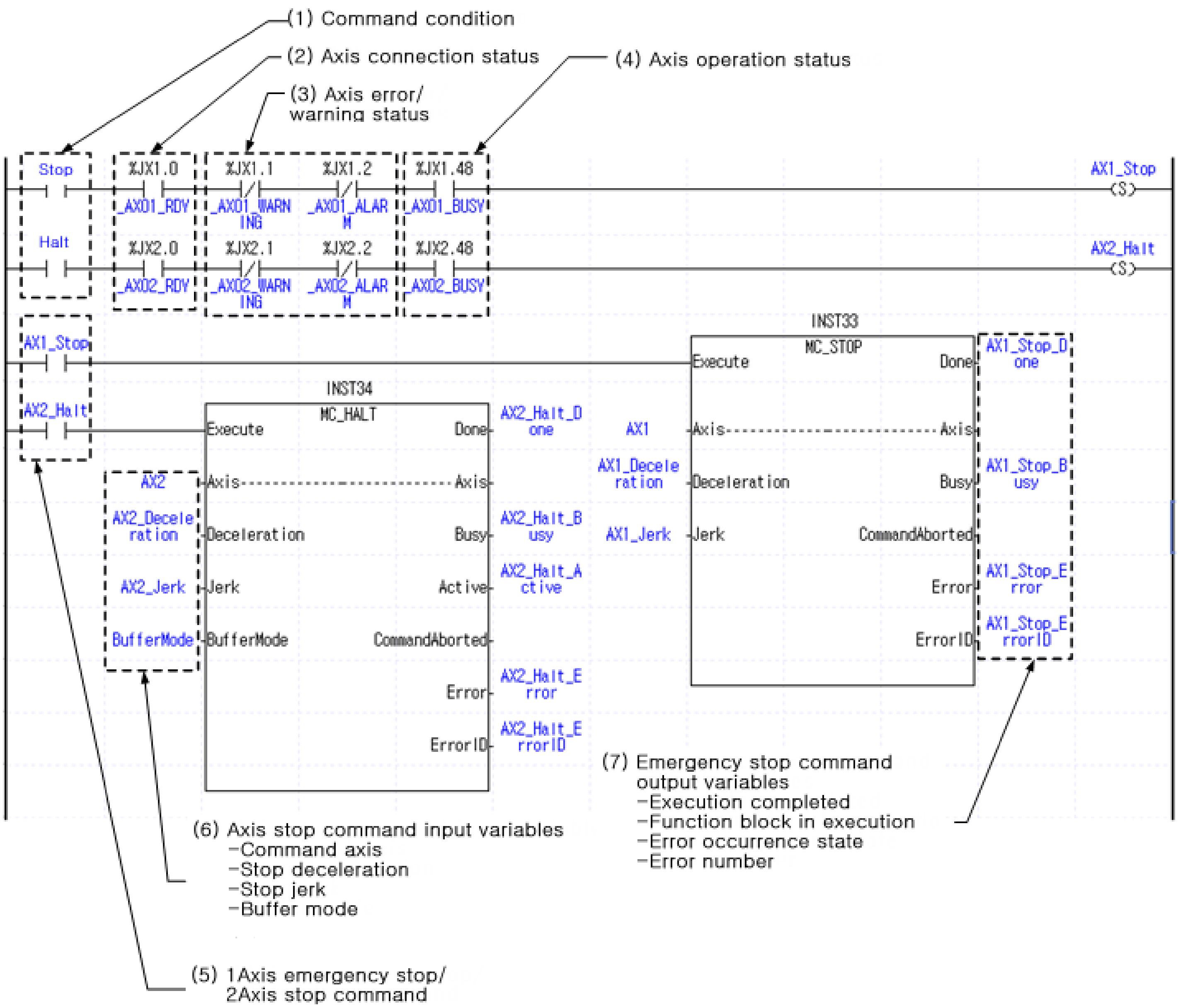
(9) Speed control operation command output variable

: It is a variable to store output values generated when specified velocity operation (MC_MoveVelocity) motion function block is executed.

- Reaching the set speed completed: When the set speed is reached through speed control operation, it is On.
- Function Block in execution: If motion function block is being performed, it is On, and operation is completed, it becomes Off.
- Function Block axis control in operation: In case motion function block controls the axis, it is On.
- Error occurrence state: In case error occurs while the motion function block is being executed, it is On.
- Error number: In case error occurs, the number that corresponds to error is generated.
- For more details on the output of function block, refer to “Edge operation motion function block” of “6.1.3 Basic input and output variables”.

### 7.3.5 Axis Stop

It is an example program to stop the axis in operation. The motion function block to stop the axis in operation includes “Immediate Stop (MC_Stop)” and “Halt (MC_Halt)”. As a command to implement emergency stop of the axis, “Immediate Stop (MC_Stop)” performs “Immediate Stop (MC_Stop)”, and other motion function blocks cannot be executed during the stop. As a command to stop the axis, “Halt (MC_Halt)” performs “Halt (MC_Halt)”, the stop status is aborted by other motion function blocks during the stop, and other motion function blocks can be executed. For more details, refer to “Chapter 6 Command”.



(1) Command condition

: It is a condition to give emergency stop/axis stop commands to the axis.

(2) Axis connection state flag

: In case the axis to be operated is connected to motion control module, and EtherCAT communication with motion control module is normally performed, it is On.

(3) Axis error/warning status flag

: If there are errors and warning in the axis, it is On.

(4) Axis operation status flag

: If the axis is in operation, it is On.

(5) 1-axis emergency stop / 2-axis axis stop commands

: In example programs, immediate stop (MC_Stop) motion function block is executed in 1-axis, and halt (MC_Halt) motion function block is executed in 2-axis under the following conditions.

- The axis stop condition is On.
- The axis is normally connected.
- There should be no errors and warnings.
- In operation

Conditions to perform motion function block may vary depending on systems.

(6) Axis stop command input variables

: These are input variables to execute Halt (MC_Halt) motion function block.

- Command axis: It sets the axis in which motion function block is executed.
- Stop deceleration: Its sets deceleration from operating speed at the time of axis stop to a stop.
- Stop jerk: it sets the jerk at the stop time.
- Buffer mode: It sets the point of time when motion function block is executed. That is, it sets whether to execute immediately or execute after the completion of commands which are currently being performed. For details, refer to “6.1.4 Buffer Mode input”.

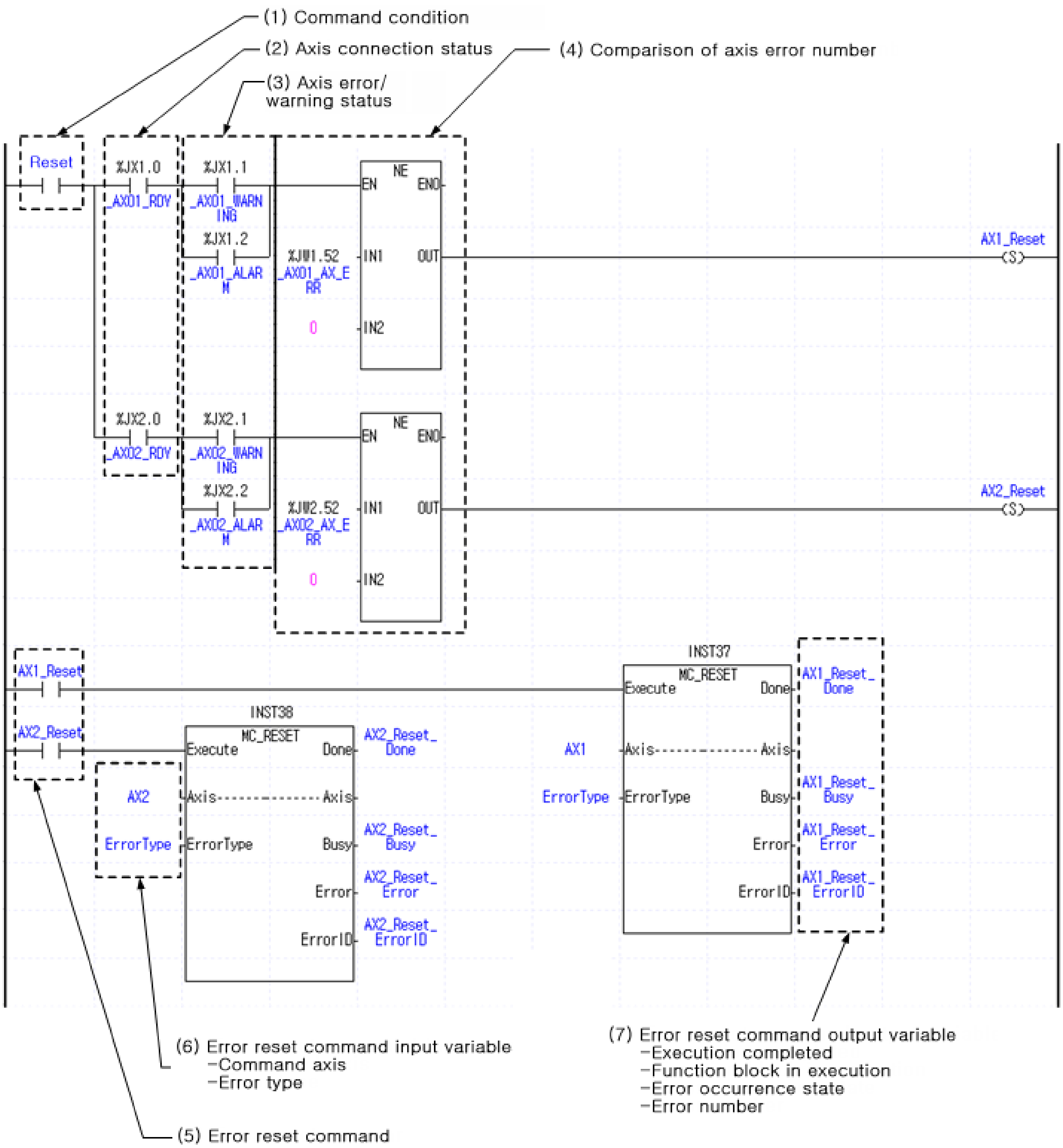
(7) Emergency stop command output variables

: It is a variable to store output values generated when Immediate Stop (MC_Stop) motion function block is executed.

- Execution completed: In case the axis stop, it is On.
- Function Block in execution: If motion function block is being performed, it is On, and execution is completed, it becomes Off.
- Error occurrence state: In case error occurs while the motion function block is being executed, it is On.
- Error number: In case error occurs, the number that corresponds to error is generated.
- For more details on the output of motion function block, refer to “Edge operation motion function block” of “6.1.3 Basic I/O Variable.

## 7.3.6 Error Processing

It is an example program to check the errors that occurred on the axis and conduct error reset.



(1) Command condition

: It is a condition to give error reset commands to the axis.

(2) Axis connection status flag

: In case the axis to be operated is connected to motion control module, and EtherCAT communication with motion control module is normally performed, it is On.

(3) Axis error/Warning status flag

: If there are errors and warnings in the axis, it is On.

(4) Comparison of axis error number

: In example programs, a case where the value of error number flag on the axis is not 0 is determined to be error reset condition through a comparison.

(5) Error reset command

: In example programs, axis error reset (MC_Reset) motion function block is executed under the following conditions.

- The axis operation condition is On.
- The axis is normally connected.
- There should be error and warnings.
- Error number is not 0.

Conditions to perform motion function block may vary depending on systems.

(6) Error reset command input variables

: These are input variables to execute axis error reset (MC_Reset) motion function block.

- Command axis: It sets the axis in which motion function block is executed.
- Error type: The type of error for error rest is set. 0 represents axis error, and 1 common error.

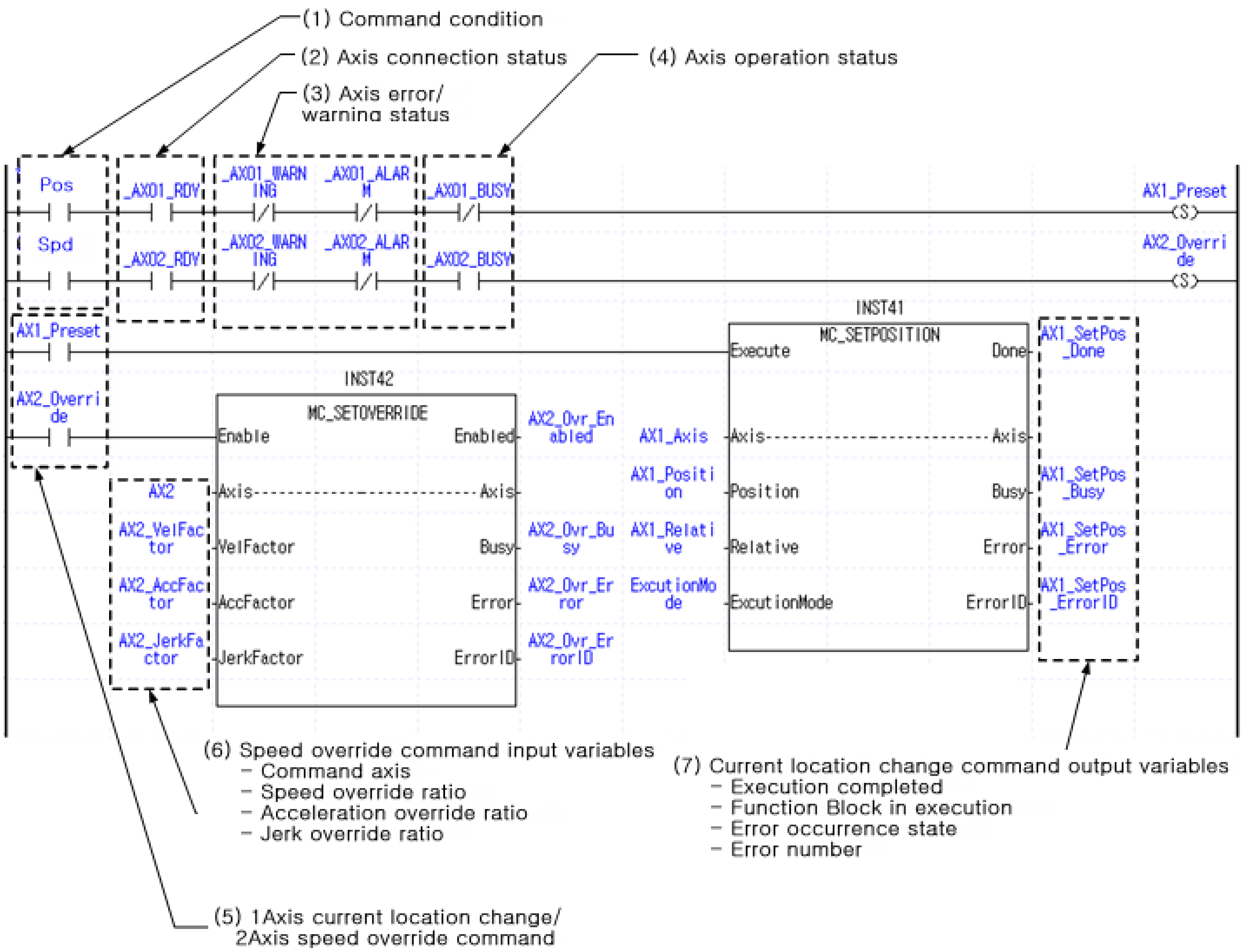
(7) Error reset command output variables

: It is a variable to store output values generated when axis error reset (MC_Reset) motion function block is executed.

- Execution completed: The execution of motion function block is completed, it is On.
- Function Block in execution: If motion function block is being performed, it is On, and execution is completed, it becomes Off.
- Error occurrence state: In case error occurs while the motion function block is being executed, it is On.
- Error number: In case error occurs, the number that corresponds to error is generated.
- For details on the output of motion function block, refer to “Edge operation motion function block” of “6.1.3 Basic I/O Variable”.

### 7.3.7 Change in Operation

It is an example program to change the current location of the axis and speed in operation.



(1) Command condition

: It is a condition to give current location change/operating speed change commands to the axis.

(2) Axis connection state flag

: In case the axis is to be operated is connected to motion control module, and EtherCAT communication with motion control module is normally performed, it is On.

(3) Axis error/Warning status flag

: If there are errors and warnings in the axis, it is On.

(4) Axis operation status flag

: If the axis is in operation, it is On.

(5) 1-axis current location change/2-axis speed override command

: In the example program, the current location setting (MC_SetPosition) motion function block is executed under the following conditions.

- The current location change condition is On.
- The axis is normally connected.
- There should be no errors and warnings.
- The axis is not in operation.

In addition, speed/acceleration override (MC_SetOverride) motion function block is executed under the following conditions.

- The operating speed change condition is On.
- The axis is normally connected.
- There should be no errors and warnings.
- The axis is in operation.

Conditions to execute motion function block may vary depending on systems.

(6) Speed override command input variables

: These are input variables to execute speed/acceleration override (MC_SetOverride) motion function block.

- Command axis: It set the axis in which motion function block is executed.
- Speed override ratio: It sets the ratio of the speed to change in comparison with operating speed that is currently set.
- Acceleration override ratio: It sets the ratio of the acceleration to change in comparison with acceleration value which is currently set.
- Jerk override ratio: It sets the ratio of the jerk to change in comparison with jerk value that is currently set. That is, if 2 is set to the value of the ratio, double the currently set value is set. .

(7) Current location change command output variables

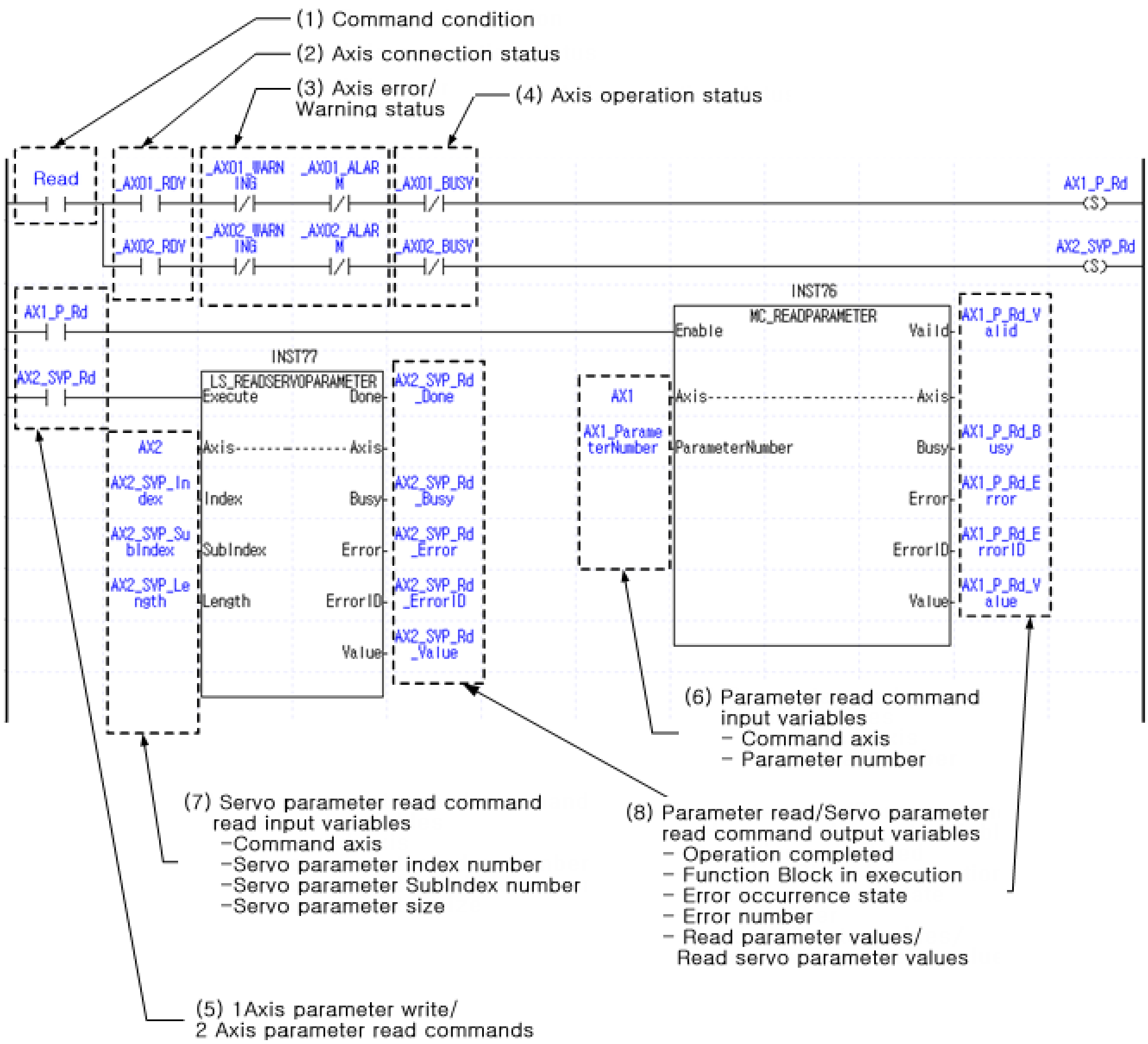
: These are variables to store output values generated when the current location setting (MC_SetPosition) motion function block is executed.

- Execution completed: If the execution of motion function block is completed, it is On.
- Function Block in execution: When motion function block is executed, it is On, and the execution is completed, It becomes Off.
- Error occurrence state: In case error occurs while the motion function block is being executed, it is O.
- Error number: In case error occurs, the number that corresponds to error is generated.
- For details on the output of motion function block, refer to “Edge operation motion function block” of “6.1.3 Basic input and output variables.

### 7.3.8 Parameter Write/Read

Parameter read/write commands include “Parameter Write (MC_WriteParameter)” and Parameter Read (MC_ReadParameter)” as well as “Servo Parameter Write (LS_WriteServoParameter)” and “Servo Parameter Read (LS_ReadServoParameter)”. “Parameter Write (MC_WriteParameter)” and “Parameter Read (MC_ReadParameter)” are commands to read or write operation parameters of the axis, and “Servo Parameter Write (LS_WriteServoParameter)” and “Servo Parameter Read (LS_ReadServoParameter)” are commands to read or write parameters of the connected servo drive. The following shows examples of programs to read or change operation parameters and servo parameters using parameter read/write commands.

■ Parameter Read




(1) Command condition

: It is a condition to read parameters and serve parameters of the axes.

(2) Axis connection state flag

: In case the axis to be operated is connected to motion control module, and EtherCAT communication with motion control module is normally performed, it is On.

(3) Axis error/Warning status flag
: If there are errors and warnings in the axis, it is On.
(4) Axis operation status flag
: If the axis is in operation, it is On.
(5) 1-axis parameter write/ 2-axis servo parameter read commands
: In example programs, Parameter Read (MC_ReadParameter) motion function block is executed in 1-axis, and Servo Parameter Read (LS_ReadServoParameter) motion function block is executed in 2-axis under the following conditions.
- Parameter read condition is On.
- The axis is normally connected.
- There should be no errors and warnings.
- Not in operation
Conditions to execute motion function block may vary depending on systems.
(6) Parameter read command input variables
: These input variables to execute Parameter Read (MC_ReadParameter) motion function block.
- Command axis: It sets the axis in which motion function block is executed.
- Parameter number: It sets the parameter numbers to read with motion function block.
Numbers by parameter are as follows.

| Number | Parameter | Item | Settings |
|---|---|---|---|
| 0 | Basic Parameter | Unit | 0:pulse, 1:mm, 2:inch, 3:degree |
| 1 | | Pulses per rotation | [pulse] |
| 2 | | Travel per rotation | [Unit] |
| 3 | | Speed command unit | 0:Unit/Time, 1:rpm |
| 4 | | Speed limit | [Unit/s, rpm] |
| 5 | | Emergency stop deceleration | [Unit/s$^2$] |
| 6 | | Encoder select | 0:Incremental Encoder,1:Absolute Encoder |
| 7 | | Gear ratio(Motor) | |
| 8 | | Gear ratio(Machine) | |
| 9 | | Operation mode of the reverse rotation | 0:Disable, 1:Enaable |
| 10 | Extended Parameter | S/W upper limit | [Unit] |
| 11 | | S/W lower limit | [Unit] |
| 12 | | Infinite running repeat position | [Unit] |
| 13 | | Infinite running repeat | 0:Disable, 1:Enable |
| 14 | | Command inposition range | [Unit] |
| 15 | | Tracking error over-range value | [Unit] |
| 16 | | Current position compensation amount | |
| 17 | | Current speed filter time constant | |
| 18 | | Error reset monitoring time | [ms] |
| 19 | | S/W limit during speed control | 0:Don’t detect, 1:Detect |
| 20 | | Tracking error level | 0:Warning, 1:Alarm |
| 21 | | JOG high speed | [Unit/s] |
| 22 | | JOG low speed | [Unit/s] |
| 23 | | JOG Acceleration | [Unit/s$^2$] |
| 24 | | JOG Deceleration | [Unit/s$^2$] |
| 25 | | JOG Jerk | [Unit/s$^3$] |

(7) Servo parameter read command read input variables

: These are input variables to execute Servo Parameter Read (LS_ReadServoParameter) motion function block.

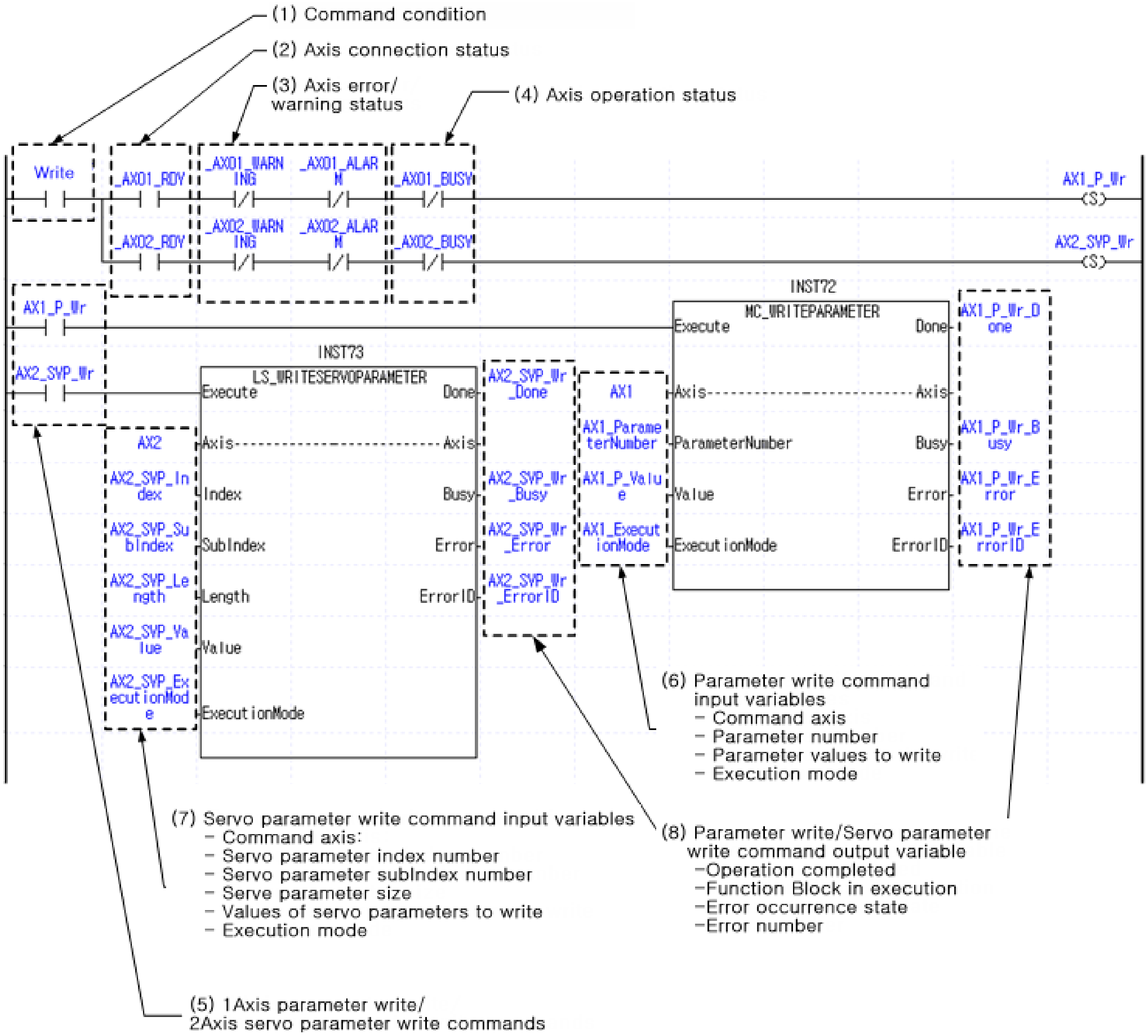
- Command axis: It sets the axis in which motion function block is executed.
- Servo parameter index number, SubIndex number, size: Each value is set in servo parameters to read. Refer to the instruction manual of the servo drive for index number, subindex number and size of servo parameters.

(8) Parameter read/Servo parameter read command output variables

: These are variables to store output values generated when Parameter Read (MC_ReadParameter) and Servo Parameter Read (LS_ReadServoParameter) motion function block is executed.

- Operation completed: If values of parameters and servo parameters is read, it is On.
- Function Block in execution: When motion function block is executed, it is On, and the operation completion is On, it becomes Off.
- Error occurrence state: In case error occurs while the motion function block is being executed, it is On.
- Error number: In case error occurs, the number that corresponds to error is generated.
- Read parameter values/Read servo parameter values: Values of parameters and servo parameters read by the execution of motion function block is stored.

■ Parameter Write

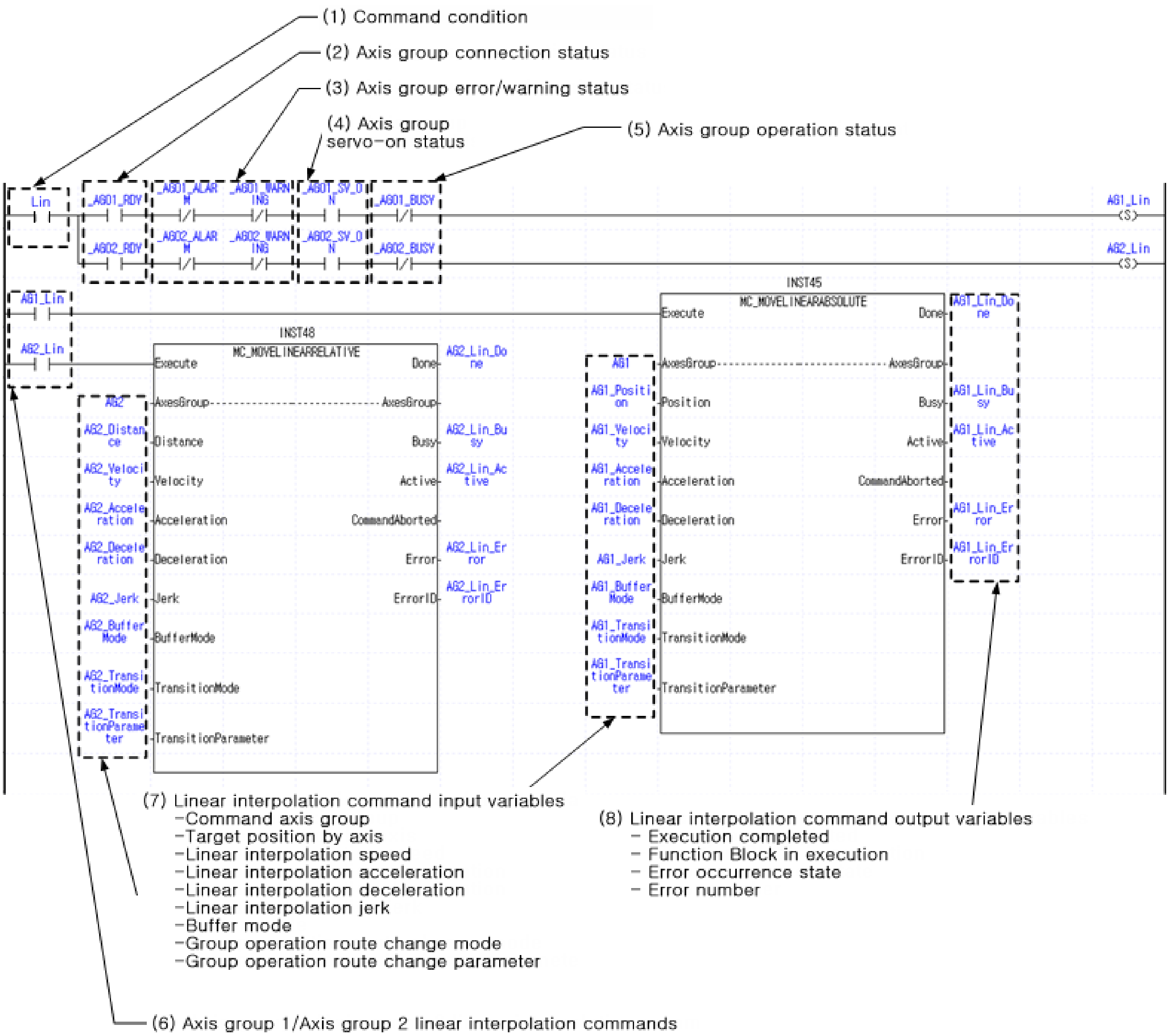


(1) Command condition
: It is a condition to write parameters and servo parameters of the axes.
(2) Axis connection state flag
: In case the axis to be operated is connected to motion control module, and EtherCAT communication with motion control module is normally performed, it is On.
(3) Axis error/Warning status flag
: If there are errors and warnings in the axis, it is On.
(4) Axis operation status flag
: If the axis is in operation, it is On.
(5) 1-axis parameter write/ 2-axis servo parameter write commands
: In example programs, Parameter Write (MC_WriteParameter) motion function block is executed in 1-axis, and Servo Parameter Write (LS_WriteServoParameter) motion function block is executed in 2-axis under the following conditions.
- Parameter write condition is On
- The axis is normally connected.
- There should be no errors and warnings.
- Not in operation
Conditions to execute function block may vary depending on systems.
(6) Parameter write command input variables
: These are input variables to execute Parameter Write (MC_WriteParameter) motion function block.
- Command axis: It sets the axis in which motion function block is executed.
- Parameter number: It set parameter numbers to write with the motion function block.
- Parameter values to write: Values to write in the parameters are set.
- Execution mode: It specifies the point of time when parameters are written. If it sets 0, it changes parameter values upon executing motion function block. If it sets 1, it is changed to the same point of time with “Buffered” of BufferMode. (Refer to 6.1.4 BufferMode)
(7) Servo parameter write command input variables
: These are input variables to execute Servo Parameter Write (LS_WriteServoParameter) motion function block.
- Command axis: It sets the axis in which motion function block is executed.
- Servo parameter index number, subIndex number, size: Each value is set according to servo parameters to write. Refer to instruction manual of the servo drive for index number, subindex number and size of servo parameters.
- Values of servo parameters to write: Values to be written in the servo parameters is set.
- Execution mode: it certifies the point of time when parameters are written. It is sets 0, it changes parameter values upon executing motion function block. If it sets 1, it is changed to the same point o time with ‘Buffered’ of BufferMode. (Refer to 6.1.4 BufferMode)
(8) Parameter write/Servo parameter write command output variable
: It is a variable to store output values generated when Parameter Write (MC_WriteParameter) and Servo Parameter Write (LS_WriteServoParameter) motion function block is executed.
- Operation completed: If values of the parameters and servo parameters are written, it is On.
- Function Block in execution: When motion function block is executed, it is On, and operation completion is On, it becomes Off.
- Error occurrence state: In case error occurs while motion function block is being executed, it is On. As for error number, the number that corresponds to error is generated in case error occurs.

## 7.4 Multi-Axis Operation Program

### 7.4.1 Linear Interpolation Operation

It is an example program to operate linear interpolation with axes set to the same group. In the example program, 1-axis and 2-axis are assumed to be included in the same axis group. Refer to the example program of “7.4.5 Axis group processing” to include an axis in axis group or remove the axis from axis group.



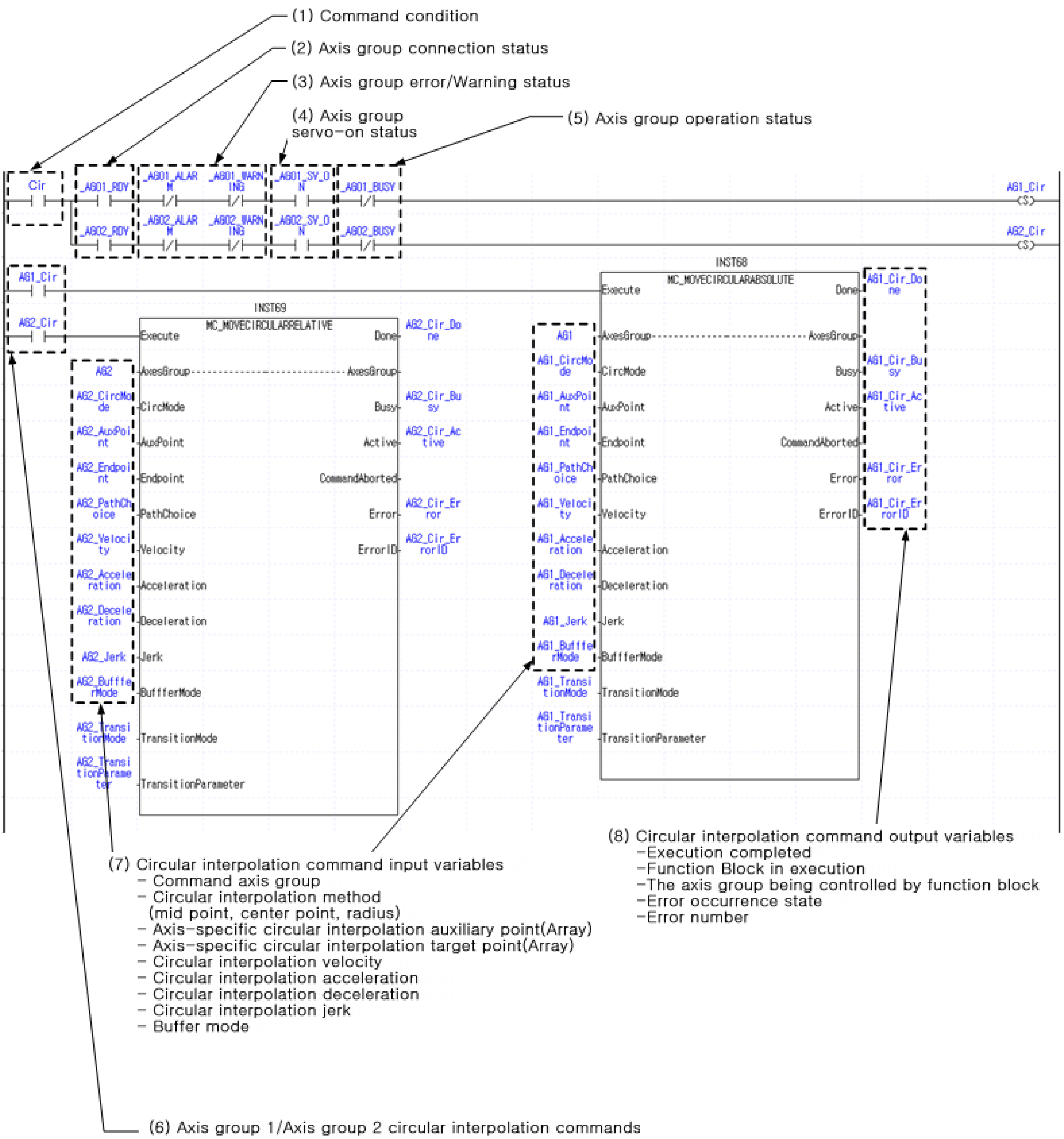
(1) Command condition
: It is a condition to give linear interpolation command to the axis group.
(2) Axis group connection state flag
: In case axes of the axis group to be operated are connected to motion control module, and EtherCAT communication with motion control module is normally performed, it is On.
(3) Axis group error/Warning status flag
: If there are errors and warnings in axes included in the axis group, it is On.
(4) Axis group servo-on status
: If axes included in the axis group are in servo-on state, it is On.
(5) Axis group operation status flag
: If axes of the axis group are in operation, it is On.
(6) Axis group 1 absolute position linear interpolation/Axis group 2 relative position linear interpolation commands
: In example programs, absolute position linear interpolation operation (MC_MoveLinearAbsolute) is executed in axis group 1, and relative position linear interpolation operation (MC_MoveLinearRelative) motion function block in axis 2 under the following conditions.
- Linear interpolation operation condition is On.
- Axes included in the axis group are normally connected.
- There should be no errors and warnings.
- Axes of the axis group are not in operation.

Conditions to execute motion function block may vary depending on systems.
(7) Linear interpolation command input variables
: These are input variables to execute absolute position linear interpolation operation (MC_MoveLinearAbsolute) and relative position linear interpolation operation (MC_MoveLinearRelative) motion function block.
- Command axis group: It sets axis group in which motion function block is executed.
- Target position by axis: Array variables are set, and linear interpolation operation target position of axes included in axis group is set in order.
- Linear interpolation speed: It sets target speed to execute linear interpolation, when the speed refers to the interpolation speed.
- Linear interpolation acceleration, deceleration, jerk: they set values to be applied when performing linear interpolation.
- Buffer mode: It sets the point of time when motion function block is executed. That is, it sets whether to execute immediately or execute after the completion of commands which are currently being performed. For details, refer to “6.1.4 Buffer Mode Input”.
- Group operation route change mode and group operation route change parameter: It specifies in which way the axis group in operation is connected to the trace the existing commands describe when linear interpolation command is given. Refer to “6.1.6 Group operation route change settings”.

(8) Linear interpolation command output variable
: It is a variable to store output values generated when absolute position linear interpolation operation (MC_MoveLinearAbsolute) and relative position linear interpolation operation (MC_MoveLinearRelative) motion function block is executed.
- Execution completed: When the execution of function block is completed, it is On.
- Function Block in execution: When motion function block is executed, it is On, and the execution is completed, it becomes Off.
- Error occurrence state: In case error occurs as the motion function block is executed, it is On.
- Error number: In case error occurs, the number that corresponds to error is generated.
- For details on the output of motion function block, refer to “Edge operation motion function block” of “6.1.3 Basic I/O Variable”.

### 7.4.2 Circular Interpolation Operation

It is an example program to operate circular interpolation operation with axes set to the same group. In the example program, 1-axis and 2-axis are assumed to be included in the same axis group. Refer to "7.4.5 Axis group processing" to include an axis in axis group or remove axis from axis group.



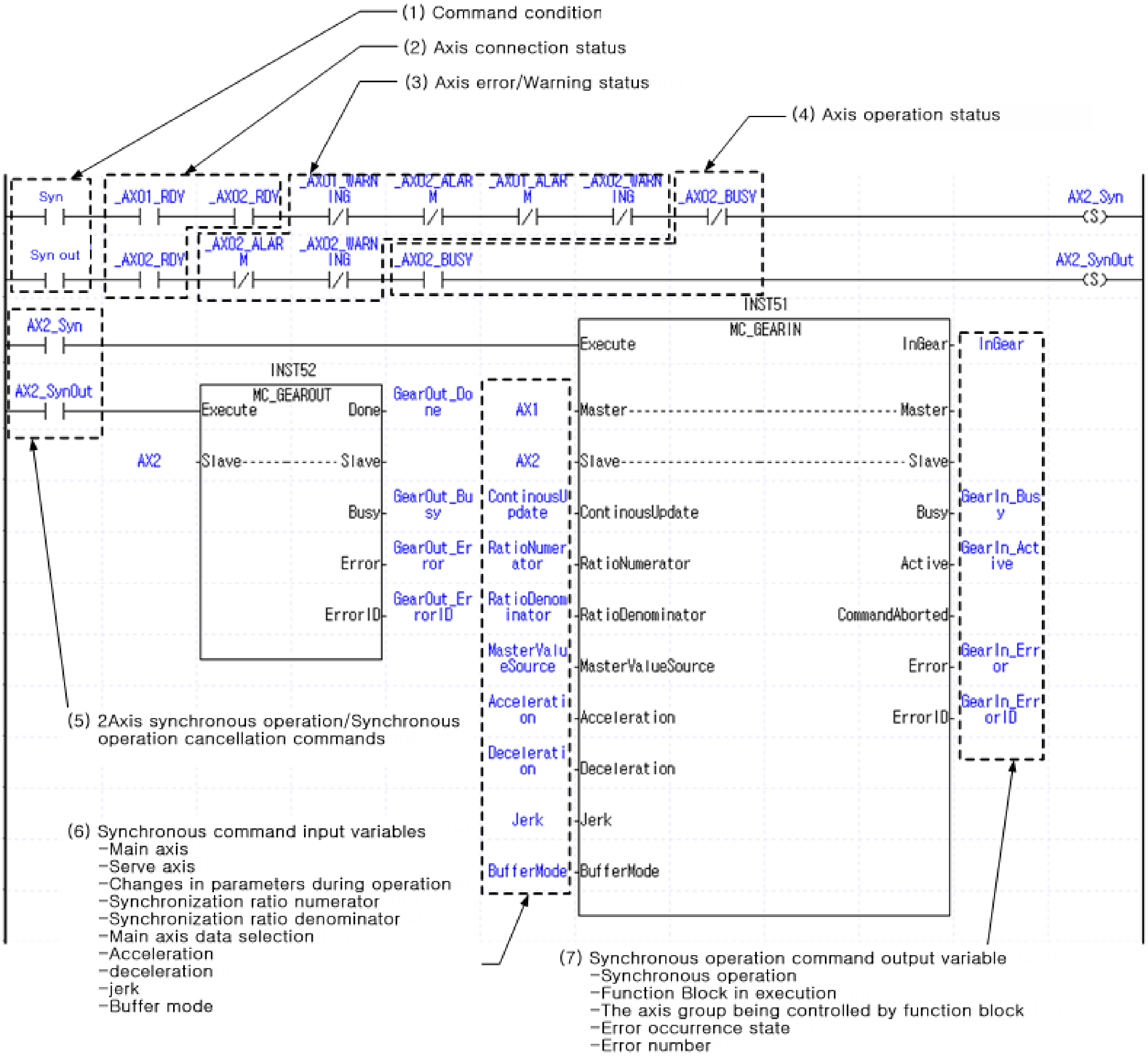
(1) Command condition
: It is a condition to give circular interpolation command to the axis group.
(2) Axis group connection state flag
: In case axes of the axis group to be operated is connected to motion control module, and EtherCAT communication with motion control module is normally performed, it is On.
(3) Axis group error/Warning status flag
: If there are errors and warnings in axes included in the axis group, it is On.
(4) Axis group servo-on status
: If axes included in the axis group are in servo-on state, it is On.
(5) Axis group operation status flag
: If axes of the axis group are in operation, it is On.
(6) Axis group 1 absolute position circular interpolation/Axis group 2 relative position circular interpolation commands
: In example programs, absolute position circular interpolation operation (MC_MoveCircularAbsolute) is executed in axis group 1, and relative position circular interpolation operation (MC_MoveCircularRelative) motion function block in axis 2 under the following conditions.
- Circular interpolation operation condition is On.
- Axes included in the axis group are normally connected.
- There should be no errors and warnings.
- Axes of the axis group are not in operation.

Conditions to execute motion function block may vary depending on systems.
(7) Circular interpolation command input variables
: These are input variables to execute absolute position circular interpolation operation (MC_MoveCircularAbsolute) and relative position circular interpolation operation (MC_MoveCircularRelative) motion function block.
- Command axis group: It sets axis group in which motion function block is to be executed.
- Target position by axis: Array variables are set, and linear interpolation operation target position of axes included in axis group is set in order.
- Circular interpolation method: It sets a method to execute circular interpolation through selection among mid-point method, center point method and radius method.
- Axis-specific circular interpolation auxiliary point: It takes a form of array and sets auxiliary point required for circular interpolation in the order of axes included in axis group.
- Axis-specific circular interpolation target point: It takes a form of array and sets target position in the order of axes included in axis group.
- Circular interpolation velocity: It sets target speed to execute circular interpolation, when the speed refers to interpolation speed.
- Circular interpolation acceleration, deceleration, jerk: Values to be applied when circular interpolation is performed are set.
- Buffer mode: It sets the point of time when motion function block is executed. That is, it set whether to execute immediately or execute after the completion of commands which are currently being performed. For details, refer to “6.1.4 Buffer Mode Input”.

(8) Circular interpolation command output variable
: It is a variable to store output values generated when absolute position circular interpolation operation (MC_MoveCircularAbsolute) and relative position circular interpolation operation (MC_MoveCircularRelative) motion function block is executed.
- Execution completed: When the execution of motion function block is completed, it is On.
- Function Block in execution: When motion function block is executed, it is On, and the execution is completed, it becomes Off.
- The axis group being controlled by function block: When motion function block controls the axis group, it is On.
- Error occurrence state: In case error occurs as the motion function block is executed, it is On.
- Error number: In case error occurs, the number that corresponds to error is generated.
- For details on the output of motion function block, refer to “Edge motion commands” of “6.1.3 Basic I/O Variable”.

### 7.4.3 Synchronous Operation

It is an example program on the synchronous operation in which serve axis moves in synchronization ratio set in the main axis.



(1) Command condition

: It is a condition to give synchronous operation/synchronous operation cancellation commands to the axis.

(2) Axis connection state flag

: When axis to be operated is connected to motion control module, and EtherCAT communication with motion control module is normally performed, it is On.

(3) Axis error/Warning state flag

: If there are errors and warning in the axis, it is On.

(4) Axis operation status flag

: If the axis is in operation, it is On.

(5) 2Axis synchronous operation/Synchronous operation cancellation commands

: In the example program, electronic gear operation (MC_GearIn) motion function block is executed under the following conditions.

- Synchronous operation condition is On.
- The axis and main axis is normally connected.
- There should be no errors and warnings.
- The axis is not in operation.

In addition, electronic gear cancellation (MC_GearOut) motion function block is executed under the following conditions.

- Synchronous operation cancellation condition is On.
- The axis is normally connected.
- There should be no errors and warnings.
- The axis is in operation.

Conditions to execute motion function block may vary depending on systems.

(6) Synchronous command input variables

: These are input variables to execute electronic gear operation (MC_GearIn) motion function block.

- Main axis: It sets serve axis of synchronous operation.
- Serve axis: It sets the axis in which synchronous operation is to be performed.
- Changes in parameters during operation: It sets whether to apply to the operation by changing input variable values of the function block. For details, refer to “6.1.5 Changes in parameters during execution of motion function block”.
- Synchronization ratio numerator: It sets numerator value among synchronization ratio to be operated by synchronization of the operation of main axis.
- Synchronization ratio denominator: It sets denominator among synchronization ratio to be operated by synchronization of the operation of main axis.
- The speed of serve axis in a state of gear operation (InGear) is set as follows.

Serve axis speed = Main axis speed x (Synchronization ratio numerator/Synchronization denominator)

- Main axis data selection: It selects whether the data of main axis is set to command speed or current speed.
  In case command speed is set, synchronization is achieved based on the speed of main axis calculated in motion control module.
  In case current speed is set, synchronization is achieved by using speed data of main axis servo drive transmitted through the communication.
- Acceleration, deceleration, jerk: Each value is set in synchronous operation.
- Buffer mode: It sets the point of time when motion function block is executed. That is, it sets whether to execute immediately or execute after the completion of commands which are currently being performed. For details, refer to “6.1.4 Buffer Mode Input”.

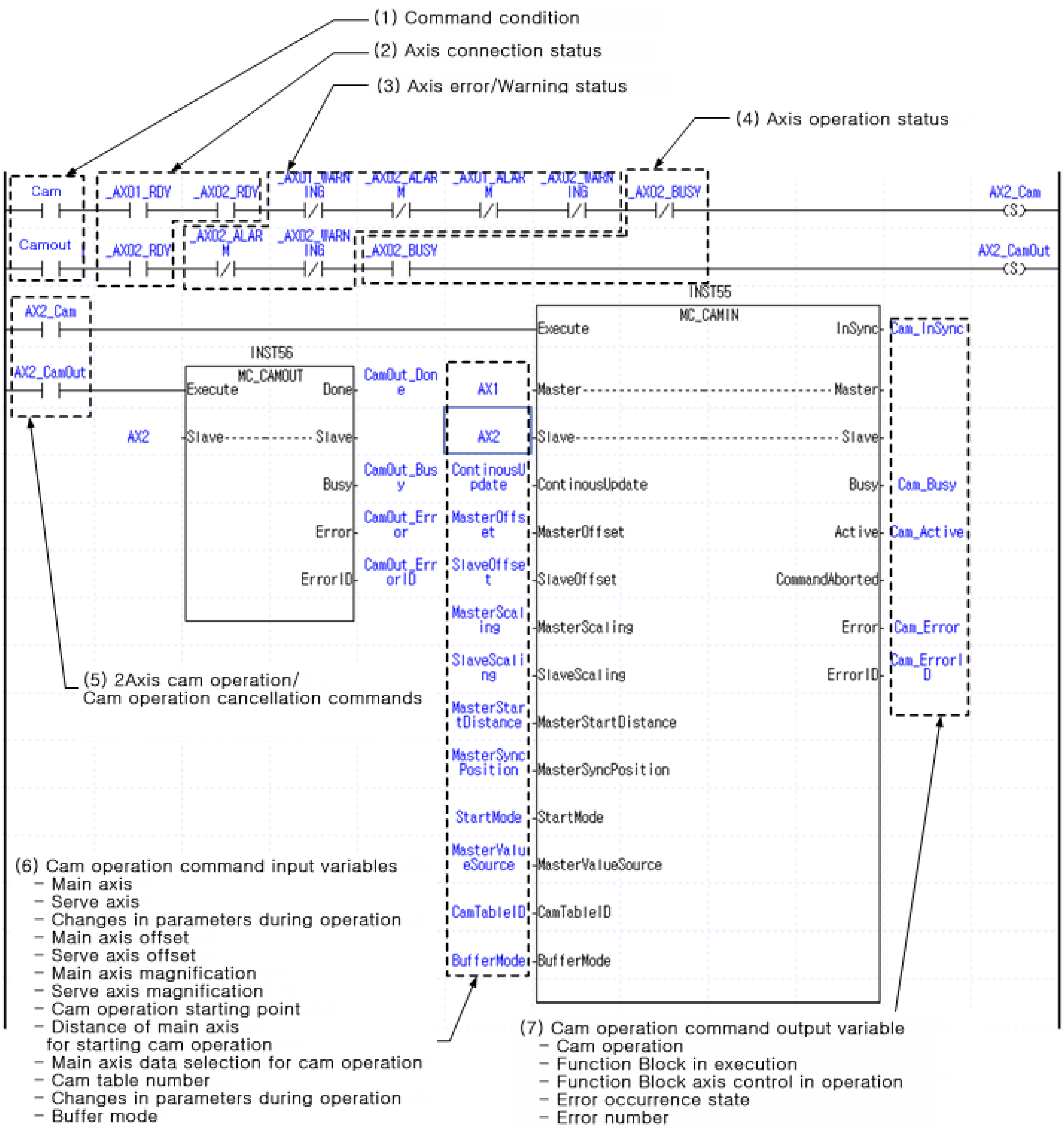
(7) Synchronous operation command output variable

: It is a variable to store output values generated when electronic gear operation (MC_GearIn) motion function block is executed.

- Synchronous operation: When serve axis is normally synchronized in main axis after the execution of motion function block, it is On.
- Function Block in execution: When motion function block is executed, it is On, and the execution is completed, it becomes Off.
- The axis group being controlled by function block: When motion function block controls the axis group, it is On.
- Error occurrence state: In case error occurs as the motion function block is executed, it is On.
- Error number: In case error occurs, the number that corresponds to error is generated.
- For details on the output of motion function block, refer to “Edge motion commands” of “6.1.3 Basic I/O Variable”.

### 7.4.4 CAM Operation

It is an example program on the cam operation that moves in synchronization based on cam (CAM) profile in which serve axis is set.



(1) Command condition
: It is a condition to give cam operation/cam operation cancellation commands to the axis.
(2) Axis connection state flag
: When the axis to be operated is connected to motion control module, and EtherCAT communication with motion control module is normally performed, it is On.
(3) Axis error/Warning status flag
: If there are errors and warnings in the axis, it is On.
(4) Axis operation status flag: If the axis is in operation, it is On.
(5) 2-axis cam operation/Cam operation cancellation commands
: In the example program, cam operation (MC_CamIn) motion function block is executed under the following conditions.
- Cam operation condition is On.
- The axis and main axis are normally connected.
- There should be no errors and warnings.
- The axis is not in operation.

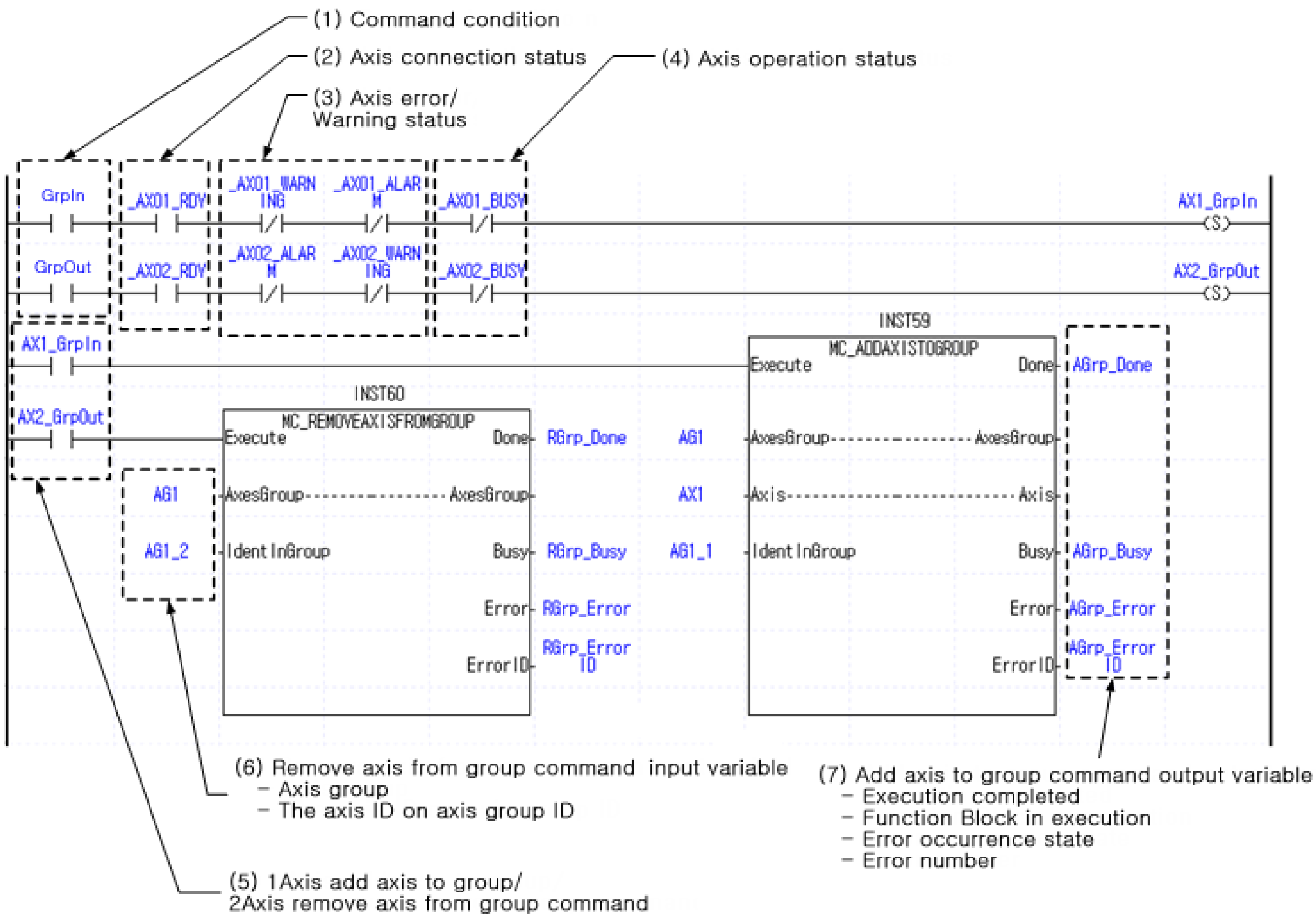
In addition, cam operation cancellation (MC_CamOut) motion function block is executed under the following conditions.
- Cam operation cancellation condition is On.
- The axis is normally connected.
- There should be no errors and warnings.
- The axis is in operation.

Conditions to execute motion function block may vary depending on systems.

(6) Cam operation command input variables
: These are input variables to execute cam operation (MC_CamIn) motion function block.
- Main axis: It sets main axis of cam operation.
- Serve axis: It sets the axis in which cam operation is executed.
- Changes in parameters during operation: It sets whether to apply to the operation by changing input variable values of the function block. For details, refer to “6.1.5 Changes in parameters during execution of motion function block”.
- Main axis offset: It sets offset values of main axis data to be used when cam table data is applied.
- Serve axis offset: It sets offset values of serve axis data to be used when cam table data is applied.
- Main axis magnification: It sets magnification of main axis data to be used when cam table data is applied.
- Serve axis magnification: It sets magnification of serve axis data to be used when cam table data is applied.
- Cam operation starting point: It sets the position of main axis which will be the starting point of cam table.
- Distance of main axis for starting cam operation: It sets the distance of main axis in which actual cam operation starts.
- Main axis data selection for cam operation: It selects main axis data which will be a basis of cam operation among main axis command position and main axis current position.
- Cam table number: It sets cam data number to conduct cam operation.
- For details on cam operation command input variables, refer to “6.4.1 Cam operation (MC_CamIn)”.
- Changes in parameters during operation: It sets whether to apply to the operation by changing input variable values of the function block. For details, refer to “6.1.5 Changes in parameters during execution of motion function block”.
- Buffer mode: It sets the point of time when motion function block is executed. That is, it sets whether to execute immediately or execute after the completion of commands which are currently being performed. For details, refer to “6.1.4 Buffer Mode Input”.

(7) Cam operation command output variable
: It is a variable to store output values generated when cam operation (MC_CamIn) motion function block is executed.
- Cam operation: It is on when serve axis is synchronized in main axis according to cam data after the execution of motion function block.
- Function Block in execution: When motion function block is executed, it is On, and the execution is completed, it becomes Off.
- Function Block axis control in operation: In case motion function block controls the axis, it is On.
- Error occurrence state: In case error occurs as the motion function block is executed, it is On.
- Error number: In case error occurs, the number that corresponds to error is generated.
- For details on the output of motion function block, refer to “Edge motion commands” of “6.1.3 Basic I/O Variable”.

### 7.4.5 Axis Group Processing



(1) Command condition
: It is a condition to give add axis to group/remove axis from group commands to the axis.
(2) Axis connection status flag
: In case the axis to be operated is connected to motion control module, and EtherCAT communication with motion control module is normally performed, it is On.
(3) Axis error/Warning status flag
: If there ae errors and warning in the axis, it is On.
(4) Axis operation status flag
: If the axis is in operation, it is On.
(5) 1-axis add axis to group/2-axis remove axis from group commands
: In the example program, add axis to group (MC_AddAxisToGroup) motion function block is executed under the following conditions.
- Add axis to group condition is On.
- The axis is normally connected.
- There should be no errors and warnings.
- The axis is not in operation.

In addition, group axis exclusion (MC_RemoveAxisFromGroup) motion function block is executed under the following conditions.
- Remove axis from group condition is On.
- The axis is normally connected.
- There should be no errors and warnings.
- The axis is not in operation.

Conditions to execute motion function block may vary depending on systems.
(6) Remove axis from group command input variables
: These are variables to execute group axis exclusion (MC_RemoveAxisFromGroup) motion function block.
- Axis group: It sets the group to exclude the axis.
- The axis ID on axis group ID: It sets ID values granted when the axis is included in axis group.
(7) Add axis to group command output variable
: It is a variable to store output values generated when add axis to group (MC_AddAxisToGroup) motion function block is executed.
- Execution completed: When motion function block is normally executed, it is On.
- Function Block in execution: When motion function block is executed, it is On, and the execution is completed, it becomes Off.
- Error occurrence state: In case error occurs as the motion function block is executed, it is On.
- Error number: In case error occurs, the number that corresponds to error is generated.
- For details on the output of motion function block, refer to “Edge motion commands” of “6.1.3 Basic I/O Variable”.

# 7.5 I/O Processing Program

Motion control module has the input of 8 points and output of 8 points internal, and it can expand input and output points using external EtherCAT input/output modules. EtherCAT input and EtherCAT output modules possible to be mounted on the outside can be expanded up to 4 stations and up to 256points.

## 7.5.1 Input Signal Processing

Internal input signals and signals inputted in external input module can be used in the program using an internal flag of the motion control module.
For details on the kinds and functions of flags, refer to “5.1.1 Flag”.

## 7.5.2 Output Signal Processing

Internal output signals and signals inputted in external output module can be used in the program using an internal flag of the motion control module.
For details on the kinds and functions of flags, refer to “5.1.1 Flag”.

# Chapter8 Functions

## 8.1 Origin Determination

In case the position control function of motion control module is used, the origin must be determined first to execute commands based on the absolute coordinate position. The position value of absolute coordinates is the distance based on the predetermined origin(0 position). The origin determination means setting the origin of the machine for position control using absolute coordinates.

### 8.1.1 Origin Determinaton

**1. Methods to determine the origin**

There are two methods to determine the origin of the machine as below.

(1) Homing

It is a method to determine the origin of the machine by moving the machine using a sensor connected to servo drive with homing (MC_Home) motion function block.

When homing command is executed, the origin determination becomes the origin indetermination status, and homing is successfully completed, it becomes the origin determination status.

(2) Current position setting

After moving the machine to a certain position by using JOG operation (LS_Jog) or relative coordinate position control (MC_MoveRelative) motion function block, the position can be set to the specific position with the current position location setting (MC_Setposition) motion function block. In this case, the position is recognized as an absolute coordinate and becomes origin determination status.

The origin determination status of axis can be identified with motion axis flag AXxx_HOME_CMOL (%JXxx.67) . (xx: axis numer)

**2. Origin determination when using absolute encoders**

In case of using absolute encoder in servo drive, absolute data value is maintained by battery backup even if the power is off. Motion control module can continue to maintain the origin determination status by reading the current position from the value of absolute encoder and calculating absolute coordinate position when it is connected to servo drive.

To this end, the encoder selection of basic parameters among operating parameters should be set to ‘1: Absolute encoder’ in case of using absolute encoder. Even though the power of motion control module and servo drive is off after the establishment of origin determination status, the previous origin determination status is maintained by calculating absolute coordinate position when servo drive is connected in case encoder selection parameter is ‘1: Absolute encoder’ when the power is re-applied.

In absolute coordinate system using absolute encoder as above, the absolute coordinate position can be controlled without the origin determination even after power off/on.

**3. Change to the origin indetermination status**

The absolute position control operation cannot be performed since motion control module becomes the origin indetermination status in the following cases.

(1) In case of re-connection after servo drive power off when using an incremental encoder

(2) In case of re-connection after PLC power off/on when using an incremental encoder

(3) In case homing is not normally completed after the execution of homing command

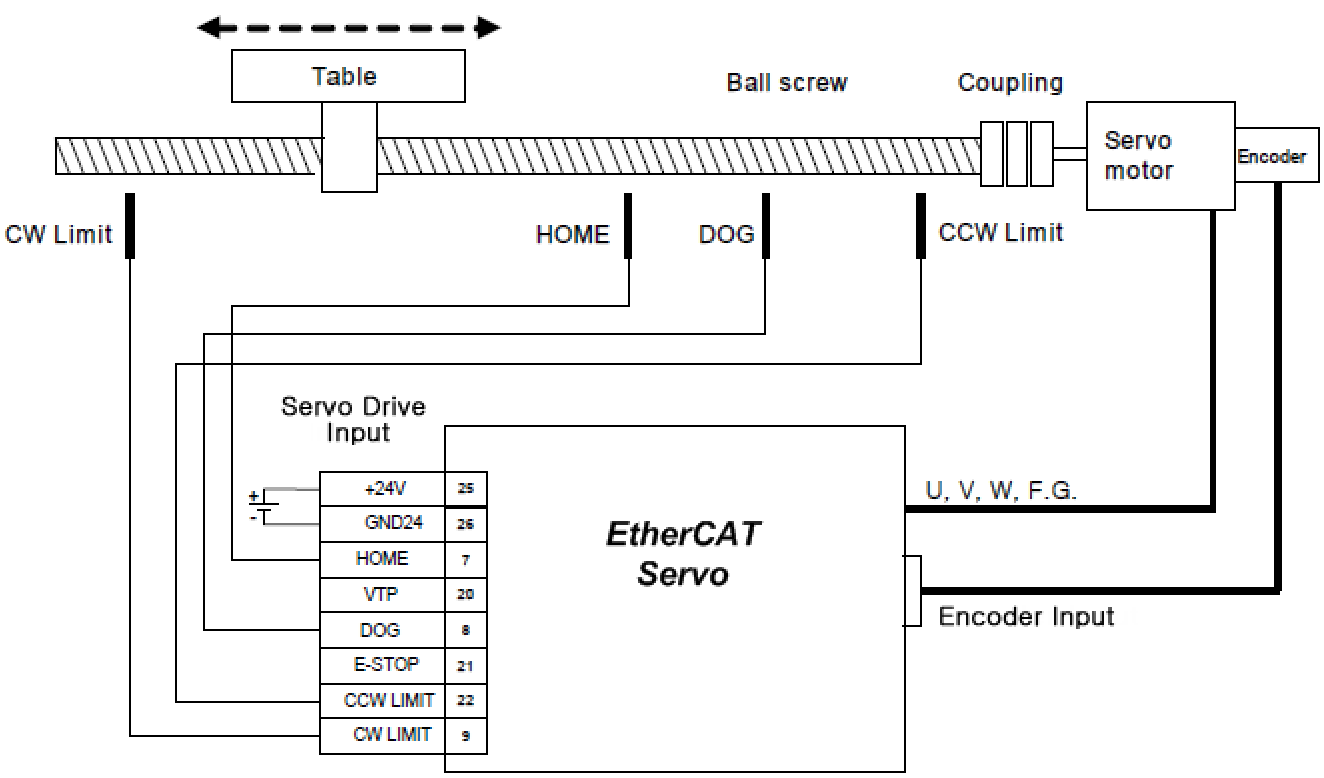
In case of the origin indetermination status as above, the origin determination should be executed for absolute coordinate position control operation.

### 8.1.2 Homing

**1. Operation**

Homing is performed to establish the origin of the machine after the power is applied. Before performing the homing, parameters related to the homing of servo drive must be set in each axis. When the origin position is determined by homing, the origin detection signal is not recognized during the motion control operation.

The contact performed at the time of homing is entered through connector of servo drive (EtherCAT CoE support servo drive). Typical wiring is as follows.




For the performance of homing, a method suitable for the system of users for homing operation mode (EtherCAT CoE support drives: Refer to instruction manual for the relevant drive) should be selected.

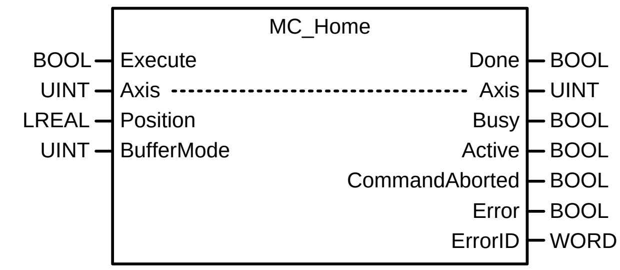
In motion control module, actual operation after starting homing is performed in servo drive, and homing method to support complies with servo drive. Before setting the homing, homing-related parameters are to be set in servo parameters of the axis.

■ Example of setting homing parameters

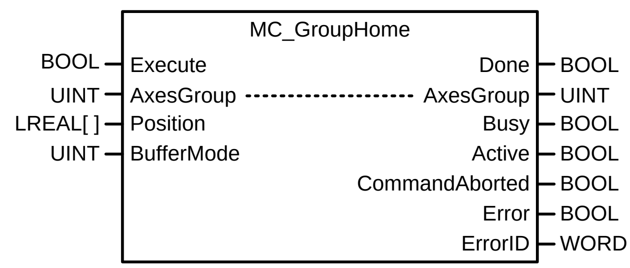
| Index | Name | Unit | Current Value | Initial Value | Access |
|---|---|---|---|---|---|
| 6098 | Homing Method | - | 0x22 | 0x22 | rw |
| 6099:00 | Homing Speeds | - | 0x02 | 0x02 | rw |
| 6099:01 | Speed during search for switch | Vel.Unit | 0x000000A0 | 0x000000A0 | rw |
| 6099:02 | Speed during search for zero | Vel.Unit | 0x00000020 | 0x00000020 | rw |
| 609A | Homing Acceleration | Acc.Unit | 0x0000C350 | 0x0000C350 | rw |

■ Relevant motion function block

| Name | Description | Operation Condition |
| --- | --- | --- |
| MC_Home | Perform homing | Edge |

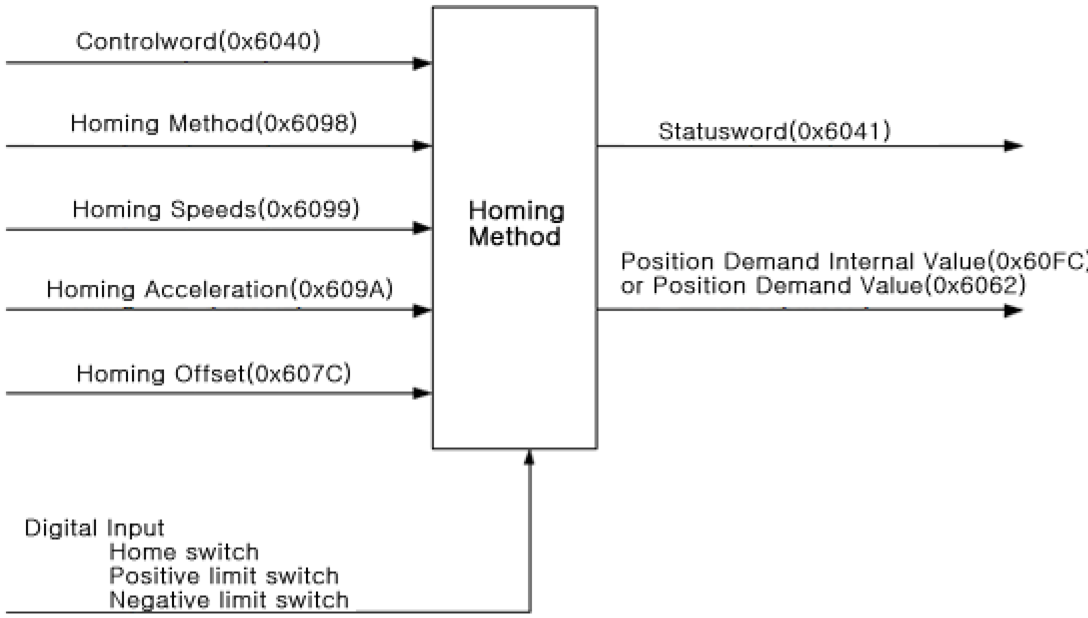



| Name | Description | Operation Condition |
| --- | --- | --- |
| MC_GroupHome | Perform group homing | Edge |



1. **XDL- N Series servo drive homing parameters and operation**

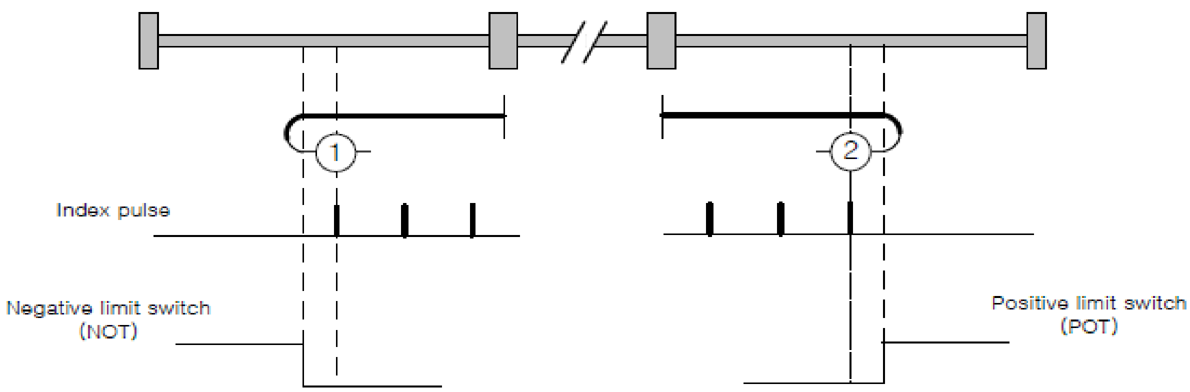
The following figure shows input and output definitions of homing-related XDL N series servo drive parameters. The velocity, acceleration and homing methods can be specified. Here, the origin (Home) offset gets the origin of user coordinate system applied as the origin.

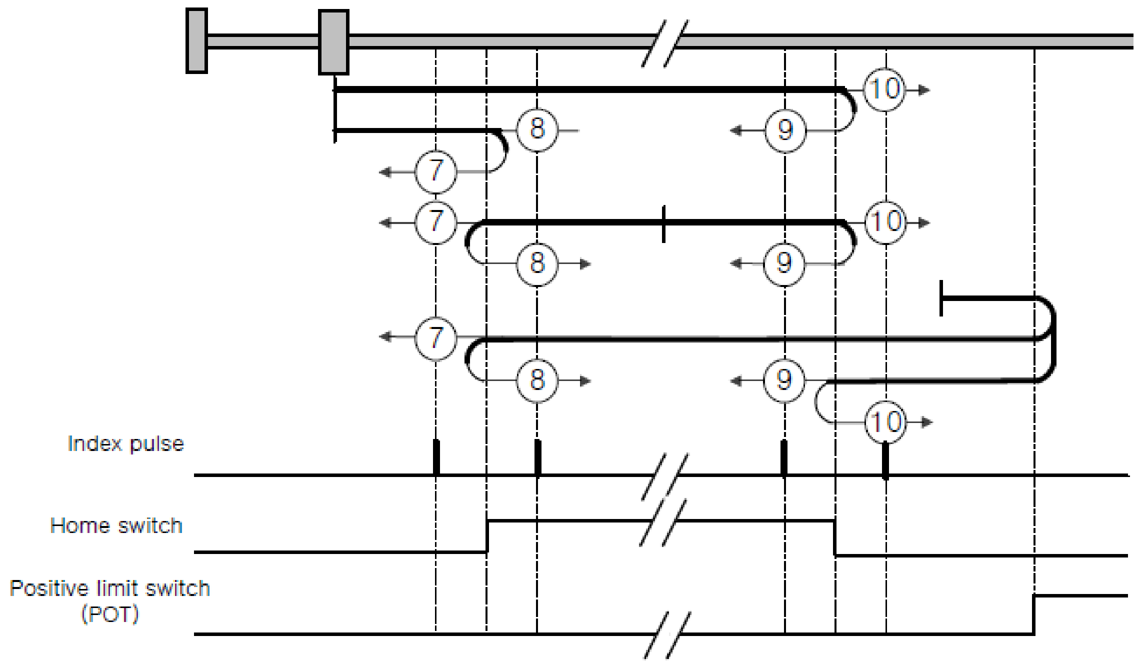
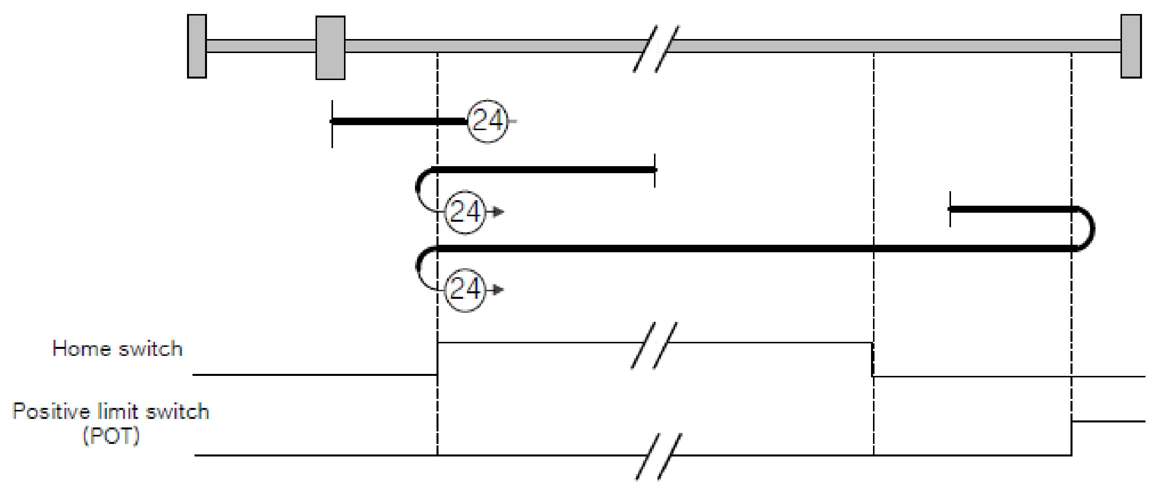


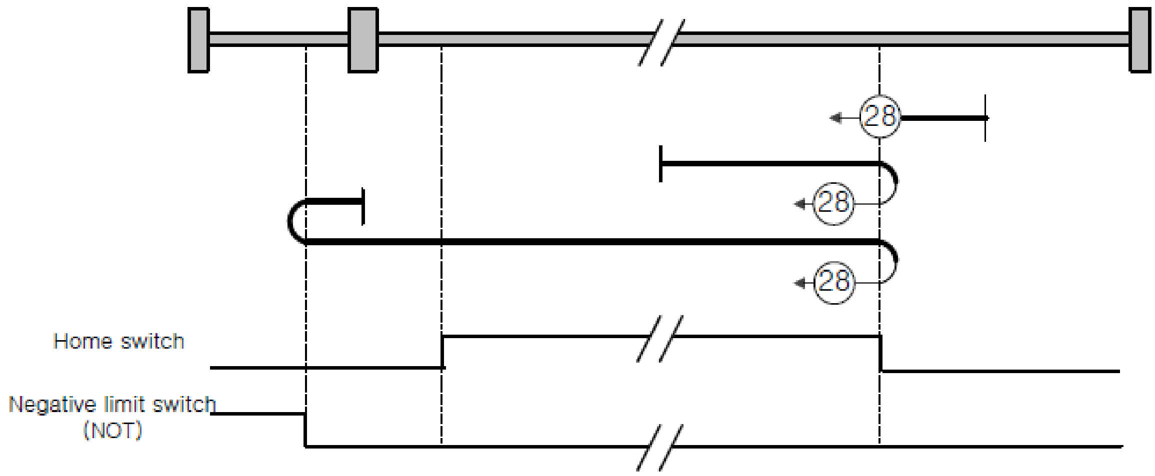
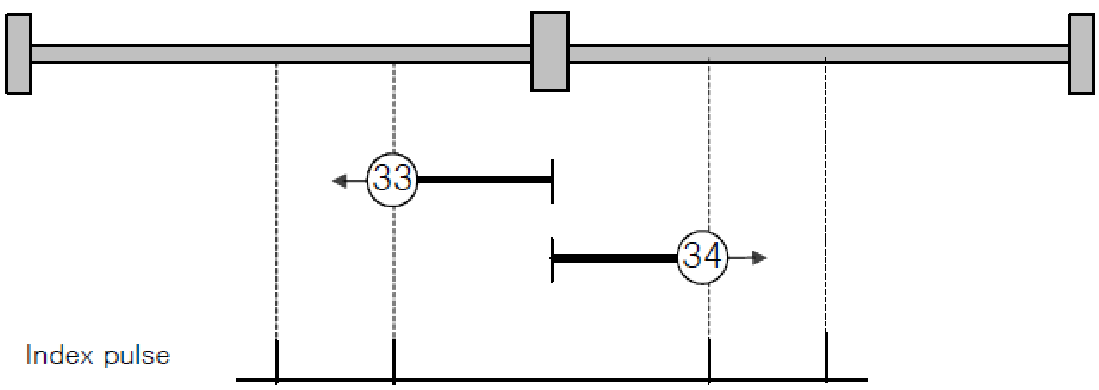

(1) Parameter related to homing

| Index | Sub | Name | Data Type | Unit |
|---|---|---|---|---|
| 0x6040 | - | Controlword | UINT | - |
| 0x6041 | - | Statusword | UINT | - |
| 0x607C | - | Homing Offset | DINT | [pls] |
| 0x6098 | - | Homing Method | SINT | - |
| 0x6099 | - | Homing Speeds | - | - |
| | 0 | Item Number | USINT | - |
| | 1 | Speed during search for switch | UDINT | [pls/s] |
| | 2 | Speed during search for zero | UDINT | [pls/s] |
| 0x607D | - | Software Position Limit | - | - |
| | 0 | Item Number | USINT | - |
| | 1 | Min position limit | DINT | [pls] |
| | 2 | Max position limit | DINT | [pls] |
| 0x609A | - | Homing acceleration | UDINT | [pls/$s^2$] |

(2) Homing Method(0x6098)

| 값 | Description |
|---|---|
| 0 | No homing |
| 1, 2 | (1) If NOT switch is Off (Off), the initial movement direction becomes forward direction (CW). If NOT switch is On (On), change of direction is made. The location that meets the first index pulse during operation in reverse direction (CCW) after NOT switch is On becomes the origin position.<br>(2) If POT switch is Off (Off), the initial movement direction becomes reverse direction (CCW). If POT switch is On (On), change of direction is made. The location that meets the first index pulse during operation in forward direction (CW) after POT switch is On becomes the origin position.<br><br> |
| 7~10 | Through (7) to (10) methods, the origin position is determined by the origin (Home) switch and POT switch.<br>(7)_Above picture: If POT switch is Off (Off), operation is made at switch (Switch) search velocity, and the initial movement direction becomes reverse direction (CCW). If the origin (Home) switch is On (On), change of direction is made. Afterwards, the location that meets the first index pulse during operation in forward direction (CW) becomes the origin position, and operation is made at Zero search velocity.<br>(7)_Picture in the middle: If POT switch is Off (Off), and the origin (Home) switch is On (On), operation is made at switch (Switch) search velocity, and the initial movement direction becomes forward direction (CW). If the origin (Home) switch is Off (Off), the speed is changed to Zero search velocity. Afterwards, the location that meets the index pulse first during operation in forward direction (CW) becomes the origin position.<br>(7)_Picture below: If POT switch is Off (Off), and the origin (Home) switch is On (On), operation is made at switch (Switch) search sped, and the initial movement direction becomes reverse direction (CCW. If POT switch is On (On), change of direction is made. When the origin (Home) switch is changed from On(On) to Off (Off), operation is made at Zero search velocity, and the location where that meets index pulse first during continuous operation in forward direction (CW) becomes the origin (Home) position.<br>(8) to (10) methods have the same positioning concept in homing with the above (7) method except for the initial operational direction and motions according to the origin (Home) switch polarity. Refer to the figure below. |

| 값 | 설명 |
|---|---|
| 7~10 |  |
| 24 | (8) The origin (Home) position is determined as in (8) method, but index pulse is not used. In addition, the point where the origin (Home) switch is On/Off becomes the origin (Home) position.<br> |

<table>
<tr><th>값</th><th>설명</th></tr>
<tr><td>28</td><td>(12) The origin (Home) position is determined as in (12) method, but index pulse is not used. In addition, the point where the origin (Home) switch is On/Off becomes the origin (Home) position.<br><br></td></tr>
<tr><td>33, 34</td><td>The location that meets index pulse first during movement in the reverse direction (CCW)/forward direction (CW) becomes the origin (Home) position.<br><br></td></tr>
<tr><td>35</td><td>Homing operation starting point becomes the origin (Home) position.</td></tr>
</table>

Note) ▬ : Speed during search for switch (0x6099:01), → : Speed during search for zero (0x6099:02)

## 8.2 Type of Control Operation

Motion control modules execute control through programs set in motion control program. Kinds of motion control operations include speed position control, speed velocity control, speed torque control, interpolation control, switching control between position/velocity, switching control between position/torque, and switching control between velocity/torque.

### 8.2.1 Single-axis Position Control

It conducts position control of the axis specified after the execution by motion function block (「Relative position operation (MC_MoveRelative)」 and 「Absolute position operation (MC_MoveAbsolute)」) from starting position (current stop position) to target position (position of the point to move)

**1. Control by absolute coordinate method (「Absolute position operation (MC_MoveAbsolute)」)**

(1) It conducts position control from starting position to target position (location specified in 'Position' of absolute position operation command).

(2) The position control is carried out based on the position (the origin position) specified in the homing.

(3) In direction (Direction) input, the direction to be operated is specified. It is valid only if operation parameter 「Infinite running repetition」 setting is '1: Enable'.

- Setting value: 0-Not specified, 1–Forward direction, 2–Shortest distance direction, 3–Reverse direction, 4–Current direction
- When the shortest direction distance is specified, the operation is made by selecting the direction that can go to the shortest direction automatically depending on the form of the axis.
- Motions according to the direction (Direction) input are as follows.

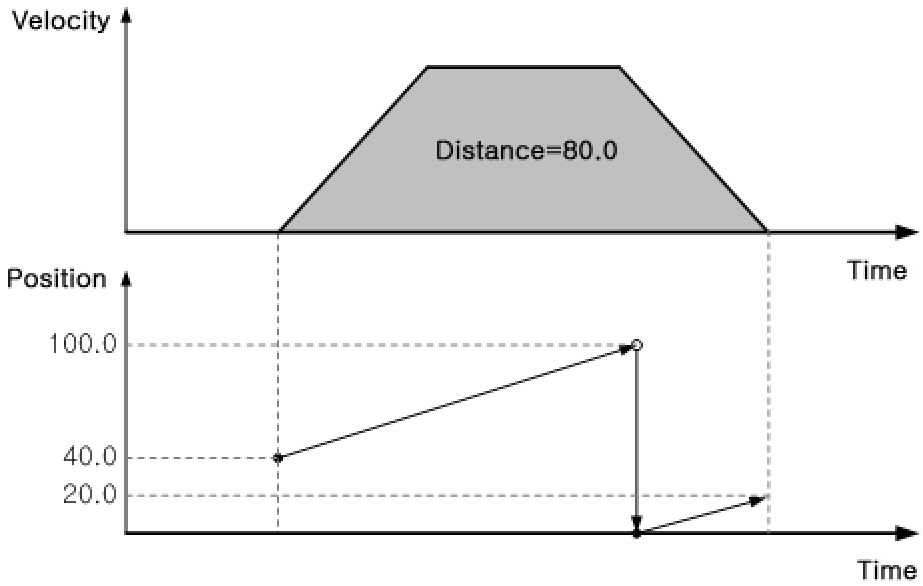
(a) 0- Not specified

The position value that exceeds repetitive length repetition position can be specified. In case of setting the position value that exceeds the infinite running repetition position, the difference from target position to current position becomes positioning distance. The command position after the absolute position operation is calculated by the following equation.

Command position = Target position – (Infinite running repetition position x n)
(n: Integer value in which infinite running repetition position x n does not exceed the target position)

[Example] The absolute position operation is executed with the following settings.

- Infinite running repetition position: 100.0
- Current position: 40.0
- Target position: 120.0
- Command position after the absolute position operation = 120.0 – (100.0 x 1) = 20.0

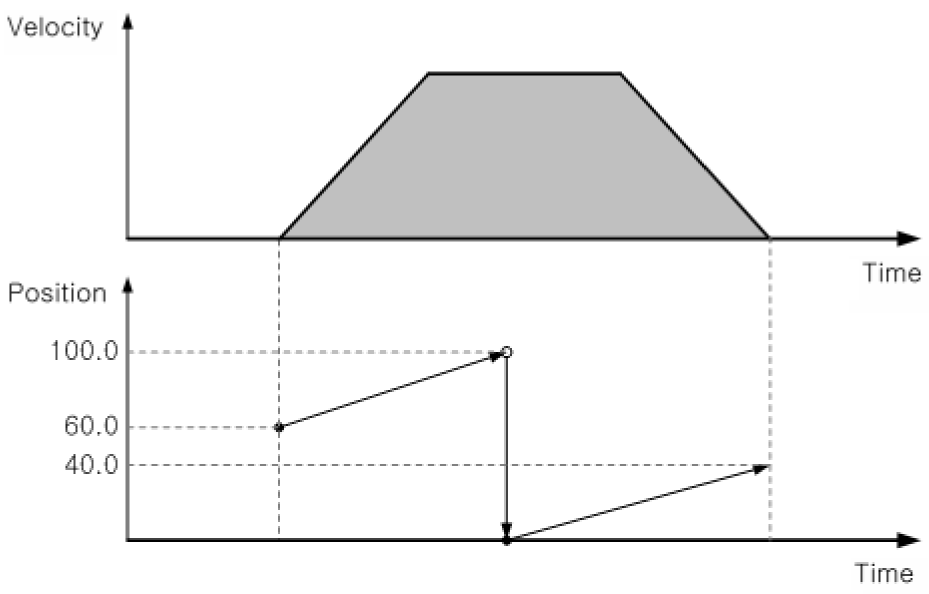



(b) 1-Forward direction

Positioning is executed toward the absolute position of forward direction. In case the target position is set with the range that exceeds infinite running repetition position, error (error code: 0x1081) occurs.

[Example] The absolute position operation is executed with the following settings.

- Infinite running repetition position: 100.0
- Current position: 60.0
- Target position: 40.0



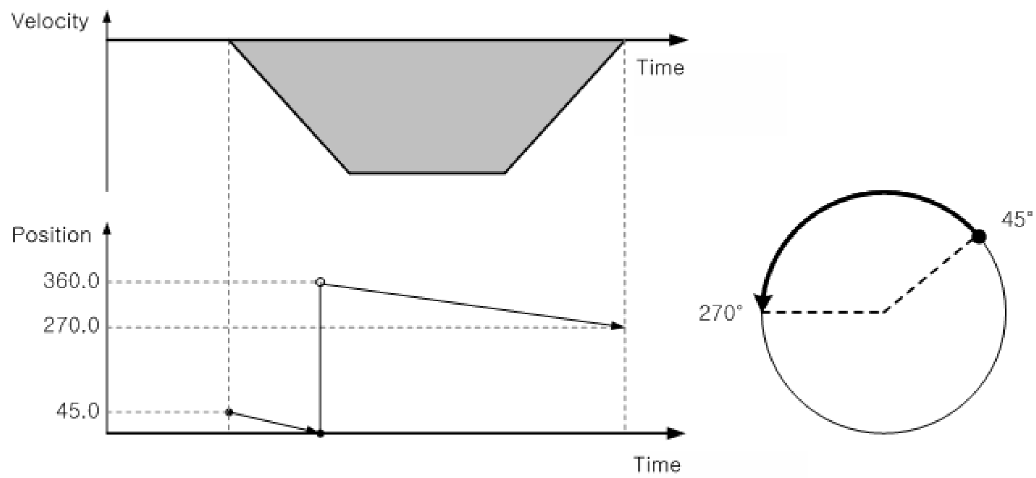
(c) 2-Shortest distance direction

Positioning is executed by automatically determining the direction of rotation possible to move through shorter distance from the current position to target position. That is, positioning toward closer direction to target position based on the current position is carried out.

In case the target position is set with the range that exceeds infinite running repetition position, error (error code: 0x1081) occurs.

[Example] The absolute position operation is executed with the following settings.

- Infinite running repetition position: 360.0
- Current position: 45.0
- Target position: 270.0
- Since the movement distance is 225.0°in case of the operation in forward direction, and 135.0°in case of the operation in reverse direction, operation is made in reverse direction, the shortest distance direction.

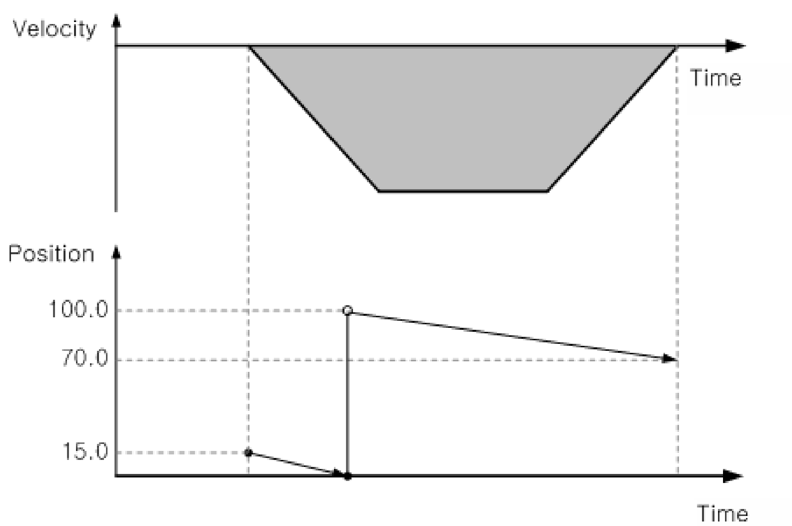



(d) 3-Reverse direction

Positioning is executed toward the absolute position of reverse direction. In case the target position is set with the range that exceeds infinite running repetition position, error (error code: 0x1081) occurs.

[Example] The absolute position operation is executed with the following settings.

- Infinite running repetition position: 100.0
- Current position: 15.0
- Target position: 70.0



(e) 4- Current direction

Positioning is executed depending on the current operating direction.

In case the current operating direction is forward, operation is made in the same way as in Direction='1-forward direction' setting.

In case the current operating direction is reverse, operation is made in the same way as in Direction='3 reverse direction' setting.

(4) In case operation parameter 「Infinite running repetition」 setting is '0: disable', operating direction is determined as follows.

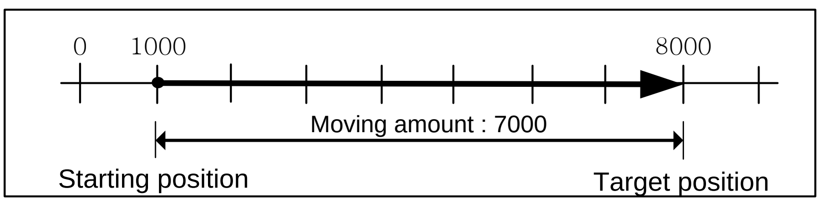
- Starting position < target position: Positioning operation in forward direction
- Starting position > target position: Positioning operation in reverse direction

**[Example]** Executes Absolute coordinate, single-axis position control with the following setting

▷Start position: 1000,

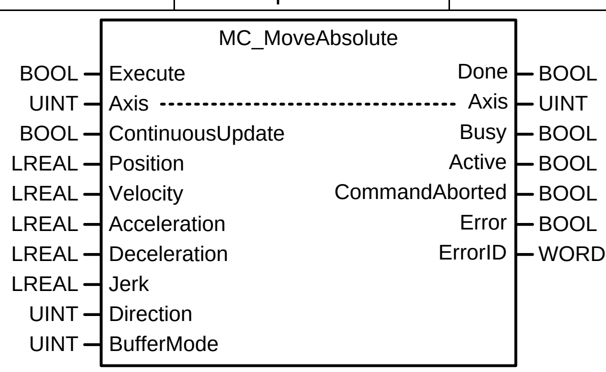
▷Target position: 8000

The moving amount to forward direction is 7000 (7000=8000-1000).




■ Relevant motion function block

| Name | Description | Operation Condition |
|---|---|---|
| MC_MoveAbsolute | Absolute positioning operation | Edge |



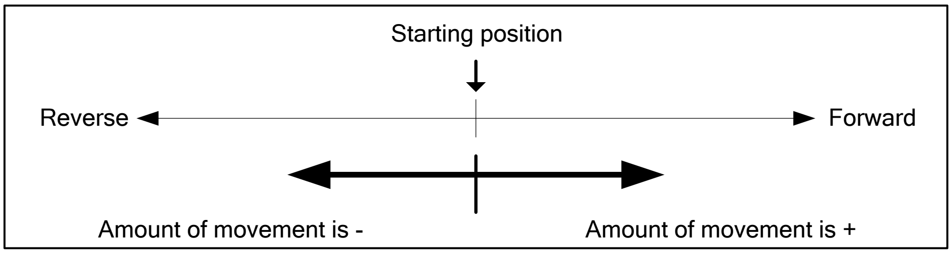
**2. Control by Incremental method (「Relative positioning operation(MC_MoveRelative)」)**

(1) It moves the object as much as the target moving amount from start position. Unlike the target position of the absolute coordinate, the value specified on target position is not position value. That is a transfer amount from the current position.

(2) Transfer direction is determined by the sign of moving amount.

▷ Transfer direction (+) or no sign: forward direction positioning (current position increases)

▷ Transfer direction ( - ) : reverse direction positioning (current position decreases)

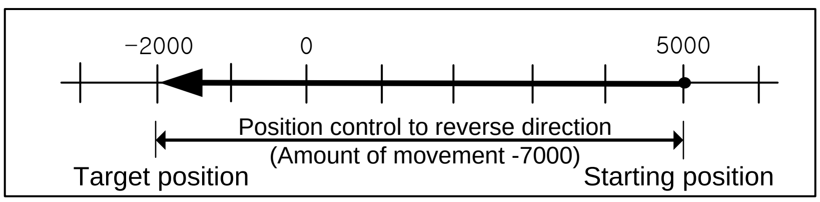



**[ Example ]** Executes Absolute coordinate, single-axis position control with the following setting

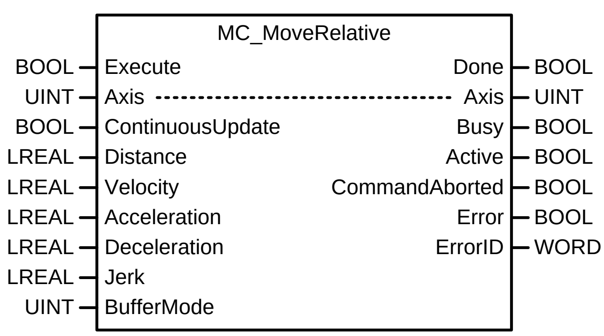
▷ Start position: 5000,

▷ Target position: -7000

It goes to reverse direction and stops at the –2000.




■ Relevant motion function block

| Name | Description | Operation Condition |
|---|---|---|
| MC_MoveRelative | Relative positioning operation | Edge |
|  | | |

### 8.2.2 Single-axis Speed Control

Execution is made by motion function block(「Specified velocity operation (MC_MoveVelocity)」), and operation is performed at the set velocity until stop condition is inputted.

**1. Features of Control**

(1) Speed control operation of the specified axis is executed using specified velocity and acceleration/deceleration. The velocity control is executed through a method to transmit the target position value that corresponds to the target velocity using position control of servo drive.

(2) In direction input, the direction to operate is specified.
(However, the forward direction is based on the operating direction specified with the target velocity (Velocity) input. For example, if a negative value is specified in target velocity (Velocity) value, and reverse direction in direction (Direction) input, the axis is finally operated in forward direction.)
■ Setting value: 1-Forward, 2-Reverse, 3-Curent direction

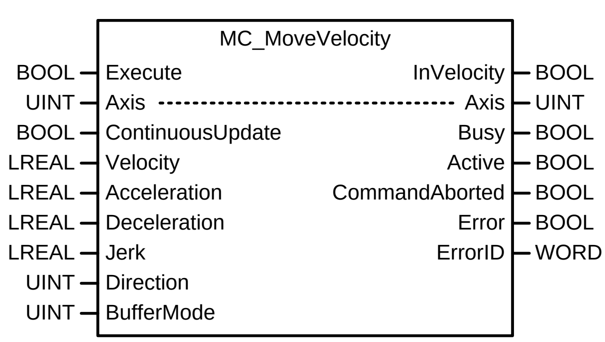
(3) Negative number can be set for target velocity (Velocity) input value. In case the target velocity setting value is negative number, operating direction becomes the opposite direction of the previously specified direction.
■ Forward operation
- Velocity > 0, Direction=1: Forward
- Velocity < 0, Direction=2: Reverse
■ Reverse operation

(4) After reaching the target velocity, InVelocity output of the function block is On (On). If there is a pending command, the pending command is executed after InVelocity output is On.

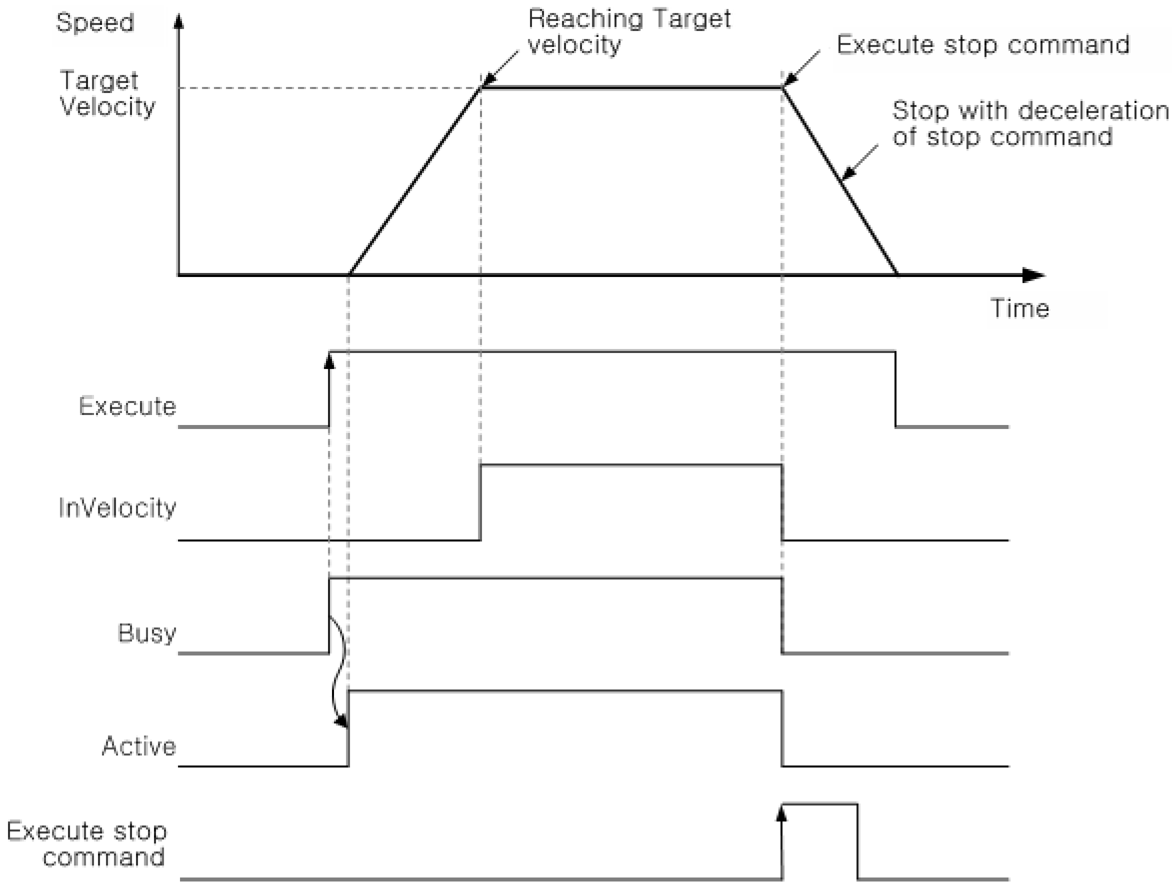
(5) The speed control which is currently being executed is stopped with halt (MC_Halt) or immediate stop (MC_Stop) motion function block.

**2. Relevant motion function block**

| Name | Description | Operation Condition |
|---|---|---|
| MC_MoveVelocity | Specified velocity operation | Edge |



**3. Operation Timing**



### 8.2.3 Single-axis Torque Control

If motion function block(「Torque control(MC_TorqueControl)」) is executed, torque control of the axis is made with the set torque value.

**1. Features of Control**

(1) Torque control of the specified axis is made using target torque value and torque rising slope.

(2) Torque rising slope (TorqueRamp) is the rate of change in torque per second to the target torque, and time to reach the target torque can be calculated as follows.

Time to reach the target torque(s) = target torque (Torque) / torque rising slope (TorqueRamp)

(3) Torque control mode is executed using torque control mode of servo drive.

(4) Target torque values are rounded to two decimals and reflected in [0.1%] unit.

(5) In Direction input, the direction to be operated is specified.

(However, the forward direction is based on the operating direction specified with the Torque input. For example, if a negative value is specified in Torque value, and reverse direction in direction (Direction) input, the axis is finally operated in forward direction.)

■ Setting value: 1-Forward, 2-Reverse, 3-Current direction

(6) Negative number can be set for Torque (target torque) input value. In case the target torque setting value is negative number, operating direction becomes the opposite direction of the previously specified direction.

■ Forward operation

- Torque > 0, Direction=1: Forward
- Torque < 0, Direction=2: Reverse

■ Reverse operation

- Torque > 0, Direction=2: Reverse
- Torque < 0, Direction=1: Forward

(7) The setting range of the torque values are as follows.

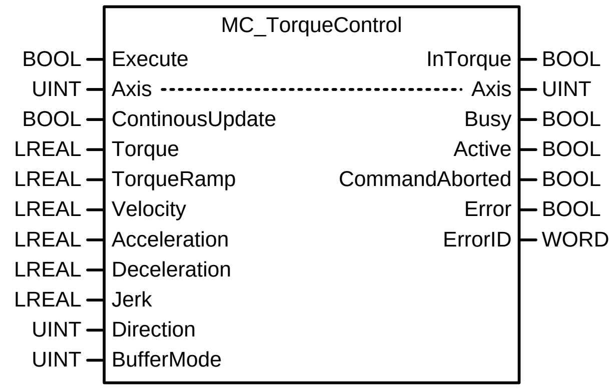
-1000.0 % ~ 1000 %

(8) After reaching the target torque, Intorque output of function block is On. In case there is a pending command, the pending command is executed after InTorque output is On.

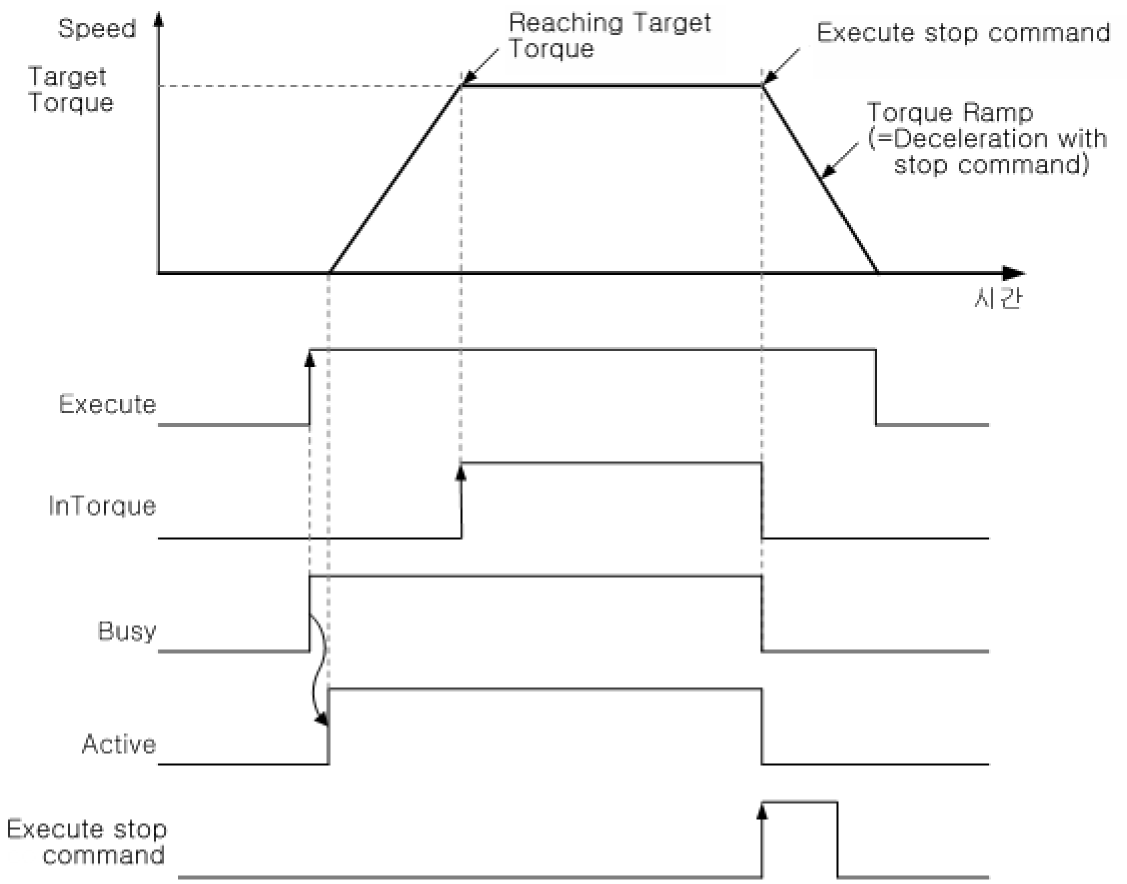
(9) Torque control which is currently being executed is stopped with halt(MC_Halt) or immediate stop (MC_Stop) motion function block.

**2. Relevant motion function block**

| Name | Description | Operation Condition |
|---|---|---|
| MC_TorqueControl | Torque Control | Edge |




**3. Operation Timing**



### 8.2.4 Specified Velocity Operation after Position Operation

Speed control of the axis specified after being executed by motion function block (「Specified speed operation after relative position operation (MC_MoveContinuousRelative)」 and 「Specified speed operation after absolute position operation (MC_MoveContinuousAbsolute)」) is carried out after the execution of position control that ends with end rate specified from starting position (current stop position) to target position (position of point to move) at the rate specified in end velocity (EndVelocity) if there are no pending commands.

**1. Features of Control**

(1) Position control that ends with end rate specified from staring position to target position is carried out. .

(2) Position control is executed based on position (the origin position) specified in the homing.

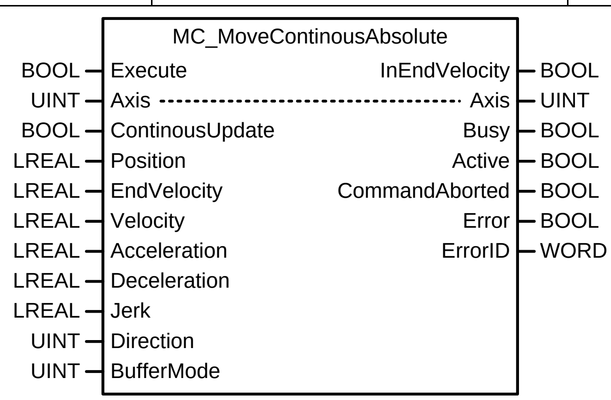
(3) In case of 「Specified speed operation after the absolute position operation (MC_MoveContinuousAbsolute)」, the direction to operate is specified in Direction input, which is valid only if operation parameter 「Infinite running repetition」 is set to '1: Enable'.

- Setting value: 0-Not specified, 1–Forward, 2–Shortest distance direction, 3–Reverse, 4–Current direction

(4) The end rate is reached after the completion of position control operation to target position, InEndVelocity outp ut of function block is On. If there is a pending command, the pending command is executed after InEndVelocity output is On.

**2. Relevant motion function block**

| Name | Description | Operation Condition |
|---|---|---|
| MC_ MoveContinuousAbsolute | Specified velocity operation after Absolute position operation | Edge |

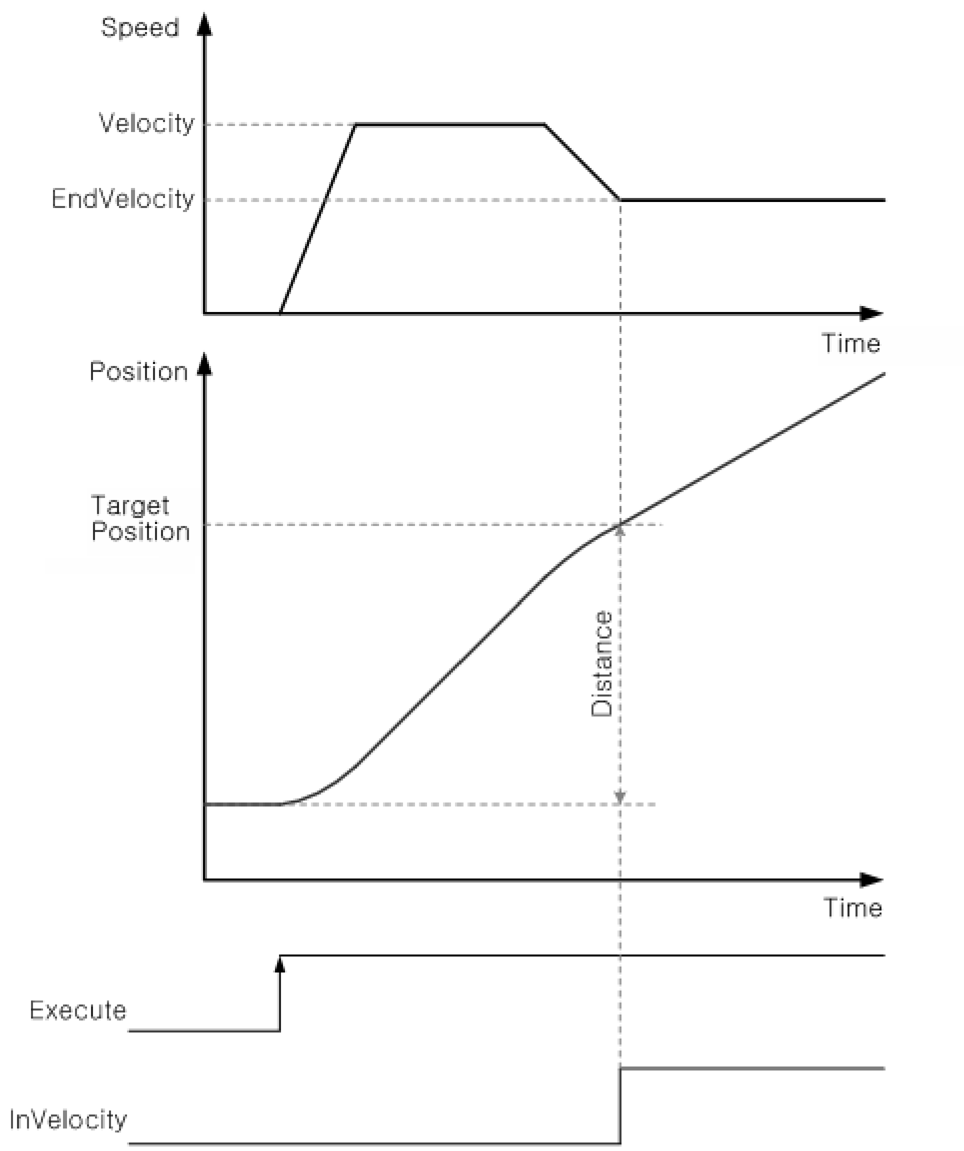


| Name | Description | Operation Condition |
|---|---|---|
| MC_ MoveContinuousRelative | Specified velocity operation after Relative position operation | Edge |

MC_MoveContinousRelative

| | | | |
|---|---|---|---|
| BOOL | Execute | InEndVelocity | BOOL |
| UINT | Axis | Axis | UINT |
| BOOL | ContinousUpdate | Busy | BOOL |
| LREAL | Distance | Active | BOOL |
| LREAL | EndVelocity | CommandAborted | BOOL |
| LREAL | Velocity | Error | BOOL |
| LREAL | Acceleration | ErrorID | WORD |
| LREAL | Deceleration | | |
| LREAL | Jerk | | |
| UINT | BufferMode | | |

**3. Operation Timing**



### 8.2.5 Switching Control

In motion control module, switching control means real-time control switch between position control / velocity control / torque control. In case the control mode that is currently being executed (position control, velocity control, torque control) are intended to change to a different control mode immediately, BufferMode of commands is to be set to Aborting, and relevant motion function block is to be executed.

**1. Position-velocity switching control**

When specified speed operation (MC_MoveVelocity) is executed in the axis in absolute/relative position operation, the position control is switched to velocity control. The velocity at the time of being changed to velocity control is operated continuously from the velocity operated with the previous position control to the target velocity of the currentvelocity control. The next operation can be continued by conducting halt (MC_Halt) during operation with velocity control, performing operation stop with immediate stop (MC_Stop) motion function block or executing other motion function block. .

**2. Velocity-position switching control**

When absolute/relative/additive position control (MC_MoveAbsolute, MC_MoveRelative, MC_MoveAdditive) motion function block is executed in the axis in specified speed operation during velocity control, the velocity control is switched to position control. The velocity at the time of being changed to position control is operated continuously from the velocity operated with the previous velocity control to the target velocity of the current position control. The next operation can be continued by conducting halt (MC_Halt) during operation with position control, performing operation stop with immediate stop (MC_Stop) motion function block or executing other motion function block.

**3. Position-torque switching control**

When torque control (MC_TorqueControl) motion function block is executed in the axis in absolute/relative position operation during position control, the position control is switched to torque control. The torque at the time of being changed to torque control is operated continuously from the current torque value operated with the previous position control to the target torque of the torque control. The next operation can be continued by conducting halt (MC_Halt) during operation with torque control, performing operation stop with immediate stop (MC_Stop) motion function block or executing other motion function block.

**4. Torque-position switching control**

When absolute/relative/additive position control torque control (MC_MoveAbsolute, MC_MoveRelative, MC_MoveAdditive) motion function block is executed in the axis in torque control operation during torque control, the torque control is switched to position control, when torque value is reduced to 0, and position control continues to operate after a stop. The next operation can be continued by conducting halt (MC_Halt) during operation with position control, performing operation stop with immediate stop (MC_Stop) motion function block or executing other motion function block.

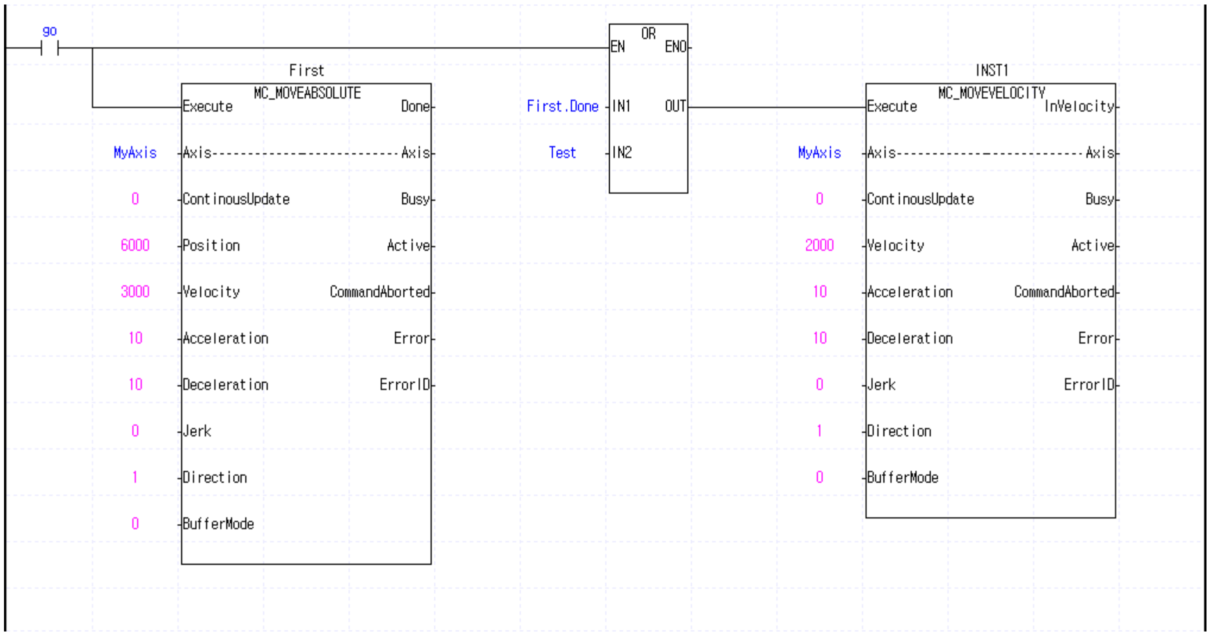
**5. Velocity –torque switching control**

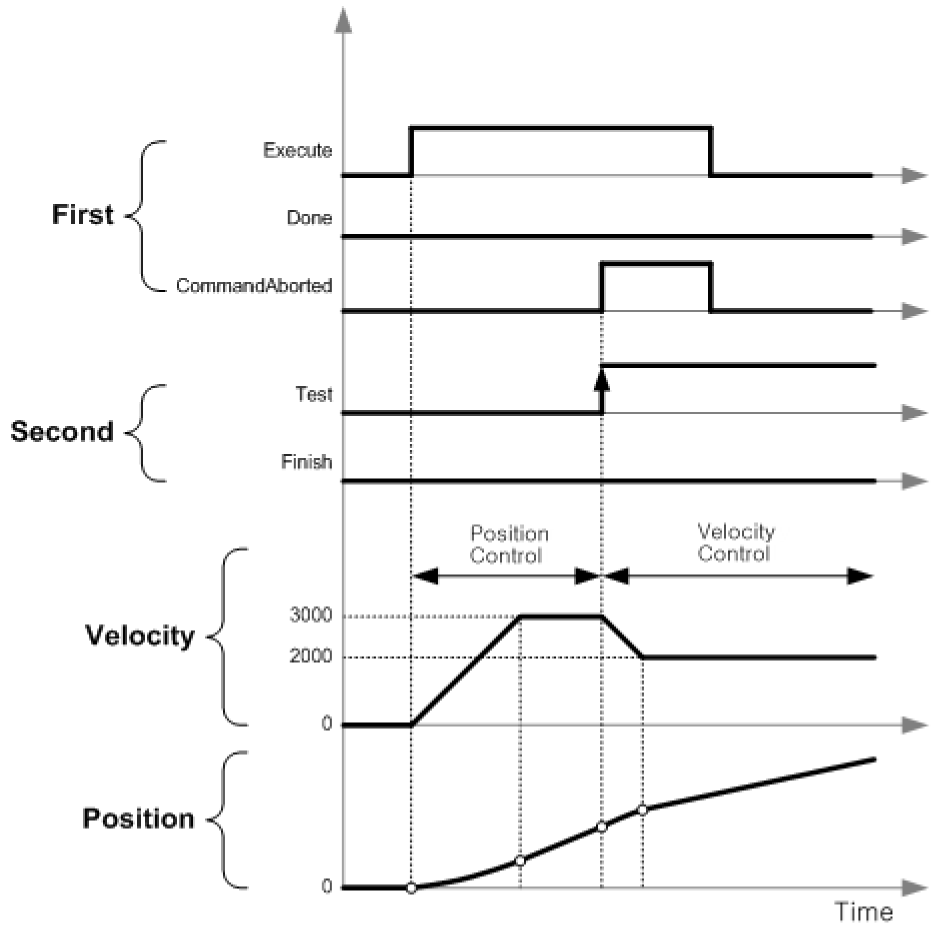
When torque control (MC_TorqueControl) motion function block is executed in the axis in specified speed operation during velocity control, the velocity control is switched to torque control. The torque at the time of being changed to torque control is operated continuously from the current torque value operated with the previous velocity control to the target torque of the torque control. The next operation can be continued by conducting halt (MC_Halt) during operation with torque control, performing operation stop with immediate stop (MC_Stop) motion function block or executing other motion function block.

**6. Torque- velocity switching control**

When specified speed operation (MC_MoveVelocity) motion function block is executed in the axis in torque control operation during speed control, the torque control is switched to velocity control, when torque value is reduced to 0, and velocity control continues to operate after a stop. The next operation can be continued by conducting halt (MC_Halt) during operation with velocity control, performing operation stop with immediate stop (MC_Stop) motion function block or executing other motion function block.

**7. Example of using switching control**




First
Execute
Done
CommandAborted
Second
Test
Finish
Velocity
Position Control
Velocity Control
3000
2000
0
Position
0
Time

## 8.2.6 Axis Group Control

Axis group control is a function to control the trajectory of moving objects by setting involved multiple axes into one axis group. For axis group control, axis group is to be set.
Axis group operation includes linear interpolation, circular interpolation and helical interpolation.
As for coordinate system in which axis group control is operated, only Cartesian coordinate system is supported

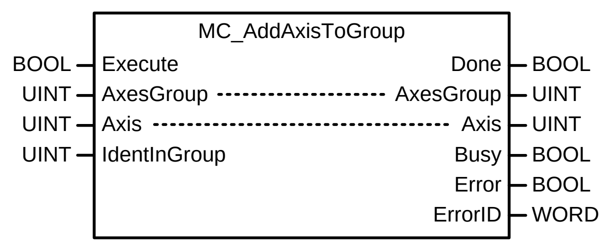
### 1. Axis group settings

For axis group control, axis group should be set and enabled prior to the execution of operation.
Configuration axis can be specified, and axis group is set using XG-PM. In addition, the use of motion function block makes it possible to add axes to axis group or remove them from it.
When axis group is configured, axis group operation can be executed after enabling the axis group.

(1) Add axis to group

It means adding an axis to the axis group. The configuration axis specified into IdentInGroup is added to the axis group specified in AxesGroup input.
It can be executed only in case where the axis group is in group disablement (GroupDisabled) and group standby (GroupStandBy) state.

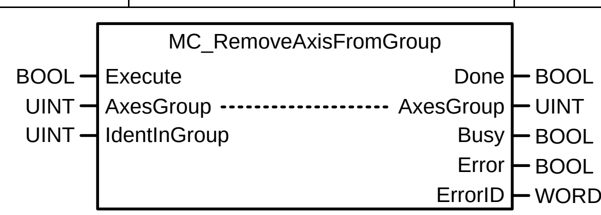
| Name | Description | Operation Condition |
|---|---|---|
| MC_AddAxisToGroup | Add axis to group | Edge |




(2) Remove axis from group

It means removing an axis from the axis group. The configuration axis specified into IdentInGroup is removed from the axis group specified in AxesGroup input.
It can be executed only in case where the axis group is in group disablement (GroupDisabled) and group standby (GroupStandBy) state.
In case there are no remaining axes in the axis group, the axis group is changed to disabled state.

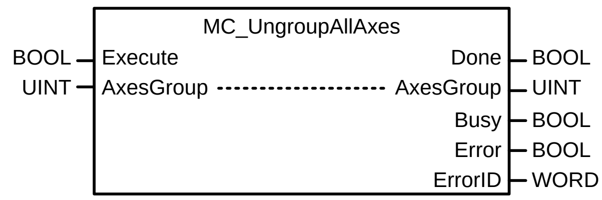
| Name | Description | Operation Condition |
|---|---|---|
| MC_RemoveAxisToGroup | Remove axis from group | Edge |



(3) Remove all axes from group

It means removing all axes from the axis group.

| Name | Description | Operation Condition |
|---|---|---|
| MC_UngroupAllAxes | Remove all axes from group | Edge |



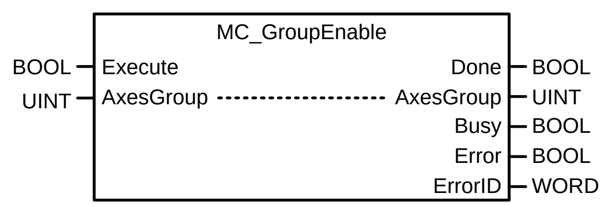

(4) Enable Group

It changes the status to enabled state in which axis group command can be executed.

The axis group cannot be enabled in the following cases.

- In case there is no axis group configuration axis, or axes included in the axis group is not connected to network
- In case the configuration axis of the axis group to be enabled belongs to other enabled axis group
- In case there is an axis in operation among configuration axes in the axis group
- In case the 'unit' of configuration axes in the axis group is not the same

| Name | Description | Operation Condition |
|---|---|---|
| MC_GroupEnable | Enable group | Edge |

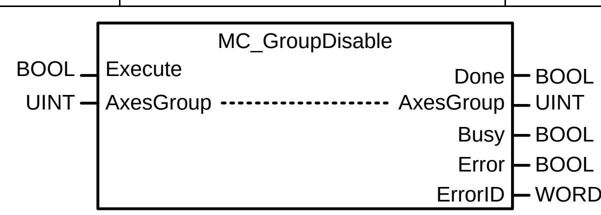



(5) Disable Group

It changes the axis group to be group disabled state.

In case the axis group is in operation, the axis group is changed to be disabled state after the immediate stop.

| Name | Description | Operation Condition |
|---|---|---|
| MC_GroupDisable | Disable group | Edge |



### 8.2.7 Linear Interpolation Control

Interpolation of multiple axes from staring point (current stop position) to target position is performed with linear trajectory by using relevant axes set in the axis group.

Linear interpolation can be performed up to 4 axes.

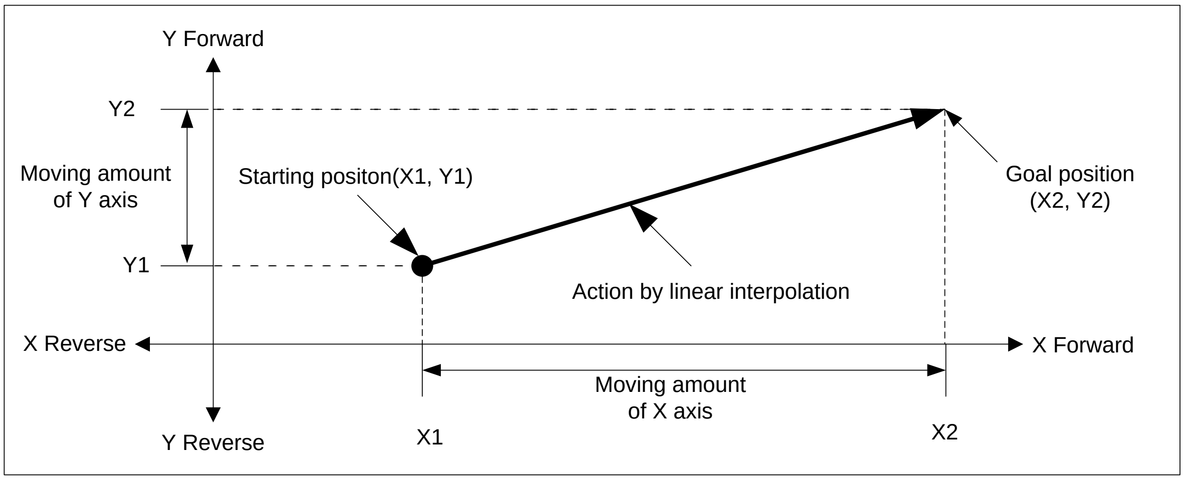
1. Linear interpolation control with absolute coordinates (「Absolute, Linear Interpolation Operation(MC_MoveLinearAbsolute)」)

(1) Executes linear interpolation from starting position to the target position designated on positioning data. Positioning control is carried out based on the position specified from homing.

(2) The direction of movement depends on the starting position and the target position for each axis.

■ Starting position < target position: Positioning operation in forward

■ Starting position > target position: Positioning operation in reverse




(3) Interpolation that is currently being executed is stopped with group halt (MC_GroupHalt) or group immediate stop (MC_GroupStop) motion function block.

(4) The speed value set in absolute position liner interpolation operation (MC_MoveLinearAbsolute) motion function block means synthesis rate of axes that make up the axis group.

Speed of each-axis and operating speed are as follows.

$$Interpolatinspeed\ (F) = Operationspeedsetinpositiondata$$

$$Interpolatingmovingamount(S) = \sqrt{S_x^{\ 2} + S_y^{\ 2} + S_z^2}$$

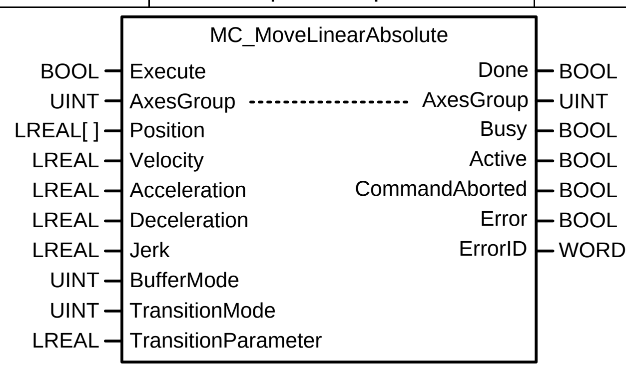
$$Mainaxisspeed(V_x) = Interpolatingspeed\ (F) \times \frac{Main\ axismovingamount(S_x)}{Interpolatingmovingamount\ (S)}$$

$$Sub - axis1\,\text{speed}\,(V_y) = Interpolatingspeed\ (F) \times \frac{Sub - axis1movingamount\ (S_y)}{Interpolatingmovingamount(S)}$$

$$Sub - axis2\,\text{speed}\,(V_z) = Interpolatingspeed\ (F) \times \frac{Sub - axis2\ movingamount\ (S_z)}{Interpolatingmovingamount\ (S)}$$

(5) Relevant motion function block

| Name | Description | Operation Condition |
|---|---|---|
| MC_MoveLinearAbsolute | Absolute positioning linear interpolation operation | Edge |



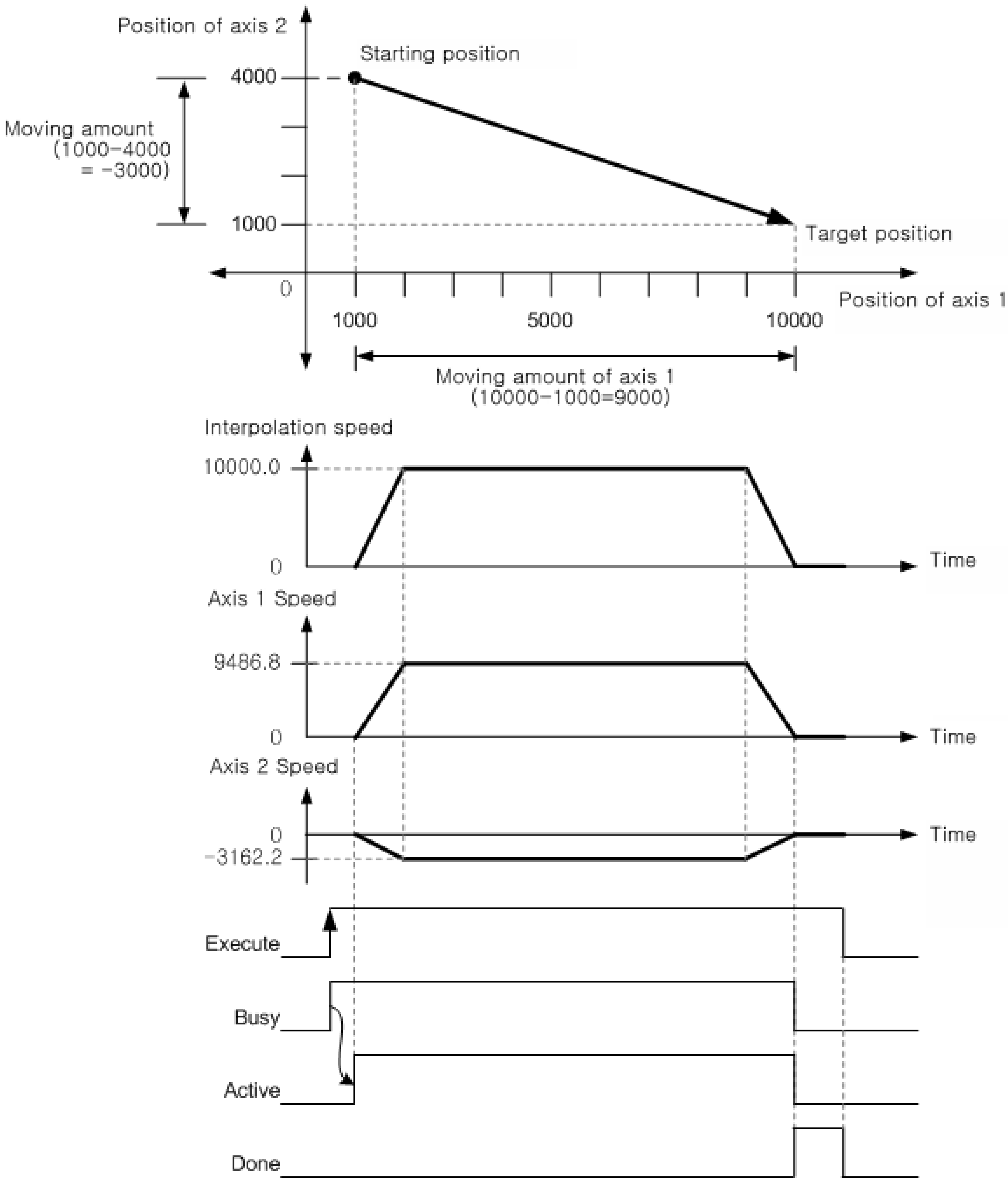

(6) Restrictions

Linear interpolation by absolute coordinate system cannot be executed in the following cases.

- In case there is an axis which is in the origin indetermination state among configuration axes (error code: 0x2090)
- In case the operation speed of configuration axis exceeds the speed limit of each axis (error code: 0x2091)
- In case there is an axis in infinite running repetition operation among configuration axes (error code: 0x2094)

(7) Operation Timing

- Current position: (1000.0, 4000.0)
- Target position: (10000.0, 1000.0)
- Target velocity: 10000.0




※ Velocity of each configuration axis is approximate estimate.

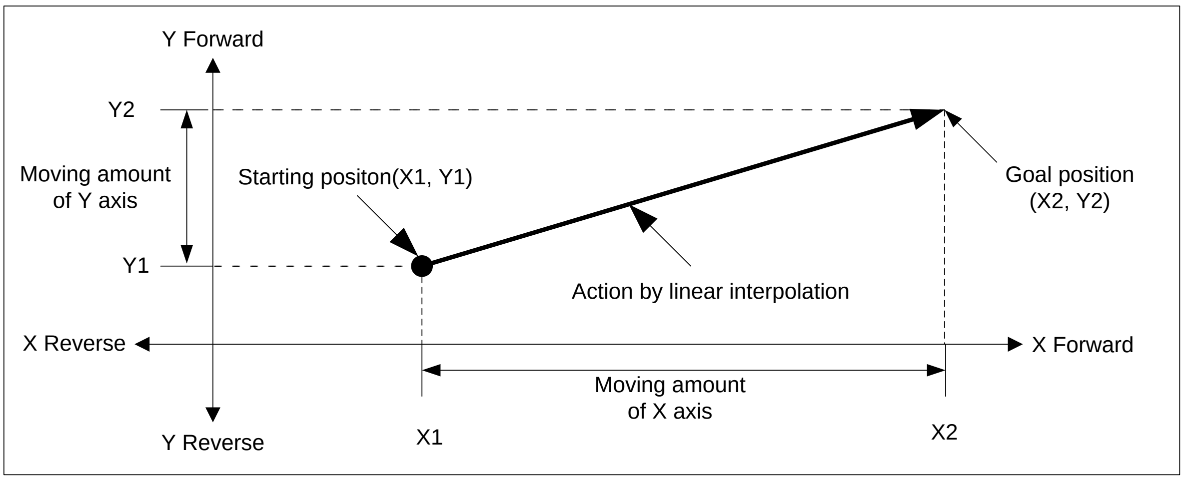
2. Linear interpolation control with relative coordinates(「Relative, Linear Interpolation Operation (MC_MoveLinearAbsolute)」)

(1) Linear interpolation is executed from starting position to movement direction targeted by each axis and position that includes movement direction. Positioning control is based on the current stop position.

(2) Movement direction is determined by the sign set in the target position (movement distance) of each axis.

■ When the sign of movement distance is positive (+ or no sign): Positioning operation in forward direction (current position increase direction)

■ When the sign of movement distance is negative ( - ):Positioning operation in reverse direction (current position decrease direction)




(3) Interpolation that is currently being executed is stopped with group halt (MC_GroupHalt) or group immediate stop (MC_GroupStop) motion function block.

(4) The speed value set in relative position liner interpolation operation (MC_MoveLinearRelative) motion function block means interpolation speed.

The operation speed of each configuration axis is calculated as follows.

$$Interpolatinspeed\ (F) = Operationspeedsetinpositiondata$$

$$Interpolatingmovingamount(S) = \sqrt{S_x{}^2 + S_y{}^2 + S_z^2}$$

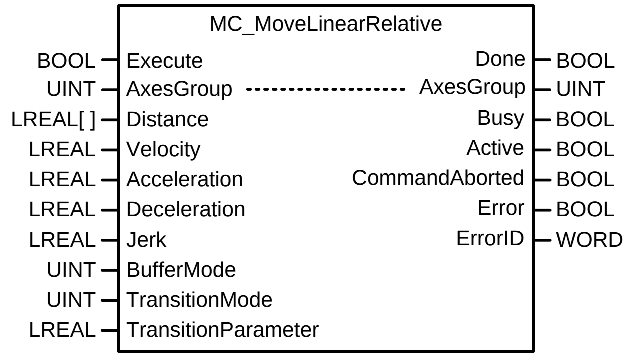
$$Mainaxisspeed(V_x) = Interpolatingspeed\ (F) \times \frac{Main\ axismovingamount(S_x)}{Interpolatingmovingamount\ (S)}$$

$$Sub - axis1\,\mathrm{speed}\ (V_y) = Interpolatingspeed\ (F) \times \frac{Sub - axis1movingamount\ (S_y)}{Interpolatingmovingamount(S)}$$

$$Sub - axis2\,\mathrm{speed}\ (V_z) = Interpolatingspeed\ (F) \times \frac{Sub - axis2\ movingamount\ (S_z)}{Interpolatingmovingamount\ (S)}$$

(5) Relevant motion function block

| Name | Description | Operation Condition |
|---|---|---|
| MC_MoveLinearRelative | Relative positioning linear interpolation operation | Edge |




(6) Restrictions

Linear interpolation by relative coordinate system cannot be executed in the flowing cases.

- In case there is an axis in infinite running repetition operation among configuration axes (error code: 0x2094)
- In case the operation speed of configuration axis exceeds the speed limit of each axis (error code: 0x2091)

### 8.2.8 Circular Interpolation Control

Interpolation operation is performed along the trajectory of the circle in the direction of axis progress set by using two axes set in the axis group.

There are three kinds of methods for circular interpolation such as midpoint method that passes through the position specified in auxiliary point, center point method that considers the position specified in auxiliary point as center point and radius method that takes the value specified in auxiliary point as the radius of an arc depending on 'CircMode' settings and auxiliary points.

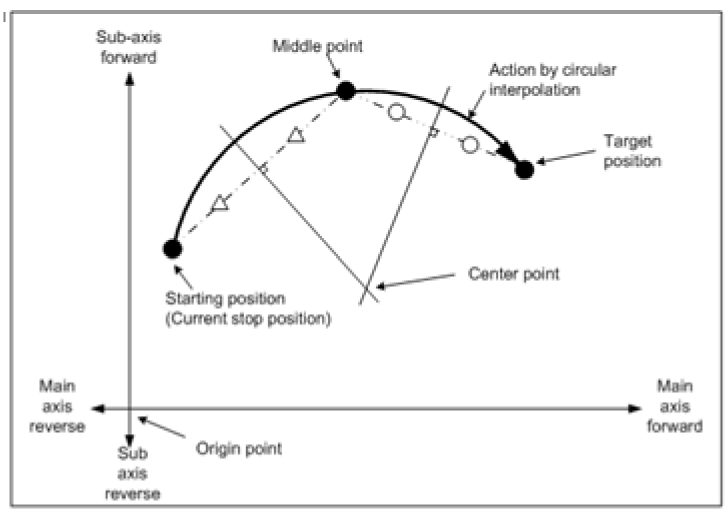
The interpolation that is currently being executed is stopped with group halt (MC_GroupHalt) or group immediate stop (MC_GroupStop) motion function block.

**1. Circular interpolation using midpoint specification method**

(1) Circular interpolation is executed from starting position to target position through midpoint position set in auxiliary point.

(2) The trajectory of the arc that takes an intersecting point caused by the vertical bisection of starting position and midpoint position, and midpoint position and target position is created.

(3) Movement direction is automatically determined in accordance with the set target position and auxiliary point of circular interpolation.



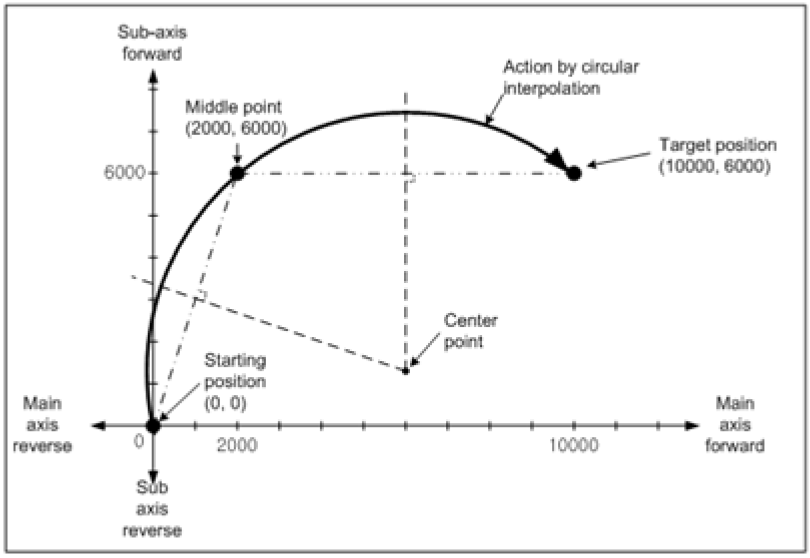

(4) Restrictions

Circular interpolation by midpoint specification method cannot be executed in the following cases.

- In case there is an axis which is in the origin undetermined state among configuration axes at the time of absolute coordinate circular interpolation operation (error code: 0x20A0)
- In case the midpoint specified as auxiliary point is the same as the starting position or target position (error code: 0x20A4)
- In case starting position is the same as the target position (error code: 0x20A5)
- In case the calculated radius of the arc exceeds 2147483647pls (error code: 0x20A6)
- In case starting position, auxiliary point position and target position are in a straight line (error code: 0x20A7)
- In case there is an axis in infinite running repetition operation among configuration axes (error code: 0x20A8)
- In case the number of configuration axes in the axis group is four (error code: 0x20A9)
- In case axis group configuration settings are not set in order (error code: 0x20AA)

(5) Operation pattern

- Current positon: (0.0, 0.0)
- Target position: (10000.0, 6000.0)
- Serve point: (2000.0, 6000.0)
- Method(CircMode): Mid point(0)
- Direction(PathChoice): - (Ignored in mid point method)

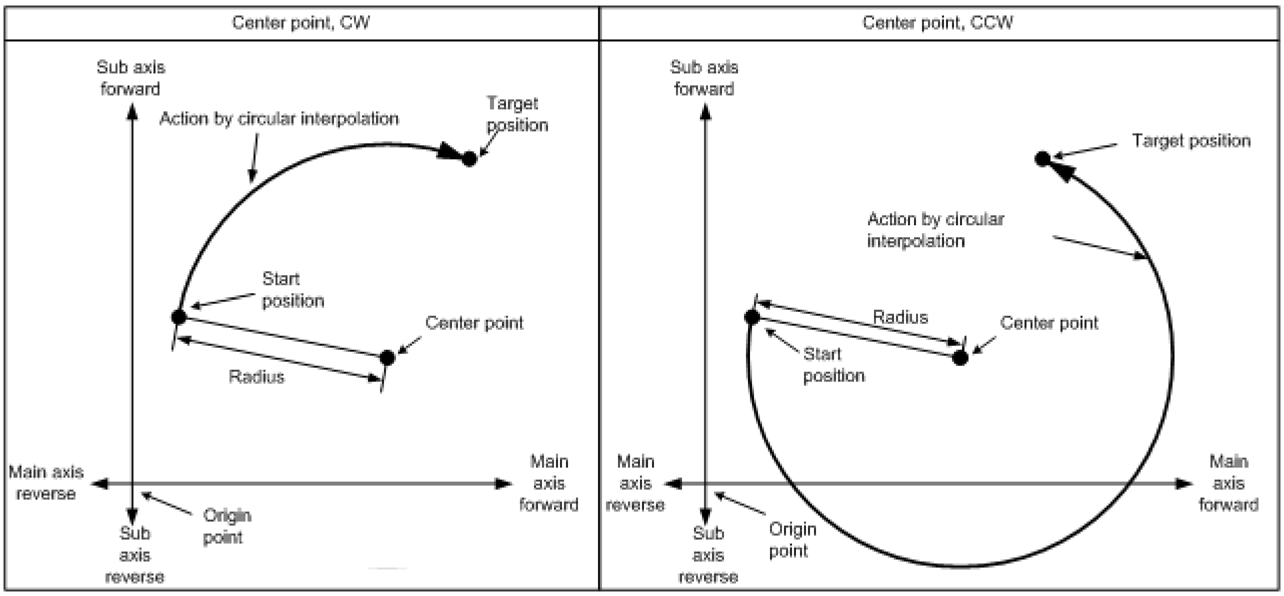


**2. Circular interpolation using center point specification method**

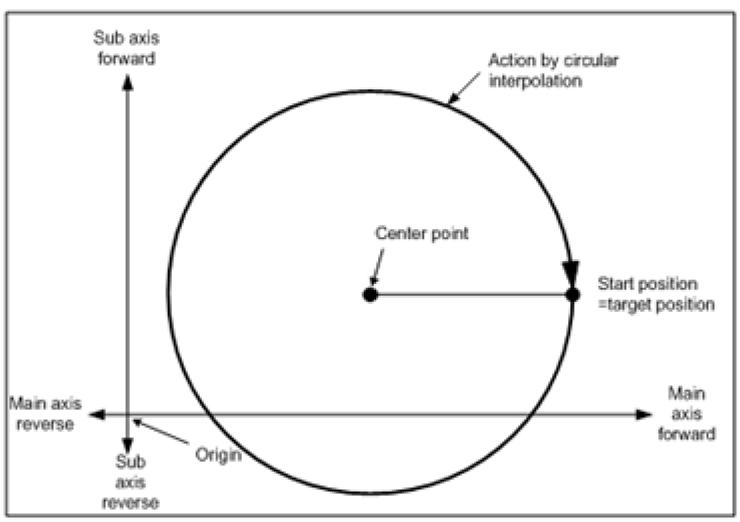
(1) Circular interpolation is performed from starting position to target position along the trajectory of the arc that takes the distance to the specified center point position as radius.

(2) Movement direction is determined by the direction set in “PathChoice” of absolute position circular interpolation operation (MC_MoveCircularAbsolute) or relative position circular interpolation operation (MC_MoveCircularRelative) motion function block.

- 0: 「CW」 - Circular interpolation is executed from the current position in a clockwise direction.
- 1: 「CCW」- Circular interpolation is executed from the current position in a counterclockwise direction.




(3) If target position is same as start position, you can execute circular interpolation whose circle radius is distance from center point to starting position.



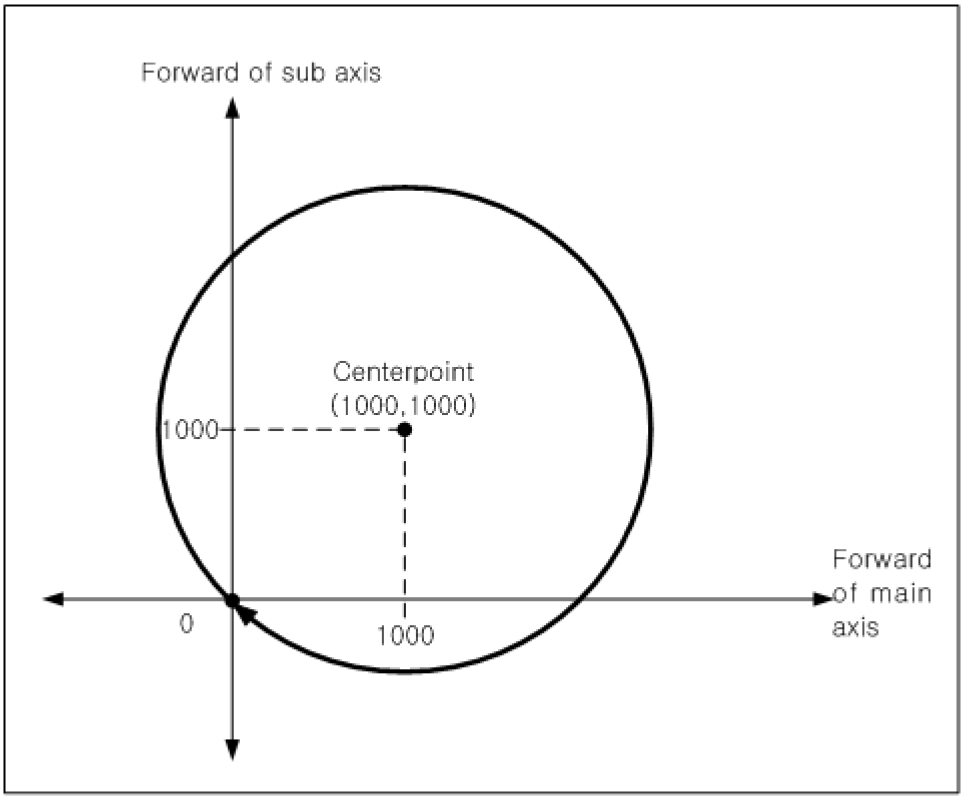
(4) Restrictions

Circular interpolation by center point specification method cannot be executed in the following cases.

- In case there is an axis which is in the origin undetermined state among configuration axes at the time of absolute coordinate circular interpolation operation (error code: 0x20A0)
- In case the midpoint specified as auxiliary point is the same as the starting position or target position (error code: 0x20A4)
- In case starting position is the same as the target position (error code: 0x20A5)
- In case the calculated radius of the arc exceeds 2147483647pls (error code: 0x20A6)
- In case starting position, auxiliary point position and target position are in a straight line (error code: 0x20A7)
- In case there is an axis in infinite running repetition operation among configuration axes (error code: 0x20A8)
- In case the number of configuration axes in the axis group is four (error code: 0x20A9)
- In case axis group configuration settings are not set in order (error code: 0x20AA)

(5) Operation pattern

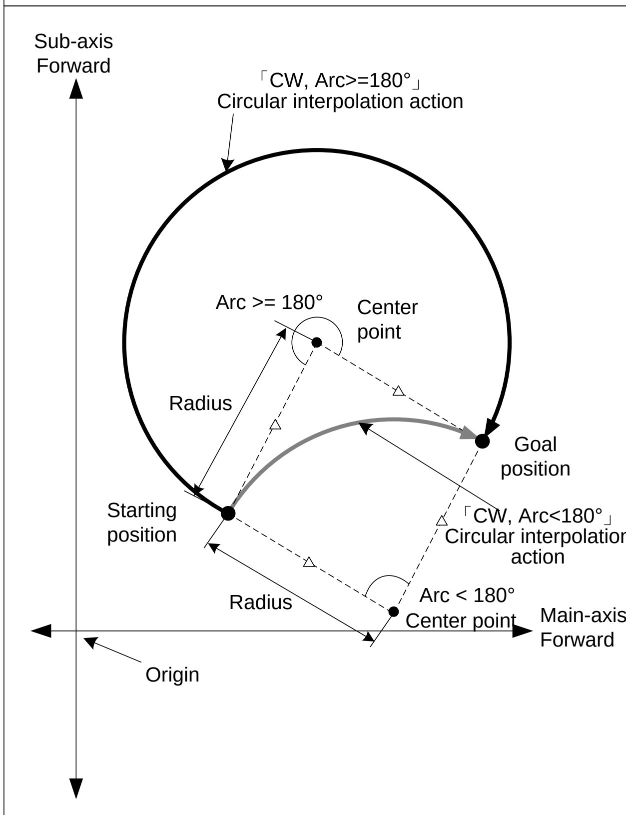
- Current position: (0.0, 0.0)
- Target position: (0.0, 0.0)
- Serve position: (1000.0, 1000.0)
- Method(CircMode): Center point(1)
- Direction(PathChoice): CW(0)

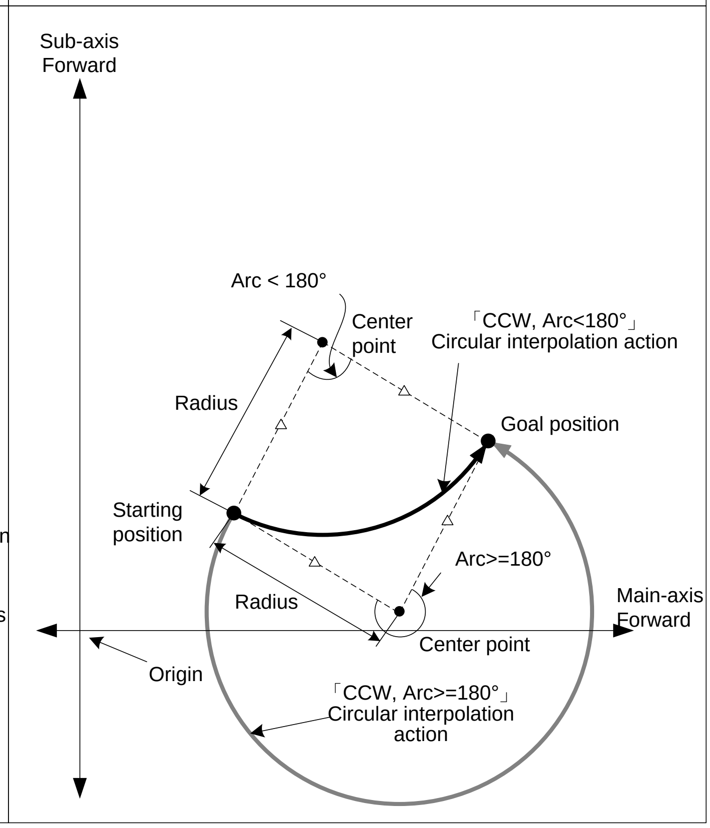


**3. Circular interpolation using radius specification method**

(1) Circular interpolation is performed from starting position to target position along the trajectory of the arc that takes the value set in circular interpolation auxiliary point. The arc that has center point depending on the sign of radius ((+): arc angle <180°, (-): arc angle>=180°) is drawn.

| CW, Arc<180° CW, Arc>=180° | CCW, Arc<180° CCW, Arc>=180° |
|---|---|




(2) In circular interpolation of radius specification method, the target position cannot be set the same as starting position.

(3) Movement direction and the size of the arc is determined by the sign of auxiliary point and directions (CW, CCW) set in "PathChoice" of absolute position circular interpolation operation (MC_MoveCircularAbsolute) or relative position interpolation operation (MC_MoveCircularRelative) motion function block

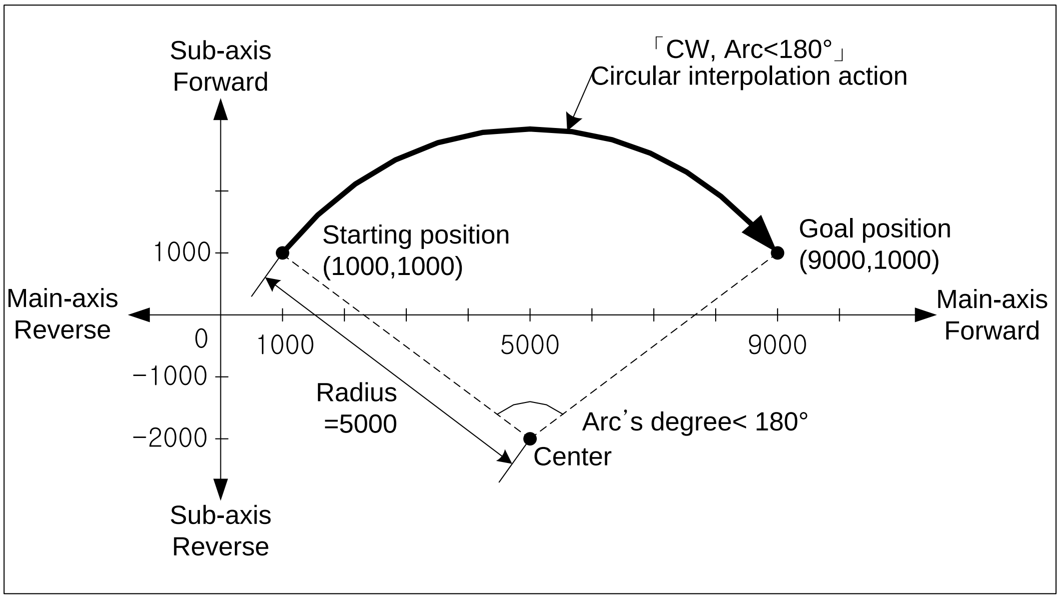
(4) Restrictions

Circular interpolation by radius specification method cannot be executed in the following cases.

- In case there is an axis which is in the origin undetermined state among configuration axes at the time of absolute coordinate circular interpolation operation (error code: 0x20A0)
- In case starting position is the same as the target position (error code: 0x20A5)
- In case the calculated radius of the arc exceeds 2147483647pls (error code: 0x20A6)
- In case starting position, auxiliary point position and target position are in a straight line (error code: 0x20A7)
- In case there is an axis in infinite running repetition operation among configuration axes (error code: 0x20A8)
- In case the number of configuration axes in the axis group is four (error code: 0x20A9)
- In case axis group configuration settings are not set in order (error code: 0x20AA)

(5) Operation patterns

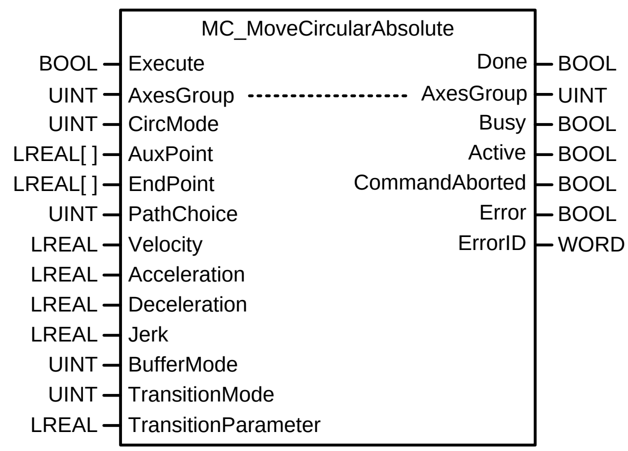
- Current position: (1000.0, 1000.0)
- Target position: (9000.0, 1000.0)
- Serve position: (5000.0, 0.0)
- Method(CircMode): Radius(2)
- Direction(PathChoice): CW(0)



**4. Relevant motion function block**

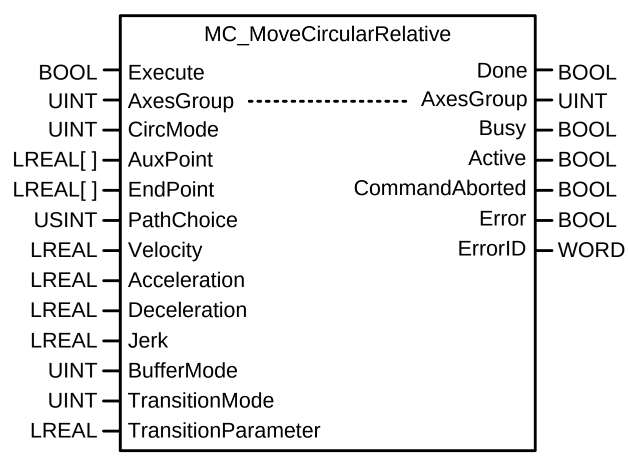
(1) Absolute positioning circular interpolation operation

| Name | Description | Operation Condition |
|---|---|---|
| MC_MoveCircularAbsolute | Absolute positioning circular interpolation operation | Edge |




(2) Relative positioning circular interpolation operation

| Name | Description | Operation Condition |
|---|---|---|
| MC_MoveCircularRelative | Relative positioning circular interpolation operation | Edge |

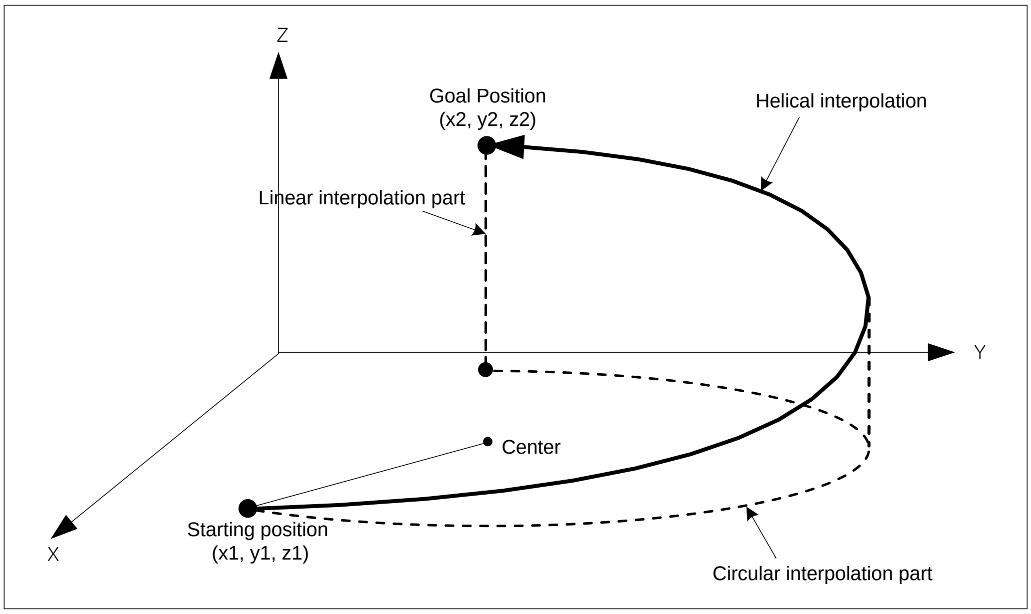


5. **Helical interpolation**

(1) Three axes are used in the execution of circular interpolation commands(「Relative position circular interpolation operation (MC_MoveCircularAbsolute)」,「Relative position circular interpolation operation (MC_MoveCircularRelative)」). That is, two axes move the trajectory of the arc depending on circular interpolation settings, and one axis performs linear interpolation in synchronization with circular interpolation motion.

(2) Linear axis is the third axis of the circular interpolation axis group.

(3) For the execution of helical interpolation, the axis group of circular interpolation command needs to be set to 3-axis, and linear interpolation target position is to be set in the third axis of 'EndPoint'.

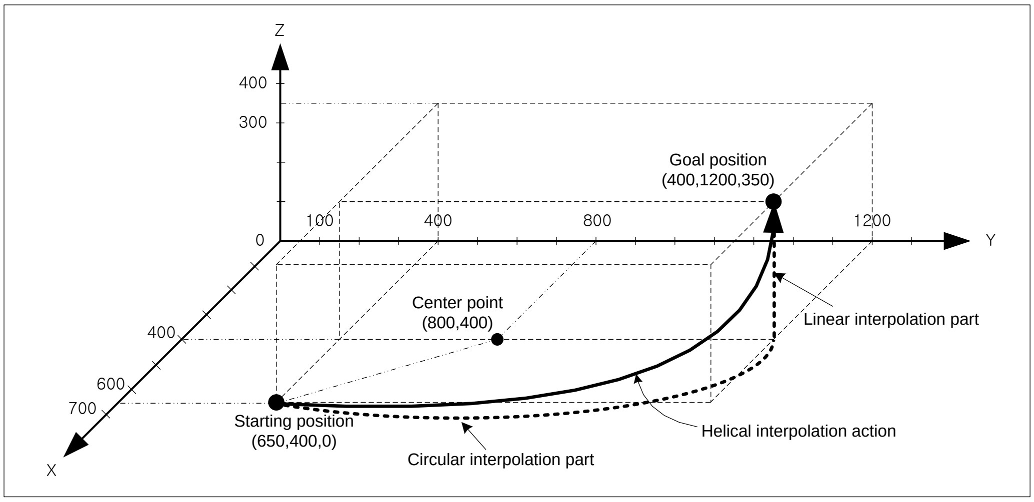



(4) Restrictions

The restrictions of helical interpolation are the same as those of circular interpolation according to the set circular interpolation modes.

(5) Operation pattern

- Current position: (650.0, 400.0, 0)
- Target position: (400.0, 1200.350)
- Serve position: (800.0, 400.0)
- Method(CircMode): Center point(1)
- Direction(PathChoice): CCW(1)



### 8.2.9 Axis Control Buffer mode

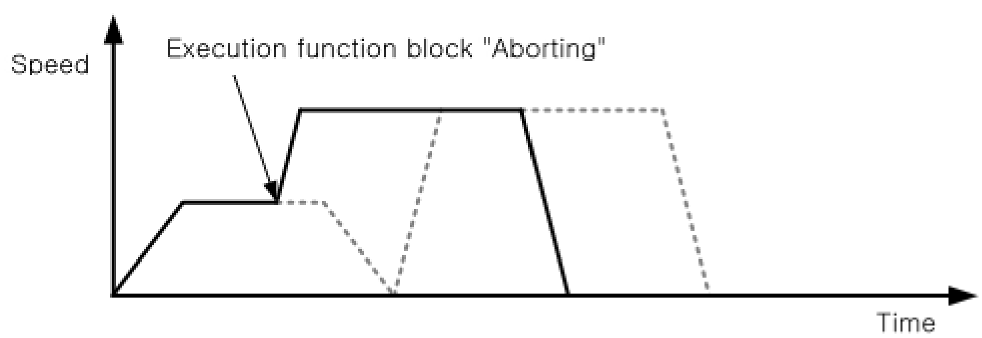
Cancellation of the existing axis motions and continued or continuous operation of them can be carried out by executing other motion function block while the axis is in operation. The motions are specified by entering buffer mode (BufferMode) in motion function block. In axis control the maximum number of runs that can be queued in the buffer is 10. In case of executing commands with buffer mode which has more than that, error (error code: 0x1022) occurs.

Values that can be set in Buffer Mode are as follows.

| Buffer Mode | Descripton |
|---|---|
| Aborting | It executes commands immediately. The existing commands in operation are aborted. |
| Buffered | It executes commands after the completion of the existing command in operation. |
| BlendingLow | It conducts a combination operation that helps blend into side with lower velocity by comparing the velocity of the existing command and the command to make. |
| BlendingPrevious | It conducts a combination operation that makes the combination with velocity of the existing commands. |
| BlendingNext | It conducts a combination operation that makes the combination with velocity of commands to make. |
| BlendingHigh | It conducts a combination operation that helps blend into side with higher velocity by comparing the velocity of the existing command and the command to make. |

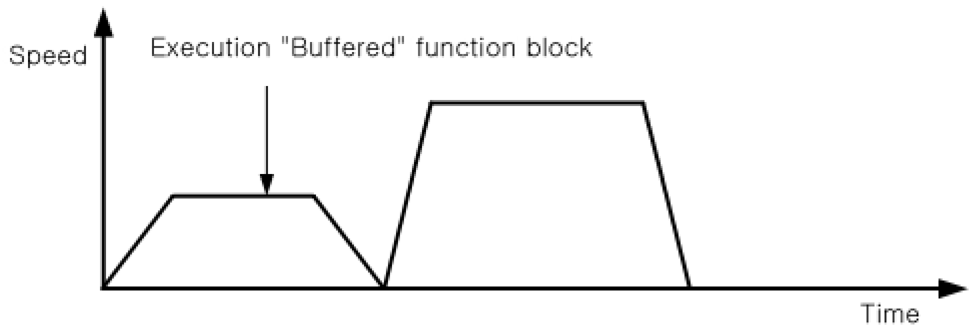
1. **Buffer Mode "Aborting"**

It aborts the existing commands in execution immediately and executes the next command. CommandAborted output of the existing motion function blocks is On.



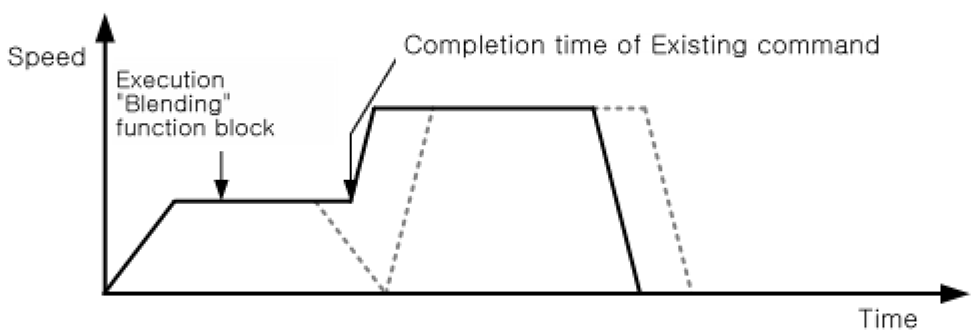
2. **Buffer Mode "Buffered"**

It execute the next command after the completion of the existing commands in execution (Done output is On).



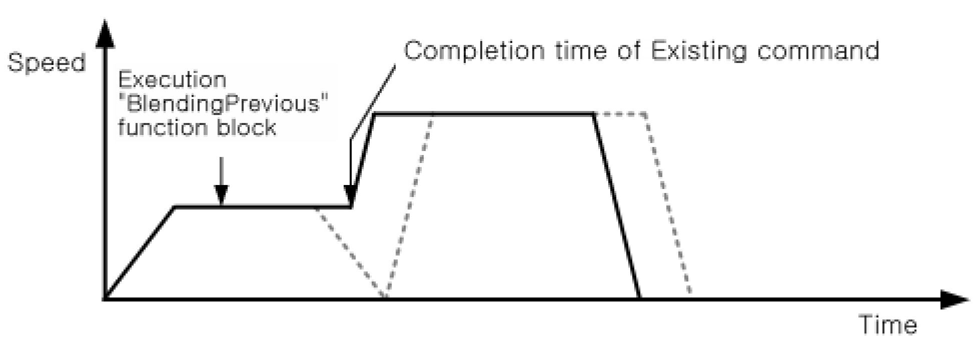

3. **Buffer Mode "BlendingLow"**

It combines operation so that operation can be made at lower velocity in a comparison between the target velocity of the existing commands in execution at the time of command completion and that of buffered command.



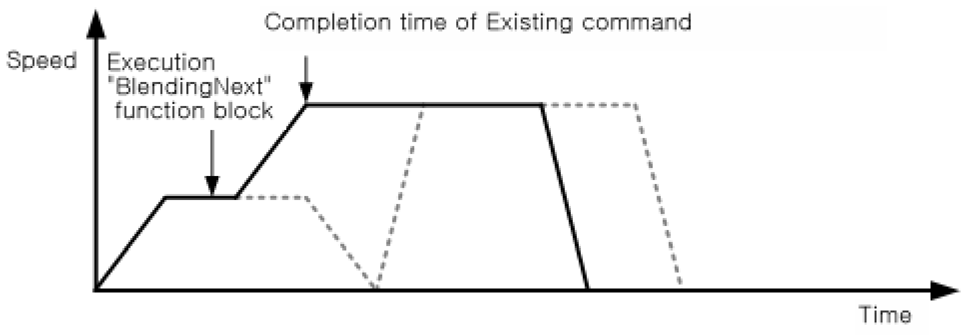

4. **Buffer Mode "BlendingPrevious"**

It executes the next command after acceleration/deceleration of the velocity to the target velocity of the next command buffered after maintaining the velocity of commands in execution at the point of time when the exiting commands are competed.



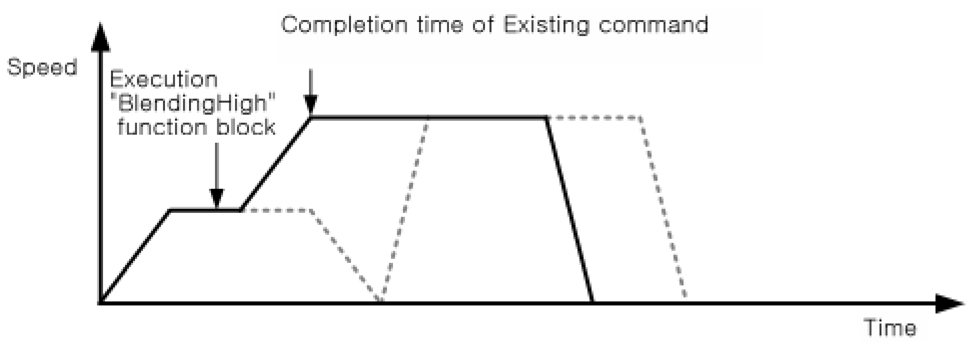
5. **Buffer Mode "BlendingNext"**

It executes the next command after acceleration/deceleration so that operation can be performed at the target velocity of the next command at the point of time when the existing commands in execution are completed.




6. **Buffer Mode "BlendingHigh"**

It combines operation so that operation can be made at higher velocity in a comparison between the target velocity of the existing commands in execution at the time of command completion and that of buffered command.



## 8.2.10 Axis Group Control Buffer Mode and Transition Mode

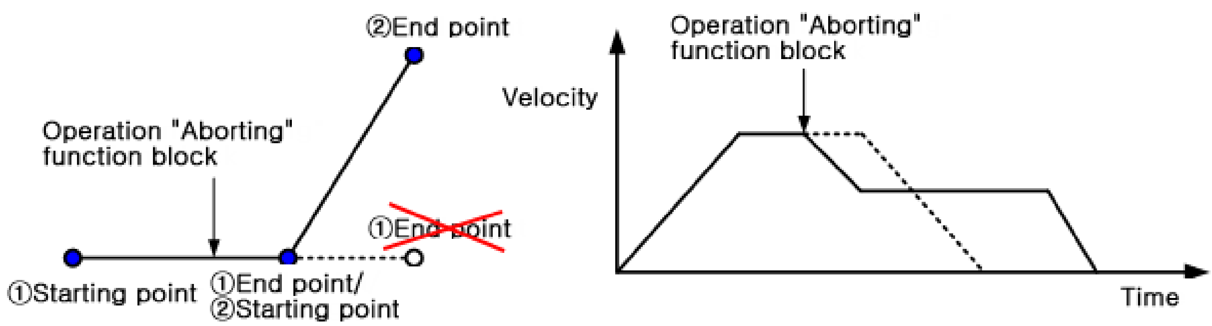
In axis group control as in speed control, motion commands can be executed continuously by using buffer mode, and the maximum number of runs that can be queued in the buffer is 10. In case of executing commands with buffer mode which is more than that, error (error code: 0x2022) occurs.

In addition, operation is possible by inserting curve between the two linear trajectories using transition mode.

**1. 'BufferMode'**

(1) Aborting

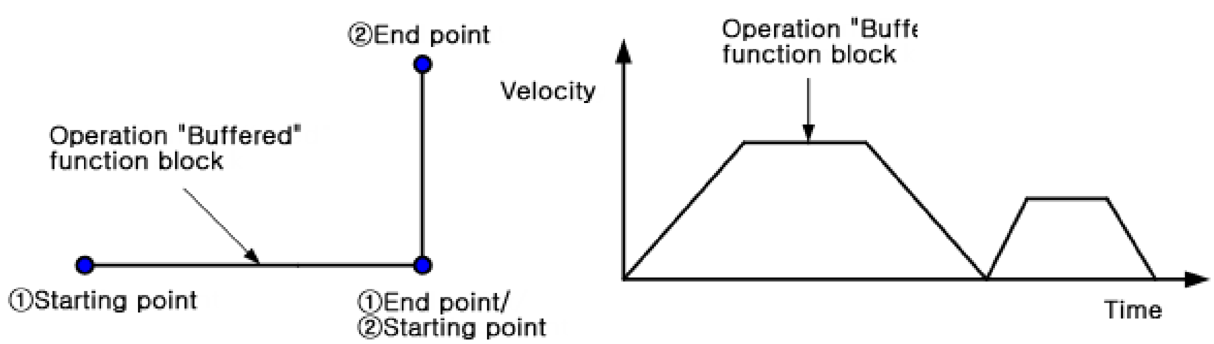
It aborts the motion that is currently running, and executes a new motion immediately.




(2) Buffered

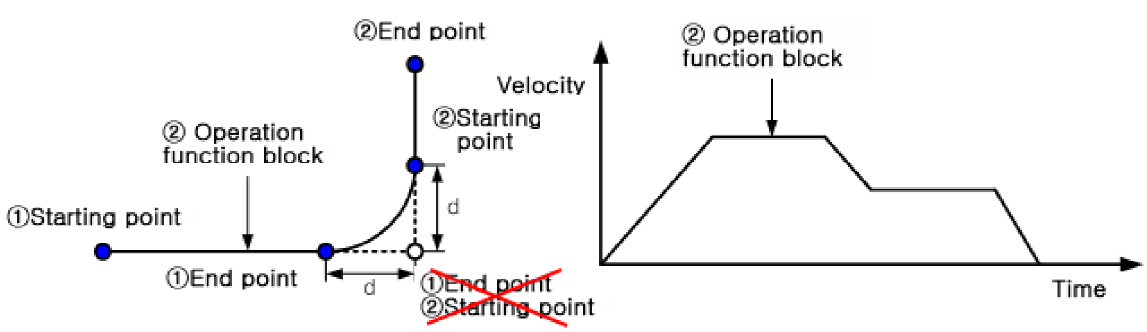
It executes the next command after completing motion operation that is being currently executed.

'TransitionMode' is not reflected.




(3) Blending

There is no stop between the two operations since the current motion is mixed with the next motion. The velocity may vary depending on blending modes (BlendingLow, BendingPrevious, BlendingNext, BlendingHigh).




※ Motions in case of the BlendingNext

**2. 'TransitionMode'**

(1) TMNone

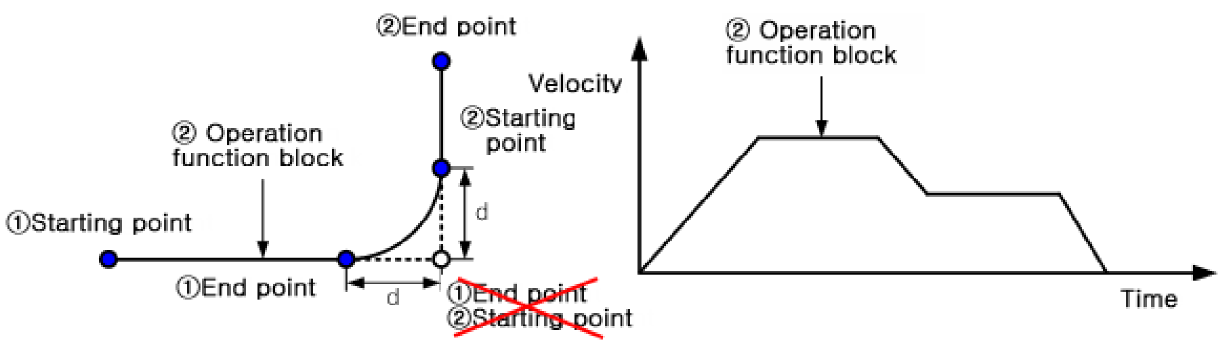
Motion trajectory is not changed, and curve is not inserted between the two operations.

In case buffer mode is Blending in this setting, Buffered mode is operated.

Motions according to the buffer mode are the same as the above Aborting and Buffered.

(2) TMCornerDistance

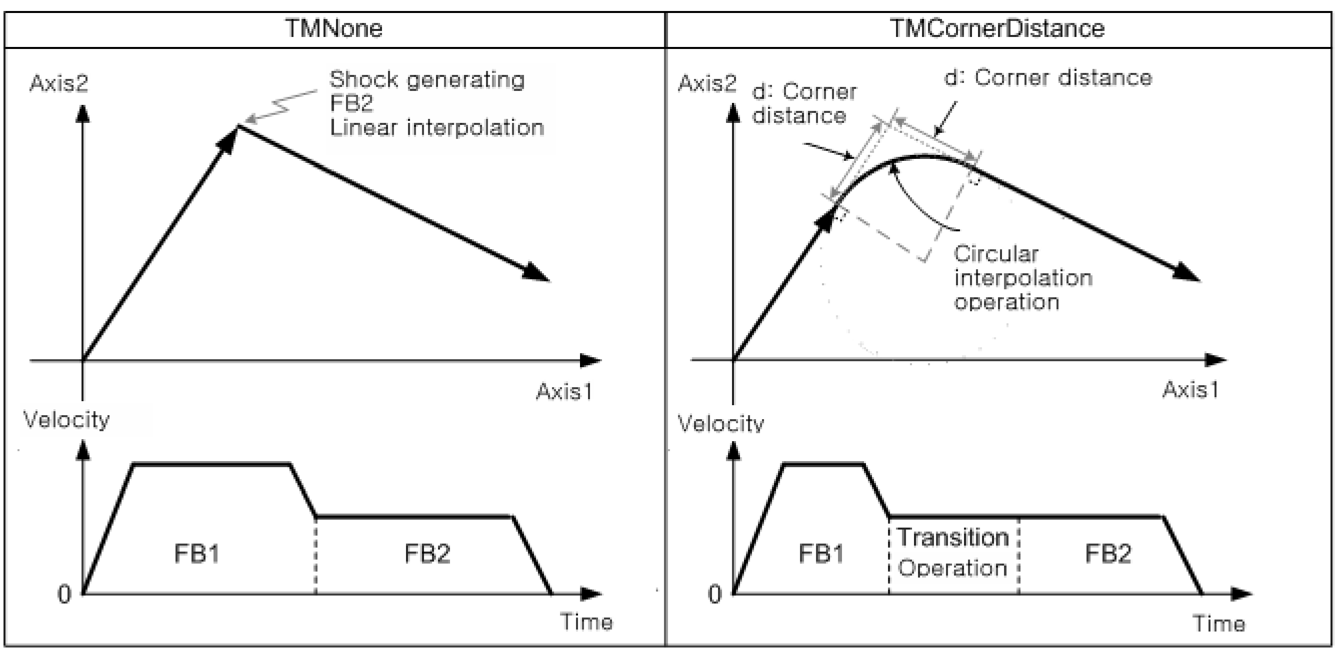
Ther curve can be inserted by specifying the distance of two motion block corners. The conversion velocity is specified by the BufferMode.




※ Motions in case of the BlendingNext

※ d: Curve insertion distance at the corner

(3) TransitionMode Comparison



## 8.2.11 Synchronous Control

### 1. Gear operation

(1) Gear operation makes speed synchronization of main axis (or encoder) and serve axis depending on the set ratio.

(2) Gear operation can be aborted with gear operation cancellation command.

(3) Gear ratio (=velocity synchronization ratio) is calculated as follows.

| Gear ratio = Main axis ratio/Serve axis ratio |
|---|

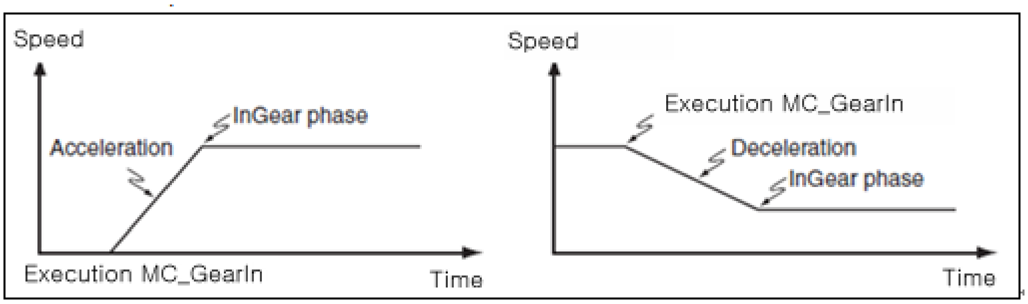
※ Main axis ratio < serve axis ratio can also be set.

(4) Rotation direction of serve axis is based on the forward direction of the main axis. In case gear ratio is positive (>0), rotation is made in forward direction, and that is negative (< 0), in reverse direction.

(5) The final operating velocity of serve axis is calculated as follows.

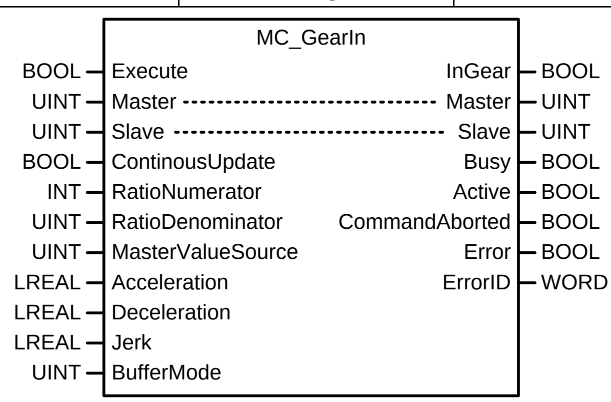
| Operation speed of serve axis<br>= Operation speed of main axis X Gear ratio<br>= Operation speed of main axis X Main axis ratio/Serve axis ratio |
|---|

(6) Acceleration/deceleration from the start of gear operation to target velocity can be set by using Acceleration and Deceleration input.

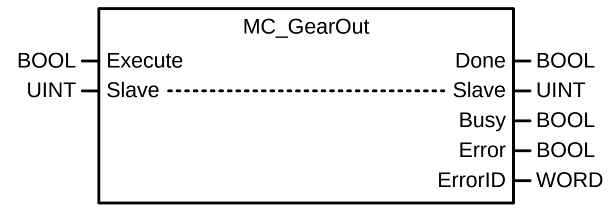



(7) Relevant motion function block

| Name | Description | Operation Condition |
|---|---|---|
| MC_GearIn | Gearing run | Edge |



| Name | Description | Operation Condition |
|---|---|---|
| MC_GearOut | Gearing disengage | Edge |

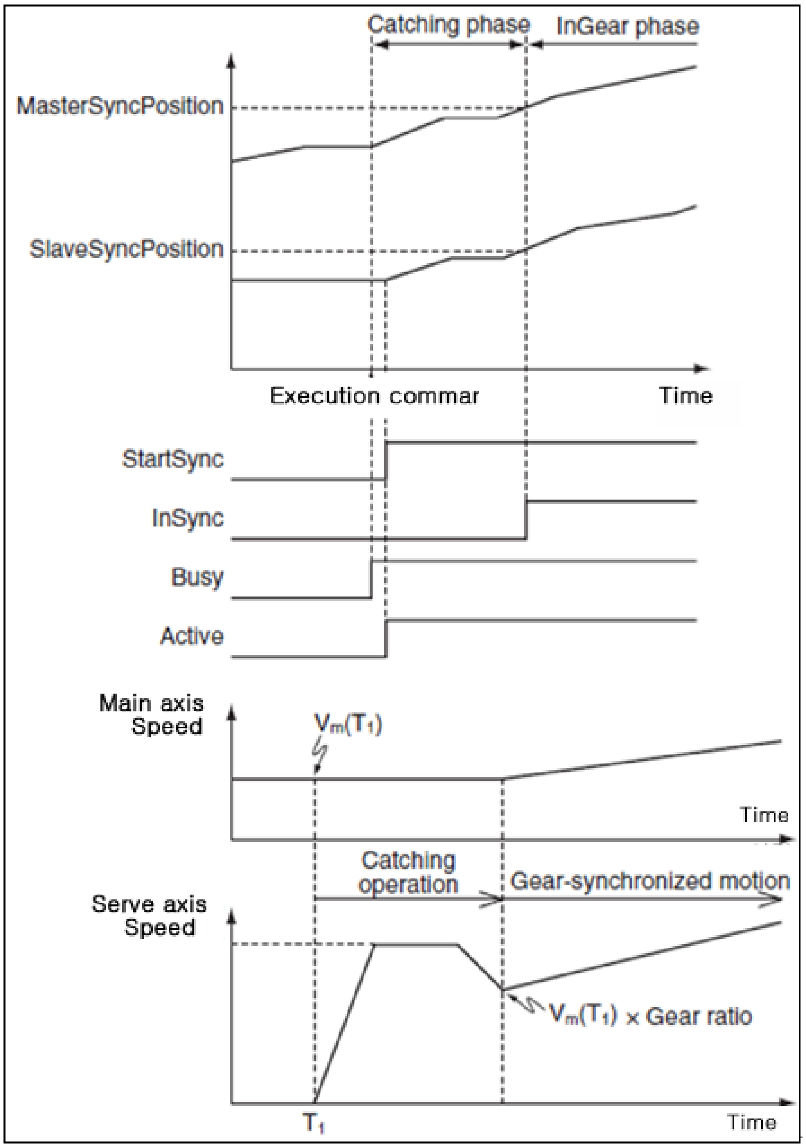



**2. Positioning gear operation**

(1) Positioning gear operation makes speed synchronization of main axis (or encoder) and serve axis depending on the ratio set the same as in gear operation basically.

(2) The starting position in which main axis and serve axis are synchronized can be specified.

(3) Methods for operation are as follows.



(4) Relevant motion function block

| Name | Description | Operation Condition |
|---|---|---|
| MC_GearInPos | Gearing by specifying the position | Edge |

MC_GearInPos

| Input type | Input | Output | Output type |
|---|---|---|---|
| BOOL | Execute | InSync | UINT |
| UINT | Master | Master | UINT |
| UINT | Slave | Slave | BOOL |
| INT | RatioNumerator | StartSync | BOOL |
| UINT | RatioDenominator | Busy | BOOL |
| UINT | MasterValueSource | Active | BOOL |
| LREAL | MasterSyncPosition | CommandAborted | BOOL |
| LREAL | SlaveSyncPosition | Error | BOOL |
| UINT | SyncMode | ErrorID | WORD |
| LREAL | MasterStartDistance | | |
| LREAL | Velocity | | |
| LREAL | Acceleration | | |
| LREAL | Deceleration | | |
| LREAL | Jerk | | |
| UINT | BufferMode | | |

## 8.2.12 Manual Control

### 1. Jog operation

(1) Jog operation makes positioning control by manual jog commands of users.

(2) Jog operation is possible even in the state in which the origin of the axis is not determined.

(3) Jog commands are executed even in the origin determined or undetermined status, which makes it possible to monitor changes in position values of the axis.

(4) Acceleration/deceleration processing and jog speed

For processing acceleration and deceleration, acceleration and deceleration control is made based on the value set in Jog Acceleration/Deceleration/Jerk among [Operation parameter – expansion parameter] setting items.

Jog speed is set in Jog high-speed and Jog low-speed among [Operation parameter – expansion parameter] setting items.

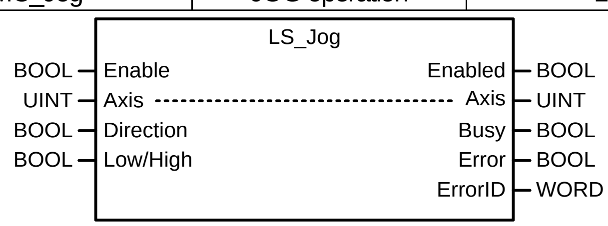
(5) Jog high-speed should be set to at the speed limit or less or at least Jog low-speed among [Operation parameter – basic parameter] setting items.

(6) Relevant parameter setting

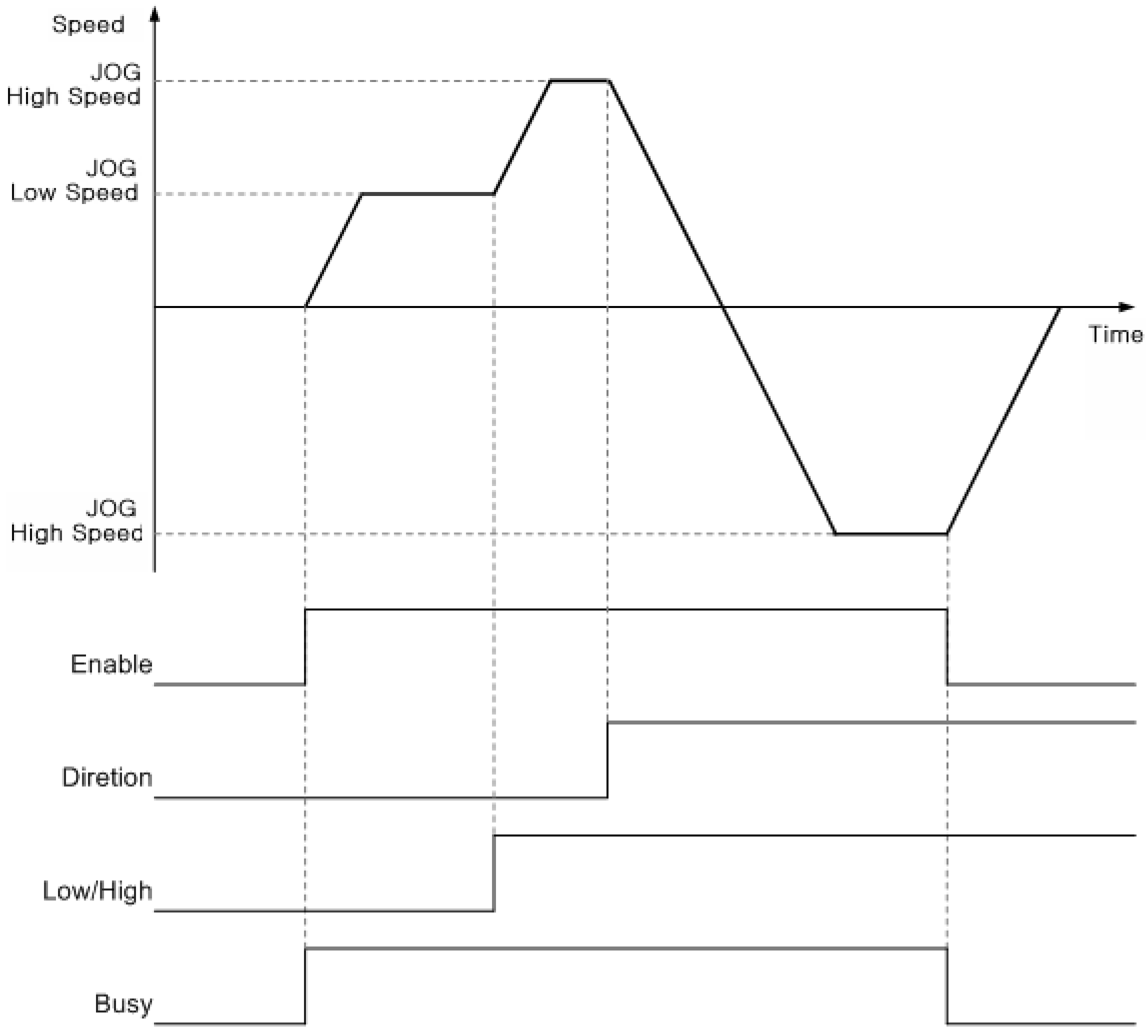
| Item | Settings | Initial Value |
|---|---|---|
| JOG High Speed | Long Real(LREAL) Positive number | 100000 pls/s |
| JOG Low Speed | | 10000 pls/s |
| JOG Acceleration | 0 or Long Real(LREAL) Positive number | 100000 $pls/s^2$ |
| JOG Deceleration | | 100000 $pls/s^2$ |
| JOG jerk | | 0 $pls/s^3$ |

(7) Relevant motion function block

| Name | Description | Operation Condition |
|---|---|---|
| MC_Jog | JOG operation | Level |



(8) Operation Timing



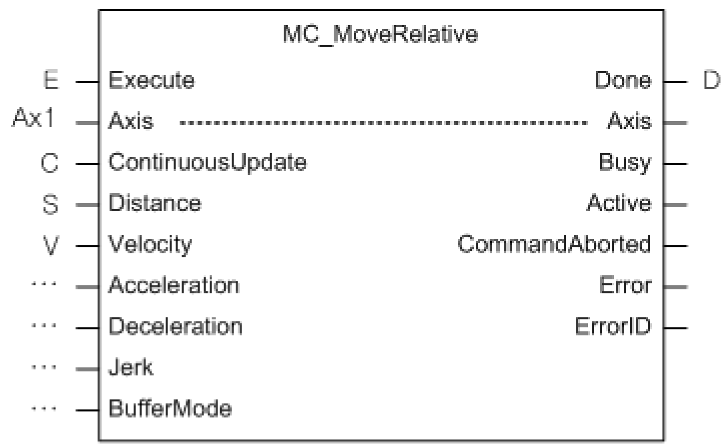
# 8.3 Other Functions

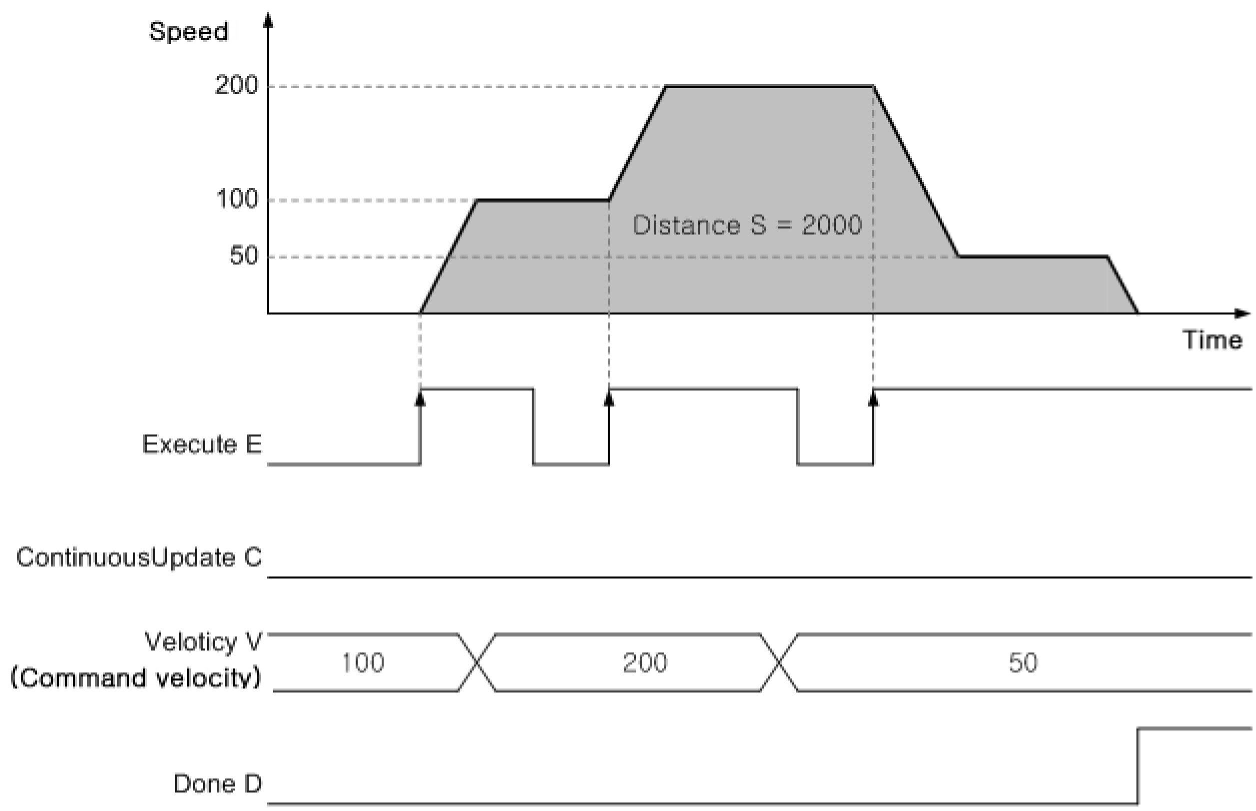
## 8.3.1 Functions to change control

**1. Changes in input variables of motion function block in execution**

(1) In case there is no ContinuousUpdate input in motion function block, or execution (Execute input enabled) is made when ContinuousUpdate input is Off, the motion function block is operated with the input at the time when Execute input is On(rising Edge) applied. To operate by changing the input of the motion function block during operation, get the Execute input to be On after changing input value, and the changed value is immediately applied for operation.

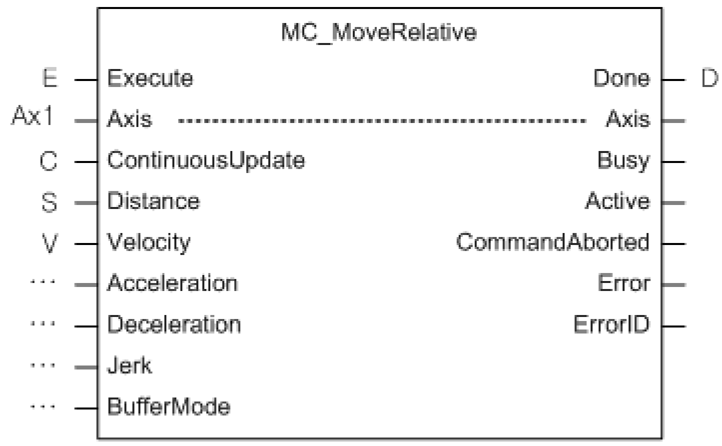
[Example] Input variable update of motion control command by re-execution of Execute

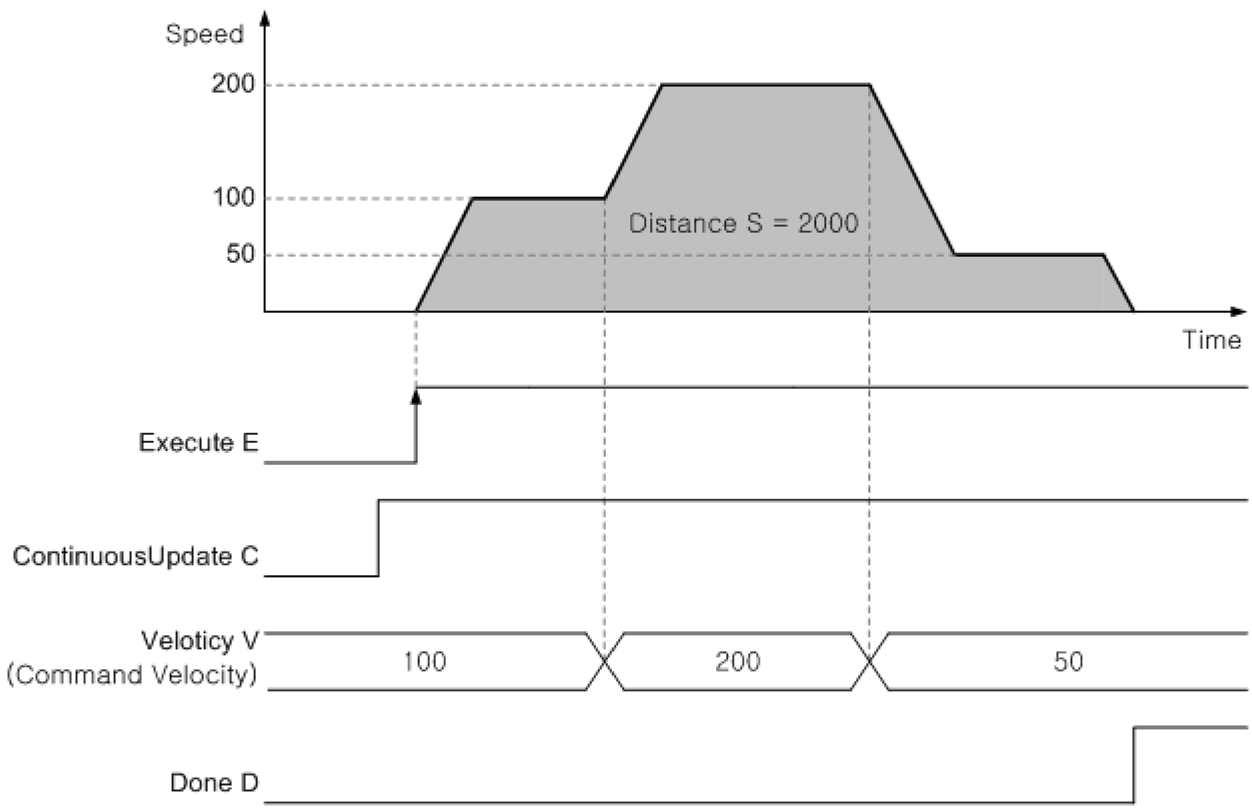


(2) In case ContinuousUpdate input is On in Edge operation motion function block, the input at the time when Execute input is On (rising Edge) is applied to the motion function block if Execute input is On, and the motion function block makes a motion to reflect the change if the input is changed while ContinuousUpdate input is On. However, changes in input are no longer reflected after the operation of the motion function block is completed or stopped (Busy output disabled).

[Example]Input variable update of the motion control command when ContinuousUpdate is On



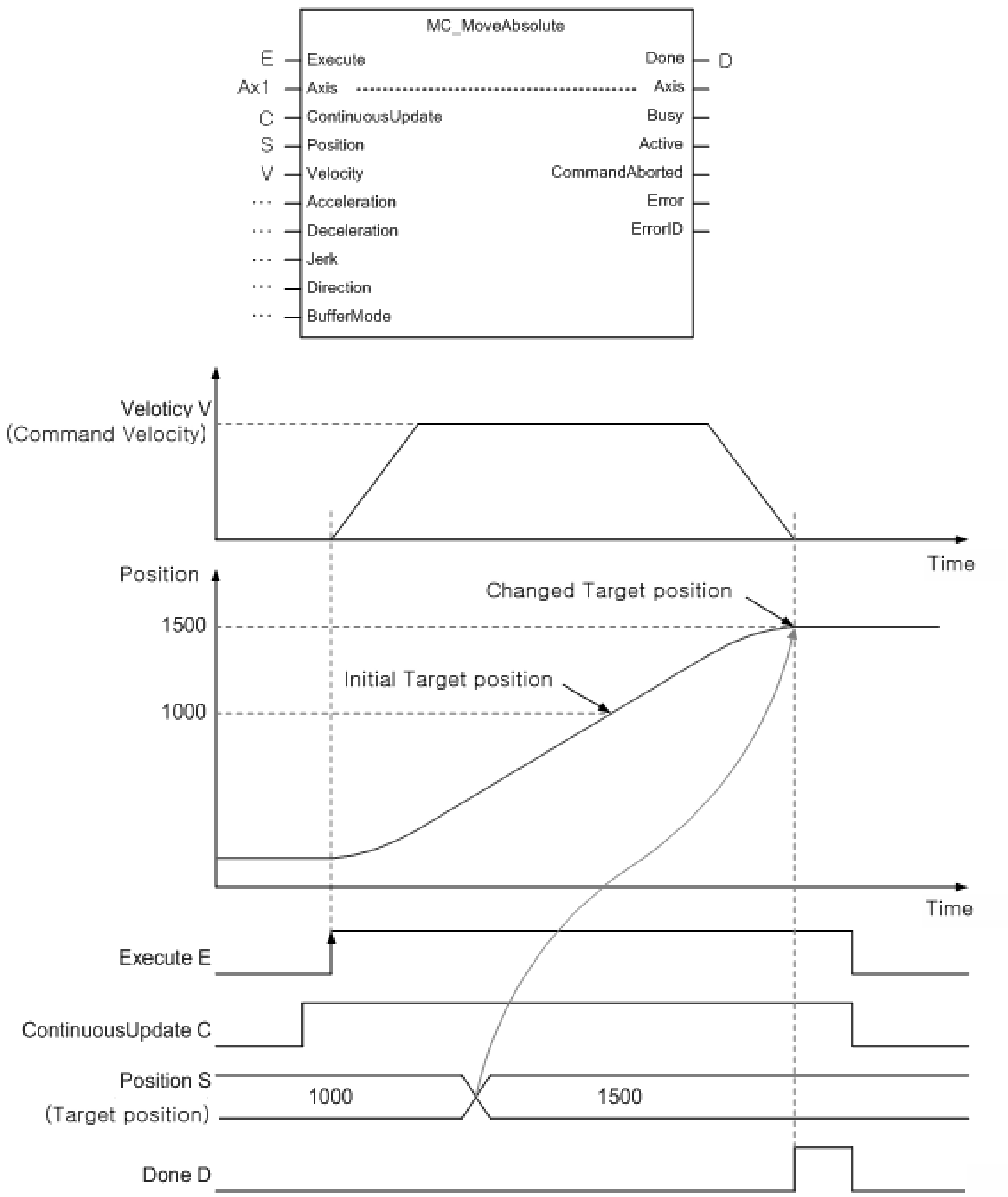

(3) In case of the level operation motion function block, input variables at the time when Enable input is On (rising Edge) are applied to operate, and input variables can be changed continuously while Enable input is On.

2. **Position override**

(1) It is a function to override the target position of the axis in position operation. Override function is enabled by suing ContinuousUpdate input of the position operation motion function block. When the position operation motion function block is being executed, the position operation to reflect changed objectives is performed by tuning Execute input On again by changing the target position after turning ContinuousUpdate input of the motion function block On.

(2) In case the target position changed at the point in time when changes in the target position are reflected is greater than the position in case of the velocity being reduced to stop from the current velocity, positioning is made in the direction of the current movement. On the contrary, in case the changed position is smaller than the position in case of the velocity being reduced to stop from the current velocity, positioning is made in the direction of the target position by operating to the opposite direction after deceleration stop.

[Example] Position override using ContinuousUpdate



**3. Velocity, Acceleration/Deceleration, Jerk override**

(1) It is a function to conduct velocity, acceleration/deceleration and jerk override of the specified axis

(2) It can override velocity, acceleration/deceleration, jerk to absolute value using ContinuousUpdate input of the motion function block in operation. When the operation motion function block is being executed, the operation to reflect changed velocity and acceleration is performed by tuning Execute input On again by changing the velocity and acceleration after turning ContinuousUpdate input of the motion function block On.

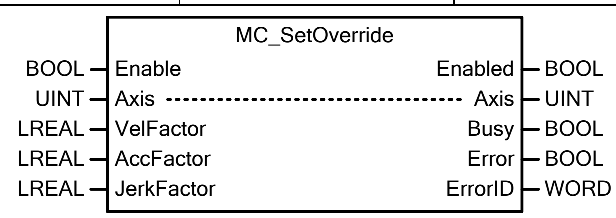
(3) For the execution of speed override operation at the rate on the current command speed, not an absolute value override (MC_SetOverride) motion function block is used for the override.

- In case the value is 1.0, the current operating speed, acceleration/deceleration, jerk is the same as before. In case VelFactor value specified is 0.0, the axis comes to a stop, but it cannot be changed to 'StandStil' state.
- The meaning of Factor value specified of override (MC_SetOverride) motion function block differs depending on the override item value of common parameters.

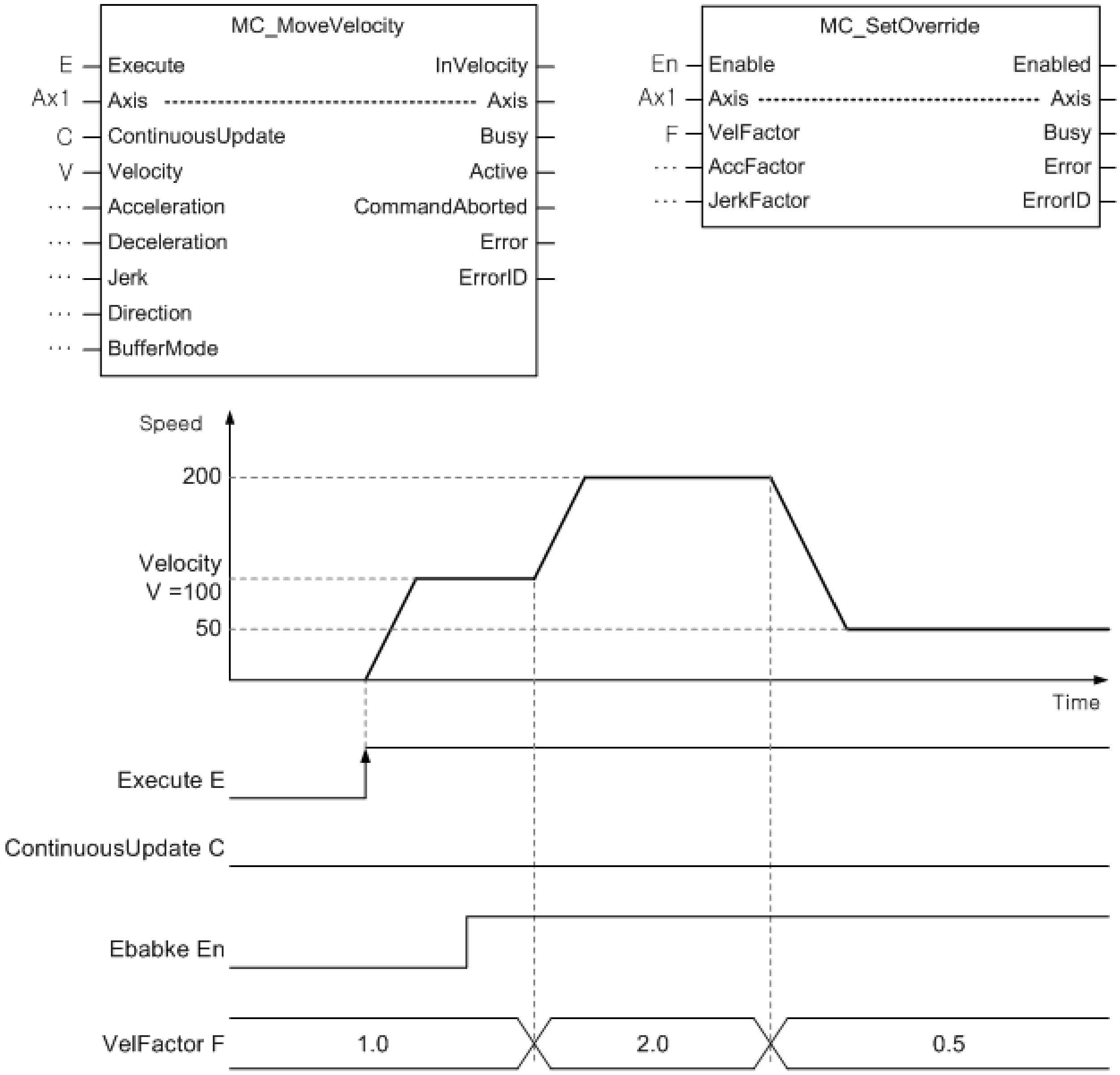
  0: percentage specified – Factor value operates at the rate on the current command speed
  1: unit value specified – Factor value is an absolute unit specified value of the set item

(4) Relevant motion function block

| Name | Description | Operation Condition |
|---|---|---|
| MC_SetOverride | Velocity override | level |



[Example] Changes in velocity using override (MC_SetOverride) motion function block



4. **Changes in the current position**

(1) It is a function to change the current position of the axis to the value specified by users.

(2) In Position input, the position is specified. In case Relative input is Off state when command is executed, the position of the axis is replaced with the Position input value, and in case Relative input is On state, Position input value is added to the current position of the axis.

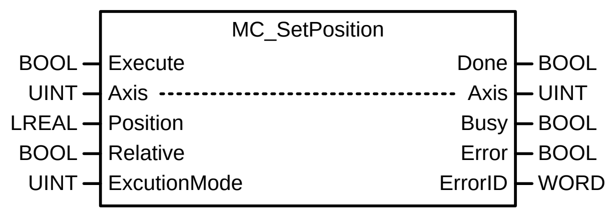
- 0: Absolute coordinate position
- 1: Relative coordinate position

(3) Set point can be specified with ExcutionMode input. When the input value is 0, the set value is set immediately after the execution of commands, and in case it is 1, it is set in the same time with 'Buffered' in a sequential operation setting.

- 0: Position value applied immediately
- 1: Applied in the same time with 'Buffered' of Buffermode

(4) Relevant motion function block

| Name | Description | Operation Condition |
|---|---|---|
| MC_SetPosition | Setting the current position | Edge |




5. **Encoder preset**

(1) It is a function to change the current encoder position value to any position value specified by users.

(2) In Encoder input, encoder to be changed is specified.

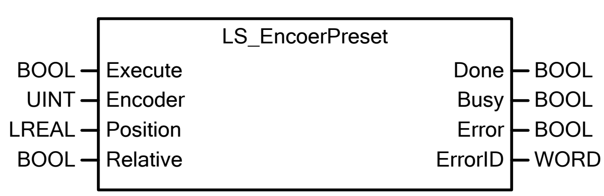
- 1: Encoder 1
- 2: Encoder 2

(3) In Position input, the encoder position is specified. In case Relative input is Off state when command is executed, the encoder position of the axis is replaced with the Position input value, and in case Relative input is On state, Position input value is added to the current position of the encoder.

- 0: Absolute coordinate position
- 1: Relative coordinate positionEncoder
-

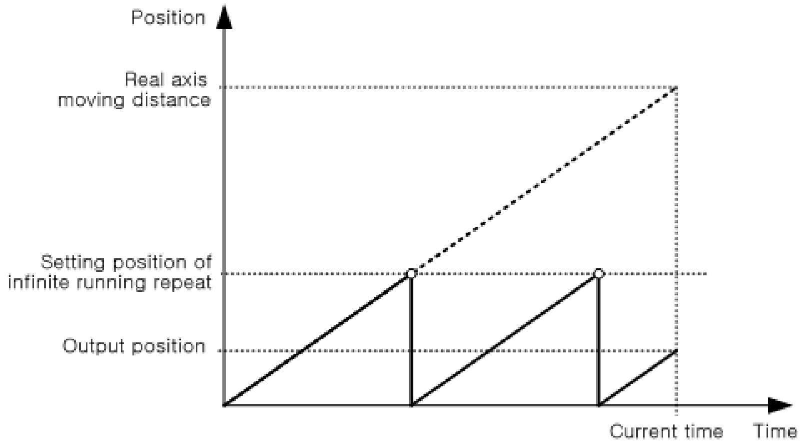
(4) Relevant motion function block

| Name | Description | Operation Condition |
|---|---|---|
| LS_EncoderPreset | Encoder preset | Edge |



**6. Infinite running operation**

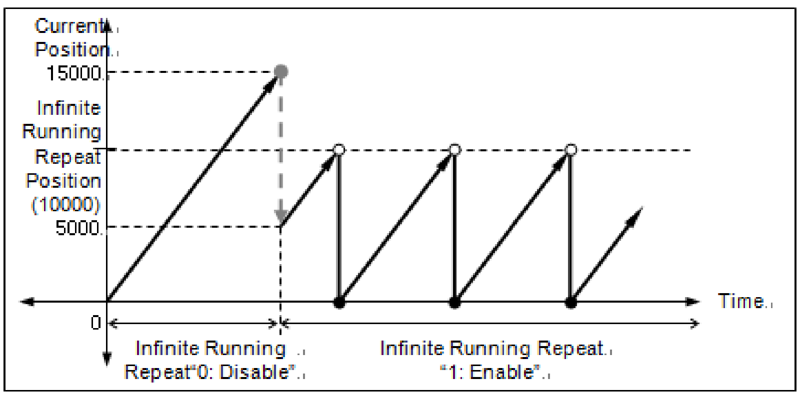
(1) Infinite running repetition function is to perform periodic updates on the display values of the command position and current position automatically with values set in ‘infinite running repetition position’ among expansion parameters of operating parameters. The use of infinite running repetition positioning function makes it possible to determine the position with repeated position value on the same direction.




(2) The instant ‘infinite running repetition’ parameter among expansion parameters of operating parameters is set to Allow, the current position is automatically changed to value within the infinite running repletion position in case it is the value other than the range of infinite running repletion position.

[Example 1] In case the current position is -32100 and infinite running repetition position 10000
When infinite running repetition “1: Allow” is set, the current position becomes 7900.

[Example 2] In case the current position is 15000, and infinite running repetition position 10000
When infinite running repetition “1: Allow” is set, the current position becomes 5000.




(3) Infinite running repetition setting of driving axis can be made by using software package or axis parameter change function.

(4) Relevant parameter setting

| Item | Description | Settings | Initial Value |
|---|---|---|---|
| Infinite running repetition position | Set repeated position range value in case of being used as infinite running repetition mode | Long Real (LREAL) Positive | 360 pls |
| Infinite running repetition | Set whether to allow infinite running repetition operation function | 0: Disable<br>1: Enable | 0: prohibited |

## 8.3.2 Auxiliary Function of Control

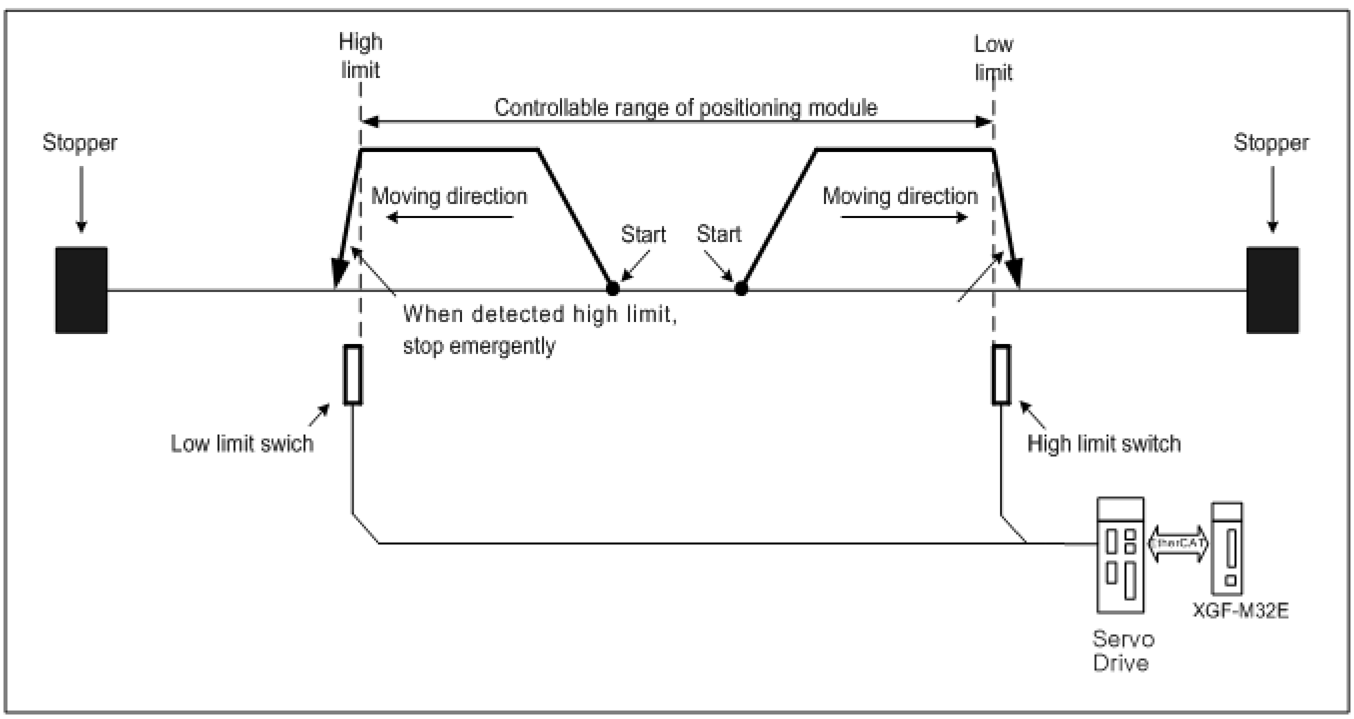
### 1. Hardware high/low limit

(1) It is used to make a sudden stop of servo drive before reaching lower limit/upper limit of the machine side by installing high/low limit switch in the inside of the high/low limit, the physical operating range of the machine side. In this case, the range is out of the upper limit, error ‘0x1200’ occurs, and lower limit, error ‘0x1201’.

(2) Input of hardware high/low limit switch is connected to each servo drive, and operation is stopped by servo drive at the time of high/low limit detection, and module immediately terminates the motion which is currently being operated.

(3) In case of the stop due to the detection of hardware high/low limit signals, it is required to move inside the controllable range of motion control module with jog operation of the opposite direction of the detected signals.

(4) Hardware high/low limit motions are as follows.



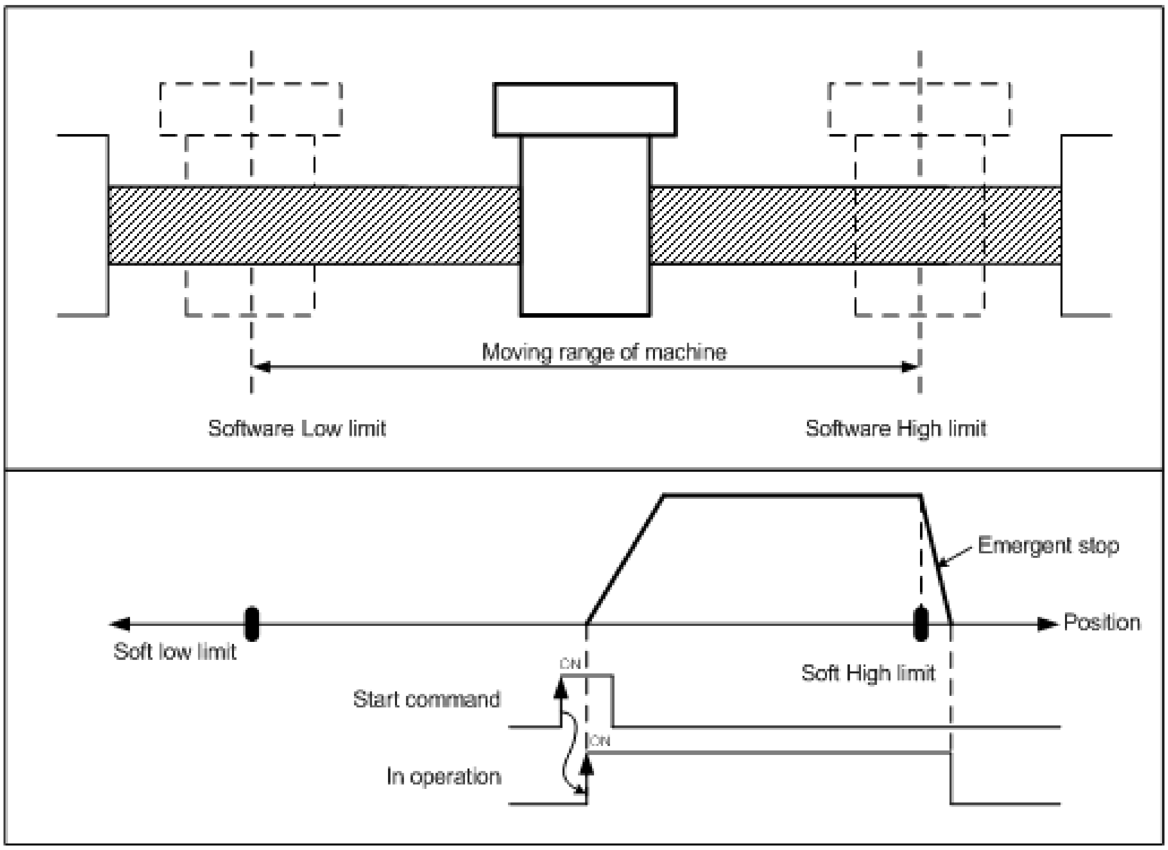
2. **Soft high/low limit**

(1) Software stroke high/low limit is a function that does not perform the operation in out of the range of soft high/low limit set by users.

(2) Software stroke high/low limit of each driving axis can be set by using software package or axis parameter change function.

(3) If the axis is outside the range of stroke, axis error occurs.

(4) When the axis is positioned outside the range of stroke, operation of the axis is impossible except for jog. Operation can be resumed by moving it inside the range of stroke through jog operation or resetting the current position to the inside the stroke range.




(5) Software high/low limit are don't detecte in the following cases.

- In case soft upper limit value and lower limit value are set to the initial value ( upper limit: 2147483647, lower limit: -2147483648)
- Software upper limit value and lower limit value are set to the same value (software upper limit = software lower limit)
- In case of the operation with speed control when expansion parameter "S/W limits during speed control" is set to " 0: Don't detect"

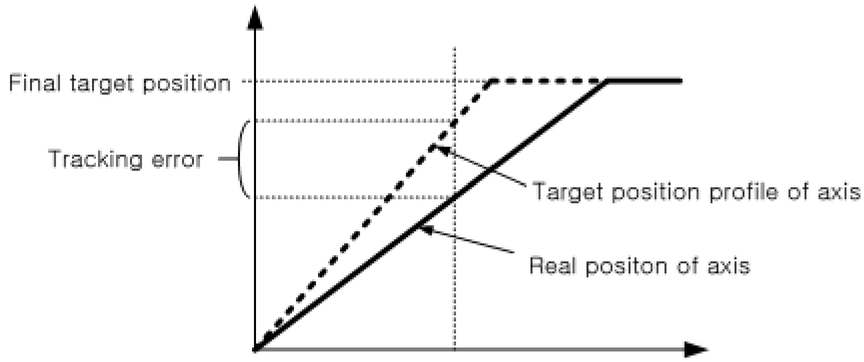
(6) Relevant parameter setting

| Item | Description | Settings | Initial Value |
|---|---|---|---|
| S/W upper limit | Set the range of software limit function | Long Real(LREAL) | 2147483647 pls |
| S/W lower limit | | | -2147483648 pls |

**3. Position tracking error**

(1) It is a function to output an error when driving axis is in position operation, or the actual position read from the axis is further beyond tracking tolerance than the target position of the position operation instruction profile.

(2) Position tracking tolerance of each driving axis can be set by using software package or axis parameter change function




(3) Whether to set abnormality to a warning or an alarm in case of the occurrence of tracking error can be set in Tracking Error Level of expansion parameter.

Motions according to the set value are as follows.

- '0: warning'
  When tracking error occurs, 「Above deviation alarm(_AXxx_DEV_WARN)」flag becomes On, and tracking error warning error (error code: 0x101D) occurs. The axis continues to operate without stopping.
- '1: alarm'
  When tracking error occurs, 「Above deviation alarm(_AXxx_DEV_ERR)」flag becomes On, and tracking error alarm error (error code: 0x101C) occurs. The axis makes a sudden stop at 「Sudden stop deceleration」.

(4) Inspection on tracking error is not performed in the following cases.

- In case 「Tracking error exceeding value」is 0
- In case of operation with homing or torque control

(5) Relevant parameter setting

| Item | Description | Settings | Initial Value |
|---|---|---|---|
| Tracking error exceeding value | Set the value to detect more than the position deviation | 0 or<br>Long Real(LREAL) Positive | 0 |
| Tracking error level | Set the above deviation error level | 0: warning<br>1: alarm | 0: warning |

**4. Latch(Touch Probe)**

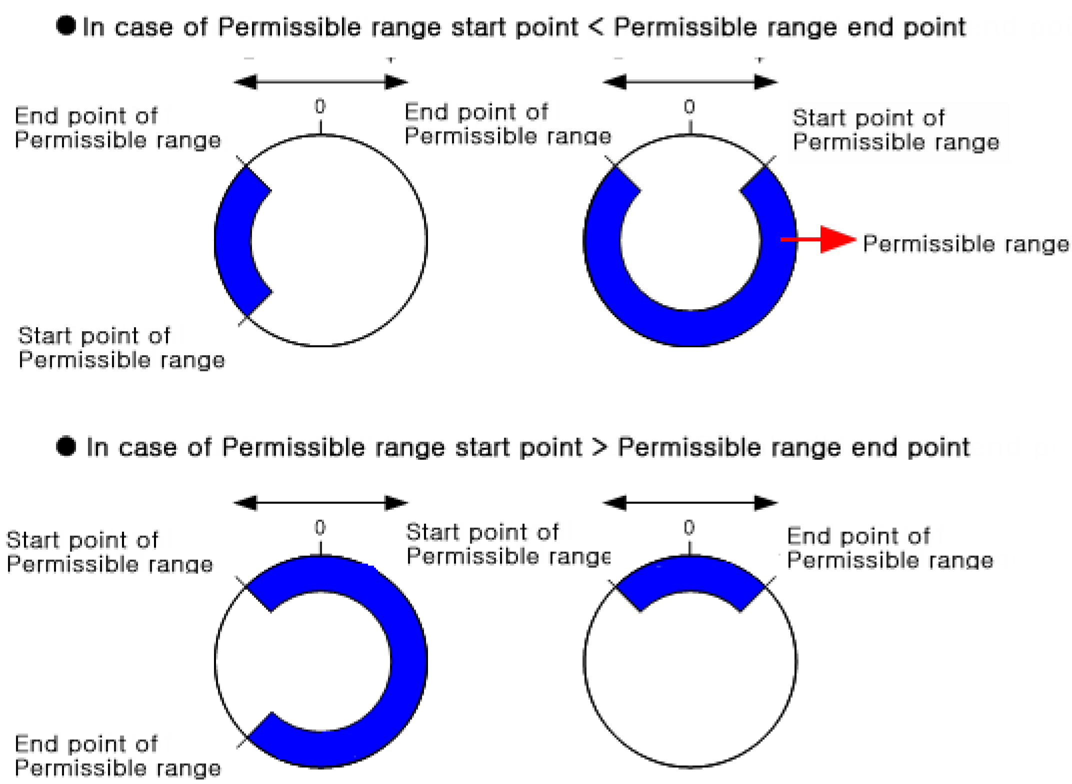
(1) It is a function to record the position of the axis when specific situation (Trigger event) occurs in the axis.

(2) Touch probe 1 and 2 can be selected to use according to trigger input (TriggerInput) settings.

- Trigger input (TriggerInput)=0 : Latch function is performed when touch probe 1 signal is Off->On .
- Trigger input (TriggerInput)=1 : Latch function is performed when touch probe 2 signal is Off->On .

(3) The area in which latch (touch probe) function is operated can be specified.

- When permitted area is specified, operation can be made only within the specified area.
- In case of the infinite running repetition operation (rotary axis), the relationship of latch (touch probe) operating area according to the beginning and end of the permitted area is as follows.

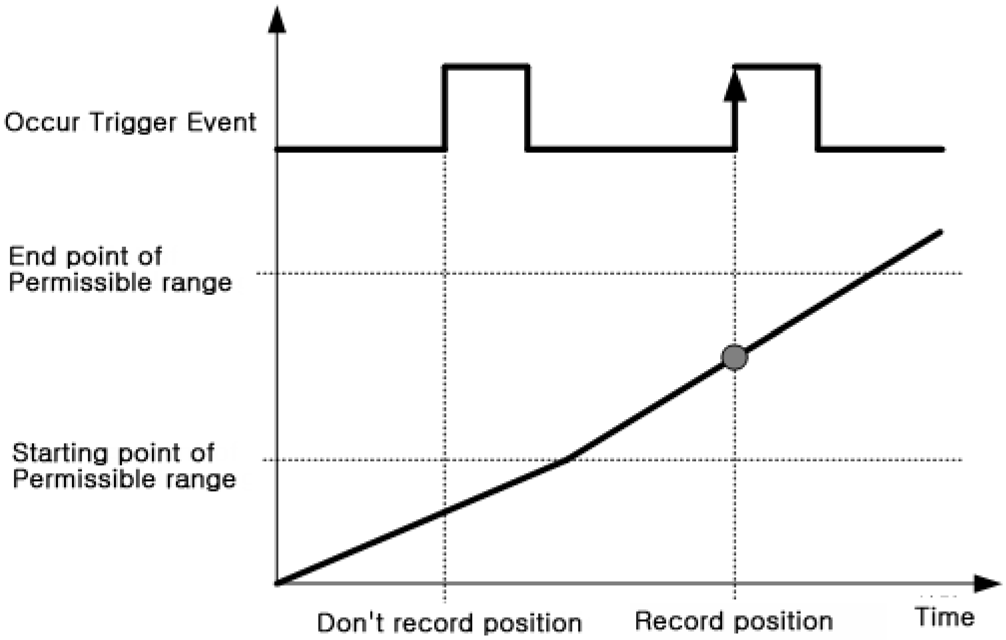



(4) For the use of latch (touch probe) function, the following objects should be included in PDO setting of slave parameter.

| Trigger input | RxPDO | TxPDO |
|---|---|---|
| Touch Probe1 | 0x60B8:0 Touch probe function | 0x60B9:0 Touch probe status<br>0x60BA:0 Forward direction positon value of touch probe1 |
| Touch Probe2 | 0x60B8:0 Touch probe function | 0x60B9:0 Touch probe status<br>0x60BC:0 Forward direction positon value of touch probe1 |

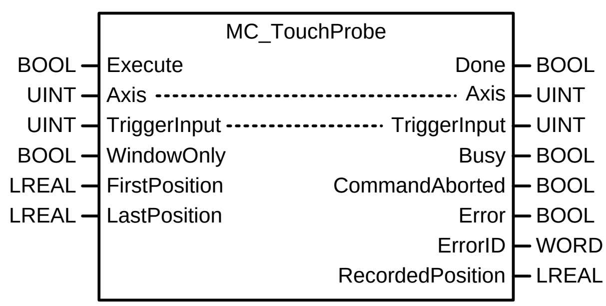
In case there are not above objects, an error (error code: 0x10E0) occurs when latch (touch probe) command is used.

(5) Operation timing

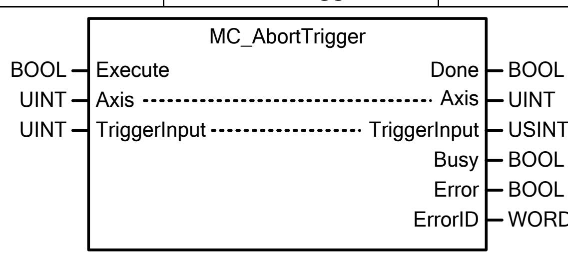



(6) Relevant motion function block

| Name | Description | Operation Condition |
|---|---|---|
| MC_TouchProbe | Touch probe | Edge |




| Name | Description | Operation Condition |
|---|---|---|
| MC_AbortTrigger | Abort trigger | Edge |



### 5. Error reset monitoring

(1) In case an error occurs in servo drive at the time of resetting error that occurs in the axis due to error reset commands, whether servo drive error is properly reset can be verified by setting error reset monitoring time.

(2) If monitoring time is exceeded, error reset is not executed any more even if the error of the drive is not reset..

(3) Error reset monitoring time of each driving axis can be set by using software package or axis parameter change function.

(4) Relevant parameter setting

| Item | Description | Settings | Initial Value |
|---|---|---|---|
| Error reset monitoring time | Set the monitoring time in case of resetting error that occurs in servo drive | 1 ~ 1000 ms | 100 ms |

## 8.3.3 Data Management Function

**1. Parameter management**

(1) It is a function to read or change axis parameters stored in the module.

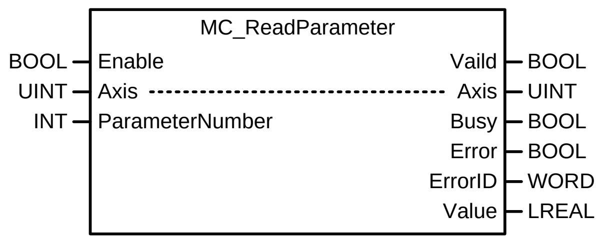
(2) It can change desired parameter values by specifying axis number and corresponding parameter number.

(3) Parameter value modified with parameter-write function is automatically stored in backup.ram in case there is no error.

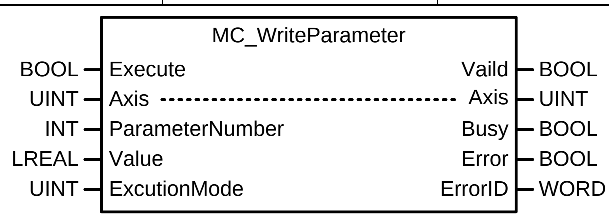
(4) For parameters to be set in “ParameterNumber”, refer to the motion function block item.

(5) Relevant motion function block

| Name | Description | Operation Condition |
|---|---|---|
| MC_ReadParameter | Read parameter | Level |




| Name | Description | Operation Condition |
|---|---|---|
| MC_WriteParameter | Write parameter | Edge |




**2. Changes in position data**

(1) Position data can be changed in the way that downloads modules by setting position data in XG-PM or directly writes position data variables in user program.

(2) In case of the position data, outage is directly maintained without data storage command.

(3) The addressing range of position data variables available is as follows.

| Variable Type | Selecting range of Variable address |
|---|---|
| LREAL | %PL0 ~ %PL6399 |

# Appendix 1 Error Information & Solutions

Here describes the information error types and its solutions.

(1) Function block error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 0005 | 5 | Motion Control module does not support this function block. | The relevant command is not performed in the current version of the module. Please contact customer support team of our company after check the version in which the relevant command can be performed. |
| 0006 | 6 | Axis or encoder number of the function block exceeds the range. | Set axis number to be 1 ~ 32 or 37 ~ 40.<br>(Encoder number: 1 ~ 2) |
| 0007 | 7 | Axis group number of the function block (AxisGroup input) exceeds the range. | Set axis group number to be between 1 and 16. |
| 0012 | 18 | Function block internal execution error was occurred. | The problem can be generated in a version of current module. Please check support version of XG-PM and module. |
| 0013 | 19 | Motion response error was occurred during function block executing. | The problem can be generated in a version of current module. Please check support version of XG-PM and module. |

(2) Program operation related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 0020 | 32 | Execution time of main task exceeded that setting time of main task period. | Module let RUN after set **main** task period of basic parameter to be longer than current setting value. |
| 0021 | 33 | Execution time of periodic task exceeded that setting time of periodic task period. | Module let RUN after set periodic task period of basic parameter to be longer than current setting value. |
| 0022 | 34 | Because abnormal basic parameter or program data, it is not possible to change to the RUN mode. | The problem can be generated in a version of current module. Please check support version of XG-PM and module. |
| 0025 | 37 | Interface error of XG-PM data writing has occurred. | The problem can be generated in a version of current module. Please check support version of XG-PM and module. |
| 0026 | 38 | Interface error of XG-PM data reading has occurred. | The problem can be generated in a version of current module. Please check support version of XG-PM and module. |
| 0027 | 39 | An attempt was made to change the device that can not be changed in XG-PM device monitor. | The problem can be generated in a version of current module. Please check support version of XG-PM and module. |
| 0028 | 40 | Command data value that sent from XG-PM exceeded allowable range. | Please execute the test operation in XG-PM after changing module to STOP status. |
| 0029 | 41 | XG-PM test operation function can not execute while module is RUN mode. | The problem can be generated in a version of current module. Please check support version of XG-PM and module. |
| 002A | 42 | CPU test operation command can not execute while module is RUN mode. | Please execute the test operation in XG-PM after changing module to STOP status. |
| 002B | 43 | Axis setting value exceeds allowable range of CPU test operation command. | Please set axis number in the range of 1~32, 37~40. |
| 002D | 45 | Can not be processed EXCEPTION occurred while motion program executing. | Please request A/S if an error repeats after downloading the program again in XG-PM. |
| 002E | 46 | Can not be processed EXCEPTION occurred while motion is operating. | Please request A/S if an error repeats after downloading the program again in XG-PM. |

| | | | |
|---|---|---|---|
| 002F | 47 | Module is restarted by abnormal termination. | Please take action after checking module error history. |

(3) Data-write related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 0030 | 48 | It is not possible to write basic parameter when module is in RUN mode or network connection state. | Please execute writing common parameter after changing module to STOP status and disconnecting network status. |
| 0031 | 49 | It is not possible to write program data when module is in RUN mode. | Please execute writing program data after changing module to STOP status. |
| 0032 | 50 | It is not possible to write position data when module is in RUN mode. | Please execute writing position data after changing module to STOP status. |
| 0033 | 51 | It is not possible to initialize the module when module is in RUN mode. | Please initialize the module after changing module to STOP status. |
| 0034 | 52 | It is not possible to write CAM data when some axis is in operation. | Please write cam data in state that all axis isn't operating status. |
| 0035 | 53 | It is not possible to write common parameter when some axis is in operation. | Please write common parameter in state that all axis isn't operating status. |
| 0036 | 54 | It is not possible to write network parameter when EtherCAT communication is connected. | Please write network data after disconnecting EtherCAT communication. |
| 0037 | 55 | After the data written, backup abnormal error of Flash(BAK_QUEUE_FULL) occurred. | The problem can be generated in a version of current module. Please check support version of XG-PM and module. |
| 0038 | 56 | After the data is written, backup abnormal error of Flash(BAK_INCOMPLETE) occurred. | The problem can be generated in a version of current module. Please check support version of XG-PM and module. |

(4) Program data related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 0040 | 64 | Program data(task table, program table, upload table) is abnormal. | Please exchange module, if an error happens again after downloading the data in XG-PM again and reloading. |
| 0043 | 67 | Upload information data is abnormal. | Please request A/S, if an error happens again after downloading the program in XG-PM again. |
| 0044 | 68 | Information data of online editing(CODE_TABLE) is abnormal. | Please request A/S, if an error happens again after downloading the program in XG-PM again. |
| 0045 | 69 | Information data of online editing(FUNC_TABLE) is abnormal. | Please request A/S, if an error happens again after downloading the program in XG-PM again. |

(5) Basic parameter data related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 0050 | 80 | Basic parameter data is abnormal. | Please exchange module, if an error happens again after downloading the data in XG-PM again and reloading. |
| 0051 | 81 | Main task period of basic parameter exceeded the range. | Please check range of main task period in basic parameter. |
| 0052 | 82 | Periodic task period of basic parameter exceeded the range. | Please check range of periodic task period in basic parameter.<br>Must be set as integer multiple of main task period. |

(6) Common parameter data related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 0060 | 96 | Common parameter data is abnormal. | Please exchange module, if an error happens again after downloading the data in XG-PM again and reloading. |
| 0061 | 97 | Encoder pulse input type of common parameter exceeded the setting range. | Please set encoder pulse input in common parameter within 0~5. |
| 0062 | 98 | Encoder1 maximum value of common parameter is out of range the expression value of pulse unit. | Please set encoder1 maximum value in common parameter over 1 in pulse unit. |
| 0063 | 99 | Encoder1 minimum value of common parameter is out of range the expression value of pulse unit. | Please set encoder1 minimum value in common parameter over 1 in pulse unit. |
| 0064 | 100 | The encoder1 maximum value, minimum value in common parameter exceeded a range. | Please set encoder1 minimum value in common parameter to less than maximum value. And setting that range of minimum value and maximum value include encoder1 current position. |
| 0065 | 101 | The encoder pulse input type in encoder exceeded a range. | Please set encoder pulse input in common parameter within 0~5. |
| 0066 | 102 | The encoder2 maximum value in common parameter exceeded a range in pulse unit. | Please set encoder2 maximum value in common parameter over 1 in pulse unit. |
| 0067 | 103 | The encoder2 minimum value in common parameter exceeded a range in pulse unit. | Please set encoder2 minimum value in common parameter over 1 in pulse unit. |
| 0068 | 104 | The encoder2 maximum value, minimum value in common parameter exceeded a range. | Please set encoder2 minimum value in common parameter to less than maximum value. And setting that range of minimum value and maximum value include encoder2 current position. |
| 0069 | 105 | It is not possible to set the encoder input because of abnormal encoder setting in common parameter. | Please set the value within range, after checking encoder relevant item in common parameter. |
| 006A | 106 | Setting value of the encoder1 pulses per rotation in common parameter exceeded a range. | Please set the encoder1 pulses per rotation in common parameter to more than 0 and less than 4294967295. |
| 006B | 107 | Setting value of the encoder1 travel per rotation in common parameter exceeded a range. | Please set the encoder1 travel per rotation in common parameter to more than 0. 000000001 and less than 4294967295. |
| 006C | 108 | Setting value of the encoder2 pulses per rotation in common parameter exceeded a range. | Please set the encoder2 pulses per rotation in common parameter to more than 0 and less than 4294967295. |
| 006D | 109 | Setting value of the encoder2 travel per rotation in common parameter exceeded a range. | Please set the encoder2 travel per rotation in common parameter to more than 0. 000000001 and less than 4294967295. |

(7) Network parameter data related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 0070 | 112 | The network parameter data is abnormal. | Please exchange module, if an error happens again after downloading the data in XG-PM again and reloading. |
| 0071 | 113 | The periodic communication time-out count in network parameter exceeded a range. | Please set The periodic communication time-out count in network parameter within 1~8. |

(8) Shared variable parameter data related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 0080 | 128 | The shared variable parameter data is abnormal. | Please set the shared variable parameter again in I/O parameter of XG-5000. Please exchange module, if an error happens again. |
| 0081 | 129 | The transmission data size in shared variable parameter exceeded a range. | The transmission data size in shared variable parameter exceeded 2048 word. Please set the transmission data size within 2048 word. |
| 0082 | 130 | The transmission CPU device type in shared variable parameter exceeded a range. | Please set the transmission CPU device type in shared variable parameter in the range of [0:D, 1:M, 2:R, 3:ZR] for XGK, [0:M, 1:R, 2:W] for XGI/R. |
| 0083 | 131 | The transmission module device type in shared variable parameter exceeded a range. | Please set the transmission module device type in shared variable parameter within 0~1[0:D,1:M]. |
| 0084 | 132 | The transmission CPU address of the shared variable parameter exceeded a range. | The transmission CPU address in shared variable parameter exceeded module device range. Please set within the value of device address range after checking address range of CPU device which will be shared. |
| 0085 | 133 | The transmission module address of the shared variable parameter exceeded a range. | The transmission module address in shared variable parameter exceeded module device range. Please set within the value of device address range after checking address range of module device which will be shared. |
| 0086 | 134 | The reception data size in shared variable parameter exceeded a range. | The reception data size in shared variable parameter exceeded 2048 word. Please set the reception data size within 2048 word. |
| 0087 | 135 | The reception CPU device type in shared variable parameter exceeded a range. | Please set the reception CPU device type in shared variable parameter in the range of [0:D, 1:M, 2:R, 3:ZR] for XGK, [0:M, 1:R, 2:W] for XGI/R. |
| 0088 | 136 | The reception module device type in shared variable parameter exceeded a range. | Please set the reception module device type in shared variable parameter within 0~1[0:D,1:M]. |
| 0089 | 137 | The reception CPU address in shared variable parameter exceeded a range. | The reception CPU address in shared variable parameter exceeded module device range. Please set within the value of device address range after checking address range of CPU device which will be shared. |
| 008A | 138 | The reception module address in shared variable parameter exceeded a range. | The reception module address in shared variable parameter exceeded module device range. Please set within the value of device address range after checking address range of module device which will be shared. |

(9) Network connecting command related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 0090 | 144 | It is not possible to execute the connection command because of abnormal network parameter. | Please set again after checking network parameter. |
| 0091 | 145 | Network connect command is operating. | Please check whether network connect command was not entered again during operating network connect command. |
| 0092 | 146 | Network disconnect command is operating. | Please check whether network disconnect command was not entered again during operating network disconnect command. |
| 0093 | 147 | It isn’t possible to execute the connect/disconnect command because of change mode. | Please check that network connect/disconnect command was not entered during change mode. |

(10) Encoder preset command related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 00A0 | 160 | It is not possible to execute the encoder preset command because of abnormal common parameter. | By using XG-PM, set a common parameter to the normal value, after checking whether it was set up as the value in the range by confirming the encoder related item of common parameter. |
| 00A1 | 161 | It is not possible to execute preset command because there is axis operating relevant encoder as main axis. | Please check that encoder preset command was entered to relevant encoder when there is axis operating relevant encoder as main axis. |
| 00A2 | 162 | The encoder preset position exceeded a range of maximum or minimum of relevant encoder. | Please set encoder preset position to more than or equal to minimum value of relevant encoder and to less than or equal to maximum value. |
| 00A3 | 163 | The encoder selection of encoder preset command exceeded a range. | Please set encoder selection within 0~1(0: Encoder1, 1:Encoder2). |

(11) EtherCAT communication related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 0F00 | 3840 | Failed to change to the EtherCAT INIT status. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F01 | 3841 | It is EtherCAT INIT status initialization (PORT_INIT) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F02 | 3842 | It is EtherCAT INIT status initialization (ESC_RD) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F03 | 3843 | It is EtherCAT INIT status initialization (ST_ADDR_RD) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F04 | 3844 | It is EtherCAT INIT status initialization (FMMU_CLEAR) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F05 | 3845 | It is EtherCAT INIT status initialization (SM_CLEAR) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F06 | 3846 | It is EtherCAT INIT status initialization (DC_INIT) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 0F07 | 3847 | It is EtherCAT INIT status initialization (AL_CR_WR) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F08 | 3848 | It is EtherCAT INIT status initialization (AL_SR_RD) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F09 | 3849 | There is no EtherCAT slave which is connected module. | Please check whether the connection cable is normally installed between EtherCAT slave and the power is normally supplied, and communication cable is exposed to noise if there is slave which is connected to module. |
| 0F0A | 3850 | It exceeded maximum connection slave number. | Please check whether number of EtherCAT slave that is connected to the module does not exceed 36. |
| 0F10 | 3856 | Failed to change to the EtherCAT PREOP status. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F11 | 3857 | It is EtherCAT PREOP status initialization (SII_CONFIG) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F12 | 3858 | It is EtherCAT PREOP status initialization (SII_DATA(V)_RD) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F13 | 3859 | It is EtherCAT PREOP status initialization (SII_DATA(P)_RD) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F14 | 3860 | It is EtherCAT PREOP status initialization (SII_DATA(R)_RD) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F15 | 3861 | It is EtherCAT PREOP status initialization (RX_ERR_CLEAR) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F16 | 3862 | It is EtherCAT PREOP status initialization (ST_ADDR_WR) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F17 | 3863 | It is EtherCAT PREOP status initialization (SM0_SET) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F18 | 3864 | It is EtherCAT PREOP status initialization (SM1_SET) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, |

| | | | |
|---|---|---|---|
| | | | and etc. And please check whether communication cable is exposed to noise, too. |
| 0F19 | 3865 | It is EtherCAT PREOP status initialization (AL_CR_WR) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F1A | 3866 | It is EtherCAT PREOP status initialization (AL_SR_RD) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 0F1B | 3867 | It exceeded maximum connection servo drive number. | Please check whether number of EtherCAT servo drive that is connected to the module does not exceed 32. |
| 0F1C | 3868 | It exceeded maximum connection I/O number. | Please check whether number of EtherCAT I/O that is connected to the module does not exceed 32. |
| 0F1D | 3869 | There is no information about slave which is connected. | Please check whether information file which is connected to slave is in **"l.eng\DriveInfo" or "l.eng\IOInfo"** folder of XG-PM installation folder and it was transmitted to a module. |
| 0F1E | 3870 | There is no network setting data. | Please transmit slave parameter to module by using XG-PM. |
| 0F1F | 3871 | The slave which was connected with network setting data is different. | Please transmit slave parameter after connecting slave by Network Slave Autoconnect of XG-PM. |
| 0F20 | 3872 | Failed to change to the EtherCAT SAFEOP status. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F21 | 3873 | It is EtherCAT SAFEOP status initialization (DRV_MODE_RD) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F22 | 3874 | It is EtherCAT SAFEOP status initialization (PDO_SET) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F23 | 3875 | It is EtherCAT SAFEOP status initialization (DC_START) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F24 | 3876 | It is EtherCAT SAFEOP status initialization (SM2_SET) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F25 | 3877 | It is EtherCAT SAFEOP status initialization (SM3_SET) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |

| Hex | Dec | Error Description | Solutions |
|---|---|---|---|
| 0F26 | 3878 | It is EtherCAT SAFEOP status initialization (FMMU0_SET) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F27 | 3879 | It is EtherCAT SAFEOP status initialization (FMMU1_SET) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F28 | 3880 | It is EtherCAT SAFEOP status initialization (AL_CR_WR) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F29 | 3881 | It is EtherCAT SAFEOP status initialization (AL_SR_WR) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F30 | 3888 | Failed to change to the EtherCAT OP status. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F31 | 3889 | It is EtherCAT OP status initialization (AL_CR_WR) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 0F32 | 3890 | It is EtherCAT OP status initialization(AL_SR_RD) error. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F40 | 3904 | Failed to change EtherCAT OP status to INIT status. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F41 | 3905 | It is INIT status initialization(AL_CR_WR) error from EtherCAT OP status. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F42 | 3906 | It is INIT status initialization(AL_SR_RD) error from EtherCAT OP status. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F43 | 3907 | It is INIT status initialization(DC_INIT) error from EtherCAT OP status. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |

| | | | |
|---|---|---|---|
| 0F50 | 3920 | There is no response from communication connection status. | Please check connection status of communication cable and operation status(power-on and error occurrence or not) of slave, and etc. And please check whether communication cable is exposed to noise, too. |
| 0F51 | 3921 | Periodic communication error occurred.(The communication error exceeding the parameter periodic communication time-out number occurred.) | Please check whether power of servo is off in communication, communication cable is normally installed and communication cable is exposed to noise. |

(12) Hardware failure related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 0FF0 | 4080 | It is not possible to execute the normal operation with module H/W problem (ASIC_RESET). | Please request A/S if an error repeats when turning on the power again. |
| 0FF1 | 4081 | It is not possible to execute the normal operation with module H/W problem (ASIC_CRAM). | Please request A/S if an error repeats when turning on the power again. |
| 0FF2 | 4082 | It is not possible to execute the normal operation with module H/W problem (ASIC_HSC). | Please request A/S if an error repeats when turning on the power again. |
| 0FF3 | 4083 | It is not possible to execute the normal operation with module H/W problem (FLASH). | Please request A/S if an error repeats when turning on the power again. |
| 0FF4 | 4084 | It is not possible to execute the normal operation with module H/W problem (ASIC_V_AREA). | Please request A/S if an error repeats when turning on the power again. |
| 0FF5 | 4085 | It is not possible to execute the normal operation with module H/W problem (ASIC_F_AREA). | Please request A/S if an error repeats when turning on the power again. |
| 0FF6 | 4086 | It is not possible to execute the normal operation with module H/W problem (ASIC_R_AREA). | Please request A/S if an error repeats when turning on the power again. |
| 0FF7 | 4087 | It is not possible to execute the normal operation with module H/W problem (FRAM). | Please request A/S if an error repeats when turning on the power again. |
| 0FF8 | 4088 | Fail to read the information (TIME_DATE) from CPU. | Please check whether it is CPU version which a module can support. Please request A/S if an error repeats when turning on the power again in case of CPU which support motion control module. |
| 0FF9 | 4089 | Fail to read the information (SPARAM) from CPU. | Please check whether it is CPU version which a module can support. Please request A/S if an error repeats when turning on the power again in case of CPU which support motion control module. |
| 0FFE | 4094 | Fail to device backup by abnormal operation(module detachment). | Please operate after checking whether data which should be backed up in the previous operation is normal. |
| 0FFF | 4095 | Backup ram **data** was damaged. | Please operate after transmitting data again by XG-PM. Please exchange module if an error happens again. |

(13) Axis status related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 1000 | 4096 | The axis is not ready for operation. (Not connected to the network.) | Please execute command when axis is ready for operation. |
| 1001 | 4097 | It can't be executed in "Disabled" state. | Please execute command in the condition that can operate the relevant command after checking the axis condition that can operate the relevant command. |
| 1002 | 4098 | It can't be executed in "Standstill" state. | Please execute command in the condition that can operate the relevant command after checking the axis condition that can operate the relevant command. |
| 1003 | 4099 | It can't be executed in "Discrete" state. | Please execute command in the condition that can operate the relevant command after checking the axis condition that can operate the relevant command. |
| 1004 | 4100 | It can't be executed in "Continuous" state. | Please execute command in the condition that can operate the relevant command after checking the axis condition that can operate the relevant command. |
| 1005 | 4101 | It can't be executed in "Synchronized" state. | Please execute command in the condition that can operate the relevant command after checking the axis condition that can operate the relevant command. |
| 1006 | 4102 | It can't be executed in "Homing" state. | Please execute command in the condition that can operate the relevant command after checking the axis condition that can operate the relevant command. |
| 1007 | 4103 | It can't be executed in "Stopping" state. | Please execute command in the condition that can operate the relevant command after checking the axis condition that can operate the relevant command. |
| 1008 | 4104 | It can't be executed in "Errorstop" state. | Please execute command in the condition that can operate the relevant command after checking the axis condition that can operate the relevant command. |
| 100A | 4106 | It is not possible to execute the motion command when assigned axis group is enable state. | Please execute the command after changing axis group to GroupDisabled state by axis group disable command. |
| 100B | 4107 | It is a command which can't issue to virtual axis. | The relevant command can't be executed in virtual axis. Please check whether the relevant command was not executed in virtual axis. |

(14) Common operation related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 1010 | 4112 | It can't continue a operation because a module is changed to STOP state | Please check whether module was not changed to STOP state while the axis operates. |
| 1011 | 4113 | It can't continue a operation because the network is disconnected. | Please check network disconnection because of slave power disorder, network cable disorder, noise inflow to the network cable while the axis operates. |
| 1012 | 4114 | The position setting value of the command is out of range from pulse unit representation value. | When converting the command position value to the pulse unit, It is out of range from 32 Bit domains. When converting the command position value into the pulse, Please set in -2147483648 ~ 2147483647 ranges. |
| 1013 | 4115 | The operation speed value was 0 or less, or exceeded the maximum speed value. | Please set the operation speed value to the bigger value than 0,or smaller than or equal to the maximum speed value which is set up in the relevant axis. |
| 1014 | 4116 | The acceleration was set up as the negative number. | Please set the acceleration value to more than 0. |
| 1015 | 4117 | The deceleration was set up as the negative number. | Please set the deceleration value over 0. |
| 1016 | 4118 | The jerk was set up as the negative number. | Please set the jerk value over 0. |
| 1017 | 4119 | The direction appointment exceeded a range. | Please set the value within a range, after checking a range of direction setting value of relevant command. (Refer to chapter6. Motion function block) |
| 1018 | 4120 | The torque setting value exceeded a range. | Please set the torque setting value within 1000%. |
| 1019 | 4121 | The torque lamp setting value exceeded a range. | Please set the torque lamp setting value over 0. |

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 101A | 4122 | Buffer Mode setting value exceeded a input range. | Please set value(0-5) can be set in the Buffer Mode. |
| 101B | 4123 | Execution Mode setting value exceeded a input range. | Please set value(0~1) can be set in the Execution Mode. |
| 101C | 4124 | You can't operate continuously because tracking error over-range alarm occurred. | Deviation between command position and current position exceeded 'Tracking error over-range value'. In order that an alarm doesn't happen, tune servo drive or set 'Tracking error over-range value' to more than existing value. |
| 101D | 4125 | Tracking error over-range warning occurred. | Deviation between command position and current position exceeded 'Tracking error over-range value'. In order that an alarm doesn't happen, tune servo drive or set 'Tracking error over-range value' to more than existing value. |
| 101F | 4127 | The command position value transmitted to the servo drive is out of range from the pulse unit representation value. | When converting the command position value to the pulse unit, It is out of range from 32 Bit domains.<br>When converting the command position value into the pulse, Please set in -2147483648 ~ 2147483647 ranges. |

(15) Function block execution related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 1020 | 4128 | It is the axis command that is not defined. | The relevant command is not performed in the current version of the module. Please contact customer support team of our company after check the version in which the relevant command can be performed. |
| 1021 | 4129 | The executed command was canceled because same command was executed. | Please check whether the relevant command was not again performed among the same command operation. |
| 1022 | 4130 | It exceeded the number of commands which can operate Buffered command. | You can't perform a command because the command buffer of the relevant axis group is full. The number of commands which can be operated with Buffered command is 10. Please control the command operation timing. |

(16) Axis parameter-write related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 1030 | 4144 | You can't write axis parameter when the axis is in operation. | Please execute writing parameter when the axis is not operating. |

(17) Axis parameter data related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 1040 | 4160 | Data of the axis parameter is abnormal. | Please exchange module, if an error happens again after downloading the data in XG-PM again and reloading. |
| 1041 | 4161 | It is not possible to execute operation because of parameter error of axis. | Please set again after confirming axis parameter. |
| 1042 | 4162 | You can't set speed limit of axis parameter to the value less than 0. | Please set speed limitation of basic parameter over1 in pulse unit. |
| 1043 | 4163 | Soft upper/lower limit value of axis parameter exceeded a range. | Soft upper limit value of axis parameter is more than or equals to soft lower limit value. |

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 1044 | 4164 | Current speed filter time constant value of axis parameter is out of range. | Please set the parameter setting value to 1~100. |
| 1045 | 4165 | Error reset monitoring time of axis parameter is out of range. | Please set the parameter setting value to 1~1000. |
| 1046 | 4166 | Setting value of travel per rotation exceeded a range. | Please set the parameter setting value to more than 0. 000000001 and less than 4294967295. |
| 1047 | 4167 | Setting value of infinite running repeat position exceeded a range. | Please set the parameter setting value to more than 0 and less than 2147483647 in pulse unit. |
| 1048 | 4168 | Setting value of command inposition range exceeded a range. | Please set the parameter setting value to more than 0 and less than 2147483647 in pulse unit. |
| 1049 | 4169 | Setting value of tracking error over-range exceeded a range. | Please set the parameter setting value to more than 0 and less than 2147483647 in pulse unit. |
| 104A | 4170 | Setting value of current position compensation amount exceeded a range. | Please set the parameter setting value to more than 0 and less than 2147483647 in pulse unit. |

| | | | |
|---|---|---|---|
| 104B | 4171 | Setting value of jog high speed exceeded a range. | Please set the parameter setting value to more than 0 and jog low speed, less than speed limitation. |
| 104C | 4172 | Setting value of jog low speed exceeded a range. | Please set the parameter setting value to more than 0 and less than jog high speed and speed limitation. |
| 104D | 4173 | Setting value of jog acceleration exceeded a range. | Please set the parameter setting value over 0. |
| 104E | 4174 | Setting value of jog deceleration exceeded a range. | Please set the parameter setting value over 0. |
| 104F | 4175 | Setting value of jog jerk exceeded a range. | Please set the parameter setting value over 0. |
| 1050 | 4176 | Setting value of gear ratio(Motor) exceeded a range. | Please set the parameter setting value to 1~65535. |
| 1051 | 4177 | Setting value of gear ratio(Machine) exceeded a range. | Please set the parameter setting value to 1~65535. |
| 1052 | 4178 | Setting value of pulses per rotation exceeded a range. | Please set the parameter setting value to more than 0 and less than 4294967295 in pulse unit. |

(18) Servo On/Off related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 1060 | 4192 | It is not possible to execute the servo on due to error occurrence of servo drive. | Please execute servo-on, after checking the error factor of the servo drive and removing the error of the servo drive. |
| 1061 | 4193 | It execute servo-on perform command again in the middle of processing servo-on. | Please check whether the servo-on command was not performed again in the middle of processing servo-on in program or XG-PM. |
| 1062 | 4194 | It is not possible to complete the servo-on because it can't change servo drive to "ReadyToSwitchON" status. | Please check the status of the servo drive. In certain circumstances, it may be servo-on command is not executed. |
| 1063 | 4195 | It is not possible to complete the servo-on because it can't change servo drive to "Switched on" status. | Please check the status of the servo drive. In certain circumstances, it may be servo-on command is not executed. |
| 1064 | 4196 | It is not possible to complete the servo-on because it can't change servo drive to "Operation enabled" status. | Please check the status of the servo drive. In certain circumstances, it may be servo-on command is not executed. |
| 1065 | 4197 | It is not possible to complete the servo-on because "Quick Stop" function of servo drive is enabled. | Please check the status of the servo drive. In certain circumstances, it may be servo-on command is not executed. |

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 1066 | 4198 | It execute servo-off perform command again in the middle of processing servo-off. | Please check whether the servo-off command was not performed again in the middle of processing servo-off in program or XG-PM. |
| 1067 | 4199 | The servo-off perform command was not completed. | Please check status of servo drive. |

(19) Servo error reset related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 1070 | 4208 | It exceeded the servo error reset monitoring time. | The error of the servo drive is not removed while error reset monitoring time which is set in axis parameter goes by. Please execute the error reset command again, after removing error factor of servo drive. |

(20) Position control operation related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 1080 | 4224 | Command that use absolute coordinate can't be executed in absolute coordinate of the state of undetermined origin. | Please execute absolute coordinate operation command after making determined origin state with homing command and setting current position command. |
| 1081 | 4225 | In the state of Infinite running repeat enable, target position is beyond the range of infinite running repeat position from relevant direction appointment. | Please set target position within infinite running repeat position frm relevant direction appointment. |

(21) Current position change related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 1090 | 4240 | The position value of the current position change command exceeded a range. | Please execute preset current position preset command after setting position setting value to more than soft lower limit value of extended parameter and less than soft upper limit value. |
| 1091 | 4241 | In case it is operating with homing, speed synchronization, cam, torque control it is not possible to execute current position change command. | Please execute current position change command when relevant axis is not one during operation among homing, can, torque control. |

(22) Torque control related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 10A0 | 4256 | The servo drive doesn't support the torque control mode. | By using the servo drive supporting the CST mode of EtherCAT CoE, Execute the torque control. |

(23) Homing related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 10B0 | 4272 | The servo drive doesn't support homing mode. | By using the servo drive which supports the CST mode of EtherCAT CoE, Execute homing. |
| 10B1 | 4273 | An error occurred during the execution of the homing of the servo drive. | Please execute homing, after checking the error factor of the servo drive and removing the error of the servo drive, |

(24) Override related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 10C0 | 4288 | It is not possible to execute override command if it isn't operated in position/speed control. | Please execute the override command during operation with position control or speed control. |
| 10C1 | 4289 | The override Factor of override command exceeded range. | Please execute the override command after setting the VelFactor, AccFactor, JerkFactor value of override over 0. |
| 10C2 | 4290 | The operation speed value after applying Factor of override command exceeded maximum speed value. | Please execute override in the range that doesn't exceed the maximum speed value of the relevant axis. |

(25) Gear operation related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 10D0 | 4304 | The gear ratio denominator value can't become 0 in gear operation. | Please execute the command after setting the gear ratio denominator to a value not 0. |
| 10D1 | 4305 | The MasterValueSource setting value is out of range in gear operation. | Please execute the command after setting the gear ratio numerator to a value not 0. |
| 10D2 | 4306 | The Main axis setting is out of range in gear operation. | Please execute the command after setting the main axis in the range of 1~32, 37~42. |
| 10D3 | 4307 | The main axis setting is identical with the serve axis in gear operation. | Please execute command after setting the main axis to the different axis from serve axis(command axis). |
| 10D4 | 4308 | The main axis was not ready. | Please execute command when main axis is ready state. |
| 10D5 | 4309 | In case the gear operation main axis is set up as an encoder, You will not be able to execute the command with common parameter error occurrence. | By using XG-PM, set a common parameter to the normal value, after checking whether it was set up as the value in the range by confirming the encoder related item of common parameter. |
| 10D6 | 4310 | It is not possible to execute MC_GearInPos command when main axis is operated in the torque control.. | Please execute the MC_GearInPos command when main axis is not operating in torque control. |
| 10D7 | 4311 | Serve axis speed of gear operation exceeded speed limitation. | Please lower main axis speed or change gear ratio lest serve axis in gear operation should exceed speed limitation or end point speed that was set on the serve axis. |
| 10D8 | 4312 | It is not possible to execute GEAROUT command if it is not gear operation. | GEAROUT command is available only in case of gear operation. |
| 10D9 | 4313 | You will not be able to execute the command because target speed setting value of MC_GearInPos command is less than current operation speed or gear operation speed. | Please execute the command, after setting target speed setting value of MC_GearInPos command to more than current operation speed or gear operation speed. |
| 10DA | 4314 | It will not be able to reach the serve axis synchronization position in the time when the main axis operates till the main axis synchronization position during MC_GearInPos operation. | Please execute the command, after increasing the setting value of the target speed of MC_GearInPos command or adjusting MasterStartDistance in order that serve axis moves till serve axis synchronization position in the time when main axis operates till the main axis synchronization position. |

(26) Touch probe related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 10E0 | 4320 | There is no object set which can execute relevant touch probe to PDO entry set in slave parameter. | Please send to the module, after setting the object to support the touch probe to PDO entry in slave parameter by XG-PM |
| 10E1 | 4321 | The TriggerInput input setting value is out of range. | Please set TriggerInput setting value to 0(Touch Probe1) or 1(Touch Probe2). |

(27) Parameter read/write

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 10F0 | 4336 | The parameter number setting value of command to read/write axis parameter is out of range. | Please execute command after setting parameter setting value of command to read/write axis parameter to 0~ 25. |
| 10F1 | 4337 | Parameter data setting value of command to write axis parameter is out of range. | Please check data setting range of axis parameter which want to set. |

(28) JOG

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 1100 | 4352 | You can't execute jog operation command in case the axis is operating. | Please execute jog command when axis is stop state. |

(29) Cam operation

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 1110 | 4368 | There is an error in the MasterScaling input value of CAM operation. | You can't put 0 in the MasterScaling input value. |
| 1111 | 4369 | There is an error in the MasterStartDistance input value of CAM operation. | Set the MasterStartDistance input value to more than 0 values and execute an command. |
| 1112 | 4370 | There is an error in the MasterSyncPosition input value of CAM operation. | Set the MasterSyncPosition input value to more than 0 values and execute a command. |
| 1113 | 4371 | The StartMode input value of CAM operation exceeded range. | Set the StartMode input value to the value between 0~1 and execute a command. |
| 1114 | 4372 | The MasterValueSource input value of CAM operation exceeded range. | Set the MasterValueSource input value to the value between 0~1 and execute a command. |
| 1115 | 4373 | The designated cam table doesn't exist. | Please execute command after adjusting the table number to the effective number. |
| 1116 | 4374 | The main axis setting of CAM operation exceeded range. | Set the main axis to the value between 1~32, 37~42 and execute a command. |
| 1117 | 4375 | The main axis setting of CAM operation is same as serve axis. | Please execute command after setting the main axis to the different axis from serve axis(command axis). |
| 1118 | 4376 | The main axis was not ready. | Please execute command when main axis is ready state. |
| 1119 | 4377 | In case the main axis is set up as an encoder, it can't execute command with common parameter error occurrence. | By using XG-PM, set a common parameter to the normal value, after checking whether it was set up as the value in the range by confirming the encoder related item of common parameter. |

| | | | |
|---|---|---|---|
| 111A | 4378 | Servo speed of CAM operation exceeded speed limitation. | Please operate by decreasing the speed of the main axis or adjusting the CAM table lest speed of serve axis in CAM operating should exceed speed limitation which was set on the serve axis or end point speed. |
| 111B | 4379 | It can't execute CAMOUT command in case it is not CAM operation. | You can use the CAMOUT command only if CAM is operating. |

(30) Servo drive input signal related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 1200 | 4608 | The hardware upper limit error occurred. | Please remove error with error reset command after breaking away outside upper limit range by using reverse jog command. |
| 1201 | 4609 | The hardware lower limit error occurred. | Please remove error with error reset command after breaking away outside lower limit range by using forward jog command. |
| **1203** | **4611** | The command can't be executed because of servo drive error occurrence during operation. | Please remove servo error with error reset command after removing an servo error factor. |
| **1204** | **4612** | The command can't be executed because of servo off during operation. | Please re-execute command after changing command axis to servo on state with servo on command. |
| **1205** | **4613** | The software upper limit error occurred. | Please remove error with error reset command after breaking away software upper limit range by using reverse jog command. |
| **1206** | **4614** | The software lower limit error occurred. | Please remove error with error reset command after breaking away software lower limit range by using forward jog command. |

(31) Network communication related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 1F00 | 7936 | The periodic communication error occurred.(The communication error exceeding the parameter periodic communication time-out number occurred.) | Please check whether power of servo is off in communication, communication cable is normally installed and communication cable is exposed to noise. |

(32) Servo parameter write/save related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 1F10 | 7952 | SDO command can't be executed any more because of SDO processing fail of servo drive that is executed previously. | Please reset connection after checking whether status of servo drive is normal. |
| 1F11 | 7953 | Writing SDO parameter command can't be executed during operation state. | Please execute command to write SDO parameter when relevant axis isn't operating. |
| 1F12 | 7954 | It is out of range from the value of which data range of the SDO parameter Index, SubIndex and etc. is allowed. | Please execute writing SDO parameter after set SDO parameter Index to 0x2000~0x9FFF, SubIndex to 0x00~0xFF, data size within 4 words. |
| 1F13 | 7955 | Abort occurred in the middle of command to write SDO parameter. | It canceled in the middle of writing SDO parameter in servo drive. Please check status of servo drive. |
| 1F14 | 7956 | There is no response of the servo drive about the command to write SDO parameter. | There is no response of servo drive in the middle of writing SDO parameter. Please check status of servo drive. |
| 1F16 | 7958 | Abort occurred in the middle of save SDO parameter EEPROM. | It canceled in the middle of saving SDO parameter EEPROM. Please check status of servo drive. |
| 1F17 | 7959 | There is no response of the servo drive about the command to save SDO parameter EEPROM. | There is no response of servo drive in the middle of saving SDO parameter EEPROM. Please check status of servo drive. |
| 1F19 | 7961 | It can't execute the other command in the middle of write SDO parameter or save SDO parameter EEPROM. | Please execute other command after saving SDO parameter EEPROM is completed. |

(33) Servo parameter read command related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 1F19 | 7968 | The Abort occurred in the middle of command to read the servo parameter. | It canceled in the middle of reading servo parameter in servo drive. Please check state of servo drive. |
| 1F20 | 7969 | There is no response of the servo drive about the command to read servo parameter. | There is no response in the middle of reading servo parameter in servo drive. Please check state of servo drive. |
| 1F22 | 7970 | It can't execute the command to read/write servo parameter in the middle of command to read/write servo parameter. | Please execute the command after the parameter reading which is being performed is completed. |

(34) EtherCAT state change related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 1F33 | 7987 | It couldn't change the operation mode of servo drive to the position control(CSP) mode. | Please check state of servo drive, after checking that relevant servo drive supports EtherCAT CoE CSP Mode. |
| 1F34 | 7988 | It couldn't change the operation mode of servo drive to the homing(Homing) mode. | Please check state of servo drive, after checking that relevant servo drive supports EtherCAT CoE Homing Mode. |
| 1F35 | 7989 | It couldn't change the operation mode of servo drive to the torque control(CST) mode. | Please check state of servo drive, after checking that relevant servo drive supports EtherCAT CoE CST Mode. |

(35) Manual tuning related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 1F50 | 8016 | It can't execute manual **tuning** function of XG-PM in case that module is the RUN state. | Please execute manual **tuning** of XG-PM after changing module to STOP state. |

(36) Axis group common related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 2000 | 8192 | The axis group didn't become the operation ready state. | Please execute command when axis group is operation ready state. |
| 2001 | 8193 | The axis group can't be executed in "Disabled" state. | Please execute command in the condition that can operate the relevant command after checking the axis group condition that can operate the relevant command. |
| 2002 | 8194 | The axis group can't be executed in "Standby" state. | Please execute command in the condition that can operate the relevant command after checking the axis group condition that can operate the relevant command. |
| 2003 | 8195 | The axis group can't be executed in "Moving" state. | Please execute command in the condition that can operate the relevant command after checking the axis group condition that can operate the relevant command. |
| 2004 | 8196 | The axis group can't be executed in "Homing" state. | Please execute command in the condition that can operate the relevant command after checking the axis group condition that can operate the relevant command. |
| 2005 | 8197 | The axis group can't be executed in "Stopping" state. | Please execute command in the condition that can operate the relevant command after checking the axis group condition that can operate the relevant command. |
| 2006 | 8198 | The axis group can't be executed in "Errorstop" state. | Please execute command in the condition that can operate the relevant command after checking the axis group condition that can operate the relevant command. |
| 2007 | 8199 | The configuration axis of the axis group is not servo on state. | Please execute command in the condition that can operate the relevant command after checking the axis group condition that can operate the relevant command. |

(37) Axis group function block execution related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 2010 | 8208 | It can't continue a operation because a module is changed to STOP state | Please check whether module was not changed to STOP state while the axis operates. |
| 2011 | 8209 | It can't continue a operation because the network is disconnected. | Please check network disconnection because of slave power disorder, network cable disorder, noise inflow to the network cable while the axis operates. |
| 2012 | 8210 | The position setting value of the command is out of range from pulse unit representation value. | When converting the command position value to the pulse unit, It is out of range from 32 Bit domains. When converting the command position value into the pulse, Please set in -2147483648 ~ 2147483647 ranges. |
| 2013 | 8211 | The operation speed value was 0 or less, or exceeded the maximum speed value. | Please set the operation speed value to the bigger value than 0,or smaller than or equal to the maximum speed value which is set up in the relevant axis group. |
| 2014 | 8212 | The acceleration was set up as the negative number. | Please set the acceleration value to more than 0. |
| 2015 | 8213 | The deceleration was set up as the negative number. | Please set the deceleration value to more than 0. |
| 2016 | 8214 | The jerk was set up as the negative number. | Please set the jerk value to more than 0. |
| 201A | 8218 | Buffer Mode setting value exceeded a range. | Please set the value which can be set(0~5) in the Buffer Mode. |
| 201B | 8219 | Execution Mode setting value exceeded a input range. | Please set the value which can be set(0~1) in Execution Mode. |
| 201C | 8220 | Transition Mode setting value exceeded a range. | Please set the value which can be set(0~1) in Transition Mode in relevant command. |
| 201D | 8221 | Transition parameter setting value exceeded a range. | Please set the value which can be se in Transition Parameter in relevant command. |
| 201E | 8222 | The axis group operation was stopped due to the error occurrence of axis group configuration axis. | Please execute command after removing an error factor and removing an error with the axis or the axis group error reset command. |
| 201F | 8223 | The command position value transmitted to the servo drive is out of range from the pulse unit representation value. | When converting the command position value to the pulse unit, It is out of range from 32 Bit domains. When converting the command position value into the pulse, Please set in -2147483648 ~ 2147483647 ranges. |

(38) Axis group function block related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 2020 | 8224 | It is undefined the axis group command. | The relevant command is not performed in the current version of the module. Please contact customer support team of our company after check the version in which the relevant command can be performed. |
| 2021 | 8225 | The executed command was canceled because same command was executed. | Please check whether the relevant command was not again performed among the same command operation. |
| 2022 | 8226 | It exceeded the number of commands which can operate Buffered command. | You can't perform a command because the command buffer of the relevant axis group is full. The number of commands which can be operated with Buffered command is 10. Please control the command operation timing. |

(39) Axis group parameter write related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 2030 | 8240 | You can't write the axis group parameter in case the axis group is operating. | Please execute writing parameter when the axis group is not operating. |

(40) Axis group parameter data related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 2040 | 8256 | Data of axis group parameter is abnormal. | Please exchange module, if an error happens again after downloading the data in XG-PM again and reloading. |
| 2041 | 8257 | It is not possible to execute operation because of parameter error of axis group. | Please set again after confirming parameter of axis group |
| 2042 | 8258 | You can't set speed limit of axis group parameter to the value less than 0. | Please set the speed limitation over 1 in pulse unit. |
| 2043 | 8259 | Configuration axis number setting value of axis group parameter exceeded a range. | Please set configuration axis of axis group within 1~32, 37~40 range. |

(41) Axis group Add/Remove command related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 2051 | 8273 | The axis which you are going to add is already registered in the axis group. | Please set another group after checking whether the axis number is in the relevant axis group. |
| 2052 | 8274 | Now, Axis group is active and the axis which you are going to add is already included in the other activated axis group. | Please execute command after changing the activated axis group in which the relevant axis is included to GroupDisabled status. |
| 2053 | 8275 | The IdentInGroup setting value of axis group add/remove command exceeded a range. | Please set IdentInGroup setting value to range of 1~4. |

(42) Axis group Enable/Disable command related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 2060 | 8288 | There are not axis setting at designed axis group of axis group enable/disable command. | Please execute command after setting axis at least 1 at relevant axis group. |
| 2061 | 8289 | It can't enable axis group because there are axis during operation among current configuration axis of axis group. | Please execute command when it isn't operating all axis belongs to a relevant axis group. |
| 2062 | 8290 | It can't be activate axis group specified because configuration of current axis group is added at another activated axis group. | Please check that axis belongs to a group of the relevant axis group is not added at another axis group activated. |
| 2063 | 8291 | It can't be enabled axis group because unit of axis group configuration axis is different from each other. | Please set same unit of configuration axis belongs to axis group. |
| 2064 | 8292 | The axis group can't be enabled activate because parameter disorder of axis group configuration axis. | Please set parameter of configuration belongs to axis group within normal range. |

(43) Axis group homing command related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 2070 | 8304 | The servo drive of configuration axis not support homing mode. | After confirm that relevant servo drive supports EtherCAT CoE CSP mode, confirm servo drive status. |
| 2071 | 8305 | There is axis that is not completed homing normally among configuration axis. | Please execute again after confirm error code of configuration axis and eliminate error factor of relevant axis. |
| 2072 | 8306 | It is not possible to execute axis group homing command if axis group is during operation. | Please execute again homing command in GroupStandby state after axis group stop operation. |

(44) Axis group current position setting command related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 2080 | 8320 | There is axis with error among configuration axis in setting current position. | Please execute again after confirm error code of configuration axis and eliminate error factor of relevant axis. |

(45) Linear interpolation command related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 2090 | 8336 | It is not possible to execute absolute coordinate linear interpolation command if configuration axis is undetermined origin state. | Please execute command after making determined origin state with homing command and setting current position command. |
| 2091 | 8337 | It exceeded speed limit value of the configuration axis of linear interpolation. | Please execute the command at a lower command speed so as not to exceed the speed limit of the configuration axis. |
| 2092 | 8338 | In case of specified corner distance transition, It is not possible to execute transition operation because moving distance to target distance is bigger than corner distance designation value. | Please set corner distance value at transition parameter to smaller than moving distance to target position |
| 2093 | 8339 | In case of specified corner distance transition, It is not possible to execute transition operation because inserted circular radius exceeds 2147483647pulse. | Please reset target position in order that two lines not located in a straight line, or execute linear interpolation after changing transition mode. |

| | | | |
|---|---|---|---|
| 2094 | 8340 | You can't execute linear interpolation when infinite running repeat of main axis and serve axis is "Enable" status. | Please execute command after changing infinite running repeat of main axis and serve axis to "0: Disable". |

(46) Circular interpolation command related error information

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 20A0 | 8352 | It is not possible to execute circular interpolation command if configuration axis is undetermined origin state. | Please execute command after making determined origin state with homing command and setting current position command. |
| 20A1 | 8353 | The mode setting value of circular interpolation exceeded a range. | Please set Mode setting of circular interpolation to 0~2(0: serve point, 1: center point, 2: radius) |
| 20A2 | 8354 | The setting value of circular interpolation pass selecting exceeded a range. | Please set pass select setting of circular interpolation to 0~1(0:CW, 1:CCW) |
| 20A3 | 8355 | The radius setting exceeded a range in circular interpolation radius method. | Please set radius setting value of main operation date in circular interpolation to half of the length from the starting point to the end to be more than 80%. |
| 20A4 | 8356 | You can't execute operation if 'starting point =center point(midpoint) or center point(midpoint)=end point' in circular interpolation. | Please execute circular interpolation after setting center point(midpoint) to another location with starting point(or end point). |
| 20A5 | 8357 | For midpoint( or radius) method, Starting point and end point can't be the same in circular interpolation. | If you set circular interpolation to center point(or radius), please execute circular interpolation after setting starting point to another location with end point. |
| 20A6 | 8358 | It is radius error in circular interpolation. | Radius of the circle that Circular interpolation operation can be performed is more than 0 and less than 2147483647pulse. Please execute command after setting input value that can be calculated within setting range. |
| 20A7 | 8359 | It is not possible to execute operation because linear profile occurred in circular interpolation. | For using midpoint method, Please execute circular interpolation after changing that the midpoint of the starting point and end point isn't located on a straight line. |
| 20A8 | 8360 | You can't execute circular interpolation when infinite running repeat of main axis and serve axis is "Enable" status | Please execute command after changing infinite running repeat of main axis and serve axis to "0: Disable". |
| 20A9 | 8361 | You can't circular interpolation if there are 4 configuration axis number of axis group. | Please set up axis group as 2axis in circular interpolation, 3axis in helical interpolation. |

| Error code | | Error Description | Solutions |
|---|---|---|---|
| Hex | Dec | | |
| 20AA | 8362 | When it is not composed of axis configuration of axis group in regular sequence, you don't execute circular interpolation. | For circular interpolation, Please set configuration axis in regular sequence. |
| 20AB | 8363 | It exceeded speed limitation of the configuration axis of circular interpolation. | Please execute the command at a lower command speed so as not to exceed the speed limitation of the configuration axis. |

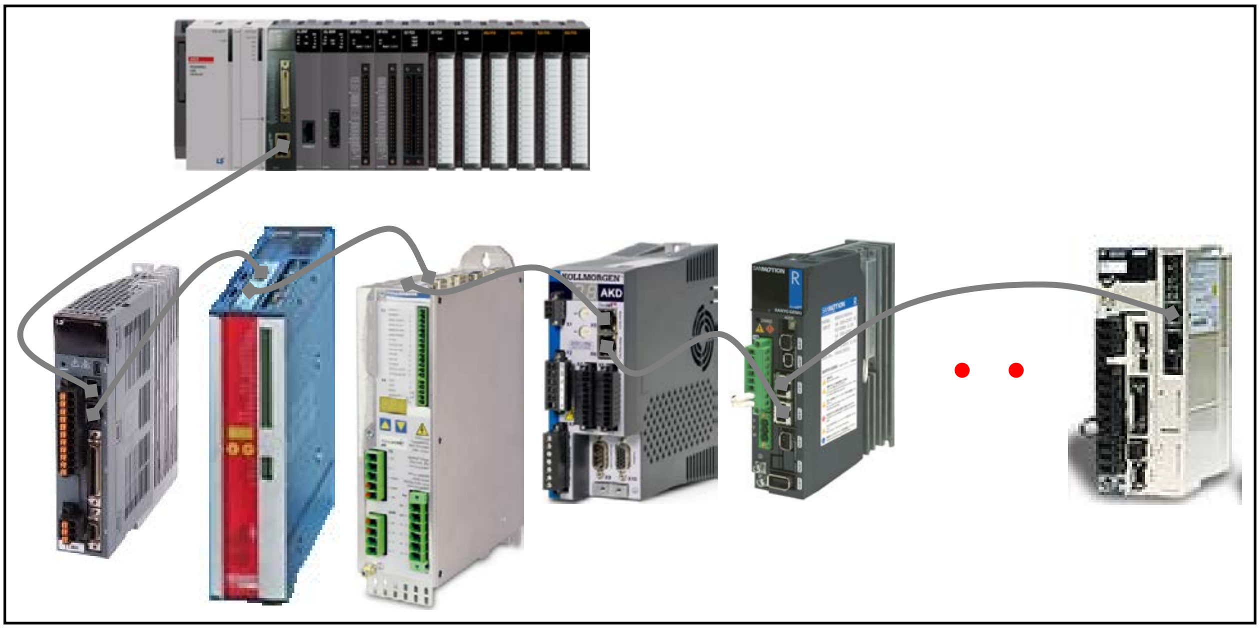
# Appendix2 Setting Example

It describes how to set when using the motion control module at the beginning.

(1) Install the servo driver.
Connect the power and motor to the servo driver and connect external signal as necessary.

(2) Install PLC.
Install PLC and mount the motion control module. And at the beginning of test-run, for safety's sake, make sure PLC CPU is STOP mode.

(3) Connect the motion control module and servo driver.
Connect the motion control module and first servo driver by using Ethernet cable. And connect other servo drivers.
At this time, check the I/O direction of communication port of the servo driver distinctly. Below is a list of servo drive which fundamentally has network setting information in the connection and module when servo drive and EtherCAT I/O are connected to Motion control module.



| Verdor | Applicable servo drive |
|---|---|
| LS Mecapion | APD-L7N |
| Beckhoff Automation GmbH | AX2000-B110 EtherCAT Drive |
| Danaher Motion GmbH (KOLLMORGEN) | S300/S400/S600/S700 EtherCAT Drive |
| | AKD EtherCAT Drive(CoE) |
| Sanyodenki Co., Ltd | R ADVANCED MODEL with EtherCAT Coe Interface |
| Yaskawa Electric Corporation | SGDV-E1 EtherCAT(CoE) SERVOPACK Rev1, Rev2, Rev3 |

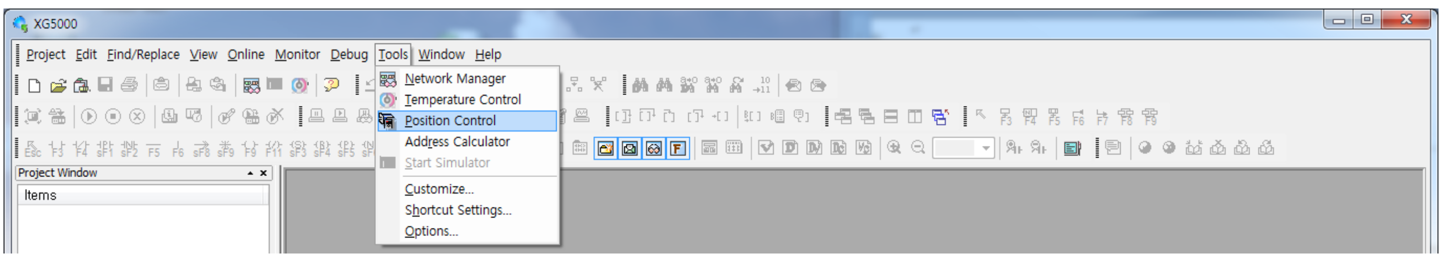
**Notes**

When the installation of servo drive has completed, make sure to check the following points by using dedicated setting TOOL provided by the servo drive manufacturer; failure to meet the standards requires reset to meet the actual user condition.

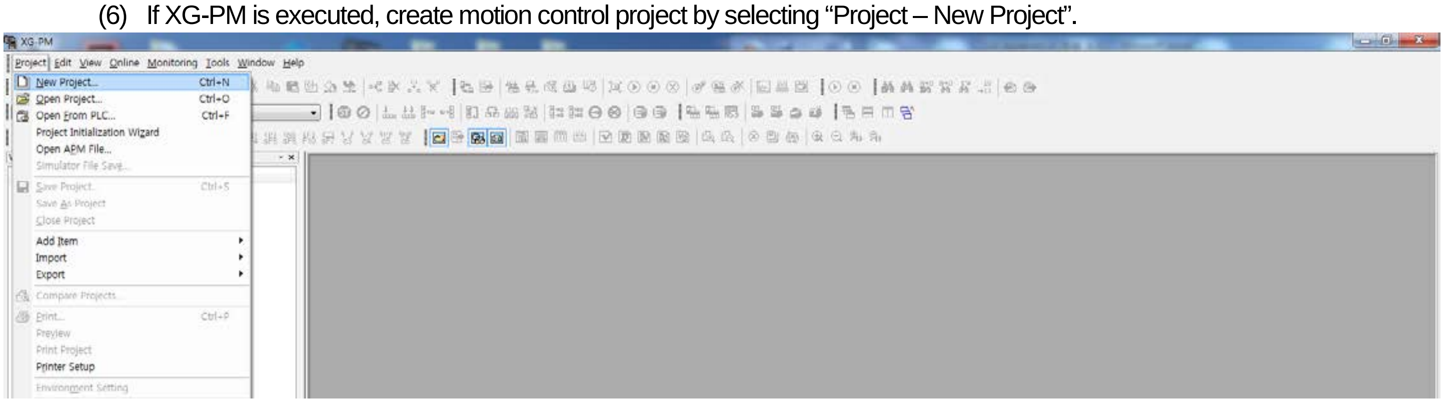
1. Power supply
   Check if the power connected to servo drive and the allowable power conditions are the same.
   (There are instances where no power setting is in parameter depending on the type of servo drive.)
2. The type of motor and encoder(feedback)
   Set the parameter according to the type of encoder and motor connected to actual servo drive.)
3. Command position unit setting
   If it is possible to set the command position unit by servo drive parameter, make sure to set it by pulse unit (Inc. or Counts), and set the encoder resolution value per motor rotation according to the bit number of encoder used.
   (There are instances where no separate setting item exists depending on the type of servo drive.)

(4) Install XG5000 at the PC.

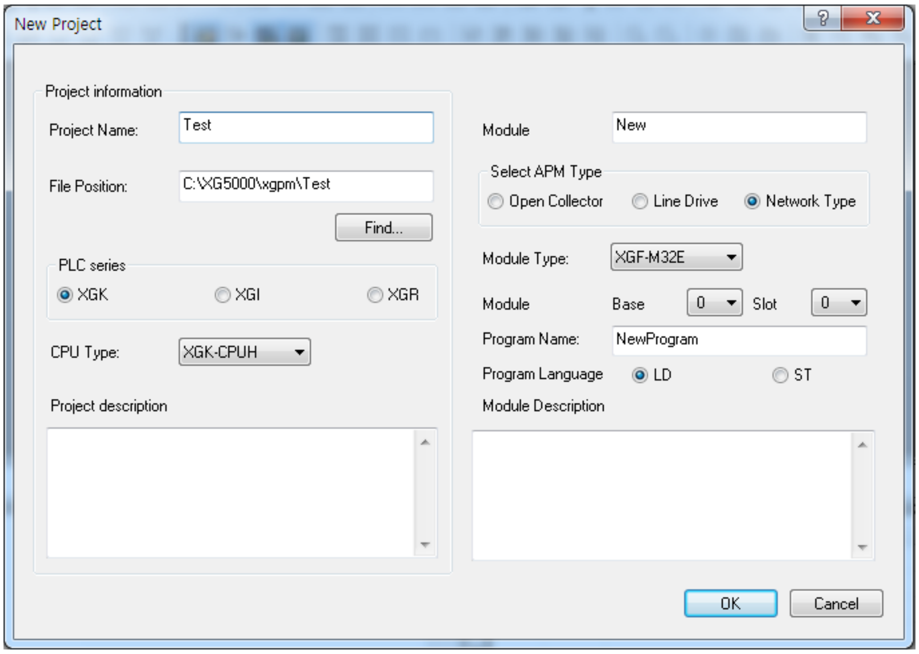
(5) Execute XG5000 and XG-PM by selecting “Tools – Position control”.
(XG-PM is used to set or monitor the program & operation parameter of initial motion control module and the parameter of servo drive.)



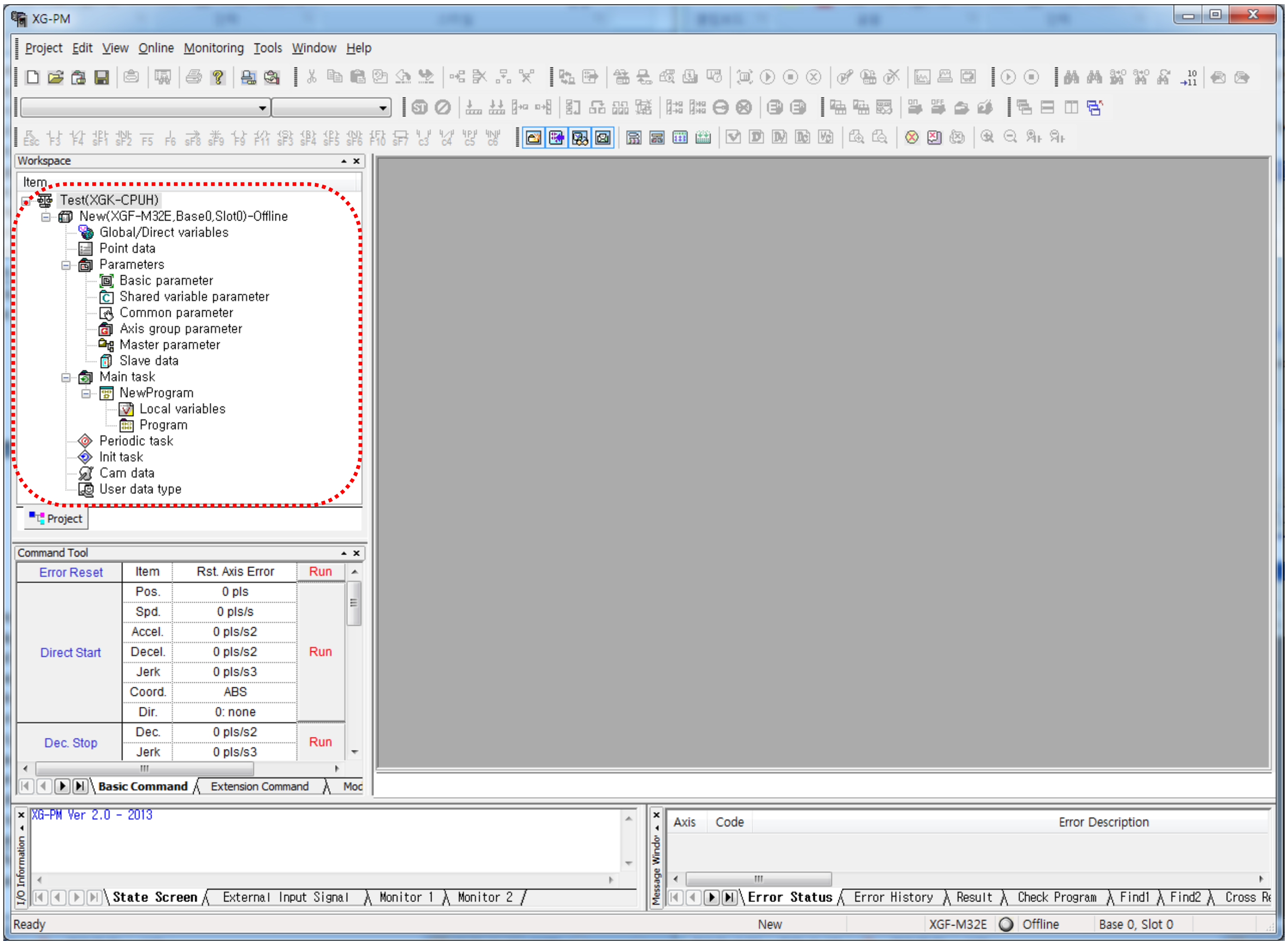

(6) If XG-PM is executed, create motion control project by selecting “Project – New Project”.



(7) In the figure below, set up Project name, PLC series, CPU type, Module name, Module type, Module position to create new project.

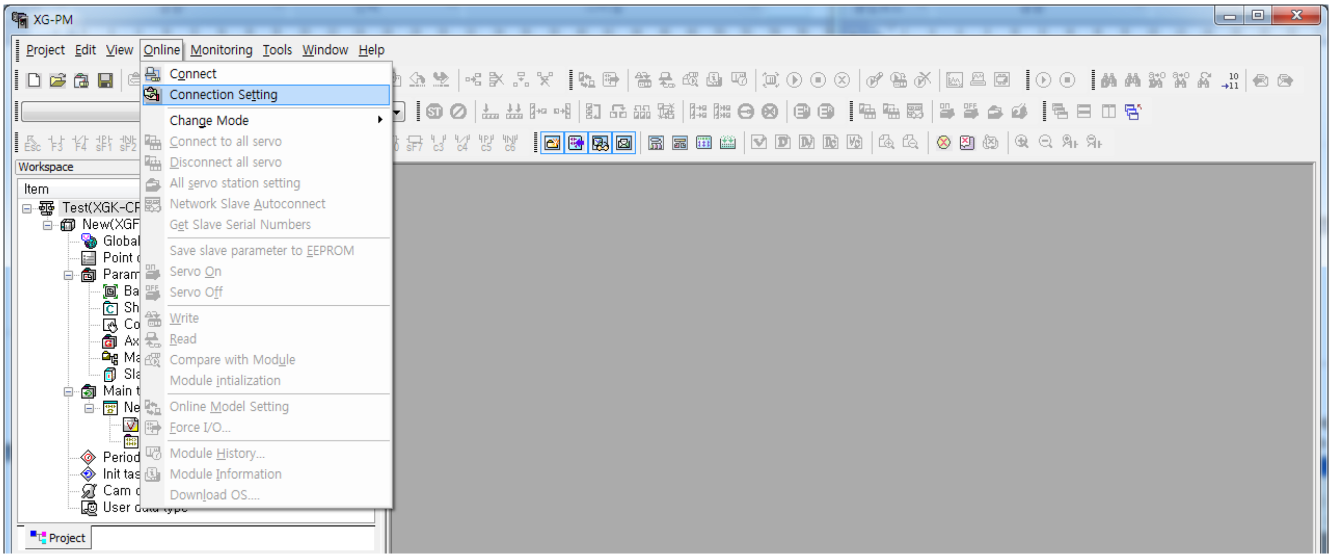


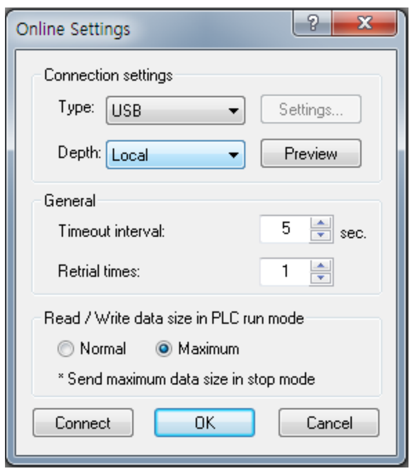
(8) If you set up as the figure above, the project will be created as follows.



(9) Turn on PLC and servo driver and connect PC with PLC CPU through USB or RS-232C cable.

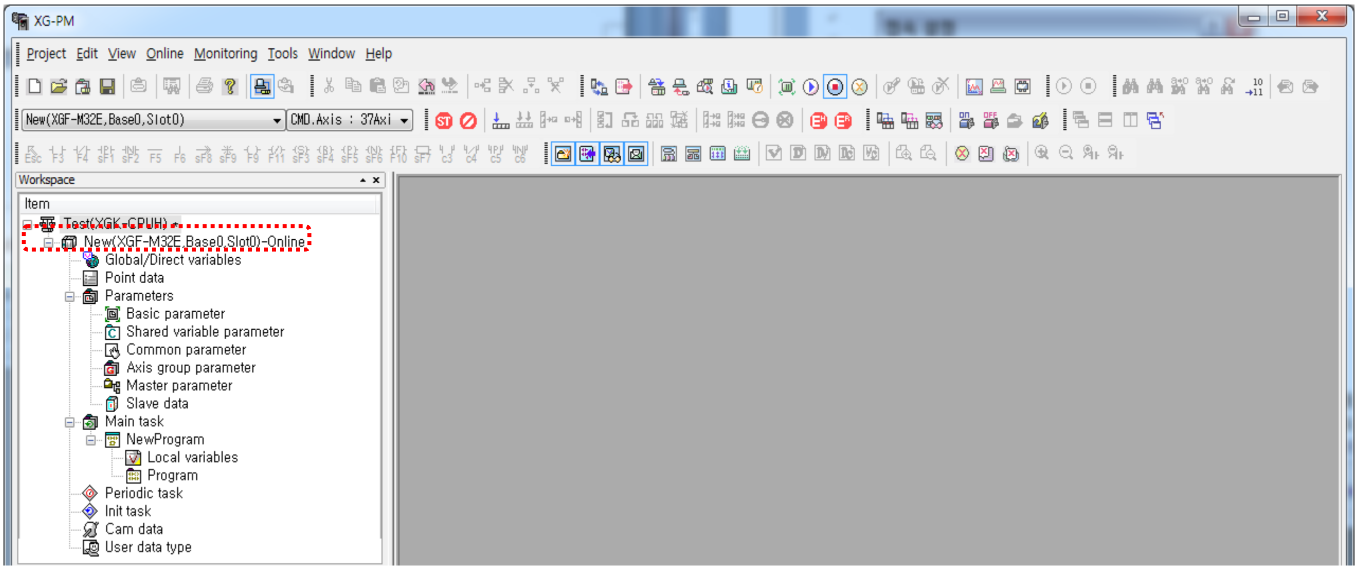
(10) Select “Online- Connection Setting” and set up connection settings.



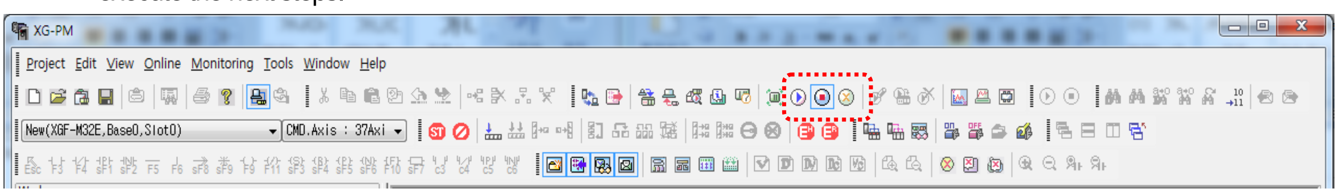

(11) Select “Online-Connect” to connect PC with PLC CPU.

(12) If connection is complete, the module will be shown in 'Online' as follows.



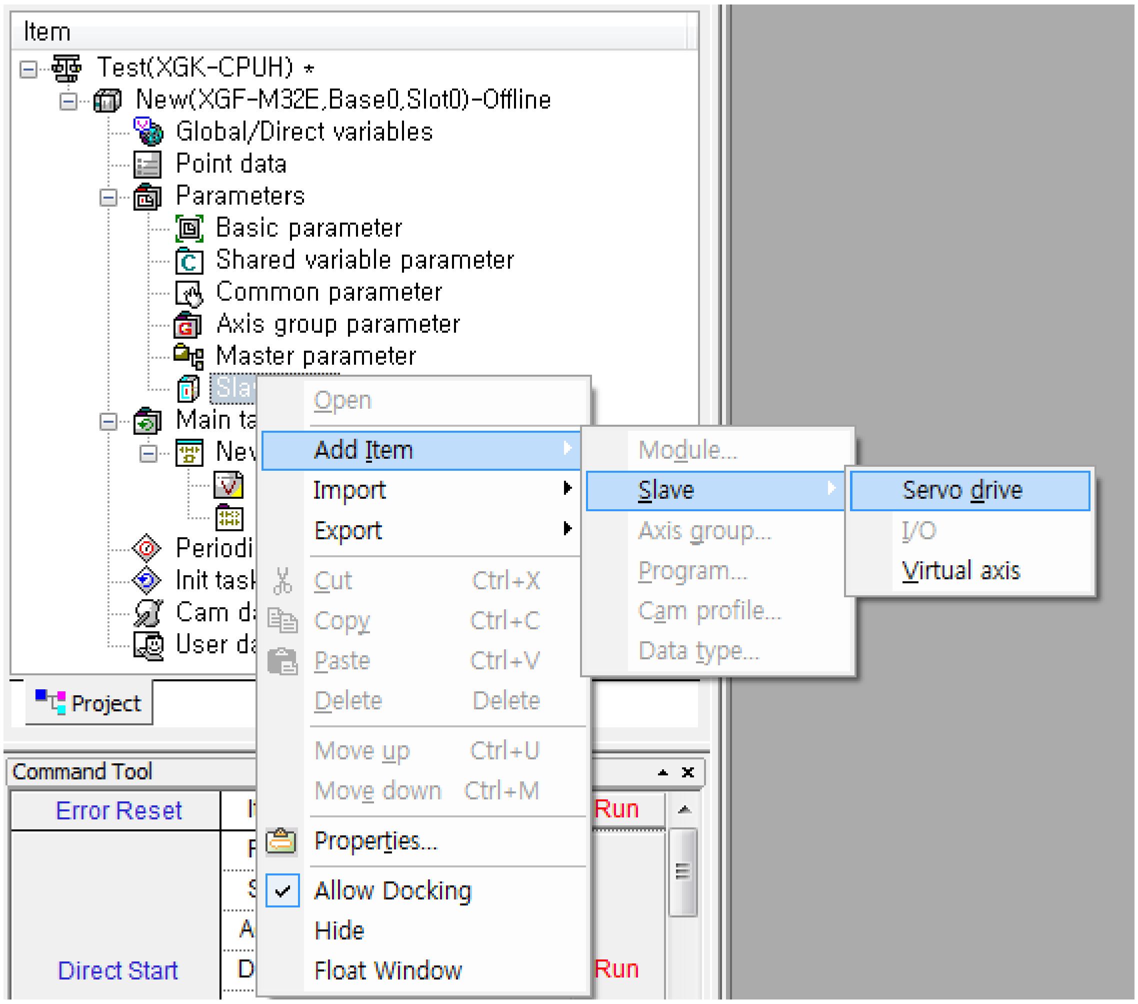

(13) If the module doesn't become "Online" and keeps "Offline", check whether the module is mounted, position or type is correct.

(14) Check if motion control module is in STOP state. If motion control module is in RUN state, change it to STOP state and execute the next steps.

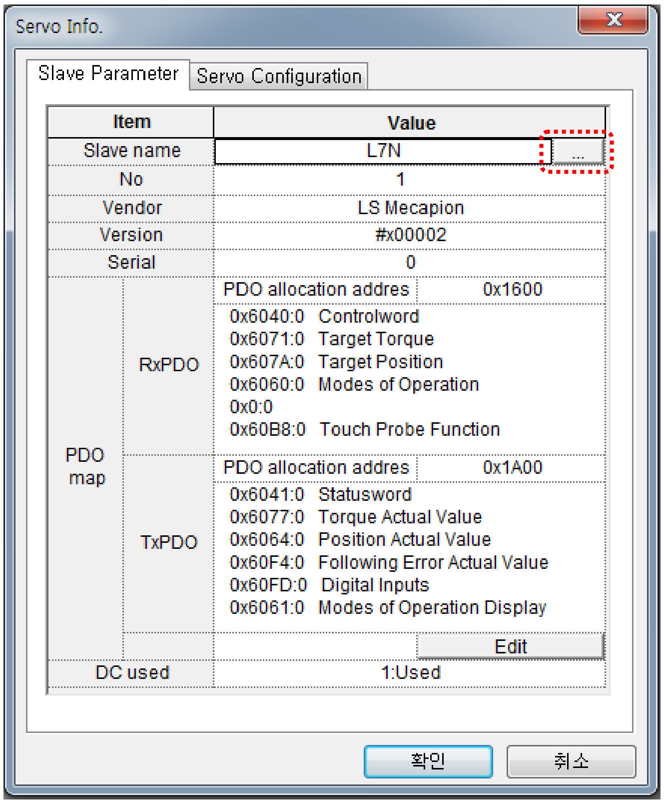



(15) Writing must be executed in the motion control module after setting the servo drive actually connected to the network parameter in order to execute the connection with servo drive. First, check if the relevant module is in off-line state to set network parameter. If it is in on-line state, execute "Online -Disconnect" to change it to off-line state.

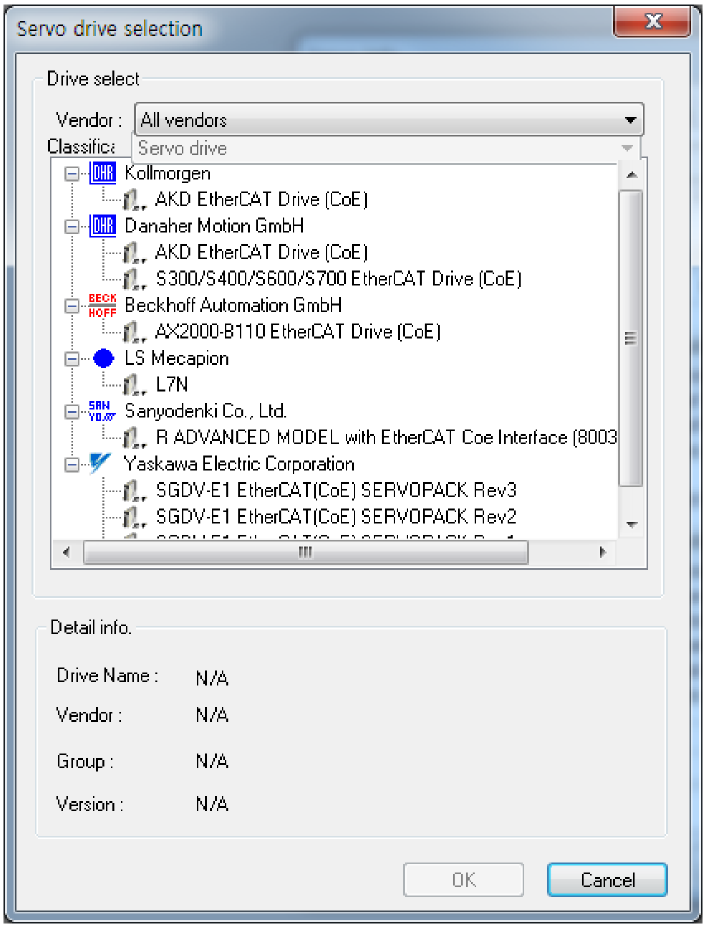
(16) Right click on a mouse in the slave parameter of the project tree and select "Add item – Slave-servo drive" in order to add servo drive to network parameter.



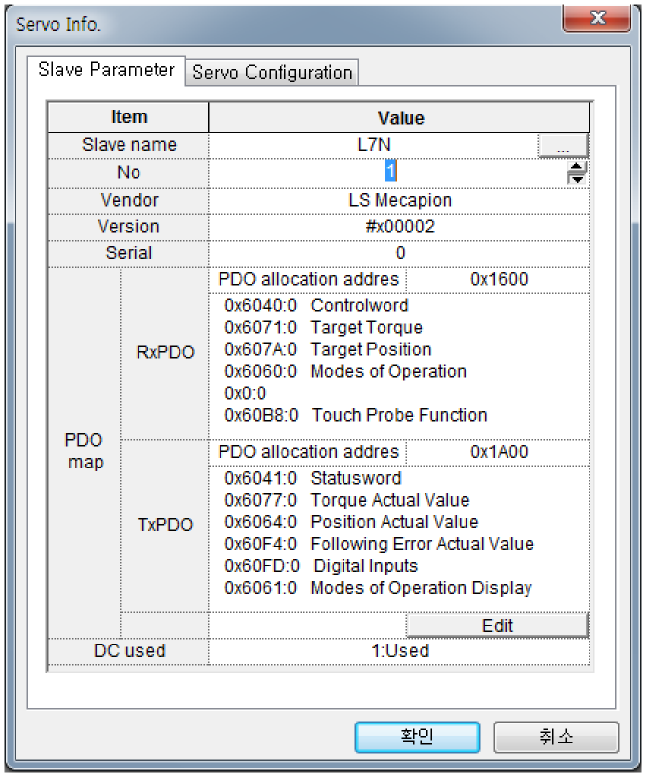
(17) When the slave information window comes up, click the"…" button next to the slave name.



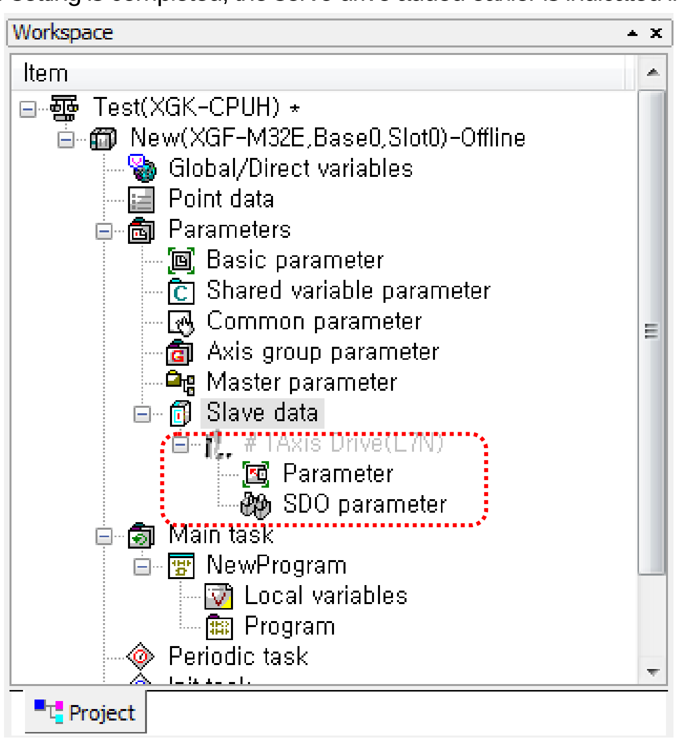

(18) Select the servo drive connected first to motion control module in the servo drive selection window and click OK.



(19) Set the axis number of servo drive which was selected in the slave information window. Connection order is not associated with the axis number. The axis number set here becomes the command axis of command/function block when making motion program.

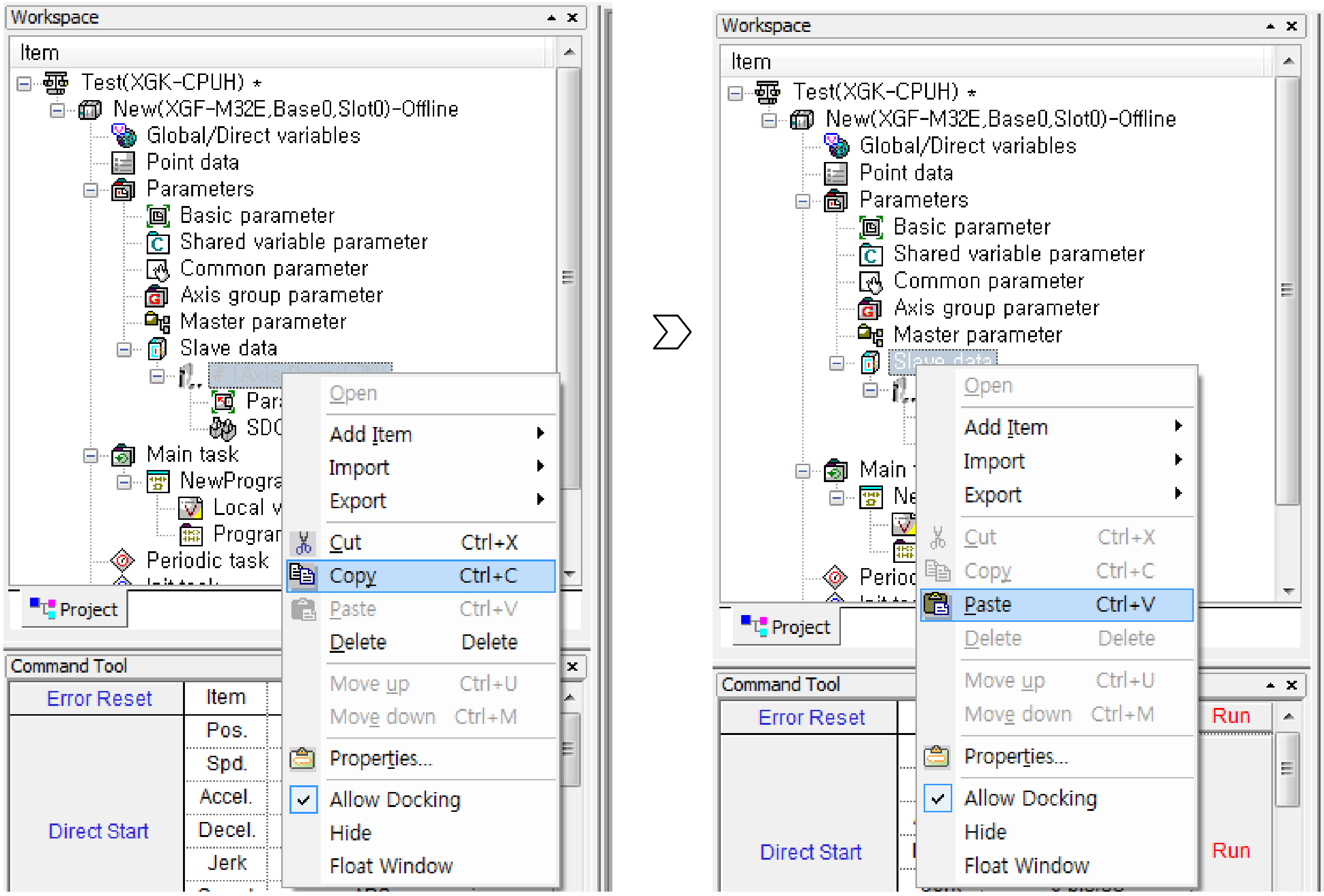



(20) When the axis number setting is completed, the servo drive added earlier is indicated in network parameter.

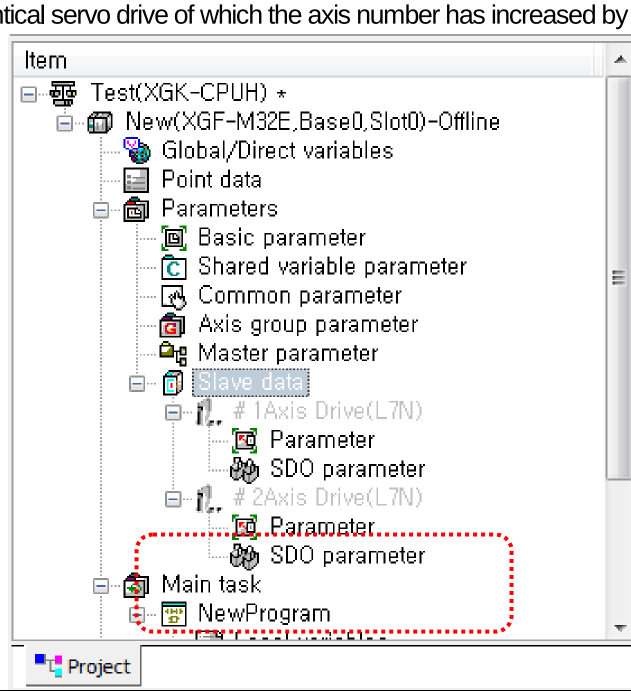


**Notes**

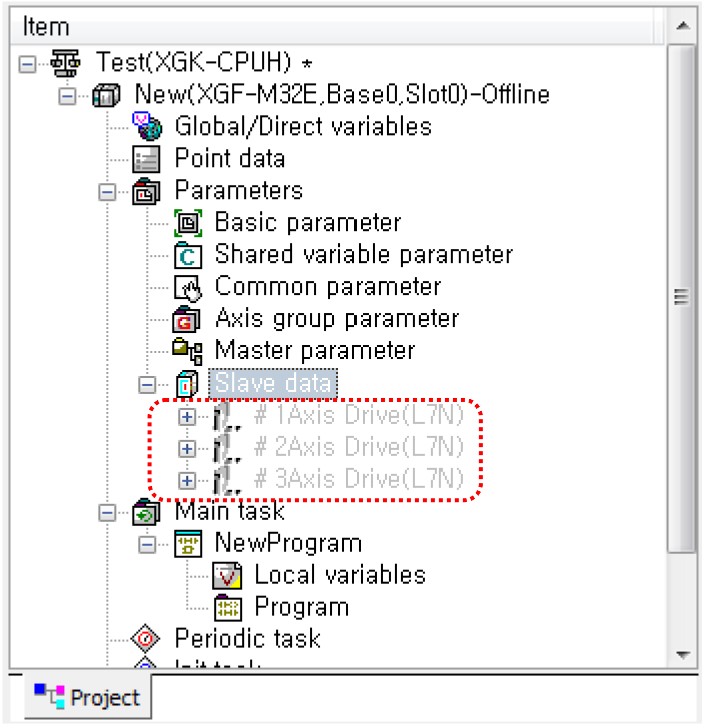
When the types of drive connected to network are the same, "Copy" and "Paste " can be used. While the first drive is added, select the "Copy(C)" menu as follows and right click on a mouse in network parameter to execute "Paste ".



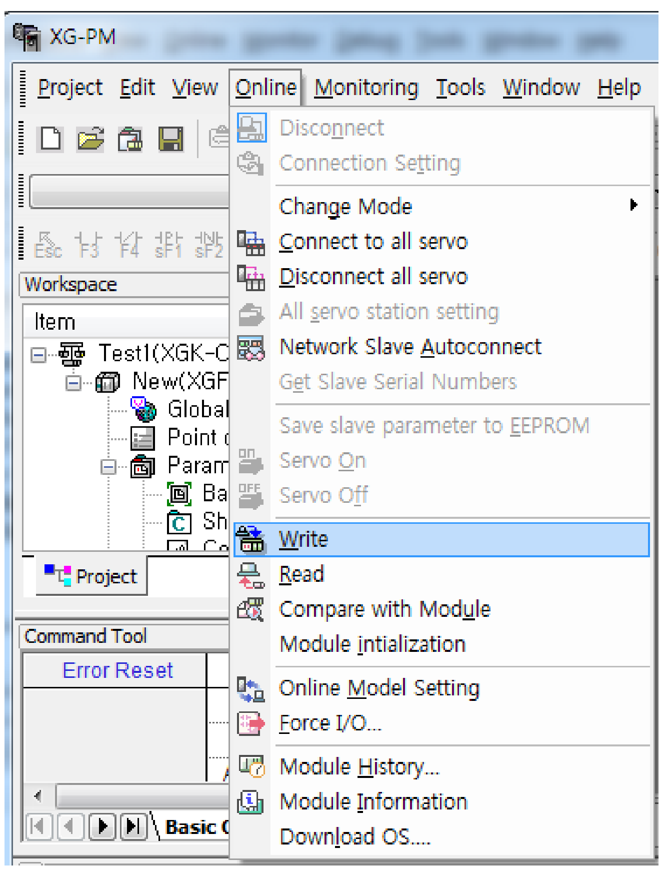

When executing as above, the identical servo drive of which the axis number has increased by 1 is added to slave parameter.



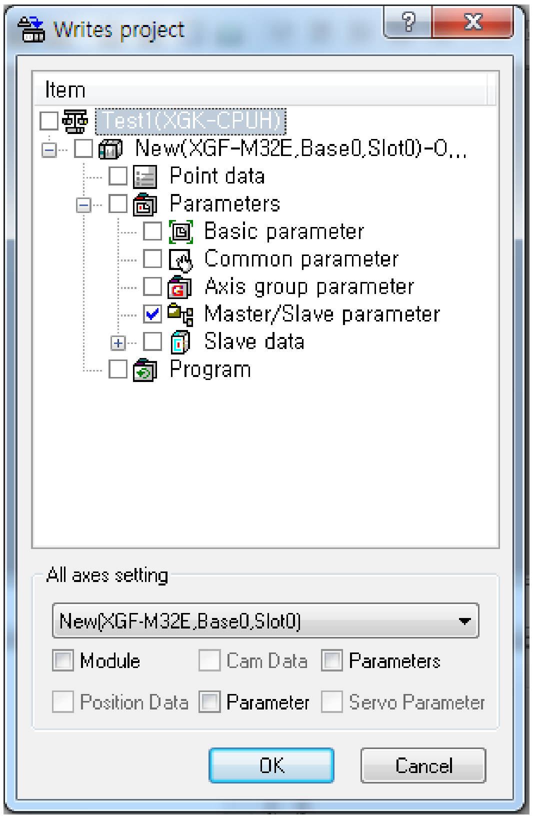
(21) Execute the servo drive addition in the same way for the other servo drives.
This is the screen to show all the servo drives actually connected to slave parameter are added. It is indicated by gray color until whole servo connection command is executed, and positioning module and servo drive are connected normally.

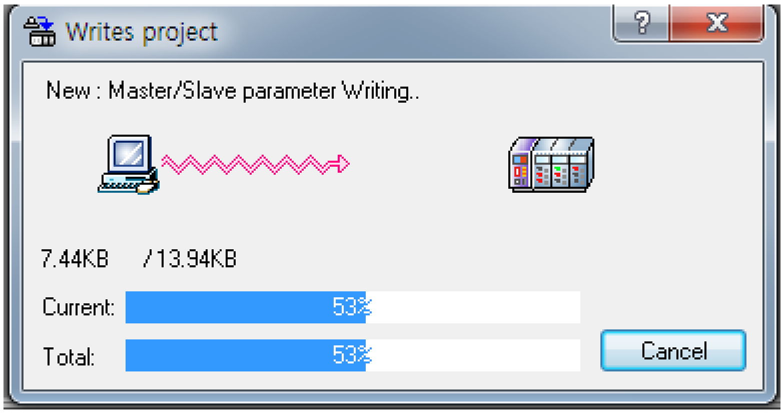


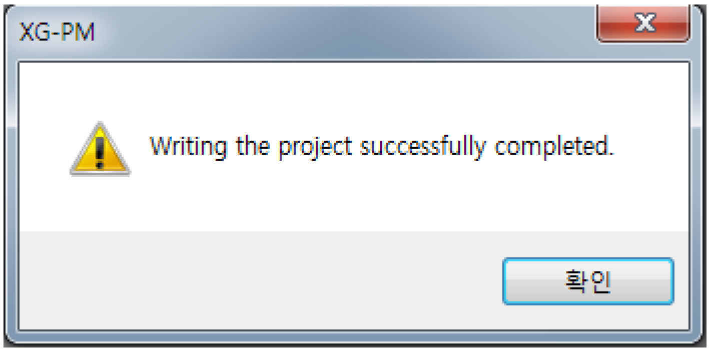

(22) After adding all the servo drives connected to slave parameter, execute "Online-Connection" first and execute "Online-Write" to write network parameter in motion control module.
(Network parameter is not indicated in the project tree.)



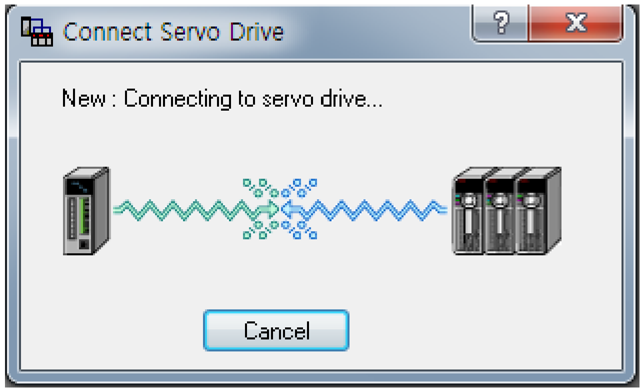
(23) When the project writing window comes up, check in the network parameter and check OK to execute writing. This is the screen to show the whole execution process of project writing.



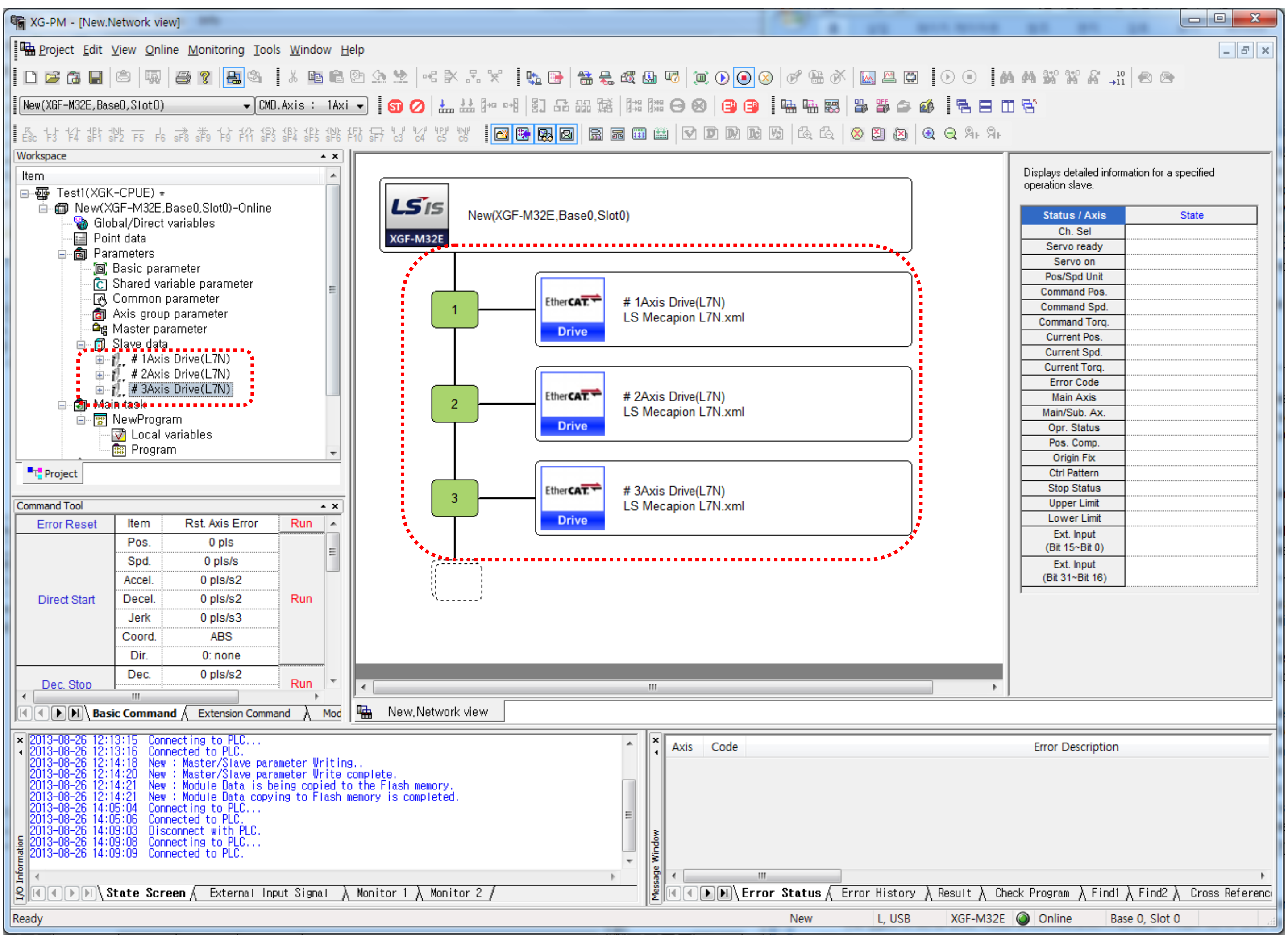



(24) Select "Online –Connect to all servo" to execute communication link between motion control module and servo drive.



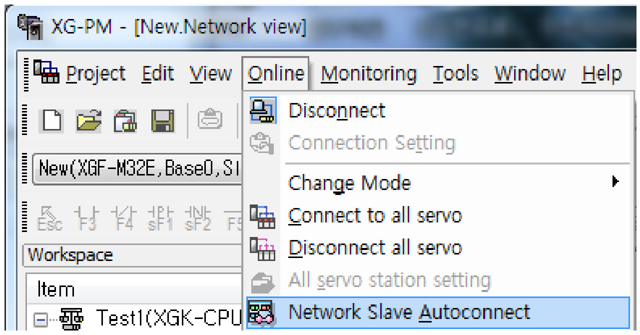

(25) When the link is completed, the servo drive name of slave parameter is activated to black from gray. Execute the "View-view Network …" in the menu to check the servo drive connection.



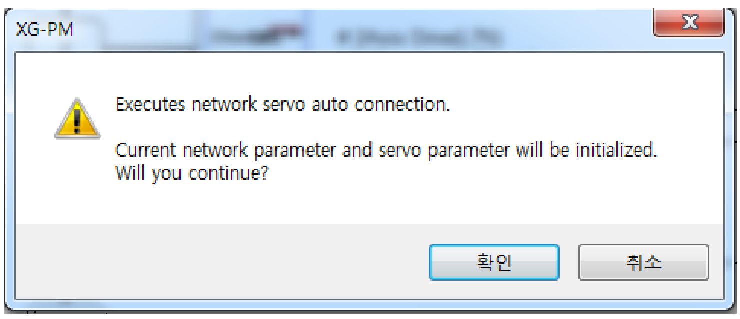
**Notes**

When connecting the network for the first time after the system configuration using XGF-M32E, use "Network slave auto connection" to conveniently execute connection to servo drive without setting the slave parameter.

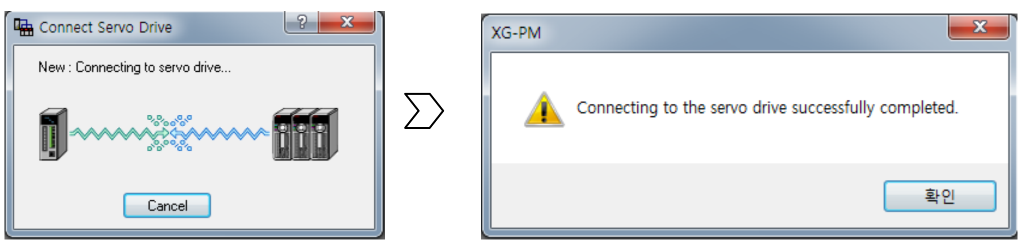
1. Execute the "Online -Network slave auto connection " menu.



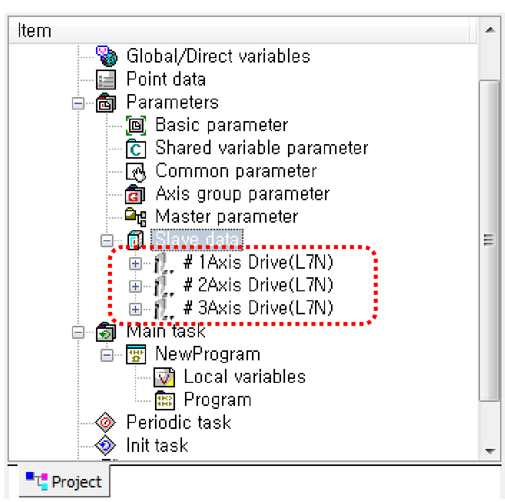

2. Popup notification message appears as follows. This is an alert message notifying when executing network slave auto connection, the network parameter set in the current XG-PM and motion control module is initialized and so the servo parameter in XG-PM is. Check the message and click OK.




3. Slave connection message appears, and if the connection is completed normally, completion message is indicated.

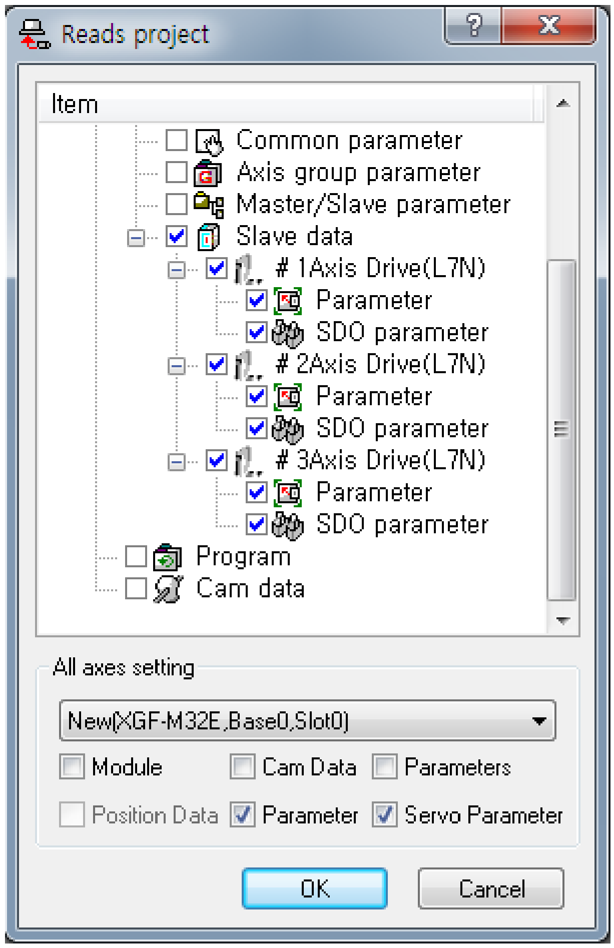



4. When executing the "Network slave auto connection" command, the EtherCAT slave information currently connected to the slave parameter of XG-PM is automatically registered if the connection command is completed normally.

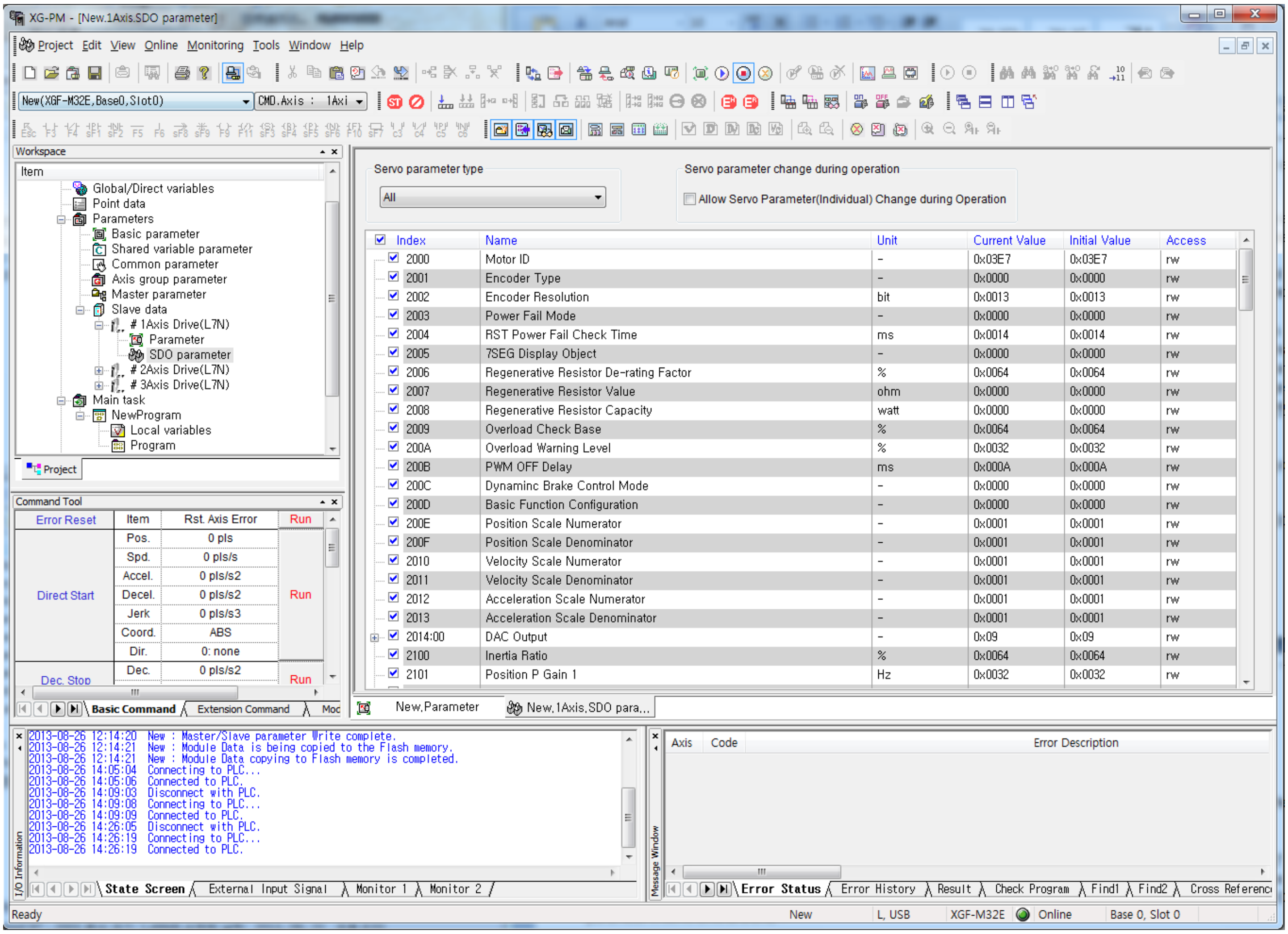


5. When executing the connection with the "Network slave auto connection" command, the axis numbers are automatically allocated in the order of connection to motion control module. In other words, the servo drive primarily connected to motion control module becomes Axis 1, and the other servo drives become Axis 2 to Axis 32 in the order. When wanting to change the axis number, execute network parameter writing by disconnecting the link and change the axis number only in off-line state, and execute the connection with "Online- Connect to all servo" command.

(26) Read slave parameter to set operation parameter and servo parameter.
Select "Online -Read"in the menu and select the item to be read.

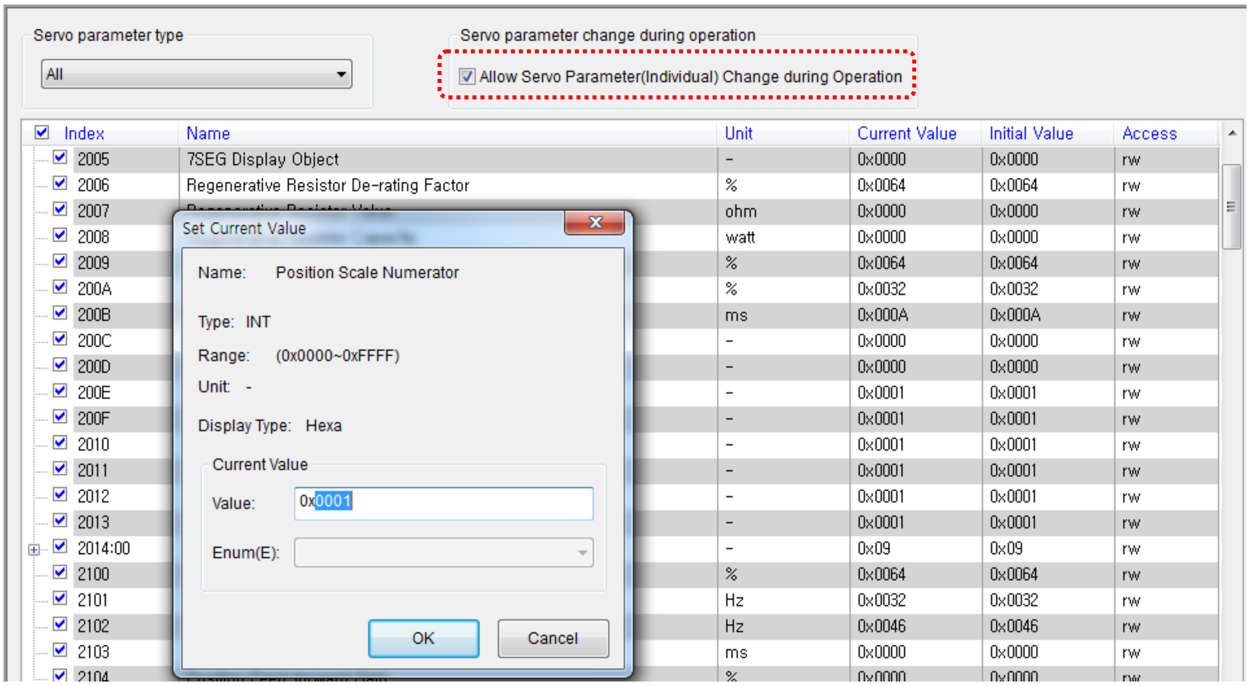


(27) Following is the reading of servo parameter content of L7N servo drive. The content of servo parameter can differ depending on the types of servo drive. Refer to the instruction manuals of each servo drive for details.



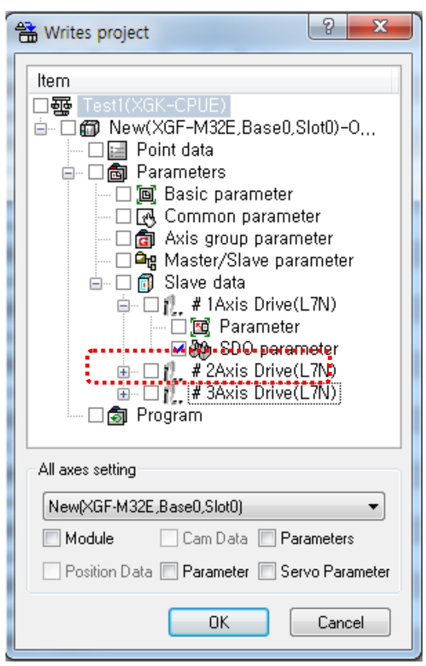
(28) Servo parameter can be set in two ways.

First method is only to change the value of one item of servo parameter (SDO parameter); select the 'Allow Servo Parameter(Individual) Change during Operation' checkbox and set the servo parameter (SDO parameter) value that you want to change, then the set value is applied to servo drive immediately. Reflection of the modified value to the 'current value' column of servo parameter means the value is transmitted normally.




In order to keep the data after turn on/off the power of servo drive, execute the "Online-Save slave parameter to EEPROM" command because modifying the parameter in operation of servo parameter (individual) is only valid when the power is currently on.

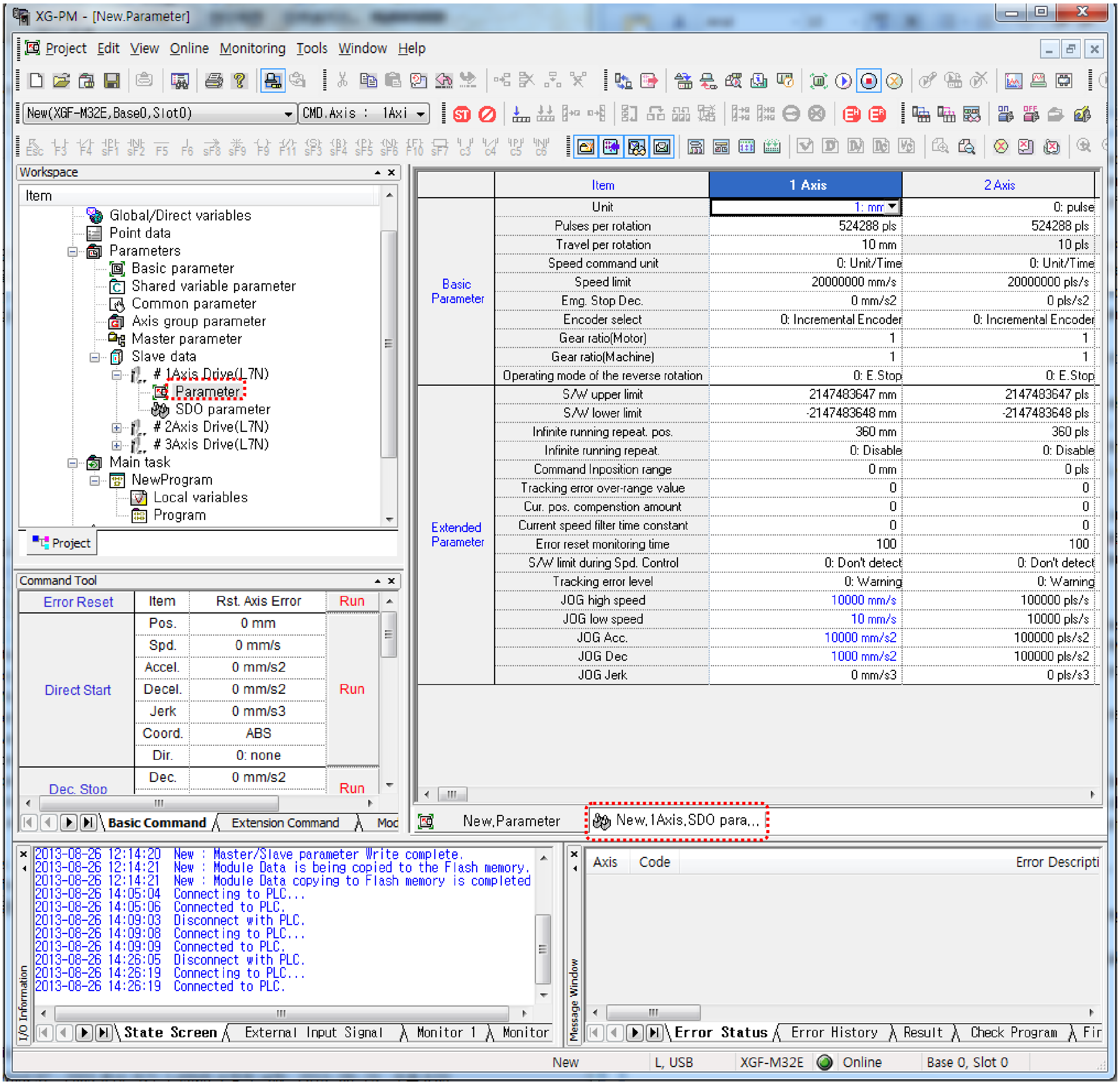
Second method is to set all the servo parameter you want to modify and execute 'Online -Write ' to write the whole SDO parameter in servo drive at a time.




When writing the whole SDO parameter, "Save slave parameter to EEPROM" command is automatically executed.

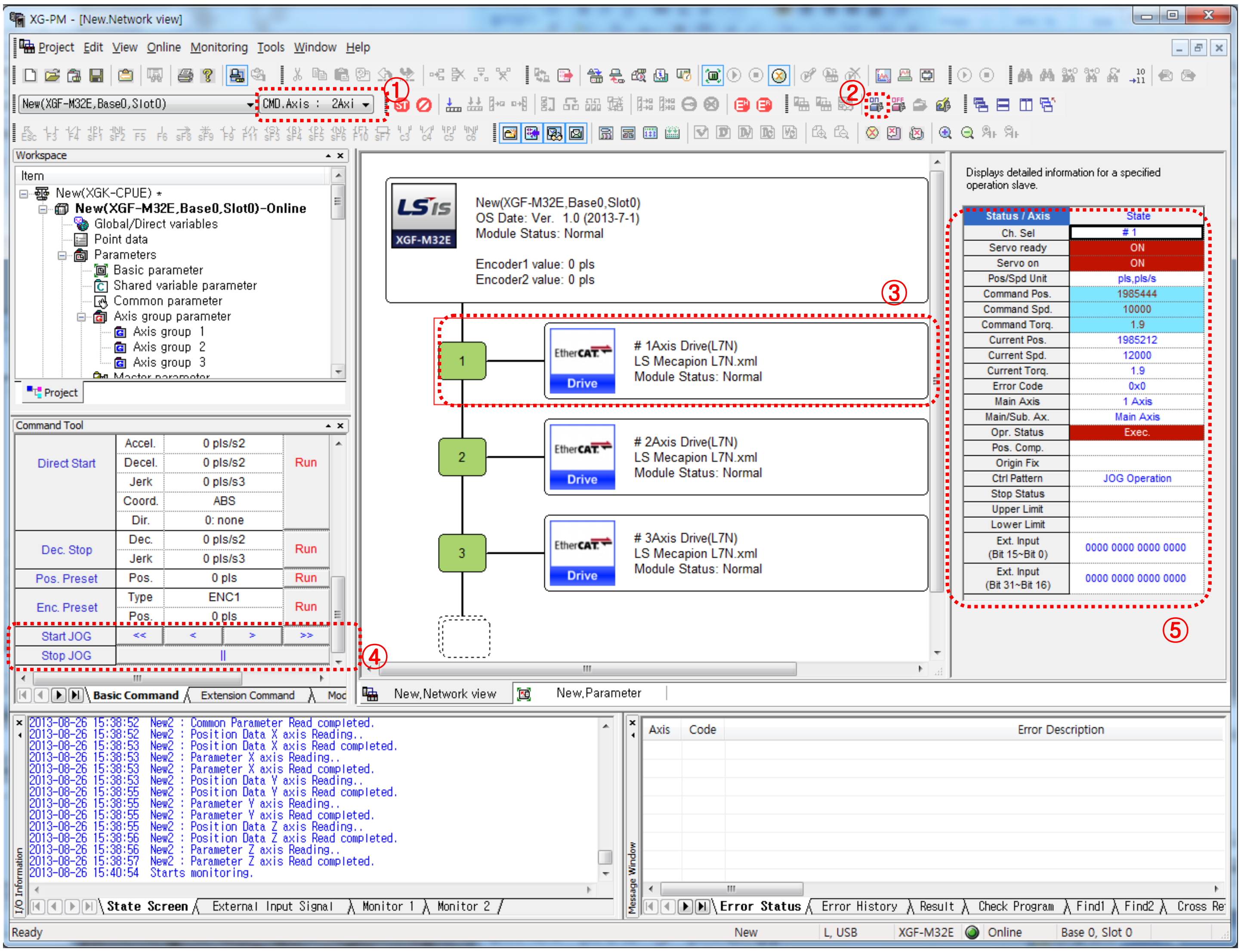
Therefore, you do not need to execute "Save slave parameter to EEPROM" separately. Refer to the instruction manual of the relevant servo drive because sometimes modified set value is applied after the power is on/off depending on the item of servo parameter.

(29) When finishing the servo parameter setting, set the operation parameter of each axis and select the operation parameter of the relevant axis in "Online-Write " to write in module.




(30) If you turned off the power of servo drive and turned it on again in the step (28), execute "Online-Connect to all servo" again to connect module and servo drive.

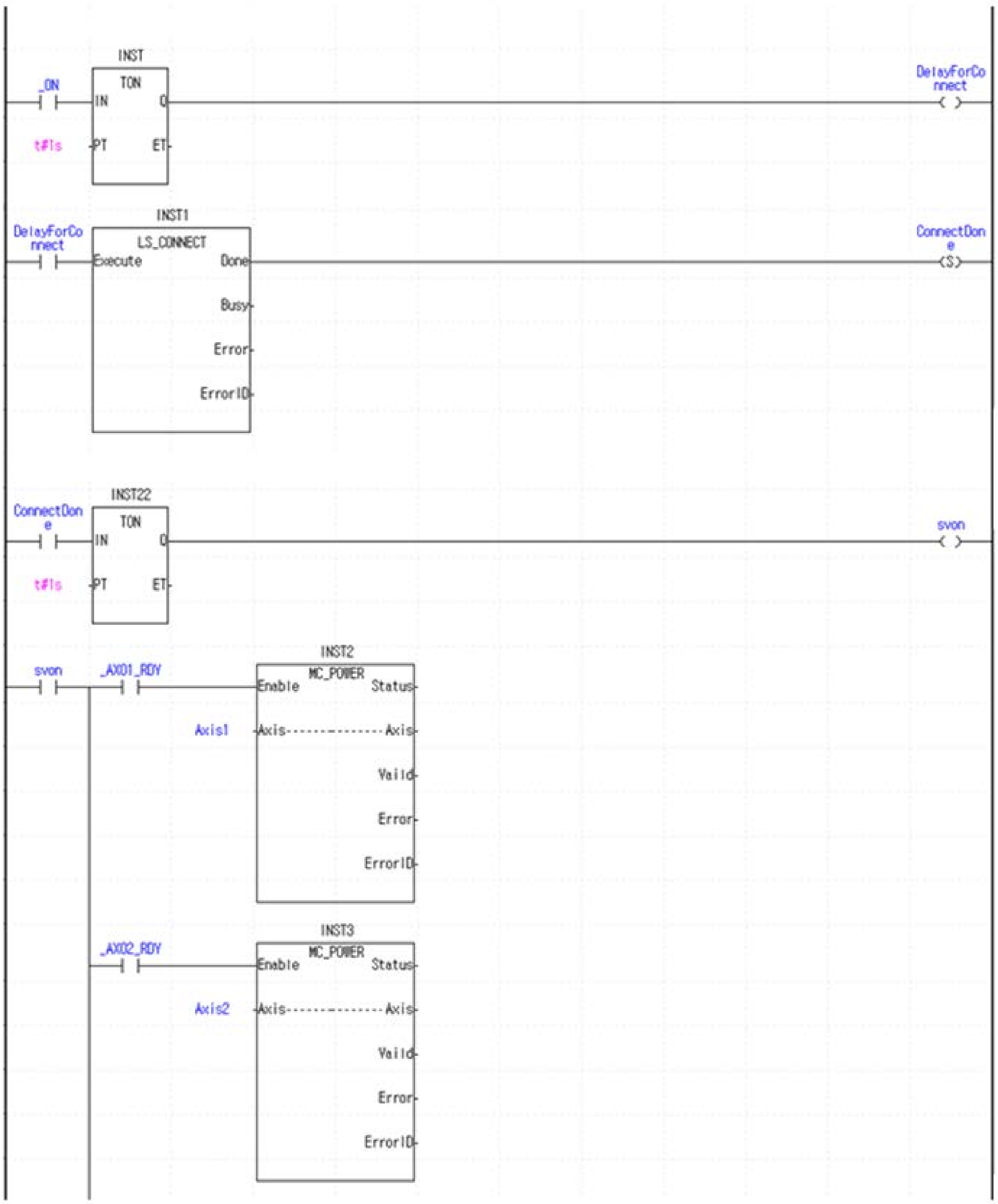
(31) After selecting the command axis and turning on the servo of the relevant axis, check if the relevant axis is in servo on state and check the motor operation by operating the motor using jog or others.




(32) If vibration or noise is generated when motor is operating, adjust the responsibility, inertia ratio, and gain values of servo parameter and transmit them to servo drive. Use the dedicated setting TOOL of servo drive for detailed setting such as auto tuning.

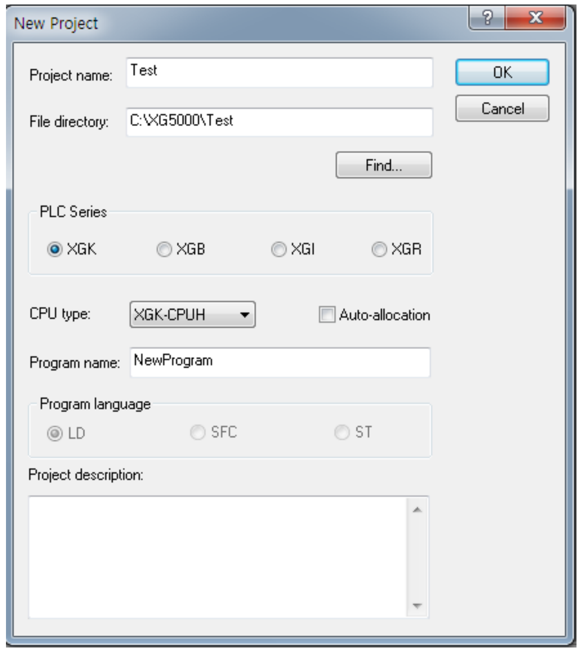
(33) Create motion program.

The exercise below is for the case that 2 servos are set to 1 & 2 axes using XGK CPU, and LS_CONNECT is used for connection and the connected axis is servo on by using MC_Power. The rest of the exercise can be added as user's need. Motion task can be divided into main task, periodic task, and initialization task. You can add program to the relevant task of the project tree depending on the character of the program.

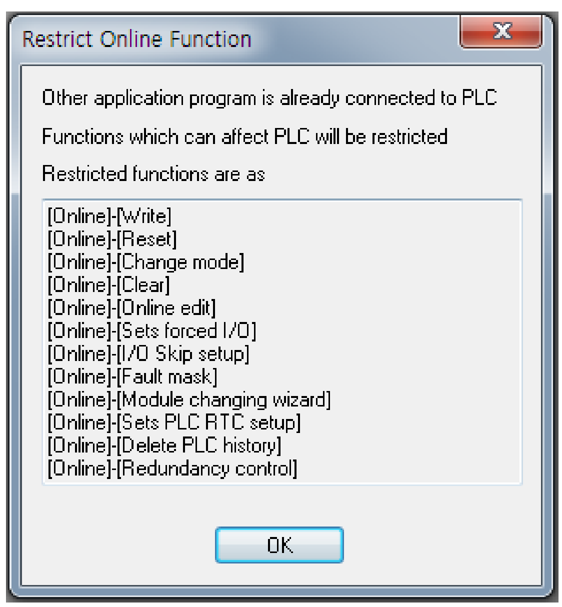


(34) Create PLC Program by using XG5000.

(a) Create new project. Select "Project -New project " in the menu, and set the name of project and others.



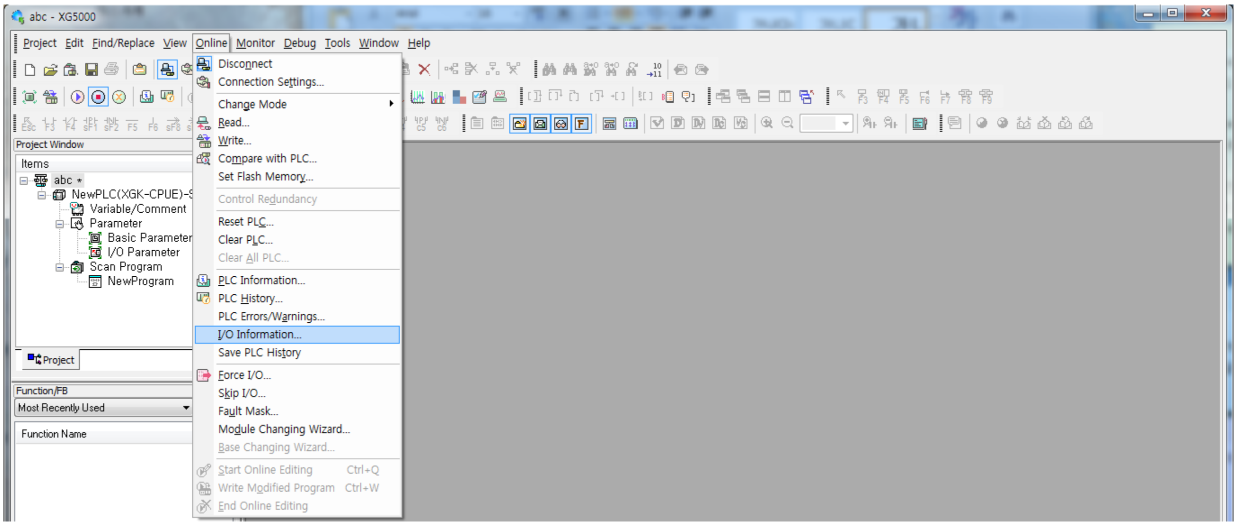

(b) Release the online connection between PLC CPU and XG-PM. If XG5000 is connected while XG-PM is linked, a dialog box appears as below and PLC function might be limited. But if you connect XG5000 first and then connect XG-PM, there is nothing to worry about it.



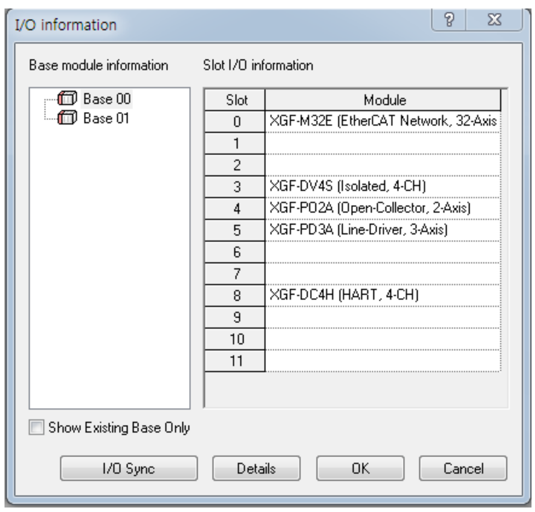

(c) Select "Online -Connection settings"in XG5000 to choose the connection method, and select "Online -Connect" to connect with PLC CPU.

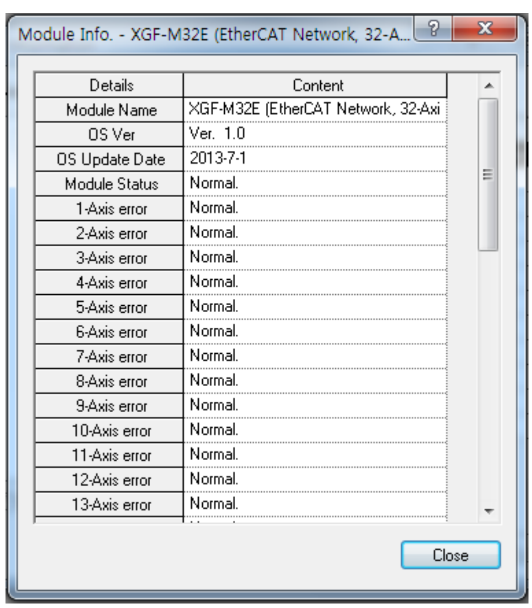
(d) Keep PLC CPU in the "STOP" state.

(e) Select “Online -I/O information ”to check the currently built-in I/O information of PLC.




(f) Check if the installation information of XGF-M32E is correctly displayed on the information window. If you want to view the version information of the relevant module and others, select the relevant module and click the "Details " button.

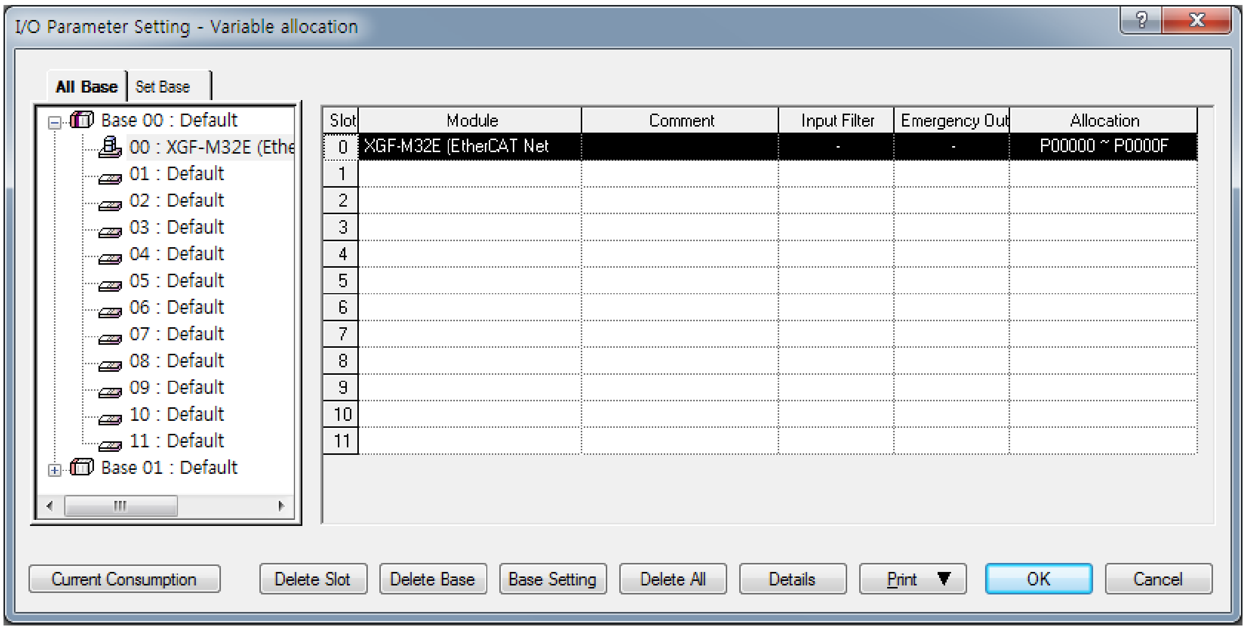


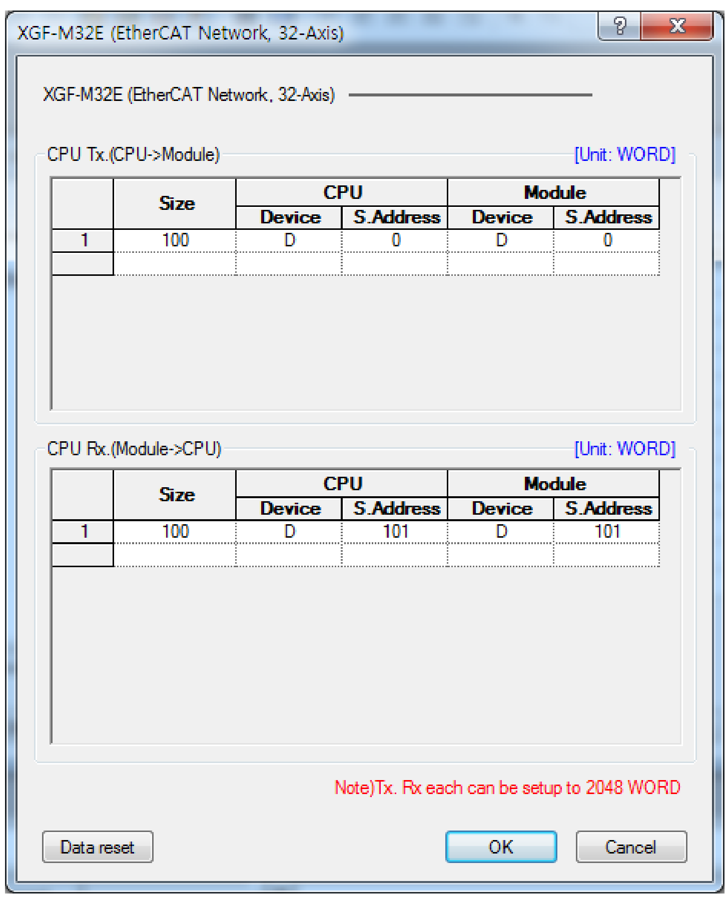



(g) Click the "I/O synchronization" button to set I/O parameter.

(h) Select "Edit –Register U Device" in the menu to register U device automatically.

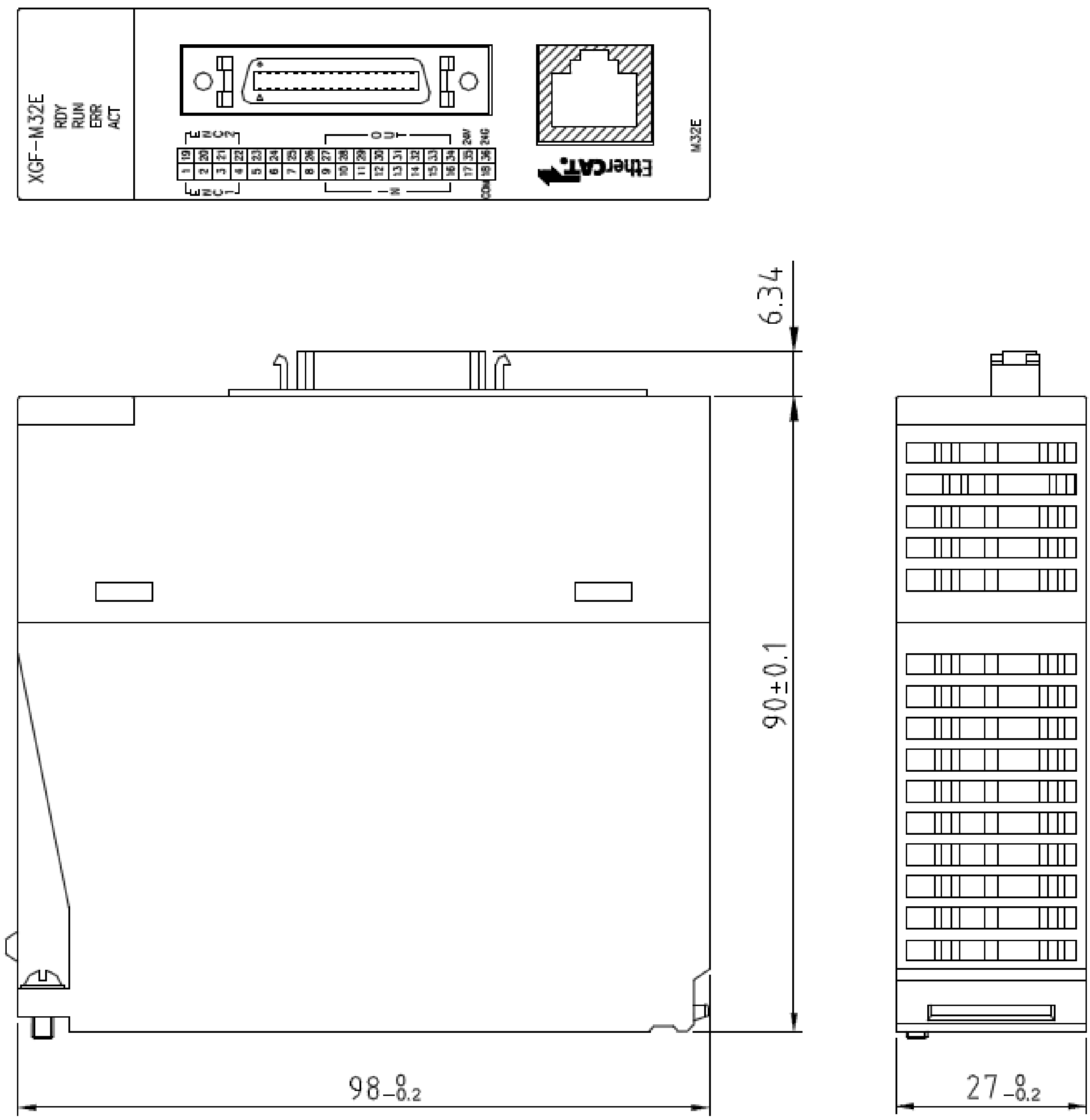
(i) Set device sharing between PLC CPU and motion control module as necessary. Device sharing can be set in I/O parameter in the project tree window.



# Appendix3 Dimension

## Appendix3.1 Dimension of XGF-M32E




**LSIS values every single customers.**

**Quality and service come first at LSIS.**

**Always at your service, standing for our customers.**

**http://www.lsis.biz**

■ **HEAD OFFICE**
LS tower, Hogye-dong, Dongan-gu, Anyang-si, Gyeonggi-do 1026-6,
Korea http://eng.lsis.biz
Tel : (82-2)2034-4870/Fax : 82-2-2034-4648 e-mail : cshwang@lsis.biz

■ **LSIS Tokyo Office _ Tokyo, Japan**
Address: 16FL. Higashi-Kan. Akasaka Twin Tower 17-22,
Akasaka.Monato-ku Tokyo 107-8470. Japan
Tel : 81-3-3582-9128/Fax : 81-3-3582-2667 e-mail : jschuna@lsis.biz

■ **LSIS (ME) FZE _ Dubai, U.A.E.**
Address : Jafza View Tower Lob 19, Room 205 Along Sheikh Zayed
Road Jebel Aali Free Zone Dubai, United Arab Emirates
Tel : 971-4-886-5360/Fax : 971-4-886-5361 e-mail : jungyongl@lsis.biz

■ **LSIS Shanghai Office _ Shanghai, China**
Address : Room E-G. 12FL Hiamin Empire Plaza. No.726. West.
Yan'an Road Shanghai 200050. P.R. China e-mail : liyong@lsis.com.cn
Tel : 86-21-5237-9977(609)/Fax : 89-21-5237-7189

■ **LSIS Beijing Office _ Beijing, China**
Address : B-Tower 17FL. Beijing Global Trade Center B/D. No. 36.
East BeisanHuan-Road. DongCheng-District. Beijing 100013. P.R. China
Tel : 86-10-5825-6027(666)/Fax : 86-10-5825-6028 e-mail : xunmj@lsis.com.cn

■ **LSIS Guangzhou Office _ Guangzhou, China**
Address : Room 1403.14FL. New Poly Tower.
2 Zhongshan Liu Road.Guangzhou.P.R China
Tel : 86-20-8328-6754/Fax : 86-20-8326-6287 e-mail : chenxs@lsis.com.cn

■ **LSIS Chengdu Office _ Chengdu, China**
Address : 12FL. Guodong Buiding. No.52 Jindun
Road Chengdu.610041. P.R. China
Tel : 86-28-8612-9151(9226)/Fax : 86-28-8612-9236 e-mail : comysb@lsis.biz

■ **LSIS Qingdao Office _ Qingdao, China**
Address : YinHe Bldg. 402 Room No. 2P Shandong Road,
Qingdao-City,Shandong-province 266071, P.R. China
Tel : 86-532-8501-6068/Fax : 86-532-8501-6057 e-mail : wangzy@lsis.com.cn

■ **LSIS Europe B.V. , Netherlands**
Address : 1st. Floor, Tupolevlaan 48, 1119NZ, Schiphol-Rijk, The Netherlands
Tel : +31 (0)20 654 1420/Fax : +31 (0)20 654 1429 e-mail : junshickp@lsis.biz

■ **Wuxi LSIS Co., Ltd _ Wuxi, China**
Address : 102-A. National High & New Tech Industrial Development Area.
Wuxi. Jiangsu. 214028. P.R. China
Tel : 86-510-8534-6666/Fax : 86-510-8534-4078 e-mail : caidx@lsis.com.cn

■ **Dalian LSIS Co., Ltd. _ Dalian, China**
Address : No. 15. Liaohexi 3-Road. Economic and Technical Development zone.
Dalian 116600. China
Tel : 86-411-273-7777/Fax : 86-411-8730-7560 e-mail : cuibx@lsis.com.cn

※ LSIS constantly endeavors to improve its product so that
information in this manual is subject to change without notice.



2013. 9