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## Programmable Logic Controller

# XGB Main unit(XBM-H2/HP Type)

## XGB Series

## User Manual

XBM-DR14H2
XBM-DN16H2
XBM-DP16H2
XBM-DN32H2
XBM-DN32HP
XBM-DP32H2
XBM-DP32HP

## Safety Instructions

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

- In case of XBM-DN32H model,
  please refer to separate manual (10310001563).

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## 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 separated into “Warning” and “Caution”, and the meaning of the terms is as follows;

| | |
|---|---|
| ⚠ **Warning** | Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury |
| ⚠ **Caution** | Indicates a potentially hazardous situation which,if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices |

- ► 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 when designing

## ⚠Warning

- **Please, install protection circuit on the exterior of PLC to protect the whole control system from any error in external power or PLC module.** Any abnormal output or operation may cause serious problem in safety of the whole system.
  - Install applicable protection unit on the exterior of PLC to protect the system from physical damage such as emergent stop switch, protection circuit, the upper/lowest limit switch, forward/reverse operation interlock circuit, etc.
  - If any system error (watch-dog timer error, module installation error, etc.) is detected during CPU operation in PLC, the whole output is designed to be turned off and stopped for system safety. However, in case CPU error if caused on output device itself such as relay or TR can not be detected, the output may be kept on, which may cause serious problems. Thus, you are recommended to install an addition circuit to monitor the output status.

- **Never connect the overload than rated to the output module nor allow the output circuit to have a short circuit**, which may cause a fire.

- **Never let the external power of the output circuit be designed to be On earlier than PLC power**, which may cause abnormal output or operation.

- **In case of data exchange between computer or other external equipment and PLC through communication or any operation of PLC (e.g. operation mode change), please install interlock in the sequence program to protect the system from any error**. If not, it may cause abnormal output or operation.

## Safety Instructions when designing

### ⚠ Caution

- **I/O signal or communication line shall be wired at least 100mm away from a high-voltage cable or power line.** If not, it may cause abnormal output or operation.

## Safety Instructions when designing

### ⚠ 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 or flames may be caused.

- **Before installing the module, be sure PLC power is off.** If not, electric shock or damage on the product may be caused.

- **Be sure that each module of PLC is correctly secured.** If the product is installed loosely or incorrectly, abnormal operation, error or dropping may be caused.

- **Be sure that I/O or extension connecter is correctly secured.** If not, electric shock, fire or abnormal operation may be caused.

- **If lots of vibration is expected in the installation environment, don’t let PLC directly vibrated.** Electric shock, fire or abnormal operation may be caused.

- **Don’t let any metallic foreign materials inside the product**, which may cause electric shock, fire or abnormal operation..

# Safety Instructions when wiring

## ⚠Warning

- **Prior to wiring, be sure that power of PLC and external power is turned off.** If not, electric shock or damage on the product may be caused.

- **Before PLC system is powered on, be sure that all the covers of the terminal are securely closed.** If not, electric shock may be caused

## ⚠Caution

- **Let the wiring installed correctly after checking the voltage rated of each product and the arrangement of terminals.** If not, fire, electric shock or abnormal operation may be caused.

- **Secure the screws of terminals tightly with specified torque when wiring.** If the screws of terminals get loose, short circuit, fire or abnormal operation may be caused.

*

- **Surely use the ground wire of Class 3 for FG terminals, which is exclusively used for PLC**. If the terminals not grounded correctly, abnormal operation 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.

# Safety Instructions for test-operation or repair

## ⚠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

- **Don’t remove PCB from the module case nor remodel the 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 installations or cell phone at least 30cm away from PLC**. If not, abnormal operation may be caused.

## 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 | Part | Page |
|---|---|---|---|---|
| V 1.0 | 2016.12 | 1. First Edition | - | - |
| V1.1 | 2018.06 | 1. XBM-DN32H(V2) → XBM-DN32H2<br>2. Chapter 12 Motor Wiring Example Added | 3 | -<br>Ch12 |
| V1.2 | 2019.09 | 1. Added Counter Clear Function<br>2. Added PID Derivative term | 2<br>2 | Ch4<br>Ch5 |
| V1.3 | 2020.02 | 1. Added XBM-DP32H2/HP Main Unit<br>2. Improved I/O Wiring Diagram | 2, 3 | 2-Ch3<br>3-Ch2,3<br>2-Ch3 |
| V 1.4 | 2020.06 | LSIS to change its corporate name to LS ELECTRIC | | Entire |
| V1.5 | 2021.05 | Variable data read/write memory address modification (3-axis operation data) | 3 | 3-Ch11 |
| V1.6 | 2021.09 | 1. Modification of terminating resistor switch description<br>2. Modify partner port range | 1<br>4 | 1-Ch3<br>4-Ch1 |
| V1.7 | 2021.12 | 1. Corrected the error in the error code description section. | 4 | 4-Ch2 |
| V1.8 | 2022.06 | 1. Instructions for System Configuration changed | 1 | 2-9 |
| V1.9 | 2022.09 | Modification of Main Unit Digital Output Specifications | 2 | 3-5~6 |
| V2.0 | 2022.09 | Change domain<br>(lselectric.co.kr -> ls-electric.com) | | Entire |
| V2.1 | 2022.10 | Minimum distance specification between nodes added | 4 | 1-3 |
| V2.2 | 2023.05 | 1. Instructions for System Configuration changed | 1 | 2-9 |
| V2.3 | 2023.05 | 1. Module added<br>(1) XBE-AC08A<br>2. Ferrule specification added | 2 | 3-11<br>3-3 |
| V2.4 | 2023.09 | 1. Web server link changed<br>2. External preset input contact point changed | 4<br>2 | 1-80<br>4-18 |
| V2.5 | 2023.12 | 1. Main unit added<br>(1) XBM-DN16H2<br>(2) XBM-DP16H2<br>(3) XBM-DR14H2<br>2. Failsafe circuit schematic change<br>3. Smart link board module added | Entire<br>1<br>2 | Entire<br>4-3<br>3-34 |

| | | | | |
|---|---|---|---|---|
| V2.6 | 2024.06 | 1. Warranty period, scope changed | 6 | |
| V2.7 | 2024.10 | Overall correction of typos and errors in the manual | Entire | Entire |

# About User's Manual

Congratulations on purchasing PLC of LS ELECTRIC 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 Use'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://sol.ls-electric.com) and download the information as a PDF file.

Relevant User's Manual

| Title | Description | No. of User Manual |
|---|---|---|
| XG5000 User's Manual | It describes how to use XG5000 software especially about online functions such as programming, printing, monitoring and debugging by using XGT series products. | 10310000512 |
| XGK/XGB Series Instruction & Programming | It describes how to use the instructions for programming using XGK/XGB series. | |
| XBC Ultimate Performance XGB Unit | It describes how to use XGB main unit, system configuration, mechanism, program function, input/output function, Built-in High-speed Counter, Datalog, PID Control, Built-in Communication function, Built-in Position, Built-in Analog input/output.. | 10310001374 |
| XGB Analog User's Manual | It describes how to use the specification of analog input/analog output/temperature input module, system configuration and built-in PID control for XGB main unit. | 10310000920 |
| XGB Position User's Manual | It describes how to use built-in Position function for XGB main unit. | 10310000927 |
| XGB Cnet I/F User's Manual | It describes how to use built-in communication function for XGB main unit and external Cnet I/F module. | 10310000816 |
| XGB Fast Ethernet I/F User's Manual | It describes how to use XGB FEnet I/F module. | 10310000873 |
| CANopen Communication Module | It describes how to use XGB CANopen Communication Module | 10310001245 |
| EtherNet/IP Communication Module | It describes how to use XGB EtherNet/IP Communication module | 10310001159 |
| XGB Profibus-DP I/F (Master) User's Manual | It describes how to use XGB Profibus-DP I/F (Master) Communication Module | 10310001310 |
| XGB Profibus-DP I/F (Slave) User's Manual | It describes how to use XGB Profibus-DP I/F (Slave) Communication Module | 10310001410 |
| XGB DeviceNet I/F (Slave) User's Manual | It describes how to use XGB DeviceNet I/F (Slave) Communication Module | 10310001414 |
| XGB High speed counter module User's Manual | It describes how to use High speed counter(XBF-HO02A, XBF-HD02A) | 10310001240 |

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# Part 1. System

## Chapter 1 Introduction

### 1.1 Guide to this Manual

This manual includes specifications, functions and handling instructions for XGB series PLC. This manual is divided up into chapters as follows.

| | No. | Title | Contents |
|---|---|---|---|
| 1.System | Chapter 1 | Introduction | Describes configuration of this manual, unit's features and terminology. |
| | Chapter 2 | System Configurations | Describes available units and system configuration in the XGB series. |
| | Chapter 3 | Specifications | Describes general specifications of units used in the XGB series. |
| | Chapter 4 | CPU Specifications | Describes performances, specifications and operations. |
| | Chapter 5 | Maintenance | Describes the check items and method for long-term normal operation of the PLC system. |
| | Chapter 6 | Troubleshooting | Describes various operation errors and corrective actions. |
| | Chapter 7 | EMC Specifications | Describes system configuration following EMC specification. |
| 2.Main | Chapter 1 | Program Configuration and Operation Method | Describes performances, specifications and operations. |
| | Chapter 2 | CPU Specifications | |
| | Chapter 3 | Input/Output Specifications | Describes operation of basic and input/output. |
| | Chapter 4 | Built-in High-speed Counter Function | Describes built-in high-speed counter functions. |
| | Chapter 5 | Built-in PID Function | Describes Built-in PID Function |
| 3.Positioning | Chapter 1 | Overview | Describes the specification, method to use each positioning function, programming and the wiring with external equipment of embedded positioning function. |
| | Chapter 2 | Specifications | Describes general specifications of Positing function. |
| | Chapter 3 | Operation Order and Installation | Describes the Operation order in case of positioning operation by embedded positioning. |
| | Chapter 4 | Positioning Control | Describes Positioning task, which synchronizes with positioning control period. |
| | Chapter 5 | Positioning Parameter & Operation data | Describes parameter and operation data to be set by software package with embedded positioning. |

| | | | |
|---|---|---|---|
| 3.Positioning | Chapter 6 | Internal Memory and I/O Signal | Describes internal memory used for positioning module of XGB Main unit. |
| | Chapter 7 | Command | Describes positioning command used in XGB PLC. |
| | Chapter 8 | Program | Describes the basic program that operates positioning module case by using its commands. |
| | Chapter 9 | Functions | Describes various functions related to embedded positioning function. |
| | Chapter 10 | Positioning Error Information & Solutions | Describes the positioning error types and its solutions. |
| | Chapter 11 | Internal Memory Address of “Read/Write Variable Data” command | Describes the internal memory address of the positioning module for reading/writing parameters, operation data, and CAM data. |
| | Chapter 12 | Motor Wiring Example | Describes wiring example between XGB PLC and motor driver. |
| 4.Communications | Chapter 1 | Built-in FEnet Communication | Describes Ethernet communications. |
| | Chapter 2 | Built-in Cnet Communication | Describes serial (232/485) communications. |
| 5.Appendix | Appendix 1 | Flag List | Describes the types and contents of various flags. |
| | Appendix 2 | Dimension | Shows dimensions of the main units and expansion modules. |
| | Appendix 3 | Instruction List | Describes the special relay and instruction list. |

## 1.2 Features

The features of XGB system are as follows.

### 1.2.1 Advanced Performances

(1) Rapid Processing Speed

The processing speed has been improved up to more than 75% compared to the existing XBM PLC.

| Items | XBM ‘S' Type | XBM ‘H2/HP’ Type | Remarks |
|---|---|---|---|
| Sequence command | 160 ns | 40 ns | Based on MLOAD command |
| Data command | 3.52 ㎲ | 1.22 ㎲ | Based on MOV command |
| Real | 10.3 ㎲ | 2.0 ㎲ | RADD command |
| | 10.6 ㎲ | 2.0 ㎲ | RMUL command |
| Long Real | 11.8 ㎲ | 3.7 ㎲ | LADD command |
| | 16.9 ㎲ | 3.7 ㎲ | LMUL command |

(2) Program/Data memory expanded

| Items | XBM ‘S' Type | XBM ‘H2/HP’ Type | Remarks |
|---|---|---|---|
| Program capacity | 10KStep | 64KStep | |
| Data Capacity | 5,120 word | 32,768 word | Based on D area |

(3) Advanced functions

-Built -in 10/100 BASE-TX Ethernet (max 16 channel P2P service)

- provides EtherCAT expansion module

(4) Permanent data backup : permanent data backup is available by implementing MRAM.

### 1.2.2 Flexibility of System Configuration

(1) You can build small and medium-sized system that controls up to 256 points I/O through 7-stage expansion.

(2) Compact size

Compared to the existing XGB basic unit, this product has various embedded functions to enhance functionality and has a reduced size so you can install it even in a smaller space. (Unit : ㎜)

| Type | Model | Size (W * H * D) | Remarks |
|---|---|---|---|
| Main unit | XBM-DN32HP / XBM-DN32H2<br>XBM-DP32HP / XBM-DP32H2<br>XBM-DN16H2, XBM-DP16H2, XBM-DR14H2 | 42 * 90 * 64 | |
| Expansion module | XBF-,XBE-,XBL- | 20 * 90 * 60 | Based on minimum size |

(3) Securing compatibility of the existing expansion/special/communication module

All types of the existing XGB expansion/special/communication modules are available.

(4) Expanding the applications through various expansion modules

- It provides 8 points, 16 points, 32 points module I/O expansion module (In the case of relay output, 8/16 points module) with single input, single output, mixed I/O module.
- It supports various special modules such as positioning, high-speed counter, analog I/O, temperature input, temperature control.
- It provides various communication I/F modules such as Cnet, FEnet, Rnet, RAPIEnet, CANOpen, Profibus-DP, DeviceNet.

### 1.2.3 Powerful Embedded Functions

(1) Embedded high-speed counter function

- It has built-in 4-channel high-speed counter features of up to 200kpps (based on 1 phase 1 input 1 multiplication)
- Various additional functions such as comparative readout, comparative task, frequency measurement, revolutions per hour, etc. are provided.
- Parameter setting, various monitoring and diagnosis functions are provided using XG5000.
- You can conduct a trial run through XG5000's monitoring without the program so you can easily check of abnormalities of external wirings and data setting.

(2) Embedded communication function

- It has two embedded Cnet channels and one embedded Ethernet channel.
- It can communicate with other devices very easily without the communication module by using the embedded communication function.
- It enhances convenience by providing various protocols such as dedicated communication, MODBUS, user-customized protocol, etc.
- You can check the communication state very easily thanks to the diagnosis function and Tx/Rx frame monitoring function.

(3) Embedded PID function

- It supports the embedded PID control function up to 16 loops.
- It provides parameter setting using XG5000, loop state monitoring through trend monitor feature.
- You can get the control constant easily by the improved automatic synchronization function.
- You can improve control accuracy by using various additional functions such as PWM output, ∆MV, ∆PV, SV Ramp, etc.
- It provides various control modes such as forward/reverse mixed operation, 2-stage SV PID control, cascade control, etc.
- You can secure stability through various alarm functions such as PV MAX, PV change warning, etc.

(4) Embedded position control function (XBM-H2: 2axis, XBM-HP: 6axis.)

- It has up to 6-axis 200kpps embedded positioning function with open collector output.
- It provides parameter setting using XG-PM which supports operation data edition, diverse monitoring and diagnosis functions.
- You can conduct a trial run through XG-PM monitoring without the program so you can easily check the external wirings and operation data.
- (Relay output module (XBM-DR14H2) does not support embedded positioning function.)

### 1.2.4 Easy maintenance

(1) Program modularization has improved maintenance through the creation of multiple programs and task programs.

(2) Built-in RTC(real time clock) function provides convenient schedule and history management.

(3) Integrated programming environment

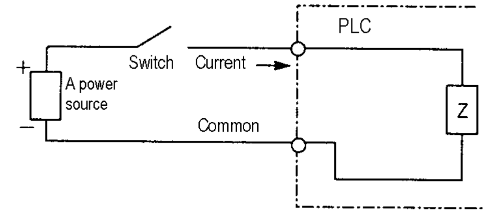
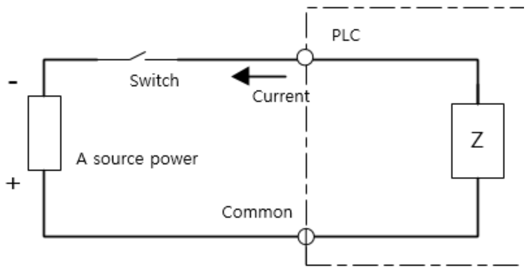
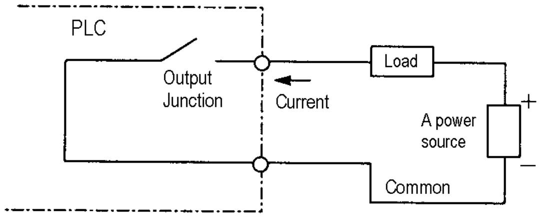
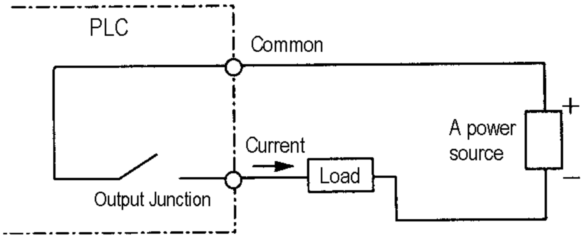
-Separated XG5000(ladder programming, parameter setting, monitoring) and XG-PD(communication and network parameter setting, frame monitoring) have combined in one XG5000. It is possible to control PLC in one program.

## 1.3 Terminology

### 1.3.1 General term

The following table gives definition of terms used in this manual.

| Terms | Definition | Remark |
|---|---|---|
| Module | A standard element that has a specified function which configures the system. Devices such as I/O board, which inserted onto the mother board. | Example)<br>Expansion module,<br>Special module,<br>Communication module |
| Unit | A single module or group of modules that perform an independent operation as a part of PLC systems. | Example)<br>Main unit,<br>Expansion unit |
| PLC System | A system which consists of the PLC and peripheral devices.<br>A user program can control the system. | - |
| XG5000 | A program and debugging tool for the MASTER-K series.<br>It executes program creation, edit, compile and debugging.<br>(PADT: Programming Added Debugging Tool) | - |
| XG-PM | Exclusive tool for modifying position parameter like Built-in position, network type position | |
| I/O image area | Internal memory area of the CPU module which used to hold I/O status. | |
| Cnet | Computer Link Network | - |
| FEnet | Fast Ethernet Network | - |
| RAPIEnet | RAPIEnet Network | - |
| CANopen | Controller Area Network | - |
| Pnet | Profibus-DP Network | - |
| Dnet | DeviceNet Network | - |
| RTC | Abbreviation of ‘Real Time Clock’. It is used to call general IC that contains clock function. | - |
| Watchdog Timer | Supervisors the pre-set execution times of programs and warns if a program is not competed within the pre-set time. | - |

| Terms | Definition | Remark |
|---|---|---|
| Task | It refers to the program start condition. There are 6 types such as initialization, constant cycle, internal contact, external contact, high-speed counter task, and positioning task. | |
| Sink Input | Current flows from the switch to the PLC input terminal if a input signal turns on.<br> | Z: Input impedance |
| Source Input | Current flows from the PLC input terminal to the switch after a input signal turns on.<br> | Z: Input impedance |
| Sink Output | Current flows from the load to the output terminal and the PLC output turn on.<br> | - |
| Source Output | Current flows from the output terminal to the load and the PLC output turn on.<br> | - |

## 1.3.2 Serial communication term

(1) **Communication type**

(a) Simplex

This is the communication type that data is transferred in a constant direction. Information cannot be transferred in the reverse direction.

(b) Half-Duplex

Data is transferred in two ways with one cable if time interval provided, though it can't be transferred simultaneously.

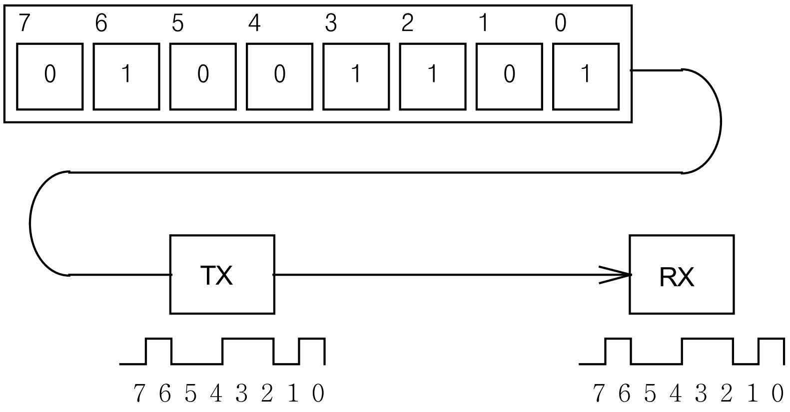
(c) Full-Duplex

Data is simultaneously transferred and received in two ways with two cables.

(2) **Transmission type**

(a) Serial transmission

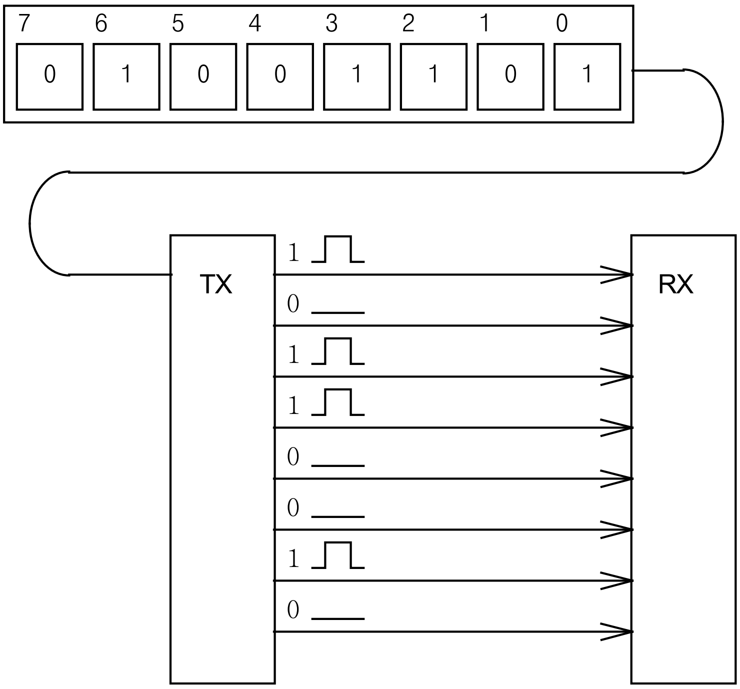
This type transmits bit by bit via 1 cable. The speed of transmission is slow, but the cost of installation is low and the software is simplified.



RS-232C, RS-422 and RS-485 are the examples

(b) Parallel transmission

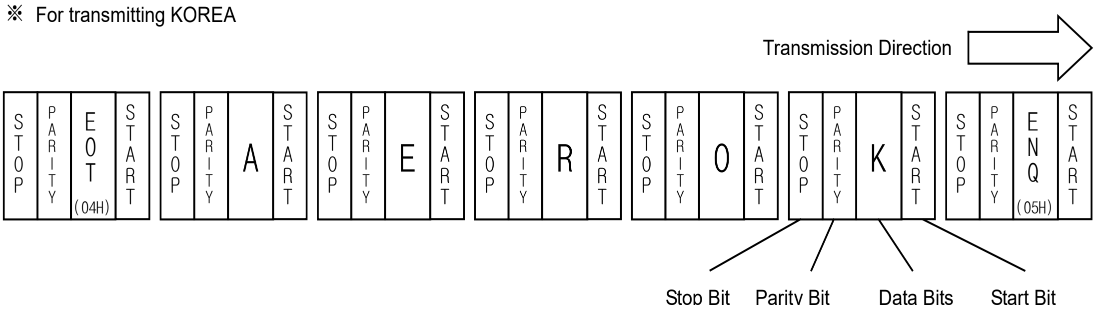
This type is used in printer, etc., which transmits data in unit of 1 byte, so the speed is high and the accuracy of data is reliable. However, the longer the transmission distance is, the higher the cost of installation is geometrically.



(3) Asynchronous Communication

This communication type transmits characters one by one synchronously in serial transmission. At this time, synchronous signal (Clock, etc.) is not transmitted. Character code is transmitted with a start bit attached to the head of 1 character, and it is finished with a stop bit attached to the tail.

※ For transmitting KOREA



(4) Protocol

This is communication rule established in relation between the transmission side and the receiving side of information in order to send and accept information between two computers/terminals or more without error, effectively, and reliably. In general, this specifies call establishment, connection, structure of message exchange form, re-transmission of error message, procedure of line inversion, and character synchronization between terminals, etc.

(5) BPS(Bits Per Second)와 CPS(Characters Per Second)

BPS is a unit of transfer rate that represents how many bits are transferred per second. CPS is the number of the characters transferred for a second. Generally, one character is 1Byte (8Bits), so CPS is the number of bytes which can be transferred per second.

(6) Node

Node is a term that means the connected nodes of the data in the network tree structure, generally network is composed of a great number of nodes, and is also expressed as the station number.

(7) Packet

Packet, a compound term of package and bucket used for packet exchange type to send information as divided in a unit of packet, separates transferred data into the defined length to add a header that presents the correspondent addresses (station No., etc.) thereto.

(8) Port

Port is meant to be the part of the data process device which sends or receives the data from a remote control terminal in data communications, but in Cnet serial communication is meant to be the RS-232C or RS-422 port.

(9) RS-232C

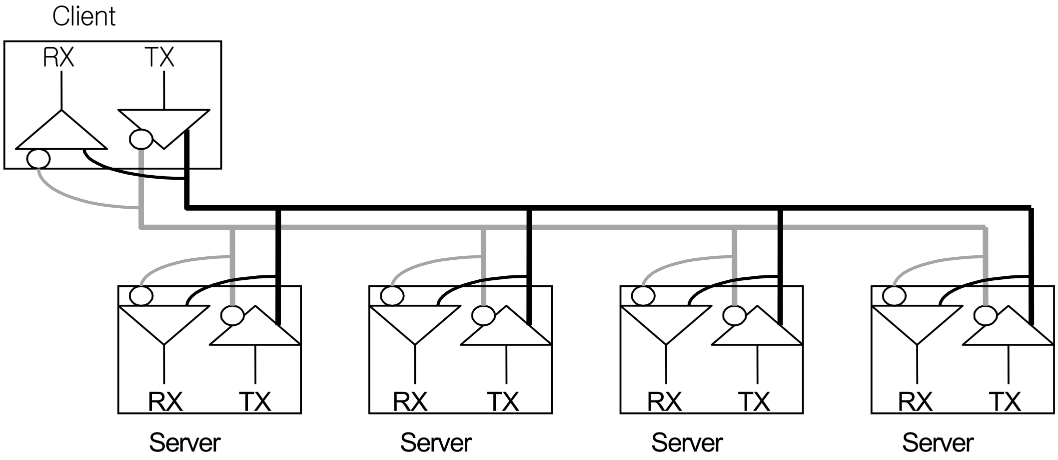
RS-232C is the interface to link a modem with a terminal and to link a modem with a computer, and is also the serial communications specification established by EIA according to the recommendations of the CCITT. This is also used to link the null modem directly as well as the modem linkage. The disadvantage is that the transfer length is short and that only 1 : 1 communication is available, and the specifications which have overcome this disadvantage are RS-422 and RS-485.

(10) RS-422/RS-485

As one of the serial transmission specifications, its transferring length is long with 1 : N connection available compared to RS-232C. The difference of these two specifications is that RS-422 uses 4 signals of TX(+), TX(-), RX(+) and RX(-), while RS-485 has 2 signals of (+) & (-), where data is sent and received through the same signal line. Accordingly, RS-422 executes the full-duplex type of communication and RS-485 executes the half-duplex type of communication.

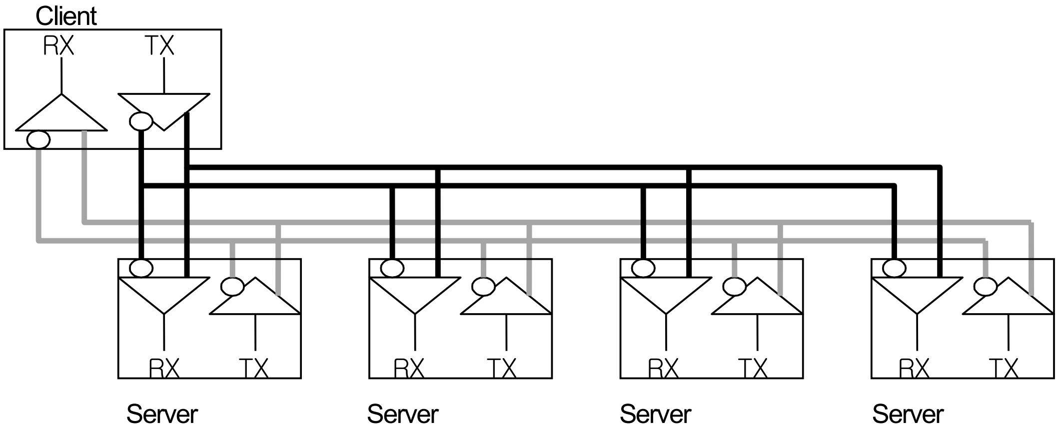
(11) Half Duplex Communication

Two-way communication is available, however simultaneous communication of transmission & receiving isn't available. This communication type is applied to RS-485 for instance. It is used a lot for multi-drop communication type which communicates via one signal line by several stations. Half Duplex Communication results from the transmission characteristic performed by stations one by one not allowing simultaneous transmission by multi stations due to the data damage of data impact caused by the simultaneous multi-transmission of the stations. The figure below shows an example of structure based on Half Duplex Communication. Each station in communication with the terminal as linked with each other can send or receive data via one line so to execute communication with all stations, where multi-server is advantageously available.



(12) Full Duplex Communication

Two way-communications of simultaneous transmission & receiving is available. This communication type is applied to RS-232C & RS-422. Since the transmission line is separated from the receiving line, simultaneous transmission & receiving is available without data impact, so called as Full Duplex Communication. The figure shows an example of structure based on RS-422 of Full Duplex Communication. Since transmission terminal of the client station and receiving terminals of the sever stations are connected to one line, and transmission terminals of the sever stations are linked with receiving terminal of the client station, the communication between sever stations is unavailable with the restricted function of multi-sever.

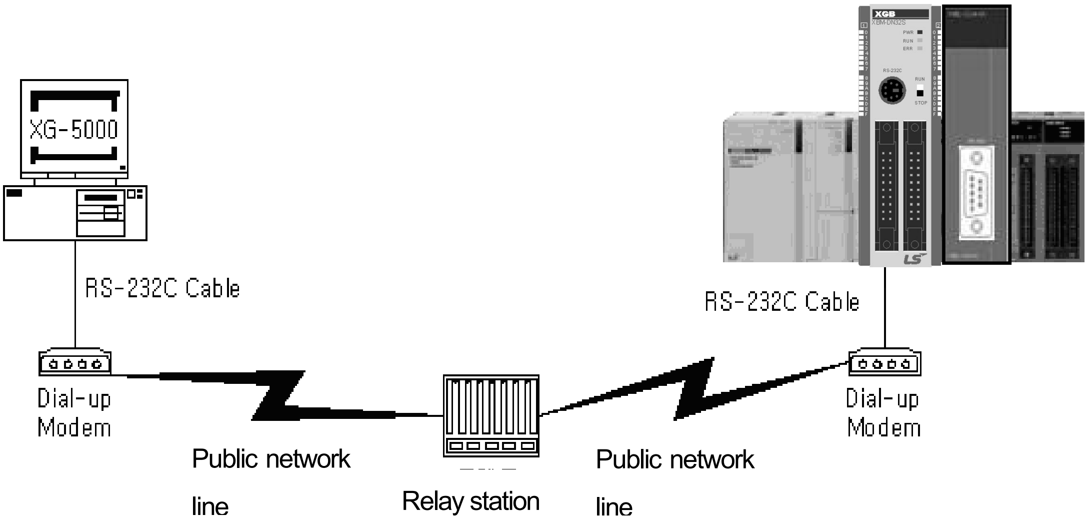


(13) BCC (Block Check Character)

As serial transmission may have signals distorted due to undesirable noise in transmission line, BCC is used as data to help receiving side to check the signals if normal or distorted and to detect errors in signals as compared with the received BCC after calculating BCC by receiving side itself using the data input to the front terminal of BCC.

(14) XG5000 service

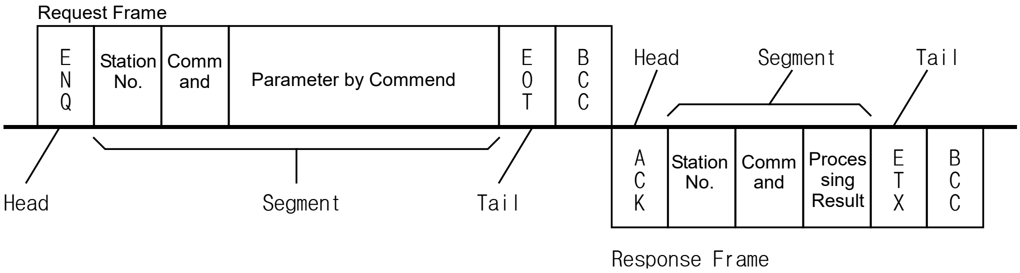
This is the function to remotely perform programming, reading/writing user's program, debugging, and monitoring, etc. without moving the physical connection of XG5000 in the network system where PLC is connected to Cnet I/F module. Especially, it is convenient to control a remote PLC via modem.



* XG5000 : Programming software of XGT PLC for Windows

(15) Frame

Frame is composed of transmitted and received data as in a specified form in data communication including additional information of segments [station No., command, parameter by command], control characters [ENQ, ACK, EOT, ETX] for synchronization, parity for detecting error, and BCC. The structure of frame used for serial communication of Cnet is as follows.



[Structure of general Tx/Rx frame]

- Head: ASCII value indicating frame start.
- Tail: ASCII value indicating frame end.
- BCC (Block Check Character)
  - ◆ Check data for Tx/Rx frame
  - ◆ Used to inspect reliability of data with such various methods as ADD, OR, Exclusive OR, MULTPLY, etc

(16) Reset

This function is used to initialize the communication module with errors.

Use XG-PD to select [On-Line] → [Reset] so to execute Reset, which will restart PLC.

### 1.3.3 Ethernet term

This chapter describes about the general terminology of FEnet I/F module. For more detail, refer to professional book on the Ethernet.

(1) IEEE 802.3

IEEE 802.3 specifies standards for CSMA/CD based Ethernet. Exactly it is a LAN based on CSMA/CD (Carrier Sense Multiple Access with Collision Detection) Ethernet designed by IEEE 802.3 group, which is classified into detailed projects as specified below;

A) IEEE P802.3 - 10G Base T study Group
B) IEEE P802.3ah - Ethernet in the First Mile Task Force
C) IEEE P802.3ak - 10G Base-CX4 Task Force

※ Ethernet and IEEE 802.3 are standardized at RFC894 and RFC1042 so each should process another frame.

(2) ARP (Address Resolution Protocol)

Protocol to search for MAC address by means of correspondent IP address on the Ethernet LAN

(3) Bridge

A device used to connect two networks so to be operated as one network. Bridge is used not only to connect two different types of networks but also to divide one big network into two small networks in order to increase the performance.

(4) Client

A user of the network service, or a computer or program (mainly the one requesting services) using other computer's resource.

(5) CSMA/CD(Carrier Sense Multiple Access with Collision Detection)

Each client checks if there is any sign prior to transmission of data to the network (Carrier Sense) and then sends its data when the network is empty. At this time, all the clients have the equal right to send (Multiple Access). If two or more clients send data, collision may occur. The client who detects the collision tries to send again in a specific time.

(6) DNS (Domain Name System)

A method used to convert alphabetic Domain Name on the Internet to its identical Internet number (namely, IP address)

(7) Dot Address

Shows IP address of '100.100.100.100', where each figure is displayed in decimal with 1 byte occupied respectively for 4 bytes in total.

(8) E-mail Address

The address of the user with login account for the specific machine connected via the Internet. Usually user's ID @ domain name (machine name) is assigned. In other words, it will be like hjjee@microsoft.com, where @ is called as 'at' displayed with shift+2 pressed on the keyboard. The letters at the back of @ are for the domain name of specific company (school, institute,..) connected with the Internet, and the letters in front of @ are for the user ID registered in the machine. The last letters of the domain name are for the highest level. USA generally uses the following abbreviation as specified below, and Korea uses .kr to stand for Korea. .com : usually for companies) / .edu : usually for educational organizations such as universities. / .ac(academy) is mostly used in Korea / .gov : for governmental organizations. For example, nasa.gov is for NASA (government) / .mil : military related sites. For example, af.mil is for USA air force (military)/ .org : private organizations / .au : Australia / .uk : the United Kingdom / .ca : Canada / .kr : Korea / .jp : Japan / .fr : France / .tw : Taiwan, etc.

(9) Ethernet

A representative LAN connection system (IEEE 802.3) developed by Xerox, Intel and DEC of America which can send about 10Mbps and use the packet of 1.5kB. Since Ethernet can allow various types of computers to be connected as one via the network, it has been called a pronoun of LAN as a universal standard with various products available, not limited to some specific companies.

(10) FTP (File Transfer Protocol)

An application program used to transfer files between computers among application programs providing TCP/IP protocol. If an account is allowed to the computer to log in, fast log in the computer is available wherever the computer is so to copy files.

(11) Gateway

Software/Hardware used to translate for two different protocols to work together, which is equivalent to the gateway necessary to exchange information with the different system.

(12) Header

Part of the packet including self station number, correspondent station number and error checking area.

(13) HTML

Hypertext Markup Language, standard language of WWW. In other words, it is a language system to prepare Hypertext documents. The document made of HTML can be viewed through the web browser

(14) HTTP

Hypertext Transfer Protocol, standard protocol of WWW. It is a protocol supporting the hypermedia system.

(15) ICMP (Internet Control Message Protocol)

An extended protocol of IP address used to create error messages and test packets to control the Internet.

(16) IP (Internet Protocol)

Protocol of network layers for the Internet

(17) IP Address

Address of respective computers on the Internet made of figures binary of 32 bits (4 bytes) to distinguish the applicable machine on the Internet. Classified into 2 sections, network distinguishing address and host distinguishing address. The network address and the host address is respectively divided into class A, B and C based on the bits allotted. IP address since it shall be unique all over the world, shall be decided not optionally but as assigned by NIC(Network Information Center) of the applicable district when joining the Internet. In Korea, KRNIC(Korea Network

Information Center) is in charge of this work. Ex.) 165.244.149.190

(18) ISO (International Organization for Standardization)

A subsidiary organization of UN establishing and managing the international standards

(19) LAN (Local Area Network)

Called also as local area communication network or district information communication network, which allows lots of computers to exchange data with each other as connected though communication cable within a limited area such as in an office or a building

(20) MAC (Medium Access Control)

A method used to decide which device should use the network during given time on the broadcast network

(21) Node

Each computer connected with the network is called Node

(22) Packet

A package of data which is the basic unit used to send through the network. Usually the package is made of several tens or hundreds of bytes with the header attached in front to which its destination and other necessary information are added

(23) PORT number

Used to classify the applications on TCP/UDP.
Ex.) 21/tcp : Telet

(24) PPP (Point-to-Point Protocol)

Phone communication protocol which allows packet transmission in connecting with the Internet. In other words, normal phone cable and modem can be used for the computer to connect through TCP/IP with this most general Internet protocol.
Similar to SLIP, however with modern communication protocol factors such as error detection and data compression, it demonstrates more excellent performance than SLIP.

(25) Protocol

Contains regulations related with mutual information transmission method between computers connected with each other through the network. The protocol may specify detailed interface between machines in Low level (for example, which bit/byte should go out through the line) or high level of message exchange regulations as files are transferred through the Internet.

(26) Router

A device used to transfer the data packet between the networks. It sends the data packet to its final destination, waits if the network is congested, or decides which LAN is good to connect to at the LAN junction. Namely, it is a special computer/software used to control the two or more networks connected.

(27) Server

The side which passively responds to the client’s request and shares its resources.

(28) TCP (Transmission Control Protocol)

A transport layer protocol for the Internet
- Data Tx/Rx through connection
- Multiplexing
- Transmission reliable
- Emergent data transmission supported

(29) TCP/IP (Transmission Control Protocol/Internet Protocol)

Transmission protocol used for communication among different kinds of computers, which makes the communication available between general PC and medium host, IBM PC and MAC, and medium or large-sized different types of computers. It is also used as a general term for information transmission protocol between computer networks including FTP, Telnet, SMTP, etc. TCP divides data into packets to send through IP and the packets sent will be united back together through TCP.

(30) Telnet

It means remote login via Internet. To login to remote host via TELNET, account of that host is necessary.
But for some hosts providing public service, you can connect without account

### (31) Token Ring

As short-distance network using Token to connect to network having physical ring structure, one of the Node connection methods at network. If node sending data gets Token, then node gets right to send message packet. Realistically structured examples are IEEE 802.5, ProNet-1080 and FDDI. Terms called Token is used as IEEE 802.5

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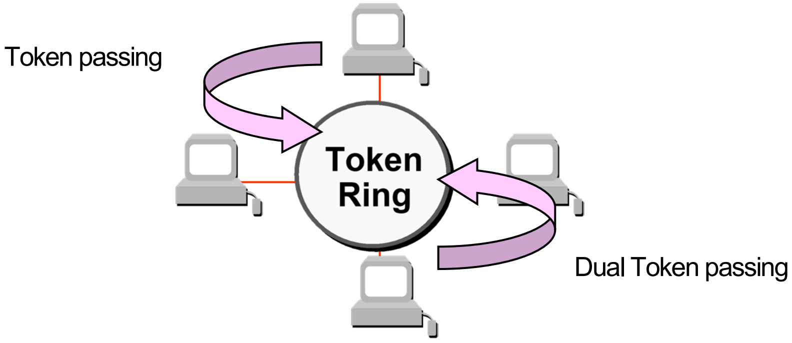


### (32) UDP(User Datagram Protocol)

A transport layer protocol for the Internet
- High speed communication because of communication without connection
- Multiplexing
- Lower reliability than TCP in transmission (Tough data doesn’t arrive, it doesn’t send data again)

### (33) Auto-Negotiation

Fast Ethernet is that Ethernet exchanges information like operation speed, duplex mode.

1. Detect disconnection
2. Decide the specification of network device
3. Change connection speed

### (34) FDDI (Fiber Distributed Data Interface)

Based on optical cable, provides 100Mbps, Shared Media Network as Dual Ring method, Token Passing is done in two-way.
Max 200Km distance for entire network, Max 2Km between Nodes, Max 500 nodes. Generally, this used as Backbone Network.

### (35) Reset

This is function used when you want to initialize the communication module to clear the error
Select [Online] → [Rest] in the XG-PD
If you execute this function, PLC will restart.

# Chapter 2 System Congifuration

You can configure various systems by using the XBM H2/HP Type basic unit and expansion· special communication I/F modules. This chapter describes how to configure the system through the XBM H2/HP Type basic unit.

## 2.1 Table of Products Configuration

The available configurations for the XBM H2/HP Type PLC system are as table below.

| Types | Model | Description | Remark |
|---|---|---|---|
| Main Unit | XBM-DR14H2 | DC24V power supply, DC24V input 8 point, Relay output 6 point<br>Built-in positioning is not supported | OS : V3.0 or above |
| | XBM-DN16H2 | DC24V power supply, DC24V input 8 point, Transistor output 8 point(sink)<br>Built-in positioning of 2-axis | |
| | XBM-DP16H2 | DC24V power supply, DC24V input 8 point, Transistor output 8 point(source)<br>Built-in positioning of 2-axis | |
| | XBM-DN32H2 | DC24V power supply, DC24V input 16 point, Transistor output 16 point(sink)<br>Built-in positioning of 2-axis | H/W : V2.0<br>O/S : V2.0 or above |
| | XBM-DN32HP | DC24V power supply, DC24V input 16 point, Transistor output 16 point(sink)<br>Built-in positioning of 6-axis | |
| | XBM-DP32H2 | DC24V power supply, DC24V input 16 point, Transistor output 16 point(source)<br>Built-in positioning of 2-axis | |
| | XBM-DP32HP | DC24V power supply, DC24V input 16 point, Transistor output 16 point(source)<br>Built-in positioning of 6-axis | |
| Expansion Unit | XBE-DC08A | DC24V Input 8 point | Input |
| | XBE-DC16A | DC24V Input 16 point | |
| | XBE-DC16B | DC12V/24V Input 16 point | |
| | XBE-DC32A | DC24V Input 32 point | |
| | XBE-AC08A | AC110V Input 8 point | |
| | XBE-RY08A | Relay output 8 point | Output |
| | XBE-RY08B | Relay output 8 point (isolated ouput common) | |
| | XBE-RY16A | Relay output 16 point | |
| | XBE-TN08A | Transistor output 8 point (sink type) | |
| | XBE-TN16A | Transistor output 16 point (sink type) | |
| | XBE-TN32A | Transistor output 32 point (sink type) | |
| | XBE-TP08A | Transistor output 8 point (source type) | |
| | XBE-TP16A | Transistor output 16 point (source type) | |
| | XBE-TP32A | Transistor output 32 point (source type) | |
| | XBE-DR16A | DC24V Input 8 point, Relay output 8 point | In/Output |
| | XBE-DN32A | DC24V Input 8 point, Transistor output 16 point (sink type) | |

| Types | Model | Description | Remark |
|---|---|---|---|
| Special Module | XBF-AD04A | Current/Voltage input 4 channel, 1/4000 resolution | Analog In/Out |
| | XBF-AD04C | Current/Voltage input 4 channel, 1/16000 resolution | |
| | XBF-AD08A | Current/Voltage input 8 channel, 1/4000 resolution | |
| | XBF-DC04A | Current output 4 channell, 1/4000 resolution | |
| | XBF-DC04C | Current output 4 channel, High resolutionl, 1/16000 resolution | |
| | XBF-DV04A | Voltage output 4 channell, 1/4000 resolution | |
| | XBF-DV04C | Voltage output 4 channel, 1/16000 resolution | |
| | XBF-AH04A | Current/Voltage input 2 channel, Current/Voltage output 2 channel, 1/4000 resolution | |
| | XBF-RD04A | RTD (Resistance Temperature Detector) input 4 channel, Pt100, Jpt100 | Temperature |
| | XBF-RD01A | RTD (Resistance Temperature Detector) input 1 channel, Pt100, Jpt100 | |
| | XBF-TC04S | TC (Thermocouple) input 4 channel | |
| | XBF-PD02A | Position 2Axis, Line Drive type, Max 2Mpps | Positioning |
| | XBF-HD02A | High Speed Counter 2 channel, Line Drive Type | Counter |
| | XBF-HO02A | High Speed Counter 2 channel, Open Collector Type | |
| | XBF-TC04RT | Temperature controller module (RTD input, 4 roof) | Temperature |
| | XBF-TC04TT | Temperature controller module (TC input, 4 roof) | |
| | XBF-PN04B | Network position (Open type EtherCAT) 4 Axis | Positioning |
| | XBF-PN08B | Network position (Open type EtherCAT) 8 Axis | |
| | XBF-LD02S | Loadcell input, insulation type | Loadcell |
| Communication Module | XBL-C21A | Cnet (RS-232C/Modem) I/F | - |
| | XBL-C41A | Cnet (RS-422/485) I/F | - |
| | XBL-EMTA | Ethernet I/F | - |
| | XBL-EIMT/F/H | RAPIEnet I/F (UTP/Optic Fiber/Hybrid) | - |
| | XBL-EIPT | EtherNet I/P Module | - |
| | XBL-CMEA | CANopen Master I/F | - |
| | XBL-CSEA | CANopen Slave I/F | - |
| | XBL-PMEC | Profibus-DP, Master | - |
| | XBL-PSEA | Profibus-DP, Slave | |
| | XBL-DSEA | DeviceNet, Slave | |
| | XBL-RMEA | Rnet, Master I/F | |
| | USB-301A | Connection cable (PC to PLC), USB | |

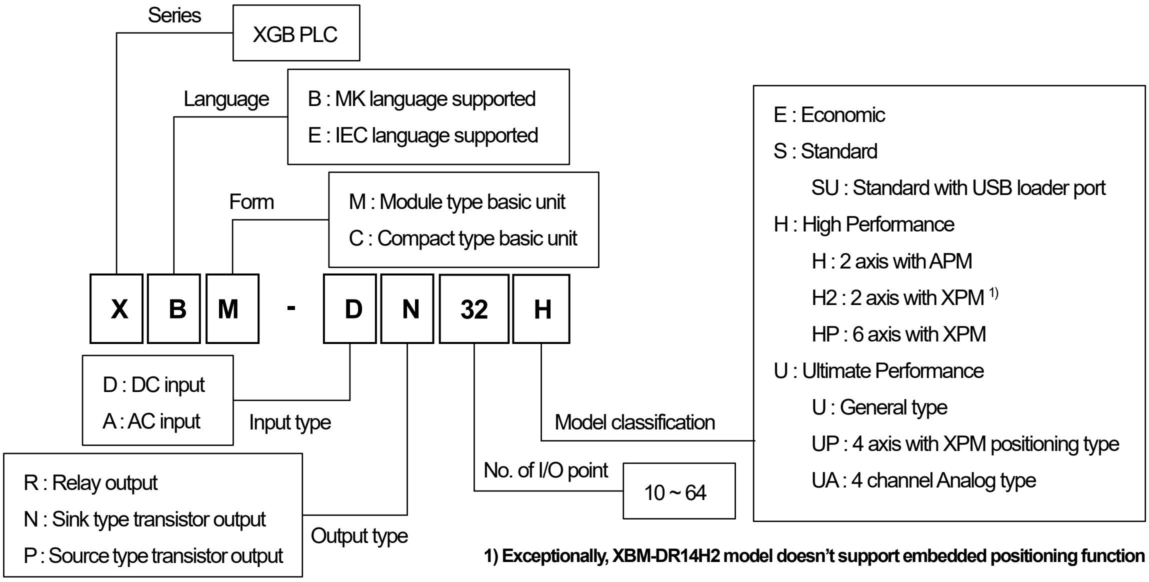
**Notice**

LS ELECTRIC CO., LTD. has consistently developed and launched new products.
For new products that are not included to this manual, please contact a nearby exclusive agency.

## 2.2 Classification and Type of Product Name

### 2.2.1 Classification and type of basic unit

Name of basic unit is classified as follows.



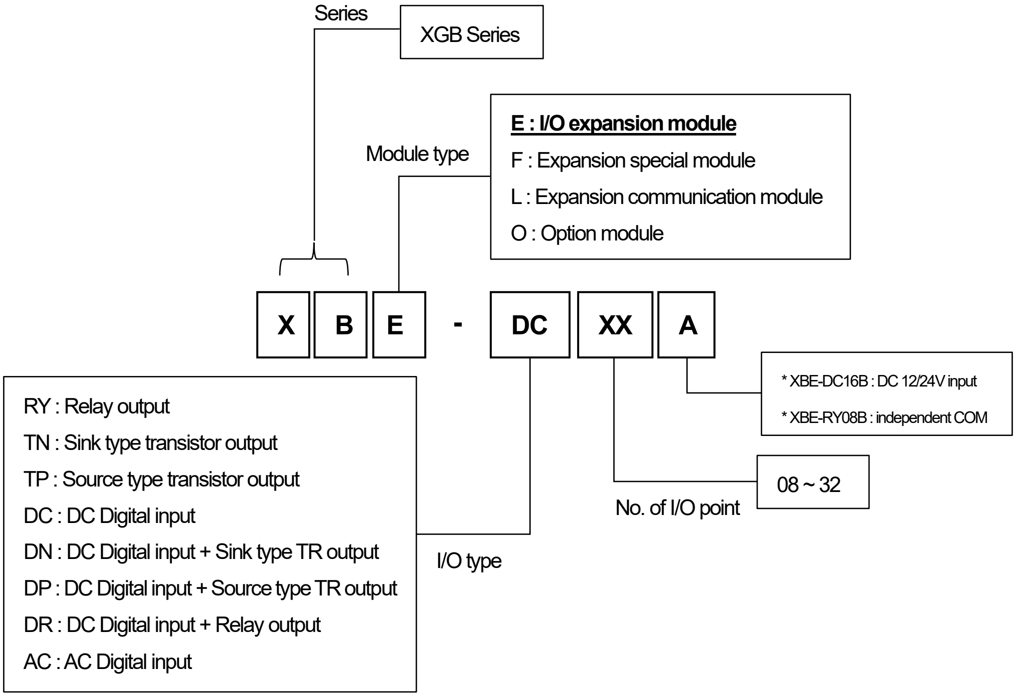
**1) Exceptionally, XBM-DR14H2 model doesn't support embedded positioning function**

| Classification | Name | DC input | Relay output | Transistor output | Embedded High-speed counter | Embedded Positioning function | Power |
|---|---|---|---|---|---|---|---|
| Module type Main unit - Standard | XBM-DR16S | 8 point | 8 point | None | 4 point | Not supported | DC24V |
| | XBM-DN16S | 8point | None | 8point | 4 point | 2-axis(APM) | |
| | XBM-DN32S | 16 point | None | 16 point | 4 point | 2-axis(APM) | |
| Module type Main unit - High performance | XBM-DR14H2 | 8 point | 6 point | None | 4 point | Not supported | |
| | XBM-DN16H2 | 8 point | None | 8 Point | 4 point | 2-axis(XPM) | |
| | XBM-DP16H2 | 8 point | None | 8 Point | 4 point | 2-axis(XPM) | |
| | XBM-DN32H | 16 point | None | 16 point | 4 point | 2-axis(APM) | |
| | XBM-DN32H2 | 16 point | None | 16 point | 4 point | 2-axis(XPM) | |
| | XBM-DN32HP | 16 point | None | 16 point | 4 point | 6-axis(XPM) | |
| | XBM-DP32H2 | 16 point | None | 16 point | 4 point | 2-axis(XPM) | |
| | XBM-DP32HP | 16 point | None | 16 point | 4 point | 6-axis(XPM) | |
| Compact type Main unit - Economic | XBC-DR10E | 6 point | 4 point | None | 4 point | Not supported | AC100 ~240V |
| | XBC-DR14E | 8 point | 6 point | None | 4 point | Not supported | |
| | XBC-DR20E | 12 point | 8 point | None | 4 point | Not supported | |
| | XBC-DR30E | 18 point | 12 point | None | 4 point | Not supported | |
| | XBC-DN10E | 6 point | None | 4 point | 4 point | Not supported | |
| | XBC-DN14E | 8 point | None | 6 point | 4 point | Not supported | |
| | XBC-DN20E | 12 point | None | 8 point | 4 point | Not supported | |
| | XBC-DN30E | 18 point | None | 12 point | 4 point | Not supported | |
| | XBC-DP10E | 6 point | None | 4 point | 4 point | Not supported | |
| | XBC-DP14E | 8 point | None | 6 point | 4 point | Not supported | |
| | XBC-DP20E | 12 point | None | 8 point | 4 point | Not supported | |
| | XBC-DP30E | 18 point | None | 12 point | 4 point | Not supported | |

| Classification | Name | DC input | Relay output | Transistor output | Embedded High-speed counter | Embedded Positioning function | Power |
|---|---|---|---|---|---|---|---|
| Compact type Main unit - Standard | XBC-DN20S(U) | 12 point | None | 8 point | 8 point | 2-axis(APM) | AC100 ~240V |
| | XBC-DN30S(U) | 18 point | None | 12 point | 8 point | 2-axis(APM) | |
| | XBC-DN40SU | 24 point | None | 16 point | 8 point | 2-axis(APM) | |
| | XBC-DN60SU | 36 point | None | 24 point | 8 point | 2-axis(APM) | |
| | XBC-DR20SU | 12 point | 8 point | None | 8 point | Not supported | |
| | XBC-DR30SU | 18 point | 12 point | None | 8 point | Not supported | |
| | XBC-DR40SU | 24 point | 16 point | None | 8 point | Not supported | |
| | XBC-DR60SU | 36 point | 24 point | None | 8 point | Not supported | |
| | XBC-DP20SU | 12 point | None | 8 point | 8 point | 2-axis(APM) | |
| | XBC-DP30SU | 18 point | None | 12 point | 8 point | 2-axis(APM) | |
| | XBC-DP40SU | 24 point | None | 16 point | 8 point | 2-axis(APM) | |
| | XBC-DP60SU | 36 point | None | 24 point | 8 point | 2-axis(APM) | |
| Compact type Main unit - High Performance | XBC-DR32H | 16 point | 16 point | None | 8 point | Not supported | AC100 ~240V |
| | XBC-DN32H | 16 point | None | 16 point | 8 point | 2-axis(APM) | |
| | XBC-DR64H | 32 point | 32 point | None | 8 point | Not supported | |
| | XBC-DN64H | 32 point | None | 32 point | 8 point | 2-axis(APM) | |
| | XBC-DR32H/DC | 16 point | 16 point | None | 8 point | Not supported | DC24V |
| | XBC-DN32H/DC | 16 point | None | 16 point | 8 point | 2-axis(APM) | |
| | XBC-DR64H/DC | 32 point | 32 point | None | 8 point | Not supported | |
| | XBC-DN64H/DC | 32 point | None | 32 point | 8 point | 2-axis(APM) | |
| Compact type Main unit - Ultimate | XBC-DN32U | 16 point | None | 16 point | 8 point | Not supported | AC100 ~240V |
| | XBC-DP32U | 16 point | None | 16 point | 8 point | Not supported | |
| | XBC-DR28U | 16 point | 12 point | None | 8 point | Not supported | |
| | XBC-DN32UP | 16 point | None | 16 point | 8 point | 4-axis(XPM) | |
| | XBC-DP32UP | 16 point | None | 16 point | 8 point | 4-axis(XPM) | |
| | XBC-DR28UP | 16 point | 12 point | None | 8 point | 4-axis(XPM) | |
| | XBC-DN32UA | 16 point | None | 16 point | 8 point | Not supported | |
| | XBC-DP32UA | 16 point | None | 16 point | 8 point | Not supported | |
| | XBC-DR28UA | 16 point | 12 point | None | 8 point | Not supported | |
| | XBC-DN32U/DC | 16 point | None | 16 point | 8 point | Not supported | DC24V |
| | XBC-DP32U/DC | 16 point | None | 16 point | 8 point | Not supported | |
| | XBC-DR28U/DC | 16 point | 12 point | None | 8 point | Not supported | |
| | XBC-DN32UP/DC | 16 point | None | 16 point | 8 point | 4-axis(XPM) | |
| | XBC-DP32UP/DC | 16 point | None | 16 point | 8 point | 4-axis(XPM) | |
| | XBC-DR28UP/DC | 16 point | 12 point | None | 8 point | 4-axis(XPM) | |
| | XBC-DN32UA/DC | 16 point | None | 16 point | 8 point | Not supported | |
| | XBC-DP32UA/DC | 16 point | None | 16 point | 8 point | Not supported | |
| | XBC-DR28UA/DC | 16 point | 12 point | None | 8 point | Not supported | |

## 2.2.2 Classification and type of expansion module

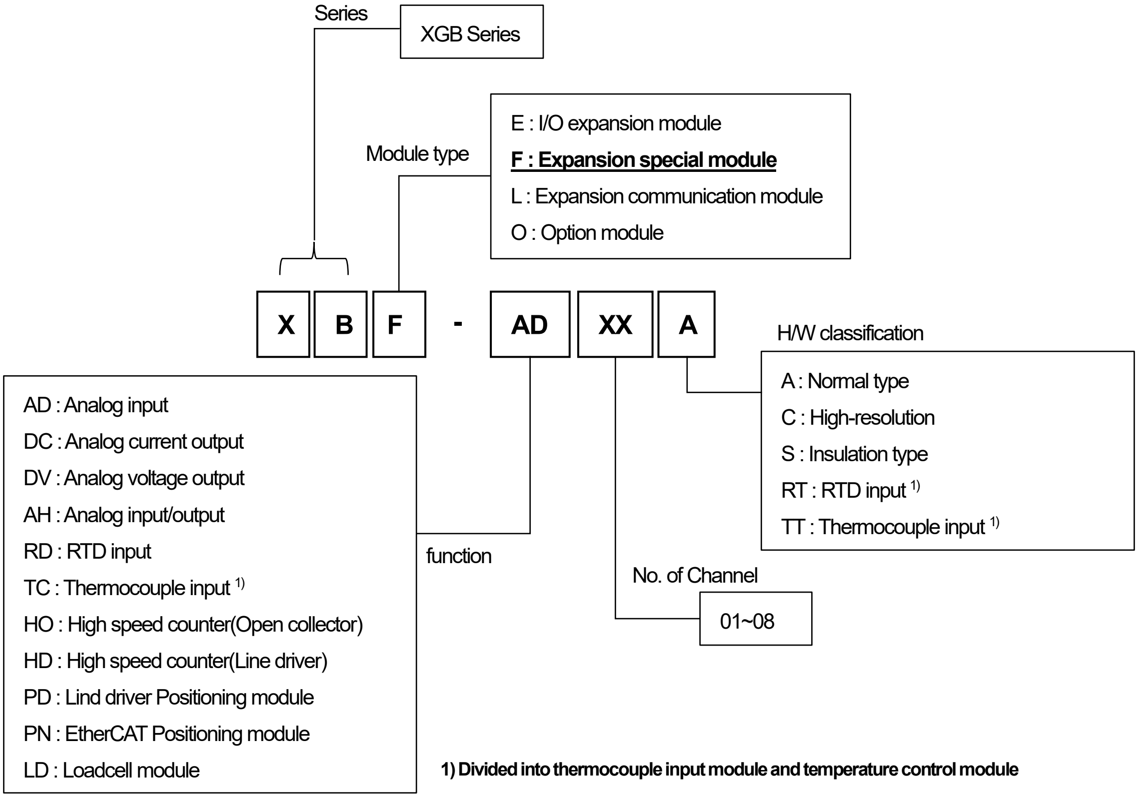
Name of expansion module is classified as follows.



| Name | DC input | AC input | Relay output | Transistor output | Reference |
|---|---|---|---|---|---|
| XBE-DC08A | 8 point | None | None | None | DC24V input (Sink/Source) |
| XBE-DC16A | 16 point | None | None | None | DC24V input (Sink/Source) |
| XBE-DC16B | 16 point | None | None | None | DC12/24V input (Sink/Source) |
| XBE-DC32A | 32 point | None | None | None | DC24V input (Sink/Source) |
| XBE-AC08A | None | 8 point | None | None | AC110V input |
| XBE-RY08A | None | None | 8 point | None | Relay output |
| XBE-RY08B | None | None | 8 point | None | Relay output (independent common) |
| XBE-RY16A | None | None | 16 point | None | Relay output |
| XBE-TN08A | None | None | None | 8 point | Sink type output |
| XBE-TN16A | None | None | None | 16 point | |
| XBE-TN32A | None | None | None | 32 point | |
| XBE-TP08A | None | None | None | 8 point | Source type output |
| XBE-TP16A | None | None | None | 16 point | |
| XBE-TP32A | None | None | None | 32 point | |
| XBE-DR16A | 8 point | None | 8 point | None | DC24V input (Sink/Source)<br>Relay output |
| XBE-DN32A | 16 point | None | None | 16 point | DC24V input (Sink/Source)<br>Sink type output |

### 2.2.3 Classification and type of special module

Special module is classified as follows.

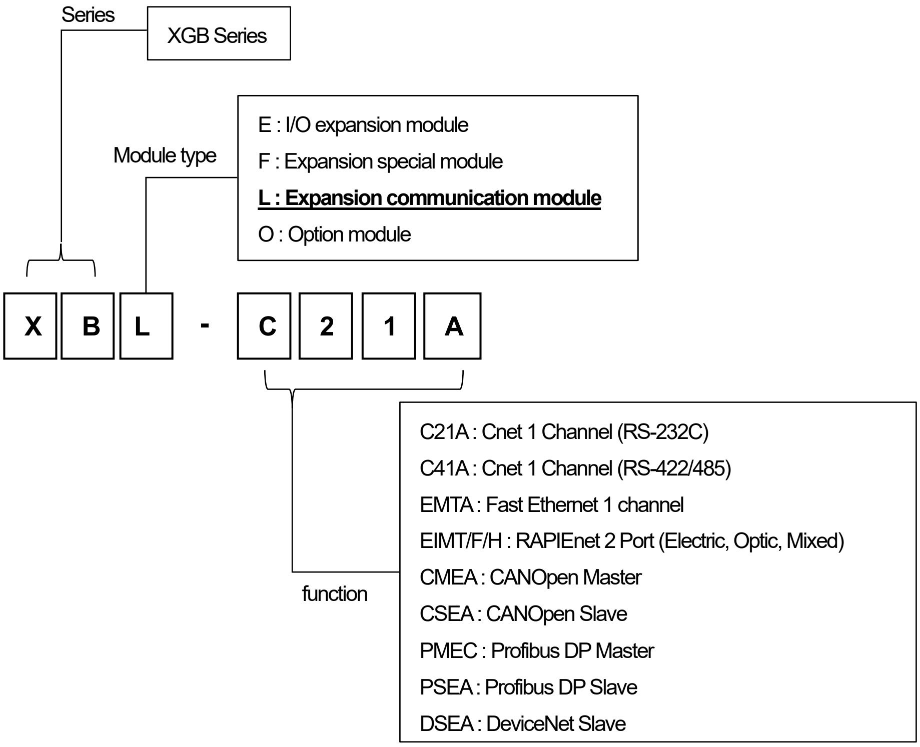


**1) Divided into thermocouple input module and temperature control module**

| Classification | Name | No. of input ch. | Input type | No. of output ch. | Output type |
|---|---|---|---|---|---|
| Analog input | XBF-AD04A/C | 4 | Voltage/Current | None | - |
| | XBF-AD08A | 8 | Voltage/Current | None | |
| Analog output | XBF-DC04A/C | None | - | 4 | Current |
| | XBF-DV04A/C | None | - | 4 | Voltage |
| Analog In/Output | XBF-AH04A | 2 | Voltage/Current | 2 | Voltage/Current |
| RTD input | XBF-RD04A | 4 | PT100/JPT100 | None | - |
| | XBF-RD01A | 1 | PT100/JPT100 | None | - |
| TC input | XBF-TC04S | 4 | K, J, T, R | None | - |
| | XBF-TC04RT | 4 | PT100/JPT100 | 4 | Transistor |
| | XBF-TC04TT | 4 | K, J, T, R | 4 | Transistor |
| Positioning | XBF-PD02A | - | Line Driver | 2 | Transistor |
| | XBF-PN04B | - | Line Driver | 4 | EtherCAT |
| | XBF-PN08B | - | Line Driver | 8 | EtherCAT |
| High Speed Counter | XBF-HD02A | 2 | Line Driver | - | Voltage |
| | XBF-HO02A | 2 | Open Collector | - | Voltage |
| Loadcell | XBF-LD02A | 2 | Voltage | - | |

## 2.2.4 Classification and type of communication module

Name of communication module is classified as follows.

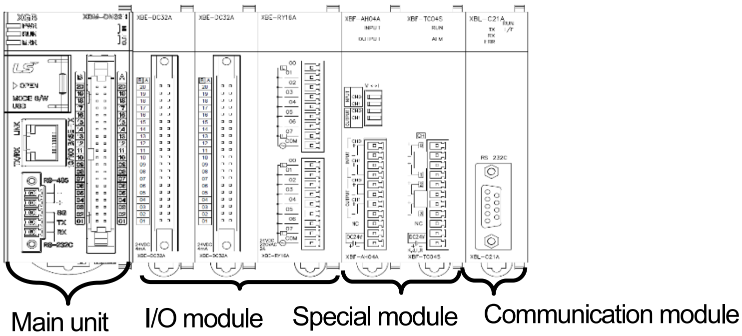


| Classification | Name | Type |
|---|---|---|
| Cnet Comm. Module | XBL-C21A | RS-232C, 1 channel |
| | XBL-C41A | RS-422/485, 1 channel |
| FEnet Comm. Module | XBL-EMTA | Electricity, open type Ethernet |
| Rnet Comm. Module | XBL-RMEA | RemoteNet Master |
| RAPIEnet Comm. Module | XBL-EIMT/EIMF/EIMH | Comm. Module between PLCs, electric, optic, and mixed(electric& optic)<br>100 Mbps industrial Ethernet supported |
| EtherNet Comm. Module | XBL-EIPT | Open EtherNet I/P |
| CANopen Comm. Module | XBL-CMEA | CANopen Master |
| | XBL-CSEA | CANopen Slave |
| Pnet Comm. Module | XBL-PMEC | Profibus-DP Master |
| | XBL-PSEA | Profibus-DP Slave |
| DeviceNet Comm. Module | XBL-DSEA | DeviceNet Slave |

# 2.3 XBM H2/HP Type's System Configuration

## 2.3.1 How to configure the System

You can configure the system by using the XBM H2/HP Type PLC as below.
You can connect the expansion modules up to 7EA.



| Items | | | Description |
|---|---|---|---|
| Number of I/O configuration points | | | • XBM-DR14H2 : 14 ~ 238 points<br>• XBM-DN16H2 : 16 ~ 240 points<br>• XBM-DP16H2 : 16 ~ 240 points<br>• XBM-DN32H : 32 points~256 points<br>• XBM-DN32H2 : 32 points~256 points<br>• XBM-DP32H2 : 32 points~256 points<br>• XBM-DN32HP : 32 points~256 points<br>• XBM-DP32HP : 32 points~256 points |
| Number of accessible expansion modules | | Digital I/O module | • Up to 7 EA |
| | | Special module | • Up to 7 EA |
| | | Communication module | • Up to 2 EA |
| | | High speed expansion module | • Up to 2 EA (Can be expanded for 2 slots just behind the basic unit) |
| | | Option module | • Cannot be installed. |
| Configuration of products | Main Unit | XBM series | • XBM-DN16S<br>• XBM-DR16S<br>• XBM-DN32S<br>• XBM-DN32H<br>• XBM-DN32H2<br>• XBM-DN32HP<br>• XBM-DP32H2<br>• XBM-DP32HP<br>• XBM-DR14H2<br>• XBM-DN16H2<br>• XBM-DP16H2 |
| | Expansion module | Digital I/O module | •XBE-DC08/16/32A<br>•XBE-TN08/16/32A<br>•XBE-RY08/16A<br>•XBE-DC16B<br>• XBE-TP08/16/32A<br>•XBE-RY08B<br>• XBE-DR16A<br>• XBE-DN32A |
| | | Special module | • XBF-AD04A<br>• XBF-DC04A<br>• XBF-HO02A<br>• XBF-AD04C<br>• XBF-DC04C<br>• XBF-HD02A<br>• XBF-AD08A<br>• XBF-DV04A<br>• XBF-TC04RT<br>• XBF-AH04A<br>• XBF-DV04C<br>• XBF-TC04TT<br>• XBF-RD04A<br>• XBF-TC04S<br>• XBF-LD02S<br>• XBF-RD01A<br>• XBF-PD02A |
| | | Communication module | • XBL-C41A<br>• XBL-C21A<br>• XBL-PSEA<br>• XBL-EMTA<br>• XBL-EIMT/F/H<br>• XBL-CMEA/CSEA<br>• XBL-PMEC<br>• XBL-EIPT<br>• XBL-DSEA<br>• XBL-RMEA |
| | | High speed I/F module | • XBF-PN04B<br>• XBF-PN08B |

### 2.3.2 Instructions for System Configuration

(1) High speed expansion module

XBM H2/HP type PLC supports high-speed expansion I/F to speed up expansion module processing.

This section explains the precautions when configuring the system using the high-speed expansion module and the general expansion module.

- There are two types of high-speed expansion modules using high-speed expansion I/F: XBF-PN04B and XBF-PN08B.
- XBM H2/HP type can use both general and high-speed expansion modules.
- The high-speed expansion module can be installed only in the 2nd or 3rd slot.
- If the high-speed expansion module is installed in the 3rd slot, the high-speed expansion module must be present in the 2nd slot as well.
- High-speed expansion module cannot be installed behind general expansion module. Therefore, the high-speed expansion module and the general expansion module in case of mixed use, the general expansion module must be installed behind the high-speed expansion module.
- Expansion communication module can be installed up to 2 units as before.
- The table below shows an example of system configuration when using a high-speed expansion module and a general expansion module.

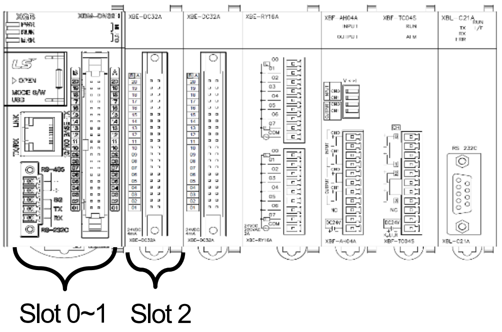
(◇ : General expansion module (Special, I/O)., ◎ : General expansion module (Communication), ◈ : High speed expansion modules)

| Basic Unit | Slot Number | | | | | Definitions of Operations | Remarks |
|---|---|---|---|---|---|---|---|
| | No.1 | No.2 | No.3 | No.4 | No.6~8 | | |
| XBM-H2/HP Type | ◈ | ◈ | ◎ OR ◇ | | | Slot 2, 3: high-speed expansion module, slot 3~8: general expansion module | 2 communication modules work |
| | ◈ | ◎ OR ◇ | | | | Slot 2, 3: high-speed expansion module, slot 3~8: general expansion module | 2 communication modules work |
| | ◇ | ◈ | ◎ | ◇ | ◇ | Not configurable<br>(Cannot use high-speed expansion module after general expansion module) | |
| | ◈ | ◈ | ◈ | ◇ | ◇ | Not configurable<br>(exceeds the allowable number of high-speed expansion modules) | |
| | ◎ | ◎ | ◎ | ◇ | ◇ | Not configurable (exceeds the allowable number of communication modules) | |
| | ◇ | ◇ | ◎ | ◎ | ◇ | Consists of only general expansion modules | 2 communication modules work |
| Existing XGB | ◎ | ◎ | ◇ | ◇ | ◇ | Consists of only general expansion modules | 2 communication modules work |
| | ◎ | ◎ | ◎ | ◇ | ◇ | Not configurable (exceeds the allowable number of communication modules) | |
| | ◈ | ◎ | ◎ | ◇ | ◇ | Not configurable (high-speed expansion module is not supported) | |

(2) How to allocate slots for expansion modules

-In the case of the XBM H2/HP, built-in Ethernet occupies No.1 slot. Accordingly, No.2 slot is allocated for the first expansion module.

-In the case of the XBM H2/HP type, empty slot is allocated for No.1.

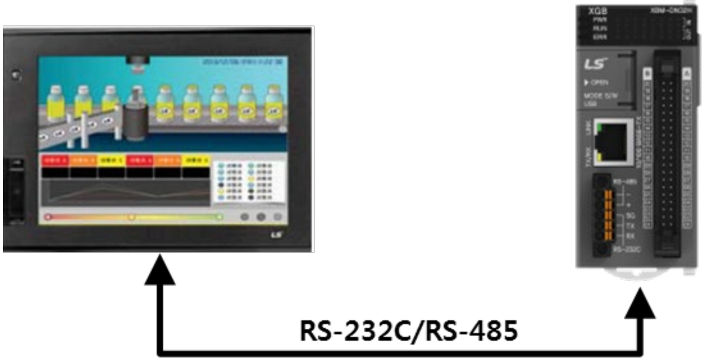


## 2.3.3 Embedded Communication System Configuration

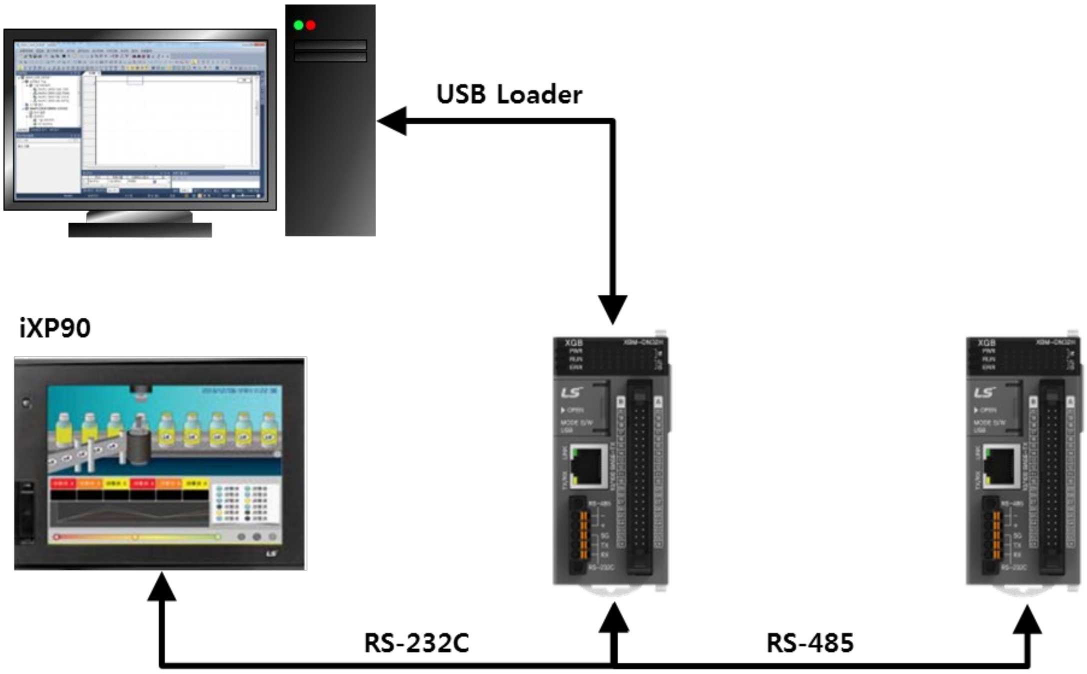
### 2.3.3.1 Embedded Cnet I/F System Configuration

The Cnet I/F system is the system to transmit·receive external devices including PC and data through RS-232C/RS-422 I/F. In the case of Built-in Cnet, RS-232C and RS-485 communication I/F are respectively embedded. Moreover, you can additionally install the Cnet I/F module (XBL-C21A) for RS-232C only that is the expansion module and Cnet I/F module (XBL-C41A) for 485 only so it is possible to build up various communication systems for the purposes. Some examples of communication systems are represented here, which can be configured by the Cnet I/F embedded in XGB basic unit.

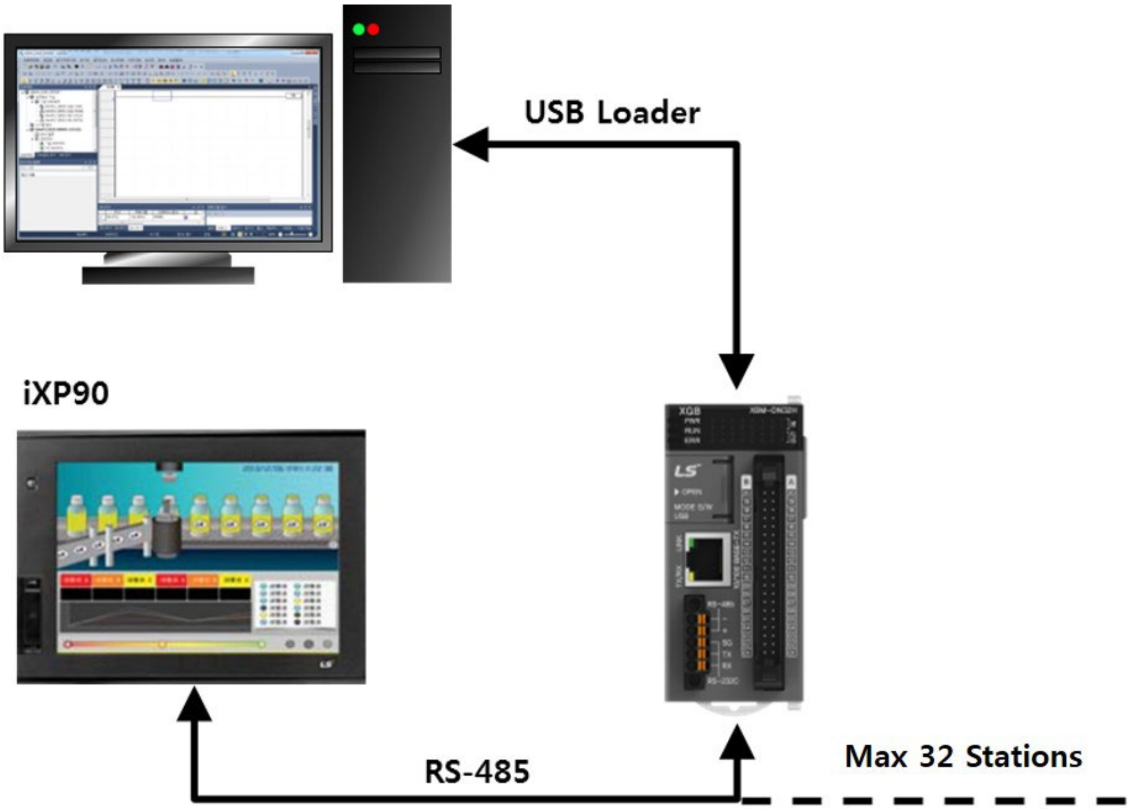
(1) 1:1 connection with the HMI by using the basic unit's embedded RS-232C or RS-485 port



(2) Communication with the other PLC through the basic unit's embedded RS-485 port/ 1:1 connection with the HMI through the embedded RS-232C port



(3) Configuring 1:N communication system with the maximum 32 stations by using the basic unit's embedded RS-485port



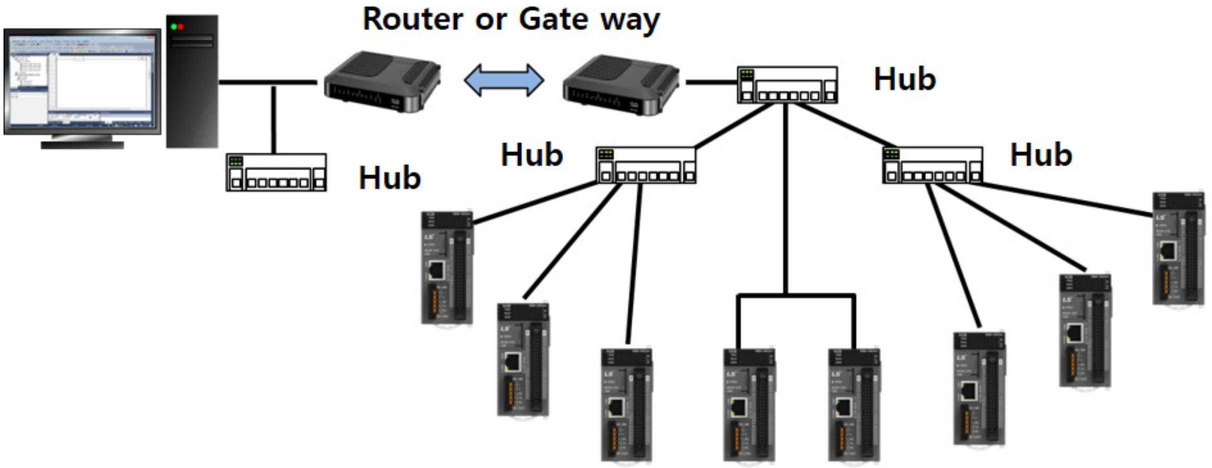
**Notice**

For detailed specificaitons of the embedded Cnet communication, refer to Part4 Communication in this manual.
For detailed specificaitons of the expansion Cnet communication module, refer to “XGB Cnet I/F” manual.

### 2.3.3.2 Embedded Ethernet I/F System Configuration

The Ethernet is the typical LAN interface (IEEE802.3) developed commonly by Xerox, Intel, DEC of U.S.A. It is the network connection system with the transfer capacity of 100Mbps and packets of 1.5kB. The Ethernet can integrate different types of computers through network so it is regarded as the representative LAN interface. It is not the standard for a specific company but the common standard so you can find various products. In addition, it can control communication through CSMA/CD and builds up the network easily, furthermore, can collect high-capacity data.

(1) Ethernet system's block diagram

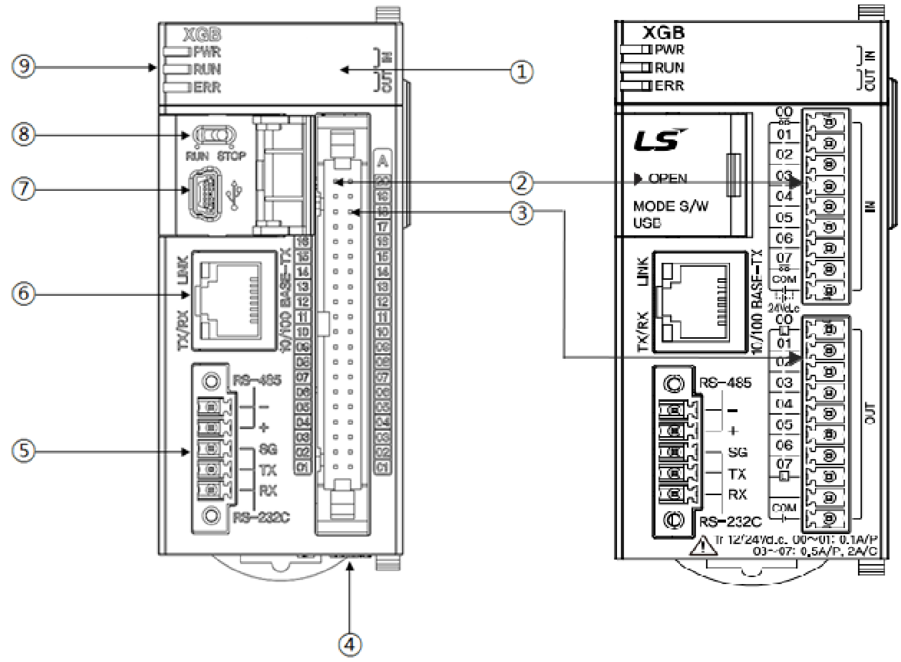


**Notice**

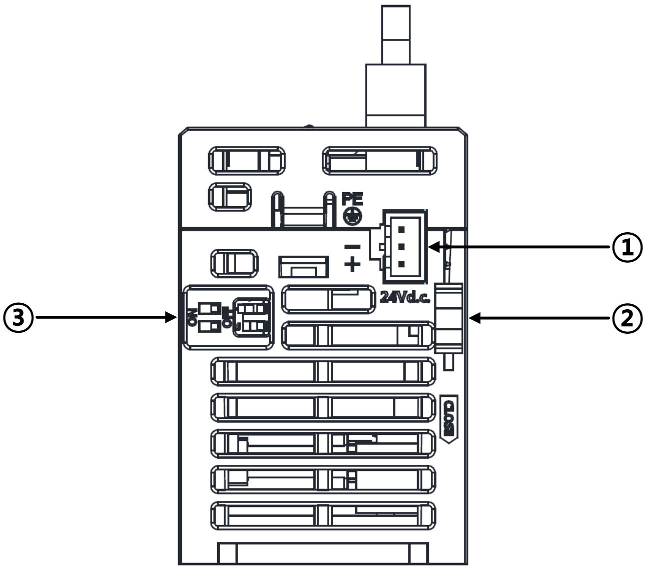
For more details on how to the above LS ELECTRIC's network system configuration and Enet system configuration, refer to Chap.5 Embedded Communication and "XGB FEnet I/F " of this manual.

# Chapter 3 Specifications

## 3.1 Names and Functions of Each Part



| No | Names | | Purposes |
|---|---|---|---|
| ① | LED for displaying input, output | | ■ Displays the On/Off status of input, output contacts |
| ② | I/O Connector | Input points | ■ Terminal block receiving the actual input signal |
| ③ | | Output points | ■ Terminal block outputting the actual output signal |
| ④ | Built-in serial communication connecting connector | | ■ Built-in RS-232C/485 connecting connector |
| ⑤ | Built-in ethernet connecting connector | | ■ Built-in Enet connecting connector |
| ⑥ | PADT connecting connector | | ■ PADT connecting connector |
| ⑦ | RUN/STOP mode switch | | ■ Sets the basic unit's operation mode.<br>• STOP → RUN : Program's operation is executed.<br>• RUN → STOP : Program's operation is stopped.<br>(In case of STOP, the remote operation is available.) |
| ⑧ | Status display LED | | ■ Displays the basic unit's operation status.<br>• PWR(Red light On) : The power is supplied.<br>• RUN(Green light On) : During RUN mode<br>• ERR(Flickering red light) : Occurrence of errors during operation |



| No | Names | Purposes |
|---|---|---|
| ① | Power terminal | ■ Power supply terminal (DC24V) |
| ② | Expansion module hook | ■ Fix hook when installing extension module |
| ③ | Terminating resistance selector switch | ■ Terminating resistance selector switch for built-in RS-485<br>• Switch both On : Using Terminating resistance<br>• Switch both Off : Not using Terminating resistance |

## 3.2 General specifications

<table>
<tr><th>No.</th><th>Items</th><th colspan="4">Specification</th><th>Reference</th></tr>
<tr><td>1</td><td>Ambient Temp.</td><td colspan="4">0 ~ 55 °C</td><td rowspan="5">-</td></tr>
<tr><td>2</td><td>Storage Temp.</td><td colspan="4">−25 ~ +70 °C</td></tr>
<tr><td>3</td><td>Ambient humidity</td><td colspan="4">5 ~ 95%RH (Non-condensing)</td></tr>
<tr><td>4</td><td>Storage humidity</td><td colspan="4">5 ~ 95%RH (Non-condensing)</td></tr>
<tr><td rowspan="8">5</td><td rowspan="8">Vibration</td><td colspan="3">Occasional vibration</td><td>-</td></tr>
<tr><td>Frequency</td><td>Acceleration</td><td>Pulse width</td><td>Times</td><td rowspan="8">IEC61131-2</td></tr>
<tr><td>5≤ f < 8.4Hz</td><td>–</td><td>3.5mm</td><td rowspan="6">10 times<br>each<br>direction<br>(X,Y and Z)</td></tr>
<tr><td>8.4≤ f ≤150Hz</td><td>9.8$m/s^2$(1G)</td><td>–</td></tr>
<tr><td colspan="3">Continuous vibration</td></tr>
<tr><td>Frequency</td><td>Acceleration</td><td>Pulse width</td></tr>
<tr><td>5≤ f < 8.4Hz</td><td>–</td><td>1.75mm</td></tr>
<tr><td>8.4≤ f ≤150Hz</td><td>4.9$m/s^2$(0.5G)</td><td>–</td></tr>
<tr><td>6</td><td>Shocks</td><td colspan="4">• Peak acceleration : 147 $m/s^2$(15G)<br>• Duration : 11ms<br>• Pulse wave type : Half-sine (3 times each direction per each axis)</td></tr>
<tr><td rowspan="5">7</td><td rowspan="5">Impulse noise</td><td>Square wave impulse noise</td><td colspan="3">AC: ±1,500 V<br>DC: ±900 V</td><td>LS ELECTRIC standard</td></tr>
<tr><td>Electrostatic discharge</td><td colspan="3">Voltage: 4kV (Contact discharge)</td><td>IEC61131-2<br>IEC61000-4-2</td></tr>
<tr><td>Radiated electromagnetic field noise</td><td colspan="3">80 ~ 1,000MHz, 10 V/m</td><td>IEC61131-2,<br>IEC61000-4-3</td></tr>
<tr><td rowspan="2">Fast transient /Burst noise</td><td>Classifi-cation</td><td>Power supply</td><td>Digital/Analog Input/Output, Communication Interface</td><td rowspan="2">IEC61131-2<br>IEC61000-4-4</td></tr>
<tr><td>Voltage</td><td>2kV</td><td>1kV</td></tr>
<tr><td>8</td><td>Operation ambience</td><td colspan="4">Free from corrosive gases and excessive dust</td><td rowspan="4">-</td></tr>
<tr><td>9</td><td>Altitude</td><td colspan="4">Less than 2,000m</td></tr>
<tr><td>10</td><td>Pollution degree</td><td colspan="4">Less than 2</td></tr>
<tr><td>11</td><td>Cooling method</td><td colspan="4">Air-cooling</td></tr>
</table>

**Notes**

**1) IEC (International Electrotechnical Commission)**

: An international civil community that promotes international cooperation for standardization of electric/ electro technology, publishes international standard and operates suitability assessment system related to the above.

**2) Pollution Degree**

: An index to indicate the pollution degree of used environment that determines the insulation performance of the device. For example, pollution degree 2 means the state to occur the pollution of non-electric conductivity generally, but the state to occur temporary electric conduction according to the formation of dew.

## 3.3 Power specifications

This section describes XBM H2/HP PLC main unit's power specifications.

| Items | | Specification | condition |
|---|---|---|---|
| Input | Input volatage range | DC20.4~28.8V(-15%, + 20%) | -15%, + 20% of rated voltage |
| | Rated input voltage | DC24V | |
| | Input current | 1A or less | Input max +DC28.8V load |
| | Inrush current | 70 Apeak or less | Input max +DC28.8V load |
| | Efficiency | 60% or more | Input max +DC28.8V load |
| | Permitted momentary power failure | 1ms or less | Input max +DC28.8V load |
| Ouput | Rated output voltage | DC 5V(±2%) | |
| | Output current | 2.0A | |
| Power supply status indication | | LED On when power supply is normal | |
| Cable specification | | 0.75 ~ 2 $mm^2$ | |

* For protection of the power supply, you are recommended to use the power supply with the maximum of 4A fuse.

**Notice**

(1) Allowable instantaneous interruption time

It is the time to maintain the normal output voltage (normal operation) on the condition that the input voltage (DC24V) is lower than the lowest rated input voltage (DC20.4V).

(2) Use UL certified power supply

- Power supply device should meet Class 2 or LVLC (Limited voltage Limited circuit).

(3) Overcurrent protection

- If a current above the specification flows in the DC5V/DC24V circuit, the overcurrent protection blocks the circuit to stop the system.
- If an overcurrent occurs, remove causes such as insufficient current capacity, short circuit and restart the system.

(4) Overvoltage protection

- If a voltage above the specification is applied to the DC5V circuit, the overvoltage protection blocks the circuit to stop the system.

## 3.3.1 Consumption current

| Type | Model | Description | Consumption current (Unit : ㎃) |
|---|---|---|---|
| **Main unit** | XEM-DR14H2 | DC24V input 8 point, output 6 point (relay) | 460 |
| | XEM-DN16H2 | DC24V input 8 point, ouput 8 point (sink) | 350 |
| | XEM-DP16H2 | DC24V input 8 point, output 8 point (source) | 350 |
| | XEM-DN32H2/HP | DC24V input 16 point, output 16 point (sink) | 540 |
| | XEM-DP32H2/HP | DC24V input 16 point, output 16 point (Source) | 540 |
| **Expansion I/O module** | XBE-DC32A | DC24V input 32 point | 50 |
| | XBE-DC16A/B | DC24V input 16 point, DC12/24V input 16 point | 40 |
| | XBE-DC08A | DC24V input 8point | 40 |
| | XBE-AC08A | AC110V input 8 point | 30 |
| | XBE-RY16A | Relay output 16point | 440 |
| | XBE-RY08A/B | Relay output 8 point, Relay ouput 8point (independent COM) | 230 |
| | XBE-TN32/16/08A | TR ouput 32/16/8 point(sink) | 70/50/40 |
| | XBE-DR16A | DC24 input 8point, Relay ouput 8point | 240 |
| | XBE-TP32/16/08A | TR ouput 32/16/8 point(source) | 70/50/40 |
| | XBE-DN32A | DC24V input 16 point, TR output 16 point(sink) | 60 |
| **Expansion Special module** | XBF-AD04A | Current/Voltage input 4 channel, 1/4000 resolution | 120 |
| | XBF-AD08A | Current/Voltage input 8 channel, 1/4000 resolution | 105 |
| | XBF-AH04A | Current/Voltage input 2 Ch, output 2 Ch, 1/4000 resolution | 120 |
| | XBF-DV04A | Voltage ouput 4channel, 1/4000 resolution | 110 |
| | XBF-DC04A | Current ouput 4channel, 1/4000 resolution | 110 |
| | XBF-RD04/01A | RTD input 4 / 1 channel, Pt100, Jpt100 | 100/100 |
| | XBF-TC04S | TC input 4channel, TC K/J/T/R type (0~65,535) | 100 |
| | XBF-PD02A | Positioning 2 axis (line driver), max. out 2Mbps | 500 |
| | XBF-HO02A | HSC open collector, 2channel | 270 |
| | XBF-HD02A | HSC line driver, 2channel | 330 |
| | XBF-AD04C | Current/Voltage input 4channel, 1/16000 resolution | 105 |
| | XBF-DC04C | Current output 4channel, 1/16000 resolution | 70 |
| | XBF-DV04C | Voltage output 4channel, 1/16000 resolution | 70 |
| | XBF-TC04RT | Temp. control module (RTD input, 4loop) | 120 |
| | XBF-TC04TT | Temp. control module (TC input, 4loop) | 120 |
| | XBF-PN04/08B | Network type positioning (Open type EtherCAT) 4/8 Axis | 510/510 |
| | XBF-LD02S | Loadcell input | 110 |
| **Expansion Communication module** | XBL-C21A | Cnet RS-232C 1Ch | 110 |
| | XBL-C41A | Cnet RS-422 1Ch | 110 |
| | XBL-EMTA | Fast Ethernet 1Ch | 190 |
| | XBL-EIMT/F/H | RAPIEnet electric/optic/mixed 1ch | 280/670/480 |
| | XBL-EIPT | EtherNet/IP electric 1ch | 400 |
| | XBL-CMEA | CANopen Master 1Ch | 150 |
| | XBL-CSEA | CANopen Slave 1Ch | 150 |
| | XBL-PMEC | Profibus-DP, Master | 300 |
| | XBL-PSEA | Profibus-DP, Slave | 230 |
| | XBL-DSEA | DeviceNet, Slave | 100 |
| | XBL-RMEA | Rnet, Master | 250 |

### 3.3.2 Calculation Example of Current / Power Consumption

Calculate the consumption current and configure the system not to exceed the output current capacity of main unit. Refer to section 3.3.1 for each module's consumption current.

(1) XGB PLC configuration example 1
Consumption of current/voltage is calculated as follows.

| Type | Model | Unit No. | Internal 5V consumption current (Unit : ㎃) | Remark |
|---|---|---|---|---|
| Main unit | XBM-DN32HP | 1 | 540 | In case all contact points are On.<br>(Maximum consumption current) |
| Expansion module | XBE-DC32A | 2 | 50 | |
| | XBE-TN32A | 2 | 80 | |
| | XBF-AD04A | 1 | 120 | All channel is used.<br>(Maximum consumption current) |
| | XBF-DC04A | 1 | 110 | |
| | XBL-C21A | 1 | 110 | |
| Current comsumption | 1140mA | | | – |
| Power consumption | 5.7W | | | 1.14A x 5V = 5.7W |

In case the system is configured as above, since internal 5V has current consumption of 1,140mA, and the maximum current output of the main unit is 2A. So, the configured system is valid.

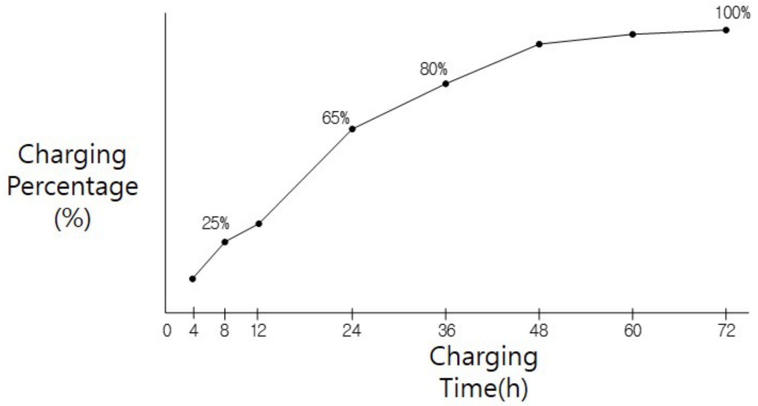
(2) XGB PLC configuration example 2

| Type | Model | Unit No. | Internal 5V consumption current (Unit : ㎃) | Remark |
|---|---|---|---|---|
| Main unit | XBM-DN32HP | 1 | 540 | In case all contact points are On.<br>(Maximum consumption current) |
| Expansion module | XBE-DR16A | 2 | 250 | |
| | XBE-RY16A | 2 | 440 | |
| | XBF-AD04A | 2 | 120 | All channel is used.<br>(Maximum consumption current) |
| | XBL-C21A | 1 | 110 | |
| Current comsumption | 2,150mA | | | - |
| Power consumption | 10.75W | | | 2.15 * 5V = 10.75W |

In case the system is configured as above, since internal 5V has current consumption of 2,150mA, and the maximum current output of the main unit is 2A. So, for the safety of the system, it is recommended to use main unit with higher specification.

## 3.4 Battery

### 3.4.1 Battery specifications

<table>
<tr><th>Items</th><th>Specifications</th></tr>
<tr><td>Nominal voltage / current</td><td>DC 3.0V / 6.5 mAh</td></tr>
<tr><td>Warranty term</td><td>3 years(at room temperature)</td></tr>
<tr><td>Purpose</td><td>RTC operation during the blackout</td></tr>
<tr><td>Charging time</td><td>

72 hours to fully charge (room temperature)</td></tr>
<tr><td>Backup time</td><td>About 6 months(25℃)
<table>
<tr><th>Surrounding temperature</th><th>Back-up time</th></tr>
<tr><td>70℃</td><td>about 195 days</td></tr>
<tr><td>25℃</td><td>about 183 days</td></tr>
<tr><td>-25℃</td><td>about 133 days</td></tr>
</table></td></tr>
</table>

### 3.4.2 Instruction for Use

(1) It is impossible to replace internal battery
(2) Do not apply heat or solder electrode (It may cause a battery's life-shortening)
(3) Do not measure voltage with a tester or short-circuit (It may cause a fire.)
(4) Do not disassemble the battery.
(5) Do not change the battery on purpose.

### 3.4.3 Battery Life

(1) Battery's life may be different depending on the conditions of blackout time, service temperature, etc.
(2) Battery is charged when the power is on, and it is used for RTC function.
(3) Battery can be discharged when PLC power has been off for a long time. When you put power on PLC, it will be charged automatically. And the PLC time should be set again.
(4) Program and data backup is preserved regardless of the battery discharge.

# 3.5 Performance specifications

## 3.5.1 CPU performance specifications

The XBM-H2/HP unit's common performance specifications for CPU are as below.

| Items | | Specifications | | | | | Remark |
|---|---|---|---|---|---|---|---|
| | | XBM-DN32H2,<br>XBM-DN32HP | XBM-DP32H2,<br>XBM-DP32HP | XBM-DN16H2 | XBM-DP16H2 | XBM-DR14H2 | |
| Operation method | | Iterative operation, constant cycle operation, interrupt operation, fixed period scan | | | | | |
| Program control method | | Cyclic execution of stored program,<br>Time-driven interrupt, Process-driven interrupt | | | | | |
| I/O control method | | Batch processing by simultaneous scan (Refresh method),<br>Directed by program instruction | | | | | |
| Program language | | LD (Ladder Diagram), IL (Instruction List),<br>SFC (Sequential Function Chart), ST (Structured Text) | | | | | |
| Number of instructions | Basic | About 30 | | | | | |
| | Application | About 740 | | | | | |
| Processing speed (Basic instruction) | | 40ns/step | | | | | |
| Program capacity | | 64kStep | | | | | |
| Max. I/O points | | 256 points | 256 points | 240 points | 240 points | 238 points | Main+7 expansion |
| Data area | P | P0000 ~ P2047F (32,768 points) | | | | | Input/Ouput |
| | M | M0000 ~ M2047F (32,768 points) | | | | | Internal relay |
| | K | K0000 ~ K4095F (65,536 points) | | | | | Keep relay |
| | L | L0000 ~ L4095F (65,536 points) | | | | | Link relay |
| | F | F0000 ~ F2047F (32,768 points) | | | | | Flags |
| | T | 100㎳, 10㎳, 1㎳: T0000 ~ T2047 (set by parameter) | | | | | Timer |
| | C | C0000 ~ C2047 | | | | | Counter |
| | S | S00.00 ~ S127.99 | | | | | Step relay |
| | D | D0000 ~ D32767 | | | | | Data register |
| | U | U0.0 ~ U08.31 | | | | | Analog Data |
| | Z | Z000 ~ Z127 (128word) | | | | | |
| | N | N0000 ~ N10239 (10,240 word) | | | | | |
| File register | R | RAM area 8block (R00000 ~ R32,767) | | | | | |
| No. of total program | | 256 | | | | | |
| task | Initial task | 1 | | | | | |
| | Cyclic task | Max 16 | | | | | |
| | I/O task | Max 8 | | | | | |
| | Internal device task | Max 16 | | | | | |
| | High Speed Counter task | Max 4 | | | | | |
| | Positioning task | 1 | | | | | |
| Operation mode | | RUN, STOP, DEBUG | | | | | |
| Self-diagnosis function | | Detects errors of scan time, memory, I/O and power supply | | | | | |
| Program port | | USB 1 channel | | | | | |
| Back-up method | | Latch area setting in basic parameter | | | | | |
| Internal consumption current | | 540mA | 540mA | 350mA | 350mA | 460mA | |
| Weight | | 134g | 140g | 140g | 140g | 150g | |

| Items | | | Specifications | | | | | Remark |
|---|---|---|---|---|---|---|---|---|
| | | | **XBM-DN32H2,<br>XBM-DN32HP** | **XBM-DP32H2,<br>XBM-DP32HP** | **XBM-DN16H2** | **XBM-DP16H2** | **XBM-DR14H2** | |
| Built-in Function | PID control | | • Control by instruction, auto-tuning, PWM output, Forced output<br>• Operation scan time setting, AntiWindup, Delta MV<br>• SV lamp, Hybrid operation, Cascade operation | | | | | |
| | Cnet | Protocol | • Dedicated protocol(XGT)<br>• Modbus protocol<br>• User defined protocol<br>• LS bus (inverter protocol) | | | | | |
| | | Channel | RS-232C 1 port and RS-485 1 port | | | | | |
| | Enet | Transfer spec. | • Cable: 100Base-TX<br>• Speed: 100Mbps<br>• Auto-MDIX 1) supported<br>• IEEE 802.3 standard satisfied | | | | | |
| | | Topology | Star | | | | | |
| | | Diagnosis | Module information, Service condition | | | | | |
| | | Protocol | • XGT dedicated<br>• Modbus TCP/IP<br>• User-defined frame | | | | | |
| | | Service | • P2P<br>• High Speed link<br>• Remote connection<br>• E-mail transfer (SMTP)<br>• Time synchronization (SNTP)<br>• Auto scan | | | | | |
| | High Speed Counter | Performance | 1 phase: 200㎑ (2 phase: 100㎑) | | | | | |
| | | Channels | 1 phase 4 channels, 2 phase 2 channels | | | | | |
| | | Counter mode | 4 counter modes are supported based on input pulse and INC/DEC method<br>• 1 pulse operation Mode : INC/DEC count by program<br>• 1 pulse operation Mode : INC/DEC count by phase B pulse input<br>• 2 pulse operation Mode : INC/DEC count by input pulse<br>• 2 pulse operation Mode : INC/DEC count by difference of phase | | | | | |
| | | Function | • Internal/external preset<br>• Latch counter<br>• Compare output<br>• No. of rotation per unit time | | | | | |
| | Pulse catch | | 10㎲ 4point(P0000 ~ P0003), 50㎲ 4point(P0004 ~ P0007) | | | | | |
| | External point Interrupt | | 10㎲ 4point(P0000 ~ P0003), 50㎲ 4point(P0004 ~ P0007) | | | | | |
| | Input filter | | 1,3,5,10,20,70,100 ms | | | | | |

1) Auto-MDIX(Automatic medium-dependent interface crossover) : It is the function to automatically detect whether the cable connected to the Ethernet port is peer-to-peer(straight) or cross cable

### 3.5.2 Built-in Positioning function performance specifications

The XBM-H2/HP unit's performance specifications for Built-in positioning functions are as below.

| Items | | | Specifications | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | XBM-DN32HP | XBM-DP32HP | XBM-DN32H2 | XBM-DP32H2 | XBM-DN16H2 | XBM-DP16H2 | XBM-DR14H2 [1] |
| Built-in Positioning function | Basic function | No. of axis | 6 axis | | 2 axis | | | | Not supported |
| | | Control method | Position control, Speed control, Speed/Position conversion control, Position/Speed conversion control | | | | | | |
| | | Control unit | Pulse, mm, inch, degree | | | | | | |
| | | Positioning data | 400 steps for each axis (Step number : 1 ~ 400) | | | | | | |
| | | Operation mode | End, Keep, Continuous | | | | | | |
| | | Operation method | Single, Repeat | | | | | | |
| | Interpolation function | | ▪ 2/3/4/5/6 axis linear interpolation<br>▪ 2 axis circular interpolation<br>▪ 3 axis helical interpolation | | ▪ 2 axis linear interpolation<br>▪ 2 axis circular interpolation | | | | Not supported |
| | Positioning | Method | Absolute / Incremental | | | | | | Not supported |
| | | Address range | -2,147,483,648 ~ 2,147,483,647 | | | | | | |
| | | Speed | Up to 200kpps (setting range : 1 ~ 200,000pps) | | | | | | |
| | | Acc/Dec processing | Operation pattern: Trapezoid, S-curve | | | | | | |
| | Origin return method [2] | | ▪ DOG(Off) + HOME signal<br>▪ DOG(On) + HOME signal<br>▪ DOG signal<br>▪ Upper / Lower Limit signal + HOME signal<br>▪ High Speed origin return<br>▪ HOME signal | | | | | | Not supported |
| | Manual operation | | Jog Operation, MPG Operation, Inching Operation | | | | | | Not supported |

1) Relay output model XBM-DR14H2 doesn't support Built-in positioning function. If the embedded positioning instruction/command is executed, positioning function is not performed.
2) DOG : Near home signal

# Chapter 4 Installation and wiring

## 4.1 Parameter & Operation data

⚠ Danger

▸ Please design protection circuit at the external of PLC for entire system to operate safely because an abnormal output or an malfunction may cause accident when any error of external power or malfunction of PLC module.

(1) It should be installed at the external side of PLC to emergency stop circuit, protection circuit, interlock circuit of opposition action such as forward /reverse operation and interlock circuit for protecting machine damage such as upper/lower limit of positioning.

(2) If PLC detects the following error, all operation stops and all output is off.
(Available to hold output according to parameter setting)
(a) When over current protection equipment or over voltage protection operates
(b) When self diagnosis function error such as WDT error in PLC CPU occurs

▸ When error about IO control part that is not detected by PLC CPU, all output is off.
Design Fail Safe circuit at the external of PLC for machine to operate safely. Refer to 4.1.1 Fail Safe circuit.

(1) Because of error of output device, Relay, TR, etc., output may not be normal. About output signal that may cause the heavy accident, design supervisory circuit to external.

▸ When load current is more than rating or over current by load short flows continuously, danger of heat, fire may occur so design safety circuit to external such as fuse.

▸ Design for external power supply to be done first after PLC power supply is done. If external power supply is done first, it may cause accident by misoutput, misoperation.

▸ In case communication error occurs, for operation status of each station, refer to each communication manual.

▸ In case of controlling the PLC while peripheral is connected to CPU module, configure the interlock circuit for system to operate safely. During operation, in case of executing program change, operation status change, familiarize the manual and check the safety status. Especially, in case of controlling long distance PLC, user may not response to error of PLC promptly because of communication error or etc.
Limit how to take action in case of data communication error between PLC CPU and external device adding installing interlock circuit at the PLC program.

## ⚠ Danger

▸ Don’t close the control line or communication cable to main circuit or power line. Distance should be more than 100mm. It may cause malfunction by noise.

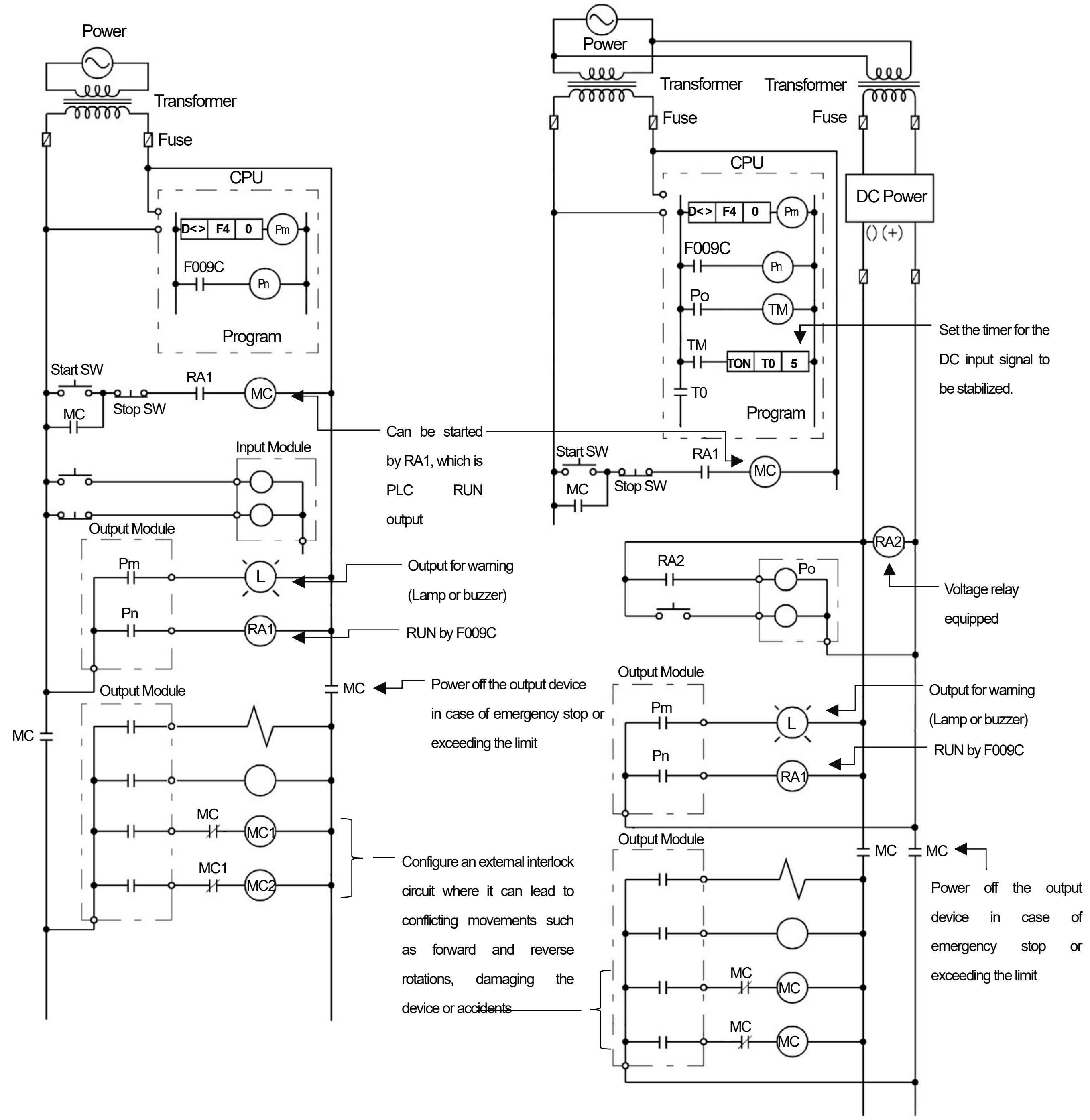
▸ In case of controlling lamp load, heater, solenoid valve, etc. in case of Off -> On, large current (10 times of normal current) may flows, so consider changing the module to module that has margin at rated current.

▸ Process output may not work properly according to difference of delay of PLC main power and external power for process (especially DC in case of PLC power On-Off and of start time.
For example, in case of turning on PLC main power after supplying external power for process, DC output module may malfunction when PLC is on, so configure the circuit to turn on the PLC main power first
Or in case of external power error or PLC error, it may cause the malfunction.

▸ Not to lead above error to entire system, part causing breakdown of machine or accident should be configured at the external of PLC

## 4.1.1 fail safe circuit

(1) example of system design



In case of AC

In case of AC . DC

Can be started by RA1, which is PLC RUN output

Output for warning (Lamp or buzzer)

RUN by F009C

Power off the output device in case of emergency stop or exceeding the limit

Configure an external interlock circuit where it can lead to conflicting movements such as forward and reverse rotations, damaging the device or accidents

Set the timer for the DC input signal to be stabilized.

Voltage relay equipped

Output for warning (Lamp or buzzer)

RUN by F009C

Power off the output device in case of emergency stop or exceeding the limit

Start Sequence of power

In case of AC

1) Turn on the power

2) Run CPU.

3) Turn on the start SW.

4) Output device runs by program through Magnetic Contactor(MC) On.

Start Sequence of power

In case of AC·DC

1) Turn on the power.

2) Run CPU.

3) RA2 Turns on as DC power on

4) Turn on the timer after DC power is stabilized.

5) Turn on the start SW.

6) Output device runs by program through Magnetic Contactor(MC) On.

# 4.2 Attachment/Detachment of Modules

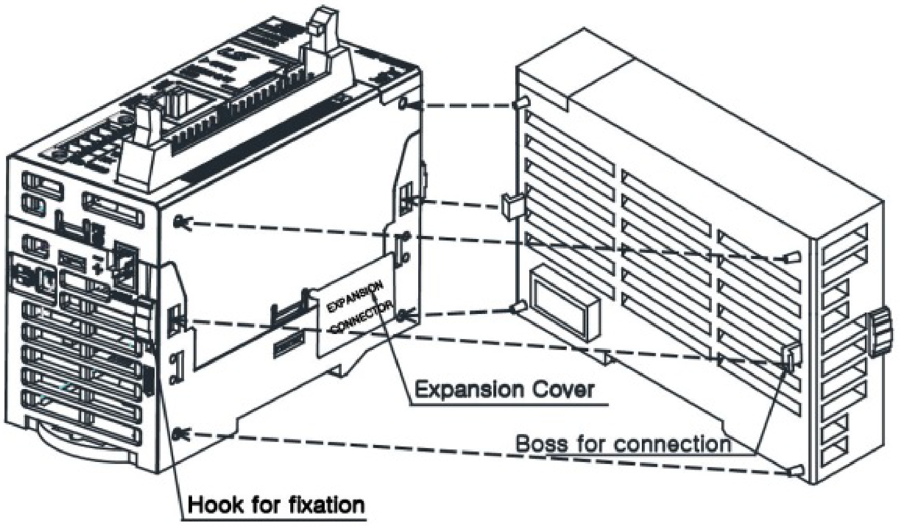
## 4.2.1 Attachment/Detachment of modules

Caution in handling
Use PLC in the range of general specification specified by manual.
In case of usage out of range, it may cause electric shock, fire, malfunction, damage of product.

> ⚠ Remark
>
> - Module must be mounted to hook for fixation properly before its fixation.
>   The module may be damaged from over-applied force. If module is not mounted properly, it may cause malfunction.
> - Do not drop or impact the module case, terminal block connector.
> - Do not separate PCB from case.
> - When detaching module, do not apply excessive force. If so, hook may be damaged.

(1) Equipment of module

- Eliminate the Extension Cover at the product.
- Push the product and connect it in agreement with *Hook For Fixation* of four edges and Hook For Connection at the bottom.
- After connection, push down the *Hook For Fixation* to fix it completely.



(2) Detachment of module

- Push up the *Hook For Fixation*, and then detach the product with two hands.
  (Do not detach the product by force)

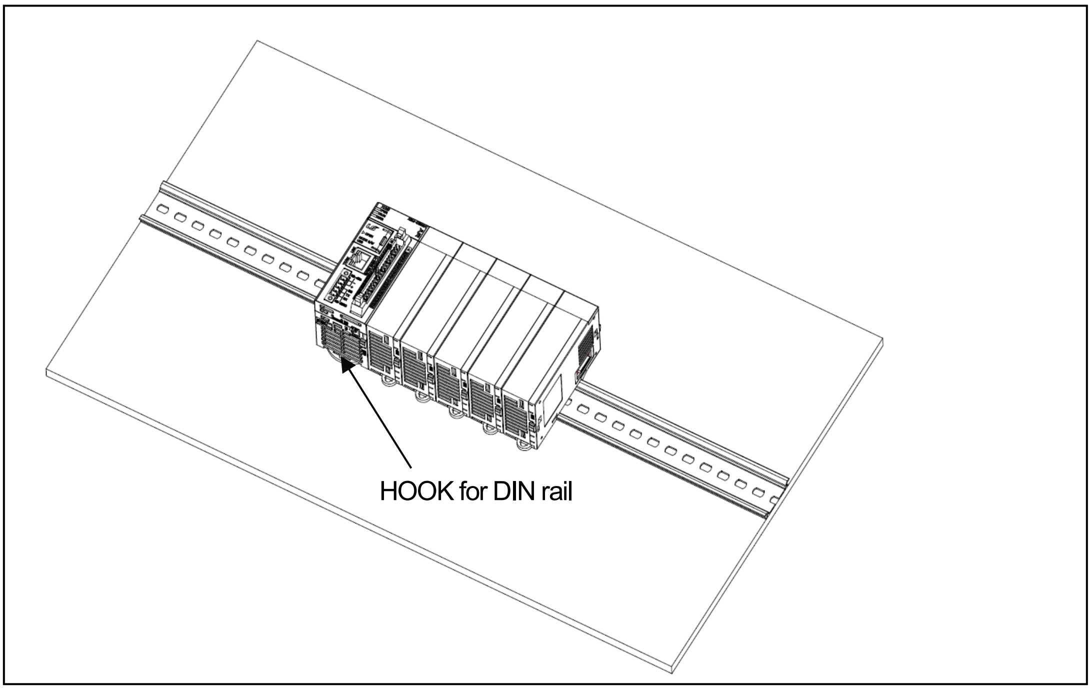
> **Caution in handling**
>
> Use PLC in the range of general specification specified by manual.
> In case of usage out of range, it may cause electric shock, fire, malfunction, or damage of the product.

(3) Installation of module

XGB PLC has a hook for DIN rail (rail width: 35mm) so that it can be installed at DIN rail.

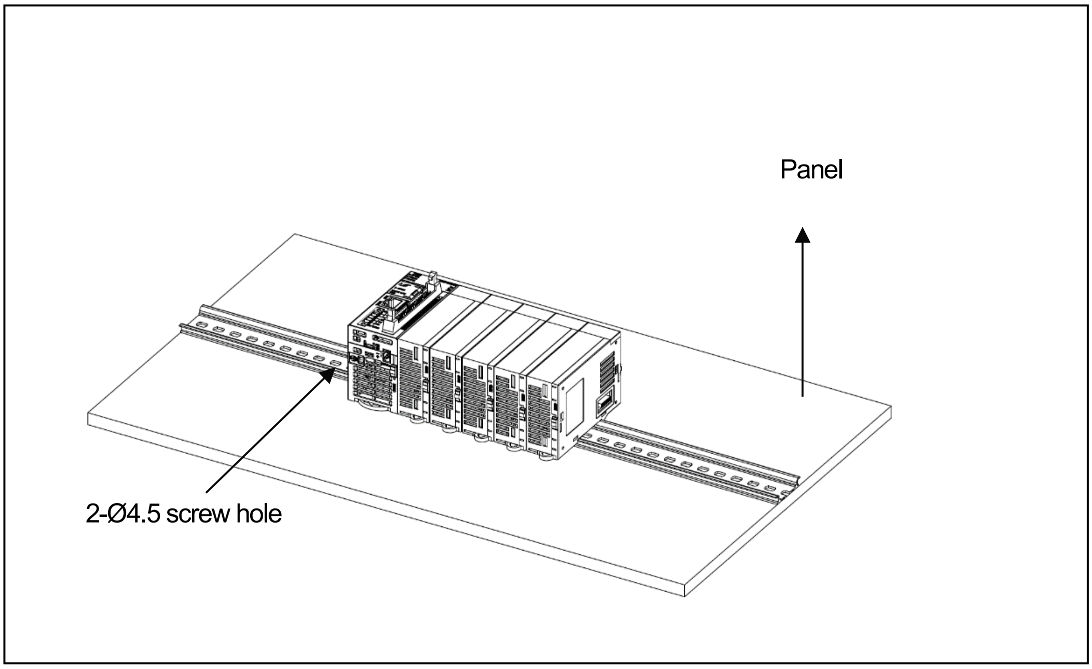
(a) In case of installing at DIN rail

- Pull the hook as shown below for DIN rail at the bottom of module and install it at DIN rail
- Push the hook to fix the module at DIN rail after installing module at DIN rail



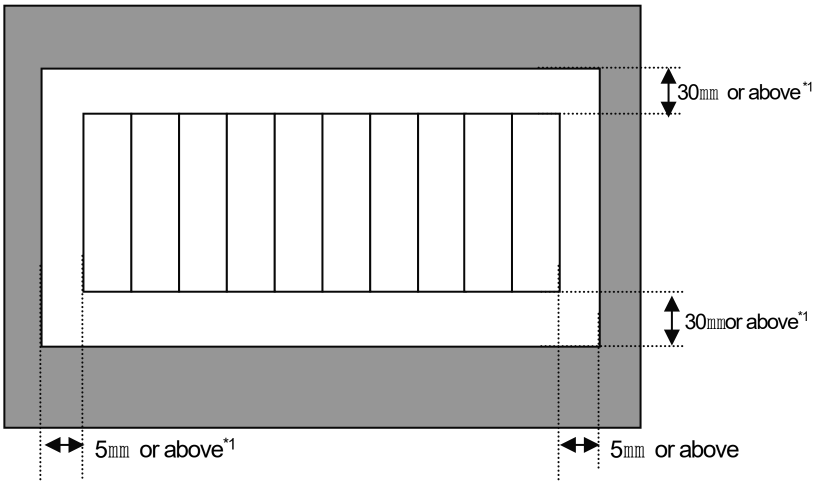
(b) In case of installing at panel

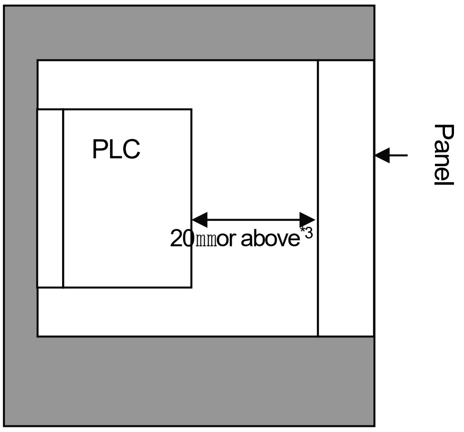
- You can install XGB compact type main unit onto a panel directly using screw hole
- Use M4 type screw to install the product onto a panel.



(4) Module equipment location

Keep the following distance between module and structure or part for ventilation, easy detachment and attachment.

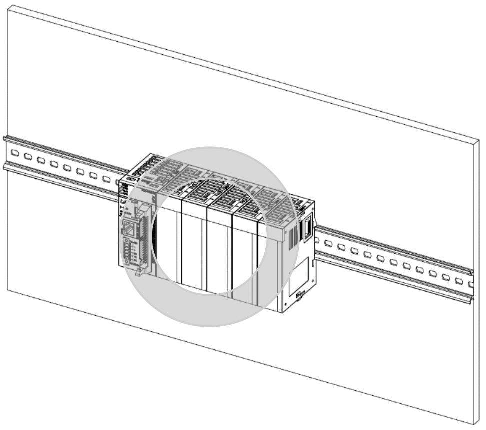




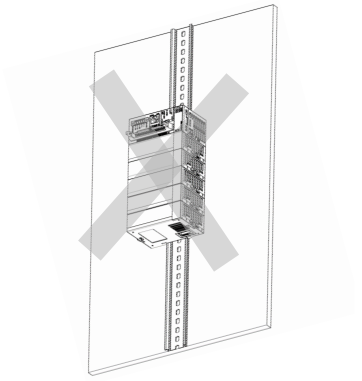
*1 : In case height of wiring duct is less than 50 mm (except this 40mm or more)  
*2 : In case of equipping cable without removing near module, 20mm or more  
*3 : In case of connector type, 20mm or above

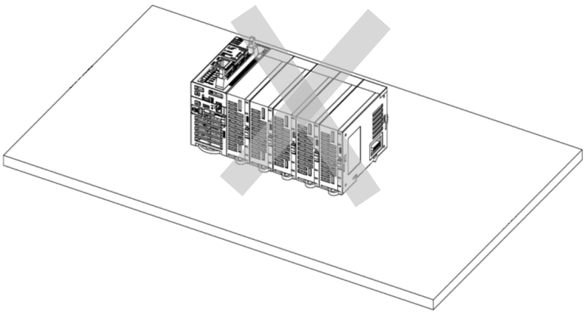
(5) Module equipment direction

(a) For easy ventilation, install as shown below.



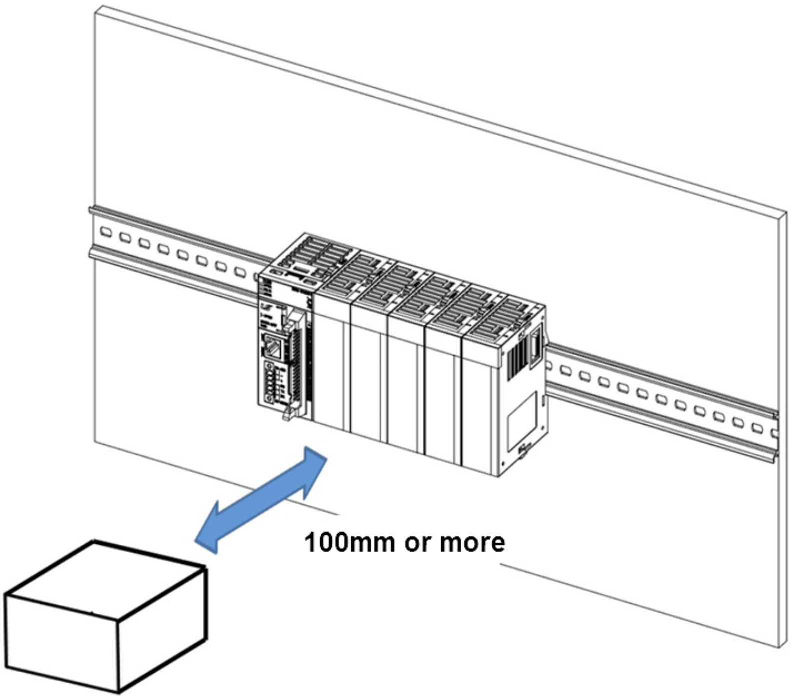
(b) Don’t install as shown below.

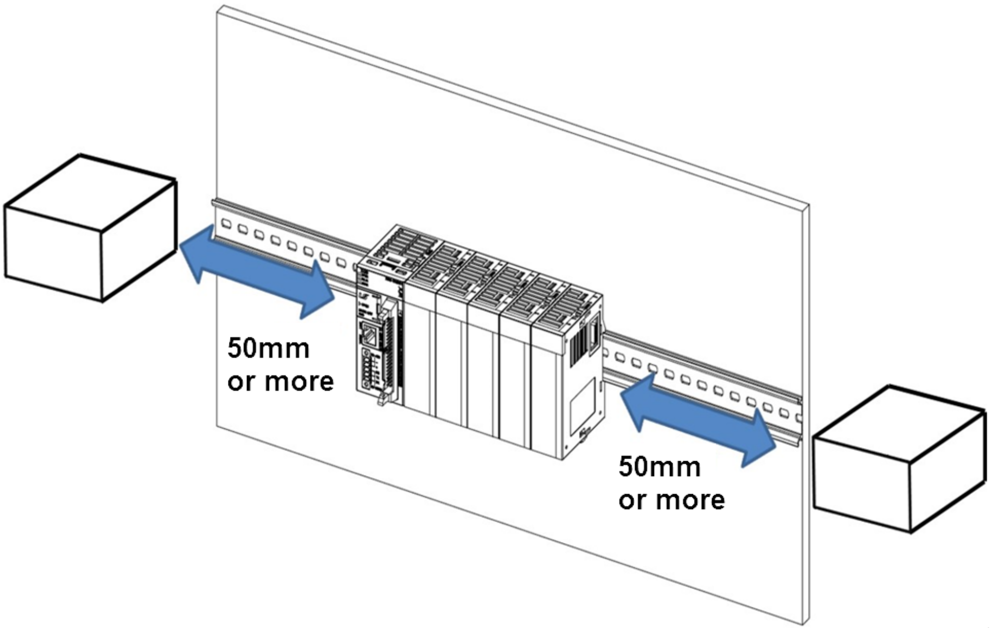




(6) Distance with other devices

To avoid radiation noise or heat, keep the distance between PLC and device (connector and relay) as far as the following figure.
Device installed in front of PLC: 100㎜ or more
Device installed beside PLC: 50㎜ or more





### 4.2.2 Caution in handling

Here describes caution from open to install

- Don't drop or impact product.
- Don't disassemble the PCB from case. It may cause an error.
- In case of wiring, make sure foreign substance not to enter upper part of module. If it enters, eliminate it.

(1) Caution in handling IO module

It describes caution in handling IO module.

(a) Recheck of IO module specification

For input module, be cautious about input voltage, for output module, if voltage that exceeds the maximum open/close voltage is induced, it may cause the malfunction, breakdown or fire.

(b) Proper wire

When selecting wire, consider ambient temp, allowed current and minimum size of wire is AWG22(0.3mm$^2$) or above.

(c) Environment

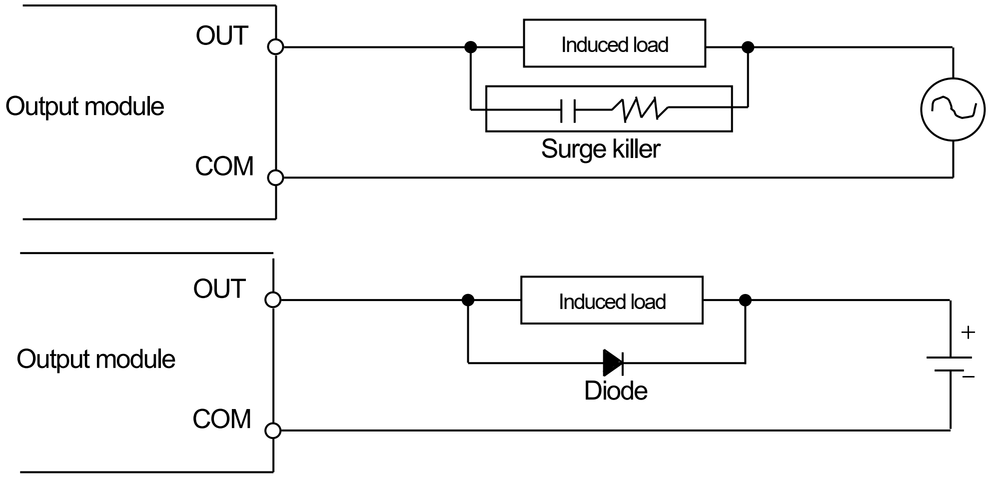
In case of wiring IO module, if the device or material with high heat is too close to the PLC, or if the wire makes a direct contact with the oil for a long time, it may cause short, malfunction or error.

(d) Polarity

Check the polarity before supplying power on the module.

(e) Wiring

- In case of wiring IO line with high voltage line or power line, inductive interference may cause error.
- Do not allow wires to pass in front of the the IO operation indication part (LED).
  (You can't discriminate the IO indication.)
- In case inductive load is connected to the output module, connect the surge killer or diode in parallel with the load. Connect cathode of diode to (+) side of power.



(f) Terminal block

Make sure that the wire is tightly fixed to the terminal block. Please ensure that wire scraps or other foreign materials do not enter the PLC during terminal block wiring or screw hole processing. Otherwise, this may cause malfunction and failure.

(g) Don't impact IO module or disassembling the PCB board from case.

## 4.3 Wire

In case using system, it describes caution about wiring.

### ⚠ Danger

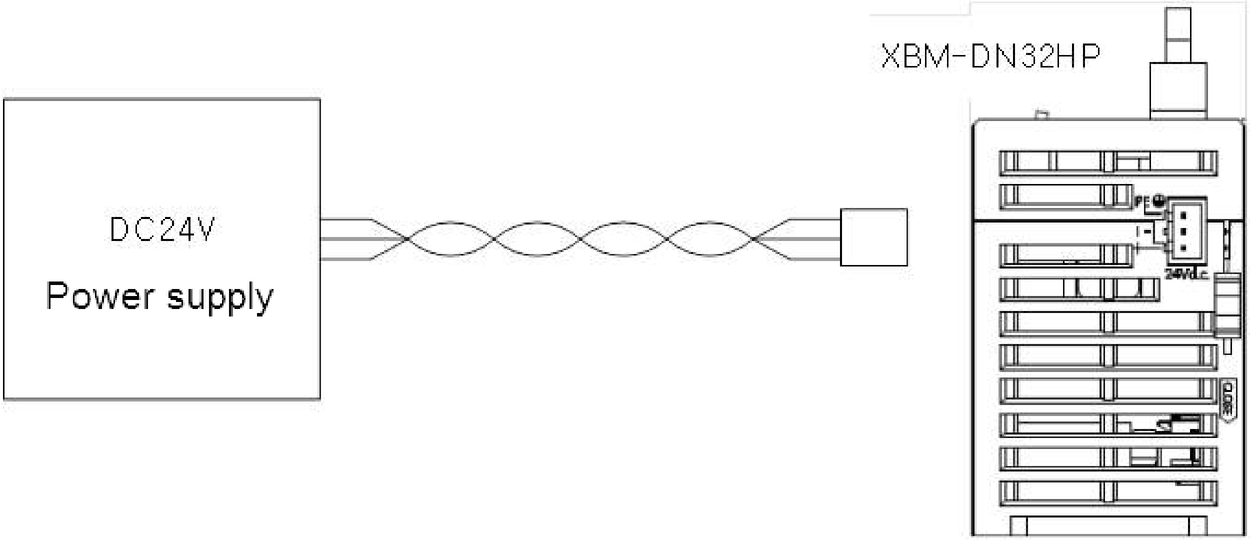
- When wiring, cut off the external power.
- If all the power is cut off, it may cause electric shock or damage of product.
- In case of flowing electric or testing after wiring, equip terminal cover included in product. It not, it may cause electric shock.

### ⚠ Remark

- Do D type ground (type 3 ground) or above dedicated for PLC for FG and LG terminal. It may cause electric shock or malfunction.
- When wiring module, check the rated voltage and terminal array and do properly.
If rating is different, it may cause fire, malfunction.
- For external connecting connector, use designated device and solder.
If connecting is not safe, it may cause short, fire, malfunction.
- For screwing, use designated torque range. If it is not fit, it may cause short, fire, malfunction.
- Let no foreign material enter such as garbage or disconnection part into module. It may cause fire, malfunction, error.

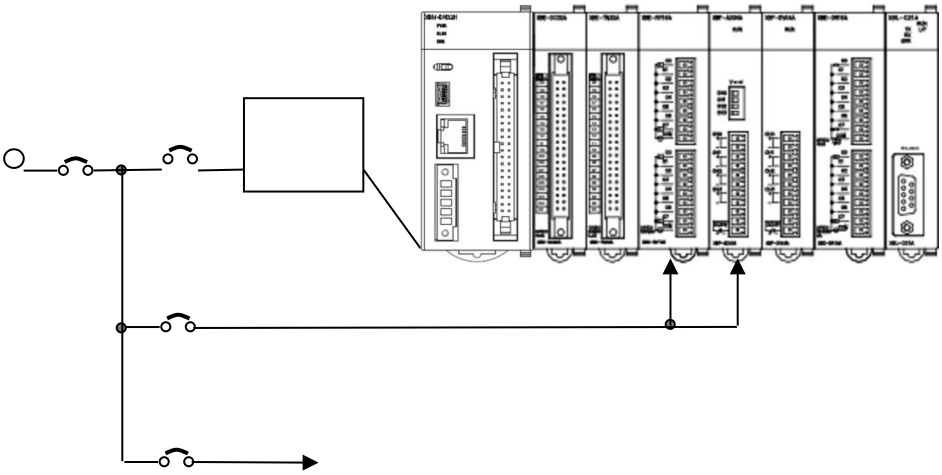
### 4.3.1 Power wiring

(1) AC110V/AC220V/DC24V cables should be twisted compactly as possible, and connected in the shortest distance



(2) DC Power supply capacity should be 1A or more

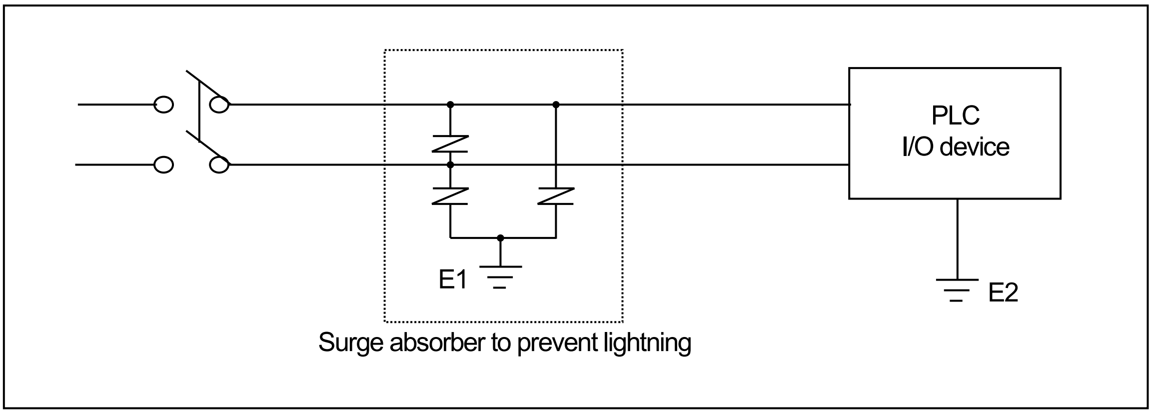
(3) Isolate the PLC power, power for I/O devices and power devices as follows.



(4) AC110V, AC220V cable should be as thick as possible(2mm$^2$) to reduce voltage drop

(5) AC110V, DC24V cable should not be installed close to main circuit cable (high voltage/high current) and I/O signal cable. They should be at least 100mm away from such cables

(6) To prevent surge from lightning, use the lightning surge absorber as presented below.



Surge absorber to prevent lightning

(7) When there is a risk of noise interfernece, please use an iisolated transformer or a noise filter.

(8) Wiring of each input power should be twisted as short as possible and the wiring of shielding transformer or noise filter should not be arranged via a duct.

(9) All field-wiring connections to this unit shall be from Limited Voltage / Limited Current, below 24Vdc isolated secondary source with an output fused with a 4A fuse max. or class 2 secondary circuits as defined in UL 508, 17th Edition.

**Remark**

(1) Isolate the grounding(E1) of lightning surge absorber from the grounding(E2) of the PLC.
(2) Select a lightning surge absorber type so that the max. voltage may not the specified allowable voltage of the absorber.

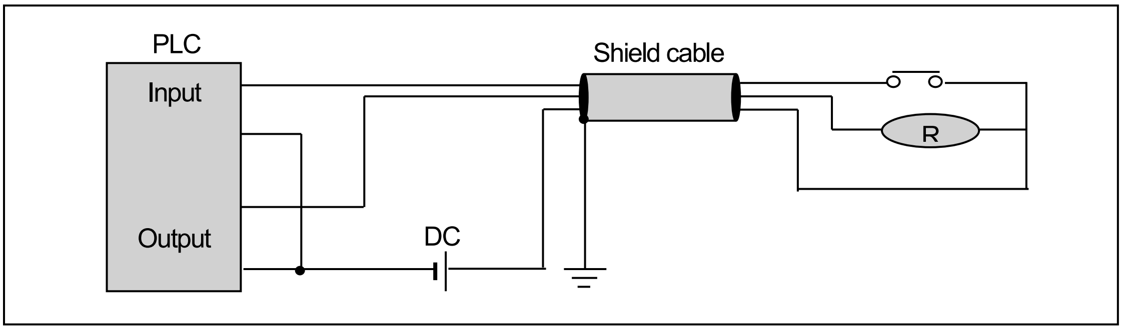
### 4.3.2 I/O Device wiring

(1) The size of I/O device cable is limited to 0.3~2 mm$^2$ but it is recommended to select a size(0.3 mm$^2$) to use conveniently.

(2) Please isolate input signal line from output signal line.

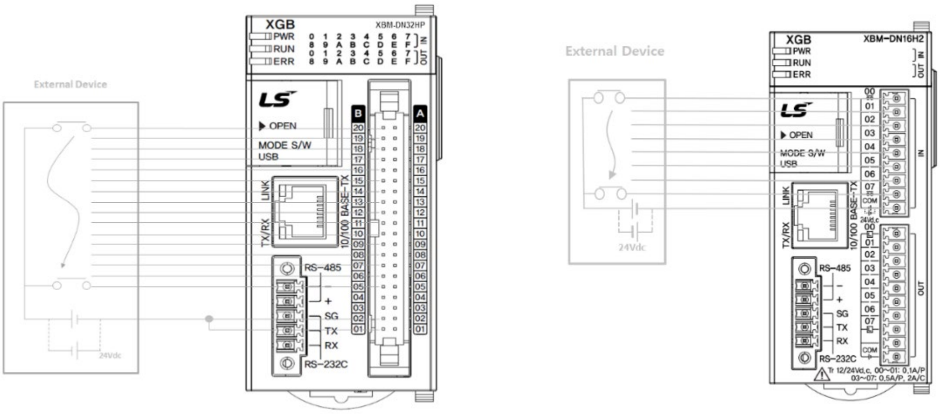
(3) I/O signal lines should be wired 100mm and more away from high voltage/high current main circuit cable.

(4) If it is not possible to separate the main circuit lines from the power lines, please use shielded cables for all lines and ground the PLC side.

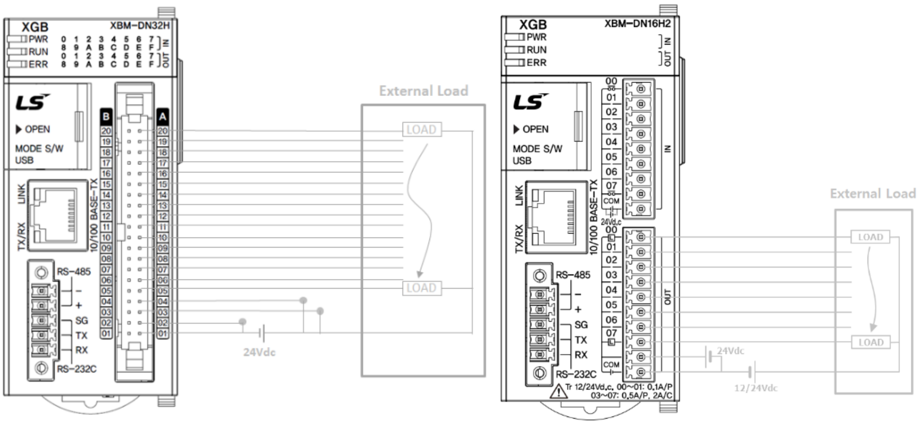


(5) When applying pipe-wiring, make sure to ground the pipe firmly.

(6) Example of input module.

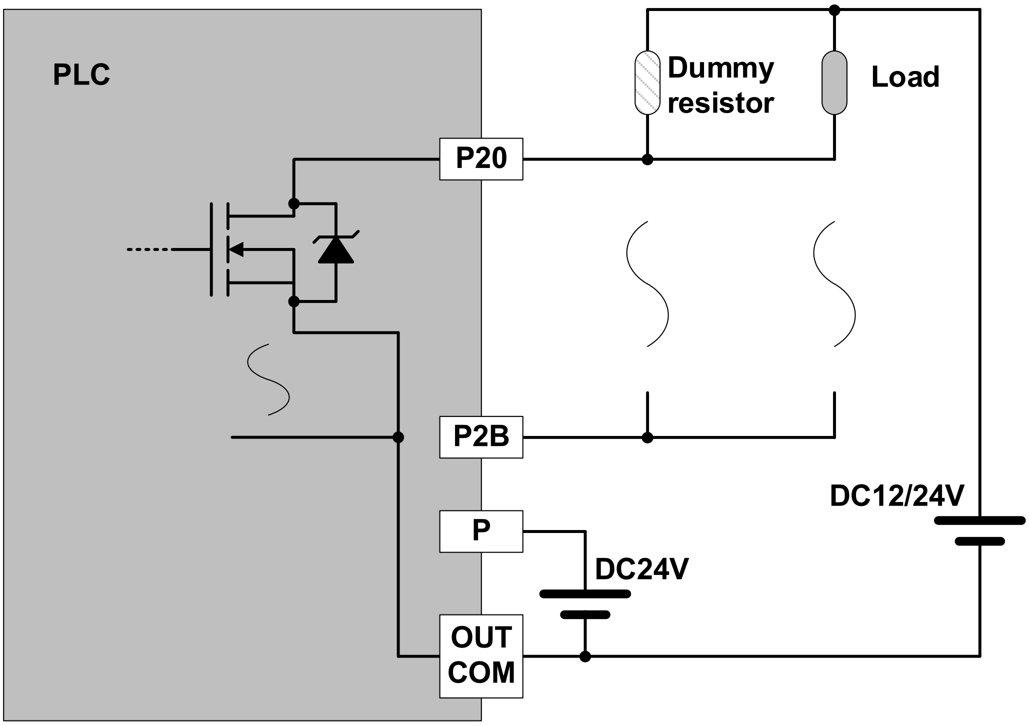


(7) Example of output module.



**Notes**

1) For reducing noise and improving system safety, add Dummy resistor to increase load current



When using Positioning instruction, out current should be 10mA~100mA

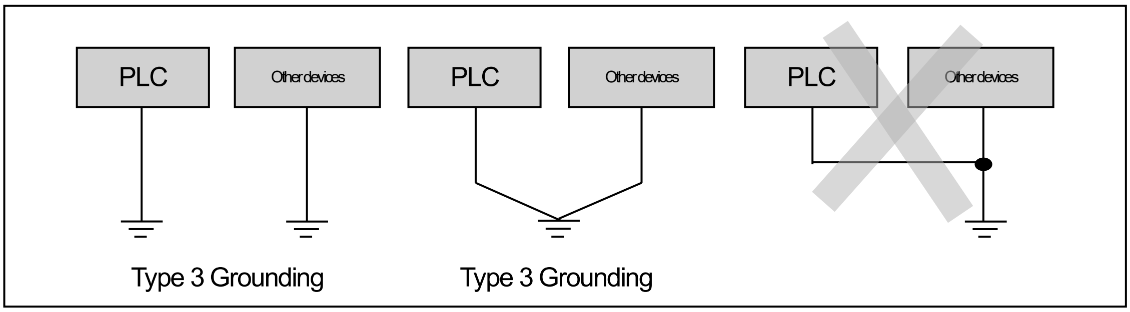
| List | Description |
|---|---|
| Load Voltage | DC12V / DC24V |
| Range of Load current | 10mA ~100mA |
| Output frequency | 200kpps or below |

### 4.3.3 Grounding wiring

(1) The PLC contains a proper noise measure, so it can be used without any separate grounding if there is a large noise. However, if grounding is required, please refer to the followings.

(2) For grounding, please make sure to use the exclusive grounding.
For grounding construction, apply type 3 grounding(grounding resistance lower than 100 Ω)

(3) If the exclusive grounding is not possible, use the common grounding as presented in B) of the figure below.



A) Exclusive grounding : best B) common grounding : good C) common grounding: defective

(4) Use the grounding cable more than 2 mm$^2$. To shorten the length of the grounding cable, place the grounding point as close to the PLC as possible.

(5) If any malfunction from grounding is detected, separate the FG of the base from the grounding.

### 4.3.4 Specifications of wiring cable

The specifications of cable used for wiring are as follows.

| Types of external connection | Cable specification (mm$^2$) | | Wire Type | Temperature rating |
|---|---|---|---|---|
| | Lower limit | Upper limit | | |
| Digital input | 0.18 (AWG24) | 1.5 (AWG16) | Cu | 60℃/75℃ |
| Digital output | 0.18 (AWG24) | 2.0 (AWG14) | | |
| Analogue I/O | 0.18 (AWG24) | 1.5 (AWG16) | | |
| Communication | 0.18 (AWG24) | 1.5 (AWG16) | | |
| Main power | 1.5 (AWG16) | 2.5 (AWG12) | | |
| Protective grounding | 1.5 (AWG16) | 2.5 (AWG12) | | |

# Chapter 5 Maintenance

Be sure to perform daily and periodic maintenance and inspection to maintain the PLC in the best conditions.

## 5.1 Maintenance and Inspection

The I/O module mainly consist of semiconductor devices and its service life is semi-permanent. However, periodic inspection is requested for ambient environment may cause damage to the devices. When inspecting one or two times per six months, check the following items.

| Check Items | | Judgment | Corrective Actions |
|---|---|---|---|
| Change rate of input voltage | | Within change rate of input voltage | Hold it with the allowable range. |
| Power supply for input/output | | Input/Output specification of each module | Hold it with the allowable range of each module. |
| Ambient environment | Temperature | 0 ~ + 55℃ | Adjust the operating temperature and humidity with the defined range. |
| | Humidity | 5 ~ 95%RH | |
| | Vibration | No vibration | Use vibration resisting rubber or the vibration prevention method. |
| Play of modules | | No play allowed | Securely enrage the hook. |
| Connecting conditions of terminal screws | | No loose allowed | Retighten terminal screws. |
| Spare parts | | Check the number of spare parts and their store conditions | Cover the shortage and improve the conditions. |

## 5.2 Daily Inspection

The following table shows the inspection and items which are to be checked daily.

| Check Items | | Check Points | Judgment | Corrective Actions |
|---|---|---|---|---|
| PLC Panel Attachment Status | | Check the loosening of mounting screws | Must be securely attached | Retighten Screws. |
| Connection conditions of Input/Output module | | Check Hook for fixation | Placed in CLOSE | Retighten Screws. |
| Connecting conditions of terminal block or extension cable | | Check for loose mounting screws. | Screws should not be loose. | Retighten Screws. |
| | | Check the distance between solderless terminals. | Proper clearance should be provided. | Correct. |
| | | Connecting of expansion cable. | Connector should not be loose. | Correct. |
| LED indicator | PWR LED | Check that the LED is On. | On (Off indicates an error) | |
| | Run LED | Check that the LED is On during Run. | On (flickering or Off indicates an error) | |
| | ERR LED | Check that the LED is Off during Run. | Flickering indicates an error | |
| | Input LED | Check that the LED turns On and Off. | On when input is On,<br>Off when input is off. | |
| | Output LED | Check that the LED turns On and Off | On when output is On,<br>Off when output is off | |

## 5.3 Periodic Inspection

Check the following items once or twice every six months, and perform corrective actions as needed.

| Check Items | | Checking Methods | Judgment | Corrective Actions |
|---|---|---|---|---|
| Ambient environment | Ambient temperature | -. Measure with thermometer and hygrometer<br>-. measure corrosive gas | 0 ~ 55 °C | Adjust to general standard (Internal environmental standard of control section) |
| | Ambient Humidity | | 5 ~ 95%RH | |
| | Ambient pollution level | | There should be no corrosive gases | |
| PLC Conditions | Looseness, Ingress | Move each modiule | The module should be mounted securely. | Retighten screws |
| | dust or foreign material | Visual check | No dust or foreign material | |
| Connecting conditions | Loose terminal screws | Re-tighten screws | Screws should not be loose | Retighten |
| | Distance between terminals | Visual check | Proper clearance | Correct |
| | Loose connectors | Visual check | Connectors should not be loose. | Retighten connector mounting screws |
| Line voltage check | | Measure voltage between input terminals | 3.3 Power specifications | Change supply power |

# Chapter 6 Troubleshooting

The following explains contents, diagnosis and corrective actions for various errors that can occur during system operation.

## 6.1 Basic Procedure of Troubleshooting

System reliability not only depends on reliable equipment but also on short downtimes in the event of fault. The short discovery and corrective action are needed for speedy operation of system. The following shows the basic instructions for troubleshooting.

(1) Visual checks

Check the following points.

- Machine operating condition (in stop and operation status)
- Power On/Off
- Status of I/O devices
- Condition of wiring (I/O wires, extension and communication cables)
- Check the display states of various indicators. (such as POWER LED, RUN LED, ERR LED and I/O LED)

After checking them, connect peripheral devices and check the operation status of the PLC and the program contents.

(2) Trouble Check

Observe any change in the error conditions during the following.

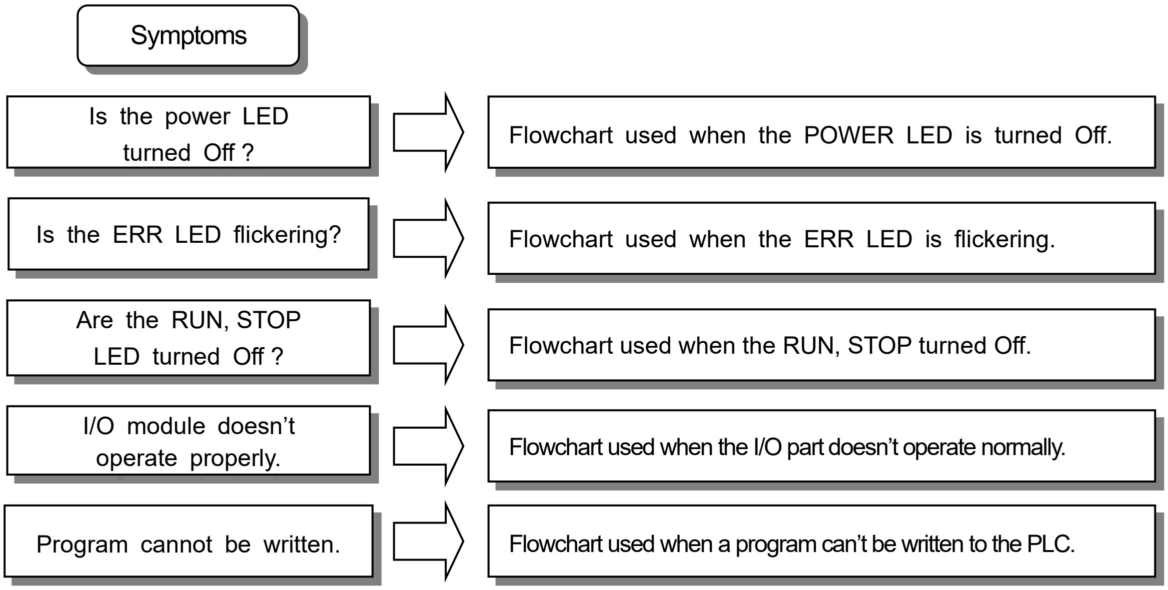
- Switch the key switch to the STOP position, and then turn the power on and off.

(3) Narrow down the possible causes of the trouble where the fault lies, i.e.:

- Is it the problem of PLC itself? or is it because of the external factor?
- Is it I/O module or another module?
- Is it because of the PLC program?

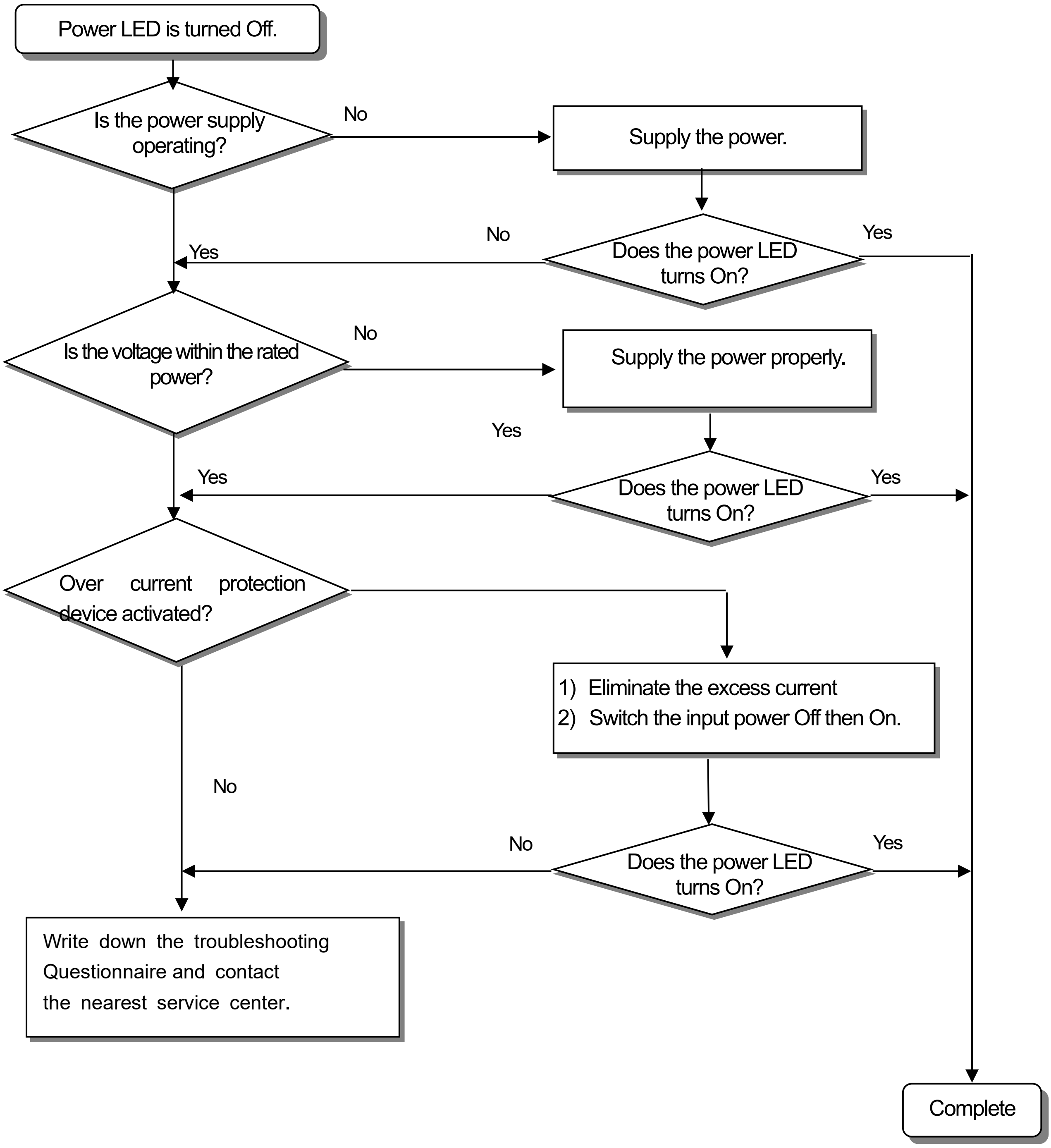
## 6.2 Troubleshooting

This section explains the procedure for determining the cause of troubles as well as the errors and corrective actions.



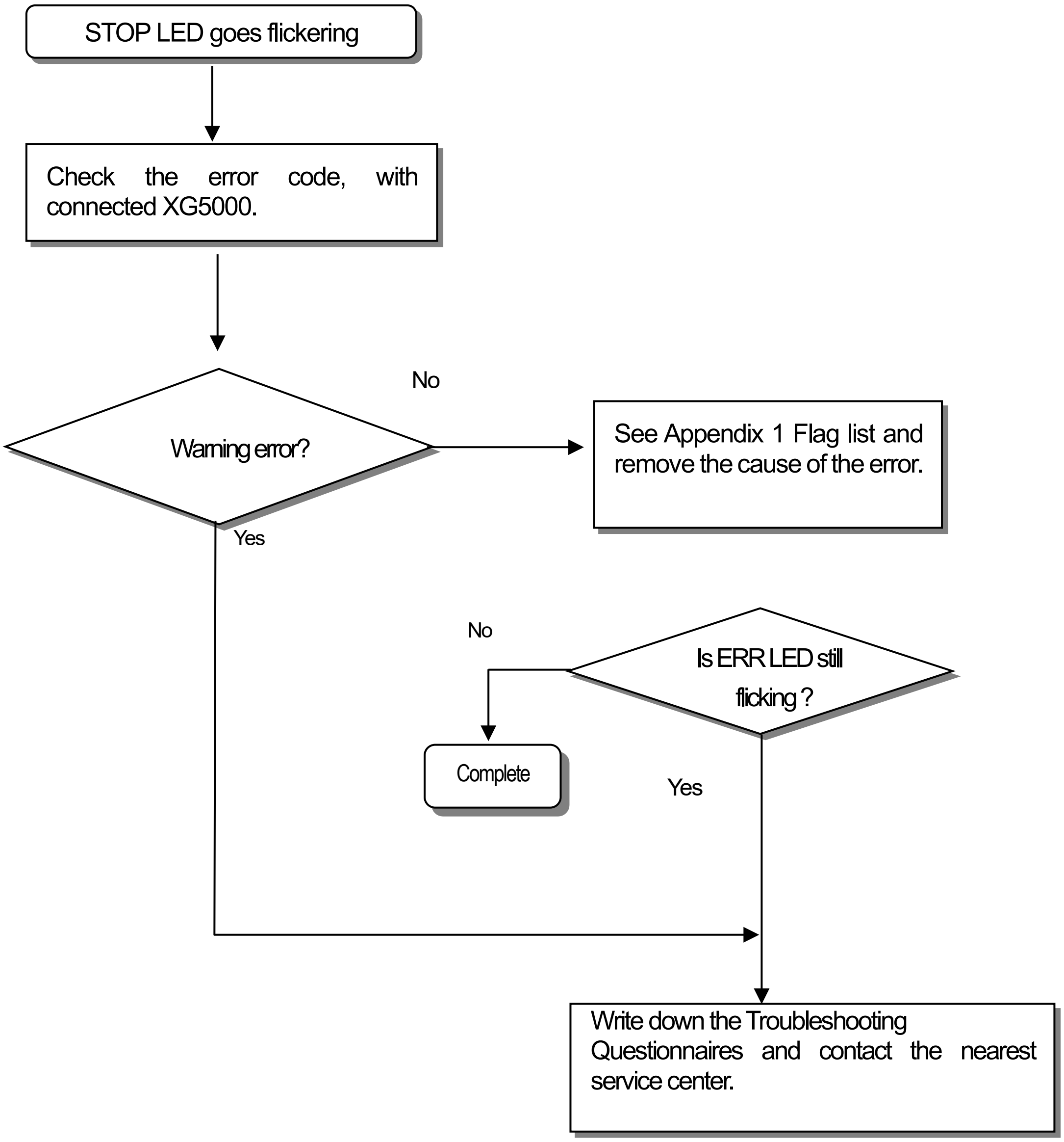
### 6.2.1 Troubleshooting flowchart used when the PWR (Power) LED turns Off

The following flowchart explains corrective action procedure used when the power is supplied or the power LED turns Off during operation.



### 6.2.2 Troubleshooting flowchart used with when the ERR (Error) LED is flickering

The following flowchart explains corrective action procedure used when the power is supplied starts or the ERR LED is flickering during operation.

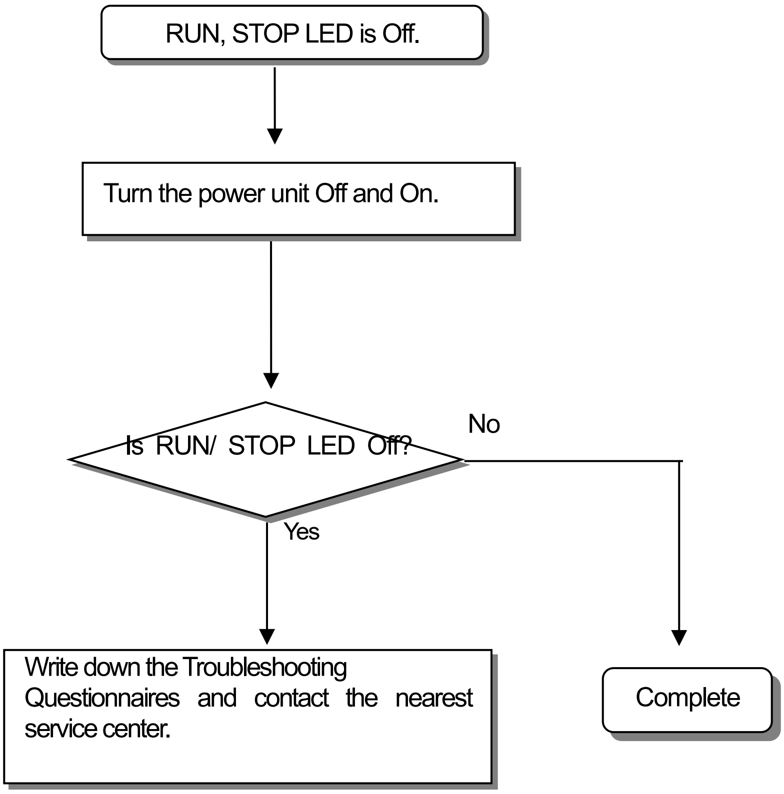


**⚠ Warning**

Though warning error appears, PLC system doesn't stop but corrective action is needed promptly. If not, it may cause the system failure.

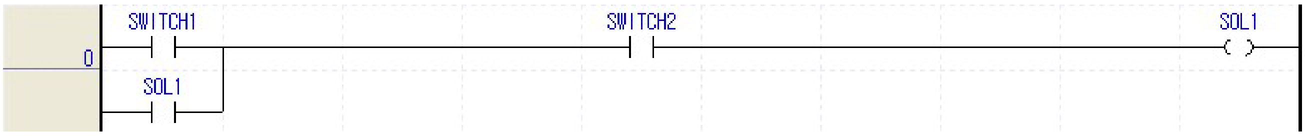
### 6.2.3 Troubleshooting flowchart used with when the RUN , STOP LED turns Off.

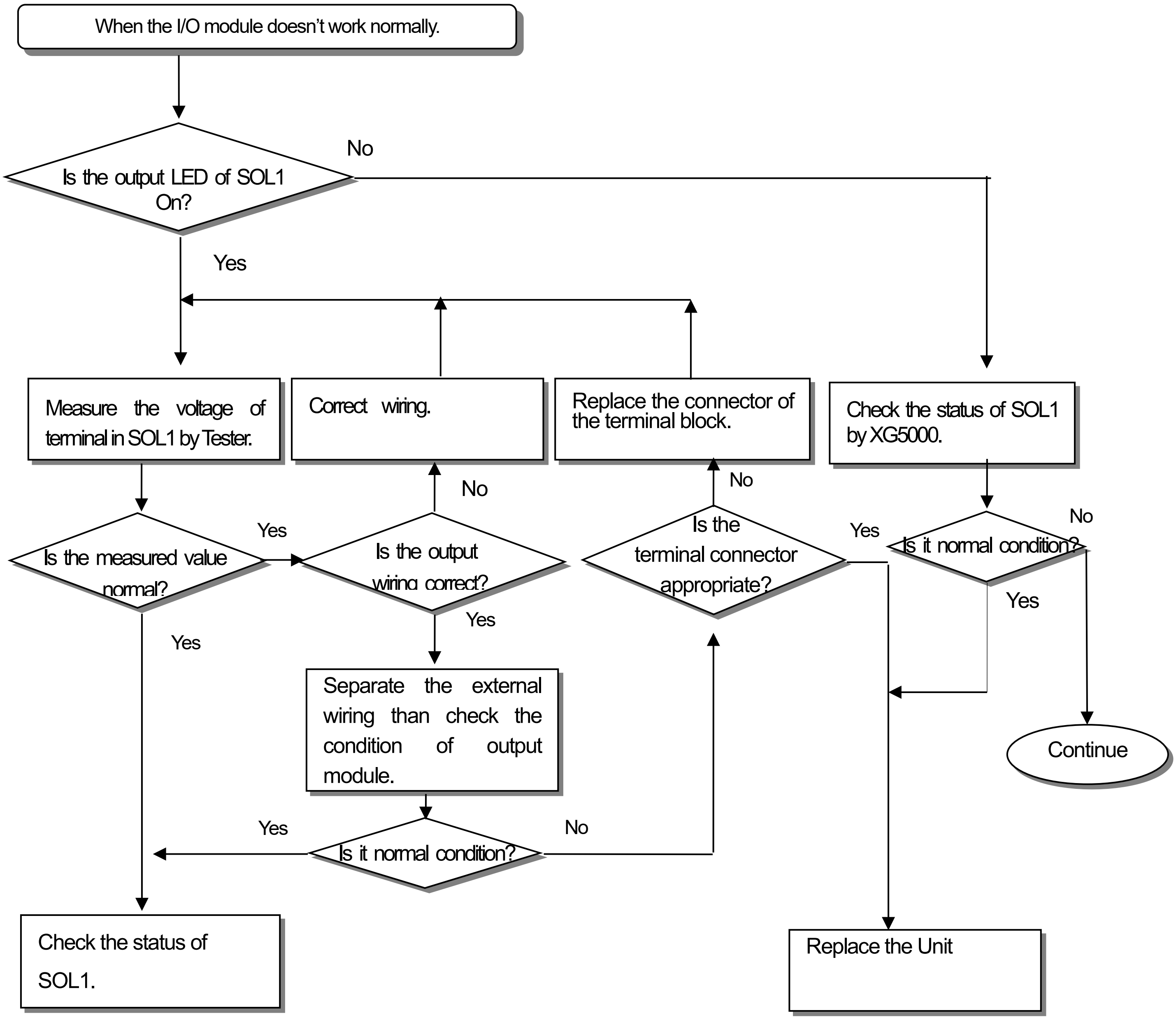
The following flowchart explains corrective action procedure to treat the lights-out of RUN LED when the power is supplied, operation starts or is in the process.

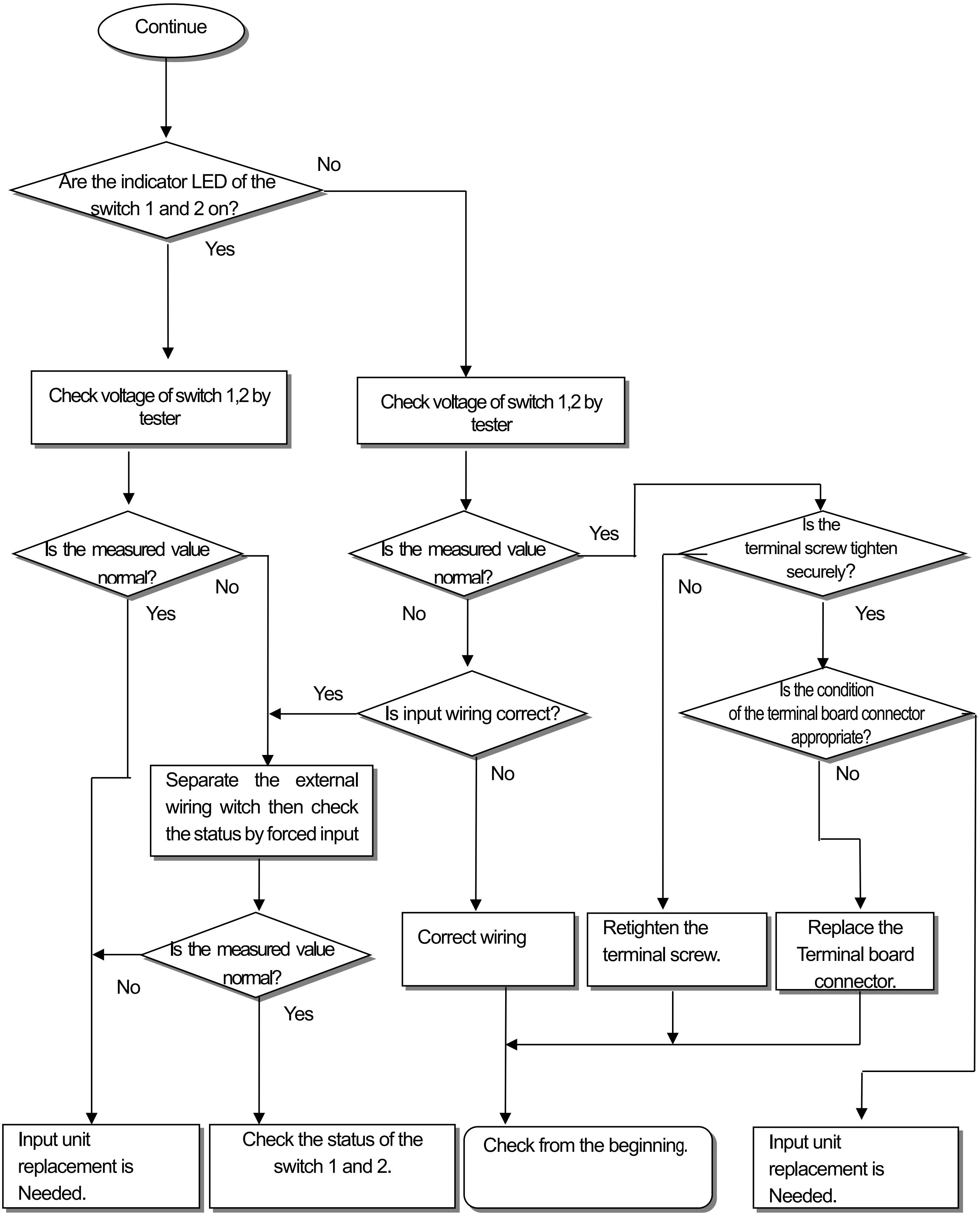


### 6.2.4 Troubleshooting flowchart used when the I/O part doesn't operate normally.

The following flowchart explains corrective action procedure used when the I/O module doesn't operate normally.






Continue
Are the indicator LED of the switch 1 and 2 on?
No
Yes
Check voltage of switch 1,2 by tester
Check voltage of switch 1,2 by tester
Is the measured value normal?
No
Yes
Is the measured value normal?
Yes
No
Is the terminal screw tighten securely?
No
Yes
Yes
Is input wiring correct?
No
Is the condition of the terminal board connector appropriate?
No
Separate the external wiring witch then check the status by forced input
Is the measured value normal?
No
Yes
Correct wiring
Retighten the terminal screw.
Replace the Terminal board connector.
Input unit replacement is Needed.
Check the status of the switch 1 and 2.
Check from the beginning.
Input unit replacement is Needed.

## 6.3 Troubleshooting Questionnaire

If any problem occurs during the operation of XGB series, please write down this Questionnaires and contact the service center via telephone or facsimile.

- For errors relating to special or communication modules, use the questionnaire included in the User's manual of the unit.

1. Telephone & FAX No
   Tell) FAX)
2. Using equipment model:

3. Details of using equipment
   CPU model: ( ) OS version No.: ( ) Serial No. ( )
   XG5000 (for program compile) version No.: ( )

4.General description of the device or system used as the control object:

5. The kind of the base unit:
– Operation by the mode setting switch ( ),
– Operation by the XG5000 or communications ( ),
– External memory module operation ( ),

6. Is the STOP. LED of the CPU module turned On ? Yes ( ), No ( )

7. XG5000 error message:

8. History of corrective actions for the error message in the article 7:

9. Other tried corrective actions:

10. Characteristics of the error
- Repetitive ( ): Periodic ( ), Related to a particular sequence ( ), Related to environment ( )
- Sometimes ( ): General error interval:

11. Detailed Description of error contents:

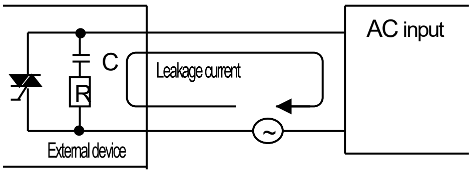
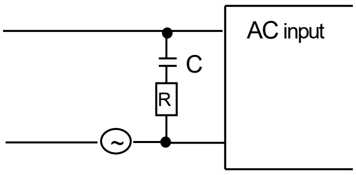
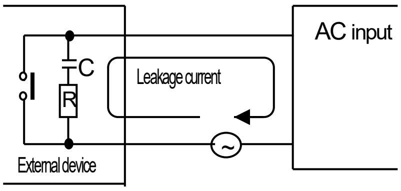
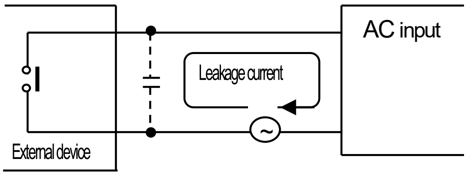
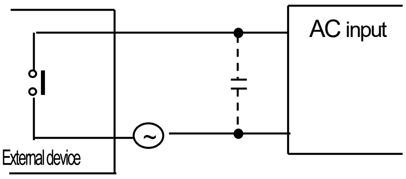
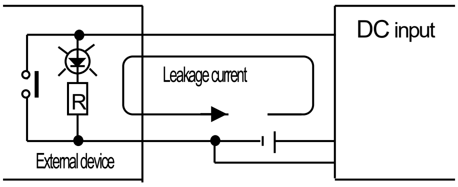
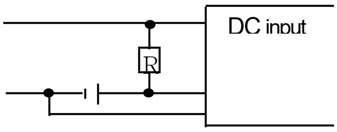
12. Configuration diagram for the applied system:

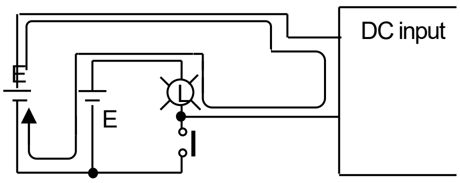
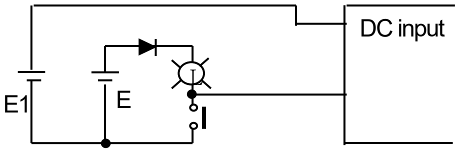
## 6.4 Troubleshooting Examples

Possible troubles with various circuits and their corrective actions are explained.

### 6.4.1 Input circuit troubles and corrective actions

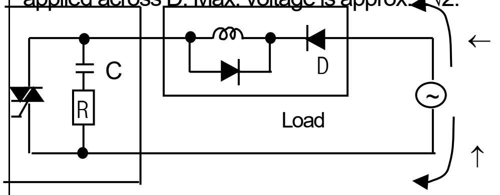
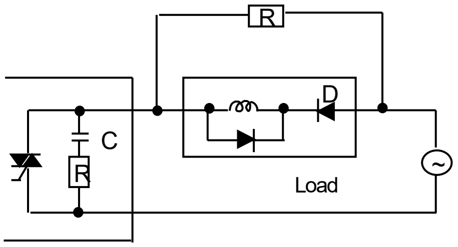
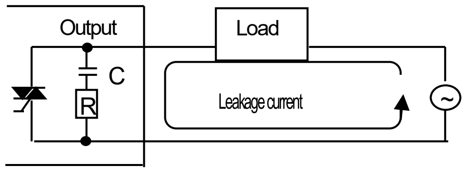
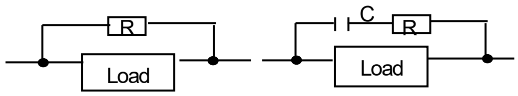
The followings describe possible troubles with input circuits, as well as corrective actions.

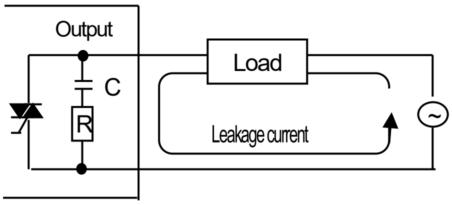
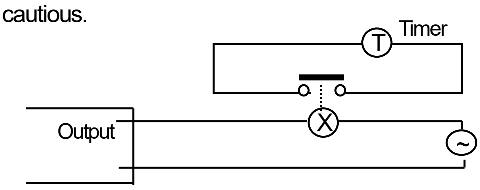
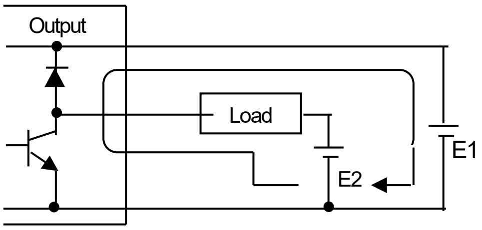
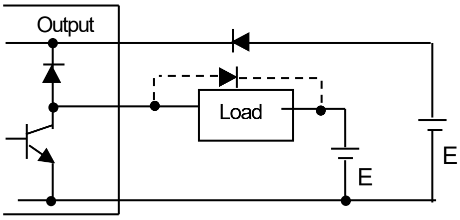
| Condition | Cause | Corrective Actions |
|---|---|---|
| Input signal doesn't turn off. | Leakage current of external device<br>(Such as a drive by non-contact switch)<br> | • Connect an appropriate register and capacity, which will make the voltage lower across the terminals of the input module.<br> <br>• CR values are determined by the leakage current value.<br>– Recommended value C : 0.1 ~ 0.47μF<br>R: 47 ~ 120 Ω (1/2W)<br>Or make up another independent display circuit. |
| Input signal doesn't turn off. (Neon lamp may be still on) | Leakage current of external device<br>(Drive by a limit switch with neon lamp)<br> | |
| Input signal doesn't turn off. | Leakage current due to line capacity of wiring cable.<br> | • Locate the power supply on the external device side as shown below.<br> |
| Input signal doesn't turn off. | Leakage current of external device (Drive by switch with LED indicator)<br> | • Connect an appropriate register, which will make the voltage higher than the OFF voltage across the input module terminal and common terminal.<br> |

| | | |
|---|---|---|
| Input signal doesn't turn off. | • Sneak current due to the use of two different power supplies.<br><br> <br>• E1 > E2, sneaked. | • Use only one power supply.<br>• Connect a sneak current prevention diode.<br><br> |

## 6.4.2 Output circuit and corrective actions

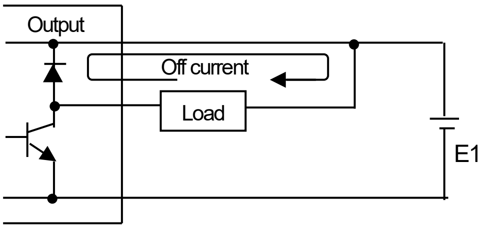
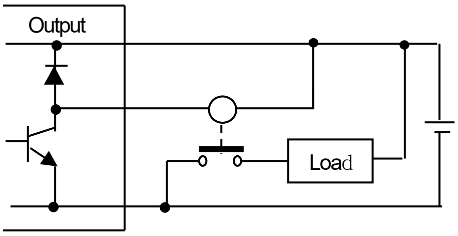
The following describes possible troubles with output circuits, as well as their corrective actions.

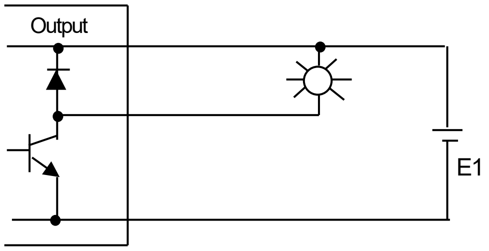
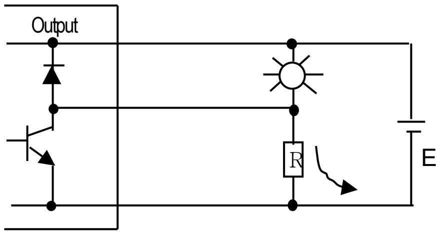
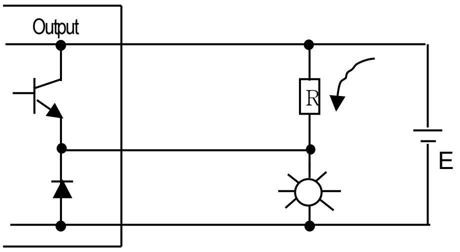
| Condition | Cause | Corrective Action |
|---|---|---|
| When the output is off, excessive voltage is applied to the load. | •Load is half-wave rectified inside (in some cases, it is true of a solenoid)<br>•When the polarity of the power supply is as shown in ①, C is charged. When the polarity is as shown in ②, the voltage charged in C plus the line voltage are applied across D. Max. voltage is approx. 2√2.<br><br> <br>*) If a resistor is used in this way, it does not pose a problem to the output element. But it may make the performance of the diode (D), which is built in the load, drop to cause problems. | • Connect registers of tens to hundreds KΩ across the load in parallel.<br><br> |
| The load doesn't turn off. | • Leakage current by surge absorbing circuit, which is connected to output element in parallel.<br><br> | • Connect C and R across the load, which are of registers of tens KΩ. When the wiring distance from the output module to the load is long, there may be a leakage current due to the line capacity.<br><br> |

| | | |
|---|---|---|
| When the load is C-R type timer, time constant fluctuates. | • Leakage current by surge absorbing circuit, which is connected to output element in parallel.<br><br> | • Drive the relay using a contact and drive the C-R type timer using the since contact.<br>• Use other timer than the C–R contact some timers have half-ware rectified internal circuits therefore, be cautious.<br><br> |
| The load does not turn off. | • Sneak current due to the use of two different power supplies.<br><br> <br>E1<E2, sneaks. E1 is off (E2 is on), sneaks. | • Use only one power supply.<br>• Connect a sneak current prevention diode.<br><br> <br>If the load is the relay, etc, connect a counter-electromotive voltage absorbing code as shown by the dot line. |

;

Output circuit troubles and corrective actions (continued).

| Condition | Cause | Corrective actions |
|---|---|---|
| The load off response time is long. | • Over current at off state [The large solenoid current fluidic load (L/R is large) such as is directly driven with the transistor output.<br><br> <br>• The off response time can be delayed by one or more second as some loads make the current flow across the diode at the off time of the transistor output. | • Insert a small L/R magnetic contact and drive the load using the same contact.<br><br> |

| | | |
|---|---|---|
| Output transistor is destroyed. | Surge current of the white lamp on.<br><br> <br>A surge current of 10 times or more when turned on. | • To suppress the surge current make the dark current of 1/3 to 1/5 rated current flow.<br><br> <br>Sink type transistor output<br><br> <br>Source type transistor output |

## 6.5 Error Code List

| Error code (Dec) | Error cause | Action (restart mode after taking an action) | Operation status | LED status | Diagnosis point |
|---|---|---|---|---|---|
| 23 | Program to execute is abnormal | Start after reloading the program | Warning | 0.5 second Flicker | RUN mode |
| 24 | I/O parameter error | Start after reloading I/O parameter,<br>Battery change if battery has a problem.<br>Check the preservation status after I/O parameter reloading and if error occurs, change the unit. | Warning | 0.5 second Flicker | Reset<br>RUN mode switching |
| 25 | Basic parameter error | Start after reloading Basic parameter,<br>Change battery if it has a problem.<br>Check the preservation status after Basic parameter reloading and if error occurs, change the unit. | Warning | 0.5 second Flicker | Reset<br>RUN mode switching |
| 26 | Compile error exceed | Reduce the program and down. | Warning | 0.5 second Flicker | RUN mode switching |
| 27 | Compile error | Check the program | Warning | 0.5 second Flicker | RUN mode switching |
| 30 | Module set in parameter and the installed module does not match | modify the module or parameter and then restart. | Warning | 0.5 second Flicker | RUN mode switching |
| 31 | Module falling during operation or additional setup | After checking the position of attachment/detachment of expansion module during Run mode | Heavy error | 0.1 second Flicker | Every scan |
| 33 | Data of I/O module does not access normally during operation. | After checking the position of slot where the access error occurs by XG5000, change the module and restar (acc.to parameter.) | Heavy error | 0.1 second Flicker | Scan end |
| 34 | Normal access of special/link module data during operation not available | After checking the position of slot that access error occurred by XG5000, change the module and restart (acc.to parameter). | Heavy error | 0.1 second Flicker | Scan end |
| 38 | Extension<br>Module exceed | Extension module is attached over 10 slot or communication module is attached over 3 slot | Heavy error | 0.1 second Flicker | RUN mode switching |
| 39 | Abnormal stop of CPU or malfunction | Abnormal system end by noise or hard ware error.<br>1) If it occurs repeatedly when power reinput, request service center<br>2) Noise measures | Heavy error | 0.1 second Flicker | Ordinary time |
| 40 | Scan time of program during operation exceeds the scan watchdog time designated by parameter. | After checking the scan watchdog time designated by parameter, modify the parameter or the program and then restart. | Warning | 0.5 second Flicker | While running the program |

| Error code (Dec) | Error cause | Action (restart mode after taking an action) | Operation status | LED status | Diagnosis point |
|---|---|---|---|---|---|
| 41 | Operation error occurs while running the user program. | Remove operation error → reload the program and restart. | Warning | 0.5 second Flicker | While running the program |
| 44 | Timer index user error | After reloading a timer index program modification, start | Warning | 0.5 second Flicker | Scan end |
| 50 | Heavy error of external device | Refer to Heavy error detection flag and modifies the device and restart. (Acc. Parameter) | Warning | 0.5 second Flicker | Scan end |
| 55 | Task confliction | Check task occurrence | Warning | 1 second Flicker | Every time |
| 60 | E_STOP function executed | After removing error causes which starts E_STOP function in program, power reinput | Warning | 1 second Flicker | While running the program |
| 500 | Data memory backup not possible | If not error in battery, power reinput<br>Remote mode is switched to STOP mode. | Warning | 1 second Flicker | Reset |
| 501 | Abnormal clock data | Setting the time by XG5000 if there is no error | Warning | 1second Flicker | Ordinary time |

# Chapter 7 EMC Standard

The following explains contents, diagnosis and corrective actions for various errors that can occur during system operation.

## 7.1 Requirements for Conformance to EMC Directive

The EMC Directive specifies that “The products must be constructed so that they do not cause excessive electromagnetic interference (emissions) and are not unduly affected by electromagnetic interference (immunity)”. The applicable products are requested to meet these requirements.
This section summarizes the precautions on conformance to the EMC Directive of the machinery assembled using PLC XGB series. The details of these precautions are based on the requirements and the applicable standards control. However, LS ELECTRIC will not guarantee that the overall machinery manufactured according to these details conforms to the below-described directives. The method of conformance to the EMC directive and the judgment on whether or not the machinery conforms to the EMC Directive must be determined finally by the manufacturer of the machinery.

### 7.1.1 EMC Standard

The standards applicable to the EMC Directive are listed below.

| Specification | Test item | Test details | Standard value |
|---|---|---|---|
| EN50081-2 | EN55011 Radiated noise *2 | Electromagnetic emissions from the product are measured | 30~230 ㎒ QP : 50 ㏈㎶/m *1<br>230~1000 ㎒ QP : 57 ㏈㎶/m |
| | EN55011 Conducted noise | Electromagnetic emissions from the product to the power line is measured | 150~500 ㎑ QP : 79 ㏈ Mean: 66 ㏈<br>500~230 ㎒ QP : 73 ㏈ Mean: 60 ㏈ |
| EN61131-2 | EN61000-4-2<br>Electrostatic immunity | Immunity test in which static electricity is applied to the case of the equipment | 15 ㎸ Aerial discharge<br>8 ㎸ Contact discharge |
| | EN61000-4-4<br>Fast transient burst noise | Immunity test in which burst noise is applied to the power line and signal lines | Power line: 2 ㎸<br>Digital /O : 1 ㎸<br>Analog I/O, signal lines: 1 ㎸ |
| | EN61000-4-3<br>Radiated field AM modulation | Immunity test in which field is irradiated to the product | 10Vm,26~1000 ㎒<br>80%AM modulation@ 1 ㎑ |
| | EN61000-4-12<br>Damped oscillatory wave immunity | Immunity Testing of Fluctuating Damped Oscillation in Electric Power Line | Power line: 1 ㎸<br>Digital I/O (24V or higher): 1 ㎸ |

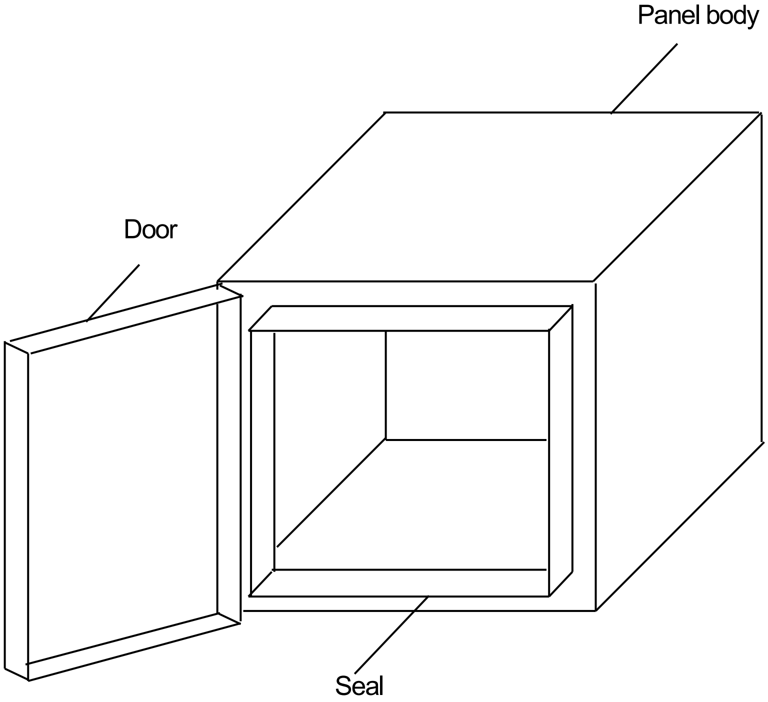
*1) QP: Quasi-peak value, Mean: Average value

*2) The PLC is an open type device (device installed to another device) and must be installed in a conductive control panel. The tests for the corresponding items were performed while the PLC was installed inside a control panel.

### 7.1.2 Control Panel

The PLC is an open type device (device installed to another device) and must be installed in a control panel. This is needed to prevent electric shock by touching XGB PLC and reduce the PLC-generated noise. Install the XGB PLC in a metallic panel to reduce PLC-generated EMI (Electro-magnetic interference),
The specifications for the control panel are as follows:

(1) Control panel
The PLC control panel must have the following features:
(a) Use SPCC (Steel Plate Cold Commercial) for the control panel.
(b) The steel plate should be thicker than 1.6mm.
(c) Use isolating transformers to protect the power supply from external surge voltage.
(d) The control panel must have a structure which the radio waves do not leak out. For example, make the door as a box-structure so that the panel body and the door are overlapped each other. This structure reduces the surge voltage generate by PLC.

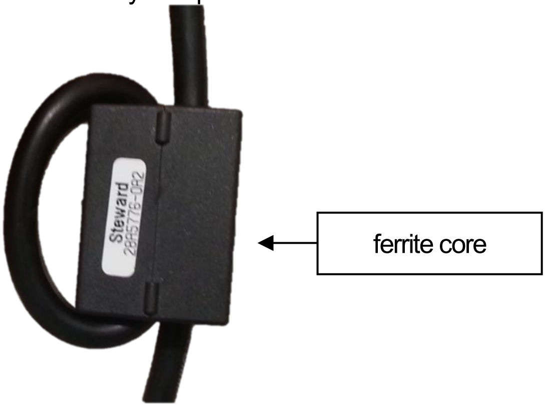


(e) To ensure good electrical contact with the control panel or base plate, mask painting and weld so that good surface contact can be made between the panel and plate.

(2) Connection of power and earth wires

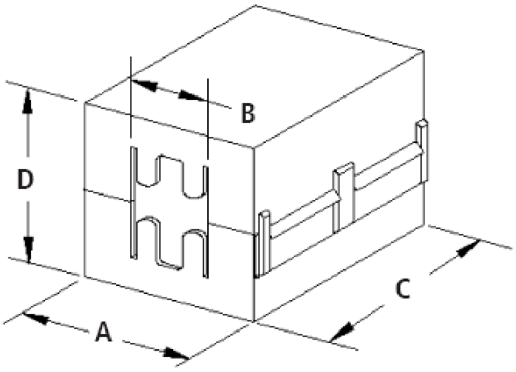
Earthing and power supply wires for the PLC system must be connected as described below.

(a) Earth the control panel with a thick wire so that a low impedance connection to ground can be ensured even at high frequencies.
(b) The function of LG (Line Ground) and FG (Frame Ground) terminals is to pass the noise generated in the PLC system to the ground, so an impedance that is as low as possible must be ensured.
(c) The earthing wire itself can generate the noise, so wire as short and thick to prevent from acting as an antenna.
(d) Attach ferrite core to the power cable like a picture below to satisfy CE specification.



［ferrite core］

| Manufacturer | Product name | External Dimension (mm) | | | | maximum cable diameter (mm) | address |
|---|---|---|---|---|---|---|---|
| | | A | B | C | D | | |
| Laird | 28A3851-0A2 | 30.00 | 13.00 | 33.70 | 30.00 | 12.85 | www.lairdtech.com |
| Laird | 28A5776-0A2 | 29.20 | 20.00 | 42.00 | 42.00 | 19.40 | www.lairdtech.com |
| Coilmaster | C2L RU130B | 31.50 | 13.00 | 33.00 | 31.50 | 13.00 | www.coilmaster.com.tw |
| TDK | ZCAT3035-1330 | 30.00 | 13.00 | 34.00 | 30.00 | 13.00 | www.tdk.com |



## 7.2 Requirement to Conform to the Low-voltage Directive

The low-voltage directive requires each device that operates with the power supply ranging from 50V to 1000VAC and 75V to 1500VDC to satisfy the safety requirements. Cautions and installation and wiring of the PLC XGB series to conform to the low-voltage directive are described in this section.
The described contents in this manual are based on the requirements and the applicable standards control. However, LS ELECTRIC will not guarantee that the overall machinery manufactured according to these details conforms to the above regulation. The method of conformance to the low-voltage directive and the judgment on whether the machinery conforms to the low-voltage directive must be determined by the manufacturer of the machinery.

### 7.2.1 Standard Applied for XGB Series

The XGB PLC complies with EN6100-1 (safety of equipment used in measurement and control laboratories.)
XGB series PLCs have been developed in accordance with the above standards for modules operating at rated voltage of AC50V / DC75V or higher.

### 7.2.2 XGB Series PLC Selection

(1) Main Unit

Since the rated voltage of the main unit is less than the DC24V rating, it is outside the scope of the low voltage directive.

(2) I/O module

There are dangerous voltages (voltages higher than 42.4V peak) inside the I/O modules of the AC110/220V rated I/O voltages.
Therefore, the CE mark-compliant models are enhanced in insulation internally between the primary and secondary.
The I/O modules of DC24V or less rating are out of the low-voltage directive application range.

(3) Special module, Communication module

The special module and communication modules are DC24V or less in rated voltage, therefore they are out of the low-voltage directive application range.

# Part 2. Basic Functions

# Chapter 1 Program Configuration and Operation Method

This Chapter covers the details of programming and operations, monitoring function of main unit

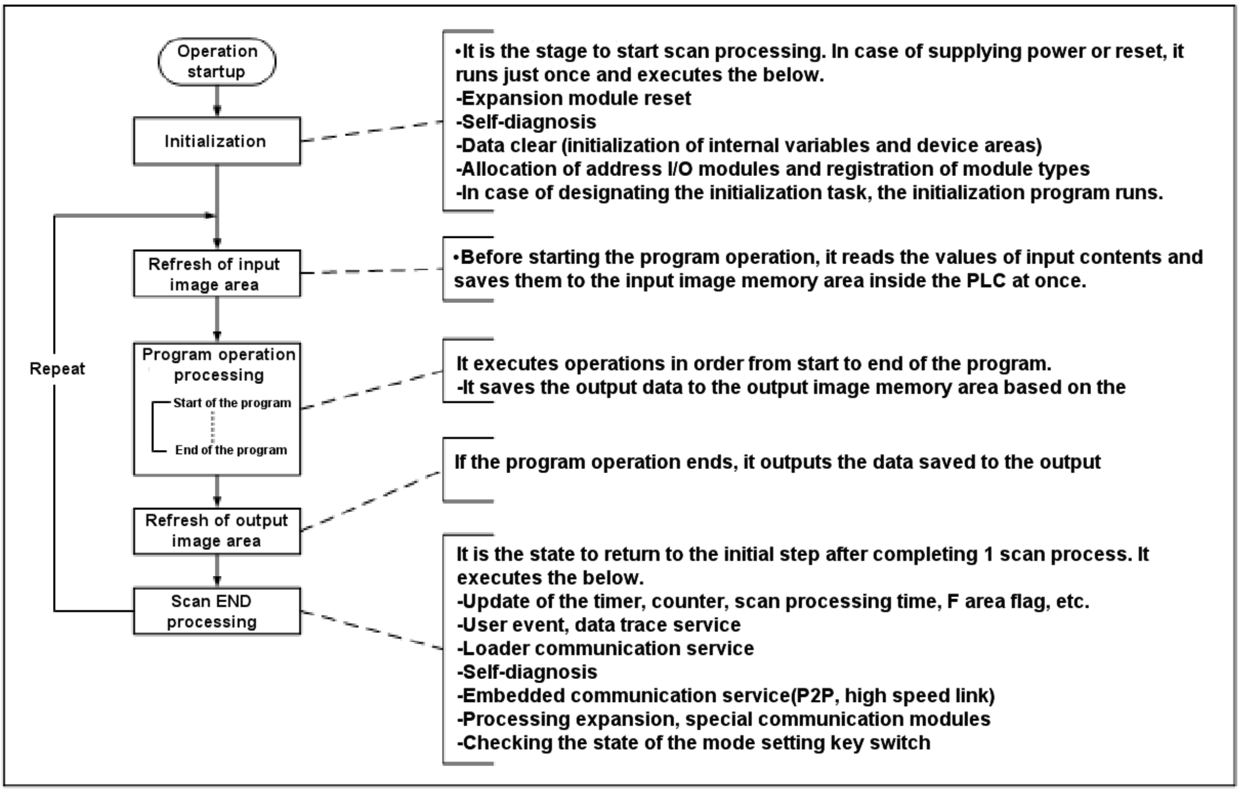
## 1.1 Programming Basics

### 1.1.1 Programming Method

The main unit supports programming method of repetitive operation, interrupt operation, and fixed operation.

(1) Repetitive operation mode (Scan)

It means the basic programming method of the PLC.
It is the method that performs the written program repetitively from the first step to the last one and a series of such procedures is called 'program scan'. A series of such processing is called the repetitive operation mode and it can be divided as below.



•It is the stage to start scan processing. In case of supplying power or reset, it runs just once and executes the below.
-Expansion module reset
-Self-diagnosis
-Data clear (initialization of internal variables and device areas)
-Allocation of address I/O modules and registration of module types
-In case of designating the initialization task, the initialization program runs.

•Before starting the program operation, it reads the values of input contents and saves them to the input image memory area inside the PLC at once.

It executes operations in order from start to end of the program.
-It saves the output data to the output image memory area based on the

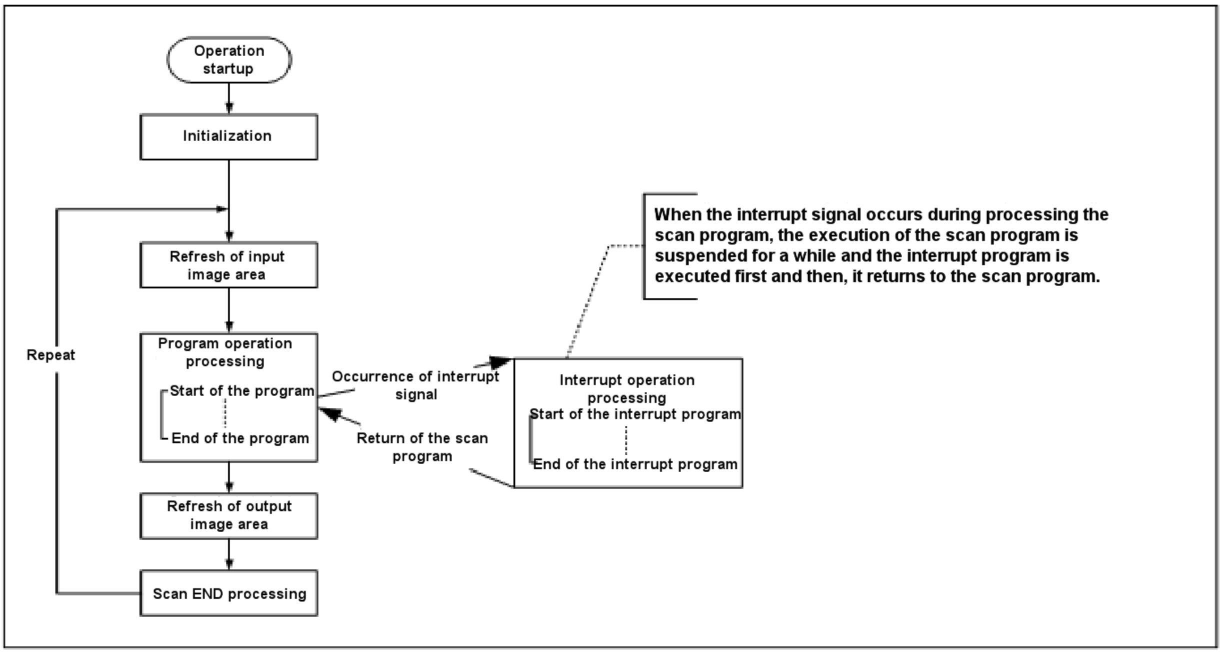
If the program operation ends, it outputs the data saved to the output

It is the state to return to the initial step after completing 1 scan process. It executes the below.
-Update of the timer, counter, scan processing time, F area flag, etc.
-User event, data trace service
-Loader communication service
-Self-diagnosis
-Embedded communication service(P2P, high speed link)
-Processing expansion, special communication modules
-Checking the state of the mode setting key switch

(2) Interrupt operation mode (fixed cycle, external interrupt, internal device start, high speed counter, positioning control)

It is the mode that suspends the currently executed scan program operation and handles the interrupt program immediately when urgent priority matter occurs during execution of the PLC scan program. The signals that inform the CPU of such interrupt occurrence is called 'interrupt signal' and there are 4 kinds as below.
For more details on each interrupt operation, refer to Section 1.1.5 ~ 1.1.10.
(For the positioning interrupt operation method, refer to Part 3. Embedded Positioning)

- Fixed cycle signal: Interrupt signal occurring at the fixed interval
- External input signal: External contact (P0000~00007) input signal
- Internal device: In case the internal device value is matched with the set occurrence condition
- High speed counter: In case the current value of high speed counter is matched with the set value
- Position : An interrupt signal generated at a predetermined time interval



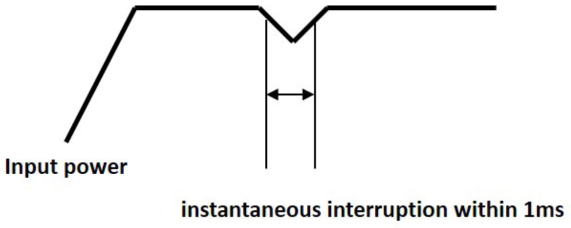
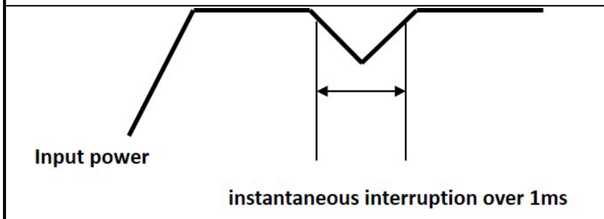
(3) Fixed Cycle Operation mode

It is the mode that executes the scan program every fixed time.
After executing all scan programs, it stands by until the fixed cycle time and then, the next scan will resume at the specified time.
At this time, the current scan time displayed in F area indicates the net program processing time except waiting time.
If the actual scan program processing time is longer than the fixed cycle, fixed cycle error flag will be turned on.
The flags related to fixed cycle operation are as below.

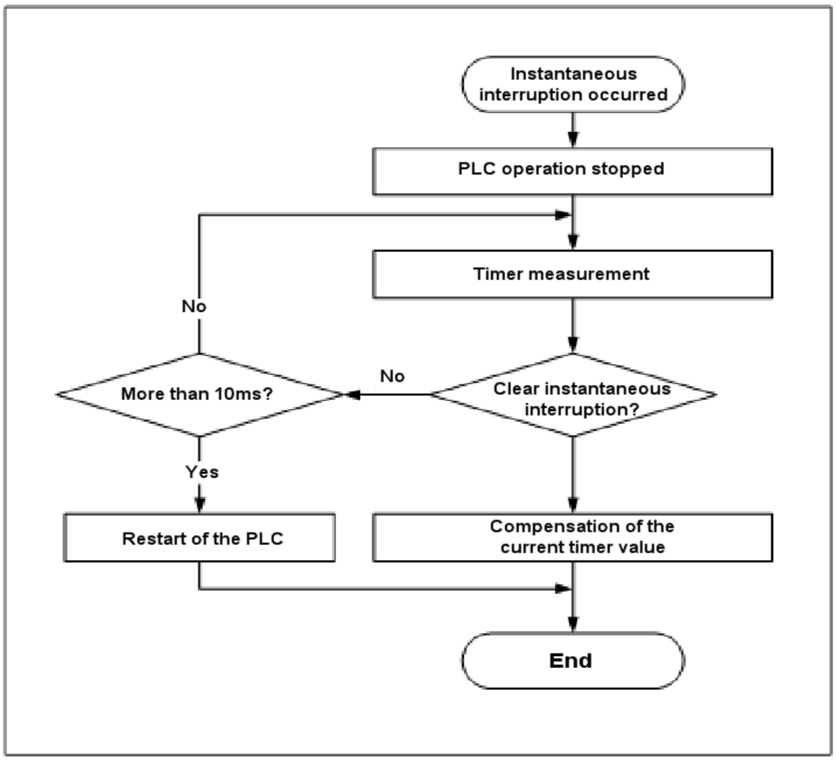
| Bit | Flag Name | Name | Description |
|---|---|---|---|
| F005C | _CONSTANT_ER | Fixed cycle error | In case the actual scan time is longer than the fixed cycle set value |
| F0080 | _CONSTANT_RUN | Fixed cycle operation is running | Turned ON during fixed cycle operation |

### 1.1.2 Execution processing in case of instantaneous interruption

If the input power voltage supplied to basic unit is lower than the specification, the PLC will detect instantaneous interruption. When the PLC detects instantaneous interruption, the following execution will be processed.

| Blackout time | Execution processing |
|---|---|
|  | (1) Execution is interrupted, maintaining output state of when instantaneous interruption occurred.<br>(2) If instantaneous interruption is canceled, execution will resume.<br>(3) In case execution is suspended due to instantaneous interruption, timer measurement and one for fixed cycle interrupt will be continuously run. |
|  | (1) If instantaneous interruption exceeds 1ms, the PLC will execute restart like the time when power is supplied. |

The below figure shows the PLC's execution processing flow chart when instantaneous interruption occurs.



**Notice**

Instantaneous interruption means the state that the PLC exceeds the allowable variation rage of the specified power and is lower than the range. The brief (several ms ~ dozens of ms) blackout is called instantaneous interruption.

### 1.1.3 Scan Time

The scan time is the time that takes to complete a single control operation from step 0 of the full scan program to step 0 of the next scan; it is directly related to the system's control performance.

(1) Scan time formula

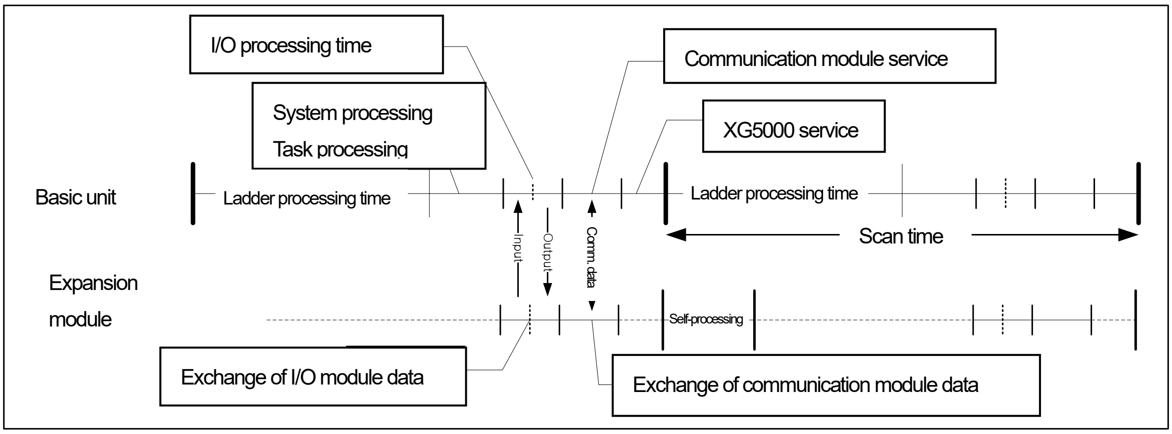
The scan time is the sum of the process time of the scan program and interrupt program written by a user and the PLC's internal END processing time; it can be calculated by the formula below.

(a) Scan time = scan program processing time + interrupt program processing time + PLC internal processing time

- Scan program processing time = Processing time of the user program excluding the interrupt program
- Interrupt program processing time = Sum of the interrupt program running time processed for 1 scan
- PLC internal processing time = Self-diagnosis time + I/O refresh time + internal data processing time + communication service processing time (processing XG5000 service and embedded communication)

| **Model** | **MPU processing time** | | **Expansion interface processing time** | | |
|---|---|---|---|---|---|
| | **Scan program running (20K)** | **PLC internal Processing time** | **Digital I/O module (32 points, 1 EA)** | **Analog module (8 channels, 1EA)** | **Communication module (200 byte, 1 block)** |
| XBM-DN32HP | 7.2 ㎳ | 0.8㎳ | 0.3㎳ | 2.0㎳ | 0.8㎳ |

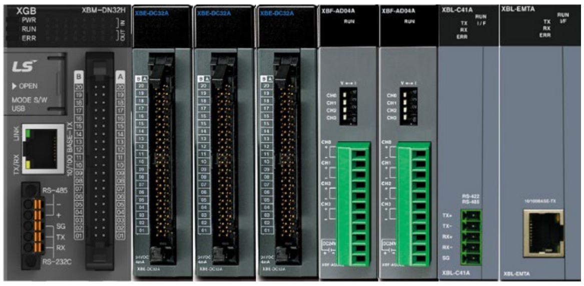
XBM H2/HP unit performs the control operation based on the sequence below. Accordingly, you can roughly estimate the control performance of the system to be designed by using the calculation method below.



Scan time = Ladder processing time + system processing time + digital module I/O processing time + analog I/O processing time + communication module processing time + XG5000 Service processing time

(2) Example of calculating the scan time

The example of the PLC's system configuration and the calculation result of the scan time are as follows.



| Items | System Configuration | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Basic unit | SLOT2 | SLOT3 | SLOT4 | SLOT5 | SLOT6 | SLOT7 | SLOT8 |
| Product name | XBM-DN32HP | XBE-DC32A * 3EA | | | XBF-AD04A * 2EA | | XBL-C41A | XBL-EMTA |
| Operating conditions | 20kStep | - | | | - | | 200 Byte per module, 1 block | |

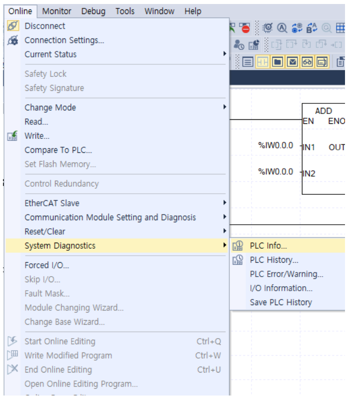
Scan time= Ladder processing time + system processing time + digital I/O processing time
+ analog I/O processing time + communication module processing time + XG5000 Service
processing time = 7.2 + 0.8 + 0.3*3 + 2.0*2 + 0.8*2 +0.1= 14.6ms

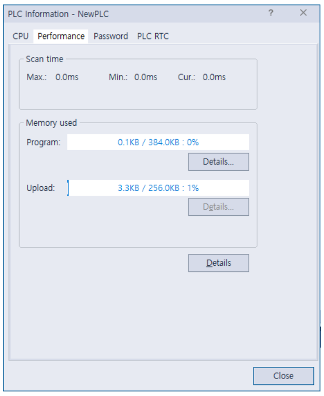
However, in the event of changing during RUN or writing communication parameters with XG5000, it requires converting the program changed during RUN into executable machine code in the PLC or other internal processing operations for changed communication parameters so the scan time may be temporarily increased by several ms or more.

(3) Verification of the scan time

The PLC's scan time can be verified by using XG5000 or flag as below.

(a) How to use XG5000: Click『Online』-『System Diagnosis』-『PLC Info.』-『Performance』.





Max.: 0.0ms Min.: 0.0ms Cur.: 0.0ms

Program: 0.1KB / 384.0KB : 0%

Upload: 3.3KB / 256.0KB : 1%

(b) How to use flag : The scan time is saved in the system flag (F) area below.

| WORD | Flag Name | Name | Description |
|---|---|---|---|
| F0050 | _SCAN_MAX | Maximum scan time | The longest scan time<br>(update in case of occurrence only), in 0.1ms |
| F0051 | _SCAN_MIX | Minimum scan time | The shortest scan time<br>(update in case of occurrence only), in 0.1ms |
| F0052 | _SCAN_MAX | Current scan time | Running time of this scan (scan update), in 0.1ms |

### 1.1.4 Program Composition

The program consists of all the function factors required to perform a specific control and they are saved in the basic unit's internal RAM or flash memory. The function factors to execute the program can be generally divided as below.

| Function factors | Executing details |
|---|---|
| Initialization program | • After applying power, the initialization program is firstly executed after completing the self-initialization operations required to operate the PLC. It should run until the INIT_DONE command executes.<br>•When the initialization program runs, only the initialization program is available until the INIT_DONE command runs; the scan program and fixed cycle, external interrupt, internal device task program are not executed. All other embedded functions such as I/O refresh, high speed counter, communication are executed normally.<br>• It is used to program various operations required for the initial settings of the system configured with the XGB PLC. |
| Scan program | •Repeated regularly at every scan. It performs the operation repetitively from the first step to the last step in order of being written.<br>•If the fixed cycle interrupt, external contact interrupt, or high speed counter interrupt occurs during execution of the scan program, it will stop the scan program and return to the scan program after executing the relevant interrupt program. |
| Fixed cycle interrupt program | •Executed at every set cycle regardless of the scan program. It can be applied to execute the following time conditions.<br>▸ Execution at the shorter time interval than 1 scan processing time<br>▸ Execution at the longer time interval than 1 scan processing time<br>▸ Execution at the fixed time interval |
| External contact interrupt program | • Executed every time the input conditions (rising edge, falling edge, transition) of the set external input signal occur. It can be applied when immediate execution is required for external input conditions. |
| High speed counter interrupt program | •Executed when the high speed counter's current value is matched with the set value. |
| positioning interrupt program | •refer to Part 3 Built-in Positioning |
| Internal device interrupt program | •Executed when the set internal device is matched with relational conditions.<br>•Detects whether starting conditions of the internal device interrupt occurs during END after executing the scan program |
| Subroutine program | • Executed only when the input condition of the CALL command is On. |

**Notice**

1) Make the interrupt program as short as possible. In case the same interrupt occurs repeatedly during executing the interrupt program, O/S watchdog error may occur with non-execution of the scan program.
(In case the self-interrupt occurs during executing the interrupt program, task conflict error may occur.)
2) Although interrupts with low priority occur several times during executing the one with high priority, the interrupt will run just once. So you should pay attention to set up the priority.

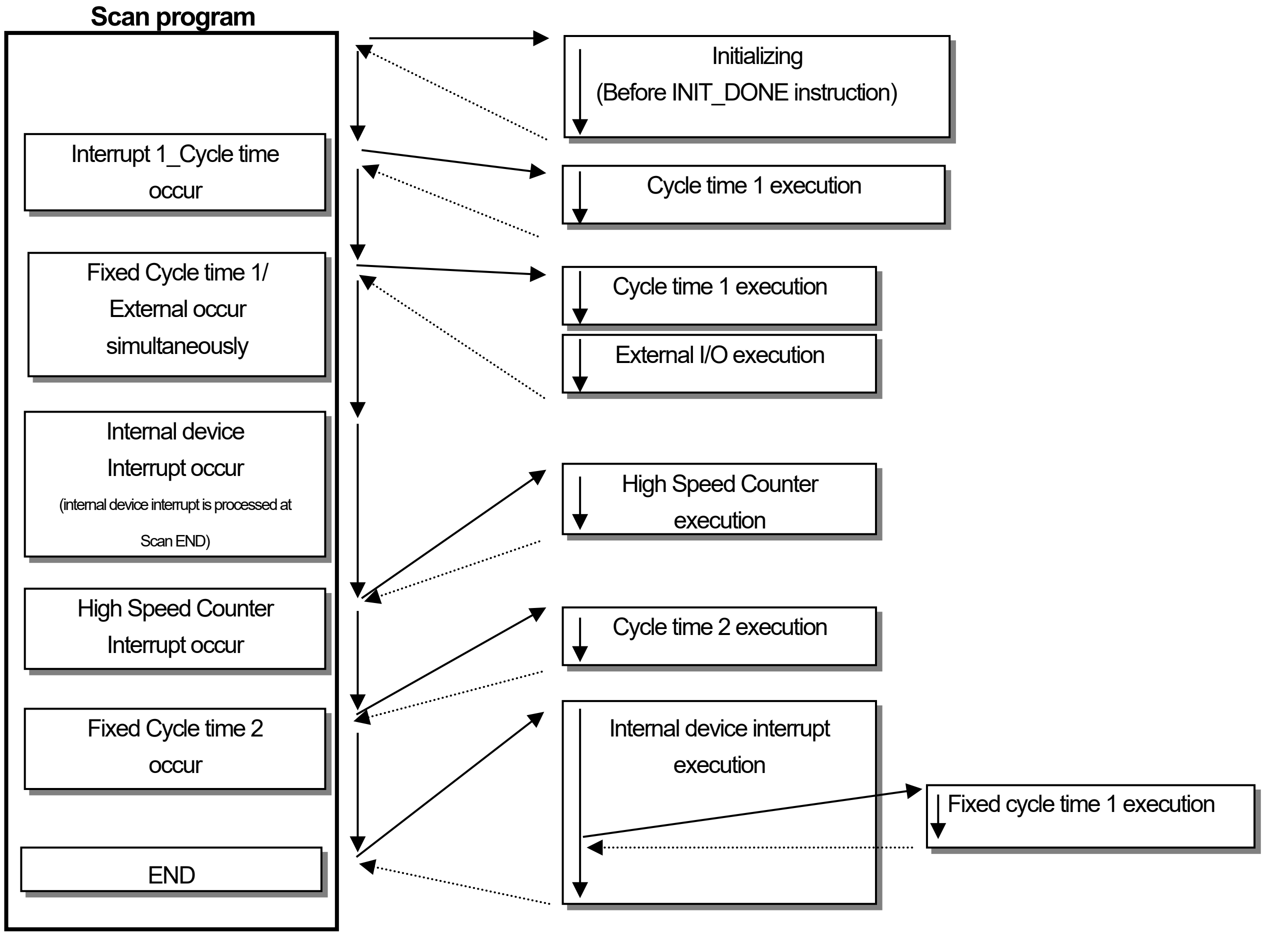
## 1.1.5 Interrupt

(1) Interrupt processing flow chart

It describes the PLC's operation flow chart, giving you the example of setting the interrupt program as below.

- Interrupt setting

| Interrupt type | Interrupt Name | Priority | Task No. | Program Name |
|---|---|---|---|---|
| Initialization | Interrupt0 | - | - | Initialization program |
| Fixed cycle 1 | Interrupt1 | 2 | 0 | Fixed cycle 1 |
| External | Interrupt2 | 2 | 16 | External |
| Internal device | Interrupt3 | 3 | 24 | Internal device |
| High speed counter | Interrupt4 | 4 | 40 | High speed counter |
| Fixed cycle 2 | Interrupt5 | 3 | 1 | Fixed cycle 2 |



**Notice**

1) If the interrupt with the same priority occur at the same time, the early set interrupt will be executed first.
   (In case 'interrupt 1'and 'interrupt 2'occur at the same time, 'interrupt1'will be executed first.)
2) If the interrupt with higher priority occurs during execution of interrupts, the interrupt with higher priority will be executed first.
3) All interrupts are allowable (Enable) when the power is On. If you want to run interrupt by program or to prohibit them, you can use EI, DI command.
4) The internal device interrupt will run after getting the END command.

(2) Types and operation standards of tasks

The types and operation standards of tasks that are available for the PLC are as below.

| Type / Spec. | Fixed cycle task | External contact task | Internal contact task | High speed counter task | positioning task |
|---|---|---|---|---|---|
| Maximum number | 16 EA | 8 EA | 16 EA | 4 EA | 1EA |
| Start conditions | Fixed cycle (Can be set up to 4,294,967.295 seconds, in 1ms ) | Rising or falling edge of the basic unit P000~P007 input contacts | Internal device's designated conditions | High speed counter comparative output 0 / The minimum set value is matched | Fixed cycle (can be set up to 10ms in 1ms increments) |
| Detection and Execution | Executed cyclically at every setting time | Executed immediately when the edge of the basic unit P008~P00F input contacts occur | Executed with searching conditions after completing the scan program | Executed when the current counter value is matched with the minimum set value of the comparative output 0 | Executed cyclically at every setting time |
| Detection delay Time | Delayed for the maximum of 1ms | Within the maximum of 0.05㎳ | Delayed as much as the maximum scan time | Within the maximum of 0.25㎳ | Delayed for the maximum of 1ms |
| Priority of executions | 2 ~ 7 level setting (2 level has the highest priority) | Same as the left | Same as the left | Same as the left | Cannot set priority (Has a higher priority than other tasks) |
| Task No. | Designated without overlapped users in the range of 0~15 | Designated without overlapped users in the range of 16~23 | Designated without overlapped users in the range of 24~39 | Designated without overlapped users in the range of 40~43 | 44 |

(3) Processing method of the task program

It describes the common processing methods and instructions for the task program.

(a) Characteristics of the task program

- In contrast with the scan program, the task program runs only when the execution conditions occur without repetition processing. When writing the task program, consider this point.

For example, if the timer and counter are applied to the task program with the fixed cycle of 10 seconds, the maxim error of 10 seconds may occur in the timer. The counter reflects the input state every 10 seconds so the input that changed within 10 seconds is not counted.

(b) Execution priority

- In case several tasks to be executed stand by, the task program with high priority should be processed first. If the tasks with the same priority stand by, they should be processed in order of occurrence.
- When the fixed cycle task and external contact task occur at the same time, the task set early by XG5000 will be executed by priority.
- Set up the priority of the task programs in consideration of characteristics, importance of the programs and urgency of required executions.

(c) Processing delay time

The delay of task program processing is caused by the below causes. Consider these factors when setting up tasks and writing programs.

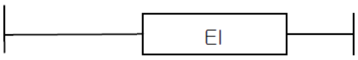
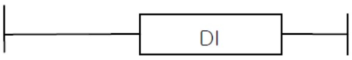
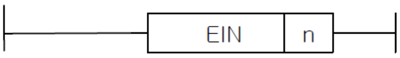
- Delayed detection of tasks (Refer to the detailed description of each task.)
- Program execution delay due to execution of the preceding task program
- Input/output data refresh of expansion special module

(d) Relation between the initialization, scan program and the task program

- When executing the initialization task program, the fixed cycle, external contact, high speed counter, internal contact task cannot be started.
- The scan program has the lowest priority so when the task occurs, the scan program will be suspended and the task program will be executed preemptively. Accordingly, in case the tasks occur frequently during one scan or they converge intermittently, the scan time may be extended abnormally. You should consider this point when setting tasks.

(e) Protection of the currently running scan program by prohibiting tasks execution

- If you do not want the scan program to be suspended by the task program with high priority during executing the scan program, you can partially prohibit the execution of task programs by using the below DI, EI command in order to protect the scan program.
(When the power is supplied to the PLC, the initial values of all tasks are EI (allowable) state.)

| Command | Use | Description |
|---|---|---|
| EI |  | Allows the start of all tasks. |
| DI |  | Prohibits the start of all tasks. |
| EIN |  | Allows the start of the task designated as n. |
| DIN |  | Prohibits the start of the task designated as n. |

(4) Verification of task program

After writing the task program, verify it based on the following instructions.

(a) Are the occurrence conditions of tasks proper?

If tasks occur frequently beyond necessity or if several tasks occur in one scan, the scan time may be extended or become irregular. / If you cannot change task settings, check the maximum scan time.

(b) Are the priorities of tasks arranged well?

The task program with low priority may be delayed and fail to be executed in time due to the task program with high priority, in some cases, the pending tasks occur redundantly during execution of the preceding tasks so it may lead to tasks conflicts.

Set up the priority in consideration of urgency, running time, etc. of tasks.

(c) Are task programs made as shortly as possible?

Long running time of the task program can cause the long or irregular scan time or may lead to the conflict of task programs. Make the task programs as shortly as possible.

Especially, when attaching expansion special module, or using PUT,GET instructions, program processing might be delayed.( More than 10ms task cycle is recommended).

When making the task program with fixed cycle, the task program should be executed within 10% of the operation cycle of the shortest task among several tasks.

Ex.) When the task program's running time is 1ms, the fixed cycle time should be more than 10ms.

(d) Is the protection of the program needed for the task with high priority during execution of the program?

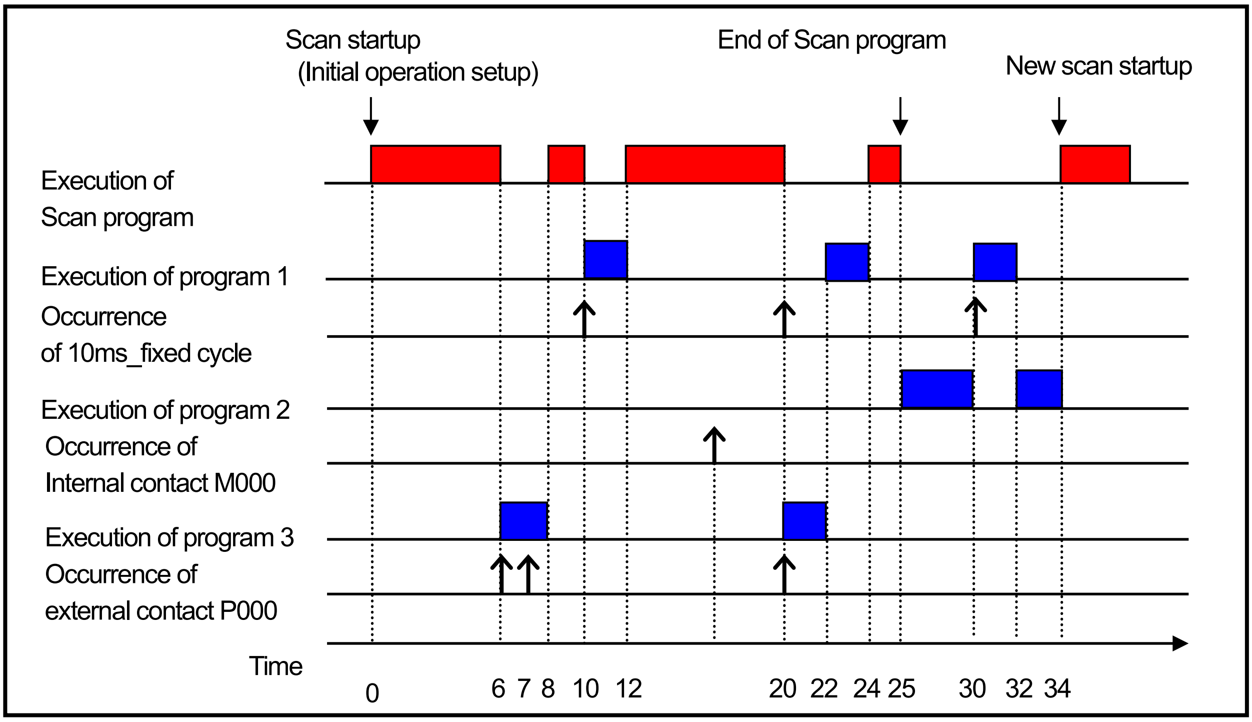
If the other task interrupts during execution of the task program, after the executing task is completed, among pending tasks, the one will run in order of priority. If you do not want interruption of other tasks during execution of the task program, protect the program with DI, EI applied commands.

(5) Example of program configuration and processing

The example of the program execution sequence is given under the registered tasks and programs as below.

- Registered task programs

| Interrupt source | Interrupt Name | Priority | Task No. | Program Name | running time |
|---|---|---|---|---|---|
| Fixed cycle | 10㎳_fixed cycle | 3 | 0 | Program1 | 2ms |
| Internal contact | Internalcontact_M00 | 5 | 24 | Program2 | 7ms |
| External contact | Externalcontact_P08 | 2 | 16 | Program3 | 2ms |
| - | - | - | - | Scan program | 17ms |



| Time (㎳) | Executed details |
|---|---|
| 0~6 | The scan program starts and is executed. |
| 6~8 | Request on running the external contact interrupt is entered and the scan program is interrupted and the program 3 runs. There is the request on rerun at 7[㎳] but it is ignored since the program is running. |
| 8~10 | The execution of the program 3 is completed and the scan program will run continuously. |
| 10~12 | There is the request on running 10㎳_fixed cycle interrupt so the scan program is interrupted and the program 1 runs. |
| 12~20 | The execution of the program 1 is completed and the scan program that was interrupted runs continuously. |
| 20 | Although there are the requests on 10㎳_fixed cycle interrupt and the external contact interrupt at the same time, the external contact interrupt has higher priority so the program 3 runs and the program 1 stands by for execution. |
| 20~22 | The scan program is interrupted and the program 3 runs. |
| 22~24 | The execution of the program 3 is completed and the pending 10㎳_fixed cycle interrupt program 1 runs. |

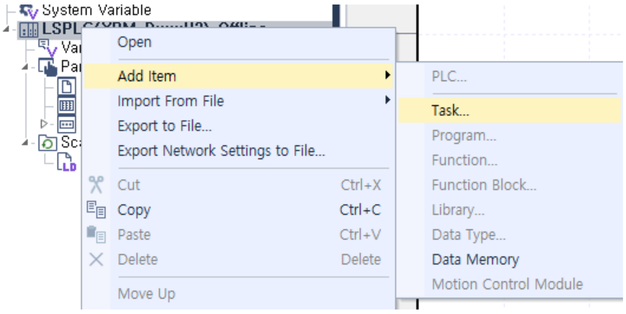
| time (㎳) | Executed details |
|---|---|
| 24~25 | The execution of the program 1 is completed and the scan program is finished. |
| 25 | The program 2 is executed by checking the interrupt request on internal contact_M0 of P2 at the time of completion of the scan program. |
| 25~30 | The program 2 runs. |
| 30~32 | The request on 10㎳_fixed cycle interrupt occurs and the 10㎳_fixed cycle has higher priority so the program 2 is interrupted and the program 1 runs. |
| 32~34 | The execution of the program 1 is completed and the program 2 that was interrupted is finished. |
| 34 | The new scan starts (startup of executing the scan program) |

## 1.1.6 Initialization task

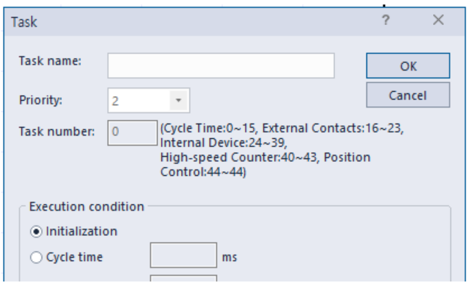
(1) How to set up the task

You can add initialization tasks in the project window of XG5000 as below and add the programs to be executed. For more details, refer to the XG5000 manual. (You cannot add tasks on online. After disconnecting the PLC, add tasks.)

(a) Adding task: Select 『Project』 – 『Add Items』 – 『Task』 or after clicking with the right mouse button on the project name of the project tree, select 『Add Items』 - 『Task』 as shown in the below figure.



(b) The screen for registering the task will be displayed. Click 『Initialization』 in the execution conditions and enter the task name.



Task name:

Priority: 2

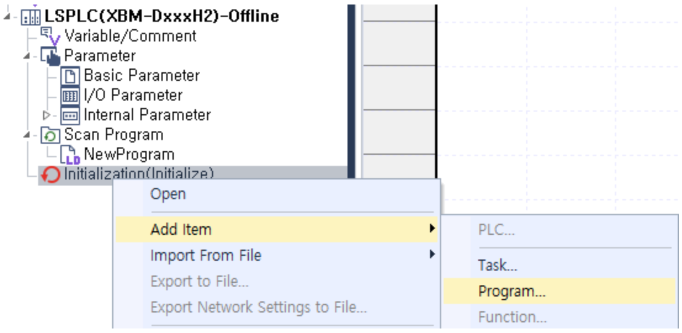
Task number: 0 (Cycle Time:0~15, External Contacts:16~23, Internal Device:24~39, High-speed Counter:40~43, Position Control:44~44)

Execution condition

● Initialization

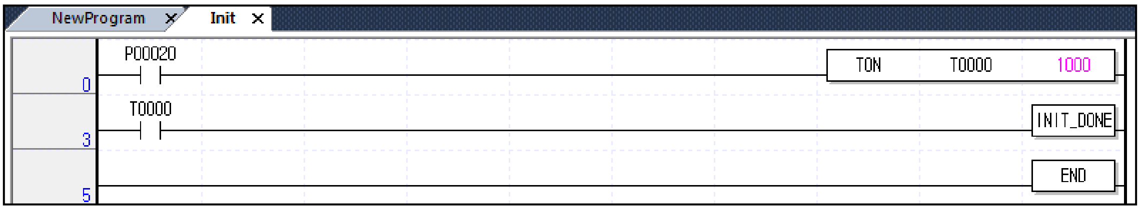
○ Cycle time ms

(c) Click on the right mouse button on the registered task and click 『Add Items』 - 『Program』.



(d) Make the necessary initialization program and make sure to include the INIT_DONE command to the initialization task program.

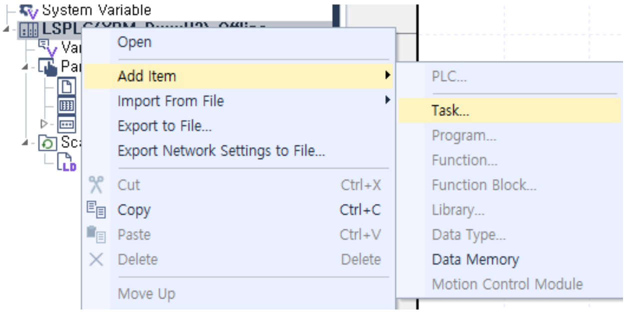
(If the operation conditions of INIT_DONE runs, the initialization task ends and the scan program runs.)



### 1.1.7 Fixed cycle task

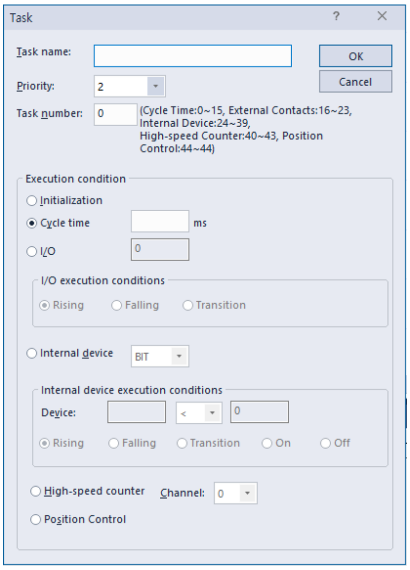
(1) How to set up the task

(a) Adding tasks: Select 『Project』 – 『Add Items』 – 『Task』 or after clicking with the right mouse button on the project name of the project tree, select 『Add Items』 - 『Task』 as shown in the below figure.



(b) The screen for registering the task will be displayed. Click 『Fixed cycle』 in the execution conditions and after entering the task name, input the items required for setting as below

| Items | Input range | Description |
|---|---|---|
| priority | 2~7 | Designates the priority of tasks. |
| Task No. | 0~15 | Designates the task number.<br>The numbers overlapped with are not available. |
| cycle | 1~4,294,967,295 (ms) | Designates the task's running cycle. |



Task

Task name:

Priority: 2

Task number: 0 (Cycle Time:0~15, External Contacts:16~23, Internal Device:24~39, High-speed Counter:40~43, Position Control:44~44)

Execution condition

○ Initialization

● Cycle time ms

○ I/O 0

I/O execution conditions

● Rising ○ Falling ○ Transition

○ Internal device BIT

Internal device execution conditions

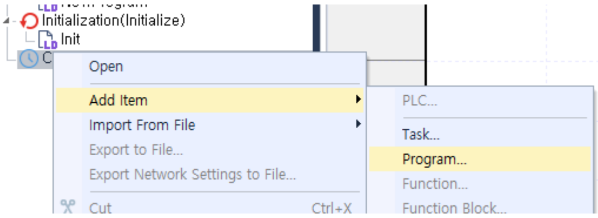
Device: < 0

● Rising ○ Falling ○ Transition ○ On ○ Off

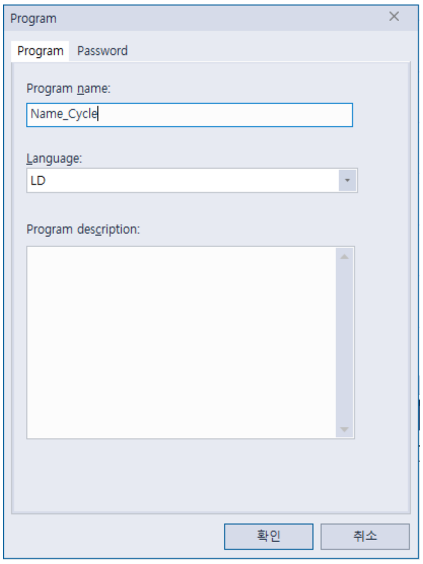
○ High-speed counter Channel: 0

○ Position Control

(c) Click on the right mouse button on the registered task and click 『Add Items』 - 『Program』.



(d) Register the task program name and comment.

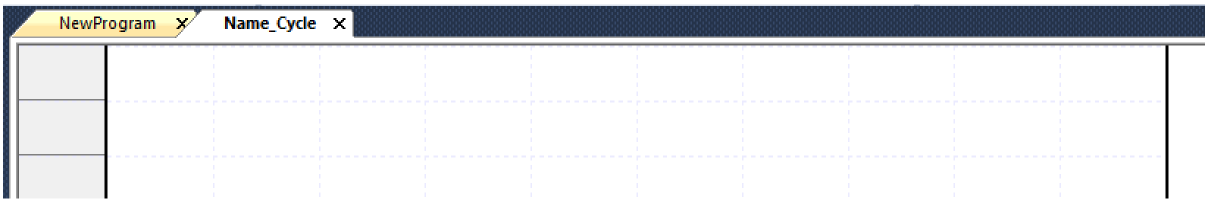


Program name: Name_Cycle

Language: LD

Program description:

(e) If the program window for writing the task program is displayed, you can make the task program here.



(2) Instructions to use the fixed cycle task

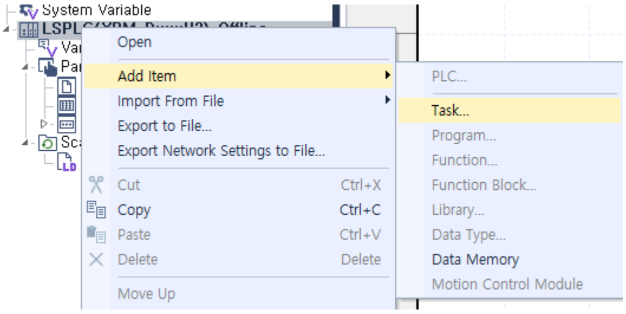
The corresponding task program with fixed cycle runs at every set time interval (running cycle) and keep the below instructions in mind.

- When the specific task program with the fixed cycle runs currently or stands by for execution, if the request on running the same task program occurs, the newly occurred task will be ignored.
- The timer generating the request on running the task program with fixed cycle works only when the operation mode is RUN mode. Ignore all the blackout time.
- When setting up the running cycle of the task program with fixed cycle, the request on running several task programs should not occur.
  If you apply 4 task programs with the fixed cycle of 2 seconds, 4 seconds, 10 seconds, 20 seconds, 4 execution requests occur simultaneously every 20 seconds and 4 tasks runs at once so the scan time may be longer momentarily.

## 1.1.8 External contact task

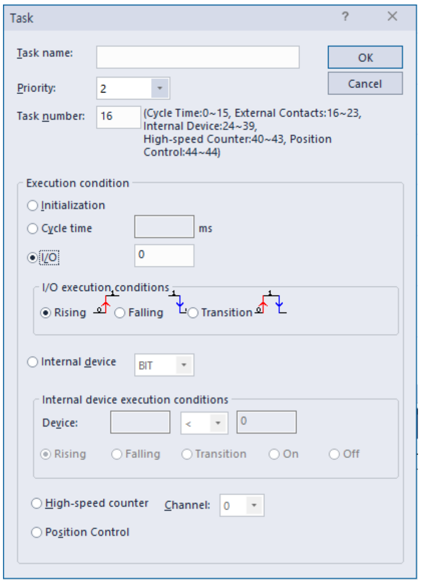
(1) How to set up the task

(a) Adding tasks: Select 『Project』 – 『Add Items』 – 『Task』 or after clicking with the right mouse button on the project name of the project tree, select 『Add Items』 - 『Task』 as shown in the below figure.



(b) The screen for registering the task will be displayed. Click 『External contact』 in the execution conditions and after entering the task name, input the items required for setting as below.

| Items | Input range | Description |
|---|---|---|
| Priority | 2~7 | Designates the priority of tasks. |
| Task No. | 16~23 | Designates the task number.<br>The numbers overlapped with are not available. |
| Contact No. | 0~7 | Designates the task start contact number. |
| Starting conditions | rising, falling, transition | Sets up starting conditions of tasks. |



Task name:

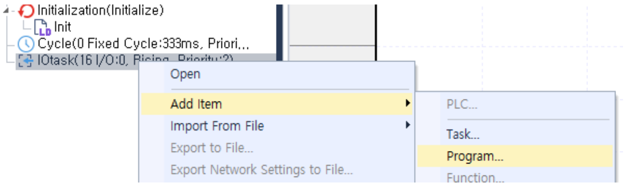
Priority: 2

Task number: 16 (Cycle Time:0~15, External Contacts:16~23, Internal Device:24~39, High-speed Counter:40~43, Position Control:44~44)

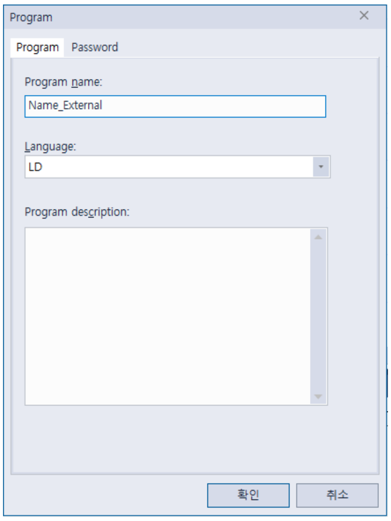
● I/O 0

● Rising

(c) Click on the right mouse button on the registered task and click 『Add Items』-『Program』.



(d) Register the task program name and comment.



Program name: Name_External

Language: LD

Program description:

(e) If the program window for writing the task program is displayed, you can make the task program here.

(3) Instructions to use the external contact task

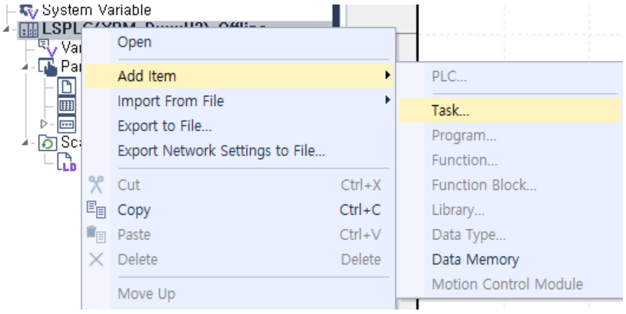
When the rising, falling or transition conditions occur in the set input contact, the corresponding external contact task program runs and keep the below instructions in mind.

- 8 external contacts are available in the range of P0000~P0007.
- When the specific external contact task program runs currently or stands by for execution, if the request on running the same input task program occurs, the newly occurred task will be ignored.
- The input contact monitoring for the external contact tasks is executed only when the operation mode is RUN mode. The input contact monitoring for task startup is not executed in STOP mode.
- The detection delay time of the external contact task is approximately 50us.
- When designing the system, several external contact tasks should not start at the same time. If P0000 ~ P0007 contacts are ON at the same time under all the external contacts of P0000 ~ P0007 are set as the external contact tasks, 8 external contact task programs run at one so the scan time may be longer momentarily.

## 1.1.9 Internal device task

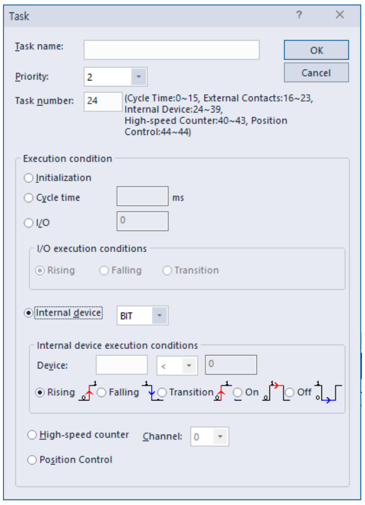
(1) How to set up the task

(a) Adding tasks: Select 『Project』 – 『Add Items』 – 『Task』 or after clicking with the right mouse button on the project name of the project tree, select 『Add Items』 - 『Task』 as shown in the below figure.



(b) The screen for registering the task will be displayed. Click 『Internal device』 in the execution conditions and after entering the task name, input the items required for setting as below.

| Items | | Input range | Description | |
|---|---|---|---|---|
| Priority | | 2~7 | Designates the priority of tasks. | |
| Task No. | | 24~39 | Designates the task number.<br>The numbers overlapped with are not available. | |
| Internal device | | BIT, WORD | Selects the device type that will start the task. | |
| Device | | Direct input | Input directly the device that will start the task and set the startup conditions. | |
| Startup conditions | Bit | Rising, falling, transition, On, Off | Rising | Starts the task in case of rising edge. |
| | | | Falling | Starts the task in case of falling edge. |
| | | | Transition | Starts the task in case of rising or falling edge. |
| | | | On | Starts every scan task during ON. |
| | | | Off | Starts every scan task during OFF. |
| | Word | <, <=, ==, >=, > | < | Starts the task when the word is less than the set value. |
| | | | <= | Starts the task when the word is less than or equal to the set value. |
| | | | == | Starts the task when the word is the same as the set value. |
| | | | >= | Starts the task when the word is more than or equal to the set value. |
| | | | > | Starts the task when the word is more than the set value. |



Task name:

Priority: 2

Task number: 24 (Cycle Time:0~15, External Contacts:16~23, Internal Device:24~39, High-speed Counter:40~43, Position Control:44~44)

Execution condition

○ Initialization

○ Cycle time ms

○ I/O 0

I/O execution conditions: ● Rising ○ Falling ○ Transition

● Internal device BIT

Internal device execution conditions

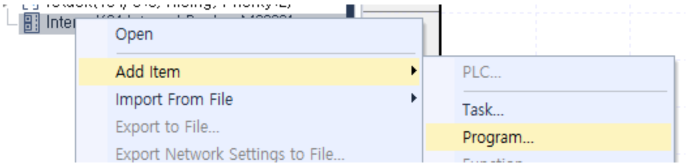
Device: < 0

● Rising ○ Falling ○ Transition ○ On ○ Off

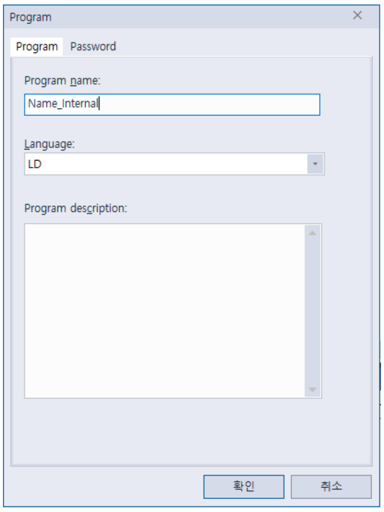
○ High-speed counter Channel: 0

○ Position Control

(c) Click on the right mouse button on the registered task and click 『Add Items』-『Program』.



(d) Register the task program name and comment.



Program name: Name_Internal

Language: LD

Program description:

(e) If the program window for writing the task program is displayed, you can make the task program here.

(2) Instructions to use the internal device task

The internal contact task detects the startup conditions of the internal device set by the scan END and runs the relevant internal device task program. Keep the below instructions in mind.

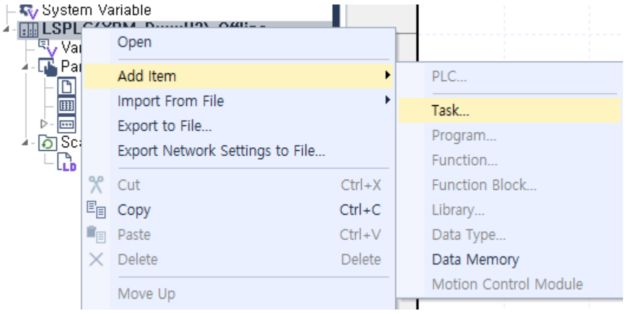
- The internal device task program runs when the scan program is completed. Accordingly, although the execution conditions of the internal device task program occur in the scan programs or task programs (fixed cycle, external contact, high speed counter), it will run at the time of completing the scan program instead of running immediately.

- In the case of the internal device task, the execution conditions are searched when the scan program is completed. Accordingly, if the execution conditions of the internal device task occur and dissipate by the scan program or other task programs, the task will not run since the execution conditions cannot detected at the time of searching the conditions.

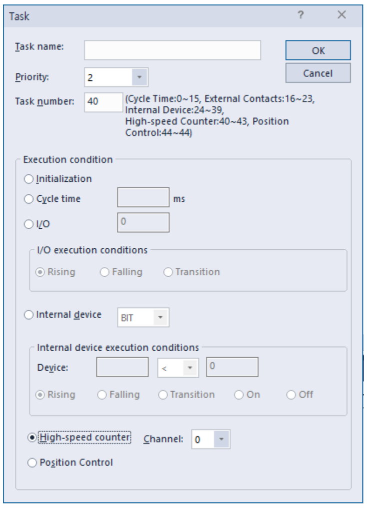
## 1.1.10 High speed counter task

(1) How to set up the task

(a) Adding tasks: Select 『Project』 – 『Add Items』 – 『Task』 or after clicking with the right mouse button on the project name of the project tree, select 『Add Items』 - 『Task』 as shown in the below figure.



(b) The screen for registering the task will be displayed. Click 『High speed counter』 in the execution conditions and after entering the task name, select the channel.



Task name:

Priority: 2

Task number: 40 (Cycle Time:0~15, External Contacts:16~23, Internal Device:24~39, High-speed Counter:40~43, Position Control:44~44)

Execution condition

○ Initialization

○ Cycle time ms

○ I/O 0

I/O execution conditions

● Rising ○ Falling ○ Transition

○ Internal device BIT

Internal device execution conditions

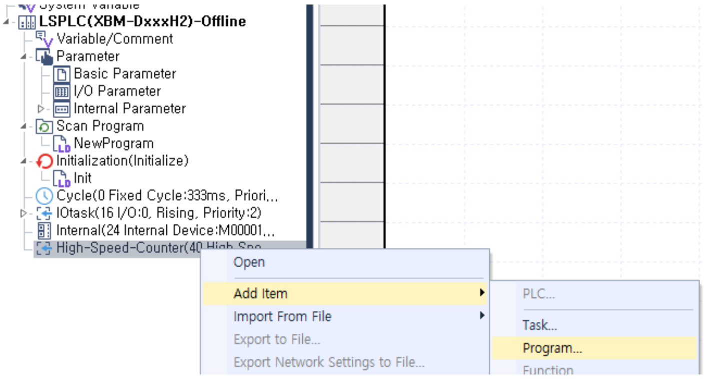
Device: < 0

● Rising ○ Falling ○ Transition ○ On ○ Off

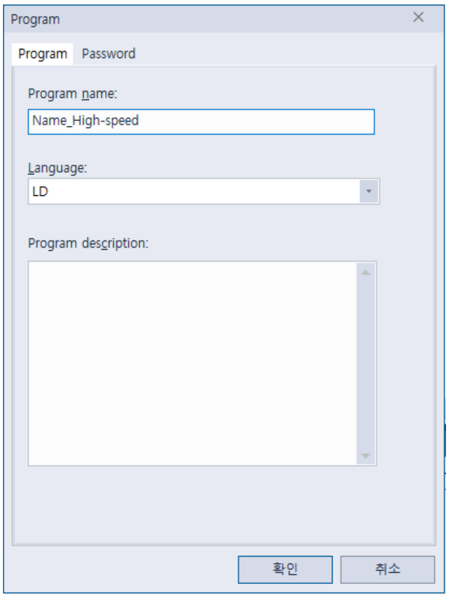
● High-speed counter Channel: 0

○ Position Control

(c) Click on the right mouse button on the registered task and click 『Add Items』 - 『Program』.



(d) Register the task program name and comment.



Program name: Name_High-speed

Language: LD

Program description:

(e) If the program window for writing the task program is displayed, you can make the task program here.

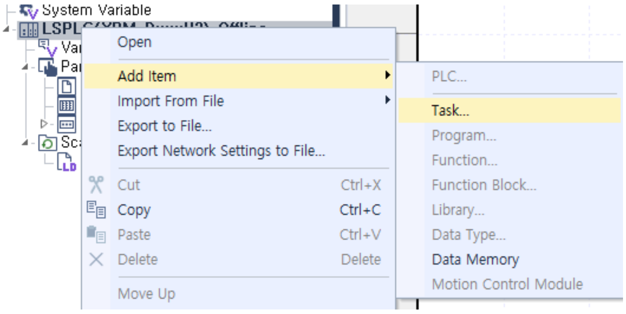
(2) Instructions to use the high speed counter task

- When the high speed counter's current value in the selected channel becomes equal to the comparative output set value of 0 of the relevant channel in the below Fig., the high speed counter task will be detected and the task program will run.
- You can check whether the conditions of the high speed counter task occur at every 250us cycle so detection delay may occur up to 250us.
- The operations of the high speed counter task are performed only when the operation mode is RUN mode.

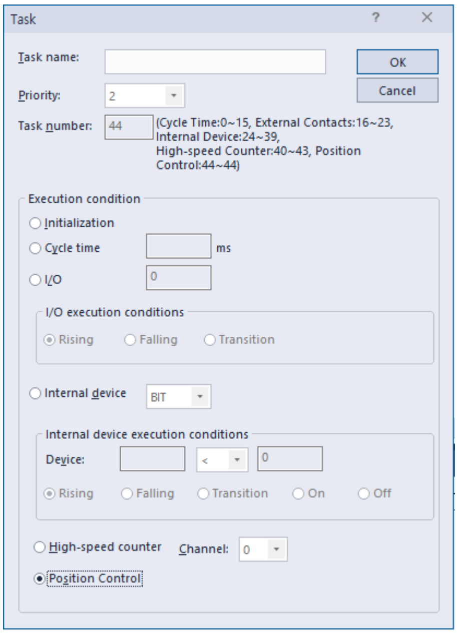
## 1.1.11 Positioning control task

(1) How to set up the task

(a) Adding tasks: Select 『Project』 – 『Add Items』 – 『Task』 or after clicking with the right mouse button on the project name of the project tree, select 『Add Items』 - 『Task』 as shown in the below figure.



(b) The screen for registering the task will be displayed. Click 『Position control』 in the execution conditions and enter the task name



Task

Task name:

Priority: 2

Task number: 44 (Cycle Time:0~15, External Contacts:16~23, Internal Device:24~39, High-speed Counter:40~43, Position Control:44~44)

Execution condition

○ Initialization

○ Cycle time ms

○ I/O 0

I/O execution conditions

● Rising ○ Falling ○ Transition

○ Internal device BIT

Internal device execution conditions

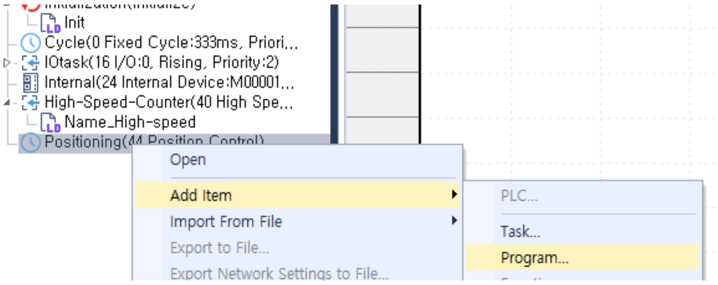
Device: < 0

● Rising ○ Falling ○ Transition ○ On ○ Off

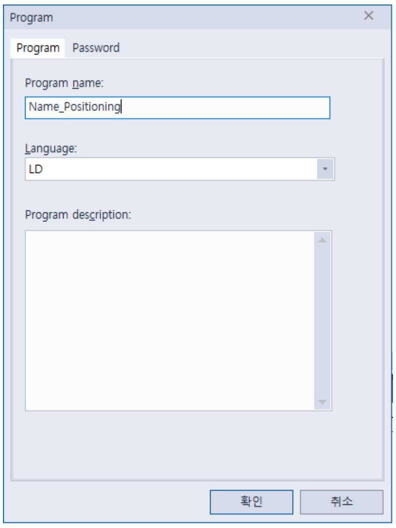
○ High-speed counter Channel: 0

● Position Control

(c) Click on the right mouse button on the registered task and click 『Add Items』 - 『Program』.



(d) Register the task program name and comment.



Program name:
Name_Positioning

Language:
LD

Program description:

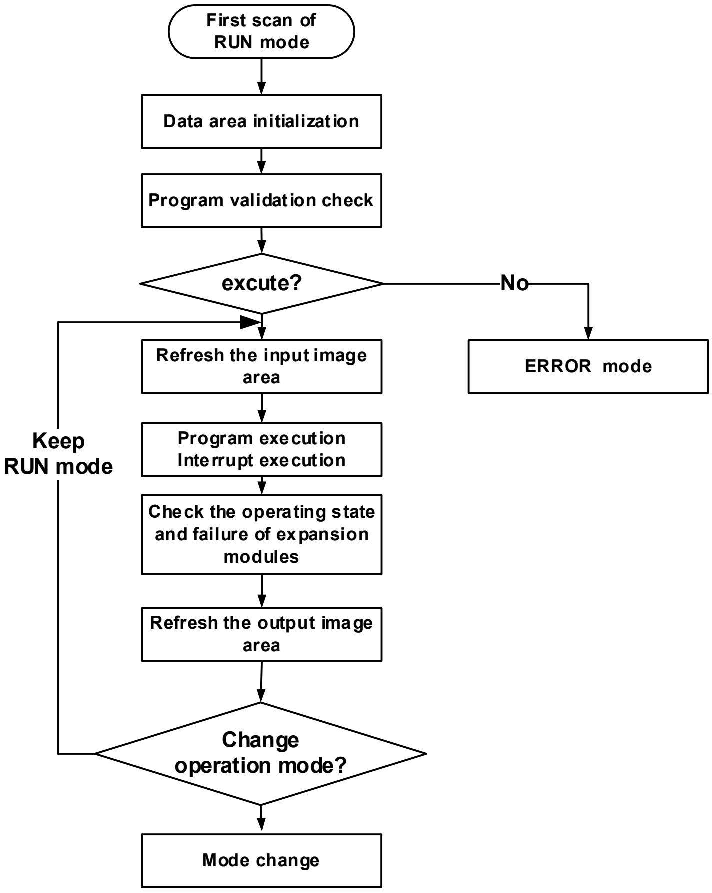
(e) Details of Positioning control task: refer to Part3 Ch04 Positioning Control

## 1.2 Operation mode

The XGB PLC has 3 operation modes; RUN mode, STOP mode, DEBUG mode.
This section describes the execution processing of each operation mode.

### 1.2.1 RUN mode

It is the mode executing the program normally.



(1) When changing the mode from other into RUN
Initialize the data area at the beginning stage and check the validity of the program to determine whether it can be executed or not.

(2) Execution processing details
I/O Refresh and program operation are executed.
- (a) The interrupt program is executed by detecting the startup conditions of the interrupt program.
- (b) Normal operation or fail of the equipped module is checked.
- (c) Communication services are executed with other internal processing.

### 1.2.2 STOP Mode

It is the mode of block state without operations of the program. In STOP mode, you can write the programs and parameters through XG5000.

(1) When changing the mode from other into STOP
Eliminate the output image area and execute Output Refresh.

(2) Execution processing details
(a) I/O Refresh is executed.
(b) Normal operation or fail of the equipped module is checked.
(c) Communication services are executed with other internal processing.

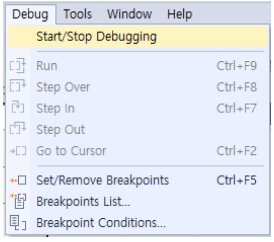
### 1.2.3 DEBUG Mode

This is the mode to detect Program error or trace the operation process and the conversion to this mode is available only in STOP mode. This is the mode to check the program execution state and the contents of each data and verify the program.

(1) Processing at mode change
(a) Initializes the data area at the beginning of mode change.
(b) Clears the output image area and execute input refresh.

(2) Operation processing contents
(a) Executes I/O refresh.
(b) Debug operation according to setting state.
(c) After finishing Debug operation by the end of Program, execute output refresh.
(d) Examine the normal operation or missing of module.
(e) Executes communication service or other service.

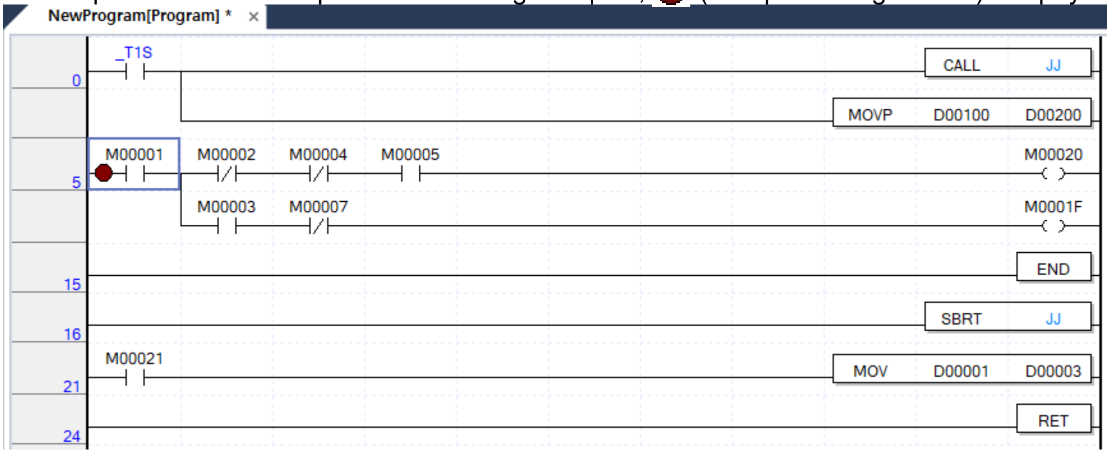
(3) Debug operation : describes debug menu and debug mode.



| Item | Description | Remark |
|---|---|---|
| Start/Stop Debugging | Change the debug ↔ stop mode | |
| Go | It starts debug operation. | |
| Step Over | It operates by 1 step. | |
| Step In | It enters the subroutine program. | Other operation is identical to Step Over. |
| Step Out | It gets out of the subroutine program. | |
| Go to Cursor | It operates to current cursor position. | |
| Set/Remove Breakpoints | Set/Removes current cursor position to break points. | |
| Breakpoints List | It displays list of breakpoints. | |
| Breakpoint Conditions | It specifies device value and number of scan. | |

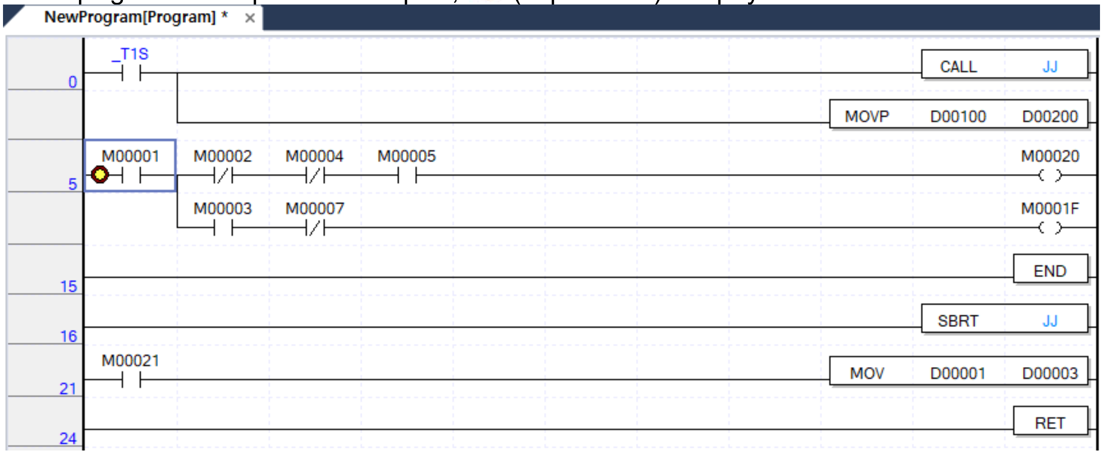
(a) Set/Remove Breakpoints

Sets breakpoint at current cursor position. After setting breakpoint, ● (breakpoint setting indicator) is displayed.



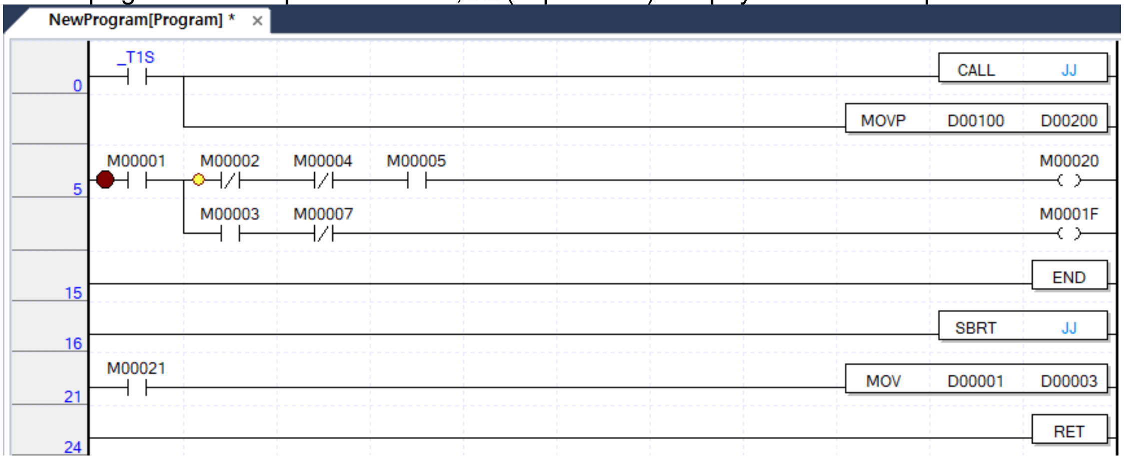
(b) Go

Run the program to breakpoint. At break point, ○ (stop indicator) is displayed.

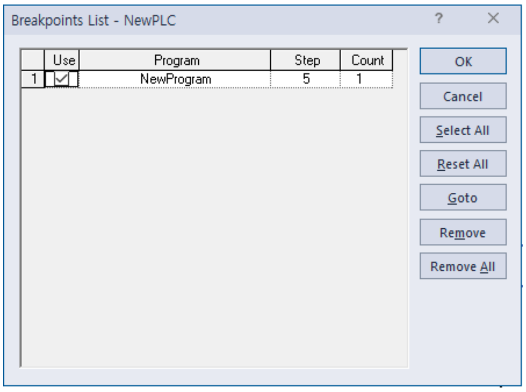


(c) Step Over

Run the program to next step. After executed, ○(stop indicator) is displayed at the next step.

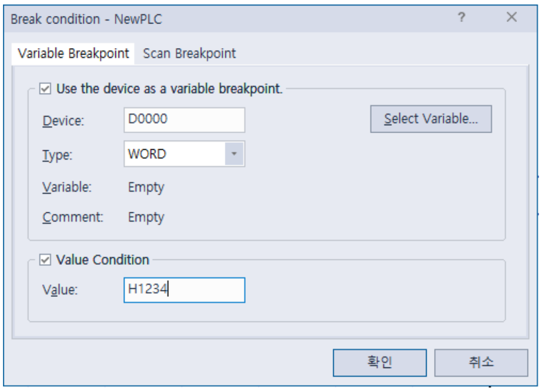


(d) Breakpoint List
It displays current Breakpoint List. It supports Select All, Reset All, Goto, Remove, Remove All features.



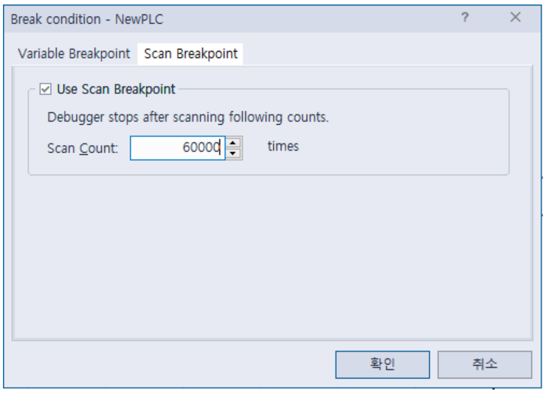
|  | Use | Program | Step | Count |
|---|---|---|---|---|
| 1 | ☑ | NewProgram | 5 | 1 |

(e) Break condition
It sets Device Break and Scan Break.



☑ Use the device as a variable breakpoint.
Device: D0000
Type: WORD
Variable: Empty
Comment: Empty

☑ Value Condition
Value: H1234



☑ Use Scan Breakpoint
Debugger stops after scanning following counts.
Scan Count: 60000 times

**Notice**

1) Refer to XG5000 User's Manual 'Chapter 12 Debugging' for detailed information.

### 1.2.4 Change of operation modes

(1) How to change operation modes

You can change the operation mode with the below methods.

(a) Change by the mode key of the basic unit
(b) Change by connecting the programming tool (XG5000) to the PLC
(c) Changing the operation mode of the other basic unit connected to network with XG5000 accessed to the basic unit 1 (remote access)
(d) Change by using XG5000, HMI, communication module connected to the network
(e) Change by the 'STOP' command during execution of the program

(2) Kinds of operation modes

The following operation modes are set by the mode setting key of the basic unit and XG5000's commands.

| Operation mode switch | XG5000 command | Operation mode | Remarks |
|---|---|---|---|
| RUN | Unchangeable | Local RUN | When the operation mode switch is located in RUN position, the mode change by XG5000 is impossible. |
| STOP | RUN | remote RUN | |
| | STOP | remote STOP | |
| | Debug | Debug | |
| RUN →STOP | - | STOP | |

(a) The mode change by XG5000 is available only when the operation mode switch is in **STOP** state.
(b) If you want to change the mode into 'STOP' with a switch in the remote RUN state by XG5000, operate the switch as **STOP→ RUN → STOP.**

Notice

▪In case the mode is changed into RUN by a switch in the remote RUN mode, the PLC is operates continuously without intermission.

▪ Modificaiton is possible during run in the RUN mode by a switch but the mode change operaitons through XG5000 are restricted. Only when mode change is not allowable in a remote site, set the mode switch in RUN position.

# 1.3 Memory

## 1.3.1 Data memory

(1) Bit device area

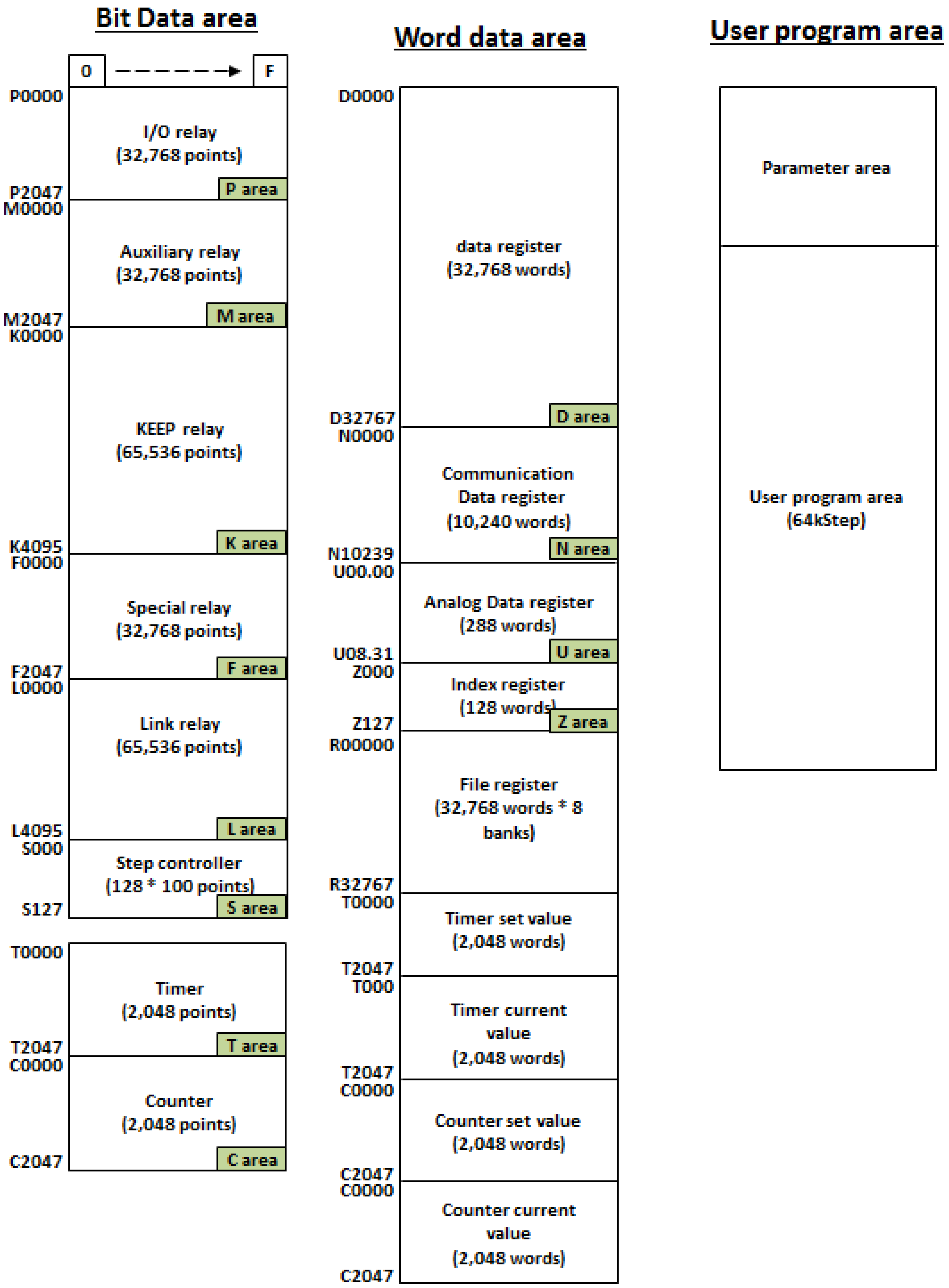
Various bit devices are provided by function. In terms of designation method, the first digit indicates the device type; the middle digit indicates the decimal word position; the last digit indicates the hexadecimal bit position in word.

| Displaying areas by device | Characteristics of devices | Purpose |
|---|---|---|
| P0000 ~ P2047F | I/O contact | It is the image area saving the state of I/O contacts. The device reads the input module state and saves it to the P area.<br>The P area data saving operation results is saved to the output module. |
| M0000 ~ M2047F | Internal contact | It is the internal memory to save bit or word data in the program. |
| L0000 ~ L4095F | Communication contact | The device displays the state information of high speed link/P2P service in the communication module. |
| K00000~K4095F | Contacts against blackout for embedded special functions | It is the device area maintaining the data during blackout. It can be used without setting the parameters against blackout separately. (Among K areas, some areas are used by the embedded high speed counter, data log, PID function. If 'Write' is executed in the relevant area, the embedded function will not work normally so be careful about this. |
| F0000~F2047F | Special contacts | It is the system flag area managing the flags required to operate the system in the PLC. |
| T0000~T2047 | Timer contacts | It is the area saving the state of the timer contacts/current values/set values. |
| C0000~C2047 | Counter contacts | It is the area saving the state of the counter contacts/current values/set values. |
| S00.00~S127.99 | Step controller 128 x 100 Step | It is the relay for step control. |

(2) Word device area

| Displaying areas by device | Characteristics of devices | Purpose |
|---|---|---|
| D0000~D32767 | Data register | It is the area keeping the internal data. It also can be expressed as bit. (Ex.: D0000.0→ No.0 bit of D0) |
| U00.00~U08.31 | Analog data register | It is the register used to read the data from the special module equipped to the slot. (It can be expressed as bit) |
| N0000~N10239 | Communication data register | Area saving the P2P service of the communication module. (It cannot be expressed as bit) |
| Z000~Z127 | Index register | Dedicated device to use index functions (It cannot be expressed as bit) |
| T0000~T2047 | Timer's current value register | Area indicating the timer's current value. |
| C0000~C2047 | Counter's current value register | Area indicating the counter's current value. |
| R0000~R32767 | File register | File saving register, consists of 8 banks |

### 1.3.2 Memory block diagram



### 1.3.3 Setup of the data latch area

If you want to keep and use the data required for operations or data generated during operations even when the PLC restarts after the stoppage, 'data latch' can be applied. You can use the certain areas of some data devices as the latch areas by setting parameters.

•You can set up the latch range for the below devices by parameters.

| Device | Latch area 1 | Latch area 2 | Characteristics |
|---|---|---|---|
| P | X | X | Image area saving the I/O contacts state |
| M | O | O | Internal contact area |
| K | X | X | Contacts that keep the contact state during blackout. |
| F | X | X | System flag area |
| T | O | O | Area related to the timer ( For both bit/word ) |
| C | O | O | Area related to the counter (For both bit/word) |
| S | O | O | Relay for step control |
| D | O | O | Area saving general word data |
| U | X | X | Analog data register (Not latched) |
| L | X | X | High speed link/P2P service state contacts of the communication module (Not latched) |
| N | X | X | Communication module's P2P service address area (latched) |
| Z | X | X | Register for index only (Not latched) |
| R | X | X | File register (latched) |

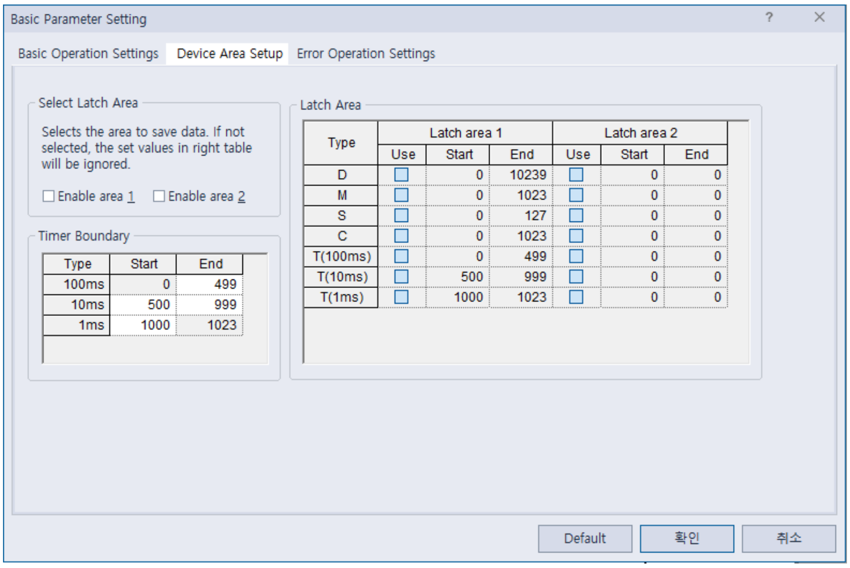
**Notice**

▪K, N, R devices can be basically latched without setting parameters.

▪ P, U, Z devices cannot be latched.

(1) How to set up the latch area

(a) After clicking the 'Device Area Setup' of the basic parameter, select the latch to be used and input the initial address and end address.



Selects the area to save data. If not selected, the set values in right table will be ignored.

☐ Enable area 1 ☐ Enable area 2

| Type | Start | End |
|---|---|---|
| 100ms | 0 | 499 |
| 10ms | 500 | 999 |
| 1ms | 1000 | 1023 |

| Type | Latch area 1 | | | Latch area 2 | | |
|---|---|---|---|---|---|---|
| | Use | Start | End | Use | Start | End |
| D | ☐ | 0 | 10239 | ☐ | 0 | 0 |
| M | ☐ | 0 | 1023 | ☐ | 0 | 0 |
| S | ☐ | 0 | 127 | ☐ | 0 | 0 |
| C | ☐ | 0 | 1023 | ☐ | 0 | 0 |
| T(100ms) | ☐ | 0 | 499 | ☐ | 0 | 0 |
| T(10ms) | ☐ | 500 | 999 | ☐ | 0 | 0 |
| T(1ms) | ☐ | 1000 | 1023 | ☐ | 0 | 0 |

(2) Operation of the data latch area

(a) The device set as the latch area keeps the previous data without initialization when the power is recovered after cutting the power supply of the PLC.

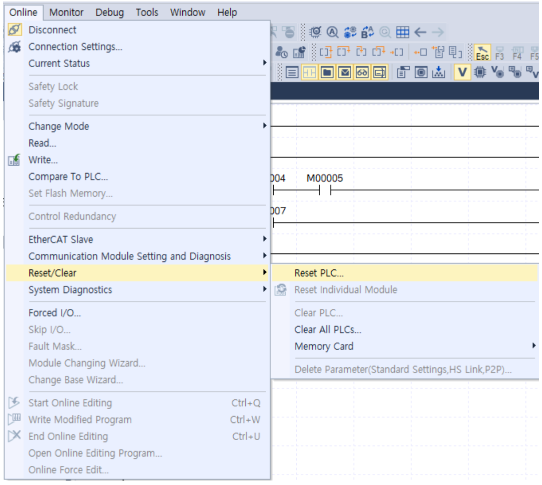
(b) You can delete the latched data in the following ways.

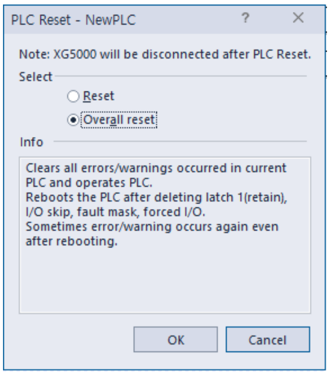
- Deleting latch1, latch 2 with XG5000
- Writing with the program (The initialization program is recommended)
- Inputting 0 in the window of XG5000 monitor

Refer to the below table for Maintaining or Reset (clear) operation of the latch area data depending on the PLC operations.

| No. | Operations | Detailed operations | latch1 | latch2 |
|---|---|---|---|---|
| 1 | Power On/Off | On / Off | Maintain | Maintain |
| 2 | Reset by XG5000 | Overall Reset | Reset | Maintain |
| 3 | Write program (online) | - | Maintain | Maintain |
| 4 | Broken backup data | Broken SRAM due to (breakdown of a battery, etc.) | Reset | Reset |
|  |  | Broken data due to other reasons | Reset | Reset |
| 5 | XG5000 online | Latch 1 Clear | Reset | Maintain |
|  |  | Latch 2 Clear | Reset | Reset |

(c) If you click 『Online』 - 『 Reset/Clear 』 - 『 Reset PLC 』 - 『Overall Reset』, the latch 1 area will be cleared.




PLC Reset - NewPLC

Note: XG5000 will be disconnected after PLC Reset.

Select

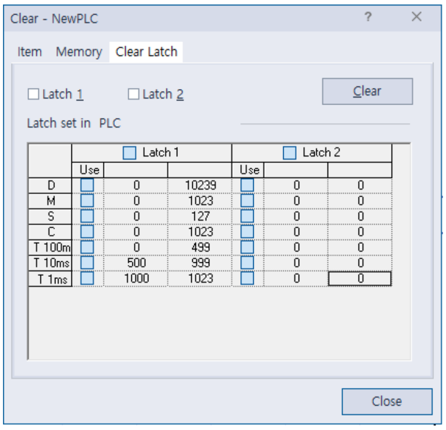
○ Reset

● Overall reset

Info

Clears all errors/warnings occurred in current PLC and operates PLC. Reboots the PLC after deleting latch 1(retain), I/O skip, fault mask, forced I/O. Sometimes error/warning occurs again even after rebooting.

(d) After selecting 『Online』-『 Reset/Clear 』-『Clear PLC 』latch area 1,2, if you click “Delete”, it will be cleared.



☐ Latch 1 ☐ Latch 2

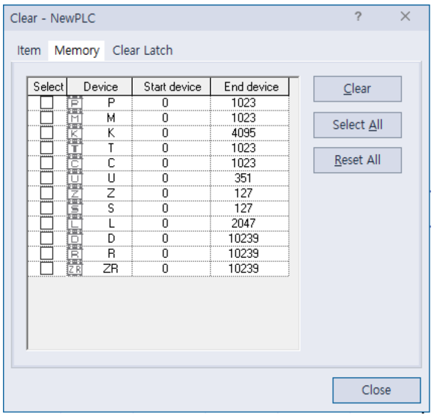
Latch set in PLC

| | ☐ Latch 1 | | | ☐ Latch 2 | | |
|---|---|---|---|---|---|---|
| | Use | | | Use | | |
| D | ☐ | 0 | 10239 | ☐ | 0 | 0 |
| M | ☐ | 0 | 1023 | ☐ | 0 | 0 |
| S | ☐ | 0 | 127 | ☐ | 0 | 0 |
| C | ☐ | 0 | 1023 | ☐ | 0 | 0 |
| T 100m | ☐ | 0 | 499 | ☐ | 0 | 0 |
| T 10ms | ☐ | 500 | 999 | ☐ | 0 | 0 |
| T 1ms | ☐ | 1000 | 1023 | ☐ | 0 | 0 |

(3) Deletion of data at once

If you click ‘Delete’ in the memory area, the memory of all devices will be deleted as ‘0’. So this function can be used when you want to delete the certain area of the device at once.

(a) After selecting『Online』-『Reset/Clear』-『Clear PLC』-『Clear Memory』, if you set up the area to be deleted and click “Delete”, the device area will be cleared.

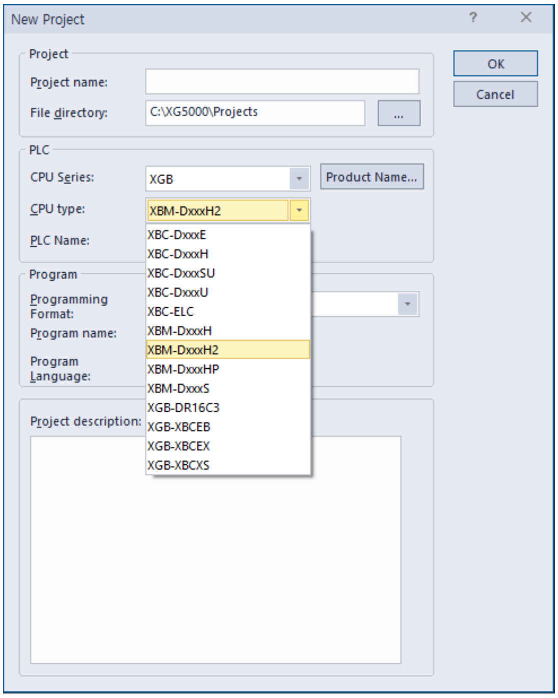


| Select | Device | Start device | End device |
|---|---|---|---|
| ☐ | P | 0 | 1023 |
| ☐ | M | 0 | 1023 |
| ☐ | K | 0 | 4095 |
| ☐ | T | 0 | 1023 |
| ☐ | C | 0 | 1023 |
| ☐ | U | 0 | 351 |
| ☐ | Z | 0 | 127 |
| ☐ | S | 0 | 127 |
| ☐ | L | 0 | 2047 |
| ☐ | D | 0 | 10239 |
| ☐ | R | 0 | 10239 |
| ☐ | ZR | 0 | 10239 |

# Chapter 2 CPU Function

## 2.1 Type Setting

This section describes setting models of XGB PLC.



File directory: C:\XG5000\Projects

CPU Series: XGB

CPU type: XBM-DxxxH2

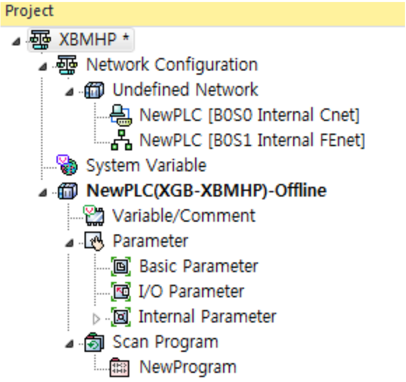
| PLC Name | CPU Type | Language | Description | Remarks |
|---|---|---|---|---|
| XGB | XGB-DR16C3 | MK language | Dedicated product | Modular type |
| | XGB-DR32HL | MK language | Dedicated product | Compact type |
| | XGB-XBCE | MK language | Economic : XBC-DR10/14/20/30E<br>XBC-DN10/14/20/30E,<br>XBC-DP10/14/20/30E | Compact type |
| | XGB-XBCH | MK language | Deluxe: XBC-DR32/64H, XBC-DN32/64H<br>XBC-DP32/64H | Compact type<br>(DC power PLC included) |
| | XGB-XBCS | MK language | Standard : XBC-DR20/30/40/60SU,<br>XBC-DN20/30S(U), XBC-DN40/60SU | Compact type |
| | XGB-XBMS | MK language | Standard : XBM-DN16/32S , XBM-DR16S | Modular type |
| | XGB-XBMH | MK language | Deluxe 2axis APM positioning: XBM-DN/DP32H | Modular type, O/S Ver 1.x |
| | XGB-XBMH2 | MK language | Deluxe 2axis XPM positioning:<br>XBM-DN/DP32H2, XBM-DN/DP16H2<br>Deluxe Relay output : XBM-DR14H2 | XBM-DN/DP32H2:<br>O/S Ver 2.x or above<br>XBM-DN/D16H2, DR14H2 :<br>O/S Ver 3.0 or above |
| | XGB-XBMHP | MK language | Deluxe 6axis XPM positioning : XBM-DN/DP32HP | O/S Ver 2.0 or above |
| | XGB-XBCU | MK language | Ultimate performance :<br>XBC-DN32U, XBC-DN32UP, XBC-DN32UA<br>XBC-DP32U, XBC-DP32UP, XBC-DP32UA<br>XBC-DR28U, XBC-DR28UP, XBC-DR28UA | Compact type<br>(DC power PLC included) |

## 2.2 Parameter Setting

This section describes XGB PLC's parameter setting.

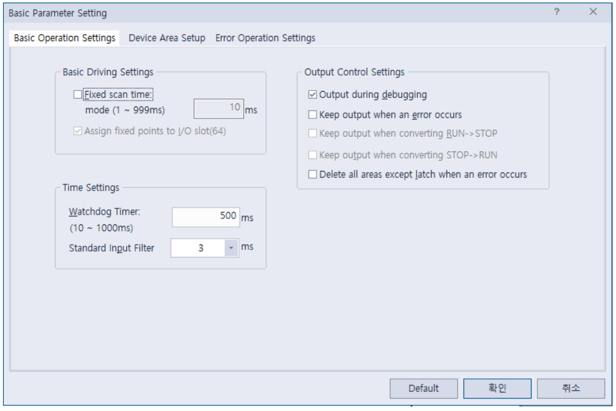
### 2.2.1 Basic parameter setting

If you click the basic parameter in the project window, the below screen will be displayed.



Project
- XBMHP *
  - Network Configuration
    - Undefined Network
      - NewPLC [B0S0 Internal Cnet]
      - NewPLC [B0S1 Internal FEnet]
  - System Variable
  - **NewPLC(XGB-XBMHP)-Offline**
    - Variable/Comment
    - Parameter
      - Basic Parameter
      - I/O Parameter
      - Internal Parameter
    - Scan Program
      - NewProgram

You can set up 3 items; 'Basic operation setting', 'Device area setting', 'Error operation setting'.



Basic Parameter Setting

Basic Operation Settings | Device Area Setup | Error Operation Settings

Basic Driving Settings
- ☐ Fixed scan time: mode (1 ~ 999ms) 10 ms
- ☑ Assign fixed points to I/O slot(64)

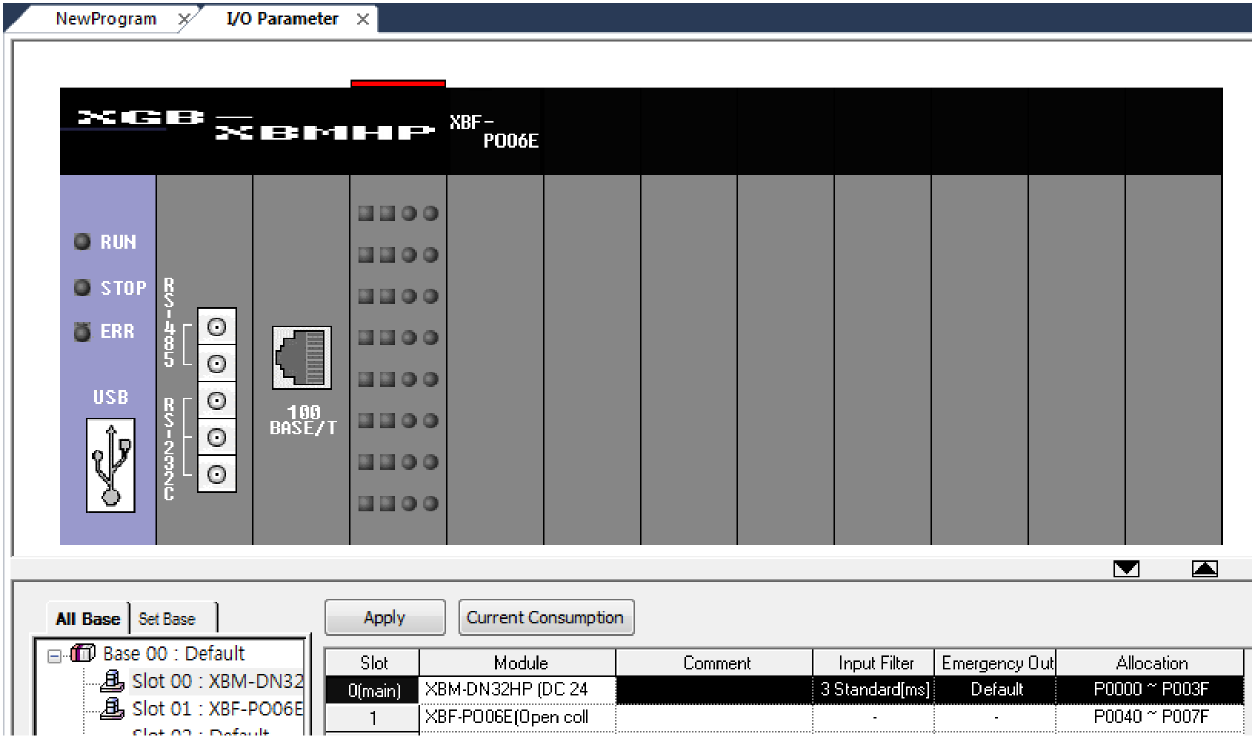
Time Settings
- Watchdog Timer: (10 ~ 1000ms) 500 ms
- Standard Input Filter 3 ms

Output Control Settings
- ☑ Output during debugging
- ☐ Keep output when an error occurs
- ☐ Keep output when converting RUN->STOP
- ☐ Keep output when converting STOP->RUN
- ☐ Delete all areas except latch when an error occurs

| Classification | Items | Descriptions | Set values |
|---|---|---|---|
| Basic operations | Fixed cycle operation | Set the fixed cycle operation time. | 1~999ms |
| | Watchdog timer | Set the scan Watch Dog's time. | 10~1000ms |
| | Standard input filter | Set the standard input filter's time. | 1,3,5,10,20,70,100ms |
| | Output during debugging | Set whether allowing the actual output during debug operation. | Allowable/Prohibited |
| | Output Hold when errors occur | Determine whether allowing the Output Hold function set in I/O parameters when errors occur | Allowable/Prohibited |
| Device area setting | Selection of latch area | Set each device's latch area. | |
| Error operation | Resumption of operation in case of computational errors. | Determine whether stopping or resuming the operation in case of computational errors. | Stop/Resume |

### 2.2.2 I/O parameter Setting

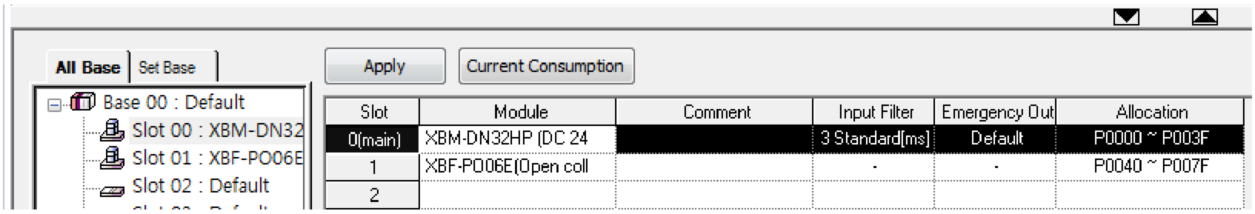
It is the function to set up and reserve the information for each I/O. If you click 『I/O Parameter』 in the project window, the below setting window will be displayed.



Base 00 : Default
Slot 00 : XBM-DN32
Slot 01 : XBF-PO06E

| Slot | Module | Comment | Input Filter | Emergency Out | Allocation |
|---|---|---|---|---|---|
| 0(main) | XBM-DN32HP (DC 24 |  | 3 Standard[ms] | Default | P0000 ~ P003F |
| 1 | XBF-PO06E(Open coll |  | - | - | P0040 ~ P007F |

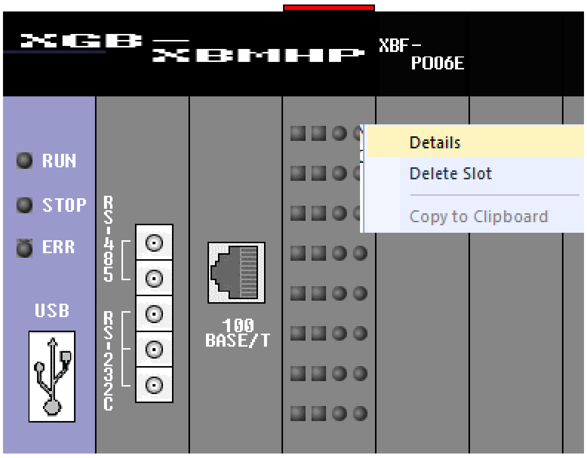
If you click 『Module』 in the 『slot』 position, the list of each module will be displayed. Then, choose the module that is matched with the actual system to be configured. The selected slot will be displayed as below.

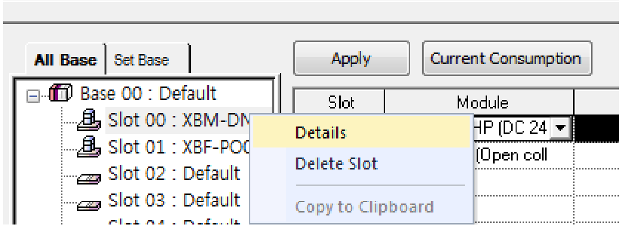


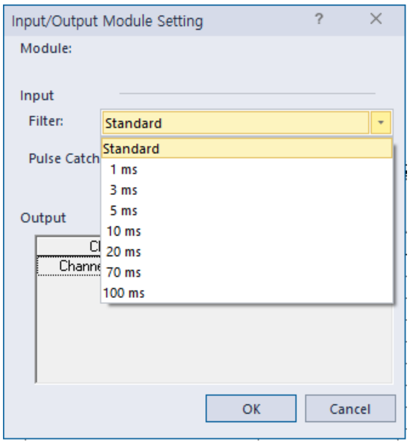
Base 00 : Default
Slot 00 : XBM-DN32
Slot 01 : XBF-PO06E
Slot 02 : Default

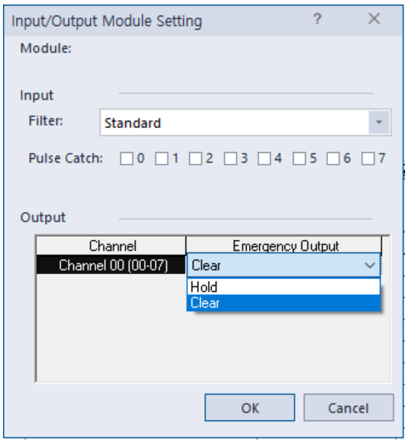
| Slot | Module | Comment | Input Filter | Emergency Out | Allocation |
|---|---|---|---|---|---|
| 0(main) | XBM-DN32HP (DC 24 |  | 3 Standard[ms] | Default | P0000 ~ P003F |
| 1 | XBF-PO06E(Open coll |  | - | - | P0040 ~ P007F |
| 2 |  |  |  |  |  |

If you press 『In Detail』 button on the slot image or the relevant slot position in the base window as below, the window for setting the filter, emergency output will be displayed.









**Notice**

- In case each set details are different from the actually accessed I/O module, 'Module Type Mismatch Error' occurs and the error will be displayed.
- If there is no setting, the CPU reads each I/O module's information for operation.

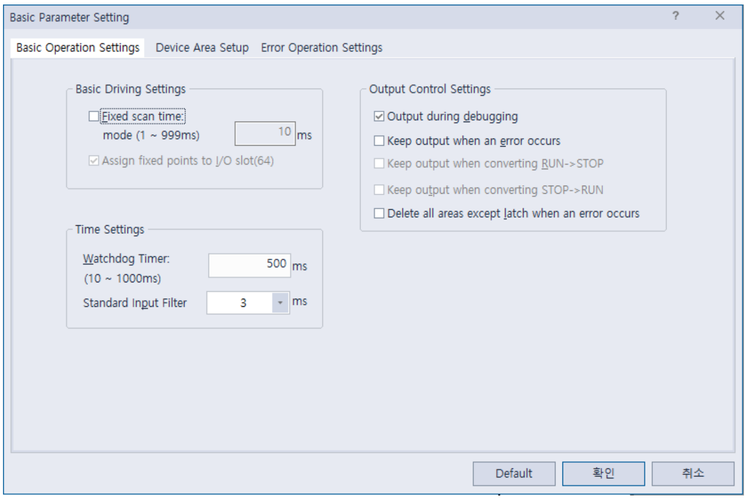
## 2.3 Self-Diagnosis Function

The Self-Diagnosis function is the function for the CPU part to diagnose the PLC system for defects. In case errors occur during supplying the power to the PLC system or during operation, it detects errors to prevent malfunction of the system and preventive maintenance.

### 2.3.1 Scan Watchdog timer (Scan Watchdog Timer)

The WDT (Watchdog Timer) is the function to detect the congestion of programs caused by PLC module’s hardware or software.

(1) The Watchdog timer is the timer to be used to detect operation delay caused by the user program error. You can set up the Watchdog timer’s detection time in XG5000’s basic parameters as below (Initial value: 500ms).



Basic Parameter Setting

Basic Operation Settings | Device Area Setup | Error Operation Settings

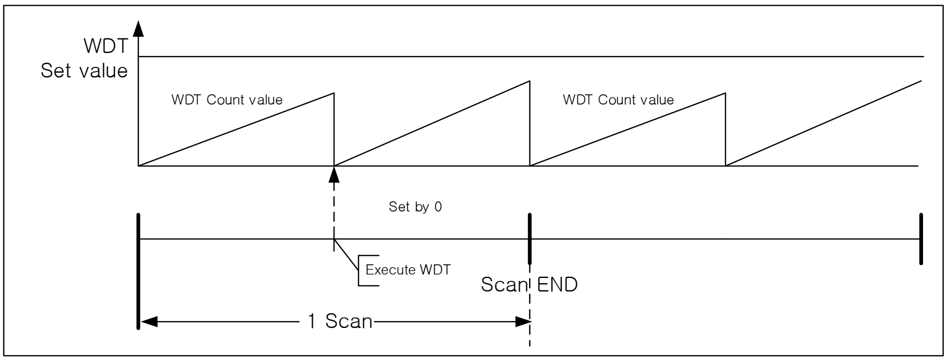
Basic Driving Settings
- ☐ Fixed scan time: mode (1 ~ 999ms) 10 ms
- ☑ Assign fixed points to I/O slot(64)

Time Settings
- Watchdog Timer: (10 ~ 1000ms) 500 ms
- Standard Input Filter 3 ms

Output Control Settings
- ☑ Output during debugging
- ☐ Keep output when an error occurs
- ☐ Keep output when converting RUN->STOP
- ☐ Keep output when converting STOP->RUN
- ☐ Delete all areas except latch when an error occurs

(2) The Watchdog timer monitors the scanning time during operation and when set detection time is exceeded, it stops the PLC’s operations immediately. At this time, the output status is maintained or cleared based on the details of ‘Output Hold when errors occur’.

(3) If it is expected that the Scan Watchdog Time is exceeded since it takes more time to process the specific part of the user programs (in case of using FOR ~ NEXT command, CALL command, etc.), clear the Watchdog timer through the ‘WDT’ command.
The ‘WDT’ command initializes the scan Watchdog time and restarts measuring time from 0.

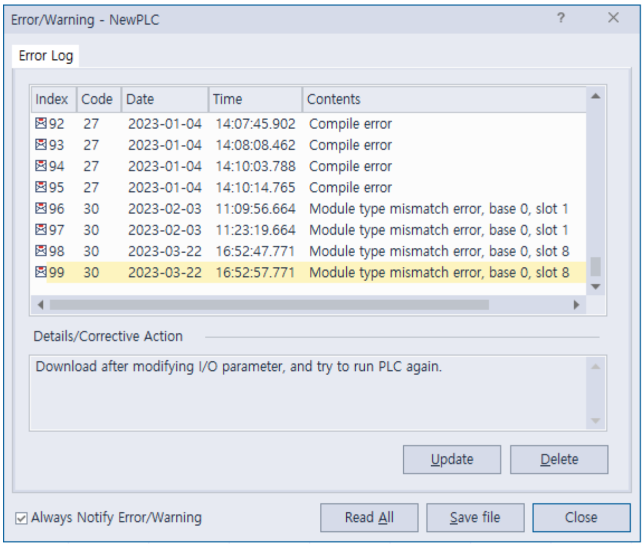


(Example of initializing scan Watchdog timer through the WDT command )

(4) In case the Watchdog error occurs, you can clear the error by resupplying the power or converting the mode into STOP.

## 2.3.2 Function to save error history

When errors occur, XGB basic unit records the error history to clean up causes easily. If you click 『Online』- 『Error/Warning』, you can see the current errors and the history. Remove the causes of errors referring to the details and corrective measures of each error item.



| Index | Code | Date | Time | Contents |
|---|---|---|---|---|
| 92 | 27 | 2023-01-04 | 14:07:45.902 | Compile error |
| 93 | 27 | 2023-01-04 | 14:08:08.462 | Compile error |
| 94 | 27 | 2023-01-04 | 14:10:03.788 | Compile error |
| 95 | 27 | 2023-01-04 | 14:10:14.765 | Compile error |
| 96 | 30 | 2023-02-03 | 11:09:56.664 | Module type mismatch error, base 0, slot 1 |
| 97 | 30 | 2023-02-03 | 11:23:19.664 | Module type mismatch error, base 0, slot 1 |
| 98 | 30 | 2023-03-22 | 16:52:47.771 | Module type mismatch error, base 0, slot 8 |
| 99 | 30 | 2023-03-22 | 16:52:57.771 | Module type mismatch error, base 0, slot 8 |

Details/Corrective Action

Download after modifying I/O parameter, and try to run PLC again.

☑ Always Notify Error/Warning

| Items | Description | Remarks |
|---|---|---|
| Error/Warning | Displays the current Error/Warning. | - |
| Error history | Displays Error/Warning occurred in order of time. | Saving up to 100 |

**Notice**

If you click 'Delete' in the Error/Warning window, all the saved error history will be deleted.

In case the error histories exceed 100EA, the histories are deleted in order from the one that occurred first and the 100EA recent histories are saved

## 2.3.3 Failure Management

(1) Failure Types

The troubles are caused by failure of the PLC itself, system configuration's error, error detection of operational results, etc. They can be divided into the failure mode stopping the operation for system safety; minor failure mode that informs a user of failure warning and resumes the operation.

The failures of the PLC system are mainly caused by the below.

- PLC hardware's problems
- System configuration's error
- Operational error during execution of user programs
- Detection of errors caused by external device failure

(2) Operation mode in case of failures

In case failures occur, the PLC system records the failure details in the special flag (F area) and determines whether resuming the operation based on the failure mode.

- In case of the PLC hardware's failure

In case there are problems with the CPU, power, etc. that the PLC cannot works normally, the system will be stopped; In case of minor failures such as a battery's low voltage, the warning is displayed and the operation will be resumed.

- In case of system configuration's error

It is the failure occurred when the actual PLC's module configuration is not matched with the module configuration set in XG5000. The system will be stopped.

- Computational error during execution of user programs

In case of the numeric operation error (Ex.: in case the denominator of division operation is 0) occurred during execution of user programs, the details will be displayed in the error flag and the system will resume the operation. If the operational time exceeds the operation delay monitoring set time during operation or equipped I/O modules cannot be normally controlled, the system will be stopped.

**Notice**

- When operational errors occur during executing programs, you can determine whether resuming the operation based on the settings of "Basic parameter -> Error operations setting -> Resume the operation in case of operational errors" of the XG5000 project.
- This parameter's default value is set as "Resume the operation in case of operational errors".

- Detection of errors caused by external device failure

The failure of the external control device can be detected by the PLC's user program; in case of detecting failures, the system will be stopped; in case of detecting minor failures, only the detection status will be displayed and the operation will be continued. (For the detailed use of the function to detect external device's failures, refer to the 2.3.5 Failure Diagnosis Function for the External Device.)

The information on failures occurrence is saved in the special relay (F area). Among F area flags, the information related to the failures are as below.

| Word | Bit | Flag Name | Function | Description |
|---|---|---|---|---|
| F000 | F0002 | _ERROR | ERROR | ERROR status |
| F002~3 | - | _CNF_ER | System error | Reports the failure status of the system. |
| | F0021 | _IO_TYER | Module type error | The module type is not matched. |
| | F0022 | _IO_DEER | Module separation error | The module is separated. |
| | F0024 | _IO_RWER | Module I/O error | There are some problems with the module I/O. |
| | F0025 | _IP_IFER | Module interface error | There are some problems with the special / communication module interface. |
| | F0026 | _ANNUM_ER | External device failure | Failures are detected from the external device. |
| | F0028 | _BPRM_ER | Basic parameters | There are some problems with the basic parameters. |
| | F0029 | _IOPRM_ER | IO parameters | There are some problems with I/O parameters. |
| | F002A | _SPPRM_ER | Special module parameters | Abnormal special module parameters |
| | F002B | _CPPRM_ER | Communication module parameters | Abnormal communication module parameters |
| | F002C | _PGM_ER | Program error | There are some errors with the program. |
| | F002D | _CODE_ER | Code error | There are some errors with the program code. |
| | F002E | _SWDT_ER | System Watch dog | The system Watchdog works. |
| | F0030 | _WDT_ER | Scan Watch dog | The scan Watchdog works. |

| Word | Bit | Flag Name | Function | Description |
|---|---|---|---|---|
| F004 | | _CNF_WAR | System warning | Reports the minor failure status of the system. |
| | F0041 | _DBCK_ER | Backup error | There are some problems with data backup. |
| | F0043 | _ABSD_ER | Shutdown cased by abnormal operation | Stoppage caused by abnormal operation. |
| | F0046 | _ANNUM_WAR | External device failure | Minor failures are detected from the external device. |
| | F0048 | _HS_WAR1 | High speed link1 | High speed link – more than parameter1 |
| | F0049 | _HS_WAR2 | High speed link2 | High speed link – more than parameter2 |
| | F0054 | _P2P_WAR1 | P2P parameter1 | P2P – more than parameter1 |
| | F0055 | _P2P_WAR2 | P2P parameter2 | P2P – more than parameter2 |
| | F0056 | _P2P_WAR3 | P2P parameter3 | P2P – more than parameter3 |
| | F005C | _CONSTANT_ER | Fixed cycle error | Fixed cycle error |
| F011 | | _LOGIC_RESULT | Logic result | Displays the logic result. |
| | F0110 | _LER | Operational error | It Is On during 1 scan in case of operational error. |
| | F0111 | _ZERO | Zero flag | It is On when the operational result is 0. |
| | F0112 | _CARRY | CARRY flag | It is On when CARRY occurs during operation. |
| | F0113 | _ALL_Off | All outputs Off | It is On when all outputs are Off. |
| | F0115 | _LER_LATCH | Operational error latch | It maintains 0 in case of operational error. |
| F015 | - | _PUTGET_ERR0 | PUT/GET error 0 | main base PUT / GET error |
| F023 | - | _PUTGET_NDR0 | PUT/GET completion 0 | main base PUT / GET completion |
| F058 | - | _ERR_STEP | Error step | Saves error step. |
| F060 | - | _REF_COUNT | Refresh | Increases when executing module REFRESH |
| F062 | - | _REF_OK_CNT | Refresh OK | Increases when module REFRESH is normal. |
| F064 | - | _REF_NG_CNT | Refresh NG | Increases when module REFRESH is abnormal. |
| F066 | - | _REF_LIM_CNT | Refresh Limit | Increases when module REFRESH is abnormal. (TIME OUT) |
| F068 | - | _REF_ERR_CNT | Refresh Error | Increases when module REFRESH is abnormal. |
| F090 | - | _IO_TYER_N | Mismatch slot | Displays the slot number with the mismatch module type. |
| F091 | - | _IO_DEER_N | Slot with separated module | Displays the slot number with the separated module. |
| F093 | - | _IO_RWER_N | RW error slot | Displays the slot number with module Read/Write error |
| F094 | - | _IP_IFER_N | IF error slot | Displays the slot number with module interface error |
| F096 | - | _IO_TYER0 | Module type 0 error | Main base's module type error |
| F104 | - | _IO_DEER0 | Module separation 0 error | Main base's module separation error |
| F120 | - | _IO_RWER0 | Module RW 0 error | Main base's module Read/Write error |
| F128 | - | _IO_IFER_0 | Module IF 0 error | Main base's module interface error |
| F202 | - | _ANC_ERR | Information on the external device's failure | Displays the information on the external device's failure |
| F203 | - | _ANC_WAR | Information on the external device's minor failure | Displays the information on the external device's minor failure |

**Notice**

- For more details on the whole flags, refer to the Appendix 1 Flag Table of the Outline of this manual.

### 2.3.4 Function to check the expansion module

It is the function to check whether I/O modules work normally during startup and operation. It checks the status of every scan expansion module and the PLC checks whether the following situations occur.

- In case the module that is different from the set parameter is installed at the time of initial operation or failure is suspected
- In case expansion modules are detached or failure is suspected.

If abnormal conditions are detected, the basic unit's ERR LED will be flickering and the PLC will be stopped.

### 2.3.5 Failure Diagnosis Function for the External Device

It is the function to detect the failure of the external device, which connected to the PLC to realize stoppage of the system and warning easily. Through this function, you can detect the external device's failure without complex programming and can monitor the failure position without special devices (XG5000, etc.) or programs.
You can use the failure diagnosis function for the external devices as below.

(1)Failure types of external devices

- The failures of external devices are divided into the two types; failure (error) detected by combination of user programs and special relay (F area) requires stoppage of the PLC operation; minor failure (warning) that continues the PLC's operation and displays the detection status only.

(2) Flag to detect failures of external devices

The following flag types are used to diagnose failures of external devices.

| Word | Bit | Flag Name | Function | Description |
|---|---|---|---|---|
| F0202 | - | _ANC_ERR | Information on the external device's failures | Input the error code of user-defined serious failure of external device. |
| F0203 | - | _ANC_WAR | Information on the external device's MINOR failures | Input the error code of user-defined minor failure of external device. |
| - | F0026 | _ANNUM_ER | detection of external serious error | It is On when the external device's serious failure occurs. |
| - | F0046 | _ANNUM_WAR | detection of external slight error | It is On when the external device's minor failure occurs. |
| - | F2002 | _CHK_ANC_ERR | Request detection of external serious error | It is the command flag asking to detect the external device's serious failure. |
| - | F2003 | _CHK_ANC_WAR | Request detection of external slight error minor failure | It is the command flag asking to detect the external device's minor failure. |

(3) Detecting the external device's serious failures

The following programs are detecting the external device's serious failures.

(a) Save the error code that can be distinguished by external device's serious failures in F202 (_ANC_ERR) through the FWRITE command as below. (Input the values excluding 0)

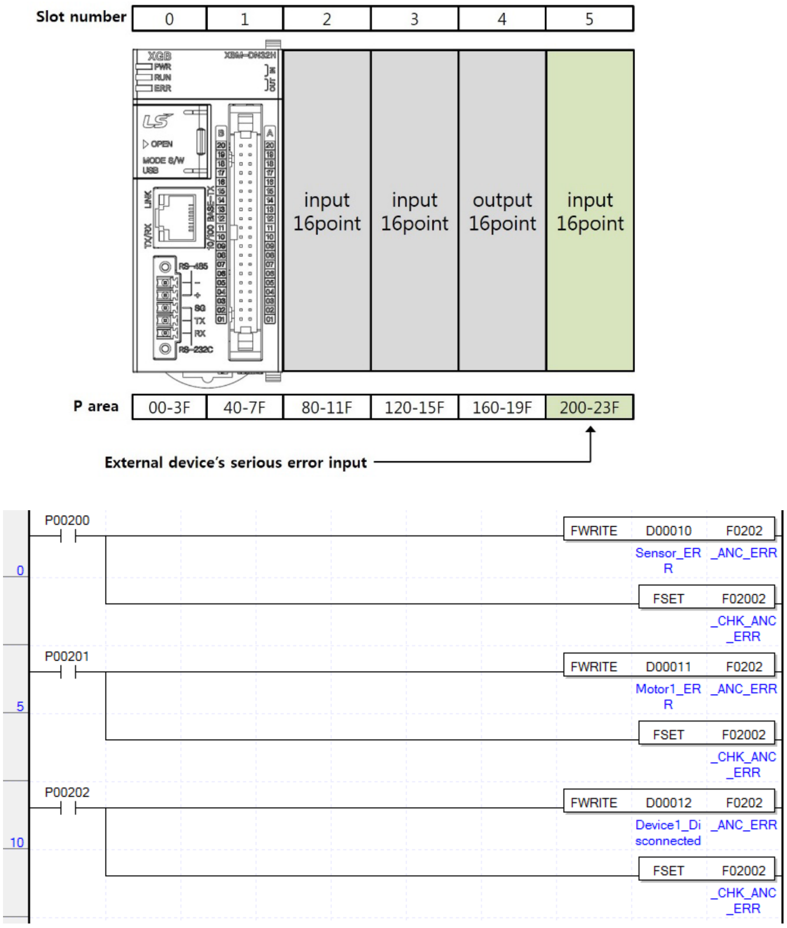
(b) In case the external device's serious failures occur, F2002 (_CHK_ANC_ERR)flag will be On.

(c) When the scan program is completed, the PLC checks whether F2002 (_CHK_ANC_ERR) is ON and detects serious failures.

(d) If the external device's serious failures occur, the PLC will be in error status and will stop the operation. Then, F0026 (_ANNUM_ER) is ON and F2002 flag is automatically Off. All outputs works based on IO parameter's emergency output settings.

(e) When failures occur, through XG5000, a user can figure out the causes of failures by monitoring F202 (_ANC_ERR)flag.

(f) The below figure describes the example of the program detecting the external device's serious failures with operation details.



<Example of the system configuration and program >

- In this example, assume that the input signal to detect the external device's failures is connected to the input module of No.5 slot in the system configuration as below.
  - In case of the sensor failure, P200 is ON. The error code is the value saved in D0010.
  - In case of the motor failure, P201 is ON. The error code is the value saved in D0011.
  - When the device 1 is disconnected, P202 is ON. The error code is the value saved in D0012.
- In the above programming, when P20 is On (In case of sensor failure), the value of D0010 is saved in F202 (_ANC_ERR) and F2002 (_CHK_ANC_ERR) will be On.
- If F2002 is ON, it is detected by the scan end and the external device's serious failures are generated.
- You can detect the failure of motor 1, disconnection of device 1 in the same way.
- After accessing to XG5000, a user can check which external devices have failures by verifying the F202 value and can take follow-up measures.

(4) How to detect the external device’s minor failures

The following programming is used to detect the external device’s minor failures.

(a) Save the warning code that can be distinguished by external device’s minor failures in F203_ANC_WAR through the FWRITE command as below.  (Input the values excluding 0)

(b) In case the external device’s minor failures occur, F2003 (_CHK_ANC_WAR)flag will be On.

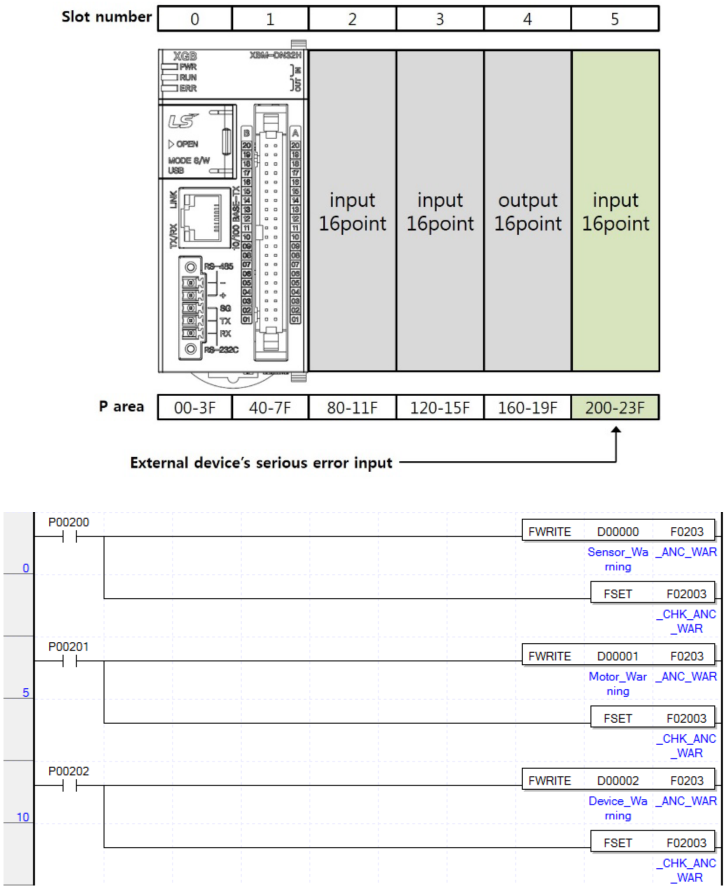
(c) When the scan program is completed, the PLC checks whether F2003 (_CHK_ANC_WAR) is ON and detects minor failures.

(d) If the external device’s minor failures occur, the ERR LED will be flickering at 2 seconds interval and the PLC will run continuously. Then, F0046 (_ANNUM_WAR) is ON and F2003 flag is automatically Off. All outputs works based on IO parameter’s emergency output settings.

(e) When minor failures occur, through XG5000, a user can figure out the causes of failures by monitoring F203 (_ANC_WAR)flag.

(f) If you input 0 again to F203 (_ANC_WAR) after removing the causes of failures and turn ON F2003 (_CHK_ANC_WAR) again, detection of minor failures is canceled.

(g) The below figure describes the example of the program detecting the external device’s minor failures with operation details.



< Example of the system configuration and program >

- In this example, assume that the input signal to detect the external device’s minor failures is connected to the input module of No.5 slot in the system configuration as below.
  - In case of the sensor warning, P200 is ON. The warning code is the value saved in D0000.
  - In case of the motor warning, P201 is ON. The warning code is the value saved in D0001.

- When the device  is warned, P202 is ON. The warning code is the value saved in D0002.

- In the above programming, when P200 is On (in case of sensor failure), the value of D000 is saved in F203 (_ANC_WAR) and F2003 (_CHK_ANC_WAR)will be On.
- If F2003 is ON, it is detected by the scan end and the external device's serious failures are generated.
- You can detect the warnings on motor 1 and device 1 in the same way.
- After accessing to XG5000, a user can check which external devices have minor failures by verifying the F203 value and can take follow-up measures.

## 2.4 RTC Function

XBM H' unit has the clock (RTC) function and the clock keeps working thanks to the battery backup even when the power is Off. You can use the embedded RTC's time data for time management such as the system's operating history or failure history, etc. The RTC's current time is updated every scan based on the operation status information flag of the system.

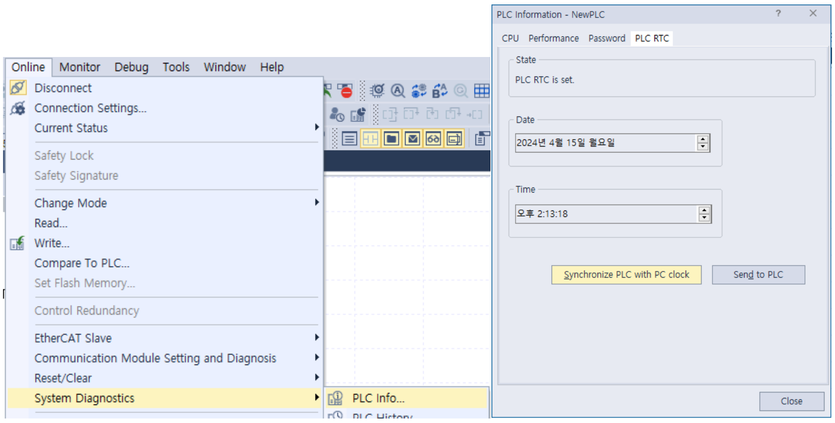
### 2.4.1 How to use the RTC Function

(1) Read/Set clock data

(a) Read/Set from XG5000

1) Click 『Online』 - 『Diagnosis』 - 『PLC information』.

2) Click the PLC clock tab of 『PLC information』.



State: PLC RTC is set.

Date: 2024년 4월 15일 월요일

Time: 오후 2:13:18

3) If you want to transfer the PLC's time to the PLC, click the PC clock and synchronization button.

4) If you want to set up your preferred time, after changing the set values of the data and time box, click them to the PLC.

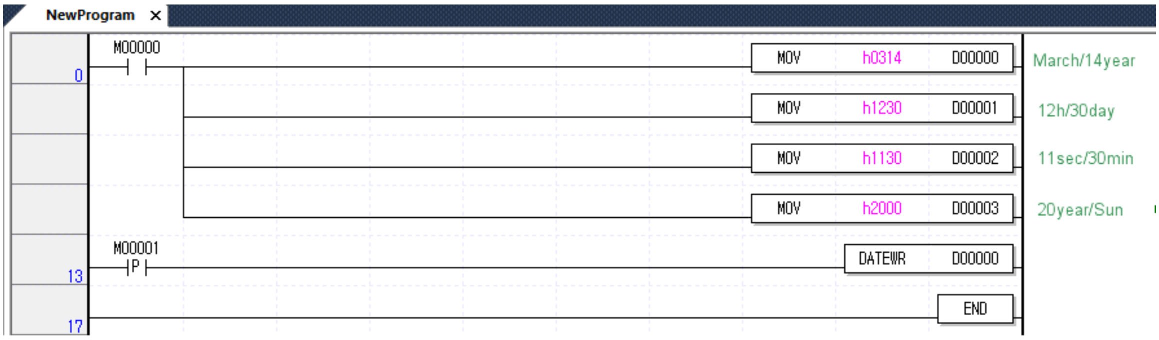
(b) Read with the special relay

You can monitor the data with the special relay as below.

| Word | Flag Name | Name | Data | Description |
|---|---|---|---|---|
| F053 | _MON_YEAR | Clock data (month/year) | H0709 | July, xx09 |
| F054 | _TIME_DAY | Clock data (hour/day) | h1214 | 14h.12th |
| F055 | _SEC_MIN | Clock data (second/minute) | H2040 | 20 min. 40 sec. |
| F056 | _HUND_WK | Clock data (Year/week) | H2003 | 20xx,Wed. |

(c) Example of changing the clock data through programs

You can change the clock data through the programs as below.



```
NewProgram
0   M00000  MOV  h0314  D00000   March/14year
            MOV  h1230  D00001   12h/30day
            MOV  h1130  D00002   11sec/30min
            MOV  h2000  D00003   20year/Sun
13  M00001 P  DATEWR  D00000
17  END
```

| Area | Item | Input data | Description |
|---|---|---|---|
| D0000 | Month/ Year | h'0314 | Mar./xx14 |
| D0001 | Hour/ Day | h'1230 | 12:00/30th |
| D0002 | Second/ Minute | h'1130 | 11 seconds/30 minutes |
| D0003 | Year/ Week | h'2000 | 20xx /Sun. |

Input the clock data in the random devices (P,M,K,L,Z,U,D,R) and turn On/Off the DATEWR input contact M0001.

(If the clock data is not correct except the day of the week, it will not be written. Day of the week data is automatically corrected and written)

Check whether the data was correctly changed by monitoring the above special areas (F053~F056).

(d) How to express the day

| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Day | Sun. | Mon. | Tue. | Wed. | Thu. | Fri. | Sat. |

(2) Time error

The RTC's error is different depending on the service temperature.

| temperature | max error(sec/day) | normal condition(sec/day) |
|---|---|---|
| 0℃ | -4.67 ~ 1.56 | -1.55 |
| 25℃ | -3.11 ~ 1.96 | 0.58 |
| 55℃ | -10.37 ~ -1.56 | -5.97 |

**Notice**

- The clock data may not be stated in the shipped product so you need to set up the clock data correctly before use.
- If you write unserviceable clock data in the RTC, it will not work properly.
  Ex.) 25:00, 32th, 14 month
- In case the RTC stops or error occurs due to a battery failure, if you write the new clock data in the RTC, the error will be cleared.

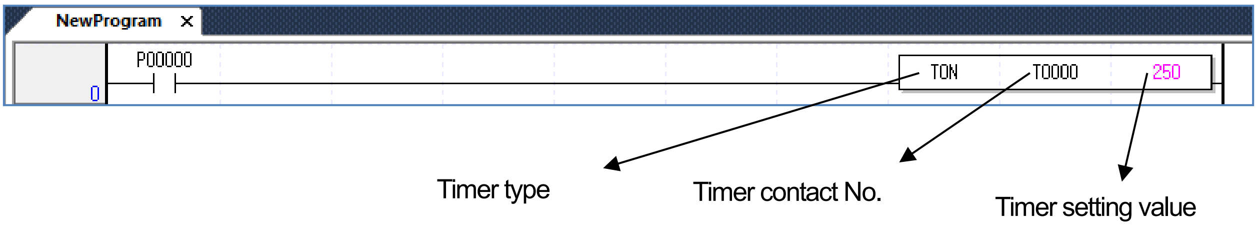
## 2.5 Timer counter function

### 2.5.1 Timer Function

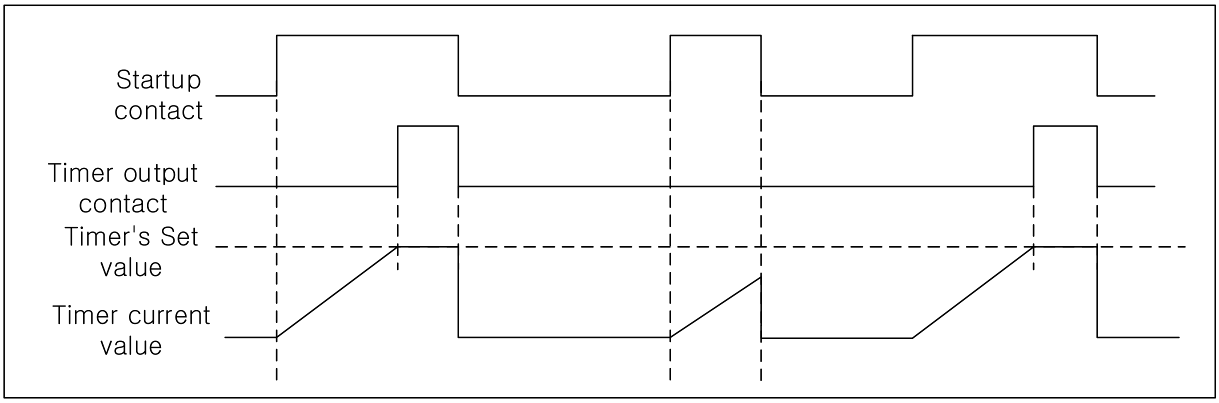
The XGB's timer is the additional timer increasing the current value depending on the measuring time. There are 5 available timer types; On delay timer (TON), Off delay timer (TOFF), Cumulative (TMR), Monostable (TMON), retriggerble (TRTG).

The measurable time ranges by timers are as below.

| | 100ms timer | 10ms timer | 1ms timer |
|---|---|---|---|
| Range | 0.1 seconds ~ 6553.5 seconds | 0.01 seconds ~ 655.35 seconds | 0.001 seconds ~ 65.535 seconds |



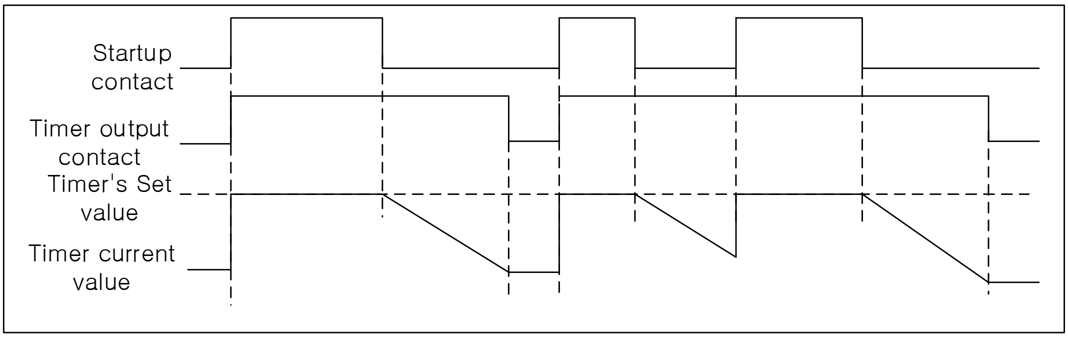
(1) Updating the current value of On delay timer and contact On/Off
If the input contact is On, the current value starts to increase. When the current value reaches the set time (PT) (current value=set value), the timer's output contact (Txxx) will be On. When the input contact is Off while the current value increases, the timer's current value will be 0. The timing chart of the On delay timer is as below.



(2) Updating the current value of Off delay timer and contact On/Off

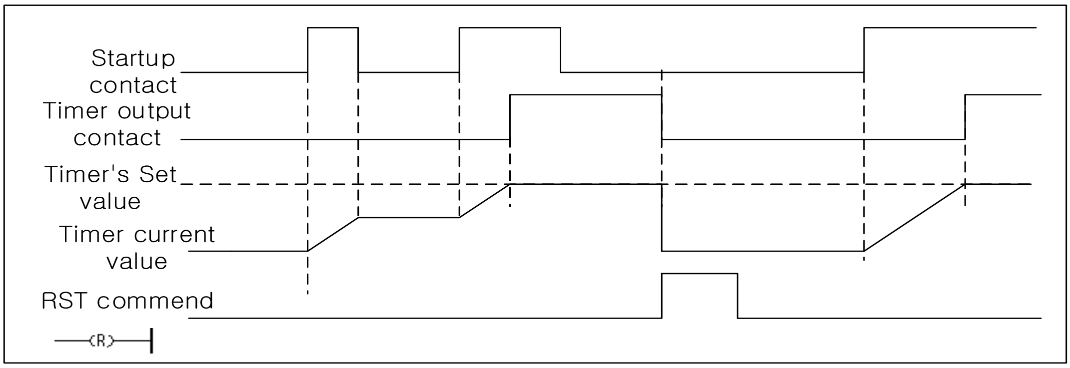
If the input condition is On, the timer's output contact (Txxx)is On and the current value becomes the set value. When the input contact is Off, the current value starts to decrease and if the elapse time reaches the set time (PT (current value=0), the timer's output contact (Txxx) will be Off. If the input contact is On while the current value decreases, the current value becomes the set value.

The timing chart of the Off delay timer is as below.



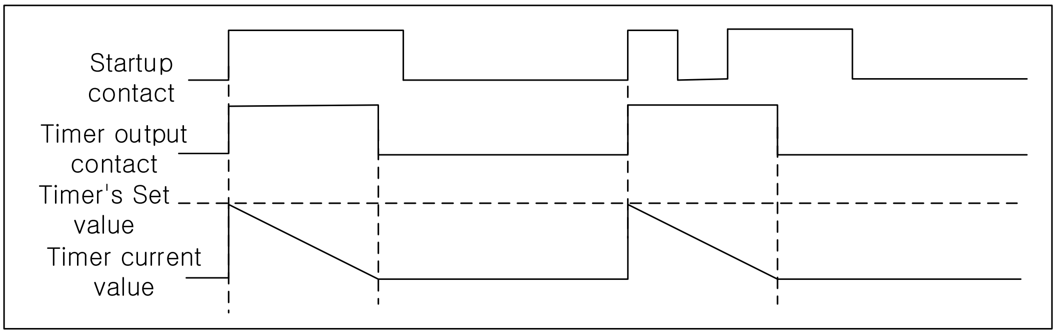
(3) Updating the current value of Cumulative timer and contact On/Off

The current value increases only when the input contact is On and if the cumulative value reaches the timer's et time (PT), timer output contact is on. The timer output contact maintains the On status until it is Off by the reset coil (IL : RST command). The timing chart of the Cumulative timer is as below.



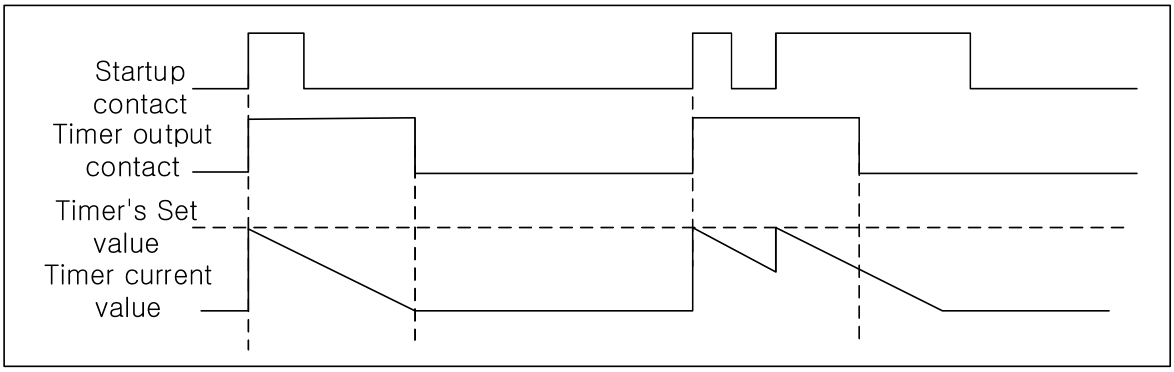
(4) Updating the current value of Monostable timer and contact On/Off

If the input condition is On, the timer's output contact (Txxx) is On. When the timer's current value starts to decrease from the set value (PT) and it becomes 0, the output contact is Off. The change of On/Off of the input contact is regarded until the current value reaches 0. The timing chart of the Monostable timer is as below.



(5) Updating the current value of retriggerble timer and contact On/Off

If the input condition is On, the timer's (Txxx) is On.
When the timer's current value starts to decrease from the set value (PV) and it becomes 0, the output contact is Off. Before the timer's current value becomes "0', the input contact is Off→On again, the timer's current value is updated to the initial set value again. The timing chart of the retriggerble timer is as below.



**Notice**

- The timer's current value and output processing are executed in the scan END so the maximum error is as below.
  Max. error : 1 scan time + Executing time from the startup of the scan to the timer command step
- For more details on how to use the timer command, refer to the XGB command manual.

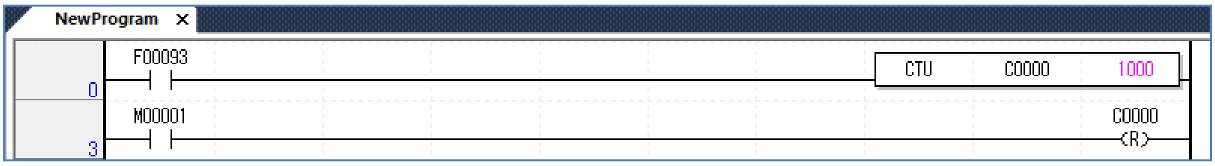
## 2.5.2 Counter Function

The CPU part's counter detects the input signal's rising edge (Off→On) and increases·decreases the current value. XGB PLC supports 4 kinds of counter commands; additional counter (CTU), subtractive counter (CTD),additional·subtractive counter (CTUD),ring counter (CTR).

- The additional counter increases the current value.
- The subtractive counter decreases the current value.
- The additional·subtractive counter increases or decreases the current value depending on the 2 input conditions.
- The ring counter increases the current value and renews the current value as "0" whenever the current value becomes the set value.

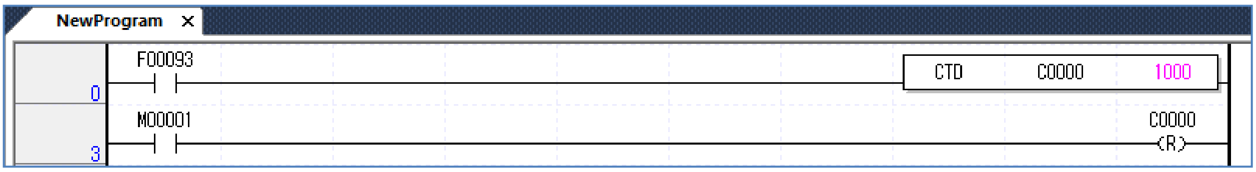
(1) Updating the counter's current value and contact On/Off

(a) Additional counter



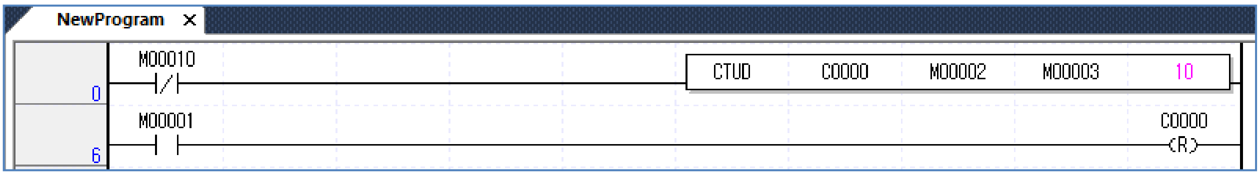
- It increases the current value under the rising edge of the input condition.
- When the current value increases and becomes the same as the set value, the counter's output contact (Cxxx) is On.
- The current value is "0" and the output contact (Cxxx) is Off while the reset signal is On.

(b) Subtractive counter



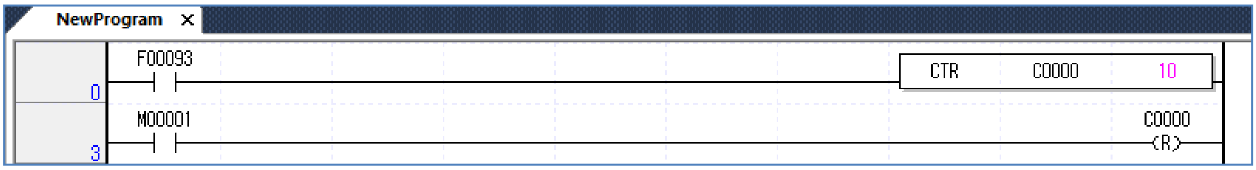
- It decreases the current value of the rising edge of the input condition.
- When the current value decreases and becomes “0”, the counter’s output contact (Cxxx) is On.
- The current value is “0” and the output contact (Cxxx) is Off while the reset signal is On.

(c) Additional ·subtractive counter



- The current value increases under the rising edge of the additional input condition and the current value decreases under the rising edge of the subtractive input condition. When the current value is greater than or equal to the set value, the output contact Cxxx is On. The current value is smaller than or equal to the set value, the output contact Cxxx is Off.
- The current value becomes 0 in case of reset signal input.

(d) Ring counter



- The current value increases by 1 under the rising edge of the input condition. After the current value reaches the set value, the current value becomes 0 under the rising edge of the next input condition.
- When the current value is the set value, output contact Cxxx is On. Under the rising edge of the next input condition or the rising edge of the reset condition, output contact Cxxx is Off.
- During counting the ring counter, it the reset condition is input, the current value becomes 0.

(2) Counter’s maximum counting speed

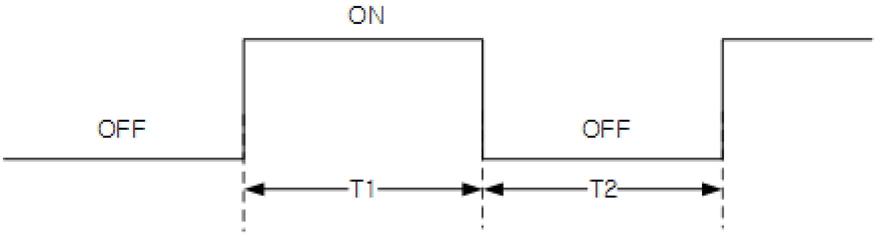
The counter’s maximum counting speed is determined by the scan time. only when On/Off time of the input condition is greater than the scan time, it can be countable.

$$\text{Max. counting speed} \quad C_{max} = \frac{n}{100} \times \left(\frac{1}{t_s}\right)$$

n :Duty (%)

$t_s$ : scan time[s]

- The duty (n) puts the input signal’s On, Off time ratio on a percentage basis



T1 ≤ T2 : $n = \frac{T1}{T1+T2} * 100$ [%]

T1 > T2 : $n = \frac{T2}{T1+T2} * 100$ [%]

**Notice**

• You are recommended to use the high speed counter function to count the high speed’s input pulse accurately that cannot be counted with the counter command

## 2.6 Remote Function

In XGB basic unit, you can change the operation mode through the key switch attached to the module or through communication. For remote operation, put the basic unit's mode change switch on STOP position.

(1) The kinds of remote operations are as below.

- Access to XG5000 and operation through the USB port installed in the basic unit
- You can operate the other PLCs connected to the network by using the PLC's communication functions when XG5000 is connected to the basic unit.
- You can control the PLC's operation status with HMI software, etc. though the dedicated communication

(2) Remote RUN/STOP

- It is the function to execute RUN/STOP through communication modules through the outside.
- This convenient function can be helpfully used when the PLC is installed in the bad palace to operate or you need to RUN/STOP the CPU modules of a control panel from the outside.

(3) Remote DEBUG

- It is the function to execute DEBUG when the operation mode switch is on STOP position. DEBUG is the function to execute the program operation based on the specified operating conditions.
- This convenient function can be helpfully used when you need to check the program's progress or each data's details during the system's debugging works.

(4) Remote reset

- It is the function to reset the CPU module by remote control when errors occur.
- 'Reset' and 'Overall Reset' are available.

**Notice**

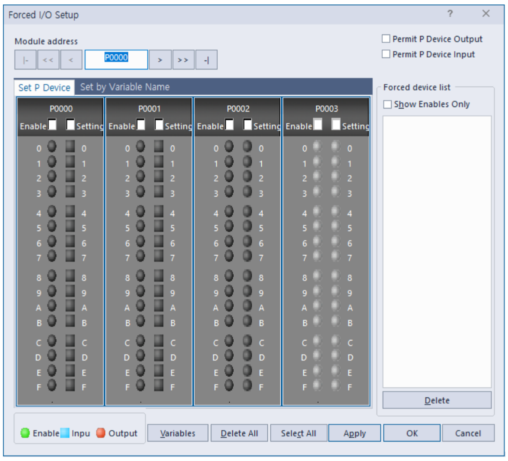
- For more details on how to operate the remote functions, refer to 'Chap.10 Online' of the XG5000 manual.

## 2.7 I/O forced On/Off Functions

The forced I/O function is used to turn On/Off I/O areas by force regardless of the results of program execution.

### 2.7.1 Forced I/O setting method

Click『Online』-『 Forced I/O setting 』.



The below table represents the items related to the forced I/O setting.

| Item | | Description |
|---|---|---|
| Movement of address | | You can select the base and slot. |
| Apply | | You can set the forced input and output Enable / Unable |
| Individual | Data | You can set the forced I/O Enable / Unable by bit. |
| | Flag | You can set the forced I/O data (On/Off) by bit. |
| View variables/comments | | You can check the set input, output variables. |
| Select All | | You can set the forced I/O Enable under the condition that the whole I/O areas are On. |
| Delete All | | You can delete the forced I/O Enable under the condition that the whole I/O areas are Off. |
| Set device | | It displays the I/O area where even one bit is set. |

### 2.7.2 Time to process the forced I/O On / Off and processing method

(1) Forced input

When the forced input is set, among the data read from the input model at the time of Refresh, the data of the contact set as the forced On/Off is replaced by the forced set data to update the input image area. Accordingly, during program operation, among the actual input data, the forced set area is operated with the results replaced by the forced set data.

(2) Forced output

After completing the operation of user programs, at the time of output Refresh, among the data of the output image areas including the operation results, the data of the contact set as the forced On/Off is replaced by the forced set data, and then, they are output. Accordingly, in contrast with the forced input, in the case of the forced output, the data of the output image area shows the same data with the program operation results but the actual output changes by the forced output On/Off settings.

(3) Instructions to use the Forced I/O functions

- It works from the time of setting each I/O ‘Enable’ after setting the forced data.
- Although the actual I/O modules are not equipped, the forced input can be set.
- In spite of Off-> On of the power, change of operation modes and operation by the reset key The previously set On/Off data is stored in the PLC.
- Even in STOP mode, the forced input and output data is not eliminated.
- When you try to set the new data from the beginning, cancel all settings of I/O by using ‘Delete All’ before use.

(4) Operations in case of errors

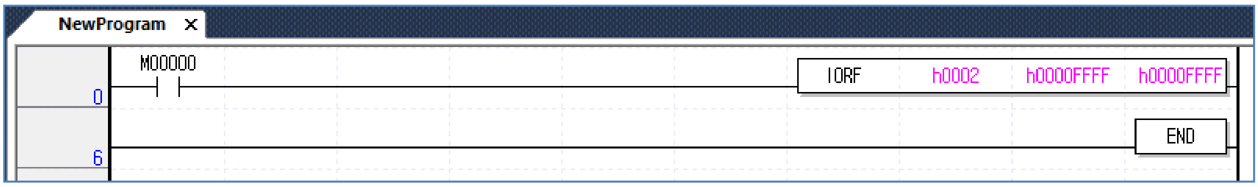
•When errors occur after setting the forced output, it works based on 「Output Hold when errors occur」 of output control settings in the basic parameters and 「Emergency Output」 of the I/O parameters. In case of error occurrence, if you select the emergency output as 「Clear」 after setting Output Hold when errors occur」, the output is off when errors occur; if you choose 「Hold」, the output status will be maintained.

• In case 「Output Hold when errors occur」 is not set in the output control setting of the basic parameters, the output is Off.

## 2.8 Direct I/O Operation Function

I/O contact’s Refresh is executed after the scan program is finished. Accordingly, the data of the I/O contact that changes during execution of programs is refreshed to the I/O data of when the END command is executed instead of being refreshed when the data changes.

If you need to immediately refresh the I/O data during execution of the program, through ‘IORF’ command, you can directly read the input contact status for operation or can directly print out the operation results in the output contact. The below figure indicates the example of the direct I/O operation through the IORF command.



• When M00000 is On, the IORF’ command is executed and the first operand specifies the slot number. The second operand is the mask data of the upper 32 bits, the third operand is the mask data of the lower 32 bits. You need to set the bit to be refreshed as ‘1’. The bit set as ‘0’ is not refreshed.

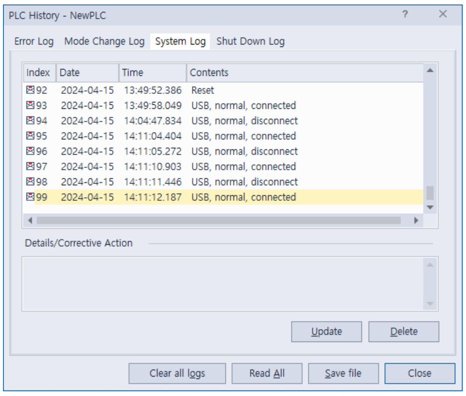
**Notice**

• When you read and write the data in the expansion module through the IORF command, it takes approximately 1~2ms. Accordingly, if the IORF command is used in the fixed cycle task or the external interrupt task program that is input at a short interval, task conflict may occur.

• For more details on the IORF command, refer to the XGK/XGB command manuals.

## 2.9 Function saving the operation history

There are 4 types of operation history; error history, mode conversion history, power down history and system history. The occurrence time, frequency, operating details of each event are saved in the memory and you can conveniently monitor the data through XG5000. The operation history is saved in the PLC unless it is deleted through XG5000.



| Index | Date | Time | Contents |
|---|---|---|---|
| 92 | 2024-04-15 | 13:49:52.386 | Reset |
| 93 | 2024-04-15 | 13:49:58.049 | USB, normal, connected |
| 94 | 2024-04-15 | 14:04:47.834 | USB, normal, disconnect |
| 95 | 2024-04-15 | 14:11:04.404 | USB, normal, connected |
| 96 | 2024-04-15 | 14:11:05.272 | USB, normal, disconnect |
| 97 | 2024-04-15 | 14:11:10.903 | USB, normal, connected |
| 98 | 2024-04-15 | 14:11:11.446 | USB, normal, disconnect |
| 99 | 2024-04-15 | 14:11:12.187 | USB, normal, connected |

### 2.9.1 Error Log

It saves the error history occurred during operation.

- The error code, date, time, error details are saved.
- The histories can be saved up to 100 EA.
- It is automatically canceled when the memory backup is cleared due to the battery's low voltage, etc.

### 2.9.2 Mode Change Log

It saves the information on the changed mode and time when changing the operation mode.

- It saves the data, time, mode conversion details.
- The histories can be saved up to 100 EA.

### 2.9.3 Shut down Log

On or Off time of the power is saved as the ON/OFF information.

- ON/OFF information, date and time are saved.
- The histories can be saved up to 100 EA.

### 2.9.4 System Log

It saves the operation history of the system occurred during operation.

- The date, time and details of operation changes are saved.
- The histories related to system operation are saved; XG5000 operation information, change of the key switch position, etc.
- The histories can be saved up to 100 EA.

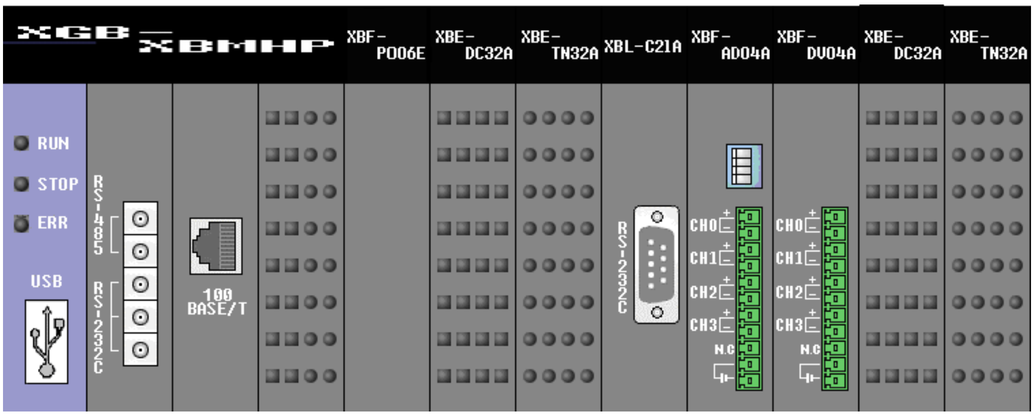
## 2.10 How to allocate I/O No.

Allocation of I/O No. is to allocate the address to each module's I/O terminals to read the data from the input modules and output the data in the output modules when executing operation. In the XGB PLC, all modules occupy 64 points.

(1) Allocation of I/O No.

The basic unit occupies 2 slots of No.1 so 128 points are allocated and all remaining expansion module occupies 64 points. (including special, communication modules)

**Example of allocating I/O No. based on the system configuration**

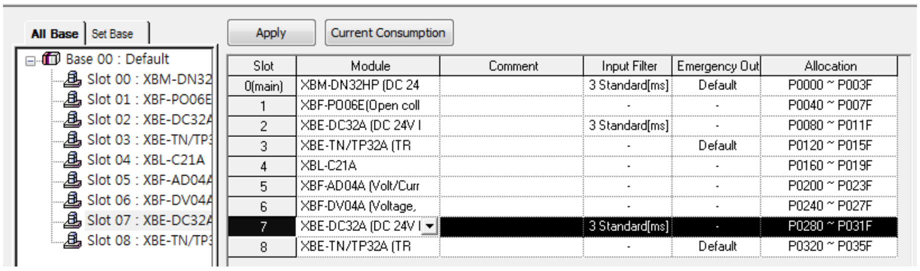


| Slot No. | Model | I/O allocation | Remakrs |
|---|---|---|---|
| 0 | XBM-DN32HP | input : P0000 ~ P001F<br>output : P0020 ~ P003F | Fixed as the basic unit |
| 1 | Embedded functions | P0040~P007F | - |
| 2 | XBE-DC32A | input : P0080~P011F | Actual input : P0080 ~ P009F |
| 3 | XBE-TN32A | output : P0120 ~ P015F | Actual output : P0120 ~ P013F |
| 4 | XBL-C21A | P0160 ~ P019F | - |
| 5 | XBF-AD04A | P0200 ~ P023F | - |
| 6 | XBF-DV04A | P0240 ~ P027F | - |
| 7 | XBE-DC32A | input : P0280 ~ P031F | Actual input : P0280 ~ P029F |
| 8 | XBE-TN32A | output : P0320 ~ P035F | Actual output : P0320 ~ P033F |

* The number of empty I/O points can be used as the internal relay.

* In the case of the high performance XGB basic type, it does not have the embedded special function corresponding to No.1 slot but occupies No.1 slot as an empty slot.

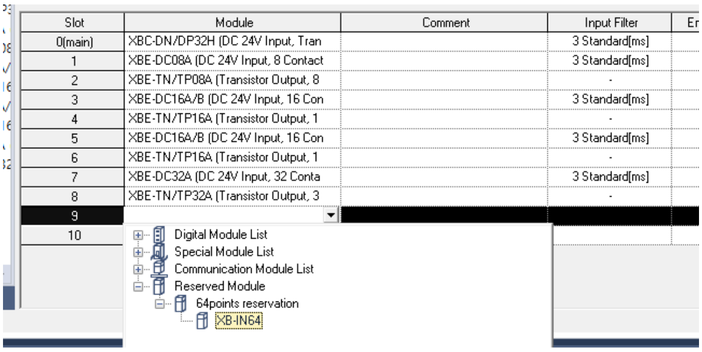
(2) When the I/O of the I/O parameter is allocated, the allocation information is displayed.



| Slot | Module | Comment | Input Filter | Emergency Out | Allocation |
|---|---|---|---|---|---|
| 0(main) | XBM-DN32HP (DC 24 | | 3 Standard[ms] | Default | P0000 ~ P003F |
| 1 | XBF-PO06E(Open coll | | - | - | P0040 ~ P007F |
| 2 | XBE-DC32A (DC 24V I | | 3 Standard[ms] | - | P0080 ~ P011F |
| 3 | XBE-TN/TP32A (TR | | - | Default | P0120 ~ P015F |
| 4 | XBL-C21A | | - | - | P0160 ~ P019F |
| 5 | XBF-AD04A (Volt/Curr | | - | - | P0200 ~ P023F |
| 6 | XBF-DV04A (Voltage, | | - | - | P0240 ~ P027F |
| 7 | XBE-DC32A (DC 24V I | | 3 Standard[ms] | - | P0280 ~ P031F |
| 8 | XBE-TN/TP32A (TR | | - | Default | P0320 ~ P035F |

(3) Module Reservation function

It is used to fix the module's location on XGB series products where the user cannot specify the module's installation location. The module reservation feature allows systems with different configurations to use the same PLC program.



| Slot | Module | Comment | Input Filter | Er |
|---|---|---|---|---|
| 0(main) | XBC-DN/DP32H (DC 24V Input, Tran | | 3 Standard[ms] | |
| 1 | XBE-DC08A (DC 24V Input, 8 Contact | | 3 Standard[ms] | |
| 2 | XBE-TN/TP08A (Transistor Output, 8 | | - | |
| 3 | XBE-DC16A/B (DC 24V Input, 16 Con | | 3 Standard[ms] | |
| 4 | XBE-TN/TP16A (Transistor Output, 1 | | - | |
| 5 | XBE-DC16A/B (DC 24V Input, 16 Con | | 3 Standard[ms] | |
| 6 | XBE-TN/TP16A (Transistor Output, 1 | | - | |
| 7 | XBE-DC32A (DC 24V Input, 32 Conta | | 3 Standard[ms] | |
| 8 | XBE-TN/TP32A (Transistor Output, 3 | | - | |
| 9 | | | | |
| 10 | | | | |

The module reservation function can be used by selecting 'Reserved Module' > '64points reservation' > 'XB-IN64'. Slots reserved by the module reservation function also occupy 64 points.

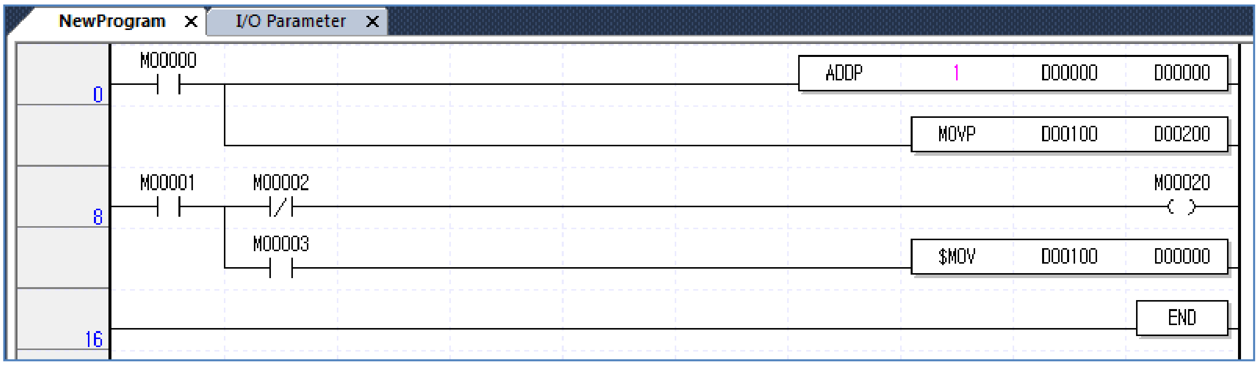
## 2.11 Modification Procedures during RUN

Program Modification during operation (Modification during RUN)

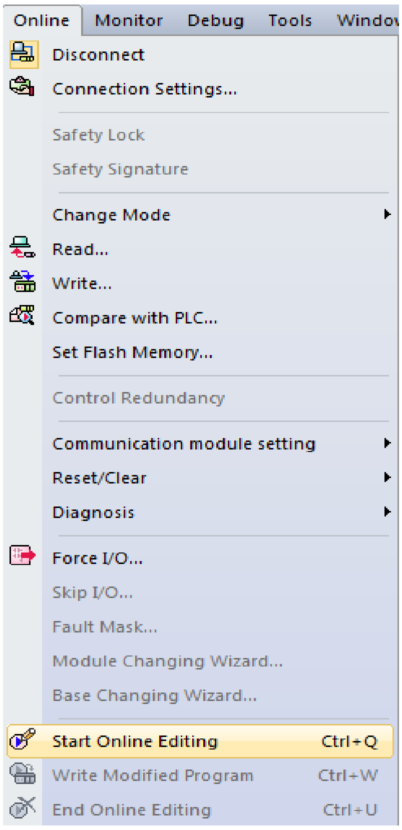
You can modify the programs and communication parameters without stopping control operations during running the PLC. The below describes the basic modification method. For more details on Modification during RUN, refer to the XG5000 manual.

The items that can be modified during RUN are limited to programs, network parameters.
You cannot modify adding tasks, deletion, parameters, etc. during RUN.

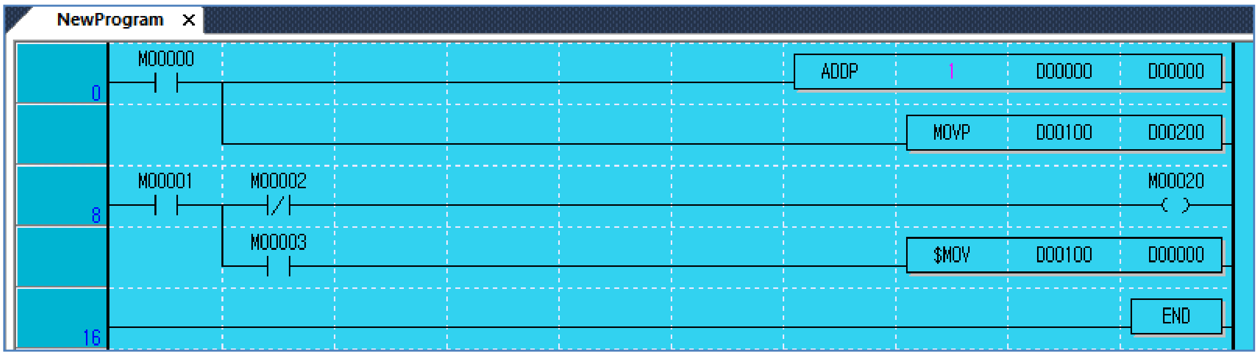
(1) It shows the currently running program.



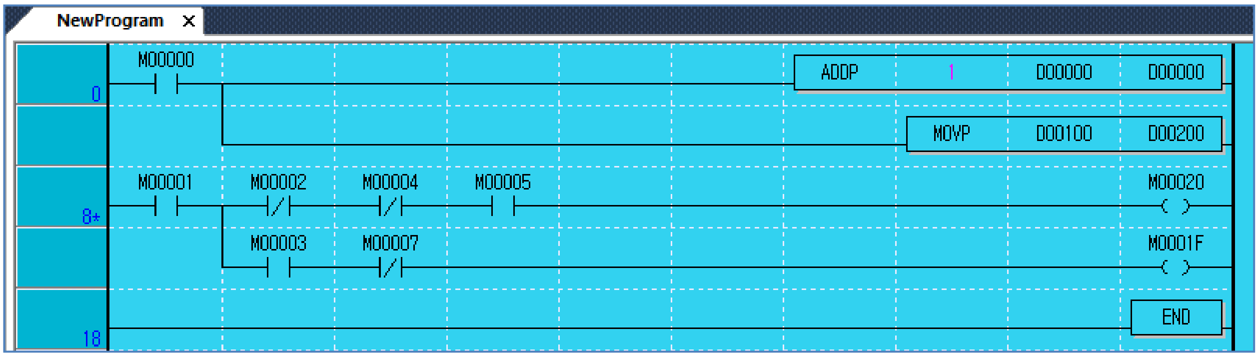
(2) Click『Online』-『Start Modification Online Editing』.



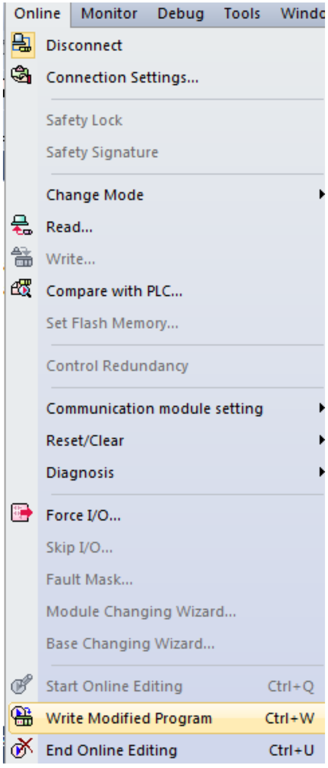
(3) Then, the background color of the program window changes and it is converted into the mode of modification during RUN.

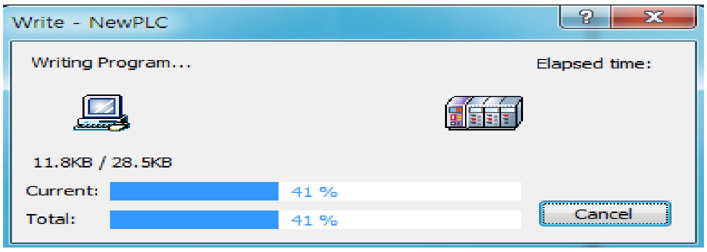


(4) You can modify the program.



(5) When the modification of the program is completed, click 『Online』 - 『Write Modified Program』





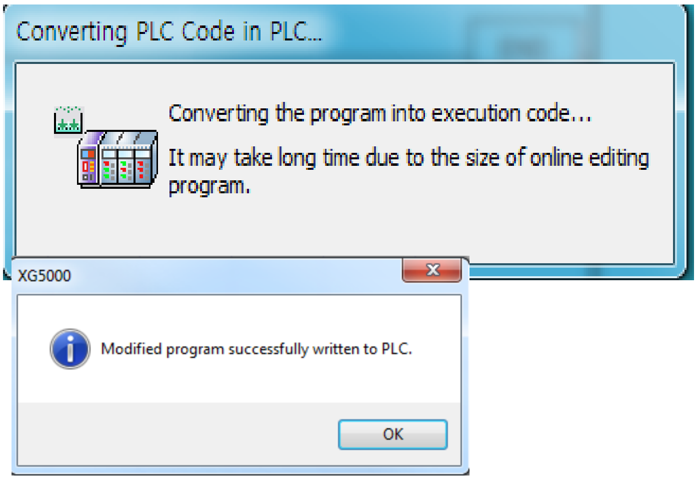
Writing Program...

Elapsed time:

11.8KB / 28.5KB

Current: 41 %

Total: 41 %

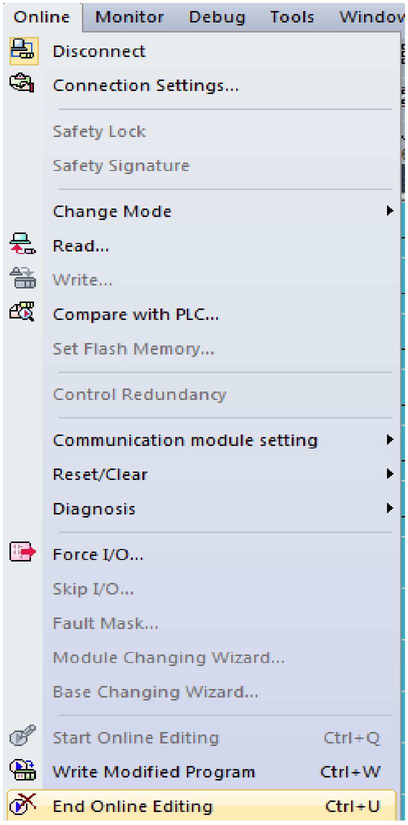


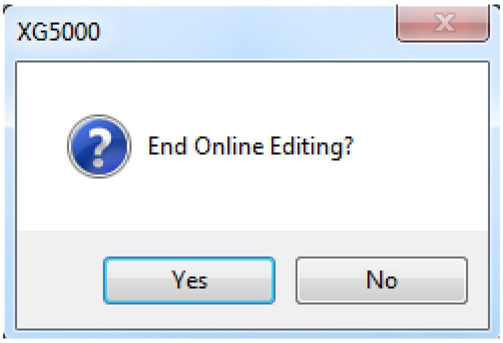
Converting the program into execution code...

It may take long time due to the size of online editing program.

Modified program successfully written to PLC.

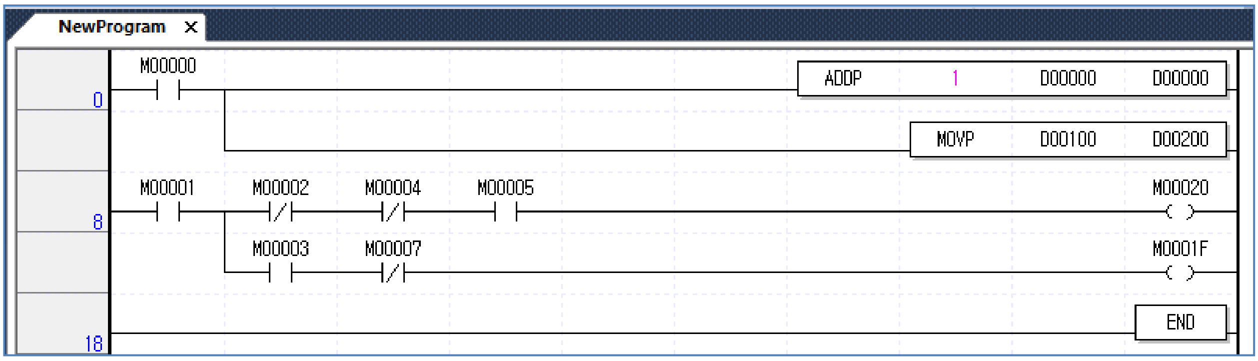
(6) When Write Program is completed, click 『Online』 - 『End Online Editing』.




XG5000

End Online Editing?

(7) The background color of the program window changes into the original one and modification during RUN is completed.



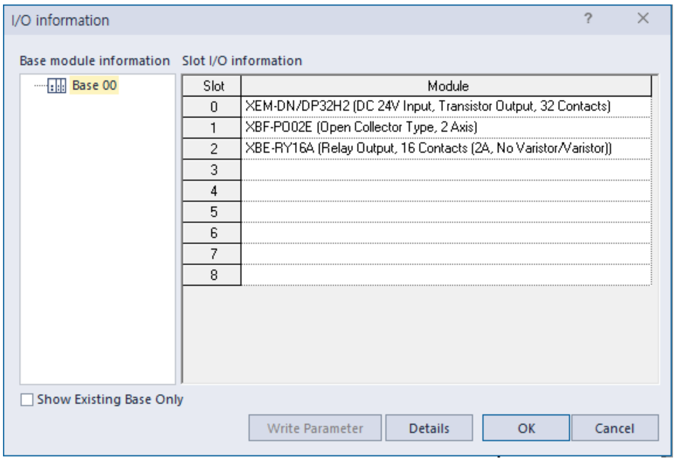
**Notice**

- For Modification of communication parameters during RUN, after changing the network configuration items of XG5000 in the RUN status without going into the Modification during RUN menu, click 『Online』 - 『Write』 and choose 'Network Parameter' to execute Write.

## 2.12 Read I/O information

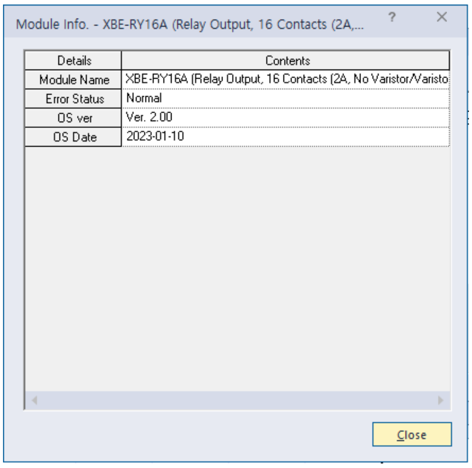
It is the function to monitor each module's information comprising the XGB PLC system.

(1) If you click 『Online』-『I/O Information』, the information of each module of connected systems will be monitored.



| Slot | Module |
|---|---|
| 0 | XEM-DN/DP32H2 (DC 24V Input, Transistor Output, 32 Contacts) |
| 1 | XBF-PO02E (Open Collector Type, 2 Axis) |
| 2 | XBE-RY16A (Relay Output, 16 Contacts (2A, No Varistor/Varistor)) |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |

(2) If you click 'Detailed Information' after choosing the module, the details on the module will be displayed.



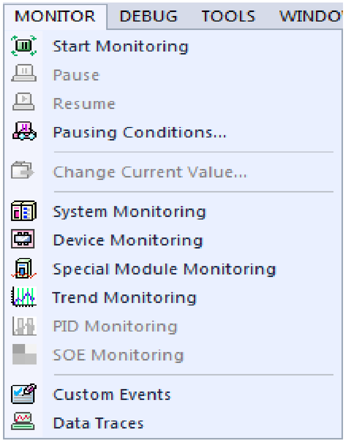
| Details | Contents |
|---|---|
| Module Name | XBE-RY16A (Relay Output, 16 Contacts (2A, No Varistor/Varisto |
| Error Status | Normal |
| OS ver | Ver. 2.00 |
| OS Date | 2023-01-10 |

(3) By clicking the 'I/O Sync', you can overwrite module information on the 'I/O Information' into the 'I/O Parameter' of the PLC. I/O Synchronization can only be executed in the STOP mode.

## 2.13 Monitoring Functions

It is the function to monitor the XGB PLC system's general information.

(1) If you click 『Monitor』, the submenu will be displayed as below.

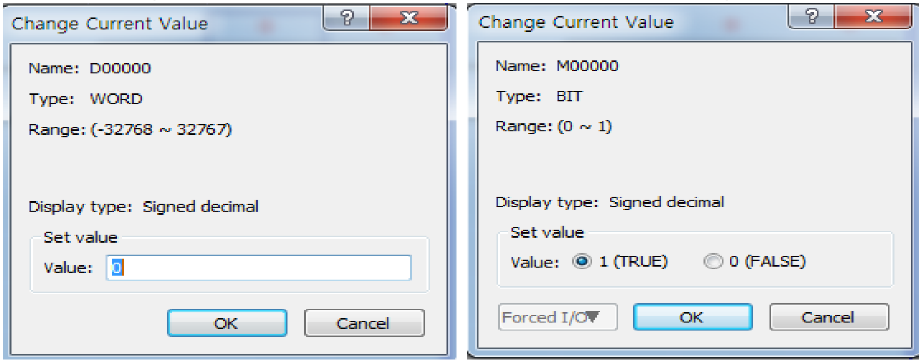


(2) The below table provides the descriptions on each item.

| Items | Descriptions | Remarks |
|---|---|---|
| Start/End monitor | Specifies the startup and end of the monitor. | Changes every time you click |
| Pause | Suspends the monitor. | |
| Resume | Executes the suspended monitor again. | |
| Pausing Conditions | It is the function to suspend the monitor when the set device's value is matched with the conditions. | Restarts when you click 'Restart Monitor' |
| Change the Current value | Changes the currently selected device's current value. | |
| System Monitoring | Monitors the current system's general information. | |
| Device Monitoring | It is the function to monitor each device. | |
| Trend Monitoring | Monitors the set device's trend. | For more details, refer to the XG-5000 manual. |
| Custom Events | Monitors the set device's value when the event specified by a user occurs. | |
| Data Trace | Traces the set device's value. | |

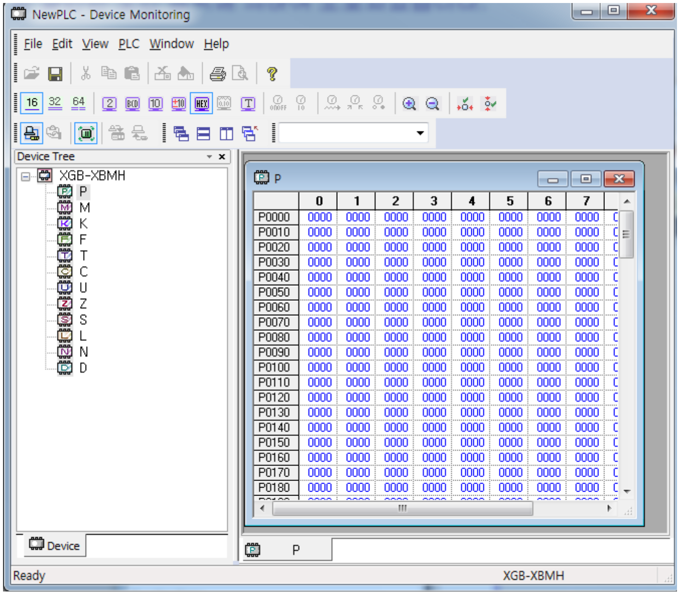
(a) Changing the current value

It is the function to change the current value of each selected device in the program window.



(b) Device monitor

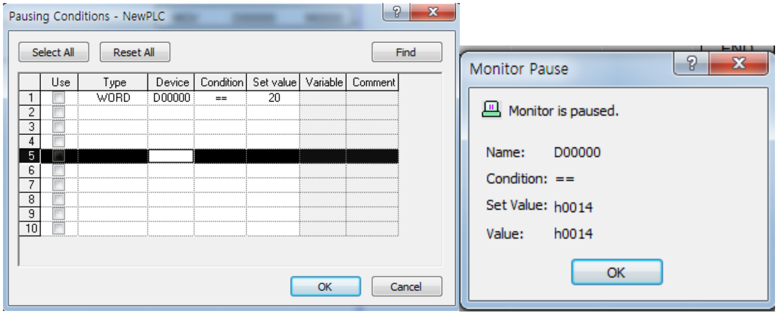
It is the monitoring function by device.



|  | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| P0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 |
| P0010 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 |
| P0020 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 |
| P0030 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 |
| P0040 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 |
| P0050 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 |
| P0060 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 |
| P0070 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 |
| P0080 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 |
| P0090 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 |
| P0100 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 |
| P0110 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 |
| P0120 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 |
| P0130 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 |
| P0140 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 |
| P0150 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 |
| P0160 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 |
| P0170 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 |
| P0180 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 |

(c) Monitor suspension setting

It is the function to stop monitoring when the set device value is matched.



|  | Use | Type | Device | Condition | Set value | Variable | Comment |
|---|---|---|---|---|---|---|---|
| 1 | ☐ | WORD | D00000 | == | 20 |  |  |
| 2 | ☐ |  |  |  |  |  |  |
| 3 | ☐ |  |  |  |  |  |  |
| 4 | ☐ |  |  |  |  |  |  |
| 5 | ☐ |  |  |  |  |  |  |
| 6 | ☐ |  |  |  |  |  |  |
| 7 | ☐ |  |  |  |  |  |  |
| 8 | ☐ |  |  |  |  |  |  |
| 9 | ☐ |  |  |  |  |  |  |
| 10 | ☐ |  |  |  |  |  |  |

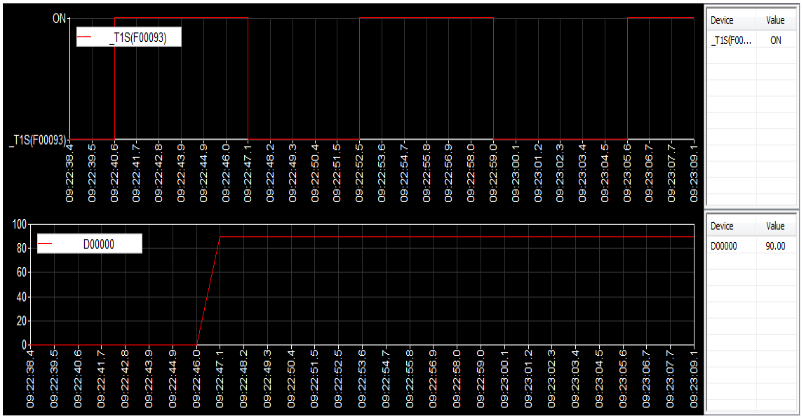
Monitor is paused.

Name: D00000
Condition: ==
Set Value: h0014
Value: h0014

(d) Trend Monitor

It is the function to represent the set device value in a graphic form. The value represented on the graph is not the data collected by the PLC at the right timing but the value read from XG5000 through the communication function. Accordingly, communication delay can occur so it may not be matched with the actual data collected at the right cycle.

You are recommended to use the Trend Monitor function only to check the rough data trend.



| Device | Value |
|---|---|
| _T1S(F00... | ON |

| Device | Value |
|---|---|
| D00000 | 90.00 |

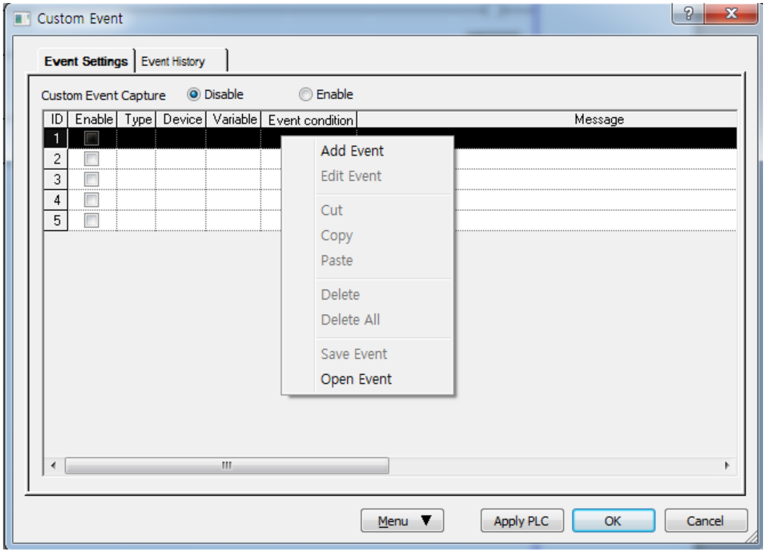
(e) Custom event

It is the function to monitor the detailed information when the event set by a user occurs.

As an example, the following steps explain how to use a user event. When a rising edge of the M0000 device occurs, it records the alarm message ‘Tank 1 Error -> Check’ and logs the values of the D0000, L0000, D0100, and N1000 devices at that time.

1) Register the user event.

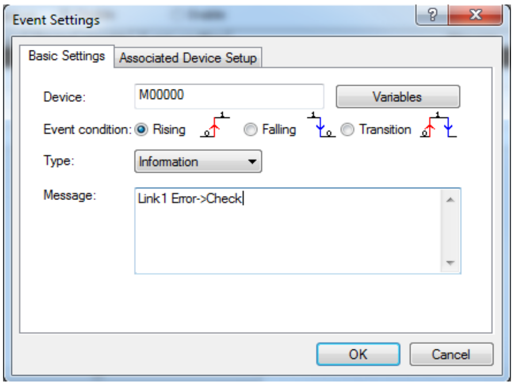
‘Custom Event Capture’ must be set to ‘Enable’ for the user event to function.



Custom Event Capture ● Disable ○ Enable

| ID | Enable | Type | Device | Variable | Event condition | Message |
|---|---|---|---|---|---|---|
| 1 | ☐ | | | | | |
| 2 | ☐ | | | | | |
| 3 | ☐ | | | | | |
| 4 | ☐ | | | | | |
| 5 | ☐ | | | | | |

2) In the Basic Settings, configure the device to be monitored, the event conditions, event type, and the message to be displayed.



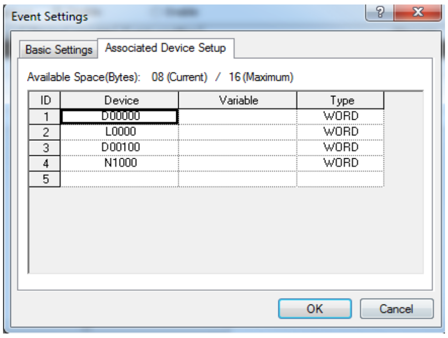
Device: M00000

Event condition: ● Rising ○ Falling ○ Transition

Type: Information

Message: Link1 Error->Check

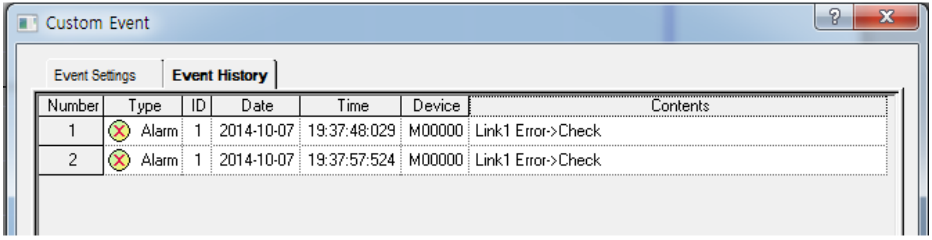
3) Set the devices to be logged.



Available Space(Bytes): 08 (Current) / 16 (Maximum)

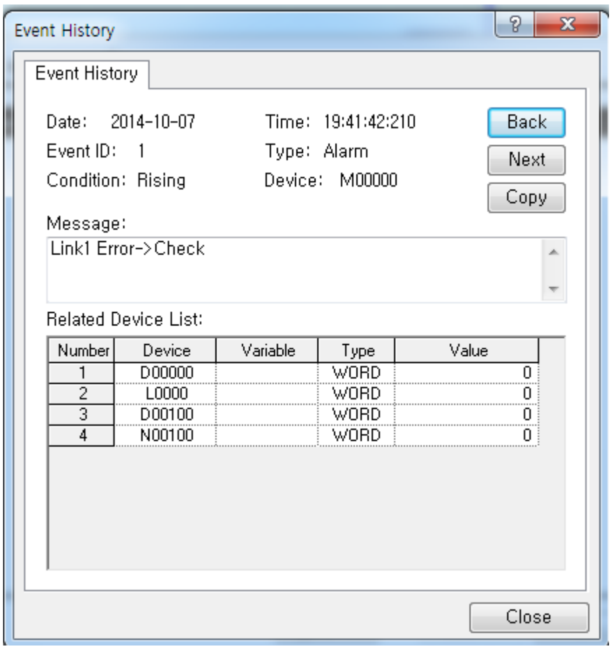
| ID | Device | Variable | Type |
|---|---|---|---|
| 1 | D00000 | | WORD |
| 2 | L0000 | | WORD |
| 3 | D00100 | | WORD |
| 4 | N1000 | | WORD |
| 5 | | | |

4) When the event condition occurs, the event time and device values are logged. You can check the event history in the ‘Event History’ tab.



| Number | Type | ID | Date | Time | Device | Contents |
|---|---|---|---|---|---|---|
| 1 | ⊗ Alarm | 1 | 2014-10-07 | 19:37:48:029 | M00000 | Link1 Error->Check |
| 2 | ⊗ Alarm | 1 | 2014-10-07 | 19:37:57:524 | M00000 | Link1 Error->Check |

5) If you double-click the event number, the detailed value of the device at the time of occurrence will be monitored with the details as below.



Date: 2014-10-07
Time: 19:41:42:210
Event ID: 1
Type: Alarm
Condition: Rising
Device: M00000

Message:
Link1 Error->Check

Related Device List:

| Number | Device | Variable | Type | Value |
|---|---|---|---|---|
| 1 | D00000 | | WORD | 0 |
| 2 | L0000 | | WORD | 0 |
| 3 | D00100 | | WORD | 0 |
| 4 | N00100 | | WORD | 0 |

**Notice**

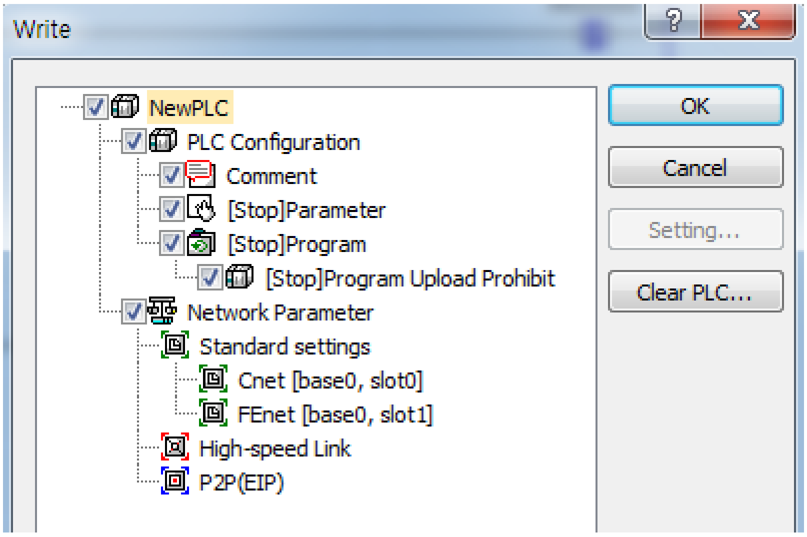
- For more details on the monitor, refer to the XG5000 manual.

## 2.14 PLC’s Read-Protect Function

The PLC’s Read-Protect function is the function to prohibit the upload of comment, parameter, program downloaded to the PLC. If this function is set up, the use of the functions such as Open from PLC, Read PLC, Compare with PLC, etc. are restricted.

(1) How to set up the PLC’s Read-Protect function

(a) Click『Online』-『Write』.

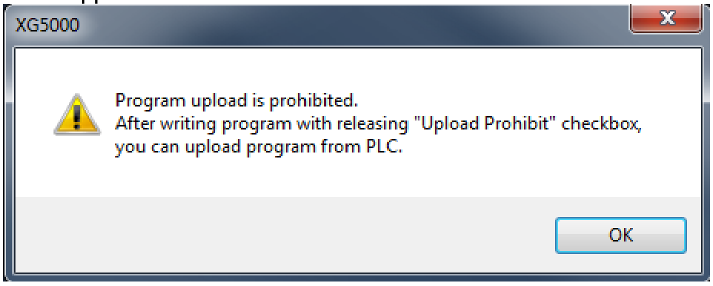


Write

- ☑ NewPLC
  - ☑ PLC Configuration
    - ☑ Comment
    - ☑ [Stop]Parameter
    - ☑ [Stop]Program
      - ☑ [Stop]Program Upload Prohibit
  - ☑ Network Parameter
    - Standard settings
      - Cnet [base0, slot0]
      - FEnet [base0, slot1]
    - High-speed Link
    - P2P(EIP)

(b) If you choose the program among the items of Write, ‘[Stop]Program Upload Prohibit’ will be activated.
(c) Then, choose ‘[Stop]Program Upload Prohibit’ and click the OK button.

(2) When you try to read the PLC under the condition that the ‘[Stop]Program Upload Prohibit’ function is set up, the below dialog box will pop up. Reading is not available in the PLC where ‘Read-Protect’ is set although the password is cleared. Namely, you cannot read the PLC in any way until a new program is applied.

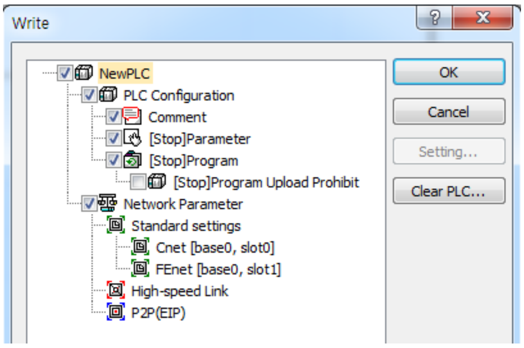


XG5000

Program upload is prohibited.
After writing program with releasing "Upload Prohibit" checkbox,
you can upload program from PLC.

(3) How to cancel the PLC’s ‘[Stop]Program Upload Prohibit’ function

(a) Click『Online』-『Write』.
(b) Cancel “[Stop]Program Upload Prohibit” and click the OK button.



Write

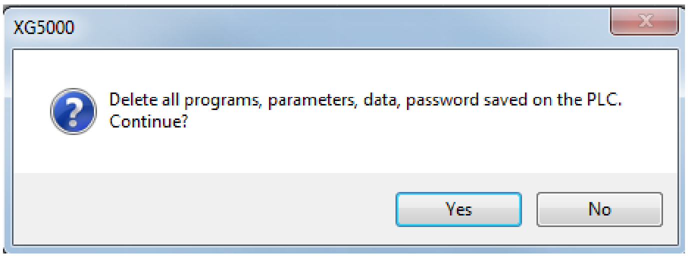
- ☑ NewPLC
  - ☑ PLC Configuration
    - ☑ Comment
    - ☑ [Stop]Parameter
    - ☑ [Stop]Program
      - ☐ [Stop]Program Upload Prohibit
  - ☑ Network Parameter
    - Standard settings
      - Cnet [base0, slot0]
      - FEnet [base0, slot1]
    - High-speed Link
    - P2P(EIP)

## 2.15 Function to delete all of the PLC

The function to delete all of PLC is the initialization function to delete all programs, parameters, passwords, data stored in the PLC.

(1) How to delete all of PLC

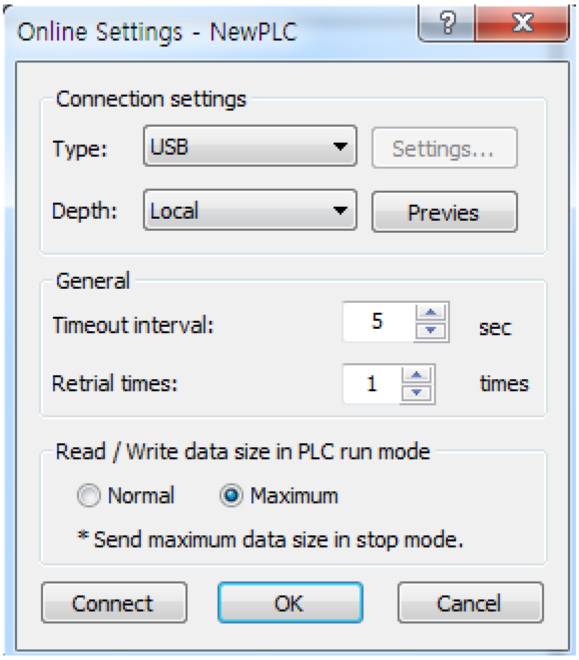
(a) Click 『Online』 - 『Delete all of PLC 』.



XG5000

Delete all programs, parameters, data, password saved on the PLC.
Continue?

(b) If you choose 『Yes』 in the dialog box, the window for selecting the connection method with the PLC to be deleted is created.



Online Settings - NewPLC

Connection settings

Type: USB

Depth: Local

General

Timeout interval: 5 sec

Retrial times: 1 times

Read / Write data size in PLC run mode

○ Normal ● Maximum

* Send maximum data size in stop mode.

(c) After choosing the connection method with the PLC to be deleted, if you click 『Access』 or 『OK』, all PLC programs, parameters, data, passwords will be deleted.

**Notice**

- Although the initial PLC is not connected, the function is executed. You can connect to the PLC after connection setting.
- If you use the function to delete all of PLC, all PLCs' internal data including passwords will be completely deleted so be careful of this.
- If you use the function to delete all of PLC when the password is lost, it is possible to connect to the PLC so you can reuse the PLC.

# Chapter 3 Input/Output Specifications

## 3.1 Introduction

Here describes the notices when selecting digital I/O module used for XGB series.

(1) For the type of digital input, it can be used as a current sink input, or can be used as a current source input. (It's a two-way input)

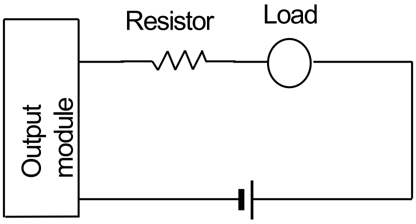
(2) The number of maximum simultaneous input contact point is different according to module type. Use input module after checking the specification.

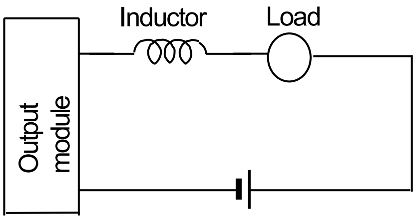
(3) When response to high-speed input is necessary, use interrupt input contact point. Up to 8 interrupt points are supported. (P0000 ~ P0007)

(4) In case that open/close frequency is high or it is used for conductive load open/close, use transistor output module as the durability of relay output module shall be reduced.

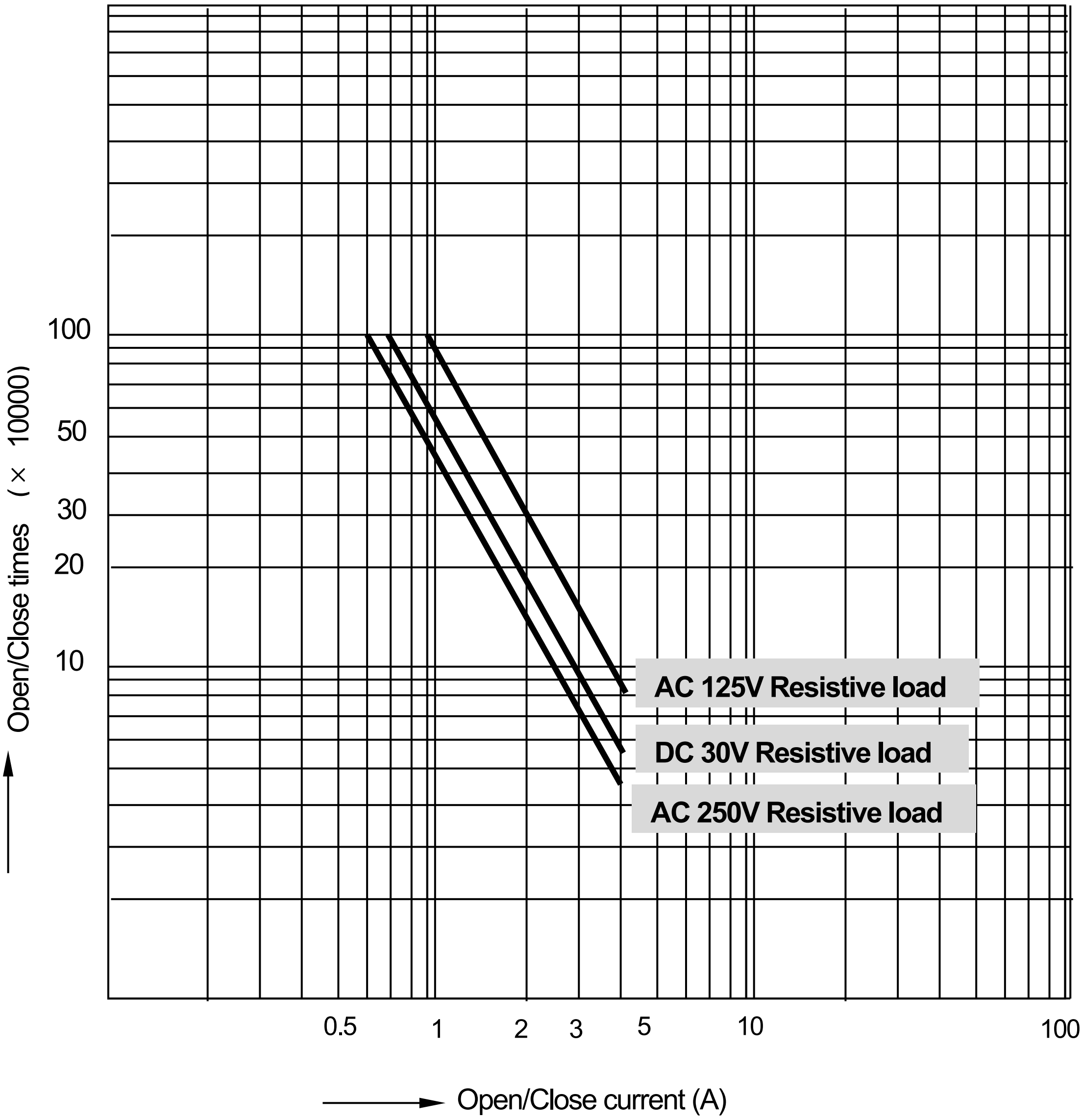
(5) For output module to run the inductive (L) load, maximum open/close frequency should be used by 1second On, 1 second Off.

(6) For output module, in case that counter timer using DC/DC Converter as a load was used, Inrush current may flow in a certain cycle when it is ON or during operation. In this case, if average current is selected, it may cause the failure. Accordingly, if the previous load was used, it is recommended to connect resistor or inductor to the load in serial in order to reduce the impact of Inrush current or use the large module having a max. load current value.





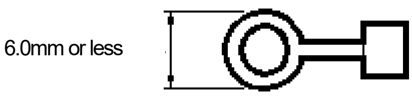
(7) Relay lifespan of Relay output module is shown as below.

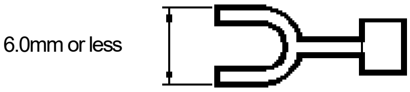


(8) There are barrier type and pluggable type of terminal block, and pluggable terminal blocks have screw type and push-in type depending on the connection method.

1) Barrier terminal block

As a terminal block mainly applied to the XGB compact type basic unit, crimp terminals with insulation sleeves cannot be used. Crimp terminals suitable for connection to terminal blocks are as follows.





For the size of the wire connected to the terminal block, use a stranded wire of 0.3 to 0.75 ㎟ and a thickness of 2.8 mm or less. Please note that the allowable current may differ depending on the insulation thickness of the wire.

The tightening torques of the module fixing screws and terminal block screws must be within the following ranges.

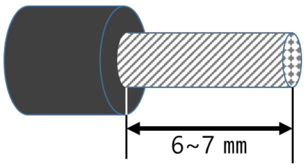
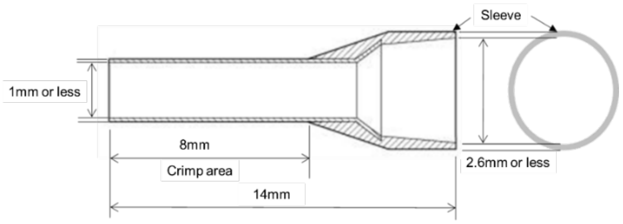
| Coupling position | Coupling torque range |
|---|---|
| IO module terminal strip screw (M3 screw) | 42 ~ 58 N·㎝ |
| IO module terminal strip fixation screw (M3 screw) | 66 ~ 89 N·㎝ |
| IO module external connector (M2 screw) | 18 ~ 22 N·㎝ |

2) Screw connection type plug (PCB plug, Screw connection):XBE-xx08A, XBE-xx16A

① Wire size

| Number of wires per contact | single wire | stranded wire | When using ferrules with plastic sleeves | When using ferrules without plastic sleeves |
|---|---|---|---|---|
| 1 | 0.2 ~ 1.5 ㎟ | 0.2 ~ 1.5 ㎟ | 0.25 ~ 0.5 ㎟ | 0.25 ~ 1.5 ㎟ |
| 2 | 0.75 ㎟ | 0.75 ㎟ | 0.5 ㎟ (Twin Ferrules) | 0.25 ~ 0.34 ㎟ |

② Ferrule size

| Stripping Dimensions of Wires | penhole |
|---|---|
|  |  |

③ Recommended ferrule

| Manufacturer | model name | line size | crimping tool |
|---|---|---|---|
| GLW GmbH | DN00508D | 0.5 ㎟ | CO225<br>Or<br>CAP4 |
| | DN00308D | 0.34 ㎟ | |
| | DN00208D | 0.25 ㎟ | |

Peel off about 6-7 mm of the sheath from the end of the wire and connect it to the ferrule. Excessive stripping of the sheath can result in poor contact with the crimp area of the ferrule.

Tighten the terminal block screws as follows.

| | |
|---|---|
| **Screw thread** | M2 |
| **Flat screwdriver size** | 0.4 x 2.5 |
| **Tightening torque** | 0.2 N · m |

(9) Noise can be inserted into input module. To prevent this noise, the user can set filter for input delay in parameter. Consider the environment and set the input filter time. For more information about setting up input filters, please refer chapter 3.8.1

| Input filter time (ms) | Noise signal pulse size (ms) |
|---|---|
| 1 | 0.3 |
| 3 | 1.8 |
| 5 | 3 |
| 10 | 6 |
| 20 | 12 |
| 70 | 45 |
| 100 | 60 |

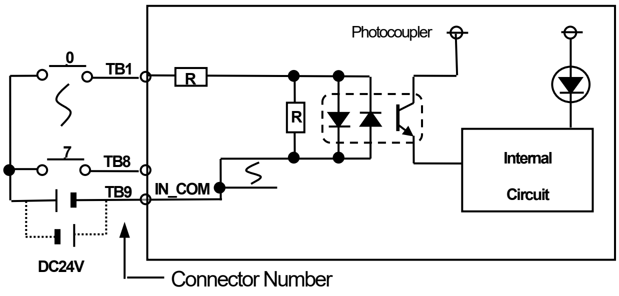
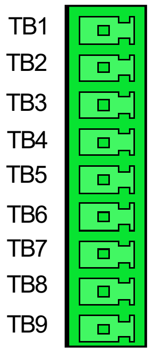
(10) Use power cable as follow

| Item | Cable Standard | Cable type | Immunity of Temp. | Torque |
|---|---|---|---|---|
| Power and protection GND | 24AWG | Cu | 80℃ | - |

## 3.2 Main Unit Digital Input Specifications

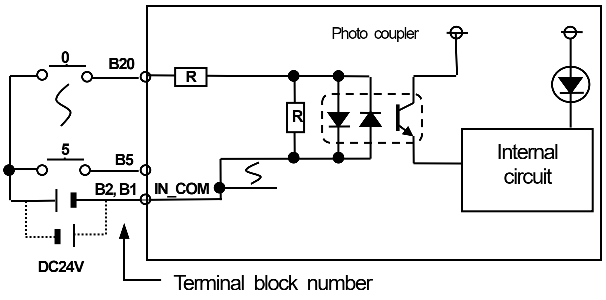
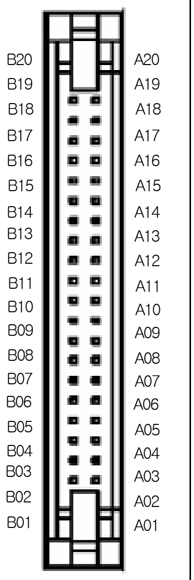
### 3.2.1 XBM-DN16H2, XBM-DP16H2, XBM-DR14H2 8 point DC24V input (Source/Sink Type)

| Model<br>Specification | | Main Unit |
|---|---|---|
| | | XBM-DN16H2/XBM-DP16H2/XBM-DR14H2 |
| Input point | | 8 points |
| Insulation method | | Photocoupler insulation |
| Rated input voltage | | DC 24V |
| Rated input current | | P00 ~ P03 : about 5mA, P04 ~ P07 : about 4mA |
| Operation voltage range | | DC 20.4 ~ 28.8V (within ripple rate 5%) |
| On voltage / On current | | DC 19V or higher / 3mA or higher (P00 ~ P03 : 3.5mA or higher) |
| Off voltage / Off current | | DC6V or lower / 1mA or lower |
| Input Resistance | | About 5.6 ㏀ (P00~P03: About 4.7 ㏀) |
| Response time | Off → On | 1/3/5/10/20/70/100 ㎳ (Set by I/O parameter) Default: 3 ㎳ |
| | On → Off | |
| Insulation withstand voltage | | AC850Vrms / 3cycle (altitude 2000m) |
| Insulation resistance | | 10 ㏁ or more by MegOhmMeter |
| Common method | | 8point / COM |
| Proper cable size | | 0.3 ㎟ |
| Operation indicator | | LED lights up when input is On |
| External connection method | | 9 point terminal block connector |
| Weight | | 140g |

| Circuit configuration | No. | Contact | Type |
|---|---|---|---|
|  | TB1 | 00 |  |
| | TB2 | 01 | |
| | TB3 | 02 | |
| | TB4 | 03 | |
| | TB5 | 04 | |
| | TB6 | 05 | |
| | TB7 | 06 | |
| | TB8 | 07 | |
| | TB9 | IN_COM | |

### 3.2.2 XBM-DN32H2/HP, XBM-DP32H2/HP 16 point DC24V input (Source/Sink type)

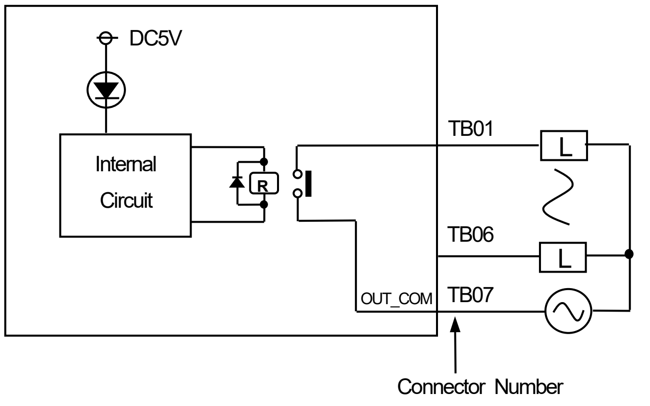
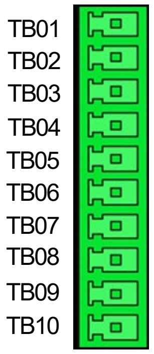
| Model / Specification | | Main unit |
|---|---|---|
| | | XBM-DN32H2/XBM-DN32HP, XBM-DP32H2/XBM-DP32HP |
| Input point | | 16 point |
| Insulation method | | Photo coupler insulation |
| Rated input voltage | | DC24V |
| Rated input current | | P00 ~ P03 : about 5mA, P04 ~ P0F : about 4mA |
| Operation voltage range | | DC 20.4~28.8V (within ripple rate 5%) |
| On voltage / On current | | DC19V or higher / 3㎃ or higher(P00 ~ P03: 3.5㎃ or higher) |
| Off voltage / Off current | | DC6V or lower / 1㎃ or lower |
| Input resistance | | About 5.6㏀ (P00~P03: about 4.7㏀) |
| Response time | Off → On | 1/3/5/10/20/70/100㎳ (Set by I/O parameter) Default: 3㎳ |
| | On → Off | |
| Insulation pressure | | AC850Vrms / 3 cycle (altitude 2000m) |
| Insulation resistance | | 10㏁ or more by MegOhmMeter |
| Common method | | 16 point / COM |
| Proper cable size | | 0.3~0.75㎟ |
| Operation indicator | | LED On when Input On |
| External connection method | | 40point terminal connector |
| Weight | | 134g |

| Circuit configuration | No. | Contact | No. | Contact | Type |
|---|---|---|---|---|---|
|  | B20 | 00 | A20 | 20 |  |
| | B19 | 01 | A19 | 21 | |
| | B18 | 02 | A18 | 22 | |
| | B17 | 03 | A17 | 23 | |
| | B16 | 04 | A16 | 24 | |
| | B15 | 05 | A15 | 25 | |
| | B14 | 06 | A14 | 26 | |
| | B13 | 07 | A13 | 27 | |
| | B12 | 08 | A12 | 28 | |
| | B11 | 09 | A11 | 29 | |
| | B10 | 0A | A10 | 2A | |
| | B9 | 0B | A9 | 2B | |
| | B8 | 0C | A8 | 2C | |
| | B7 | 0D | A7 | 2D | |
| | B6 | 0E | A6 | 2E | |
| | B5 | 0F | A5 | 2F | |
| | B4 | NC | A4 | P/OUT_COM | |
| | B3 | NC | A3 | P/OUT_COM | |
| | B2 | IN_COM | A2 | OUT_COM/N | |
| | B1 | IN_COM | A1 | OUT_COM/N | |

## 3.3 Main Unit Digital Output Specifications

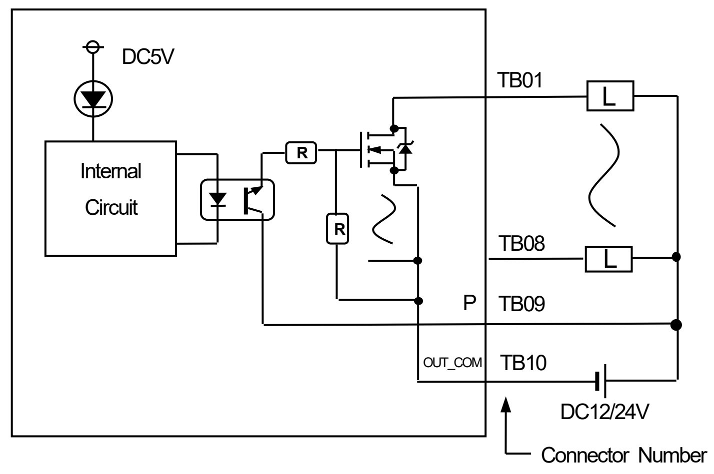
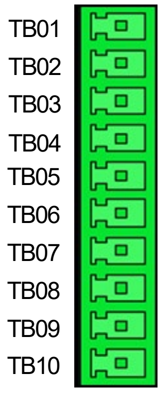
### 3.3.1 XBM-DR14H2 6 point relay output

| Model<br>Specification | | Main unit |
|---|---|---|
| | | **XBM-DR14H2** |
| Output point | | 6 point |
| Insulation method | | Relay insulation |
| Rated load voltage / current | | DC 24V 2A (Resistitive load) / AC220V 2A (COSΦ = 1), 5A/COM |
| Min. load voltage / current | | DC5V / 1mA |
| Max. load voltage | | AC250V, DC125V |
| Off leakage current | | 0.1㎃ (AC220V, 60Hz) |
| Max. On/Off frequency | | 3,600times / hr |
| Surge absorber | | None |
| Service life | Mechanical | 20 million times or more |
| | Electrical | Rated load voltage / current : 100,000 times or more |
| | | AC200V / 1.5A, AC240V / 1A (COSΦ = 0.7) : 100,000 times or more |
| | | AC200V / 1A, AC240V / 0.5A (COSΦ = 0.35) : 100,000 times or more |
| | | DC24V / 1A, DC100V / 0.1A (L / R = 7ms) : 100,000 times or more |
| Response Time | Off → On | 10㎳ or less |
| | On → Off | 12㎳ or less |
| Common method | | 6 points / COM |
| Proper cable size | | Stranded cable 0.3~0.75㎟ (External diameter 2.8㎜ or less) |
| Current Consumption | | 460mA (When all point is On) |
| Operation indicator | | LED lights up when output is ON |
| External Connection method | | 10 point terminal block connector |
| Weight | | 150g |

| Circuit Configuration | No. | Contact | Type |
|---|---|---|---|
|  | TB01 | 20 |  |
| | TB02 | 21 | |
| | TB03 | 22 | |
| | TB04 | 23 | |
| | TB05 | 24 | |
| | TB06 | 25 | |
| | TB07 | OUT_COM | |
| | TB08 | N.C. | |
| | TB09 | N.C. | |
| | TB10 | N.C. | |

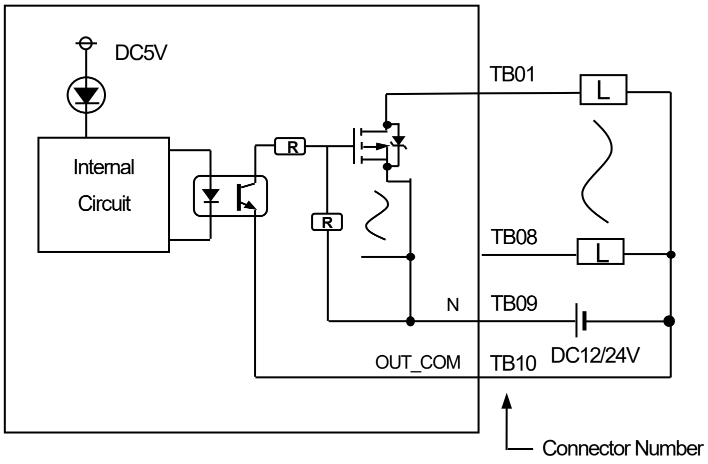
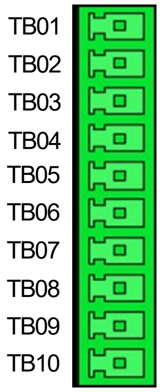
### 3.3.2 XBM-DN16H2 8 point transistor output (Sink type)

| Model / Specification | | Main Unit |
|---|---|---|
| | | **XBM-DN16H2** |
| Output Point | | 8 point |
| Insulation method | | Photocoupler insulation |
| Rated load voltage | | DC 12 / 24V |
| Operation load voltage range | | DC 10.2 ~ 26.4V |
| Max. load current | | P20 ~ P21 : 0.1A/ 1 point, P22 ~ P27 : 0.5A / 1 point, 2A / 1COM |
| Off leakage current | | 0.1㎃ or less |
| Max. inrush current | | 4A / 10㎳ or less |
| Max. voltage drop when ON | | DC 0.4V or less |
| Surge absorber | | TVS diode |
| Response time | Off → On | 1㎳ or less |
| | On → Off | 1㎳ or less (rated load, resistive load) |
| Common method | | 8 point / COM |
| Proper wire size | | Stranded wire 0.3~0.75㎟ (external diameter 2.8㎜ or less) |
| External power | Voltage | DC 12/24V ± 10% (Ripple voltage 4 Vp-p or less) |
| | Current | 35㎃ or less (When connecting DC24V) |
| Operation indicator | | LED lights up when output is ON |
| External connection method | | 10 point terminal block connector |
| Weight | | 140g |

| Circuit configuration | No. | Contact | Type |
|---|---|---|---|
|  | TB01 | 20 |  |
| | TB02 | 21 | |
| | TB03 | 22 | |
| | TB04 | 23 | |
| | TB05 | 24 | |
| | TB06 | 25 | |
| | TB07 | 26 | |
| | TB08 | 27 | |
| | TB09 | P | |
| | TB10 | OUT_COM | |

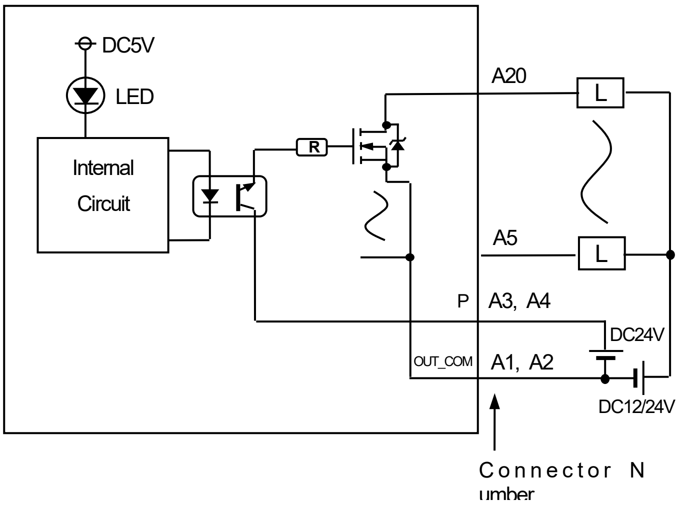
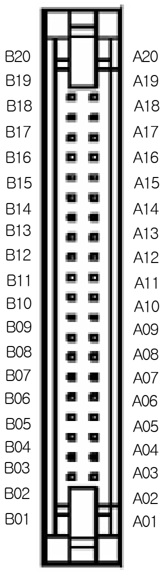
### 3.3.3 XBM-DP16H2 8 point transistor output (Source type)

| Model<br>Specification | | Main Unit |
|---|---|---|
| | | **XBM-DP16H2** |
| Output point | | 8 point |
| Insulation method | | Photocoupler method |
| Rated load voltage | | DC 12 / 24V |
| Operation load voltage range | | DC 10.2 ~ 26.4V |
| Max. load current | | P20 ~ P21 : 0.1A/ 1 point, P22 ~ P27 : 0.5A / 1 point, 2A / 1COM |
| Off leakage current | | 0.1㎃ or less |
| Max. inrush current | | 4A / 10㎳ or less |
| Max. voltage drop when On | | DC 0.4V or less |
| Surge absorber | | TVS diode |
| Response time | Off → On | 1㎳ or less |
| | On → Off | 1㎳ or less (rated load, resistive load) |
| Common method | | 8 point / COM |
| Proper wire size | | Stranded wire 0.3~0.75㎟ (External diemeter 2.8㎜ or less) |
| External power | Voltage | DC 12 / 24V ± 10% (Ripple voltage 4 Vp-p or less) |
| | Current | 30㎃ or less (When connecting DC24V) |
| Operation indicator | | LED lights up when output is On |
| External connection method | | 10 point terminal block connector |
| Weight | | 140g |

| Circuit configuration | No. | Contact | Type |
|---|---|---|---|
|  | TB01 | 20 |  |
| | TB02 | 21 | |
| | TB03 | 22 | |
| | TB04 | 23 | |
| | TB05 | 24 | |
| | TB06 | 25 | |
| | TB07 | 26 | |
| | TB08 | 27 | |
| | TB09 | OUT_COM | |
| | TB10 | N | |

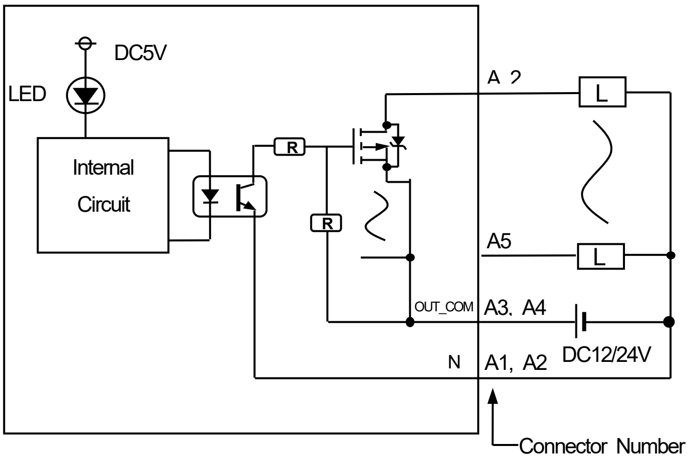
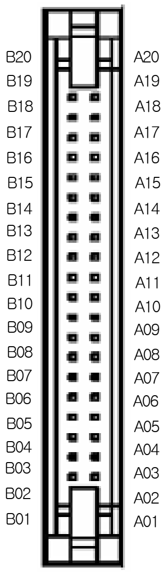
### 3.3.4 XBM-DN32H2/HP 16 point transistor output (Sink type)

| Specification \ Model | | Main unit |
|---|---|---|
| | | XBM-DN32H2/XBM-DN32HP |
| Output point | | 16 point |
| Insulation method | | Photo coupler insulation |
| Rated load voltage | | DC 12/24V |
| Operation load voltage range | | DC 10.2 ~ 26.4V |
| Max.load current | | P20 ~ P2B : 0.1A/ 1 point, P2C ~ P2F : 0.5A / 1 point, 2A / 1COM |
| Off leakage current | | 0.1㎃ or less |
| Max. inrush current | | 4A / 10㎳ or less |
| Max. voltage drop when On | | DC 0.4V or less |
| Surge absorber | | TVS diode |
| Response time | Off → On | 1㎳ or less |
| | On → Off | 1㎳ or less (rated load, resistive load) |
| Common method | | 16 point / COM |
| Proper wire size | | Stranded wire 0.3~0.75㎟ (external diameter 2.8㎜ or less) |
| External power | Voltage | DC 24V ± 10% (Ripple voltage 4 Vp-p or less) |
| | Current | 80㎃ or less (When connecting DC24V) |
| Operation indicator | | LED On when Output On |
| External connection method | | 40 point terminal block connector |
| Weight | | 134g |

| Circuit configuration | No. | Contact | No. | Contact | Type |
|---|---|---|---|---|---|
|  | B20 | 00 | A20 | 20 |  |
| | B19 | 01 | A19 | 21 | |
| | B18 | 02 | A18 | 22 | |
| | B17 | 03 | A17 | 23 | |
| | B16 | 04 | A16 | 24 | |
| | B15 | 05 | A15 | 25 | |
| | B14 | 06 | A14 | 26 | |
| | B13 | 07 | A13 | 27 | |
| | B12 | 08 | A12 | 28 | |
| | B11 | 09 | A11 | 29 | |
| | B10 | 0A | A10 | 2A | |
| | B9 | 0B | A9 | 2B | |
| | B8 | 0C | A8 | 2C | |
| | B7 | 0D | A7 | 2D | |
| | B6 | 0E | A6 | 2E | |
| | B5 | 0F | A5 | 2F | |
| | B4 | NC | A4 | P | |
| | B3 | NC | A3 | P | |
| | B2 | IN_COM | A2 | OUT_COM | |
| | B1 | IN_COM | A1 | OUT_COM | |

## 3.3.5 XBM-DP32H2/HP 16 point transistor output (Source type)

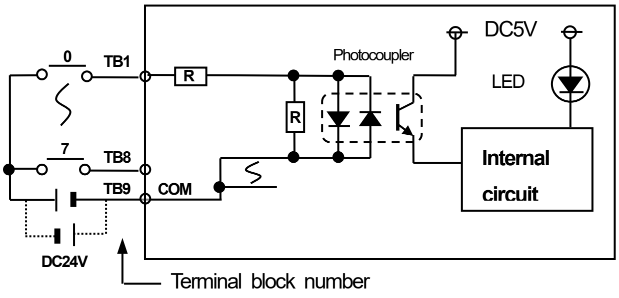
| Model<br>Specification | | Main unit |
|---|---|---|
| | | XBM-DP32H2/XBM-DP32HP |
| Output point | | 16 point |
| Insulation method | | Photo coupler insulation |
| Rated load voltage | | DC 12/24V |
| Operation load voltage range | | DC 10.2 ~ 26.4V |
| Max.load current | | P20 ~ P2B : 0.1A/ 1 point, P2C ~ P2F : 0.5A / 1 point, 2A / 1COM |
| Off leakage current | | 0.1㎃ or less |
| Max. inrush current | | 4A / 10㎳ or less |
| Max. voltage drop when On | | DC 0.4V or less |
| Surge absorber | | TVS diode |
| Response time | Off → On | 1㎳ or less |
| | On → Off | 1㎳ or less (rated load, resistive load) |
| Common method | | 16 point / COM |
| Proper wire size | | Stranded wire 0.3~0.75㎟ (external diameter 2.8㎜ or less) |
| External power | Voltage | DC12/24V ± 10% (Ripple voltage 4 Vp-p or less) |
| | Current | 50㎃ or less (When connecting DC24V) |
| Operation indicator | | LED On when Output On |
| External connection method | | 40 point terminal block connector |
| Weight | | 140g |

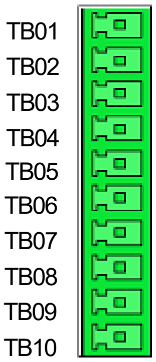
| Circuit configuration | No. | Contact | No. | Contact | Type |
|---|---|---|---|---|---|
|  | B20 | 00 | A20 | 20 |  |
| | B19 | 01 | A19 | 21 | |
| | B18 | 02 | A18 | 22 | |
| | B17 | 03 | A17 | 23 | |
| | B16 | 04 | A16 | 24 | |
| | B15 | 05 | A15 | 25 | |
| | B14 | 06 | A14 | 26 | |
| | B13 | 07 | A13 | 27 | |
| | B12 | 08 | A12 | 28 | |
| | B11 | 09 | A11 | 29 | |
| | B10 | 0A | A10 | 2A | |
| | B9 | 0B | A9 | 2B | |
| | B8 | 0C | A8 | 2C | |
| | B7 | 0D | A7 | 2D | |
| | B6 | 0E | A6 | 2E | |
| | B5 | 0F | A5 | 2F | |
| | B4 | NC | A4 | OUT_COM | |
| | B3 | NC | A3 | OUT_COM | |
| | B2 | IN_COM | A2 | N | |
| | B1 | IN_COM | A1 | N | |

## 3.4 Digital Input Specifications

### 3.4.1 8 point DC24V input module (Source/Sink type)

| Model / Specification | | DC input module |
|---|---|---|
| | | XBE-DC08A |
| Input point | | 8 point |
| Insulation method | | Photo coupler insulation |
| Rated input voltage | | DC24V |
| Rated input current | | About 4㎃ |
| Operation voltage range | | DC20.4~28.8V (ripple rate < 5%) |
| On Voltage/Current | | DC19V or higher / 3 ㎃ or higher |
| Off Voltage/Current | | DC6V or less / 1㎃ or less |
| Input resistance | | About 5.6㏀ |
| Response time | Off → On | 1/3/5/10/20/70/100㎳ (set by CPU parameter) Default: 3㎳ |
| | On → Off | |
| Insulation pressure | | AC850Vrms / 3Cycle (altitude 2000m) |
| Insulation resistance | | 10㏁ or more by Megohmmeter |
| Common method | | 8 point / COM |
| Proper cable size | | Stranded pair 0.3~0.75㎟ (External diameter 2.8㎜ or less) |
| Current consumption | | 30㎃ (when all point On) |
| Operation indicator | | Input On, LED On |
| External connection method | | 10 point terminal block connector |
| Weight | | 52 g |

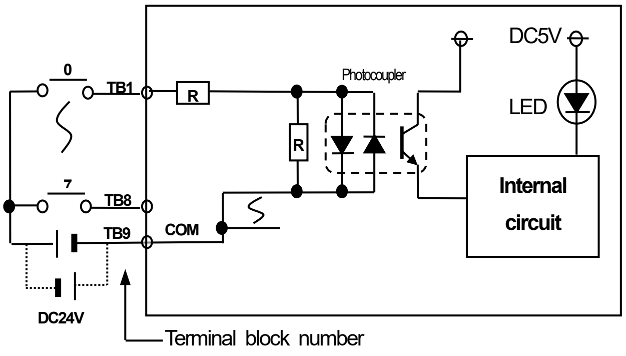
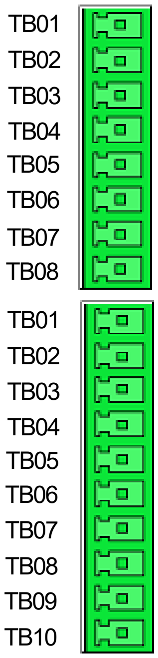
<table>
<tr><th>Circuit configuration</th><th>No.</th><th>Contact</th><th>Type</th></tr>
<tr><td rowspan="10">


</td><td>TB01</td><td>0</td><td rowspan="10">


</td></tr>
<tr><td>TB02</td><td>1</td></tr>
<tr><td>TB03</td><td>2</td></tr>
<tr><td>TB04</td><td>3</td></tr>
<tr><td>TB05</td><td>4</td></tr>
<tr><td>TB06</td><td>5</td></tr>
<tr><td>TB07</td><td>6</td></tr>
<tr><td>TB08</td><td>7</td></tr>
<tr><td>TB09</td><td>COM</td></tr>
<tr><td>TB10</td><td>COM</td></tr>
</table>

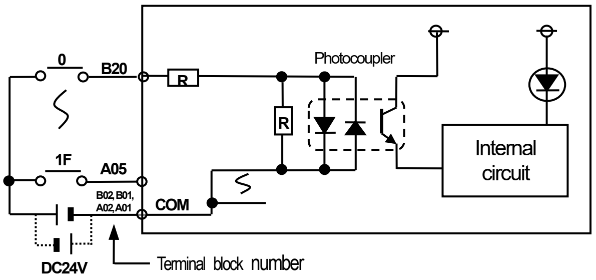
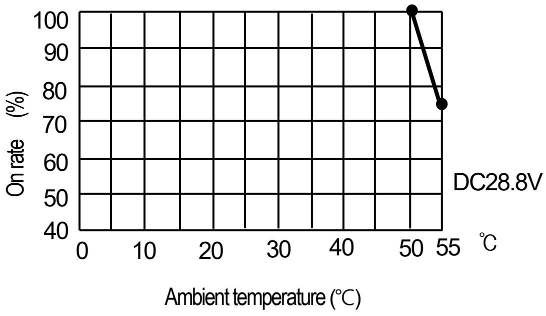
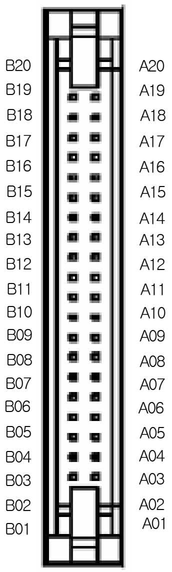
### 3.4.2 16 point DC24V input module (Source/Sink type)

| Model / Specification | | DC input module | |
|---|---|---|---|
| | | XBE-DC16A | XBE-DC16B |
| Input point | | 16 point | |
| Insulation method | | Photo coupler insulation | |
| Rated input voltage | | DC24V | DC12/24V |
| Rated input current | | About 4mA | About 4/8mA |
| Operation voltage range | | DC20.4~28.8V (ripple rate < 5%) | DC9.5~30V (ripple rate < 5%) |
| On Voltage/Current | | DC19V or higher / 3 mA or higher | DC9V or higher / 3 mA or higher |
| Off Voltage/Current | | DC6V or less / 1mA or less | DC5V or less / 1mA or less |
| Input resistance | | About 5.6kΩ | About 2.7kΩ |
| Response time | Off → On | 1/3/5/10/20/70/100ms (set by CPU parameter) Default: 3ms | |
| | On → Off | | |
| Insulation pressure | | AC850Vrms / 3Cycle (altitude 2000m) | |
| Insulation resistance | | 10MΩ or more by Megohmmeter | |
| Common method | | 16 point / COM | |
| Proper cable size | | Stranded cable 0.3~0.75mm² (External diameter 2.8mm or less) | |
| Current consumption | | 40mA (when all point On) | |
| Operation indicator | | Input On, LED On | |
| External connection method | | 8 pin terminal block connector + 10 pin terminal block connector | |
| Weight | | 53 g | |

| Circuit configuration | No. | Contact | Type |
|---|---|---|---|
|  | TB01 | 0 |  |
| | TB02 | 1 | |
| | TB03 | 2 | |
| | TB04 | 3 | |
| | TB05 | 4 | |
| | TB06 | 5 | |
| | TB07 | 6 | |
| | TB08 | 7 | |
| | TB01 | 8 | |
| | TB02 | 9 | |
| | TB03 | A | |
| | TB04 | B | |
| | TB05 | C | |
| | TB06 | D | |
| | TB07 | E | |
| | TB08 | F | |
| | TB09 | COM | |
| | TB10 | COM | |

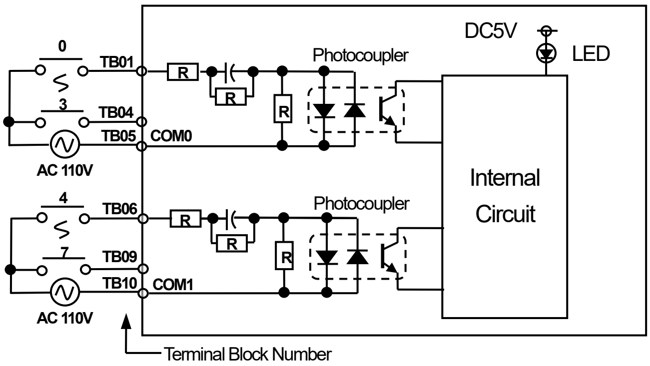
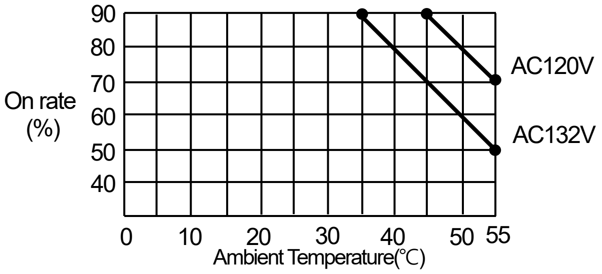
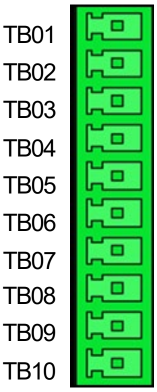
### 3.4.3 32 point DC24V input module (Source/Sink type)

| Model<br>Specification | | DC input module |
|---|---|---|
| | | XBE-DC32A |
| Input point | | 32 point |
| Insulation method | | Photo coupler insulation |
| Rated input voltage | | DC24V |
| Rated input current | | About 4㎃ |
| Operation voltage range | | DC20.4~28.8V (ripple rate < 5%) |
| Input Derating | | Refer to Derating diagram |
| On Voltage/Current | | DC 19V or higher / 3 ㎃ or higher |
| Off Voltage/Current | | DC 6V or less / 1 ㎃ or less |
| Input resistance | | About 5.6㏀ |
| Response time | Off → On | 1/3/5/10/20/70/100㎳ (set by CPU parameter) Default:3㎳ |
| | On → Off | |
| Insulation pressure | | AC 850Vrms / 3 Cycle (altitude 2000m) |
| Insulation resistance | | 10㏁ or more by Megohmmeter |
| Common method | | 32 point / COM |
| Proper cable size | | 0.3㎟ |
| Current consumption | | 50㎃ (when all point On) |
| Operation indicator | | Input On, LED On |
| External connection method | | 40 pin connector |
| Weight | | 60g |

| Circuit configuration | No. | Contact | No. | Contact | Type |
|---|---|---|---|---|---|
| <br>**Input Derating diagram**<br> | B20 | 00 | A20 | 10 |  |
| | B19 | 01 | A19 | 11 | |
| | B18 | 02 | A18 | 12 | |
| | B17 | 03 | A17 | 13 | |
| | B16 | 04 | A16 | 14 | |
| | B15 | 05 | A15 | 15 | |
| | B14 | 06 | A14 | 16 | |
| | B13 | 07 | A13 | 17 | |
| | B12 | 08 | A12 | 18 | |
| | B11 | 09 | A11 | 19 | |
| | B10 | 0A | A10 | 1A | |
| | B09 | 0B | A09 | 1B | |
| | B08 | 0C | A08 | 1C | |
| | B07 | 0D | A07 | 1D | |
| | B06 | 0E | A06 | 1E | |
| | B05 | 0F | A05 | 1F | |
| | B04 | NC | A04 | NC | |
| | B03 | NC | A03 | NC | |
| | B02 | COM | A02 | COM | |
| | B01 | COM | A01 | COM | |

### 3.4.4 8 point AC110V input module

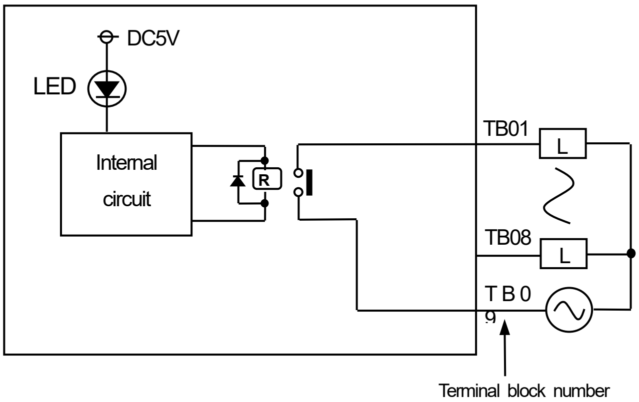
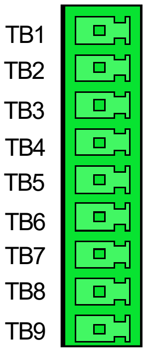
| Specification \ Model | | AC input module |
|---|---|---|
| | | XBE-AC08A |
| Input point | | 8 point |
| Insulation method | | Photo coupler insulation |
| Rated input voltage | | AC100-120V(+10/-15%) 50/60 ㎐(±3 ㎐) (distortion rate < 5%) |
| Rated input current | | About 8 ㎃(AC100,60 ㎐), About 7mA(AC100, 50 ㎐) |
| Inrush current | | Max. 200 ㎃ 1 ㎳ (AC132V) |
| Input Derating | | Refer to the below Derating diagram. |
| On Voltage/Current | | AC80V or higher / 5 mA or higher (50 ㎐, 60 ㎐) |
| Off Voltage/Current | | AC30V or lower / 1 mA or lower (50 ㎐, 60 ㎐) |
| Input resistance | | About 12 kΩ(60 ㎐), About 15 kΩ(50 ㎐) |
| Response time | Off → On | 20 ms or less (AC100V 50 ㎐, 60 ㎐) |
| | On → Off | 25 ms or less (AC100V 50 ㎐, 60 ㎐) |
| Insulation pressure | | AC3000Vrms / 3Cycle (altitude 2000m) |
| Insulation resistance | | 10 ㏁ or more by Megohmmeter |
| Common method | | 4 point / COM |
| Proper cable size | | Twisted pair 0.3~0.75 ㎟ (external diameter 2.8mm or less) |
| Current consumption | | 30 ㎃ (when all point On) |
| Operation indicator | | Input On, LED On |
| External connection method | | 10 point terminal block connector |
| Weight | | 70 g |

| Circuit configuration | No. | Contact | Type |
|---|---|---|---|
|   Derating level | TB01 | 0 |  |
| | TB02 | 1 | |
| | TB03 | 2 | |
| | TB04 | 3 | |
| | TB05 | COM0 | |
| | TB06 | 4 | |
| | TB07 | 5 | |
| | TB08 | 6 | |
| | TB09 | 7 | |
| | TB10 | COM1 | |

## 3.5 Digital Output Specifications

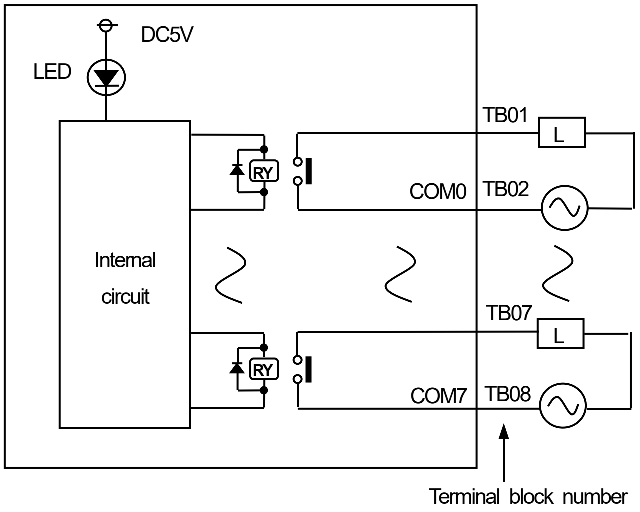
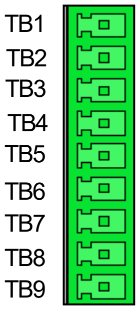
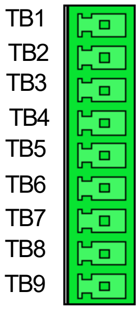
### 3.5.1 8 point relay output module

| Model<br>Specification | | Relay output module<br>XBE-RY08A |
|---|---|---|
| Output point | | 8 point |
| Insulation method | | Relay insulation |
| Rated load voltage / Current | | DC24V 2A (Resistive load) / AC220V 2A (COSΨ = 1), 5A/COM |
| Min. load voltage/Current | | DC5V / 1㎃ |
| Max. load voltage/Current | | AC250V, DC125V |
| Off leakage current | | 0.1㎃ (AC220V, 60㎐) |
| Max. On/Off frequency | | 3,600 times/hr |
| Surge absorber | | None |
| Service life | Mechanical | 20 millions times or more |
| | Electrical | Rated load voltage / current 100,000 times or more |
| | | AC200V / 1.5A, AC240V / 1A (COSΨ = 0.7) 100,000 times or more |
| | | AC200V / 1A, AC240V / 0.5A (COSΨ = 0.35) 100,000 times or more |
| | | DC24V / 1A, DC100V / 0.1A (L / R = 7㎳) 100,000 times or more |
| Response time | Off → On | 10㎳ or less |
| | On → Off | 12㎳ or less |
| Common method | | 8 point / COM |
| Proper cable size | | Stranded cable 0.3~0.75㎟ (External diameter 2.8㎜ or less) |
| Current consumption | | 230㎃ (when all point On) |
| Operation indicator | | Output On, LED On |
| External connection method | | 9 point terminal block connector |
| Weight | | 80g |

| Circuit configuration | No. | Contact | Type |
|---|---|---|---|
|  | TB01 | 0 |  |
| | TB02 | 1 | |
| | TB03 | 2 | |
| | TB04 | 3 | |
| | TB05 | 4 | |
| | TB06 | 5 | |
| | TB07 | 6 | |
| | TB08 | 7 | |
| | TB09 | COM | |

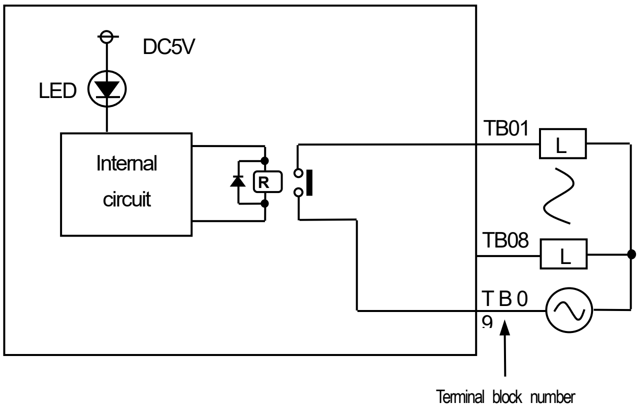
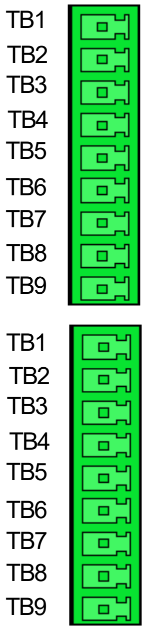
### 3.5.2 8 point relay output module (Independent point)

| Model<br>Specification | | Relay output module |
|---|---|---|
| | | **XBE-RY08B** |
| Output point | | 8 point |
| Insulation method | | Relay insulation |
| Rated load voltage / Current | | DC24V 2A (Resistive load) / AC220V 2A (COSΨ = 1), 2A/COM |
| Min. load voltage/Current | | DC5V / 1㎃ |
| Max. load voltage/Current | | AC250V, DC125V |
| Off leakage current | | 0.1㎃ (AC220V, 60㎐) |
| Max. On/Off frequency | | 3,600 times/hr |
| Surge absorber | | None |
| Service life | Mechanical | 20 millions times or more |
| | Electrical | Rated load voltage / current 100,000 times or more |
| | | AC200V / 1.5A, AC240V / 1A (COSΨ = 0.7) 100,000 times or more |
| | | AC200V / 1A, AC240V / 0.5A (COSΨ = 0.35) 100,000 times or more |
| | | DC24V / 1A, DC100V / 0.1A (L / R = 7㎳) 100,000 times or more |
| Response time | Off → On | 10㎳ or less |
| | On → Off | 12㎳ or less |
| Common method | | 1 point / COM |
| Proper cable size | | Stranded cable 0.3~0.75㎟ (External diameter 2.8㎜ or less) |
| Current consumption | | 230㎃ (when all point On) |
| Operation indicator | | Output On, LED On |
| External connection method | | 9 point terminal block connector x 2 |
| Weight | | 81g |

| Circuit configuration | No. | Contact | No. |
|---|---|---|---|
|  | TB01 | 0 |  |
| | TB02 | COM0 | |
| | TB03 | 1 | |
| | TB04 | COM1 | |
| | TB05 | 2 | |
| | TB06 | COM2 | |
| | TB07 | 3 | |
| | TB08 | COM3 | |
| | TB09 | NC | |
| | TB01 | 4 |  |
| | TB02 | COM4 | |
| | TB03 | 5 | |
| | TB04 | COM5 | |
| | TB05 | 6 | |
| | TB06 | COM6 | |
| | TB07 | 7 | |
| | TB08 | COM7 | |
| | TB09 | NC | |

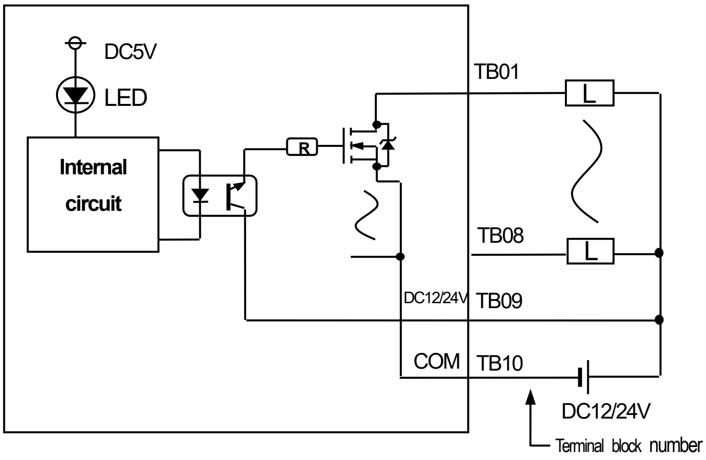
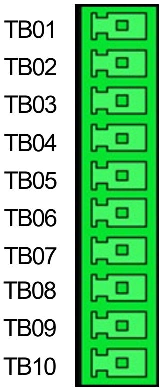
### 3.5.3 16 point relay output module

| Model<br>Specification | | Relay output module |
|---|---|---|
| | | XBE-RY16A |
| Output point | | 16 point |
| Insulation method | | Relay insulation |
| Rated load voltage/ current | | DC24V 2A (Resistive load) / AC220V 2A (COSΨ = 1), 5A/COM |
| Min. load voltage/current | | DC5V / 1㎃ |
| Max. load voltage/current | | AC250V, DC125V |
| Off leakage current | | 0.1㎃ (AC220V, 60㎐) |
| Max. On/Off frequency | | 3,600 times/hr |
| Surge absorber | | None |
| Service life | Mechanical | 20 millions times or more |
| | Electrical | Rated load voltage / current 100,000 times or more |
| | | AC200V / 1.5A, AC240V / 1A (COSΨ = 0.7) 100,000 times or more |
| | | AC200V / 1A, AC240V / 0.5A (COSΨ = 0.35) 100,000 times or more |
| | | DC24V / 1A, DC100V / 0.1A (L / R = 7㎳) 100,000 times or more |
| Response time | Off → On | 10㎳ or less |
| | On → Off | 12㎳ or less |
| Common method | | 8 point / COM |
| Proper cable size | | Stranded cable 0.3~0.75㎟ (External diameter 2.8㎜ or less) |
| Current consumption | | 420㎃ (when all point On) |
| Operation indicator | | Output On, LED On |
| External connection method | | 9 point terminal block connector x 2 ea |
| Weight | | 130g |

| Circuit configuration | No. | Contact | Type |
|---|---|---|---|
|  | TB1 | 0 |  |
| | TB2 | 1 | |
| | TB3 | 2 | |
| | TB4 | 3 | |
| | TB5 | 4 | |
| | TB6 | 5 | |
| | TB7 | 6 | |
| | TB8 | 7 | |
| | TB9 | COM | |
| | TB1 | 8 | |
| | TB2 | 9 | |
| | TB3 | A | |
| | TB4 | B | |
| | TB5 | C | |
| | TB6 | D | |
| | TB7 | E | |
| | TB8 | F | |
| | TB9 | COM | |

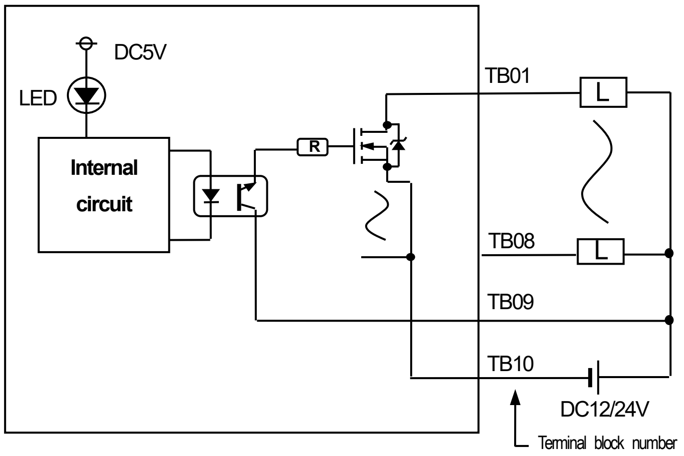
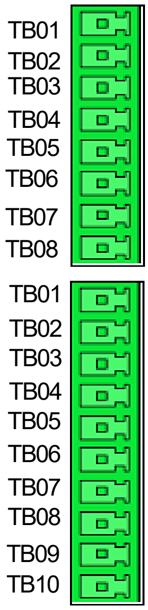
### 3.5.4 8 point transistor output module (Sink type)

| Model / Specification | | Transistor output module |
|---|---|---|
| | | XBE-TN08A |
| Output point | | 8 point |
| Insulation method | | Photo coupler insulation |
| Rated load voltage | | DC 12 / 24V |
| Load voltage range | | DC 10.2 ~ 26.4V |
| Max. load voltage | | 0.5A / 1 point |
| Off leakage current | | 0.1㎃ or less |
| Max. inrush current | | 4A / 10㎳ or less |
| Max. voltage drop (On) | | DC 0.4V or less |
| Surge absorber | | Zener Diode |
| Response time | Off → On | 1㎳ or less |
| | On → Off | 1㎳ or less (Rated load, resistive load) |
| Common method | | 8 point / COM |
| Proper cable size | | Stranded cable 0.3~0.75㎟ (External diameter 2.8㎜ or less) |
| Current consumption | | 40㎃ (when all point On) |
| External power supply | Voltage | DC12/24V ± 10% (ripple voltage 4 Vp-p or less) |
| | Current | 10㎃or less (DC24V connection) |
| Operation indicator | | Output On, LED On |
| External connection method | | 10 point terminal block connector |
| Weight | | 52g |

| Circuit configuration | No. | Contact | Type |
|---|---|---|---|
|  | TB01 | 0 |  |
| | TB02 | 1 | |
| | TB03 | 2 | |
| | TB04 | 3 | |
| | TB05 | 4 | |
| | TB06 | 5 | |
| | TB07 | 6 | |
| | TB08 | 7 | |
| | TB09 | DC12<br>/24V | |
| | TB10 | COM | |

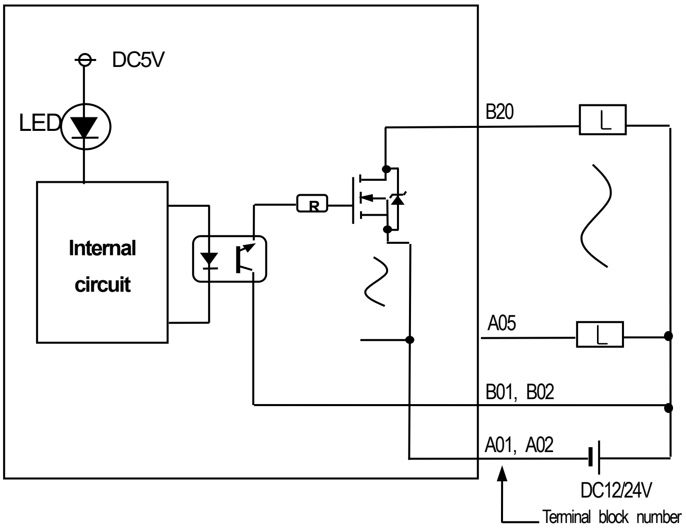
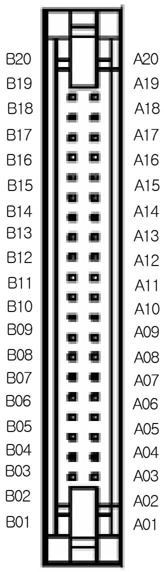
### 3.5.5 16 point transistor output module (Sink type)

| Model<br>Specification | | Transistor output module<br>XBE-TN16A |
|---|---|---|
| Output point | | 16 point |
| Insulation method | | Photo coupler insulation |
| Rated load voltage | | DC 12 / 24V |
| Load voltage range | | DC 10.2 ~ 26.4V |
| Max. load voltage | | 0.5A / 1 point, 2A / 1COM |
| Off leakage current | | 0.1㎃ or less |
| Max. inrush current | | 4A / 10㎳ or less |
| Max. voltage drop (On) | | DC 0.4V or less |
| Surge absorber | | Zener Diode |
| Response time | Off → On | 1㎳ or less |
| | On → Off | 1㎳ or less (Rated load, resistive load) |
| Common method | | 16 point / COM |
| Proper cable size | | Stranded cable 0.3~0.75㎟ (External diameter 2.8㎜ or less) |
| Current consumption | | 60㎃ (when all point On) |
| External power supply | Voltage | DC12/24V ± 10% (ripple voltage 4 Vp-p or less) |
| | Current | 10㎃ or less (DC24V connection) |
| Operation indicator | | Output On, LED On |
| External connection method | | 8 pin terminal block connector + 10 pin terminal block connector |
| Weight | | 54 g |

| Circuit configuration | No. | Contact | Type |
|---|---|---|---|
|  | TB01 | 0 |  |
| | TB02 | 1 | |
| | TB03 | 2 | |
| | TB04 | 3 | |
| | TB05 | 4 | |
| | TB06 | 5 | |
| | TB07 | 6 | |
| | TB08 | 7 | |
| | TB01 | 8 | |
| | TB02 | 9 | |
| | TB03 | A | |
| | TB04 | B | |
| | TB05 | C | |
| | TB06 | D | |
| | TB07 | E | |
| | TB08 | F | |
| | TB09 | DC12<br>/24V | |
| | TB10 | COM | |

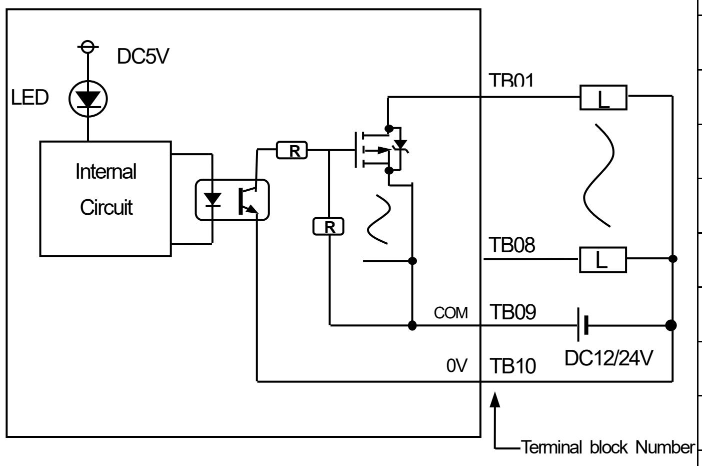
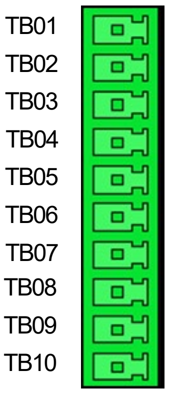
### 3.5.6 32 point transistor output module (Sink type)

| Model<br>Specification | | Transistor output module |
|---|---|---|
| | | XBE-TN32A |
| Output point | | 32 point |
| Insulation method | | Photo coupler insulation |
| Rated load voltage | | DC 12 / 24V |
| Load voltage range | | DC 10.2 ~ 26.4V |
| Max. load voltage | | 0.5A / 1 point, 2A / 1COM |
| Off leakage current | | 0.1㎃ or less |
| Max. inrush current | | 0.7A / 10㎳ or less |
| Max. voltage drop (On) | | DC 0.4V or less |
| Surge absorber | | Zener Diode |
| Response time | Off → On | 1㎳ or less |
| | On → Off | 1㎳ or less (Rated load, resistive load) |
| Common method | | 32 point / COM |
| Proper cable size | | 0.3㎟ |
| Current consumption | | 120㎃ (when all point On) |
| External power supply | Voltage | DC12/24V ± 10% (ripple voltage 4 Vp-p or less) |
| | Current | 20㎃ or less (DC24V connection) |
| Operation indicator | | Output On, LED On |
| External connection method | | 40 pin connector |
| Weight | | 60g |

| Circuit configuration | No. | Contact | No. | Contact | Type |
|---|---|---|---|---|---|
|  | B20 | 00 | A20 | 10 |  |
| | B19 | 01 | A19 | 11 | |
| | B18 | 02 | A18 | 12 | |
| | B17 | 03 | A17 | 13 | |
| | B16 | 04 | A16 | 14 | |
| | B15 | 05 | A15 | 15 | |
| | B14 | 06 | A14 | 16 | |
| | B13 | 07 | A13 | 17 | |
| | B12 | 08 | A12 | 18 | |
| | B11 | 09 | A11 | 19 | |
| | B10 | 0A | A10 | 1A | |
| | B09 | 0B | A09 | 1B | |
| | B08 | 0C | A08 | 1C | |
| | B07 | 0D | A07 | 1D | |
| | B06 | 0E | A06 | 1E | |
| | B05 | 0F | A05 | 1F | |
| | B04 | NC | A04 | NC | |
| | B03 | NC | A03 | NC | |
| | B02 | DC12/ 24V | A02 | COM | |
| | B01 | | A01 | | |

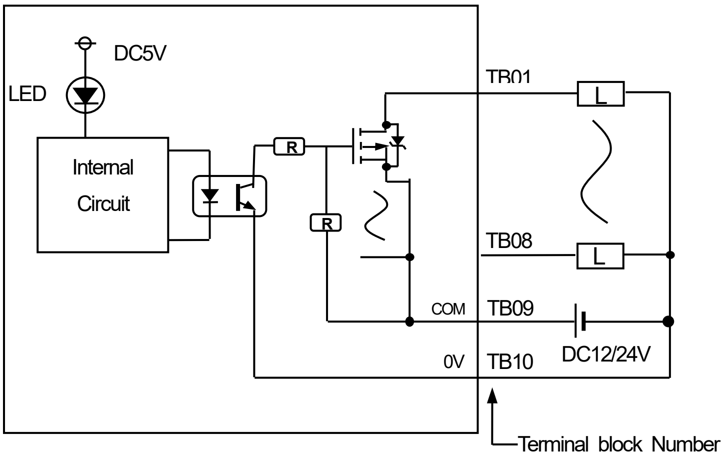
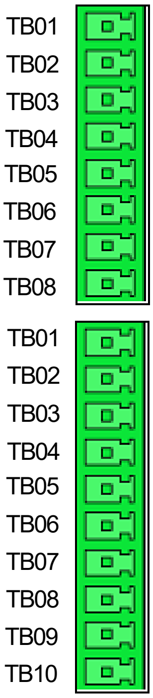
### 3.5.7 8 point transistor output module (Source type)

| Specification / Model | | Transistor output module |
|---|---|---|
| | | **XBE-TP08A** |
| Output point | | 8 point |
| Insulation method | | Photo coupler insulation |
| Rated load voltage | | DC 12 / 24V |
| Load voltage range | | DC 10.2 ~ 26.4V |
| Max. load voltage | | 0.5A / 1 point |
| Off leakage current | | 0.1㎃ or less |
| Max. inrush current | | 4A / 10㎳ or less |
| Max. voltage drop (On) | | DC 0.4V or less |
| Surge absorber | | Zener Diode |
| Response time | Off → On | 1㎳ or less |
| | On → Off | 1㎳ or less (Rated load, resistive load) |
| Common method | | 8 point / COM |
| Proper cable size | | Stranded cable 0.3~0.75㎟ (external diameter 2.8㎜ or less) |
| Current consumption | | 40㎃ (when all outputs are on) |
| External power | Voltage | DC12/24V ± 10% (ripple voltage 4 Vp-p or less) |
| | Current | 10㎃ or less (when connecting DC24V) |
| Operation indicator | | LED on when output on |
| External connection method | | 10 pin terminal block connector |
| Weight | | 30g |

| Circuit configuration | No. | Contact | Type |
|---|---|---|---|
|  | TB01 | 0 |  |
| | TB02 | 1 | |
| | TB03 | 2 | |
| | TB04 | 3 | |
| | TB05 | 4 | |
| | TB06 | 5 | |
| | TB07 | 6 | |
| | TB08 | 7 | |
| | TB09 | COM | |
| | TB10 | 0V | |

### 3.5.8 16 point transistor output module (Source type)

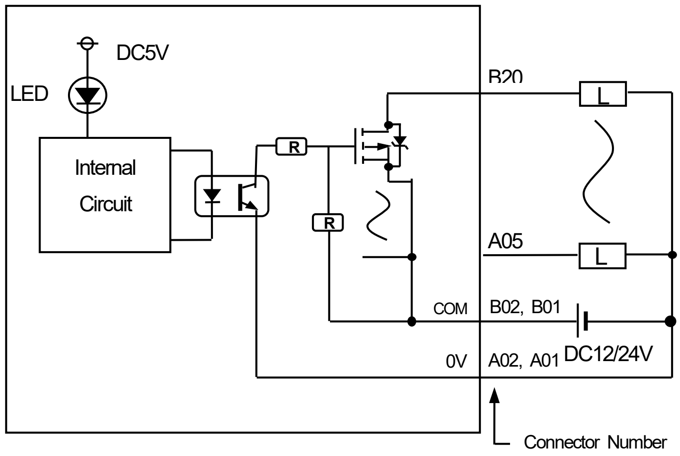
| Model<br>Specification | | Transistor output module |
|---|---|---|
| | | XBE-TP16A |
| Output point | | 16 point |
| Insulation method | | Photo coupler insulation |
| Rated load voltage | | DC 12 / 24V |
| Load voltage range | | DC 10.2 ~ 26.4V |
| Max. load voltage | | 0.5A / 1 point, 2A / 1COM |
| Off leakage current | | 0.1㎃ or less |
| Max. inrush current | | 4A / 10㎳ or less |
| Max. voltage drop (On) | | DC 0.4V or less |
| Surge absorber | | Zener Diode |
| Response time | Off → On | 1㎳ or less |
| | On → Off | 1㎳ or less (Rated load, resistive load) |
| Common method | | 16 point / COM |
| Proper cable size | | Stranded cable 0.3~0.75㎟ (external diameter 2.8㎜ or less) |
| Current consumption | | 60㎃ (When all outputs are on) |
| External power | Voltage | DC12/24V ± 10% (ripple voltage 4 Vp-p or less) |
| | Current | 10㎃ or less (connecting DC24V) |
| Operation indicator | | LED On when output On |
| External connection method | | 8 pin terminal block connector + 10 pin terminal block connector |
| Weight | | 40g |

| Circuit configuration | No. | Contact | Type |
|---|---|---|---|
| <br> | TB01 | 0 | <br> |
| | TB02 | 1 | |
| | TB03 | 2 | |
| | TB04 | 3 | |
| | TB05 | 4 | |
| | TB06 | 5 | |
| | TB07 | 6 | |
| | TB08 | 7 | |
| | TB01 | 8 | |
| | TB02 | 9 | |
| | TB03 | A | |
| | TB04 | B | |
| | TB05 | C | |
| | TB06 | D | |
| | TB07 | E | |
| | TB08 | F | |
| | TB09 | COM | |
| | TB10 | 0V | |

### 3.5.9 32 point transistor output module (Source type)

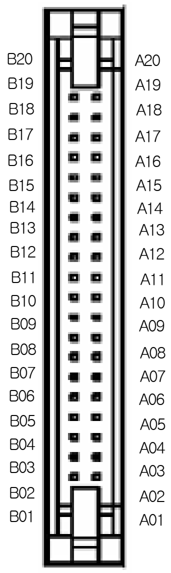
| Specification \ Model | | Transistor output module |
|---|---|---|
| | | XBE-TP32A |
| Output point | | 32 point |
| Insulation method | | Photo coupler insulation |
| Rated load voltage | | DC 12 / 24V |
| Load voltage range | | DC 10.2 ~ 26.4V |
| Max. load voltage | | 0.5A / 1 point, 2A / 1COM |
| Off leakage current | | 0.1㎃ or less |
| Max. inrush current | | 4A / 10 ㎳ or less |
| Max. voltage drop (On) | | DC 0.4V or less |
| Surge absorber | | Zener Diode |
| Response time | Off → On | 1㎳ or less |
| | On → Off | 1㎳ or less (Rated load, resistive load) |
| Common method | | 32 point / COM |
| Proper cable size | | 0.3㎟ |
| Current consumption | | 120㎃ (When all outputs are on) |
| External power | Voltage | DC12/24V ± 10% (ripple voltage 4 Vp-p or less) |
| | Current | 20㎃ or less (connecting DC24V) |
| Operation indicator | | LED On when output On |
| External connection method | | 40 pin connector |
| Weight | | 60g |

Circuit configuration



| No. | Contact | No. | Contact |
|---|---|---|---|
| B20 | 00 | A20 | 10 |
| B19 | 01 | A19 | 11 |
| B18 | 02 | A18 | 12 |
| B17 | 03 | A17 | 13 |
| B16 | 04 | A16 | 14 |
| B15 | 05 | A15 | 15 |
| B14 | 06 | A14 | 16 |
| B13 | 07 | A13 | 17 |
| B12 | 08 | A12 | 18 |
| B11 | 09 | A11 | 19 |
| B10 | 0A | A10 | 1A |
| B09 | 0B | A09 | 1B |
| B08 | 0C | A08 | 1C |
| B07 | 0D | A07 | 1D |
| B06 | 0E | A06 | 1E |
| B05 | 0F | A05 | 1F |
| B04 | NC | A04 | NC |
| B03 | NC | A03 | NC |
| B02 | COM | A02 | 0V |
| B01 | | A01 | |

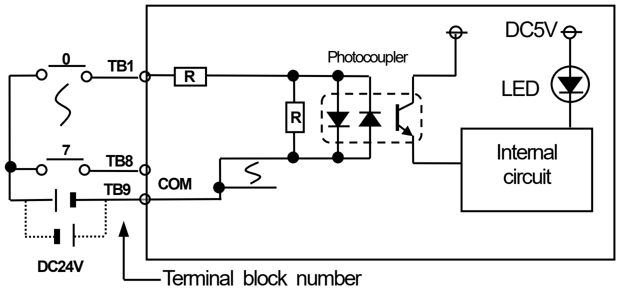
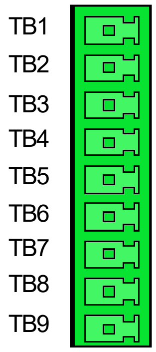
Type



## 3.6 Combined Digital I/O module Input Specification

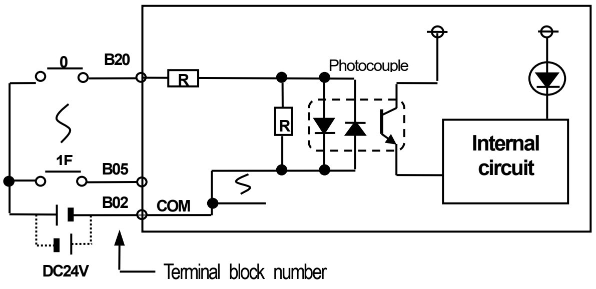
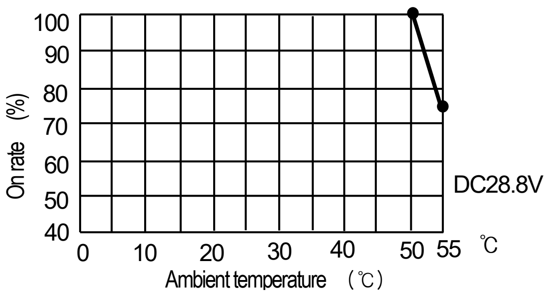
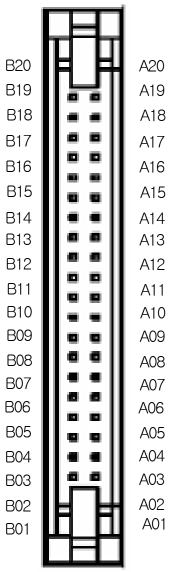
### 3.6.1 8 point DC24V input (Source/Sink type)

| Model<br>Specification | | DC input module |
|---|---|---|
| | | XBE-DR16A |
| Input point | | 8 point |
| Insulation method | | Photo coupler insulation |
| Rated input voltage | | DC24V |
| Rated input current | | About 4㎃ |
| Operation voltage range | | DC20.4~28.8V (within ripple rate 5%) |
| On Voltage/Current | | DC19V or higher / 3㎃ or higher |
| Off Voltage/Current | | DC6V or less / 1㎃ or less |
| Input resistance | | About 5.6㏀ |
| Response time | Off → On | 1/3/5/10/20/70/100㎳ (set by CPU parameter) Default: 3㎳ |
| | On → Off | |
| Insulation pressure | | AC560Vrms / 3Cycle (altitude 2000m) |
| Insulation resistance | | 10㏁ or more by Megohmmeter |
| Common method | | 8 point / COM |
| Proper cable size | | Stranded cable 0.3~0.75㎟ (External diameter 2.8㎜ or less) |
| Current consumption | | 280㎃ (When all inputs and outputs are on) |
| Operation indicator | | LED on when input on |
| External connection method | | 9 pin terminal block connector |
| Weight | | 81g |

| Circuit configuration | No. | Contact | Type |
|---|---|---|---|
|  | TB1 | 0 |  |
| | TB2 | 1 | |
| | TB3 | 2 | |
| | TB4 | 3 | |
| | TB5 | 4 | |
| | TB6 | 5 | |
| | TB7 | 6 | |
| | TB8 | 7 | |
| | TB9 | COM | |

### 3.6.2 16 point DC24V input (Source/Sink type)

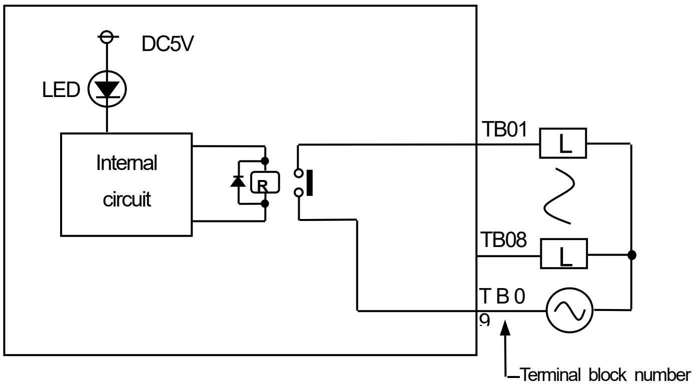
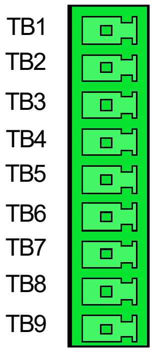
| Specification \ Model | | DC input module |
|---|---|---|
| | | XBE-DN32A |
| Input point | | 16 point |
| Insulation method | | Photo coupler insulation |
| Rated input voltage | | DC24V |
| Rated input current | | About 4㎃ |
| Operation voltage range | | DC20.4~28.8V (ripple rate < 5%) |
| Input Derating | | Refer to Derating diagram |
| On Voltage/Current | | DC 19V or higher / 3 ㎃ or higher |
| Off Voltage/Current | | DC 6V or less / 1 ㎃ or less |
| Input resistance | | About 5.6㏀ |
| Response time | Off → On | 1/3/5/10/20/70/100㎳ (set by CPU parameter) Default:3㎳ |
| | On → Off | |
| Insulation pressure | | AC 560Vrms / 3 Cycle (altitude 2000m) |
| Insulation resistance | | 10㏁ or more by Megohmmeter |
| Common method | | 16 point / COM |
| Proper cable size | | 0.3㎟ |
| Current consumption | | 60㎃ (When all inputs and outputs are on) |
| Operation indicator | | Input On, LED On |
| External connection method | | 40 pin connector |
| Weight | | 60g |

| Circuit configuration | No. | Contact | No. | Contact | Type |
|---|---|---|---|---|---|
|  <br>Input Derating diagram<br> | B20 | 00 | A20 | 20 |  |
| | B19 | 01 | A19 | 21 | |
| | B18 | 02 | A18 | 22 | |
| | B17 | 03 | A17 | 23 | |
| | B16 | 04 | A16 | 24 | |
| | B15 | 05 | A15 | 25 | |
| | B14 | 06 | A14 | 26 | |
| | B13 | 07 | A13 | 27 | |
| | B12 | 08 | A12 | 28 | |
| | B11 | 09 | A11 | 29 | |
| | B10 | 0A | A10 | 2A | |
| | B09 | 0B | A09 | 2B | |
| | B08 | 0C | A08 | 2C | |
| | B07 | 0D | A07 | 2D | |
| | B06 | 0E | A06 | 2E | |
| | B05 | 0F | A05 | 2F | |
| | B04 | NC | A04 | P | |
| | B03 | NC | A03 | P | |
| | B02 | IN_COM | A02 | OUT_COM | |
| | B01 | IN_COM | A01 | OUT_COM | |

## 3.7 Combined Digital I/O module Output Specification

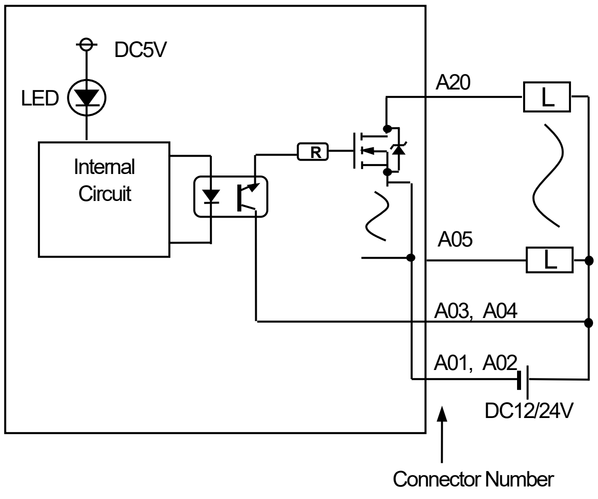
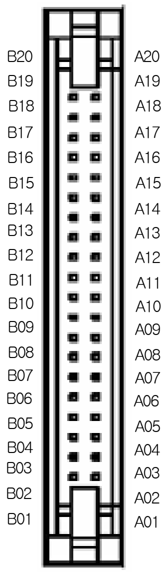
### 3.7.1 8 point relay output

| Model / Specification | | Relay output module |
|---|---|---|
| | | XBE-DR16A |
| Output point | | 8 point |
| Insulation method | | Relay insulation |
| Rated load voltage / Current | | DC24V 2A (Resistive load) / AC220V 2A (COSΨ = 1), 5A/COM |
| Min. load voltage/Current | | DC5V / 1㎃ |
| Max. load voltage | | AC250V, DC125V |
| Off leakage current | | 0.1㎃ (AC220V, 60㎐) |
| Max. On/Off frequency | | 3,600 times/hr |
| Surge absorber | | None |
| Service life | Mechanical | 20 millions times or more |
| | Electrical | Rated load voltage / current 100,000 times or more |
| | | AC200V / 1.5A, AC240V / 1A (COSΨ = 0.7) 100,000 times or more |
| | | AC200V / 1A, AC240V / 0.5A (COSΨ = 0.35) 100,000 times or more |
| | | DC24V / 1A, DC100V / 0.1A (L / R = 7㎳) 100,000 times or more |
| Response time | Off → On | 10㎳ or less |
| | On → Off | 12㎳ or less |
| Common method | | 8 point / COM |
| Proper cable size | | Stranded cable 0.3~0.75㎟ (external diameter 2.8㎜ or less) |
| Current consumption | | 280㎃ (When all inputs and outputs are on) |
| Operation indicator | | LED on when output on |
| External connection method | | 9 pin terminal block connector |
| Weight | | 81g |

| Circuit configuration | No. | Contact | Type |
|---|---|---|---|
|  | TB01 | 0 |  |
| | TB02 | 1 | |
| | TB03 | 2 | |
| | TB04 | 3 | |
| | TB05 | 4 | |
| | TB06 | 5 | |
| | TB07 | 6 | |
| | TB08 | 7 | |
| | TB09 | COM | |

### 3.7.2 16 point transistor output (Sink type)

| Model / Specification | | Transistor output module |
|---|---|---|
| | | XBE-DN32A |
| Output point | | 16 point |
| Insulation method | | Photo coupler insulation |
| Rated voltage | | DC12/24V |
| Operation voltage range | | DC10.2~26.4V |
| Max. load current | | 0.2A / 1 point, 2A / 1COM |
| Off leakage current | | 0.1㎃ or less |
| Max. load voltage | | 0.7A / 10ms or less |
| Max. voltage drop (On) | | DC 0.4V or less |
| Surge absorber | | TVS Diode |
| Response time | Off → On | 1㎳ or less |
| | On → Off | 1㎳ or less (Rated load, resistive load) |
| Common method | | 32 point / COM |
| Proper cable size | | 0.3㎟ |
| Current consumption | | 60㎃ (when all point On) |
| External power | Voltage | DC 12/24V ± 10% (ripple voltage 4 Vp-p or less) |
| | Current | 20mA or less (when connecting DC24V) |
| Operation indicator | | LED On when output On |
| External connection method | | 40 pin terminal block connector |
| Weight | | 60g |

| Circuit configuration | No. | Contact | No. | Contact | Type |
|---|---|---|---|---|---|
|  | B20 | 00 | A20 | 20 |  |
| | B19 | 01 | A19 | 21 | |
| | B18 | 02 | A18 | 22 | |
| | B17 | 03 | A17 | 23 | |
| | B16 | 04 | A16 | 24 | |
| | B15 | 05 | A15 | 25 | |
| | B14 | 06 | A14 | 26 | |
| | B13 | 07 | A13 | 27 | |
| | B12 | 08 | A12 | 28 | |
| | B11 | 09 | A11 | 29 | |
| | B10 | 0A | A10 | 2A | |
| | B09 | 0B | A09 | 2B | |
| | B08 | 0C | A08 | 2C | |
| | B07 | 0D | A07 | 2D | |
| | B06 | 0E | A06 | 2E | |
| | B05 | 0F | A05 | 2F | |
| | B04 | NC | A04 | P | |
| | B03 | NC | A03 | P | |
| | B02 | IN_COM | A02 | OUT_COM | |
| | B01 | | A01 | | |

# 3.8 I/O modules' Functions

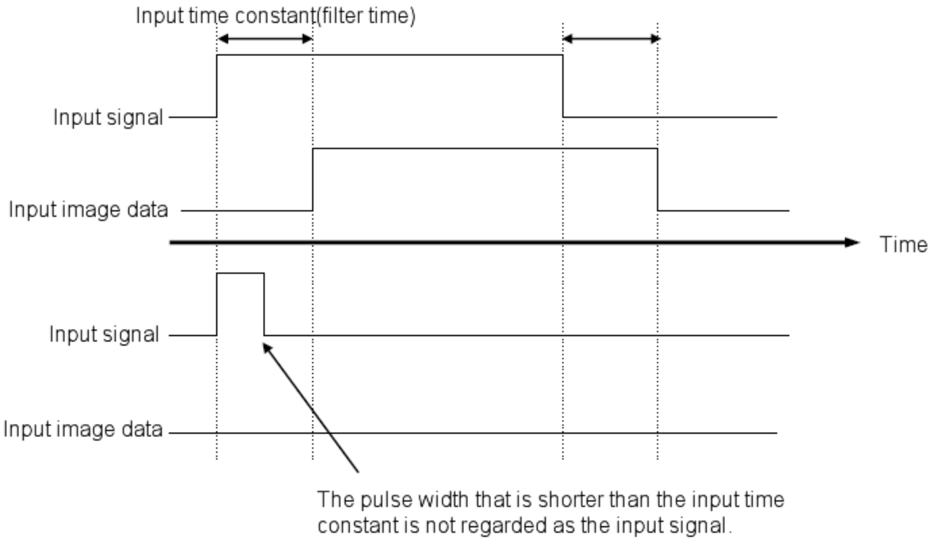
## 3.8.1 Input filter function

The XGB PLC's input modules have the input filter function to prevent the external noise signal flowed into the input signal. For more details on the input filter function, refer to the below.

(1) Purposes and Operations of the input filter function

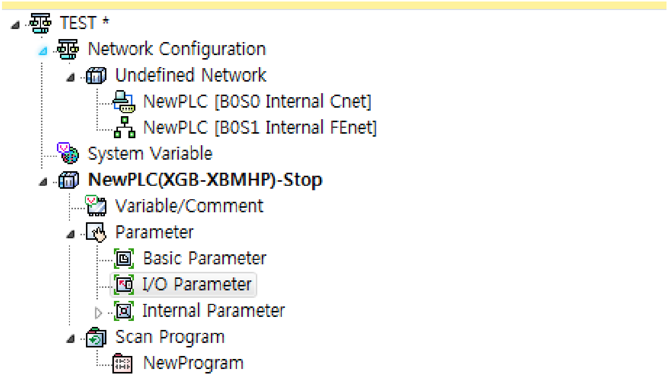
Under the environment with serious noise or in the case of the equipment that is greatly affected by the input signal's pulse width, the system may receive incorrect input depending on the input signal status. To prevent such incorrect input, the input filter function does not regard the signal that is shorter than the set time by a user as input. In the case of the XGB PLC, you can set the input filter time in the range of 1ms~100ms.

The timing chart below represents the operations of the input filter function.

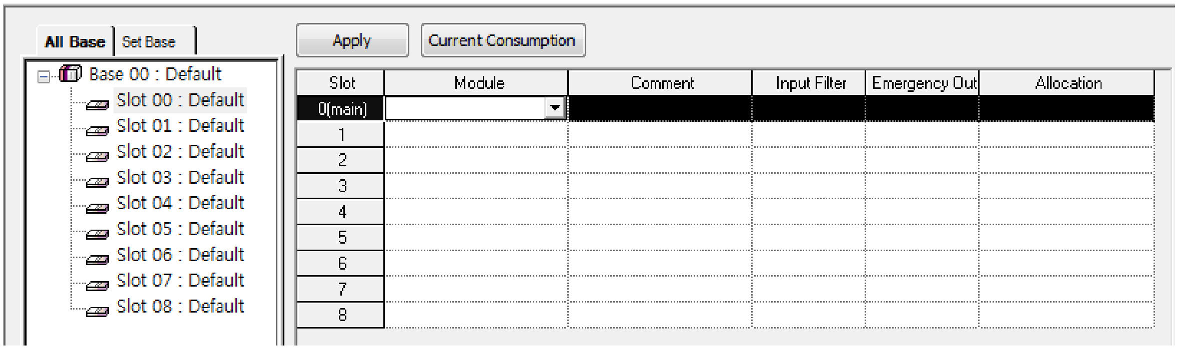


(2) How to set Input filter

1) Click [I/O Parameter] in XG5000

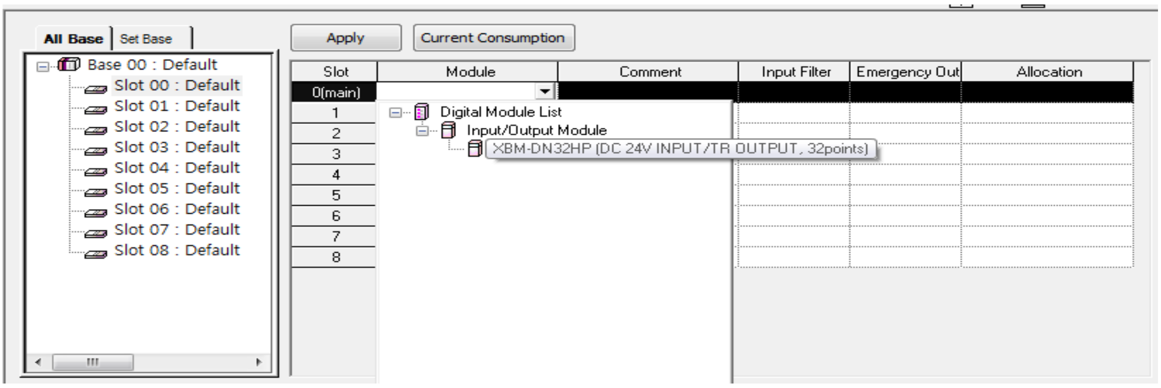


2) Click [Module] in Slot

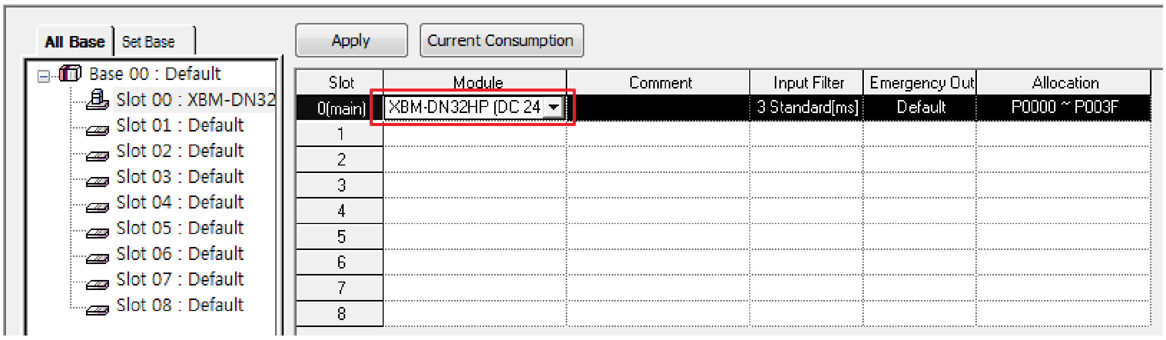


| Slot | Module | Comment | Input Filter | Emergency Out | Allocation |
|---|---|---|---|---|---|
| 0(main) | | | | | |
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |

3) Set I/O Module

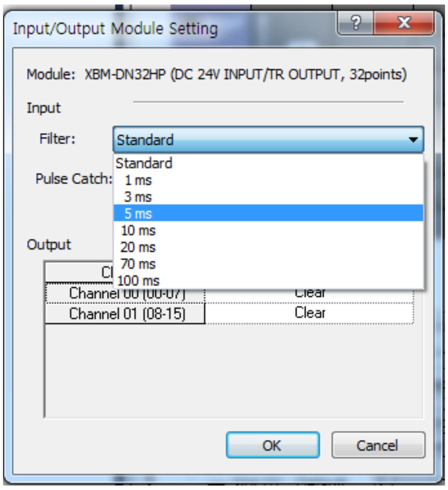


4) Click the below box and set Inpu filter



| Slot | Module | Comment | Input Filter | Emergency Out | Allocation |
|---|---|---|---|---|---|
| 0(main) | XBM-DN32HP (DC 24 | | 3 Standard[ms] | Default | P0000 ~ P003F |
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |

5) Set Input filter



Module: XBM-DN32HP (DC 24V INPUT/TR OUTPUT, 32points)

Input

Filter: Standard

Pulse Catch:

Output

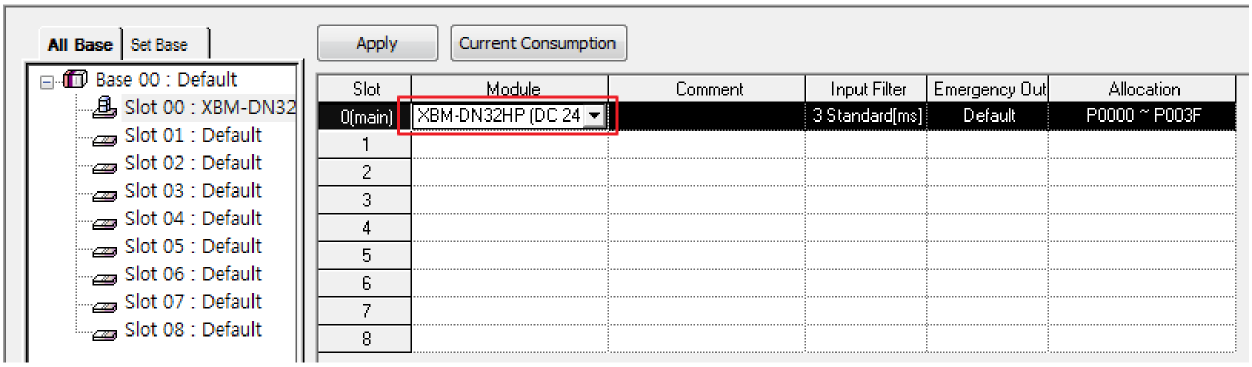
Channel 00 (00-07) Clear

Channel 01 (08-15) Clear

## 3.8.2 Emergency output function

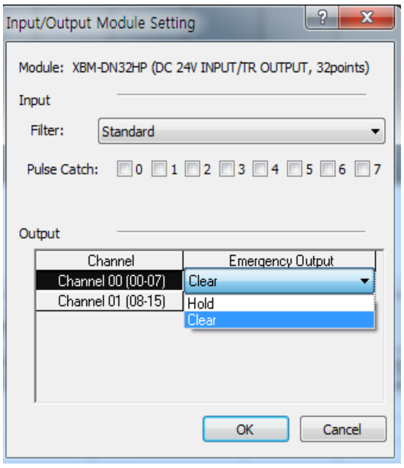
The XGB PLC's output module supports the emergency output function to determine whether maintaining the output status of the output module or clearing it when the PLC is stopped due to errors.
You can set the emergency output by 8 points. For more details on how to set the emergency output, refer to the below.

(1) Double click the box below



| Slot | Module | Comment | Input Filter | Emergency Out | Allocation |
|---|---|---|---|---|---|
| 0(main) | XBM-DN32HP (DC 24 |  | 3 Standard[ms] | Default | P0000 ~ P003F |
| 1 |  |  |  |  |  |
| 2 |  |  |  |  |  |
| 3 |  |  |  |  |  |
| 4 |  |  |  |  |  |
| 5 |  |  |  |  |  |
| 6 |  |  |  |  |  |
| 7 |  |  |  |  |  |
| 8 |  |  |  |  |  |

(2) Set Emergency output



Module: XBM-DN32HP (DC 24V INPUT/TR OUTPUT, 32points)

Filter: Standard

| Channel | Emergency Output |
|---|---|
| Channel 00 (00-07) | Clear |
| Channel 01 (08-15) |  |

When the emergency output is set as Clear, the output is turned off when an error occurs in the PLC. If you set Emergency output as Hold, the output maintains the current state when an error occurs in the PLC.

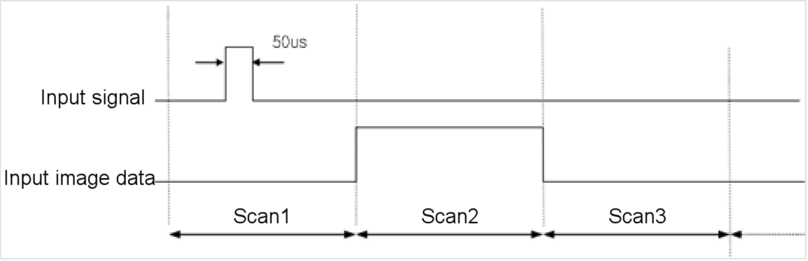
### 3.8.3 Pulse Catch Function

The XGB PLC basic unit has 8 input contacts (P0000 ~ P0007) for Pulse Catch. Through these contacts, it is possible to receive the very short pulse signal that cannot be detected by the normal digital input.

(1) Purposes and Operations of the Pulse Catch function

The PLC's input data is refreshed all at once during each scan. Accordingly, very short pulse signals that are input during scan but turn off before the scan finishes cannot be recognized as inputs. If it is necessary to recognize and process such short pulse signals, you can use the Pulse Catch function. This function allows you to detect pulses as short as 10㎲ (for P0004 ~ P0007, 50㎲).

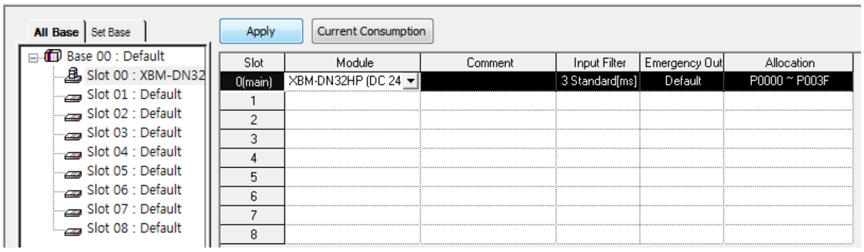
The timing chart below represents the operations of the Pulse Catch function.



| Step | Processing details |
|---|---|
| Scan 1 | When the pulse signal of 50 ㎲ is input, the CPU detects it and stores the status. |
| Scan 2 | The pulse catch result flag is turned On. |
| Scan 3 | The pulse catch result flag is turned Off. |

(2) Setting pulse catch

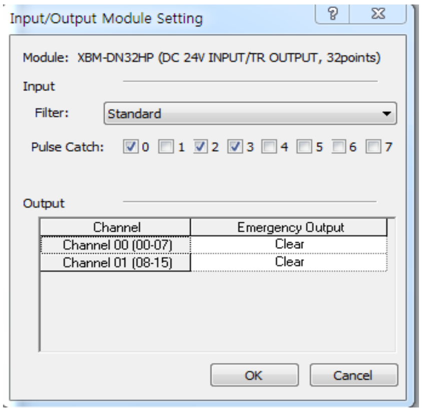
1) Double click the basic unit in the I/O parameter.



Base 00 : Default
- Slot 00 : XBM-DN32
- Slot 01 : Default
- Slot 02 : Default
- Slot 03 : Default
- Slot 04 : Default
- Slot 05 : Default
- Slot 06 : Default
- Slot 07 : Default
- Slot 08 : Default

| Slot | Module | Comment | Input Filter | Emergency Out | Allocation |
|---|---|---|---|---|---|
| 0(main) | XBM-DN32HP (DC 24 |  | 3 Standard[ms] | Default | P0000 ~ P003F |
| 1 |  |  |  |  |  |
| 2 |  |  |  |  |  |
| 3 |  |  |  |  |  |
| 4 |  |  |  |  |  |
| 5 |  |  |  |  |  |
| 6 |  |  |  |  |  |
| 7 |  |  |  |  |  |
| 8 |  |  |  |  |  |

2) Select the input contact to use the Pulse Catch.



Module: XBM-DN32HP (DC 24V INPUT/TR OUTPUT, 32points)

Input

Filter: Standard

Pulse Catch: ☑ 0 ☐ 1 ☑ 2 ☑ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

Output

| Channel | Emergency Output |
|---|---|
| Channel 00 (00-07) | Clear |
| Channel 01 (08-15) | Clear |

(3) Pulse Catch result flags

1) Pulse catch flags are stored in below device

| WORD | BIT | Variables | Description |
|---|---|---|---|
| F137 | F01730 | _PLS_CATCH_0 | Input Contact 0 Pulse Catch Result |
| | F01731 | _PLS_CATCH_1 | Input Contact 1 Pulse Catch Result |
| | F01732 | _PLS_CATCH_2 | Input Contact 2 Pulse Catch Result |
| | F01733 | _PLS_CATCH_3 | Input Contact 3 Pulse Catch Result |
| | F01734 | _PLS_CATCH_4 | Input Contact 4 Pulse Catch Result |
| | F01735 | _PLS_CATCH_5 | Input Contact 5 Pulse Catch Result |
| | F01736 | _PLS_CATCH_6 | Input Contact 6 Pulse Catch Result |
| | F01737 | _PLS_CATCH_7 | Input Contact 7 Pulse Catch Result |

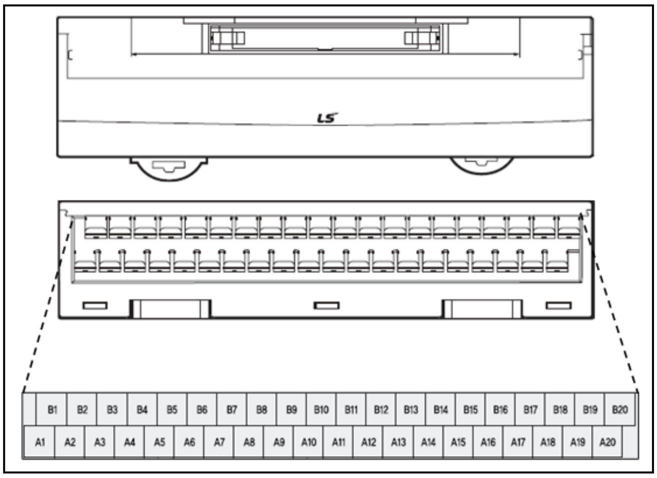
## 3.9 I/O link board

When wiring the input/output circuit of the main unit or extension module, It can be done easily by connecting the I/O connector to the I/O Link Board. The available I/O Link Boards and I/O cables for each product are as follows.

| XGB | | Smart link | | Connection cable | | |
|---|---|---|---|---|---|---|
| Item | Model | Model | Pin | Model | Length | Contents |
| Main unit | XBM-DN32H2/HP<br>XBM-DP32H2/HP | XTB-40H<br>(TG7-1H40S) | 40 | C40HH-05SB-XBI<br>C40HH-10SB-XBI | 0.5~1m | For main unit connection (40Pin) |
| Expansion module | XBE-DC32A | XTB-40H<br>(TG7-1H40S) | 40 | C40HH-05SB-XBE<br>C40HH-10SB-XBE<br>C40HH-15SB-XBE<br>C40HH-20SB-XBE<br>C40HH-30SB-XBE | 0.5m~ 3m | For expansion module connection (40Pin) |
| | XBE-TN32A | XTB-40H<br>(TG7-1H40S) | 40 | | | |
| | | R32C-NS5A-40P | 40 | | | For expansion module connection (40Pin)<br>Exclusive for relay built-in type |
| | XBE-TP32A | XTB-40H<br>(TG7-1H40S) | 40 | | | For expansion module connection (40Pin) |
| | | R32C-PS5A-40P | 40 | | | For expansion module connection (40Pin)<br>Exclusive for relay built-in type |
| | XBE-DN32A | XTB-40H<br>(TG7-1H40S) | 40 | | | For expansion module connection (40Pin) |

1) XTB-40H terminal array

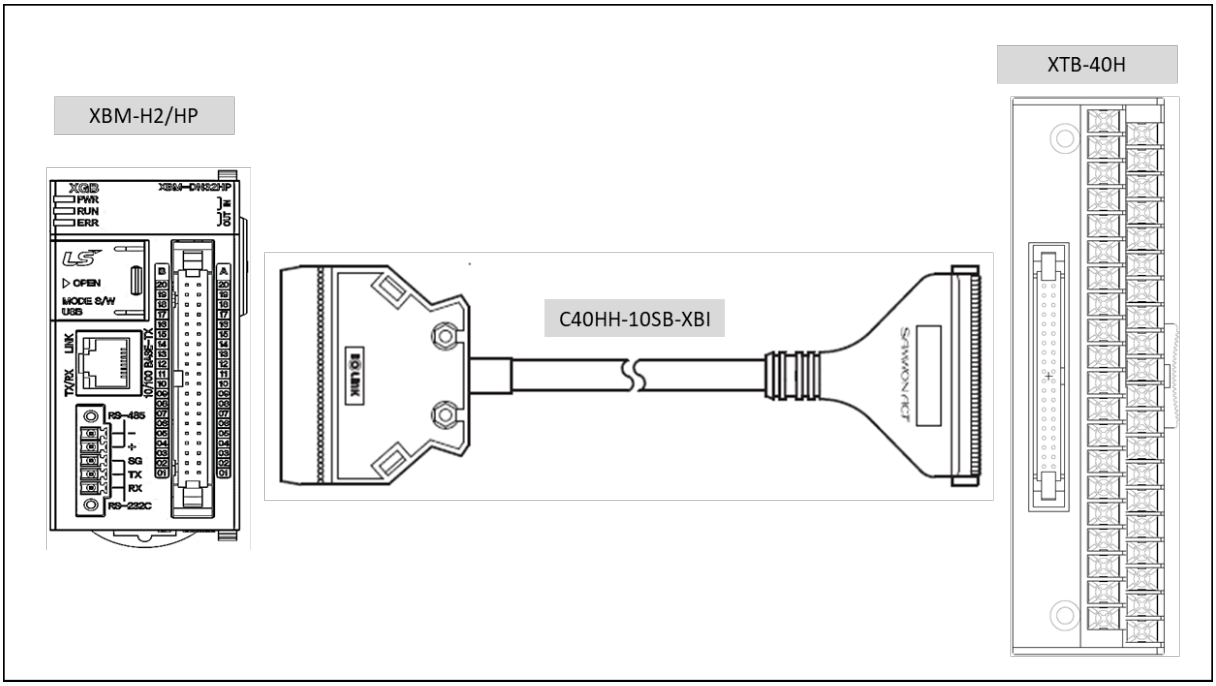
Terminal array of XTB-40H is as follows.



| Item | | Specification |
|---|---|---|
| Rated voltage | | AC125 / DC 24[V] |
| Rated current | | Max. 1[A] |
| Withstanding voltage | | 500V 1min |
| Insulation resistor | | 100MΩ (DC500V) |
| Cable specification | | AWG22-16 (1.5mm$^2$ / MAX) |
| Terminal/screw | | M3 X 8L |
| Torque | | 1.2N · m (12kgf · cm) |
| material | Terminal | Modified PP0 |
| | Cover | Polycarbonate |
| | PCB | Epoxy 1.6t |

2) Wiring of XTB-40H and XGB extension module

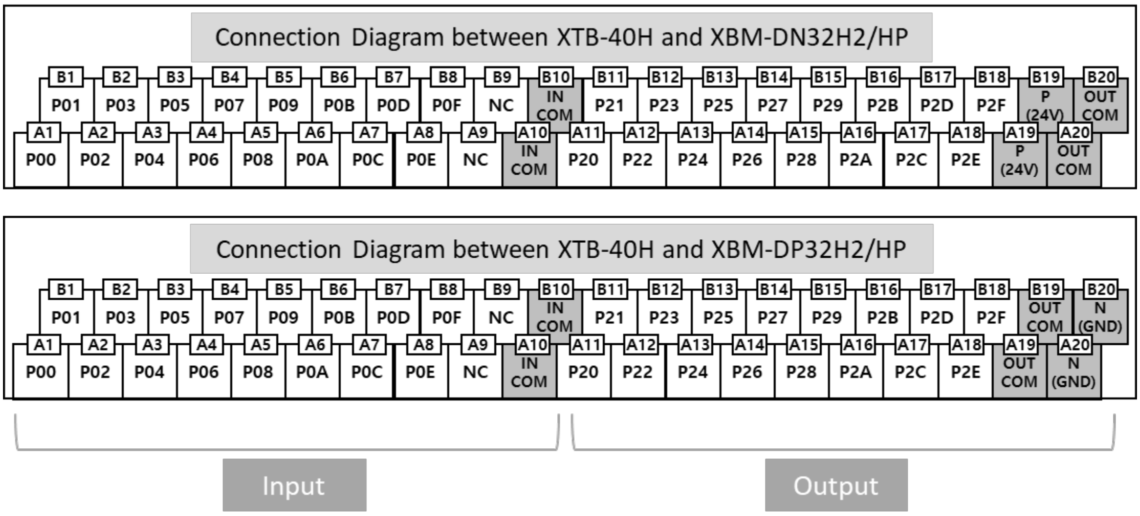
Wiring of XGB main unit through XTB-40H and C40HH-10SB-XBI is as follows.



If you reverse the direction of the cables, the I/O connections of the XBM-H2/HP and XTB-40H will be different. So be careful about the direction of cable connection.

The relationship between the input/output signals of the XGB I/O signal and I/O Link board terminal number is shown in the figure below.
The following figure describes signal assignment when the C40HH-10SB-XBI is used in connection.
When the user makes the cable, make sure that wiring is done as figure below.

| XTB-40 Terminal No. | PLC Input | XBM-H2/HP Connector | | PLC Output | XTB-40 Terminal No. |
|---|---|---|---|---|---|
| A1 | P00 | B20 | A20 | P20 | A11 |
| B1 | P01 | B19 | A19 | P21 | B11 |
| A2 | P02 | B18 | A18 | P22 | A12 |
| B2 | P03 | B17 | A17 | P23 | B12 |
| A3 | P04 | B16 | A16 | P24 | A13 |
| B3 | P05 | B15 | A15 | P25 | B13 |
| A4 | P06 | B14 | A14 | P26 | A14 |
| B4 | P07 | B13 | A13 | P27 | B14 |
| A5 | P08 | B12 | A12 | P28 | A15 |
| B5 | P09 | B11 | A11 | P29 | B15 |
| A6 | P0A | B10 | A10 | P2A | A16 |
| B6 | P0B | B9 | A9 | P2B | B16 |
| A7 | P0C | B8 | A8 | P2C | A17 |
| B7 | P0D | B7 | A7 | P2D | B17 |
| A8 | P0E | B6 | A6 | P2E | A18 |
| B8 | P0F | B5 | A5 | P2F | B18 |
| A9 | NC | B4 | A4 | P/OUT_COM | A19 |
| B9 | NC | B3 | A3 | P/OUT_COM | B19 |
| A10 | IN_COM | B2 | A2 | OUT_COM/N | A20 |
| B10 | IN_COM | B1 | A1 | OUT_COM/N | B20 |



Connection Diagram between XTB-40H and XBM-DN32H2/HP

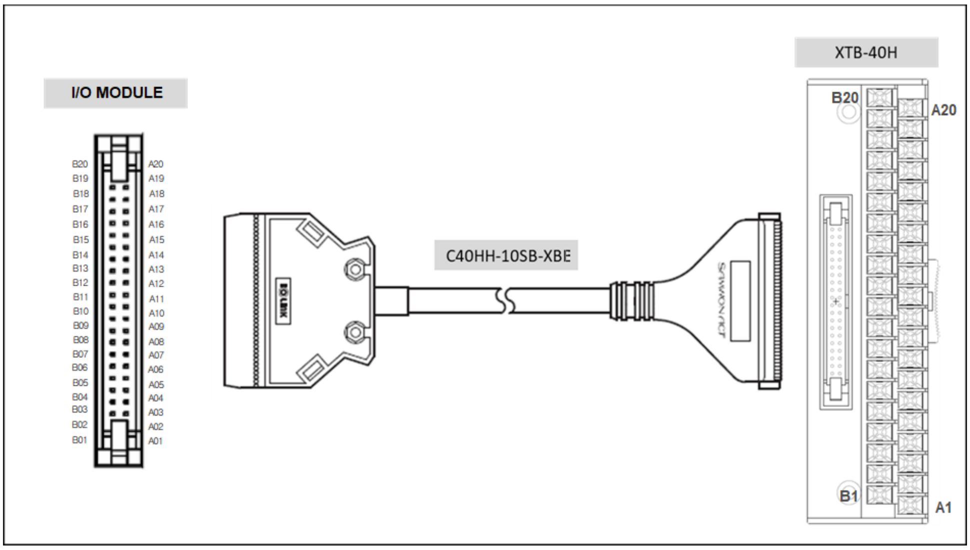
| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B1 | B2 | B3 | B4 | B5 | B6 | B7 | B8 | B9 | B10 | B11 | B12 | B13 | B14 | B15 | B16 | B17 | B18 | B19 | B20 |
| P01 | P03 | P05 | P07 | P09 | P0B | P0D | P0F | NC | IN COM | P21 | P23 | P25 | P27 | P29 | P2B | P2D | P2F | P (24V) | OUT COM |
| A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | A11 | A12 | A13 | A14 | A15 | A16 | A17 | A18 | A19 | A20 |
| P00 | P02 | P04 | P06 | P08 | P0A | P0C | P0E | NC | IN COM | P20 | P22 | P24 | P26 | P28 | P2A | P2C | P2E | P (24V) | OUT COM |

Connection Diagram between XTB-40H and XBM-DP32H2/HP

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B1 | B2 | B3 | B4 | B5 | B6 | B7 | B8 | B9 | B10 | B11 | B12 | B13 | B14 | B15 | B16 | B17 | B18 | B19 | B20 |
| P01 | P03 | P05 | P07 | P09 | P0B | P0D | P0F | NC | IN COM | P21 | P23 | P25 | P27 | P29 | P2B | P2D | P2F | OUT COM | N (GND) |
| A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | A11 | A12 | A13 | A14 | A15 | A16 | A17 | A18 | A19 | A20 |
| P00 | P02 | P04 | P06 | P08 | P0A | P0C | P0E | NC | IN COM | P20 | P22 | P24 | P26 | P28 | P2A | P2C | P2E | OUT COM | N (GND) |

3) Wiring of XTB-40H and XGB extension module

Wiring of XGB extension module through XTB-40H and C40HH-10SB-XBE is as follows.



If you reverse the direction of the cables, the I/O connections of the XGB I/O module and XTB-40H will be different. So be careful about the direction of cable connection.

The relationship between the input/output signals of the XGB I/O signal and I/O Link board terminal number is shown in the table below.

The following table describes signal assignment when the C40HH-10SB-XBE is used in connection.

When the user makes the cable, make sure that wiring is done as table below.

| PLC | | | | | | | | | | Terminal Block Pin No. | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Pin No. | | XBE-DC32A | | XBE-TN32A | | XBE-TP32A | | XBE-DN32A | | XTB-40H | |
| B20 | A20 | 00 | 10 | 00 | 10 | 00 | 10 | 00 | 10 | B20 | A20 |
| B19 | A19 | 01 | 11 | 01 | 11 | 01 | 11 | 01 | 11 | B19 | A19 |
| B18 | A18 | 02 | 12 | 02 | 12 | 02 | 12 | 02 | 12 | B18 | A18 |
| B17 | A17 | 03 | 13 | 03 | 13 | 03 | 13 | 03 | 13 | B17 | A17 |
| B16 | A16 | 04 | 14 | 04 | 14 | 04 | 14 | 04 | 14 | B16 | A16 |
| B15 | A15 | 05 | 15 | 05 | 15 | 05 | 15 | 05 | 15 | B15 | A15 |
| B14 | A14 | 06 | 16 | 06 | 16 | 06 | 16 | 06 | 16 | B14 | A14 |
| B13 | A13 | 07 | 17 | 07 | 17 | 07 | 17 | 07 | 17 | B13 | A13 |
| B12 | A12 | 08 | 18 | 08 | 18 | 08 | 18 | 08 | 18 | B12 | A12 |
| B11 | A11 | 09 | 19 | 09 | 19 | 09 | 19 | 09 | 19 | B11 | A11 |
| B10 | A10 | 0A | 1A | 0A | 1A | 0A | 1A | 0A | 1A | B10 | A10 |
| B09 | A09 | 0B | 1B | 0B | 1B | 0B | 1B | 0B | 1B | B9 | A9 |
| B08 | A08 | 0C | 1C | 0C | 1C | 0C | 1C | 0C | 1C | B8 | A8 |
| B07 | A07 | 0D | 1D | 0D | 1D | 0D | 1D | 0D | 1D | B7 | A7 |
| B06 | A06 | 0E | 1E | 0E | 1E | 0E | 1E | 0E | 1E | B6 | A6 |
| B05 | A05 | 0F | 1F | 0F | 1F | 0F | 1F | 0F | 1F | B5 | A5 |
| B04 | A04 | NC | NC | NC | NC | NC | NC | NC | DC 12/24V | B4 | A4 |
| B03 | A03 | NC | NC | NC | NC | NC | NC | NC | | B3 | A3 |
| B02 | A02 | COM | COM | DC 12/24V | COM | COM | DC0V | IN COM | OUT COM | B2 | A2 |
| B01 | A01 | | | | | | | | | B1 | A1 |

# Chapter 4 Built-in High-speed Counter Function

XGB (XBM-H2/HP) series have built-in function of High-speed counter in basic unit. This chapter describes specifications and usage of High-speed counter's function.

## 4.1 High-speed Counter Specifications

### 4.1.1 Performance specifications

(1) Performance specification

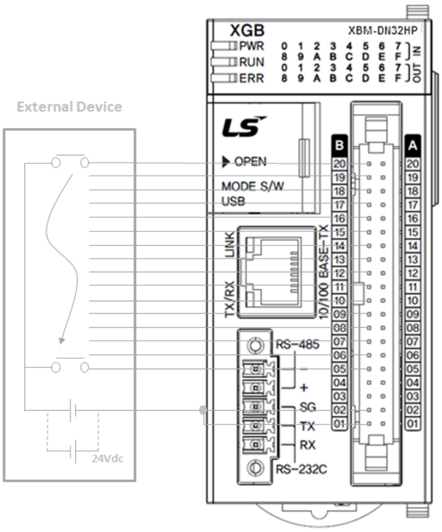
| Classification | | Description |
|---|---|---|
| Count input signal | Signal | A-phase, B-phase |
| | Input type | Voltage input (Open collector) |
| | Signal level | 24V |
| Max. coefficient speed | | 200 kpps |
| Number of channels | 1 phase | 200kpps 4 channels |
| | 2 phase | 100kpps 2 channels |
| Coefficient range | | Signed 32 Bit (-2,147,483,648 ~ 2,147,483,647) |
| Count mode (Program setting) | | Linear count (if 32-bit range exceeded, Carry/Borrow occurs)<br>Counter max. and min. value is indicated |
| | | Ring count (repeated count within setting range) |
| Input mode (Program setting) | | 1-phase input |
| | | 2-phase input |
| | | CW/CCW input |
| Signal type | | Voltage |
| Up/Down setting | 1 phase input | Increasing/decreasing operation setting by B-phase input |
| | | Increasing/decreasing operation setting by program |
| | 2 phase input | Automatic setting by difference in phase |
| | CW/CCW | A-phase input: increasing operation |
| | | B-phase input: decreasing operation |
| Multiplication function | 1 phase input | 1 multiplication |
| | 2 phase input | 4 multiplication |
| | CW/CCW | 1 multiplication |
| Control input | Signal | Preset instruction input |
| | Signal level | DC 24V input type |
| | Signal type | Voltage |
| External output | Output points | 2 point/channel (for each channel) : output contact point of basic unit is available |
| | Type | Single comparison (>, >=, =, =<, <)<br>or range comparison (included or excluded) output |
| | Output type | Open-collector output |
| Count Enable | | To be set through program (count only available in enable status) |
| Preset function | | To be set through input contact or program |
| Auxiliary mode | | Count Latch<br>Frequency Count<br>Count value per unit time (time setting : 1~60,000ms)<br>Count Pause |

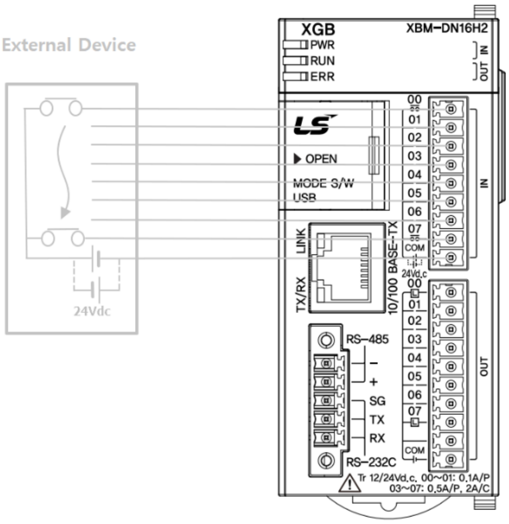
(2) Counter/Preset input specification

| Classification | Spcification |
|---|---|
| Input voltage | 24V DC (20.4V ~ 28.8V) |
| Input current | 4㎃ |
| On guranteed voltage (min.) | 20.4V |
| Off guranteed voltage (max.) | 6V |

## 4.1.2 Designation of parts

(1) Designation of parts

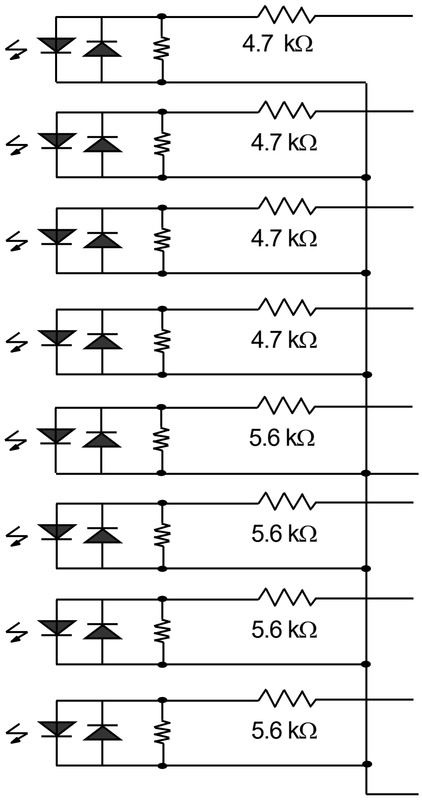




| Terminal No. | | Names | | Usage | |
|---|---|---|---|---|---|
| 32-point model | 14/16-point model | 1-phase | 2-phase | 1-phase | 2-phase |
| B20 | 00 | Ch0 counter input | Ch0 A-phase input | Counter input terminal | A-phase input |
| B19 | 01 | Ch1 counter input | Ch0 B-phase input | Counter input terminal | B-phase input |
| B18 | 02 | Ch2 counter input | Ch2 A-phase input | Counter input terminal | A-phase input |
| B17 | 03 | Ch3 counter input | Ch2 B-phase input | Counter input terminal | B-phase input |
| B16 | 04 | Ch0 preset 24V | Ch0 preset 24V | Preset input terminal | Preset input terminal |
| B15 | 05 | Ch1 preset 24V | - | Preset input terminal | No use |
| B14 | 06 | Ch2 preset 24V | Ch2 preset 24V | Preset input terminal | Preset input terminal |
| B13 | 07 | Ch3 preset 24V | - | Preset input terminal | No use |
| B12 | - | | | | |
| B11 | - | | | | |
| B10 | - | | | | |
| B09 | - | | | | |
| B08 | - | | | | |
| B07 | - | | | | |
| B06 | - | | | | |
| B05 | - | | | | |
| B04 | - | | | | |
| B03 | - | | | | |
| B02 | COM | Input common | Input common | Common terminal | Common terminal |
| B01 | | Input common | Input common | Common terminal | Common terminal |

(2) Interface with external devices

The internal circuit of High-speed counter is as shown below.

| **I/O** | **Internal circuit** | **Terminal No.** | | **Signal** | | **Operatio** | **On/Off guaranteed voltage** |
|---|---|---|---|---|---|---|---|
| | | **32-point model** | **14/16-point model** | **1-phase** | **2-phase** | | |
| Input |  | B20 | 00 | Ch 0<br>Pulse input | Ch 0<br>A-phase input | On | 20.4~28.8V |
| | | | | | | Off | 6V or less |
| | | B19 | 01 | Ch 1<br>Pulse input | Ch 0<br>B-phase input | On | 20.4~28.8V |
| | | | | | | Off | 6V or less |
| | | B18 | 02 | Ch 2<br>Pulse input | Ch 2<br>A-phase input | On | 20.4~28.8V |
| | | | | | | Off | 6V or less |
| | | B17 | 03 | Ch 3<br>Pulse input | Ch 2<br>B-phase input | On | 20.4~28.8V |
| | | | | | | Off | 6V or less |
| | | B16 | 04 | Ch 0<br>Preset input | Ch 0<br>Preset input | On | 20.4~28.8V |
| | | | | | | Off | 6V or less |
| | | B15 | 05 | Ch 1<br>Preset input | - | On | 20.4~28.8V |
| | | | | | | Off | 6V or less |
| | | B14 | 06 | Ch 2<br>Preset input | Ch 2<br>Preset input | On | 20.4~28.8V |
| | | | | | | Off | 6V or less |
| | | B13 | 07 | Ch 2<br>Preset input | - | On | 20.4~28.8V |
| | | | | | | Off | 6V or less |
| | | B01/B02 | COM | COM (input common) | | | |

### 4.1.3 High speed counter Functions

(1) Counter mode

(a) High Speed counter module can count High Speed pulses which can not be processed by CPU module's counter instructions (CTU, CTD, CTUD, etc.), up to binary value of 32 bits (-2,147,483,648 ~ 2,147,483,647).

(b) Available input is 1-phase input, 2-phase input and CW/ CCW input.

(c) Count increasing/decreasing methods are as follows;

- For 1-phase input :
  1) Increasing/decreasing count operation by program setting
  2) Increasing/decreasing count operation by B-phase input signal
- For 2-phase input: setting by difference in phase between A-phase and B-phase
- For CW/CCW input: Increasing operation if B-phase is LOW with A-phase input, and Decreasing operation if A-phase is LOW with B-phase input.

(d) Auxiliary modes are as follows :

- Count Latch
- Periodic Pulse Count
- Frequency measure function
- Count prohibited function

(e) Pulse input mode

1) 1-Phase Count Mode

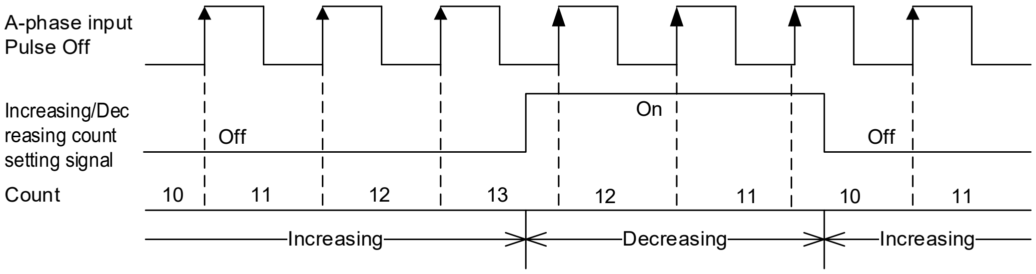
a) Increasing / Decreasing count operation by programming setting

- 1-phase 1-input 1-multiplication operation mode

A-phase input pulse counts at rising and increasing/decreasing will be decided by the applicable program.

| Increasing/Decreasing classification | A-phase input pulse rising | A-phase input pulse falling |
|---|---|---|
| Increasing/decreasing count setting signal Off | Increasing count | - |
| Increasing/decreasing count setting signal On | Decreasing count | - |

- Operation example



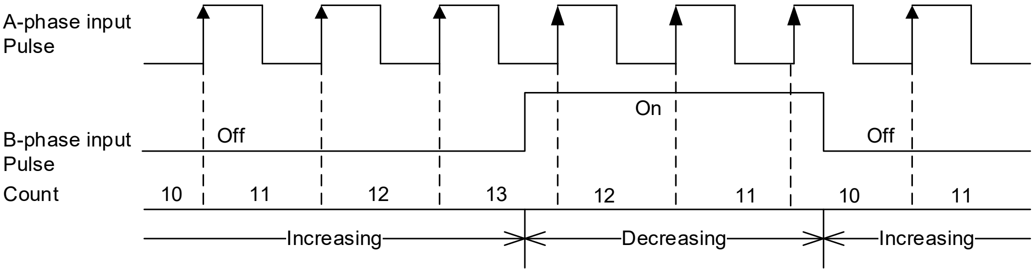
b) Increasing/decreasing count operation by B-phase input signal

- 1-phase 2-input 1-multiplication operation mode

A-phase input pulse counts at rising and increasing/decreasing will be decided by B-phase.

| Increasing/Decreasing classification | A-phase input pulse rising | A-phase input pulse falling |
|---|---|---|
| B-phase input pulse Off | Increasing count | - |
| B-phase input pulse On | Decreasing count | - |

- Operation example

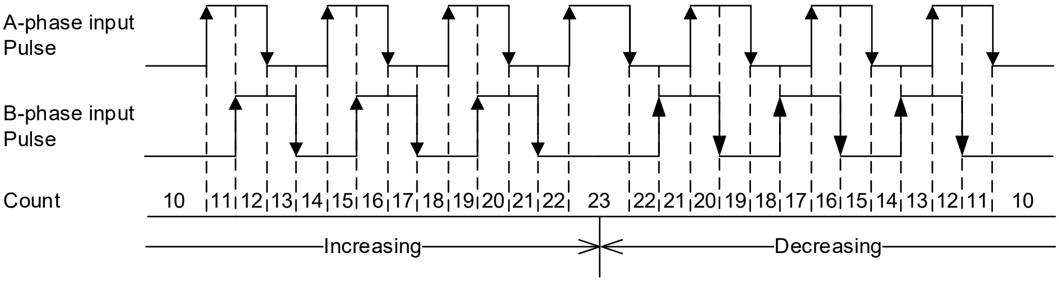


2) 2-Phase Count Mode

a) 2-phase 4-multiplication operation mode

A-phase input pulse and B-phase input pulse count at rising/falling respectively. If A-phase input is antecedent to B-phase input, increasing operation starts, and if B-phase input is antecedent to A-phase input, decreasing operation starts.

▪ Operation example



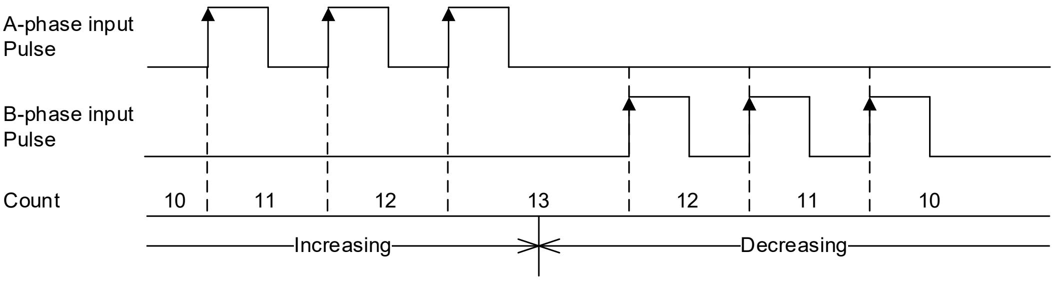
3) CW(Clockwise) / CCW(Counter Clockwise) operation mode

A-phase input pulse counts at rising , or B-phase input pulse counts at rising.

Increasing operation executed when B-phase input pulse is Low with A-phase input pulse at rising, and Decreasing operation executed when A-phase input pulse is Low with B-phase input pulse at rising.

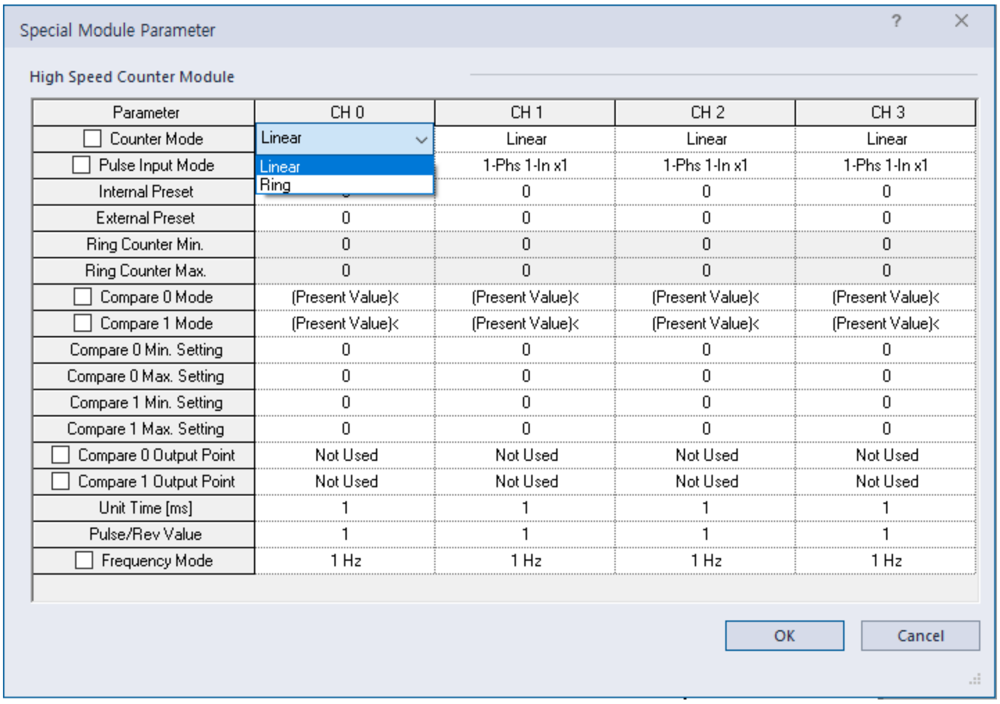
| Increasing/Decreasing classification | A-phase input pulse High | A-phase input pulse Low |
|---|---|---|
| B-phase input pulse High | - | decreasing count |
| B-phase input pulse Low | Increasing count | - |

▪ Operation example



### (2) Counter type

2 types of count (Linear counter, Ring counter) can be selected for the applicable use.



Special Module Parameter

High Speed Counter Module

| Parameter | CH 0 | CH 1 | CH 2 | CH 3 |
|---|---|---|---|---|
| ☐ Counter Mode | Linear<br>Linear<br>Ring | Linear | Linear | Linear |
| ☐ Pulse Input Mode | | 1-Phs 1-In x1 | 1-Phs 1-In x1 | 1-Phs 1-In x1 |
| Internal Preset | | 0 | 0 | 0 |
| External Preset | 0 | 0 | 0 | 0 |
| Ring Counter Min. | 0 | 0 | 0 | 0 |
| Ring Counter Max. | 0 | 0 | 0 | 0 |
| ☐ Compare 0 Mode | (Present Value)< | (Present Value)< | (Present Value)< | (Present Value)< |
| ☐ Compare 1 Mode | (Present Value)< | (Present Value)< | (Present Value)< | (Present Value)< |
| Compare 0 Min. Setting | 0 | 0 | 0 | 0 |
| Compare 0 Max. Setting | 0 | 0 | 0 | 0 |
| Compare 1 Min. Setting | 0 | 0 | 0 | 0 |
| Compare 1 Max. Setting | 0 | 0 | 0 | 0 |
| ☐ Compare 0 Output Point | Not Used | Not Used | Not Used | Not Used |
| ☐ Compare 1 Output Point | Not Used | Not Used | Not Used | Not Used |
| Unit Time [ms] | 1 | 1 | 1 | 1 |
| Pulse/Rev Value | 1 | 1 | 1 | 1 |
| ☐ Frequency Mode | 1 Hz | 1 Hz | 1 Hz | 1 Hz |

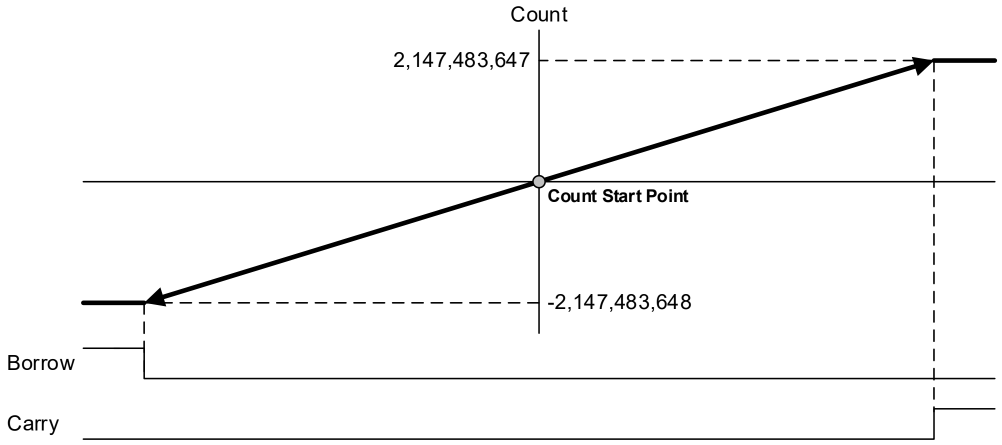
▪ Counter mode is saved at the following special K area.

| Mode | Area per each channel (word) | | | | Reference[*1] |
|---|---|---|---|---|---|
| | Ch.0 | Ch.1 | Ch.2 | Ch.3 | |
| Counter mode | K300 | K330 | K360 | K390 | 0 : linear<br>1 : ring |

*1) If counter mode is set as value other than 0, 1, error code '20' will occur.

(a) Linear counter

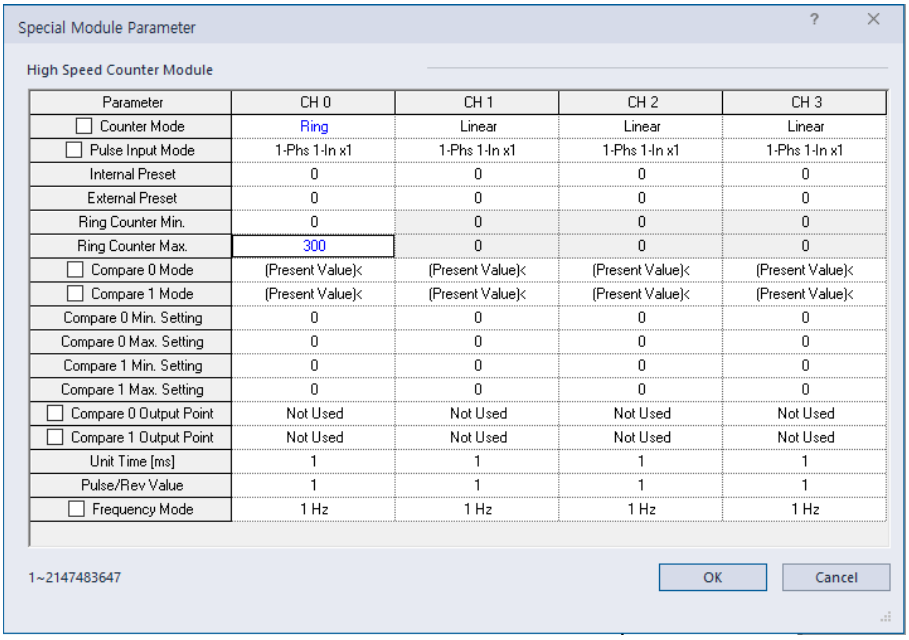
- ■ Linear Count range: -2,147,483,648 ~ 2,147,483,647
- ■ If count value reaches the maximum value while increased, Carry will occur, and if count value reaches the minimum value while decreased, Borrow will occur.
- ■ If Carry occurs, count stops and increasing is not available but decreasing is available.
- ■ If Borrow occurs, count stops and decreasing is not available but increasing is available.



(b) Ring count

■ Ring Count range: user-defined minimum value ~ user-defined maximum value

■ The preset value and the comparator value should be set within the range of the ring counter maximum / minimum value.



High Speed Counter Module

| Parameter | CH 0 | CH 1 | CH 2 | CH 3 |
|---|---|---|---|---|
| ☐ Counter Mode | Ring | Linear | Linear | Linear |
| ☐ Pulse Input Mode | 1-Phs 1-In x1 | 1-Phs 1-In x1 | 1-Phs 1-In x1 | 1-Phs 1-In x1 |
| Internal Preset | 0 | 0 | 0 | 0 |
| External Preset | 0 | 0 | 0 | 0 |
| Ring Counter Min. | 0 | 0 | 0 | 0 |
| Ring Counter Max. | 300 | 0 | 0 | 0 |
| ☐ Compare 0 Mode | (Present Value)< | (Present Value)< | (Present Value)< | (Present Value)< |
| ☐ Compare 1 Mode | (Present Value)< | (Present Value)< | (Present Value)< | (Present Value)< |
| Compare 0 Min. Setting | 0 | 0 | 0 | 0 |
| Compare 0 Max. Setting | 0 | 0 | 0 | 0 |
| Compare 1 Min. Setting | 0 | 0 | 0 | 0 |
| Compare 1 Max. Setting | 0 | 0 | 0 | 0 |
| ☐ Compare 0 Output Point | Not Used | Not Used | Not Used | Not Used |
| ☐ Compare 1 Output Point | Not Used | Not Used | Not Used | Not Used |
| Unit Time [ms] | 1 | 1 | 1 | 1 |
| Pulse/Rev Value | 1 | 1 | 1 | 1 |
| ☐ Frequency Mode | 1 Hz | 1 Hz | 1 Hz | 1 Hz |

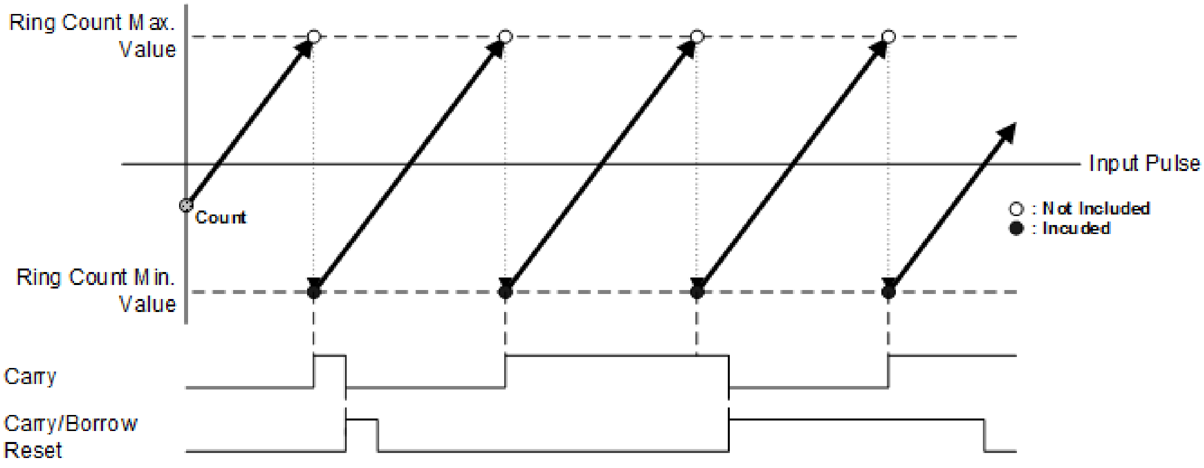
1~2147483647

• Ring counter value is saved at the following special K area.

| **type** | **Area per each channel (Double word)** | | | | **Reference** |
|---|---|---|---|---|---|
| | **Ch.0** | **Ch.1** | **Ch.2** | **Ch.3** | |
| Ring counter Min. value | K308 | K338 | K368 | K398 | |
| Ring counter Max. value | K310 | K340 | K370 | K400 | |

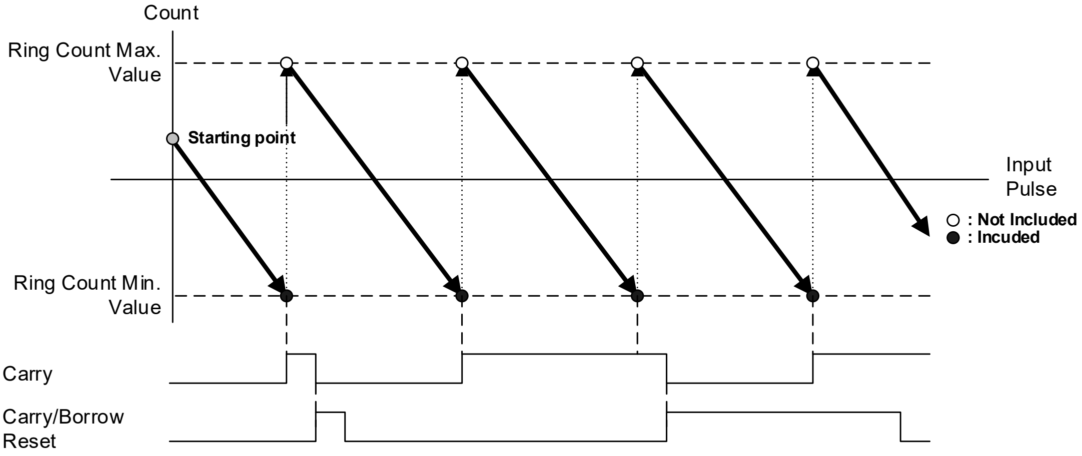
1) During increasing count

■ Even if count value exceeds user-defined maximum value during increasing count, only carry occurs and count does not stop differently to Linear Count.



2) During decreasing count

■ Even if count value exceeds user-defined minimum value during decreasing count, Borrow only occurs and count does not stop differently to Linear Count.

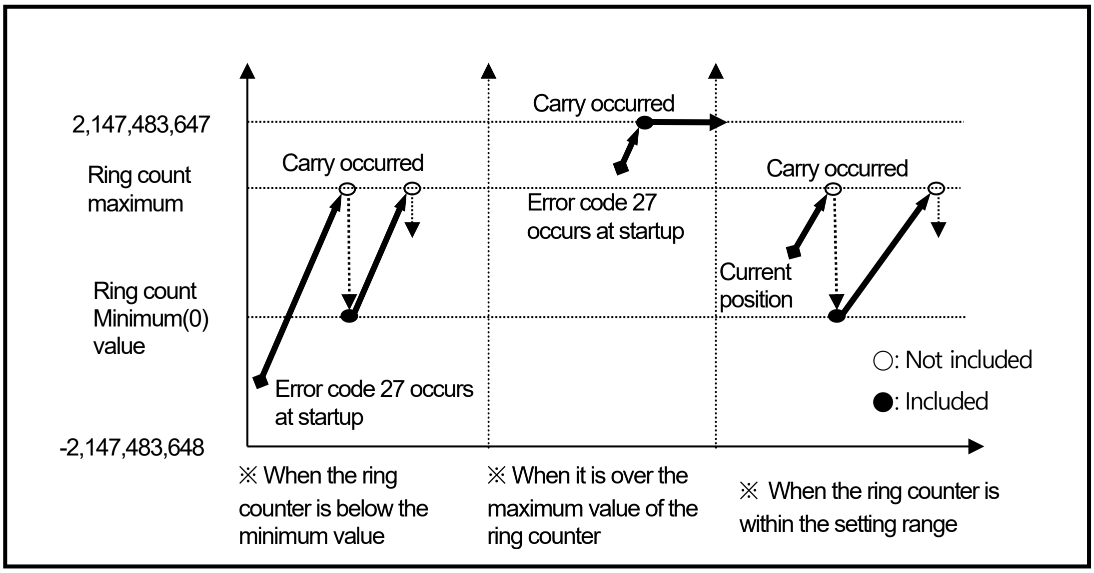


3) Operation when setting the ring count according to the current count value (at the count of addition)

■ When setting the ring count, the current count value is below the minimum value of the ring counter.
- Opens an error (Code No. 27), operates as a linear counter, and operates as a ring count when the current count value falls within the range of the ring count (error codes are not cleared).

■ When setting the ring count, the current count value is above the maximum value of the ring counter.
- Displays an error (Code No. 27), operates as a linear counter, and stops counting when the current count value reaches the maximum count value (error code is not cleared).

■ When setting the ring count, the current count value is within the user setting range
- It starts to increase from the current count value, increases to the maximum value set by the user, then becomes the minimum value set by the user and continues to count after carrying a carry.
- As shown in the figure below, the maximum value is not displayed, and the count continues after displaying the minimum value.



4) Operation when setting the ring count according to the current count value (when subtracting count)

■ When setting the ring count, the current count value is below the minimum value of the ring counter.

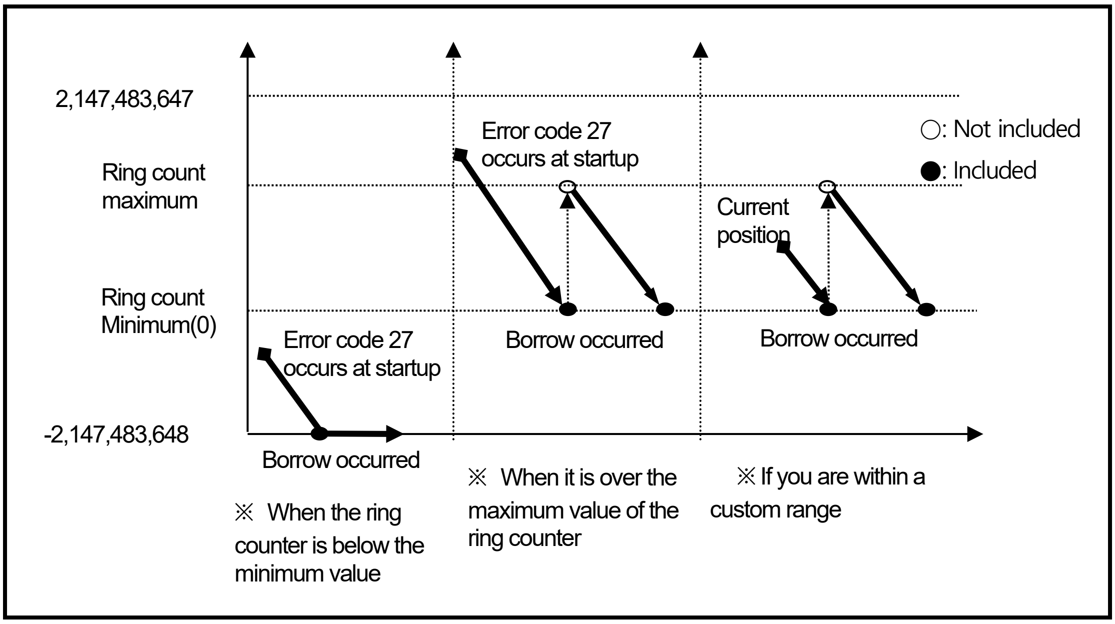
- When an error (Code No. 27) is displayed, it operates as a linear counter, and if the current count value falls within the range of the ring count, it operates as a ring count. (The error code is not cleared)

■ When setting the ring count, the current count value is above the maximum value of the link counter.

- An error (Code No. 27) is displayed, and it operates as a linear counter, but stops counting when the current count value reaches the count minimum value. (The error code is not cleared)

■ When setting the ring count, the current count value is within the user setting range

- It starts to decrease from the current count value, decreases to the minimum value set by the user, and becomes the maximum value set by the user, and then continues counting after Borrow occurs.



**Remark**

(1) When using a ring count, be sure to place the count value within the range using a preset or the like.

(3) Compared output

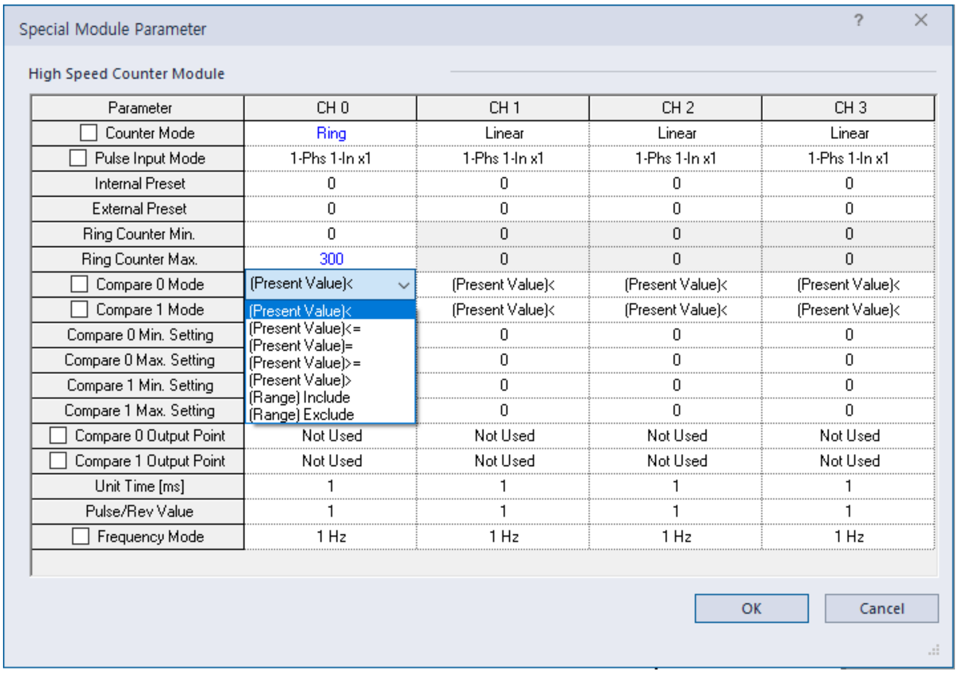
(a) High Speed counter module has a compared output function used to compare present count value with compared value in size to output as compared.

(b) Available compared outputs are 2 for 1 channel, which can be used separately.

(c) Compared output conditions are 7 associated with >, =, < .

(d) Parameter setting

■ Compared output mode setting



Special Module Parameter

High Speed Counter Module

| Parameter | CH 0 | CH 1 | CH 2 | CH 3 |
|---|---|---|---|---|
| ☐ Counter Mode | Ring | Linear | Linear | Linear |
| ☐ Pulse Input Mode | 1-Phs 1-In x1 | 1-Phs 1-In x1 | 1-Phs 1-In x1 | 1-Phs 1-In x1 |
| Internal Preset | 0 | 0 | 0 | 0 |
| External Preset | 0 | 0 | 0 | 0 |
| Ring Counter Min. | 0 | 0 | 0 | 0 |
| Ring Counter Max. | 300 | 0 | 0 | 0 |
| ☐ Compare 0 Mode | (Present Value)< | (Present Value)< | (Present Value)< | (Present Value)< |
| ☐ Compare 1 Mode | (Present Value)<<br>(Present Value)<=<br>(Present Value)=<br>(Present Value)>=<br>(Present Value)><br>(Range) Include<br>(Range) Exclude | (Present Value)< | (Present Value)< | (Present Value)< |
| Compare 0 Min. Setting | | 0 | 0 | 0 |
| Compare 0 Max. Setting | | 0 | 0 | 0 |
| Compare 1 Min. Setting | | 0 | 0 | 0 |
| Compare 1 Max. Setting | | 0 | 0 | 0 |
| ☐ Compare 0 Output Point | Not Used | Not Used | Not Used | Not Used |
| ☐ Compare 1 Output Point | Not Used | Not Used | Not Used | Not Used |
| Unit Time [ms] | 1 | 1 | 1 | 1 |
| Pulse/Rev Value | 1 | 1 | 1 | 1 |
| ☐ Frequency Mode | 1 Hz | 1 Hz | 1 Hz | 1 Hz |

■ Upper setting value is saved in special K area.

| Compared output condition | Memory address (word) | | Value*1) |
|---|---|---|---|
| Present Value < Compared Value | Channel 0 : K302<br>Channel 1 : K332<br>Channel 2 : K362<br>Channel 3 : K392 | Channel 0 : K303<br>Channel 1 : K333<br>Channel 2 : K363<br>Channel 3 : K393 | Set to "0" |
| Present Value ≤ Compared Value | | | Set to "1" |
| Present Value = Compared Value | | | Set to "2" |
| Present Value ≥ Compared Value | | | Set to "3" |
| Present Value > Compared Value | | | Set to "4" |
| Compared value 1 ≤ Count value ≤ Compared value 2 | | | Set to "5" |
| Count value ≤ Compared value 1,<br>Count value ≥ Compared value 2 | | | Set to "6" |

*1) If compared output value not set to 0~6 using counter, error code '23' will be occurred.

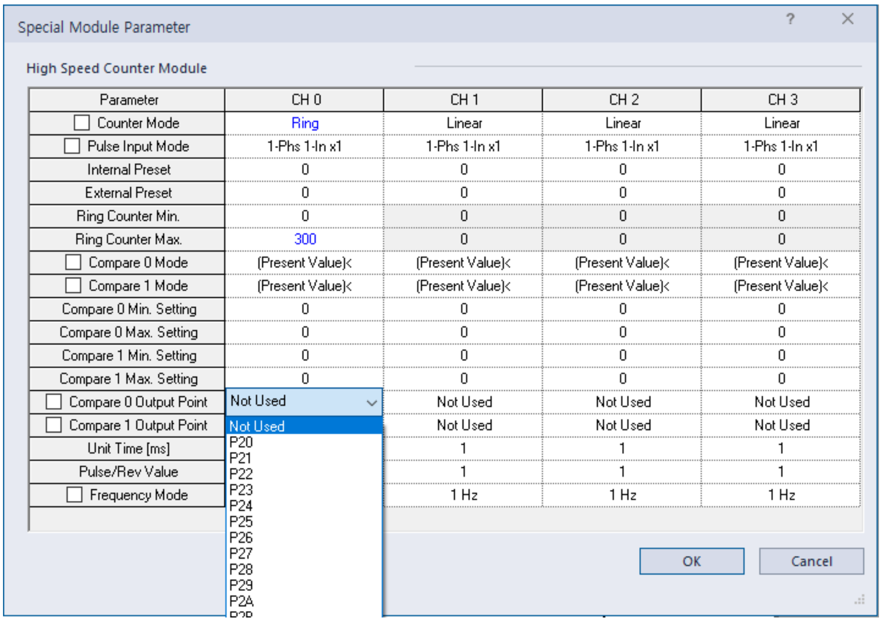
■ In order to make actual comparison enabled after compared output condition set, the compared enable signal is to be On.

| Classification | Area per channel | | | | Operation |
|---|---|---|---|---|---|
| | Ch. 0 | Ch. 1 | Ch. 2 | Ch. 3 | |
| Count enable signal | K2600 | K2700 | K2800 | K2900 | 0: N/A, 1: enable |
| Compared enable0 signal | K2604 | K2704 | K2804 | K2904 | 0: forbidden, 1: enable |
| Compared enable1 signal | K2607 | K2707 | K2807 | K2907 | 0: forbidden, 1: enable |

- In order to make external output, the compared equivalent output signal (P20~P2F) must be set. If Compared output contact is Off, Compared coincidence output signal (internal device) is only output.

| Classification | Area per channel | | | | Operation |
|---|---|---|---|---|---|
| | Ch. 0 | Ch. 1 | Ch. 2 | Ch. 3 | |
| Comparator output signal0 | K2612 | K2712 | K2812 | K2912 | 0: Compared output not equivalent<br>1: Compared output equivalent |
| Comparator output signal1 | K2613 | K2713 | K2813 | K2913 | 0: Compared output not equivalent<br>1: Compared output equivalent |

- Comp output point (P20 ~ P2F) setting



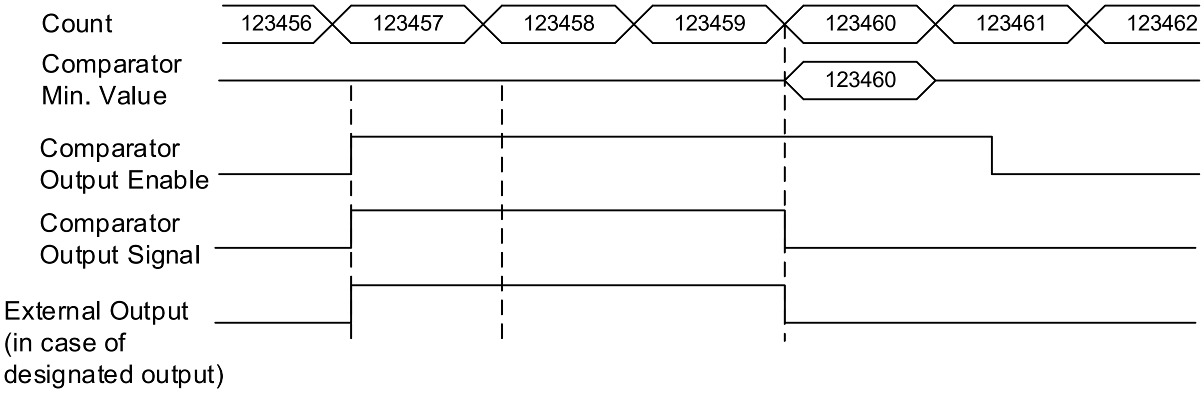
High Speed Counter Module

| Parameter | CH 0 | CH 1 | CH 2 | CH 3 |
|---|---|---|---|---|
| ☐ Counter Mode | Ring | Linear | Linear | Linear |
| ☐ Pulse Input Mode | 1-Phs 1-In x1 | 1-Phs 1-In x1 | 1-Phs 1-In x1 | 1-Phs 1-In x1 |
| Internal Preset | 0 | 0 | 0 | 0 |
| External Preset | 0 | 0 | 0 | 0 |
| Ring Counter Min. | 0 | 0 | 0 | 0 |
| Ring Counter Max. | 300 | 0 | 0 | 0 |
| ☐ Compare 0 Mode | (Present Value)< | (Present Value)< | (Present Value)< | (Present Value)< |
| ☐ Compare 1 Mode | (Present Value)< | (Present Value)< | (Present Value)< | (Present Value)< |
| Compare 0 Min. Setting | 0 | 0 | 0 | 0 |
| Compare 0 Max. Setting | 0 | 0 | 0 | 0 |
| Compare 1 Min. Setting | 0 | 0 | 0 | 0 |
| Compare 1 Max. Setting | 0 | 0 | 0 | 0 |
| ☐ Compare 0 Output Point | Not Used | Not Used | Not Used | Not Used |
| ☐ Compare 1 Output Point | | Not Used | Not Used | Not Used |
| Unit Time [ms] | | 1 | 1 | 1 |
| Pulse/Rev Value | | 1 | 1 | 1 |
| ☐ Frequency Mode | | 1 Hz | 1 Hz | 1 Hz |

(e) Detailed description for compared output (Based On Comp0 output mode)

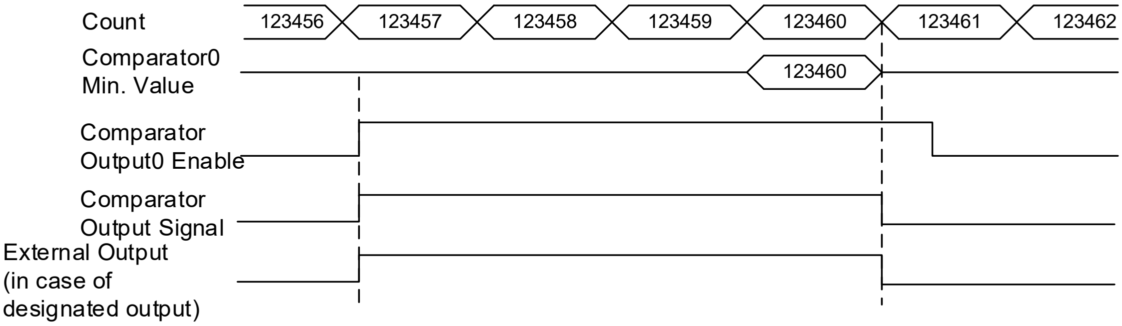
1) Mode 0 (Present value < Compared value)

■ If counted present value is less than compared value, output is sent out, and if present value increases to be equal to or greater than compared value, output is not sent out.



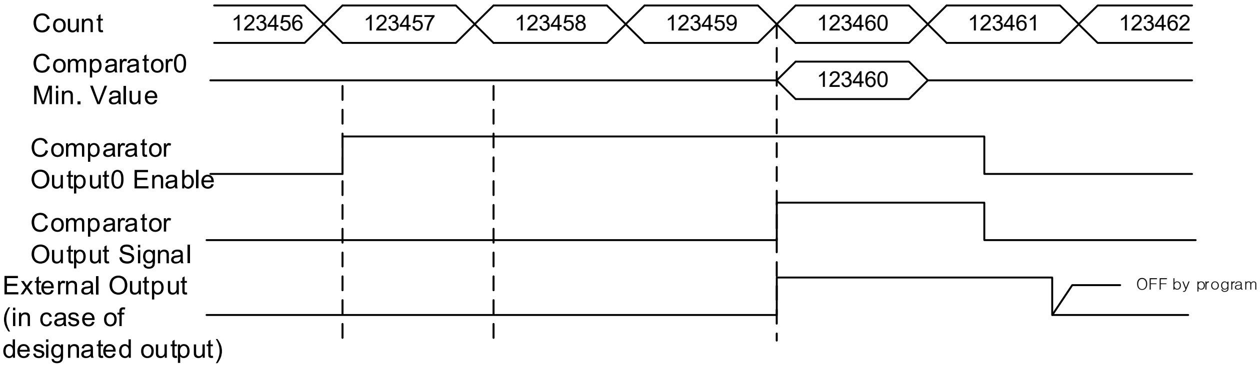
2) Mode1 (Count value ≤ Compared value)

■ If present count value is less than or equal to compared value, output is sent out, and if count value increases to be greater than compared value, output is not sent out.



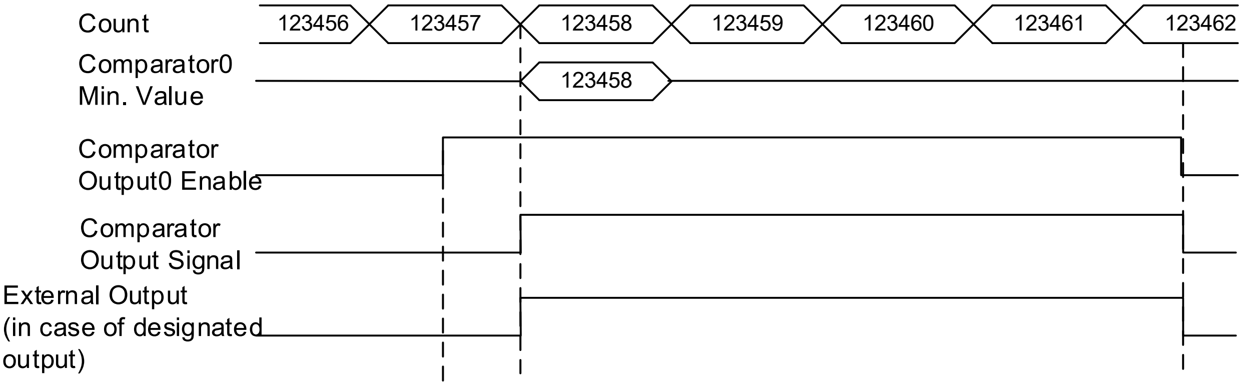
3) Mode 2 (Count value = Compared value)

- ■ If present count value is equal to compared value, output is sent out. In order to turn the output Off, Compared output Enable and Compared output signal is to be On.



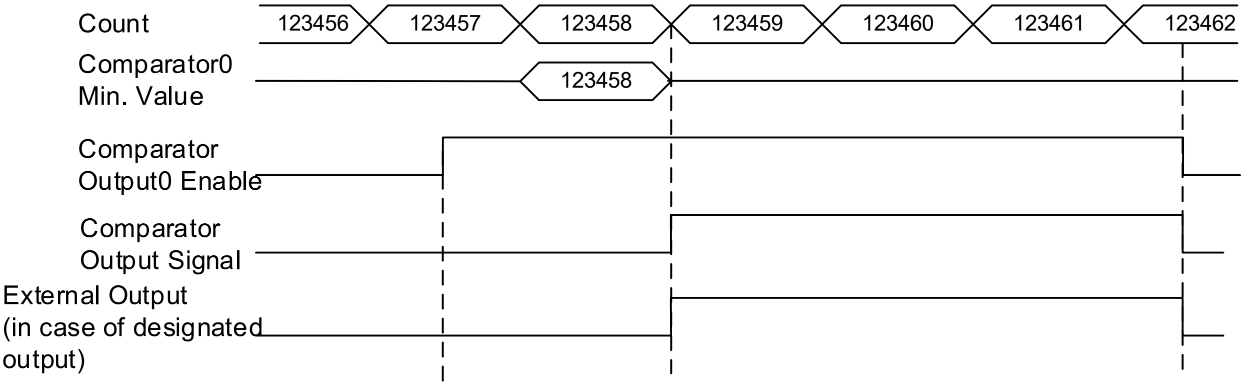
4) Mode 3 (Count value ≥ Compared value)

- ■ If present count value is greater than or equal to compared value, output is sent out, and if count value decreases to be less than compared value, output is not sent out.



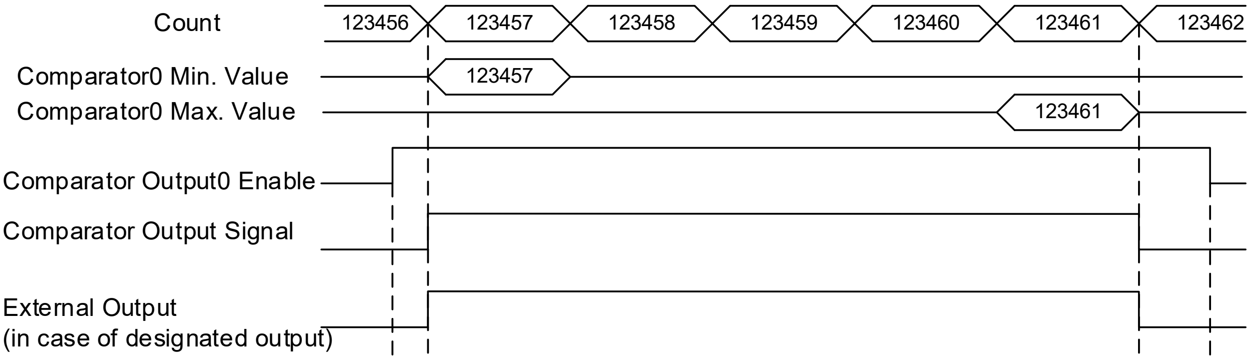
5) Mode 4 (Count value > Compared value)

■ If present count value is greater than compared value, output is sent out, and if count value decreases to be less than or equal to compared value, output is not sent out.



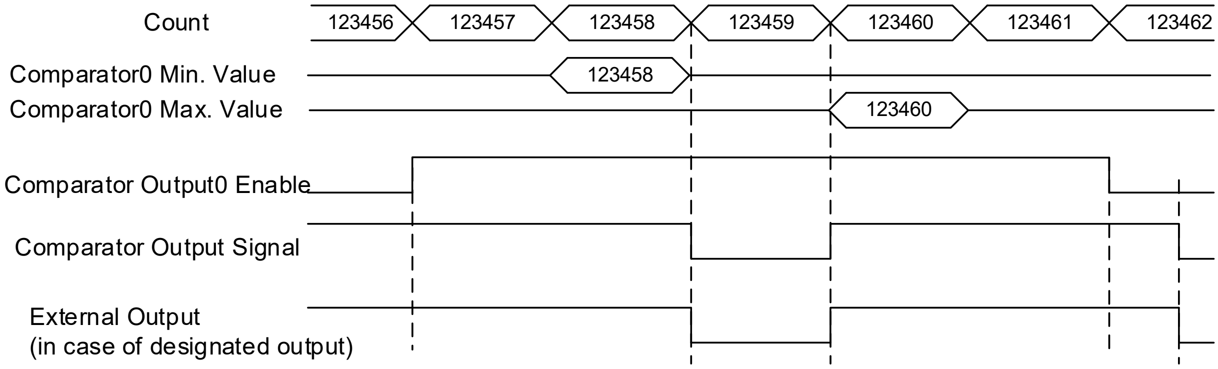
6) Mode 5
(Compared output Min. set value ≤ Count value ≤ Compared output Max. set value)

■ If present count value is greater than or equal to compared output Min. value and less than or equal to compared output Max. set value, output is sent out, and if count value increases/decreases to exceed compared value's range, output is not sent out.



7) Mode 6 (Count value ≤ Compared output Min. value, Count value ≥ Compared output Max. value)

- If present count value is less than or equal to compared output Min. value and greater than or equal to compared output Max. value, output is sent out, and if count value increases/decreases to exceed compared value's range, output is not sent out.



## (4) Carry signal

(a) Carry signal occurs

1) When count range maximum value of 2,147,483,647 is reached during Linear Count.

2) When user-defined maximum value of Ring Count changed to the minimum value during Ring Count.

(b) Count when Carry Signal occurs

1) Count stops if Carry occurs during Linear Count.

2) Count does not stop even if Carry occurs during Ring Count.

(c) Carry reset

1) The Carry generated can be cancelled by Carry/Borrow reset signal On.

| Classification | Device area per channel (BIT) | | | |
|---|---|---|---|---|
| | Channel 0 | Channel 1 | Channel 2 | Channel 3 |
| Carry signal | K2610 | K2710 | K2810 | K2910 |

**Notes**

The XGB modular high-end basic unit performs the comparison output function by checking the current count value every 500 μs.
Therefore, a delay of up to 500 μs may occur for the detection of the comparison condition.

## (5) Borrow signal

(a) Borrow signal occurs

1) When count range minimum value of -2,147,483,648 is reached during Linear Count.

2) When user-defined minimum value of Ring Count changed to the maximum value during Ring Count.

(b) Count when Borrow signal occurs

1) Count stops if Borrow occurs during Linear Count.

2) Count does not stop even if Borrow occurs during Ring Count.

(c) Borrow reset

1) The Borrow generated can be cancelled by Carry/Borrow reset signal On..

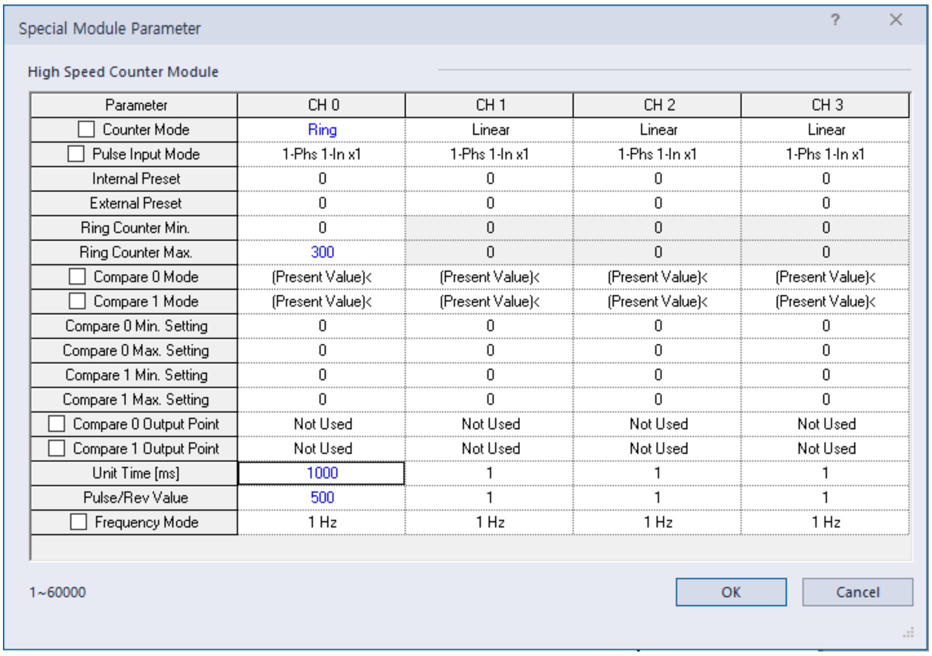
| Classification | Device area per channel (BIT) | | | |
|---|---|---|---|---|
| | Channel 0 | Channel 1 | Channel 2 | Channel 3 |
| Borrow signal | K2611 | K2711 | K2811 | K2911 |

(6) Revolution/Unit time

While auxiliary mode enable signal is On, it counts the number of input pulses for a specified time.

(a) Unit time setting

1) Input unit time and pulse number per 1 revolution



Special Module Parameter

High Speed Counter Module

| Parameter | CH 0 | CH 1 | CH 2 | CH 3 |
|---|---|---|---|---|
| ☐ Counter Mode | Ring | Linear | Linear | Linear |
| ☐ Pulse Input Mode | 1-Phs 1-In x1 | 1-Phs 1-In x1 | 1-Phs 1-In x1 | 1-Phs 1-In x1 |
| Internal Preset | 0 | 0 | 0 | 0 |
| External Preset | 0 | 0 | 0 | 0 |
| Ring Counter Min. | 0 | 0 | 0 | 0 |
| Ring Counter Max. | 300 | 0 | 0 | 0 |
| ☐ Compare 0 Mode | (Present Value)< | (Present Value)< | (Present Value)< | (Present Value)< |
| ☐ Compare 1 Mode | (Present Value)< | (Present Value)< | (Present Value)< | (Present Value)< |
| Compare 0 Min. Setting | 0 | 0 | 0 | 0 |
| Compare 0 Max. Setting | 0 | 0 | 0 | 0 |
| Compare 1 Min. Setting | 0 | 0 | 0 | 0 |
| Compare 1 Max. Setting | 0 | 0 | 0 | 0 |
| ☐ Compare 0 Output Point | Not Used | Not Used | Not Used | Not Used |
| ☐ Compare 1 Output Point | Not Used | Not Used | Not Used | Not Used |
| Unit Time [ms] | 1000 | 1 | 1 | 1 |
| Pulse/Rev Value | 500 | 1 | 1 | 1 |
| ☐ Frequency Mode | 1 Hz | 1 Hz | 1 Hz | 1 Hz |

1~60000

Setting value is saved at the following special K are and user can designate it directly.

| Classification | Device area per channels (WORD) | | | | Setting Range |
|---|---|---|---|---|---|
| | Channel 0 | Channel 1 | Channel 2 | Channel 3 | |
| Unit time | K322 | K352 | K382 | K412 | 1~60000ms*1) |
| Pulse no. per revolution | K323 | K353 | K383 | K413 | 1~60000*2) |

*1) If revolution per unit time is enabled and unit time value is other than 1~60000ms, error code '34' occurs.

*2) If revolution per unit time is enabled and pulse number/revolution is other than 1~60000, error code '35' occurs.

2) To use count function of revolution per unit time, enable signal must be set to '1'.

| Classification | Device area per channels (BIT) | | | | Operation |
|---|---|---|---|---|---|
| | Channel 0 | Channel 1 | Channel 2 | Channel 3 | |
| Revolution/unit time command | K2605 | K2705 | K2805 | K2905 | 0 : disabled<br>1 : enabled |

3) Revolution Per Unit value is saved to K area below.

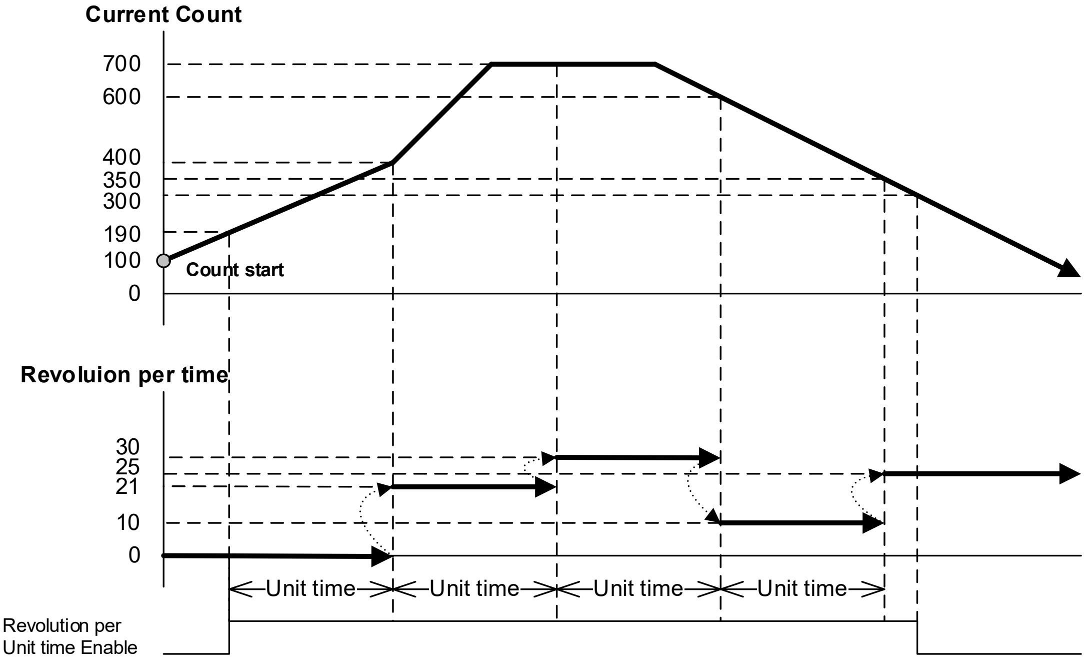
| Classification | Device area per channels (DWORD) | | | |
|---|---|---|---|---|
| | Channel 0 | Channel 1 | Channel 2 | Channel 3 |
| Revolution Per Unit | K264 | K274 | K284 | K294 |

(b) Count function of Revolution per Unit time is used to count the number of pulses for a specified time while Enable signal is On.

$$Input\ pulse\left(\frac{\text{pls}}{\text{sec}}\right) \times \frac{Unit\ time(\text{ms}) \times \frac{1}{1000}}{Pulse/REV(\text{pls})} = \text{pulse per 1 revolution}$$

(c) If you enter Pulse/Rev and set the Unit time setting to 1 second (1000ms), the number of rotations per second is displayed. To mark the number of revolutions per minute (RPM), you can set the unit time to 1 minute (60,000 ms).

(d) The example that number of Pulse/Rev set to '10'



(7) Count latch

The latch counter function latches the current count value when the count lacth signal is On and the power is turned off.

■ Setting :To latch the current counter value, the Count Latch function must be set to 'Enabled'.

| Classification | Device area per channel(BIT) | | | | Operation |
|---|---|---|---|---|---|
| | Channel 0 | Channel 1 | Channel 2 | Channel 3 | |
| Count latch command | K2606 | K2706 | K2806 | K2906 | 0 : disabled<br>1 : enabled |

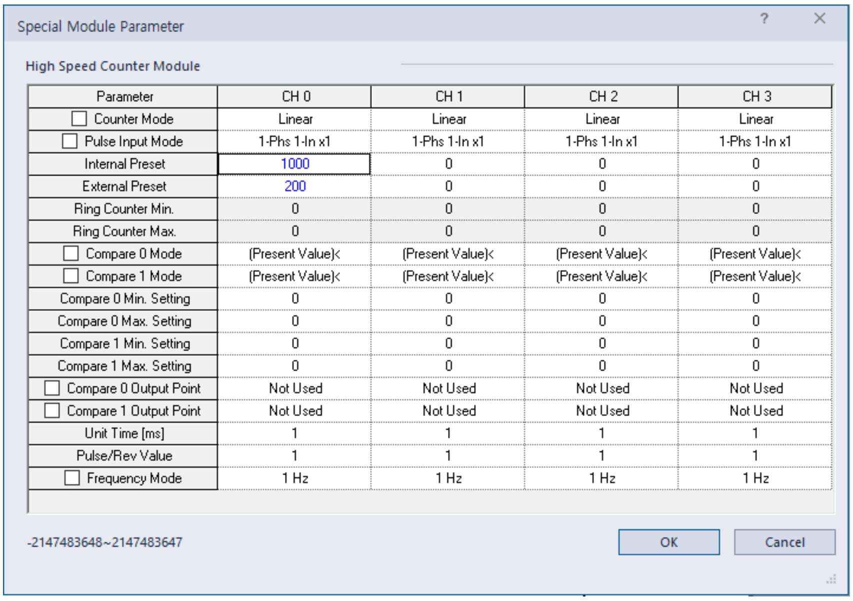
■ The latch counter function operates when the Count Latch Signal is On. In other words, the counter value is not cleared when the power is turned Off and then On, or during a mode change; it continues counting from the previous value.

■ When using the latch counter, to clear the current value, the internal or external preset function must be used.

## (8) Preset function

It changes the current value into preset value.

There are two types of preset function, internal preset and external preset. External preset is fixed as input contact point (P0004~P0007).



Special Module Parameter

High Speed Counter Module

| Parameter | CH 0 | CH 1 | CH 2 | CH 3 |
|---|---|---|---|---|
| ☐ Counter Mode | Linear | Linear | Linear | Linear |
| ☐ Pulse Input Mode | 1-Phs 1-In x1 | 1-Phs 1-In x1 | 1-Phs 1-In x1 | 1-Phs 1-In x1 |
| Internal Preset | 1000 | 0 | 0 | 0 |
| External Preset | 200 | 0 | 0 | 0 |
| Ring Counter Min. | 0 | 0 | 0 | 0 |
| Ring Counter Max. | 0 | 0 | 0 | 0 |
| ☐ Compare 0 Mode | (Present Value)< | (Present Value)< | (Present Value)< | (Present Value)< |
| ☐ Compare 1 Mode | (Present Value)< | (Present Value)< | (Present Value)< | (Present Value)< |
| Compare 0 Min. Setting | 0 | 0 | 0 | 0 |
| Compare 0 Max. Setting | 0 | 0 | 0 | 0 |
| Compare 1 Min. Setting | 0 | 0 | 0 | 0 |
| Compare 1 Max. Setting | 0 | 0 | 0 | 0 |
| ☐ Compare 0 Output Point | Not Used | Not Used | Not Used | Not Used |
| ☐ Compare 1 Output Point | Not Used | Not Used | Not Used | Not Used |
| Unit Time [ms] | 1 | 1 | 1 | 1 |
| Pulse/Rev Value | 1 | 1 | 1 | 1 |
| ☐ Frequency Mode | 1 Hz | 1 Hz | 1 Hz | 1 Hz |

-2147483648~2147483647

- Preset setting value is saved at the following special K area.

| Type | Area per each channel (DWORD) | | | | Ref. |
|---|---|---|---|---|---|
| | Ch.0 | Ch.1 | Ch.2 | Ch.3 | |
| Internal preset | K304 | K334 | K364 | K394 | - |
| External preset | K306 | K336 | K366 | K396 | - |

- Preset command is specified through the following special K area, external preset is used by executing the designated input contact point after allowance bit is on.

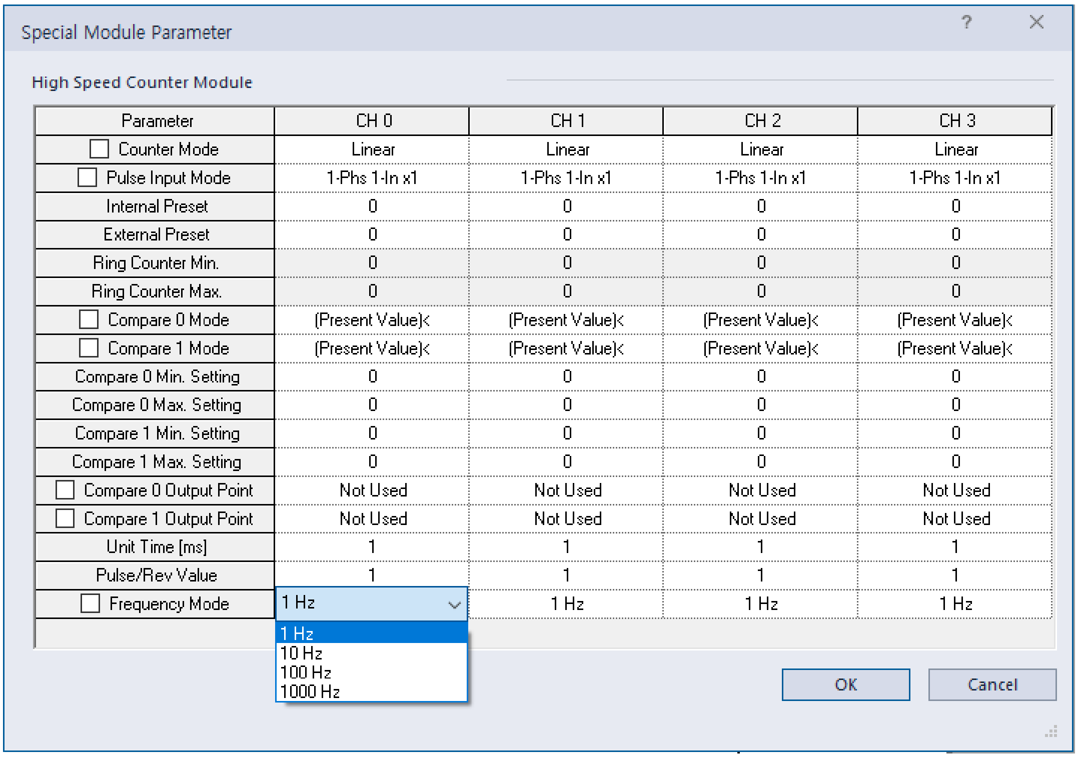
| Type | Area per each channel (BIT) | | | | Ref. |
|---|---|---|---|---|---|
| | Ch.0 | Ch.1 | Ch.2 | Ch.3 | |
| Internal preset command | K2601 | K2701 | K2801 | K2901 | - |
| External preset allowance | K2602 | K2702 | K2802 | K2902 | - |
| External preset command | P004 | P005 | P006 | P007 | - |

### (9) Frequency measure

Display and measure the frequency at every measurement period you set during Frequecny enable flag is on.

(a) Setting method

1) Set Freq. Measure



High Speed Counter Module

| Parameter | CH 0 | CH 1 | CH 2 | CH 3 |
|---|---|---|---|---|
| ☐ Counter Mode | Linear | Linear | Linear | Linear |
| ☐ Pulse Input Mode | 1-Phs 1-In x1 | 1-Phs 1-In x1 | 1-Phs 1-In x1 | 1-Phs 1-In x1 |
| Internal Preset | 0 | 0 | 0 | 0 |
| External Preset | 0 | 0 | 0 | 0 |
| Ring Counter Min. | 0 | 0 | 0 | 0 |
| Ring Counter Max. | 0 | 0 | 0 | 0 |
| ☐ Compare 0 Mode | (Present Value)< | (Present Value)< | (Present Value)< | (Present Value)< |
| ☐ Compare 1 Mode | (Present Value)< | (Present Value)< | (Present Value)< | (Present Value)< |
| Compare 0 Min. Setting | 0 | 0 | 0 | 0 |
| Compare 0 Max. Setting | 0 | 0 | 0 | 0 |
| Compare 1 Min. Setting | 0 | 0 | 0 | 0 |
| Compare 1 Max. Setting | 0 | 0 | 0 | 0 |
| ☐ Compare 0 Output Point | Not Used | Not Used | Not Used | Not Used |
| ☐ Compare 1 Output Point | Not Used | Not Used | Not Used | Not Used |
| Unit Time [ms] | 1 | 1 | 1 | 1 |
| Pulse/Rev Value | 1 | 1 | 1 | 1 |
| ☐ Frequency Mode | 1 Hz | 1 Hz | 1 Hz | 1 Hz |

| Type | Area per each channel (WORD) | | | | Freq. Range |
|---|---|---|---|---|---|
| | Ch.0 | Ch.1 | Ch.2 | Ch.3 | |
| Freq. Mode | K324 | K354 | K384 | K414 | 1, 10, 100, 1000 Hz |

2) To use frequency measurement, set Freq. Enable bit to On

| Type | Area per each channel (BIT) | | | | Operation |
|---|---|---|---|---|---|
| | Ch.0 | Ch.1 | Ch.2 | Ch.3 | |
| Freq. Enable | K2608 | K2708 | K2808 | K2908 | 0: Disable<br>1: Enable |

3) Frequency measurement values are stored in devices below.

| Type | Area per each channel (DWORD) | | | |
|---|---|---|---|---|
| | Ch.0 | Ch.1 | Ch.2 | Ch.3 |
| Freq. Measurement | K268 | K278 | K288 | K298 |

4) The frequcncy unit settings are as follows, and the frequency update cycle changes depending on the unit

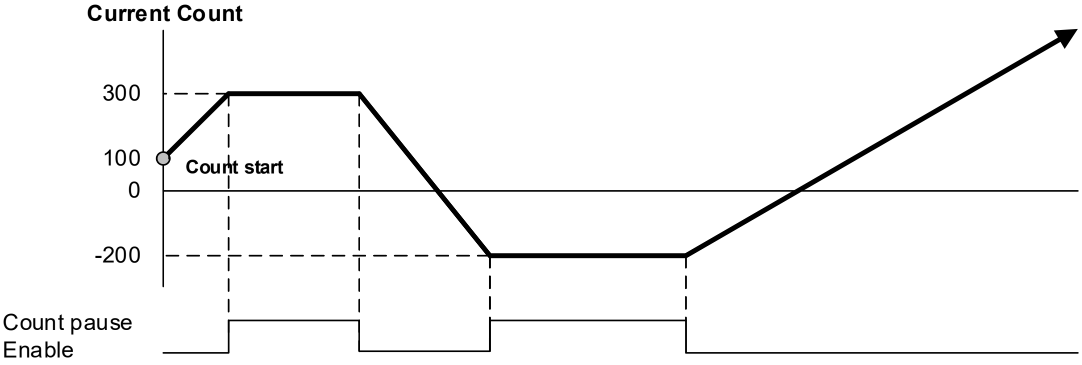
| Set number | Hz | Freq. update period[ms] |
|---|---|---|
| 0 | 1 | 1000 |
| 1 | 10 | 100 |
| 2 | 100 | 10 |
| 3 | 1000 | 1 |

### (10) Count pause

Count will not operate during Count pause flag is on.

To use Count pause, set below device as “On”

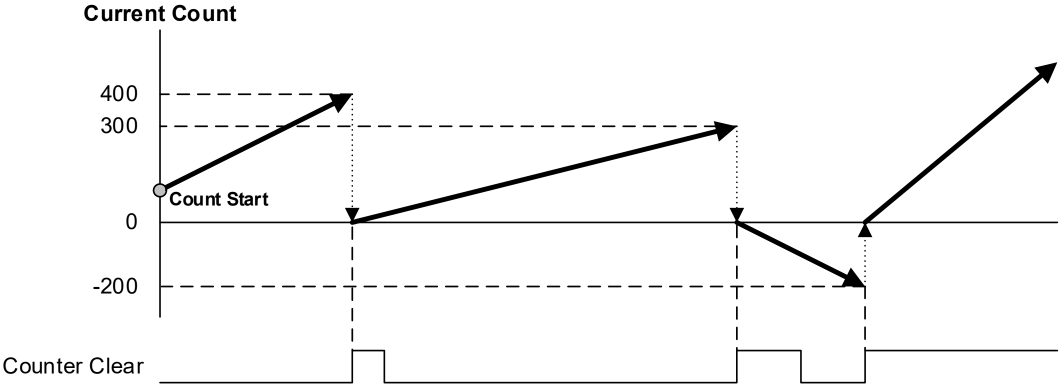
| Type | Area per each channel (BIT) | | | | Operation |
|---|---|---|---|---|---|
| | Ch.0 | Ch.1 | Ch.2 | Ch.3 | |
| Count pause | K260A | K270A | K280A | K290A | 0: Disable<br>1: Enable |



### (11) Counter clear

The current count is changed to 0 the moment the counter clear enable flag is turned on. The counter clear function operates at the rising edge of the flag enable command.

| Type | Area per each channel (BIT) | | | | Operation |
|---|---|---|---|---|---|
| | Ch.0 | Ch.1 | Ch.2 | Ch.3 | |
| Counter Clear | K2609 | K2709 | K2809 | K2909 | 0: Disable<br>1: Enable |



# 4.2 Installation and Wiring

## 4.2.1 Precaution for wiring

Pay attention to the counteractions against wiring noise especially for High-speed pulse input.

(1) Alternating current and input/output signals from the high speed counter modules are used to generate a surge or decrease on the alternating current

(2) The wires should be chosen for ambient temperature and acceptable current.

(3) Too close to the equipment or materials that occur in the case of a wire, or if the wires have prolonged contact with the oil etc. Causes for short circuit to short circuit to damage or malfunction.

(4) Before applying an external contact signal to the terminal, the polarity must be checked.

(5) If wiring is wired with a high-pressure wire or a power line, it may cause induction disturbances to cause malfunction or malfunction.

(6) Earthing of pipes requires grounding of piping.

(7) If you believe that there is no source source in the wiring between the high speed counter and the access device, please connect the wiring input via the twisted pair and the shielded cable wires to the high speed counter.

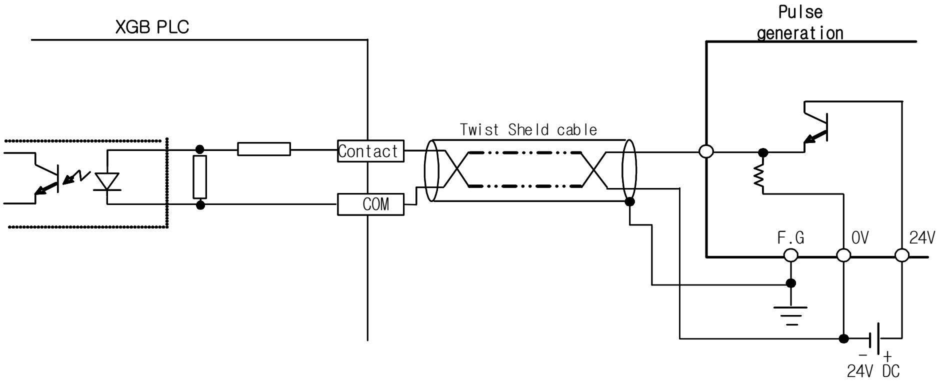
(8) For Phase 1 input, connect only A-Phase.

(9) Route the maximum output distance of the pulse generator and allow it to be as short as possible.

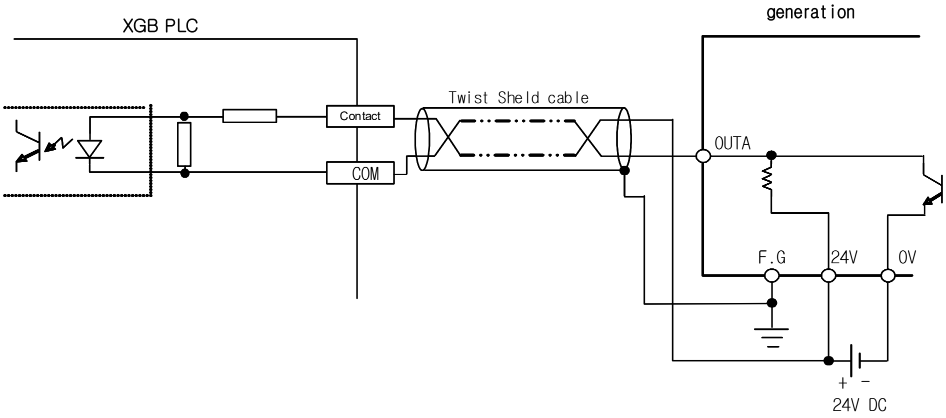
(10) For grounding, perform type 3 grounding.

## 4.2.2 Example of wiring

(1) In case of pulse generator (encoder) is voltage output type



(2) In case of pulse generator is open collector type



## 4.3 Internal Memory

### 4.3.1 Special area for High-speed counter

The Built-in high-speed counter uses the K device for its parameters and operation command area. If the values set in the parameters are changed in the program, the counter operates with the updated values.

(1) Parameter setting

| Parameter | Description | | Device area per channel | | | | Remark |
|---|---|---|---|---|---|---|---|
| | Value | Setting | Ch 0 | Ch 1 | Ch 2 | Ch 3 | |
| Counter mode | h0000 | Linear count | K300 | K330 | K360 | K390 | Word |
| | h0001 | Ring count | | | | | |
| Pulse input mode | h0000 | 1 phase 1 input 1 multiplication | K301 | K331 | K361 | K391 | Word |
| | h0001 | 1 phase 2 input 1 multiplication | | | | | |
| | h0002 | CW / CCW | | | | | |
| | h0003 | 2 phase 4 multiplication | | | | | |
| Comp. Output0 mode | h0000 | (Magnitude) < | K302 | K332 | K362 | K392 | Word |
| | h0001 | (Magnitude) ≤ | | | | | |
| | h0002 | (Magnitude) = | | | | | |
| | h0003 | (Magnitude) ≥ | | | | | |
| | h0004 | (Magnitude) > | | | | | |
| | h0005 | (Range) Include | | | | | |
| | h0006 | (Range) Exclude | | | | | |
| Comp. Output1 mode | h0000 | (Magnitude) < | K303 | K333 | K363 | K393 | Word |
| | h0001 | (Magnitude) ≤ | | | | | |
| | h0002 | (Magnitude) = | | | | | |
| | h0003 | (Magnitude) ≥ | | | | | |
| | h0004 | (Magnitude) > | | | | | |
| | h0005 | (Range) Include | | | | | |
| | h0006 | (Range) Exclude | | | | | |
| Internal preset value setting | -2,147,483,648 ~ 2,147,483,647 | | K304 | K334 | K364 | K394 | DWord |
| External preset value setting | -2,147,483,648 ~ 2,147,483,647 | | K306 | K336 | K366 | K396 | DWord |
| Ring counter Min. value setting | -2,147,483,648 ~ 2,147,483,647 | | K308 | K338 | K368 | K398 | DWord |
| Ring counter Max. value setting | -2,147,483,648 ~ 2,147,483,647 | | K310 | K340 | K370 | K400 | DWord |
| Comp. Output Min. value setting | -2,147,483,648 ~ 2,147,483,647 | | K312 | K342 | K372 | K402 | DWord |
| Comp. output Max. value setting | -2,147,483,648 ~ 2,147,483,647 | | K314 | K344 | K374 | K404 | DWord |

| Parameter | Description | | Device area per channel | | | | Remark |
|---|---|---|---|---|---|---|---|
| | Value | Setting | Ch 0 | Ch 1 | Ch 2 | Ch 3 | |
| Comp. output 0 point designation | HFFFF | No use | K320 | K350 | K380 | K410 | Word |
| | h0000 | P0020 | | | | | |
| | h0001 | P0021 | | | | | |
| | h0002 | P0022 | | | | | |
| | h0003 | P0023 | | | | | |
| | h0004 | P0024 | | | | | |
| | h0005 | P0025 | | | | | |
| | h0006 | P0026 | | | | | |
| | h0007 | P0027 | | | | | |
| | h0008 | P0028 | | | | | |
| | h0009 | P0029 | | | | | |
| | h000A | P002A | | | | | |
| | h000B | P002B | | | | | |
| | h000C | P002C | | | | | |
| | h000D | P002D | | | | | |
| | h000E | P002E | | | | | |
| | h000F | P002F | | | | | |
| Comp. output 1 point designation | HFFFF | No use | K321 | K351 | K381 | K411 | Word |
| | h0000 | P0020 | | | | | |
| | h0001 | P0021 | | | | | |
| | h0002 | P0022 | | | | | |
| | h0003 | P0023 | | | | | |
| | h0004 | P0024 | | | | | |
| | h0005 | P0025 | | | | | |
| | h0006 | P0026 | | | | | |
| | h0007 | P0027 | | | | | |
| | h0008 | P0028 | | | | | |
| | h0009 | P0029 | | | | | |
| | h000A | P002A | | | | | |
| | h000B | P002B | | | | | |
| | h000C | P002C | | | | | |
| | h000D | P002D | | | | | |
| | h000E | P002E | | | | | |
| | h000F | P002F | | | | | |
| Unit time [ms] | 1 ~ 60,000 | | K322 | K352 | K382 | K412 | DWord |
| Pulse/Rev.value | 1 ~ 60,000 | | K323 | K353 | K383 | K413 | DWord |
| Frequency | h0000 | 1Hz | K324 | K354 | K384 | K414 | Word |
| | h0001 | 10Hz | | | | | |
| | h0002 | 100Hz | | | | | |
| | h0003 | 1000Hz | | | | | |

(2) Operation command

| Parameter | Device area per channel (BIT) | | | |
|---|---|---|---|---|
| | Ch 0 | Ch 1 | Ch 2 | Ch 3 |
| Counter enabling | K2600 | K2700 | K2800 | K2900 |
| Internal preset designation of counter0 | K2601 | K2701 | K2801 | K2901 |
| External preset enabling of counter1 | K2602 | K2702 | K2802 | K2902 |
| Designation of decremental counter | K2603 | K2703 | K2803 | K2903 |
| Comp. output enabling | K2604 | K2704 | K2804 | K2904 |
| Enabling of revolution time per unit time | K2605 | K2705 | K2805 | K2905 |
| Designation of latch counter | K2606 | K2706 | K2806 | K2906 |
| Carry signal (Bit) | K2610 | K2710 | K2810 | K2910 |
| Borrow signal | K2611 | K2711 | K2811 | K2911 |
| Comp. output signal | K2612 | K2712 | K2812 | K2912 |

(3) Monitoring area

| Parameter | Device area per channel | | | | Remark |
|---|---|---|---|---|---|
| | Ch 0 | Ch 1 | Ch 2 | Ch 3 | |
| Current counter value | K262 | K272 | K282 | K292 | DWORD |
| Revolution time per unit time | K264 | K274 | K284 | K294 | DWORD |
| Frequency measurement | K268 | K278 | K288 | K298 | DWORD |

### 4.3.2 Error code

It describes errors of the built-in high-speed counter.

- Error occurred is saved in the following area.

| Category | Device area per channel | | | | Remark |
|---|---|---|---|---|---|
| | Ch0 | Ch1 | Ch2 | Ch3 | |
| Error code | K266 | K276 | K286 | K296 | WORD |

- Error codes and descriptions

| Error code (Decimal) | Description | Remark |
|---|---|---|
| 20 | Counter type is set out of range | |
| 21 | Pulse input type is set out of range | |
| 22 | Requesting #1(3,5,7)channel Run during the 2-phase operation of #0(2,4,6)<br>* During #0(2,4,6) channel 2-phase operation, using #1(3,5,7)channel is not possible. | |
| 23 | Compared output type setting is set out of range. | |
| 25 | Internal preset value is set out of counter range | |
| 26 | External present value is set out of counter range | |
| 27 | Ring counter setting is set out of range<br>* Note ring counter setting should be 2 and more. | |
| 28 | Compared output min. value is set out of permissible max. input range | |
| 29 | Compared output max. value is set out of permissible max. input range | |
| 30 | Error of Compared output min. value>Compared output max. value | |
| 31 | Output point designation value of Compared output is set out of range | |
| 34 | Set value of Unit time is out of the range | |
| 35 | Pulse value per 1 revolution is set out of range | |
| 36 | Compared output min. value is set out of permissible max. input range (Compared output 1) | |
| 37 | Compared output max. value is set out of permissible max. input range (Compared output 1) | |
| 38 | Error of Compared output min. value>Compared output max. value (Compared output 1) | |
| 39 | Output point designation value of Compared output is set out of range (Compared output 1) | |
| 40 | Frequency measure error | |

**Remark**

If two or more errors occur, the module outputs the latter error code.

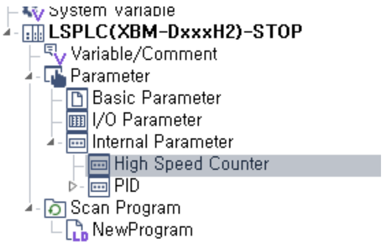
## 4.4 Examples: Using High-speed Counter

It describes examples of using high-speed counter.

1) Setting high-speed counter parameter

How to set types of parameters to operate a high-speed counter is described as follows.

A) Set 『Internal Parameters』 in the basic project window.

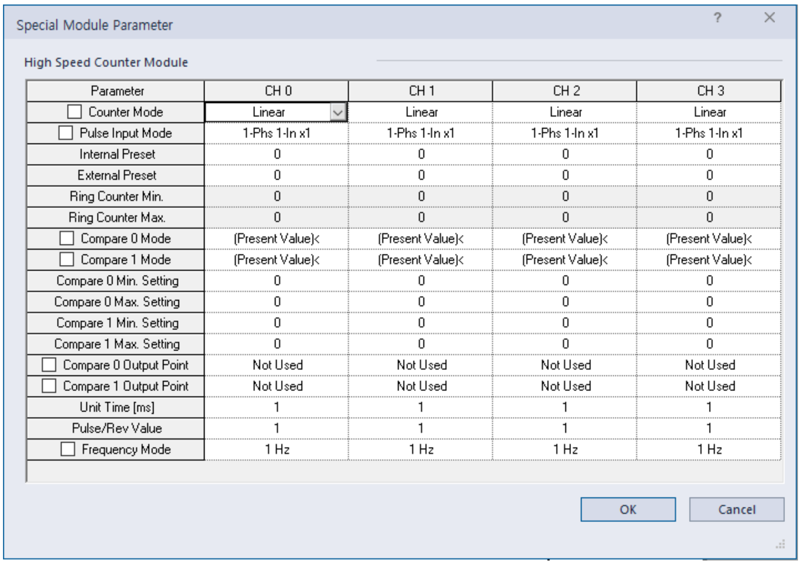


- System Variable
- LSPLC(XBM-DxxxH2)-STOP
  - Variable/Comment
  - Parameter
    - Basic Parameter
    - I/O Parameter
    - Internal Parameter
      - High Speed Counter
      - PID
  - Scan Program
    - NewProgram

B) Selecting high-speed counter opens a window to set high-speed counter parameters as follows.

For details regarding each parameter setting, refer to 8.1~8.3.

(Every parameter settings are saved in the K device area.)

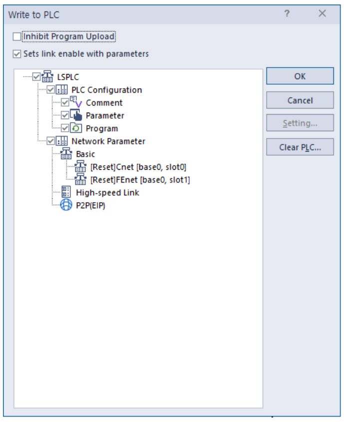


Special Module Parameter

High Speed Counter Module

| Parameter | CH 0 | CH 1 | CH 2 | CH 3 |
|---|---|---|---|---|
| ☐ Counter Mode | Linear | Linear | Linear | Linear |
| ☐ Pulse Input Mode | 1-Phs 1-In x1 | 1-Phs 1-In x1 | 1-Phs 1-In x1 | 1-Phs 1-In x1 |
| Internal Preset | 0 | 0 | 0 | 0 |
| External Preset | 0 | 0 | 0 | 0 |
| Ring Counter Min. | 0 | 0 | 0 | 0 |
| Ring Counter Max. | 0 | 0 | 0 | 0 |
| ☐ Compare 0 Mode | (Present Value)< | (Present Value)< | (Present Value)< | (Present Value)< |
| ☐ Compare 1 Mode | (Present Value)< | (Present Value)< | (Present Value)< | (Present Value)< |
| Compare 0 Min. Setting | 0 | 0 | 0 | 0 |
| Compare 0 Max. Setting | 0 | 0 | 0 | 0 |
| Compare 1 Min. Setting | 0 | 0 | 0 | 0 |
| Compare 1 Max. Setting | 0 | 0 | 0 | 0 |
| ☐ Compare 0 Output Point | Not Used | Not Used | Not Used | Not Used |
| ☐ Compare 1 Output Point | Not Used | Not Used | Not Used | Not Used |
| Unit Time [ms] | 1 | 1 | 1 | 1 |
| Pulse/Rev Value | 1 | 1 | 1 | 1 |
| ☐ Frequency Mode | 1 Hz | 1 Hz | 1 Hz | 1 Hz |

C) If the setting is completed, download the program and parameters to PLC.



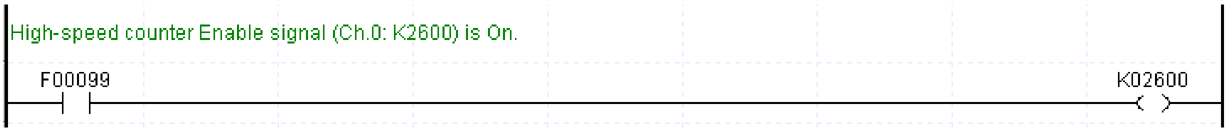
Write to PLC

☐ Inhibit Program Upload

☑ Sets link enable with parameters

- ☑ LSPLC
  - ☑ PLC Configuration
    - ☑ Comment
    - ☑ Parameter
    - ☑ Program
  - ☑ Network Parameter
    - Basic
      - [Reset]Cnet [base0, slot0]
      - [Reset]FEnet [base0, slot1]
    - High-speed Link
    - P2P(EIP)

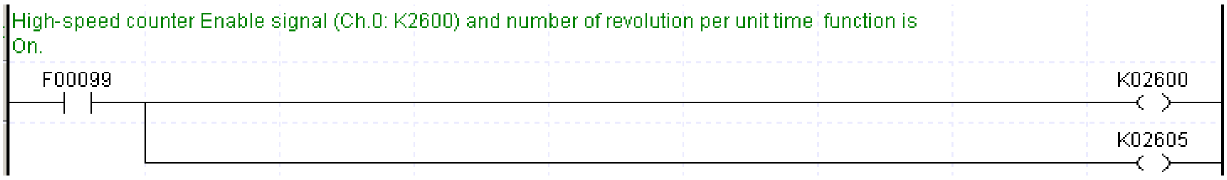
D) Turn on the high-speed counter Enable signal(CH0 : K2600) in the program.



High-speed counter Enable signal (Ch.0: K2600) is On.

E) To use additional functions of the high-speed counter, you need to turn on the flag allowing the operation command.
* Refer <4.3.1 Special K Area for High-speed Counter>

For instance, to use revolution per unit time function, turn on K2605 bit.

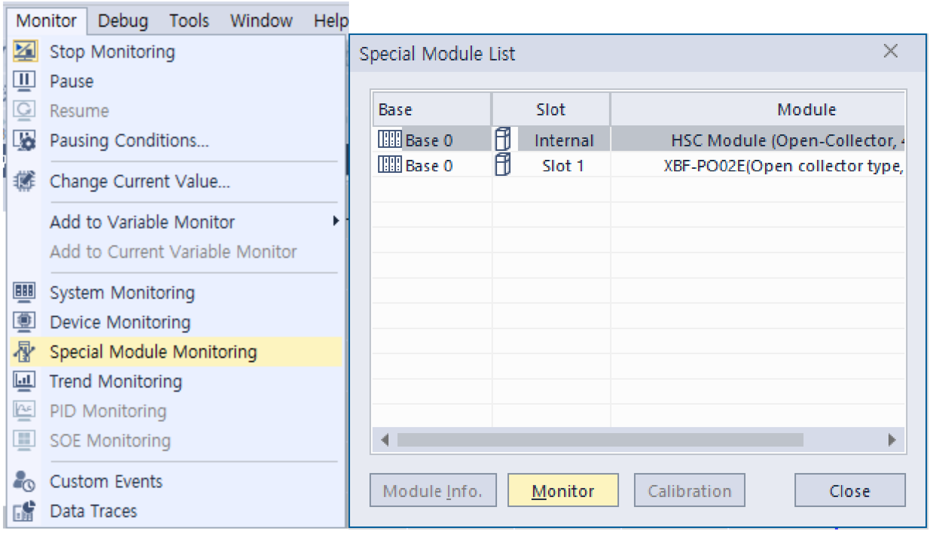


High-speed counter Enable signal (Ch.0: K2600) and number of revolution per unit time function is On.

2) Monioring and setting command

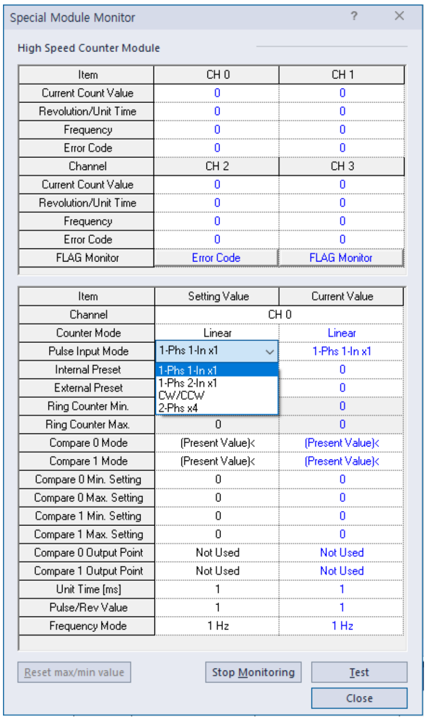
Monitoraing and command setting of high-speed counter are described as follows.

A) After starting the monitoring, by clicking the Special Module Monitor menu, the following window is opened.



| Base | Slot | Module |
|---|---|---|
| Base 0 | Internal | HSC Module (Open-Collector, |
| Base 0 | Slot 1 | XBF-PO02E(Open collector type, |

B) Clicking 『Monitor』 shows monitor and test window of high-speed counter.



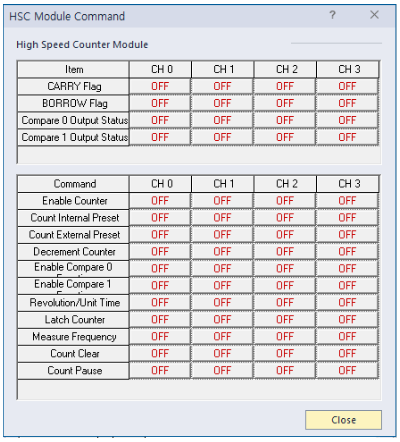
| Item | CH 0 | CH 1 |
|---|---|---|
| Current Count Value | 0 | 0 |
| Revolution/Unit Time | 0 | 0 |
| Frequency | 0 | 0 |
| Error Code | 0 | 0 |
| Channel | CH 2 | CH 3 |
| Current Count Value | 0 | 0 |
| Revolution/Unit Time | 0 | 0 |
| Frequency | 0 | 0 |
| Error Code | 0 | 0 |
| FLAG Monitor | Error Code | FLAG Monitor |

| Item | Setting Value | Current Value |
|---|---|---|
| Channel | CH 0 | |
| Counter Mode | Linear | Linear |
| Pulse Input Mode | 1-Phs 1-In x1 | 1-Phs 1-In x1 |
| Internal Preset | | 0 |
| External Preset | | 0 |
| Ring Counter Min. | | 0 |
| Ring Counter Max. | 0 | 0 |
| Compare 0 Mode | (Present Value)< | (Present Value)< |
| Compare 1 Mode | (Present Value)< | (Present Value)< |
| Compare 0 Min. Setting | 0 | 0 |
| Compare 0 Max. Setting | 0 | 0 |
| Compare 1 Min. Setting | 0 | 0 |
| Compare 1 Max. Setting | 0 | 0 |
| Compare 0 Output Point | Not Used | Not Used |
| Compare 1 Output Point | Not Used | Not Used |
| Unit Time [ms] | 1 | 1 |
| Pulse/Rev Value | 1 | 1 |
| Frequency Mode | 1 Hz | 1 Hz |

| Item | Description |
|---|---|
| FLAG Monitor | Show flag monitoring and command window of high-speed counter |
| Start Monitoring | Start monitoring each item (special K device area monitor). |
| Test | Write each item setting to PLC. (Write the setting to special K device) |
| Close | Close monitor |

C) Clicking 『Start Monitoring』 shows the high-speed counter monitor display, in which you may set each parameter. At this moment, if any, changed values are not saved if the power is turned off or if the mode is changed. So use it for testing purpose only.

D) Clicking 『FLAG Monitor』 shows the monitor of each flag in high-speed counter, in which you may direct the operation instructions for each flag. (Flag value is reversed when clicked)



| Item | CH 0 | CH 1 | CH 2 | CH 3 |
|---|---|---|---|---|
| CARRY Flag | OFF | OFF | OFF | OFF |
| BORROW Flag | OFF | OFF | OFF | OFF |
| Compare 0 Output Status | OFF | OFF | OFF | OFF |
| Compare 1 Output Status | OFF | OFF | OFF | OFF |

| Command | CH 0 | CH 1 | CH 2 | CH 3 |
|---|---|---|---|---|
| Enable Counter | OFF | OFF | OFF | OFF |
| Count Internal Preset | OFF | OFF | OFF | OFF |
| Count External Preset | OFF | OFF | OFF | OFF |
| Decrement Counter | OFF | OFF | OFF | OFF |
| Enable Compare 0 | OFF | OFF | OFF | OFF |
| Enable Compare 1 | OFF | OFF | OFF | OFF |
| Revolution/Unit Time | OFF | OFF | OFF | OFF |
| Latch Counter | OFF | OFF | OFF | OFF |
| Measure Frequency | OFF | OFF | OFF | OFF |
| Count Clear | OFF | OFF | OFF | OFF |
| Count Pause | OFF | OFF | OFF | OFF |

# Chapter 5. Built-in PID Function

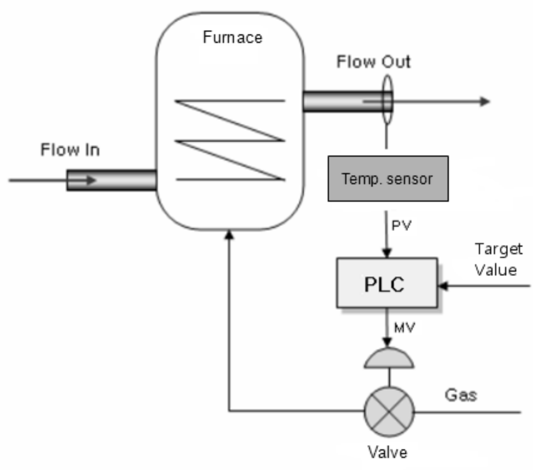
## 5.1 Features of Built-in PID Function

Here describes built-in PID (Proportional Integral Derivative) function. When there is plant (target of control), Control means that the user changes the status such as velocity, temperature, position, voltage, current etc. as the user wishes. Here describes PID control that is most frequently used among diverse control methods.

Basic concept of PID control is as follows. First, it detects the PV (Process Value) through sensor and calculates what the difference with SV (Set value) is. Then it outputs MV (Manipulated Value) for PV to be same with SV.

At this time, 3 types of operation, such as Proportion, Integration, Derivation is executed according to the requirement of the user. PID control has high compatibility, flexibility, affordability in comparison with Robust control and Linear optimal control. In case of other control methods, since control device can be applied to the system after mathematical analysis of system, if system or the requirement of the user changes, the analysis of system is done again. But in case of PID control, PID device copes with change of system or requirement of the user with simple auto-tunings without analysis of system rapidly.

The figure 5.1 is example indicating system configuration of temperature control of heating system.



<Figure 5.1PID Temperature control system with PLC>

At this time, PLC becomes control device for this system, output temperature of heating system becomes target for control. And temperature sensor and valve becomes devices to detect and manipulate the status of system respectively. If temperature sensor detects the output temperature and inputs that to PLC, PLC manipulate the valve status through PID operation and control the quantity of gas that goes into heating system. So temperature of heating system changes. This process is called control loop and PID control is executed by repeating the control loop. The control loop is repeated with a cycle of ms ~ s.

The built-in PID control functions of XBM feature as follows.

(1) Since operations are executed within CPU part, it can be controlled by PID parameters and PLC program without PID module.

(2) A variety of controls can be selected

- That is, a user can easily select P operation, PI operation and PID operation.

(3) Precise control operation

- It can make precise PID control operations possible through floating point operations.

(4) PWM (Pulse Width Modulation) output available.

- It outputs control operation results to the output contact point designated by a user through PWM.

(5) Improving convenience of control settings and monitoring

- Through parameter setting method and K area flag, it maximizes control parameter settings during operation and convenience of monitoring

(6) Freely selectable operation direction

- Forward, reverse and mixed forward/reverse operations are available

(7) Cascade operation realizing quick and precise PID control

- It can increase quickness of response to disturbance through cascade loop.

(8) Various additional functions

- PID control can be achieved by various methods a user wishes because set value ramp, the present value follow-up, limiting change of values and types of alarm functions are provided.

## 5.2 Basic Theory of PID Control

Here describes basic theory of PID control and how to configure PID control.

(1) Terms

Terms used in this user manual are as follows.

- PV: status of plant detected by sensor (Process value)
- SV: Target value (Set Value) to control plant, if control is done normally, PV should follow the SV.
- E: error between SV and PV. It can be expressed as (SV-PV).
- Kp: proportional coefficient
- Ti: Integral time constant. Sometimes called integral time
- Td: Derivative time constant. Sometimes called derivative time
- MV: Control input or control device output. The input to plant to make PV follow the V
- Ts: Sampling time, a cycle of operation to execute PID control

(2) PID operation expression

Basic PID operation expressions are as follows.

$$E = SV - PV \tag{5.2.1}$$

$$MV_P = K_P E \tag{5.2.2}$$

$$MV_i = \frac{K_P}{T_i}\int Edt \tag{5.2.3}$$

$$MV_d = K_P T_d \frac{dE}{dt} \tag{5.2.4}$$

$$MV = MV_P + MV_i + MV_d \tag{5.2.5}$$

PID control operation expressions of XGB series are more complicate than expression (5.2.1) ~ (5.2.5) mathematically but those are based on the above expression. The followings describe the characteristics of control process with an example that controls the output temperature of heating system in figure 5.1. At this example, the system and PID parameters imaginary to help the comprehension and those may be different with real heating system. If the heating system in figure 5.1 is expressed as second order system with transfer function like expression (5.2.6) in frequency domain, it is expressed as differential equation like expression (5.2.6) in the time domain.

$$\text{Transfer function} = \frac{32}{(2s+1)(3s+5))} \tag{5.2.6}$$

$$\frac{6}{32}\frac{d^2y(t)}{dt^2}+\frac{13}{32}\frac{dy(t)}{dt}+5y(t)=x(t) \tag{5.2.7}$$

That is, x(t) is Manipulated value and y(t) is Process value.

At this system, we assume that the PID parameter is specified as shown below to describe the PID control operation.

| Items | Value | Items | Value |
|---|---|---|---|
| Output temperature of heating system (PV) | 0℃ | Proportional coefficient ($K_P$) | 5 |
| Target temperature (SV) | 50℃ | Integral time ($T_i$) | 3s |
| Cycle of operation | 0.01s | Derivative time ($T_d$) | 0.19s |

<Table 5.1 example of control of heating system>

At this system, if we assume that target value of output temperature is 50℃ and initial value of output temperature is 0℃, SV and PV becomes 50 and 0 respectively. In case of this, PID controller acts as follows.

(3) Proportional control (P control)

In the proportional control, the controller yields output that is proportional to error.

Manipulated value of controller by Proportional control is as follows.

$$MV_P = E \times K_P \tag{5.2.8}$$

(a) If P control starts, output of controller by initial P operation is as follows.

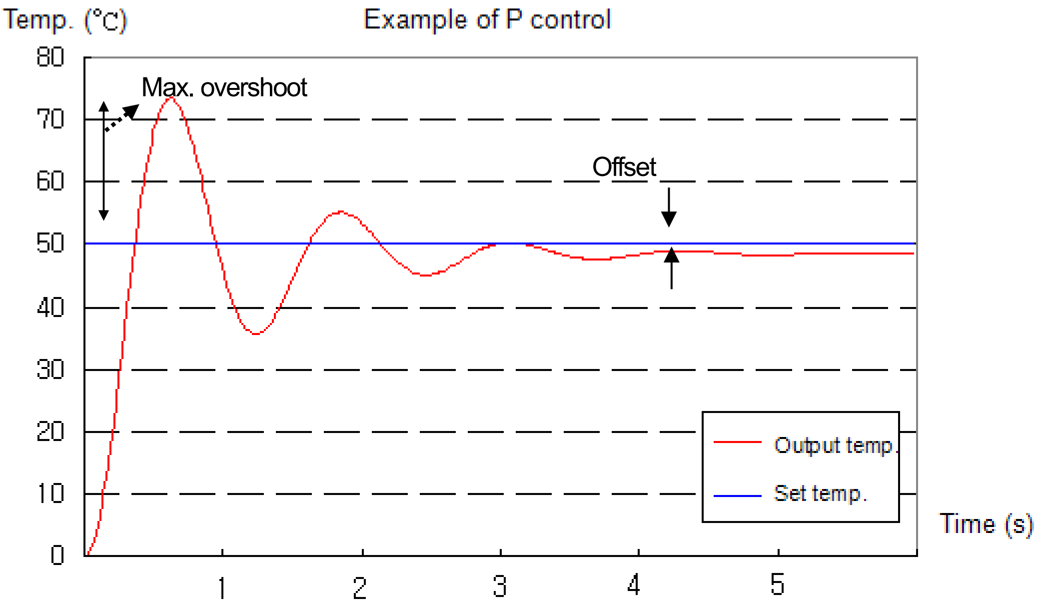
$$\mathrm{MV}_0 = 50 \times 5 = 250$$

If P control is executed for 10 seconds, output temperature will be as table 5.2.

If this is expressed with graph, it will be as Figure 5.2.

| Time | Target temp. | Proportional coefficient | Output temp. | Error |
|---|---|---|---|---|
| 0 | 50 | 5 | 0 | 50 |
| 1 | 50 | 5 | 44.98 | 5.02 |
| 2 | 50 | 5 | 53.08 | -3.08 |
| 3 | 50 | 5 | 50.15 | -0.15 |
| 4 | 50 | 5 | 48.42 | 1.58 |
| 5 | 50 | 5 | 48.28 | 1.72 |
| 6 | 50 | 5 | 48.44 | 1.56 |
| 7 | 50 | 5 | 48.49 | 1.51 |
| 8 | 50 | 5 | 48.49 | 1.51 |
| 9 | 50 | 5 | 48.49 | 1.51 |

< Table 5.2 example of Proportional control >



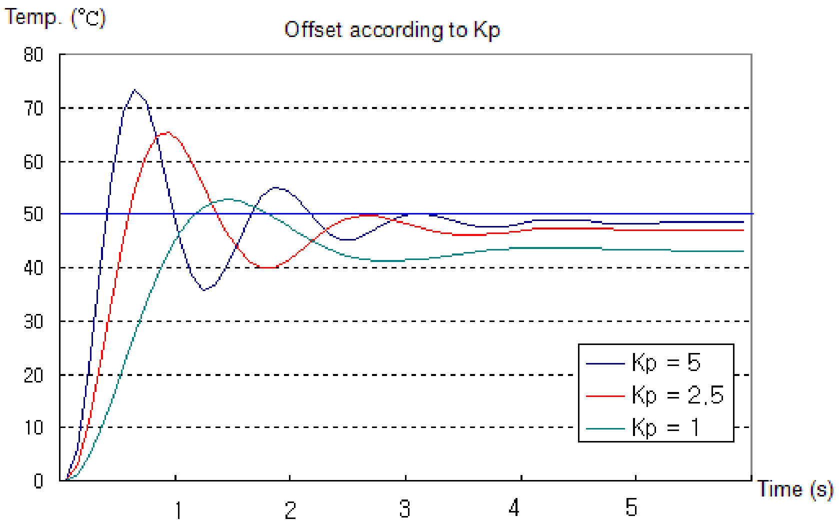
< Figure5.2 simulation of proportional control >

(b) Concerning the result of simulation, it has the maximum overshoot of about 23.4℃ at 0.62s and after 7s, it converges at 48.49℃ with offset of 1.51℃ (about 3%).

(c) Offset is an unavoidable error when only P control is executed. Offset decreases proportional to P coefficient but overshoot increases proportional to P coefficient. Table 5.3 and Figure 5.3 is simulation of offset and overshoot according to P coefficient.

| Time | Target temperature | Kp = 5 | Kp = 2.5 | Kp = 1 |
|---|---|---|---|---|
| 0 | 50 | 0 | 0 | 0 |
| 1 | 50 | 45.02 | 63.46 | 46.67 |
| 2 | 50 | 53.11 | 42.52 | 46.77 |
| 3 | 50 | 50.15 | 47.93 | 41.38 |
| 4 | 50 | 50.22 | 47.25 | 41.60 |
| 5 | 50 | 48.27 | 46.96 | 43.30 |
| 6 | 50 | 48.35 | 46.92 | 43.25 |
| 7 | 50 | 48.44 | 46.90 | 43.21 |
| 8 | 50 | 48.53 | 46.90 | 43.18 |
| 9 | 50 | 48.53 | 46.90 | 43.18 |

<Table 5.3 Temperature- time table according to P coefficient>



< Figure 5.3 Temperature- time graph according to P coefficient >

(c) Considering table 5.3, as P coefficient decreases, offset increases but overshoot decreases.

(d) Generally, offset can't be solved with only P control. In order to remove the offset, P control and I control is used together.

(4) Proportional Integral Control (PI Control)

In I control, it yields the output proportional to error accumulated according to time. And the expression is as follows.

$$MV_i = \frac{K_P}{T_i}\int Edt \qquad (5.2.9)$$

(a) In the expression 5.2.9, Ti means the time takes for MVi, output by I control, to be added into real output.

(b) Generally, I control is used with P control. So the expression of PI control is as follows.

$$MV = MV_P + MV_i = E \times K_P + \frac{K_P}{T_i}\int Edt \qquad (5.2.10)$$

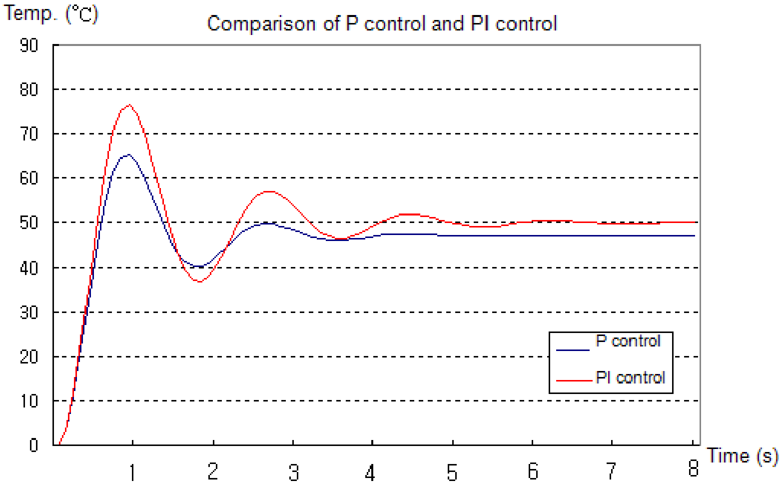
(c) In the above heating system, the simulation results are as shown in the table 5.4 when proportional coefficient is 2.5 and integral time is 1.5s.

| Time | Target temp. | Proportional coefficient | Integral time | P Control | PI Control |
|---|---|---|---|---|---|
| 0 | 50 | 2.5 | 1.5 | 0 | 0 |
| 1 | 50 | 2.5 | 1.5 | 63.46 | 74.41 |
| 2 | 50 | 2.5 | 1.5 | 42.52 | 40.63 |
| 3 | 50 | 2.5 | 1.5 | 47.93 | 52.99 |
| 4 | 50 | 2.5 | 1.5 | 47.05 | 49.67 |
| 5 | 50 | 2.5 | 1.5 | 46.96 | 49.70 |
| 6 | 50 | 2.5 | 1.5 | 47.12 | 50.38 |
| 7 | 50 | 2.5 | 1.5 | 47.03 | 49.76 |
| 8 | 50 | 2.5 | 1.5 | 47.07 | 50.14 |
| 9 | 50 | 2.5 | 1.5 | 47.06 | 49.94 |
| 10 | 50 | 2.5 | 1.5 | 47.06 | 50.02 |
| 11 | 50 | 2.5 | 1.5 | 47.06 | 49.99 |
| 12 | 50 | 2.5 | 1.5 | 47.06 | 50.00 |
| 13 | 50 | 2.5 | 1.5 | 47.06 | 50.00 |
| 14 | 50 | 2.5 | 1.5 | 47.06 | 50.00 |
| 15 | 50 | 2.5 | 1.5 | 47.06 | 50.00 |

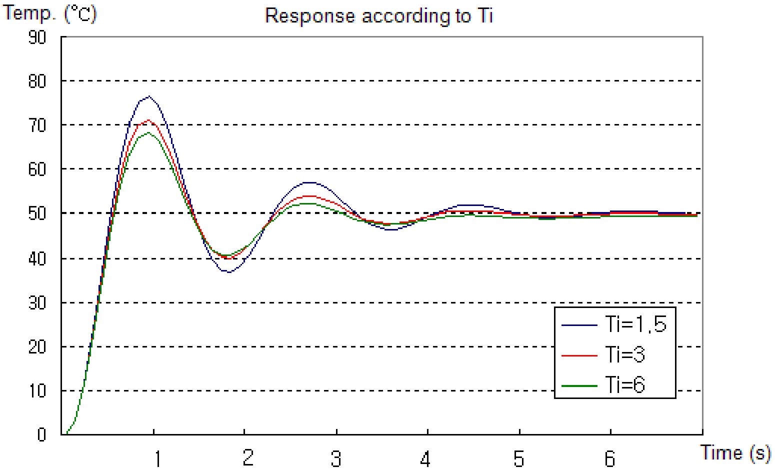
< Table 5.4 Temperature- time table according to P coefficient >

(d) Considering table 5.4 and Figure 5.4, if P and I control is used together, offset is removed and temp. converges at 50℃, target temp. after 12s

(e) But in this case, convergence time is longer than that of P control and overshoot is larger. Generally, as integral time increases, overshoot decrease. About this, refer to the Figure 5.5.



< Figure5.4 Temp.- time graph >



< Figure 5.5 overshoot according to integral time >

(f) Like this, if I control is used, overshoot is larger. According to system, large overshoot can be problem. In order to solve this, PID control is used.

(5) Proportional integral derivative control (PID control)

In D control, when status of system changes rapidly, D control yields the output to reduce the error. Namely, D control yields the output proportional to change velocity of current status. So if D control is used, response speed of controller about status change of system increases, and overshoot decreases. Output of controller by D control is as shown in expression 5.2.11.

$$MV_d = K_P T_d \frac{dE}{dt} \qquad (5.2.11)$$

(a) In the expression 5.2.11, Td means the time takes for MVd output by I control, to be added into real output.

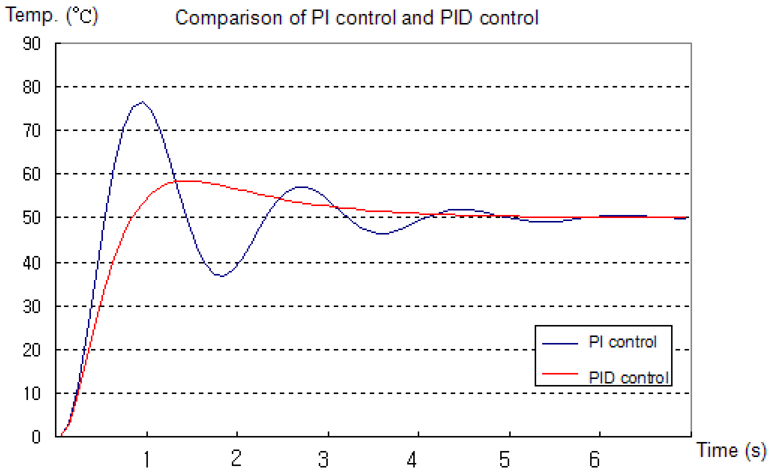
(b) Generally, D control is not used solely but with PD control. So PID control is expressed as expression 5.2.12.

$$MV = MV_P + MV_i + MV_d = E \times K_P + \frac{K_P}{T_i}\int Edt + K_p T_d \frac{dE}{dt} \qquad (5.2.12)$$

(c) The Figure 5.6 is simulation result when PID control is applied to above heating system.

| Time | Target temp. | Proportional coefficient | Integral time | Derivative time | PI Control | PID Control |
|---|---|---|---|---|---|---|
| 0 | 50 | 2.5 | 1.5 | 0.3 | 0 | 0 |
| 1 | 50 | 2.5 | 1.5 | 0.3 | 74.41 | 55.50 |
| 2 | 50 | 2.5 | 1.5 | 0.3 | 40.63 | 56.33 |
| 3 | 50 | 2.5 | 1.5 | 0.3 | 52.99 | 52.50 |
| 4 | 50 | 2.5 | 1.5 | 0.3 | 49.67 | 50.92 |
| 5 | 50 | 2.5 | 1.5 | 0.3 | 49.70 | 50.34 |
| 6 | 50 | 2.5 | 1.5 | 0.3 | 50.38 | 50.12 |
| 7 | 50 | 2.5 | 1.5 | 0.3 | 49.76 | 50.05 |
| 8 | 50 | 2.5 | 1.5 | 0.3 | 50.14 | 50.02 |
| 9 | 50 | 2.5 | 1.5 | 0.3 | 49.94 | 50.01 |
| 10 | 50 | 2.5 | 1.5 | 0.3 | 50.02 | 50.00 |
| 11 | 50 | 2.5 | 1.5 | 0.3 | 49.99 | 50.00 |
| 12 | 50 | 2.5 | 1.5 | 0.3 | 50.00 | 50.00 |
| 13 | 50 | 2.5 | 1.5 | 0.3 | 50.00 | 50.00 |

< Table 5.5 comparison of PI control and PID control >



< Figure 5.6 comparison of PI control and PID control >

(d) Considering table 5.5, in case PID control is used, max. overshoot decreases from 16.5℃ to 8.5℃. At this time, P coefficient, integral time, derivative time are not optimal values, just one of the examples. Actually, P coefficient, integral time, derivative time values vary according to PID control system.

## 5.3 Functional Specifications of PID Control

The performance specifications of the built-in PID control function in XGB series are summarized in the below table.

| Item | | Specifications |
|---|---|---|
| No. of loops | | 16 Loop |
| Scope of setting PID constants | Proportional constant(P) | Real number (0 ~ 3.40282347e+38) |
| | Integral constant(I) | Real number (0 ~ 3.40282347e+38), unit: second |
| | Differential constant(D) | Real number (0 ~ 3.40282347e+38), unit: second |
| Scope of set value | | INT (-32,768 ~ 32,767) |
| Scope of present value | | INT (-32,768 ~ 32,767) |
| Scope of maneuver value | | INT (-32,768 ~ 32,767) |
| Scope of manual maneuver value | | INT (-32,768 ~ 32,767) |
| Indication | RUN/STOP | Operation: PID RUN Flag On (by loops)<br>Stop: PID RUN Flag Off (by loops) |
| | Error | Normal: PID Error Flag Off (by loops)<br>Error: PID Error Flag On, Error code occurrence (by loops) |
| | Warning | Normal: PID Warning Flag Off (by loops)<br>Error: PID Warning Flag On, Warnig code occurrence (by loops) |
| Control operation | | Control of P,PI,PD and PID, control of forward/reverse operation |
| Control interval | | 10.0ms ~ 6,553.6ms (0.1msUnit) |
| Additional functions | PWM output | Supportable |
| | Mixed forward/reverse output | Supportable |
| | Limiting change of present value | INT (-32,768 ~ 32,767) |
| | Limiting change of maneuver value | INT (-32,768 ~ 32,767) |
| | Equally dividing set value | 0 ~ 65,536 (frequency of control cycle time) |
| | Present value follow-up | 0 ~ 65,536 (frequency of control cycle time) |
| | Cascade control | Supportable. |
| | Min./max. present value | -32,768 ~ 32,767 |
| | Differential filter | 0.01 ~ 655.35 (x 100 Scaled Up) |
| | Dead band setting | 0 ~ 65,535 |
| | Prevention of dual integral accumulation | Supportable |
| | PID operation pause | Supportable |

< Table 5.6 built-in PID control performance specification >

# 5.4 Usage of PID Control Functions

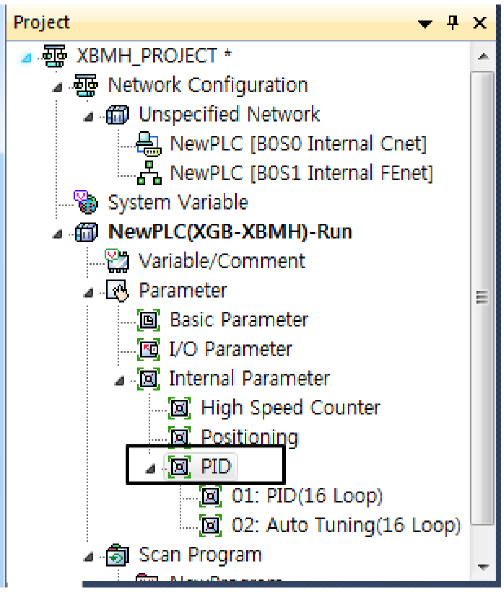
## 5.4.1 PID Control Parameter Setting

To use the built-in PID control function of XGB series, it is necessary to set PID control parameters by loops in the parameter window and operate it though the commands. Here, it explains parameters to use PID control functions and how to set them.

(1) PID parameter settings

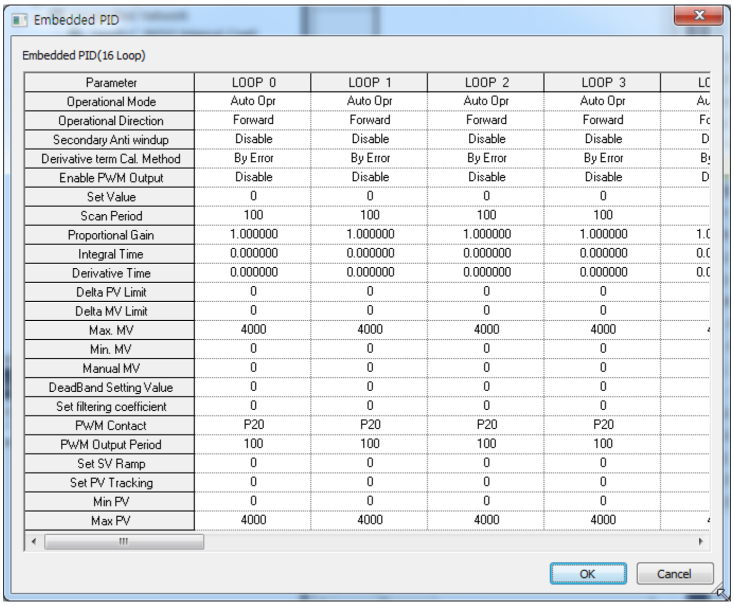
Follow the steps below to set the PID control function parameters of XGB series.

(a) If selecting the built-in parameters in Parameter of the project window, it shows the built-in parameter setting window as in below figure.



< Figure 5.7 Parameters setting window >

(b) If selecting PID Control, it shows the PID control parameter setting window as in below figure.



| Parameter | LOOP 0 | LOOP 1 | LOOP 2 | LOOP 3 |
|---|---|---|---|---|
| Operational Mode | Auto Opr | Auto Opr | Auto Opr | Auto Opr |
| Operational Direction | Forward | Forward | Forward | Forward |
| Secondary Anti windup | Disable | Disable | Disable | Disable |
| Derivative term Cal. Method | By Error | By Error | By Error | By Error |
| Enable PWM Output | Disable | Disable | Disable | Disable |
| Set Value | 0 | 0 | 0 | 0 |
| Scan Period | 100 | 100 | 100 | 100 |
| Proportional Gain | 1.000000 | 1.000000 | 1.000000 | 1.000000 |
| Integral Time | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Derivative Time | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Delta PV Limit | 0 | 0 | 0 | 0 |
| Delta MV Limit | 0 | 0 | 0 | 0 |
| Max. MV | 4000 | 4000 | 4000 | 4000 |
| Min. MV | 0 | 0 | 0 | 0 |
| Manual MV | 0 | 0 | 0 | 0 |
| DeadBand Setting Value | 0 | 0 | 0 | 0 |
| Set filtering coefficient | 0 | 0 | 0 | 0 |
| PWM Contact | P20 | P20 | P20 | P20 |
| PWM Output Period | 100 | 100 | 100 | 100 |
| Set SV Ramp | 0 | 0 | 0 | 0 |
| Set PV Tracking | 0 | 0 | 0 | 0 |
| Min PV | 0 | 0 | 0 | 0 |
| Max PV | 4000 | 4000 | 4000 | 4000 |

[ Figure 5.8 Built-in PID function parameters setting window ]

(c) Input items

The items to set in the built-in PID function parameter window and the available scope of them are summarized in below table.

| Items | Description | Scope |
|---|---|---|
| RUN mode | Set the operation mode of PID control. | Auto/manual operation |
| RUN direction | Set the operation direction of PID control. | Forward/reverse |
| Prevention of dual integral accumulation | Set whether to allow dual integral accumulation. | Disabled/enabled |
| PWM output | Set whether to allow PWM output of maneuver value. | Disabled/enabled |
| Operation cycle time | Set the operation cycle time of PID control cycle. | 100 ~ 65535 |
| Set value | Set target control value. | -32,768 ~ 32,767 |
| Proportional gain | Set proportional gain. | Real number |
| Integral time | Set integral time. | Real number |
| Differential time | Set differential time. | Real number |
| Limiting change of present value | Set the limited change of present value per operation cycle. | -32,768 ~ 32,767 |
| Limiting change of maneuver value | Set the limited change of maneuver value per operation cycle. | -32,768 ~ 32,767 |
| Max. maneuver value | Set the max. maneuver value for control. | -32,768 ~ 32,767 |
| Min. maneuver value | Set the min. maneuver value for control. | -32,768 ~ 32,767 |
| Manual maneuver value | Set the manual maneuver value for control. | -32,768 ~ 32,767 |
| DeadBand setting | Set the deadband width of the set value. | 0 ~ 65,535 |
| Differential filter value | Set the filter coefficient of differential operation. | 0 ~ 65,535 |
| PWM junction | Set the junction to which PWM output is out. | P20 ~ P3F |
| PWM output cycle | Set the output cycle of PWM output. | 100 ~ 65,535 |
| Set value ramp | Set the frequency of set value ramp. | 0 ~ 65,535 |
| Present value follow-up | Set the follow-up frequency of the present value follow-up function. | 0 ~ 65,535 |
| Min. present value | Set the min. value of the input present value. | -32,768 ~ 32,767 |
| Max. present value | Set the max. value of input present value. | -32,768 ~ 32,767 |

< Table 5.7 PID function parameter setting items >

(2) Description of Setting of PID Parameters

(a) Operation mode

It is the mode to set the operation for PID control of a loop in question.
The available scope is automatic operation or manual operation.
If automatic operation is selected, it outputs the PID control result internally operated by the input PID control parameter as the maneuver value while if manual operation is selected, it outputs the value input to the manual maneuver value parameter without PID operation modified. The default is automatic operation.

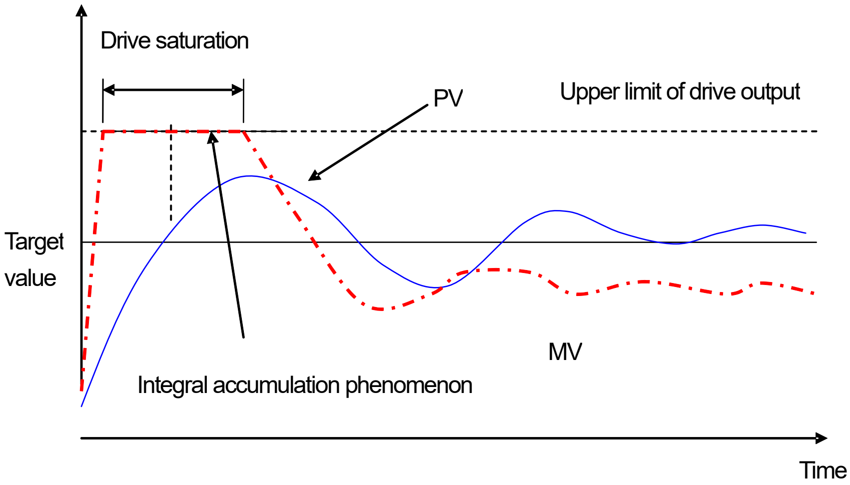
(b) Operation direction

It is designed to set the operation direction for PID control of a loop in question. The available scope is forward or reverse direction. At the moment, forward direction means increase of PV when MV increases; reverse direction means decrease PV when MV increases. For instance, a heater is a kind of forward direction system because PV(temperature) increases when output(heating) increases. A refrigerator is a kind of reverse direction system in which PV(temperature) decreases when output increases.

(c) Prevention of dual integral accumulation

It makes dual integral accumulation function enabled/disabled. To understand integral accumulation prevention function, it is necessary to explain the phenomenon of integral accumulation first of all. Every drive has a limit. That is, a motor is limited to the speed and a valve can become status overcoming the complete open/close. If it happens that MV output from a control is beyond the output limit of a drive, its output is maintained as saturated, which may deteriorate the control performance of a system and shorten the life of a drive. Formula (5.2.3) shows that the integral control among PID control output components accumulates errors as time goes on, from which it may take more time to return the normal status after the actuator is saturated in a system of which response characteristically is slow. It is so called integral accumulation phenomenon as illustrated in Fig. 5.9, which shows that if the initial error is very large, the error is continuously accumulated by integral control. Accordingly, a drive is saturated within its output upper limit while the control signal is getting larger, keeping being saturated for a long while until the drift becomes negative and the integral term turns small enough. Due to the operation, the PV may have a large over-shoot as seen in the figure. Such a wind-up phenomenon may occur if the initial drift is large or by a large disturbance or due to malfunction of a device.

The PID function of XGB series is basically with the integral accumulation prevention function, cutting off any integral accumulation phenomenon. In addition, it can detect a time when SV is suddenly decreased, providing a more strong dual integral accumulation prevention function.



< Figure 5.9 Integral accumulation phenomenon >

(d) PWM Output Enabled

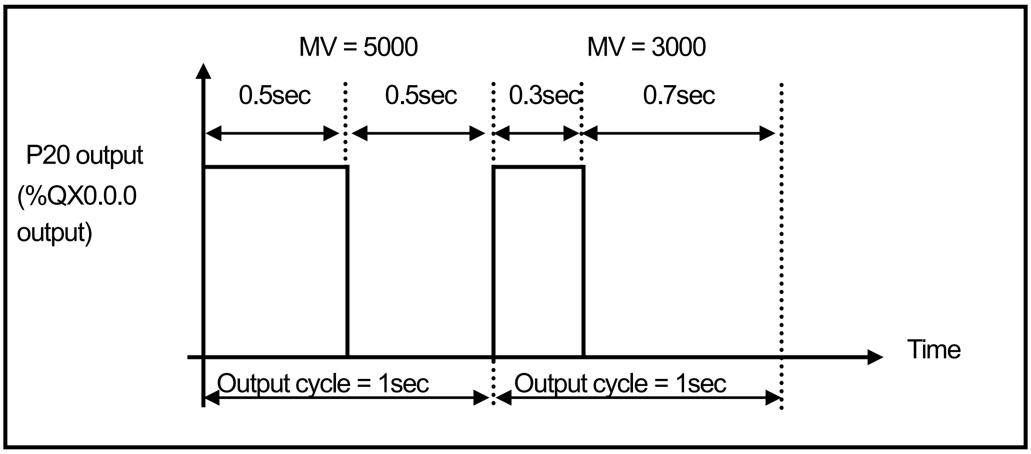
PWM output means an output method to turn a junction on – off with a duty proportional to control output calculated by a uniform output cycle. If PWM output is enabled, it realizes PWM output in accordance with PWM output cycle set in the parameter of PWM output junction(P20 ~ P3F) designated in the parameter. At the moment, the PWM output cycle follows the PWM output cycle separately set in PID operation cycle. PWM output cycle is available between 10ms ~ 6553.5ms (setting value: 100 ~ 65,535) while it is set at a unit of integer per 0.1ms.

(Be aware, actual PWM output value have max. 2ms output err)

figure shows the relation between PID control output and PWM output.

Ex) if PWM output cycle: 1 second, PWM output junction: P20, max. output: 10000, min. output: 0

| Time | Output | P40 junction operation |
|---|---|---|
| 0 sec | 5000 | 0.5 sec On, 0.5 sec Off |
| 1 sec | 3000 | 0.3 sec On, 0.7 sec Off |



[ Figure 5.10 Relation between PWM output cycle and MV ]

(e) Set value

It sets the target of a loop in question, that is, the target status a user wishes to control. In case of the PID control built in XGB, physical values (temperature, flow rate, pressure and etc) of an object to control is not meaningful and instead, it should use the physical amount of an object to control after converting them into numerals. For instance, in order to control a system using a sensor that the output is 0V when its heating device temperature is 0℃ while it is 10V when the temperature is 100℃ as much as 50℃, it is necessary to set SV as 2000 (as long as it uses AD input module XBE-AD04A).

(f) Operation cycle

It sets the cycle to yield control output by executing the built-in PID operation. The setting cycle is 0.1ms and available between 10ms ~ 6553.5ms (setting value: 100 ~ 65,535) while it is set at a unit of integer per 0.1ms. For instance, to set PID operation per 100ms, set the operation cycle as 1000.

(g) Proportional gain

It is intended to set the proportional coefficient of a PID loop in question (Kp). As larger Kp, the proportional control operation is getting stronger. The scope is real number.

(h) Integral time

It sets the integral time of PID loop in question (Ti). As larger the integral time, the integral operation is getting weaker. The scope is real number at the unit of second.

(i) Differential time

It sets the differential time of PID loop in question (Td). As larger the differential time, the differential operation is getting stronger. The scope is real number at the unit of second.

(j) Limiting change of present value

It sets the limit of change in present value of PID loop in question. If PV suddenly changes due to signal components such as sensor's malfunction, noise or disturbance during control of PID, it may cause sudden change of PID control output. To prevent the phenomenon, a user can set the max. limit of change in present value that is allowed per PID operation cycle. If the change of present value is limited accordingly, it may calculate the present value as much as the limit although the present value is changed more than the limit once the limit of change in present value is set. If using the PV change limit function, it may prevent against sudden change of control output owing to noise or etc. If it is, however, set too small, it may reduce the response speed to the PV change of an actual system, not to sudden change by noise or etc, so it is necessary to set the value appropriately according to the environment of a system to control in order that the PV toward the set value does not take a longer time. The available scope is between -32,768~32,767. If setting the PV change limit as 0, the function is not available.

(k) Limiting change of MV (ΔMV function)

It limits the max. size that control output, which is output by PID operation is changed at a time. The output MV in this operation cycle is not changed more than the max. change limit set in the previous operation cycle. The function has an effect to prevent a drive from operating excessively due to sudden change of output by preventing sudden change of output resulting from instantaneous change of set value. If it is, however, set too small, it may cause taking a longer time until PV reaches to its target, so it is necessary to adjust it appropriately. The available scope is between -32,768 ~ 32,767. If setting it as 0, the function does not work.

(l) Max. MV

It sets the max. value of control output that may be output by the result of PID operation. The available scope is between -32,768 ~ 32,767. if it exceeds the max. output designated by PID operation result, it outputs the set max. output and alerts the max. output excess warning. For the types and description of warnings, refer to Error/Warning Codes.

(m) Min. MV

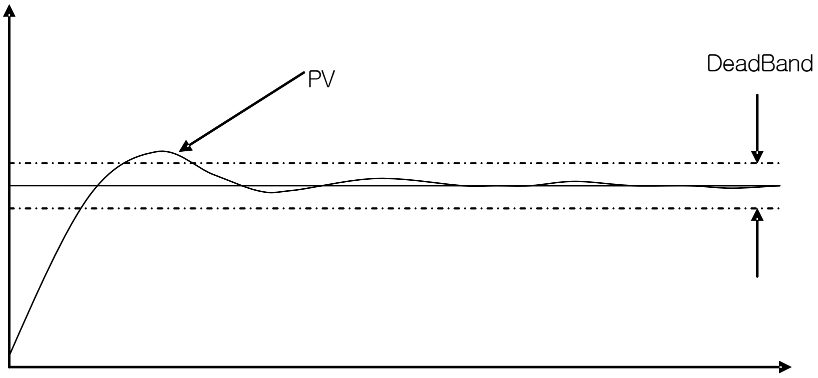
It sets the min. value of control output that may be output by the result of PID operation. The available scope is between -32,768 ~ 32,767. If it is smaller than the min. output value designated by PID operation result, it outputs the set min. MV and alerts the min. output shortage warning. For the types and description of warnings, refer to Error/Warning Codes.

(n) Manual MV

It sets the output when the operation mode is manual. The available scope is between -32,768 ~ 32,767.

(o) DeadBand setting

It sets the deadband between set value and present value. Although it may be important to reduce normal status reply of PV for its set value even when MV fluctuates heavily, depending on control system, it may be more important to reduce the frequent change of MV although the normal status reply is somewhat getting larger. DeadBand may be useful in the case. Below figure shows an example of DeadBand setting.



[ Figure 5.11 Example of DeadBand setting ]

If setting deadband as in the figure, the PID control built in XGB may regard the error between PV and set value as 0 as long as PV is within the available scope of deadband from set value.

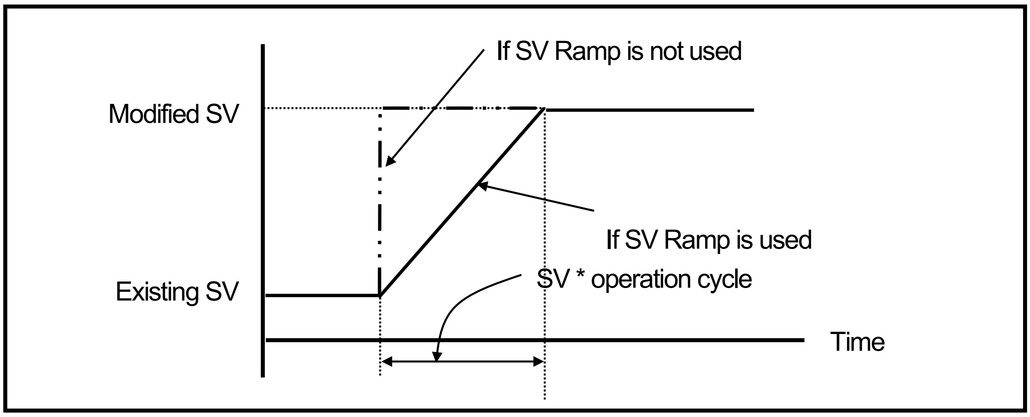
That is, in this case, the change of MV is reduced. The available scope of setting is between 0 ~ 65,535 and if it is set as 0, it does not work.

(o) Differential Filter Value Setting

It sets the coefficient of differential filter. Since differential control outputs in proportion to gradient of error and gradient of PV change, it may suddenly change MV as it generates a large response to instantaneous noise or disturbance. To prevent it, XGB series uses a value to which PV is filtered mathematically for differential control. Differential filter value is the coefficient to determine the filter degree for differential control. As smaller differential value set, as stronger differential operation is. The available scope is between 0 ~ 65,535 and if it is set as 0, the differential filter does not work.

(p) Setting set value ramp

Since the drift is suddenly large if SV is heavily changed during PID control, MV is also changed heavily to correct it. Such an operation may cause excessive operation of a system to control and a drive. To prevent it, SV ramp is used, changing SV gradually step by step when modifying SV during operation. If using the function, SV is gradually changed by SV ramp when SV is changed during PID control. At the moment, SV ramp setting represents the frequency of PID operation cycle taken from when SV starts changing to when it reaches to the final SV. For instance, if SV is to be changed from 1000 to 2000 during operation as PID operation cycle is 10ms and its SV ramp is 500, SV may reach to 2000 after 500X10ms = 5 seconds, that is, as it increases each 2 per operation cycle and after the 500th operation scans. The available scope of setting is between 0 ~65,535 and it is set as 0, it does not work.



[ Figure 5.12 SV Ramp function ]

(q) PV Follow-up setting

It is intended to prevent any excessive operation of a drive resulting from sudden change of output at the initial control and changes SV gradually from PV at the time when PID operation starts, not directly to SV in case control just turns from stop to operation mode or it changes from manual to automatic operation. At the moment, SV represents the frequency of PID operation cycles taken from when control starts to when it reaches to the set SV (other operations are same as SV ramp function). The available scope is between 0 ~ 65,535. If SV is changed again while PV follow-up is in operation, the SV would be also changed according to SV ramp.

(r) Min./max. PV

It sets the min./max. value entered as the present value of PID control. The available scope is between -32,768 ~ 32,767.

## 5.4.2 PID Flags

The parameter set by the XGB series built-in PID control function is saved into the flash memory of the basic unit. Such parameters are moved to K area for the built-in PID function as soon as PLC turns from STOP to RUN mode. PID control operation by PID control command is executed through K area data for PID functions. Therefore, if a user changes the value in the trend monitor window or variable monitor window during operation, PID operation is executed by the changed value. At the moment, if PLC is changed to RUN again after being changed to STOP, it loads the parameters in flash memory to K area, so the data changed in K area is lost. Thus, to keep applying the parameters adjusted in K area, it is necessary to write the parameter set in K area to flash memory by using WRT command. (In case of IEC, APM_WRT)

(1) PID Flag Configuration

K area flags for XGB series built-in PID control function are summarized in the below table.

| Loop | K area | IEC type | Symbol | Data type | Default | Description |
|---|---|---|---|---|---|---|
| Common | K12000~F | %KX19200~15 | _PID_MAN | Bit | Auto | PID output designation (0:auto, 1:manual) |
| | K12010~F | %KX19216~31 | _PID_PAUSE | Bit | RUN | PID pause (0:RUN, 1:pause) |
| | K12020~F | %KX19232~47 | _PID_REV | Bit | Forward | Control direction(0:forward, 1:reverse) operation control |
| | K12030~F | %KX19248~63 | _PID_AW2D | Bit | Disabled | Dual integral accumulation Prevention (0:enabled, 1:disabled) |
| | K12060~F | %KX19296~311 | _PID_D_on_ERR | Bit | ERR | PID Derivative term (0:on PV, 1:on ERR) |
| | K12040~F | %KX19264~79 | _PID_REM_RUN | Bit | Disabled | PID remote operation (0:disabled, 1:enabled) |
| | K1205~K1207 | %KW1205~%KW1207 | Reserved | WORD | - | Reserved area |
| | K12080~F | %KX19328~43 | _PID_PWM_EN | Bit | Disabled | PWM output enable (0:disabled, 1:enabled) |
| | K12090~F | %KX19344~59 | _PID_STD | Bit | - | PID operation indication (0:stop, 1:run) |
| | K12100~F | %KX19360~75 | _PID_ALARM | Bit | - | PID warning (0:normal, 1:warning) |
| | K12110~F | %KX19376~91 | _PID_ERROR | Bit | - | PID error(0:normal, 1:error) |
| | K12120~F | %KX19392~407 | _PID_MV_BMPL | Bit | Disabled | PID MV BuMPLess changeover (0:disabled, 1:enabled) |
| | K1213~K1215 | %KW1213~%KW1215 | Reserved | WORD | - | Reserved |
| Loop 0 | K1216 | %KW1216 | _PID00_SV | INT | 0 | PID SV |
| | K1217 | %KW1217 | _PID00_T_s | WORD | 100 | PID operation cycle[0.1ms] |
| | K1218 | %KD609 | _PID00_K_p | REAL | 1 | PID proportional constant |
| | K1220 | %KD610 | _PID00_T_i | REAL | 0 | PID integral time[sec] |
| | K1222 | %KD611 | _PID00_T_d | REAL | 0 | PID differential time[sec] |
| | K1224 | %KW1224 | _PID00_d_PV_max | WORD | 0 | PID PV change limit |
| | K1225 | %KW1225 | _PID00_d_MV_max | WORD | 0 | PID MV change limit |
| | K1226 | %KW1226 | _PID00_MV_max | INT | 4000 | PID MV max. value limit |
| | K1227 | %KW1227 | _PID00_MV_min | INT | 0 | PID MV min. value limit |
| | K1228 | %KW1228 | _PID00_MV_man | INT | 0 | PID manual output |

| | | | | | | |
|---|---|---|---|---|---|---|
| | K1229 | %KW1229 | _PID00_PV | INT | - | PID PV |

< Table 5.8 K area flags for PID control >

| Loop | K area | IEC type | Symbol | Data type | Default | Description |
|---|---|---|---|---|---|---|
| Loop 0 | K1230 | %KW1230 | _PID00_PV_old | INT | - | PID PV of previous cycle |
| | K1231 | %KW1231 | _PID00_MV | INT | 0 | PID MV |
| | K1232 | %KD616 | _PID00_ERR | DINT | - | PID control error |
| | K1234 | %KD617 | _PID00_MV_p | REAL | 0 | PID MV proportional value component |
| | K1236 | %KD618 | _PID00_Mv_i | REAL | 0 | PID MV integral control component |
| | K1238 | %KD619 | _PID00_MV_d | REAL | 0 | PID MV differential control component |
| | K1240 | %KW1240 | _PID00_DB_W | WORD | 0 | PID deadband setting |
| | K1241 | %KW1241 | _PID00_Td_lag | WORD | 0 | PID differential filter coefficient |
| | K1242 | %KW1242 | _PID00_PWM | WORD | H'20 | PID PWM junction setting |
| | K1243 | %KW1243 | _PID00_PWM_Prd | WORD | 100 | PID PWM output cycle |
| | K1244 | %KW1244 | _PID00_SV_RAMP | WORD | 0 | PID SV Ramp value |
| | K1245 | %KW1245 | _PID00_PV_Track | WORD | 0 | PID PV follow-up setting |
| | K1246 | %KW1246 | _PID00_PV_MIN | INT | 0 | PID PV min. value limit |
| | K1247 | %KW1247 | _PID00_PV_MAX | INT | 4000 | PID PV max. value limit |
| | K1248 | %KW1248 | _PID00_ALM_CODE | Word | 0 | PID warning code |
| | K1249 | %KW1249 | _PID00_ERR_CODE | Word | 0 | PID error code |
| | K1250 | %KW1250 | _PID00_CUR_SV | INT | 0 | PID SV of current cycle |
| | K1251-1255 | %KW1251-1255 | Reserved | WORD | - | Reserved area |
| Loop 1 | K1256~K1295 | %KW1256~%KW1295 | - | - | - | PID Loop1 control parameter |
| ~ | | | | | | |
| Loop16 | K1816~K1855 | %KW1816~%KW1855 | - | - | - | PID Loop16 control parameter |

< Table 5.8 K area flags for PID control (continued) >

K1200 ~ K1211 areas are the common bit areas of PID loops while each bit represents the status of each PID control loop. Therefore, each 16 bits, the max number of loops of XGB PID control represents loop status and setting respectively. K1216 ~ K1255 areas are K areas for PID control loop 0 and save the loop 0 setting and status. It also contains parameters such as SV, operation cycle, proportional coefficient, integral time and differential time set in the built-in parameter window and the XGB built-in PID function executes PID control by each device value in question. In addition, the output data such as MV calculated and output while PID control is executed is also saved into the K areas. By changing the values in K areas, control setting may be changed any time during PID control.

**Remark**

By changing value of area, you can change control setting whenever you want during the PID control

1) PID control flag expression : _PID[n]_xxx

➔ [n] : loop number

➔ xxx : flag function

Ex) _PID10_K_p : means K_p of loop 10.

(2) PID flag function

Each function of K area flags for XGB series built-in PID control function is summarized as follows.

(a) Common bit area

The area is a flag collecting operation setting and information consisting of bits to each 16 loop. Each bit of each word device represents the information of each loop. That is, 'n' th bit represents the information about PID loop n.

1) _PID_MAN (PID RUN mode setting)

| Flag name | address | IEC type address | Unit | Setting |
|---|---|---|---|---|
| _PID_MAN<br>(PID RUN mode setting) | K1200n | %KX19200 + n | BIT | Available |

It determines whether to operate the PID control of n loop automatically or manually. For more information about RUN mode, refer to 5.4.1 PID control parameter setting. If the bit is off, it operates automatically; if on, it runs manually.

2) _PID_PAUSE (PID Pause setting)

| Flag name | Address | IEC type address | Unit | Setting |
|---|---|---|---|---|
| _PID_PAUSE (PID pause setting) | K1201n | %KX19216 + n | BIT | Available |

It changes PID control of n loop to pause status. If PID control is paused, the control MV is fixed as the output at the time of pause. At the moment, PID operation is continued internally with output fixed. If changing pause status to operation status again, it resumes control, so it may take a longer time until the PV is going to SV once system status is largely changed during pause. If the bit is off, it cancels pause; if on, it operates as paused.

3) _PID_REV (PID RUN direction setting)

| Flag name | Address | IEC type address | Unit | Setting |
|---|---|---|---|---|
| _PID_REV<br>(PID RUN direction setting) | K1202n | %KX19232 + n | BIT | Available |

It sets the RUN direction of PID control of 'n'th loop. For more information about run direction, refer to 7.2.3 PID control parameter setting. If the bit is off, it operates normally; if on, it operates reversely.

4) _PID_AW2D (Dual Integral accumulation prevention setting)

| Flag name | Address | IEC type address | Unit | Setting |
|---|---|---|---|---|
| _PID_AW2D (dual integral accumulation prevention setting) | K1203n | %KX19248 + n | BIT | Available |

1.1

It sets enable/disable of dual integral accumulation prevention of ‘n’th loop. For more information about dual integral accumulation prevention, refer to 7.2.3 PID control parameter setting. If the bit is off, it is enabled; if on, it is disabled.

5) _PID_D_on_ERR (PID Derivative term)

| Flag name | Address | IEC type address | Unit | Setting |
|---|---|---|---|---|
| _PID_D_on_ERR (PID Derivative term) | K1206n | %KX19296 + n | BIT | Available |

Set the D operation source of the nth loop to PV / ERR.

6) _PID_REM_RUN (PID remote operation setting)

| Flag name | Address | IEC type address | Unit | Setting |
|---|---|---|---|---|
| _PID_REM_RUN (PID remote run setting) | K1204n | %KX19264 + n | BIT | Available |

XGB series built-in PID function can be started by both run from command’s start junction and remote run bit setting. That is, XGB starts PID control if PIDRUN command’s start junction is on or remote run setting bit is on. Namely, if one of them is on, it executed PID control.

7) _PID_PWM_EN (PWM output enable)

| Flag name | Address | IEC type address | Unit | Setting |
|---|---|---|---|---|
| _PID_PWM_EN (PWM output enable) | K1208n | %KX19328 + n | BIT | Available |

It determines whether to output the MV of PID control of ‘n’th loop as PWM output. For more information about PWM output, refer to 5.2.3 PID control parameter setting. If the bit is off, it is disabled; if on, it is enabled.

8) _PID_STD (PID RUN status indication)

| Flag name | Address | IEC type address | Unit | Setting |
|---|---|---|---|---|
| _PID_STD (PID RUN status indication) | K1209n | %KX19344 + n | BIT | Unavailable |

It indicates the PID control RUN status of ‘n’ th loop. If a loop is running or paused, it is on while if it stops or has an error during RUN, it is off. In the area as monitoring area, it is changed to the current run status by PLC although a user enters any value temporarily.

9) _PID_ALARM (PID Warning occurrence)

| Flag name | Address | IEC type address | Unit | Setting |
|---|---|---|---|---|
| _PID_ALARM<br>(PID Warning occurrence) | K1210n | %KX19360 + n | BIT | Unavailable |

It indicates warning if any warning occurs during PID control of 'n'th loop. Once a warning occurs during PID control operation of a loop, it is on while if it is normal, it is off. At the moment, despite of warning, PID control continues without interruption, but it is desirable to check warning information and take a proper measure. Once a warning occurs, the warning code is also indicated in warning code area of a loop. For more information about the types of warning codes and measures, refer to 5.5. In the area as monitoring area, it is changed to the current run status by PLC although a user enters any value temporarily.

10) _PID_ERROR (PID Error occurrence)

| Flag name | Address | IEC type address | Unit | Setting |
|---|---|---|---|---|
| _PID_ERROR<br>(PID error occurrence) | K1211n | %KX19376 + n | BIT | Unavailable |

If an error that discontinues running during PID control of 'n' th loop occurs, it indicates the error's occurrence. If an error generates warning, it is on; if normal, it is off. When an error occurs, PID control stops and MV output becomes 0. Also, if an error occurs, the error code is indicated in the error code area of a loop. For more information about type of error codes and measures, refer to 5.5. In the area as monitoring area, it is changed to the current run status by PLC although a user enters any value temporarily.

11) _PID_MV_BMPL (PID MV BuMPLess changeover)

| Flag name | Address | IEC type address | Unit | Setting |
|---|---|---|---|---|
| _PID_MV_BMPL<br>(PID MV BuMPLess changeover) | K1212n | %KX19392 + n | BIT | Available |

This allows to not only determine an appropriate MV value through operation so that MV can continue smoothly when the corresponding PID loop changes from manual to auto output mode, but also reflect the MV value to the internal state so as to stabilize MV. This function shows an algorithm difference between single operation and cascade operation, but both operations are performed by this bit.
If the corresponding bit (in cascade operation, the corresponding bit of the master/slave loop is On) is On, Bumpless changeover is performed. If it is Off, The [Default] Bumpless changeover function is Disabled

(b) PID Flag area by loops

PID flag areas by loops are allocated between K1216 ~ K1855 and for totally 16 loops, each 40 words is allocated per loop. Therefore, the individual data areas of 'n' th loop are between K (1216+16*n) ~ K (1255+16*n). Every setting of the PID flag areas by loops may be changed during PID control operation. Once the settings are changed, they are applied from the next PID control cycle.

1) _PIDxx_SV (PID xx Loop SV setting)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| I<br>t _PIDxx_SV<br>(PID xx Loop SV setting) | K1216+16*xx | %KW1216+16*xx | INT | -32,768 ~ 32,767 |

It sets/indicates the SV of PID control of 'xx' th loop. For more information about SV, refer to 5.2.3 PID control parameter setting. The available scope is between -32,768 ~ 32,767.

2) _PIDxx_T_s (PID xx Loop operation cycle)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_T_s<br>(PID xx Loop operation cycle) | K1217+16*xx | %KW1217+16*xx | WORD | 100 ~ 65,535 |

It sets/indicates the operation cycle of PID control of 'xx' th loop. For more information about operation cycle, refer to 5.2.3 PID control parameter setting. The available scope is between 100 ~ 65,535.

3) _PIDxx_K_p (PID xx Loop proportional constant)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_K_p<br>(PID xx Loop proportional constant) | K1218+16*xx | %KD609+20*xx | REAL | Real number |

It sets/indicates the proportional constant of PID control of 'xx' th loop. For more information about proportional constant, refer to 7.2.3 PID Control Parameter Setting. The available scope is real number (-3.40282347e+38 ~ -1.17549435e-38 , 0 , 1.17549435e-38 ~ 3.40282347e+38). If it is, however, set as 0 and lower, the PID control of a loop generates an error and does not work.

4) _PIDxx_T_i (PID xx Loop Integral time)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_T_i<br>(PID xx Loop integral time) | K1220+16*xx | %KD610+20*xx | REAL | Real number |

It sets/indicates integral time of PID control of 'xx' th loop. The available scope is real number. If it is set as 0 and lower, it does not execute integral control.

5) _PIDxx_T_d (PID xx Loop differential time)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_T_d<br>(PID xx Loop differential time) | K1222+16*xx | %KD611+20*xx | REAL | Real number |

It sets/indicates differential time of PID control of 'xx' th loop. The available scope is real number. If it is set as 0 and lower, it does not execute differential control.

6) _PIDxx_d_PV_max (PV change limit)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_d_PV_max<br>(PV change limit) | K1224+16*xx | %KD612+20*xx | WORD | 0 ~ 65,535 |

It sets the PV change limit of 'xx' th loop.
For more information about PV change limit, refer to 5.2.3 PID control parameter setting. If it is set as 0, the PV change limit function does not work.

7) _PIDxx_d_MV_max (MV change limit)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_d_MV_max<br>(MV change limit) | K1225+16*xx | %KD610+20*xx | WORD | 0 ~ 65,535 |

It sets the MV change limit of 'xx'th loop. For more information about MV change limit, refer to 5.2.3 PID control parameter setting. If it is set as 0, the MV change limit function does not work.

8) _PIDxx_MV_max, _PIDxx_MV_min, _PIDxx_MV_man (max. MV, min. MV, manual MV)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_MV_max (max. MV) | K1226+16*xx | %KW1226+16*xx | INT | -32,768 ~ 32,767 |
| _PIDxx_MV_min (min. MV) | K1227+16*xx | %KW K1227+16*xx | | |
| _PIDxx_MV_man (manual MV) | K1228+16*xx | %KW K1228+16*xx | | |

It sets the max. MV, min. MV and manual MV of 'xx' th loop. For more information about max. MV, min. MV and manual MV, refer to 5.2.3 PID control parameter setting. If the max. MV is set lower than the min. MV, the PID control loop generates an error and does not work.

9) _PIDxx_PV (prevent value)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_PV<br>(present value) | K1229+16*xx | %KW1229+16*xx | INT | -32,768 ~ 32,767 |

It is the area that receives the present value of 'xx' th PID control loop. PV is the present status of the system to control and is normally saved into U device via input devices such as A/D input module if it is entered from a sensor. The value is used to execute PID operation by moving to _PIDxx_PV by means of commands like MOV.

10) _PIDxx_PV_OLD (PV of previous control cycle)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_PV_OLD<br>(PV of previous control cycle) | K1230+16*xx | %KW1230+16*xx | INT | Unavailable |

The area indicates the PV just before the xx th PID control loop. The flag, as a dedicated monitoring flag, would be updated by PLC although a user directly enters it.

11) _PIDxx_MV (Control MV)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_MV (control MV) | K1231+16*xx | %KW1231+16*xx | INT | Unavailable |

The area shows the MV of 'xx' th PID control loop. As the area in which XGB built-in PID operation result is output every PID control cycle, it delivers the value in the area to U device every scanning by using commands like MOV in the program and outputs to D/A output module, operating a drive.

12) _PIDxx_ERR (Present error)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_ERR (present error) | K1232+16*xx | %KW1232+16*xx | DINT | Unavailable |

The areas shows the current error of 'xx' th PID control loop. It is also used as an indicator about how much gap the present status has with a desired status and if an error is 0, it means the control system reaches a desired status exactly. Therefore, if control starts, error is quickly reduced at transient state and it reaches normal state, maintaining remaining drift as 0, it could be an ideal control system. The flag, as a dedicated monitoring, is updated although a user directly enters it.

13) _PIDxx_MV_p, _PIDxx_MV_i, _PIDxx_MV_d (P/I/D control components of MV)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_MV_p (MV proportional control component) | K1234+16*xx | %KD616+20*xx | REAL | Unavailable |
| _PIDxx_MV_i (MV integral control component) | K1236+16*xx | %KD617+20*xx | | |
| _PIDxx_MV_d (MV differential control component) | K1238+16*xx | %KD618+20*xx | | |

It indicates 'n' th loop MV by classifying proportional control MV, integral control max. MV and differential control MV. The entire MV consists of the sum of these three components. The flag, as a dedicated monitoring, is updated although a user directly enters it.

14) _PIDxx_DB_W (DeadBand setting)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_DB_W (DeadBand setting) | K1240+16*xx | %KW1232+16*xx | WORD | 0 ~ 65,535 |

It sets the deadband of 'xx' th loop. For more information about Deadband function, refer to 5.2.3 PID control parameter setting. If it is set as 0, the function does not work.

15) _PIDxx_Td_lag (Differential filter coefficient)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_Td_lag<br>(differential filter coefficient) | K1241+16*xx | %KW1241+16*xx | WORD | 0 ~ 65,535 |

It sets the differential filter coefficient of 'xx' th loop. For more information about differential filter coefficient, refer to 5.2.3 PID control parameter setting. If it is set as 0, the function does not work.

16) _PIDxx_PWM (PWM output junction setting)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PID00_PWM<br>(PWM output junction setting) | K1242+16*xx | %KW1242+16*xx | WORD | H'20 ~ H'3F |

It sets the junction to which PWM output of 'xx' th loop is output. PWM output junction is valid only between H'20 ~ H'3F. If any other value is entered, PWM output does not work.

17) _PIDxx_PWM_Prd (PWM Output cycle setting)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_PWM_Prd<br>(PWM output cycle setting) | K1243+16*xx | %KW1243+16*xx | WORD | 100 ~ 65,535 |

It sets the PWM output cycle of 'xx' th loop. The available scope is between 100 ~ 65,535 at the unit of 0.1ms.

18) _PIDxx_SV_RAMP (SV ramp setting)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_SV_RAMP<br>(SV ramp setting) | K1244+16*xx | %KW1244+16*xx | WORD | 0 ~ 65,535 |

It sets the SV ramp value of 'xx' th loop. For more information about SV ramp of PV, refer to 5.2.3 PID control parameter setting. If it is set as 0, the function does not work.

19) _PIDxx_PV_Track (PV follow-up setting)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_PV_Track<br>(PV follow-up setting) | K1245+16*xx | %KW1245+16*xx | WORD | 0 ~ 65,535 |

It sets the PV follow-up SV of 'xx' th loop. For more information about PV follow-up, refer to 5.2.3 PID control parameter setting. If it is set as 0, the function does not work.

20) _PIDxx_PV_MIN, _PIDxx_PV_MAX(Min. PV input, Max. PV input)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| _PIDxx_MV_p<br>(MV proportional control component) | K1246+16*xx | %KW1246+16*xx | INT | -32,768 ~ 32,767 |
| _PIDxx_MV_i<br>(MV integral control component) | K1247+16*xx | %KW1247+16*xx | | |

It sets the min./max. PV of 'xx' th loop.

21) _PIDxx_ALM_CODE (Warning code)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_ALM_CODE<br>(Warning code) | K1248+16*xx | %KW1248+16*xx | WORD | Unavailable |

It indicates warning code if a warning occurs during 'xx' th loop run. The flag, as a dedicated monitoring, is updated although a user directly enters it. For more information about warning code, refer to 5.5.

22) _PIDxx_ERR_CODE (Error code)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_ERR_CODE<br>(error code) | K1249+16*xx | %KW1249+16*xx | WORD | Unavailable |

It indicates error code if an error occurs during 'xx' th loop run. The flag, as a dedicated monitoring, is updated although a user directly enters it. For more information about warning code, refer to 5.5.

23) _PIDxx_CUR_SV (SV of the present cycle)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_CUR_SV<br>(SV of the present cycle) | K1250+16*xx | %KW1250+16*xx | INT | Unavailable |

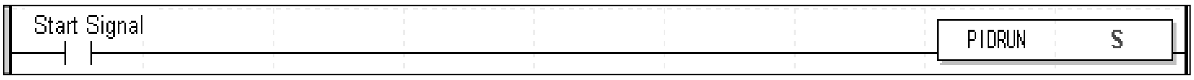
It indicates SV currently running of 'xx' th loop. If SV is changing due to SV ramp or PV follow-up function, it shows the currently changing PV. The flag, as a dedicated monitoring, is updated although a user directly enters it.

## 5.5 PID Instructions

It describes PID control commands used in XGB series. The command type of PID control used in XGB series built-in PID control is 4.

(1) PIDRUN

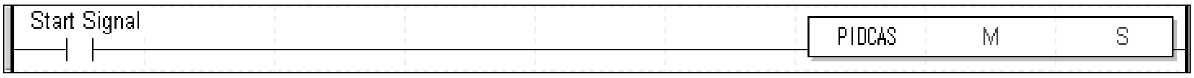
PIDRUN is used to execute PID control by loops.



- Operand S means the loop no. to execute PID control and avaiable only for constant(0~15).
- If start signal contact is on, the PID control of a loop starts.

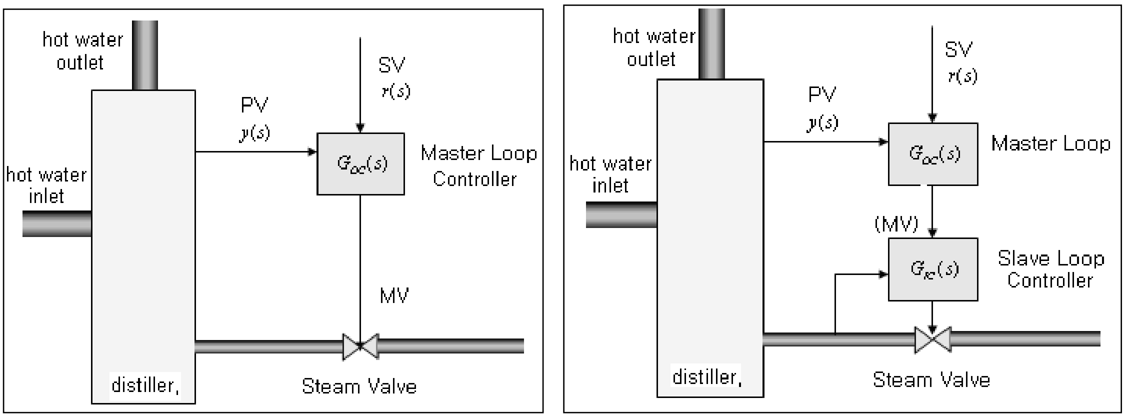
(2) PIDCAS

PIDCAS is a command to execute CASCADE control.



- Operand M and S mean master loop and slave loop respecively and available only for constant(0~15).
- If start signal contact is on, cascade control is executed through master loop and slave loop.

Cascade control is called a control method which is intended to increase control stability through quick removal of disturbance by connecting two PID control loops in series and is structured as follows.



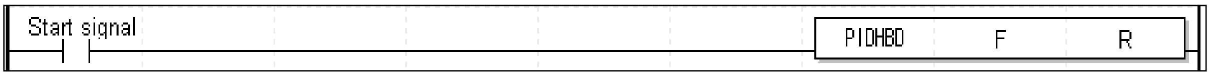
[Figure 5.13 Comparison of single loop control and cascade control]

Looking at the figure, it is found that cascade control contains slave loop control within external control loop. That is, the control output of external loop PID control is entered as SV of the internal loop control. Therefore, if steam valve suffers from disturbance in the figure, single loop PID control may not be modified until PV, y(s) appears while cascade control is structured to remove any disturbance by the internal PID loop control before any disturbance that occurs in its internal loop affects the PV, y(s), so it can early remove the influence from disturbance.

XGB internal PID control connects two PID control loops each other, making cascade control possible. At the moment, MV of external loop is automatically entered as the SV of internal loop, so it is not necessary to enter it through program.

(3) PIDHBD

PIDHBD is a command to execute the mixed forward/reverse E control.



- Operand F and R represent forward operation loop and reverse operation loop and available only for constant(0~15).
- If start signal conatact is on, it starts the mixed forward/reverse operation from the designated forward/reverse loops.

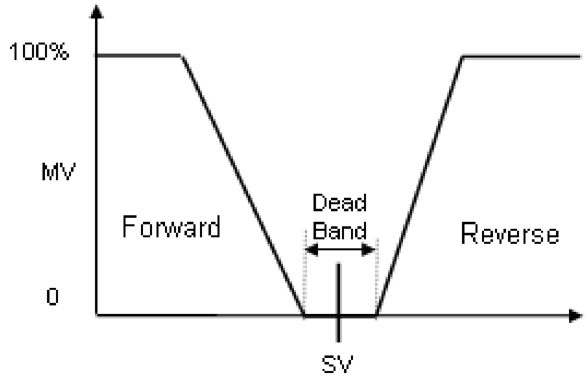
The mixed forward/reverse control is called a control method to control forward operation control output and reverse operation control operation alternatively to a single control process. The XGB built-in PID control enables the mixed forward/reverse control by connecting two PID control loops set as forward/reverse operations. At the moment, it uses PIDHBD command. For more information about the command, refer to 5.2.5. The mixed forward/reverse run is executed as follows in the XGB built-in PID control.

(a) Commencement of mixed run

If PIDHBC command starts first, it starts reverse run when PV is higher than SV; it starts forward run if PV is lower than SV.

(b) Conversion of RUN direction

The conversion of run direction is executed according to the following principles. In case of forward operation run, it keeps running by converting to reverse operation once PV is over SV + DeadBand value. At the moment, the DeadBand setting value uses the deadband of a loop set for forward operation. If PV is below SV – DeadBand value during reverse operation, it also keeps running by converting to forward operation. In the case, the DeadBand setting uses the deadband of a loop set for reverse loop. It may be illustrated as 5.14.



[Figure 5.14 Conversion of RUN direction in the mixed forward/reverse control]

(c) At the moment, every control parameter uses the parameter of a loop set for forward operation while MV is output to MV output area of a loop of forward operation. Reversely, every control parameter uses the parameter of a loop set for reverse operation during reverse operation run while MV is also output to MV output area of reverse operation loop.

## 5.6 PID Auto-tuning

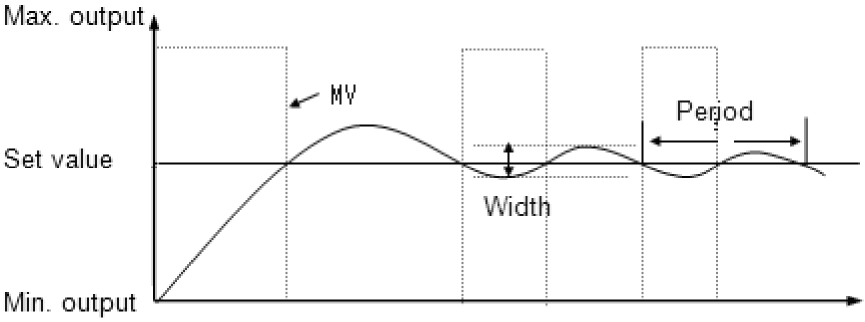
### 5.6.1 Basic Theory of PID Auto-tuning

It describes the function of PID auto-tuning.

The performance of PID controller is very different according to P, I, D coefficient. Generally, It is very difficult and takes long time to predict the system and set P, I, D coefficient because of non-periodical disturbance, interference of other control loop, dynamic characteristic of control system though the engineer is good at handling the PID controller. So auto-tuning that sets the PID coefficient automatically is very useful. Generally, there are many methods in setting the PID coefficient. Here, it will describe Relay Auto-tuning.

(1) PID coefficient setting by Relay auto-tuning

It makes critical oscillation by force and uses the width and period of oscillation to specify the PID coefficient. It applies max. output and min. output to control system for auto-tuning. Then, oscillation with steady period and steady width occurs around the Set value like figure 5.15, and it can calculate the boundary gain by using it like expression (5.3.1).



< Figure 5.15 Relay auto-tuning >

$$K_u = \frac{4 \times (Max.output - Min.output)}{\pi \times width} \qquad (5.4.1)$$

At this time, oscillation period is called boundary period. If boundary gain and period is specified, use table 5.9, Ziegler & Nichols tuning table to specify the PID coefficient. This Relay tuning is relatively simple to configure and easy to know the boundary gain and period so it is used frequently and XGB built-in PID auto-tuning uses this method.

| Controller | Proportional gain (Kp) | Integral time(Ti) | Differential time(Td) |
|---|---|---|---|
| P | $0.5K_u$ | - | - |
| PI | $0.45K_u$ | $P_u/1.2$ | - |
| PID | $0.6K_u$ | $P_u/2$ | $P_u/8$ |

< Table 5.9 Ziegler & Nichols tuning table >

## 5.6.2 PID Auto-tuning Function Specifications

The specifications of the XGB series built-in PID auto-tuning function are summarized as in Table.

| Item | | Specifications |
|---|---|---|
| Scope of SV | | INT (-32,768 ~ 32,767) |
| Scope of PV | | INT (-32,768 ~ 32,767) |
| Scope of MV | | INT (-32,768 ~ 32,767) |
| Error indication | | Normal: error flag off<br>Error: error flag off, error code occurs |
| AT direction setting | | Forward/Reverse |
| Control cycle | | 100 ~ 65,536 (0.1msUnit) |
| Additional function | PWM output | Supportable |
| | Hysteresis | Supportable |

[Table 5.10 Spec. of built-in PID auto-tuning function]

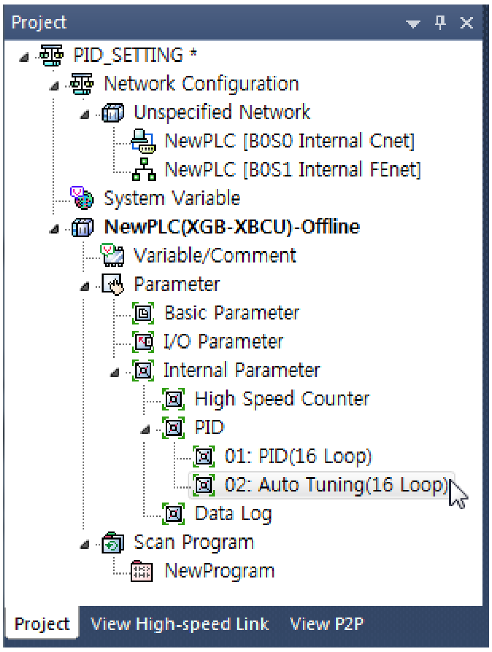
## 5.6.3 Auto-tuning Parameter Setting

To use the XGB series auto-tuning function, it is necessary to start it by using a command after setting auto-tuning parameters by loops in the parameter window. It explains the parameters to use auto-tuning function and how to set them.

(1) Auto-tuning parameter setting

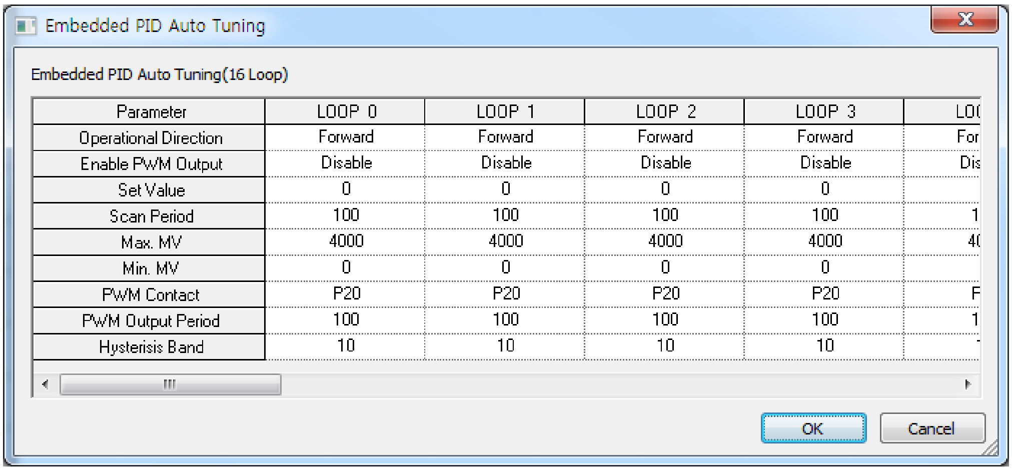
To set the parameters of XGB series auto-tuning function, follow the steps.

(a) If selecting parameter in project window and the built-in parameter, it shows the built-in parameter setting window as seen in below figure.



< Figure 5.16 Built-in parameter setting window >

(b) If selecting auto-tuning, it shows the parameter setting window as seen in Figure 5.17.



Embedded PID Auto Tuning(16 Loop)

| Parameter | LOOP 0 | LOOP 1 | LOOP 2 | LOOP 3 | LO |
|---|---|---|---|---|---|
| Operational Direction | Forward | Forward | Forward | Forward | For |
| Enable PWM Output | Disable | Disable | Disable | Disable | Dis |
| Set Value | 0 | 0 | 0 | 0 | |
| Scan Period | 100 | 100 | 100 | 100 | 1 |
| Max. MV | 4000 | 4000 | 4000 | 4000 | 4 |
| Min. MV | 0 | 0 | 0 | 0 | |
| PWM Contact | P20 | P20 | P20 | P20 | F |
| PWM Output Period | 100 | 100 | 100 | 100 | 1 |
| Hysterisis Band | 10 | 10 | 10 | 10 | |

<Figure 5.17 Built-in auto-tuning function parameter setting window>

(c) Input items

Table shows the items to set in auto-tuning parameter window and the available scopes.

| Items | Description | Scope |
|---|---|---|
| RUN direction | Set the run direction of auto-tuning. | Forward/reverse |
| PWM output enable | Set whether to set PWM output of MV enabled/ disabled. | Disable/enable |
| SV | Set SV. | -32,768 ~ 32,767 |
| Operation time | Set auto-tuning operation time. | 100 ~ 65535 |
| Max. MV | Set the max. MV in control. | -32,768 ~ 32,767 |
| Min. mV | Set the min. MV in control. | -32,768 ~ 32,767 |
| PWM junction designation | Designate the junction to which PWM output is output. | P20 ~ P3F |
| PWM output cycle | Set the output cycle of PWM output. | 100 ~ 65,535 |
| Hysteresis setting | Set the hysteresis of auto-tuning MV. | 0 ~ 65,535 |

< Table 5.11 Auto-tuning function parameter setting items>

(2) Description of auto-tuning parameters and how to set them

(a) RUN direction

RUN direction is to set the direction of auto-tuning run of a loop. The available option is forward or reverse. The former (forward) means that PV increase when MV increases while the latter (reverse) means PV decreases when MV increases. For instance, a heater is a kind of forward direction system because PV (temperature) increases when output (heating) increases. A refrigerator is a kind of reverse direction system in which PV (temperature) decreases when output increases.

(b) PWM output enable

PWM output means an output method to turn a junction on – off with a duty proportional to control output calculated by a uniform output cycle. If PWM output is enabled, it realizes PWM output in accordance with PWM output cycle set in the parameter of PWM output junction (P20 ~ P3F) designated in the parameter. At the moment, the PWM output cycle follows the PWM output cycle separately set in auto-tuning operation cycle.

(c) SV

It sets the auto-tuning SV of a loop in question. Similar to PID control, physical values (temperature, flow rate, pressure and etc) of an object to control is not meaningful and instead, it should use the physical amount of an object to control after converting them into numerals. For instance, in order to control a system using a sensor that the output is 0V when its heating device temperature is 0℃ while it is 10V when the temperature is 100℃ as much as 50℃, it is necessary to set SV as 2000(as long as it uses AD input module XBE-AD04A).

(d) Operation time

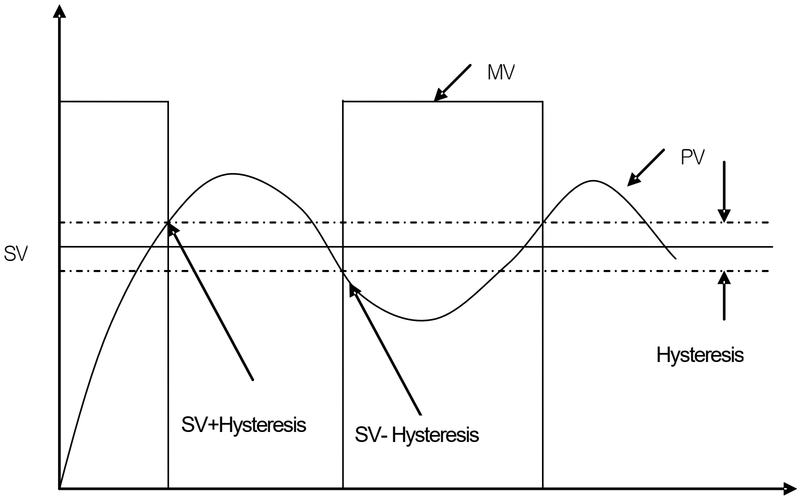
It sets the cycle to execute operation for auto-tuning. The setting cycle is 0.1ms and available between 10ms ~ 6553.5ms (setting value: 100 ~ 65,535) while it is set at a unit of integer per 0.1ms.

(e) Max./min. MV

It sets the max./min. value of output for auto-tuning. The available scope is between -32,768 ~ 32,767. If the max. MV is set lower than min. MV, the auto-tuning function of a loop generates an error and does not work.

(f) Hysteresis setting

Looking at relay tuning in Figure 5.15, it shows it outputs the max. MV as auto-tuning starts but it converts to min. output as PV is over SV and then, it converts to the max. output as PV is lower than SV. However, if input PV contains noise components or reply components, auto-tuning ends by a slight vibration of PV around SV, yielding incorrect tuning result. To prevent it, hysteresis may be set. XGB auto-tuning converts output at SV + Hysteresis when PV increases or at SV – Hysteresis when it decreases once hysteresis is set. With it, it may prevent incorrect tuning by a slight vibration around SV.



[Figure 5.16 Example of Hysteresis setting ]

### 5.6.4 Auto-tuning Flags

The parameters set in the XGB series auto-tuning function are saved to the flash memory of basic unit. Such parameters are moved to K area for auto-tuning function as soon as PLC enters to RUN mode from STOP. Auto-tuning operation using auto-tuning command is achieved by data in K area. At the moment, if PLC is changed to RUN again after being changed to STOP, it takes the parameters in flash memory to K area, so the data changed in K area is lost. Therefore, to continuously apply the parameters adjusted in K area, it is necessary to write the parameters set in K area into flash memory by using WRT command. (In case of IEC type, APM_WRT function block)

(1) Auto-tuning flag configuration

The K area flags of XGB series auto-tuning function are summarized in Table 5.12.

| Loops | K area | IEC type | Symbol | Data type | Default | Description |
|---|---|---|---|---|---|---|
| Common | K18560~F | %KX29696<br>~%KX29711 | _AT_REV | Bit | Forward | Auto-tuning direction(0:forward, 1:reverse) |
| | K18570~F | %KX29712<br>~%KX29727 | _AT_PWM_EN | Bit | Disable | PWM output enable(0:disable, 1:enable) |
| | K18580~F | %KX29728<br>~%KX29743 | _AT_ERROR | Bit | - | Auto-tuning error(0:normal,1:error) |
| | K1859 | %KW1859 | Reserved | WORD | - | Reserved area |
| Loop0 | K1860 | %KW1860 | _AT00_SV | INT | 0 | AT SV – loop 00 |
| | K1861 | %KW1861 | _AT00_T_s | WORD | 100 | AT operation cycle (T_s)[0.1msec] |
| | K1862 | %KW1862 | _AT00_MV_max | INT | 4000 | AT MV max. value limit |
| | K1863 | %KW1863 | _AT00_MV_min | INT | 0 | AT MV min. value limit |
| | K1864 | %KW1864 | _AT00_PWM | WORD | 0 | AT PWM junction setting |
| | K1865 | %KW1865 | _AT00_PWM_Prd | WORD | 0 | AT PWM output cycle |
| | K1866 | %KW1866 | _AT00_HYS_val | WORD | 0 | AT hysteresis setting |
| | K1867 | %KW1867 | _AT00_STATUS | WORD | 0 | AT auto-tuning status indication |
| | K1868 | %KW1868 | _AT00_ERR_CODE | WORD | 0 | AT error code |
| | K1869 | %KD | _AT00_K_p | REAL | 0 | AT result proportional coefficient |
| | K1871 | - | _AT00_T_i | REAL | 0 | AT result integral time |
| | K1873 | - | _AT00_T_d | REAL | 0 | AT result differential time |
| | K1875 | - | _AT00_PV | INT | 0 | AT PV |
| | K1876 | - | _AT00_MV | INT | 0 | AT MV |
| | K1877~1879 | %KW1877<br>~%KW1879 | Reserved | Word | 0 | Reserved area |

[Table 5.12 K area flags for auto-tuning]

K1856 ~ K1859 areas (In case of IEC type, %KW1856~%KW1859) are the common bit areas for auto-tuning and each bit represents auto-tuning loop status respectively. K1860~K1879 areas save the setting and status of loop 0 as the K area for auto-tuning loop 0. In the area, the parameters such as PV, operation cycle and etc set in the built-in parameter window are saved and the XGB built-in auto-tuning function executes auto-tuning by the device values and saves the results into the K areas.

(2) Auto-tuning flag function

Each function of K area flags for XGB series auto-tuning is summarized as follows.

A) Common bit area

The area is a flag collecting operation setting and information consisting of bits to each 16 loop. Each bit of each word device represents the information of each loop.

1) _AT_REV (auto-tuning run direction setting)

| Flag name | Address | IEC type address | Unit | Setting |
|---|---|---|---|---|
| _AT_REV<br>(PID RUN direction setting) | K1856n | %KX29696 + n | BIT | Available |

It determines the run direction of auto-tuning of ‘n’ th loop. If the bit is off, it is forward operation; if on, it is reverse operation.

2) _AT_PWM_EN (PWM output enable)

| Flag name | Address | IEC type address | Unit | Setting |
|---|---|---|---|---|
| _AT_PWM_EN<br>(PWM output enable) | K1857 | %KX29713 + n | BIT | Available |

It sets whether to output the auto-tuning MV of ‘n’ th loop as PWM output. If the bit is off, it is disabled; if on, it is enabled.

3) _AT_ERROR (Auto-tuning error occurrence)

| Flag name | Address | IEC type address | Unit | Setting |
|---|---|---|---|---|
| _PID_ERROR<br>(PID error occurrence) | K1858n | %KX29728 + n | BIT | Unavailable |

It indicates the error in case an error that discontinues operation during auto-tuning of ‘n’th loop occurs. If an error occurs, it is on; if normal, it is off. Once an error occurs, auto-tuning stops and the MV is output as the min. output set in the parameter. Also, if an error occurs, it indicates the error code in the error code area of a loop. For more information about error code types and measures, refer to 5.5. The area, as a dedicated monitor area, is updated although a user directly enters it.

B) Auto-tuning flag area by loops

The auto-tuning flag areas by loops are K1860 ~ K2179 and each 20 words per loop are allocated to totally 16 loops. Therefore, individual data area of ‘n’ th loop is between K (1860+16*n) ~ K (1879+16*n).

1) _ATxx_SV (auto-tuning xx Loop SV setting)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _ATxx_SV<br>(AT xx Loop SV setting) | K1860+16*xx | %KW1860+16*xx | INT | -32,768 ~ 32,767 |

It sets/indicates the auto-tuning SV of ‘xx’th loop.

The available scope is between -32,768 ~ 32,767.

2) _ATxx_T_s (Auto-tuning xx Loop operation cycle)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_T_s<br>(Auto-tuning xx Loop operation cycle) | K1861+16*xx | %KW1861+16*xx | WORD | 100 ~ 65,535 |

It sets/indicates the operation cycle of 'xx' th loop auto-tuning. The available scope is 100 ~ 65,535.

3) _ATxx_MV_max, _ATxx_MV_min(max. MV, min. MV)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _PIDxx_MV_max (Max. MV) | K1862+16*xx | %KW1862+16*xx | INT | -32,768 ~ 32,767 |
| _PIDxx_MV_min (Min. MV) | K1863+16*xx | %KW1863+16*xx | | |

It sets max. MV and min. MV of 'xx' th loop respectively. If the max. MV is set lower than min. MV, the auto-tuning loop generates an error and does not work.

4) _ATxx_PWM (AT output junction setting)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _AT00_PWM<br>(AT output junction setting) | K1864+16*xx | %KW1864+16*xx | WORD | H'20 ~ H'3F |

It sets the junction that PWM output of 'xx'th loop is output. The PWM output junction is valid only between H'20 ~ H'3F (hex). If any other value is entered, PWM output does not work.

5) _ATxx_PWM_Prd (PWM output cycle setting)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _ATxx_PWM_Prd<br>(PWM output cycle setting) | K1865+16*xx | %KW1865+16*xx | WORD | 100 ~ 65,535 |

It sets the PWM output cycle of 'xx' th loop. The available scope is between 100 ~ 65,535 at the unit of 0.1ms.

6) _ATxx_HYS_val (Hysteresis setting)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _ATxx_HYS_val (Hysteresis setting) | K1866+16*xx | %KW1866+16*xx | WORD | 0 ~ 65,535 |

It sets the hysteresis of 'xx' th loop. For more information about hysteresis function, refer to 5.3.3 Auto-Tuning Parameter Setting. If it is set as 0, it does not work.

7) _ATxx_STATUS (Auto-tuning status)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _ATxx_STATUS<br>(Auto-tuning status) | K1867+16*xx | %KW1867+16*xx | WORD | Unavailable |

It indicates the auto-tuning status of 'xx' th loop. If auto-tuning is in operation, it is 1(h0001); if completed, it is 128(h0080). In any other cases, it shows 0(h0000).

8) _ATxx_ERR_CODE (Error code)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _ATxx_ERR_CODE<br>(Error code) | K1868+16*xx | %KW1868+16*xx | WORD | Unavailable |

It indicates error code in case an error occurs during the auto-tuning of 'xx'th loop. The flag, as a dedicated monitor, is updated although a user directly enters it. For more information about error code, refer to 5.5.

9) _ATxx_K_p, _ATxx_T_i, _ATxx_T_d (AT result proportional coefficient, integral time, differential time)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _ATxx_K_p<br>(proportional coefficient) | K1869+16*xx | %KD934+20*xx | Real | Unavailable |
| _ATxx_T_i<br>(integral time) | K1871+16*xx | %KD1004+20*xx | | |
| _ATxx_T_d<br>(differential time) | K1873+16*xx | %K1005+20*xx | | |

The area indicates proportional coefficient, integral time and differential time calculated after the auto-tuning of 'xx' th loop is normally completed. The flag, as a dedicated monitoring, updated although a user directly enters it.

10) _ATxx_PV (PV)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _ATxx_PV (PV) | K1875+16*xx | %KW1875+16*xx | INT | -32,768 ~ 32,767 |

It is the area to receive PV of 'xx' th auto-tuning loop. PV is the present status of a system to control and in case of PID control, the entry from a sensor is saved into U device through input devices such as A/D input module and it moves the value to _ATxx_PV by using commands such as MOV every scanning, executing auto-tuning.

11) _ATxx_MV (Auto-tuning MV)

| Flag name | Address | IEC type address | Unit | Scope |
|---|---|---|---|---|
| _ATxx_MV (auto-tuning MV) | K1876+16*xx | %KW1876+16*xx | INT | Unavailable |

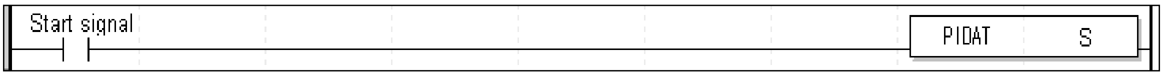
It is the area to output MV of 'xx' th auto-tuning loop. Every auto-tuning cycle, it saves XGB auto-tuning and it delivers the value in the area by using commands like MOV in a program and operates a drive every scanning.

### 5.6.5 Auto-tuning Instructions

The commands used in XGB series auto-tuning are as follows.

1) PIDAT

PIDAT is a command to execute auto-tuning by loops.

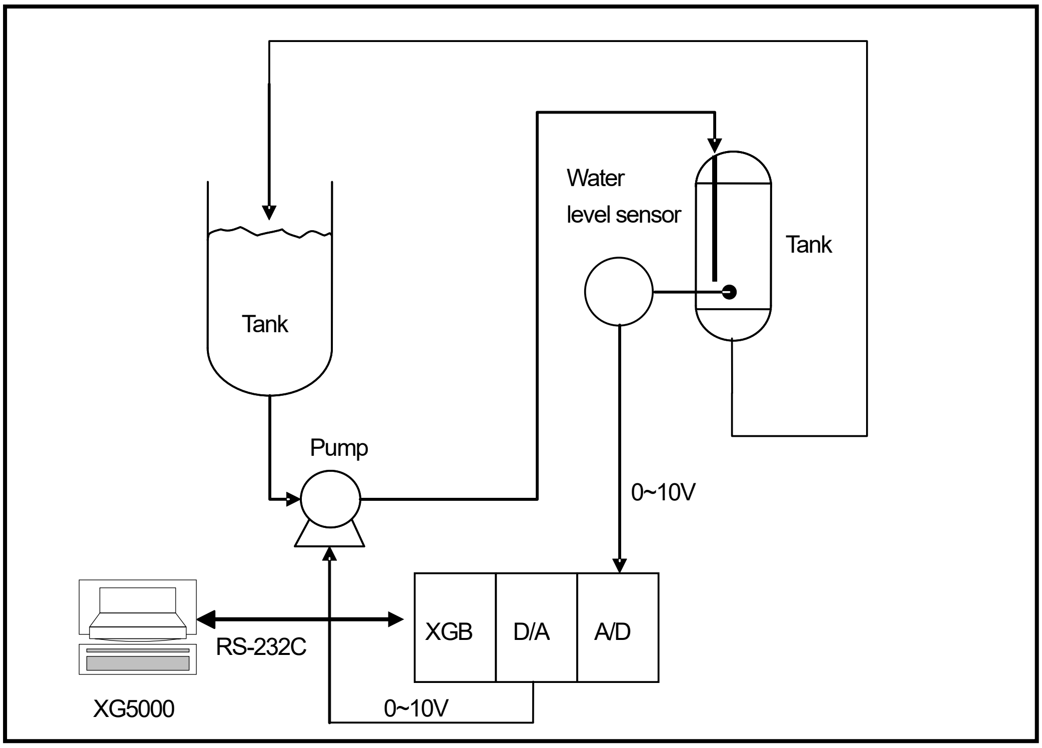


- Operand S means the loop no. to execute auto-tuning and avaiable only for constant(0~15).
- If start signal contact is on, the PID control of a loop starts.

## 5.7 Example Programs

The paragraph explains example programs regarding the directions of XGB built-in PID function.

The example programs are explained with water level system as illustrated in 5.17.



[ Figure 5.17 Example of water level control system ]

### 5.7.1 Example System Structure

The example system in figure is an example of a system to control a pail's water level to a desired level. The pail's water level is sensed by a water level sensor and entered to A/D input module while PID control operation result, MV is output to a pump through D/A output module, controlling a pump's rotation velocity, regulating the water amount flowing into a pail and regulating the water level as desired. Each mechanism is explained as follows.

(1) XGB basic unit

The XGB basic unit operates by PID control operating PID control operation. It receives PV from A/D input module (XBF-AD04A), executes the built-in PID control operation, output the MV to D/A (XBF-DV04A) and executes PID control.

(2) A/D input module (XBF-AD04A)

It functions as receiving PV of an object to control from a water level sensor and delivering it to basic unit. XBF-AD04A is a 4CH analog input module and settings of analog input types and scopes can be changed in the I/O parameter setting window appeared when selecting I/O parameter in the parameter item of project window. For more information, refer to Analog I/O Module.

(3) D/A output module (XBF-DV04A)

It functions as delivering control MV from basic unit to a drive (pump). XBF-DV04A is a 4CH analog voltage output module and ranges 0 ~ 10V. For detail setting, refer to Analog I/O Module.

(4) Water Level Sensor

A water level sensor plays a role to deliver the PV of an object to control to XGB by measuring the water level of a pail and outputting it within 0 ~ 10V. Since the types and output scope of water level sensors varies, the output scope of a sensor should be identical with that of A/D input module's input scope. The example uses a water level sensor outputting between 0 ~ 10V.

(5) Drive (pump)

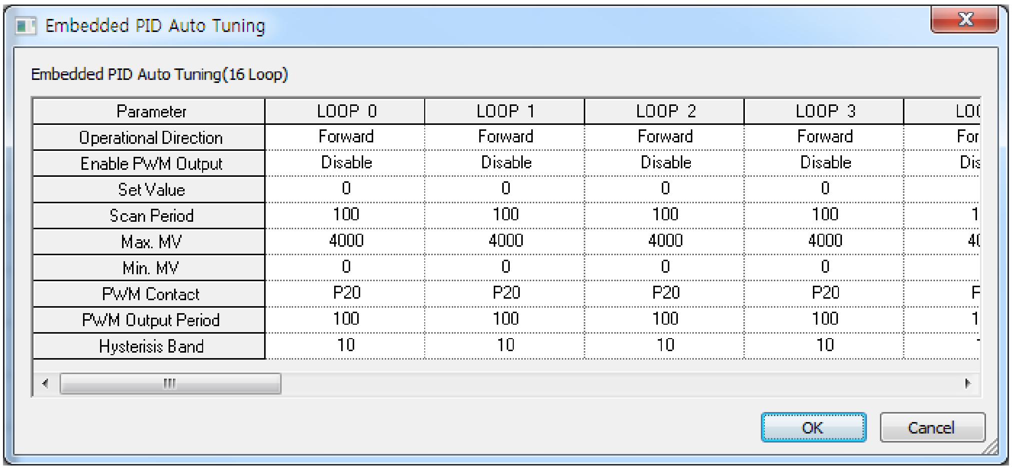
A drive uses a pump that receives control output of XGF-DV04A and of which rotation velocity is variable. For accurate PID control, the output scope of XBF-DV04A (0~10V) should be same with that of a pump's control input. The example uses a pump that receives its control input between 0 ~ 10V.

## 5.7.2 Example of PID Auto-tuning

Here, with examples, it explains how to calculate proportional constant, integral time and differential time by using PID auto-tuning function

(1) PID auto-tuning parameter setting

(a) If double-clicking Parameter – Built-in Parameter – PID – Auto-tuning parameter in the project window, it opens up the auto-tuning parameter setting window as illustrated in Figure 5.18.



Embedded PID Auto Tuning(16 Loop)

| Parameter | LOOP 0 | LOOP 1 | LOOP 2 | LOOP 3 | LO |
|---|---|---|---|---|---|
| Operational Direction | Forward | Forward | Forward | Forward | For |
| Enable PWM Output | Disable | Disable | Disable | Disable | Dis |
| Set Value | 0 | 0 | 0 | 0 | |
| Scan Period | 100 | 100 | 100 | 100 | 1 |
| Max. MV | 4000 | 4000 | 4000 | 4000 | 4 |
| Min. MV | 0 | 0 | 0 | 0 | |
| PWM Contact | P20 | P20 | P20 | P20 | F |
| PWM Output Period | 100 | 100 | 100 | 100 | 1 |
| Hysterisis Band | 10 | 10 | 10 | 10 | |

[Figure 5.18 Auto-tuning parameter setting window]

(b) Set each parameter and click OK.
In the example, Loop 0 is set as follows.

- RUN direction: forward
  - Since in the system, water level is going up as MV increases and pump's rotation velocity increases, it should be set as forward operation.

- PWM output: disabled
  - In the example, auto-tuning using PWM is not executed. Therefore, PWM output is set as disabled.

- SV: 1000(2.5V)
  - It shows an example in which XBF-AD04A is set as the voltage input of 0~10V.

- Max. MV: 4000
  - Max. MV is set as 4000. If MV is 4000, XBF-DV04A outputs 10V.

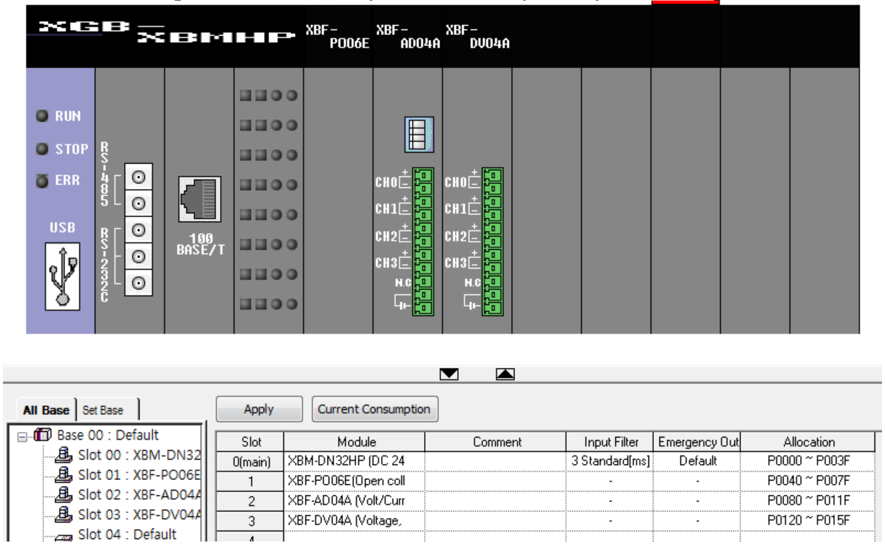
- Min. MV: 0
  - Min. MV is set as 0. If MV is 0, XBF-DV04A outputs 0V.

- PWM junction, PWM output cycle
  - It is not necessary to set it because the example does not use PWM output.

- Hysteresis setting: 10

(2) A/D input module parameter setting

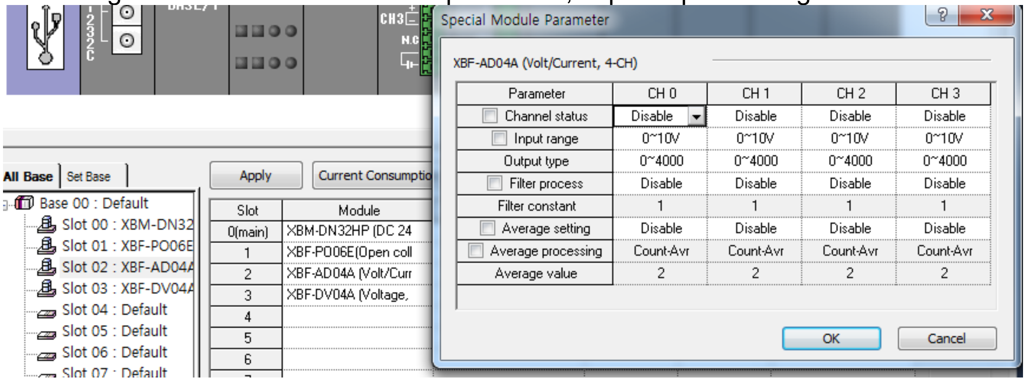
(a) If double-clicking Parameter – I/O parameter, it opens up the setting window as illustrated in figure 5.19.



| Slot | Module | Comment | Input Filter | Emergency Out | Allocation |
|---|---|---|---|---|---|
| 0(main) | XBM-DN32HP (DC 24 |  | 3 Standard[ms] | Default | P0000 ~ P003F |
| 1 | XBF-PO06E(Open coll |  | - | - | P0040 ~ P007F |
| 2 | XBF-AD04A (Volt/Curr |  | - | - | P0080 ~ P011F |
| 3 | XBF-DV04A (Voltage, |  | - | - | P0120 ~ P015F |

[ Figure 5.19 I/O parameter setting window ]

(b) If selecting A/D module for a slot in A/D input module, it opens up the setting window as illustrated in Figure 5.20.



XBF-AD04A (Volt/Current, 4-CH)

| Parameter | CH 0 | CH 1 | CH 2 | CH 3 |
|---|---|---|---|---|
| ☐ Channel status | Disable | Disable | Disable | Disable |
| ☐ Input range | 0~10V | 0~10V | 0~10V | 0~10V |
| Output type | 0~4000 | 0~4000 | 0~4000 | 0~4000 |
| ☐ Filter process | Disable | Disable | Disable | Disable |
| Filter constant | 1 | 1 | 1 | 1 |
| ☐ Average setting | Disable | Disable | Disable | Disable |
| ☐ Average processing | Count-Avr | Count-Avr | Count-Avr | Count-Avr |
| Average value | 2 | 2 | 2 | 2 |

[ Figure 5.20 A/D input mode setting window ]

(c) Check A/D Module operation parameter and click OK. The example is set as follows.

- RUN CH: CH0 RUN
  - The example receives the water level sensor input as CH0.

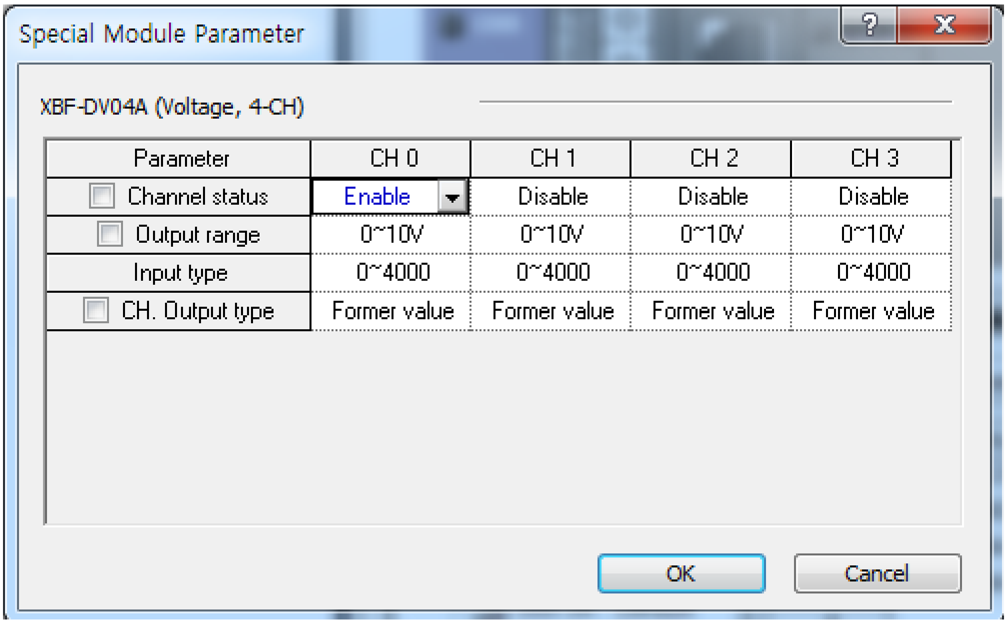
- Input scope: 0 ~ 10V
  - Set XBF-AD04A input scope as 0 ~ 10V so that it should be identical with the output scope of water level sensor.

- Output data type: 0 ~ 4000
  - It converts the input 0 ~ 10V to digital value from 0 ~ 4000 and delivers it to basic unit.
  - In the case, the resolving power of digital value 1 is 10/4000 = 2.5mV

- Filter process, averaging: disabled
  - The example sets the input values in order that filter process and averaging are not available.
  - For more information about each function, refer to Analog Manual.

(3) D/A Output Module Parameter setting

(a) Set the parameter of D/A output module(XBF-DV04A) that output MV to a drive.
How to set them is as same as A/D input module. In the example, it is set as follows.



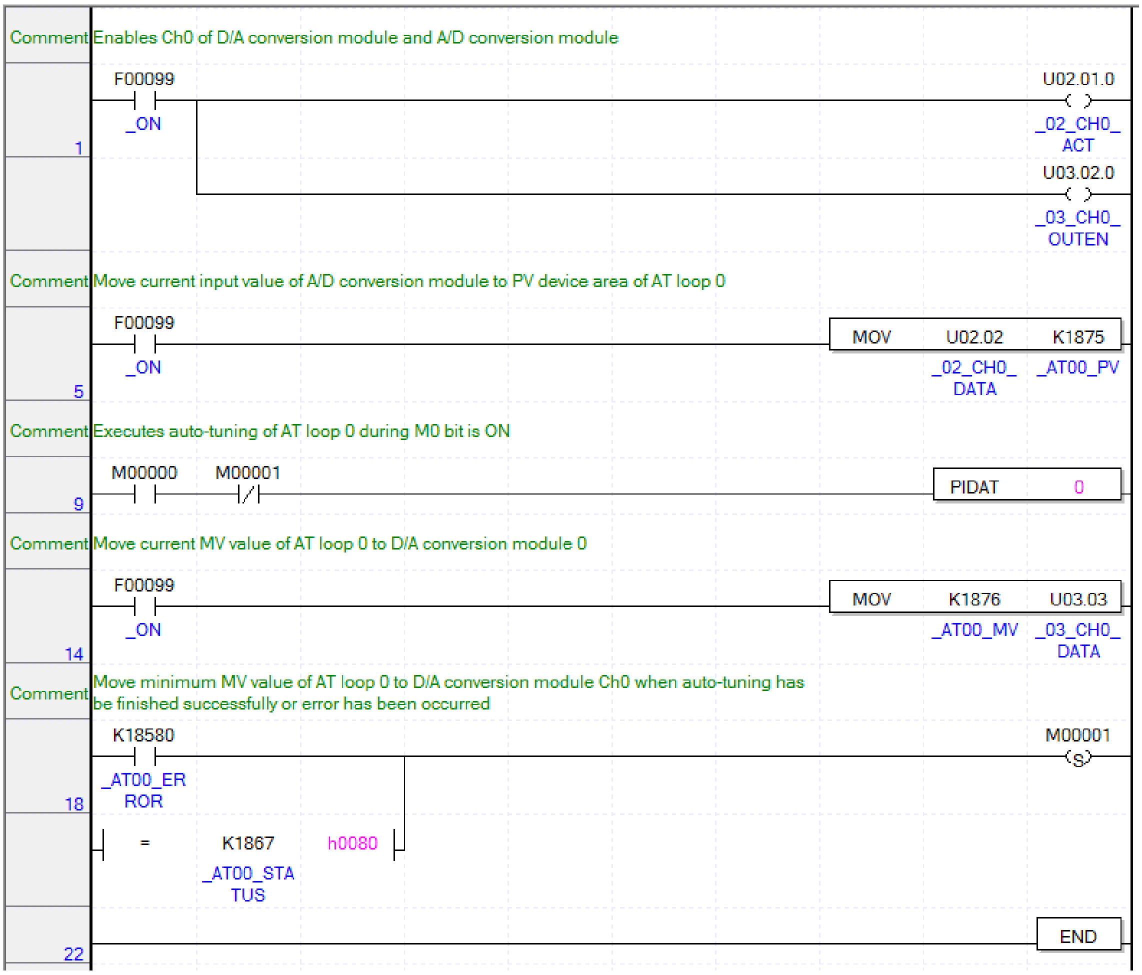
XBF-DV04A (Voltage, 4-CH)

| Parameter | CH 0 | CH 1 | CH 2 | CH 3 |
|---|---|---|---|---|
| ☐ Channel status | Enable | Disable | Disable | Disable |
| ☐ Output range | 0~10V | 0~10V | 0~10V | 0~10V |
| Input type | 0~4000 | 0~4000 | 0~4000 | 0~4000 |
| ☐ CH. Output type | Former value | Former value | Former value | Former value |

- RUN CH: CH0 RUN
  - In the example, MV is output as CH0 of D/A output module.
- Output range : 0 ~ 10V
- Input type: 0 ~ 4000

(4) Example of PID Auto-tuning program

The example of PID auto-tuning program is illustrated as Figure 5.21.



Comment Enables Ch0 of D/A conversion module and A/D conversion module

Comment Move current input value of A/D conversion module to PV device area of AT loop 0

Comment Executes auto-tuning of AT loop 0 during M0 bit is ON

Comment Move current MV value of AT loop 0 to D/A conversion module 0

Comment Move minimum MV value of AT loop 0 to D/A conversion module Ch0 when auto-tuning has be finished successfully or error has been occurred

< Figure 5.21 Auto-tuning example program >

(a) Devices used

| Device | Data type | Application |
|---|---|---|
| F0099 | BIT | It is always on, so it readily operates once PLC is RUN. |
| U02.02.0 | BIT | It starts operation of CH0 of Slot 2 A/D input module. |
| U03.02.0 | BIT | It starts operation of CH0 of Slot 3 D/A output module. |
| U02.02 | INT | PV entered to A/D input module. |
| U03.03 | INT | MV entered to D/A output module. |
| K1875 | INT | Device to which PV is entered for LOOP 0 auto-tuning |
| K1876 | INT | Device to which auto-tuning MV of LOOP 0 is output. |
| K1867 | WORD | Device to which auto-tuning status indicates. |
| K18580 | BIT | Junction that is on once auto-tuning has an error. |
| K1863 | INT | Min. MV of auto-tuning designated in parameter. |

(b) Program explanation

1) Since F0099(always on) is ON if PLC is converted form STOP to RUN, CH0 of A/D and D/A starts operating.

2) At the moment, PV entered to CH0 of A/D is moved to K1875, the input device of PV and saved accordingly.

3) Once M0000 junction is on, the auto-tuning of loop 0 starts.

4) The auto-tuning MV of loop 0 that is output by PIDAT command is output to D/A output module by line 14 MOV command.

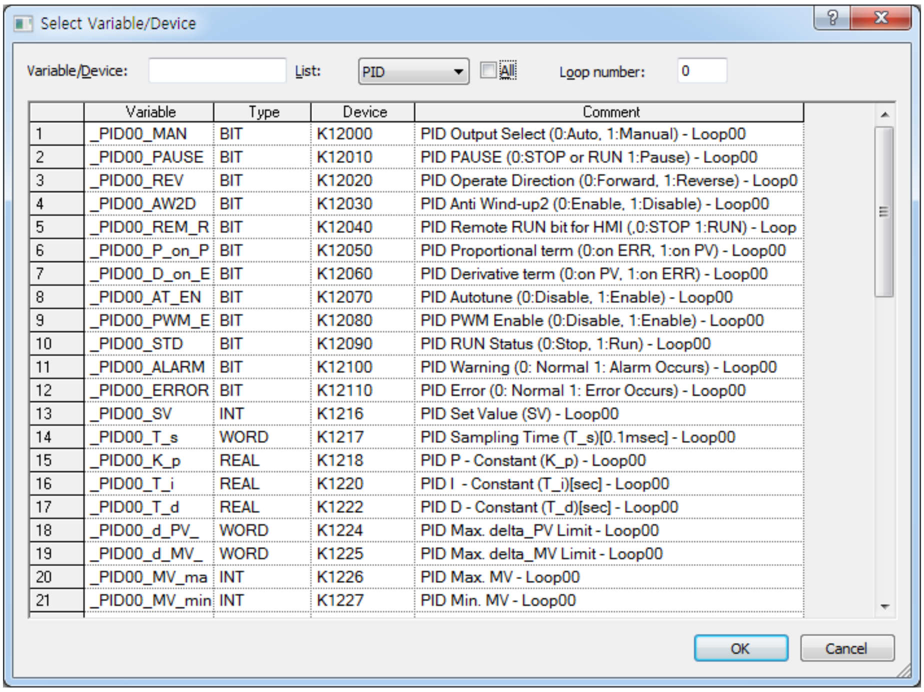
5) If auto-tuning is complete or there is any error during auto-tuning, M0001 junction is set, blocking operation of PIDAT command and it outputs min. MV set in parameter to D/A output module.

(c) Monitoring and changing PID control variables using K area

In XGB series built-in auto-tuning, it can monitor and change RUN status of auto-tuning by using K area allocated as fixed area by loops.

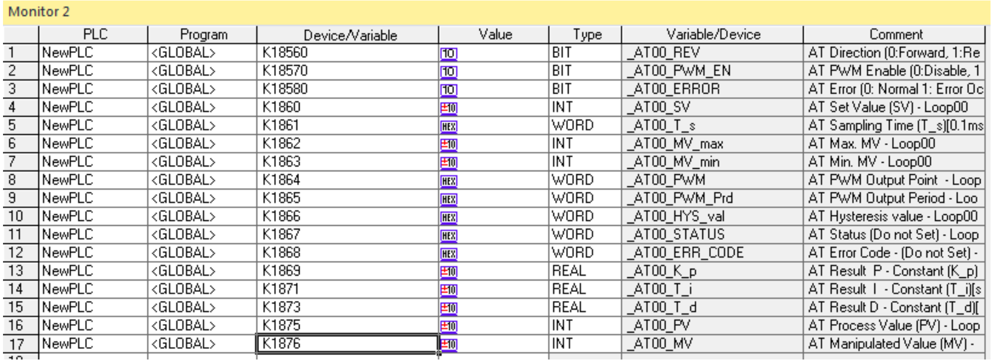
1) Variable registration

If selecting “Register in Variable/Description” by right clicking in the variable monitor window, “Variable/Device Selection” window appears. Select “Item” as PID, deselect “View All” and enter 0(means loop number) in “Parameter No”, K area device list to save every setting and status of loop 0 appears as shown Figure 5.22. Then, if selecting a variable to monitor and clicking “OK”, a selected device is registered to variable monitor window as illustrated in Figure 5.23. Through the monitor window, a user can monitor auto-tuning run status or change the settings.



| | Variable | Type | Device | Comment |
|---|---|---|---|---|
| 1 | _PID00_MAN | BIT | K12000 | PID Output Select (0:Auto, 1:Manual) - Loop00 |
| 2 | _PID00_PAUSE | BIT | K12010 | PID PAUSE (0:STOP or RUN 1:Pause) - Loop00 |
| 3 | _PID00_REV | BIT | K12020 | PID Operate Direction (0:Forward, 1:Reverse) - Loop0 |
| 4 | _PID00_AW2D | BIT | K12030 | PID Anti Wind-up2 (0:Enable, 1:Disable) - Loop00 |
| 5 | _PID00_REM_R | BIT | K12040 | PID Remote RUN bit for HMI (,0:STOP 1:RUN) - Loop |
| 6 | _PID00_P_on_P | BIT | K12050 | PID Proportional term (0:on ERR, 1:on PV) - Loop00 |
| 7 | _PID00_D_on_E | BIT | K12060 | PID Derivative term (0:on PV, 1:on ERR) - Loop00 |
| 8 | _PID00_AT_EN | BIT | K12070 | PID Autotune (0:Disable, 1:Enable) - Loop00 |
| 9 | _PID00_PWM_E | BIT | K12080 | PID PWM Enable (0:Disable, 1:Enable) - Loop00 |
| 10 | _PID00_STD | BIT | K12090 | PID RUN Status (0:Stop, 1:Run) - Loop00 |
| 11 | _PID00_ALARM | BIT | K12100 | PID Warning (0: Normal 1: Alarm Occurs) - Loop00 |
| 12 | _PID00_ERROR | BIT | K12110 | PID Error (0: Normal 1: Error Occurs) - Loop00 |
| 13 | _PID00_SV | INT | K1216 | PID Set Value (SV) - Loop00 |
| 14 | _PID00_T_s | WORD | K1217 | PID Sampling Time (T_s)[0.1msec] - Loop00 |
| 15 | _PID00_K_p | REAL | K1218 | PID P - Constant (K_p) - Loop00 |
| 16 | _PID00_T_i | REAL | K1220 | PID I - Constant (T_i)[sec] - Loop00 |
| 17 | _PID00_T_d | REAL | K1222 | PID D - Constant (T_d)[sec] - Loop00 |
| 18 | _PID00_d_PV_ | WORD | K1224 | PID Max. delta_PV Limit - Loop00 |
| 19 | _PID00_d_MV_ | WORD | K1225 | PID Max. delta_MV Limit - Loop00 |
| 20 | _PID00_MV_ma | INT | K1226 | PID Max. MV - Loop00 |
| 21 | _PID00_MV_min | INT | K1227 | PID Min. MV - Loop00 |

[Figure 5.22 Variable registration window]



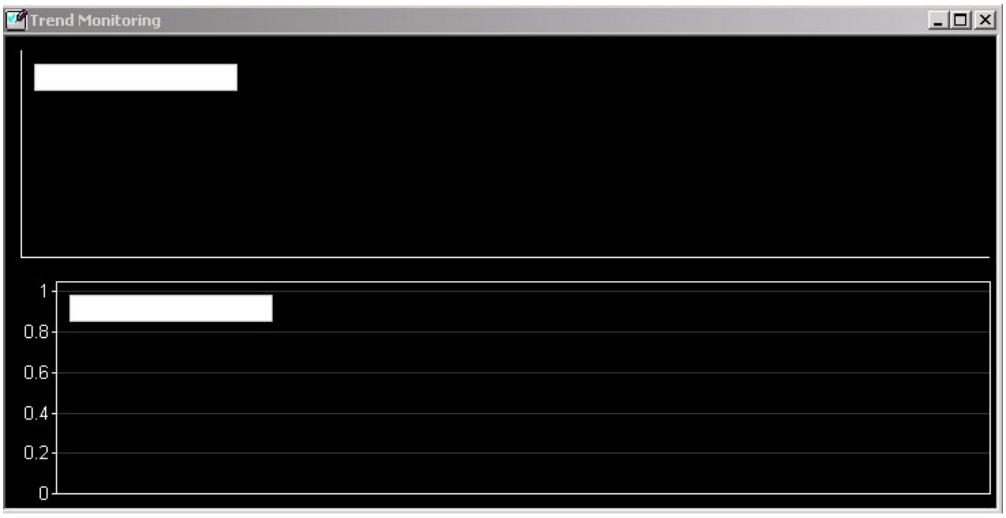
| | PLC | Program | Device/Variable | Value | Type | Variable/Device | Comment |
|---|---|---|---|---|---|---|---|
| 1 | NewPLC | <GLOBAL> | K18560 | 10 | BIT | _AT00_REV | AT Direction (0:Forward, 1:Re |
| 2 | NewPLC | <GLOBAL> | K18570 | 10 | BIT | _AT00_PWM_EN | AT PWM Enable (0:Disable, 1 |
| 3 | NewPLC | <GLOBAL> | K18580 | 10 | BIT | _AT00_ERROR | AT Error (0: Normal 1: Error Oc |
| 4 | NewPLC | <GLOBAL> | K1860 | ±10 | INT | _AT00_SV | AT Set Value (SV) - Loop00 |
| 5 | NewPLC | <GLOBAL> | K1861 | HEX | WORD | _AT00_T_s | AT Sampling Time (T_s)[0.1ms |
| 6 | NewPLC | <GLOBAL> | K1862 | ±10 | INT | _AT00_MV_max | AT Max. MV - Loop00 |
| 7 | NewPLC | <GLOBAL> | K1863 | ±10 | INT | _AT00_MV_min | AT Min. MV - Loop00 |
| 8 | NewPLC | <GLOBAL> | K1864 | HEX | WORD | _AT00_PWM | AT PWM Output Point - Loop |
| 9 | NewPLC | <GLOBAL> | K1865 | HEX | WORD | _AT00_PWM_Prd | AT PWM Output Period - Loo |
| 10 | NewPLC | <GLOBAL> | K1866 | HEX | WORD | _AT00_HYS_val | AT Hysteresis value - Loop00 |
| 11 | NewPLC | <GLOBAL> | K1867 | HEX | WORD | _AT00_STATUS | AT Status (Do not Set) - Loop |
| 12 | NewPLC | <GLOBAL> | K1868 | HEX | WORD | _AT00_ERR_CODE | AT Error Code - (Do not Set) - |
| 13 | NewPLC | <GLOBAL> | K1869 | ±10 | REAL | _AT00_K_p | AT Result P - Constant (K_p) |
| 14 | NewPLC | <GLOBAL> | K1871 | ±10 | REAL | _AT00_T_i | AT Result I - Constant (T_i)[s |
| 15 | NewPLC | <GLOBAL> | K1873 | ±10 | REAL | _AT00_T_d | AT Result D - Constant (T_d)[ |
| 16 | NewPLC | <GLOBAL> | K1875 | ±10 | INT | _AT00_PV | AT Process Value (PV) - Loop |
| 17 | NewPLC | <GLOBAL> | K1876 | ±10 | INT | _AT00_MV | AT Manipulated Value (MV) - |

[Figure 5.23 Auto-tuning variables registered]

(5) Observing RUN status by using trend monitor function

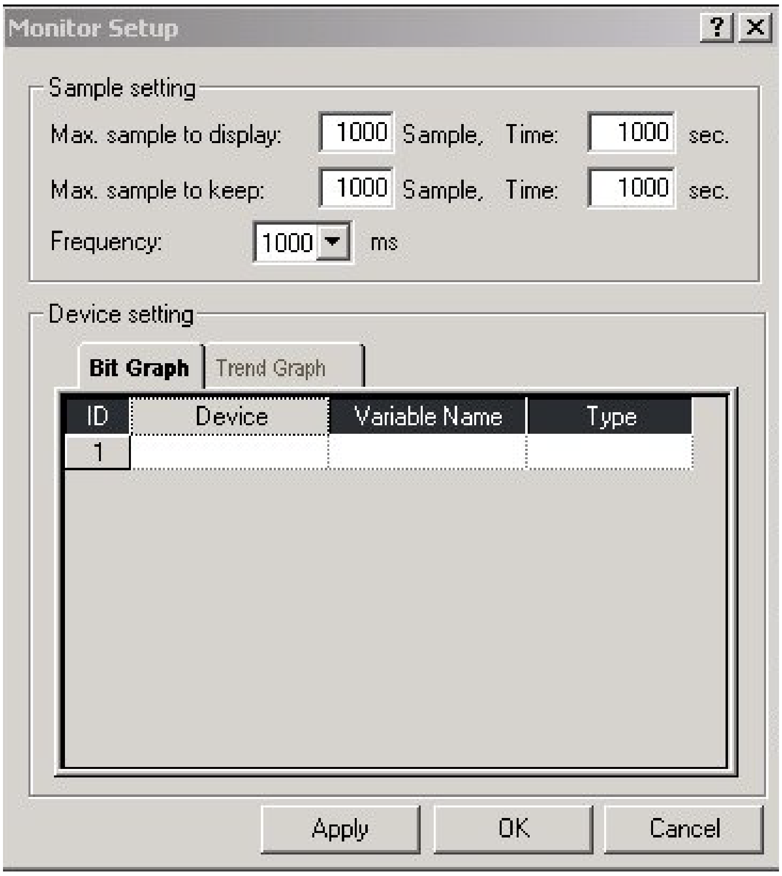
Since it is possible to monitor the operation status of XGB series built-in auto-tuning graphically, it is useful to monitor the operation status of auto-tuning clearly.

(a) If selecting Monitor – Trend monitor menu, it shows the trend monitor widow as illustrated in Figure 5.24.



[ Figure 5.24 Trend Monitor window ]

(b) If right-clicking trend setting, a user can select a variable to monitor as illustrated in Figure 5.25.



Sample setting

Max. sample to display: 1000 Sample, Time: 1000 sec.

Max. sample to keep: 1000 Sample, Time: 1000 sec.

Frequency: 1000 ms

Device setting

| ID | Device | Variable Name | Type |
|---|---|---|---|
| 1 | | | |

[ Figure 5.25 window to register trend monitor variable ]

(c) For more information about trend monitor, refer to “XG5000 Use’s Manual.”

### 5.7.3 Stand-alone Operation After PID Auto-tuning

Here, with example, it explains how to execute PID control followed by PID auto-tuning.

(1) PID auto-tuning parameter setting

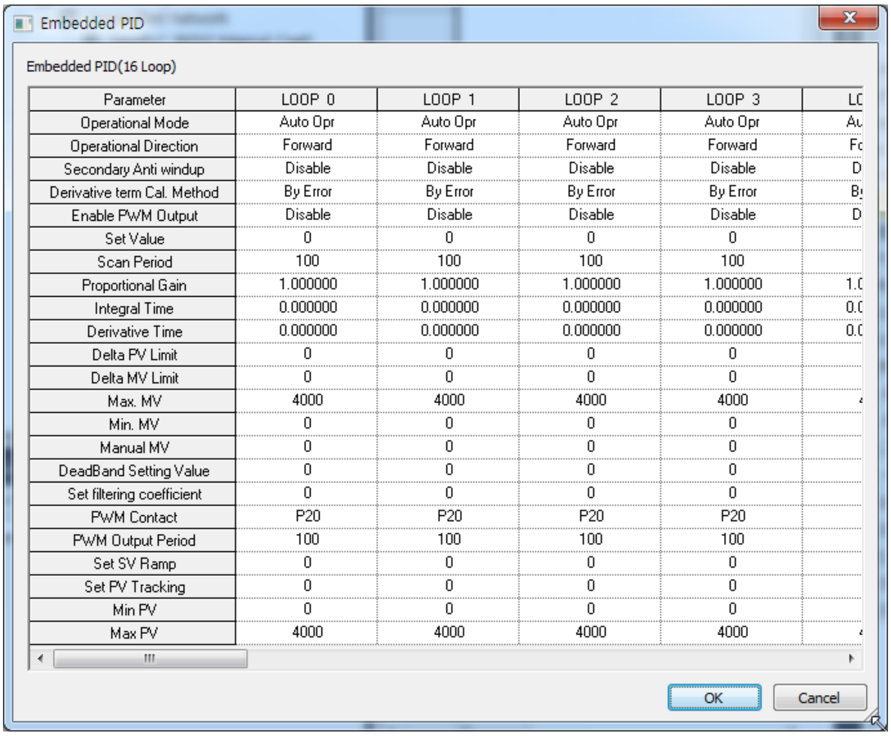
▪ PID auto-tuning parameters are set as same as examples of 5.4.2 Example of PID Auto-tuning.

(2) Setting parameters of A/D input module and D/A output module

▪ Set the parameters of A/D input module and D/A output module as same as the example in 5.4.2 Example of PID Auto-tuning.

(3) PID parameter setting

(a) If double-clicking Parameter – Built-in Parameter – PID – PID Parameter, it shows the built-in PID parameter setting window as seen in Figure 5.26.



Embedded PID(16 Loop)

| Parameter | LOOP 0 | LOOP 1 | LOOP 2 | LOOP 3 | LC |
|---|---|---|---|---|---|
| Operational Mode | Auto Opr | Auto Opr | Auto Opr | Auto Opr | Au |
| Operational Direction | Forward | Forward | Forward | Forward | Fc |
| Secondary Anti windup | Disable | Disable | Disable | Disable | D |
| Derivative term Cal. Method | By Error | By Error | By Error | By Error | B |
| Enable PWM Output | Disable | Disable | Disable | Disable | D |
| Set Value | 0 | 0 | 0 | 0 | |
| Scan Period | 100 | 100 | 100 | 100 | |
| Proportional Gain | 1.000000 | 1.000000 | 1.000000 | 1.000000 | 1. |
| Integral Time | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0. |
| Derivative Time | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0. |
| Delta PV Limit | 0 | 0 | 0 | 0 | |
| Delta MV Limit | 0 | 0 | 0 | 0 | |
| Max. MV | 4000 | 4000 | 4000 | 4000 | |
| Min. MV | 0 | 0 | 0 | 0 | |
| Manual MV | 0 | 0 | 0 | 0 | |
| DeadBand Setting Value | 0 | 0 | 0 | 0 | |
| Set filtering coefficient | 0 | 0 | 0 | 0 | |
| PWM Contact | P20 | P20 | P20 | P20 | |
| PWM Output Period | 100 | 100 | 100 | 100 | |
| Set SV Ramp | 0 | 0 | 0 | 0 | |
| Set PV Tracking | 0 | 0 | 0 | 0 | |
| Min PV | 0 | 0 | 0 | 0 | |
| Max PV | 4000 | 4000 | 4000 | 4000 | |

[ Figure 5.26 Auto-tuning parameter setting window ]

(b) Set each parameter and click OK.
In the example, Loop 0 is set as follows.

- RUN mode: automatic
  - Set as automatic in order that PID control is executed as the built-in PID operation outputs MV.

- RUN direction: forward
  - Since in the system, water level is going up as MV increases and pump’s rotation velocity increases, it should be set as forward operation.

- PWM Output: disabled
  - In the example, auto-tuning using PWM is not executed. Therefore, PWM output is set as disabled.

- SV: 1000(2.5V)
  - It shows an example in which XBF-AD04A is set as the voltage input of 0~10V

- Operation cycle: 1000
  - In the example, it is set that PID control is executed every 100ms.

- Proportional gain, integral time and differential time
  - It should be initially set as 1,0,0 because PID auto-tuning results is used with PID constant.

- Max. MV: 4000
  - Max. MV is set as 4000. If MV is 4000, XBF-DV04A outputs 10V.

- DeadBand: 0
  - It is set as 0 because the example does not use DeadBand function.

- Differential filter setting: 0
  - it is also set as 0 because the example does not use differential filter.

- Min. MV: 0
  - Min. MV is set as 0. If MV is 0, XBF-DV04A outputs 0V.

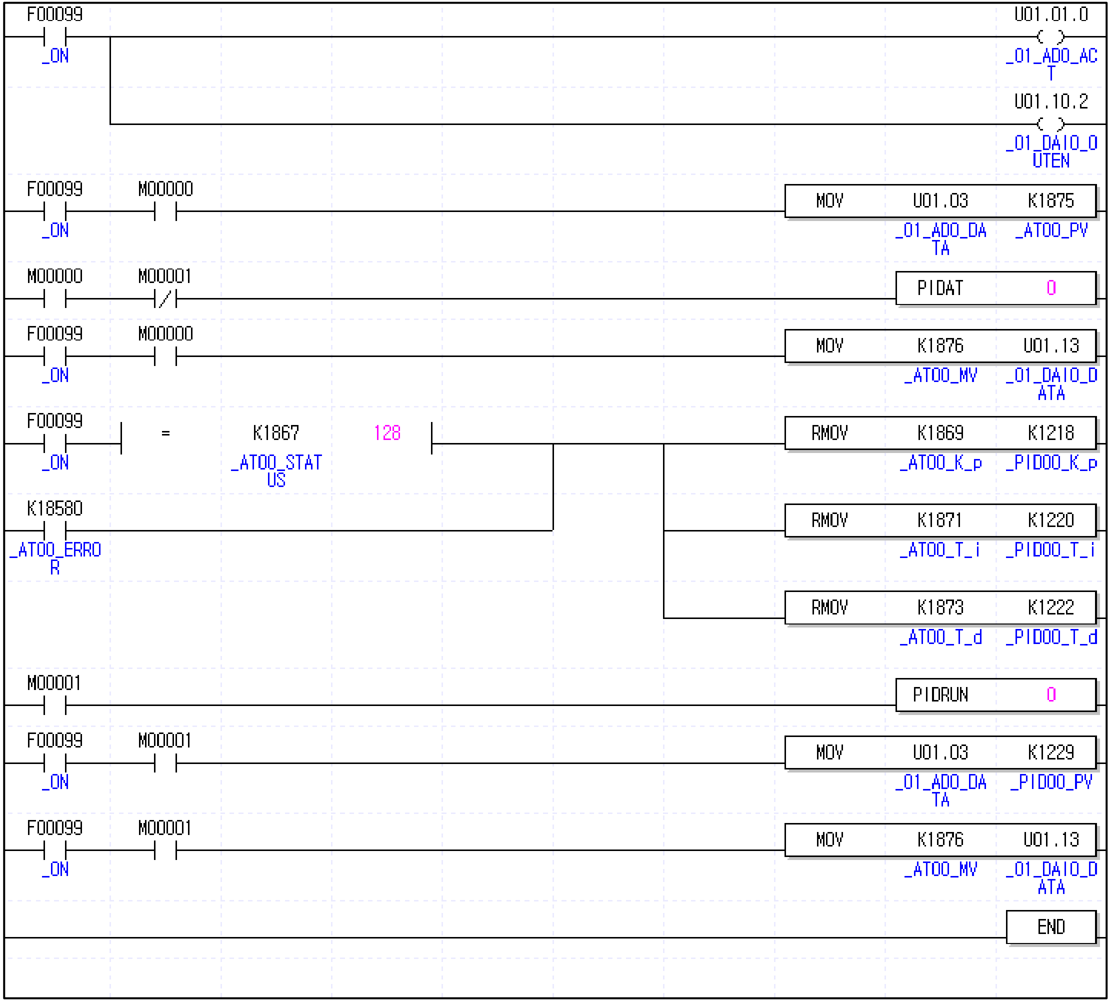
- PWM junction, PWM output cycle
  - It is not necessary to set them because the example does not use PWM output.

- SV ramp, PV follow-up: 0
  - It is not necessary to set SV ramp and PV follow-up because the example does not use them.

- Min. PV, Max. PV: 0
  - Set them as 0 and 4000 respectively so that it could be identical with A/D input module's input scope.

(c) Example of PID control program after PID auto-tuning

The program example for PID auto-tuning is illustrated as Figure 5.27.



[Figure 5.27 Example program of PID control after auto-tuning]

1) Devices used

| Device | Data type | Application |
|---|---|---|
| F0099 | BIT | It is always on, so it readily operates once PLC is RUN. |
| U01.01.0 | BIT | It starts operation of CH0 of Built-in A/D input module. |
| U01.10.2 | BIT | It starts operation of CH0 of Built-in D/A output module. |
| U01.03 | INT | PV entered to A/D input module. |
| U01.13 | INT | MV entered to D/A output module. |
| K1875 | INT | Device to which PV is entered for LOOP 0 auto-tuning |
| K1876 | INT | Device to which auto-tuning MV of LOOP 0 is output. |
| K1867 | WORD | Device to which auto-tuning status indicates. |
| K18580 | BIT | Junction that is on once auto-tuning has an error. |
| K1869 | REAL | proportional coefficient calculated after the auto-tuning |
| K1871 | REAL | integral time calculated after the auto-tuning. |
| K1873 | REAL | differential time calculated after the auto-tuning. |

| | | |
|---|---|---|
| K1218 | REAL | proportional coefficient of PID designated in parameter. |
| K1220 | REAL | integral time of PID designated in parameter. |
| K1222 | REAL | differential time of PID designated in parameter. |
| K1229 | INT | Device to which PV is entered for Loop 0 PID control |
| K1876 | INT | Device to which MV of loop 0 PID control is output. |

2) Program explanation

a) Since F0099 (always on) is ON if PLC is converted form STOP to RUN, CH0 of A/D and D/A starts operating.
b) Once M0000 junction is on, the auto-tuning of loop 0 starts. At the moment, PV entered to CH0 of A/D is moved to K1875, the PV input device of loop 0 and saved accordingly.
c) The auto-tuning MV of Loop 0 output by PIDAT command is output to D/A output module by line 11, MOV command.
d) Once auto-tuning is complete, it moves P, I, D coefficients generated from auto-tuning to the input devices of P, I and D, K1218,K1220 and K1222, sets M001 and starts the operation of PID loop 0.

## 5.8 Error / Warning Codes

It describes error codes and warning codes of the XGB built-in PID function. The error codes and warning codes that may occur during use of the XGB built-in PID function are summarized as table. If any error or warning occurs, remove potential causes of the error by referring to the tables.

### 5.8.1 Error Codes

| Error codes | Indications | Measures |
|---|---|---|
| H'0001 | MV_MIN_MAX_ERR | It occurs when max. MV is set lower than min. MV. Make sure to set max. MV larger than min. MV. |
| H'0002 | PV_MIN_MAX_ERR | It occurs when max. PV is set lower min. Pv. Make sure to set max. PV larger than min. PV. |
| H'0003 | PWM_PERIOD_ERR | It occurs when the period of auto tuning or PID operation loop is set under 100(10ms). Make sure to set output period more than 100. |
| H'0004 | SV_RANGE_ERR | It occurs when SV is larger than PV at the start time of auto-tuning if auto-tuning is forward or when SV is larger than PV at the start time of auto-tuning if auto-tuning is reverse. |
| H'0005 | PWM_ADDRESS_ERR | It occurs when the junction designated as PWM output junction is beyond between P20 ~ P3F. |
| H'0006 | P_GAIN_SET_ERR | It occurs when proportional constant is set lower than 0. |
| H'0007 | I_TIME_SET_ERR | It occurs when integral time is set lower than 0. |
| H'0008 | D_TIME_SET_ERR | It occurs when differential time is set lower than 0. |
| H'0009 | CONTROL_MODE_ERR | It occurs when control mode is not P, PI, PD or PID. |
| H'000A | TUNE_DIR_CHG_ERR | It occurs when operation direction is changed during auto-tuning. Never attempt to change operation direction during auto-tuning. |
| H000B | PID_PERIOD_ERR | It occurs when period of operation is smaller than 100 (10ms) at Auto-tuning or PID operation.<br>Make sure to set period of operation larger than 100. |
| H000C | HBD_WRONG_DIR | In mixed operation, It occurs when the direction parameter of forward operation set to reverse operation or the direction parameter of reverse operation set to forward operation. Make sure set to appropriate direction each loop. |
| H000D | HBD_SV_NOT_MATCH | In mixed operation, it occurs when the Set value of each loop is not concurrent. Make sure set to Set value concurrently. |
| - | - | If the PID LOOP number is outside the settable range, the command will not be executed without an error code. The range that can be set is 0 ~ 15. |

[Table 5.13 : PID error codes]

### 5.8.2 Warning Codes

| Error codes | Indications | Measures |
|---|---|---|
| H’0001 | PV_MIN_MAX_ALM | It occurs when the set PV is beyond the min./max. PV. |
| H’0002 | PID_SCANTIME_ALM | It occurs when PID operation cycle is too short. It is desirable to set PID operation cycle longer than PLC scan time. |
| H’0003 | PID_dPV_WARN | It occurs when the PV change of PID cycle exceeds PV change limit. |
| H’0004 | PID_dMV_WARN | It occurs when the PV cycle MV change exceeds MV change limit. |
| H’0005 | PID_MV_MAX_WARN | It occurs when the calculated MV of PID cycle exceeds the max. MV. |
| H’0006 | PID_MV_MIN_WARN | It occurs when the calculated MV of PID cycle is smaller than the min. MV |

[Table 5.14 : PID error codes]

# Part 3. Embedded Positioning

## Chapter 1 Overview

Part 3 describes the specification, method to use each positioning function, programming and the wiring with external equipment of embedded positioning function.

### 1.1 Characteristics

The characteristics of positioning module are as follows.

(1) The positioning function is embedded in XBM-H2/HP PLC.

(2) Various positioning control function

It has various functions needed for positioning system such as positioning control, speed control etc.
The operation data including positioning address and operation method, operation pattern is available to set up to 400 for each axis with this operation data, positioning for each axis is available.

(a) Various sing-axis operations are available.

1) Position Control
2) Speed Control
3) Feed Control
4) Multi-axis Synchronous Start
5) Point Operation

(b) Various Multi-axis Operations are available.

1) Circular arc Interpolation
2) Linear Interpolation
3) Helical Interpolation
4) Ellipse Interpolation

(c) Switching Control in operation is available.

1) Position/Speed Control Switching
2) Speed/Position Control Switching.

(d) Cam Control is available.

It is available to create up to 8 kinds of cam data with various cam profile of XG-PM Software.

e) Various Homing Control Function.
  1) 7 methods are available for Homing.
    a) Origin detection after DOG Off
    b) Origin detection after deceleration in case of DOG On
    c) Origin detection by the HOME and upper/lower limit
    d) Origin detection by DOG
    e) High speed Origin detection
    f) Origin detection by upper/lower limit
    g) Origin detection by HOME
  2) It is Available to set the origin of machine without homing by setting the floating origin
(f) For the Acceleration/Deceleration method, it is available to select trapezoid or S curve.

(3) High speed positioning process.

When processing the positioning function, the delay depends on the control period of the common parameters. The delay time of positioning process is less than (control Parameter-control period * 2) ms. In addition, there is no delay time between axes in synchronous start and interpolation start. In the same scan, the positioning command entered on different axes are processed simultaneously.

(4) Easy maintenance.

Various data such as operation data, operation parameter are saved on FLASH Memory in PLC. Therefore, data will be saved permanently after the power is turned off.

(5) Self-diagnosis, monitoring, and test are available with XG-PM software package.
  (a) Monitoring (Module & External Input/output Signal) Function
  (b) Trace Function
  (c) Trend Function
  (d) Reading and Saving Module Parameter/Operation Data
  (e) Creation of Cam Data
  (f) Providing details about errors and the solution for it
  (g) Print Function of various forms
  (h) Editing operation data in Excel program is available

(6) XBM-H2/HP can create positioning tasks that match positioning controls. The positioning task work in cycle as set in Control period of the Common parameters. Positioning task time is included in control period of common parameter. Positioning control period error occurs when sum of positioning operation time and positioning task execution time exceed Control period, which set in Common parameter.

## 1.2 Purpose of Positioning Control

The purpose of positioning is to transfer the objects (tools etc.) with setting speed from the current position and stop them on the setting position correctly. And high precision positioning is available by positioning pulse string signal as it is connected to various control driving devices such as servo driving devices or stepping motor.
In application, it can be used widely with engineering machine, semiconductor assembly machine, grinder, small machine center, lifter etc.

## 1.3 Signal Flow of Embedded Positioning

The flow of PLC system using the embedded positioning is as follows.

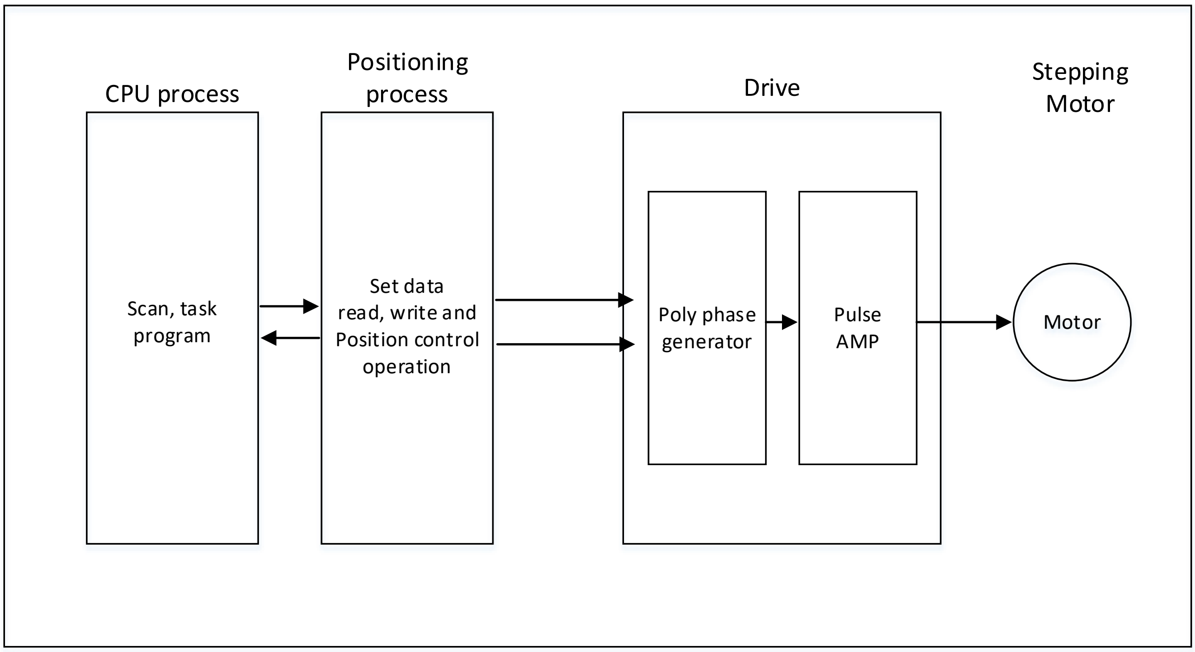


Fig. 1.1 Overview of Position Control for Stepping Motor

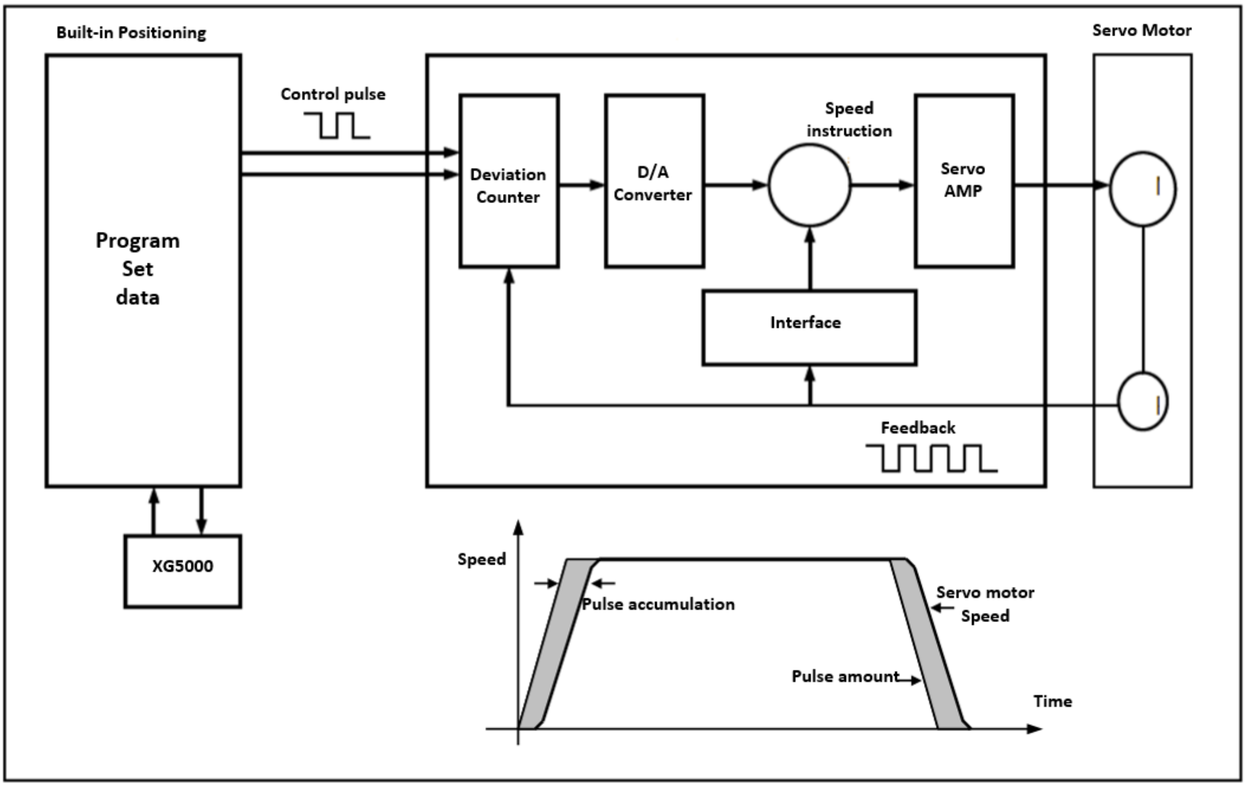
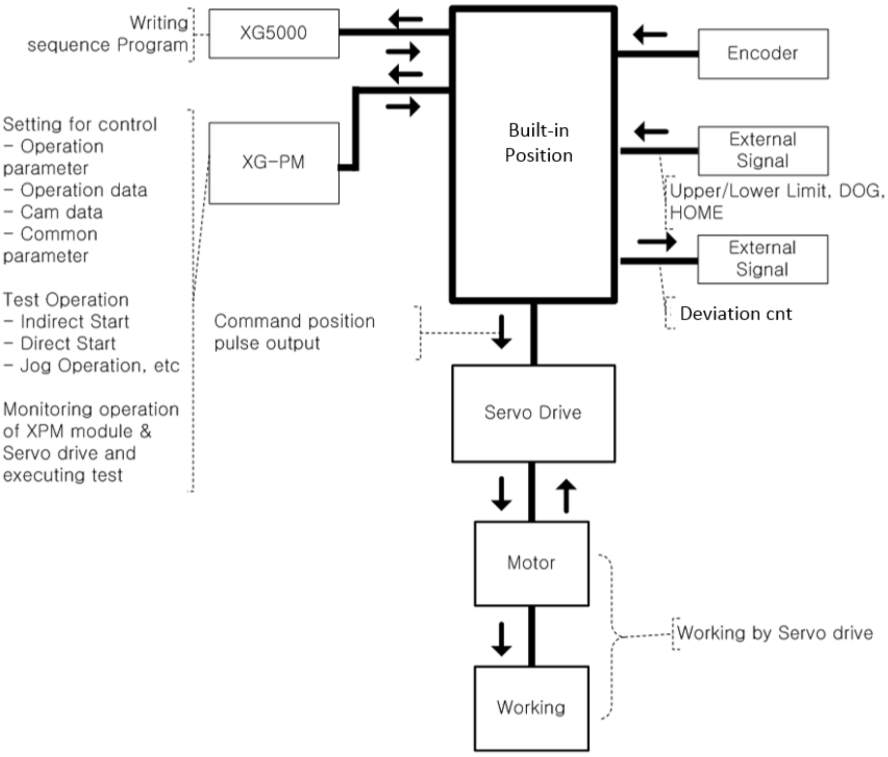


Fig. 1.2 Overview of Position Control for Servo Motor



## 1.4 Function overview of embedded positioning

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

### 1.4.1 Position Control

Execute positioning control for the designated axis from the 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 positioning data

(b) Positioning control is executed based on origin designated in homing

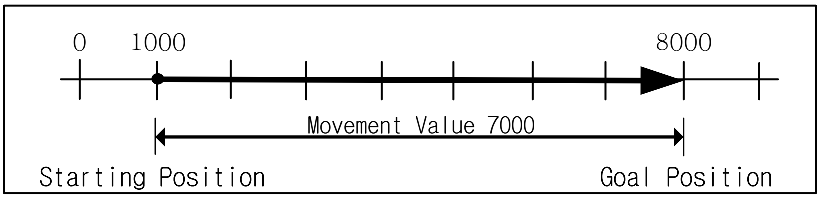
(c) Moving direction is decided by starting position and goal position.

- ■Starting Position < Goal Position : Forward Positioning Operation
- ■Starting Position > Goal Position : Reverse Positioning Operation

[ Example ]

- ■Starting Position : 1000
- ■Goal Position : 8000

Value of Forward movement is 7000 (7000=8000-1000)



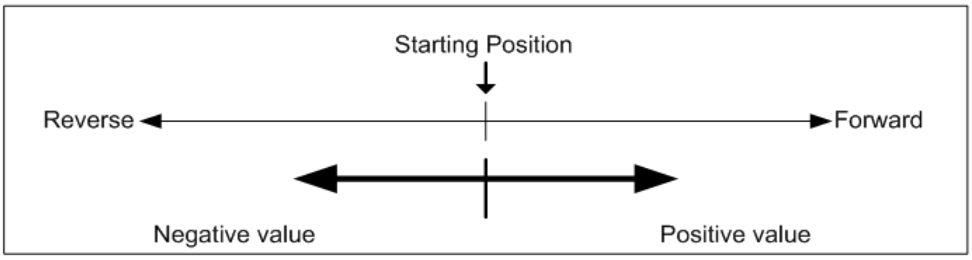
#### (2) Control by Incremental Coordinates

(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.

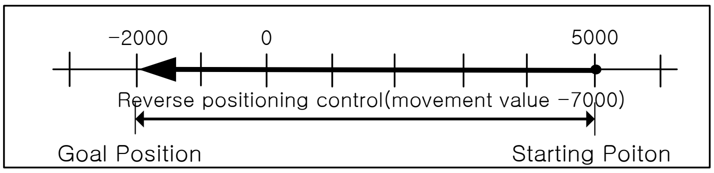
- ■Positive value (+ or 0) : Positioning operation with forward direction
- ■Negative value (-) : Positioning operation with reverse direction



[ Example ]

- Starting Position : 5000
- Goal Position : -7000

In this condition, it moves reversely and stops at -2000.



## 1.4.2 Interpolation Control

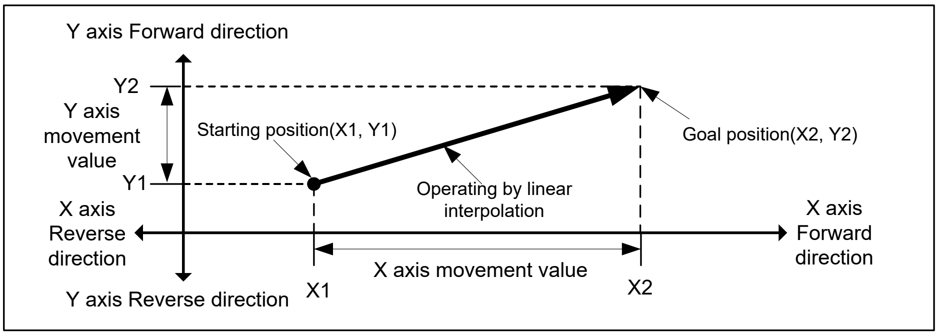
### (1) Linear Interpolation Control

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

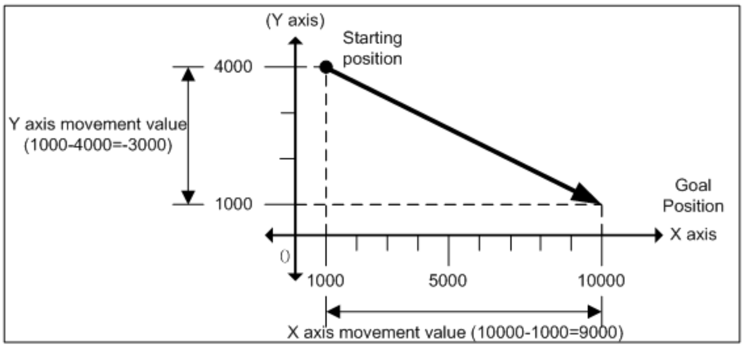
1) Execute linear interpolation from starting position to goal position designated by positioning data.
2) Positioning control is executed based on origin designated in homing.
3) Movement direction is designated by starting position & goal position of each axis.
   - Starting position < Goal position : Positioning operation with forward direction
   - Starting position > Goal position : Positioning operation with reverse direction



[ Example ]

- Starting Position (1000, 4000)
- Goal Position (10000, 1000)

In this condition, operation is as follows.

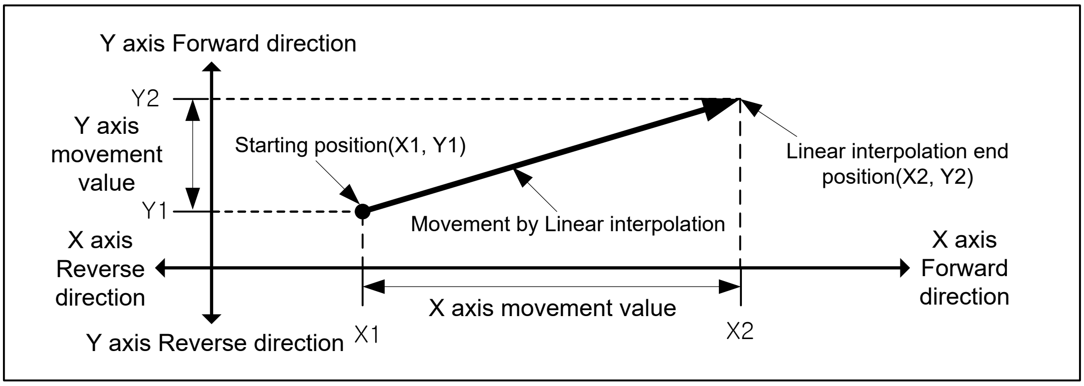


**(b) Linear Interpolation by incremental coordinates**

1) Goal value becomes movement value

2) Moving direction depends on movement value is positive or negative.

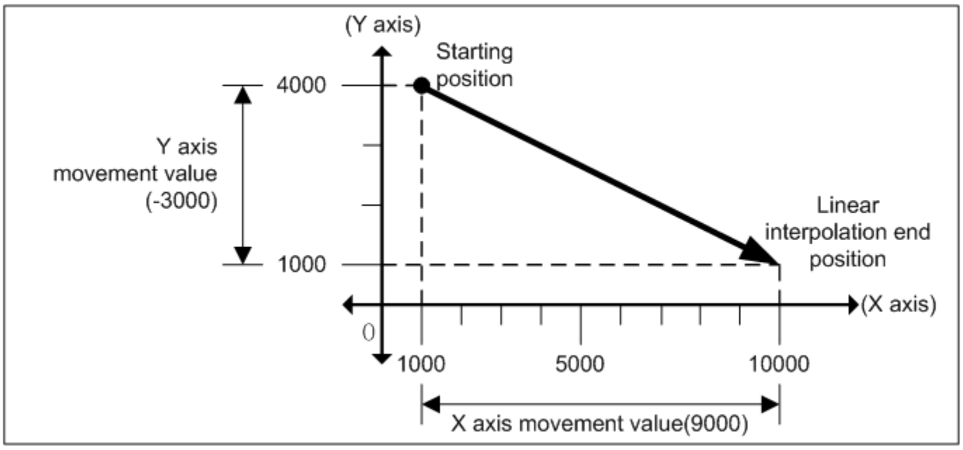
- Positive value (+ or 0) : Positioning operation with forward direction
- Negative value (-) : Positioning operation with reverse direction



[ Example ]

- Starting position (1000, 4000)
- Goal position (9000, -3000)

In this condition, operation is as follows.

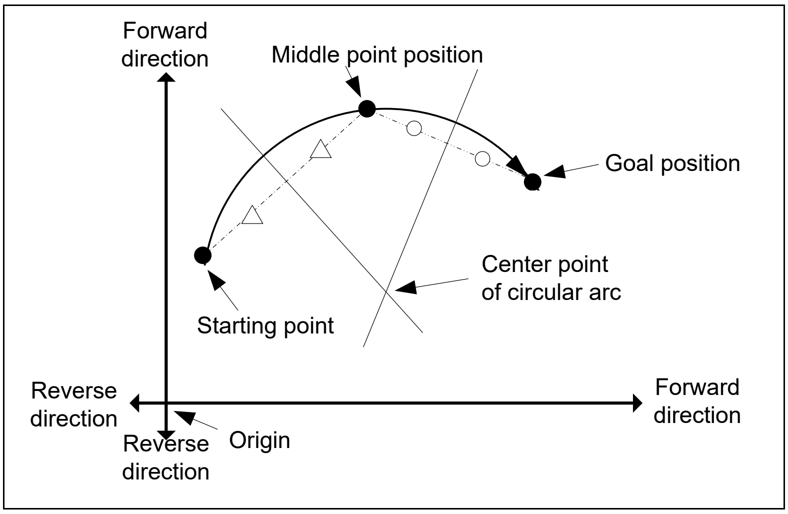


### (2) Circular Interpolation Control

Execute interpolation operation along the trace of circle with 2 axes in 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.
In addition, it is available to be executed more than 360° circular interpolation according to the value of “circular interpolation turns’.
There is no limitation for the combination of 2 axes that used in circular interpolation.(Available to use any 2 of axis1~4)

#### (a) Circular interpolation with middle point designation form.

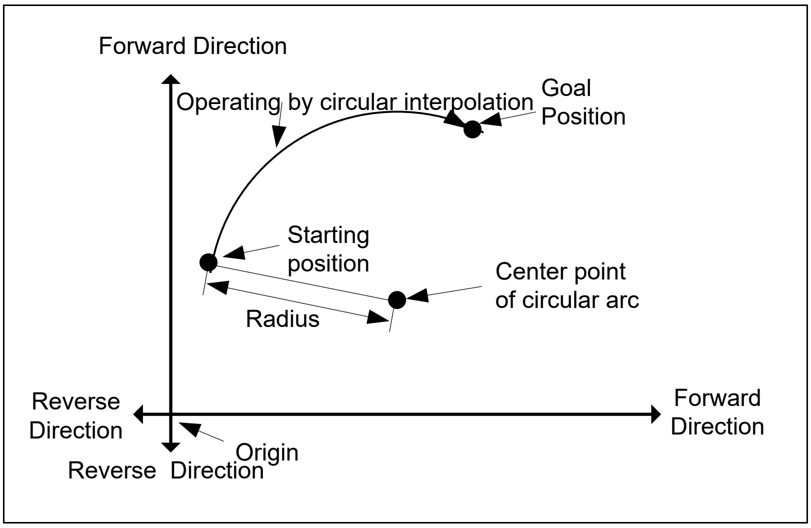
1) Starts operating at starting position and execute circular interpolation through the designated middle point.
2) There will be a circular arc whose center point is crossing point of perpendicular bisection between starting position and middle point or middle point and goal position.



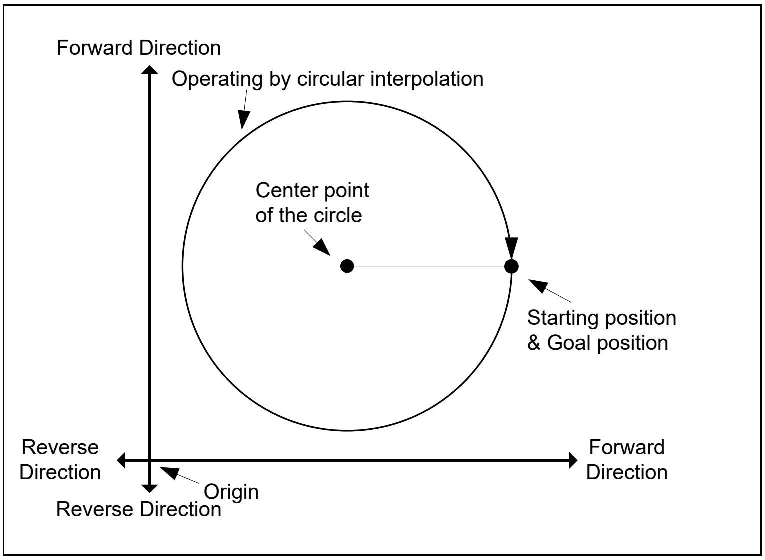
3) Control unit “degree” is not available to be used for circular interpolation control.
4) Movement direction is automatically designated by goal position and auxiliary point of circular interpolation

#### (b) Circular interpolation with center point designation form

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

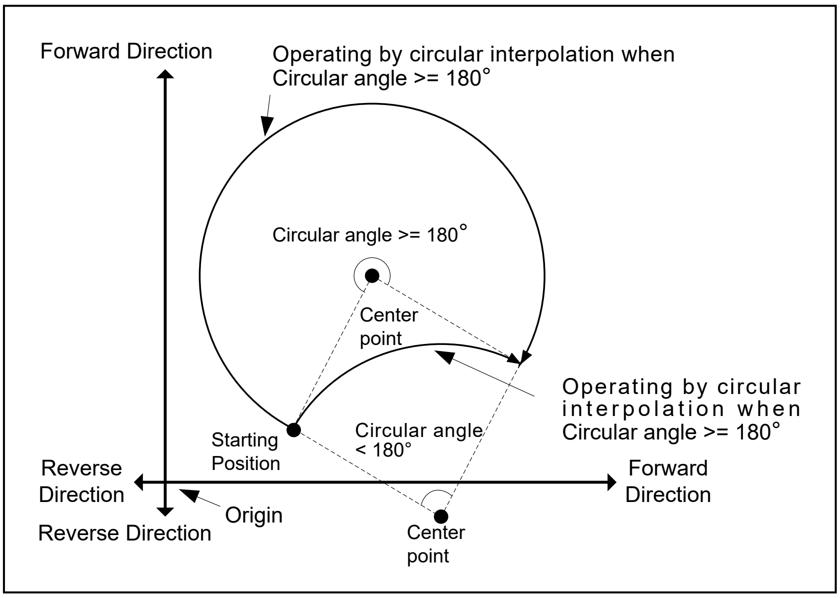


3) Control unit “degree” is not available to be used for circular interpolation control.

4) Direction is determined in setting of “Cir int. mode” (Center point CW, Center point CCW).

**(c) Circular interpolation with radius designation form**

1) 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. Depending on size setting of circular arc(<180°,>=180°), center point of circular arc will be different.



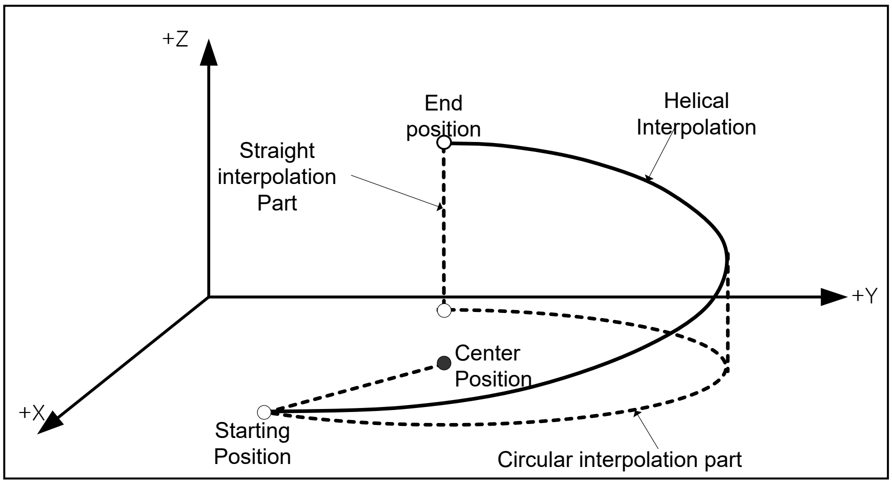
2) In radius designation form, goal position can’t be set the same as starting position.

3) Control unit “degree” is not available to be used for circular interpolation control.

4) The direction and arc size are determined in “Cir. int. mode”.

### (3) Helical Interpolation

(1) Moves along the designated trace of circular arc depending on circular arc interpolation setting and executes linear interpolation synchronously.
(2) It is available to execute helical interpolation of more than 360°depending on 'Circular interpolation turns' setting.
(3) The combination of axis that used for helical interpolation control is unlimited, 3 axes among axis1 ~ 4 are used.



### 1.4.3 Speed Control

(1) It is executed by positioning operation start command (Direct start, Indirect start, Synchronous start) and keeps operating with designated speed until Dec. stop command.

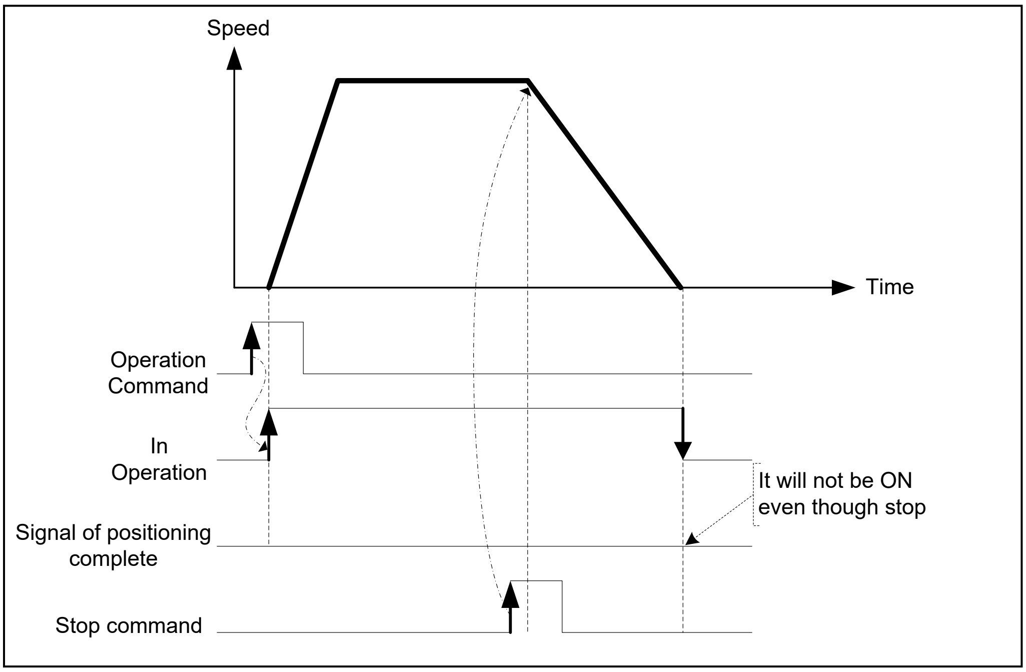
(2) Speed control has forward operation and reverse operation.

  (a) Forward operation : Position value >= 0

  (b) Reverse operation : Position value < 0

(3) In case of speed control, M code will be on only when M code mode is “With”.

(4) Operating Timing



### 1.4.4 FEED Control

(1) After executed by positioning start, reset the current position as 0 and start positioning as much as movement value already set.

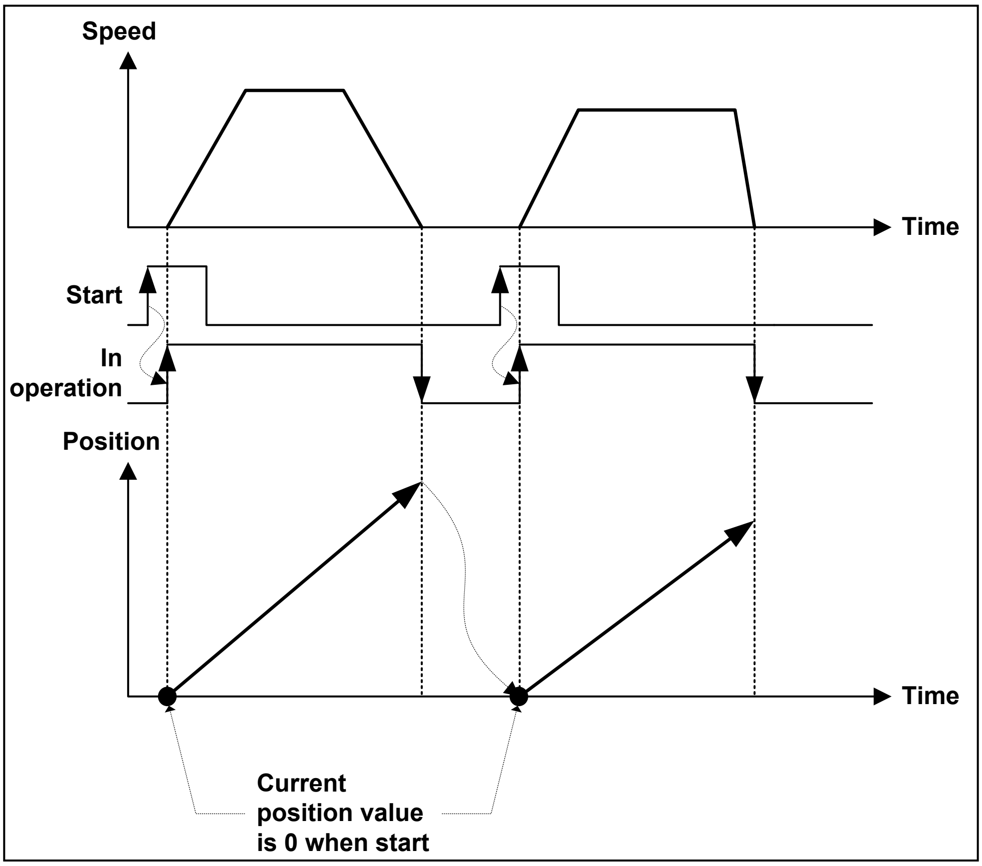
(2) Movement direction is decided by movement value.

(3) Feed control has forward direction operation and reverse direction operation.

  (a) Forward direction : Position value >= 0

  (b) Reverse direction : Position value < 0

(4) Operation timing is as follows.



# Chapter 2 Specifications

## 2.1 Performance Specifications

The following table shows the performance specifications of Embedded Positioning. [1]

<table>
<tr><th colspan="2">Model<br>Items</th><th>XBM-DN16H2, XBM-DP16H2<br>XBM-DN32H2, XBM-DP32H2</th><th>XBM-DN32HP, XBM-DP32HP</th></tr>
<tr><td colspan="2">No. of control axis</td><td>2</td><td>6</td></tr>
<tr><td colspan="2">Interpolation function</td><td>▪2 axis linear interpolation<br>▪2 axis circular interpolation</td><td>▪2/3/4/5/6 axis linear interpolation<br>▪2 axis circular interpolation<br>▪3 axis helical interpolation</td></tr>
<tr><td colspan="2">Control method</td><td colspan="2">Position control, Speed control, Speed/Position control, Position/Speed control, Feed control</td></tr>
<tr><td colspan="2">Control unit</td><td colspan="2">Pulse, mm, inch, degree</td></tr>
<tr><td colspan="2">Positioning data</td><td colspan="2">Each axis can have up to 400 operation data . (Operation step number : 1 ~ 400)<br>Available to set with software package (XG-PM) or program</td></tr>
<tr><td rowspan="3">XG-PM</td><td>Connection</td><td colspan="2">USB port</td></tr>
<tr><td>Setting data</td><td colspan="2">Common parameter, Basic parameter, Extended parameter, Manual operation, Homing, Input/output signal parameter, Operation data, Cam data, Command information</td></tr>
<tr><td>Monitor</td><td colspan="2">Operation information, Trace, Input terminal information, Error information</td></tr>
<tr><td colspan="2">Back-up</td><td colspan="2">Save the parameter, operation data in Flash ROM (No need of Battery)</td></tr>
<tr><td rowspan="5">POSITIONING</td><td>Positioning method</td><td colspan="2">Absolute address / Incremental address</td></tr>
<tr><td>Position address range</td><td colspan="2"><table>
<tr><th></th><th>Absolute</th><th>Incremental</th><th>Speed/Position, Position/Speed Switching control</th></tr>
<tr><td>mm</td><td>-214748364.8~ 214748364.7(㎛)</td><td>-214748364.8~ 214748364.7(㎛)</td><td>-214748364.8~ 214748364.7(㎛)</td></tr>
<tr><td>Inch</td><td>-21474.83648 ~ 21474.83647</td><td>-21474.83648 ~ 21474.83647</td><td>-21474.83648 ~ 21474.83647</td></tr>
<tr><td>degree</td><td>-21474.83648 ~ 21474.83647</td><td>-21474.83648 ~ 21474.83647</td><td>-21474.83648 ~ 21474.83647</td></tr>
<tr><td>pulse</td><td>-2147483648 ~ 2147483647</td><td>-2147483648 ~ 2147483647</td><td>-2147483648 ~ 2147483647</td></tr>
</table></td></tr>
<tr><td>Speed range</td><td colspan="2"><table>
<tr><td>mm</td><td>0.01 ~ 21474836.47 (mm/min)</td></tr>
<tr><td>Inch</td><td>0.001 ~ 2147483.647 (Inch/ min)</td></tr>
<tr><td>degree</td><td>0.001 ~ 2147483.647 (degree/ min)</td></tr>
<tr><td>pulse</td><td>1 ~ 200,000(pulse/sec): Open Collector</td></tr>
<tr><td>rpm</td><td>0.1 ~ 100000.0(RPM)</td></tr>
</table>- mm,Inch,degree cannot exceed 200,000 pulse/sec</td></tr>
<tr><td>Acc./Dec. process</td><td colspan="2">Trapezoid type, S-Curve</td></tr>
<tr><td>Acc./Dec. time</td><td colspan="2">0 ~ 2,147,483,647ms. Selection is available from 4 types of acceleration / deceleration time.</td></tr>
<tr><td colspan="2">Manual Operation</td><td colspan="2">Jog Operation, MPG Operation, Inching Operation</td></tr>
<tr><td colspan="2">Homing method [2]</td><td colspan="2">DOG + HOME (Off), DOG + HOME(On), Upper / Lower limit + HOME, DOG, High speed, Upper/Lower limit, HOME</td></tr>
<tr><td colspan="2">Speed change function</td><td colspan="2">Speed change (Percent / Absolute value)</td></tr>
<tr><td colspan="2">Control period</td><td colspan="2">1ms ~ 10ms</td></tr>
<tr><td colspan="2">Maximum speed</td><td colspan="2">200 kpps</td></tr>
<tr><td colspan="2">Connector</td><td colspan="2">32 point models : 40 Pin connector / 16 point models : 10 Pin Terminal block connector</td></tr>
<tr><td colspan="2">Size of the connection cable</td><td colspan="2">AWG #24</td></tr>
</table>

1) Relay output model XBM-DR14H2 doesn't support embedded positioning function. If the embedded positioning instruction or command is executed, it will be ignored.

2) DOG : Near home signal

## 2.2 External Interface I/O Specifications

Here describes the I/O interface for external equipment.

### 2.2.1 Input Specifications

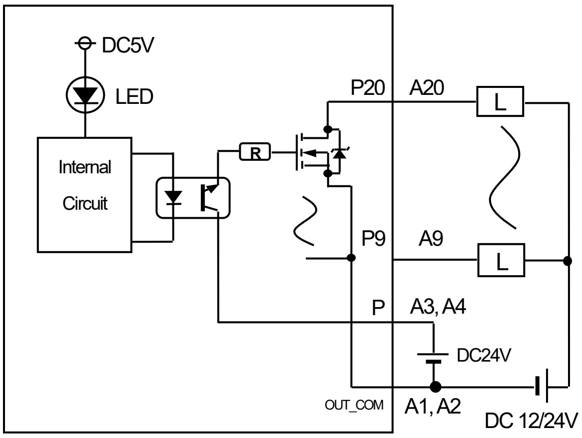
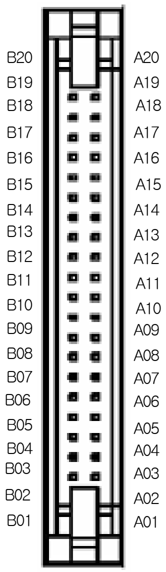
External input signal of Built-in Positioning can be set by P area where user can set the device in Extended parameter.
(In case of HOME signal, P area of range P00 ~ P0F can be set)

### 2.2.2 Output Specifications

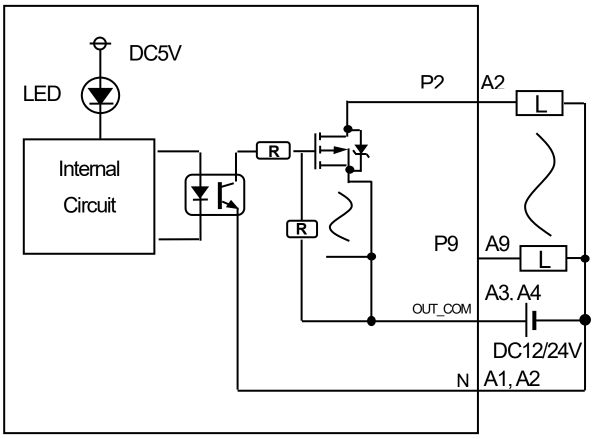
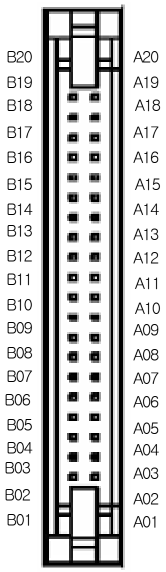
Deviation signal can be set by P area where user can set the device in Extended parameter.

### 2.2.3 Positioning output

| **Type** | | **XBM-DN32H2 / XBM-DN32HP (Sink)** | | |
|---|---|---|---|---|
| **Contact no.** | **1axis** | **P00020** | **P00026** | **Ref.** |
| | **2axis** | **P00021** | **P00027** | |
| | **3axis** | **P00022** | **P00028** | |
| | **4axis** | **P00023** | **P00029** | |
| | **5axis** | **P00024** | **P0002A** | |
| | **6axis** | **P00025** | **P0002B** | |
| Signal name | | Pulse train output (PLS) | Direction output (DIR) | |
| Rated load voltage | | DC12~24V (DC10.2 ~ 26.4V) | | |
| Max. load current | | 0.1A/1 point or below | | |
| Insulation method | | Photo-coupler insulation | | |
| Inrush current | | 4A/10㎳ or below | | |
| Voltage drop when On | | DC 0.4V or below | | |
| Leakage current when Off | | 0.1㎃ or below | | |
| Response time | | 5us or below (at 10mA or above) | | |

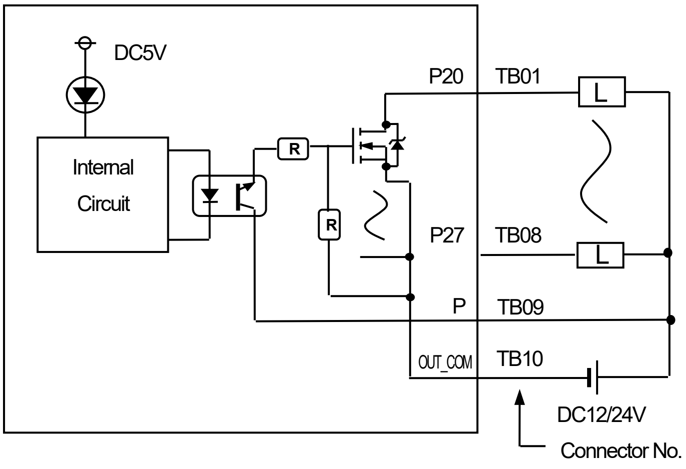
| **Circuit and connector configuration** | **No.** | **Contact** | **No.** | **Contact** | |
|---|---|---|---|---|---|
|  | B20 | 00 | **A20** | **20** |  |
| | B19 | 01 | **A19** | **21** | |
| | B18 | 02 | **A18** | **22** | |
| | B17 | 03 | **A17** | **23** | |
| | B16 | 04 | **A16** | **24** | |
| | B15 | 05 | **A15** | **25** | |
| | B14 | 06 | **A14** | **26** | |
| | B13 | 07 | **A13** | **27** | |
| | B12 | 08 | **A12** | **28** | |
| | B11 | 09 | **A11** | **29** | |
| | B10 | 0A | **A10** | **2A** | |
| | B9 | 0B | **A9** | **2B** | |
| | B8 | 0C | A8 | 2C | |
| | B7 | 0D | A7 | 2D | |
| | B6 | 0E | A6 | 2E | |
| | B5 | 0F | A5 | 2F | |
| | B4 | NC | A4 | P | |
| | B3 | NC | A3 | P | |
| | B2 | IN_COM | A2 | OUT_COM | |
| | B1 | IN_COM | A1 | OUT_COM | |

| **Type** | | **XBM-DP32H2 / XBM-DP32HP (Source)** | | |
|---|---|---|---|---|
| **Contact no.** | **1axis** | **P00020** | **P00026** | **Ref.** |
| | **2axis** | **P00021** | **P00027** | |
| | **3axis** | **P00022** | **P00028** | |
| | **4axis** | **P00023** | **P00029** | |
| | **5axis** | **P00024** | **P0002A** | |
| | **6axis** | **P00025** | **P0002B** | |
| Signal name | | Pulse train output (PLS) | Direction output (DIR) | |
| Rated load voltage | | DC12~24V (DC10.2~26.4V) | | |
| Max. load current | | 0.1A/1 point or below | | |
| Insulation method | | Photo-coupler insulation | | |
| Inrush current | | 4A/10㎳ or below | | |
| Voltage drop when On | | DC 0.4V or below | | |
| Leakage current when Off | | 0.1㎃ or below | | |
| Response time | | 5us or below (at 10mA or above) | | |

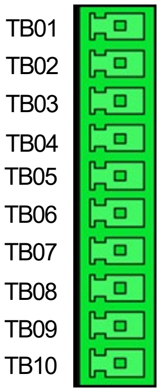
| **Circuit and connector configuration** | **No.** | **Contact** | **No.** | **Contact** | |
|---|---|---|---|---|---|
|  | B20 | 00 | **A20** | **20** |  |
| | B19 | 01 | **A19** | **21** | |
| | B18 | 02 | **A18** | **22** | |
| | B17 | 03 | **A17** | **23** | |
| | B16 | 04 | **A16** | **24** | |
| | B15 | 05 | **A15** | **25** | |
| | B14 | 06 | **A14** | **26** | |
| | B13 | 07 | **A13** | **27** | |
| | B12 | 08 | **A12** | **28** | |
| | B11 | 09 | **A11** | **29** | |
| | B10 | 0A | **A10** | **2A** | |
| | B9 | 0B | **A9** | **2B** | |
| | B8 | 0C | A8 | 2C | |
| | B7 | 0D | A7 | 2D | |
| | B6 | 0E | A6 | 2E | |
| | B5 | 0F | A5 | 2F | |
| | B4 | NC | A4 | OUT_COM | |
| | B3 | NC | A3 | OUT_COM | |
| | B2 | IN_COM | A2 | N | |
| | B1 | IN_COM | A1 | N | |

| Spec. / Type | | XBM-DN16H2 (Sink) | | |
|---|---|---|---|---|
| Contact No. | 1axis | P00020 | P00026 | Ref. |
| | 2axis | P00021 | P00027 | |
| Signal name | | Pulse train output (PLS) | Direction output (DIR) | |
| Rated load voltage | | DC12~24V (DC10.2 ~ 26.4V) | | |
| Max. load voltage | | 0.1A/ 1 point or below | 0.5A/ 1 point or below | |
| Insulation method | | Photocoupler insulation | | |
| Inrush current | | 4A/10 ㎳ or below | | |
| Voltage drop when On | | DC 0.4V or below | | |
| Leakage current when Off | | 0.1 ㎃ or below | | |
| Response time | | 5 ㎲ or below(10mA or above) | | |

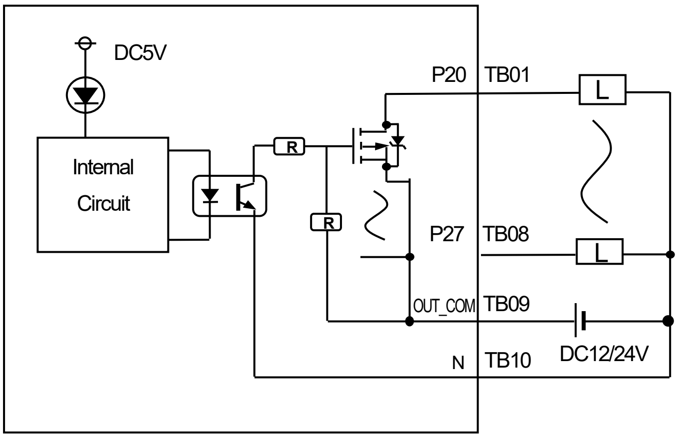
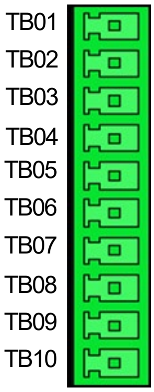
**Circuit and connector configuration**



| No. | Contact |
|---|---|
| **TB01** | **20** |
| **TB02** | **21** |
| TB03 | 22 |
| TB04 | 23 |
| TB05 | 24 |
| TB06 | 25 |
| **TB07** | **26** |
| **TB08** | **27** |
| TB09 | P |
| TB10 | OUT_COM |

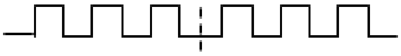
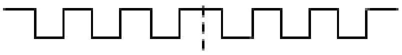


| Spec. / Type | | XBM-DP16H2 (Source) | | |
|---|---|---|---|---|
| **Contact No.** | **1axis** | **P00020** | **P00026** | **Ref.** |
| | **2axis** | **P00021** | **P00027** | |
| Signal name | | Pulse train output (PLS) | Direction output (DIR) | |
| Rated load voltage | | DC12~24V (DC10.2 ~ 26.4V) | | |
| Max. load current | | 0.1A/ 1 point or below | 0.5A/ 1 point or below | |
| Insulation method | | Photocoupler insulation | | |
| Inrush current | | 4A/10 ㎳ or below | | |
| Voltage drop when On | | DC 0.4V or below | | |
| Leakage current when Off | | 0.1 ㎃ or below | | |
| Response time | | 5 ㎲ or below(10mA or above) | | |

| **Circuit and connector configuration** | **No.** | **Contact** | |
|---|---|---|---|
|  | **TB01** | **20** |  |
| | **TB02** | **21** | |
| | TB03 | 22 | |
| | TB04 | 23 | |
| | TB05 | 24 | |
| | TB06 | 25 | |
| | **TB07** | **26** | |
| | **TB08** | **27** | |
| | TB09 | OUT_COM | |
| | TB10 | N | |

### 2.2.4 External Equipment and Interface Specifications

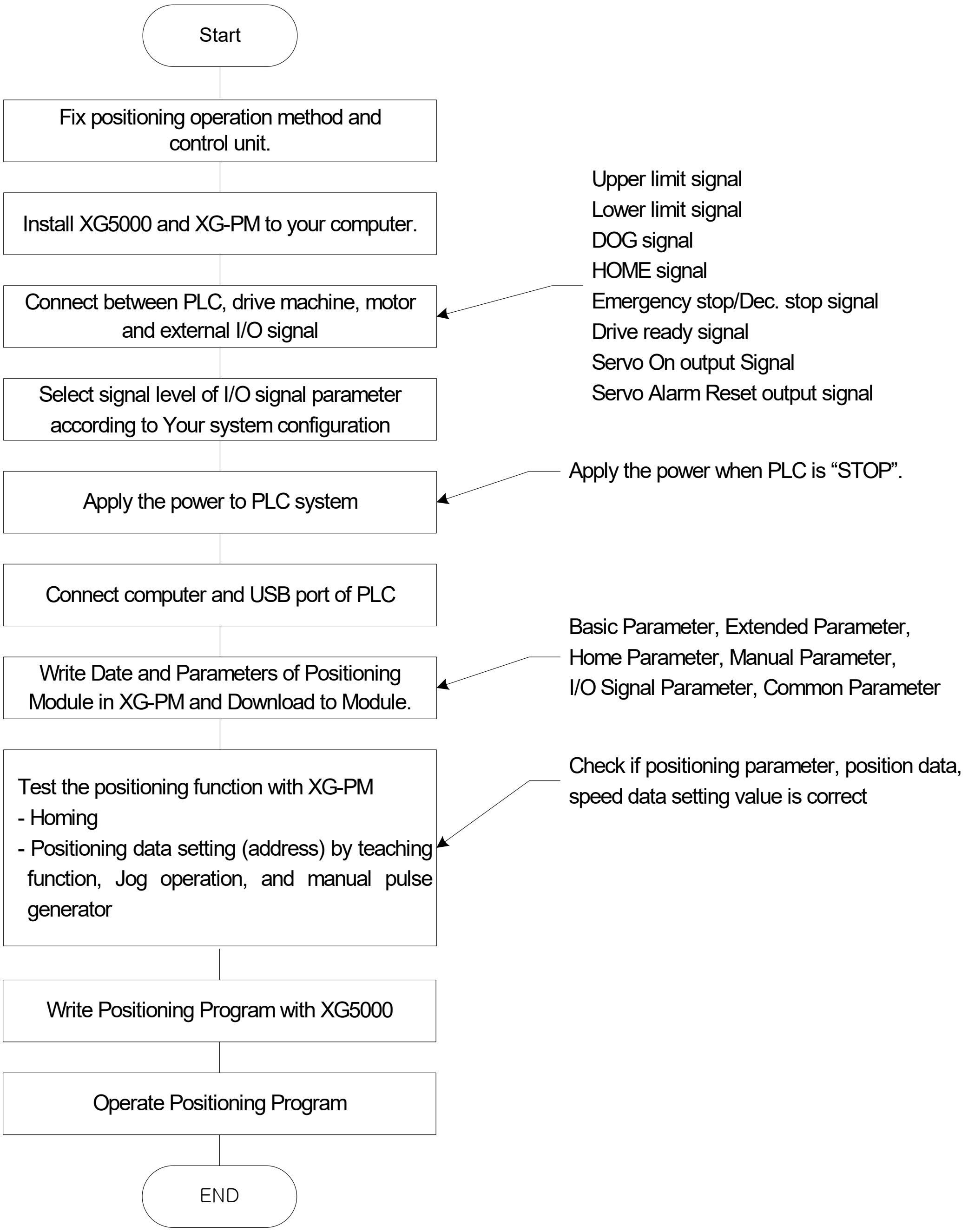
Output pulse of XGB built-in positioning consists of Pulse + Direction like figure below.
Output level of Low Active and High Active can be specified by common parameter.

| Pulse output type | Output signal | Output signal level | | | |
|---|---|---|---|---|---|
| | | High Active mode | | Low Active mode | |
| | | Forward | Reverse | Forward | Reverse |
| Pulse + direction mode | Pulse |  | |  | |
| | Direction | Low | High | High | Low |

# Chapter 3 Operation Order and Installation

## 3.1 Operation Order

This chapter describes the operation order in case of positioning operation by embedded positioning.



Upper limit signal
Lower limit signal
DOG signal
HOME signal
Emergency stop/Dec. stop signal
Drive ready signal
Servo On output Signal
Servo Alarm Reset output signal

Apply the power when PLC is “STOP”.

Basic Parameter, Extended Parameter,
Home Parameter, Manual Parameter,
I/O Signal Parameter, Common Parameter

Check if positioning parameter, position data,
speed data setting value is correct

# 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**

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

**(2) Installation Construction**

- In case of processing the screw hole or wiring, cares should be taken not to put the wiring remnants to PLC inside.
- Install on the good place to operate.
- Do not install the high voltage machine on the same Panel.
- The distance from duct or surrounding module shall be more than 50mm.
- 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 drop the module, and do not 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.
(5) When using the system of positioning control, please use it after you've set up the origin.
When Power On or Off, change of pulse output could occurred by Power On or Off.

# 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. 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) In case that there may be the noise source in wiring between positioning module and drive machine, it is required to use and connect Twist pair and shielded cable for the wiring of output pulse that comes from the positioning and enters into the motor drive.

# Chapter 4 Positioning Control

## 4.1 Positioning task

### 4.1.1 Positioning control task

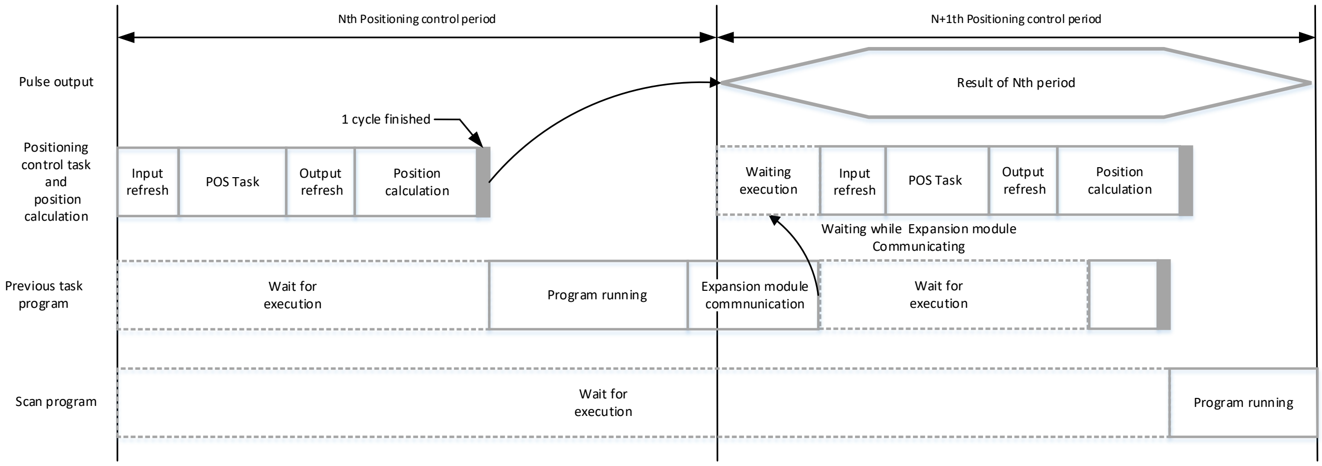
The XBM-H2/HP has a position control task that synchronizes with the positioning control period. Position control task operates with a period of control period set in common parameters.

### 4.1.2 Operation of Positioning control task

Position control tasks provide built-in I/O refresh to increase the responsiveness of signal, which changed or enabled in Position control task. The position control task and the position control operation have a same period. The processing priority of the Position control task is higher than the scan program or the existing task programs. And it has same priority level with the position control operation. Position control tasks are performed prior to the start of the Position control operation. However, the position control task waits for the execution while communicating with the expansion module.

If the sum of the position control task execution time and the positioning operation time is greater than the control period set in the common parameter, an error occurs, and the position control task is not executed.(However, the position control operation operates even in the error state) If control period exceed error occurs, increase the control period of common parameter up to 10ms or adjust the position control task program.

The following shows the operation flow of the scan program and existing tasks (fixed cycle, internal / external contact, high-speed counter) and positioning task.



**Notes**

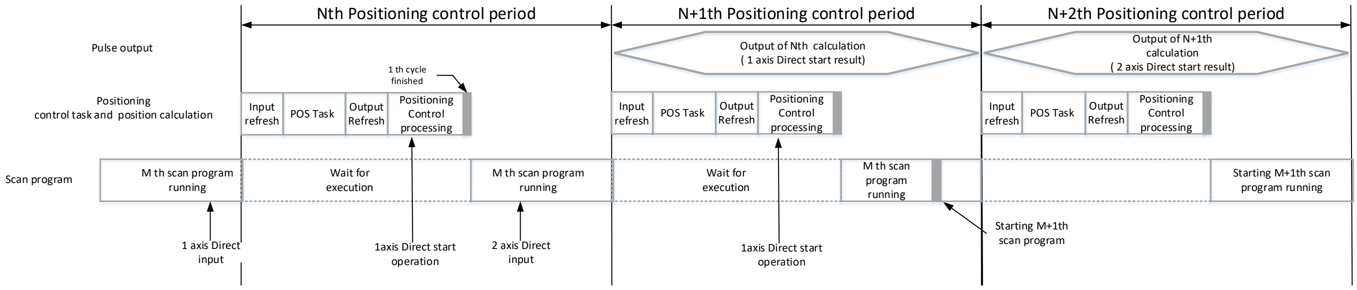
▶ systems using expansion units, set the position control cycle to at least 3 ms. Expansion unit communication time takes several hundreds of us to 2ms. Therefore, if the control period is set to 1 ms and an expansion unit is used, control cycle errors may occur frequently.

### 4.1.3 Built-in position control command operation

The built-in position control commands mainly include start command and non-start command. Start command is a command to perform position control operation over several scans such as direct start or indirect start. Non-start instruction is data processing related instruction to complete the operation within one scan such as reading current status and presetting current. The non-start instruction entered from the scan program or task program is applied to the positioning. operation unit immediately after the instruction is executed. On the other hand, the start command is processed by the position control operator. Since the position control operation is synchronous, the start command input from the position control task is processed by the position control operation unit. It is processed at the same time. Therefore, it is convenient to use the position control task to synchronize the start of multiple axes. For example, if you want to operate the 1-axis and 2-axis at the same time by direct starting, use the command in the position control task. Direct start of 1-axis and 2-axis starts simultaneously.

(1) Instruction processing in scan program and existing task program

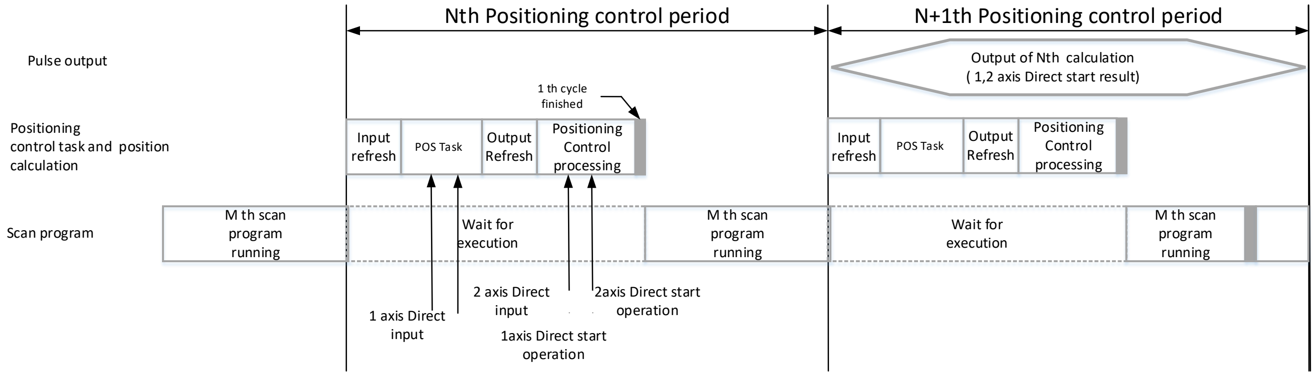
The scan program has a lower priority than the position control operation. Therefore, when the position control processing period is reached during the operation of the scan program, the scan program processing enters the execution standby state and processes the position control operation.



In the scan program as above, when start command is input to different operation axis in the same scan, the actual operating time of each axis may be different.

(2) Instruction processing in position control task program

Since the POS task operates in a structure in which one scan is completed within the positioning control cycle, the start commands for the different axes executed in the same scan are simultaneously output. This is convenient when precise synchronous control between axes is required.

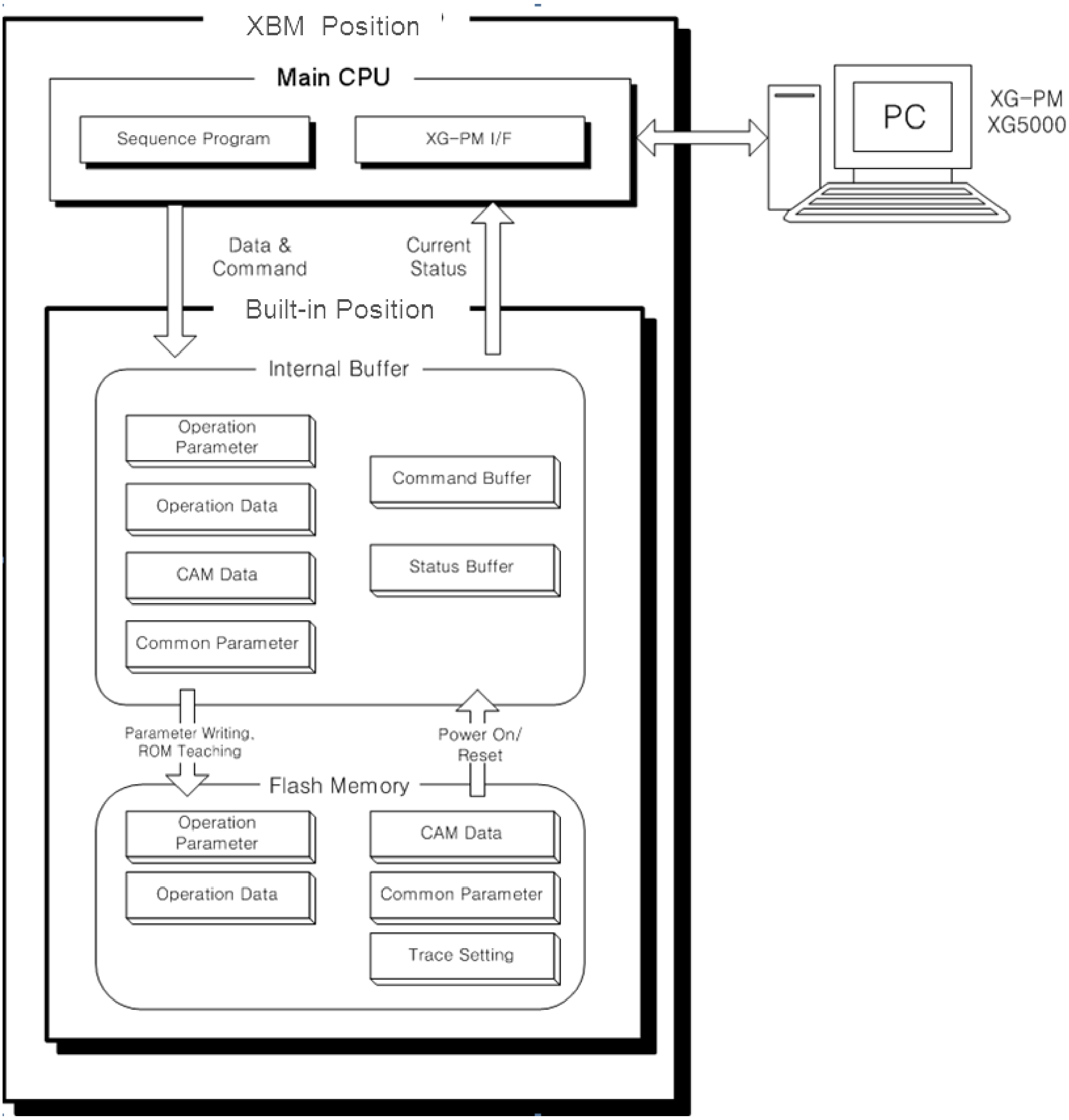


# Chapter 5 Positioning Parameter & Operation Data

This chapter describes parameter and operation data to be set by software package with embedded positioning.
Item of Parameter and operation data should be set for each axis (But common parameter shall be applied to all axis)

## 5.1 Parameter & Operation data

The picture below describes the flow of parameters and operation data saved in the PLC.



## 5.2 Basic Parameter

Here describes about basic parameter of embedded positioning.

### 5.2.1 Basic parameter

| Item | Setting range |
|---|---|
| Pulse output | 0 : Pulse Output Disable, 1 : Pulse Output Enable |
| Unit | 0:Pulse, 1:mm, 2:Inch, 3:Degree |
| Pulse per revolution | 1 ~ 200,000,000 |
| Travel per revolution | ㎜ : 1 ~ 200,000,000 [$X10^{-4}$㎜]<br>(1 ~ 200,000,000 [$X10^{-1}$㎛])<br>Inch : 1 ~ 200,000,000 [$X10^{-5}$Inch]<br>degree : 1 ~ 200,000,000 [$X10^{-5}$ degree] |
| Unit multiplier | 0: x 1, 1: x 10, 2: x 100, 3: x 1000 |
| Speed unit | 0: unit/time, 1: rpm |
| Bias speed [1] | ㎜ : 1 ~ 2,147,483,647 [$X10^{-2}$㎜/min]<br>Inch : 1 ~ 2,147,483,647 [$X10^{-3}$Inch/ min]<br>degree : 1 ~ 2,147,483,647 [$X10^{-3}$ degree/ min]<br>pulse : 1 ~ 200,000 [pulse/Sec] |
| Speed limit [2] | ㎜ : 1 ~ 2,147,483,647 [$X10^{-2}$㎜ / min]<br>Inch : 1 ~ 2,147,483,647 [$X10^{-3}$Inch / min]<br>degree : 1 ~ 2,147,483,647 [$X10^{-3}$ degree / min]<br>pulse : 1 ~ 200,000 [pulse/Sec] |
| Acceleration time 1 | 0 ~ 2,147,483,647 [ms] |
| Acceleration time 2 | |
| Acceleration time 3 | |
| Acceleration time 4 | |
| Deceleration time 1 | 0 ~ 2,147,483,647 [ms] |
| Deceleration time 2 | |
| Deceleration time 3 | |
| Deceleration time 4 | |
| Deceleration time for EMG stop | 0 ~ 2,147,483,647 [ms] |

1) The bias speed can not greater than the speed limit.

2) The mm, inch, degree unit is not available when a value converted to the pulse/sec unit is greater than 200,000.

**Notes**

For Deceleration time, when it stops by DEC. stop, DEC. time set in command is applied. At this time, if DEC. time is set as 0 in command, DEC. time set in basic parameter is applied. In case it stops by EMG stop because of internal factor, not external factor, EMG stop deceleration time in basic parameter is applied.

### 5.2.2 Basic parameter setting

(1) Unit

(a) You can set the command unit for positioning control according to control object. The command unit (mm, inch, pulse, degree) can be set for each axis separately.

(b) In case of changing the unit setting, as the value of other parameter and operation data does not change, the value of parameter or operation data should be set within the setting range of the unit to be changed.

Ex) mm, inch, pulse : X-Y Table, Conveyor
degree : a rotating body (360degree/revolution)

(2) Pulse per Revolution

(a) Only in case of using mm, inch, degree as a positioning command unit, you should set pulse per revolution

(b) In case of using SERVO, you should set the value of "the number of out put pulse per revolution".
If this value does not correspond with parameter value of servo drive, command and motor action may be different.

Travel per pulse = Transfer per rotation (Al) / Pulse per rotation (Ap)

Ex1) Speed: 60mm/min, Al:2000um, Ap: 200pls/revolution
60mm/min = 1mm/sec = 1000um/sec
1000um = 0.5 Revolution = 100pls
→ Pulse output speed is 100pls/sec when driving 60mm/min speed.

(3) Travel per rotation and unit multiplier

(a) Only in case of using mm, inch, degree as a positioning command unit, you should set travel per revolution and multiplier

(b) Actual Machine's travel distance per revolution of motor is determined by the structure of machine.
If the lead of ball screw (mm/rev) is PB and the rate of deceleration is 1/n,
Transfer amount per revolution (AL) = PB ×1/n.

(c) Settable Travel per revolution (Al) is as below

| Setting unit | mm | Inch | degree |
|---|---|---|---|
| Travel per revolution | 0.1 ~ 20000000.0 um | 0.00001 ~ 2000.00000 inch | 0.00001 ~ 2000.00000 degree |

In case Transfer amount per revolution (AL) exceeds the above range, The travel per rotation (Al) should be set as follows:

- Transfer amount (AL) = PB ×1/n = Travel per rotation (Al) × Unit multiplier (Am)

［**Note**］

In case unit is mm, unit multiplier (Am) can be 1,10,100,1000.
If the value of "PB ×1/n" exceeds 20,000,000.0㎛, it is required to adjust the unit multiplier so that the travel per rotation (Al) does not exceed 20,000,000.0㎛.

Ex1) In case that (AL) = PB ×1/n = 2500000.0㎛(= 2500㎜)
→ Transfer amount per revolution (AL) = (Al) × (Am) = 25000000 ×1

Ex2) In case that (AL) = PB ×1/n = 25000000.0㎛(= 25000㎜)
→ Transfer amount per revolution (AL) = (Al) × (Am) = 25000000 ×10 = = 2500000 ×100

(4) Speed Limit, Acceleration Time, Deceleration Time

(a) Speed Limit

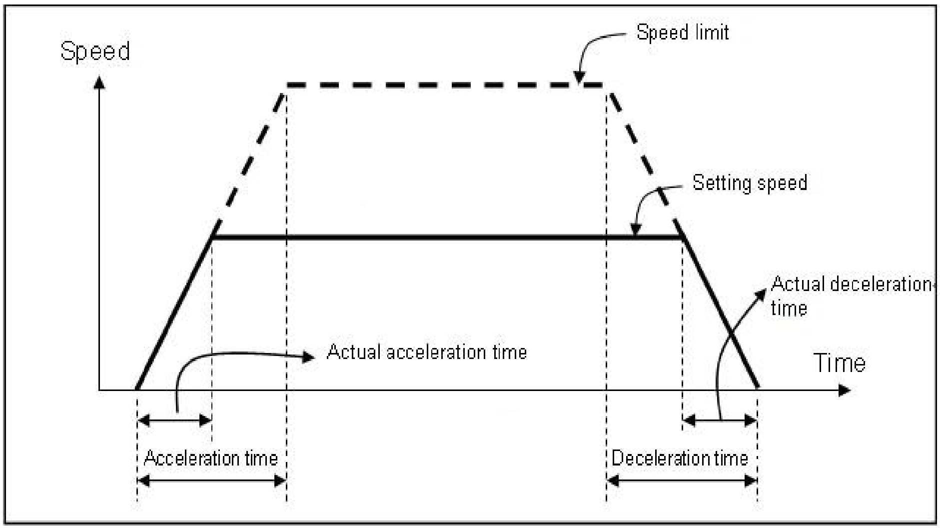
The Speed limit means available maximum speed of positioning operation
All of the operating speed in positioning operation should be set to be lower than speed limit.

(b) Acceleration Time

Acceleration Time is the time required to reach the limit speed which is set by parameter from zero speed(stop state).
(It doesn't mean the time require to reach the Target speed)

(c) Deceleration Time

Deceleration Time is the time required to reach zero speed(stop state) from the limit speed which is set by parameter.
(It doesn't mean the time require to reach zero speed from the operating speed.)



(5) Pulse Output Enable/Disenable

Built-in Position use output. If you disable pulse output for the axes that you do not use, you can use it as a normal output contact.

(6) Bias Speed

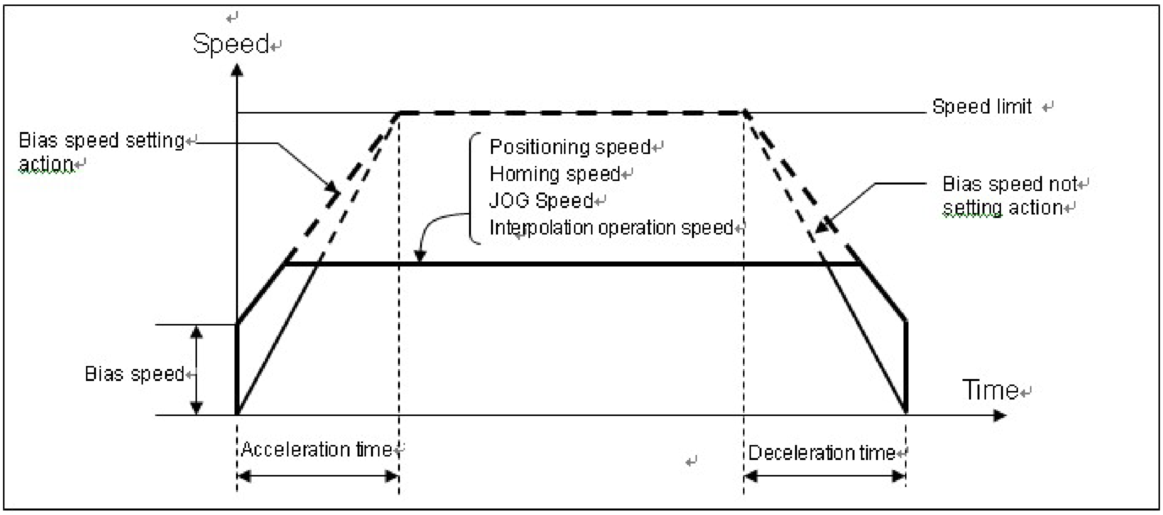
Because the stepping motor has unstable torque near zero speed, 0~bias speed is skipped in operation to smooth the rotation of motor and reduce the positioning time..

(a) The setting range is 0 ～ 200,000[pps] in case of pulse unit.

If the Unit parameter is not "Pulse", The bias speed should be not less than 1 when converted to "pulse unit" by Travel per revolution and pulse per revolution. if this value is smaller than 1, The PLC occurs error code "105" and adjust bias speed to satisfy above condition automatically.

[ Note ]

In case, Unit = mm, Pulse per revolution = 100 pls, Travel per revolution = 10000.0um, Unit multiplier
Available minimum bias speed can be calculated as below.
EX1) Travel per revolution (Al) = 10000.0um, Pulse per revolution(Ap)=1000pls
Trael per pulse = Travel per revolution (Al) / Pulse per revolution (Ap)
= 10000.0um/100pls
= 10.0um/pls = 0.6mm/min.



**Note**

1. If Bias speed is set as high, total operation time shall be reduced but if the setting value is too high, it may cause the occurrence of impact sound in the start/end time and forces the excessive effect to the machine. Cares shall be taken in using..
2. The bias speed should be set within the range as follows :
   1) Bias speed ≤ Positioning speed data
   2) Bias speed ≤ Homing-low speed ≤ Homing-high speed
   3) Bias speed ≤ JOG low speed ≤ JOG high speed
3. It causes error in connection with bias speed in the following example..
   1) Bias speed > Positioning speed data : error code 153
   2) Bias speed > Homing-high speed : error code 133
   3) Bias speed > Homing-low speed : error code 134
   4) Bias speed > JOG high speed : error code 121
   5) Bias speed > JOG high speed : error code 122
   6) Bias speed > inching speed : error code 123
   7) Converted Bias speed > 1pulse/s: error code 105

## 5.3 Extended Parameter

It describes about extended parameter of positioning module.

### 5.3.1 Contents of extended parameter

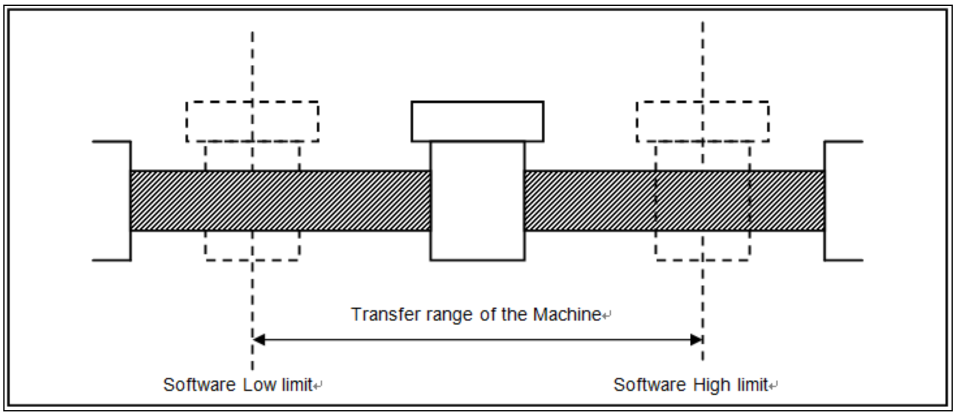
| Extended parameter Items | Setting Range |
|---|---|
| Software upper limit | ㎜ :-2,147,483,648 ~ 2,147,483,647[X$10^{-4}$㎜]<br>(-2,147,483,648 ~ 2,147,483,647[X$10^{-1}$㎛])<br>Inch:-2,147,483,648 ~ 2,147,483,647[X$10^{-5}$Inch]<br>degree:-2,147,483,648 ~ 2,147,483,647[X$10^{-5}$degree]<br>pulse:-2,147,483,648 ~ 2,147,483,647[pulse] |
| Software lower limit | |
| Infinite running repeat position | mm: 1 ~ 2,147,483,647[X$10^{-4}$㎜]<br>(1 ~ 2,147,483,647[X$10^{-1}$㎛])<br>Inch: 1 ~ 2,147,483,647[X$10^{-5}$Inch]<br>degree: 1 ~ 2,147,483,647[X$10^{-5}$degree]<br>pulse: 1 ~ 2,147,483,647[pulse] |
| Infinite running repeat | 0: Disable, 1: Enable |
| Backlash compensation amount | mm: 0 ~ 65,535[X$10^{-4}$㎜]<br>(0 ~ 65,535[X$10^{-1}$㎛])<br>inch: 0 ~ 65,535[X$10^{-5}$Inch]<br>degree: 0 ~ 65,535[X$10^{-5}$degree]<br>pulse: 0 ~ 65,535[pulse] |
| Position completion time | 0 ~ 65,535[ms] |
| S-Curve ratio(%) | 1 ~ 100 |
| Pulse output direction | 0: CW, 1: CCW |
| Acceleration/Deceleration pattern | 0:Trapezoid operation, 1:S-Curve operation |
| M Code mode | 0: NONE, 1: WITH, 2: AFTER |
| Software limit detection | 0:Don't detect, 1: Detect |
| Interpolation speed selection | 0: main axis speed, 1: synthetic speed |
| Arc insertion position in 2-axis linear interpolation continuous operation | mm: 0 ~ 2,147,483,647[X$10^{-4}$㎜]<br>(0 ~ 2,147,483,647[X$10^{-1}$㎛])<br>Inch: 0 ~ 2,147,483,647[X$10^{-5}$Inch]<br>degree: 0 ~ 2,147,483,647[X$10^{-5}$degree]<br>pulse: 0 ~ 2,147,483,647[pulse] |
| Arc insertion in 2-axis linear interpolation continuous operation | 0 : Don't insert , 1 : Insert arc continuous operation |
| Speed/Position switching coordinate | 0: Incremental, 1: Absolute |
| Pos.-specified speed override coordinate | 0: absolute, 1: incremental |

### 5.3.2 Extended parameter setting

(1) Software upper/Lower Limit

(a) The function is designed so that the machine does not execute the positioning operation out of the range by setting the range of machine available to move through software upper limit and software lower limit. That is, this function is used to prevent any breakaway by incorrect operation position setting and incorrect operation by user program fault.

(b) External input upper/lower limit can be also set besides the software upper/lower limit.



(c) The range check of software upper/lower limit is done at the start of operation and during operating.

(d) If the software upper/lower limit is detected, error (Software upper limit error: 501, Software lower limit error: 502) occurs and the pulse output of positioning module shall be disabled.
Therefore, when you want to operate again, it is required to reset error and release the 'output inhibition' before using.

(e) Setting range

| Unit | Software upper/lower limit range |
|---|---|
| pulse | -2,147,483,648～2,147,483,647[pulse] |
| mm | -2,147,483,648～2,147,483,647[X$10^{-4}$㎜] |
| Inch | -2,147,483,648～2,147,483,647[X$10^{-5}$Inch] |
| degree | -2,147,483,648～2,147,483,647[X$10^{-5}$degree] |

* Software upper limit value always should be equal or higher than software lower limit.

(f) If the software upper/lower limit was set by default value (upper limit: 2,147,483,647, lower limit: -2,147,483,648) or same value, then it wouldn't detect upper/lower limit.

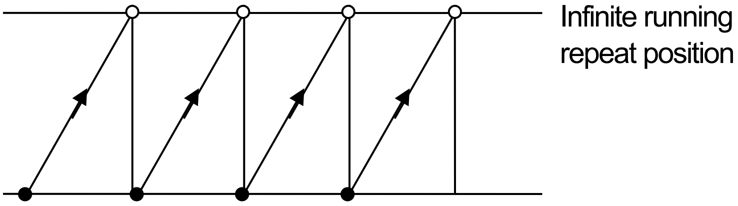
(g) The software upper and lower limits, when exceeded, will move the additional distance required for an emergency stop before stopping. The time required for the emergency stop can be set in the 'Dec. time for emg. stop' in the Basic Parameter.

(2) Infinite running repeat position

(a) When using "Infinite running repeat" mode, it sets the repeated position value.

(b) This is applied when "Infinite running repeat" in the extended parameter is "1: Enable". When this parameter setting value is "0: Disable", command position and current position is expressed within position expression range according to value set in "Unit" of basic parameter.

(c) When "Infinite running repeat" parameter is "1: enable", command position and current position is expressed as 0 ~ "infinite running repeat position-1".



(d) Setting range

| Unit | Infinite running repeat position range |
|---|---|
| pulse | 1～2,147,483,647[pulse] |
| mm | 1～2,147,483,647[X10$^{-4}$㎜] |
| Inch | 1～2,147,483,647[X10$^{-5}$Inch] |
| degree | 1～2,147,483,647[X10$^{-5}$degree] |

(3) Infinite running repeat

(a) It sets whether to enable or disable "Infinite running repeat"

(b) When you set "Infinite running repeat" as "1: enable", command position and current position refreshes within the range set in "Infinite running repeat position" periodically.

(c) When you don't use "Infinite running repeat" function, set as "0: disable".

(4) Backlash Compensation Amount

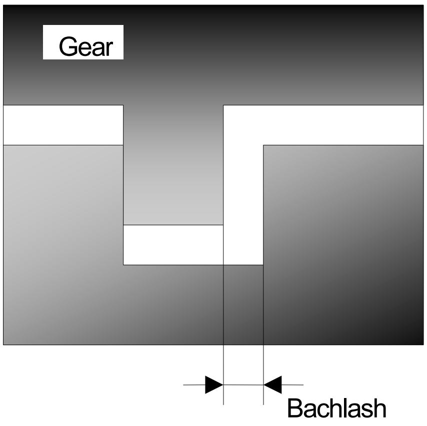
(a) In case that a gear, screw etc is combined to the motor axis, The tolerance that the machine does not work by the wear, when the rotation direction changes, is called as 'Backlash". Therefore, when you change the rotation direction, it is required to add the backlash compensation amount to the positioning amount for output.

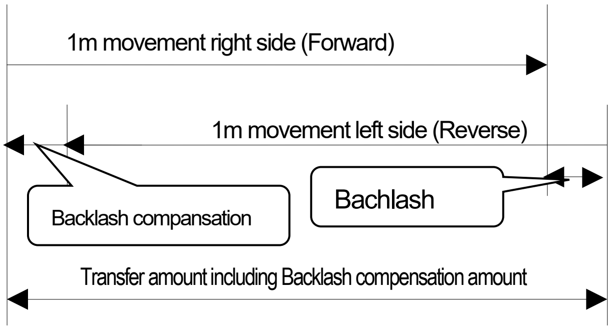
(b) This is used for positioning operation, inching operation and jog operation

(c) Setting range

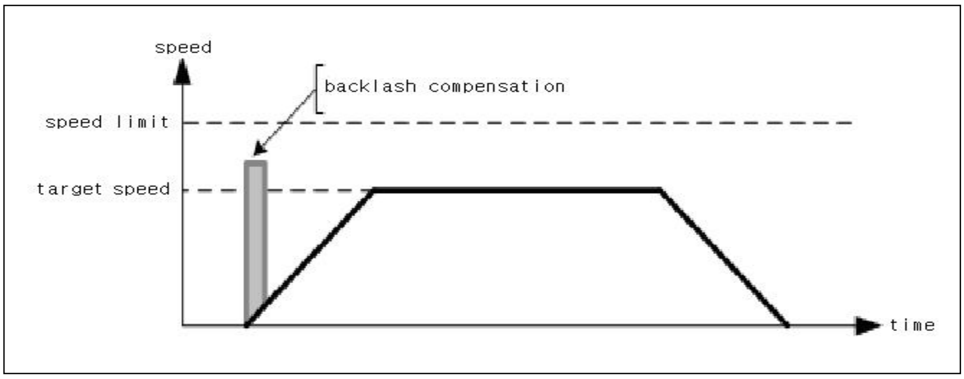
| Unit | Backlash setting range |
|---|---|
| pulse | 0 ～ 65,535[pulse] |
| mm | 0 ～ 65,535[X10$^{-4}$㎜] |
| Inch | 0 ～ 65,535[X10$^{-5}$Inch] |
| degree | 0 ～ 65,535[X10$^{-5}$degree] |

(d) As presented in the following figure, if the position moved 1m to the right and again 1m to the left, it is not possible to reach the original position by backlash. At this time, it is required to add backlash compensation amount.



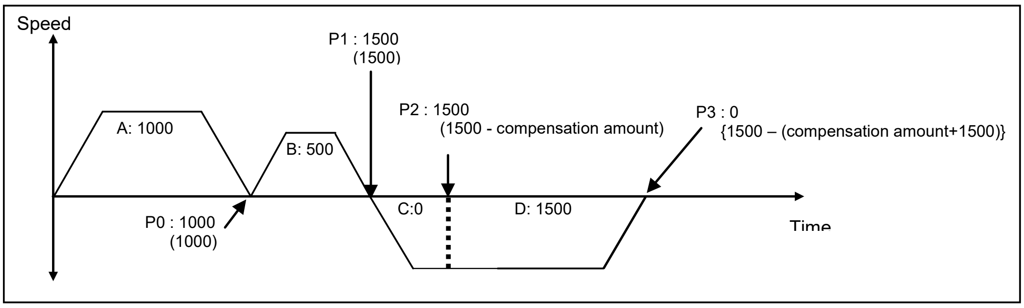


(e) It compensates by adding backlash compensation pulse to current output pulse within speed limit.
In case backlash compensation amount is bigger than Max. output Pulse (Speed limit × Control cycle) for one control cycle, distribute compensation amount to several control cycles



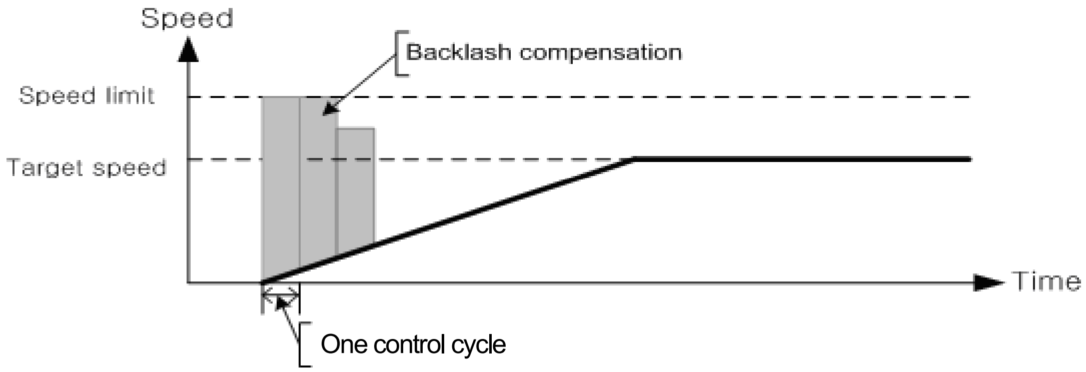
A,B,C,D : Relative position

P0 ,P1,P2,P3 : transfer amount of load



**Notes**

In case backlash compensation is bigger than Max. Pulse (Speed limit x Control cycle) for one control cycle, progress is as shown below. For example, in case that Speed limit is 100000 and backlash is 250, backlash compensation is bigger than Max. output Pulse (100000pps x 0.001s = 100) for one control cycle, and performed for several control cycles. In this case, the number of output pulse which comes from positioning module per one control cycle is different according to Acc. time. Compensation pulse is added to above pulse for total pulse output to be smaller than Max. output pulse for one control cycle. So the number of control cycle compensation acts is different.



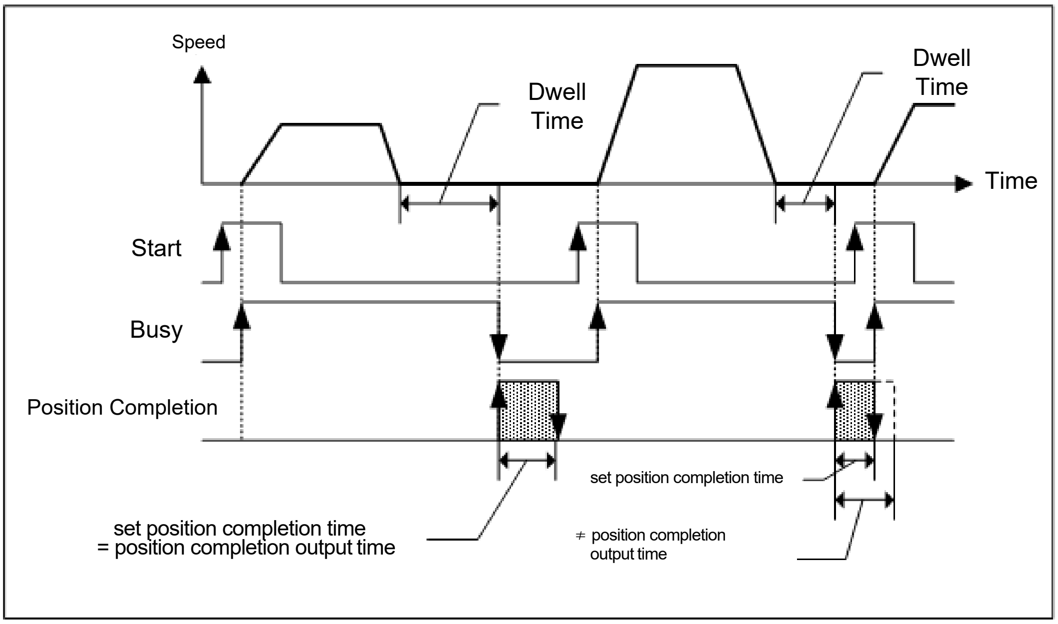
(5) Positioning Completion Time

(a) Positioning completion signal shall be OFF after sustaining "ON" for Positioning Completion Time after positioning is completed and positioning completion signal becomes "ON" in single operation, repeat operation, keep operation, continuous operation, linear interpolation operation, circular interpolation operation, speed/position switching control operation, inching operation

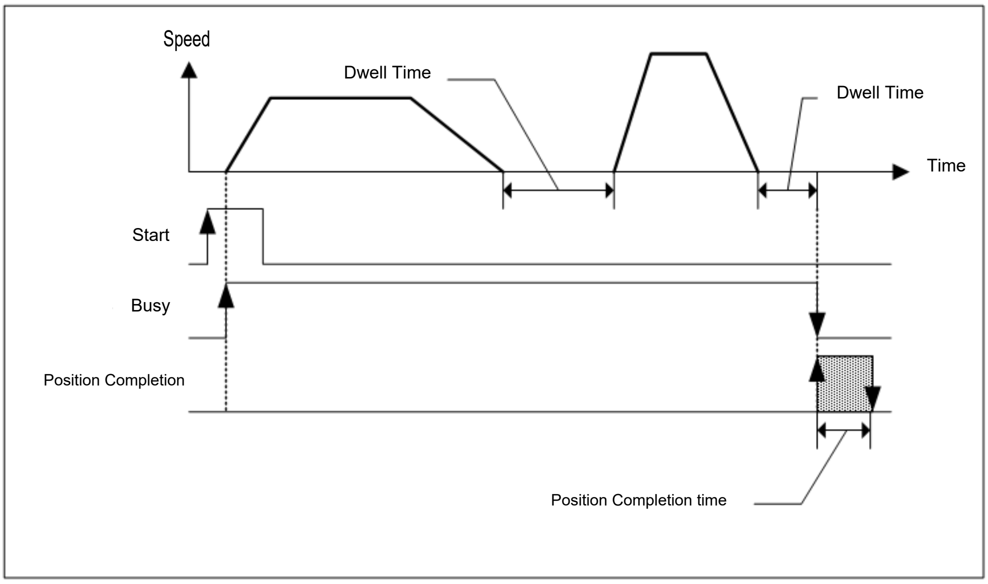
At this time, if all start command is executed while positioning completion signal is ON, completion signal shall be OFF immediately. In case of keep operation and continuous mode operation, positioning completion signal will be on after all steps end.

(b) The setting range is 0 ～ 65,535 (unit: 1㎳).

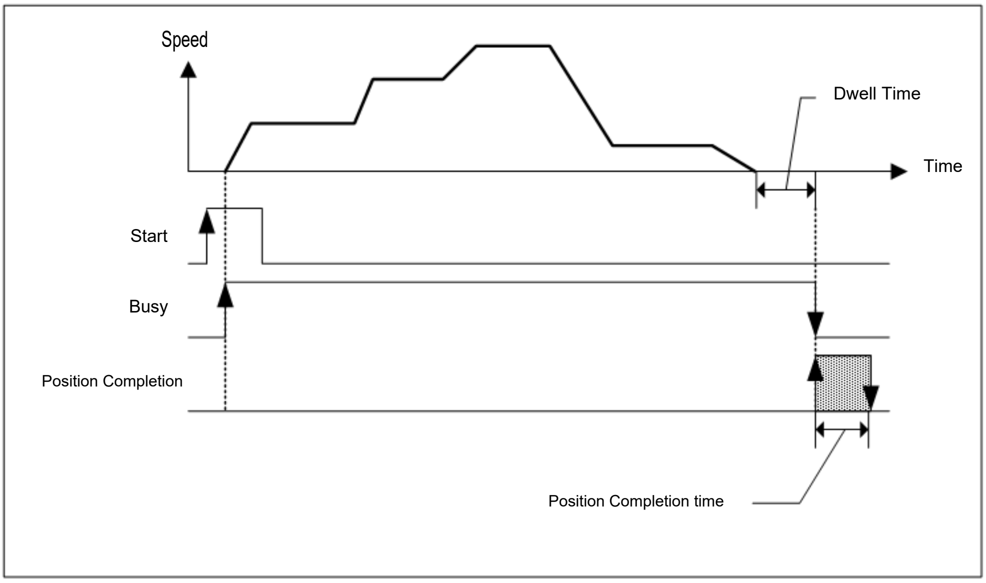
(c) The action of single operation mode is as follows.



(d) The action of Keep operation mode is as follows :



(e) The action of Continuous operation mode is as follows.



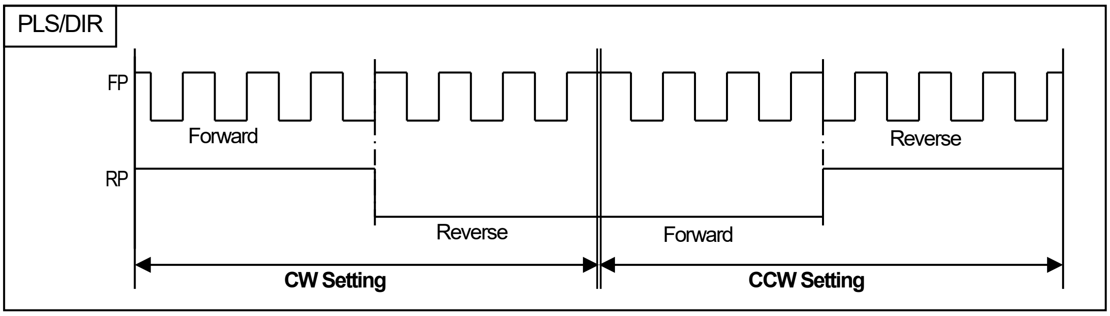
(6) Pulse output direction

(a) This is used to set machine's actual movement direction according to pulse output direction (rotation direction of motor) of positioning function.

(b) If pulse output direction is set as "CW" and machine moves forward direction in case of forward direction operation, it is set correctly.

(c) If pulse output direction is set as "CW" and machine moves reverse direction in case of forward direction operation, it is not set correctly. Set the pulse output direction as "CCW". In case of forward direction operation, if machine moves forward direction, it is set correctly.

(d) In the following figure, pulse output level is set as Low Active"



(7) M Code Output

(a) M code mode set by parameter shall be applied to all positioning data of the corresponding axis.

(b) Available to set M code number differently at each operation step no. of positioning data.

(c) M code number setting range : 1 ~ 65,535

(d) Available to read and use M code for the identification of operation step no. in operation and the execution of auxiliary works (Clamp, tool change etc).

(e) M code signal occurring during the operation shall be reset by "MOF" command.

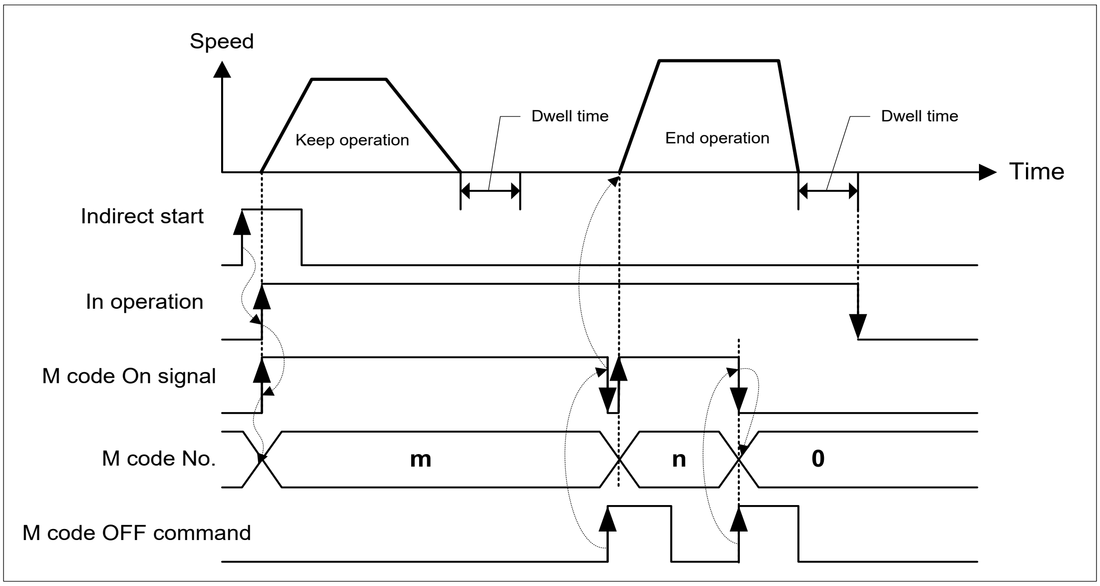
**Notes**

If you execute the next step after the positioning is completed and M code signal is "ON", the next operation step no. does not work and the error code(233) will occur. Therefore, in order to execute the positioning of the next operation step number, M code signal should be "OFF" by "MOF" command

(f) There are two kinds of M code mode according to the output timing of M code signal: With mode and After mode
(In case of setting NONE, there is no M code signal, even if M code No. was set.)

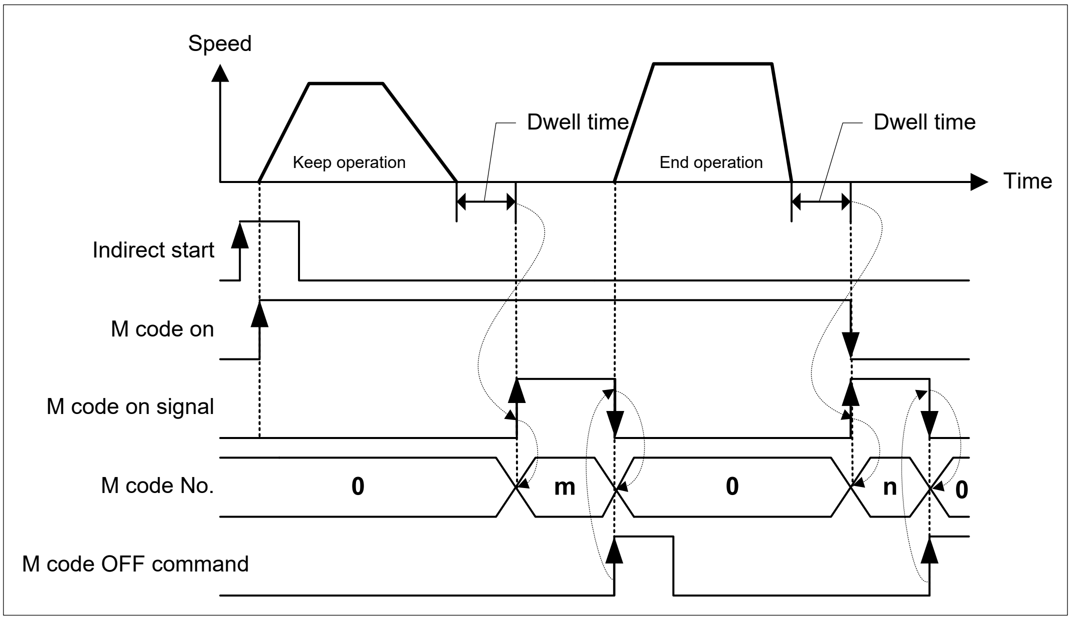
1) With mode

It turns on the M code signal and outputs M code number with start of positioning [Indirect start, direct start and simultaneous start].



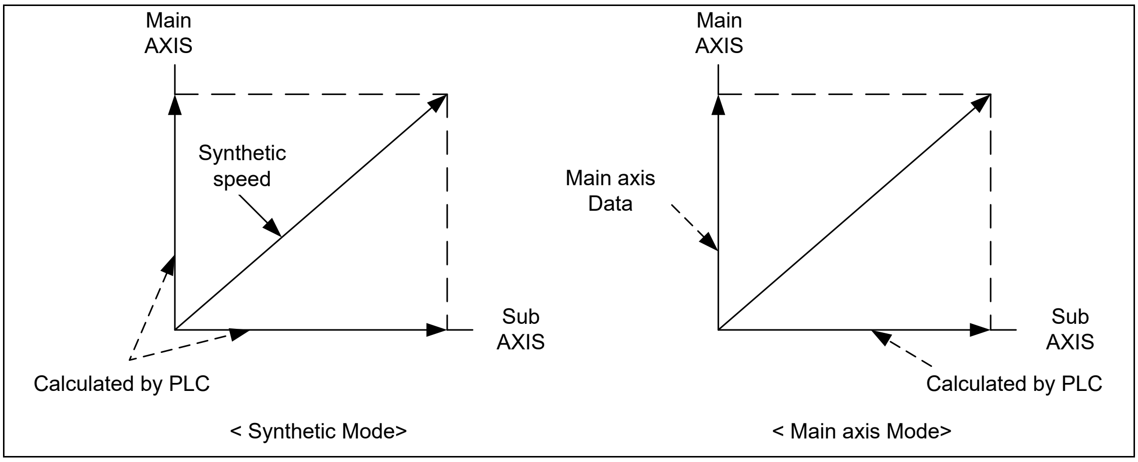
2) After mode

It turns on the M code signal and outputs M code number after completion of positioning [indirect start, direct start and simultaneous start].



### (8) Interpolation speed selection

It selects whether to consider the operation speed of the position data as main axis speed or synthetic speed.



### (9) Software limit detect

(a) Selects whether to stop the operation or not when detecting software limit.

(b) If the software upper/lower limit is set as default value (upper limit: 2,147,483,647, lower limit: -2,147,483,648) or same value, it wouldn't detect software upper/lower limit.

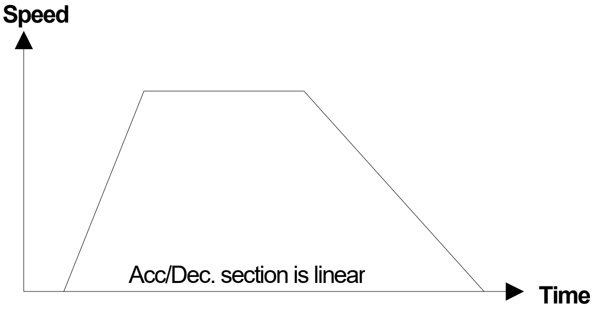
### (10) Acceleration/Deceleration Pattern

(a) There are 2 kinds of Acceleration/Deceleration operation pattern: Trapezoid operation and S-Curve operation.

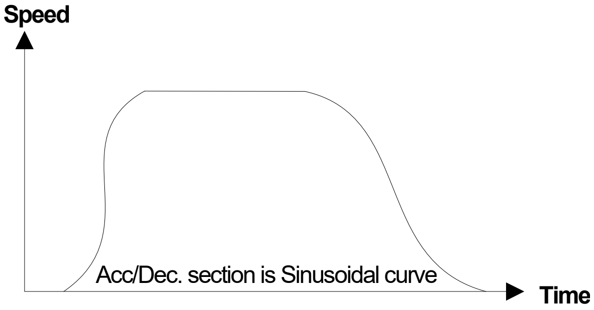
(b) In case of positioning operation, it is available to select operation pattern (either trapezoid operation or S-Curve operation) at the section of acceleration and de deceleration.

(c) As it is not possible to use S-Curve operation pattern in case of continuous operation mode and speed override, care should be taken in setting.

(d) By using S-Curve acceleration/deceleration, it is available to protect the motor from the load effect at the point that the motor starts to move the moving object and stops it.



<Trapezoidal method>



<S-Curve method>

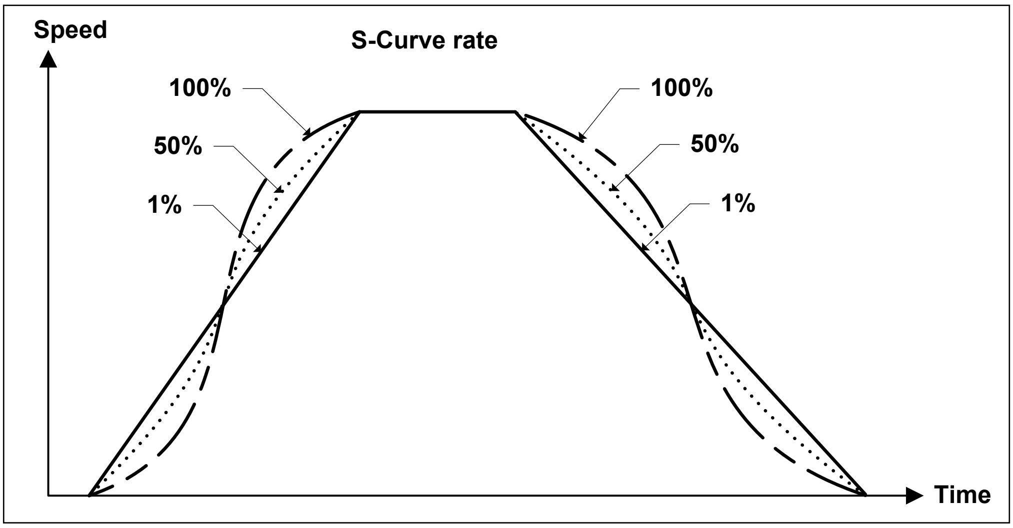
### (11) S-curve rate

(a) In case of selecting S-Curve operation as an acceleration/deceleration pattern, S-Curve rate (1~100%) should be set.

(b) According to S-Curve rate, S-Curve operation pattern shall be formed in accordance with Sinusoidal curve.

(c) If S-Curve rate is 1%, it becomes the same as trapezoid operation and if the 100% rate is set, it becomes the acceleration/deceleration curve which is the closest to the Sinusoidal Curve.

(d) The figure as below shows the example of S-Curve rate setting



(12) Linear interpolation positioning method

In case control method is linear interpolation or circular interpolation and operation method is continuous operation, positioning control will be different in accordance with the value set in "Int continuous opr. Type".

The two method types of interpolation control continuous operation are as follows;

- Pass target position (Passes designated target position)
- Pass near position (Before reaching target position of current step, moves to target position of next step

Setting range of the Interpolation continuous operation positioning method is as follows;

| Items | Setting value | Description |
|---|---|---|
| Interpolation continuous operation method | 0 : Pass target position | In case of continuous operation from current step to next step, it passes target position of current step . |
| | 1 : Pass near position | In case of continuous operation from current step to next step, it passes near target position of current step |

For further information, please refer to operation mode (4) continuous operation of 9.2.2 positioning control.

(13) Arc insertion during 2-axis linear interpolation continuous operation

When executing linear interpolation, determine whether to add arc during 2-axis linear interpolation continuous operation. Here describes Arc insertion during 2-axis linear interpolation continuous operation

| Setting item | Setting Value | Content |
|---|---|---|
| Arc insertion during 2-axis linear interpolation continuous operation | 0 : Don't insert | When executing 2-axis linear continuous interpolation, doesn't inserts arc. . |
| | 1 : insert arc | When executing 2-axis linear continuous interpolation, inserts arc. |

For further information about Arc insertion during 2-axis linear interpolation continuous operation, please refer to (4) 2-axis linear interpolation continuous operation arc insertion of 2-axis linear interpolating control of 9.2.6.

(14) Arc insertion position

When 「Arc insertion」 was set as "insert arc", confirm the position where it was set by 'inputting circular arc continuous operation', reset start position of circular interpolation(Goal position of linear path 1) and goal position (Start position of linear path 2).

This is the setting of 'Position-specified speed override coordinate'.

| Item | Setting value | Content |
|---|---|---|
| Position of inputting circular arc from axis 2 linear interpolation continuous operation | 0 ~ 2,147,483,647 | Set the position that circular will be inputted. It is relative distance from goal position.. |

For further information about inputting circular arc from axis 2 linear interpolation continuous operation, please refer to (4) inputting circular arc from axis 2 linear interpolation continuous operation of control linear interpolation (9.2.6).

### (15) Position-specified speed override coordinate

Position-specified speed override command is the command changing the operation speed when the object reaches the specified position. At this time, operation may be different according to the type of position value. Position value can be absolute position value or incremental position value.

This is the setting of 'Position-specified speed override coordinate'.

| Item | Setting value | Content |
|---|---|---|
| Position-specified speed override coordinate | 0 : ABS | Speed changes at the specified absolute position. |
| | 1 : INC | Speed changes at the position as far as the set value from start position. |

For further information, refer to 9.5.6 position-specified speed override.

### (16) Speed/Position switching coordinate

If "Speed/Position switching command" is executed during speed control, speed control changes into position control and executes position control with the value set in target position. At this time, this sets whether to consider the target position as absolute position value or incremental position value.

This is the setting of "Speed/Position switching coordinate".

| Item | Setting value | Content |
|---|---|---|
| Speed/position switching coordinate | 0 : INC | Executes positioning as far as the set value from position where speed/position switching command is executed. |
| | 1 : ABS | Considers the set value as absolute position and executes positioning into the set absolute position. |

For further information, refer to 9.2.14 speed/position switching control.

# 5.4 Manual Operation Parameter

Here describes Manual operation parameter of embedded positioning.

Manual operation parameter use in event that operation of JOG, Inching is used

## 5.4.1 Manual Operation Parameter

| Manual operating parameter item | Setting range |
|---|---|
| JOG high speed | ㎜ : 1 ~ 2,147,483,647 [X10$^{-2}$㎜/ min]<br>Inch : 1 ~ 2,147,483,647 [X10$^{-3}$Inch/ min]<br>degree : 1 ~ 2,147,483,647 [X10$^{-3}$ degree/min]<br>pulse : 1 ~ 200,000 [pulse/sec] |
| JOG low speed | |
| JOG acceleration speed (ms) | 0 ~ 2,147,483,647 [ms] |
| JOG deceleration speed (ms) | |
| Inching Speed | ㎜ : 1 ~ 65,535[X10$^{-2}$㎜/min]<br>Inch : 1 ~ 65,535[X10$^{-3}$Inch/min]<br>degree : 1 ~ 65,535[X10$^{-3}$ degree/min]<br>pulse : 1 ~ 65,535[pulse/sec] |

## 5.4.2 Manual Operation Parameter Setting

(1) JOG high Speed

(a) Jog speed is related to Jog operation (a kind of manual operation) and has 2 types of operation : Jog low speed operation and Jog high speed operation.

(b) For further information, please refer to 9.3.1 JOG Operation.

(c) JOG high speed operation has operation pattern as acceleration, constant speed, deceleration section. Therefore, acceleration section and deceleration section is controlled by JOG acceleration/deceleration time.

(d) Jog high speed setting range

All of control by embedded positioning is made within speed limit. Therefore, jog high speed also couldn't exceed the speed limit and must be larger than jog low speed.

(Notices when setting the high speed : Bias speed ≤ Jog low speed ≤ Jog high speed ≤ Speed limit)

(2) JOG Low Speed

(a) JOG low speed operation has operation pattern as acceleration, constant speed, deceleration section.

(b) JOG low speed setting range : Bias speed ~ Jog high speed

(3) JOG Acceleration/Deceleration Time

(a) This means JOG acceleration/deceleration time when Jog high speed and low speed operation.

(b) JOG acceleration/deceleration time setting range : 0 ~ 2,147,483,647 [ms]

In case of 0, operates according to acceleration time 1 and deceleration time 1 of parameter..

(4) Inching Speed

(a) The speed necessary for inching operation is set here.

(b) Inching speed setting range : 1 ~ 65,535(unit: 1pps)

# 5.5 Homing Parameter

Here describes about homing parameter of embedded positioning.

Homing parameter is needed when positioning module returns to origin.

## 5.5.1 Homing Parameter

| Homing Parameter option | | Setting range |
|---|---|---|
| Origin address | | ㎜ : -2147483648 ～ 2147483647 [X10$^{-4}$㎜]<br>(-2147483648 ～ 2147483647 [X10$^{-1}$㎛])<br>Inch : -2147483648 ～ 2147483647 [X10$^{-5}$Inch]<br>degree : -2147483648 ～ 2147483647 [X10$^{-5}$degree]<br>pulse : -2147483648 ～ 2147483647 [pulse] |
| Homing-high speed | | ㎜ : Bias Speed ～ Speed Limit(Homing Low Speed<=Homing high Speed)<br>Inch : Bias Speed ～ Speed Limit(Homing Low Speed<=Homing high Speed)<br>degree : Bias Speed ～ Speed Limit(Homing Low Speed<=Homing high Speed)<br>pulse : Bias Speed ～ Speed Limit(Homing Low Speed<=Homing high Speed) |
| Homing-low speed | | |
| Homing Acceleration time | | 0 ~ 2,147,483,647 [ms] |
| Homing deceleration time | | |
| Homing dwell time | | 0 ~ 65,535[ms] |
| Origin compensation amount | | ㎜ : -2147483648 ～ 2147483647 [X10$^{-3}$㎜]<br>(-2147483648 ～ 2147483647 [X10$^{-1}$㎛])<br>Inch : -2147483648 ～ 2147483647 [X10$^{-5}$Inch]<br>degree : -2147483648 ～ 2147483647 [X10$^{-5}$degree]<br>pulse : -2147483648 ～ 2147483647 [pulse] |
| Homing restart waiting time | | 0 ~ 65,535[ms] |
| Control word | Homing mode(bit 0 ~ 2) | 0:Dog/Home(Off), 1: Dog/Home (On), 2:Upper-Lower Limit/Home, 3:Dog, 4:High Speed Homing, 5: Upper-Lower Limit, 6: Home |
| | Homing direction(bit 3) | 0:forward direction, 1:reverse direction |

## 5.5.2 Homing parameter setting

### (1) Homing Method

(a) There are 7 kinds of Homing method.

| Homing method | XG-PM Software package indication |
|---|---|
| Origin detection after DOG OFF | 0: DOG/origin(OFF) |
| Origin detection after deceleration when DOG ON | 1: DOG/origin(ON) |
| Origin detection by the origin and Upper/Lower limit | 2: High/low limit/origin |
| Origin detection by DOG | 3: DOG |
| High speed homing | 4: High speed origin |
| Origin detection by Upper/Lower limit | 5: High/low limit |
| Origin detection by HOME | 6: HOME |

(b) For further information of homing method, please refer to 9.1 homing of chapter 9

### (2) Homing direction

(a) There are 2 kinds of homing direction, forward direction and reverse direction.

(b) In case of homing command was set by forward, begin to homing operation to currently increasing direction of position, searching needed external signal for homing.

(c) In case of homing command was set by reverse, begin to homing operation to currently decreasing direction of position, searching needed external signal for homing.

### (3) Origin Address

(a) When homing is completed by homing command, the value set by homing address shall be used to change the present address value.

(b) Setting range of homing address: -2,147,483,648 ～ 2,147,483,647(unit: pulse)

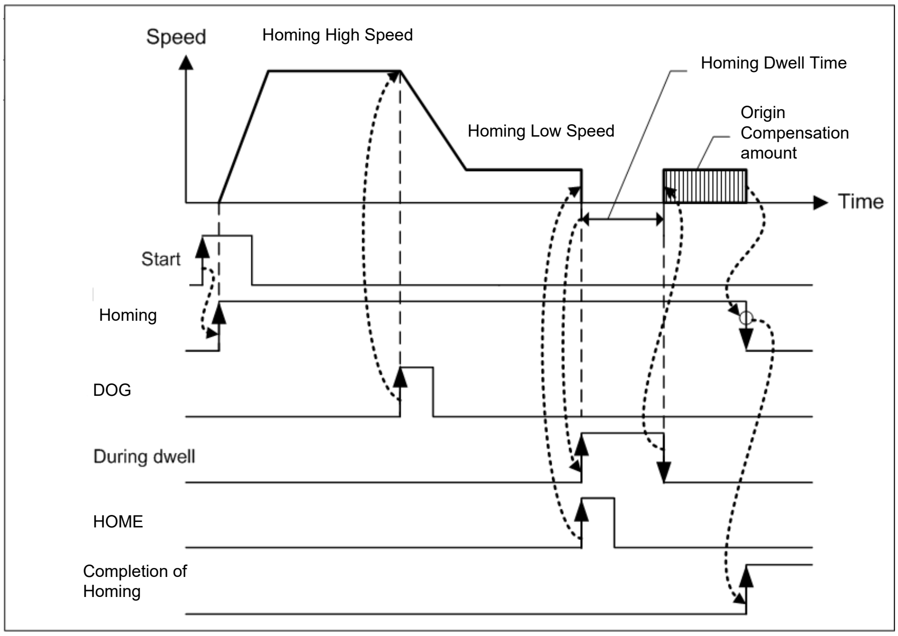
(4) Origin compensation amount

(a) If the machine origin is deviated slightly – the difference between the setting value and the actual transfer amount caused by the mechanical tolerance - at the origin detection (Z phase input), this is used to compensate the tolerance.

(b) If origin compensation amount is set, PLC outputs additional pulses as much as data amount set as origin compensation amount after detecting origin. If origin compensation amount is (+), it moves to the homing direction.
if origin compensation amount is (-), it moves to the opposite direction of homing.

(c) Origin compensation amount setting range : -2,147,483,648 ～ 2,147,483,647 (unit: pulse)

(d) This picture is one of the examples about homing method that was applied by homing compensation amount from "Origin detection after DOG OFF".



(5) Homing-High speed

(a) There are 2 kinds of homing speed : high speed and low speed.

(b) There is two stage in homing action ; 'Detecting Home'& 'Detecting Home area'.
PLC stop moving immediately when detects the Home signal. therefore when homing speed is fast, there can be difference between "the origin signal" and "the stopped postion of machine" . Therefore, The moving speed must be low enough to stop in the correct home signal position and this speed is "homing low speed". But, need to move as fast as possible until detecting " Home Area(DOG)". This speed is is "homing High speed".

(c) All of the control by positioning module doing work within speed limit. And Homing high speed also can't exceed speed limit. And, Homing high speed must be faster than or same with homing low speed.

- Bias speed ≤ Homing-low speed ≤ Homing-high speed ≤ Speed limit

(6) Homing-Low speed

(a) The speed that acts to the constant speed section from high speed section via deceleration section by homing command.

**Notes**

When setting the homing speed, it is recommended to set the homing-low speed as low speed as possible.
If setting the low speed as "too fast", it may cause the incorrect origin signal detection.

(7) Homing restart waiting time

(a) It is standby time until restart "Homing" automatically in case that can't complete "Homing" by detection of high/low limit during homing operation.

(b) Motor do not move while it was set by reset time.

(8) Homing accelerating speed/ deceleration speed

(a) When operates by homing command, it will be accelerated or decelerated by the homing acceleration time and homing deceleration time".

(b) Available range is 0 ~ 2,147,483,647 [ms].
if it is set by ‘0’, It will be accelerated or decelerated according to acceleration/deceleration time1 of basic parameter when homing.

(9) Homing dwell time

(a) This is the time needed to maintain the precise stop accuracy of SERVO motor when using the SERVO motor for positioning.

(b) Practically, Dwell time is the time needed to remove the residual pulse of deviation counter after completion of positioning and especially Dwell time when returning to the origin is called as “homing dwell time”.

(c) Setting range of Homing dwell time : 0 ～ 65,535(unit: 1㎳)

## 5.6 I/O Signal Parameter

Here describes using input/output signal parameter in embedded positioning.
Input/output signal parameters are used to decide active level of input signal.

### 5.6.1 I/O Signal Parameter

| Input/output signal parameter Item | Setting range |
|---|---|
| High limit signal | 0 : A contact(Normaly Open), 1 : B contact(Normaly Close) |
| Low limit signal | |
| DOG signal | |
| Home signal | |
| Deviation signal | |
| Upper limit signal | All P area |
| lower limit signal | All P area |
| DOG signal | Output P area |
| HOME signal | All P area |

### 5.6.2 Setting Range of I/O Signal Parameter

In case of setting the input signal by A contact, it acts when external is ON and in case of setting by B contact, it acts when external signal is OFF.

(1) If setting the upper limit signal of input signal parameter by A contact and the lower limit signal by B contact, the upper limit is detected when external upper limit signal is ON while the lower limit is detected when external upper signal is OFF.
(2) If selecting Emergency stop from External stop selection of extended parameter, the external input signal is used by Emergency stop signal. And if setting Emergency stop signal of input signal parameter by A contact, the positioning module stop immediately when Emergency stop signal is ON. On the contrary, if setting Emergency stop signal of input signal parameter by B contact, the positioning module stop immediately when external Emergency stop signal is OFF.
(3) If setting the home signal of input signal parameter by A contact, the origin is detected when external home signal is 'Rising edge', while if setting by B contact, the origin is detected when external home signal is 'Falling edge'.

## 5.7 Common Parameter

Here describes common parameter of embedded positioning.
The common parameters are applied universally to all axes connected to the positioning module.

### 5.7.1 Common parameter

| Items | Setting range |
|---|---|
| Pulse output level | 0: Low Active, 1: High Active |
| Speed override | 0: % designate, 1 : Speed designate |
| Home status set during EMG stop | 0 : Previous stage, 1 : ORG undefined |
| SSP Position | 0 : INC, 1 : ABS |
| Control period | 1 ~ 10ms |

### 5.7.2 Common Parameter Setting

(1) Speed override

(a) When operate changing speed command (Speed override, Positioning speed override, etc), select speed(will be changed) or percentage of goal speed.

(b) In case of setting percentage (%) can set each from 0.01% to 655.35%( unit: 0.01%)

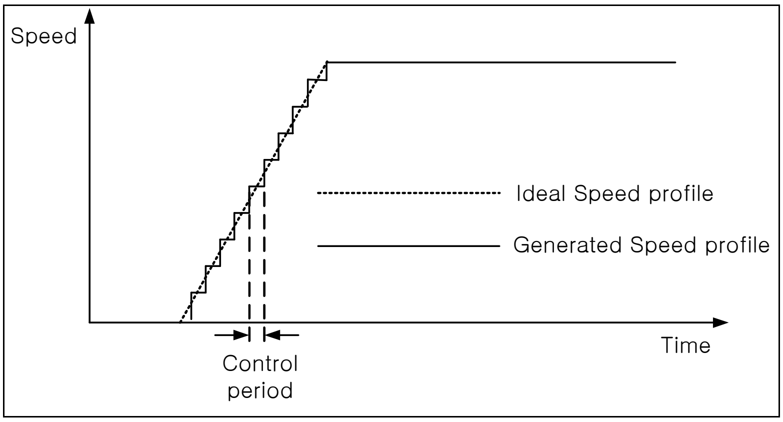
(2) Continuous Operarion

(a) The embedded positioning function generate speed profile for each predetermined period.

If continuous operation is disabled, Speed profile will be generated every 1ms and will be generated every 5ms if enabled.

(b) if Continuous Operation parameter is disabled, Continuous operation command can not be executed (Error Code 160 occurs)

(c) The figure below shows example of generated speed profile of trapezoidal acceleration.



## 5.8 Operation Data

Here describes Operation Data of positioning module.
Can set 400 operation data per each axis, operation of circular interpolation and Linear interpolation act in accordance with information of operation data.

### 5.8.1 Operation Data

<table>
<tr><th>Operation data item</th><th>Setting range</th></tr>
<tr><td>Control type</td><td>Absolute, Single axis positioning<br>Absolute, Single axis speed control<br>Absolute, Single axis feed control<br>Absolute, linear interpolation<br>Absolute, circular interpolation<br>incremental, Single axis positioning<br>incremental, Single axis speed control<br>incremental, Single axis feed control<br>incremental, linear interpolation<br>incremental, circular interpolation</td></tr>
<tr><td>Operation type</td><td>Singular, End<br>Singular, Keep<br>Singular, Continuous<br>Repeat, End<br>Repeat, Keep<br>Repeat, Continuous</td></tr>
<tr><td>Target position</td><td>㎜ : -2147483648 ~ 2147483647 [$X10^{-4}$㎜]<br>(-2147483648 ~ 2147483647 [$X10^{-4}$㎜])<br>Inch : -2147483648 ~ 2147483647 [$X10^{-5}$Inch]<br>degree : -2147483648 ~ 2147483647 [$X10^{-5}$degree]<br>pulse : -2147483648 ~ 2147483647 [pulse]</td></tr>
<tr><td>Operation speed</td><td>㎜ : Bias Speed ～ Speed Limit<br>Inch : Bias Speed ～ Speed Limit<br>degree : Bias Speed ～ Speed Limit<br>pulse : Bias Speed ～ Speed Limit</td></tr>
<tr><td>Acceleration No.</td><td>0 ~ 3</td></tr>
<tr><td>Decelleration No.</td><td>0 ~ 3</td></tr>
<tr><td>M Code</td><td>0 ~ 65,535</td></tr>
<tr><td>Dwell time</td><td>0 ~ 65,535[ms]</td></tr>
<tr><td>Sub axis setting</td><td><table><tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr><tr><td>-</td><td>-</td><td>Axis 6</td><td>Axis 5</td><td>Axis 4</td><td>Axis 3</td><td>Axis 2</td><td>Axis 1</td></tr></table></td></tr>
<tr><td>Circular interpolation auxiliary point *1)</td><td>㎜ : -2147483648 ~ 2147483647 [$X10^{-4}$㎜]<br>(-2147483648 ~ 2147483647 [$X10^{-4}$㎜])<br>Inch : -2147483648 ~ 2147483647 [$X10^{-5}$Inch]<br>degree : -2147483648 ~ 2147483647 [$X10^{-5}$degree]<br>pulse : -2147483648 ~ 2147483647 [pulse]</td></tr>
<tr><td>Circular interpolation mode</td><td>Middle-point<br>Center-point, Clockwise<br>Center-point, CounterClockwise<br>Radius, CW, Arc<180<br>Radius, CW, Arc >=180<br>Radius, CCW, Arc <180<br>Radius, CCW, Arc >=180</td></tr>
<tr><td>Circular interpolation turns</td><td>0 ~ 65,535</td></tr>
<tr><td>Helical interpolation *2)</td><td>Not used, Axis 1 ~ Axis 6</td></tr>
</table>

**Notes**

*1) The circular interpolation can not be executed in degree unit. Therefore, it is meaningless to set value at the circular interpolating auxiliary position item.

*2) The helical interpolation requires 3 axis. Therefore, it is impossible to use helical interpolation in 2-axis positioning model (XBM-DxxxH2)

### 5.8.2 Operation Data Setting

(1) Step No

(a) The setting range of positioning data as serial no. is 0 ～ 400.

(b) The first Starting step of operation data is no.1 step.

**Notes**

In case of designating step number as '0' with indirect start, Simultaneous start, Position synchronous start, it means current operation step.

(2) Coordinate

(a) Coordinate of position data includes absolute coordinate and incremental coordinate.

1) Absolute Method

a) This carries out the positioning control from the current position to the goal position (the goal position assigned by positioning data).

b) Positioning is carried out based on the assigned position of homing (origin address).

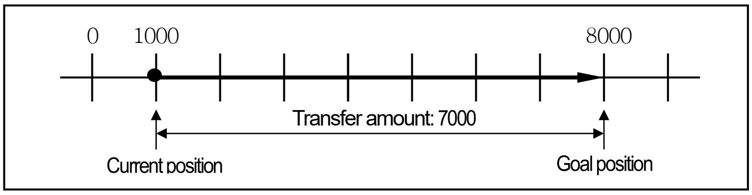
c) Transfer direction shall be determined by the current position and goal position.

▶ Start position < Goal position : forward direction positioning

▶ Start position > Goal position : reverse direction positioning

**[Example]**

■ When current position : 1000 , Goal position : 8000, forward direction transfer amount is 7000(8000-1000).



**Notes**

Positioning by Absolute method (Absolute coordinate) can start only in the state that the origin is determined. If starting in the state that the origin is not determined, Error will occur.

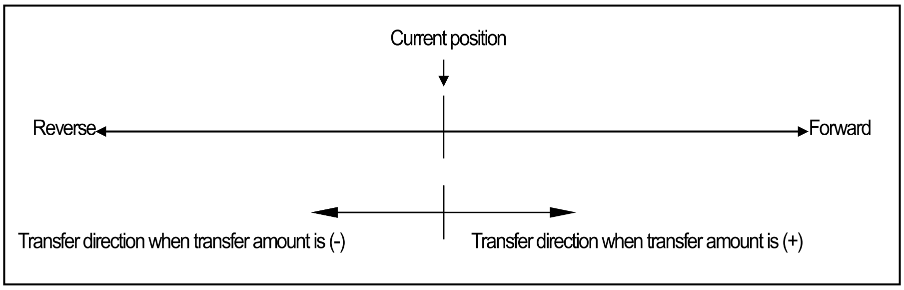
2) Incremental method

a) This carries out the positioning control as much as goal transfer amount from the current position.

b) Transfer direction shall be determined by the sign of transfer amount..

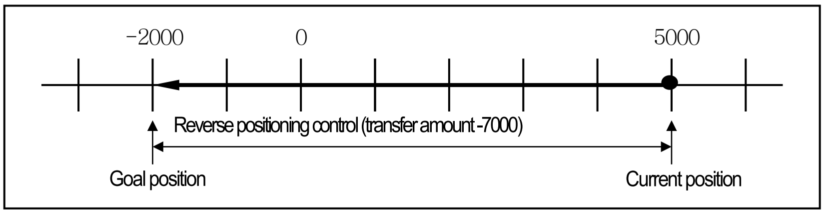
■ When transfer direction is (+) or no sign : forward direction positioning (position increase direction)

■ When transfer direction is ( - ) : reverse direction positioning (position decrease direction)



**[Example]**

- When current position : 5000 , Goal position : -7000, the positioning shall be done at –2000 position.



(3) Control Method

(a) Select the control method: single-axis position control, single-axis Speed control, single-axis Feed control, linear interpolation, circular interpolation.

(b) For further information, please refer to 9.2 Positioning control of Chapter 8 “Function”.

**Notes**

Set coordinate and control method in all at the same time in “control method” item with positioning software package.

And the software package “Control Method” item is same as follows.

Absolute, Single-axis Positioning Control / Incremantal, Single-axis Positioning Control
Absolute, Single-axis Speed Control / Incremantal, Single-axis Speed Control
Absolute, Single-axis FEED control / Incremantal, Single-axis FEED control
Absolute, linear Interpolation / Incremantal, linear Interpolation
Absolute, Circular Interpolation / Incremantal, Circular Interpolation

(4) Operation Pattern (End/Keep/Continuous)

(a) Operation pattern is setting item, how can step of operation data connect with next step and operate.

(b) Select one operation pattern from End, Keep, Continuous operation.

(c) For further information, please refer to 9.2.2 operation mode of Positioning control of Chapter 9 “Function”.

(5) Operation Method (Singular/Repeat)

(a) Operating Method is an option for selecting a operating step after finish operating step from the driving data setting step.

(b) In case of setting singular, it will be select next step after finish operating settled step. If you set by Repeat, It will be select settled Repeat step after finish operating settled step.

(c) Select one positioning operation pattern from Singular, Repeat operation.

(d) For further information, please refer to 9.2.2 operation mode of positioning control of Chapter 8 “Function”.

**Notes**

Set operation pattern and operation method at the “operation method” item with XG-PM software package.

These are “operation method” item;

Singular,End / Repeat,End

Singular,Keep / Repeat,Keep

Singular,Continuous / Repeat,Continuous.

(6) Goal Position

(a) This is the area to set the transfer amount of position data as “position value”.

(b) The setting range is –2,147,483,648 ～ 2,147,483,647[unit]

(7) M Code

(a) M code is applied to the whole axis in a bundle by M code mode set by positioning parameter and is given to each operation step no. as a Number within the setting range to use at Program.

(b) The setting range is 1 ～ 65,535

(c) M code no. can be identified by read by the operation state code

(d) For further information, please refer to M code output of chapter 5.3.2.(7)

(8) Acceleration/Deceleration No

(a) The dual acceleration/deceleration time setting is available by setting the acceleration/deceleration time 1/2/3/ 4 of basic parameter as acceleration/deceleration no. 1/2/3/4 respectively.

(9) Operation Speed

(a) Operation speed is the goal speed which it is applied when it operate positioning

(b) Operation speed is set within the range that does not exceed Speed limit of basic parameter.

(10) Dwell Time

(a) This is the waiting time before carrying out the next positioning operation after completing one positioning operation.

(b) Setting range is 0 ～ 65,535 (㎳).

(c) Especially, in case of using SERVO motor, this is the data to set the waiting time by the stable stop state as positioning module is in the stop state but actual SERVO motor does not reach to the goal position or in transition state.

(d) While dwell time is active, the corresponding axis of positioning module maintains “ON” of the “Busy Flag” and if dwell time proceeds, “Busy Flag” becomes “OFF” and the positioning end signal becomes “ON”.

(11) Setting Axis of ordinates

(a) This is an option for axis of ordinates of driving shaft when should operate at least over 2 axis such as linear interpolation or circular interpolation.

(b) Setting each bit from 1 axis to 6 axis. Each bit is as follows

| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|
| - | - | Axis 6 | Axis 5 | Axis 4 | Axis 3 | Axis 2 | Axis 1 |

(c) Could choice multiple axes. For example, to choose axis 2 and axis 4 as axis of ordinates, set “000A’by hexadecimal in setting axis of ordinates.

(12) Circular interpolating auxiliary position

(a) This is an option for setting auxiliary data when the circular interpolation operates.

(b) According to circular interpolation, mean of circular interpolating auxiliary position is decided.
It means midpoint which is through by circular arc in midpoint method.
It is central point of circular arc in central point method. And It is radius of circular arc in radius method.

(c) In case that circular interpolation method is radius, be valid only value of circular interpolating auxiliary position of principal axis.

(d) For further information, please refer to “Circular interpolating control” of 9.2.9 ~ 9.2.11.

### (13) Circular interpolating method

(a) This is an option for method setting from circular interpolating operation.

(b) There are three method for circular interpolation; midpoint, central point, radius.

(c) For further information, please refer to “Circular interpolation control” of 9.2.9 ~ 9.2.11.

### (14) Circular interpolating direction

(a) This is an option for setting direction of drawing circle from circular interpolating operation when the operation starts.

(b) Circular interpolation direction is based on drawing circular interpolation when the principal axis is axis ‘X’ and the axis of ordinates is axis ‘Y’.

(c) This option is ignored from circular interpolation of midpoint because circular interpolating direction is selected by position of midpoint.

(d) For further information, please refer to circular interpolation of 9.2.9 ~ 9.2.11.

### (15) Circular arc size

(a) When circular interpolating method is set by radius method, User can select one of 2 circular arcs.

(b) Select one of over the 180-degree circular interpolation or under the 180-degree circular interpolation.

(c) This option is ignored in the circular interpolation of midpoint method and central point method.

(d) For further information, please refer to designating radius circular interpolation of 9.2.11

**Notes**

Positioning software package set as follows at a time.

- circular arc method, circular interpolating direction, circular arc size with ‘Circular interpolating mode’.

Software package ‘Circular interpolating mode’ is as follows.

- Midpoint
- Central point, CW
- Central point, CCW
- Radius, CW, Circular arc < 180-degree
- Radius, CW, Circular arc >= 180-degree
- Radius, CCW, Circular arc < 180-degree
- Radius, CCW, Circular arc >= 180-degree

### (16) The number of circular interpolating turn

(a) This is an option setting the number of rotation of circular arc when operating over the 360-degree.

(b) Setting range is 1 ~ 65,535.

### (17) Helical interpolation axis

(a) It is item which is setting axis for linear operation in operating helical interpolation.

(b) Settled axis from helical interpolation rectilinearly operates to settled position at the goal position.

(c) Helical interpolation requires more than 3 axis.
So it is impossible to use helical interpolation in 2-axis models. (XBM-DxxxH2)

(d) For further information, please refer to helical interpolating control of 9.2.12.

# Chapter 6 Internal Memory and I/O Signal

## 6.1 Internal Memory

Here describes the internal memory used for positioning module of XGB Main unit.

Internal memory is used when executing direct Data read/write between positioning module and PLC CPU by using PUT(PUTP), GET(GETP) command instead of using the dedicated command. For Data read/write using the dedicated command, please refer to 7.2 Dedicated Command

### 6.1.1 Step Data during Point Start

(1) Memory Address of POINT Start Step Data

| Memory Address | | | | | | Description |
|---|---|---|---|---|---|---|
| 1 axis | 2 axis | 3 axis | 4 axis | 5 axis | 6 axis | |
| 2A1 | 32D | 3B9 | 445 | 4D1 | 55D | Point Operation Step 1 |
| 2A2 | 32E | 3BA | 446 | 4D2 | 55E | Point Operation Step 2 |
| 2A3 | 32F | 3BB | 447 | 4D3 | 55F | Point Operation Step 3 |
| 2A4 | 330 | 3BC | 448 | 4D4 | 560 | Point Operation Step 4 |
| 2A5 | 331 | 3BD | 449 | 4D5 | 561 | Point Operation Step 5 |
| 2A6 | 332 | 3BE | 44A | 4D6 | 562 | Point Operation Step 6 |
| 2A7 | 333 | 3BF | 44B | 4D7 | 563 | Point Operation Step 7 |
| 2A8 | 334 | 3C0 | 44C | 4D8 | 564 | Point Operation Step 8 |
| 2A9 | 335 | 3C1 | 44D | 4D9 | 565 | Point Operation Step 9 |
| 2AA | 336 | 3C2 | 44E | 4DA | 566 | Point Operation Step 10 |
| 2AB | 337 | 3C3 | 44F | 4DB | 567 | Point Operation Step 11 |
| 2AC | 338 | 3C4 | 450 | 4DC | 568 | Point Operation Step 12 |
| 2AD | 339 | 3C5 | 451 | 4DD | 569 | Point Operation Step 13 |
| 2AE | 33A | 3C6 | 452 | 4DE | 56A | Point Operation Step 14 |
| 2AF | 33B | 3C7 | 453 | 4DF | 56B | Point Operation Step 15 |
| 2B0 | 33C | 3C8 | 454 | 4E0 | 56C | Point Operation Step 16 |
| 2B1 | 33D | 3C9 | 455 | 4E1 | 56D | Point Operation Step 17 |
| 2B2 | 33E | 3CA | 456 | 4E2 | 56E | Point Operation Step 18 |
| 2B3 | 33F | 3CB | 457 | 4E3 | 56F | Point Operation Step 19 |
| 2B4 | 340 | 3CC | 458 | 4E4 | 570 | Point Operation Step 20 |

(2) POINT Start Step Data Setting

(a) The POINT start step data setting command for POINT start e during POINT operation is XPWR.

(b) References for XPST (command of XGK point operating) and XPWR (command of point operating step data setting) are on ‘Chapter 6.3.45’.

(c) In PLC program, POINT operation data setting during POINT operation should be done in the step before POINT operation command is executed for normal action of POINT operation.

### 6.1.2 Teaching Data

(1) Memory Address of Teaching Data

| Memory Address | | | | | | Description |
|---|---|---|---|---|---|---|
| **1 axis** | **2 axis** | **3 axis** | **4 axis** | **5axis** | **6 axis** | |
| 280 | 30C | 398 | 424 | 4B0 | 53C | Teaching Data1(LOWER) |
| 281 | 30D | 399 | 425 | 4B1 | 53D | Teaching Data1(UPPER) |
| 282 | 30E | 39A | 426 | 4B2 | 53E | Teaching Data2(LOWER) |
| 283 | 30F | 39B | 427 | 4B3 | 53F | Teaching Data2(UPPER) |
| 284 | 310 | 39C | 428 | 4B4 | 540 | Teaching Data3(LOWER) |
| 285 | 311 | 39D | 429 | 4B5 | 541 | Teaching Data3(UPPER) |
| 286 | 312 | 39E | 42A | 4B6 | 542 | Teaching Data4(LOWER) |
| 287 | 313 | 39F | 42B | 4B7 | 543 | Teaching Data4(UPPER) |
| 288 | 314 | 3A0 | 42C | 4B8 | 544 | Teaching Data5(LOWER) |
| 289 | 315 | 3A1 | 42D | 4B9 | 545 | Teaching Data5(UPPER) |
| 28A | 316 | 3A2 | 42E | 4BA | 546 | Teaching Data6(LOWER) |
| 28B | 317 | 3A3 | 42F | 4BB | 547 | Teaching Data6(UPPER) |
| 28C | 318 | 3A4 | 430 | 4BC | 548 | Teaching Data7(LOWER) |
| 28D | 319 | 3A5 | 431 | 4BD | 549 | Teaching Data7(UPPER) |
| 28E | 31A | 3A6 | 432 | 4BE | 54A | Teaching Data8(LOWER) |
| 28F | 31B | 3A7 | 433 | 4BF | 54B | Teaching Data8(UPPER) |
| 290 | 31C | 3A8 | 434 | 4C0 | 54C | Teaching Data9(LOWER) |
| 291 | 31D | 3A9 | 435 | 4C1 | 54D | Teaching Data9(UPPER) |
| 292 | 31E | 3AA | 436 | 4C2 | 54E | Teaching Data10(LOWER) |
| 293 | 31F | 3AB | 437 | 4C3 | 54F | Teaching Data10(UPPER) |
| 294 | 320 | 3AC | 438 | 4C4 | 550 | Teaching Data11(LOWER) |
| 295 | 321 | 3AD | 439 | 4C5 | 551 | Teaching Data11(UPPER) |
| 296 | 322 | 3AE | 43A | 4C6 | 552 | Teaching Data12(LOWER) |
| 297 | 323 | 3AF | 43B | 4C7 | 553 | Teaching Data12(UPPER) |
| 298 | 324 | 3B0 | 43C | 4C8 | 554 | Teaching Data13(LOWER) |
| 299 | 325 | 3B1 | 43D | 4C9 | 555 | Teaching Data13(UPPER) |
| 29A | 326 | 3B2 | 43E | 4CA | 556 | Teaching Data14(LOWER) |
| 29B | 327 | 3B3 | 43F | 4CB | 557 | Teaching Data14(UPPER) |
| 29C | 328 | 3B4 | 440 | 4CC | 558 | Teaching Data15(LOWER) |
| 29D | 329 | 3B5 | 441 | 4CD | 559 | Teaching Data15(UPPER) |
| 29E | 32A | 3B6 | 442 | 4CE | 55A | Teaching Data16(LOWER) |
| 29F | 32B | 3B7 | 443 | 4CF | 55B | Teaching Data16(UPPER) |

(2) Setting

(a) The command of Teaching data setting is XTWR.

(b) References for XTEAA (command of Teaching) and XTWR (command of Teaching Data Setting ) are on 'Chapter 7.3.45'.

(c) In PLC program, in order to carry out the normal action of Teaching command, the Teaching data setting should be done in the step before Teaching command is executed.

### 6.1.3 Step Data of Simultaneous Start

(1) Step Data of Simultaneous Start Memory Address

| Memory Address | | | | | | Description |
|---|---|---|---|---|---|---|
| 1 axis | 2 axis | 3 axis | 4 axis | 5 axis | 6 axis | |
| 2B6 | 342 | 3CE | 45A | 4E6 | 572 | Simultaneous Start 1axis Step Number |
| 2B7 | 343 | 3CF | 45B | 4E7 | 573 | Simultaneous Start 2axis Step Number |
| 2B8 | 344 | 3D0 | 45C | 4E8 | 574 | Simultaneous Start 3axis Step Number |
| 2B9 | 345 | 3D1 | 45D | 4E9 | 575 | Simultaneous Start 4axis Step Number |
| 2BA | 346 | 3D2 | 45E | 4EA | 576 | Simultaneous Start 5axis Step Number |
| 2BB | 347 | 3D3 | 45F | 4EB | 577 | Simultaneous Start 6axis Step Number |

(2) Setting

(a) The command for Step Data of Simultaneous Start setting is XSWR.

(b) References for XSST (command of Simultaneous Start) and XSWR(Setting command for Step Data of Simultaneous Start )are on 'Chapter 7.3.6.

(c) In PLC program, in order to carry out the normal action of Simultaneous Start, the Step data setting of Simultaneous Start should be done in the step before Simultaneous Start command is executed.

## 6.1.4 Status Information

(1) Memory Address of Status Information

| XSRD Command Device Offset | Memory Address | | | | | | Description |
|---|---|---|---|---|---|---|---|
| | 1 axis | 2 axis | 3 axis | 4 axis | 5 axis | 6 axis | |
| 0 | 2C0 | 34C | 3D8 | 464 | 4F0 | 57C | Operation state bit information (Lower) |
| 1 | 2C1 | 34D | 3D9 | 465 | 4F1 | 57D | Operation state bit information (Upper) |
| 2 | 2C2 | 34E | 3DA | 466 | 4F2 | 57E | Axis information |
| 3 | 2C3 | 34F | 3DB | 467 | 4F3 | 57F | External I/O signal state |
| 4 | 2C4 | 350 | 3DC | 468 | 4F4 | 580 | Current Position ( LOWER) |
| 5 | 2C5 | 351 | 3DD | 469 | 4F5 | 581 | Current Position ( UPPER) |
| 6 | 2C6 | 352 | 3DE | 46A | 4F6 | 582 | Current Position ( LOWER) |
| 7 | 2C7 | 353 | 3DF | 46B | 4F7 | 583 | Current Position ( UPPER) |
| 8 | 2C8 | 354 | 3E0 | 46C | 4F8 | 584 | Step Number |
| 9 | 2C9 | 355 | 3E1 | 46D | 4F9 | 585 | M Code Number |
| 10 | 2CA | 356 | 3E2 | 46E | 4FA | 586 | Current error information |
| 11 | 2CB | 357 | 3E3 | 46F | 4FB | 587 | Error information 1 |
| 12 | 2CC | 358 | 3E4 | 470 | 4FC | 588 | Error information 2 |
| 13 | 2CD | 359 | 3E5 | 471 | 4FD | 589 | Error information 3 |
| 14 | 2CE | 35A | 3E6 | 472 | 4FE | 58A | Error information 4 |
| 15 | 2CF | 35B | 3E7 | 473 | 4FF | 58B | Error information 5 |
| 16 | 2D0 | 35C | 3E8 | 474 | 500 | 58C | Error information 6 |
| 17 | 2D1 | 35D | 3E9 | 475 | 501 | 58D | Error information 7 |
| 18 | 2D2 | 35E | 3EA | 476 | 502 | 58E | Error information 8 |
| 19 | 2D3 | 35F | 3EB | 477 | 503 | 58F | Error information 9 |
| 20 | 2D4 | 360 | 3EC | 478 | 504 | 590 | Error information 10 |
| 21 | 2D5 | 361 | 3ED | 479 | 505 | 591 | Encoder Value1 (LOWER) |
| 22 | 2D6 | 362 | 3EE | 47A | 506 | 592 | Encoder Value1 (UPPER) |
| 23 | 2D7 | 363 | 3EF | 47B | 507 | 593 | Encoder Value2 (LOWER) |
| 24 | 2D8 | 364 | 3F0 | 47C | 508 | 594 | Encoder Value2 (UPPER) |
| 25 | 2D9 | 365 | 3F1 | 47D | 509 | 595 | Encoder Value3 (LOWER) |
| 26 | 2DA | 366 | 3F2 | 47E | 50A | 596 | Encoder Value3 (UPPER) |
| 27 | 2DB | 367 | 3F3 | 47F | 50B | 597 | Encoder Value4 (LOWER) |
| 28 | 2DC | 368 | 3F4 | 480 | 50C | 598 | Encoder Value4 (UPPER) |

(2) Setting

(a) The area of state information of internal memory is the Read only area. Thus, it is available to use only by GET, GETP command. (PUT, PUTP command is not allowed to use in this area).

(b) The command of State Information ready only is XSRD.

(c) If you use only command XSRD, the information of axis status is read at the same time.

(d) If you want to choose to read among the state information, it is available to read memory address of above table using by GET/GETP

(e) Status Information details

1) Operation State Bit Information (Lower)

| Memory Address | | | | | | Information |
|---|---|---|---|---|---|---|
| 1 axis | 2 axis | 3 axis | 4 axis | 3 axis | 4 axis | |
| 2C0 | 34C | 3D8 | 464 | 4F0 | 57C | Operation State Bit Information (LOWER) |

| | | |
|---|---|---|
| Bit 0 | In operation | [0: Stop 1: In operation] |
| Bit 1 | Error | [0: No Error 1: Error] |
| Bit 2 | Position Completed | [0: Not completed, 1: Completed] |
| Bit 3 | M code signal | [0: M code Off, 1: M code On] |
| Bit 4 | Homing state | [0: Not Fixed, 1:Fixed] |
| Bit 5 | No use | |
| Bit 6 | Stop state | [0: Not stop by stop command, 1: Stop by stop command] |
| Bit 7 | Variable Data Read/Write | [0: Variable data access finished,<br>1: Variable data access is on going] |
| Bit 8 | Upper Limit Detection | [0: No Detection, 1: Detection] |
| Bit 9 | Lower Limit Detection | [0: No Detection, 1: Detection] |
| Bit 10 | Emergency Stop state | [0: Normal, 1: Emergency Stop] |
| Bit 11 | Direction | [0: Forward, 1: Reverse] |
| Bit 12 | Acceleration State | [0: Not Accelerating, 1: Accelerating] |
| Bit 13 | Constant Speed state | [0: Not Constant speed, 1: Constant speed] |
| Bit 14 | Deceleration state | [0: Not Decelerating, 1: Decelerating] |
| Bit 15 | Dwell State | [0: No Dwelling, 1: Dwelling] |

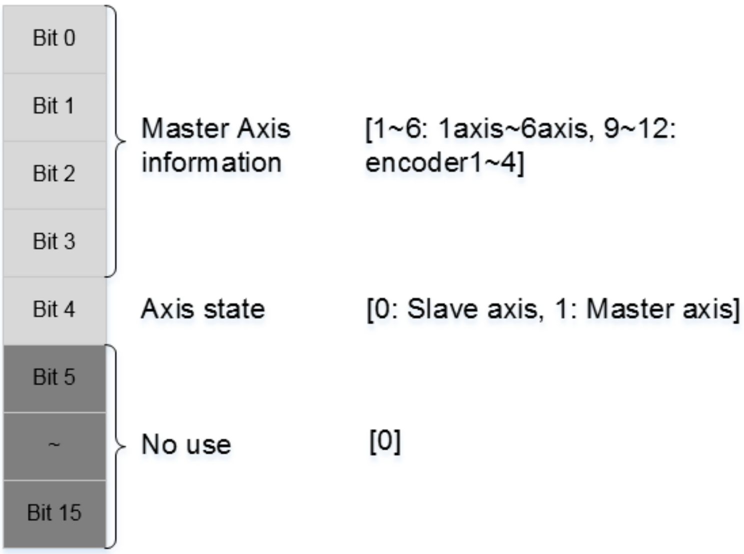
2) Operation State Bit Information (Upper)

| Memory Address | | | | | | Information |
|---|---|---|---|---|---|---|
| 1 axis | 2 axis | 3 axis | 4 axis | 5 axis | 6 axis | |
| 2C1 | 34D | 3D9 | 465 | 4F1 | 57D | Operation State Bit Information |

| | | |
|---|---|---|
| Bit 0 | [SNG] Position Controlling | [0: Position not in control, 1: Position in control] |
| Bit 1 | [SNG]Speed Controlling | [0: Speed not in control, 1: Speed in control] |
| Bit 2 | Linear Interpolation | [0: Not in operation, 1: In operation] |
| Bit 3 | No use | [0] |
| Bit 4 | Circular Interpolation in Operation | [0: Not in operation, 1: In operation] |
| Bit 5 | Homing Operating | [0: Not in operation, 1: In operation] |
| Bit 6 | Synchronous Start by Position in Operation | [0: Not in operation, 1: In operation] |
| Bit 7 | Synchronous Start by speed in Operation | [0: Not in operation, 1: In operation] |
| Bit 8 | JOG Operation | [0: Not in operation, 1: In operation] |
| Bit 9 | No use | [0] |
| Bit 10 | Inching in Operation | |
| Bit 11 | No use | [0] |
| Bit 12 | RTP in Operation | [0: Not in operation, 1: In operation] |
| Bit 13 | CAM in Operation | [0: Not in operation, 1: In operation] |
| Bit 14 | FEED in Operation | |
| Bit 15 | Circular in Operation | [0: Not in operation, 1: In operation] |

3) Axis Information

| Memory Address | | | | | | Information |
|---|---|---|---|---|---|---|
| 1 axis | 2 axis | 3 axis | 4 axis | 5 axis | 6 axis | |
| 2C2 | 34E | 3DA | 466 | 4F2 | 57E | Axis Information |



### 4) External I/O Signal State

| Memory Address | | | | | | Information |
|---|---|---|---|---|---|---|
| 1 axis | 2 axis | 3 axis | 4 axis | 5 axis | 6 axis | |
| 2C3 | 34F | 3DB | 467 | 4F3 | 57F | External I/O Signal State |

| | | |
|---|---|---|
| Bit 0 | No use | [0] |
| Bit 1 | | |
| Bit 2 | | |
| Bit 3 | | |
| Bit 4 | Upper limit Signal | [0: Upper limit Signal OFF, 1: Upper limit Signal ON] |
| Bit 5 | Lower limit Signal | [0: Lower limit Signal OFF, 1: Lower limit Signal ON] |
| Bit 6 | HOME | [0: HOME signal OFF, 1: HOME signal ON] |
| Bit 7 | DOG | [0: DOG signal OFF, 1: DOG signal ON] |
| Bit 8 | No use | [0] |
| Bit 9 | | |
| Bit 10 | | |
| Bit 11 | | |
| Bit 12 | | |
| Bit 13 | | |
| Bit 14 | | |
| Bit 15 | | |

## 6.2 K area Signal

Here describes the contents and functions of K area signal for the exchange of data between Positioning and CPU.

### 6.2.1 Contents of K area Signal

(1) Built-in positioning signal displays on K area.

(2) Built-in Positioning ready signal (K0437F) becomes “ON” only when Modules are in normal state in H/W and it always keeps “ON” regardless of PLC operation mode.

(3) Output Signal

This is the signal, which transfers to positioning module from PLC CPU.

| Comment | Variable | K area | Type | R/W |
|---|---|---|---|---|
| 1Axis Busy | _POS_1_Busy | K04200 | BIT | R |
| 2Axis Busy | _POS_2_Busy | K04400 | BIT | R |
| 3Axis Busy | _POS_3_Busy | K04600 | BIT | R |
| 4Axis Busy | _POS_4_Busy | K04800 | BIT | R |
| 5Axis Busy | _POS_5_Busy | K05000 | BIT | R |
| 6Axis Busy | _POS_6_Busy | K05200 | BIT | R |
| 1Axis Error | _POS_1_Err | K04201 | BIT | R |
| 2Axis Error | _POS_2_Err | K04401 | BIT | R |
| 3Axis Error | _POS_3_Err | K04601 | BIT | R |
| 4Axis Error | _POS_4_Err | K04801 | BIT | R |
| 5Axis Error | _POS_5_Err | K05001 | BIT | R |
| 6Axis Error | _POS_6_Err | K05201 | BIT | R |
| 1Axis Position Complete | _POS_1_Done | K04202 | BIT | R |
| 2Axis Position Complete | _POS_2_Done | K04402 | BIT | R |
| 3Axis Position Complete | _POS_3_Done | K04602 | BIT | R |
| 4Axis Position Complete | _POS_4_Done | K04802 | BIT | R |
| 5Axis Position Complete | _POS_5_Done | K05002 | BIT | R |
| 6Axis Position Complete | _POS_6_Done | K05202 | BIT | R |
| 1Axis M Code ON | _POS_1_McodeOn | K04203 | BIT | R |
| 2Axis M Code ON | _POS_2_McodeOn | K04403 | BIT | R |
| 3Axis M Code ON | _POS_3_McodeOn | K04603 | BIT | R |
| 4Axis M Code ON | _POS_4_McodeOn | K04803 | BIT | R |
| 5Axis M Code ON | _POS_5_McodeOn | K05003 | BIT | R |
| 6Axis M Code ON | _POS_6_McodeOn | K05203 | BIT | R |

| Comment | Variable | K area | Type | R/W |
|---|---|---|---|---|
| 1Axis Home Complete | _POS_1_OriginFix | K04204 | BIT | R |
| 2Axis Home Complete | _POS_2_OriginFix | K04404 | BIT | R |
| 3Axis Home Complete | _POS_3_OriginFix | K04604 | BIT | R |
| 4Axis Home Complete | _POS_4_OriginFix | K04804 | BIT | R |
| 5Axis Home Complete | _POS_5_OriginFix | K05004 | BIT | R |
| 6Axis Home Complete | _POS_6_OriginFix | K05204 | BIT | R |
| 1Axis Output Enable | _POS_1_PlsOutEn | K04205 | BIT | R |
| 2Axis Output Enable | _POS_2_PlsOutEn | K04405 | BIT | R |
| 3Axis Output Enable | _POS_3_PlsOutEn | K04605 | BIT | R |
| 4Axis Output Enable | _POS_4_PlsOutEn | K04805 | BIT | R |
| 5Axis Output Enable | _POS_5_PlsOutEn | K05005 | BIT | R |
| 6Axis Output Enable | _POS_6_PlsOutEn | K05205 | BIT | R |
| 1Axis Stop | _POS_1_Stop | K04206 | BIT | R |
| 2Axis Stop | _POS_2_Stop | K04406 | BIT | R |
| 3Axis Stop | _POS_3_Stop | K04606 | BIT | R |
| 4Axis Stop | _POS_4_Stop | K04806 | BIT | R |
| 5Axis Stop | _POS_5_Stop | K05006 | BIT | R |
| 6Axis Stop | _POS_6_Stop | K05206 | BIT | R |
| 1Axis Variable Data Read/Write | _POS_1_VarWriteBusy | K04207 | BIT | R |
| 2Axis Variable Data Read/Write | _POS_2_VarWriteBusy | K04407 | BIT | R |
| 3Axis Variable Data Read/Write | _POS_3_VarWriteBusy | K04607 | BIT | R |
| 4Axis Variable Data Read/Write | _POS_4_VarWriteBusy | K04807 | BIT | R |
| 5Axis Variable Data Read/Write | _POS_5_VarWriteBusy | K05007 | BIT | R |
| 6Axis Variable Data Read/Write | _POS_6_VarWriteBusy | K05207 | BIT | R |
| 1Axis Upper Limit Detection | _POS_1_ULimit | K04208 | BIT | R |
| 2Axis Upper Limit Detection | _POS_2_ULimit | K04408 | BIT | R |
| 3Axis Upper Limit Detection | _POS_3_ULimit | K04608 | BIT | R |
| 4Axis Upper Limit Detection | _POS_4_ULimit | K04808 | BIT | R |
| 5Axis Upper Limit Detection | _POS_5_ULimit | K05008 | BIT | R |
| 6Axis Upper Limit Detection | _POS_6_ULimit | K05208 | BIT | R |
| 1Axis Lower Limit Detection | _POS_1_LLimit | K04209 | BIT | R |
| 2Axis Lower Limit Detection | _POS_2_LLimit | K04409 | BIT | R |
| 3Axis Lower Limit Detection | _POS_3_LLimit | K04609 | BIT | R |
| 4Axis Lower Limit Detection | _POS_4_LLimit | K04809 | BIT | R |
| 5Axis Lower Limit Detection | _POS_5_LLimit | K05009 | BIT | R |
| 6Axis Lower Limit Detection | _POS_6_LLimit | K05209 | BIT | R |

| Comment | Variable | K area | Type | R/W |
|---|---|---|---|---|
| 1Axis Emergency Stop | _POS_1_Estop | K0420A | BIT | R |
| 2Axis Emergency Stop | _POS_2_Estop | K0440A | BIT | R |
| 3Axis Emergency Stop | _POS_3_Estop | K0460A | BIT | R |
| 4Axis Emergency Stop | _POS_4_Estop | K0480A | BIT | R |
| 5Axis Emergency Stop | _POS_5_Estop | K0500A | BIT | R |
| 6Axis Emergency Stop | _POS_6_Estop | K0520A | BIT | R |
| 1Axis CW/CCW | _POS_1_Dir | K0420B | BIT | R |
| 2Axis CW/CCW | _POS_2_Dir | K0440B | BIT | R |
| 3Axis CW/CCW | _POS_3_Dir | K0460B | BIT | R |
| 4Axis CW/CCW | _POS_4_Dir | K0480B | BIT | R |
| 5Axis CW/CCW | _POS_5_Dir | K0500B | BIT | R |
| 6Axis CW/CCW | _POS_6_Dir | K0520B | BIT | R |
| 1Axis Acceleration state | _POS_1_Acc | K0420C | BIT | R |
| 2Axis Acceleration state | _POS_2_Acc | K0440C | BIT | R |
| 3Axis Acceleration state | _POS_3_Acc | K0460C | BIT | R |
| 4Axis Acceleration state | _POS_4_Acc | K0480C | BIT | R |
| 5Axis Acceleration state | _POS_5_Acc | K0500C | BIT | R |
| 6Axis Acceleration state | _POS_6_Acc | K0520C | BIT | R |
| 1Axis Constant speed state | _POS_1_Const | K0420D | BIT | R |
| 2Axis Constant speed state | _POS_2_Const | K0440D | BIT | R |
| 3Axis Constant speed state | _POS_3_Const | K0460D | BIT | R |
| 4Axis Constant speed state | _POS_4_Const | K0480D | BIT | R |
| 5Axis Constant speed state | _POS_5_Const | K0500D | BIT | R |
| 6Axis Constant speed state | _POS_6_Const | K0520D | BIT | R |
| 1Axis Deceleration state | _POS_1_Dec | K0420E | BIT | R |
| 2Axis Deceleration state | _POS_2_Dec | K0440E | BIT | R |
| 3Axis Deceleration state | _POS_3_Dec | K0460E | BIT | R |
| 4Axis Deceleration state | _POS_4_Dec | K0480E | BIT | R |
| 5Axis Deceleration state | _POS_5_Dec | K0500E | BIT | R |
| 6Axis Deceleration state | _POS_6_Dec | K0520E | BIT | R |
| 1Axis Dwell state | _POS_1_Dwell | K0420F | BIT | R |
| 2Axis Dwell state | _POS_2_Dwell | K0440F | BIT | R |
| 3Axis Dwell state | _POS_3_Dwell | K0460F | BIT | R |
| 4Axis Dwell state | _POS_4_Dwell | K0480F | BIT | R |
| 5Axis Dwell state | _POS_5_Dwell | K0500F | BIT | R |
| 6Axis Dwell state | _POS_6_Dwell | K0520F | BIT | R |

| Comment | Variable | K area | Type | R/W |
|---|---|---|---|---|
| 1Axis POSition control | _POS_1_Position | K04210 | BIT | R |
| 2Axis Position control | _POS_2_Position | K04410 | BIT | R |
| 3Axis Position control | _POS_3_Position | K04610 | BIT | R |
| 4Axis Position control | _POS_4_Position | K04810 | BIT | R |
| 5Axis Position control | _POS_5_Position | K05010 | BIT | R |
| 6Axis Position control | _POS_6_Position | K05210 | BIT | R |
| 1Axis Speed control | _POS_1_Speed | K04211 | BIT | R |
| 2Axis Speed control | _POS_2_Speed | K04411 | BIT | R |
| 3Axis Speed control | _POS_3_Speed | K04611 | BIT | R |
| 4Axis Speed control | _POS_4_Speed | K04811 | BIT | R |
| 5Axis Speed control | _POS_5_Speed | K05011 | BIT | R |
| 6Axis Speed control | _POS_6_Speed | K05211 | BIT | R |
| 1Axis Linear interpolation running | _POS_1_LinearInt | K04212 | BIT | R |
| 2Axis Linear interpolation running | _POS_2_LinearInt | K04412 | BIT | R |
| 3Axis Linear interpolation running | _POS_3_LinearInt | K04612 | BIT | R |
| 4Axis Linear interpolation running | _POS_4_LinearInt | K04812 | BIT | R |
| 5Axis Linear interpolation running | _POS_5_LinearInt | K05012 | BIT | R |
| 6Axis Linear interpolation running | _POS_6_LinearInt | K05212 | BIT | R |
| 1Axis Circular interpolation running | _POS_1_CircleInt | K04214 | BIT | R |
| 2Axis Circular interpolation running | _POS_2_CircleInt | K04414 | BIT | R |
| 3Axis Circular interpolation running | _POS_3_CircleInt | K04614 | BIT | R |
| 4Axis Circular interpolation running | _POS_4_CircleInt | K04814 | BIT | R |
| 5Axis Circular interpolation running | _POS_5_CircleInt | K05014 | BIT | R |
| 6Axis Circular interpolation running | _POS_6_CircleInt | K05214 | BIT | R |
| 1Axis Homing | _POS_1_Home | K04215 | BIT | R |
| 2Axis Homing | _POS_2_Home | K04415 | BIT | R |
| 3Axis Homing | _POS_3_Home | K04615 | BIT | R |
| 4Axis Homing | _POS_4_Home | K04815 | BIT | R |
| 5Axis Homing | _POS_5_Home | K05015 | BIT | R |
| 6Axis Homing | _POS_6_Home | K05215 | BIT | R |
| 1Axis POSition sync running | _POS_1_PosSync | K04216 | BIT | R |
| 2Axis Position sync running | _POS_2_PosSync | K04416 | BIT | R |
| 3Axis Position sync running | _POS_3_PosSync | K04616 | BIT | R |
| 4Axis Position sync running | _POS_4_PosSync | K04816 | BIT | R |
| 5Axis Position sync running | _POS_5_PosSync | K05016 | BIT | R |
| 6Axis Position sync running | _POS_6_PosSync | K05216 | BIT | R |

| Comment | Variable | K area | Type | R/W |
|---|---|---|---|---|
| 1Axis speed sync running | _POS_1_SpdSync | K04217 | BIT | R |
| 2Axis speed sync running | _POS_2_SpdSync | K04417 | BIT | R |
| 3Axis speed sync running | _POS_3_SpdSync | K04617 | BIT | R |
| 4Axis speed sync running | _POS_4_SpdSync | K04817 | BIT | R |
| 5Axis speed sync running | _POS_5_SpdSync | K05017 | BIT | R |
| 6Axis speed sync running | _POS_6_SpdSync | K05217 | BIT | R |
| 1Axis Jog running | _POS_1_JogBusy | K04218 | BIT | R |
| 2Axis Jog running | _POS_2_JogBusy | K04418 | BIT | R |
| 3Axis Jog running | _POS_3_JogBusy | K04618 | BIT | R |
| 4Axis Jog running | _POS_4_JogBusy | K04818 | BIT | R |
| 5Axis Jog running | _POS_5_JogBusy | K05018 | BIT | R |
| 6Axis Jog running | _POS_6_JogBusy | K05218 | BIT | R |
| 1Axis Inching running | _POS_1_Inching | K0421A | BIT | R |
| 2Axis Inching running | _POS_2_Inching | K0441A | BIT | R |
| 3Axis Inching running | _POS_3_Inching | K0461A | BIT | R |
| 4Axis Inching running | _POS_4_Inching | K0481A | BIT | R |
| 5Axis Inching running | _POS_5_Inching | K0501A | BIT | R |
| 6Axis Inching running | _POS_6_Inching | K0521A | BIT | R |
| 1Axis RTP running | _POS_1_RtpVusy | K0421C | BIT | R |
| 2Axis RTP running | _POS_2_RtpVusy | K0441C | BIT | R |
| 3Axis RTP running | _POS_3_RtpVusy | K0461C | BIT | R |
| 4Axis RTP running | _POS_4_RtpVusy | K0481C | BIT | R |
| 5Axis RTP running | _POS_5_RtpVusy | K0501C | BIT | R |
| 6Axis RTP running | _POS_6_RtpVusy | K0521C | BIT | R |
| 1Axis CAM running | _POS_1_Cam | K0421D | BIT | R |
| 2Axis CAM running | _POS_2_Cam | K0441D | BIT | R |
| 3Axis CAM running | _POS_3_Cam | K0461D | BIT | R |
| 4Axis CAM running | _POS_4_Cam | K0481D | BIT | R |
| 5Axis CAM running | _POS_5_Cam | K0501D | BIT | R |
| 6Axis CAM running | _POS_6_Cam | K0521D | BIT | R |
| 1Axis Feed control running | _POS_1_Feed | K0421E | BIT | R |
| 2Axis Feed control running | _POS_2_Feed | K0441E | BIT | R |
| 3Axis Feed control running | _POS_3_Feed | K0461E | BIT | R |
| 4Axis Feed control running | _POS_4_Feed | K0481E | BIT | R |
| 5Axis Feed control running | _POS_5_Feed | K0501E | BIT | R |
| 6Axis Feed control running | _POS_6_Feed | K0521E | BIT | R |

| Comment | Variable | K area | Type | R/W |
|---|---|---|---|---|
| 1Axis Ellipse interpolation running | _POS_1_Ellipse | K0421F | BIT | R |
| 2Axis Ellipse interpolation running | _POS_2_Ellipse | K0441F | BIT | R |
| 3Axis Ellipse interpolation running | _POS_3_Ellipse | K0461F | BIT | R |
| 4Axis Ellipse interpolation running | _POS_4_Ellipse | K0481F | BIT | R |
| 5Axis Ellipse interpolation running | _POS_5_Ellipse | K0501F | BIT | R |
| 6Axis Ellipse interpolation running | _POS_6_Ellipse | K0521F | BIT | R |
| 1Axis Main axis | _POS_1_MstAxis | K04220 | NIBBLE | R |
| 2Axis Main axis | _POS_2_MstAxis | K04420 | NIBBLE | R |
| 3Axis Main axis | _POS_3_MstAxis | K04620 | NIBBLE | R |
| 4Axis Main axis | _POS_4_MstAxis | K04820 | NIBBLE | R |
| 5Axis Main axis | _POS_5_MstAxis | K05020 | NIBBLE | R |
| 6Axis Main axis | _POS_6_MstAxis | K05220 | NIBBLE | R |
| 1Axis main/slave status | _POS_1_AxisStatus | K04224 | BIT | R |
| 2Axis main/slave status | _POS_2_AxisStatus | K04424 | BIT | R |
| 3Axis main/slave status | _POS_3_AxisStatus | K04624 | BIT | R |
| 4Axis main/slave status | _POS_4_AxisStatus | K04824 | BIT | R |
| 5Axis main/slave status | _POS_5_AxisStatus | K05024 | BIT | R |
| 6Axis main/slave status | _POS_6_AxisStatus | K05224 | BIT | R |
| 1Axis Positive limit signal | _POS_1_ULSigStatus | K04234 | BIT | R |
| 2Axis Positive limit signal | _POS_2_ULSigStatus | K04434 | BIT | R |
| 3Axis Positive limit signal | _POS_3_ULSigStatus | K04634 | BIT | R |
| 4Axis Positive limit signal | _POS_4_ULSigStatus | K04834 | BIT | R |
| 5Axis Positive limit signal | _POS_5_ULSigStatus | K05034 | BIT | R |
| 6Axis Positive limit signal | _POS_6_ULSigStatus | K05234 | BIT | R |
| 1Axis Negative limit signal | _POS_1_LLSigStatus | K04235 | BIT | R |
| 2Axis Negative limit signal | _POS_2_LLSigStatus | K04435 | BIT | R |
| 3Axis Negative limit signal | _POS_3_LLSigStatus | K04635 | BIT | R |
| 4Axis Negative limit signal | _POS_4_LLSigStatus | K04835 | BIT | R |
| 5Axis Negative limit signal | _POS_5_LLSigStatus | K05035 | BIT | R |
| 6Axis Negative limit signal | _POS_6_LLSigStatus | K05235 | BIT | R |
| 1Axis Home signal | _POS_1_HomeSigStatus | K04236 | BIT | R |
| 2Axis Home signal | _POS_2_HomeSigStatus | K04436 | BIT | R |
| 3Axis Home signal | _POS_3_HomeSigStatus | K04636 | BIT | R |
| 4Axis Home signal | _POS_4_HomeSigStatus | K04836 | BIT | R |
| 5Axis Home signal | _POS_5_HomeSigStatus | K05036 | BIT | R |
| 6Axis Home signal | _POS_6_HomeSigStatus | K05236 | BIT | R |
| 1Axis Dog signal | _POS_1_DogSigStatus | K04237 | BIT | R |
| 2Axis Dog signal | _POS_2_DogSigStatus | K04437 | BIT | R |
| 3Axis Dog signal | _POS_3_DogSigStatus | K04637 | BIT | R |
| 4Axis Dog signal | _POS_4_DogSigStatus | K04837 | BIT | R |
| 5Axis Dog signal | _POS_5_DogSigStatus | K05037 | BIT | R |
| 6Axis Dog signal | _POS_6_DogSigStatus | K05237 | BIT | R |

| Comment | Variable | K area | Type | R/W |
|---|---|---|---|---|
| 1Axis Current Position | _POS_1_CurPos | K0424 | DINT | R |
| 2Axis Current Position | _POS_2_CurPos | K0444 | DINT | R |
| 3Axis Current Position | _POS_3_CurPos | K0464 | DINT | R |
| 4Axis Current Position | _POS_4_CurPos | K0484 | DINT | R |
| 5Axis Current Position | _POS_5_CurPos | K0504 | DINT | R |
| 6Axis Current Position | _POS_6_CurPos | K0524 | DINT | R |
| 1Axis Current Speed | _POS_1_CurSpd | K0426 | DWORD | R |
| 2Axis Current Speed | _POS_2_CurSpd | K0446 | DWORD | R |
| 3Axis Current Speed | _POS_3_CurSpd | K0466 | DWORD | R |
| 4Axis Current Speed | _POS_4_CurSpd | K0486 | DWORD | R |
| 5Axis Current Speed | _POS_5_CurSpd | K0506 | DWORD | R |
| 6Axis Current Speed | _POS_6_CurSpd | K0526 | DWORD | R |
| 1Axis Step Number | _POS_1_Step | K0428 | WORD | R |
| 2Axis Step Number | _POS_2_Step | K0448 | WORD | R |
| 3Axis Step Number | _POS_3_Step | K0468 | WORD | R |
| 4Axis Step Number | _POS_4_Step | K0488 | WORD | R |
| 5Axis Step Number | _POS_5_Step | K0508 | WORD | R |
| 6Axis Step Number | _POS_6_Step | K0528 | WORD | R |
| 1Axis M Code number | _POS_1_MCodeNum | K0429 | WORD | R |
| 2Axis M Code number | _POS_2_MCodeNum | K0449 | WORD | R |
| 3Axis M Code number | _POS_3_MCodeNum | K0469 | WORD | R |
| 4Axis M Code number | _POS_4_MCodeNum | K0489 | WORD | R |
| 5Axis M Code number | _POS_5_MCodeNum | K0509 | WORD | R |
| 6Axis M Code number | _POS_6_MCodeNum | K0529 | WORD | R |
| 1Axis Error Code | _POS_1_ErrCode | K0430 | WORD | R |
| 2Axis Error Code | _POS_2_ErrCode | K0450 | WORD | R |
| 3Axis Error Code | _POS_3_ErrCode | K0470 | WORD | R |
| 4Axis Error Code | _POS_4_ErrCode | K0490 | WORD | R |
| 5Axis Error Code | _POS_5_ErrCode | K0510 | WORD | R |
| 6Axis Error Code | _POS_6_ErrCode | K0530 | WORD | R |
| 1Axis Target position | _POS_1_TargetPos | K0432 | DINT | R |
| 2Axis Target position | _POS_2_TargetPos | K0452 | DINT | R |
| 3Axis Target position | _POS_3_TargetPos | K0472 | DINT | R |
| 4Axis Target position | _POS_4_TargetPos | K0492 | DINT | R |
| 5Axis Target position | _POS_5_TargetPos | K0512 | DINT | R |
| 6Axis Target position | _POS_6_TargetPos | K0532 | DINT | R |

| Comment | Variable | K area | Type | R/W |
|---|---|---|---|---|
| 1Axis Target speed | _POS_1_TargetSpd | K0434 | DWORD | R |
| 2Axis Target speed | _POS_2_TargetSpd | K0454 | DWORD | R |
| 3Axis Target speed | _POS_3_TargetSpd | K0474 | DWORD | R |
| 4Axis Target speed | _POS_4_TargetSpd | K0494 | DWORD | R |
| 5Axis Target speed | _POS_5_TargetSpd | K0514 | DWORD | R |
| 6Axis Target speed | _POS_6_TargetSpd | K0534 | DWORD | R |
| 1Axis Positive jog command | _POS_1_CwJogStart | K04360 | BIT | R/W |
| 2Axis Positive jog command | _POS_2_CwJogStart | K04560 | BIT | R/W |
| 3Axis Positive jog command | _POS_3_CwJogStart | K04760 | BIT | R/W |
| 4Axis Positive jog command | _POS_4_CwJogStart | K04960 | BIT | R/W |
| 5Axis Positive jog command | _POS_5_CwJogStart | K05160 | BIT | R/W |
| 6Axis Positive jog command | _POS_6_CwJogStart | K05360 | BIT | R/W |
| 1Axis Negative jog command | _POS_1_CcwJogStart | K04361 | BIT | R/W |
| 2Axis Negative jog command | _POS_2_CcwJogStart | K04561 | BIT | R/W |
| 3Axis Negative jog command | _POS_3_CcwJogStart | K04761 | BIT | R/W |
| 4Axis Negative jog command | _POS_4_CcwJogStart | K04961 | BIT | R/W |
| 5Axis Negative jog command | _POS_5_CcwJogStart | K05161 | BIT | R/W |
| 6Axis Negative jog command | _POS_6_CcwJogStart | K05361 | BIT | R/W |
| 1Axis Jog speed command | _POS_1_JogLowHigh | K04362 | BIT | R/W |
| 2Axis Jog speed command | _POS_2_JogLowHigh | K04562 | BIT | R/W |
| 3Axis Jog speed command | _POS_3_JogLowHigh | K04762 | BIT | R/W |
| 4Axis Jog speed command | _POS_4_JogLowHigh | K04962 | BIT | R/W |
| 5Axis Jog speed command | _POS_5_JogLowHigh | K05162 | BIT | R/W |
| 6Axis Jog speed command | _POS_6_JogLowHigh | K05362 | BIT | R/W |
| Internal position control ready | _POS_Rdy | K0437F | BIT | R |
| Internal position control data saving | _POS_Writing | K0437E | BIT | R |
| Encoder1 current position | _ENC1_CurPos | K0538 | DINT | R |
| Encoder2 current position | _ENC2_CurPos | K0540 | DINT | R |
| Encoder3 current position | _ENC3_CurPos | K0542 | DINT | R |
| Encoder4 current position | _ENC4_CurPos | K0544 | DINT | R |
| Current internal position control time(us) | _POS_TASK_SCAN_CUR | K0546 | WORD | R |
| Maximum internal position control time(us) | _POS_TASK_SCAN_MAX | K0547 | WORD | R |
| Internal position control period error | _POS_TASK_SCAN_ERR | K0548 | WORD | R |

### 6.2.2 Usage of I/O Signal

(1) JOG Operation

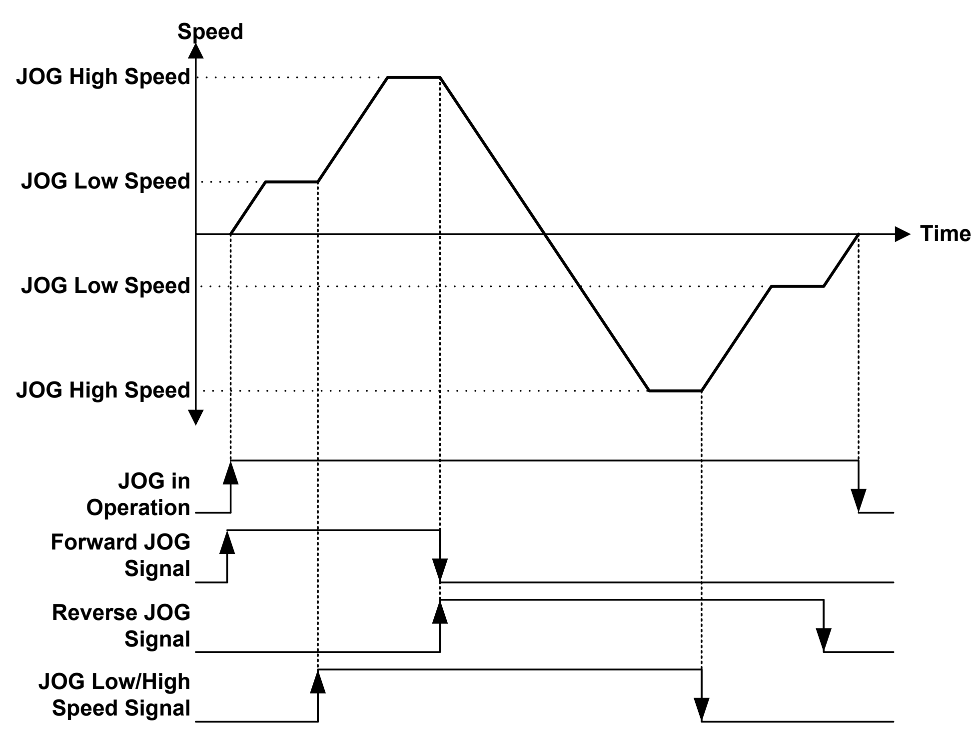
(a) Forward/Reverse Jog Signals show the direction of Jog Operation. The Jog operation shall be divided into Forward/Reverse direction according to the On/Off signals. When Forward Jog Signal is On, it starts Forward Operation and When Jog Signal is Off, it starts Reverse Operation. When both signals Off, it stops Jog Signals. When both signals On, it does Forward Jog Signal.

| Forward Jog Signal | Reverse Jog Signal | Jog Operation Status |
|---|---|---|
| On | Off | Forward Jog Operation |
| Off | On | Reverse Jog Operation |
| Off | Off | Stop |
| On | On | Forward Jog Operation |

(b) If Jog direction is changed during Jog operation, it slows down at first and then operates as the direction it changed.

(c) According to value of Jog low/high Signals, it could operate with low/high speed. When jog low/high signals Off, it operates with low speed and when they are ON, it operates with high speed.

(d) If you change value of low/high jog signals during Jog operation, there will be no stop and apply the speed as you changed.



# Chapter 7 Command

Here describes the positioning command used in XGB PLC.

## 7.1 General Command

| Command | Description | Operand |
|---|---|---|
| PUT | Internal memory write (Level) | Base, memory address, save device leading address, data number to write at one time |
| PUTP | Internal memory write (Edge) | Base, memory address, save device leading address, data number to write at one time |
| GET | Internal memory read (Level) | Base, memory address, save device leading address, data number to write at one time |
| GETP | Internal memory read (Edge) | Base, memory address, save device leading address, data number to write at one time |

### 7.1.1 Internal Memory Read (GET, GETP Command)

| Form | Description | Available area |
|---|---|---|
| n1 | Base and slot No. installed with special module | Constant |
| n2 | Leading address of special module internal memory to read a data | Constant |
| D | Leading address of device to save the data to read | M, P, K, L, U, N, D, R |
| n3 | Word number of data to read | M, P, K, L, Constant |

(1) Difference between GET Command and GETP Command

(a) GET Command

Always execute when operating condition is ON. (Level)

That is, when execute condition is ON, it operates continuously.

(b) GETP Command

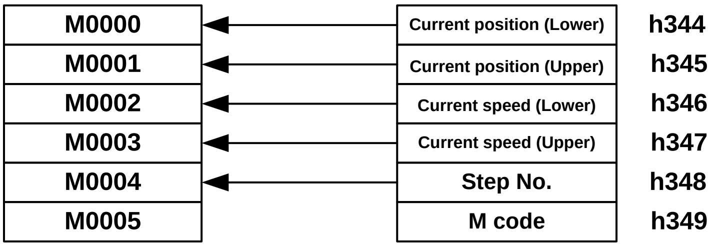
Execute with operation start of execute condition. (Edge).

That is, when execute condition is ON, it operates only one time.

To operate again, execute condition should be off and on again.

**[Example]**

The case is that read current position, current speed and step number from axis 4 state information of embedded positioning to PLC CPU M0000. Set the number of data as 5 to read 5 Word from current position to step number.



## 7.1.2 Internal Memory Write (PUT, PUTP Command)

| Form | Description | Available area |
|---|---|---|
| n1 | Base and slot No. installed with special module | Constant |
| n2 | Leading address of special module internal memory to write a data | Constant |
| S | Leading address of device that the data to Write is saved | M, P, K, L, U, N, D, R |
| n3 | Word number of data to write | M, P, K, L, Constant |

(1) Difference between PUT Command and PUTP Command

(a) PUT Command

Always execute when operating condition is ON. (Level)

That is, when execute condition is ON, it operates continuously.

(b) PUTP Command

Execute with operation start of execute condition. (Edge).

That is, when execute condition is ON, it operates only one time.

To operate again, execute condition should be off and on again.

**[Example]**

The case that writes value of CPU as axis 3 teaching value by 16 Word data of D00000~D00015

| | | |
|---|---|---|
| D00000 | Teaching data1(lower) | h280 |
| D00001 | Teaching data1(upper) | h281 |
| D00002 | Teaching data2(lower) | h282 |
| D00003 | Teaching data2(upper) | h283 |
| D00004 | Teaching data3(lower) | h284 |
| D00005 | Teaching data3(upper) | h285 |
| D00006 | Teaching data4(lower) | h286 |
| D00007 | Teaching data4(upper) | h287 |
| D00008 | Teaching data5(lower) | h288 |
| D00009 | Teaching data5(upper) | h289 |
| D00010 | Teaching data6(lower) | h28A |
| D00011 | Teaching data6(upper) | h28B |
| D00012 | Teaching data7(lower) | h28C |
| D00013 | Teaching data7(upper) | h28D |
| D00014 | Teaching data8(lower) | h28E |
| D00015 | Teaching data8(upper) | h28F |

### 7.1.3 Common memory read(GETM,GETMP Command)

| Form | Description | Available area |
|---|---|---|
| **n1** | Base and slot No. installed with special module | Constant |
| **n2** | Leading address of commonl memory to read a data | Constant |
| **S** | Leading address of device to save the data to read | M, P, K, L, U, N, D, R |
| **n3** | Number of data to read(DWORD unit, Max. 64) | M, P, K, L, U, N, D, R |

(1) Difference between GETM Command and GETMP Command

(a) GETM Command

Always execute when operating condition is ON. (Level)

That is, when execute condition is ON, it operates continuously.

(b) GETMP Command

Execute with operation start of execute condition. (Edge).

That is, when execute condition is ON, it operates only one time.

To operate again, execute condition should be off and on again.

(2) Number of data to read

(a) n3 is Number of DWORD data to read.

Because embedded positioning has 64 Dwords of common memory area, GETM command can read maximun 64DWORD at one time.

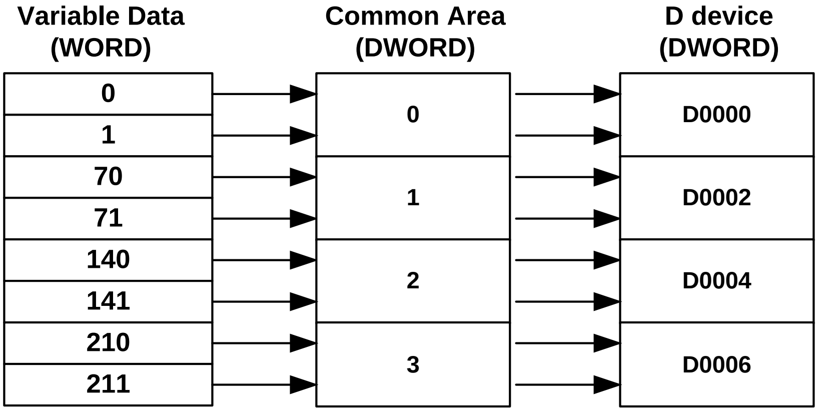
(b) if n3 value or n2 + n3 value exceeds the range, the error flag(_LER, _ERR) will be set to ON and command is not executed.

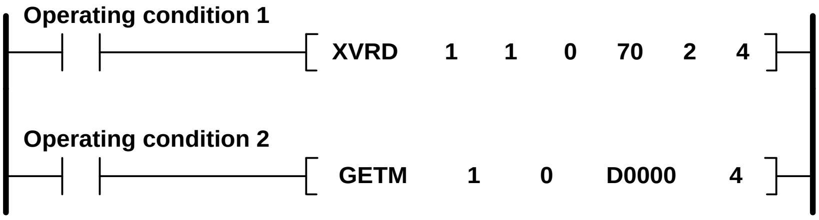
**[Example]**

The case that reads speed limit value of Axis1~4 from variable memory of embedded positioning, then save these values to device D0~D6.

(*Notes)

It takes up to 5ms to copy the data from variable data area to common memory public domain with XVRD command. Therefore, it needs 5ms waiting time at least when execute GETM command after execution of XVRD command.





### 7.1.4 Pulse Width Modulation

- PWM is the operation to turn on / off the output contact with the fixed period and duty ratio
- XBMH2 has two PWM output(P0020,P0021) and XBMHP has 6 PWM output(P0020~P0025)
- PWM operation is possible when the positioning pulse output of each P contact is disabled.

For example, if you want to set PWM on P0020 output point, disable the pulse output setting in 1 axis basic parameter.

(1) **Pulse Width Modulation** (PWM)

| Ins | | available area | | | | | | | | | | | | | | Step | Flag | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PMK | F | L | T | C | S | Z | D.x | R.x | Constant | U | N | D | R | | Error (F110) | Zero (F111) | Carry (F112) |
| PWM | sl | - | - | - | - | - | - | - | - | - | ○ | - | - | - | - | 4~7 | ○ | - | - |
| | ax | ○ | - | ○ | - | - | - | ○ | - | - | ○ | - | - | ○ | - | | | | |
| | n1 | ○ | - | ○ | - | - | - | ○ | - | - | ○ | - | - | ○ | - | | | | |
| | n2 | ○ | - | ○ | - | - | - | ○ | - | - | ○ | - | - | ○ | - | | | | |

**[Operand Setting]**

| operand | description | range | Data size |
|---|---|---|---|
| sl | Slot number | XBMH2,<br>XBMHP are fixed to 1 | WORD |
| ax | axes(output point)<br>0: P00020<br>1: P00021<br>2: P00022<br>3: P00023<br>4: P00024<br>5: P00025 | 0~1(XBMH2)<br>0~5(XBMHP) | WORD |
| n1 | Output cycle(ms) | 1~20,000(ms) | WORD |
| n2 | Off Duty ratio | 0~100(%) | WORD |

**[Flag set (Set)]**

| Flay | description | Device No. |
|---|---|---|
| Error | If ax is out of range | F110 |

(a) Function

•This command is to issue PWM output command to XBMH output contact

•While the input condition is ON, the pulse string is output to the contact specified by ax of XGB output contact with the cycle set to n1 and the Off Duty set to n2.

(b) Error

• If the value specified by ax (output contact) is out of the settable range, the error flag (F110) is set and the instruction is not executed.

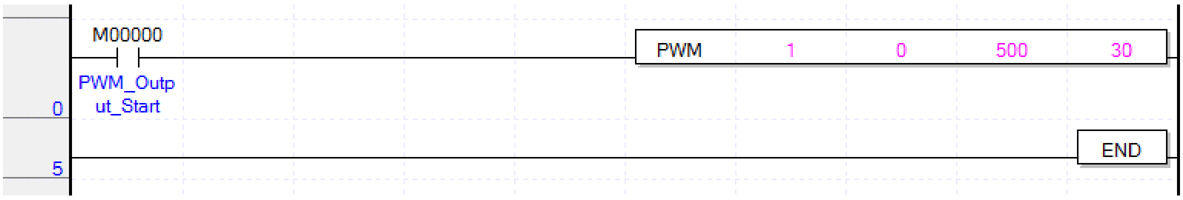
**Notice**

- Even if the output cycle is changed during PWM output, it is not applied.

(2) Example of using PWM

- Below program show example of PWM
- An example of the use of the PWM is described with reference to P00020.

(a)Program example



(b) Used device

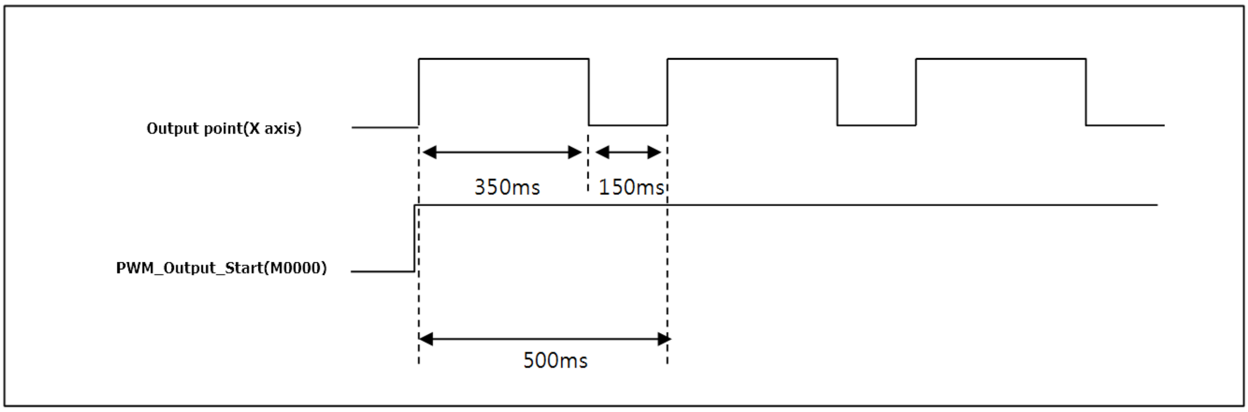
- M0000: PWM output start signal.

(c) Operation of program

- P00020 PWM signal is output while M00000 which contact is used as PWM command signal is On.

(At this time, it does not operate if the basic parameter pulse output of the built-in positioning axis 1 using P00020 is set as output.)

- When the PWM command is executed, specified output cycle (500 ms in this case) and Off duty (30% in this case) will come out.



## 7.2 Dedicated Commands

| Command | Command description | Command condition |
|---|---|---|
| XORG | Homing start | Slot, command axis |
| XFLT | Floating origin setting | Slot, command axis |
| XDST | Direct start | Slot, command axis, position, speed, dwell time, M code, control word |
| XIST | Indirect start | Slot, command axis, step no. |
| XSST | Simultaneous start | Slot, command axis, Simultaneous start axis |
| XSWR | Simultaneous start step setting | Slot, command axis, step no., device, number of steps |
| XELIN | Ellipse interpolation | Slot, command axis, ratio of the ellipse, driving angle |
| XVTP | Speed/position switching control | Slot, command axis |
| XVTPP | Position specified speed/position switching control | Slot, command axis, target position |
| XPTV | Position/speed switching control | Slot, command axis |
| XSTP | Deceleration stop | Slot, command axis, deceleration time |
| XSKP | Skip operation | Slot, command axis |
| XSSP | Position synchronous start | Slot, command axis, step no., main axis position, main axis setting |
| XSSS | Speed synchronous start | Slot, command axis, main axis rate, subordinate axis rate, main axis setting |
| XSSSP | Position assigned<br>Speed synchronous start | Slot, command axis, main axis rate, subordinate axis rate, main axis setting, goal position |
| XCAM | CAM Operation | Slot, command axis, main axis setting, CAM block no. |
| XCAMO | Main axis offset-specified CAM operation | Slot, command axis, main axis setting, CAM block no., main axis offset |
| XPOR | Position override | Slot, command axis, position |
| XSOR | Speed override | Slot, command axis, speed |
| XPSO | Position assigned speed override | Slot, command axis, position, speed |
| XNMV | Continuous operation | Slot, command axis |
| XINCH | Inching operation | Slot, command axis, inching amount |
| XRTP | Return to the previous position of manual operation | Slot, command axis |
| XSNS | Start step No. change | Slot, command axis, step no. |
| XSRS | Repeat step No. change | Slot, command axis, step no. |
| XMOF | M code release | Slot, command axis |
| XPRS | Current position preset | Slot, command axis, position |
| XEPRS | Encoder preset | Slot, command axis, position, Encoder No.(=0) |
| XTEAA | Teaching Array | Slot, command axis, step no., RAM/ROM, position/speed, Teaching no. |
| XTWR | Teaching array data setting | Slot, command axis, teaching data device, no. of teaching |
| XSBP | Basic parameter teaching | Slot, command axis, basic parameter change value, item to change, RAM/ROM |
| XSEP | Extended parameter setting | Slot, command axis, extended parameter change value, item to change, RAM/ROM |
| XSHP | Homing parameter setting | Slot, command axis, homing parameter change value, item to change, RAM/ROM |
| XSMP | Manual operation parameter setting | Slot, command axis, manual operation parameter change value, item to change, RAM/ROM |
| XSES | Input signal parameter setting | Slot, command axis, input signal parameter change value, RAM/ROM |
| XSCP | Common parameter setting | Slot, command axis, common parameter change value, item to change, RAM/ROM |
| XSMD | Operation data teaching | Slot, command axis, operation data value, operation data item, step no., RAM/ROM |
| XVRD | Variable data reading | Slot, command axis, read address, block offset, block size, block count |

| Command | Command description | Command condition |
|---|---|---|
| XVWR | Variable data writing | Slot, command axis, data device, write address, block offset, block size, block count |
| XWRT | Parameter/operation data save | Slot, command axis, axis information |
| XEMG | Emergency stop | Slot, command axis |
| XCLR | Error reset | Slot, command axis, common error reset |
| XECLR | Error history reset | Slot, command axis |
| XPST | Point Start | Slot, command axis, step no. |
| XPWR | Point start step data setting | Slot, command axis, step data device, step no. |
| XSRD | Operation state reading | Slot, command axis, operation state save, device no. |
| XRSTR | Restart | Slot, command axis |

**Note**

1.The dedicated command acts at rising edge. That is, it executed the first action once when input condition is “ON.” To execute the action again, It should be “OFF” and then “ON” again.

(SRD just execute High level action. When input condition is “On,” it keeps operating and it doesn’t operate when it’s “Off.” )

2.Start instruction,needed for position control operation, begins immediate processing on following position-control operation without immediately processing the input command.

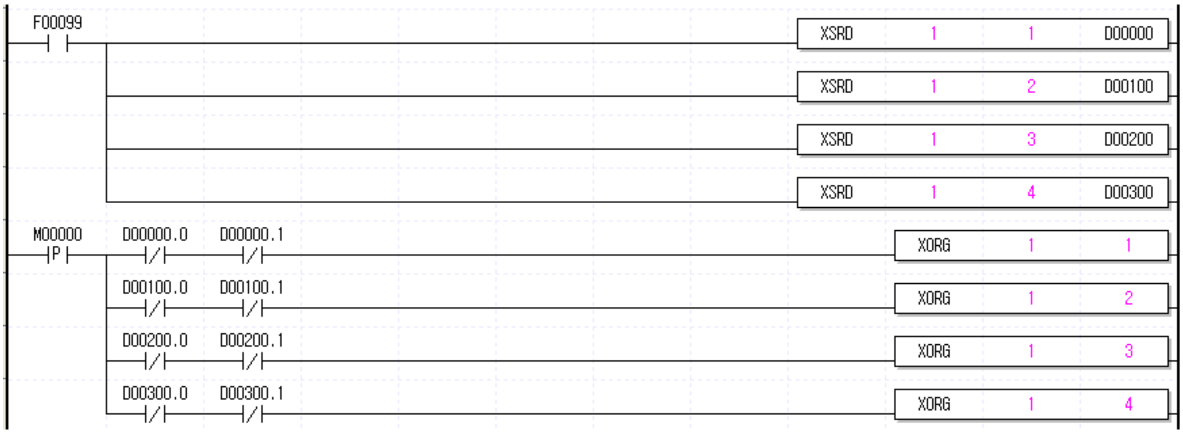
3. The XWRT instruction is not a start instruction that requires a position control operation but requires processing time. Therefore, the position control operation unit does not process the instruction immediately after inputting a command like other non-start. XWRT operation time is max. 2s. If XWRT command is executed again during XWRT command processing, error code 477 is generated and restarted XWRT is ignored.

## 7.3 Use of Dedicated Command

Here describes the command usage based on 1 axis of embedded positionig. The position and speed use the units of pulse and pulse/sec [pps], respectively.

**Notes**

▶ This is the method used with the operation state bit(in operation, error state) read by using SRD as the program operation condition



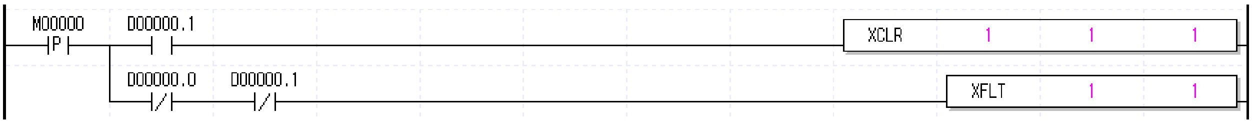
※ D00000.0: 1 axis in operation, D00000.1: 1 axis error state
D00100.0: 2 axis in operation, D00100.1: 2 axis error state
D00200.0: 3 axis in operation, D00200.1: 3 axis error state
D00300.0: 4 axis in operation, D00300.1: 4 axis error state

▶ The example program for command in this Chapter 8 also uses the operation state bit as the program operation condition as the above

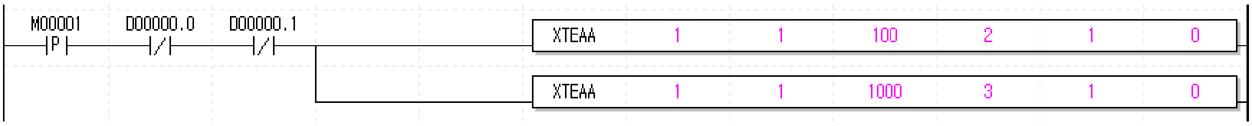
**Notes**

- ▶ The start command that must be executed over several scans must be executed only for the command execution axis within one scan. If you use the following example program, the command may not work normally. The XWRT instruction does not operate while some axes are running or when ROM data is being saved.

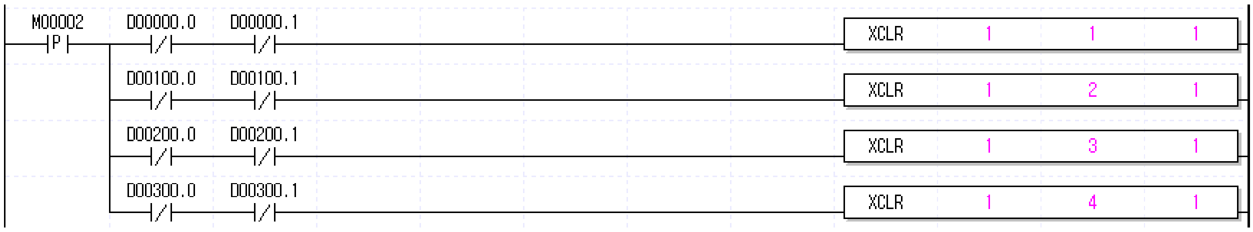
**If executing other command**



**If executing same command**

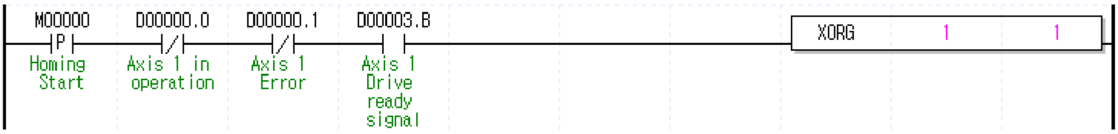


- ▶ A same command can not be executed for other axis.



## 7.3.1 Homing (Command : XORG)

### (1) Program



### (2) Description

| Device | Description |
|---|---|
| M00000 | axis1 homing start input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D00003.B | axis1 drive ready signal |

| Command | XORG | | | | Homing start |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK, constant, D, Z, R, ZR | WORD | Command axis (1~6 : axis1 ~ axis6 ) |

※ PMLK means P, M, L and K areas

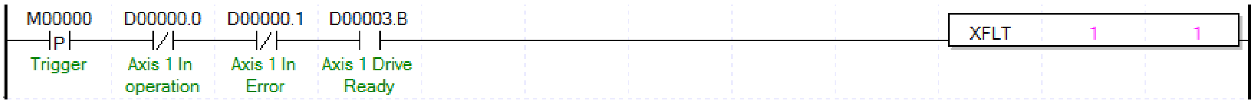
(a) If homing start command is executed, it carries out homing operation by the setting homing parameter and if homing is complete by external input signal, the origin determination end signal is “ON”.

(b) Please refer to "9.1 Homing Start” about detailed explanation of Homing Start.

(c) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

## 7.3.2 Floating origin setting (Command : XFLT)

### (1) Program



### (2) Description

| Device | Description |
|---|---|
| M00000 | axis1 homing start input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D00003.B | axis1 drive ready signal |

| Command | XFLT | | | | Floating origin setting |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK, constant, D, Z, R, ZR | WORD | Command axis (1~6 : axis1 ~ axis6 ) |

※ PMLK means P, M, L and K areas

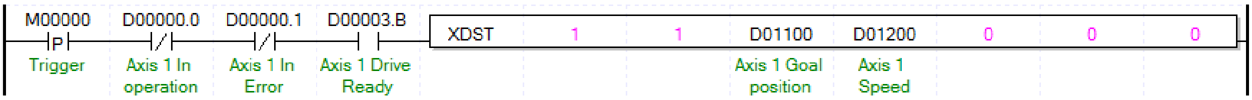
(a) If the floating origin setting command is executed, the current position is changed to the origin address of homing parameter and the origin determination signal (bit) is ON.

(b) Floating origin setting that different from homing origin is set at the current position and can not be set in operation.

(c) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

## 7.3.3 Direct start (Command : XDST)

### (1) Program



### (2) Description

| Device | Description |
|---|---|
| M00000 | axis1 homing start input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D00003.B | axis1 drive ready signal |

| Command | XDST | | | | Direct start |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis<br>( 1 ~ 6 : axis1 ~ axis6) |
| | OP3 | Goal position | PMLK,constant,D,Z,R,ZR | DINT | Goal position<br>(-2,147,483,648 ~ 2,147,483,647) |
| | OP4 | Goal speed | PMLK,constant,D,Z,R,ZR | DWORD | Goal speed |
| | OP5 | Dwell time | PMLK,constant,D,Z,R,ZR | WORD | Dwell time (0~65,535) |
| | OP6 | M code | PMLK,constant,D,Z,R,ZR | WORD | M code (0~65,535) |
| | OP7 | Control word | PMLK,constant,D,Z,R,ZR | WORD | |

※ PMLK means P, M, L and K areas

(a) Details of Control word (OP7) for each Bit are as follows.

| 15 ~ 12 | 11 ~ 10 | 9 ~ 8 | 7 ~ 5 | 4 | 3 ~ 2 | 1 ~ 0 |
|---|---|---|---|---|---|---|
| - | Dec. Time | Acc. Time | - | 0:Absolute<br>1:Relative | - | 0:Position Control<br>1:Speed control<br>2:Feed Control<br>3:Shortest Position Control |

(b) If control word is h0012, it shall be set by Feed control, relative, acc./dec. time 1.

(c) No.2~3, 5~7, 12~15 Bit of control word is the unused area and does not affect the setting.

(d) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

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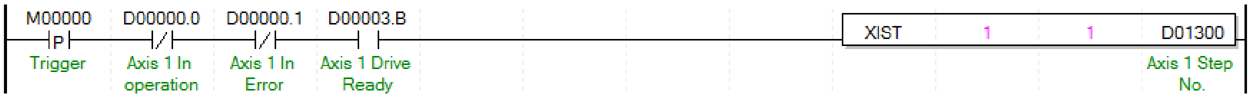
## 7.3.4 Indirect start (Command : XIST)

### (1) Program



### (2) Description

| Device | Description |
|---|---|
| M00000 | axis1 homing start input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D00003.B | axis1 drive ready signal |

| Command | XIST | | | | Indirect start |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis<br>(1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | Operation step | PMLK,constant,D,Z,R,ZR | WORD | Step No. to operate (0~400) |

※ PMLK means P, M, L and K areas

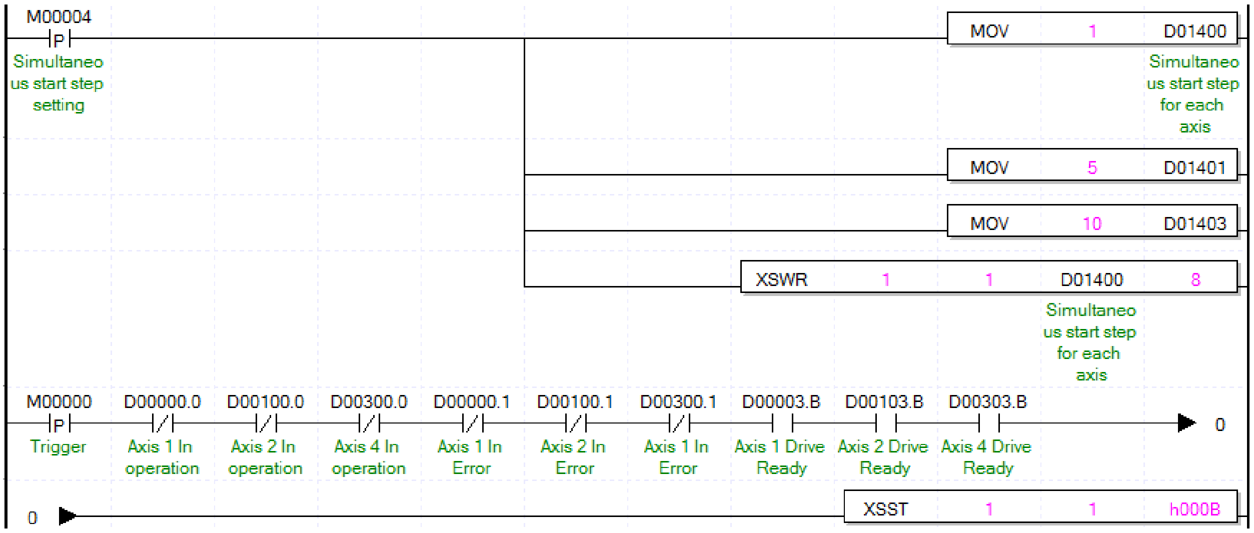
(a) If operation step No. is set as “0” in indirect start, it will be operated as current step No. If other number except 0 is set as the operation step number, it operates only for step no. set.

(b) If operation pattern is set as Continous or go-on, several steps can be operated by an indirect start command. (Continous operation can be executed when the continous operation parameter is enabled)

(c) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command

### 7.3.5 Simultaneous Start (Command : XSST)

(1) Program



(2) Description

| Device | Description | Device | Description |
|---|---|---|---|
| M00004 | Simultaneous start step setting | D00103.B | axis2 drive ready signal |
| M00000 | Simultaneous start input | D00300.0 | axis4 signal in operation |
| D00000.0 | axis1 signal in operation | D00300.1 | axis4 error state |
| D00000.1 | axis1 error state | D00303.B | axis4 drive ready signal |
| D00003.B | axis1 drive ready signal | D01400 | axis1 simultaneous start step |
| D00100.0 | axis2 signal in operation | D01401 | axis2 simultaneous start step |
| D00100.1 | axis2 error state | D01403 | axis4 simultaneous start step |

| Command | XSST | | | | Simultaneous start |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | Operation axis | PMLK,constant,D,Z,R,ZR | WORD | Simultaneous start axis |

※ PMLK means P, M, L and K areas

(a) Simultaneous command is the command operates simultaneous steps saved in 'operation axis(OP3)' at a time.

(b) Axis setting is set by setting the bits to the axis

| 15 ~ 6 Bit | 5Bit | 4Bit | 3Bit | 2Bit | 1Bit | 0Bit |
|---|---|---|---|---|---|---|
| Not use | axis6 | axis5 | axis4 | axis3 | axis2 | axis1 |

That is, axis4, axis2, axis1 will be set if set as h000B

But, the axis which command simultaneous start is basically included without being set in operating axis.

(c) In the example program above, axis1 operates step no.1, axis2 operates step no.5, 5 axes operates step no.10.

(d) To set steps of axis for simultaneous start, use XSWR command or PUT/PUTP command to set simultaneous start step no. on simultaneous start step memory address. This must be complete before simultaneous start executes.

(e) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

## 7.3.6 Simultaneous Start Step Setting (Command : XSWR)

### (1) Program

Refer to the chapter 7.3.5 for example program.

### (2) Description

Refer to the chapter 7.3.5 for example program.

| Command | XSWR | | | | Simultaneous start step setting |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | Device | PMLK,constant,D,Z,R,ZR | WORD | The device leading no. has simultaneous start step no. |
| | OP4 | Number of step | PMLK,constant,D,Z,R,ZR | WORD | The number of step to use. |

※ PMLK means P, M, L and K areas

(a) The command for setting the simultaneous start step reads the data for the number of steps (OP4) from the data address specified in the'device (OP3)' and saves it in the simultaneous start step of the positioning module.

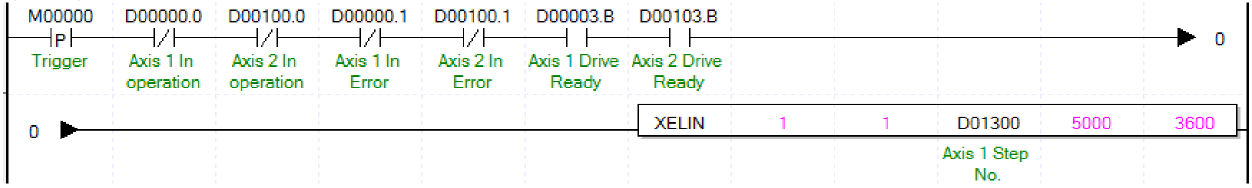
(b) In the example program above, save 8 WORD data from D1400 address as simultaneous start step

(c) To set steps of axis for simultaneous start, use XSWR command or PUT/PUTP command to set simultaneous start step no. on simultaneous start step memory address. This must be complete before simultaneous start executes.

(d) When using PUT command to set simultaneous start, refer to the memory address of “6.1.3 simultaneous start step data” and “7.1.2 internal memory writing”.

## 7.3.7 Ellipse Interpolation (Command : XELIN)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M00000 | axis1/axis2 ellipse interpolation input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D00003.B | axis1 drive ready signal |
| D00100.0 | axis2 signal in operation |
| D00100.1 | axis2 error state |
| D00103.B | axis2 drive ready signal |
| D01300 | axis1 operation step |

| Command | XELIN | | | | Ellipse Interpolation |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | operation step | PMLK,constant,D,Z,R,ZR | WORD | Step no. to execute ellipse interpolation |
| | OP4 | Ellipse ratio | PMLK,constant,D,Z,R,ZR | WORD | Ellipse ratio (%) |
| | OP5 | Operation degree | PMLK,constant,D,Z,R,ZR | WORD | Degree for ellipse interpolation |

※ PMLK means P, M, L and K areas

(a) Ellipse interpolation distorts operation data which set as circular arc interpolation by ratio set on ellipse ratio and executes ellipse operation by set degree on OP5. Therefore, step of operation data set on operation step (OP3) must be set as circular arc interpolation control.

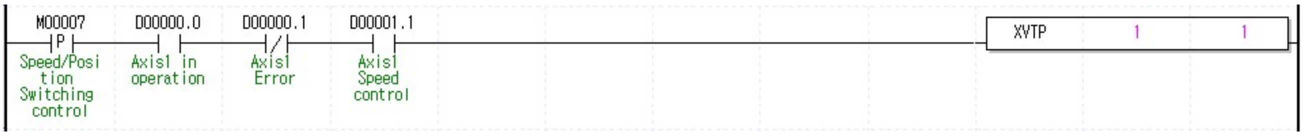
(b) Ellipse ratio is able to be set from 1 to 65535, has [X10$^{-2}$%] unit. That is, 65535 will be 655.35%.

(c) Operation degree is able to be set from 1 to 65535, has [X10$^{-1}$ degree] unit. That is, 3650 will be 365.0 degree.

(d) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

## 7.3.8 Speed/Position Switching Control (Command : XVTP)

### (1) Program



### (2) Description

| Device | Description |
|---|---|
| M00007 | axis1 speed/position switching control input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D00001.1 | axis1 signal in speed control |

| Command | XVTP | | | | Speed/position switching control |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |

※ PMLK means P, M, L and K areas

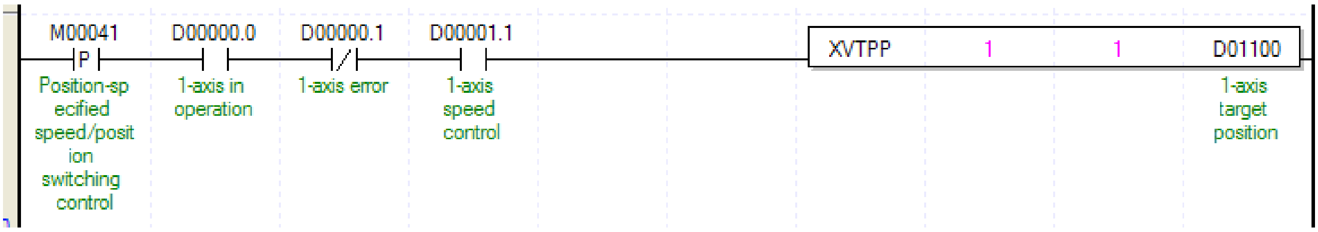
(a) If speed/position switching control is executed in the state of speed control operation, it shall be switched to position control and positioning operation is executed with the position set in the speed control.

(b) For detail description about speed/position switching control, refer to “8.2.14 Speed/Position Switching Control”

(c) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

### 7.3.9 Position specified Speed/Position Switching Control (Command : XVTPP)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M00041 | 1-axis position-specified speed/position switching control input |
| D00000.0 | 1-axis signal in operation |
| D00000.1 | 1-axis error state |
| D00001.1 | 1-axis signal in speed control |
| D01100 | 1-axis target position |

| Command | XVTPP | | | | Speed/position switching control |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | Target position | PMLK,constant,D,Z,R,ZR | DINT | Transfer amount after position control switching |

※ PMLK means P, M, L and K areas

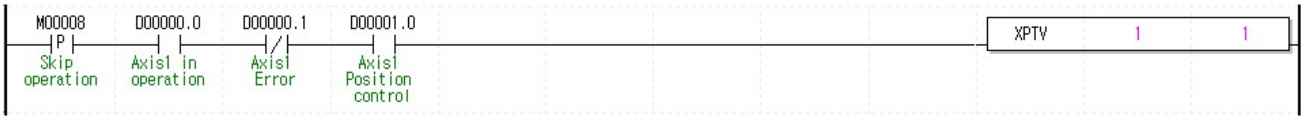
(a) If speed/position switching control is executed in the state of speed control operation, it shall be switched to position control and positioning operation is executed with the position set in the speed control.

(b) For detail description about speed/position switching control, refer to “8.2.15 Position-specified Speed/Position Switching Control”

(c) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

### 7.3.10 Position/Speed Switching Control (Command : XPTV)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M00008 | axis1 position/speed switching control input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D00001.0 | axis1 signal in position control |

| Command | XPTV | | | | Position/speed switching control |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |

※ PMLK means P, M, L and K areas

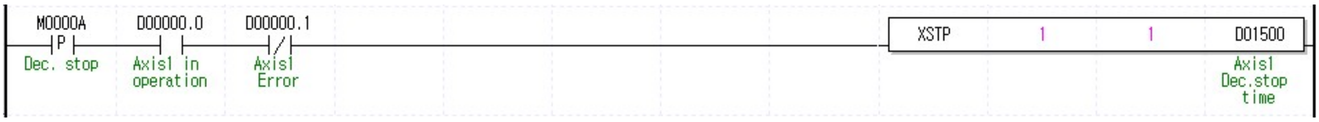
(a) If position/speed switching control is executed during position control operation, it is converted to speed control, operates at the speed set during position control and stops by executing deceleration stop.

(b) For the detail description about position/speed switching control, refer to “8.2.16 Position/Speed Switching Control”.

(c) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

### 7.3.11 Deceleration Stop (Command : XSTP)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M0000A | axis1 deceleration stop input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D01500 | axis1 deceleration stop time set |

| Command | XSTP | | | | Deceleration stop |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | Deceleration time | PMLK,constant,D,Z,R,ZR | WORD | deceleration time<br>(0 ~ 2,147,483,647 ms) |

※ PMLK means P, M, L and K areas

(a) Deceleration stop carry out the command in deceleration, acceleration and equal speed areas.

(b) Deceleration time means the time required from deceleration start to stop and it is available to set from 0 ~ 2,147,483,647ms. But if setting as “0”, it stops only by deceleration time set at the beginning of operation.

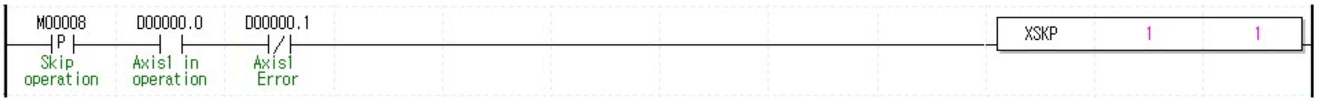
(c) Deceleration time means the time required from the speed limit of basic parameter on operation axis to stop.

(d) If deceleration stop command is executed in speed sync., position sync. or CAM operation, it stops speed sync., position sync. or CAM operation depending on current operation control state.

(e) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

## 7.3.12 Skip Operation (Command : XSKP)

### (1) Program



### (2) Description

| Device | Description |
|---|---|
| M0000A | axis1 deceleration stop input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |

| Command | XSKP | | | | Skip operation |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |

※ PMLK means P, M, L and K areas

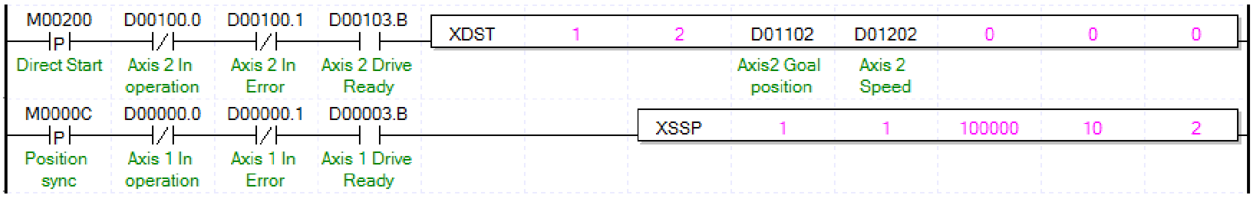
(a) This ends and stops the operation of step which is in operation currently and then continues to operate the next step.

(b) For the details description of skip operation, refer to “8.5.3 Skip Operation.

(c) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

### 7.3.13 Synchronous Start by Position (Command : XSSP)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M0000C | axis1 synchronous start by position input |
| M00200 | axis1 direct start input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error signal |
| D00003.B | axis1 drive ready signal |
| D00100.0 | axis2 signal in operation |
| D00100.1 | axis2 error state |
| D00103.B | axis2 drive ready signal |

| Command | XSSP | | | | Synchronous start by position |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | Main axis position | PMLK,constant,D,Z,R,ZR | DINT | Position of sub axis to operate |
| | OP4 | Operation step | PMLK,constant,D,Z,R,ZR | WORD | Sub axis operation step No. (0~ 400) |
| | OP5 | Main axis | PMLK,constant,D,Z,R,ZR | WORD | Main axis<br>( 1 ~ 6 : axis1 ~ axis6,<br>9 ~ 12 : Encoder1 ~ Encoder4) |

※ PMLK means P, M, L and K areas

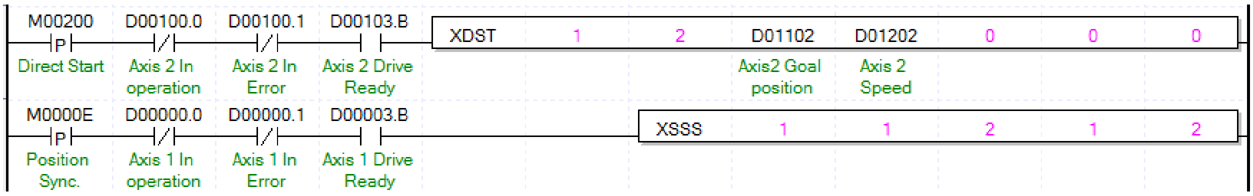
(a) If the command of synchronous start by position is executed, it becomes in operation state but motor does not operate actually. At the point that axis2 as main axis setting starts and its current position is 1000, axis1 will start and the motor will operate.

(b) For the detail description about position synchronous start, refer to “8.4.2 position synchronous start control”

(c) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

## 7.3.14 Synchronous Start by Speed (Command : XSSS)

### (1) Program



### (2) Description

| Device | Description |
|---|---|
| M0000E | axis1 speed synchronous start input |
| M00200 | axis2 direct start input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D00003.B | axis1 drive ready signal |
| D00100.0 | axis2 signal in operation |
| D00100.1 | axis2 error state |
| D00103.B | axis2 drive ready signal |

| Command | XSSS | | | | Synchronous start by speed |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | Main axis ratio | PMLK,constant,D,Z,R,ZR | WORD | Speed sync. main axis ratio<br>(-32768 ~ 32767) |
| | OP4 | Subordinate axis ratio | PMLK,constant,D,Z,R,ZR | WORD | Speed sync. sub axis ratio<br>(-32768 ~ 32767) |
| | OP5 | Main axis | PMLK,constant,D,Z,R,ZR | WORD | Main axis<br>(1 ~ 6 : axis1 ~ axis6,<br>9 ~ 12 : Encoder1 ~ Encoder4) |

※ PMLK means P, M, L and K areas

(a) In the example program above, if the command of synchronous start by speed is executed, axis1 (subordinate axis) is indicated as 'in operation' but the motor does not operate. If operating axis2 set as the main axis, axis1 (subordinate axis) is operated depending on the designated ratio between main axis (OP3) and sub axis(OP4).

(b) If speed sync. ratio (sub axis ratio / main axis ratio) is positive integer, sub axis operation turns main axis direction, if not positive integer, it turns the opposite of main axis direction.

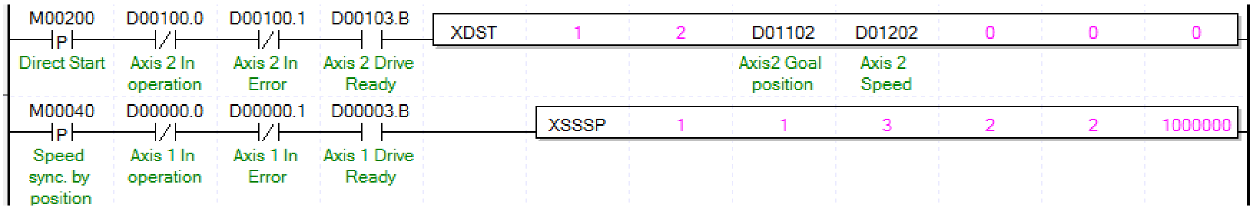
(c) For example, if main axis ratio is 3, sub axis ratio is 2, when main axis moves by 3000, sub axis moves 2000.

(d) For the detail description about speed sync., refer to "8.4.1 Speed Synchronous Start Control".

(e) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command

## 7.3.15 Speed synchronous start by position (Command: XSSSP)

### (1) Program



### (2) Description

| Device | Description |
|---|---|
| M00040 | axis1 speed synchronous start input by position |
| M00200 | axis2 direct start input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D00003.B | axis1 drive ready signal |
| D00100.0 | axis2 signal in operation |
| D00100.1 | axis2 error state |
| D00103.B | axis2 drive ready signal |

| Command | XSSSP | | | | Speed synchronous start by position |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | Main axis ratio | PMLK,constant,D,Z,R,ZR | INT | Speed sync. main axis ratio<br>(-32768 ~ 32767) |
| | OP4 | Sub axis ratio | PMLK,constant,D,Z,R,ZR | INT | Speed sync. sub axis ratio<br>(-32768 ~ 32767) |
| | OP5 | Main axis | PMLK,constant,D,Z,R,ZR | WORD | Main axis<br>(1 ~ 6 : axis1 ~ axis6,<br>9 ~ 12 : Encoder1 ~ Encoder4) |
| | OP6 | Target position | PMLK,constant,D,Z,R,ZR | DINT | Target position of Speed synchronous start with position |

※ PMLK means P, M, L and K areas

(a) In the example program above, if the command of synchronous start by speed is executed, axis1 (subordinate axis) is indicated as 'in operation' but the motor does not operate. If operating axis2 set as the main axis, axis1 (subordinate axis) is operated depending on the designated ratio between main axis (OP3) and sub axis(OP4).

(b) If speed sync. ratio (sub axis ratio / main axis ratio) is positive integer, sub axis operation turns main axis direction, if not positive integer, it turns the opposite of main axis direction.

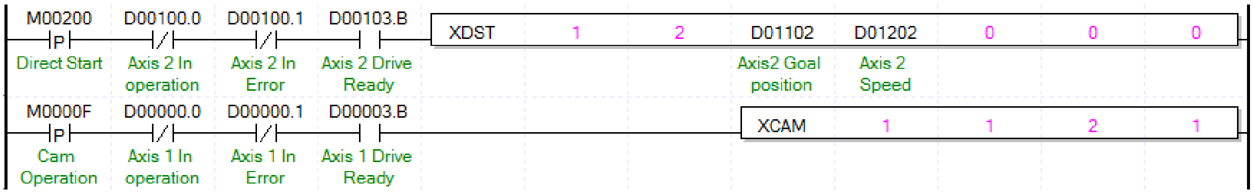
(c) For example, if main axis ratio is 3, sub axis ratio is 2 and target position is 1,000,000, when main axis moves by 3000, sub axis moves 2000. It stops by where position of main axis is at 1,000,000.

(d) For the detail description about speed sync., refer to "8.4.1 Speed Synchronous Start Control".

(e) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

### 7.3.16 CAM Operation (Command : XCAM)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M0000F | axis1 cam operation input |
| M00200 | axis2 direct start input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D00003.B | axis1 drive ready signal |
| D00100.0 | axis2 signal in operation |
| D00100.1 | axis2 error state |
| D00103.B | axis2 drive ready signal |

| Command | XCAM | | | | Cam Operation |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | Main axis | PMLK,constant,D,Z,R,ZR | WORD | Main axis<br>(1 ~ 6 : axis1 ~ axis6,<br>9 ~ 12 : Encoder1 ~ Encoder4) |
| | OP4 | Cam Block | PMLK,constant,D,Z,R,ZR | WORD | Cam data block to apply to operation (1 ~ 9) |

※ PMLK means P, M, L and K areas

(a) In the example program above, if cam operation command is executed, axis1 (sub axis) is indicated as “In operation” but the motor does not operate actually. When axis2 starts operating as a main axis, motor of axis1 starts operating toward sub axis location depending on data which set on cam block (OP4).

(b) Maximum number of cam data block is 7. (Set on positioning package)

(c) Cam data is set on positioning package but has to be downloaded at positioning module before cam operation.

(d) For the detail description about cam operation, refer to “8.4.3 Cam Operation (XCAM).

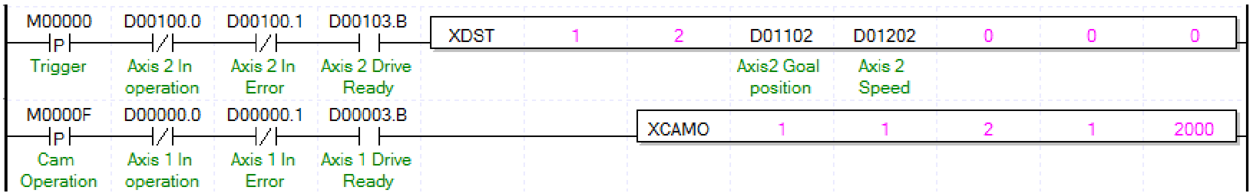
(e) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

(f) In order to use user CAM operation, you have to set CAM block number 8.

(g) For detail information on user CAM operation, refer to “8.4.4 user CAM operation”.

## 7.3.17 Main axis offset-designated CAM Operation (Command : XCAMO)

### (1) Program



### (2) Description

| Device | Description |
|---|---|
| M0000F | axis1 cam operation input |
| M00000 | axis2 direct start input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D00003.B | axis1 drive ready signal |
| D00100.0 | axis2 signal in operation |
| D00100.1 | axis2 error state |
| D00103.B | axis2 drive ready signal |

| Command | XCAMO | | | | Offset-designated Cam Operation |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | Main axis | PMLK,constant,D,Z,R,ZR | WORD | Main axis<br>(1 ~ 6 : axis1 ~ axis6,<br>9 ~ 12 : Encoder1 ~ Encoder4) |
| | OP4 | Cam Block | PMLK,constant,D,Z,R,ZR | WORD | Cam data block to apply to operation (1 ~ 9) |
| | OP5 | Main axis offset | PMLK,constant,D,Z,R,ZR | DINT | Main axis position to start CAM operation |

※ PMLK means P, M, L and K areas

(a) In the example program above, if cam operation command is executed, axis1 (sub axis) is indicated as “In operation” but the motor does not operate actually. When axis2 starts operating as a main axis and transfer amount becomes 2000, motor of axis1 starts operating toward sub axis location depending on data which set on cam block (OP4).

(b) Maximum number of cam data block is 7. (Set on positioning package)

(c) Cam data is set on positioning package but has to be downloaded at positioning module before cam operation.

(d) For the detail description about cam operation, refer to “8.4.3 Cam Operation (XCAM).

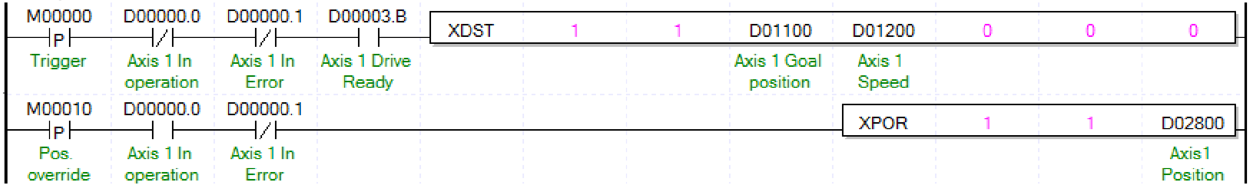
(e) D device signal (axis1 in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

(f) In order to use user CAM operation, you have to set CAM block number as 8.

(g) For detailed information on user CAM operation, refer to “8.4.4. user CAM operation”.

## 7.3.18 Position Override (Command : XPOR)

### (1) Program



### (2) Description

| Device | Description |
|---|---|
| M00010 | axis1 position override input |
| M0000 | axis1 direct start input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D00003.B | axis1 drive ready signal |
| D01100 | axis1 Goal position value |
| D02800 | Position override value |

| Command | XPOR | | | | Position override |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | Position value | PMLK,constant,D,Z,R,ZR | DINT | Goal position value to change<br>(Absolute coordinate) |

※ PMLK means P, M, L and K areas

(a) If position override is executed before reaching goal position, goal position shall be changed where set at D02800 for positioning operation. If executing position override after passing a position to execute position override, Once stops at the current position. and then moving back to position where set at D02800.

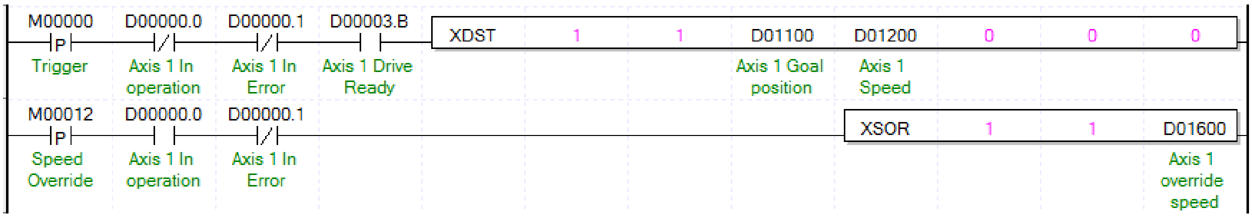
(b) Position override set on position override value is absolute coordinate position.

(c) For the detail description about position override, refer to “8.5.4 Position Override”.

(d) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

### 7.3.19 Speed Override (Command : XSOR)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M00012 | axis1 speed override input |
| M00011 | axis1 direct start input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D00003.B | axis1 drive ready signal |
| D01200 | Goal speed value |
| D01600 | Speed override value |

| Command | XSOR | | | | Speed override |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | Speed value | PMLK,constant,D,Z,R,ZR | DWORD | Goal speed value to change |

※ PMLK means P, M, L and K areas

(a) Speed override value (OP3) will be set as “% ” or “Speed value” depending on the value which set on “speed override” in common parameter.

(b) If unit of speed override value is %, the setting area is from 1 to 65,535, it means 0.01% ~ 655.35%.

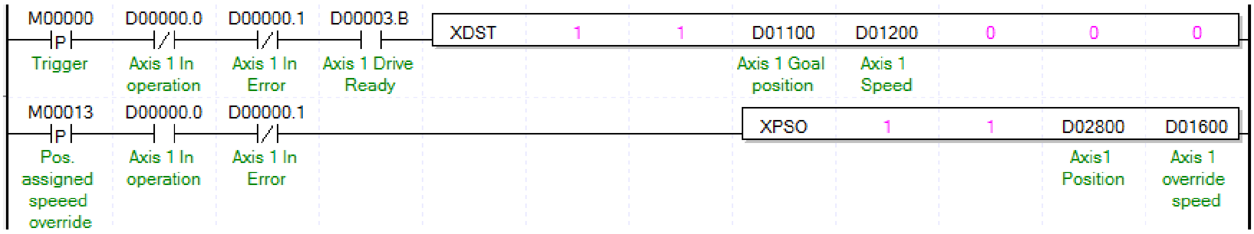
(c) If unit of speed override value is speed value, setting area is from 1 to speed limit value. The speed limit value is set on “Speed limit value” of basic parameter and unit of speed override value depends on unit of axis.

(d) For the detail description about speed override operation, refer to “8.5.5 Speed Override”.

(d) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

## 7.3.20 Position Assigned Speed Override (Command : XPSO)

### (1) Program



### (2) Description

| Device | Description |
|---|---|
| M00013 | axis1 position assigned speed override input |
| M0000 | axis1 direct start input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D00003.B | axis1 drive ready signal |
| D01200 | Goal speed value |
| D01600 | Speed override value |
| D02800 | Position value to execute speed change |

| Command | XPSO | | | | Position assigned speed override |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | Position value | PMLK,constant,D,Z,R,ZR | DINT | Position value to change the speed |
| | OP4 | Speed value | PMLK,constant,D,Z,R,ZR | DWORD | Goal speed value to change |

※ PMLK means P, M, L and K areas

(a) Speed override value (OP3) will be set as “% ” or “Speed value” depending on the value which set on “speed override” in common parameter.

(b) If unit of speed override value is %, the setting area is from 1 to 65,535, it means 0.01% ~ 655.35%.

(c) If unit of speed override value is speed value, setting area is from 1 to speed limit value. The speed limit value is set on “Speed limit value” of basic parameter and unit of speed override value depends on unit of axis.

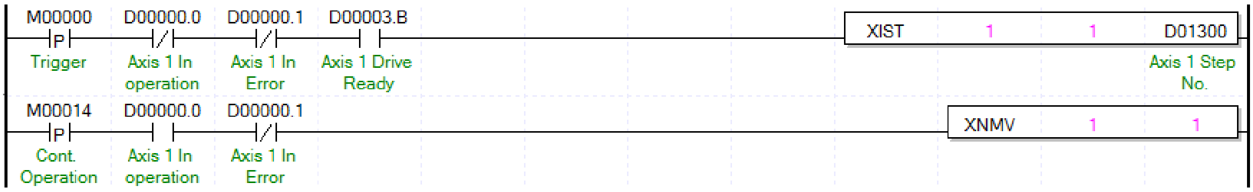
(d) In the example program above, axis1 position assigned speed override input(M00013) become “on” to execute position assigned speed override after axis1 direct start input (M0000) become “on”. When the position of axis1 is located at the position where set at D02800, the speed will be changed to the value set at D01600.

(e) For the detail description about position assigned speed override operation, refer to “8.5.6 Position Assigned Speed Override”.

(f) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

## 7.3.21 Continuous Operation (Command : XNMV)

### (1) Program



### (2) Description

| Device | Description |
|---|---|
| M00014 | axis1 continuous operation input |
| M0000 | axis1 indirect start input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D00003.B | axis1 drive ready signal |

| Command | XNMV | | | | Continuous operation |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |

※ PMLK means P, M, L and K areas

(a) If continuous operation command is executed, the step No. is changed from the step in current operation to the next step No. and continues positioning operation to the speed of the next step and goal position. Connection with the next step is executed by continuous operation pattern.

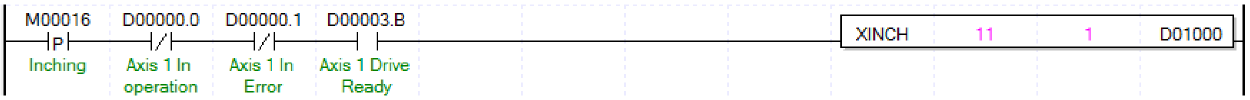
(b) Continuous operation command changes the only current operation pattern in operation, not the operation data.

(c) For the detail description about continuous operation, refer to “8.5.2 Continuous Operation”.

(d) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

### 7.3.22 Inching Operation (Command : XINCH)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M00016 | axis1 inching operation input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D00003.B | axis1 drive ready signal |
| D01000 | axis1 inching value |

| Command | XINCH | | | | Inching operation |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | Position value | PMLK,constant,D,Z,R,ZR | DINT | Position value to move for inching operation |

※ PMLK means P, M, L and K areas

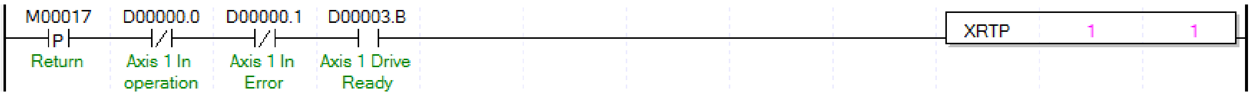
(a) It carries out the relative coordinate operation by inching operation speed set in manual operation parameter as much as position value (OP3).

(b) For the detail description about inching operation, refer to “8.3.2 Inching Operation”.

(c) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

### 7.3.23 Return to the Previous Manual Operation Position (Command : XRTP)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M00017 | axis1 return to the previous manual operation position start input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D00003.9 | axis1 drive ready signal |

| Command | XRTP | | | | Return to the previous manual operation position |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |

※ PMLK means P, M, L and K areas

(a) If the current position is changed as external axis speed sync. operation, inching operation, Jog operation after completing the positioning, it returns to the previous position of manual operation.

(b) Return to the previous position of manual operation command will be ignored if it is not in manual operation.

(c) The detail description about return to the previous position of manual operation, refer to “8.3.3 Return to the Previous Position of Manual Operation”

(d) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

### 7.3.24 Start Step No. Change (Command : XSNS)

(1) Program

(2) Description

| Device | Description |
|---|---|
| M00018 | axis1 start step No. change input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D01300 | axis1 start step no. to change |

| Command | XSNS | | | | Start step No. change |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | Step No. | PMLK,constant,D,Z,R,ZR | WORD | step No. to change with start step (1~400) |

※ PMLK means P, M, L and K areas

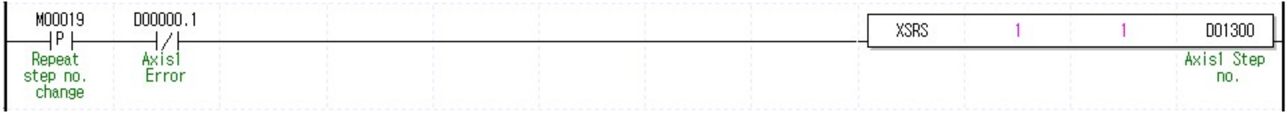
(a) Change the current step into the step value which set on step no.(OP3)

(b) It is not available to be executed in operation.

(c) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

### 7.3.25 Repeat Step No. Change (Command : XSRS)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M00019 | axis1 start step No. change input |
| D00000.1 | axis1 error state |
| D01300 | axis1 repeat step no. to change |

| Command | XSRS | | | | Repeat step No. change |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | Step No. | PMLK,constant,D,Z,R,ZR | WORD | step No. to change into repeat step (0~400) |

※ PMLK means P, M, L and K areas

(a) Change repeat step into the step value which set on step no.(OP3).

(b) Repeat step No. change is available for command execution even during positioning operation.

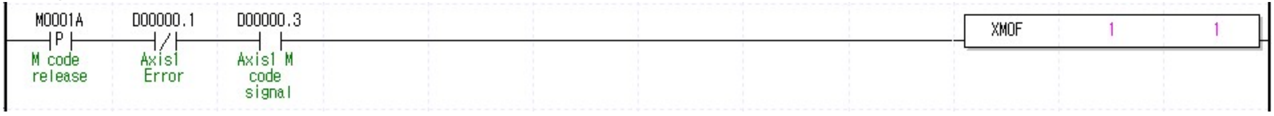
(c) Set the next step after finish operating designated repeat step.

(d) The detail description about “8.5.10 Repeat Operation Step no. Change”.

(e) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

## 7.3.26 M code Release (Command : XMOF)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M0001A | axis1 M code release input |
| D00000.1 | axis1 error state |
| D00000.3 | axis1 M code signal |

| Command | MOF | | | | M code release |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |

※ PMLK means P, M, L and K areas

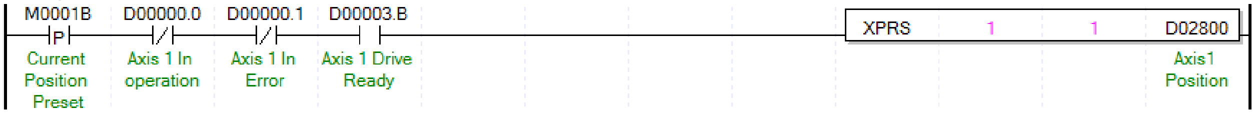
(a) When M code occurs, M code signal and M code No. are released at the same time (M code and M code No. are changed to OFF and 0, respectively).

(b) It is available to be executed in operation.

(c) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

### 7.3.27 Current Position Preset (Command : XPRS)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M0001B | axis1 current position preset input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D00003.B | axis1 drive ready signal |
| D02800 | axis1 preset position value |

| Command | XPRS | | | | Current position preset |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | Position value | PMLK,constant,D,Z,R,ZR | DINT | Current position value to change |

※ PMLK means P, M, L and K areas

(a) The command that change the current position value to the designated position (OP3).

(b) If current position preset command is executed in the origin unsettled state, positioning state signal (bit) is ON and the current position is changed by setting value (OP3).

(c) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

## 7.3.28 Encoder Preset (Command : XEPRS)

### (1) Program

M0001C

XEPRS 1 D02900 0

### (2) Description

| Device | Description |
|---|---|
| M0001C | Encoder preset input |
| D02900 | Encoder preset position value |

| Command | XEPRS | | | | Encoder preset |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | DINT | Current position value to change |
| | OP3 | Encoder | PMLK,constant,D,Z,R,ZR | WORD | 0 ~ 3: Encoder 1 ~ Encoder 4 |

※ PMLK means P, M, L and K areas

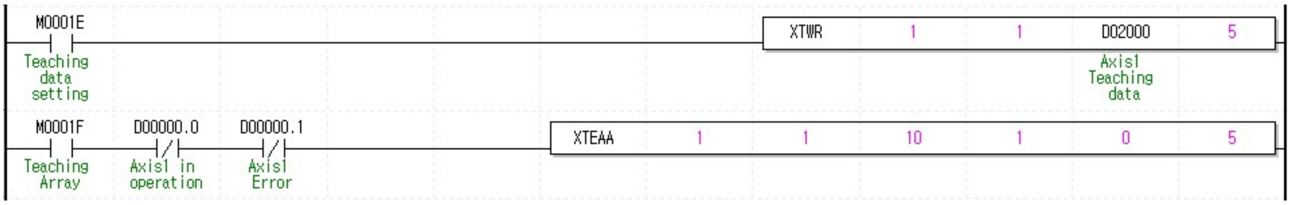
(a) This is the command that changes the current position to the designated position.

(b) Available range of OP2 is Encoder minimum value ~ Encoder maximum value – 1 of common parameter. If exceeds the range, error code 534 occurs.

(b) Encoder selection has to be set by 0.

### 7.3.29 Teaching Array (Command : XTEAA)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M0001E | axis1 teaching data setting input |
| M0001F | axis1 teaching array input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D02000 | axis1 teaching array data leading address |

| Command | XTEAA | | | | Teaching Array |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | Teaching step | PMLK,constant,D,Z,R,ZR | WORD | leading step No. for teaching (0~400) |
| | OP4 | Teaching method | PMLK,constant,D,Z,R,ZR | WORD | 0:RAM Teaching, 1:ROM Teaching |
| | OP5 | Teaching item | PMLK,constant,D,Z,R,ZR | WORD | 0:Position teaching 1:Speed teaching |
| | OP6 | Number of Teaching | PMLK,constant,D,Z,R,ZR | WORD | Number of step for Teaching (1~16) |

※ PMLK means P, M, L and K areas

(a) This is the command that change the goal position or goal speed (OP5) among the operation data to the number as many as from the designated step (OP3) to the number of teaching (OP6). In the case of operating RAM teaching according to the teaching method (OP3), the changed value is maintained during PLC is connected to power. In the case of operating ROM teaching, it is maintained without power connection of PLC.

(b) Teaching Array command is must be executed when all axes are not operating.

(c) The number of times for ROM teaching is limited to 1,000,000 because operation data is saved on FLASH Memory.

(d) Before executing teaching array, teaching data should be set in the teaching array setting area. For teaching array data setting, refer to TWR command.

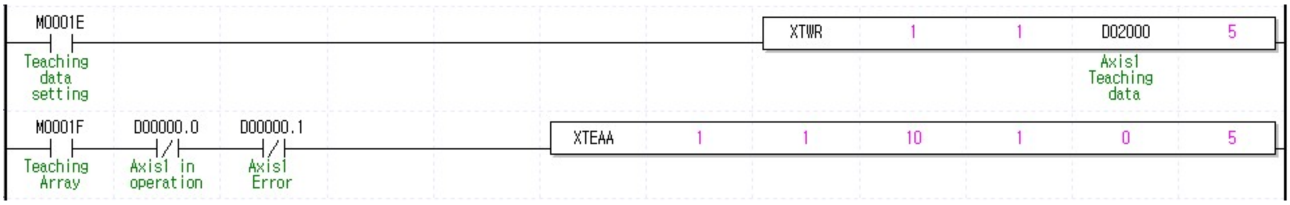
(e) In the example program above, execute ROM teaching for position data between no.10 step and no.14 step of axis1 operation data using 5 axis1 teaching data.

(f) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

(g) if operation data is teached by ROM teaching, all operation data of the axis is saved to Flash memory. but the all operation datas of other axes are not saved to flash memory.

### 7.3.30 Teaching Array Data Setting (Command: XTWR)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M0001E | axis1 teaching data setting input |
| M0001F | axis1 teaching array input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D02000 | axis1 teaching array data leading address |

| Command | XTWR | | | | Teaching Array Data Setting |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | Device | PMLK,D,Z,R,ZR | WORD | Leading device No. with teaching array data |
| | OP3 | Number of data | PMLK,constant,D,Z,R,ZR | WORD | Number of data to save |

※ PMLK means P, M, L and K areas

(a) Teaching data must be set in teaching array data setting area before teaching array is executed.

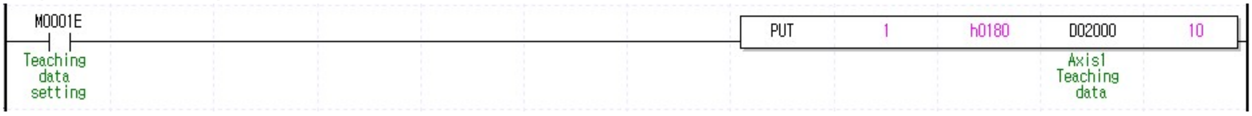
(b) Teaching array is not executed only by executing teaching array data setting command. Please refer to teaching array command (TEAA).

(c) In the example program above, execute ROM teaching for position data between no.10 step and no.14 step of axis1 operation data using 5 axis1 teaching data.

(d) According to the leading No. of device, the data are set in teaching array data area as follows

| No. | Device NO. | Teaching array data |
|---|---|---|
| 1 | Device + 0 | Teaching array data 1 |
| 2 | Device + 2 | Teaching array data 2 |
| 3 | Device + 4 | Teaching array data 3 |
| 4 | Device + 6 | Teaching array data 4 |
| 5 | Device + 8 | Teaching array data 5 |
| 6 | Device + 10 | Teaching array data 6 |
| 7 | Device + 12 | Teaching array data 7 |
| 8 | Device + 14 | Teaching array data 8 |
| 9 | Device + 16 | Teaching array data 9 |
| 10 | Device + 18 | Teaching array data 10 |
| 11 | Device + 20 | Teaching array data 11 |
| 12 | Device + 22 | Teaching array data 12 |
| 13 | Device + 24 | Teaching array data 13 |
| 14 | Device + 26 | Teaching array data 14 |
| 15 | Device + 28 | Teaching array data 15 |
| 16 | Device + 30 | Teaching array data 16 |

(e) Teaching array data can be set by using PUT command. For this, refer to memory address of "5.1.2 Teaching data" and "7.1.2 Internal Memory Writing". If use PUT command in the example program above, it displayed like the picture below.

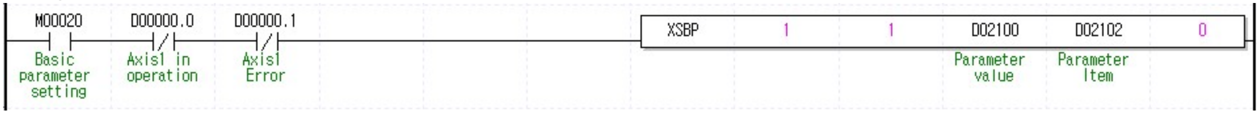


```
M0001E                                              PUT   1   h0180   D02000   10
Teaching                                                            Axis1
data                                                                Teaching
setting                                                             data
```

(f) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

### 7.3.31 Basic Parameter Teaching (Command : XSBP)

(1) Program



M00020 Basic parameter setting
D00000.0 Axis1 in operation
D00000.1 Axis1 Error

XSBP 1 1 D02100 D02102 0

D02100 Parameter value
D02102 Parameter Item

(2) Description

| Device | Description |
|---|---|
| M00020 | axis1 basic parameter setting input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D02100 | Parameter value |
| D02102 | Parameter items |

| Command | XSBP | | | | Basic parameter Teaching |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | Parameter value | PMLK,constant,D,Z,R,ZR | DWORD | Parameter value to change |
| | OP4 | Parameter item | PMLK,constant,D,Z,R,ZR | WORD | Parameter item to change (1~17) |
| | OP5 | Setting method | PMLK,constant,D,Z,R,ZR | WORD | 0: RAM setting, 1: ROM setting |

※ PMLK means P, M, L and K areas

(a) This is the command that changes the value of the item (OP4) which already set among basic parameter items to setting value (OP3). In the case of RAM setting by the setting method (OP5), the changed value is maintained during PLC module is being connected to power. In the case of ROM setting, it is maintained without the power connection of PLC module.

(b) The number of times for ROM teaching is limited to 1,000,000 because operation data is saved on FLASH Memory.

(c) Basic parameter setting command is unavailable to be executed when the axis is operating.

(d) Basic parameter items

| Setting Value | Items | Setting Range |
|---|---|---|
| 1 | Speed limit value | mm : 1 ～ 2,147,483,647 [X10$^{-2}$㎜/min]<br>Inch : 1 ～ 2,147,483,647 [X10$^{-3}$Inch/min]<br>degree : 1 ～ 2,147,483,647 [X10$^{-3}$ degree/min]<br>pulse : 1 ～ 200,000 [pulse/sec] |
| 2 | Acc. Time 1 | 1 ~ 2,147,483,647 [ms] |
| 3 | Acc. Time 2 | |
| 4 | Acc. Time 3 | |
| 5 | Acc. Time 4 | |
| 6 | Dec. Time 1 | 1 ~ 2,147,483,647 [ms] |
| 7 | Dec. Time 2 | |
| 8 | Dec. Time 3 | |
| 9 | Dec. Time 4 | |
| 10 | Sudden Stop Dec. Time | 1 ~ 2,147,483,647 [ms] |
| 11 | Dividing output pulse/rotation | 1 ~ 200,000,000 |
| 12 | Travel distance/rotation | |
| 13 | Unit | 0:Pulse, 1:mm, 2:Inch, 3:Degree |
| 14 | Unit allocation | 0: x 1, 1: x 10, 2: x 100, 3: x 1000 |
| 15 | Speed command unit | 0: Unit/Time, 1: rpm |
| 16 | Bias Speed | 1 ~ Speed limit value |
| 17 | Pulse output mode | 0: CW/CCW, 1: PLS/DIR, 2: PHASE |

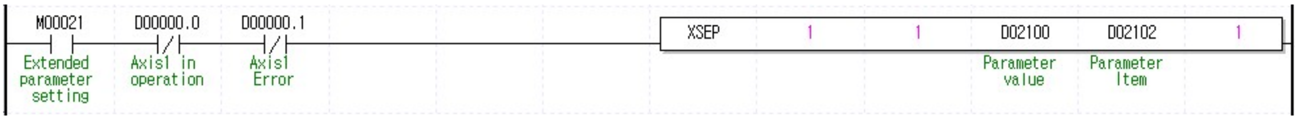
(e) For the change value (OP3) setting range of each basic parameter item (OP4) which already set, refer to “4.1.1 Basic Parameter Content”

(f) In the example program above, it changes the item that saved on D02102 of axis1 basic parameter to the value that saved on D02100 using RAM setting method. In the case of D02102=10, D02100=100, it sets sudden stop time as “100ms” using RAM setting method.

(g) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

### 7.3.32 Extended Parameter Setting (Command : XSEP)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M00021 | axis1 extended parameter setting input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D02100 | Parameter value |
| D02102 | Parameter items |

| Command | XSEP | | | | Extended parameter Teaching |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No<br>(Embedded positioning :Fixed to 1) |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6 ) |
| | OP3 | Parameter value | PMLK,constant,D,Z,R,ZR | DWORD | Parameter value to change |
| | OP4 | Parameter item | PMLK,constant,D,Z,R,ZR | WORD | Parameter item to change (1~17) |
| | OP5 | Setting method | PMLK,constant,D,Z,R,ZR | WORD | 0: RAM setting, 1: ROM setting |

※ PMLK means P, M, L and K areas

(a) This is the command that changes the value of the item (OP4) which already set among basic parameter items to setting value (OP3). In the case of RAM setting by the setting method (OP5), the changed value is maintained during APM module is being connected to power. In the case of ROM setting, it is maintained without the power connection of APM module.

(b) The number of times for ROM teaching is limited to 1,000,000 because operation data is saved on FLASH Memory..

(c) Extended parameter setting command is unavailable to be executed when the axis is operating.

(d) Extended parameter items

| Setting value | Items | Setting value |
|---|---|---|
| 1 | S/W high limit | ㎜:-2147483648 ~ 2147483647[X10$^{-4}$㎜]<br>Inch:-2147483648 ~ 2147483647[X10$^{-5}$Inch]<br>degree:-2147483648~2147483647[X10$^{-5}$degree]<br>pulse:-2147483648 ~ 2147483647[pulse] |
| 2 | S/W low limit | |
| 3 | Backlash compensation amount | mm: 0 ~ 65,535[X10$^{-4}$㎜]<br>inch: 0 ~ 65,535[X10$^{-5}$Inch]<br>degree: 0 ~ 65,535[X10$^{-5}$degree]<br>pulse: 0 ~ 65,535[pulse] |
| 4 | Positioning complete time | 0 ~ 65,535[ms] |
| 5 | S-Curve ratio | 1 ~ 100 |
| 6 | axis2 Linear interpolation continuous operation circular arc adding position | mm: 0 ~ 2147483647[X10$^{-4}$㎜]<br>Inch: 0 ~ 2147483647[X10$^{-5}$Inch]<br>degree: 0 ~ 2147483647[X10$^{-5}$degree]<br>pulse: 0 ~ 2147483647[pulse] |
| 7 | Acc./dec. pattern | 0: Trapezoid operation, 1: S-Curve operation |
| 8 | M code mode | 0: None, 1: With, 2: After |
| 9 | High&Low limit detection in speed control | 0: Not detect, 1: Detect |
| 10 | Interpolation continous operation positioning form | 0: Goal position passage, 1: The neighborhood passage |
| 11 | axis2 Linear interpolation continuous operation circular arc adding | 0: No circular arc addition,<br>1: Circular arc addition continuous operation. |
| 13 | External emergency stop/Acc.&Dec. stop selection | 0: Emergency stop, 1: Dec. stop |
| 14 | Positioning speed override coordinate | 0: Absolute coordinate, 1: Relative coordinate |
| 15 | Pulse output direction | 0: CW, 1: CCW |
| 16 | Infinite running repeat position | mm: 1 ~ 2147483647[X10-4㎜]<br>Inch: 1 ~ 2147483647[X10-5Inch]<br>degree: 1 ~ 2147483647[X10-5degree]<br>pulse: 1 ~ 2147483647[pulse] |
| 17 | Infinite running repeat | 0: disable, 1: enable |
| 18 | Speed/position switching coordinate | 0: Incremental, 1: Absolute |
| 19 | Interpolation speed selection | 0: main axis speed 1: synthetic speed |

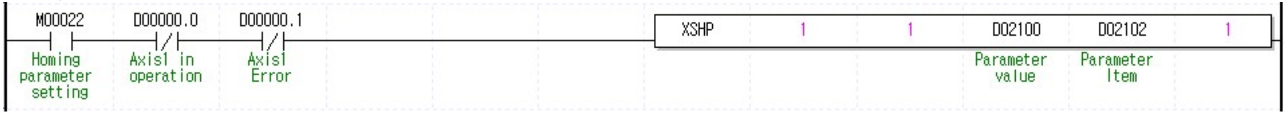
(e) For the change value (OP3) setting range of each extended parameter item (OP4) which already set, refer to “4.2.1 Extended Parameter Content”

(f) In the example program above, it changes the item that saved on D02102 of axis1 basic parameter to the value that saved on D02100 using RAM setting method. In the case of D02102=8, D02100=1, it sets sudden stop time as “With” using RAM setting method.

(g) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

### 7.3.33 Homing Parameter Teaching (Command : XSHP)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M00022 | axis1 homing parameter teaching input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D02100 | Parameter value |
| D02102 | Parameter items |

| Command | XSHP | | | | Homing parameter Teaching |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis(1 ~ 4 : axis1 ~ axis4) |
| | OP3 | Parameter value | PMLK,constant,D,Z,R,ZR | DWORD | Parameter value to change |
| | OP4 | Parameter item | PMLK,constant,D,Z,R,ZR | WORD | Parameter item to change (1~10) |
| | OP5 | Setting method | PMLK,constant,D,Z,R,ZR | WORD | 0: RAM setting, 1: ROM setting |

※ PMLK means P, M, L and K areas

(a) This is the command that changes the value of the item (OP4) which already set among homing parameter items to setting value (OP3). In the case of RAM setting by the setting method (OP5), the changed value is maintained during PLC is being connected to power. In the case of ROM setting, it is maintained without the power connection of PLC.

(b) The number of times for ROM teaching is limited to 1,000,000 because operation data is saved on FLASH Memory..

(c) Homing parameter setting command is unavailable to be executed when the axis is operating.

(d) Homing parameter item is as follows.

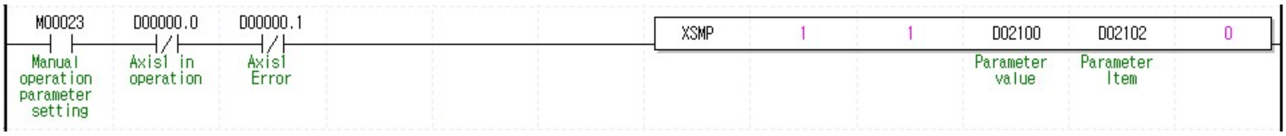
| Setting Value | Items | Setting value |
|---|---|---|
| 1 | Origin address | ㎜ : -2147483648 ~ 2147483647 [X10$^{-4}$㎜]<br>Inch : -2147483648 ~ 2147483647 [X10$^{-5}$Inch]<br>degree : -2147483648 ~ 2147483647 [X10$^{5}$degree]<br>pulse : -2147483648 ~ 2147483647 [pulse] |
| 2 | Homing high speed | ㎜ : 1 ~ 2,147,483,647 [X10$^{-2}$㎜/min]<br>Inch : 1 ~ 2,147,483,647 [X10$^{-3}$Inch/min]<br>degree : 1 ~ 2,147,483,647 [X10$^{-3}$ degree/min]<br>pulse : 1 ~ 2,147,483,647 [pulse/sec] |
| 3 | Homing low speed | |
| 4 | Homing acc. time | 0 ~ 2,147,483,647 [ms] |
| 5 | Homing dec. time | |
| 6 | Homing dwell time | 0 ~ 65,535[ms] |
| 7 | Origin compensation amount | ㎜ : -2147483648 ~ 2147483647 [X10$^{-3}$㎜]<br>Inch : -2147483648 ~ 2147483647 [X10$^{-5}$Inch]<br>degree : -2147483648 ~ 2147483647 [X10$^{-5}$degree]<br>pulse : -2147483648 ~ 2147483647 [pulse] |
| 8 | Homing restart time | 0 ~ 65,535[ms] |
| 9 | Homing mode | 0:Approximate origin/Origin (Off),<br>1: Approximate origin /Origin (On), 2:High/Low limit/Origin,3: Approximate origin, 4:High speed origin, 5:High/Low Origin, 6:Origin |
| 10 | Homing direction | 0:Forward, 1:Backward |

(e) For the change value (OP3) setting range of each homing parameter item (OP4) which already set, refer to “4.5.1 Homing Parameter”

(f) In the example program above, it changes the item that saved on D02102 of axis1 homing parameter to the value that saved on D02100 using RAM setting method. In the case of D02102=6, D02100=100, it sets homing dwell time as “1000ms” using RAM setting method.

### 7.3.34 Manual Operation Parameter Teaching (Command :XSMP)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M00023 | axis1 manual operation parameter setting input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D02100 | Parameter value |
| D02102 | Parameter items |

| Command | XSMP | | | | Manual operation parameter setting |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis(1 ~ 4 : axis1 ~ axis4) |
| | OP3 | Parameter value | PMLK,constant,D,Z,R,ZR | DWORD | Parameter value to change |
| | OP4 | Parameter item | PMLK,constant,D,Z,R,ZR | WORD | Parameter item to change (1~5) |
| | OP5 | Setting method | PMLK,constant,D,Z,R,ZR | WORD | 0: RAM setting, 1: ROM setting |

※ PMLK means P, M, L and K areas

(a) This is the command that changes the value of the item (OP4) which already set among manual operation parameter items to setting value (OP3). In the case of RAM setting by the setting method (OP5), the changed value is maintained during APM module is being connected to power. In the case of ROM setting, it is maintained without the power connection of APM module.

(b) The number of times for ROM teaching is limited to 1,000,000 because operation data is saved on FLASH Memory.

(c) Manual operation parameter setting command is unavailable to be executed when the axis is operating.

(d) Manual operation parameter items are as follows.

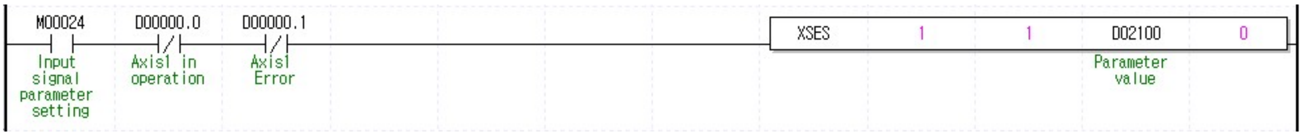
| Setting value | Items | Setting value |
|---|---|---|
| 1 | Jog high speed | ㎜ : 1 ~ 2,147,483,647 [X10$^{-2}$㎜/min]<br>Inch : 1 ~ 2,147,483,647 [X10$^{-3}$Inch/min]<br>degree : 1 ~ 2,147,483,647 [X10$^{-3}$ degree/min]<br>pulse : 1 ~ 200,000 [pulse/sec] |
| 2 | Jog low speed | |
| 3 | Jog acc. time | 0 ~ 2,147,483,647 [ms] |
| 4 | Jog dec. time | |
| 5 | Inching speed | ㎜ : 1 ~ 65,535[X10$^{-2}$㎜/min]<br>Inch : 1 ~ 65,535[X10$^{-3}$Inch/min]<br>degree : 1 ~ 65,535[X10$^{-3}$ degree/sec]<br>pulse : 1 ~ 65,535[pulse/sec] |

(e) For the change value (OP3) setting range of each manual operation parameter item (OP4) which already set, refer to "4.4.1 Manual Operation Parameter Content"

(f) In the example program above, it changes the item that saved on D02102 of axis1 manual operation parameter to the value that saved on D02100 using RAM setting method. In the case of D02102=3, D02100=500, it sets jog acc. time as "500ms" using RAM setting method.

## 7.3.35 I/O Signal Parameter Teaching (Command : XSES)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M00024 | axis1 input signal parameter teaching input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D02100 | Parameter value |
| D02102 | Parameter items |

| Command | XSES | | | | Input signal parameter Teaching |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis(1 ~ 4 : axis1 ~ axis4) |
| | OP3 | Parameter value | PMLK,constant,D,Z,R,ZR | DWORD | Parameter value to change |
| | OP4 | Setting method | PMLK,constant,D,Z,R,ZR | WORD | 0: RAM setting, 1: ROM setting |

※ PMLK means P, M, L and K areas

(a) This is the command that changes the value of the item (OP4) which already set among Input/output signal parameter items to setting value (OP3). In the case of RAM setting by the setting method (OP5), the changed value is maintained during APM module is being connected to power. In the case of ROM setting, it is maintained without the power connection of APM module.

(b) The number of times for ROM teaching is limited to 1,000,000 because operation data is saved on FLASH Memory.

(c) Input/output signal operation parameter setting command is unavailable to be executed when the axis is operating.

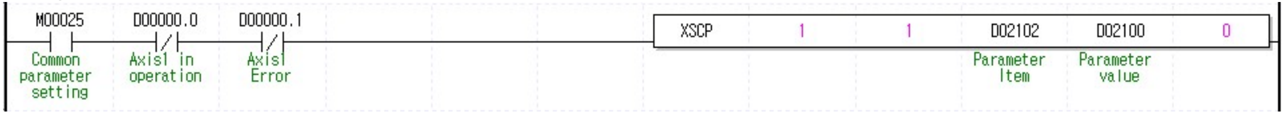
(d) The input signal applied with each bit of the value to be set in parameter item is as follows. If each bit are set, it operates as “B contact point”. If they are clear, it operates as “A contact point”

| Bit | Signal |
|---|---|
| 0 | Upper limit signal |
| 1 | Lower limit signal |
| 2 | Dog Signal |
| 3 | Home signal |
| 4 | Emergency stop/Deceleration stop signal |
| 5 | Drive ready signal |
| 6 | Servo On output signal |
| 7 | Servo reset output signal |
| 8 ~ 15 | Not use |

(e) In the example program above, it changes axis1 input signal to the value set on D02100 using RAM setting method. If D02100 value is h43, upper and lower limit signal, drive ready signal will be changed to “B contact point”, the rest will be changed to “A contact point”.

### 7.3.36 Common Parameter Setting (Command : XSCP)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M00025 | Common parameter setting input |
| D02100 | Parameter value |
| D02102 | Parameter items |

| Command | XSCP | | | | Common parameter Setting |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 6 : axis1 ~ axis6) |
| | OP3 | Parameter value | PMLK,constant,D,Z,R,ZR | DINT | parameter value to change |
| | OP4 | Parameter item | PMLK,constant,D,Z,R,ZR | WORD | Parameter item to change (1~3) |
| | OP5 | Setting Method | PMLK,constant,D,Z,R,ZR | WORD | 0: RAM setting, 1: ROM setting |

※ PMLK means P, M, L and K areas

(a) This is the command that changes the value of the item (OP4) which already set among common parameter items to setting value (OP3). In the case of RAM setting by the setting method (OP5), the changed value is maintained during PLC is being connected to power. In the case of ROM setting, it is maintained without the power connection of PLC.

(b) Common parameters of positioning module are saved in ROM, and there is no limit to the number of times to perform ROM setting.

(c) The value to be set in parameter item is as follows.

| Setting value | Items | Setting value |
|---|---|---|
| 1 | Pulse output level | 0 : Low Active, 1 : High Active |
| 2 | Speed override method | 0: % setting 1: Speed setting |
| 3 | Control period | 1~10(ms), keep previous value when setting other values |

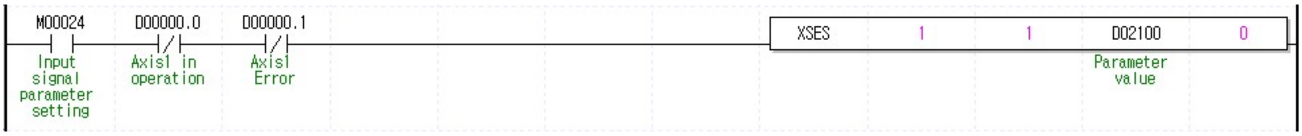
(d) For the change value (OP3) setting range of each common parameter item (OP4) which already set, refer to “4.7.1 Common Parameter Content”

(e) In the example program above, it changes the item that saved on D02102 of common parameter to the value that saved on D02100 using RAM setting method. In the case of D02102=1, D02100=1, it sets speed override method time as “1: speed setting” using RAM setting method

(f) Common parameter setting command is unavailable to be executed when the axis is operating.

### 7.3.37 Operation Data Teaching (Command: XSMD)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M00026 | axis1 Operation data setting input |
| D00000.0 | axis1 signal in operation |
| D00000.1 | axis1 error state |
| D02110 | Operation data value |
| D02112 | Operation data items |

| Command | XSMD | | | | Operation data setting |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis(1 ~ 4 : axis1 ~ axis4) |
| | OP3 | Operation data value | PMLK,constant,D,Z,R,ZR | DINT | Operation data value to change |
| | OP4 | Operation data item | PMLK,constant,D,Z,R,ZR | WORD | Operation data item (1~17) |
| | OP5 | Step No. | PMLK,constant,D,Z,R,ZR | WORD | Operation data step No. to change (0~400) |
| | OP6 | Step method | PMLK,constant,D,Z,R,ZR | WORD | 0: RAM setting, 1: ROM setting |

※ PMLK means P, M, L and K areas

(a) This is the command that changes the item (OP4) of a step which already set on OP5 among operation data items to setting value (OP3). In the case of RAM setting by the setting method (OP6), the changed value is maintained during APM module is being connected to power. In the case of ROM setting, it is maintained without the power connection of APM module.

(b) The number of times for ROM teaching is limited to 1,000,000 because operation data is saved on FLASH Memory.

(c) Operation data teaching command is available to be executed when the axis is operating. But teaching data of operating step do not apply instantly. Operating step data will apply end of present step operation

(d) if operation data is teached by ROM teaching, all operation data of the axis is saved to Flash memory. but the all operation datas of other axes are not saved to flash memory.

(e) The values to be set in operation data item are as follows

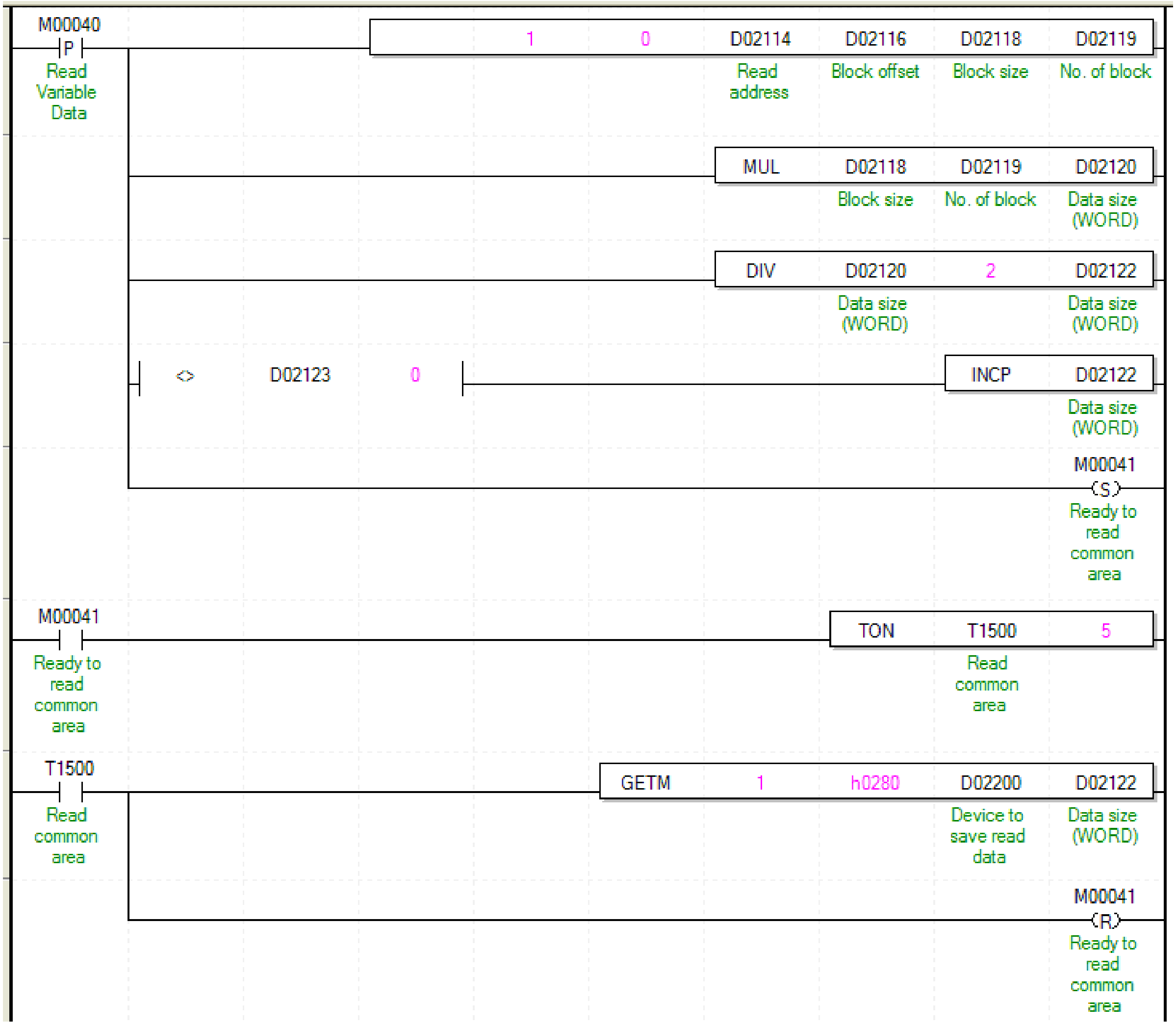
<table>
<tr><th>Setting value</th><th>Items</th><th>Setting value</th></tr>
<tr><td>1</td><td>Goal position</td><td>㎜ : -2147483648 ～ 2147483647 [$X10^{-4}$㎜]<br>Inch : -2147483648 ～ 2147483647 [$X10^{-5}$Inch]<br>degree : -2147483648 ～ 2147483647 [$X10^{-5}$degree]<br>pulse : -2147483648 ～ 2147483647 [pulse]</td></tr>
<tr><td>2</td><td>Circular interpolation subordinate position</td><td>-</td></tr>
<tr><td>3</td><td>Operation speed</td><td>㎜ : 1 ～ 2,147,483,647 [$X10^{-2}$㎜/min]<br>Inch : 1 ～ 2,147,483,647 [$X10^{-3}$Inch/min]<br>degree : 1 ～ 2,147,483,647 [$X10^{-3}$ degree/min]<br>pulse : 1 ～ 200,000 [pulse/sec]</td></tr>
<tr><td>4</td><td>Dwell time</td><td>0 ~ 65,535[ms]</td></tr>
<tr><td>5</td><td>M code No.</td><td>0 ~ 65,535</td></tr>
<tr><td>6</td><td>Sub coordinate setting</td><td>Bit unit setting<table><tr><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr><tr><td>axis4</td><td>axis3</td><td>axis2</td><td>axis1</td></tr></table></td></tr>
<tr><td>7</td><td>Helical interpolation axis</td><td>0, axis1 ~ axis4 (0: General circular arc interpolation)</td></tr>
<tr><td>8</td><td>Number of circular arc interpolation turn</td><td>0~65,535</td></tr>
<tr><td>9</td><td>Coordinate</td><td>0:absolute, 1:relative</td></tr>
<tr><td>10</td><td>Control method</td><td>0:Unit position control, 1:, Shortening speed control<br>2:Shortening Feed control, 3:Linear interpolation,<br>4:Circular arc interpolation</td></tr>
<tr><td>11</td><td>Operation method</td><td>0:Single, 1:Repeat</td></tr>
<tr><td>12</td><td>Operation Pattern</td><td>0:End, 1:Continuous, 2:Go on</td></tr>
<tr><td>13</td><td>Circular arc size</td><td>0:Circular arc<180 1:Circular arc>=180</td></tr>
<tr><td>14</td><td>Acc. No.</td><td>0 ~ 3</td></tr>
<tr><td>15</td><td>Dec. No.</td><td>0 ~ 3</td></tr>
<tr><td>16</td><td>Circular arc interpolation method</td><td>0:Middle point, 1:Center point, 2:Radius</td></tr>
<tr><td>17</td><td>Circular arc interpolation direction</td><td>0:CW, 1:CCW</td></tr>
</table>

(f) For the change value (OP3) setting range of each position data item (OP4) which already set, refer to “4.7.1 Operation Data Content”

(g) In the example program above, it changes the item that saved on D02112 of axis1 operation to the value that saved on D02100 using RAM setting method. In the case of D02112=5, D02100=125, it changes M code no. of step no.4 to “125” using RAM setting method.

### 7.3.38 Read Variable Data (Command: XVRD)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M00040 | Input to read variable data |
| M00041 | Ready flag to read common area (ready flag to save in internal device by GETM after executing command reading variable data) |
| D02114 | Head address to read internal memory data of module |
| D02116 | Block offset |
| D02118 | Block size |
| D02119 | Number of block |
| D02120 | Size of data to read (WORD) |
| D02122 | Size of data to read (DWORD) |
| D02123 | Remaining (after changing WORD to DWORD) |
| D02200 | Head device to save data |

| Command | XVRD | | | | Read variable data |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Base and slot number where positioning module is equipped |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Axis to command<br>(1 ~ 4: 1 axis ~ 4 axis) |
| | OP3 | Read address | PMLK,constant,D,Z,R,ZR | DWORD | Head address of data in module internal memory to read (0 ~49586) |
| | OP4 | Block offset | PMLK,constant,D,Z,R,ZR | DWORD | Offset between blocks (0 ~49586) |
| | OP5 | Block size | PMLK,constant,D,Z,R,ZR | WORD | Size of one block (1 ~ 128) |
| | OP6 | No. of block | PMLK,constant,D,Z,R,ZR | WORD | No. of block to read (1 ~ 128) |

※ PMLK means P, M, L and K areas

(a) This is command that reads data among parameter, operating data, CAM data by WORD unit from “Read address” into CPU. The number of data is set in “Block size”. In case “No. of block” set in OP6 is more than 2, it reads multiple blocks. At this time, head address of next block is “Block offset” apart from head address of current block.

(b) Max data size (Block size X No. of block) can be read with one command is 128 WORD.

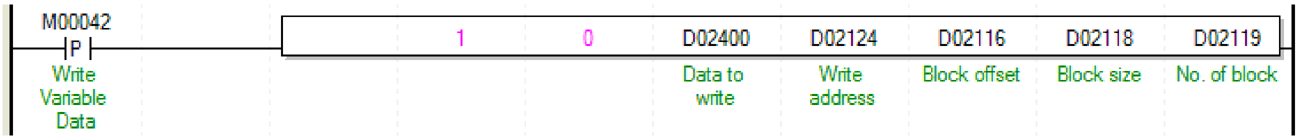
(c) “Read variable data” can be executed in operation.

(d) If you execute “Read variable data”, the data read from positioning module will be saved in common area. In order to save in device for using in program, use GETM command [Read address: h280, data size: read data size (DWORD) as program example after executing “Read variable data” command

(e) In the above program, it reads data starting “Read address” set in D02114 by WORD unit into CPU. The number of data is “D02118”. In case “No. of block set in D02119 is more than 2, it reads multiple blocks starting “Read address” D02114 in order. In the above program, saves the read data in D02200 5ms after executing “Read variable data: command. You have to execute GETM command minimum 5ms after executing “Read variable data” to save the read data in common area.

### 7.3.39 Write Variable Data (Command: XVWR)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M00042 | Input to write variable data |
| D2400 | Head address where data for writing is saved |
| D2124 | Write address |
| D2116 | Block offset |
| D2118 | Block size |
| D2119 | No. of block |

| Command | XVWR | | | | Write variable data |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot number |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Axis to command<br>(1 ~ 4: 1 axis ~ 4 axis) |
| | OP3 | Data device | PMLK,constant,D,Z,R,ZR | WORD | Head address where data to write is saved. |
| | OP4 | Write address | PMLK,constant,D,Z,R,ZR | DWORD | Head address to write module internal memory data (0 ~49586) |
| | OP5 | Block offset | PMLK,constant,D,Z,R,ZR | DWORD | Offset between blocks (0 ~ 49586) |
| | OP6 | Block size | PMLK,constant,D,Z,R,ZR | WORD | Size of one block (1 ~ 128) |
| | OP7 | No. of block | PMLK,constant,D,Z,R,ZR | WORD | No. of block to read (1 ~ 128) |

※ PMLK means P, M, L and K areas

(a) This is command that writes data starting “Write address” set in OP4 among parameter of positioning module internal memory, operation data, CAM data to internal memory address starting OP3. The number of data to write is “Block size” OP7. In case “No. of block” is more than 2, writes multiple blocks. At this time, head address of next block is “Block offset” OP5 apart from head address of current block.

(b) Max data size (Block seze X No. of block) that can be written with one command is 128 WORD.

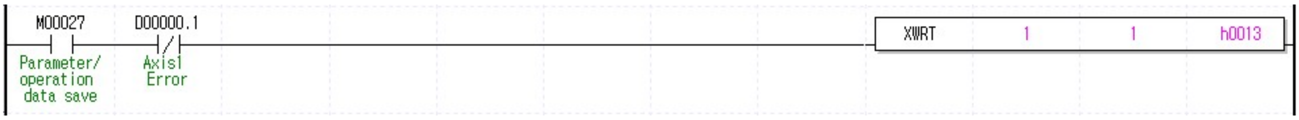
(c) “Write variable data” command can’t be executed in operation.

(d) In case you execute “Write variable data”, the changed value is kept during power on. So, to save the data, execute “Save Parameter/Operation data (XWRT) command.

(e) In the above program example, writes data starting from D02400 to internal memory address starting form “D2124” in order by WORD unit. The number of data is “Block size”. In case “No. of Block” set in D02119 is larger than 2, writes multiple blocks. At this time, head address of next block is “Block offset” OP5 apart from head address of current block.

## 7.3.40 Parameter/Operation Data Save (Command : XWRT)

### (1) Program



### (2) Description

| Device | Description |
|---|---|
| M00027 | axis1 parameter/operation data save input |
| D00000.1 | axis1 error state |

| Command | XWRT | | | | Parameter/operation Data save |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No. |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis<br>(1 ~ 4 : axis1 ~ axis4) |
| | OP3 | Selection axis | PMLK,constant,D,Z,R,ZR | WORD | Axis to save data |

※ PMLK means P, M, L and K areas

(a) This is the command that saves the parameter data & operation data of selected axis on FRAM.

(b) The current parameter & operation data of selected axis will be saved on Flash memoty it is also maintained when the power is off.

(c) The number of times for parameter/operation data save is limited to 1,000,000 because operation data is saved on FLASH Memory.

(d) Parameter/operation data save command is unavailable to be executed when the axis is operating. Execute it when all axes are not in operation.

(e) Set the selection axis by setting each bit of axis.

| 15 ~ 4 Bit | 3Bit | 2Bit | 1Bit | 0Bit |
|---|---|---|---|---|
| Not use | axis4 | axis3 | axis2 | axis1 |

That is, if set h0003, axis2, axis1 will be set to execute parameter/operation data save.

(f) In the example program above, save parameter/operation data of 1, axis2 on Flash memory.

(g) If CAM data changed by XVWR command, These data is saved to flash memory when XWRT command is executed

## 7.3.41 Emergency Stop (Command : XEMG)

### (1) Program

### (2) Description

| Device | Description |
|---|---|
| M00028 | axis1 internal emergency stop input |

| Command | XEMG | | | | Emergency stop |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No. |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 4 : axis1 ~ axis4) |

※ PMLK means P, M, L and K areas

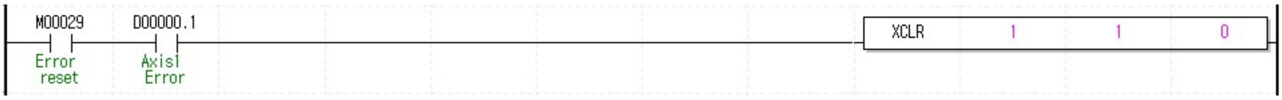
(a) Execute internal emergency stop command to command axis.

(b) dec. time in emergency stop become the time which set on “Emergency stop dec. time” item of each basic parameter.

(c) The example program above is the command stop axis1 emergently.

### 7.3.42 Error Reset (Command : XCLR)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M00029 | axis1 error reset input |
| D00000.1 | axis1 error state |

| Command | XCLR | | | | Error reset |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No. |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 4 : axis1 ~ axis4) |
| | OP3 | Common error | PMLK,constant,D,Z,R,ZR | WORD | Common error reset<br>(Ignored inembedded positioning) |

※ PMLK means P, M, L and K areas

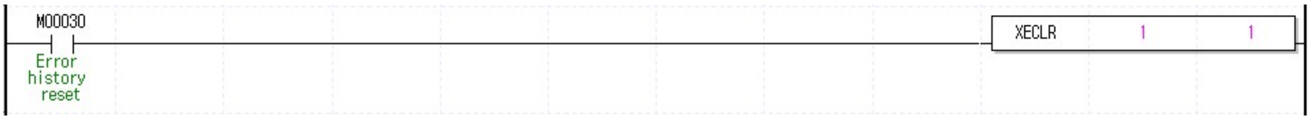
(a) This is the command that reset the error occurred on command axis.

(b) Common error item does not affect operation even if it is set by any value.

(c) The example program above is that reset the error occurred on axis1

### 7.3.43 Error History Reset (Command : XECLR)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M00030 | axis1 error history reset input |

| Command | XECLR | | | | Error history reset |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No. |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 4 : axis1 ~ axis4) |

※ PMLK means P, M, L and K areas

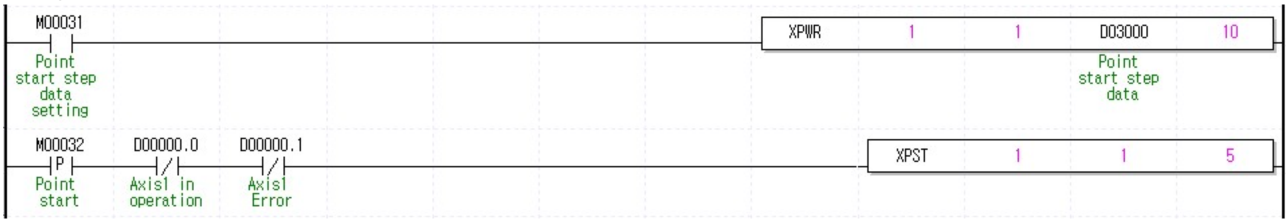
(a) This is the command that reset the error history about command axis.

(b) Embedded positionig module in each axis saves 10 (Maximum) error histories.

(c) The example program above is that reset error history of axis1.

### 7.3.44 Point Start (Command : XPST)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M00031 | axis1 point start step data setting input |
| M00032 | axis1 point start input |
| D00000.0 | axis1 operating state |
| D00000.1 | axis1 error state |
| D03000 | Point start step data setting leading device |

| Command | XPST | | | | Point operation |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 4 : axis1 ~ axis4) |
| | OP3 | Point operation No. | PMLK,constant,D,Z,R,ZR | WORD | Point operation step No. (1~20) |

※ PMLK means P, M, L and K areas

(a) This is the command that execute point start of command axis.

(b) It is unavailable to be executed when the axis is operating.

(c) It is able to set maximum 20 point start step.

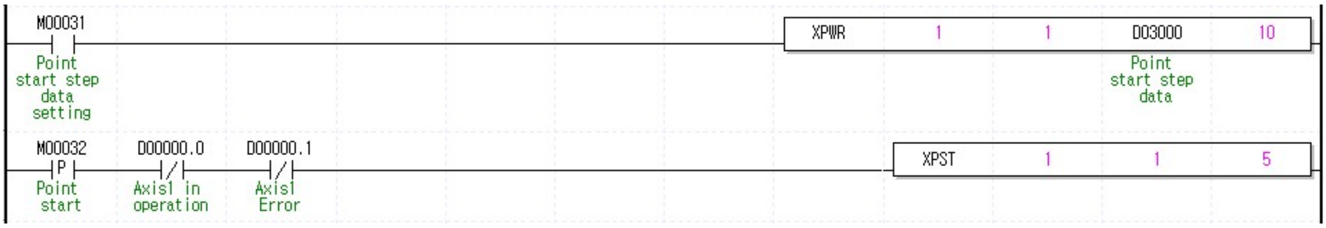
(d) Step data must be set in point start data area before execute point start. For the point start step data setting, refer to the next page about XPWR command.

(d) For the detail description about operation of point start, refer to “8.2.17 Positioning start (4) Point start”.

(f) The example program sets 10 point steps from D03000 on axis1 and executes point start to 5 point step which already set.

### 7.3.45 POINT Start Step Data Setting (Command: XPWR)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M00031 | axis1 Point Start Step Data Setting Input |
| M00032 | axis1 Point Start Input |
| D00000.0 | axis1 Operating State |
| D00000.1 | axis1 Error State |
| D03000 | Point Start Step Data Setting Leading Device No. |

| Command | XPWR | | | | POINT Start Step Data Setting |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No. |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Command axis (1 ~ 4 : axis1 ~ axis4) |
| | OP3 | Device | PMLK,D,Z,R,ZR | WORD | Leading No. of device with POINT Start Step Data |
| | OP4 | Data No. | PMLK,constant,D,Z,R,ZR | WORD | Data No. to save (1 ~ 20) |

※ PMLK means P, M, L and K areas.

(a) This is the command that sets step which set on device of point step area of command axis.

(b) Point start won't be executed by only point start step data setting command. Refer to the previous page about PST command.

(c) It is able to set maximum 20 point start step.

(d) Point start step data will be set like item below depending on the leading no. of device.

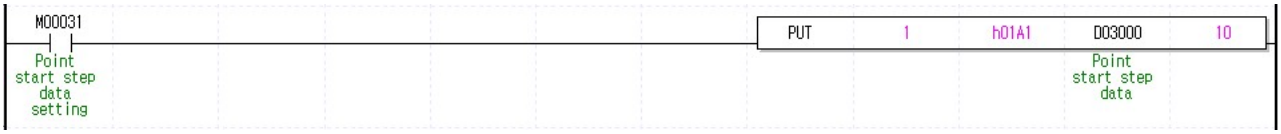
| No. | Device No. | POINT start step data |
|---|---|---|
| 1 | Device + 0 | POINT start step data 1 |
| 2 | Device + 1 | POINT start step data 2 |
| 3 | Device + 2 | POINT start step data 3 |
| 4 | Device + 3 | POINT start step data 4 |
| 5 | Device + 4 | POINT start step data 5 |
| 6 | Device + 5 | POINT start step data 6 |
| 7 | Device + 6 | POINT start step data 7 |
| 8 | Device + 7 | POINT start step data 8 |
| 9 | Device + 8 | POINT start step data 9 |
| 10 | Device + 9 | POINT start step data 10 |
| 11 | Device + 10 | POINT start step data 11 |
| 12 | Device + 11 | POINT start step data 12 |
| 13 | Device + 12 | POINT start step data 13 |
| 14 | Device + 13 | POINT start step data 14 |
| 15 | Device + 14 | POINT start step data 15 |
| 16 | Device + 15 | POINT start step data 16 |
| 17 | Device + 16 | POINT start step data 17 |
| 18 | Device + 17 | POINT start step data 18 |
| 19 | Device + 18 | POINT start step data 19 |
| 20 | Device + 19 | POINT start step data 20 |

(e) Step data must be set in point start data area before execute point start.

(f) For detail description of point start operation, refer to “8.2.17 Positioning Start (4) Point Start”.

(g) The example program above sets 10 point steps from D03000 on axis1 and executes point start to 5 point steps which already set.

(h) It is possible to set point operation step with PUT command. At that time, refer to memory address of “5.1.1 Point Operation Step Data” and “7.1.2 Internal Memory Writing”. If apply PUT to the example program above, refer to follows.



M00031

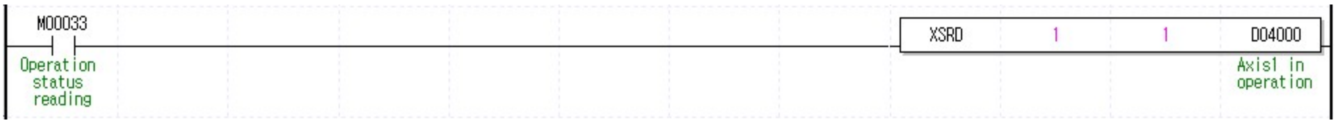
Point start step data setting

PUT 1 h01A1 D03000 10

Point start step data

### 7.3.46 Operation State Reading (Command: XSRD)

(1) Program



(2) Description

| Device | Description |
|---|---|
| F00099 | Always ON Flag |
| D04000 | Head address to save the operation status of axis 1 |

| Command | XSRD | | | | Operation state reading |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No. |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Axis to read the current state |
| | OP3 | Device | PMLK,D,Z,R,ZR | WORD | Leading No. of device to read and save the current state value |

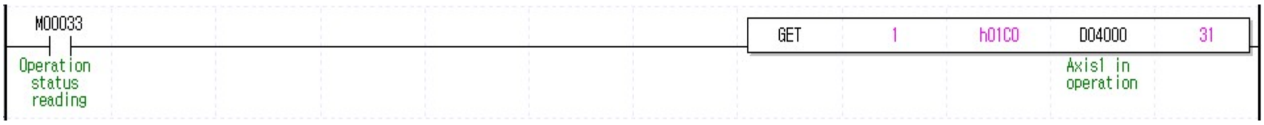
※ PMLK means P, M, L and K areas.

(a) This is the command that checks the operation state of command axis and save it on designated device.

(b) The current state will be saved like items below depending on leading no. of device.

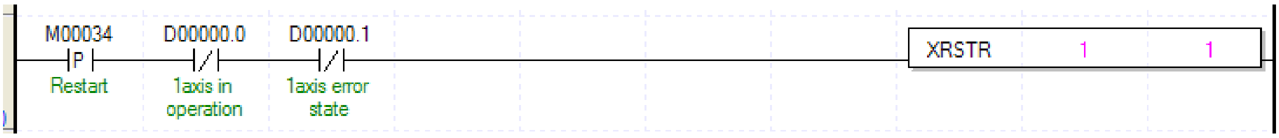
| Device No. | Size | State |
|---|---|---|
| Device | WORD | Operation State Information (Lower) |
| Device + 1 | WORD | Operation State Information (Upper) |
| Device + 2 | WORD | Axis Information |
| Device + 3 | WORD | External Input/Output Signal State |
| Device + 4 | DINT | Current Position |
| Device + 6 | DWORD | Current Speed |
| Device + 8 | WORD | Step No. |
| Device + 9 | WORD | M Code No. |
| Device + 10 | WORD | Error state |
| Device + 11 ~ Device + 20 | WORD | Error History 1 ~ 10 |
| Device + 21 | DINT | Encoder Value |

(c) It is able to read the current state of axis with GET command. At this time, refer to memory address of “5.1.4 State Information” and “7.1.1 Internal Memory Reading”. If use GET command in the example above, it is as follows. In addition, it is able to read the states that you need with GET command.



### 7.3.47 Restart (Command: XRSTR)

(1) Program



(2) Description

| Device | Description |
|---|---|
| M0034 | 1axis restart command input |

| Command | XRSTR | | | | Restart |
|---|---|---|---|---|---|
| Operand | OP1 | Slot | Constant | WORD | Slot No. |
| | OP2 | Axis | PMLK,constant,D,Z,R,ZR | WORD | Axis to read the current state |

※ PMLK means P, M, L and K areas.

(a) This is the command that makes the servo restart with position data set up at previous operation after it stops with DEC. stop

(b) You can’t execute this command while axis is in operation.

(c) If you start the axis with commands other than “Restart” after it stops with DEC. stop, “Restart” will not be executed

(d) In example above, it gives the command to 1-axis

# Chapter 8 Program

Here describes the basic program that operate positioning module case by using its commands.

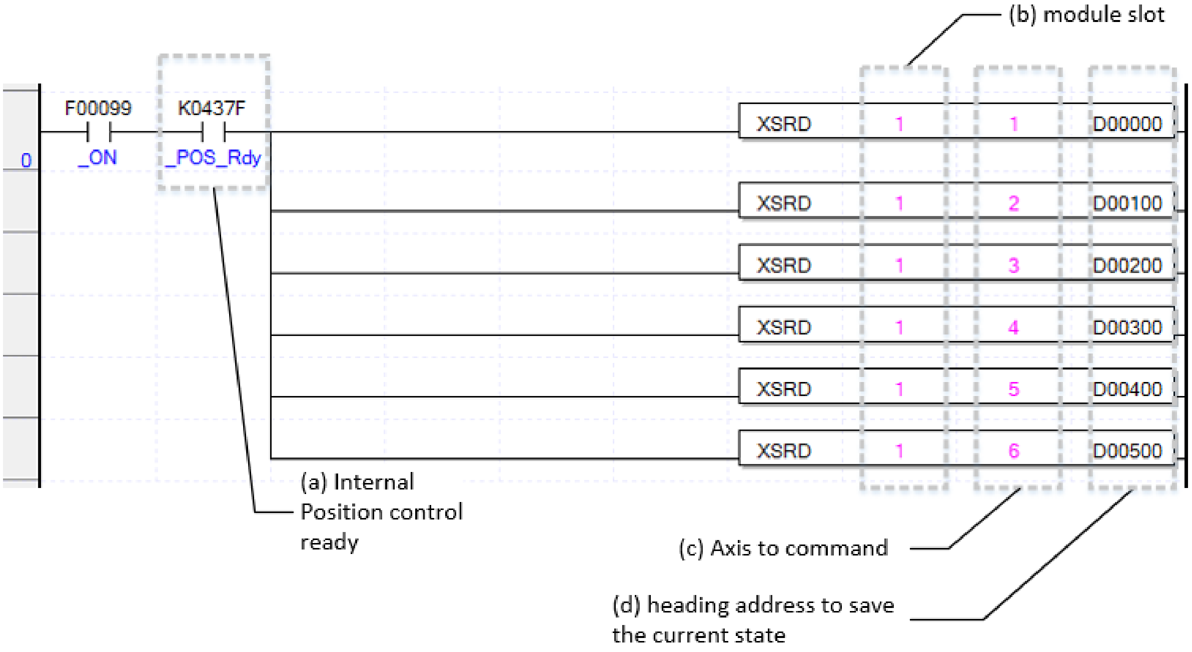
## 8.1 Example of Programming

### 8.1.1 General description

Here we supposed the embedded positioning of   PLC. In the real usage, you need to change its value according to your system configuration.

### 8.1.2 Current State Read

(1) Using XSRD command



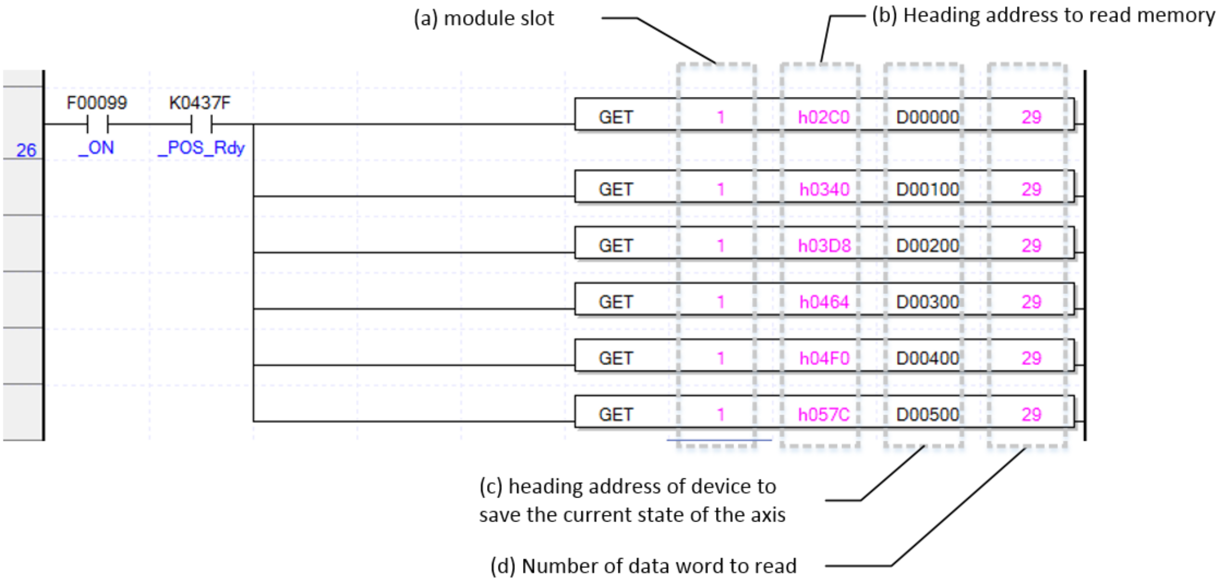
(a) Address of Embedded Positioning
Before operation, you need to configure its position by numbers. In this example, The slot number of embedded positioning is fixed to Slot 1.

(b) Axis of operation
Positioning module operate as 6 axes(XBM-DNxxxH: 2axes). In this example, number 1 through 4 means axis 1 through axis 4.

(c) Address of first device where those conditions of current axis are saved
This D00000 tells the address of first device which already register from the configuration of sequence program. For example, in this program above, the condition of axis 1 will be saved from D00000 to D00022. How to setup a device function would be explained at the "Chapter 6.3.46 Operation State Reading."

(d) Also you can use the bit information from saved data in the device for as a condition of another operation. For example, in this program above, according to use axis 1 driving signal, you need to setup a data as D00000.0, and to check error condition of axis 2, you need to configure as D0000.1.

(2) Using command Get



(a) module slot

(b) Heading address to read memory

(c) heading address of device to save the current state of the axis

(d) Number of data word to read

(a) The address of Positioning Module.

(b) The first memory address of operating Axis.
You can setup the memory address of condition information case by axis. For example, in this program above, “h0200” refers that condition information of 3axis. How to setup a memory address by axis would be explained at “Chapter 6.1.4 Status Information.”

(c) The first address of device which can save the condition of axis

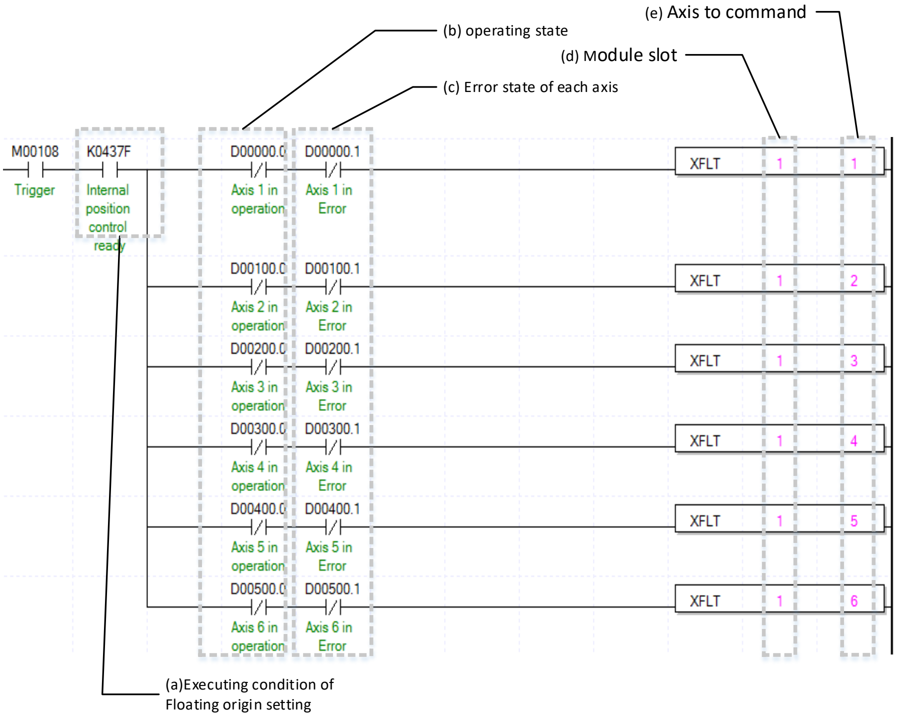
(d) Number of reading data by WORD
Using command GET to read condition information, can save number of data by WORD, hence you only chosen data will be saved.

(e) Also you can use the bit information from saved data in the device for as a condition of another operation. For example, in this program above, according to use axis 1 driving signal, you need to setup a data as D00000.0, and to check error condition of axis 2, you need to configure as D0000.1.

### 8.1.3 Operation Test

(1) Floating Origin Setting

Decide origin of current motor's position without set a machinery origin.



(a) Condition of running a Floating Origin Setting

It only works with XFLT command.

(b) Operating state by axis

According to exercise from "Chapter 8.1.2 Current State Reading," it is a signal of "Operating" for each axis.

(c) Error state for each axis

According to exercise from "Chapter 8.1.2 Current State Reading," it is a signal of "Error state" for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Ready signal for each axis

According to exercise from "Chapter 8.1.2 Current State Reading," it is a signal of "Drive Ready" for each axis. This command only works when the condition of Floating Origin Setting is on. If it is not set as "ON," the "error 212" would be appeared.

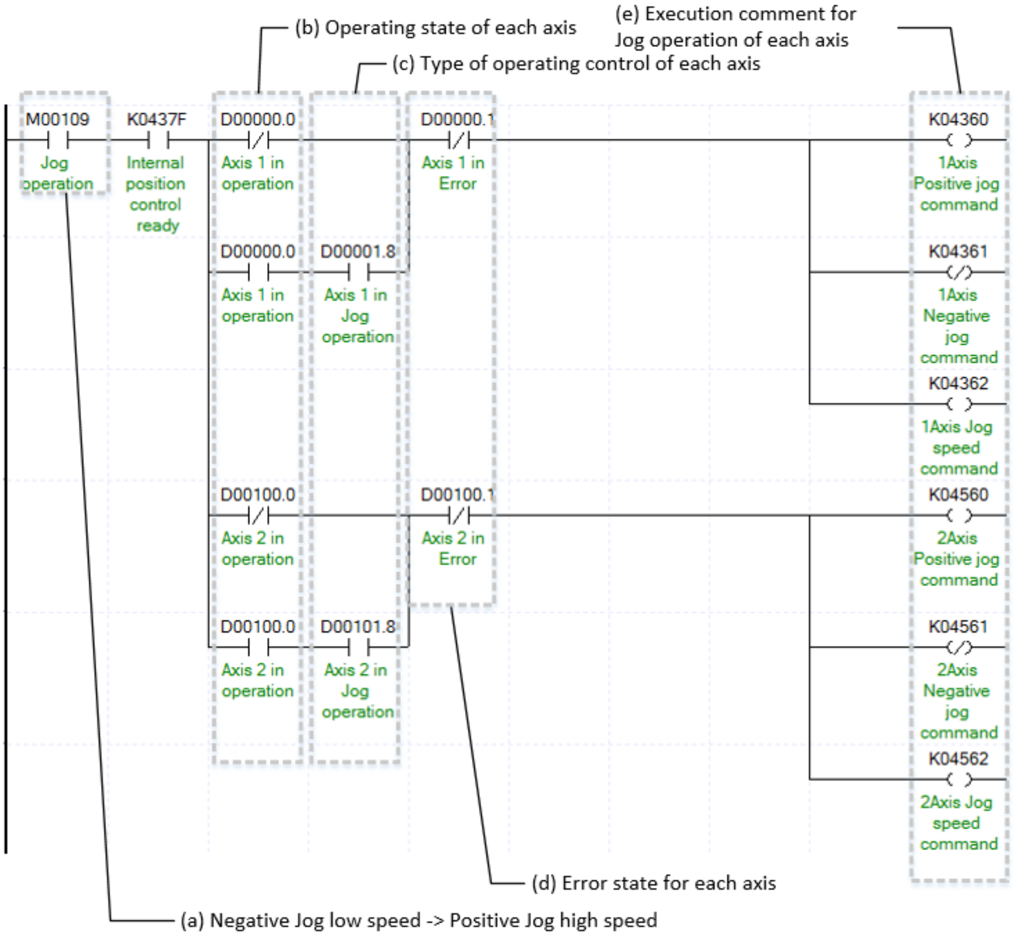
(e) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

(f) Axis of command execution

You can set an axis for Floating Origin Setting. XBM-HP series supports for 6 axes(XBM-DNxxxH: 2axes). In the "execution of axis" from the configuration of Floating Origin Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes)

(2) Jog Operation



(a) Condition of Jog Operation

This is the condition for executing jog operation command. In the above example program, if Jog operation contact is OFF, 1 axis and 2 axis are negative jog low speed operation, and when Jog operation contact is ON, 1 axis and 2 axis are forward jog high speed operation.

(b) Operating state by axis

Jog Operation can only be working when the state of axis set as Jog Operation. In this example above, specific axis set as Jog Operation otherwise it is not operating.

(c) State of driving control by axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Jog Operating” for each axis. It turns on when it is operating. Jog Operation configuration can be changed while it is operating.

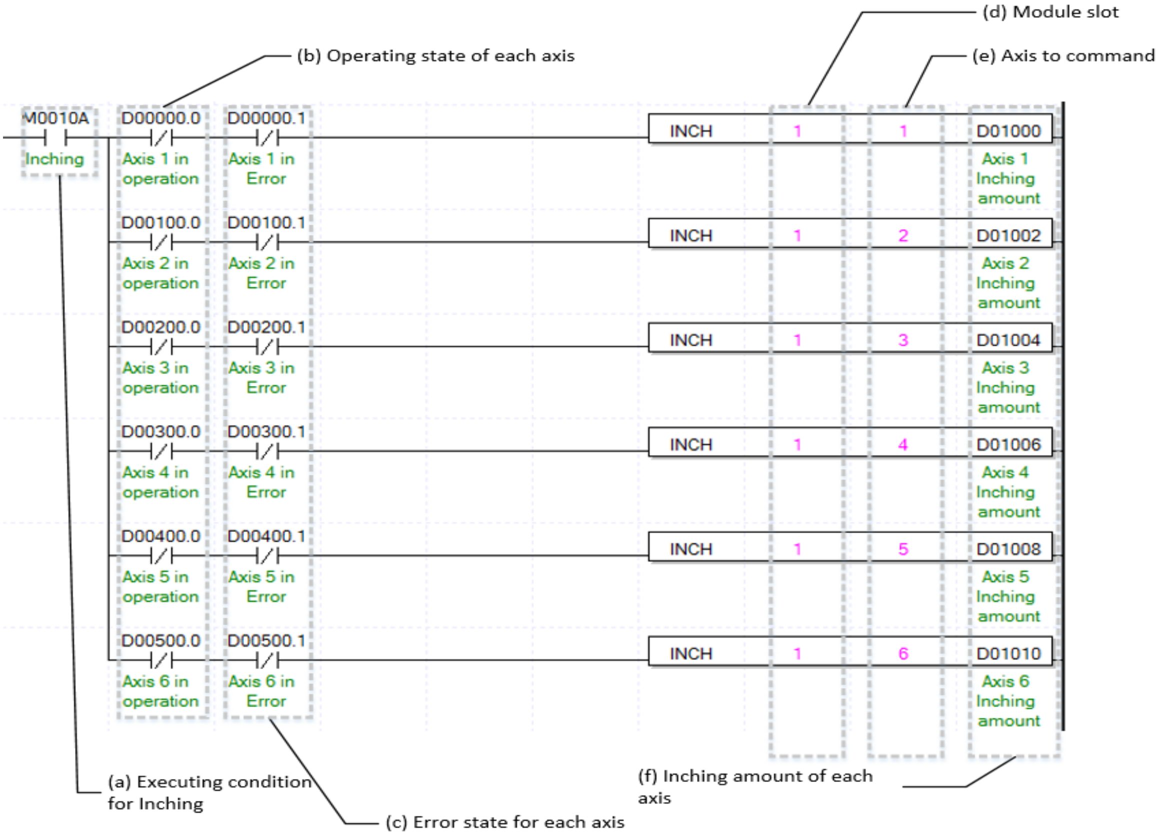
(d) Error state for each axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(e) Ready signal for each axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Drive Ready” for each axis. This command only works when the condition of Jog Operation is on. If it is not set as “ON,” the “error 413” would be appeared.

(3) Inching Operation



(a) Condition of Inching Operation

Condition of Inching Operation Command (XINCH)

(b) Operating state by axis

According to exercise from "Chapter 8.1.2 Current State Reading," it is a signal of "Inching Operating" for each axis. It turns on when it is operating. Inching Operation can not be configured while it is running hence configuration will only be configured when it is not running. If you execute Inching Operation while it is running, the "error 401" would be appeared.

(c) Error state for each axis

According to exercise from "Chapter 8.1.2 Current State Reading," it is a signal of "Error state" for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Ready signal for each axis

According to exercise from "Chapter 8.1.2 Current State Reading," it is a signal of "Drive Ready" for each axis. This command only works when the condition of Inching Operation is on. If it is not set as "ON," the "error 403" would be appeared.

(e) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

(f) Axis of command execution

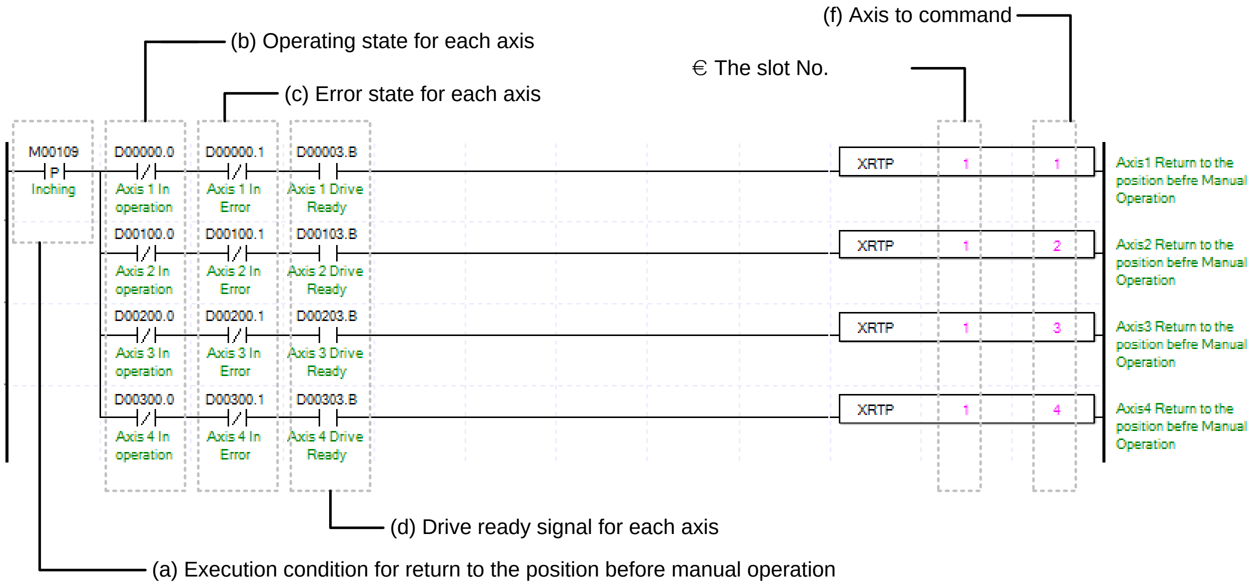
You can set an axis for Inching Operation. XBM-HP supports for 6 axes(XBM-DNxxxH: 2axes). In the "execution of axis" from the configuration of Inching Operation, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(g) Amount of Inching Operation Movement

Measure the amount of moving range by Inching Operation.

(h) Reference for Inching Operation is from "Chapter 9.3.2."

(4) Return to the position before Manual Operation



(a) Condition of Return to the position before Manual Operation
Condition of Return to the position before Manual Operation Command (XRTP)

(b) Operating state by axis
According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Manual Operating” for each axis. It turns on when it is operating. Inching Operation can not be configured while it is running hence configuration will only be configured when it is not running. If you execute Manual Operation while it is running, the “error 431” would be appeared.

(c) Error state for each axis
According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Ready signal for each axes
According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Drive Ready” for each axis. This command only works when the condition of Manual Operation is on. If it is not set as “ON,” the “error 434” would be appeared.

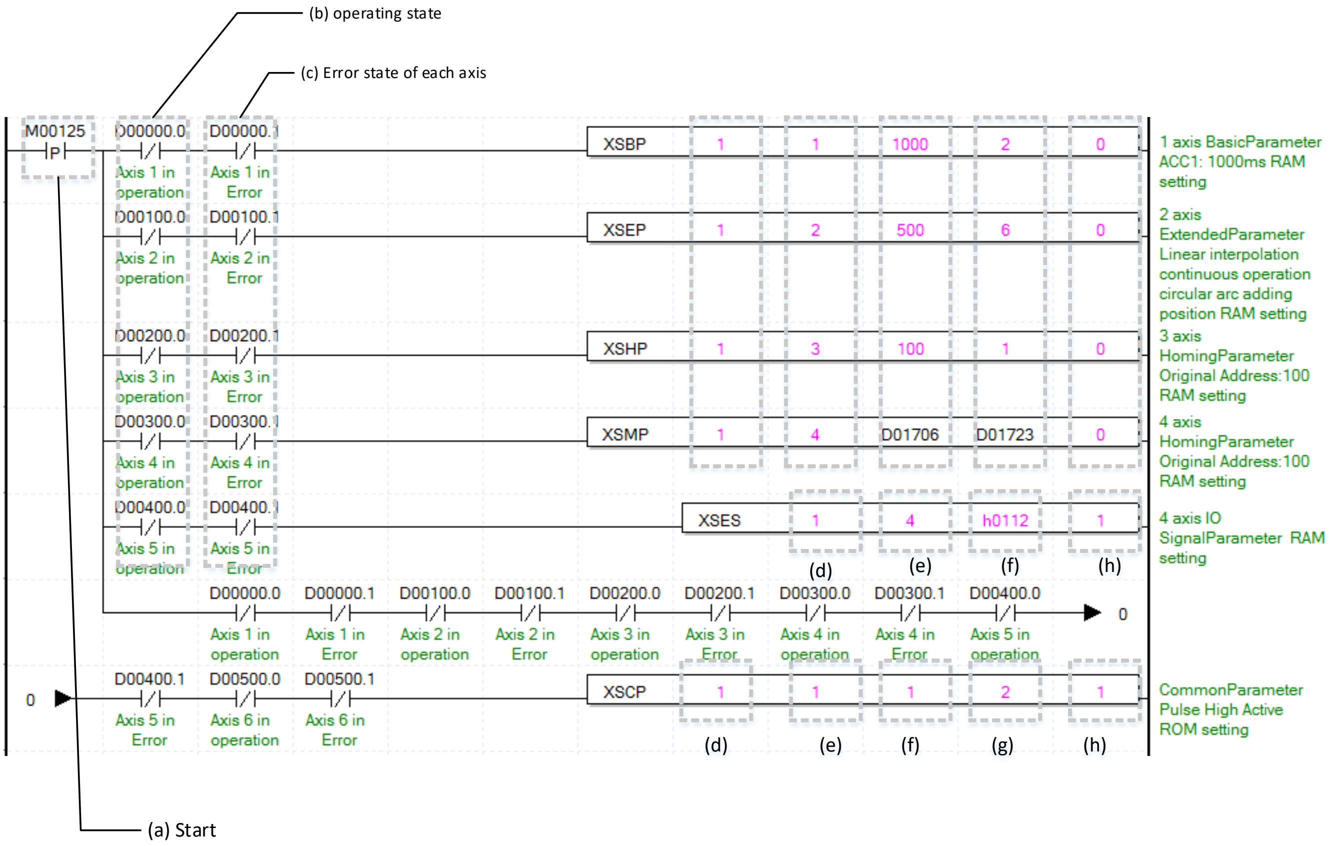
(e) Address of Positioning Module
The slot number of embedded positioning is fixed to Slot 1.

(f) Axis of command execution
You can set an axis for Inching Operation. XBM-HP series supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Manual Operation, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(g) When manual operation is running, the other operations are going back to its original position such as Jog Operation and Inching Operation. Reference for Manual Operation is from “Chapter 9.3.3.”

## 8.1.4 Parameter and Operation Data Setting

(1) Parameter Setting



(a) Condition of Parameter Setting Command

Condition of Parameter Setting Command (XSEP, XSHP, XSMP, XSES, XSCP)

(b) Operating state by axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Operating” for each axis. It turns on when it is operating. Except common parameter setting, parameter setting can not be configured while it is running hence configuration will only be configured when it is not running. If you execute Parameter Setting while it is running, the “error 471” would be appeared.

(c) Error state for each axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

(e) Axis of command execution

You can set an axis for Parameter Setting. PLC supports for 6 axes(XBM-DNxxxH: 2axes)(XBM-DN32H: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(f) Value of Changing Parameter

You can set a value of changing parameter. For more information about Parameter Value Changing look for "Chapter 7. Command." In case of setting I/O parameter, the value would be parameter value itself.

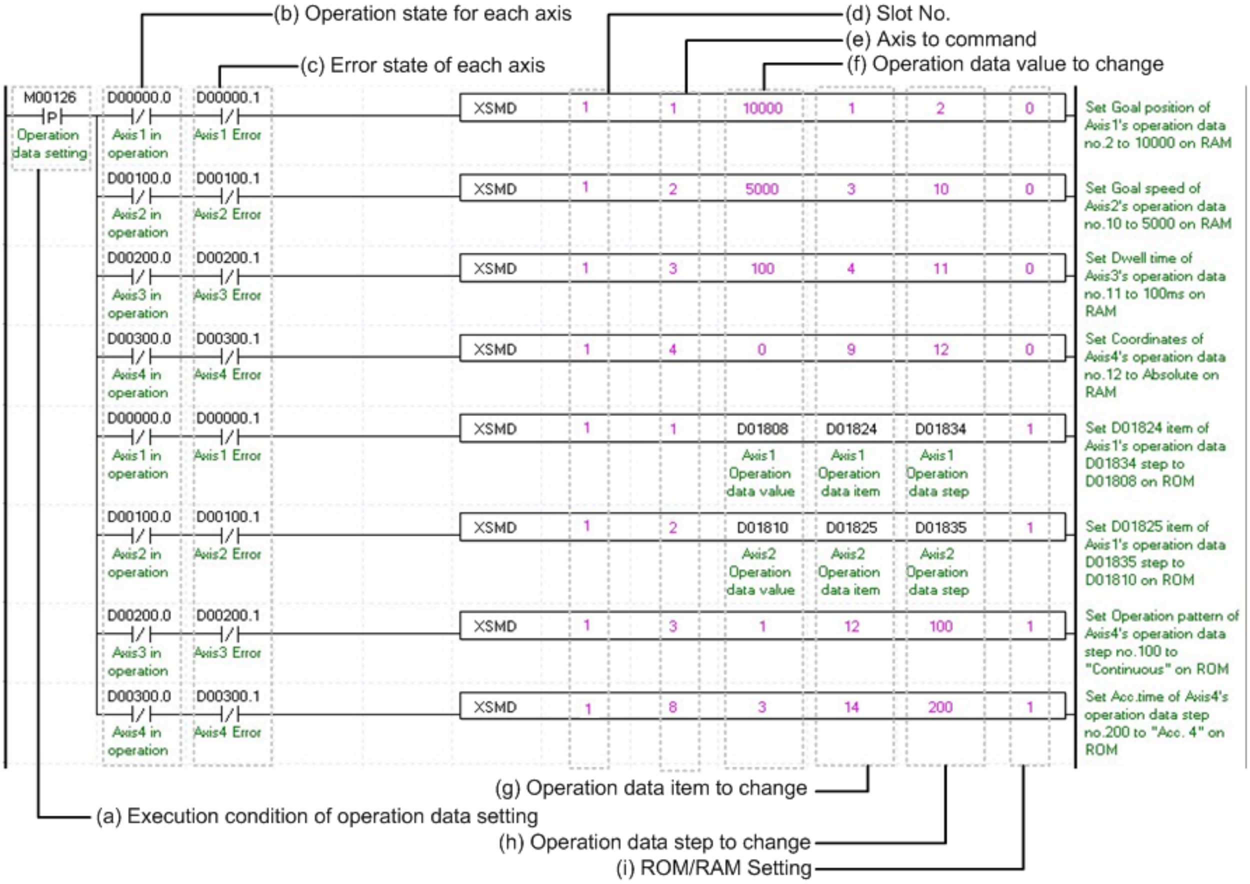
(g) List of Changing Parameter

You need to set a list for parameter (f) changing from set command. Once operating is working, this value will change to parameter (f). For more information of list of changing parameter look for "Chapter 6. Command." In case of setting I/O parameter, the value would be parameter value itself. Therefore changing of list would not be necessary.

(h) ROM/RAM Setting

This function sets whether you save value of changing parameter to Rom or Ram. If you choose Rom the data will be saved regardless of power and if you save in the ram the data will be vanished when powers off. This parameter sets as 1 means Rom saved, and sets as 0 means Ram saved. The number of times for ROM teaching is limited to 1,000,000 because operation data is saved on FLASH Memory.

(2) Operating Data Setting



| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| D00000.0 Axis1 in operation | D00000.1 Axis1 Error | XSMD | 1 | 1 | 10000 | 1 | 2 | 0 | Set Goal position of Axis1's operation data no.2 to 10000 on RAM |
| D00100.0 Axis2 in operation | D00100.1 Axis2 Error | XSMD | 1 | 2 | 5000 | 3 | 10 | 0 | Set Goal speed of Axis2's operation data no.10 to 5000 on RAM |
| D00200.0 Axis3 in operation | D00200.1 Axis3 Error | XSMD | 1 | 3 | 100 | 4 | 11 | 0 | Set Dwell time of Axis3's operation data no.11 to 100ms on RAM |
| D00300.0 Axis4 in operation | D00300.1 Axis4 Error | XSMD | 1 | 4 | 0 | 9 | 12 | 0 | Set Coordinates of Axis4's operation data no.12 to Absolute on RAM |
| D00000.0 Axis1 in operation | D00000.1 Axis1 Error | XSMD | 1 | 1 | D01808 Axis1 Operation data value | D01824 Axis1 Operation data item | D01834 Axis1 Operation data step | 1 | Set D01824 item of Axis1's operation data D01834 step to D01808 on ROM |
| D00100.0 Axis2 in operation | D00100.1 Axis2 Error | XSMD | 1 | 2 | D01810 Axis2 Operation data value | D01825 Axis2 Operation data item | D01835 Axis2 Operation data step | 1 | Set D01825 item of Axis1's operation data D01835 step to D01810 on ROM |
| D00200.0 Axis3 in operation | D00200.1 Axis3 Error | XSMD | 1 | 3 | 1 | 12 | 100 | 1 | Set Operation pattern of Axis4's operation data step no.100 to "Continuous" on ROM |
| D00300.0 Axis4 in operation | D00300.1 Axis4 Error | XSMD | 1 | 8 | 3 | 14 | 200 | 1 | Set Acc.time of Axis4's operation data step no.200 to "Acc. 4" on ROM |

(a) Condition of Operating Data Command

Condition of Operating Data Command (XSMD)

(b) Operating state by axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Operating” for each axis. It turns on when it is operating. Operating Data Setting can be configured while it is running. If you execute Operating Data Setting while it is running, it is reflected after current step operating ended.

(c) Error state for each axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1

(e) Axis of command execution

You can set an axis for Parameter Setting. PLC supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(f) Value of Changing Parameter

You can set a value of changing parameter.

(g) List of Changing Parameter

You need to set a list for parameter (f) changing from set command. Once operating is working, this value will change to parameter (f). Each value of Operating Data is listed below. For example if you put 1000 for value of Changing Operating Data and 4 for Operating data then the value of Dwell is going to be set as 1000ms.

| Setting Value | Items |
|---|---|
| 1 | Goal Position |
| 2 | Circular interpolation auxiliary position |
| 3 | Operating speed |
| 4 | Dwell Time |
| 5 | M code No. |
| 6 | sub axis setting |
| 7 | Helical interpolation axis |
| 8 | The number of circular interpolation turn |
| 9 | Coordinates |
| 10 | Control method |
| 11 | Operating method |
| 12 | Operting pattern |
| 13 | Size of Circular arc |
| 14 | Acc. No. |
| 15 | Dec. No. |
| 16 | Circular interpolation method |
| 17 | Circular interpolation direction |

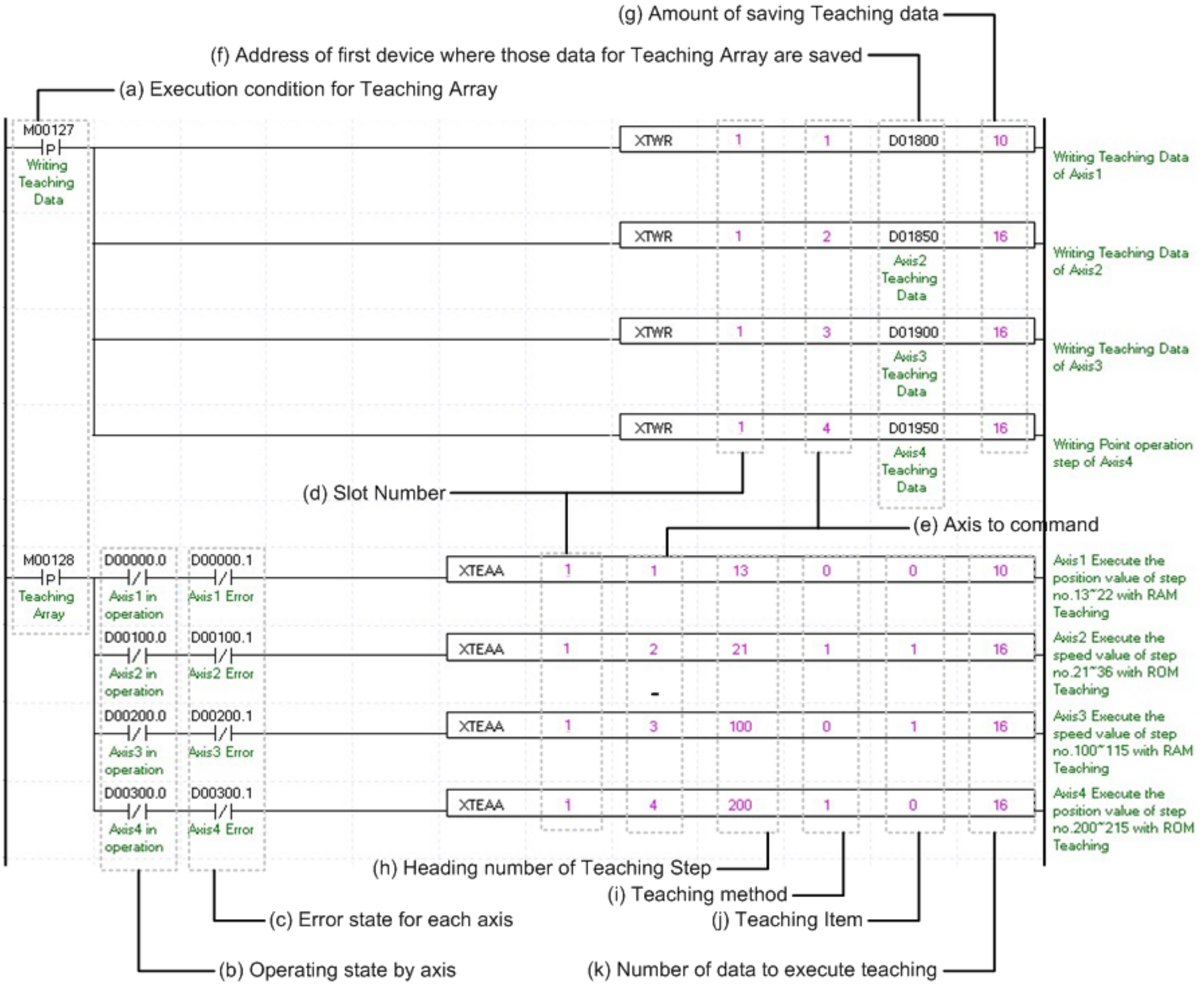
(h) Changing Operating Data Step

You can configure the changing operating data step number by using the operating data step command. XBM-H(P) supports 400 steps for each axis. This value supports from number 0 to 400. The numbers are considered as a step meaning number 1~400 are same as 1~400 steps. When you set this value as 0 means that you will stay put with current value.

(i) ROM/RAM Setting

This function sets whether you save value of changing parameter to Rom or Ram. If you choose Rom the data will be saved regardless of power and if you save in the ram the data will be vanished when powers off. This parameter sets as 1 means Rom saved, and sets as 0 means Ram saved. The number of times for ROM teaching is limited to 1,000,000 because operation data is saved on FLASH Memory

### (3) Operation Data Teaching Array



(a) Condition of Teaching Array

Condition Teaching Array Command (XTWR, XTEAA)

(b) Operating state by axis

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Operating” for each axis. It turns on when it is operating. Teaching Array can be configured while it is running. If you execute Teaching Array while it is running, the step data will be change instantly. But the step data in operation will be change after the end of current step operation.

(c) Error state for each axis

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

(e) Axis of command execution

You can set an axis for Parameter Setting. Embedded positioning function series supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(f) Address of first device where those data for Teaching Array are saved

To execute a Teaching Array, you need to set a specific value first. TWR commands are using for set up those Teaching Array data. It has to be done before actual Teaching Array operation. Teaching Data will be set up depends on number of first device as below table.

| No. | Device No. | Teaching array data |
|---|---|---|
| 1 | Device + 0 | Teaching array data1 |
| 2 | Device + 2 | Teaching array data2 |
| 3 | Device + 4 | Teaching array data3 |
| 4 | Device + 6 | Teaching array data4 |
| 5 | Device + 8 | Teaching array data5 |
| 6 | Device + 10 | Teaching array data6 |
| 7 | Device + 12 | Teaching array data7 |
| 8 | Device + 14 | Teaching array data8 |
| 9 | Device + 16 | Teaching array data9 |
| 10 | Device + 18 | Teaching array data10 |
| 11 | Device + 20 | Teaching array data11 |
| 12 | Device + 22 | Teaching array data12 |
| 13 | Device + 24 | Teaching array data13 |
| 14 | Device + 26 | Teaching array data14 |
| 15 | Device + 28 | Teaching array data15 |
| 16 | Device + 30 | Teaching array data16 |

(g) Amount of Saving Teaching data

Decide how many data will be saved by using XTWR command. Maximum 16 data can be saved. In this example above, 10 Teaching data saved in the axis 1. Therefore those Teaching data from D01800~D01818 saved in the module.

(h) First number of Teaching Step

You can setup the first number of Teaching Step among the Operating Data step. In this example above, Teaching Array of axis 1 will be operate from 22th step, which is 10th step away from 13th step, hence it will be operate between 13th step and 22th step.

(i) Teaching Method

This function sets whether you save value of changed Teaching data to Rom or Ram. If you choose Rom the data will be saved regardless of power and if you save in the ram the data will be vanished when powers off. This parameter sets as 1 means Rom saved, and sets as 0 means Ram saved. The number of times for ROM teaching is limited to 1,000,000 because operation data is saved on FLASH Memory

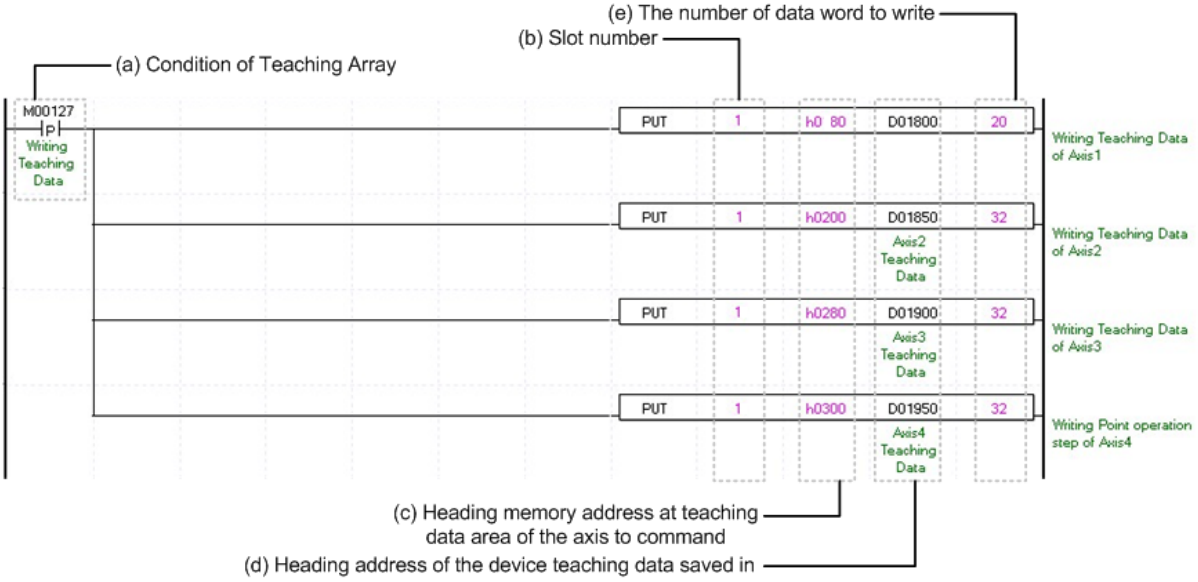
(j) List of Teaching

You can set a data with Teaching Method among the Operating Data. Both “Goal Position” and “Operating Speed” can be changed by Teaching Array. When its value set “0” means set a Goal Position and “1” means set an Operating Speed.

(k) Amount of Teaching Method

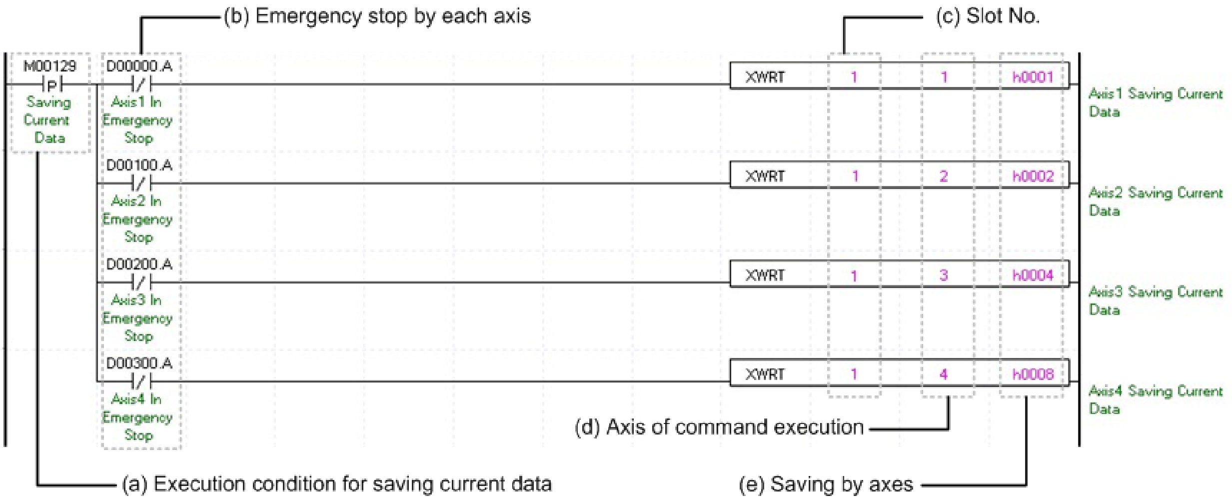
Decide how many steps will be operated using by Teaching Method. Maximum 16 Teaching Array data can be used. For more information about Teaching Array Operation, look for reference from “Chapter 8.7.1”

(l) This example above can also be operated, using command PUT from XTWR as below.



For more information about each saving Teaching Data, look for reference from “Chapter 5.1.2.” When you are using a command “PUT,” you need to setup a type of data as a “WORD” not a “DINT” considered its size

(4) Saving Current Data



(a) Condition of Saving Current Data

Condition of Saving Current Data Command (XWRT). When current saving data operated, those values of module parameter and operating data would be saved in FLASH Memory. Therefore configuration of Ram or Ram Teaching would be constantly saved whether power is on or not.

(b) Emergency Stop by each axis

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “State of Emergency Stop” for each axis. It turns on when it is Emergency Stop. Emergency Stop can not be configured while it is running hence configuration will only be configured when it is not running.

(c) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

(d) Axis of command execution

You can set an axis for Parameter Setting. XBM-DXXXHP series supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

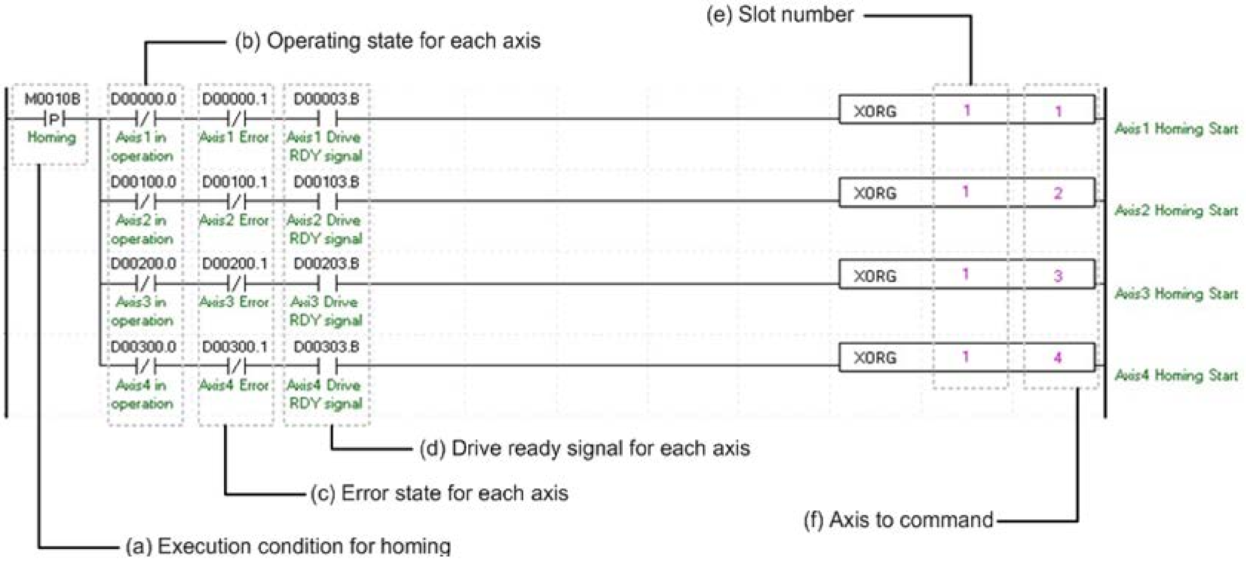
(e) Saving by axes

Configure current data operation setting. Choosing axes are configured follow by below table. Therefore even if those axis are not operated as it programmed, saving axis can be saved in Array. The data of operated axis saved in FLASH Memory, which make constantly stable whether its power is on or not.

| 15 ~ 4 Bit | 3Bit | 2Bit | 1Bit | 0Bit |
|---|---|---|---|---|
| N/A | axis 4 | axis 3 | axis 2 | axis 1 |

## 8.1.5 Positioning Operation

### (1) Homing



(a) Condition of Homing

Condition of Homing Command (XORG)

(b) Operating state by axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Operating” for each axis. It turns on when it is operating. Homing command can not be configured while it is running hence configuration will only be configured when it is not running. If you execute Homing while it is running, the “error 201” would be appeared.

(c) Error state for each axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Ready signal for each axes

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Drive Ready” for each axis. This command only works when the condition of Drive Ready is on. If it is not set as “ON,” the “error 203” would be appeared.

(e) Address of Positioning Module

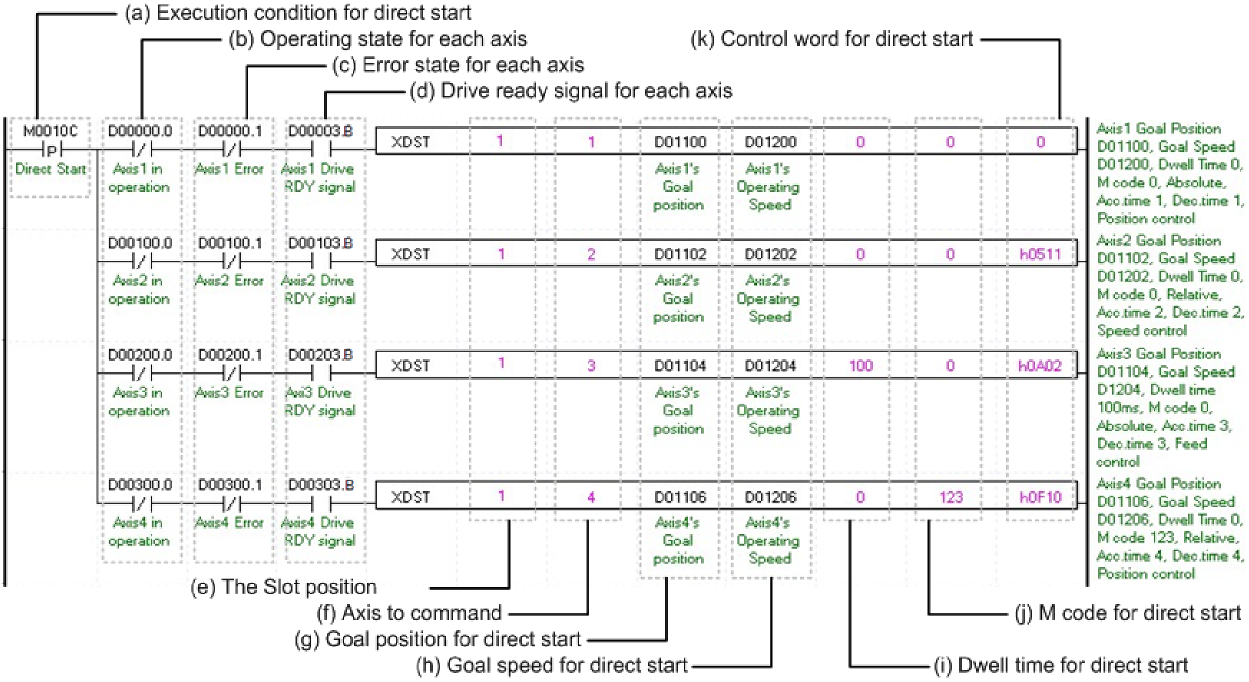
The slot number of embedded positioning is fixed to Slot 1.

(f) Axis of command execution

You can set an axis for Inching Operation. XBM-HP supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Manual Operation, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).(XBM-H: 2axes)

(g) For more information, reference for Homing is in the “Chapter 9.1.Homing”

(2) Direct Start



(a) Condition of Direct Start

Condition of Direct Start Command (XDST)

(b) Operating state by axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Operating” for each axis. It turns on when it is operating. Direct Start command can not be configured while it is running hence configuration will only be configured when it is not running. If you execute Direct Start while it is running, the “error 221” would be appeared.

(c) Error state for each axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Ready signal for each axes

According to exercise from “Chapter 81.2 Current State Reading,” it is a signal of “Drive Ready” for each axis. This command only works when the condition of Drive Ready is on. If it is not set as “ON,” the “error 225” would be appeared.

(e) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

(f) Axis of command execution

You can set an axis for Inching Operation. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Manual Operation, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(g) Goal of Direct Start

Decide changing position of Direct Start command. In this example above, the initialized value is “device,” but you can also change it with “real numbers,” which data type is “DINT.”

(h) Speed of Direct Start

Decide goal speed of Direct Start. In this example above, the initialized value is “device,” but you can also change it with “real numbers,” which data type is “UDINT.”

(i) Dwell Time of Direct Start

Dwell Time consider as a total amount of time from beginning of Direct Start operation that reach to the goal position and make output of Positioning Done Signal. That means after done its operation, direct Start will make a Positioning done signal. Its unit is "ms," and type is "UINT"

(j) Direct Start M code

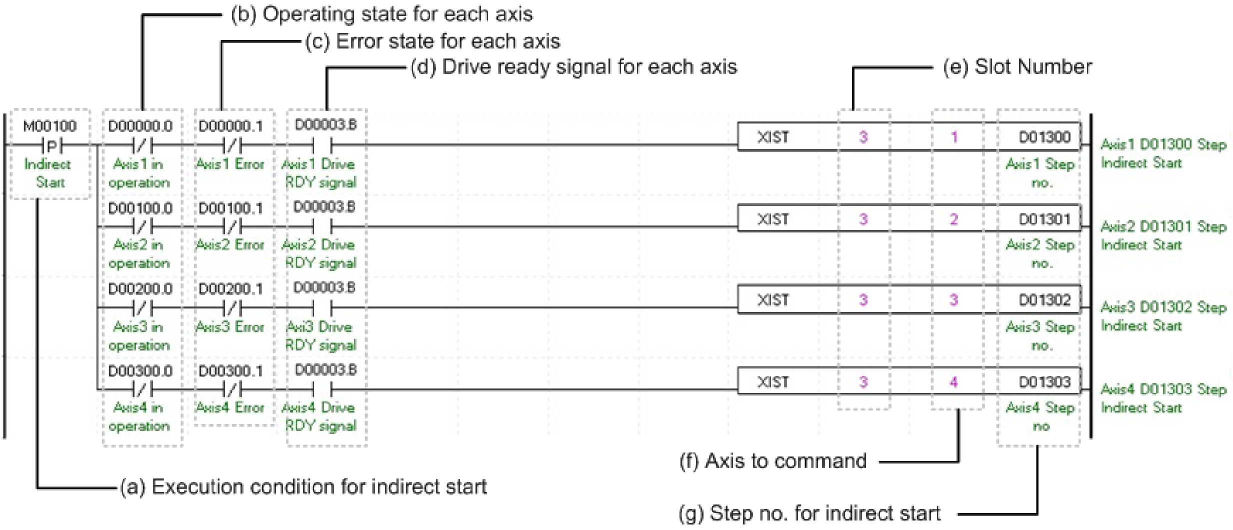
You can set a value of M code which are displaying of Operating Parameter by Direct Start. The way of M code outputs are "Parameter Expansion, M code Mode," within the "None, With, After." It will make an M code besides you choose "None" for its parameter. For more information, reference for M code is in the "Chapter 5.3.2"

(k) Direct Start Control Word

These are list of setting values in a form of Word by Bit for Direct Start. The details of Bits are in the table below.

| 15 ~ 12 | 11 ~ 10 | 9 ~ 8 | 7 ~ 5 | 4 | 3 ~ 2 | 1 ~ 0 |
|---|---|---|---|---|---|---|
| - | Dec. Time | Acc. Time | - | 0:Absolute<br>1:Ralative | - | 0:Position control<br>1:Speed control<br>2:Feed control |

(3) Indirect Start



(a) Condition of Indirect Start
Condition of Indirect Start Command (XIST)

(b) Operating state by axis
According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Operating” for each axis. It turns on when it is operating. Operating Data Setting can not be configured while it is running hence configuration will only be configured when it is not running. If you execute Indirect Start while it is running, the “error 231” would be appeared.

(c) Error state for each axis
According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Ready signal for each axes
According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Drive Ready” for each axis. This command only works when the condition of Drive Ready is on. If it is not set as “ON,” the “error 235” would be appeared.

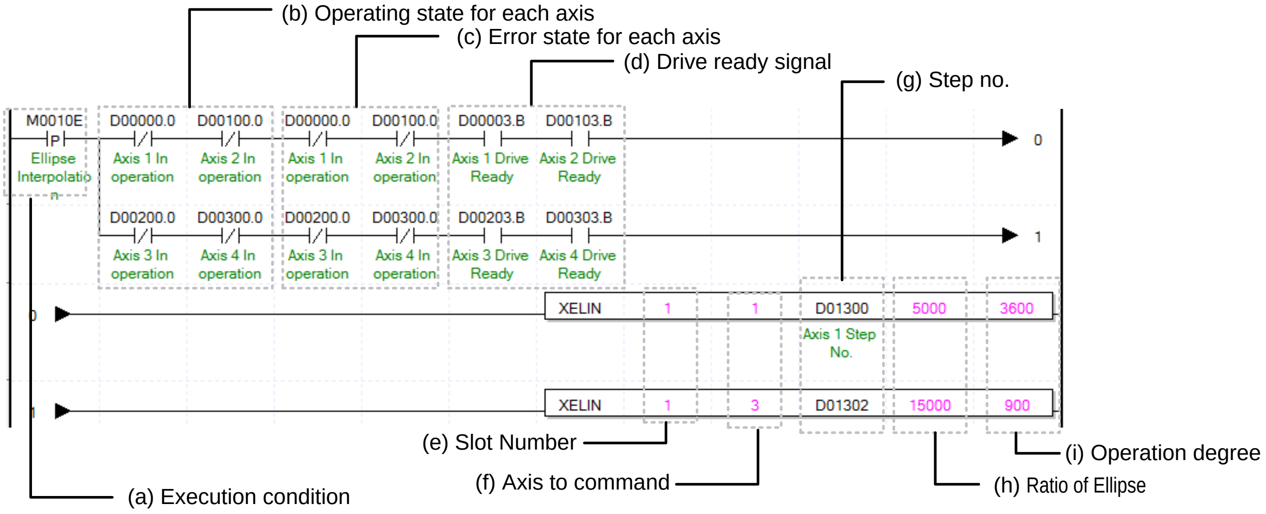
(e) Address of Positioning Module
The slot number of embedded positioning is fixed to Slot 1.

(f) Axis of command execution
You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(g) Operating step number by Indirect Start
Set the operating step number by indirect start for main command axis.

(h) Indirect start operates by appointing step of position data for each axis. Therefore it could run those commands of Positioning control, Speed control, Feed control, Linear circular interpolation depends on setting of positioning data. For more information, reference for Setting of Operating Data is in the “Chapter4.8.”

(4) Ellipse Interpolation



(a) Condition of Ellipse Interpolation

Condition of Ellipse Interpolation Command (XELIN)

(b) Operating state by axis

According to exercise from "Chapter 7.1.2 Current State Reading," it is a signal of "Operating" for each axis. It turns on when it is operating. Operating Data Setting can not be configured while it is running hence configuration will only be configured when it is not running. If you execute Ellipse Interpolation while it is running, the "error 541" would be appeared.

(c) Error state for each axis

According to exercise from "Chapter 7.1.2 Current State Reading," it is a signal of "Error state" for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Ready signal for each axes

According to exercise from "Chapter 7.1.2 Current State Reading," it is a signal of "Drive Ready" for each axis. This command only works when the condition of Drive Ready is on. If a Drive Ready of main axis is not set as "ON," the "error 549" would be appeared and If a Drive Ready of subordinate axis is not set as "ON," the "error 550" would be appeared and

(e) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

(f) Axis of command execution

You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the "execution of axis" from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(g) Operating step number by Ellipse Interpolation

Set the operating step number by Ellipse Interpolation. The setting of main operating step and subordinate step is the same.

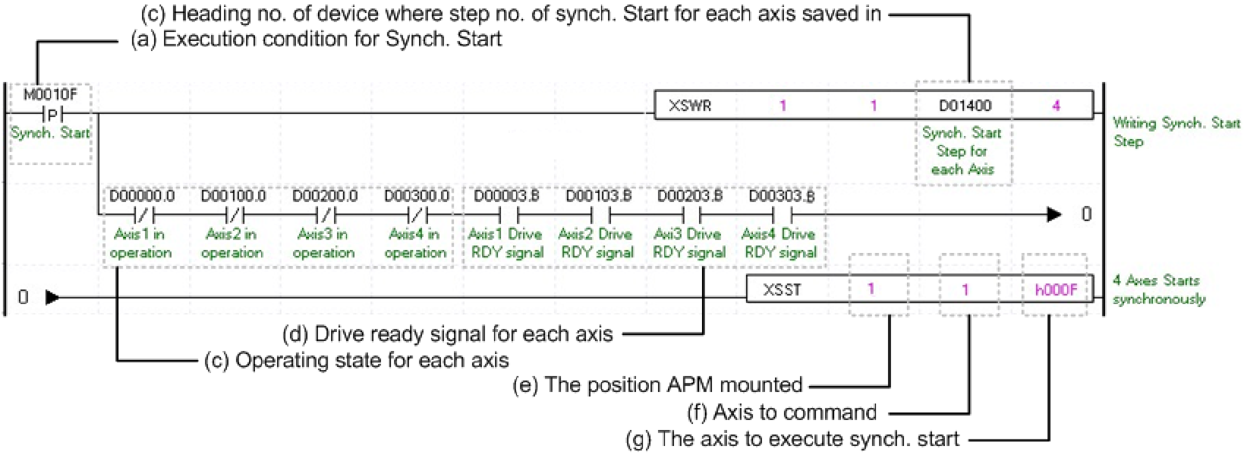
(h) Ratio of Ellipse Interpolation Axis

Set both ratio values for main and subordinate axis of set operates data from circular interpolation locus. It is to change circular locus into ellipse locus by using ratio of main and subordinate axis.

(i) Degree of Ellipse Interpolating Operation

Set the degree for Ellipse Interpolating Operation. Unit is [X$10^{-1}$ degree]. For more information, reference for Ellipse Interpolation is in the "Chapter 8.2.13"

### (5) Simultaneous Start



(a) Condition of Simultaneous Start

Condition of Simultaneous Start Command

(b) Address of first device where those step numbers for Simultaneous Start of each axis are saved

To execute a Synchronous Start, set data steps for each axis. XSWR commands are using for set up those step data for Simultaneous Start. It has to be done before actual Simultaneous Start operation. Simultaneous Start will be set up depends on number of first device as below table.

| Value | Device No. | Teaching Array Data |
|---|---|---|
| 1 | Device + 0 | Axis1 Simultaneous Start Step |
| 2 | Device + 1 | Axis2 Simultaneous Start Step |
| 3 | Device + 2 | Axis3 Simultaneous Start Step |
| 4 | Device + 3 | Axis4 Simultaneous Start Step |

(c) Operating state by axis

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Operating” for each axis. It turns on when it is operating. Operating Data Setting can not be configured while it is running hence configuration will only be configured when it is not running. If you execute Axis1 Simultaneous Start while it is running, the “error 291” would be appeared.

(d) Ready signal for each axes

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Drive Ready” for each axis. This command only works when the condition of Drive Ready is on. If it is not set as “ON,” the “error 295” would be appeared.

(e) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

(f) Axis of command execution

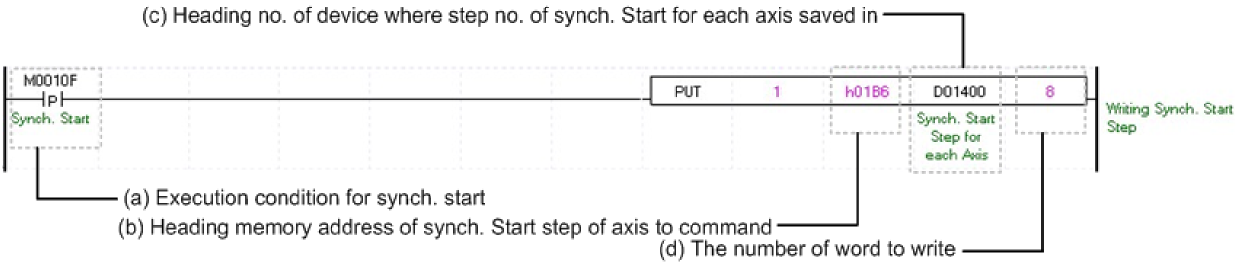
You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(g) Axis for Synchronous Start

Set axis for Synchronous Start. The axis for Synchronous Start uses a “bit” from WORD Data setting as a “1” for each axis. Axis for each bits are as below.

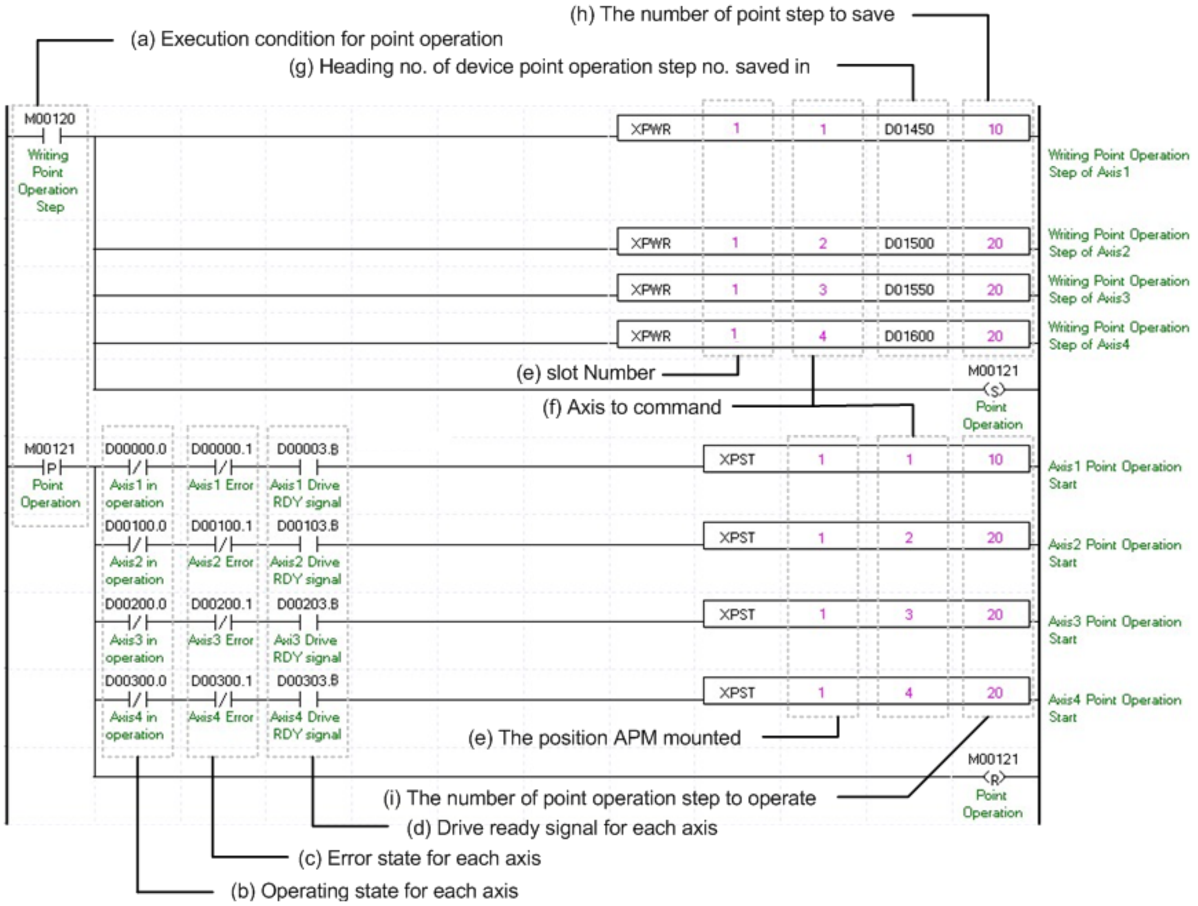
| 15 ~ 4 Bit | 3Bit | 2Bit | 1Bit | 0Bit |
|---|---|---|---|---|
| Not use | Axis4 | Axis3 | Axis2 | Axis1 |

(h) In this program above, you can use command “PUT” instead of XSWR.



Setting a memory address for each axis of Synchronous Start step number, look up reference for Synchronous Start is in the “Chapter5.1.3.”

(6) Point Operation



(a) Condition of Point Operation

Condition of Point Operation Command (XPST) Point Operation Step Writing has to be done before execute the Point Operation.

(b) Operating state by axis

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Operating” for each axis. It turns on when it is operating. Operating Data Setting can not be configured while it is running hence configuration will only be configured when it is not running. If you execute Point Operation while it is running, the “error 231” would be appeared.

(c) Error state for each axis

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Ready signal for each axes

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Drive Ready” for each axis. This command only works when the condition of Drive Ready is on.

(e) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

(f) Axis of command execution

You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(g) Address of first device where those data for Step Numbers of Point Operation are saved

To execute a Point Operation, you need to set a specific value first. XPWR commands are using for set up those Point Operation steps. It has to be done before actual Point Operation. Point Operation Step Data will be set up depends on number of first device as below table.

| Value | Device No. | Point start step data |
|---|---|---|
| 1 | Device + 0 | Point start step data 1 |
| 2 | Device + 1 | Point start step data 2 |
| 3 | Device + 2 | Point start step data 3 |
| 4 | Device + 3 | Point start step data 4 |
| 5 | Device + 4 | Point start step data 5 |
| 6 | Device + 5 | Point start step data 6 |
| 7 | Device + 6 | Point start step data 7 |
| 8 | Device + 7 | Point start step data 8 |
| 9 | Device + 8 | Point start step data 9 |
| 10 | Device + 9 | Point start step data 10 |
| 11 | Device + 10 | Point start step data 11 |
| 12 | Device + 11 | Point start step data 12 |
| 13 | Device + 12 | Point start step data 13 |
| 14 | Device + 13 | Point start step data 14 |
| 15 | Device + 14 | Point start step data 15 |
| 16 | Device + 15 | Point start step data16 |
| 17 | Device + 16 | Point start step data17 |
| 18 | Device + 17 | Point start step data18 |
| 19 | Device + 18 | Point start step data19 |
| 20 | Device + 19 | Point start step data20 |

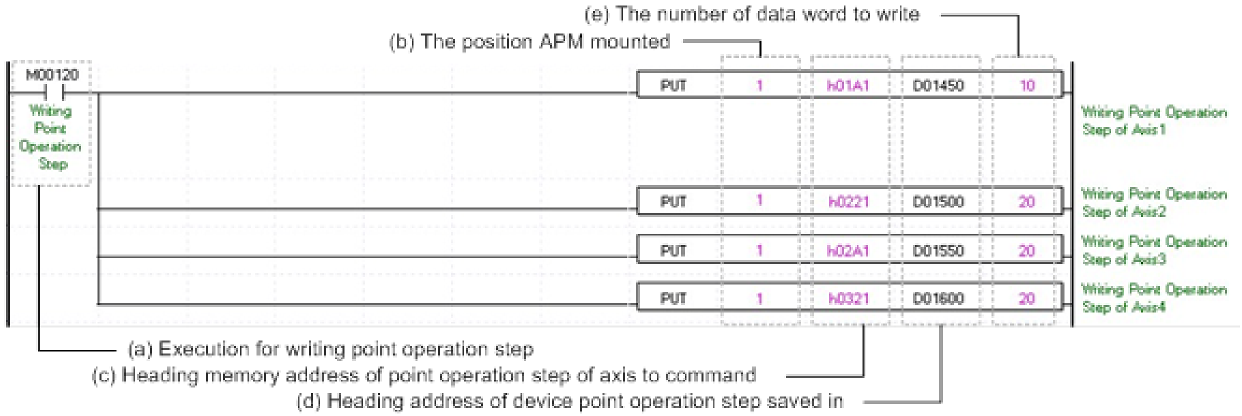
(h) Amount of Saving Point Operation Steps

Decide how many data will be saved by using XTWR command. In this example above, 10 Point Operation steps are saved in the axis 1. Therefore those Step data from D01450~D01459 are saved in the module.

(i) Number of Operation amount by Point Operation

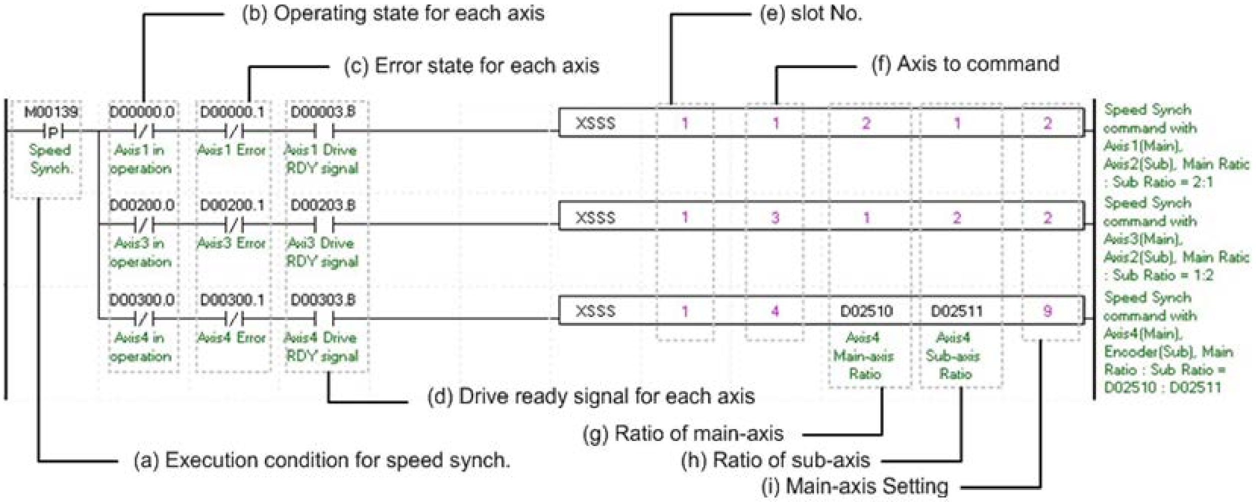
Set the number of saving Step numbers by Point Operating Writing command. For more information, reference for Setting of Point Operation is in the "Chapter 8.2.17."

(j) In this program above, you can use command "PUT" instead of XPWR.



Setting a memory address for each axis of Point Operation step number, look up reference for Point Operation is in the "Chapter5.1.1."

(7) Speed Synchronization



(a) Condition of Speed Synchronization

Condition of Speed Synchronization Command (XSSS)

(b) Operating state by axis

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Operating” for each axis. It turns on when it is operating. Operating Data Setting can not be configured while it is running hence configuration will only be configured when it is not running. If you execute Speed Synchronization while it is running, the “error 351” would be appeared.

(c) Error state for each axis

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Ready signal for each axis

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Drive Ready” for each axis. This command only works when the condition of Drive Ready is on. If a Drive Ready of main axis is not set as “ON,” the “error 354” would be appeared.

(e) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

(f) Axis of command execution

You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(g) Ratio of Main Axis

Set value for Ratio of Main Axis to execute a Speed Synchronization.

(h) Ratio of Subordinate Axis

Set value for Ratio of Subordinate Axis to execute a Speed Synchronization. In this example above, the ratio of main and subordinate axis is 2:1. Meaning that operational speed ratio of those axes is 2 to 1. So, if main axis is operating in speed of 10000, subordinate axis will be operating in speed of 5000.

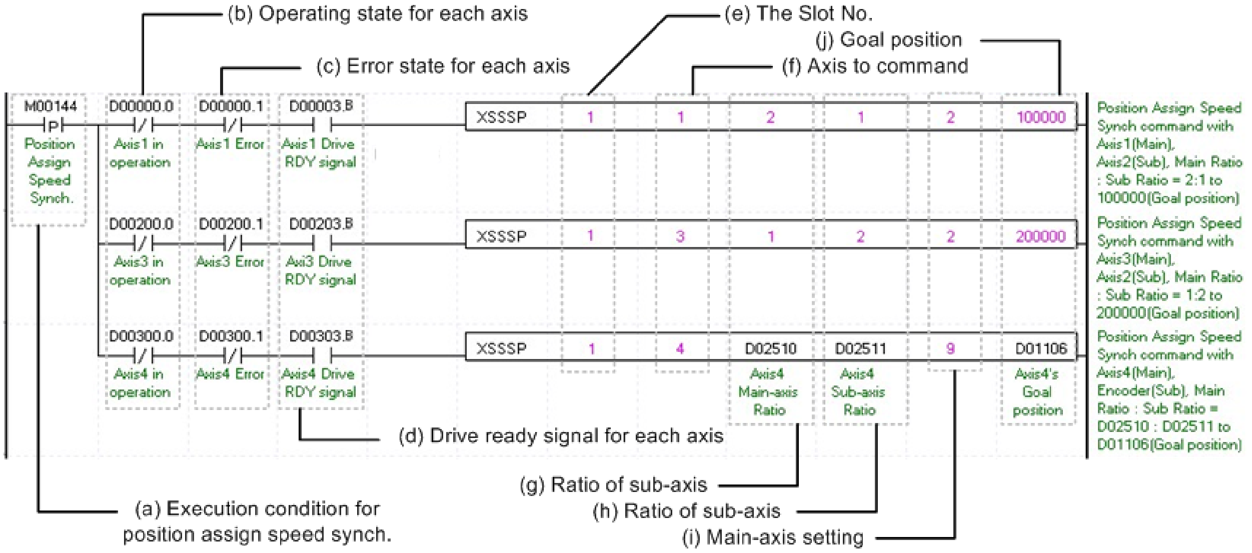
(i) Main Axis Setting

Setting of main axis to operate Speed Synchronization. This setting is for main axis of Speed Synchronization. This setting cannot be set as same value as command axis, and possible setting values are as below.

| Setting value | Main Axis |
|---|---|
| 1 | Axis1 |
| 2 | Axis2 |
| 3 | Axis3 |
| 4 | Axis4 |
| 5 | - |
| 6 | - |
| 7 | - |
| 8 | - |
| 9 | Encoder |

(k) For more information, reference for Speed Synchronization is in the “Chapter 8.4.1.”

(8) Position Assign Speed Synchronization



(a) Condition of Position Assign Speed Synchronization

Condition of Position Assign Speed Synchronization Command (XSSSP)

(b) Operating state by axis

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Operating” for each axis. It turns on when it is operating. Operating Data Setting can not be configured while it is running hence configuration will only be configured if it is not running. If you execute Position Assign Speed Synchronization while it is running, the “error 351” would be appeared.

(c) Error state for each axis

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Ready signal for each axes

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Drive Ready” for each axis. This command only works when the condition of Drive Ready is on. If a Drive Ready of main axis is not set as “ON,” the “error 354” would be appeared.

(e) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

(f) Axis of command execution

You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(g) Ratio of Main Axis

Set value for Ratio of Main Axis to execute a Speed Synchronization.

(h) Ratio of Subordinate Axis

Set value for Ratio of Subordinate Axis to execute a Speed Synchronization. In this example above, the ratio of main and subordinate axis is 2:1. Meaning that operational speed ratio of those axes is 2 to 1. So, if main axis is operating in speed of 10000, subordinate axis will be operating in speed of 5000.

(i) Main Axis Setting

Setting of main axis to operate Speed Synchronization. This setting is for main axis of Speed Synchronization. This setting cannot be set as same value as command axis, and possible setting values are as below.

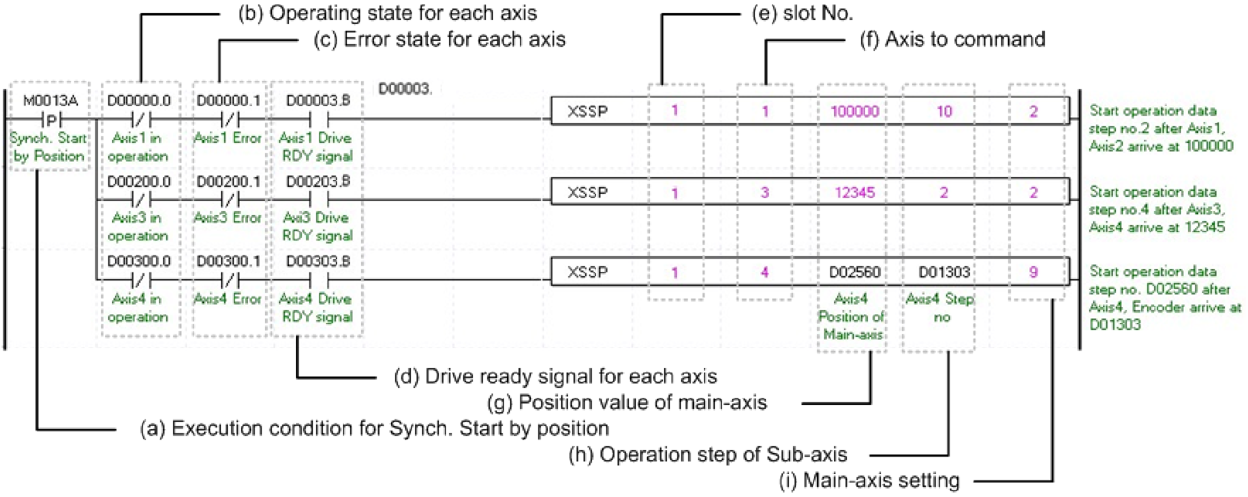
| Setting value | Main Axis |
|---|---|
| 1 | Axis1 |
| 2 | Axis2 |
| 3 | Axis3 |
| 4 | Axis4 |
| 5 | - |
| 6 | - |
| 7 | - |
| 8 | - |
| 9 | Encoder |

(j) Goal Position

Set goal of Position Assign Speed Synchronization. Once command axis reaches the goal position, Speed Synchronization ends and operation will be stop immediately.

(k) For more information, reference for Position Assign Speed Synchronization is in the “Chapter 8.4.1.”

(9) Synchronous Start by Position



(a) Condition of Synchronous Start by Position

Condition of Synchronous Start by Position Command (XSSP)

(b) Operating state by axis

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Operating” for each axis. It turns on when it is operating. Operating Data Setting can not be configured while it is running hence configuration will only be configured when it is not running. If you execute Synchronous Start by Position while it is running, the “error 341” would be appeared.

(c) Error state for each axis

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Ready signal for each axes

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Drive Ready” for each axis. This command only works when the condition of Drive Ready is on. If a Drive Ready of main axis is not set as “ON,” the “error 354” would be appeared.

(e) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

(f) Axis of command execution

You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(g) Value of Main Axis

Set value for Main Axis to execute Synchronous Start by Position. Therefore main axis will be executed the command when the subordinate axis reaches this set value.

(h) Step of Subordinate Axis

Set step number for Subordinate Axis to execute a Speed Synchronization.

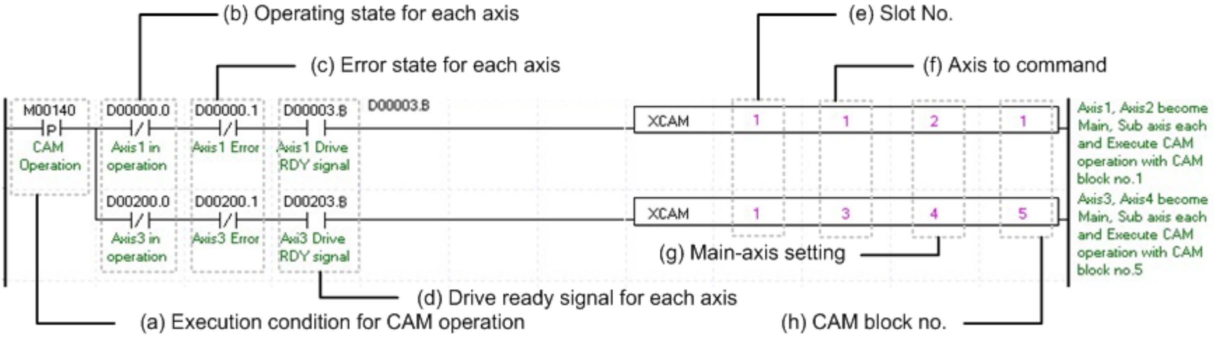
(i) Main Axis Setting

Setting of main axis to operate Speed Synchronization. This setting is for main axis of Speed Synchronization. This setting cannot be set as same value as command axis, and possible setting values are as below.

| Setting value | Main Axis |
|---|---|
| 1 | Axis1 |
| 2 | Axis2 |
| 3 | Axis3 |
| 4 | Axis4 |
| 5 | - |
| 6 | - |
| 7 | - |
| 8 | - |
| 9 | Encoder |

(j) For more information, reference for Synchronous Start by Position is in the “Chapter 8.4.2.”

### (10) CAM Operation



(a) Condition of CAM Operation

Condition of CAM Operation Command (XCAM)

(b) Operating state by axis

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Operating” for each axis. It turns on when it is operating. Operating Data Setting can not be configured while it is running hence configuration will only be configured when it is not running. If you execute CAM Operation while it is running, the “error 701” would be appeared.

(c) Error state for each axis

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Ready signal for each axes

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Drive Ready” for each axis. This command only works when the condition of Drive Ready is on. If a Drive Ready of main axis is not set as “ON,” the “error 703” would be appeared.

(e) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

(f) Axis of command execution

You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(g) Main Axis Setting

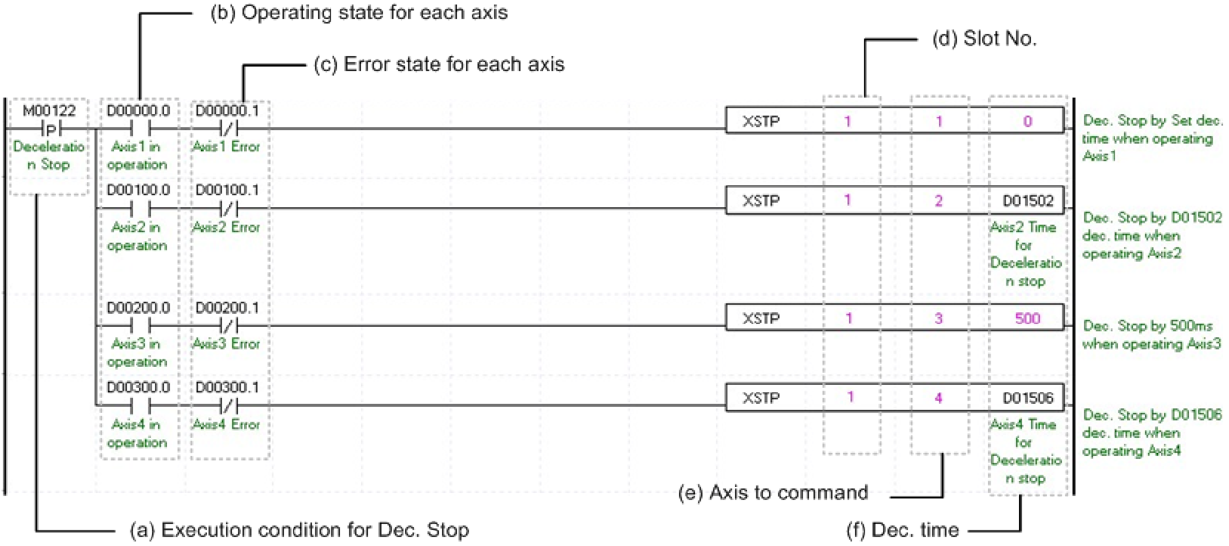
Setting of main axis to operate .This setting is for main axis of CAM Operating. This setting cannot be set as same value as command axis. Can set a value 1~4, meaning from axis 1 to axis 4 or 8(Encoder).

(h) CAM Block Numbers

Setting for Block Numbers of CAM data to operate CAM operation. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes) 7 CAM Blocks. The CAM Data for each Block would be downloaded to module written from Software Package.

(i) For more information, reference of CAM Operation is in the “Chapter 8.4.3.”

(11) Deceleration Stop



(a) Condition of Deceleration Stop

Condition of Deceleration Stop Command (XSTP)

(b) Operating state by axis

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Operating” for each axis. It turns on when it is operating. Operating Data Setting can not be configured while it is running hence configuration will only be configured when it is not running.

(c) Error state for each axis

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

(e) Axis of command execution

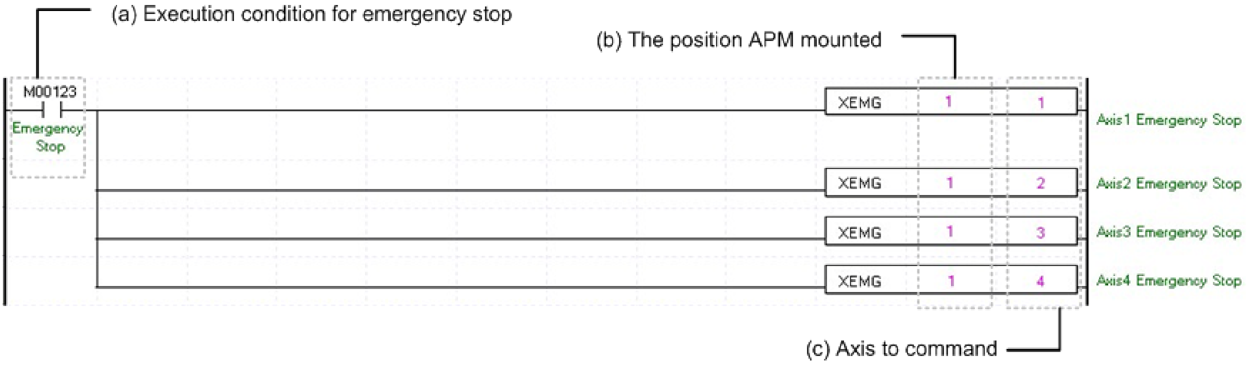
You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(f) Deceleration time of Deceleration Stop

Setting a deceleration time of Deceleration Stop operation. Unit of Deceleration Stop is [ms]. Since this time refers deceleration time from the speed limit, there might be little difference between Deceleration Stop set time and actual stop time. The range of deceleration time is “0~2,147,483,674.” 1~2,147,483,674 means Deceleration Time set as 1ms ~ 2,147483674ms. If it set as “0,” it will be operated with set deceleration value. Also it use to stop Speed Synchronous Operation or CAM Operation while Speed and CAM Operation. During this time Deceleration Time is meaningless, CAM Operation Is just cancelled.

(g) For more information, reference of Deceleration Stop is in the “Chapter 8.2.18.”

(12) Emergency Stop



(a) Condition of Emergency Stop

Condition of Emergency Stop Command (XEMG)

(b) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

(c) Axis of command execution

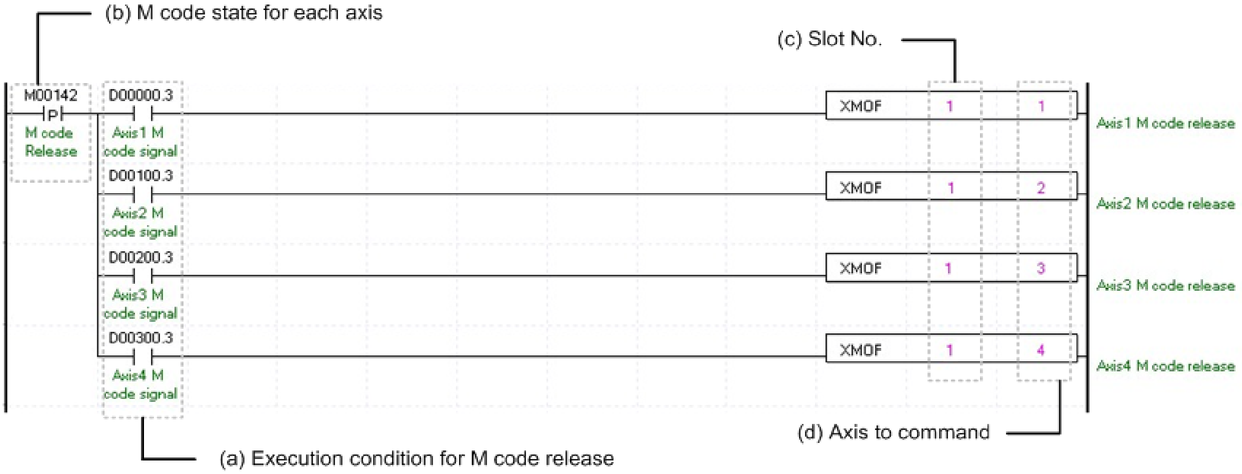
You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(d) Emergency Stop is operating by each axis.

Once Emergency Stop command executes the error “481” would be occurred. With the set value for deceleration time, it will be decelerated and stop the operation

(e) For more information, reference of Emergency Stop is in the “Chapter 8.2.18.”

(13) M code Off



(a) Condition of M code Cancellation

Condition of M code Cancellation (XMOF). Once M code Cancellation command executed, number of M code would be change to “0,” and signal of M code to “Off.”

(b) M code state for each axis

According to exercise from “Chapter 7.1.2 Current State Reading,” it is a signal of “M Code” for each axis. It turns on when it is operating. M code Cancellation command can only be valid once M code are generated. The condition for execution is operation possible when it is “On.”

(c) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

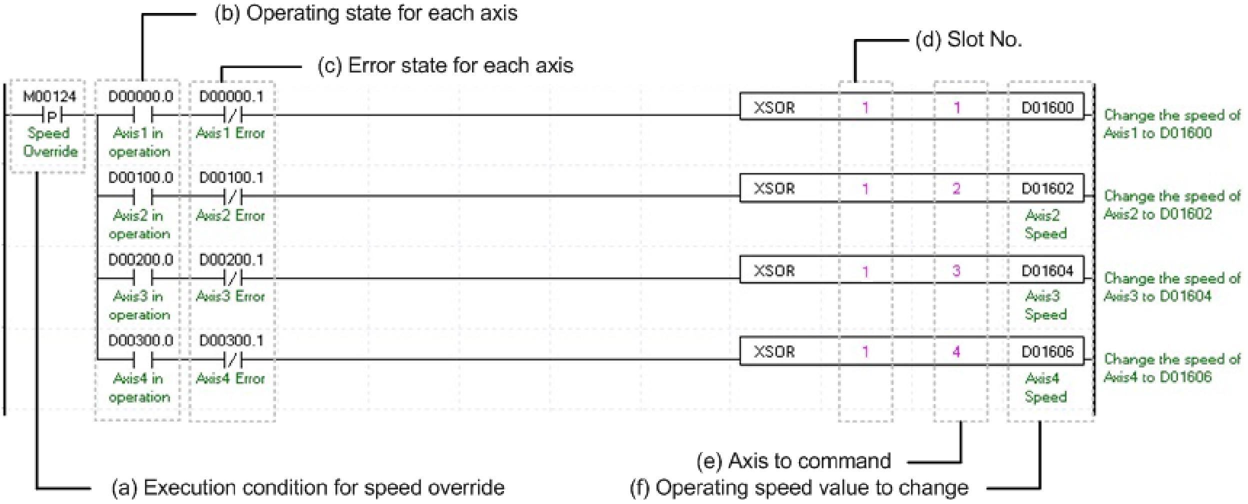
(d) Axis of command execution

You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(e) For more information, reference of M code Cancellation is in the “Chapter 8.6.2.”

## 8.1.6 Operation Setting Change while Operating

### (1) Speed Override



(a) Condition of Speed Override

Condition of Speed Override Command (XSOR)

(b) Operating state by axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Operating” for each axis. It turns on when it is operating. Operating Data Setting can not be configured while it is running hence configuration will only be configured when it is not running. If you execute Speed Override while it is running, the “error 371” would be appeared.

(c) Error state for each axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

(e) Axis of command execution

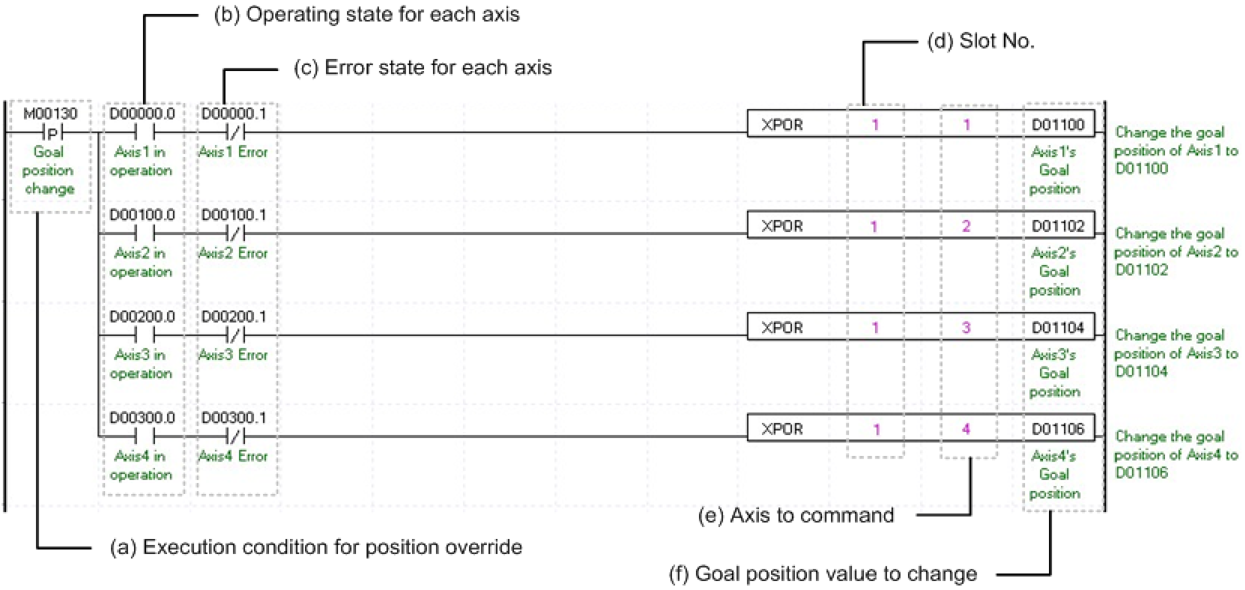
You can set an axis for Speed Override command. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(f) Value Change for Speed Operation

Setting Value Change for Speed Operation. According to Speed Override from common parameters, it is a signal of “%” or “Speed Value” depends on setting of category. Also, when Speed Override set as Speed Value, it means Unit/Time depends on Speed Command Unit from basic parameters, or it means “rpm.” If a changing Operation Speed Value is “%,” then the unit would be [X$10^{-2}$%]. If it is “rpm, “then the unit would be X$10^{-1}$rpm].

(g) For more information, reference of Speed Override is in the “Chapter 8.5.5.”

(2) Position Override



(a) Condition of Position Override

Condition of Position Override Command (XPOR)

(b) Operating state by axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Operating” for each axis. It turns on when it is operating. Operating Data Setting can not be configured while it is running hence configuration will only be configured when it is not running. If you execute Position Override while it is running, the “error 361” would be appeared.

(c) Error state for each axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

(e) Axis of command execution

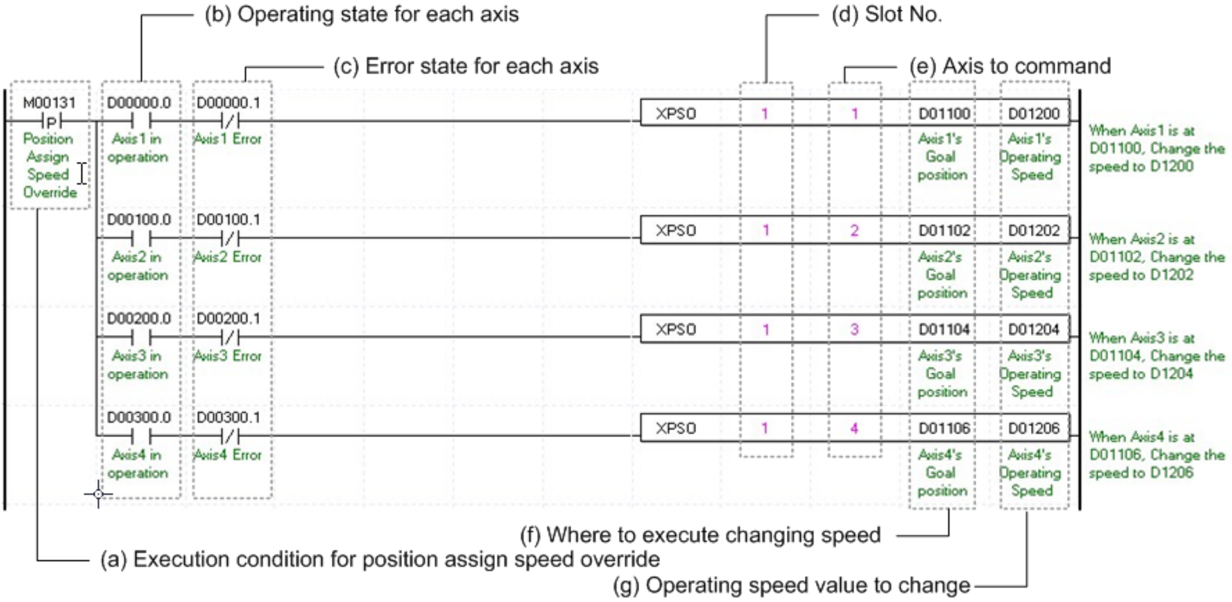
You can set an axis for Parameter Setting. Embedded positioning supports supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(f) Change for Goal Position Value

Setting Value Change for Goal Position Value. The unit of this value depends on “Unit” category. Once Position Override commands are executed, the goal position of executed axis will be changed to set goal position.

(g) For more information, reference of Position Override is in the “Chapter 8.5.4.”

(3) Position Assign Speed Override



(a) Condition of Position Assign Speed Override

Condition of Position Assign Speed Override Command (XPSO)

(b) Operating state by axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Operating” for each axis. It turns on when it is operating. Operating Data Setting can not be configured while it is running hence configuration will only be configured when it is not running. If you execute Position Assign Speed Override while it is running, the “error 381” would be appeared.

(c) Error state for each axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

(e) Axis of command execution

You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(f) Position of Speed Change Execution

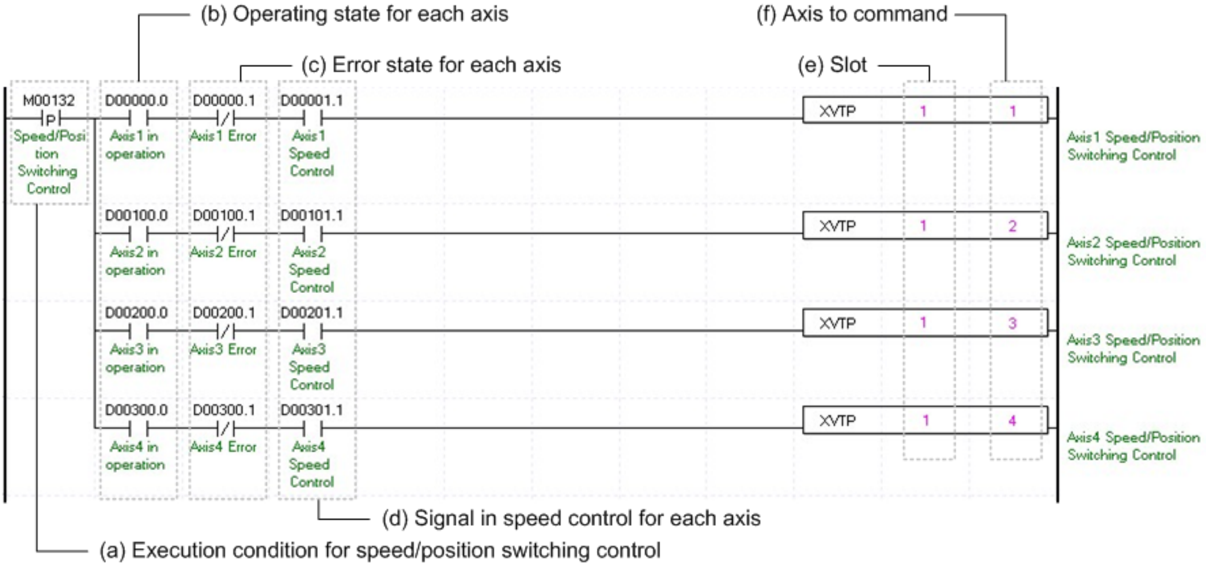
Setting position of Speed Change. Once the actual position located at set position with speed override command running, the speed change commands are executed.

(g) Value Change for Operation speed

Setting Value Change for Operation speed. According to Speed Override from common parameters, it is a signal of “%” or “Speed Value” depends on setting of category. Also, when Speed Override set as Speed Value, it means Unit/Time depends on Speed Command Unit from basic parameters, or it means “rpm.” If a changing Operation Speed Value is “%,” then the unit would be [$X10^{-2}$%]. If it is “rpm, “then the unit would be $X10^{-1}$rpm].

(h) For more information, reference of Position Assign Speed Override is in the “Chapter 8.5.6.”

(4) Speed/Position Switching Control



(a) Condition of Speed/Position Switching Control

Condition of Speed/Position Switching Control Command (XVTP)

(b) Operating state by axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Operating” for each axis. It turns on when it is operating. Operating Data Setting can not be configured while it is running hence configuration will only be configured when it is not running. If you execute Speed/Position Switching Control while it is running, the “error 301” would be appeared.

(c) Error state for each axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Signal from Speed Control by each Axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Speed Control state” for each axis. It turns on when it is operating. Speed/Position Switching Control Setting can only be configured while it is running. If you execute Speed/Position Switching Control while it is not running, the “error 302” would be appeared.

(e) Address of Positioning Module

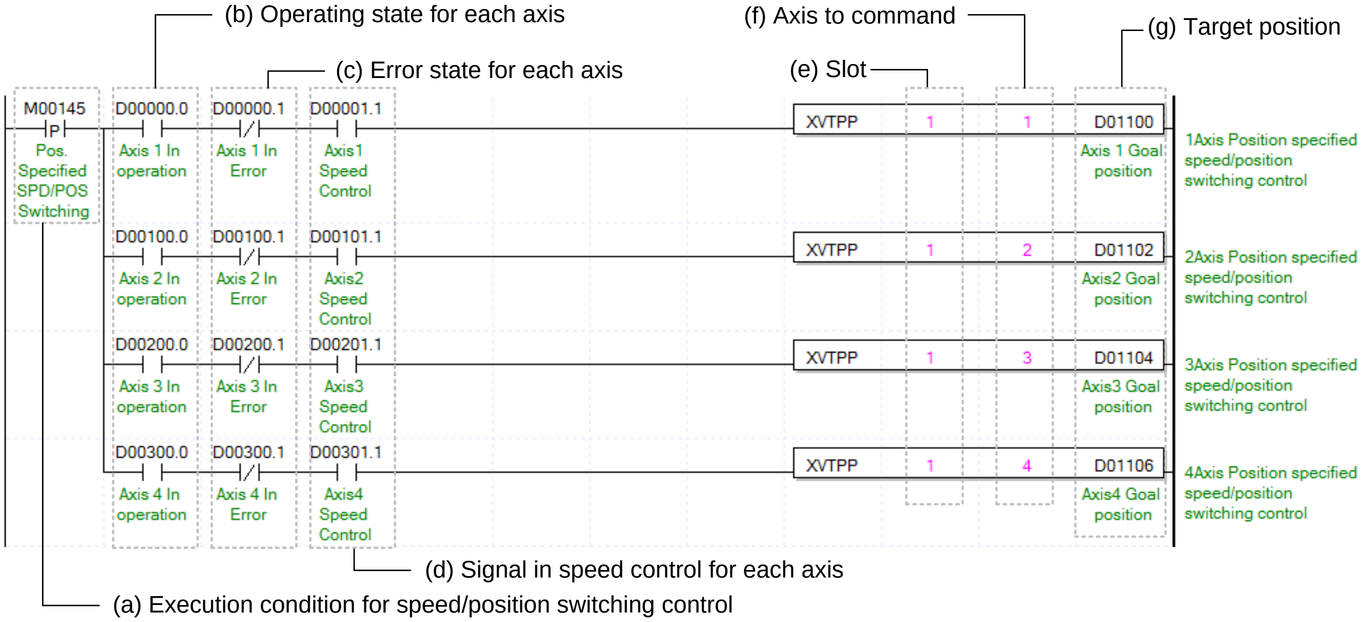
The slot number of embedded positioning is fixed to Slot 1.

(f) Axis of command execution

You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(g) For more information, reference of Speed/Position Switching Control is in the “Chapter 8.2.14.”

(5) Position-specified Speed/Position Control Switching



(a) Condition to perform “position-specified speed/position switching control”

Condition to perform control command (XVTPP) for position-specified speed/position switching

(b) Operation state for each axis

In case that an example program of“8.1.2 Read Current State” is applied, it is a signal showing that each axis is “operating.” If a relevant axis is running, it becomes ‘On’. A condition has been set to make the control command for position specified speed/position switching valid only when the relevant axis is running. If the control command for position specified switching is carried out when the relevant axis is not running, No.301 Error will take place.

(c) Error State for each axis

In case that an example program of“8.1.2 Read Current State” is applied, it is a signal showing “Error State” for each axis. If any error takes place, it becomes ‘On’. A condition has been set to perform a control command only when there is no error with the relevant axis. If the user wants to execute a command regardless of the occurrence of errors, he/she may remove this condition.

(d) Speed Control Signal for each axis

In case that an example program of“8.1.2 Read Current State” is applied, it is a signal showing each axis is “controlling its speed.” If the relevant axis is running under speed control, it becomes ‘On.’ A condition has been set to make the control command for position specified speed/position switching control valid only when the relevant axis is in a speed control status. If the control command is carried out when the relevant axis is not in a speed control status, No.302 Error will take place.

(e) Position of a module

The slot number of embedded positioning is fixed to Slot 1

(f) Axis to make a command

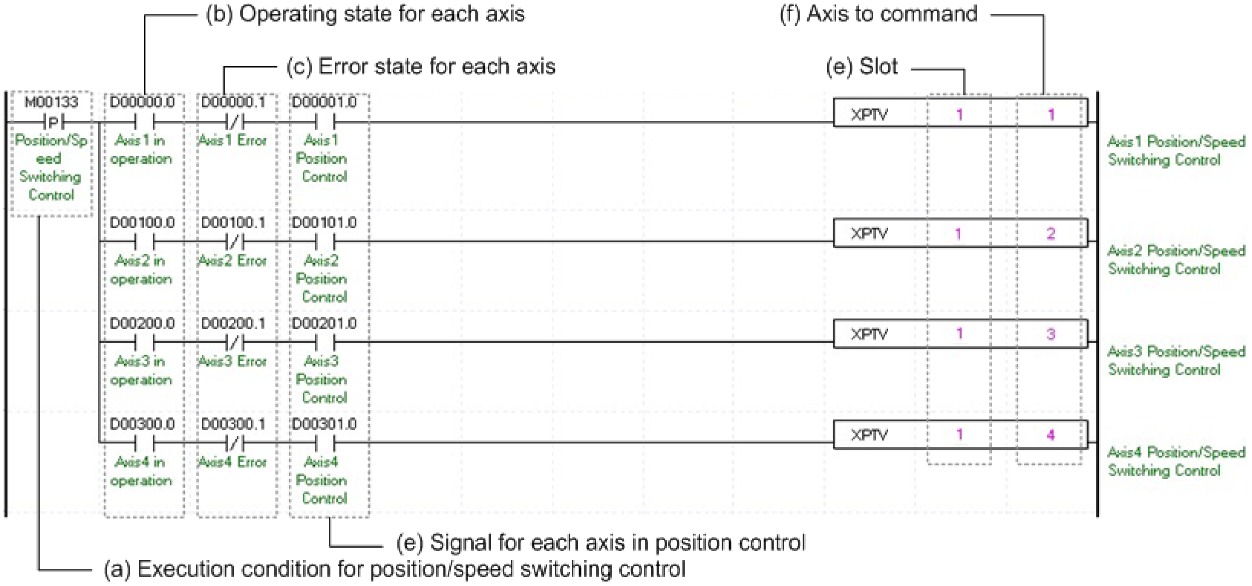
Decide an axis that will execute the control command. Embedded positioning can control up to four axes and assign 1 through 4 referring to 1-axis through 4-axis for this item.

(g) Transfer amount

After the control command for position specified speed/position control switching is executed, convert from speed control to position control and moves by transfer amount.

(h) For details on the operation of position specified speed/position switching control, refer to “position specified speed/position switching control”

(6) Position/ Speed Switching Control



(a) Condition of Position/ Speed Switching Control

Condition of Position/ Speed Switching Control Command (XPTV)

(b) Operating state by axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Operating” for each axis. It turns on when it is operating. Operating Data Setting can not be configured while it is running hence configuration will only be configured when it is not running. If you execute Position/ Speed Switching Control while it is running, the “error 311” would be appeared.

(c) Error state for each axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Signal from Position Control by each Axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Position Control state” for each axis. It turns on when it is operating. Position/ Speed Switching Control Setting can only be configured while it is running. If you execute Position/Speed Switching Control while it is not running, the “error 317” would be appeared.

(e) Address of Positioning Module

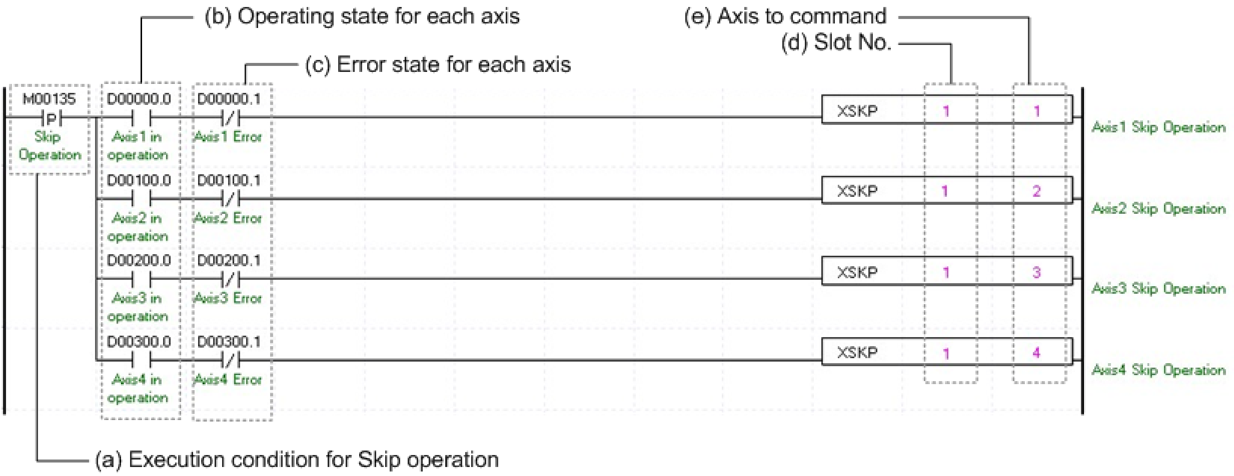
The slot number of embedded positioning is fixed to Slot 1

(f) Axis of command execution

You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(g) For more information, reference of Position/ Speed Switching Control is in the “Chapter 8.2.16.”

### (7) Skip Operation



(a) Condition of Skip Operation

Condition of Skip Operation Command (XSKP) Once Skip Operation is executed, current operation step is stop and will go to operate with next step.

(b) Operating state by axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Operating” for each axis. It turns on when it is operating. Operating Data Setting can not be configured while it is running hence configuration will only be configured when it is not running. If you execute Skip Operation while it is running, the “error 331” would be appeared.

(c) Error state for each axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Address of Positioning Module

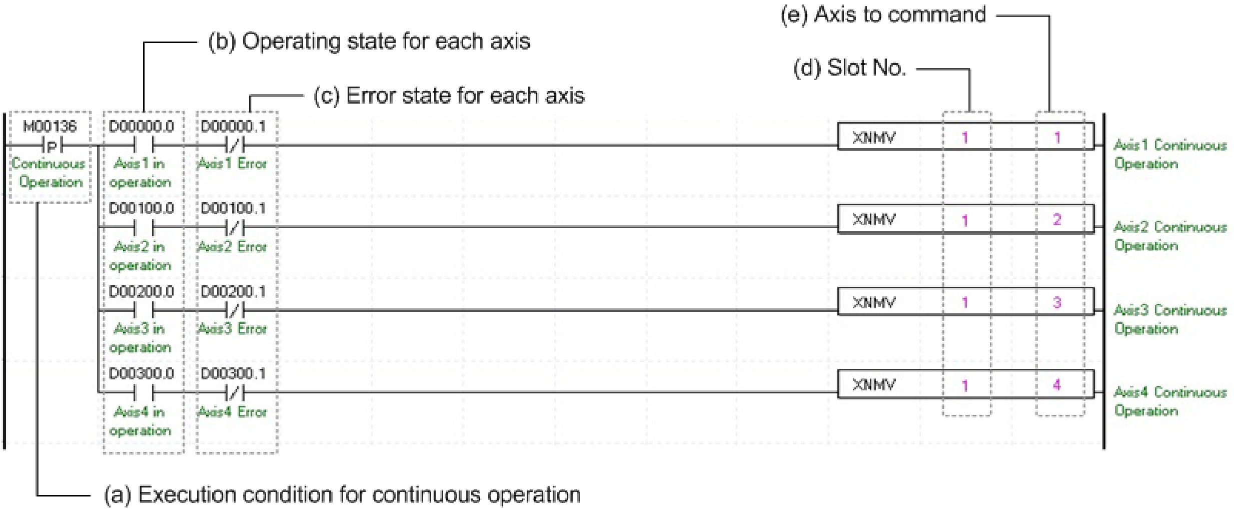
The slot number of embedded positioning is fixed to Slot 1

(e) Axis of command execution

You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(f) For more information, reference of Skip Operation is in the “Chapter 8.5.3”.

(8) Continuous Operation



(a) Condition of Continuous Operation

Condition of Continuous Operation Command (XNMV). Once Continuous Operation is executed, current operation step and next operation step would be operated continuously.

(b) Operating state by axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Operating” for each axis. It turns on when it is operating. Operating Data Setting can not be configured while it is running hence configuration will only be configured when it is not running. If you execute Continuous Operation while it is running, the “error 391” would be appeared.

(c) Error state for each axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Address of Positioning Module

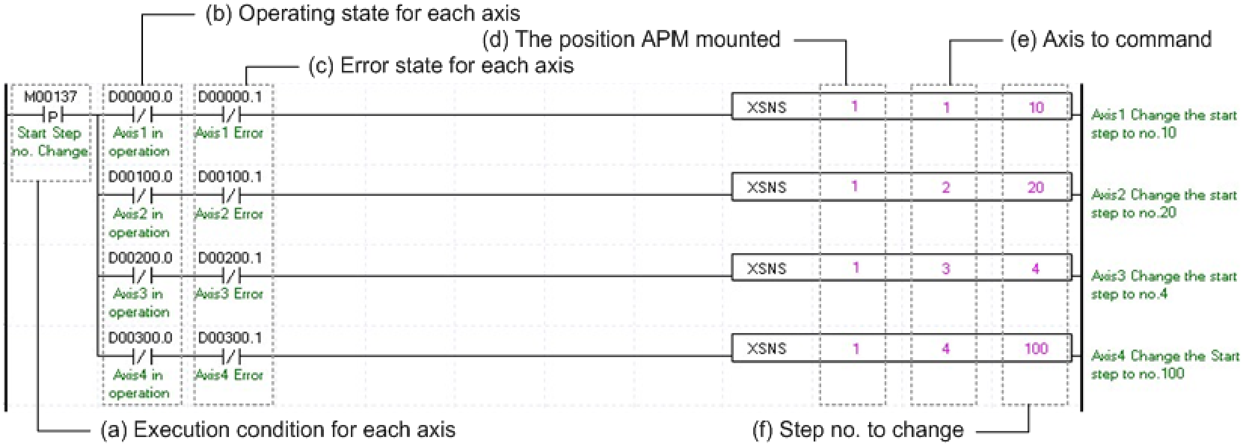
The slot number of embedded positioning is fixed to Slot 1.

(e) Axis of command execution

You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(f) For more information, reference of Continuous Operation is in the “Chapter 8.5.2”.

(9) Current Step Change (Start Step Number Change)



(a) Condition of Current Step Change
   Condition of Current Step Change Command (XSNS). Once Current Step Change is executed, current operation step will move set step.

(b) Operating state by axis
   According to exercise from "Chapter 8.1.2 Current State Reading," it is a signal of "Operating" for each axis. It turns on when it is operating. Operating Data Setting can not be configured while it is running hence configuration will only be configured when it is not running. If you execute Current Step Change while it is running, the "error 441" would be appeared.

(c) Error state for each axis
   According to exercise from "Chapter 8.1.2 Current State Reading," it is a signal of "Error state" for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

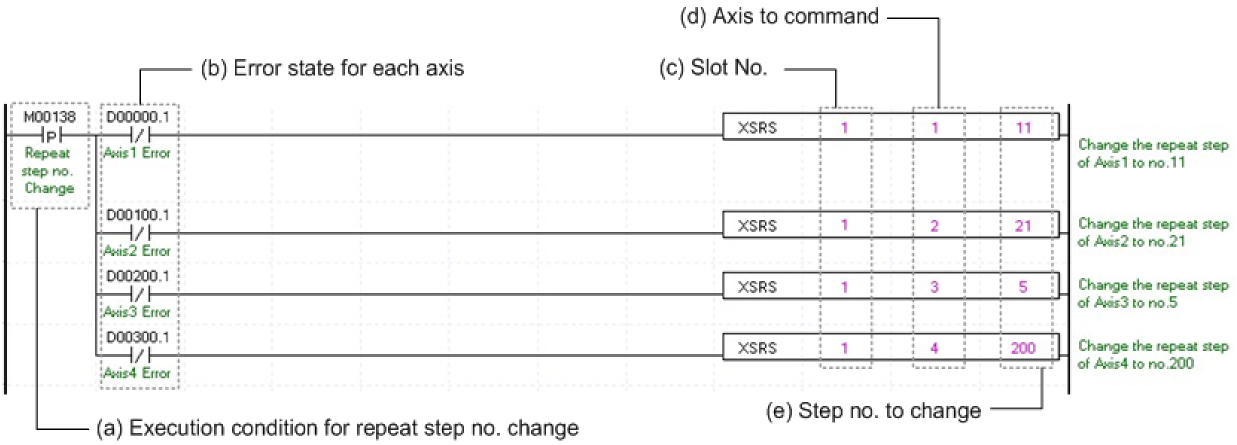
(d) Address of Positioning Module
   The slot number of embedded positioning is fixed to Slot 1.

(e) Axis of command execution
   You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the "execution of axis" from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(f) Change Step Number
   Set change step number by Current Step Change. Embedded positioning support 400 step operation data for each Axis. Therefore, the range of step number setting of Current Step Change is 1~400.

(g) For more information, reference of Current Step Change is in the "Chapter 8.5.9."

(10) Repeat Step No. Change



(a) Condition of Repeat Step No. Change

Condition of Repeat Step No. Change Command (XSRS). Once Repeat Step No. Change is executed, current operation step will move set step. It will execute an operation when set of Operation Method is “Repeat.”

(b) Error state for each axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(c) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

(d) Axis of command execution

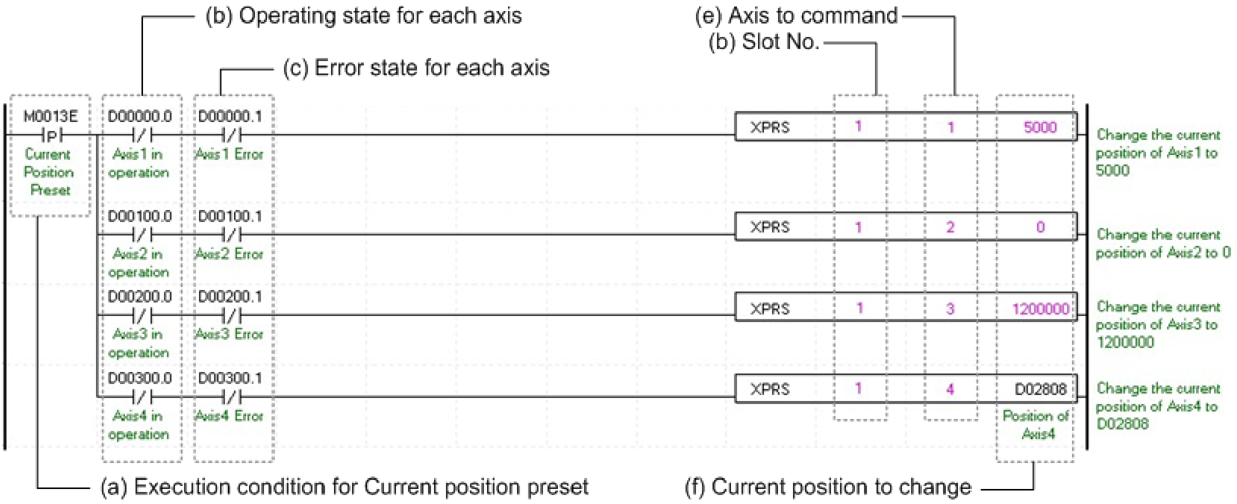
You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(e) Change Step Number

Set change step number by Current Step Change. Embedded positioning support 400 step operation data for each Axis.Therefore, the range of step number setting of Current Step Change is 1~400.

(f) For more information, reference of Repeat Step No. Change is in the “Chapter 8.5.10.”

### (11) Current Position Preset



(a) Condition of Current Position Preset

Condition of Current Position Preset Command (XSNS). Once Current Position Preset is executed, current operation step will move to set step. If the origin has not set yet, the origin would be set to origin decided.

(b) Operating state by axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Operating” for each axis. It turns on when it is operating. Operating Data Setting can not be configured while it is running hence configuration will only be configured when it is not running. If you execute Current Position Preset while it is running, the “error 451” would be appeared.

(c) Error state for each axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(d) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

(e) Axis of command execution

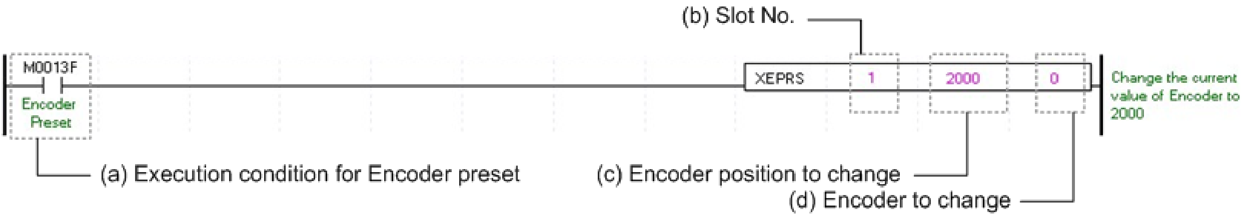
You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(f) Change Current Position

Set change current position by Current Position Preset. Unit follows the value from “Unit” of basic parameter.

(g) For more information, reference of Current Position Preset is in the “Chapter 9.5.7.”

(12) Encoder Preset



(a) Condition of Encoder Preset
Condition of Encoder Preset Command (XEPRS). Once Encoder Preset is executed, current operation step will move to set step.

(b) Address of Positioning Module
The slot number of embedded positioning is fixed to Slot 1.

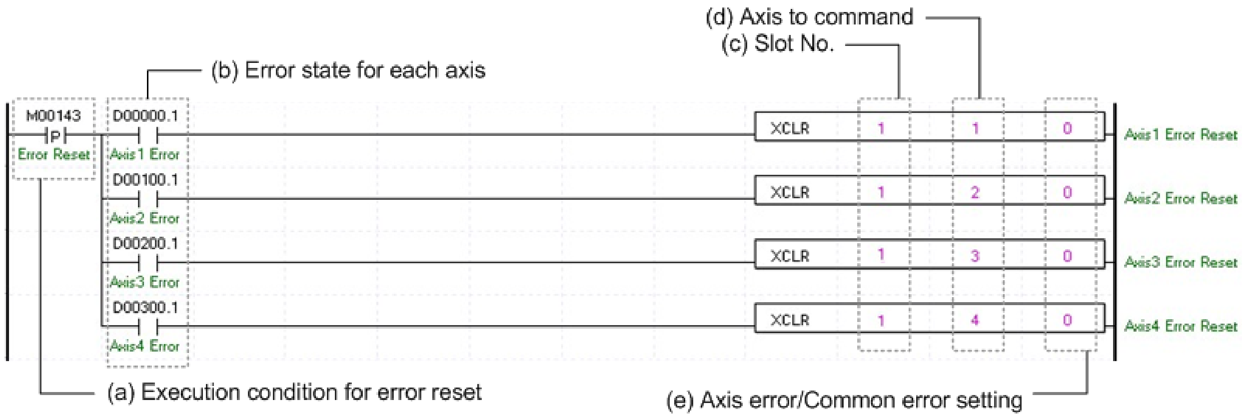
(c) Changing Encoder Position
Set for Changing Encoder Position

(d) Changing Encoder
Set Changing Encoder to execute a preset.

(e) For more information, reference of Encoder Preset is in the “Chapter 9.5.8.”

## 8.1.7 Error

(1) Error Reset



(a) Condition of Error Reset

Condition of Error Reset Command (XCLR). Once Error Reset is executed, it erases errors of module form each axis.

(b) Error state for each axis

According to exercise from “Chapter 8.1.2 Current State Reading,” it is a signal of “Error state” for each axis. It turns on when an error occurred. Operation will only work when there is no error. If you want to operate a system regardless of errors, you can just inactivate the function.

(c) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

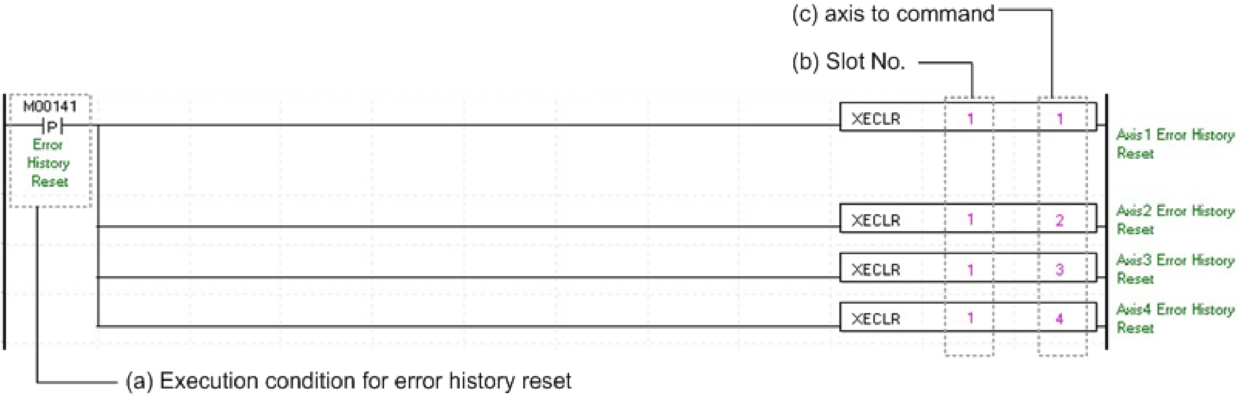
(d) Axis of command execution

You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(e) Error setting of Error/Common by axis

Setting for type of errors. XBM-DXXXHP series always set as “0.”

(2) Error History Reset



(a) Condition of Error History Reset

Condition of Error History Reset Command (XECLR). Once Error Reset is executed, it erases history of generated errors of module. XBM-DXXXHP series has ten error histories by each axis. It will be saved to Flash memory, remain still even there is no power.

(b) Address of Positioning Module

The slot number of embedded positioning is fixed to Slot 1.

(c) Axis of command execution

You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through axis 4.

# Chapter 9 Functions

## 9.1 Homing

Homing is carried out to confirm the origin of the machine when applying the power. In case of homing, it is required to set homing parameter per axis. If the origin position is determined by homing, the origin detection signal is not recognized during positioning operation.

### 9.1.1 Homing method

(1) Methods using DOG signal

(a) Origin detection after DOG "Off" (0:DOG /HOME(Off))
(b) Origin detection after deceleration when DOG "On" (1: DOG /HOME(On))
(c) Origin detection by DOG (3: DOG)

(2) Methods without using DOG signal

(a) Origin detection by Home and upper/lower limit (2: U.L.Limit /Home)
(b) High speed Homing (4: High speed)
(c) Origin detection by upper/Lowerlimit (5: Upper/Lower limit)
(d) Origin detection by Home (6: Home)
※() is homing parameter selection item of XG-PM software package.

### 9.1.2 Parameters for Homing

(1) Home position
(2) Home high speed
(3) Home low speed
(4) Homing acceleration time
(5) Homing deceleration time
(6) Homing dwell time
(7) Origin compensation amount
(8) Homing reset waiting time
(9) Homing mode
(10) Homing Direction
※ For further information about homing parameters and setting value, please refer to Chapter 5.

**NOTE**

Homing is performed by receiving signals generated from the outside while rotating the motor. When the final origin complete signal is input, the home position is completed after stopping. The signals required for home return are shown below.

(1) HOME signal: It is used as operating sequence and final origin confirmation signal when detecting origin after approximate origin Off, origin detection after deceleration when approximate origin On, origin detection by origin and upper / lower limit, origin detection by origin. To use the origin signal, specify the P device to be mapped to the origin signal of the external signal parameter and set the corresponding contact level to A contact or B contact. The P device that can be mapped to the origin signal is the high-performance XBM's built-in input P

(2) Dog signal: This is the signal used for the operating sequence when determining the home position by the approximate origin method in the homing method. In particular, it is used as the final origin determination signal in the home position detection operation by the near home position. To use the approximate origin signal, specify the P device to be mapped to the approximate origin signal of the external signal parameter and set the corresponding contact level to A contact or B contact.

(3) Upper/lower signal: Used to check the upper and lower limits of the machine coordinate during home return. In particular, it is a signal used for the operation sequence when detecting the origin by the origin and the upper / lower limit, and the origin by the upper / lower limit. To use the upper / lower limit signal, specify the P device to be mapped to the upper / lower limit signal of the external signal parameter and set the corresponding

(4) Deviation clear signal: This signal is used to cancel the residual pulse of servo drive after completion of origin determination. Since the servo drive must output a deviation count clear signal before outputting all residual pulses, use the high-performance XBM built-in output as the P device to be mapped to the deviation counter clear signal as much as possible. When using the P contact output of the extension module, the output time may not be constant depending on the position control cycle and the corresponding

## 9.1.3 Origin Detection after DOG Off (0: DOG /HOME(Off))

This is the method using the DOG and HOME signal and the action by homing command is as follows.

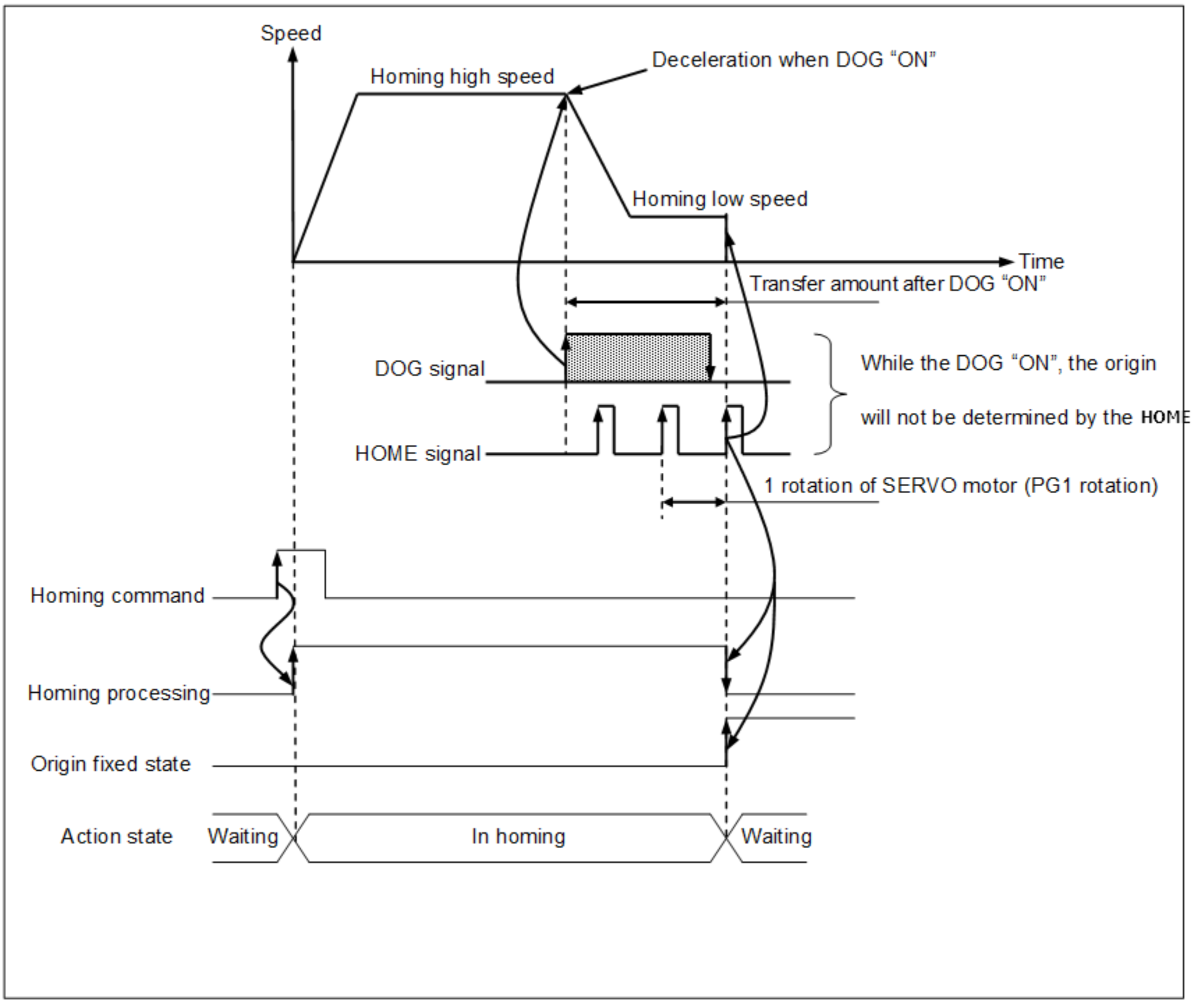
### (1) Operation

(a) Accelerates to the setting homing direction and acts by homing high speed.

(b) At the rising edge DOG signal it decelerates and acts by homing low speed.

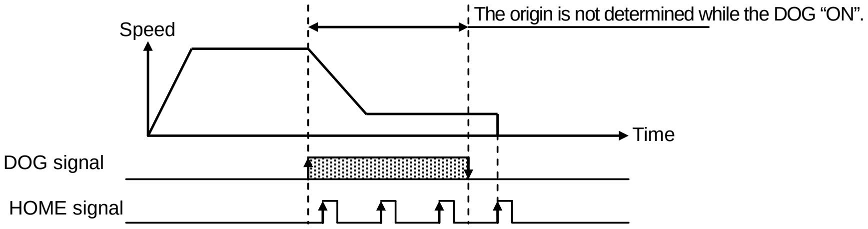
(c) If HOME signal is entered after the DOG signal has changed from “On” to “Off”, the origin shall be determined and it stops pulse output.

■ Operating Pattern

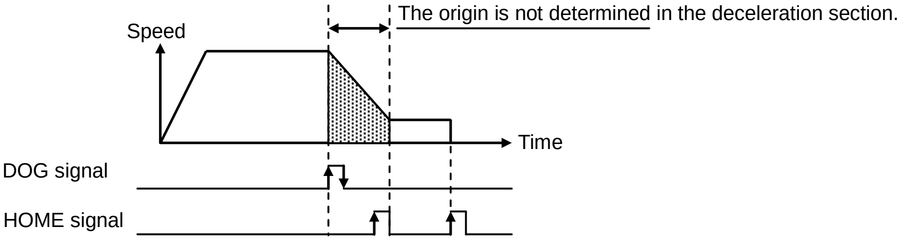


**NOTE**

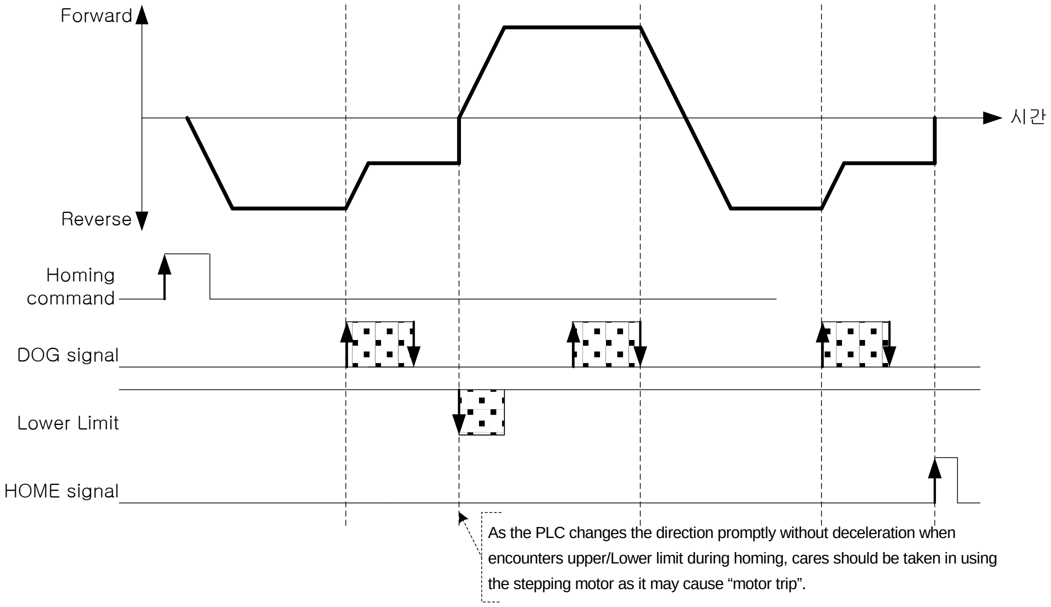
1. While DOG signal maintains “On”, the origin will not be determined by HOME signal.
   That is, when DOG signal changes from “Off” to “On”(acceleration section -> homing high speed) , from “On” to “Off” (deceleration section -> homing low speed) and then when the HOME changes from “Off” to “On”, the origin will be determined.



2. While the homing speed acts to the deceleration section by homing high speed after the DOG signal is changed from “Off” to “On”, from “On” to “Off”, the origin will not be determined even if encounters the HOME input.

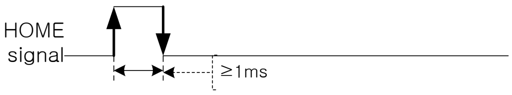


3. If the DOG signal is changed from “Off” to “On”, from “On” to “Off” and encounters external upper/lower limit while waiting the HOME input, the action is as follow.



As the PLC changes the direction promptly without deceleration when encounters upper/Lower limit during homing, cares should be taken in using the stepping motor as it may cause “motor trip”.

4. If “On” time of the origin is too short, the positioning module can not recognize it.



### 9.1.4 Origin Detection after Deceleration when DOG On(1: DOG /HOME(On))

This is the method using the DOG and HOME signal and the action by homing command is as follows.

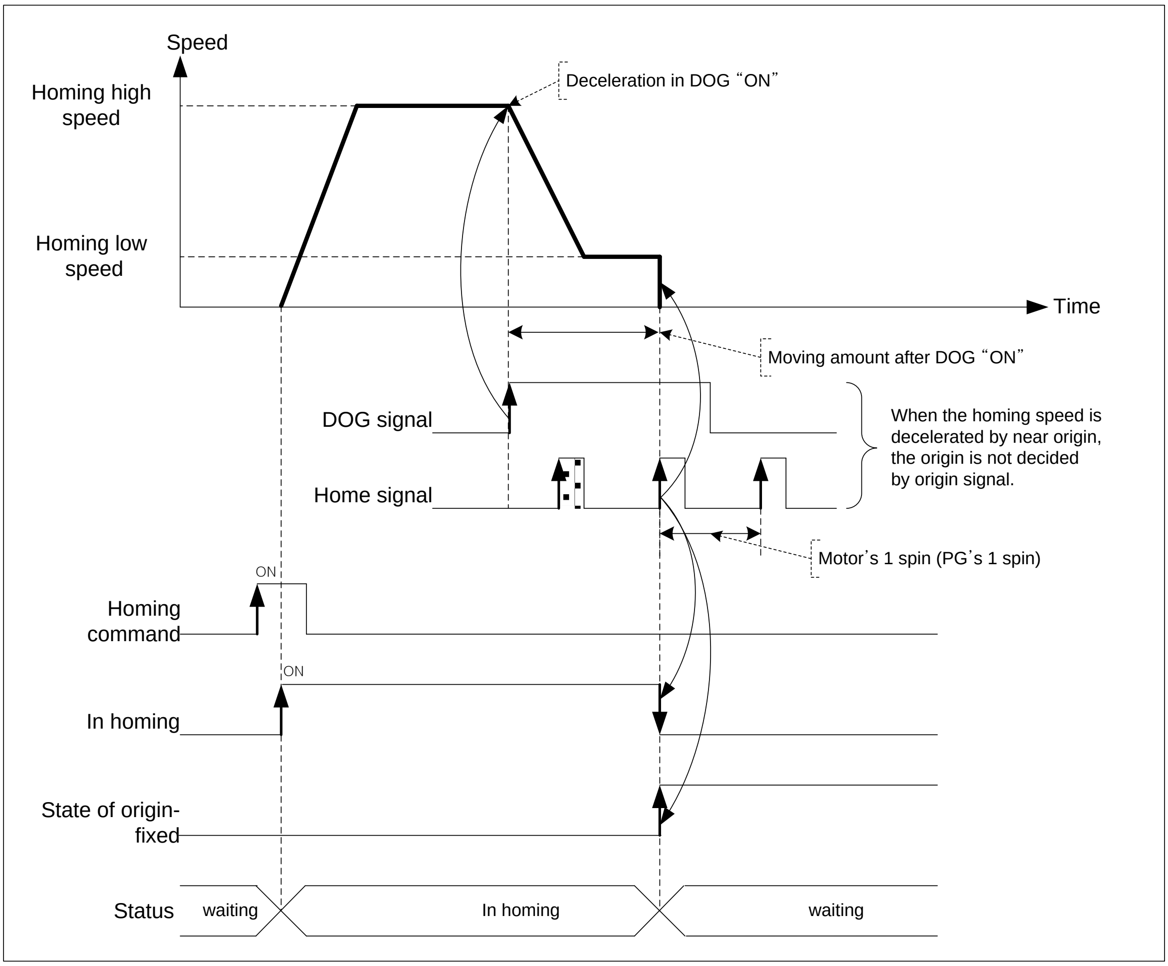
(1) Operation

(a) Accelerates to the setting homing direction and acts by homing high speed.

(b) At the rising edge DOG signal it decelerates and acts by homing low speed.

(c) while the DOG signal is "On" and the homing low speed is active, the origin shall be determined if HOME signal is entered.

■ Operating Pattern



**Note**

1. Once the DOG signal is "On", when the homing speed acts from high speed to low speed via deceleration section, if the HOME is entered in the state that the DOG signal is "ON", the origin will be determined promptly. That is, The origin will not be determined by the HOME signal during the decelerating.

2. When encounters the Upper/Lower limit signal before HOME after the DOG signal has changed from "Off" to "On", the action will be the same as the method of Article 9.1.3

3. If "On" time of HOME signal is short, the positioning module can not recognize it.

## 9.1.5 Origin Detection by Origin and High/Low Limit (2: U.L Limit/Home)

This is the method using the DOG and HOME and the action by homing command is as follows.

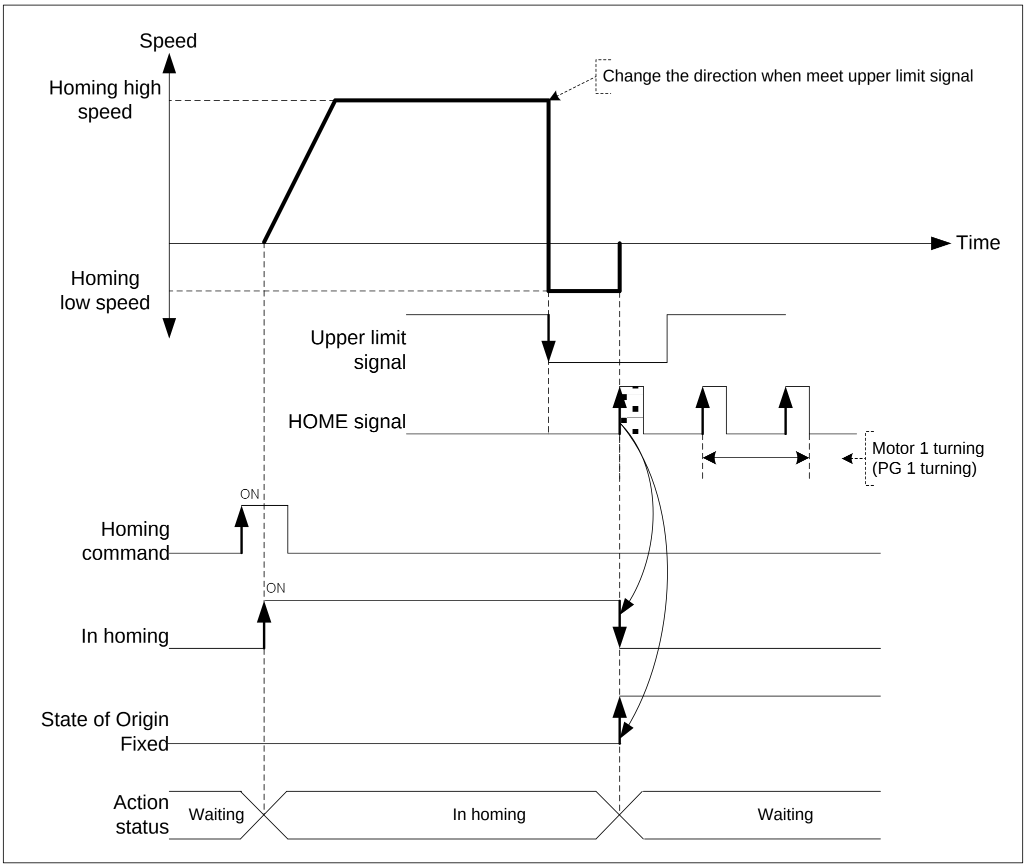
### (1) Operation

(a) Accelerates to the setting homing direction and acts by homing high speed.

(b) If Upper/Lower signal is entered, it transferred to opposite direction and acts by homing low speed.

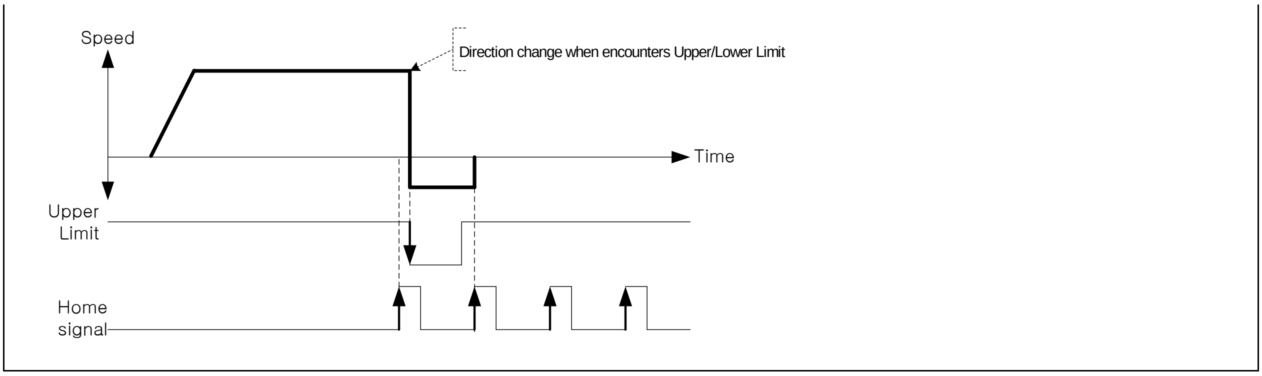
(c) If encounters the HOME signals while the homing low speed is active, the origin would be determined and it stops..

■ Operating Pattern



**Note**

In case that HOME signal is “ON” before entering the Upper/Lower limit signal, it carries out the homing low speed operation when the Upper/Lower limit signal is entered and when HOME is “ON”, the origin will be determined



## 9.1.6 Origin Detection by DOG signal (3: DOG)

This is used when determines the origin only by using the DOG signal.

### (1) Operation

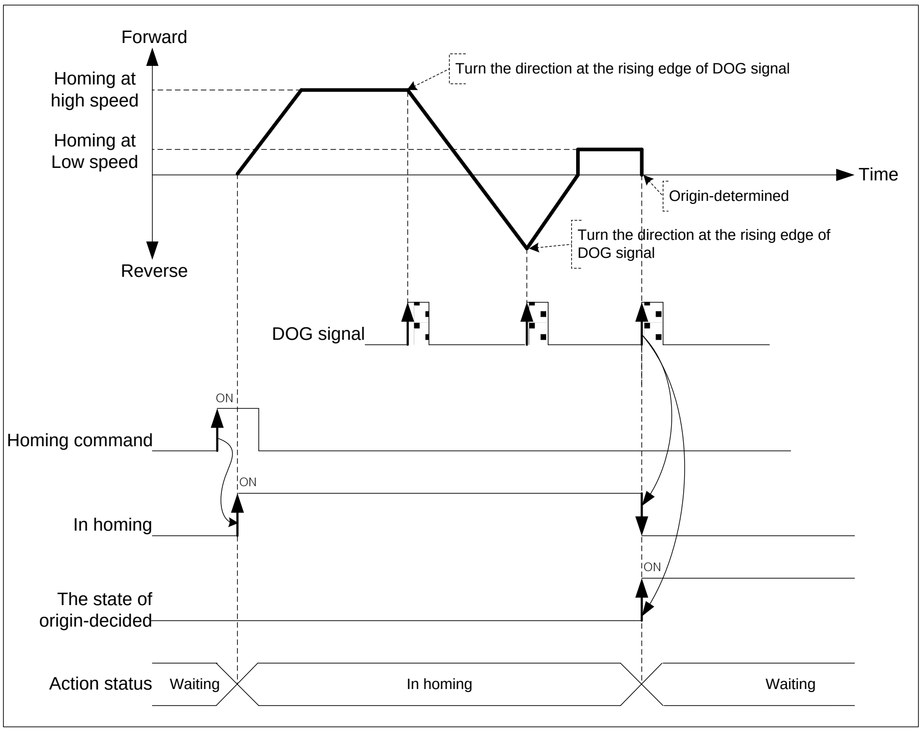
(a) Accelerates to the setting homing direction and acts by homing high speed.

(b) If DOG signal is entered, it decelerates and transferred to opposite direction acts by homing high speed.

(c) When it operates in opposite direction, if DOG is entered again, it decelerates and transferred to opposite direction and acts by homing low speed.

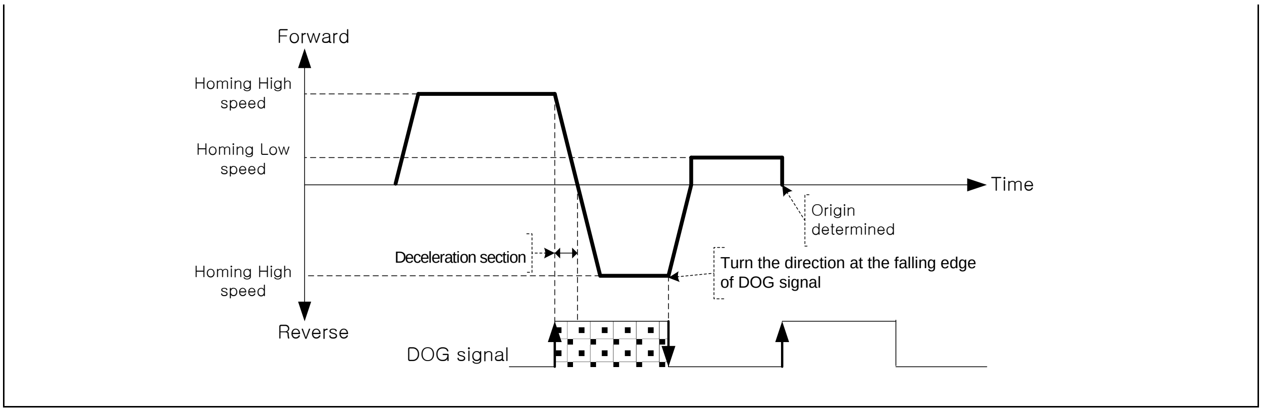
(d) If encounters the DOG signals again while the homing low speed is active, the origin would be determined and it stops..

■ Operating Pattern



**Note**

If "ON" time of DOG is longer than deceleration time, the action is as follows.



## 9.1.7 High Speed Homing (4: High Speed)

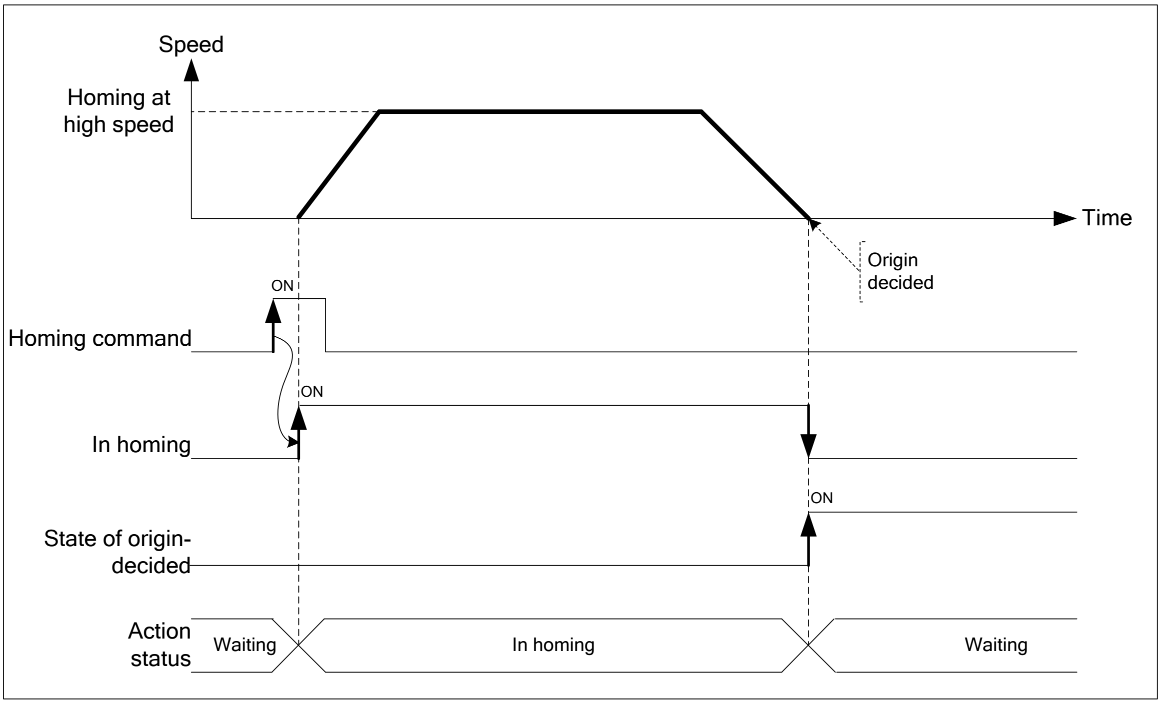
High speed origin detection is one of the homing methods that returns to the origin determination position without detection of external signal (DOG, HOME, Upper/Lower limit) when returning to the mechanical origin position after completion of the mechanical homing.

### (1) Operation

(a) Once Homing command executes, it operates positioning with high speed and homing from current position

(b) When using High speed homing, it should be carried out in the state that the positioning by 6 types of mechanical homing, by floating origin, or by the current position preset is completed in advance.

■ Operating Pattern



### 9.1.8 Origin Detection by Upper/Lower Limit (5: Upper/Lower Limit)

This is the homing method using the Upper/Lower limit signal and is used when not using the HOME or DOG signal .

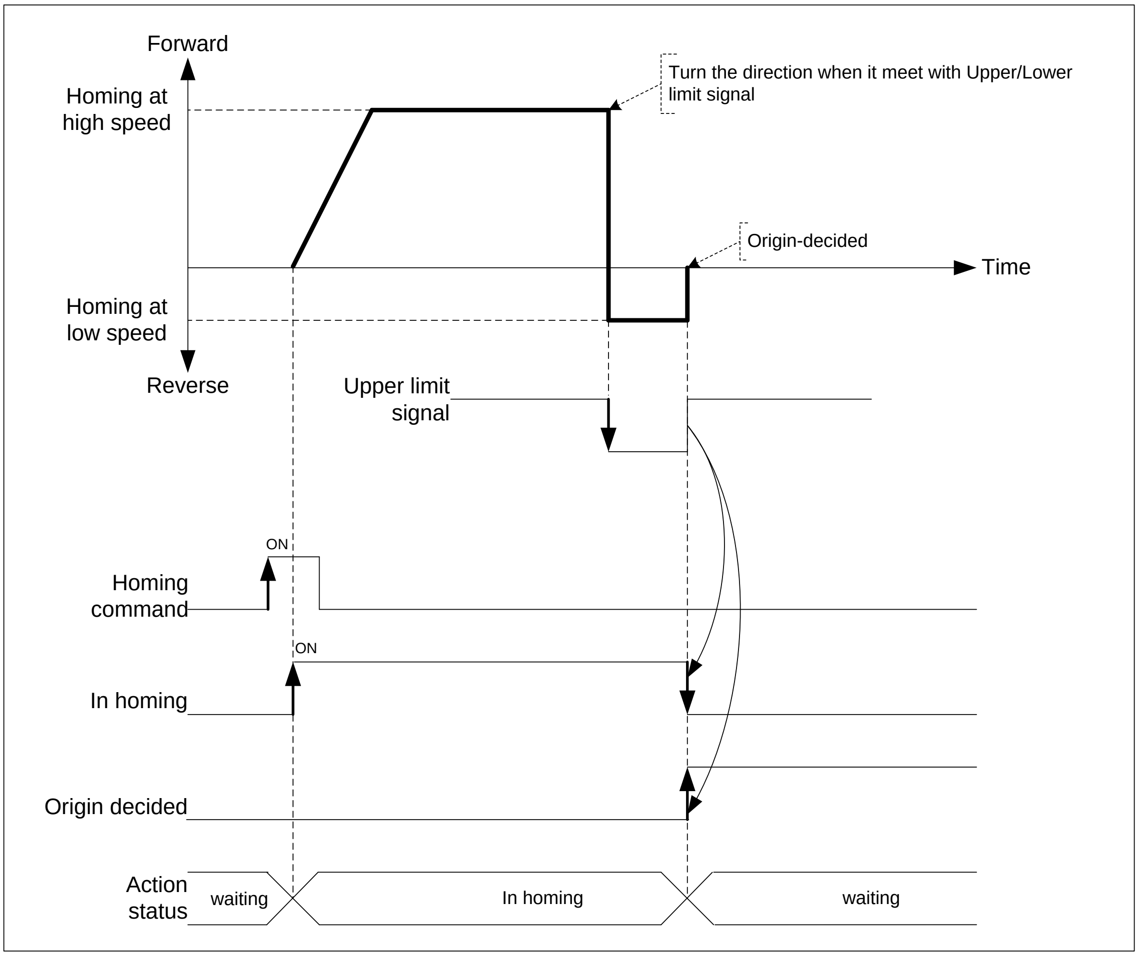
(1) Operation

(a) It accelerates to the setting homing direction and acts by homing high speed.

(b) If Upper/Lower limit signal is entered, it transferred to opposite direction and acts by homing low speed.

(c) If Upper/Lower limit signal is turned off while the homing low speed is active, the origin would be determined and it stops.

■ Operating Pattern



## 9.1.9 Origin Detection by HOME (6: Home)

This is used when determines the origin only by using the HOME signal.

### (1) Operation

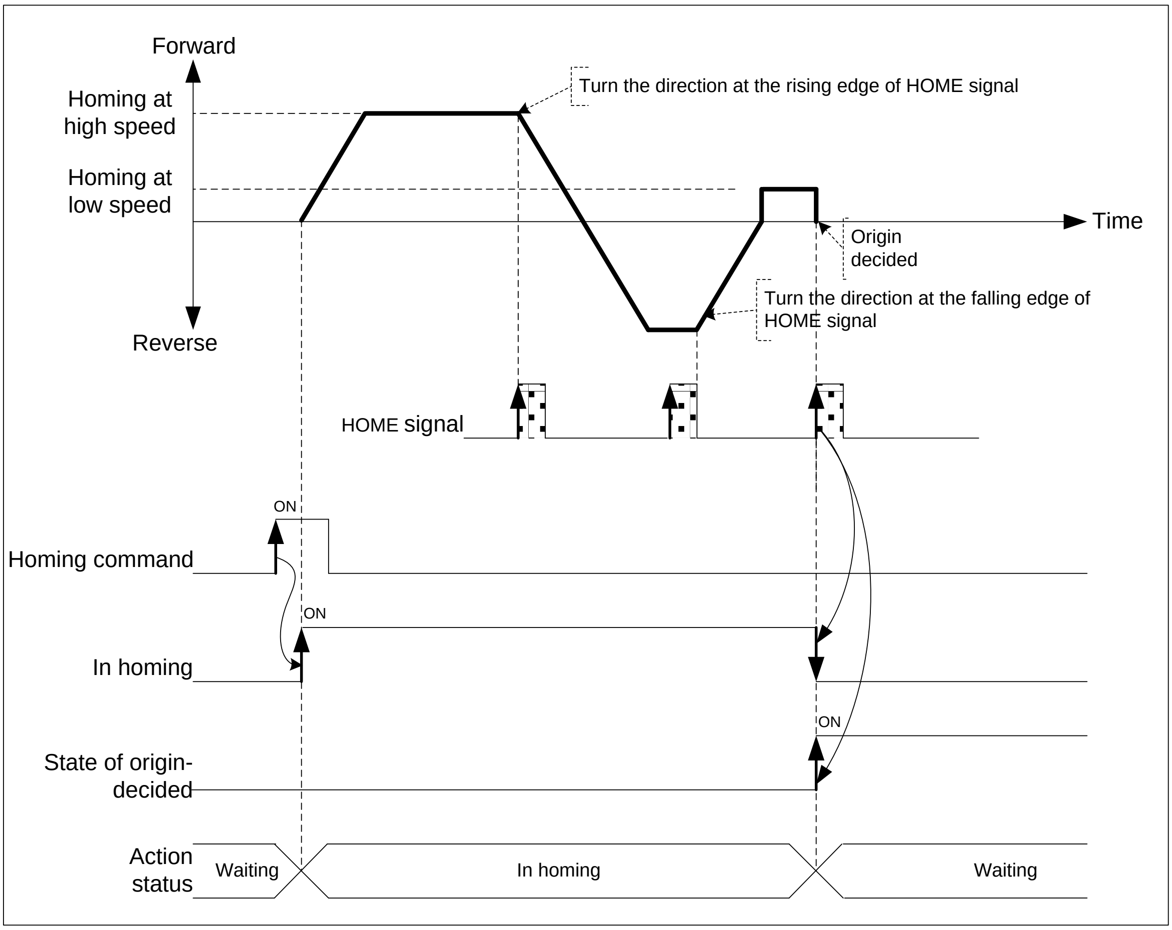
(a) It accelerates to the setting homing direction and acts by homing high speed.

(b) In this case, if HOME signal is entered, it decelerates and transferred to opposite direction acts by homing high speed.

(c) When it operates in opposite direction, if HOME is entered again, it decelerates and transferred to opposite direction and acts by homing low speed.

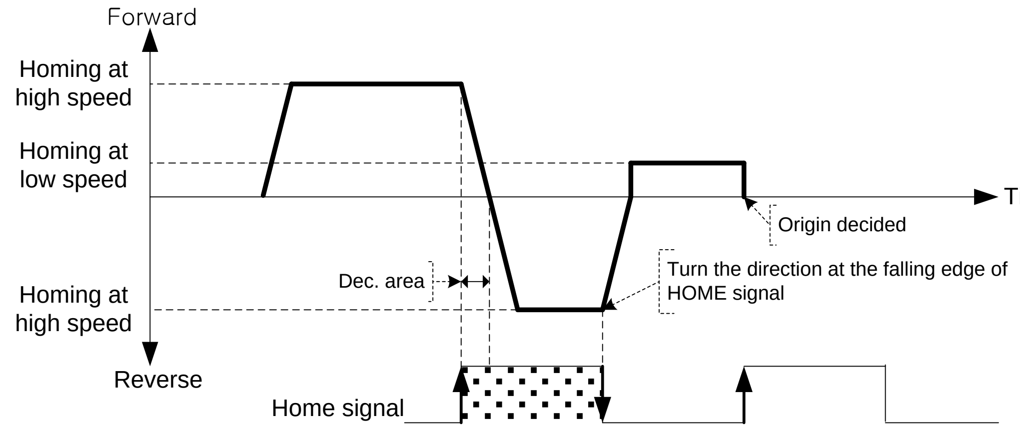
(d) If encounters the HOME signals again, the origin would be determined and it stops.

■ Operating Pattern

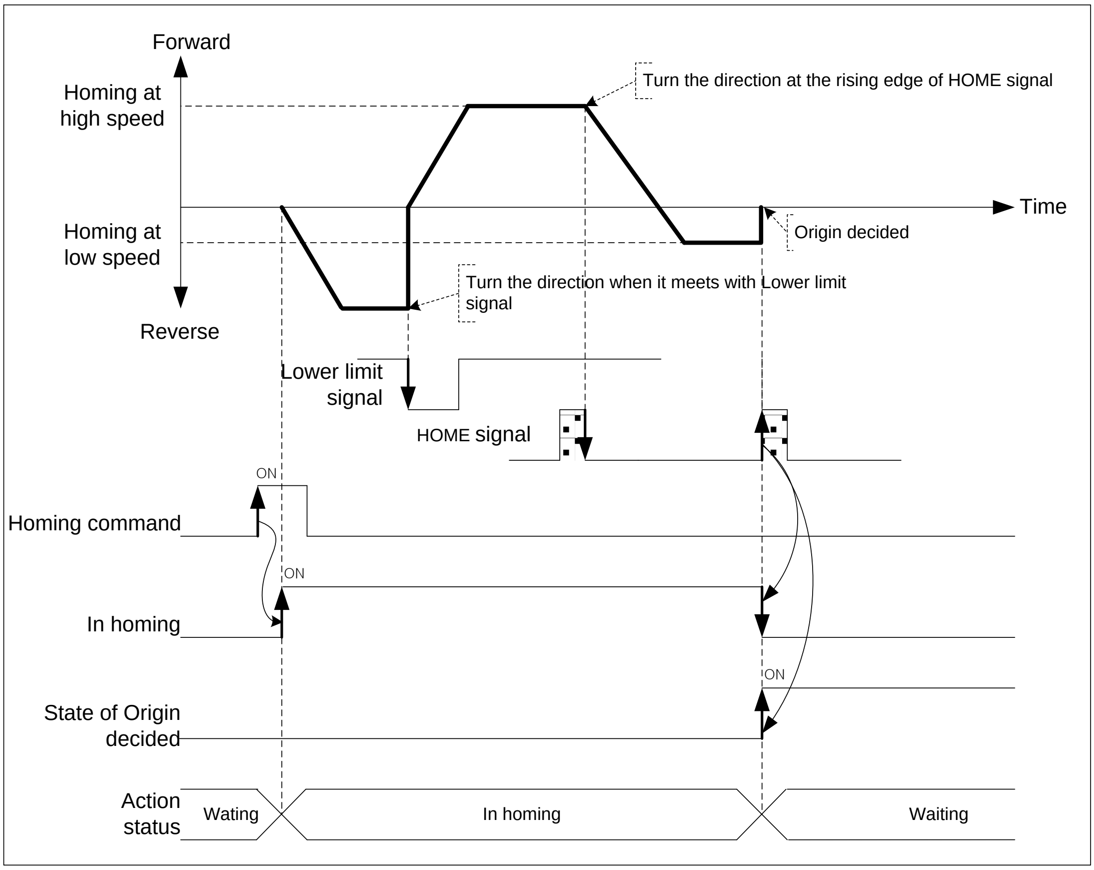


**Note**

1. If “ON” time of DOG is longer than deceleration time, the action is as follows



2. It acts as follows if Lower limit (if homing direction is forward, upper limit) signal is entered before HOME signal is entered..



## 9.2 Positioning Control

Positioning control execute using data which set on the 「Operation Data」. Positioning Control includes Single-axis Position control, Single-axis Speed Control, Single-axis Feed Control, Interpolation control, Speed/Position Switching control, Position/Speed Switching control.

| Positioning Control | | Control Method | Operation |
|---|---|---|---|
| Positioning Control | Single-axis Position Control | Absolute, Single-axis Position Control<br>Incremental, Single-axis Position Control | Specified axis executes positioning control from the beginning (current position) to the goal position. |
| | Single-axis Feed Control | Absolute, Single-axis Feed Control<br>Incremental, Single-axis Feed Control | The starting position (the current stop position), changes to 0 and executes positioning control as much as setting amount of movement. . |
| | Linear Interpolation | Absolute, Linear Interpolation<br>Incremental, Linear Interpolation | Executing linear interpolation control by using starting address (current stop position) from the axis (2 axes or more) to the target position. |
| | Circular Interpolation | Absolute, Circular Interpolation<br>Incremental, Circular Interpolation | Execute positioning control until goal position by the trajectory of arc and control sub-axis as using axis-2 according to data of main axis. |
| | Helical Interpolation | | Set by helical interpolation axis, execute linear interpolation control until goal position by the trajectory of arc and control sub-axis as using axis-3 according to data of main axis. |
| | Ellipse Interpolation | | Execute positioning control until goal position by trajectory angle of the ellipse is set to operate and control sub-axis as using axis- 2 according to data of main axis. |
| Speed Control | | Absolute, Single-axis Speed Control<br>Incremental, Single-axis Speed Control | Execute Speed control as setting speed until deceleration stop command is entered. |
| Speed/Position Switching Control | | Absolute, Single-axis Speed Control<br>Incremental, Single-axis Speed Control | Speed controlling and then speed / position switching command or speed / position control switching input signal is entered, speed control switch to position control and execute positioning control as much as target position. |
| Position/Speed Switching Control | | Absolute, Single-axis Position Control<br>Incremental, single-axis Position Control | Position controlling and then position / speed switching command is executed, position control switch to speed control and execute speed control as setting speed until deceleration stop command is entered. |

### 9.2.1 Operation Data for Positioning Control

Describe the Operation data and Setting to execute positioning control.

| Operation Data | Setting |
|---|---|
| Control Method | Set the Type of control and Standard coordinates of Positioning control. |
| Operation Method | Set the control method of continuous operation data. |
| Goal Position | Set the absolute target position or distance of positioning control. |
| Operation Speed | Set the value of operation speed during operation control. |
| Acceleration Number | Set the operation number of operation control during acceleration time.<br>Acceleration Number is selected from basic parameters which are Acceleration Number1, 2, 3, and 4. |
| Deceleration Number | Set the operation number of operation control during deceleration time.<br>Deceleration Number is selected from basic parameters which are Deceleration Number1, 2, 3, and 4. |
| M Code | Set the M Code when using the code number for sub operation of positioning control. |
| Dwell Time | After complete the positioning control, set the time until servo drive complete positioning control. |
| Sub Axis Setting | Set the sub axis during interpolation control. |
| Circular Interpolation | Set the secondary data (middle point, center point and radius) during circular interpolation. |
| Circular Interpolation Mode | Set the generating method of arc (middle point, center point and radius) during circular interpolation. |
| Circular Interpolation Turn Number | Set the number of arcs to draw during circular interpolation. |
| Helical Interpolation | Set the axis to run linear operation during helical interpolation. |

**Note**

It is available to set the operation data each of 1~400 steps and axis1~6.

### 9.2.2 Operation mode of Positioning Control

Operation mode describes various configurations for how to operate the positioning data using several operation step no. and how to determine the speed of position data.

Operation mode types are as follows

| Control Method | Operation Method | Operation Pattern | Executable | Operation |
|---|---|---|---|---|
| Single-axis Position Control | Single | End | ○ | Finish after the completion of the current step position control |
| | | Keep | ○ | Continue to the next step after the completion of the current step position control |
| | | Continuous | ○ | Continue to the next step continuously without stop. |
| | Repeat | End | ○ | Change the step No. to the Repeat step No. after the completion of the current step position control. |
| | | Keep | ○ | Continue to the repeat step No. after the completion of the current step position control |
| | | Continuous | ○ | The current step and the repeat step No. continuously without stop |
| Single-axis Speed Control | Single | End | ○ | Speed control using current step's DATA |
| | | Keep | ○ | Speed control using current step's DATA.<br>If VTP command executed, continue to the next step after the completion of the current step's positioning. |
| | | Continuous | X | Errors |
| | Repeat | End | ○ | Speed control using current step's DATA |
| | | Keep | ○ | Speed control using current step's DATA.<br>If VTP command executed, continue to the repeat step No. after the completion of the current step's positioning. |
| | | Continuous | X | Errors |
| Single-axis FEED Control | Single | End | ○ | Finish after the completion of the current step's FEED control |
| | | Keep | ○ | Continue to the next step after the completion of the current step FEED control |
| | | Continuous | X | Errors |
| | Repeat | End | ○ | Change the step No. to the Repeat step No. after the completion of the current step FEED control. |
| | | Keep | ○ | Continue to the repeat step No. after the completion of the current step FEED control |
| | | Continuous | X | Errors |
| Linear Interpolation | Single | End | ○ | Finish after the completion of the current step's linear interpolation |
| | | Keep | ○ | Continue to the next step after the completion of the current step s linear interpolation |
| | | Continuous | ○ | Continue to the next linear interpolation step continuously without stop |
| | Repeat | End | ○ | Change the step No. to the Repeat step No. after the completion of the current step linear interpolation. |
| | | Keep | ○ | Continue to the repeat step No. after the completion of the current step s linear interpolation |
| | | Continuous | ○ | The current linear interpolation and the repeat step No. continuously without stop |
| Circular Interpolation | Single | End | ○ | Finish after the completion of the current step's circular interpolation |
| | | Keep | ○ | Continue to the next step after the completion of the current step s circular interpolation |
| | | Continuous | ○ | Continue to the next circular interpolation step continuously without stop |
| | Repeat | End | ○ | Change the step No. to the Repeat step No. after the completion of the current step circular interpolation. |
| | | Keep | ○ | Continue to the repeat step No. after the completion of the current step s circular interpolation |
| | | Continuous | ○ | The current circular interpolation and the repeat step No. continuously without stop |

**Note**

1. Operation mode shall be set from PLC Program or Operation data of XG-PM.
2. Operation data can be set up to 400 from operation step no. 1 ~ 400 at each axis.
3. With one time start command, positioning operation method by one operation step positioning data and positioning operation method by several operation step in order shall be determined by operation mode of each positioning data set.

3. With one time start command, positioning operation method by one operation step positioning data and positioning operation method by several operation step in order shall be determined by operation mode of each positioning data set.

4. when executing continuous operation, The continuous operation item of common parameter must be set to “Enable”. if Continuous Operation parameter is disabled, Continuous operation command can not be executed

(1) End Operation (Single)

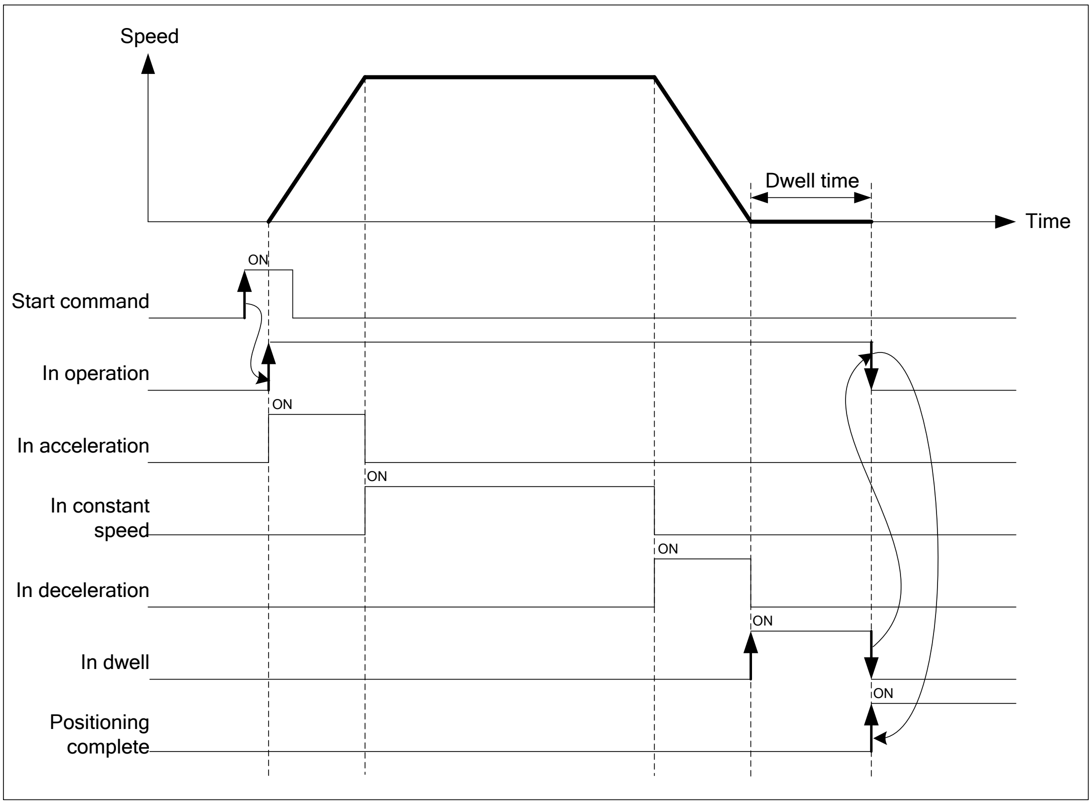
(a) With one time start command, the positioning to the goal position is executed and the positioning shall be completed at the same time as the dwell time proceeds.

(b) The positioning completion of this operation mode can be used as operation mode of last positioning data of Keep operation mode and Continuous operation mode.

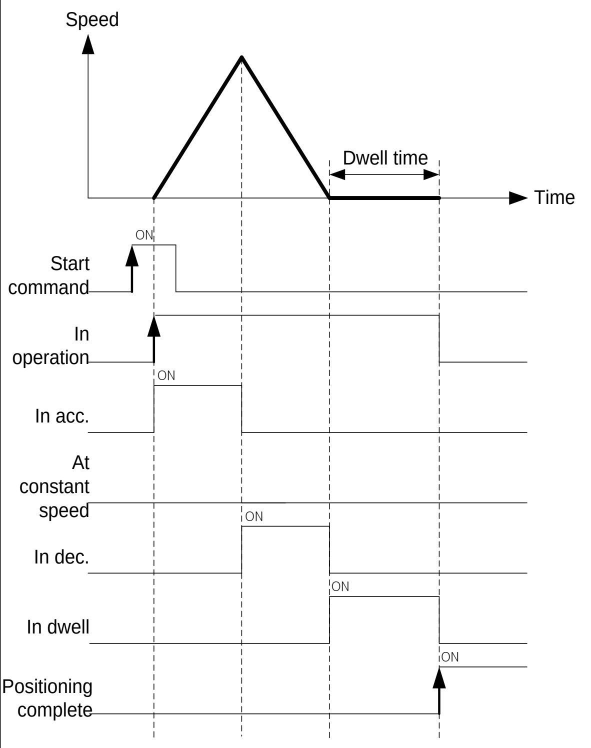
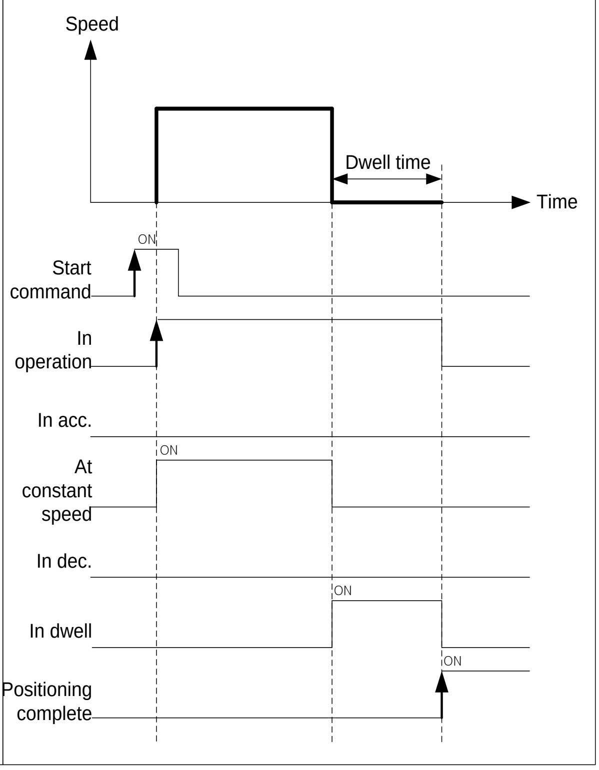
(c) Operation direction shall be determined by the value of address.

(d) Operation action is trapezoid(or S-Curve) type operation that has acceleration, constant, deceleration section according to the setting speed and position data but the operation pattern according to the setting value is as follows.

1) Normal Operation Patterns



### 2) Abnormal Operation Patterns

| When moving amount is very small. | When Acc. time = 0, Dec. time = 0 |
|---|---|
|  |  |

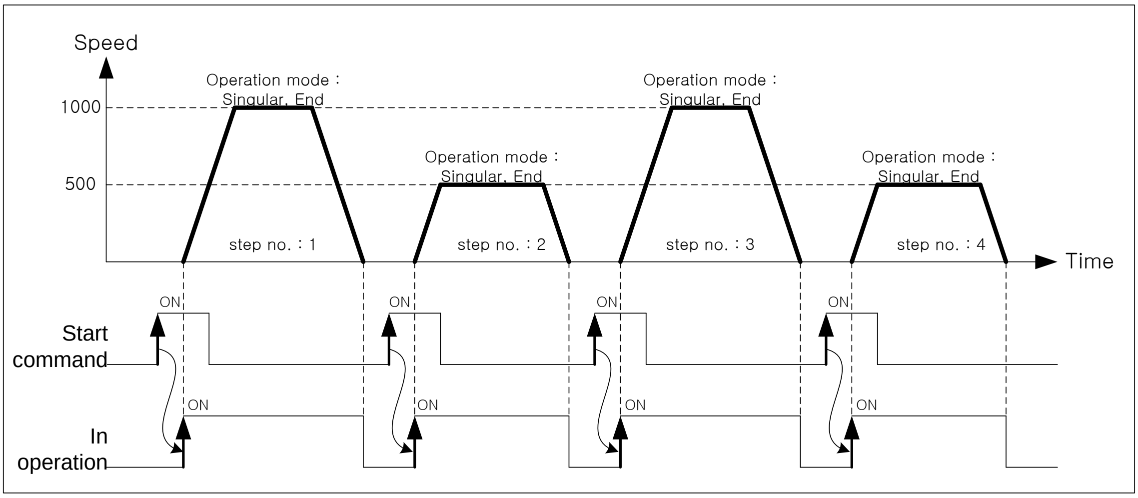
**[ Example ]**

- When indirect start command is executed[when Step No. of  command is set to 0].
- Starting command execute total four times.

■ Setting of XG-PM

| Step NO. | Control Method | Operation Method | Goal Position [pls] | Operation Speed [pls/s] | Accel NO. | Decel NO. | M Code | Dwell Time |
|---|---|---|---|---|---|---|---|---|
| 1 | Absolute Single-axis Positioning Control | Single,End | 10000 | 1000 | 1 | 1 | 0 | 0 |
| 2 | Absolute Single-axis Positioning Control | Single,End | 15000 | 500 | 1 | 1 | 0 | 0 |
| 3 | Absolute Single-axis Positioning Control | Single,End | 25000 | 1000 | 1 | 1 | 0 | 0 |
| 4 | Absolute Single-axis Positioning Control | Single,End | 30000 | 500 | 1 | 1 | 0 | 0 |

■ Operation Pattern



The operating step for each starting command will be [1] → [2] → [3] → [4].

(2) End Operation (Repeat)

(a) With one time start command, the positioning to the goal position is executed and the positioning shall be completed at the same time as the dwell time proceeds.

(b) The operation pattern of Repeat operation mode is same as that of Single operation but the different thing is to determine next operation by operation step no. assigned by repeat step no. change command after positioning completion of Repeat operation mode.

(c) Therefore, if Repeat step no. change command was not executed, the step no."1" shall be assigned after positioning completion of Repeat operation mode and operated at next Start command. Thus, this operation can be used for the structure that several operation steps are repeated.

(d) In case that operation step is set as the value except "0" (1~400) for Indirect Start, the positioning operation shall be done with the setting step no. regardless of the current operation step no. But, if the step no. is set as "0", the positioning operation shall be done with the current step no. changed by Repeat operation mode.

(e) Operation direction shall be determined by position address.

(f) Repeat operation step no. change command is available to execute during operation.

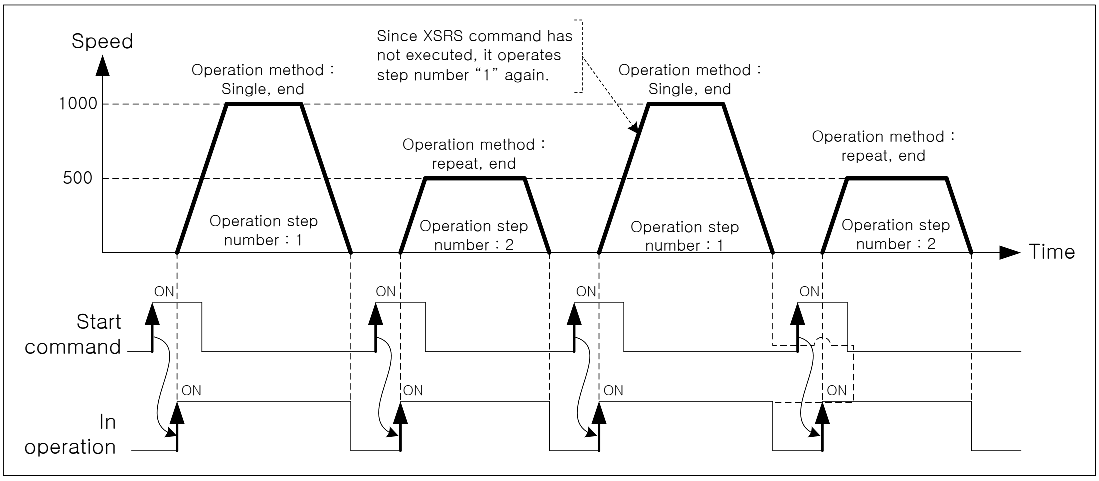
**[ Example 1]**

- When indirect start command is executed[when Step No. of command is set to 0].
- Starting command execute total four times.

■ Setting of XG-PM

| Step NO. | Control Method | Operation Method | Goal Position [pls] | Operation Speed [pls/s] | Accel NO. | Decel NO. | M Code | Dwell Time |
|---|---|---|---|---|---|---|---|---|
| 1 | Absolute Single-axis Positioning Control | Single,End | 10000 | 1000 | 1 | 1 | 0 | 0 |
| 2 | Absolute Single-axis Positioning Control | Repeat,End | 15000 | 500 | 1 | 1 | 0 | 0 |
| 3 | Absolute Single-axis Positioning Control | Single,End | 25000 | 1000 | 1 | 1 | 0 | 0 |
| 4 | Absolute Single-axis Positioning Control | Repeat,End | 30000 | 500 | 1 | 1 | 0 | 0 |

■ Operation Pattern



The operating step for each starting command will be [1] → [2] → [1] → [2].

The operating step3 and step4 will not be executed

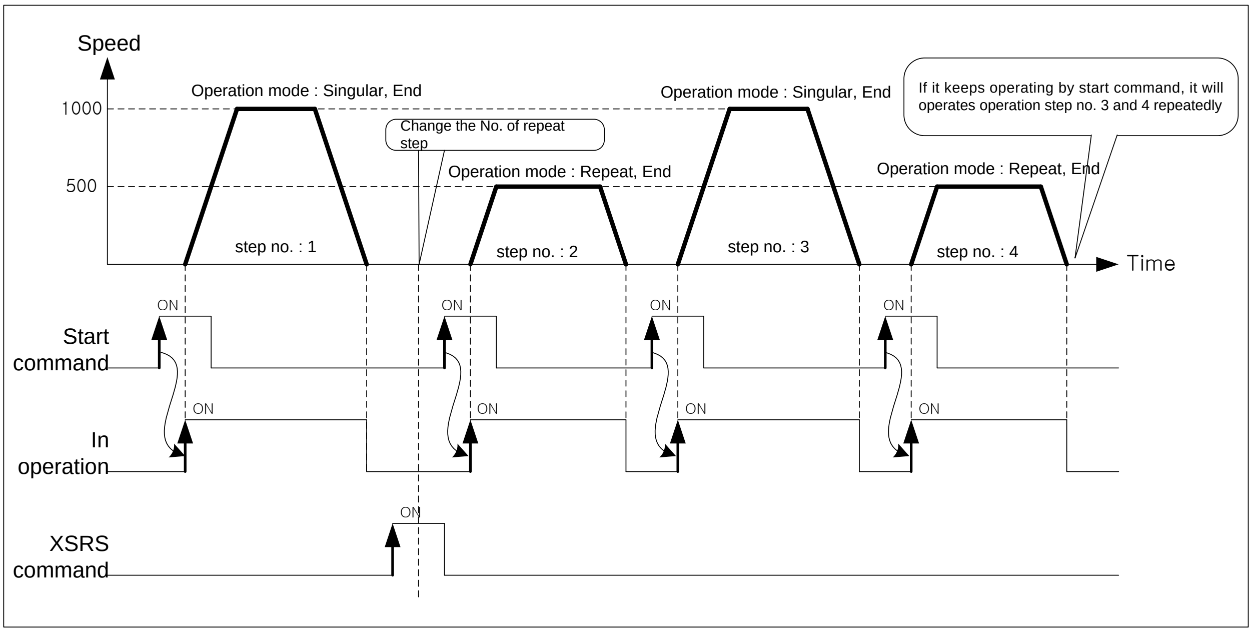
**[ Example 2]**

- When indirect start command is executed[when Step No. of command is set to 0].
- After the first starting command, change repeat operation step number as “3” by Change repeat step number」 command(XSRS).
- Execute starting command 3 times more.

■ Setting of XG-PM

| Step NO. | Control Method | Operation Method | Goal Position [pls] | Operation Speed [pls/s] | Accel NO. | Decel NO. | M Code | Dwell Time |
|---|---|---|---|---|---|---|---|---|
| 1 | Absolute Single-axis Positioning Control | Single,End | 10000 | 1000 | 1 | 1 | 0 | 0 |
| 2 | Absolute Single-axis Positioning Control | Repeat,End | 15000 | 500 | 1 | 1 | 0 | 0 |
| 3 | Absolute Single-axis Positioning Control | Single,End | 25000 | 1000 | 1 | 1 | 0 | 0 |
| 4 | Absolute Single-axis Positioning Control | Repeat,End | 30000 | 500 | 1 | 1 | 0 | 0 |

■ Operation Pattern



The operating step for each starting command will be [1] → [2] → [3] → [4].

### (3) Keep Operation

(a) With one time Start command, the positioning to the goal position of operation step is executed and the positioning shall be completed at the same time as dwell time proceeds and without additional start command, the positioning of operation step for (current operation step no. +1) shall be done.

(b) Keep operation mode is available to execute several operation steps in order.

(c) Set the operation pattern by 'End' when executing the last step of Keep operation.

(d) When operation pattern is Keep, continue operation until operation pattern come out as 'End'. If there is no "END" operation pattern, execute until operation step No. 400. and if operation pattern of step 400 is not "End"', error occurs and operation will be stop. When operation pattern of step 400 is 'Repeat,Keep", execute operation data of Repeat Step Number.

(e) Operation direction shall be determined by setting value of goal position.

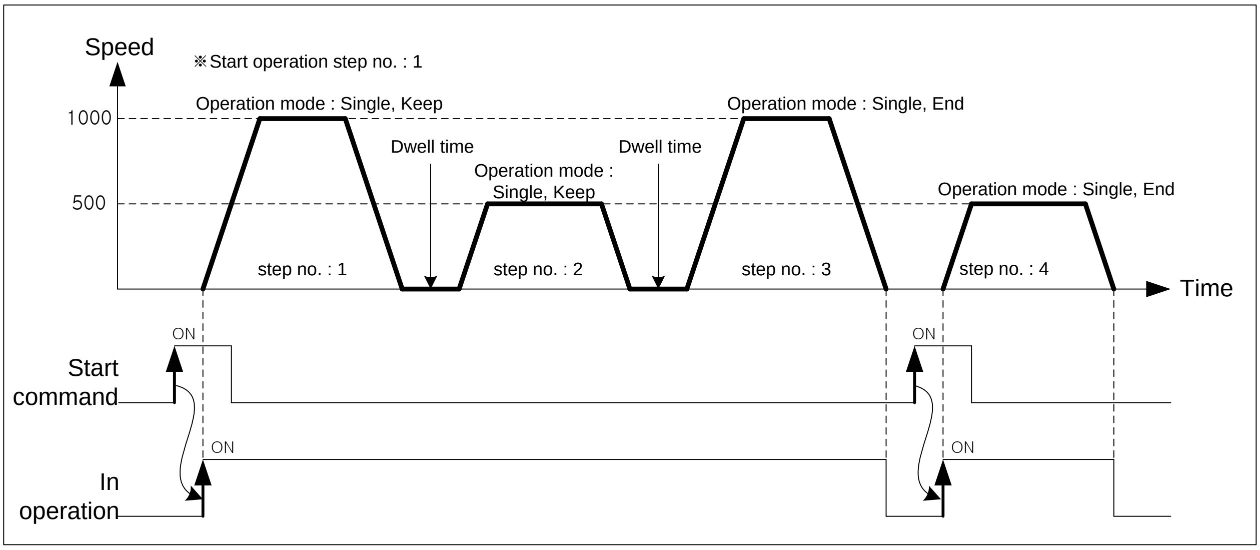
**[ Example]**

- When indirect start command is executed[when Step No. of command is set to 0].
- Starting command execute total two times.

■ Setting of XG-PM

| Step NO. | Control Method | Operation Method | Goal Position [pls] | Operation Speed [pls/s] | Accel NO. | Decel NO. | M Code | Dwell Time |
|---|---|---|---|---|---|---|---|---|
| 1 | Absolute Single-axis Positioning Control | Single,Keep | 10000 | 1000 | 1 | 1 | 0 | 0 |
| 2 | Absolute Single-axis Positioning Control | Single,Keep | 15000 | 500 | 1 | 1 | 0 | 0 |
| 3 | Absolute Single-axis Positioning Control | Single,End | 25000 | 1000 | 1 | 1 | 0 | 0 |
| 4 | Absolute Single-axis Positioning Control | Single,End | 30000 | 500 | 1 | 1 | 0 | 0 |

■ Operation Pattern



The operating step for each starting command will be [1 → 2 → 3] → [4].

## (4) Continuous Operation

### (a) Continuous Operation Overview

1) With one time Start command, the positioning for operation step set by continuous operation mode is executed to the goal position without stop and the positioning shall be completed at the same time as dwell time proceeds.
2) if the moving amount of next operation step is smaller than the deceleration distance from current position, the "Look ahead control" is activated to avoid immediate stop at [operation speed ≠ bias speed].
3) Steps of dwell time set as 'Continuous' operation mode is ignored, steps of dwell time set as 'End' operation pattern is valid.
4) When you execute 'Continuous' operation mode, always set as 'End' for the very last operation step.
5) When operation pattern is continuous, continue operation until operation pattern come out as 'End'. If there is no "END" operation pattern, execute until operation step No. 400. and if operation pattern of step 400 is not "End"', error occurs and operation will be stop. When operation pattern of step 400 is 'Repeat, continuous", execute operation data of Repeat Step Number.
6) Operation direction shall be determined by setting value of goal position.
7) If you want to operate with the position and speed of next step before the current operation step reaches the goal position, the operation by the Next Move continuous operation」(XNMV) command is available.
8) 「Next Move continuous operation」(XNMV) command can be executes in the acceleration, constant speed, deceleration section of Continuous operation.
9) when executing continuous operation, The continuous operation item of common parameter must be set to "Enable". Control period will be 5ms if continuous operation is enabled and it will be 1ms if continuous operation is disabled. therfore it is recommanded to disable this parameter if continuous operation is not required.

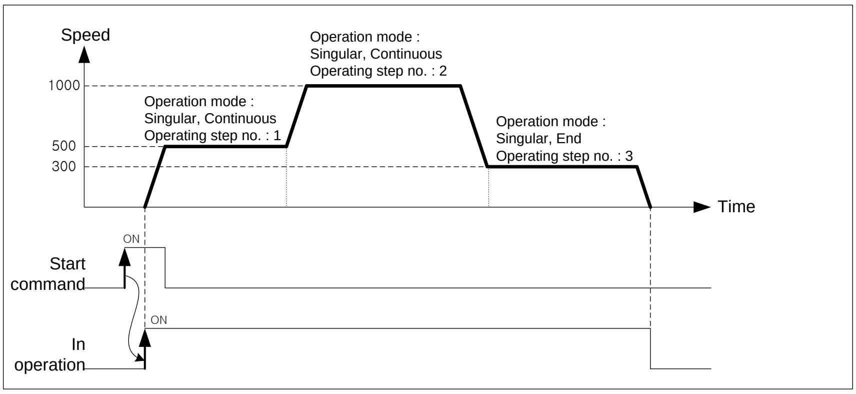
**[ Example]**

- When indirect start command is executed[when Step No. of command is set to 0].
- Starting command execute one time.

■ Setting of XG-PM

| Step NO. | Control Method | Operation Method | Goal Position [pls] | Operation Speed [pls/s] | Accel NO. | Decel NO. | M Code | Dwell Time |
|---|---|---|---|---|---|---|---|---|
| 1 | Absolute Single-axis Positioning Control | Single,Cont | 10000 | 500 | 1 | 1 | 0 | 0 |
| 2 | Absolute Single-axis Positioning Control | Single,Cont | 30000 | 1000 | 1 | 1 | 0 | 0 |
| 3 | Absolute Single-axis Positioning Control | Single,End | 40000 | 300 | 1 | 1 | 0 | 0 |

■ Operation Pattern



Operating step that execute according to starting command order will be [1 → 2 → 3].

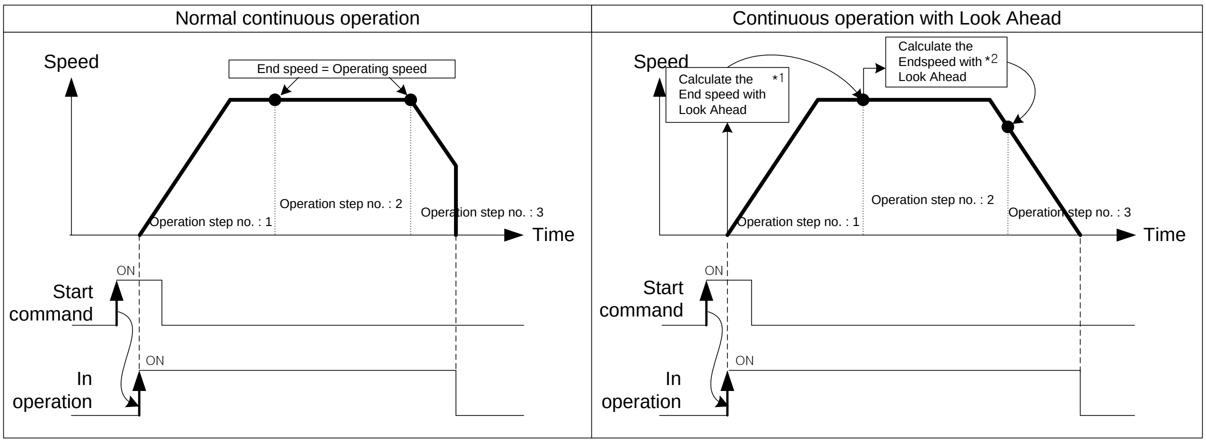
**Note**

1. When operation method is continuous, sometimes it can be changed to next operation step speed before reaching the amount of movement current step's goal position. This is operation to change operating speed continuously, The remained moving amount of current step is operated in next step.
   (The remaining distance is less than the distance can be moved within 1 control cycle at current speed)
2. If the control method is set as linear or circular interpolation and the operation method is set as continuous, operating speed of positioning will be different according to the interpolation continuous operation positioning method」 of extended parameter.
   refer to continuous operation of interpolation control for detail.

(b) Look Ahead

1) if the moving amount of next operation step is smaller than the deceleration distance from current position, the "Look ahead control" is activated to avoid immediate stop at [operation speed ≠ bias speed].
2) The "Look Ahead control" is control method which calculate the available entry speed for next step by goal position of current and next step and change current speed. if the moving amount of next operation step is smaller than the deceleration distance from current position, it will decrease the current speed to make stop speed and bias speed equal..
3) XBM-H(P) embedded positioning executes the "Look Ahead" using goal position of total 3 steps including current step..

The difference of general continuous operation and Look Ahead control is as below.



*1 : moving amount of Step 2 and Step 3 is more than the deceleration stop distance from operation speed. So, endpoint speed = operation speed.

*2 : When moving amount of step 3 is smaller than deceleration stop distance from operation speed of step 2. Therefore, it calculate available end point speed for step 2 by goal position of step2,3 and change speed to this..

.

(c) Continuous operation of interpolation control

When control method is linear or circular interpolation and operation method is Continuous, positioning operation is different according to the setting value by extended parameter of 「Continuous interpolation positioning method」. There are two methods of interpolation.

One is「Passing Goal Position」which passes through the specified goal position and the other is「Near Passing」which proceed to the next step at near position not to exceed a specified goal position.

「continuous interpolation positioning method」 setting of expanded parameter is as below.

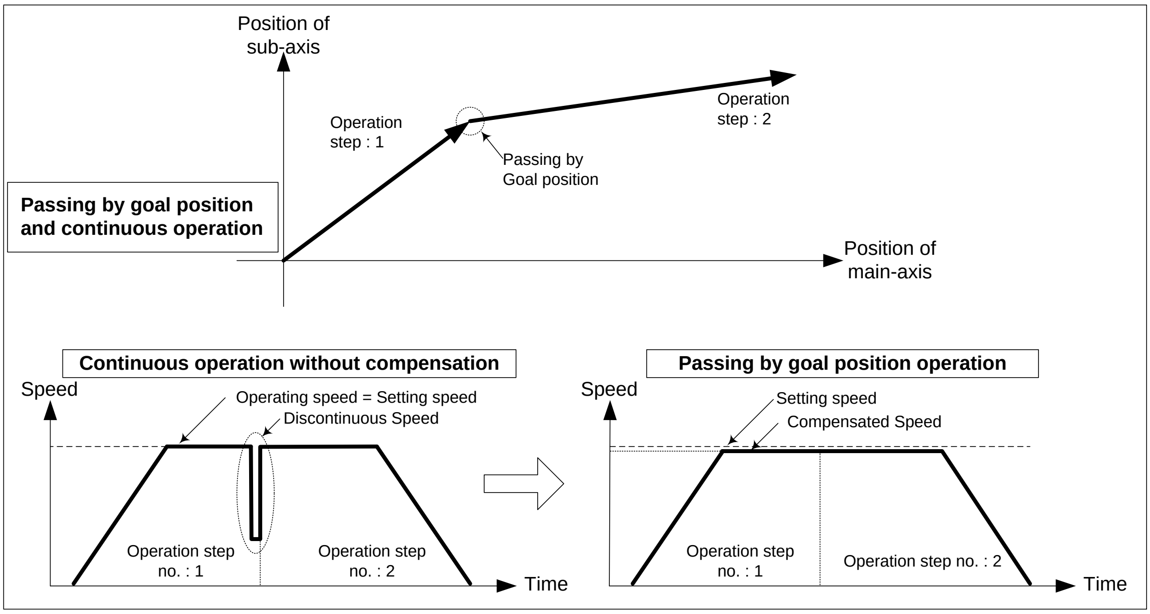
| Item | Setting Value | Contents |
|---|---|---|
| Continuous interpolation positioning method | 0 : Passing Goal Position | Execute Continuous Operation which passes exact goal position of current step which set on operation data. |
| | 1 : Near Passing | Execute Continuous operation which passes near position not to exceed a current step's goal position.. |

1) Passing Goal Position Continuous Operation

「Passing Goal Position」 Continuous Operation must be passing by goal position to the data set on goal position when changing from current step to next step. In the interpolation control, when execute a continuous operation from current step to next step, there can be mechanical vibration caused by discontinuous operating speed because of remaining moving amount.

XBM-H(P) use the speed compensation. It can solve mechanical vibration problem and execute Continuous operation which user set by from goal position to next step.

Next, describing the principle of「passing goal position」Continuous operation



It decrease speed of acceleration, constant speed section as much as remaining amount of movement at the last section of current step to compensate position if operates as passing goal position operation.

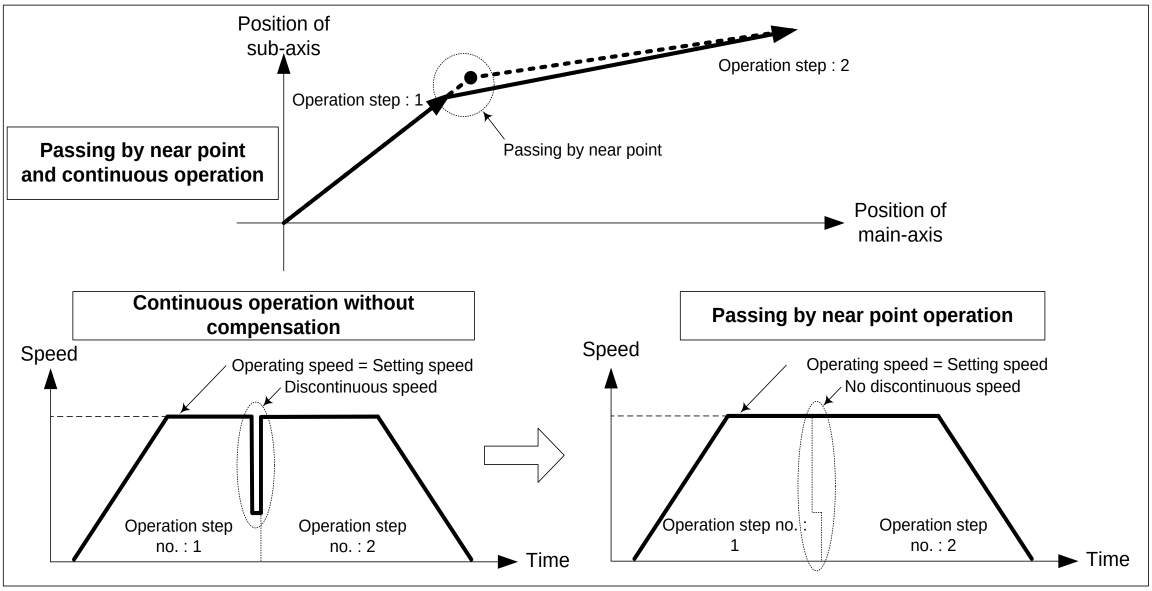
Because next step can start with compensated speed, can avoid occurrence of discontinuous operating speed.

2) Near Passing Continuous Operation

It changes to the next step at near position not exceeding goal position of current step.

This is the way to eliminate discontinuous operating speed which occurs by remaining amount of movement data at the last of current step.

Next, describing the principle of「Near Passing」Continuous operation.



In the picture above, during general Continuous Operation, Occurring speed discontinuity because of remaining amount of movement at the last operation step NO.1. 「Near Passing」Continuous Operation, you can move the remaining amount of movement to next step and execute Continuous Operation without speed discontinuity.

**Note**

When using「Near passing」continuous operation, sometimes it operates with next step speed before reaching the amount of movement set on goal position to remove the discontinuity of speed.

However in the case of Interpolation Continuous Operation control, it can have a gap with trajectory data which user set if it operates speed of the next step before reaching the goal position.

The following is the maximum difference of position for each axis.

- Difference of maximum axis position <( speed of each axis (pls / s) x control cycle (= 1ms or 5ms))

(d) Deceleration Stop of Continuous Operation

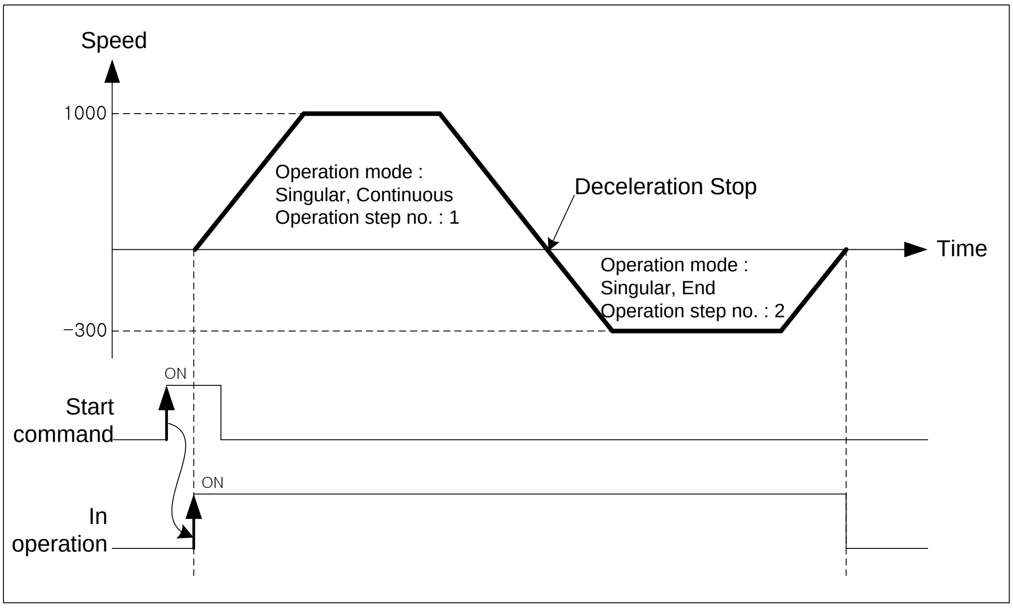
Continuous operation control is decelerating and positioning completed during the 'End' operation step. However, next time, it keeps next step operation after decelerating as bias speed

1) When the moving direction of current executing operation step and the moving direction of next step is different (the case of single positioning control only)

■ Setting of XG-PM

| Step NO. | Control Method | Operation Method | Goal Position [pls] | Operation Speed[pls/s] | Accel NO. | Decel NO. | M Code | Dwell Time |
|---|---|---|---|---|---|---|---|---|
| 1 | Absolute Single-axis Positioning Control | Single Continuous | 10000 | 1000 | 1 | 1 | 0 | 0 |
| 2 | Absolute Single-axis Positioning Control | Single End | 3000 | 300 | 1 | 1 | 0 | 0 |

■ Operation Pattern



The Step1 will be operated by the start command. however, because the goal position of next step is on opposite direction from the goal position of step1, it stops after deceleration, and then operate Step2 to a opposite direction.

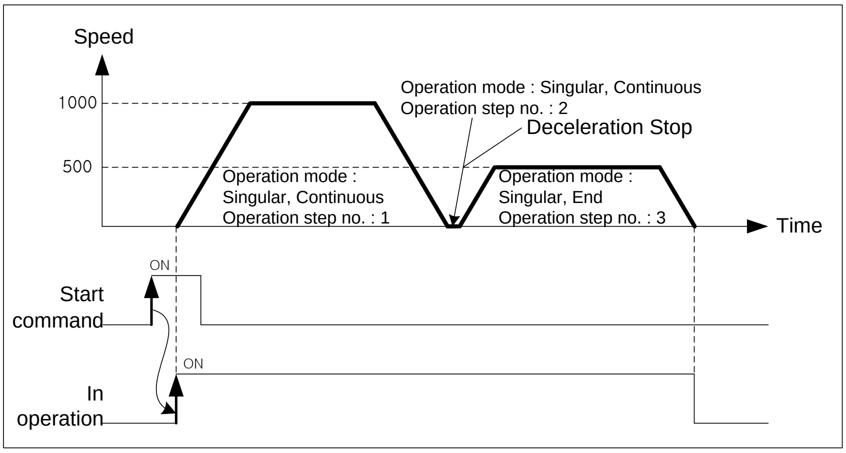
2) When the moving amount of next step is 0

When the next step's moving amount is 0, operation speed will be 0 during one control period.

■ Setting of XG-PM

| Step NO. | Control Method | Operation Method | Goal Position [pls] | Operation Speed [pls/s] | Accel NO. | Decel NO. | M Code | Dwell Time |
|---|---|---|---|---|---|---|---|---|
| 1 | Absolute Single-axis Positioning Control | Signle Continuous | 10000 | 1000 | 1 | 1 | 0 | 0 |
| 2 | Absolute Single-axis Positioning Control | Signle Continuous | 10000 | 700 | 1 | 1 | 0 | 0 |
| 3 | Absolute Single-axis Positioning Control | Signle End | 15000 | 500 | 1 | 1 | 0 | 0 |

■ Operation Pattern



The Step1 will be operated by the start command. However, because the moving amount of next step is 0, it stops after deceleration, and then operates Step3 after 1 control period.

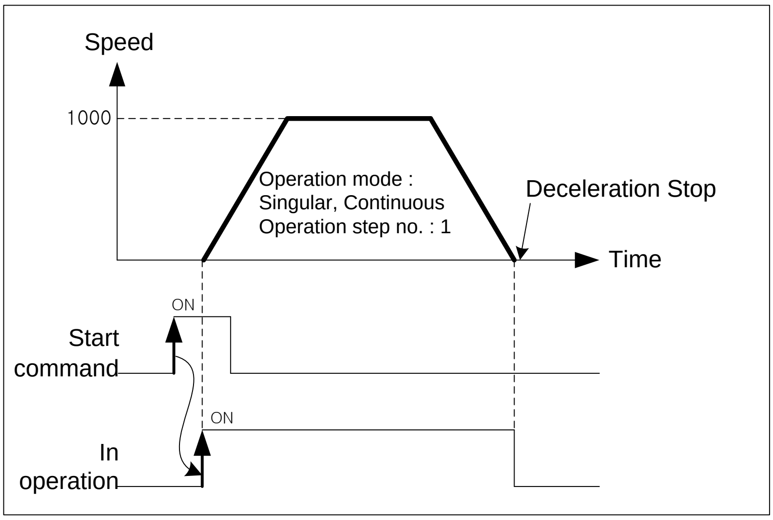
3) If there is an error on the operation data of next step

If there is an error on the next step's data(for example, if the operation speed of next step is 0 or if the operation method of current step is「Single-axis Positioning Control」but operation method of Next step is「Single-axis FEED Control」), it stops after deceleration after current step's operation, and then completes operation.

■ Setting of XG-PM

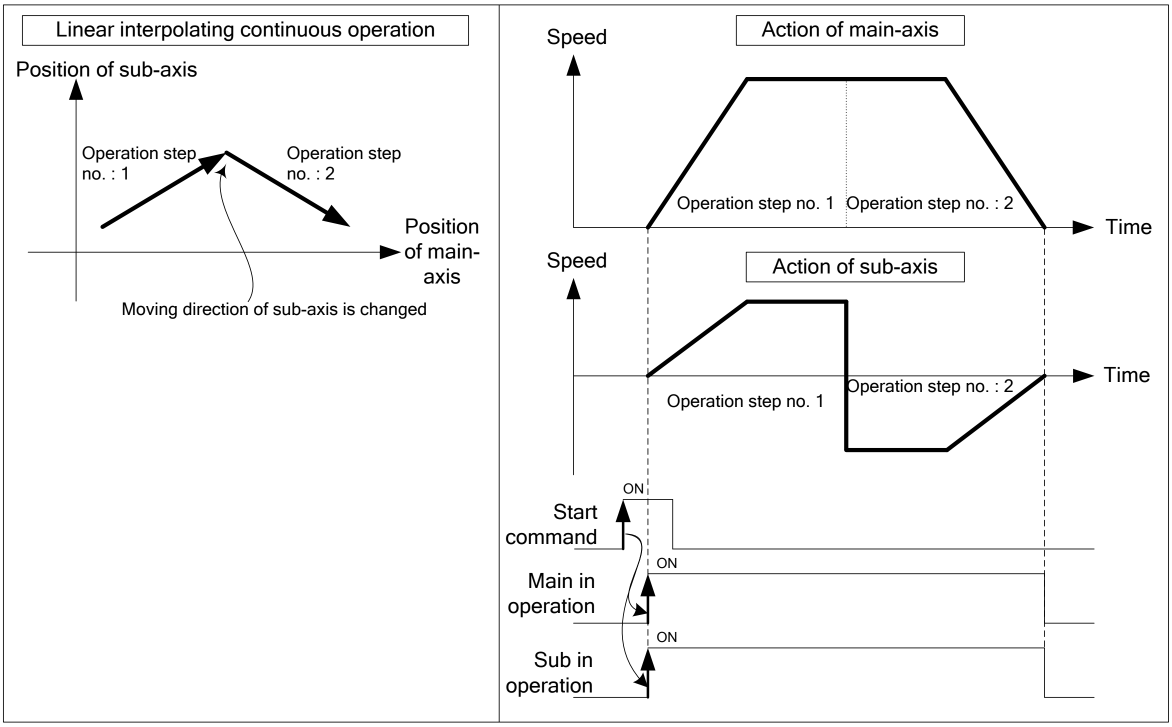
| Step NO. | Control Method | Operation Method | Goal Position [pls] | Operation Speed [pls/s] | Accel NO. | Decel NO. | M Code | Dwell Time |
|---|---|---|---|---|---|---|---|---|
| 1 | Absolute Single-axis Positioning Control | Signle Continuous | 10000 | 1000 | 1 | 1 | 0 | 0 |
| 2 | Absolute Single-axis Feed Control | Signle Continuous | 20000 | 1000 | 1 | 1 | 0 | 0 |
| 3 | Absolute Single-axis Positioning Control | Signle End | 30000 | 1000 | 1 | 1 | 0 | 0 |

■ Operation Pattern



**Note**

During Continuous Operation of Linear interpolation or circular interpolation, because the PLC does not check the direction of movement, does not deceleration stop even if the moving direction is changed.
Therefore, if there is opposite direction of goal position set on operation data,
it may cause damages to machine because of rapid direction changing.
In this case, use the operation method of 「Keep」 to prevent the damage for system.



### 9.2.3 Single-axis Positioning Control

After executed by the start positioning operation command (「Direct start」, 「Indirect start」, 「Simultaneous start」), positioning control from specified axis (the current stop position) to goal position (the position to move).

#### (1) Control by Absolute method (Absolute coordinate) (「Absolute, Single-axis Positioning Control」)

(a) Positioning control from start position to goal position (the position assigned by positioning data). Positioning control is carried out based on the position assigned (origin position) by homing.

(b) Moving direction shall be determined by start position and goal position.

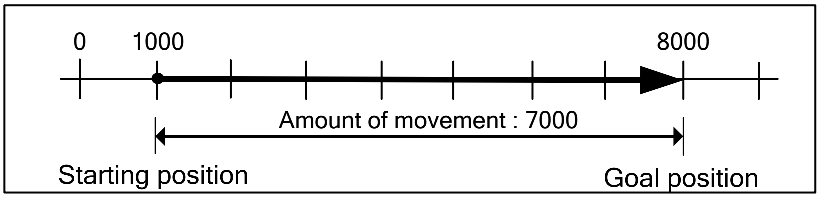
- ▶ Start position < Goal position: forward direction positioning
- ▶ Start position > Goal position: reverse direction positioning

[Example] Set the Absolute Coordinates as follow, Operate single-axis positioning control.

▷Start position: 1000,

▷Goal position: 8000

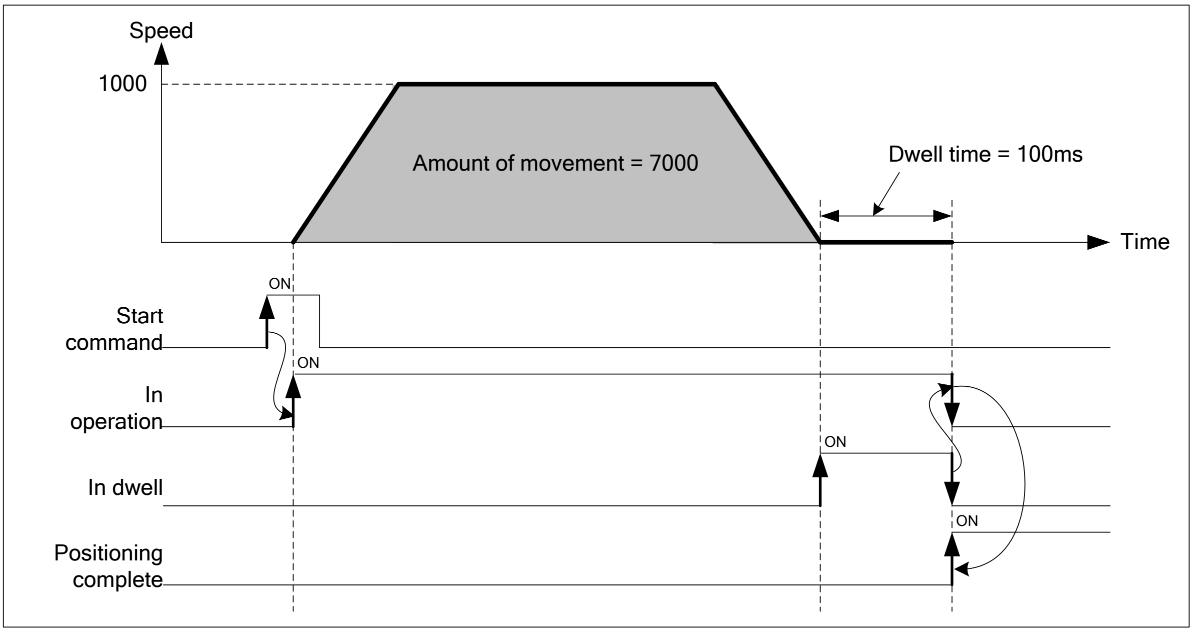
The transfer amount to forward direction shall be 7000 (7000=8000-1000).



■ Setting of XG-PM

| Step NO. | Control Method | Operation Method | Goal Position [pls] | Operation Speed [pls/s] | Accel NO. | Decel NO. | M Code | Dwell Time |
|---|---|---|---|---|---|---|---|---|
| 1 | Absolute Single-axis Positioning Control | Single End | 8000 | 1000 | 1 | 1 | 0 | 100 |

■ Operation Pattern



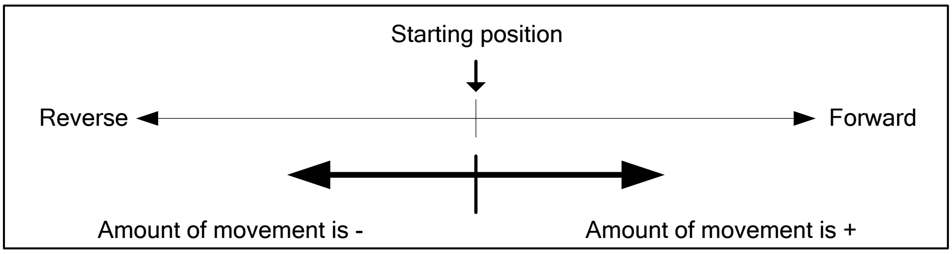
(2) Control by Incremental method (Relative coordinate) (「Relative, Single-axis Positioning Control」)

(a) Positioning control as much as the goal transfer amount from start position. Unlike the absolute coordinates of goal position, it is not a value of specified on goal position; it is a moving amount of current position.

(b) Transfer direction shall be determined by the sign of transfer amount.

▷Transfer direction (+) or no sign: forward direction (current position increase) positioning

▷Transfer direction ( - ) : reverse direction (current position decrease) positioning

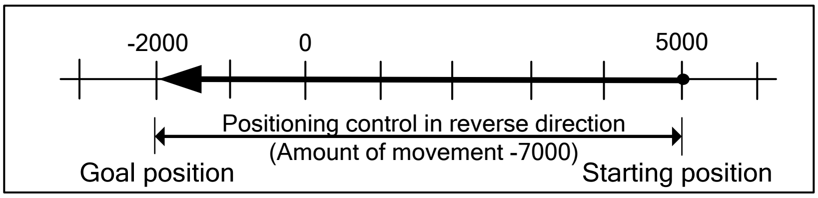


[Example] Set the Relative Coordinates as follow, Operate single-axis positioning control.

▷Start position: 5000,

▷Goal position: -7000

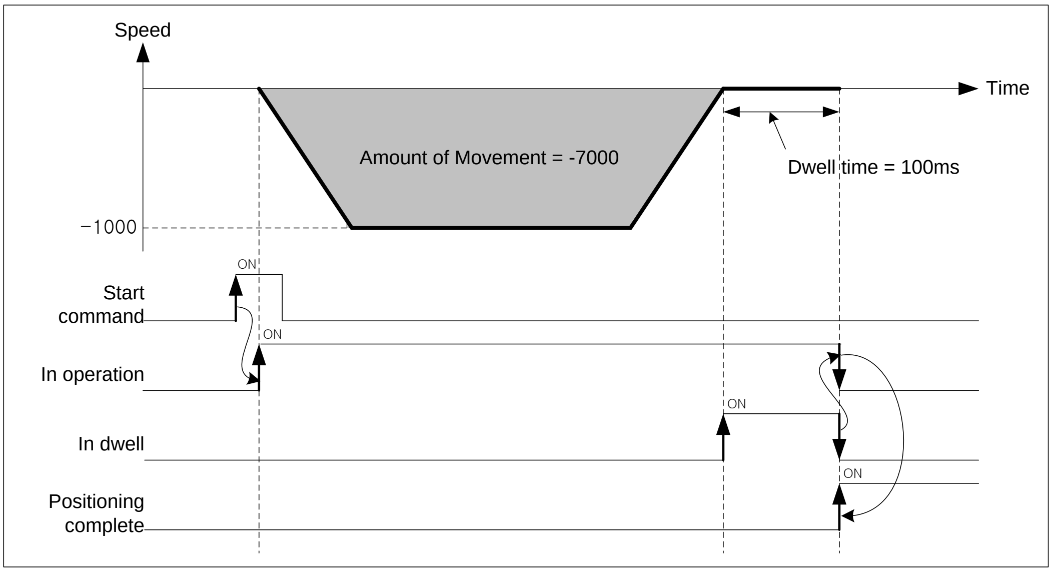
This will be reverse direction and positioning will be at the point of –2000.



■ Setting of XG-PM

| Step NO. | Control Method | Operation Method | Goal Position [pls] | Operation Speed [pls/s] | Accel NO. | Decel NO. | M Code | Dwell Time |
|---|---|---|---|---|---|---|---|---|
| 1 | Incremental Single-axis Positioning Control | Single End | -7000 | 1000 | 1 | 1 | 0 | 100 |

■ Operation Pattern



### 9.2.4 Single-axis Speed Control

After executed by the start positioning operation command (「Direct start」, 「Indirect start」, 「Simultaneous start」), this controls the speed by the setting speed until deceleration stop command is entered.

(1) Features of Control

(a) Speed control contains 2 types of start : Forward direction start and Reverse direction start.

▷Forward direction : when position value is positive number (+) ("0" included)

▷Reverse direction : when position value is negative number (-)

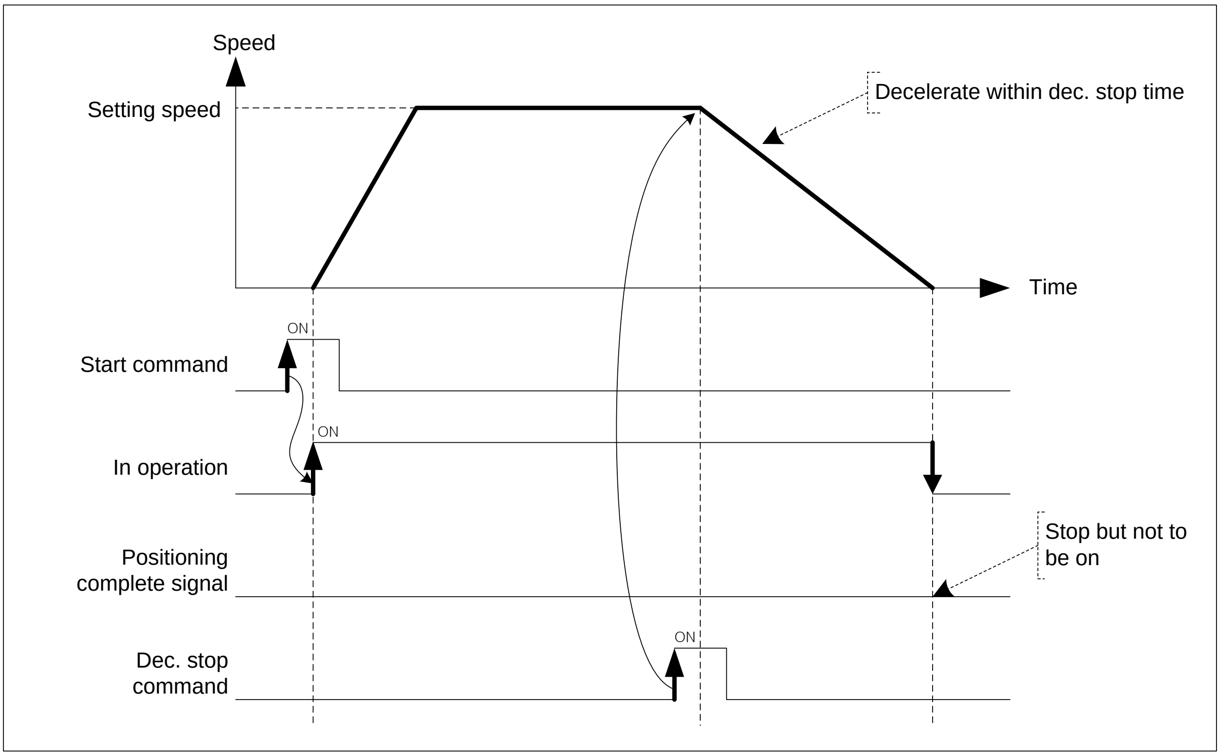
(b) In case of using speed control, the following items of operation data do not affect.

▷ Coordinates, Operation method, Dwell time

▷ "Absolute, single-axis speed control", "Relative, single-axis speed control" execute same operation.

(c) Accelerating operation of speed control operate with acceleration number and time on setting data, decelerating operation operate with deceleration number and time of a command 「deceleration stop」

(2) Operation Timing



(3) Restrictions

(a) Set the operation pattern of speed control as 'End' or 'Keep'. When it is set on "Continuous", error occurs (error code: 236) and can not execute speed control.

(b) Using as speed control, only when 「M code mode」 of extended parameter is "with" , M code signal is "On". (When "After mode", M code signal is not "On".)

(c) Speed control of software upper/lower limit checking change according to the setting of the speed control of software upper/lower limit check.

| Item | Setting Value | Contents |
|---|---|---|
| During Speed Control S/W Upper/Lower limit | 0 : Not Detect | During Speed Control, do not operate to check the range of upper/lower limit of software |
| | 1 : Detect | During Speed Control, operate to check the range of upper/lower limit of software |

(4) Setting of XG-PM

| Step NO. | Control Method | Operation Method | Goal Position [pls] | Operation Speed [pls/s] | Accel NO. | Decel NO. | M Code | Dwell Time |
|---|---|---|---|---|---|---|---|---|
| 1 | Absolute Single-axis Speed Control | Single End | 100 | 1000 | 1 | 1 | 0 | 0 |

## 9.2.5 Single-axis Feed Control

After executed by the start positioning operation command (「Direct start」, 「Indirect start」, 「Simultaneous start」), change current stop position as '0', positioning control until setting goal position.

### (1) Features of control

(a) The value set on goal position is moving amount. That is, moving direction is decided by the code of setting goal position.

▷Forward direction : when position address is positive number (+) ("0" included)

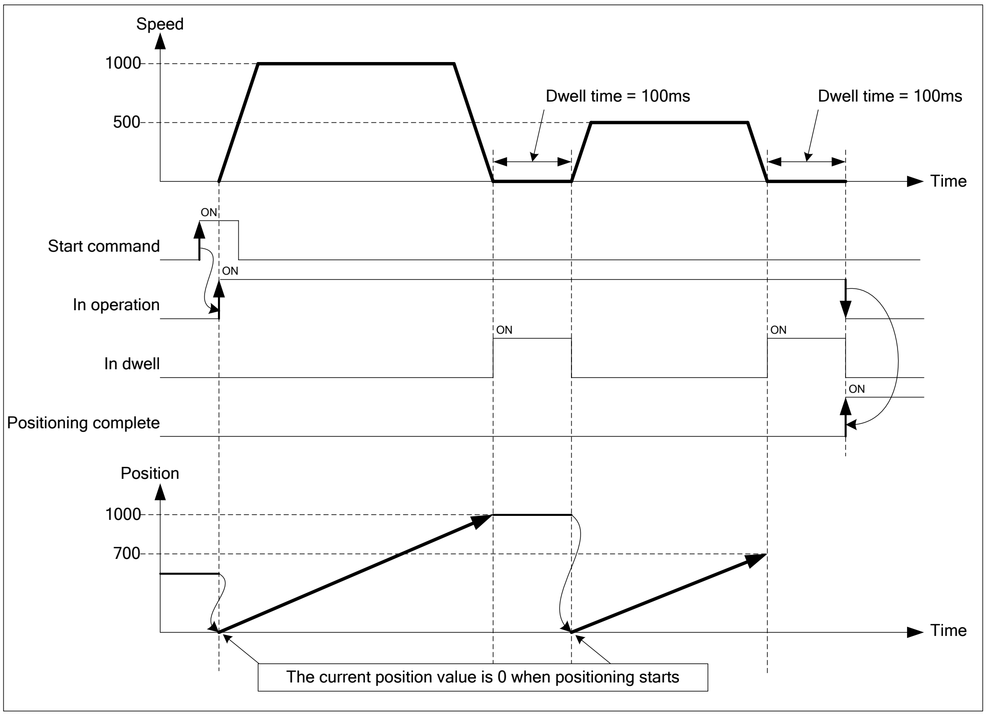
▷Reverse direction : when position address is negative number (-)

(b) In case of using Single-axis Feed Control, the following items of operation data do not affect.

▷ Coordinates

▷ "Absolute, single-axis speed control", "Relative, single-axis speed control" execute same operation.

### (2) Operation Timing



### (3) Restrictions

(a) Set the operation pattern of Feed control as 'End' or 'Keep'. When it is set on "Continuous", error occurs (error code: 230) and can not execute Feed control.

### (4) Setting of XG-PM

| Step NO. | Control Method | Operation Method | Goal Position [pls] | Operation Speed [pls/s] | Accel NO. | Decel NO. | M Code | Dwell Time |
|---|---|---|---|---|---|---|---|---|
| 1 | Absolute Single-axis Feed Control | Single Keep | 1000 | 1000 | 1 | 1 | 0 | 100 |
| 2 | Absolute Single-axis Feed Control | Single End | 700 | 500 | 1 | 1 | 0 | 100 |

## 9.2.6 Linear Interpolation Control with 2 axes

After executed by positioning operation start command (「Indirect start」, 「Synchronous start」), then executing interpolation control from starting position to the goal position with interpolation axis set as the main axis and sub axis.

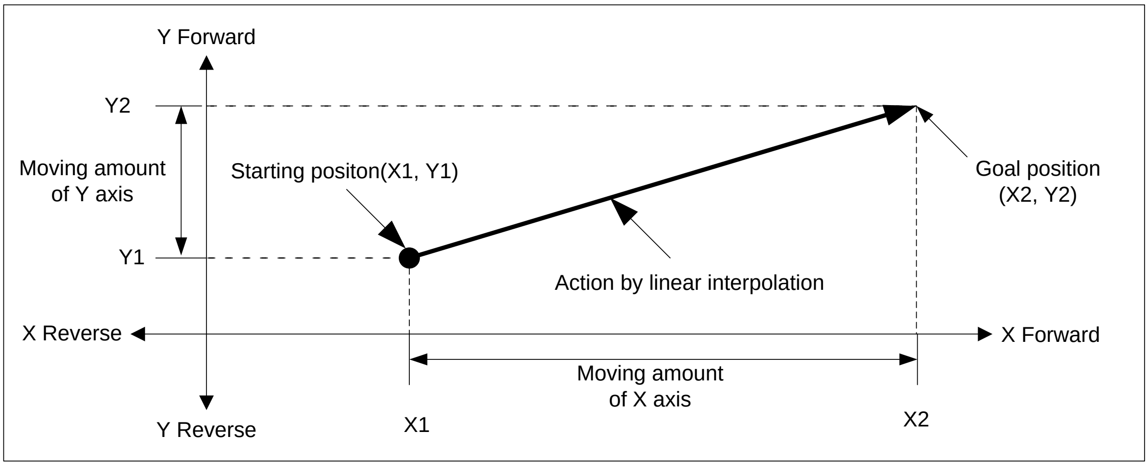
### (1) Linear interpolation control with absolute coordinates (「Absolute, Linear Interpolation」)

(a) Execute linear interpolation from starting position to the goal position designated on positioning data. Positioning control is on basis of the designated position from homing.

(b) The direction of movement depends on the starting position and the goal position for each axis.

■ Starting position < Goal position : Positioning operation in forward

■ Starting position > Goal position : Positioning operation in reverse



(c) Restrictions

Linear interpolation with 2 axes may not be executed in the case below.

■ 「Sub axis setting」 Error (error code : 253)

- 「Sub axis setting」 of main axis operating data is “Axis-undecided”
- 「Sub axis setting」 of main axis operating data is the same as main axis no.
- 「Sub axis setting」 of main axis operating data exceeds the settable axis No.

**Note**

Because more than 2 axes are in action, so need user to pay attention

(1) The commands available are as follows.

Speed override, Dec. time, Emergent stop, Skip operation, Continuous operation

(2) The commands unavailable in linear interpolation are as follows.

Position/Speed switching control, Position override

(3) The parameter items which work depending on the value of each axis are as follows.

Backlash compensation, Software Upper/Lower limit

(d) Setting example of operating data

| Items | Main-axis setting | Sub-axis setting | Description |
|---|---|---|---|
| Control method | Absolute, Linear interpolation | - [*1] | When linear interpolation control is executed by the method of absolute coordinates, set「Absolute, Linear interpolation」on the main axis |
| Operating method | Singular, End | - | Set the operating method to execute linear interpolation |
| Goal position [pls] | 10000 | 5000 | Set the goal position to position on main-axis and sub-axis |
| Operating speed [pls/s] | 1000 | - | Use speed-designated method of main axis for linear interpolation |
| Acc. no. | No.1 | - | Set acc. no. for acceleration (no.1 ~ no.4) |
| Dec. no. | No.2 | - | Set dec. no. for deceleration (no.1 ~ no.4) |
| M code | 0 | - | When need to execute auxiliary work synchronizing with linear interpolation |
| Dwell time | 500 | - | Set dwell time(ms) to outputting the signal positioning completion |
| Sub-axis setting | Axis2 | - | Set an axis to be used as sub-axis among settable axis in operating data of main-axis |

[*1] : It does not need to be set. Whatever value is set as, it does not affect linear interpolation.

**Note**

Linear interpolation control is executed on the basis of operating data of main axis.
Only 「Goal position」 item of sub-axis setting affect linear interpolation. In other word, whatever value is set as, it does not affect the operation and errors do not arise.

**[Example] axis1 and axis2 are main and sub axis each. Execute linear interpolation by the setting as follows**

■ Starting position (1000, 4000), Goal position (10000, 1000) : In this condition, the operation is as follows.

■ Setting example of XG-PM

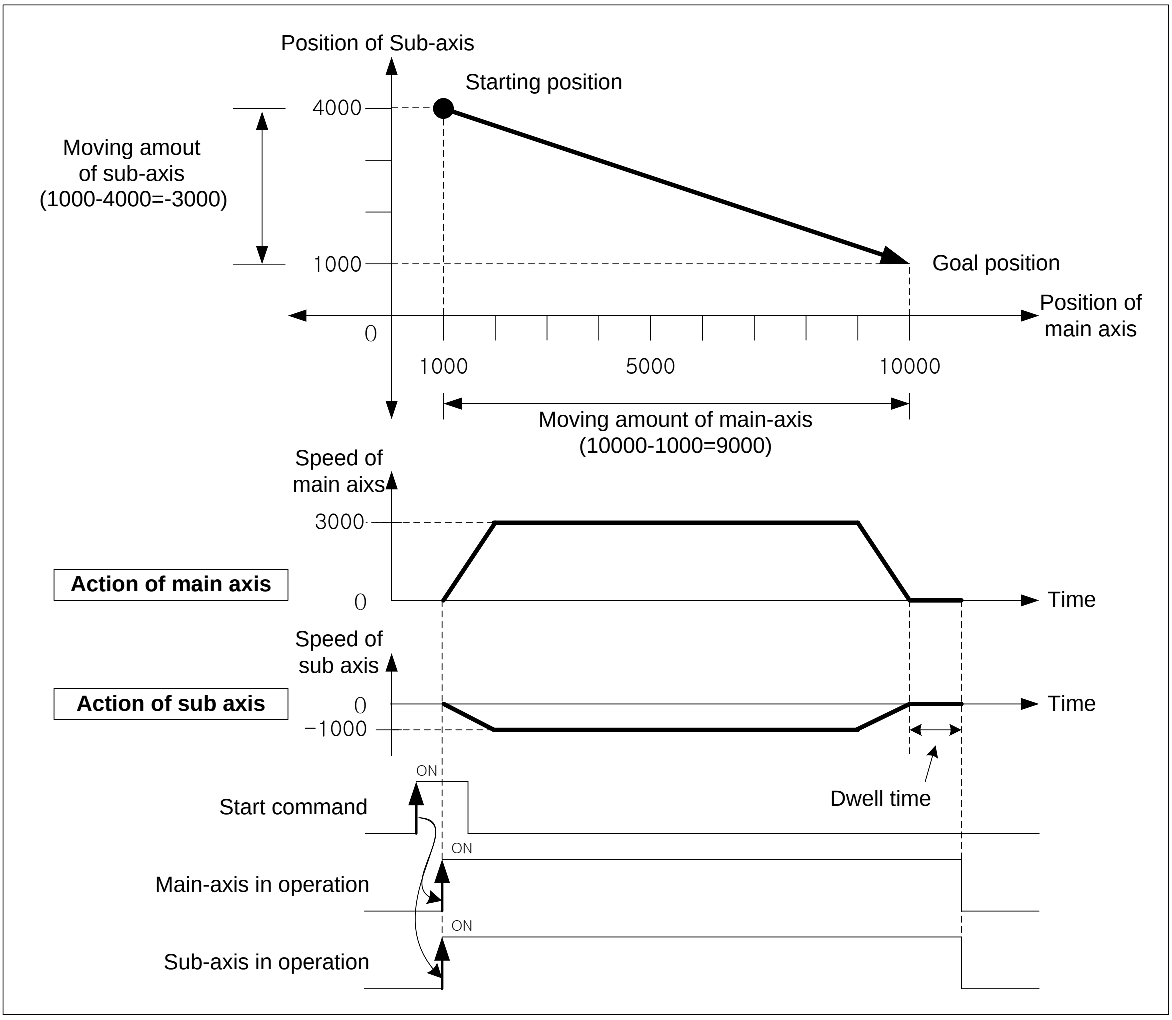
▪ Operating data of main-axis(axis1)

| Step NO. | Control Method | Operation Method | Goal Position [pls] | Operation Speed [pls/s] | Accel NO. | Decel NO. | M Code | Dwell Time | Sub axis setting |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Linear | Singular, End | 10000 | 3000 | 1 | 1 | 0 | 100 | Axis 2 |

▪ Operating data of sub-axis(axis2)

| Step NO. | Control Method | Operation Method | Goal Position [pls] | Operation Speed [pls/s] | Accel NO. | Decel NO. | M Code | Dwell Time | Sub axis setting |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Single positioning control | Singular, End | 1000 | 0 | 1 | 1 | 0 | 0 | Axis-undecided |

■ Operating pattern



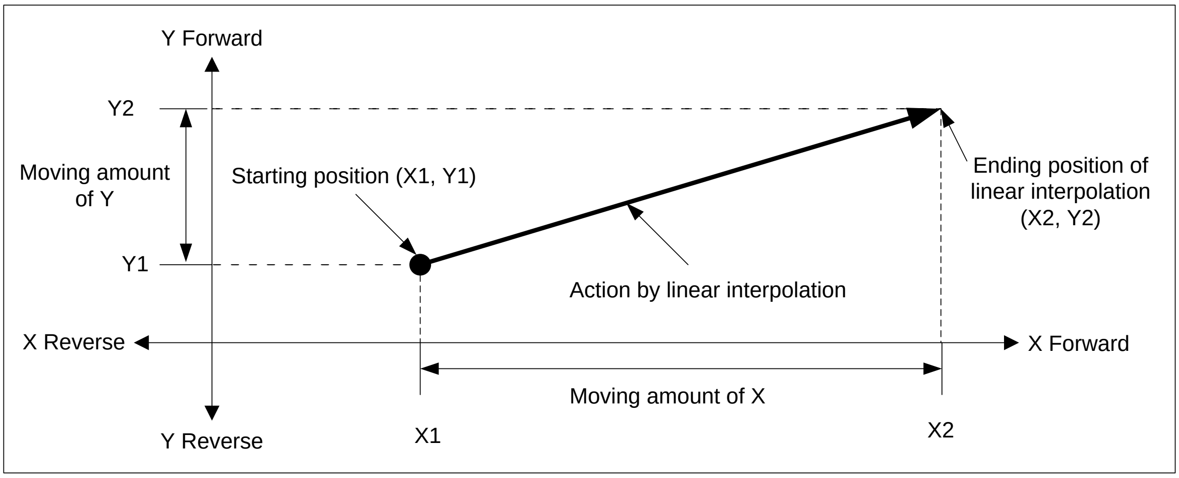
### (2) Linear interpolation control with relative coordinates (「Relative, Linear Interpolation」)

(a) Execute 2 axes linear interpolation from starting position to the goal position. Positioning control is on basis of the current stop position.

(b) Moving direction depends on the sign of the goal position (Moving amount)

■ The sign is positive (+ or nothing) : Positioning operation in forward

■ The sign is negative (-) : Positioning operation in reverse



(c) Restrictions

Linear interpolation with 2 axes may not be executed in the case below.

■ 「Sub-axis setting」 error (error code : 253)

- 「Sub-axis setting」 value of main axis operating data is “Axis-undecided”
- 「Sub-axis setting」 value of main axis operating data is same as the main axis no.
- 「Sub-axis setting」 value of main axis operating data exceeds settable axis no.

(d) Setting example of operation data

| Items | Main-axis setting | Sub-axis setting | Description |
|---|---|---|---|
| Control method | ABS, (LIN)INT | ABS, (SIN)POS | When linear interpolation control is executed by the method of relative coordinates, set「Relative, Linear interpolation」 on the main axis |
| Operating method | Singular, End | - [*1] | Set the operating method to execute linear interpolation |
| Goal position[pls] | 10000 | 5000 | Set the goal position to position on main & sub-axis |
| Operating speed [pls/s] | 1000 | - | Use speed-designated method of main axis for linear interpolation |
| Acc. no. | No.1 | - | Set acc. no. for acceleration (no.1 ~ no.4) |
| Dec. no. | No.2 | - | Set dec. no. for deceleration (no.1 ~ no.4) |
| M code | 0 | - | When need to execute auxiliary work synchronizing with linear interpolation |
| Dwell time | 500 | - | Set dwell time(ms) to outputting the signal positioning completion |
| Sub-axis setting | Axis2 | - | Set an axis to be used as sub-axis among settable axis in operating data of main-axis |

[*1] : It does not need to be set. Whatever value is set as, it does not affect linear interpolation.

**Note**

Linear interpolation control executes the operation based on the item set in the operation data of the main axis (command axis).
Items other than "coordinate" and "target position" during setting of subordinate axis during linear interpolation operation do not affect linear interpolation operation. That is, setting any value does not affect the operation and does not cause an error.
Since the coordinate setting of the longitudinal axis control method indicates whether the target position on the vertical axis is an absolute coordinate or a relative coordinate, when the linear interpolation is controlled by the relative coordinate system, the coordinate of the vertical axis must be set to "relative".

**[Example] axis1 and axis2 are main and sub axis each. Execute linear interpolation by the setting as follows.**

■ Starting position (1000, 4000), Goal position (9000, -3000) : In this condition, the operation is as follows.

■ Setting example of XG-PM

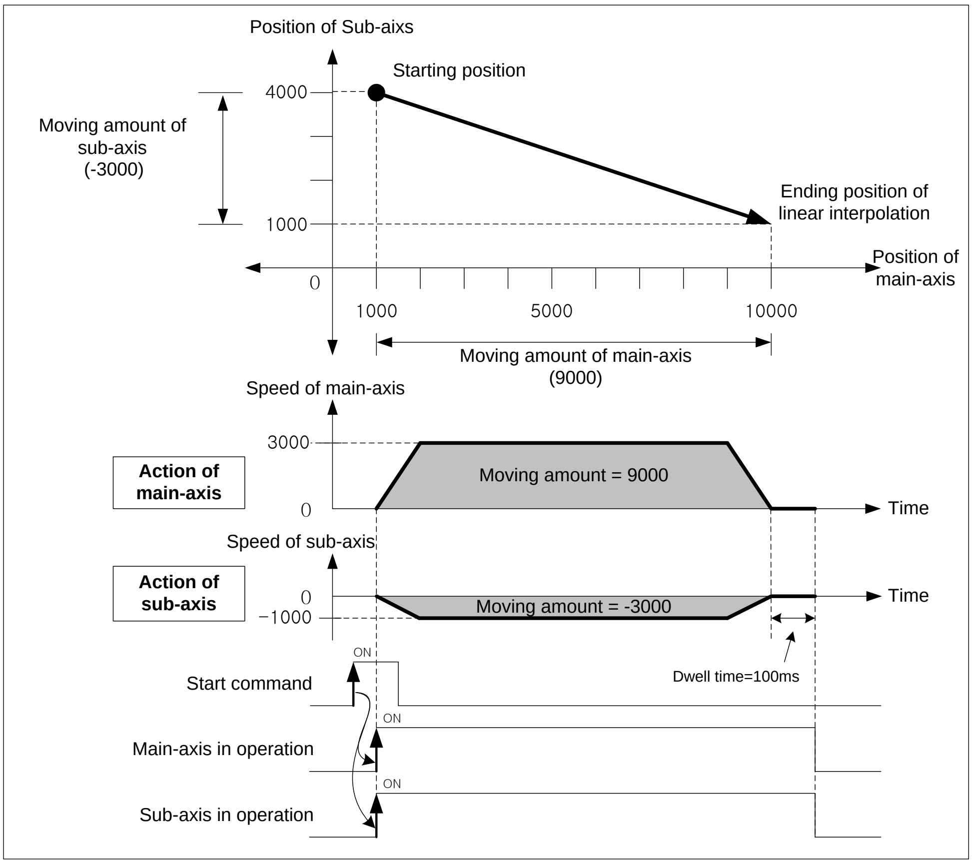
▪ Operating data of main-axis(axis1)

| Step NO. | Control Method | Operation Method | Goal Position [pls] | Operation Speed [pls/s] | Accel NO. | Decel NO. | M Code | Dwell Time | Sub axis setting |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Linear | Singular, End | 9000 | 3000 | 1 | 1 | 0 | 100 | Axis2 |

▪ Operating data of sub-axis(axis2)

| Step NO. | Control Method | Operation Method | Goal Position [pls] | Operation Speed [pls/s] | Accel NO. | Decel NO. | M Code | Dwell Time | Sub axis setting |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Single positioning control | Singular, End | -3000 | 0 | 1 | 1 | 0 | 0 | None |

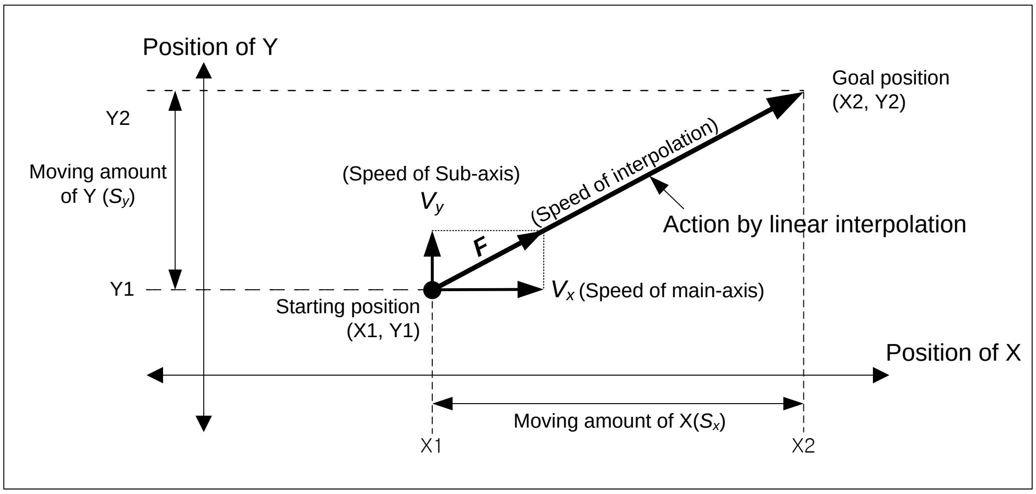
■ Operating pattern



### (3) Speed in 2 axes linear interpolation control

Operating speed in linear interpolation is according to the method of main-axis designating. After operating speed is set on command axis (main), the designated axis for interpolation is operated by PLC's calculating each moving amount. Speed of sub-axis and actual speed of machine are calculated as follows.

■ Speed in 2 axes linear interpolation



$$\text{Speed of sub}(V_y) = \text{Speed of main}(V_x) \times \frac{\text{Moving amount of Sub}(S_y)}{\text{Moving amount of Main}(S_x)}$$

$$\text{Interpolating speed}(F) = \sqrt{V_x{}^2 + V_y{}^2}$$

**[Example]**

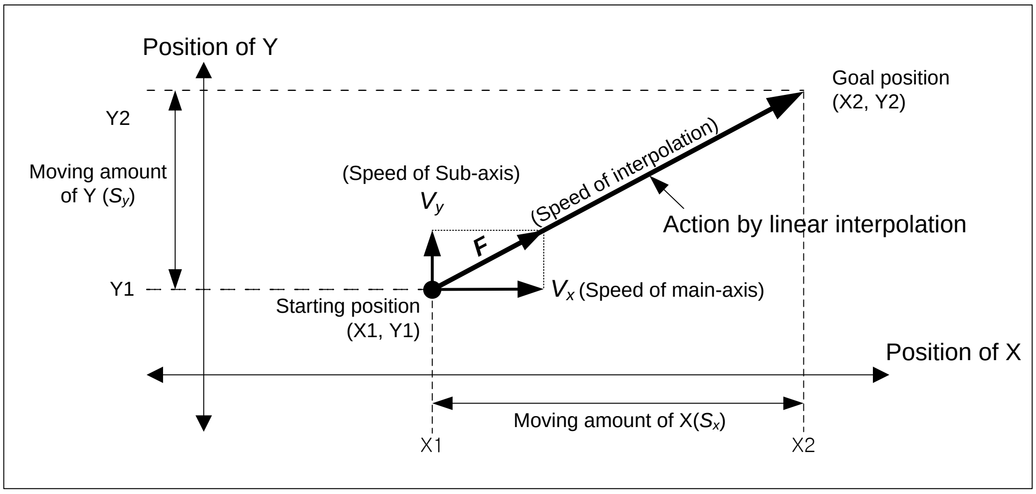
- ■ Starting position (2000, 1000)
- ■ Goal position (6000, 4000)
- ■ Operating speed : 400 [pls/s]

Speed of sub-axis and interpolating speed are as follows.

Speed of sub-axis = $400 \times \frac{3000}{4000} = 300$ [pls/s]

Interpolating speed = $\sqrt{400^2 + 300^2} = 500$ [pls/s]

■ Speed in 2 axes linear interpolation(when Synthetic speed is selected)



Interpolating speed(F) = Operating speed of main axis

Interpolating moving amount(S)= $\sqrt{S_x^{\ 2} + S_y^{\ 2}}$

Speed of main-axis = Interpolating speed(F) $\times \dfrac{\text{Main axis moving amount}(S_x)}{\text{Synthetic axis moving amount}(S)}$

Speed of sub-axis = Interpolating speed(F) $\times \dfrac{\text{Sub axis moving amount}(S_y)}{\text{Synthetic axis moving amount}(S)}$

**[Example]**

- Starting position (2000, 1000)
- Goal position (6000, 4000)
- Synthetic speed : 400 [pls/s]

Speed of sub-axis and interpolating speed are as follows.

Interpolating moving amount(S)= $\sqrt{4000^2 + 3000^2}$ = 5000

Speed of main-axis = $400 \times \dfrac{4000}{5000} = 320$

Speed of sub-axis = $400 \times \dfrac{3000}{5000} = 240$ [pls/s]

**Note**

(1) Speed limit for Sub-axis

When using linear interpolation control and moving distance of main < moving distance of sub, it is possible that sub-axis speed calculated by PLC exceeds 「Speed limit」 of basic parameter. In this case, error (error code : 261) arises and sub-axis speed is recalculated, then sub-axis continues to operate. To prevent that errors arise, operate it at the speed below limit.

(2) The speed when the distance main-axis moved is 0

When the distance main-axis moved is 0, the operating speed of main-axis operating data becomes actual interpolating speed. In the case that the distance main-axis moved is 0 and executing 2 axes linear interpolation, only sub-axis operates at the speed set on command axis.

■ Setting example of XG-PM

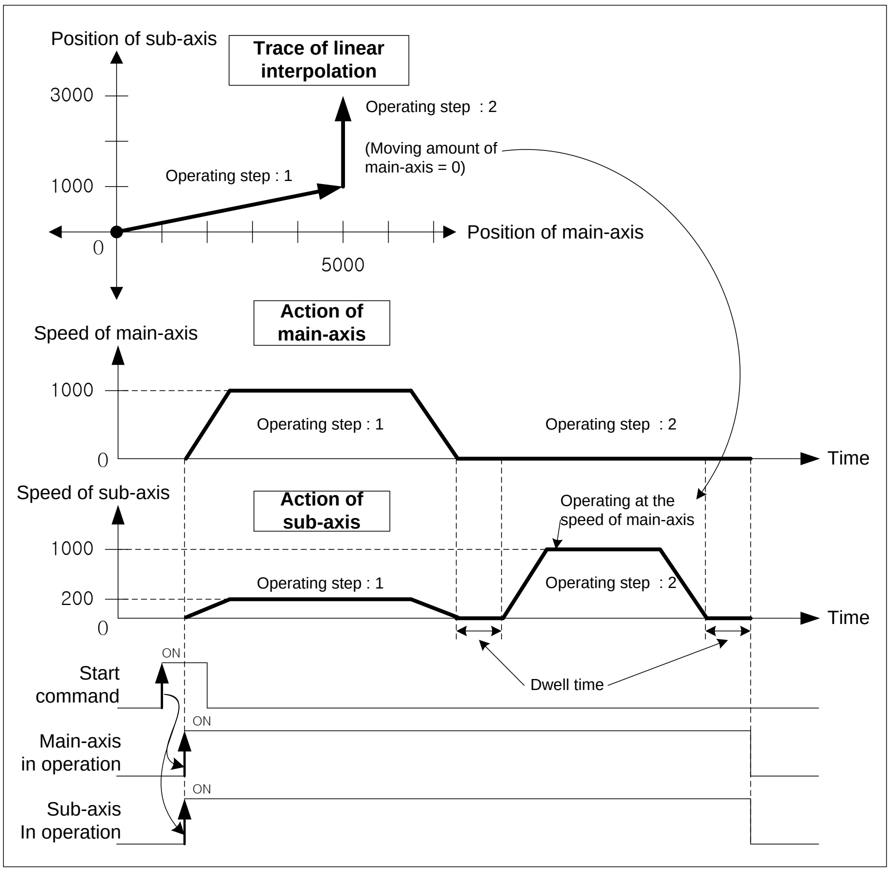
▪ Operating data of Main-axis

| Step no. | Control method | Operating method | Goal position [pls] | Operating speed [pls/s] | Acc. no. | Dec. no. | M code | Dwell time | Sub axis setting |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Linear interpolation | Singular, Continuous | 5000 | 1000 | No.1 | No.1 | 0 | 100 | Axis2 |
| 2 | Absolute, Linear interpolation | Singular, End | 5000 | 1000 | No.1 | No.1 | 0 | 100 | Axis2 |

▪ Operating data of Sub-axis

| Step no. | Control method | Operating method | Goal position [pls] | Operating speed [pls/s] | Acc. no. | Dec. no. | M code | Dwell time | Sub axis setting |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, single position control | Singular, End | 1000 | 0 | No.1 | No.1 | 0 | 0 | None |
| 2 | Absolute, single position control | Singular, End | 3000 | 0 | No.1 | No.1 | 0 | 0 | None |

■ Operating pattern



### (4) 2 axes linear interpolating continuous operation with circular arc interpolation

When the operation method is set as “continuous” and the direction of movement changes rapidly, machine is possible to be damaged. When it does not have to position to the goal position, user may interpolate ‘circular interpolating operation’ between two trace to make operation softer and smoother.

(a) Operation order

1) Confirm the execution of 2 axes linear interpolating continuous operation with circular arc interpolation when linear interpolation starts. It may be set in「2 axes linear interpolating continuous operation with circular arc interpolation」of extended parameter.

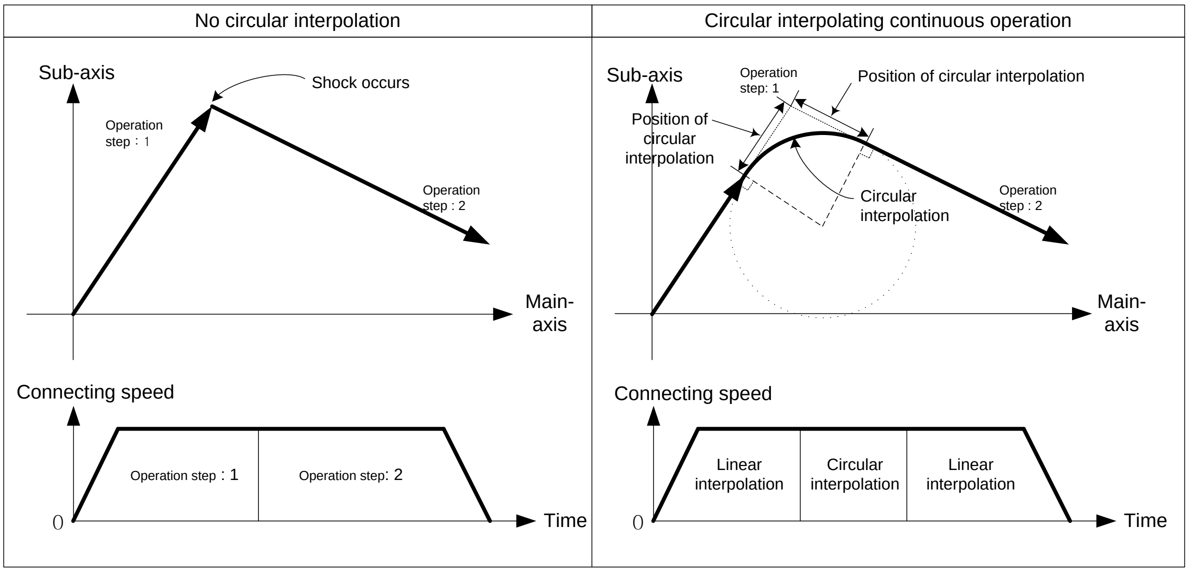
| Setting items | Setting value | Description |
|---|---|---|
| 2 axes linear interpolating continuous operation with circular arc interpolation | 0 : Not to execute | When executing it, not to interpolate circular arc |
| | 1 : To execute | When executing it, interpolate circular arc |

2) Reset the starting position of circular interpolation (Goal position of Linear trace 1) and the goal position (Starting position of Linear trace 2) through checking the position circular arc will be interpolated at. The position circular arc will be interpolation at may be set in「Circular arc interpolating position」of extended parameter.

| Setting items | Setting value | Description |
|---|---|---|
| 2 axes linear interpolating continuous operation with circular arc interpolation | 0 ~ 2147483647 | Set the position circular arc will be interpolated at. This value means the relative distance from the goal position of linear trace 1. |

3) Execute linear interpolation to the starting position of circular arc and continue to execute circular interpolation at the same speed as linear interpolation. After finish the circular interpolation, continue to execute linear interpolation at the same speed.

(b) Operating pattern



(c) Restrictions

Circular interpolation is not executed in the case below but linear interpolation is executed to the goal position.

▪ Operating method of operation data is “End” or “Continue”

▪ Position of circular arc interpolating is bigger than linear trace 1, 2 (Error code : 262)

▪ Trace of both linear interpolations are on the same line

**[Example] Execute linear interpolation when the extended parameter setting is same as follows at the current position (0,0)**

| Extended parameter | Setting value |
|---|---|
| 2 axes linear interpolating continuous operation with circular arc interpolation | 1 : Circular arc interpolating continuous operation |
| Position of 2 axes linear interpolating continuous operation with circular arc interpolation | 2000 |

■ Setting example of XG-PM

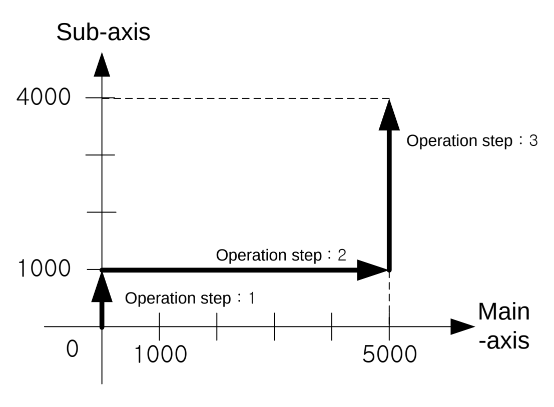
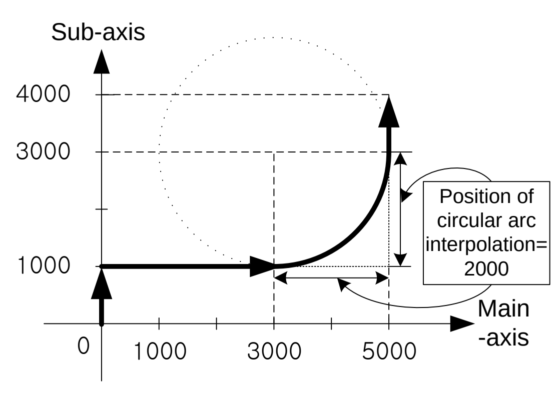
▪ Operating data of Main-axis

| Step no. | Control method | Operating method | Goal pos[pls] | speed [pls/s] | Acc. no. | Dec. no. | M code | Dwell time | Sub axis setting |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Linear interpolation | singular, continuous | 0 | 3000 | No.1 | No.1 | 0 | 0 | Axis2 |
| 2 | Absolute, Linear interpolation | singular, continuous | 5000 | 3000 | No.1 | No.1 | 0 | 0 | Axis2 |
| 3 | Absolute, Linear interpolation | singular, end | 5000 | 3000 | No.1 | No.1 | 0 | 100 | Axis2 |

▪ Operating data of Sub-axis

| Step no. | Control method | Operating method | Goal pos[pls] | speed [pls/s] | Acc. no. | Dec. no. | M code | Dwell time | Sub axis setting |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, single axis position control | singular, end | 1000 | 0 | No.1 | No.1 | 0 | 0 | None |
| 2 | Absolute, single axis position control | singular, end | 1000 | 0 | No.1 | No.1 | 0 | 0 | None |
| 3 | Absolute, single axis position control | singular, end | 4000 | 0 | No.1 | No.1 | 0 | 0 | None |

■ Operating pattern

| No circular arc interpolation | Circular arc interpolating continuous operation |
|---|---|
|  |  |

■ Description about action

When executing operation step no.1, execute linear interpolation to original goal position (0,1000) without circular arc interpolation because position to interpolate circular arc(2000) is bigger than the length of line 1(1000).

When finishing linear interpolation to goal position of operation step no.1 and executing operation step no.2, because position to interpolate circular arc(2000) is smaller than line length of step no.2(5000) and no.3(3000), so recalculate the starting position (Goal position of linear trace no.1) and the goal position (Starting position of linear trace no.2) of circular interpolation.

After continue to execute linear interpolation to the recalculated goal position of operation step no.2(3000,1000), then execute circular interpolation to recalculated starting position of operation step no.3(5000,3000).

After circular interpolation, execute linear interpolation to the goal position of operation step no.3(5000,4000), Positioning will be complete.

### 9.2.7 Linear Interpolation Control with 3 axes

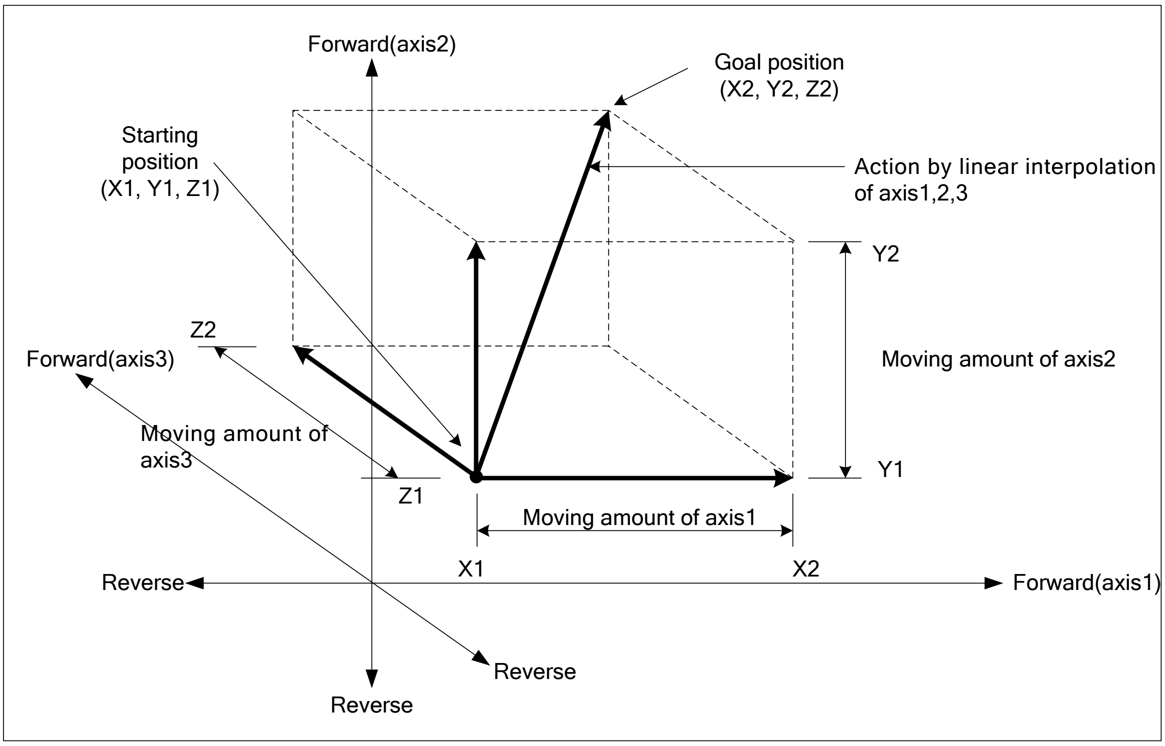
After executed by positioning operation start command (「Indirect start」, 「Synchronous start」), then executing interpolation control from starting position to the goal position with interpolation axis set as the main axis and sub axis.

(1) Linear interpolation control with absolute coordinates (「Absolute, Linear Interpolation」)

(a) Execute linear interpolation with 3 axes from starting position to the goal position designated on positioning data. Positioning control is on basis of the designated position from homing.

(b) The direction of movement depends on the starting position and the goal position for each axis.

- ■ Starting position < Goal position : Positioning operation in forward
- ■ Starting position > Goal position : Positioning operation in reverse



(c) Restrictions

Linear interpolation with 3 axes may not be executed in the case below.

- ■ 「Sub axis setting」 Error (error code : 253)
  - ▪ 「Sub axis setting」 of main axis operating data is “Axis-undecided”
  - ▪ 「Sub axis setting」 of main axis operating data is the same as main axis no.
  - ▪ 「Sub axis setting」 of main axis operating data exceeds the settable axis no. of module now using
- ■ If only one axis is set as sub axis, execute “linear interpolation control with 2 axes”.

(d) Setting example of operating data

| Setting items | Main-axis setting (axis1) | Sub-axis setting(axis2) | Sub-axis setting(axis3) | Description |
|---|---|---|---|---|
| Control method | Absolute, Linear interpolation | -[*1] | -[*1] | When linear interpolation control is executed by the method of absolute coordinates, set「Absolute, Linear interpolation」on the main axis |
| Operating method | Singular, End | - | | Set the operating method to execute linear interpolation |
| Goal position [pls] | 5000 | 6000 | 4000 | Set the goal position to position on main-axis and sub-axis |
| Operating speed [pls/s] | 1000 | - | | Use speed-designated method of main axis for linear interpolation |
| Acc. no. | No.1 | - | | Set acc. no. for acceleration<br>(no.1 ~ no.4) |
| Dec. no. | No.2 | - | | Set dec. no. for deceleration.<br>(no.1 ~ no.4) |
| M code | 0 | - | | When need to execute auxiliary work synchronizing with linear interpolation |
| Dwell time | 500 | - | | Set dwell time(ms) to outputting the signal positioning completion |
| Sub-axis setting | Axis2, Axis3 | - | | Set an axis to be used as sub-axis among settable axis in operating data of main-axis |

[*1] : It does not need to be set. Whatever value is set as, it does not affect linear interpolation.

**Note**

Linear interpolation control is executed on the basis of operating data of main axis.
Only 「Goal position」item of sub-axis setting affect linear interpolation. In other word, whatever value is set as, it does not affect the operation and errors do not arise

**[Example] axis1 is main axis, axis2 and axis3 are sub axis. Execute linear interpolation by the setting as follows.**

- Starting position (2000, 1000, 1000), Goal position (5000, 6000, 4000)

  In this condition, the operation is as follows.

- Setting example of XG-PM
  - Operating data of main-axis(axis1)

| Step no. | Control method | Operating method | Goal position [pls] | Operating speed [pls/s] | Acc. no. | Dec. no. | M code | Dwell time | Sub axis setting |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Linear | Singular, End | 5000 | 1000 | No.1 | No.1 | 0 | 100 | Axis2 |

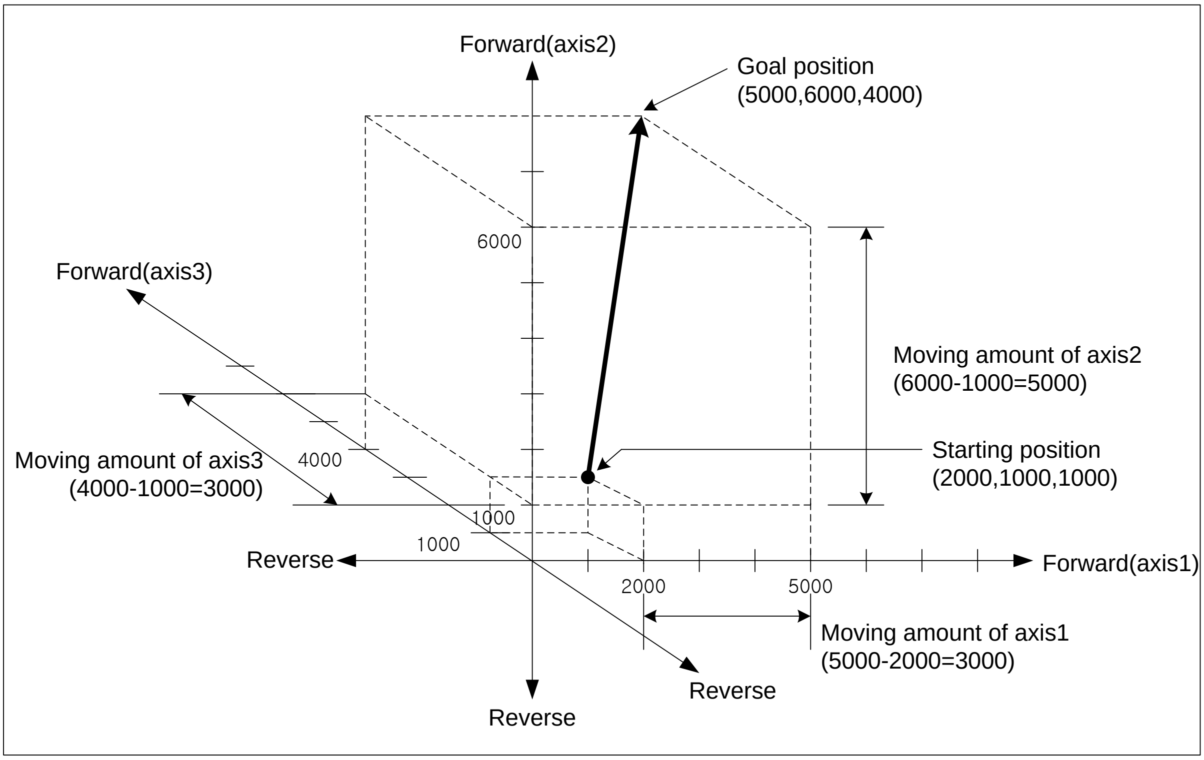
- Operating data of sub-axis1(axis2)

| Step no. | Control method | Operating method | Goal position [pls] | Operating speed [pls/s] | Acc. no. | Dec. no. | M code | Dwell time | Sub axis setting |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Single axis positioning control | Singular, End | 6000 | 0 | No.1 | No.1 | 0 | 0 | None |

- Operating data of sub-axis2(axis3)

| Step no. | Control method | Operating method | Goal position [pls] | Operating speed [pls/s] | Acc. no. | Dec. no. | M code | Dwell time | Sub axis setting |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Single axis positioning control | Singular, End | 4000 | 0 | No.1 | No.1 | 0 | 0 | None |

- Operating pattern

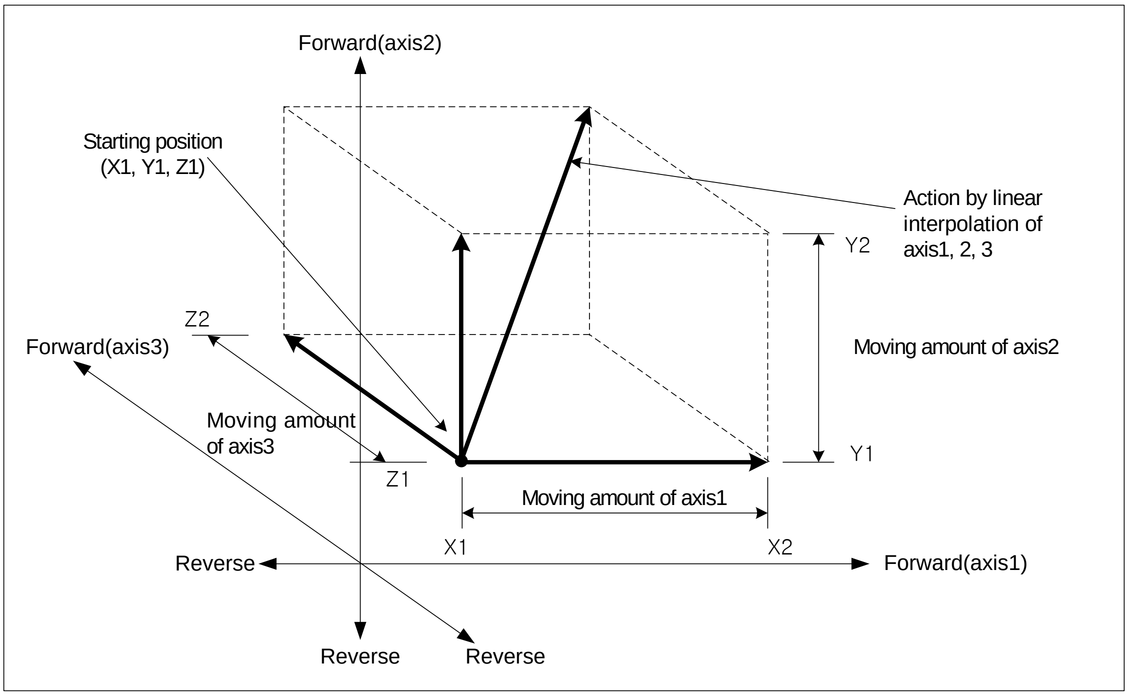


(2) Linear interpolation control with relative coordinates (「Relative, Linear Interpolation」)

(a) Execute 3 axes linear interpolation from starting position to the goal position. Positioning control is on basis of the current stop position.

(b) Moving direction depends on the sign of the goal position (Moving amount)

- ■ The sign is positive (+ or nothing) : Positioning operation in forward
- ■ The sign is negative (-) : Positioning operation in reverse



(c) Restrictions

Linear interpolation with 3 axes may not be executed in the case below.

- ■「Sub-axis setting」 error (error code : 253)
  - ▪ 「Sub-axis setting」 value of main axis operating data is “Axis-undecided”
  - ▪ 「Sub-axis setting」 value of main axis operating data is same as the main axis no.
  - ▪ 「Sub-axis setting」 value of main axis operating data exceeds settable axis no.
- ■ If only one axis is set as sub axis, execute “linear interpolation control with 2 axes”.

(d) Setting example of operating data

| Setting items | Main-axis setting (axis1) | Sub-axis setting(axis2) | Sub-axis setting(axis3) | Description |
|---|---|---|---|---|
| Control method | Absolute, Linear interpolation | - [*1] | - [*1] | When linear interpolation control is executed by the method of absolute coordinates, set「Absolute, Linear interpolation」on the main axis |
| Operating method | Singular, End | - | | Set the operating method to execute linear interpolation |
| Goal position[pls] | 5000 | 6000 | 4000 | Set the goal position to position on main-axis and sub-axis |
| Operating speed[pls/s] | 1000 | - | | Use speed-designated method of main axis for linear interpolation |
| Acc. no. | No.1 | - | | Set acc. no. for acceleration (no.1 ~ no.4) |
| Dec. no. | No.2 | - | | Set dec. no. for deceleration (no.1 ~ no.4) |
| M code | 0 | - | | When need to execute auxiliary work synchronizing with linear interpolation |
| Dwell time | 500 | - | | Set dwell time(ms) to outputting the signal positioning completion |
| Sub-axis setting | Axis2, Axis3 | - | | Set an axis to be used as sub-axis among settable axis in operating data of main-axis |

- [*1] : It does not need to be set. Whatever value is set as, it does not affect linear interpolation.

**Note**

Linear interpolation control is executed on the basis of operating data of main axis.
Only 「Goal position」item of sub-axis setting affect linear interpolation. In other word, whatever value is set as, it does not affect the operation and errors do not arise.

**[Example] axis1 and axis2 are main and sub axis each. Execute linear interpolation by the setting as follows**

■ Starting position (2000, 1000, 1000), Goal position (5000, 6000, 4000) : In this condition, the operation is as follows.
■ Setting example of XG-PM

▪ Operating data of main-axis(axis1)

| Step no. | Control method | Operating method | Goal position [pls] | Operating speed [pls/s] | Acc. no. | Dec. no. | M code | Dwell time | Sub axis setting |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Linear | Singular, End | 5000 | 1000 | No.1 | No.1 | 0 | 100 | Axis2 |

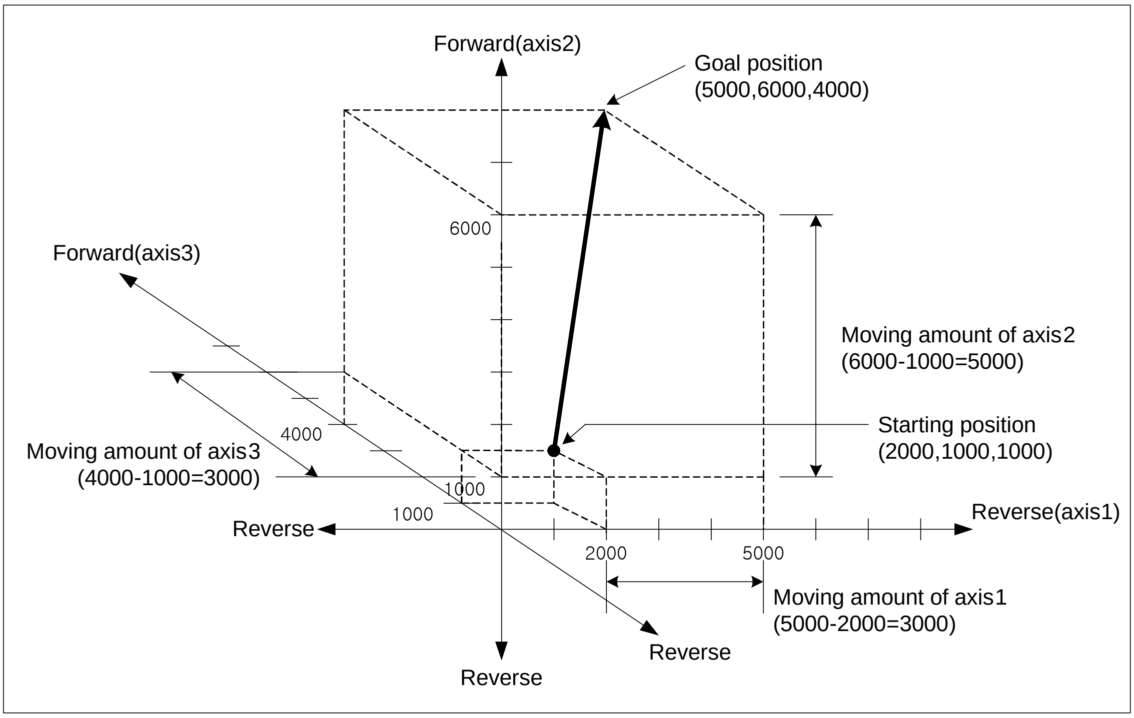
▪ Operating data of sub-axis1(axis2)

| Step no. | Control method | Operating method | Goal position [pls] | Operating speed [pls/s] | Acc. no. | Dec. no. | M code | Dwell time | Sub axis setting |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Single axis positioning control | Singular, End | 6000 | 0 | No.1 | No.1 | 0 | 0 | None |

▪ Operating data of sub-axis2(axis3)

| Step no. | Control method | Operating method | Goal position [pls] | Operating speed [pls/s] | Acc. no. | Dec. no. | M code | Dwell time | Sub axis setting |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Single axis positioning control | Singular, End | 4000 | 0 | No.1 | No.1 | 0 | 0 | None |

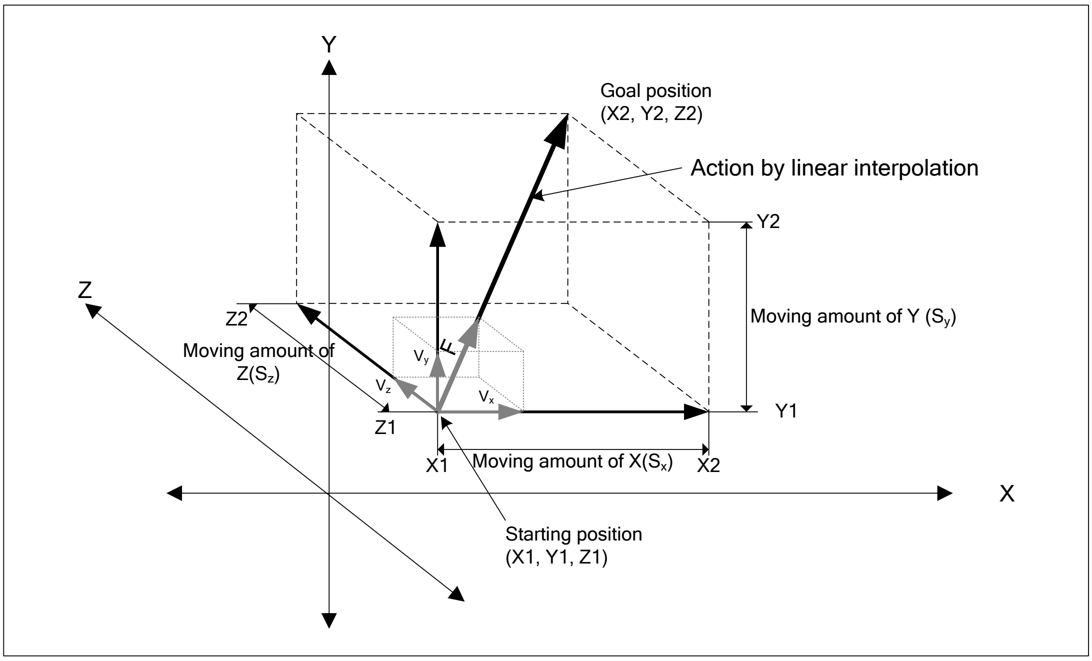
■ Operating pattern



### (3) Speed in 3 axes linear interpolation control

Operating speed in linear interpolation is according to the method of main-axis designating. After operating speed is set on command axis (main), the designated axis for interpolation is operated by embedded positionig module's calculating each moving amount. Speed of sub-axis and actual speed of machine are calculated as follows.

■ Speed in 3 axes linear interpolation



$$\text{Speed of sub}(V_y) = \text{Speed of main}(V_x) \times \frac{\text{Moving amount of Sub}(S_y)}{\text{Moving amount of Main}(S_x)}$$

$$\text{Speed of sub}(V_z) = \text{Speed of main}(V_x) \times \frac{\text{Moving amount of sub}(S_z)}{\text{Moving amount of main}(S_x)}$$

$$\text{Interpolating speed}(F) = \sqrt{V_x^2 + V_y^2 + V_z^2}$$

**[Example]**

- Starting position (2000, 1000, 1000)
- Goal position (6000, 5000, 6000)
- Operating speed : 400 [pls/s]

Speed of sub-axis and interpolating speed are as follows.

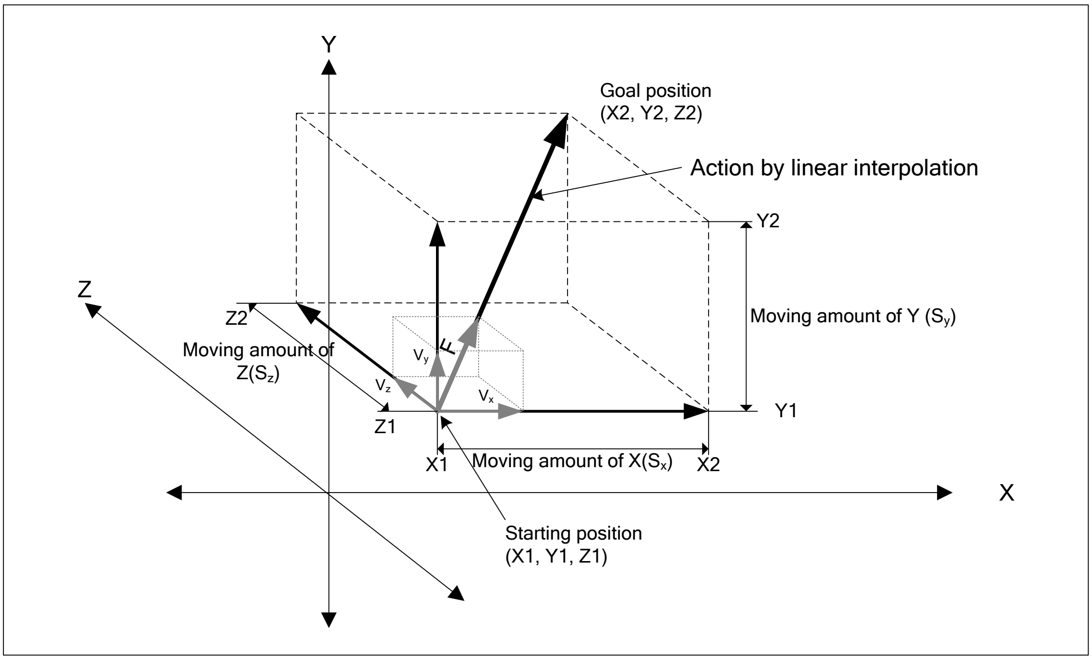
Speed of sub-axis1 = $400 \times \frac{3000}{4000} = 300$ [pls/s]

Speed of sub-axis2 = $400 \times \frac{5000}{4000} = 500$ [pls/s]

Interpolating speed = $\sqrt{400^2 + 300^2 + 500^2} \approx 707$ [pls/s]

- Speed in 3 axes linear interpolation

(When the interpolation speed selection is set to the composite speed)



$$\text{Interpolating speed}\,(F) = \text{Main axis's target position}$$

$$\text{Moving Amount}\,(S) = \sqrt{S_x{}^2 + S_y{}^2 + S_z^2}$$

$$\text{Speed of Main}\,(V_x) = \text{interpolating speed}\,(F) \times \frac{\text{Main Axis's Movement}(S_x)}{\text{Moving Amount}\,(S)}$$

$$\text{Sub1 Speed}(V_y) = \text{Interpolating speed}\,(F) \times \frac{\text{Sub1's Movement}\,(S_y)}{\text{Moving Amount}(S)}$$

$$\text{Sub2 Speed}\,(V_z) = \text{Interpolating speed}\,(F) \times \frac{\text{Sub2's Movement}(S_z)}{\text{Moving Amount}\,(S)}$$

[ 예 ]

- Starting point (2000, 1000, 1000),
- Taget position (6000, 5000, 6000)
- Speed : 400 [pls/s]

In the above cases, the spindle speed and subordinate axis speed are as follows

Interpolation movement amount = $\sqrt{4000^2 + 4000^2 + 5000^2} \approx 7549.8$

Main Speed = $400 \times \frac{4000}{7549.8} \approx 211.9$

Sub1 Speed = $400 \times \frac{4000}{7549.8} \approx 211.9$ [pls/s]

Sub2 Speed = $400 \times \frac{5000}{7549.8} \approx 264.9$ [pls/s]

**Note**

(1) Speed limit for Sub-axis

When using linear interpolation control and moving distance of main < moving distance of sub, it is possible that sub-axis speed calculated by embedded positionig module exceeds 「Speed limit」 of basic parameter. In this case, error (error code : 261) arises and sub-axis speed is recalculated, then sub-axis continues to operate. To prevent that errors arise, operate it at the speed below limit.

(2) The speed when the distance main-axis moved is 0

When the distance main-axis moved is 0, the operating speed of main-axis operating data becomes actual interpolating speed.

In case of linear interpolation with more than 3 axes, the speed of sub-axis is calculated by the formula below.

$$Speed\ of\ \ sub-axis\,(V_y) = Interpolating\ \ speed\,(F) \times \frac{Moving\ \ amount\ \ of\ \ sub-axis\,(S_y)}{Merged\ \ moving\ \ amount\ \ (S_f)}$$

$$Speed\ of\ \ sub-axis\,(V_z) = Interpolating\ \ speed\,(F) \times \frac{Moving\ \ amount\ \ of\ \ sub-axis\,(S_z)}{Merged\ \ moving\ \ amount\,(S_f)}$$

### 9.2.8 Linear Interpolation Control with 4 axes

After executed by positioning operation start command (「Indirect start」, 「Synchronous start」), then executing interpolation control from starting position to the goal position with interpolation axis set as the main axis and sub axis. Combination of interpolation axis is unlimited and maximum 6 axes(XBMH:2axes) linear interpolation control is available. Characteristics of action are same as linear interpolation control with 3 axes. For the details, refer to linear interpolation control with 3 axes.

(1) Linear interpolation control with absolute coordinates (「Absolute, Linear Interpolation」)

(a) Execute linear interpolation from starting position to the goal position designated on positioning data. Positioning control is on basis of the designated position from homing.

(b) The direction of movement depends on the starting position and the goal position for each axis.

- ■ Starting position < Goal position : Positioning operation in forward
- ■ Starting position > Goal position : Positioning operation in reverse

(2) Linear interpolation control with relative coordinates (「Relative, Linear Interpolation」)

(a) Execute 4 axes linear interpolation from starting position to the goal position. Positioning control is on basis of the current stop position.

(b) Moving direction depends on the sign of the goal position (Moving amount)

- ■ The sign is positive (+ or nothing) : Positioning operation in forward
- ■ The sign is negative (-) : Positioning operation in reverse

(3) Speed in 4 axes linear interpolation control

Operating speed in linear interpolation is according to the method of main-axis designating. After operating speed is set on command axis (main), the designated axis for interpolation is operated by embedded positionig module's calculating each moving amount. Speed of sub-axis and actual speed of machine are calculated as follows.

$$\text{Speed of sub-axis(axis2)}\ (V_2) = \text{Speed of main-axis}(V_1) \times \frac{\text{Moving amount of sub-axis}\ (S_2)}{\text{Moving amount of main-axis}\ (S_1)}$$

$$\text{Speed of sub-axis(axis3)}\ (V_3) = \text{Speed of main-axis}\ (V_1) \times \frac{\text{Moving amount of sub-axis}\ (S_3)}{\text{Moving amount of main-axis}(S_1)}$$

$$\text{Speed of sub-axis(axis4)}(V_4) = \text{Speed of main-axis}\ (V_1) \times \frac{\text{Moving amount of sub-axis}\ (S_4)}{\text{Moving amount of main-axis}(S_1)}$$

$$\text{Interpolating Speed}\ (F) = \sqrt{V_1^{\,2} + V_2^{\,2} + V_3^{\,2} + V_4^{\,2}}$$

### 9.2.9 Designate Midpoint of Circular Interpolation

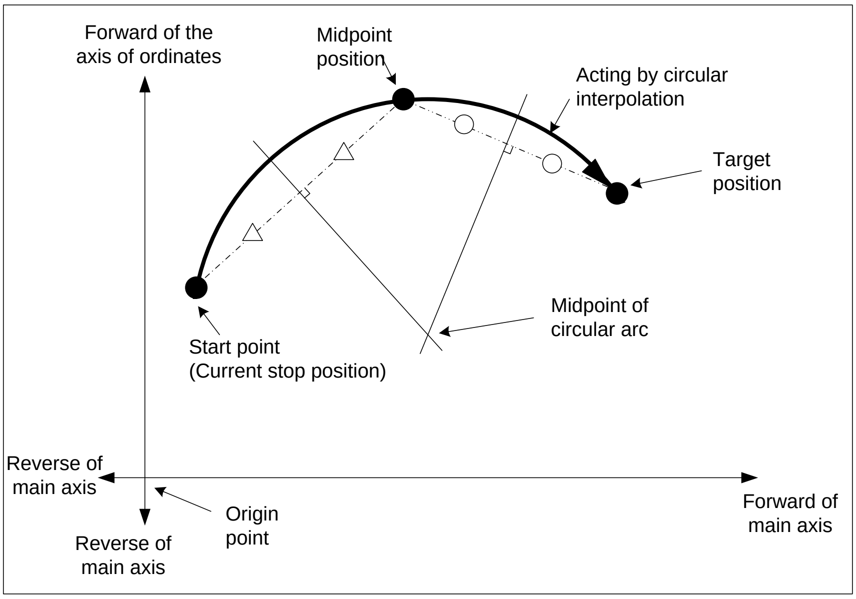
It was progressed by start command of positioning operation (「Indirect start」, 「direct start」) and operate interpolation following the path of circular which is through midpoint that is set by 2 axes.
And, Can progress circular interpolation of over 360 degrees by the set number of circular interpolation.
The combination of 2 axes for circular interpolation is unlimited. User can randomly use 2 axes from axis 1 to axis 4.

(1) Control of circular interpolation by absolute coordinate, designate midpoint(Absolute, circular interpolation)

(a) Operate circular interpolation from starting point and pass the midpoint that is set operation data to target point.

(b) To be made path of circular interpolation with start position, midpoint and a crossing which is perpendicular divide equally position of midpoint and target position.

(c) Movement direction is decided automatically depends on set target position and auxiliary point of circular interpolation.



(d) Restriction

■ User can't draw circle which is starting point same with last point on the circular interpolation of midpoint designation method. If you want to draw circle, please use method of midpoint.

■ User cannot progress circular interpolation of midpoint designation method with following cases.

- 「Sub axis setting」 disorder (Error code : 279)
  - In case of the value of 「Sub axis setting」 of main axis operation data is no setting axis
  - In case of the value of 「Sub axis setting」 of the main axis operation data same with the number of main axis,
  - In case of value of「Sub axis setting」 of main axis operation data exceed the axis No. of module which is can set.
- In case of "degree" is set as item of main axis or sub axis, (Error code : 282(Main axis), 283(Sub axis))
- Midpoint that is designated as auxiliary point same with start position or target position. (Error code : 284)
- In case of start position same with target position (Error code : 285)
- In case of calculated radius of circular arc exceed 2147483647pls (Error code : 286)
- In case of auxiliary position and target position in a straight line from start position, (Error code : 287)

**Note**

Have to be careful, because 2 axes work both in the circular interpolation maneuver.

(1) Available auxiliary operation is as follows ;

- Speed override, Deceleration stop, Emergency stop, Skip operation

(2) Operation of circular interpolation unavailable command is as follows ;

- Position/Speed conversion control, Position override, Continuous operation

(3) The parameter item which is operated by set value of each axis is as follows ;

- amount of compensate of Backlash, high limit of software, low limit of software on the item of expansion parameter

(e) Example of setting operation data

| Setting item | Main axis (axis1) setting | Sub axis (axis 2) setting | Contents |
|---|---|---|---|
| Control method | Absolute, circular interpolation | - [*1] | Set 「absolute, circular interpolation」 on main axis, when control circular interpolation by absolute coordinates. |
| Operation method | Singleness, End | - | Set operation method for circular interpolation. |
| Target position [pls] | 10000 | 0 | Set the target position for positioning on the main axis and sub axis. |
| Operation speed [pls/s] | 1000 | - | Circular interpolation use method of designating composition speed |
| Acceleration speed | No.1 | - | Set the acceleration time No. for acceleration. (No.1 ~ 4) |
| Deceleration speed | No.2 | - | Set the deceleration time No. for deceleration. (No.1 ~ 4) |
| M code | 0 | - | Set it for progressing auxiliary operation depends on circular interpolation operation. |
| Dwell time | 500 | - | set the dwell time taken until plc outputs the signal which informs users of finishing the position decision |
| The axis of ordinates setting | Axis 2 | - | Set axis as sub axis among settable axes of module which is using for now on the main axis operation data. |
| Circular interpolation Auxiliary point | 5000 | 5000 | Set midpoint for passing circular arc on the method of the designating midpoint. |
| Circular interpolation mode | Midpoint | - | In case of using the method of designating midpoint, set 「midpoint」 on the main axis. |
| Circular interpolation The number of rotations | 0 | - | When user want to draw circle which is over 360 degrees, set the number of rotations of circular arc. |
| Helical interpolation | Do not use | - | In case of using circular interpolation, set 「Do not use」 on the main axis. |

- [*1] : Do not need setting. Whatever you set, there is no effect to circular interpolation.

**Note**

The circular interpolation control of the method of designating midpoint operate by standards of set item on the operation data of main axis (command axis).

When circular interpolation operation of the method of designating midpoint, there is no effect except for「Target position」, 「Auxiliary point of circular interpolation」 on the axis of setting. What ever you take for the value, there is no effect to operate, there is no error.

**[Example] Operate circular interpolation of designating midpoint and absolute coordinate (main axis; axis 1, sub axis; axis 2)**

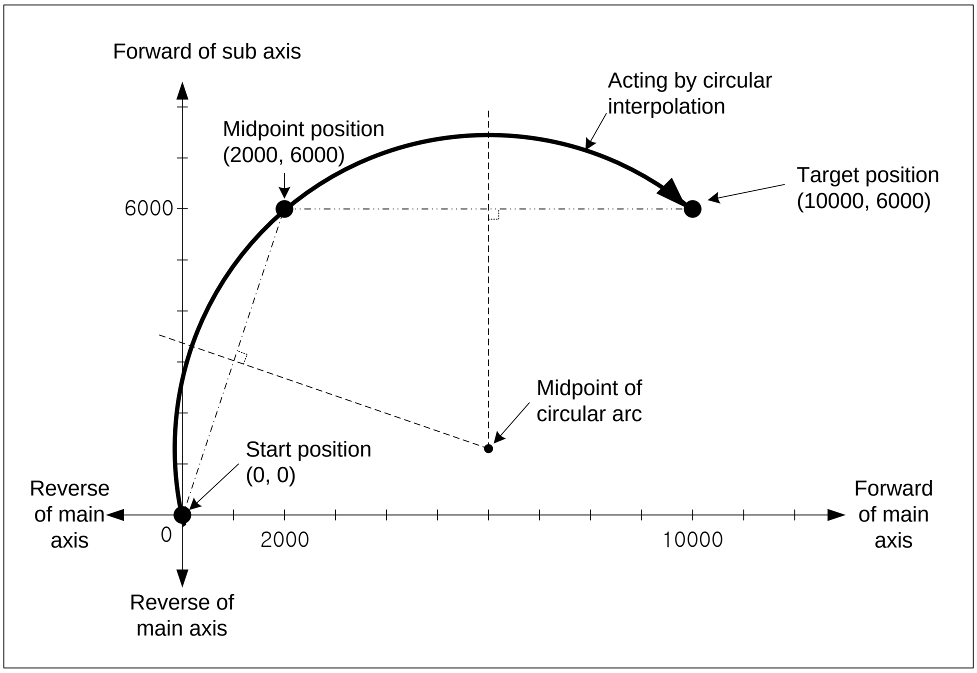
- ■ In case of Start position (0, 0), Target position (10000, 6000), Auxiliary point (2000, 6000), operation is as follows;
- ■ Example of setting in the XG-PM
  - ▪ Main axis(axis1) operation data

| Step No. | Control Method | Operation method | Target position [pls] | Operation Speed [pls/s] | Acc. Speed | Dec. Speed | M code | Dwell time | Sub axis setting | Circular interpolation Auxiliary point | Circular interpolation mode | The number of rotations of Circular interpolation | Helical interpolation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Circular interpolation | Singleness, End | 10000 | 1000 | No. 1 | No. 1 | 0 | 100 | Axis 2 | 10000 | Midpoint | 0 | Do not use |

- ▪ The axis(axis 2) of ordinates operation data

| Step No. | Control Method | Operation method | Target position [pls] | Operation Speed [pls/s] | Acc. Speed | Dec. speed | M code | Dwell time | Sub axis setting | Circular interpolation Auxiliary point | Circular interpolation mode | The number of rotations of Circular interpolation | Helical interpolation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Reduction positioning control | Singleness End | 6000 | 0 | No. 1 | No. 1 | 0 | 0 | Do not setting axis | 7500 | Midpoint | 0 | Do not use |

- ■ Operation pattern



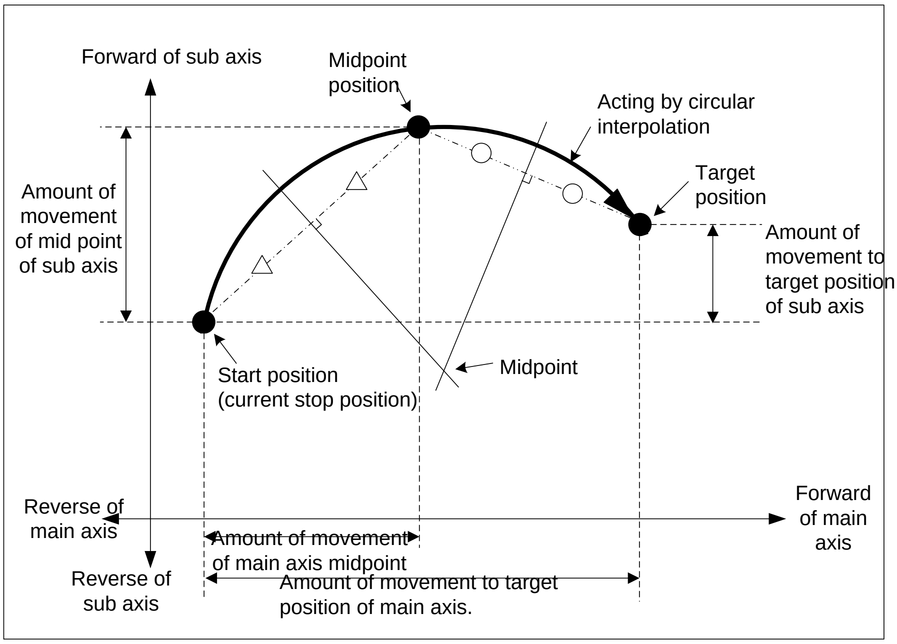
### (2) Circular interpolation by relative coordinates, the method of designating midpoint (Relative, circular interpolation)

(a) Operate circular interpolation from start position and go through midpoint to target position as amount of set movement.

(b) Midpoint position is the incremented position as set value on 「the circular interpolation auxiliary point」 from current stop position.

(c) The intersection of perpendicular bisectors of starting position and midpoint, the current stop position and the goal position will be the center-point of the arc.

(d) Movement direction is decided by set target position and circular interpolation auxiliary point.



(e) Restriction

- ■ Can not draw circle which starting point is the same with last point on the circular interpolation of the method of designating midpoint. When want to draw circle, should use midpoint method.
- ■ In this following case, it will be error and can not working circular interpolation of method of designating midpoint.
  - ▪ 「Sub axis setting」 disorder (Error code : 279)
    - - It is axis-undecided that the value of sub axis of main axis operation data.
    - - The value of 「Sub axis setting」 of main axis operation data is set is same with main axis No.
    - - The value of 「Sub axis setting」 of main axis operation data exceed axis No. of settable module which is using.
  - ▪ In case of “Degree” is set as control item of main/sub axis. (Error code : 282(Main axis), 283(Sub axis))
  - ▪ In case of midpoint which is designated as auxiliary point is same with start position and target position. (Error code : 284)
  - ▪ In case of start position same with target position. (Error code : 285)
  - ▪ Radius of calculated circle exceed 2147483647pls (Error code : 286)
  - ▪ Start position is in alignment with auxiliary position and target position. (Error code : 287)

(f) Example of operation data setting

| Setting item | Main axis(axis 1) setting | Sub axis(axis 2) setting | Contents |
|---|---|---|---|
| Control method | Relative, Circular interpolation | - [*1] | When control circular interpolation by relative coordinates, set 「relative, circular interpolation」 on main axis. |
| Operation method | Singleness, End | - | Set operation method for circular interpolation. |
| Target position [pls] | 10000 | 0 | Set target position as a amount of increment of stop position for positioning on the main axis, sub axis. |
| Operation speed [pls/s] | 1000 | - | Circular interpolation use method of designating composition speed. Set composition speed on the main axis. |
| Acceleration speed | No.1 | - | Set acceleration time No. for acceleration.<br>(No.1 ~ No.4) |
| Deceleration speed | No. 2 | - | Set deceleration time No. for deceleration.<br>(No.1 ~ No.4) |
| M code | 0 | - | Set it when user wants to progress other auxiliary action with circular interpolation operation. |
| Dwell time | 500 | - | set the dwell time taken until plc outputs the signal which informs users of finishing the position decision |
| Sub axis setting | Axis 2 | - | Set axis among the settable axes of current module on the main axis operation for sub. |
| Circular interpolation auxiliary point | 5000 | 5000 | Set the middle point that the arc with mid-point designating method would pass by as an increment from the current stop position |
| Circular interpolation mode | Midpoint | - | Set “midpoint”, when use method of designating midpoint. |
| The number of rotations of circular interpolation | 0 | - | Set the number of rotations for drawing circle that it is over 360 degrees. |
| Helical interpolation | Not use | - | Set “not use”, when use circular interpolation. |

- [*1] : Do not need setting. Whatever user set, there is no effect to circular interpolation.

**Note**

Circular interpolation of method of designating midpoint is depends on item that it is set on operation data of main axis (command axis).

There is no effect to circular interpolation operation except for 「Target position」 and 「Circular interpolation auxiliary point」, when operate circular interpolation of method of designating midpoint. Whatever user set, there is no effect and no error.

**[ Example ] Operate circular interpolation of method of designating relative coordinate midpoint with axis 1 (main axis), with axis 2 (sub axis)**

■ Start position : (1000, 1000)

Target position (amount of movement) setting : (8000, 4000)

Auxiliary point (amount of movement) setting : (5000, 5000)

In this case operation is as follows:

■ Example of setting XG-PM

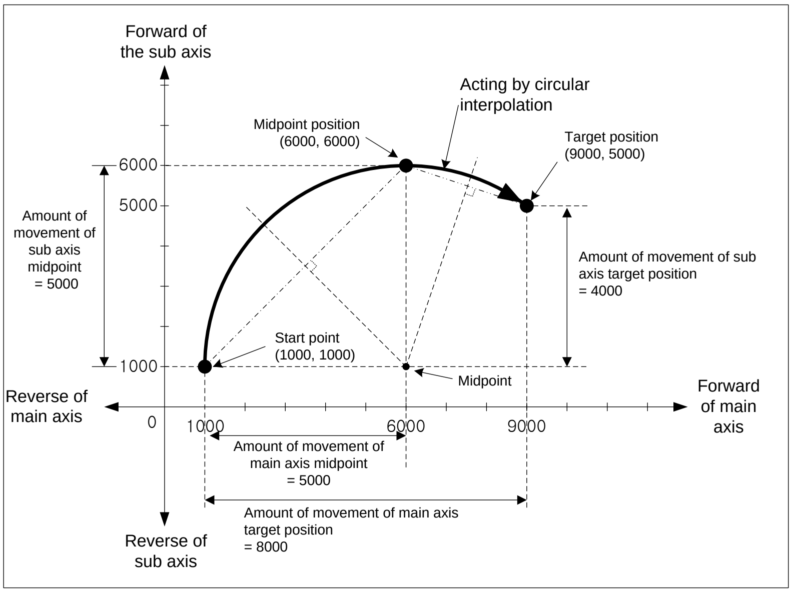
▪ Main axis(axis 1) Operation data

| Step No. | Control Method | Operation method | Target position [pls] | Operation Speed [pls/s] | Acc. Speed | Dec. Speed | M code | Dwell time | Sub axis setting | Circular interpolation Auxiliary point | Circular interpolation mode | The number of rotations of Circular interpolation | Helical interpolation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Relative, Circular interpolation | Singleness , End | 8000 | 1000 | No. 1 | No. 1 | 0 | 100 | Axis 2 | 5000 | Midpoint | 0 | Do not use |

▪ Sub axis(axis 2) Operation data

| Step No. | Control Method | Operation method | Target position [pls] | Operation Speed [pls/s] | Acc. Speed | Dec. Speed | M code | Dwell time | Sub axis setting | Circular interpolation Auxiliary point | Circular interpolation mode | The number of rotations of Circular interpolation | Helical interpolation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Reduction positioning control | Singleness , End | 4000 | 0 | No. 1 | No. 1 | 0 | 0 | Axis-undecided | 5000 | Midpoint | 0 | Do not use |

■ Operation pattern



### 9.2.10 Circular interpolation control of designating midpoint

Operate interpolation up to trace of the circle after operate by starting command of positioning operation (「indirect start」, 「Start at a time」). And then, Midpoint is center of circle and it is move to rotation direction of circular interpolation.
「The number of rotations of circular interpolation」 can operate circular interpolation which is over 360 degrees with setting value.

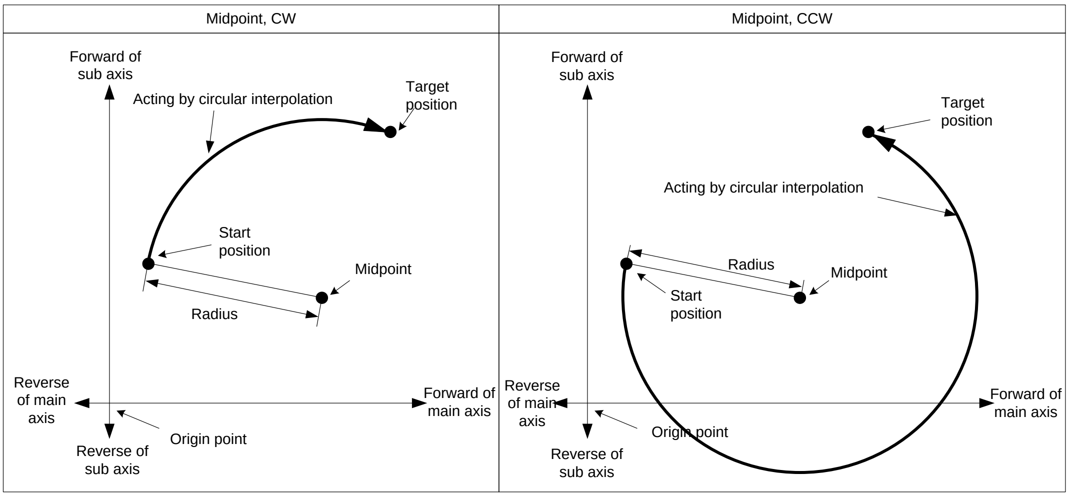
There is no limit for composition of axis 2 that it needs to use circular interpolation control. User can select 2 axes from axis1 to axis 6 randomly.

#### (1) Circular interpolation by method of absolute coordinate, designating midpoint (Absolute, Circular interpolation)

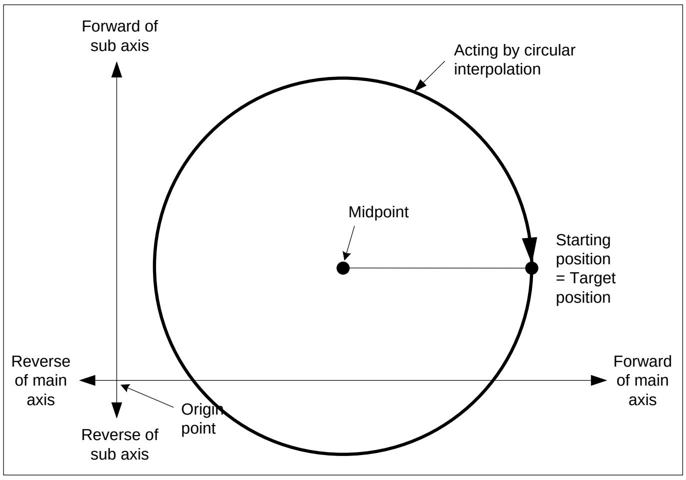
(a) Operate from start position and circular interpolate to target position with the trace of circle. And the circle has radius which distance is to set midpoint position. 「Circular interpolation auxiliary point」 is midpoint of this circle.

(b) Moving direction depends on set direction on "circular interpolation mode" of operation data.

- 「Midpoint, CW」 - Circular interpolation go clockwise from current position.
- 「Midpoint, CCW」- Circular interpolation go counterclockwise from current position.



(c) If target position is same with start position, can progress circular interpolation. And the circle radius is distance from midpoint to starting position (=target position)



(d) Condition

■ In this following case, to be error and can not progress circular interpolation control of method of designating midpoint.

- 「Sub axis setting」 disorder (Error code : 279)
  - In case of the value of 「Sub axis setting」 of main axis operation data is "axis-undecided",
  - In case of the value of 「Sub axis setting」 of main axis operation data is same with main axis No. by setting.
  - In case of the value of 「Sub axis setting」 of main axis operation data exceed settable axis No.
- In case of "degree" is set as item of main/sub axis control, (Error code : 282(Main axis), 283(Sub axis))
- In case of midpoint which is set as auxiliary point is same with starting/target position, (Error code : 284)
- In case of calculated radius of circle exceed 2147483647pls, (Error code : 286)

**Note**

Should be careful during starting circular interpolation, because 2 axes act at a time.

1. Available auxiliary operation is as follows:
   - Speed override, Deceleration stop, Emergency stop, Skip operation
2. Unavailable command with circular interpolation is as follows:
   - Position/Speed conversion control, Position override, Consecutive operation
3. The parameter item that it is operated by set value each axes is as follows:
   - Amount of backlash compensation of expansion parameter item, Software high limit, Software low limit

(e) Example of operation data setting

| Setting item | Main axis(axis1) setting | Sub axis(axis2) setting | Contents |
|---|---|---|---|
| Control method | Absolute, Circular interpolation | - *1 | When control circular interpolation by relative coordinates, set 「relative, circular interpolation」 on main axis. |
| Operation method | Singleness, End | - | Set operation method for circular interpolation. |
| Target position [pls] | 10000 | 0 | Set target position as a amount of increment of stop position for positioning on the main axis, sub axis. |
| Operation speed [pls/s] | 1000 | - | Circular interpolation use method of designating composition speed. Set composition speed on the main axis. |
| Acceleration speed | No.1 | - | Set acceleration time No. for acceleration.<br>(No.1 ~ No.4) |
| Deceleration speed | No.2 | - | Set deceleration time No. for deceleration.<br>(No.1 ~ No.4) |
| M code | 0 | - | Set it when user wants to progress other auxiliary action with circular interpolation operation. |
| Dwell time | 500 | - | set the dwell time taken until plc outputs the signal which informs users of finishing the position decision |
| Sub axis setting | Axis 2 | - | Set axis among the settable axes of current module on the main axis operation for sub. |
| Circular interpolation auxiliary point | 5000 | -5000 | Set the center-point on the method of designating center-point. |
| Circular interpolation mode | Midpoint, CW | - | In case of using the method of designating center-point, set the 「center-point, CW」 or 「center-point, CCW」 by moving direction of circular arc. |
| The number of rotations of circular interpolation | 0 | - | Set the number of rotations for drawing circle that it is over 360 degrees. |
| Helical interpolation | Not use | - | Set “not use”, when use circular interpolation. |

- *1 : Do not need setting. Whatever user set, there is no effect to circular interpolation.

**Note**

Circular interpolation of method of designating midpoint is depends on item that it is set on operation data of main axis (command axis).
There is no effect to circular interpolation operation except for 「Target position」 and 「Circular interpolation auxiliary point」, when operate circular interpolation of method of designating midpoint. Whatever user set, there is no effect and no error.

**[Example] Operate circular interpolation of designating midpoint and absolute coordinate (main axis; axis 1, sub axis; axis 2)**

■ In case of Start position (0, 0), Target position (0, 0), Auxiliary point (1000, 1000), direction of rotation :CW operation is as follows;

■ Example of setting in the XG-PM

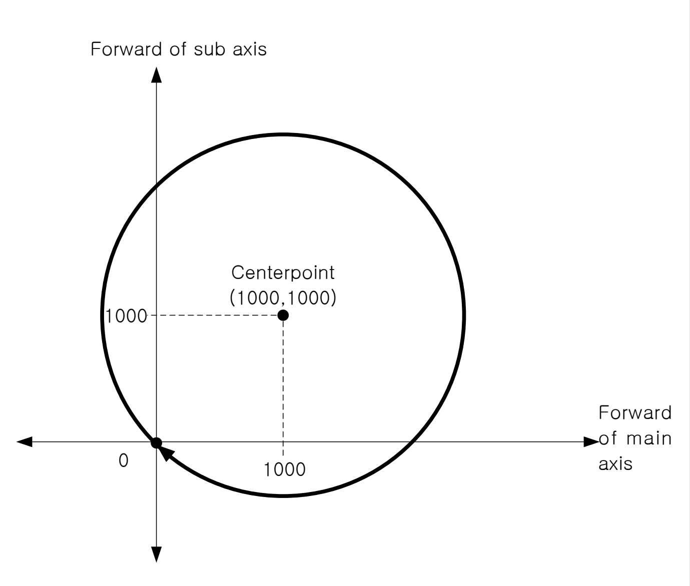
▪ Main axis(axis1) operation data

| Step No. | Control Method | Operation method | Target position [pls] | Operation Speed [pls/s] | Acc. Speed | Dec. Speed | M code | Dwell time | Sub axis setting | Circular interpolation Auxiliary point | Circular interpolation mode | The number of rotations of Circular interpolation | Helical interpolati-on |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Circular interpolation | Singleness , End | 0 | 1000 | No. 1 | No. 1 | 0 | 100 | Axis 2 | 1000 | Centerpoint ,CW | 0 | Do not use |

▪ Sub axis(axis 2) operation data

| Step No. | Control Method | Operation method | Target osition [pls] | Operation Speed [pls/s] | Acc. Speed | Decel-eration Speed | M code | Dwell time | Sub axis setting | Circular interpolation Auxiliary point | Circular Interpolation mode | The number of rotations of Circular interpolation | Helical interpol-ation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Reduction positioning control | Singleness , End | 0 | 0 | No.1 | No.1 | 0 | 0 | Axis-undecided | 1000 | Centerpoint | 0 | Do not use |

■ Operation pattern



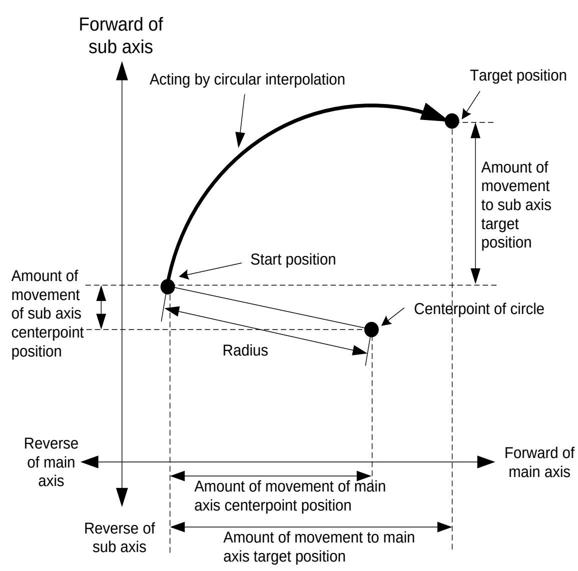
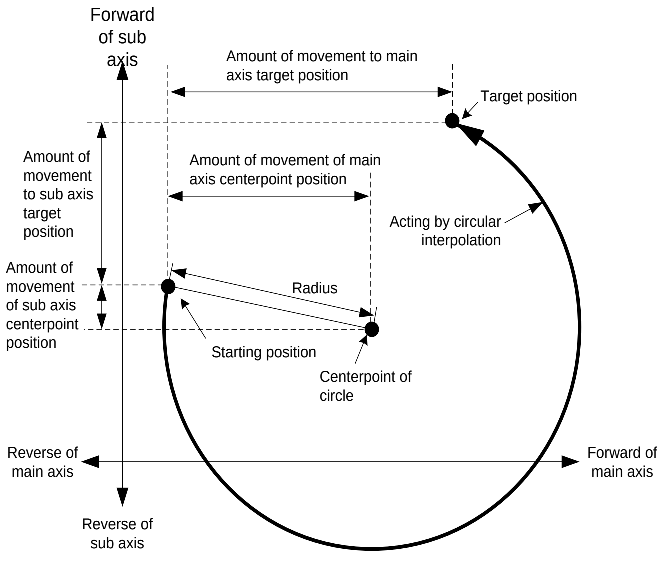
(2) Circular interpolation control by the method of relative coordinate, designating center-point

(「Relative, Circular interpolation」)

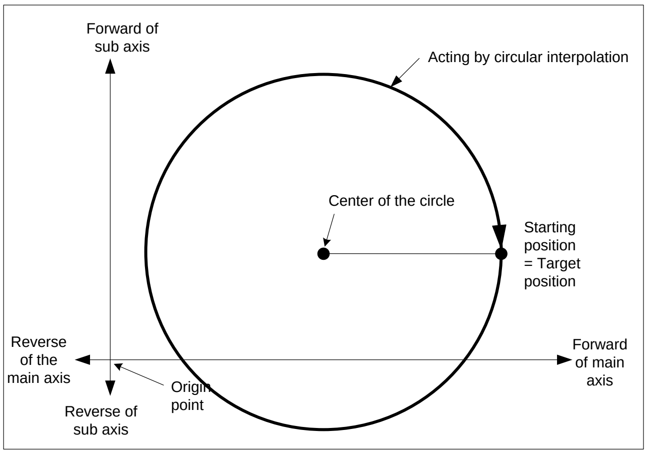
(a) Start operating at starting position and then execute circular interpolation by moving amount already set, along the trace of the arc which has a distance between starting position and designated mid-point as radius. 「Circular interpolation auxiliary point」 means the moving amount between the current position and mid-point.

(b) Moving direction is decided to set direction on "circular interpolation mode" of operation data.

- 「Center-point, CW」 - Circular interpolation go clockwise from current position..
- 「Center-point, CCW」 - Circular interpolation go counterclockwise from current position.

| Centerpoint, CW | Centerpoint, CCW |
|---|---|
|  |  |

(c) If set target position of main axis and sub axis as "0", than starting position will be same with target position and can progress circular interpolation that it is drawing circle. The radius of the circle is distance from starting position to center-point.



(d) Condition

■ User cannot progress circular interpolation of midpoint designation method with following cases.

- ▪「Sub axis setting」disorder (Error code: 279)
  - In case of the value of 「Sub axis setting」 of main axis operation data is no setting axis,
  - In case of the value of 「Sub axis setting」 of the main axis operation data same with the number of main axis,
  - In case of value of「Sub axis setting」 of main axis operation data exceed the axis No. of module which is can set ,
- ▪ In case of “degree” is set as item of main axis or sub axis, (Error code: 282(Main axis), 283(Sub axis))
- ▪ Midpoint that is designated as auxiliary point same with start position or target position. (Error code: 284)
- ▪ In case of start position same with target position (Error code: 285)
- ▪ In case of calculated radius of circular arc exceed 2147483647pls (Error code: 286)

(e) Example of operation data setting

| Setting item | Main axis(axis1) setting | Sub axis(axis2) setting | Contents |
|---|---|---|---|
| Control method | Relative, Circular interpolation | - [*1] | When control circular interpolation by relative coordinates, set 「relative, circular interpolation」 on main axis. |
| Operation method | Singleness, End | - | Set operation method for circular interpolation. |
| Target position [pls] | 10000 | 0 | Set target position as the amount of increment of stop position for positioning on the main axis, sub axis. |
| Operation speed [pls/s] | 1000 | - | Circular interpolation use method of designating composition speed. Set composition speed on the main axis. |
| Acceleration speed | No.1 | - | Set acceleration time No. for acceleration.<br>(No.1 ~ No.4) |
| Deceleration speed | No.2 | - | Set deceleration time No. for deceleration.<br>(No.1 ~ No.4) |
| M code | 0 | - | Set it when users want to progress other auxiliary action with circular interpolation operation. |
| Dwell time | 500 | - | set the dwell time taken until plc outputs the signal which informs users of finishing the position decision |
| Sub axis setting | Axis 2 | - | Set axis among the settable axes of current module on the main axis operation for sub. |
| Circular interpolation auxiliary point | 5000 | -5000 | Set the center-point position by amount of increment of current stop position on the method of designating center-point. |
| Circular interpolation mode | Midpoint, CW | - | In case of using the method of designating center-point, set the 「center-point, CW」or 「center-point, CCW」 by moving direction of circular arc. |
| The number of rotations of circular interpolation | 0 | - | Set the number of rotations for drawing circle that it is over 360 degrees. |
| Helical interpolation | Not use | - | Set “not use”, when use circular interpolation. |

- [*1] : Do not need setting. Whatever user set, there is no effect to circular interpolation.

**Note**

Circular interpolation of method of designating midpoint is depends on item that it is set on operation data of main axis command axis).
There is no effect to circular interpolation operation except for 「Target position」 and「Circular interpolation auxiliary point」, when operate circular interpolation of method of designating midpoint. Whatever user set, there is no effect and no error.

**[ Example ] Operate circular interpolation of the method of designating relative coordinate centerpoint with axis 1 (main axis), with axis 2 (sub axis)**

■ Start position: (0, 0)
Target position (amount of movement) setting: (2000, 0)
Auxiliary point (amount of movement) setting: (1000, 0)
Direction of rotations: CW
In this case operation is as follows:

■ Example of setting XG-PM

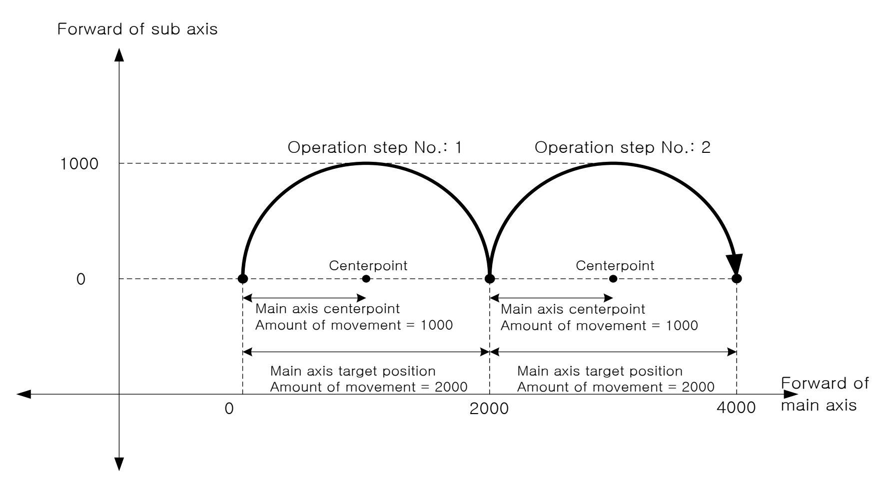
▪ Main axis (axis 1) Operation data

| Step No. | Control Method | Operation method | Target position [pls] | Operation Speed [pls/s] | Acc. Speed | Dec. Speed | M code | Dwell time | Sub axis setting | Circular interpolation Auxiliary point | Circular Interpolation mode | The number of rotations of Circular interpolation | Helical Interpolation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Relative, Circular interpolation | Singleness, Continue | 2000 | 1000 | No. 1 | No. 1 | 0 | 100 | Axis 2 | 1000 | Center-point ,CW | 0 | Do not use |
| 1 | Relative, Circular interpolation | Singleness, End | 2000 | 1000 | No. 1 | No. 1 | 0 | 100 | Axis 2 | 1000 | Center-point ,CW | 0 | Do not use |

▪ Sub axis (axis 2) Operation data

| Step No. | Control Method | Operation method | Target position [pls] | Operation Speed [pls/s] | Acc. Speed | Dec. Speed | M code | Dwell time | Sub axis setting | Circular interpolation Auxiliary point | Circular Interpolation mode | The number of rotations of Circular interpolation | Helical interpolation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Reduction positioning control | Singleness, End | 0 | 0 | No. 1 | No. 1 | 0 | 0 | Axis-undecided | 0 | Midpoint | 0 | Do not use |
| 1 | Absolute, Reduction positioning control | Singleness, End | 0 | 0 | No. 1 | No. 1 | 0 | 0 | Axis-undecided | 0 | Midpoint | 0 | Do not use |

■ Operation pattern



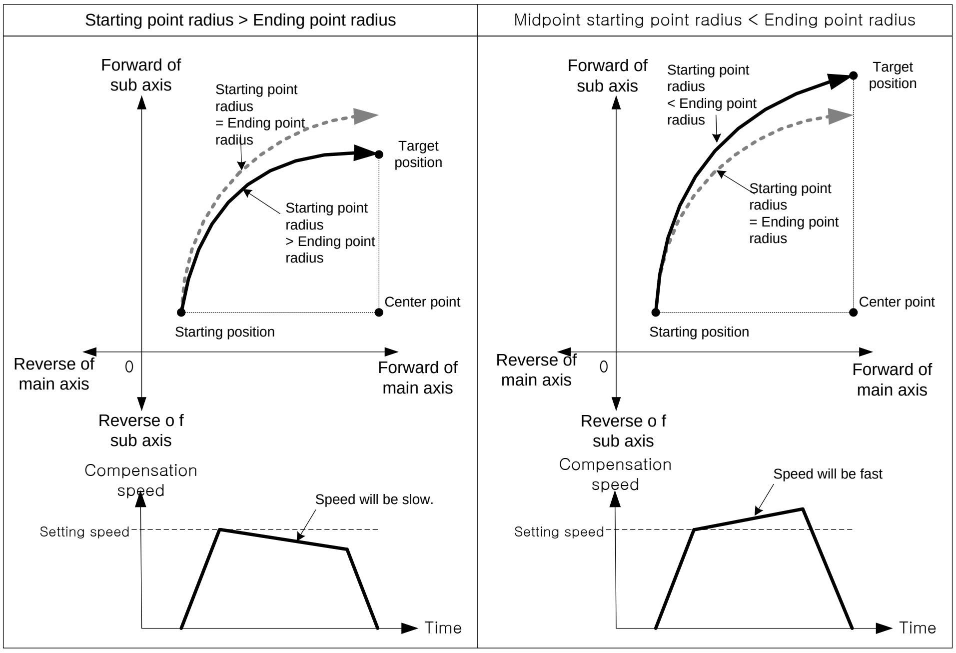
(3) Circular interpolation control which radius of starting point is different with radius of ending point.

(「Relative, Circular interpolation」)

(a) According to set value of target position, distance A which it is distance from start point to center point is different with distance B which it is distance from target position to center point (End point, Radius) on circular interpolation control of the method of designating center point. Sometimes do not operate normally.
When starting point radius have difference with end point radius, calculate each speed on the set operation speed, and operate circular interpolation control with compensating radius.

(b) In case of starting point radius has some difference with ending point radius, compensating speed is as follows:

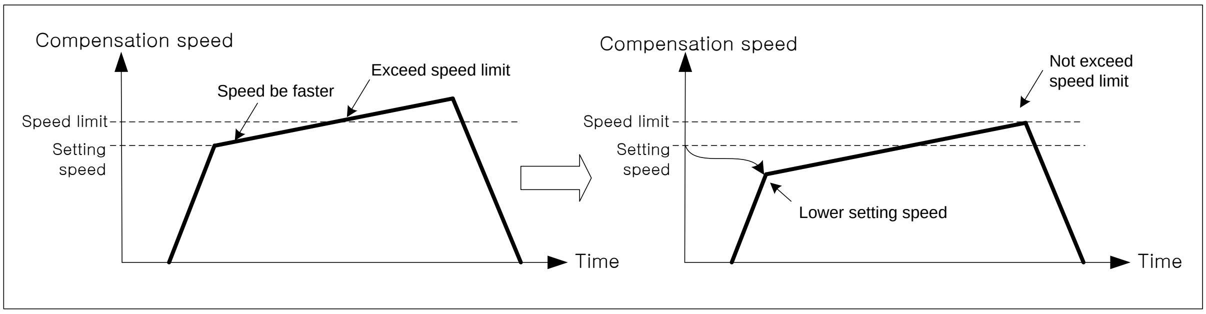
- Radius of starting point > Radius of ending point: The more near from target position, the slower.
- Radius of starting point < Radius of ending point: The more near from target position, the faster.


Starting point radius > Ending point radius

Midpoint starting point radius < Ending point radius

**Note**

In case of "Starting point radius < Ending point radius", the more operate circular interpolation, the faster. Sometimes exceed 「Speed limit」 of parameter. When operate circular interpolation, in case of starting point radius shorter than ending point radius, lower speed for never exceeding 「Speed limit」.
Can operate no exceed 「Speed limit」, even if it is near to target position.



(4) Absolute coordinate function of the number of circular interpolation's rotation

(a) In case of circular interpolation setting exceed 1 on circular interpolation control of the method of absolute coordinate, designating center point. To set of the number of circular interpolation's rotations operate the number of rotations at the absolute coordinate of first start.

(b) Even if decelerate and stop, operate origin circular interpolation by restart.

(c) Condition

In this following case position is changed after deceleration stop command. The number of circular interpolation's rotation is not the number of absolute rotations. It operate by the number of relative rotations.

- After operate positioning command except for current step indirect start (Directing start, Jog operation, Inching operation, Sync. operation, etc),
- After progress position changing command,

**[ Example ] Progress circular interpolation that is the method of absolute, designating center point. And then axis 1 is main axis, axis 2 is sub axis.**

■ In this case of Starting position (100, 500), Target position (400, 500), Auxiliary position (600, 500), Direction of rotations: CW, operating is as follows:

■ Example of setting XG-PM

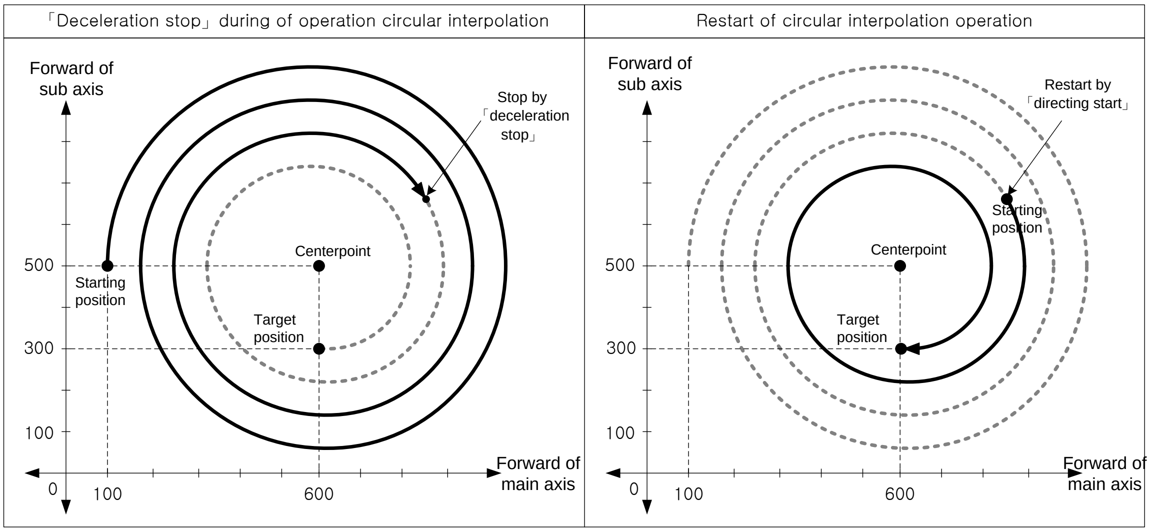
▪ Main axis (axis 1) operation data

| Step No. | Control Method | Operation method | Target position [pls] | Operation Speed [pls/s] | Acc. Speed | Dec. Speed | M code | Dwell time | Sub axis setting | Circular interpolation Auxiliary point | Circular Interpolation mode | The number of rotations of Circular interpolation | Helical interpolation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, circular interpolation | Singleness , End | 600 | 1000 | No.1 | No.1 | 0 | 100 | Axis 2 | 600 | Midpoint ,CW | 3 | Do not use |

▪ Sub axis (axis 2) operation data

| Step No. | Control Method | Operation method | Target position [pls] | Operation Speed [pls/s] | Acc. Speed | Dec. Speed | M code | Dwell time | Sub axis setting | Circular interpolation Auxiliary point | Circular Interpolation mode | The number of rotations of Circular interpolation | Helical interpolation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Reduction positioning control | Singleness , End | 300 | 0 | No.1 | No.1 | 0 | 0 | Axis-undecided | 500 | Midpoint | 0 | Do not use |

■ Operation pattern



When decelerating in circular interpolation by dec. stop command and restart the same step no., not that executing circular interpolation after circular interpolation being executed 3 times, but that positioning at the goal position after going around 1 time, because 2 times of circular interpolation was executed in former operation.

### 9.2.11 Circular interpolation control with designated radius

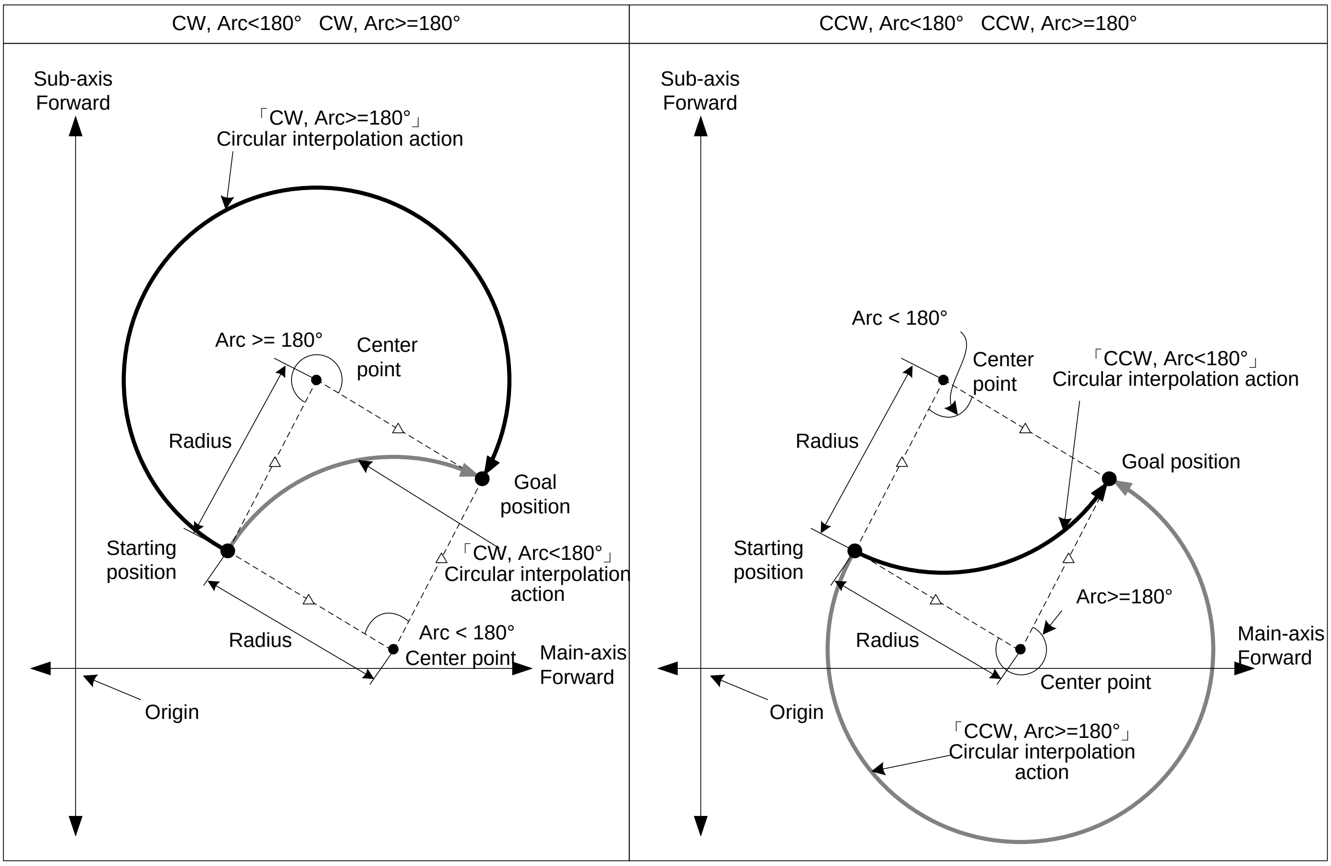
After being executed by positioning operation start (「Indirect start」, 「Sync. start」), then it operates along the trace of the circle made by circular interpolation with 2 axes. According to「The turn no. of circular interpolation」, circular interpolation which is bigger than 360° is available to be executed.

Combination of 2 axes for a circular interpolation is not limited. User may use any 2 axes from aixs1 ~ axis4.

#### (1) Circular interpolation by method of absolute and designating radius (「Absolute, Circular interpolation」)

(a) Start operating at starting position and execute circular interpolation along the trace of the circle which has radius set on circular interpolation auxiliary point of main-axis operating data. Center point of Circular arc depends on the turning direction (CW, CCW) of「Circular interpolation mode」 and size setting of circular arc (Circular arc<180°, Circular arc>=180°).

| Circular interpolation mode | Description |
|---|---|
| Radius, CW, Arc<180° | Execute circular interpolation in clockwise and the arc is smaller than 180° |
| Radius, CW, Arc>=180° | Execute circular interpolation in clockwise and the arc is bigger than 180° |
| Radius, CCW, Arc<180° | Execute circular interpolation in counterclockwise and the arc is smaller than 180° or same. |
| Radius, CCW, Arc>=180° | Execute circular interpolation in counterclockwise and the arc is bigger than 180° or same. |



(b) Restrictions

■ Circular interpolation with designating radius method may not draw an exact circle that the starting position and ending position are same. If user wants to draw an exact circle, use circular interpolation with center point method.

■ In the cases below, error would arise and circular interpolation may not be executed.

- 「Sub-axis setting」 error (error code:279)
  - Value of 「Sub-axis setting」 is "Axis-undecided"
  - 「Sub axis setting」 of main axis operating data is the same as main axis no.
  - 「Sub axis setting」 of main axis operating data exceeds the settable axis no. of module now using.
- Control unit of main or sub axis is set as "degree". (error code : 282(main), 283(sub))
- Starting position and goal position are same (error code:285)
- Radius value of circular interpolation of main-axis operating data is smaller than half of the length from starting position to goal position
  - Radius < (R x 0.8) : Error (error code:270)
  - (R x 0.8) <= Radius < R

    : Execute circular interpolation after reset the radius to R. In other words, execute circular interpolation by setting the center of the line from starting position to goal position as center point.

**Note**

If executing circular interpolation start, 2 axes will operate at the same time. Need user to pay attention.

(1) Auxiliary operations may be used are as follows.

- Speed override, Dec. stop, Emergent stop, Skip operation.

(2) The commands may not be used in circular interpolating operation are as follows.

- Position/Speed switching control, Position override, Continuous operation

(3) The parameter items operating by standards of each axis are as follows.

- Amount of backlash revision in extended parameter items, Software high limit, Software low limit

(c) Setting example of Operating data

| Items | Main-axis setting | Sub-axis setting | Description |
|---|---|---|---|
| Control Method | Absolute, Circular interpolation | - [*1] | When executing circular interpolation with absolute coordinates, set「Absolute, Circular interpolation」on main |
| Operating Method | Singular, End | - | Set the method to execute circular interpolation |
| Goal position[pls] | 10000 | 0 | Set the goal position to execute on Main, Sub, Helical axis |
| Operating speed[pls/s] | 1000 | - | Use connecting speed designation method for circular interpolation. Set connecting speed on main-axis |
| Acc. no. | No.1 | - | Set no. of acc. time to use in acceleration (no1~4) |
| Dec. no. | No.2 | - | Set no. of dec. time to use in deceleration (no1~4) |
| M code | 0 | - | Set it when executing another auxiliary operation synchronizing with circular interpolation |
| Dwell time | 500 | - | Set dwell time for outputting positioning complete |
| Sub-axis setting | Axis2 | - | Set an axis to use as sub-axis among the axis available on main-axis operating data. |
| Auxiliary point | 7000 | - | Set the radius on main-axis |
| Circular interpolation | Radius,<br>CW, Arc<180° | - | If use radius designation method, set「Radius」on main-axis and set moving direction of arc and size of arc |
| The No. of Turns | - | - | Set the no. of turns of arc for making a circle bigger than 360° |
| Helical | Not use | - | When using circular interpolation, set it to「Not use」 |

- [*1] : It means that no need to be set. Whatever value it is, it dose not affect circular interpolation.

**Note**

(1) Circular interpolation control of Radius designation method is executed on the basis of the items set on operating data. When it is executed, only「Goal position」can affect circular interpolation. In other words, whatever value is set as, it does not affect the action and no errors arise.
(2) When setting the circular interpolating auxiliary point (radius) of main-axis, it must be bigger than the half of the length between starting position and goal position. If it is smaller than the half(R) and the value is higher than 80% of R, circular interpolation which has middle point between starting position and goal position as center-point is executed. If it is smaller than the half(R) and the value is lower than 80% of R, error (error code:270) arises and circular interpolation is not executed.

**[Example] Axis1 is main-axis and Axis2 is sub-axis. Execute circular interpolation with relative coordinates and designated radius.**

■ Starting position (1000, 1000), Goal position (9000, 1000), Auxiliary point (5000, 0)

Moving direction of arc : CCW, Size of arc : Arc >= 180°

The action is as follows in the condition above

■ Setting example in XG-PM

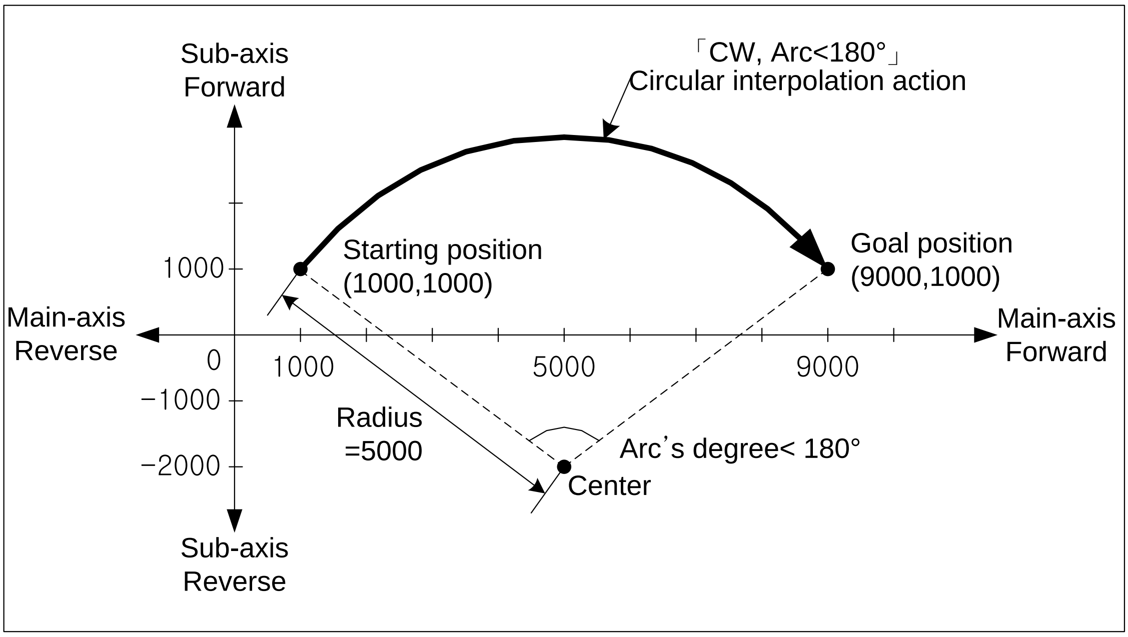
▪ Main-axis(Axis1) Operating data

| Step No. | Control method | Operation Method | Goal position [pls] | Operating speed [pls/s] | Acc. No, | Dec. No, | M Code | Dwell Time | Sub-axis Setting | Auxiliary Point | Circular interpolation mode | The no. of turns | Helical interpolation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Circular interpolation | Singular, End | 9000 | 1000 | No.1 | No.1 | 0 | 100 | Axis2 | 5000 | Radius, CW, Arc<180 | 0 | Not use |

▪ Sub-axis(Axis2) Operating data

| Step No. | Control method | Operation Method | Goal position [pls] | Operating speed [pls/s] | Acc. No, | Dec. No, | M Code | Dwell Time | Sub-axis Setting | Auxiliary Point | Circular interpolation mode | The no. of turns | Helical interpolation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, single axis position control | Singular, End | 1000 | 0 | No.1 | No.1 | 0 | 100 | Axis2 | 5000 | Radius, CW, Arc<180 | 0 | Not use |

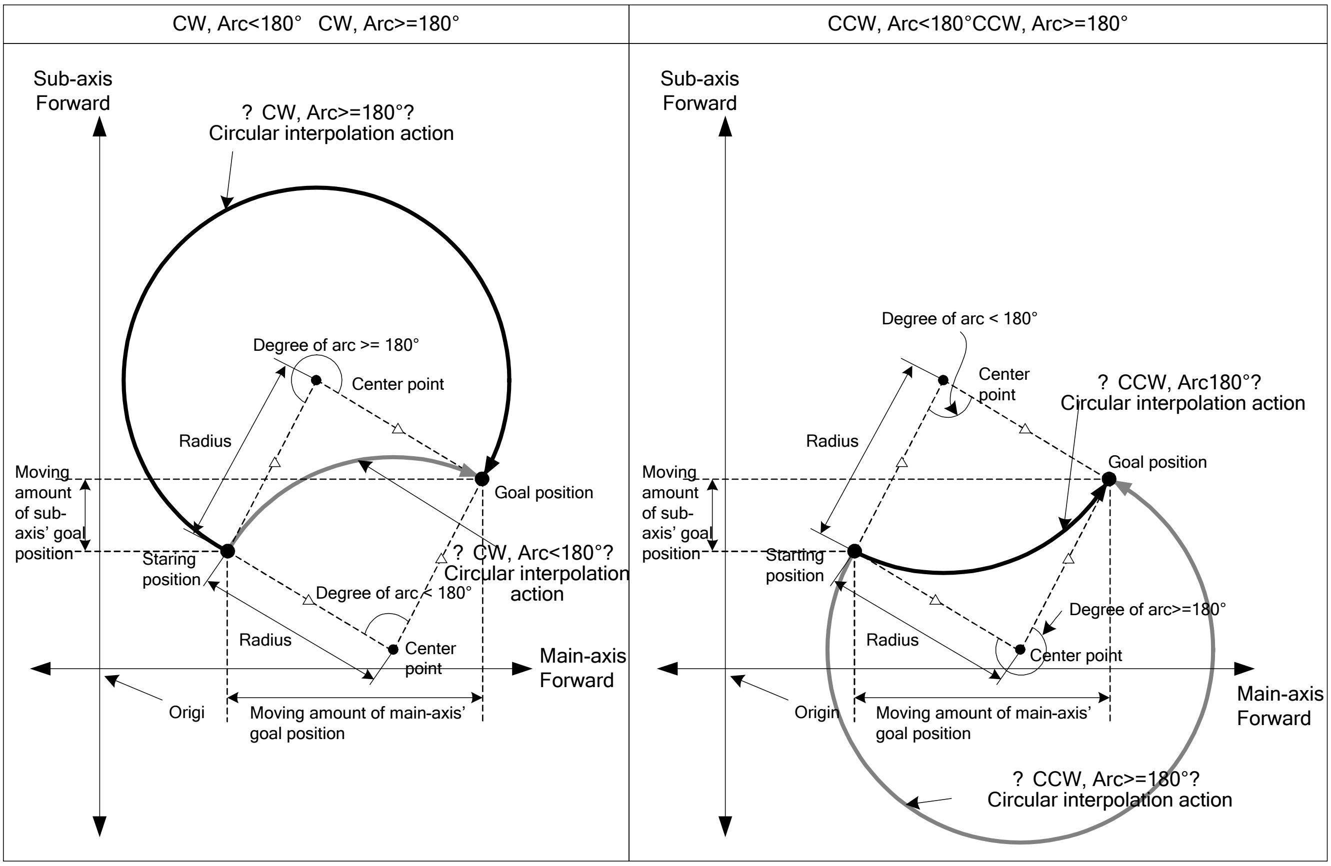
■ Operation pattern



### (2) Circular interpolation by method of relative and designating radius (「Relative, Circular interpolation」)

(a) Start operating from starting position and then execute circular interpolation by increment set on goal position along the trace of the circle which has the value set on circular interpolation auxiliary point of main-axis operation data as a radius. Circular arc depends on the moving direction of「Circular interpolation mode」(CW, CCW) and setting of arc size(Arc<180°, Arc>=180°)

| Circular interpolation mode | Description |
|---|---|
| Radius, CW, Arc<180° | Execute circular interpolation with center-point of arc which smaller than 180°in direction of CW |
| Radius, CW, Arc >=180° | Execute circular interpolation with center-point of arc which bigger than 180°in direction of CW |
| Radius, CCW, Arc<180° | Execute circular interpolation with center-point of arc which smaller than 180°in direction of CCW |
| Radius, CCW, Arc>=180° | Execute circular interpolation with center-point of arc which bigger than 180°in direction of CWW |



(b) Restrictions

■ Circular interpolation with designating radius method may not draw an exact circle that the starting position and ending position are same. If user wants to draw an exact circle, use circular interpolation with center point method.

■ In the cases below, error would arise and circular interpolation may not be executed.

▪「Sub-axis setting」 error (error code: 279)

- Value of 「Sub-axis setting」 is "Axis-undecided"
- 「Sub axis setting」 of main axis operating data is the same as main axis no.
- 「Sub axis setting」 of main axis operating data exceeds the settable axis no. of module now using.

▪ Control unit of main or sub axis is set as "degree". (error code : 282(main), 283(sub))

▪ Starting position and goal position are same (error code: 285)

▪ Radius value of circular interpolation of main-axis operating data is smaller than half of the length from starting position to goal position

- Radius < (R x 0.8) : Error (error code: 270)
- (R x 0.8) <= Radius < R

: Execute circular interpolation after reset the radius to R. In other words, execute circular interpolation by setting the center of the line from starting position to goal position as center point.

(c) Setting example of Operating data

| Items | Main-axis setting | Sub-axis setting | Description |
|---|---|---|---|
| Control Method | Relative, Circular interpolation | - [*1] | When executing circular interpolation with absolute coordinates, set「Relative, Circular interpolation」 on main |
| Operating Method | Singular, End | - | Set the method to execute circular interpolation |
| Goal position[pls] | 10000 | 0 | Set the goal position to execute on Main, Sub, Helical axis |
| Operating speed[pls/s] | 1000 | - | Use connecting speed designation method for circular interpolation. Set connecting speed on main-axis |
| Acc. no. | No.1 | - | Set no. of acc. time to use in acceleration (no1~4) |
| Dec. no. | No.2 | - | Set no. of dec. time to use in deceleration (no1~4) |
| M code | 0 | - | Set it when executing another auxiliary operation synchronizing with circular interpolation |
| Dwell time | 500 | - | Set dwell time for outputting positioning complete |
| Sub-axis setting | Axis2 | - | Set an axis to use as sub-axis among the axis available on main-axis operating data. |
| Auxiliary point | 7000 | - | Set the radius on main-axis |
| Circular interpolation | Radius,<br>CW, Arc<180° | - | If use middle-point-designation method, set「Middle-point」on main-axis |
| The No. of Turns | - | - | Set the no. of turns of arc for making a circle bigger than 360° |
| Helical | Not use | - | When using circular interpolation, set it to「Not use」 |

- [*1] : It means that no need to be set. Whatever value it is, it dose not affect circular interpolation.

**Note**

(1) Circular interpolation control of Radius designation method is executed on the basis of the items set on operating data. When it is executed, only「Goal position」can affect circular interpolation. In other words, whatever value is set as, it does not affect the action and no errors arise.
(2) When setting the circular interpolating auxiliary point (radius) of main-axis, it must be bigger than the half of the length between starting position and goal position. If it is smaller than the half(R) and the value is higher than 80% of R, circular interpolation which has middle point between starting position and goal position as center-point is executed. If it is smaller than the half(R) and the value is lower than 80% of R, error (error code:270) arises and circular interpolation is not executed.

**[Example] Axis1 is main-axis and Axis2 is sub-axis. Execute circular interpolation with relative coordinates and designated radius.**

■ Starting position (1000, 1000), Goal position (8000, 0), Auxiliary point (5000, 0)
Moving direction of arc : CCW, Size of arc : Arc >= 180°
The action is as follows in the condition above

■ Setting example in XG-PM

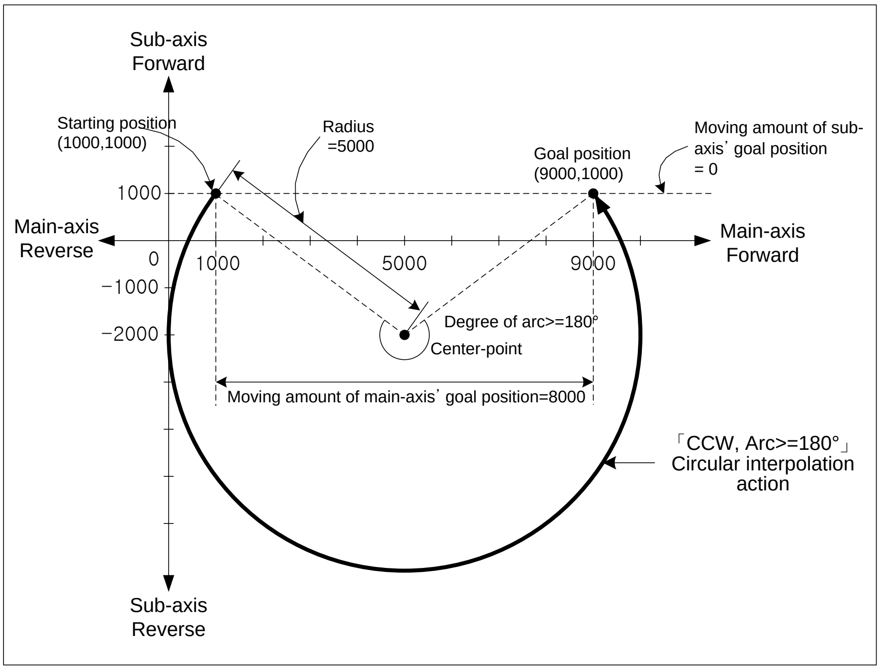
▪ Main-axis(Axis1) Operating data

| Step No. | Control method | Operation Method | Goal position [pls] | Operating speed [pls/s] | Acc. No, | Dec. No, | M Code | Dwell Time | Sub-axis Setting | Auxiliary Point | Circular interpolation mode | The no. of turns | Helical interpolation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Relative, Circular interpolation | Singular, End | 8000 | 1000 | No.1 | No.1 | 0 | 100 | Axis2 | 5000 | Radius, CCW, Arc>=180 | 0 | Not use |

▪ Sub-axis(Axis2) Operating data

| Step No. | Control method | Operation Method | Goal position [pls] | Operating speed [pls/s] | Acc. No, | Dec. No, | M Code | Dwell Time | Sub-axis Setting | Auxiliary Point | Circular interpolation mode | The no. of turns | Helical interpolation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, single axis position control | Singular, End | 1000 | 0 | No.1 | No.1 | 0 | 100 | Axis2 | 0 | Middle point | 0 | Not use |

■ Operation pattern



## **9.2.12** Helical Interpolation Control

After executed by positioning operation start command (Indirect, Synchronous), 2 axes move along the circular arc, an axis execute linear interpolation synchronizing with circular interpolation.
It may execute helical interpolation of bigger scale than 360°
Combinations of axis to use are not limited and 3 axes are used among axis1~axis6.

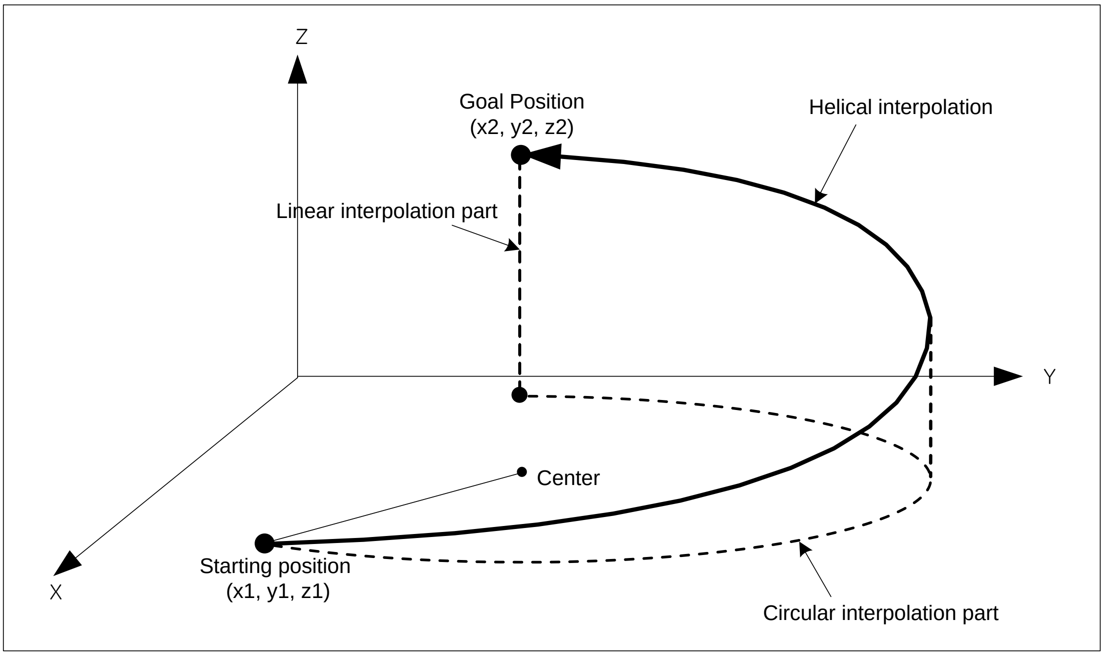
### (1) Characteristics of control

(a) After setting operating data to circular interpolation, then set a helical interpolation axis on the item “Helical interpolation”, the helical interpolation will be executed.

(b) The direction of circular arc depends on the goal position and the mode of circular interpolation, the direction of helical axis depends on the coordinates setting and the goal position.

■ The case of「Absolute, Circular interpolation」
Starting position < Goal position : Positioning operation in forward direction
Starting position > Goal position : Positioning operation in reverse direction

■ The case of「Relative, Circular interpolation」
Positive sign (+) or No sign : Positioning operation in forward direction
Negative sign (-) : Positioning operation in reverse direction



### (2) Restrictions

(a) The restrictions of helical interpolation are same as various kinds of circular interpolation depending on the mode of circular interpolation.

(b) If user sets「Helical Interpolation」 to “Not use”, it will be same as the action of circular interpolation.

(c) If user sets the goal position of helical interpolation axis to the same starting position, it will be same as the action of circular interpolation.

**Note**

If executing helical interpolation, 3 axes will operate at the same time. Need user to pay attention.

(1) Auxiliary operations may be used are as follows.

- Speed override, Dec. stop, Emergent stop, Skip operation.

(2) The commands may not be used in circular interpolating operation are as follows.

- Position/Speed switching control, Position override, Continuous operation

(3) The parameter items operating by standards of each axis are as follows.

- Amount of backlash revision in extended parameter items, Software high limit, Software low limit

(3) Example of operation data setting

| Items | Main axis(axis1) Setting | Sub axis(axis2) Setting | Helical axis(axis3) setting | Description |
|---|---|---|---|---|
| Control method | Absolute, Circular interpolation | - [*1] | - [*1] | Circular interpolation must be set when executing helical interpolation |
| Operation method | Singular, End | - | - | Set operation method for helical interpolation |
| Goal position[pls] | 10000 | 0 | 10000 | Set the goal position on main, sub, helical axis for executing positioning. |
| Operation speed[pls/s] | 1000 | - | - | Helical interpolation designates composition speed of circular interpolation part |
| Acc. no. | No.1 | - | - | Set acc. time no. used in acceleration (no.1 ~ no.4) |
| Dec. no | No.2 | - | - | Set dec. time no. used in deceleration (no.1 ~ no.4) |
| M code | 0 | - | - | Set it when user needs to synchronize another auxiliary operation with helical interpolation. |
| Dwell time | 500 | - | - | Set dwell time(ms) for outputting positioning complete signal |
| Sub axis setting | Axis2 | - | - | Set an axis to be used as sub axis from settable axis on main axis operation data |
| Auxiliary point of Circular interpolation | 5000 | 5000 | - | Set auxiliary data of circular interpolation action |
| Circular interpolation mode | Middle point | - | - | Set circular interpolation mode to be used in circular action of helical interpolation |
| No. of turn of circular interpolation | 0 | - | - | Set the no. of turn of circular arc when user need to execute helical interpolation of bigger degree than 360° |
| Helical interpolation | Axis3 | - | - | Set an axis to be used as helical interpolation axis from settable axis on main axis operation data |

- [*1] : This item does not need to be set. Whatever it is set as, it dose not affect circular interpolation.

**Note**

Helical interpolation control is executed on the item basis set on operation data of main axis.
When executing circular interpolation of helical interpolation, only “Goal position”, “Auxiliary point of circular interpolation” items of sub axis setting and “Goal position” item of helical axis setting affect helical interpolation. In other words, Whatever the setting value is, it does not affect operation and cause any errors.

**[Example] Execute helical interpolation of absolute coordinates, center point designating method and axis1, axis2, axis3 are main, sub, helical axis.**

■ The action in the case (Starting point (650, 400, 0), Goal position (400, 1200, 350), Auxiliary point (800, 400)) is as follows.

■ Setting example of XG-PM

▪ Operation data of main axis(axis1)

| Step no. | Control method | Operating method | Goal position [pls] | Operating speed [pls/s] | Acc. no. | Dec. no. | M code | Dwell time | Sub axis setting | Auxiliary point of circular interpolation | Circular interpolation mode | No. of turn of circular interpolation | Helical interpolation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, circular interpolation | Singular, End | 400 | 1000 | No.1 | No.1 | 0 | 100 | Axis2 | 800 | Middle point,CCW | 0 | Axis3 |

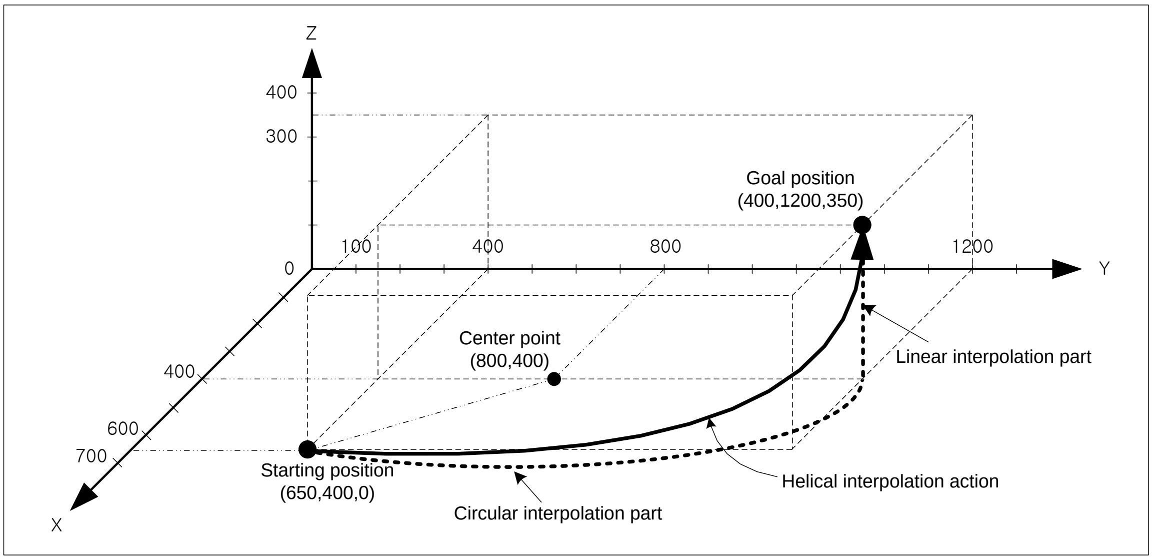
▪ Operation data of sub axis(axis2)

| Step no. | Control method | Operating method | Goal position [pls] | Operating speed [pls/s] | Acc. no. | Dec. no. | M code | Dwell time | Sub axis setting | Auxiliary point of circular interpolation | Circular interpolation mode | No. of turn of circular interpolation | Helical interpolation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, single axis position control | Singular, End | 1200 | 0 | No.1 | No.1 | 0 | 100 | - | 400 | Middle point | 0 | Not use |

▪ Operation data of sub axis(axis2)

| Step no. | Control method | Operating method | Goal position [pls] | Operating speed [pls/s] | Acc. no. | Dec. no. | M code | Dwell time | Sub axis setting | Auxiliary point of circular interpolation | Circular interpolation mode | No. of turn of circular interpolation | Helical interpolation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, single axis position control | Singular, End | 350 | 0 | No.1 | No.1 | 0 | 100 | - | 0 | Middle point | 0 | Not use |

■ Operating pattern



### 9.2.13 Ellipse Interpolation Control

Execute ellipse interpolation at ellipse rate and the moving angle of circular interpolation operating data and ellipse interpolation command.

Combinations of axis to be used in ellipse interpolation control are unlimited and 2 axes from axis1~4 are used.

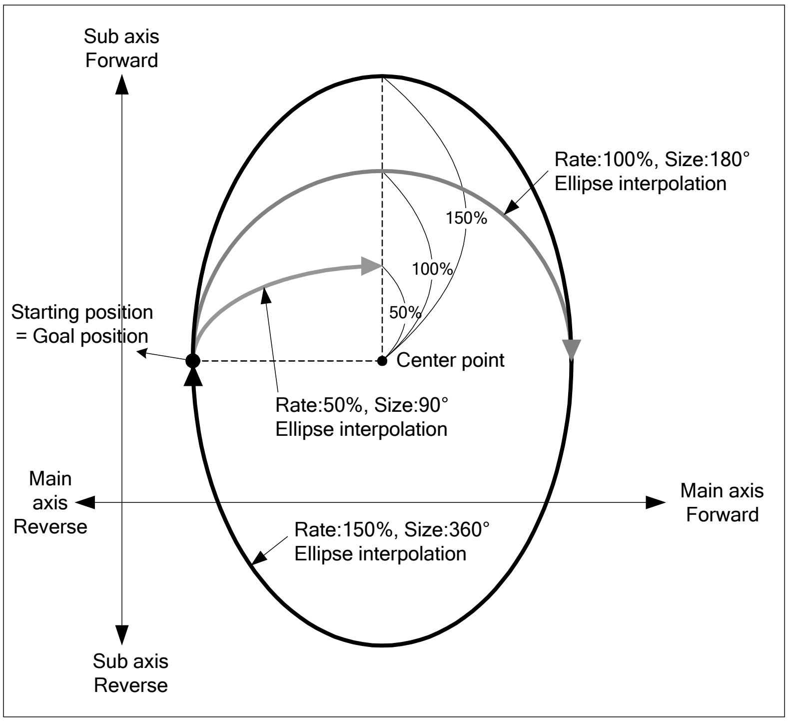
#### (1) Characteristics of Control

(a) Ellipse interpolation is set with circular interpolation of center-designated method and the rate and size of ellipse is set with auxiliary data of "ellipse interpolation command"

| Auxiliary data | Setting value | Description |
|---|---|---|
| Ratio of ellipse (%) | 0 ~ 65535 | Set the ratio of horizontal axis and vertical axis with the ratio to the circle<br>(1 = 0.01%) |
| Size(Degree) of ellipse | 0 ~ 65535 | Set the degree of ellipse's movement<br>(1 = 0.1°) |

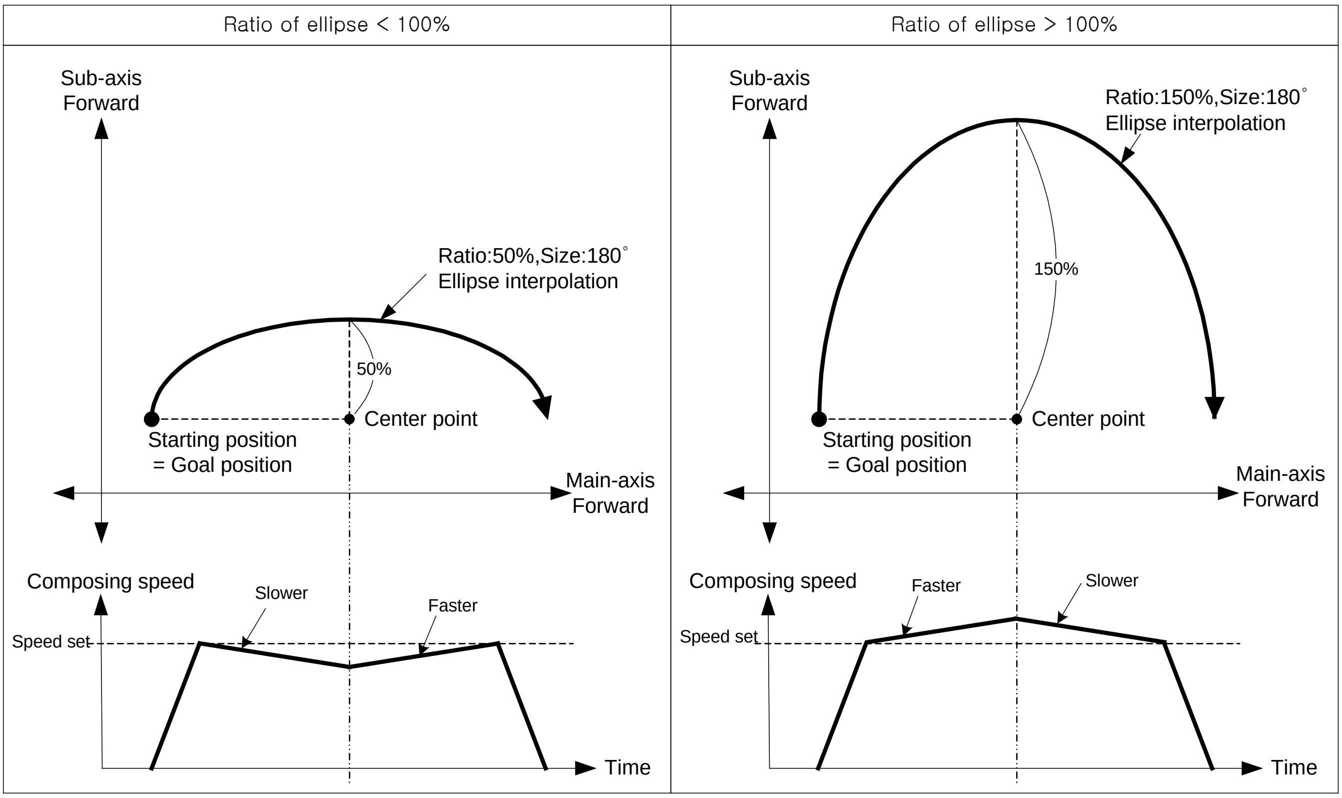
(b) Moving direction of ellipse is decided by the direction set on "circular interpolation mode" of operation data.

- 「Center point, CW」 - Execute ellipse interpolation in clockwise.
- 「Center point, CCW」 - Execute ellipse interpolation in counterclockwise.



(c) Starting position and goal position must be same when executing ellipse interpolation.

(d) When executing ellipse interpolation, the radius changes continuously and composing speed also changes depending on the ratio of ellipse. When the ratio of ellipse is bigger than 100%, operating speed of sub axis and composing speed get faster. So it calls user’s attention. Sub axis of ellipse interpolation is not limited by “speed limit”, so user must set operating speed below limit.



### (2) Restrictions

(a) Ellipse interpolation may not be executed in the case below.

- 「Sub-axis setting」 Error (error code : 547)
  - The value of sub-axis setting of main axis operating data is “Axis-undecided”.
  - The value of sub-axis setting of main axis operating data is set equally to the no. of main-axis.
  - The value of sub-axis setting of main axis operating data is set wrongly. (Exceeding settable axis no.)
  - An axis of helical interpolation is set.
- Control unit of main or sub axis is set as “degree”. (error code : 551(main), 552(sub))
- The center point designated as auxiliary point is the same as starting position or goal position. (error code : 553)
- The radius of circular arc that calculated exceeds 2147483647pls. (error code : 554)
- The operating method is “continuous” or “go on”. (error code : 556) If user executes ellipse interpolation, End operation must be set before use.
- Staring position and Goal position are different. (error code : 558)
- Size of circular arc (Moving degree) is 0. (error code : 559)

**Note**

Need user to heed the synchronous operation of 2 axes in ellipse interpolation start.

1. Auxiliary operations available are as follows.
   - ▪ Speed override, Dec. stop, Emergent stop, Skip operation
2. The commands unavailable in ellipse interpolating operation are as follows.
   - ▪ Position/Speed switching control, Position override, Continuous operation
3. Parameter items of each axis on setting value basis are as follows.
   - ▪ Backlash revision of extended parameter, Software high limit, Software low limit

(3) Setting example of operation data

| Items | Main-axis setting | Sub-axis setting | Description |
|---|---|---|---|
| Control Method | Absolute, Circular interpolation | - [*1] | Set circular interpolation when executing ellipse interpolation |
| Operating Method | Singular, End | - | "End" must be set in ellipse interpolation |
| Goal position[pls] | 10000 | 0 | Set the goal position to execute on Main, Sub, Helical axis |
| Operating speed[pls/s] | 1000 | - | Designate composing speed for circular interpolation part in ellipse interpolation |
| Acc. no. | No.1 | - | Set no. of acc. time to use in acceleration (no1~4) |
| Dec. no. | No.2 | - | Set no. of dec. time to use in deceleration (no1~4) |
| M code | 0 | - | Set it when executing another auxiliary operation synchronizing with ellipse interpolation |
| Dwell time | 500 | - | Set dwell time for outputting positioning complete |
| Sub-axis setting | Axis2 | - | Set an axis to use as sub-axis among the axis available on main-axis operating data. |
| Auxiliary point | 5000 | 5000 | Set the center point of ellipse |
| Circular interpolation | Center point, CW | - | Must be set center point when using ellipse interpolation |
| The No. of Turns | - | - | The no. of turn is not operated in ellipse interpolation |
| Helical | Not use | - | Set axis of helical interpolation as "Not Use" in ellipse interpolation |

- [*1] : It means that no need to be set. Whatever value it is, it dose not affect circular interpolation.

**Note**

Ellipse interpolation control is executed by the standard set on operating data of main-axis.
When executing ellipse interpolation, only「Goal position」and「Auxiliary point of circular interpolation」affect the operation of ellipse interpolation. In other words, whatever value is set to, it does not affect operation and no errors arise.

**[Example] Execute ellipse interpolation with 20% of ellipse ratio, 360°of movement degree and relative coordinates**

■ Starting position (100, 100),
Setting of goal position : (0, 0)
Setting of auxiliary point : (500, 200)
Direction of operation : CW

■ Example setting in XG-PM

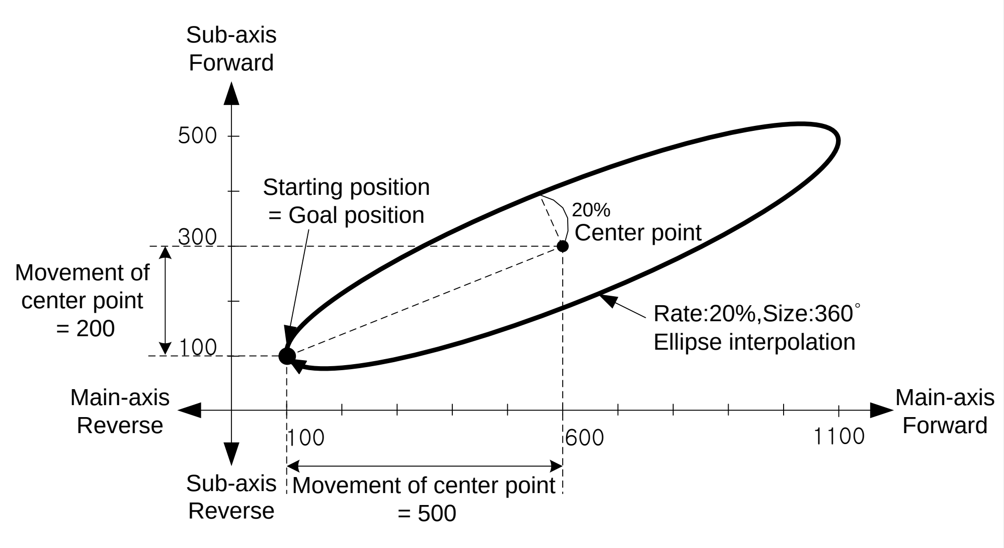
▪ Operation data of Main-axis(axis1)

| Step no. | Control method | Operating method | Goal position [pls] | Operating speed [pls/s] | Acc. No. | Dec. No. | M code | Dwell Time | Setting Sub axis | Auxiliary point of circular interpolation | Circular interpolation mode | The no. of turns | Helical interpolation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Relative, circular interpolation | Singular, End | 0 | 1000 | No.1 | No.1 | 0 | 100 | Axis2 | 800 | Center,CW | 0 | Not use |

▪ Operation data of Sub-axis(axis2)

| Step no. | Control method | Operating method | Goal position [pls] | Operating speed [pls/s] | Acc. No. | Dec. No. | M code | Dwell Time | Setting Sub axis | Auxiliary point of circular interpolation | Circular interpolation mode | The no. of turns | Helical interpolation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Single axis position control | Singular, End | 0 | 0 | No.1 | No.1 | 0 | 0 | Undecided | 400 | Middle point | 0 | Not use |

■ Operating data



**Note**

(1) If the degree of ellipse is not 360°, the goal position and actual position after stop operating are not same.

(2) If the ratio of ellipse is 0%, the trace of ellipse interpolation is shown as straight line. Ratio of ellipse need to be set to above 0.

## 9.2.14 Speed/Position Switching Control

The setting axis by positioning start carries out the speed control and is switched from speed control to position control when speed/position switching signal is entered to the positioning module inside or outside, and then carries out the positioning as much as goal transfer amount.

### (1) Characteristics of Control

(a) Set control method of operating data as "Single axis speed control" and executing positioning with「Speed/Position Switching」in speed control operation.

(b) Direction of movement depends on the sign of value.

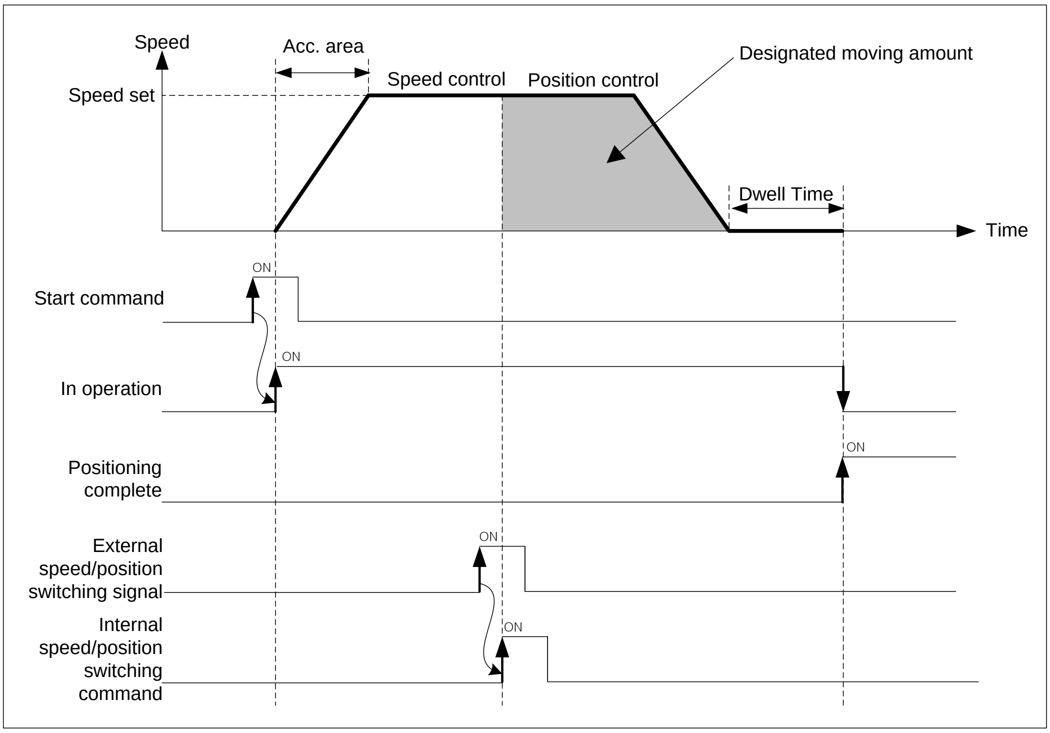
- ■ Forward : The position value is Positive(+)
- ■ Reverse : The position value is Negative(-)

(c) For using「External speed/position switching control」, "External speed/position switching control" must be set as '1 : Allowed'

| Item | Setting value | Description |
|---|---|---|
| External speed/position switching control | 0 : Absolute | Executes the positioning at the incremented position by the value set at the position where the speed / position switching command was executed. |
| | 1 : Relative | The set position value is regarded as an absolute position and the positioning is executed at the set absolute position |

(d) In speed/position switching control, the value of coordinates has no affection. In other words, actions of "Absolute, Single axis speed control" and "Relative, Single axis speed control" are same.

### (2) Operation timing



(3) Restrictions

(a) Operation pattern of speed control has to be set as “End” or “Go on”. If “Continuous” is set as, error (error code:236) arises and speed control may not be executed.

(b) If the value of goal position is 0, speed/position switching command may not be executed. In this case, it continues to operate with speed control.

(4) Setting example of operation data

| Items | Setting value | Description |
|---|---|---|
| Control method | Absolute, Single axis speed control | When executing speed/position switching control, set single axis speed control |
| Operating method | Singular, End | When executing speed/position switching control, set “end” or “continuous” |
| Goal position [pls] | 10000 | After inputting speed/position switching control, set moving amount to position. |
| Operating speed [pls/s] | 1000 | Set the operating speed of speed/position switching control |
| Acc. no. | No1 | Set acc. no. used in acceleration (no.1~4) |
| Dec. no. | No.2 | Set dec. no. used in deceleration (no.1~4) |
| M code | 0 | Set it when user needs to execute another auxiliary work synchronizing with speed/position switching control |
| Dwell time | 500 | Set dwell time(ms) between switching command’s inputting and positioning completion’s outputting |

### 9.2.15 Position specified Speed/Position Switching Control

The setting axis by positioning start carries out the speed control and is switched from speed control to position control when speed/position switching signal is entered to the positioning module, and then carries out the positioning by transfer amount.

(1) Characteristics of Control

(a) Set control method of operating data as "Single axis speed control" and execute 「Speed/Position Switching」 in speed control operation.

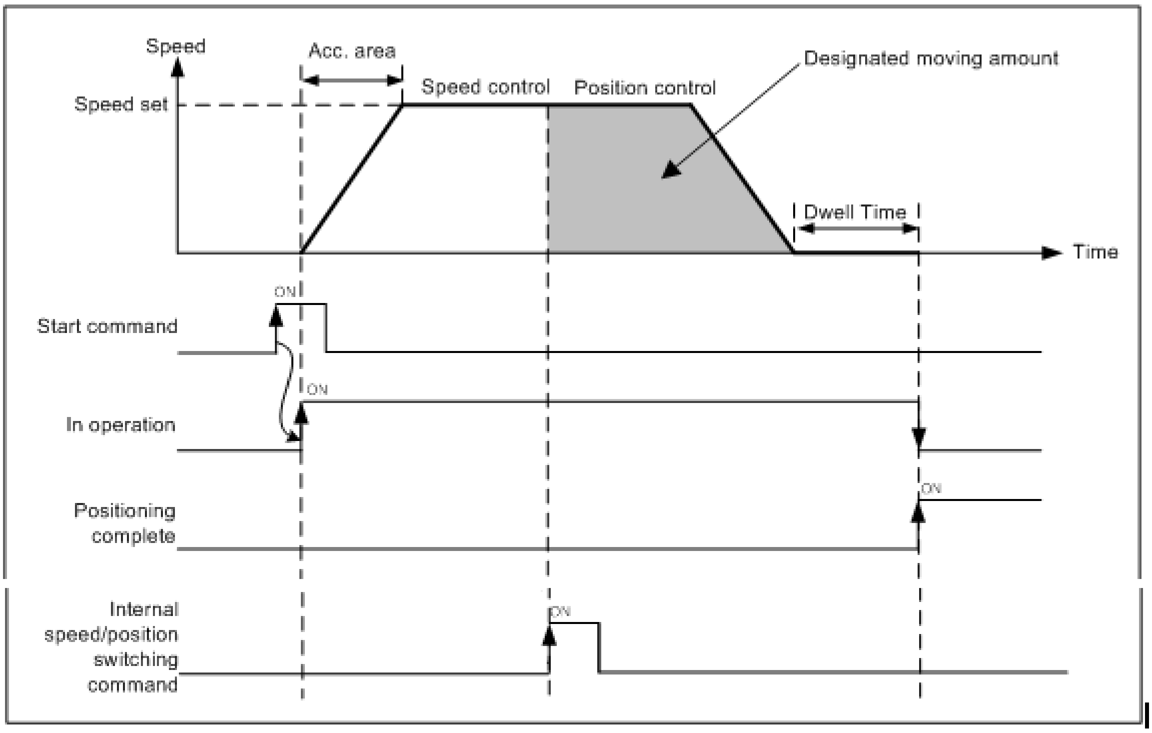
(b) Set the speed/position switching coordinate

| Item | Setting value | Description |
|---|---|---|
| speed/position switching coordinate | 0 : Relative | Operates as relative coordinates from the position at command executed. |
| | 1 : Absolute | Operates as absolute coordinates regardless of executed position.. |

(c) In speed/position switching control, the value of coordinates has no affection. In other words, actions of "Absolute, single axis speed control" and "Relative, single axis speed control" are same.

(d) In Position specified speed/position control, a target position set in the operation data or direct start is ignored and it moves according to target position operand of 「Position specified speed/position switching control」 command

(2) Operation timing



(3) Restrictions

(a) Operation pattern of speed control has to be set as "End" or "Go on". If "Continuous" is set as, error (error code:236) arises and speed control may not be executed.

(b) If the value of goal position is 0, position specified speed/position switching command may not be executed. In this case, it continues to operate with speed control.

(4) Setting example of operation data

| Items | Setting value | Description |
|---|---|---|
| Control method | Absolute, Single axis speed control | When executing speed/position switching control, set single axis speed control |
| Operating method | Singular, End | When executing speed/position switching control, set "end" or "continuous" |
| Goal position [pls] | 10000 | After inputting speed/position switching control, set moving amount to position. |
| Operating speed [pls/s] | 1000 | Set the operating speed of speed/position switching control |
| Acc. no. | No1 | Set acc. no. used in acceleration (no.1~4) |
| Dec. no. | No.2 | Set dec. no. used in deceleration (no.1~4) |
| M code | 0 | Set it when user needs to execute another auxiliary work synchronizing with speed/position switching control |
| Dwell time | 500 | Set dwell time(ms) between switching command's inputting and positioning completion's outputting |

### 9.2.16 Position/Speed Switching Control

The setting axis by positioning start carries out the position control and is switched from position control to speed control when position/speed switching signal is entered to the positioning module inside, and then it stops by deceleration stop or SKIP operation or continues next operation.

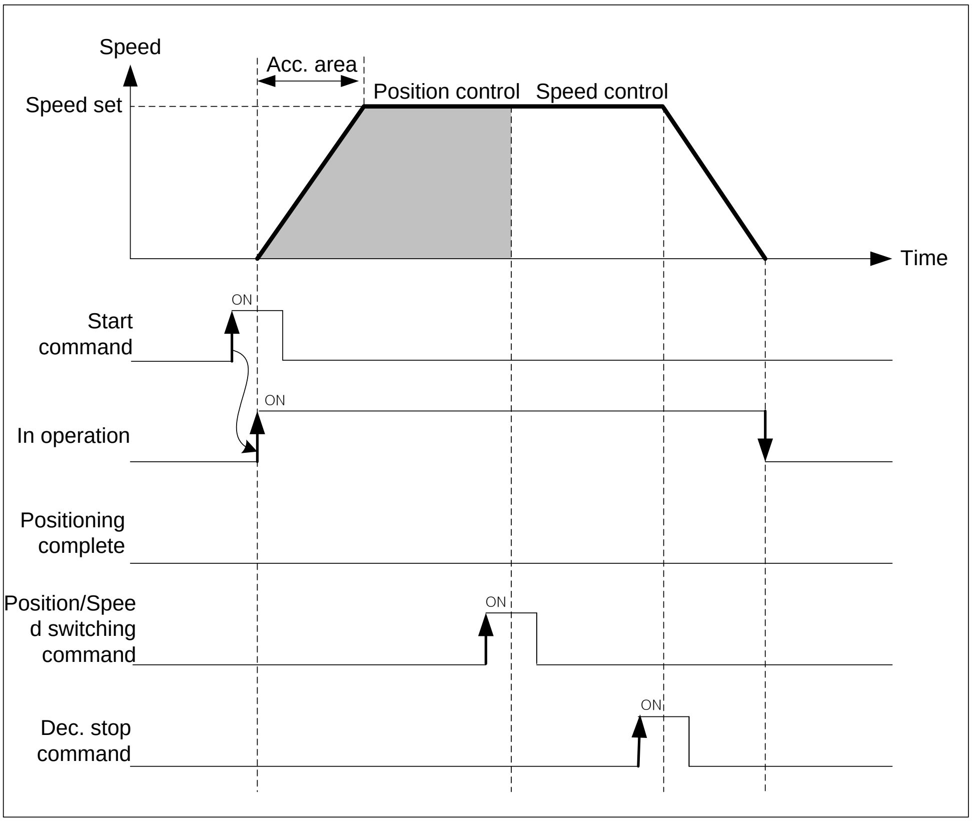
(1) Characteristics of Control

(a) Set control method of operating data as "Single axis position control" and user may change position control to speed control with「Speed/Position Switching」

(b) Direction of movement depends on the sign of value and coordinates

- 「Absolute, Single axis position control」
  - Starting position < Goal position : Positioning in forward direction
  - Starting position > Goal position : Positioning in reverse direction
- 「Relative, Single axis position control」
  - The value of goal position has positive sign (+) : Positioning in forward direction
  - The value of goal position has negative sign (-) : Positioning in reverse direction

(2) Operating timing



(3) Restrictions

(a) Position/speed switching command is not inputted before positioning to the goal position, it stops by deceleration and finishes the positioning.

(b) After position/speed switching, software high/low limit check depends on “Soft high/low limit in speed control” of extended parameter.

| Items | Setting value | Description |
|---|---|---|
| Soft high/low in speed control | 0 : Not detect | Not to execute checking for software high/low limit in speed control |
| | 1 : Detect | Execute checking for software high/low limit in speed control |

(4) Setting example of operation data

| Items | Setting value | Description |
|---|---|---|
| Control method | Absolute, Single axis speed control | When executing position/speed switching control, set single axis speed control |
| Operating method | Singular, End | Set operating method for position control |
| Goal position [pls] | 10000 | Set the value of goal position for position control |
| Operating speed [pls/s] | 1000 | Set the operating speed of position/speed switching control |
| Acc. no. | No.1 | Set acc. no. used in acceleration (no.1~4) |
| Dec. no. | No.2 | Set dec. no. used in deceleration (no.1~4) |
| M code | 0 | Set it when user needs to execute another auxiliary work synchronizing with speed/position switching control |
| Dwell time | 500 | When it is executed with position control and without position/speed switching command, set dwell time between positioning and complete signal’s outputting. |

## 9.2.17 Start of Positioning

In case of stop in action of dynamic positioning, can positioning by restart. Three Starting types are general start, Simultaneous start, point operation. Operating signal is have to “OFF”, when it start.

### (1) Direct start

(a) Do not use operating data, directly input positioning data by auxiliary data and perform positioning control.

(b) Setting auxiliary data of direct start.

| Setting item | Contents |
|---|---|
| Target position | Set target position of control. |
| Operating speed | Set operating speed of control. |
| Dwell time | Set dwell time (ms) that it is from positioning to outputting signal of positioning. (0~65535) |
| M code | Set for performing auxiliary action which is depending on set control.(0~65535) |
| Acceleration time No. | Set acceleration time number for acceleration. (No.1 ~ No.4) |
| Reduction time No. | Set reduction time number for reduction. (No.1 ~ No.4) |
| Coordinate | Set coordinate about target position of set control.(absolute, relative) |
| Control method | When command of converting position/speed is not inputted and only operated by positioning control, set dwell time (ms) that it is from positioning to outputting signal of positioning.<br>(0:Positioning, 1:Speed control, 2:Feed control) |

**Note**

Direct start only can use when it is shortened operation. In case that Interpolation operation, use indirect starts.

### (2) Indirect Start

(a) Start control of positioning by designating step number of operation data which was saved in positioning module.

(b) Setting auxiliary data of indirect start

| Setting item | Contents |
|---|---|
| Operation step | Set step number of operation data what you need operating.(0 or 1 ~ 400) |

**Note**

Set ‘O’ operation step of Indirect start and carry out command of indirect start. And then start operation data which was saved in step number.

(3) Simultaneous start

(a) According to axis information and setting step, Simultaneous start positioning operation data of axis 2 ~ axis 6.

(b) When Input stop command, only it decelerates and stops on the corresponding axis. In case of Simultaneous start setting step number is current operating step number. Input start command, and then according to relative coordinate and absolute coordinate, operate positioning.

(c) Condition

In these cases can not operate all of the axes which were set simultaneous start by error.

- When occurred error in over an axis among setting axes of simultaneous start. (Output error code in its axis.)
- When command axis of simultaneous start was wrong. (Error code : 296)
  - Only set command axis (Set over 2 axes is necessary.)
  - In case of exceeding number of possible setting axis of current using module among the possible setting axes

**[ Example ] Set Simultaneous start of axis 1, axis 2, axis 3 is as follows;**

■ Current position of axis 1: 0, Operation step: 1
Current position of axis 2: 0, Operation step: 3
Current position of axis 3: 0, Operation step: 10

■ Example of setting XG-PM

- Operation data of axis 1

| Step No. | Control method | Operation method | Target position [pls] | Operation speed [pls/s] | Acceleration No. | Deceleration No. | M code | Dwell time |
|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Shorten position control | Single, Continuous | 1000 | 1000 | 1 | 1 | 0 | 0 |
| 2 | Absolute, Shorten position control | Single, End | 1800 | 800 | 1 | 1 | 0 | 100 |

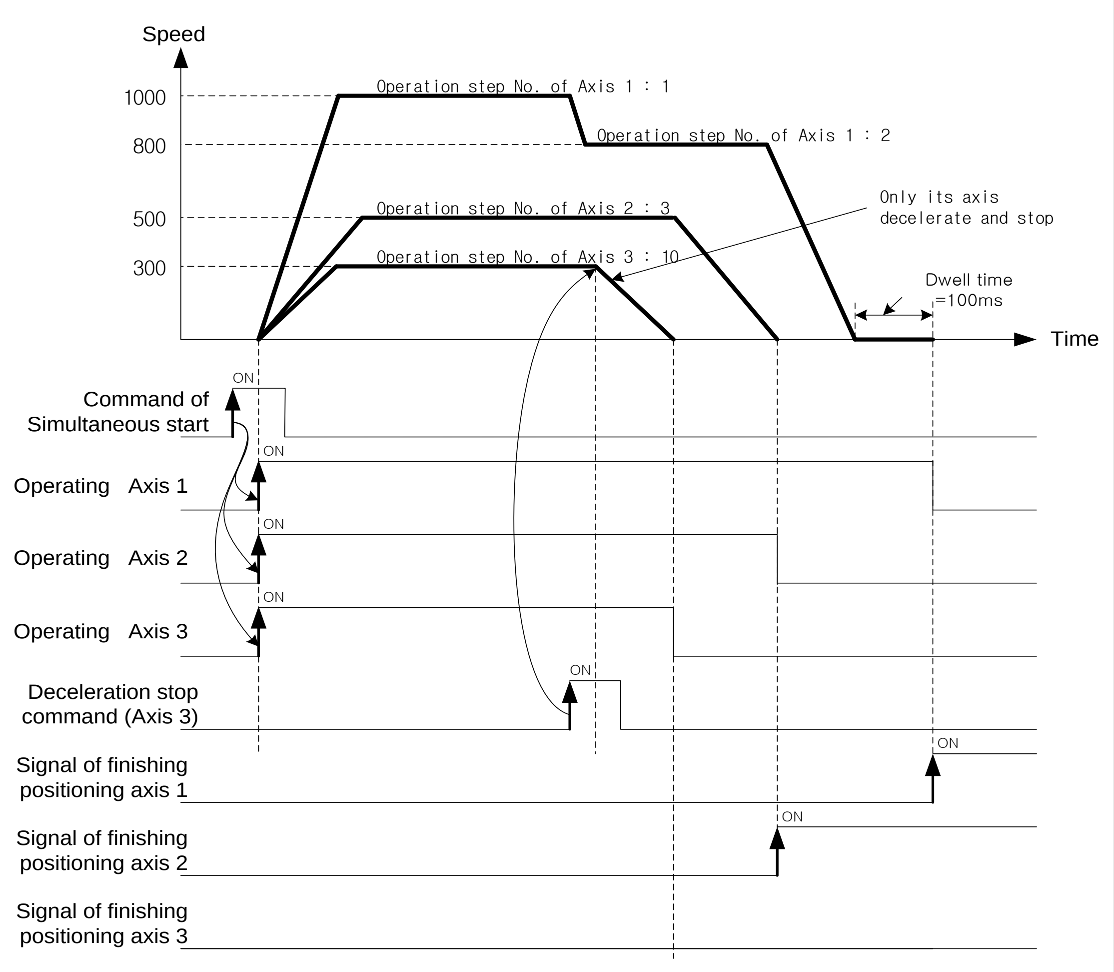
- Operation data of axis 2

| Step No. | Control method | Operation method | Target position [pls] | Operation speed [pls/s] | Acceleration No. | Deceleration No. | M code | Dwell time |
|---|---|---|---|---|---|---|---|---|
| 3 | Absolute, Shorten position control | Single, End | 900 | 500 | 2 | 2 | 0 | 0 |

- Operation data of axis 3

| Step No. | Control method | Operation method | Target position [pls] | Operation speed [pls/s] | Acceleration No. | Deceleration No. | M code | Dwell time |
|---|---|---|---|---|---|---|---|---|
| 10 | Absolute, Shorten speed control | Single, End | 1000 | 300 | 3 | 3 | 0 | 100 |

■ Operation pattern



(4) Point operation

(a) Point maneuvering is a positioning drive also called ptp drive. Which processes the sequential data of user defined steps in order

(b) It can be appointed 20 steps by point operation.

(c) Start point maneuvers as much as the number of set points from setting step (point1), irrespective of end, continue, automatic operation mode.

**[ Example ] Point operation of axis 1 is as follows;**

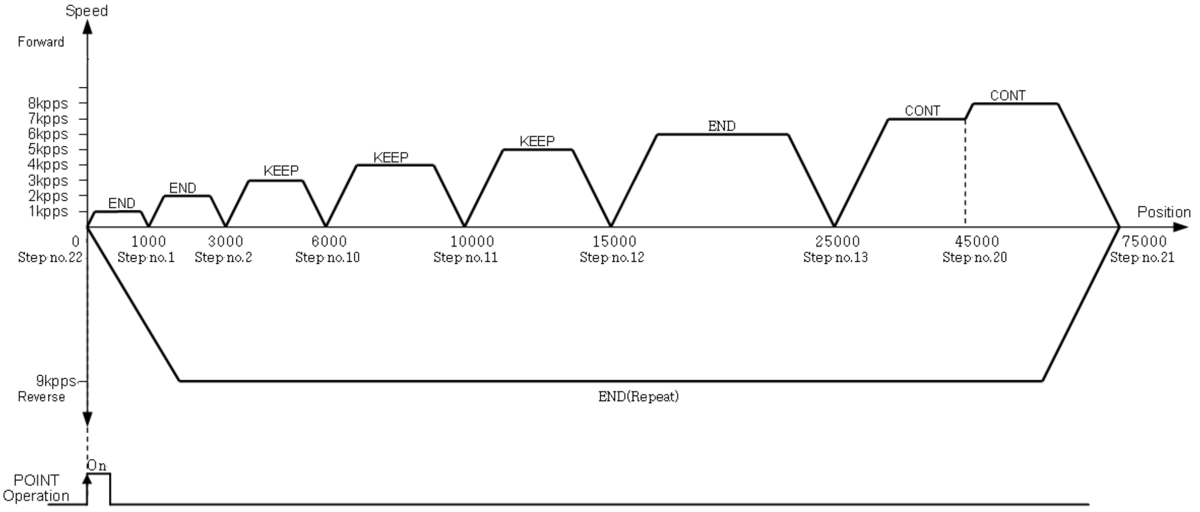
■ The number of point operation: 4

Point operation step No. : 1, 2, 10, 20

Current position of Axis 1 : 0

■ Example of setting XG-PM

| Step No. | Control method | Operation method | Target position [pls] | Operation speed [pls/s] | Acceleration No. | Deceleration No. | M code | Dwell time |
|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Shorten position control | Singleness, End | 1000 | 1000 | 1 | 1 | 0 | 20 |
| 2 | Absolute, Shorten position control | Singleness, End | 3000 | 2000 | 1 | 1 | 0 | 20 |
| | | | | | | | | |
| 10 | Absolute, Shorten position control | Singleness, Keep | 6000 | 3000 | 1 | 1 | 0 | 20 |
| 11 | Absolute, Shorten position control | Singleness, Keep | 10000 | 4000 | 1 | 1 | 0 | 20 |
| 12 | Absolute, Shorten position control | Singleness, Keep | 15000 | 5000 | 1 | 1 | 0 | 20 |
| 13 | Absolute, Shorten position control | Singleness, End | 25000 | 6000 | 1 | 1 | 0 | 20 |
| | | | | | | | | |
| 20 | Absolute, Shorten position control | Singleness, Continue | 45000 | 7000 | 1 | 1 | 0 | 0 |
| 21 | Absolute, Shorten position control | Singleness, continue | 75000 | 8000 | 1 | 1 | 0 | 0 |
| 22 | Absolute, Shorten position control | Singleness, End | 0 | 9000 | 1 | 1 | 0 | 0 |



## 9.2.18 Positioning stop

Here describes factor which are stop axis during operation.

### (1) Stop command and Stop factor

Command & Stop factor of stop positioning operating is as follows;

(a) It will stop, when stop command is “On” or there are some stop factors at each axis. But, interpolation control (linear interpolation, Circular interpolation, helical interpolation, elliptic interpolation)

In case of there is stop command or stop factor on main axis, operation axes of interpolation control will stop.

| Status Stop factor | | Positioning[*1] | Homing[*2] | Jog Operation | Speed synchronous Cam control | Status of Axis after stop | M code On Status of signal |
|---|---|---|---|---|---|---|---|
| Parameter setting[*3] | Exceed soft high-limit | Prompt stop | No Detection | Prompt stop[*5] | | Error (Error501) | No change |
| | Exceed soft low-limit | Prompt stop | No Detection | Prompt stop | | Error (Error502) | No change |
| Sequence program[*4] | Deceleration stop command | Deceleration stop | Deceleration stop | Error 322 (Keep operation) | Deceleration[*6] stop | Stop On | No change |
| | Emergency stop command | Sudden stop | | | | Error (Error481) | “Off” |
| External signal | External high-limit “On” | Sudden stop | | When operate to forward, sudden stop | Sudden stop[*7] | Error (Error492) | No change |
| | External low-limit “On” | Sudden stop | | When operate to reverse, sudden stop | Sudden stop | Error (Error493) | No change |
| XG-PM Software | Deceleration stop command | Deceleration stop | Deceleration stop | Error322 (Keep operation) | Deceleration stop | Stop “On” | No change |
| | Emergency stop command | Sudden stop | | | | Stop “On” | “Off” |

**Note**

*1 : Positioning means position control, speed control, interpolation control, speed/position switching control, position/speed switching control, position/torque control by positioning data.

*2 : When complete homing, approximate origin and HOME signal do not effect to positioning control.

*3 : Only work while software high/low limit on the speed control of expansion parameter at the speed control operation mode is set “1:detection”

*4 : Sequence program means XGT program type.

*5 : Output speed become “0”, when it has factor of stop.

*6 : Speed goes to "0" while the deceleration stop time of deceleration stop command support data decelerates as a set time.

*7 : Speed goes to “0” decelerate by set time as「sudden stop, deceleration」of parameter.

(2) Deceleration Stop

(a) If meet emergency stop while operate indirect start, direct start, simultaneous start, start operation, homing operation, inching operation, it will sudden stop.

(b) Deceleration stop command not different at these sections: acceleration section, constant section, deceleration section.

(c) If it is decelerated and stopped by deceleration stop command, will not be completed positioning operation as set target position. And….

- No signal for completely positioning
- M code signal cannot be "On" during "After" mode of "M code" mode.

(d) If it receives order for indirect start command (step No. = current step No.) while it is stop,

- Positioning of absolute coordinate method: Operate amount of the position reminder which it isn't outputted on the current operation step.
- Positioning of relative coordinate method: Operate as set movement at the target position.

(e) There are two type of deceleration stop: Internal/external deceleration stop.

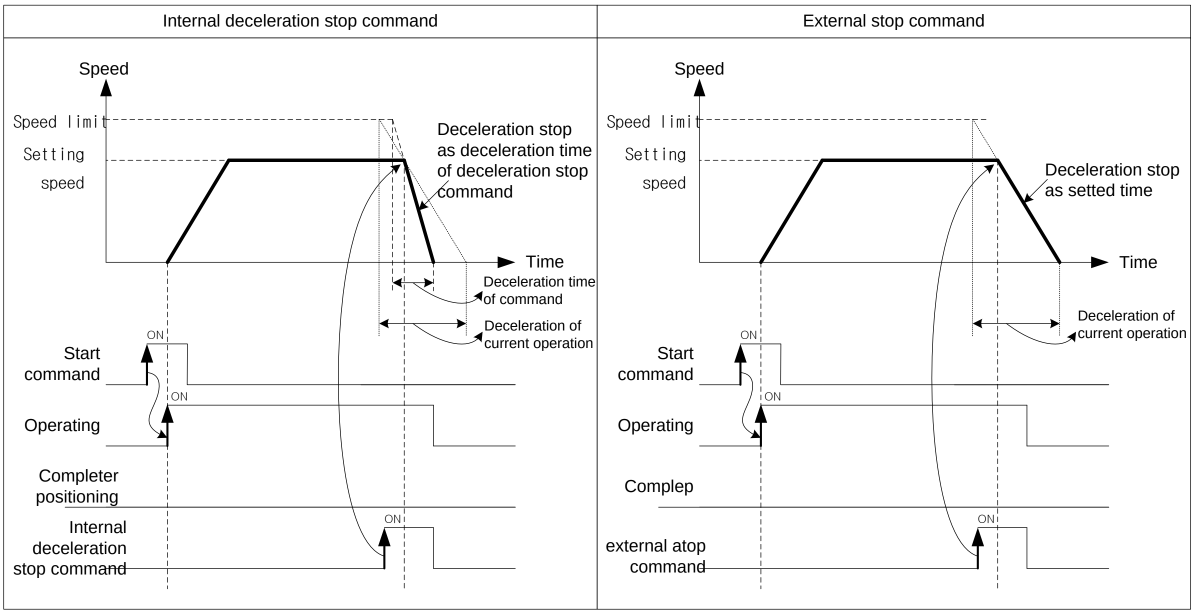
- Internal deceleration stop command
  It decelerate and stop by XG-PM and「deceleration stop」command of sequence program as set support data.
- External deceleration stop signal
  In case of input signal of external emergency stop/deceleration stop to be "On", it will be decelerated and stopped by set deceleration time in current positioning operation.
  Have to set item of "select external emergency stop/deceleration stop" of expansion parameter for using input signal of external emergency stop/deceleration stop as external deceleration stop command.

| Item | Setting value | Contents |
|---|---|---|
| Select external emergency stop/ deceleration stop | 0: Emergency stop | Use as "emergency stop" signal when input external signal. |
| | 1: Deceleration stop | Use as "deceleration stop" signal when input external signal. |

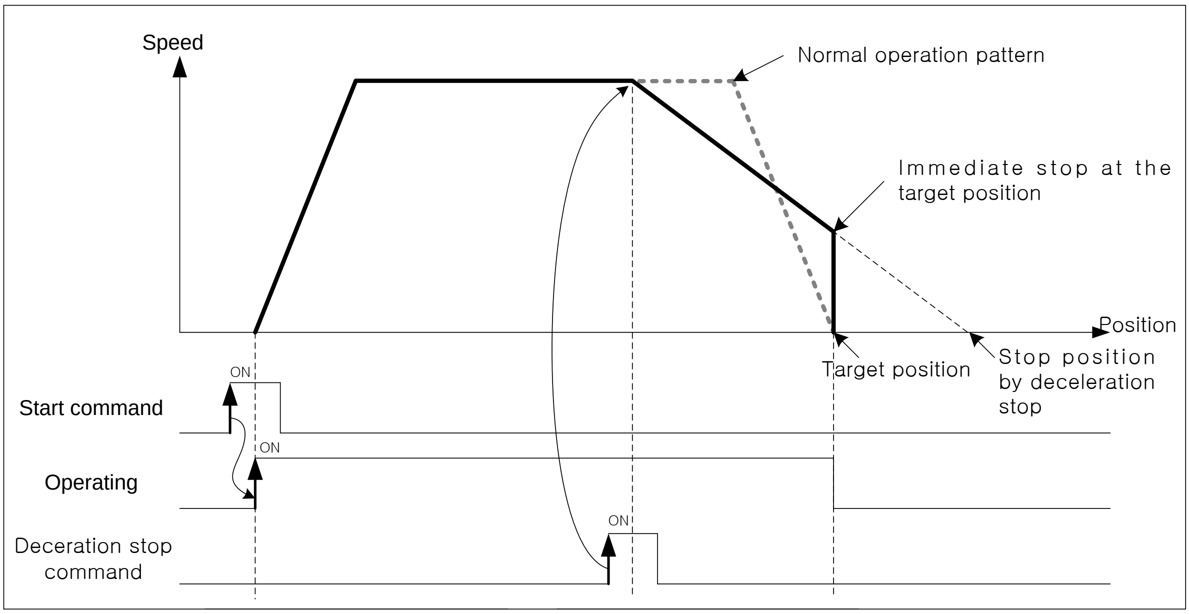
(f) Condition

- When command internal deceleration stop
  The value of deceleration time can bigger than set value of deceleration time by auxiliary data.
- If deceleration stop command is inputted while operate Jog, error (error code: 322) will be made. Use "Stop Jog" command for Jog operation stop.

(g) Movement Time



■ If the deceleration distance is longer than distance to target position when input deceleration stop command during positioning control operation, it will be stopped at the target position.



### (3) Emergency Stop

(a) It will be decelerated, stopped and occurred error as set time in「deceleration time when it is suddenly stopped」during indirect start, direct start, start at the same time, synch. operation, homing operation, jog operation, inching operation, when it be emergency stopped during operation.

(b) In case of internal emergency stop, error 481 will occur and in case of external emergency stop, error 491 will occur.

(c) M code signal will be "Off" after Emergency stop.

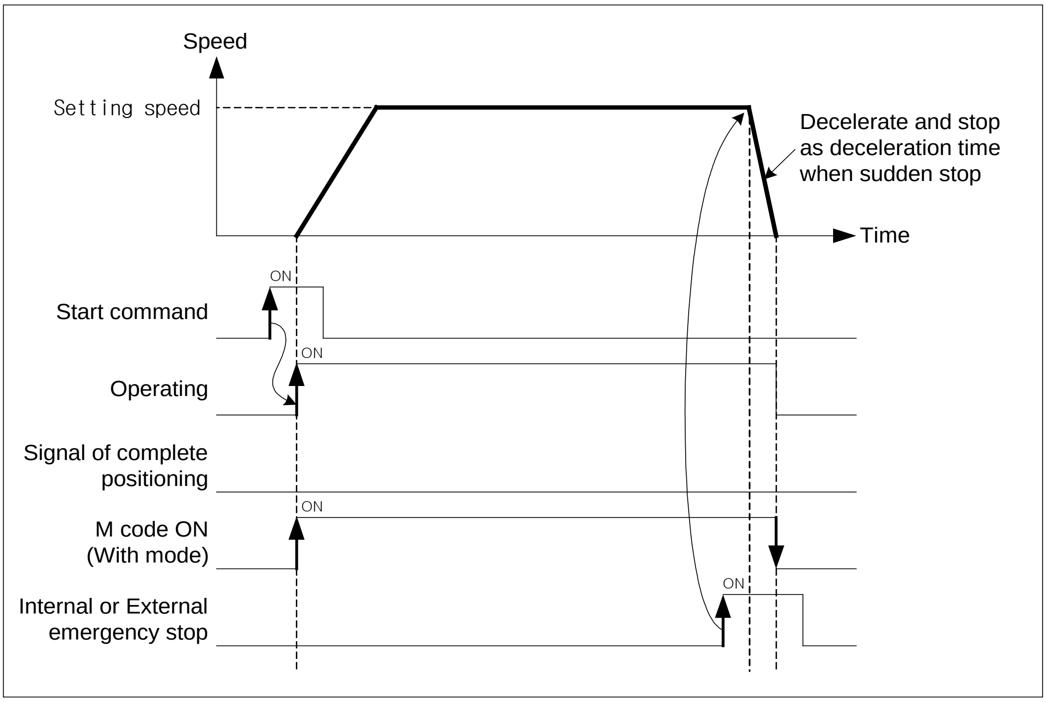
(d) Internal emergency stop command

To be decelerated and stopped by「emergency stop」command of XG-PM & Sequence program as set time in「deceleration time when it is suddenly stopped」, and error will be occurred.

■ Setting related parameter (Basic parameter)

| Item | Setting value | Contents |
|---|---|---|
| When sudden stop, deceleration time | 0 ~ 2147483647 [ms] | Set deceleration time for using when detect hardware high/low limit signal. Deceleration time express needed time for deceleration as bias speed at speed limit, when suddenly stop. |

(e) Motion timing



### (4) Stop hardware by high/low limit

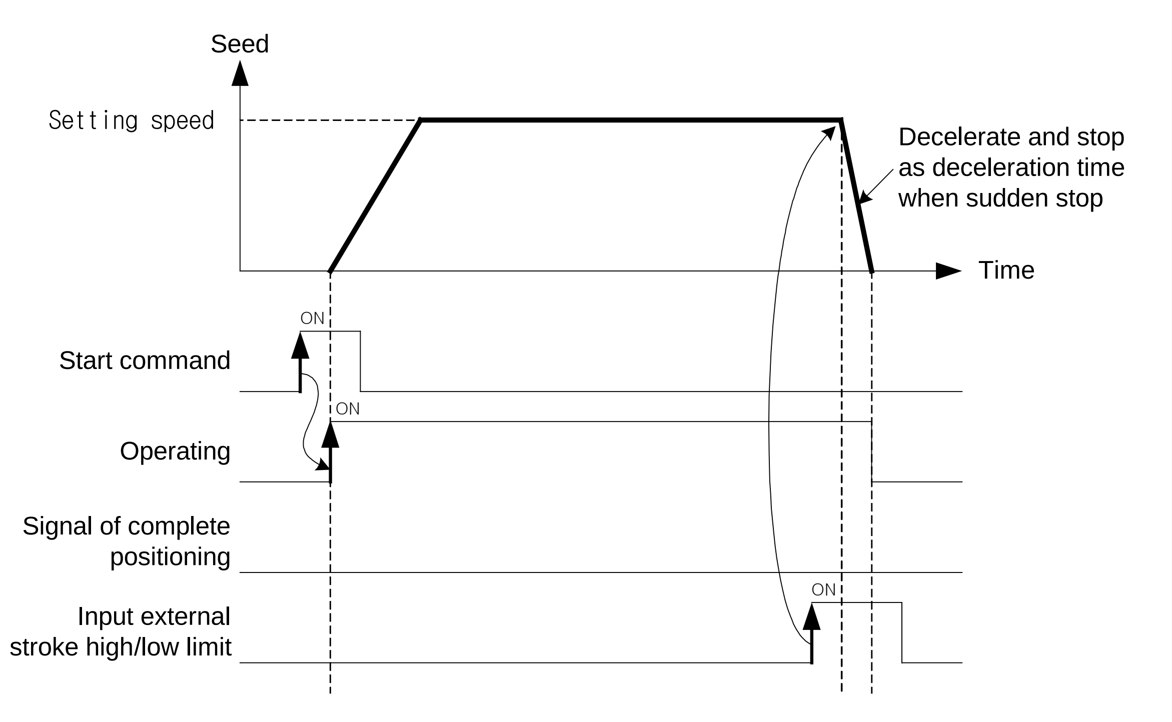
(a) When positioning control, if the signal of hardware high/low limit is inputted, then stop positioning control and it will be decelerated and stopped as set time at「deceleration time when it is suddenly stopped」, and error will be occurred.

(b) In case of external input stroke high limit error, error 492 will occur and in case of external input stroke low limit error, error 493 will occur.

■ Setting related parameter (basic parameter)

| Item | Setting value | Content |
|---|---|---|
| When sudden stop, deceleration time | 0 ~ 2147483647 [ms] | Set deceleration time for using when detect hardware high/low limit signal. Deceleration time express needed time for deceleration as bias speed at speed limit, when suddenly stop. |

(c) Motion timing



### (5) Stop by software high/limit

(a) When positioning control, if value of current command position out of set value of expansion parameter in「software high limit」 and「software low limit」, it will promptly be stopped without outputting value of command position.

(b) If value of command position to be out of software high limit range, will occur error 501, and if it to be out of software low limit range, will occur error 502.

■ Setting related parameter (expansion parameter)

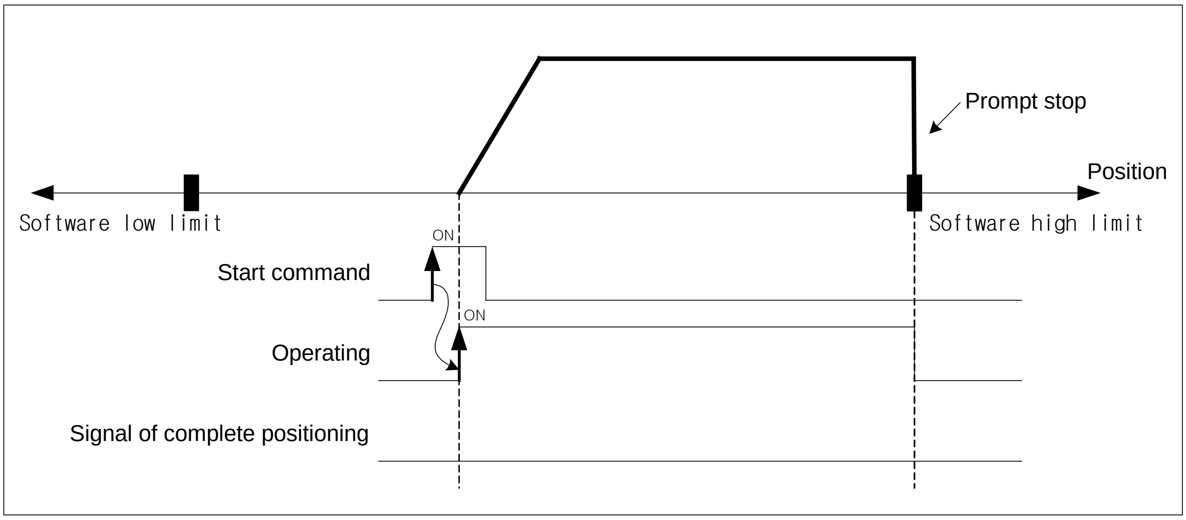
| Item | Setting value | Contents |
|---|---|---|
| Software high limit | -2147483648 ~ 2147483647 | Set position of software high limit. |
| Software low limit | -2147483648 ~ 2147483647 | Set position of software low limit. |

(c) Condition

Software high/low limit not to be checked in the following case:

- In case of setting Software high/low limits as maximum (2147483647), minimum (-2147483648)
- In case of "Software high limit = Software low limit"

(d) Motion timing



(6) The priority of stop process

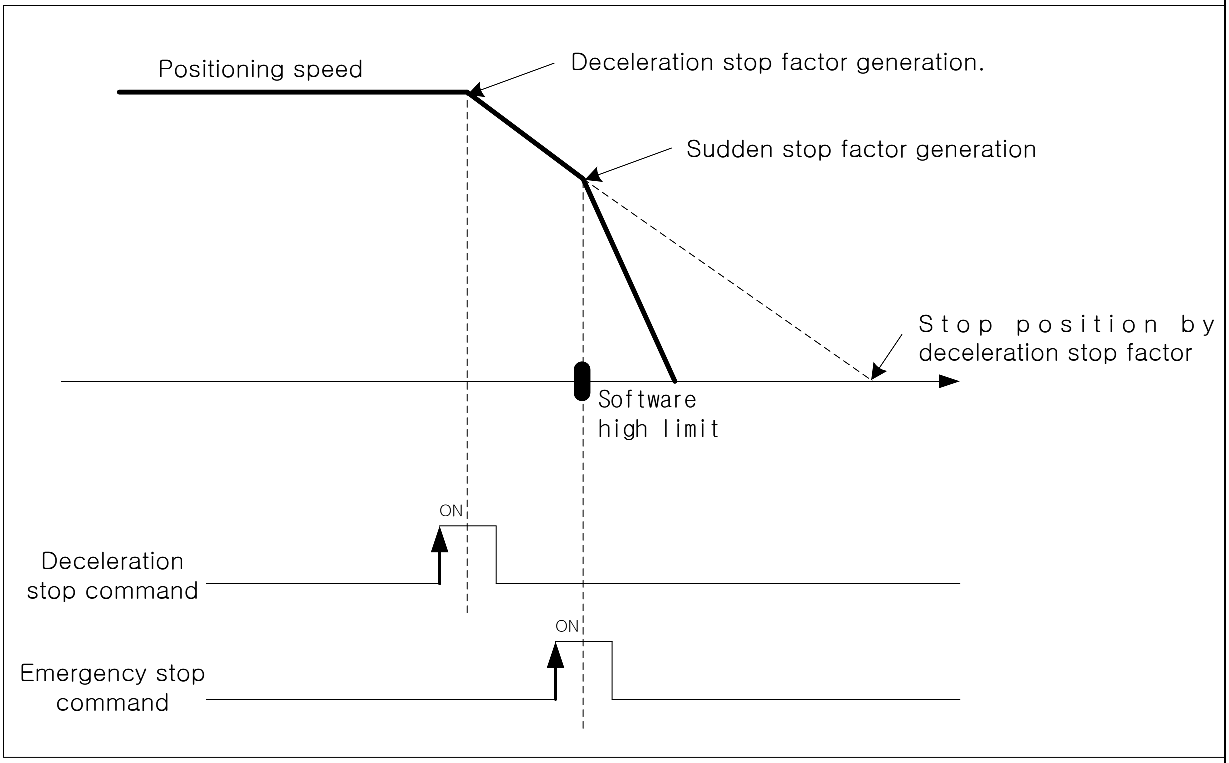
The priority of stop process of positioning module is as follows:

| Deceleration stop < Sudden stop |
|---|

When encounter factor of sudden stop in deceleration stop of positioning, it will be suddenly stopped. In case of sudden top deceleration time bigger than deceleration stop time, it will be decelerated and stopped as set deceleration stop time.

**Note**

Process is as follows, when factor of sudden stop is occurred during deceleration stop.



The factor of sudden stop : Emergency stop command or software high/low limit

(7) Stop command under interpolation operation

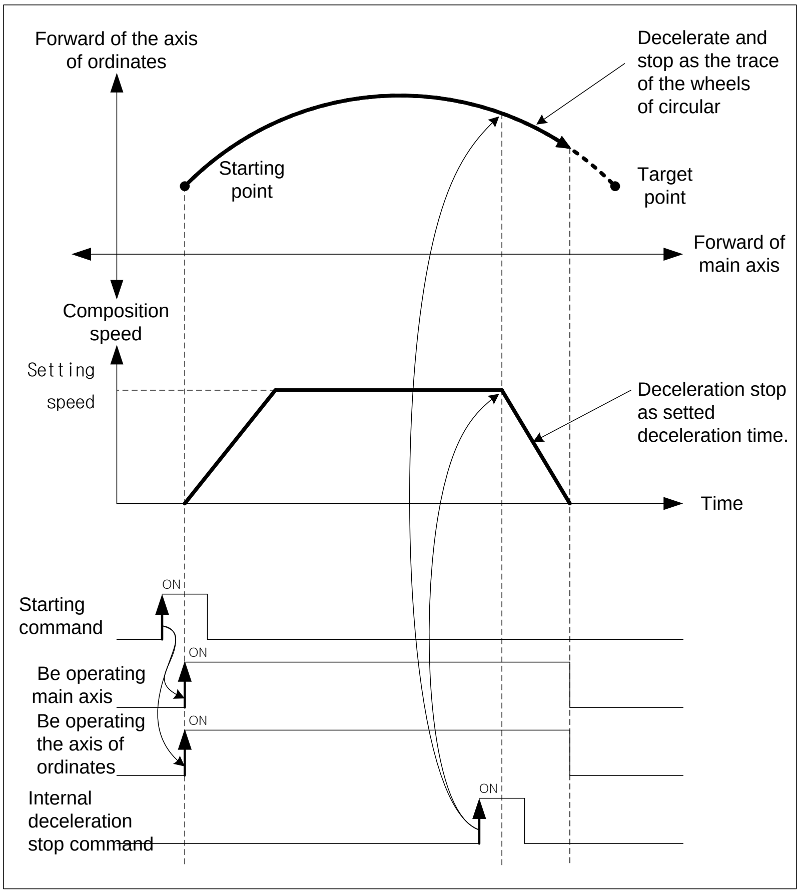
(a) If encounters stop command during interpolation operation (linear interpolation, circular interpolation, helical interpolation, elliptic interpolation), it carries out the deceleration stop. It depends on the trace of wheels of origin.

(b) When it restarts after deceleration stop, indirect start command carries out operation to target position of positioning. And then, operation depends on absolute coordinate and relative coordinate.

(c) Stop command during interpolation operation can external/internal deceleration stop.

(d) Deceleration stop command should be progressed at main axis which is operating for interpolation.

(e) Operation pattern



(8) Restart after Positioning stop

(a) Deceleration stop

When indirect start after deceleration stop, operate positioning as set operation step.

In case of using with mode, Signal “On” of M code has to “Off” for restart.

Signal On of M code have to be changed “Off” by「Cancellation M code (XMOF)」command.

(b) Restart after Internal/External emergency stop

In case of emergency stop, signal On of M code will automatically be “Off”, therefore can operate positioning as set operation step, when it operate indirect start.

## 9.3 Manual Operation Control

Manual control is a function that execute random positioning according to user's demand without operation data
Manual operations include Jog operation, Manual pulse generator operation, inching operation, previous position movement of manual operation etc.

### 9.3.1 Jog Operation

### (1) Characteristic of Control

(a) Jog Operation is

- ▪Execute positioning control at jog high/low speed depending on the signal of high/low speed during forward/reverse jog start signal is being ON.
- ▪Positioning is started by Jog command from the state that the origin is determined. The value of positioning stars changing, user can monitor it.
- ▪This is a way of manual operation that can be executed before determination of origin.

(b) Acceleration/Deceleration process and Jog speed

The acceleration/deceleration processing is controlled based on the setting time of Jog acceleration/ deceleration time from XG-PM manual operation parameter setting.
Set the Jog speed on Jog high/low speed of XG-PM manual operation parameter setting.
If Jog speed is set out of the setting range, error will occur and the operation does not work.

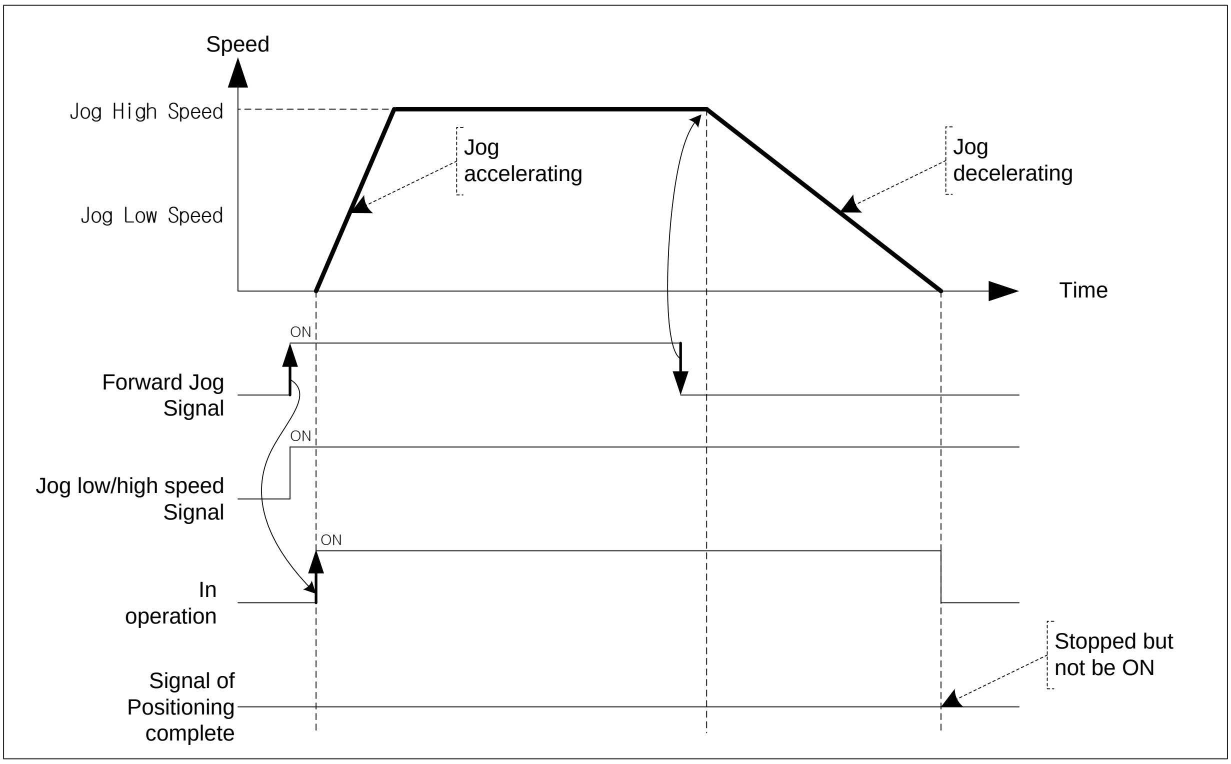
■ Parameter setting (Manual Parameter)

| Item | Setting value | Description |
|---|---|---|
| Jog High Speed | 1 ~ Speed limit | Set Jog speed. Jog high speed must be set below speed limit |
| Jog Low Speed | 1 ~ Jog High Speed | Set Jog speed. Jog low speed must be set below Jog high speed |
| Jog Acc. Time | 0 ~ 2147483647 | Set the acc. Time used in acceleration of Jog operation |
| Jog Dec. Time | 0 ~ 2147483647 | Set the dec. time used in deceleration of Jog operation |

Note

If "Jog Acc. Time" is 0, it operates at "Acc. Time1" of basic parameter.
If "Jog Dec. Time" is 0, it operates at "Dec. Time1" of basic parameter.

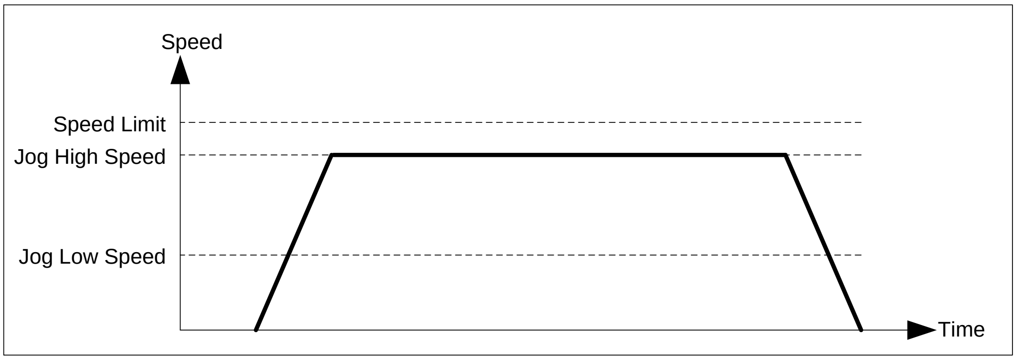
### (2) Operation Timing



**Note**

Notices for setting Jog speed are as follows.

**Bias Speed ≤ Jog High Speed ≤ Speed Limit**



### (3) Restrictions

You can not execute Jog operation in the case as follows.

(a) Value of Jog High Speed exceeds the speed limit of basic parameter (Error code : 121)

(b) Value of Jog Low Speed exceeds the value of Jog high speed. (Error code : 122)

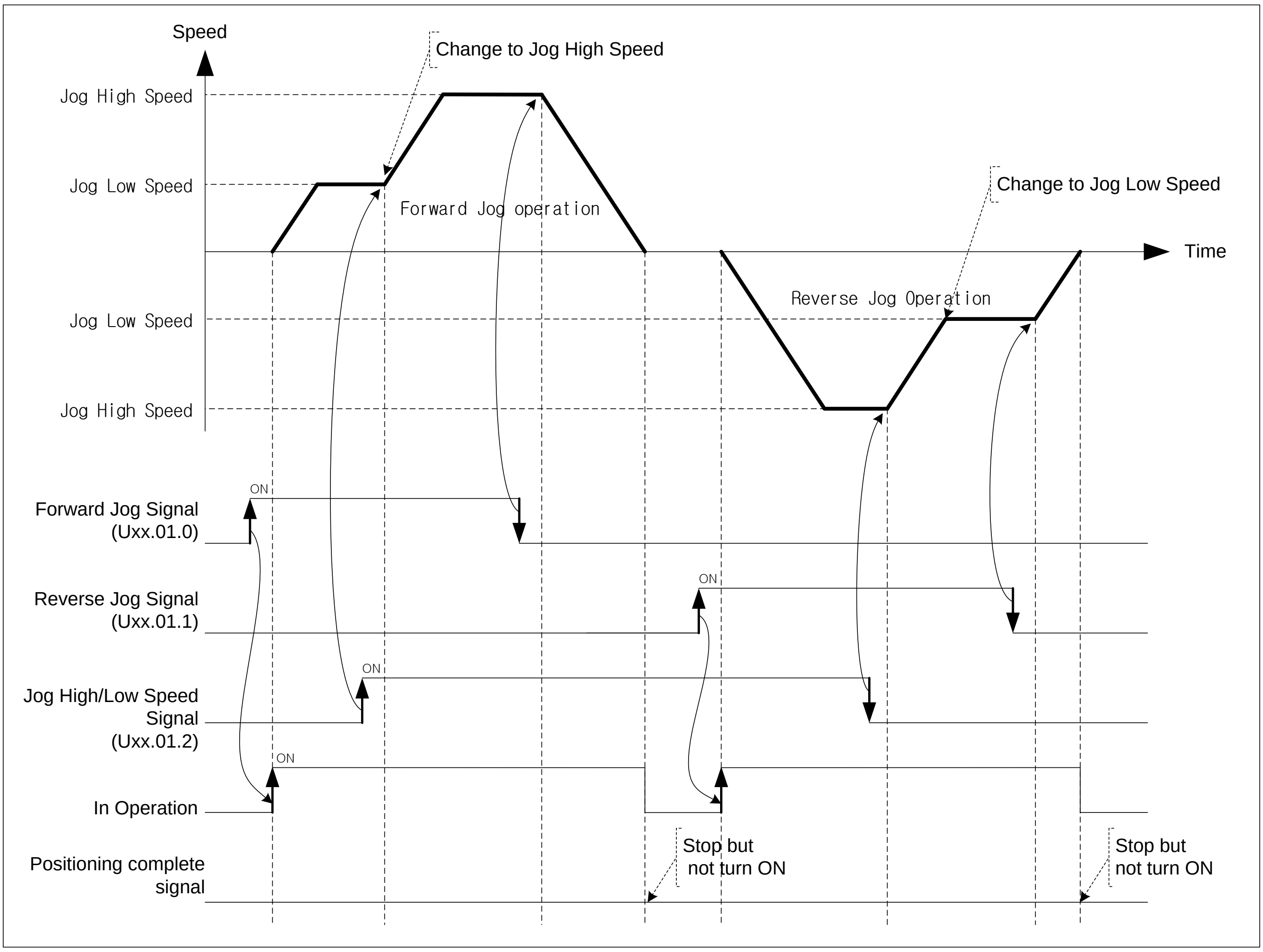
### (4) Jog Operation Start

Jog operation start consists of Start by XG-PM and Start by Sequence program. The start by sequence program is that execute Jog operation with output contact of CPU.

| Axis | Direction of Signal : CPU -> Positioning module | |
|---|---|---|
| | Output Signal | Description |
| Axis1 | K04360 | Axis1 Forward Jog |
| | K04361 | Axis1 Reverse Jog |
| | K04362 | Axis1 Jog Low/High Speed |
| Axis2 | K04560 | Axis2 Forward Jog |
| | K04561 | Axis2 Reverse Jog |
| | K04562 | Axis2 Jog Low/High Speed |
| Axis3 | K04760 | Axis3 Forward Jog |
| | K04761 | Axis3 Reverse Jog |
| | K04762 | Axis3 Jog Low/High Speed |
| Axis4 | K04960 | Axis4 Forward Jog |
| | K04961 | Axis4 Reverse Jog |
| | K04962 | Axis4 Jog Low/High Speed |
| Axis5 | K05160 | Axis5 Forward Jog |
| | K05161 | Axis5 Reverse Jog |
| | K05162 | Axis5 Jog Low/High Speed |
| Axis6 | K05360 | Axis6 Forward Jog |
| | K05361 | Axis6 Reverse Jog |
| | K05362 | Axis6 Jog Low/High Speed |

**[Example] Execute Jog start in the order as follows.**

■ Forward Jog Low speed Operation -> Forward Jog High speed Operation -> Stop
Reverse Jog High speed Operation -> Reverse Jog Low speed Operation -> Stop



**Note**

Dec. stop command will not be executed in Jog Operation.
Jog operation will stop if turn the Jog signal of the current operating direction Off.

### 9.3.2 Inching Operation

This is a kind of manual operation and executing positioning at the speed already set on manual operation parameter as much as the amount of movement already set on the data of inching operation command.

### (1) Characteristics of Control

(a) While the operation by ON/OFF of Jog signal is difficult in moving to the correct position as the operation starts and stops according to the command, the inching command enables to set the desired transfer amount easily and reach the goal point.

(b) Thus, it is available to reach the correct goal position by moving fast near the working position by Jog command and operating the detail movement by inching command.

(c) The setting range is –2147483648 ～2147483647 Pulse.

(d) The direction of moving depends on the amount of inching.

■ The amount is POSITIVE(+) : Positioning operation in forward direction

■ The amount is NEGATIVE(-) : Positioning operation in reverse direction

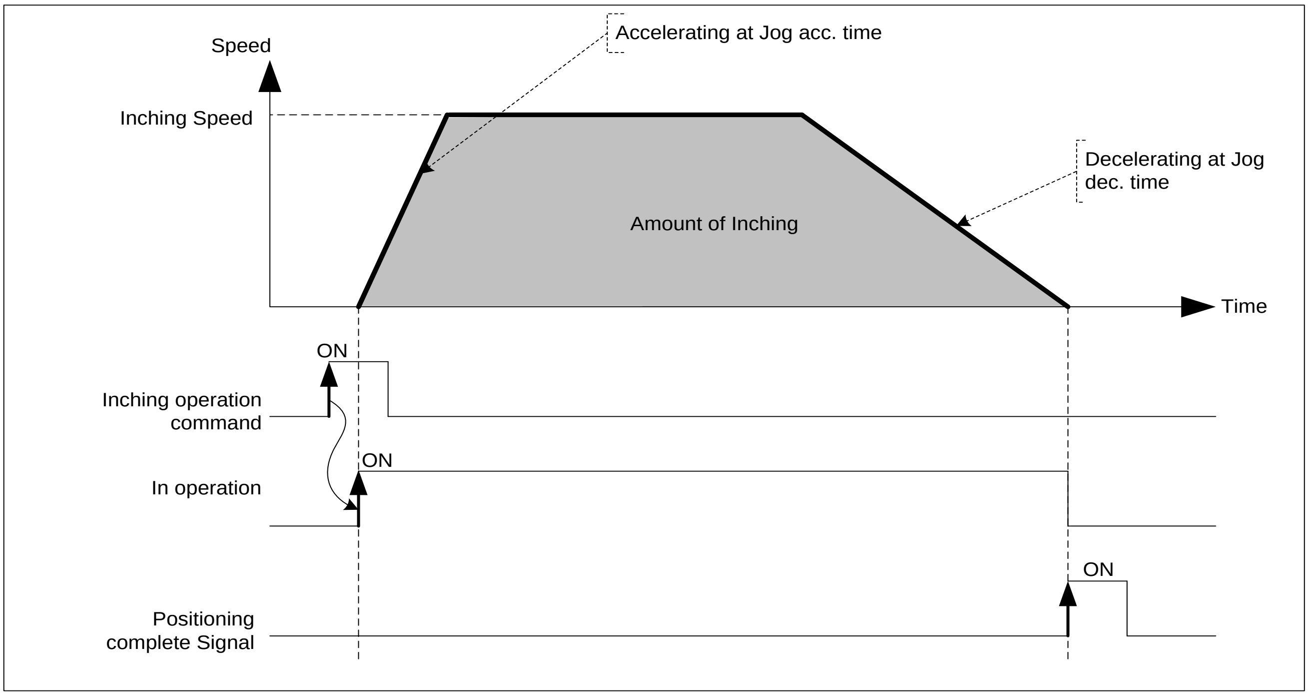
(e) Acc./Dec process and Inching speed

Use Jog acc./dec. Time of manual operation as acc./dec. time of Inching operation.
Set Jog acc./dec. time on “Jog acc./dec. time” of manual operation parameter setting of XG-PM.
Set Inching speed on “Inching speed” of manual operation parameter setting.
If inching speed is set out of the setting range, error will occur and the operation does not work.

■ Related parameter setting (Manual operation parameter)

| Items | Setting value | Description |
|---|---|---|
| Jog acc. Time | 0 ~ 2147483647 | Set the accelerating time for acceleration of Inching operation |
| Jog dec. Time | 0 ~ 2147483647 | Set the decelerating time for deceleration of Inching operation |
| Inching Speed | 1 ~ Speed limit | Set the speed of Inching operation |

### (2) Operation Timing



### 9.3.3 Returning to the previous position of manual operation

This positioning control function is used to return to the position address that the positioning is completed before manual operation when the position is changed by manual operation (Jog operation, inching operation).

#### (1) Characteristic of Control

(a) Direction of moving depends on the current position and the previous position of manual operation.

- ■ Starting position < The previous position of manual operation : Forward direction
- ■ Starting position < The previous position of manual operation : Reverse direction

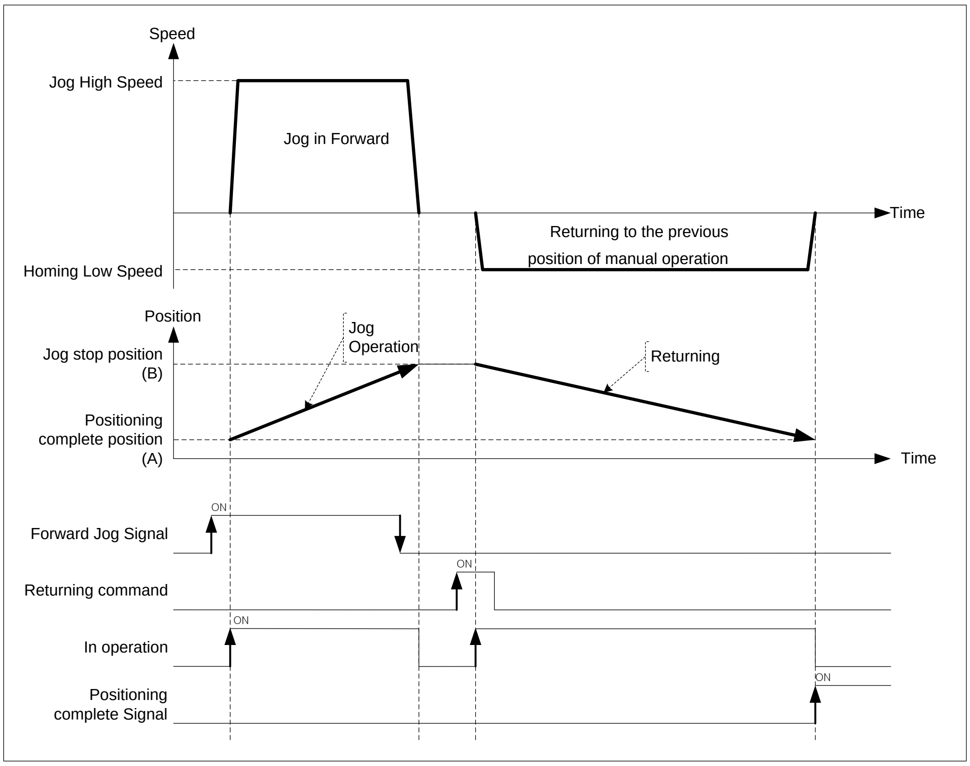
(b) Acc./Dec. process and the speed of return

Acc./Dec. time of returning is the same as homing acc./dec. time of homing parameter.
Set acc./dec. time on homing acc./dec, time of homing parameter of XG-PM.
If returning speed is set out of the setting range, error will occur and the operation does not work.

■ Related parameter setting (Homing Parameter)

| Item | Setting value | Description |
|---|---|---|
| Homing speed | 1 ~ Speed limit | Set returning speed |
| Homing acc. time | 0 ~ 2147483647 | Set acc. time used in return |
| Homing dec. time | 0 ~ 2147483647 | Set dec. time used in return |

#### (2) Operation timing



If value of the current position is “A” after positioning control operation and the positioning value changed by Jog operation is “B”, execute positioning to “A” when executing the returning to the previous position of manual operation.

## 9.4 Synchronous Control

This is the command that control the operation synchronizing with the main axis or operating of encoder.

### 9.4.1 Speed Synchronous Control

This is the command that synchronize with sub axis in speed and control operation depending on speed synchronous rate already set when main axis starts.

### (1) Characteristic of Control

(a) Start and Stop is repeated depending on operating of main axis after execution of speed synchronous command. The operating direction of sub axis and the main's are same.

(b) The operating direction of sub axis depends on the ratio of speed sync. $(\frac{SubAxis}{MainAxis})$ . If it is positive, the direction is forward. If it is negative, the direction is reverse.

(c) If execute speed sync. command, it will be the state of operating and remain in the state of speed sync. operation before release of speed sync. command.

(d) Auxiliary data of speed sync. command

The auxiliary data used in speed sync. command is as follows.

| Item | Setting value | Description |
|---|---|---|
| Main Axis | 1(axis1) ~ 6(axis6),<br>9~12(Encoder1~4) | Set the main axis of speed sync. |
| Ratio of Main axis | -32768 ~ 32767 | Set the ratio of main axis at speed sync. ratio. |
| Ratio of Sub axis | -32768 ~ 32767 | Set the ratio of sub axis at speed sync. ratio.. |

Ratio of Speed sync. is calculated as follows.

$$\boxed{Ratio = \frac{SubAxis}{MainAxis}}$$

It is possible to set like "Ratio of Main axis(Absolute) < Ratio of Sub axis(Absolute)" at setting ratio of speed sync.

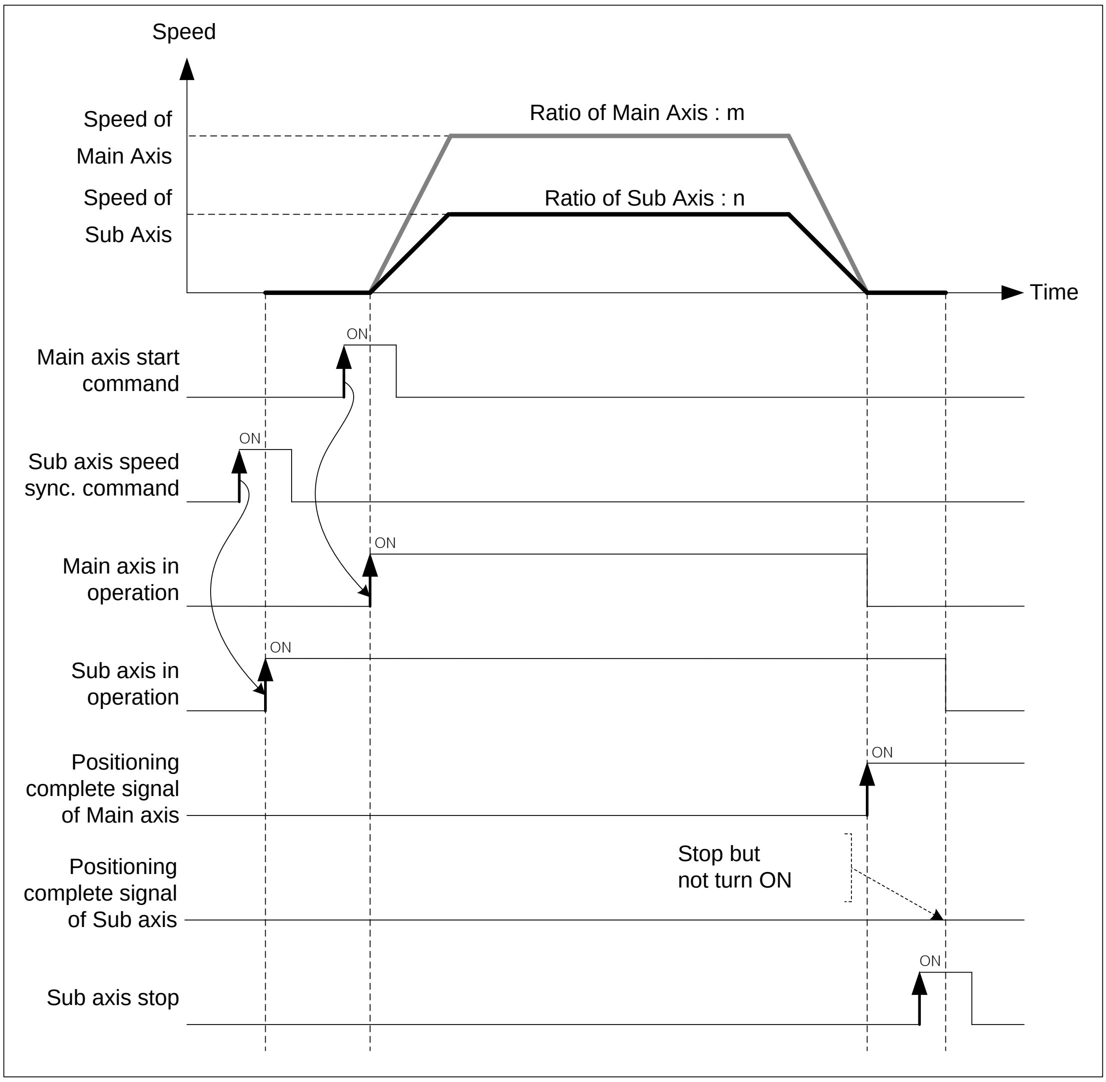
Operating speed of sub axis is calculated as follows.

$$\begin{aligned} Operaing\ \ speed\ \ of\ \ SubAxis &= Operating\ \ Speed\ \ of\ \ MainAxis \times Ratio\ \ of\ \ speed\ \ sync. \\ &= Operating\ \ Speed\ \ of\ \ MianAxis \times \frac{Ratio\ \ of\ \ SubAxis}{Ratio\ \ of\ \ MainAxis} \end{aligned}$$

(e) Modifying the ratio of speed sync. in operation is available.

When modify the ratio, if there is too big gap between the former ratio and the current ratio, the machine is possible to be damaged.

## (2) Operation Timing



## (3) Restrictions

You can not execute Jog operation in the case as follows.

(a) If speed sync. is executed in being On of M code signal, error (code:353) arises. Make M code "off" with M code release command (XMOF) before use.

(b) In the case that the axis set as main axis is not the axis can be set or the case that the setting of main axis is the same as the setting of command axis, error (code"355) arises. Set the main axis among the axis available to be set.

(c) If the speed of main axis exceeds the speed limit, error (code:357) arises. In the case, the speed of main axis has to be down below the speed limit.
In the case that the speed of main axis exceeds the speed limit, error arises and it decelerate in "Dec. time of emergent stop".

**Note**

If master axis is encoder, input frequency can be recognized as 1000pps even though the actual input speed is lower than 1000pps. In this case, the speed limit error can be occurs according to synchronous ratio.
Therefore, Care must be taken when master axis is encoder.

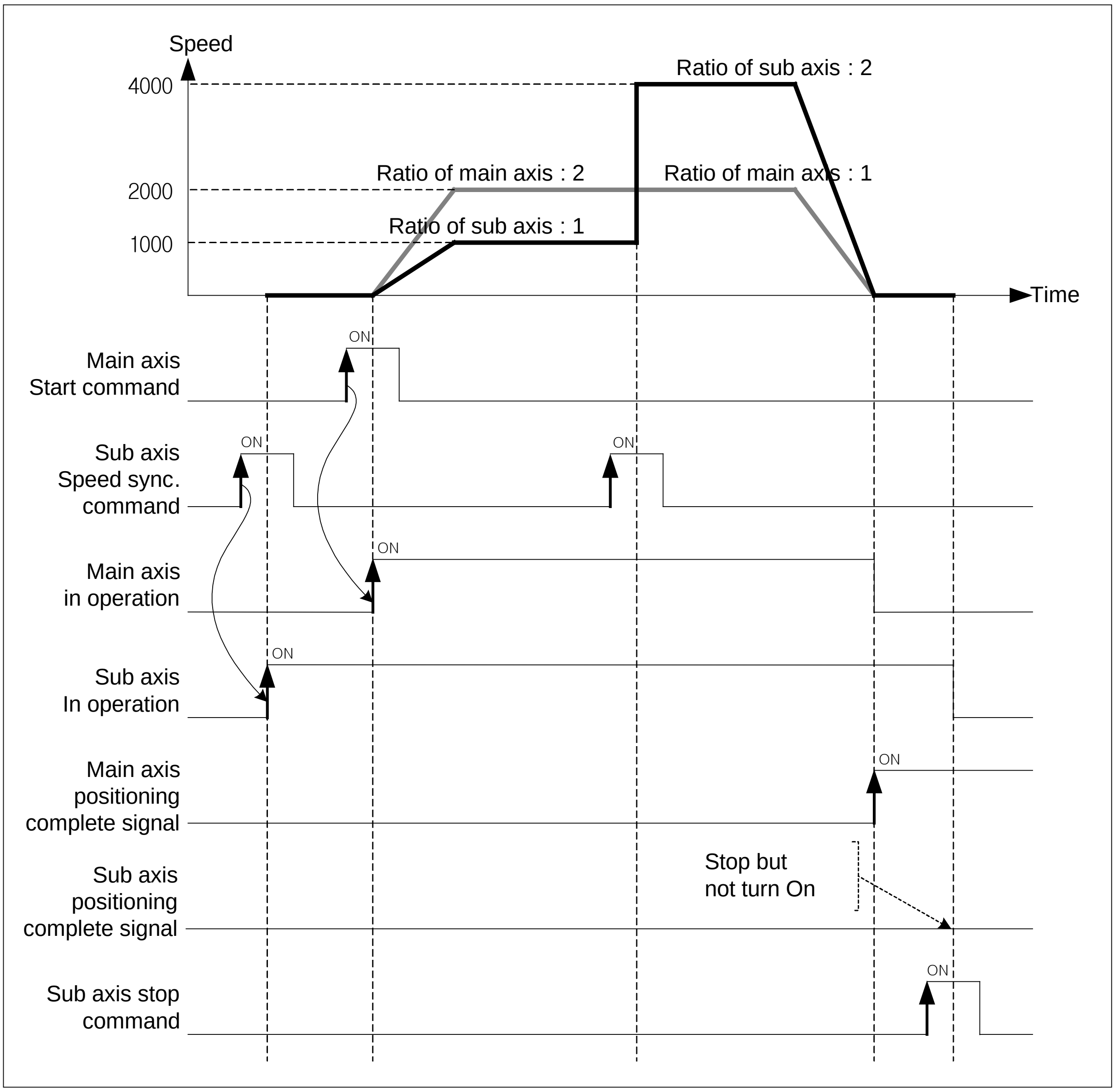
**[Example] axis1 is main axis, axis2 is sub axis. Operate at "ratio of main axis : ratio of sub axis = 2 : 1" at the beginning and then execute speed sync. control changing the ratio to "ratio of main axis : ratio of sub axis = 1 : 2"**

■ Example of setting in XG-PM

▪Operation data of main axis(axis1)

| Step no. | Control method | Operation method | Goal Position [pls] | Operating speed [pls/s] | Acc. no. | Dec. no. | M code | Dwell Time |
|---|---|---|---|---|---|---|---|---|
| 1 | Relative, Reduction position control | Single, End | 10000 | 2000 | No. 1 | No. 1 | 0 | 0 |

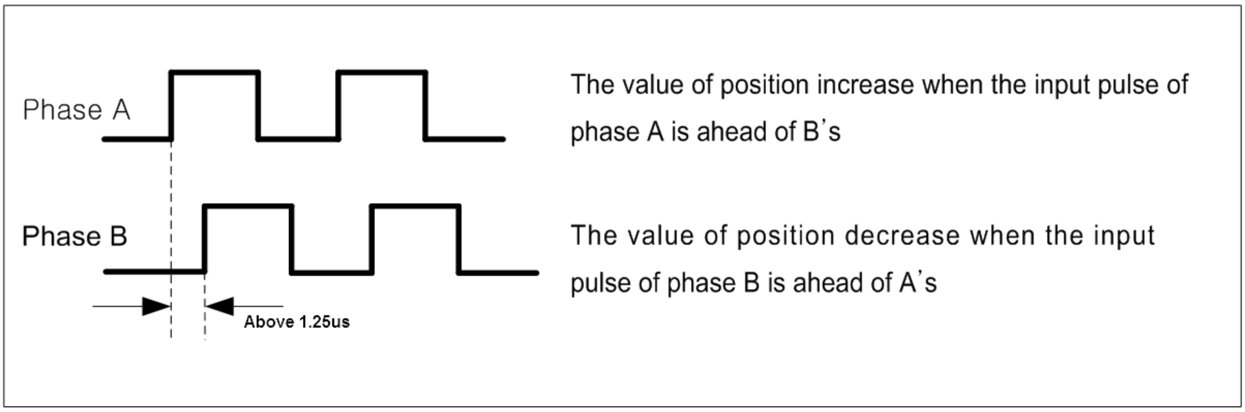
■ Operating pattern



### (4) Speed synchronous control with encoder

(a) Set encoder as the main axis of speed sync. and execute positioning control by ratio of speed sync. that consists of pulse speed from encoder, ratio of main axis and ratio of sub axis.
(b) This command is used in the case that executing thorough positioning manually.
(c) After executed speed sync. command, when the pulse string is inputted, speed sync. control starts.
(d) Operate regardless of the state of origin.
(e) The pulse inputted by encoder increase of decrease the position value of encoder.
(f) The direction of moving depends on encoder pulse input mode and ratio of speed sync,

■ Encoder direction in PHASE A/B 1multiplying
- Positioning in forward direction : Input pulse of A phase is ahead of B's
- Positioning in reverse direction : Input pulse of B phase is ahead of A's



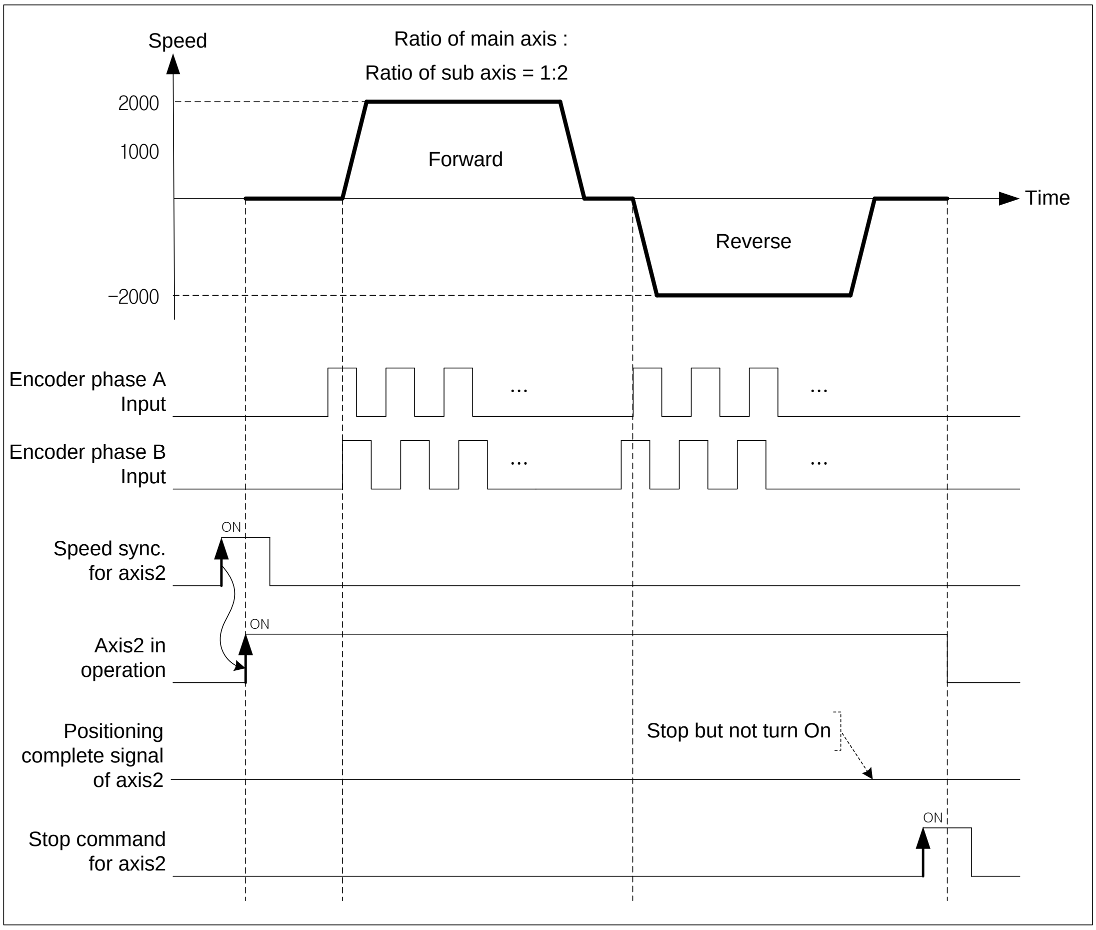
- The operating direction of sub axis depends on $Ratio\ of\ speed\ sync.(\frac{Ratio\ of\ SubAxis}{Ratio\ of\ MainAxis})$. If it is positive, operating direction will be forward direction of encoder. If it is negative, operating direction will be reverse direction of encoder.

**[Example] Execute speed sync. control with encoder (main axis), axis2(sub axis) at "the ratio of main axis : the ratio of sub axis = 1 : 2".**

**(Hypothesize that the input speed of encoder is 1Kpps)**

When the direction of encoder is forward, the operating direction of sub axis is reverse. When the direction of encoder is reverse, the operating direction of sub axis is forward.

■ Operating pattern



## (5) Positioning speed sync. control

(a) The basic operation of positioning speed sync. control is similar to speed synchronization. After executing positioning speed sync. command, start and stop are repeated depending on operation of main axis. The direction of sub axis and the direction of main axis are same.

(b) The operating direction of sub axis depends on $Ratio\ of\ speed\ sync.(\frac{Ratio\ of\ SubAxis}{Ratio\ of\ MainAxis})$. If it is positive, operating direction will be forward direction of main axis. If it is negative, operating direction will be reverse direction of main axis.

(c) If give speed sync. command to sub axis, it will be changed to the operating state and stay at operating state until release command.

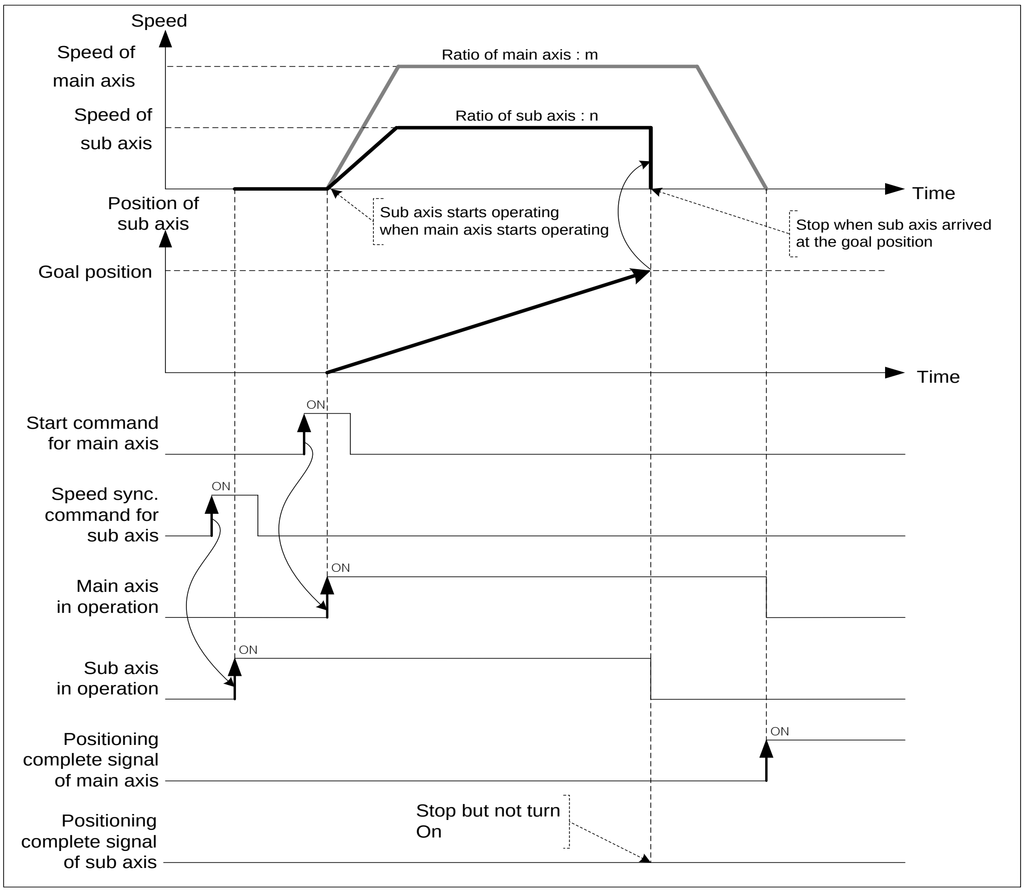
(d) If the current position of sub axis become the goal position, it stops speed sync. and stay there. For the details, refer to “Speed sync. control”.

(e) Auxiliary data of positioning speed sync. command.

The auxiliary data used in speed sync. is as follows.

| Items | Setting value | Description |
|---|---|---|
| Main axis | 1(axis1) ~ 4(axis4), 9(Encoder) | Set main axis |
| Ratio of main axis | -32768 ~ 32767 | Set ratio of main axis |
| Ratio of sub axis | -32768 ~ 32767 | Set ratio of sub axis |
| Goal position | -2147483648 ~ 2147483647 | Set the goal position of positioning speed sync. |

(f) Operation timing



(a) 동작 타이밍

## 9.4.2 Position synchronous control

Start positioning with step no. and operation data when the current position of main axis is same as the position set in position sync.

### (1) Characteristics of control

(a) Synchronous Start by Position (SSP) command is carried out only in case that the main axis is in the origin determination state.

(b) SSP command starts by the synchronization of the subordinate axis according to the current position of the main axis.

(c) SSP carries out the SSP command at the subordinate axis.

(d) If SSP command is executed, it becomes the state in operation and the actual operation is carried out at the subordinate axis where the current position of the main axis is the setting position of the position synchronous start.

(e) In case of cancellation after executing the SSP command at the subordinate axis, if you execute the stop command, the SSP command shall be released.

(f) The auxiliary data of position sync. command

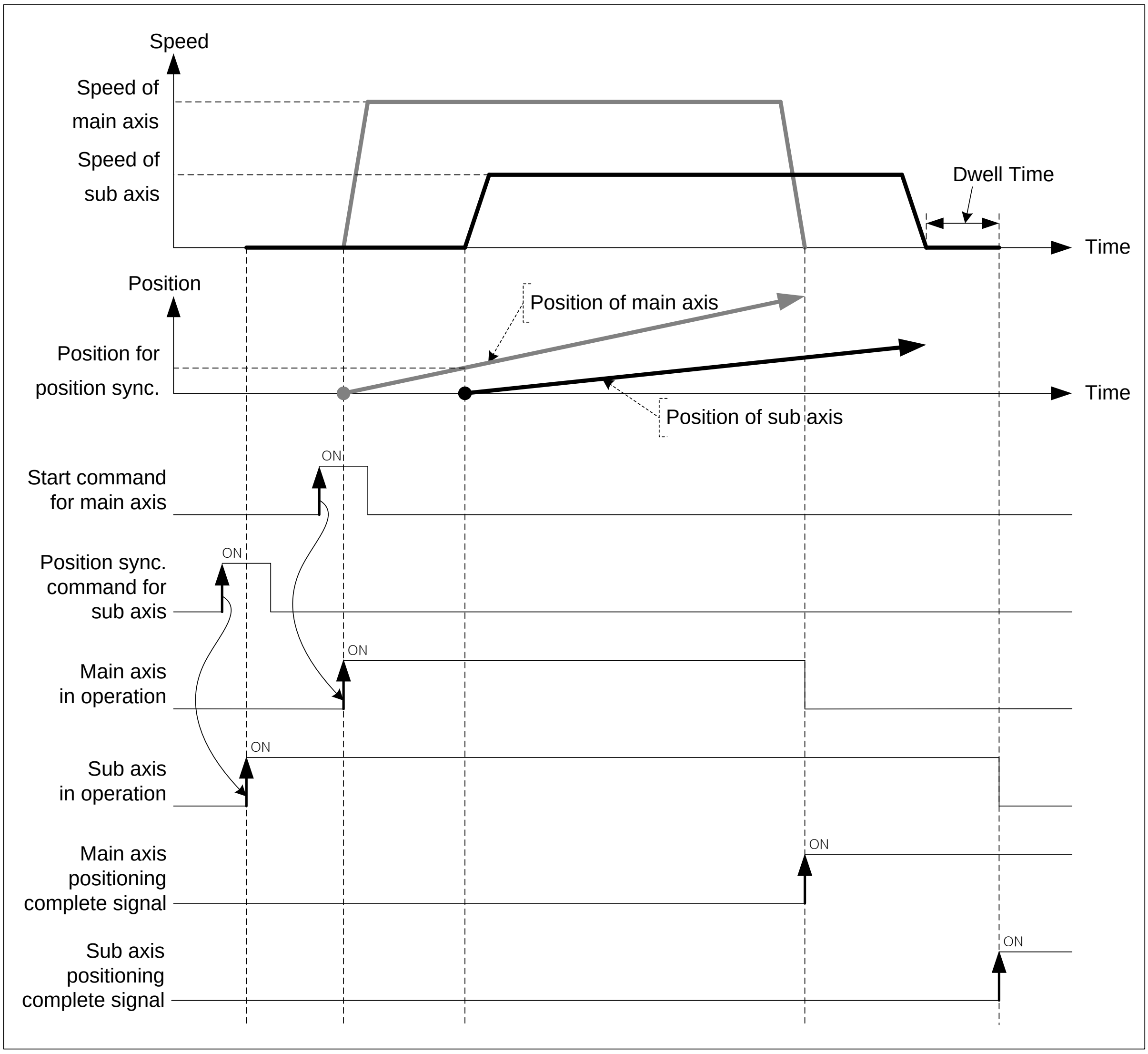
The auxiliary data used in position sync. is as follows.

| Items | Setting Value | Description |
|---|---|---|
| Position of position sync. | -2147483648 ~ 2147483647 | Set the position of main axis in position sync. control |
| Operation step | 1 ~ 400 | Set the step no. to be executed when the main axis arrives at the position for position sync. |
| Main axis | 1(axis1) ~ 6(axis4),<br>9~12 (Encoder1~4) | Set the main axis of position sync. |

**Note**

Even though the current position of main axis and the setting value set on position sync. are not exactly same, if the current position of main axis is at between the position of main axis of previous scan and the current position of main axis, the sub axis will be executed with the positioning data of step no. set on operation step.

## (2) Operation timing



## (3) Restrictions

Position sync. control can be executed in the case below.

(a) If position sync. command is executed in M code signal is On, error (code:343) arises. Use it after making M code “Off” with M code release command(XMOF).

(b) If the current main axis is not the axis can be set on the current module or main axis and command axis are the same axis, error (code:355) arises. Set the main axis among one of the axis can be set on module.

**[Example] Axis1 is main axis, axis2 is sub axis. The position of main axis for position sync. is 1000, execute position sync. with operation data no.10.**

■ The current position of axis1 : 0

The current position of axis2 : 0

■ Example in XG-PM

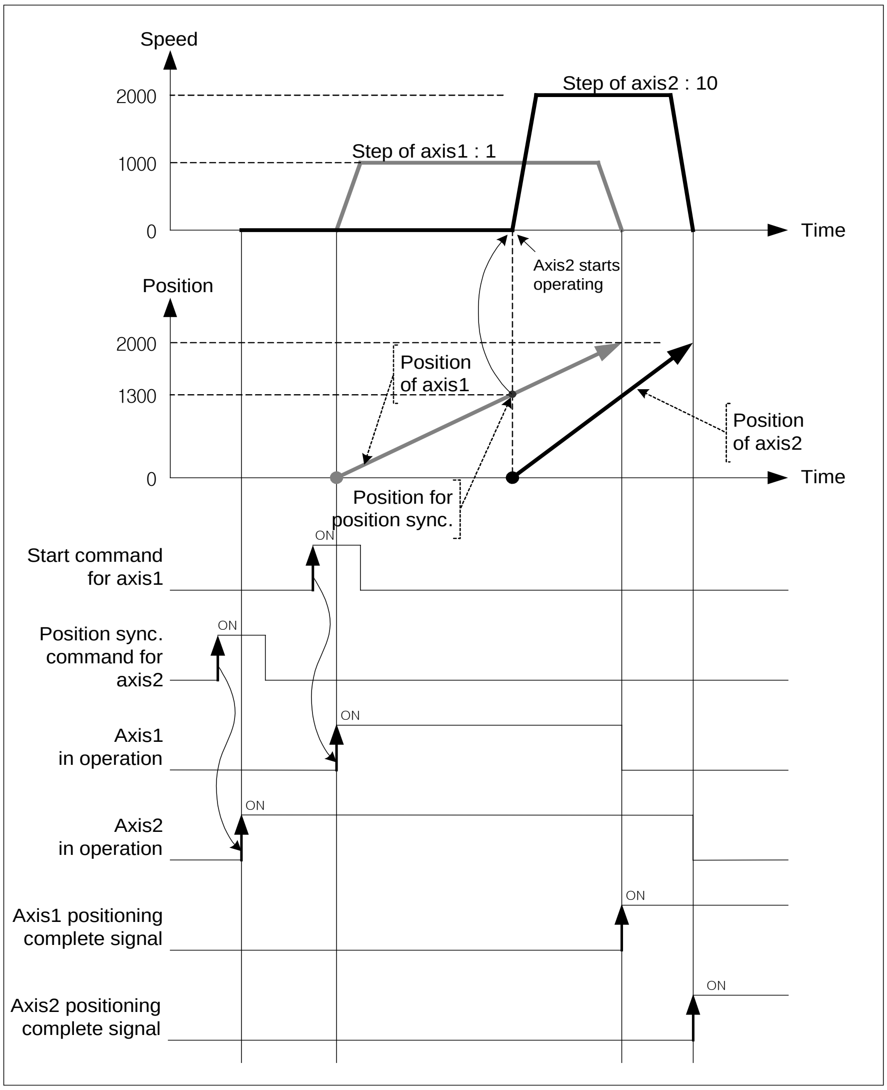
▪ Main axis (axis1) Operation data

| Step no. | Control method | Operation | Goal position [pls] | Operating speed [pls/s] | Acc. no. | Dec. no. | M code | Dwell time |
|---|---|---|---|---|---|---|---|---|
| 1 | Relative, Single axis position control | Single axis, End | 2000 | 1000 | No. 1 | No. 1 | 0 | 0 |

▪ Sub axis (axis2) Operation data

| Step no. | Control method | Operation | Goal position [pls] | Operating speed [pls/s] | Acc. no. | Dec. no. | M code | Dwell time |
|---|---|---|---|---|---|---|---|---|
| 10 | Relative, Single axis position control | Single axis, End | 2000 | 2000 | No. 2 | No. 2 | 0 | 0 |

■ Operating pattern

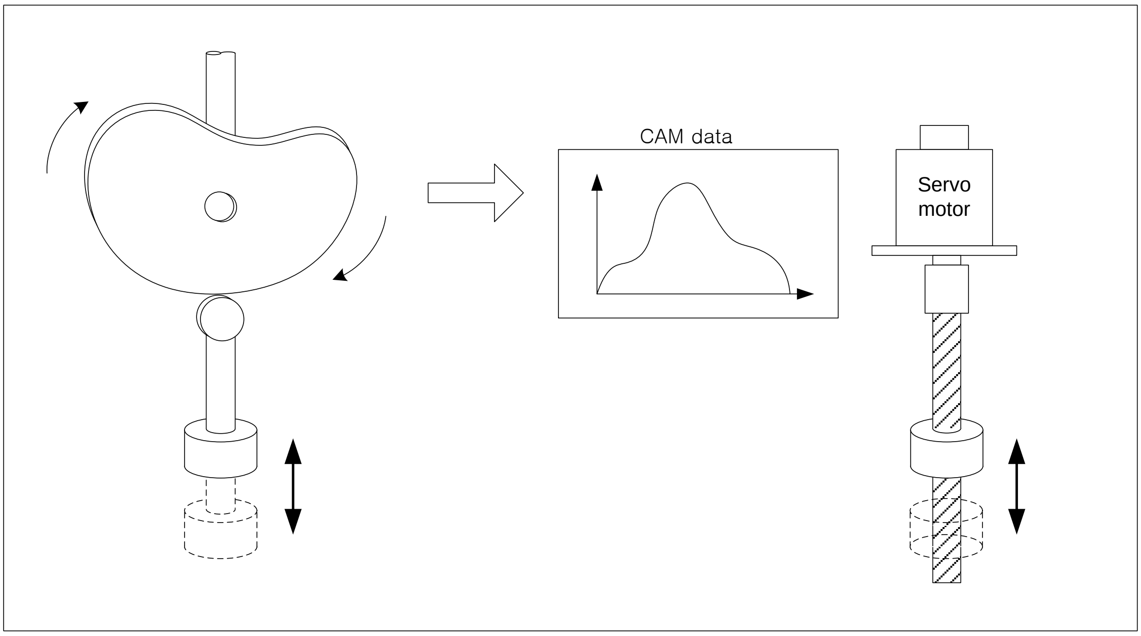


### 9.4.3 CAM Operation

CAM axis control synchronizing with the position of main motor.

#### (1) Characteristics of Control

(a) Replace existing mechanical work of CAM with software CAM operation



(b) You may write max. 9 CAM data blocks and apply it to each axis.

(c) Each block consists of 2048 CAM data.

(d) Auxiliary data of CAM command

Auxiliary data used in CAM command is as follows.

| Item | Setting value | Description |
|---|---|---|
| Main Axis | 1(Axis1) ~ 4(Axis4), 9(Encoder) | Set the main axis of CAM operation |
| CAM block | 1(no.1) ~ 8(no.8) | Set CAM block no. |
| Main axis offset | -2147483648 ~ 2147483647 | Set the position of main-axis position as offset value if main-axis reaches this position, the sub-axis starts CAM operation. |

Encoder can not be used as main axis.

You may set different CAM block no. for each axis. In addition, it is possible to execute CAM operation with the same CAM block. In order to use user CAM operation, you have to set up CAM block number as 8.

(e) You can make sub-axis start the CAM operation at the specified position of main-axis by setting the “Main axis offset”. Main axis offset setting is available at “Offset specified CAM start command (XCAMO, XPM_CAMO).

(f) Create CAM data by setting CAM parameter on XG-PM to use CAM.

(g) After main axis is operated, input the calculated value per CAM block setting and point unit based on the current value per rotation of main axis. For the detail description, refer to “(3) Principle of CAM operation”.

(h) If CAM operation is executed on sub axis, it become ‘operating status’ and keep executing CAM operation with CAM data according to the position of main axis until stop command.

## (2) CAM Parameter

The table below describes the parameter items for writing CAM data.

| Item | | Setting Range | Description |
|---|---|---|---|
| Main/Sub axis parameter | Unit | pulse, mm, inch, degree | Set unit of main/sub axis |
| | Transfer distance per 1 rotation | Depending on Unit | Set the transfer distance of main/sub axis per 1 rotation |
| | No. of Pulse per 1 rotation | 1 ~ 200000000 | Set no. of pulse of main/sub axis per 1 rotation |
| CAM control mode | Control method | Repeat, Increase | Set CAM control method |
| | Point unit | No. of pulse per 1 rotation | Set the resolution ability of CAM data |
| CAM block data | Starting position of main axis | Depending on Unit | Set the CAM position of sub axis corresponding to main axis |
| | Ending position of main axis | | |
| | Starting position of sub axis | | |
| | Ending position of sub axis | | |
| | CAM curve | Straight Line ~ 7th curve | Set the curve of each CAM data step |

(a) Main/Sub parameter setting

1) Unit

Set the control unit of main/sub axis. Set the same as the value already set on “Unit” of basic parameter.

| Item | Setting Range | Remarks |
|---|---|---|
| Unit of main axis | pulse, mm, inch, degree | - |
| Unit of sub axis | pulse, mm, inch | Degree may not be used. |

2) Transfer distance per 1 rotation

Set the transfer distance per 1 rotation of main/sub axis. The unit of transfer distance is according to 1).
If the unit is “mm” or “inch”, this value is the maximum last position of main/sub axis.
Transfer distance per 1 rotation is depending on unit.

■ Setting range for transfer distance per 1 rotation

| Unit | Setting Range | Remarks |
|---|---|---|
| pulse | - | No need to set |
| mm | 0.1 ~ 20000000.0 um | The maximum last position of main/sub axis |
| inch | 0.00001 ~ 2000.00000 inch | The maximum last position of main/sub axis |
| degree | 360.00000 Fixed | No need to set<br>The maximum last position of main/sub axis |

3) No. of pulse per 1 rotation

Set the no. of pulse per 1rotation of main/sub axis.
If the unit is “pulse”, the value is the maximum last position of main/sub axis

(b) CAM control mode setting

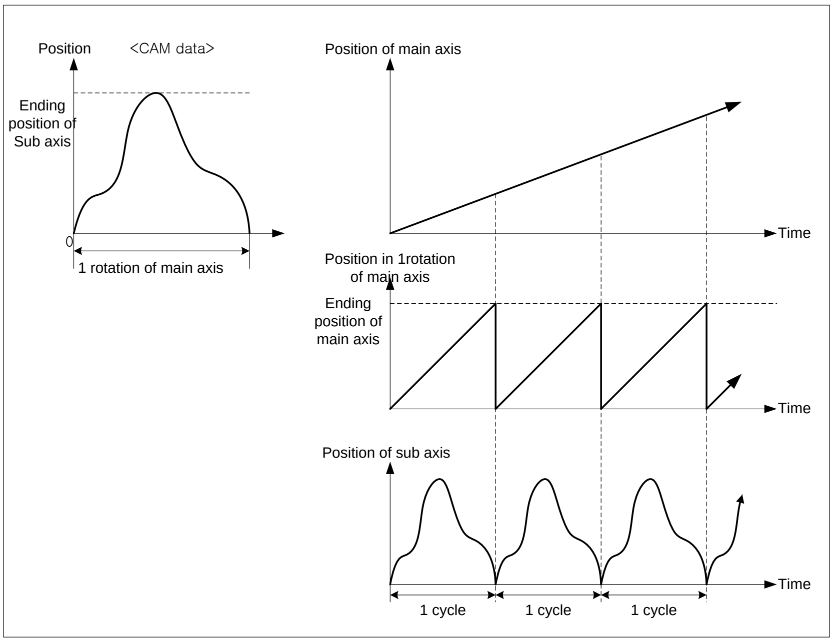
1) Control method

Set the form of CAM repeat pattern. “Repeat mode” and “Increase mode” may be set.

- Repeat (Two-way mode)

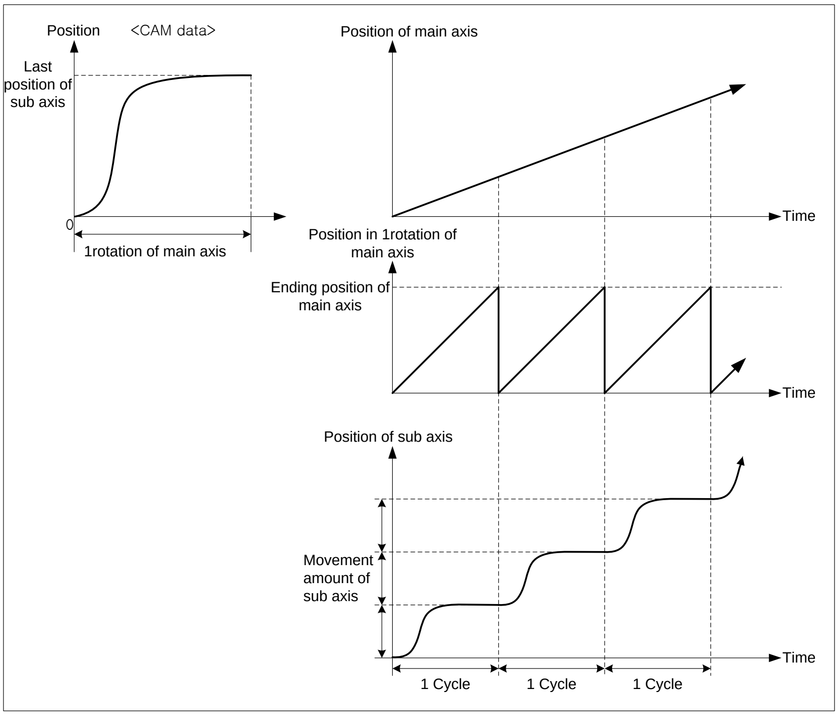
  Execute round-trip motion repeatedly in the range already set from starting position of sub axis to ending position according to the position of main axis in 1 rotation.

  When CAM data is created in repeat, the ending position of the last step of sub axis user last set must be set as 0.



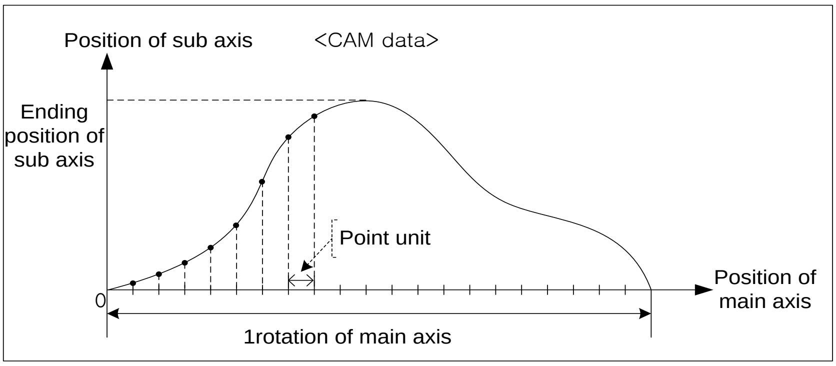
- Increase (Feed mode)

  Execute CAM operation from starting position of sub axis to ending position according to the position in 1rotation of main axis.



2) Point unit

Set the resolution ranging from starting position of main axis to ending position of main axis on each step data of CAM block data setting. When CAM data is created, calculate the position of sub axis corresponding to the position of main axis from the starting position of main axis by point unit. The smaller point unit is, the more no. of CAM data is, so you may execute much smoother CAM operation. However, if point unit is small, no. of CAM data exceeds 2048, so there is a chance that user can not create CAM data.



**Note**

When set CAM block data after point unit setting, “Ending position of main axis” must be set as positive multiple number of point unit. For example, if the unit of main axis is “degree” and point unit is 10, “Ending position of main axis” must be set as multiple number of 10 like 40, 90, 180, ···.

(c) CAM block data setting

20 data sections may be set in a CAM block and every section may have specific curve.

1) Starting position of main axis

Set the starting position of main axis in designated section. Starting position of main axis is the same as the ending position of main axis in previous section.

2) Ending position of main axis

Set ending position of main axis in designated section. The ending position of main axis in the last section must be set as much as the transfer distance per 1rotation set on main/sub axis parameter.

3) Starting position of sub axis

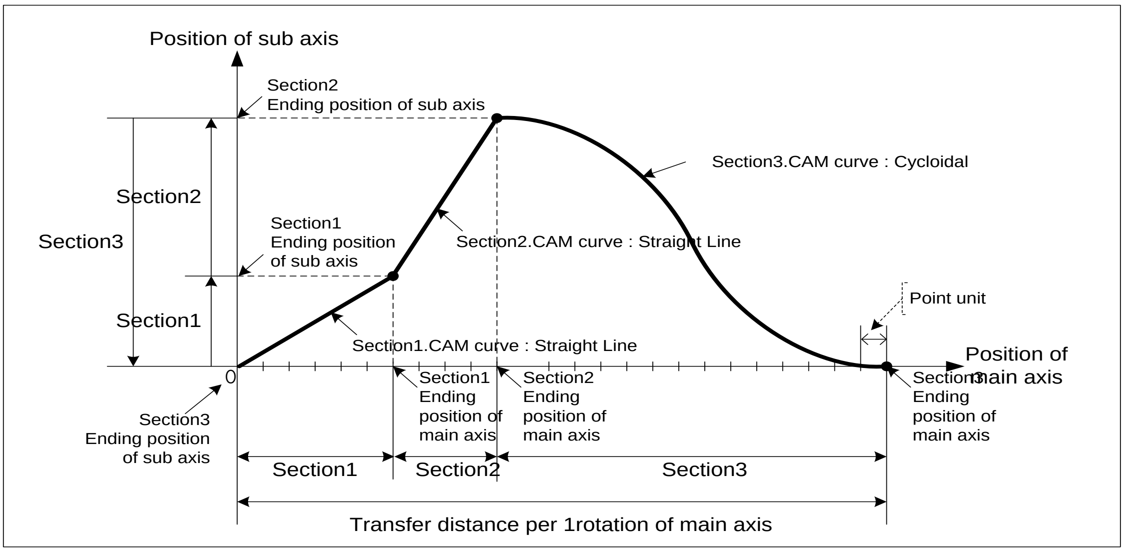
Set the starting position of sub axis corresponding to the starting position of main axis in the designated section. Starting position of sub axis is the same as the ending position of sub axis in previous section.

4) Ending position of sub axis

Set ending position of sub axis corresponding to the ending position of main axis in the designated section. If control method is “Repeat (Two-way mode), the ending position of sub axis in the last section must be 0. If control method is “Increase(Feed mode)”, the ending position of sub axis in the last section generally has to be set as much as the transfer distance per 1rotation set on main/sub axis parameter.

5) CAM curve

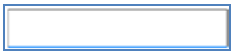
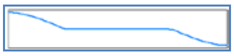
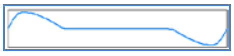
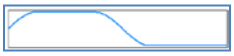
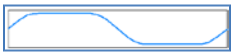
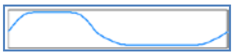
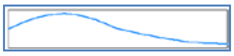
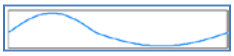
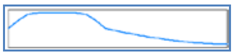
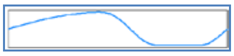
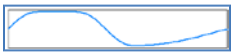
Set CAM specific curve to create data ranging from starting position of sub axis to ending position of sub axis in the designated section. The position of sub axis is calculated by characteristic of selected CAM curve, the position of main axis increase by point unit at the same time.



There are 22 kinds of CAM curve.

Describe characteristic of each CAM curve on next page.

■ Characteristic of CAM curve

| Name | Acc. type | Position ($S_{max}$) | Speed ($V_{max}$) | Acc. ($A_{max}$) | Jerk ($J_{max}$) |
|---|---|---|---|---|---|
| Straight Line |  | 1.00000 | 0.00000 | 0.00000 | 0.00000 |
| Constant Acceleration |  | 1.00000 | 2.00000 | 4.00000 | 0.00000 |
| Simple Harmonic |  | 1.00000 | 1.57076 | 4.93409 | 2.46735 |
| No-Dwell Simple Harmonic |  | 1.00000 | 1.57076 | 4.93409 | 2.46735 |
| Double Harmonic |  | 1.00000 | 2.04047 | 5.55125 | 0.10285 |
| Reverse Double Harmonic |  | 1.00000 | 2.04048 | 9.86605 | 4.93455 |
| No-Dwell Modified Constant Velocity |  | 1.00000 | 1.22203 | 7.67383 | 3.83881 |
| Modified Constant Velocity |  | 1.00000 | 1.27526 | 8.00947 | 0.98712 |
| No-Dwell Modified Trapezoid |  | 1.00000 | 1.71788 | 4.19885 | 2.09942 |
| One-Dwell Modified Trapezoid |  | 1.00000 | 1.91589 | 4.43866 | 55.77788 |
| Modified Trapezoid |  | 1.00000 | 1.99975 | 4.88812 | 0.30562 |
| Asymmetrical Modified Trapezoid |  | 1.00000 | 1.99982 | 6.11015 | 0.47620 |
| One-Dwell Cycloidal |  | 1.00000 | 1.75953 | 5.52756 | 0.17345 |
| Cycloidal |  | 1.00000 | 1.99985 | 6.28273 | 0.19715 |
| Asymmetrical Cycloidal |  | 1.00000 | 1.99989 | 7.85304 | 0.30783 |
| One-Dwell Trapecloid |  | 1.00000 | 1.73636 | 4.91007 | 0.30699 |
| Reverse Trapecloid |  | 1.00000 | 2.18193 | 6.16975 | 0.38579 |
| Trapecloid |  | 1.00000 | 2.18193 | 6.17044 | 0.38579 |
| One-Dwell Modified Sine |  | 1.00000 | 1.65978 | 5.21368 | 0.32603 |
| Modified Sine |  | 1.00000 | 1.75953 | 5.52697 | 0.34562 |
| 5th Curve |  | 1.00000 | 1.87500 | 5.77350 | 60.00000 |
| 7th Curve |  | 1.00000 | 2.18750 | 7.51283 | 41.99646 |

## (3) Principle of CAM operation

(a) When CAM operation command is executed, the current position of main axis is recognized as 0.

(b) When the main axis starts operating, "the current position in 1rotation of main axis" increase to "no. of pulse per 1rotation (-1)" then become 0. The position value (0~"no. of pulse per 1rotation (-1)") is repeated.

(c) Calculate CAM data step no. corresponding to "the current position per 1rotation" with "point unit" of CAM parameter.

$$\text{Cam Data Step no.} = \frac{\text{Current Positio per 1rotation of Main Axis}}{\text{Point Unit}}$$

For example, if the position of main axis at the beginning of CAM operation is 1000, the current position is 1073 and point unit is 10, the step no. of CAM data is as follows.

$$\text{Cam Data Step no.} = \frac{\text{Current Positio per 1rotation of Main Axis}}{\text{Point Unit}}$$

$$= \frac{1073 - 1000}{10}$$
$$= 7.3$$

(d) Calculate update position of sub axis with CAM data step. If main axis is forward direction, calculate the position of sub axis with the position corresponding to "the part of positive number of CAM data step no." and the position corresponding to "the part of positive number of CAM data step no. +1".

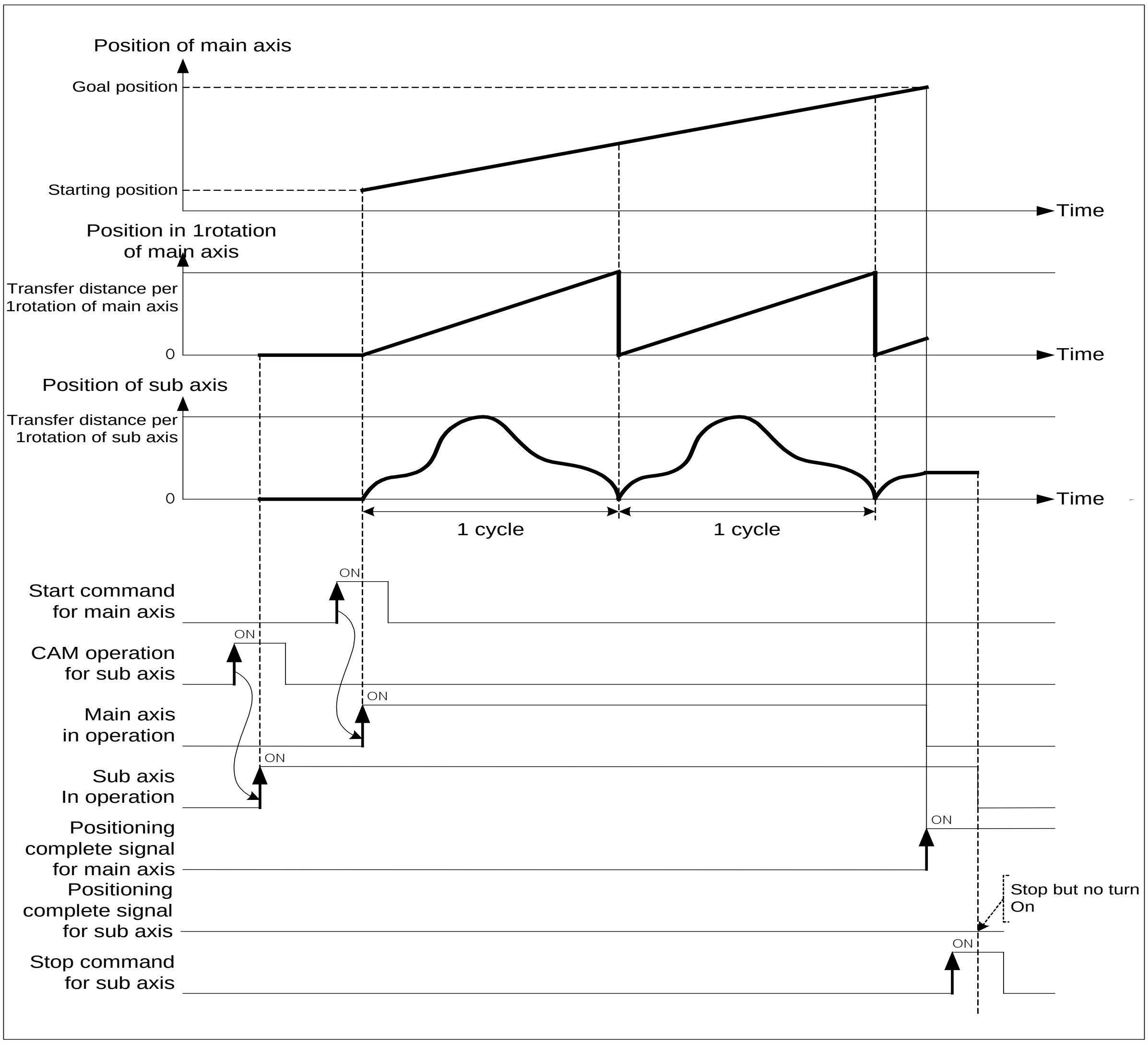
Position of sub axis
= {(Step position of CAM data +1) – (Step position of CAM data)} x Decimal part of CAM data step no.
+ (Step position of CAM data)

For example, if position value of sub axis of step 7 is 395 and step 8's is 475, the position of sub axis is as follows.

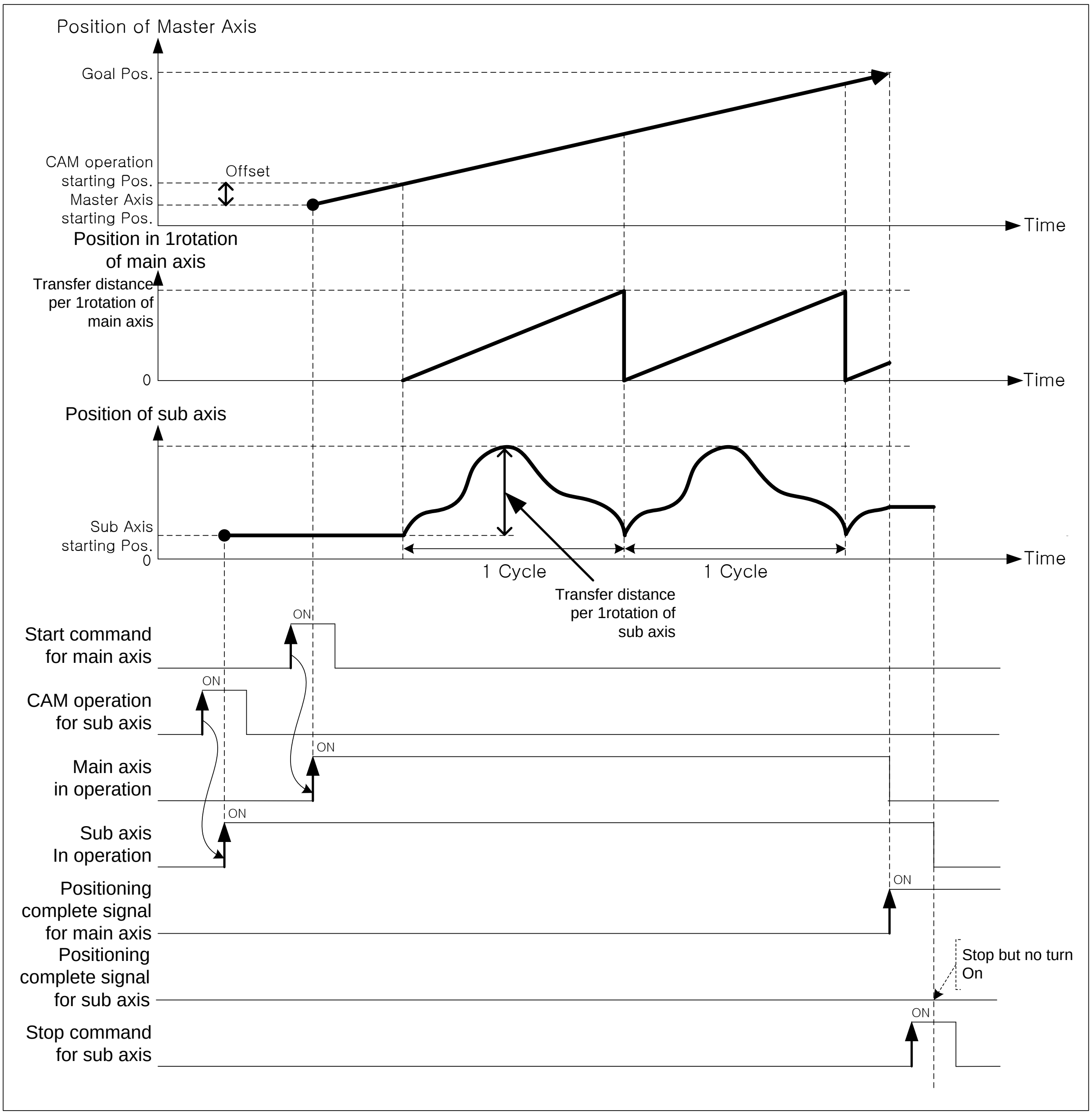
$$\begin{aligned}\text{Position of sub axis} &= 395 + (475 - 395) \times 0.3 \\ &= 395 + 24 \\ &= 419\end{aligned}$$

## (4) Operation timing

### (a) General CAM command



(a) Master axis offset designated CAM command



## (5) Restrictions

CAM operation command may not be executed in the cases below.

(a) If execute CAM operation command in being On of M code, error (code:702) arises. Make M code “OFF” with “M code release (XMOF)” command before use.

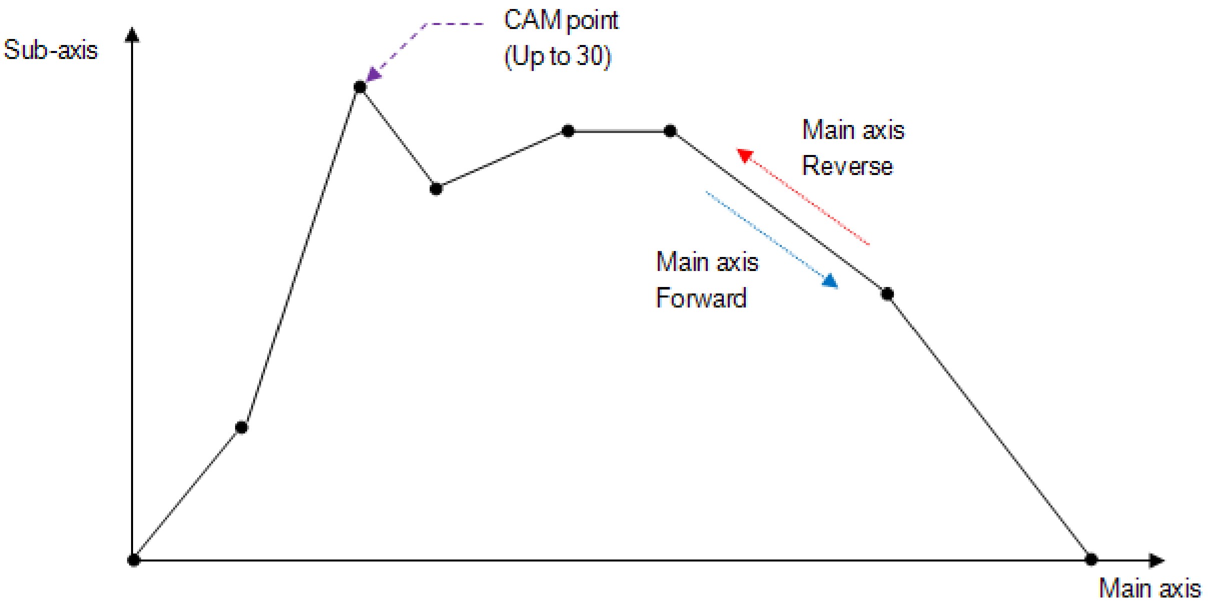
(b) If the current main axis is not the axis can be set on the current module or main axis and command axis are the same axis, error (code:704) arises. Set the main axis among one of the axis can be set on module.

(c) If speed of main axis is too fast and speed of sub axis exceeds speed limit, error (code:708) arises. In this case, you have to lower the operation speed.

## 9.4.4 User CAM Operation

User CAM operation, like CAM operation, executes CAM axis control in which CAM data shown as CAM curve synchronize with position of the motor set as main-axis. The difference with CAM operation is that user sets up CAM data not in XG-PM but in PLC program (XG5000), and the number of CAM data is 30.

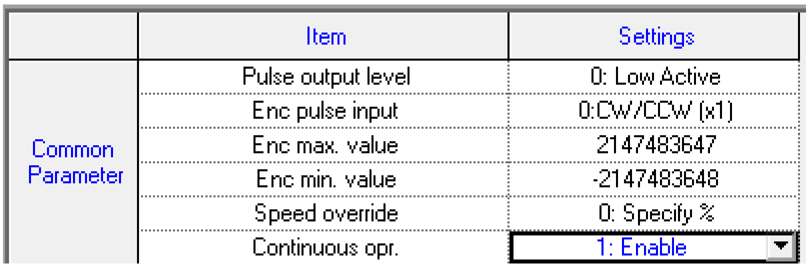
1) Operation



Like figure above, you can set up maximum 30 CAM data points, and it operates CAM curve between CAM points with straight line. CAM point data is set up at sub-axis and as type of (main-axis position, sub-axis position). CAM data point can be saved at the specified memory address of each axis by using “Write Variable Data” (XVWR, XPM_VWR) command. For memory address to save CAM data point of each axis, refer to 11.9 User CAM data memory address.

**Note**

Change of User CAM data is available when the User CAM is operating. The changed User CAM data is applied after finishing the implementing cycle. This function can be used without stop of User CAM operation.
Changing User CAM when operating is only available in continuous operation.
Take notice that control period should be increased(1ms->5ms)



| | Item | Settings |
|---|---|---|
| Common Parameter | Pulse output level | 0: Low Active |
| | Enc pulse input | 0:CW/CCW (x1) |
| | Enc max. value | 2147483647 |
| | Enc min. value | -2147483648 |
| | Speed override | 0: Specify % |
| | Continuous opr. | 1: Enable |

# 9.5 Modification Function of Control

## 9.5.1 Floating Origin Setting

This is used to force to set the current position as the origin without carrying out the homing action of the machine.

### (1) Characteristic of Control

(a) Modify the current position into “Homing end position” of homing parameter and become Origin-decided status.

(b) After floating origin setting command is executed, the current position is changed to “The position of homing completion” of homing parameter.

(c) Related parameter (Homing Parameter)

| Items | Setting value | Description |
|---|---|---|
| Position of homing completion | -2147483648 ~ 2147483647 | Set the position after homing completion or floating origin setting |

**Note**

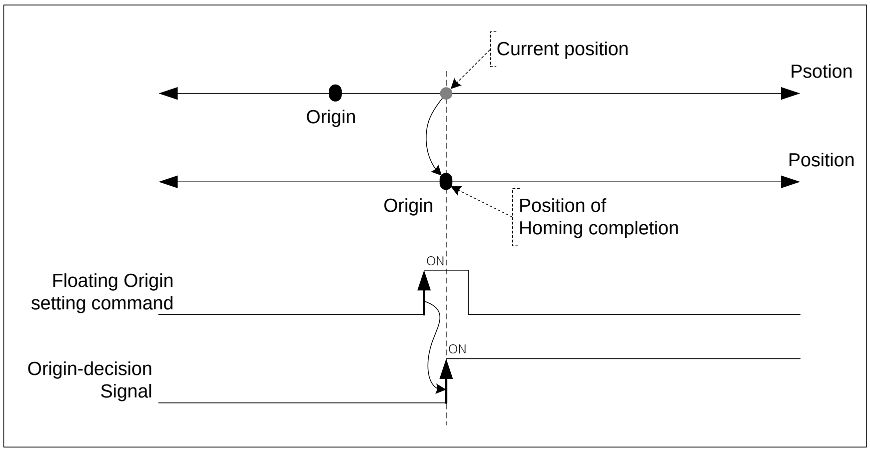
Floating origin setting just executes forced origin-decision from the current position to origin completion position. So user need to take notice as follows.

(1) When error arose, clear the cause of error and reset,

(2) set floating origin again,

(3) change the operation step no. to operate with start step no. change command and then execute.

### (2) Operation timing



### (3) Restrictions

If drive ready signal is in “OFF”, floating origin setting command is not executed but error (code:212)arises. When drive ready signal is in “ON”, execute floating origin setting command.

## 9.5.2 Continuous Operation

Execute positioning control changing the current operation step no. to the next one.

### (1) Characteristics of Control

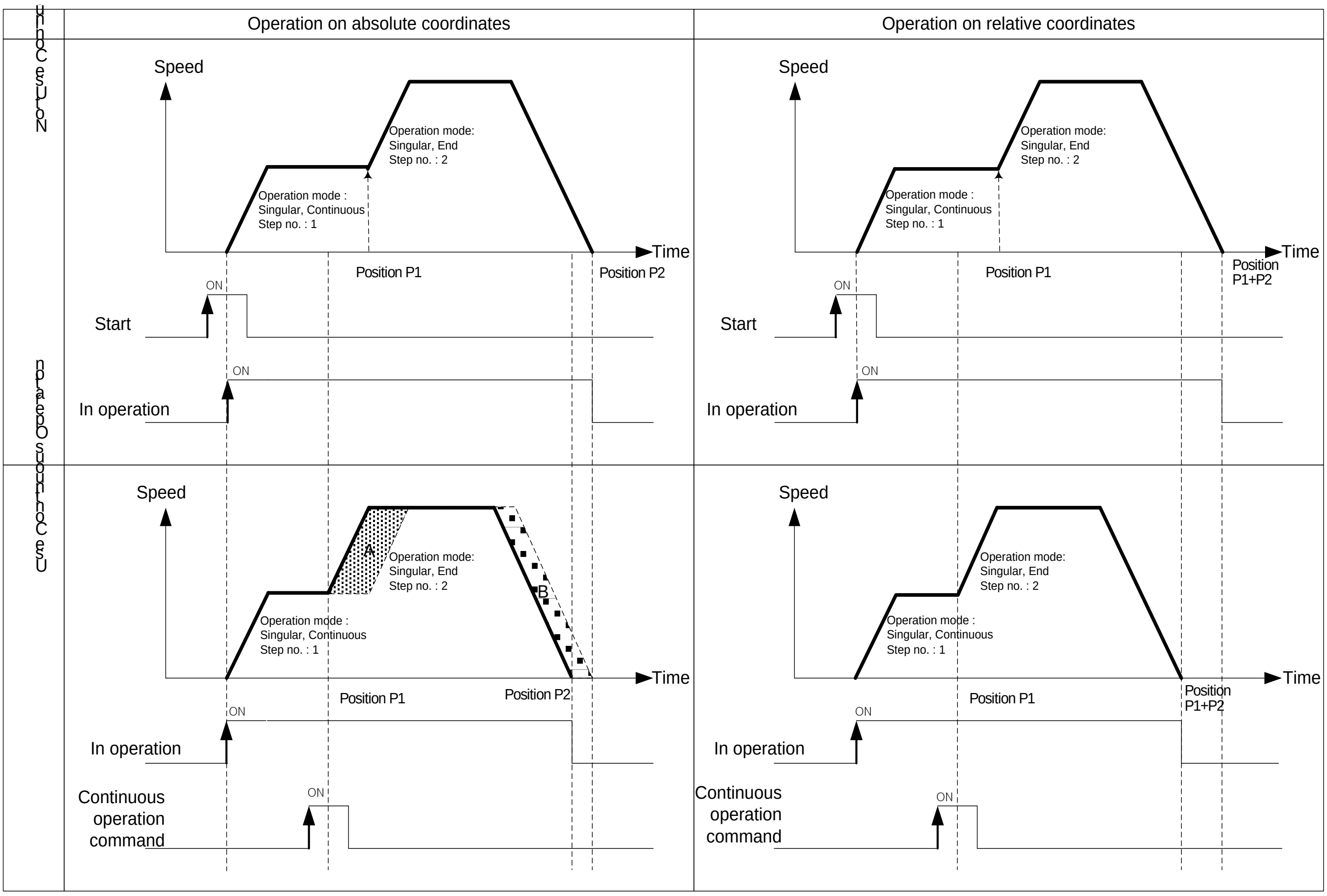
(a) When continuous operation command is executed, operating speed is changed into the speed of next operation step directly.

(b) This command may be used in End, Go on, Continuous mode and used at Acc.,Dec.,Steady speed section.

(c) If continuous operation command is executed in operation, the current operation step no. is changed to the next step no. and keep operating.

(d) There are differences of operation depending on between absolute coordinates and relative coordinates.

### (2) Operation timing



■ The goal positions of continuous operation on absolute coordinates are same, so the goal position is the same as the position before and after continuous operation. Therefore, the current position positioned by continuous operation is P2. (A area and B area both are same size)

■ When continuous operation is executed on relative coordinates, the movement amount between current position and goal position is the real goal position. Therefore, the goal position is different from the one without continuous operation. The position positioned by continuous operation is P1 + P2.

### (3) Restrictions

In the cases below, continuous operation is not executed and previous operation is being kept.

(a) Acc./Dec. pattern of extended parameter is “S-curve operation”. (error code : 390)

(b) It is in dwell. (error code : 392)

(c) The current control is not single axis position control or linear interpolation. (error code : 393)

(d) Speed data value of operation step to be executed next is 0 or exceeds the speed limit. (error code : 394)

(e) Execute continuous operation command on sub axis. (error code : 395)
User has to execute continuous operation command on main axis in linear interpolation.

(f) Execute continuous operation command on axis in circular interpolation. (error code : 396)

(g) Execute continuous operation on sub axis in sync. operation. (error code : 397)

(h) The current operation step no. is the last step(400) of operation data. (error code : 399)

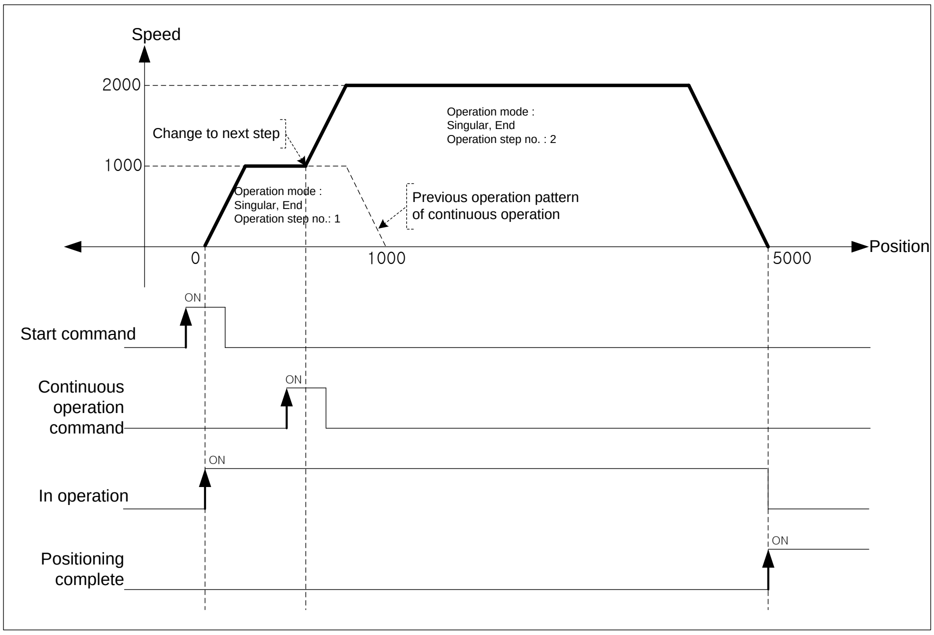
(i) The current axis in operation is executed by direct start command. (error code : 400)

**[Example] Execute continuous operation on axis1 operating by absolute, single axis position control**

- ■ Current position of Axis1 : 0
- ■ Setting example in XG-PM
  - ▪ Operation data of axis1

| Step no. | Control method | Operation | Goal position [pls] | Operation speed [pls/s] | Acc. no. | Dec. no. | M code | Dwell time |
|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, single axis position control | Singular, end | 1000 | 1000 | No.1 | No.1 | 0 | 0 |
| 2 | Absolute, single axis position control | Singular, end | 5000 | 2000 | No.1 | No.1 | 0 | 0 |

- ■ Operation pattern



### 9.5.3 Skip Operation

Decelerate and stop the current operation step and change to the operation data of next operation step no., then execute positioning control.

#### (1) Characteristics of Control

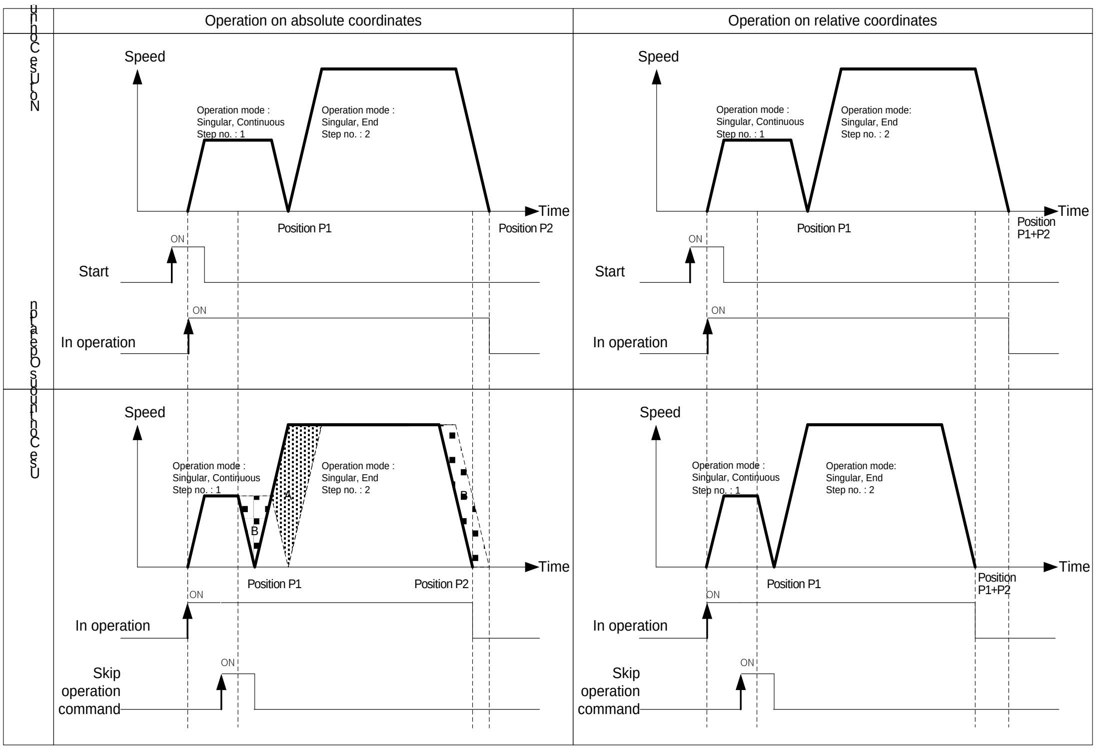
(a) SKIP operation command stops the operation and carries out the operation of next step after executing the command other than Continuous operation command (Next Move).

(b) This is used in case that the operation mode is End, Keep, Continuous and the operation pattern is in Acceleration, Constant speed, Deceleration section.

(c) If SKIP operation command is executed in the status that the operation data of next step is not yet set, Error 151 will occur.

(d) When set position data, there would be differences on skip operation command depending on absolute coordinates and relative coordinates,

#### (2) Operation timing



- ■ The goal position of next operation step after skip operation command is executed on absolute coordinates is the same as the case did not execute skip operation. Therefore, current position positioned by skip operation is P2. (A area and B area both are same size)
- ■ When skip operation is executed on relative coordinates, the movement amount between current position and goal position is the real goal position. Therefore, the goal position is different from the one without continuous operation. The position positioned by skip operation is P1 + P2.

### (3) Restrictions

In the cases below, skip operation is not executed and previous operation is being kept.

(a) Execute skip operation command on the sub axis of linear interpolation. (error code:332)
Skip operation in linear interpolation operation must be executed on main axis.

(b) Execute skip operation command on the sub axis of sync. operation. (error code:333)

(c) Execute skip operation command on the axis in Jog operation. (error code:335)

(d) The current axis is executed by direct start. (error code:336)

(e) Execute skip operation on the axis in Inching operation. (error code:337)

(f) Execute skip operation on the sub axis of circular interpolation. (error code:338)
Skip operation in circular interpolation operation must be executed on main axis.

**[Example] Execute skip operation command on axis1 operating by absolute and single axis position control.**

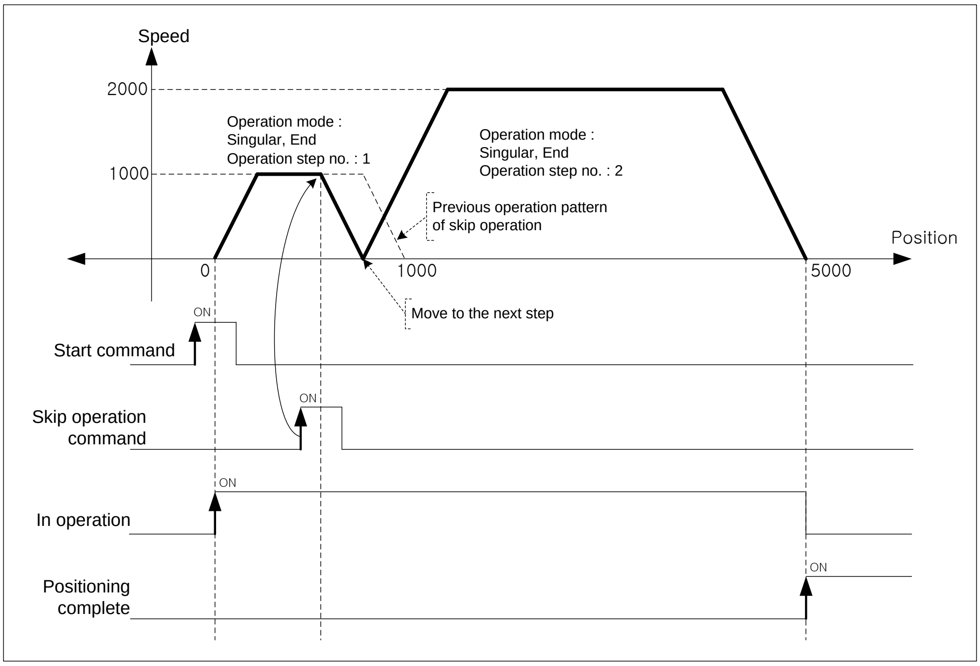
■ Current position of axis1 : 0

■ Setting example in XG-PM

▪ Operation data of axis1

| Step no. | Control method | Operation method | Goal position [pls] | Operating speed [pls/s] | Acc.no. | Dec.no. | M code | Dwell time |
|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, Single axis position control | Singular,End | 1000 | 1000 | No.1 | No.1 | 0 | 0 |
| 2 | Absolute, Single axis position control | Singular,End | 5000 | 2000 | No.1 | No.1 | 0 | 0 |

■ Operation pattern



### 9.5.4 Position Override

This is used to change the goal position during positioning operation by positioning data.

#### (1) Characteristics of Control

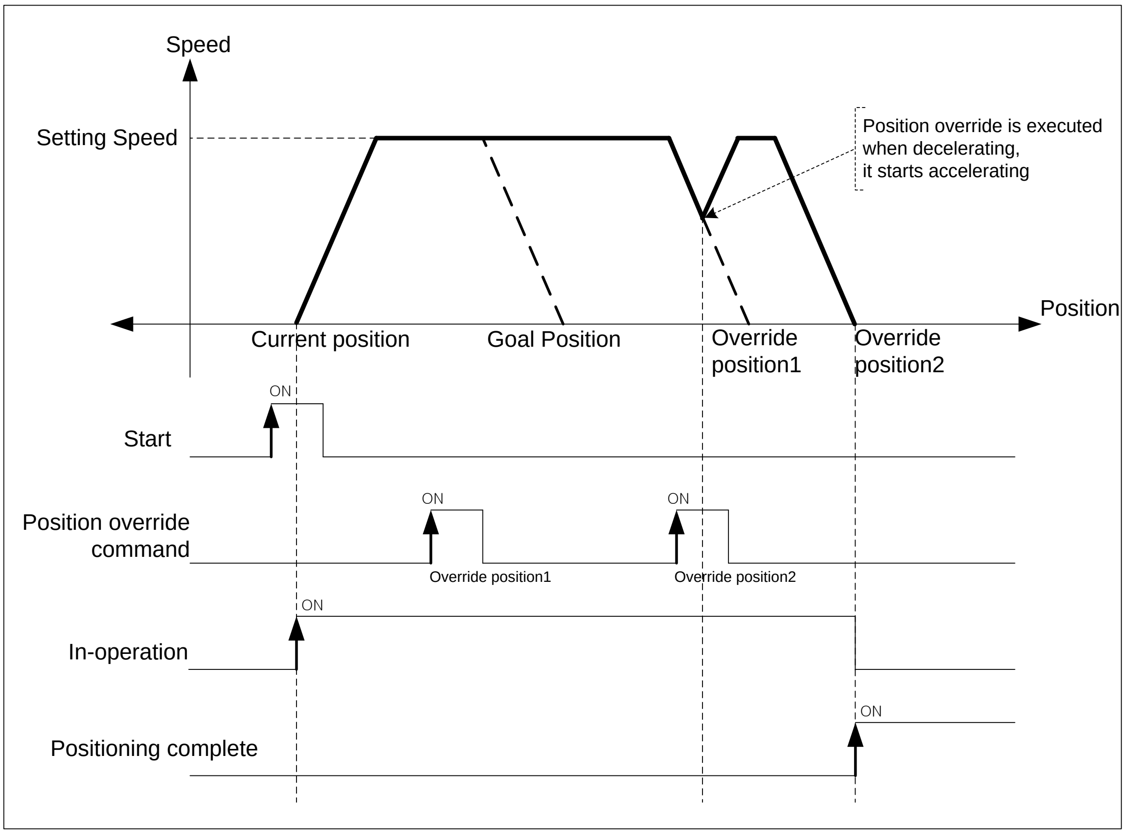
(a) Position override command is used in the operation pattern (Acceleration, Constant speed, Deceleration section) and the available operation mode is End operation, Keep operation, Continuous operation.

(b) Position setting range is –2147483648 ~ 2147483647 Pulse.

(c) As the operation is different according to Position Override command during operation, cares should be taken in using. In other words, if position of position override at the moment of commanding position override is bigger than the position it stopped at, the positioning direction would be forward. If it is smaller, the direction would be reverse.

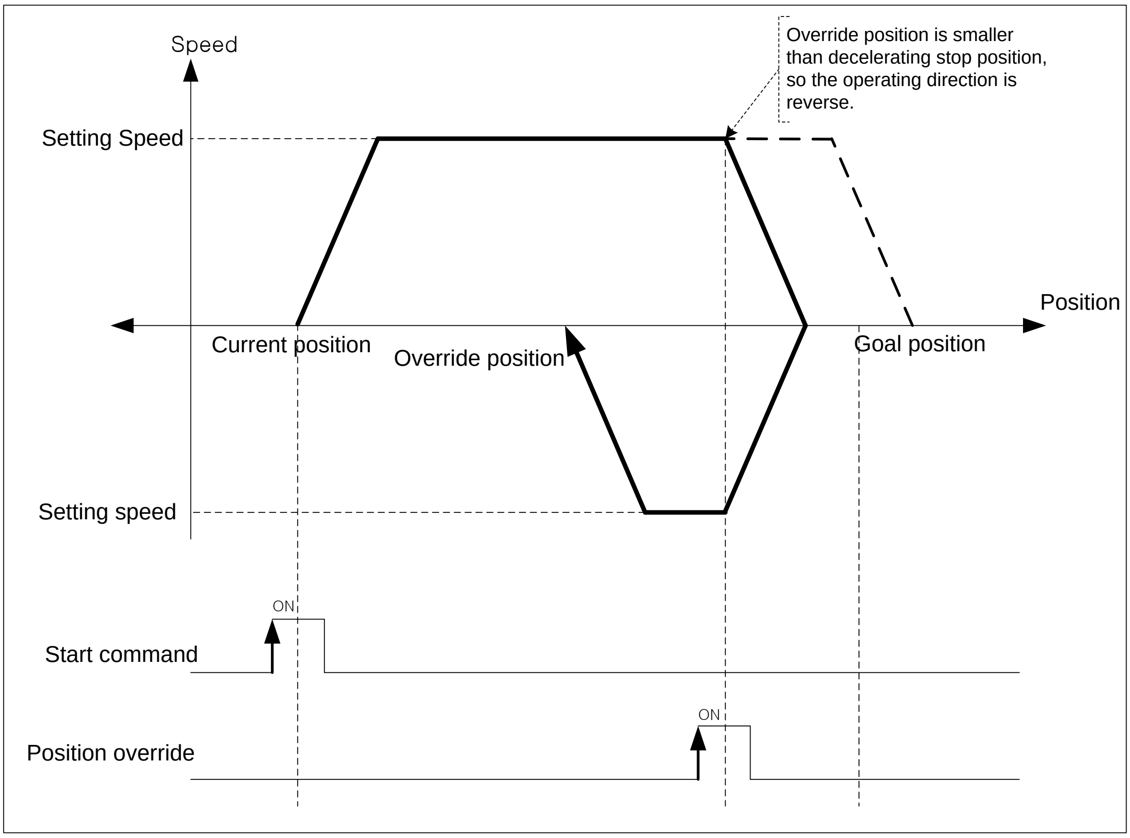
(d) This command may be executed several times in operation.

#### (2) Operation timing



If position override is executed in operation, the goal position is changed to override position1 and keep operating. If position override for override position2 is executed at dec. area, positioning is finished by acc. speed already set at override position2.

■ The case that override position is smaller than decelerating stop position.



## (3) Restrictions

In the cases below, position override is not executed and previous operation is being kept.

(a) Execute position override in dwell. (error code:362)
(b) Current operation is not positioning control(single axis positioning, Inching operation). (error code:363)
(c) Execute position override on the axis operating linear interpolation. (error code:364)
(d) Execute position override on the axis operating circular interpolation. (error code:365)
(e) Execute position override on the sub axis of sync. operation. (error code:366)

**[Example] Execute position override on axis1 operating by absolute, single axis positon control.**

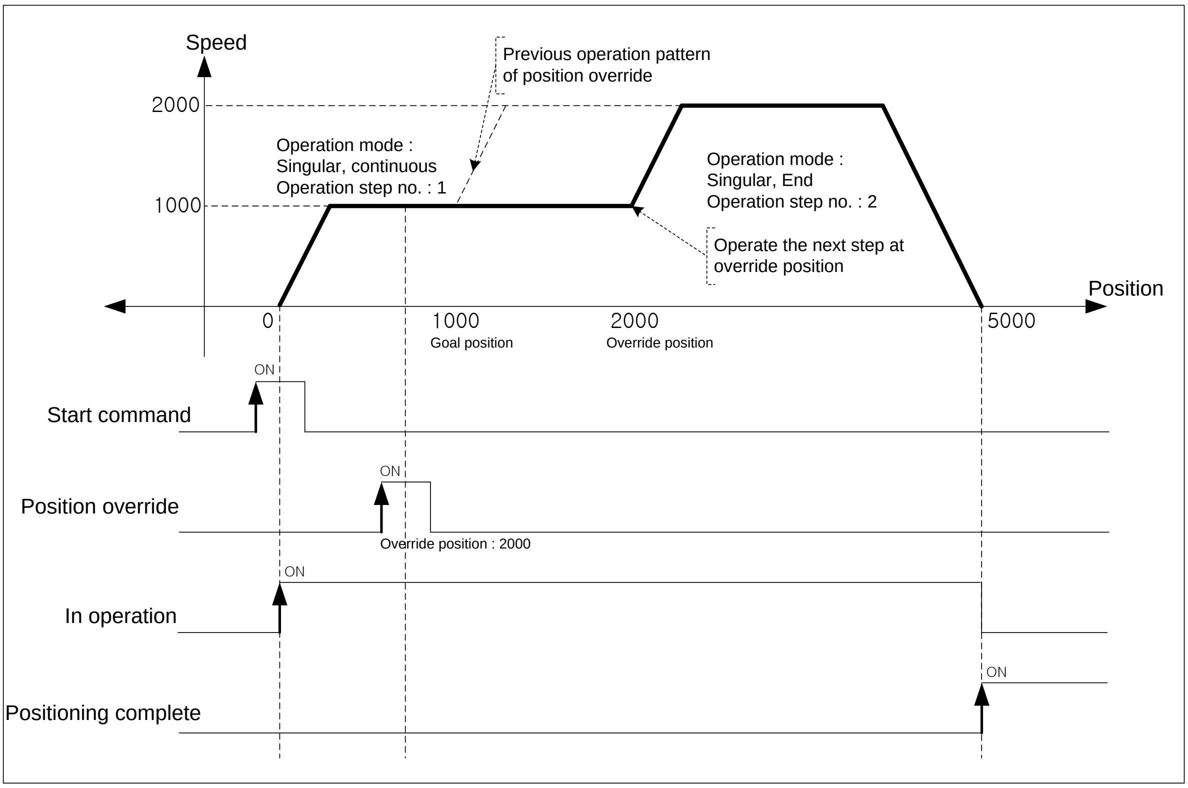
■ Current position of axis1 : 0

■ Setting example in XG-PM

▪ Operation data of axis1

| Step no. | Control method | Operation method | Goal position [pls] | Operation speed [pls/s] | Acc.no. | Dec.no. | M code | Dwell time |
|---|---|---|---|---|---|---|---|---|
| 1 | Absolute single axis position control | Singular, End | 1000 | 1000 | No.1 | No.1 | 0 | 0 |
| 2 | Absolute single axis position control | Singular, End | 5000 | 2000 | No.1 | No.1 | 0 | 0 |

■ Operation pattern



**Note**

If operation pattern is “continuous” and override position is bigger than goal position, keep operating at current speed then continue to operate the next step. If override position is smaller than goal position, execute decelerating stop and position in reverse direction, then continue to operate the next step.

### 9.5.5 Speed Override

When user wants to change the operation speed of positioning control, user may change the speed with speed override command.

#### (1) Characteristics of Control

(a) Speed override command is available in acc./steady speed area and available operation modes are "end", "go on" and "continuous".

(b) It may be executed several times in operation.

(c) User may set speed override value as "%setting" or "speed setting" on [Speed override] of common parameter.

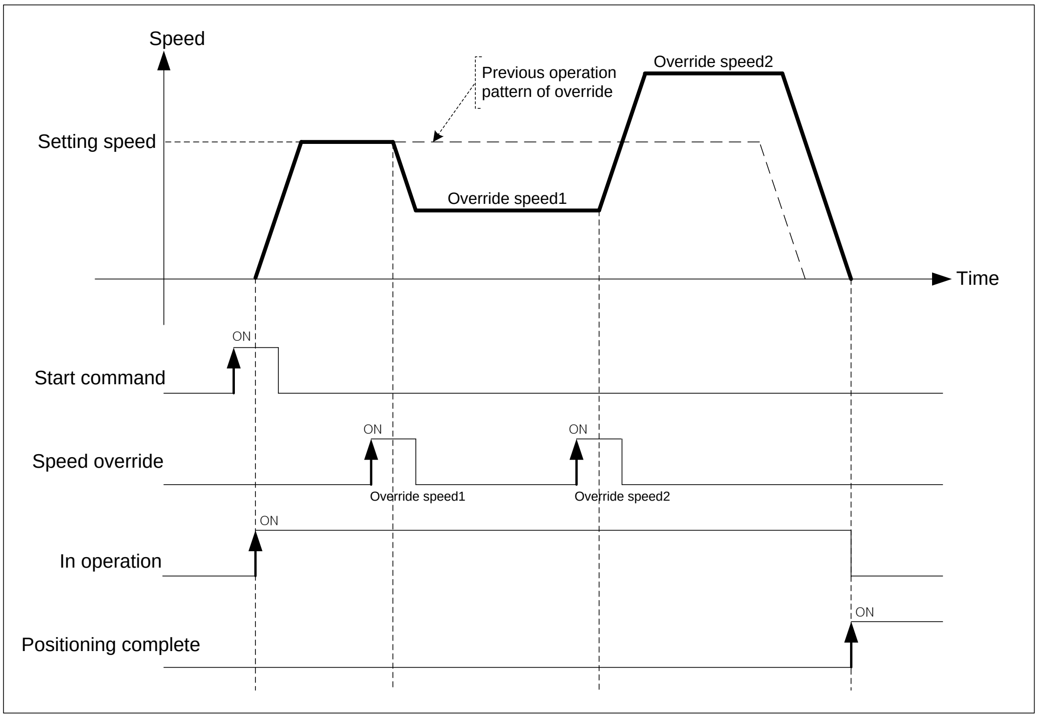
(d) Related parameter setting (common parameter)

| Items | Setting value | Description |
|---|---|---|
| Speed override | 0 : %setting | Set the speed override setting value by % |
| | 1 : speed setting | Set the speed override setting value with exact number |

(e) Auxiliary data of speed override command setting

| Items | Setting value | Description |
|---|---|---|
| Speed | 1 ~ 65535 (1=0.01%) | Set the speed override setting value with percentage<br>(If it is 100%, set 10000) |
| | 1 ~ Speed limit | Set the speed override setting value directly |

#### (2) Operation timing



현재 운전 중인 위치결정 제어의 운전 속도를 변경하고자 하는 경우에 속도 오버라이드 명령을 사용하여 운전 속도를 변경할 수 있습니다.

### (3) Restrictions

In the cases below, speed override is not executed and previous operation is being kept.

(a) Value of speed override exceeds speed limit of basic parameter. (error code:372)
Speed value of Speed override must be below speed limit.
Override speed of linear interpolation for each axis need to be below speed limit.

(b) Execute speed override on the sub axis of linear interpolation. (error code:373)
In linear interpolation, speed override must be executed on main axis.

(c) Execute speed override on the sub axis of circular interpolation. (error code:374)
In circular interpolation, speed override must be executed on main axis.'

(d) Execute speed override on sub axis of sync. operation. (error code:375)

(e) Execute speed override in dec. area. (error code:377)

(f) In the case that acc./dec. pattern of extended parameter is "S-curve operation". (error code:378)

**[Example] Execute speed override(50%→100%→200%→150%) on axis1 operating by absolute, single axis position control.**

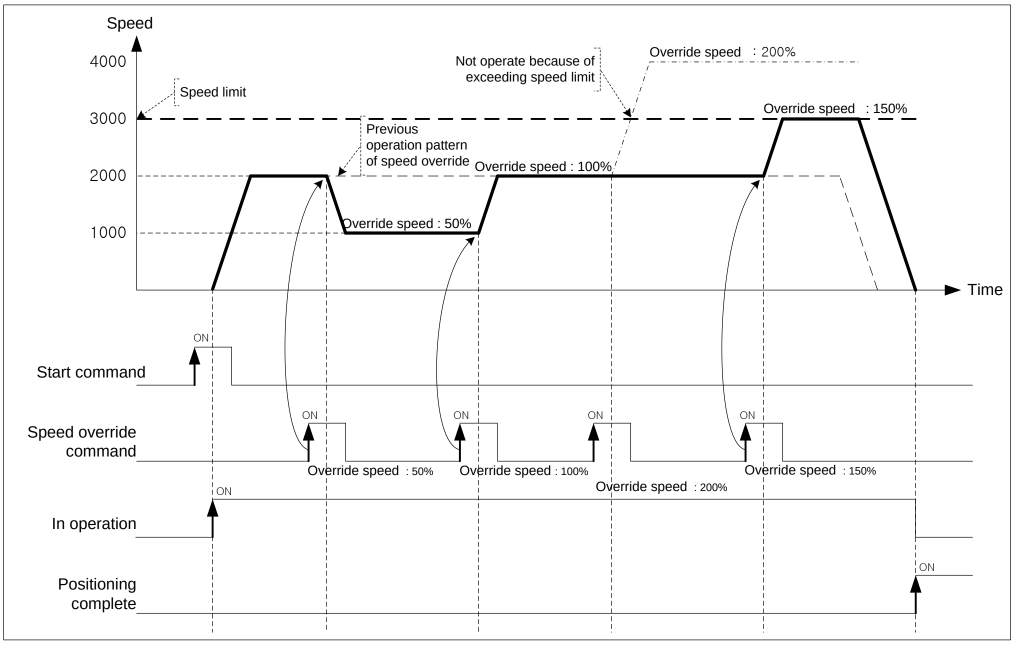
■ Current position of axis1 : 0
"Speed override" of common parameter : Set %
"Speed limit" of basic parameter : 3000 [pls/s]

■ Setting example of XG-PM

▪ Operation data of axis1

| Step no. | Control method | Operation method | Goal position [pls] | Operation speed [pls/s] | Acc.no. | Dec.no. | M code | Dwell time |
|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, single axis position control | Singular, End | 1000 | 2000 | No.1 | No.1 | 0 | 0 |

■ Operation pattern



### 9.5.6 Position designated Speed Override

This is the command to operate by the changed operation speed if it reaches the setting position during positioning operation.

#### (1) Characteristics of Control

(a) This command is used only in Acceleration and Constant speed section from operation pattern and the available operation mode is End, Keep, Continuous operation.

(b) As this command is not carried out in Deceleration section, cares should be taken in using.

(c) The position setting range is –2147483648 ~ 2147483647 Pulse.

(d) User may set speed override value as "%setting" or "speed setting" on [Speed override] of common parameter.

(e) User may select that consider the designated position value on "coordinates of positioning speed override" of extended parameter as an absolute position or a relative position.

(f) Related parameter setting

■ Common parameter

| Items | Setting value | Description |
|---|---|---|
| Speed override | 0 : Set % | Set the value of speed override by % |
| | 1 : Set speed | Set the value of speed override with exact number |

■ Extended parameter

| Items | Setting value | Description |
|---|---|---|
| Coordinates of positioning speed override | 0 : Absolute | Speed override is executed in the designated absolute position |
| | 1 : Relative | Start speed override from the position increment added |

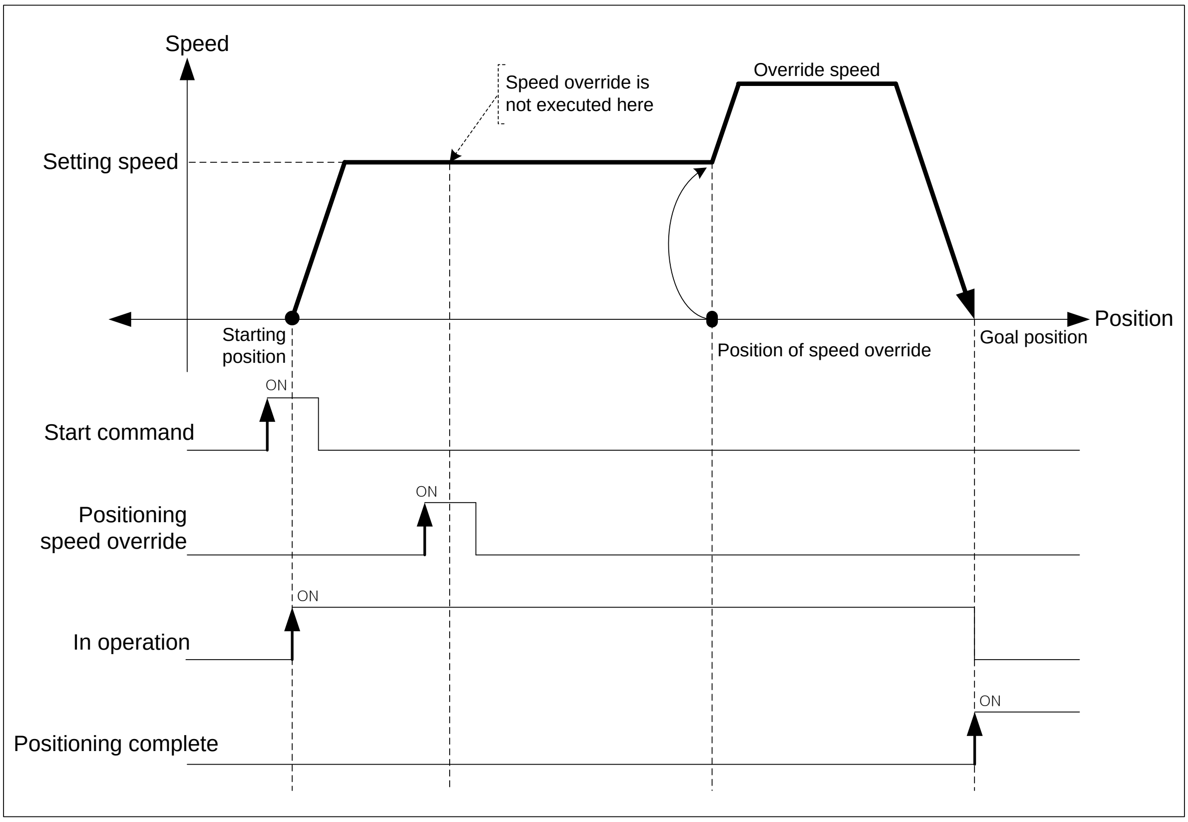
(g) Auxiliary data setting of positioning speed override command

| Items | Setting value | Description |
|---|---|---|
| Position | -2147483648 ~ 2147483647 | Set the position to start speed override |
| Speed | 1 ~ 65535 (1=0.01%) | If speed override is "%", set the speed by %<br>(100% is 10000) |
| | 1 ~ Speed limit | If speed override is "Exact number", set the speed with exact number |

**Note**

While the current position is not exactly same as the value set on speed override, if the position of speed override is at between previous scan and current scan, speed override is executed at the speed set.

### (2) Operation timing



### (3) Restrictions

In the cases below, positioning speed override is not executed and previous operation is being kept.

(a) Current operation is not positioning (single axis position control, Inching operation) control. (error code:382)

(b) The value of speed override exceeds speed limit of basic parameter. (error code:383)
The speed value of speed override must be below speed limit.
Override speed of linear interpolation for each axis need to be below speed limit.

(c) Execute positioning speed override on the sub axis of linear interpolation. (error code:384)
In linear interpolation, positioning speed override must be executed on main axis.

(d) Execute speed override on the sub axis of circular interpolation. (error code:385)
In circular interpolation, positioning speed override must be executed on main axis.’

(e) Execute speed override on sub axis of sync. operation. (error code:386)

(f) In the case that acc./dec. pattern of extended parameter is “S-curve operation”. (error code:389)

(g) If execute positioning speed override in dec. area., although error does not arise but speed override is not executed. However, execute positioning speed override command in non-dec. area and speed override is executed when it is decelerating, error arises. (error code:377)

**[Example] Execute positioning speed override at 4000 [pls/s] at 2000(position of speed override) on axis1 operating by absolute, single axis position control.**

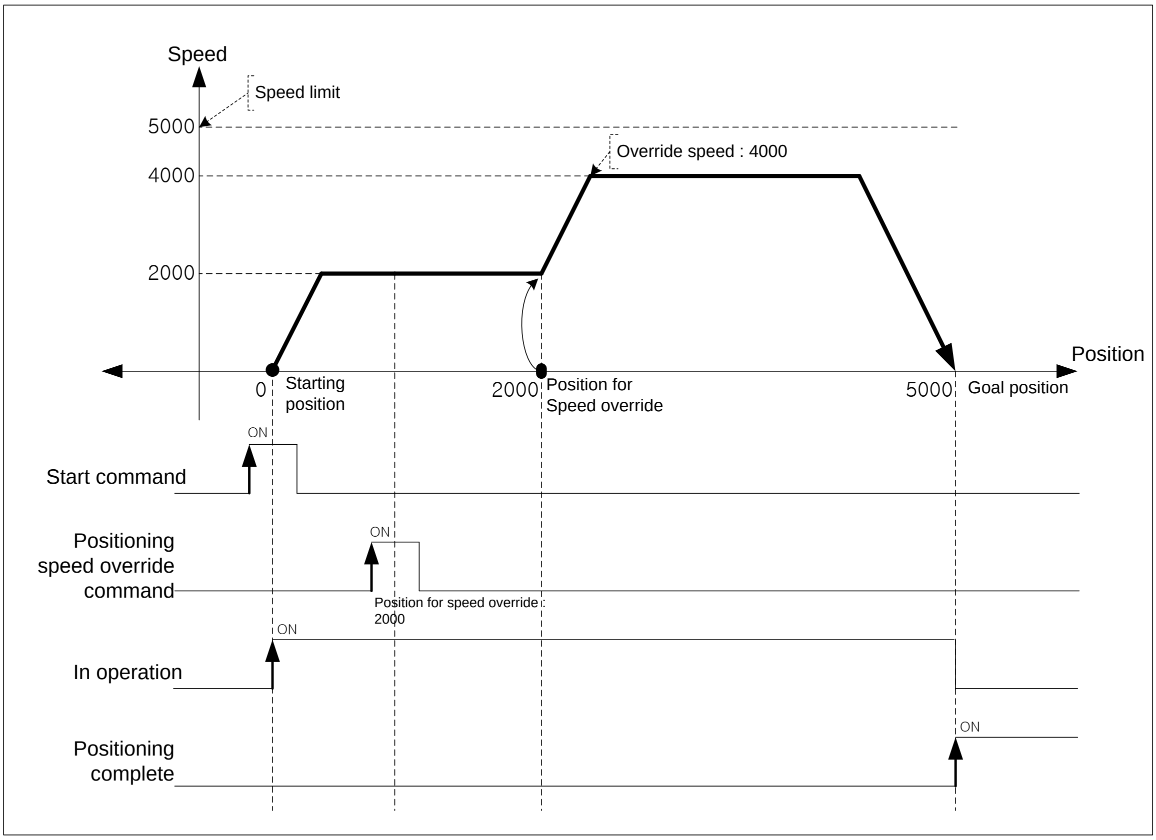
- ■ Current position of axis1 : 0

「Speed override」 of common parameter : Speed setting
「Speed limit」 of basic parameter : 5000 [pls/s]
「Coordinates of positioning speed override」 of extended parameter : Absolute

- ■ Setting example in XG-PM
  - ▪ Operation data of axis1

| Step no. | Control method | Operation method | Goal position [pls] | Operation speed [pls/s] | Acc.no. | Dec.no. | M code | Dwell time |
|---|---|---|---|---|---|---|---|---|
| 1 | Absolute single axis position control | Singular, End | 5000 | 2000 | No.1 | No.1 | 0 | 0 |

- ■ Operation pattern



## 9.5.7 Current Position Preset

This command is for changing the current position value to the value at user's pleases.

### (1) Characteristics of Control

(a) If user uses this command, the origin-undecided status becomes origin-decided status.

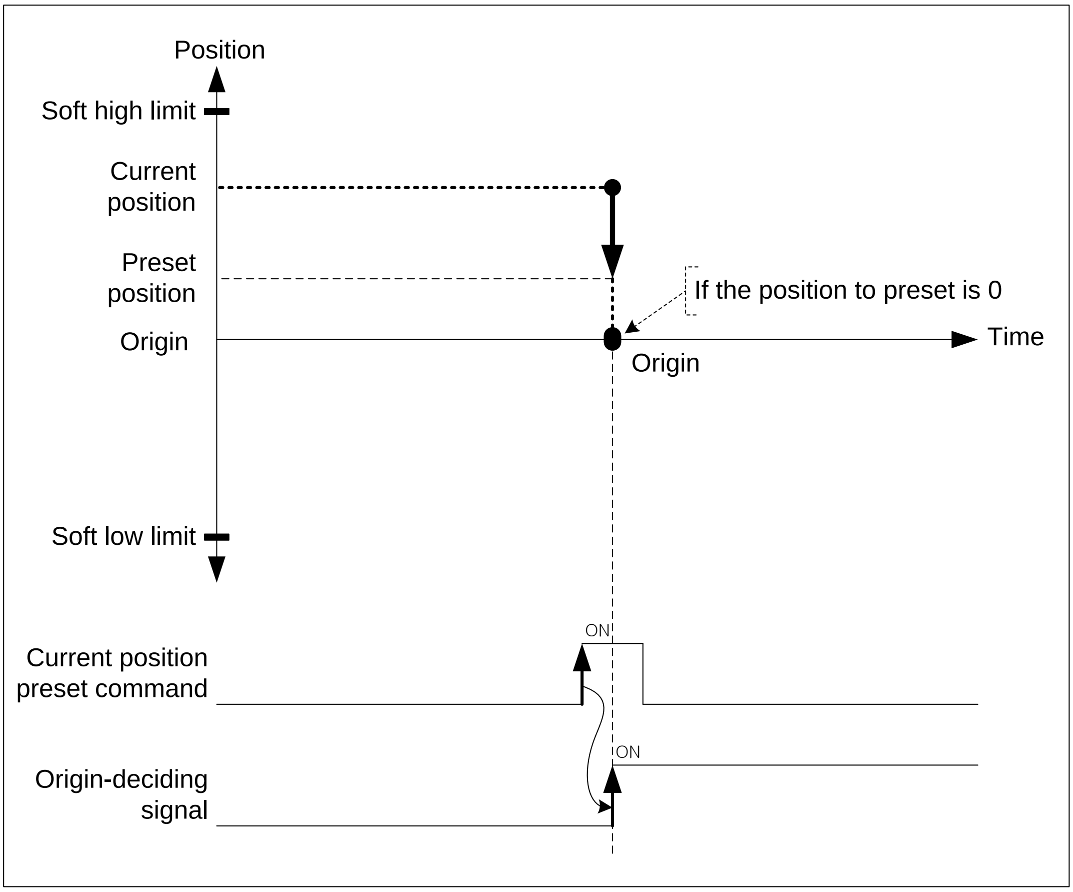
(b) When the current position is changed by position changing command, the mechanical origin position is changed. If user wants to use the mechanical origin again, has to execute homing command.

(c) The current position preset command may not be executed in operation.

(d) Auxiliary data setting of current position preset command.

| Items | Setting value | Description |
|---|---|---|
| Position | -2147483648 ~ 2147483647 | Set the position to change |

### (2) Operation timing



### (3) Restrictions

In the cases below, current position preset is not executed and error arises.

(a) Setting value of current position preset exceeds soft high/low limit of extended parameter. (error code:452)

### 9.5.8 Encoder Preset

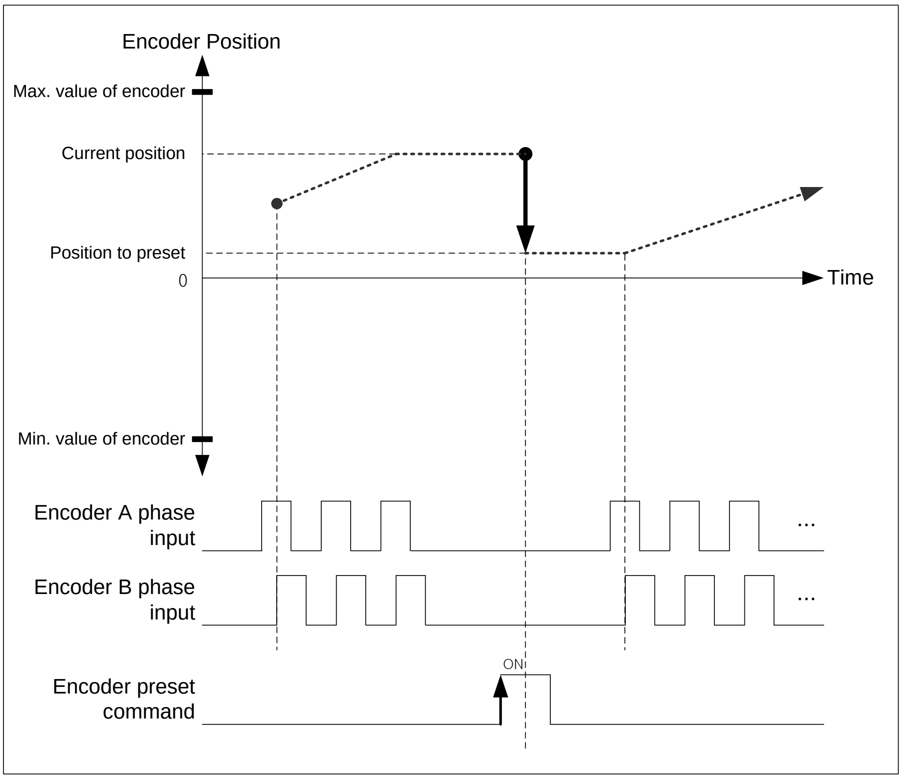
This command is for changing the value of current encoder position to the value at user's pleases.

#### (1) Characteristics of Control

(a) User may change the current position value.
(b) If there is an encoder being main axis, the speed of sub axis is possible to be changed dramatically, so encoder preset command may not be executed.
(c) Encoder preset command should be executed in the status that external encoder pulse input is not entered.
(d) Auxiliary data setting of encoder preset command

| Items | Setting value | Description |
|---|---|---|
| Position | -2147483648 ~ 2147483647 | Set the encoder position to change on selected encoder |
| Types | 0 : Encoder | Select encoder to change (Must be 0) |

#### (2) Operation timing



#### (3) Restrictions

In the cases below, encoder preset command may not be executed and error arises.
(a) There is an encoder as a main axis (error code: 532)
(b) Position value of encoder preset exceeds the max./min. value of encoder of common parameter. (error code:534)

## 9.5.9 Start Step no. Change

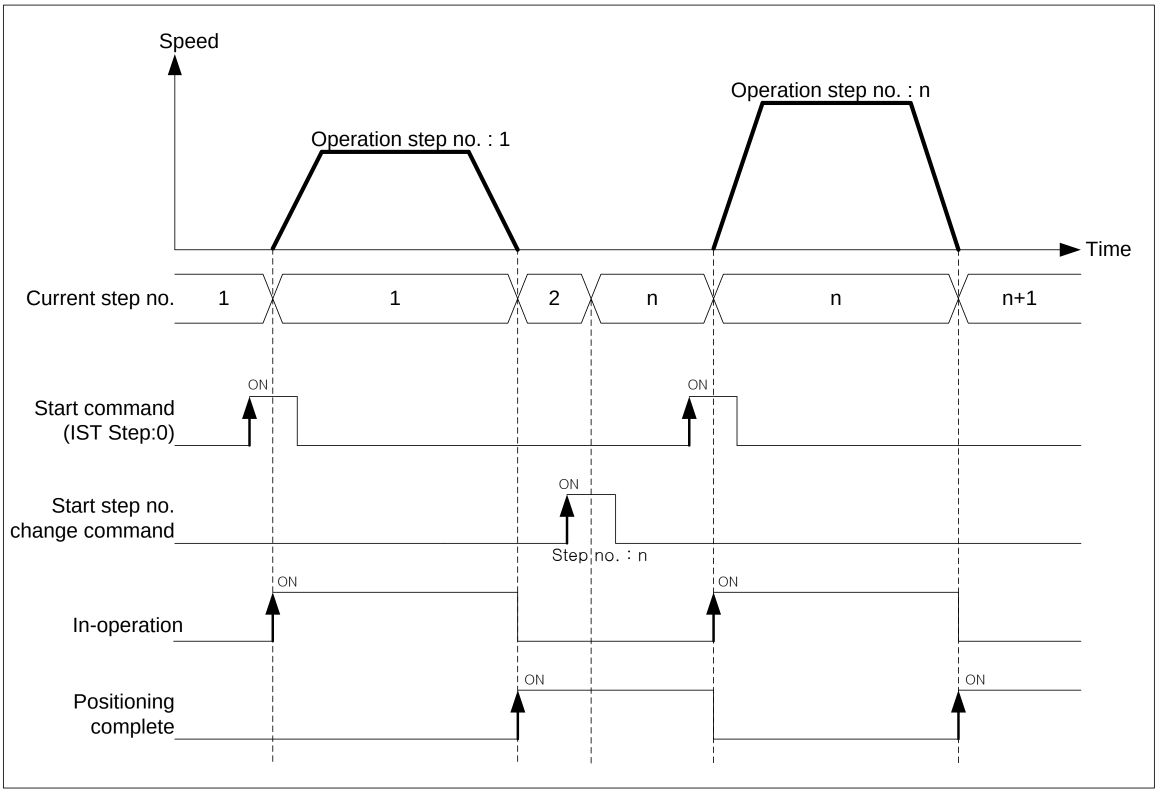
This command is for changing the current step no. when executing indirect start command.

### (1) Characteristics of Control

(a) When starting with setting step no. as 0 in indirect start command, current operation step no. is executed. The current step no. may be changed by start step no. change command.
(b) This command may be only executed in stop motion or error arises.
(c) Auxiliary data setting of start step no. change command.

| Items | Setting value | Description |
|---|---|---|
| Step | 1 ~ 400 | Set the step no. to change |

### (2) Operation timing



### (3) Restrictions

In the case below, start step no. change command is not executed.
(a) Step no. to change is out of 0 ~ 400. (error code:442)
If step no. is 0, keep the current step no.

### **9.5.10** Repeat Operation Step no. Change

This command is for changing the repeat operation step no will be executed next.

#### (1) Characteristics of Control

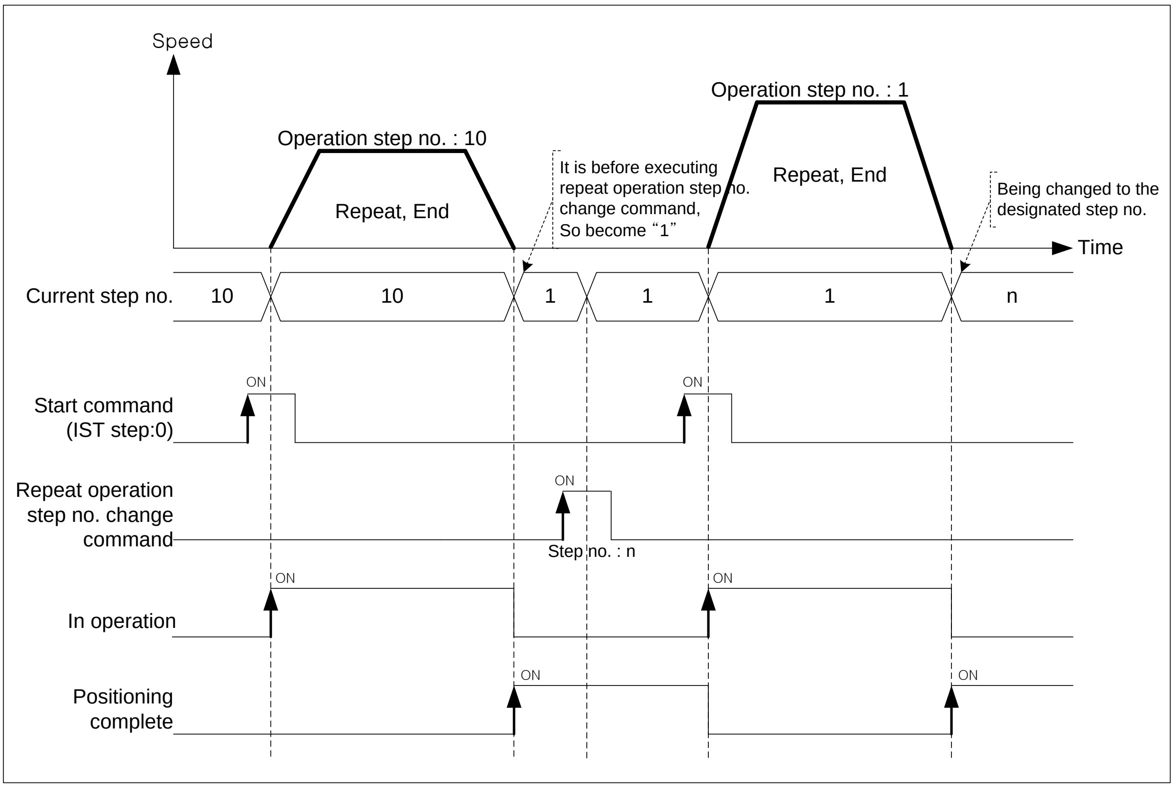
(a) In case of repeat operation mode setting (End, Keep, Continuous operation), the current operation step no. will be changed automatically to operate the step no.1 when repeat operation mode setting step completes the positioning operation but if start step no. change command is executed in repeat operation, the step no. will be changed with the assigned step no. not the step no.1 .

(b) The repeat operation step no. change command can be executed during positioning operation.

(c) Auxiliary data setting of repeat operation step no. change command

| Items | Setting value | Description |
|---|---|---|
| Step | 1 ~ 400 | Set the repeat operation step no. to change |

#### (2) Operation timing



**Note**

The current operation step is not changed at the moment of executing the command. After “Repeat” positioning data operation is finished, it is changed to the step designated by repeat operation step no. change command.

### (3) Restrictions

In the case below, repeat operation step no. change command is not executed.

(a) Step no. to change is out of 0 ~ 400. (error code:442)

If the step no. is 0, keep the previous step no.

[Example] Execute repeat operation step no. change command on axis1 operating by absolute, single axis position control.

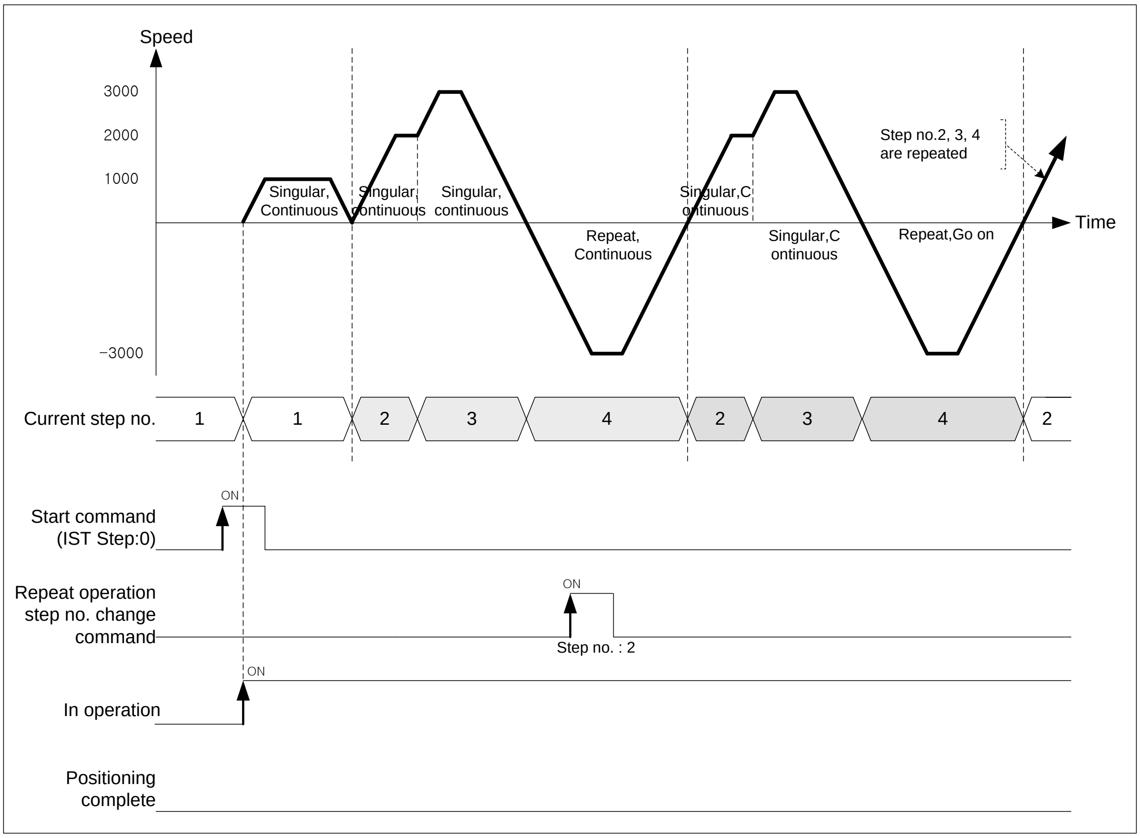
■ Current position of axis1 : 0

■ Setting example in XG-PM

▪ Operation data of axis1

| Step no. | Control method | Operation method | Goal position [pls] | Operation speed [pls/s] | Acc. no. | Dec. no. | M code | Dwell time |
|---|---|---|---|---|---|---|---|---|
| 1 | Absolute single axis position control | Singular, Go on | 1000 | 1000 | No.1 | No.1 | 0 | 0 |
| 2 | Absolute single axis position control | Singular, continuous | 2000 | 2000 | No.1 | No.1 | 0 | 0 |
| 3 | Absolute single axis position control | Singular, continuous | 4000 | 3000 | No.1 | No.1 | 0 | 0 |
| 4 | Absolute single axis position control | **Repeat**, Continuous | 2000 | 3000 | No.1 | No.1 | 0 | 0 |
| 5 | Absolute single axis position control | Singular, End. | 5000 | 2000 | No.1 | No.1 | 0 | 0 |

■ Operation pattern



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# 9.6 Auxiliary Function of Control

## 9.6.1 High/Low limit

Positioning module includes Hardware high/low limit and Software high/low limit.

### (1) Hardware High/Low Limit

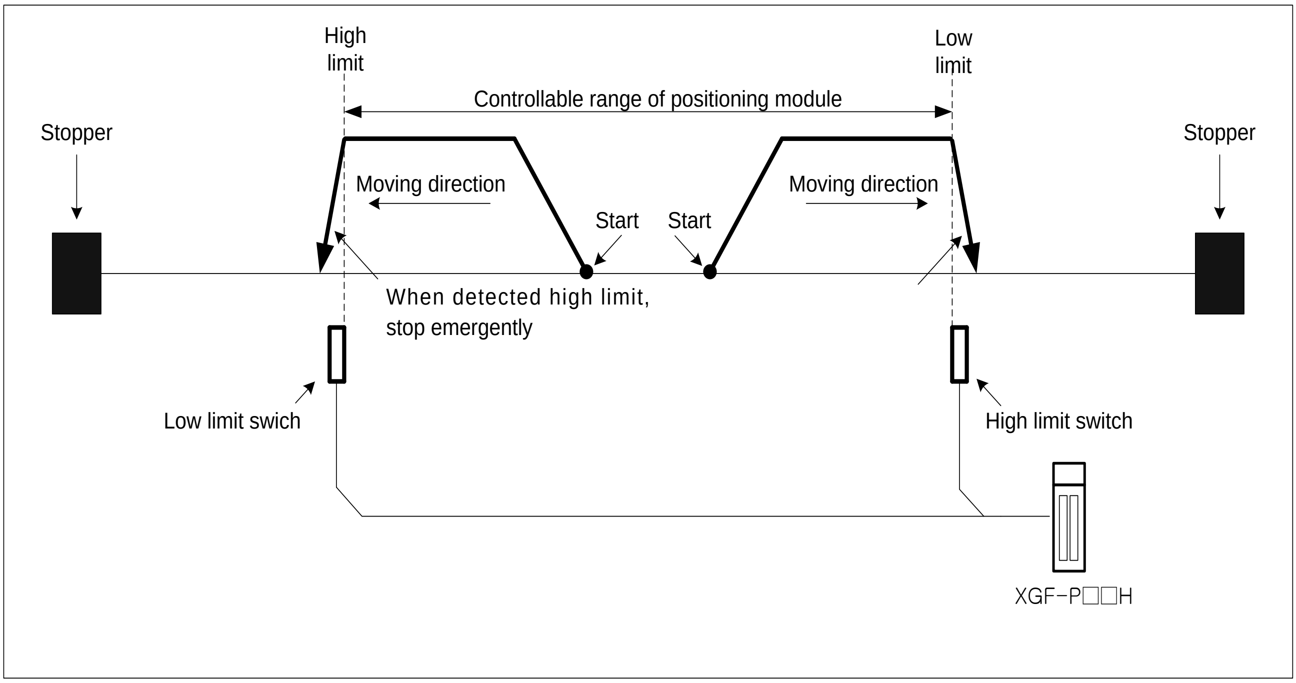
(a) This is used to stop the positioning module promptly before reaching Stroke limit/Stroke End of the Driver by installing the stroke limit of positioning module inside Stroke limit/Stroke end of the Driver. In this case, if it is out of the high limit, Error 492 will occur and if it is out of the low limit, Error 493 will occur.

(b) Input of high/low limit switch is connected to input/out terminal block.

(c) When positioning module is not in the controllable area, positioning operation is not executed.

(d) If it is stopped by hardware high/low limit detection, move it into the controllable area with Jog operation in reverse direction of detected signal.

(e) Hardware high/low limit is shown as follows.



(f) Emergent stop when hardware high/low limit is detected

When hardware high/low limit is detected, stop the current positioning control and then decelerate within “Dec. time for Emergent stop”.

■ Related parameter setting (Basic parameter)

| Items | Setting value | Description |
|---|---|---|
| Dec. time of Emergent stop | 0 ~ 2147483647 [ms] | Set the dec. time for emergent stop. Dec. time for emergent stop means the time needed at decelerating by bias speed. |

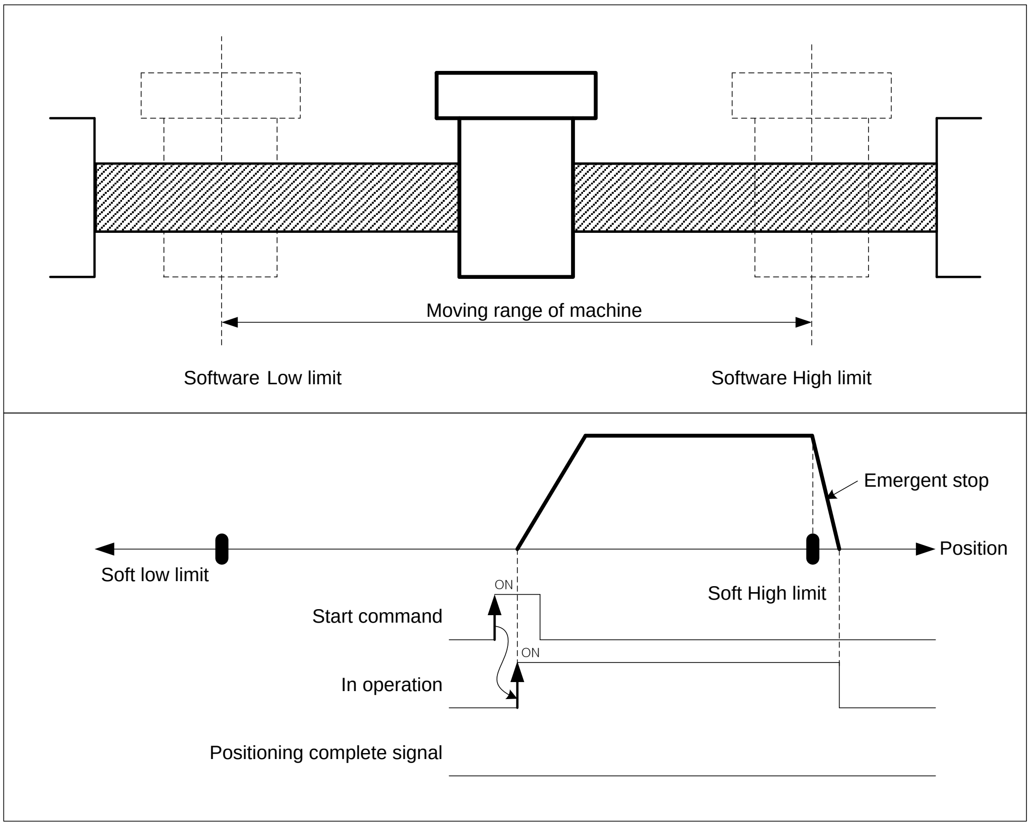
## (2) Software High/Low Limit

(a) This command is for setting the movable range of machine as software high/low limit. If it is out of the range in operation, stop emergently within dec. time for emergency. In other words, this command is for preventing errors, malfunctions and being out of range.
(b) If it is out of the range of software high/low limit, set external input high/low limit for use.
(c) Checking range of software high/low limit is executed at the beginning.
(d) If software high/low limit is detected, error arises. (High limit error:501, Low limit error:502)
(e) User may set the position value of high/low limit on extended parameter.

■ Related parameter setting (Extended parameter)

| Items | Setting value | Description |
|---|---|---|
| Soft High Limit | -2147483648 ~ 2147483647 | Set the position of soft high limit |
| Soft Low Limit | -2147483648 ~ 2147483647 | Set the position of soft low limit |

(f) Software high/low limit is shown as follows.



(g) In the case below, software high/low limit are not detected.
- The value of soft high limit 2147483647, the value of soft low limit is -2147483648
- The value of soft high and low limit are same. (High limit = Low limit)

**Note**

(1) It does not detect software high/low limit in origin-undecided state

(2) Not to detect software high/low limit

If the value of current position becomes 2147483647 in forward operation, the current position becomes -2147483646 and keeps operating in forward direction.

If the value of current position becomes -2147483647 in reverse operation, the current position becomes 2147483646 and keeps operating in reverse direction.

## 9.6.2 M code

This is used to confirm the current operation step no. and carry out the auxiliary work (Clamp, Drill rotation, Tool change etc.) by reading M Code from the program.

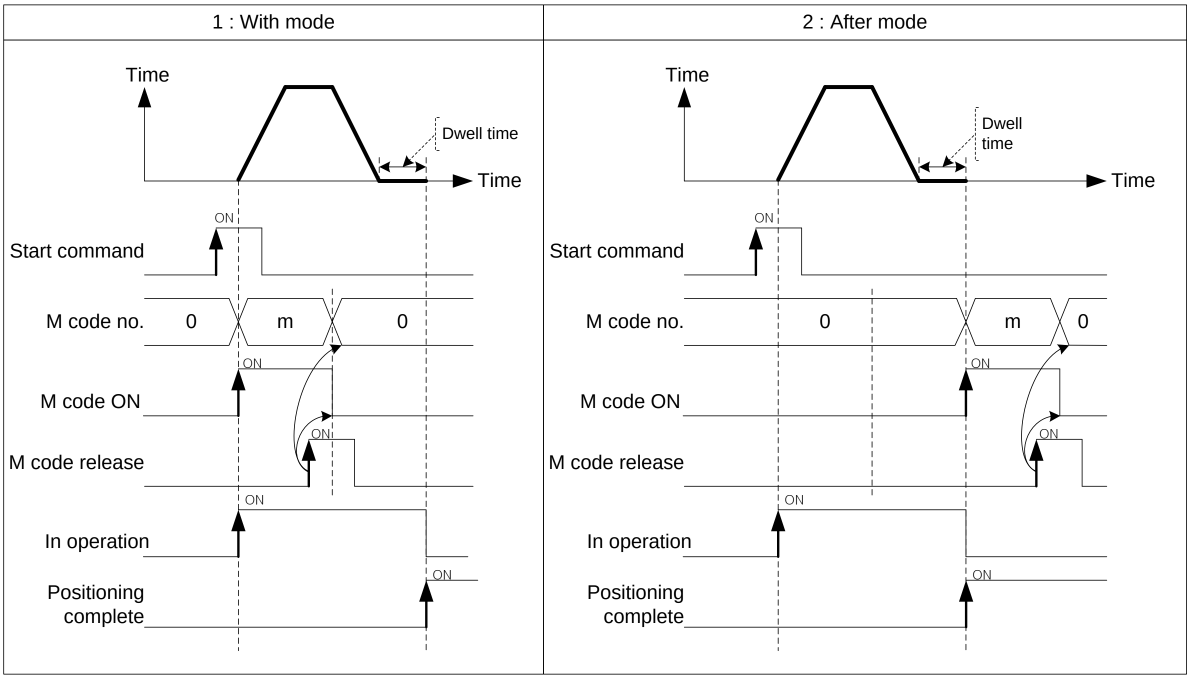
### (1) Characteristics of Control

(a) M code should be set in the M code item of operation data.(Setting range : 0~ 65535)
(b) If M code is set as “0”, M code signal will not occur.
(c) If M code occurs, M code no.(1 ~ 65535) and M code signal (On) will occur simultaneously.
(d) In case of Keep operation mode, if M code no. and M code signal occur, it becomes standby for the next step; if executing M code release (MOF) command, it carries out Keep operation to the next step without start command.
(e) In continuous operation mode, even if M code no. and M code On signal occur, not to wait but execute continuous operation to the next step.
(f) User may turn M code signal off and set M code no. to 0 with M code release command. M code release command can be used even during operation.
(g) M code mode is set from M code output item of extended parameter. ( 0 : NONE, 1 : WITH, 2 : AFTER)

■ Related parameter setting (Extended parameter)

| Items | Setting value | Description |
|---|---|---|
| M code mode | 0 : None | Not to output M code signal and M code no. |
| | 1 : With | Start and turn M code signal on at the same time, then output M code no. set in operation data. |
| | 2 : After | After finishing positioning by start command, turn M code signal on and then output M code no. set in operation data. |

### (2) Operation timing



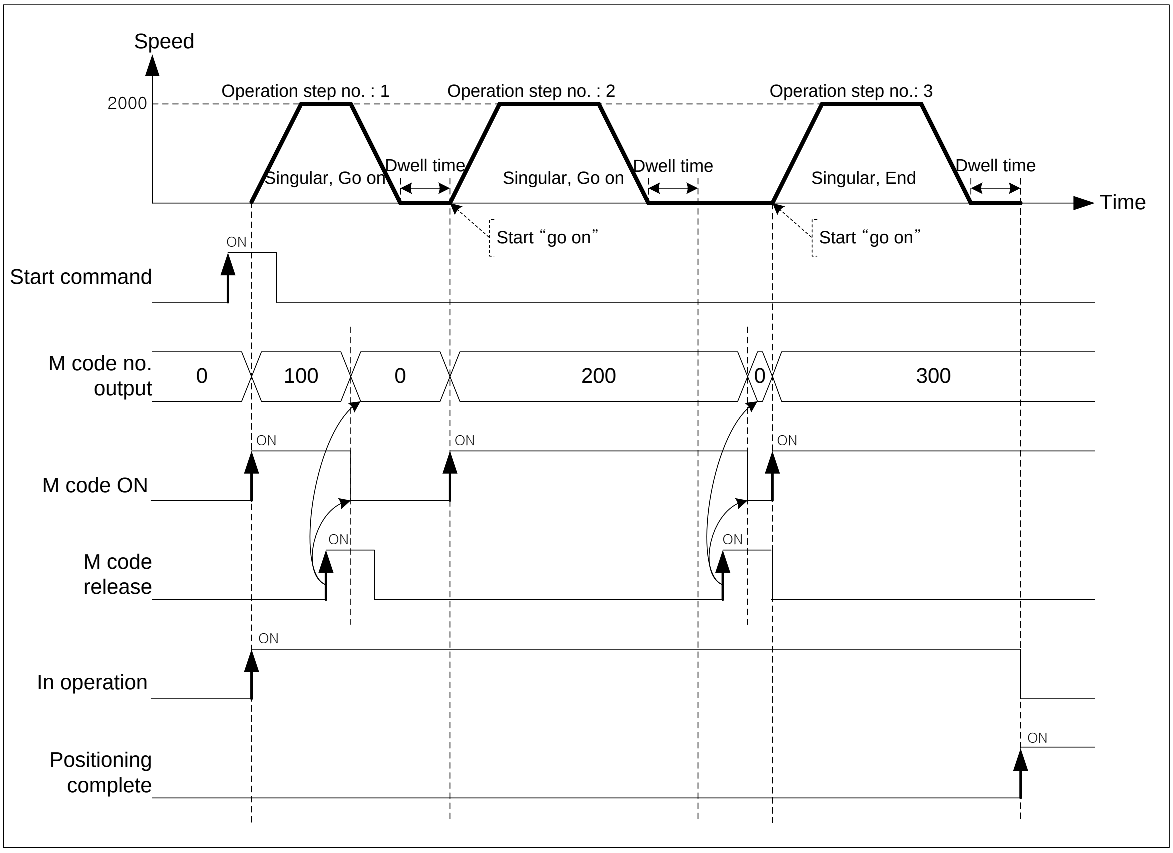
**[Example] Set M code no. in operation data as follows and execute absolute, single axis positioning control.**

- Current position of axis1 : 0
  M code mode of basic parameter : With

- Setting example in XG-PM
  - Operation data of axis1

| Step no. | Control method | Operation method | Goal position [pls] | Operation speed [pls/s] | Acc. no. | Dec. no. | M code | Dwell time |
|---|---|---|---|---|---|---|---|---|
| 1 | Absolute, single axis positioning control | Singular, continuous | 1000 | 2000 | No.1 | No.1 | 100 | 100 |
| 2 | Absolute, single axis positioning control | Singular, continuous | 3000 | 2000 | No.1 | No.1 | 200 | 100 |
| 3 | Absolute, single axis positioning control | Singular, continuous | 5000 | 2000 | No.1 | No.1 | 300 | 100 |

- Operation pattern



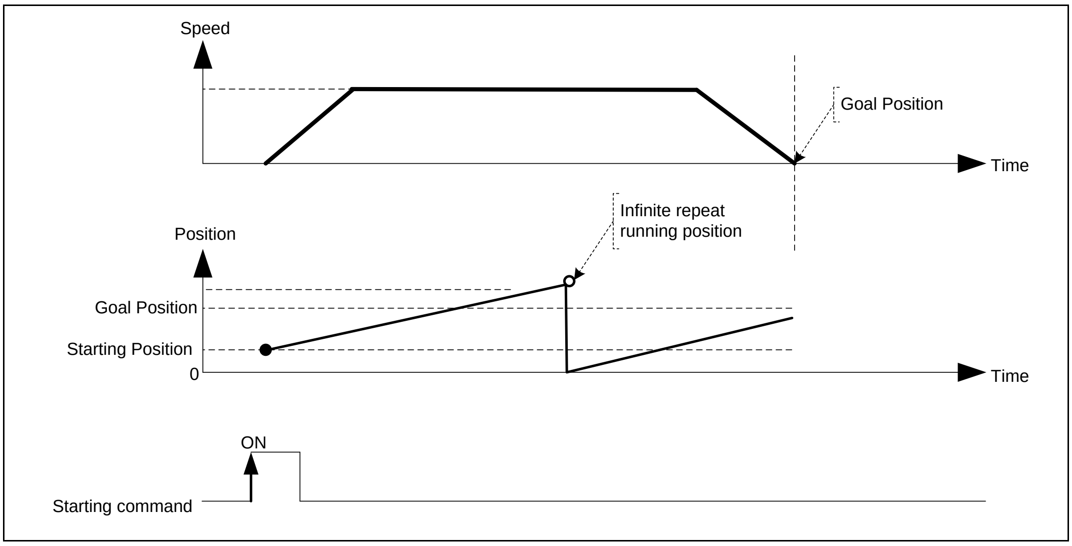
## 9.6.3 Infinite running repeat function

This is used to repeat operation between "0" and "infinite running repeat position-1". t is activated when the infinite running repeat parameter is "enabled".

### (1) Characteristics of Control

(a) infinite running repeat position can be designated between 1~2,147,483,647.

■ Operation pattern



## 9.7 Data Modification Function

This function is for changing operation data and operation parameter of embedded positionig module

### 9.7.1 Teaching Array

User may change the operating speed and the goal position of the step user designated with teaching command but without XG-PM.

#### (1) Characteristics of Control

(a) This command is for changing operating speed or the goal position on several steps.
(b) User may change maximum 16 data.
(c) RAM teaching and ROM teaching are available depending on the saving position.

■ RAM teaching
When executing teaching to operation data of module and operating module in power connection, user may change speed value or position value but the speed value and position value are not saved in non-power connection.

■ ROM teaching
When executing teaching to operation data of module and operating module in power connection, user may change speed value or position value and operation data is saved permanently even in non-power connection.

(d) The value of goal position being changed is position teaching, the value of operating speed being changed is speed teaching.
(e) The axis in operation may be the subject of position teaching or speed teaching.
(f) If user changes the value of goal position or operating speed frequently, this command is very useful for it.
(g) Auxiliary data setting of teaching array command

| Items | Setting value | Description |
|---|---|---|
| Step | 0 ~ 400 | Set the step no. for teaching |
| Position | 0 : RAM teaching<br>1 : ROM teaching | Set the method of teaching |
| Data | 0 : Position<br>1 : Speed | Set the data items for teaching |
| The No. | 1 ~ 16 | Set the number of operating step |

(h) Teaching Array command is available to be executed when the axis is operating. But teaching data of operating step do not apply instantly. Operating step data will apply end of present step operation

**Note**

The teaching data must be set in the data setting area for teaching array before teaching array command is executed. Refer to the teaching array command XTWR.

### (2) Restrictions

Teaching array command may not be executed in the case as follows.

(a) The number of teaching array is out of the range (1~16). (Error code: 462)

(b) Teaching step no. is out of the range (1~400). (Error code: 465)

Total number (Teaching step no. + The number of Teaching) must be below 400.

### 9.7.2 Parameter Change from Program

User may modify the operation parameter set on XG-PM with teaching command for each parameter.

#### (1) Characteristics of Control

(a) There are 6 kinds of parameter teaching command. (Basic, Extended, Manual operation, Homing, External signal, common parameter teaching)

(b) Parameter teaching is not available in operation.

(c) RAM teaching and ROM teaching are available depending on the saving position.

■ RAM teaching

When executing teaching to operation data of module and operating module in power connection, user may change speed value or position value but the speed value and position value are not saved in non-power connection.

■ ROM teaching

When executing teaching to operation data of module and operating module in power connection, user may change speed value or position value and operation data is saved permanently even in non-power connection.

### (2) Basic Parameter Teaching

(a) Change the setting value of designated item from basic parameter of module into teaching data.

(b) Auxiliary data setting of basic parameter teaching command

| Item | Setting value | | Description | |
|---|---|---|---|---|
| Teaching data | Refer to “setting range” | | Set the teaching value of parameter selected | |
| | | | Setting range | |
| Teaching item | 1 | Speed limit | 1 ~ 2147483647 | Choose the parameter item to do execute teaching |
| | 2 | Acc.time 1 | 0 ~ 2147483647 | |
| | 3 | Acc.time 2 | | |
| | 4 | Acc.time 3 | | |
| | 5 | Acc.time 4 | | |
| | 6 | Dec.time 1 | | |
| | 7 | Dec.time 2 | | |
| | 8 | Dec.time 3 | | |
| | 9 | Dec.time 4 | | |
| | 10 | Emergent Dec.time | | |
| | 11 | Plse/rotation | 1 ~ 200000000 | |
| | 12 | Transferring distance/rotation | 1 ~ 200000000 | |
| | 13 | Unit | 0:pulse<br>1:mm<br>2:inch<br>3:degree | |
| | 14 | Double precision of unit | 0:x1<br>1:x10<br>2:x100<br>3:x1000 | |
| | 15 | Speed unit | 0: unit/time<br>1: rpm | |
| | 16 | Bias speed | 1 ~ Speed limit | |
| | 17 | Pulse output mode | 0:CW/CCW<br>1:PLS/DIR<br>2:PHASE | |
| Teaching method | 0 : RAM Teaching<br>1 : ROM Teaching | | Set the teaching method | |

For the details about basic parameter items and setting value, refer to “Chapter 5 Positioning Parameter & Operation Data.”.

### (3) Extended Parameter Teaching

(a) Change the setting value of designated item from extended parameter of module into teaching data.

(b) Auxiliary data setting of extended parameter teaching command

| Items | Setting value | | Description | |
|---|---|---|---|---|
| Teaching data | Refer to “Setting range” | | Set the teaching value of parameter selected | |
| | | | Setting value | |
| Teaching items | 1 | Soft high limit | -2147483648 ~ 2147483647 | Select the parameter item to execute teaching |
| | 2 | Soft low limit | -2147483648 ~ 2147483647 | |
| | 3 | Backlash compensation | 0 ~ 65535 | |
| | 4 | Positioning complete Output time | 0 ~ 65535 | |
| | 5 | Ratio of S-curve | 1 ~ 100 | |
| | 6 | Circular interpolating position of 2 axes linear interpolation continuous operation | 0 ~ 2147483647 | |
| | 7 | Acc./Dec. Pattern | 0 : Trapezoid operation<br>1 : S-curve operation | |
| | 8 | M code mode | 0 : None, 1 : With, 2 : After | |
| | 9 | Soft high/low limit In speed control | 0 : Not to detect<br>1 : Detect | |
| | 10 | Servo reset retention time | 1 ~ 5000[ms] | |
| | 11 | Positioning method of interpolation continuous operation | 0 : Pass the goal position<br>1 : Pass near position | |
| | 12 | Circular interpoation of 2 axes linear interpolating continuous operation | 0 : No circular interpolation<br>1 : Circular interpolating continuous operation | |
| | 13 | External emergent/dec. stop | 0 : Emergent stop<br>1 : Dec. stop | |
| | 14 | Coordinates of positioning speed override | 0 : Absolte<br>1 : Relative | |
| | 15 | Pulse output direction | 0: CW, 1: CCW | |
| | 16 | Infinite running repeat position | 1 ~ 2147483647 | |
| | 17 | Infinite running repeat enable/diable | 0: Disable,<br>1: Enable | |
| | 18 | Speed/Position switching coordinate | 0: Incremental<br>1: Absolute | |
| | 19 | Interpolation speed selection | 0: Main axis speed<br>1: Synthetic speed | |
| Teaching method | 0 : RAM teaching<br>1 : ROM teaching | | Set the teaching method | |

For the details about basic parameter items and setting value, refer to “Chapter 4 parameter and operation data”.

### (4) Homing Parameter Teaching

(a) Change the setting value of designated item from homing parameter of module into teaching data.

(b) Auxiliary data setting of homing parameter teaching command

| Items | Setting value | | Description | |
|---|---|---|---|---|
| Teaching data | Refer to “setting range” | | Set the teaching value of parameter selected | |
| | | | Setting range | |
| Teaching items | 1 | Position of origin | -2147483648 ~ 2147483647 | Select the parameter item to execute teching |
| | 2 | High speed homing | Bias speed ~ Speed limit | |
| | 3 | Low speed homing | Bias speed ~ Speed of High speed homing | |
| | 4 | Acc.time for homing | 0 ~ 2147483647 | |
| | 5 | Dec.time for homing | | |
| | 6 | Dwell time for homing | 0 ~ 65535 | |
| | 7 | Origin revision | -2147483648 ~ 2147483647 | |
| | 8 | Restart time for homing | 0 ~ 65535 | |
| | 9 | Homing mode | 0 : Near Origin/Origin (Off)<br>1 : Near Origin /Origin (On)<br>2 : High/Low limit Origin<br>3 : Near Origin<br>4 : High speed origin<br>5 : High/Low limit<br>6 : Origin | |
| | 10 | Direction for homing | 0 : Forward<br>1 : Reverse | |
| Teaching method | 0 : RAM teaching<br>1 : ROM teaching | | Set the teaching method | |

For the details about basic parameter items and setting value, refer to “Chapter 4 parameter and operation data”.

## (5) Manual Operation Parameter Teaching

(a) Change the setting value of designated item from manual operation parameter of module into teaching data.

(b) Auxiliary data setting of manual operation parameter teaching command

<table>
<tr><th>Items</th><th colspan="2">Setting value</th><th colspan="2">Description</th></tr>
<tr><td rowspan="2">Teaching data</td><td colspan="2" rowspan="2">Refer to “setting range”</td><td colspan="2">Set the teaching value of parameter selected</td></tr>
<tr><td>Setting range</td><td></td></tr>
<tr><td rowspan="5">Teaching items</td><td>1</td><td>Jog high speed</td><td>Bias speed ~ Speed limit</td><td rowspan="5">Select the parameter item to execute teching</td></tr>
<tr><td>2</td><td>Jog low speed</td><td>Bias speed ~ Jog high speed</td></tr>
<tr><td>3</td><td>Jog acc. time</td><td rowspan="2">0 ~ 2147483647</td></tr>
<tr><td>4</td><td>Jog dec. time</td></tr>
<tr><td>5</td><td>Inching speed</td><td>Bias speed ~ Speed limit</td></tr>
<tr><td>Teaching method</td><td colspan="2">0 : RAM teaching<br>1 : ROM teaching</td><td colspan="2">Set the teaching method</td></tr>
</table>

For the details about basic parameter items and setting value, refer to “Chapter 4 parameter and operation data”.

## (6) I/O Signal Parameter Teaching

(a) Change the setting value of designated item from I/O signal parameter of module into teaching data.

(b) Auxiliary data setting of I/O signal parameter teaching command

<table>
<tr><th>Items</th><th colspan="2">Setting value</th><th>Description</th></tr>
<tr><td rowspan="9">Teaching data</td><td>Bit 0</td><td>High limit signal</td><td rowspan="9">Set the setting form of input signal parameter. If bit is 0, the corresponding signal is recognized as A contact, If it is 1, the signal is recognized as B contact.</td></tr>
<tr><td>Bit 1</td><td>Low limit signal</td></tr>
<tr><td>Bit 2</td><td>DOG signal</td></tr>
<tr><td>Bit 3</td><td>HOMEsignal</td></tr>
<tr><td>Bit 4</td><td>Emergent stop/Dec. stop signal</td></tr>
<tr><td>Bit 5</td><td>Drive ready signal</td></tr>
<tr><td>Bit 6</td><td>Servo On output signal</td></tr>
<tr><td>Bit 7</td><td>Servo reset output signal</td></tr>
<tr><td>Bit 8 ~ Bit 15</td><td>-</td></tr>
<tr><td>Teaching method</td><td colspan="2">0 : RAM teaching<br>1 : ROM teaching</td><td>Set the teaching method</td></tr>
</table>

For the details about basic parameter items and setting value, refer to “Chapter 4 parameter and operation data”.

### (7) Common Parameter Teaching

(a) Change the setting value of designated item from common parameter of XPM module into teaching data.

(b) Auxiliary data setting of common parameter teaching command

| Items | Setting value | | Description | |
|---|---|---|---|---|
| Teaching data | Refer to “setting range” | | Set the teaching value of parameter selected | |
| | | | Setting range | |
| Teaching items | 1 | Speed override | 0 : % setting<br>1 : speed setting | Select the parameter item to execute teching |
| | 2 | Encoder pulse input | 0 : CW/CCW 1 multiplying<br>1 : PULSE/DIR 1 multiplying<br>2 : PHASE A/B 4 multiplying | |
| | 3 | Maximum value of encoder | -2147483648 ~ 2147483647 | |
| | 4 | Minimum value of encoder | | |
| | 5 | Pulse output level | 0 : Low Active<br>1 : High Active | |
| | 6 | Continuous operation | 0: Disable<br>1:Enable | |
| Teaching method | 0 : RAM teaching<br>1 : ROM teaching | | Set the teaching method | |

For the details about basic parameter items and setting value, refer to “Chapter 4 parameter and operation data”.

### 9.7.3 Operation Data Change from Program

User may modify the positioning operation data set on XG-PM with operation data teaching command.

#### (1) Characteristics of Control

(a) Change setting value of designated step and item from PLC's operation data into teaching data.

(b) Operation data teaching command is available to be executed when the axis is operating. But teaching data of operating step do not apply instantly. Operating step data will apply end of present step operation.

(c) RAM teaching and ROM teaching are available depending on the saving position.

■ RAM teaching

When executing teaching to operation data of embedded positioning and operating embedded positioning in power connection, user may change speed value or position value but the speed value and position value are not saved in non-power connection.

■ ROM teaching

When executing teaching to operation data of embedded positioning and operating embedded positioning in power connection, user may change speed value or position value and operation data is saved permanently even in non-power connection. .(The number of Rom teaching time is limited. /about 1,000,000 times)

(d) Auxiliary data setting of operation data teaching command

| Items | Setting value | | Description | |
|---|---|---|---|---|
| Teaching data | Refer to “Setting range” | | Set the teaching value of parameter selected | |
| | | | Setting range | |
| Teaching items | 1 | Goal position | -2147483648 ~ 2147483647 | Select the parameter item to execute teching |
| | 2 | Auxiliary point of Circular interpolation | -2147483648 ~ 2147483647 | |
| | 3 | Operating speed | 1 ~ Speed limit | |
| | 4 | Dwell time | 0 ~ 65535 | |
| | 5 | M code | 0 ~ 65535 | |
| | 6 | Set a sub axis | Set it on Bit 0 ~ Bit 3<br>0 : Not be set<br>1 : Be set | |
| | 7 | Helical interpolation (Only XBM-HP) | 0 : Not use<br>1 ~6 : axis1 ~ axis6 | |
| | 8 | No. of circular interpolation turn | 0 ~ 65535 | |
| | 9 | Coordinates | 0 : Absolute<br>1 : Relative | |
| | 10 | Control method | 0 : single axis position control<br>1 : single axis speed control<br>2 : single axis Feed control<br>3 : Linear interpolation control<br>4 : Circular interpolation control | |
| | 11 | Operating method | 0 : Singular<br>1 : Repeat | |
| | 12 | Operating pattern | 0 : End<br>1 : Keep<br>2 : Continuous | |
| | 13 | Size of circular arc | 0 : Circular arc < 180<br>1 : Circular arc >= 180 | |
| | 14 | Acc. no. | 0 ~ 3 | |
| | 15 | Dec. no. | 0 ~ 3 | |
| | 16 | Method of circular interpolation | 0 : Middle point<br>1 : Center point<br>2 : Radius | |
| | 17 | Direction of circular interpolation | 0 : CW<br>1 : CCW | |
| Step no. | 0 ~ 400 | | Set the step no. of operation data to execute teaching | |
| Teaching method | 0 : RAM Teaching<br>1 : ROM Teaching | | Set the teaching method | |

For the details about basic parameter items and setting value, refer to “Chapter 4 parameter and operation data”.

## 9.7.4 Write/Read Variable Data

Parameter, operation data, CAM data can be read by “Read Variable Data” command and written by “Write Variable Data” command directly.

### (1) Read Variable Data

(a) You read data you want by designating module internal memory address of parameter, operation data, CAM data directly.

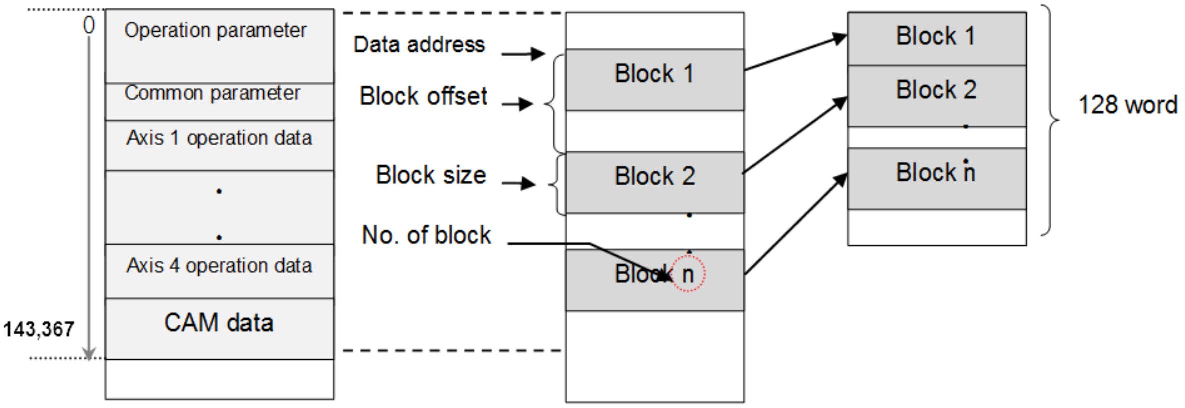
(b) Reads data as many as “Block size” starting position set in “Read address” with WORD unit to CPU among parameter, operation data, CAM data. In case “CNT” is higher than 2, reads blocks with interval of “Block offset” starting “Read address” as many as “CNT”-1.

(c) Max. data size (block size x No. of block) you can read with one command is 128 WORD

(d) “Read Variable Data” command can be executed in operation.

(e) Auxiliary data setting of “Read Variable Data” command

| Item | Setting value | Description |
|---|---|---|
| Read address | 0 ~ 143,367 | Sets head address of Read Data |
| Block offset | 0 ~ 143,367 | Sets offset between blocks of Read Data |
| Block size | 1 ~ 128 | Sets size of block |
| No. of block | 1 ~ 128 | Sets No. of Read Block |



(f) Restriction

In the following case, error occurs and can’t execute “Read Variable Data” command

■ Data setting error (Error code: 711)

▪ Read data size (Block size x No. of block) is 0 or higher than 128 WORD.

▪ Read data address [Read address + {block offset x (No. of block -1)} + Block size is higher than last address value (49586)

**Note**

If you execute “Read Variable Data” command in XGB PLC, Read data from positioning module is saved in common area. To save in device for using in PLC program, use GETM command [Read address: 0, data size: Read data size (DWORD)]

In XGB PLC, Read data is saved in register set in Function Block automatically.

(2) Write Variable Data

(a) You write data you want by designating module internal memory address of parameter, operation data, CAM data directly.

(b) Writes data set in PLC program as many as “Block size” starting position set in “Write address” with WORD unit among parameter, operation data, CAM data of positioning module. In case “No. of block” is higher than 2, writes blocks with interval of “OFFSET” starting “Write address” as many as “CNT”-1.

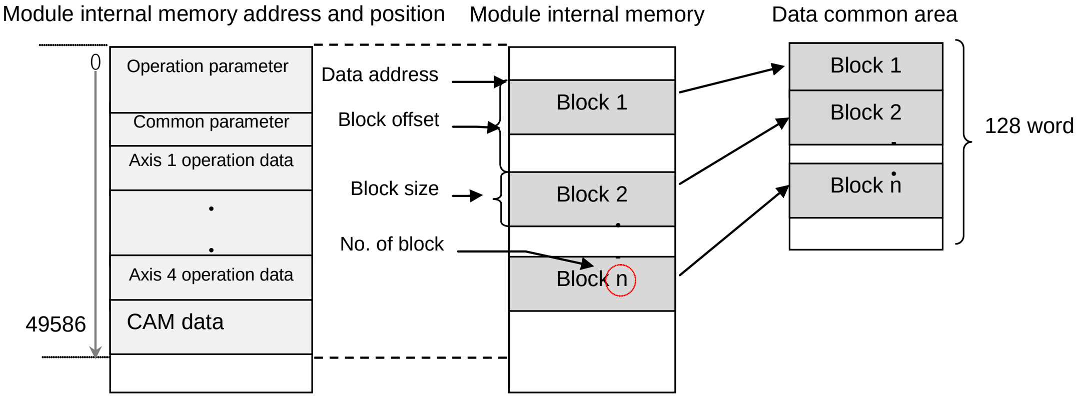
(c) Max. data size (Block size x No. of block) you can write with one command is 128 WORD.

(d) “Read Variable Data” command can’t be executed in operation. But “Read Variable Data” command can be executed to User CAM data in User CAM operation.

(e) After executing “Write Variable Data” command, since the changed value is maintained while power is on, in order to keep the changed value, execute “Save parameter/Operation data” command

(f) Auxiliary data setting of “Write Variable Data” command

| Item | Setting value | Description |
|---|---|---|
| Data device | 0 ~ 49586 | Sets device where data to write to module is saved |
| Write address | 0 ~ 49586 | Sets head address of positioning module internal memory |
| Block offset | 0 ~ 49586 | Sets offset between blocks of Write data |
| Block size | 1 ~ 128 | Sets size of block |
| No. of block | 1 ~ 128 | Sets No. of Write block |



(g) Restriction

In the following case, error occurs and can’t execute “Read Variable Data” command

- ■ Data range setting error (Error code: 711)
  - ▪ Write data size (Block size x No. of block) is 0 or higher than 128 WORD
  - ▪ Write data address [Write address + {Block offset x (No. of block -1)} + Block size] is higher than last address value (49586)
- ■ Block overlap error (Error code: 713)
  - ▪ In case module internal block to write is overlapped each other (In case no. of block is higher than 2, block offset is smaller than block size)
- ■ Execution inhibition error in operation (Error code: 712)
  - ▪ Any axis of positioning module is in operation

# Chapter 10 Positioning Error Information & Solutions

Here describes the positioning error types and its solutions.

(1) Error Information of Basic Parameter

| Error Code | Error Description | Solutions |
|---|---|---|
| 101 | Max. speed value of Basic Parameter exceeds the range. | The speed limit of basic parameter for pulse units are bigger than bias speed and less than 200,000 |
| 102 | Bias speed value of Basic Parameter exceeds the range. | Bias speed of Basic Parameter should be less than max. speed of Basic Parameter. |
| 104 | Circular interpolation(Ellipse interpolation) cannot be executed because the speed limit of the basic parameter that is converted into angular velocity, is equal to or greater than 180 degrees. | Retry after lowering the speed limit of the circular interpolation(ellipse interpolation) main axis. |
| 105 | Bias speed value of basic parameter is out of range. | The value of the bias speed of basic parameter, enter one or more based on the pulse unit. Bias speed of basic parameter is reset to the minimum value of the bias speed. |

(2) Error Information of Expanded Parameter

| Error Code | Error Description | Solutions |
|---|---|---|
| 111 | Extended Parameter software upper/lower limit range error | S/W upper limit of Extended Parameter should be greater than or equal to S/W lower limit of Extended Parameter.. |
| 112 | M Code Mode value of Extended Parameter exceeds the range. | M Code output of Extended Parameter is 0:None, 1:With, 2:After. Select one among three. |
| 113 | S-Curve rate of Extended Parameter exceeds the range. | Change S-Curve rate of Extended Parameter to be more than 1 and less than 100 |

(3) Error Information of Manual Operation Parameter

| Error Code | Error Description | Solutions |
|---|---|---|
| 121 | Jog high speed value of Manual operation parameter exceeds the range. | Set Jog high speed of Manual operation parameter to be greater than or equal to bias speed of Basic Parameter and less than or equal to max. speed of Basic Parameter. |
| 122 | Jog low speed value of Manual operation parameter exceeds the range. | Set Jog low speed of Manual operation parameter to be more than 1 and less than Jog high speed of Manual operation parameter. |
| 123 | Inching speed value of Manual operation parameter exceeds the range. | Set Inching speed of Manual operation parameter to be greater than or equal to bias speed of Basic Parameter and less than or equal to max. speed of Basic parameter. |

(4) Error Information of Homing Origin Parameter

| Error Code | Error Description | Solutions |
|---|---|---|
| 131 | Homing mode value of Homing parameter exceeds the range. | Homing method of Homing parameter is 0:Dog/Origin(Off), 1:Dog/Origin(On),2:High/low limit/Origin, 3: Near Point, 4:High speed origin, 5: High/low, 6:Origin Select one among seven. |
| 132 | Homing address of Homing parameter exceeds the range. | Set Homing address of Homing parameter to be greater than S/W low limit of Extended parameter and less than S/W high limit of Extended Parameter. |
| 133 | Homing high speed value of Homing parameter exceeds the range. | Set Homing high speed of Homing parameter to be greater than or equal to bias speed of Basic parameter and less than or equal to max. speed of Basic parameter. |
| 134 | Homing low speed value of Homing parameter exceeds the range. | Set Homing low speed of Homing parameter to be greater than or equal to bias speed of Basic parameter and less than or equal to Homing high speed of Homing parameter. |

(5) Error Information of Operating Data

| Error Code | Error Description | Solutions |
|---|---|---|
| 151 | Not available to set operation speed value of Operation data as “0”. | Set operation speed to be greater than “0”. |
| 152 | Operation speed of Operation data exceeds max. speed value. | Set operation speed to be less than or equal to max. speed set in the Basic Parameter. |
| 153 | Operation speed of Operation data is set less than bias speed. | Set operation speed to be greater than or equal to bias speed set in Basic Parameter. |
| 155 | Exceeds End/Go on/Continuous operation setting range of Operation data. | Set one from operation pattern (0:End, 1:Go on, 2: Continuous) of operation data to operate |
| 156 | Even the operation pattern settled continuous, next command cannot support continuous operation. | Set for abstract positioning control or speed control. If it is for current step command then next step command should be a interpolation command. |
| 157 | Even the operation pattern settled continuous, next command cannot support axis of current command. | If operation pattern is continuous, them set both Operation data and next step operation data equally |
| 158 | Even the operation pattern set continuous, current command cannot support continuous current command. | Continuous operation only can be operated when it is shortening position control, linear interpolation, and circular interpolation. In other commands, set operation option to end or continuous. |
| 159 | Goal position of operation data exceeds the range. | For positioning control operating change goal position more than 2,147,483,648 and less than 2,147,483,647. |

(6) Error Information of Data Writing

| Error Code | Error Description | Solutions |
|---|---|---|
| 171 | Parameter writing command cannot be done because of start command execution while XG-PM is sending common parameter | Once current operation is done, eliminate error with error-reset command, then execute writing command again. Do not execute start operation while parameter sending. |
| 172 | Parameter writing command cannot be done because of start command execution while XG-PM is sending operating parameter. | Once current operation is done, eliminate error with error-reset command, then execute writing command again. Do not execute start operation while parameter sending. |
| 173 | Parameter writing command cannot be done because of start command execution while XG-PM is sending operating data. | Once current operation is done, eliminate error with error-reset command, then execute writing command again. Do not execute start operation while operating data sending. |
| 174 | Parameter writing command cannot be done because of start command execution while XG-PM is sending CAM data. | Once current operation is done, eliminate error with error-reset command, then execute writing command again. Do not execute start operation while CAM data sending. |
| 175 | Start command cannot be executed while writing sending-parameters or operating-data from XG-PM. | Execute again once writing of parameter or operating data are done. |
| 176 | It can not be saved during flash or during start-up | Data can not be written to the flash during start-up. Stop all axis startup and execute flash write again. |

(7) Error Information of Positioning command and Step control

| Error Code | Error Description | Solutions |
|---|---|---|
| 190 | Home return HOME signal contact set value error | Set the home position signal between P00000 and P0000F |
| 191 | P contact point index range error | Set the P device index to a value between 0 and F. |
| 192 | I / O device duplication setting error | do not overlap Setting the I / O signals ithin the same channel. Duplicate input / output signals are not reflected in operation. |

| Error Code | Error Description | Solutions |
|---|---|---|
| 201 | Homing command is not available to carry out in operation status | Check if the command axis is in operation or not when giving the homing command |
| 203 | Homing command is not available to carry out in the Driver ready OFF status | Check if the Driver ready signal of command is OFF when giving the homing command |
| 211 | Floating point setting command is not available to carry out in operation status | Check if the command axis is in operation when giving floating point setting command |
| 212 | Floating point setting command is not available to carry out in the Driver ready OFF status | Check if the Driver ready signal of command axis is OFF when giving the floating point setting command |
| 221 | Direct start command is not available to carry out in operation status | Check if the command axis is in operation when giving direct start command |
| 223 | Not possible to carry out Direct Start command in the state of M Code ON. | Check if M code signal of command axis is ON when Direct Start command is executed. XMOF command can make M Code OFF. |
| 224 | Not possible to carry out Direct Start command at the absolute coordinate in the origin unsettled state. | Not possible to carry out absolute coordinate operation in the origin unsettled state. Check the coordinate of operation data to operate and the current origin determination. Available to carry out absolute coordinate operation after origin determination by Homing command or floating origin setting command. |
| 225 | Not possible to carry out Direct Start command in the state of Servo Ready OFF. | Check if Driver Ready signal of command axis is OFF when Direct Start command is executed. |
| 226 | Shortest Distance Control of Direct Start can't be executed in Incremental coordinate. | Change the coordinate from Absolute coordinate to Incremental coordinate. |
| 227 | Invalid target position in case of Shortest Distance Control at Unlimited Length Repeat mode | For Shortest Distance Control at Unlimited Length Repeat mode, target position should be higher than 0 and smaller than "Unlimited Length Repeat Position" of Extended Parameter. |
| 230 | Not possible to carry out continuous operating out Indirect Start command in the state of feed control. | Execute indirect start with setting of feed control for operation control, continuous for operating pattern if it is set as continuous or end. |
| 231 | Not possible to carry out Indirect Start command in the state of in operation. | Check if command axis is in operation when Indirect Start command is executed. |
| 233 | Not possible to carry out Indirect Start command in the state of M Code ON. | Check if M code signal of command axis is ON when Indirect Start command is executed<br>Available to make M Code OFF by XMOF command. |
| 234 | Not possible to carry out Indirect Start command at the absolute coordinate in the origin unsettled state. | Not available to carry out absolute coordinate operation in the origin unsettled state. Check the coordinate of step to operate and the current origin determination state. Available to carry out absolute coordinate operation after origin determination by Homing command or floating origin setting command. |
| 235 | Not possible to carry out Indirect Start command in the state of Servo Ready OFF. | Check if Driver Ready signal of command axis is OFF when Indirect Start command is executed. |
| 236 | Not possible to carry out Continuous operation of Indirect Start at speed control. | Check if there is no step that control method is set as speed control in the middle of Continuous operation of position control among Operation data and operation pattern is set as Continuous. |

| Error Code | Error Description | Solutions |
|---|---|---|
| 237 | Step no. of POINT start is limited up to 20. | Set the step no. for POINT start to be less than 20 and greater than 1 |
| 238 | Not possible to carry out Continuous operation of Indirect Start at S-Curve acceleration /deceleration pattern. | Check if acc./dec. pattern of extended parameter of command axis is set as S-Curve. |
| 241 | Not possible to carry out Linear interpolation Start in the state that main axis of linear interpolation is in operation. | Check if main axis is in operation when Linear interpolation command is executed. |
| 242 | Not possible to carry out Linear interpolation Start in the state that subordinate axis 1 of linear interpolation is in operation. | Check if subordinate axis 1 is in operation when Linear interpolation command is executed. |
| 247 | Not possible to carry out Linear interpolation Start in the state that M Code signal of main axis of Linear interpolation is ON. | Check if M Code signal of main axis is ON when Linear interpolation command is executed. Available to make M Code OFF by XMOF command. |
| 248 | Not possible to carry out Linear interpolation Start in the state that M Code signal of subordinate axis 1 of Linear interpolation is ON. | Check if M Code signal of subordinate axis 1 is ON when Linear interpolation command is executed. Available to make M Code OFF by XMOF command. |
| 250 | Not possible to carry out positioning operation of absolute coordinate in the state that main axis of Linear interpolation is origin unsettled. | Not available to carry out absolute coordinate operation in the origin unsettled state. Check the coordinate of step to operate and the current origin determination state. Available to carry out absolute coordinate operation after origin determination by Homing command or floating origin setting command. |
| 251 | Not possible to carry out positioning operation of absolute coordinate in the state that subordinate axis 1 of Linear interpolation is origin unsettled. | Not available to carry out absolute coordinate operation in the origin unsettled state. Check the coordinate of step to operate and the current origin determination state. Available to carry out absolute coordinate operation after origin determination by Homing command or floating origin setting command. |
| 253 | In case that main axis and subordinate axis is set wrong in Linear interpolation. (the case that the subordinate axis is not assigned, the case that only one axis is assigned, or the case that no axis is assigned) | Check if the subordinate axis is not assigned, or only one axis is assigned, or no axis is assigned when Linear interpolation command is executed. |
| 254 | Not possible to carry out the operation as Servo Ready is OFF at the main axis of Linear interpolation | Check if Driver Ready signal of master axis is OFF when Linear interpolation command is executed. |
| 255 | Not possible to carry out the operation as Servo Ready is OFF at the subordinate axis of Linear interpolation | Check if Driver Ready signal of subordinate axis is OFF when Linear interpolation command is executed. |
| 261 | Main axis speed of linear interpolation exceeds its speed limit. | Set low for main axis speed so that linear interpolation speed limit would not exceeds. |
| 262 | Not possible to insert the circular because the position of 2axis continuous linear interpolation circular insertion are longer than goal position. | Set low for position of 2 axis linear interpolation continuous operating circular insertion from expanded parameter, smaller than goal position. |
| 263 | Not possible to insert the circular because two lines of 2axis continuous linear interpolation circular insertion are at the same position. | Set again for goal position or set “0:Not insert circular” for 2 axis linear interpolation continuous operating circular insertion. |

| Error Code | Error Description | Solutions |
|---|---|---|
| 264 | Not possible to insert the circular because the radius of | Set again for goal position so those two lines would not be at the |

| | | |
|---|---|---|
| | 2axis continuous linear interpolation circular insertion are bigger than 2147483647. | same location or set “0:Not insert circular” for 2 axis linear interpolation continuous operating circular insertion then execute linear interpolation. |
| 265 | Not possible to insert the circular because the radius of 2axis continuous linear interpolation circular insertion are rarely small or its speed limits are too high. | Make bigger for circular insert position and less for speed limit or set “0:Not insert circular” for 2 axis linear interpolation continuous operating circular insertion then execute linear interpolation. |
| 266 | Not possible to insert the circular because the circular of 2axis continuous linear interpolation circular insertion are at the same position from where it is supposedly located. | Set again for goal position so those two lines would not be at the same location or set “0:Not insert circular” for 2 axis linear interpolation continuous operating circular insertion then execute linear interpolation. |
| 267 | Interpolation operation can not be executed in upper / lower limit error or emergency stop state. | Execute the command after removing the upper / lower limit error of subordinate axis or releasing emergency stop state |
| 270 | Error of radius setting from radius circular interpolation. | Set radius setting from circular interpolation main axis operating data for 80% bigger than its half distance of beginning point to end point. |
| 271 | Not possible to carry circular interpolation start in the state that main axis of circular interpolation is in operation. | Check if main axis is in operation when circular interpolation command is executed. |
| 272 | Not possible to carry circular interpolation start in the state that subordinate axis of circular interpolation is in operation | Check if subordinate axis is in operation when circular interpolation command is executed. |
| 275 | Not possible to carry circular interpolation start in the state that M Code signal of main axis of circular interpolation is ON. | Check if M Code signal of main axis is ON when circular interpolation command is executed. Available to make M Code OFF by XMOF command. |
| 276 | Not possible to carry circular interpolation start in the state that M Code signal of subordinate axis of circular interpolation is ON. | Check if M Code signal of subordinate axis is ON when circular interpolation command is executed. Available to make M Code OFF by XMOF command. |
| 277 | Not possible to carry positioning operation of absolute coordinate in the state that main axis of circular interpolation is origin unsettled. | Not available to carry out absolute coordinate operation in the origin unsettled state. Check the coordinate of step to operate and the current origin determination state. Available to carry out absolute coordinate operation after origin determination by Homing command or floating origin setting command. |
| 278 | Not possible to carry positioning operation of absolute coordinate in the state that subordinate axis of circular interpolation is origin unsettled | Not available to carry out absolute coordinate operation in the origin unsettled state. Check the coordinate of step to operate and the current origin determination state. Available to carry out absolute coordinate operation after origin determination by Homing command or floating origin setting command. |
| 279 | Incorrect setting of main axis from circular Interpolation. (Either, unset main axis, incorrect helical interpolation axis, exceeding number of current possible operating axis) | Execute circular interpolation after 1.Set one more operational axis from circular interpolation data except main axis 2. Set one more operate able axis from helical interpolation. |
| 280 | Not possible to carry out the operation as Drive Ready is OFF in main axis of circular interpolation. | Check if Driver Ready signal of main axis is OFF when circular interpolation command is executed. |
| 281 | Not possible to carry out the operation as Drive Ready is OFF in subordinate axis of circular interpolation. | Check if Driver Ready signal of subordinate axis 1 is OFF when circular interpolation command is executed. |

| Error Code | Error Description | Solutions |
|---|---|---|
| 282 | Not possible to carry out degree operation in circular | Check if the unit of Basic Parameter of main axis of circular |

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| | interpolation. | interpolation command is set as degree. |
| 283 | Not possible to carry out degree operation in circular interpolation. | Check if the unit of Basic Parameter of subordinate axis of circular interpolation command is set as degree. |
| 284 | Not possible to carry out the operation if start point =center point (middle point) or center point (middle point) =end point in circular interpolation. | Check if the center point or middle point is set as the same point as start point or end point in circular interpolation. |
| 285 | The start point and end point is Not possible to be same in the middle point mode of circular interpolation. | Check if circular interpolation method of<br>Common parameter is set as middle point and<br>if the position of start point is not the same as end point.. |
| 286 | Radius setting error in circular interpolation. | The radius of the circle to carry out circular interpolation operation is up to 2,147,483,647pulse. Check if it is set in order to carry out the circular interpolation more than the size |
| 287 | Not possible to carry out the operation as linear profile comes out of circular interpolation. | Check if circular interpolation method of Common parameter is set as Middle point and the middle point is set to be aligned with start point and end point. |
| 290 | Since angular velocity is greater than 90°,<br>correct circle cannot be drawn. | Set operation speed lower than 90° for circular<br>Interpolation angular velocity. |
| 291 | Not possible to carry out Synchronous Start command in the state of in operation. | Check if the Error occurred axis is included in Synchronous Start command and if there is no axis in operation when the command is executed. |
| 293 | Not possible to carry out Synchronous Start command in the state of M Code ON. | Check if the Error occurred axis is included in Synchronous Start command and if M Code signal is ON when the command is executed. Available to make M Code OFF by XMOF command |
| 294 | Not possible to carry out Synchronous Start command in case that there is no goal position. | Check if the Error occurred axis is included in Synchronous Start command, and if the goal position of operation data of the step to operate is not the same as the current position for absolute coordinate and is set as "0" for relative coordinate. |
| 295 | Not possible to carry out Synchronous Start command in the state that Servo Ready is OFF. | Check if the Error occurred axis is included in Synchronous Start command, and if Driver Ready signal is OFF when the command is executed. |
| 296 | In case that Synchronous Start command axis setting is wrong. | Check if only one axis of Simultenous Start command is assigned. The axis assignment address means 0 bit : 1 axis, 1 bit :2Y axis, 2 bit : 3 axis, 3 bit : 4axis and each bit is set as "1" for axis assignment |
| 297 | An error occurred from axis of synchronous<br>start operating. | Execute synchronous start after eliminate an error<br>element from error occurred axis. |
| 301 | Not possible to carry out Speed/Position control switching command not in the state of in operation. | Check if the axis is 'stop' state when speed/position control switching command is executed. |
| 302 | Not possible to carry out Speed/Position control switching command not in the state of speed control. | Check if the axis is 'speed control' state when speed/position control switching command is executed. |
| 303 | Not possible to carry out Speed/Position control switching command at subordinate axis of Synchronous Start operation. | Check if the axis is in operation by subordinate axis of Synchronous Start operation when speed/position control switching command is executed. |

| Error Code | Error Description | Solutions |
|---|---|---|

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| 304 | Not possible to carry out Speed/Position control switching command if there is no goal position. | Check if the operation has the goal position when speed /position control switching command is executed. |
| 306 | For "position specified speed/position switching instruction", when "Unlimited length repetition= enable" and "Speed/position switching coordinate=absolute", the position value which makes the object go in the opposite direction is not valid. | For "position specified speed/position switching instruction", input the positive position value for the forward direction and the negative position value for the reverse direction. |
| 311 | Not possible to carry out Position/Speed control switching command not in the state of in operation. | Check if the axis is 'stop' state when position/speed control switching command is executed. |
| 312 | Not possible to carry out Position/Speed control switching command at subordinate axis of Synchronous Start operation. | Check if the axis is in operation by subordinate axis of Synchronous Start operation when position/speed control switching command is executed. |
| 313 | Not possible to carry out Position/Speed control switching command in the state of circular interpolation operation. | Check if the axis is in circular interpolation operation when position/speed control switching command is executed. |
| 314 | Not possible to carry out Position/Speed control switching command in the state of Linear interpolation operation. | Check if the axis is in linear interpolation operation when position/speed control switching command is executed. |
| 316 | Not possible to carry out Position/Speed switching command in the state of decreasing section. | Execute Position/Speed switching command before the decreasing of axis, while in increasing section or regular section. |
| 317 | Not possible to carry out Position/Speed switching command when it is not either at the positioning control or inching operation | Execute Position/Speed switching command while the commanding axis is positioning control or inching operation |
| 322 | Not possible to carry out deceleration stop command in the state of Jog operation. | Not possible to carry out deceleration stop command in the state of Jog operation. |
| 324 | Deceleration time setting from deceleration stop commands are out of range. | The range of deceleration time is between0 and 2147483647. Execute deceleration command after set the value from its range. |
| 331 | Not possible to carry out Skip command not in the state of in operation. | Check if the axis is 'stop' state when Skip command is executed. |
| 332 | Not possible to carry out Skip command for subordinate axis of Linear interpolation operation. | Check if the axis is in operation by subordinate axis of Linear interpolation when Skip command is executed. |
| 333 | Not possible to carry out Skip command for subordinate axis of Synchronous Start operation. | Check if the axis is in operation by subordinate axis of Synchronous Start operation when Skip command is executed. |
| 335 | Not possible to carry out Skip command in the state of Jog operation. | Check if the axis is in Jog operation when Skip command is executed. |
| 336 | Not possible to carry out Skip command in the state of Direct Start operation. | Check if the axis is in Direct Start operation when Skip command is executed. |
| 337 | Not possible to carry out Skip command in the state of Inching operation. | Check if the axis is in Inching operation when Skip command is executed. |
| 338 | Not possible to carry out Skip command for subordinate axis of circular interpolationoperation. | Check if the axis is in operation by subordinate axis of circular interpolation operation when Skip command is executed. |

| Error Code | Error Description | Solutions |
|---|---|---|
| 341 | Not possible to carry out Synchronous Start by Position | Check if the axis is in operation when Synchronous Start by Position |

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|---|---|---|
| | command in the state of in operation. | command is executed. |
| 343 | Not possible to carry out Synchronous Start by Position command in the state of M Code ON. | Check if the M Code signal of the axis is ON when Synchronous Start by Position command is executed. Available to make M Code OFF by XMOF command. |
| 344 | Not possible to carry out Synchronous Start by Position command at the absolute coordinate in the state of origin unsettled. | Not available to carry out absolute coordinate operation in the origin unsettled state. Check the coordinate of step to operate and the current origin determination state. Available to carry out absolute coordinate operation after origin determination by Homing command or floating origin setting command. |
| 345 | Not possible to carry out Synchronous Start by Position command in the state that Servo Ready is OFF. | Check if Driver Ready signal of the axis is OFF when Synchronous Start by Position command is executed. |
| 346 | Not possible to carry out Synchronous Start by Position command in the state that the origin of main axis is not settled. | Check if main axis is in the origin unsettled state when Synchronous Start command is executed. |
| 347 | There is error in setting main axis/subordinate axis of Synchronous Start by Position command. | Check if main axis of Synchronous Start by Position command is set as the same as command axis. Main axis is set by writing 1~4(Axis1 ~ Axis4)0(X axis) and 9(Encoder) to the setting address. |
| 350 | Not possible to carry out Synchronous Start by Speed command in the state of in operation of main axis. | Execute Synchronous Start by Speed command while main axis Is not operating when it is state of stop. |
| 351 | Not possible to carry out Synchronous Start by Speed command in the state of in operation. | Check if the axis is in operation when Synchronous Start by Speed command is executed. |
| 353 | Not possible to carry out Synchronous Start by Speed command in the state of M Code ON. | Check if the M Code signal of the axis is ON when Synchronous Start by Speed command is executed. Available to make M Code OFF by XMOF command. |
| 354 | Not possible to carry out Synchronous Start by Speed command in the state that Servo Ready is OFF. | Check if Driver Ready signal of the axis is OFF when Synchronous Start by speed command is executed. |
| 355 | There is error in setting main axis/subordinate axis of Synchronous Start by Speed command. | Check if main axis of Synchronous Start by Speed command is set as the same as command axis. Main axis is set by writing 1~4(Axis1 ~ Axis4)0(X axis) and 9(Encoder) to the setting address. |
| 356 | There is error in main axis rate (main axis rate=0) of Synchronous start by speed command. | Main axis rate of Synchronous start by speed can't be 0. Set as -32768 ~ 32767 except 0. |
| 357 | The speed of Synchronous Start by Speed command cannot exceeds its speed limit. | Set low for main axis ratio/second axis ratio values so The value would not exceed its limitation. |
| 361 | Not possible to carry out Position Override command not in the state of in operation (Busy). | Check if the axis is 'stop' state when Position Override command is executed. |
| 362 | Not possible to carry out Position Override command not in the state of in dwell. | Check if the axis is in dwell when Position Override command is executed.. |
| 363 | Not possible to carry out Position Override command not in the state of positioning operation. | Check if the axis is in operation by position control when Position Override command is executed. |
| 364 | Not possible to carry out Position Override command for the axis of Linear interpolation operation. | Check if the axis is in Linear interpolation operation when Position Override command is executed. |

| Error Code | Error Description | Solutions |
|---|---|---|
| 365 | Not possible to carry out Position Override command for the axis of circular interpolation operation. | Check if the axis is in circular interpolation operation when Position Override command is executed. |
| 366 | Not possible to carry out Position Override command for the subordinate axis of Synchronous operation. | Check if the axis is in operation by subordinate axis of Synchronous Start operation when Position Override command is executed. |
| 371 | Not possible to carry out Speed Override command not in the state of in operation (Busy). | Check if the axis is 'stop' state when Speed Override is executed. |
| 372 | Exceeds the range of speed override value. | Speed value of Speed Override command should be less than or equal to max. speed set in Basic Parameter. Check the speed value. |
| 373 | Not possible to carry out Speed Override command for the subordinate axis of Linear interpolation operation. | Check if the axis is in operation by subordinate axis of Linear interpolation operation when Speed Override command is executed. |
| 374 | Not possible to carry out Speed Override command for the axis of circular interpolation operation. | Check if the axis is in operation by subordinate axis of circular interpolation operation when Speed Override command is executed. |
| 375 | Not possible to carry out Speed Override command for the subordinate axis of Synchronous operation. | Check if the axis is in operation by subordinate axis of Synchronous Start operation when Speed Override command is executed. |
| 377 | Not possible to carry out Speed Override command in the deceleration section. | Check if the axis is in the state of deceleration stop when Speed Override command is executed. |
| 378 | Not possible to carry out Speed Override command in S-curve acceleration/deceleration pattern. | Check if the acceleration/deceleration pattern of Extended Parameter of command axis is set as S-Curve. |
| 381 | Not possible to carry out Random position speed override command not in the state of in operation. | Check if the axis is 'stop' state when Random position speed override command is executed. |
| 382 | Not possible to carry out Random position speed override command not in positioning operation. | Check if the axis is in speed control operation when Random position speed override command is executed. |
| 383 | Exceeds the speed override value range of Random position speed override command. | Speed value of Random position speed override command should be less than or equal to max. speed set in Basic Parameter. Check the speed value. |
| 384 | Not possible to carry out Random position speed override command for the subordinate axis of Linear interpolation operation. | Check if the axis is in operation by subordinate axis of Linear interpolation operation when Random position speed override command is executed. |
| 385 | Not possible to carry out Random position speed override command for the axis of circular interpolation operation. | Check if the axis is in circular interpolation operation when Speed Override command is executed. |
| 386 | Not possible to carry out Random position speed override command for the subordinate axis of Synchronous operation. | Check if the axis is in operation by subordinate axis of Synchronous Start operation when Speed Override command is executed. |
| 389 | Not possible to carry out Random position speed override command in S-Curve acceleration / deceleration pattern. | Check if the acceleration/deceleration pattern of Extended Parameter of command axis is set as S-Curve |
| 390 | Not possible to carry out Continuous operation command in S-Curve acceleration/deceleration pattern. | Check if the acceleration/deceleration pattern of Extended Parameter of command axis is set as S-Curve |
| 391 | Not possible to carry out Continuous operation command not in the state of in operation. | Check if the axis is 'stop' state when Continuous operation command is executed. |
| 392 | Not possible to carry out Continuous operation command not in the state of in dwell. | Check if the axis is in dwell when Continuous operation command is executed. |

| Error Code | Error Description | Solutions |
|---|---|---|
| 393 | Not possible to carry out Continuous operation command not in the settled of positioning operation. | Check if the axis is in speed control operation when Continuous operation command is executed. |
| 394 | Speed data value of Continuous operation command exceeds the allowable range. | Speed value of Continuous operation command should be less than or equal to max. speed set in Basic Parameter. Check the speed value. |
| 395 | Not possible to carry out Continuous operation command for the subordinate axis of Linear interpolation operation. | Check if the axis is in operation by subordinate axis of Linear interpolation operation when Continuous operation command is executed. |
| 396 | Not possible to carry out Continuous operation command for the axis of circular interpolation operation axis. | Check if the axis is in circular interpolation operation when Continuous operation command is executed. |
| 397 | Not possible to carry out Continuous operation command for the subordinate axis of Synchronous operation. | Check if the axis is in operation by subordinate axis of Synchronous Start operation when Continuous operation command is executed. |
| 399 | Not possible to carry out Continuous operation command at the last step of Operation data. | Check if the axis is in operation of 400th step when Continuous operation command is executed. |
| 400 | Not possible to carry out Continuous operation command in the state of Direct Start operation. | Check if the axis is in operation by Direct Start command that Continuous operation command is executed. |
| 401 | Not possible to carry out Inching command in the state of in operation. | Check if the axis is in operation when Inching command is executed. |
| 403 | Not possible to carry out Inching command in the state that Drive Ready is OFF. | Check if Drive Ready signal of the axis is OFF when Inching command is executed. |
| 411 | Not possible to carry out Jog Start command in the state of in operation. | Check if the axis is in operation when Jog Start command is executed. |
| 413 | Not possible to carry out Jog Start command in the state that Servo Ready is OFF. | Check if Driver Ready signal of the axis is OFF when Jog Start command is executed. |
| 431 | Not possible to carry out Return to the Position before Manual Operation in the state of in operation. | Check if the axis is in operation when Return to the position before manual operation command is executed . |
| 434 | Not possible to carry out Return to the Position before Manual Operation in the state that Drive Ready is OFF. | Check if Driver Ready signal of the axis is ON when Return to the position before manual operation command is executed. |
| 441 | Not possible to carry out Start step no. Change/Repeat Operation Start step no. assignment command in the state of in operation. | Check if the axis is in operation when Start step no. change /repeat command is executed. |
| 442 | Exceeds the step assignment range of Start step no. Change/Repeat Operation Start step no. assignment command. | Check if the setting step value of Start step no. change command or repeat operation start step no. assignment command is greater than or equal to 1 and less than or equal to 400. |
| 451 | Not possible to carry out Current Position Preset command in the state of in operation. | Check if the axis is in operation when Current position preset command is executed. |
| 452 | Not possible to set the auxiliary position data value out of range of software high/low limit while Current Position Preset command is executed. | Check if the position value of current position preset command is within the range of soft high /low limit set in Extended Parameter. |
| 461 | Not possible to carry out Position Teaching command in the state of in operation. | Check if the axis is in operation when Position teaching command is executed. |

| Error Code | Error Description | Solutions |
|---|---|---|
| 462 | Not possible to carry out Teaching Array command for the data over 16. | Check if the data no. of Teaching Array command is set in the range that is greater than or equal to 1 and less than or equal to 16. |
| 463 | Not possible to carry out Speed Teaching command in the state of in operation. | Check if the axis is in operation when Speed teaching command is executed. |
| 465 | Error from step number appointing which are about to execute teaching operation. | Make sure step for teaching operation is smaller than 400 or same as 400. |
| 466 | Teaching list error for multi teaching command. | Execute teaching command after set teaching data list as 0:position or 1:speed |
| 467 | Teaching method error for multi teaching command. | Execute teaching command after set teaching method as 0:position or 1:speed |
| 471 | Parameter teaching command cannot be Executed while its operating. | Check if the axis was operating when parameter teaching commands are executing |
| 472 | Operating data teaching command cannot be Executed while its operating. | Check if the axis was operating when operating Data teaching commands are executing |
| 473 | Set data cannot be teaching. | Execute teaching command after setting right value for parameter teaching data or operating data teaching list. |
| 474 | Parameter/Operation data saving commands cannot be done while the axis is operating. | Check if the axis is operating when Parameter/ Operation data saving commands are operating. Execute Parameter/Operation command when any axis are not operating. |
| 475 | Error of value for teaching data is out of range. | Execute teaching command after setting value of parameter teaching or operating data teaching data among its set range. |
| 476 | Error of value for teaching method is out of range. | Execute teaching command after setting value of parameter teaching or operating data teaching data for 1(RAM teaching) or 2(ROM teaching). |
| 477 | Parameter/operation data may be damaged because of power failure during saving parameter/operation data. | Write parameter/operation data by "Writing Project" instruction at XG-PM. |
| 481 | Internal emergency stop | Eliminate reason of emergency stop and execute XCLR command to delete the error. |
| 491 | Error of external emergency stop | Eliminate reason of emergency stop and execute XCLR command to delete the error. |
| 492 | Hard Upper Error | Be out of limited external upper signal rangeby using counter direct jog command. Then execute XCLR command to delete the error. |
| 493 | Hard Lower Error | Be out of limited external lower signal range by using direct jog command. Then execute XCLR command to delete the error. |
| 501 | Soft Upper Error | Be out of limited soft upper range by using counter direct jog command. Then execute XCLR command to delete the error. |
| 502 | Soft Lower Error | Be out of limited soft upper range by using direct jog command. Then execute XCLR command to delete the error. |

| Error Code | Error Description | Solutions |
|---|---|---|
| 511 | Inappropriate command | Check the commands are appropriate. Look up the references for COMMANDS. |
| 512 | Step number of auxiliary data is out of range. | Commands set for bigger than 400. Set it Between 1 and 400. |
| 522 | The command cannot be done when the signal of Drive Ready is OFF during the operation. | Execute again once Drive Ready is ON. |
| 531 | Error for Encoding number exceed from Encoder preset command. | Execute Encoder preset command after set “0” For encoder number. |
| 532 | Preset command cannot be done because of the axis which using encoder as a main axis | Execute Encoder preset when the encoder using axis is not operating |
| 535 | | |
| 541 | Ellipse interpolation cannot be operated while main axis of circular interpolation is operating. | Execute the Ellipse interpolation command when main axis is not operating. |
| 542 | Ellipse interpolation cannot be operated while support axis of circular interpolation is operating. | Execute the circular interpolation command when subordinate axis is not operating |
| 543 | Ellipse interpolation start cannot be operated when M code from main axis circular interpolation is “ON.” | Execute Ellipse interpolation command after set M code from main axis Ellipse interpolation is “OFF” with XMOF command. |
| 544 | Ellipse interpolation start cannot be operated when M code from subordinate axis circular interpolation is “ON.” | Execute Ellipse interpolation command after set M code from subordinate axis Ellipse interpolation is “OFF” with XMOF command. |
| 545 | Unable to execute the determine absolute coordinate position operation when ellipse interpolation main axis is not positioned. | Execute Ellipse interpolation command after set main axis as a state of being origin with homing command or floating origin setting. |
| 546 | Unable to execute the determine absolute coordinate position operation when ellipse interpolation sub axis is not positioned. | Execute Ellipse interpolation command after set sub axis as a state of being origin with homing command or floating origin setting. |
| 547 | Incorrect setting for main and subordinate axis from Ellipse interpolation.(Unset for main/ subordinate axis Set as Helical interpolation Exceed number of possible current operating Axis.) | Execute Ellipse interpolation after set a axis From subordinate axis setting beside its main axis and unset Helical interpolation. |
| 548 | Ellipse interpolation cannot be operated with middle point setting and radius setting. | Ellipse interpolation only can operate in center point setting. Execute Ellipse interpolation after changing operating data Ellipse interpolation mode for center point setting. |
| 549 | Cannot be operated when Drive Ready of Ellipse interpolation main axis is “OFF.” | Execute Ellipse interpolation command after Drive Ready is “ON” of main axis. |
| 550 | Cannot be operated when Drive Ready of Ellipse interpolation subordinate axis is “OFF.” | Execute Ellipse interpolation command after Drive Ready is “ON” of subordinate axis. |
| 551 | Cannot be operated when unit of Ellipse interpolation main axis is “degree.” | Execute Ellipse interpolation command after Basic parameter unit is “degree” of main axis. |
| 552 | Cannot be operated when unit of Ellipse interpolation subordinate axis is “degree.” | Execute Ellipse interpolation command after basic parameter unit is “degree” of subordinate axis. |
| 553 | Cannot be operated when three parameters of Ellipse interpolation are same.<br>(start point=main point=end point) | Execute Ellipse interpolation command after set those parameters differently. (start point, main point, end point) |

| Error Code | Error Description | Solutions |
|---|---|---|
| 554 | Radius setting error from Ellipse interpolation. | The range of possible execution for Ellipse Interpolation is between 0 and 2147483647. Set radius of circle from its range, smaller than 2147483647pulse. |
| 555 | Exact circle cannot be draw because of degree of Ellipse interpolation is bigger than 90˚ | Set lower for operation speed so that degree of Ellipse interpolation is smaller than 90˚ |
| 556 | Continuous operation cannot be done for Ellipse interpolation. | Execute Ellipse interpolation after terminate operation step of circular interpolation. |
| 557 | Ellipse interpolation only can be operated when control setting is circular interpolation. | Execute Ellipse interpolation after change control setting for drive step of Ellipse interpolation to circular interpolation. |
| 558 | Operation cannot be executed when beginning point and end point of ellipse interpolation are not same. | Execute Ellipse interpolation after set the goal Position of ellipse interpolation operating step Same as current position. |
| 559 | Operation cannot be executed when operating degree of ellipse interpolation is “0.” | Set the value of operating degree for ellipse interpolation, larger than “0.”(1~65535) |
| 571 | Operation cannot be executed because of error from sub-coordinate axis of main axis by current axis. | Check the error from subordinate axis of main axis by current axis whether it is occurred during the operation of current axis. |
| 572 | Operation cannot be executed because of error from sub coordinate axis of main axis by interpolated axis. | Check the error from subordinate axis of main axis by current axis whether it is occurred during the operation of interpolated axis. |
| 701 | Not possible to carry out CAM command in the state of in operation. | Execute CAM command when main axis is not operating. |
| 702 | Not possible to carry out CAM command in the state of M Code ON | Execute CAM command after set M Code OFF from commanding axis with XMOF. |
| 703 | Not possible to carry out CAM command in the state that Drive Ready is OFF. | Execute CAM command when Drive Ready is “ON.” |
| 704 | Error of setting main/subordinate axis from CAM command. | Set main axis for CAM command as other axis besides its command axis from connecting axis. Set parameters are 1axis through 4axis. |
| 705 | CAM command of main axis cannot be executed during the operation. | Execute CAM command when the main axis setting of CAM command is not operating. |
| 706 | Error of CAM block setting from CAM command. | Execute CAM command after set a CAM block from CAM command as bigger than 1 and smaller than 8. |
| 707 | Error for CAM data of appointed block from CAM command. | Execute CAM command after set right data for appointed block from CAM command. |
| 708 | The speed of subordinate axis from CAM command cannot exceed its speed limit. | Set lower speed for main axis so that speed of subordinate axis from CAM data which is calculated by subordinate position would not exceed its speed limit. |

| Error | Error Description | Solutions |
|---|---|---|

| Code | | |
|---|---|---|
| 710 | The speed of the master axis of cam command is so high that moving position per control period exceeds the master axis scope. | After slow down the speed of the master axis then operate the axis. |
| 711 | Data area setting value (block size and no. of block) of Variable Data Read/Write command is out of range. | Set the block size and no. of block for [block size X no. of block] to be 1~128. |
| 712 | Variable Data Write command can't be executed during operation. | Check whether any axis is under operation when executing the Variable Data Write command |
| 713 | Block area of Variable Data Write command is overlapped so Writing is unavailable. | In case the number of block is more than 2, set the block set to be larger than block size. (Or set the block size to be smaller than block offset) |
| 721 | Restart is impossible, After the command that restart is not supported like Circular interpolation, | Before using restart command, check if the command that restart is not supported is used. |
| 722 | Restart command can't be executed during operation. | Check whether any axis is under operation. |
| 733 | The module (H / W) currently used does not support the setting position output function. | In order to use the setting position output function, please replace with the module (H / W) that supports the function |
| 801 | Current module of command axis is set<br>lager than number of possible operating axis. | Execute after set a possible operating number<br>of command axis for current module. |
| 811 | Previous command is not processed. It is impossible to execute command additionally. | Check previous command is executed. If the process is finished, execute other command additionally |

# Chapter 11 Internal Memory Address of “Read/Write Variable Data” command

“Read/Write Variable Data” commands (XVRD, XVWR) can be used to read/write the parameters of the positioning module. The internal memory address of the embedded positioning module is as follows.

## 11.1 Parameter memory address

| Item | Axis 1 | | Axis 2 | | Axis 3 | | Axis 4 | | Axis 5 | | Axis 6 | | Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DEC | HEX | DEC | HEX | DEC | HEX | DEC | HEX | DEC | HEX | DEC | HEX | |
| Basic parameter | 0 | 0 | 80 | 50 | 160 | A0 | 240 | F0 | 320 | 140 | 400 | 190 | Speed limit (Low) |
| | 1 | 1 | 81 | 51 | 161 | A1 | 241 | F1 | 321 | 141 | 401 | 191 | Speed limit (High) |
| | 2 | 2 | 82 | 52 | 162 | A2 | 242 | F2 | 322 | 142 | 402 | 192 | Bias speed (Low) |
| | 3 | 3 | 83 | 53 | 163 | A3 | 243 | F3 | 323 | 143 | 403 | 193 | Bias speed (High) |
| | 4 | 4 | 84 | 54 | 164 | A4 | 244 | F4 | 324 | 144 | 404 | 194 | Acc. time1 (Low) |
| | 5 | 5 | 85 | 55 | 165 | A5 | 245 | F5 | 325 | 145 | 405 | 195 | Acc. time1 (High) |
| | 6 | 6 | 86 | 56 | 166 | A6 | 246 | F6 | 326 | 146 | 406 | 196 | Acc. time2 (Low) |
| | 7 | 7 | 87 | 57 | 167 | A7 | 247 | F7 | 327 | 147 | 407 | 197 | Acc. time2 (High) |
| | 8 | 8 | 88 | 58 | 168 | A8 | 248 | F8 | 328 | 148 | 408 | 198 | Acc. time3 (Low) |
| | 9 | 9 | 89 | 59 | 169 | A9 | 249 | F9 | 329 | 149 | 409 | 199 | Acc. time3 (High) |
| | 10 | A | 90 | 5A | 170 | AA | 250 | FA | 330 | 14A | 410 | 19A | Acc. time4 (Low) |
| | 11 | B | 91 | 5B | 171 | AB | 251 | FB | 331 | 14B | 411 | 19B | Acc. time4 (High) |
| | 12 | C | 92 | 5C | 172 | AC | 252 | FC | 332 | 14C | 412 | 19C | Dec. time1 (Low) |
| | 13 | D | 93 | 5D | 173 | AD | 253 | FD | 333 | 14D | 413 | 19D | Dec. time1 (High) |
| | 14 | E | 94 | 5E | 174 | AE | 254 | FE | 334 | 14E | 414 | 19E | Dec. time2 (Low) |
| | 15 | F | 95 | 5F | 175 | AF | 255 | FF | 335 | 14F | 415 | 19F | Dec. time2 (High) |
| | 16 | 10 | 96 | 60 | 176 | B0 | 256 | 100 | 336 | 150 | 416 | 1A0 | Dec. time3 (Low) |
| | 17 | 11 | 97 | 61 | 177 | B1 | 257 | 101 | 337 | 151 | 417 | 1A1 | Dec. time3 (High) |
| | 18 | 12 | 98 | 62 | 178 | B2 | 258 | 102 | 338 | 152 | 418 | 1A2 | Dec. time4 (Low) |
| | 19 | 13 | 99 | 63 | 179 | B3 | 259 | 103 | 339 | 153 | 419 | 1A3 | Dec. time4 (High) |
| | 20 | 14 | 100 | 64 | 180 | B4 | 260 | 104 | 340 | 154 | 420 | 1A4 | Dec. time for EMG stop (Low) |
| | 21 | 15 | 101 | 65 | 181 | B5 | 261 | 105 | 341 | 155 | 421 | 1A5 | Dec. time for EMG stop (High) |
| | 22 | 16 | 102 | 66 | 182 | B6 | 262 | 106 | 342 | 156 | 422 | 1A6 | Pulse per rotation (Low) |
| | 23 | 17 | 103 | 67 | 183 | B7 | 263 | 107 | 343 | 157 | 423 | 1A7 | Pulse per rotation (High) |
| | 24 | 18 | 104 | 68 | 184 | B8 | 264 | 108 | 344 | 158 | 424 | 1A8 | Distance per rotation (Low) |
| | 25 | 19 | 105 | 69 | 185 | B9 | 265 | 109 | 345 | 159 | 425 | 1A9 | Distance per rotation (High) |
| | 26 | 1A | 106 | 6A | 186 | BA | 266 | 10A | 346 | 15A | 426 | 1AA | CONTROL WORD |
| | 27 | 1B | 107 | 6B | 187 | BB | 267 | 10B | 347 | 15B | 427 | 1AB | Rsvd. |
| Extended parameter | 28 | 1C | 108 | 6C | 188 | BC | 268 | 10C | 348 | 15C | 428 | 1AC | S/W upper limit (Low) |
| | 29 | 1D | 109 | 6D | 189 | BD | 269 | 10D | 349 | 15D | 429 | 1AD | S/W upper limit (High) |
| | 30 | 1E | 110 | 6E | 190 | BE | 270 | 10E | 350 | 15E | 430 | 1AE | S/W lower limit (Low) |
| | 31 | 1F | 111 | 6F | 191 | BF | 271 | 10F | 351 | 15F | 431 | 1AF | S/W lower limit (High) |
| | 32 | 20 | 112 | 70 | 192 | C0 | 272 | 110 | 352 | 160 | 432 | 1B0 | Backlash compensation |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 33 | 21 | 113 | 71 | 193 | C1 | 273 | 111 | 353 | 161 | 433 | 1B1 | Position completion time |
| | 34 | 22 | 114 | 72 | 194 | C2 | 274 | 112 | 354 | 162 | 434 | 1B2 | S-curve ratio |
| | 35 | 23 | 115 | 73 | 195 | C3 | 275 | 113 | 355 | 163 | 435 | 1B3 | Rsvd. |
| | 36 | 24 | 116 | 74 | 196 | C4 | 276 | 114 | 356 | 164 | 436 | 1B4 | Infinite repeat position(Low) |
| | 37 | 25 | 117 | 75 | 197 | C5 | 277 | 115 | 357 | 165 | 437 | 1B5 | Infinite repeat position (High) |
| | 38 | 26 | 118 | 76 | 198 | C6 | 278 | 116 | 358 | 166 | 438 | 1B6 | Arc insertion position (Low) |
| | 39 | 27 | 119 | 77 | 199 | C7 | 279 | 117 | 359 | 167 | 439 | 1B7 | Arc insertion position (High) |
| | 40 | 28 | 120 | 78 | 200 | C8 | 280 | 118 | 360 | 168 | 440 | 1B8 | CONTROL WORD |
| | 41 | 29 | 121 | 79 | 201 | C9 | 281 | 119 | 361 | 169 | 441 | 1B9 | Rsvd. |
| Manual operation parameter | 42 | 2A | 122 | 7A | 202 | CA | 282 | 11A | 362 | 16A | 442 | 1BA | JOG high speed (Low) |
| | 43 | 2B | 123 | 7B | 203 | CB | 283 | 11B | 363 | 16B | 443 | 1BB | JOG high speed (High) |
| | 44 | 2C | 124 | 7C | 204 | CC | 284 | 11C | 364 | 16C | 444 | 1BC | JOG low speed (Low) |
| | 45 | 2D | 125 | 7D | 205 | CD | 285 | 11D | 365 | 16D | 445 | 1BD | JOG low speed (High) |
| | 46 | 2E | 126 | 7E | 206 | CE | 286 | 11E | 366 | 16E | 446 | 1BE | JOG acc. time (Low) |
| | 47 | 2F | 127 | 7F | 207 | CF | 287 | 11F | 367 | 16F | 447 | 1BF | JOG acc. time (High) |
| | 48 | 30 | 128 | 80 | 208 | D0 | 288 | 120 | 368 | 170 | 448 | 1C0 | JOG dec. time (Low) |
| | 49 | 31 | 129 | 81 | 209 | D1 | 289 | 121 | 369 | 171 | 449 | 1C1 | JOG dec. time (High) |
| | 50 | 32 | 130 | 82 | 210 | D2 | 290 | 122 | 370 | 172 | 450 | 1C2 | Inching speed |
| | 51 | 33 | 131 | 83 | 211 | D3 | 291 | 123 | 371 | 173 | 451 | 1C3 | Rsvd |
| Homing parameter | 52 | 34 | 132 | 84 | 212 | D4 | 292 | 124 | 372 | 174 | 452 | 1C4 | Home position (Low) |
| | 53 | 35 | 133 | 85 | 213 | D5 | 293 | 125 | 373 | 175 | 453 | 1C5 | Home position (High) |
| | 54 | 36 | 134 | 86 | 214 | D6 | 294 | 126 | 374 | 176 | 454 | 1C6 | Home high speed (Low) |
| | 55 | 37 | 135 | 87 | 215 | D7 | 295 | 127 | 375 | 177 | 455 | 1C7 | Home high speed (High) |
| | 56 | 38 | 136 | 88 | 216 | D8 | 296 | 128 | 376 | 178 | 456 | 1C8 | Home low speed (Low) |
| | 57 | 39 | 137 | 89 | 217 | D9 | 297 | 129 | 377 | 179 | 457 | 1C9 | Home low speed (High) |
| | 58 | 3A | 138 | 8A | 218 | DA | 298 | 12A | 378 | 17A | 458 | 1CA | Home acc. time (Low) |
| | 59 | 3B | 139 | 8B | 219 | DB | 299 | 12B | 379 | 17B | 459 | 1CB | Home acc. time (High) |
| | 60 | 3C | 140 | 8C | 220 | DC | 300 | 12C | 380 | 17C | 460 | 1CC | Home dec. time (Low) |
| | 61 | 3D | 141 | 8D | 221 | DD | 301 | 12D | 381 | 17D | 461 | 1CD | Home dec. time (High) |
| | 62 | 3E | 142 | 8E | 222 | DE | 302 | 12E | 382 | 17E | 462 | 1CE | Home compensation (Low) |
| | 63 | 3F | 143 | 8F | 223 | DF | 303 | 12F | 383 | 17F | 463 | 1CF | Home compensation (High) |
| | 64 | 40 | 144 | 90 | 224 | E0 | 304 | 130 | 384 | 180 | 464 | 1D0 | Home restart time |
| | 65 | 41 | 145 | 91 | 225 | E1 | 305 | 131 | 385 | 181 | 465 | 1D1 | Home dwell time |
| | 66 | 42 | 146 | 92 | 226 | E2 | 306 | 132 | 386 | 182 | 466 | 1D2 | CONTROL WORD |
| | 67 | 43 | 137 | 89 | 207 | CF | 277 | 115 | 387 | 183 | 467 | 1D3 | Rsvd |
| I/O signal parameter | 68 | 44 | 148 | 94 | 228 | E4 | 308 | 134 | 388 | 184 | 468 | 1D4 | I/O signal parameter |
| | 69 | 45 | 149 | 95 | 229 | E5 | 309 | 135 | 389 | 185 | 469 | 1D5 | Rsvd. |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 70 | 46 | 150 | 96 | 230 | E6 | 310 | 136 | 390 | 186 | 470 | 1D6 | Upper limit signal WORD OFFSET |
| | 71 | 47 | 151 | 97 | 231 | E7 | 311 | 137 | 391 | 187 | 471 | 1D7 | Upper limit signal bit Index |
| | 72 | 48 | 152 | 98 | 232 | E8 | 312 | 138 | 392 | 188 | 472 | 1D8 | lower limit signal WORD OFFSET |
| | 73 | 49 | 153 | 99 | 233 | E9 | 313 | 139 | 393 | 189 | 473 | 1D9 | lower limit signal bit Index |
| | 74 | 4A | 154 | 9A | 234 | EA | 314 | 13A | 394 | 18A | 474 | 1DA | DOG WORD OFFSET |
| | 75 | 4B | 155 | 9B | 235 | EB | 315 | 13B | 395 | 18B | 475 | 1DB | DOG bit Index |
| | 76 | 4C | 156 | 9C | 236 | EC | 316 | 13C | 396 | 18C | 476 | 1DC | HOME WORD OFFSET |
| | 77 | 4D | 157 | 9D | 237 | ED | 317 | 13D | 397 | 18D | 477 | 1DD | HOME bit Index |
| | 78 | 4E | 158 | 9E | 238 | EE | 318 | 13E | 398 | 18E | 478 | 1DE | Deviation CNT WORD OFFSET |
| | 79 | 4F | 159 | 9F | 239 | EF | 319 | 13F | 399 | 18F | 479 | 1DF | Deviation CNT bit Index |
| Common parameter | | | | | | | | | | | 640 | 280 | CONTROL WORD |
| | | | | | | | | | | | 641 | 281 | Rsvd |
| | | | | | | | | | | | 642 | 282 | Rsvd |
| | | | | | | | | | | | 643 | 283 | Rsvd |
| | | | | | | | | | | | 644 | 284 | Rsvd |
| | | | | | | | | | | | 645 | 285 | Rsvd |
| | | | | | | | | | | | 646 | 286 | Rsvd |
| | | | | | | | | | | | 647 | 287 | Rsvd |
| | | | | | | | | | | | 648 | 288 | Rsvd |
| | | | | | | | | | | | 648 | 289 | Rsvd |

### 11.1.1 Basic parameter Control Word

The table describes how to set the Control Word of the basic parameter.

| Bit position | Contents |
|---|---|
| Pulse output mode (bit 2 ~ 3) | 0: pulse |
| | 1: mm |
| | 2: inch |
| | 3: degree |
| Unit multiplier (bit 4 ~ 5) | 0: x1 |
| | 1: x10 |
| | 2: x100 |
| | 3: x1000 |
| Speed command unit (bit 6) | 0:Unit/Time |
| | 1:rpm |

### 11.1.2 Extended parameter Control Word

The table describes how to set the Control Word of the extended parameter.

| Bit position | Contents |
|---|---|
| Pulse output direction (bit 0) | 0: CW, 1: CCW |
| Acceleration/Deceleration pattern (bit 1) | 0:Trapezoid operation, 1:S-Curve operation |
| M Code mode(bit 2 ~ 3) | 0: NONE, 1: WITH, 2: AFTER |
| Interpolation speed selection (bit 4) | 0: main axis speed, 1: synthetic speed |
| Software limit detection during speed control (bit 5) | 0:Don't detect, 1: Detect |
| Reserved (bit6~8) | - |
| Speed/Position switching coordinate (bit 9) | 0: Incremental, 1: Absolute |
| Reserved (bit 10 ~ 11) | - |
| Infinite running repeat (bit 12) | 0: Disable, 1: Enable |
| Interpolation continuous operation Type (bit 13) | 0 : Pass target position, 1 : Pass near position |
| Arc insertion in 2-axis linear interpolation continuous operation (bit 14) | 0 : Don't insert , 1 : Insert arc continuous operation |
| Pos.-specified speed override coordinate(bit 15) | 0: absolute, 1: incremental |

### 11.1.3 Homing parameter Control Word

The table describes how to set the Control Word of the homing parameter.

| Bit position | Contents |
|---|---|
| Home method (bit 0 ~ 2) | 0: DOG/HOME(OFF) |
| | 1: DOG/HOME(ON) |
| | 2: U.L. Limit/HOME |
| | 3: DOG |
| | 4: High speed |
| | 5: Upper/lower limit |
| | 6: Home |
| Home direction (bit 3) | 0: Forward |
| | 1: Reverse |

### 11.1.4 I/O signal parameter Control Word

The table describes how to set the Control Word of the I/O signal parameter.

| Bit position | Contents |
|---|---|
| High limit(bit 0~1) | 0: No use<br>1: A<br>2: B |
| Low limit(bit 2~3) | |
| DOG(bit 4~5) | |
| HOME(bit 6~7) | |
| Deviation clear(bit 8~9) | |

### 11.1.5 Common parameter Control Word

The table describes how to set the Control Word of the common parameter.

| Bit position | Contents |
|---|---|
| Control period(bit4~7) | 1ms~10ms |
| Speed override (bit 8) | 0: Specify % |
| | 1: Specify speed |
| Pulse output level (bit 15) | 0: Low Active |
| | 1: High Active |

## 11.2 Operation data memory address

"Read/Write Variable Data" commands (XVRD, XVWR) can be used to read/write the operation data of the positioning module. The internal memory address of the embedded positioning module is as follows.

XBM-HP model has operation data of 6-axis, and XBM-H2 model has operation data of 2-axis. Each axis has 400 step data.

### 11.2.1 Axis 1 operation data memory address

| Step | Target position | | Circular interpolation auxiliary point | | Operation speed | | Dwell time | M code | Sub. Axis setting | Helical int. | Circular int. turns | Control word |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Low | High | Low | High | Low | High | | | | | | |
| 1 | 650 | 651 | 652 | 653 | 654 | 655 | 656 | 657 | 658 | 659 | 660 | 661 |
| 2 | 662 | 663 | 664 | 665 | 666 | 667 | 668 | 669 | 670 | 671 | 672 | 673 |
| 3 | 674 | 675 | 676 | 677 | 678 | 679 | 680 | 681 | 682 | 683 | 684 | 685 |
| 4 | 686 | 687 | 688 | 689 | 690 | 691 | 692 | 693 | 694 | 695 | 696 | 697 |
| 5 | 698 | 699 | 700 | 701 | 702 | 703 | 704 | 705 | 706 | 707 | 708 | 709 |
| 6 | 710 | 711 | 712 | 713 | 714 | 715 | 716 | 717 | 718 | 719 | 720 | 721 |
| 7 | 722 | 723 | 724 | 725 | 726 | 727 | 728 | 729 | 730 | 731 | 732 | 733 |
| 8 | 734 | 735 | 736 | 737 | 738 | 739 | 740 | 741 | 742 | 743 | 744 | 745 |
| 9 | 746 | 747 | 748 | 749 | 750 | 751 | 752 | 753 | 754 | 755 | 756 | 757 |
| 10 | 758 | 759 | 760 | 761 | 762 | 763 | 764 | 765 | 766 | 767 | 768 | 769 |
| … | | | | | | | | | | | | |
| n step | 638 +12n | 639 +12n | 640 +12n | 641 +12n | 642 +12n | 643 +12n | 644 +12n | 645 +12n | 646 +12n | 647 +12n | 648 +12n | 649 +12n |
| … | | | | | | | | | | | | |
| 390 | 5318 | 5319 | 5320 | 5321 | 5322 | 5323 | 5324 | 5325 | 5326 | 5327 | 5328 | 5329 |
| 391 | 5330 | 5331 | 5332 | 5333 | 5334 | 5335 | 5336 | 5337 | 5338 | 5339 | 5340 | 5341 |
| 392 | 5342 | 5343 | 5344 | 5345 | 5346 | 5347 | 5348 | 5349 | 5350 | 5351 | 5352 | 5353 |
| 393 | 5354 | 5355 | 5356 | 5357 | 5358 | 5359 | 5360 | 5361 | 5362 | 5363 | 5364 | 5365 |
| 394 | 5366 | 5367 | 5368 | 5369 | 5370 | 5371 | 5372 | 5373 | 5374 | 5375 | 5376 | 5377 |
| 395 | 5378 | 5379 | 5380 | 5381 | 5382 | 5383 | 5384 | 5385 | 5386 | 5387 | 5388 | 5389 |
| 396 | 5390 | 5391 | 5392 | 5393 | 5394 | 5395 | 5396 | 5397 | 5398 | 5399 | 5400 | 5401 |
| 397 | 5402 | 5403 | 5404 | 5405 | 5406 | 5407 | 5408 | 5409 | 5410 | 5411 | 5412 | 5413 |
| 398 | 5414 | 5415 | 5416 | 5417 | 5418 | 5419 | 5420 | 5421 | 5422 | 5423 | 5424 | 5425 |
| 399 | 5426 | 5427 | 5428 | 5429 | 5430 | 5431 | 5432 | 5433 | 5434 | 5435 | 5436 | 5437 |
| 400 | 5438 | 5439 | 5440 | 5441 | 5442 | 5443 | 5444 | 5445 | 5446 | 5447 | 5448 | 5449 |

## 11.2.2 Axis 2 operation data memory address

| Step | Target position | | Circular interpolation auxiliary point | | Operation speed | | Dwell time | M code | Sub. Axis setting | Helical int. | Circular int. turns | Control word |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Low | High | Low | High | Low | High | | | | | | |
| 1 | 5450 | 5451 | 5452 | 5453 | 5454 | 5455 | 5456 | 5457 | 5458 | 5459 | 5460 | 5461 |
| 2 | 5462 | 5463 | 5464 | 5465 | 5466 | 5467 | 5468 | 5469 | 5470 | 5471 | 5472 | 5473 |
| 3 | 5474 | 5475 | 5476 | 5477 | 5478 | 5479 | 5480 | 5481 | 5482 | 5483 | 5484 | 5485 |
| 4 | 5486 | 5487 | 5488 | 5489 | 5490 | 5491 | 5492 | 5493 | 5494 | 5495 | 5496 | 5497 |
| 5 | 5498 | 5499 | 5500 | 5501 | 5502 | 5503 | 5504 | 5505 | 5506 | 5507 | 5508 | 5509 |
| 6 | 5510 | 5511 | 5512 | 5513 | 5514 | 5515 | 5516 | 5517 | 5518 | 5519 | 5520 | 5521 |
| 7 | 5522 | 5523 | 5524 | 5525 | 5526 | 5527 | 5528 | 5529 | 5530 | 5531 | 5532 | 5533 |
| 8 | 5534 | 5535 | 5536 | 5537 | 5538 | 5539 | 5540 | 5541 | 5542 | 5543 | 5544 | 5545 |
| 9 | 5546 | 5547 | 5548 | 5549 | 5550 | 5551 | 5552 | 5553 | 5554 | 5555 | 5556 | 5557 |
| 10 | 5558 | 5559 | 5560 | 5561 | 5562 | 5563 | 5564 | 5565 | 5566 | 5567 | 5568 | 5569 |
| ... | | | | | | | | | | | | |
| n step | 5438 +12n | 5439 +12n | 5440 +12n | 5441 +12n | 5442 +12n | 5443 +12n | 5444 +12n | 5445 +12n | 5446 +12n | 5447 +12n | 5448 +12n | 5449 +12n |
| ... | | | | | | | | | | | | |
| 390 | 10118 | 10119 | 10120 | 10121 | 10122 | 10123 | 10124 | 10125 | 10126 | 10127 | 10128 | 10129 |
| 391 | 10130 | 10131 | 10132 | 10133 | 10134 | 10135 | 10136 | 10137 | 10138 | 10139 | 10140 | 10141 |
| 392 | 10142 | 10143 | 10144 | 10145 | 10146 | 10147 | 10148 | 10149 | 10150 | 10151 | 10152 | 10153 |
| 393 | 10154 | 10155 | 10156 | 10157 | 10158 | 10159 | 10160 | 10161 | 10162 | 10163 | 10164 | 10165 |
| 394 | 10166 | 10167 | 10168 | 10169 | 10170 | 10171 | 10172 | 10173 | 10174 | 10175 | 10176 | 10177 |
| 395 | 10178 | 10179 | 10180 | 10181 | 10182 | 10183 | 10184 | 10185 | 10186 | 10187 | 10188 | 10189 |
| 396 | 10190 | 10191 | 10192 | 10193 | 10194 | 10195 | 10196 | 10197 | 10198 | 10199 | 10200 | 10201 |
| 397 | 10202 | 10203 | 10204 | 10205 | 10206 | 10207 | 10208 | 10209 | 10210 | 10211 | 10212 | 10213 |
| 398 | 10214 | 10215 | 10216 | 10217 | 10218 | 10219 | 10220 | 10221 | 10222 | 10223 | 10224 | 10225 |
| 399 | 10226 | 10227 | 10228 | 10229 | 10230 | 10231 | 10232 | 10233 | 10234 | 10235 | 10236 | 10237 |
| 400 | 10238 | 10239 | 10240 | 10241 | 10242 | 10243 | 10244 | 10245 | 10246 | 10247 | 10248 | 10249 |

### 11.2.3 Axis 3 operation data memory address

| Step | Target position | | Circular interpolation auxiliary point | | Operation speed | | Dwell time | M code | Sub. Axis setting | Helical int. | Circular int. turns | Control word |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Low | High | Low | High | Low | High | | | | | | |
| 1 | 10250 | 10251 | 10252 | 10253 | 10254 | 10255 | 10256 | 10257 | 10258 | 10259 | 10260 | 10261 |
| 2 | 10262 | 10263 | 10264 | 10265 | 10266 | 10267 | 10268 | 10269 | 10270 | 10271 | 10272 | 10273 |
| 3 | 10274 | 10275 | 10276 | 10277 | 10278 | 10279 | 10280 | 10281 | 10282 | 10283 | 10284 | 10285 |
| 4 | 10286 | 10287 | 10288 | 10289 | 10290 | 10291 | 10292 | 10293 | 10294 | 10295 | 10296 | 10297 |
| 5 | 10298 | 10299 | 10300 | 10301 | 10302 | 10303 | 10304 | 10305 | 10306 | 10307 | 10308 | 10309 |
| 6 | 10310 | 10311 | 10312 | 10313 | 10314 | 10315 | 10316 | 10317 | 10318 | 10319 | 10320 | 10321 |
| 7 | 10322 | 10323 | 10324 | 10325 | 10326 | 10327 | 10328 | 10329 | 10330 | 10331 | 10332 | 10333 |
| 8 | 10334 | 10335 | 10336 | 10337 | 10338 | 10339 | 10340 | 10341 | 10342 | 10343 | 10344 | 10345 |
| 9 | 10346 | 10347 | 10348 | 10349 | 10350 | 10351 | 10352 | 10353 | 10354 | 10355 | 10356 | 10357 |
| 10 | 10358 | 10359 | 10360 | 10361 | 10362 | 10363 | 10364 | 10365 | 10366 | 10367 | 10368 | 10369 |
| ... | | | | | | | | | | | | |
| n step | 10238 +12n | 10239 +12n | 10240 +12n | 10241 +12n | 10242 +12n | 10243 +12n | 10244 +12n | 10245 +12n | 10246 +12n | 10247 +12n | 10248 +12n | 10249 +12n |
| ... | | | | | | | | | | | | |
| 390 | 14918 | 14919 | 14920 | 14921 | 14922 | 14923 | 14924 | 14925 | 14926 | 14927 | 14928 | 14929 |
| 391 | 14930 | 14931 | 14932 | 14933 | 14934 | 14935 | 14936 | 14937 | 14938 | 14939 | 14940 | 14941 |
| 392 | 14942 | 14943 | 14944 | 14945 | 14946 | 14947 | 14948 | 14949 | 14950 | 14951 | 14952 | 14953 |
| 393 | 14954 | 14955 | 14956 | 14957 | 14958 | 14959 | 14960 | 14961 | 14962 | 14963 | 14964 | 14965 |
| 394 | 14966 | 14967 | 14968 | 14969 | 14970 | 14971 | 14972 | 14973 | 14974 | 14975 | 14976 | 14977 |
| 395 | 14978 | 14979 | 14980 | 14981 | 14982 | 14983 | 14984 | 14985 | 14986 | 14987 | 14988 | 14989 |
| 396 | 14990 | 14991 | 14992 | 14993 | 14994 | 14995 | 14996 | 14997 | 14998 | 14999 | 15000 | 15001 |
| 397 | 15002 | 15003 | 15004 | 15005 | 15006 | 15007 | 15008 | 15009 | 15010 | 15011 | 15012 | 15013 |
| 398 | 15014 | 15015 | 15016 | 15017 | 15018 | 15019 | 15020 | 15021 | 15022 | 15023 | 15024 | 15025 |
| 399 | 15026 | 15027 | 15028 | 15029 | 15030 | 15031 | 15032 | 15033 | 15034 | 15035 | 15036 | 15037 |
| 400 | 15038 | 15039 | 15040 | 15041 | 15042 | 15043 | 15044 | 15045 | 15046 | 15047 | 15048 | 15049 |

### 11.2.4 Axis 4 operation data memory address

| Step | Target position | | Circular interpolation auxiliary point | | Operation speed | | Dwell time | M code | Sub. Axis setting | Helical int. | Circular int. turns | Control word |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Low | High | Low | High | Low | High | | | | | | |
| 1 | 15050 | 15051 | 15052 | 15053 | 15054 | 15055 | 15056 | 15057 | 15058 | 15059 | 15060 | 15061 |
| 2 | 15062 | 15063 | 15064 | 15065 | 15066 | 15067 | 15068 | 15069 | 15070 | 15071 | 15072 | 15073 |
| 3 | 15074 | 15075 | 15076 | 15077 | 15078 | 15079 | 15080 | 15081 | 15082 | 15083 | 15084 | 15085 |
| 4 | 15086 | 15087 | 15088 | 15089 | 15090 | 15091 | 15092 | 15093 | 15094 | 15095 | 15096 | 15097 |
| 5 | 15098 | 15099 | 15100 | 15101 | 15102 | 15103 | 15104 | 15105 | 15106 | 15107 | 15108 | 15109 |
| 6 | 15110 | 15111 | 15112 | 15113 | 15114 | 15115 | 15116 | 15117 | 15118 | 15119 | 15120 | 15121 |
| 7 | 15122 | 15123 | 15124 | 15125 | 15126 | 15127 | 15128 | 15129 | 15130 | 15131 | 15132 | 15133 |
| 8 | 15134 | 15135 | 15136 | 15137 | 15138 | 15139 | 15140 | 15141 | 15142 | 15143 | 15144 | 15145 |
| 9 | 15146 | 15147 | 15148 | 15149 | 15150 | 15151 | 15152 | 15153 | 15154 | 15155 | 15156 | 15157 |
| 10 | 15158 | 15159 | 15160 | 15161 | 15162 | 15163 | 15164 | 15165 | 15166 | 15167 | 15168 | 15169 |
| ... | | | | | | | | | | | | |
| n step | 15038 +12n | 15039 +12n | 15040 +12n | 15041 +12n | 15042 +12n | 15043 +12n | 15044 +12n | 15045 +12n | 15046 +12n | 15047 +12n | 15048 +12n | 15049 +12n |
| ... | | | | | | | | | | | | |
| 390 | 19718 | 19719 | 19720 | 19721 | 19722 | 19723 | 19724 | 19725 | 19726 | 19727 | 19728 | 19729 |
| 391 | 19730 | 19731 | 19732 | 19733 | 19734 | 19735 | 19736 | 19737 | 19738 | 19739 | 19740 | 19741 |
| 392 | 19742 | 19743 | 19744 | 19745 | 19746 | 19747 | 19748 | 19749 | 19750 | 19751 | 19752 | 19753 |
| 393 | 19754 | 19755 | 19756 | 19757 | 19758 | 19759 | 19760 | 19761 | 19762 | 19763 | 19764 | 19765 |
| 394 | 19766 | 19767 | 19768 | 19769 | 19770 | 19771 | 19772 | 19773 | 19774 | 19775 | 19776 | 19777 |
| 395 | 19778 | 19779 | 19780 | 19781 | 19782 | 19783 | 19784 | 19785 | 19786 | 19787 | 19788 | 19789 |
| 396 | 19790 | 19791 | 19792 | 19793 | 19794 | 19795 | 19796 | 19797 | 19798 | 19799 | 19800 | 19801 |
| 397 | 19802 | 19803 | 19804 | 19805 | 19806 | 19807 | 19808 | 19809 | 19810 | 19811 | 19812 | 19813 |
| 398 | 19814 | 19815 | 19816 | 19817 | 19818 | 19819 | 19820 | 19821 | 19822 | 19823 | 19824 | 19825 |
| 399 | 19826 | 19827 | 19828 | 19829 | 19830 | 19831 | 19832 | 19833 | 19834 | 19835 | 19836 | 19837 |
| 400 | 19838 | 19839 | 19840 | 19841 | 19842 | 19843 | 19844 | 19845 | 19846 | 19847 | 19848 | 19849 |

### 11.2.5 Axis 5 operation data memory address

| Step | Target position | | Circular interpolation auxiliary point | | Operation speed | | Dwell time | M code | Sub. Axis setting | Helical int. | Circular int. turns | Control word |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Low | High | Low | High | Low | High | | | | | | |
| 1 | 19850 | 19851 | 19852 | 19853 | 19854 | 19855 | 19856 | 19857 | 19858 | 19859 | 19860 | 19861 |
| 2 | 19862 | 19863 | 19864 | 19865 | 19866 | 19867 | 19868 | 19869 | 19870 | 19871 | 19872 | 19873 |
| 3 | 19874 | 19875 | 19876 | 19877 | 19878 | 19879 | 19880 | 19881 | 19882 | 19883 | 19884 | 19885 |
| 4 | 19886 | 19887 | 19888 | 19889 | 19890 | 19891 | 19892 | 19893 | 19894 | 19895 | 19896 | 19897 |
| 5 | 19898 | 19899 | 19900 | 19901 | 19902 | 19903 | 19904 | 19905 | 19906 | 19907 | 19908 | 19909 |
| 6 | 19910 | 19911 | 19912 | 19913 | 19914 | 19915 | 19916 | 19917 | 19918 | 19919 | 19920 | 19921 |
| 7 | 19922 | 19923 | 19924 | 19925 | 19926 | 19927 | 19928 | 19929 | 19930 | 19931 | 19932 | 19933 |
| 8 | 19934 | 19935 | 19936 | 19937 | 19938 | 19939 | 19940 | 19941 | 19942 | 19943 | 19944 | 19945 |
| 9 | 19946 | 19947 | 19948 | 19949 | 19950 | 19951 | 19952 | 19953 | 19954 | 19955 | 19956 | 19957 |
| 10 | 19958 | 19959 | 19960 | 19961 | 19962 | 19963 | 19964 | 19965 | 19966 | 19967 | 19968 | 19969 |
| … | | | | | | | | | | | | |
| n step | 19838 +12n | 19839 +12n | 19840 +12n | 19841 +12n | 19842 +12n | 19843 +12n | 19844 +12n | 19845 +12n | 19846 +12n | 19847 +12n | 19848 +12n | 19849 +12n |
| … | | | | | | | | | | | | |
| 390 | 24518 | 24519 | 24520 | 24521 | 24522 | 24523 | 24524 | 24525 | 24526 | 24527 | 24528 | 24529 |
| 391 | 24530 | 24531 | 24532 | 24533 | 24534 | 24535 | 24536 | 24537 | 24538 | 24539 | 24540 | 24541 |
| 392 | 24542 | 24543 | 24544 | 24545 | 24546 | 24547 | 24548 | 24549 | 24550 | 24551 | 24552 | 24553 |
| 393 | 24554 | 24555 | 24556 | 24557 | 24558 | 24559 | 24560 | 24561 | 24562 | 24563 | 24564 | 24565 |
| 394 | 24566 | 24567 | 24568 | 24569 | 24570 | 24571 | 24572 | 24573 | 24574 | 24575 | 24576 | 24577 |
| 395 | 24578 | 24579 | 24580 | 24581 | 24582 | 24583 | 24584 | 24585 | 24586 | 24587 | 24588 | 24589 |
| 396 | 24590 | 24591 | 24592 | 24593 | 24594 | 24595 | 24596 | 24597 | 24598 | 24599 | 24600 | 24601 |
| 397 | 24602 | 24603 | 24604 | 24605 | 24606 | 24607 | 24608 | 24609 | 24610 | 24611 | 24612 | 24613 |
| 398 | 24614 | 24615 | 24616 | 24617 | 24618 | 24619 | 24620 | 24621 | 24622 | 24623 | 24624 | 24625 |
| 399 | 24626 | 24627 | 24628 | 24629 | 24630 | 24631 | 24632 | 24633 | 24634 | 24635 | 24636 | 24637 |
| 400 | 24638 | 24639 | 24640 | 24641 | 24642 | 24643 | 24644 | 24645 | 24646 | 24647 | 24648 | 24649 |

## 11.2.6 Axis 6 operation data memory address

| Step | Target position | | Cir. int. auxiliary point | | Operation speed | | Dwell time | Mcode | Sub Axis | Helical int. | Circular int. turns | Control word |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Low | High | Low | High | Low | High | | | | | | |
| 1 | 24650 | 24651 | 24652 | 24653 | 24654 | 24655 | 24656 | 24657 | 24658 | 24659 | 24660 | 24661 |
| 2 | 24662 | 24663 | 24664 | 24665 | 24666 | 24667 | 24668 | 24669 | 24670 | 24671 | 24672 | 24673 |
| 3 | 24674 | 24675 | 24676 | 24677 | 24678 | 24679 | 24680 | 24681 | 24682 | 24683 | 24684 | 24685 |
| 4 | 24686 | 24687 | 24688 | 24689 | 24690 | 24691 | 24692 | 24693 | 24694 | 24695 | 24696 | 24697 |
| 5 | 24698 | 24699 | 24700 | 24701 | 24702 | 24703 | 24704 | 24705 | 24706 | 24707 | 24708 | 24709 |
| 6 | 24710 | 24711 | 24712 | 24713 | 24714 | 24715 | 24716 | 24717 | 24718 | 24719 | 24720 | 24721 |
| 7 | 24722 | 24723 | 24724 | 24725 | 24726 | 24727 | 24728 | 24729 | 24730 | 24731 | 24732 | 24733 |
| 8 | 24734 | 24735 | 24736 | 24737 | 24738 | 24739 | 24740 | 24741 | 24742 | 24743 | 24744 | 24745 |
| 9 | 24746 | 24747 | 24748 | 24749 | 24750 | 24751 | 24752 | 24753 | 24754 | 24755 | 24756 | 24757 |
| 10 | 24758 | 24759 | 24760 | 24761 | 24762 | 24763 | 24764 | 24765 | 24766 | 24767 | 24768 | 24769 |
| … | | | | | | | | | | | | |
| n step | 24638 +12n | 24639 +12n | 24640 +12n | 24641 +12n | 24642 +12n | 24643 +12n | 24644 +12n | 24645 +12n | 24646 +12n | 24647 +12n | 24648 +12n | 24649 +12n |
| … | | | | | | | | | | | | |
| 390 | 29318 | 29319 | 29320 | 29321 | 29322 | 29323 | 29324 | 29325 | 29326 | 29327 | 29328 | 29329 |
| 391 | 29330 | 29331 | 29332 | 29333 | 29334 | 29335 | 29336 | 29337 | 29338 | 29339 | 29340 | 29341 |
| 392 | 29342 | 29343 | 29344 | 29345 | 29346 | 29347 | 29348 | 29349 | 29350 | 29351 | 29352 | 29353 |
| 393 | 29354 | 29355 | 29356 | 29357 | 29358 | 29359 | 29360 | 29361 | 29362 | 29363 | 29364 | 29365 |
| 394 | 29366 | 29367 | 29368 | 29369 | 29370 | 29371 | 29372 | 29373 | 29374 | 29375 | 29376 | 29377 |
| 395 | 29378 | 29379 | 29380 | 29381 | 29382 | 29383 | 29384 | 29385 | 29386 | 29387 | 29388 | 29389 |
| 396 | 29390 | 29391 | 29392 | 29393 | 29394 | 29395 | 29396 | 29397 | 29398 | 29399 | 29400 | 29401 |
| 397 | 29402 | 29403 | 29404 | 29405 | 29406 | 29407 | 29408 | 29409 | 29410 | 29411 | 29412 | 29413 |
| 398 | 29414 | 29415 | 29416 | 29417 | 29418 | 29419 | 29420 | 29421 | 29422 | 29423 | 29424 | 29425 |
| 399 | 29426 | 29427 | 29428 | 29429 | 29430 | 29431 | 29432 | 29433 | 29434 | 29435 | 29436 | 29437 |
| 400 | 29438 | 29439 | 29440 | 29441 | 29442 | 29443 | 29444 | 29445 | 29446 | 29447 | 29448 | 29449 |

### 11.2.7 Control Word of operation data

The table describes how to set the Control Word of the operation data.

| Bit position | Contents |
|---|---|
| Coordinate (bit 0) | 0 : absolute, 1 : incremental |
| Control method (bit 1~3) | 0 : single axis positioning<br>1 : Single axis speed control<br>2 : Single axis Feed control<br>3 : Linear interpolation<br>4 : Circular interpolation |
| Operation method (bit 4) | 0 : Singular, 1 : Repeat |
| Operation pattern (bit 5~6) | 0 : End, 1 : Keep, 2 : Continuous |
| Circular size (bit 7) | 0 : Arc < 180, 1 : Arc >= 180 |
| Acceleration No. (bit 8~9) | 0 ~ 3 |
| Deceleration No. (bit 10~11) | 0 ~ 3 |
| Circular interpolation method (bit 12~13) | 0 : midpoint, 1 : central point, 2 : radius |
| Circular interpolating direction (bit 14) | 0 : CW, 1 : CCW |

## 11.3 CAM data memory address

“Read/Write Variable Data” commands (XVRD, XVWR) can be used to read/write the CAM data of the positioning module. The internal memory address of the embedded positioning module is as follows.

| Item | | Block 1 | Block 2 | Block 3 | Block 4 | Block 5 | Block 6 | Block 7 | Block 8 |
|---|---|---|---|---|---|---|---|---|---|
| CAM Main axis per rotation distance(Low) | | 41820 | 46050 | 50280 | 54510 | 58740 | 62970 | 67200 | 71430 |
| CAM Main axis distance per rotation (High) | | 41821 | 46051 | 50281 | 54511 | 58741 | 62971 | 67201 | 71431 |
| CAM Main axis pulse per rotation (Low) | | 41822 | 46052 | 50282 | 54512 | 58742 | 62972 | 67202 | 71432 |
| CAM Main axis pulse per rotation (High) | | 41823 | 46053 | 50283 | 54513 | 58743 | 62973 | 67203 | 71433 |
| CAM Sub axis distance per rotation (Low) | | 41824 | 46054 | 50284 | 54514 | 58744 | 62974 | 67204 | 71434 |
| CAM Sub axis distance per rotation (High) | | 41825 | 46055 | 50285 | 54515 | 58745 | 62975 | 67205 | 71435 |
| CAM Sub axis pulse per rotation (Low) | | 41826 | 46056 | 50286 | 54516 | 58746 | 62976 | 67206 | 71436 |
| CAM Sub axis pulse per rotation (High) | | 41827 | 46057 | 50287 | 54517 | 58747 | 62977 | 67207 | 71437 |
| CAM Data End Step(WORD) | | 41828 | 46058 | 50288 | 54518 | 58748 | 62978 | 67208 | 71438 |
| CAM Data Info(WORD)<br>Bit 0~1: Main axis Unit<br>Bit 2~3: Sub axis Unit<br>Bit 8: CAM mode(0: repeat, 1: increase) | | 41829 | 46059 | 50289 | 54519 | 58749 | 62979 | 67209 | 71439 |
| User Data[0] | Main axis end pos(low 16bit) | 41830 | 46060 | 50290 | 54520 | 58750 | 62980 | 67210 | 71440 |
| | Main axis end pos(high 16bit) | 41831 | 46061 | 50291 | 54521 | 58751 | 62981 | 67211 | 71441 |
| | Sub axis end pos(low 16bit) | 41832 | 46062 | 50292 | 54522 | 58752 | 62982 | 67212 | 71442 |
| | Sub axis end pos(high 16bit) | 41833 | 46063 | 50293 | 54523 | 58753 | 62983 | 67213 | 71443 |
| | CAM Curve | 41834 | 46064 | 50294 | 54524 | 58754 | 62984 | 67214 | 71444 |
| | - | 41835 | 46065 | 50295 | 54525 | 58755 | 62985 | 67215 | 71445 |
| User Data[1] | Main axis end pos(low 16bit) | 41836 | 46066 | 50296 | 54526 | 58756 | 62986 | 67216 | 71446 |
| | Main axis end pos(high 16bit) | 41837 | 46067 | 50297 | 54527 | 58757 | 62987 | 67217 | 71447 |
| | Sub axis end pos(low 16bit) | 41838 | 46068 | 50298 | 54528 | 58758 | 62988 | 67218 | 71448 |
| | Sub axis end pos(high 16bit) | 41839 | 46069 | 50299 | 54529 | 58759 | 62989 | 67219 | 71449 |
| | CAM Curve | 41840 | 46070 | 50300 | 54530 | 58760 | 62990 | 67220 | 71450 |
| | - | 41841 | 46071 | 50301 | 54531 | 58761 | 62991 | 67221 | 71451 |
| User Data[2] | Main axis end pos(low 16bit) | 41842 | 46072 | 50302 | 54532 | 58762 | 62992 | 67222 | 71452 |
| | Main axis end pos(high 16bit) | 41843 | 46073 | 50303 | 54533 | 58763 | 62993 | 67223 | 71453 |
| | Sub axis end pos(low 16bit) | 41844 | 46074 | 50304 | 54534 | 58764 | 62994 | 67224 | 71454 |
| | Sub axis end pos(high 16bit) | 41845 | 46075 | 50305 | 54535 | 58765 | 62995 | 67225 | 71455 |
| | CAM Curve | 41846 | 46076 | 50306 | 54536 | 58766 | 62996 | 67226 | 71456 |
| | - | 41847 | 46077 | 50307 | 54537 | 58767 | 62997 | 67227 | 71457 |
| User Data[3] | Main axis end pos(low 16bit) | 41848 | 46078 | 50308 | 54538 | 58768 | 62998 | 67228 | 71458 |
| | Main axis end pos(high 16bit) | 41849 | 46079 | 50309 | 54539 | 58769 | 62999 | 67229 | 71459 |
| | Sub axis end pos(low 16bit) | 41850 | 46080 | 50310 | 54540 | 58770 | 63000 | 67230 | 71460 |
| | Sub axis end pos(high 16bit) | 41851 | 46081 | 50311 | 54541 | 58771 | 63001 | 67231 | 71461 |
| | CAM Curve | 41852 | 46082 | 50312 | 54542 | 58772 | 63002 | 67232 | 71462 |
| | - | 41853 | 46083 | 50313 | 54543 | 58773 | 63003 | 67233 | 71463 |
| User Data[4] | Main axis end pos(low 16bit) | 41854 | 46084 | 50314 | 54544 | 58774 | 63004 | 67234 | 71464 |
| | Main axis end pos(high 16bit) | 41855 | 46085 | 50315 | 54545 | 58775 | 63005 | 67235 | 71465 |
| | Sub axis end pos(low 16bit) | 41856 | 46086 | 50316 | 54546 | 58776 | 63006 | 67236 | 71466 |
| | Sub axis end pos(high 16bit) | 41857 | 46087 | 50317 | 54547 | 58777 | 63007 | 67237 | 71467 |
| | CAM Curve | 41858 | 46088 | 50318 | 54548 | 58778 | 63008 | 67238 | 71468 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | - | 41859 | 46089 | 50319 | 54549 | 58779 | 63009 | 67239 | 71469 |
| User Data[5] | Main axis end pos(low 16bit) | 41860 | 46090 | 50320 | 54550 | 58780 | 63010 | 67240 | 71470 |
| | Main axis end pos(high 16bit) | 41861 | 46091 | 50321 | 54551 | 58781 | 63011 | 67241 | 71471 |
| | Sub axis end pos(low 16bit) | 41862 | 46092 | 50322 | 54552 | 58782 | 63012 | 67242 | 71472 |
| | Sub axis end pos(high 16bit) | 41863 | 46093 | 50323 | 54553 | 58783 | 63013 | 67243 | 71473 |
| | CAM Curve | 41864 | 46094 | 50324 | 54554 | 58784 | 63014 | 67244 | 71474 |
| | - | 41865 | 46095 | 50325 | 54555 | 58785 | 63015 | 67245 | 71475 |
| User Data[6] | Main axis end pos(low 16bit) | 41866 | 46096 | 50326 | 54556 | 58786 | 63016 | 67246 | 71476 |
| | Main axis end pos(high 16bit) | 41867 | 46097 | 50327 | 54557 | 58787 | 63017 | 67247 | 71477 |
| | Sub axis end pos(low 16bit) | 41868 | 46098 | 50328 | 54558 | 58788 | 63018 | 67248 | 71478 |
| | Sub axis end pos(high 16bit) | 41869 | 46099 | 50329 | 54559 | 58789 | 63019 | 67249 | 71479 |
| | CAM Curve | 41870 | 46100 | 50330 | 54560 | 58790 | 63020 | 67250 | 71480 |
| | - | 41871 | 46101 | 50331 | 54561 | 58791 | 63021 | 67251 | 71481 |
| User Data[7] | Main axis end pos(low 16bit) | 41872 | 46102 | 50332 | 54562 | 58792 | 63022 | 67252 | 71482 |
| | Main axis end pos(high 16bit) | 41873 | 46103 | 50333 | 54563 | 58793 | 63023 | 67253 | 71483 |
| | Sub axis end pos(low 16bit) | 41874 | 46104 | 50334 | 54564 | 58794 | 63024 | 67254 | 71484 |
| | Sub axis end pos(high 16bit) | 41875 | 46105 | 50335 | 54565 | 58795 | 63025 | 67255 | 71485 |
| | CAM Curve | 41876 | 46106 | 50336 | 54566 | 58796 | 63026 | 67256 | 71486 |
| | - | 41877 | 46107 | 50337 | 54567 | 58797 | 63027 | 67257 | 71487 |
| User Data[8] | Main axis end pos(low 16bit) | 41878 | 46108 | 50338 | 54568 | 58798 | 63028 | 67258 | 71488 |
| | Main axis end pos(high 16bit) | 41879 | 46109 | 50339 | 54569 | 58799 | 63029 | 67259 | 71489 |
| | Sub axis end pos(low 16bit) | 41880 | 46110 | 50340 | 54570 | 58800 | 63030 | 67260 | 71490 |
| | Sub axis end pos(high 16bit) | 41881 | 46111 | 50341 | 54571 | 58801 | 63031 | 67261 | 71491 |
| | CAM Curve | 41882 | 46112 | 50342 | 54572 | 58802 | 63032 | 67262 | 71492 |
| | - | 41883 | 46113 | 50343 | 54573 | 58803 | 63033 | 67263 | 71493 |
| User Data[9] | Main axis end pos(low 16bit) | 41884 | 46114 | 50344 | 54574 | 58804 | 63034 | 67264 | 71494 |
| | Main axis end pos(high 16bit) | 41885 | 46115 | 50345 | 54575 | 58805 | 63035 | 67265 | 71495 |
| | Sub axis end pos(low 16bit) | 41886 | 46116 | 50346 | 54576 | 58806 | 63036 | 67266 | 71496 |
| | Sub axis end pos(high 16bit) | 41887 | 46117 | 50347 | 54577 | 58807 | 63037 | 67267 | 71497 |
| | CAM Curve | 41888 | 46118 | 50348 | 54578 | 58808 | 63038 | 67268 | 71498 |
| | - | 41889 | 46119 | 50349 | 54579 | 58809 | 63039 | 67269 | 71499 |
| User Data[10] | Main axis end pos(low 16bit) | 41890 | 46120 | 50350 | 54580 | 58810 | 63040 | 67270 | 71500 |
| | Main axis end pos(high 16bit) | 41891 | 46121 | 50351 | 54581 | 58811 | 63041 | 67271 | 71501 |
| | Sub axis end pos(low 16bit) | 41892 | 46122 | 50352 | 54582 | 58812 | 63042 | 67272 | 71502 |
| | Sub axis end pos(high 16bit) | 41893 | 46123 | 50353 | 54583 | 58813 | 63043 | 67273 | 71503 |
| | CAM Curve | 41894 | 46124 | 50354 | 54584 | 58814 | 63044 | 67274 | 71504 |
| | - | 41895 | 46125 | 50355 | 54585 | 58815 | 63045 | 67275 | 71505 |
| User Data[11] | Main axis end pos(low 16bit) | 41896 | 46126 | 50356 | 54586 | 58816 | 63046 | 67276 | 71506 |
| | Main axis end pos(high 16bit) | 41897 | 46127 | 50357 | 54587 | 58817 | 63047 | 67277 | 71507 |
| | Sub axis end pos(low 16bit) | 41898 | 46128 | 50358 | 54588 | 58818 | 63048 | 67278 | 71508 |
| | Sub axis end pos(high 16bit) | 41899 | 46129 | 50359 | 54589 | 58819 | 63049 | 67279 | 71509 |
| | CAM Curve | 41900 | 46130 | 50360 | 54590 | 58820 | 63050 | 67280 | 71510 |
| | - | 41901 | 46131 | 50361 | 54591 | 58821 | 63051 | 67281 | 71511 |
| User Data[12] | Main axis end pos(low 16bit) | 41902 | 46132 | 50362 | 54592 | 58822 | 63052 | 67282 | 71512 |
| | Main axis end pos(high 16bit) | 41903 | 46133 | 50363 | 54593 | 58823 | 63053 | 67283 | 71513 |
| | Sub axis end pos(low 16bit) | 41904 | 46134 | 50364 | 54594 | 58824 | 63054 | 67284 | 71514 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Sub axis end pos(high 16bit) | 41905 | 46135 | 50365 | 54595 | 58825 | 63055 | 67285 | 71515 |
| | CAM Curve | 41906 | 46136 | 50366 | 54596 | 58826 | 63056 | 67286 | 71516 |
| | - | 41907 | 46137 | 50367 | 54597 | 58827 | 63057 | 67287 | 71517 |
| User Data[13] | Main axis end pos(low 16bit) | 41908 | 46138 | 50368 | 54598 | 58828 | 63058 | 67288 | 71518 |
| | Main axis end pos(high 16bit) | 41909 | 46139 | 50369 | 54599 | 58829 | 63059 | 67289 | 71519 |
| | Sub axis end pos(low 16bit) | 41910 | 46140 | 50370 | 54600 | 58830 | 63060 | 67290 | 71520 |
| | Sub axis end pos(high 16bit) | 41911 | 46141 | 50371 | 54601 | 58831 | 63061 | 67291 | 71521 |
| | CAM Curve | 41912 | 46142 | 50372 | 54602 | 58832 | 63062 | 67292 | 71522 |
| | - | 41913 | 46143 | 50373 | 54603 | 58833 | 63063 | 67293 | 71523 |
| User Data[14] | Main axis end pos(low 16bit) | 41914 | 46144 | 50374 | 54604 | 58834 | 63064 | 67294 | 71524 |
| | Main axis end pos(high 16bit) | 41915 | 46145 | 50375 | 54605 | 58835 | 63065 | 67295 | 71525 |
| | Sub axis end pos(low 16bit) | 41916 | 46146 | 50376 | 54606 | 58836 | 63066 | 67296 | 71526 |
| | Sub axis end pos(high 16bit) | 41917 | 46147 | 50377 | 54607 | 58837 | 63067 | 67297 | 71527 |
| | CAM Curve | 41918 | 46148 | 50378 | 54608 | 58838 | 63068 | 67298 | 71528 |
| | - | 41919 | 46149 | 50379 | 54609 | 58839 | 63069 | 67299 | 71529 |
| User Data[15] | Main axis end pos(low 16bit) | 41920 | 46150 | 50380 | 54610 | 58840 | 63070 | 67300 | 71530 |
| | Main axis end pos(high 16bit) | 41921 | 46151 | 50381 | 54611 | 58841 | 63071 | 67301 | 71531 |
| | Sub axis end pos(low 16bit) | 41922 | 46152 | 50382 | 54612 | 58842 | 63072 | 67302 | 71532 |
| | Sub axis end pos(high 16bit) | 41923 | 46153 | 50383 | 54613 | 58843 | 63073 | 67303 | 71533 |
| | CAM Curve | 41924 | 46154 | 50384 | 54614 | 58844 | 63074 | 67304 | 71534 |
| | - | 41925 | 46155 | 50385 | 54615 | 58845 | 63075 | 67305 | 71535 |
| User Data[16] | Main axis end pos(low 16bit) | 41926 | 46156 | 50386 | 54616 | 58846 | 63076 | 67306 | 71536 |
| | Main axis end pos(high 16bit) | 41927 | 46157 | 50387 | 54617 | 58847 | 63077 | 67307 | 71537 |
| | Sub axis end pos(low 16bit) | 41928 | 46158 | 50388 | 54618 | 58848 | 63078 | 67308 | 71538 |
| | Sub axis end pos(high 16bit) | 41929 | 46159 | 50389 | 54619 | 58849 | 63079 | 67309 | 71539 |
| | CAM Curve | 41930 | 46160 | 50390 | 54620 | 58850 | 63080 | 67310 | 71540 |
| | - | 41931 | 46161 | 50391 | 54621 | 58851 | 63081 | 67311 | 71541 |
| User Data[17] | Main axis end pos(low 16bit) | 41932 | 46162 | 50392 | 54622 | 58852 | 63082 | 67312 | 71542 |
| | Main axis end pos(high 16bit) | 41933 | 46163 | 50393 | 54623 | 58853 | 63083 | 67313 | 71543 |
| | Sub axis end pos(low 16bit) | 41934 | 46164 | 50394 | 54624 | 58854 | 63084 | 67314 | 71544 |
| | Sub axis end pos(high 16bit) | 41935 | 46165 | 50395 | 54625 | 58855 | 63085 | 67315 | 71545 |
| | CAM Curve | 41936 | 46166 | 50396 | 54626 | 58856 | 63086 | 67316 | 71546 |
| | - | 41937 | 46167 | 50397 | 54627 | 58857 | 63087 | 67317 | 71547 |
| User Data[18] | Main axis end pos(low 16bit) | 41938 | 46168 | 50398 | 54628 | 58858 | 63088 | 67318 | 71548 |
| | Main axis end pos(high 16bit) | 41939 | 46169 | 50399 | 54629 | 58859 | 63089 | 67319 | 71549 |
| | Sub axis end pos(low 16bit) | 41940 | 46170 | 50400 | 54630 | 58860 | 63090 | 67320 | 71550 |
| | Sub axis end pos(high 16bit) | 41941 | 46171 | 50401 | 54631 | 58861 | 63091 | 67321 | 71551 |
| | CAM Curve | 41942 | 46172 | 50402 | 54632 | 58862 | 63092 | 67322 | 71552 |
| | - | 41943 | 46173 | 50403 | 54633 | 58863 | 63093 | 67323 | 71553 |
| User Data[19] | Main axis end pos(low 16bit) | 41944 | 46174 | 50404 | 54634 | 58864 | 63094 | 67324 | 71554 |
| | Main axis end pos(high 16bit) | 41945 | 46175 | 50405 | 54635 | 58865 | 63095 | 67325 | 71555 |
| | Sub axis end pos(low 16bit) | 41946 | 46176 | 50406 | 54636 | 58866 | 63096 | 67326 | 71556 |
| | Sub axis end pos(high 16bit) | 41947 | 46177 | 50407 | 54637 | 58867 | 63097 | 67327 | 71557 |
| | CAM Curve | 41948 | 46178 | 50408 | 54638 | 58868 | 63098 | 67328 | 71558 |
| | - | 41949 | 46179 | 50409 | 54639 | 58869 | 63099 | 67329 | 71559 |
| Step Offset | | 41950 | 46180 | 50410 | 54640 | 58870 | 63100 | 67330 | 71560 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| - | 41951 | 46181 | 50411 | 54641 | 58871 | 63101 | 67331 | 71561 |
| Total pulse | 41952 | 46182 | 50412 | 54642 | 58872 | 63102 | 67332 | 71562 |
| - | 41953 | 46183 | 50413 | 54643 | 58873 | 63103 | 67333 | 71563 |

| Item | Block 1 | Block 2 | Block 3 | Block 4 | Block 5 | Block 6 | Block 7 | Block 8 |
|---|---|---|---|---|---|---|---|---|
| CAM Data[0](Low) | 41954 | 46184 | 50414 | 54644 | 58874 | 63104 | 67334 | 71564 |
| CAM Data[0](High) | 41955 | 46185 | 50415 | 54645 | 58875 | 63105 | 67335 | 71565 |
| CAM Data[1](Low) | 41956 | 46186 | 50416 | 54646 | 58876 | 63106 | 67336 | 71566 |
| CAM Data[1](High) | 41957 | 46187 | 50417 | 54647 | 58877 | 63107 | 67337 | 71567 |
| CAM Data[2](Low) | 41958 | 46188 | 50418 | 54648 | 58878 | 63108 | 67338 | 71568 |
| CAM Data[2](High) | 41959 | 46189 | 50419 | 54649 | 58879 | 63109 | 67339 | 71569 |
| CAM Data[3](Low) | 41960 | 46190 | 50420 | 54650 | 58880 | 63110 | 67340 | 71570 |
| CAM Data[3](High) | 41961 | 46191 | 50421 | 54651 | 58881 | 63111 | 67341 | 71571 |
| CAM Data[4](Low) | 41962 | 46192 | 50422 | 54652 | 58882 | 63112 | 67342 | 71572 |
| CAM Data[4](High) | 41963 | 46193 | 50423 | 54653 | 58883 | 63113 | 67343 | 71573 |
| CAM Data[5](Low) | 41964 | 46194 | 50424 | 54654 | 58884 | 63114 | 67344 | 71574 |
| CAM Data[5](High) | 41965 | 46195 | 50425 | 54655 | 58885 | 63115 | 67345 | 71575 |
| CAM Data[6](Low) | 41966 | 46196 | 50426 | 54656 | 58886 | 63116 | 67346 | 71576 |
| CAM Data[6](High) | 41967 | 46197 | 50427 | 54657 | 58887 | 63117 | 67347 | 71577 |
| CAM Data[7](Low) | 41968 | 46198 | 50428 | 54658 | 58888 | 63118 | 67348 | 71578 |
| CAM Data[7](High) | 41969 | 46199 | 50429 | 54659 | 58889 | 63119 | 67349 | 71579 |
| CAM Data[8](Low) | 41970 | 46200 | 50430 | 54660 | 58890 | 63120 | 67350 | 71580 |
| CAM Data[8](High) | 41971 | 46201 | 50431 | 54661 | 58891 | 63121 | 67351 | 71581 |
| CAM Data[9](Low) | 41972 | 46202 | 50432 | 54662 | 58892 | 63122 | 67352 | 71582 |
| CAM Data[9](High) | 41973 | 46203 | 50433 | 54663 | 58893 | 63123 | 67353 | 71583 |
| CAM Data[10](Low) | 41974 | 46204 | 50434 | 54664 | 58894 | 63124 | 67354 | 71584 |
| CAM Data[10](High) | 41975 | 46205 | 50435 | 54665 | 58895 | 63125 | 67355 | 71585 |
| … | | | | | | | | |
| CAM Data[n](Low) | 41954 +2n | 46184 +2n | 50414 +2n | 54644 +2n | 58874 +2n | 63104 +2n | 67334 +2n | 71564 +2n |
| CAM Data[n](High) | 41955 +2n | 46185 +2n | 50415 +2n | 54645 +2n | 58875 +2n | 63105 +2n | 67335 +2n | 71565 +2n |
| … | | | | | | | | |
| CAM Data[2042](Low) | 46038 | 50268 | 54498 | 58728 | 62958 | 67188 | 71418 | 75648 |
| CAM Data[2042](High) | 46039 | 50269 | 54499 | 58729 | 62959 | 67189 | 71419 | 75649 |
| CAM Data[2043](Low) | 46040 | 50270 | 54500 | 58730 | 62960 | 67190 | 71420 | 75650 |
| CAM Data[2043](High) | 46041 | 50271 | 54501 | 58731 | 62961 | 67191 | 71421 | 75651 |
| CAM Data[2044](Low) | 46042 | 50272 | 54502 | 58732 | 62962 | 67192 | 71422 | 75652 |
| CAM Data[2044](High) | 46043 | 50273 | 54503 | 58733 | 62963 | 67193 | 71423 | 75653 |
| CAM Data[2045](Low) | 46044 | 50274 | 54504 | 58734 | 62964 | 67194 | 71424 | 75654 |
| CAM Data[2045](High) | 46045 | 50275 | 54505 | 58735 | 62965 | 67195 | 71425 | 75655 |
| CAM Data[2046](Low) | 46046 | 50276 | 54506 | 58736 | 62966 | 67196 | 71426 | 75656 |
| CAM Data[2046](High) | 46047 | 50277 | 54507 | 58737 | 62967 | 67197 | 71427 | 75657 |
| CAM Data[2047](Low) | 46048 | 50278 | 54508 | 58738 | 62968 | 67198 | 71428 | 75658 |
| CAM Data[2047](High) | 46049 | 50279 | 54509 | 58739 | 62969 | 67199 | 71429 | 75659 |

## **11.4** User CAM data memory address

“Read/Write Variable Data” commands (XVRD, XVWR) can be used to read/write the CAM data of the positioning module. The internal memory address of the embedded positioning module is as follows.

| Item | Axis 1 | Axis 2 | Axis 3 | Axis 4 | Axis 5 | Axis 6 |
|---|---|---|---|---|---|---|
| user CAM data | 142636 | 142758 | 142880 | 143002 | 143124 | 143246 |
| - | 142637 | 142759 | 142881 | 143003 | 143125 | 143247 |
| Main axis position 1 Low | 142638 | 142760 | 142882 | 143004 | 143126 | 143248 |
| Main axis position 1 High | 142639 | 142761 | 142883 | 143005 | 143127 | 143249 |
| Sub axis position 1 Low | 142640 | 142762 | 142884 | 143006 | 143128 | 143250 |
| Sub axis position 1 High | 142641 | 142763 | 142885 | 143007 | 143129 | 143251 |
| Main axis position 2 Low | 142642 | 142764 | 142886 | 143008 | 143130 | 143252 |
| Main axis position 2 High | 142643 | 142765 | 142887 | 143009 | 143131 | 143253 |
| Sub axis position 2 Low | 142644 | 142766 | 142888 | 143010 | 143132 | 143254 |
| Sub axis position 2 High | 142645 | 142767 | 142889 | 143011 | 143133 | 143255 |
| Main axis position 3 Low | 142646 | 142768 | 142890 | 143012 | 143134 | 143256 |
| Main axis position 3 High | 142647 | 142769 | 142891 | 143013 | 143135 | 143257 |
| Sub axis position 3 Low | 142648 | 142770 | 142892 | 143014 | 143136 | 143258 |
| Sub axis position 3 High | 142649 | 142771 | 142893 | 143015 | 143137 | 143259 |
| Main axis position 4 Low | 142650 | 142772 | 142894 | 143016 | 143138 | 143260 |
| Main axis position 4 High | 142651 | 142773 | 142895 | 143017 | 143139 | 143261 |
| Sub axis position 4 Low | 142652 | 142774 | 142896 | 143018 | 143140 | 143262 |
| Sub axis position 4 High | 142653 | 142775 | 142897 | 143019 | 143141 | 143263 |
| Main axis position 5 Low | 142654 | 142776 | 142898 | 143020 | 143142 | 143264 |
| Main axis position 5 High | 142655 | 142777 | 142899 | 143021 | 143143 | 143265 |
| Sub axis position 5 Low | 142656 | 142778 | 142900 | 143022 | 143144 | 143266 |
| Sub axis position 5 High | 142657 | 142779 | 142901 | 143023 | 143145 | 143267 |
| Main axis position 6 Low | 142658 | 142780 | 142902 | 143024 | 143146 | 143268 |
| Main axis position 6 High | 142659 | 142781 | 142903 | 143025 | 143147 | 143269 |
| Sub axis position 6 Low | 142660 | 142782 | 142904 | 143026 | 143148 | 143270 |
| Sub axis position 6 High | 142661 | 142783 | 142905 | 143027 | 143149 | 143271 |
| Main axis position 7 Low | 142662 | 142784 | 142906 | 143028 | 143150 | 143272 |
| Main axis position 7 High | 142663 | 142785 | 142907 | 143029 | 143151 | 143273 |
| Sub axis position 7 Low | 142664 | 142786 | 142908 | 143030 | 143152 | 143274 |
| Sub axis position 7 High | 142665 | 142787 | 142909 | 143031 | 143153 | 143275 |
| Main axis position 8 Low | 142666 | 142788 | 142910 | 143032 | 143154 | 143276 |
| Main axis position 8 High | 142667 | 142789 | 142911 | 143033 | 143155 | 143277 |
| Sub axis position 8 Low | 142668 | 142790 | 142912 | 143034 | 143156 | 143278 |
| Sub axis position 8 High | 142669 | 142791 | 142913 | 143035 | 143157 | 143279 |
| Main axis position 9 Low | 142670 | 142792 | 142914 | 143036 | 143158 | 143280 |
| Main axis position 9 High | 142671 | 142793 | 142915 | 143037 | 143159 | 143281 |
| Sub axis position 9 Low | 142672 | 142794 | 142916 | 143038 | 143160 | 143282 |
| Sub axis position 9 High | 142673 | 142795 | 142917 | 143039 | 143161 | 143283 |
| Main axis position 10 Low | 142674 | 142796 | 142918 | 143040 | 143162 | 143284 |
| Main axis position 10 High | 142675 | 142797 | 142919 | 143041 | 143163 | 143285 |
| Sub axis position 10 Low | 142676 | 142798 | 142920 | 143042 | 143164 | 143286 |
| Sub axis position 10 High | 142677 | 142799 | 142921 | 143043 | 143165 | 143287 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Main axis position 11 Low | 142678 | 142800 | 142922 | 143044 | 143166 | 143288 |
| Main axis position 11 High | 142679 | 142801 | 142923 | 143045 | 143167 | 143289 |
| Sub axis position 11 Low | 142680 | 142802 | 142924 | 143046 | 143168 | 143290 |
| Sub axis position 11 High | 142681 | 142803 | 142925 | 143047 | 143169 | 143291 |
| Main axis position 12 Low | 142682 | 142804 | 142926 | 143048 | 143170 | 143292 |
| Main axis position 12 High | 142683 | 142805 | 142927 | 143049 | 143171 | 143293 |
| Sub axis position 12 Low | 142684 | 142806 | 142928 | 143050 | 143172 | 143294 |
| Sub axis position 12 High | 142685 | 142807 | 142929 | 143051 | 143173 | 143295 |
| Main axis position 13 Low | 142686 | 142808 | 142930 | 143052 | 143174 | 143296 |
| Main axis position 13 High | 142687 | 142809 | 142931 | 143053 | 143175 | 143297 |
| Sub axis position 13 Low | 142688 | 142810 | 142932 | 143054 | 143176 | 143298 |
| Sub axis position 13 High | 142689 | 142811 | 142933 | 143055 | 143177 | 143299 |
| Main axis position 14 Low | 142690 | 142812 | 142934 | 143056 | 143178 | 143300 |
| Main axis position 14 High | 142691 | 142813 | 142935 | 143057 | 143179 | 143301 |
| Sub axis position 14 Low | 142692 | 142814 | 142936 | 143058 | 143180 | 143302 |
| Sub axis position 14 High | 142693 | 142815 | 142937 | 143059 | 143181 | 143303 |
| Main axis position 15 Low | 142694 | 142816 | 142938 | 143060 | 143182 | 143304 |
| Main axis position 15 High | 142695 | 142817 | 142939 | 143061 | 143183 | 143305 |
| Sub axis position 15 Low | 142696 | 142818 | 142940 | 143062 | 143184 | 143306 |
| Sub axis position 15 High | 142697 | 142819 | 142941 | 143063 | 143185 | 143307 |
| Main axis position 16 Low | 142698 | 142820 | 142942 | 143064 | 143186 | 143308 |
| Main axis position 16 High | 142699 | 142821 | 142943 | 143065 | 143187 | 143309 |
| Sub axis position 16 Low | 142700 | 142822 | 142944 | 143066 | 143188 | 143310 |
| Sub axis position 16 High | 142701 | 142823 | 142945 | 143067 | 143189 | 143311 |
| Main axis position 17 Low | 142702 | 142824 | 142946 | 143068 | 143190 | 143312 |
| Main axis position 17 High | 142703 | 142825 | 142947 | 143069 | 143191 | 143313 |
| Sub axis position 17 Low | 142704 | 142826 | 142948 | 143070 | 143192 | 143314 |
| Sub axis position 17 High | 142705 | 142827 | 142949 | 143071 | 143193 | 143315 |
| Main axis position 18 Low | 142706 | 142828 | 142950 | 143072 | 143194 | 143316 |
| Main axis position 18 High | 142707 | 142829 | 142951 | 143073 | 143195 | 143317 |
| Sub axis position 18 Low | 142708 | 142830 | 142952 | 143074 | 143196 | 143318 |
| Sub axis position 18 High | 142709 | 142831 | 142953 | 143075 | 143197 | 143319 |
| Main axis position 19 Low | 142710 | 142832 | 142954 | 143076 | 143198 | 143320 |
| Main axis position 19 High | 142711 | 142833 | 142955 | 143077 | 143199 | 143321 |
| Sub axis position 19 Low | 142712 | 142834 | 142956 | 143078 | 143200 | 143322 |
| Sub axis position 19 High | 142713 | 142835 | 142957 | 143079 | 143201 | 143323 |
| Main axis position 20 Low | 142714 | 142836 | 142958 | 143080 | 143202 | 143324 |
| Main axis position 20 High | 142715 | 142837 | 142959 | 143081 | 143203 | 143325 |
| Sub axis position 20 Low | 142716 | 142838 | 142960 | 143082 | 143204 | 143326 |
| Sub axis position 20 High | 142717 | 142839 | 142961 | 143083 | 143205 | 143327 |
| Main axis position 21 Low | 142718 | 142840 | 142962 | 143084 | 143206 | 143328 |
| Main axis position 21 High | 142719 | 142841 | 142963 | 143085 | 143207 | 143329 |
| Sub axis position 21 Low | 142720 | 142842 | 142964 | 143086 | 143208 | 143330 |
| Sub axis position 21 High | 142721 | 142843 | 142965 | 143087 | 143209 | 143331 |
| Main axis position 22 Low | 142722 | 142844 | 142966 | 143088 | 143210 | 143332 |
| Main axis position 22 High | 142723 | 142845 | 142967 | 143089 | 143211 | 143333 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Sub axis position 22 Low | 142724 | 142846 | 142968 | 143090 | 143212 | 143334 |
| Sub axis position 22 High | 142725 | 142847 | 142969 | 143091 | 143213 | 143335 |
| Main axis position 23 Low | 142726 | 142848 | 142970 | 143092 | 143214 | 143336 |
| Main axis position 23 High | 142727 | 142849 | 142971 | 143093 | 143215 | 143337 |
| Sub axis position 23 Low | 142728 | 142850 | 142972 | 143094 | 143216 | 143338 |
| Sub axis position 23 High | 142729 | 142851 | 142973 | 143095 | 143217 | 143339 |
| Main axis position 24 Low | 142730 | 142852 | 142974 | 143096 | 143218 | 143340 |
| Main axis position 24 High | 142731 | 142853 | 142975 | 143097 | 143219 | 143341 |
| Sub axis position 24 Low | 142732 | 142854 | 142976 | 143098 | 143220 | 143342 |
| Sub axis position 24 High | 142733 | 142855 | 142977 | 143099 | 143221 | 143343 |
| Main axis position 25 Low | 142734 | 142856 | 142978 | 143100 | 143222 | 143344 |
| Main axis position 25 High | 142735 | 142857 | 142979 | 143101 | 143223 | 143345 |
| Sub axis position 25 Low | 142736 | 142858 | 142980 | 143102 | 143224 | 143346 |
| Sub axis position 25 High | 142737 | 142859 | 142981 | 143103 | 143225 | 143347 |
| Main axis position 26 Low | 142738 | 142860 | 142982 | 143104 | 143226 | 143348 |
| Main axis position 26 High | 142739 | 142861 | 142983 | 143105 | 143227 | 143349 |
| Sub axis position 26 Low | 142740 | 142862 | 142984 | 143106 | 143228 | 143350 |
| Sub axis position 26 High | 142741 | 142863 | 142985 | 143107 | 143229 | 143351 |
| Main axis position 27 Low | 142742 | 142864 | 142986 | 143108 | 143230 | 143352 |
| Main axis position 27 High | 142743 | 142865 | 142987 | 143109 | 143231 | 143353 |
| Sub axis position 27 Low | 142744 | 142866 | 142988 | 143110 | 143232 | 143354 |
| Sub axis position 27 High | 142745 | 142867 | 142989 | 143111 | 143233 | 143355 |
| Main axis position 28 Low | 142746 | 142868 | 142990 | 143112 | 143234 | 143356 |
| Main axis position 28 High | 142747 | 142869 | 142991 | 143113 | 143235 | 143357 |
| Sub axis position 28 Low | 142748 | 142870 | 142992 | 143114 | 143236 | 143358 |
| Sub axis position 28 High | 142749 | 142871 | 142993 | 143115 | 143237 | 143359 |
| Main axis position 29 Low | 142750 | 142872 | 142994 | 143116 | 143238 | 143360 |
| Main axis position 29 High | 142751 | 142873 | 142995 | 143117 | 143239 | 143361 |
| Sub axis position 29 Low | 142752 | 142874 | 142996 | 143118 | 143240 | 143362 |
| Sub axis position 29 High | 142753 | 142875 | 142997 | 143119 | 143241 | 143363 |
| Main axis position 30 Low | 142754 | 142876 | 142998 | 143120 | 143242 | 143364 |
| Main axis position 30 High | 142755 | 142877 | 142999 | 143121 | 143243 | 143365 |
| Sub axis position 30 Low | 142756 | 142878 | 143000 | 143122 | 143244 | 143366 |
| Sub axis position 30 High | 142757 | 142879 | 143001 | 143123 | 143245 | 143367 |

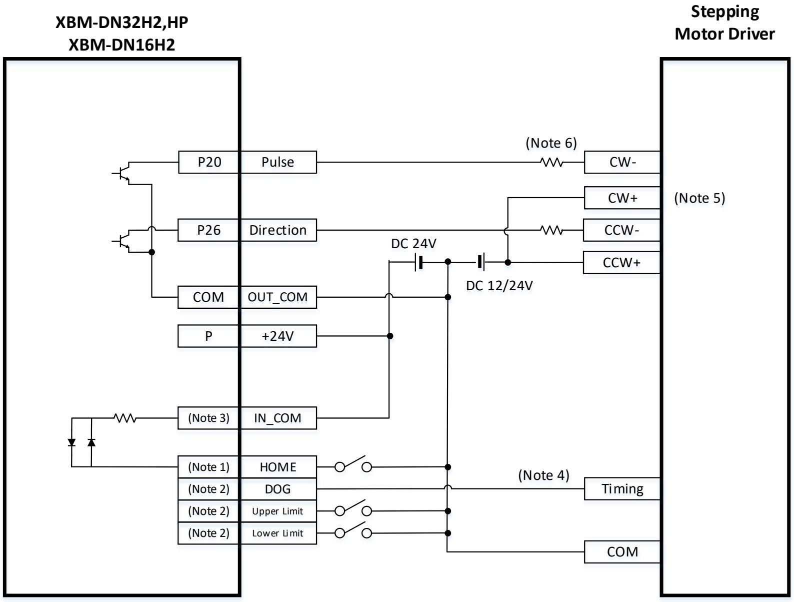
# Chapter 12 Motor Wiring Example

## 12.1 Stepping Motor Wiring Example

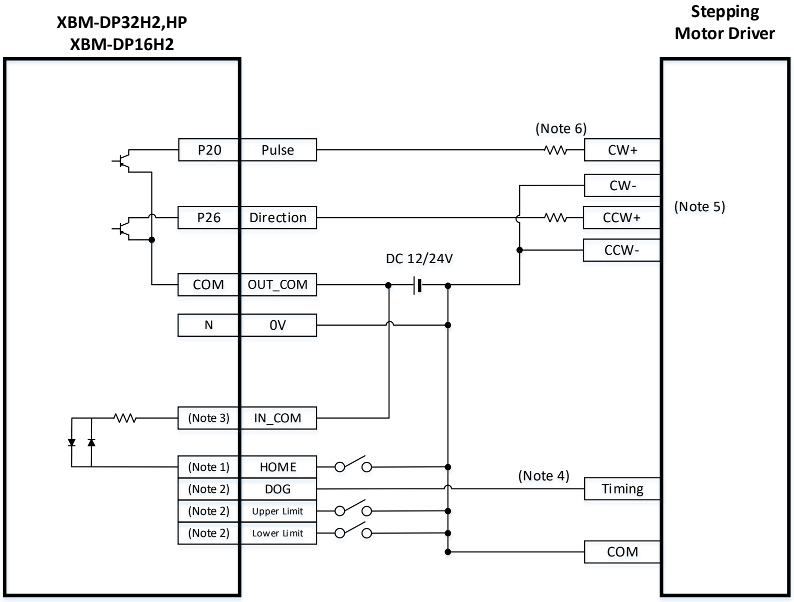
Here describes wiring example between XBM positioning output and stepping motor.
In case of using stepping motor not described in here, please refer to corresponding motor driver's user manual.

(1) Connection to a stepping motor driver

(a) Sink type output models (XBM-DN32H2/HP, XBM-DN16H2)



(b) Source type output models (XBM-DP32H2/HP, XBM-DP16H2)



(Note 1) HOME signal can be set to any contact between P00 and P0F through the I/O Signal Parameter settings in the XG-PM software.

(Note 2) Input signals other than HOME signal can be set to any contact with P device through the I/O Signal Parameter settings in the XG-PM software. If not used, they will function as general input contacts. The emergency stop signal can be used by using the emergency stop command (XEMG).

(Note 3) For each input, please connect the input COM to the COM contact corresponding to the set P device contact.

(Note 4) In case of VEXTA RKD series, timing output is on every time a motor rotates 7.2 degrees. For precise home return, timing output and origin sensor should be structured by AND circuit. Depending on a system's features, it is recommended to use home return only by DOG signal or origin sensor by origin signal (XGB origin input rating is DC 24V)

(Note 5) Since the built-in positioning output of the XBM-H2/HP only supports the 'Pulse + Direction' mode, please make sure to change the input mode of the stepper motor driver to single-phase input mode for proper operation.

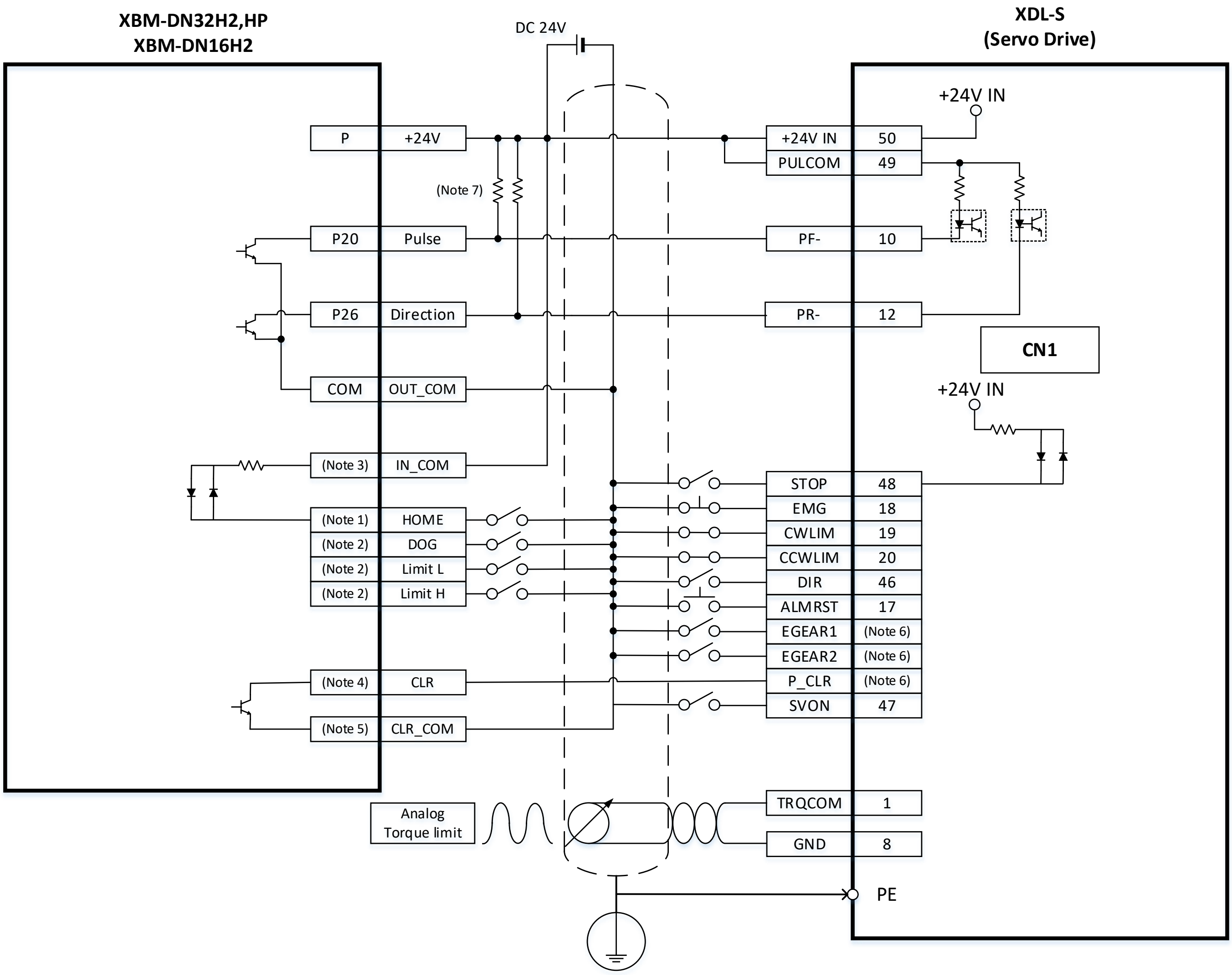
## 12.2 Servo Motor Wiring Example

Here describes wiring example between XGB and servo motor.

In case of using servo motor not described here, please refer to corresponding motor driver's user manual.

(1) Connection to a servor motor driver (XGT Servo XDL-S)

(a) Sink type output models (XBM-DN32H2/HP, XBM-DN16H2)



(Note 1) The home position signal can be set to P0000~P000F through the I/O Signal Parameter setting.

(Note 2) Input signals other than HOME signal can be set within the entire range of P devices. Set P devices that are designated as inputs because it is not checked whether it is input or output.

(Note 3) For each input, please connect the COM to the corresponding COM contact of the configured P device.

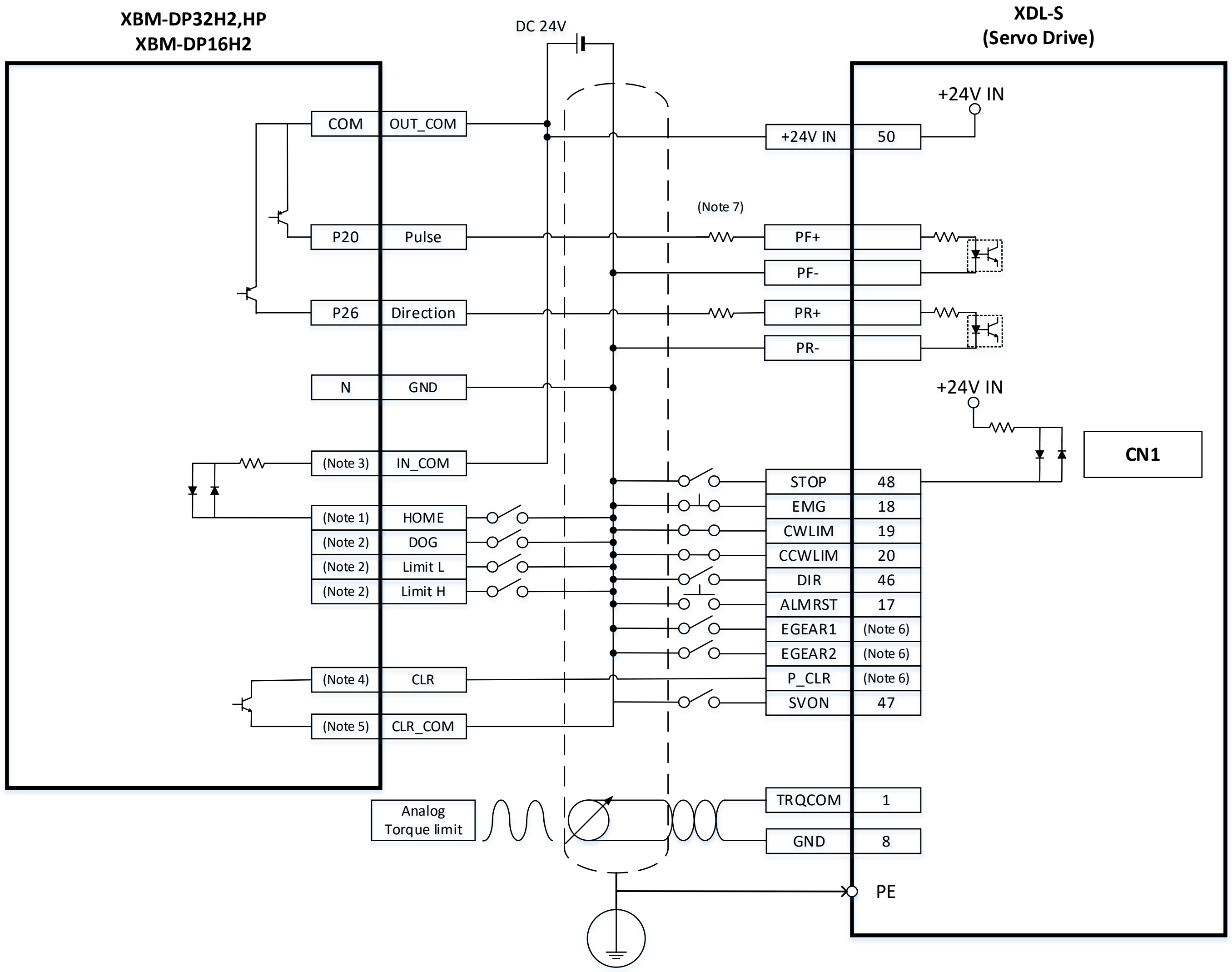
(Note 4) The deviation clear signal can be set within the entire range of P device. Set P devices that are designated as inputs because it is not checked whether it is input or output.

(Note 5) For COM contact of the deviation clear signal, connect the COM to the corresponding COM contact of the configured P device.

(Note 6) EGEAR1, EGEAR2, P_CLR are not allocated. It can be allocated with Parameter Settings. For more information, please refer to Servo manual.

(Note 7) The Off time of the transistor tends to increase when the load current is low. If you need to reduce the Off time of the transistor, please increase the load current by adding a dummy resistor as shown in the diagram.

(b) Source type output models (XBM-DP32H2/HP, XBM-DP16H2)



(Note 1) The home position signal can be set to P0000~P000F through the I/O Signal Parameter setting.

(Note 2) Input signals other than HOME signal can be set within the entire range of P devices. Set P devices that are designated as inputs because it is not checked whether it is input or output.

(Note 3) For each input, please connect the COM to the corresponding COM contact of the configured P device.

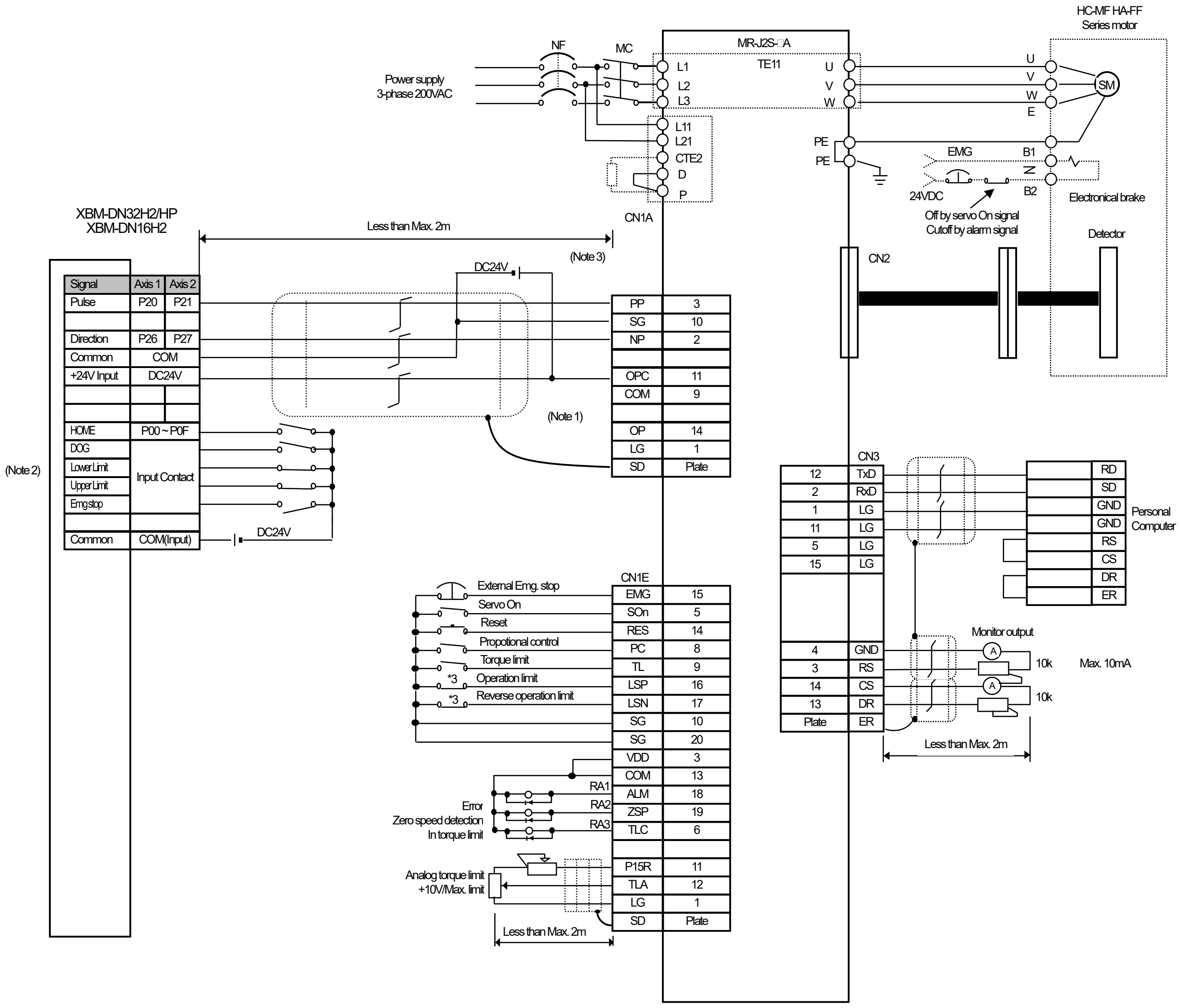
(Note 4) The deviation clear signal can be set within the entire range of P device. Set P devices that are designated as inputs because it is not checked whether it is input or output.

(Note 5) For COM contact of the deviation clear signal, connect the COM to the corresponding COM contact of the configured P device.

(Note 6) EGEAR1, EGEAR2, P_CLR are not allocated. It can be allocated with Parameter Settings. For more information, please refer to Servo manual.

(Note 7) When using a 5V power : R = 100 ~ 150Ω, 1/2W
When using a 12V power : R = 560 ~ 680Ω, 1/2W
When using a 24V power : R = 1.5kΩ, 1/2W

(2) Connection to a servo motor driver (MR-J2/J2S-□A)

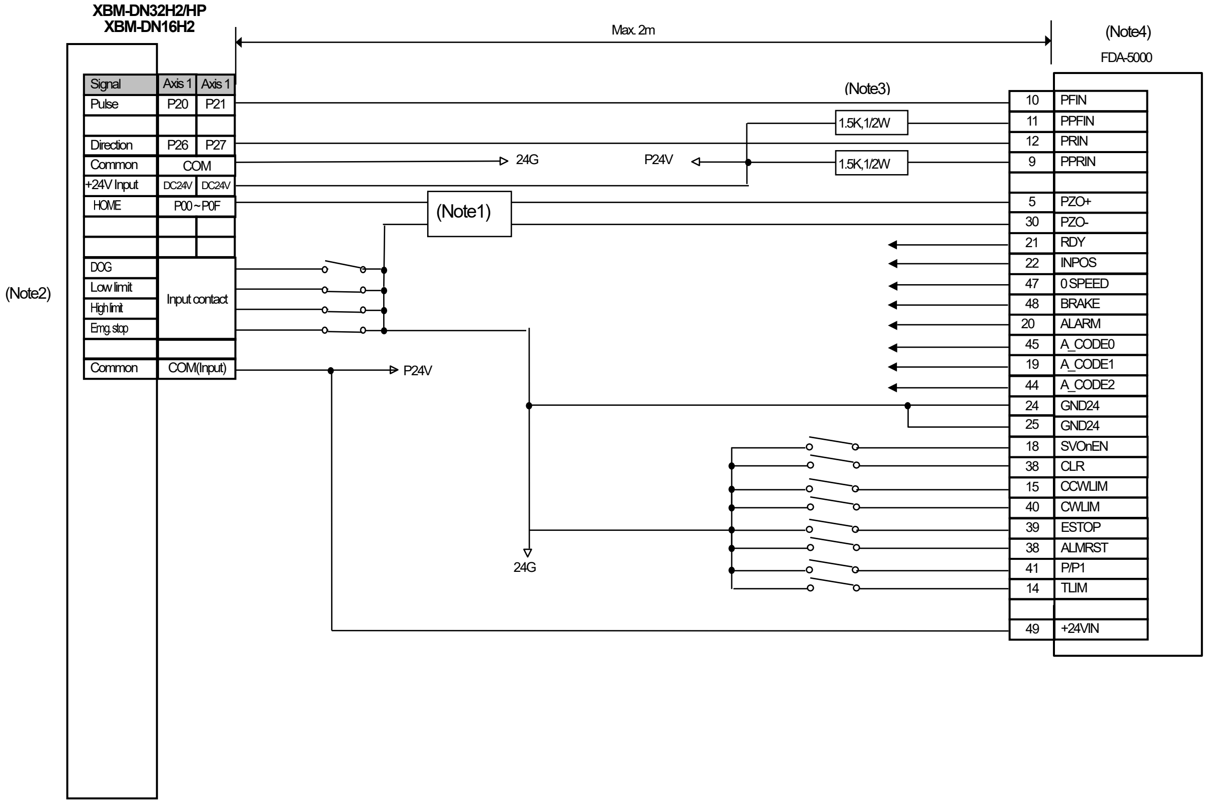


(Note 1) HOME signal can be set from P00 to P0F through the I/O Signal Parameter settings in the XG-PM software. The HOME signal input rating of XGB product is DC 24V. Be sure to connect it to the open collector output of the driver.

(Note 2) Input signals other than HOME signal can be set to any contact with P device through the I/O Signal Parameter settings in the XG-PM software. If not used, they will function as general input contacts. The emergency stop signal can be used by using the emergency stop command (XEMG).

(Note 3) Since the built-in positioning output of the XBM-H2/HP only supports the 'Pulse + Direction' mode, please make sure to change the input mode of the stepper motor driver to single-phase input mode for proper operation.

(3) Connection to a servo motor driver (FDA-5000 AC Servo Driver)



(Note 1) The rating of HOME signal is 24VDC. It is impossible to connect it to a line driver output. Please either connect an external device that converts the line driver output to an open collector output method, use the home return method based on a DOG signal, or use a home sensor as the HOME signal. The HOME signal can be configured from P00 to P0F through the I/O Signal Parameter settings in the XG-PM software.

(Note 2) Input signals other than HOME signal can be set to any contact with P device through the I/O Signal Parameter settings in the XG-PM software. If not used, they will function as general input contacts. The emergency stop signal can be used by using the emergency stop command (XEMG).

(Note 3) When using a DC 24V power, please connect a resistor (1.5K,1/2W) in series with the driver to ensure proper operation.

(Note 4) Since the built-in positioning output of the XBM-H2/HP only supports the ‘Pulse + Direction’ mode, please make sure to change the input mode of the stepper motor driver to single-phase input mode for proper operation.

# Part 4 Communication

This part describes the specifications, performance and operation methods of built-in FEnet and Cnet (RS-232C, RS-485) communication.

# Chapter 1 Built-in FEnet communication

## 1.1 Outline

Ethernet is the international standard registered to IEEE (Institute of Electrical and Electronics Engineers), which controls data transfer through CSMA/CD (Carrier Sense Multiple Access/Collision Detection).

Ethernet can transmit data at the speed of10 Mbps and 100 Mbps and it is stated as 'Fast Ethernet' in the standard. The speed of Fast Ethernet can be expressed as 10 BASE-T, 100 BASE-T. 'T' means the twisted pair wire. In the case of 100 BASE-T, for stable communication with high speed, the specification of the cable to be used is defined and standardized cables are recommended.

**Notice**

XBM-H2/HP operate at 10/100 BASE, but only supports Auto-Negotiation setting, and the user cannot select the speed directly. When auto-negotiation is used, the network speed is automatically configured to recognize and match the highest supported speed between devices.

### 1.1.1 Characteristics

Built-in FEnet supports ARP, ICMP, TCP, UDP, IP, SMTP and SNTP protocols and has the following features.

1) Supporting IEEE 802.3u standard
2) Supporting high speed link for high-speed data communication between LS ELECTRIC modules
   - Providing the parameter setting program (XG5000)
   - Transmission of the maximum 32 blocks x 200 words, reception of the maximum 32 blocks x 200 words, transmission reception of maximum 64 blocks x 200 words.
3) Communication with up to 16 modules except HS link (maximum 16 channels when using dedicated communication and P2P communication)
4) Supporting the loader service (XG5000) through Ethernet
   - Dedicated TCP/IP PORT: 2002 allocations
5) Easy connection with other companies' systems through P2P communication and XG5000
   - Variable READ/WRITE service is available: Using the Dynamic Connection functions
6) Auto Negotiation
   - Supporting 10/100BASE-TX media auto setting
7) Auto-MDIX (Using HP Auto-MDIX)
   - Function to assort the cross cable and straight cable automatically
8) Supporting various communication functions
   - System access through public network
   - Supporting LS ELECTRIC protocol (XGT) and other companies' protocols (Modbus TCP/IP) (dedicated service)

- Supporting the simple and convenient client function for communication between LS ELECTRIC IS communication modules and communication with other companies' modules
- XGT, Modbus TCP, user-defined P2P client function
- Providing the host Enable table for upper PC (MMI) and communication security
- Supporting Dynamic Connection/Disconnection through P2P service

9) Providing various diagnosis functions, status information of modules and network
   - Status of the CPU module
   - Status of communication modules
   - Status of communication services (high speed link, dedicated service, P2P)
   - Providing the PING function to verify the presence of other modules
   - Providing packet types received by LS ELECTRIC communication modules and packet reception rate per minute (network load can be estimated)
   - Providing the diagnosis function of communication modules through the network
   - Auto scan(Shows network connected device of LS ELECTRIC IS product) provided (Except for XBL-EMTA)
   - IP search function provided in XG5000(Except for XBL-EMTA)

10) Providing commercial service
   - Providing E-mail transmission service through SMTP.
   - Providing PLC time synchronization service though SNTP protocol.

## 1.2 Specifications

### 1.2.1 Performance Specifications

1) Transmission Specifications

| Items | | Specifications | Remarks |
|---|---|---|---|
| Transmission specifications | Transfer rate | Auto | |
| | Transfer mode | Base band | |
| | Flow control | HALF/FULL | |
| | Modulation method | NRZI | 4B/5B coding |
| | Transformer CT | 1:1 | node– hub |
| | Maximum distance between nodes | 100 m | |
| | Minimum distance between nodes | 1m or more Note1) | |
| | Maximum protocol size | Data 512 bytes | |
| | Communication zone access method | CSMA/CD | |
| | Frame error check | CRC 32 | |
| | Communication channel | 1 Channel | |

*Note1) When using a cable of less than 1 m, the SNR (Signal to Noise Ratio) decreases due to the influence of reflected waves, which may cause Link Down or packet loss.

2) Maximum number of channels

| Items | Specifications | Remarks |
|---|---|---|
| Maximum server access channel | 25 channels | XGT dedicated or Modbus: 16 channels<br>UDP dedicated server: 1channel(UDP)<br>High speed link: 1channel(UDP)<br>Remote 1,2: each 2channel(TCP)<br>Auto Scan: 2channels(UDP)<br>SMTP: 2channels<br>(including relay server 1channel)(TCP)<br>SNTP: 1channel(UDP) |

3) Performance specifications by communication service

| Items | | Specifications | | | |
|---|---|---|---|---|---|
| | | Driver | Comm. method | Port No. | Remarks |
| FUNCTION | Dedicated | XGT server | TCP/IP | 2004 | ▪ Up to 16 channels<br>▪ Up to 512 bytes |
| | | | UDP/IP | 2005 | |
| | | Modbus TCP server | TCP/IP | 502 | |
| | High speed link | - | UDP/IP | 2006 | ▪ Up to 64 blocks<br>▪ 200 words per block |
| | P2P | XGT client | TCP/IP | 2004 | ▪ Up to 15 channels<br>▪ Up to 512 bytes |
| | | | UDP/IP | 2005 | |
| | | Modbus TCP client | TCP/IP | 502 | |
| | | User-defined frame | TCP/IP | Customized | |
| | | | UDP/IP | Customized | |
| | Remote | Server | TCP/IP | 2002 | ▪ Up to 1channel |
| | | Client | TCP/IP | 2002 | ▪ Up to 1channel |

| | | | | | |
|---|---|---|---|---|---|
| | Auto Scan | - | UDP/IP | 2007(list),<br>2008(inforamtion0 | ▪ Up to 2channel |
| | SNTP | Client | UDP/IP | Customized | ▪Up to 1channel |
| | SMTP | Client | TCP/IP | 25(relay)<br>Customized | ▪Up to 2channel |

4) Performance specifications of diagnosis function

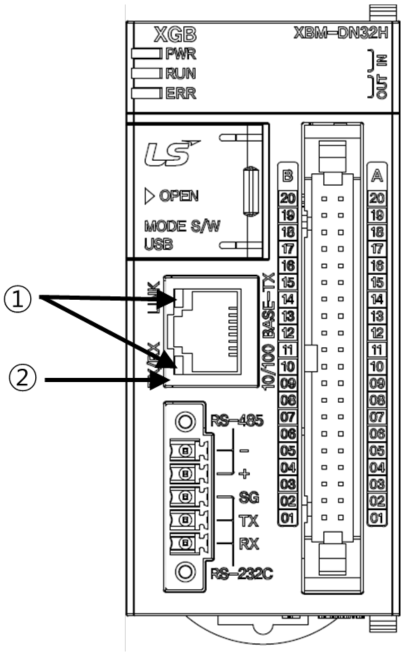
| Items | | | Specifications |
|---|---|---|---|
| Diagnosis function | Information of built-in communication functions | | high speed link exchange number/whether using DHCP<br>IP address/MAC address<br>module status/presence of system parameters<br>Group status/media setting value<br>hardware/software version |
| | Status by service | Dedicated service | Number of transmitted packets/ Number of received packets / Number of error packets / status drive setting |
| | | High speed link | Number of transmitted/received packets<br>high speed link flag<br>(RUN, link, Mode, Status, TRX, Error) |
| | | P2Pservice | Connection status / service status<br>service count / error count |
| | Media information | Total number of received packets | BROAD, MULTI, UNI, UDP, ARP, packet drop |
| | | Packet rate per second | |
| | Ping Test | | IP Address / Number of settings / Timeout |
| | Auto-Scan | | available |

5) Available PLC Area

(1) XGB Series(MK type)

| AREA | Device Type | Size(Word) | Remark |
|---|---|---|---|
| P | P0 – P2047 | 2048 | Read, Write Enable |
| M | M0 – M2047 | 2048 | Read, Write Enable |
| K | K0 – K4095 | 4096 | Read, Write Enable |
| F | F0 – F219 | 220 | Read Enable |
| | F220 – F2047 | 1828 | Read, Write Enable |
| T | T0 – T2047 | 2048 | Read, Write Enable |
| C | C0 – C2047 | 2048 | Read, Write Enable |
| L | L0 – L4095 | 4096 | Read, Write Enable |
| N | N0 – N10239 | 10240 | Read Enable |
| D | D0 – D32767 | 32768 | Read, Write Enable |
| U | U00.00 – U08.31 | 288 | Read, Write Enable |
| Z | Z0 – Z127 | 128 | Read, Write Enable |
| S | S0 – S127 | 128 | Read, Write Enable |
| R | R0 – R32767 | 32768 | Read, Write Enable |

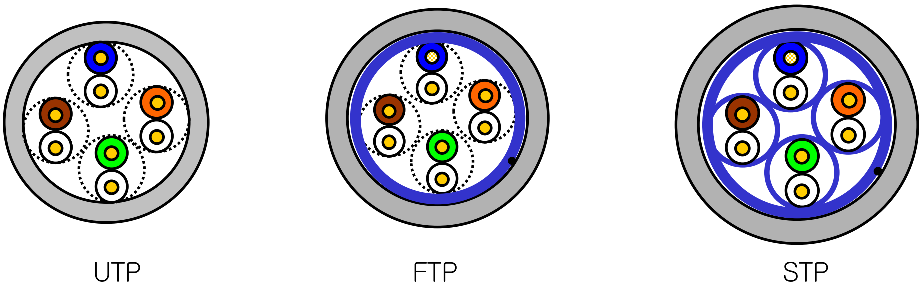
## 1.2.2 Names and roles of built-in FEnet parts



<table>
<tr><th>No.</th><th>Name</th><th>Details</th></tr>
<tr><td>①</td><td>LED display part</td><td>Displays the status of modules and communication.
<table>
<tr><th>Item</th><th>Color</th><th colspan="3">Operation details of each status</th></tr>
<tr><td rowspan="2">RX/TX</td><td rowspan="2">Yellow</td><td>OFF</td><td>Connection error</td><td>No connected device</td></tr>
<tr><td>Flickering</td><td>During communication</td><td>Flickering in case RX, TX occur</td></tr>
<tr><td rowspan="2">SPEED</td><td rowspan="2">Green</td><td>ON</td><td>100BASE-T</td><td>In progress at 100Mbps</td></tr>
<tr><td>OFF</td><td>10BASE-T</td><td>In progress at 10Mbps</td></tr>
</table></td></tr>
<tr><td>②</td><td>FEnet communication connector</td><td>FEnet communication connector (RJ 45)</td></tr>
</table>

## 1.2.3 Cable Specifications

1) Classification of cables



| Items | Names | Remarks |
|---|---|---|
| UTP (or U.UTP) | Cable for unshielded high speed signal | Up to 200MHz<br>Sound + information (Data)+low-grade video signal |
| FTP (or S.UTP) | Cable with shielded core only | Up to 100MHz<br>Considering electromagnetic interference (EMI) and electronic stability<br>Sound + information (Data)+low-grade video signal |
| STP (or S.STP) | Dual Shielded, pair individual twisted and cable with shield core only | Up to 500MHz<br>Sound + information (Data)+Video signal<br>Substitute for the coaxial cable of 75Ω |

- UTP(Unshielded Twisted Pair): A cable made by twisting an insulated copper wire to reduce electromagnetic induction.
- FTP(Foil Screened Pair): Aluminum silver foil wrapped around four strands of cable, insulation is higher than UTP cable
- STP(Shielded Twisted Pair): By adding a shielding material that can serve as a ground, it prevents external noise from entering or is resistant to signal interference.

For 100 BASE-TX,'T' indicates 'a twisted wire is applied' and 'X' indicates the kinds of twisted wires for classification. 'TX' uses an unshielded twisted pair wire 5 (UTP 5) or shielded twisted pair wire ; 'T2' uses an unshielded twisted pair wire 3 (UTP 3); 'T4' uses the unshielded twisted pair wire 3, 4, 5 (UTP 3, 4, 5). The built-in FEnet specifies 100 BASE-TX and adopts the UTP cables of more than Category 5.
The cables can be classified as below.

**Notice**

XGB FEnet does not support AUI (10BASE-5).

(1) In the case of twisted pair cable unit (more than Category 5) adopts the hub of 100Mbps and it can be used with the zone of 10Mbps (less than Category3) but at this time, the network speed is limited to 10Mbps so be careful for system installation.

(2) Both twisted cables and straight cables can be applied.

(3) UTP : Unshielded Twisted Paired Copper Cable
- FTP : (Overall) Foiled Twisted Paired Copper Cable
- STP : (Overall) Shielded (and Shielded Individually Pair)Twisted Paired Copper Cable

(4) Patch Cable (or Patch Cord)
In order to enhance the UTP 4-paired cable's flexibility, the conductor with twisted wire can be used instead of a solid conductor; used standard specification and material is Un-coated AWG 24 (7/0203A). Namely, the diameter of an element wire is 0.203mm and the element wire is standardized with the structure of 1+6 and it is made of annealed copper wire.

2) Classification by using frequency

| Classification | Using frequency (MHz) | Transfer rate (Mbps) | Use |
|---|---|---|---|
| Category 1 | Sound frequency | 1 | ▪Telephone network (2Pair) |
| Category 2 | 4 | 4 | ▪Multi-Pair communication cable |
| Category 3 | 16 | 16 | ▪Telephone network + computer network |
| Category 4 | 20 | 20 | ▪Computer network transfer rate Up<br>▪Low-loss communication cable |
| Category 5 and expanded category 5 | 100 | 100 | ▪Digital telephone network +computer network<br>▪Low-loss, broadband cable<br>▪Gigabit Ethernet (1000 BASE-T) |
| Category 6,6a | 250 ~ 500 | 10G | ▪10G BASE-T Cable |
| Category 7 | 600~ | 10G | ▪appropriate foe STP |

**Notice**

Now, Category 3, 5, En-Category 5 and Category 6 are widely used domestically and internationally. Category 4 disappeared due to emergence of Category 5 and Category 7 that is the STP structure is still at a development stage worldwidely.

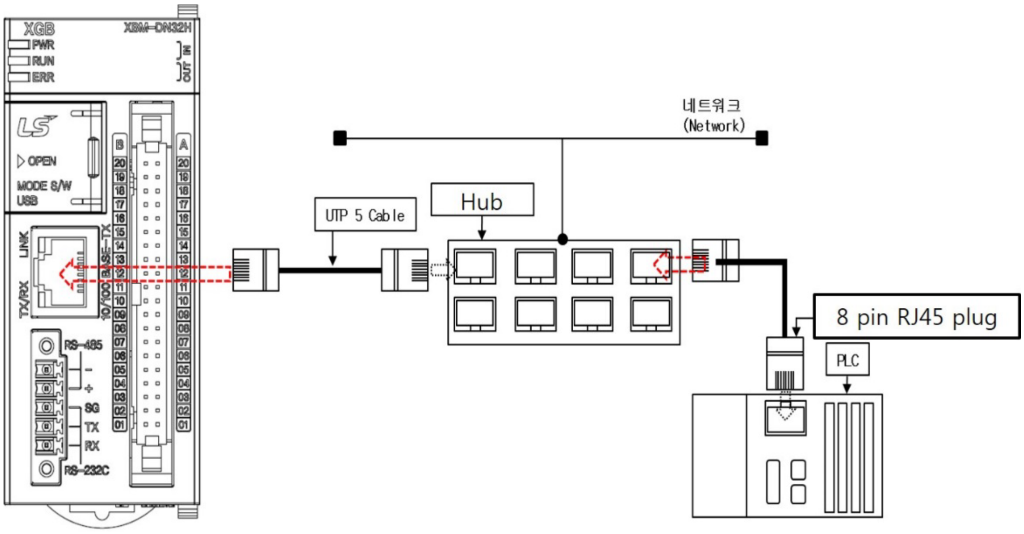
3) Example of Category 5e cable(LS cable, UTP-E-C5G-E1VN-M 0.5X004P/GY)

| Items | Unit | | Value |
|---|---|---|---|
| Conductor resistance (Max.) | Ω/100m | | 9.38/100m |
| Insulation resistance (Min.) | Ω(1~100MHz) | | 100 ± 15 |
| Attenuation | Less than dB/100m | 10MHz | 7.1 dB/100m |
| | | 25MHz | 11.4 dB/100m |
| | | 100MHz | 24.0 dB/100m |
| Near-end crosstalk attenuation | Less than dB/100m | 10MHz | 47.0 dB |
| | | 25MHz | 40.3 dB |
| | | 100MHz | 30.1 dB |

<UTP cable specifications>

# 1.3 Specifications of installation and a trial run

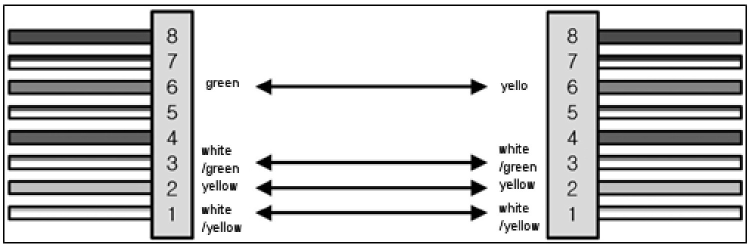
## 1.3.1 Example of FEnet installation



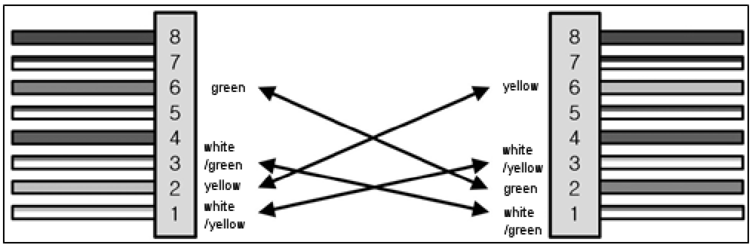
## 1.3.2 Instructions to install cables

In the case of 10/100 BASE-TX, the maximum length between nodes is 100m (distance between this module and the hub). Generally, a hub uses the straight cable made of twisted transmission (TD) and reception (RD)internally. If you connect these 2 basic units, they can be used regardless of cable types since the built-in FEnet interface supports Auto-MDIX.
You can connect the signal lines of straight cables and cross cables as below.

(1) Straight cable



(2) Cross cable



**Notice**

(1) Separate the hub's power supply from the PLC's power supply.
(2) For termination and manufacture, installation of cables, contact the professional manufacturers.

## 1.3.3 Instructions to install the UTP

Use the UTP cable that meets the characteristics of Category-5. Be careful not to exceed the cable's tensile force by constraint during wiring. When stripping the cable's sheath, strip it by the length to be connected and be careful not to damage the insulator.
When installing the UTP cable, keep the proper distance between the EMI source and the UTP cable.

| **Conditions** | **Minimum separation distance** | | |
|---|---|---|---|
| | **Less than 2.0 kVA** | **2.5 kVA** | **More than 5.0 kVA** |
| In case the unshielded power line or electric equipments are open or close to the non-metallic pipes. | 127 mm | 305 mm | 610 mm |
| In case the unshielded power line or electric equipments are open or close to the buried metallic pipes. | 64 mm | 152 mm | 305 mm |
| In case the power line of the buried metallic pipes (or equivalent shielded ones) is close to the buried metallic pipes. | - | 76 mm | 152 mm |
| Transformer /electric motor fluorescent light | 1,016 mm / 305 mm | | |

< Separation distance by conditions when installing the UTP cable>

| **Items** | **Color** | **Operation details of each status** | | |
|---|---|---|---|---|
| LINK/ACT | Yellow | ON | Normal connection | Linked with the connected device normally |
| | | OFF | Connection error | No connected device |
| | | Flickering | During communication | Flickering in case RX, TX occur |
| SPEED | Green | ON | 100BASE-T | In progress at 100Mbps |
| | | OFF | 10BASE-T | In progress at 10Mbps |

## 1.3.4 How to make a trial run

1) Setting procedures of the product before operation

It describes the installation of the product and procedures before operation. If the installation of the product is completed, install and set up the system based on the below procedures.

Refer to the following items to be checked before operating the system with the built-in FEnet.

2) Communication interface

| Items to be checked |
|---|
| Installation and execution, operation of XG5000 |
| Access Status of communication cables (Only when the cable is accessed) |

3) Trial run sequence

| Startup |
|---|
| Apply the power:<br>(1) Check input power.<br>(2) Check the communication cable access.<br>(3) Apply the power.<br>(4) Check whether the power LED is turned on.<br>(5) Check the LED status of the basic unit<br>→ In case of abnormal status, refer to 'Troubleshooting' of the basic unit manual.<br>(6) Check whether the status of the LINK LED is normal.<br>→ In case the LED is turned off despite connecting the line to the cable, refer to 'Troubleshooting' of the basic unit manual.<br>(7) After setting the system parameters correctly, download them. |

4) Instructions for system configuration

When you configure the system with XGB's built-in FEnet, refer to the below for installation.

(1) Check the basic factors required for system configuration and select the proper communication interface.

(2) Choose the dedicated cable for communication modules.

(3) When installing communication cables, check whether the connector pins are damaged or not.

(4) For expansion communication modules besides built-in communication, the maximum of 4 stages can be equipped within the number of stages as below.

(2EA of existing communication expansion modules, 2 EA of high speed communication interfaces for XBM 'H(P)' unit can be equipped)

The following table shows the number of expansion stages for each basic unit type.

| Type | XBC | | | XEC | | | XBM |
|---|---|---|---|---|---|---|---|
| | U-type | H-type | SU-type | U-type | H-type | SU-type | S,H,H2,HP |
| Maximum number of expansion stages | 10-stage | 10-stage | 7-stage | 10-stage | 10-stage | 7-stage | 7-stage |

(5) When installing modules, lock the modules after equipping the relevant slot without accessing the communication cable. In case the device is not locked up, interface error with the basic unit may occur.

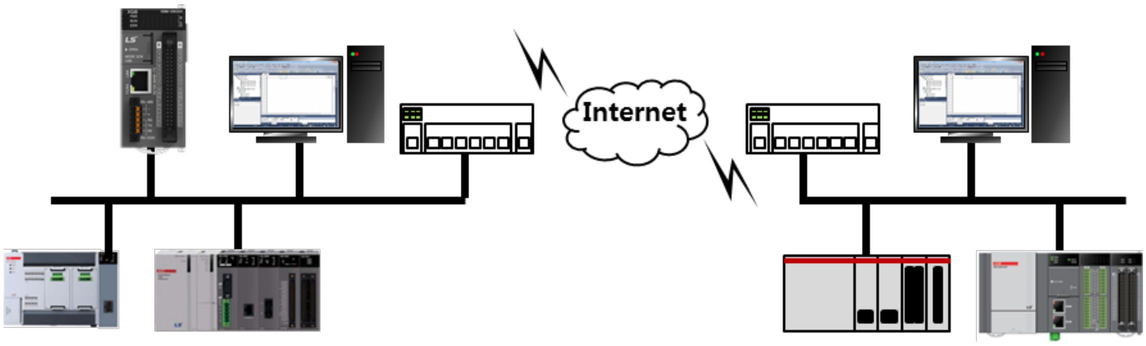
5) Instructions for network configuration

(1) The IP addresses of devices should be different. If the IP addresses are overlapped, communication will not work normally.
(2) Set up the different exchange numbers for each station to use the high speed link service.
(3) Use the specified communication cables. Otherwise, communication problems may occur.
(4) Check whether the cables are disconnected or shorted before installing the communication cables.
(5) Fix them tightly until the communication cable connector clicks
(6) In case the cable access is unstable, it may cause serious communicable problems.
(7) For wiring, separate the communication cables from the power line or inductive noise.

# 1.4 Configuration of FEnet communication system

FEnet supports open Ethernet so you can configure the network by connecting with LS ELECTRIC IS and other companies' PLCs, PCs. Some examples of network system configurations are represented as below.

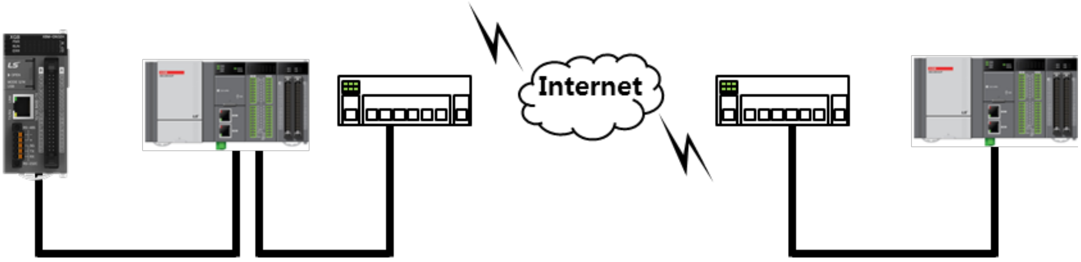
## 1.4.1 Mixed network configuration



[Fig.1.4.1] System configuration diagram

Built-in FEnet accesses LS ELECTRIC PLC, other companies' PLCs, PCs, etc. through the network. You can configure the system by using dedicated communication, Modbus TCP/IP, user-defined frame, high speed link communication.

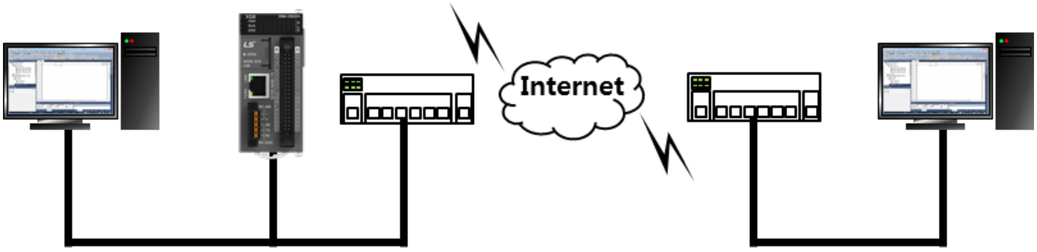
## 1.4.2 Network configuration through XGB PLC



[Fig. 1.4.2] System configuration diagram

XGB's built-in FEnet can access to 1:1 communication or network and perform 1:N communication by using cross cables or straight cables. You can transmit and receive the data through the dedicated services, Modbus TCP/IP, user-defined frame and high speed link communication.

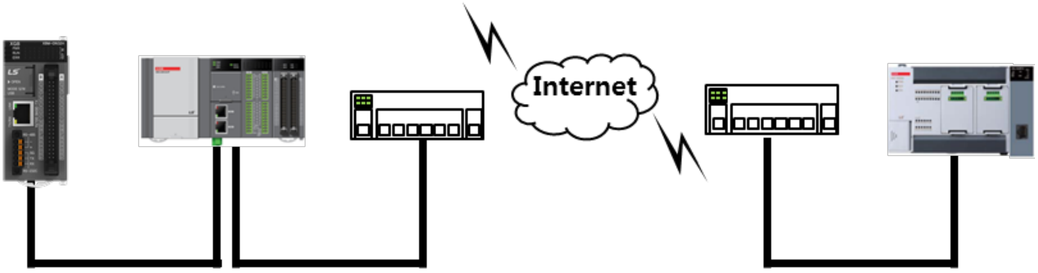
## 1.4.3 Network configuration through XGB PLC and MMI



[Fig.1.4.3] System configuration diagram

For communication between XGB's built-in FEnet and the PC, 1:N communication is available by assessing to 1:1 communication or the network using cross cables or straight cables. You can transmit and receive data in the PC by using XG5000 or MMI. In addition, through XG5000, you can make, download, upload the program and parameters and transmit·receive data through dedicated services, Modbus TCP/IP, user-defined frame.

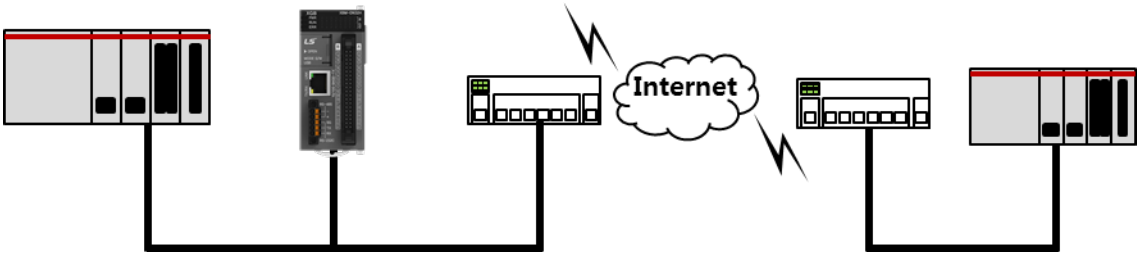
## 1.4.4 Network configuration between LS ELECTRIC modules



[Fig.1.4.4] System configuration diagram

You can configure the system by using XGB's built-in FEnet and XGK PLC's FEnet I/F expansion modules. 1:N communication is available through 1:1 communication using cross cables or accessing to network. You can transmit and receive the data through the dedicated services, Modbus TCP/IP, user-defined frame and high speed link communication.

## 1.4.5 Network configuration using XGB PLC and other companies' PLCs



[Fig.1.4.5] System configuration diagram

XGB's built-in FEnet can communicate with other companies' PLCs, HMIs, MMIs. 1:N communication is available through 1:1 communication using cross cables or accessing to network. For communication, the PLCs should have the same protocol.

## 1.5 Protocols for each service

Built-in FEnet interface supports Ethernet(open Ethernet), so you can configure the network by connecting with LS ELECTRIC and other companies' PLCs, PCs.

For communication after network configuration, make sure to set up IP, parameters of each PLC, protocols. The protocols supported by the built-in FEnet are XGT dedicated, Modbus TCP/IP, user-defined frame, File Transfer Protocol (FTP).

Each protocol is operated by the server or client and dedicated server, P2P functions communicate based on designated protocols.

| **Items** | | **Specifications** | | | |
|---|---|---|---|---|---|
| | | **Driver** | **Communication method** | **Port No.** | **Remarks** |
| Communi-cation function | Dedicated | XGT server | TCP/IP | 2004 | Up to 16channels<br>Up to 512 bytes |
| | | | UDP/IP | 2005 | |
| | | Modbus TCP server | TCP/IP | 502 | |
| | P2P | XGT client | TCP/IP | 2004 | Up to 15channels<br>Up to 512 bytes |
| | | | UDP/IP | 2005 | |
| | | Modbus TCP client | TCP/IP | 502 | |
| | | User-defined frame | TCP/IP | Customized | |
| | | | UDP/IP | Customized | |
| | Remote | Server | TCP/IP | 2002 | Up to 1channels |
| | | Client | UDP/IP | 2002 | Up to 1channels |
| | Auto Scan | - | UDP/IP | 2007(list)<br>2008(Information) | Up to 2channels |
| | SNTP | Client | UDP/IP | Customized | Up to 1channels |
| | SMTP | Client | TCP/IP | 25(Relay)<br>Customized | Up to 2channels |

[Table 1.5.1] Protocols by communication functions

## 1.5.1 XGT dedicated protocol

1) Protocol outline

Dedicated protocols for XGT are the communication protocols for LS ELECTRIC PLC only for communication between LS ELECTRIC modules. You can Read/Write data with commands and communication is available in PC, HMI by using dedicated protocols for XGT. Two communication methods of TCP and UDP can be applied to the dedicated protocols for XGT.

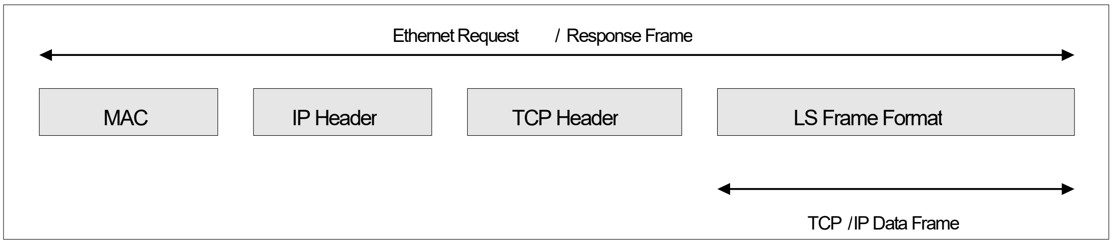
| Protocol | Communication Method | Port No. |
|---|---|---|
| For XGT only | TCP/IP | 2004 |
| | UDP/IP | 2005 |

[Table 1.5.2] Classification of dedicated protocols for XGT

2) Frame structure

(1) XGT dedicated packet's structure through Ethernet

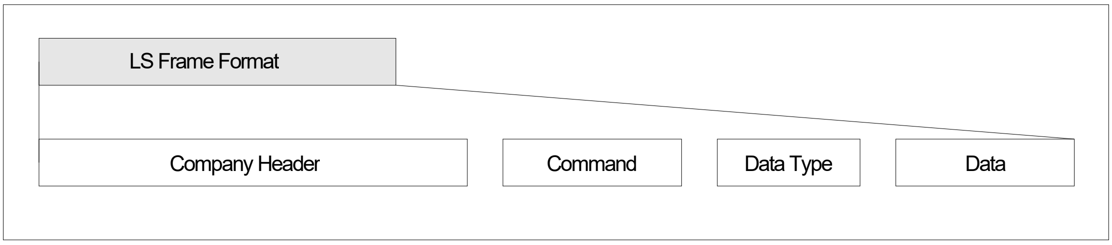
When communicating with dedicated protocols for XGT, MAC, IP header (IP Header), TCP Header and LS frames containing data are included for Ethernet communication. [Fig. 1.5.1] shows the frame structure for Ethernet communication.



[Fig. 1.5.1] XGT dedicated packet structure through Ethernet

3) Structure of XGT dedicated frame

The LS frames for data communication include LS ELECTRIC's own data (Company ID), command (Command),
data type (Data Type), data (Data). [Fig. 1.5.2] shows the frame form.



[Fig. 1.5.2] Structure of dedicated frames for XGT

## 4) Data type of XGT dedicated protocols

### (1) Device type

The data types of [Table 1.5.3] are available in the dedicated protocols for XGT. When you designate the devices, '%' (25H) should be attached to the front of string.
('%'is the character indicating the startup of devices)

| Data type | Type code value | Flag | Example of application |
|---|---|---|---|
| Bit | h0000 | X (58h) | %PX000, %MX000, %LX000, %KX000, %CX000, %TX000, %FX000, %IX0.0.0, %QX0.0.0, %UX00.00.0, etc. |
| Byte | h0100 | B (42h) | PB000, %MB000, %LB000, %KB000, %CB000, %TB000, %FB000, %IB0.0.0, %QB0.0.0 , etc. |
| Word | h0200 | W (57h) | %PW000, %MW000, %LW000, %KW000, %CW000, %TW000, %FW000, %DW000, %IW0.0.0, %QW0.0.0, %MW0, %RW0, %WW0, %UW00.00 , etc. |
| D word | h0300 | D (44h) | %PD000, %MD000, %LD000, %KD000, %CD000, %TD000, %FD000, %DD000, %ID0.0.0, %QD0.0.0, %MD0, %RD0, %WD0 , etc. |
| L word | h0400 | L (4Ch) | %PL000, %ML000, %LL000, %KL000, %CL000, %TL000, %FL000, %DL000, %IL0.0.0, %QL0.0.0, %ML0, %RL0, %WL0 , etc. |

[Table 1.5.3] Data types of dedicated protocols for XGT

**Notice**

(1) In the timer/counter, designating bit means the contact values; designating byte, word values means the current values.
(2) The data register (D) can be designated as Byte, Word only.
(3) In the case of byte type command, the address value is doubled compared to the value at the time of designating word. Namely, in the case of D1234, %DW1234 should be applied for word designation but %DB2468 should be applied for byte designation.

5) Commands of XGT dedicated protocols

4 commands are used for XGT dedicated protocols and each command processes Read/Write, Request/Response.

For available data types for each command, individual one can apply bit, byte, word, double word, long word; continuous one can adopt byte only.

| **Command** | **Command code** | **Data format** | | **Processing details** |
|---|---|---|---|---|
| Read | Request: h0000 | Individual | h0000 | Request on reading data depending on each data type |
| | | | h0100 | |
| | | | h0200 | |
| | | | h0300 | |
| | | | h0400 | |
| | | Continuous | h1400 | Request on reading byte type of variables by block |
| | Response: h5500 | Individual | h0000 | Response to the request on reading data |
| | | | h0100 | |
| | | | h0200 | |
| | | | h0300 | |
| | | | h0400 | |
| | | Continuous | h1400 | Response to the request on reading by block |
| Write | Request: h5800 | Individual | h0000 | Request on writing data depending on each data type |
| | | | h0100 | |
| | | | h0200 | |
| | | | h0300 | |
| | | | h0400 | |
| | | Continuous | h1400 | Request on writing byte type of variables by block |
| | Response: h5900 | Individual | h0000 | Response to the request on writing data |
| | | | h0100 | |
| | | | h0200 | |
| | | | h0300 | |
| | | | h0400 | |
| | | Continuous | h1400 | Response to the request on writing by block |

[Table 1.5.4] Command types of XGT dedicated protocols

6) Headers and data structures of XGT dedicated protocols

| **Items** | **Client (request frame)** | | | | **Server (response frame)** | | | |
|---|---|---|---|---|---|---|---|---|
| | **Classification** | **Details** | | **Size** | **Classification** | **Details** | | **Size** |
| Company header | LS'S OWN | Company ID 1 | | 10 | LS'S OWN | Company ID 1<br>Company ID 2 | | 10 |
| | PLC information | h00~hFF | | 2 | PLC information | h00 ~ hFF | | 2 |
| | CPU information | hA0 | | 1 | CPU information | hA0 | | 1 |
| | Frame direction | h33 | | 1 | Frame direction | h11 | | 1 |
| | Frame sequence number | h0000~hFFFF | | 2 | Frame sequence number | h0000~hFFFF | | 2 |
| | Length | h0000~h0100 | | 2 | Length | h0000~h0100 | | 2 |
| | Positioninformation | h00~hFF | | 1 | Position information | h00~hFF | | 1 |
| | Check Sum | h00~hFF | | 1 | Check Sum | h00~hFF | | 1 |
| Command | Command | h5400 | Read | 2 | Command | h5500 | Read | 2 |
| | | h5800 | Write | 2 | | h5900 | Write | 2 |
| Data Type | Data type | h0000 | bit | 2 | Data type | h0000 | bit | 2 |
| | | h0100 | byte | | | h0100 | byte | |
| | | h0200 | word | | | h0200 | word | |
| | | h0300 | Double word | | | h0300 | Double word | |
| | | h0400 | long word | | | h0400 | Long word | |
| | | h1400 | Continuous | | | h1400 | Continuous | |
| Data | Reserved area | - | | 2 | Reserved area | - | | 2 |
| | Number of blocks | h0100~h1000 | | 2 | Error status | h0000~hFFFF | | 2 |
| | Variable length (N) | h0400~h1000 | | 2 | Data | | | 2 |
| | Data address | - | | N | | | | |
| | Number of data | h0 (M)00 | | M | | | | |

[Table 1.5.5] Headers and data structures of XGT dedicated protocols

(1) Company ID (LS ELECTRIC'S own number)

The LS ELECTRIC's own number has two types; XGK and XGB PLC use Company ID 1 when they are operated as the client; the Company ID requested by the client is used when they are operated as server. For client, Company ID 1 or Company ID 2 should be used.

| **Type** | **Mode** | **Frame** | | | | | | | | | | **Remarks** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Company ID 1 | ASCII | L | S | I | S | - | X | G | T | /n | /n | XGT |
| | HEX | h4C | h53 | h49 | h53 | h2D | h58 | h47 | h54 | h00 | h00 | |
| Company ID 2 | ASCII | L | G | I | S | - | G | L | O | F | A | GM,MK |
| | HEX | h4C | h47 | h49 | h53 | h2D | h47 | h4C | h4F | h46 | h41 | |

[Table 1.5.6] LS's Own Number

### 7) Example of transmission·reception frames

#### (1) Request frame for reading variables individually

| Items | Type | Frame | | | | | | | | | | Size |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Company ID | ASCII | L | S | I | S | - | X | G | T | /n | /n | 10 |
| | HEX | 0x4C | 0x53 | 0x49 | 0x53 | 0x2D | 0x58 | 0x47 | 0x54 | 0x00 | 0x00 | |
| | ASCII | L | G | I | S | - | G | L | O | F | A | |
| | HEX | 0x4C | 0x47 | 0x49 | 0x53 | 0x2D | 0x47 | 0x4C | 0x4F | 0x46 | 0x41 | |
| PLC Info | HEX | 0x00 | 0x00 | | | | | | | | | 2 |
| CPU Info | | 0xA0 | | | | | | | | | | 1 |
| Source of Frame | | 0x33 | | | | | | | | | | 1 |
| Invoked ID | | 0x00 | 0x01 | | | | | | | | | 2 |
| Length | | 0x10 | 0x00 | | | | | | | | | 2 |
| Position | | 0x00 | | | | | | | | | | 1 |
| Check Sum | | 0x09 | | | | | | | | | | 1 |
| Command | | 0x54 | 0x00 | | | | | | | | | 2 |
| Data Type | | 0x14 | 0x00 | | | | | | | | | 2 |
| Reserved | | 0x00 | 0x00 | | | | | | | | | 2 |
| Block No. | | 0x01 | 0x00 | | | | | | | | | 2 |
| Variable Length | | 0x04 | 0x00 | | | | | | | | | 2 |
| Data Address | ASCII | % | M | B | 0 | | | | | | | 4 |
| | HEX | 0x25 | 0x4D | 0x42 | 0x30 | | | | | | | |
| Data Count | HEX | 0x02 | 0x00 | | | | | | | | | 2 |

[Table 1.5.7] Request frame for reading variables individually

#### (2) Response frame for reading variables individually

| Items | Type | Frame | | | | | | | | | | Size |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Company ID | ASCII | L | S | I | S | - | X | G | T | /n | /n | 10 |
| | HEX | 0x4C | 0x53 | 0x49 | 0x53 | 0x2D | 0x58 | 0x47 | 0x54 | 0x00 | 0x00 | |
| | ASCII | L | G | I | S | - | G | L | O | F | A | |
| | HEX | 0x4C | 0x47 | 0x49 | 0x53 | 0x2D | 0x47 | 0x4C | 0x4F | 0x46 | 0x41 | |
| PLC Info | HEX | 0x02 | 0x08 | | | | | | | | | 2 |
| CPU Info | | 0xA0 | | | | | | | | | | 1 |
| Source of Frame | | 0x11 | | | | | | | | | | 1 |
| Invoked ID | | 0x00 | 0x01 | | | | | | | | | 2 |
| Length | | 0x0E | 0x00 | | | | | | | | | 2 |
| Position | | 0x01 | | | | | | | | | | 1 |
| Check Sum | | 0x25 | | | | | | | | | | 1 |
| Command | | 0x55 | 0x00 | | | | | | | | | 2 |
| Data Type | | 0x14 | 0x00 | | | | | | | | | 2 |
| Reserved | | 0x00 | 0x00 | | | | | | | | | 2 |
| Error State | | 0x00 | 0x00 | | | | | | | | | 2 |
| Block No. | | 0x10 | 0x00 | | | | | | | | | 2 |
| Data Count | | 0x02 | 0x00 | | | | | | | | | 2 |
| Data | | 0x00 | 0x00 | | | | | | | | | 2 |

[Table 1.5.8] Response frame for reading variables individually

(3) Request frame for reading variables sequentially

| Items | Type | Frame | | | | | | | | | | Size |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Company ID | ASCII | L | S | I | S | - | X | G | T | /n | /n | 10 |
| | HEX | 0x4C | 0x53 | 0x49 | 0x53 | 0x2D | 0x58 | 0x47 | 0x54 | 0x00 | 0x00 | |
| | ASCII | L | G | I | S | - | G | L | O | F | A | |
| | HEX | 0x4C | 0x47 | 0x49 | 0x53 | 0x2D | 0x47 | 0x4C | 0x4F | 0x46 | 0x41 | |
| PLC Info | HEX | 0x00 | 0x00 | | | | | | | | | 2 |
| CPU Info | | 0xA0 | | | | | | | | | | 1 |
| Source of Frame | | 0x33 | | | | | | | | | | 1 |
| Invoked ID | | 0x00 | 0x01 | | | | | | | | | 2 |
| Length | | 0x10 | 0x00 | | | | | | | | | 2 |
| Position | | 0x00 | | | | | | | | | | 1 |
| Check Sum | | 0x09 | | | | | | | | | | 1 |
| Command | | 0x54 | 0x00 | | | | | | | | | 2 |
| Data Type | | 0x14 | 0x00 | | | | | | | | | 2 |
| Reserved | | 0x00 | 0x00 | | | | | | | | | 2 |
| Block No. | | 0x01 | 0x00 | | | | | | | | | 2 |
| Variable Length | | 0x04 | 0x00 | | | | | | | | | 2 |
| Data Address | ASCII | % | M | B | 0 | | | | | | | 4 |
| | HEX | 0x25 | 0x4D | 0x42 | 0x30 | | | | | | | |
| Data Count | HEX | 0x02 | 0x00 | | | | | | | | | 2 |

[표 1.5.9] Frame for reading variables sequentially

(4) Response frame for reading variables sequentially

| Items | Type | Frame | | | | | | | | | | Size |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Company ID | ASCII | L | S | I | S | - | X | G | T | /n | /n | 10 |
| | HEX | 0x4C | 0x53 | 0x49 | 0x53 | 0x2D | 0x58 | 0x47 | 0x54 | 0x00 | 0x00 | |
| | ASCII | L | G | I | S | - | G | L | O | F | A | |
| | HEX | 0x4C | 0x47 | 0x49 | 0x53 | 0x2D | 0x47 | 0x4C | 0x4F | 0x46 | 0x41 | |
| PLC Info | HEX | 0x02 | 0x08 | | | | | | | | | 2 |
| CPU Info | | 0xA0 | | | | | | | | | | 1 |
| Source of Frame | | 0x11 | | | | | | | | | | 1 |
| Invoked ID | | 0x00 | 0x01 | | | | | | | | | 2 |
| Length | | 0x0E | 0x00 | | | | | | | | | 2 |
| Position | | 0x01 | | | | | | | | | | 1 |
| Check Sum | | 0x25 | | | | | | | | | | 1 |
| Command | | 0x55 | 0x00 | | | | | | | | | 2 |
| Data Type | | 0x14 | 0x00 | | | | | | | | | 2 |
| Reserved | | 0x00 | 0x00 | | | | | | | | | 2 |
| Error State | | 0x00 | 0x00 | | | | | | | | | 2 |
| Block No. | | 0x10 | 0x00 | | | | | | | | | 2 |
| Data Count | | 0x02 | 0x00 | | | | | | | | | 2 |
| Data | | 0x00 | 0x00 | | | | | | | | | 2 |

[Table 1.5.10] Response frame for reading variables sequentially

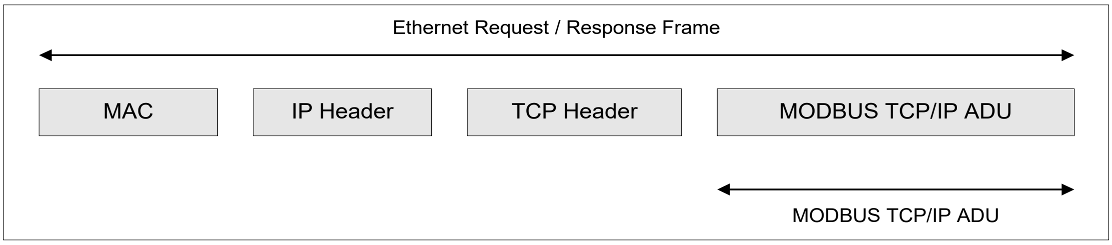
## 1.5.2 Modbus TCP/IP protocol

The Modbus TCP/IP protocol is the function to Read/Write data by using the function codes. The Modbus TCP/IP frame is composed of MAC for Ethernet communication, IP header, TCP header, Modbus ADU.

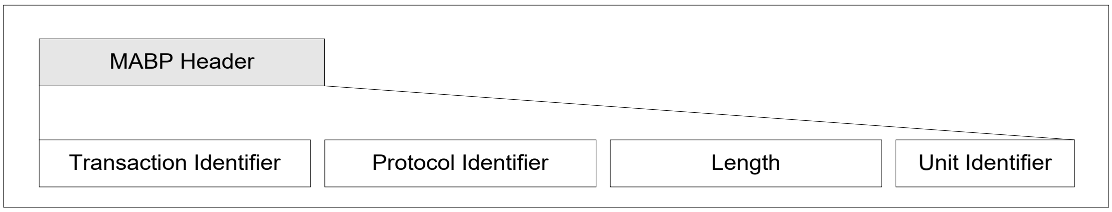
1) ADU: Application Data Unit
2) MBAP: Modbus Application Protocol
3) PDU: Protocol Data Unit

1) Frame structure of Modbus TCP/IP

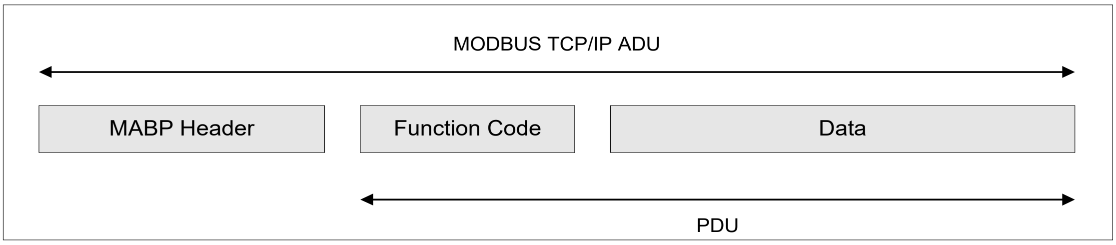
(1) Modbus TCP/IP's frame structure through Ethernet



[Table 1.5.1] Modbus TCP/IP's frame structure through Ethernet



[Table 1.5.2] Modbus MABP structure



[Table 1.5.3] Modbus ADU structure

(2) MBAP Header structure

| Type | Size | Description | Client | Server |
|---|---|---|---|---|
| Transaction Identifier | 2byte | Separation of MODBUS request/response processing | Initialized by the client | When the server responds, it is copied and responded. |
| Protocol Identifier | 2byte | 0 = MODBUS protocol | Initialized by the client | When the server responds, it is copied from the request frame. |
|  | 2byte | Frame size except MBAP | Created by the client (On request) | Created by the server (In case of response) |
| Unit Identifier | 1byte | Separation of units connected to the serial line | Initialized by the client | When the server responds, it is copied from the request frame |

(3) Available function codes

| Function codes | Function | Modbus transcription |
|---|---|---|
| Function Code 01 (h01) | Reading output bit | Read Coils |
| Function Code 02 (h02) | Reading input bit | Read Discrete Inputs |
| Function Code 03 (h03) | Reading output word | Read Holding Registers |
| Function Code 04 (h04) | Reading input word | Write Input Register |
| Function Code 05 (h05) | Writing output bit | Write single Coil |
| Function Code 06 (h06) | Writing output word | Write single Register |
| Function Code 15 (h0F) | Writing output bit sequentially | Write Multiple Coils |
| Function Code 16 (h10) | Writing output word sequentially | Write Multiple Registers |

2) Frame structures by function codes

(1) Function code h01 : Reading output bit (Read Coils)

- Request

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h01 |
| Initial address | 2 bytes | h0000 ~ hFFFF |
| Number of coils | 2 bytes | h0001 ~ h07D0 (2000 bit) |

- Response

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h01 |
| Number of bytes | 2 bytes | N |
| Coil status | n byte | n = N or N + 1 |

- Error

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h81 (function code+ h80) |
| Exceptional code | 1 byte | h01,h02,h03,h04 |

•Example of Application

| Request frame | | Response frame | |
|---|---|---|---|
| **Items** | **HEX** | **Items** | **HEX** |
| Function code | h01 | Function code | h01 |
| Initial address (upper byte) | h00 | Number of bytes | h03 |
| Initial address (lower byte) | h13 | Coil status (27-20) | hCD |
| Number of coils (upper byte) | h00 | Coil status (36-28) | h6B |
| Number of coils (lower byte) | h13 | Coil status (38-36) | h05 |

(2) Function code h02 : Reading input bit (Read Discrete Inputs)

- Request

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h02 |
| Initial address | 2 bytes | h0000 ~ hFFFF |
| Number of inputs | 2 bytes | h0001 ~ h07D0 (2000 bit) |

- Response

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h01 |
| Number of bytes | 2 bytes | N |
| Input status | N x 1 byte | - |

- Error

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h82 (Function code + h80) |
| Exceptional code | 1 byte | h01,h02,h03,h04 |

- Example of application

| Request frame | | Response frame | |
|---|---|---|---|
| **Items** | **HEX** | **Items** | **HEX** |
| Function code | h02 | Function code | h02 |
| Initial address (upper byte) | h00 | Initial address (upper byte) | h00 |
| Initial address (lower byte) | hC4 | Initial address (lower byte) | hC4 |
| Input status (upper byte) | h00 | Input status (upper byte) | h00 |
| Number of coils (lower byte) | h16 | Number of coils (lower byte) | h16 |

(3) Function code h03 : Reading output word (Read Holding Registers)

- Request

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h03 |
| Initial address | 2 bytes | h0000 ~ hFFFF |
| Number of inputs | 2 bytes | h0001 ~ h007D (125word) |

- Response

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h01 |
| Number of bytes | 2 bytes | 2 x N |
| Input status | N x 2 bytes | - |

- Error

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h83 (Function code + h80) |
| Exceptional code | 1 byte | h01,h02,h03,h04 |

- Example of application

| Request frame | | Response frame | |
|---|---|---|---|
| **Items** | **HEX** | **Items** | **HEX** |
| Function code | h03 | Function code | h03 |
| Initial address (upper byte) | h00 | Number of bytes | h06 |
| Initial address (lower byte) | h6B | Word status (108) | h02 |
| Number of words (upper byte) | h00 | Word status (108) | h2B |
| Number of words (lower byte) | h03 | Word status (109) | h00 |
| | | Word status (109) | h00 |
| | | Word status (110) | h00 |
| | | Word status (110) | h64 |

(4) Function code h04 : Writing input word (Read Input Registers)

- Request

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h04 |
| Initial address | 2 bytes | h0000 ~ hFFFF |
| Number of inputs | 2 bytes | h0001 ~ h007D (125word) |

- Response

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h04 |
| Number of bytes | 2 bytes | 2 x N |
| Input status | N x 2 bytes | - |

- Error

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h84 (Function code + h80) |
| Exceptional code | 1 byte | h01,h02,h03,h04 |

- Example of application

| Request frame | | Response frame | |
|---|---|---|---|
| Items | HEX | Items | HEX |
| Function code | h04 | Function code | h04 |
| Initial address (upper byte) | h00 | Number of bytes | h02 |
| Initial address (lower byte) | h08 | Word status (108) | h00 |
| Number of words (upper byte) | h00 | Word status (108) | h0A |
| Number of words (lower byte) | h01 | | |

(5) Function code h05 : Writing output bit (Write Single Coil)

- Request

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h05 |
| Initial address | 2 bytes | h0000 ~ hFFFF |
| Input value | 2 bytes | h0000 or hFF0D |

- Response

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h05 |
| Number of bytes | 2 bytes | h0000 ~ hFFFF |
| Input status | 2 bytes | h0000 or hFF00 |

- Error

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h85 (function code+ h80) |
| Exceptional code | 1 byte | h01,h02,h03,h04 |

- Example of application

| Request frame | | Response frame | |
|---|---|---|---|
| Items | HEX | Items | HEX |
| Function code | h02 | Function code | h01 |
| Initial address (upper byte) | h00 | Number of bytes | h03 |
| Initial address (lower byte) | hC4 | Coil status (27-20) | hCD |
| Input status (upper byte) | h00 | Coil status (36-28) | h6B |
| Number of coils (lower byte) | h16 | Coil status (38-36) | h05 |

(6) Function code h 0F : Writing output word sequentially (Write Multiple Registers)

- Request

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h0F |
| Initial address | 2 bytes | h0000 ~ hFFFF |
| Number of outputs | 2 bytes | h0001 ~ h07BD |
| Number of bytes | 1 byte | N |
| Output value | N x 1 byte | |

- Response

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h0F |
| Number of bytes | 2 bytes | h0000 ~ hFFFF |
| Input status | 2 bytes | h0001 ~ h07B0 |

- Error

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h8F (function code+ h80) |
| Exceptional code | 1 byte | h01,h02,h03,h04 |

- Example of application

| Request frame | | Response frame | |
|---|---|---|---|
| Items | HEX | Items | HEX |
| Function code | h0F | Function code | h0F |
| Initial address(upper byte) | h00 | Initial address (upper byte) | h00 |
| Initial address(lower byte) | h13 | Initial address (lower byte) | h13 |
| Number of outputs (upper byte) | h00 | Number of outputs (upper byte) | h00 |
| Number of outputs (lower byte) | h0A | Number of outputs (lower byte) | h0A |
| Number of bytes | h02 | | |
| Output value (upper byte) | hCD | | |
| Output value (lower byte) | h01 | | |

(7) function codeh06 : output word (Write Single Register)

- Request

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h06 |
| Initial address | 2 bytes | h0000 ~ hFFFF |
| Output value | 2 bytes | h0000 or hFFFF |

- Response

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h06 |
| Initial address | 2 bytes | h0000 ~ hFFFF |
| Output value | 2 bytes | h0000 or hFFFF |

- Error

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h86 (function code+ h80) |
| Exceptional code | 1 byte | h01,h02,h03,h04 |

- Example of application

| Request frame | | Response frame | |
|---|---|---|---|
| Items | HEX | Items | HEX |
| Function code | h06 | Function code | h06 |
| Initial address (upper byte) | h00 | Number of bytes | h00 |
| Initial address (lower byte) | h01 | Coil status (27-20) | h01 |
| Input status (upper byte) | h00 | Coil status (36-28) | h00 |
| Number of coils (lower byte) | h03 | Coil status (38-36) | h03 |

(8) Function code h10 : Writing output sequentially (Write Multiple Registers)

- Request

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h10 |
| Initial address | 2 bytes | h0000 ~ hFFFF |
| Number of outputs | 2 bytes | h0001 or h07D8 |
| Number of bytes | 1 byte | 2 x N |
| Output value | N x 2 bytes | value |

- Response

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h10 |
| Number of bytes | 2 bytes | h0000 ~ hFFFF |
| Number of outputs | 2 bytes | h0001 ~ h007B |

- Error

| Items | Size | Range |
|---|---|---|
| Function code | 1 byte | h90 (function code+ h80) |
| Exceptional code | 1 byte | h01,h02,h03,h04 |

- Example of application

| Request frame | | Response frame | |
|---|---|---|---|
| Items | HEX | Items | HEX |
| Function code | h10 | Function code | h01 |
| Initial address (upper byte) | h00 | Initial address (upper byte) | h00 |
| Initial address (lower byte) | h01 | Initial address (lower byte) | h01 |
| Number of outputs (upper byte) | h00 | Number of outputs (upper byte) | h00 |
| Number of outputs (lower byte) | h02 | Number of outputs (lower byte) | h02 |
| Number of bytes | h04 | | |
| Output value(upper byte) | h00 | | |
| Output value(lower byte) | h0A | | |
| Output value(upper byte) | h01 | | |
| Output value(lower byte) | h02 | | |

## 1.6 **Dedicated services**

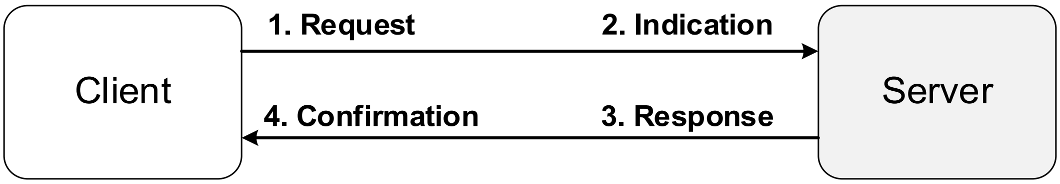
### 1.6.1 Outline

1) Server model

The dedicated services mean the server functions in the below client/server model of [Fig. 1.6.1]. It Reads/Writes data based on the protocols assessed and set by the client.

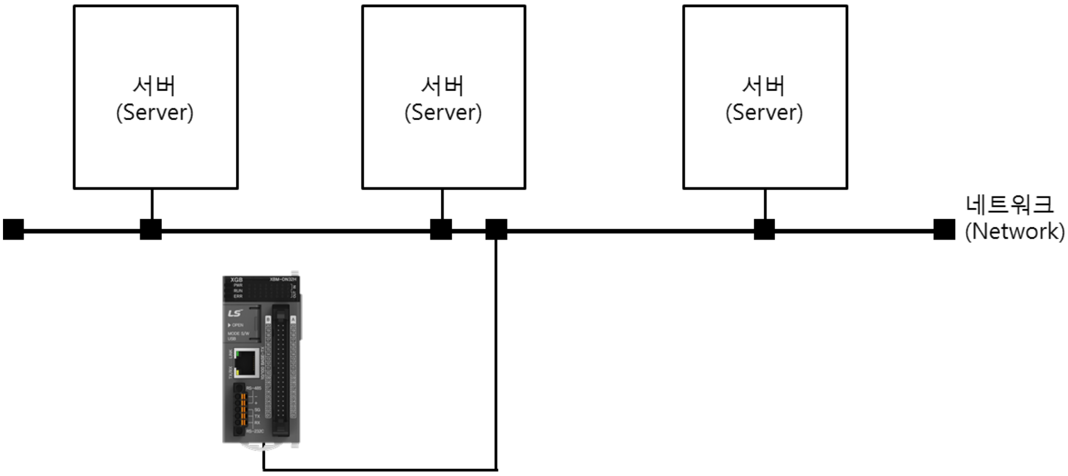
(1) Client/server model

The server performs the functions; ② detection of reception ③ transmission of response.



[Fig.1.6.1] Server/client model

(2) System configuration



(3) Classification of dedicated services

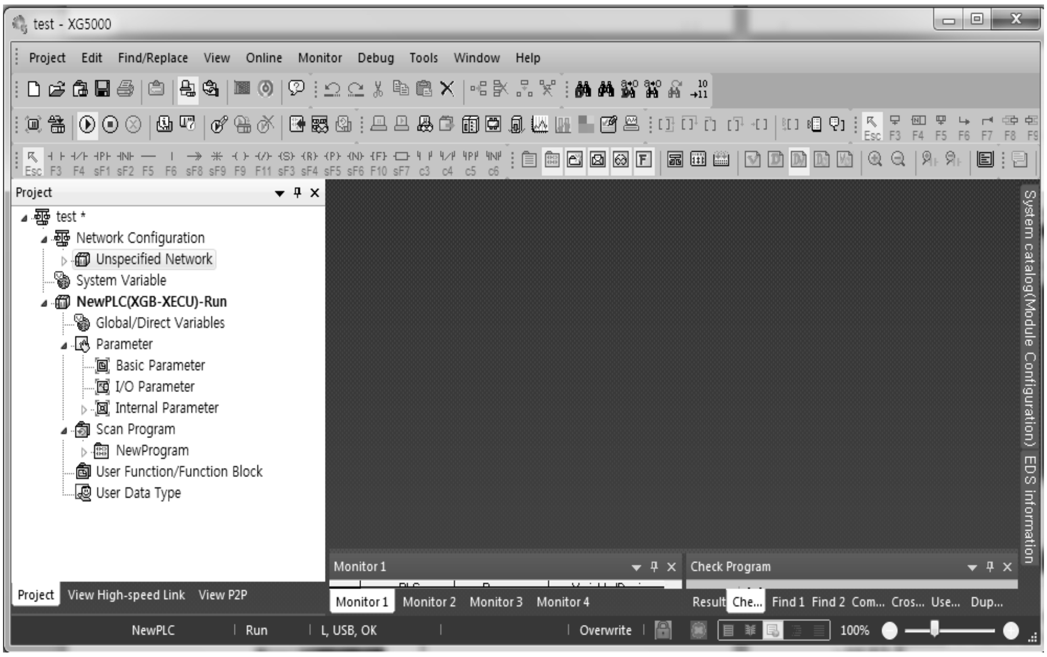
| Dedicated services | | Port No. | Protocol | Max./Min. number of accesses |
|---|---|---|---|---|
| XGT server | TCP XGT server | 2004 | TCP | 1/16 |
| | UDP XGT server | 2005 | UDP | 1/16 |
| Modbus TCP/IP server | | 502 | TCP | 1/16 |

## 1.6.2 Setting the basic parameters

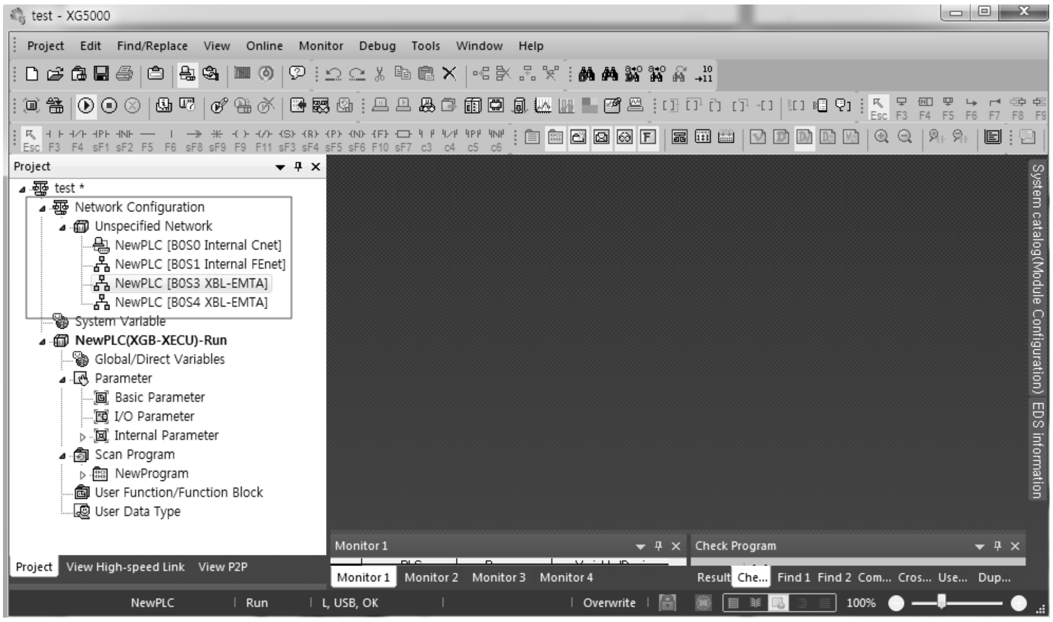
1) Confirming registration of built-in communication

(1) Setting the basic parameters for XG5000 communication

If you create a project after executing XG5000, only the basic network will be displayed in the network configuration. After accessing to the PLC, if you execute I/O synchronization in [Online] →[Diagnosis] →[I/O information], the built-in communication modules will be updated. Then, if you choose the built-in FEnet, the window for setting communication modules will be executed. The built-in FEnet is automatically set so you cannot change the type, base, slot.



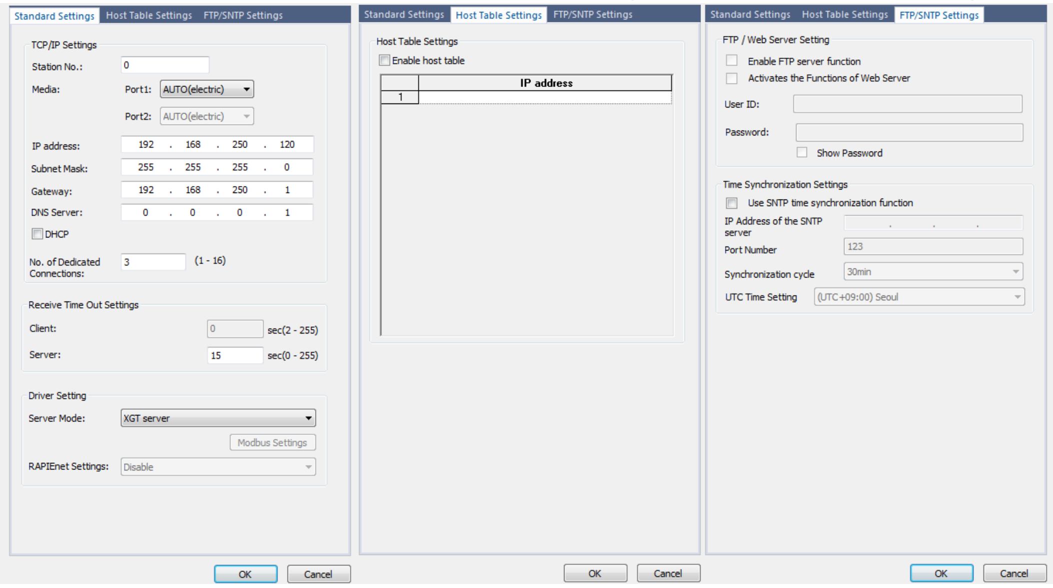
[Fig. 1.6.2] Creation of new project in XG5000



[Fig. 1.6.3] Changes of the network configuration after I/O synchronization

(2) Basic setting

If you double-click the FEnet, the window for the basic setting will be created as below [Fig. 1.6.4].



TCP/IP Settings
Station No.: 0
Media: Port1: AUTO(electric)
Port2: AUTO(electric)
IP address: 192 . 168 . 250 . 120
Subnet Mask: 255 . 255 . 255 . 0
Gateway: 192 . 168 . 250 . 1
DNS Server: 0 . 0 . 0 . 1
☐ DHCP
No. of Dedicated Connections: 3 (1 - 16)

Receive Time Out Settings
Client: 0 sec(2 - 255)
Server: 15 sec(0 - 255)

Driver Setting
Server Mode: XGT server
RAPIEnet Settings: Disable

Host Table Settings
☐ Enable host table

| | IP address |
|---|---|
| 1 | |

FTP / Web Server Setting
☐ Enable FTP server function
☐ Activates the Functions of Web Server
User ID:
Password:
☐ Show Password

Time Synchronization Settings
☐ Use SNTP time synchronization function
IP Address of the SNTP server: . . .
Port Number: 123
Synchronization cycle: 30min
UTC Time Setting: (UTC+09:00) Seoul

[Fig.1.6.4] Window for the basic settings of communication

The descriptions on each item are as below.

a) TCP/IP setting

| Item | Description |
|---|---|
| High speed link exchange number | For high speed link communication between XGT PLC's FEnet I/F modules, the FEnet I/F module to set exchange number should not overlapped with the exchange numbers of other FEnet I/F modules that are accessible in the network. |
| Media | Select the media to be used.<br>▷ AUTO (electricity): It sets the media of the currently equipped module automatically.<br>▷ 10M/HALF: Half Duplex electricity of 10Mbps<br>▷ 10M/FULL: Full Duplex electricity of 10Mbps<br>▷ 100M/HALF: Half Duplex electricity of 100Mbps<br>▷ 100M/FULL: Full Duplex electricity of 10Mbps<br>Optical(FX) cable is not supported in built-in FEnet |
| IP address | You can set the IP address of the FEnet I/F module. |
| Subnet Mask | Value to determine whether the opposing station exists in the same network as its own. |
| Gateway | Gateway module address (router address) to transmit and receive data through the station using different network from its own or public network. |
| DNS server | You can designate domain name server. |
| DHCP | For using the flexible IP instead of the static IP. |
| Reception standby time (second) | During dedicated communication, if there is not any RUN request for the set time from the upper system on condition that it is assessed to the upper PC or MMI, the connection with the dedicated service will end regardless of normal termination on the assumption that there are some problems with the upper system. The standby time is used for dedicated services to reset the channels when there are some errors in the opposing station or cables are disconnected. |
| Number of dedicated accesses | It means the maximum number of TCP dedicated services that are assessable at the same time. Setting of 1~16 is available.<br>(In the case of P2P channel, the number of 16-dedicated accesses) |

b) Driver (server) setting

| Item | Description |
|---|---|
| XGT server | For operation with the dedicated communication server |
| Modbus TCP/IP server | For operation with the Modbus server driver |
| Smart server | Provide both XGT and Modbus TCP/IP server |

c) Host table setting

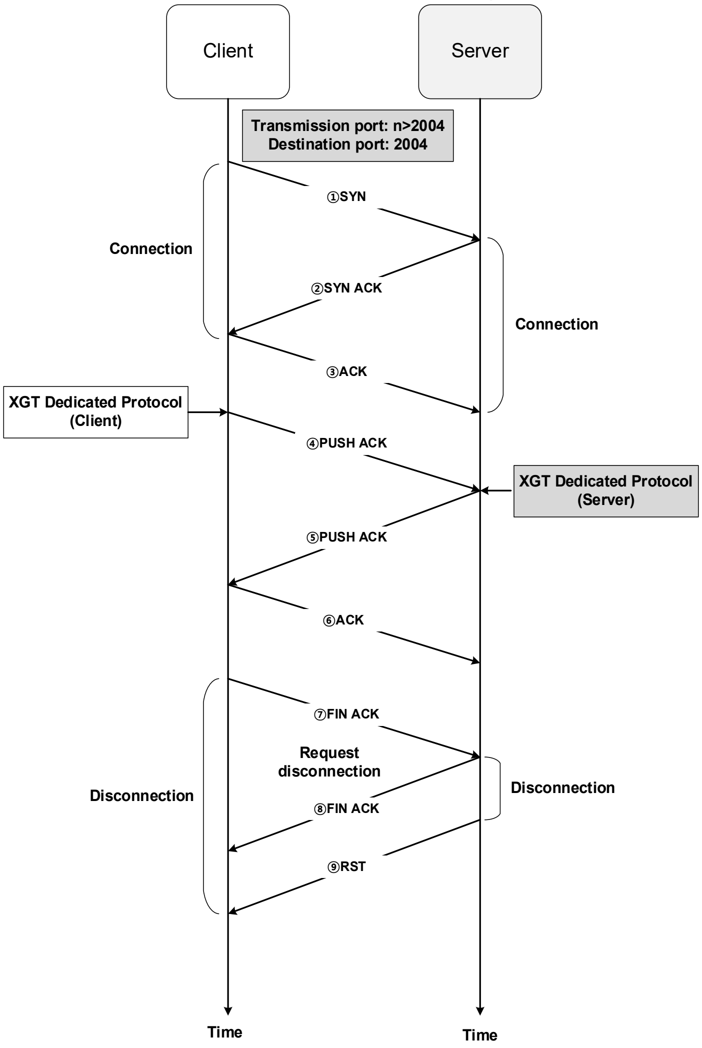
| Item | Description |
|---|---|
| Enable host table | In case of Enable host table, it allows assess for the client who has the IP address registered to the host table. |

d) Setting the time synchronization function

| Item | Description |
|---|---|
| SNTP time synchronization function | Setting SNTP time synchronization operations |
| IP Address of the SNTP | SNTP server's IP address |
| Port Number | SNTP server's port No. |
| Synchronization cycle | Time synchronization cycle between the SNTP server and the PLC |
| UTC Time setting | Setting SNTP time according to UTC |

## 1.6.3 XGT server

The TCP XGT server works in sequence as shown in the operating sequence of the below [Fig. 1.6.5].



[Fig.1.6.5] Operating sequence of the TCP XGT server

1) Connection

The client sends the ①connection request to the server and then, the server transmits the ②response to connection request. The connection port number is Port No. 2004 of the XGT dedicated protocols.
Then, the client sends the ③ response to confirmation of connection. After the stages of ①~ ③ are completed,connection between client/server is made.

2) TCP XGT server

After connection, the client transmits the ④request frame based on the XGT dedicated protocols.
Then, the server transmits the ⑤response to the request frame and the client transmits the ⑥confirmation of response.

3) Disconnection

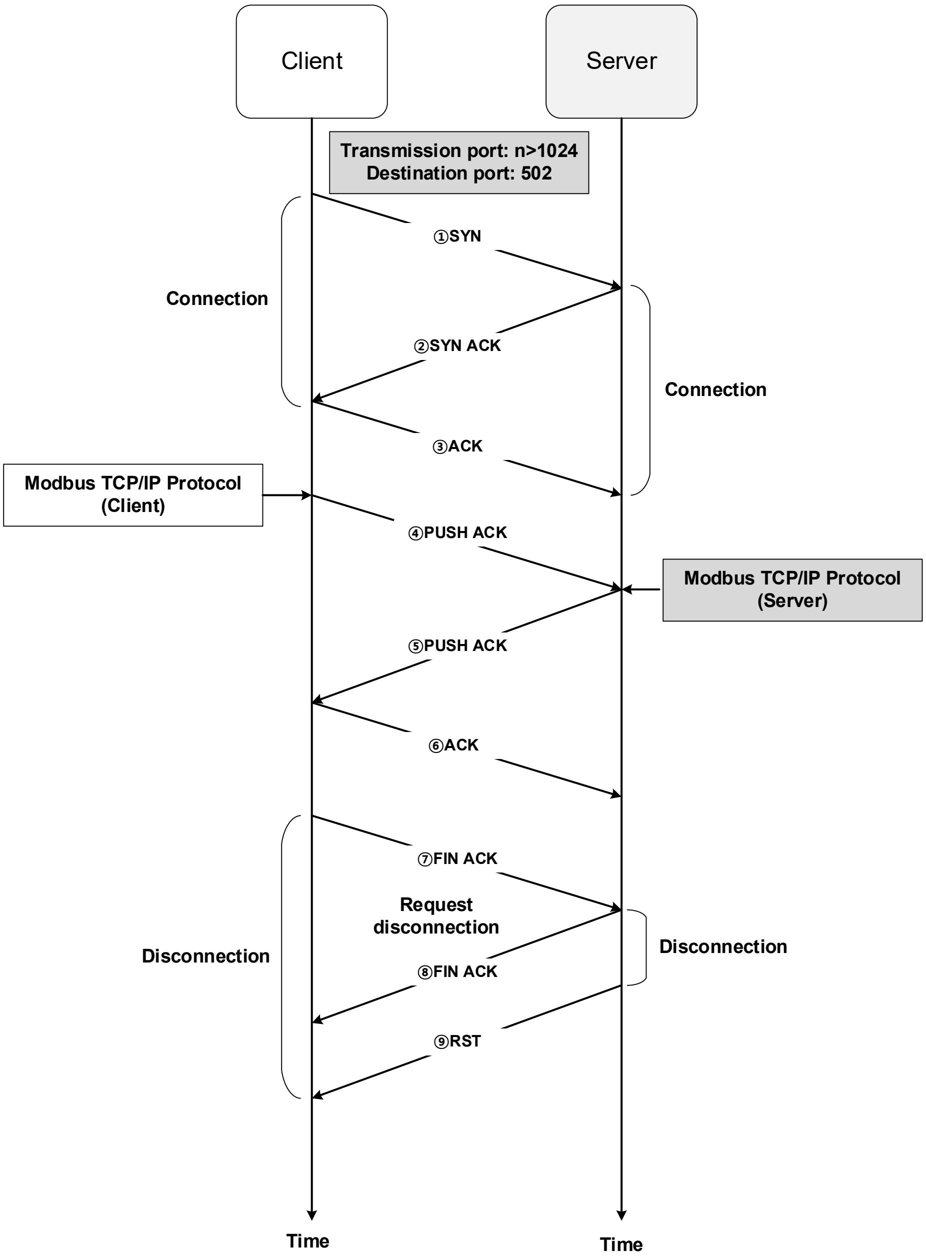
The client transmits ⑦ disconnection request and the server transmits ⑧confirmation of disconnection and ⑨terminates the connection.

Notes

UDP XGT server uses a non-connection-oriented communication method.
Therefore, the number of dedicated server connections is not affected.
XGT server diagnostic information unable to verify, because the UDP XGT server uses a non-connection-oriented UDP protocol,

## 1.6.4 Modbus TCP/IP server

The Modbus TCP/IP server works in sequence as shown in the operating sequence of the below [Fig. 1.6.6].

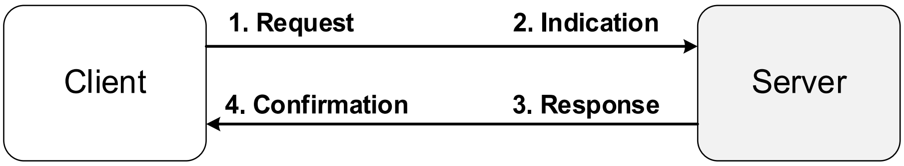


[Fig.1.6.6] Operating sequence of the Modbus TCP/IP server

# 1.7 **P2P service**

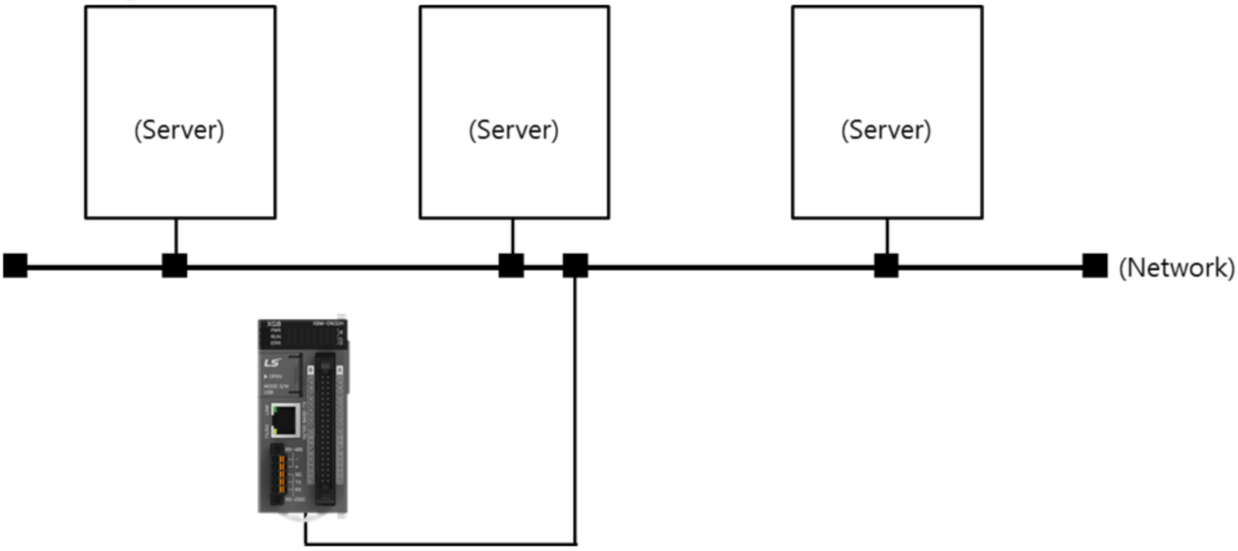
## 1.7.1 Outline

The P2P service means the client function in the below client/server model of [Fig. 1.7.1].
It is the function to request Read/Write Data to the server. If the startup conditions of each block are On, it creates the request frames and receives responses for processing with the protocols that are designated as the relevant channel.
XGB's built-in FEnet can realize the function through up to 7 channels and you can use other protocols for each channel.



[Fig. 1.7.1] Server/client model

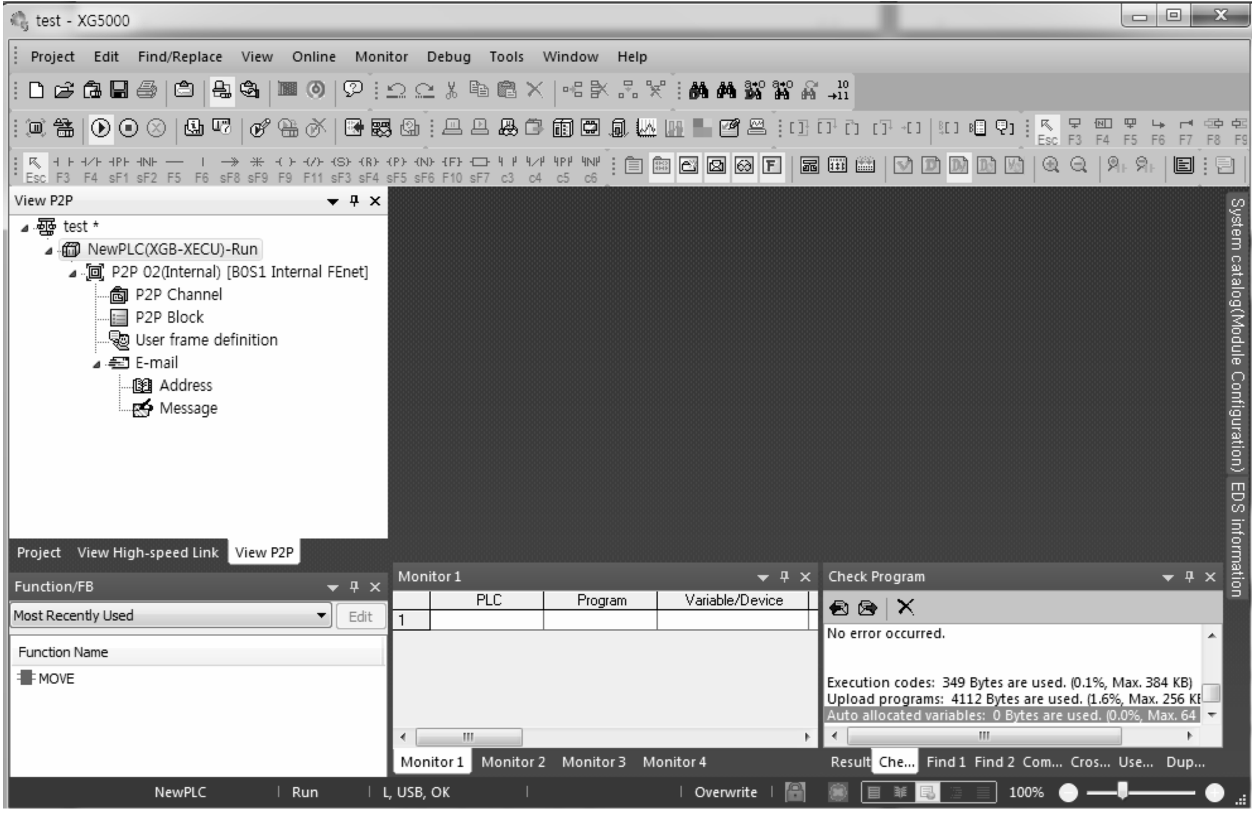
The Client performs the functions of ① transmission of request ④ confirmation.



[Fig. 1.7.2] Server/client configuration

### 1.7.2 Setting P2P parameters

[Fig. 1.7.3] shows the example of setting P2P parameters of XG5000.



```
No error occurred.

Execution codes:  349 Bytes are used. (0.1%, Max. 384 KB)
Upload programs:  4112 Bytes are used. (1.6%, Max. 256 KE
Auto allocated variables:  0 Bytes are used. (0.0%, Max. 64
```

[Fig. 1.7.3] Window for P2P setting of XG5000

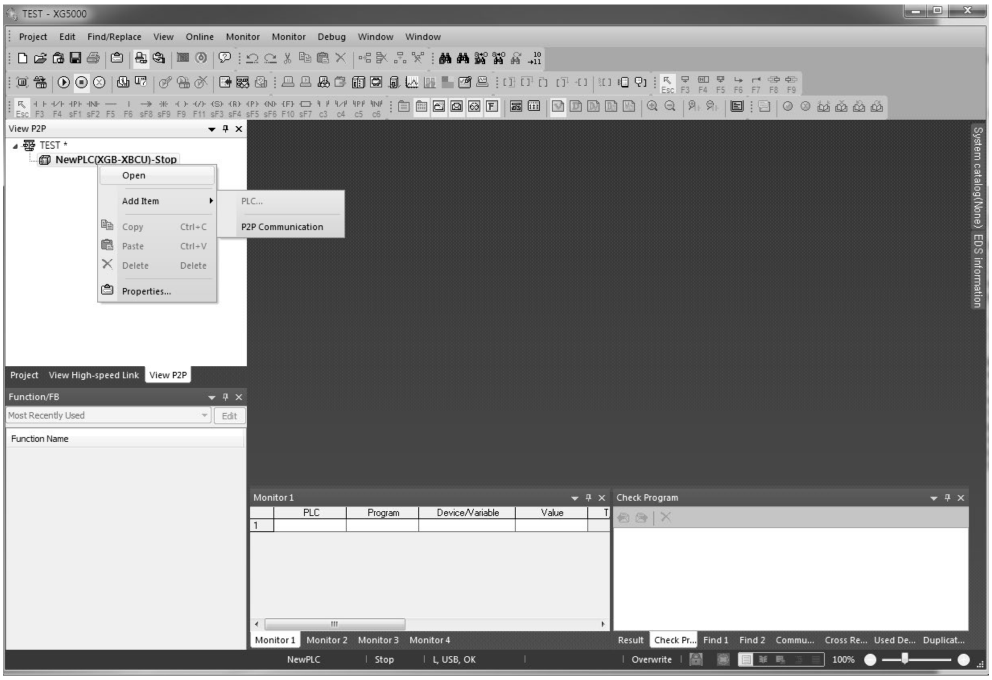
- Window for registering P2P parameters
  - You can set the P2P parameters up to 6.
  - Each P2P is composed of P2P channel, P2P block, user-defined frame, E-mail.

- Window for editing P2P
  - You can register and edit P2P block up to 32.
  - You can separately register frames by driver.

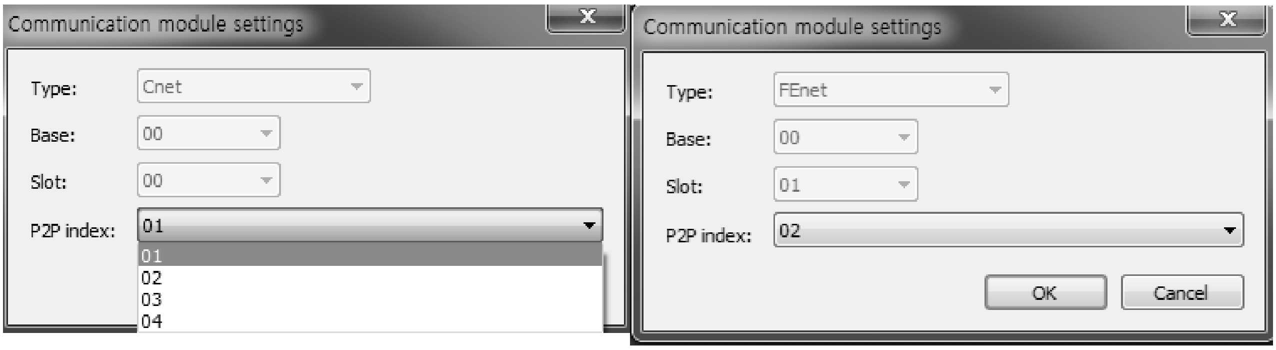
1) Setting FEnet communication

You need to set P2P parameters to use P2P services.

(1) Click the PLC module with the right mouse button on the P2P tab and choose P2P communication.



(2) Choose the P2P number to create the P2P module to be used.



Communication module settings

Type: Cnet

Base: 00

Slot: 00

P2P index: 01

Communication module settings

Type: FEnet

Base: 00

Slot: 01

P2P index: 02

(3) P2P 01 that XGB basic unit's built-in communication setting is fixed as Cnet.

(4) P2P 02 that XGB basic unit's built-in communication setting is fixed as FEnet.

(5) Double-click to confirm the communication settings.

(6) The base is fixed as 0.

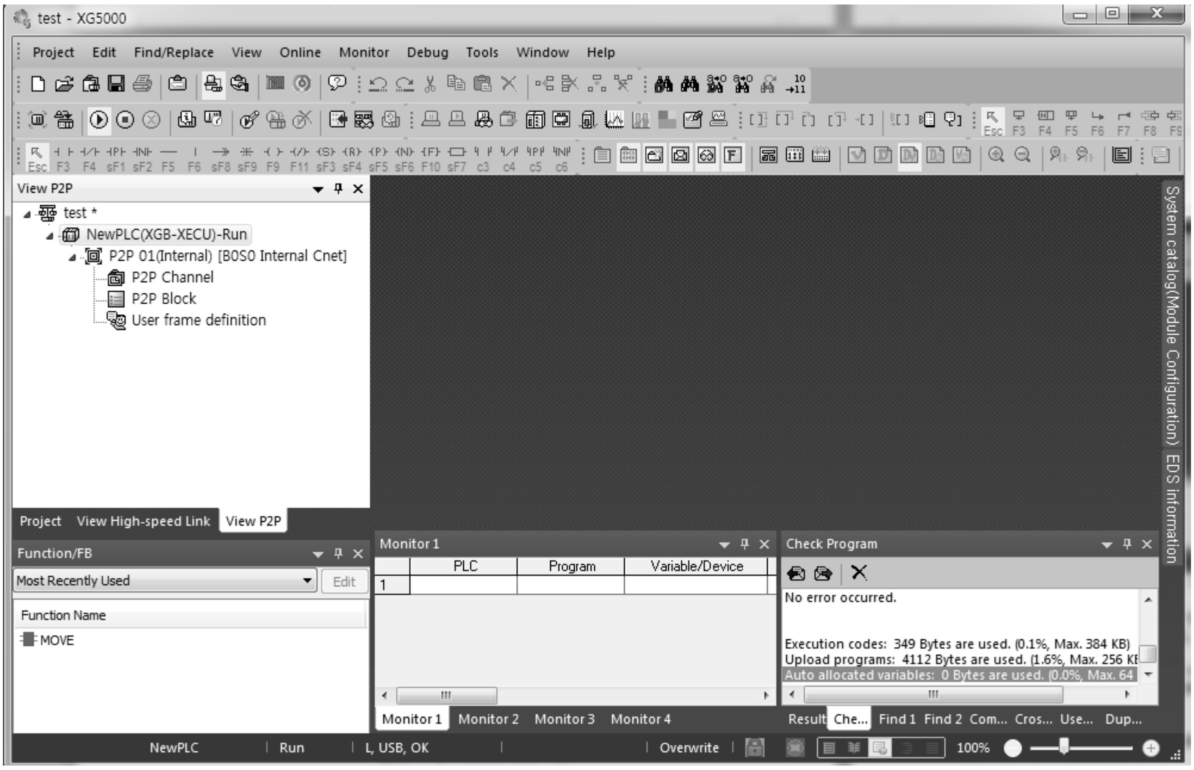
(7) The slot is automatically designated as slot 2 that has the built-in FEnet.

(8) If communication settings are completed, click the 'OK' button.

(9) If you click the 'OK' button, the detailed items of P2P will be created in the project window as the figure of the

2) Configuration of P2P parameters

If you set the communication modules in the P2p screen, the window for setting P2P parameters will be displayed as the below figure. P2P is composed of 4 data.

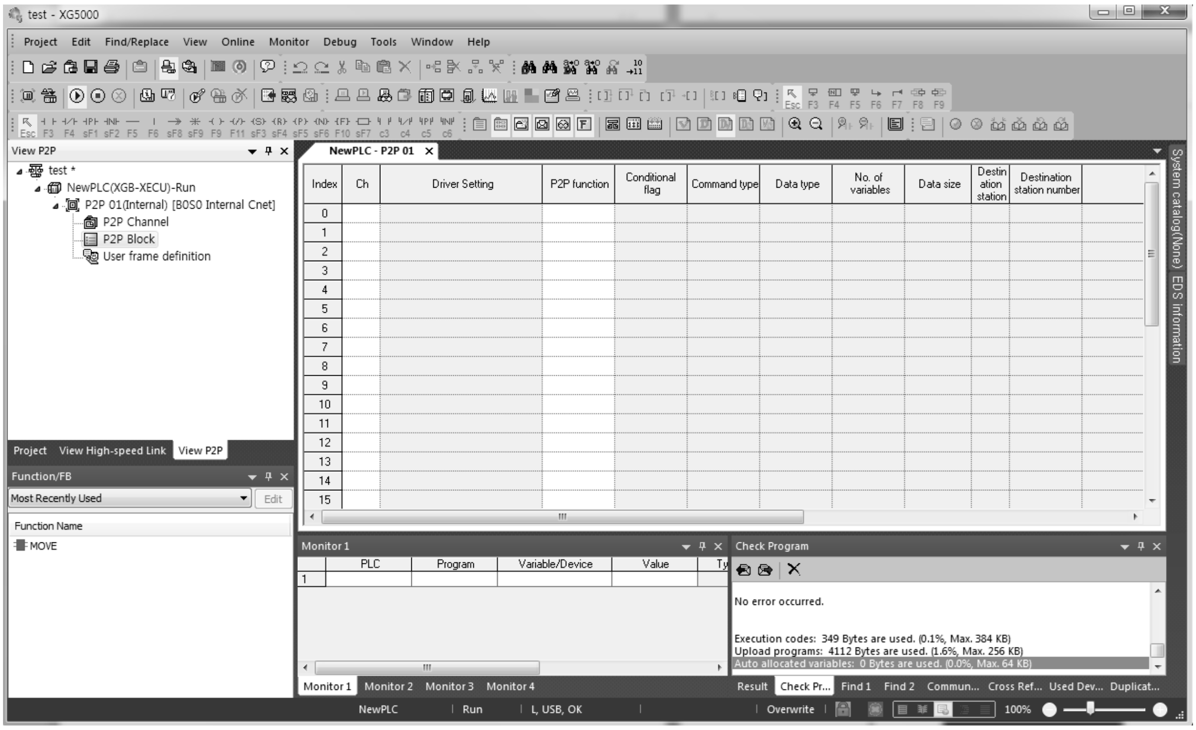


- test *
  - NewPLC(XGB-XECU)-Run
    - P2P 01(Internal) [B0S0 Internal Cnet]
      - P2P Channel
      - P2P Block
      - User frame definition

| | PLC | Program | Variable/Device |
|---|---|---|---|
| 1 | | | |

No error occurred.

Execution codes: 349 Bytes are used. (0.1%, Max. 384 KB)
Upload programs: 4112 Bytes are used. (1.6%, Max. 256 KB
Auto allocated variables: 0 Bytes are used. (0.0%, Max. 64



- test *
  - NewPLC(XGB-XECU)-Run
    - P2P 01(Internal) [B0S0 Internal Cnet]
      - P2P Channel
      - P2P Block
      - User frame definition

| Index | Ch | Driver Setting | P2P function | Conditional flag | Command type | Data type | No. of variables | Data size | Destination station | Destination station number |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | | |
| 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |
| 6 | | | | | | | | | | |
| 7 | | | | | | | | | | |
| 8 | | | | | | | | | | |
| 9 | | | | | | | | | | |
| 10 | | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | | | | | | | | | | |

| | PLC | Program | Variable/Device | Value | Ty |
|---|---|---|---|---|---|
| 1 | | | | | |

No error occurred.

Execution codes: 349 Bytes are used. (0.1%, Max. 384 KB)
Upload programs: 4112 Bytes are used. (1.6%, Max. 256 KB)
Auto allocated variables: 0 Bytes are used. (0.0%, Max. 64 KB)

(1) P2P channel
- Setting logical channels (IP, PORT, dedicated driver) of P2P services.
- Setting user-defined frame, XGT client, MODBUS TCP client
- Setting communication equipments using the protocols other than XGT/MODBUS TCP.

(2) P2P block
- Setting 32 P2P blocks that are operated independently.

(3) User-defined frames
- Registration of user-defined frames

(4) E-mail
- Registration of frames to transmit and receive E-mail frames

### 1.7.3 Kinds of P2P services

1) Kinds of P2P commands

The P2P that a user applies for programming can be divided into 6 commands.
The commands should be different depending on the service types so refer to the below table for proper application.

| Items | Commands | Purposes |
|---|---|---|
| XGT client | Read | Reads the designated area of the opposing station. |
| | Write | Transmits its own station's area data to the opposing station. |
| User-defined frame | Send | Sends its own station's area data to the opposing station. |
| | Receive | Receives the transferred data from the opposing station and saves it. |
| Modbus TCP | Read | Reads the designated area of the opposing station. |
| | Write | Transmits its own station's area data to the opposing station. |
| E-mail | ESend | Transmits the message in case of occurrence of events. |

2) Kinds of P2P services

(1) XGT client

The XGT client service is used to define transmission and reception of data of XGB's built-in FEnet. For simple communication, a user only needs to designate the basic settings such as channels and data type (BIT,BYTE,WORD, etc.) and memory areas, etc. No. 2004 port is used for TCP and No. 2005 port is used for UDP.

(2) User-defined frame

It is the service that makes a user define other companies' protocols in XGB FEnet for communication between XGB's built-in FEnet and other XGT's FEnet I/F modules or communication with other models. The communication protocols may be different depending on the manufacturers. Through the function of user-defined frame, a user can apply and edit the frames according to the characteristics of the relevant communication modules. The basic structure of user-defined frame is composed of HEAD, BODY,TAIL.

(3) Modbus TCP

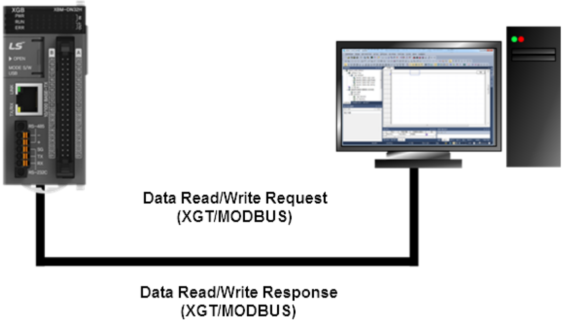
XGB FEnet supports the Modbus protocol that is the industrial standards. The Port No. is fixed as 502.

### 1.7.4 How to set up P2P services

1) Ethernet Driver

(1) Driver setting

The Ethernet Driver means the protocols that will work when the built-in FEnet is operated by the server. There are the XGT server and Modbus TCP/IP server for the built-in protocols. You can set the Ethernet Driver based on the protocols to be used when the opposing station reads the basic unit's data through the built-in FEnet or writes the data to the basic unit. In the majority of cases, the communication opposing station is usually MMI (or HMI). In this case, a user can communicate with the opposing devices by setting parameters without separate communication programming. The below figure shows the typical example of using the Ethernet Driver; communication with MMI PC. When the MMI PC requests the data, FEnet will respond.



- Types of Ethernet (server) Drivers

  The available driver types are as below.

| Types | Descriptions |
|---|---|
| XGT server | LS ELECTRIC's XGT FEnet dedicated protocol |
| Modbus TCP/IP server | Modicon's open protocol |

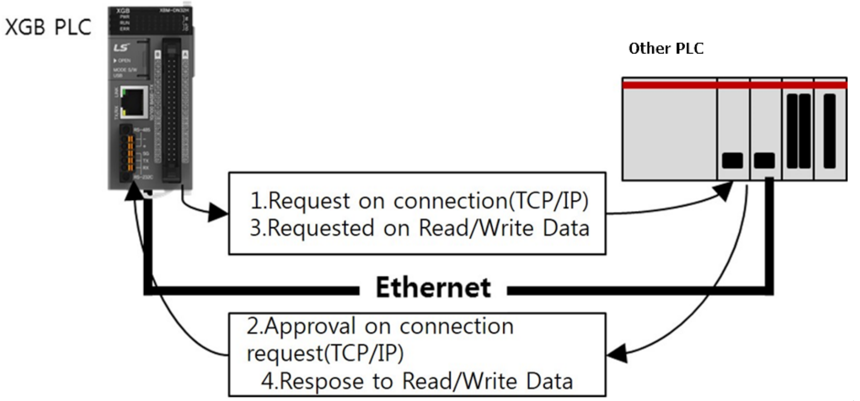
**Notice**

(1) The number of drivers varies depending on the set Ethernet channels and if you set the Ethernet channels, the number of available drivers will be as small as the number of set channels. Accordingly, be careful of this.

(2) The Ethernet (server) Driver can realize 1:N communication so several client devices can connect the one set port to obtain data.

2) P2P channel

The Ethernet P2P channel is used When the PLC is operated as Master by using XGT FEnet's built-in protocols or when the PLC should communicate through user-defined protocols



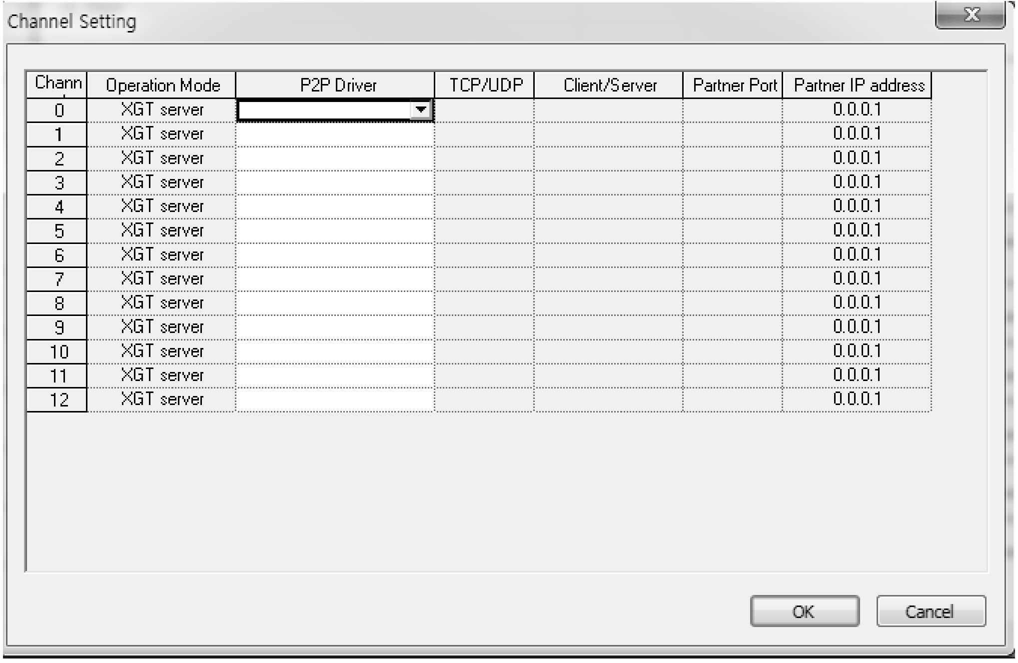
<Example of using P2P channel information>

(1) P2P channel setting

The built-in FEnet can transmit and receive the data by using the maximum of 16 channels and the channel is composed of the IP address and port number of the communication device.
The number of available channels in P2P is the number that subtracts the number of dedicated accesses in the basic parameter from the total number of channels (16). (Number of P2P channels=16–number of dedicated accesses)

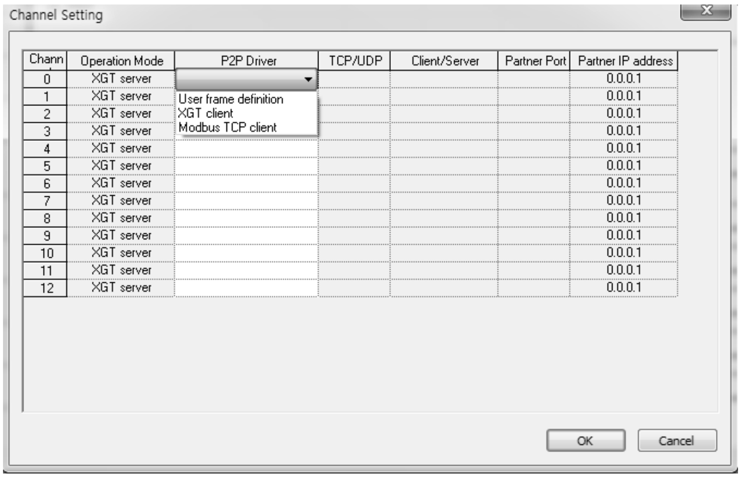
For user convenience, P2P allows the communication with the devices using XGT, Modbus TCP protocols by setting simple parameters. For communication with other devices, it provides the function of user-defined frames. In addition, a user can register the message and mail address to transmit and receive the E-mail frame. (It supports ASCII)

However, you do not need to set the channels for E-mail communication. If you choose the P2P channel in the window for P2P setting, the below window will pop up.



| Chann | Operation Mode | P2P Driver | TCP/UDP | Client/Server | Partner Port | Partner IP address |
|---|---|---|---|---|---|---|
| 0 | XGT server | | | | | 0.0.0.1 |
| 1 | XGT server | | | | | 0.0.0.1 |
| 2 | XGT server | | | | | 0.0.0.1 |
| 3 | XGT server | | | | | 0.0.0.1 |
| 4 | XGT server | | | | | 0.0.0.1 |
| 5 | XGT server | | | | | 0.0.0.1 |
| 6 | XGT server | | | | | 0.0.0.1 |
| 7 | XGT server | | | | | 0.0.0.1 |
| 8 | XGT server | | | | | 0.0.0.1 |
| 9 | XGT server | | | | | 0.0.0.1 |
| 10 | XGT server | | | | | 0.0.0.1 |
| 11 | XGT server | | | | | 0.0.0.1 |
| 12 | XGT server | | | | | 0.0.0.1 |

You can define the P2P driver type by selecting the‘P2P Driver’ of the desired channel.



| Chann | Operation Mode | P2P Driver | TCP/UDP | Client/Server | Partner Port | Partner IP address |
|---|---|---|---|---|---|---|
| 0 | XGT server | | | | | 0.0.0.1 |
| 1 | XGT server | | | | | 0.0.0.1 |
| 2 | XGT server | | | | | 0.0.0.1 |
| 3 | XGT server | | | | | 0.0.0.1 |
| 4 | XGT server | | | | | 0.0.0.1 |
| 5 | XGT server | | | | | 0.0.0.1 |
| 6 | XGT server | | | | | 0.0.0.1 |
| 7 | XGT server | | | | | 0.0.0.1 |
| 8 | XGT server | | | | | 0.0.0.1 |
| 9 | XGT server | | | | | 0.0.0.1 |
| 10 | XGT server | | | | | 0.0.0.1 |
| 11 | XGT server | | | | | 0.0.0.1 |
| 12 | XGT server | | | | | 0.0.0.1 |

<Selection of P2P Driver client >

The below table shows the available driver types for the built-in FEnet interface and the descriptions

| Items | | Descriptions |
|---|---|---|
| P2P Driver | User defined frame | It is the protocol defined by a user for communication with the opposing device. |
| | XGT client | XGT dedicated protocol.<br>(No user-defined frame) |
| | Modbus TCP client | Defines the operations with MODICON’s Modbus TCP protocols. |
| TCP/UDP | | You can select between the TCP/UDP.<br>If you select the Modbus TCP, it will be fixed as TCP. |
| Client/Server | | You can select between the Client/Server.<br>If you select the XGT dedicated protocol OR Modbus TCP, it will be fixed as Client. |
| Partner Port | | You can input the opposing device’s port number.<br>It is the user-defined frame so when defining the protocols, the random port is designated and you can set the ports at the range of 1~65535. However, the XGT dedicated protocol is fixed as 2004 and the TCP is fixed as 502. |
| Partner IP Address | | You can input the opposing device’s IP address. |

If you choose the XGT client or Modbus TCP client for the P2P Driver, you cannot apply the user-defined frame

**Notice**

(1) Opposing station’s IP address

In case XGT is client, make sure to set the server device’s IP address. If the server is dynamically allocated the IP through DHCP, the IP address may be changed so you need to check the IP address before use.

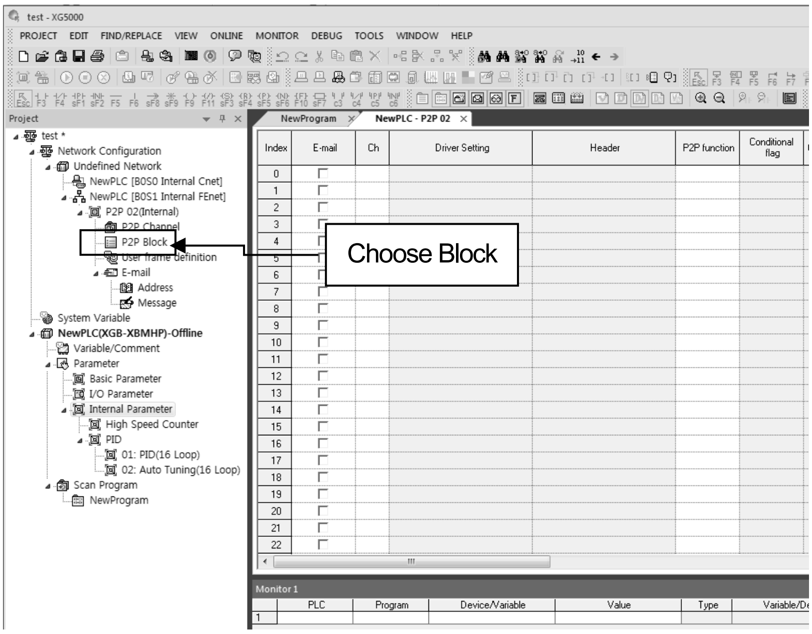
3) How to use the Modbus Driver

The below table shows the commands and addresses of the Modbus devices.

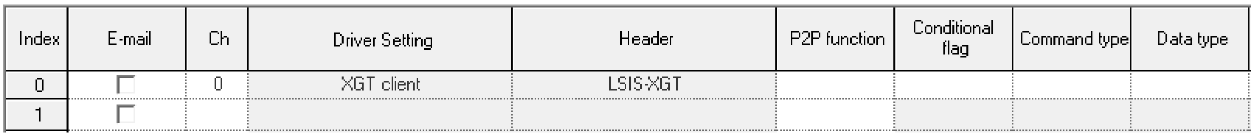
| Code | Names of function codes | Modicon PLC's data address | Remarks |
|---|---|---|---|
| 01 | Read output contact status (Read Coil Status) | 0XXXX (bit-output) | Bit Read |
| 02 | Read input contact status(Read Input Status) | 1XXXX (bit-input) | Bit Read |
| 03 | Read output register (Read Holding Registers) | 4XXXX (word-output) | Word Read |
| 04 | Read input register (Read Input Registers) | 3XXXX (word-input) | Word Read |
| 05 | Write output contact 1 bit (Force Single Coil) | 0XXXX (bit-output) | Bit Write |
| 06 | Write output register 1 word (Preset Single Register) | 4XXXX (word-output) | Word Write |
| 15 | Sequential Write output contact(Force Multiple Coils) | 0XXXX (bit-output) | Bit Write |
| 16 | Sequential Write output register<br>(Preset Multiple Register) | 4XXXX (word-output) | Word Write |

4) P2P block

If you choose the P2P block of the relevant parameter, the window for setting P2P parameters will be displayed.



You can set up the independent blocks up to 32. If you choose the random block in XG5000, you can designate the operations of the relevant block by selecting functions as below.



| Index | E-mail | Ch | Driver Setting | Header | P2P function | Conditional flag | Command type | Data type |
|---|---|---|---|---|---|---|---|---|
| 0 | ☐ | 0 | XGT client | LSIS-XGT | | | | |
| 1 | ☐ | | | | | | | |

The setting items by functions and the descriptions are as below.

(1) E-mail

It is used to set up the E-mail service.

(2) Channel

You can select the communication port to be used for the relevant block. The communication port of each block is determined at the time of setting parameter and it cannot be changed during RUN. The maximum number of configurable channels is the number that subtracts the number of set dedicated accesses from total 16 communication modules 'basic settings' of XG5000.

(3) Driver Setting

It means the communication driver designated by P2P setting. When designating channels, the driver for the relevant channel is automatically loaded. In case of arbitrary deletion of P2P channel setting, the set driver will be deleted. For more details, refer to 1.7.2 P2P channel.

(4) P2P functions

You can choose the P2P functions depending on the set channel drivers. Read/Write data can be performed from the opposing station with the set drivers.

- For the XGT client, choose READ/WRITE.
- For the Modbus TCP client, choose READ/WRITE.
- For the user-defined frame, choose SEND/RECEIVE

a) READ

It is the function to read and save the random area of the opposing station. It can be used for both the XGT client and the Modbus TCP client driver.

b) WRITE

It is the function to write data in the desired area of the opposing station. It can be used for both the XGT client and the Modbus TCP client driver. It supports Sequential Write and Individual Write and it is possible to write data for the maximum of 4 individual areas.

c) Send

It is the function to transmit the random frame to the external device to be accessed through unspecified communication not XGT client/Modbus TCP client protocol. It is applied to the user-defined frame.

You can select and use just one frame per one Frame Send. Through this function, you need to designate the fixed /variable sized variables of the relevant frames. Before using this function, you need to define the frame to be transmitted.

d) Receive

It is the function to receive some frames among the frames that are sent to the opposing station. You cannot choose the same frame for each P2P Frame Receive function block. You can choose just one reception function block for the reception frame.

(5) Conditional flag

It defines when the P2P block works and you can choose fixed cycle and memory set trigger conditions. Startup conditions are the internal contacts of XGB basic unit.

(6) Command Type

You can determine the detailed operations of Read; you can choose between Individual Read and Sequential Read. Individual Read covers the maximum of 4 memory areas (XGT protocol) and Sequential Read covers the defined size at the designated position.

(7) Data type

It defines the data type that will be processed by the blocks. In the case of XGT, it is possible to process data of bit, byte, 2 bytes (1word), 4 bytes (double word), 8 bytes (long word).

(8) Number of variables

It can be defined only when you choose Individual Read. It determines the number of areas to be read individually and in the case of XGT, you can choose them up to 4.In the case of Modbus, it is fixed as 1.

(9) Data size

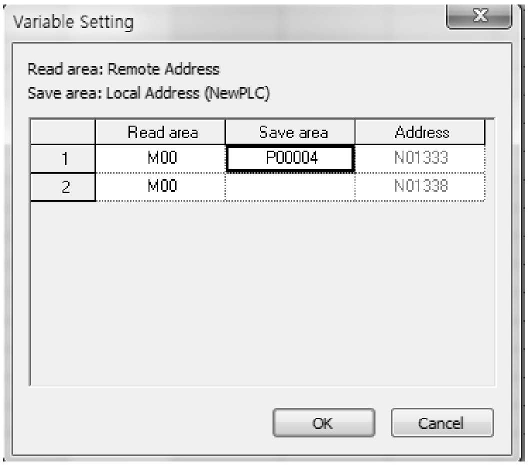
It defines the size of the data to be read when you choose Sequential Read and the data size is different depending on the data type.

(10) Frame

You can select the relevant frame (group) setting that will perform communication when defining the user frame.

(11) Setting

You can designate the memory area to be transmitted·received when setting XGT client or user definition. For transmission, as shown in the below figure, designate the area that will save the area (M0000) to be transmitted and the received data from the opposing station.



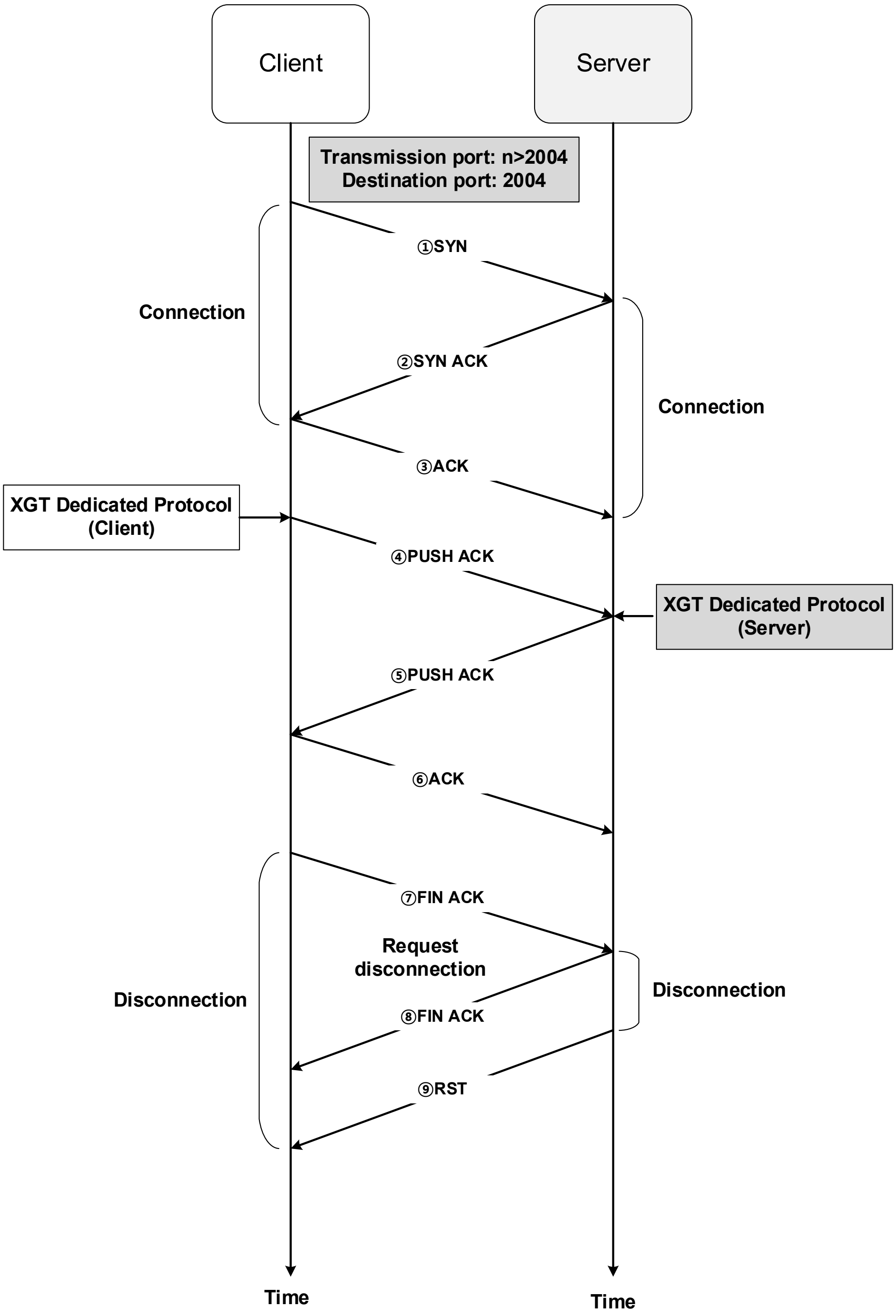
Read area: Remote Address

Save area: Local Address (NewPLC)

| | Read area | Save area | Address |
|---|---|---|---|
| 1 | M00 | P00004 | N01333 |
| 2 | M00 | | N01338 |

## 1.7.5 XGT client

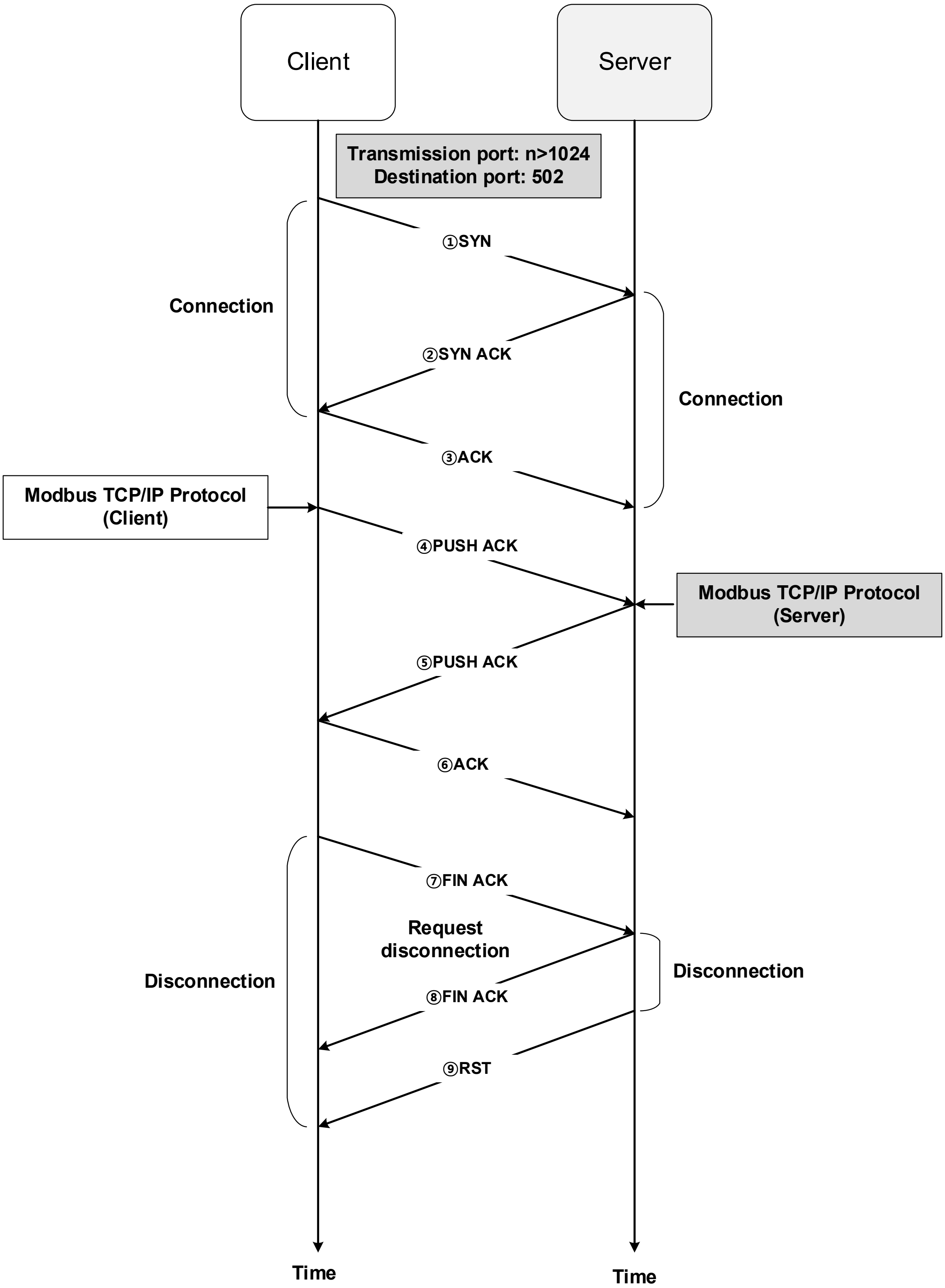
XGT client is the function to Read/Write Data, which transmits the request frame to the server through XGT dedicated protocols. It transmits the frame when the startup conditions of each block set in parameters are On. In the case of XBL-EMTA, you can use the XGT client function in two ways; TCP and UDP.



<Setting TCP XGT client channel>

## 1.7.6 Modbus TCP client

It is the function to Read/Write Data, which transmits the request frame to the server by using function code based on Modbus TCP/IP protocol. It transmits the frame when the startup conditions of each block set in parameters are On.



<Setting Modbus TCP client channel>

## 1.7.7 User-defined frame

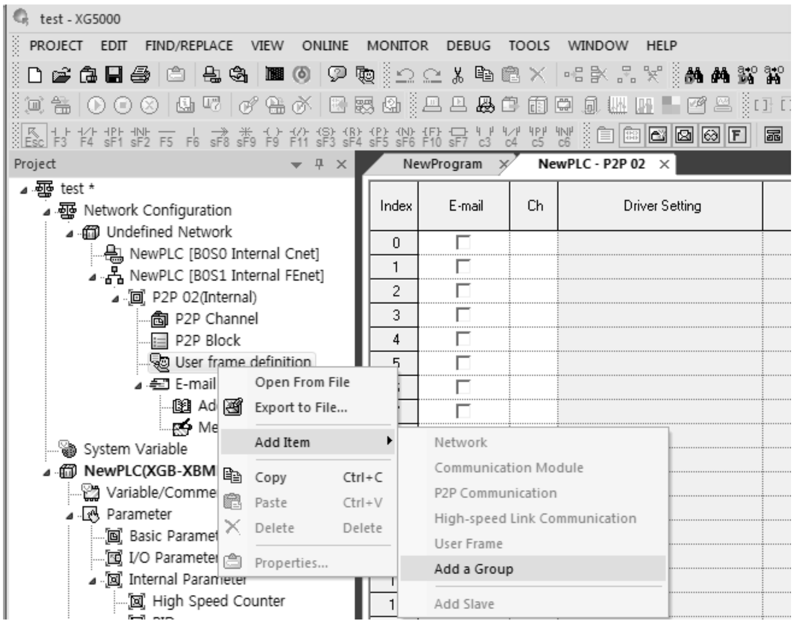
If you want to transmit the user's desirable frame or receive one among the frames of the network, you need to define the relevant transmission·reception frame. The function is available in the P2P service only. All frames are composed of Header, Data, Tail and each element can be omitted.
The user-defined frame is expressed as the group name and frame name. Each meaning is as below.

1) Group

It is the set of frames having the same Headers and Tails. To register frames, you need to register groups.

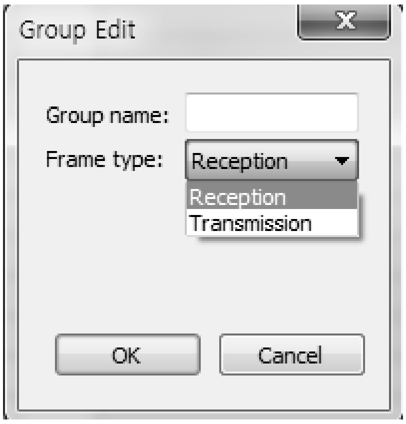
(1) Adding groups of user-defined frame

After choosing the user-defined frame as below, click the right mouse button. Select "Add a Group" in the popup menu for adding items.



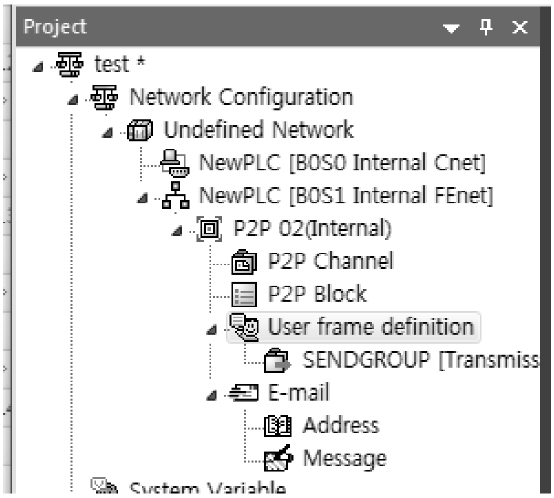
(2) Selecting group names and frame types of the user-defined frame

Enter the group name in the group edition menu and select the frame type. You can input the group name discretionally.



< Selecting group names and frame types of the user-defined frame >

The below figure shows the results of the project window when selecting “SEND” of the group name, transmission frame.



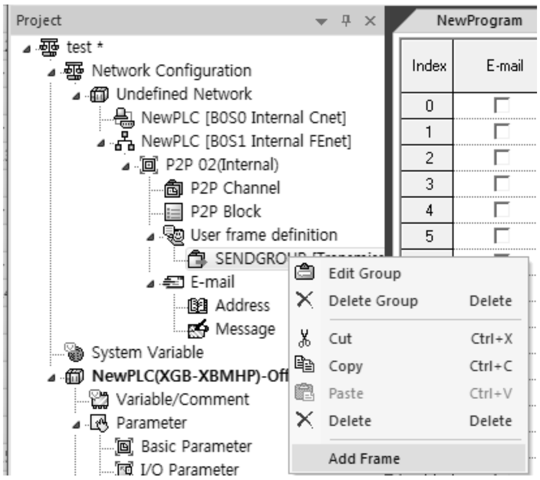
< Completion of adding groups of the user-defined frame>

2) Frame

- It is composed of the Head, Body, Tail.
- It defines the transmission · reception frames.
- You can add the fixed·variable sized variables to the Body.
- The frame is composed of multiple segments and you can register the maximum of 4 variable segments to one Body.

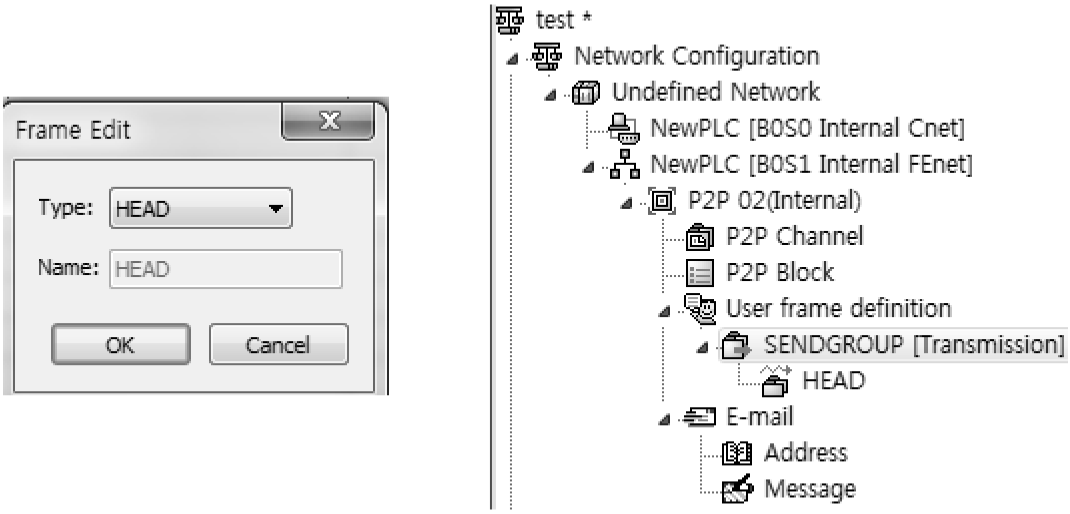
(1) Adding frames to the groups

If you click the right mouse button on the added group as below, the popup menu will come on. Choose 'Add Frames' and choose the frame types. The below figure represents the added frames to the group when you select HEAD, TAIL, BODY respectively.



< Adding the transmission frame of the user-defined frame>

a) Adding the user-defined frame's HEAD

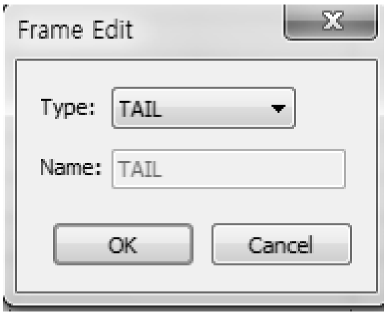


Type: HEAD

Name: HEAD

<Adding the use defined frame's HEAD>

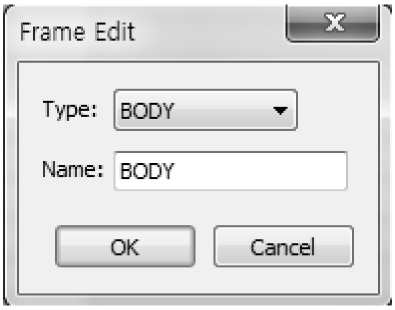
(2) Adding the user-defined frame's TAIL



Type: TAIL

Name: TAIL

(3) Adding the user-defined frame's BODY



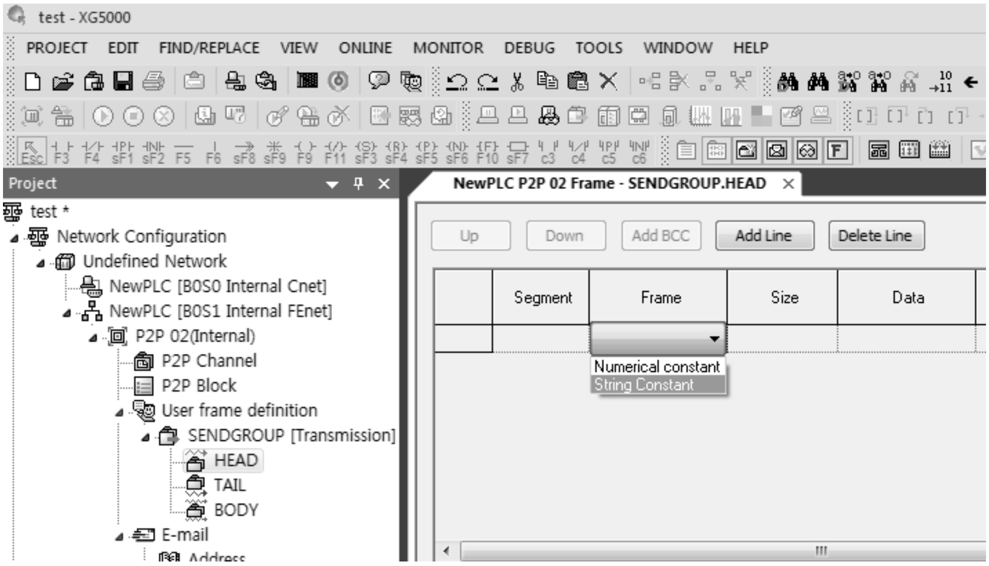
Type: BODY

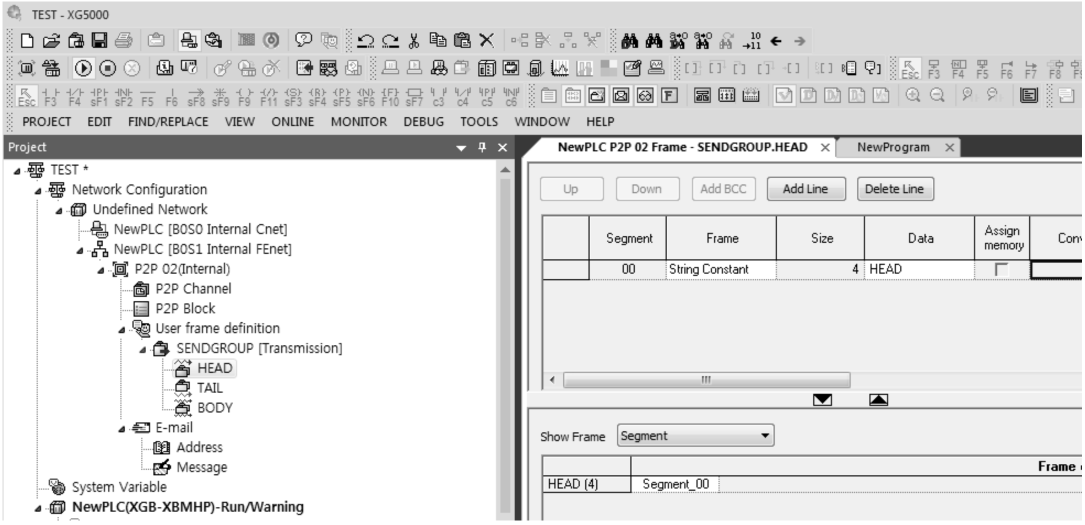
Name: BODY

3) Segments

(1) Kind of segments

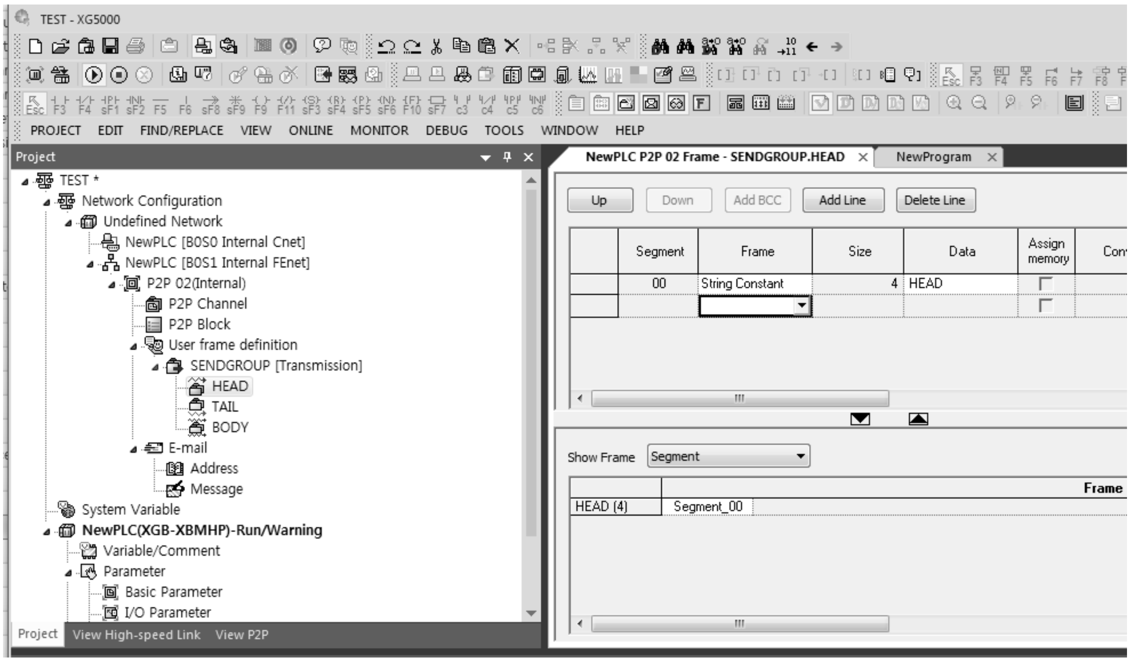
The frame's Headers, Bodies, Tails are composed of multiple segments. You can add segments by clicking the right mouse button.





| | Segment | Frame | Size | Data | Assign memory | Conv |
|---|---|---|---|---|---|---|
| | 00 | String Constant | 4 | HEAD | ☐ | |

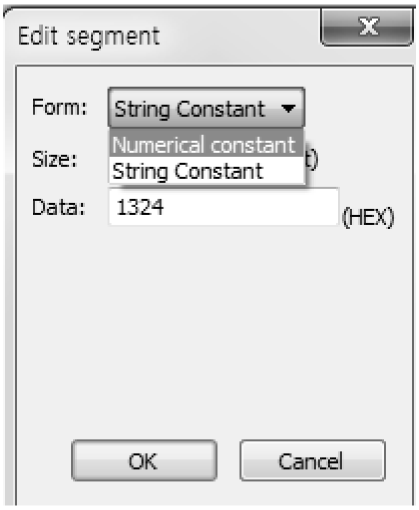
< Example of the window where the segment is registered>



| | Segment | Frame | Size | Data | Assign memory | Con |
|---|---|---|---|---|---|---|
| | 00 | String Constant | 4 | HEAD | ☐ | |
| | | | | | ☐ | |

<Example of add line>

There are the numerical constant, string constant, fixed · variable sized variables for the segments forming the frames.



Edit segment

Form: String Constant

Numerical constant
String Constant

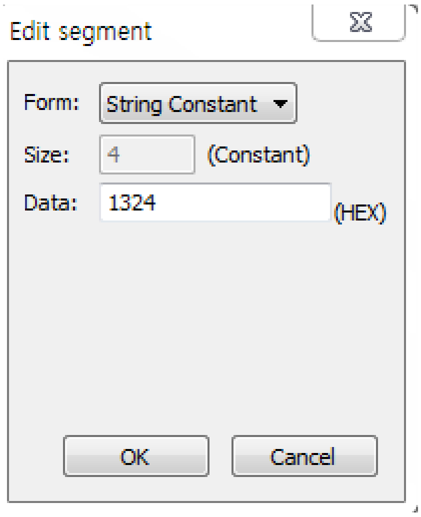
Size:

Data: 1324 (HEX)

<Adding segment>

a) Numerical constant

It defines the part that is fixed as the constant among frames and the value of data term should be designated as Hex.



Edit segment

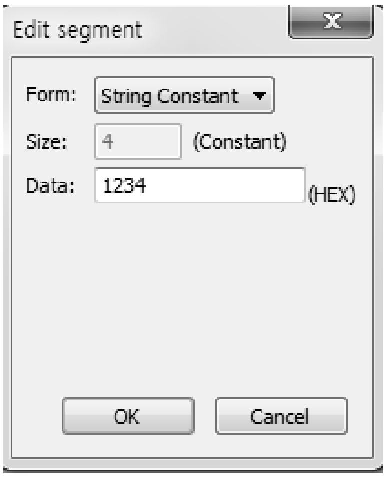
Form: String Constant

Size: 4 (Constant)

Data: 1324 (HEX)

b) String constant

Register the string constant among frames and designate the value of data term as ASCII.



Edit segment

Form: String Constant

Size: 4 (Constant)

Data: 1234 (HEX)

c) Fixed size variables

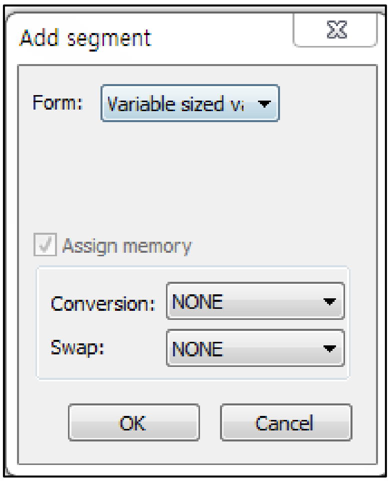
The fixed size variables can be used for the frame's Body area only. It is used when you process the data as much as the defied size among the received frames. If you check memory specification, it can be saved to the PLC memory. At this time, data values can be changed, swapped.

d) Variable size variables

- They can be used for the frame's Body area.
- Transmission frame: It is used to change the frame length. If you check memory specification, the transmission frame will be composed of the data read from the PLC memory.
- Reception frame

It is used to process variable sized data among received frames.

It can be registered to the last segment among the Body areas. If you check memory specification, the data for the corresponding segment will be saved among received frames (it also can be swapped and changed)



Add segment

Form: Variable sized v

☑ Assign memory

Conversion: NONE

Swap: NONE

(2) Data conversion processing

In case you need to convert the data into ASCII from Hex during transmission·reception of frames or execute Byte Swap, it can be defined in the frame editing frame.

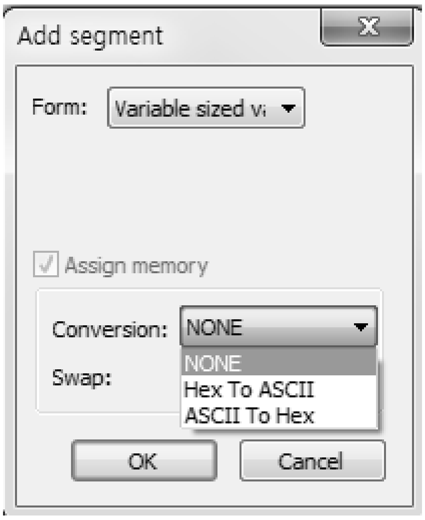
a) Conversion

(a) Hex To ASCII

- Transmission: Converts the data read from the PLC memory into ASCII and composes the transmission frame
- Reception: Converts the received data into ASII and saves it.

(b) ASCII To Hex

- Transmission: Converts the data read from the PLC memory into Hex and composes the transmission frame.
- Reception: Converts the received data into Hex and saves it.



For configuring the transmission frame, in CASE you use the PLC memory MW100’s 2word and convert it into Hex to ASCII or in case h34353637 is saved in MW100, the corresponding segment of the transmission frame will be made of “4567”.
In addition, when you convert the part of the received frames into Hex and save it, if the value of the corresponding area is “4567”, h34353637 will be saved to the PLC memory.

b) Swap

(a) 2byte

- Swapping the corresponding part of transmission · reception frames by 2 bytes

(b) 4byte

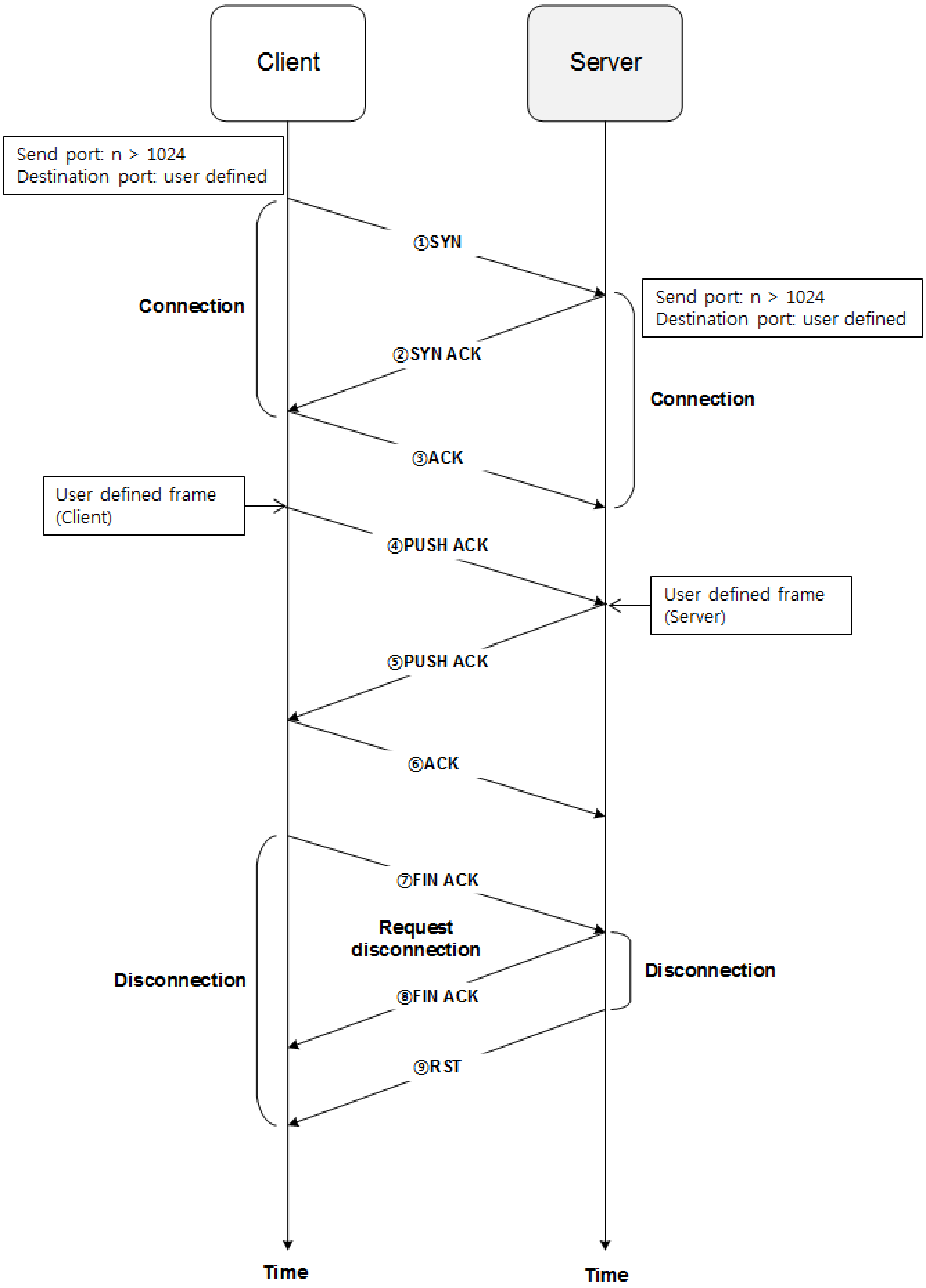
- Swapping the corresponding part of transmission · reception frames by 4 bytes

(c) 8byte

- Swapping the corresponding part of transmission · reception frames by 8 bytes

* h1234567811223344 can be converted by each method as below.
- 2byte Swap: h3412785622114433
- 4byte Swap: h7856341244332211
- 8byte Swap: h4433221178563412

4) TCP/UDP user-defined frame server



▪<TCP user-defined frame server>

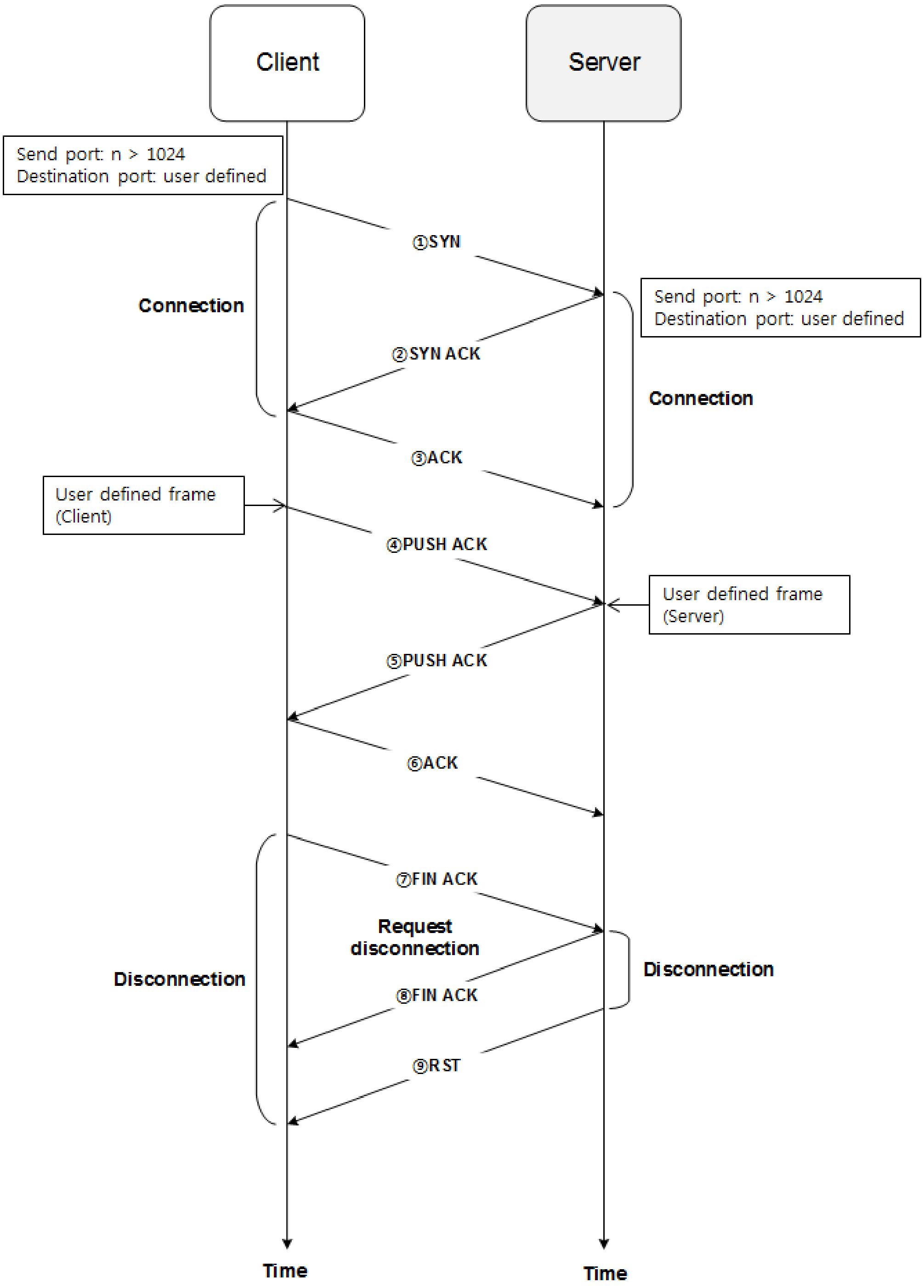
(1) It is the function to receive the frame registered in the transmission block to the port designated by a user.

(2) After the access request is received from the client and connection is completed, when the frame registered in the reception block is received from the client, the corresponding block will be processed.

(3) In case the ports or frame forms are different, reception process is not available.

(4) In the case of UDP user frame server, when the frame registered in the reception block is received to the port, it will be processed.

5) TCP/UDP user-defined frame client



<TCP user-defined frame client>

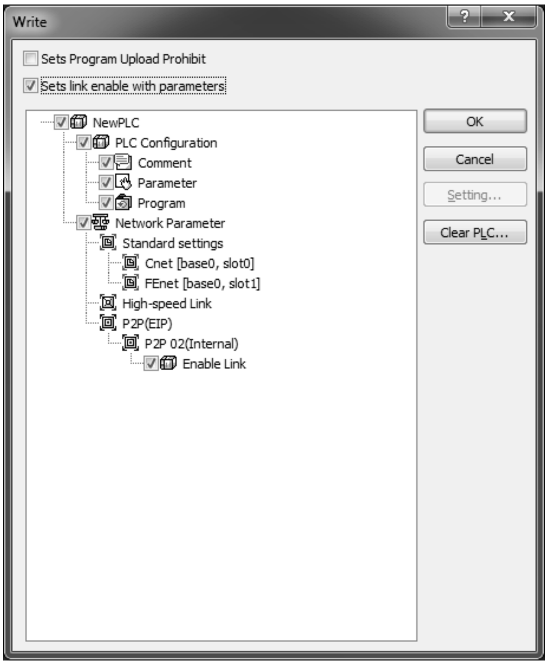
1) It is the function to transmit the frame that is registered in the transmission block to the port designated by a user.
2) If the startup conditions of the block are On, the connection request will be sent to the server and the frame registered in the transmission block will be sent to the corresponding port.
3) In the case of UDP, when the startup conditions are On to the corresponding port without connection request, the frame will be transmitted.

### 1.7.8 Operation of P2P service

After setting P2P parameters, you need to download the parameters to the PLC’s CPU and start up the P2P service. Assume that the P2P parameters to be downloaded are already made and accesses to the PLC’s CPU.

1) P2P parameter download

If you choose [Online] -> [Write] in the XG5000 menu to download the completed P2P parameters, the window for parameters download will pop up. If you click the ‘OK’ button, the communication parameters will be downloaded to the CPU. if you check ‘Set up with Link Enable’, Link Enable can be applied with writing P2P/HS parameters at the same time.



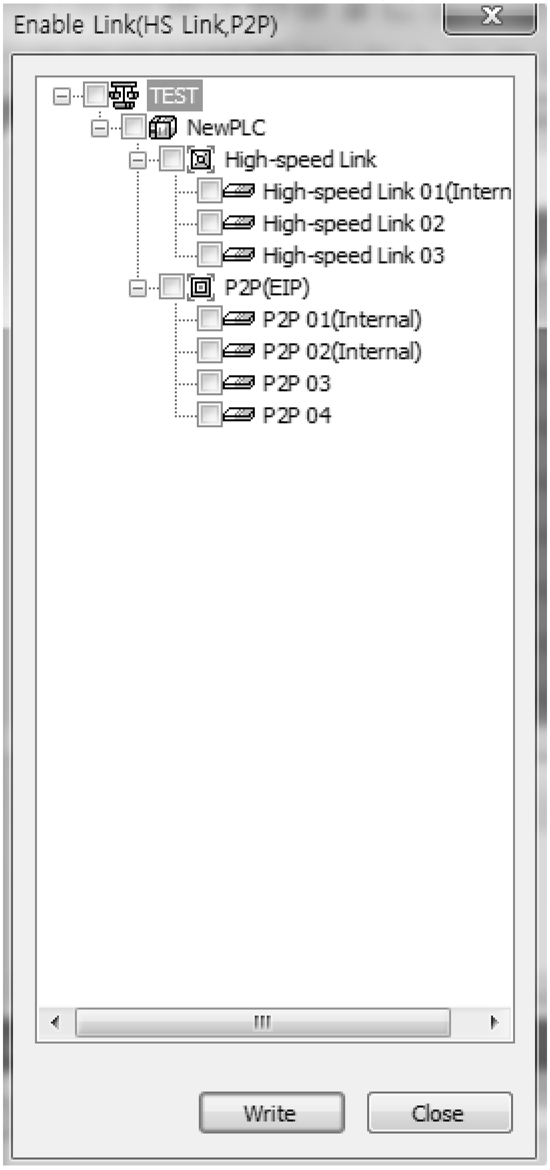
Write

☐ Sets Program Upload Prohibit
☑ Sets link enable with parameters

- ☑ NewPLC
  - ☑ PLC Configuration
    - ☑ Comment
    - ☑ Parameter
    - ☑ Program
  - ☑ Network Parameter
    - Standard settings
      - Cnet [base0, slot0]
      - FEnet [base0, slot1]
    - High-speed Link
    - P2P(EIP)
      - P2P 02(Internal)
        - ☑ Enable Link

(1) Startup of P2Pservice

After downloading P2P parameters, you need to start up P2P for P2P service. To achieve this, choose [Online] →[Communication Module Setting]→[Link Enable (high speed link,P2P)] in the menu.

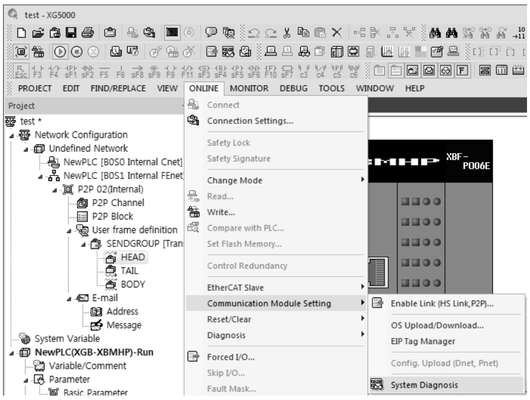


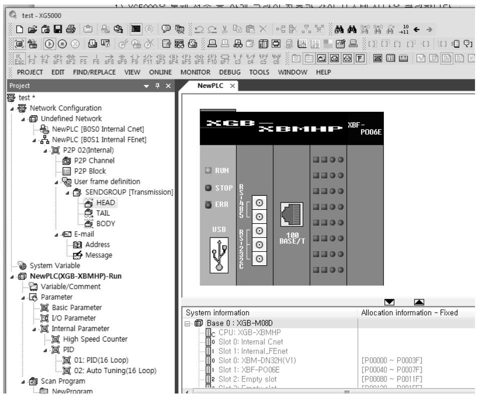
Choose the P2P parameters to be started in the [link Enable (high speed link, P2P)] window. If you cancel the already checked P2P parameter, the relevant P2P service will stop.

## 1.7.9 P2P diagnosis function

1) Click the System Diagnosis as shown in the left figure after access through XG5000.

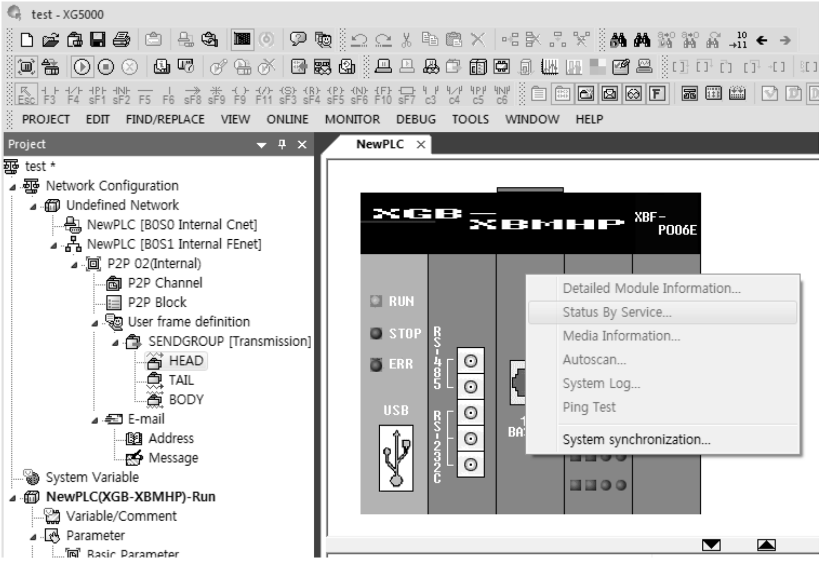
2) Then, the current system is displayed as shown in the right figure.



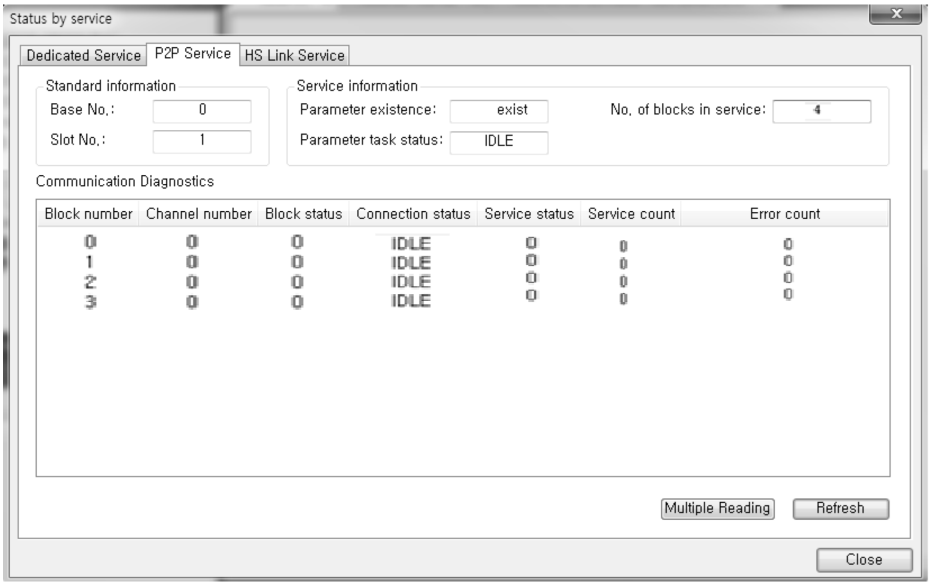


3) Put the mouse on the figure of the module and click the right mouse button as shown in the left side of the below figure.

4) Choose the status by services and click them.



5) Then, the status window by service is displayed.
6) If you select the P2P service tab, you can check the status of P2P service as below.



Standard information
Base No.: 0
Slot No.: 1

Service information
Parameter existence: exist
Parameter task status: IDLE
No. of blocks in service: 4

Communication Diagnostics

| Block number | Channel number | Block status | Connection status | Service status | Service count | Error count |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | IDLE | 0 | 0 | 0 |
| 1 | 0 | 0 | IDLE | 0 | 0 | 0 |
| 2 | 0 | 0 | IDLE | 0 | 0 | 0 |
| 3 | 0 | 0 | IDLE | 0 | 0 | 0 |

**Remaks**

We support Dedicated Service in case of Only TCP client which Connected to XGT server
Dedicated Service not available in XGT Server(UDP)
However, the XGT client (UDP) can check diagnosis history from P2P service.

# 1.8 High speed link

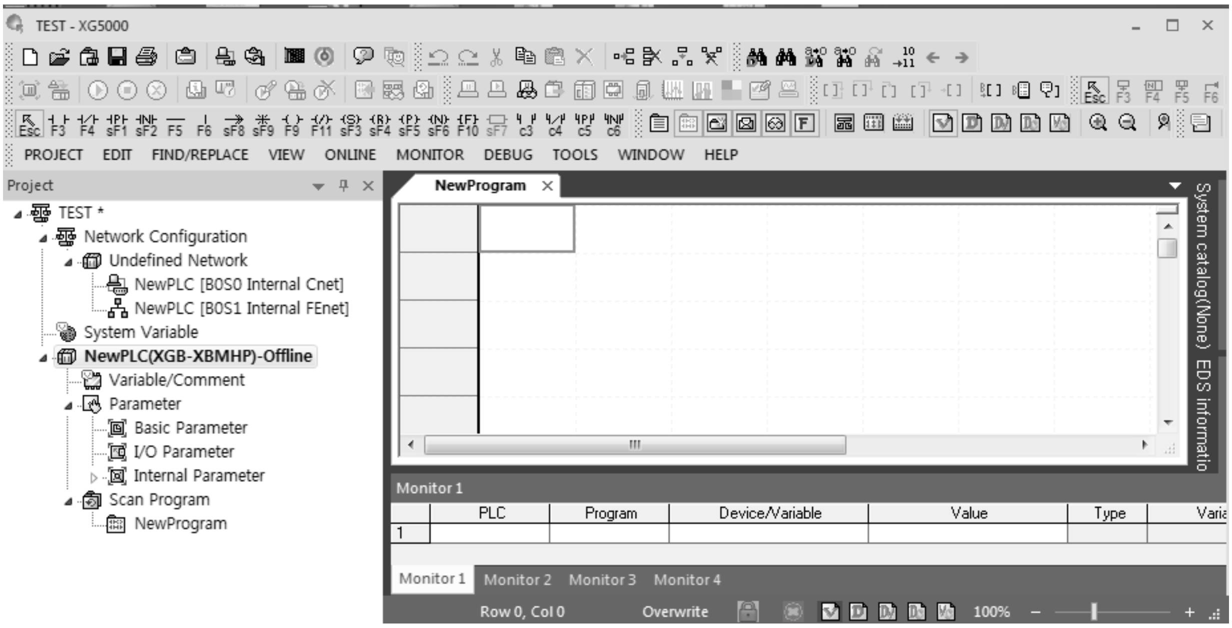
## 1.8.1 Outline

The high speed link that is the communicate method between XGB PLC and XGK PLC's communication module is the function to transmit and receive data regularly by setting high speed link parameters. The high speed link service transmits the frame to Subnet Broadcast by using UDP protocols.
The device that is in the same subnet receives the Broadcast frame and if the relevant frame is registered in the reception list, the data will be processed. The functions of the high speed link are as below.

1) Function for setting the high speed link block
If there are several transmission · reception areas, you can set the blocks up to 64. It is possible to set 200 words per one block.
2) Function for setting the transmission cycle
A user can set the transmission cycle by parameters. It is possible for a user to set the transmission · reception cycle from 20ms to 10 seconds.
3) Function for setting transmission · reception areas
You can set the transmission · reception areas by data blocks. It is possible to use the maximum of 64 blocks without distinction of transmission·reception.
4) Function for providing the high speed link information
You can check the operating status of the high speed link through flags.
You also can use the convenient diagnosis function through XG5000.

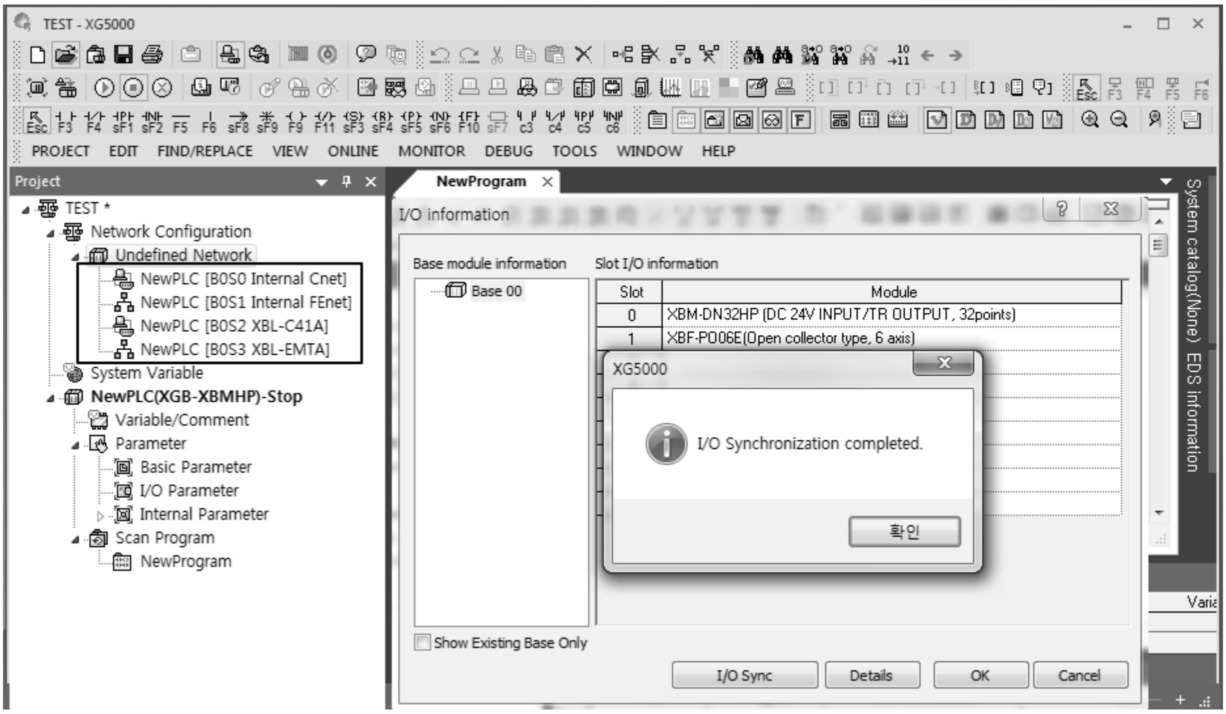
## 1.8.2 Parameters setting

1) Basic parameters
(1) When creating the XG5000 project, any RUN communication modules are not registered in the basic network.



[Fig. 1.8.1] Creation of XG5000 project

(2) If you execute I/O synchronization in [online]→[diagnosis]→[I/O information] after accessing to the PLC, even the currently installed expansion communication module including built-in communication will be registered.



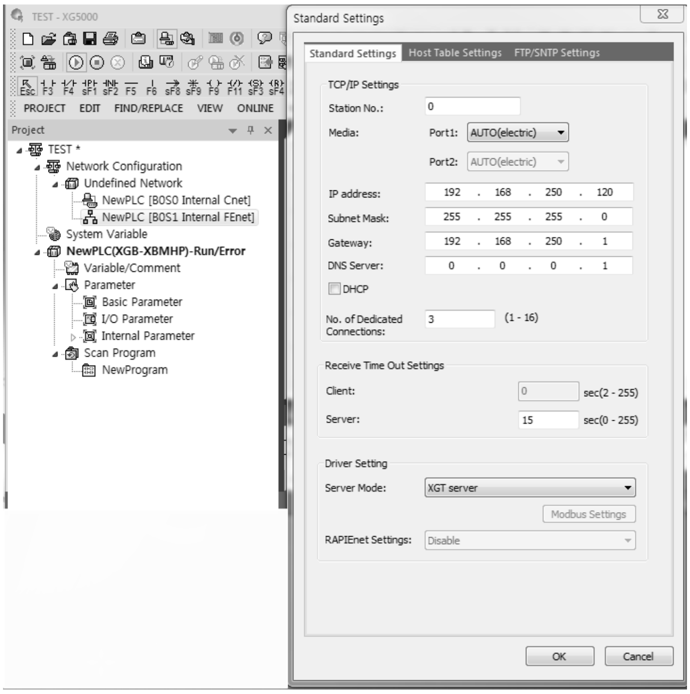
TEST *
- Network Configuration
  - Undefined Network
    - NewPLC [B0S0 Internal Cnet]
    - NewPLC [B0S1 Internal FEnet]
    - NewPLC [B0S2 XBL-C41A]
    - NewPLC [B0S3 XBL-EMTA]
- System Variable
- NewPLC(XGB-XBMHP)-Stop
  - Variable/Comment
  - Parameter
    - Basic Parameter
    - I/O Parameter
    - Internal Parameter
  - Scan Program
    - NewProgram

| Slot | Module |
|---|---|
| 0 | XBM-DN32HP (DC 24V INPUT/TR OUTPUT, 32points) |
| 1 | XBF-PO06E(Open collector type, 6 axis) |

I/O Synchronization completed.

[Fig. 1.8.2] Registration of XG5000 project communication module

(3) Double-click the built-in Fenet and input high speed link's exchange number and network parameter information.



Standard Settings

TCP/IP Settings
Station No.: 0
Media: Port1: AUTO(electric)
Port2: AUTO(electric)
IP address: 192 . 168 . 250 . 120
Subnet Mask: 255 . 255 . 255 . 0
Gateway: 192 . 168 . 250 . 1
DNS Server: 0 . 0 . 0 . 1
☐ DHCP
No. of Dedicated Connections: 3 (1 - 16)

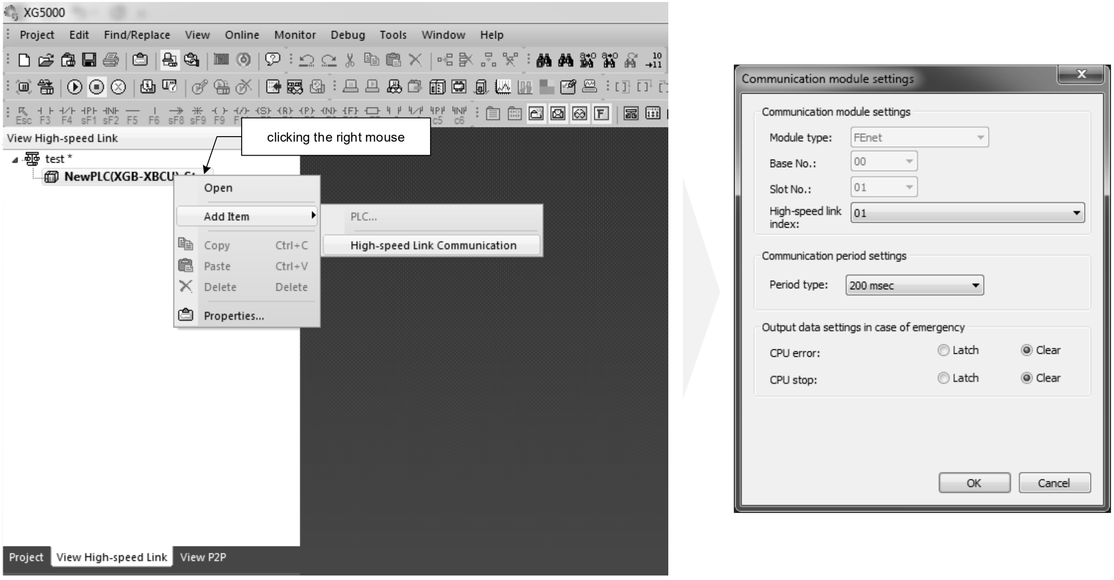
Receive Time Out Settings
Client: 0 sec(2 - 255)
Server: 15 sec(0 - 255)

Driver Setting
Server Mode: XGT server
RAPIEnet Settings: Disable

[Fig. 1.8.3] Setting the basic communication module

## 2) High speed link parameter

### (1) Communication setting



Communication module settings

Communication module settings
Module type: FEnet
Base No.: 00
Slot No.: 01
High-speed link index: 01

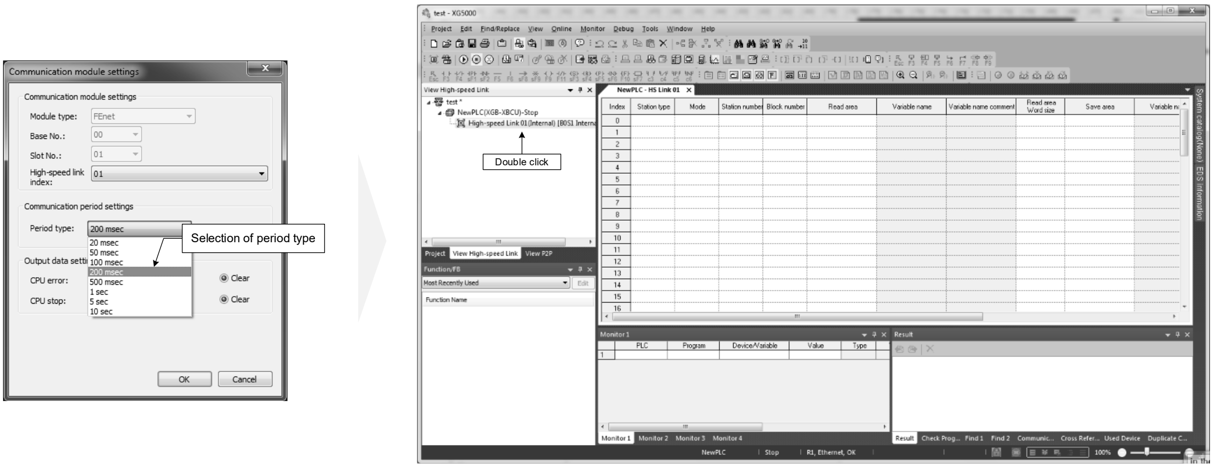
Communication period settings
Period type: 200 msec

Output data settings in case of emergency
CPU error: ○ Latch ● Clear
CPU stop: ○ Latch ● Clear

[Fig. 1.8..4] Basic setting of high speed link

a) After clicking the right mouse on the high speed link tab, add high speed link communication items as shown in the left side of the figure[1.8.4].

b) Then, the window for setting communication modules is activated as shown in the right side of the figure[1.8.4] and you can set the basic high speed link. No.01 high speed link is the built-in FEnet and No. 02 and 03 .high speed links can be used for expansion communication modules as before.

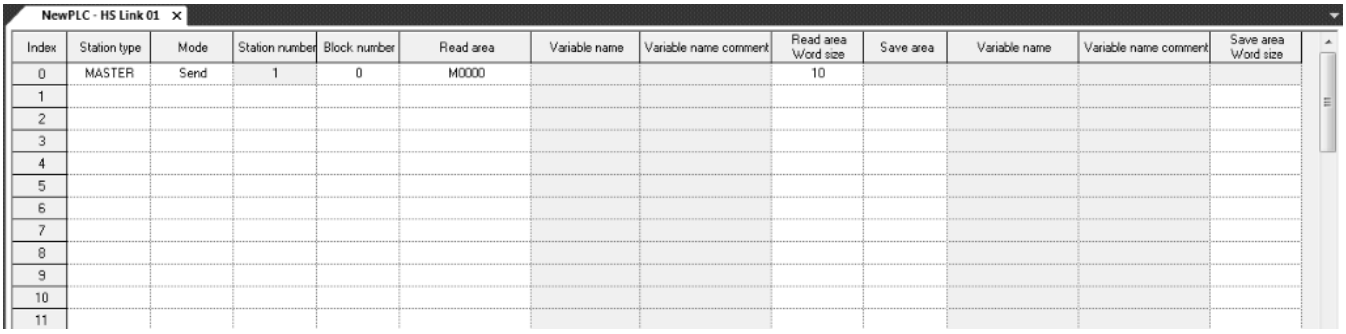


Communication module settings
Module type: FEnet
Base No.: 00
Slot No.: 01
High-speed link index: 01
Period type: 200 msec
CPU error: ● Clear
CPU stop: ● Clear

[Fig. 1.8.5] Completion of setting high speed link communication module

c) Select the cycle to be communicated in communication cycle setting as shown in the left side of [Fig. 1.8.5].Choose the cycle and click 'OK' button. Then, if you double-click the No.1 module of high speed link, the window for setting block will be displayed as shown in the right side of [Fig. 1.8.5].

(2) Setting the high speed link transmission block



| Index | Station type | Mode | Station number | Block number | Read area | Variable name | Variable name comment | Read area Word size | Save area | Variable name | Variable name comment | Save area Word size |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | MASTER | Send | 1 | 0 | M0000 | | | 10 | | | | |
| 1 | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | |

[Fig. 1.8.6]Setting high speed link transmission block

a) Set the station type as MASTER

b) Choose the transmission mode

c) If you choose transmission, it will be automatically set as the exchange number set in the basic

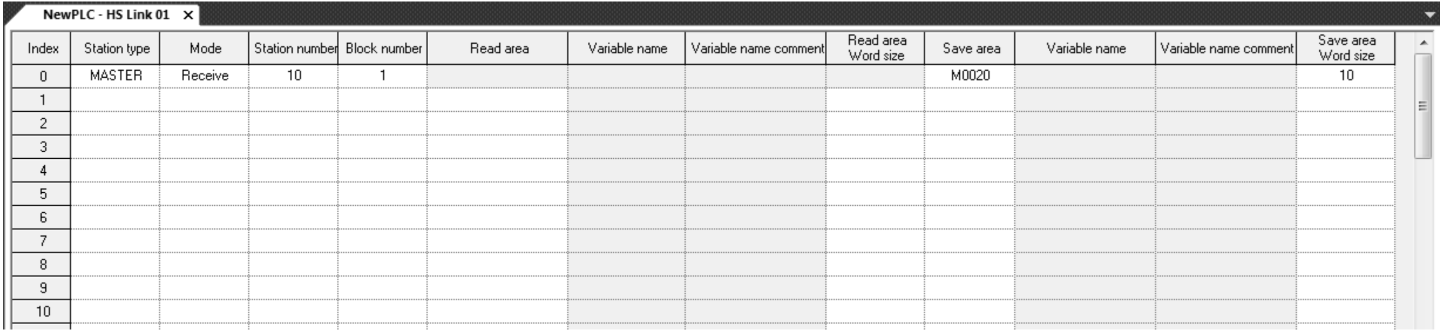
d) parameters.

e) Input the block number(range: 0~31).

f) Input the area to be read. The area to be read is the each area of XGB's CPU modules.

g) If you input the word size of the area to be read, setting transmission blocks is completed.

(3) Setting high speed link reception block



| Index | Station type | Mode | Station number | Block number | Read area | Variable name | Variable name comment | Read area Word size | Save area | Variable name | Variable name comment | Save area Word size |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | MASTER | Receive | 10 | 1 | | | | | M0020 | | | 10 |
| 1 | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | |

[Fig. 1.8.7] Setting high speed link reception block

a) Set the station type as MASTER as show in [Fig. 1.8.7].

b) Choose the mode as reception.

c) Input the exchange number.This one is the exchange number of the opposing device transmitting the relevant block.

d) Input the block number. When the received frame is the same as the relevant block number, reception is processed.

e) Input the storage area. The storage area is the area saving data when the frames of the relevant

f) block

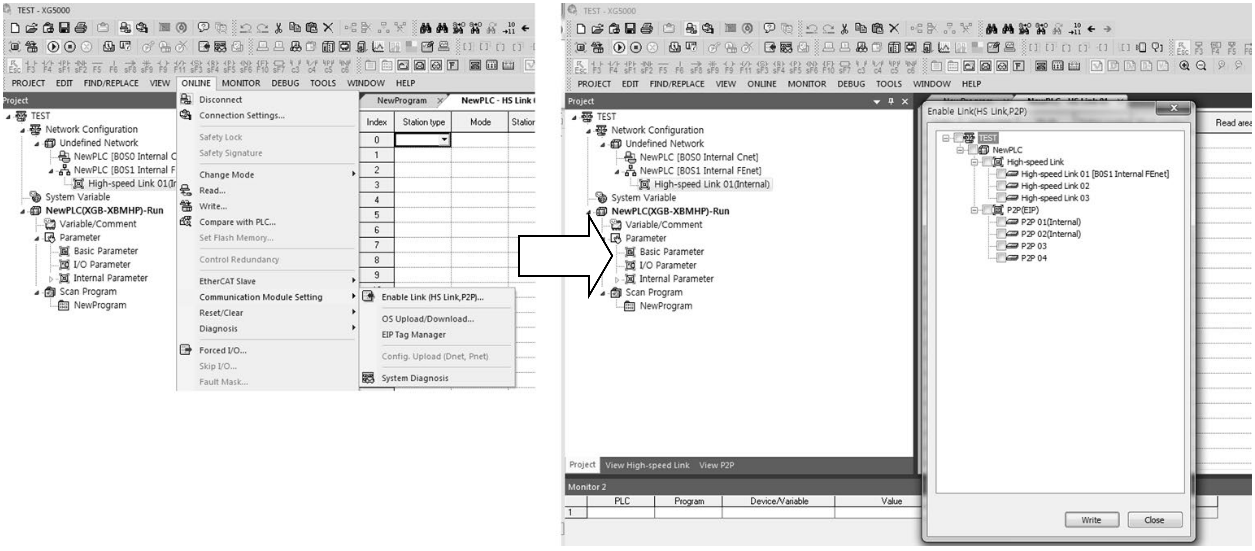
g) Numbers are received to each area of XGB CPU modules.

h) If you input the word size of the data to be read, setting reception block is completed.

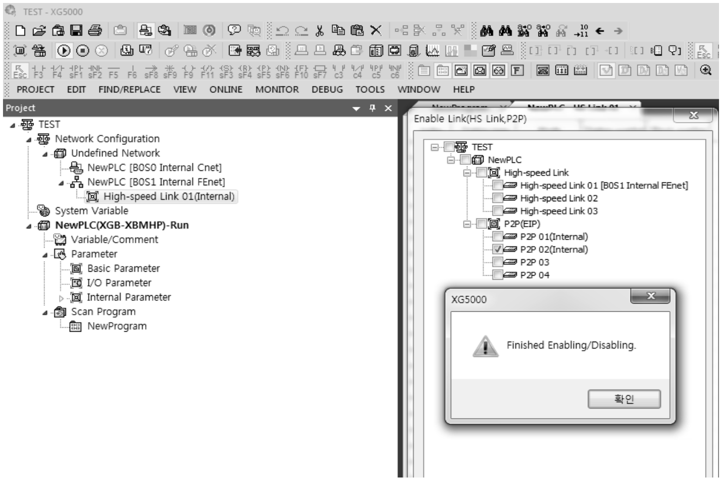
(4) HS parameter download

If you choose [Online] -> [Write] in the XG5000 menu to download the completed HS parameters, the window for parameters download will pop up. If you click the 'OK' button, the communication parameters will be downloaded to the CPU. If you check 'Set up with Link Enable', Link Enable can be applied with writing P2P/HS parameters at the same time.

(5) High speed link Enable



[Fig. 1.8.8] High speed link Enable



Finished Enabling/Disabling.

a) Choose [Online]→[Communication module setting]→[Link Enable] after accessing to the PLC through XG5000.

b) Choose high speed link 01 that built-in FEnet is designated as the base.

c) After clicking the checkbox, click 'Write' button.

d) If you click the 'OK' button after the message is output, high speed link communication will start.

3) High speed link flag

The high speed link service is the function for data exchange between communication modules of more than two stations. For a user's information, it provides the way how to check the status of the high speed link service aiming to verify the reliability of the data read from the opposing station through the high speed link.

For the high speed link information, the communication module inform a user whether the high speed link is operated based on the parameters set by the user by synthesizing received data every a certain time.

The high speed link information can be divided into RUN-link (_HSxRLINK) showing the information of the whole communication network; Link-Trouble (_HSxLTRBL)'s whole information; _HSxSTATUS, _HSxTRX, _HSxMOD, _HSxERR's individual information showing the communication status by 64 registered items of the parameters.

A user can use the above information during programming in the format of keywords and monitor the status of the high speed link by using the monitoring function. When operating several PLCs with the high speed link, you need to verify the reliability of the transmitted·received data by using the high speed link information such as RUN-link, link-Trouble, etc.

[Table 1.8.1] shows the functions and definitions of the high speed link information.

| Items | RUN-Link | Link-Trouble | Transmission · reception status | Operation mode | Error | Status of high speed link |
|---|---|---|---|---|---|---|
| Information type | General information | General information | Individual information | Individual information | Individual information | Individual information |
| Keyword name (x=high speed link No.) | _HSxRLINK | _HSxLTRBL | _HSxTRX[n] (n=0..64) | _HSxMOD[n] (n=0..64) | _HSxERR[n] (n=0..64) | _HSxSTATUS [n] (n=0..64) |
| Data type | Bit | Bit | Bit-Array | Bit-Array | Bit-Array | Bit-Array |
| Monitoring | Available | Available | Available | Available | Available | Available |
| Use of programs | Available | Available | Available | Available | Available | Available |

[Table 1.8.1] High speed link flag

(1) RUN link flag

It is the whole information showing whether the high speed link works normally based on the parameters set by the user. It is the contact that maintains the status of 'On' until Link Enable is 'Off' once it is 'On'. It is 'On' under the following conditions.

- In case Link Enable is 'On'.
- In case all parameter registering lists are set normally
- In case all relevant data is transmitted and received to the parameter registering list based on the set cycle.
- In case the status of all opposing stations set in the parameters is RUN with no error.

(2) Trouble link flag

It is the information showing whether the high speed link works normally based on the parameters set by the user. Under the situation of RUN-link On, when the conditions of RUN-link On are violated, it will be 'On'; when the conditions are recovered, it will be 'off'.

(3) Flag displaying the general status of the blocks

It is the individual information showing the operating status of the resisted lists of the high speed link parameters. It displays the status of high speed link by registered lists up to 64 like the maximum number of registrations. It displays the general information for the registered lists by synthesizing individual information of each item. When the transmission · reception status of the relevant list is normal and the operation mode is RUN with no error, it will be 'On'; when the above items are violated, it will be 'Off'.

(4) RUN operating mode flag of the block station

It is the individual information showing the operating status of the resisted lists of the high speed link parameters. It displays the operating mode information by registered lists up to 64 like the maximum number of registrations. When the station of the registered items is under Run mode, the relevant bit will be 'On'; when the station is under Stop/Pause/Debug mode, it will be 'Off'.

(5) Flag displaying the block station and normal communication

It is the individual information showing the operating status of the resisted lists of the high speed link parameters. It displays the transmission · reception information of the registered list up to 64. When the transmission · reception operation works based on the cycle, the relevant bit will be 'On'; when the operation does not work normally, it will be 'Off'.

(6) Operation error mode flag of the block station

It is the individual information showing the operating status of the resisted lists of the high speed link parameters. It displays the error information of the registered list up to 64 the maximum number of registrations. The error synthetically indicates the situation that the PLC cannot execute the user programs normally. When it is Off, it means the opposing station's PLC works normally; when it is On, it means the opposing station is abnormal.

4) Limitation of the high speed link's transfer rate

The below table indicates the limitation guaranteeing the high speed link's transmission speed. When you set the high speed link, refer to the below table to determine the communication load.  In case of going out of the limitation, the data may be transferred, exceeding the transmission cycle.

**(Communication speed: 100Mbps)**

| **Based on 200 words per block** | | | **Based on 100 words per block** | | | **Based on 50 words per block** | | |
|---|---|---|---|---|---|---|---|---|
| **Cycle** | **Scan time** | **Blocks No.** | **Cycle** | **Scan time** | **Blocks No.** | **Cycle** | **Scan time** | **Blocks No.** |
| 20 ms | Less than 1 ms | 12 blocks | 20 ms | Less than 1 ms | 24 blocks | 20 ms | Less than 1 ms | 32 blocks |
| | Less than 2 ms | 8 blocks | | Less than 2 ms | 16 blocks | | Less than 2 ms | 32 blocks |
| | Less than 5 ms | 4 blocks | | Less than 5 ms | 8 blocks | | Less than 5 ms | 16 blocks |
| | Less than 10 ms | 1 block | | Less than 10 ms | 4 blocks | | Less than 10 ms | 8 blocks |
| 50 ms | Less than 1 ms | 32 blocks | 50 ms | Less than 1 ms | 32 blocks | 50 ms | Less than 1 ms | 32 blocks |
| | Less than 2 ms | 24 blocks | | Less than 2 ms | 32 blocks | | Less than 2 ms | 32 blocks |
| | Less than 5 ms | 12 blocks | | Less than 5 ms | 24 blocks | | Less than 5 ms | 32 blocks |
| | Less than 10 ms | 8 blocks | | Less than 10 ms | 12 blocks | | Less than 10 ms | 24 blocks |
| 100 ms | Less than 1 ms | 32 blocks | 100 ms | Less than 1 ms | 32 blocks | 100 ms | Less than 1 ms | 32 blocks |
| | Less than 2 ms | 32 blocks | | Less than 2 ms | 32 blocks | | Less than 2 ms | 32 blocks |
| | Less than 5 ms | 24 blocks | | Less than 5 ms | 32 blocks | | Less than 5 ms | 32 blocks |
| | Less than 10 ms | 12 blocks | | Less than 10 ms | 32 blocks | | Less than 10 ms | 32 blocks |
| 200 ms | Less than 1 ms | 32 Blocks | 200 ms | Less than 1 ms | 32 Blocks | 200 ms | Less than 1 ms | 32 Blocks |
| | Less than 2 ms | 32 Blocks | | Less than 2 ms | 32 Blocks | | Less than 2 ms | 32 Blocks |
| | Less than 5 ms | 32 Blocks | | Less than 5 ms | 32 Blocks | | Less than 5 ms | 32 Blocks |
| | Less than 10 ms | 32 Blocks | | Less than 10 ms | 32 Blocks | | Less than 10 ms | 32 Blocks |
| 500 ms | Less than 1 ms | 32 Blocks | 500 ms | Less than 1 ms | 32 Blocks | 500 ms | Less than 1 ms | 32 Blocks |
| | Less than 2 ms | 32 Blocks | | Less than 2 ms | 32 Blocks | | Less than 2 ms | 32 Blocks |
| | Less than 5 ms | 32 Blocks | | Less than 5 ms | 32 Blocks | | Less than 5 ms | 32 Blocks |
| | Less than 10 ms | 32 Blocks | | Less than 10 ms | 32 Blocks | | Less than 10 ms | 32 Blocks |
| 1s | Less than 1 ms | 32 blocks | 1s | Less than 1 ms | 32 blocks | 1s | Less than 1 ms | 32 blocks |
| | Less than 2 ms | 32 blocks | | Less than 2 ms | 32 blocks | | Less than 2 ms | 32 blocks |
| | Less than 5 ms | 32 blocks | | Less than 5 ms | 32 blocks | | Less than 5 ms | 32 blocks |
| | Less than 10 ms | 32 blocks | | Less than 10 ms | 32 blocks | | Less than 10 ms | 32 blocks |
| 5s | Less than 1 ms | 32 blocks | 5s | Less than 1 ms | 32 blocks | 5s | Less than 1 ms | 32 blocks |
| | Less than 2 ms | 32 blocks | | Less than 2 ms | 32 blocks | | Less than 2 ms | 32 blocks |
| | Less than 5 ms | 32 blocks | | Less than 5 ms | 32 blocks | | Less than 5 ms | 32 blocks |
| | Less than 10 ms | 32 blocks | | Less than 10 ms | 32 blocks | | Less than 10 ms | 32 blocks |
| 10s | Less than 1 ms | 32 blocks | 10s | Less than 1 ms | 32 blocks | 10s | Less than 1 ms | 32 blocks |
| | Less than 2 ms | 32 blocks | | Less than 2 ms | 32 blocks | | Less than 2 ms | 32 blocks |
| | Less than 5 ms | 32 blocks | | Less than 5 ms | 32 blocks | | Less than 5 ms | 32 blocks |
| | Less than 10 ms | 32 blocks | | Less than 10 ms | 32 blocks | | Less than 10 ms | 32 blocks |

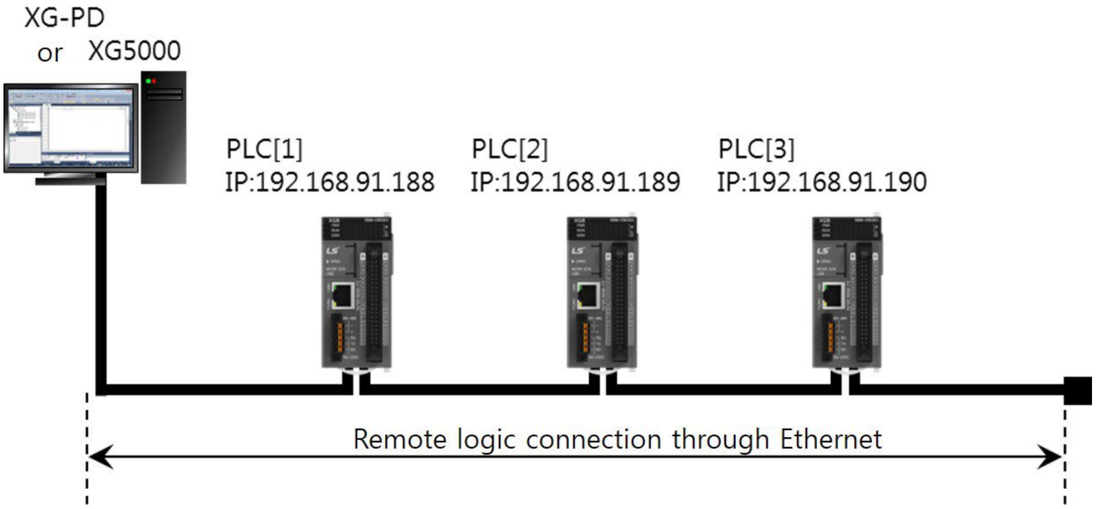
**※ The above values are based on using high speed link only.**

## 1.9 Remote communication

### 1.9.1 Outline

It is the function to realize remotely programming, user program download, program debugging, monitor, etc. in the network system where the PLCs are connected with each other through Ethernet without moving physical connection of XG5000.

For the devices that are far from the network, it is the convenient function to access to each device in one place without translocation. You can execute XG5000's remote communication service by creating the logical path as below.



If the Ethernet module is installed in the PC where XG5000 is running and it is connected to the same network with the PLC in the above figure, you can perform the remote 1-stage access through Ethernet. Assume that the Ethernet cables are connected to the PLC #1 station in XG5000 and PLC #1, PLC #2, PLC #N are connected with each other through Ethernet.

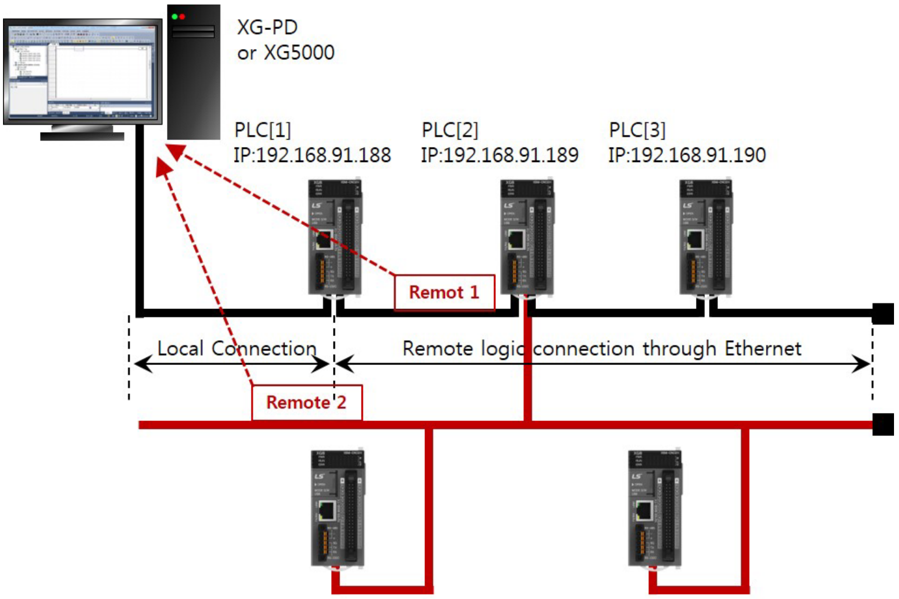
To access the details of the PLC #N station in the above figure, set the access method as Ethernet in access setting of XG5000's online menu and input the relevant PLC #N station's IP and remote stage. In this status, you can realize all functions in the PLC #1 such as programming, download, debugging and monitor, etc.

If you use XG5000's remote communication service, you can access easily without moving to the distant PLC. In addition, although the PLC is located in the inaccessible position, it is possible to access from the other PLC so easy access can be realized after installation.

## 1.9.2 Setup and Access of XG5000

You can access all PLCs that access to the XGT network through XG5000 communication service. The XG5000 remote access is composed of 1-stage access and 2-stage access.

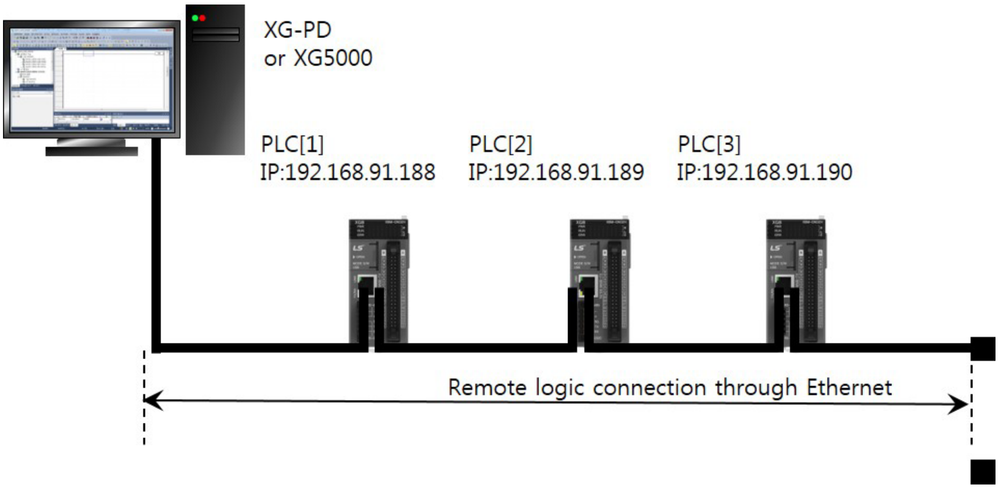
The below figure describes the remote 1-stage and 2-stage access methods.



The above figure shows the example of 1-stage (PLC B) and 2-stage (PLC E) access in the system composed of two networks.

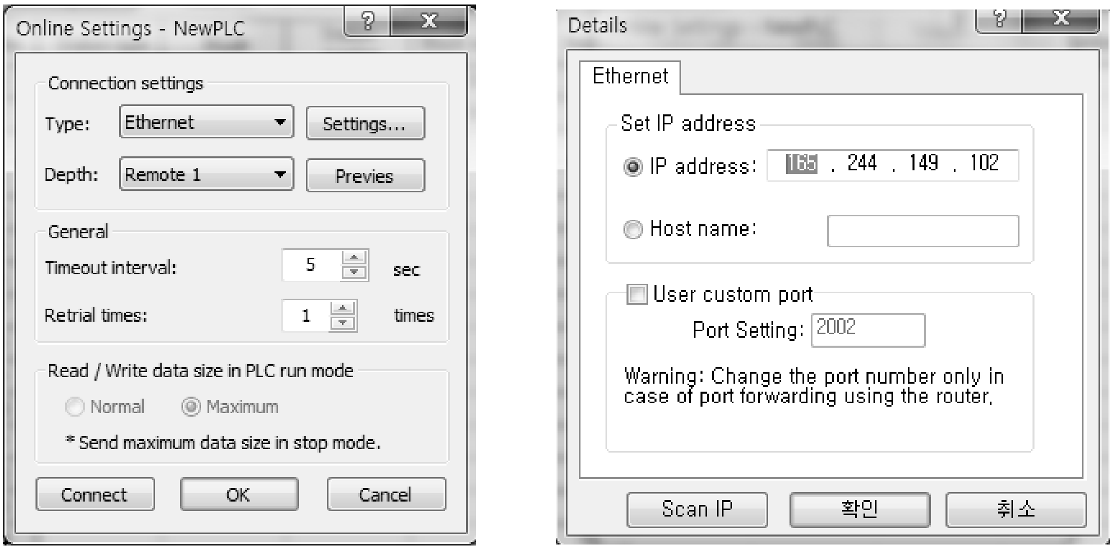
1) Direct and remote 1-stage access in the PC connected to Ethernet

If the PC where XG5000 is running is connected to the PLC through network, you can perform the remote 1-stage access through Ethernet without connecting RS-232C to the PLC's CPU.



[Fig. 1.9.1] Remote 1-stage access system through the PC

[Fig. 1.9.1] shows the case that the PC and the PLC are connected through Ethernet. In this case, you can access to all PLCs in the network. The local access is omitted and the remote 1-stage access is performed for all PLCs. You need to choose the connection options and change settings as shown in the below dialog box in order to the direct and remote 1-stage access through Ethernet.


Online Settings - NewPLC

Connection settings

Type: Ethernet

Depth: Remote 1

General

Timeout interval: 5 sec

Retrial times: 1 times

Read / Write data size in PLC run mode

○ Normal ● Maximum

* Send maximum data size in stop mode.

Details

Ethernet

Set IP address

● IP address: 165 . 244 . 149 . 102

○ Host name:

☐ User custom port

Port Setting: 2002

Warning: Change the port number only in case of port forwarding using the router.

[Fig. 1.9.2] Direct and remote 1-stage access in the PC

(1) Access Method
You can select the access methods. In [Fig. 9.2.6], Ethernet is used for access instead of RS-232C so choose Ethernet.

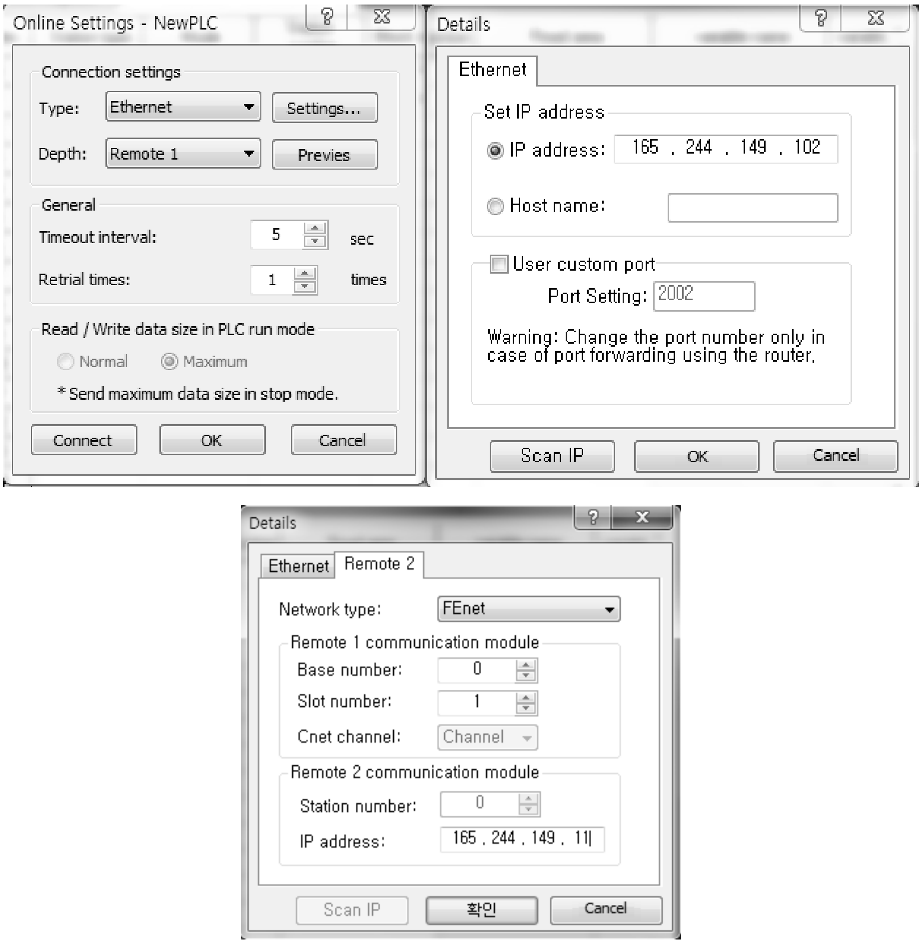
(2) Access stage
You can determine to connect with the PLC through remote 1-stage or 2-stage. In this case, you need to choose 1-stage.

(3) IP address
Record the IP address of the FEnet I/F module to be accessed.

(4) All further processes are the same as the case using RS-232C.
Click the OK button and choose ‘Access’ in the online menu

2) Direct and remote 2-stage access in the PC connected Ethernet

It is possible to realize the remote 2-stage access through Ethernet. The method is the same as the remote 1-stage and the example of setting access options is as below.



Type: Ethernet

Depth: Remote 1

Timeout interval: 5 sec

Retrial times: 1 times

○ Normal ● Maximum

* Send maximum data size in stop mode.

● IP address: 165 . 244 . 149 . 102

○ Host name:

☐ User custom port

Port Setting: 2002

Warning: Change the port number only in case of port forwarding using the router.

Network type: FEnet

Base number: 0

Slot number: 1

Cnet channel: Channel

Station number: 0

IP address: 165 . 244 . 149 . 11

[Fig. 1.9.3] Direct and remote 2-stage access in the PC

**Notice**

Instructions for remote 1-stage/2-stage access

(1) In case the currently open project in XG5000 is not matched with the accessed 1-stage and 2-stage CPU types, the following menu items are not available.
  a) Write program and each parameter
  b) Read program and each parameter
  c) Monitor
  d) Link Enable setting
  e) I/O information
  f) Forced I/O information

(2) Open the project to be accessed and execute remote access when programming XG5000을 through remote 1-stage and 2-stage access.

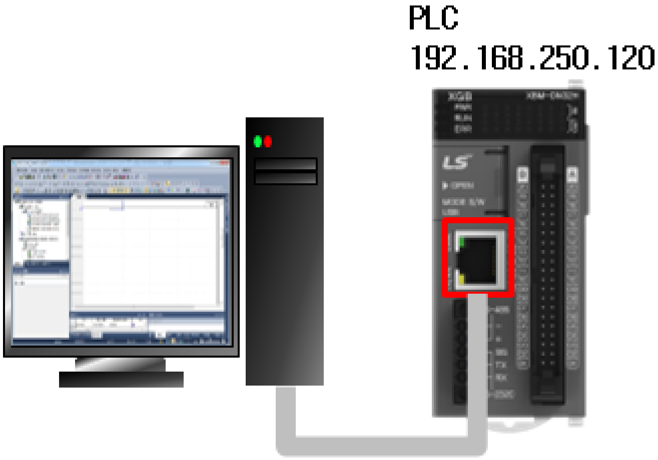
(3) The remote access is supported up to 2-stage only and further remote access is not allowable.

(4) In case of writing parameters after modifying communication parameters through remote access, the modified parameters will be applied only after disconnecting remote access.

(5) IP Scan is not supported in Remote 1(Only supported in Local connection)

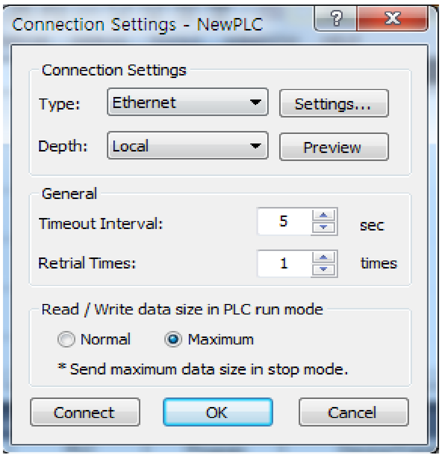
### 1.9.3 XG5000 Local Ethernet

It is possible to read and write the program faster than previous remote connection.
Remote 1,2 are not provide by Ethernet local connection.
1) Local Ethernet connection from PC connected to Ethernet
-If PC with XG5000 is connected and PLC is connected, you can connect Ethernet locally to PLC without connecting USB.



Local connection by Ethernet

2)Local Ethernet connection
XG5000-[ONLINE]-[Connection setting] and choose local

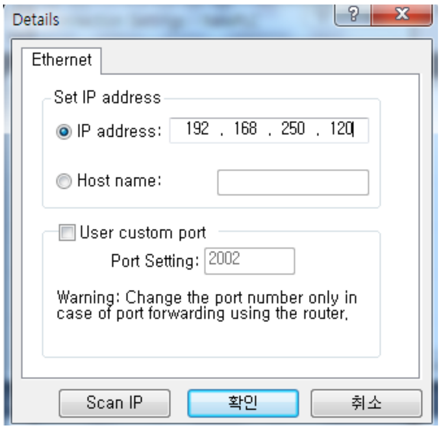

Connection Settings - NewPLC

Connection Settings
Type: Ethernet
Depth: Local

General
Timeout Interval: 5 sec
Retrial Times: 1 times

Read / Write data size in PLC run mode
○ Normal ● Maximum
* Send maximum data size in stop mode.

Click [Setting] and input IP Address. Initial IP adress is 192.168.250.120 .



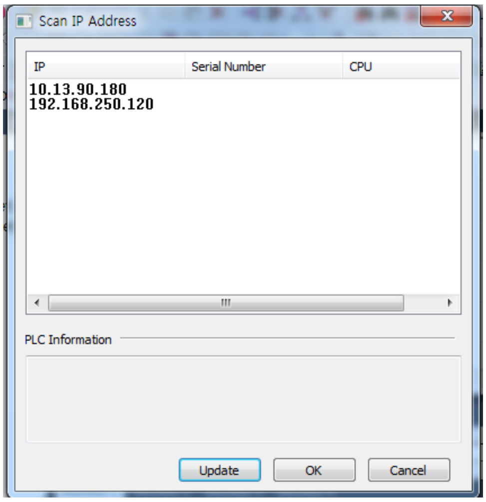
IP address: 192 . 168 . 250 . 120

☐ User custom port

Port Setting: 2002

Warning: Change the port number only in case of port forwarding using the router.

Scan IP Address make it possible to search the IP set information.
If you select Scan IP, the IP of the PLC connected to the current PC or network is displayed as shown below.
Select the IP of PLC you want to connect and press OK.



| IP | Serial Number | CPU |
|---|---|---|
| 10.13.90.180 | | |
| 192.168.250.120 | | |

After setting, You can connect PLC

**Notes**

1. Local Ethernet provided ver
   (1) XBM-DN32H
   (2) XBM-DN/DP32H2
   (3) XBM-DN/DP32HP
   (4) XBM-DN/DP16H2
   (5) XBM-DR14H2
   (6) XBC-DN32Ux (O/S V1.6 or above)
   (7) XEC-DN32Ux (O/S V1.6 or above)
2. host name is not provided
3. XBL-EMTA do not provide Auto scan and IP Scan
4. You can access PLC only by remote connection or local connection
   In case of use connection, multi-connection is available.

## 1.10 **E-mail Transfer(SMTP)**

### 1.10.1 Outline of the Simple Mail Transfer Protocol(SMTP)

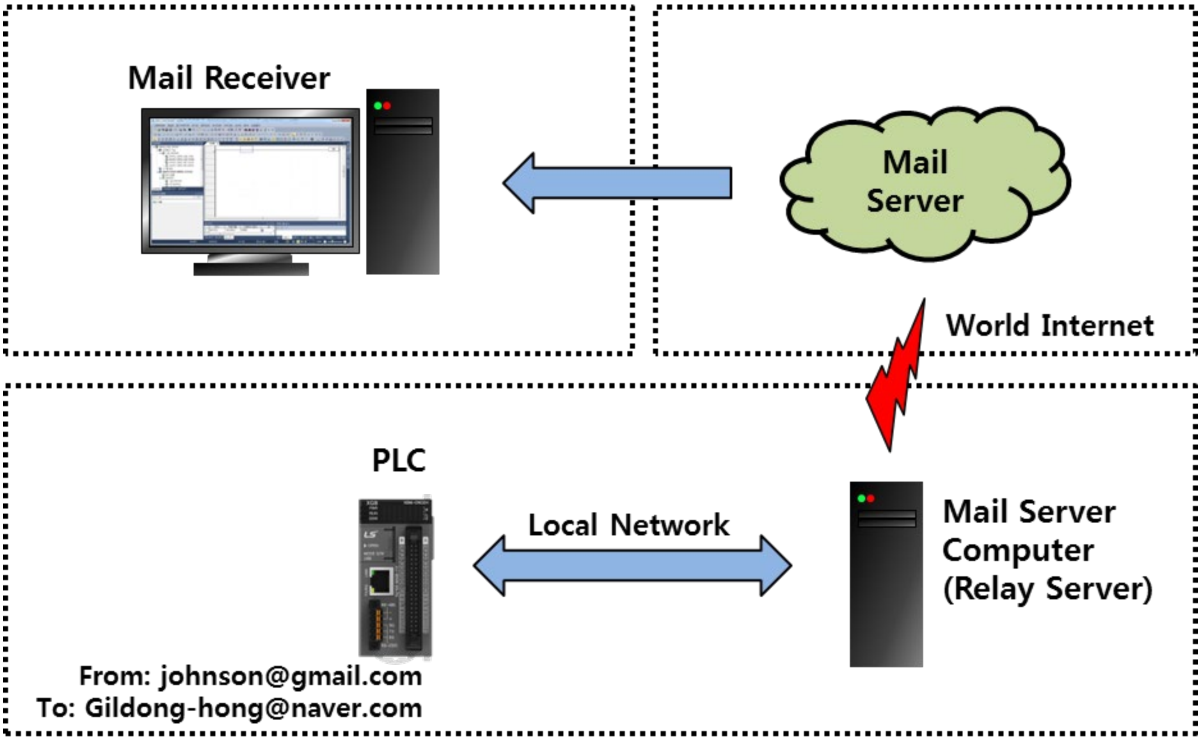
XGB high-performance module PLC supports the Simple Mail Transfer Protocol (SMTP). The SMTP is the protocol to send the E-mail on the Internet. The using TCP Port is No.25. In the SMTP that is the text-based protocol, not only request/response messages but also all characters should be 7 bit ACSII.

1) E-mail service

If the system has some problems, E-mail service is required to inform the administrator of the state remotely through the mail. When the CPU's state changes during operation or events occur, you can inform the administrator of the state through the mail server. The E-mail service is also available in common mails and you need to configure the separate relay server to send a common mail.

2) Configuration of the E-mail system

To use the common E-mail service, the configuration for using E-mail is needed. To transfer a common mail, you need to encrypt the mail for security but it is not easy for the PLC to treat this process so that is why you have to use the SMTP relay server. The SMTP relay server accesses to the common E-mail server by using the mail information transferred by the PLC and send the mail in place of the PLC. Therefore, as shown in [Fig. 11.1.1.1] E-mail transfer process, you can send the mail through the SMTP relay server.



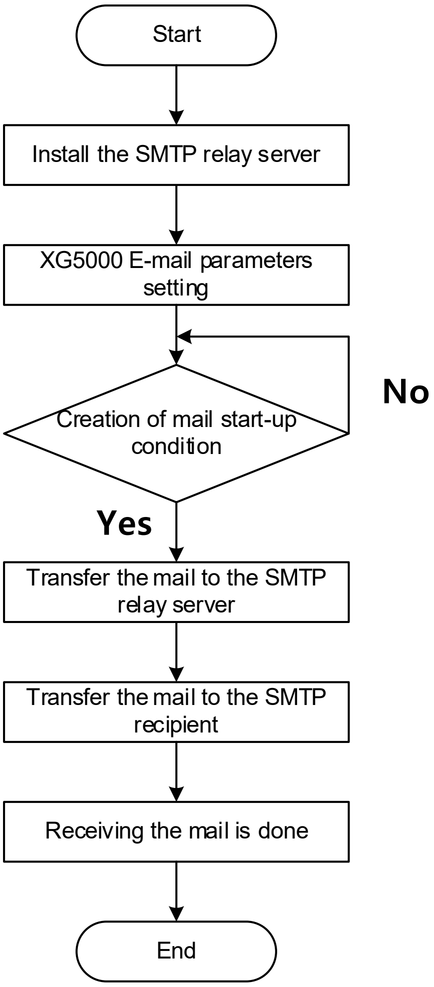
[Fig. 11.1.1.1] E-mail transfer process

3) Specifications of SMTP Realy server

| Items | Specifications | Remarks |
|---|---|---|
| Maximum concurrent connection number | 8 | For some email account, because it limits the mail sent through the multi-connection, some mail(occurred simultaneously by the PLC using the same account server) may not be transmitted. |

### 4) Flow Chart of E-mail transfer

The following is the flow chart of E-mail transfer. As shown in [Fig. 11.1.1.2] Flow chart of E-mail **transfer,** in order to transfer a mail, you need to install the SMTP relay server and set up E-mail parameters through XG5000 and meet the start-up conditions to send the mail. If the start-up conditions are met, the mail information is sent to the SMTP relay server and then, the SMTP relay server substitutingly goes through authentication process and sends the final mail to a recipient. The mail recipient can see the ID and title, details of the E-mail set in XG5000.



[Fig. 11.1.1.2] Flow Chart of E-mail transfer

**Notice**

(1)The SMTP relay server and PLC should be connected to the Ethernet network. The SMTP relay server sends the mail to a recipient in place of the PLC.

(2) For more details on setting, refer to 1.11.2 E-mail Setting.

### 1.10.2 E-mail Setting

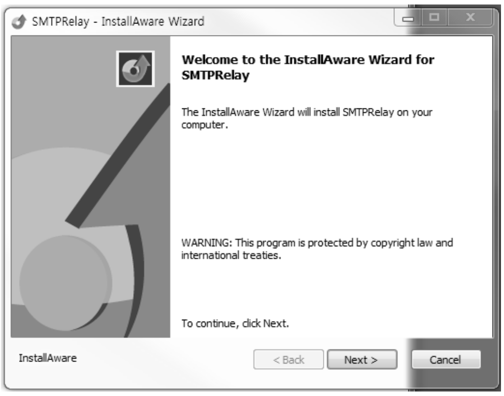
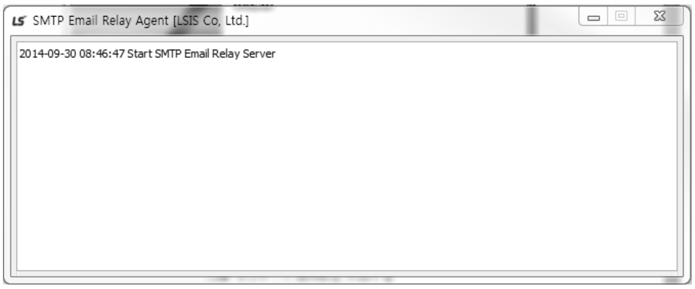
In order to use the common E-mail function, you need to set up the E-mail parameters and relay server.

1) Relay server setting
You need to set up the SMTP relay server to use the common E-mail as shown below.

2) Relay server program download
In order to set up the relay server, first of all, you need to download the relay server program. You can download the relay server program from LS ELECTRIC Solution Square (SMTP relay server.zip).

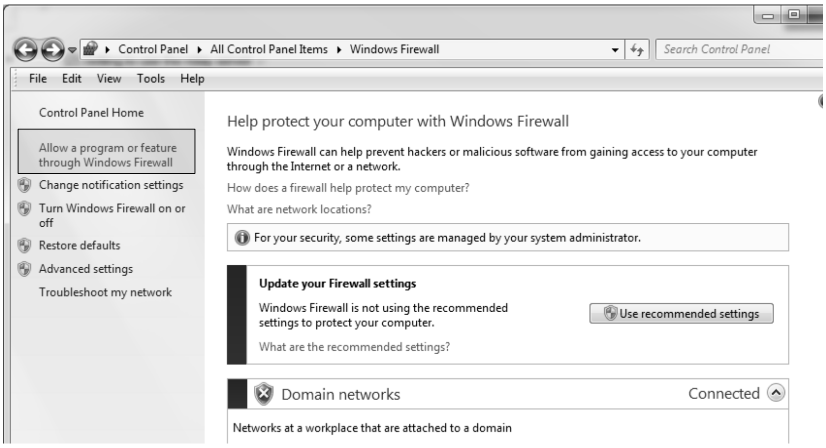
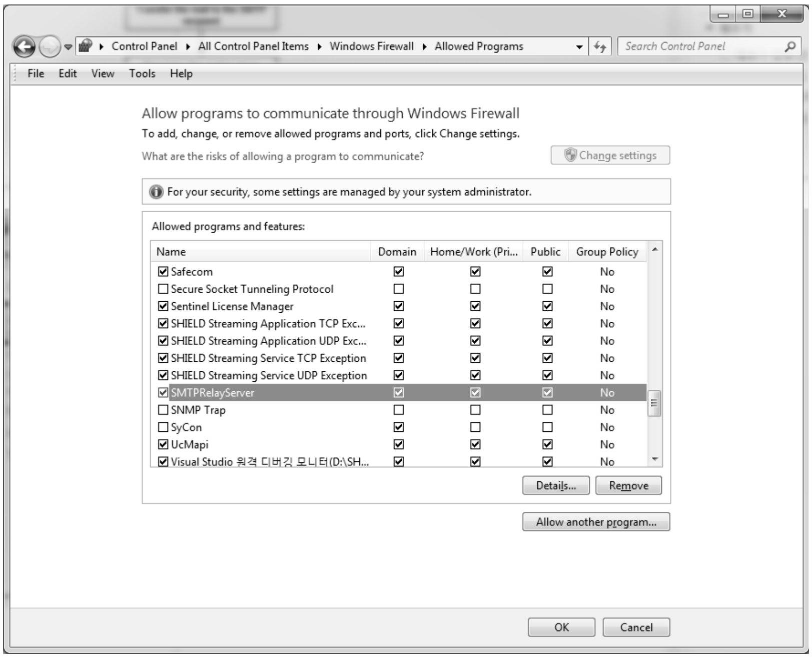
-website: https://sol.ls-electric.com/ww/en/main

(1) Installaiton of the relay server

| **Procedures** | **Description** | |
|---|---|---|
| 1 | Program execution |  SMTPRelay - InstallAware Wizard<br>**Welcome to the InstallAware Wizard for SMTPRelay**<br>The InstallAware Wizard will install SMTPRelay on your computer.<br>WARNING: This program is protected by copyright law and international treaties.<br>To continue, click Next.<br> <br> <br> <br> |
| | 1) After downloading the program to set up the SMTP relay to the PC where you want to configure the relay server, double-click SMTPRelay.msi.<br>2) After clicking the Next button in the SMTP Relay window, if you select the remaining processes properly and click the Finish button, installation will be done. | |
| 2 | SMTP relay server operations |  SMTP Email Relay Agent [LSIS Co, Ltd.]<br>2014-09-30 08:46:47 Start SMTP Email Relay Server |
| | 1) If you double-click the 'SMTPRelayServer' icon on the desktop, the program will run as shown in the SMTP Relay server window. | |

(2) Setting to use the relay server

After installing the relay server, you need to register the relay server program in Windows as show below.

| Procedures | Description | |
|---|---|---|
| 1 | Firewall setting |  |
| | 1) Click Windows – Control Panel – Windows firewall.<br>2) Through 'Windows Firewall' in the upper-left of the Windows firewall setting screen, click the Program or Firewall Enable. | |
| 2 | Firewall Enable |  |
| | Find the program called 'SMTPRelayServer' and check all items of domain, home/company(individual), common areas and then, click the 'OK' button. | |

Help protect your computer with Windows Firewall

Windows Firewall can help prevent hackers or malicious software from gaining access to your computer through the Internet or a network.

How does a firewall help protect my computer?

What are network locations?

For your security, some settings are managed by your system administrator.

**Update your Firewall settings**

Windows Firewall is not using the recommended settings to protect your computer.

What are the recommended settings?

Domain networks

Networks at a workplace that are attached to a domain

Allow programs to communicate through Windows Firewall

To add, change, or remove allowed programs and ports, click Change settings.

What are the risks of allowing a program to communicate?

For your security, some settings are managed by your system administrator.

Allowed programs and features:

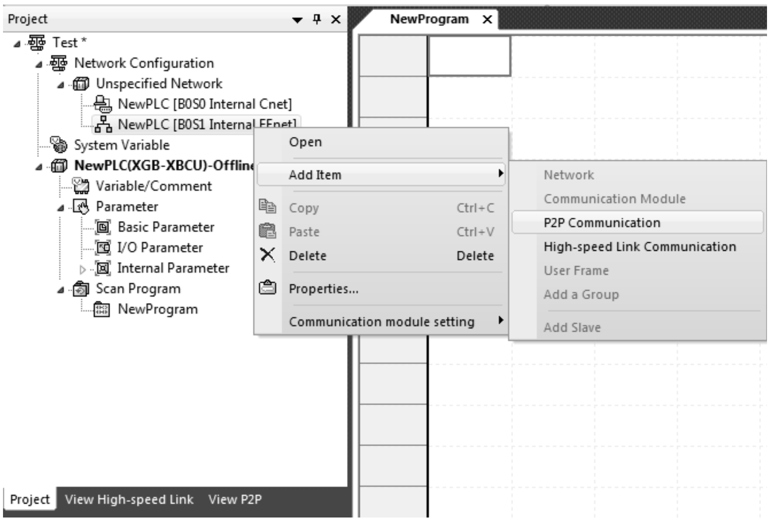
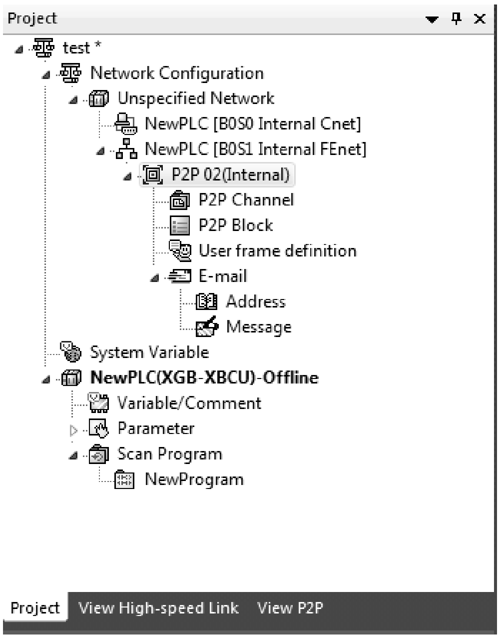
| Name | Domain | Home/Work (Pri... | Public | Group Policy |
|---|---|---|---|---|
| ☑ Safecom | ☑ | ☑ | ☑ | No |
| ☐ Secure Socket Tunneling Protocol | ☐ | ☐ | ☐ | No |
| ☑ Sentinel License Manager | ☑ | ☑ | ☑ | No |
| ☑ SHIELD Streaming Application TCP Exc... | ☑ | ☑ | ☑ | No |
| ☑ SHIELD Streaming Application UDP Exc... | ☑ | ☑ | ☑ | No |
| ☑ SHIELD Streaming Service TCP Exception | ☑ | ☑ | ☑ | No |
| ☑ SHIELD Streaming Service UDP Exception | ☑ | ☑ | ☑ | No |
| ☑ SMTPRelayServer | ☑ | ☑ | ☑ | No |
| ☐ SNMP Trap | ☐ | ☐ | ☐ | No |
| ☐ SyCon | ☑ | ☐ | ☐ | No |
| ☑ UcMapi | ☑ | ☑ | ☑ | No |
| ☑ Visual Studio 원격 디버깅 모니터(D:\SH... | ☑ | ☑ | ☑ | No |

**Notice**

(1) After the SMTP relay server setting is completed, in the E-mail setting window of 1.11.2 E-mail Setting, you need to input the IP address of the current PC for the IP address of the SMTP relay server information.

3) E-mail setting of the P2P service

You can use the E-mail function of the P2P service as shown below.

<table>
<tr><th>Procedures</th><th colspan="2">Description</th></tr>
<tr><td rowspan="2">1</td><td>Add P2P</td><td>
</td></tr>
<tr><td colspan="2">After selecting [Embedded FEnet] in XG5000's project window, click on the right mouse button and then, select [Add Items] →[P2P communication].</td></tr>
<tr><td rowspan="2">2</td><td>Creation of P2P</td><td>
</td></tr>
<tr><td colspan="2">When the P2P selection window is created, after selecting No.2 slot, click the 'OK' button.</td></tr>
</table>

**Notice**

(1) In the P2P view tab, E-mail can be set up in the same way.

| Procedures | Description | |
|---|---|---|
| 3 | E-mail setting | <br>Dialog<br>☑ Use E-Mail<br>☑ Use SMTP relay server<br>User information<br>User name: Test<br>Mail address: Test@test.com<br>SMTP relay server information<br>IP address: 165.244.148.92<br>Port number: 25<br>SMTP server information<br>SMTP server address: smtp.gmail.com<br>Port number: 465<br>Account name: email<br>Password: ••••••••<br>Event information<br>Message surveillance period: 10 Sec.(10 ~ )<br>Address Message<br>☑ RUN => STOP 3 0<br>☑ STOP => RUN 3 1<br>☑ ERROR 3 2<br>OK Cancel |
| | 1) Double-click 'E-mail' in the P2P setting project window.<br>2) Set up the values referring to each E-mail's set value.<br>3) After setting parameters in the E-mail setting window, click the 'OK' button. | |

E-mail setting values

| Item | | Description |
|---|---|---|
| Using E-mail | | It determines whether using the E-mail service or now. To start the E-mail service, you need to check this item. |
| Using SMTP relay server | | To send the mail to the common mail server, you need to check the SMTP relay server item. |
| User information | User name | It sets up the user name displayed when the other part received the mail. If you set up the user name with the PLC, the sender name will be displayed as the PLC. |
| | Mail address | It is the recipient's mail address when pressing 'Reply'. It indicates the transmitting mail server composed of the user name and mail server. You can also set up that the PLC sends data and a normal PC receives the reply. |
| SMTP relay server information | IP address | When checking the SMTP relay server item, you can fill in this. Enter the IP address to relay. |
| | Port Number | You can input the port No. of the relay server. The port is No.25. |
| SMTP server information | SMTP server address | It means the SMTP server's address. For example, Gmail's SMTP server address is 'smtp.gmail.com'. |
| | Port number | It means the SMTP server's port No. Gmail uses No.465. |
| | Account name | You can input the registered account name to the SMTP server. |
| | Password | You can input the password of the registered account to the SMTP server. |

The below table provides the address and port No of the common SMTP server. Input the address and port No. of the desired server to the SMTP server information.

| SMTP server | SMTP server address | Port No. |
|---|---|---|
| Google | smtp.gmail.com | 465 |
| Yahoo | smtp.mail.yahoo.com | 25 |
| Naver | smtp.naver.com | 465 |

The event information monitors the CPU's state periodically and keeps track of the state information. In case the PLC stops or errors occur, communication parameter does now work so in preparation for such a situation, the optional service is provided.

| Item | | Description |
|---|---|---|
| Event information | Message monitoring cycle | It should be set as 10 seconds or more. It is the time to check whether the PLC's mode has been changed. |
| | RUN => STOP | It is the option that the embedded Ethernet sends the E-mail by itself when the PLC's mode changes from RUN into STOP. |
| | STOP => RUN | It is the option that the embedded Ethernet sends the E-mail by itself when the PLC's mode changes from STOP into RUN. |
| | ERROR | It is the option that the embedded Ethernet sends the E-mail by itself when some errors occur in the PLC. |

**Notice**

(1) When sending the mail through the SMTP relay server, there may be the common E-mail server that can send the mail only when the SMTP server information's 'SMTP server address' and 'account name' are matched with the user information's 'mail address'. Accordingly, check the mail server's policy and input the user information's 'mail address' based on the policy.

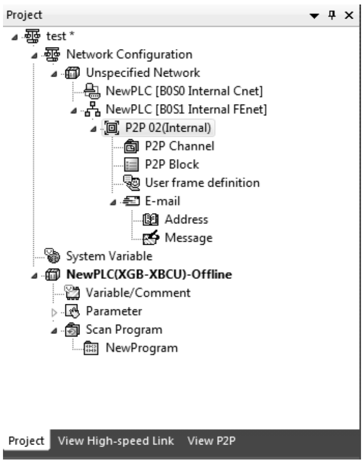
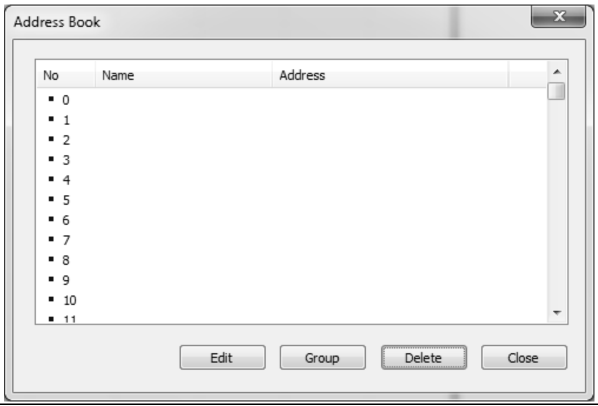
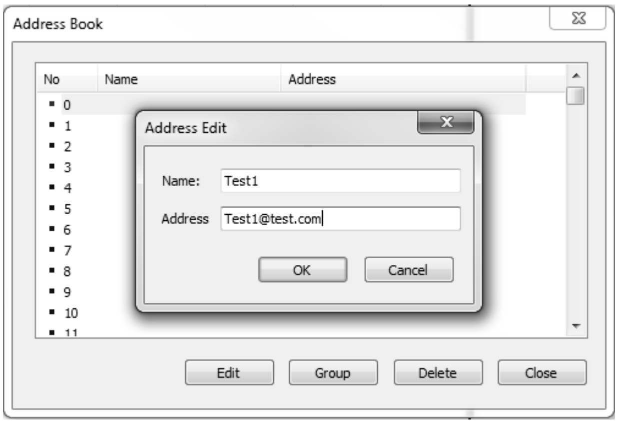
(2) The account name and password of the SMTP server information should be registered in the SMTP server. If you do not have any account, please register the account in the mail server for use.

(3) For more details on the address and message No. of the event information, refer to (1) Writing an address book and (3) Writing message.

(4) You may need to enable SMTP at the server site where you want to use SMTP, or you may need additional settings such as allowing less secure applications

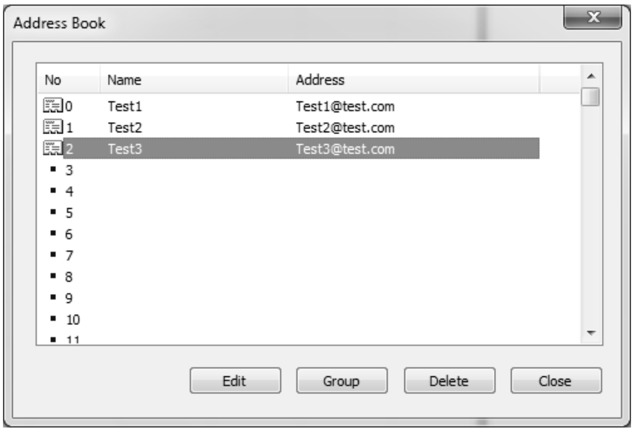
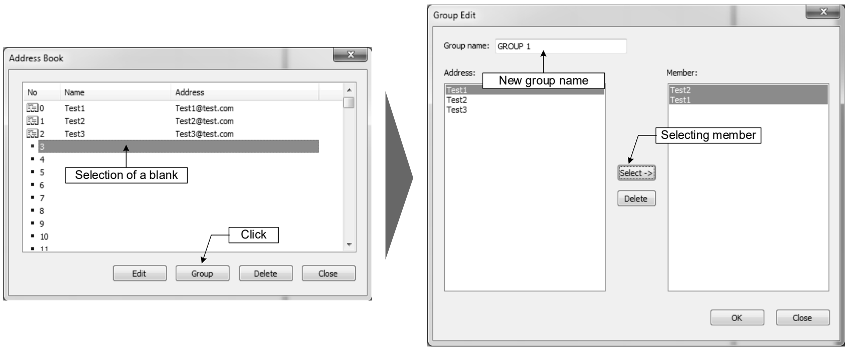
(1) (3) Wirting an address book

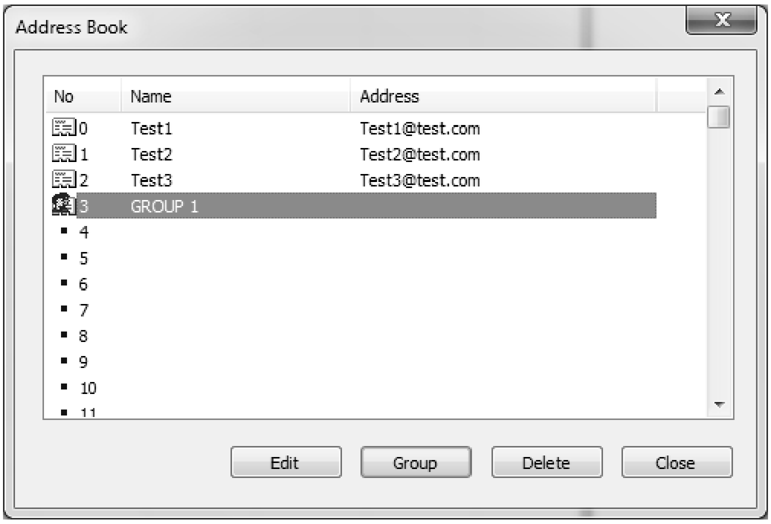
You can write the recipient's mail address used for the E-mail service as shown below.

<table>
<tr><th>Procedures</th><th colspan="2">Description</th></tr>
<tr><td rowspan="2">1</td><td>Create the address book</td><td>  </td></tr>
<tr><td colspan="2">After selecting [Embedded FEnet] in XG5000's project window, double-click the address of [P2P 02(embedded)] or double-click the address of P2P No.2 in [P2P View].</td></tr>
<tr><td rowspan="2">2</td><td>Register the address</td><td> Name: Test1<br>Address Test1@test.com</td></tr>
<tr><td colspan="2">In the window for setting E-mail address book, register the address to which you want to send the mail. If you select 'Edit'. The address edition window will pop up. If you enter the name and mail address in this screen and select the OK button, registration of the address will be done.</td></tr>
</table>

(2) (4) Registration of group address

If you want to send the mail not to individual but to the group, you can set up the group address as shown below.

| **Procedures** | **Description** | |
|---|---|---|
| 1 | Create group | <br><Address book> |
| | 1) Double-click the address of P2P No.2. | |
| 2 | Register group |  |
| | After selecting to a blank of [Address book], select [Address book]- [group], the edition window for E-mail address book's group will be created. The details of the group edition window are as shown below.<br>1) Group name: Name of the group to create newly<br>2) Contact information: Currently registered addresses<br>3) Members: Addresses to be included to the group<br>4) Select: It adds the addresses selected from the Contact Information to the Members.<br>5) Delete: It deletes the addresses selected in the Members from the Group.<br>After selecting the addresses to add to the group in the Contact Information, if you click [Select], you can see the addresses are added to the Members. | |

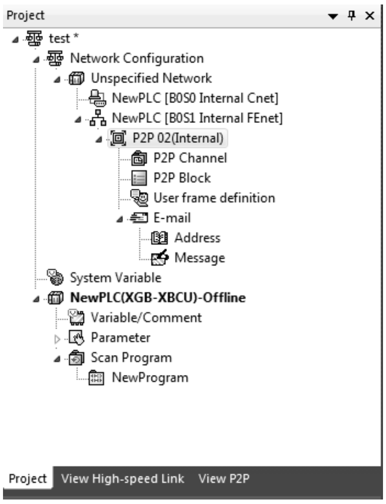
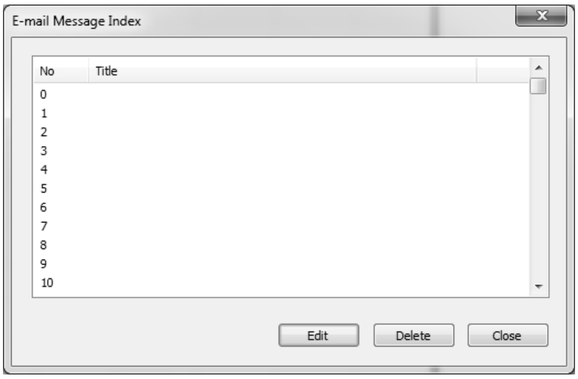
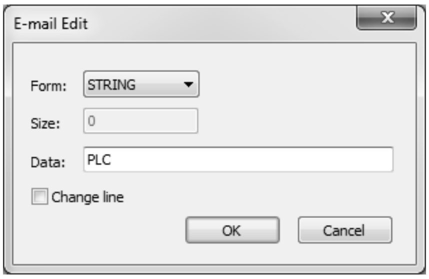
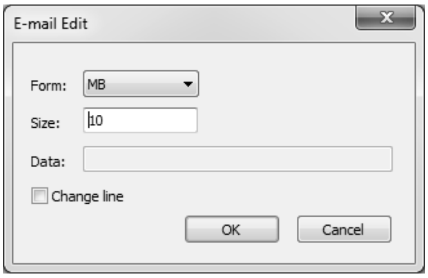
<table>
<tr><th>Procedures</th><th colspan="2">Description</th></tr>
<tr><td rowspan="2">3</td><td>Confirm creation of the group</td><td>

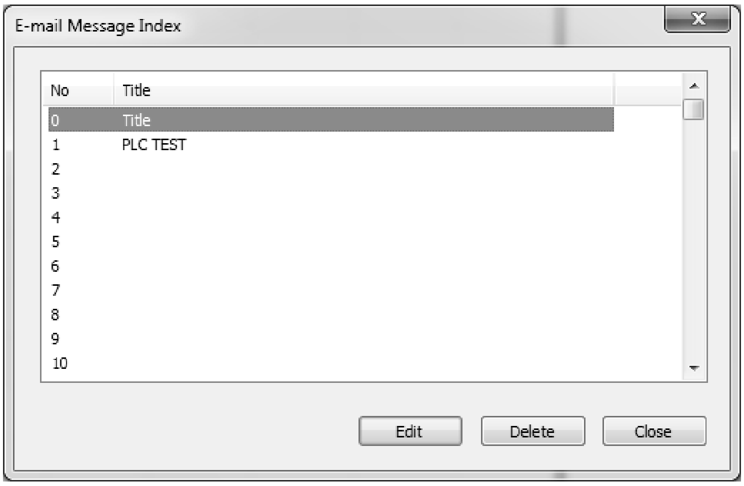
| No | Name | Address |
|---|---|---|
| 0 | Test1 | Test1@test.com |
| 1 | Test2 | Test2@test.com |
| 2 | Test3 | Test3@test.com |
| 3 | GROUP 1 | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |
| 11 | | |

</td></tr>
<tr><td colspan="2">If you click the OK button in [Group Edition], the group list added newly to the address book will be displayed with the individual addresses.</td></tr>
</table>

(3) (5)Writing the message

You can write the mail message used for the E-mail service as shown below.

<table>
<tr><th>Procedures</th><th colspan="2">Description</th></tr>
<tr><td rowspan="2">1</td><td>Create the message list</td><td> <br> </td></tr>
<tr><td colspan="2">1) After selecting [Embedded FEnet] in XG5000’s project window, double-click the message of [P2P 02(embedded)] or double-click the message of P2P No.2 in [P2P View].</td></tr>
<tr><td rowspan="2">2</td><td>Write messages</td><td>E-mail Edit<br>Form: STRING<br>Size: 0<br>Data: PLC<br>☐ Change line<br> <br>E-mail Edit<br>Form: MB<br>Size: 10<br>Data:<br>☐ Change line<br> </td></tr>
<tr><td colspan="2">Click the ‘Add’ button in the E-mail message editing window and input the details to send.<br>The configuration and details of E-mail edition are as shown below.<br>1) Format: Selection of the message type<br>- STRING: Selected when the transferred message is a string type<br>- MB: Selected when the transferred message is a device type<br>2) Size: It is activated only when the format is [MB]. It means the size of Byte.<br>3) Data: It is activated only when the format is [STRING]. You can input the test to send.<br>4) Line break: Means the break of a message line.</td></tr>
</table>

<table>
<tr><th>Procedures</th><th colspan="2">Description</th></tr>
<tr><td rowspan="2">3</td><td>Confirm creation of messages</td><td><br>E-mail Message Index<br>No Title<br>0 Title<br>1 PLC TEST<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>Edit Delete Close</td></tr>
<tr><td colspan="2">When the creation of the message is complete, the title will be added to the list of e-mail messages index.</td></tr>
</table>

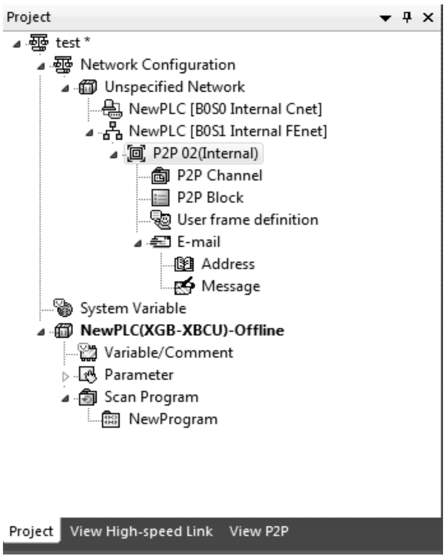
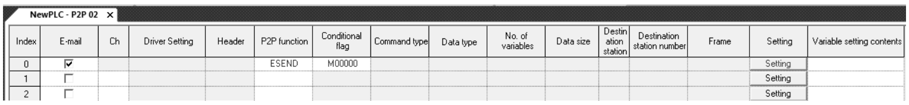
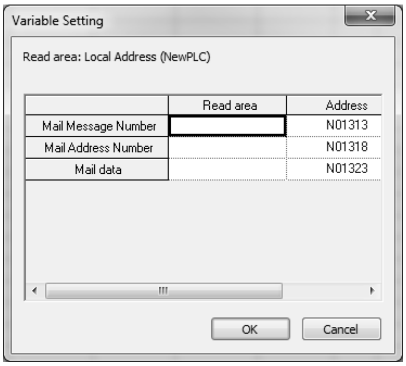
**Notice**

(1) The format of an E-mail message can be divided into String and Byte data received from the CPU. The MB type is used to send the P2P ESend parameter’s message data as many as the number of bytes set in the Size.

(2) The line break includes the command to write on the next line when outputting the message in the received screen.

(4) P2P block setting

For the actual E-mail service, you can create the mail address book and message written above in the P2P block as shown below.

<table>
<tr><th>Procedures</th><th colspan="2">Description</th></tr>
<tr><td rowspan="2">1</td><td>P2P block</td><td> </td></tr>
<tr><td colspan="2">After selecting [Embedded FEnet] in XG5000's project window, double-click [P2P block] of [P2P 02(embedded)] or double-click [P2P block] of P2P No.2 in [P2P View].</td></tr>
<tr><td rowspan="2">2</td><td>Make P2P block</td><td>NewPLC - P2P 02
<table>
<tr><th>Index</th><th>E-mail</th><th>Ch</th><th>Driver Setting</th><th>Header</th><th>P2P function</th><th>Conditional flag</th><th>Command type</th><th>Data type</th><th>No. of variables</th><th>Data size</th><th>Destination station</th><th>Destination station number</th><th>Frame</th><th>Setting</th><th>Variable setting contents</th></tr>
<tr><td>0</td><td>☑</td><td></td><td></td><td></td><td>ESEND</td><td>M00000</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Setting</td><td></td></tr>
<tr><td>1</td><td>☐</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Setting</td><td></td></tr>
<tr><td>2</td><td>☐</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Setting</td><td></td></tr>
</table></td></tr>
<tr><td colspan="2">1) In the P2P parameter setting window, tick the [E-mail] checkbox.<br>2) Select [ESEND] in P2P functions.<br>3) Set up the start-up conditions to transfer E-mail.</td></tr>
<tr><td rowspan="2">3</td><td>Setting</td><td>Variable Setting<br>Read area: Local Address (NewPLC)
<table>
<tr><th></th><th>Read area</th><th>Address</th></tr>
<tr><td>Mail Message Number</td><td></td><td>N01313</td></tr>
<tr><td>Mail Address Number</td><td></td><td>N01318</td></tr>
<tr><td>Mail data</td><td></td><td>N01323</td></tr>
</table>
</td></tr>
<tr><td colspan="2">Click the setting button to set up each variable.<br>For more details, refer to 'E-mail variables'</td></tr>
<tr><td>4</td><td colspan="2">If you click the [OK] button, the parameter settings to transfer E-mail will be done.</td></tr>
</table>

The details of E-mail variables are as shown below.

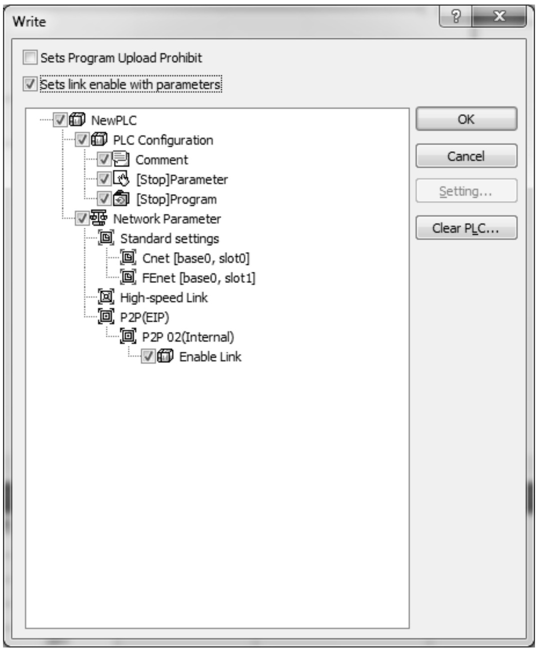
| Item | | | Description |
|---|---|---|---|
| E-mail | | | It enables you to use the E-mail service. |
| P2P function | | ESEND | It sends the E-mail. |
| | | ERECEIVE | It receives the E-mail. |
| Setting | Transmission | Mail message No. | Enter the index No. of the message list among E-mail settings of P2P and determine the mail tile and data. |
| | | Mail address No. | Establish the registration No. set in the address book and decide to whom.<br>* If you want to send the mail to several people, you can set up grouping. In this case, the **recipient's** mail address should be input in advance before grouping. The maximum number of groupings is limited to 10EA or less. |
| | | Mail data | It means the start address of the data to send. In terms of the size of the transmitted data, starting with the first part, the mail is transmitted as many as the number of arrays corresponding to MB[10] among E-mail message settings. |
| | Reception | Mail information | It is the area where the mail information is saved. |
| | | Mail message | It saves the received mail message to the PLC memory. |

**Notice**

(1) The receiving pare is not supported in settings.

(5) Writing parameters

After parameter setting for the E-mail service is completed, you can apply the parameters to the PLC as show below.

| Procedures | Description | |
|---|---|---|
| 1 | Write parameters and Link Enable | <br>Write<br>☐ Sets Program Upload Prohibit<br>☑ Sets link enable with parameters<br>☑ NewPLC<br>☑ PLC Configuration<br>☑ Comment<br>☑ [Stop]Parameter<br>☑ [Stop]Program<br>☑ Network Parameter<br>Standard settings<br>Cnet [base0, slot0]<br>FEnet [base0, slot1]<br>High-speed Link<br>P2P(EIP)<br>P2P 02(Internal)<br>☑ Enable Link<br> |
| | Select [Online] → [Write] in XG5000's project window. After checking [Set together with Link Enable] in the [Write] window, check 'Link Enable' in P2P 02(embedded). | |
| 2 | If you click the [OK] button, 'Write Parameters' and 'Link Enable' will be done. | |

**Notice**

(1) If you set up the parameters for the SMTP relay server to use common E-mails (Gmail, yahoo, etc.), you need to set up for SMTP relay server.

- Refer to (2) Setting to use the relay server of 1.11.2 E-mail Setting

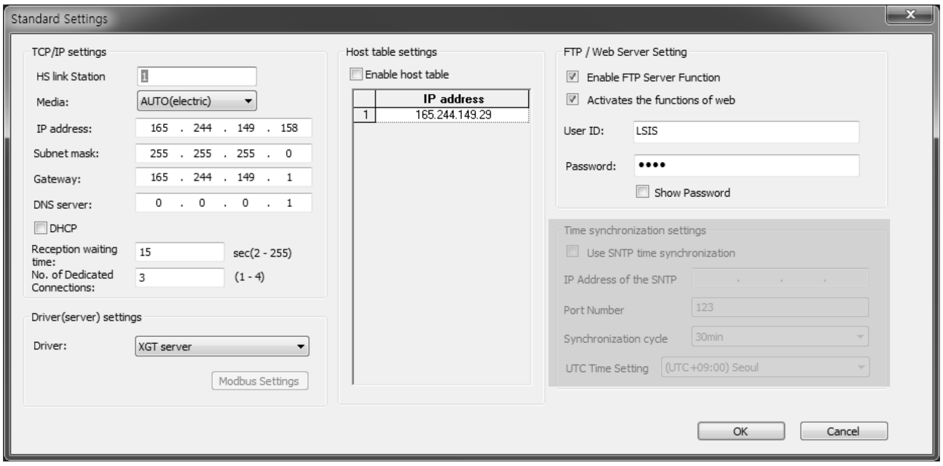
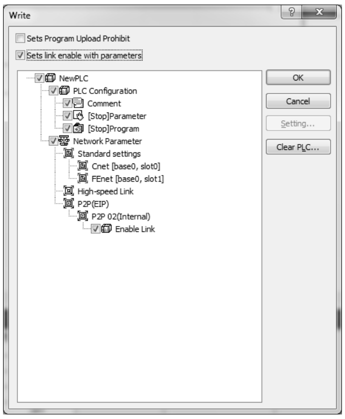
## 1.11 Time synchronization(SNTP)

### 1.11.1 Outline of the time synchronization protocol

The XGB high-performance PLC supports the NTP(Network Time Protocol) that obtains the time information by accessing to the SNTP(Simple Network Time Protocol)server and synchronizes time. The NTP is the protocol to synchronize the time of the PLC connected to the network.

### 1.11.2 SNTP server parameter setting

You can set up the parameters to use the SNTP server function as shown below.

<table>
<tr><th>Procedures</th><th colspan="2">Description</th></tr>
<tr><td rowspan="2">1</td><td>Setting<br>for SNTP</td><td><br>Standard Settings<br>TCP/IP settings<br>HS link Station: 1<br>Media: AUTO(electric)<br>IP address: 165 . 244 . 149 . 158<br>Subnet mask: 255 . 255 . 255 . 0<br>Gateway: 165 . 244 . 149 . 1<br>DNS server: 0 . 0 . 0 . 1<br>☐ DHCP<br>Reception waiting time: 15 sec(2 - 255)<br>No. of Dedicated Connections: 3 (1 - 4)<br>Driver(server) settings<br>Driver: XGT server<br>Host table settings<br>☐ Enable host table<br>IP address: 1 165.244.149.29<br>FTP / Web Server Setting<br>☑ Enable FTP Server Function<br>☑ Activates the functions of web<br>User ID: LSIS<br>Password: ●●●●<br>☐ Show Password<br>Time synchronization settings<br>☐ Use SNTP time synchronization<br>IP Address of the SNTP: . . .<br>Port Number: 123<br>Synchronization cycle: 30min<br>UTC Time Setting: (UTC+09:00) Seoul</td></tr>
<tr><td colspan="2">1)Input the [TCP/IP setting] parameters in the FEnet basic setting window.<br>- Enter the IP address, subnet mask, gateway, DNS server address.<br>- This address is commonly used for P2P service, high speed link service, remote service, FTP, SNTP service, etc.<br>2) Check [SNTP Time Synchronization Enable].<br>3) Then, set up the SNTP server's IP address and Port No., synchronization cycle, UTC time setting.</td></tr>
<tr><td rowspan="2">2</td><td>Write<br>parameters and<br>Link Enable</td><td><br>Write<br>☐ Sets Program Upload Prohibit<br>☑ Sets link enable with parameters<br>☑ NewPLC<br>☑ PLC Configuration<br>☑ Comment<br>☑ [Stop]Parameter<br>☑ [Stop]Program<br>☑ Network Parameter<br>Standard settings<br>Cnet [base0, slot0]<br>FEnet [base0, slot1]<br>High-speed Link<br>P2P(EIP)<br>P2P 02(Internal)<br>☑ Enable Link</td></tr>
<tr><td colspan="2">1) Select [Online] → [Write] in XG5000's project window.<br>2) If P2P Enable is needed, after checking [Set together with Link Enable] in the [Write] window, check 'Link Enable' in P2P 02(embedded).</td></tr>
<tr><td>3</td><td colspan="2">If you click the [OK] button, 'Write Parameters' will be done.</td></tr>
</table>

**Notice**

(1) When parameter setting is done, the PLC reads periodically the time value from the SNTP server.
(2) In the SNTP server's IP address, the initial '203.248.240.140'port is set as '123'.
This is the open SNTP server called 'Time.bora.net'.
(3) If you want to use other SMTP servers, change the IP address and port No. of the SNTP server before input. Below is an example of public NTP server and port..

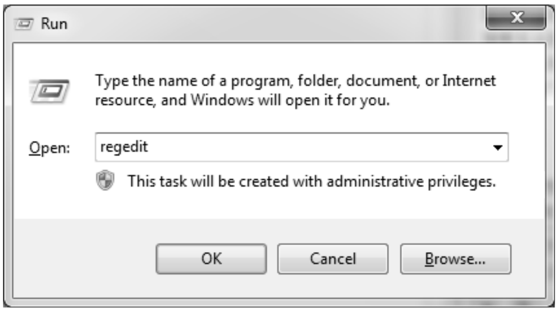
| Server address | IP | Port | Support |
|---|---|---|---|
| time.apple.com | 17.253.6.243 | 123 | Apple |
| time.asia.apple.com | 17.83.253.7 | 123 | Apple |
| time.euro.apple.com | 17.72.148.52 | 123 | Apple |
| ntp.kornet.net | 168.126.3.6 | 123 | KT(Korea) |
| time.kriss.re.kr | 210.98.16.100 | 123 | KRISS(Korea) |
| time.nuri.net | 211.115.194.21 | 123 | inethosting(Korea) |
| time.nist.gov | 132.163.4.102 | 123 | NIST(Korea) |
| time.windows.com | 191.233.81.105 | 123 | MS |
| 1.kr.pool.ntp.org | 211.233.40.78 | 123 | Navyism(Korea) |
| 1.asia.pool.ntp.org | 125.62.193.121 | 123 | Navyism(Korea) |
| 2.asia.pool.ntp.org | 82.200.209.236 | 123 | Navyism(Korea) |
| 3.asia.pool.ntp.org | 218.189.210.4 | 123 | Navyism(Korea) |

(4) If you cannot use a public NTP server, Please setup a local NTP server refer to **'1.12.3 How to setup a local NTP server'.**

### 1.11.3 How to setup a local NTP server

If you cannot use a public NTP server, Please setup a local NTP server as follows:

1) Select the [Start] button of Windows for execution.(Shortcut key /Windows key + R)
2) Input 'regedit' to the execution window and run the process.



Open: regedit

3) Check the below path.
**HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\W32Time\TimeProviders\NtpServer**
4) Change the value of '**Enabled**' to '**1**' in the folder.

Enabled REG_DWORD 0x00000001 (1)

5) Check the below path.
**HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\W32Time\Config**
6) Change the value of **'AnnounceFlags'** to '5' in the folder.

AnnounceFlags REG_DWORD 0x00000005 (5)

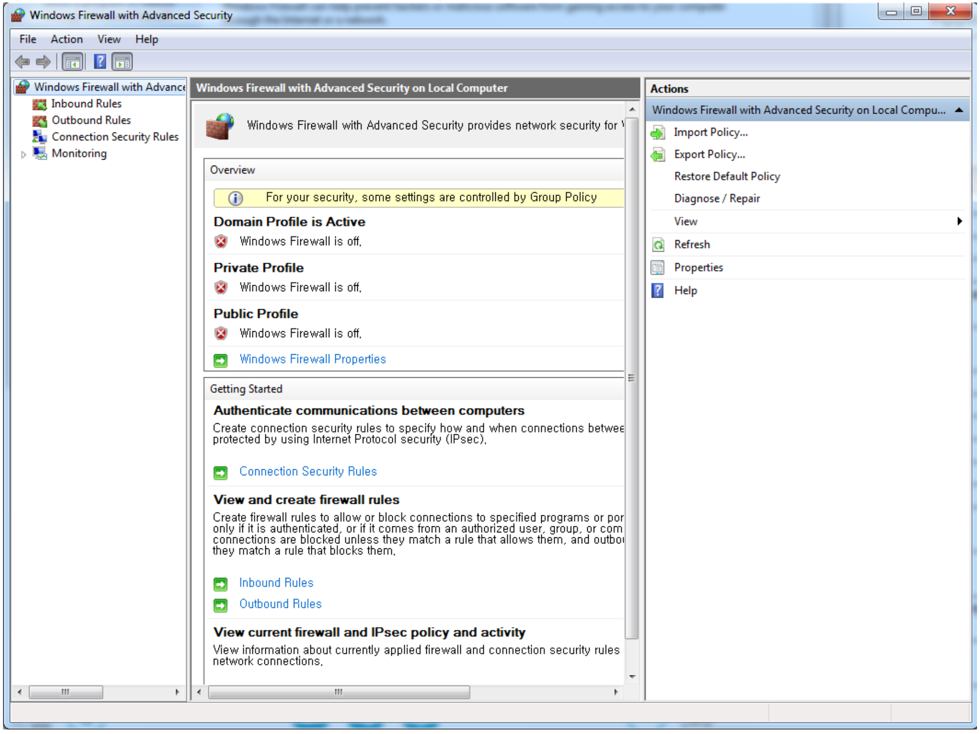
7) Reboot the computer.

8) Setup inbound firewall rules.

(1) Run the Control Panel.

(2) Run the Window Firewall

(3) When you run the Advanced Settings. screen will pop up as shown below.



**Windows Firewall with Advanced Security on Local Computer**

Windows Firewall with Advanced Security provides network security for

Overview

For your security, some settings are controlled by Group Policy

**Domain Profile is Active**

Windows Firewall is off.

**Private Profile**

Windows Firewall is off.

**Public Profile**

Windows Firewall is off.

Windows Firewall Properties

Getting Started

**Authenticate communications between computers**

Create connection security rules to specify how and when connections betwee protected by using Internet Protocol security (IPsec).

Connection Security Rules

**View and create firewall rules**

Create firewall rules to allow or block connections to specified programs or por only if it is authenticated, or if it comes from an authorized user, group, or com connections are blocked unless they match a rule that allows them, and outbo they match a rule that blocks them.

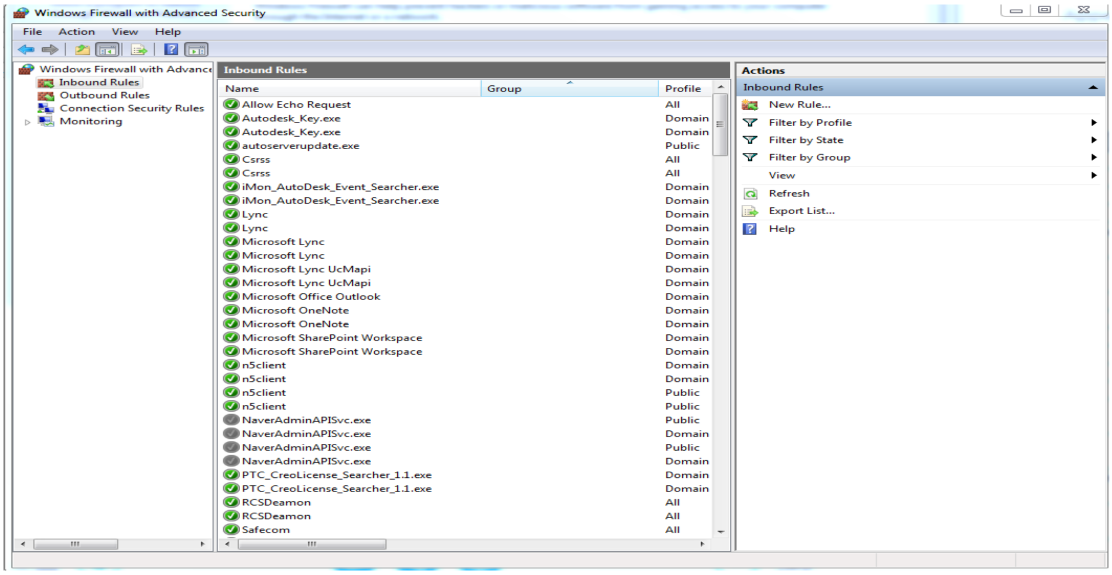
Inbound Rules

Outbound Rules

**View current firewall and IPsec policy and activity**

View information about currently applied firewall and connection security rules network connections.

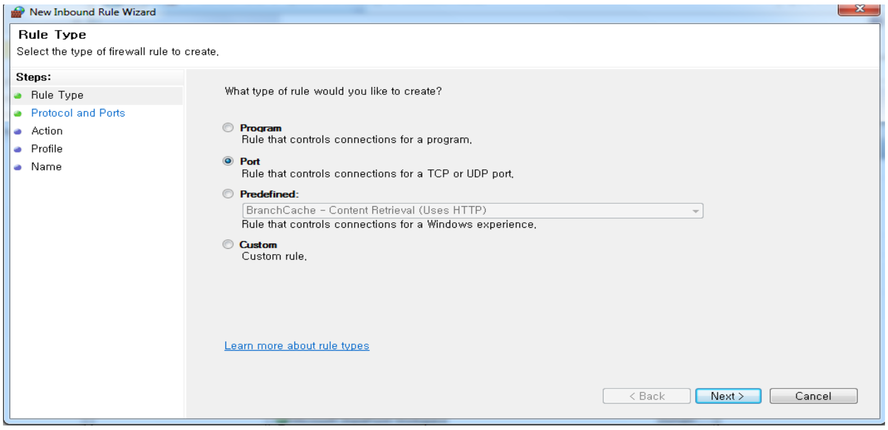
(4) Select inbound rules.



**Inbound Rules**

| Name | Group | Profile |
|---|---|---|
| Allow Echo Request | | All |
| Autodesk_Key.exe | | Domain |
| Autodesk_Key.exe | | Domain |
| autoserverupdate.exe | | Public |
| Csrss | | All |
| Csrss | | All |
| iMon_AutoDesk_Event_Searcher.exe | | Domain |
| iMon_AutoDesk_Event_Searcher.exe | | Domain |
| Lync | | Domain |
| Lync | | Domain |
| Microsoft Lync | | Domain |
| Microsoft Lync | | Domain |
| Microsoft Lync UcMapi | | Domain |
| Microsoft Lync UcMapi | | Domain |
| Microsoft Office Outlook | | Domain |
| Microsoft OneNote | | Domain |
| Microsoft OneNote | | Domain |
| Microsoft SharePoint Workspace | | Domain |
| Microsoft SharePoint Workspace | | Domain |
| n5client | | Domain |
| n5client | | Domain |
| n5client | | Public |
| n5client | | Public |
| NaverAdminAPISvc.exe | | Public |
| NaverAdminAPISvc.exe | | Domain |
| NaverAdminAPISvc.exe | | Public |
| NaverAdminAPISvc.exe | | Domain |
| PTC_CreoLicense_Searcher_1.1.exe | | Domain |
| PTC_CreoLicense_Searcher_1.1.exe | | Domain |
| RCSDeamon | | All |
| RCSDeamon | | All |
| Safecom | | All |

(5) Select the new rule in the top right.(New Rules)



New Inbound Rule Wizard

**Rule Type**

Select the type of firewall rule to create.

Steps:
- Rule Type
- Protocol and Ports
- Action
- Profile
- Name

What type of rule would you like to create?

○ **Program**
Rule that controls connections for a program.

● **Port**
Rule that controls connections for a TCP or UDP port.

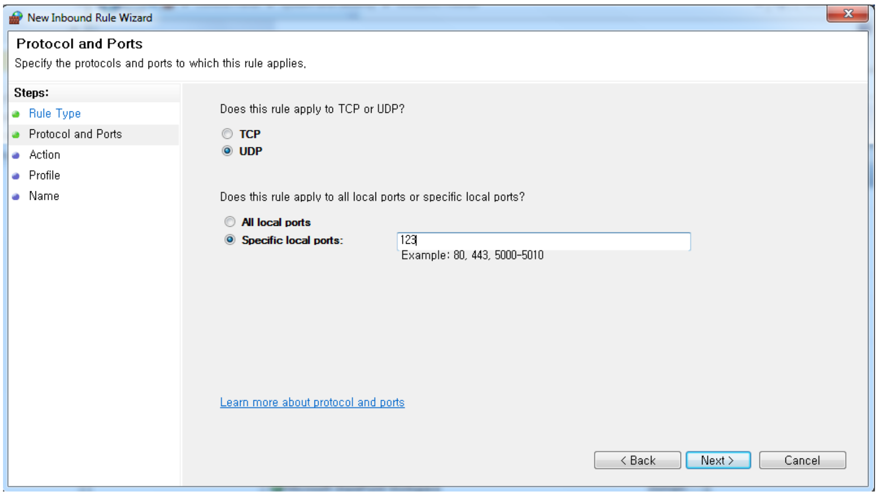
○ **Predefined:**
BranchCache - Content Retrieval (Uses HTTP)
Rule that controls connections for a Windows experience.

○ **Custom**
Custom rule.

Learn more about rule types

< Back | Next > | Cancel

(6) Select the port and click Next button.



New Inbound Rule Wizard

**Protocol and Ports**

Specify the protocols and ports to which this rule applies.

Steps:
- Rule Type
- Protocol and Ports
- Action
- Profile
- Name

Does this rule apply to TCP or UDP?

○ **TCP**
● **UDP**

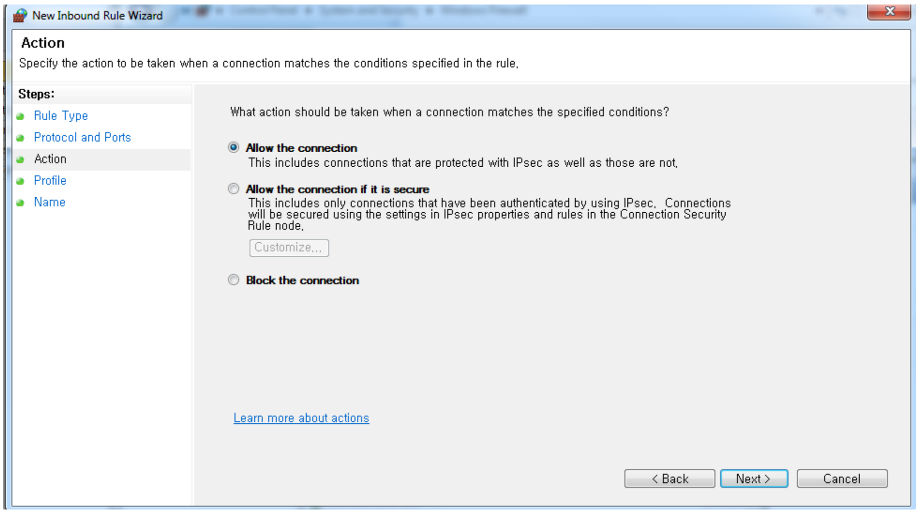
Does this rule apply to all local ports or specific local ports?

○ **All local ports**
● **Specific local ports:** 123
Example: 80, 443, 5000-5010

Learn more about protocol and ports

< Back | Next > | Cancel

(7) Select **UDP(U)** and **Special local port(S).** Input ‘**123**’ and click Next button.



New Inbound Rule Wizard

**Action**

Specify the action to be taken when a connection matches the conditions specified in the rule.

Steps:
- Rule Type
- Protocol and Ports
- Action
- Profile
- Name

What action should be taken when a connection matches the specified conditions?

● **Allow the connection**
This includes connections that are protected with IPsec as well as those are not.

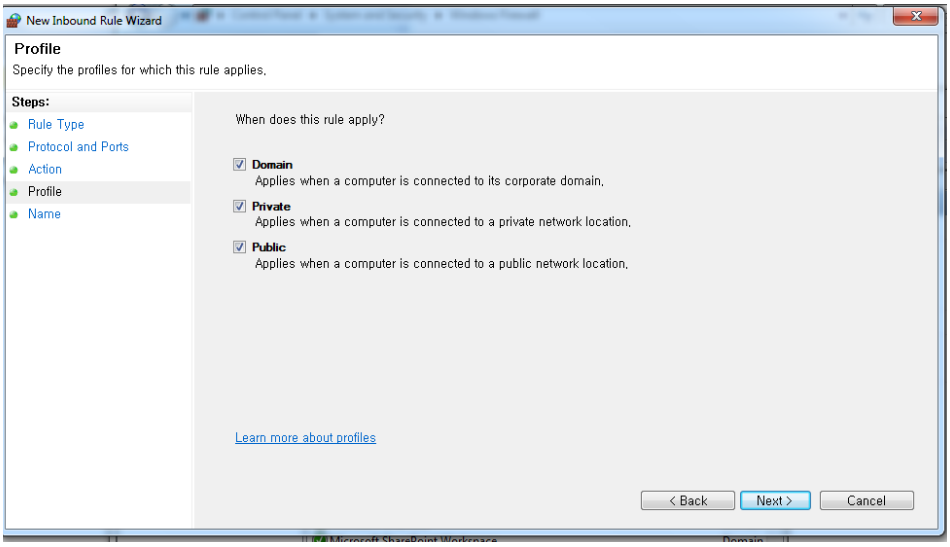
○ **Allow the connection if it is secure**
This includes only connections that have been authenticated by using IPsec. Connections will be secured using the settings in IPsec properties and rules in the Connection Security Rule node.
Customize...

○ **Block the connection**

Learn more about actions

< Back | Next > | Cancel

(8) Select **Allow connections(A)** and click Next button.



**Profile**

Specify the profiles for which this rule applies.

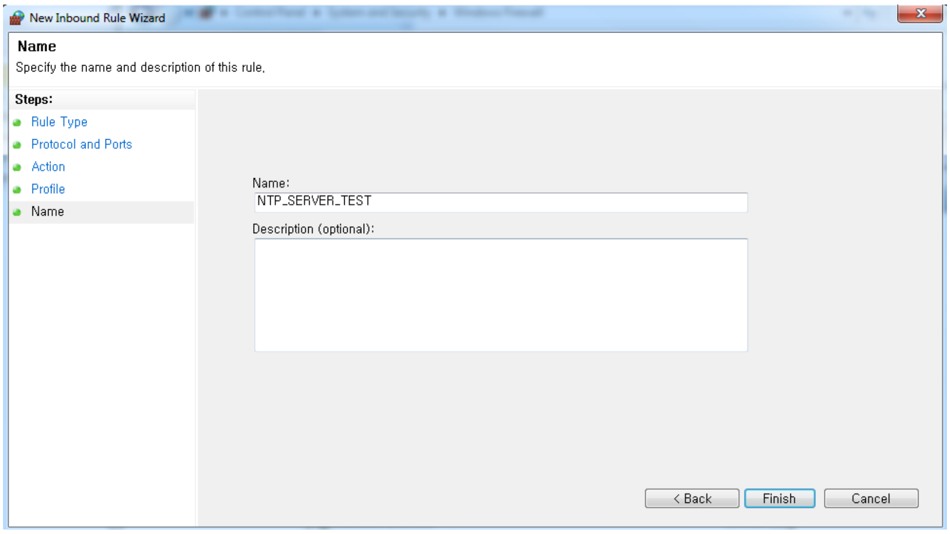
When does this rule apply?

☑ **Domain**
Applies when a computer is connected to its corporate domain.

☑ **Private**
Applies when a computer is connected to a private network location.

☑ **Public**
Applies when a computer is connected to a public network location.

(9) Please select the checkbox to meet your security policy, and click Next button.



**Name**

Specify the name and description of this rule.

Name:
NTP_SERVER_TEST

Description (optional):

(10) Input the server name(anything) and description and click Finish button.

9) Select the [Start] button of Windows for execution(Shortcut Key /Windowskey + R)
10) Enter ‘**CMD**’ and click Confirm.(Administrator)
11) In the command window, Input ‘**net stop w32time**’and press Enter key. And then, also input ‘**net start w32time**’and press Enter key.
12) Input ‘**ipconfig**’ and press Enter key in the command window to find out the IP address of NTP server.
13) Setting the parameters using IP address of NTP server.(refer to **‘1.12.2 SNTP server parameter setting’**)

## 1.12 Trouble Shooting

It describes errors that may occur during system operation and provides the causes of errors, corrective measures. You can check whether there are some problems with the XGB embedded Fenet and the details through the below procedures. Please note that we do not provide after-sales service for discretionary repair or disassembly based on the Quality Policy.

| Problem | Corrective Measures |
|---|---|
| In case LINK/ACT LED flickers or is not turned on after connecting to network. | 1. Check whether the cables clicked inserted. |
| | 2. Check whether the XG-PD parameters are already downloaded.<br>☞ In case XG-PD's communication basic parameters are not downloaded, you cannot set up Full Duplex /Half Duplex communication. |
| In case the LINK/ACT, SPEED LED are still turned Off, although you download parameters after supplying power and connecting network | Module defect is suspected so follow-up service may be required. |
| In case Read/Write Data do not work during dedicated services | 1. Check the communication speed(Auto/10/100M-TX) .<br>It should have the same communication speed with the opposing device to be communicated.<br>☞ In case the device with Auto Negotiation and the device with manual speed are mixed in the network, the former recognizes the latter as Half Duplex(standard specification of IEC 802.3u) |
| | 2. Check the IP address settings. The IP should be valid in the network.<br>☞ In case the set IP addresses are overlapped in the network or invalid IP exists, communication is impossible. |
| | 3. Check the driver(dedicated, Modbus TCP/IP) settings.<br>☞ You should apply the same protocols with the opposing device. |
| | 4. Check whether the opposing device's IP is registered in the host table.<br>☞ When the opposing device's IP address is not registered under host table Enable, communication does not work. |
| | 5. Check the MAC Address<br>☞ In case the MAC Address is abnormal, communication does not work. |

| Problem | Corrective Measures |
|---|---|
| In case transmission -reception is impossible during high speed link service | 1. Check the communication speed(Auto/10/100M-TX). It should have the same communication speed with the opposing device to be communicated.<br>☞ The communication speed in the network should be same or set as Auto for communication. |
| | 2. Check the IP address settings. The IP should be valid in the network.<br>☞ In case the set IP addresses are overlapped in the network or invalid IP exists, communication is impossible. |
| | 3. Check whether the high speed link's parameters are set.<br>☞ In case the parameters are not set; or the set exchange numbers are overlapped in the network; or you have wrong block setting or block number, communication is impossible. |
| | 4. Check the Link Enable<br>☞ The frame can be transmitted only when the Link Enable is set. |
| In case of P2P service, Not working | 1Confirm communication speed (Auto / 10 / 100M-TX)<br>☞Communication is possible if the communication speed on the network is the same or set to Auto. |
| | 2.Verify IP address settings<br>☞Communication is not possible if the IP address is duplicated on the network or is invalid. |
| | 3.Confirm whether P2P parameter setting<br>☞Communication is possible only when P2P parameter channel and block are set. |
| | 4.Checking the other party's IP address in the P2P channel setting<br>☞Communication is not possible if the IP address of the other device is not valid |
| | 5.Check Driver Settings<br>☞The communication protocol must be set the same as that of the other device of the corresponding channel. |
| | 6.Check Link Enable Settings<br>Send frame when link enable is set |
| | 7.Confirm whether operation condition is working<br>☞If the activation condition set in the block is ON, |
| | 8.Check base unit operation mode<br>☞Basic unit operation mode should be RUN |

# Chapter 2 Built-in Cnet Communication

## 2.1 General

### 2.1.1 Characteristic

XBM-DN32H2/HP model has 1 channel of built-in RS-232C and one channel of RS-485.
Main characteristic of built-in Cnet is as shown below.

(1) A convenient user interface is provided through the dedicated XG5000 program, allowing the user to configure communication parameters with ease.

(2) The built-in Cnet of the main unit provides one RS-232C port and one RS-485 port. It operates independently according to channel.

(3) The downloaded Cnet communication parameters are stored in the main unit, so even if the communication module is replaced later, there is no need to re-download the parameters.

(4) Data can be transmitted and received using the XGT dedicated protocol, Modbus protocol, or user-defined protocols.

(5) RS-485 supports communication in a multi-drop configuration with up to 32 connections.

(6) Various communication speeds can be set. (1200,2400,4800,9600,19200,38400,57600,115200bps)

(7) 1:1 and 1:N communication are available.

(8) Diagnostic functions can be used through XG5000, making fault diagnosis simple.

(9) It supports dedicated server/client, Modbus server/client, and user-defined communication.

## 2.2 Specification

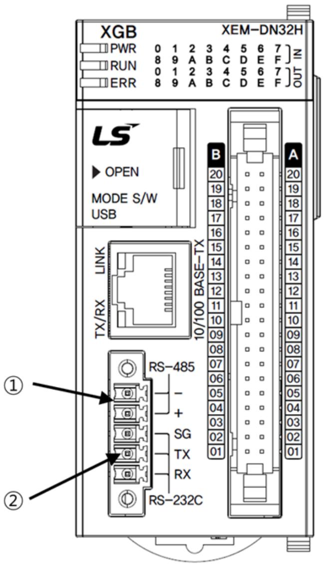
### 2.2.1 Performance Specification

| Item | | Specification | |
|---|---|---|---|
| | | Channel 1 | Channel 2 |
| Serial communication method | | RS-232C | RS-485 |
| Modem connection function | | - | - |
| Operation mode (Operation define by channel) | P2P | Act as communication client<br>- XGT dedicated protocol client<br>- Modbus ASCII/RTU client<br>- User defined communication<br>- LS Bus Client Notes 1) | |
| | Server | - XGT dedicated protocol server<br>- Modbus ASCII/RTU server | |
| Data type | Data bit | 7 or 8 | |
| | Stop bit | 1 or 2 | |
| | Parity | Even/Odd/None | |
| Synchronization type | | Asynchronous type | |
| Transmission speed (bps) | | 1200/2400/4800/9600/19200/38400/57600/115200 bps available | |
| Station No. setting | | Setting range: 0~255 Notes2)<br>Max. station No. available: 32 stations | |
| Transmission distance | | Max. 15m | Max. 500m |
| Diagnosis function | | Check available by XG5000 diagnosis service | |

**Notes**

Notes1) It indicates LS inverter dedicated protocol.
Notes2) When consisting Client and server, max. 32 stations is possible. Station No. can be set up 0 to 255.

## 2.2.2 Name and Function of Built-in Cnet Part

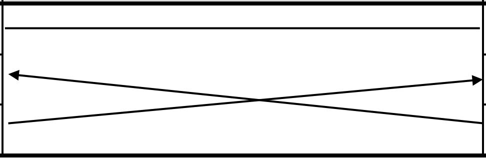


| No. | Item | Description |
|---|---|---|
| ① | RS-485<br>connection terminal | Built-in RS-485 connection connector |
| ② | RS-232C<br>connection terminal | Built-in RS-232C connection connector |

| Pin No. | Name | Description | Signal direction (XBMH2/HP ↔ External Device) | Function Description |
|---|---|---|---|---|
| 1 | 485- | 485 – Signal | ↔ | Built-in RS-485- Signal |
| 2 | 485+ | 485 + Signal | ↔ | Built-in RS-485+ Signal |
| 3 | SG | Signal Ground | — | Signal ground |
| 4 | TX | Transmitted Data | → | Built-in RS-232C transmitted data signal |
| 5 | RX | Received Data | ← | Built-in RS-232C received data signal |

1) Wiring method when using built-in RS-232C

When connecting in null modem mode, connect 3-wire system as follow.

| Cnet(9-PIN) | | Connection number and signal direction | Computer/communication device |
|---|---|---|---|
| Pin No. | Name | | Name |
| 3 | SG |  | SG |
| 4 | TX | | TXD |
| 5 | RX | | RXD |

2) Wiring method when using built-in RS-485

| Pin No. | Name | Signal direction | External communication device |
|---|---|---|---|
| 1 | 485- | ↔ | 485- |
| 2 | 485+ | ↔ | 485+ |

### 2.2.3 Cable Specifications

When communicating using an RS-485 channel, RS-422 twisted pair cables should be used to ensure superior signal transmission and control characteristics.

[Table 2.2.1] describes recommended specifications of cable. Also when using other cable than recommended, the cable conforming to characteristics in [Table 2.2.1] shall be used.

- Product : Low Capacitance LAN Interface Cable
- Type : LIREV-AMESB
- Size : 2P X 22AWG(D/0.254 TA)
- Manufacturer: LS Cable

#### 1) Cable specification

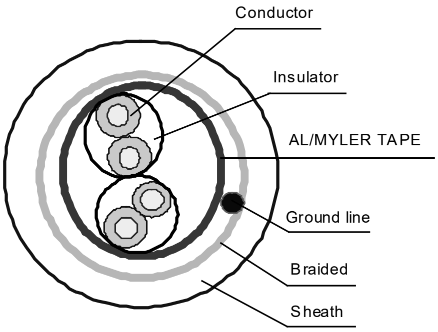
(1) Electrical characteristic

| Item | Standard | Test conditions |
|---|---|---|
| Withstanding voltage | No destruction | 500V/1min |
| Insulation resistance | 1,000 ㏁.km or above | 20 ℃ |
| Static electricity capacity | 45 ㎊/M or less | 1 ㎑ |
| Characteristics impedance | 120 ± 5 Ω | 10 ㎒ |

(2) External characteristic

| Item | | Unit | Standard |
|---|---|---|---|
| Conductor | Cores | Pair | 2 |
| | Size | AWG | 22 |
| | Composition | No./㎜ | 7/0.254 |
| | Outer dia. | ㎜ | 0.76 |
| Insulator | Thickness | ㎜ | 0.59 |
| | Outer dia. | ㎜ | 1.94 |

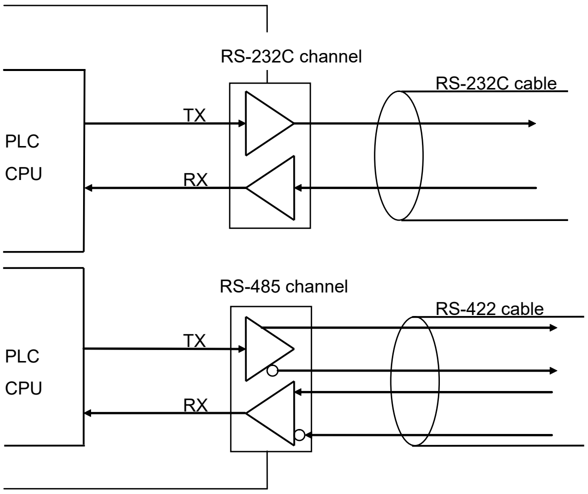
[Table 2.2.1] Cnet twisted pair cable specification



[Figure 2.2.1] Structure

### 2.2.4 Channel Operation of Built-in Communication

In case of built-in Cnet, each communication port operates independently to allow simultaneous Tx/Rx in separate transmission specifications. Transmission specifications can be set per RS-232C and RS-485 channel, and the operation is started and stopped according to channels. Data flow of each channel is as below.



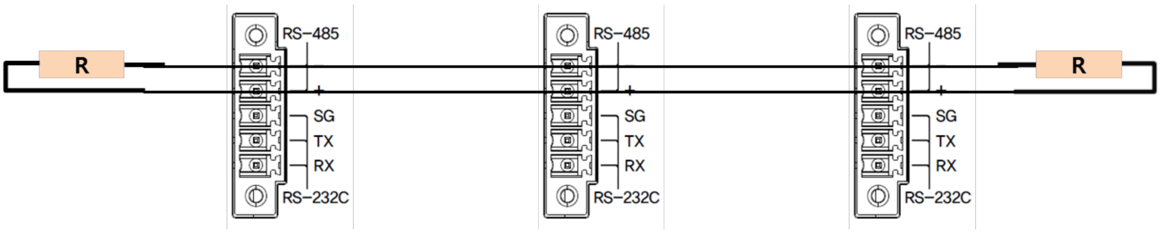
**Note**

(1) For mode change during RUN, download parameter by using XG5000.
(2) Though you don't reset the PLC, if download is complete, changed mode is applied.

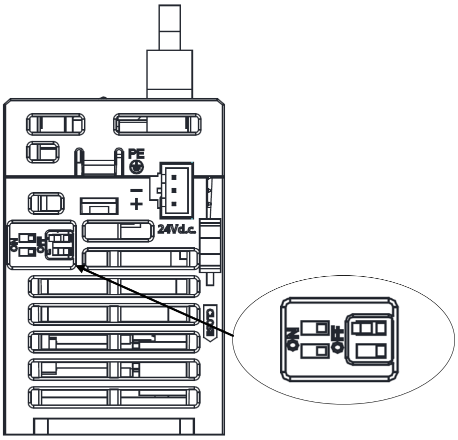
### 2.2.5 Termination Resistor

For communication via PLC built-in RS-485 channel, termination resistor from external must be connected. Termination resistor has the function to prevent distortion of signal by reflected wave of cable for long-distance communication, and the same resistance (1/2W) as characteristic impedance of cable must be connected to terminal of network. When using the recommended cable in 2.2.3 connect termination resistor of 120 to both ends of cable. Also when using other cable than recommended, the same resistance (1/2W) as characteristic impedance of cable must be connected to both ends of cable

- Recommended termination resistor: 1/2W, 120Ω, 5% tolerance



[Termination resistor connection diagram for RS-485 ]



[Termination resistor Switch]

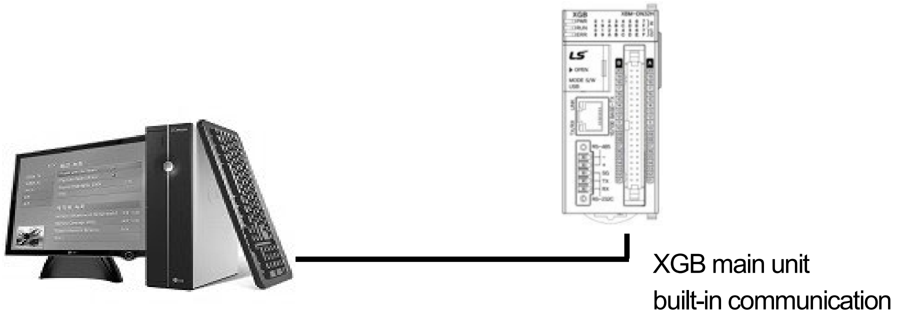
## 2.3 Cnet Communication System Configuration

Communication system by using XGB built-in communication function is diverse. In this chapter, it describes system configuration example.

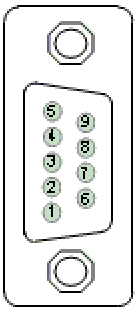
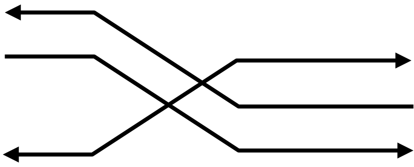
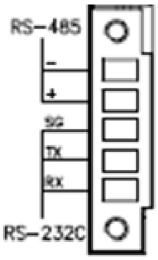
### 2.3.1 1:1 Connection to PC (HMI) (No Modem)

PC (HMI) and main unit are connected by RS-232C or RS-485 channel, PC (HMI) and PLC is connected by 1:1 without modem. In most case, PC (HMI) acts as client and Cnet I/F module acts as server which respond request of PC (HMI). Since there is no modem, in case of using RS-232C channel, communication distance is max 15m, in case of using RS-422 channel, communication distance is max 500m. Operation mode of Cnet I/F is set according to PC (HMI)'s communication method.

1) In case of using 1:1 connection with normal PC

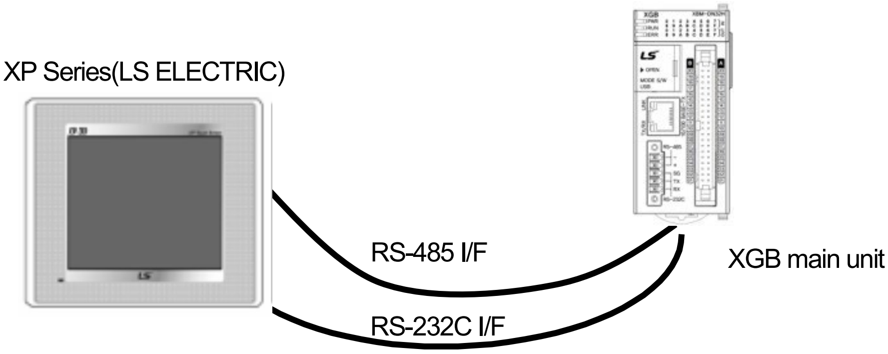


- Wiring method

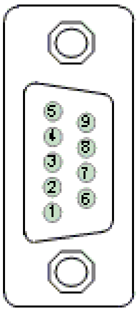
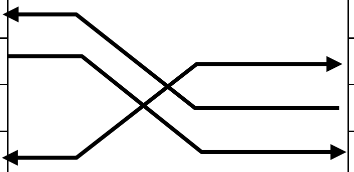
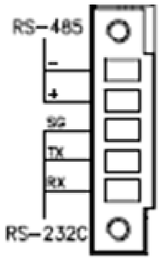
| External form of PC | PC | Connection number and signal direction | XGB main unit | | XGB external form |
|---|---|---|---|---|---|
| | Pin no. | | Pin no. | Signal name | |
|  <br>Female Type | 1 |  | 1 | 485- |  |
| | 2 (RXD) | | 2 | 485+ | |
| | 3(TXD) | | 3 | SG | |
| | 4 | | 4 | TX | |
| | 5(GND) | | 5 | RX | |
| | 6 | | | | |
| | 7 | | | | |
| | 8 | | | | |
| | 9 | | | | |

In case of using channel 2, connect 485+ and 485- of RS485 terminal.

2) In case of using 1:1 connection with monitoring device such as XGT Panel



- Wiring method (RS-232C)

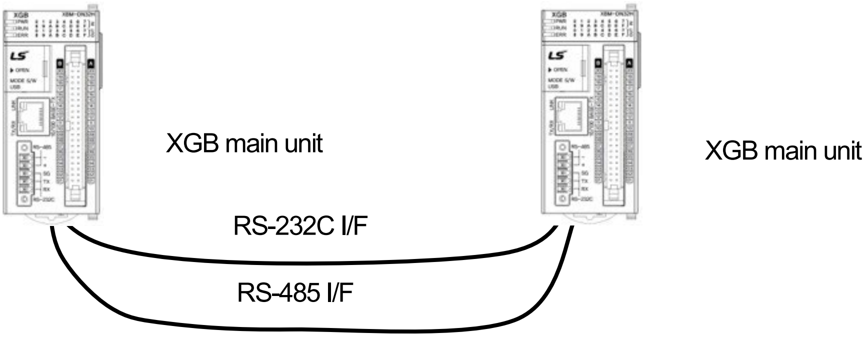
| XP external form | XP | Connection number and signal direction | XGB main unit | | XGB external form |
|---|---|---|---|---|---|
| | Pin No. | | Pin No. | Signal Name | |
|  Female Type | 1 |  | 1 | 485- |  |
| | 2(RXD) | | 2 | 485+ | |
| | 3(TXD) | | 3 | SG | |
| | 4 | | 4 | TX | |
| | 5(GND) | | 5 | RX | |
| | 6 | | | | |
| | 7 | | | | |
| | 8 | | | | |
| | 9 | | | | |

Note) In case of PMU, short no.4 and no.6, short no.7 and no.8.

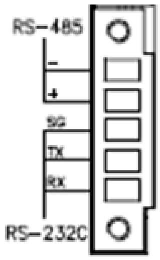
- Wiring method (RS-485)

| PMU | Connection no. and signal direction | XGB main unit |
|---|---|---|
| 485+ | ↔ | 485+ |
| 485- | ↔ | 485- |

3) In case of using 1:1 connection with XGB main unit

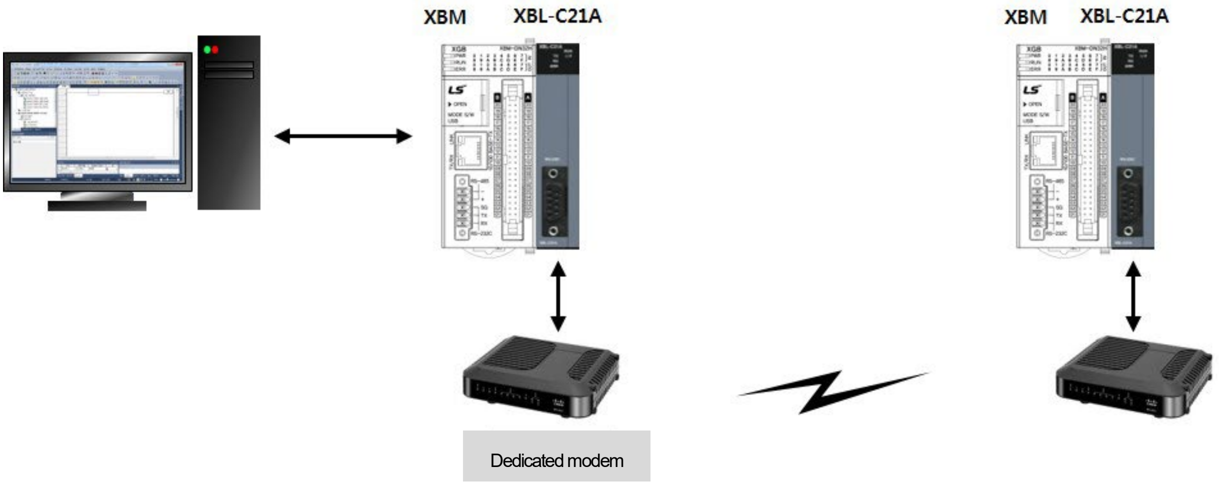


- Wiring method

| XGB external form | XGB main unit | Connection no. and signal direction | XGB main unit | |
|---|---|---|---|---|
| | Pin No. | | Pin No. | Signal name |
|  | 1 | ↔ | 1 | 485- |
| | 2 | ↔ | 2 | 485+ |
| | 3 | — | 3 | SG |
| | 4 | ↘ | 4 | TX |
| | 5 | ↙ | 5 | RX |

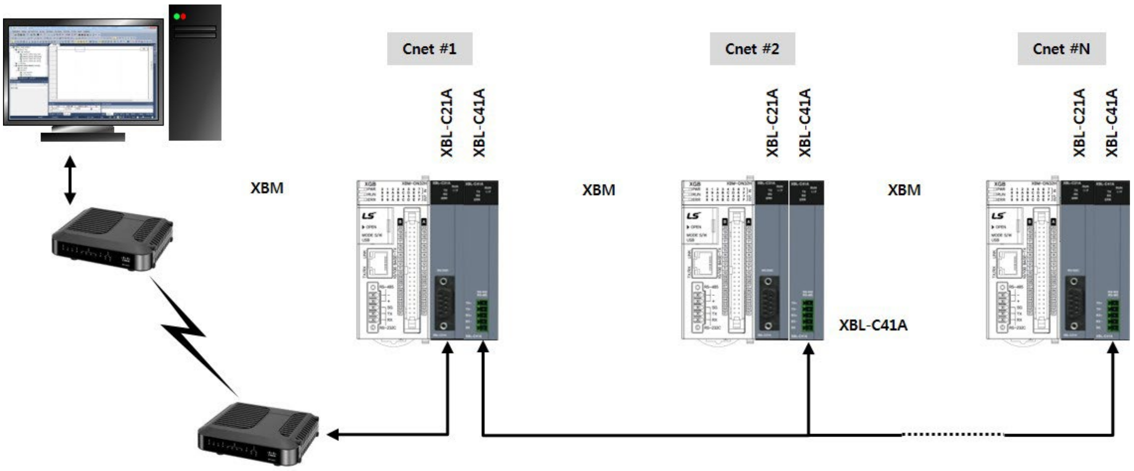
## 2.3.2 Dedicated Modem Connection with PC(HMI)

It is 1:1 communication system connected through dedicated modem through RS-232C channel with PC (HMI). Normally, PC (HMI) acts as client station, Cnet I/F module acts as server station which respond request of PC (HMI). Since it uses modem, RS-232C channel should be set as dedicated modem and long distance communication is available. Operation mode of this module should be set according to communication method of PC (HMI).



## 2.3.3 Modem Connection with PC and Communication between Cnet I/F Modules

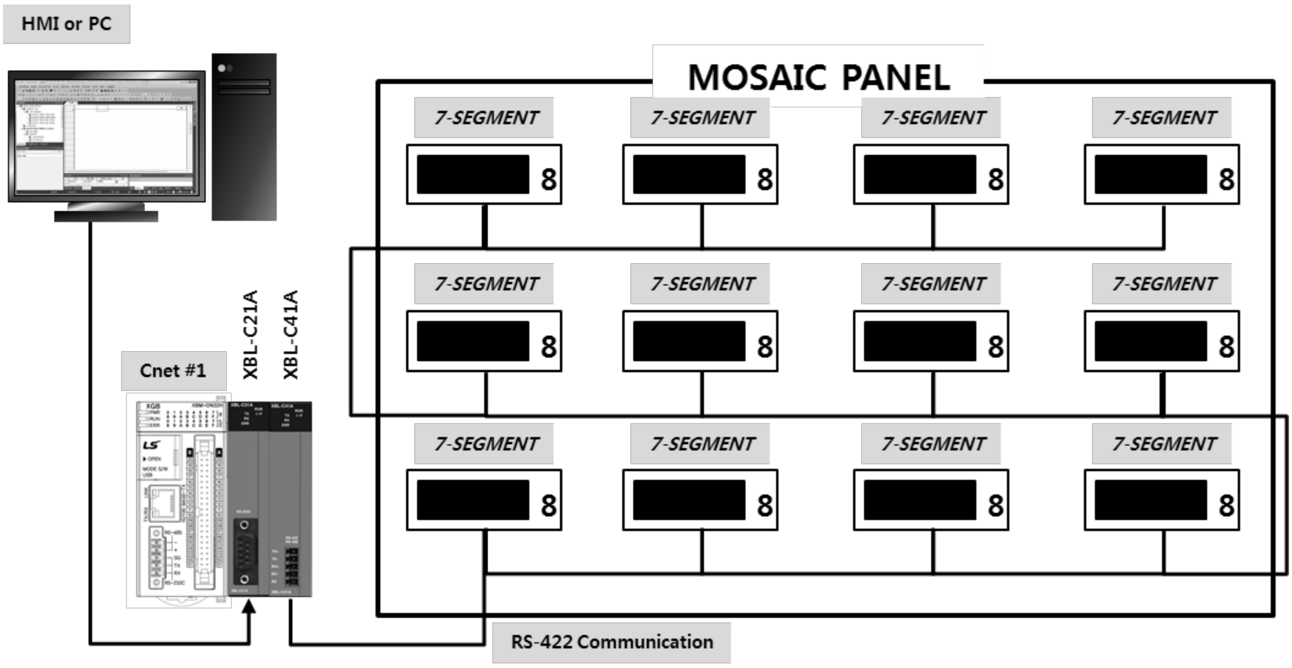
- PC and Cnet #1 station is connected by modem through RS-232C channel
- Cnet #1 station ~ N station is communication between Cnet I/F module through RS-422 channel
- Cnet #1 station ~ N station is Communication between Cnet I/F modules through RS-422 channel
- PC acts as client station of Cnet #1 station
- Up to max 32 station connection is available in case of Cnet I/F module (RS-422/485 communication)
- It sets station 1 among Cnet I/F module as server station
- Dedicate modem or dial-up modem available



| Type | Module setting | |
|---|---|---|
| | XBL-C41A | Station no. |
| PLC Cnet #1 | P2P | 1 |
| | XGT client | |
| Cnet #2 ~ #N | XGT server | 2~N |

## 2.3.4 Dedicated Communication with PC(HMI) and Different type RS-422 Communication

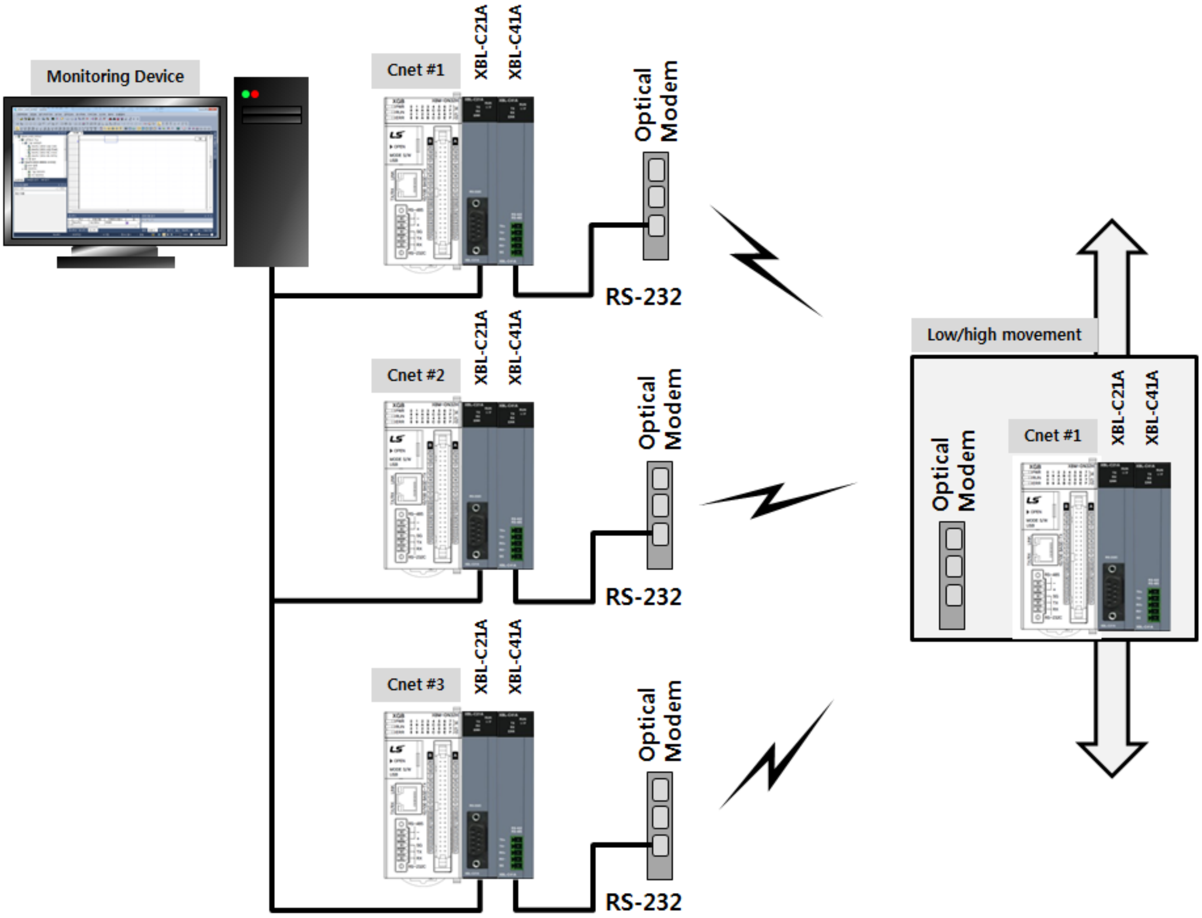
- Null-modem communication by using PC (HMI) and RS-232C channel
- PC (HMI) acts as client station, Cnet I/F module acts as server, at this time, module setting acts as RS-232C XGT server
- Cnet I/F module RS-422 channel acts as P2P mode.
- It transmits indication data to display module of mosaic panel through RS-422 channel
- Reading display transmission data from PC



<table>
<tr><th rowspan="2">Type</th><th colspan="3">Module setting</th></tr>
<tr><th>XBL-C21A</th><th>XBL-C41A</th><th>Station no.</th></tr>
<tr><td>PLC Cnet #1</td><td>XGT server</td><td>P2P</td><td>1</td></tr>
</table>

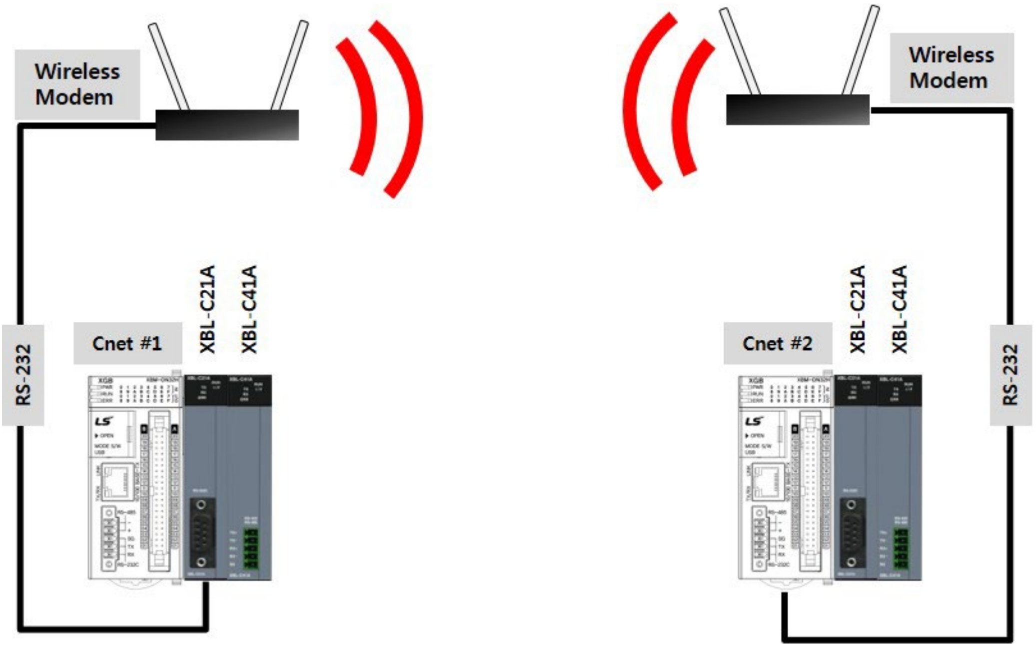
### 2.3.5 Optical Modem Communication for Moving Material Communication

- Optical modem communication system for Cnet communication on material above moving linearly
- P2P communication or dedicated mode communication with monitoring device
- RS-232C/RS-422 communication with optical modem
- Communication between Cnet I/F module is dedicated server/client communication
- Optical modem connected with Cnet I/F module on mobile body can communicate with the other optical modem only when positioned in communication available
- Main application: Parking tower



### 2.3.6 Wireless Modem Communication for Communication between Revolution Bodies

- Wireless modem communication system for Cnet communication on the revolution bodies
- RS-232C communication with wireless modem
- Communication between Cnet I/F module is dedicated/client communication
- RS-232C channel of Cnet I/F module is dedicated modem mode



| Type | Module setting | | |
|---|---|---|---|
| | RS-232C | RS-422 | Station |
| XBL-C21A | Dedicated mode<br>User mode | Not used | 2 station |

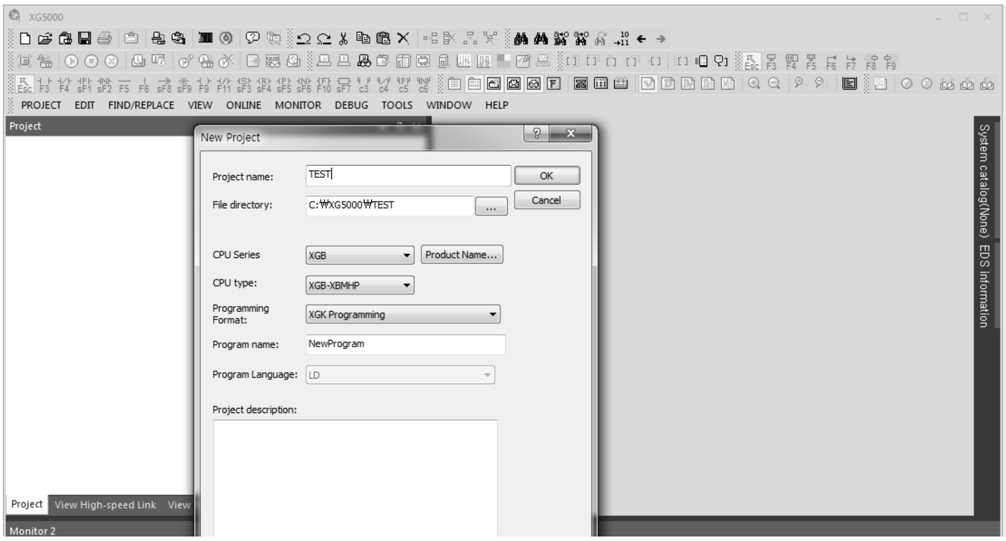
# 2.4 Basic Setting for Communication

## 2.4.1 PLC Type Setting and Communication Module Registration

To use Cnet I/F function, communication parameter should be written by XG5000 and the module should be registered in XG5000. Method on register Cnet I/F module is as follows according to On/Off line status.

1) Making new project

First, after click Project-New Project and input project name, select XGB as CPU series.



New Project

Project name: TEST

File directory: C:₩XG5000₩TEST

CPU Series: XGB

CPU type: XGB-XBMHP

Programming Format: XGK Programming

Program name: NewProgram

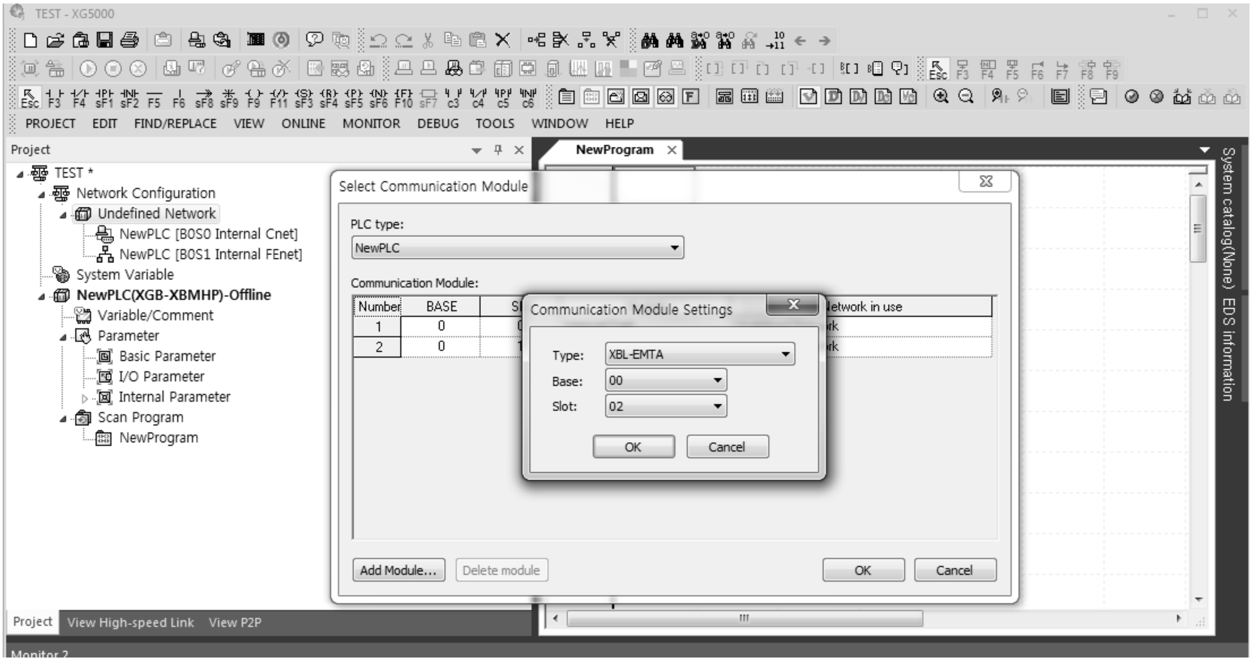
Program Language: LD

Project description:

2) In case of off-line, method on Cnet I/F module registration

In the status PLC is not connected, in case the user set about communication module and write parameter related with communication. In the “project” window, select “Undefined Network” and then click mouse right button. Select “Add item – Communication module”. In the window, click “Add Module…” to register Communication module.

At this time, slot 0 is set as built-in Cnet. (Slot 0 : Cnet, Slot 1: Enet) Expansion module starts from slot 2.



TEST *
Network Configuration
Undefined Network
NewPLC [B0S0 Internal Cnet]
NewPLC [B0S1 Internal FEnet]
System Variable
NewPLC(XGB-XBMHP)-Offline
Variable/Comment
Parameter
Basic Parameter
I/O Parameter
Internal Parameter
Scan Program
NewProgram

Select Communication Module

PLC type: NewPLC

Communication Module:

| Number | BASE |
|---|---|
| 1 | 0 |
| 2 | 0 |

Communication Module Settings

Type: XBL-EMTA

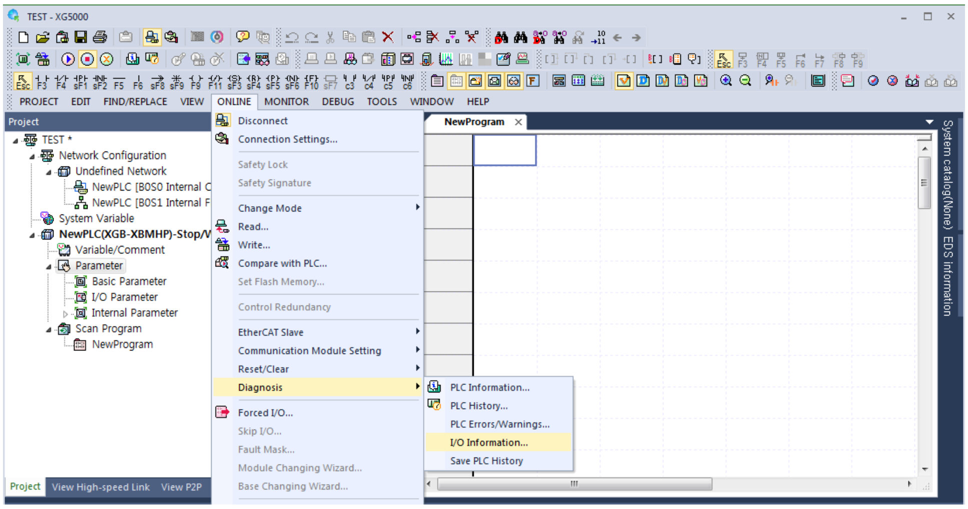
Base: 00

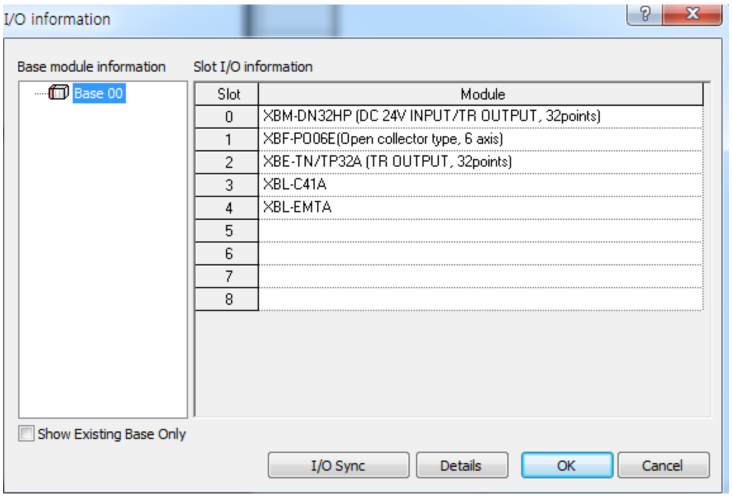
Slot: 02

[ Cnet module registration ]

### 3) In case of on-line, method on Cnet I/F module registration

If you register communication module at online status by using XG5000, you should connect basic unit. After [Online]-> [Connect] after doing communication setting by using “Online -> Connection settings” and doing local connection. After setting PLC to STOP status, select [Online] → [Diagnosis] → [I / O Information] and perform I / O synchronization.




I/O information

Base module information

Base 00

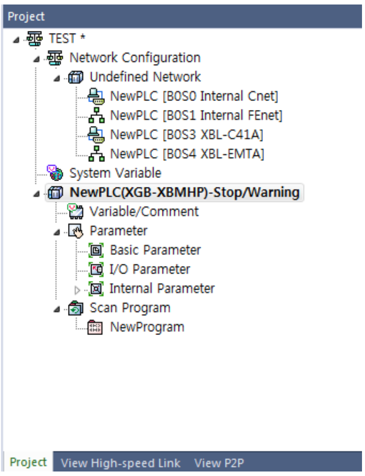
Slot I/O information

| Slot | Module |
|---|---|
| 0 | XBM-DN32HP (DC 24V INPUT/TR OUTPUT, 32points) |
| 1 | XBF-PO06E(Open collector type, 6 axis) |
| 2 | XBE-TN/TP32A (TR OUTPUT, 32points) |
| 3 | XBL-C41A |
| 4 | XBL-EMTA |
| 5 | |
| 6 | |
| 7 | |
| 8 | |

☐ Show Existing Base Only

[I/O information change message ]

If you Synchronize I/O, communication module will be registered.

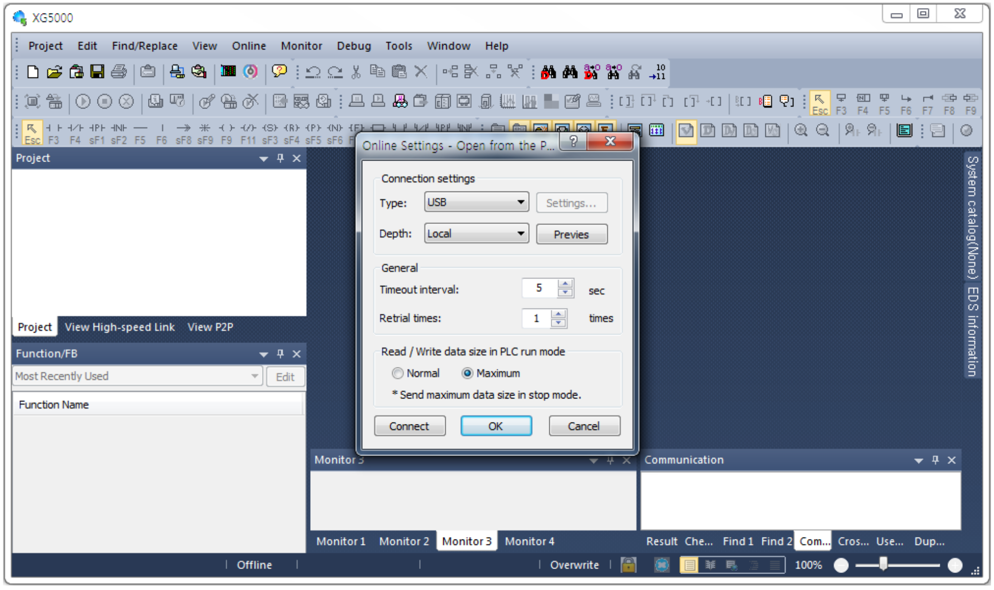

Project

TEST *
  Network Configuration
    Undefined Network
      NewPLC [B0S0 Internal Cnet]
      NewPLC [B0S1 Internal FEnet]
      NewPLC [B0S3 XBL-C41A]
      NewPLC [B0S4 XBL-EMTA]
  System Variable
  NewPLC(XGB-XBMHP)-Stop/Warning
    Variable/Comment
    Parameter
      Basic Parameter
      I/O Parameter
      Internal Parameter
    Scan Program
      NewProgram

[Communication module registration compete screen ]

### 4) How to read the parameter saved in PLC

The method to read basic setting value and P2P setting value of communication module saved in PLC is as follow. While connecting to main unit, select [Project] -> [ Open from PLC ]. After setting “Online Settings”, click “OK” and then the saved parameter and project in PLC is opened as follow.



Online Settings - Open from the P...

Connection settings

Type: USB

Settings...

Depth: Local

Previes

General

Timeout interval: 5 sec

Retrial times: 1 times

Read / Write data size in PLC run mode

○ Normal ● Maximum

* Send maximum data size in stop mode.

Connect OK Cancel

[ Open from PLC ]

### 2.4.2 Basic Parameter Setting

Communication function used in Cnet I/F module is classified as followings.

1) Server mode service

Without other program at PLC, you can read or write information in PLC and data.

- It can act as XGT server providing XGT dedicated protocol and Modbus server providing RTU/ASCII protocol.

2) Client (P2P) service

Cnet I/F module acts as client in network.

- In case designated event occurs, you can read or write memory of other station.
- It can act as XGT client and Modbus client.
- In case of sending/receiving user wanted frame and communicating with other device.
- You can define P2P block with max. 32 per one channel acting independently.

3) Loader service

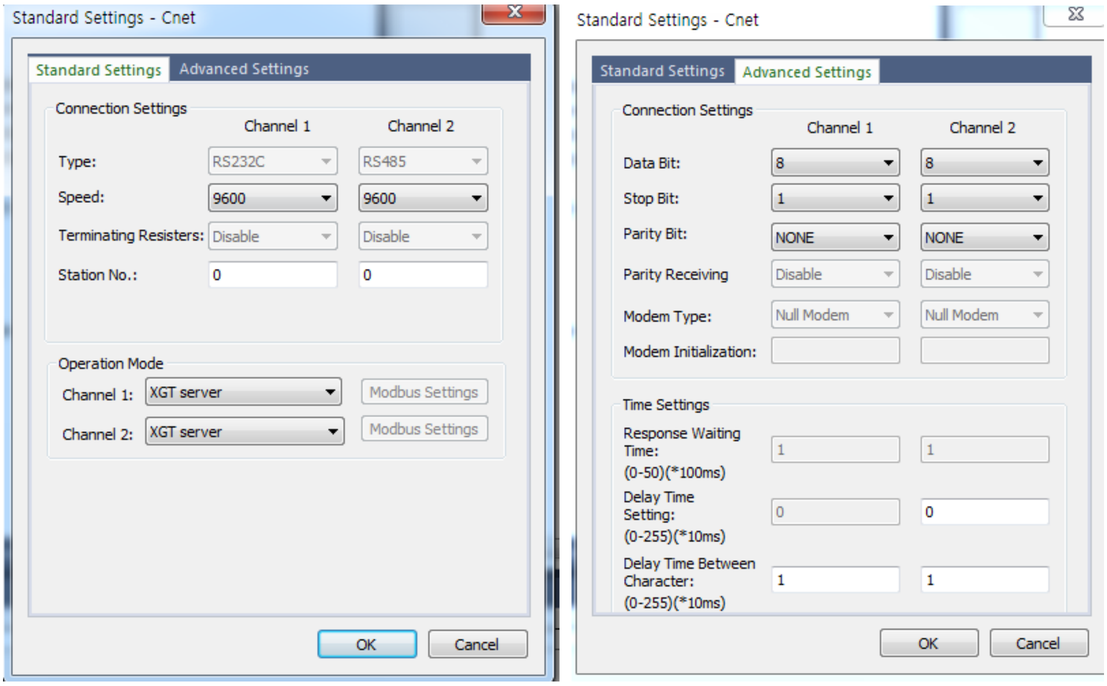
By using remote 1/2, you can monitor/download program about remote PLC.

To use Cnet I/F module, you should set transmission specification such as data type like transmission speed and data/stop bit.
You should select transmission specification of system to be same with specification of system.

Written standard setting value is saved main unit of PLC and this value keeps though power goes off and this value is not changed before writing. Also though Cnet I/F module is changed and new module is installed, the standard setting value saved at main unit previously written is applied to new module automatically. Standard communication setting parameter and P2P, all parameter is applied if download is complete.

### 4) Setting Item

When setting Cnet communication parameter, the user should define as follows.



Standard Settings - Cnet

Standard Settings | Advanced Settings

Connection Settings

| | Channel 1 | Channel 2 |
|---|---|---|
| Type: | RS232C | RS485 |
| Speed: | 9600 | 9600 |
| Terminating Resisters: | Disable | Disable |
| Station No.: | 0 | 0 |

Operation Mode

Channel 1: XGT server

Channel 2: XGT server

Standard Settings - Cnet

Standard Settings | Advanced Settings

Connection Settings

| | Channel 1 | Channel 2 |
|---|---|---|
| Data Bit: | 8 | 8 |
| Stop Bit: | 1 | 1 |
| Parity Bit: | NONE | NONE |
| Parity Receiving | Disable | Disable |
| Modem Type: | Null Modem | Null Modem |
| Modem Initialization: | | |

Time Settings

| | Channel 1 | Channel 2 |
|---|---|---|
| Response Waiting Time: (0-50)(*100ms) | 1 | 1 |
| Delay Time Setting: (0-255)(*10ms) | 0 | 0 |
| Delay Time Between Character: (0-255)(*10ms) | 1 | 1 |

[Built-in communication standard setting screen ]

<table>
<tr><th>Item</th><th>Setting content</th></tr>
<tr><td>Station no.</td><td>• set from station 0 to station 255.</td></tr>
<tr><td>Speed</td><td>• 1200, 2400, 4800, 9600, 19200, 38400, 57600,76800, 115200 bps available</td></tr>
<tr><td>Data bit</td><td>• 7 or 8 bit available</td></tr>
<tr><td>Parity bit</td><td>• None, Even, Odd available.
<table>
<tr><th>Kinds</th><th>Meaning</th><th>NO</th></tr>
<tr><td>None</td><td>Do not use parity bits</td><td></td></tr>
<tr><td>Even</td><td>If the number of 1s in one byte is an even number, & quot; 0 & quot; is transmitted to the parity bit</td><td></td></tr>
<tr><td>Odd</td><td>If the number of 1s in one byte is odd, "0" is sent to the parity bit</td><td></td></tr>
</table></td></tr>
<tr><td>Stop bit</td><td>• 1 or 2 bit available</td></tr>
<tr><td>Modem initialization</td><td>• When using dialup modem, the function is available. In case of modem communication, input the initialization instruction of applied modem.</td></tr>
<tr><td>Type</td><td>• It is fixed as follows according to Cnet type<br>1) Built-in communication → channel 1 : RS-232C , channel 2 : RS-485<br>2) XBL-C41A → channel 1 : not used, channel 2: RS-422/RS-485<br>3) XBL-C21A → channel 1 : not used, channel 2: RS-232C</td></tr>
<tr><td>Response waiting time</td><td>• It means the time from sending frame to receving.<br>1) operation setting : it is available when active mode is set to “Use P2P”.<br>2) waiting time : 100ms+(setting value × 100ms)</td></tr>
<tr><td>Delay time Setting</td><td>• It means that frame is sent at user-defined frame send timing with delay as setting delay time.<br>1) operation setting : it is available when communication type is RS-422/485.</td></tr>
</table>

<table>
<tr><td>Delay time between characters</td><td>• It means interval between characters in one frame.<br>1) operation setting : it is always available regardless of active mode.<br>2) In case of that wating time is set to 0, it is applied 3.5 character time[1)] as communication speed.</td></tr>
<tr><td>Operation mode setting</td><td>• Sets operation mode of communication module.
<table>
<tr><th>Driver type</th><th>Meaning</th><th>Reference</th></tr>
<tr><td>P2P</td><td>Each port acts as client and executes the communication by setting P2P parameter.</td><td>P2P setting reference</td></tr>
<tr><td>XGT server</td><td>It acts as XGT server supporting XGT dedicated communication.</td><td>Dedicated service</td></tr>
<tr><td>Modbus ASCII server</td><td>It acts as Modbus ASCII server</td><td>Modbus communication</td></tr>
<tr><td>Modbus RTU server</td><td>It acts as Modbus RTU server</td><td>Modbus communication</td></tr>
</table>
</td></tr>
</table>

[ communication parameter setting item ]

**Note**

Character Time: It means the required time to send 1 character and it is variable depends on communication speed.

1) In case of that communication speed is 9600bps, how to calculate 3.5 Character Time

Character time = (number of bits of 1 character(11) / communication time) * Character time(3.5)
= (11 / 9600) * 3.5 = 4.01ms

### 5) Parameter download

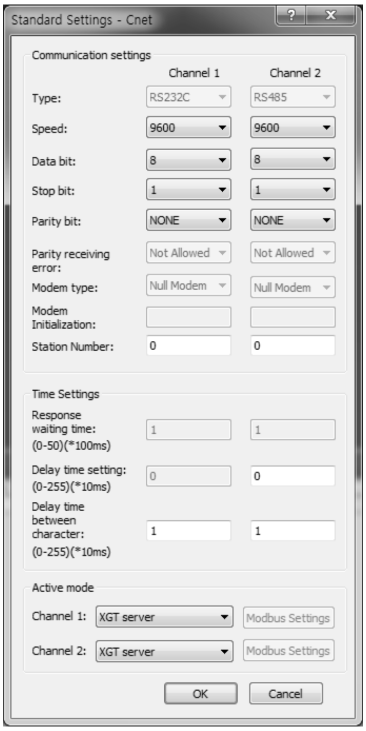
You should do like following to operate Cnet I/F module according to communication specification defined by user. In case of setting like the followings about XBL-C41A (RS-422/485 1 port) installed slot 3, setting method is as follows.

(1) Communication specification

- ■ Channel 2: RS-485, 115200Bps, 8/1/Odd, Null modem, P2P, station 0, Response waiting time 100ms, Delay time 10㎳,
  Waiting time between characters 0ms, XGT server

(2) Executing XG5000, you register communication module Cnet for setting at each slot position.

(3) After Cnet module is registered, if you double-click Cnet module, the following standard setting window shows.



Communication settings

| | Channel 1 | Channel 2 |
|---|---|---|
| Type: | RS232C | RS485 |
| Speed: | 9600 | 9600 |
| Data bit: | 8 | 8 |
| Stop bit: | 1 | 1 |
| Parity bit: | NONE | NONE |
| Parity receiving error: | Not Allowed | Not Allowed |
| Modem type: | Null Modem | Null Modem |
| Modem Initialization: | | |
| Station Number: | 0 | 0 |

Time Settings

| | | |
|---|---|---|
| Response waiting time: (0-50)(*100ms) | 1 | 1 |
| Delay time setting: (0-255)(*10ms) | 0 | 0 |
| Delay time between character: (0-255)(*10ms) | 1 | 1 |

Active mode

Channel 1: XGT server

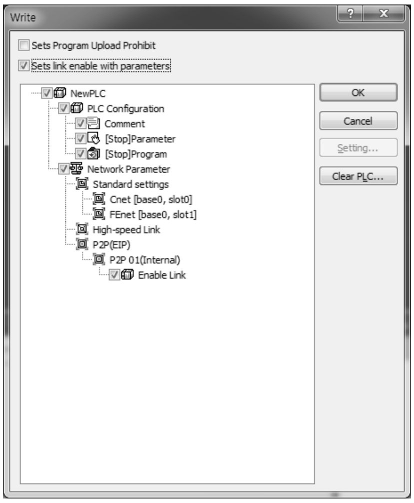
Channel 2: XGT server

[Communication module setting screen ]

(4) If standard communication parameter setting ends, download Cnet module.

If you select [Online -> connection -> Write], download is executed. After downloading, parameter is applied shortly.

If you check 'Set up with Link Enable', Link Enable can be applied with writing P2P/HS parameters at the same time.



☐ Sets Program Upload Prohibit

☑ Sets link enable with parameters

- ☑ NewPLC
  - ☑ PLC Configuration
    - ☑ Comment
    - ☑ [Stop]Parameter
    - ☑ [Stop]Program
  - ☑ Network Parameter
    - Standard settings
      - Cnet [base0, slot0]
      - FEnet [base0, slot1]
    - High-speed Link
    - P2P(EIP)
      - P2P 01(Internal)
        - ☑ Enable Link

## 2.5 Remote Connection

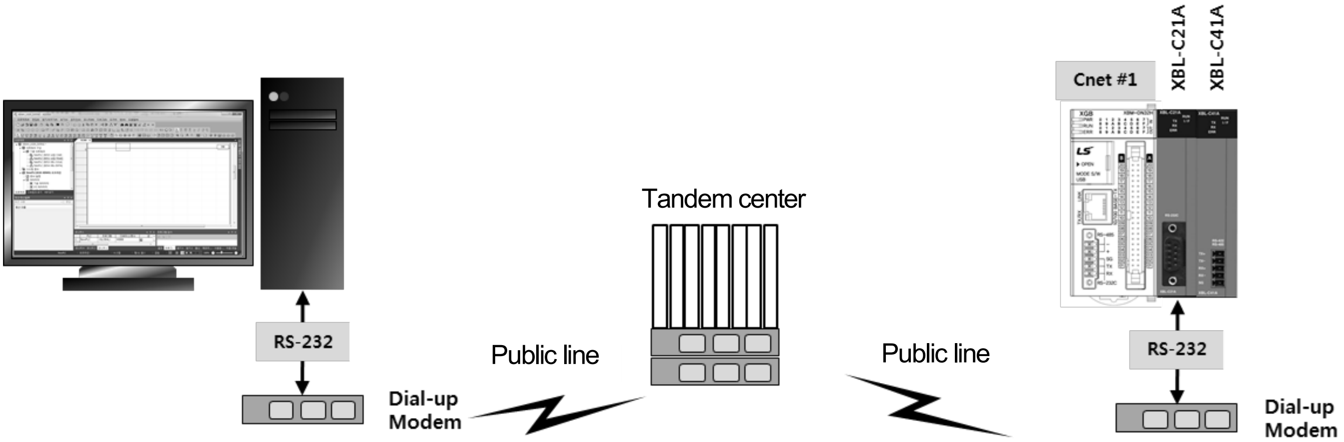
In case PC executing XG5000 is far from XGB PLC, if you use remote connection function of Cnet I/F module, you can control remote PLC such as program download, upload, program debugging and monitor. Especially, in case XG5000 is far from PLC, if you use XG5000 remote connection function and modem connection function of Cnet I/F module, you can access easily by remote connection through air line. Remote connection is supported at XGB communication module, FEnet I/F module and Cnet I/F module. Connection between networks is available and you can control remote PLC through multiple connections. There are two methods for remote connection by using Cnet I/F module, first, XG5000 is connected with Cnet I/F module of remote PLC through modem, second, XG5000 and local PLC are connected into CPU through RS-232C, Cnet I/F module of local PLC communicates with Cent I/F module of remote PLC.

### 2.5.1 XG5000 remote connection

[Figure 2.5.1] is figure indicating remote connection example where XG5000 and PLC are connected through modem. Like figure, it is necessary configuration in case PC executing XG5000 is far from PLC and telephone line and connected by dedicated modem or wireless modem. At this case, you should connect Cnet I/F module by modem from XG5000 and you should select modem as connection method at connection option. There are two methods, dedicated modem connection using dedicated line and dial-up modem connection using public line.

(1) Dial-up modem connection

You can establish remote connection by connecting dial-up modem to PC and Cnet I/F module (RS-232C). In PC side, you can use external modem or internal dial-up modem and in Cnet I/F side (RS-232C), you should use external modem.



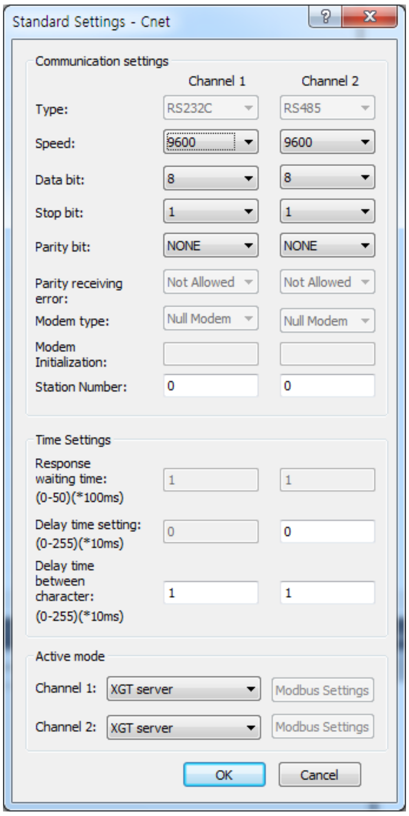
[Figure 2.5.1] XG5000 remote connection example by dial-up modem

Remote connection sequence by using dial-up modem is as follows.

(1) Cnet I/F module connected with PLC setting

a) Sets active mode of RS-232C channel of Cnet I/F as XGT server at XG5000.

b) Sets Modem type of Cnet I/F module (RS-232C) as Dial-up modem and inputs atz in Modem Initialization.



Communication settings

| | Channel 1 | Channel 2 |
|---|---|---|
| Type: | RS232C | RS485 |
| Speed: | 9600 | 9600 |
| Data bit: | 8 | 8 |
| Stop bit: | 1 | 1 |
| Parity bit: | NONE | NONE |
| Parity receiving error: | Not Allowed | Not Allowed |
| Modem type: | Null Modem | Null Modem |
| Modem Initialization: | | |
| Station Number: | 0 | 0 |

Time Settings

| | | |
|---|---|---|
| Response waiting time: (0-50)(*100ms) | 1 | 1 |
| Delay time setting: (0-255)(*10ms) | 0 | 0 |
| Delay time between character: (0-255)(*10ms) | 1 | 1 |

Active mode

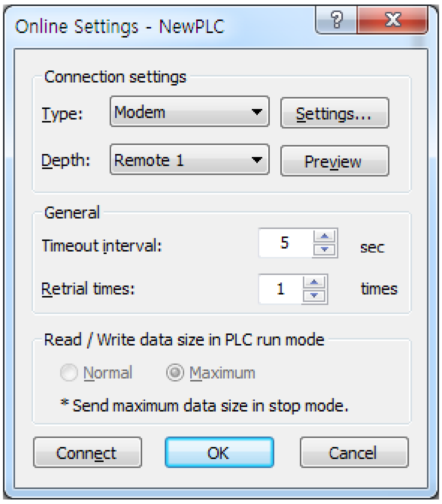
Channel 1: XGT server

Channel 2: XGT server

[Figure 2.5.2] XG5000 setting example

(2) XG5000 setting

a) Execute XG5000 and pop up online settings window by selecting “Online -> Connection settings”. Here selects “Connection settings -> Type” as Modem.



Connection settings

Type: Modem

Depth: Remote 1

General

Timeout interval: 5 sec

Retrial times: 1 times

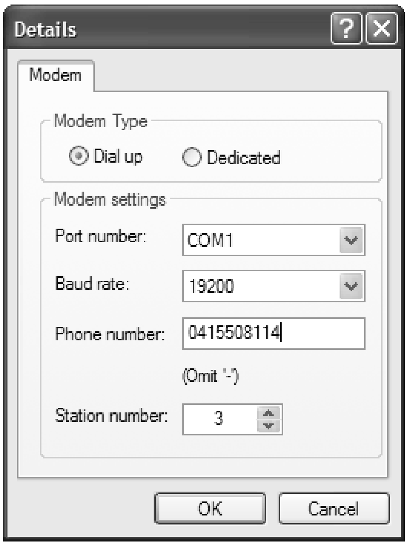
Read / Write data size in PLC run mode

○ Normal ● Maximum

* Send maximum data size in stop mode.

(3) Dial up modem setting

a) Select settings of “Connection settings” and set detail of modem



Modem Type
◉ Dial up ○ Dedicated

Modem settings
Port number: COM1
Baud rate: 19200
Phone number: 0415508114
(Omit '-')
Station number: 3

b) Phone number means phone number of modem side connected with Cnet I/F module, in case of going out from local through extension line, you can use extension number and ‘,’ symbol.

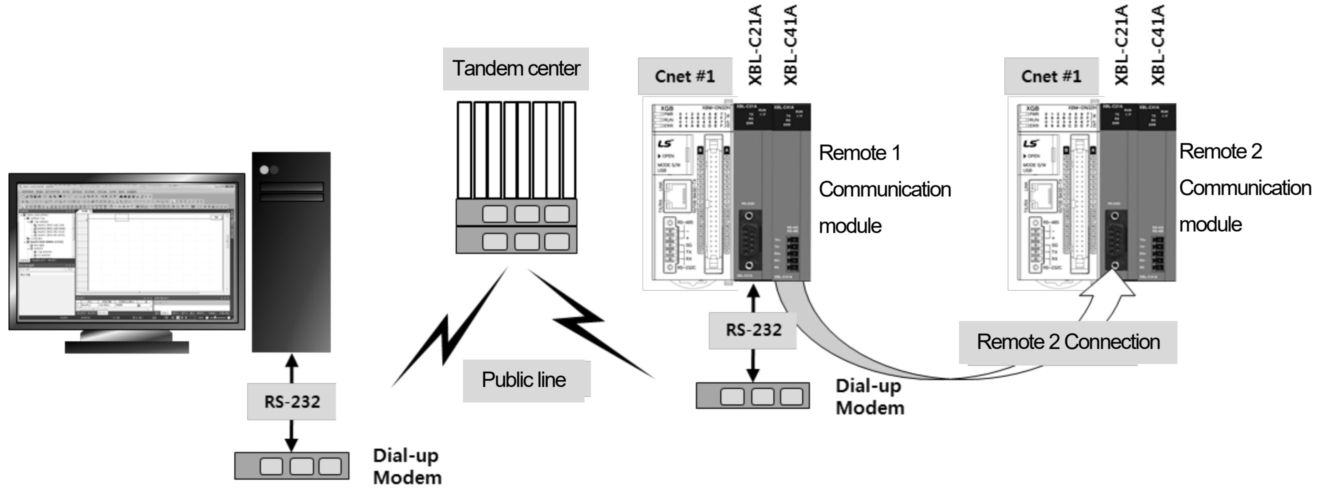
(Ex) In case extension number is ‘9’: set as 9, 0343-398-xxxx

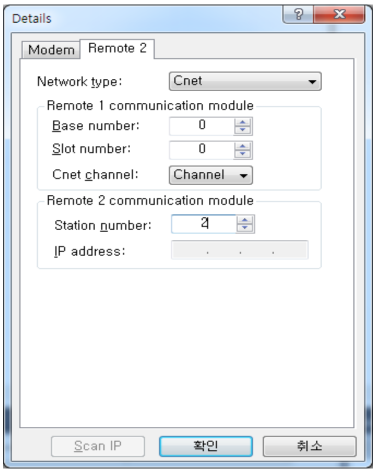
**Note**

Baud rate in modem settings means communication speed between PC and modem, not communication speed of modem. Baud rate of modem means communication speed between modem and modem, it is set automatically according to quality of public line and destination modem’s speed.

For XG5000 remote connection at XGB PLC, you should use RS-232C channel. At communication standard setting, set “RS-232C dial-up modem” and write it to XGB Cnet I/F module.

c) In case of selecting connection step as remote 2, like the following, select base and slot number of remote 1 communication module in detail and communication module station number of remote 2. Inputs station number set in Cnet I/F module, In case of Cnet channel, selects communication channel of remote 2.





Network type: Cnet

Remote 1 communication module

Base number: 0

Slot number: 0

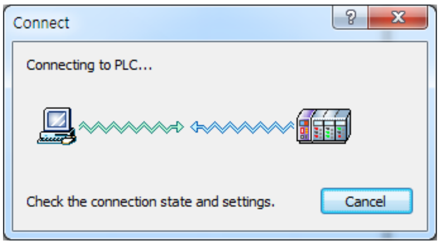
Cnet channel: Channel

Remote 2 communication module

Station number: 2

IP address: . . .

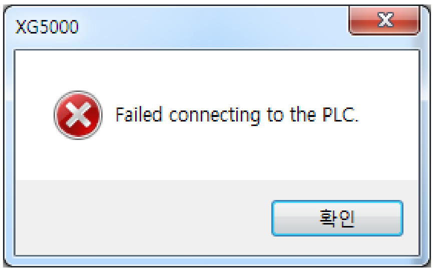
d) Select connection on online after setting connection option, modem initialization dialog box shows and modem is initialized.



Connecting to PLC...

Check the connection state and settings.

e) In case setting of COM channel of modem or connection with modem is wrong or, the error message shows. At this time, check COM channel or modem connection.



Failed connecting to the PLC.

f) If making phone call is complete, XG5000 tries remote connection. In case remote connection is complete, “Online” menu is activated.

g) This case is same with connection status where connection is established through RS-232C cable. Here you can use all function of online menu.

h) In case you want to disconnect remote connection, select disconnect at online menu. Then disconnection menu box shows and remote connection is disconnected.

i) If connection is disconnected, XG5000 quit call automatically and disconnection telephone connection.

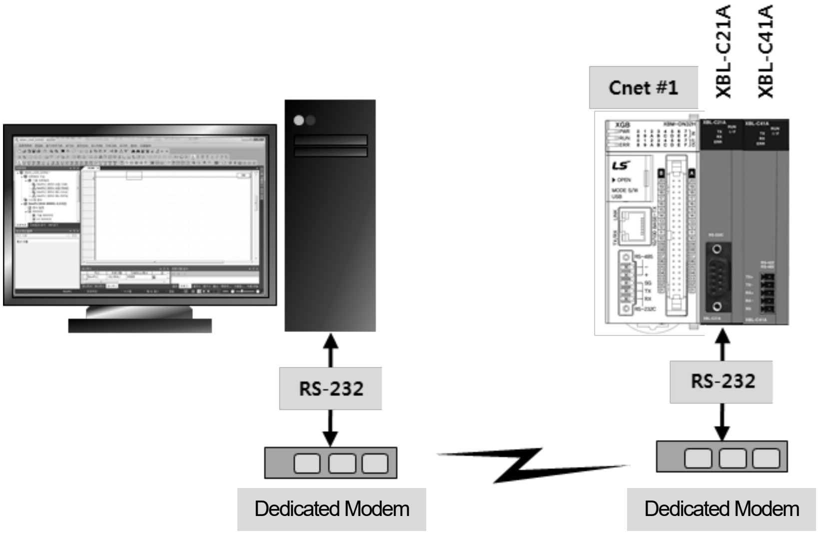
j) If it is success to quit call normally, local and remote modems return to initialization status. You can establish remote connection through making phone call.

**Note**

After remote connection, you can use online menu of XG5000 like local connection. You can use program download/upload/monitor function etc. PLC control through modem is affected by capability of modem and status of telephone line. In case telephone line is bad, connection may be canceled. At this time, don't try reconnection instantly, wait for 30s and retry again from step 1)

2) Dedicated modem connection

The following figure indicates that PC and Cent module is connected by dedicated modem through dedicated line.



[XG5000 remote connection example by dedicated modem]

This is example of dedicated modem connection by dedicated line. You can use wireless modem, optical modem other than dedicated modem. For setting method of modem not using public line, it is same with case of dedicated modem and refer to the followings.

Remote connection sequence by dedicated modem is as follows.

(1) Connects PC with dedicated modeDedicated line

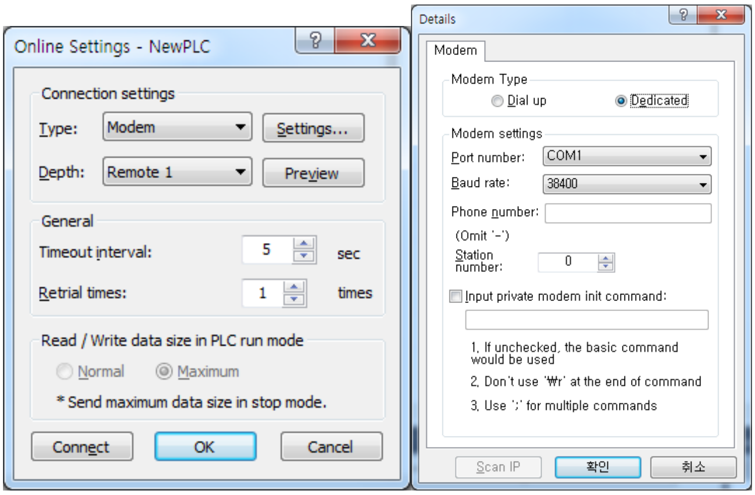
(2) Cnet I/F module setting connected at remote PLC

a) Sets RS-232C channel of Cnet I/F module as XGT server.

b) Sets RS-232C channel operation of Cnet I/F module as dedicated modem.

(3) XG5000 setting

a) Execute XG5000 and select “Online -> connection settings” and pop up online settings window. Here set “Connection settings -> Type” as Modem. Press the “Settings” button and set communication channel and baud rate set in dedicated modem connected with PC. Baud rate should be same with communication speed of dedicated modem.



Connection settings

Type: Modem

Depth: Remote 1

General

Timeout interval: 5 sec

Retrial times: 1 times

Read / Write data size in PLC run mode

○ Normal ● Maximum

* Send maximum data size in stop mode.

Modem Type

○ Dial up ● Dedicated

Modem settings

Port number: COM1

Baud rate: 38400

Phone number:

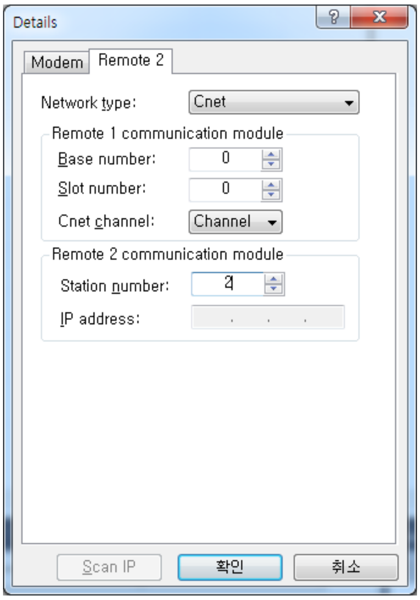
(Omit '-')

Station number: 0

☐ Input private modem init command:

1. If unchecked, the basic command would be used
2. Don't use '₩r' at the end of command
3. Use ';' for multiple commands

b) In case of setting depth as remote 2, set settings related with remote 1, 2 at the "Detail" window like the followings.



Network type: Cnet

Remote 1 communication module

Base number: 0

Slot number: 0

Cnet channel: Channel

Remote 2 communication module

Station number: 2

IP address:

[Figure 5.1.10] dedicated modem remote 2 setting screen

c) After completing setting, if you click connection of connection setting, XG5000 tried remote connection. In case remote connection is complete, it is same when connection is established by RS-232C cable. Here you can use all functions of "Online" menu.

d) In case you want to disconnect remote connection, select disconnect at online menu. Disconnection menu box shows and remote connection is disconnected.

e) If disconnection is done normally, Cnet I/F module and XG5000 are switch into initial mode. In case of reconnection, retry from 2) item to reconnect.

f) Since for optical modem, wireless modem, only media between modems is different. Connection method is same.

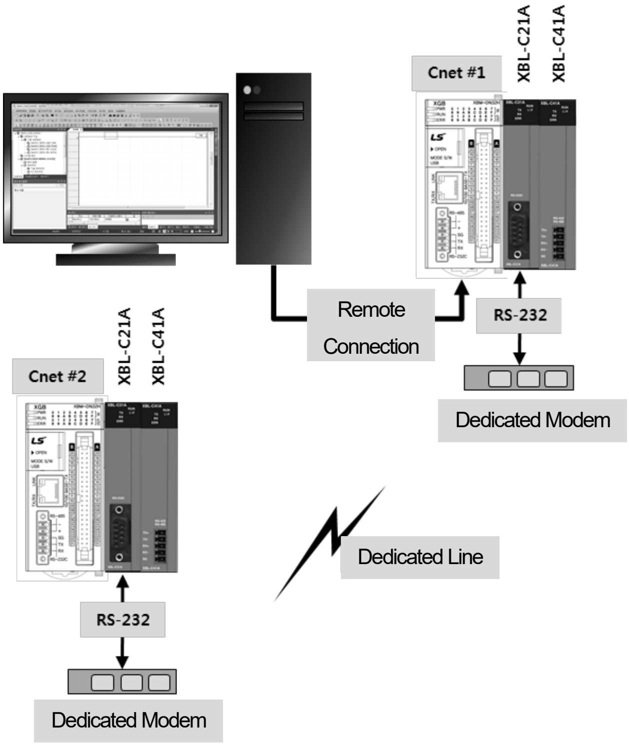
**Note**

After remote connection, you can use online menu of XG5000 like local connection.
You can use program download/upload/monitor etc. PLC control through modem is affected by capability of modem and status of telephone line. In case telephone line is bad, connection may be canceled. At this time, don't try reconnection instantly, wait for 30s and retry again from step 1)

## 2.5.2 Remote connection between Cnet I/F modules

### 1) Remote connection through dedicated modem

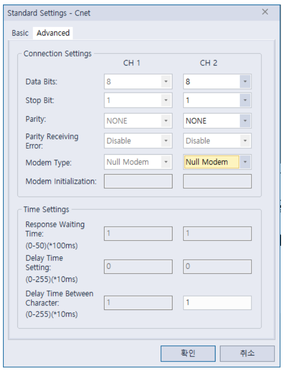
Figure below indicates that XG5000 and local PLC is connected through RS-232C cable and in case RS-232C channel of Cnet I/F module equipped at local PLC communicates with Cnet I/F module of remote PLC through dedicated modem. Figure is example indicating remote connection with remote PLC. Like figure, XG5000 uses modem communication function between Cnet I/F modules and control remote PLC by using remote connection.



Remote connection sequence by dedicated modem is as follows.

(1) Cnet I/F module setting connected at remote PLC

a) Set RS-232C channel operation of Cnet I/F module at XG5000 as dedicated modem and have it operate as XGT server.



Connection Settings

| | CH 1 | CH 2 |
|---|---|---|
| Data Bits: | 8 | 8 |
| Stop Bit: | 1 | 1 |
| Parity: | NONE | NONE |
| Parity Receiving Error: | Disable | Disable |
| Modem Type: | Null Modem | Null Modem |
| Modem Initialization: | | |

Time Settings

| | | |
|---|---|---|
| Response Waiting Time: (0-50)(*100ms) | 1 | 1 |
| Delay Time Setting: (0-255)(*10ms) | 0 | 0 |
| Delay Time Between Character: (0-255)(*10ms) | 1 | 1 |

(2) Cnet I/F module setting connected at local PLC

a) Converts local connected PLC to Stop mode

b) Configure the Standard Settings for the RS-232C channel of the Cnet I/F module.

c) Set the Modem Type of the Cnet I/F module (RS-232C) as Dedicated Modem.

d) Write the communication parameters with [Online – Write] menu.

**Note**

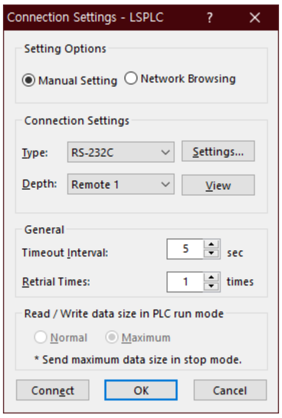
Basic parameter of remote server connected through XG5000 should be set as server. In case of remote client, it should be set as P2P client.

In case there are many communications, if you try to remote connection, you may fail. Be sure to convert local PLC to stop mode and stop communication before remote connection.

(3) XG5000 setting for remote connection

a) Execute XG5000 and select "Online – Connection Settings" and set connection method.

Select Type as RS-232C and communication channel. This is same in case of local connection.



● Manual Setting ○ Network Browsing

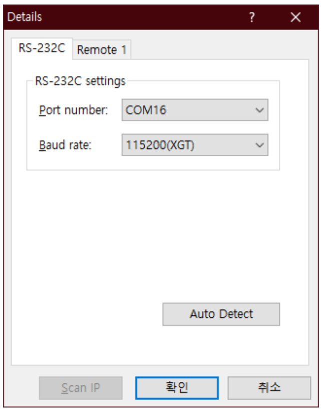
Type: RS-232C

Depth: Remote 1

Timeout Interval: 5 sec

Retrial Times: 1 times

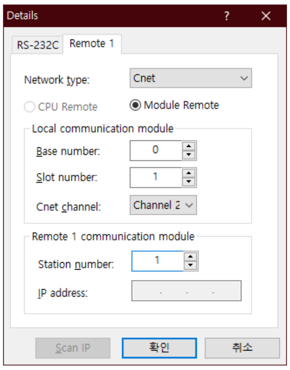
* Send maximum data size in stop mode.



Port number: COM16

Baud rate: 115200(XGT)

b) Select depth as remote 1 and click "Settings" for detail setting. In the detail window, set station number. AS for station number, input station number set in Cnet I/F module to execute remote connection. Figure is case Cnet station number is set as 1.



Network type: Cnet

○ CPU Remote ● Module Remote

Base number: 0

Slot number: 1

Cnet channel: Channel 2

Station number: 1

IP address: . . .

c) XG5000 tries remote connection and in case remote connection is complete, online related function is activated.

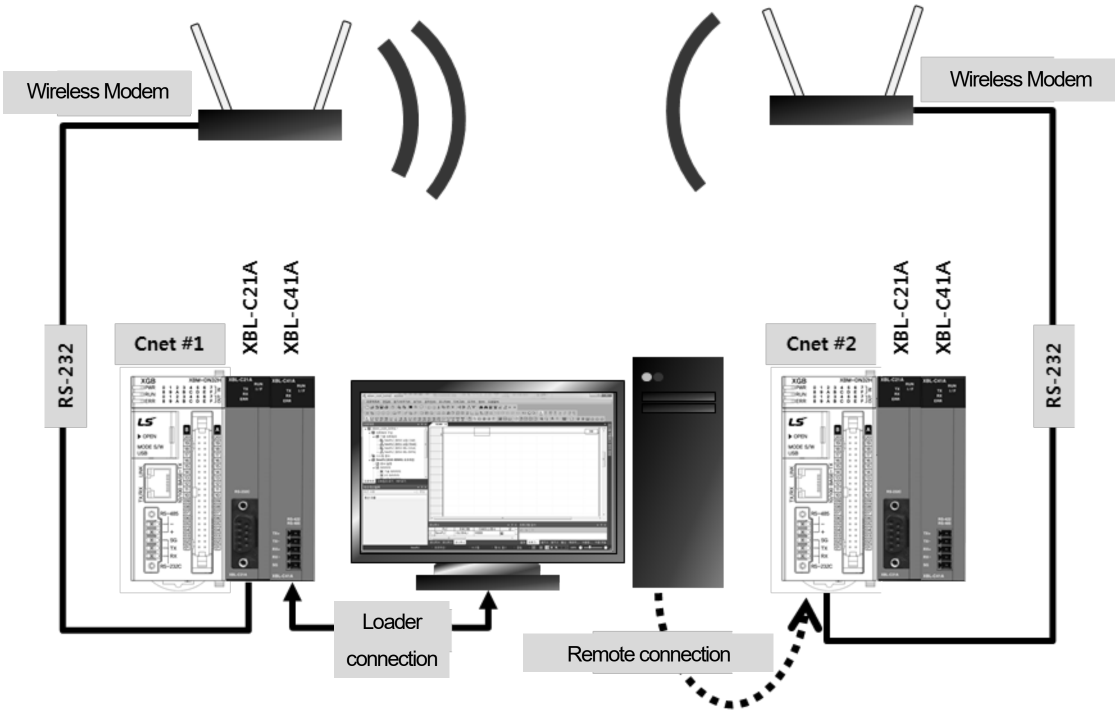
d) In this case, remote 1 connection is complete, it is same status with where it is connected by RS-232C cable. Here you can use all functions of online menu.

e) In case you want to disconnect remote connection, select disconnect at online menu. Disconnection menu box shows and remote connection is disconnected.

In case disconnection is done normally, Cnet I/F module and XG5000 are converted into initial mode. In case of reconnection, retry from a) for reconnection.

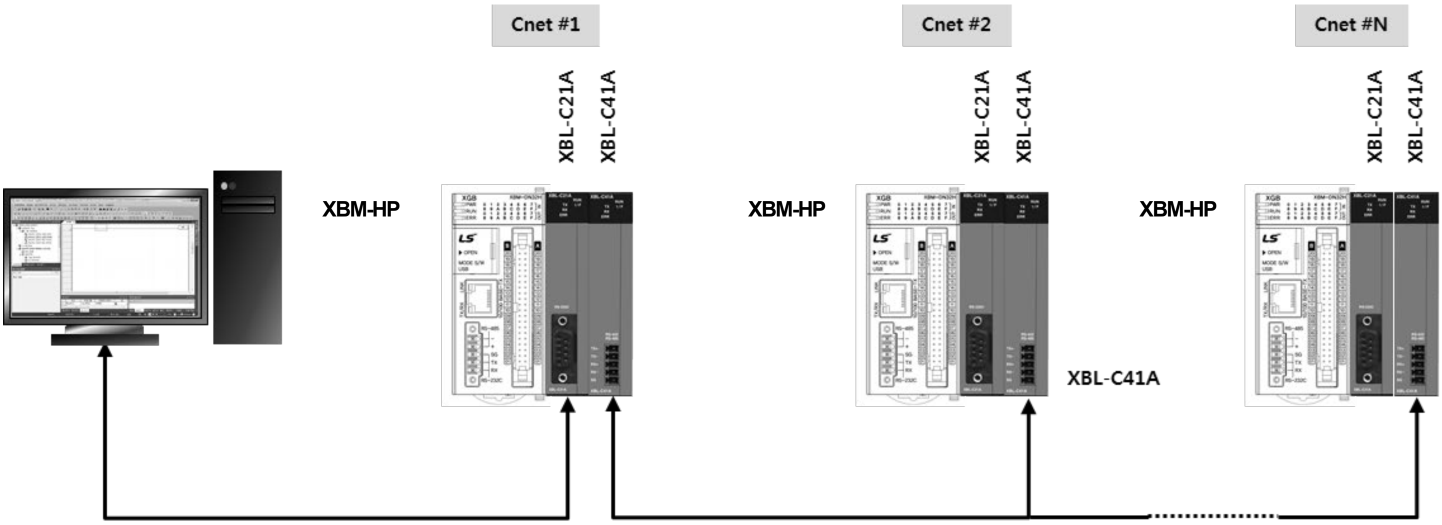
f) In case of optical modem, wireless modem other than dedicated modem, communication media is only different, method of remote connection is same.

g) Figure below indicates remote connection by wireless modem. As for connection method, it is same with method of remote connection between Cnet I/F module by using communication. In case of using wireless modem, 1:N remote connection where there are many Cnet I/F module is also available.



### 2) Remote connection by RS-422/485

Figure below indicates XG5000 and local PLC is connected into CPU module by RS-232C cable, in case RS-422/485 channel of Cnet I/F module connected at local PLC communicates, it is figure indicating remote connection example to remote PLC. Like figure, XG5000 can control program of remote PLC by remote connection through remote connection function between Cnet I/F modules.



[Remote connection in case of RS-422/485 communication]

**Note**

1) Basic parameter of remote server connected through XG5000 should be set as server, in case of remote client, it should be set P2P client.
2) If there is a large volume of communication, remote access may fail. Please ensure to make the local PLC to the STOP mode to halt communication before attempting remote connection.

# 2.6 Server Function and P2P service

## 2.6.1 Server Function

Dedicated service is built-in service in Cnet I/F module. Without specific program at PLC, you can read or write information and data from PC and other device. It acts as server at communication network and if read, write request conforming XGT dedicated protocol or Modbus protocol come, it responds.

### 1) XGT dedicated server

It is used in case of communication between our products by our dedicated service, all characters are configured as ASCII code. In case of using multi drop, up to 32 stations can be connected. In case of setting station number, duplicated station number should not be set. In case of using multi drop, communication speed/stop bit/parity bit/data bit of all Cnet I/F module in network should be same. For more detail protocol, refer to “chapter 2.7 XGT dedicated protocol”.

### 2) Modbus server

It is used in case partner device acts as Modbus client.

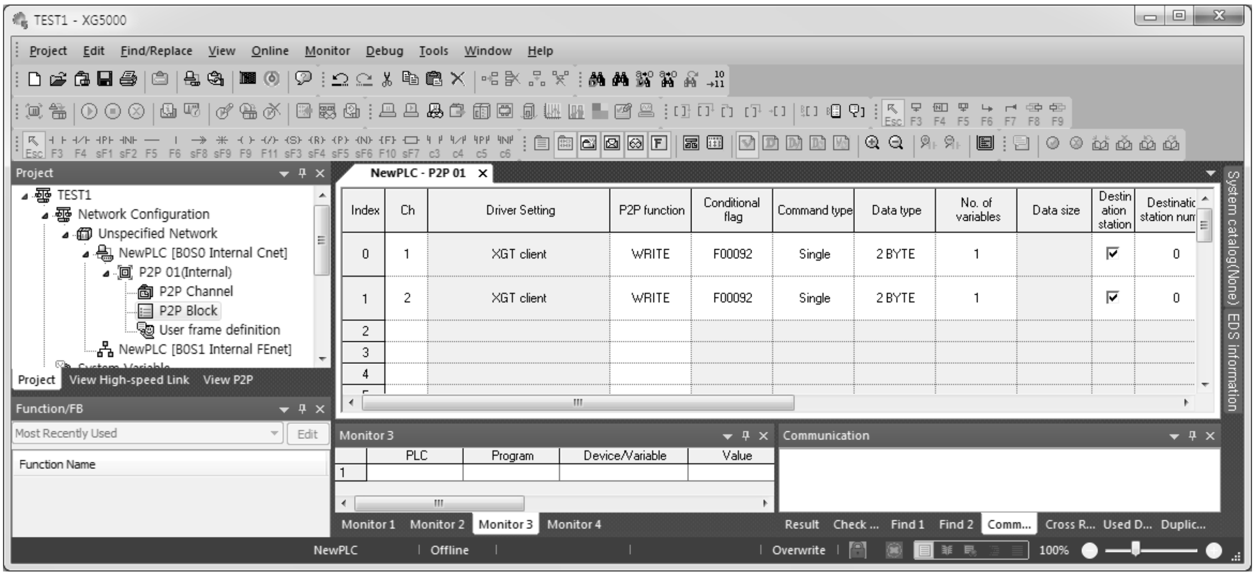
ASCII mode and RTU mode of Modbus are all supported. You can define in standard settings active mode. For more detail protocol, refer to “chapter 2.9 Modbus protocol”.

Modbus instruction and response data max. number which is supported by Modbus RTU/ASCII driver are as follows. Other client device should request in the range of the following table.

| Code | Purpose | Address | Max. no. of response data |
|---|---|---|---|
| 01 | Read Coil Status | 0XXXX | 2000 Coils |
| 02 | Read Input Status | 1XXXX | 2000 Coils |
| 03 | Read Holding Registers | 4XXXX | 125 Registers |
| 04 | Read Input Registers | 3XXXX | 125 Registers |
| 05 | Force Single Coil | 0XXXX | 1 Coil |
| 06 | Preset Single Register | 4XXXX | 1 Register |
| 15 | Force Multiple Coils | 0XXXX | 1968 Coils |
| 16 | Preset Multiple Registers | 4XXXX | 120 registers |

## 2.6.2 P2P Service

P2P service means acting client operation of communication module. P2P instructions available at Cnet I/F module are 4 (Read/Write/Send/Receive).
Registration and edit of P2P service is executed in XG5000, each P2P parameter consists of max. 32 P2P block.
The following figure is example of P2P parameter setting window of XG5000.



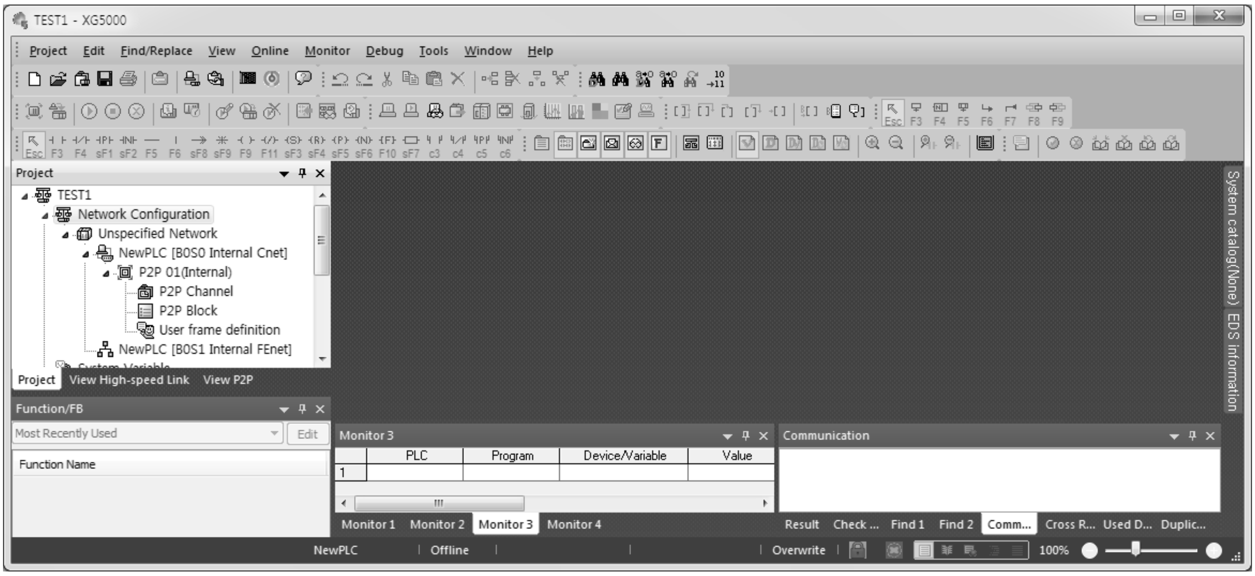
| Index | Ch | Driver Setting | P2P function | Conditional flag | Command type | Data type | No. of variables | Data size | Destination station | Destinatic station num |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | XGT client | WRITE | F00092 | Single | 2 BYTE | 1 |  | ☑ | 0 |
| 1 | 2 | XGT client | WRITE | F00092 | Single | 2 BYTE | 1 |  | ☑ | 0 |
| 2 |  |  |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |  |  |  |

**Note**

P2P 01 is fixed allocated at built-in Cnet, and P2P 02 is fixed allocated at built-in FEnet. Therefore, it will operate normally with appropriate slot number.

### 1) P2P parameter configuration

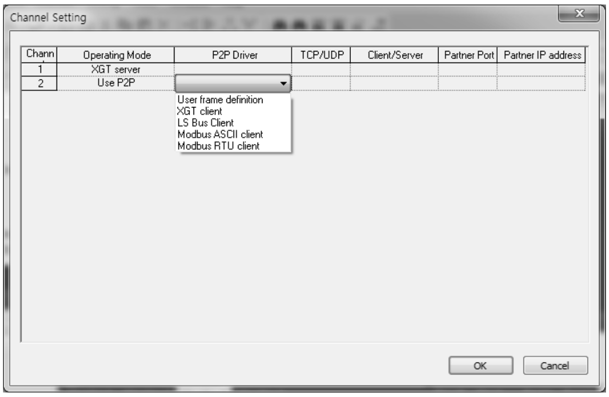
To use P2P service, the user executes the setting for the wanted operation at the P2P parameter window. Like the following figure, P2P parameter consists of three informations.



| Types | Descriptions | Remark |
|---|---|---|
| P2P channel | - P2P channel setting defining communication protocol of P2P service to execute<br>- XGT/Modbus available<br>- Each channel is independent. It is applied when active mode is "Use P2P settings" | |
| P2P Block | Setting P2P block of 32 acting independently | |
| User frame definition | User frame definition registration | |

### 2) Channel Setting

Built-in Cnet I/F function provides two fixed communication channel as fixed P2P 1.
Cnet I/F module are allocated P2P 2 and P2P 3 according to equipment sequence and communication channel supports only one channel. At Built-in Cnet I/F, you can define driver type for P2P service about each.
If you select P2P channel at P2P setting window, like the following, P2P channel setting window shows. If you select P2P driver to use, setting is complete.



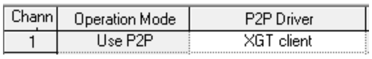
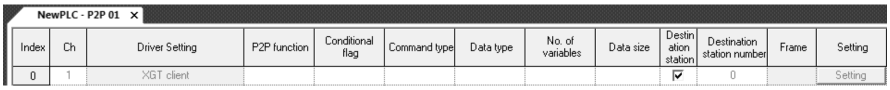
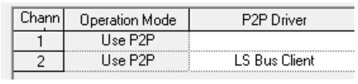
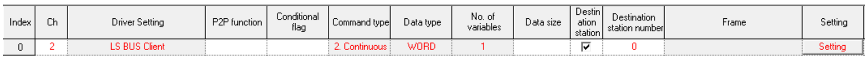
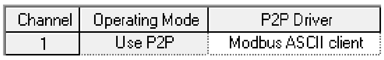
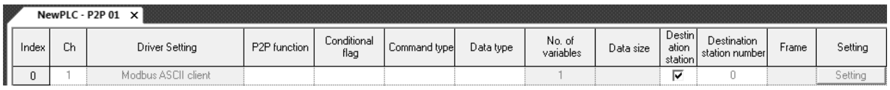
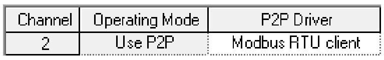
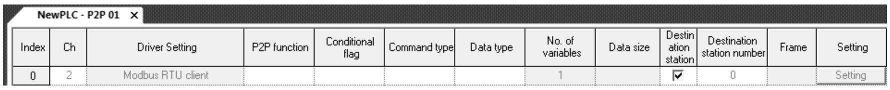
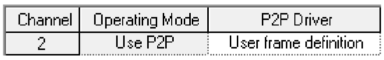
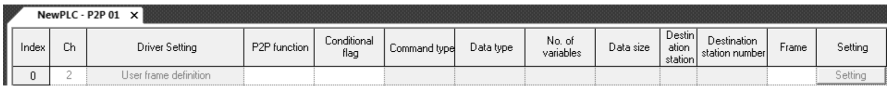
| Chann | Operating Mode | P2P Driver | TCP/UDP | Client/Server | Partner Port | Partner IP address |
|---|---|---|---|---|---|---|
| 1 | XGT server | | | | | |
| 2 | Use P2P | | | | | |

| Driver | Meaning |
|---|---|
| None | Not using P2P service |
| User frame definition | In case of transmitting/receiving user frame definition |
| XGT client | Select in case of executing read, write of XGT memory. |
| Modbus ASCII client | Select in case of acting as Modbus client, using ASCII mode |
| Modbus RTU client | Select in case of acting as Modbus client, using RTU mode. |

About communication channel, in case of selecting P2P driver as XGT or Modbus, user frame definition cannot be used.

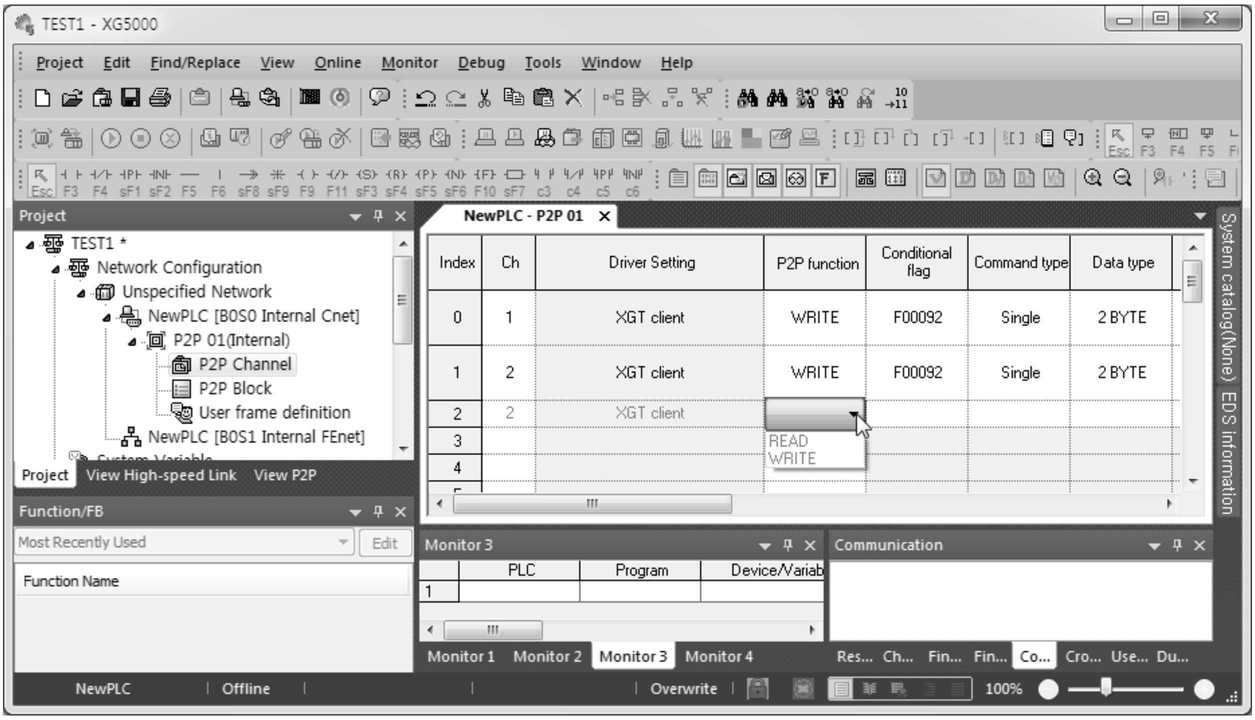
### 3) Block information

If you select P2P block of each parameter at P2P parameter setting window, P2P block setting window shows. Setting value of P2P block will be displayed differently as user sets the P2P Driver of channel.

<table>
<tr><th>P2P Channel</th><th>P2P Block Setting</th></tr>
<tr><td>
<table><tr><th>Chann</th><th>Operation Mode</th><th>P2P Driver</th></tr><tr><td>1</td><td>Use P2P</td><td>XGT client</td></tr></table></td>
<td>
NewPLC - P2P 01
<table><tr><th>Index</th><th>Ch</th><th>Driver Setting</th><th>P2P function</th><th>Conditional flag</th><th>Command type</th><th>Data type</th><th>No. of variables</th><th>Data size</th><th>Destination station</th><th>Destination station number</th><th>Frame</th><th>Setting</th></tr><tr><td>0</td><td>1</td><td>XGT client</td><td></td><td></td><td></td><td></td><td></td><td></td><td>☑</td><td>0</td><td></td><td>Setting</td></tr></table></td></tr>
<tr><td>
<table><tr><th>Chann</th><th>Operation Mode</th><th>P2P Driver</th></tr><tr><td>1</td><td>Use P2P</td><td></td></tr><tr><td>2</td><td>Use P2P</td><td>LS Bus Client</td></tr></table></td>
<td>
<table><tr><th>Index</th><th>Ch</th><th>Driver Setting</th><th>P2P function</th><th>Conditional flag</th><th>Command type</th><th>Data type</th><th>No. of variables</th><th>Data size</th><th>Destination station</th><th>Destination station number</th><th>Frame</th><th>Setting</th></tr><tr><td>0</td><td>2</td><td>LS BUS Client</td><td></td><td></td><td>2. Continuous</td><td>WORD</td><td>1</td><td></td><td>☑</td><td>0</td><td></td><td>Setting</td></tr></table></td></tr>
<tr><td>
<table><tr><th>Channel</th><th>Operating Mode</th><th>P2P Driver</th></tr><tr><td>1</td><td>Use P2P</td><td>Modbus ASCII client</td></tr></table></td>
<td>
NewPLC - P2P 01
<table><tr><th>Index</th><th>Ch</th><th>Driver Setting</th><th>P2P function</th><th>Conditional flag</th><th>Command type</th><th>Data type</th><th>No. of variables</th><th>Data size</th><th>Destination station</th><th>Destination station number</th><th>Frame</th><th>Setting</th></tr><tr><td>0</td><td>1</td><td>Modbus ASCII client</td><td></td><td></td><td></td><td></td><td>1</td><td></td><td>☑</td><td>0</td><td></td><td>Setting</td></tr></table></td></tr>
<tr><td>
<table><tr><th>Channel</th><th>Operating Mode</th><th>P2P Driver</th></tr><tr><td>2</td><td>Use P2P</td><td>Modbus RTU client</td></tr></table></td>
<td>
NewPLC - P2P 01
<table><tr><th>Index</th><th>Ch</th><th>Driver Setting</th><th>P2P function</th><th>Conditional flag</th><th>Command type</th><th>Data type</th><th>No. of variables</th><th>Data size</th><th>Destination station</th><th>Destination station number</th><th>Frame</th><th>Setting</th></tr><tr><td>0</td><td>2</td><td>Modbus RTU client</td><td></td><td></td><td></td><td></td><td>1</td><td></td><td>☑</td><td>0</td><td></td><td>Setting</td></tr></table></td></tr>
<tr><td>
<table><tr><th>Channel</th><th>Operating Mode</th><th>P2P Driver</th></tr><tr><td>2</td><td>Use P2P</td><td>User frame definition</td></tr></table></td>
<td>
NewPLC - P2P 01
<table><tr><th>Index</th><th>Ch</th><th>Driver Setting</th><th>P2P function</th><th>Conditional flag</th><th>Command type</th><th>Data type</th><th>No. of variables</th><th>Data size</th><th>Destination station</th><th>Destination station number</th><th>Frame</th><th>Setting</th></tr><tr><td>0</td><td>2</td><td>User frame definition</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Setting</td></tr></table></td></tr>
</table>

[ P2P block setting screen ]

You can set up to 32 independent blocks. If you select temporary block, you can designate each block operation by selecting instruction.



| Index | Ch | Driver Setting | P2P function | Conditional flag | Command type | Data type |
|---|---|---|---|---|---|---|
| 0 | 1 | XGT client | WRITE | F00092 | Single | 2 BYTE |
| 1 | 2 | XGT client | WRITE | F00092 | Single | 2 BYTE |
| 2 | 2 | XGT client | | | | |
| 3 | | | | | | |
| 4 | | | | | | |

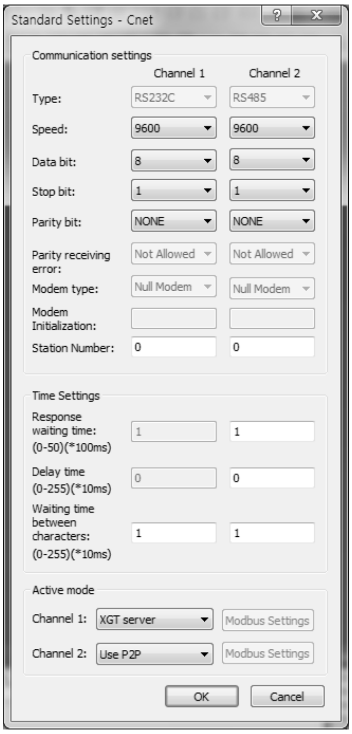
[ P2P instruction screen ]

## 2.6.3 XGT Client Service

When using the XGT protocol, XGT client requests writing/reading the data. XGT server analyzes the received data. In case of normal frame, XGT server deals with the received data with ACK response and in case of abnormal frame, XGT transmits the NAK response including error code to XGT client.

1) Channel setting

Cnet I/F module is available to define driver type for P2P service about each channel. However, active mode in the standard settings should be set as "Use P2P settings". P2P setting according to active mode is as follows.



Standard Settings - Cnet

Communication settings

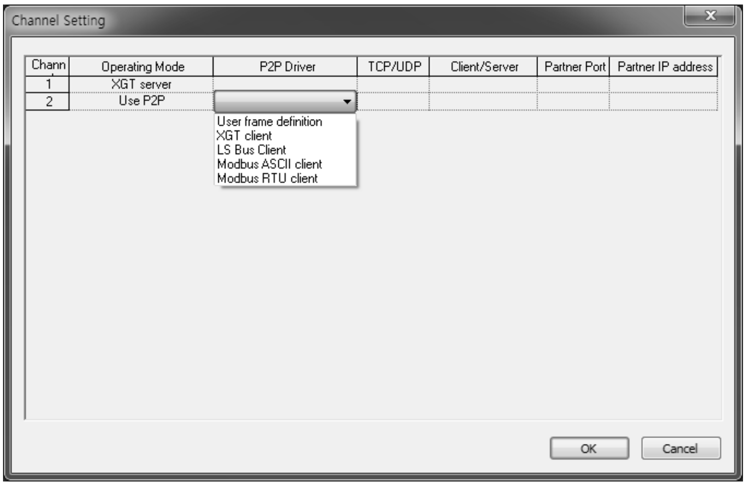
| | Channel 1 | Channel 2 |
|---|---|---|
| Type: | RS232C | RS485 |
| Speed: | 9600 | 9600 |
| Data bit: | 8 | 8 |
| Stop bit: | 1 | 1 |
| Parity bit: | NONE | NONE |
| Parity receiving error: | Not Allowed | Not Allowed |
| Modem type: | Null Modem | Null Modem |
| Modem Initialization: | | |
| Station Number: | 0 | 0 |

Time Settings

| | | |
|---|---|---|
| Response waiting time: (0-50)(*100ms) | 1 | 1 |
| Delay time (0-255)(*10ms) | 0 | 0 |
| Waiting time between characters: (0-255)(*10ms) | 1 | 1 |

Active mode

Channel 1: XGT server
Channel 2: Use P2P



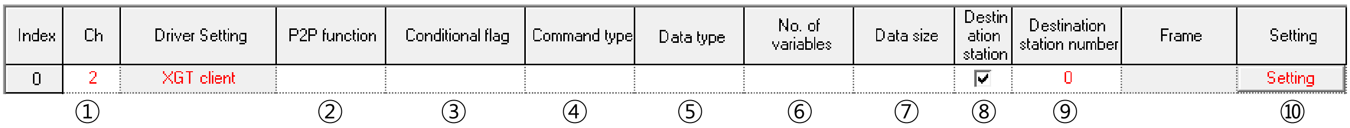
Channel Setting

| Chann | Operating Mode | P2P Driver | TCP/UDP | Client/Server | Partner Port | Partner IP address |
|---|---|---|---|---|---|---|
| 1 | XGT server | | | | | |
| 2 | Use P2P | | | | | |

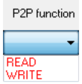
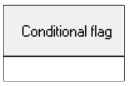
2) P2P block setting

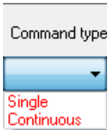
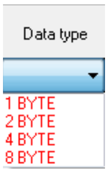
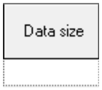
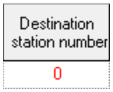
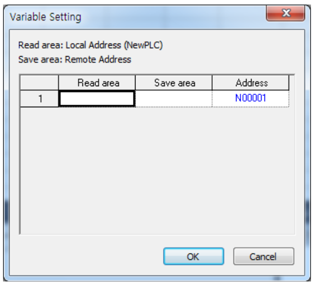
If selecting P2P block in the P2P parameter setting window, P2P block setting window shows.

Block setting window is same according to protocol and activated area is different P2P. Each of items means as follow.



| Index | Ch | Driver Setting | P2P function | Conditional flag | Command type | Data type | No. of variables | Data size | Destination station | Destination station number | Frame | Setting |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2 | XGT client | | | | | | | ☑ | 0 | | Setting |

| No. | Type | Block form | Contents |
|---|---|---|---|
| 1 | Channel | <br>Ch<br>2<br>1<br>2 | Driver name changes according to driver set in the P2P Driver. |
| 2 | P2P function | <br>P2P function<br>READ<br>WRITE | 1. Read : when reading the destination station's memory<br>2. Write: when writing self-station's memory to destination station's memory. |
| 3 | Conditional flag | <br>Conditional flag | 1. Determines when Cnet sends request frame<br>2. In case of XBC type Ex. : F90(20ms flag), M01<br>3. In case of XEC type Ex. : _T20MS(20ms flag), %MX01 |

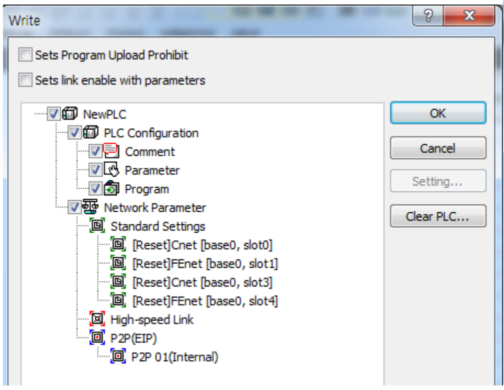
| No. | Type | Block form | Contents |
|---|---|---|---|
| 4 | Command type |  | 1. Single: When reading/writing max. 4 memory areas.<br>(Ex. : M01, M10, M20, M30)<br>2. Continuous: When reading/writing continuous memory areas.<br>(Ex. : M01~M10) |
| 5 | Data type |  | 1. In case that command type is single:<br>bit, 1 byte, 2byte, 4 byte, 8 byte available<br>2. In case that command type is continuous:<br>1 byte, 2byte, 4 byte, 8 byte |
| 6 | No. of variable |  | 1. This is activated when command type is single and available max. no. is 4.<br>2. When command type is continuous, it is fixed as 1. |
| 7 | Data size |  | 1. This is activated when command type is continuous.<br>2. When data type is 1 byte, available max. no. is 120 byte |
| 8 | Destination station |  | 1. Check: Specify the destination station<br>2. Uncheck: In case of using P2PSN command, communicate with previously designated (P2PSN)destination station |
| 9 | Destination station number |  | 1. Destination station number, setting range is 0~63. |
| 10 | Setting |  <br>Read area: Local Address (NewPLC)<br>Save area: Remote Address<br>Read area \| Save area \| Address<br>1 \| \| \| N00001 | 1. When P2P function is Read<br>1)Read area : device area of server<br>2)Save area : client's device to save the data from server<br>2. When P2P function is Write<br>1)Read area : device area of client<br>2)Save area : Server's device area to save client's data |

### 3) Writing parameter

After P2P block setting is completed, download setting parameter to CPU.

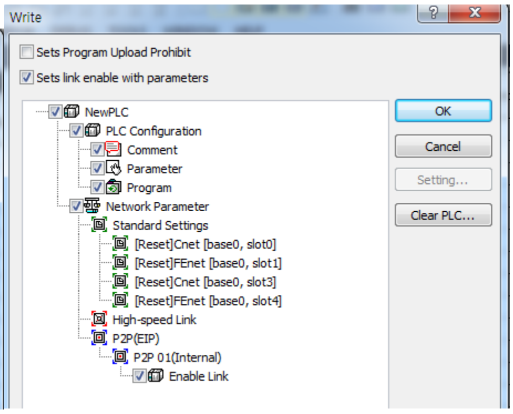
Select [Online] – [Connect] – [Write], and click OK in parameter download window, and then it will be downloaded.

After download, the parameter is applied immediately. If you check ‘Set up with Link Enable’, Link Enable can be applied with writing P2P/HS parameters at the same time.



☐ Sets Program Upload Prohibit
☐ Sets link enable with parameters

[Not checking link enable]

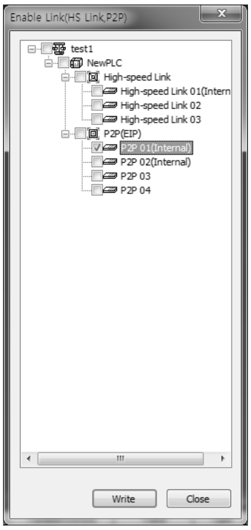


☐ Sets Program Upload Prohibit
☑ Sets link enable with parameters

[Check link enable]

### 4) Enabling link

After setting P2P parameter and downloading the parameter to PLC CPU, enable P2P service. If parameter is downloaded but P2P(EIP) is not enabled, the P2P block is not operated. In order to enable P2P(EIP), Select [Online] – [Communication module setting] – [Enable Link], and click P2P(EIP) number which you want to operate and then click Wirte button. The P2P(EIP) is enabled.



### 5) Diagnosis service

In order to check the setting parameter operates normally, diagnosis service is available.

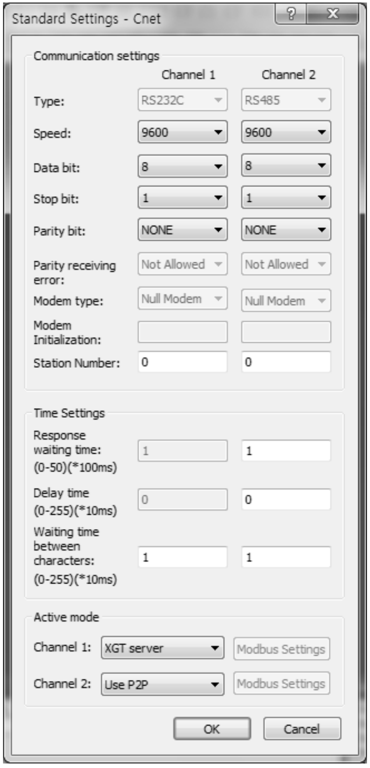
Select [Online] – [Communication module setting] – [System Diagnosis]. Click the module and then click mouse right-button. If you select Frame Monitor or Status by Service, it can be checked whether the communication is normal or not. For more detail, refer to chapter 2.9 Diagnosis Function.

## 2.6.4 Modbus Client Service

Modbus protocol is specified open protocol used between client-server, which executes reading/writing data according to function code. Communication between devices that use Modbus protocol uses Client-server function in which only one client processes the data.

### 1) Channel setting

Cnet I/F module is available to define driver type for P2P service about each channel. However, active mode in the standard settings should be set as “Use P2P settings”.



Standard Settings - Cnet

Communication settings

| | Channel 1 | Channel 2 |
|---|---|---|
| Type: | RS232C | RS485 |
| Speed: | 9600 | 9600 |
| Data bit: | 8 | 8 |
| Stop bit: | 1 | 1 |
| Parity bit: | NONE | NONE |
| Parity receiving error: | Not Allowed | Not Allowed |
| Modem type: | Null Modem | Null Modem |
| Modem Initialization: | | |
| Station Number: | 0 | 0 |

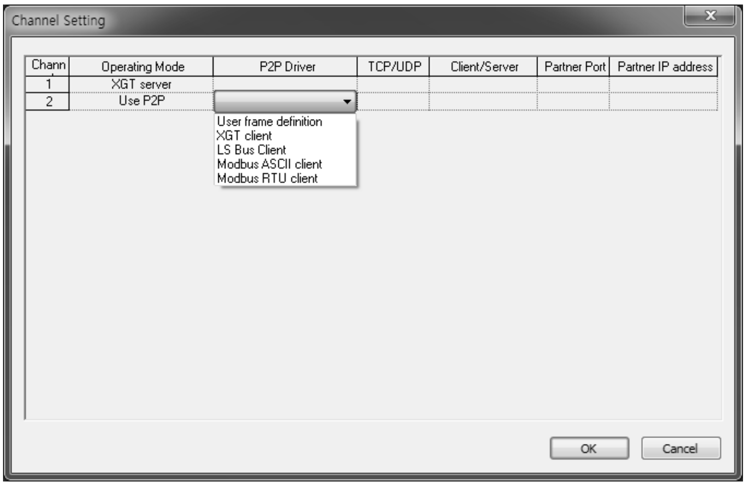
Time Settings

| | | |
|---|---|---|
| Response waiting time: (0-50)(*100ms) | 1 | 1 |
| Delay time (0-255)(*10ms) | 0 | 0 |
| Waiting time between characters: (0-255)(*10ms) | 1 | 1 |

Active mode

Channel 1: XGT server

Channel 2: Use P2P

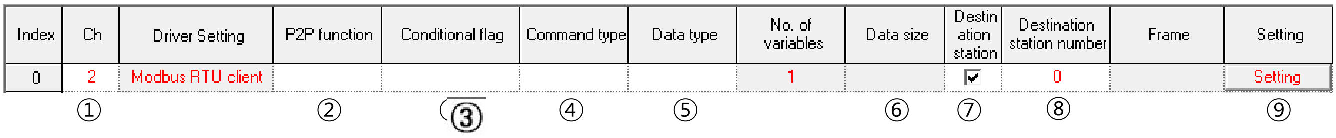


Channel Setting

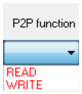
| Chann | Operating Mode | P2P Driver | TCP/UDP | Client/Server | Partner Port | Partner IP address |
|---|---|---|---|---|---|---|
| 1 | XGT server | | | | | |
| 2 | Use P2P | | | | | |

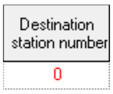
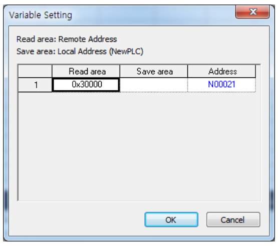
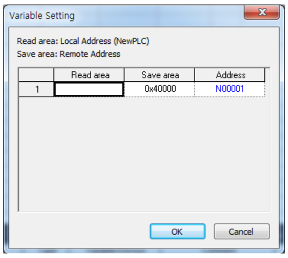
### 2) P2P block setting

There are two commands; Write (writes memory of self station to destination station’s memory area) and Read (reads memory of destination memory and saves it in the memory area of self station)
Setting methods of both RTU and ASCII clients are same.



| Index | Ch | Driver Setting | P2P function | Conditional flag | Command type | Data type | No. of variables | Data size | Destination station | Destination station number | Frame | Setting |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2 | Modbus RTU client | | | | | 1 | | ☑ | 0 | | Setting |

| No. | Type | Block type | Meaning |
|---|---|---|---|
| 1 | Channel |  Ch<br>2<br>1<br>2 | Driver name changes according to driver set in the P2P Driver. |
| 2 | P2P function |  P2P function<br>READ<br>WRITE | 1. Read : when reading the destination station’s memory<br>2. Write: when writing self-station’s memory to destination station’s memory. |

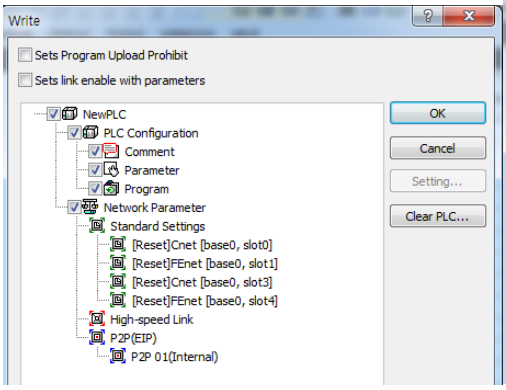
| No. | Type | Block type | Meaning |
|---|---|---|---|
| 3 | Conditional flag | <br>Conditional flag | 1. Determines when Cent sends frame<br>2. In case of XBC type Ex. : F90(20ms flag), M01<br>3. In case of XEC type Ex. : _T20MS(20ms flag), %MX01 |
| 4 | Command type | <br>Command type<br>Single<br>Continuous | 1. single: When reading/writing max. 4 memory areas.<br>(Ex. : M01, M10, M20, M30)<br>2. continuous: When reading/writing continuous memory areas.<br>(Ex. : M01~M10) |
| 5 | Data type | <br>Data type<br>BIT<br>WORD | Data type can be bit or word. |
| 6 | Data size | <br>Data size | ▷ Determines size of data to communicate and it is activated when command type is continuous.<br>1. when P2P function is Read<br>1) Modbus RTU client<br>(1)Bit type : 1~2000<br>(2)Word type : 1~125<br>2) Modbus ASCII client<br>(1)Bit type : 1~976<br>(2)Word type : 1~61<br>2. when P2P function is Write<br>1) Modbus RTU client<br>(1)Bit type : 1~1968<br>(2)Word type : 1~123<br>2) Modbus ASCII client<br>(1)Bit type : 1~944<br>(2)Word type : 1~125 |
| 7 | Destination station | <br>Destination station<br>☑ | 1. It is checked automatically.<br>2. In case that the user doesn't want to use relevant block, remove the check indication. Then that block doesn't work. |
| 8 | Destination station number | <br>Destination station number<br>0 | 1. Destination station number, setting range is 0~31. |
| 9 | Setting | <br>Variable Setting<br>Read area: Remote Address<br>Save area: Local Address (NewPLC)<br>Read area / Save area / Address<br>1 0x30000 N00021<br>OK Cancel | ▶ When P2P function is Read<br>1. Read area: device area of server<br>1) Bit: bit input (0x10000), bit output (0x00000)<br>2) Word: word input (0x30000), word output (0x40000)<br>2. Save area: client's device to save the data |
| | | <br>Variable Setting<br>Read area: Local Address (NewPLC)<br>Save area: Remote Address<br>Read area / Save area / Address<br>1 0x40000 N00001<br>OK Cancel | ▶ When P2P function is Write<br>1. Read area: device area of self station<br>2. Save area: server's device area to save the data<br>1) Bit: bit input (0x10000), bit output (0x00000)<br>2) Word: word input (0x30000), word output (0x40000) |

### 3) Writing parameter

After P2P block setting is completed, download setting parameter to CPU.

Select [Online] – [Connect] – [Write], and click OK in parameter download window, and then it will be downloaded.

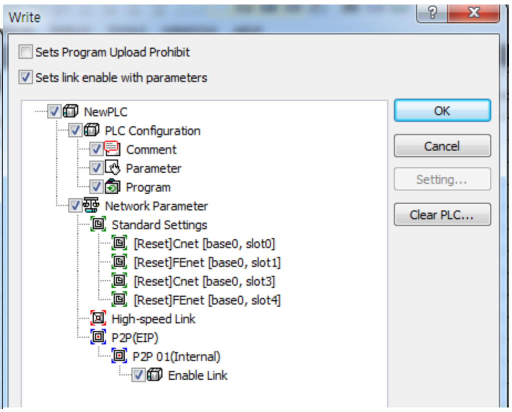
After download, the parameter is applied immediately. If you check ‘Set up with Link Enable’, Link Enable can be applied with writing P2P/HS parameters at the same time.



☐ Sets Program Upload Prohibit
☐ Sets link enable with parameters

- ☑ NewPLC
  - ☑ PLC Configuration
    - ☑ Comment
    - ☑ Parameter
    - ☑ Program
  - ☑ Network Parameter
    - Standard Settings
      - [Reset]Cnet [base0, slot0]
      - [Reset]FEnet [base0, slot1]
      - [Reset]Cnet [base0, slot3]
      - [Reset]FEnet [base0, slot4]
    - High-speed Link
    - P2P(EIP)
      - P2P 01(Internal)

[Not checking link enable]



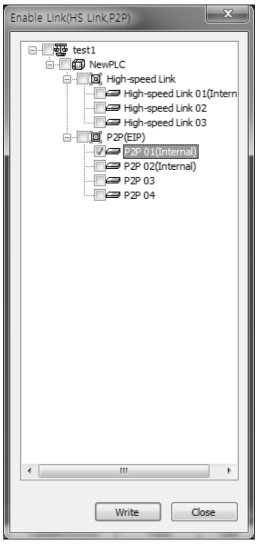
☐ Sets Program Upload Prohibit
☑ Sets link enable with parameters

- ☑ NewPLC
  - ☑ PLC Configuration
    - ☑ Comment
    - ☑ Parameter
    - ☑ Program
  - ☑ Network Parameter
    - Standard Settings
      - [Reset]Cnet [base0, slot0]
      - [Reset]FEnet [base0, slot1]
      - [Reset]Cnet [base0, slot3]
      - [Reset]FEnet [base0, slot4]
    - High-speed Link
    - P2P(EIP)
      - P2P 01(Internal)
        - ☑ Enable Link

[Check link enable]

### 4) Enabling link

After setting P2P parameter and downloading the parameter to PLC CPU, enable P2P service. If parameter is downloaded but P2P(EIP) is not enabled, the P2P block is not operated. In order to enable P2P(EIP), Select [Online] – [Communication module setting] – [Enable Link], and click P2P(EIP) number which you want to operate and then click Wirte button. The P2P(EIP) is enabled.



- ☐ test1
  - ☐ NewPLC
    - ☐ High-speed Link
      - ☐ High-speed Link 01(Intern
      - ☐ High-speed Link 02
      - ☐ High-speed Link 03
    - ☐ P2P(EIP)
      - ☑ P2P 01(Internal)
      - ☐ P2P 02(Internal)
      - ☐ P2P 03
      - ☐ P2P 04

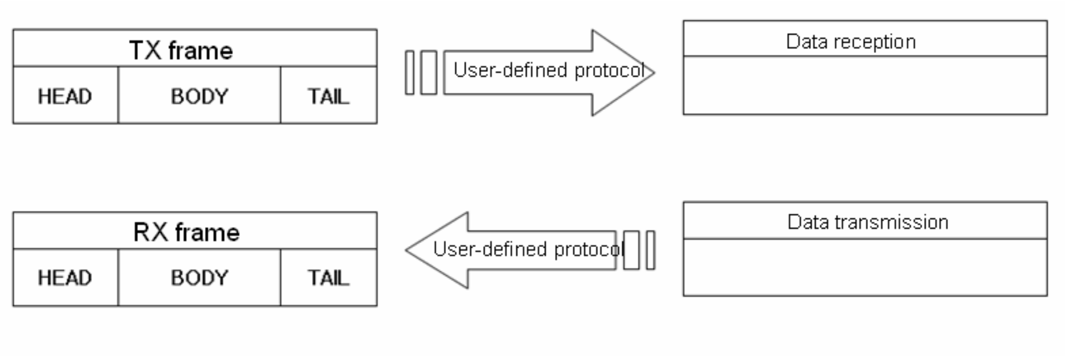
### 5) Diagnosis service

In order to check the setting parameter operates normally, diagnosis service is available.

Select [Online] – [Communication module setting] – [System Diagnosis]. Click the module and then click mouse right-button. If you select Frame Monitor or Status by Service, it can be checked whether the communication is normal or not. For more detail, refer to chapter 2.9 Diagnosis Function.

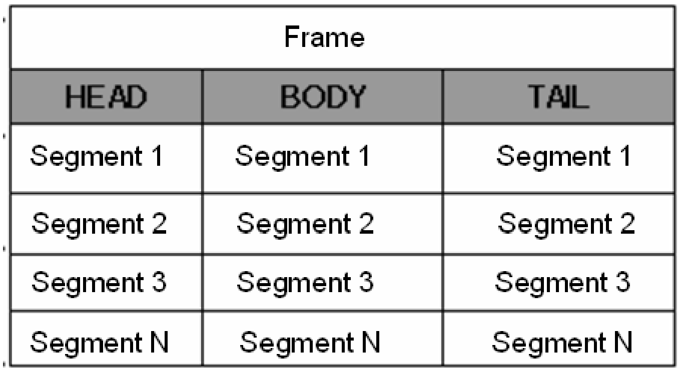
## 2.6.5 User-defined Communication Service

There are many protocols according to producer of communication device and it is impossible to supports diverse protocols. So if the user defines protocols and writes program, Cnet I/F module allows the communication between different devices according to defined protocol. In order to communicate with device which doesn't use specific protocols (XGT protocol, Modbus protocol), the user can directly define protocol used in the device the user want to communicate and communicate. At this time, the user should define TX and RX frame so that it meets partner device's protocol.



### 1) Structure of user-defined frame

When writing frame by user definition frame, frame is divided into HEAD, TAIL and BODY generally and each HEAD, TAIL and BODY is divided into segment. Total size of one frame should be less than 1024 byte.



| Frame | | |
|---|---|---|
| HEAD | BODY | TAIL |
| Segment 1 | Segment 1 | Segment 1 |
| Segment 2 | Segment 2 | Segment 2 |
| Segment 3 | Segment 3 | Segment 3 |
| Segment N | Segment N | Segment N |

(1) Structure of HEAD

Input type of segment for HEAD is divided into numerical constant and string constant.
In case of numerical constant, it means HEX value and in case of string constant, it means ASCII value.

(2) Structure of TAIL

Input type of segment for HEAD is divided into numerical constant, string constant and BCC which check frame error. Meaning of numerical constant and string constant is same with HEAD's. BCC is segment used for checking TRX frame error, only one can be set in the TAIL.

a) BCC error check

When BCC is applied, calculation about TRX frame is executed and if calculation is different, relevant frame is ignored to improve the reliability of communication. Calculation methods about each BCC are as follows.

| Classification | BCC method | Contents description |
|---|---|---|
| General method checking error | Byte SUM | Adds designated data as I byte unit and uses lower byte value |
| | Word SUM | Adds designated data as 1 word unit and uses lower word value |
| | Byte XOR | Executes Exclusive OR calculation about designated data as 1 byte unit and uses lower byte |
| | 7bit SUM | Uses result value of byte sum except the most significant bit |
| | 7bit XOR | Uses result value of byte XOR except the most significant bit |
| | 7bit SUM#1 | If result of 7 bit SUM is less than $20_{H,}$ it adds $20_{H.}$ |
| | Byte SUM 2'S COMP | Takes 2's complement about byte sum result |
| | Byte SUM 1'S COMP | Takes 1's complement about byte sum result |
| | CRC 16 | 16 bit error detection method |
| | CRC 16 IBM | 16 bit IBM CRC error detection method |
| | CRC 16 CCITT | 16 bit CCITT CRC error detection method |
| | MODBUS LRC | MODBUS LRC error detection method |
| Method checking error for dedicated communication | LS CRC | Error detection method used for LS PLC |
| | DLE AB | Error detection method used for DF1Protocol of Allen Bradley |
| | DLE SIEMENS | Error detection method used for Siemens 3964R communication |

When setting BCC, in case of general method, the user need not set BCC setting range and indication method and in case of dedicated method, the user should set BCC setting range and indication method.

| Item | | Contents |
|---|---|---|
| Start position | Start area | Determines where BCC calculation starts from among HEAD/BODY/TAIL |
| | Segment | Determines segment location to start BCC calculation in HEAD/BODY/TAIL. 0 means first segment will be included in the BCC calculation |
| End position | Before BCC | Included from start position to before BCC |
| | End of area | Included from start position to end of designated area |
| | Settings | Included from start position to designated area segment |
| ASCII conversion | | Converts result value, its size will be double |
| Initial value 0 | | Designates BCC initial value as 0. If there is no designation, initial value is $FF_{H.}$ |

(3) Structure of BODY

Input type of segment which composes BODY is different according to reception and transmission.
In case of transmission, they are divided into string constant, numerical constant and fix sized variable. Meaning of string constant and numerical constant is same with HEAD's.

a) Variable sized variable(in Rx frame)

Part where size and contents changes are defined as variable sized variable. Variable sized variable can be set in the BODY and after variable sized variable, the user can't add segment. When using variable sized variable, there should be one among HEAD, TAIL. If the user registers variable sized variable without HEAD, TAIL, when receiving frame, there may be error according to communication status. For reliability of communication, register one among HEAD, TAIL. (In case of Variable sized variable of TX frame, the size is designated in P2P Block setting, so the function and characteristic is same with Fix sized variable of RX frame.)

b) Fixed sized variable ( in Rx frame)

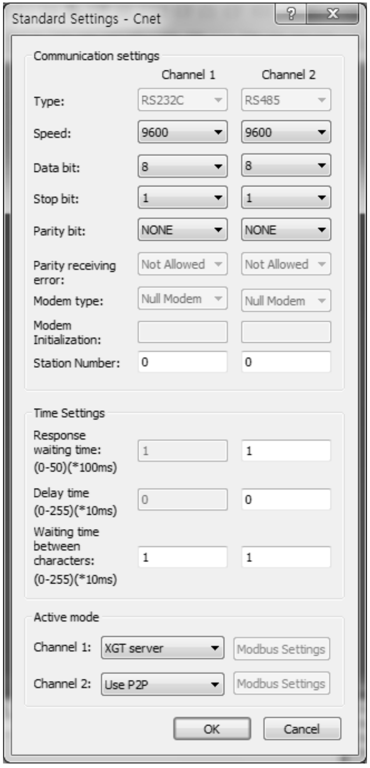
Frame part where size is fixed but contents changes are defined as Fix sized variable. It can be set in the BODY. In case of Fix sized variable, the user can register up to 4.

TRX frame standard for user - defined communication of XGB Cnet I/F module is as follows.

| Group | Frame | Segment | Reference |
|---|---|---|---|
| TX frame | HEAD | Numerical constant | Max. 10 byte |
| | | String constant | Max. 10 byte |
| | TAIL | Numerical constant | Max. 10 byte |
| | | String constant | Max. 10 byte |
| | | BCC | Only one BCC applicable |
| | BODY | Numerical constant | Max. 10 byte |
| | | String constant | Max. 10 byte |
| | | Variable sized variable | Available up to 4 |
| RX frame | HEAD | Numerical constant | Max. 10 byte |
| | | String constant | Max. 10 byte |
| | TAIL | Numerical constant | Max. 10 byte |
| | | String constant | Max. 10 byte |
| | | BCC | Only one BCC applicable |
| | BODY | Numerical constant | Max. 10 byte |
| | | String constant | Max. 10 byte |
| | | Fix sized variable | Available up to 4<br>Fix sized variable 3, variable sized variable 1 are available |
| | | Variable sized variable | Only one variable sized variable available<br>After variable sized variable, adding segment is impossible |

### 2) Channel setting

Cnet I/F module is available to define driver type for P2P service about each channel. However, active mode in the standard settings should be set as “Use P2P settings”.



Standard Settings - Cnet

Communication settings

| | Channel 1 | Channel 2 |
|---|---|---|
| Type: | RS232C | RS485 |
| Speed: | 9600 | 9600 |
| Data bit: | 8 | 8 |
| Stop bit: | 1 | 1 |
| Parity bit: | NONE | NONE |
| Parity receiving error: | Not Allowed | Not Allowed |
| Modem type: | Null Modem | Null Modem |
| Modem Initialization: | | |
| Station Number: | 0 | 0 |

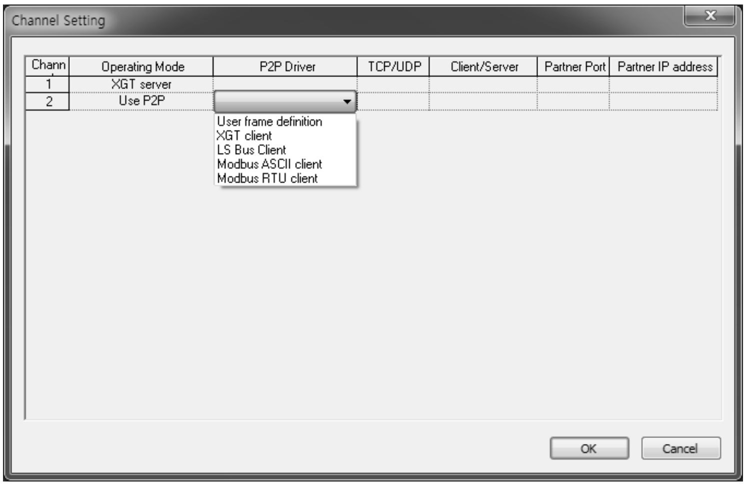
Time Settings

| | Channel 1 | Channel 2 |
|---|---|---|
| Response waiting time: (0-50)(*100ms) | 1 | 1 |
| Delay time (0-255)(*10ms) | 0 | 0 |
| Waiting time between characters: (0-255)(*10ms) | 1 | 1 |

Active mode

Channel 1: XGT server

Channel 2: Use P2P

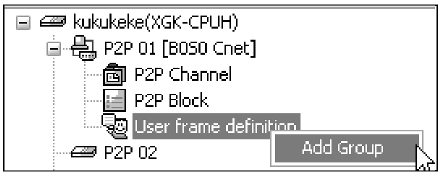
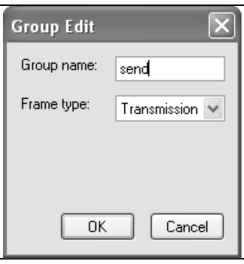


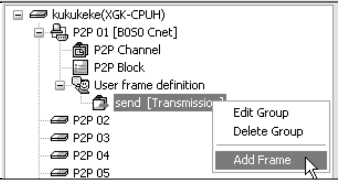
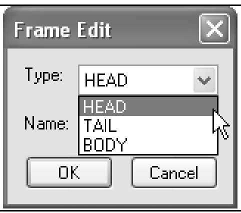
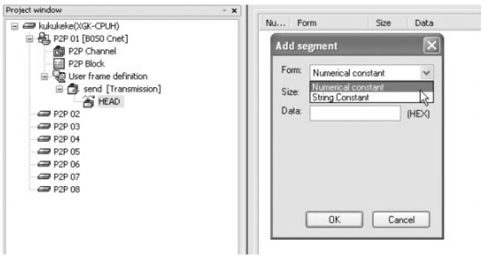
Channel Setting

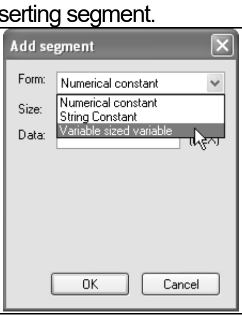
| Chann | Operating Mode | P2P Driver | TCP/UDP | Client/Server | Partner Port | Partner IP address |
|---|---|---|---|---|---|---|
| 1 | XGT server | | | | | |
| 2 | Use P2P | | | | | |

### 3) Set-up transmission frame

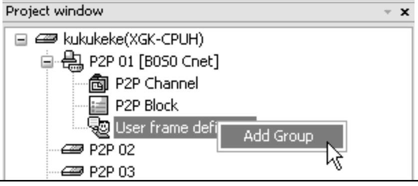
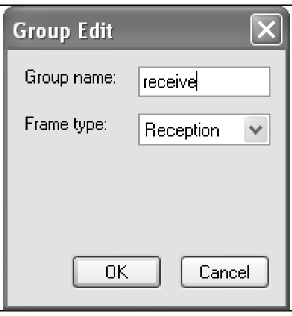
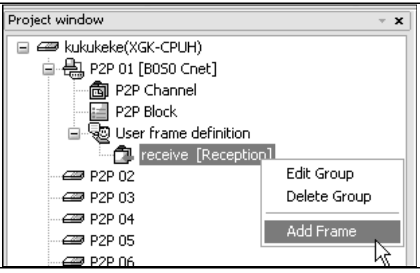
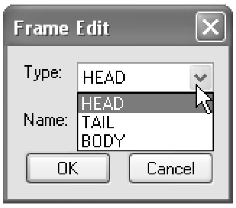
Frame is composed of HEAD indicating start, TAIL indicating end and BODY which is data area. How to write transmission frame is as follows.

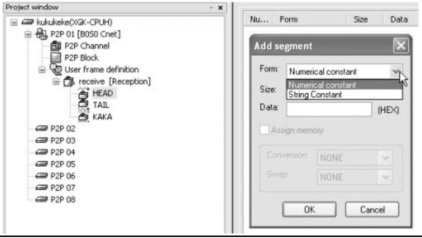
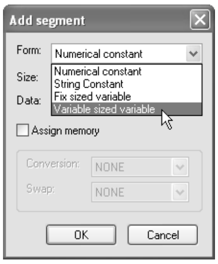
| Sequence | Setting contents | Setting method |
|---|---|---|
| 1 | Writing user frame definition | <br> |
| | 1. Select User frame definition.<br>2. Click right button of mouse and click Add Group | |
| 2 | Creating frame | <br>Group Edit<br>Group name: send<br>Frame type: Transmission<br> |
| | 1. Group name is name of frame for user to write.<br>2. Select Transmission as frame type. | |

<table>
<tr><th>Sequence</th><th>Setting contents</th><th>Setting method</th></tr>
<tr><td rowspan="2">3</td><td>Creating frame</td><td>
</td></tr>
<tr><td colspan="2">1. Check creation of frame.<br>2. Select frame name and click right button of mouse.<br>3. Click Add Frame to create HEAD, TAIL and BODY.<br>4. Group Edit: when changing frame name.<br>5. Delete Group: when deleting frame.</td></tr>
<tr><td rowspan="2">4</td><td>Creating HEAD, TAIL, BODY</td><td>
</td></tr>
<tr><td colspan="2">1. After clicking Add Frame, select type of frame.<br>2. type: HEAD,TAIL,BODY<br>3. Select HEAD.<br>4. To create TAIL, BODY, repeat step 3.<br>5. Name of frame edit window is activated when frame type is BODY.<br>6. Available to creating many BODYs with different name.</td></tr>
<tr><td rowspan="2">5</td><td>HEAD registration</td><td>
</td></tr>
<tr><td colspan="2">1. Double-click HEAD. Then edit window is created.<br>2. Double-click edit window or click right button and select Add segment.<br>3. Select Form.<br>  1) Numerical constant<br>    (1) Defines numerical constant among frame<br>    (2) Data value is always Hex (Hexadecimal)<br>  2) String constant<br>    (1) Registers string constant among frame<br>    (2) Data value is always ASCII<br>4. Input value into Data.<br>      Ex.) Form: Numerical constant<br>          Data: 5(ENQ)<br>* When clicking the right button on the created segment, edit, deletion, insertion, copy, etc. are available.</td></tr>
</table>

<table>
<tr><th>Sequence</th><th>Setting contents</th><th>Setting method</th></tr>
<tr><td>6</td><td>TAIL registration</td><td>1. If double-click TAIL, edit window shows.<br>2. Setting method is same with step 5.<br>3. Add BCC is activated after inserting segment.</td></tr>
<tr><td rowspan="2">7</td><td>BODY registration</td><td>
</td></tr>
<tr><td colspan="2">1. Double-click BODY and select data form.<br>1) Numerical constant and string constant are same as described above.<br>2) Variable sized variable<br>(1) used when frame length change<br>(2) available to insert up to 4 for one body<br>(3) ‘Assign memory’ is checked automatically<br>(4) Control by byte unit<br>3) Conversion<br>▶Hex To ASCII: converts the data red from PLC into ASCII and configures transmission frame<br>▶ASCII To Hex: converts the data red from PLC into Hex and configures transmission frame<br>4) Swap<br>▶2 Byte swap: 2 byte swap of data (ex.: 0x1234->0x3412)<br>▶4 Byte swap: 4 byte swap of data (ex.: 0x12345678->0x78564321)<br>▶8 Byte swap: 8 byte swap of data</td></tr>
</table>

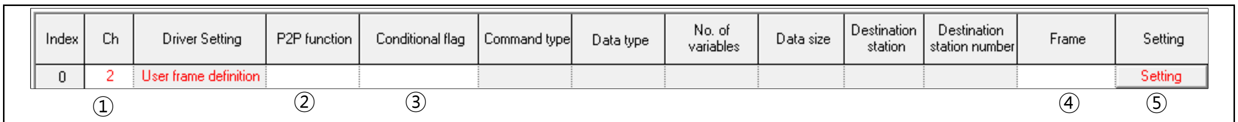
### 4) Set-up reception frame

| Sequence | Setting method | Setting method |
|---|---|---|
| 1 | Writing user-defined frame |  |
| | 1. Select User frame definition.<br>2. Click the right button of mouse and select Add Group. | |
| 2 | Creating frame |  Group name: receive<br>Frame type: Reception |
| | 1. Group name is name of frame for user to write.<br>2. Select Reception as frame type. | |
| 3 | Creating frame |  |
| | 1. Check creation of frame.<br>2. Select frame name and click right button of mouse.<br>3. Click Add Frame to create HEAD, TAIL and BODY.<br>4. Group Edit: when changing frame name.<br>5. Delete Group: when deleting frame. | |
| 4 | Creating HEAD, TAIL, BODY |  Type: HEAD |
| | 1. After clicking Add Frame, select type of frame.<br>2. type: HEAD, TAIL, BODY<br>3. Select HEAD.<br>4. To create TAIL, BODY, repeat step 3.<br>5. Name of frame edit window is activated when frame type is BODY.<br>6. Available to creating many BODYs with different name. | |

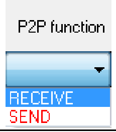
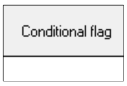
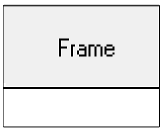
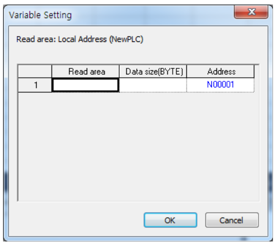
<table>
<tr><th>Sequence</th><th>Setting method</th><th>Setting method</th></tr>
<tr><td rowspan="2">5</td><td>HEAD registration</td><td>
</td></tr>
<tr><td colspan="2">1. Double-click HEAD. Then edit window is created.<br>2. Double-click edit window or click right button and select Add segment.<br>3. Select Form.<br>  1) Meaning of each form is same as described in the transmission.<br>4. Input value into Data.</td></tr>
<tr><td>6</td><td>TAIL registration</td><td>1. If double-click TAIL, edit window shows.<br>2. Setting method is same with step 5.<br>3. Add BCC is activated after inserting segment.</td></tr>
<tr><td rowspan="2">7</td><td>BODY registration</td><td>
</td></tr>
<tr><td colspan="2">1. Double-click BODY and select data form.<br>  1) Numerical constant and string constant are same as described above.<br>  2) Variable sized variable<br>    (1) used when frame length changes<br>    (2) Available to insert only one variable sized variable and it is impossible to add segment after variable sized variable<br>    (3) When checking [Assign memory], it is available to save in the PLC memory<br>    (4) Control by byte unit<br>  3) Fix sized variable<br>    (1) Used when frame size is fixed.<br>    (2) available to insert up to 4 for one body<br>    (3) When checking [Assign memory], it is available to save in the PLC memory<br>  4) Assign memory: when setting the device area of PLC to save data.<br>  5) Conversion<br>    ▶Hex To ASCII: converts the data received into ASCII and configures reception frame<br>    ▶ASCII To Hex: converts the data received into Hex and configures reception frame<br>  6) Swap<br>    ▶2 Byte swap: 2 byte swap of data (ex.: 0x1234->0x3412)<br>    ▶4 Byte swap: 4 byte swap of data (ex.: 0x12345678->0x78564321)<br>    ▶8 Byte swap: 8 byte swap of data</td></tr>
</table>

### 5) Setting parameter

To send and receive the user definition frame of XG5000, the user should set the parameter by P2P block. How to set the P2P block is as follows.



| Index | Ch | Driver Setting | P2P function | Conditional flag | Command type | Data type | No. of variables | Data size | Destination station | Destination station number | Frame | Setting |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2 | User frame definition | | | | | | | | | | Setting |

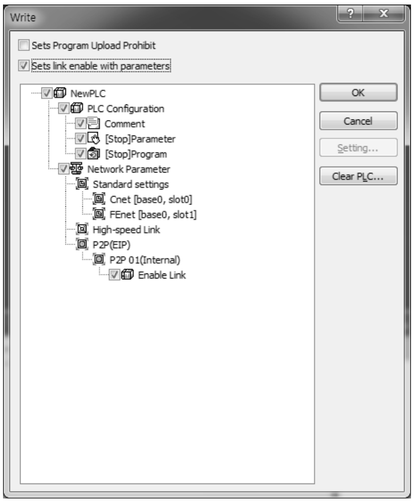
| No. | Type | Block type | Meaning |
|---|---|---|---|
| 1 | Channel |  | Driver name changes according to driver set in the P2P Driver. |
| 2 | P2P Function |  | 1. Receive: used when receiving the frame written according to partner's protocol<br>2. Send: used when sending the frame written according to partner's protocol |
| 3 | Conditional flag |  | 1. Determines when Cent sends frame<br>2. It is activated when P2P function is [Send].<br>3. In case of XBC type Ex.: F90(20ms flag), M01<br>4. In case of XEC type Ex.: _T20MS(20ms flag), %MX01 |
| 4 | Frame |  | 1. In case of selecting [SEND] in the P2P function, select body of transmission frame written in the user definition frame. |
| | | | 1. In case of selecting [RECEIVE] in the P2P function, select body of reception frame written in the user definition frame. |
| 5 | Setting |  | 1. Setting is available when [Assign memory] of Fix sized variable and variable sized variable is checked.<br>2. Save area: start address to save the data received from destination station. |

### 6) Writing parameter

After P2P block setting is completed, download setting parameter to CPU.

Select [Online] – [Connect] – [Write], and click OK in parameter download window, and then it will be downloaded.

After download, the parameter is applied immediately. If you check 'Set up with Link Enable', Link Enable can be applied with writing P2P/HS parameters at the same time.

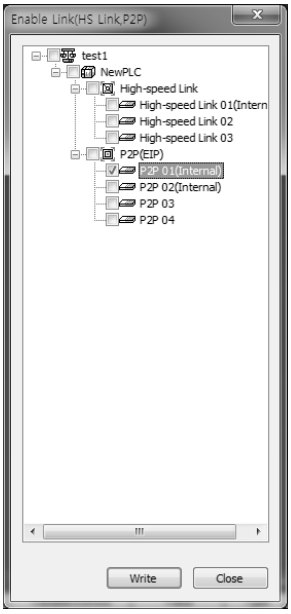


☐ Sets Program Upload Prohibit
☑ Sets link enable with parameters

### 7) Enabling link

After setting P2P parameter and downloading the parameter to PLC CPU, enable P2P service. If parameter is downloaded but P2P(EIP) is not enabled, the P2P block is not operated.

In order to enable P2P(EIP), Select [Online] – [Communication module setting] – [Enable Link], and click P2P(EIP) number which you want to operate and then click Wirte button. The P2P(EIP) is enabled.



☑ P2P 01(Internal)

### 8) Diagnosis service

In order to check the setting parameter operates normally, diagnosis service is available.

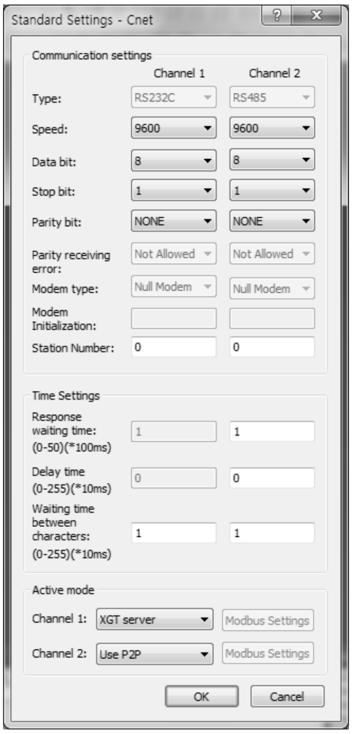
Select [Online] – [Communication module setting] – [System Diagnosis]. Click the module and then click mouse right-button. If you select Frame Monitor or Status by Service, it can be checked whether the communication is normal or not. For more detail, refer to chapter 2.9 Diagnosis Function.

## 2.6.6 LS Bus Client

LS Bus Protocol communication is function executing communication between XGB Cnet and LS Inverter.User can configure LS Bus communication system between our products without special setting by usingreading/writing data of internal device area and monitoring function

### 1) Channel setting

Cnet I/F module is available to define driver type for P2P service about each channel. However, active mode in the standard settings should be set as “Use P2P settings”. P2P setting according to active mode is as follows.



Standard Settings - Cnet

Communication settings

| | Channel 1 | Channel 2 |
|---|---|---|
| Type: | RS232C | RS485 |
| Speed: | 9600 | 9600 |
| Data bit: | 8 | 8 |
| Stop bit: | 1 | 1 |
| Parity bit: | NONE | NONE |
| Parity receiving error: | Not Allowed | Not Allowed |
| Modem type: | Null Modem | Null Modem |
| Modem Initialization: | | |
| Station Number: | 0 | 0 |

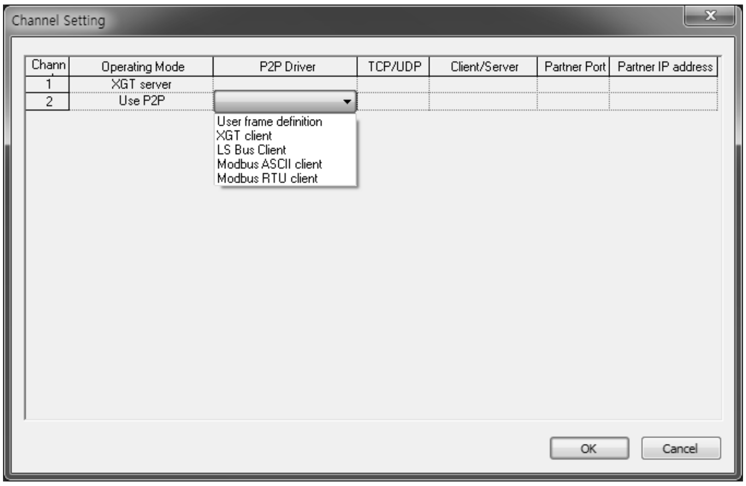
Time Settings

| | | |
|---|---|---|
| Response waiting time: (0-50)(*100ms) | 1 | 1 |
| Delay time (0-255)(*10ms) | 0 | 0 |
| Waiting time between characters: (0-255)(*10ms) | 1 | 1 |

Active mode

Channel 1: XGT server

Channel 2: Use P2P

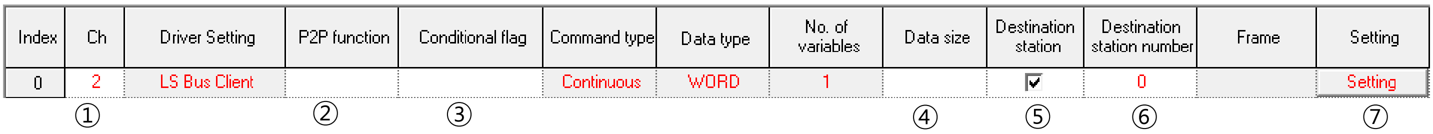


Channel Setting

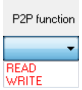
| Chann | Operating Mode | P2P Driver | TCP/UDP | Client/Server | Partner Port | Partner IP address |
|---|---|---|---|---|---|---|
| 1 | XGT server | | | | | |
| 2 | Use P2P | | | | | |

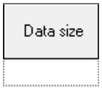
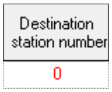
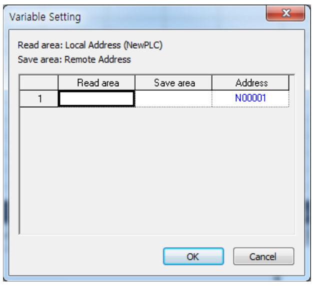
### 2) P2P block setting

If selecting P2P block in the P2P parameter setting window, P2P block setting window shows.
Block setting window is same according to protocol and activated area is different P2P. Each of items means as follow.



| Index | Ch | Driver Setting | P2P function | Conditional flag | Command type | Data type | No. of variables | Data size | Destination station | Destination station number | Frame | Setting |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2 | LS Bus Client | | | Continuous | WORD | 1 | | ☑ | 0 | | Setting |

| No. | Type | Block form | Contents |
|---|---|---|---|
| 1 | Channel |  | Driver name changes according to driver set in the P2P Driver. |
| 2 | P2P function |  | 1. Read : when reading the destination station’s memory<br>2. Write: when writing self-station’s memory to destination station’s memory. |
| 3 | Conditional flag |  | 1. Determines when Cnet sends request frame<br>2. In case of XBC type Ex. : F90(20ms flag), M01<br>3. In case of XEC type Ex. : _T20MS(20ms flag), %MX01 |

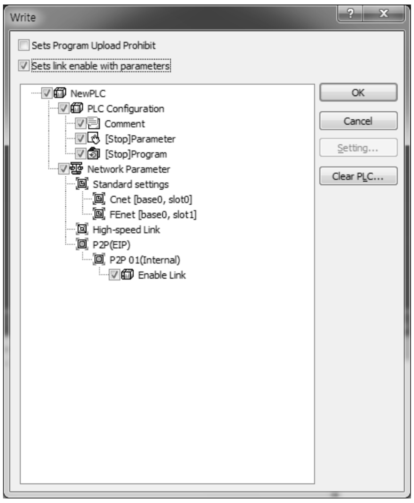
| No. | Type | Block form | Contents |
|---|---|---|---|
| 4 | Data size | <br>Data size | 1. This is activated when command type is continuous.<br>2. When data type is 1 word, available max. no. is 8 word |
| 5 | Destination station | <br>Destination station<br>☑ | 1. Check: Specify the destination station |
| 6 | Destination station number | <br>Destination station number<br>0 | 1. Destination station number, setting range is 0~63. |
| 7 | Setting | <br>Variable Setting<br>Read area: Local Address (NewPLC)<br>Save area: Remote Address<br>Read area<br>Save area<br>Address<br>1<br>N00001<br>OK<br>Cancel | 1. When P2P function is Read<br>1)Read area : device area of server<br>2)Save area : client's device to save the data from server<br>2. When P2P function is Write<br>1)Read area : device area of client<br>2)Save area : Server's device area to save client's data |

### 3) Writing parameter

After P2P block setting is completed, download setting parameter to CPU.

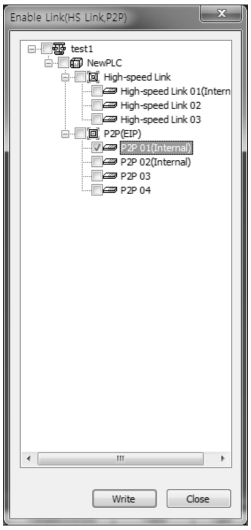
Select [Online] – [Connect] – [Write], and click OK in parameter download window, and then it will be downloaded.

After download, the parameter is applied immediately. If you check ‘Set up with Link Enable’, Link Enable can be applied with writing P2P/HS parameters at the same time.



### 4) Enabling link

After setting P2P parameter and downloading the parameter to PLC CPU, enable P2P service. If parameter is downloaded but P2P(EIP) is not enabled, the P2P block is not operated. In order to enable P2P(EIP), Select [Online] – [Communication module setting] – [Enable Link], and click P2P(EIP) number which you want to operate and then click Wirte button. The P2P(EIP) is enabled.



### 5) Diagnosis service

In order to check the setting parameter operates normally, diagnosis service is available.

Select [Online] – [Communication module setting] – [System Diagnosis]. Click the module and then click mouse right-button. If you select Frame Monitor or Status by Service, it can be checked whether the communication is normal or not. For more detail, refer to chapter 2.9 Diagnosis Function.

# 2.7 XGT Dedicated Protocol

XGT series dedicated protocol communication is function executing communication by our dedicated protocol. User can configure the intended communication system between our products without special setting by using reading/writing data of internal device area and monitoring function.

Dedicated protocol function supported by XGB is as follows.

- Device individual/continuous read
- Device individual/continuous write
- Monitor variable registration
- Monitor execution
- 1:1 connection (Our link) system configuration

**Note**

- XGB's built-in communication function supports Cnet communication without any separate Cnet I/F module. It must be used under the following instructions.
- Channel 1 of XGB's main unit supports 1:1 communication only. For 1:N system having master-slave Format, use RS-485 communication in channel 2 or XGB's main unit with XGL-C41A module connected. XGL-C41A module supports RS-422/485 protocol.
- RS-232C communication cable for XGB's main unit is different from RS-232C cable for XG5000 (XG-PD) in pin arrangement and from the cable for Cnet I/F module, too. The cable can't be used without any treatment. For the detailed wiring method, refer to configuration of respective communication.
- It's possible to set baud rate type and station No. in XG5000 (XG-PD).

## 2.7.1 XGT Dedicated Protocol

1) Frame structure

(1) Basic format

a) Request frame (external communication device → XGB)

| | | | | | | |
|---|---|---|---|---|---|---|
| Header (ENQ) | Station number | Command | Command type | Structurized data area | Tail (EOT) | Frame check (BCC) |

b) ACK response frame (XGB → external communication device, when receiving data normally)

| | | | | | | |
|---|---|---|---|---|---|---|
| Header (ACK) | Station number | Command | Command type | Structurized data area or Null code | Tail (ETX) | Frame check (BCC) |

c) NAK response frame (XGB → Cnet I/F module → external communication device when receiving data abnormally)

| | | | | | | |
|---|---|---|---|---|---|---|
| Header (NAK) | Station number | Command | Command type | Error code ( ASCII 4 Byte ) | Tail (ETX) | Frame check (BCC) |

**Note**

1) The numerical data of all frames are ASCII codes equal to hexadecimal value, if there's no clear statement. The terms in hexadecimal are as follows.
   - Station No.
   - When the main command is R(r) or W (w) and the command type is numerical (means a data type)
   - All of the terms indicating size of all data in the Formatted data area.
   - Monitoring registration and command registration number of execution commands.
   - All contents of data
2) If it is hexadecimal, H is attached in front of the number of frames like H01, H12345, H34, H12, and H89AB.
3) Available frame length is maximum 256 bytes.
4) Used control codes are as follows.

| Codes | Hex value | Name | Contents |
|---|---|---|---|
| ENQ | H05 | Enquire | Request frame initial code |
| ACK | H06 | Acknowledge | ACK response frame initial code |
| NAK | H15 | Not Acknowledge | NAK response frame initial code |
| EOT | H04 | End of Text | Request frame ending ASCII code |
| ETX | H03 | End Text | Response frame ending ASCII code |

5) If the command is small letter (r), BCC value is added in check frame. The other side capital letter (R), BCC value is not added in check frame.

(2) Command frame sequence

a) Sequence of command request frame

| | | | | | |
|---|---|---|---|---|---|
| ENQ | Station No. | Command | Formatted data | EOT | BCC |

| | | | | | |
|---|---|---|---|---|---|
| ACK | Station No. | Command | Formatted data | ETX | BCC |

(PLC ACK response)

| | | | | | |
|---|---|---|---|---|---|
| NAK | Station No. | Command | Formatted data | ETX | BCC |

(PLC NAK response)

b) List of commands

List of commands used in dedication communication is as shown below.

| Classification / Items | | Command | | | | Treatment |
|---|---|---|---|---|---|---|
| | | Main command | | Command type | | |
| | | Code | ASCII code | Code | ASCII code | |
| Reading device | Individual | r(R) | H72<br>(H52) | SS | 5353 | Reads direct variable of Bit, Byte, Word, Dword, Lword type. |
| | Continuous | r(R) | H72<br>(H52) | SB | 5342 | Read direct variable of Byte, Word, Dword, Lword with block unit<br>(Bit continuous read is not allowed) |
| Writing device | Individual | w(W) | H77<br>(H57) | SS | 5353 | Write data of Bit, Byte, Word, Dword, Lword at direct variable |
| | Continuous | w(W) | H77<br>(H57) | SB | 5342 | Write data of Byte, Word, Dword, Lword at direct variable with block unit<br>(Bit continuous read is not allowed) |

| Classification / Item | Command | | | Treatment |
|---|---|---|---|---|
| | Main command | | Register No | |
| | Code | ASCII code | | |
| Monitoring variable register | x(X) | H78<br>(H58) | H00~H0F | Register device to monitor. |
| Execution of monitoring | y(Y) | H79<br>(H59) | H00~H0F | Execute registered device to monitor. |

**Note**

- It identifies capitals or small letters for main commands, but not for the others.

(3) Data type

It’s possible to read and write device in built-in communication. When device is used, be aware of data type.

a) Available types of device (XBC type)

| Device | Range | Size (Word) | Remark |
|---|---|---|---|
| P | P0 – P2047 | 2048 | Read/Write/Monitor available |
| M | M0 – M2047 | 2048 | Read/Write/Monitor available |
| K | K0 – K8191 | 8192 | Read/Write/Monitor available |
| F | F0 – F2047 | 2048 | Read/Monitor available |
| T | T0 – T2047 | 2048 | Read/Write/Monitor available |
| C | C0 – C2047 | 2048 | Read/Write/Monitor available |
| L | L0 – L4095 | 4096 | Read/Write/Monitor available |
| N | N0 – N10239 | 10240 | Read/Monitor available |
| D | D0 – D19999 | 20000 | Read/Write/Monitor available |
| U | U00.00 – U0B.31 | 384 | Read/Write/Monitor available |
| Z | Z0 – Z127 | 128 | Read/Write/Monitor available |
| R | R0 – R16383 | 16384 | Read/Write/Monitor available |

**Note**

- In case of U device, it will be available only for operation as server.
- Timer/Counter used in bit command means contact point values.
  (word command means current values.)
- Data register (D) can uses only word or byte commands.
- In byte type commands, address is doubled. For example, D1234 is addressed to ‘%DW1234’ in word type, and is addressed to ‘%DB2468’ in byte type.

(4) Error codes

Error code is displayed as hex 2 byte (4 byte as ASCII code). The user can see error by frame monitor and in case of viewing by ASCII, the user can see the following error code.

| Error code | Error type | Error details and causes | Example |
|---|---|---|---|
| 0003 | Number of blocks exceeded | Number of blocks exceeds 16 at Individual Read/Write Request | 01rSS1105%MW10… |
| 0004 | Variable length error | Variable Length exceeds the max. size of 16 | 01rSS010D%MW10000000000.. |
| 0007 | Data type error | Other data type than X,B,W,D,L received | 01rSS0105%MK10 |
| 0011 | Data error | Data length area information incorrect | 01rSB05%MW10%4 |
| | | In case % is unavailable to start with | 01rSS0105$MW10 |
| | | Variable’s area value wrong | 01rSS0105%MW^& |
| | | Other value is written for Bit Write than 00 or 01 | 01wSS0105%MX1011 |
| 0090 | Monitor execution error | Unregistered monitor execution requested | |
| 0190 | Monitor execution error | Reg. No. range exceeded | |

| | | | |
|---|---|---|---|
| 0290 | Monitor reg. Error | Reg. No. range exceeded | |
| 1132 | Device memory error | Other letter than applicable device is input | |
| 1232 | Data size error | Request exceeds the max range of 60 Words to read or write at a time. | 01wSB05%MW1040AA5512,.. |
| 1234 | Extra frame error | Unnecessary details exist as added. | 01rSS0105%MW10000 |
| 1332 | Data type discordant | All the blocks shall be requested of the identical data type in the case of Individual Read/Write | 01rSS0205%MW1005%MB10 |
| 1432 | Data value error | Data value unavailable to convert to Hex | 01wSS0105%MW10AA%5 |
| 7132 | Variable request area exceeded | Request exceeds the area each device supports. | 01rSS0108%MWFFFFF |

## 2.7.2 Detail of instruction

### 1) Individual reading of device (R(r)SS)

This is a function that reads PLC device specified in accord with memory data type. Separate device memory can be read up to 16 at a time.

(1) PC request format

| Format name | Header | Station No. | Command | Command type | Number of blocks | Device length | Device name | .... | Tail | Frame check |
|---|---|---|---|---|---|---|---|---|---|---|
| Ex. of frame | ENQ | H20 | R(r) | SS | H01 | H06 | %MW100 | | EOT | BCC |
| ASCII value | H05 | H3230 | H52(72) | H5353 | H3031 | H3036 | H254D57313030 | | H04 | |

1 block (setting can be repeated up to max. 16 blocks)

| Item | Description |
|---|---|
| BCC | When command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from ENQ to EOT is converted into ASCII and added to BCC. For example, the BCC of the above frame is gotten as below:<br>H05+H32+H30+H72+H53+H53+H30+H31+H30+H36+H25+H4D+H57+H31+H30+H30+H04 = H03A4 Therefore BCC value is A4 (ASCII value : H4134). |
| Number of Blocks | This specifies how much of the blocks composed of "[device length][device name]" are in this request format. This can be set up to 16. Therefore, the value of [Number of blocks] must be set between H01(ASCII value:3031)-H10(ASCII value:3030). |
| Device length (Length of device name) | This indicates the number of name's characters that means device, which is allowable up to 16 characters. This value is one of ASCII converted from hex type, and the range is from H01(ASCII value:3031) to H10(ASCII value:3130). For example, if the device name is %MW0, it has 4 characters to be H04 as its length. If %MW000 characters to be H06. |
| Device name | Address to be actually read is entered. This must be ASCII value within 16 characters, and in this name, digits, upper/lower case, '%' is only allowable to be entered. |

**Note**

- BCC values convert ASCII values to ASCII values and lower values to ASCII values.
- In case of making actual frame, 'H' is not attached. Because the number data of frame indicates hexadecimal.

(2) XGB response format (ACK response)

| Format name | Header | Station No. | Command | Command type | Number of blocks | Number of data | data | …… | Tail | Frame check |
|---|---|---|---|---|---|---|---|---|---|---|
| Ex. of frame | ACK | H20 | R(r) | SS | H01 | H02 | HA9F3 | | ETX | BCC |
| ASCII value | H06 | H3230 | H52(72) | H5353 | H3031 | H3032 | H41394633 | | H04 | |

1 block (max. 16 blocks possible)

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>BCC</td><td>When command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from ACK to ETX is converted into ASCII and added to BCC, and sent.</td></tr>
<tr><td>Number of data</td><td>Number of data means byte number of hex type, and is converted into ASCII. This number is determined according to data type (X,B,W) included in device name of computer request Format.<br>• Number of data in accordance with its data type is as follows:
<table>
<tr><th>Data type</th><th>Available variable</th><th>Number of data</th></tr>
<tr><td>Bit(X)</td><td>%(P,M,L,K,F,T,C,D,R,I,Q,W)X</td><td>1</td></tr>
<tr><td>Byte(B)</td><td>%(P,M,L,K,F,T,C,D,R,I,Q,W)B</td><td>1</td></tr>
<tr><td>Word(W)</td><td>%(P,M,L,K,F,T,C,D,R,I,Q,W)W</td><td>2</td></tr>
</table>
※R area is supported at XBC-DXXXU</td></tr>
<tr><td>Data</td><td>• In data area, there are the values of hex data converted to ASCII code saved.</td></tr>
</table>

▪Example 1

The fact that number of data is H04 (ASCII code value:H3034) means that there is hex data of 4 bytes in data. Hex data of 4 bytes is converted into ASCII code in data.

▪Example 2

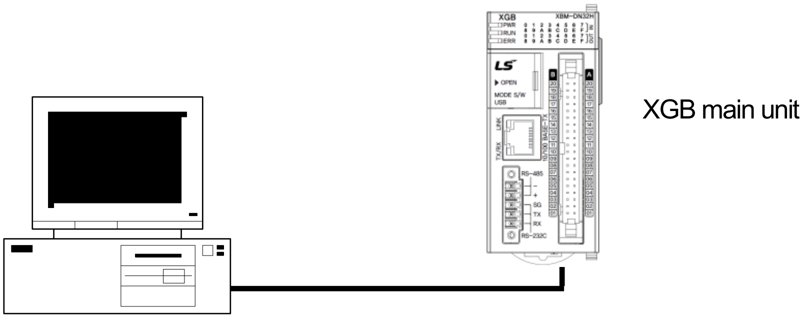
If number of data is H04 and the data is H12345678, ASCII code converted value of this is "31 32 33 34 35 36 37 38," and this contents is entered in data area. Name directly, highest value is entered first, lowest value last.

(3) XGB response format (NCK response)

| Format name | Header | Station No. | Command | Command type | Error code (Hex 2 Byte) | Tail | Frame check |
|---|---|---|---|---|---|---|---|
| Ex. of frame | NAK | H20 | R(r) | SS | H1132 | ETX | BCC |
| ASCII value | H15 | H3230 | H52(72) | H5353 | H31313332 | H03 | |

| Item | Explanation |
|---|---|
| BCC | When command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from NAK to ETX is converted into ASCII and added to BCC. |
| Error code | Hex and 2 bytes (ASCII code, 4 bytes) indicate error type. For the details, Refer to 2.6.1 XGT dedicated communication error codes and countermeasures. |

(4) Example



This example supposes when 1 WORD from M20 and 1 WORD from P001 address of station No.1 are read
(At this time, it is supposed that H1234 is entered in M20, and data of H5678 is entered in P001.)

a) PC request format (PC → XGB)

| Format name | Header | Station No. | Command | Command type | Number of blocks | Variable length | Variable name | Device length | Variable name | Tail | Frame check |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ex. of frame | ENQ | H01 | R(r) | SS | H02 | H06 | %MW020 | H06 | %PW001 | EOT | BCC |
| ASCII value | H05 | H3031 | H52(72) | H5353 | H3032 | H3036 | H254D57303230 | H3036 | H25505730303031 | H04 | |

b) For ACK response after execution of command (PC ← XGB)

| Format name | Header | Station No. | Command | Command type | Number of blocks | Number of data | Data | Number of data | Data | Tail | Frame check |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ex. of frame | ACK | H01 | R(r) | SS | H02 | H02 | H1234 | H02 | H5678 | ETX | BCC |
| ASCII value | H06 | H3031 | H52(72) | H5353 | H3032 | H3032 | H31323334 | H3032 | H35363738 | H03 | |

c) For NAK response after execution of command (PC ← XGB)

| Format name | Header | Station No. | Command | Command type | Error code | Tail | Frame check |
|---|---|---|---|---|---|---|---|
| Ex. of frame | NAK | H01 | R(r) | SS | Error code (2 Byte) | ETX | BCC |
| ASCII value | H15 | H3031 | H52(72) | H5353 | Error code (4 Byte) | H03 | |

## 2) Direct variable continuous reading (R(r)SB)

This is a function that reads the PLC device memory directly specified in accord with memory data type. With this, data is read from specified address as much as specified continuously.

### (1) PC request format

| Format name | Header | Station No. | Command | Command type | Device length | Device | Number of data | Tail | Frame check |
|---|---|---|---|---|---|---|---|---|---|
| Ex. of frame | ENQ | H10 | R(r) | SB | H06 | %MW100 | H05 | EOT | BCC |
| ASCII value | H05 | H3130 | H52(72) | H5342 | H3036 | H254D5731 3030 | H3035 | H04 | |

| Item | Description |
|---|---|
| BCC | When command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from ENQ to EOT is converted into ASCII and added to BCC. |
| Device length (Length of device name) | This indicates the number of name's characters that means device, which is allowable up to 16 characters. This value is one of ASCII converted from hex type, and the range is from H01 (ASCII value:3031) to H10 (ASCII value:3130). |
| Device name | Address to be actually read is entered. This must be ASCII value within 16 characters, and in this name, digits, upper/lowercase, and '%' only are allowable to be entered. |

**Note**

- Number of data specifies the number to read according to the type of data. Namely, if the data type of device is word and number is 5, it means that 5 words should be read.
- In the number of data, you can use up to 60 words (120Byte).
- Protocol of continuous reading of direct variable doesn't have number of blocks.
- Bit device continuous reading is not supported.

(2) XGB response format (ACK response)

| Format name | Header | Station No. | Command | Command type | Number of blocks | Number of data | data | Tail | Frame check |
|---|---|---|---|---|---|---|---|---|---|
| Ex. of frame | ACK | H10 | R(r) | SB | H01 | H02 | H1122 | ETX | BCC |
| ASCII value | H06 | H3130 | H52(72) | H5342 | H3031 | H3134 | H31313232 | H03 | |

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Number of data</td><td>It means byte number of hex type, and is converted into ASCII
<table>
<tr><th>Data type</th><th>Available device</th><th>Data size (Byte)</th></tr>
<tr><td>BYTE(B)</td><td>%(P,M,L,K,F,T,C,D,R,I,Q,W)B</td><td>1</td></tr>
<tr><td>WORD(W)</td><td>%(P,M,L,K,F,T,C,D,R,I,Q,W)W</td><td>2</td></tr>
<tr><td>DWord(D)</td><td>%(P,M,L,K,F,T,C,D,R,I,Q,W)D</td><td>4</td></tr>
<tr><td>LWord(L)</td><td>%(P,M,L,K,F,T,C,D,I,Q,W)L</td><td>8</td></tr>
</table>
※R area is supported at XBC-DXXXU</td></tr>
</table>

- Example 1
  When memory type included in variable name of computer request Format is W (Word), and data number of computer request Format is 03, data number of PLC ACK response after execution of command is indicated by H06 (2*03 = 06 bytes)Byte and ASCII code value 3036 is entered in data area.
- Example 2
  In just above example, when data contents of 3 words are 1234, 5678, and 9ABC in order, actual ASCII code converted values are 31323334 35363738 39414243, and the contents are entered in data area.

(3) XGB response format (NAK response)

| Format name | Header | Station No. | Command | Command type | Error code (Hex 2 Byte) | Tail | Frame check |
|---|---|---|---|---|---|---|---|
| Ex. of frame | NAK | H10 | R(r) | SB | H1132 | ETX | BCC |
| ASCII value | H15 | H3130 | H52(72) | H5342 | H31313332 | H03 | |

| Item | Description |
|---|---|
| BCC | When command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from NAK to ETX is converted into ASCII and added to BCC, and sent. |
| Error code | Hex and 2 bytes (ASCII code, 4 bytes) indicate error type. For the details, Refer to 2.6.1 XGT dedicated communication error codes and countermeasures. |

(4) Example

This example supposes that 2 WORDs from M000 of station No. 10 is read
(It supposes that M000 = H1234, M001 = H5678.)

a ) PC request format (PC → XGB)

| Format name | Header | Station No. | Command | Command type | Device length | Device name | Number of data | Tail | Frame check |
|---|---|---|---|---|---|---|---|---|---|
| Frame (Example) | ENQ | H0A | R(r) | SB | H06 | %MW000 | H02 | EOT | BCC |
| ASCII value | H05 | H3041 | H52(72) | H5342 | H3036 | H254D3030 30 | H3032 | H04 | |

b) For ACK response after execution of command (PC ← XGB)

| Format name | Header | Station No. | Command | Command type | Number of block | Number of data | Data | Tail | Frame check |
|---|---|---|---|---|---|---|---|---|---|
| Frame (Example) | ACK | H0A | R(r) | SB | H01 | H04 | 12345678 | ETX | BCC |
| ASCII value | H06 | H3041 | H52(72) | H5342 | H3031 | H3034 | H3132333435363738 | 03 | |

c) For NAK response after execution of command (PC ← XGB)

| Format name | Header | Station No. | Command | Command type | Error code | Tail | BCC |
|---|---|---|---|---|---|---|---|
| Frame (Example) | NAK | H0A | R(r) | SB | Error code (2 Byte) | ETX | BCC |
| ASCII value | H15 | H3041 | H52(72) | H5342 | Error code (4 Byte) | H03 | |

### 3) Individual writing of device (W(w)SS)

This is a function that writes the PLC device memory directly specified in accord with memory data type.

(1) PC request format

| Format name | Header | Station No. | Command | Command type | Number of blocks | Device Length | Device Name | Data | ..... | Tail | Frame check |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Frame (Example) | ENQ | H20 | W(w) | SS | H01 | H06 | %MW100 | H00E2 | | EOT | BCC |
| ASCII value | H05 | H3230 | H57(77) | H5353 | H3031 | H3036 | H254D57313030 | H30304532 | | H04 | |

1 block (setting can be repeated up to max. 16 blocks)

| Item | Description |
|---|---|
| BCC | When command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from ENQ to EOT is converted into ASCII and added to BCC. |
| Number of blocks | This specifies how much of the blocks composed of "[device length][device name]" are in this request Format. This can be set up to 16. Therefore, the value of [Number of blocks] must be set between H01(ASCII value:3031)-H10 (ASCII value:3030). |
| Device Length (Name length of device) | This indicates the number of name's characters that means device, which is allowable up to 16 characters. This value is one of ASCII converted from hex type, and the range is from H01 (ASCII value: 3031) to H10 (ASCII value:3130). |
| device | Address to be actually read is entered. This must be ASCII value within 16 characters, and in this name, digits, upper/lower case, and '%' only is allowable to be entered. |
| Data | If the value to be written in %MW100 area is H A, the data Format must be H000A. If the value to be written in %MW100 area is H A, the data Format must be H000A. In data area, the ASCII value converted from hex data is entered. |

▪Example 1

If type of data to be currently written is WORD, the data is H1234, ASCII code converted value of this is "31323334" and this content must be entered in data area. Namely, most significant value must be sent first, least significant value last.

**Note**

- Device data types of each block must be the same
- If data type is Bit, the data to be written is indicated by bytes of hex. Namely, if Bit value is 0, it must be indicated by H00 (3030), and if 1, by H01 (3031).

(2) XGB Response format (ACK response)

| Format name | Header | Station No. | Command | Command type | Tail | Frame check |
|---|---|---|---|---|---|---|
| Frame (Example) | ACK | H20 | W(w) | SS | ETX | BCC |
| ASCII value | H06 | H3230 | H57(77) | H5353 | H03 | |

| Item | Description |
|---|---|
| BCC | When command is lowercase (r), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from ACK to ETX is converted into ASCII and added to BCC, and sent. |

(3) XGB Response format (NAK response)

| Format name | Header | Station No. | Command | Command type | Error code (Hex 2 Byte) | Tail | Frame check |
|---|---|---|---|---|---|---|---|
| Frame (Example) | NAK | H20 | W(w) | SS | H4252 | ETX | BCC |
| ASCII value | H15 | H3230 | H57(77) | H5353 | H34323532 | H03 | |

| Item | Description |
|---|---|
| BCC | When command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from NAK to ETX is converted into ASCII and added to BCC, and sent. |
| Error code | Hex and 2 bytes (ASCII code, 4 bytes) indicate error type. For the details, Refer to 2.6.1 XGT dedicated communication error codes and countermeasures. |

(4) Example

This example supposes that "HFF" is written in M230 of station No. 1.

1) PC request format (PC → XGB)

| Format name | Header | Station No. | Command | Command type | Number of blocks | Device Length | Device Name | Data | Tail | Frame check |
|---|---|---|---|---|---|---|---|---|---|---|
| Frame (Example) | ENQ | H01 | W(w) | SS | H01 | H06 | %MW230 | H00FF | EOT | BCC |
| ASCII value | H05 | H3031 | H57(77) | H5353 | H3031 | H3036 | H254D57323330 | H30304646 | H04 | |

2) For ACK response after execution of command (PC ← XGB)

| Format name | Header | Station No. | Command | Command type | Tail | Frame check |
|---|---|---|---|---|---|---|
| Frame (Example) | ACK | H01 | W(w) | SS | ETX | BCC |
| ASCII value | H06 | H3031 | H57(77) | H5353 | H03 | |

3) For NAK response after execution of command (PC ← XGB)

| Format name | Header | Station No. | Command | Command type | Error code | Tail | Frame check |
|---|---|---|---|---|---|---|---|
| Frame (Example) | NAK | H01 | W(w) | SS | Error code (2 Byte) | ETX | BCC |
| ASCII value | H15 | H3031 | H57(77) | H5353 | Error code (4 Byte) | H03 | |

### 4) Continuous writing of device (W(w)SB)

This is a function that directly specifies PLC device memory and continuously writes data from specified address as much as specified length.

(1) Request format

| Format name | Header | Station No. | Command | Command type | Device Length | Device name | Number of data | Data | Tail | Frame check |
|---|---|---|---|---|---|---|---|---|---|---|
| Frame (Example) | ENQ | H10 | W(w) | SB | H06 | %MW100 | H02 | H11112222 | EOT | BCC |
| ASCII value | H05 | H3130 | H57(77) | H5342 | H3036 | H254D57313030 | H3032 | H3131313132323232 | H04 | |

| Item | Description |
|---|---|
| BCC | When command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from ENQ to EOT is converted into ASCII and added to BCC. |
| Device Length (Name length of variable) | This indicates the number of name's characters that means device, which is allowable up to 16 characters. This value is one of ASCII converted from hex type, and the range is from H01 (ASCII value: 3031) to H10 (ASCII value: 3130). |
| Device name | Address to be actually read. This must be ASCII value within 16 characters, and in this name, digits, upper/lower case, and '%' only are allowable to be entered. |

**Note**

- Number of data specifies the number according to the type of device. Namely, if the data type of device is WORD, and number of data is 5, it means that 5 WORDs should be written.
- Number of data can be used up to 120Bytes (60 Words).

(2) XGB Response format (ACK response)

| Format name | Header | Station No. | Command | Command type | Tail | Frame check |
|---|---|---|---|---|---|---|
| Frame (Example) | ACK | H10 | W(w) | SB | ETX | BCC |
| ASCII value | H06 | H3130 | H57(77) | H5342 | H03 | |

| Item | Description |
|---|---|
| BCC | When command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from ACK to ETX is converted into ASCII and added to BCC, and sent. |

(3) XGB Response format (NAK response)

| Format name | Header | Station No. | Command | Command type | Error code (Hex 2 Byte) | Tail | Frame check |
|---|---|---|---|---|---|---|---|
| Frame (Example) | ENQ | H10 | W(w) | SB | H1132 | EOT | BCC |
| ASCII value | H05 | H3130 | H57(77) | H5342 | H31313332 | H03 | |

| Item | Description |
|---|---|
| BCC | When command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from NAK to ETX is converted into ASCII and added to BCC, and sent. |
| Error code | Hex and 2 bytes (ASCII code, 4 bytes) indicate error type. For the details, Refer to 2.6.1 XGT dedicated communication error codes and countermeasures. |

(4) Example

This example supposes that 2 byte H'AA15 is written in D000 of station No. 1.

(a) PC request format (PC → XGB)

| Format name | Header | Station No. | Command | Command type | Device Length | Device | Number of data | Data | Tail | Frame check |
|---|---|---|---|---|---|---|---|---|---|---|
| Frame (Example) | ENQ | H01 | W(w) | SB | H06 | %DW000 | H01 | HAA15 | EOT | BCC |
| ASCII value | H05 | H3031 | H57(77) | H5342 | H3036 | H254457303030 | H3031 | H41413135 | H04 | |

(b) For ACK response after execution of command (PC ← XGB)

| Format name | Header | Station No. | Command | Command type | Tail | Frame check |
|---|---|---|---|---|---|---|
| Frame (Example) | ACK | H01 | W(w) | SB | ETX | BCC |
| ASCII value | H06 | H3031 | H57(77) | H5342 | H03 | |

(c) For NAK response after execution of command (PC ← XGB)

| Format name | Header | Station No. | Command | Command type | Error code | Tail | Frame check |
|---|---|---|---|---|---|---|---|
| Frame (Example) | NAK | 01 | W(w) | SB | Error code (2) | ETX | BCC |
| ASCII value | H15 | H3031 | H57(77) | H5342 | Error code (4) | H03 | |

### 5) Monitor variable register (X##)

Monitor register can separately register up to 16 (from 0 to 15) in combination with actual variable reading command and carries out the registered one through monitor command after registration.

(1) PC request format

| Format name | Header | Station No. | Command | Registration No. | Registration format | Tail | Frame check |
|---|---|---|---|---|---|---|---|
| Frame (Example) | ENQ | H10 | X(x) | H09 | Refer to registration format | EOT | BCC |
| ASCII value | H05 | H3130 | H58(78) | H3039 | Refer to *1 | H04 | |

| Item | Description |
|---|---|
| BCC | When command is lowercase(x), only one lower byte of the value resulted by adding 1 byte each to ASCII values from ENQ to EOT is converted into ASCII, added to BCC. |
| Register No. | This can be registered up to 16 (0 to 15, H00-H0F), and if an already registered No. is registered again, the one currently being executed is registered. |
| Register Format | This is used to before EOT in command of Formats of separate reading of variable, continuous reading, and named variable reading. |

*1 : Register Format of request Formats must select and use only one of the followings.

(a) Individual reading of device

| RSS | Number of blocks (2 Byte) | Device length (2 Byte) | Device name (16 Byte) | ... |
|---|---|---|---|---|
| | | 1 block (max. 16 blocks) | | |

(b) Continuous reading of device

| RSB | Device length (2 Byte) | Device name (16 Byte) | Number of data |
|---|---|---|---|

(2) XGB Response format (ACK response)

| Format name | Header | Station No. | Command | Registration no. | Tail | Frame check |
|---|---|---|---|---|---|---|
| Frame (Example) | ACK | H10 | X(x) | H09 | ETX | BCC |
| ASCII value | H06 | H3130 | H58(78) | H3039 | H03 | |

| Item | Description |
|---|---|
| BCC | When command is lowercase(x), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from ACK to ETX is converted into ASCII and added to BCC, and sent. |

(3) XGB Response format (NAK response)

| Format name | Header | Station No. | Command | Registration No. | Error code (Hex 2Byte) | Tail | Frame check |
|---|---|---|---|---|---|---|---|
| Frame (Example) | NAK | H10 | X(x) | H09 | H1132 | ETX | BCC |
| ASCII value | H15 | H3130 | H58(78) | H3039 | H31313332 | H03 | |

| Item | Description |
|---|---|
| BCC | When command is one of lower case(x), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from NAK to ETX is converted into ASCII and added to BCC, and sent. |
| Error code | Hex and 2 bytes (ASCII code, 4 bytes) indicate error type. For the details, Refer to 2.6.1 XGT dedicated communication error codes and countermeasures. |

(4) Example

This example supposes that device M000 of station NO. 1 is monitor registered.

(a) PC request format (PC → XGB)

| Format name | Header | Station No. | Command | Registration No. | Registration Format | | | | Tail | Frame check |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | R## | Number of blocks | Device length | Device name | | |
| Frame (Example) | ENQ | H01 | X(x) | H01 | RSS | H01 | H06 | %MW000 | EOT | BCC |
| ASCII value | H05 | H3031 | H58(78) | H3031 | H525353 | H3031 | H3036 | H255457303030 | H04 | |

(b) For ACK response after execution of command (PC ← XGB)

| Format name | Header | Station No. | Command | Registration No. | Tail | Frame check |
|---|---|---|---|---|---|---|
| Frame (Example) | ACK | H01 | X(x) | H01 | ETX | BCC |
| ASCII value | H06 | H3031 | H58(78) | H3031 | H03 | |

(c) For NAK response after execution of command (PC ← XGB)

| Format name | Header | Station No. | Command | Registration No. | Error code | Tail | Frame check |
|---|---|---|---|---|---|---|---|
| Frame (Example) | NAK | H01 | X(x) | H01 | Error code (2) | ETX | BCC |
| ASCII value | H15 | H3031 | H58(78) | H3031 | Error code (4) | H03 | |

### 6) Monitor execution (Y##)

This is a function that carries out the reading of the variable registered by monitor register. This also specifies a registered number and carries out reading of the variable registered by the number.

(1) PC request format

| Format name | Header | Station No. | Command | Registration No. | Tail | Frame check |
|---|---|---|---|---|---|---|
| Frame (Example) | ENQ | H10 | Y(y) | H09 | EOT | BCC |
| ASCII value | H05 | H3130 | H59(79) | H3039 | H03 | |

| Item | Description |
|---|---|
| Register No. | Register No. uses the same number registered during monitor register for monitor execution. It is possible to set from 00-09 (H00-H09). |
| BCC | When command is lower case(y), only one lower byte of the value resulted by adding 1 byte each to ASCII values from ENQ to EOT is converted into ASCII, added to BCC. |

(2) XGB Response format (ACK response)

1) In case that the register Format of register No. is the Individual reading of device

| Format name | Header | Station No. | Command | Registration No. | Number of Blocks | Number of data | Data | Tail | Frame check |
|---|---|---|---|---|---|---|---|---|---|
| Frame (Example) | ACK | H10 | Y(y) | H09 | H01 | H02 | H9183 | ETX | BCC |
| ASCII value | H06 | H3130 | H59(79) | H3039 | H3031 | H3032 | H39313833 | H03 | |

2) In case that the register Format of register No. is the continuous reading of device

| Format name | Header | Station No. | Command | Registration No. | Number of data | Data | Tail | Frame check |
|---|---|---|---|---|---|---|---|---|
| Frame (Example) | ACK | H10 | Y(y) | H09 | H04 | H9183AABB | ETX | BCC |
| ASCII value | H06 | H3130 | H59(79) | H3039 | H3034 | H3931383341414242 | H03 | |

(3) XGB Response Format (NAK response)

| Format name | Header | Station No. | Command | Registration No. | Error code (Hex 2Byte) | Tail | Frame check |
|---|---|---|---|---|---|---|---|
| Frame (Example) | NAK | H10 | Y(y) | H09 | H1132 | ETX | BCC |
| ASCII value | H15 | H3130 | H59(79) | H3039 | H31313332 | H03 | |

| Item | Description |
|---|---|
| BCC | When command is lowercase(y), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from NAK to ETX is converted into ASCII and added to BCC, and sent. |
| Error code | Hex and 2 bytes (ASCII code, 4 bytes) indicate error type. For the details, Refer to 2.6.1 XGT dedicated communication error codes and countermeasures. |

(4) Example

This example supposes that registered device No. 1 of station No. 1 is read. and BCC value is checked. And it is supposed that device M000 is registered and the number of blocks is 1.

(a) PC request format (PC → XGB)

| Format name | Header | Station No. | Command | Registration No. | Tail | Frame check |
|---|---|---|---|---|---|---|
| Frame (Example) | ENQ | H01 | Y(y) | H01 | EOT | BCC |
| ASCII value | H05 | H3031 | H59(79) | H3031 | H04 | |

(b) For ACK response after execution of command (PC → XGB)

| Format name | Header | Station No. | Command | Registration No. | Number of Blocks | Number of data | Data | Tail | Frame check |
|---|---|---|---|---|---|---|---|---|---|
| Frame (Example) | ACK | H01 | Y(y) | H01 | H01 | H02 | H2342 | ETX | BCC |
| ASCII value | H06 | H3031 | H59(79) | H3031 | H3031 | H3032 | H32333432 | H03 | |

(c) For NAK response after execution of command (PC → XGB)

| Format name | Header | Station No. | Command | Registration No. | Error code | Tail | Frame check |
|---|---|---|---|---|---|---|---|
| Frame (Example) | NAK | H01 | Y(y) | H01 | Error code(2) | ETX | BCC |
| ASCII value | H15 | H3031 | H59(79) | H3031 | Error code(4) | H03 | |

# 2.8 LS Bus Protocol

LS Bus Protocol communication is function executing communication between XGB Cnet and LS Inverter.User can configure LS Bus communication system between our products without special setting by usingreading/writing data of internal device area and monitoring function

## 2.8.1 LS Bus Protocol

LS Bus Protocol communication is function executing communication between XGB Cnet and LS Inverter.
User can configure LS Bus communication system between our products without special setting by using reading/writing data of internal device area and monitoring function.

The function of LS Bus Protocol supported by XGB is as follows.

◆ Device continuous reading
◆ Device continuous writing

### 1) Frame structure

(1) Base format

(a) Request frame (External communication → XGB)

| | | | | | |
|---|---|---|---|---|---|
| Header (ENQ) | Station number | Command | Structurized data area | Frame check (BCC) | Tail (EOT) |

(b) ACK response frame (XGB → External communication, when receiving data normally)

| | | | | | |
|---|---|---|---|---|---|
| Header (ACK) | Station number | Command | Structurized data area | Frame check (BCC) | Tail (EOT) |

(c) NAK response frame (XGB → External communication, when receiving data abnormally)

| | | | | | |
|---|---|---|---|---|---|
| Header (NAK) | Station number | Command | Error code ( ASCII 4 Byte ) | Frame check (BCC) | Tail (EOT) |

**Note**

1) The numerical data of all frames are ASCII codes equal to hexadecimal value, if there’s no clear statement. The terms in hexadecimal are as follows.

- Station No.
- Command type is supported R (read) and W (write).
- All contents of data

2) If it is hexadecimal, H is attached in front of the number of frames like H01, H12345, H34, H12, and H89AB.
3) Available frame length is maximum 44 bytes.
4) Used control codes are as follows.

| Code | Hex value | Name | Contents |
|---|---|---|---|
| ENQ | H05 | Enquire | Request frame initial code |
| ACK | H06 | Acknowledge | ACK response frame initial code |
| NAK | H15 | Not Acknowledge | NAK response frame initial code |
| EOT | H04 | End of Text | Request frame ending ASCII code |

## 2) Command frame sequence

### (1) Sequence of command request frame

| | | | | | |
|---|---|---|---|---|---|
| ENQ | Station No. | Command | Formatted data | BCC | EOT |

| | | | | | |
|---|---|---|---|---|---|
| ACK | Station No. | Command | Formatted data | BCC | EOT |

(Inverter ACK response)

| | | | | | |
|---|---|---|---|---|---|
| NAK | Station No. | Command | Formatted data | BCC | EOT |

(Inverter NAK response)

### (2) List of commands

List of commands used in LS Bus communication is as shown below.

| Classification / Items | Command | | Treatment |
|---|---|---|---|
| | Command type | | |
| | Code | ASCII code | |
| Continuous read | R | H52 | Read inverter variable of Word. |
| Continuous write | W | H57 | Write inverter variable of Word. |

## 2.8.2 Detail of instruction

### 1) Continuous writing to inverter (W)

This command is to write PLC data in specified address of inverter.

- LS Bus Client Request format

| Format name | Header | Station No. | Command | Device Length | Address of inverter | Data | ..... | Frame check | Tail |
|---|---|---|---|---|---|---|---|---|---|
| Frame (Example) | ENQ | H20 | W | H6 | 0100 | H00E2 | - | BCC | EOT |
| ASCII value | H05 | H3230 | H57 | H36 | H30313030 | H30304532 | - | - | H04 |

| Item | Description |
|---|---|
| BCC | When ASCII value of each 1byte except ENQ and EOT is summed, the lowest 1byte of the result value is BCC. |
| Device Length | This specifies how many Words you will write. As converted value to ASCII, the range is from H01 (ASCII value: 3031) to H08 (ASCII value: 3038). |
| Address of inverter | Enter the address that you want to read. ASCII value above 4 characters and non-numeric is not allowed. |
| Data | When you write data H'A to inverter address 0100 area, the data format has to be H000A. |

- Example)

If you want to write H1234, 31323334 (Converted value to ASCII) should be included in the data area. So, the highest value has to be sent first and the lowest value has to be sent last.

**Note**

• Device data of Word type is only supported.

- Inverter Response format (ACK response)

| Format name | Header | Station No. | Command | Data | | Frame check | Tail |
|---|---|---|---|---|---|---|---|
| Frame (Example) | ACK | H20 | W | H00E2 | … | BCC | EOT |
| ASCII value | H06 | H3230 | H57 | H30304532 | - | - | H04 |

| Item | Description |
|---|---|
| BCC | When ASCII value of each 1byte except ENQ and EOT is summed, the lowest 1byte of the result value is BCC. |

- Inverter Response format (NAK response)

| Format name | Header | Station No. | Command | Error code (ASC 2 Byte) | Frame check | Tail |
|---|---|---|---|---|---|---|
| Frame (Example) | NAK | H20 | W | H12 | BCC | EOT |
| ASCII value | H15 | H3230 | H57 | H3132 | - | H04 |

| Item | Description |
|---|---|
| BCC | When ASCII value of each 1byte except ENQ and EOT is summed, the lowest 1byte of the result value is BCC. |
| Error code | Error information is shown as hex 1byte (2bytes of ASCII code).<br>For more information, please refer to the error code of the inverter user manual. |

- Example

This describes if the user want to write "H00FF" to address number 1230 of station number 1 of inverter.

- XGB request format (XGB → Inverter)

| Format name | Header | Station No. | Command | Device length | Address of inverter | Data | Frame check | Tail |
|---|---|---|---|---|---|---|---|---|
| Frame (Example) | ENQ | H01 | W | H1 | 1230 | H00FF | BCC | EOT |
| ASCII value | H05 | H3031 | H57 | H3031 | H31323330 | H30304646 | - | H04 |

- For ACK response after execution of command (XGB ← Inverter)

| Format name | Header | Station No. | Command | Data | Frame check | Tail |
|---|---|---|---|---|---|---|
| Frame (Example) | ACK | H01 | W | H00FF | BCC | EOT |
| ASCII value | H06 | H3031 | H57 | H30304646 | - | H04 |

- For NAK response after execution of command (XGB ← Inverter)

| Format name | Header | Station No. | Command | Error code | Frame check | Tail |
|---|---|---|---|---|---|---|
| Frame (Example) | NAK | H01 | W | H12 | BCC | EOT |
| ASCII value | H15 | H3031 | H57 | Error code (2 Byte) | - | H04 |

### 1) Continuous reading from inverter (R)

This is a function of continuous reading of designated amount of PLC data from designated address number.

- PC Request format

| Format name | Header | Station No. | Command | Address of inverter | Number of data | Frame check | Tail |
|---|---|---|---|---|---|---|---|
| Frame (Example) | ENQ | H10 | R | 0100 | H5 | BCC | EOT |
| ASCII value | H05 | H3130 | H52 | H30313030 | H35 | - | H04 |

| Item | Description |
|---|---|
| BCC | When ASCII value of each 1byte except ENQ and EOT is summed, the lowest 1byte of the result value is BCC. |
| Device length | This specifies how many Words you will write. As converted value to ASCII, the range is from H01 (ASCII value: 3031) to H08 (ASCII value: 3038). |
| Address of inverter | Enter the address that you want to read. ASCII value above 4 characters and non-numeric is not allowed. |

**Note**

• Device data of Word type is only supported.

- Inverter response format (ACK response)

| Format name | Header | Station No. | Command | Data | | Frame check | Tail |
|---|---|---|---|---|---|---|---|
| Frame (Example) | ACK | H20 | R | H00E2 | … | BCC | EOT |
| ASCII value | H06 | H3230 | H52 | H30304532 | - | - | H04 |

| Item | Description |
|---|---|
| BCC | When ASCII value of each 1byte except ENQ and EOT is summed, the lowest 1byte of the result value is BCC. |

- Inverter response format (NAK response)

| Format name | Header | Station No. | Command | Error code (ASC 2 Byte) | Frame check | Tail |
|---|---|---|---|---|---|---|
| Frame (Example) | NAK | H20 | R | H12 | BCC | EOT |
| ASCII value | H15 | H3230 | H52 | H3132 | - | H04 |

| Item | Description |
|---|---|
| BCC | When ASCII value of each 1byte except ENQ and EOT is summed, the lowest 1byte of the result value is BCC. |
| Error code | Error information is shown as hex 1byte (2bytes of ASCII code).<br>For more information, please refer to the error code of the inverter user manual. |

- Example

This describes if the user want to read 1Word data from address number 1230 of station number 1 of inverter..

- XGB request format (XGB → Inverter)

| Format name | Header | Station No. | Command | Address of inverter | Device length | Frame check | Tail |
|---|---|---|---|---|---|---|---|
| Frame (Example) | ENQ | H01 | R | 1230 | H1 | BCC | EOT |
| ASCII value | H05 | H3031 | H52 | H31323330 | H31 | - | H04 |

- For ACK response after execution of command (XGB ← Inverter)

| Format name | Header | Station No. | Command | Data | Frame check | Tail |
|---|---|---|---|---|---|---|
| Frame (Example) | ACK | H01 | R | H1234 | BCC | EOT |
| ASCII value | H06 | H3031 | H52 | H31323334 | - | H04 |

- For NAK response after execution of command (XGB ← Inverter)

| Format name | Header | Station No. | Command | Error code | Frame check | Tail |
|---|---|---|---|---|---|---|
| Frame (Example) | NAK | H01 | R | H12 | BCC | EOT |
| ASCII value | H15 | H3031 | H52 | H3132 | - | H04 |

## 2.9 Modbus Protocol

Modbus protocol is specified open protocol used between client-server, which executes reading/writing data according to function code. Communication between devices that use Modbus protocol uses Client-server function in which only one client processes the data.

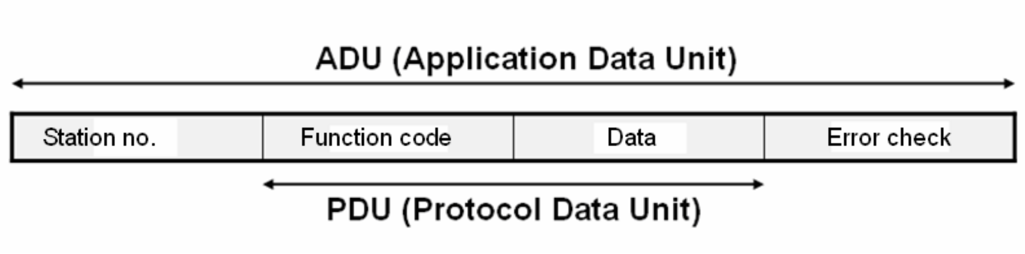
### 2.9.1 Modbus Protocol

There are two communication modes of Modbus, ASCII and RTU.

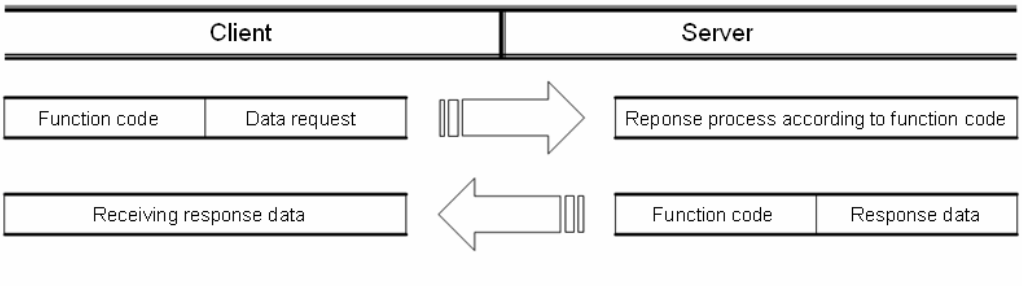
| Characteristic | | ASCII mode | RTU mode |
|---|---|---|---|
| Coding method | | ASCII code | 8 bit binary code |
| No. of data per one character | Start bit | 1 | 1 |
| | Data bit | 7 | 8 |
| | Parity bit | Even,Odd,None | Even,Odd,None |
| | Stop bit | 1 or 2 | 1 or 2 |
| Error check | | LRC(Longitudinal Redundancy Check) | CRC (Cyclical Redundancy Check) |
| Start of frame | | Colon (:) | 3.5 Character no response time |

1) Structure of Modbus protocol

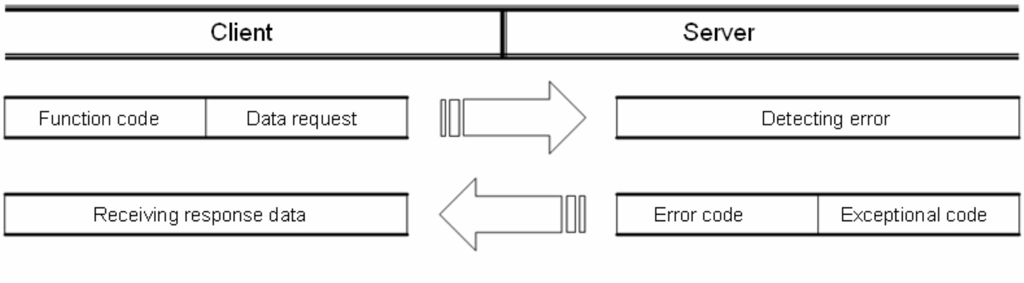
Modbus protocol's structure is as follows.



In case of normal communication, process step is as follows.



In case of abnormal communication, process step is as follows.



When receiving the abnormal frame from client, server transmits error code and exceptional code. Error code is function code adding 80(Hex) and exceptional code indicate the specific error content. Each code has following content.

| Code | Code name | Meaning |
|---|---|---|
| 01 | Function code error | Function code error |
| 02 | Address error | Exceeds allowed address range |
| 03 | Data setting error | Not allowed data value |
| 04 | Server error | Server(slave) is error |
| 05 | Server requesting re-transmission | Now server is too busy to process and requests re-transmission later |
| 06 | Server process time delay | Server takes time to process. Master should request again. |

## 2.9.2 Frame Structure

### 1) Frame structure in ASCII mode

Frame structure in the ASCII mode is as follows.

| Classification | Start | Station no. | Function code | Data | Error check | End |
|---|---|---|---|---|---|---|
| Size (byte) | 1 | 2 | 2 | N | 2 | 2 |

(1) Characteristic of ASCII mode
  a) In the ASCII mode, start of frame is indicated with colon (:), which is ASCII code, and end of frame is indicated with ‘CRLF’.
  b) Each character allows maximum 1s interval.
  c) How to check the error uses LRC, it takes 2’s complement except frame of start and end and converts it as ASCII conversion.

(2) Address area
  a) It consists of 2 byte.
  b) When using the XGT Cnet I/F module, range of station is 0~31.
  c) Station number 0 is used for client.
  d) When server responds, it contains self address to response frame to know client’s response.

(3) Data area
  a) Transmits the data by using the ASCII data, data structure changes according to function code.
  b) In case of receiving normal frame, it responds as normal response.
  c) In case of receiving abnormal frame, it responds by using error code.

(4) Error check area
  How to check error of frame takes 2’s complement except start and end of frame and converts it as ASCII.

### 2) Frame structure in RTU mode

Frame structure in the RTU mode is as follows.

| Classification | Start | Station number | Function code | Data | Error check | End |
|---|---|---|---|---|---|---|
| size(byte) | Idle time | 1 | 1 | N | 2 | Idle time |

(1) Characteristic of RTU mode
- a) It uses hexadecimal.
- b) Start character is station number and frame is classified by CRC error check.
- c) Start and end of frame is classified by adding idle time of 1 bit.
- d) Between frames, there is interval of 3.5 character time. When exceeding 1.5 character time, it is acknowledged as independent frame.

(2) Address area
- a) It consists of 1 byte.
- b) When using the XGT Cnet I/F module, range of station is 0~31.
- c) Station number 0 is used for client.
- d) When server responds, it contains self address to response frame to know client's response.

(3) Data area
- a) Transmits the data by using the Hex. data, data structure changes according to function code.
- b) In case of receiving normal frame, it responds as normal response.
- c) In case of receiving abnormal frame, it responds by using error code.

(4) Error check area

It determines if frame is normal or not by using CRC check of 2 byte.

### 3) Modbus address rules

The address in the data starts from 0 and is equal to the value obtained by subtracting 1 from the modbus memory. That is, Modbus address 2 is the same as address 1 in the data.

### 4) Expression of data and address

To express data and address of modbus protocol, the characteristic is as follows.
(1) It used hexadecimal as basic form.
(2) In the ASCII mode, Hex data is converted into ASCII code.
(3) RTU mode uses Hex data.
(4) Each function code has following meaning.

| Code(Hex) | Purpose | Used area | address | Max. response data |
|---|---|---|---|---|
| 01 | Read Coil Status | Bit output | 0XXXX | 2000bit |
| 02 | Read Input Status | Bit input | 1XXXX | 2000bit |
| 03 | Read Holding Registers | Word output | 4XXXX | 125word |
| 04 | Read Input Registers | Word input | 3XXXX | 125word |
| 05 | Force Single Coil | Bit output | 0XXXX | 1bit |
| 06 | Preset Single Register | Word output | 4XXXX | 1word |
| 0F | Force Multiple Coils | Bit output | 0XXXX | 1968bit |
| 10 | Preset Multiple Registers | Word output | 4XXXX | 120word |

### 2.9.3 Modbus Instruction

1) Reading data of bit type at the bit output (01)

(1) Reading bit of output area (function code: 01)

In case of reading data of bit type, request and response frame is as follows.
Detail of frame is applied in case of ASCII mode.

(a) Request frame

| Frame | Station no. | Function code (01) | Address | Data size | Frame error check | Tail (CRLF) |
|---|---|---|---|---|---|---|
| Size (byte) | 1 | 1 | 2 | 2 | 2 | 2 |

(b) Response frame (In case of receiving normal frame)

| Frame | Station no. | Function code (01) | No. of byte | Data | Frame error check | Tail (CRLF) |
|---|---|---|---|---|---|---|
| Size (byte) | 1 | 1 | 2 | N | 2 | 2 |

(c) In case of response frame (In case of receiving abnormal frame)

| Frame | Station no. | Error code | Exceptional code | Tail (CRLF) |
|---|---|---|---|---|
| Size (byte) | 1 | 1 | 1 | 2 |

(2) Details of frame

(a) Station no.: indicates the station no. of slave to read bit of output area.
(b) Function code: ‘01’ indicating Read Coil Status
(c) Address: start address of data to read and it consists of 2 byte. At this time, start address conforms to modbus address regulation.
(d) Data size: size of data to read and it consists of 2 byte.
(e) Frame error check: in case of ASCII mode, it uses LRC and in case of STU mode, it uses CRC. It consists of 2 byte.
(f) Tail: it is applies in case of ASCII mode, CRLF is added after LRC.
(g) No. of byte: no. of byte of response data
(h) Data: makes address of request frame as start address and transmits data with byte unit
(i) Error code: error code is expressed by adding 80(Hex) to function code and in case of reading bit of output area, it is expressed as 81(Hex).
(j) Exceptional code: indicates detail of error and consists of 1 byte

(3) Frame example

Example that requests reading bit of 20~28 to station number 1 server acting as modbus RTU mode

(a) Request frame

| Classification | Station no. | Function code | Address | | Data size | | Error check |
|---|---|---|---|---|---|---|---|
| | | | Upper byte | Lower byte | Upper byte | Lower byte | |
| Frame | 01 | 01 | 00 | 13 | 00 | 13 | CRC |

(b) Response frame (In case receiving normal frame)

| Classification | Station no. | Function code | No. of byte | Data | | | Error check |
|---|---|---|---|---|---|---|---|
| Frame | 01 | 01 | 03 | 12 | 31 | 05 | CRC |

(c) Response frame (In case of receiving abnormal frame)

| Classification | Station no. | Function code | Exceptional code | Error check |
|---|---|---|---|---|
| Frame | 01 | 81 | 02 | CRC |

## 2) Reading data of bit type at the bit input (02)

### (1) Reading bit of input area

In case of reading data of bit type of input area, request and response frame is as follows.
Tail of frame is applied in case of ASCII mode.

(a) Request frame

| Classification | Station no. | Function code (02) | Address | Data size | Frame error check | Tail (CRLF) |
|---|---|---|---|---|---|---|
| Size (byte) | 1 | 1 | 2 | 2 | 2 | 2 |

(b) Response frame (In case of receiving normal frame)

| Classification | Station no. | Function code (02) | No. of byte | Data | Frame error check | Tail (CRLF) |
|---|---|---|---|---|---|---|
| Size (byte) | 1 | 1 | 2 | N | 2 | 2 |

(c) Response frame (In case of receiving abnormal frame)

| Classification | Station no. | Error code | Exceptional code | Tail (CRLF) |
|---|---|---|---|---|
| Size (byte) | 1 | 1 | 1 | 2 |

### (2) Details of frame

(a) Station no.: indicates station no. of slave to read bit of input area
(b) Function code: ‘02’ indicating Read Input Status
(c) Address: indicating start address of data to read. It consists of 2 byte. At this time, start address conforms to modbus address regulation.
(d) Data size: size of data to read, consists of 2 byte
(e) Frame error check: in case of ASCII mode, it uses LRC and in case of STU mode, it uses CRC for error check. It consists of 2 byte.
(f) Tail: it is applied in case of ASCII mode, CRLF is added after LRC.
(g) No. of byte: no. of byte of data responding
(h) Data: address of request frame is start address and transmits data with byte unit.
(i) Error code: Error code is expressed by adding 80(Hex) and in case of reading bit of output area, it is expressed 82(Hex).
(j) Exceptional code: details of error, consists of 1 byte.

### (3) Frame example

Example that reads bit (20~38) from station number 1 server acting as modbus RTU

(a) Request frame

| Classification | Station no. | Function code | Address | | Data size | | Error check |
|---|---|---|---|---|---|---|---|
| | | | Upper byte | Lower byte | Upper byte | Lower byte | |
| Frame | 01 | 02 | 00 | 13 | 00 | 13 | CRC |

(b) Response frame (When receiving normal frame)

| Classification | Station no. | Function code | No. of byte | Data | | | Error check |
|---|---|---|---|---|---|---|---|
| Frame | 01 | 02 | 03 | 12 | 31 | 05 | CRC |

(c) Response frame (When receiving abnormal frame)

| Classification | Station no. | Function code | Exceptional code | Error check |
|---|---|---|---|---|
| Frame | 1 | 82 | 2 | CRC |

### 3) Reading data of word type at the word output (03)

(1) Reading word of output area

When reading data of word type of output area, request and response frame is as follows.

Tail of frame is applied in case of ASCII mode.

(a) Request frame

| Classification | Station no. | Function code (03) | Address | Data size | Frame error check | Tail (CRLF) |
|---|---|---|---|---|---|---|
| Size (byte) | 1 | 1 | 2 | 2 | 2 | 2 |

(b) Response frame (When receiving normal frame)

| Classification | Station no. | Function code (03) | No. of byte | Data | Frame error check | Tail (CRLF) |
|---|---|---|---|---|---|---|
| Size (Byte) | 1 | 1 | 2 | N*2 | 2 | 2 |

(c) Response frame (When receiving abnormal frame)

| Classification | Station no. | Error code | Exceptional code | Tail (CRLF) |
|---|---|---|---|---|
| Size (byte) | 1 | 1 | 1 | 2 |

(2) Details of frame

(a) Station no.: indicates the station no. of slave to read word data of output area.

(b) Function code: '03' indicating Read Holding Registers

(c) Address: indicating start address of data to read. It consists of 2 byte. At this time, start address conforms to modbus address regulation.

(d) Data size: size of data to read, consists of 2 byte

(e) Frame error check: in case of ASCII mode, it uses LRC and in case of STU mode, it uses CRC for error check. It consists of 2 byte.

(f) Tail: it is applied in case of ASCII mode, CRLF is added after LRC.

(g) No. of byte: no. of byte of data responding

(h) Data: address of request frame is start address and transmits data with byte unit. At this time, since data is word type, it is double of no. of byte.

(i) Error code: error code is expressed by adding 80(Hex) and in case of reading word of output area, it is expressed 83(Hex).

(j) Exceptional code: details of error, consists of 1 byte.

(3) Frame example

Example that reads word (108~110) from station number 1 server acting as modbus RTU

(a) Request frame

| Classification | Station no. | Function code | Address | | Data size | | Error check |
|---|---|---|---|---|---|---|---|
| | | | Upper byte | Lower byte | Upper byte | Lower byte | |
| Frame | 01 | 03 | 00 | 6B | 00 | 03 | CRC |

(b) Response frame (receiving normal frame)

| Classification | Station no. | Function code | No. of byte | Data | | | | | | Error check |
|---|---|---|---|---|---|---|---|---|---|---|
| Frame | 01 | 03 | 06 | 13 | 12 | 3D | 12 | 40 | 4F | CRC |

(c) Response frame (receiving abnormal frame)

| Classification | Station no. | Function code | Exceptional code | Error check |
|---|---|---|---|---|
| Frame | 01 | 83 | 04 | CRC |

## 4) Reading data of word type at the word input (04)

(1) Reading word of input area

In case of reading word of input area, request and response frame is as follows.
Tail of frame is applied in case of ASCII mode.

(a) Request frame

| Classification | Station no. | Function code (04) | Address | Data size | Frame error check | Tail (CRLF) |
|---|---|---|---|---|---|---|
| Size (byte) | 1 | 1 | 2 | 2 | 2 | 2 |

(b) Response frame (In case of receiving normal frame)

| Classification | Station no. | Function code (04) | No. of byte | Data | Frame error check | Tail (CRLF) |
|---|---|---|---|---|---|---|
| Size (byte) | 1 | 1 | 2 | N*2 | 2 | 2 |

(c) In case of response frame (In case of receiving abnormal frame)

| Classification | Station no. | Error code | Exceptional code | Tail (CRLF) |
|---|---|---|---|---|
| Size (byte) | 1 | 1 | 1 | 2 |

(2) Details of frame

(a) Station no.: indicates the station no. of slave to read word of input area.
(b) Function code: '04' indicating Read Input Registers
(c) Address: start address of data to read and it consists of 2 byte. At this time, start address conforms to modbus address regulation.
(d) Data size: size of data to read and it consists of 2 byte.
(e) Frame error check: in case of ASCII mode, it uses LRC and in case of STU mode, it uses CRC. It consists of 2 byte.
(f) Tail: it is applies in case of ASCII mode, CRLF is added after LRC.
(g) No. of byte: no. of byte of response data
(h) Data: makes address of request frame as start address and transmits data with byte unit. At this time, since data is word type, it is double of no. of byte.
(i) Error code: error code is expressed by adding 80(Hex) to function code and in case of reading word of input area, it is expressed as 84(Hex).
(j) Exceptional code: indicates detail of error and consists of 1 byte

(3) Frame example

Example that requests reading word of 9 to station number 1 server acting as modbus RTU mode

(a) Request frame

| Classification | Station no. | Function code | Address | | Data size | | Error check |
|---|---|---|---|---|---|---|---|
| | | | Upper byte | Lower byte | Upper byte | Lower byte | |
| Frame | 01 | 04 | 00 | 08 | 00 | 01 | CRC |

(b) Response frame (In case receiving normal frame)

| Classification | Station no. | Function code | No. of byte | Data | | Error check |
|---|---|---|---|---|---|---|
| Frame | 01 | 04 | 02 | 00 | 0A | CRC |

(c) Response frame (In case of receiving abnormal frame)

| Classification | Station no. | Function code | Exceptional code | Error check |
|---|---|---|---|---|
| Frame | 01 | 84 | 04 | CRC |

### 5) Individual writing data of bit type at the bit output (05)

(1) Individual writing bit of output area

When writing single bit of output area, request and response frame is as follows.
Tail of frame is applied in case of ASCII mode.

(a) Request frame

| Classification | Station no. | Function code (05) | Address | Output | Frame error check | Tail (CRLF) |
|---|---|---|---|---|---|---|
| Size (byte) | 1 | 1 | 2 | 2 | 2 | 2 |

(b) Response frame (In case of receiving normal frame)

| Classification | Station no. | Function code (05) | Address | Output | Frame error check | Tail (CRLF) |
|---|---|---|---|---|---|---|
| Size (byte) | 1 | 1 | 2 | 2 | 2 | 2 |

(c) In case of response frame (In case of receiving abnormal frame)

| Classification | Station no. | Error code | Exceptional code | Tail (CRLF) |
|---|---|---|---|---|
| Size (byte) | 1 | 1 | 1 | 2 |

(2) Details of frame

(a) Station no.: indicates the station no. of slave to write single bit of output area.
(b) Function code: '05' indicating Force Single Coil
(c) Address: start address of data to write and it consists of 2 byte. At this time, start address conforms to modbus address regulation.
(d) Output: in case of turning on address set in the Address, FF00(Hex) is indicated and in case of turning off addres set in the Address, it is indicated 0000(Hex).
(e) Frame error check: in case of ASCII mode, it uses LRC and in case of STU mode, it uses CRC. It consists of 2 byte.
(f) Tail: it is applies in case of ASCII mode, CRLF is added after LRC.
(g) No. of byte: no. of byte of response data
(h) Error code: error code is expressed by adding 80(Hex) to function code and in case of Force Single Coil, it is expressed as 85(Hex).
(i) Exceptional code: indicates detail of error and consists of 1 byte

(3) Frame example

Example that turning on 9th bit to station number 1 server acting as Modbus RTU mode

(a) Request frame

| Classification | Station no. | Function code | Address | | Output | | Error check |
|---|---|---|---|---|---|---|---|
| | | | Upper byte | Lower byte | Upper byte | Lower byte | |
| Frame | 01 | 05 | 00 | 08 | FF | 00 | CRC |

(b) Response frame (In case receiving normal frame)

| Classification | Station no. | Function code | Address | | Output | | Error check |
|---|---|---|---|---|---|---|---|
| | | | Upper byte | Lower byte | Upper byte | Lower byte | |
| Frame | 01 | 05 | 00 | 08 | FF | 00 | CRC |

(c) Response frame (In case of receiving abnormal frame)

| Classification | Station no. | Function code | Exceptional code | Error check |
|---|---|---|---|---|
| Frame | 01 | 85 | 04 | CRC |

### 6) Individual writing data of word type at the word output (06)

(1) Individual writing word of output area

In case of writing single word to output area, request and response frame is as follows.
Detail of frame is applied in case of ASCII mode.

a) Request frame

| Classification | Station no. | Function code (06) | Address | Output | Frame error check | Tail (CRLF) |
|---|---|---|---|---|---|---|
| Size (byte) | 1 | 1 | 2 | 2 | 2 | 2 |

b) Response frame (In case of receiving normal frame)

| Classification | Station no. | Function code (06) | Address | Output | Frame error check | Tail (CRLF) |
|---|---|---|---|---|---|---|
| Size (byte) | 1 | 1 | 2 | 2 | 2 | 2 |

c) In case of response frame (In case of receiving abnormal frame)

| Classification | Station no. | Error code | Exceptional code | Tail (CRLF) |
|---|---|---|---|---|
| Size (byte) | 1 | 1 | 1 | 2 |

(2) Details of frame

(a) Station no.: indicates the station no. of slave to write single word of output area.

(b) Function code: '06' indicating Preset Single Register

(c) Address: start address of data to write and it consists of 2 byte. At this time, start address conforms to modbus address regulation.

(d) Output: data value to write in the address set in the Address.

(e) Frame error check: in case of ASCII mode, it uses LRC and in case of STU mode, it uses CRC. It consists of 2 byte.

(f) Tail: it is applies in case of ASCII mode, CRLF is added after LRC.

(g) No. of byte: no. of byte of response data

(h) Error code: error code is expressed by adding 80(Hex) to function code and in case of writing single word of output area, it is expressed as 86(Hex).

(i) Exceptional code: indicates detail of error and consists of 1 byte

(3) Frame example

Example writing 0003(Hex) to 9th word of station number 1 server acting as modbus RTU mode

(a) Request frame

| Classification | Station no. | Function code | Address | | Output | | Error check |
|---|---|---|---|---|---|---|---|
| | | | Upper byte | Lower byte | Upper byte | Lower byte | |
| Frame | 01 | 06 | 00 | 08 | 00 | 03 | CRC |

(b) Response frame (In case receiving normal frame)

| Classification | Station no. | Function code | Address | | Output | | Error check |
|---|---|---|---|---|---|---|---|
| | | | Upper byte | Lower byte | Upper byte | Lower byte | |
| Frame | 01 | 06 | 00 | 08 | 00 | 03 | CRC |

(c) Response frame (In case of receiving abnormal frame)

| Classification | Station no. | Function code | Exceptional code | Error check |
|---|---|---|---|---|
| Frame | 01 | 86 | 02 | CRC |

### 7) Continuous writing data of bit type at the bit output (0F)

(1) Continuous writing bit of output area

In case of writing continuous bit to output area, request and response frame is as follows.
Tail of frame is applied in case of ASCII mode.

(a) Request frame

| Classification | Station no. | Function code (0F) | Address | No. of output | Data size | Output | Frame error check | Tail (CRLF) |
|---|---|---|---|---|---|---|---|---|
| Size (byte) | 1 | 1 | 2 | 2 | 1 | N | 2 | 2 |

(b) Response frame (In case of receiving normal frame)

| Classification | Station no. | Function code (0F) | Address | No. of output | Frame error check | Tail (CRLF) |
|---|---|---|---|---|---|---|
| Size (byte) | 1 | 1 | 2 | 2 | 2 | 2 |

(c) In case of response frame (In case of receiving abnormal frame)

| Classification | Station no. | Error code | Exceptional code | Tail (CRLF) |
|---|---|---|---|---|
| Size (byte) | 1 | 1 | 1 | 2 |

(2) Details of frame

(a) Station no.: indicates the station no. of slave to write continuous bit of output area.
(b) Function code: '06' indicating Force Multiple Coils
(c) Address: start address of data to read and it consists of 2 byte. At this time, start address conforms to Modbus address regulation.
(d) No. of output: no. of output to write and it consists of 2 byte
Ex.) When writing 10 continuous data from address number 20, no. of output is 000A(Hex)
(e) Data size: indicates no. of output as byte. Namely, in case data size is 1, no. of data is 9.
Ex.) In case of writing 10 continuous bits, data size is 2.
(f) Output: data value to write in the address set in the Address.
(g) Frame error check: in case of ASCII mode, it uses LRC and in case of STU mode, it uses CRC. It consists of 2 byte.
(h) Tail: it is applies in case of ASCII mode, CRLF is added after LRC.
(i) No. of byte: no. of byte of response data
(j) Error code: error code is expressed by adding 80(Hex) to function code and in case of writing continuous bit of output area, it is expressed as 8F(Hex).
(k) Exceptional code: indicates detail of error and consists of 1 byte.

(3) Frame example

Example writing 10 continuous bits starting 20th address of 1 server acting as Modbus RTU mode

Ex.) Data value to write continuously

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bit value | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Hex | C | | | | D | | | | 0 | | | | 1 | | | |
| Address | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | - | - | - | - | - | - | 29 | 28 |

(a) Request frame

| Classification | Station no. | Function code | Address | | No. of output | | Data size | Output | | Error check |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Upper byte | Lower byte | Upper byte | Lower byte | | Upper byte | Lower byte | |
| Frame | 01 | 0F | 00 | 13 | 00 | 0A | 02 | CD | 01 | CRC |

(b) Response frame (In case receiving normal frame)

| Classification | Station no. | Function code | Address | | No. of output | | Error check |
|---|---|---|---|---|---|---|---|
| | | | Upper byte | Lower byte | Upper byte | Lower byte | |
| Frame | 01 | 04 | 00 | 13 | 00 | 0A | CRC |

(c) Response frame (In case of receiving abnormal frame)

| Classification | Station no. | Function code | Exceptional code | Error check |
|---|---|---|---|---|
| Frame | 01 | 8F | 01 | CRC |

### 8) Continuous writing data of word type at the word output (10)

(1) Continuous writing word of output area

In case of writing word continuously to output area, request and response frame is as follows.
Tail of frame is applied in case of ASCII mode.

(a) Request frame

| Classification | Station no. | Function code (10) | Address | No. of output | Data size | Output | Frame error check | Tail (CRLF) |
|---|---|---|---|---|---|---|---|---|
| Size (byte) | 1 | 1 | 2 | 2 | 1 | N*2 | 2 | 2 |

(b) Response frame (In case of receiving normal frame)

| Classification | Station no. | Function code (10) | Address | No. of output | Frame error check | Tail (CRLF) |
|---|---|---|---|---|---|---|
| Size (byte) | 1 | 1 | 2 | 2 | 2 | 2 |

(c) In case of response frame (In case of receiving abnormal frame)

| Classification | Station no. | Error code | Exceptional code | Tail (CRLF) |
|---|---|---|---|---|
| Size (byte) | 1 | 1 | 1 | 2 |

(2) Details of frame

(a) Station no.: indicates the station no. of slave to write continuous word of output area.
(b) Function code: ‘10’ indicating Preset Multiple Registers
(c) Address: start address of data to read and it consists of 2 byte. At this time, start address conforms to modbus address regulation.
(d) No. of output: no. of output to write and it consists of 2 byte
Ex.) When writing 10 continuous data from address number 20, no. of output is 000A(Hex)
(e) Data size: indicates no. of output as byte. Since data type is word, in case of writing data of 1 word, data size is 2.
(f) Output: data value to write in the address set in the Address.
(g) Frame error check: in case of ASCII mode, it uses LRC and in case of STU mode, it uses CRC. It consists of 2 byte.
(h) Tail: it is applies in case of ASCII mode, CRLF is added after LRC.
(i) No. of byte: no. of byte of response data
(j) Error code: error code is expressed by adding 80(Hex) to function code and in case of writing continuous word of output area, it is expressed as 90(Hex).
(k) Exceptional code: indicates detail of error and consists of 1 byte.

(3) Frame example

Example writing continuous 2 words starting 20th address of server 1acting as Modbus RTU mode

Ex.) value to write continuously

| Hex | C | D | 0 | 1 | 0 | 0 | 0 | A |
|---|---|---|---|---|---|---|---|---|
| Address | 20 | | | | 21 | | | |

(a) Request frame

| Classification | Station no. | Function code | Address | | No. of output | | Data size | Output | | | | Error check |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Upper byte | Lower byte | Upper byte | Lower byte | | | | | | |
| Frame | 01 | 10 | 00 | 13 | 00 | 02 | 04 | CD | 01 | 00 | 0A | CRC |

(b) Response frame (In case receiving normal frame)

| Classification | Station no. | Function code | Address | | No. of output | | Error check |
|---|---|---|---|---|---|---|---|
| | | | Upper byte | Lower byte | Upper byte | Lower byte | |
| Frame | 01 | 10 | 00 | 13 | 00 | 02 | CRC |

(c) Response frame (In case of receiving abnormal frame)

| Classification | Station no. | Function code | Exceptional code | Error check |
|---|---|---|---|---|
| Frame | 01 | 90 | 01 | CRC |

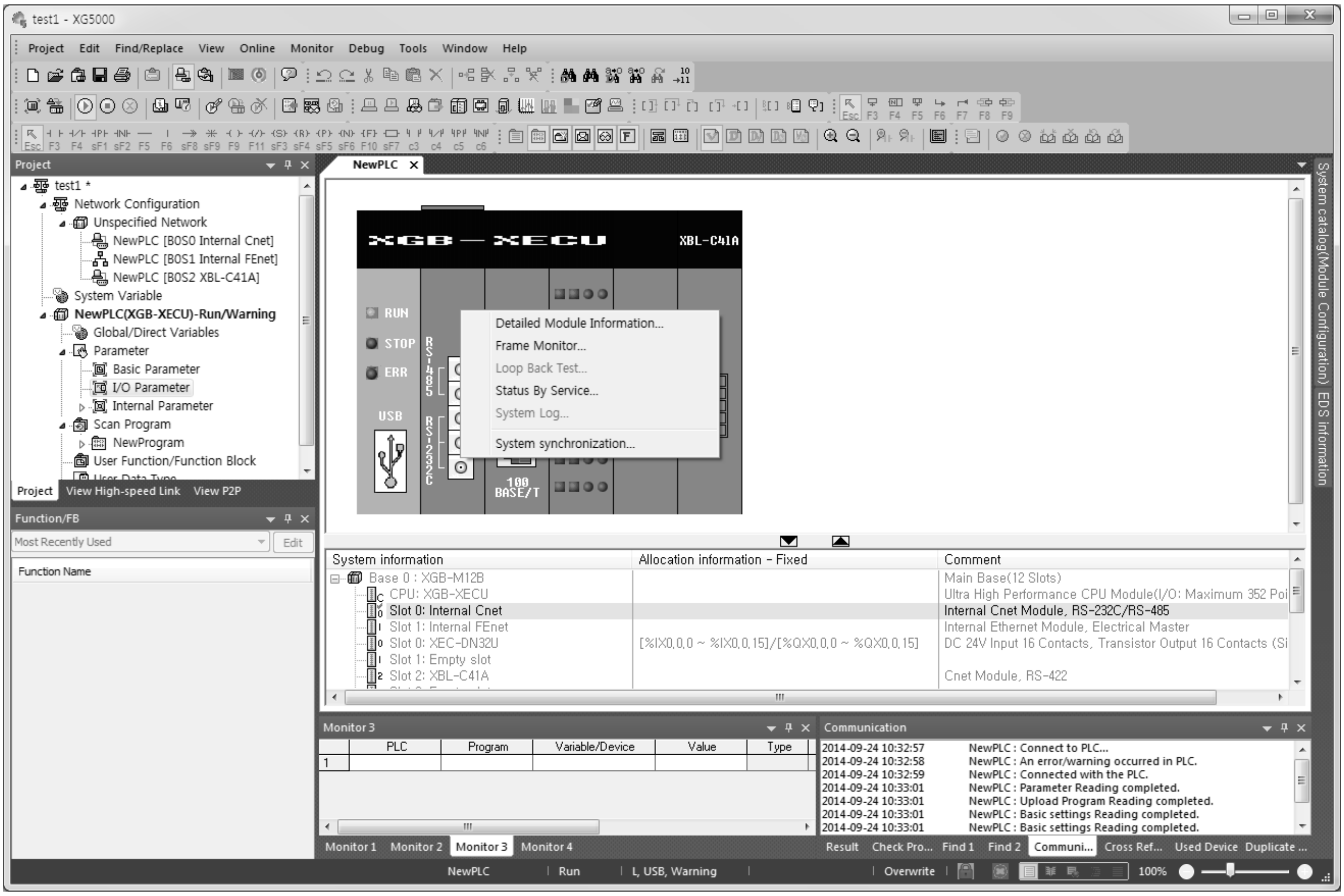
## 2.10 Diagnosis Function

With XG5000 used, the status of the system and the network can be checked and diagnosed.
Diagnosis function is composed as described below

▶ CPU module information
▶ Communication module information
▶ Frame monitor
▶ Status by service

### 2.10.1 Diagnosis Function of XG5000

How to diagnosis system and network status by XG5000 system diagnosis are described below.
Connect XG5000 to loader port of main unit and if you select “Online -> Communication module setting -> System Diagnosis”, the following window is created.

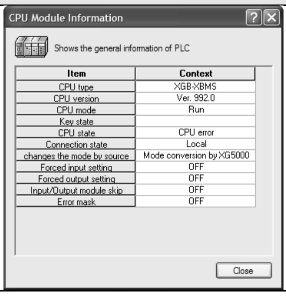


| System information | Allocation information - Fixed | Comment |
|---|---|---|
| Base 0 : XGB-M12B | | Main Base(12 Slots) |
| CPU: XGB-XECU | | Ultra High Performance CPU Module(I/O: Maximum 352 Poi |
| Slot 0: Internal Cnet | | Internal Cnet Module, RS-232C/RS-485 |
| Slot 1: Internal FEnet | | Internal Ethernet Module, Electrical Master |
| Slot 0: XEC-DN32U | [%IX0,0,0 ~ %IX0,0,15]/[%QX0,0,0 ~ %QX0,0,15] | DC 24V Input 16 Contacts, Transistor Output 16 Contacts (Si |
| Slot 1: Empty slot | | |
| Slot 2: XBL-C41A | | Cnet Module, RS-422 |

```
2014-09-24 10:32:57        NewPLC : Connect to PLC...
2014-09-24 10:32:58        NewPLC : An error/warning occurred in PLC.
2014-09-24 10:32:59        NewPLC : Connected with the PLC.
2014-09-24 10:33:01        NewPLC : Parameter Reading completed.
2014-09-24 10:33:01        NewPLC : Upload Program Reading completed.
2014-09-24 10:33:01        NewPLC : Basic settings Reading completed.
2014-09-24 10:33:01        NewPLC : Basic settings Reading completed.
```

- Select [Online] – [Communication module setting] – [System Dianosis] and click the icon ( ).
- Click the right button on the the relevant module and click Frame Monitor or Status By Service to check.

1) Checking status of main unit

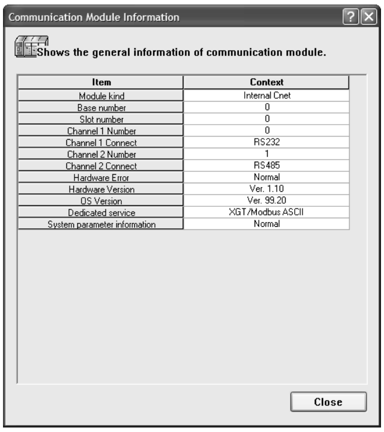
<table>
<tr><th>Check list</th><th>Detail result</th></tr>
<tr><td>CPU<br>Module information</td><td></td></tr>
<tr><td colspan="2">1. Select [Online] – [Communication module setting] – [System Diagnosis] or click the icon ( ).<br>2. You can check the status of main unit by clicking CPU module information after clicking main unit.</td></tr>
</table>

CPU Module Information

Shows the general information of PLC

| Item | Context |
|---|---|
| CPU type | XGB-XBMS |
| CPU version | Ver. 992.0 |
| CPU mode | Run |
| Key state | |
| CPU state | CPU error |
| Connection state | Local |
| changes the mode by source | Mode conversion by XG5000 |
| Forced input setting | OFF |
| Forced output setting | OFF |
| Input/Output module skip | OFF |
| Error mask | OFF |

1) Communication module information

<table>
<tr><th>Check list</th><th>Detail result</th></tr>
<tr><td>Communication<br>module<br>information</td><td></td></tr>
<tr><td colspan="2">1. Select [Online] – [Communication module setting] – [System Diagnosis] or click the icon ( ).<br>2. You can check communication module status by clicking communication module information and click the right button after clicking Cnet I/F module and built-in communication.<br>3. Meaning of each item of communication module information is as follows.</td></tr>
</table>

Communication Module Information

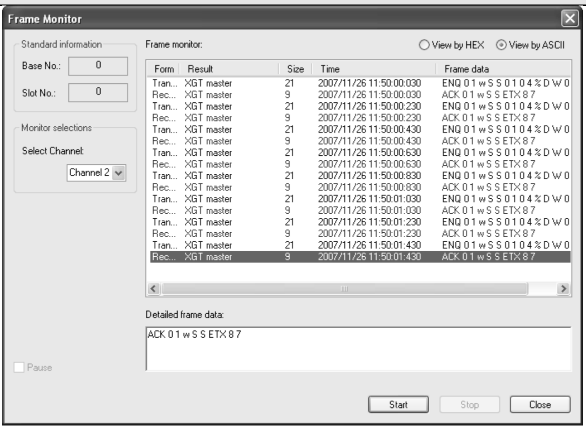
Shows the general information of communication module.

| Item | Context |
|---|---|
| Module kind | Internal Cnet |
| Base number | 0 |
| Slot number | 0 |
| Channel 1 Number | 0 |
| Channel 1 Connect | RS232 |
| Channel 2 Number | 1 |
| Channel 2 Connect | RS485 |
| Hardware Error | Normal |
| Hardware Version | Ver. 1.10 |
| OS Version | Ver. 99.20 |
| Dedicated service | XGT/Modbus ASCII |
| System parameter information | Normal |

| Item | Content | Remark |
|---|---|---|
| Module kind | Information of module kind under diagnosis | |
| Base number | Base information of communication module under diagnosis. It is fixed as 0 at XGB PLC. | |
| Slot number | Slot no. of communication module under diagnosis<br>In case of built-in communication, it is fixed as 0. | |
| Station number | Station no. of relevant channel used at dedicated service, P2P | |
| Connection method | Information of communication type (RS-232C, RS-422) of relevant channel | |
| Hardware error | Indicates whether hardware of communication module is normal or not. | |
| Hardware version | Version of communication module hardware | |
| OS version | Indicates version of communication module OS | |
| P2P | Indicates whether P2P communication is activated or not | |
| System parameter information | Whether standard communication parameter is downloaded or not<br>Standard communication parameter error information expression | |

### 2) Frame monitor

The user can check whether frame is normal or not by monitoring TRX frame through Cnet I/F module by XG-PD's frame monitor.

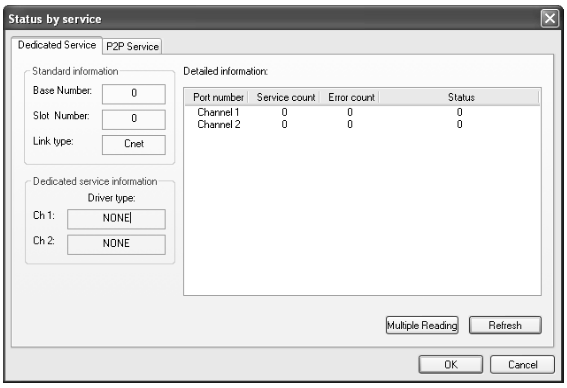
| Check list | Detail result |
|---|---|
| Frame monitor |  |
| 1. Select [Online] – [Communication module setting] – [System Diagnosis] or click the icon ( ).<br>2. If you click right button after clinking Cnet I/F module and click frame monitor, you can monitor current communication data.<br>3. If you use frame monitor function, you can check frame of TRX data between Cnet I/F module and external communication device easily.<br>4. Detailed content of information indicated frame monitor window is as follows. | |

| Form | Result | Size | Time | Frame data |
|---|---|---|---|---|
| Tran... | XGT master | 21 | 2007/11/26 11:50:00:030 | ENQ 0 1 w S S 0 1 0 4 % D W 0 |
| Rec... | XGT master | 9 | 2007/11/26 11:50:00:030 | ACK 0 1 w S S ETX 8 7 |
| Tran... | XGT master | 21 | 2007/11/26 11:50:00:230 | ENQ 0 1 w S S 0 1 0 4 % D W 0 |
| Rec... | XGT master | 9 | 2007/11/26 11:50:00:230 | ACK 0 1 w S S ETX 8 7 |
| Tran... | XGT master | 21 | 2007/11/26 11:50:00:430 | ENQ 0 1 w S S 0 1 0 4 % D W 0 |
| Rec... | XGT master | 9 | 2007/11/26 11:50:00:430 | ACK 0 1 w S S ETX 8 7 |
| Tran... | XGT master | 21 | 2007/11/26 11:50:00:630 | ENQ 0 1 w S S 0 1 0 4 % D W 0 |
| Rec... | XGT master | 9 | 2007/11/26 11:50:00:630 | ACK 0 1 w S S ETX 8 7 |
| Tran... | XGT master | 21 | 2007/11/26 11:50:00:830 | ENQ 0 1 w S S 0 1 0 4 % D W 0 |
| Rec... | XGT master | 9 | 2007/11/26 11:50:00:830 | ACK 0 1 w S S ETX 8 7 |
| Tran... | XGT master | 21 | 2007/11/26 11:50:01:030 | ENQ 0 1 w S S 0 1 0 4 % D W 0 |
| Rec... | XGT master | 9 | 2007/11/26 11:50:01:030 | ACK 0 1 w S S ETX 8 7 |
| Tran... | XGT master | 21 | 2007/11/26 11:50:01:230 | ENQ 0 1 w S S 0 1 0 4 % D W 0 |
| Rec... | XGT master | 9 | 2007/11/26 11:50:01:230 | ACK 0 1 w S S ETX 8 7 |
| Tran... | XGT master | 21 | 2007/11/26 11:50:01:430 | ENQ 0 1 w S S 0 1 0 4 % D W 0 |
| Rec... | XGT master | 9 | 2007/11/26 11:50:01:430 | ACK 0 1 w S S ETX 8 7 |

Detailed frame data: ACK 0 1 w S S ETX 8 7

| Item | | Content | Remark |
|---|---|---|---|
| Standard information | Base No. | Information of base number under diagnosis | |
| | Slot No. | Information of slot number under diagnosis | |
| Monitor selections | Select Channel | Select channel to monitor | |
| Frame monitor window | Form | Indicates whether it is TX or RX frame. | |
| | Result | Indicates the protocol type<br>1) XGT server<br>2) XGT client<br>3) Modbus server<br>4) Modbus client<br>5) User definition frame<br>6) Unknown: frame that Cnet can't deal with | |
| | Size | Size of frame | |
| | Time | Time when sending/receiving the frame<br>In case main unit is standard type (XBM-D***S), it indicates elapsed time from start. | |
| | Frame data | Indicates the frame data | |
| View by HEX | | Indicates the frame data as HEX | |
| View by ASCII | | Indicates the frame data as ASCII | |
| Start | | Starts the frame monitor | |
| Stop | | Stops the frame monitor | |
| Close | | Closes the frame monitor window | |

3) Status by service(Dedicated Service)

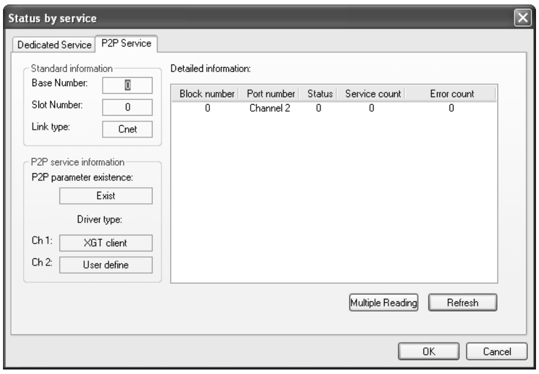
| Check list | Detail result |
|---|---|
| Dedicated service |  |
| 1. Select [Online] – [Communication module setting] – [System Diagnosis] or click the icon ( ).<br>2. Click the right button on the the Cnet I/F module and click Status By Service.<br>3. Click Dedicated Service tap.<br>4. Check the status by service by clicking Multiple Reading and Refresh<br>5. Detailed content of information indicated in dedicated service window is as follows. | |

Base Number: 0
Slot Number: 0
Link type: Cnet
Ch 1: NONE
Ch 2: NONE

| Port number | Service count | Error count | Status |
|---|---|---|---|
| Channel 1 | 0 | 0 | 0 |
| Channel 2 | 0 | 0 | 0 |

| Classification | Item | | Content |
|---|---|---|---|
| Multiple reading/Refresh | Multiple reading | | Checks the dedicated service status every second. |
| | Refresh | | Checks the dedicated service status information at started time |
| Dedicated Service | Standard information | Base Number | Information of base number under diagnosis |
| | | Slot Number | Information of slot number under diagnosis |
| | | Link type | Type of communication module under diagnosis |
| | Dedicated service information | | Drive type by service |
| | Detailed information window | Port number | Channel number |
| | | Service count | Indicates how many dedicated service communication is done |
| | | Error count | Indicates how many error occurs during dedicated service communication |
| | | Status | Indicates status of dedicated service communication |

4) Status by service(P2P Service)

<table>
<tr><th>Check list</th><th>Detail result</th></tr>
<tr><td>P2P service</td><td><br>Status by service<br>Dedicated Service | P2P Service<br>Standard information<br>Base Number: 0<br>Slot Number: 0<br>Link type: Cnet<br>P2P service information<br>P2P parameter existence: Exist<br>Driver type:<br>Ch 1: XGT client<br>Ch 2: User define<br>Detailed information:<br>Block number | Port number | Status | Service count | Error count<br>0 | Channel 2 | 0 | 0 | 0<br>Multiple Reading | Refresh<br>OK | Cancel</td></tr>
<tr><td colspan="2">1. Select [Online] – [Communication module setting] - [System diagnosis] or click the icon ( ▦ ).<br>2. Click the right button on the the Cnet I/F module and click Status By Service.<br>3. Click P2P service of Status by Service<br>4. Click mutiple reading and check Status by Service.</td></tr>
</table>

| Classification | Item | | Contents |
|---|---|---|---|
| P2P service | Standard information | Base number | Information of base number under diagnosis |
| | | Slot number | Information of slot number under diagnosis |
| | | Link type | Type of communication module under diagnosis |
| | P2P service information | P2P parameter existence | Indicates whether P2P parameter exists or not |
| | | Driver type | Indicates the P2P driver by port<br>XGT/Modbus/User definition frame |
| | Detailed information | Block number | Available range:0~63<br>Only block under operation is indicated. |
| | | Port number | Indicates the channel number |
| | | Status | Indicates the status by service |
| | | Service count | Indicates how many P2P service is done. |
| | | Error count | Indicates how many error occurs during service |
| Multiple reading/Refresh | Multiple reading | | Checks the P2P service status every second. |
| | Refresh | | Check the P2P service status when refresh is done. |

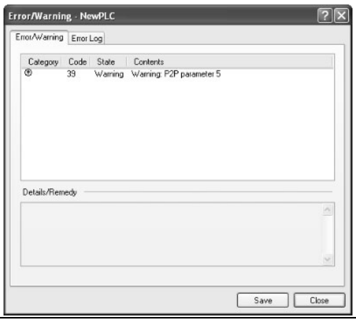
### 5) Service status code

It is used to check whether Cnet I/F module is normal or not.

| Dedicated service | | P2P service | |
|---|---|---|---|
| Status | Meaning | Status | Meaning |
| 0 | Normal | 0 | Normal |
| 1 | Error of RX frame head<br>(There is no ACK/NAK.) | 4 | Error of max. station number<br>(Available range: 0~255) |
| 2 | Error of RX frame tail<br>(There is no tail.) | 5 | Time out |
| 3 | BCC error of RX frame | FFFE | 1. Modbus address error<br>2. Commands except Read/Write are used. |
| 9 | Station number of RX frame is different with self station number (Self station number = 0) | - | |
| 0A | In case of not get response from CPU | | |
| 0B | RX frame size exceeds the modbus max. frame size | | |
| 0C | RX frame is not Modbus ASCII/RTU. | | |
| 0D | HEX conversion error in Modbus | | |

## 2.10.2 Trouble Shooting by Error

1) Trouble shooing when P2P parameter setting error occurs in case of XG5000 connection

| Phenomenon | Reason | Trouble shooting |
|---|---|---|
| P2P setting error warning in case of XG5000 connection<br><br>Error/Warning - NewPLC<br>Category Code State Contents<br>39 Warning Warning: P2P parameter 5<br> | In case of enabling link, the user enabled the link where P2P is not set | 1. In Enable Link menu of XG5000, check P2P setting number and delete P2P number not selected properly.<br>2. After disconnecting XG-PD, connect XG5000 again and check |

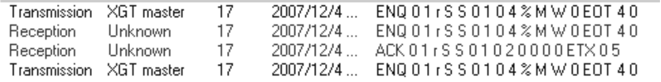
1) Trouble shooting when communication is not done after P2P client setting

| Phenomenon | Reason | Trouble shooting |
|---|---|---|
| Tough communication setting is completed, Tx/Rx LED of Cnet I/F doesn't flicker | In case CPU is stop mode | Connect XG5000 and check CPU mode.<br>If CPU mode is stop, change mode into RUN. |
| | Non-coincidence of communication standard parameter between client and server | Connect XG-PD and click [File] – [Open from PLC]. Check standard settings of module acting as client and server. |
| | Enable Link setting error | After executing P2P parameter, enable right P2P link |

2) Trouble shooting when response frame is missed in case of acting as client and using RS-485

| Phenomenon | Reason | Trouble shooting |
|---|---|---|
| After setting diverse P2P parameter in P2P block, if frame monitor is executed, response frame is missed. | In case P2P conditional flag is faster than communication time | 1. Consider communication time and change P2P conditional flag.<br>2. Communication time: transmission time + reception time<br>- transmission time: conditional flag+CPU Scan Time+reaction time of communication module+data transmission time<br>- reception time: CPU Scan Time + reaction time of communication module+data transmission time |
| | In case that response time of partner is slow. | 1. Increase Delay time in standard settings of XG-PD. |

### 3) Two response frame are dealt with as unknown when executing frame monitor

| Phenomenon | Reason | Trouble shooting |
|---|---|---|
| Two response frame are dealt with as unknown when executing frame monitor<br><br>Transmission XGT master 17 2007/12/4 ... ENQ 0 1 r S S 0 1 0 4 % M W 0 EOT 4 0<br>Reception Unknown 17 2007/12/4 ... ENQ 0 1 r S S 0 1 0 4 % M W 0 EOT 4 0<br>Reception Unknown 17 2007/12/4 ... ACK 0 1 r S S 0 1 0 2 0 0 0 0 ETX 0 5<br>Transmission XGT master 17 2007/12/4 ... ENQ 0 1 r S S 0 1 0 4 % M W 0 EOT 4 0 | Communication type in XG-PD is set as RS-422 but output wiring method is RS-485 | Change communication type as RS-485 and write it to PLC. |

### 4) Unable to analyze TRX frame

| Phenomenon | Reason | Trouble shooting |
|---|---|---|
| Unable to analyze TRX frame | More than one server sends frame | 1. Execute 1:1 communication with server and check if it works properly.<br>2. Take interlock for servers not to sends frame simultaneously. |
| | In case parity bit setting is not coincident | Set the parity bit to be same each other |
| | In case stop bit setting is not coincident | Set the stop bit to be same each other |
| | In case communication speed setting is not coincident | Set the communication speed to be same each other |
| | In case of multi drop, terminal resistance is not installed | Install terminal resistance |

### 5) Unable to know which one is reason of error, client or server

| Phenomenon | Reason | Trouble shooting |
|---|---|---|
| Unable to know which one is reason of error, client or server | - | 1. Check Cnet I/F module<br>- Check module's equipment status<br>- Check wiring<br>2.Check main unit status |

6) Communication is not normal or communication is not executed repeatedly

| Phenomenon | Reason | Trouble shooting |
|---|---|---|
| Communication is not normal or communication is not executed repeatedly | In case of multi drop, More than one server sends frame | 1. Execute 1:1 communication with server and check if it works properly.<br>2. Take interlock for servers to sends frame simultaneously. |
| | Connection error of wiring communication line | Change cable or check connection of cable |
| | In case of RS-485 (Half duplex), non-coincidence of timing of TRX signal | Increase delay time of client and server |
| | 1. When transmission is not complete,<br>it requests next process of transmission<br>2. When reception is not complete, it requests next process of reception | Use handshake in program thoroughly |

# 2.11 Example Program

## 2.11.1 Setting of Cnet I/F Module in the XG5000

Operation of XGT Cnet I/F is divided into P2P service and Server.

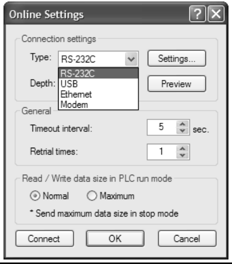
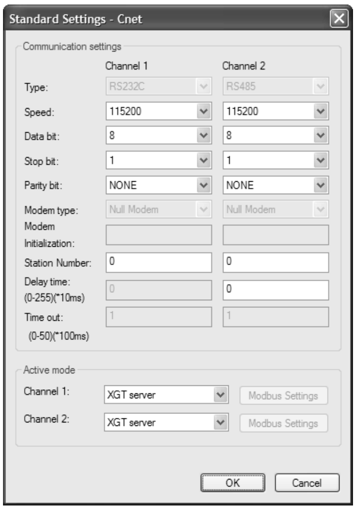
- P2P service: acts as client (master) and request reading/writing.

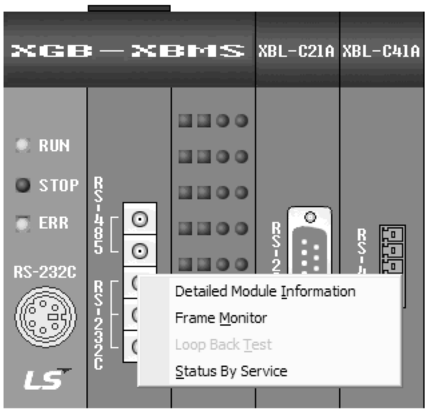
- XGT client
- Modbus RTU/ASCII client
- User frame definition

- Server: acts as server (slave) and acts according to request

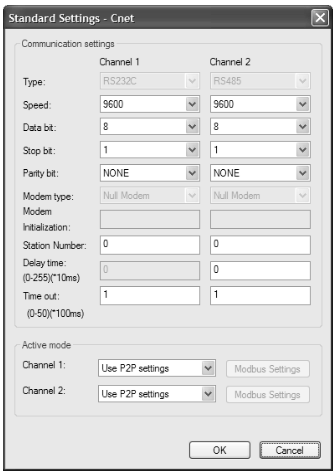
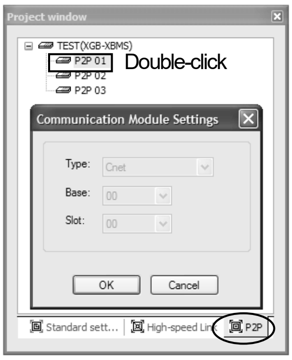
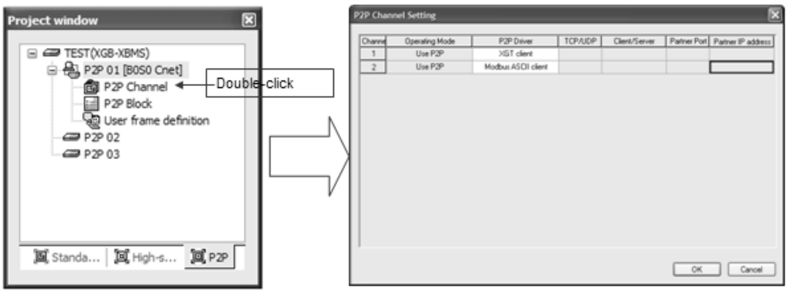
- XGT server
- Modbus RTU server
- Modbus ASCII server

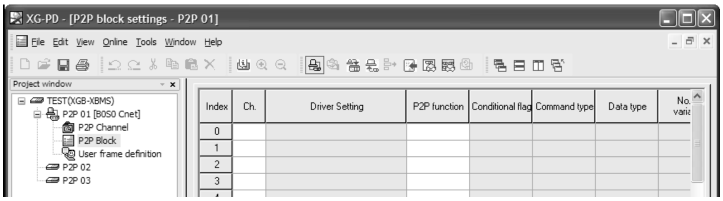
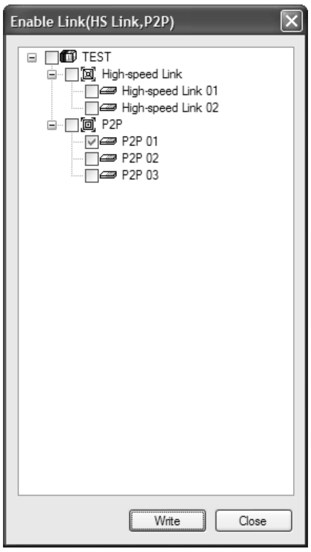
1) In case of acting as server

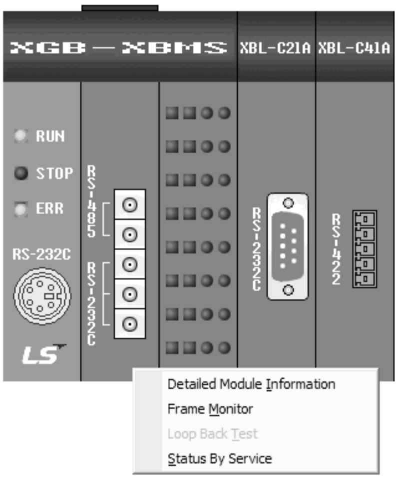
<table>
<tr><th>Sequence</th><th>Procedure</th><th>Setting method</th></tr>
<tr><td rowspan="2">1</td><td>Connection setting</td><td><br>Online Settings<br>Connection settings<br>Type: RS-232C (RS-232C, USB, Ethernet, Modem)<br>Depth:<br>General<br>Timeout interval: 5 sec.<br>Retrial times: 1<br>Read / Write data size in PLC run mode<br>● Normal ○ Maximum<br>* Send maximum data size in stop mode<br> </td></tr>
<tr><td colspan="2">1. Select [Online]-[Connection Settings] or click icon( )<br>2. Click [Connect] after setting.</td></tr>
<tr><td>2</td><td>Read I/O information</td><td>Select [Online] – [Read I/O Information] or click icon ( )<br>Reads the information about currently equipped module.</td></tr>
<tr><td rowspan="2">3</td><td>Standard Settings</td><td><br>Standard Settings - Cnet<br>Communication settings<br>Channel 1 / Channel 2<br>Type: RS232C / RS485<br>Speed: 115200 / 115200<br>Data bit: 8 / 8<br>Stop bit: 1 / 1<br>Parity bit: NONE / NONE<br>Modem type: Null Modem / Null Modem<br>Modem Initialization:<br>Station Number: 0 / 0<br>Delay time: (0-255)(*10ms): 0 / 0<br>Time out: (0-50)(*100ms): 1 / 1<br>Active mode<br>Channel 1: XGT server<br>Channel 2: XGT server<br> </td></tr>
<tr><td colspan="2">1. Double-click Cnet I/F module and execute standard setting window. Set Type, Speed, Data bit, Stop bit, station no. of connection menu.<br>2. Modem initialization is available in case of dial modem, not null modem.<br>3. Delay time setting: when sending frame, it sends frame after specific delay time.<br>(a) Operation setting: Available when type is RS-422/485.<br>* When using as Modbus ASCII server, data bit should be 7.</td></tr>
</table>

| Sequence | Procedure | Setting method |
|---|---|---|
| 4 | Selecting the active mode | 1. Select active mode of server for user to use.<br>2. XGB Cnet I/F module supports XGT server, Modbus ASCII server, Modbus RTU server. |
| 5 | Writing parameter |  |
| | 1. Select [Online] – [Write Parameter] or click icon ( 🖫 )<br>2. Click [OK].<br>3. If you click [OK] button, parameter is sent to PLC.<br>If you don't reset relevant module, XGB Cnet I/F module acts as changed parameter. | |
| 6 | Checking the operation |  |
| | 1. Select [Online] – [System Diagnosis] or click icon ( 🖫 ).<br>2. Click the right button on the relevant module and click Frame Monitor or Status By Service to check | |

1) In case of acting as P2P service (client)

<table>
<tr><th>Sequence</th><th>Procedure</th><th>Setting method</th></tr>
<tr><td>1</td><td>Standard settings</td><td>1. Step 1~3 is same as described above.<br>*In case of ASCII client, data bit should be 7.</td></tr>
<tr><td rowspan="2">2</td><td>Active mode</td><td><br>Standard Settings - Cnet<br>Communication settings: Channel 1 / Channel 2<br>Type: RS232C / RS485<br>Speed: 9600 / 9600<br>Data bit: 8 / 8<br>Stop bit: 1 / 1<br>Parity bit: NONE / NONE<br>Modem type: Null Modem / Null Modem<br>Modem Initialization:<br>Station Number: 0 / 0<br>Delay time: (0-255)(*10ms): 0 / 0<br>Time out: (0-50)(*100ms): 1 / 1<br>Active mode<br>Channel 1: Use P2P settings<br>Channel 2: Use P2P settings</td></tr>
<tr><td colspan="2">1. Select Use P2P settings as active mode.</td></tr>
<tr><td rowspan="2">3</td><td>P2P settings</td><td><br>Double-click<br>Communication Module Settings<br>Type: Cnet<br>Base: 00<br>Slot: 00</td></tr>
<tr><td colspan="2">1. After selecting P2P setting window, double-clock P2P block address and input base and slot no. of communication module.<br>2. P2P 01 is fixed as built-in Cnet and base and slot is fixed as 0 and you can’t change that.</td></tr>
<tr><td rowspan="2">4</td><td>P2P channel setting</td><td><br>Double-click<br>P2P Channel Setting<br>Channel 1: Operating Mode: Use P2P, P2P Driver: XGT client<br>Channel 2: Operating Mode: Use P2P, P2P Driver: Modbus ASCII client</td></tr>
<tr><td colspan="2">1. Double-click P2P driver and select protocol according to each channel.<br>2. P2P driver supports user definition frame, XGT client, Modbus RTU/ASCII client.</td></tr>
</table>

<table>
<tr><th>Sequence</th><th>Procedure</th><th>Setting method</th></tr>
<tr><td rowspan="2">5</td><td>P2P block setting</td><td> </td></tr>
<tr><td colspan="2">1. P2P items are activated differently according to type of client set in the channel.<br>2. Write shell according to protocol<br>* In case of user definition frame, P2P block can be set when user definition frame is written.</td></tr>
<tr><td rowspan="2">6</td><td>Writing parameter</td><td> </td></tr>
<tr><td colspan="2">1. Select [Online] – [Write Parameter] or click icon ( ).<br>2. Click [OK].<br>3. If you press [OK], parameter is sent to PLC.<br>If you don’t reset relevant module, XGB Cnet I/F module acts as changed parameter.</td></tr>
<tr><td rowspan="2">7</td><td>Enabling the link</td><td> </td></tr>
<tr><td colspan="2">1. Select [Online] – [Enable Link] or click icon ( ).<br>2. Click the P2P to enable and click Write.</td></tr>
</table>

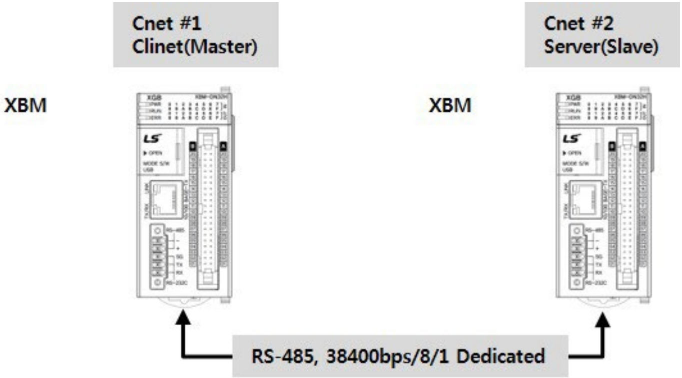
<table>
<tr><th>Sequence</th><th>Procedure</th><th>Setting method</th></tr>
<tr><td rowspan="2">8</td><td>Checking the operation</td><td>
</td></tr>
<tr><td colspan="2">1. Select [Online] – [System Diagnosis] or click icon ( ).<br>2. Click the right button on the relevant module and click Frame Monitor or Status By Service to check.</td></tr>
</table>

## 2.11.2 Dedicated Communication Example

About Dedicated communication

- As defined protocol by LS ELECTRIC, it is classified XGT client and XGT server
- XGT client: requests reading/writing of data to server
- XGT server: responds according to request of client

We assume that system configuration of dedicated service example is as [Figure 2.11.1] and communication setting is as following table.



[Figure 2.11.1] Example of dedicated service system configuration

1) Client setting

| Type | Setting content |
|---|---|
| Main unit | XBM-DN32H |
| Communication module | Main unit built-in (RS-232C) |
| Communication type | RS-232C |
| Communication speed | 38,400 |
| Data bit | 8 |
| Stop bit | 1 |
| Parity bit | - |
| Modem type | Null modem |
| Operation cycle | 1s |

[Table 2.11.1] client setting

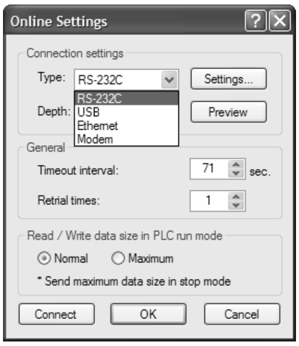
1) Server setting

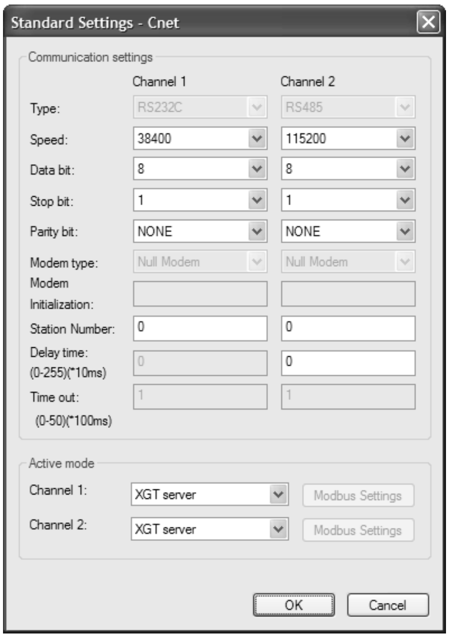
| Type | Setting content |
|---|---|
| Main unit | XBM-DN32H |
| Communication module | Main unit built-in (RS-232C) |
| Communication type | RS-232C |
| Communication speed | 38,400 |
| Data bit | 8 |
| Stop bit | 1 |
| Parity bit | - |
| Modem type | Null modem |
| Station no. | 1 |

[Table 2.11.2] Server setting

### 2) Settings of XGT server

Setting method to operate built-in RS-232C communication channel of Built-n Cnet as server is as follows.

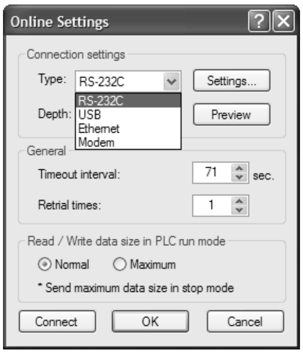
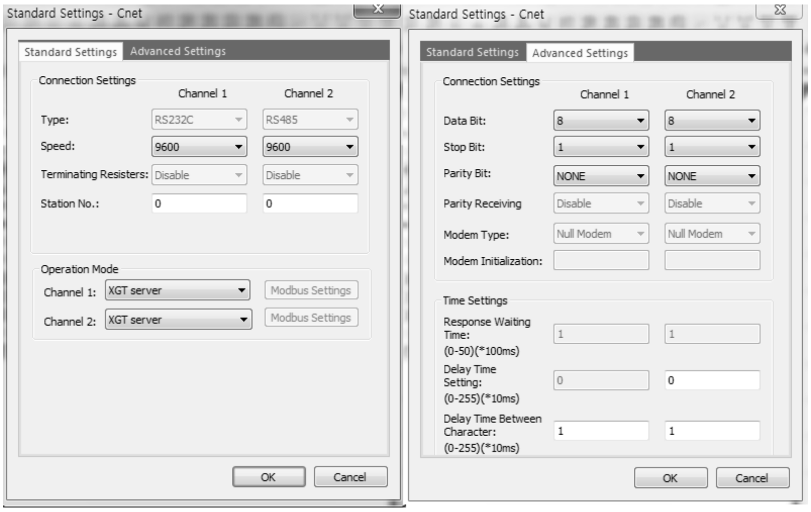
<table>
<tr><th>Sequence</th><th>Procedure</th><th>Setting method</th></tr>
<tr><td rowspan="2">1</td><td>Connection settings</td><td>

Type: RS-232C<br>Timeout interval: 71 sec.<br>Retrial times: 1<br>● Normal ○ Maximum<br>* Send maximum data size in stop mode</td></tr>
<tr><td colspan="2">1. Select [Online]-[Connection settings] and click ( ).<br>2. After setting the connection option according to user, click the ‘connection’.</td></tr>
<tr><td>2</td><td>Reading IO information</td><td>Select [Online]-[Read IO Information] and click icon ( ).<br>IO information of currently mounted is shown on the project window.</td></tr>
<tr><td rowspan="2">3</td><td>Standard settings</td><td>

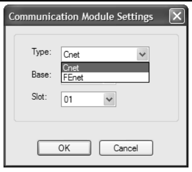
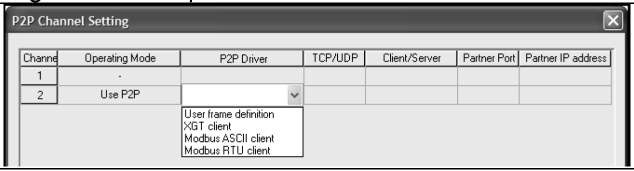
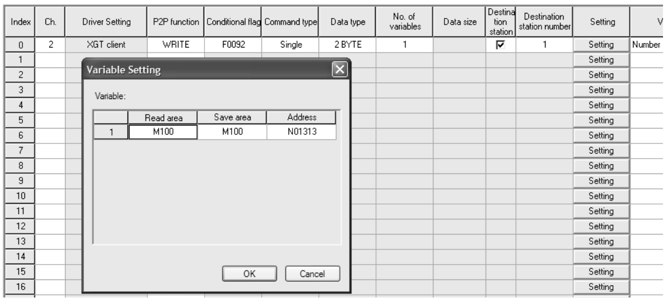
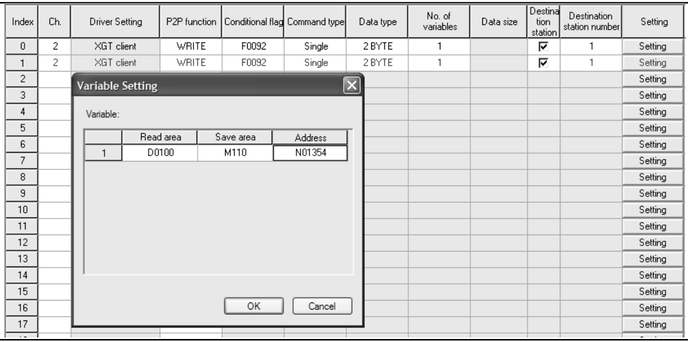
<table>
<tr><th></th><th>Channel 1</th><th>Channel 2</th></tr>
<tr><td>Type:</td><td>RS232C</td><td>RS485</td></tr>
<tr><td>Speed:</td><td>38400</td><td>115200</td></tr>
<tr><td>Data bit:</td><td>8</td><td>8</td></tr>
<tr><td>Stop bit:</td><td>1</td><td>1</td></tr>
<tr><td>Parity bit:</td><td>NONE</td><td>NONE</td></tr>
<tr><td>Modem type:</td><td>Null Modem</td><td>Null Modem</td></tr>
<tr><td>Modem Initialization:</td><td></td><td></td></tr>
<tr><td>Station Number:</td><td>0</td><td>0</td></tr>
<tr><td>Delay time: (0-255)(*10ms)</td><td>0</td><td>0</td></tr>
<tr><td>Time out: (0-50)(*100ms)</td><td>1</td><td>1</td></tr>
</table>
Channel 1: XGT server<br>Channel 2: XGT server</td></tr>
<tr><td colspan="2">1. Set standard settings at built-in communication channel to be same with [Table 10.2.2]’s standard settings.<br>2. Since active mode acts as dedicated communication server, set as XGT server.</td></tr>
</table>

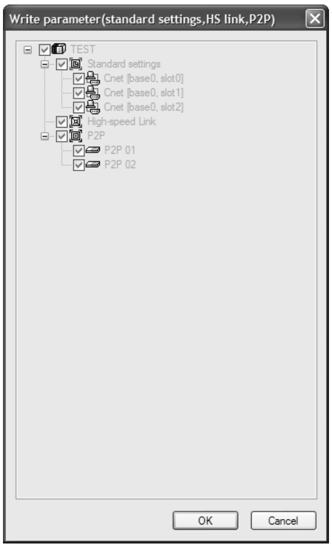
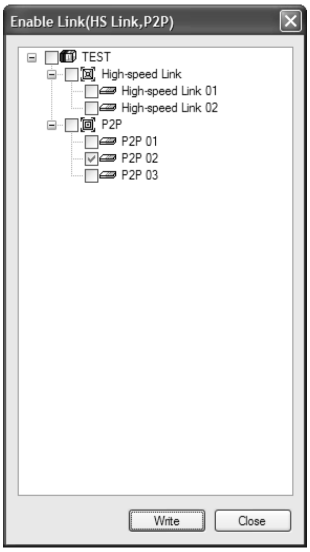
### 3) Settings of XGT client

To operate XBL-C21A of client as XGT client, set Cent I/F module as follows.

| Sequence | Procedure | Setting method |
|---|---|---|
| 1 | Connection settings | <br>Online Settings<br>Connection settings<br>Type: RS-232C (RS-232C, USB, Ethernet, Modem)<br>Depth:<br>General<br>Timeout interval: 71 sec.<br>Retrial times: 1<br>Read / Write data size in PLC run mode<br>● Normal ○ Maximum<br>* Send maximum data size in stop mode |
|  | 1. Select [Online]-[Connection settings] or click icon ( ).<br>2. After setting the connection option according to user, click the 'connection'. |  |
| 2 | Reading IO information | Select [Online]-[Read IO Information] and click icon ( ).<br>IO information of currently mounted is shown on the project window. |
| 3 | Standard settings | <br>Standard Settings - Cnet<br>Standard Settings<br>Connection Settings: Channel 1 / Channel 2<br>Type: RS232C / RS485<br>Speed: 9600 / 9600<br>Terminating Resisters: Disable / Disable<br>Station No.: 0 / 0<br>Operation Mode<br>Channel 1: XGT server<br>Channel 2: XGT server<br>Advanced Settings<br>Connection Settings: Channel 1 / Channel 2<br>Data Bit: 8 / 8<br>Stop Bit: 1 / 1<br>Parity Bit: NONE / NONE<br>Parity Receiving: Disable / Disable<br>Modem Type: Null Modem / Null Modem<br>Modem Initialization:<br>Time Settings<br>Response Waiting Time: (0-50)(*100ms): 1 / 1<br>Delay Time Setting: (0-255)(*10ms): 0 / 0<br>Delay Time Between Character: (0-255)(*10ms): 1 / 1 |
|  | 1. Select Cnet described in [Table 2.11.1].<br>2. In case of acting as client, station setting doesn't have the meaning so set temporary station (0~255).<br>3. When acting as client, active mode should be [Use P2P settings]. |  |

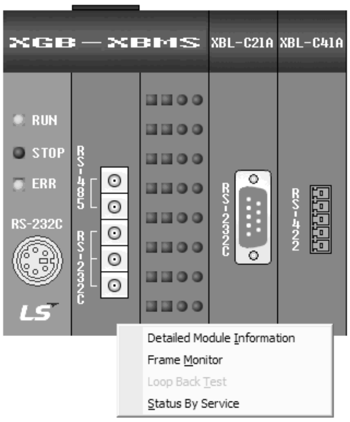
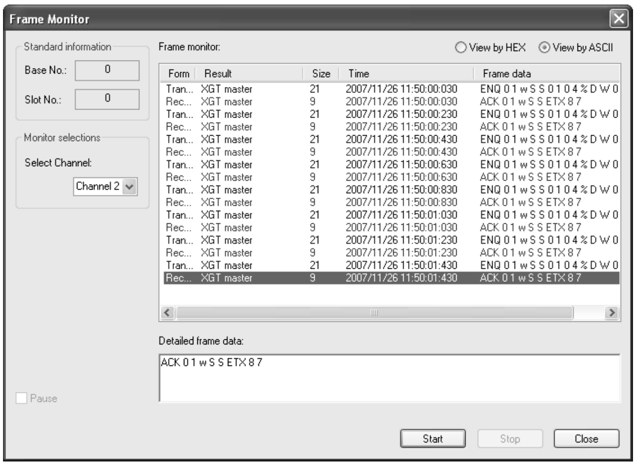
After standard settings, P2P channel and P2P block should be set. Setting methods are as follows.

<table>
<tr><th>Sequence</th><th>Procedure</th><th>Setting method</th></tr>
<tr><td>1</td><td>P2P setting</td><td>Click P2P bottom of project window.</td></tr>
<tr><td rowspan="2">2</td><td>Communication module settings</td><td><br>Communication Module Settings<br>Type: Cnet<br>Slot: 01</td></tr>
<tr><td colspan="2">1. Double-click P2P 02 of project window.<br>(P2P 01 is fixed as built-in communication module)<br>2. Select slot number (no. 1) acting as client and press OK.</td></tr>
<tr><td rowspan="2">3</td><td>P2P channel setting</td><td><br>P2P Channel Setting<br>Channel 1: Operating Mode -<br>Channel 2: Operating Mode Use P2P</td></tr>
<tr><td colspan="2">1. Double-click P2P Channel of P2P 02 and set P2P driver of channel 2 as XGT client</td></tr>
<tr><td>4</td><td colspan="2">1. Double-click P2P Block of P2P 02.</td></tr>
<tr><td rowspan="2">5</td><td>Setting of writing operation</td><td><br>Index 0: Ch. 2, Driver Setting XGT client, P2P function WRITE, Conditional flag F0092, Command type Single, Data type 2 BYTE, No. of variables 1, Destination station ☑, Destination station number 1<br>Variable Setting<br>1: Read area M100, Save area M100, Address N01313</td></tr>
<tr><td colspan="2">1. Channel: Select ch.2 set as XGT client set in P2P channel.<br>2. Since it executes write operation, select WRITE.<br>3. Conditional flag: to send frame every 200ms, use flag F92.<br>4. Command type, Data type: to write 1 word, select single and 2 byte.<br>5. No. of variable: since no. of word is 1, select 1.<br>6. Destination station number: input 1 as station number of server.<br>7. Setting: after setting Read area and Save area, click OK.<br>1) Read area: device address of data saved in the client<br>2) Save area: device address of server to save data<br>* If all settings are completed, color of index of channel becomes black.</td></tr>
<tr><td rowspan="2">6</td><td>Setting of reading operation</td><td><br>Index 0: Ch. 2, Driver Setting XGT client, P2P function WRITE, Conditional flag F0092, Command type Single, Data type 2 BYTE, No. of variables 1, Destination station ☑, Destination station number 1<br>Index 1: Ch. 2, Driver Setting XGT client, P2P function WRITE, Conditional flag F0092, Command type Single, Data type 2 BYTE, No. of variables 1, Destination station ☑, Destination station number 1<br>Variable Setting<br>1: Read area D0100, Save area M110, Address N01354</td></tr>
<tr><td colspan="2">1. Channel, conditional flag, command type, data type, No. of variable, destination station no.: Same as described in setting is writing.<br>2. P2P function: select READ.<br>3. Setting: after setting Read area and Save area, click [OK].<br>1) Read area: device address of data saved in server<br>2) Save area: device address of client to save</td></tr>
</table>

| Sequence | Procedure | Setting method |
|---|---|---|
| 7 | Writing parameter |  |
|  | 1. Select [Online] – [Write Parameter] or click icon ( ).<br>2. Click [OK].<br>3. If writing parameter is complete After clicking [OK], changed parameter is applied automatically. |  |
| 8 | Enabling the link |  |
|  | 1. Select [Online] – [Enable Link] or click icon ( )<br>2. Click the P2P to enable and click Write. |  |

### 4) Checking the operation

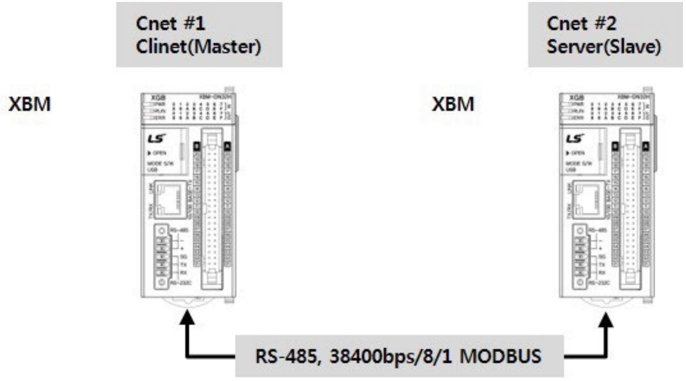
The user can analyze frame by using the frame monitor of XG-PD to check it communication is normal or not. Method of frame monitor of Cnet I/F module is same regardless of protocol.

<table>
<tr><th>Sequence</th><th>Procedure</th><th>Setting method</th></tr>
<tr><td rowspan="2">1</td><td>System Diagnosis</td><td>
</td></tr>
<tr><td colspan="2">1. Connect with cilent by XG-PD and select [Online] – [System Diagnosis] or click ( 
<br>2. Click the right button on the relevant module and click Frame Monitor or Status By Service.</td></tr>
<tr><td rowspan="2">2</td><td>Frame monitor</td><td></td></tr>
<tr><td colspan="2">1. Select channel 2 and click Start.<br>2. Since dedicated service is ASCII communication, select View by ASCII.<br>* In case of Modbus RTU, select View by HEX and in case of Modbus ASCII, select View by ASCII.</td></tr>
</table>

```
Frame Monitor
Standard information
Base No.: 0
Slot No.: 0
Monitor selections
Select Channel: Channel 2
Frame monitor:                     ○ View by HEX  ● View by ASCII
Form     Result       Size  Time                      Frame data
Tran...  XGT master   21    2007/11/26 11:50:00:030   ENQ 0 1 w S S 0 1 0 4 % D W 0
Rec...   XGT master   9     2007/11/26 11:50:00:030   ACK 0 1 w S S ETX 8 7
Tran...  XGT master   21    2007/11/26 11:50:00:230   ENQ 0 1 w S S 0 1 0 4 % D W 0
Rec...   XGT master   9     2007/11/26 11:50:00:230   ACK 0 1 w S S ETX 8 7
Tran...  XGT master   21    2007/11/26 11:50:00:430   ENQ 0 1 w S S 0 1 0 4 % D W 0
Rec...   XGT master   9     2007/11/26 11:50:00:430   ACK 0 1 w S S ETX 8 7
Tran...  XGT master   21    2007/11/26 11:50:00:630   ENQ 0 1 w S S 0 1 0 4 % D W 0
Rec...   XGT master   9     2007/11/26 11:50:00:630   ACK 0 1 w S S ETX 8 7
Tran...  XGT master   21    2007/11/26 11:50:00:830   ENQ 0 1 w S S 0 1 0 4 % D W 0
Rec...   XGT master   9     2007/11/26 11:50:00:830   ACK 0 1 w S S ETX 8 7
Tran...  XGT master   21    2007/11/26 11:50:01:030   ENQ 0 1 w S S 0 1 0 4 % D W 0
Rec...   XGT master   9     2007/11/26 11:50:01:030   ACK 0 1 w S S ETX 8 7
Tran...  XGT master   21    2007/11/26 11:50:01:230   ENQ 0 1 w S S 0 1 0 4 % D W 0
Rec...   XGT master   9     2007/11/26 11:50:01:230   ACK 0 1 w S S ETX 8 7
Tran...  XGT master   21    2007/11/26 11:50:01:430   ENQ 0 1 w S S 0 1 0 4 % D W 0
Rec...   XGT master   9     2007/11/26 11:50:01:430   ACK 0 1 w S S ETX 8 7
Detailed frame data:
ACK 0 1 w S S ETX 8 7
☐ Pause
Start  Stop  Close
```

### 2.11.3 Modbus Communication Example

We assume that system configuration of Modbus communication (Modbus RTU mode) example is as [Figure 10.3.1] and communication setting is as following table.



[Figure 2.11.2] XGT Modbus communication system configuration example

- Mount XBL-C41A on no. 1 slot of client PLC

1) Client setting

| | | |
|---|---|---|
| Main unit | | XBM-DN32S |
| Communication module | | XBL-C41A(no.1 Slot) |
| Communication type | | RS-485 |
| Communication speed | | 38,400 |
| Data bit | | 8 |
| Stop bit | | 1 |
| Parity bit | | None |
| Operation cycle | | 200ms |
| Operation status | Write | ▶Write 1 word of M100 of client to M1 of server<br>▶Write 4 words from D0 of client to M2~M5 of server<br>▶Write 15th bit of M2 to 2nd bit of M20 of server<br>▶Write 0~15th bit of M2 to 0~15th bit of M21 of server |
| | Read | ▶Read 1 word of M2 of server and save it at M160 of client<br>▶Read 4 words from P0 of server and save it at M150~M153<br>▶Read 1st bit of P2 of server and save it at 1st bit of M170.<br>▶Read 0th ~ 15th bit of M10 of server and save it at 0th ~ 15th of M180 of client. |

[client setting]

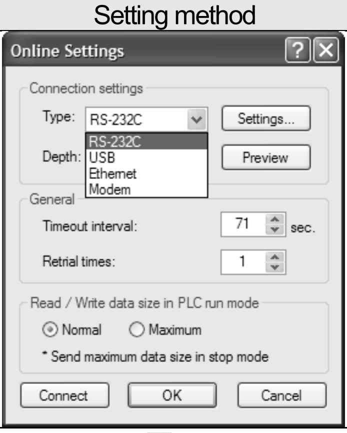
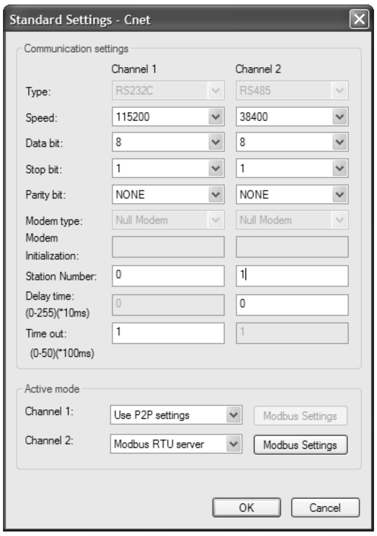
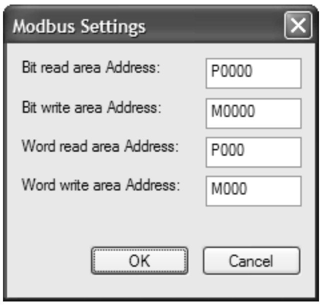
1) Server setting

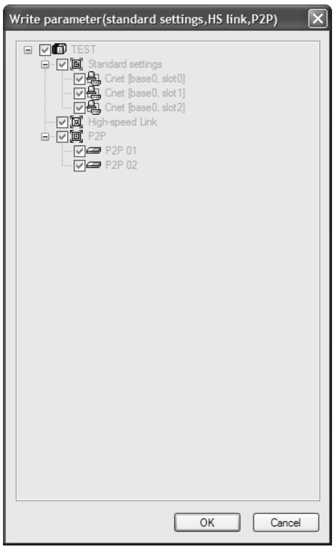
| | | |
|---|---|---|
| Main unit | | XBC-DN32H |
| Communication type | | Built-in RS-485 |
| Communication speed | | 38,400 |
| Data bit | | 8 |
| Stop bit | | 1 |
| Parity bit | | None |
| Station no. | | 1 |
| Start address | Bit read area Address | P0 |
| | Bit write area Address | M0 |
| | Word write area Address | P0 |
| | Word write area Address | M0 |

[server setting]

### 2) Modbus RTU server setting

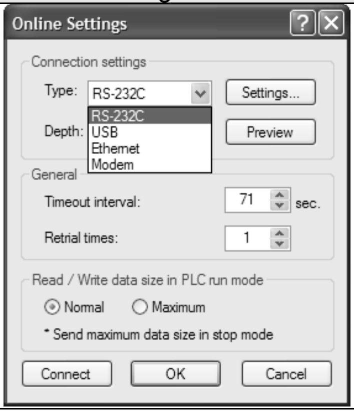
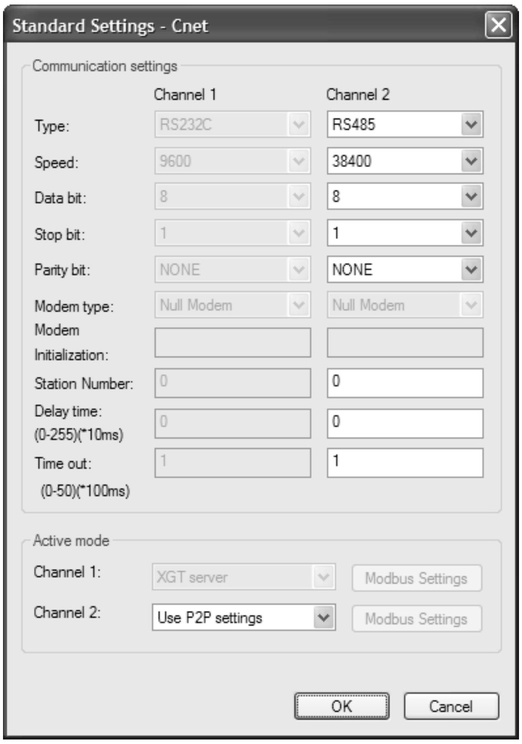
Standard settings are as follows to act built-in RS-485 communication channel of XBC-DN32H as Modbus RTU server.

| Sequence | Procedure | Setting method |
|---|---|---|
| 1 | Connection setting | <br>Online Settings<br>Connection settings<br>Type: RS-232C (RS-232C, USB, Ethernet, Modem)<br>Depth:<br>General<br>Timeout interval: 71 sec.<br>Retrial times: 1<br>Read / Write data size in PLC run mode<br>◉ Normal ○ Maximum<br>* Send maximum data size in stop mode |
| | 1. Select [Online]-[Connection settings] or click icon ( )<br>2. After setting the connection option according to user, click the 'connection'. | |
| 2 | Reading IO information | Select [Online]-[Read IO Information] and click icon ( ).<br>IO information of currently mounted is shown on the project window. |
| 3 | Standard settings | <br>Standard Settings - Cnet<br>Communication settings<br>Channel 1 / Channel 2<br>Type: RS232C / RS485<br>Speed: 115200 / 38400<br>Data bit: 8 / 8<br>Stop bit: 1 / 1<br>Parity bit: NONE / NONE<br>Modem type: Null Modem / Null Modem<br>Modem Initialization:<br>Station Number: 0 / 1<br>Delay time: (0-255)(*10ms): 0 / 0<br>Time out: (0-50)(*100ms): 1 / 1<br>Active mode<br>Channel 1: Use P2P settings<br>Channel 2: Modbus RTU server |
| | 1. Write setting value as same with [Table 2.11.2] at built-in communication channel 1.<br>2. Set active mode as Modbus RTU server. | |
| 4 | Modbus setting | <br>Modbus Settings<br>Bit read area Address: P0000<br>Bit write area Address: M0000<br>Word read area Address: P000<br>Word write area Address: M000 |
| | 1. Bit read area Address: P00000 2. Bit write area Address: M0000<br>3. Word read area Address: P0000 4. Word write area Address: M0000<br>* In the Bit read/write area Address, upper 4 digit is word address and the last digit is bit address (P00110: 0th bit of P11th word) | |

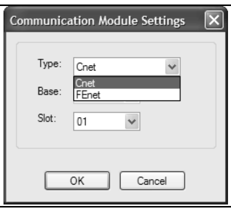
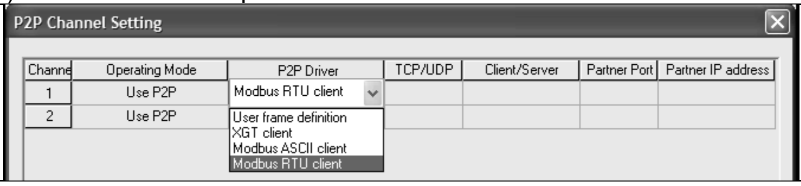
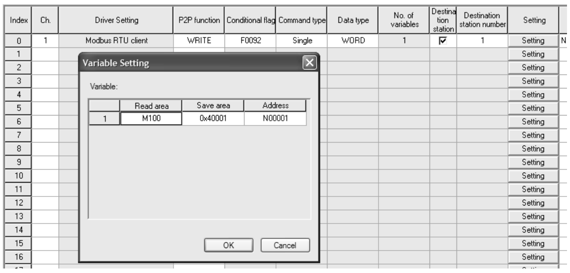
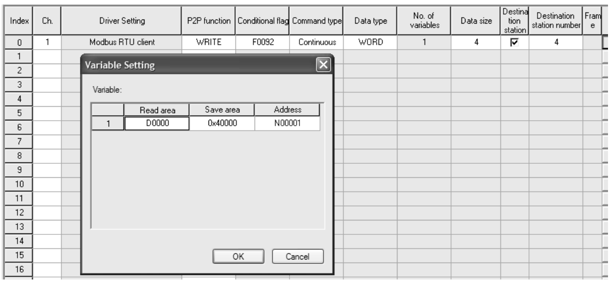
| Sequence | Procedure | Setting method |
|---|---|---|
| 5 | Writing parameter | <br>Write parameter(standard settings,HS link,P2P)<br>☑ TEST<br>☑ Standard settings<br>☑ Cnet [base0, slot0]<br>☑ Cnet [base0, slot1]<br>☑ Cnet [base0, slot2]<br>☑ High-speed Link<br>☑ P2P<br>☑ P2P 01<br>☑ P2P 02<br>OK Cancel |
| | 1. Select [Online] – [Write Parameter] or click icon ( ).<br>2. Click [OK]<br>3. If writing parameter is complete after clicking [OK] button, changed parameter is applied automatically. | |

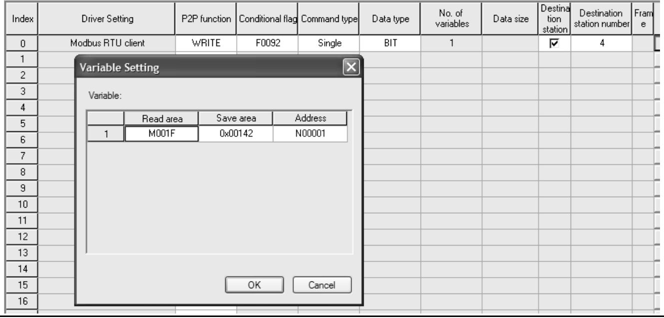
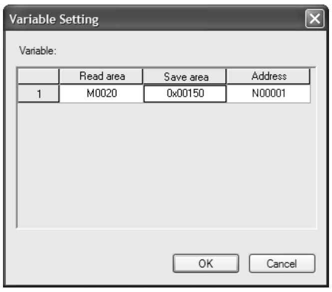
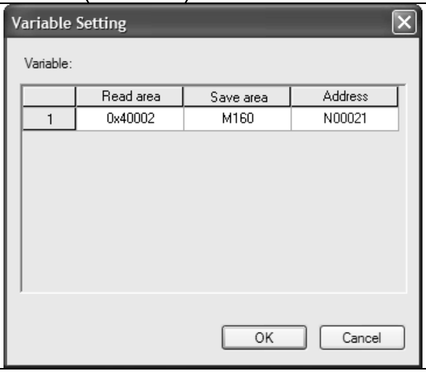
### 3) Setting of Modbus RTU client

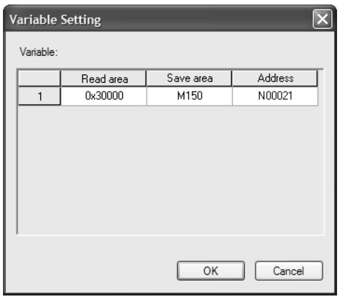
Standard settings are as follows to act XBL-C41A of client as Modbus RTU client.

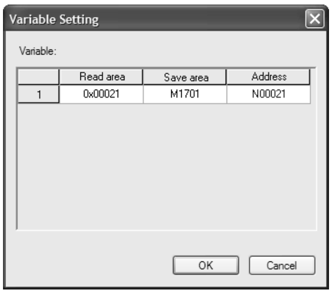
| Sequence | Procedure | Setting method |
|---|---|---|
| 1 | Connection setting | <br>Online Settings<br>Connection settings<br>Type: RS-232C (RS-232C, USB, Ethernet, Modem)<br>Depth:<br>General<br>Timeout interval: 71 sec.<br>Retrial times: 1<br>Read / Write data size in PLC run mode<br>● Normal ○ Maximum<br>* Send maximum data size in stop mode |
| | | 1. Select [Online]-[Connection settings] or click icon ( 🔌 ).<br>2. After setting the connection option according to user, click the 'connection'. |
| 2 | Reading IO information | Select [Online]-[Read IO Information] and click icon ( ▣ ).<br>IO information of currently mounted is shown on the project window. |
| 3 | Standard settings | <br>Standard Settings - Cnet<br>Communication settings<br>Channel 1 / Channel 2<br>Type: RS232C / RS485<br>Speed: 9600 / 38400<br>Data bit: 8 / 8<br>Stop bit: 1 / 1<br>Parity bit: NONE / NONE<br>Modem type: Null Modem / Null Modem<br>Modem Initialization:<br>Station Number: 0 / 0<br>Delay time: (0-255)(*10ms) 0 / 0<br>Time out: (0-50)(*100ms) 1 / 1<br>Active mode<br>Channel 1: XGT server<br>Channel 2: Use P2P settings |
| | | 1. Select XBL-C41A and write standard settings to be same with [Table 2.11.1] at channel<br>2. Since station setting doesn't have meaning when acting as client, set as temporary station number (0~255).<br>3. When acting as client mode, active mode should be Use P2P settings. |

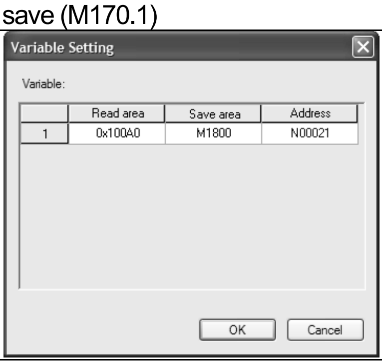
After standard settings, P2P channel and P2P block should be set. Setting methods are as follows.

<table>
<tr><th>Sequence</th><th>Procedure</th><th>Setting method</th></tr>
<tr><td>1</td><td>P2P setting</td><td>Click P2P bottom of project window.</td></tr>
<tr><td rowspan="2">2</td><td>Communication module setting</td><td><br>Communication Module Settings<br>Type: Cnet<br>Base:<br>Slot: 01</td></tr>
<tr><td colspan="2">1. Double-click P2P 02 of project window.<br>(P2P 01 is fixed as built-in communication)<br>2. Select slot no. (No. 1) of client module and press OK.</td></tr>
<tr><td rowspan="2">3</td><td>P2P channel setting</td><td><br>P2P Channel Setting<table><tr><th>Channel</th><th>Operating Mode</th><th>P2P Driver</th><th>TCP/UDP</th><th>Client/Server</th><th>Partner Port</th><th>Partner IP address</th></tr><tr><td>1</td><td>Use P2P</td><td>Modbus RTU client</td><td></td><td></td><td></td><td></td></tr><tr><td>2</td><td>Use P2P</td><td></td><td></td><td></td><td></td><td></td></tr></table></td></tr>
<tr><td colspan="2">1. Double-click P2P Channel of P2P 01 and set P2P driver of channel 1 as Modbus RTU client and click [OK].</td></tr>
<tr><td>4</td><td colspan="2">1. Double-click P2P Block of P2P 02.</td></tr>
<tr><td rowspan="2">5</td><td>Setting of writing operation (1)</td><td><table><tr><th>Index</th><th>Ch.</th><th>Driver Setting</th><th>P2P function</th><th>Conditional flag</th><th>Command type</th><th>Data type</th><th>No. of variables</th><th>Destination station</th><th>Destination station number</th><th>Setting</th></tr><tr><td>0</td><td>1</td><td>Modbus RTU client</td><td>WRITE</td><td>F0092</td><td>Single</td><td>WORD</td><td>1</td><td>☑</td><td>1</td><td>Setting</td></tr></table>Variable Setting<br>Variable:<table><tr><th></th><th>Read area</th><th>Save area</th><th>Address</th></tr><tr><td>1</td><td>M100</td><td>0x40001</td><td>N00001</td></tr></table></td></tr>
<tr><td colspan="2">▶ Write 1 word of M100 of client to M1 of server<br>1. Ch.: Select ch.2 set as Modbus RTU client set in P2P channel.<br>2. P2P function: select WRITE.<br>3. Conditional flag: to send frame every 200ms, use flag F92.<br>4. Command type, Data type: to write 1 word, select single and 2 byte.<br>5. Destination station number: select station number of server.<br>6. Setting: after setting Read area and Save area, click OK.<br>(1) Read area: device address saved in the client (M100)<br>(2) Save area: deice address of server to save (0x40001: M1)<br>* If all settings are completed, color of index of channel becomes black.</td></tr>
<tr><td rowspan="2">6</td><td>Setting of writing operation (2)</td><td><table><tr><th>Index</th><th>Ch.</th><th>Driver Setting</th><th>P2P function</th><th>Conditional flag</th><th>Command type</th><th>Data type</th><th>No. of variables</th><th>Data size</th><th>Destination station</th><th>Destination station number</th><th>Frame</th></tr><tr><td>0</td><td>1</td><td>Modbus RTU client</td><td>WRITE</td><td>F0092</td><td>Continuous</td><td>WORD</td><td>1</td><td>4</td><td>☑</td><td>4</td><td></td></tr></table>Variable Setting<br>Variable:<table><tr><th></th><th>Read area</th><th>Save area</th><th>Address</th></tr><tr><td>1</td><td>D0000</td><td>0x40000</td><td>N00001</td></tr></table></td></tr>
<tr><td colspan="2">▶ Write 4 words from D0 of client to M2~M5 of server<br>1. Ch., P2P function, conditional flag, destination station no.: same with step 5<br>2. Command type, Data type: because of writing continuous 4words, select Continuous, WORD<br>3. Data size: because of 4 words, input 4.<br>4. Setting: after setting Read area and Save area, click OK.<br>(1) Read area: device address saved in the client (D0)<br>(2) Save area: deice address of server to save (0x40002 : M2)</td></tr>
</table>

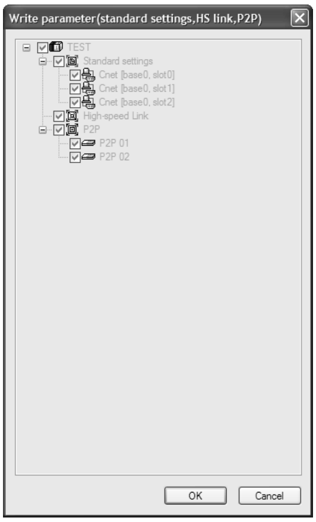
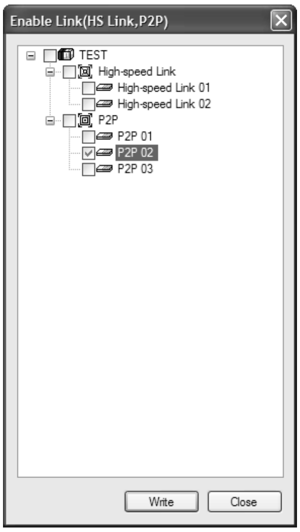
<table>
<tr><th>Sequence</th><th>Procedure</th><th>Setting method</th></tr>
<tr><td rowspan="2">7</td><td>Setting of writing operation (3)</td><td>
<table>
<tr><th>Index</th><th>Driver Setting</th><th>P2P function</th><th>Conditional flag</th><th>Command type</th><th>Data type</th><th>No. of variables</th><th>Data size</th><th>Destination station</th><th>Destination station number</th><th>Frame</th></tr>
<tr><td>0</td><td>Modbus RTU client</td><td>WRITE</td><td>F0092</td><td>Single</td><td>BIT</td><td>1</td><td></td><td>☑</td><td>4</td><td></td></tr>
</table>
Variable Setting<br>Variable:
<table>
<tr><th></th><th>Read area</th><th>Save area</th><th>Address</th></tr>
<tr><td>1</td><td>M001F</td><td>0x00142</td><td>N00001</td></tr>
</table>
</td></tr>
<tr><td colspan="2">▶ Write 15th bit of M2 to 2nd bit of M20 of server<br>1. Ch., P2P function, conditional flag, destination station no.: same with step 5<br>2. Data type: select bit<br>3. Setting: after setting Read area and Save area, click OK.<br>(1) Read area: device address saved in the client (M1.F : 15th bit of M1)<br>(2) Save area: deice address of server to save (0x00142: 2nd bit of M20)<br>* When inputting M1.F, it is converted into M0001F in the XG-PD.<br>* Device address of server is Hex value.</td></tr>
<tr><td rowspan="2">8</td><td>Setting of writing operation (4)</td><td>
Variable Setting<br>Variable:
<table>
<tr><th></th><th>Read area</th><th>Save area</th><th>Address</th></tr>
<tr><td>1</td><td>M0020</td><td>0x00150</td><td>N00001</td></tr>
</table>
</td></tr>
<tr><td colspan="2">▶ Write 0~15th bit of M2 to 0~15th bit of M21 of server<br>1. Ch., P2P function, conditional flag, destination station no.: same with step 7<br>2. Command type: select continuous.<br>3. Setting: after setting Read area and Save area, click OK.<br>(1) Read area: device address saved in the client (M2.0)<br>(2) Save area: deice address of server to save (0x00150)</td></tr>
<tr><td rowspan="2">9</td><td>Setting of reading operation (1)</td><td>
Variable Setting<br>Variable:
<table>
<tr><th></th><th>Read area</th><th>Save area</th><th>Address</th></tr>
<tr><td>1</td><td>0x40002</td><td>M160</td><td>N00021</td></tr>
</table>
</td></tr>
<tr><td colspan="2">▶ Read 1 word of M2 of server and save it at M160 of client<br>1. Ch., Conditional flag, Command type, Data type, Destination station no.: same with step 5<br>2. P2P function: select READ<br>3. Setting: after setting Read area and Save area, click OK.<br>(1) Read area: device address saved in server (0x40002)<br>(2) Save area: device address of client to save (M0160)</td></tr>
</table>

<table>
<tr><th>Sequence</th><th>Procedure</th><th>Setting method</th></tr>
<tr><td rowspan="2">10</td><td>Setting of reading operation (2)</td><td>

<table><tr><th></th><th>Read area</th><th>Save area</th><th>Address</th></tr><tr><td>1</td><td>0x30000</td><td>M150</td><td>N00021</td></tr></table></td></tr>
<tr><td colspan="2">▶ Read 4 words from P0 of server and save it at M150~M153<br>1. Ch., Conditional flag, Command type, Data type, Destination station no.: same with step 6<br>2. P2P function: select READ.<br>3. Setting: after setting Read area and Save area, click OK.<br>(1) Read area: device address saved in server (0x30000)<br>(2) Save area: device address of client to save (M0150)</td></tr>
<tr><td rowspan="2">11</td><td>Setting of reading operation (3)</td><td>

<table><tr><th></th><th>Read area</th><th>Save area</th><th>Address</th></tr><tr><td>1</td><td>0x00021</td><td>M1701</td><td>N00021</td></tr></table></td></tr>
<tr><td colspan="2">▶ Read 1st bit of P2 of server and save it at 1st bit of M170.<br>1. Ch., Conditional flag, Command type, Data type, Destination station no.: same with step 7<br>2. P2P function: select READ<br>3. Setting: after setting Read area and Save area, click OK.<br>(1) Read area: device address saved in server (0x00021)<br>(2) Save area: device address of client to save (M170.1)</td></tr>
<tr><td rowspan="2">12</td><td>Setting of reading operation (4)</td><td>

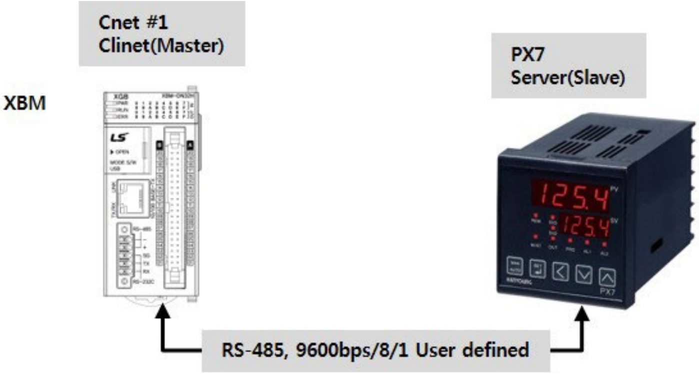
<table><tr><th></th><th>Read area</th><th>Save area</th><th>Address</th></tr><tr><td>1</td><td>0x100A0</td><td>M1800</td><td>N00021</td></tr></table></td></tr>
<tr><td colspan="2">▶ Read 0th ~ 15th bit of M10 of server and save it at 0th ~ 15th of M180 of client.<br>1. Ch., Conditional flag, Command type, Data type, Destination station no.: same with step 8<br>2. P2P function: select READ<br>3. Setting: after setting Read area and Save area, click OK.<br>(1) Read area: device address saved in server (0x100A0)<br>(2) Save area: device address of client to save (M180.0)</td></tr>
</table>

| Sequence | Procedure | Setting method |
|---|---|---|
| 13 | Writing parameter |  Write parameter(standard settings,HS link,P2P)<br>☑ TEST<br>☑ Standard settings<br>☑ Cnet [base0, slot0]<br>☑ Cnet [base0, slot1]<br>☑ Cnet [base0, slot2]<br>☑ High-speed Link<br>☑ P2P<br>☑ P2P 01<br>☑ P2P 02<br> |
| | 1. Select [Online] – [Write Parameter] or click icon ( ).<br>2. Click [OK].<br>3. If writing parameter is complete after click OK, changed parameter is applied automatically. | |
| 14 | Enabling the link |  Enable Link(HS Link,P2P)<br>☐ TEST<br>☐ High-speed Link<br>☐ High-speed Link 01<br>☐ High-speed Link 02<br>☐ P2P<br>☐ P2P 01<br>☑ P2P 02<br>☐ P2P 03<br> |
| | 1. Select [Online] – [Enable Link] or click icon ( )<br>2. Click the P2P to enable and click Write. | |

## 2.11.4 User-defined Communication Example

When communication with device of which protocol is not supported by Cnet I/F module client, how to use user-defined communication is described in the system like [Figure 2.11.3] below

- System configuration



[Figure 2.11.3] User defined communication system configuration

At this example, Cnet I/F module and partner device to communicate through user defined communication system configuration are as Table below.

| Device name | Main unit | XBC-DN32H | Han-Young temperature controller PX7*Note2) |
|---|---|---|---|
| | Communication module | Built-in RS-485 | |
| Operation mode | Client | | Server |
| Protocol | User frame definition | | PC Link |
| Communication type | RS-485 | | RS-485 |
| Communication speed | 9,600 | | 9,600 |
| Data bit | 8 | | 8 |
| Stop bit | 1 | | 1 |
| Parity bit | None | | None |
| Station no. | 0 | | 1 |
| Delay time*note1) | 100ms | | - |
| Operation | Reads present value and setting value from temperature controller every second and saves present value at MB200 and setting value at MB210. | | |

[User defined communication system configuration]

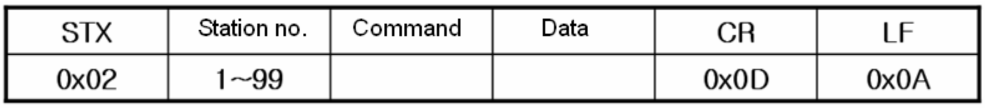
Note1) Delay time is set to prevent from frame error when communication with device of which response is slow in case of RS-422/485 communication. It varies according to partner device and it has 50~100ms value generally.

### 1) User definition communication frame structure

Frame structure of PC Link, communication protocol of Han-Young used in this example, is as follows.

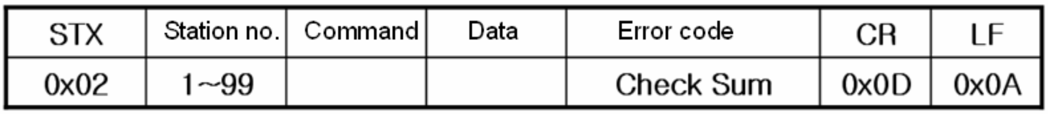
- Frame of temperature controller is executed as ASCII character string, it can read/write defined D, I Register. There are two protocols, STD standard protocol and SUM protocol adding Check Sum to standard type and protocol is selected by parameter of temperature controller. Standard protocol is STD”. It starts with first character STX (0x02) and ends with last character CR(0x0D) LF(0x0A).

The following [Table 2.11.3] and [Table 2.11.4] indicates structure of standard protocol and Sum protocol.



| STX | Station no. | Command | Data | CR | LF |
|---|---|---|---|---|---|
| 0x02 | 1~99 | | | 0x0D | 0x0A |

[Table 2.11.3] standard protocol structure

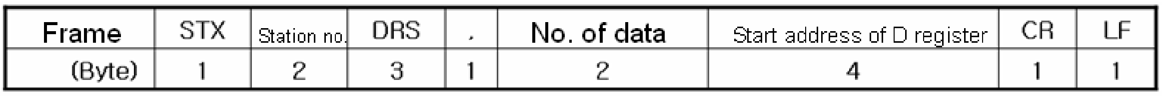


| STX | Station no. | Command | Data | Error code | CR | LF |
|---|---|---|---|---|---|---|
| 0x02 | 1~99 | | | Check Sum | 0x0D | 0x0A |

[Table 2.11.4] SUM protocol structure

### 1) Writing example frame

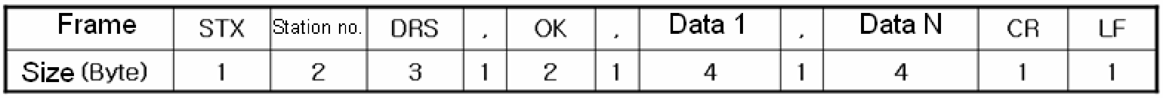
In this example, present value and setting value is saved in M device area of PLC. [Table 2.11.5] is frame requesting continuous data and [Table 2.11.6] is frame responding to request.



| Frame | STX | Station no. | DRS | , | No. of data | Start address of D register | CR | LF |
|---|---|---|---|---|---|---|---|---|
| (Byte) | 1 | 2 | 3 | 1 | 2 | 4 | 1 | 1 |

[Table 2.11.5] request frame

- **DRS**: command that request reading continuous D register value. No of data and start address of D register is necessary.
- In the example, no. of data is 2 and start address is 01.



| Frame | STX | Station no. | DRS | , | OK | , | Data 1 | , | Data N | CR | LF |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Size (Byte) | 1 | 2 | 3 | 1 | 2 | 1 | 4 | 1 | 4 | 1 | 1 |

[Table 2.11.6] response frame

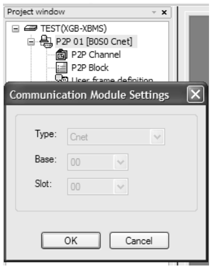
## 2) User definition communication parameter setting

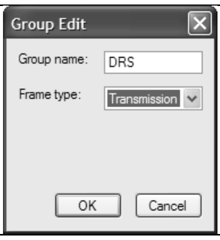
### (1) Communication standard parameter setting

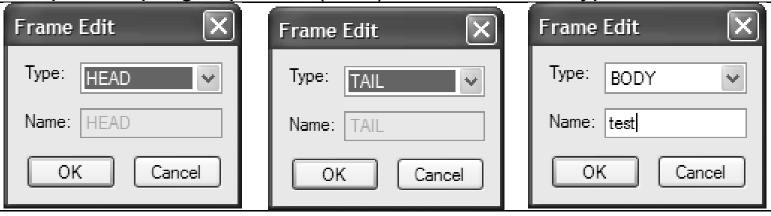
For standard setting, refer to setting method when acting as P2P service of 2.10.2 and configure above system [Table 2.11.1].

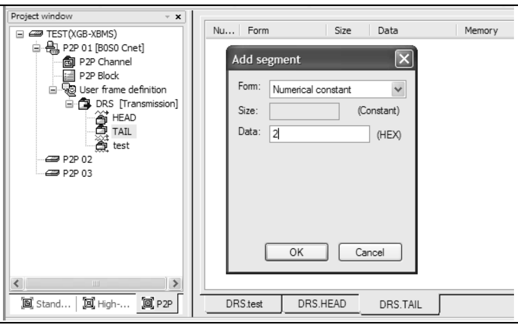
### (2) Writing frame that requests reading data

Describes how to write frame at XG-PD for user definition communication

<table>
<tr><th colspan="2">frame that requests reading data (Transmission frame)</th></tr>
<tr><th>Sequence</th><th>Setting method</th></tr>
<tr><td rowspan="2">1</td><td>

Type: Cnet<br>Base: 00<br>Slot: 00</td></tr>
<tr><td>1. After standard settings, double-click P2P 01 in the P2P window.<br>2. As for built-in communication, base and slot is fixed as 0. Click OK.<br>3. Double-click P2P Channel and select User frame definition in Channel 2.</td></tr>
<tr><td rowspan="2">2</td><td>

Group name: DRS<br>Frame type: Transmission</td></tr>
<tr><td>1. Click user definition frame and click right button of mouse.<br>2. Click ‘Add Group’ and input group name (DRS) and select frame type as transmission.</td></tr>
<tr><td rowspan="2">3</td><td>

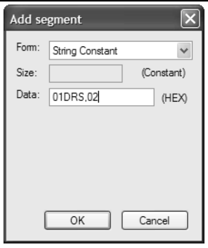
Type: HEAD<br>Name: HEAD<br>Type: TAIL<br>Name: TAIL<br>Type: BODY<br>Name: test</td></tr>
<tr><td>1. Click ‘Add Frame’ and select type HEAD, TAIL, BODY and input BODY name<br>2. BODY’s name is test here.</td></tr>
<tr><td rowspan="2">4</td><td>

Form: Numerical constant<br>Size: (Constant)<br>Data: 2 (HEX)</td></tr>
<tr><td>1. If you double-click editor window after selecting DRS.HEAD tap at right screen, segment setting screen is created.<br>2. Select Numerical constant which indicates Hex as ASCII code as Form. Input Hex value 2 which indicates STX.</td></tr>
</table>

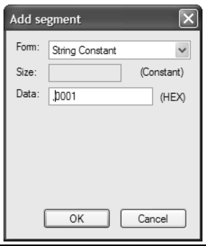
<table>
<tr><th>Sequence</th><th>Setting method</th></tr>
<tr><td rowspan="2">5</td><td>


Add segment<br>
Form: Numerical constant<br>
Size: (Constant)<br>
Data: D (HEX)

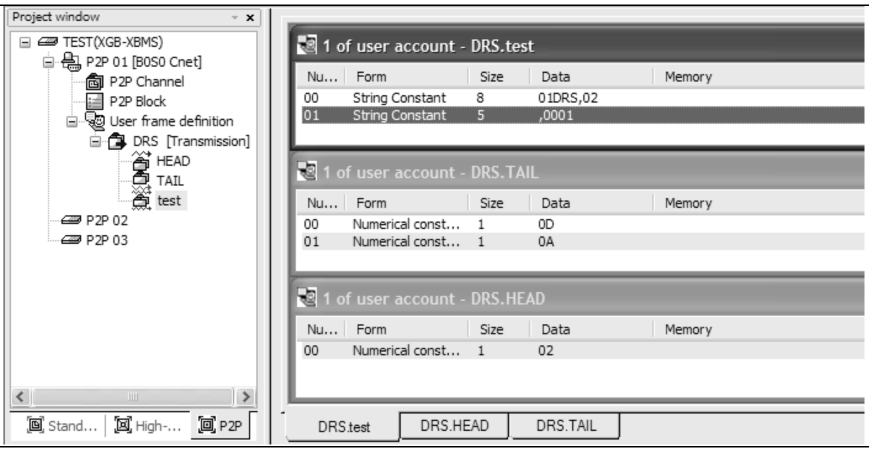
Add segment<br>
Form: Numerical constant<br>
Size: (Constant)<br>
Data: A (HEX)

</td></tr>
<tr><td>1. Select Numerical constant which indicates Hex as ASCII code as Form. Input Hex value D, A which indicates CR and LF.</td></tr>
<tr><td rowspan="2">6</td><td>


Add segment<br>
Form: String Constant<br>
Size: (Constant)<br>
Data: 01DRS,02 (HEX)



Add segment<br>
Form: String Constant<br>
Size: (Constant)<br>
Data: ,0001 (HEX)

</td></tr>
<tr><td>1. Double-click DRS.test tap and edit segment like the following.<br>
2. Write frame requesting reading data of continuous 2 areas starting first of D register of station no.1.<br>
3. When double-clicking editor screen and writing frame through segment edition, size of one segment is less than 10.</td></tr>
<tr><td rowspan="2">7</td><td>


1 of user account - DRS.test

| Nu... | Form | Size | Data | Memory |
|---|---|---|---|---|
| 00 | String Constant | 8 | 01DRS,02 | |
| 01 | String Constant | 5 | ,0001 | |

1 of user account - DRS.TAIL

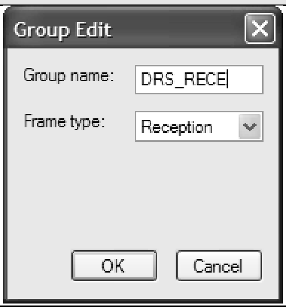
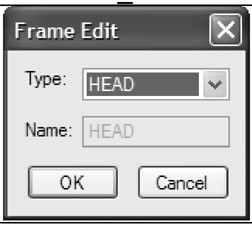
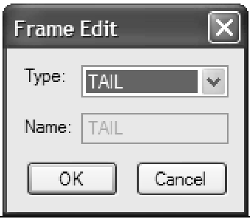
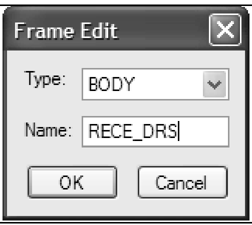
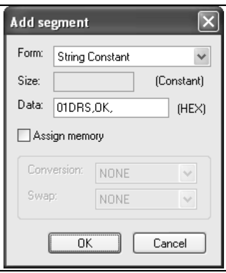
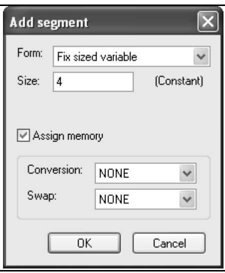
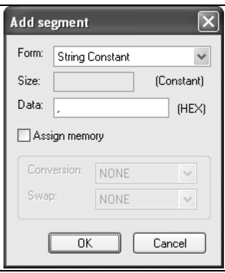
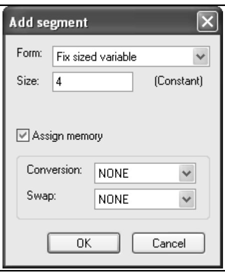
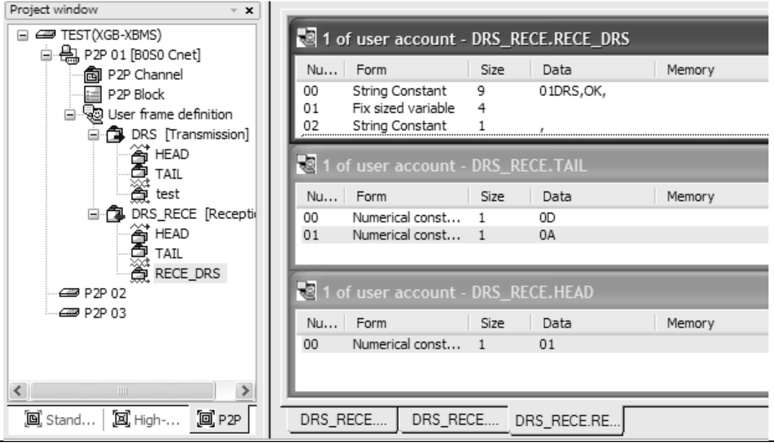
| Nu... | Form | Size | Data | Memory |
|---|---|---|---|---|
| 00 | Numerical const... | 1 | 0D | |
| 01 | Numerical const... | 1 | 0A | |

1 of user account - DRS.HEAD

| Nu... | Form | Size | Data | Memory |
|---|---|---|---|---|
| 00 | Numerical const... | 1 | 02 | |

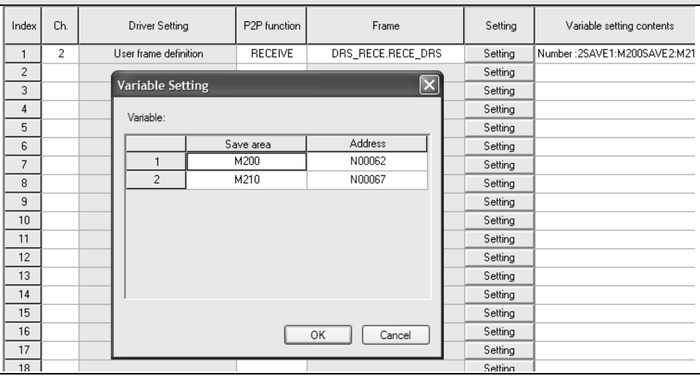
</td></tr>
<tr><td>1. Result writing entire frame of data reading request frame.</td></tr>
</table>

3) Writing frame to receive response frame of temperature controller

| Writing response frame (Reception frame) | |
|---|---|
| Sequence | Setting method |
| 1 | <br>Group name: DRS_RECE<br>Frame type: Reception |
| | 1. Write like step 2 of frame that request reading data.<br>At this time, set Frame type as reception.<br>2. Frame name is DRS_RECE. |
| 2 | <br>Type: HEAD<br>Name: HEAD<br><br>Type: TAIL<br>Name: TAIL<br><br>Type: BODY<br>Name: RECE_DRS |
| | 1. Click 'Add Frame' and select HEAD, TAIL, BODY as type and input BODY name.<br>2. BODY's name is RECE_DRS here. |
| 3 | 1. Method writing HEAD, TAIL is same with step 4~5 of method writing frame that request reading data. |
| 4 | <br>Form: String Constant<br>Size: (Constant)<br>Data: 01DRS,OK, (HEX)<br>☐ Assign memory<br>Conversion: NONE<br>Swap: NONE<br><br>Form: Fix sized variable<br>Size: 4 (Constant)<br>☑ Assign memory<br>Conversion: NONE<br>Swap: NONE<br><br>Form: String Constant<br>Size: (Constant)<br>Data: , (HEX)<br>☐ Assign memory<br>Conversion: NONE<br>Swap: NONE<br><br>Form: Fix sized variable<br>Size: 4 (Constant)<br>☑ Assign memory<br>Conversion: NONE<br>Swap: NONE |
| | 1. To save present temperature value in MB200 and setting value in MB210, set the storage area of 1st and 2nd data as set in [Table 10.4.1].<br>2. Since data size of data 1 and 2 is 4 byte, select Fix sized variable and input 4 in Size<br>3. To select storage area of data, check Assign memory. |
| 5 | <br>1 of user account - DRS_RECE.RECE_DRS<br>Nu... Form Size Data Memory<br>00 String Constant 9 01DRS,OK,<br>01 Fix sized variable 4<br>02 String Constant 1 ,<br>1 of user account - DRS_RECE.TAIL<br>Nu... Form Size Data Memory<br>00 Numerical const... 1 0D<br>01 Numerical const... 1 0A<br>1 of user account - DRS_RECE.HEAD<br>Nu... Form Size Data Memory<br>00 Numerical const... 1 01 |
| | 1. This is entire frame to receive response data of temperature controller. |

### 4) Writing P2P transmission/reception block

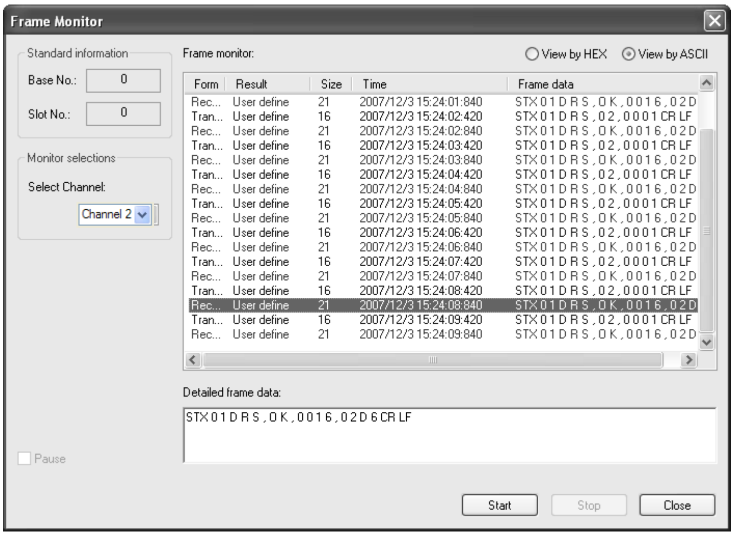
Write P2P TX/RX block as follows by using user definition communication segment written ahead.

<table>
<tr><th>Sequence</th><th>Setting method</th></tr>
<tr><td rowspan="2">1</td><td>
<table>
<tr><th>Index</th><th>Ch.</th><th>Driver Setting</th><th>P2P function</th><th>Frame</th><th>Setting</th><th>Variable setting contents</th></tr>
<tr><td>1</td><td>2</td><td>User frame definition</td><td>RECEIVE</td><td>DRS_RECE.RECE_DRS</td><td>Setting</td><td>Number :2SAVE1:M200SAVE2:M21</td></tr>
<tr><td>2</td><td></td><td></td><td></td><td></td><td>Setting</td><td></td></tr>
<tr><td>3</td><td></td><td></td><td></td><td></td><td>Setting</td><td></td></tr>
<tr><td>4</td><td></td><td></td><td></td><td></td><td>Setting</td><td></td></tr>
<tr><td>5</td><td></td><td></td><td></td><td></td><td>Setting</td><td></td></tr>
<tr><td>6</td><td></td><td></td><td></td><td></td><td>Setting</td><td></td></tr>
<tr><td>7</td><td></td><td></td><td></td><td></td><td>Setting</td><td></td></tr>
<tr><td>8</td><td></td><td></td><td></td><td></td><td>Setting</td><td></td></tr>
<tr><td>9</td><td></td><td></td><td></td><td></td><td>Setting</td><td></td></tr>
<tr><td>10</td><td></td><td></td><td></td><td></td><td>Setting</td><td></td></tr>
<tr><td>11</td><td></td><td></td><td></td><td></td><td>Setting</td><td></td></tr>
<tr><td>12</td><td></td><td></td><td></td><td></td><td>Setting</td><td></td></tr>
<tr><td>13</td><td></td><td></td><td></td><td></td><td>Setting</td><td></td></tr>
<tr><td>14</td><td></td><td></td><td></td><td></td><td>Setting</td><td></td></tr>
<tr><td>15</td><td></td><td></td><td></td><td></td><td>Setting</td><td></td></tr>
<tr><td>16</td><td></td><td></td><td></td><td></td><td>Setting</td><td></td></tr>
<tr><td>17</td><td></td><td></td><td></td><td></td><td>Setting</td><td></td></tr>
<tr><td>18</td><td></td><td></td><td></td><td></td><td>Setting</td><td></td></tr>
</table>

Variable:
<table>
<tr><th></th><th>Save area</th><th>Address</th></tr>
<tr><td>1</td><td>M200</td><td>N00062</td></tr>
<tr><td>2</td><td>M210</td><td>N00067</td></tr>
</table></td></tr>
<tr><td>1. Double-click P2P block of P2P 01.<br>2. Input channel selected at P2P channel (user frame definition).<br>3. In case P2P function is TX frame, select SEND. In case P2P function is RX, select RECEIVE.<br>4. Conditional flag is activated when P2P function is SEND.<br>5. Since it reads data every 1 second, use F93 as conditional flag.<br>6. Click Setting of RX frame and set save area of current temperature and setting value.</td></tr>
<tr><td>2</td><td>Execute Write Parameter and Enable Link.</td></tr>
</table>

### 5) Checking TRX data

Check whether written frame is transmitted/received properly

<table>
<tr><th>Sequence</th><th>Setting method</th></tr>
<tr><td rowspan="2">1</td><td>

Base No.: 0<br>
Slot No.: 0<br>
Select Channel: Channel 2
<table>
<tr><th>Form</th><th>Result</th><th>Size</th><th>Time</th><th>Frame data</th></tr>
<tr><td>Rec...</td><td>User define</td><td>21</td><td>2007/12/3 15:24:01:840</td><td>STX 0 1 D R S , O K , 0 0 1 6 , 0 2 D</td></tr>
<tr><td>Tran...</td><td>User define</td><td>16</td><td>2007/12/3 15:24:02:420</td><td>STX 0 1 D R S , 0 2 , 0 0 0 1 CR LF</td></tr>
<tr><td>Rec...</td><td>User define</td><td>21</td><td>2007/12/3 15:24:02:840</td><td>STX 0 1 D R S , O K , 0 0 1 6 , 0 2 D</td></tr>
<tr><td>Tran...</td><td>User define</td><td>16</td><td>2007/12/3 15:24:03:420</td><td>STX 0 1 D R S , 0 2 , 0 0 0 1 CR LF</td></tr>
<tr><td>Rec...</td><td>User define</td><td>21</td><td>2007/12/3 15:24:03:840</td><td>STX 0 1 D R S , O K , 0 0 1 6 , 0 2 D</td></tr>
<tr><td>Tran...</td><td>User define</td><td>16</td><td>2007/12/3 15:24:04:420</td><td>STX 0 1 D R S , 0 2 , 0 0 0 1 CR LF</td></tr>
<tr><td>Rec...</td><td>User define</td><td>21</td><td>2007/12/3 15:24:04:840</td><td>STX 0 1 D R S , O K , 0 0 1 6 , 0 2 D</td></tr>
<tr><td>Tran...</td><td>User define</td><td>16</td><td>2007/12/3 15:24:05:420</td><td>STX 0 1 D R S , 0 2 , 0 0 0 1 CR LF</td></tr>
<tr><td>Rec...</td><td>User define</td><td>21</td><td>2007/12/3 15:24:05:840</td><td>STX 0 1 D R S , O K , 0 0 1 6 , 0 2 D</td></tr>
<tr><td>Tran...</td><td>User define</td><td>16</td><td>2007/12/3 15:24:06:420</td><td>STX 0 1 D R S , 0 2 , 0 0 0 1 CR LF</td></tr>
<tr><td>Rec...</td><td>User define</td><td>21</td><td>2007/12/3 15:24:06:840</td><td>STX 0 1 D R S , O K , 0 0 1 6 , 0 2 D</td></tr>
<tr><td>Tran...</td><td>User define</td><td>16</td><td>2007/12/3 15:24:07:420</td><td>STX 0 1 D R S , 0 2 , 0 0 0 1 CR LF</td></tr>
<tr><td>Rec...</td><td>User define</td><td>21</td><td>2007/12/3 15:24:07:840</td><td>STX 0 1 D R S , O K , 0 0 1 6 , 0 2 D</td></tr>
<tr><td>Tran...</td><td>User define</td><td>16</td><td>2007/12/3 15:24:08:420</td><td>STX 0 1 D R S , 0 2 , 0 0 0 1 CR LF</td></tr>
<tr><td>Rec...</td><td>User define</td><td>21</td><td>2007/12/3 15:24:08:840</td><td>STX 0 1 D R S , O K , 0 0 1 6 , 0 2 D</td></tr>
<tr><td>Tran...</td><td>User define</td><td>16</td><td>2007/12/3 15:24:09:420</td><td>STX 0 1 D R S , 0 2 , 0 0 0 1 CR LF</td></tr>
<tr><td>Rec...</td><td>User define</td><td>21</td><td>2007/12/3 15:24:09:840</td><td>STX 0 1 D R S , O K , 0 0 1 6 , 0 2 D</td></tr>
</table>
Detailed frame data:<br>
STX 0 1 D R S , O K , 0 0 1 6 , 0 2 D 6 CR LF</td></tr>
<tr><td>1. Select [Online]-[System Diagnsis] or click icon ( )<br>2. After clicking relevant module and click right button of mouse, select Status by service or frame monitor.<br>3. When frame is not dealt with properly, unknown message is displayed.</td></tr>
<tr><td>2</td><td>Check device area by device monitor of XG-5000.</td></tr>
</table>

# 2.12 Error Code

## 2.12.1 XGT Server Error Code

Error code is displayed as hex 2 byte (4 byte as ASCII code). The user can see error by frame monitor and in case of viewing by ASCII, the user can see the following error code.

| Error code | Error type | Error details and causes | Example |
|---|---|---|---|
| 0003 | Number of blocks exceeded | Number of blocks exceeds 16 at Individual Read/Write Request | 01rSS1105%MW10… |
| 0004 | Variable length error | Variable Length exceeds the max. size of 16 | 01rSS010D%MW10000000000.. |
| 0007 | Data type error | Other data type than X,B,W,D,L received | 01rSS0105%MK10 |
| 0011 | Data error | Data length area information incorrect | 01rSB05%MW10%4 |
| | | In case % is unavailable to start with | 01rSS0105$MW10 |
| | | Variable's area value wrong | 01rSS0105%MW^& |
| | | Other value is written for Bit Write than 00 or 01 | 01wSS0105%MX1011 |
| 0090 | Monitor execution error | Unregistered monitor execution requested | |
| 0190 | Monitor execution error | Reg. No. range exceeded | |
| 0290 | Monitor reg. Error | Reg. No. range exceeded | |
| 1132 | Device memory error | Other letter than applicable device is input | |
| 1232 | Data size error | Request exceeds the max range of 60 Words to read or write at a time. | 01wSB05%MW1040AA5512,.. |
| 1234 | Extra frame error | Unnecessary details exist as added. | 01rSS0105%MW10000 |
| 1332 | Data type discordant | All the blocks shall be requested of the identical data type in the case of Individual Read/Write | 01rSS0205%MW1005%MB10 |
| 1432 | Data value error | Data value unavailable to convert to Hex | 01wSS0105%MW10AA%5 |
| 7132 | Variable request area exceeded | Request exceeds the area each device supports. | 01rSS0108%MWFFFFF |

## 2.12.2 Modbus Server Error Code

Error code is displayed as hex 1 byte (2 byte as ASCII code) and indicates type of error.

| Code | Error type | Error details and causes |
|---|---|---|
| 01 | Illegal Function | Function code error |
| 02 | Illegal Address | Address range exceeded |
| 03 | Illegal Data Value | Data value not allowed |

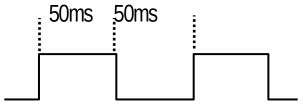
## 2.12.3 P2P Client Error Code

| Code | Error type | Error details and causes |
|---|---|---|
| 01 | ERR_NO_HEAD | There is no head of reception frame |
| 02 | ERR_NO_TAIL | There is no tail of reception frame |
| 03 | ERR_WRONG_BCC | BCC is not correct |
| 04 | ERR_STATION_NO | Station number of reception frame is not correct |
| 05 | ERR_WRONG_DRV_TYPE | Driver type is not correct |
| 07 | ERR_FRAME_SND | Can’t send TX frame |
| 09 | ERR_NO_USE_LINKID | There is no communication module |
| 0A | ERR_PLC_RESP_TIMEOUT | Reception frame is not received during time out setting time |
| 0B | ERR_FRM_LENGTH | Length of reception frame is not correct |
| 0D | ERR_ASCII_HEX_ERR | ASC-HEX conversion of reception frame is not correct |
| 0E | ERR_RANGE_OVER | Area of device is exceeded |
| 0F | ERR_NAK_ERR | Response of reception frame is NAK |

# Appendix 1 Flag list

## Appendix 1.1 Special Relay (F) List

| Word | Bit | Variables | Function | Description |
|---|---|---|---|---|
| F000~1 | - | _SYS_STATE | Mode and state | Indicates PLC mode and operation State. |
| | F0000 | _RUN | Run | Run state. |
| | F0001 | _STOP | Stop | Stop state. |
| | F0002 | _ERROR | Error | Error state. |
| | F0003 | _DEBUG | Debug | Debug state. |
| | F0004 | _LOCAL_CON | Local control | Local control mode. |
| | F0006 | _REMOTE_CON | Remote mode | Remote control mode. |
| | F0008 | _RUN_EDIT_ST | Editing during RUN | Editing program download during RUN. |
| | F0009 | _RUN_EDIT_CHK | Editing during RUN | Internal edit processing during RUN. |
| | F000A | _RUN_EDIT_DONE | Edit done during RUN | Edit is done during RUN. |
| | F000B | _RUN_EDIT_END | Edit end during RUN | Edit is ended during RUN. |
| | F000C | _CMOD_KEY | Operation mode | Operation mode changed by key. |
| | F000D | _CMOD_LPADT | Operation mode | Operation mode changed by local PADT. |
| | F000E | _CMOD_RPADT | Operation mode | Operation mode changed by Remote PADT. |
| | F000F | _CMOD_RLINK | Operation mode | Operation mode changed by Remote communication module. |
| | F0010 | _FORCE_IN | Forced input | Forced input state. |
| | F0011 | _FORCE_OUT | Forced output | Forced output state. |
| | F0014 | _MON_On | Monitor | Monitor on execution. |
| | F0015 | _USTOP_On | Stop | Stop by Stop function. |
| | F0016 | _ESTOP_On | EStop | Stop by EStop function. |
| | F0017 | _CONPILE_MODE | Compile | Compile on execution. |
| | F0018 | _INIT_RUN | Initialize | Initialization task on execution. |
| | F001C | _PB1 | Program Code 1 | Program Code 1 selected. |
| | F001D | _PB2 | Program Code 2 | Program Code 2 selected. |
| | F001E | _CB1 | Compile Code 1 | Compile Code 1 selected. |
| | F001F | _CB2 | Compile Code2 | Compile Code 2 selected. |
| F002~3 | - | _CNF_ER | System error | Reports heavy error state of system. |
| | F0021 | _IO_TYER | Module Type error | Module Type does not match. |
| | F0022 | _IO_DEER | Module detachment error | Module is detached. |
| | F0024 | _IO_RWER | Module I/O error | Module I/O error. |
| | F0025 | _IP_IFER | Module interface error | Special/communication module interface error. |
| | F0026 | _ANNUM_ER | External device error | Detected heavy error in external Device. |

| Word | Bit | Variable | Function | Description |
|---|---|---|---|---|
| F002~3 | F0028 | _BPRM_ER | Basic parameter | Basic parameter error. |
| | F0029 | _IOPRM_ER | IO parameter | I/O configuration parameter error. |
| | F002A | _SPPRM_ER | Special module parameter | Special module parameter is Abnormal. |
| | F002B | _CPPRM_ER | Communication module parameter | Communication module parameter is abnormal. |
| | F002C | _PGM_ER | Program error | Program error. |
| | F002D | _CODE_ER | Code error | Program Code error. |
| | F002E | _SWDT_ER | System watchdog | System watchdog operated. |
| | F0030 | _WDT_ER | Scan watchdog | Scan watchdog operated. |
| | F0032 | _TMRIDX_ER | Timer index error | Timer index error occurred in the program. |
| | F0034 | _INST_ER | Operation error | An operation error occurred in the program. |
| | F0035 | _IO_OVER_ER | Maximum expansion error | Maximum expansion error |
| F004 | - | _CNF_WAR | System warning | Reports light error state of system. |
| | F0041 | _DBCK_ER | Backup error | Data backup error. |
| | F0043 | _ABSD_ER | Operation shutdown error | Stop by abnormal operation. |
| | F0046 | _ANNUM_WAR | External device error | Detected light error of external device. |
| | F0048 | _HS_WAR1 | High speed link 1 | High speed link – parameter 1 error. |
| | F0049 | _HS_WAR2 | High speed link 2 | High speed link – parameter 2 error. |
| | F0054 | _P2P_WAR1 | P2P parameter 1 | P2P – parameter 1 error. |
| | F0055 | _P2P_WAR2 | P2P parameter 2 | P2P – parameter 2 error. |
| | F0056 | _P2P_WAR3 | P2P parameter 3 | P2P – parameter 3 error. |
| | F005C | _CONSTANT_ER | Constant error | Constant error. |
| F009 | - | _USER_F | User contact | Timer used by user. |
| | F0090 | _T20MS | 20ms | As a clock signal available at user program, it reverses On/Off every half period. Since clock signal is dealt with at the end of scan, there may be delay or distortion according to scan time. So use clock that's longer than scan time. Clock signal is Off status at the start of scan program and task program.<br>_T100ms clock<br> |
| | F0091 | _T100MS | 100ms | |
| | F0092 | _T200MS | 200ms | |
| | F0093 | _T1S | 1s Clock | |
| | F0094 | _T2S | 2 s Clock | |
| | F0095 | _T10S | 10 s Clock | |
| | F0096 | _T20S | 20 s Clock | |
| | F0097 | _T60S | 60 s Clock | |
| | F0099 | _On | Ordinary time On | Always On state Bit. |
| | F009A | _Off | Ordinary time Off | Always Off state Bit. |
| | F009B | _1On | 1scan On | First scan On Bit. |
| | F009C | _1Off | 1scan Off | First scan OFF bit. |
| | F009D | _STOG | Reversal | Reversal every scan. |

| Word | Bit | Variable | Function | Description |
|---|---|---|---|---|
| F010 | - | _USER_CLK | User Clock | Clock available for user setting. |
| | F0100 | _USR_CLK0 | Setting scan repeat | On/Off as much as set scan Clock 0. |
| | F0101 | _USR_CLK1 | Setting scan repeat | On/Off as much as set scan Clock 1. |
| | F0102 | _USR_CLK2 | Setting scan repeat | On/Off as much as set scan Clock 2. |
| | F0103 | _USR_CLK3 | Setting scan repeat | On/Off as much as set scan Clock 3. |
| | F0104 | _USR_CLK4 | Setting scan repeat | On/Off as much as set scan Clock 4. |
| | F0105 | _USR_CLK5 | Setting scan repeat | On/Off as much as set scan Clock 5. |
| | F0106 | _USR_CLK6 | Setting scan repeat | On/Off as much as set scan Clock 6. |
| | F0107 | _USR_CLK7 | Setting scan repeat | On/Off as much as set scan Clock 7. |
| F011 | - | _LOGIC_RESULT | Logic result | Indicates logic results. |
| | F0110 | _LER | operation error | On during 1 scan in case of operation error. |
| | F0111 | _ZERO | Zero flag | On when operation result is 0. |
| | F0112 | _CARRY | Carry flag | On when carry occurs during operation. |
| | F0113 | _ALL_Off | All output OFF | On in case that all output is Off. |
| | F0115 | _LER_LATCH | Operation error Latch | Keeps On during operation error. |
| F012 | - | _CMP_RESULT | Comparison result | Indicates the comparison result. |
| | F0120 | _LT | LT flag | On in case of “less than”. |
| | F0121 | _LTE | LTE flag | On in case of “equal or less than”. |
| | F0122 | _EQU | EQU flag | On in case of “equal”. |
| | F0123 | _GT | GT flag | On in case of “greater than”. |
| | F0124 | _GTE | GTE flag | On in case of “equal or greater than”. |
| | F0125 | _NEQ | NEQ flag | On in case of “not equal”. |
| F014 | - | _FALS_NUM | FALS no. | Indicates FALS no. |
| F015 | - | _PUTGET_ERR0 | PUT/GET error 0 | Main base Put / Get error. |
| F023 | - | _PUTGET_NDR0 | PUT/GET end 0 | Main base Put/Get end. |
| F044 | - | _CPU_TYPE | CPU Type | Indicates information for CPU Type. |
| F045 | - | _CPU_VER | CPU version | Indicates CPU version. |
| F046 | - | _OS_VER | OS version | Indicates OS version. |
| F048 | - | _OS_DATE | OS date | Indicates OS distribution date. |
| F050 | - | _SCAN_MAX | Max. scan time | Indicates max. scan time. |
| F051 | - | _SCAN_MIN | Min. scan time | Indicates min. scan time. |
| F052 | - | _SCAN_CUR | Current scan time | Current scan time. |
| F0053 | - | _MON_YEAR | Month/year | Clock data (month/year)<br>Supported when using RTC option module |
| F0054 | - | _TIME_DAY | Hour/date | Clock data (hour/date)<br>Supported when using RTC option module |
| F0055 | - | _SEC_MIN | Second/minute | Clock data (Second/minute)<br>Supported when using RTC option module |
| F0056 | - | _HUND_WK | Hundred year/week | Clock data (Hundred year/week)<br>Supported when using RTC option module |
| F057 | - | _FPU_INFO | N/A | - |
| | F0570 | _FPU_LFLAG_I | N/A | - |
| | F0571 | _FPU_LFLAG_U | N/A | - |
| | F0572 | _FPU_LFLAG_O | N/A | - |

| Word | Bit | Variable | Function | Description |
|---|---|---|---|---|
| | F0573 | _FPU_LFLAG_Z | N/A | - |
| | F0574 | _FPU_LFLAG_V | N/A | - |
| | F057A | _FPU_FLAG_I | N/A | - |
| | F057B | _FPU_FLAG_U | N/A | - |
| | F057C | _FPU_FLAG_O | N/A | - |
| | F057D | _FPU_FLAG_Z | N/A | - |
| | F057E | _FPU_FLAG_V | N/A | - |
| | F057F | _FPU_FLAG_E | Irregular input | Reports in case of irregular input. |
| F058 | - | _ERR_STEP | Error step | Saves error step. |
| F060 | - | _REF_COUNT | Refresh | Increase when module Refresh. |
| F062 | - | _REF_OK_CNT | Refresh OK | Increase when module Refresh is normal. |
| F064 | - | _REF_NG_CNT | Refresh NG | Increase when module Refresh is Abnormal. |
| F066 | - | _REF_LIM_CNT | Refresh Limit | Increase when module Refresh is abnormal (Time Out). |
| F068 | - | _REF_ERR_CNT | Refresh Error | Increase when module Refresh is Abnormal. |
| F070 | - | _MOD_RD_ERR_CNT | - | - |
| F072 | - | _MOD_WR_ERR_CNT | - | - |
| F074 | - | _CA_CNT | - | - |
| F076 | - | _CA_LIM_CNT | - | - |
| F078 | - | _CA_ERR_CNT | - | - |
| F080 | - | _BUF_FULL_CNT | Buffer Full | Increase when CPU internal buffer is full. |
| F082 | - | _PUT_CNT | Put count | Increase when Put count. |
| F084 | - | _GET_CNT | Get count | Increase when Get count. |
| F086 | - | _KEY | Current key | indicates the current state of local key. |
| F088 | - | _KEY_PREV | Previous key | indicates the previous state of local key |
| F090 | - | _IO_TYER_N | Mismatch slot | Module Type mismatched slot no. |
| F091 | - | _IO_DEER_N | Detach slot | Module detached slot no. |
| F093 | - | _IO_RWER_N | RW error slot | Module read/write error slot no. |
| F094 | - | _IP_IFER_N | IF error slot | Module interface error slot no. |
| F096 | - | _IO_TYER0 | Module Type 0 error | Main base module Type error. |

| Word | Bit | Variable | Function | Description |
|---|---|---|---|---|
| F104 | - | _IO_DEER0 | Module Detach 0 error | Main base module Detach error. |
| F120 | - | _IO_RWER0 | Module RW 0 error | Main base module read/write error. |
| F128 | - | _IO_IFER_0 | Module IF 0 error | Main base module interface error. |
| F140 | - | _AC_FAIL_CNT | Power shutdown times | Saves the times of power shutdown. |
| F142 | - | _ERR_HIS_CNT | Error occur times | Saves the times of error occur. |
| F144 | - | _MOD_HIS_CNT | Mode conversion times | Saves the times of mode conversion. |
| F146 | - | _SYS_HIS_CNT | History occur times | Saves the times of system history. |
| F148 | - | _LOG_ROTATE | N/A | |
| F150 | - | _BASE_INFO0 | Slot information 0 | Main base slot information. |
| F158 | - | _RBANK_NUM | Block number | Block using now |
| F173 | F1730 | _PLS_CATCH_0 | Pulse catch result 0 | Input0 Pulse catch result |
| | F1731 | _PLS_CATCH_1 | Pulse catch result 1 | Input1 Pulse catch result |
| | F1732 | _PLS_CATCH_2 | Pulse catch result 2 | Input2 Pulse catch result |
| | F1733 | _PLS_CATCH_3 | Pulse catch result 3 | Input3 Pulse catch result |
| | F1734 | _PLS_CATCH_4 | Pulse catch result 4 | Input4 Pulse catch result |
| | F1735 | _PLS_CATCH_5 | Pulse catch result 5 | Input5 Pulse catch result |
| | F1736 | _PLS_CATCH_6 | Pulse catch result 6 | Input6 Pulse catch result |
| | F1737 | _PLS_CATCH_7 | Pulse catch result 7 | Input7 Pulse catch result |
| | F1738 | _PLS_CATCH_8 | Pulse catch result 8 | Input8 Pulse catch result |
| | F1739 | _PLS_CATCH_9 | Pulse catch result 9 | Input9 Pulse catch result |
| | F173A | _PLS_CATCH_A | Pulse catch result A | InputA Pulse catch result |
| | F173B | _PLS_CATCH_B | Pulse catch result B | InputB Pulse catch result |
| | F173C | _PLS_CATCH_C | Pulse catch result C | InputC Pulse catch result |
| | F173D | _PLS_CATCH_D | Pulse catch result D | InputD Pulse catch result |
| | F173E | _PLS_CATCH_E | Pulse catch result E | InputE Pulse catch result |
| | F173F | _PLS_CATCH_F | Pulse catch result F | InputF Pulse catch result |
| F184 | - | _PLC_OPERATING_TIME | PLC operation time | Save PLC operation time in second |
| F190 | - | _POS_TASK_SCAN_CUR | Positioning task current scan | Current positioning task and Operation time (us) |
| F191 | - | _POS_TASK_SCAN_MAX | Positioning task maximum scan | Maximum positioning task and Operation time (us) |
| F200 | - | _USER_WRITE_F | Available contact point | Contact point available in program. |
| | F2000 | _RTC_WR | RTC RW | Data write and read in RTC. |
| | F2001 | _SCAN_WR | Scan WR | Initializing the value of scan. |
| | F2002 | _CHK_ANC_ERR | Request detection of external serious error | Request detection of external error. |
| | F2003 | _CHK_ANC_WAR | Request detection of external slight error (warning) | Request detection of external slight error (warning). |
| F201 | - | _USER_STAUS_F | User contact point | User contact point. |
| | F2010 | _INIT_DONE | Initialization completed | Initialization complete displayed. |
| F202 | - | _ANC_ERR | Display information of external serious error | Display information of external serious error |
| F203 | - | _ANC_WAR | Display information of external slight error (warning) | Display information of external slight error (warning) |
| F210 | - | _MON_YEAR_DT | Month/year | Clock data (month/year)<br>Supported when using RTC option module |
| F211 | - | _TIME_DAY_DT | Hour/date | Clock data (hour/date)<br>Supported when using RTC option module |
| F212 | - | _SEC_MIN_DT | Second/minute | Clock data (Second/minute)<br>Supported when using RTC option module |
| F213 | - | _HUND_WK_DT | Hundred year/week | Clock data (Hundred year/week)<br>Supported when using RTC option module |

## Appendix 1.2 Communication Relay (L) List

Here describes data link communication relay(L).

(1) High-speed Link 1

| Device | Keyword | Type | Description |
|---|---|---|---|
| L00000 | _HS1_RLINK | Bit | High speed link parameter 1 normal operation of all station |
| | | | Indicates normal operation of all station according to parameter set in High speed link, and On under the condition as below.<br>1. In case that all station set in parameter is RUN mode and no error,<br>2. All data block set in parameter is communicated normally, and<br>3. The parameter set in each station itself is communicated normally.<br>Once RUN_LINK is On, it keeps On unless stopped by LINK_DISABLE. |
| L00001 | _HS1_LTRBL | Bit | Abnormal state after _HS1RLINK On |
| | | | In the state of _HSmRLINK flag On, if communication state of the station set in the parameter and data block is as follows, this flag shall be On.<br>1. In case that the station set in the parameter is not RUN mode, or<br>2. There is an error in the station set in the parameter, or<br>3. The communication state of data block set in the parameter is not good.<br>LINK TROUBLE shall be On if the above 1, 2 & 3 conditions occur, and if the condition return to the normal state, it shall be OFF again. |
| L00020 ~ L0005F | _HS1_STATE[k] (k = 00~63) | Bit Array | High speed link parameter 1, K block general state |
| | | | Indicates the general state of communication information for each data block of setting parameter.<br>_HS1_STATE[k] = HS1MOD[k]&_HS1TRX[k]&(~_HS1_ERR[k]) |
| L00060 ~ L0009F | _HS1_MOD[k] (k = 00~63) | Bit Array | High speed link parameter 1, k block station RUN operation mode |
| | | | Indicates operation mode of station set in K data block of parameter. |
| L00100 ~ L0013F | _HS1_TRX[k] (k = 00~63) | Bit Array | Normal communication with High speed link parameter 1, k block station |
| | | | Indicates if communication state of Kdata of parameter is communicated smoothly according to the setting. |
| L00140 ~ L0017F | _HS1_ERR[k] (k = 00~63) | Bit Array | High speed link parameter 1, K block station operation error mode |
| | | | Indicates if the error occurs in the communication state of k data block of parameter. |
| L00180 ~ L0021F | _HS1_SETBLOCK[k] | Bit Array | High speed link parameter 1, K block setting |
| | | | Indicates whether or not to set k data block of parameter. |

(2) High-speed Link 2~5

High speed link No. 1 ~ 5

| Block Number | Address | Note |
|---|---|---|
| 2 | L0260~L047F(extension) | For each block flags, refer to the table on the preceding page. |
| 3 | L0580~L079F(extension) | |
| 4 | L0840~L104F(high extension) | |
| 5 | L1090~L129F(high extension) | |

k that is the block number indicates the information of 64 blocks in the range of 00~63 through 4 words; 16 per 1 word. For example, the mode information(_HS1MOD) indicates the information of the block 0~15 in L0006; the information of block 16~31, 32~47, 48~63 in L0007, L0008, L0009. Accordingly, the mode information of block No. 55 is indicated in L000097.

(3) P2P Flag

P2P Paramether:1~3, P2P block: 0~31

| Device | Keyword | Type | Description |
|---|---|---|---|
| L5120 | _P2P1_NDR00 | Bit | Indicates P2P parameter 1, 0 Block service normal end. |
| L5121 | _P2P1_ERR00 | Bit | Indicates P2P parameter 1, 0 Block service abnormal end. |
| L513 | _P2P1_STATUS00 | Word | Indicates error code in case of P2P parameter 1, 0 Block service abnormal end. |
| L514 | _P2P1_SVCCNT00 | DWord | Indicates P2P parameter 1, 0 Block service normal count. |
| L516 | _P2P1_ERRCNT00 | DWord | Indicates P2P parameter 1, 0 Block service abnormal count. |
| L5180 | _P2P1_NDR01 | Bit | P2P parameter 1, 1 Block service normal end. |
| L5181 | _P2P1_ERR01 | Bit | P2P parameter 1, 1 Block service abnormal end. |
| L519 | _P2P1_STATUS01 | Word | Indicates error code in case of P2P parameter 1, 1 Block service abnormal end. |
| L520 | _P2P1_SVCCNT01 | DWord | Indicates P2P parameter 1, 1 Block service normal count. |
| L522 | _P2P1_ERRCNT01 | DWord | Indicates P2P parameter 1, 1 Block service abnormal count. |

In terms of P2P parameter No.1 block, a total of 32 blocks from No.0 to No.31 exist. The parameters of each block have the same size and display function as the above table.

| P2P Number | L Address | Note |
|---|---|---|
| 1 | L05120~L0703F(Cnet) | For the saving area parameters of each block, refer to the above table. |
| 2 | L07040~L0895F(Enet) | |
| 3 | L08960~L1087F(Extension) | |
| 4 | L10880~L1279F(Extension) | |
| 5 | L12800~L1471F(HighExtension) | |
| 6 | L14720~L1663F(HighExtension) | |

(4) Network Register (N) List

Here describes Network Register for communication (N). P2P parameter: 1~6, P2P block: 0~31

| Device | Keyword | Type | Description |
|---|---|---|---|
| N000 | _P1B00SN | Word | Saves another station no. of P2P parameter 1, 00 block. |
| N0001~0004 | _P1B00RD1 | Device Structure | Saves area device 1 to read P2P parameter 1, 00 block. |
| N005 | _P1B00RS1 | Word | Saves area size 1 to read P2P parameter 1, 00block. |
| N0006~0009 | _P1B00RD2 | Device Structure | Saves area device 2 to read P2P parameter 1, 00 block. |
| N0010 | _P1B00RS2 | Word | Saves area size 2 to read P2P parameter 1, 00 block. |
| N0011~0014 | _P1B00RD3 | Device Structure | Saves area device 3 to read P2P parameter 1, 00 block. |
| N0015 | _P1B00RS3 | Word | Saves area size 3 to read P2P parameter 1, 00 block. |
| N0016~0019 | _P1B00RD4 | Device Structure | Saves area device 4 to read P2P parameter 1, 00 block. |
| N0020 | _P1B00RS4 | Word | Saves area size 4 to read P2P parameter 1, 00 block. |
| N0021~0024 | _P1B00WD1 | Device Structure | Saves area device 1 to save P2P parameter 1, 00 block. |
| N0025 | _P1B00WS1 | Word | Saves area size 1 to save P2P parameter 1, 00 block. |
| N0026~0029 | _P1B00WD2 | Device Structure | Saves area device 2 to save P2P parameter 1, 00 block. |
| N0030 | _P1B00WS2 | Word | Saves area size 2 to save P2P parameter 1, 00 block. |
| N0031~0034 | _P1B00WD3 | Device Structure | Saves area device 3 to save P2P parameter 1, 00 block. |
| N0035 | _P1B00WS3 | Word | Saves area size 3 to save P2P parameter 1, 00block. |
| N0036~0039 | _P1B00WD4 | Device Structure | Saves area device 4 to save P2P parameter 1, 00 block. |
| N0040 | _P1B00WS4 | Word | Saves area size 4 to save P2P parameter 1, 00 block. |
| N0041 | _P1B01SN | Word | Saves another station no. of P2P parameter 1, 01 block. |
| N0042~0045 | _P1B01RD1 | Device Structure | Saves area device 1 to read P2P parameter 1, 01 block. |
| N0046 | _P1B01RS1 | Word | Saves area size 1 to read P2P parameter 1, 01 block. |
| N0047~0050 | _P1B01RD2 | Device Structure | Saves area device 2 to read P2P parameter 1, 01 block. |
| N0051 | _P1B01RS2 | Word | Saves area size 2 to read P2P parameter 1, 01 block. |
| N0052~0055 | _P1B01RD3 | Device Structure | Saves area device 3 to read P2P parameter 1, 01 block. |
| N0056 | _P1B01RS3 | Word | Saves area size 3 to read P2P parameter 1, 01 block. |
| N0057~0060 | _P1B01RD4 | Device | Saves area device 4 to read P2P parameter 1, 01 block. |

| | | | |
|---|---|---|---|
| | | Structure | |
| N0061 | _P1B01RS4 | Word | Saves area size 4 to read P2P parameter 1, 01 block. |
| N0062~0065 | _P1B01WD1 | Device Structure | Saves area device 1 to save P2P parameter 1, 01 block. |
| N0066 | _P1B01WS1 | Word | Saves area size 1 to save P2P parameter 1, 01 block. |
| N0067~0070 | _P1B01WD2 | Device Structure | Saves area device 2 to save P2P parameter 1, 01 block. |
| N0071 | _P1B01WS2 | Word | Saves area size 2 to save P2P parameter 1, 01 block. |
| N0072~0075 | _P1B01WD3 | Device Structure | Saves area device 3 to save P2P parameter 1, 01 block. |
| N0076 | _P1B01WS3 | Word | Saves area size 3 to save P2P parameter 1, 01 block. |
| N0077~0080 | _P1B01WD4 | Device Structure | Saves area device 4 to save P2P parameter 1, 01 block. |
| N0081 | _P1B01WS4 | Word | Saves area size 4 to save P2P parameter 1, 01 block. |

A total of 32 blocks from No.0 to No.31 exist per P2P of No.1 to No.6. The saving parameters of each block have the same size and display function as the above table.

| P2P Number | L Address | Note |
|---|---|---|
| 1 | N0000~N1311(Cnet) | For the saving area parameters of each block, refer to the above table. |
| 2 | N1312~N2623(Enet) | |
| 3 | N2624~N3935(Extension) | |
| 4 | N3936~N5247(Extension) | |
| 5 | N5248~N6559(HighExtension) | |
| 6 | N6560~N7872(HighExtension) | |

**Notice**

(1) When you set P2P parameters through XG5000, N area is automatically set up.
(2) The N area is the flash area so it cannot be used as the internal device. (Cannot write)

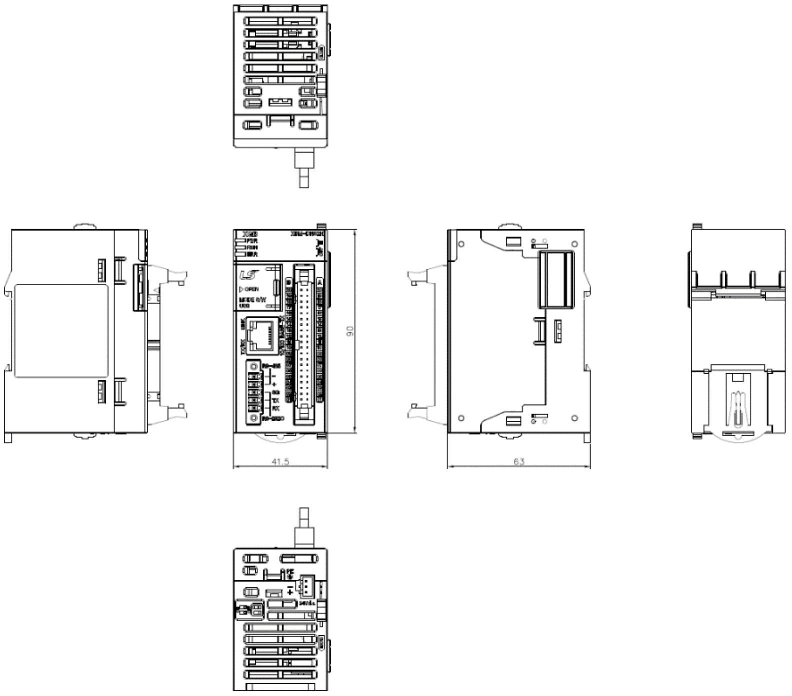
(5) ASCII(American National Standard Code for Information Interchange)

| ASCII | | Value | ASCII | | Value | ASCII | | Value | ASCII | | Value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HEX | DEC | | HEX | DEC | | HEX | DEC | | HEX | DEC | |
| 00 | 000 | NULL | 40 | 064 | @ | 20 | 032 | (space) | 60 | 096 | ` |
| 01 | 001 | SOH | 41 | 065 | A | 21 | 033 | ! | 61 | 097 | a |
| 02 | 002 | STX | 42 | 066 | B | 22 | 034 | " | 62 | 098 | b |
| 03 | 003 | ETX | 43 | 067 | C | 23 | 035 | # | 63 | 099 | c |
| 04 | 004 | EQT | 44 | 068 | D | 24 | 036 | $ | 64 | 100 | d |
| 05 | 005 | ENQ | 45 | 069 | E | 25 | 037 | % | 65 | 101 | e |
| 06 | 006 | ACK | 46 | 070 | F | 26 | 038 | & | 66 | 102 | f |
| 07 | 007 | BEL | 47 | 071 | G | 27 | 039 | ' | 67 | 103 | g |
| 08 | 008 | BS | 48 | 072 | H | 28 | 040 | ( | 68 | 104 | h |
| 09 | 009 | HT | 49 | 073 | I | 29 | 041 | ) | 69 | 105 | i |
| 0A | 010 | LF | 4A | 074 | J | 2A | 042 | * | 6A | 106 | j |
| 0B | 011 | VT | 4B | 075 | K | 2B | 043 | + | 6B | 107 | k |
| 0C | 012 | FF | 4C | 076 | L | 2C | 044 | ` | 6C | 108 | l |
| 0D | 013 | CR | 4D | 077 | M | 2D | 045 | – | 6D | 109 | m |
| 0E | 014 | SO | 4E | 078 | N | 2E | 046 | . | 6E | 110 | n |
| 0F | 015 | SI | 4F | 079 | O | 2F | 047 | / | 6F | 111 | o |
| 10 | 016 | DLE | 50 | 080 | P | 30 | 048 | 0 | 70 | 112 | p |
| 11 | 017 | DC1 | 51 | 081 | Q | 31 | 049 | 1 | 71 | 113 | q |
| 12 | 018 | DC2 | 52 | 082 | R | 32 | 050 | 2 | 72 | 114 | r |
| 13 | 019 | DC3 | 53 | 083 | S | 33 | 051 | 3 | 73 | 115 | s |
| 14 | 020 | DC4 | 54 | 084 | T | 34 | 052 | 4 | 74 | 116 | t |
| 15 | 021 | NAK | 55 | 085 | U | 35 | 053 | 5 | 75 | 117 | u |
| 16 | 022 | SYN | 56 | 086 | V | 36 | 054 | 6 | 76 | 118 | v |
| 17 | 023 | ETB | 57 | 087 | W | 37 | 055 | 7 | 77 | 119 | w |
| 18 | 024 | CAN | 58 | 088 | X | 38 | 056 | 8 | 78 | 120 | x |
| 19 | 025 | EM | 59 | 089 | Y | 39 | 057 | 9 | 79 | 121 | y |
| 1A | 026 | SUB | 5A | 090 | Z | 3A | 058 | : | 7A | 122 | z |
| 1B | 027 | ESC | 5B | 091 | [ | 3B | 059 | ; | 7B | 123 | { |
| 1C | 028 | FS | 5C | 092 | ₩ | 3C | 060 | < | 7C | 124 | \| |
| 1D | 029 | GS | 5D | 093 | ] | 3D | 061 | = | 7D | 125 | } |
| 1E | 030 | RS | 5E | 094 | ^ | 3E | 062 | > | 7E | 126 | ~ |
| 1F | 031 | US | 5F | 095 | _ | 3F | 063 | ? | 7F | 127 | □ |

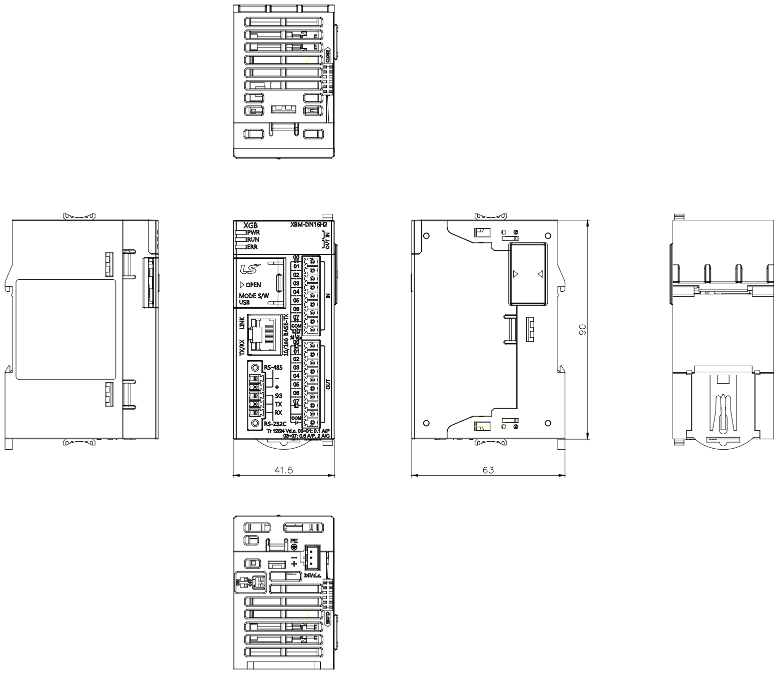
# Appendix 2 Dimension (Unit : mm)

(1) CPU Type

- XBM-DN32H2/P, XBM-DP32H2/P

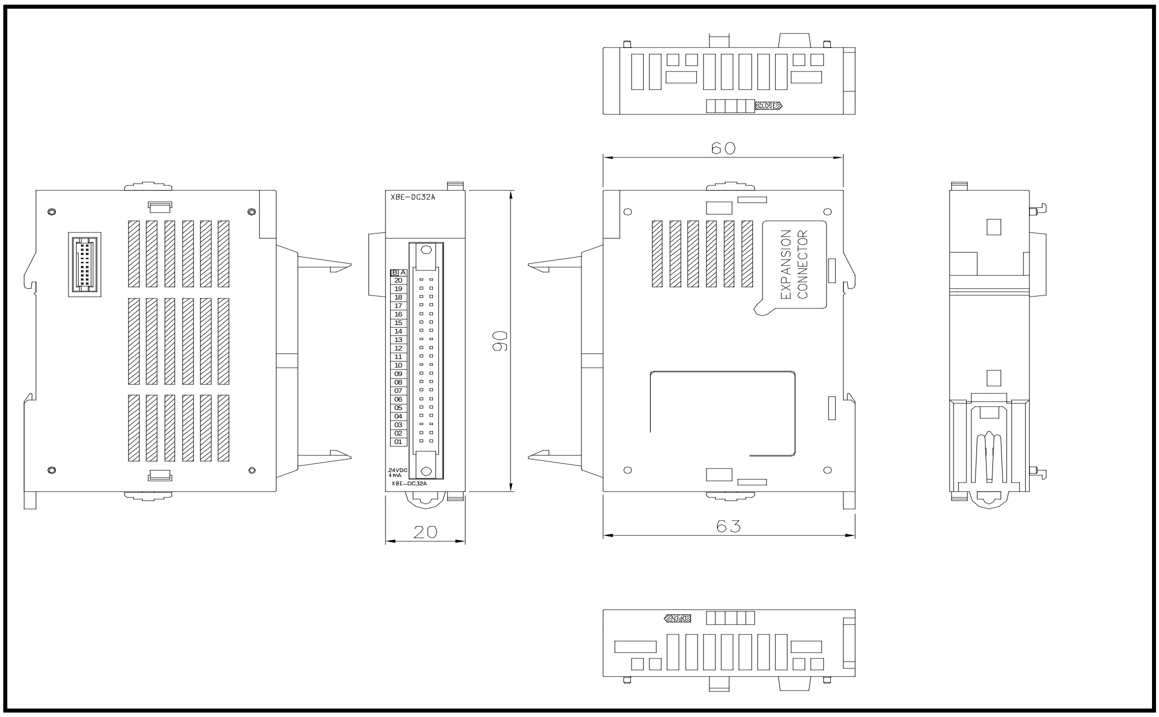


- XBM-DN16H2, XBM-DP16H2, XBM-DR14H2

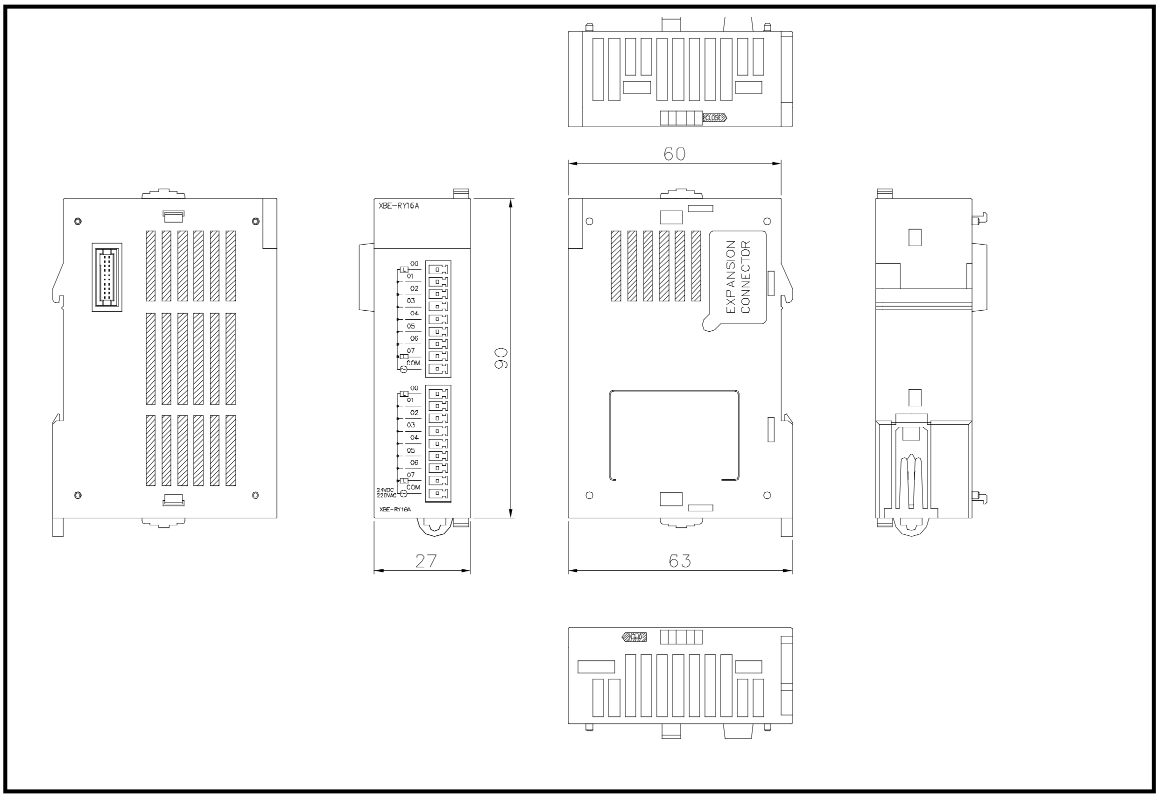


(2) Extension I/O module

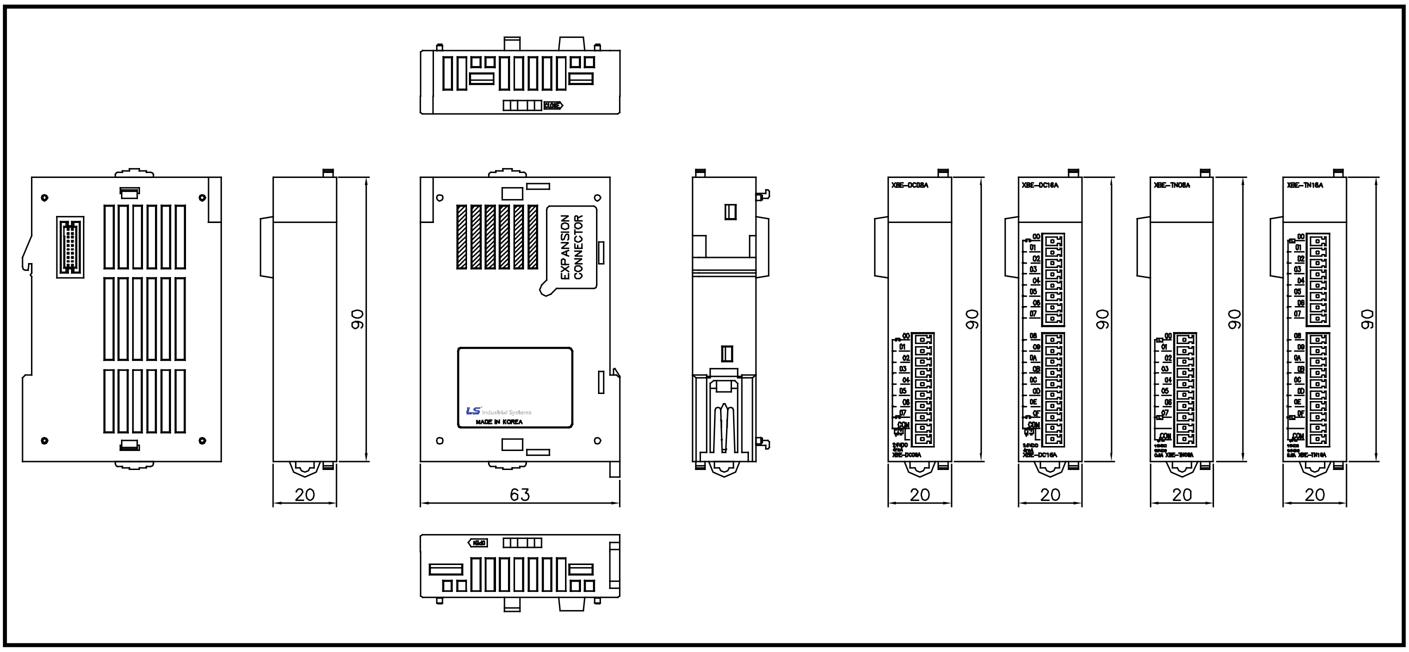
- XBE-DC32A, XBE-TR32A



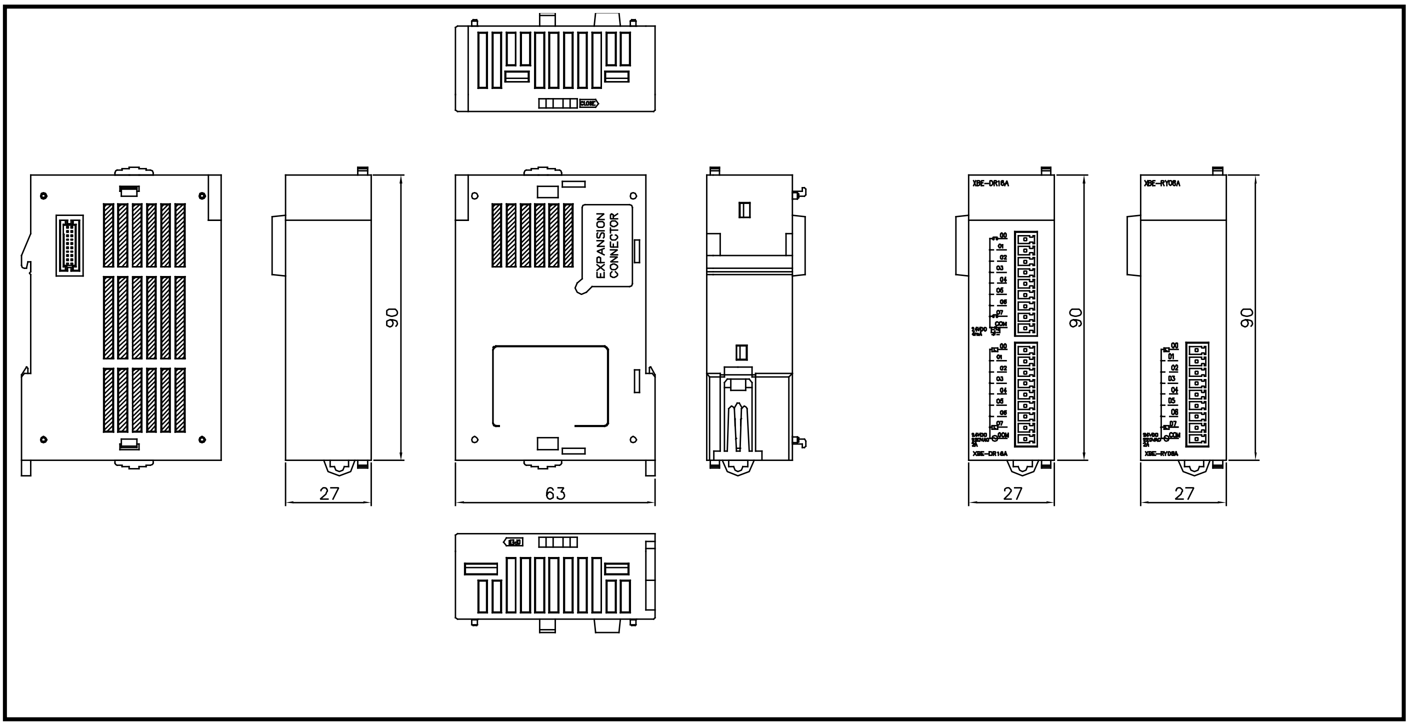
- XBE-RY16A



- XBE-DC08A, XBE-DC16A, XBE-TN08A, XBE-TP08A, XBE-TN16A, XBE-TP16A, XBE-AC08A

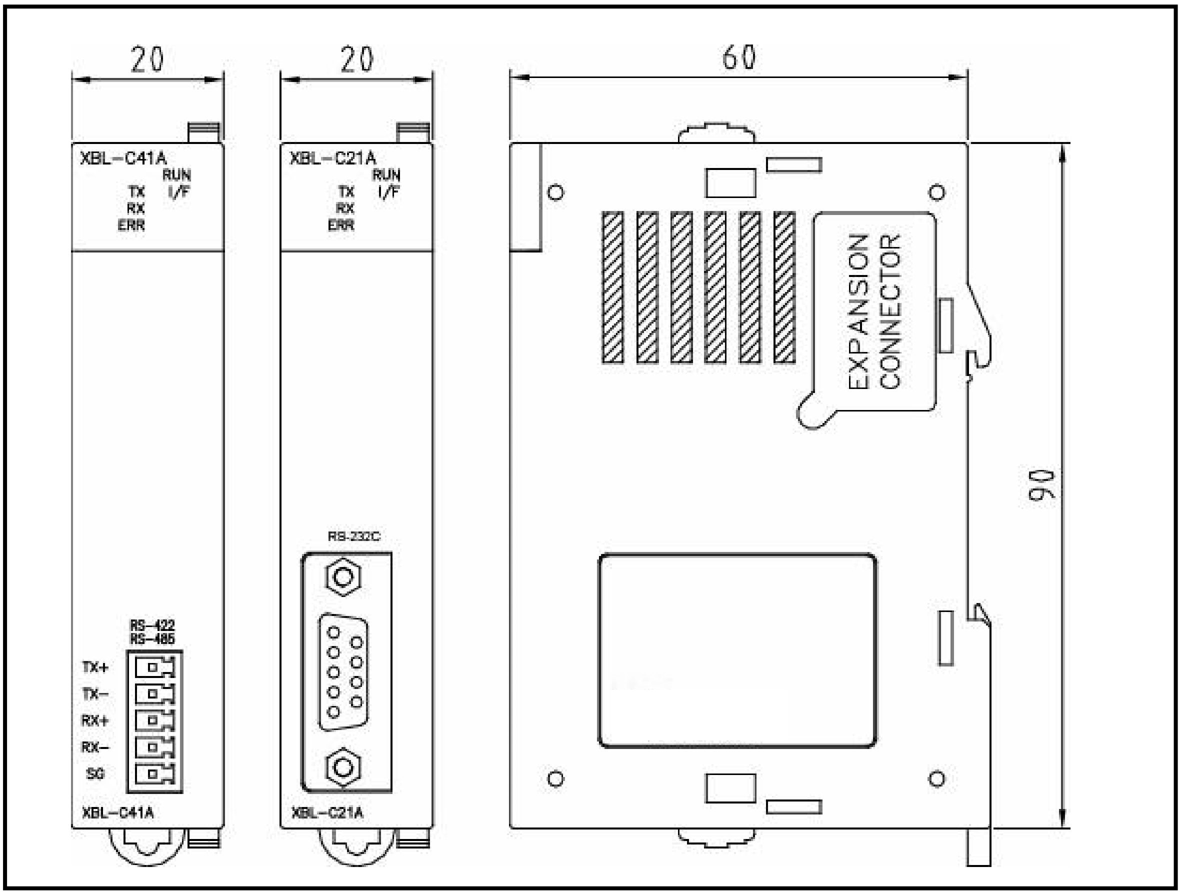


-. XBE-DR16A, XBE-RY08A



(4) Extension Cnet I/F Module

. XBL-C41A, XBL-C21A



# Appendix 3 Instruction List

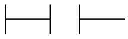
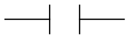
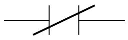
## Appendix 3.1 Classification of Instructions

| Classification | Instructions | Details | Remarks |
|---|---|---|---|
| Basic Instructions | Contact Point Instruction | LOAD, AND, OR related Instructions | |
| | Unite Instruction | AND LOAD, OR LOAD, MPUSH, MLOAD, MPOP | |
| | Reverse Instruction | NOT | |
| | Master Control Instruction | MCS, MCSCLR | |
| | Output Instruction | OUT, SET, RST, 1 Scan Output Instruction, Output Reverse Instruction (FF) | |
| | Sequence/Last-input Preferred Instruction | Step Control Instruction ( SET Sxx.xx, OUT Sxx.xx ) | |
| | End Instruction | END | |
| | Non-Process Instruction | NOP | |
| | Timer Instruction | TON, TOFF, TMR, TMON, TRTG | |
| | Counter Instruction | CTD, CTU, CTUD, CTR | |
| Application Instructions | Data Transfer Instruction | Transfers specified Data, Group, String | 4/8/64 Bits available |
| | Conversion Instruction | Converts BIN/BCD of specified Data & Group | 4/8 Bits available |
| | Data Type Conversion Instruction | Converts Integer/Real Number | |
| | Output Terminal Compare Instruction | Saves compared results in special relay | Compare to Unsigned |
| | Input Terminal Compare Instruction | Saves compared results in BR. Compares Real Number, String & Group. Compares 3 Operands | Compare to Signed |
| | Increase/Decrease Instruction | Increases or decreases specified data 1 by 1 | 4/8 Bits available |
| | Rotate Instruction | Rotates specified data to the left and right, including Carry | 4/8 Bits available |
| | Move Instruction | Moves specified data to the left and right, word by word, bit by bit | 4/8 Bits available |
| | Exchange Instruction | Exchanges between devices, higher & lower byte, group data | |
| | BIN Operation Instruction | Addition, Subtraction, Multiplication & Division for Integer/ Real Number, Addition for String, Addition & Subtraction for Group | |
| | BCD Operation Instruction | Addition, Subtraction, Multiplication, Division. | |
| | Logic Operation Instruction | Logic Multiplication, Logic Addition, Exclusive OR, Exclusive NOR, Group Operation | |
| | System Instruction | Error Display, WDT Initialize, Output Control, Operation Stop, etc. | |
| | Data Process Instruction | Encode, Decode, Data Disconnect/Connect, Search, Align, Max., Min., Total, Average, etc. | |
| | Data Table Process Instruction | Data Input/ Output of Data Table | |
| | String Process Instruction | String related Convert, Comment Read, String Extract, ASCII Convert, HEX Convert, String Search, etc. | |
| | Special Function Instruction | Trigonometric Function, Exponential/Log Function, Angle/ Radian Convert, etc. | |
| | Data Control Instruction | Max/Min Limit Control, Dead-zone Control, Zone Control | |
| | Time related Instruction | Date Time Data Read/Write, Time Data Adjust & Convert | |
| | Diverge Instruction | JMP, CALL | |

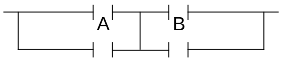
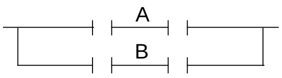
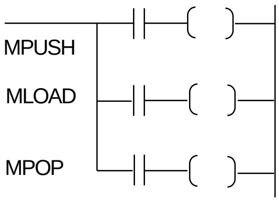
| | | | |
|---|---|---|---|
| | Loop Instruction | FOR/NEXT/BREAK | |
| | Flag related Instruction | Carry Flag Set/Reset, Error Flag Clear | |
| | Special/Communication related Instruction | Data Read/Write by BUSCON Direct Access | |
| | Interrupt related Instruction | Interrupt Enable/Disable | |
| | Sign Reverse Instruction | Reverse Integer/Real Signs, Absolute Value Operation | |

## Appendix 3.2 Basic Instructions

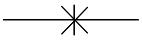
(1) Contact-point instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Contact Point | LOAD |  | A Contact Point Operation Start | O | O |
| | LOAD NOT |  | B Contact Point Operation Start | O | O |
| | AND |  | A Contact Point Series-Connected | O | O |
| | AND NOT |  | B Contact Point Series-Connected | O | O |
| | OR |  | A Contact Point Parallel-Connected | O | O |
| | OR NOT |  | B Contact Point Parallel-Connected | O | O |
| | LOADP |  | Positive Convert Detected Contact Point | O | O |
| | LOADN |  | Negative Convert Detected Contact Point | O | O |
| | ANDP |  | Positive Convert Detected Contact Point Series-Connected | O | O |
| | ANDN |  | Negative Convert Detected Contact Point Series-Connected | O | O |
| | ORP |  | Positive Convert Detected Contact Point Parallel-Connected | O | O |
| | ORN |  | Negative Convert Detected Contact Point Parallel-Connected | O | O |

(2) Union instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Unite | AND LOAD |  | A,B Block Series-Connected | O | O |
| | OR LOAD |  | A,B Block Parallel-Connected | O | O |
| | MPUSH |  | Operation Result Push up to present | O | O |
| | MLOAD | | Operation Result Load Previous to Diverge Point | O | O |
| | MPOP | | Operation Result Pop Previous to Diverge Point | O | O |

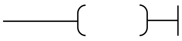
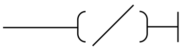
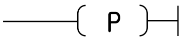
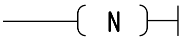
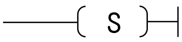
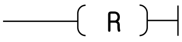
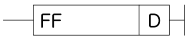
(3) reversion instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Reverse | NOT |  | Previous Operation results Reverse | O | O |

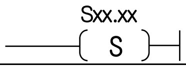
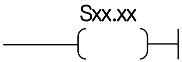
(4) Master Control instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Master Control | MCS |  | Master Control Setting (n:0~7) | O | O |
| | MCSCLR |  | Master Control Setting (n:0~7) | O | O |

(5) Output instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Output | OUT |  | Operation Results Output | O | O |
| | OUT NOT |  | Operation Results Reverse Output | O | O |
| | OUTP |  | 1 Scan Output if Input Condition rises | O | O |
| | OUTN |  | 1 Scan Output if Input Condition falls | O | O |
| | SET |  | Contact Point Output On kept | O | O |
| | RST |  | Contact Point Output Off kept | O | O |
| | FF |  | Output Reverse if Input Condition rises | O | O |

(6) Sequence/Last-input instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Step Control | SET S |  | Sequence Control | O | O |
| | OUT S |  | Last-input Preferred | O | O |

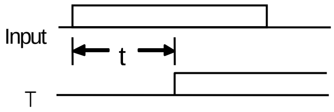
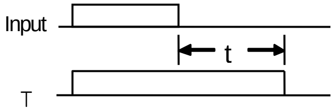
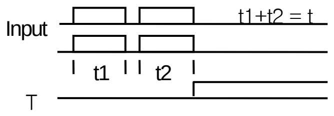
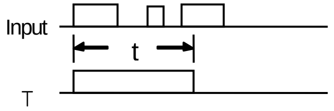
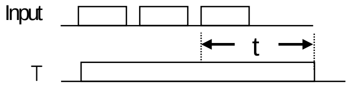
(7) End instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| End | END |  | Program End | ○ | ○ |

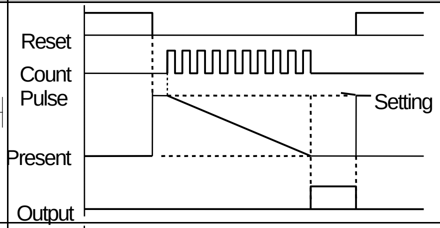
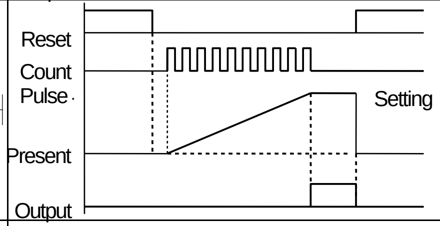
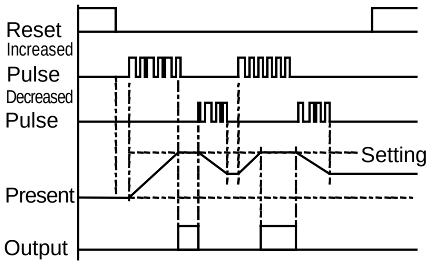
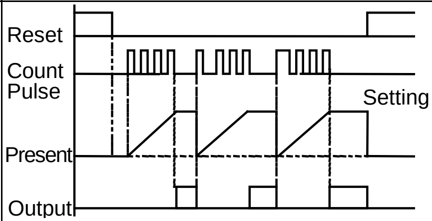
(8) Non-process instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Non-Process | NOP | Ladder not displayed | Non-process Instruction, used in Nimonic | ○ | ○ |

(9) Timer instruction

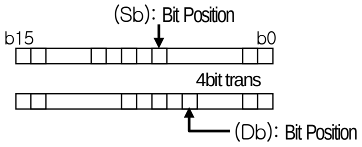
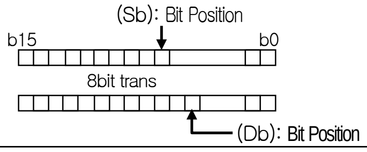
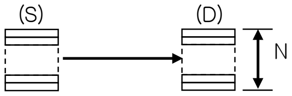
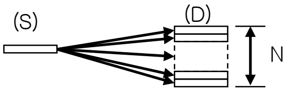
| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Timer | TON | TON T t |  | O | O |
| | TOFF | TOFF T t |  | O | O |
| | TMR | TMR T t |  | O | O |
| | TMON | TMON T t |  | O | O |
| | TRTG | TRTG T t |  | O | O |

(10) Counter instruction

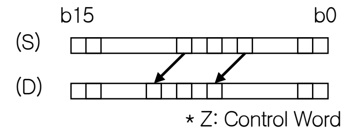
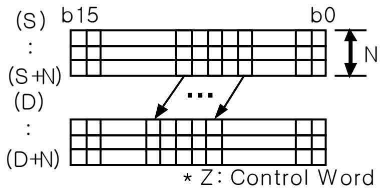
| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGB | XGB |
| 카운터 | CTD | CTD C c |  | O | O |
| | CTU | CTU C c |  | O | O |
| | CTUD | CTUD C U D c |  | O | O |
| | CTR | CTR C c |  | O | O |

## Appendix 3.3 Data transfer instruction

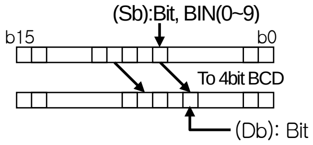
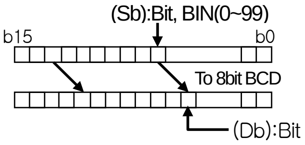
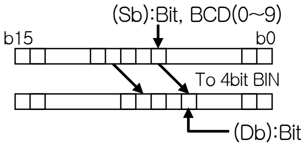
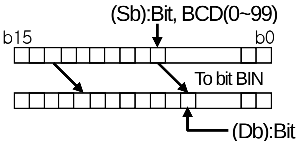
(1) Data transfer instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| 16 bits Transfer | MOV | MOV S D | $(S) \rightarrow (D)$ | O | O |
| | MOVP | MOVP S D | | | |
| 32 bits Transfer | DMOV | DMOV S D | $(S+1,S) \rightarrow (D+1,D)$ | O | O |
| | DMOVP | DMOVP S D | | | |
| Short Real Number Transfer | RMOV | RMOV S D | $(S+1,S) \rightarrow (D+1,D)$ | O | O |
| | RMOVP | RMOVP S D | | | |
| Long Real Number Transfer | LMOV | LMOV S D | $(S+3,S+2,S+1,S)$<br>$\rightarrow (D+3,D+2,D+1,D)$ | O | O |
| | LMOVP | LMOVP S D | | | |
| 4 bits Transfer | MOV4 | MOV4 Sb Db |  | O | O |
| | MOV4P | MOV4P Sb Db | | | |
| 8 bits Transfer | MOV8 | MOV8 Sb Db |  | O | O |
| | MOV8P | MOV8P Sb Db | | | |
| 1's complement Transfer | CMOV | CMOV S D | $(S) \xrightarrow{\text{1's complement}} (D)$ | O | O |
| | CMOVP | CMOVP S D | | | |
| | DCMOV | DCMOV S D | $(S+1,S) \xrightarrow{\text{1's complement}} (D+1,D)$ | O | O |
| | DCMOVP | DCMOVP S D | | | |
| 16 bits Group Transfer | GMOV | GMOV S D N |  | O | O |
| | GMOVP | GMOVP S D N | | | |
| Multiple Transfer | FMOV | FMOV S D N |  | O | O |
| | FMOVP | FMOVP S D N | | | |
| | GBMOVP | GBMOVP S D Z N | | | |

(continue)

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGK |
| Specified Bits Transfer | BMOV | BMOV S D N |  * Z: Control Word | O | O |
| | BMOVP | BMOVP S D N | | | |
| Specified Bits Group Transfer | GBMOV | GBMOV S D Z N |  * Z: Control Word | O | O |
| String Transfer | $MOV | $MOV S D | String started from (S) → String started from (D) | O | O |
| | $MOVP | $MOVP S D | | O | O |

(2) BCD/BIN conversion instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| BCD Conversion | BCD | BCD S D | $(S) \xrightarrow{\text{To BCD}} (D)$<br>BIN( 0~9999 ) | O | O |
| | BCDP | BCDP S D | | | |
| | DBCD | DBCD S D | $(S+1,S) \xrightarrow{\text{To BCD}} (D+1,D\ )$<br>BIN( 0~99999999 ) | O | O |
| | DBCDP | DBCDP S D | | | |
| 4/8 Bits BCD Conversion | BCD4 | BCD4 Sb Db |  | O | O |
| | BCD4P | BCD4P Sb Db | | | |
| | BCD8 | BCD8 Sb Db |  | O | O |
| | BCD8P | BCD8P Sb Db | | | |
| BIN Conversion | BIN | BIN S D | $(S) \xrightarrow{\text{To BIN}} (D)$<br>BCD( 0~9999 ) | O | O |
| | BINP | BINP S D | | | |
| | DBIN | DBIN S D | $(S+1,S) \xrightarrow{\text{To BIN}} (D+1,D\ )$<br>BCD( 0~99999999 ) | O | O |
| | DBINP | DBINP S D | | | |
| 4/8 Bits BIN Conversion | BIN4 | BIN4 Sb Db |  | O | O |
| | BIN4P | BIN4P Sb Db | | | |
| | BIN8 | BIN8 Sb Db |  | O | O |
| | BIN8P | BIN8P Sb Db | | | |
| Group BCD,BIN Conversion | GBCD | GBCD S D N | □Data (S) to N converted to BCD, and (D) to N saved | O | O |
| | GBCDP | GBCDP S D N | | | |
| | GBIN | GBIN S D N | □ Data (S) to N converted to BIN, and (D) to N saved | O | O |
| | GBINP | GBINP S D N | | | |

(3) Data type conversion instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| 16 Bits Integer/Real Conversion | I2R | I2R S D | (S) $\xrightarrow{\text{To Real}}$ (D+1,D)<br>Int( −32768~32767 ) | O | O |
| | I2RP | I2RP S D | | | |
| | I2L | I2L S D | (S) $\xrightarrow{\text{To Long}}$ (D+3,D+2,D+1,D)<br>Int( −32768~32767 ) | O | O |
| | I2LP | I2LP S D | | | |
| 32 Bits Integer/Real Conversion | D2R | D2R S D | (S+1,S) $\xrightarrow{\text{To Real}}$ (D+1,D)<br>Dint(−2147483648~2147483647) | O | O |
| | D2RP | D2RP S D | | | |
| | D2L | D2L S D | (S+1,S) $\xrightarrow{\text{To Long}}$ (D+3,D+2,D+1,D)<br>Dint(−2147483648~2147483647) | O | O |
| | D2LP | D2LP S D | | | |
| Short Real/Integer Conversion | R2I | R2I S D | (S+1,S) $\xrightarrow{\text{To INT}}$ (D)<br>Whole Sing Real Range | O | O |
| | R2IP | R2IP S D | | | |
| | R2D | R2D S D | (S+1,S) $\xrightarrow{\text{To DINT}}$ (D+1,D)<br>Whole Sing Real Range | O | O |
| | R2DP | R2DP S D | | | |
| Long Real/Integer Conversion | L2I | L2I S D | (S+3,S+2,S+1,S) $\xrightarrow{\text{To INT}}$ (D)<br>Whole Double Real Range | O | O |
| | L2IP | L2IP S D | | | |
| | L2D | L2D S D | (S+3,S+2,S+1,S) $\xrightarrow{\text{To DINT}}$ (D+1,D)<br>Whole Double Real Range | O | O |
| | L2DP | L2DP S D | | | |

**Remark**

In case of XGB, Integer value and Real value will be saved respectively in quite different format. For such reason, Real Number Data should be converted as applicable before used for Integer Operation.

(4) Comparison instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Unsigned Compare with Special Relay used | CMP | CMP S1 S2 | CMP(S1,S2) and applicable Flag Set (S1, S2 is Word) | O | O |
| | CMPP | CMPP S1 S2 | | | |
| | DCMP | DCMP S1 S2 | CMP(S1,S2) and applicable Flag Set (S1, S2 is Double Word) | O | O |
| | DCMPP | DCMPP S1 S2 | | | |
| 4/8 Bits Compare | CMP4 | CMP4 S1 S2 | CMP(S1,S2) and applicable Flag Set (S1, S2 is Nibble) | O | O |
| | CMP4P | CMP4P S1 S2 | | | |
| | CMP8 | CMP8 S1 S2 | CMP(S1,S2) and applicable Flag Set (S1, S2 is Byte) | O | O |
| | CMP8P | CMP8P S1 S2 | | | |
| Table Compare | TCMP | TCMP S1 S2 D | CMP(S1,S2)):<br>CMP(S1+15,S2+15)<br>Result:(D) ~ (D+15), 1 if identical | O | O |
| | TCMPP | TCMPP S1 S2 D | | | |
| | DTCMP | DTCMP S1 S2 D | CMP((S1+1,S1),(S2+1,S2))<br>CMP((S1+31,S1+30),(S2+31,S2+30)<br>Result:(D) ~ (D+15) | O | O |
| | DTCMPP | DTCMPP S1 S2 D | | | |
| Group Compare (16 Bits) | GEQ | GEQ S1 S2 D N | Compares S1 data to S2 data word by word, and saves its result in Device (D) bit by bit from the lower bit ( N ≤ 16 ) | O | O |
| | GEQP | GEQP S1 S2 D N | | | |
| | GGT | GGT S1 S2 D N | | | |
| | GGTP | GGTP S1 S2 D N | | | |
| | GLT | GLT S1 S2 D N | | | |
| | GLTP | GLTP S1 S2 D N | | | |
| | GGE | GGE S1 S2 D N | | | |
| | GGEP | GGEP S1 S2 D N | | | |
| | GLE | GLE S1 S2 D N | | | |
| | GLEP | GLEP S1 S2 D N | | | |
| | GNE | GNE S1 S2 D N | | | |
| | GNEP | GNEP S1 S2 D N | | | |

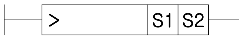
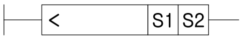
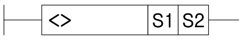
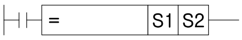
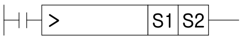
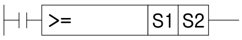
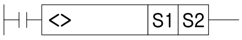
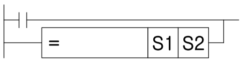
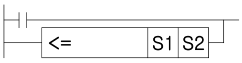
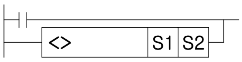
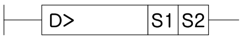
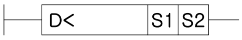
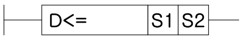
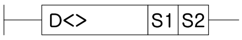
**Remark**

CMP(P), DCMP(P), CMP4(P), CMP8(P), TCMP(P) & DTCMP(P) Instructions all process the results of Unsigned Compare. All the other Compare Instructions will perform Signed Compare.

(continued)

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Group Compare (32 Bits) | GDEQ | GDEQ S1 S2 D N | Compares S1 data to S2 data 2 by 2 words, and saves its result in Device (D) bit by bit from the lower bit<br>（N ≤ 16） | O | O |
| | GDEQP | GDEQP S1 S2 D N | | O | O |
| | GDGT | GDGT S1 S2 D N | | O | O |
| | GDGTP | GDGTP S1 S2 D N | | O | O |
| | GDLT | GDLT S1 S2 D N | | O | O |
| | GDLTP | GDLTP S1 S2 D N | | O | O |
| | GDGE | GDGE S1 S2 D N | | O | O |
| | GDGEP | GDGEP S1 S2 D N | | O | O |
| | GDLE | GDLE S1 S2 D N | | O | O |
| | GDLEP | GDLEP S1 S2 D N | | O | O |
| | GDNE | GDNE S1 S2 D N | | O | O |
| | GDNEP | GDNEP S1 S2 D N | | O | O |

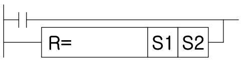
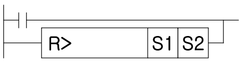
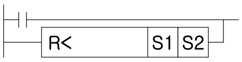
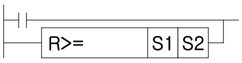
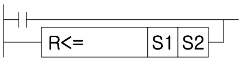
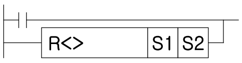
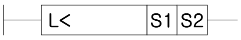
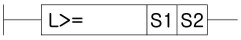
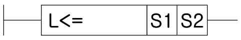
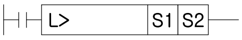
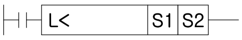
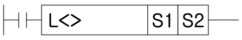
(continued)

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| 16 Bits Data Compare (LOAD) | LOAD= |  | Compares (S1) to (S2), and saves its result in Bit Result(BR) (Signed Operation) | O | O |
| | LOAD> |  | | | |
| | LOAD< |  | | | |
| | LOAD>= |  | | | |
| | LOAD<= |  | | | |
| | LOAD<> |  | | | |
| 16 Bits Data Compare (AND) | AND= |  | Performs AND operation of (S1) & (S2) Compare Result and Bit Result (BR), and then saves its result in BR (Signed Operation) | O | O |
| | AND> |  | | | |
| | AND< |  | | | |
| | AND>= |  | | | |
| | AND<= |  | | | |
| | AND<> |  | | | |
| 16 Bits Data Compare (OR) | OR= |  | Performs OR operation of (S1) & (S2) Compare Result and Bit Result (BR), and then saves its result in BR (Signed Operation) | O | O |
| | OR<= |  | | | |
| | OR<> |  | | | |
| 32 Bits Data Compare (LOAD) | LOADD= |  | Compares (S1) to (S2), and saves its result in Bit Result(BR) (Signed Operation) | O | O |
| | LOADD> |  | | | |
| | LOADD< |  | | | |
| | LOADD>= |  | | | |
| | LOADD<= |  | | | |
| | LOADD<> |  | | | |

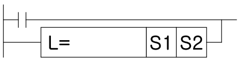
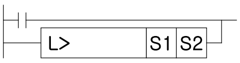
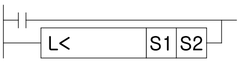
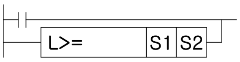
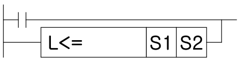
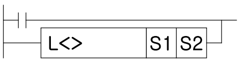
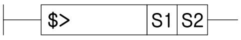
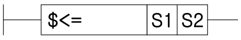
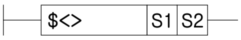
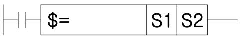
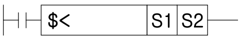
(continued)

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| 32bit<br>데이터<br>비교<br>(AND) | ANDD= | D= S1 S2 | Performs AND operation of (S1) & (S2) Compare Result and Bit Result (BR), and then saves its result in BR (Signed Operation) | O | O |
| | ANDD> | D> S1 S2 | | | |
| | ANDD< | D< S1 S2 | | | |
| | ANDD>= | D>= S1 S2 | | | |
| | ANDD<= | D<= S1 S2 | | | |
| | ANDD<> | D<> S1 S2 | | | |
| 32bt<br>Data<br>Compare<br>(OR) | ORD= | D= S1 S2 | Performs OR operation of (S1) & (S2) Compare Result and Bit Result (BR), and then saves its result in BR (Signed Operation) | O | O |
| | ORD> | D> S1 S2 | | | |
| | ORD< | D< S1 S2 | | | |
| | ORD>= | D>= S1 S2 | | | |
| | ORD<= | D<= S1 S2 | | | |
| | ORD<> | D<> S1 S2 | | | |
| Short<br>Real Number<br>Compare<br>(LOAD) | LOADR= | R= S1 S2 | Performs OR operation of (S1) & (S2) Compare Result and Bit Result (BR), and then saves its result in BR (Signed Operation) | O | O |
| | LOADR> | R> S1 S2 | | | |
| | LOADR< | R< S1 S2 | | | |
| | LOADR>= | R>= S1 S2 | | | |
| | LOADR<= | R<= S1 S2 | | | |
| | LOADR<> | R<> S1 S2 | | | |
| Short<br>Real Number<br>Compare<br>(AND) | ANDR= | R= S1 S2 | Compares (S1+1,S) to (S2+1,S2) and saves its result in Bit Result (BR) (Signed Operation) | O | O |
| | ANDR> | R> S1 S2 | | | |
| | ANDR< | R< S1 S2 | | | |
| | ANDR>= | R>= S1 S2 | | | |
| | ANDR<= | R<= S1 S2 | | | |
| | ANDR<> | R<> S1 S2 | | | |

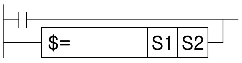
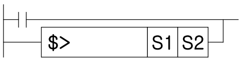
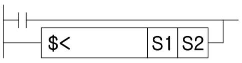
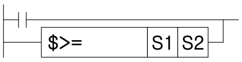
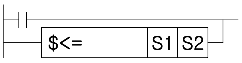
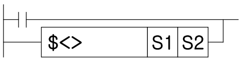
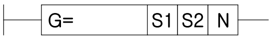
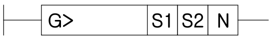
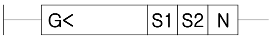
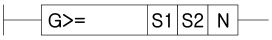
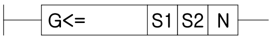
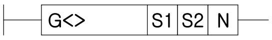
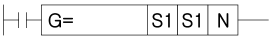
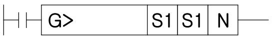
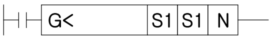
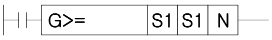
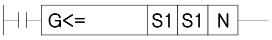
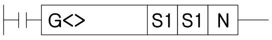
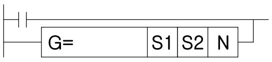
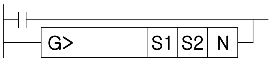
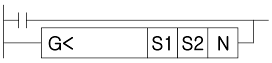
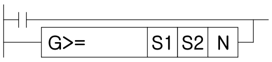
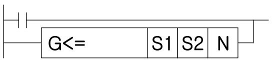
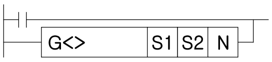
(continued)

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Short Real Number Compare (OR) | ORR= |  | Compares (S1+1,S1) to (S2+1,S2) and saves its result in Bit Result (BR) (Signed Operation) | O | O |
| | ORR> |  | | | |
| | ORR< |  | | | |
| | ORR>= |  | | | |
| | ORR<= |  | | | |
| | ORR<> |  | | | |
| Long Real Number Compare (LOAD) | LOADL= |  | Compares (S1+3,S1+2,S1+1,S) to (S2+3,S2+2, S2+1,S2) and saves its result in Bit Result(BR) (Signed Operation) | O | O |
| | LOADL> |  | | | |
| | LOADL< |  | | | |
| | LOADL>= |  | | | |
| | LOADL<= |  | | | |
| | LOADL<> |  | | | |
| Long Real Number Compare (AND) | ANDL= |  | Performs AND operation of (S1+ 1,S1) & (S2+1,S2) Compare Result and Bit Result(BR), and then saves its result in BR (Signed Operation) | O | O |
| | ANDL> |  | | | |
| | ANDL< |  | | | |
| | ANDL>= |  | | | |
| | ANDL<= |  | | | |
| | ANDL<> |  | | | |

(continued)

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Double Real Number Compare (OR) | ORL= |  | Performs OR operation of (S1 +1,S1) & (S2+1,S2) Compare Result and Bit Result(BR), and then saves its result in BR<br>(Signed Operation) | O | O |
| | ORL> |  | | | |
| | ORL< |  | | | |
| | ORL>= |  | | | |
| | ORL<= |  | | | |
| | ORL<> |  | | | |
| String Compare (LOAD) | LOAD$= |  | Compares (S1) to (S2) Starting String and saves its result in Bit Result(BR) | O | O |
| | LOAD$> |  | | | |
| | LOAD$< |  | | | |
| | LOAD$>= |  | | | |
| | LOAD$<= |  | | | |
| | LOAD$<> |  | | | |
| String Compare (AND) | AND$= |  | Performs AND operation of (S 1) & (S2) Starting String Compare Result and Bit Result(BR), and then saves its result in BR | O | O |
| | AND$> |  | | | |
| | AND$< |  | | | |
| | AND$>= |  | | | |
| | AND$<= |  | | | |
| | AND$<> |  | | | |

(continued)

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| String Compare (OR) | OR$= |  | Performs OR operation of (S1) & (S2) Starting String Compare Result and Bit Result(BR), and then saves its result in BR | O | O |
| | OR$> |  | | | |
| | OR$< |  | | | |
| | OR$>= |  | | | |
| | OR$<= |  | | | |
| | OR$<> |  | | | |
| 16 Bits Data Group Compare (LOAD) | LOADG= |  | Compares (S1), (S1+1), ⋯, (S1+N) to (S2), (S2+1), ⋯ , (S2+N) 1 to 1, and then saves 1 in Bit Result(BR) if each value compared meets given condition | O | O |
| | LOADG> |  | | | |
| | LOADG< |  | | | |
| | LOADG>= |  | | | |
| | LOADG<= |  | | | |
| | LOADG<> |  | | | |
| 16 Bits Data Group Compare (AND) | ANDG= |  | Performs AND operation of (S1), (S1+1), ⋯, (S1+N) & (S2), (S2+1), ⋯ , (S2+N) 1 to 1 Compare Result and Bit Result (BR), and then saves its result in BR | O | O |
| | ANDG> |  | | | |
| | ANDG< |  | | | |
| | ANDG>= |  | | | |
| | ANDG<= |  | | | |
| | ANDG<> |  | | | |
| 16 Bits Data Group Compare (OR) | ORG= |  | Performs OR operation of (S1), (S1+1), ⋯, (S1+N) & (S2), (S2+1), ⋯ , (S2+N) 1 to 1 Compare Result and Bit Result (BR), and then saves its result in BR | O | O |
| | ORG> |  | | | |
| | ORG< |  | | | |
| | ORG>= |  | | | |
| | ORG<= |  | | | |
| | ORG<> |  | | | |

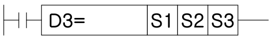
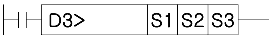
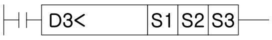
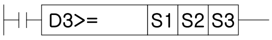
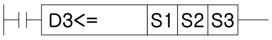
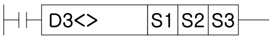
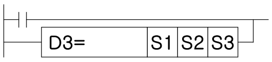
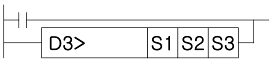
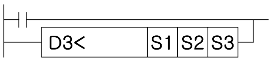
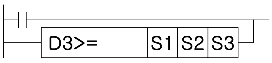
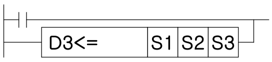
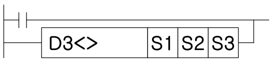
(continued)

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| 32 Bits Data Group Compare (LOAD) | LOADDG= | DG= S1 S2 N | Compares (S1), (S1+1), ⋯, (S1+N) to (S2), (S2+1), ⋯ , (S2+N) 1 to 1, and then saves 1 in Bit Result(BR) if each value compared meets given condition | O | O |
| | LOADDG> | DG> S1 S2 N | | | |
| | LOADDG< | DG< S1 S2 N | | | |
| | LOADDG>= | DG>= S1 S2 N | | | |
| | LOADDG<= | DG<= S1 S2 N | | | |
| | LOADDG<> | DG<> S1 S2 N | | | |
| 32 Bits Data Group Compare (AND) | ANDDG= | DG= S1 S1 N | Performs AND operation of (S1), (S1+1), ⋯, (S1+N) & (S2), (S2+1), ⋯ , (S2+N) 1 to 1 Compare Result and Bit Result(BR), and then saves its result in BR | O | O |
| | ANDDG> | DG> S1 S1 N | | | |
| | ANDDG< | DG< S1 S1 N | | | |
| | ANDDG>= | DG>= S1 S1 N | | | |
| | ANDDG<= | DG<= S1 S1 N | | | |
| | ANDDG<> | DG<> S1 S1 N | | | |
| 32 Bits Data Group Compare (OR) | ORDG= | DG= S1 S2 N | Performs OR operation of (S1), (S1+1), ⋯, (S1+N) & (S2), (S2+1), ⋯ , (S2+N) 1 to 1 Compare Result and Bit Result(BR), and then saves its result in BR | O | O |
| | ORDG> | DG> S1 S2 N | | | |
| | ORDG< | DG< S1 S2 N | | | |
| | ORDG>= | DG>= S1 S2 N | | | |
| | ORDG<= | DG<= S1 S2 N | | | |
| | ORDG<> | DG<> S1 S2 N | | | |

(continued)

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Three 16-Bit Data Compare (LOAD) | LOAD3= | 3= S1 S2 S3 | Saves 1 in Bit Result(BR) if each value of (S1), (S2), (S3) meets given condition | O | O |
| | LOAD3> | 3> S1 S2 S3 | | | |
| | LOAD3< | 3< S1 S2 S3 | | | |
| | LOAD3>= | 3>= S1 S2 S3 | | | |
| | LOAD3<= | 3<= S1 S2 S3 | | | |
| | LOAD3<> | 3<> S1 S2 S3 | | | |
| Three 16-Bit Data Compare (AND) | AND= | 3= S1 S2 S3 | Performs AND operation of (S1), (S2), (S3) Compare Result by given condition and Bit Result (BR), and then saves its result in BR | O | O |
| | AND> | 3> S1 S2 S3 | | | |
| | AND< | 3< S1 S2 S3 | | | |
| | AND>= | 3>= S1 S2 S3 | | | |
| | AND<= | 3<= S1 S2 S3 | | | |
| | AND<> | 3<> S1 S2 S3 | | | |
| Three 32-Bit Data Compare (OR) | OR3= | 3= S1 S2 S3 | Performs OR operation of (S1), (S2), (S3) Compare Result by given condition and Bit Result (BR), and then saves its result in BR | O | O |
| | OR3> | 3> S1 S2 S3 | | | |
| | OR3< | <3 S1 S2 S3 | | | |
| | OR3>= | >=3 S1 S2 S3 | | | |
| | OR3<= | 3<= S1 S2 S3 | | | |
| | OR3<> | 3<> S1 S2 S3 | | | |
| Three 16-Bit Data Compare (LOAD) | LOADD3= | D3= S1 S2 S3 | Saves 1 in Bit Result(BR) if each value of (S1+1,S1), (S2+ 1,S2), (S3+1,S3) meets given condition | O | O |
| | LOADD3> | D3> S1 S2 S3 | | | |
| | LOADD3< | D3< S1 S2 S3 | | | |
| | LOADD3>= | D3>= S1 S2 S3 | | | |
| | LOADD3<= | D3<= S1 S2 S3 | | | |
| | LOADD3<> | D3<> S1 S2 S3 | | | |

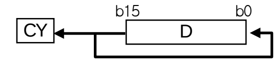
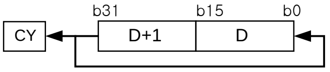
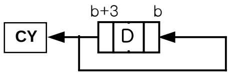
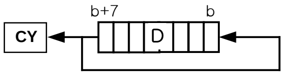
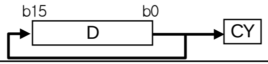
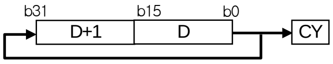
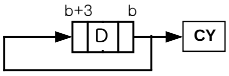
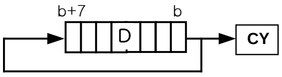
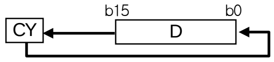
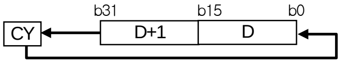
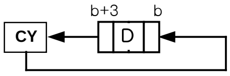
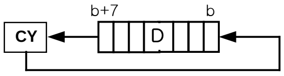
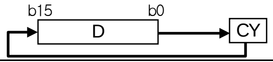
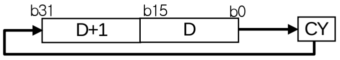
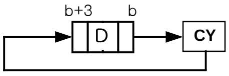
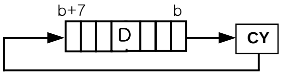
(continued)

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Three 32-Bit Data Compare (AND) | ANDD3= |  | Performs AND operation of (S1+ 1,S1), (S2+1,S2), (S3+1,S3) Compare Result by given condition and Bit Result(BR), and then saves its result in BR | O | O |
| | ANDD3> |  | | | |
| | ANDD3< |  | | | |
| | ANDD3>= |  | | | |
| | ANDD3<= |  | | | |
| | ANDD<> |  | | | |
| Three 32-Bit Data Compare (OR) | ORD3= |  | Performs OR operation of (S1+1, S1), (S2+1,S2), (S3+1,S3) Compare Result by given condition and Bit Result (BR), and then saves its result in BR | O | O |
| | ORD3> |  | | | |
| | ORD3< |  | | | |
| | ORD3>= |  | | | |
| | ORD3<= |  | | | |
| | ORD3<> |  | | | |

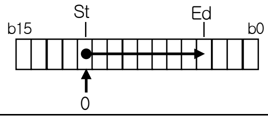
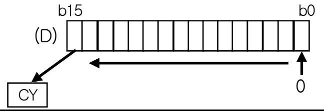
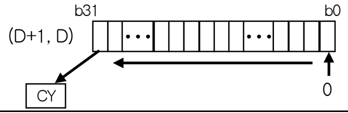
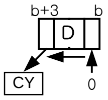
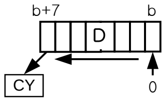
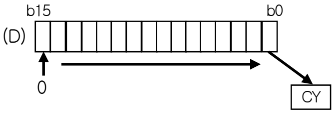
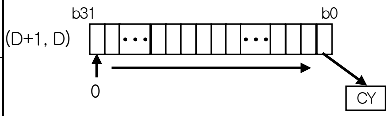
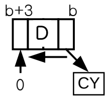
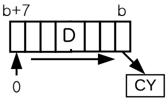
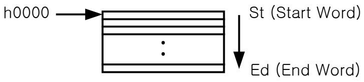
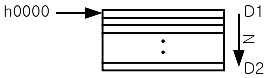
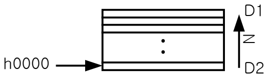
(5) Increase/Decrease instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| BIN Data Increase / Decrease (Signed) | INC | INC D | (D)+1 → (D) | O | O |
| | INCP | INCP D | | | |
| | DINC | DINC D | (D+1,D)+1 → (D+1,D) | | |
| | DINCP | DINCP D | | | |
| | DEC | DEC D | (D)−1 → (D) | O | O |
| | DECP | DECP D | | | |
| | DDEC | DDEC D | (D+1,D)−1 → (D+1,D) | | |
| | DDECP | DDECP D | | | |
| 4/8 Bits Data Increase / Decrease (Signed) | INC4 | INC4 Db | (D:x bit ~ D:x bit+4) + 1<br>→ (D:x bit ~ D:x bit+4) | O | O |
| | INC4P | INC4P Db | | | |
| | INC8 | INC8 Db | (D:x bit ~ D:x bit+8) + 1<br>→ (D:x bit ~ D:x bit+8) | | |
| | INC8P | INC8P Db | | | |
| | DEC4 | DEC4 Db | (D:x bit ~ D:x bit+4) − 1<br>→ (D:x bit ~ D:x bit+4) | O | O |
| | DEC4P | DEC4P Db | | | |
| | DEC8 | DEC8 Db | (D:x bit ~ D:x bit+8) − 1<br>→ (D:x bit ~ D:x bit+8) | | |
| | DEC8P | DEC8P Db | | | |
| BIN Data Increase / Decrease (Unsigned) | INCU | INCU D | (D)+1 → (D) | O | O |
| | INCUP | INCUP D | | | |
| | DINCU | DINCU D | (D+1,D)+1 → (D+1,D) | | |
| | DINCUP | DINCUP D | | | |
| | DECU | DECU D | (D)−1 → (D) | O | O |
| | DECUP | DECUP D | | | |
| | DDECU | DDECU D | (D+1,D)−1 → (D+1,D) | | |
| | DDECUP | DDECUP D | | | |

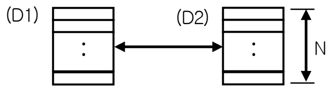
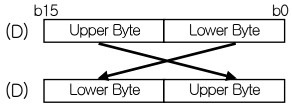
(6)Rotation instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Rotate to Left | ROL | ROL D n |  | O | O |
| | ROLP | ROLP D n | | | |
| | DROL | DROL D n |  | | |
| | DROLP | DROLP D n | | | |
| 4/8 Bits Rotate to Left | ROL4 | ROL4 Db n |  | O | O |
| | ROL4P | ROL4P Db n | | | |
| | ROL8 | ROL8 Db n |  | | |
| | ROL8P | ROL8P Db n | | | |
| Rotate to Right | ROR | ROR D n |  | O | O |
| | RORP | RORP D n | | | |
| | DROR | DROR D n |  | | |
| | DRORP | DRORP D n | | | |
| 4/8 Bits Rotate to Right | ROR4 | ROR4 Db n |  | O | O |
| | ROR4P | ROR4P Db n | | | |
| | ROR8 | ROR8 Db n |  | | |
| | ROR8P | ROR8P Db n | | | |
| Rotate to Left (including Carry) | RCL | RCL D n |  | O | O |
| | RCLP | RCLP D n | | | |
| | DRCL | DRCL D n |  | | |
| | DRCLP | DRCLP D n | | | |
| 4/8 Bits Rotate to Left (including Carry) | RCL4 | RCL4 Db n |  | O | O |
| | RCL4P | RCL4P Db n | | | |
| | RCL8 | RCL8 Db n |  | | |
| | RCL8P | RCL8P Db n | | | |
| Rotate to Right (including Carry) | RCR | RCR D n |  | O | O |
| | RCRP | RCRP D n | | | |
| | DRCR | DRCR D n |  | | |
| | DRCRP | DRCRP D n | | | |
| 4/8 Bits Rotate to Right (including Carry) | RCR4 | RCR4 Db n |  | O | O |
| | RCR4P | RCR4P Db n | | | |
| | RCR8 | RCR8 Db n |  | | |
| | RCR8P | RCR8P Db n | | | |

(7) Move location

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Bits Move | BSFT | BSFT St Ed |  | O | O |
| | BSFTP | BSFTP St Ed | | | |
| Move to Higher Bit | BSFL | BSFL D n |  | O | O |
| | BSFLP | BSFLP D n | | | |
| | DBSFL | DBSFL D n |  | | |
| | DBSFLP | DBSFLP D n | | | |
| Move to Higher Bit within 4/8 Bits range | BSFL4 | BSFL4 Db n |  | O | O |
| | BSFL4P | BSFL4P Db n | | | |
| | BSFL8 | BSFL8 Db n |  | | |
| | BSFL8P | BSFL8P Db n | | | |
| Move to Lower Bit | BSFR | BSFR D n |  | O | O |
| | BSFRP | BSFRP D n | | | |
| | DBSFR | DBSFR D n |  | | |
| | DBSFRP | DBSFRP D n | | | |
| Move to Lower Bit within 4/8 Bits range | BSFR4 | BSFR4 Db n |  | O | O |
| | BSFR4P | BSFR4P Db n | | | |
| | BSFR8 | BSFR8 Db n |  | | |
| | BSFR8P | BSFR8P Db n | | | |
| Word Move | WSFT | WSFT Et Ed |  | O | O |
| | WSFTP | WSFTP Et Ed | | | |
| Word Data Move to Left/Right | WSFL | WSFL D1 D2 N |  | O | O |
| | WSFLP | WSFLP D1 D2 N | | | |
| | WSFR | WSFR D1 D2 N |  | | |
| | WSFRP | WSFRP D1 D2 N | | | |
| Bit Move | SR | SR Db I D N | Moves N bits starting from Db bit along Input direction (I) and Move direction (D) | O | O |

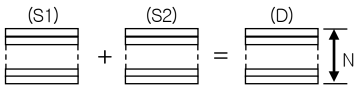
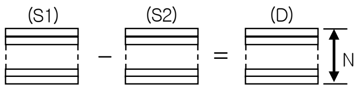
(8) Exchange instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Data Exchange | XCHG | XCHG D1 D2 | (D1) ↔ (D2) | O | O |
| | XCHGP | XCHGP D1 D2 | | | |
| | DXCHG | DXCHG D1 D2 | (D1+1, D1) ↔ (D2+1, D2) | | |
| | DXCHGP | DXCHGP D1 D2 | | | |
| Group Data Exchange | GXCHG | GXCHG D1 D2 N |  | O | O |
| | GXCHGP | GXCHGP D1 D2 N | | | |
| Higher/Lower Byte Exchange | SWAP | SWAP D |  | O | O |
| | SWAPP | SWAPP D | | | |
| Group Byte Exchange | GSWAP | GSWAP D N | Switch N numbers of Upper and Lower Byte from D | O | O |
| | GSWAPP | GSWAPP D N | | | |

(9) BIN operation instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Integer Addition (Signed) | ADD | ADD S1 S2 D | (S1)+(S2) → (D) | O | O |
| | ADDP | ADDP S1 S2 D | | | |
| | DADD | DADD S1 S2 D | (S1+1,S1)+(S2+1,S2) → (D+1,D) | | |
| | DADDP | DADDP S1 S2 D | | | |
| Integer Subtraction (Signed) | SUB | SUB S1 S2 D | (S1)−(S2) → (D) | O | O |
| | SUBP | SUBP S1 S2 D | | | |
| | DSUB | DSUB S1 S2 D | (S1+1,S1)−(S2+1,S2) → (D+1,D) | | |
| | DSUBP | DSUBP S1 S2 D | | | |
| Integer Multiplication (Signed) | MUL | MUL S1 S2 D | (S1)×(S2) → (D+1,D) | O | O |
| | MULP | MULP S1 S2 D | | | |
| | DMUL | DMUL S1 S2 D | (S1+1,S1)×(S2+1,S2) → (D+3,D+2,D+1,D) | | |
| | DMULP | DMULP S1 S2 D | | | |
| Integer Division (Signed) | DIV | DIV S1 S2 D | (S1)÷(S2) → (D) Quotient<br>(D+1) Remainder | O | O |
| | DIVP | DIVP S1 S2 D | | | |
| | DDIV | DDIV S1 S2 D | (S1+1,S1)÷(S2+1,S2) → (D+1,D) Quotient<br>(D+3,D+2)Remainder | | |
| | DDIVP | DDIVP S1 S2 D | | | |
| Integer Addition (Unsigned) | ADDU | ADDU S1 S2 D | (S1)+(S2) → (D) | O | O |
| | ADDUP | ADDUP S1 S2 D | | | |
| | DADDU | DADDU S1 S2 D | (S1+1,S1)+(S2+1,S2) → (D+1,D) | | |
| | DADDUP | DADDUP S1 S2 D | | | |
| Integer Subtraction (Unsigned) | SUBU | SUBU S1 S2 D | (S1)−(S2) → (D) | O | O |
| | SUBUP | SUBUP S1 S2 D | | | |
| | DSUBU | DSUBU S1 S2 D | (S1+1,S1)−(S2+1,S2) → (D+1,D) | | |
| | DSUBUP | DSUBUP S1 S2 D | | | |
| Integer Multiplication (Unsigned) | MULU | MULU S1 S2 D | (S1)×(S2) → (D+1,D) | O | O |
| | MULUP | MULUP S1 S2 D | | | |
| | DMULU | DMULU S1 S2 D | (S1+1,S1)×(S2+1,S2) → (D+3,D+2,D+1,D) | | |
| | DMULUP | DMULUP S1 S2 D | | | |

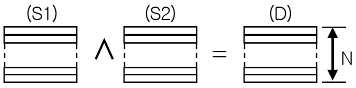
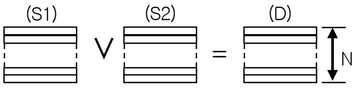
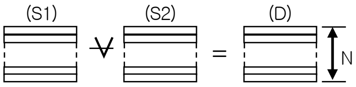
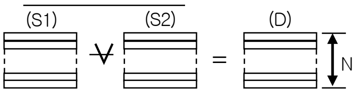
(continued)

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Integer Division (Unsigned) | DIVU | DIVU S1 S2 D | (S1)÷(S2) → (D) 몫<br>(D+1) 나머지 | O | O |
| | DIVUP | DIVUP S1 S2 D | | | |
| | DDIVU | DDIVU S1 S2 D | (S1+1,S1)÷(S2+1,S2)<br>→ (D+1,D) 몫<br>(D+3,D+2) 나머지 | | |
| | DDIVUP | DDIVUP S1 S2 D | | | |
| Real Number Addition | RADD | RADD S1 S2 D | (S1+1,S1)+(S2+1,S2)<br>→ (D+1,D) | O | O |
| | RADDP | RADDP S1 S2 D | | | |
| | LADD | LADD S1 S2 D | (S1+3,S1+2,S1+1,S1)<br>+(S2+3,S2+2,S2+1,S2)<br>→ (D+3,D+2,D+1,D) | | |
| | LADDP | LADDP S1 S2 D | | | |
| Real Number Subtraction | RSUB | RSUB S1 S2 D | (S1+1,S1)−(S2+1,S2)<br>→ (D+1,D) | O | O |
| | RSUBP | RSUBP S1 S2 D | | | |
| | LSUB | LSUB S1 S2 D | (S1+3,S1+2,S1+1,S1)<br>−(S2+3,S2+2,S2+1,S2)<br>→ (D+3,D+2,D+1,D) | | |
| | LSUBP | LSUBP S1 S2 D | | | |
| Real Number Multiplication | RMUL | RMUL S1 S2 D | (S1+1,S1)×(S2+1,S2)<br>→ (D+1,D) | O | O |
| | RMULP | RMULP S1 S2 D | | | |
| | LMUL | LMUL S1 S2 D | (S1+3,S1+2,S1+1,S1)<br>×(S2+3,S2+2,S2+1,S2)<br>→ (D+3,D+2,D+1,D) | | |
| | LMULP | LMULP S1 S2 D | | | |
| Real Number Division | RDIV | RDIV S1 S2 D | (S1+1,S1)÷(S2+1,S2)<br>→ (D+1,D) | O | O |
| | RDIVP | RDIVP S1 S2 D | | | |
| | LDIV | LDIV S1 S2 D | (S1+3,S1+2,S1+1,S1)<br>÷(S2+3,S2+2,S2+1,S2)<br>→ (D+3,D+2,D+1,D) | | |
| | LDIVP | LDIVP S1 S2 D | | | |
| String Addition | $ADD | $ADD S1 S2 D | Connects S1 String with S2 String to save in D | O | O |
| | $ADDP | $ADDP S1 S2 D | | | |
| Group Addition | GADD | GADD S1 S2 D N |  | O | O |
| | GADDP | GADDP S1 S2 D N | | | |
| Group Subtraction | GSUB | GSUB S1 S2 D N |  | O | O |
| | GSUBP | GSUBP S1 S2 D N | | | |

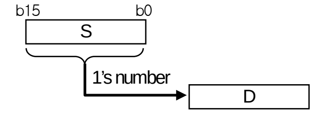
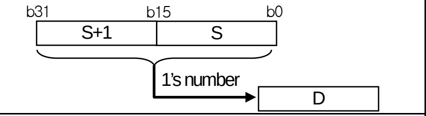
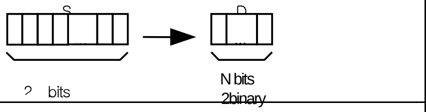
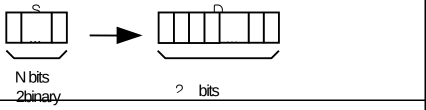
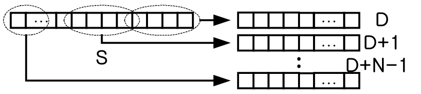
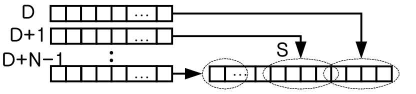
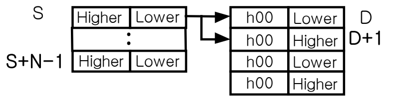
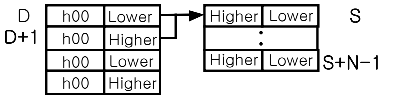
(10) BCD operation instruction

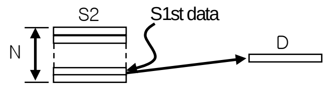
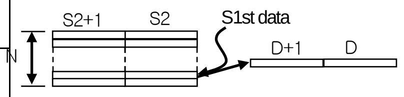
| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| BCD Addition | ADDB | ADDB S1 S2 D | (S1)+(S2) → (D) | O | O |
| | ADDBP | ADDBP S1 S2 D | | | |
| | DADDB | DADDB S1 S2 D | (S1+1,S1)+(S2+1,S2)<br>→ (D+1,D) | | |
| | DADDBP | DADDBP S1 S2 D | | | |
| BCD Subtraction | SUBB | SUBB S1 S2 D | (S1)−(S2) → (D) | O | O |
| | SUBBP | SUBBP S1 S2 D | | | |
| | DSUBB | DSUBB S1 S2 D | (S1+1,S1)−(S2+1,S2)<br>→ (D+1,D) | | |
| | DSUBBP | DSUBBP S1 S2 D | | | |
| BCD Multiplication | MULB | MULB S1 S2 D | (S1)×(S2) → (D+1,D) | O | O |
| | MULBP | MULBP S1 S2 D | | | |
| | DMULB | DMULB S1 S2 D | (S1+1,S1)×(S2+1,S2)<br>→ (D+3,D+2,D+1,D) | | |
| | DMULBP | DMULBP S1 S2 D | | | |
| BCD Division | DIVB | DIVB S1 S2 D | (S1)÷(S2) → (D) Quotient<br>(D+1) Remainder | O | O |
| | DIVBP | DIVBP S1 S2 D | | | |
| | DDIVB | DDIVB S1 S2 D | (S1+1,S1)÷(S2+1,S2)<br>→ (D+1,D) Quotient<br>(D+3,D+2) Remainder | | |
| | DDIVBP | DDIVBP S1 S2 D | | | |

(11) Logic operation instruction

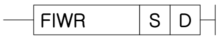
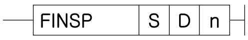
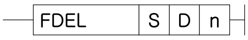
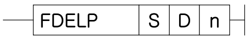
| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Logic Multiplication | WAND | WAND S1 S2 D | Word AND<br>$(S1) \wedge (S2) \longrightarrow (D)$ | O | O |
| | WANDP | WANDP S1 S2 D | | | |
| | DWAND | DWAND S1 S2 D | DWord AND<br>$(S1+1,S1) \wedge (S2+1,S2) \longrightarrow (D+1,D)$ | | |
| | DWANDP | DWANDP S1 S2 D | | | |
| Logic Addition | WOR | WOR S1 S2 D | Word OR<br>$(S1) \vee (S2) \longrightarrow (D)$ | O | O |
| | WORP | WORP S1 S2 D | | | |
| | DWOR | DWOR S1 S2 D | DWord OR<br>$(S1+1,S1) \vee (S2+1,S2) \longrightarrow (D+1,D)$ | | |
| | DWORP | DWORP S1 S2 D | | | |
| Exclusive OR | WXOR | WXOR S1 S2 D | Word Exclusive OR<br>$(S1) \veebar (S2) \longrightarrow (D)$ | O | O |
| | WXORP | WXORP S1 S2 D | | | |
| | DWXOR | DWXOR S1 S2 D | DWord Exclusive OR<br>$(S1+1,S1) \veebar (S2+1,S2) \longrightarrow (D+1,D)$ | | |
| | DWXORP | DWXORP S1 S2 D | | | |
| Exclusive NOR | WXNR | WXNR S1 S2 D | Word Exclusive NOR<br>$\overline{(S1) \veebar (S2)} \longrightarrow (D)$ | O | O |
| | WXNRP | WXNRP S1 S2 D | | | |
| | DWXNR | DWXNR S1 S2 D | DWord Exclusive NOR<br>$\overline{(S1+1,S1) \veebar (S2+1,S2)} \longrightarrow (D+1,D)$ | | |
| | DWXNRP | DWXNRP S1 S2 D | | | |
| Group Logic Operation | GWAND | GWAND S1 S2 D N |  | O | O |
| | GWANDP | GWANDP S1 S2 D N | | | |
| | GWOR | GWOR S1 S2 D N |  | O | O |
| | GWORP | GWORP S1 S2 D N | | | |
| | GWXOR | GWXOR S1 S2 D N |  | O | O |
| | GWXORP | GWXORP S1 S2 D N | | | |
| | GWXNR | GWXNR S1 S2 D N |  | O | O |
| | GWXNRP | GWXNRP S1 S2 D N | | | |

(12) Data process instruction (continued)

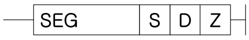
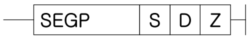
| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Bit Check | BSUM | BSUM S D |  | O | O |
| | BSUMP | BSUMP S D | | | |
| | DBSUM | DBSUM S D |  | | |
| | DBSUMP | DBSUMP S D | | | |
| Bit Reset | BRST | BRST D N | Resets N Bits (starting from D) to 0 | O | O |
| | BRSTP | BRSTP D N | | | |
| Encode | ENCO | ENCO S D n |  | O | O |
| | ENCOP | ENCOP S D n | | | |
| Decode | DECO | DECO S D n |  | O | O |
| | DECOP | DECOP S D n | | | |
| Data Disconnect & Connect | DIS | DIS S D n |  | O | O |
| | DISP | DISP S D n | | | |
| | UNI | UNI S D n |  | O | O |
| | UNIP | UNIP S D n | | | |
| Word/ Byte Conversion | WTOB | WTOB S D n |  | O | O |
| | WTOBP | WTOBP S D n | | | |
| | BTOW | BTOW S D n |  | O | O |
| | BTOWP | BTOWP S D n | | | |
| I/O Refresh | IORF | IORF S1 S2 S3 | Right after masking I/O data (located on S1) with S2 and S3 data, perform process | O | O |
| | IORFP | IORFP S1 S2 S3 | | | |
| Data Search | SCH | SCH S1 S2 D N | Finds S1 value within S2 ~ N range and saves the first identical valued position in D and S1's identical valued total number in D+1 | O | O |
| | SCHP | SCHP S1 S2 D N | | | |
| | DSCH | DSCH S1 S2 D N | | | |
| | DSCHP | DSCHP S1 S2 D N | | | |
| Max. Value Search | MAX | MAX S D n | Saves the max value in D among N words starting from S | O | O |
| | MAXP | MAXP S D n | | | |
| | DMAX | DMAX S D n | Saves the max value in D among N double words starting from S | | |
| | DMAXP | DMAXP S D n | | | |

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Min. Value Search | MIN | MIN S D n | Saves the min value in D among N words starting from S | O | O |
| | MINP | MINP S D n | | | |
| | DMIN | DMIN S D n | Saves the min value in D among N double words starting from S | | |
| | DMINP | DMINP S D n | | | |
| Sum | SUM | SUM S D n | Adds up N words starting from S to save in D | O | O |
| | SUMP | SUMP S D n | | | |
| | DSUM | DSUM S D n | Adds up N double words starting from S to save in D | | |
| | DSUMP | DSUMP S D n | | | |
| Average | AVE | AVE S D n | Averages N words starting from S to save in D | O | O |
| | AVEP | AVEP S D n | | | |
| | DAVE | DAVE S D n | Averages N double words starting from S to save in D | | |
| | DAVEP | DAVEP S D n | | | |
| MUX | MUX | MUX S1 S2 D N |  | O | O |
| | MUXP | MUXP S1 S2 D N | | | |
| | DMUX | DMUX S1 S2 D N |  | | |
| | DMUXP | DMUXP S1 S2 D N | | | |
| Data Detect | DETECT | DETECT S1 S2 D N | Detects N data from S1, to save the first value larger than S2 in D, and the extra number in D+1 | O | O |
| | DETECTP | DETECTP S1 S2 D N | | | |
| Ramp Signal Output | RAMP | RAMP n1 n2 D1 n3 D2 | Saves linear-changed value in D1 during n3 scanning of initial value n1 to final n2 and present scanning number in D1+1, and changes D2 value to ON after completed | O | O |
| Data Align | SORT | SORT S n1 n2 D1 D2 | S : Head Address of Sort Data<br>n1 : Number of Words to sort<br>n1+1 : Sorting Method<br>n2: Operation number per Scan<br>D1 : ON if complete<br>D2 : Auxiliary Area | O | O |
| | SORTP | SORTP S n1 n2 D1 D2 | | | |
| Time-based ramp signal output | TRAMP | **TRAMP N1 N2 N3 D** | During time N3 (s), saves data chaging linealy from initial value to last value in D, saves timer value in D+2, if completed, D become equal to N2 | O | O |
| | RTRAMP | **RTRAMP N1 N2 N3 D** | | O | O |

(13) Data process instruction (continued)

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Data<br>Write | FIWR |  | Adds S to the last of Data Table D ~ D+N, and increases Data Table Length(N) saved in D by 1 | O | O |
| | FIWRP |  | | | |
| First-input<br>Data<br>Read | FIFRD |  | Moves first data, S+1 of Data Table S ~ S+N to D (pull 1 place after origin deleted) and decreases Data Table Length(N) saved in D by 1 S | O | O |
| | FIFRDP |  | | | |
| Last-Input<br>Data<br>Read | FILRD |  | Moves last data, S+N of Data Table S ~ S+N to D (origin deleted) and decreases Data Table Length(N) saved in D by 1 S | O | O |
| | FILRDP |  | | | |
| Data<br>Insert | FIINS |  | Adds S to 'N'th place of Data Table D ~ D+N (origin data pulled by 1), and increases Data Table Length(N) saved in D by 1 | O | O |
| | FIINSP |  | | | |
| Data<br>Pull | FIDEL |  | Deletes 'N'th data of Data Table S ~ S+N (pull 1 place) and decreases Data Table Length(N) saved in D by 1 | O | O |
| | FIDELP |  | | | |

(14) Display instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| 7 Segment<br>Display | SEG |  | Converts S Data to 7-Segment as adjusted in Z Format so to save in D | O | O |
| | SEGP |  | | | |

(15) 문자열 처리 명령

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Convert to Decimal ASCII Cord | BINDA | BINDA S D | Converts S of 1-word BIN value to Decimal ASCII Cord to save in starting D | O | O |
| | BINDAP | BINDAP S D | | | |
| | DBINDA | DBINDA S D | Converts S of 2-word BIN value to Decimal ASCII Cord to save in starting D | | |
| | DBINDAP | DBINDAP S D | | | |
| Convert to Hexadecimal ASCII Cord | BINHA | BINHA S D | Converts S of 1-word BIN value to Hexadecimal ASCII Cord to save in starting D | O | O |
| | BINHAP | BINHAP S D | | | |
| | DBINHA | DBINHA S D | Converts S of 2-word BIN value to Hexadecimal ASCII Cord to save in starting D | | |
| | DBINHAP | DBINHAP S D | | | |
| Convert BCD to Decimal ASCII Cord | BCDDA | BCDDA S D | Converts S of 1-word BCD to ASCII Cord to save in starting D | O | O |
| | BCDDAP | BCDDAP S D | | | |
| | DBCDDA | DBCDDA S D | Converts S of 2-word BCD to ASCII Cord to save in starting D | | |
| | DBCDDAP | DBCDDAP S D | | | |
| Convert Decimal ASCII to BIN | DABIN | DABIN S D | Converts S S+2,S+1,S's Decimal ASCII Cord to BIN to save in D | O | O |
| | DABINP | DABINP S D | | | |
| | DDABIN | DDABIN S D | Converts S+5~S's Decimal ASCII Cord to BIN value to save in D+1 & D | | |
| | DDABINP | DDABINP S D | | | |
| Convert Hexadecimal ASCII to BIN | HABIN | HABIN S D | Converts S+1,S's Hexadecimal ASCII Cord to BIN value to save in D | O | O |
| | HABINP | HABINP S D | | | |
| | DHABIN | DHABIN S D | Converts S+3~S's Hexadecimal ASCII Cord to BIN to save in D | | |
| | DHABINP | DHABINP S D | | | |
| Convert Decimal ASCII to BCD | DABCD | DABCD S D | Converts S+1,S's Decimal ASCII Cord to BCD to save in D | O | O |
| | DABCDP | DABCDP S D | | | |
| | DDABCD | DDABCD S D | Converts S+3~S's Decimal ASCII Cord to BCD to save in D | | |
| | DDABCDP | DDABCDP S D | | | |
| String Length Detect | LEN | LEN S D | Saves String Length with S starting in D | O | O |
| | LENP | LENP S D | | | |

**(continued)**

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Convert BIN16/32 to String | STR | STR S1 S2 D | Adjusts S2 saved word data to S1 saved place number to convert to String and save in D | O | O |
| | STRP | STRP S1 S2 D | | | |
| | DSTR | DSTR S1 S2 D | Adjusts S2 saved double word data to S1 saved place number to convert to String and save in D | | |
| | DSTRP | DSTRP S1 S2 D | | | |
| Convert String to BIN16/32 | VAL | VAL S D1 D2 | Adjusts S saved string to number to save in word D1 and saves the place number in D2 | O | O |
| | VALP | VALP S D1 D2 | | | |
| | DVAL | DVAL S D1 D2 | Adjusts S saved string to number to save in double word D1 and saves the place number in D2 | | |
| | DVALP | DVALP S D1 D2 | | | |
| Convert Real Number to String | RSTR | RSTR S1 S2 D | Adjusts Floating decimal point point Real Number Data (S1: number, S2: places) to String format to save in D | O | X |
| | RSTRP | RSTRP S1 S2 D | | | |
| | LSTR | LSTR S1 S2 D | Adjusts Floating decimal point point Double Real Number Data (S1:number, S2:places) to String format to save in D | | |
| | LSTRP | LSTRP S1 S2 D | | | |
| Convert String to Real Number | STRR | STRR S D | Converts String S to Floating decimal point point Real Number Data to save in D | O | X |
| | STRRP | STRRP S D | | | |
| | STRL | STRL S D | Converts String S to Floating decimal point point Double Real Number Data to save in D | | |
| | STRLP | STRLP S D | | | |
| ASCII Conversion | ASC | ASC S D cw | Converts BIN Data to ASCII in Nibble unit, based on cw's format from S to save in D | O | O |
| | ASCP | ASCP S D cw | | | |
| HEX Conversion | HEX | HEX S D N | Converts 2N ASCII saved in N words from S in byte unit to Nibble unit of Hexadecimal BIN so to save in D | O | O |
| | HEXP | HEXP S D N | | | |
| String Extract from Right | RIGHT | RIGHT S D N | Extracts N string from S string's final letter to save in starting D | O | O |
| | RIGHTP | RIGHTP S D N | | | |
| String Extract from Left | LEFT | LEFT S D N | Extracts N string from S string's first letter to save in starting D | O | O |
| | LEFTP | LEFTP S D N | | | |
| String Random Extract | MID | MID S1 S2 D | Extracts string which conforms to S2 condition among S1 string to save in starting D | O | O |
| | MIDP | MIDP S1 S2 D | | | |

**(continued)**

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| String Random Replace | REPLACE | REPLACE S1 D S2 | Processes S1 String as applicable to S2 Condition to save in D String | O | O |
| | REPLACEP | REPLACEP S1 D S2 | | | |
| String Find | FIND | FIND S1 S2 D N | Finds identical String to S2 in S1 ~ N data to save the absolute position in D | O | O |
| | FINDP | FIND S1 S2 D N | | | |
| Parse Real Number to BCD | RBCD | RBCD S1 S2 D | Adjusts Floating decimal point point Real Number Data S1 to S2 place to convert to BCD, and then to save in D | O | X |
| | RBCDP | RBCDP S1 S2 D | | | |
| | LBCD | LBCD S1 S2 D | Adjusts Floating decimal point point Double Real Number Data S1 to S2 place to convert to BCD, and then to save in D | | |
| | LBCDP | LBCDP S1 S2 D | | | |
| Convert BCD Data to Real Number | BCDR | BCDR S1 S2 D | Adjusts BCD Data S1 to S2 place to convert to Floating decimal point point Real Number, and then to save in D | O | X |
| | BCDRP | BCDRP S1 S2 D | | | |
| Convert BCD Data to Real Number | BCDL | BCDR S1 S2 D | Adjusts BCD Data S1 to S2 place to convert to Floating decimal point point Double Real Number, and then to save in D | | |
| | BCDLP | BCDRP S1 S2 D | | | |

(16) Special function instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| SIN Operation | SIN | SIN S D | SIN(S+1,S) → (D+1,D) | O | O |
| | SINP | SINP S D | | | |
| COS Operation | COS | COS S D | COS(S+1,S) → (D+1,D) | O | O |
| | COSP | COSP S D | | | |
| TAN Operation | TAN | TAN S D | TAN(S+1,S) → (D+1,D) | O | O |
| | TANP | TANP S D | | | |
| ATAN Operation | ATAN | ASIN S D | $SIN^{-1}$(S+1,S) → (D+1,D) | O | O |
| | ATANP | ASINP S D | | | |
| RAD Conversion | RAD | ACOS S D | $COS^{-1}$(S+1,S) → (D+1,D) | O | O |
| | RADP | ACOSP S D | | | |
| Angle Conversion | DEG | ATAN S D | $TAN^{-1}$(S+1,S) → (D+1,D) | O | O |
| | DEGP | ATANP S D | | | |
| RAD Conversion | RAD | RAD S D | (S+1,S) → (D+1,D)<br>Converts angle to radian | O | O |
| | RADP | RADP S D | | | |
| Angle Conversion | DEG | DEG S D | (S+1,S) → (D+1,D)<br>Converts radian to angle | O | O |
| | DEGP | DEGP S D | | | |
| Square Root Operation | SQRT | SQR S D | $\sqrt{(S+1,S)}$ → (D+1,D) | O | O |
| | SQRTP | SQRP S D | | | |

(17) Data control instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Limit Control | LIMIT | LIMIT S1 S2 S3 D | If S1 < S2, then<br>D = S2<br>If S2 < S1 < S3, then<br>D = S1<br>If S3 < S1, then<br>D = S3 | O | O |
| | LIMITP | LIMITP S1 S2 S3 D | | | |
| | DLIMIT | DLIMIT S1 S2 S3 D | | | |
| | DLIMITP | DLIMITP S1 S2 S3 D | | | |
| Dead-zone Control | DZONE | DZONE S1 S2 S3 D | If S1 < -S2, then<br>D = S1+S2-S2(S3/100)<br>If –S2 < S1 < S2, then<br>D = (S3/100)S1<br>If S1 < S2, then<br>D = S1-S2+S2(S3/100) | O | O |
| | DZONEP | DZONEP S1 S2 S3 D | | | |
| | DDZONE | DDZONE S1 S2 S3 D | | | |
| | DDZONEP | DDZONEP S1 S2 S3 D | | | |
| | DZONES | VZONE S1 S2 S3 D | If S2 > S1, then<br>D = S1 – S2<br>If S3 < S1, then<br>D = S1 –S3<br>If S2 <= S1 <= S3, then<br>D = 0<br>If (S2 == S3) < S1, then<br>D = S1 –S3<br>If (S2 == S3) > S1, then | O | O |
| | DZONESP | VZONEP S1 S2 S3 D | | | |
| | DDZONES | DVZONE S1 S2 S3 D | | | |
| | DDZONESP | DVZONEP S1 S2 S3 D | | | |
| Vertical-zone Control Built-in | VZONE | PIDRUN N | If S1 < -S2(S3/100), then<br>D = S1-S2+S2(S3/100)<br>If –S2(S3/100) <S1< S2(S3/100), then<br>D = (100/S3)S1<br>If S1 < S2(S3/100), then<br>D = S1+S2-S2(S3/100) | O | O |
| | VZONEP | PIDPAUSE N | | O | X |
| | DVZONE | PIDPRMT S N | | O | X |
| | DVZONEP | PIDRUN N | | X | O |
| PID Control Instruction | PIDRUN | PIDPRMT S N | Operates PID Loop N | X | O |
| | PIDPAUSE | PIDPRMT S N | Stops PID Loop N momentarily | X | O |
| | PIDPRMT | PIDPRMT S N | Changes PID Loop N's Parameter.<br>( SV(word) / Ts(word) / Kp(real)<br>/ Ti(real) / Td(real) ) | X | O |

(18) Time related instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Date/Time Data Read | DATERD | DATERD D | Reads PLC Time to save in D ~ D+6 (Yr/Mn/Dt/Hr/Mn/Sd/Day) | O | X |
| | DATERDP | DATERDP D | | | |
| Date/Time Data Write | DATEWR | DATEWR S | Input<br>S ~ S+6's Time Data in PLC (Yr/Mn/Dt/Hr/Mn/Sd/Day) | O | X |
| | DATEWRP | DATEWRP S | | | |
| Time Data Increase | ADDCLK | ADDCLK S1 S2 D | Adds S1 ~ S1+2 & S2 ~ S2+2 Time Data to save in D ~ D+2 in Time Data format (Hr/Mn/Sd) | O | X |
| | ADDCLKP | ADDCLKP S1 S2 D | | | |
| Time Data Decrease | SUBCLK | SUBCLK S1 S2 D | Extracts S2 ~ S2+2's Time Data from S1 ~ S1+2 to save in D ~ D+2 in Time Data format (Hr/Mn/Sd) | O | X |
| | SUBCLKP | SUBCLKP S1 S2 D | | | |
| Time Data Format Conversion | SECOND | SECOND S D | Converts Time Data S ~ S+2 to seconds to save in double word D | O | X |
| | SECONDP | SECONDP S D | | | |
| | HOUR | HOUR S D | Converts the seconds saved in double word S to Hr/Mn/Sd to save in D ~ D+2 | O | X |
| | HOURP | HOURP S D | | | |

(19) Divergence instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Divergence Instruction | JMP | JMP LABEL | Jumps to LABEL location | O | O |
| | LABEL | LABEL | Jumps and designates the location to move to | | |
| Subroutine Call Functional | CALL | CALL LABEL | Calls Function applicable to LABEL | O | O |
| | CALLP | CALLP LABEL | | | |
| | SBRT | SBRT LABEL | Designates Function to be called by CALL | | |
| | RET | RET | RETURN | | |

(20) 루프 명령

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Loop Instruction | FOR | FOR \| N | Operates FOR~NEXT section n times | ○ | ○ |
| | NEXT | NEXT | | | |
| | BREAK | BREAK | Escapes from FOR~NEXT section | ○ | ○ |

(21) 플래그 제어 명령

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Carry Flag Set, Reset | STC | STC | Carry Flag( F0112 ) SET | ○ | ○ |
| | CLC | CLC | Carry Flag( F0112 ) RESET | | |
| Error Flag Clear | CLE | CLE | Error Latch Flag(F0115) RESET | ○ | ○ |

(22) 시스템 명령

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Error Display | FALS | FALS \| n | Self Diagnosis (Error Display ) | ○ | ○ |
| Scan Cluck | DUTY | DUTY \| D \| n1 \| n2 | On during n1 Scan, Off during n2 Scan | ○ | ○ |
| Time Cluck | TFLK | TFLK \| D1 \| S1 \| S2 \| D2 | On during S1 set time, Off during S2 set time | ○ | ○ |
| WDT Initialize | WDT | WDT | Watch Dog Timer Clear | ○ | ○ |
| | WDTP | WDTP | | | |
| Output Control | OUTOFF | OUTOFF | All Output Off | ○ | ○ |
| Operation Stop | STOP | STOP | Finishes applicable scan to end PLC Operation | ○ | ○ |
| Emergent Operation Stop | ESTOP | ESTOP | Ends PLC operation right after Instruction executed | ○ | ○ |

(23) 인터럽트 관련 명령

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| All Channels Interrupt Setting | EI | EI | All Channels Interrupt allowed | ○ | ○ |
| | DI | DI | All Channel Interrupt prohibited | | |
| Individual Channel Interrupt Setting | EIN | EIN \| N | Individual Channel Interrupt allowed | ○ | ○ |
| | DIN | DIN \| N | Individual Channel Interrupt prohibited | | |

(24) Sign reversion instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| 2's complement | NEG | NEG D | Saves D value again in D with 2's complement taken | ○ | ○ |
| | NEGP | NEGP D | | | |
| | DNEG | DNEG D | Saves (D+1,D) value again in (D+1,D) with 2's complement taken | | |
| | DNEGP | DNEGP D | | | |
| Real Number Data Sign Reverse | RNEG | RNEG D | Reverses D Real Number Sign then to save again | ○ | ○ |
| | RNEGP | RNEGP D | | | |
| | LNEGR | LNEG D | Reverses D Double Real Number Sign then to save again | | |
| | LNEGP | LNEGP D | | | |
| Absolute Value Operation | ABS | ABS D | Converts D highest Bit to 0 | ○ | ○ |
| | ABSP | ABSP D | | | |
| | DABS | DABS D | Converts (D+1,D) highest Bit to 0 | | |
| | DABSP | DABSP D | | | |

(25) File related instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Block Conversion | RSET | RSET S | Changes Block Number of file register to S Number | ○ | X |
| | RSETP | RSETP S | | | |
| Flash Word Data Transfer | EMOV | EMOV S1 S2 D | Transfers S2 word data in S1 Block to D | ○ | X |
| | EMOVP | EMOVP S1 S2 D | | | |
| Flash Double Word Data Transfer | EDMOV | EDMOV S1 S2 D | Transfers S2+1, S2 double word data in S1 Block to D+1, D | | |
| | EDMOVP | EDMOVP S1 S2 D | | | |
| Block Read | EBREAD | EBREAD S1 S2 | Reads Flash Memory Block | ○ | X |
| Block Write | EBWRITE | EBWRITE S1 S2 | Writes Flash Memory Block | ○ | X |
| Block Compare | EBCMP | EBCMP S1 S2 D1 D2 | Compares R Area's Bank with Flash Area's Block | ○ | X |

## Appendix 3.4 Special/Communication Instruction

(1) Communication Instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Station No. Set | P2PSN | P2PSN \| n1 \| n2 \| n3 | Sets opposite station No. for P2P Communication. n1:P2P No., n2:Block, n3:Station No. | ○ | X |
| Read Area Set (WORD) | P2PWRD | P2PWRD \| n1 \| n2 \| n3 \| n4 \| n5 | Sets word data Read Area n1:P2P No., n2:Block, n3:Variable sequence, n4:Variable Size, n5:Device | ○ | X |
| Write Area Set (WORD) | P2PWWR | P2PWWR \| n1 \| n2 \| n3 \| n4 \| n5 | Sets word data Write Area n1:P2P No., n2:Block, n3:Variable sequence, n4:Variable Size, n5:Device | ○ | X |
| Read Area Set (BIT) | P2PBRD | P2PBRD \| n1 \| n2 \| n3 \| n4 \| n5 | Sets bit data Read Area n1:P2P No., n2:Block, n3:Variable sequence, n4: Variable Size, n5:Device | ○ | X |
| Write Area Set (BIT) | P2PBWR | P2PBWR \| n1 \| n2 \| n3 \| n4 \| n5 | Sets bit data Write Area n1:P2P No., n2:Block, n3:Variable sequence,n4:Variable Size, n5:Device | ○ | X |

(2) Special/Communication Instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Special Module Read/Write | GET | GET \| sl \| S \| D \| N | Reads data of special module memory is installed on | ○ | ○ |
| | GETP | GETP \| sl \| S \| D \| N | | | |
| | PUT | PUT \| sl \| S1 \| S2 \| N | Writes data on special module memory is installed on | ○ | ○ |
| | PUTP | PUTP \| sl \| S1 \| S2 \| N | | | |

(3) Exclusive position control instruction

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Return to Origin Point | ORG | ORG sl ax | Instructions Positioning Module's ax axis installed on sl slot to return to Origin Point | O | O |
| Floating Origin Point | FLT | FLT sl ax | Instructions Positioning Module's ax axis installed on sl slot to set Floating Origin Point | O | O |
| Direct Start | DST | DST sl ax n1 n2 n3 n4 n5 | Instructions Positioning Module's ax axis installed on sl slot to start directly with Target Position(n1), Target Speed(n2), Dwell Time(n3), M Code(n4) & Control Word(n5) | O | O |
| Indirect Start | IST | IST sl ax n | Instructions Positioning Module's ax axis installed on sl slot to start n step indirectly | O | O |
| Linear Interpolation | LIN | LIN sl ax n1 n2 | Instructions Positioning Module's ax axis installed on sl slot to let n2 axes operate n1 step by Linear Interpolation | O | O |
| Circular Interpolation | CIN | CIN sl ax n1 n2 | Instructions Positioning Module's ax axis installed on sl slot to let n2 axes operate n1 step by Circular Interpolation | O | X |
| Simultaneous Start | SST | SST sl ax n1 n2 n3 n4 | Instructions Positioning Module's ax axis installed on sl slot to let n4 axes operate n1(X), n2(Y), n3(Z) steps by Simultaneous Start | O | O |
| Speed/Position Control Switch | VTP | VTP sl ax | Instructions Positioning Module's ax axis installed on sl slot to switch Speed to Position . | O | O |
| Position/Speed Control Switch | PTV | PTV sl ax | Instructions Positioning Module's ax axis installed on sl slot to switch Position to Speed Control | O | O |
| Decelerated Stop | STP | STP sl ax | Instructions Positioning Module's ax axis installed on sl slot to stop as decelerated. | O | O |
| Skip | SKP | SKP sl ax | Instructions Positioning Module's ax axis installed on sl slot to skip | O | X |
| Position Synchronization | SSP | SSP sl ax n1 n2 n3 | Instructions Positioning Module's ax axis installed on sl slot to do Position Sync with main axis of n3, n1 sync-positioned and n2 step operated | O | O |
| Speed Synchronization | SSS | SSS sl ax n1 n2 n3 | Instructions Positioning Module's ax axis installed on sl slot to do Speed Sync with main axis of n3, n1 master and n2 slave | O | O |
| Position Override | POR | POR sl ax n | Instructions Positioning Module's ax axis installed on sl slot to override Position to change the target position to n | O | O |

(continued)

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Speed Override | SOR | SOR \| sl \| ax \| n | Instructions Positioning Module's ax axis installed on sl slot to override Speed to change the target speed to n | O | O |
| Position specified Speed Override | PSO | PSO \| sl \| ax \| n | Instructions Positioning Module's ax axis installed on sl slot to override position specified speed to change the target speed to n2 from n1 position | O | O |
| Continuous Operation | NMV | NMV \| sl \| ax | Instructions Positioning Module's ax axis installed on sl slot to operate continuously to n step | O | X |
| Inching | INCH | INCH \| sl \| ax \| n | Instructions Positioning Module's ax axis installed on sl slot to inch to n position | O | O |
| Return to Position Previous to Manual Operation | RTP | RTP \| sl \| ax | Instructions Positioning Module's ax axis installed on sl slot to return to position previous to manual operation | O | X |
| Operation Step Change | SNS | IST \| sl \| ax \| n | Instructions Positioning Module's ax axis installed on sl slot to change operation step to n | O | O |
| Repeated Operation Step Change | SRS | SRS \| sl \| ax \| n | Instructions Positioning Module's ax axis installed on sl slot to change repeated operation step to n | O | X |
| M Code Off | MOF | MOF \| sl \| ax | Instructions Positioning Module's ax axis installed on sl slot to make M code off | O | O |
| Present Position Change | PRS | PRS \| sl \| ax \| n | Instructions Positioning Module's ax axis to change present position to n | O | O |
| Zone Allowed | ZOE | ZOE \| sl \| ax | Allows zone output of Positioning Module installed on sl slot | O | X |
| Zone Prohibited | ZOD | ZOD \| sl \| ax | Prohibits zone output of Positioning Module installed on sl slot | O | X |
| Encoder Value change | EPRS | EPRS \| sl \| ax \| n | Changes Encoder Value of Positioning Module installed on sl slot to n | O | X |
| Teaching 티칭 | TEA | TEA \| sl \| ax \| n1 \| n2 \| n3 \| n4 | Changes n1 step's target position or speed of Positioning Module's ax axis installed on sl slot | O | X |
| Teaching Array | TEAA | TEAA \| sl \| ax \| n1 \| n2 \| n3 \| n4 | Changes n1 step's target position or speed of Positioning Module's ax axis installed on sl slot. | O | X |
| Emergent Stop | EMG | EMG \| sl \| ax | Instructions Positioning Module installed on sl slot to perform Emergent Stop | O | O |

(continued)

| Classification | Designations | Symbol | Description | Support | |
|---|---|---|---|---|---|
| | | | | XGK | XGB |
| Error Reset | CLR | CLR sl ax n | Resets Error originated from Positioning Module's ax axis installed on sl slot | O | O |
| Error History Reset | ECLR | ECLR sl ax | Deletes Error History originated from Positioning Module's ax axis installed on sl slot | O | X |
| Point Operation | PST | PST sl ax n | Performs Point Operation of Positioning Module's ax axis installed on sl slot | O | X |
| Basic Parameter Teaching | TBP | TBP sl ax n1 n2 | Changes n2 to n1 among basic parameters of Positioning Module's ax axis installed on sl slot | O | X |
| Extended Parameter Teaching | TEP | TEP sl ax n1 n2 | Changes n2 to n1 among extended parameters of Positioning Module's ax axis installed on sl slot | O | X |
| Return to Origin Point Parameter Teaching | THP | THP sl ax n1 n2 | Changes n2 to n1 among returned parameters to origin point of Positioning Module's ax axis installed on sl slot | O | X |
| Manual Operation Parameter Teaching | TMP | TMP sl ax n1 n2 | Changes n2 to n1 among manual operation parameters of Positioning Module's ax axis installed on sl slot | O | X |
| Input Signal Parameter Teaching | TSP | TSP sl ax n | Changes input signal parameter of Positioning Module's ax axis installed on sl slot to the value set in n1 | O | X |
| Common Parameter Teaching | TCP | TCP sl ax n1 n2 | Changes n2 to n1 among common parameters of Positioning Module installed on sl slot | O | X |
| Parameter Save | WRT | WRT sl ax n | Instructions Positioning Module's ax axis installed on sl slot to save present parameter of n axis in flash ROM. | O | O |
| Present State Read | SRD | SRD sl ax D | Reads and saves present state of Positioning Module's ax axis installed on sl slot in D area of CPU | O | X |
| Point Operation Step Write | PWR | PWR sl ax S n1 | Writes n1 value of S area of CPU on point operation step area of Positioning Module's ax axis installed on sl slot in | O | X |
| Plural Teaching Data Write | TWR | TWR sl ax S n1 | Writes n1 value of S area of CPU on plural teaching data area of Positioning Module's ax axis installed on sl slot in | O | X |

## Warranty

1. Warranty Period
The product you purchased is guaranteed for 36 months from the date of manufacture.

2. Scope of Warranty
(1) The initial diagnosis of faults is basically conducted by your company. However, upon your request, our company or our service network can undertake this task for a fee. If the cause of the fault lies with our company, this service will be provided free of charge.
(2) This warranty only applies if the product is used under normal conditions according to the specifications and precautions described in the handling instructions, user manuals, catalogs, and caution labels.
(3) Even within the free warranty period, the following cases will be subject to paid repairs:
1) Replacement of consumable and life-limited parts (e.g., relays, fuses, electrolytic capacitors, fans, LCDs, batteries, etc.)
2) Failures or damages caused by improper storage, handling, negligence, or accidents by the customer
3) Failures resulting from the customer's hardware or software design
4) Failures due to modifications without our consent
(Repairs will be refused, even for a fee, if recognized as modified or repaired outside our company)
5) Failures that could have been avoided if the customer's equipment, in which our product is incorporated, had safety devices required by legal regulations or common industry standards
6) Failures that could have been prevented if maintenance and replacement of consumable parts were performed normally according to the handling instructions or user manuals
7) Failures and damages to the product caused by using connected equipment or inappropriate consumables
8) Failures caused by external factors such as fire, abnormal voltage, force majeure, and natural disasters such as earthquakes, lightning, salt damage, wind, and flood damage
9) Failures due to reasons that could not be predicted with the scientific and technical standards at the time of our shipment
10) Other failures, damages, or defects recognized as the responsibility of your company

## Environmental Policy

LS ELECTRIC Co., Ltd supports and observes the environmental policy as below.

### Environmental Management

LS ELECTRIC considers the environmental preservation as the preferential management subject and every staff of LS ELECTRIC use the reasonable endeavors for the pleasurably environmental preservation of the earth.

### About Disposal

LS ELECTRIC’ PLC unit is designed to protect the environment. For the disposal, separate aluminum, iron and synthetic resin (cover) from the product as they are reusable.

www.ls-electric.com

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