The right choice for the ultimate yield!

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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).

LS ELECTRIC

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 2. Chapter 12 Motor Wiring Example Added	3	- Ch12
V1.2	2019.09	1. Added Counter Clear Function 2. Added PID Derivative term	2 2	Ch4 Ch5
V1.3	2020.02	1. Added XBM-DP32H2/HP Main Unit 2. Improved I/O Wiring Diagram	2, 3	2-Ch3 3-Ch2,3 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 2. Modify partner port range	1 4	1-Ch3 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 (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 (1) XBE-AC08A 2. Ferrule specification added	2	3-11 3-3
V2.4	2023.09	1. Web server link changed 2. External preset input contact point changed	4 2	1-80 4-18
V2.5	2023.12	1. Main unit added (1) XBM-DN16H2 (2) XBM-DP16H2 (3) XBM-DR14H2 2. Failsafe circuit schematic change 3. Smart link board module added	Entire 1 2	Entire 4-3 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
V2.8	2025.03	Added and Modified the Ferrite Core	1	7-3

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 μs	1.22 μs	Based on MOV command
Real	10.3 μs	2.0 μs	RADD command
	10.6 μs	2.0 μs	RMUL command
Long Real	11.8 μs	3.7 μs	LADD command
	16.9 μs	3.7 μs	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 XBM-DP32HP / XBM-DP32H2 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, ΔMV, ΔPV, 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

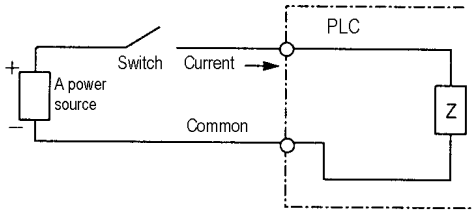
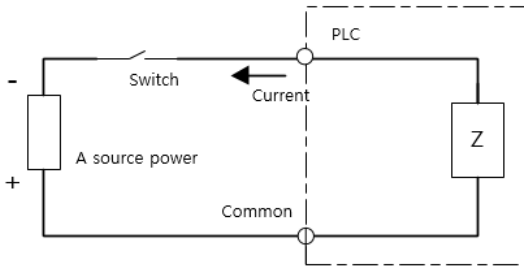
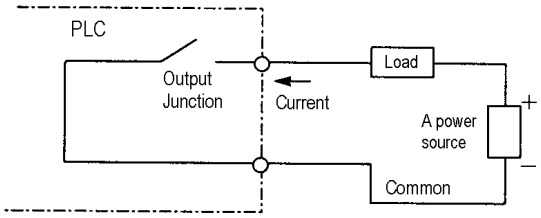
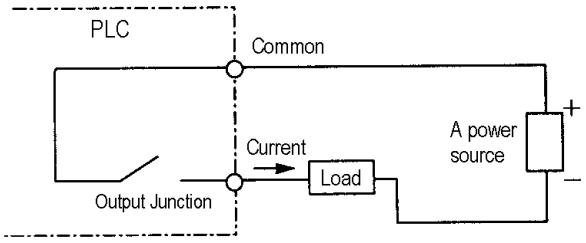
-Separated XG5000(ladder programming, parameter setting, monitoring) and XG-PD(communication and network parameter setting, frame monitoring) have combined in one XG5000. It is possible to control PLC in one program.

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) Expansion module, Special module, Communication module
Unit	A single module or group of modules that perform an independent operation as a part of PLC systems.	Example) Main unit, Expansion unit
PLC System	A system which consists of the PLC and peripheral devices. A user program can control the system.	-
XG5000	A program and debugging tool for the MASTER-K series. It executes program creation, edit, compile and debugging. (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. 	Z: Input impedance
Source Input	Current flows from the PLC input terminal to the switch after a input signal turns on. 	Z: Input impedance
Sink Output	Current flows from the load to the output terminal and the PLC output turn on. 	-
Source Output	Current flows from the output terminal to the load and the PLC output turn on. 	-

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.

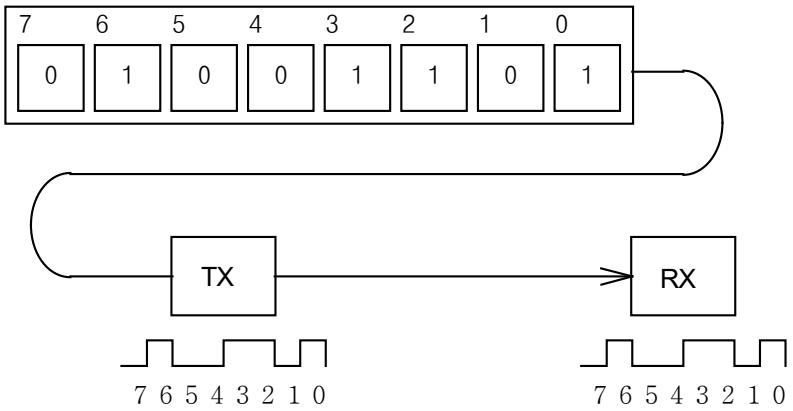
(c) Full-Duplex

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

(2) **Transmission type**

(a) Serial transmission

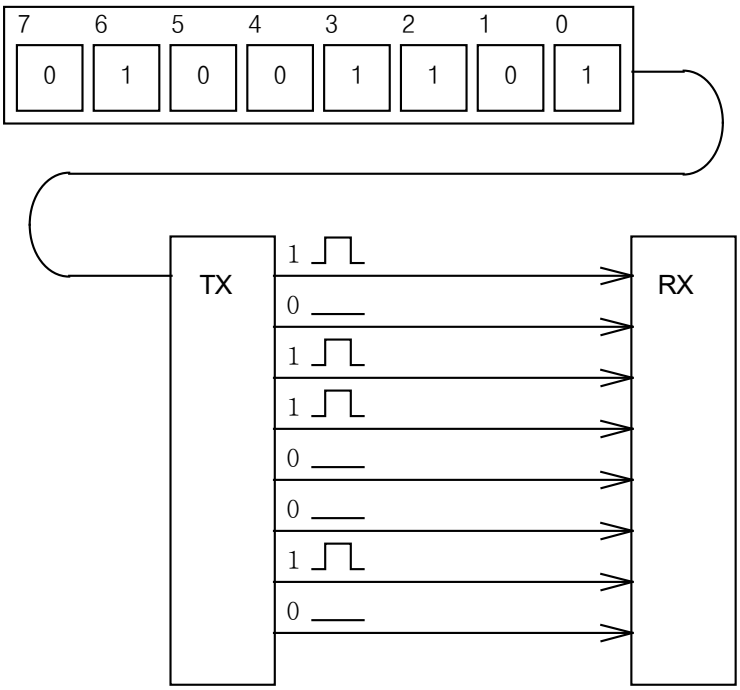
This type transmits bit by bit via 1 cable. The speed of transmission is slow, but the cost of installation is low and the software is simplified.



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

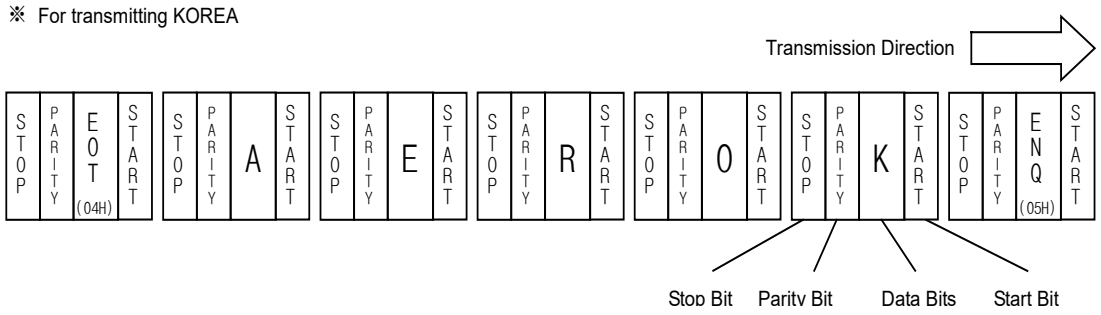
(b) Parallel transmission

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.



(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

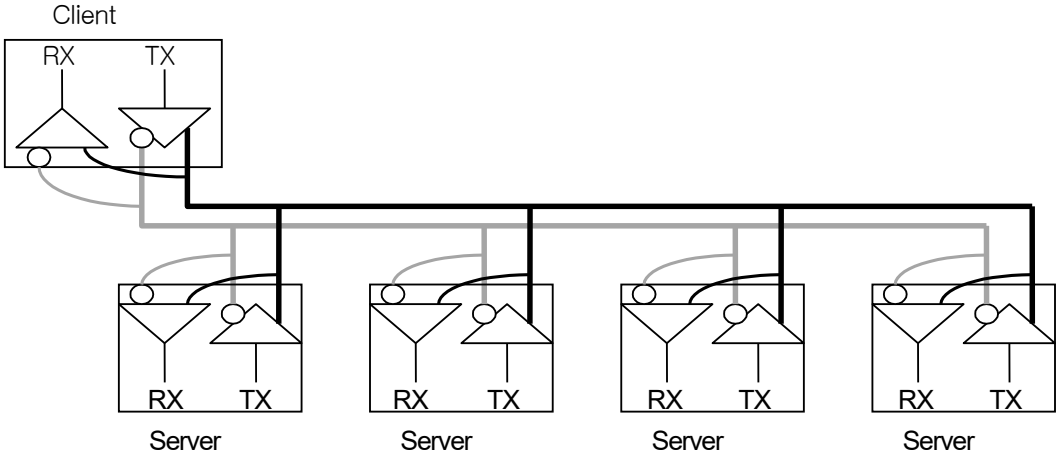
RS-232C is the interface to link a modem with a terminal and to link a modem with a computer, and is also the serial communications specification established by EIA according to the recommendations of the CCITT. This is also used to link the null modem directly as well as the modem linkage. The disadvantage 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.

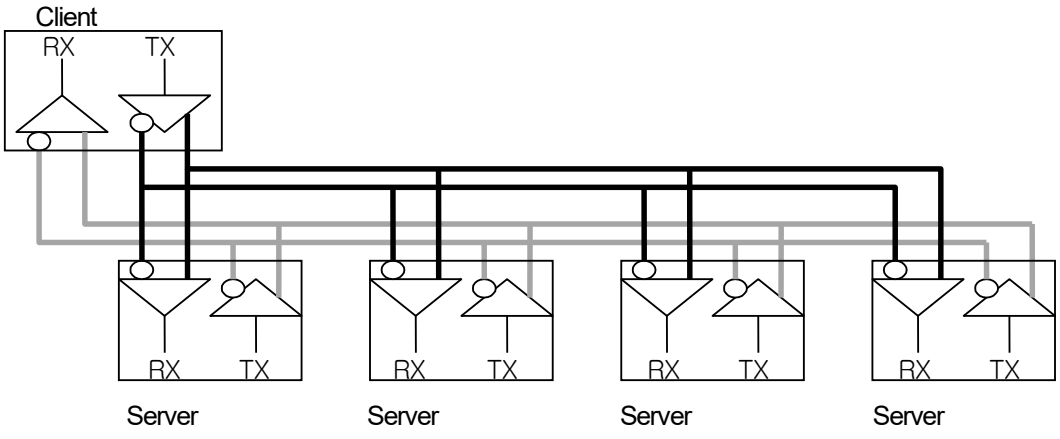
(11) Half Duplex Communication

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.

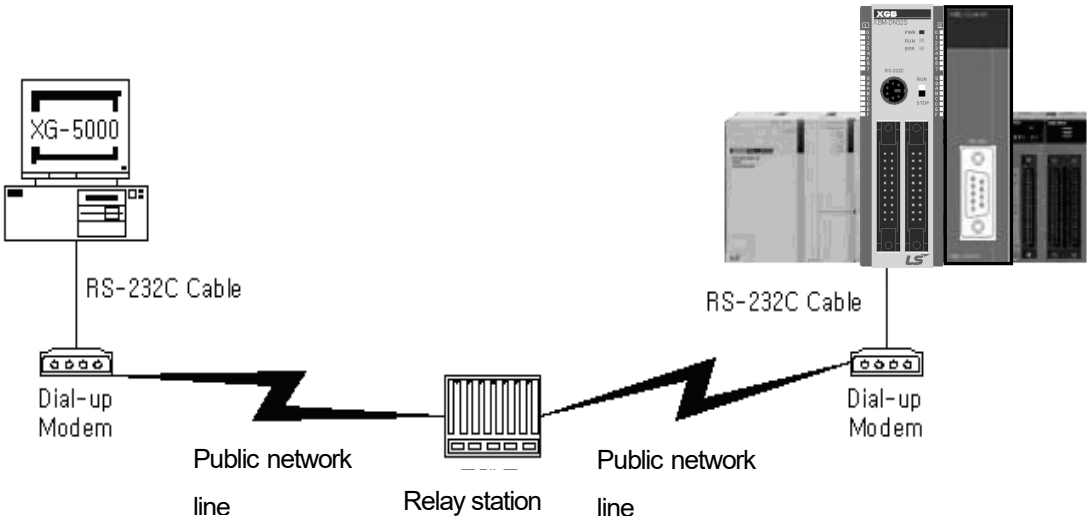


(13) BCC (Block Check Character)

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

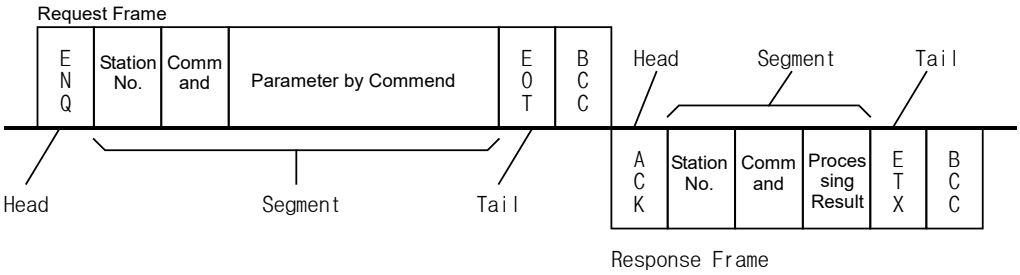
This is the function to remotely perform programming, reading/writing user's program, debugging, and monitoring, etc. without moving the physical connection of XG5000 in the network system where PLC is connected to Cnet I/F module. Especially, it is convenient to control a remote PLC via modem.



* 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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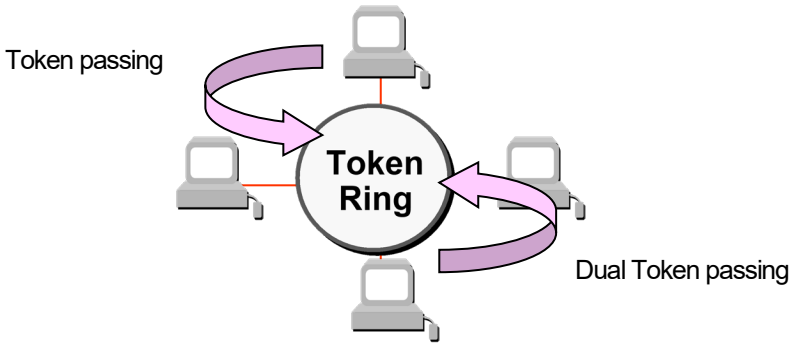


(32) UDP(User Datagram Protocol)

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 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) Built-in positioning of 2-axis	
	XBM-DP16H2	DC24V power supply, DC24V input 8 point, Transistor output 8 point(source) Built-in positioning of 2-axis	
	XBM-DN32H2	DC24V power supply, DC24V input 16 point, Transistor output 16 point(sink) Built-in positioning of 2-axis	H/W : V2.0 O/S : V2.0 or above
	XBM-DN32HP	DC24V power supply, DC24V input 16 point, Transistor output 16 point(sink) Built-in positioning of 6-axis	
	XBM-DP32H2	DC24V power supply, DC24V input 16 point, Transistor output 16 point(source) Built-in positioning of 2-axis	
	XBM-DP32HP	DC24V power supply, DC24V input 16 point, Transistor output 16 point(source) 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	

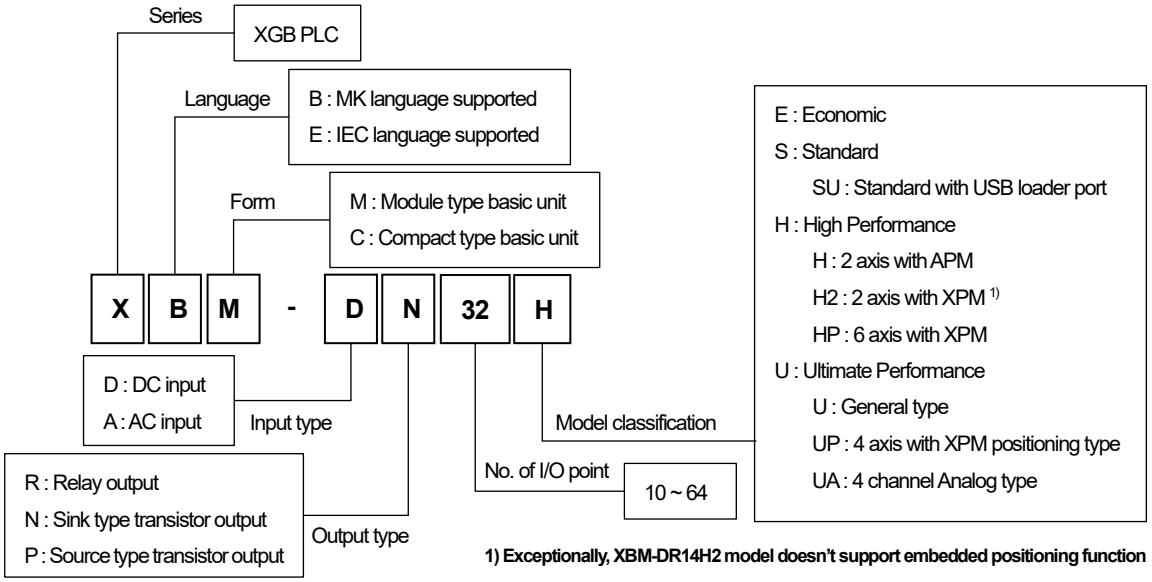
Notice

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.



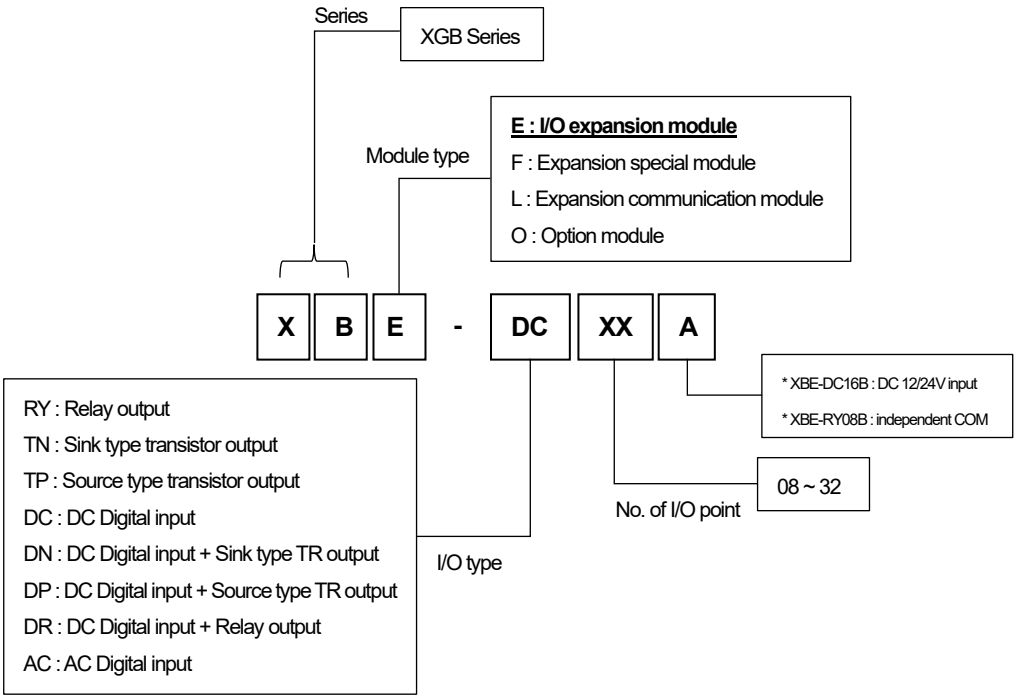
1) Exceptionally, XBM-DR14H2 model doesn't support embedded positioning function

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

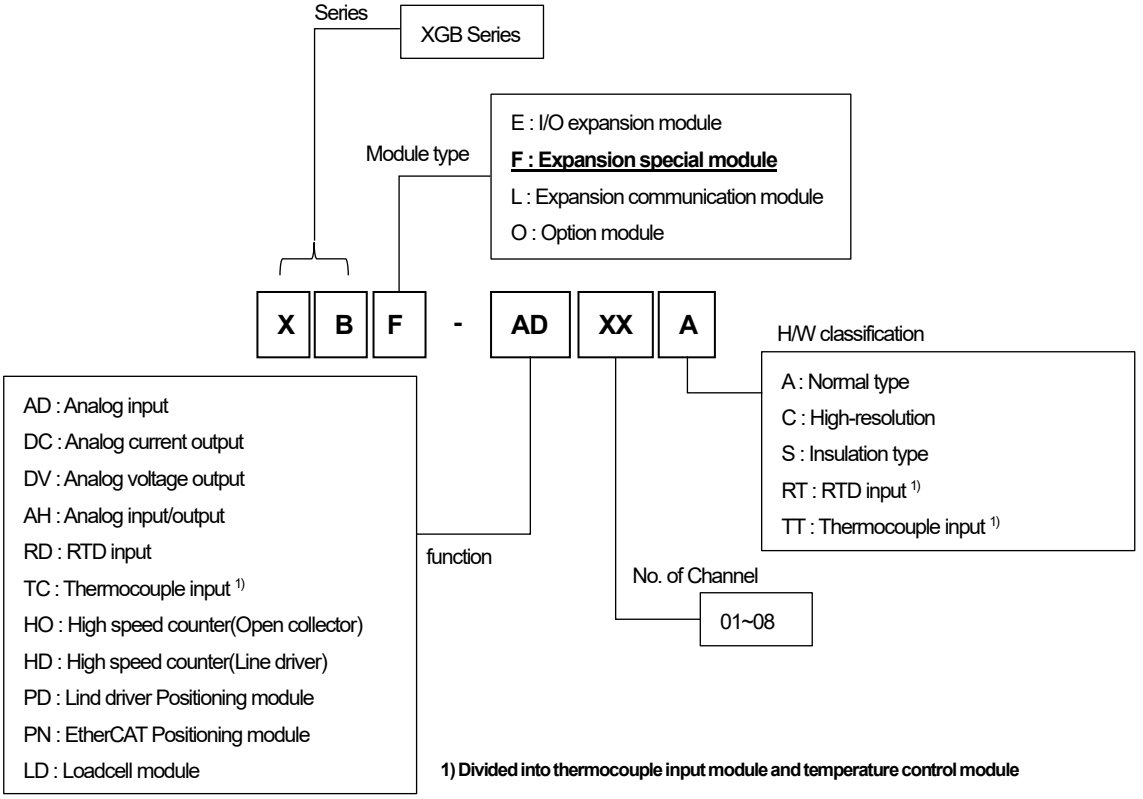
Name of expansion module is classified as follows.



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) Relay output
XBE-DN32A	16 point	None	None	16 point	DC24V input (Sink/Source) Sink type output

2.2.3 Classification and type of special module

Special module is classified as follows.

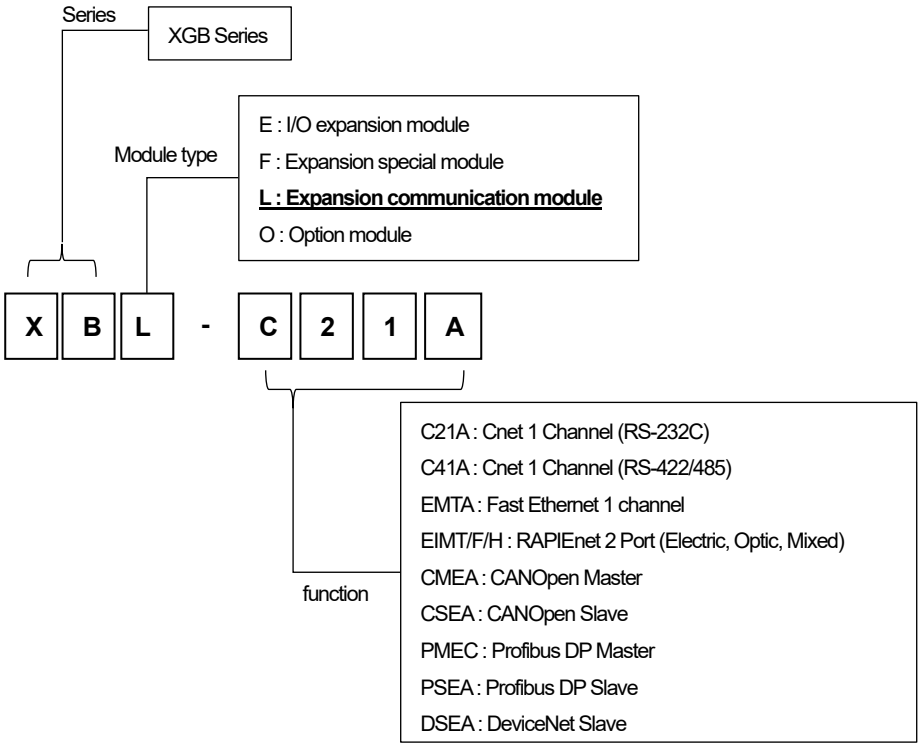


1) Divided into thermocouple input module and temperature control module

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.

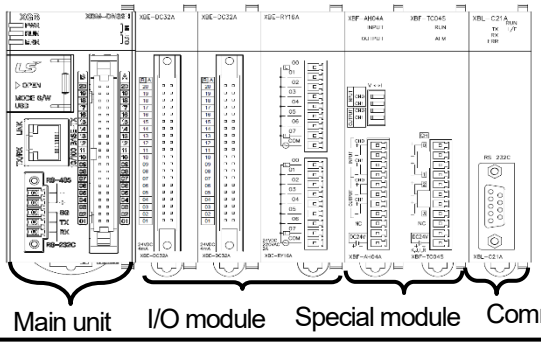


Classification	Name	Type
Cnet Comm. Module	XBL-C21A	RS-232C, 1 channel
	XBL-C41A	RS-422/485, 1 channel
FEnet Comm. Module	XBL-EMTA	Electricity, open type Ethernet
Rnet Comm. Module	XBL-RMEA	RemoteNet Master
RAPIEnet Comm. Module	XBL-EIMT/EIMF/EIMH	Comm. Module between PLCs, electric, optic, and mixed(electric& optic) 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 • XBM-DP16H2 : 16 ~ 240 points • XBM-DN32H2 : 32 points~256 points • XBM-DN32HP : 32 points~256 points	• XBM-DN16H2 : 16 ~ 240 points • XBM-DN32H : 32 points~256 points • XBM-DP32H2 : 32 points~256 points • 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 • XBM-DN32H • XBM-DP32H2 • XBM-DN16H2	• XBM-DR16S • XBM-DN32H2 • XBM-DP32HP • XBM-DP16H2	• XBM-DN32S • XBM-DN32HP • XBM-DR14H2
	Expansion module	Digital I/O module	•XBE-DC08/16/32A •XBE-DC16B • XBE-DR16A	•XBE-TN08/16/32A • XBE-TP08/16/32A • XBE-DN32A	•XBE-RY08/16A •XBE-RY08B
		Special module	• XBF-AD04A • XBF-AD04C • XBF-AD08A • XBF-AH04A • XBF-RD04A • XBF-RD01A	• XBF-DC04A • XBF-DC04C • XBF-DV04A • XBF-DV04C • XBF-TC04S • XBF-PD02A	• XBF-HO02A • XBF-HD02A • XBF-TC04RT • XBF-TC04TT • XBF-LD02S
		Communication module	• XBL-C41A • XBL-EMTA • XBL-PMEC • XBL-RMEA	• XBL-C21A • XBL-EIMT/F/H • XBL-EIPT	• XBL-PSEA • XBL-CMEA/CSEA • XBL-DSEA
		High speed I/F module	• XBF-PN04B	• 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.

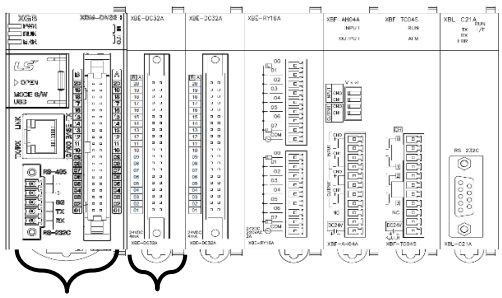
(◇ : General expansion module (Special, I/O)., ◎ : General expansion module (Communication), ◈ : High speed expansion modules)

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 (Cannot use high-speed expansion module after general expansion module)	
	◈	◈	◈	◇	◇	Not configurable (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.



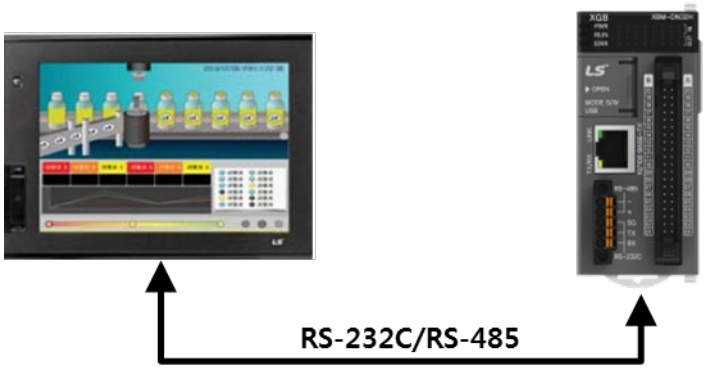
Slot 0~1 Slot 2

2.3.3 Embedded Communication System Configuration

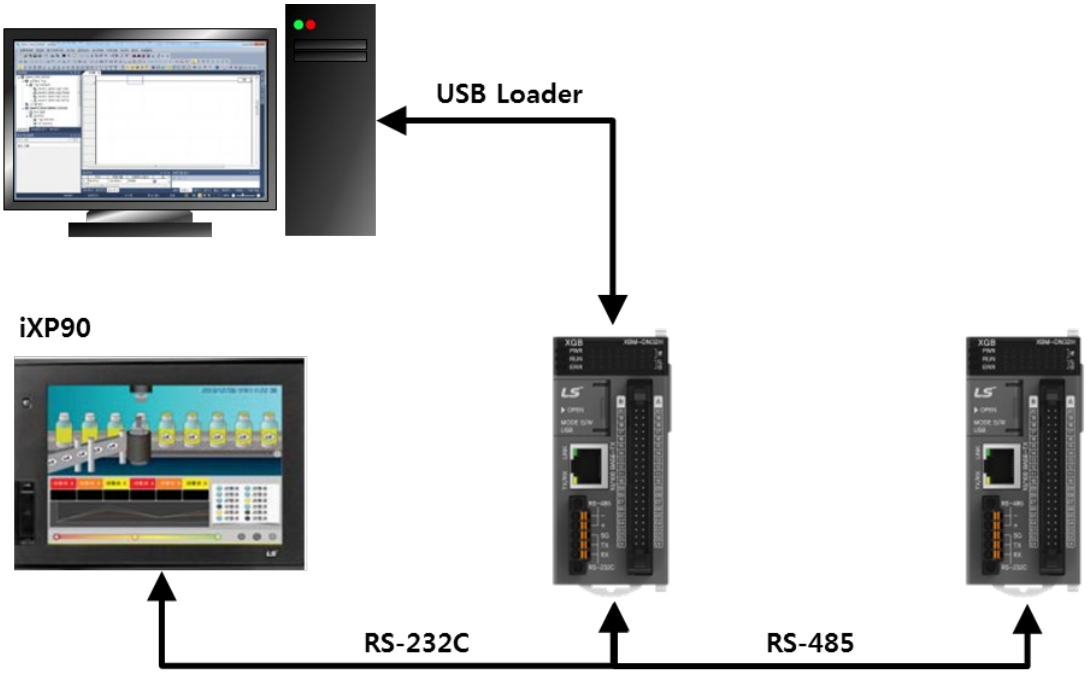
2.3.3.1 Embedded Cnet I/F System Configuration

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.

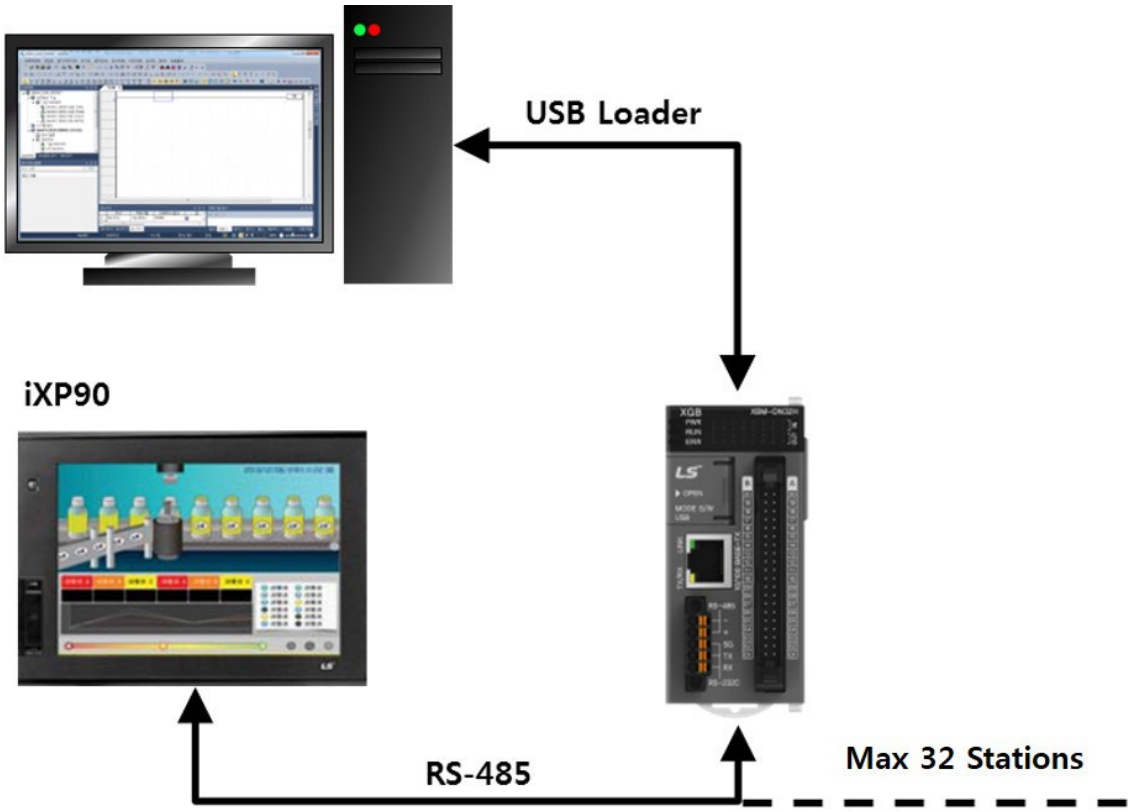
(1) 1:1 connection with the HMI by using the basic unit's embedded RS-232C or RS-485 port



(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



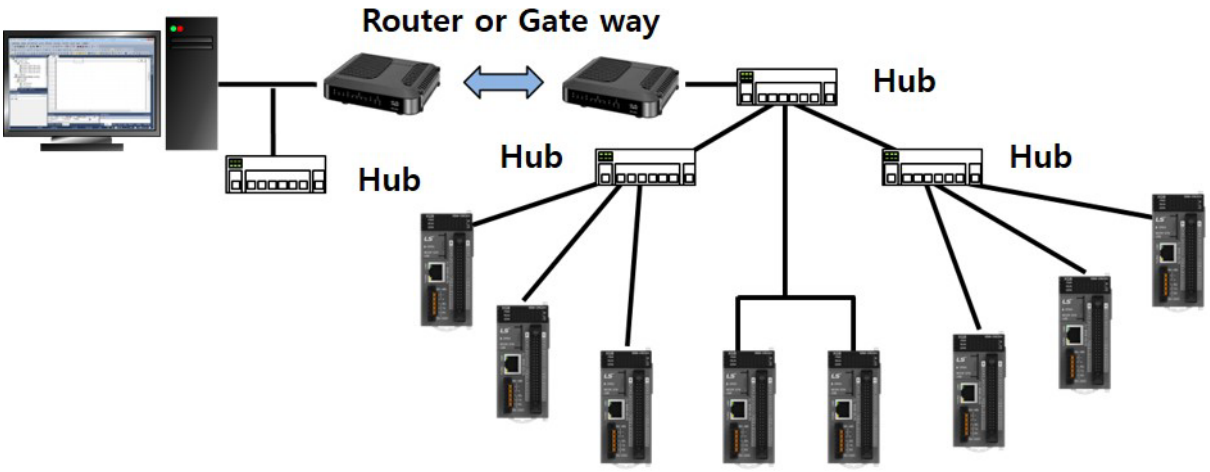
Notice

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

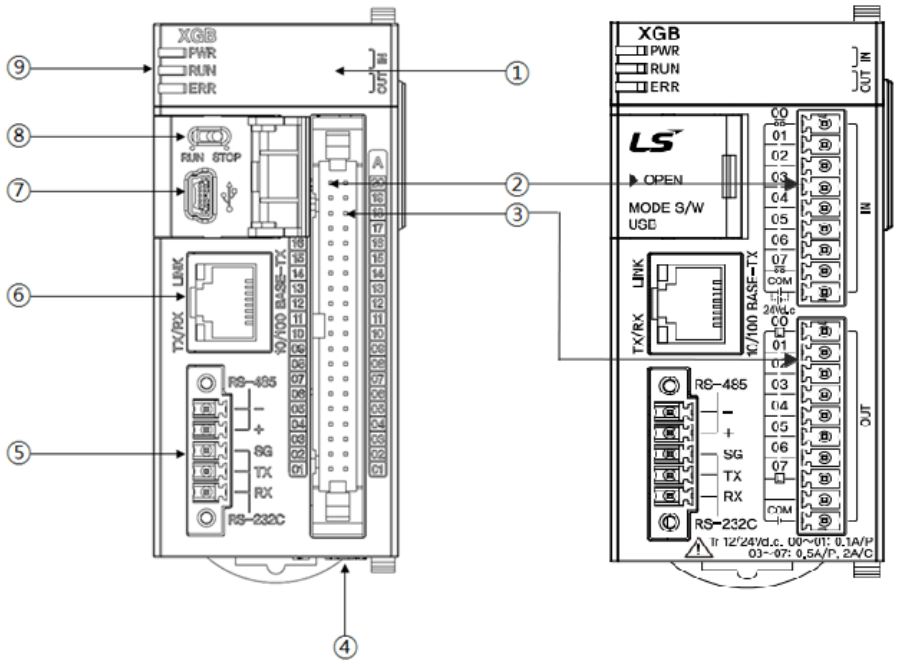


Notice

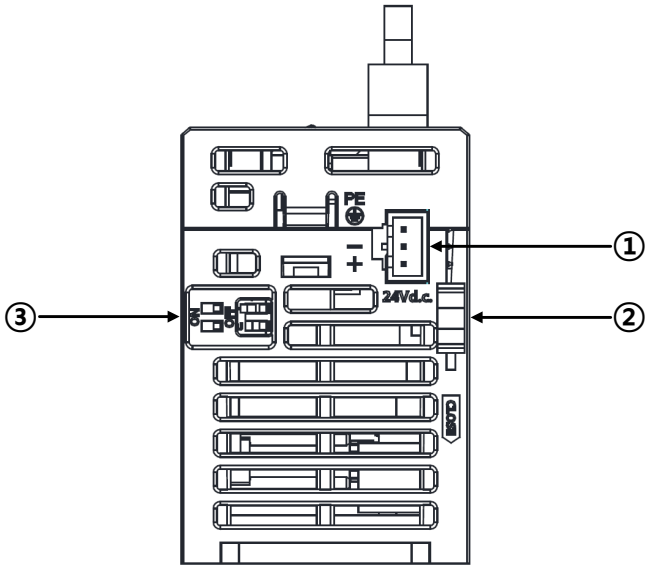
For more details on how to the above LS ELECTRIC's network system configuration and Enet system configuration, refer to Chap.5 Embedded Communication and "XGB FEnet I/F " of this manual.

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. • STOP → RUN : Program's operation is executed. • RUN → STOP : Program's operation is stopped. (In case of STOP, the remote operation is available.)
⑧	Status display LED		■ Displays the basic unit's operation status. • PWR(Red light On) : The power is supplied. • RUN(Green light On) : During RUN mode • 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 • Switch both On : Using Terminating resistance • Switch both Off : Not using Terminating resistance

3.2 General specifications

<table>
<tr><th>No.</th><th>Items</th><th colspan="6">Specification</th><th>Reference</th></tr>
<tr><td>1</td><td>Ambient Temp.</td><td colspan="6">0 ~ 55 °C</td><td rowspan="4">-</td></tr>
<tr><td>2</td><td>Storage Temp.</td><td colspan="6">–25 ~ +70 °C</td></tr>
<tr><td>3</td><td>Ambient humidity</td><td colspan="6">5 ~ 95%RH (Non-condensing)</td></tr>
<tr><td>4</td><td>Storage humidity</td><td colspan="6">5 ~ 95%RH (Non-condensing)</td></tr>
<tr><td rowspan="9">5</td><td rowspan="9">Vibration</td><td colspan="5">Occasional vibration</td><td>-</td><td rowspan="9">IEC61131-2</td></tr>
<tr><td colspan="2">Frequency</td><td colspan="2">Acceleration</td><td>Pulse width</td><td>Times</td></tr>
<tr><td colspan="2">5≤ f < 8.4Hz</td><td colspan="2">–</td><td>3.5mm</td><td rowspan="4">10 times each direction (X,Y and Z)</td></tr>
<tr><td colspan="2">8.4≤ f ≤150Hz</td><td colspan="2">9.8m/s^2(1G)</td><td>–</td></tr>
<tr><td colspan="6">Continuous vibration</td></tr>
<tr><td colspan="2">Frequency</td><td colspan="2">Acceleration</td><td>Pulse width</td></tr>
<tr><td colspan="2">5≤ f < 8.4Hz</td><td colspan="2">–</td><td>1.75mm</td></tr>
<tr><td colspan="2">8.4≤ f ≤150Hz</td><td colspan="2">4.9m/s^2(0.5G)</td><td>–</td></tr>
<tr><td>6</td><td>Shocks</td><td colspan="6">• Peak acceleration : 147 m/s^2(15G)
• Duration : 11ms
• Pulse wave type : Half-sine (3 times each direction per each axis)</td></tr>
<tr><td rowspan="4">7</td><td rowspan="4">Impulse noise</td><td>Square wave impulse noise</td><td colspan="5">AC: ±1,500 V
DC: ±900 V</td><td>LS ELECTRIC standard</td></tr>
<tr><td>Electrostatic discharge</td><td colspan="5">Voltage: 4kV (Contact discharge)</td><td>IEC61131-2
IEC61000-4-2</td></tr>
<tr><td>Radiated electromagnetic field noise</td><td colspan="5">80 ~ 1,000MHz, 10 V/m</td><td>IEC61131-2,
IEC61000-4-3</td></tr>
<tr><td rowspan="2">Fast transient /Burst noise</td><td>Classifi-cation</td><td>Power supply</td><td colspan="3">Digital/Analog Input/Output, Communication Interface</td><td rowspan="2">IEC61131-2
IEC61000-4-4</td></tr>
<tr><td>Voltage</td><td>2kV</td><td colspan="3">1kV</td></tr>
<tr><td>8</td><td>Operation ambience</td><td colspan="6">Free from corrosive gases and excessive dust</td><td rowspan="4">-</td></tr>
<tr><td>9</td><td>Altitude</td><td colspan="6">Less than 2,000m</td></tr>
<tr><td>10</td><td>Pollution degree</td><td colspan="6">Less than 2</td></tr>
<tr><td>11</td><td>Cooling method</td><td colspan="6">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 : mA)	Remark
Main unit	XBM-DN32HP	1	540	In case all contact points are On. (Maximum consumption current)
Expansion module	XBE-DC32A	2	50	
	XBE-TN32A	2	80	
	XBF-AD04A	1	120	All channel is used. (Maximum consumption current)
	XBF-DC04A	1	110	
	XBL-C21A	1	110	
Current comsumption	1140mA			-
Power consumption	5.7W			1.14A × 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.

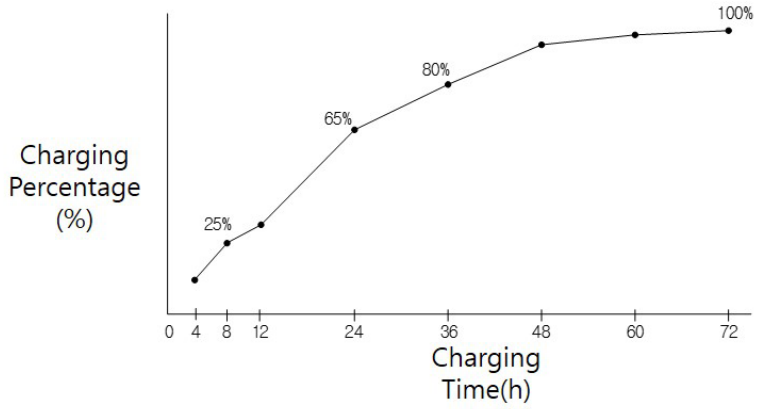
(2) XGB PLC configuration example 2

Type	Model	Unit No.	Internal 5V consumption current (Unit : mA)	Remark
Main unit	XBM-DN32HP	1	540	In case all contact points are On. (Maximum consumption current)
Expansion module	XBE-DR16A	2	250	
	XBE-RY16A	2	440	
	XBF-AD04A	2	120	All channel is used. (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

Items	Specifications
Nominal voltage / current	DC 3.0V / 6.5 mAh
Warranty term	3 years(at room temperature)
Purpose	RTC operation during the blackout
Charging time	 72 hours to fully charge (room temperature)
Backup time	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>

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, XBM-DN32HP	XBM-DP32H2, 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, Time-driven interrupt, Process-driven interrupt					
I/O control method		Batch processing by simultaneous scan (Refresh method), Directed by program instruction					
Program language		LD (Ladder Diagram), IL (Instruction List), 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, XBM-DN32HP	XBM-DP32H2, XBM-DP32HP	XBM-DN16H2	XBM-DP16H2	XBM-DR14H2	
Built-in Function	PID control		• Control by instruction, auto-tuning, PWM output, Forced output • Operation scan time setting, AntiWindup, Delta MV • SV lamp, Hybrid operation, Cascade operation					
	Cnet	Protocol	• Dedicated protocol(XGT) • Modbus protocol • User defined protocol • LS bus (inverter protocol)					
		Channel	RS-232C 1 port and RS-485 1 port					
	Enet	Transfer spec.	• Cable: 100Base-TX • Speed: 100Mbps • Auto-MDIX 1) supported • IEEE 802.3 standard satisfied					
		Topology	Star					
		Diagnosis	Module information, Service condition					
		Protocol	• XGT dedicated • Modbus TCP/IP • User-defined frame					
		Service	• P2P • E-mail transfer (SMTP) • High Speed link • Time synchronization (SNTP) • Remote connection • 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 • 1 pulse operation Mode : INC/DEC count by program • 1 pulse operation Mode : INC/DEC count by phase B pulse input • 2 pulse operation Mode : INC/DEC count by input pulse • 2 pulse operation Mode : INC/DEC count by difference of phase					
		Function	• Internal/external preset • Latch counter • Compare output • 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 ▪ 2 axis circular interpolation ▪ 3 axis helical interpolation		▪ 2 axis linear interpolation ▪ 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 ▪ DOG(On) + HOME signal ▪ DOG signal ▪ Upper / Lower Limit signal + HOME signal ▪ High Speed origin return ▪ 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.

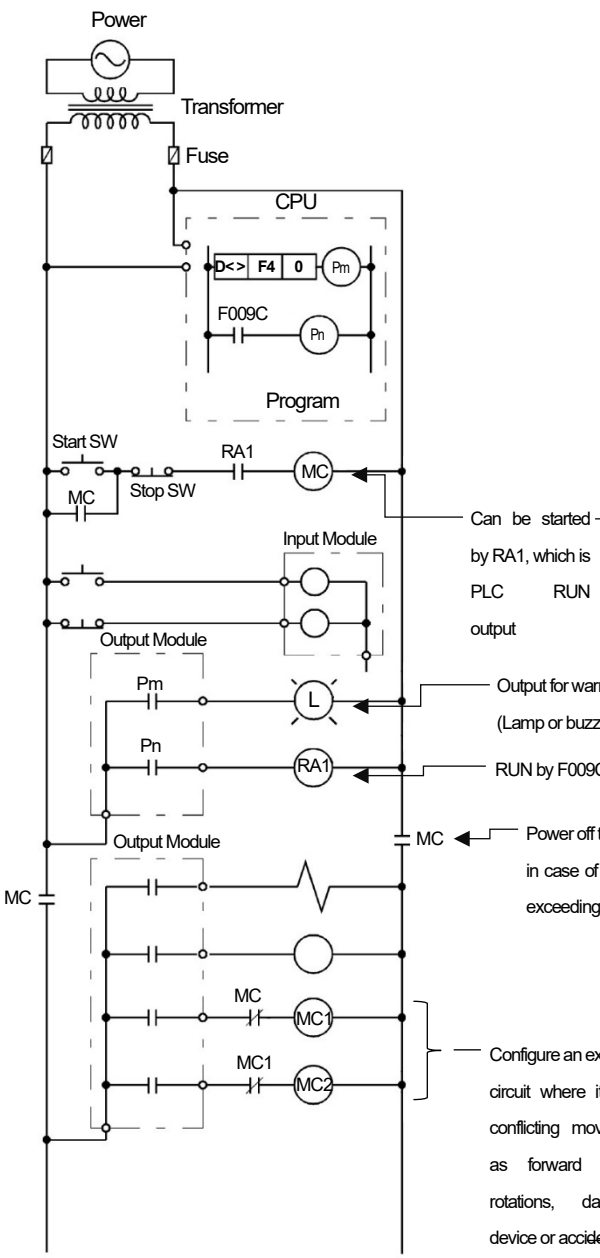
- Process output may not work properly according to difference of delay of PLC main power and external power for process (especially DC in case of PLC power On-Off and of start time.
  For example, in case of turning on PLC main power after supplying external power for process, DC output module may malfunction 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

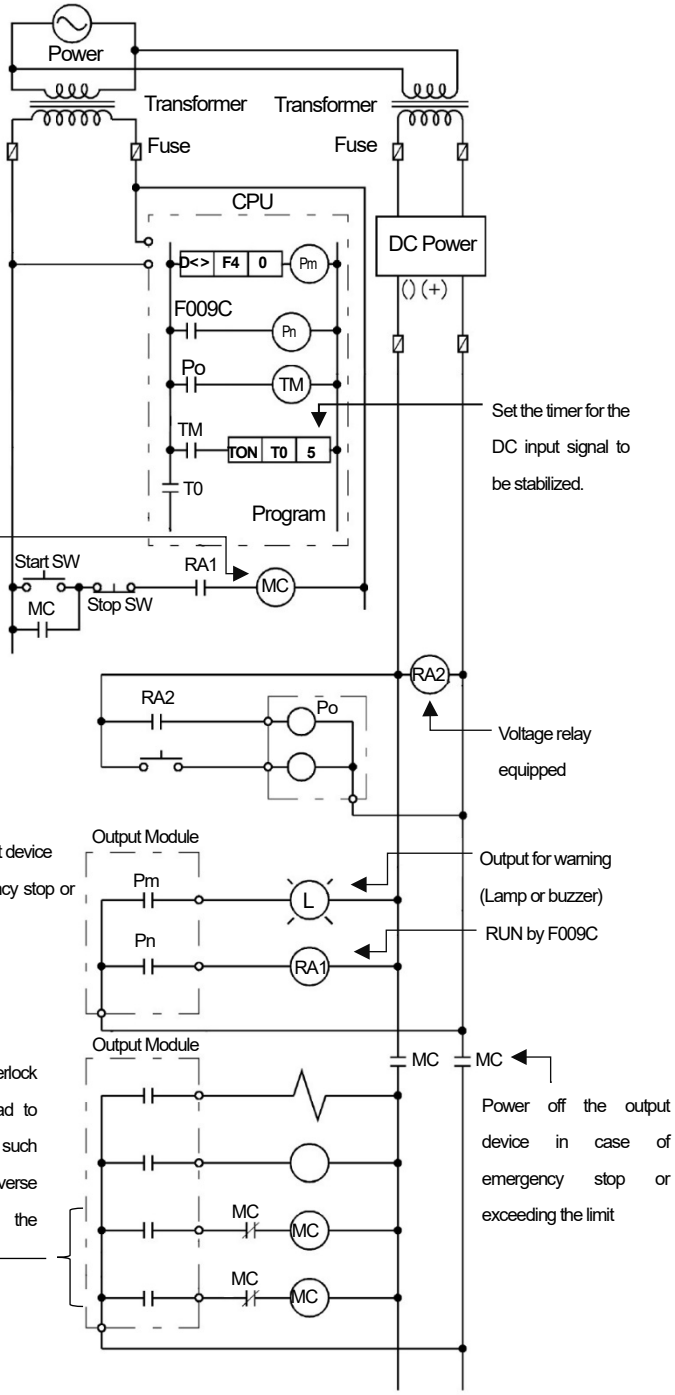
4.1.1 fail safe circuit

(1) example of system design

In case of AC



In case of AC . DC



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

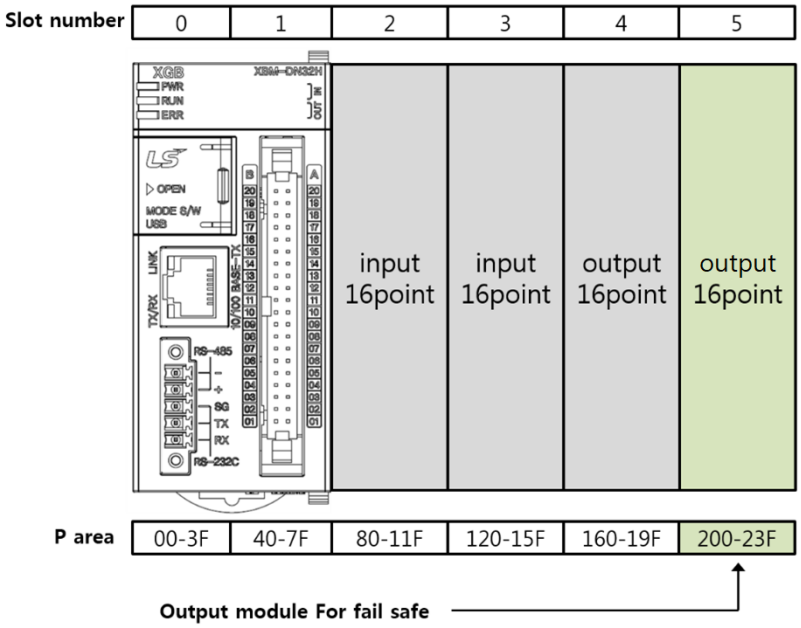
1) Turn on the power.
2) Run CPU.
3) RA2 Turns on as DC power on
4) Turn on the timer after DC power is stabilized.
5) Turn on the start SW.
6) Output device runs by program through Magnetic Contactor(MC) On.

(2) Fail Safe Measures in case of PLC failures

Failures of the PLC CPU and memory are detected by self-diagnosis but if there are some problems with I/O control part, etc, the failure may not be detected from the CPU. In this case, it can be different depending on the failure status, all contacts may be On or Off so normal operation or safety of the controlled subject cannot be guaranteed.

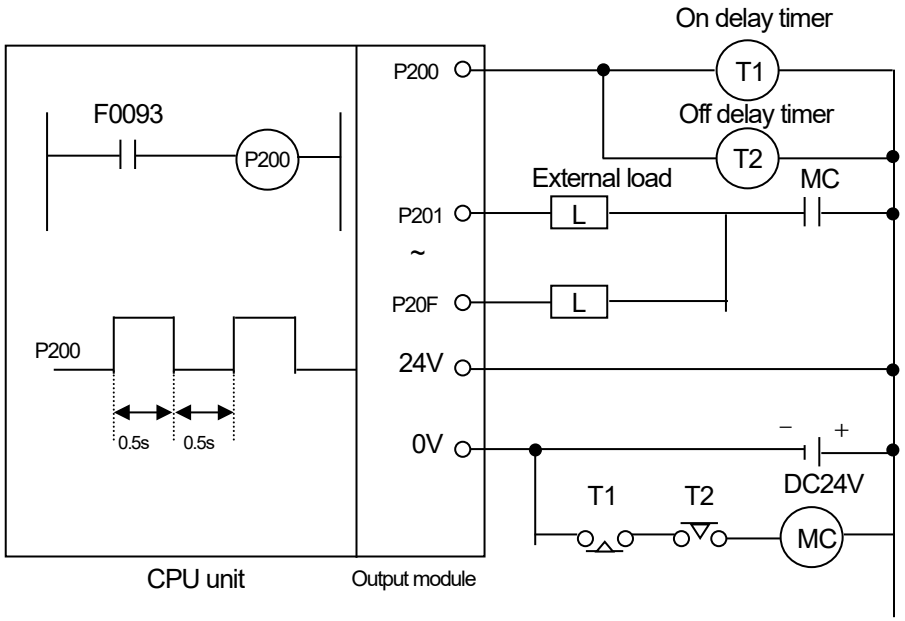
In case there are some problems with the PLC, please configure the fail safe circuit on the outside to prevent damage of the equipment or accident due to some cause. The below is the example of system configuration with the fail safe circuit.

<System example>



* Equip output module for fail safe to last slot of system.

[Fail safe circuit example]



Since P200 turns on/off every 0.5s, use TR output module

4.1.2 Calculation of PLC power consumption

(1) Power consumption of each part

(a) Power consumption of module

The power conversion efficiency of power module is about 70% and the other 30% is gone with heat; 3/7 of the output power is the pure power consumption. Therefore, the calculation is as follows.

- $W_{pw} = 3/7 \{(I_{5V} \times 5) + (I_{24V} \times 24)\}$ (W)

I_{5V} : power consumption of each module DC5V circuit(internal current consumption)

I_{24V}: the average current consumption of DC24V used for output module (current consumption of simultaneous On point)

If DC24V is externally supplied or a power module without DC24V is used, it is not applicable.

(b) Sum of DC5V circuit current consumption

The DC5V output circuit power of the power module is the sum of power consumption used by each module.

- $W_{5V} = I_{5V} \times 5$ (W)

(c) DC24V average power consumption(power consumption of simultaneous On point)

The DC24V output circuit's average power of the power module is the sum of power consumption used by each module.

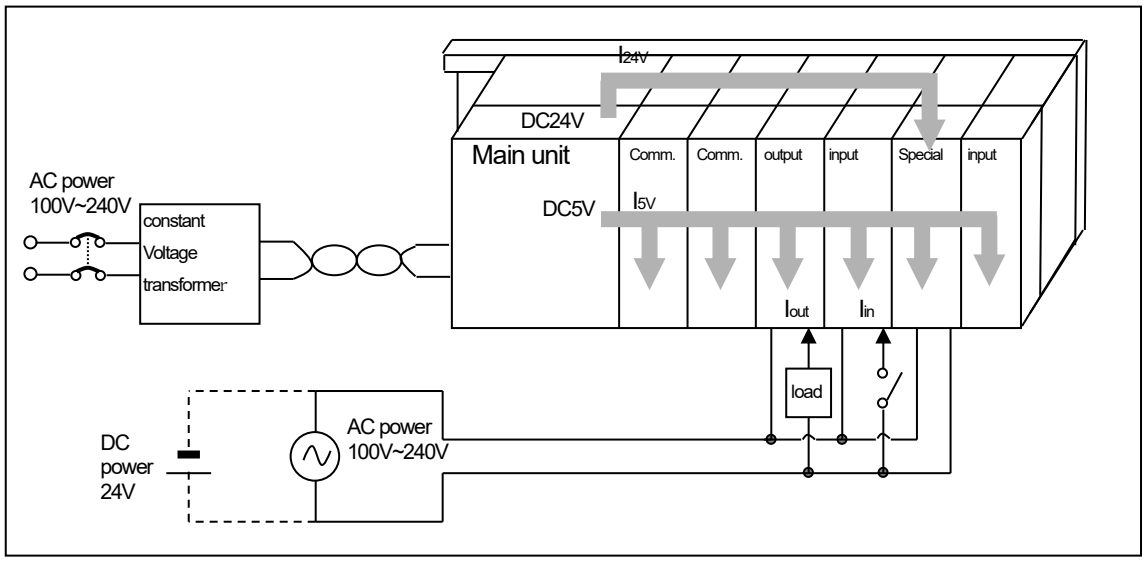
- $W_{24V} = I_{24V} \times 24$ (W)

(d) Average power consumption by output voltage drop of the output module(power consumption of simultaneous On point)

- $W_{out} = I_{out} \times V_{drop} \times$ output point X simultaneous On rate (W)

I_{out} : output current (actually used current) (A)

V_{drop}: voltage drop of each output module (V)



(e) Input average power consumption of input module
(power consumption of simultaneous On point)
• W_{in} = I_{in} X E X input point X simultaneous On rate (W)
I_{in}: input current (root mean square value in case of AC) (A)
E : input voltage (actually used voltage) (V)

(f) Power consumption of special module power assembly
• W_S = I_{5V} X 5 + I_{24V} X 24 + I_{100V} X 100 (W)
The sum of power consumption calculated by each block is the power consumption of the entire PLC system.
• W = W_{PW} + W_{5V} + W_{24V} + W_{out} + W_{in} + W_s (W)
Calculate the heats according to the entire power consumption(W) and review the temperature increase within the control panel.

The calculation of temperature rise within the control panel is displayed as follows.
T = W / UA [°C]
W : power consumption of the entire PLC system (the above calculated value)
A : surface area of control panel [m^2]
U : if equalizing the temperature of the control panel by using a fan and others : 6
If the air inside the panel is not ventilated : 4

If installing the PLC in an air-tight control panel, it needs heat-protective(control) design considering the heat from the PLC as well as other devices. If ventilating by vent or fan, inflow of dust or gas may affect the performance of the PLC system.

4.2 Attachment/Detachment of Modules

4.2.1 Attachment/Detachment of modules

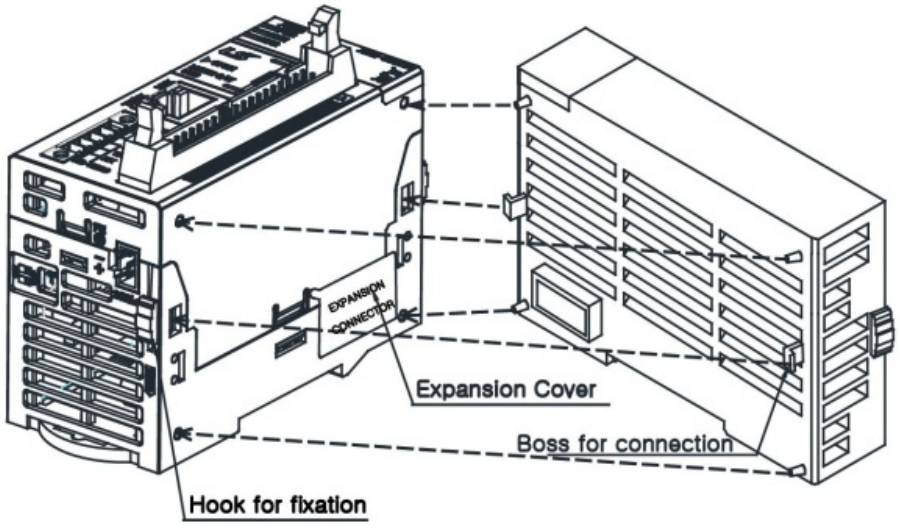
Caution in handling
Use PLC in the range of general specification specified by manual.
In case of usage out of range, it may cause electric shock, fire, malfunction, damage of product.

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

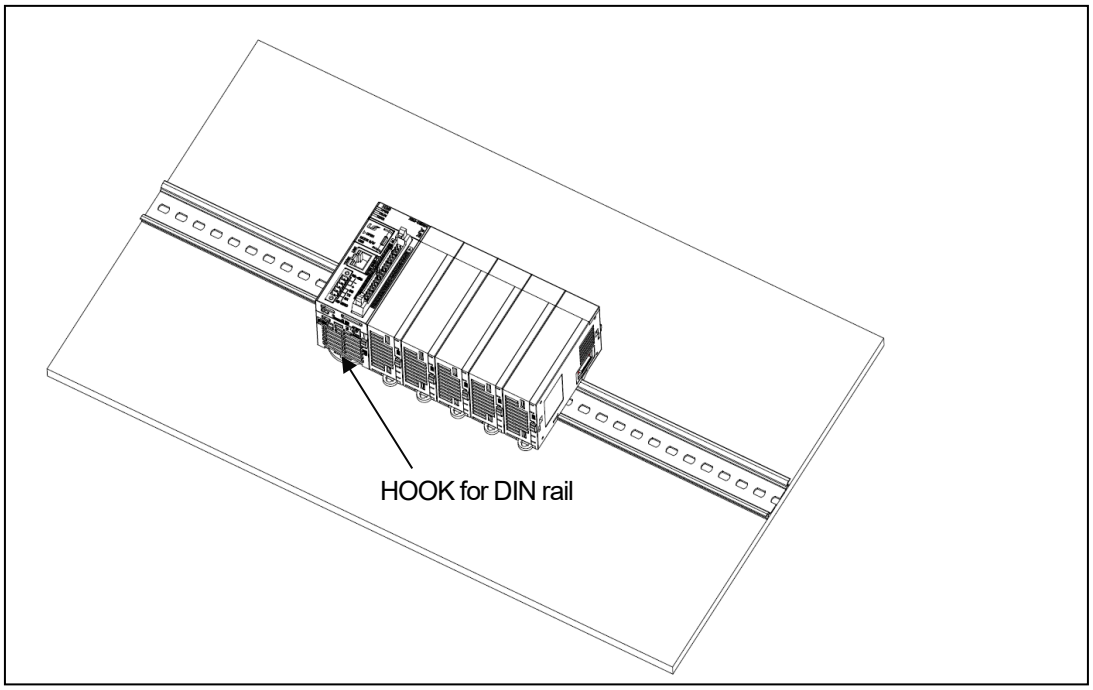
Use PLC in the range of general specification specified by manual.
In case of usage out of range, it may cause electric shock, fire, malfunction, or damage of the product.

(3) Installation of module

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

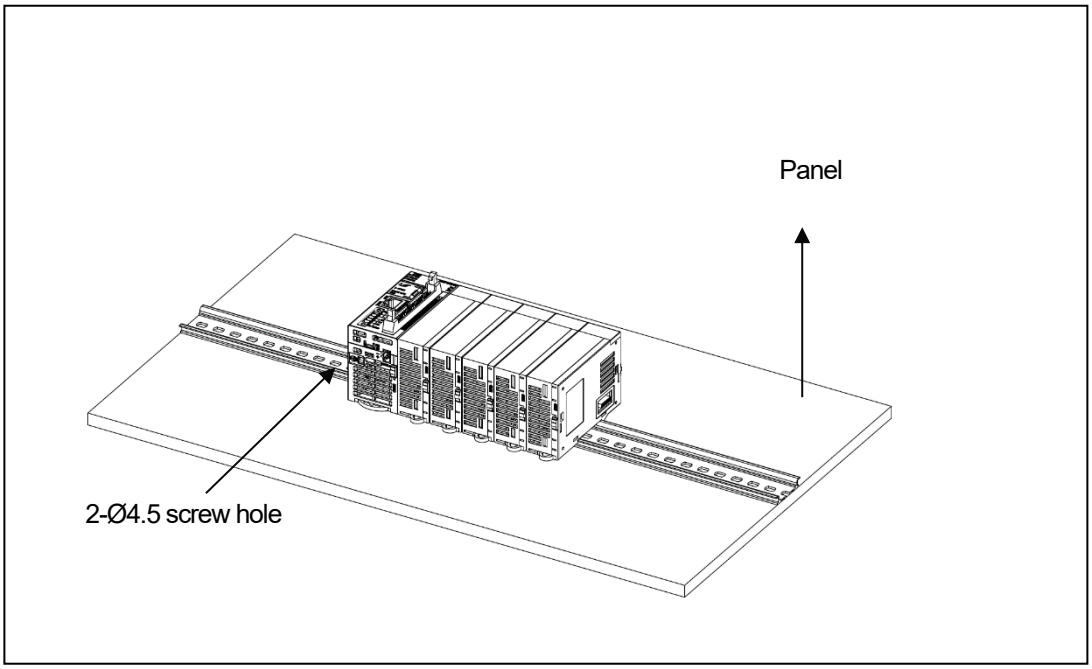
(a) In case of installing at DIN rail

- 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



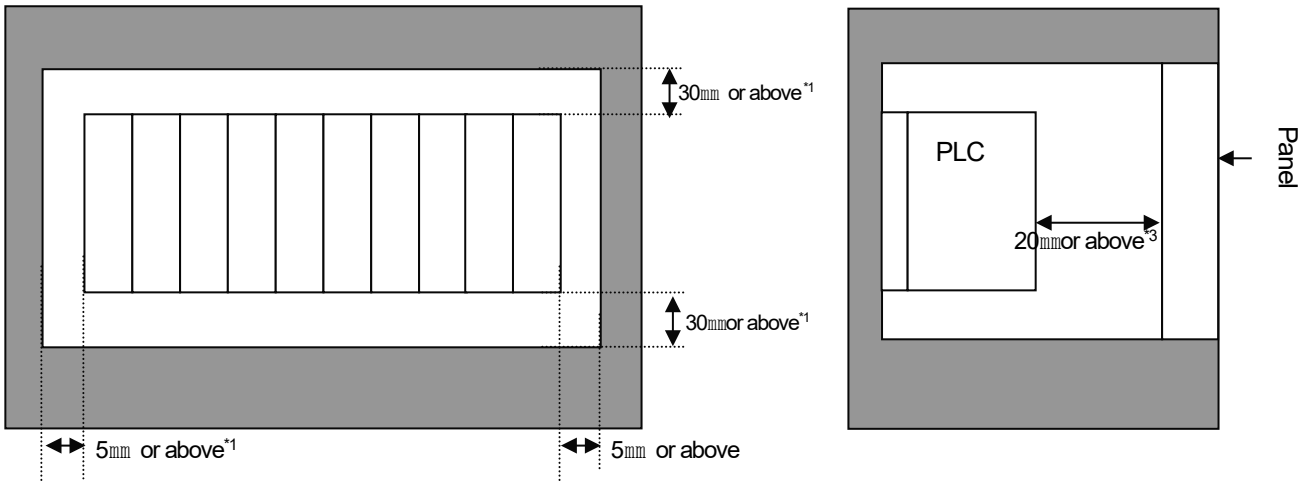
(b) In case of installing at panel

- 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

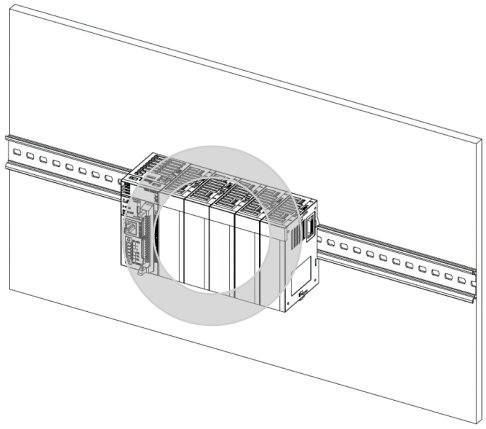
Keep the following distance between module and structure or part for ventilation, easy detachment and attachment.



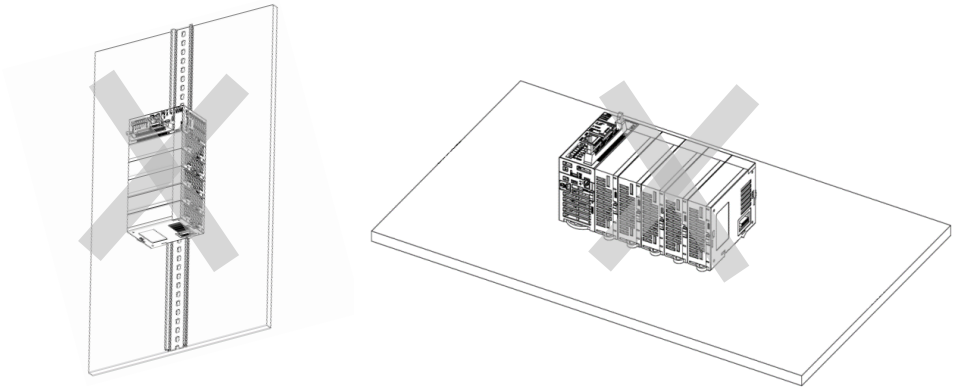
*1 : In case height of wiring duct is less than 50 mm (except this 40mm or more)
*2 : In case of equipping cable without removing near module, 20mm or more
*3 : In case of connector type, 20mm or above

(5) Module equipment direction

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

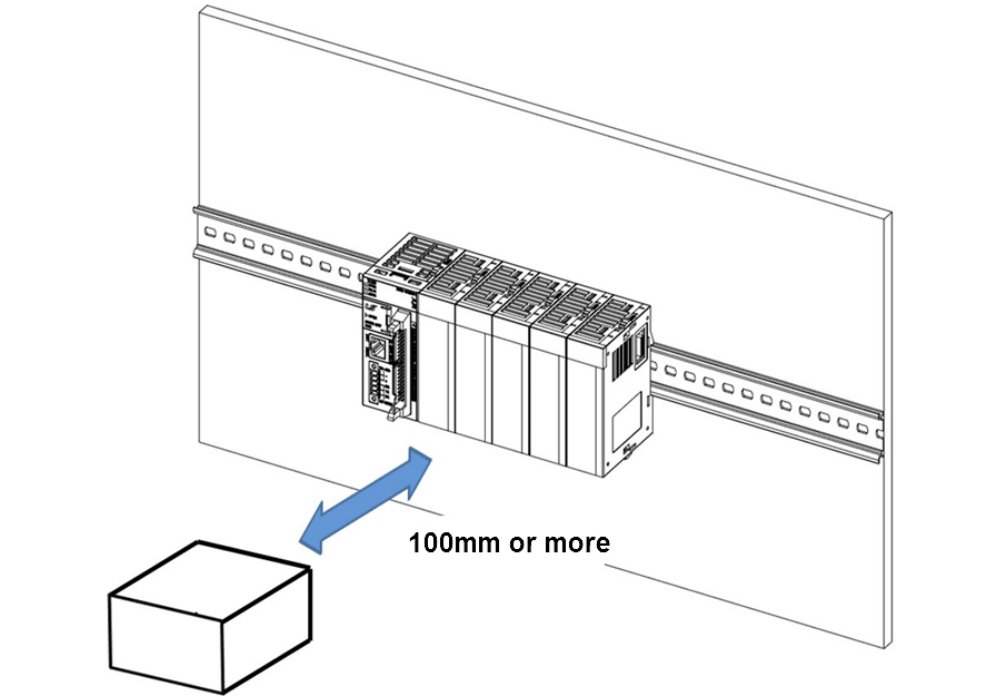


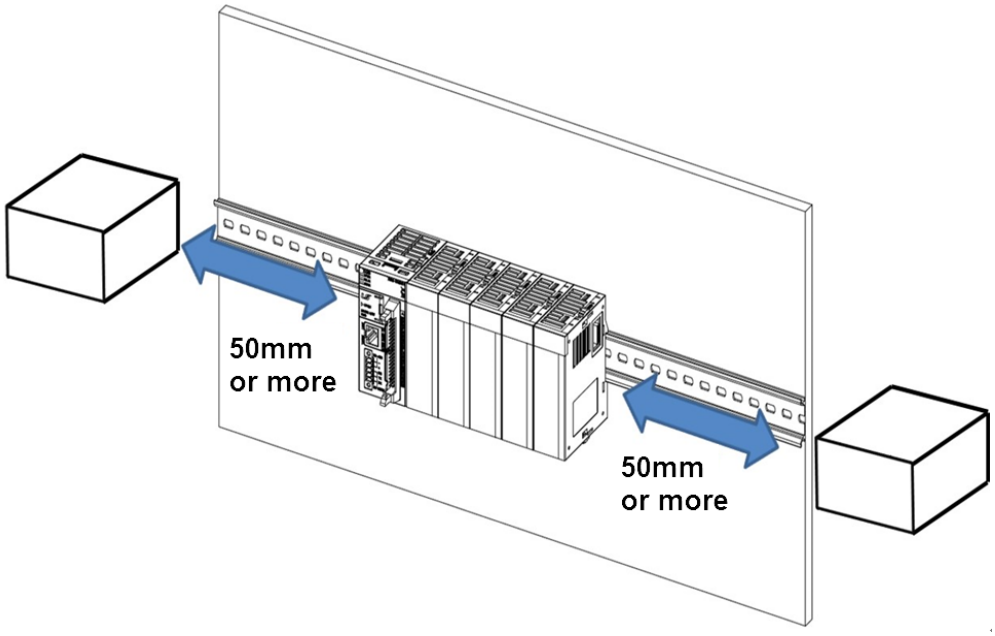
(b) Don't install as shown below.



(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

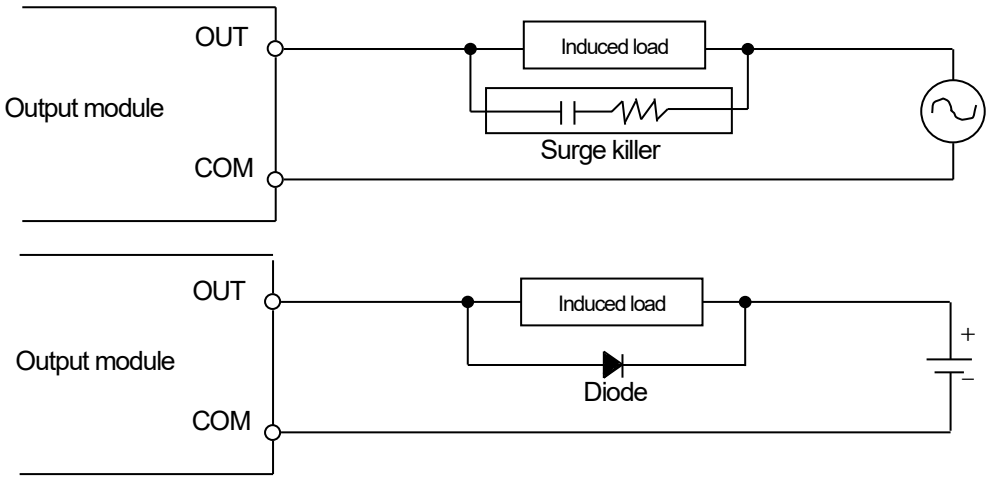
In case of wiring IO module, if the device or material with high heat is too close to the PLC, or if the wire makes a direct contact with the oil for a long time, it may cause short, malfunction or error.

(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.

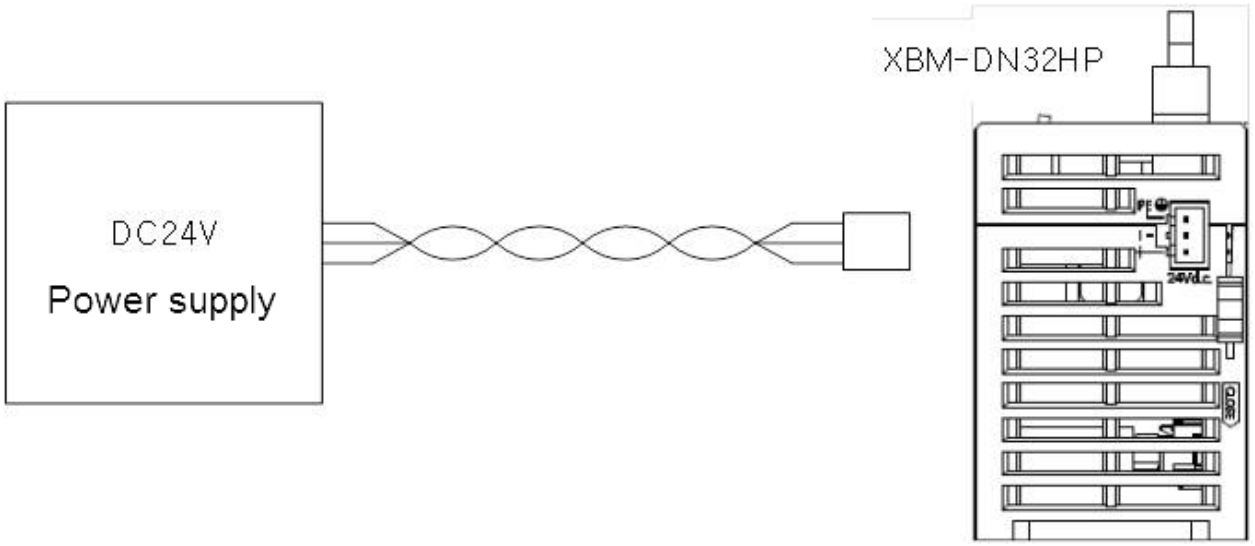
- For external connecting connector, use designated device and solder.

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.

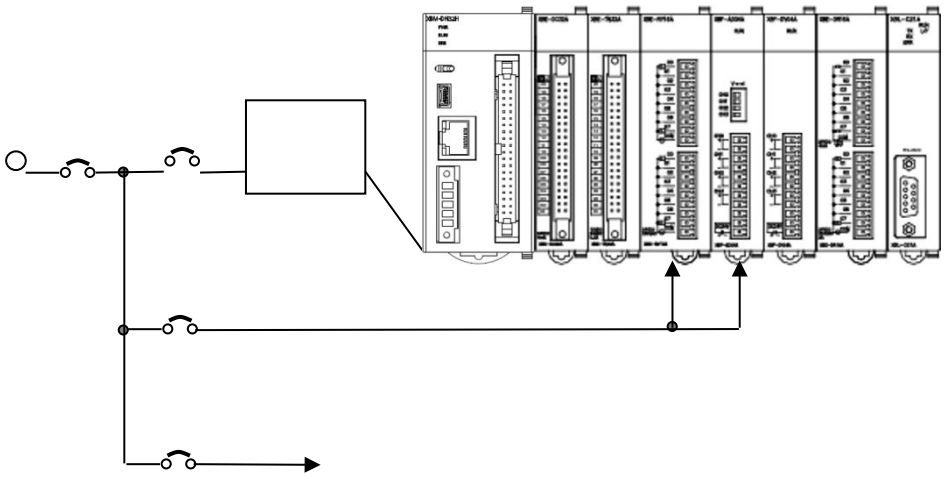
4.3.1 Power wiring

(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

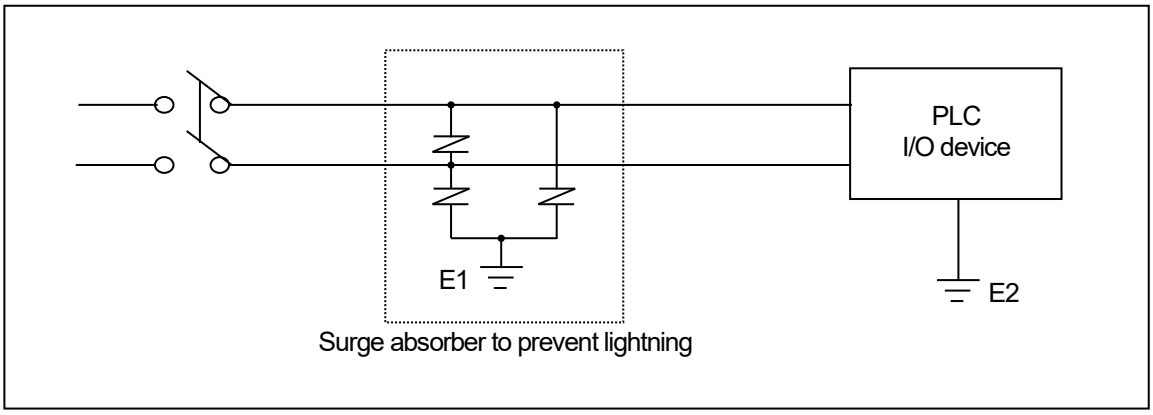
(3) Isolate the PLC power, power for I/O devices and power devices as follows.



(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.

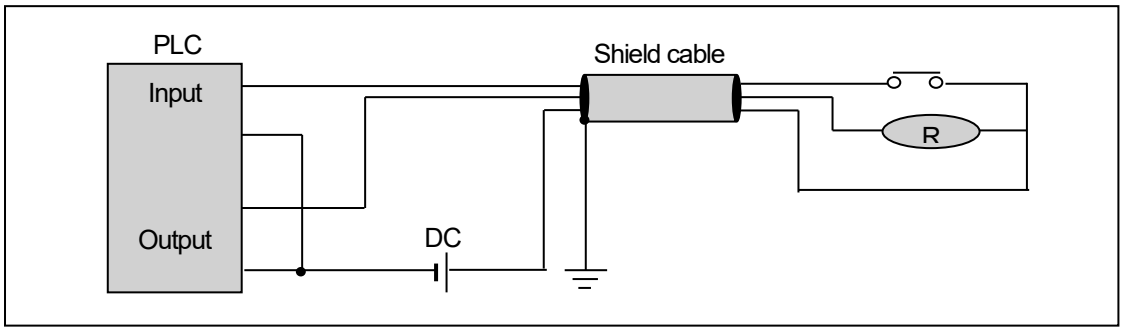
4.3.2 I/O Device wiring

(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.

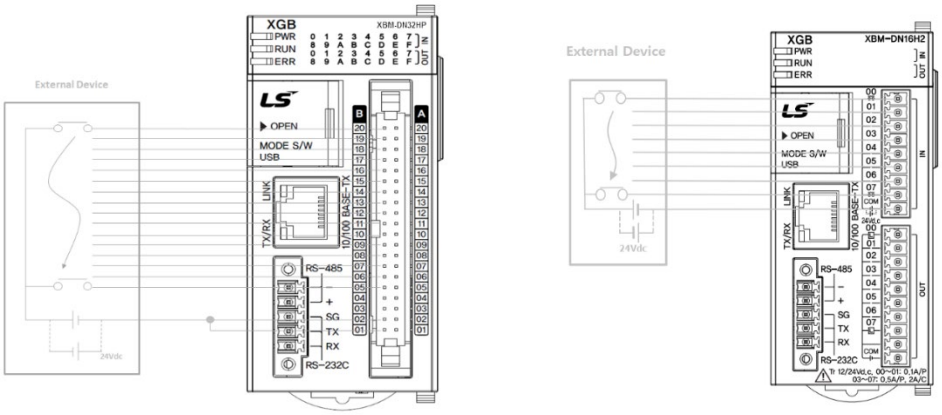
(3) I/O signal lines should be wired 100mm and more away from high voltage/high current main circuit cable.

(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.

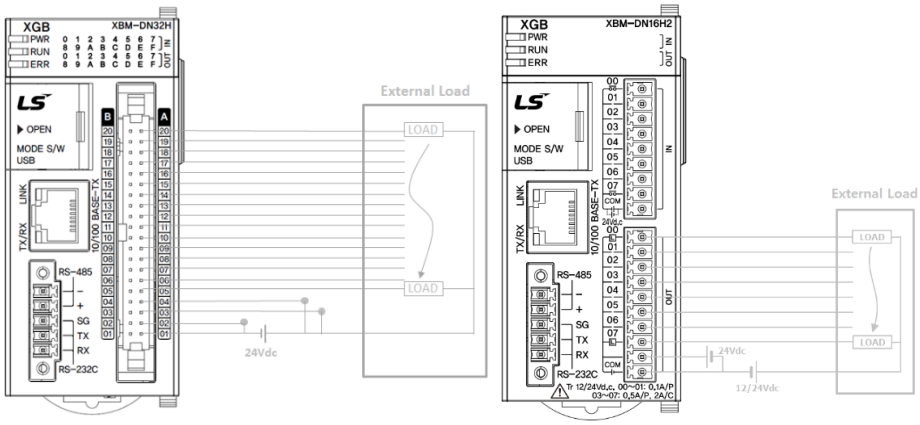


(5) When applying pipe-wiring, make sure to ground the pipe firmly.

(6) Example of input module.

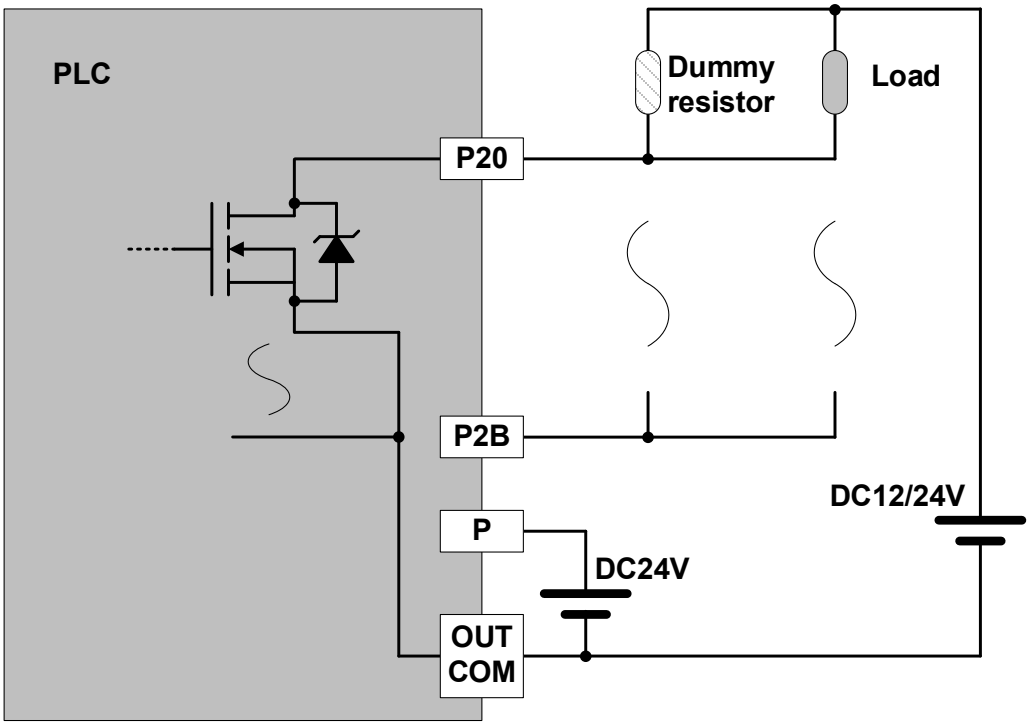


(7) Example of output module.



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

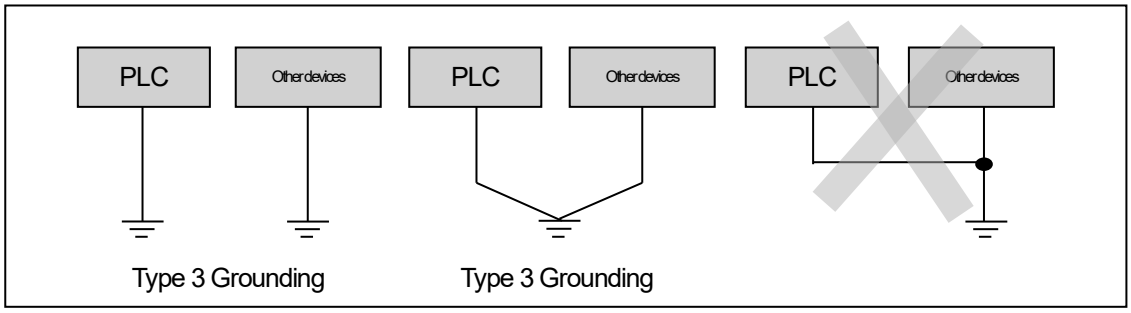
List	Description
Load Voltage	DC12V / DC24V
Range of Load current	10mA ~100mA
Output frequency	200kpps or below

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, Off when input is off.	
	Output LED	Check that the LED turns On and Off	On when output is On, 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 -. 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.

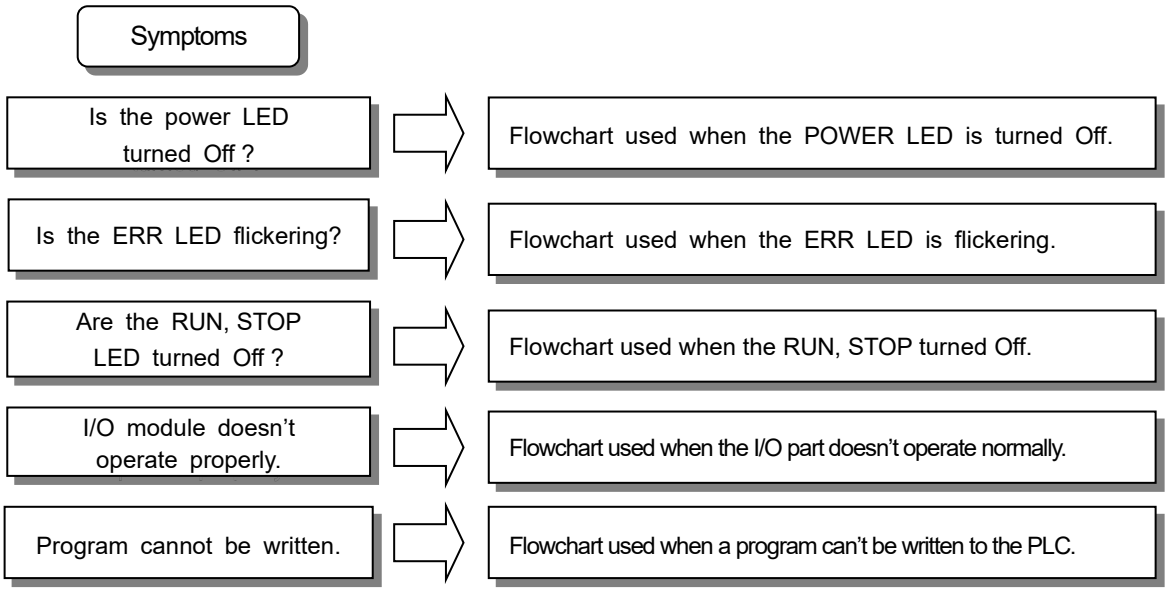
- Switch the key switch to the STOP position, and then turn the power on and off.

(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?

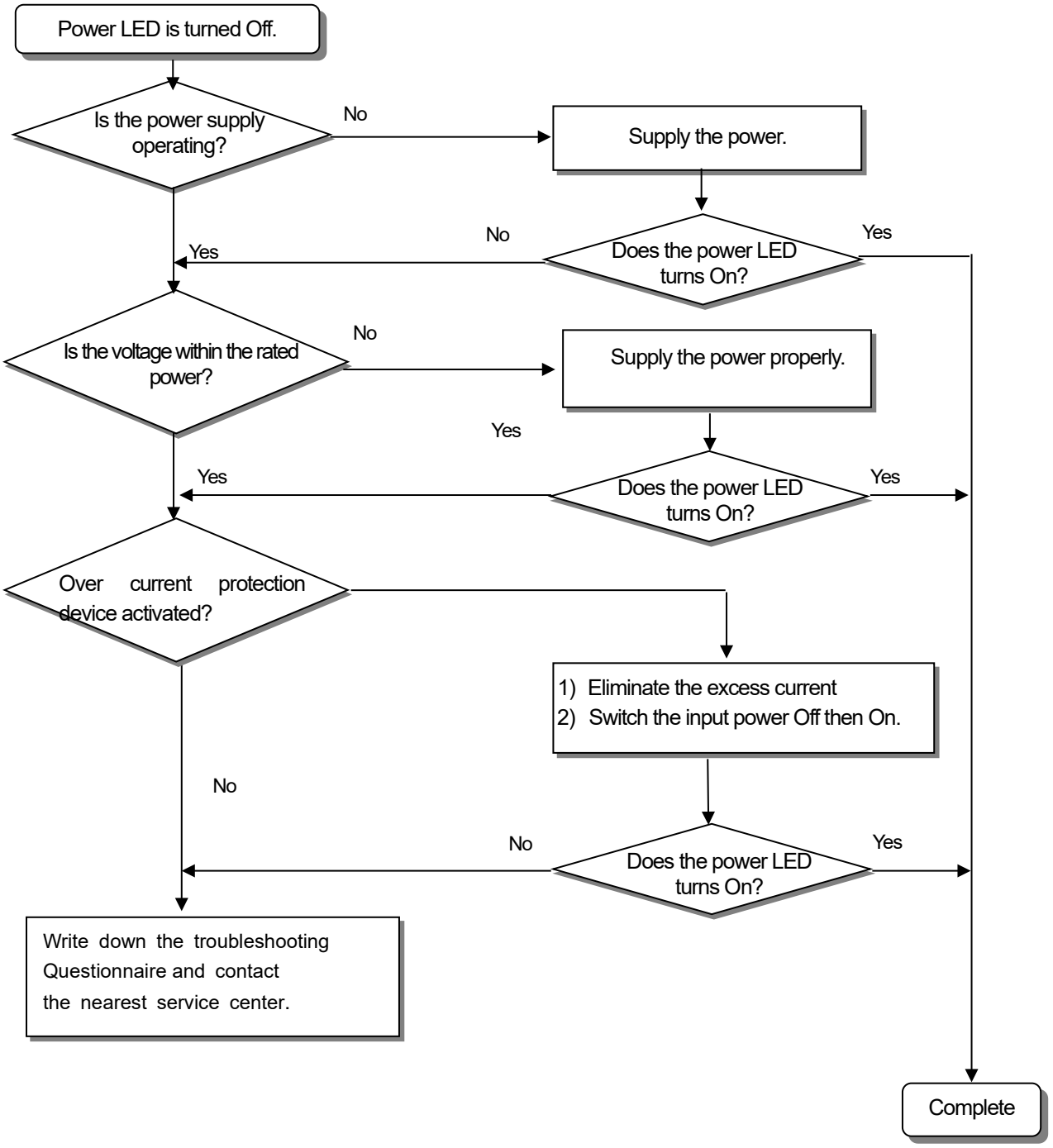
6.2 Troubleshooting

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



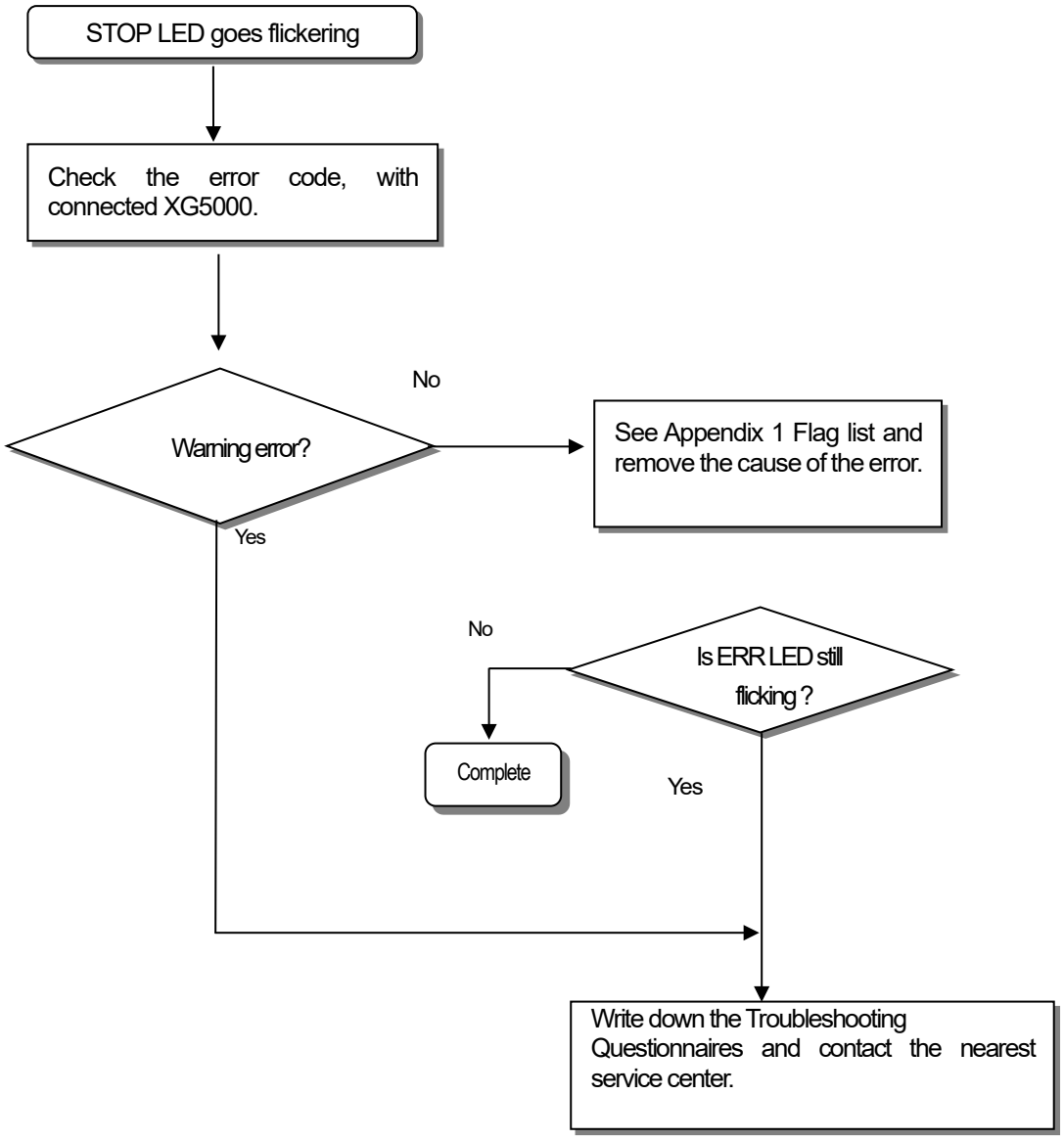
6.2.1 Troubleshooting flowchart used when the PWR (Power) LED turns Off

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.

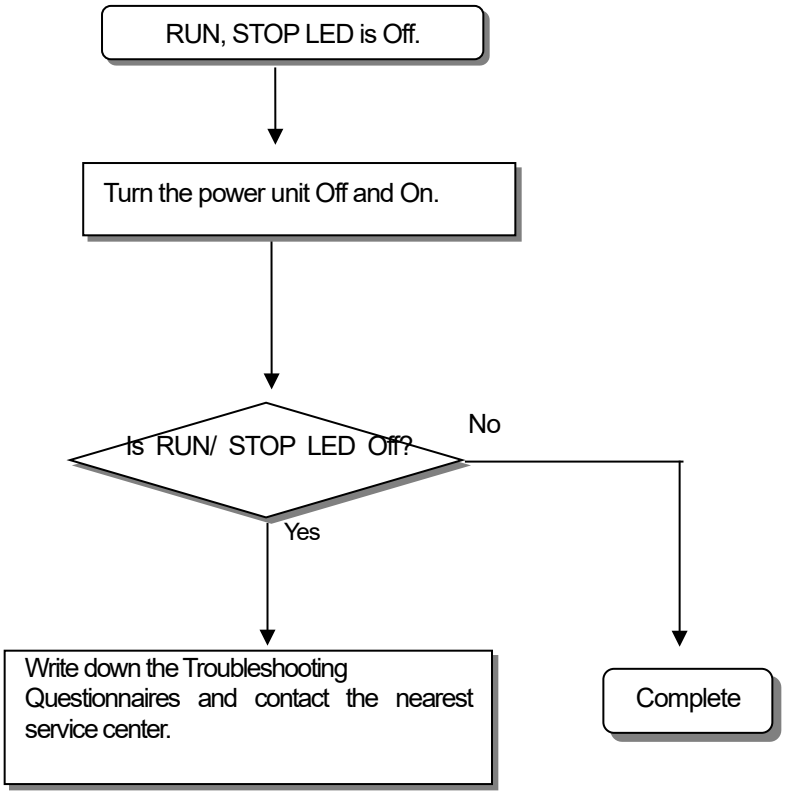


⚠ Warning

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

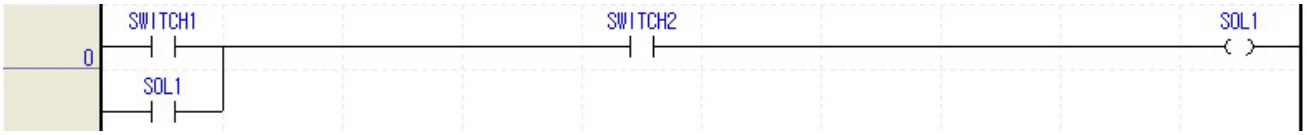
6.2.3 Troubleshooting flowchart used with when the RUN , STOP LED turns Off.

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.



When the I/O module doesn't work normally.

Is the output LED of SOL1 On?

No

Yes

Measure the voltage of terminal in SOL1 by Tester.

Correct wiring.

Replace the connector of the terminal block.

Check the status of SOL1 by XG5000.

Is the measured value normal?

Yes

Is the output wiring correct?

No

Yes

Is the terminal connector appropriate?

No

Yes

Is it normal condition?

No

Yes

Continue

Separate the external wiring than check the condition of output module.

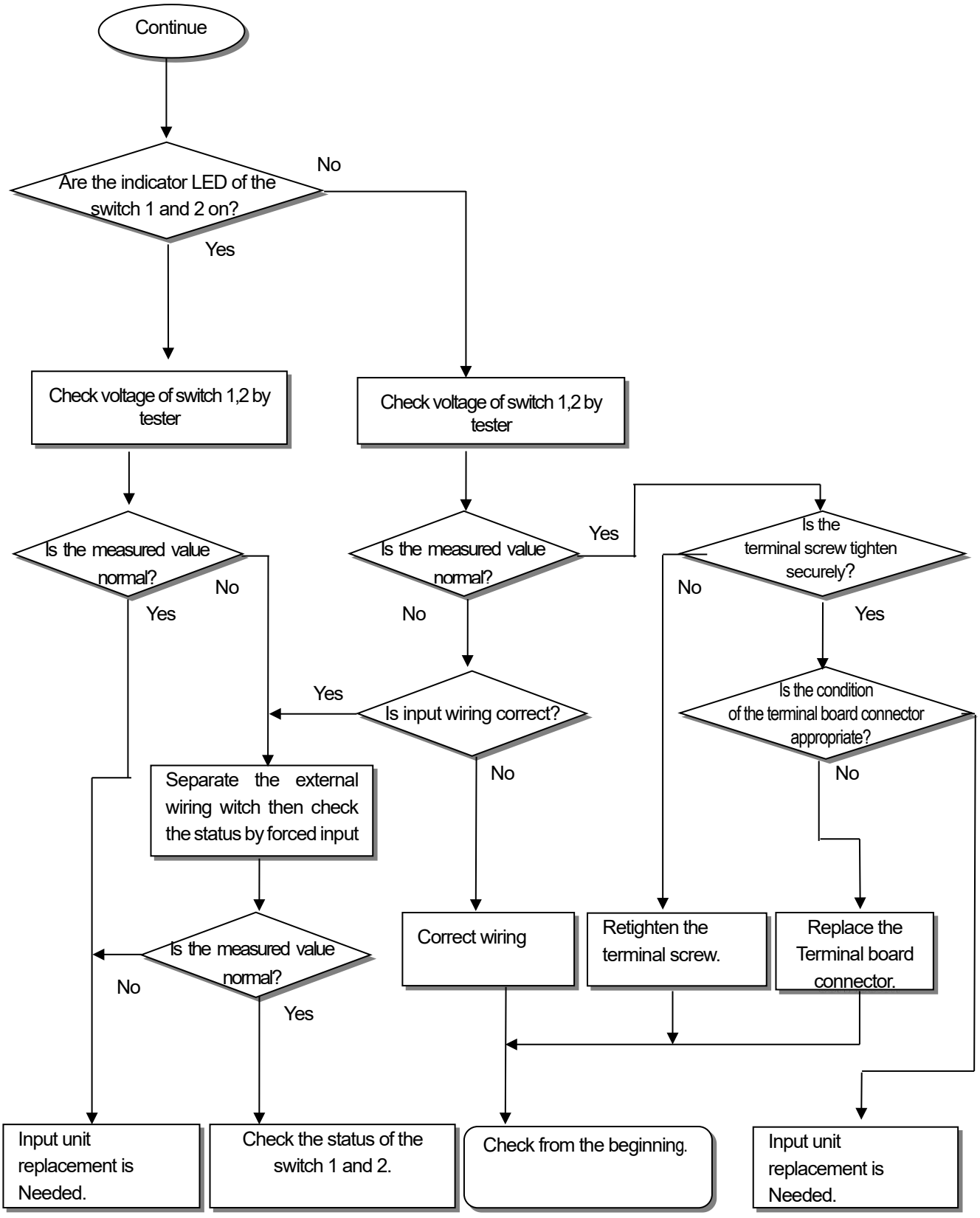
Is it normal condition?

Yes

No

Check the status of SOL1.

Replace the Unit


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
Is input wiring correct?
Yes
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:

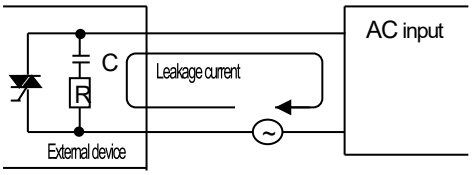
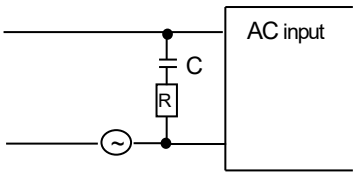
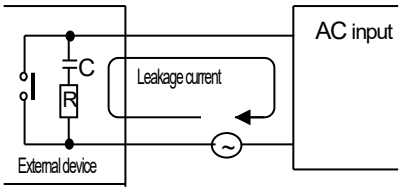
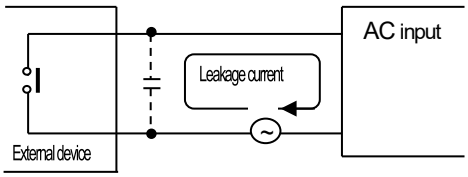
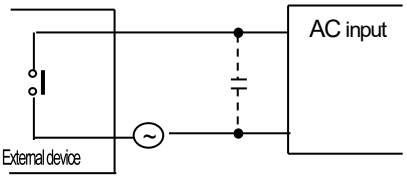
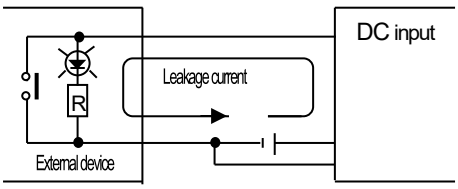
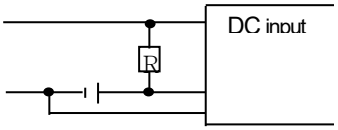
12. Configuration diagram for the applied system:

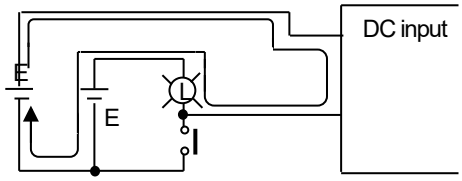
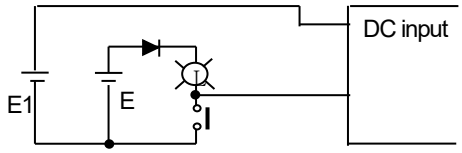
6.4 Troubleshooting Examples

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

6.4.1 Input circuit troubles and corrective actions

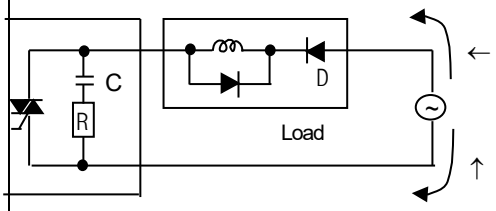
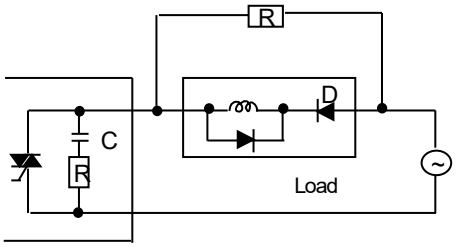
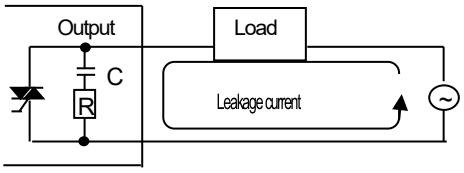
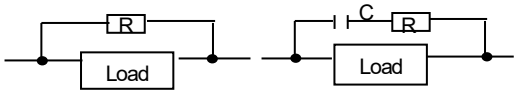
The followings describe possible troubles with input circuits, as well as corrective actions.

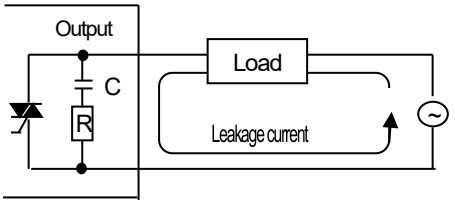
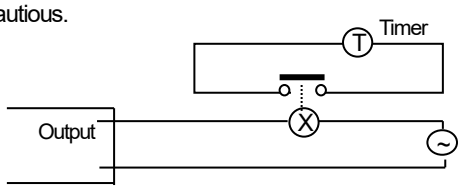
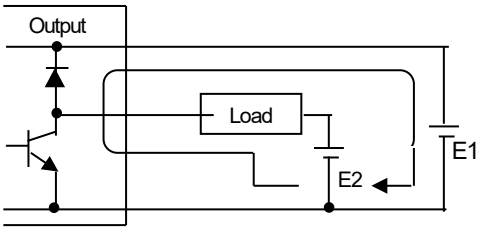
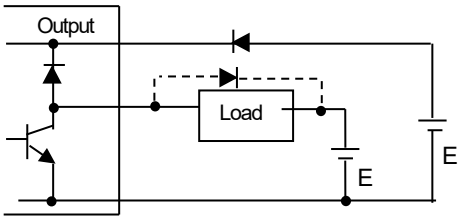
Condition	Cause	Corrective Actions
Input signal doesn't turn off.	Leakage current of external device (Such as a drive by non-contact switch) 	• Connect an appropriate register and capacity, which will make the voltage lower across the terminals of the input module. 
Input signal doesn't turn off. (Neon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

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

6.4.2 Output circuit and corrective actions

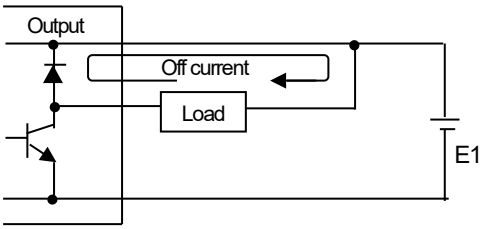
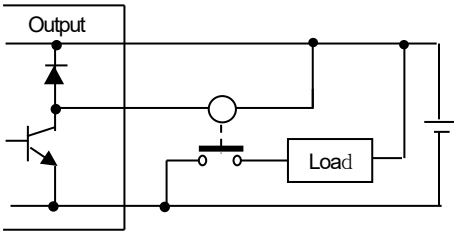
The following describes possible troubles with output circuits, as well as their corrective actions.

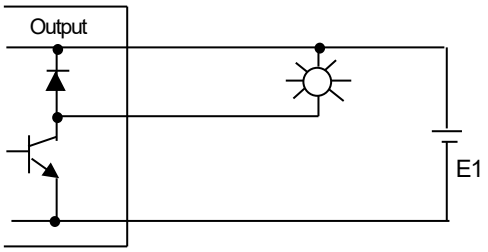
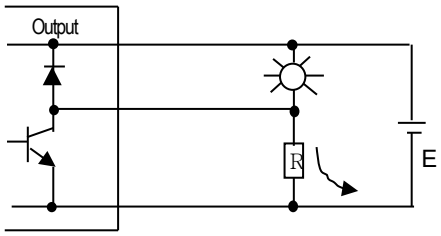
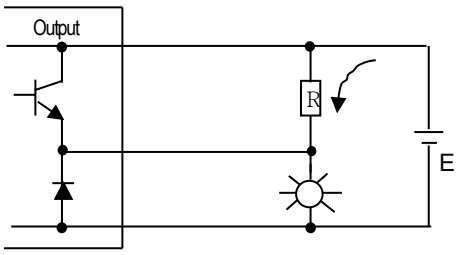
Condition	Cause	Corrective Action
When the output is off, excessive voltage is applied to the load.	•Load is half-wave rectified inside (in some cases, it is true of a solenoid) •When the polarity of the power supply is as shown in ①, C is charged. When the polarity is as shown in ②, the voltage charged in C plus the line voltage are applied across D. Max. voltage is approx. 2√2.  *) 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. 
The load doesn't turn off.	• Leakage current by surge absorbing circuit, which is connected to output element in parallel. 	• 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. 

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. 	• Drive the relay using a contact and drive the C-R type timer using the since contact. • Use other timer than the C–R contact some timers have half-ware rectified internal circuits therefore, be cautious. 
The load does not turn off.	• Sneak current due to the use of two different power supplies.  E1<E2, sneaks. E1 is off (E2 is on), sneaks.	• Use only one power supply. • Connect a sneak current prevention diode.  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.  • 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. 

Output transistor is destroyed.	Surge current of the white lamp on.  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.  Sink type transistor output  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	Abnormal program execution	Restart after reloading the program	Warning	0.5 second Flicker	RUN mode
24	I/O parameter error	Check whether the I/O parameters are retained after uploading. If they are invalid, fix it and download again. If the error keeps occuring, replace the main unit.	Warning	0.5 second Flicker	Reset RUN mode switching
25	Basic parameter error	Check whether the Basic parameters are retained after uploading. If they are invalid, fix it and download again. If the error keeps occuring, replace the main unit.	Warning	0.5 second Flicker	Reset RUN mode switching
26	Compile area exceeded	Reduce the program size and download again.	Warning	0.5 second Flicker	RUN mode switching
27	Compile error	Check the program and download again.	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	Check the connection status of the expansion module.	Heavy error	0.1 second Flicker	Every scan
33	I/O module data is not accessed normally during operation.	Check the position of slot where the access error occurred in XG5000, replace the module, and restart (according to parameter.)	Heavy error	0.1 second Flicker	Scan end
34	Special / Link module data is not accessed normally during operation.	Check the position of slot where the access error occurred in XG5000, replace the module, and restart (according to parameter.)	Heavy error	0.1 second Flicker	Scan end
38	Extension Module exceed	The number of extension module exceeds 10 stages, or more than 3 communication modules are attached.	Heavy error	0.1 second Flicker	RUN mode switching
39	Abnormal stop of CPU or malfunction	Abnormal system end by noise or hardware error. 1) If it occurs repeatedly after powering back on, contact the service center. 2) Take noise countermeasures.	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
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 use error	After modifying the timer index program, download the program and restart.	Warning	0.5 second Flicker	Scan end

Error code (Dec)	Error cause	Action (restart mode after taking an action)	Operation status	LED status	Diagnosis point
50	The malfunction of external devices is detected due to the user program.	Refer to the error flag for detecting the malfunction of the external device, repair the device, and restart. (According to Parameter)	Warning	0.5 second Flicker	Scan end
55	Task colision	Check the task occurrence	Warning	1 second Flicker	Every time
60	E_STOP function executed	After removing error causes which starts E_STOP function in program, re-input the power.	Warning	1 second Flicker	While running the program
500	Data memory backup is not possible	If there is no issue with the battery, re-input the power. (Remote mode will be switched to STOP mode.)	Warning	1 second Flicker	Reset
501	Abnormal clock data	Set the time with XG5000 or else.	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.

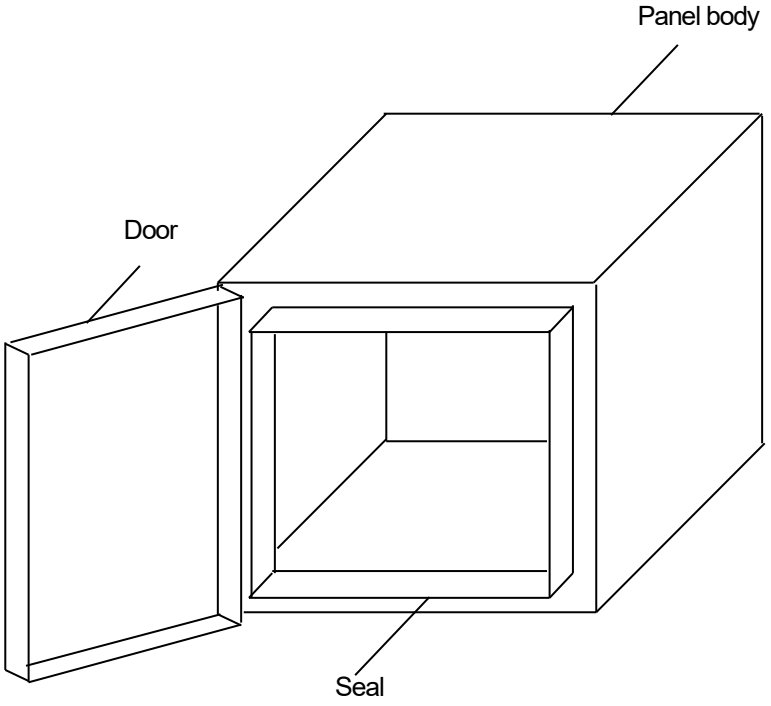
Specification	Test item	Test details	Standard value
EN50081-2	EN55011 Radiated noise *2	Electromagnetic emissions from the product are measured	30~230 ㎒ QP : 50 dBμV/m *1 230~1000 ㎒ QP : 57 dBμV/m
	EN55011 Conducted noise	Electromagnetic emissions from the product to the power line is measured	150~500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

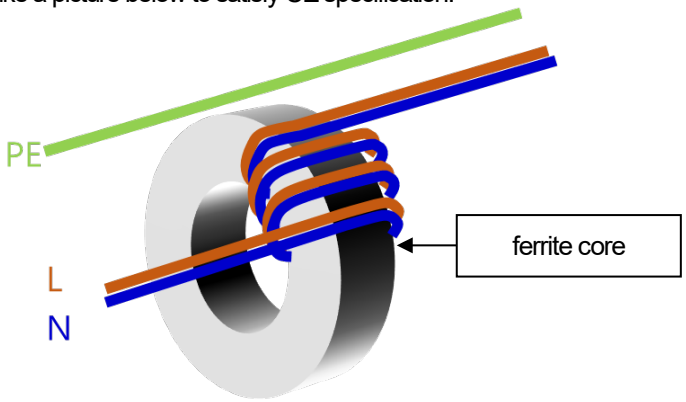


(e) To ensure good electrical contact with the control panel or base plate, mask painting and weld so that good surface contact can be made between the panel and plate.

(2) Connection of power and earth wires

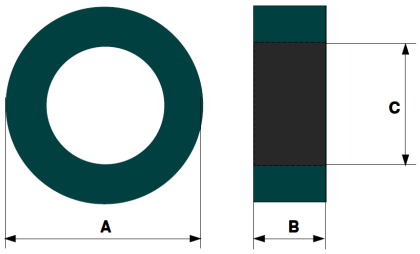
Earthing and power supply wires for the PLC system must be connected as described below.

(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 FG (Frame Ground) terminal 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.

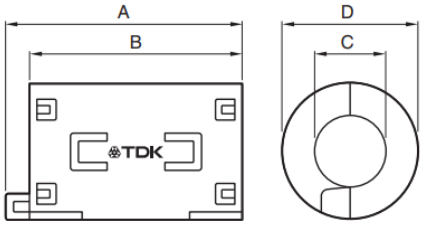


[ferrite core]

Manufacturer	Model Name	External Dimension [mm]				Impedance (Z)	Reference
KH FEELUX	G11B-TR40-24-16 GREEN	A		B	C	25MHz: 40.0Ω min. 100MHz: 70.0Ω min.	www.feelux.com
		40.5±1.0		23.7±1.0	15.8±1.0		
TDK	ZCAT2132-1130	A	B	C	D	10 to 100MHz: 40 Ω 100 to 500MHz: 80 Ω	www.tdk.com
		36±1	32±1	11±1	20.5±1		



[External Dimension, KH FEELUX]



[External Dimension, TDK]

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

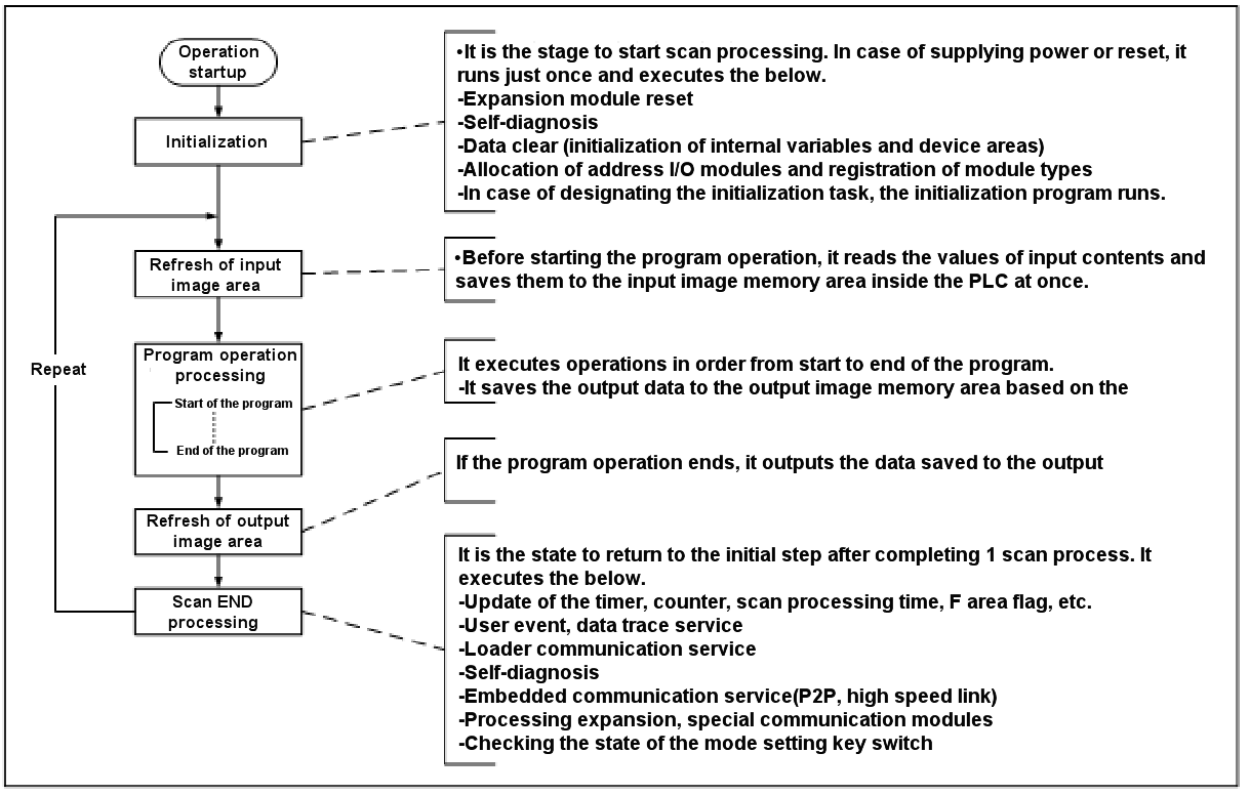
1.1 Programming Basics

1.1.1 Programming Method

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

(1) Repetitive operation mode (Scan)

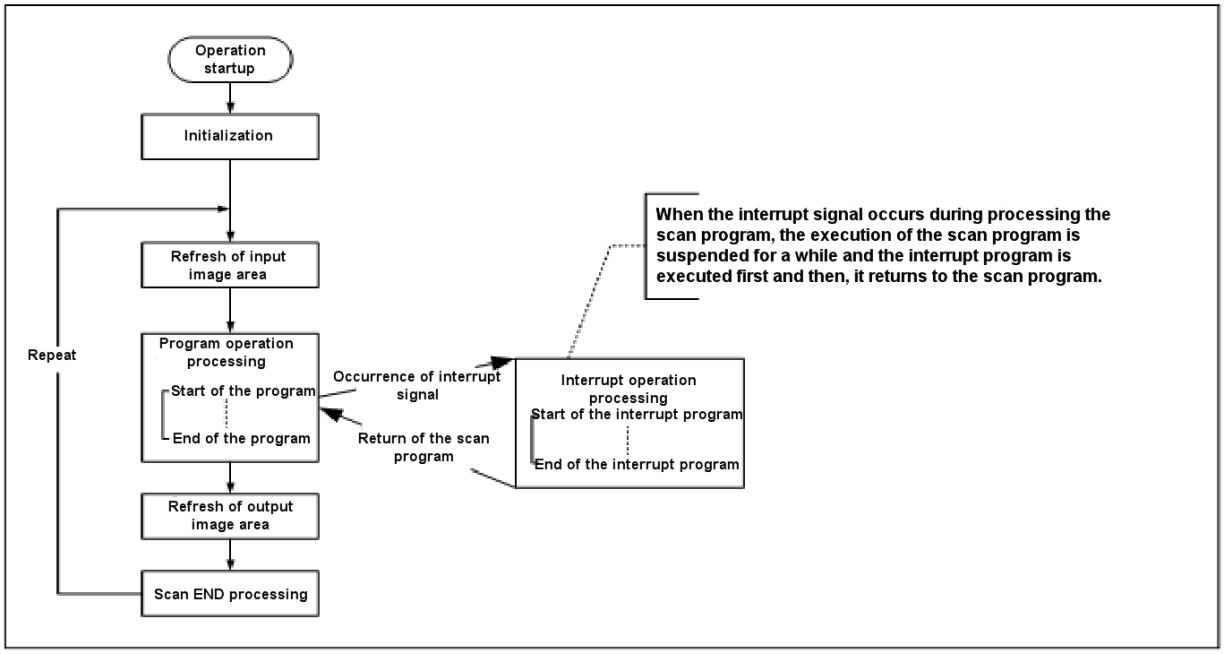
It means the basic programming method of the PLC.
It is the method that performs the written program repetitively from the first step to the last one and a series of such procedures is called 'program scan'. A series of such processing is called the repetitive operation mode and it can be divided as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



(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



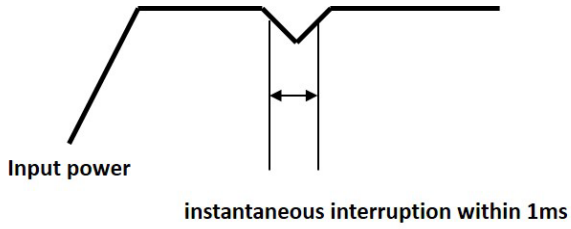
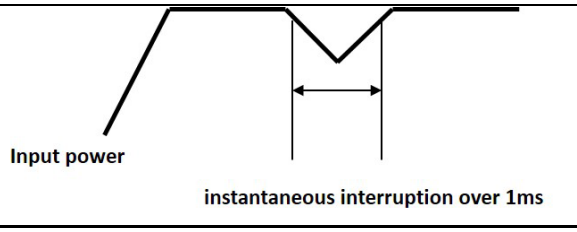
(3) Fixed Cycle Operation mode

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.

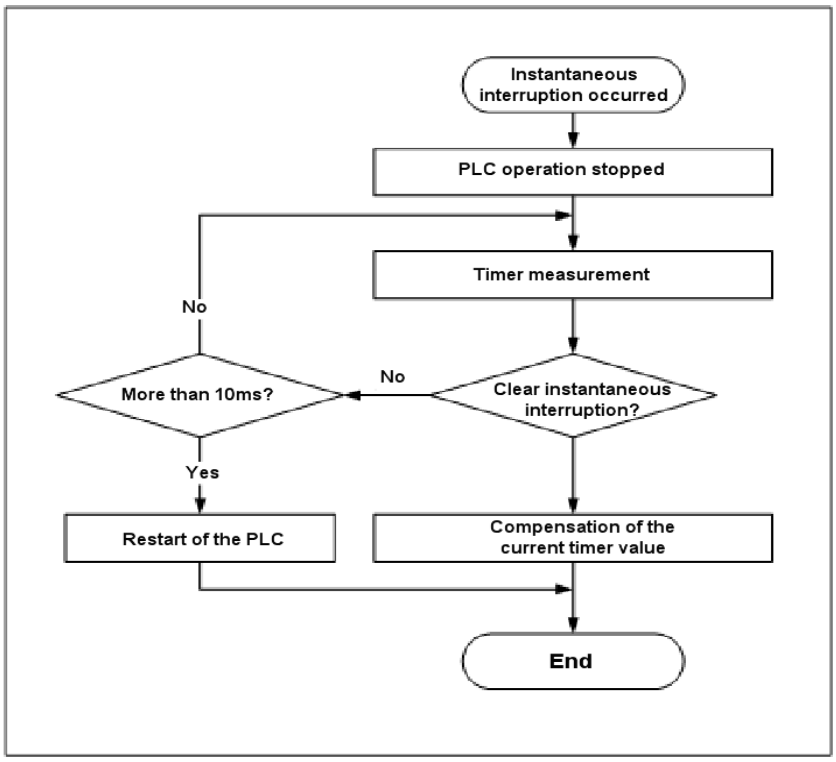
Bit	Flag Name	Name	Description
F005C	_CONSTANT_ER	Fixed cycle error	In case the actual scan time is longer than the fixed cycle set value
F0080	_CONSTANT_RUN	Fixed cycle operation is running	Turned ON during fixed cycle operation

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. (2) If instantaneous interruption is canceled, execution will resume. (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

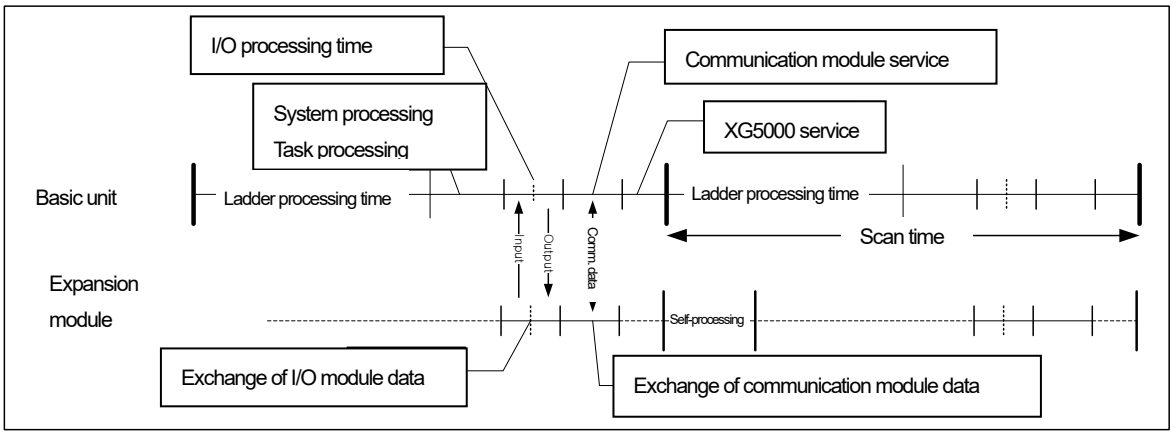
The scan time is the sum of the process time of the scan program and interrupt program written by a user and the PLC's internal END processing time; it can be calculated by the formula below.

(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㎳

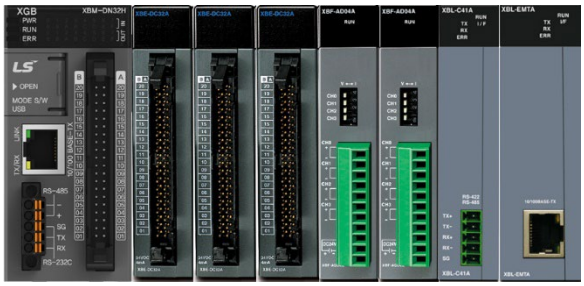
XBM H2/HP unit performs the control operation based on the sequence below. Accordingly, you can roughly estimate the control performance of the system to be designed by using the calculation method below.



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	

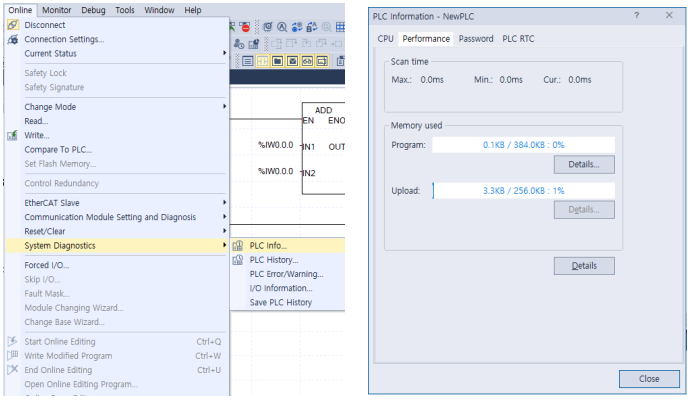
Scan time= Ladder processing time + system processing time + digital I/O processing time + analog I/O processing time + communication module processing time + XG5000 Service processing time = 7.2 + 0.8 + 0.3*3 + 2.0*2 + 0.8*2 +0.1= 14.6㎳

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』 .



(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 (update in case of occurrence only), in 0.1ms
F0051	_SCAN_MIX	Minimum scan time	The shortest scan time (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. •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. • 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. •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. ▸ Execution at the shorter time interval than 1 scan processing time ▸ Execution at the longer time interval than 1 scan processing time ▸ 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. •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

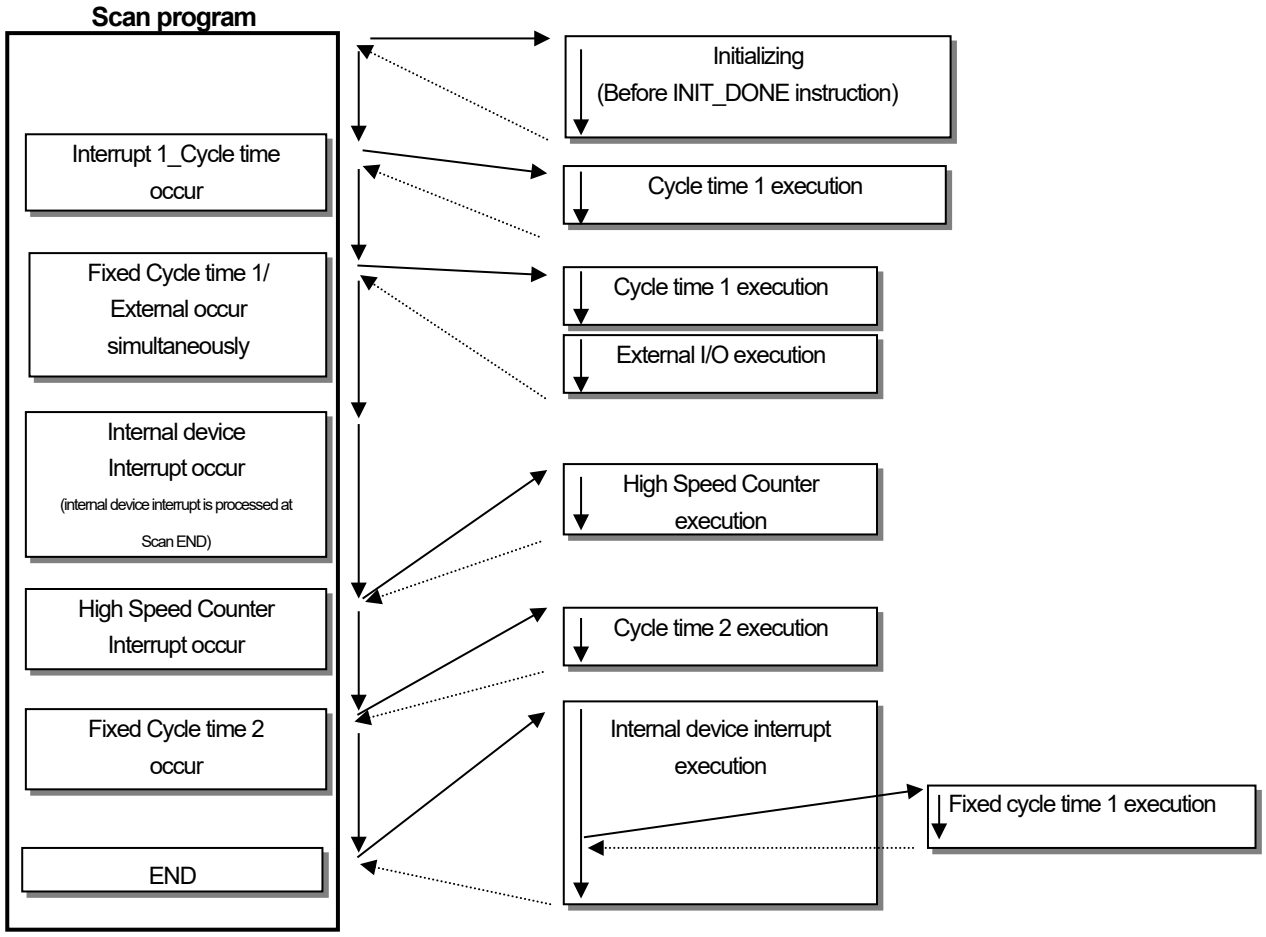
1) Make the interrupt program as short as possible. In case the same interrupt occurs repeatedly during executing the interrupt program, O/S watchdog error may occur with non-execution of the scan program.
(In case the self-interrupt occurs during executing the interrupt program, task conflict error 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.

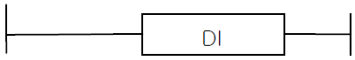
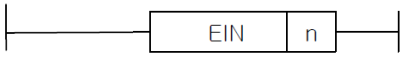
- Delayed detection of tasks (Refer to the detailed description of each task.)
- Program execution delay due to execution of the preceding task program
- Input/output data refresh of expansion special module

(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

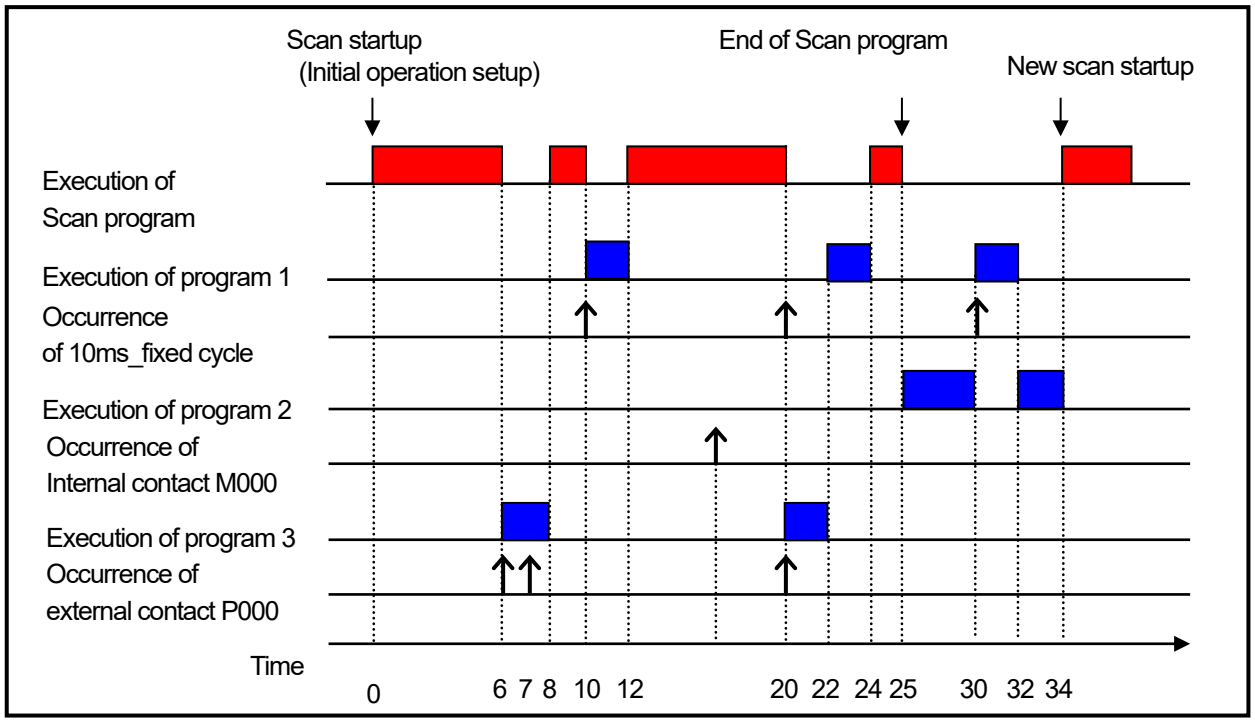
of the task program, protect the program with DI, EI applied commands.

(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.

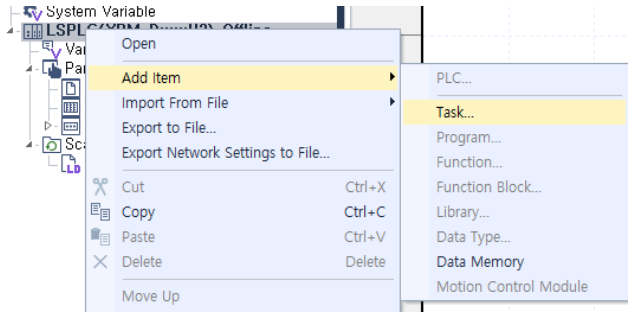
time (㎳)	Executed details
24~25	The execution of the program 1 is completed and the scan program is finished.
25	The program 2 is executed by checking the interrupt request on internal contact_M0 of P2 at the time of completion of the scan program.
25~30	The program 2 runs.
30~32	The request on 10㎳_fixed 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

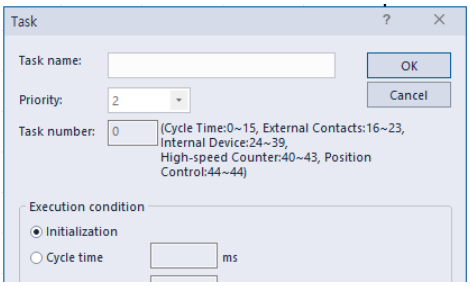
(1) How to set up the task

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.)

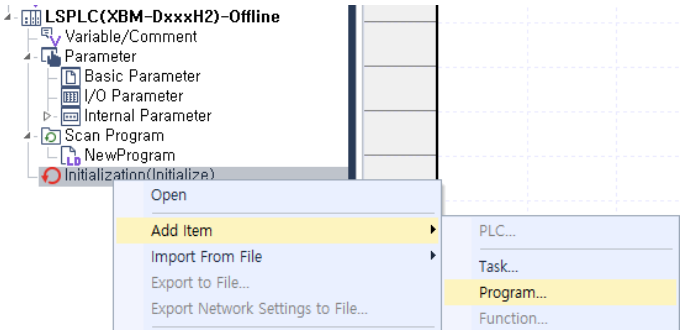
(a) Adding task: Select 『Project』 – 『Add Items』 – 『Task』 or after clicking with the right mouse button on the project name of the project tree, select 『Add Items』 - 『Task』 as shown in the below figure.



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

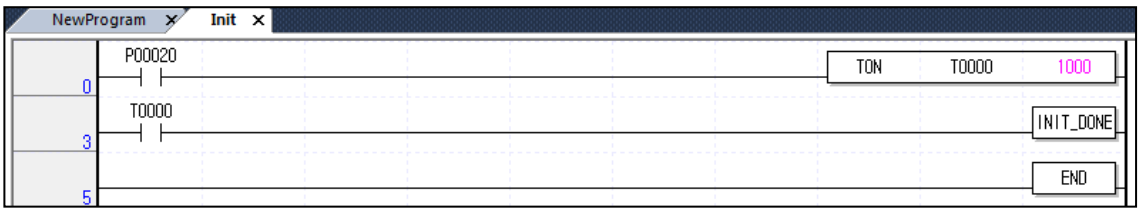


(c) Click on the right mouse button on the registered task and click 『Add Items』 - 『Program』 .



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

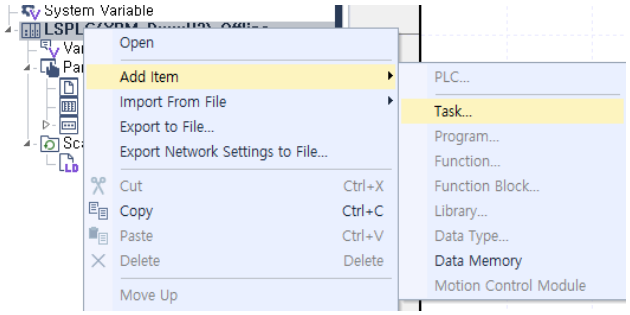
(If the operation conditions of INIT_DONE runs, the initialization task ends and the scan program runs.)



1.1.7 Fixed cycle task

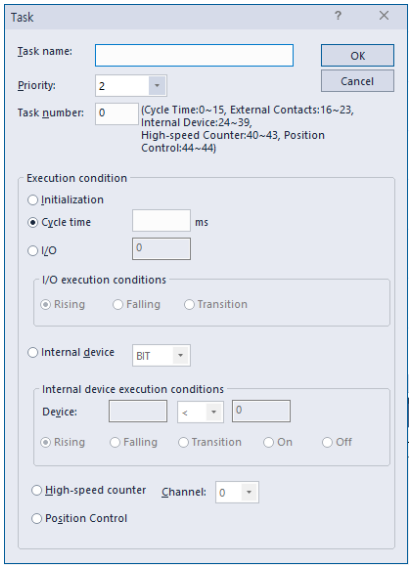
(1) How to set up the task

(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.

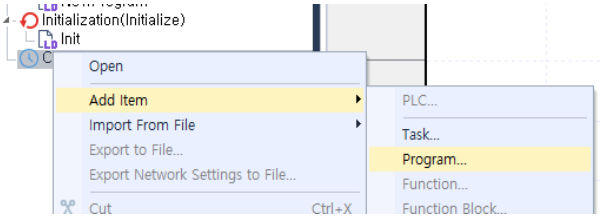


(b) The screen for registering the task will be displayed. Click 『Fixed cycle』 in the execution conditions and after entering the task name, input the items required for setting as below

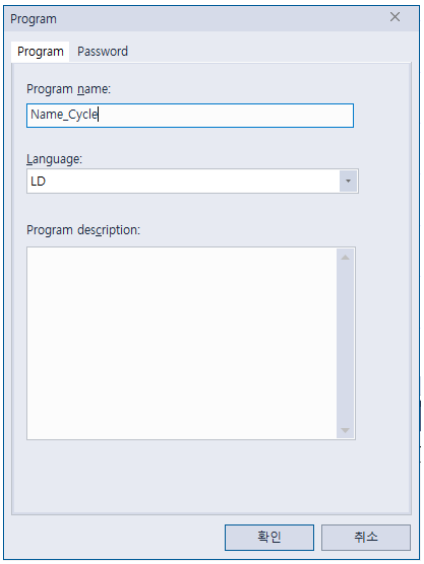
Items	Input range	Description
priority	2~7	Designates the priority of tasks.
Task No.	0~15	Designates the task number. The numbers overlapped with are not available.
cycle	1~4,294,967,295 (㎳)	Designates the task's running cycle.



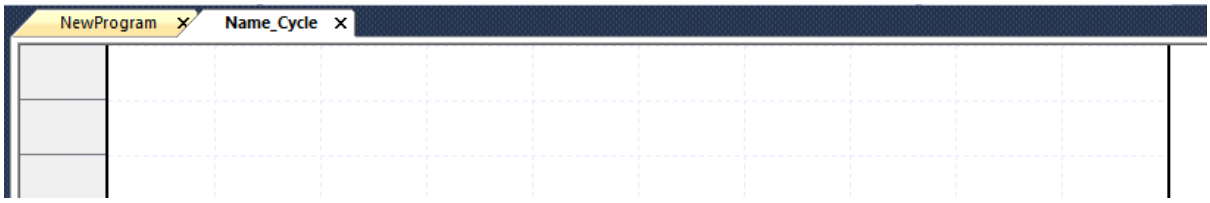
(c) Click on the right mouse button on the registered task and click 『Add Items』-『Program』.



(d) Register the task program name and comment.



(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

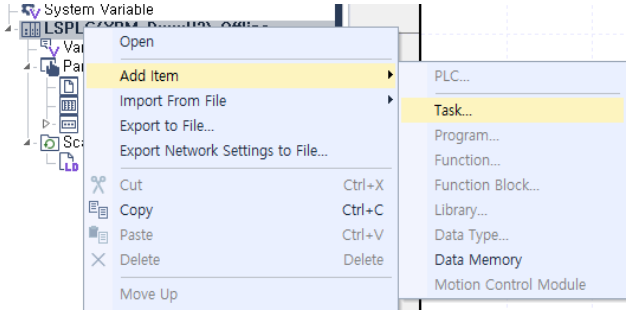
The corresponding task program with fixed cycle runs at every set time interval (running cycle) and keep the below instructions in mind.

- 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

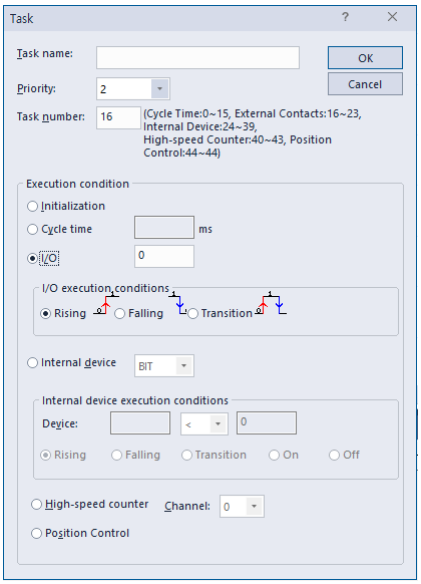
(1) How to set up the task

(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.

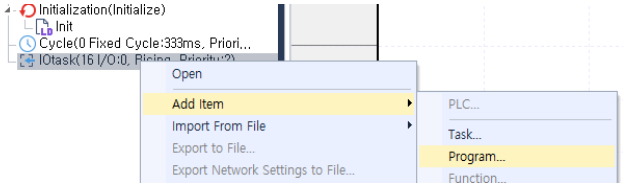


(b) The screen for registering the task will be displayed. Click 『External contact』 in the execution conditions and after entering the task name, input the items required for setting as below.

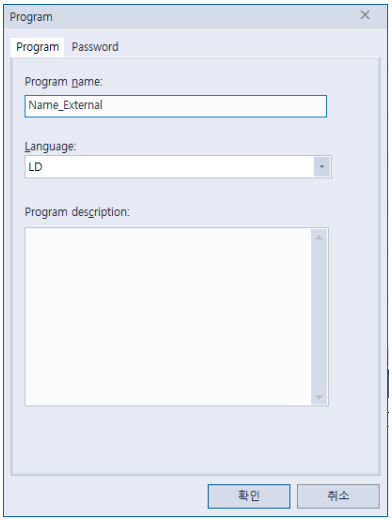
Items	Input range	Description
Priority	2~7	Designates the priority of tasks.
Task No.	16~23	Designates the task number. The numbers overlapped with are not available.
Contact No.	0~7	Designates the task start contact number.
Starting conditions	rising, falling, transition	Sets up starting conditions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



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



(d) Register the task program name and comment.



(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

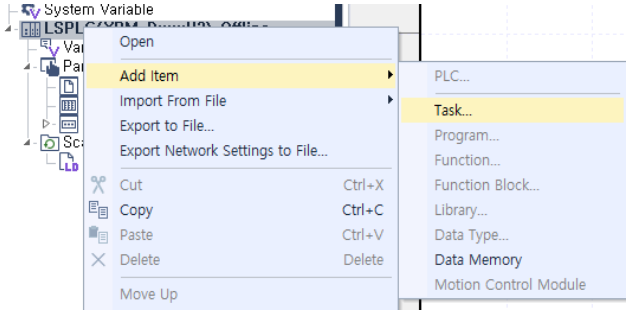
When the rising, falling or transition conditions occur in the set input contact, the corresponding external contact task program runs and keep the below instructions in mind.

- 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

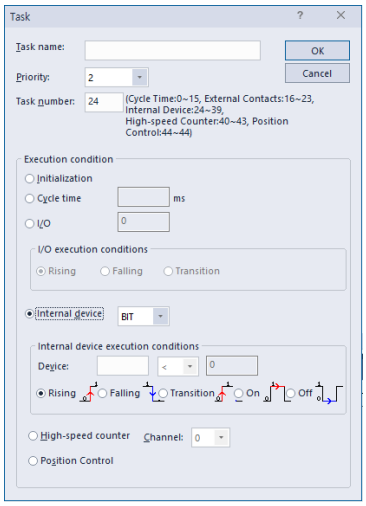
(1) How to set up the task

(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.

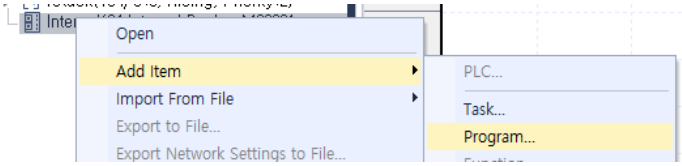


(b) The screen for registering the task will be displayed. Click 『Internal device』 in the execution conditions and after entering the task name, input the items required for setting as below.

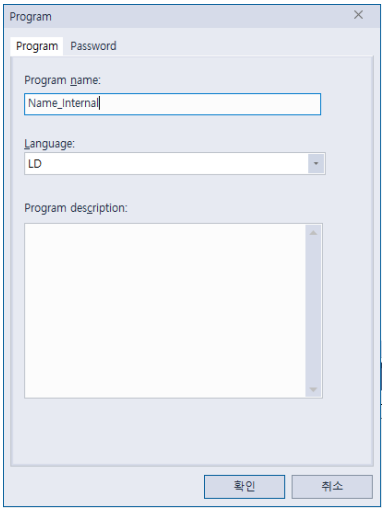
Items		Input range	Description	
Priority		2~7	Designates the priority of tasks.	
Task No.		24~39	Designates the task number. The numbers overlapped with are not available.	
Internal device		BIT, WORD	Selects the device type that will start the task.	
Device		Direct input	Input directly the device that 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.



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



(d) Register the task program name and comment.



(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.

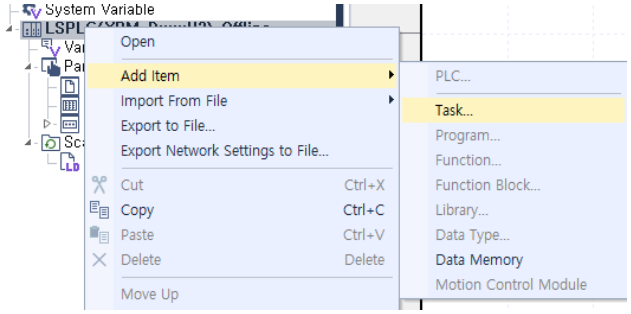
•The internal device task program runs when the scan program is completed. Accordingly, although the execution conditions of the internal device task program occur in the scan programs or task programs (fixed cycle, external contact, high speed counter), it will run at the time of completing the scan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

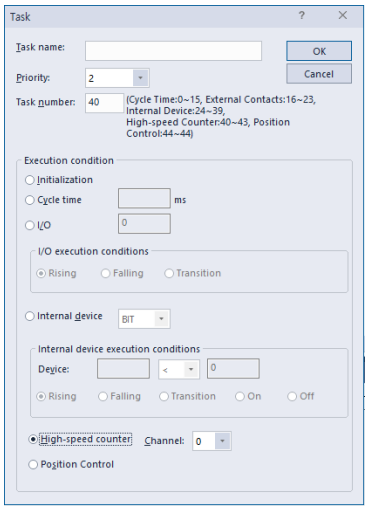
1.1.10 High speed counter task

(1) How to set up the task

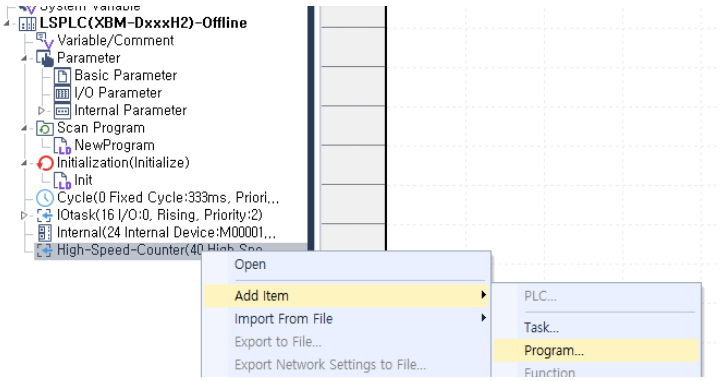
(a) Adding tasks: Select 『Project』 – 『Add Items』 – 『Task』 or after clicking with the right mouse button on the project name of the project tree, select 『Add Items』 - 『Task』 as shown in the below figure.



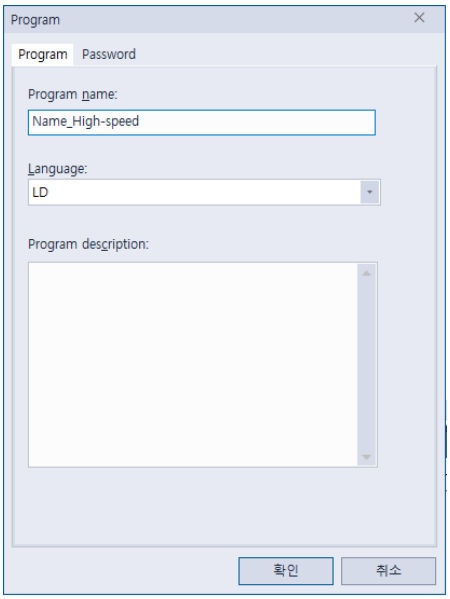
(b) The screen for registering the task will be displayed. Click 『High speed counter』 in the execution conditions and after entering the task name, select the channel.



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



(d) Register the task program name and comment.



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

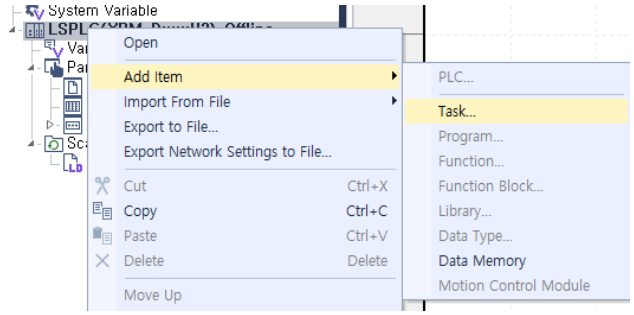
(2) Instructions to use the high speed counter task

- 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.

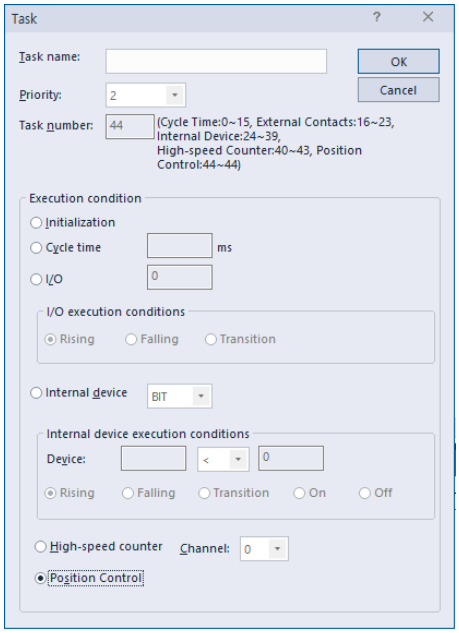
1.1.11 Positioning control task

(1) How to set up the task

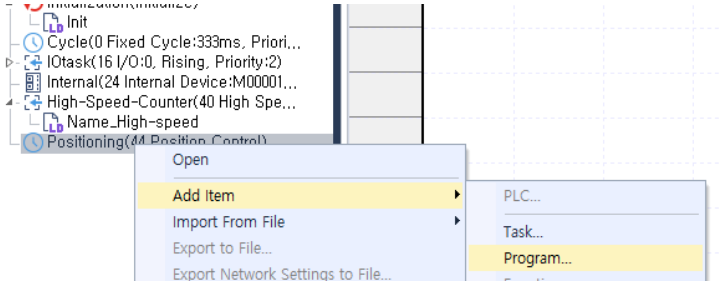
(a) Adding tasks: Select 『Project』 – 『Add Items』 – 『Task』 or after clicking with the right mouse button on the project name of the project tree, select 『Add Items』 - 『Task』 as shown in the below figure.



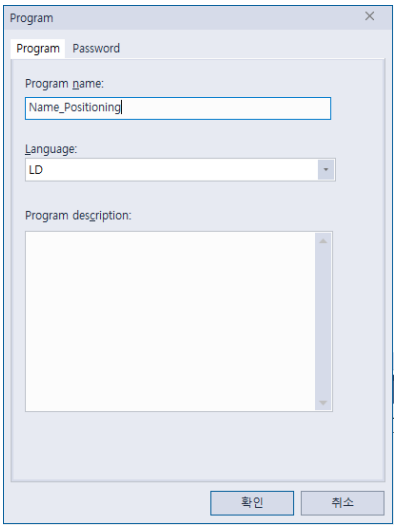
(b) The screen for registering the task will be displayed. Click 『Position control』 in the execution conditions and enter the task name



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



(d) Register the task program name and comment.



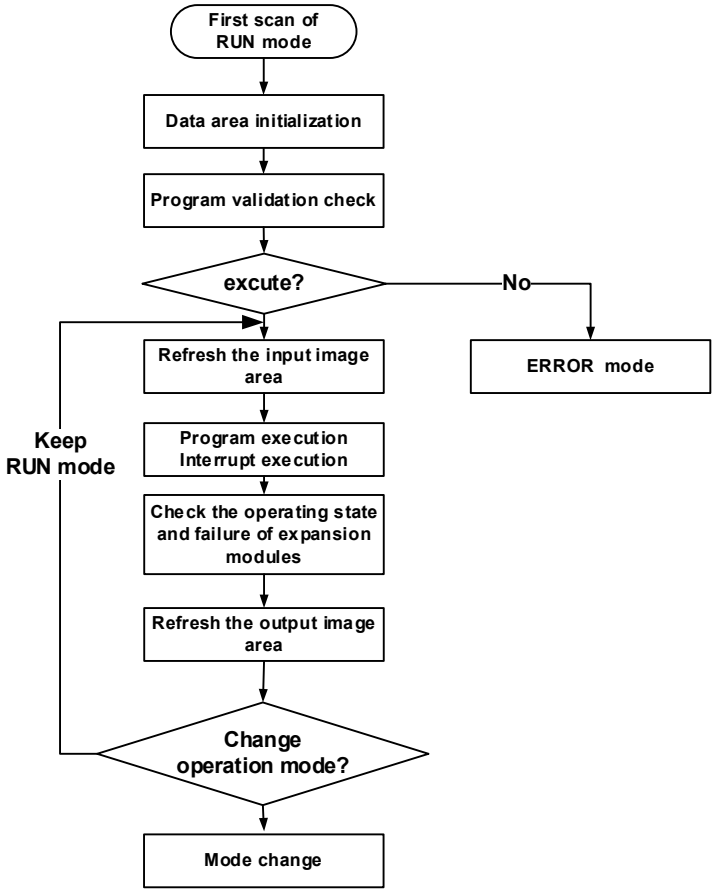
(e) Details of Positioning control task: refer to Part3 Ch04 Positioning Control

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.

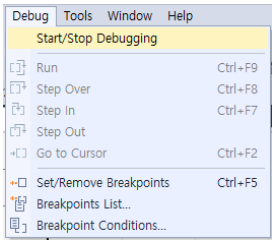
1.2.3 DEBUG Mode

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.

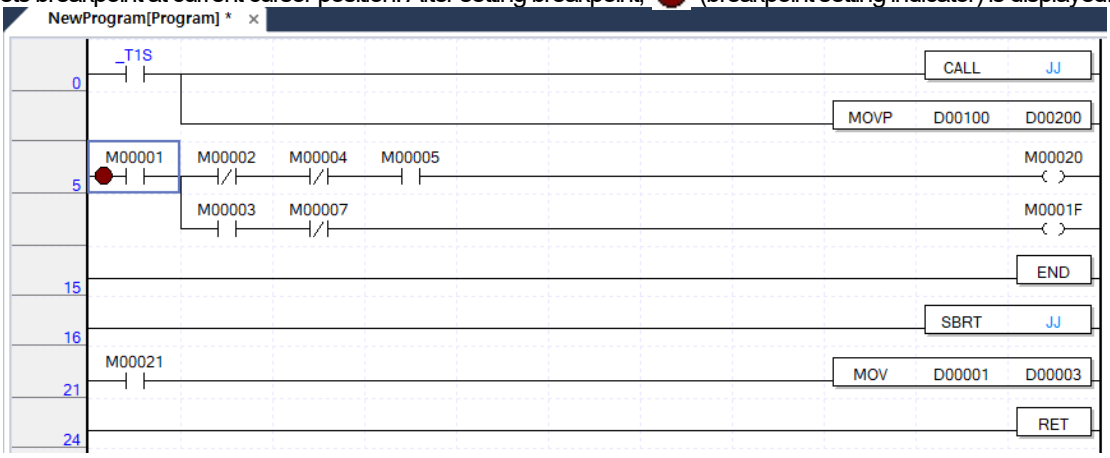
(3) Debug operation : describes debug menu and debug mode.



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.	

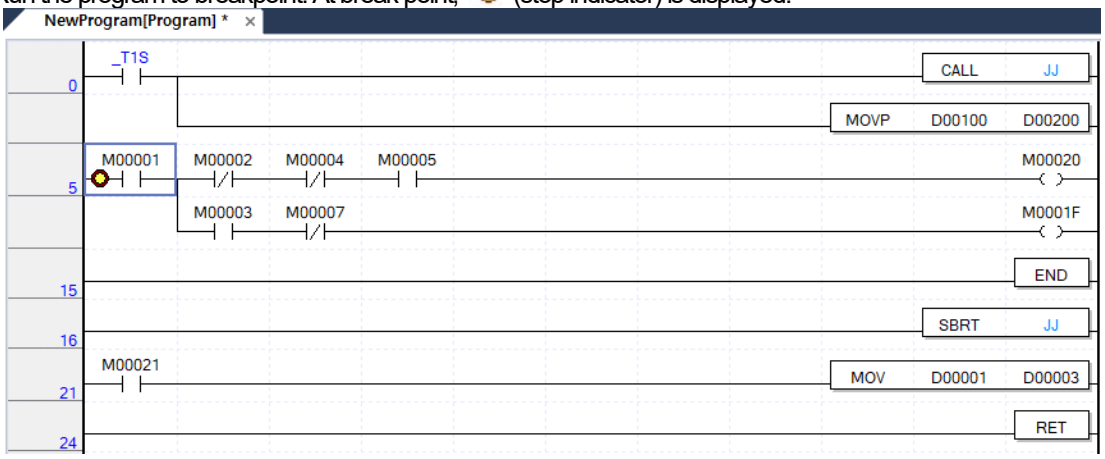
(a) Set/Remove Breakpoints

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



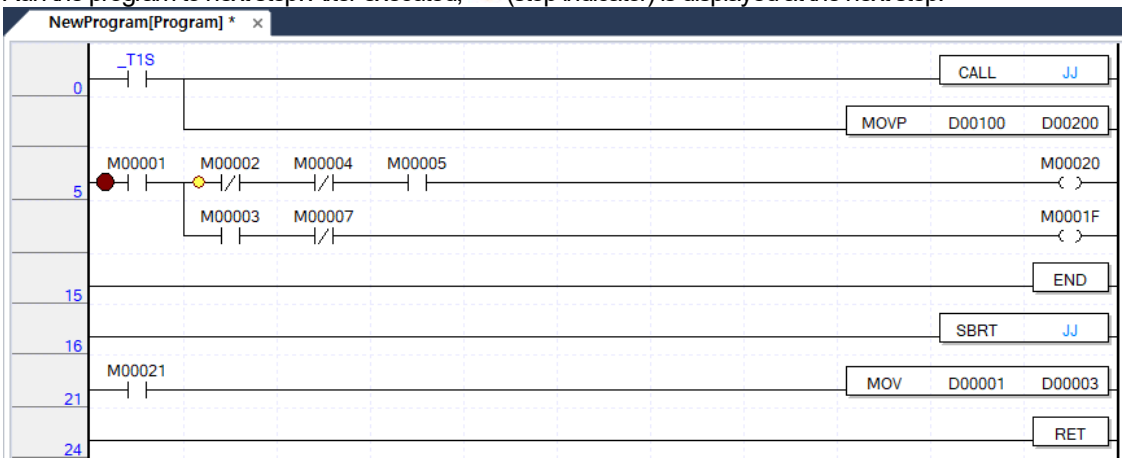
(b) Go

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

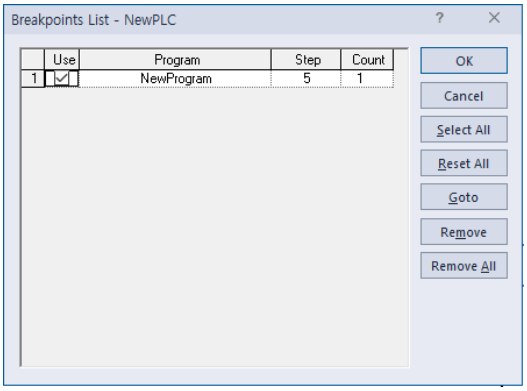


(c) Step Over

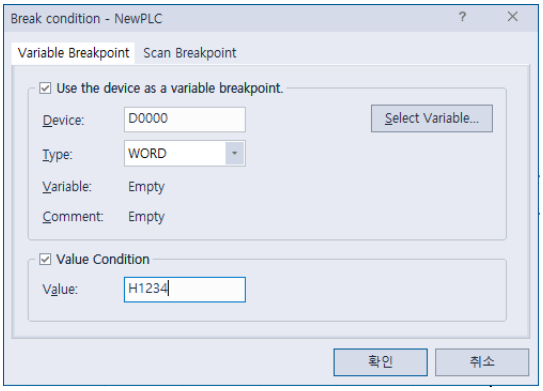
Run the program to next step. After executed, (stop indicator) is displayed at the next step.

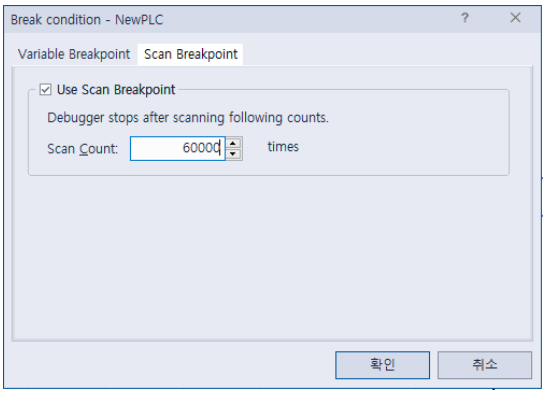


(d) Breakpoint List
It displays current Breakpoint List. It supports Select All, Reset All, Goto, Remove, Remove All features.



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





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

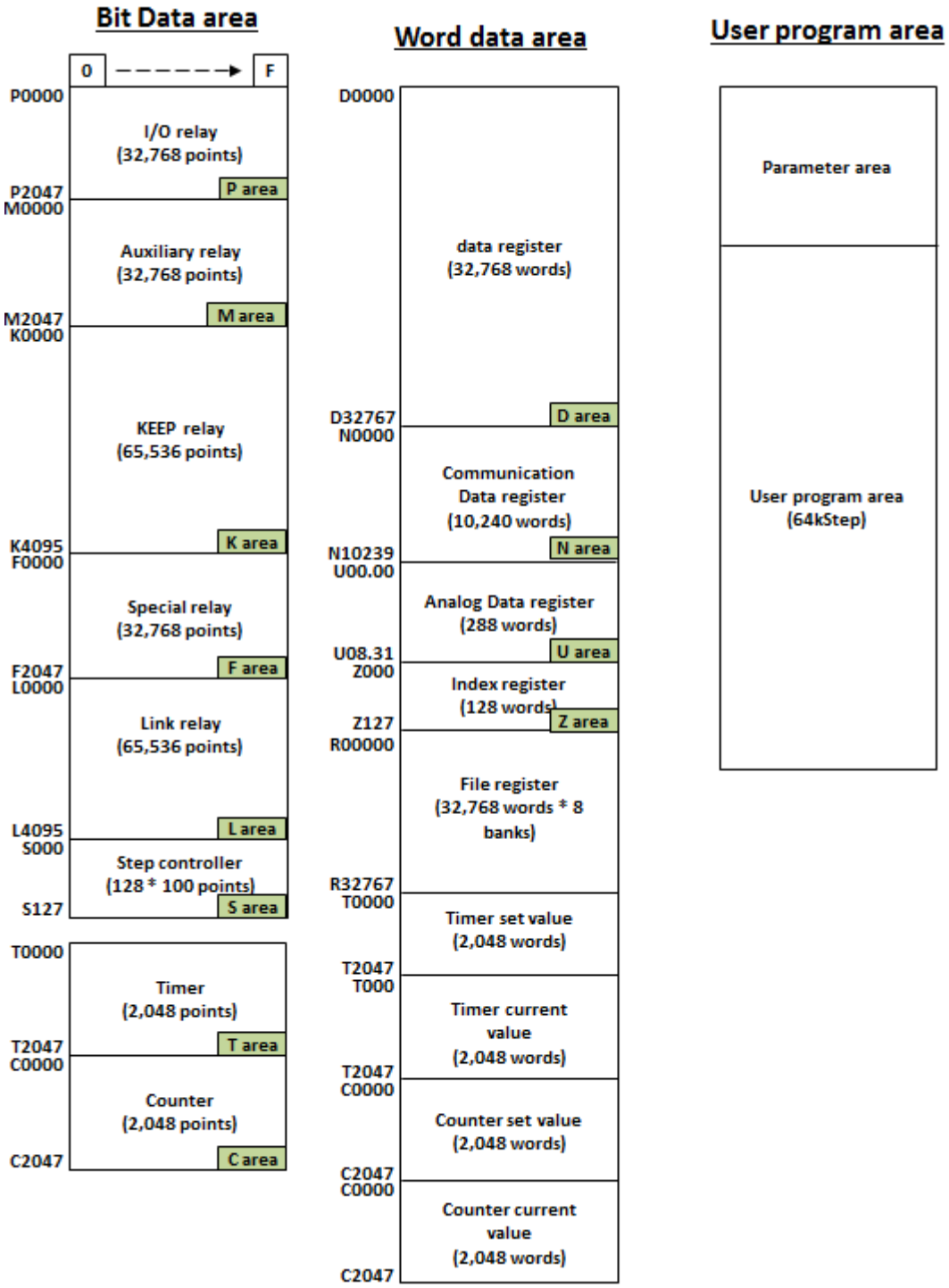
Various bit devices are provided by function. In terms of designation method, the first digit indicates the device type; the middle digit indicates the decimal word position; the last digit indicates the hexadecimal bit position in word.

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. 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.

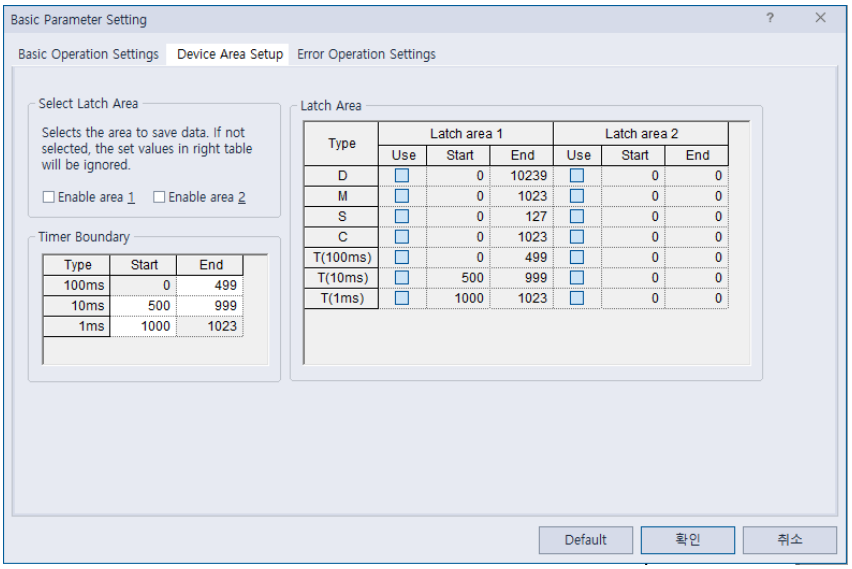
Device	Latch area 1	Latch area 2	Characteristics
P	X	X	Image area saving the I/O contacts state
M	O	O	Internal contact area
K	X	X	Contacts that keep the contact state during blackout.
F	X	X	System flag area
T	O	O	Area related to the timer (For both bit/word)
C	O	O	Area related to the counter (For both 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.



(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.

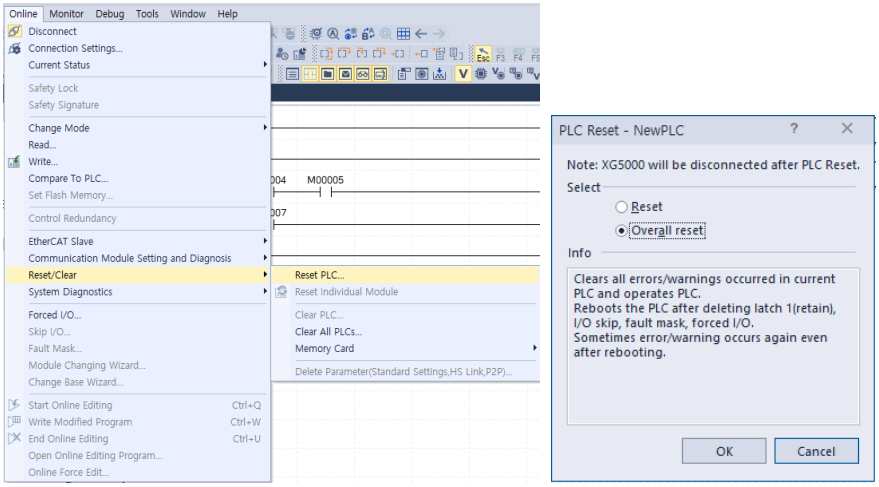
(b) You can delete the latched data in the following ways.

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

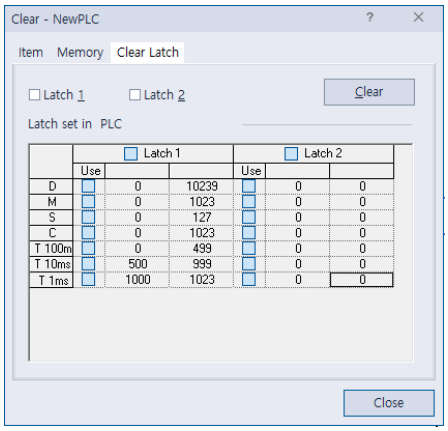
Refer to the below table for Maintaining or Reset (clear) operation of the latch area data depending on the PLC operations.

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.



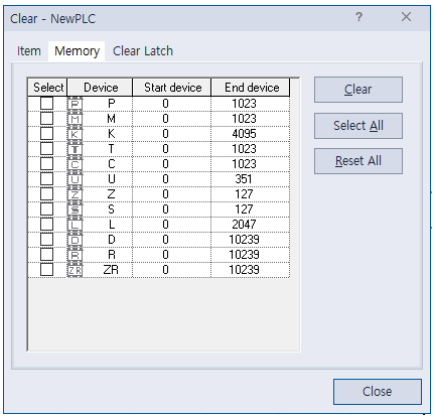
(d) After selecting 『Online』- 『 Reset/Clear 』- 『Clear PLC 』latch area 1,2, if you click “Delete”, it will be cleared.



(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.

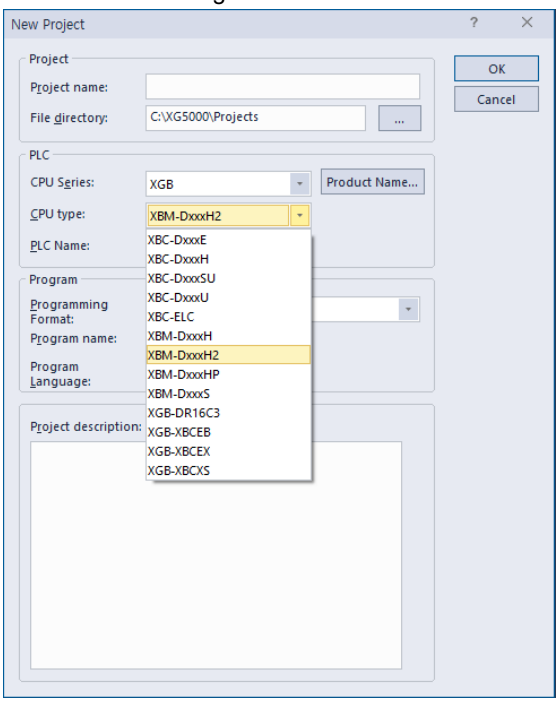
(a) After selecting 『Online』- 『Reset/Clear』- 『Clear PLC』- 『Clear Memory』, if you set up the area to be deleted and click “Delete”, the device area will be cleared.



Chapter 2 CPU Function

2.1 Type Setting

This section describes setting models of XGB PLC.



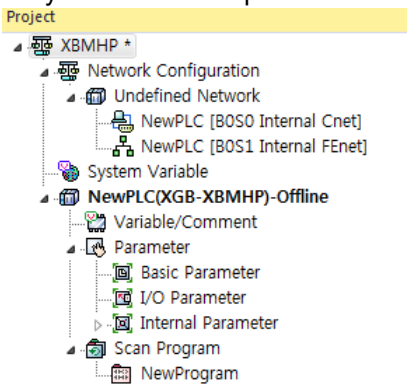
PLC Name	CPU Type	Language	Description	Remarks
XGB	XGB-DR16C3	MK language	Dedicated product	Modular type
	XGB-DR32HL	MK language	Dedicated product	Compact type
	XGB-XBCE	MK language	Economic : XBC-DR10/14/20/30E XBC-DN10/14/20/30E, XBC-DP10/14/20/30E	Compact type
	XGB-XBCH	MK language	Deluxe: XBC-DR32/64H,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

2.2 Parameter Setting

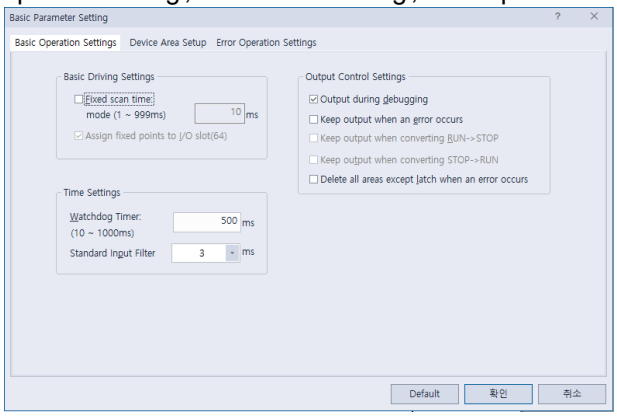
This section describes XGB PLC's parameter setting.

2.2.1 Basic parameter setting

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



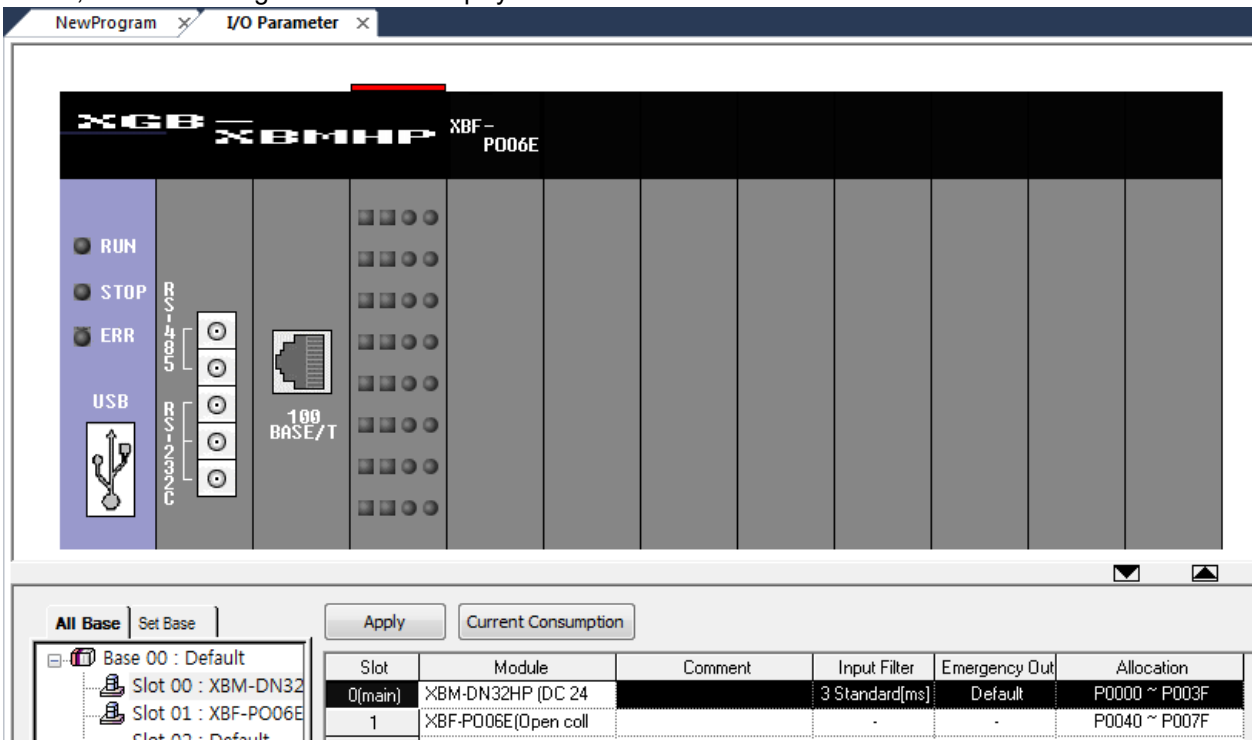
You can set up 3 items; 'Basic operation setting', 'Device area setting', 'Error operation setting'.



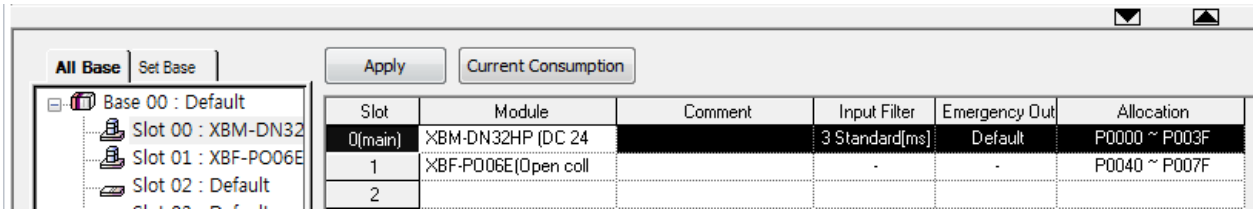
Classification	Items	Descriptions	Set values
Basic operations	Fixed cycle operation	Set the fixed cycle operation time.	1~999㎳
	Watchdog timer	Set the scan Watch Dog's time.	10~1000㎳
	Standard input filter	Set the standard input filter's time.	1,3,5,10,20,70,100㎳
	Output during debugging	Set whether 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

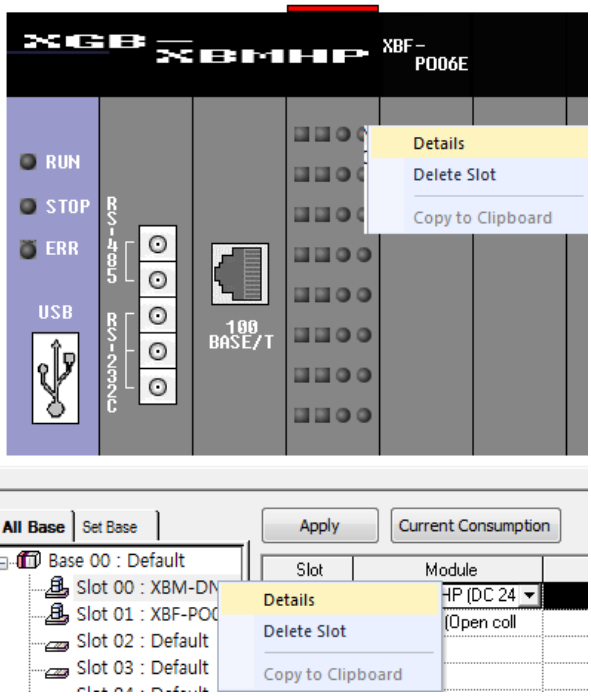
It is the function to set up and reserve the information for each I/O. If you click 『I/O Parameter』 in the project window, the below setting window will be displayed.

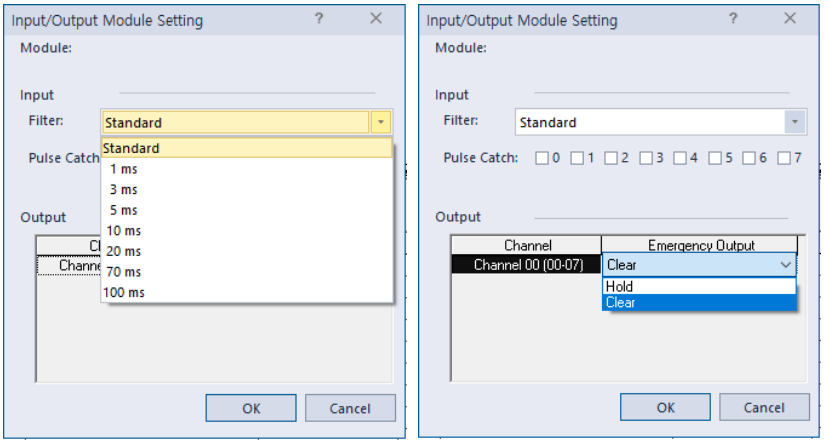


If you click the 『Module』 in the 『slot』 position, the list of each module will be displayed. Then, choose the module that is matched with the actual system to be configured. The selected slot will be displayed as below.



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.

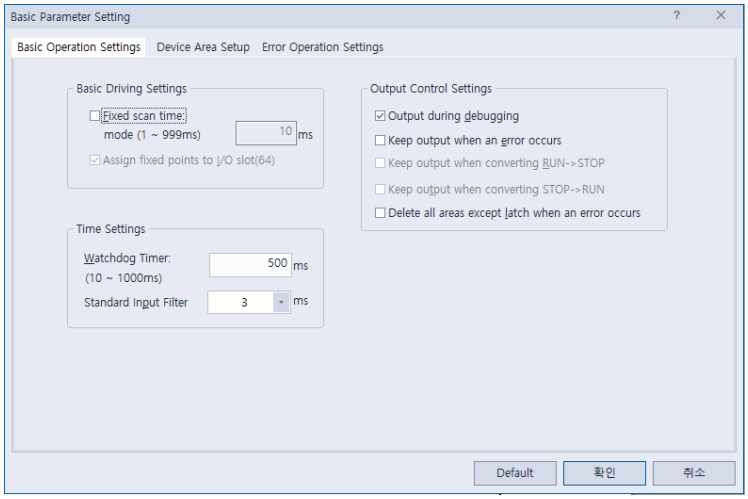
2.3 Self-Diagnosis Function

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)

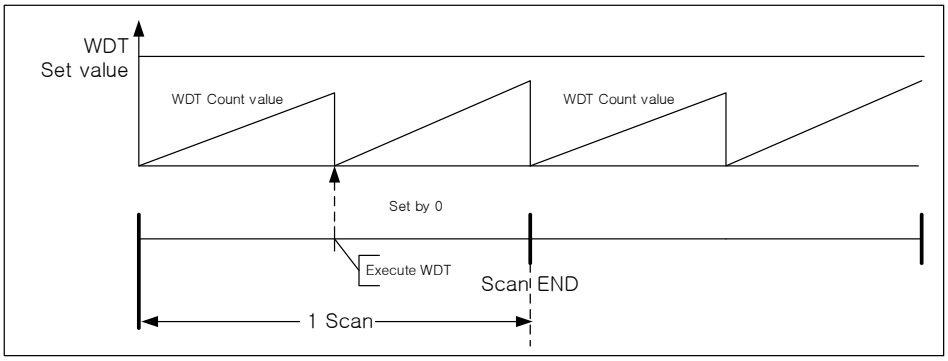
The WDT (Watchdog Timer) is the function to detect the congestion of programs caused by PLC module's hardware or software.

(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).



(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.

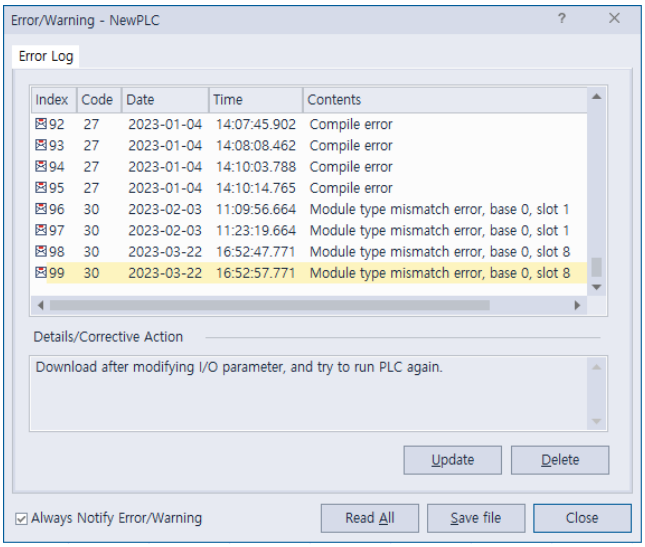


(Example of initializing scan Watchdog timer through the WDT command)

(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.



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

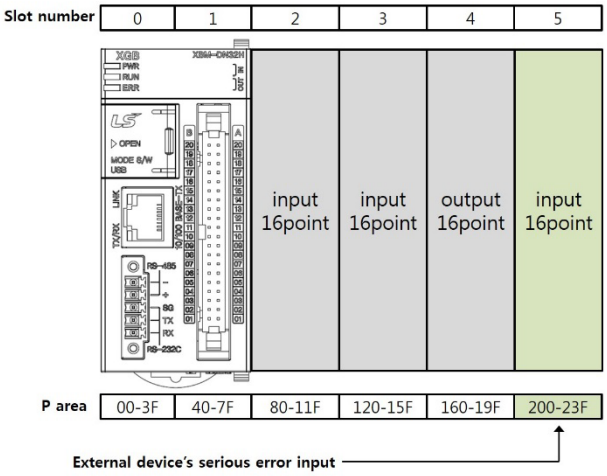
The following programs are detecting the external device's serious failures.

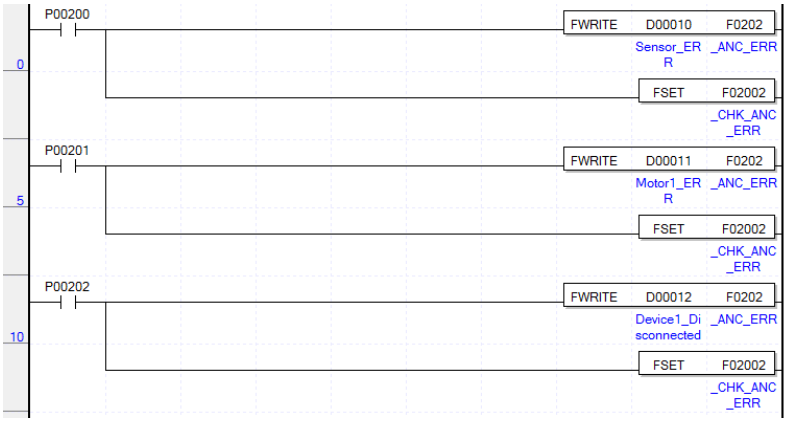
(a) Save the error code that can be distinguished by external device's serious failures in F202 (_ANC_ERR) through the FWRITE command as below. (Input the values excluding 0)
(b) In case the external device's serious failures occur, F2002 (_CHK_ANC_ERR)flag will be On.
(c) When the scan program is completed, 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.

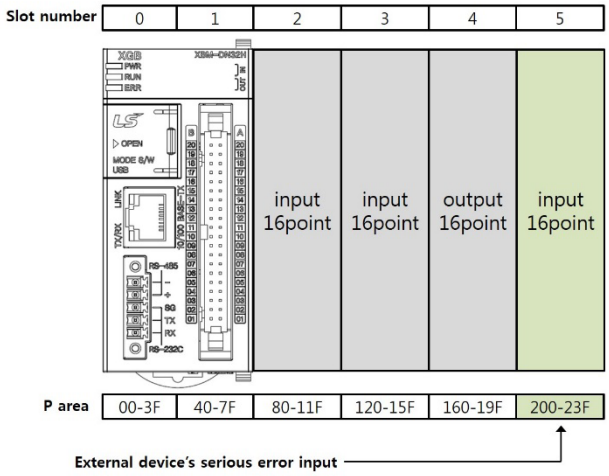
(c) When the scan program is completed, the PLC checks whether F2003 (_CHK_ANC_WAR) is ON and detects minor failures.

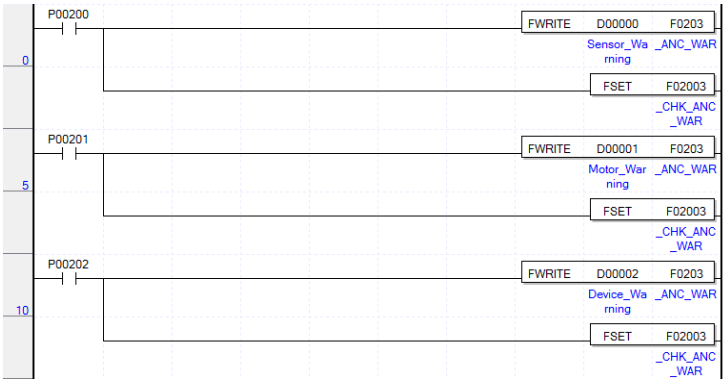
(d) If the external device's minor failures occur, the ERR LED will be flickering at 2 seconds interval and the PLC will run continuously. Then, F0046 (_ANNUM_WAR) is ON and F2003 flag is automatically Off. All outputs works based on IO parameter's emergency output settings.

(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.

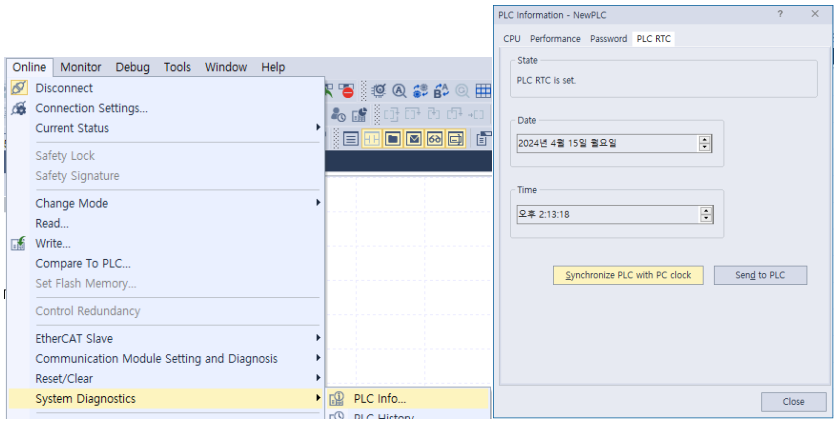
2.4.1 How to use the RTC Function

(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』.



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.

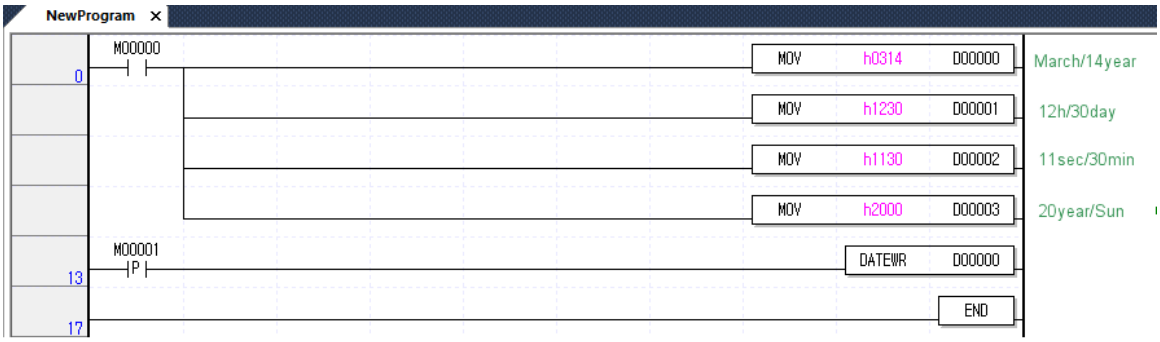
(b) Read with the special relay

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.



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.

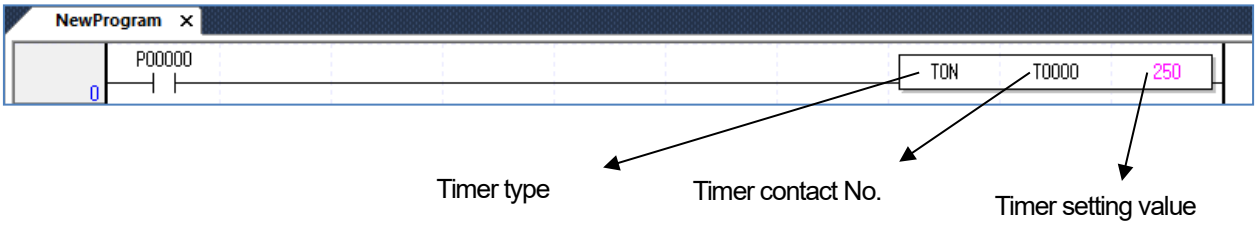
2.5 Timer counter function

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).

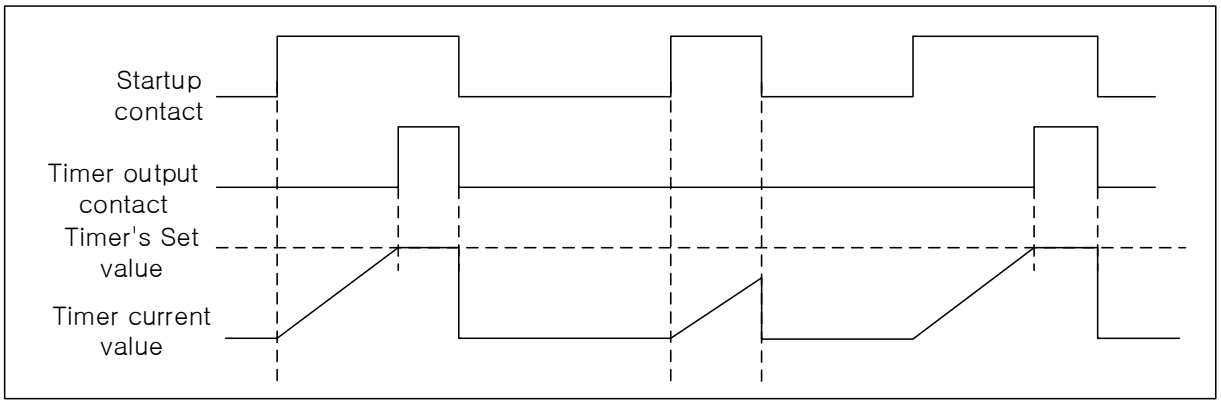
The measurable time ranges by timers are as below.

	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

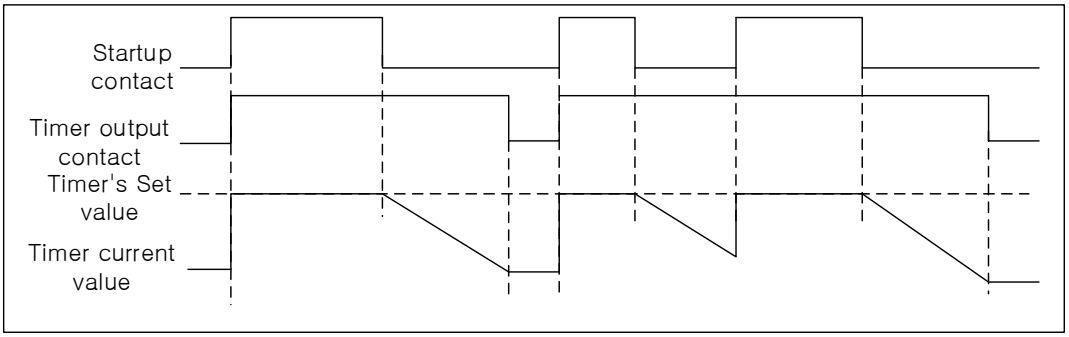
If the input contact is On, the current value starts to increase. When the current value reaches the set time (PT) (current value=set value), the timer's output contact (Txxx) will be On. When the input contact is Off while the current value increases, the timer's current value will be 0. The timing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



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

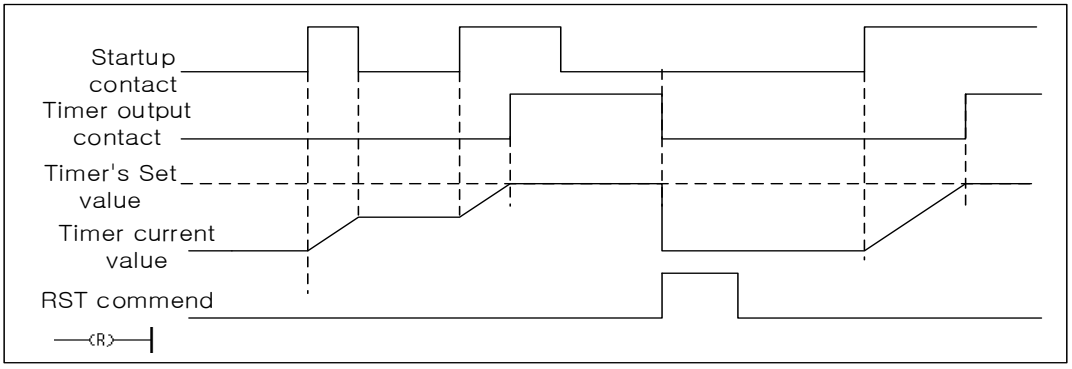
If the input condition is On, the timer's output contact (Txxx)is On and the current value becomes the set value. When the input contact is Off, the current value starts to decrease and if the elapse time reaches the set time (PT (current value=0), the timer's output contact (Txxx) will be Off. If the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



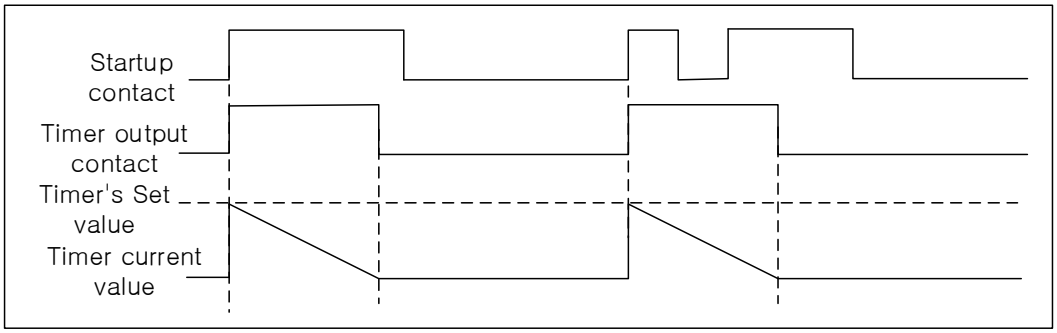
(3) Updating the current value of Cumulative timer and contact On/Off

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.



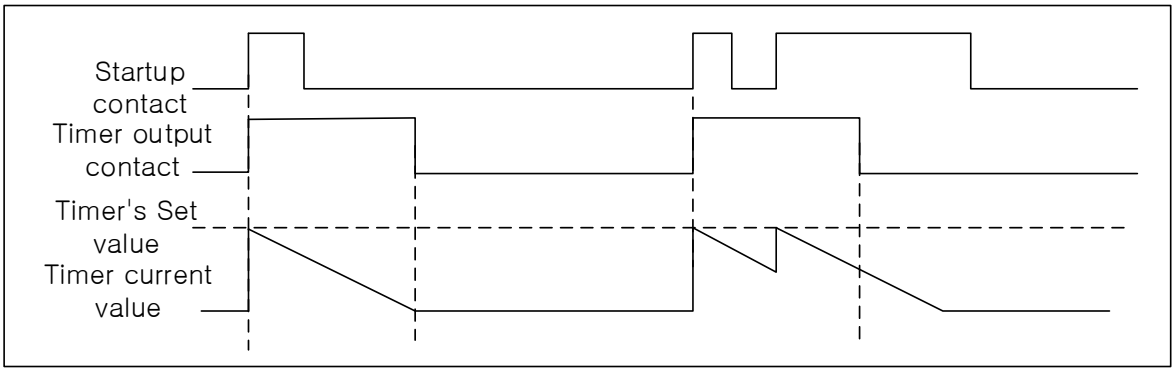
(4) Updating the current value of Monostable timer and contact On/Off

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.

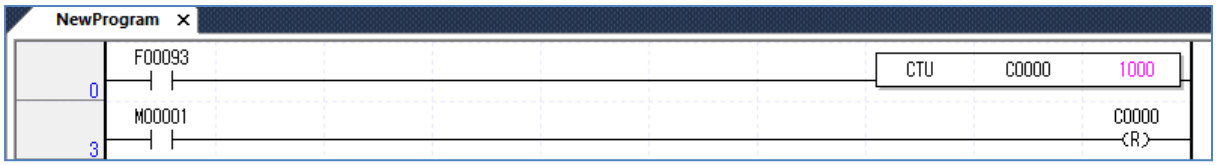
2.5.2 Counter Function

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.

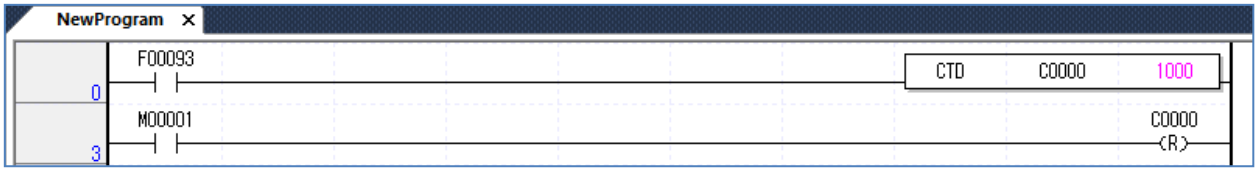
(1) Updating the counter's current value and contact On/Off

(a) Additional counter



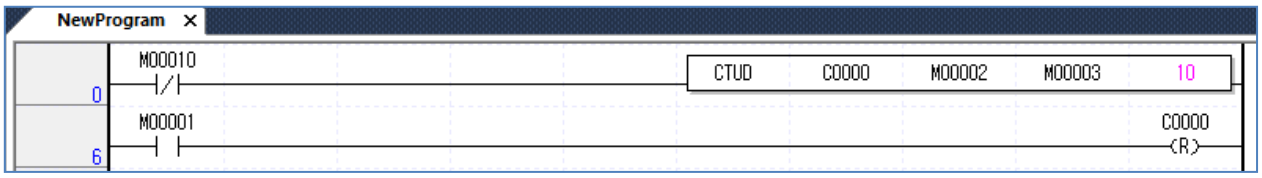
- It increases the current value under the rising edge of the input condition.
- When the current value increases and becomes the same as the set value, the counter's output contact (Cxxx) is On.
- The current value is "0" and the output contact (Cxxx) is Off while the reset signal is On.

(b) Subtractive counter



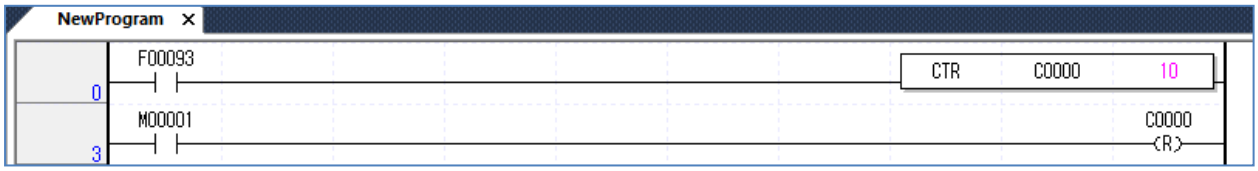
- It decreases the current value of the rising edge of the input condition.
- When the current value decreases and becomes “0”, the counter’s output contact (Cxxx) is On.
- The current value is “0” and the output contact (Cxxx) is Off while the reset signal is On.

(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

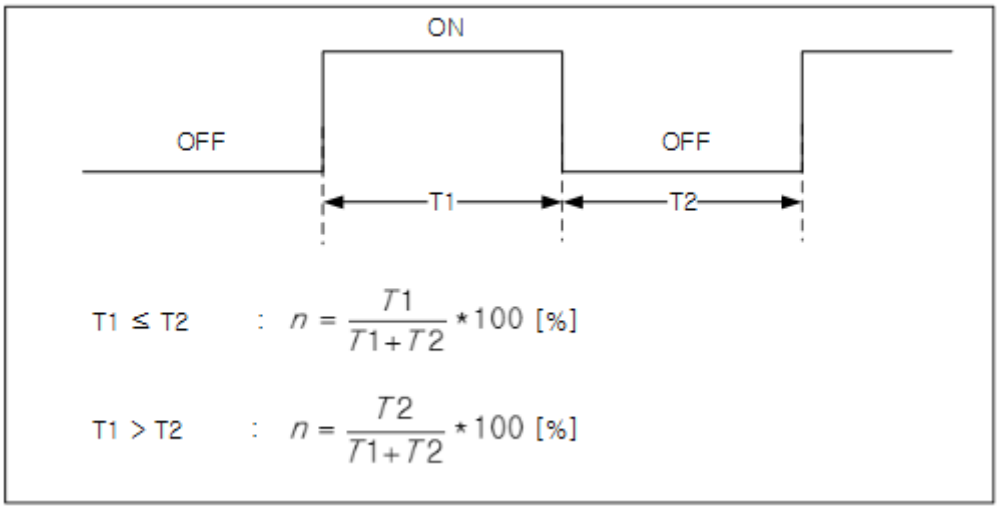
The counter's maximum counting speed is determined by the scan time. only when On/Off time of the input condition is greater than the scan time, it can be countable.

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

n :Duty (%)

t_s : scan time[s]

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



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

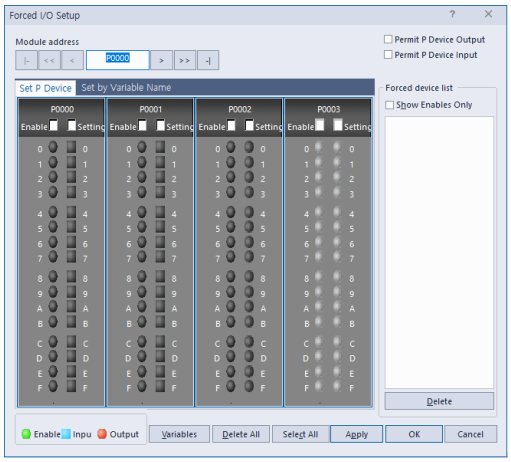
- For more details on how to operate the remote functions, refer to 'Chap.10 Online' of the XG5000 manual.

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

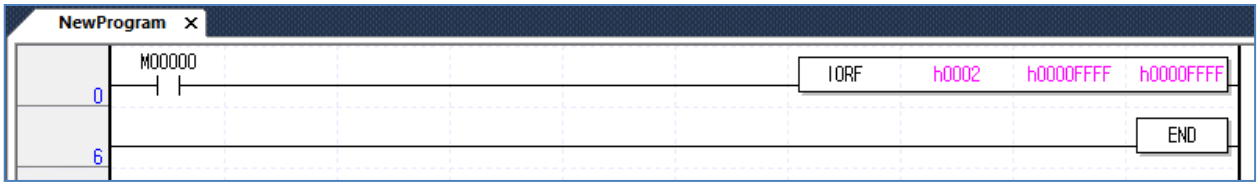
•When errors occur after setting the forced output, it works based on「Output Hold when errors occur」 of output control settings in the basic parameters and 「Emergency Output」 of the I/O parameters. In case of error occurrence, if you select the emergency output as 「Clear」 after setting Output Hold when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



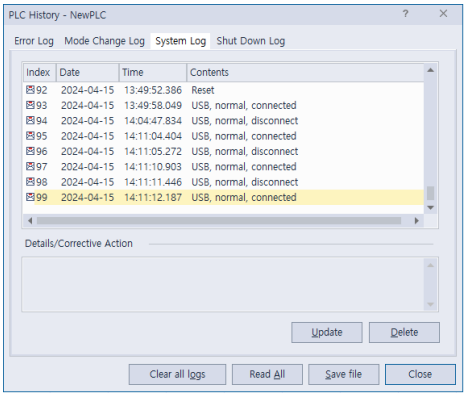
• When M00000 is On, the IORF' command is executed and the first operand specifies the slot number. The second operand is the mask data of the upper 32 bits, the third operand is the mask data of the lower 32 bits. You need to set the bit to be refreshed as '1'. The bit set as '0' is not refreshed.

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.



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.

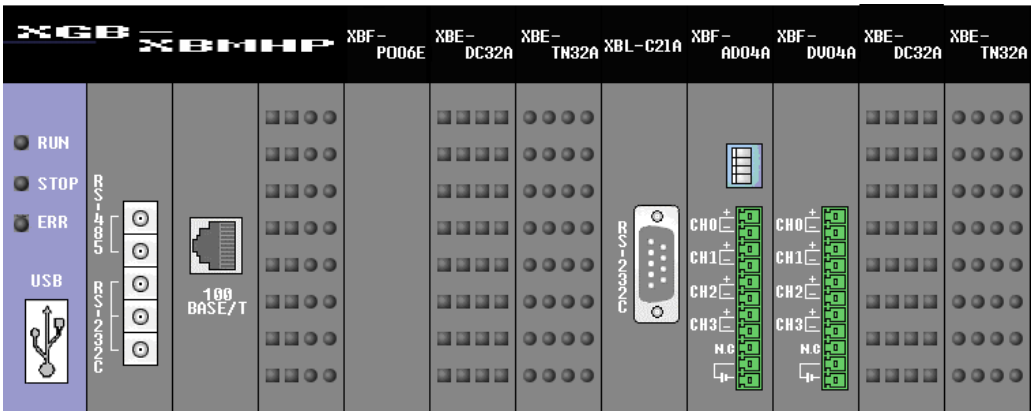
2.10 How to allocate I/O No.

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

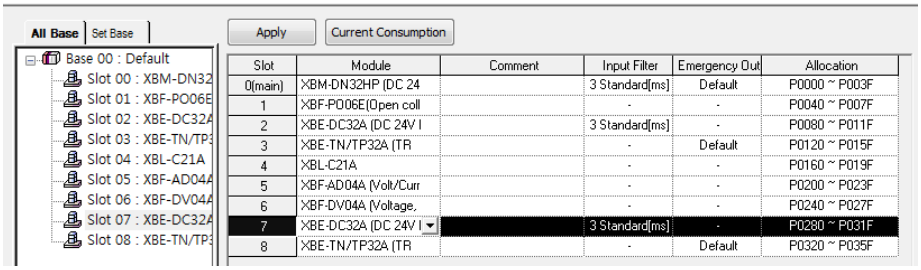


Slot No.	Model	I/O allocation	Remakrs
0	XBM-DN32HP	input : P0000 ~ P001F output : P0020 ~ P003F	Fixed as the basic unit
1	Embedded functions	P0040~P007F	-
2	XBE-DC32A	input : P0080~P011F	Actual input : P0080 ~ P009F
3	XBE-TN32A	output : P0120 ~ P015F	Actual output : P0120 ~ P013F
4	XBL-C21A	P0160 ~ P019F	-
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.

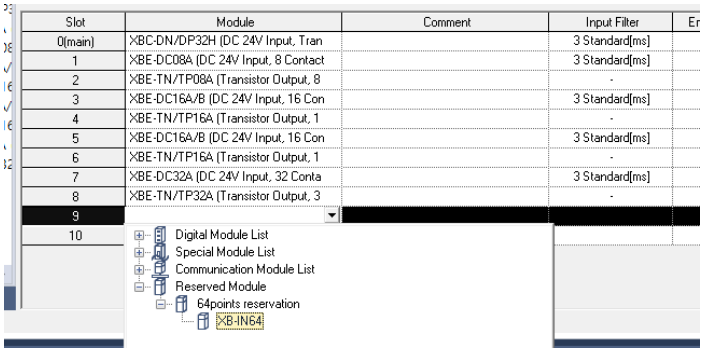
* In the case of the high performance XGB basic type, it does not have the embedded special function corresponding to No.1 slot but occupies No.1 slot as an empty slot.

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



(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.



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.

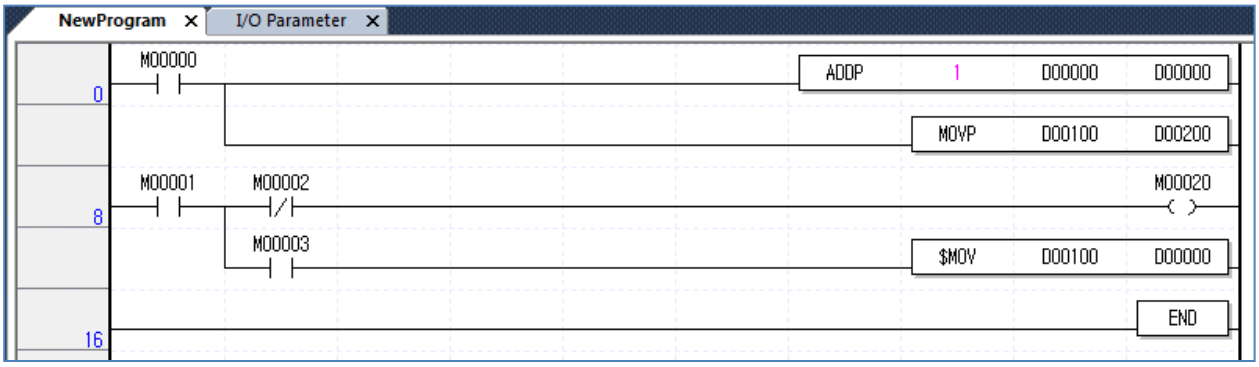
2.11 Modification Procedures during RUN

Program Modification during operation (Modification during RUN)

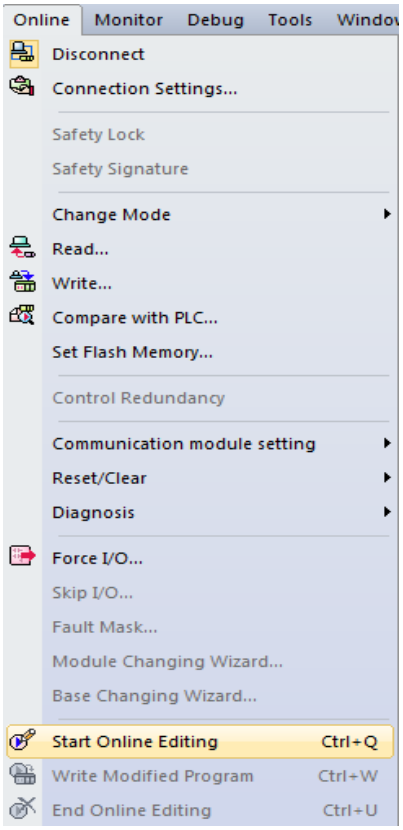
You can modify the programs and communication parameters without stopping control operations during running the PLC. The below describes the basic modification method. For more details on Modification during RUN, refer to the XG5000 manual.

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

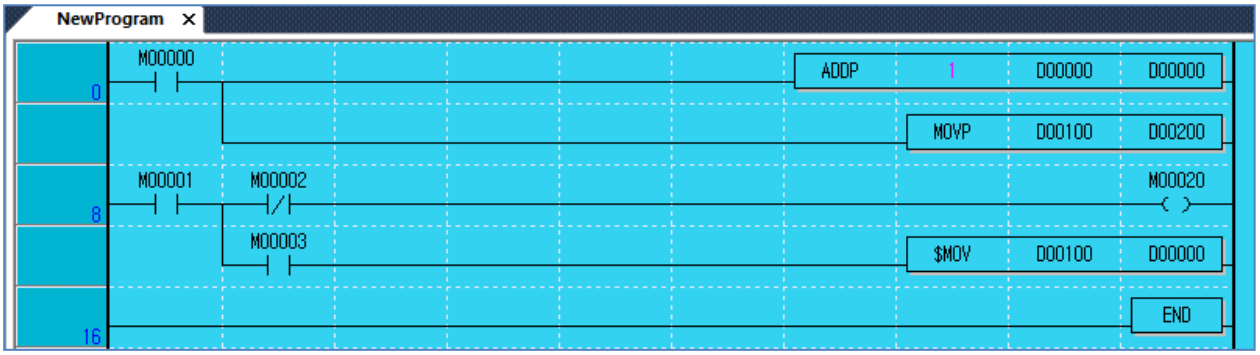
(1) It shows the currently running program.



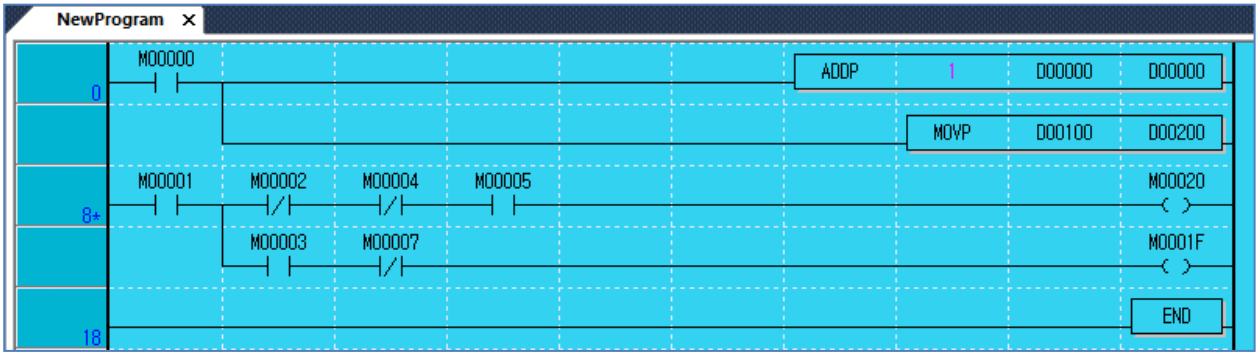
(2) Click 『Online』- 『Start Modification Online Editing』.



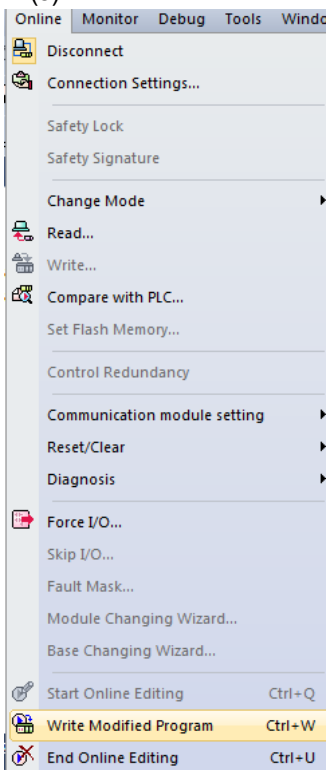
(3) Then, the background color of the program window changes and it is converted into the mode of modification during RUN.

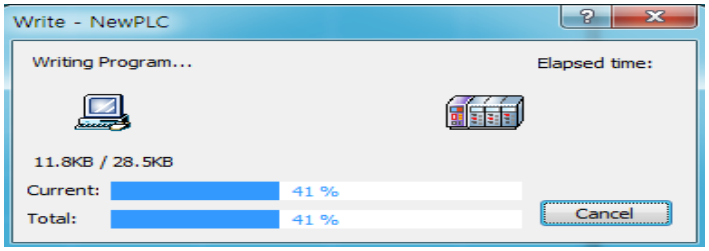


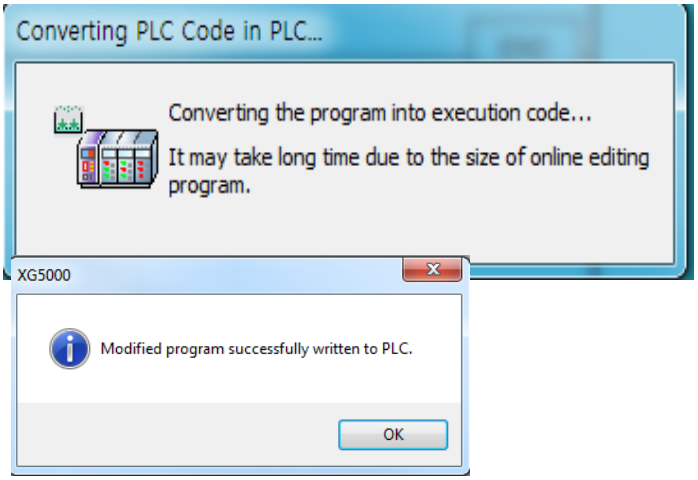
(4) You can modify the program.



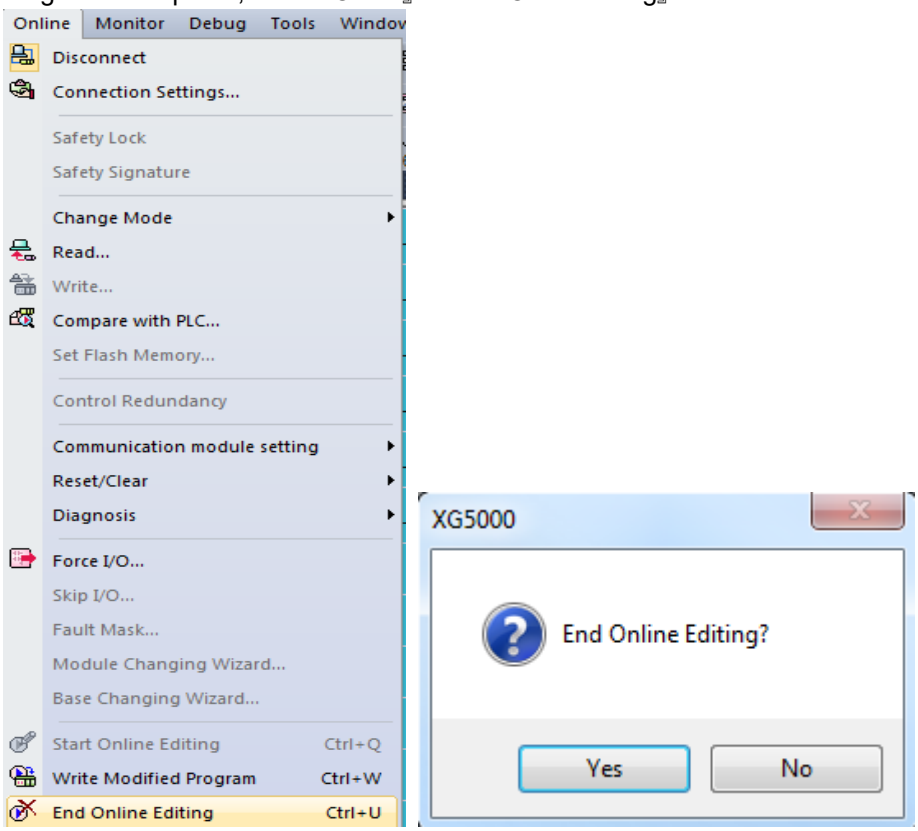
(5) When the modification of the program is completed, click 『Online』- 『Write Modified Program』



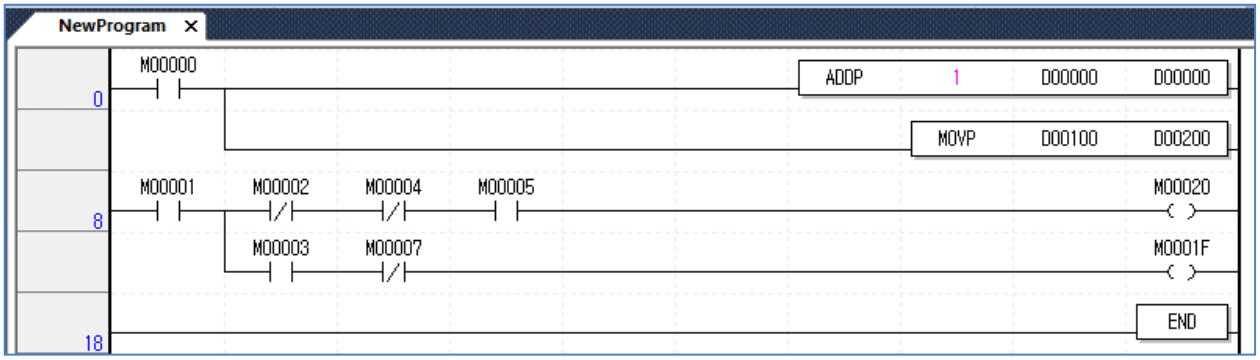




(6) When Write Program is completed, click 『Online』 - 『End Online Editing』.



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



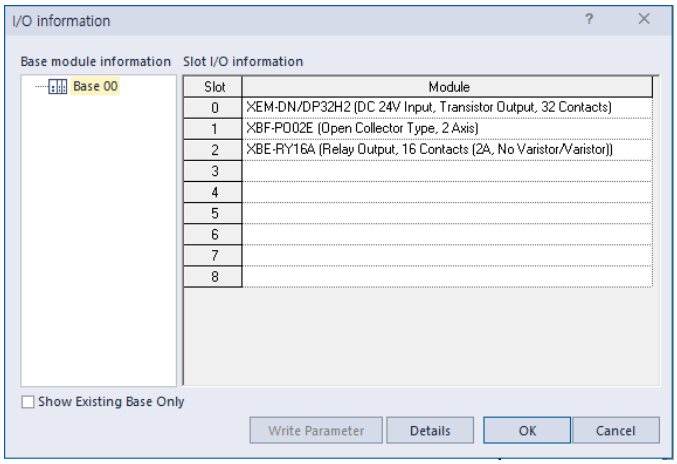
Notice

- 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.

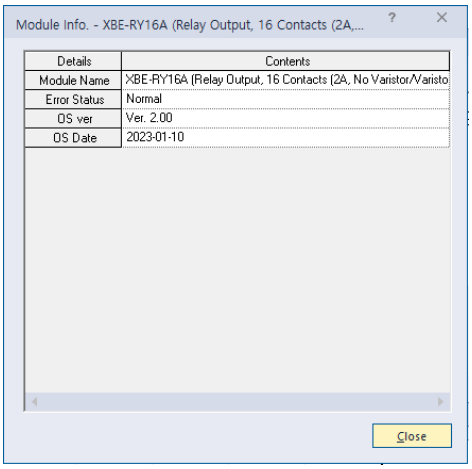
2.12 Read I/O information

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.



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

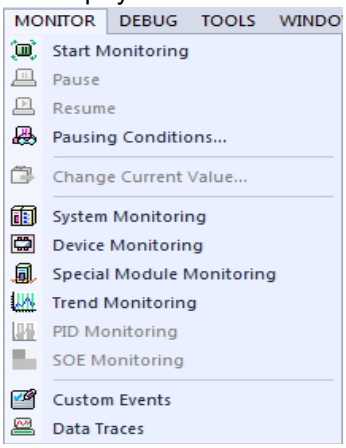


(3) By clicking the 'I/O Sync', you can overwrite module information on the 'I/O Information' into the 'I/O Parameter' of the PLC. I/O Synchronization can only be executed in the STOP mode.

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.

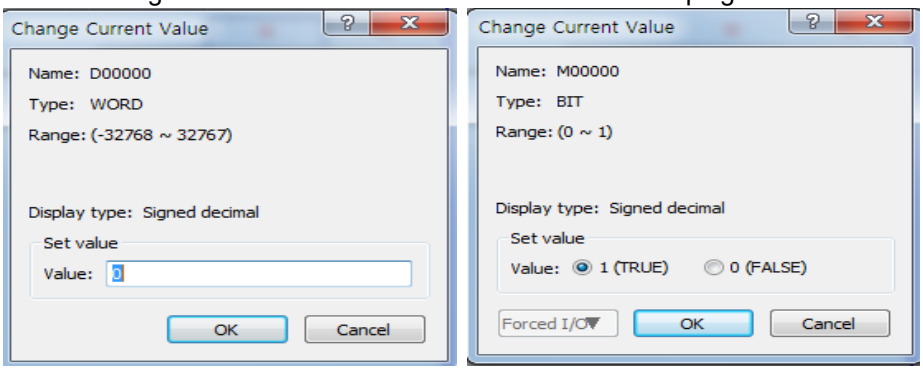


(2) The below table provides the descriptions on each item.

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.	

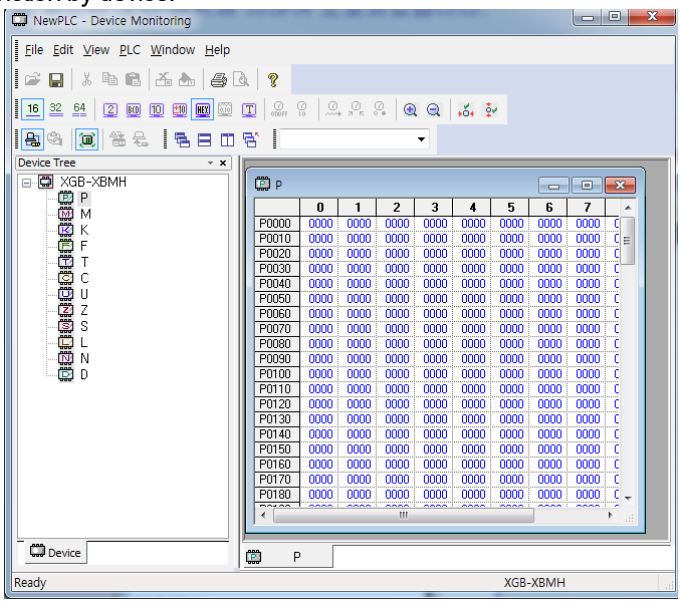
(a) Changing the current value

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



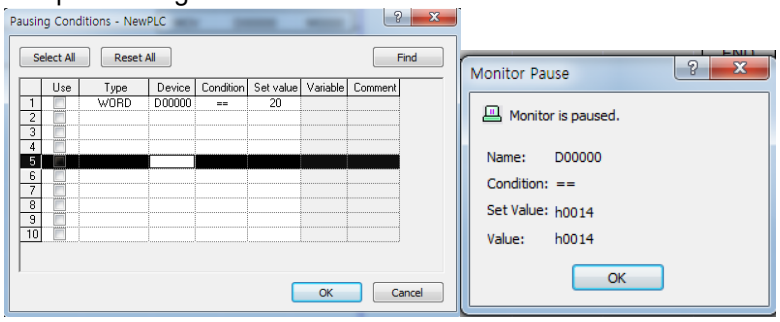
(b) Device monitor

It is the monitoring function by device.



(c) Monitor suspension setting

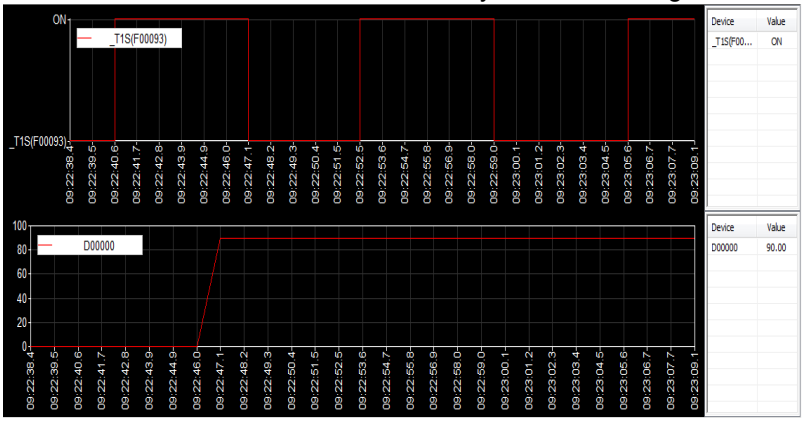
It is the function to stop monitoring when the set device value is matched.



(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.



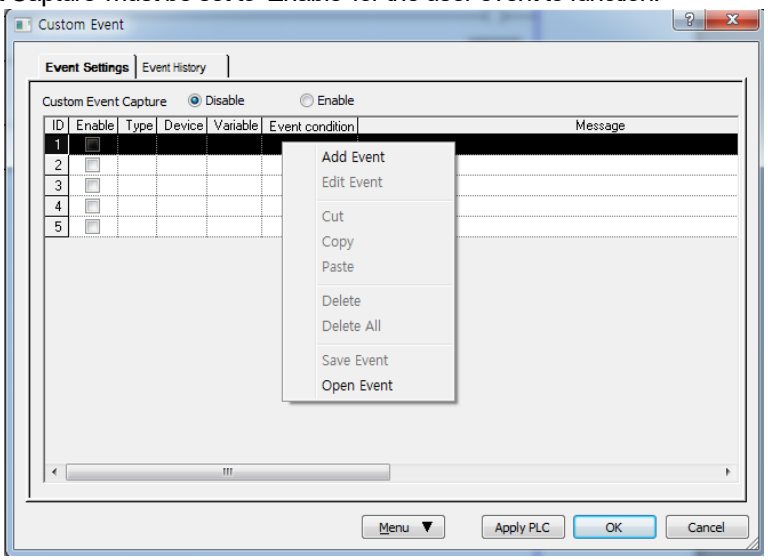
(e) Custom event

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

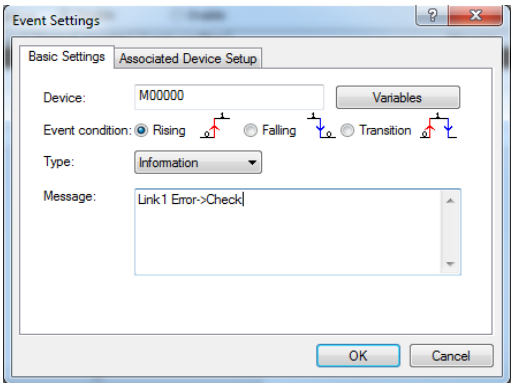
As an example, the following steps explain how to use a user event. When a rising edge of the M0000 device occurs, it records the alarm message 'Tank 1 Error -> Check' and logs the values of the D0000, L0000, D0100, and N1000 devices at that time.

1) Register the user event.

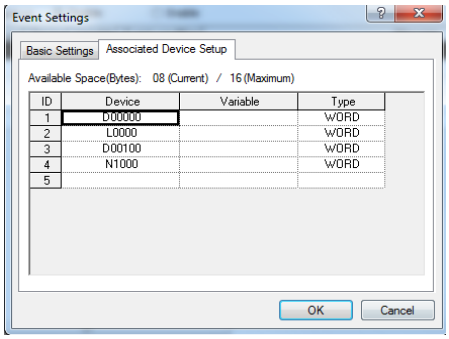
'Custom Event Capture' must be set to 'Enable' for the user event to function.



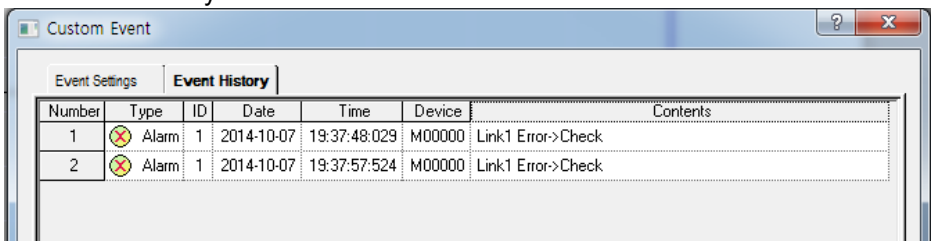
2) In the Basic Settings, configure the device to be monitored, the event conditions, event type, and the message to be displayed.



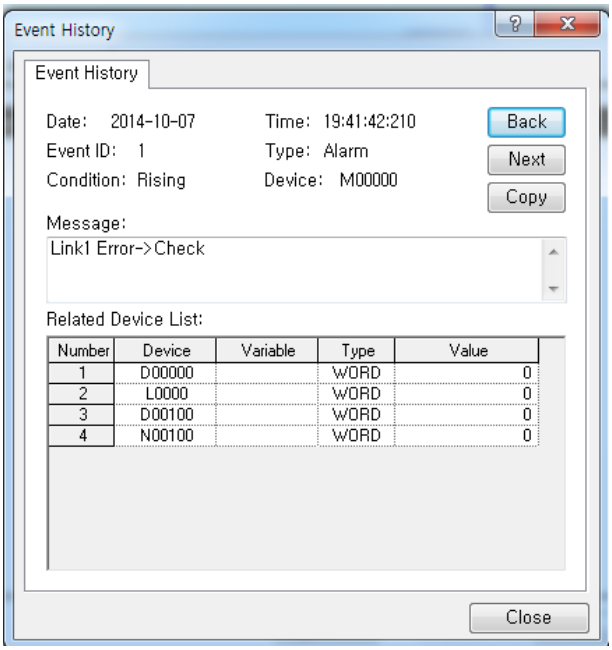
3) Set the devices to be logged.



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.



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.



Notice

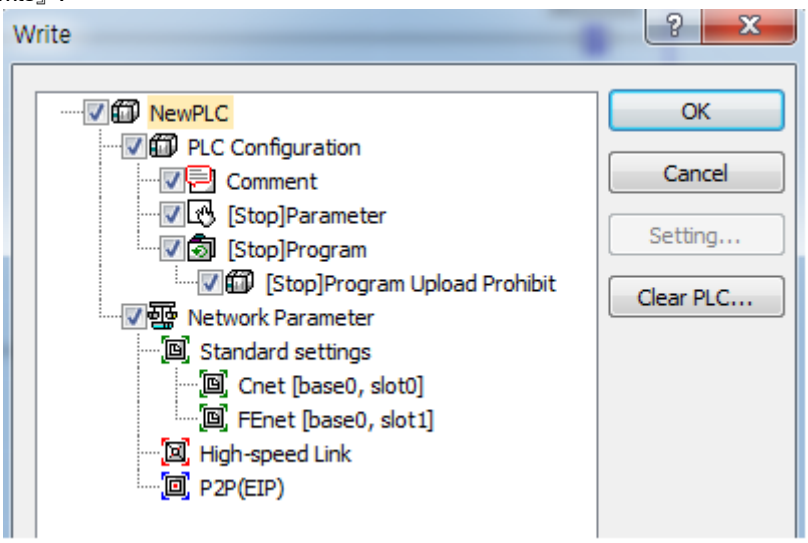
• For more details on the monitor, refer to the XG5000 manual.

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

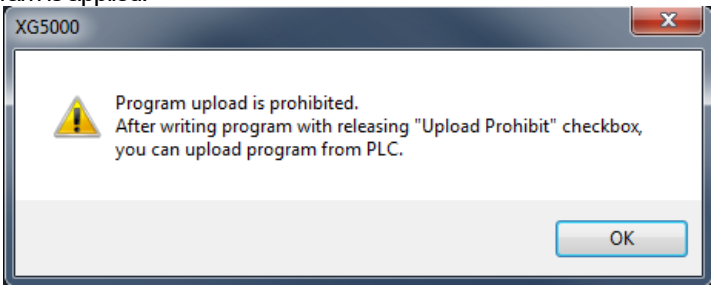
(a) Click 『Online』 - 『Write』.



(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.

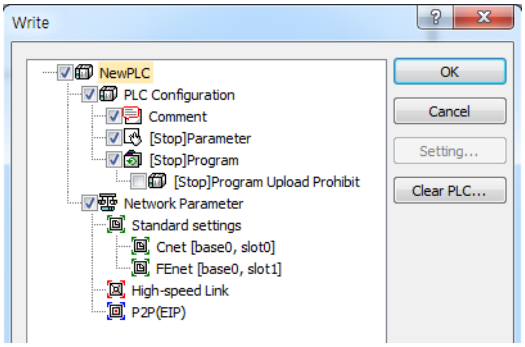
(2) When you try to read the PLC under the condition that the '[Stop]Program Upload Prohibit' function is set up, the below dialog box will pop up. Reading is not available in the PLC where 'Read-Protect' is set although the password is cleared. Namely, you cannot read the PLC in any way until a new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



(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.

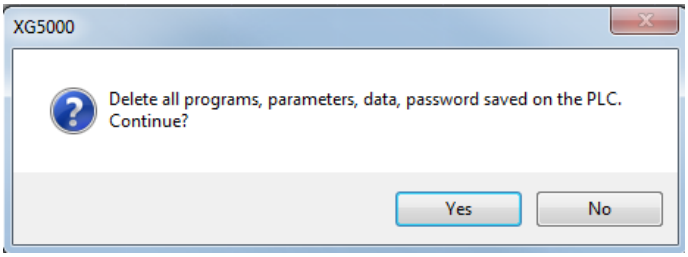


2.15 Function to delete all of the PLC

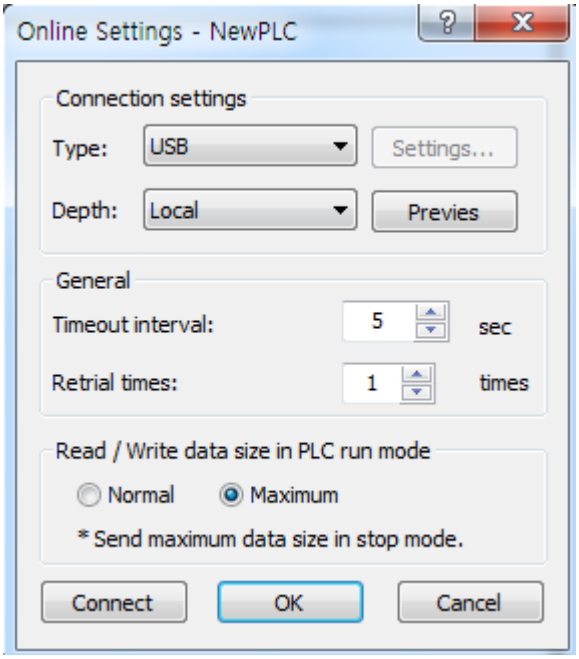
The function to delete all of PLC is the initialization function to delete all programs, parameters, passwords, data stored in the PLC.

(1) How to delete all of PLC

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



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



(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)

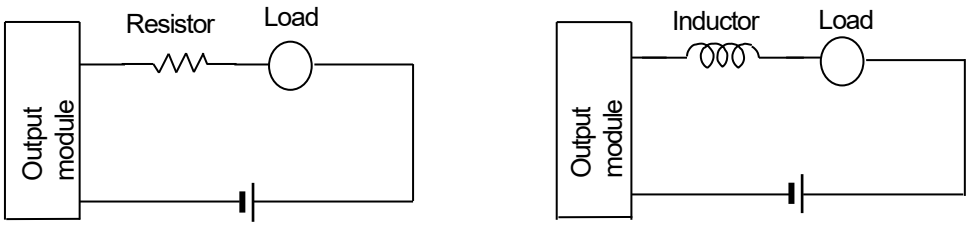
(2) The number of maximum simultaneous input contact point is different according to module type. Use input module after checking the specification.

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

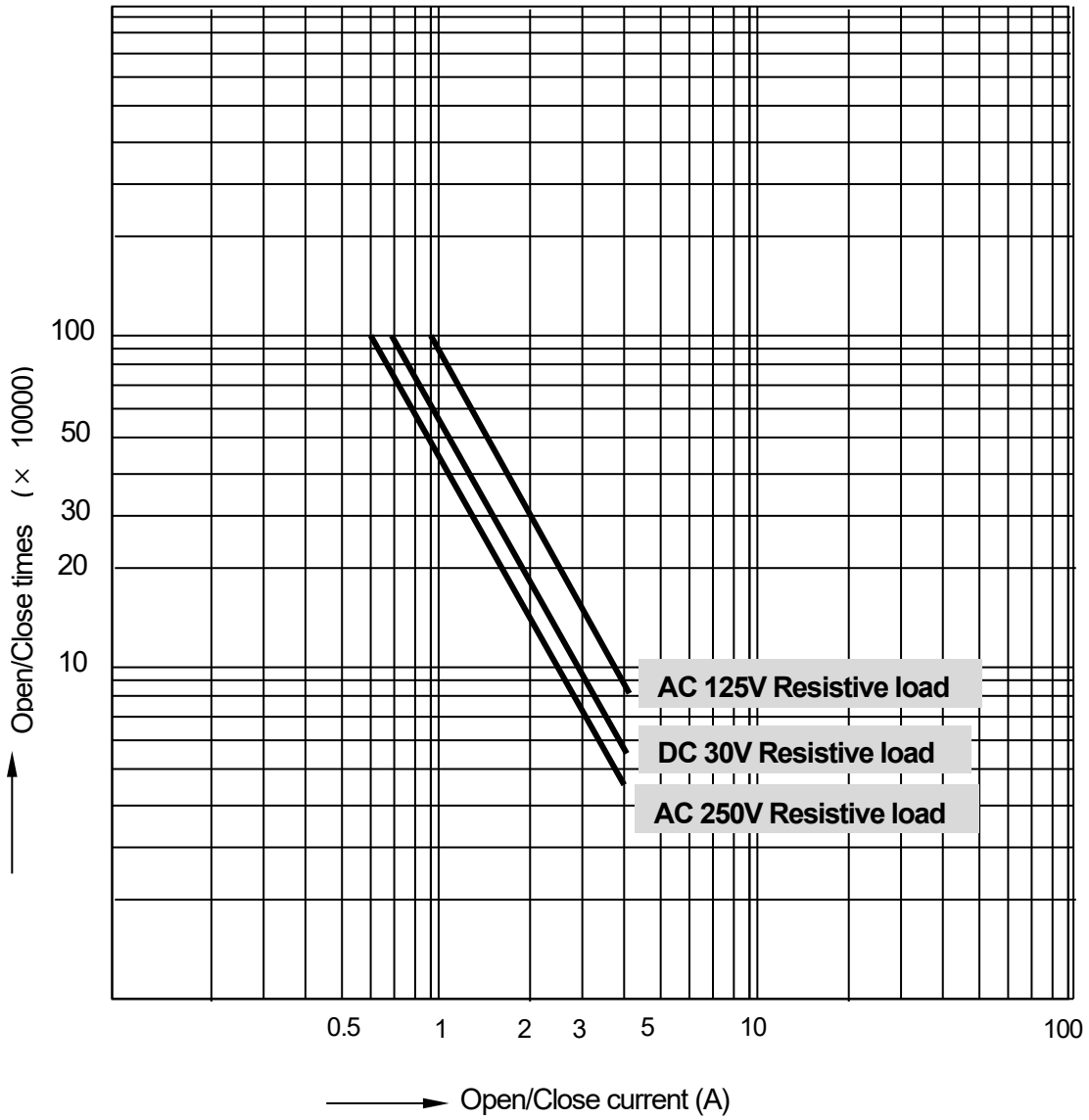
(4) In case that open/close frequency is high or it is used for conductive load open/close, use transistor output module as the durability of relay output module shall be reduced.

(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.



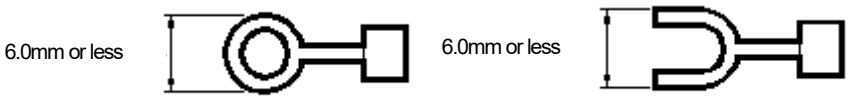
(7) Relay lifespan of Relay output module is shown as below.



(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.

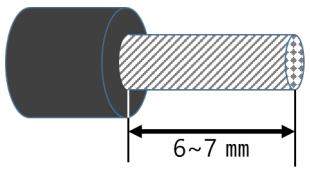
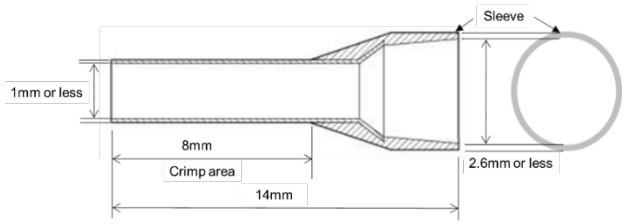
Coupling position	Coupling torque range
IO module terminal strip screw (M3 screw)	42 ~ 58 N·㎝
IO module terminal strip fixation screw (M3 screw)	66 ~ 89 N·㎝
IO module external connector (M2 screw)	18 ~ 22 N·㎝

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 Or 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

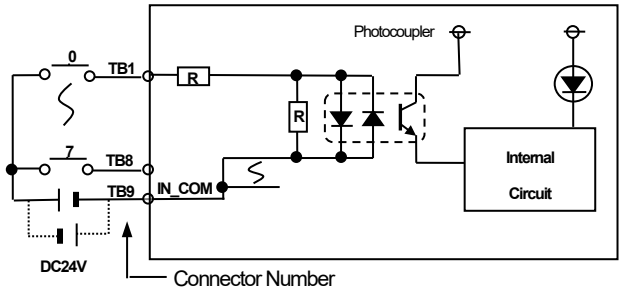
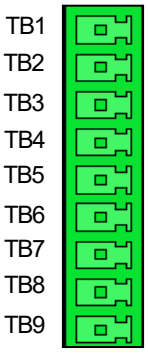
(10) Use power cable as follow

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)

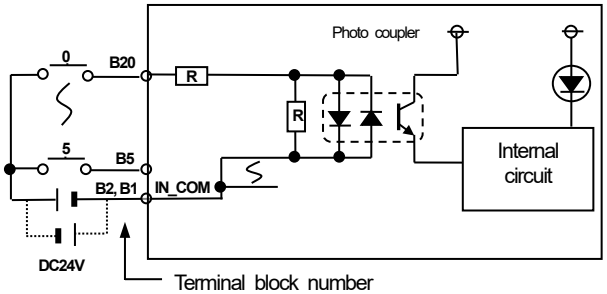
Model / Specification		Main Unit
		XBM-DN16H2/XBM-DP16H2/XBM-DR14H2
Input point		8 points
Insulation method		Photocoupler insulation
Rated input voltage		DC 24V
Rated input current		P00 ~ P03 : about 5mA, P04 ~ P07 : about 4mA
Operation voltage range		DC 20.4 ~ 28.8V (within ripple rate 5%)
On voltage / 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 kΩ (P00~P03: About 4.7 kΩ)
Response time	Off → On	1/3/5/10/20/70/100 ms (Set by I/O parameter) Default: 3 ms
	On → Off	
Insulation withstand voltage		AC850Vrms / 3cycle (altitude 2000m)
Insulation resistance		10 MΩ 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)

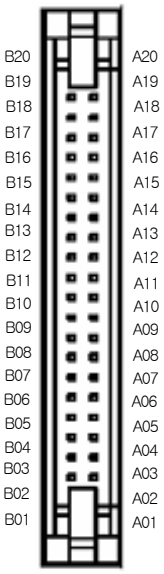
Specification \ Model		Main unit
		XBM-DN32H2/XBM-DN32HP, XBM-DP32H2/XBM-DP32HP
Input point		16 point
Insulation method		Photo coupler insulation
Rated input voltage		DC24V
Rated input current		P00 ~ P03 : about 5mA, P04 ~ P0F : about 4mA
Operation voltage range		DC 20.4~28.8V (within ripple rate 5%)
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 5.6kΩ (P00~P03: about 4.7kΩ)
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
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

Type

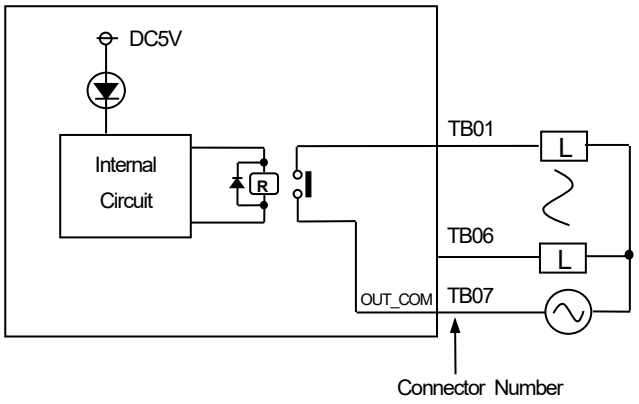


3.3 Main Unit Digital Output Specifications

3.3.1 XBM-DR14H2 6 point relay output

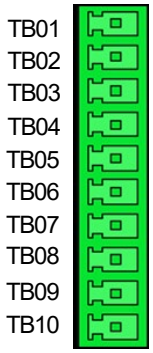
Specification \ Model		Main unit
		XBM-DR14H2
Output point		6 point
Insulation method		Relay insulation
Rated load voltage / current		DC 24V 2A (Resistitive load) / AC220V 2A (COSΦ = 1), 5A/COM
Min. load voltage / current		DC5V / 1mA
Max. load voltage		AC250V, DC125V
Off leakage current		0.1㎃ (AC220V, 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
TB01	20
TB02	21
TB03	22
TB04	23
TB05	24
TB06	25
TB07	OUT_COM
TB08	N.C.
TB09	N.C.
TB10	N.C.

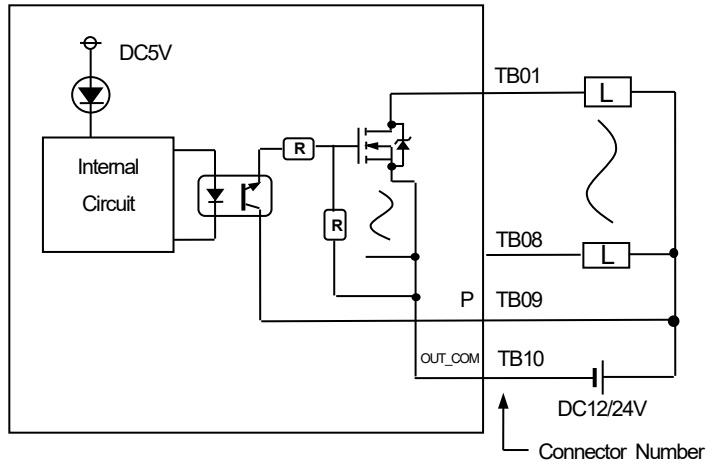
Type



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

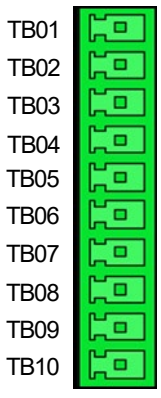
Specification \ Model		Main Unit
		XBM-DN16H2
Output Point		8 point
Insulation method		Photocoupler insulation
Rated load voltage		DC 12 / 24V
Operation load voltage range		DC 10.2 ~ 26.4V
Max. load current		P20 ~ P21 : 0.1A/ 1 point, P22 ~ P27 : 0.5A / 1 point, 2A / 1COM
Off leakage current		0.1㎃ or 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
TB01	20
TB02	21
TB03	22
TB04	23
TB05	24
TB06	25
TB07	26
TB08	27
TB09	P
TB10	OUT_COM

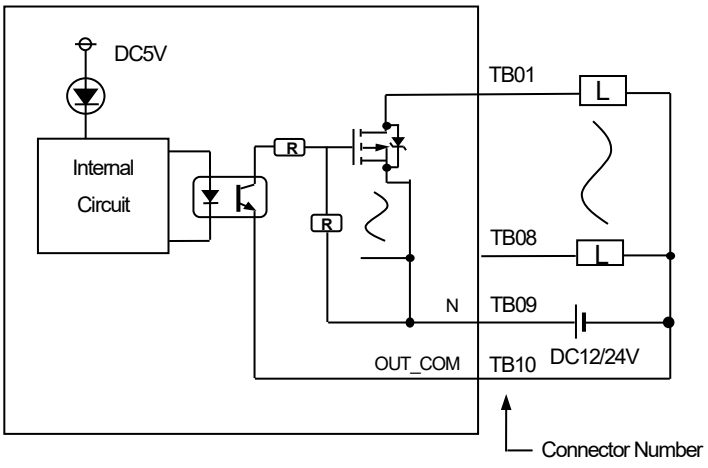
Type



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

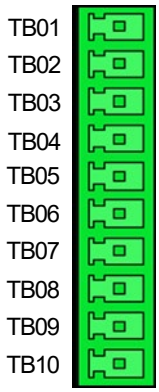
Specification \ Model		Main Unit
		XBM-DP16H2
Output point		8 point
Insulation method		Photocoupler method
Rated load voltage		DC 12 / 24V
Operation load voltage range		DC 10.2 ~ 26.4V
Max. load current		P20 ~ P21 : 0.1A/ 1 point, P22 ~ P27 : 0.5A / 1 point, 2A / 1COM
Off leakage current		0.1㎃ or less
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
TB01	20
TB02	21
TB03	22
TB04	23
TB05	24
TB06	25
TB07	26
TB08	27
TB09	OUT_COM
TB10	N

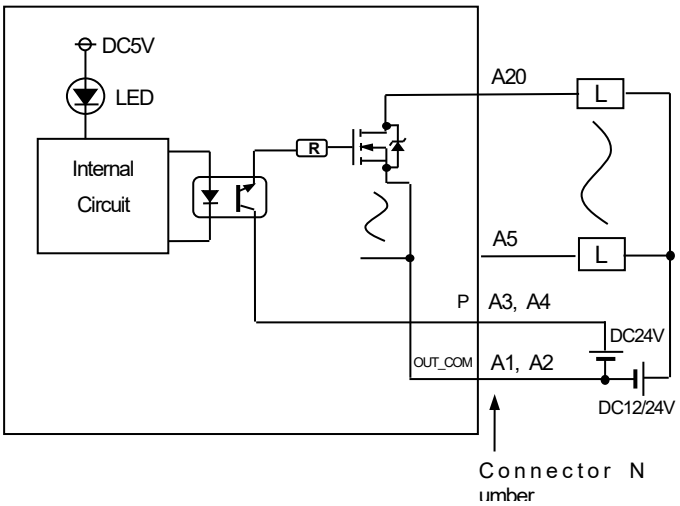
Type



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

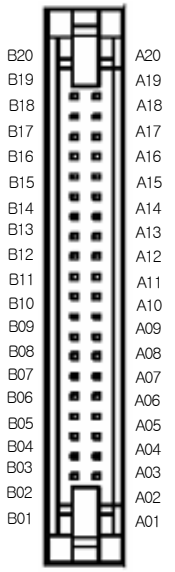
Specification \ Model		Main unit
		XBM-DN32H2/XBM-DN32HP
Output point		16 point
Insulation method		Photo coupler insulation
Rated load voltage		DC 12/24V
Operation load voltage range		DC 10.2 ~ 26.4V
Max.load current		P20 ~ P2B : 0.1A/ 1 point, P2C ~ P2F : 0.5A / 1 point, 2A / 1COM
Off leakage current		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
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

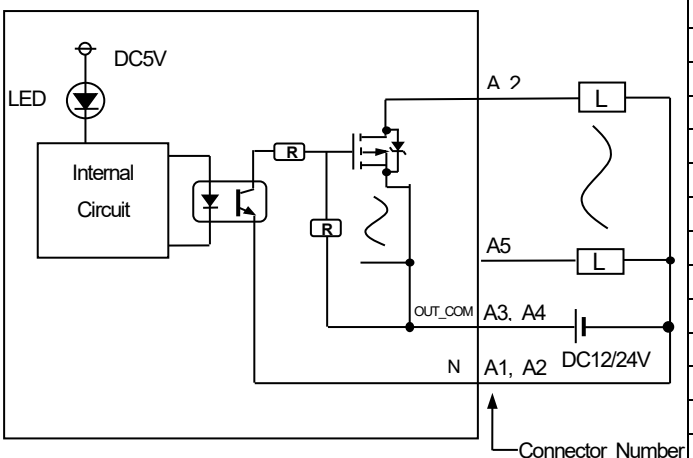
Type



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

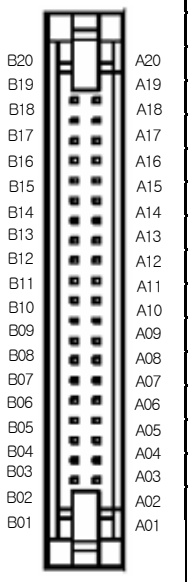
Specification \ Model		Main unit
		XBM-DP32H2/XBM-DP32HP
Output point		16 point
Insulation method		Photo coupler insulation
Rated load voltage		DC 12/24V
Operation load voltage range		DC 10.2 ~ 26.4V
Max.load current		P20 ~ P2B : 0.1A/ 1 point, P2C ~ P2F : 0.5A / 1 point, 2A / 1COM
Off leakage current		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
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

Type

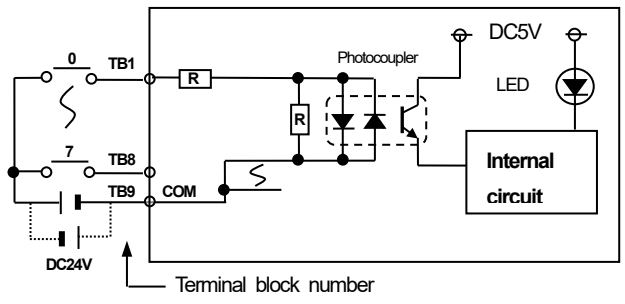


3.4 Digital Input Specifications

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

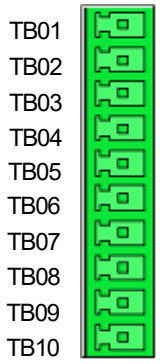
Model / Specification		DC input module
		XBE-DC08A
Input point		8 point
Insulation method		Photo coupler insulation
Rated input voltage		DC24V
Rated input current		About 4㎃
Operation voltage range		DC20.4~28.8V (ripple rate < 5%)
On Voltage/Current		DC19V or higher / 3 ㎃ or higher
Off Voltage/Current		DC6V or less / 1㎃ or less
Input resistance		About 5.6kΩ
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

Circuit configuration



No.	Contact
TB01	0
TB02	1
TB03	2
TB04	3
TB05	4
TB06	5
TB07	6
TB08	7
TB09	COM
TB10	COM

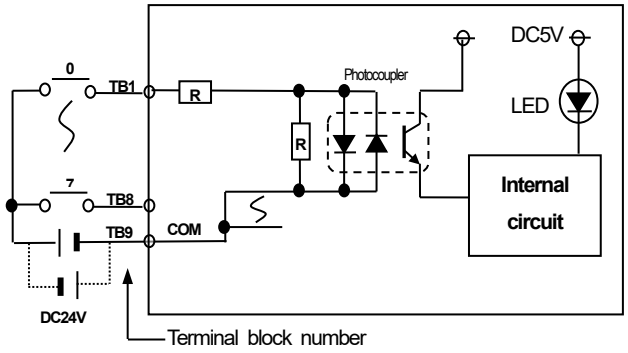
Type



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

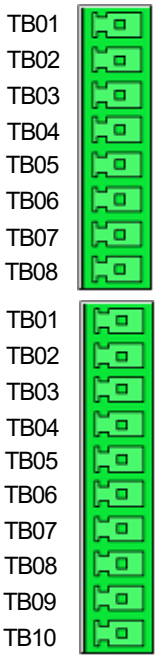
Specification \ Model		DC input module	
		XBE-DC16A	XBE-DC16B
Input point		16 point	
Insulation method		Photo coupler insulation	
Rated input voltage		DC24V	DC12/24V
Rated input current		About 4㎃	About 4/8㎃
Operation voltage range		DC20.4~28.8V (ripple rate < 5%)	DC9.5~30V (ripple rate < 5%)
On Voltage/Current		DC19V or higher / 3 ㎃ or higher	DC9V or higher / 3 ㎃ or higher
Off Voltage/Current		DC6V or less / 1㎃ or less	DC5V or less / 1㎃ or less
Input resistance		About 5.6㏀	About 2.7㏀
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		16 point / COM	
Proper cable size		Stranded cable 0.3~0.75㎟ (External diameter 2.8㎜ or less)	
Current consumption		40㎃ (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
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

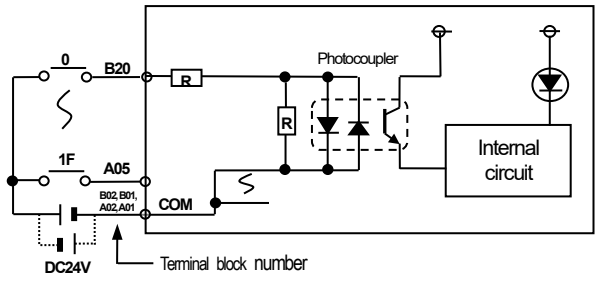
Type



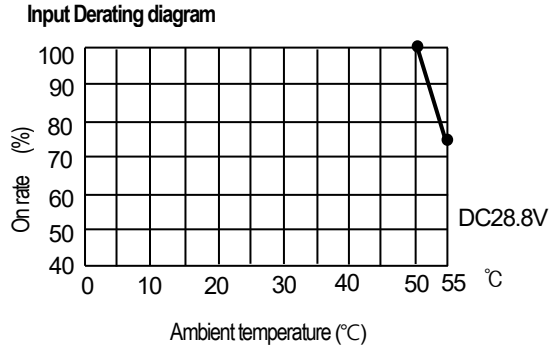
3.4.3 32 point DC24V input module (Source/Sink type)

Specification \ Model		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 5.6kΩ
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

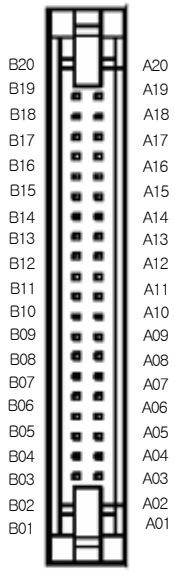


Input Derating diagram



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	COM
B01	COM	A01	COM

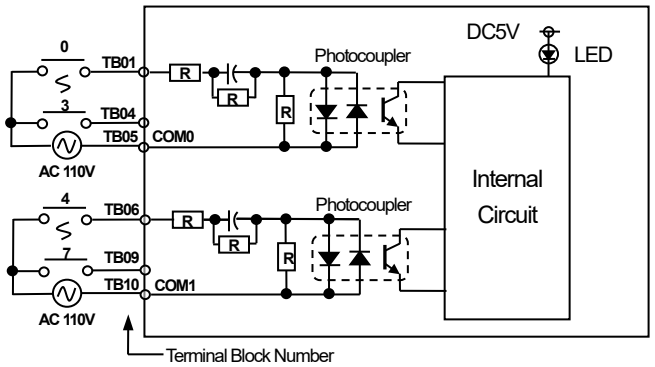
Type

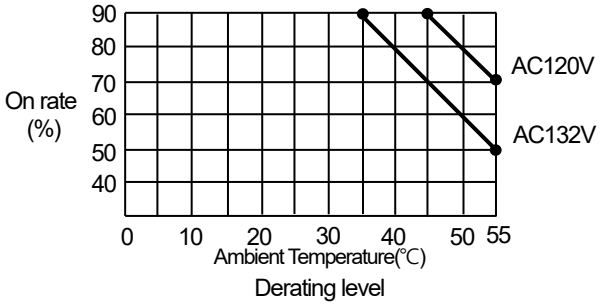


3.4.4 8 point AC110V input module

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

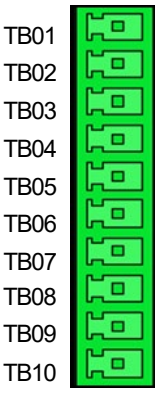
Circuit configuration





No.	Contact
TB01	0
TB02	1
TB03	2
TB04	3
TB05	COM0
TB06	4
TB07	5
TB08	6
TB09	7
TB10	COM1

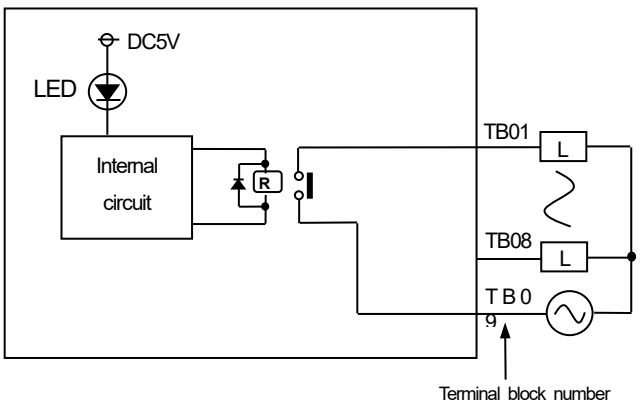
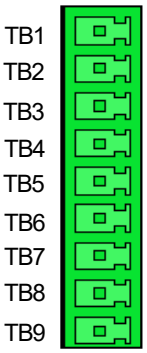
Type



3.5 Digital Output Specifications

3.5.1 8 point relay output module

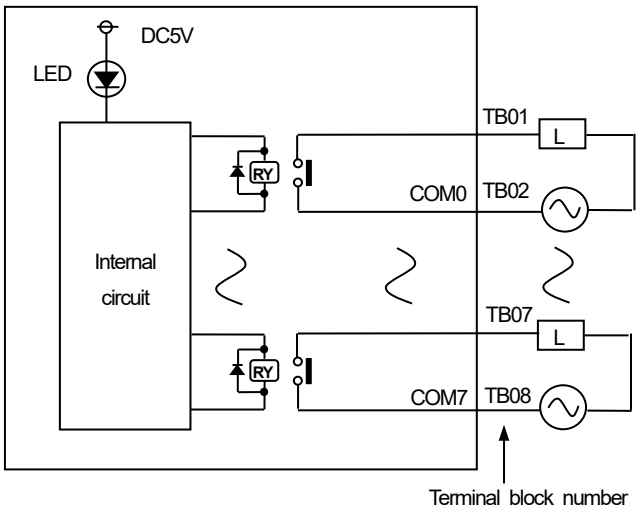
Specification \ Model		Relay output module
		XBE-RY08A
Output point		8 point
Insulation method		Relay insulation
Rated load voltage / Current		DC24V 2A (Resistive load) / AC220V 2A (COSΨ = 1), 5A/COM
Min. load voltage/Current		DC5V / 1㎃
Max. load voltage/Current		AC250V, DC125V
Off leakage current		0.1㎃ (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)

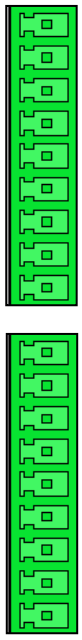
Specification \ Model		Relay output module XBE-RY08B
Output point		8 point
Insulation method		Relay insulation
Rated load voltage / Current		DC24V 2A (Resistive load) / AC220V 2A (COSΨ = 1), 2A/COM
Min. load voltage/Current		DC5V / 1㎃
Max. load voltage/Current		AC250V, DC125V
Off leakage current		0.1㎃ (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



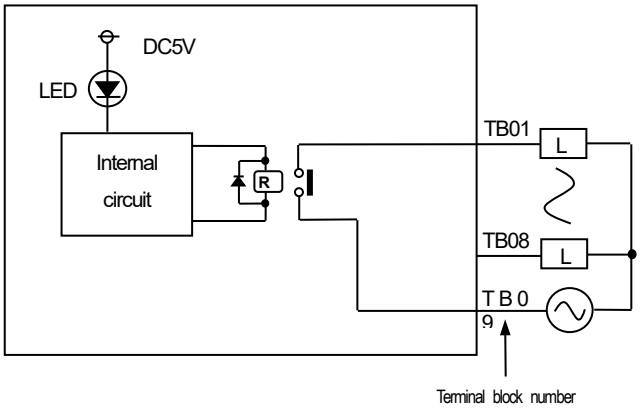
No.	Contact
TB01	0
TB02	COM0
TB03	1
TB04	COM1
TB05	2
TB06	COM2
TB07	3
TB08	COM3
TB09	NC
TB01	4
TB02	COM4
TB03	5
TB04	COM5
TB05	6
TB06	COM6
TB07	7
TB08	COM7
TB09	NC

No.



3.5.3 16 point relay output module

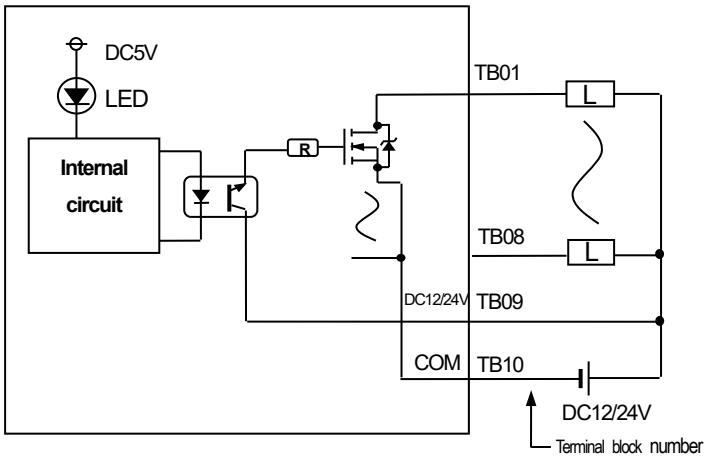
Specification \ Model		Relay output module
		XBE-RY16A
Output point		16 point
Insulation method		Relay insulation
Rated load voltage/ current		DC24V 2A (Resistive load) / AC220V 2A (COSΨ = 1), 5A/COM
Min. load voltage/current		DC5V / 1㎃
Max. load voltage/current		AC250V, DC125V
Off leakage current		0.1㎃ (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)

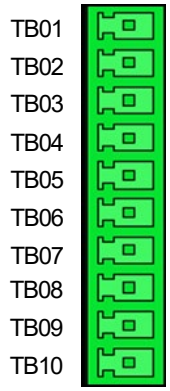
Specification \ Model		Transistor output module
		XBE-TN08A
Output point		8 point
Insulation method		Photo coupler insulation
Rated load voltage		DC 12 / 24V
Load voltage range		DC 10.2 ~ 26.4V
Max. load voltage		0.5A / 1 point
Off leakage current		0.1㎃ or less
Max. inrush current		4A / 10㎳ or less
Max. 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
TB01	0
TB02	1
TB03	2
TB04	3
TB05	4
TB06	5
TB07	6
TB08	7
TB09	DC12 /24V
TB10	COM

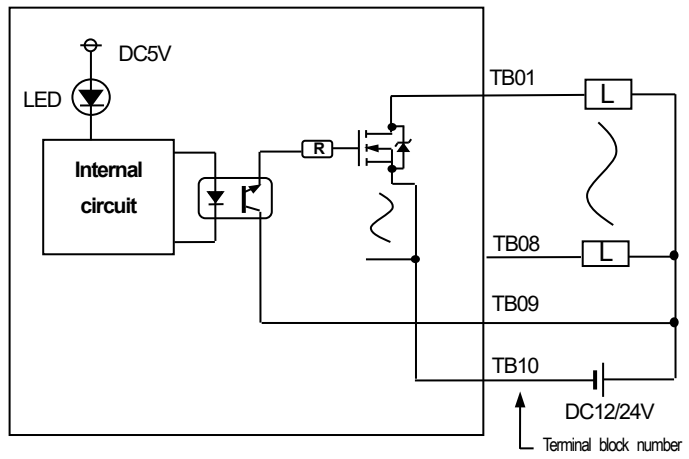
Type



3.5.5 16 point transistor output module (Sink type)

Specification \ Model		Transistor output module
		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



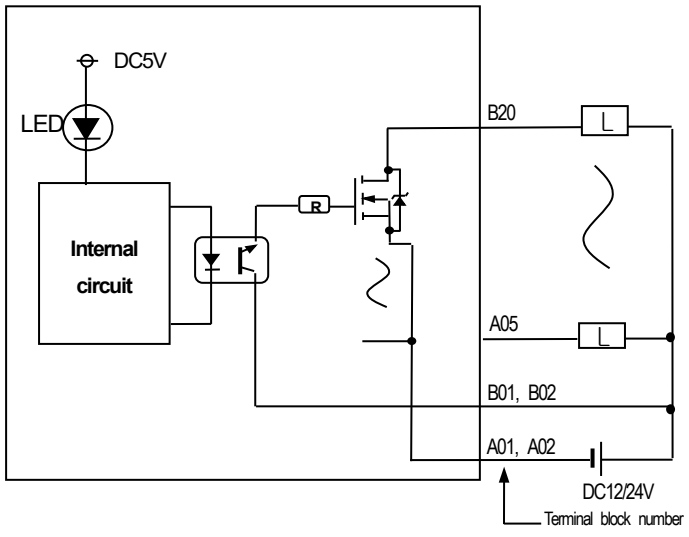
No.	Contact
TB01	0
TB02	1
TB03	2
TB04	3
TB05	4
TB06	5
TB07	6
TB08	7
TB01	8
TB02	9
TB03	A
TB04	B
TB05	C
TB06	D
TB07	E
TB08	F
TB09	DC12 /24V
TB10	COM

Type

3.5.6 32 point transistor output module (Sink type)

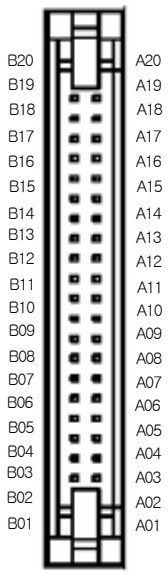
Specification \ Model		Transistor output module
		XBE-TN32A
Output point		32 point
Insulation method		Photo coupler insulation
Rated load voltage		DC 12 / 24V
Load voltage range		DC 10.2 ~ 26.4V
Max. load voltage		0.5A / 1 point, 2A / 1COM
Off leakage current		0.1㎃ or less
Max. inrush current		0.7A / 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
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	

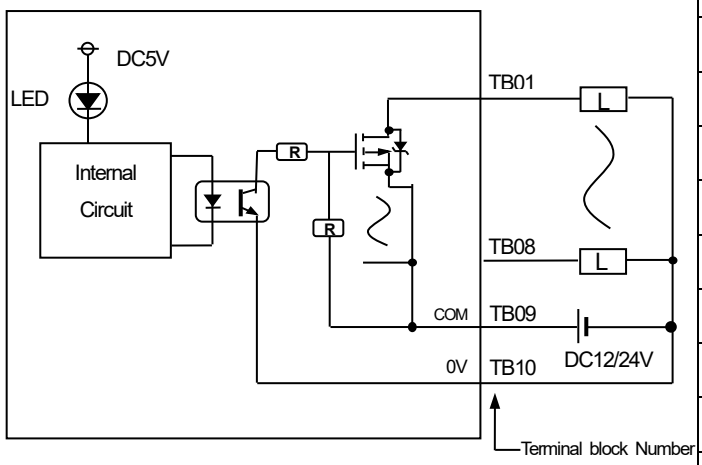
Type



3.5.7 8 point transistor output module (Source type)

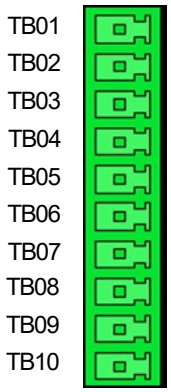
Specification \ Model		Transistor output module
		XBE-TP08A
Output point		8 point
Insulation method		Photo coupler insulation
Rated load voltage		DC 12 / 24V
Load voltage range		DC 10.2 ~ 26.4V
Max. load voltage		0.5A / 1 point
Off leakage current		0.1㎃ or less
Max. inrush current		4A / 10㎳ or less
Max. 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
TB01	0
TB02	1
TB03	2
TB04	3
TB05	4
TB06	5
TB07	6
TB08	7
TB09	COM
TB10	0V

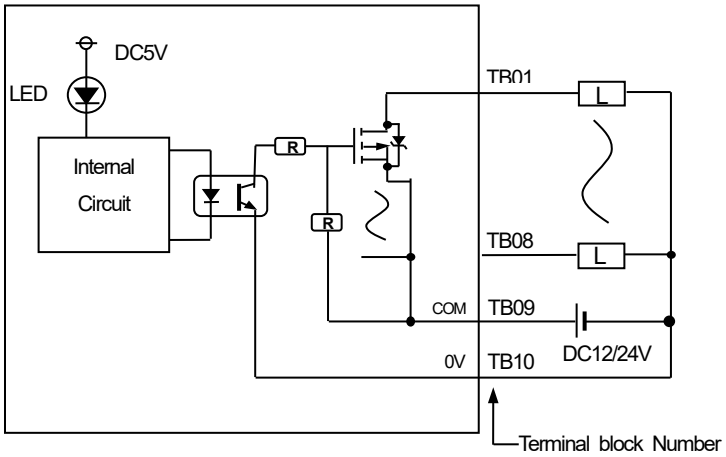
Type



3.5.8 16 point transistor output module (Source type)

Specification \ Model		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



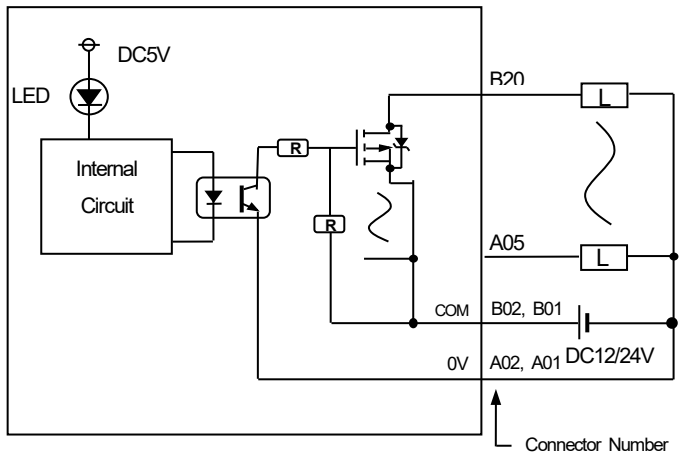
No.	Contact
TB01	0
TB02	1
TB03	2
TB04	3
TB05	4
TB06	5
TB07	6
TB08	7
TB01	8
TB02	9
TB03	A
TB04	B
TB05	C
TB06	D
TB07	E
TB08	F
TB09	COM
TB10	0V

Type

3.5.9 32 point transistor output module (Source type)

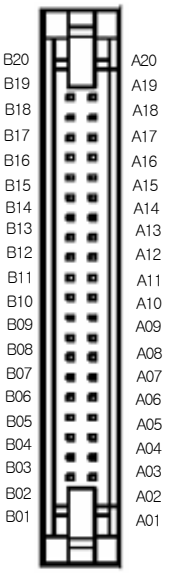
Specification \ Model		Transistor output module
		XBE-TP32A
Output point		32 point
Insulation method		Photo coupler insulation
Rated load voltage		DC 12 / 24V
Load voltage range		DC 10.2 ~ 26.4V
Max. load voltage		0.5A / 1 point, 2A / 1COM
Off leakage current		0.1㎃ or less
Max. inrush current		4A / 10 ㎳ 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

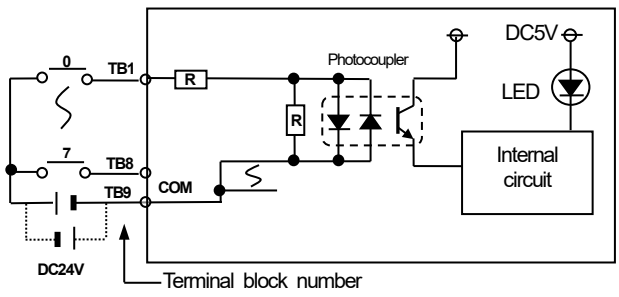


3.6 Combined Digital I/O module Input Specification

3.6.1 8 point DC24V input (Source/Sink type)

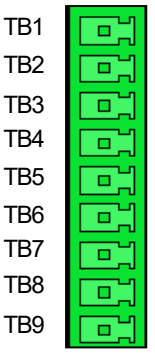
Specification \ Model		DC input module
		XBE-DR16A
Input point		8 point
Insulation method		Photo coupler insulation
Rated input voltage		DC24V
Rated input current		About 4㎃
Operation voltage range		DC20.4~28.8V (within ripple rate 5%)
On Voltage/Current		DC19V or higher / 3㎃ or higher
Off Voltage/Current		DC6V or less / 1㎃ or less
Input resistance		About 5.6kΩ
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
TB1	0
TB2	1
TB3	2
TB4	3
TB5	4
TB6	5
TB7	6
TB8	7
TB9	COM

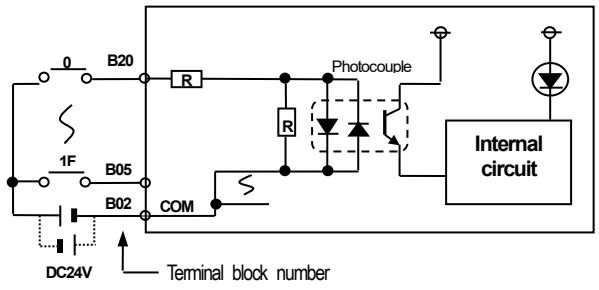
Type



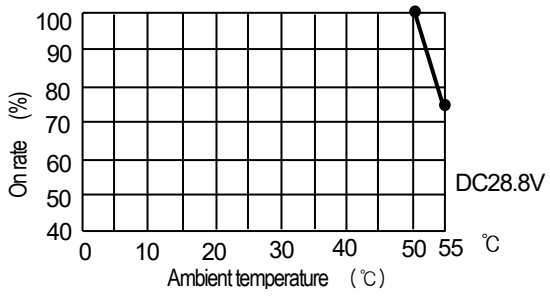
3.6.2 16 point DC24V input (Source/Sink type)

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

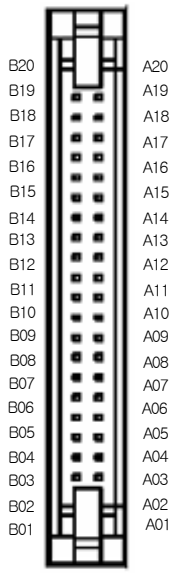


Input Derating diagram



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
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

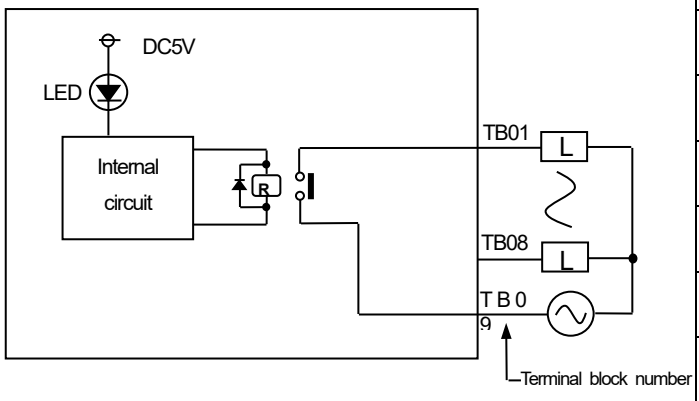
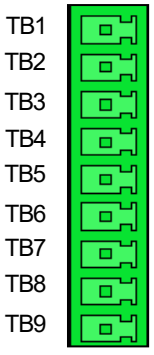
Type



3.7 Combined Digital I/O module Output Specification

3.7.1 8 point relay output

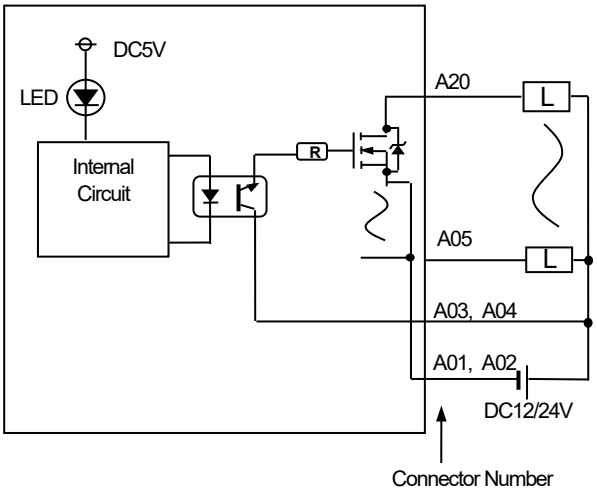
Specification \ Model		Relay output module XBE-DR16A
Output point		8 point
Insulation method		Relay insulation
Rated load voltage / Current		DC24V 2A (Resistive load) / AC220V 2A (COSΨ = 1), 5A/COM
Min. load voltage/Current		DC5V / 1㎃
Max. load voltage		AC250V, DC125V
Off leakage current		0.1㎃ (AC220V, 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)

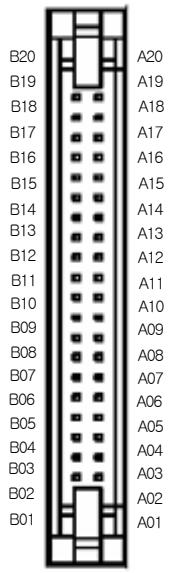
Specification \ Model		Transistor output module
		XBE-DN32A
Output point		16 point
Insulation method		Photo coupler insulation
Rated voltage		DC12/24V
Operation voltage range		DC10.2~26.4V
Max. load current		0.2A / 1 point, 2A / 1COM
Off leakage current		0.1㎃ or less
Max. load voltage		0.7A / 10ms or 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
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	

Type



3.8 I/O modules' Functions

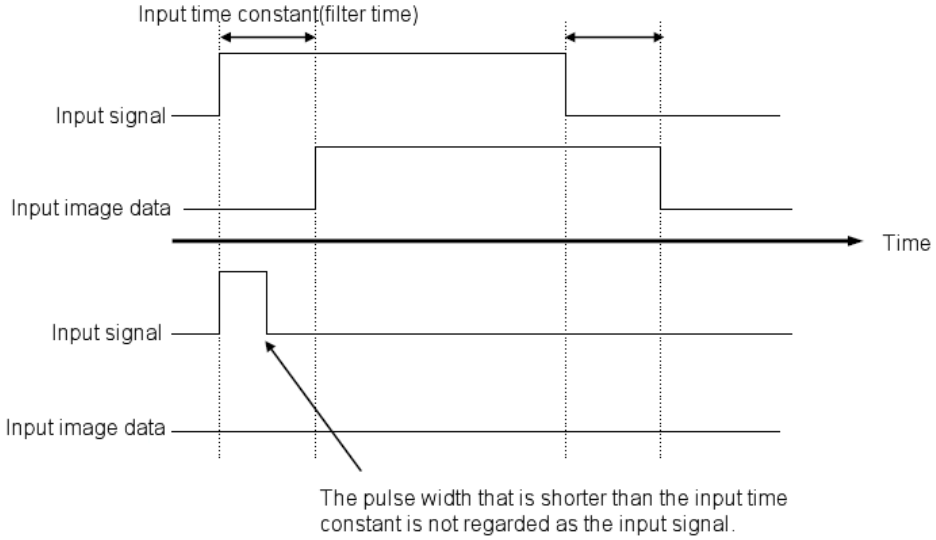
3.8.1 Input filter function

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

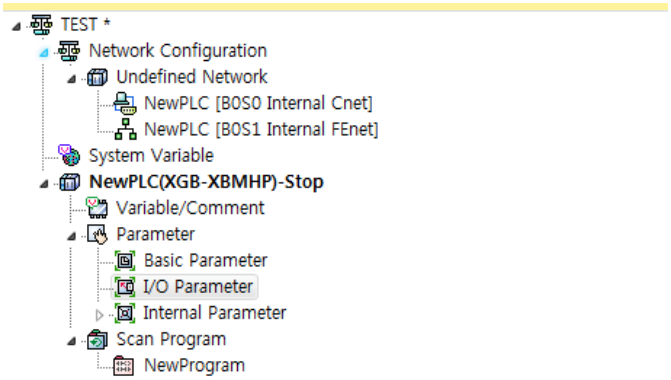
Under the environment with serious noise or in the case of the equipment that is greatly affected by the input signal's pulse width, the system may receive incorrect input depending on the input signal status. To prevent such incorrect input, the input filter function does not regard the signal that 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.

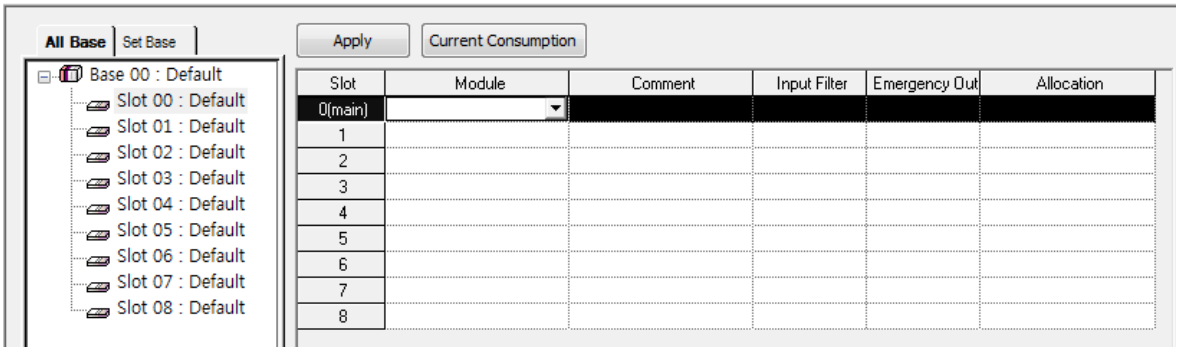


(2) How to set Input filter

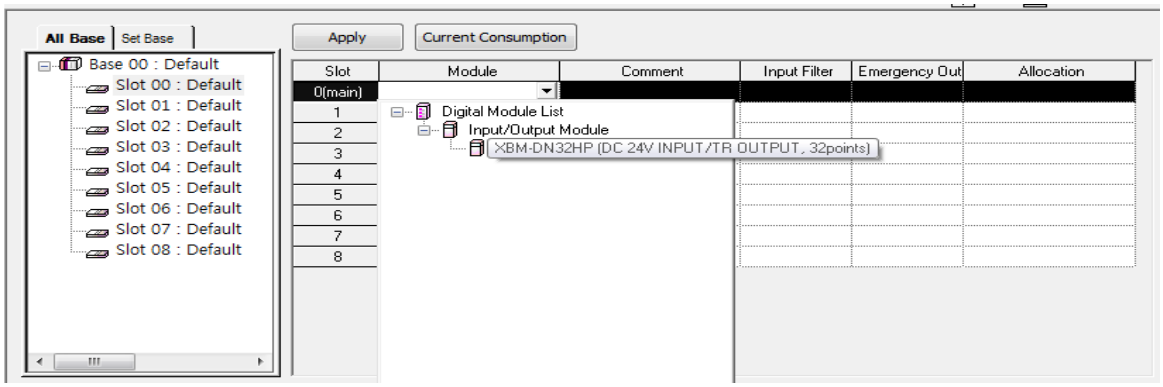
1) Click [I/O Parameter] in XG5000



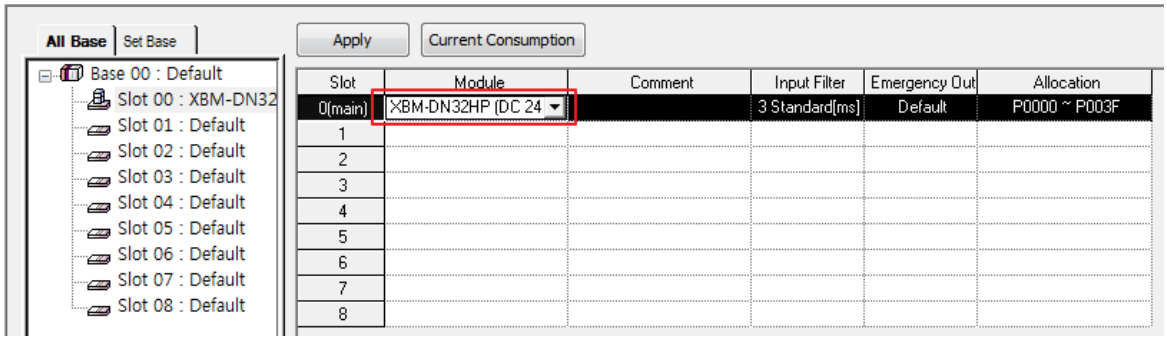
2) Click [Module] in Slot



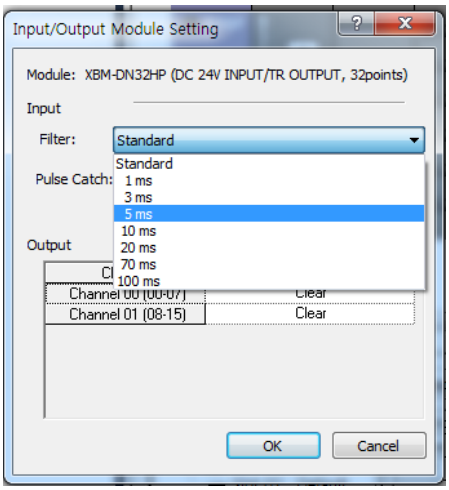
3) Set I/O Module



4) Click the below box and set Inpu filter



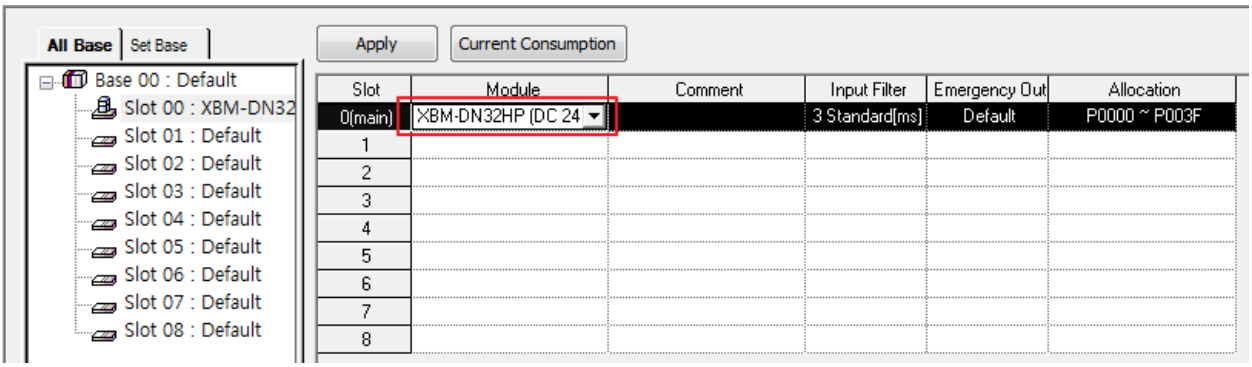
5) Set Input filter



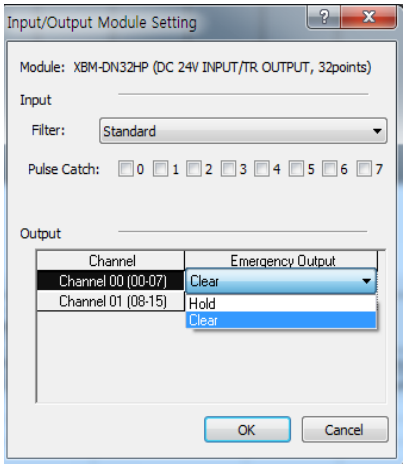
3.8.2 Emergency output function

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



(2) Set Emergency output



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.

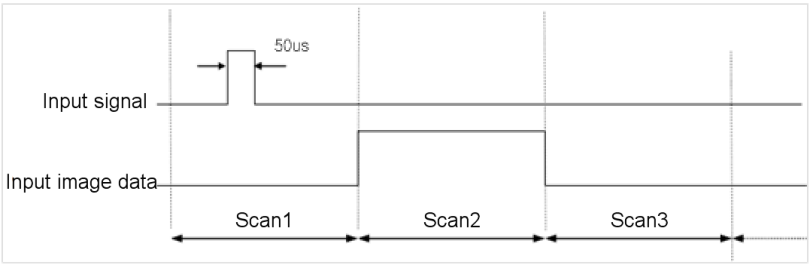
3.8.3 Pulse Catch Function

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㎲).

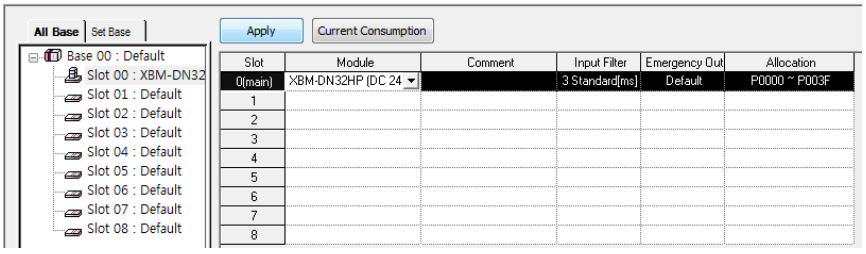
The timing chart below represents the operations of the Pulse Catch function.



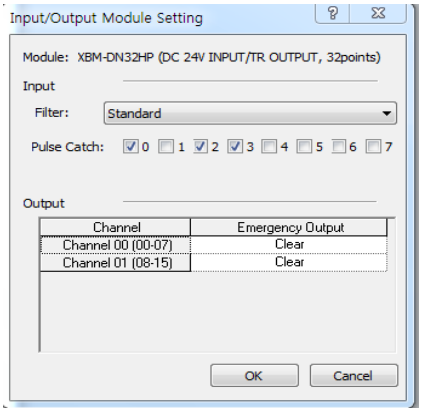
Step	Processing details
Scan 1	When the pulse signal of 50 ㎲ is input, the CPU detects it and stores the status.
Scan 2	The pulse catch result flag is turned On.
Scan 3	The pulse catch result flag is turned Off.

(2) Setting pulse catch

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



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



(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

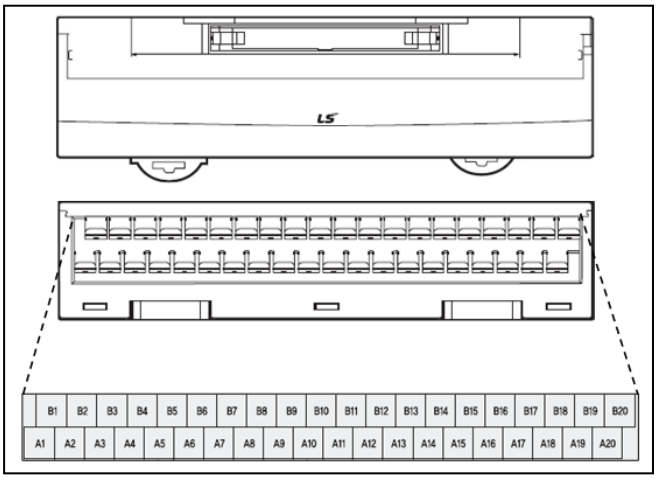
3.9 I/O link board

When wiring the input/output circuit of the main unit or extension module, It can be done easily by connecting the I/O connect or 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 XBM-DP32H2/HP	XTB-40H (TG7-1H40S)	40	C40HH-05SB-XBI C40HH-10SB-XBI	0.5~1m	For main unit connection (40Pin)
Expansion module	XBE-DC32A	XTB-40H (TG7-1H40S)	40	C40HH-05SB-XBE C40HH-10SB-XBE C40HH-15SB-XBE C40HH-20SB-XBE C40HH-30SB-XBE	0.5m~ 3m	For expansion module connection (40Pin)
	XBE-TN32A	XTB-40H (TG7-1H40S)	40			
		R32C-NS5A-40P	40			For expansion module connection (40Pin) Exclusive for relay built-in type
	XBE-TP32A	XTB-40H (TG7-1H40S)	40			For expansion module connection (40Pin)
		R32C-PS5A-40P	40			For expansion module connection (40Pin) Exclusive for relay built-in type
	XBE-DN32A	XTB-40H (TG7-1H40S)	40			For expansion module connection (40Pin)

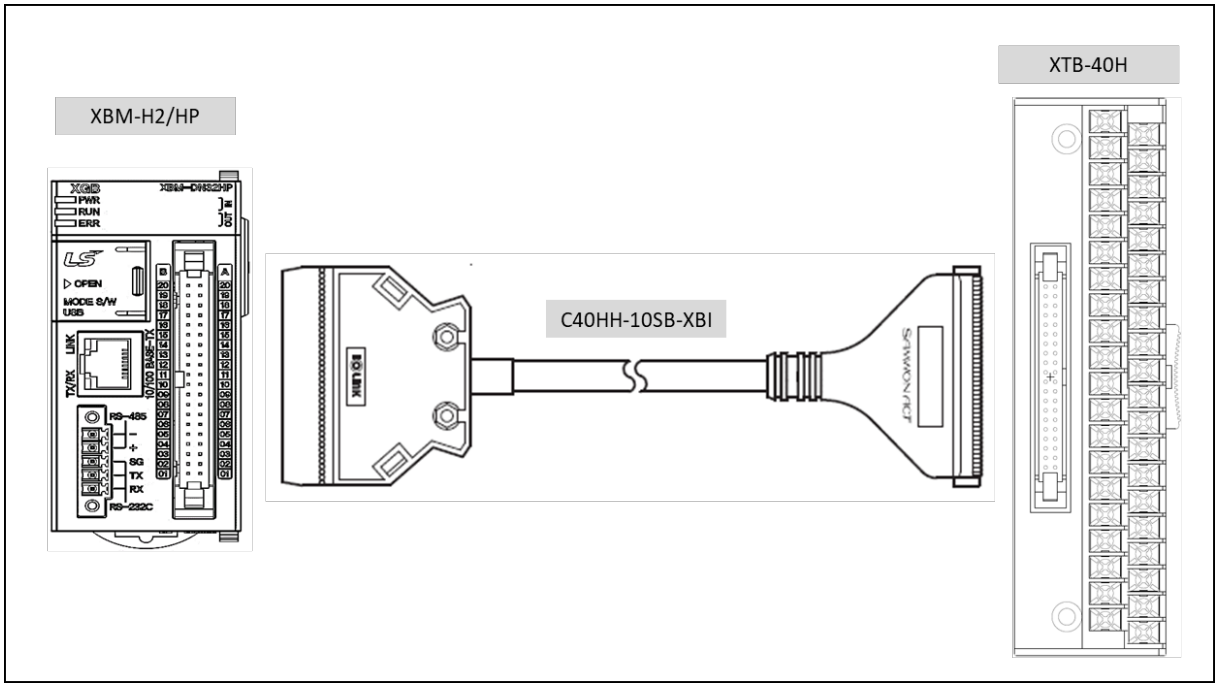
1) XTB-40H terminal array

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		100㏁ (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
A1	P00
B1	P01
A2	P02
B2	P03
A3	P04
B3	P05
A4	P06
B4	P07
A5	P08
B5	P09
A6	P0A
B6	P0B
A7	P0C
B7	P0D
A8	P0E
B8	P0F
A9	NC
B9	NC
A10	IN_COM
B10	IN_COM

XBM-H2/HP Connector	
B20	A20
B19	A19
B18	A18
B17	A17
B16	A16
B15	A15
B14	A14
B13	A13
B12	A12
B11	A11
B10	A10
B9	A9
B8	A8
B7	A7
B6	A6
B5	A5
B4	A4
B3	A3
B2	A2
B1	A1

PLC Output	XTB-40 Terminal No.
P20	A11
P21	B11
P22	A12
P23	B12
P24	A13
P25	B13
P26	A14
P27	B14
P28	A15
P29	B15
P2A	A16
P2B	B16
P2C	A17
P2D	B17
P2E	A18
P2F	B18
P/OUT_COM	A19
P/OUT_COM	B19
OUT_COM/N	A20
OUT_COM/N	B20

INPUT

OUTPUT

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

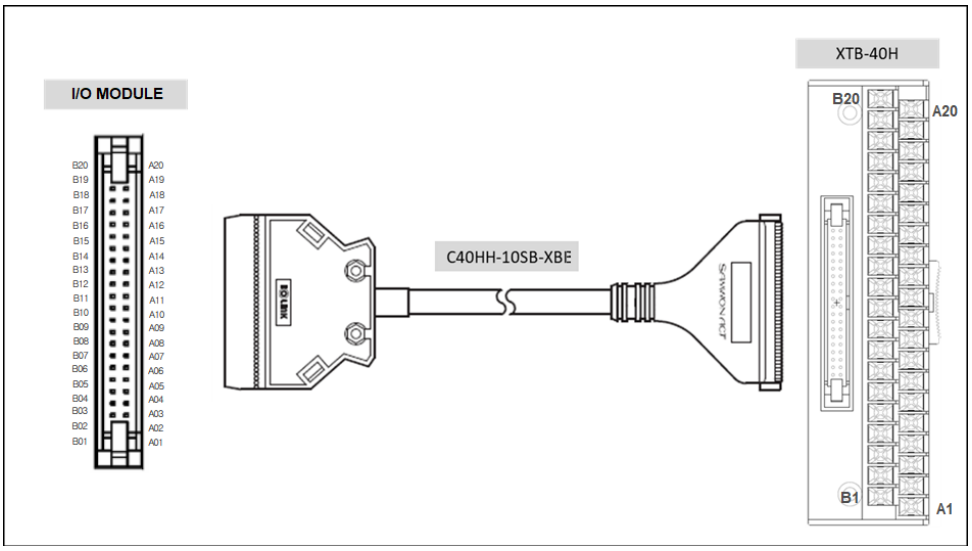
Connection Diagram between XTB-40H and XBM-DP32H2/HP

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)

Input

Output

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	B4	A4
B03	A03	NC	NC	NC	NC	NC	NC	NC	12/24V	B3	A3
B02	A02	COM	COM	DC	COM	COM	DC0V	IN	OUT	B2	A2
B01	A01			12/24V				COM	COM	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

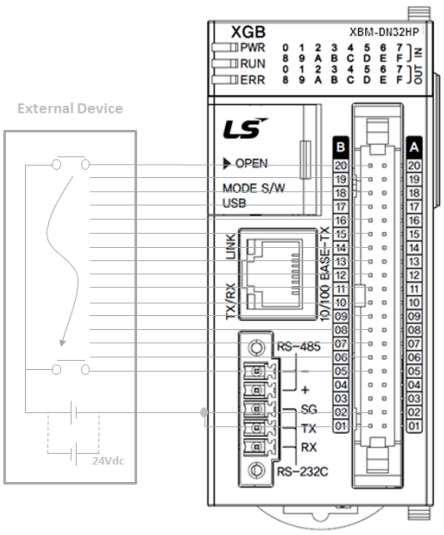
Classification		Description
Count input signal	Signal	A-phase, B-phase
	Input type	Voltage input (Open collector)
	Signal level	24V
Max. coefficient speed		200 kpps
Number of channels	1 phase	200kpps 4 channels
	2 phase	100kpps 2 channels
Coefficient range		Signed 32 Bit (-2,147,483,648 ~ 2,147,483,647)
Count mode (Program setting)		Linear count (if 32-bit range exceeded, Carry/Borrow occurs) 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 (>, >=, =, =<, <) 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 Frequency Count Count value per unit time (time setting : 1~60,000ms) Count Pause

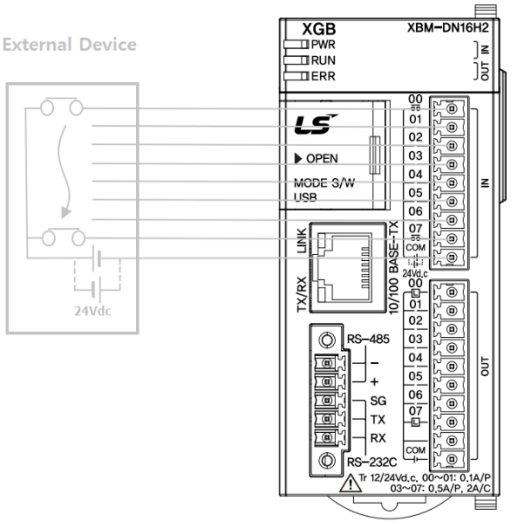
(2) Counter/Preset input specification

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

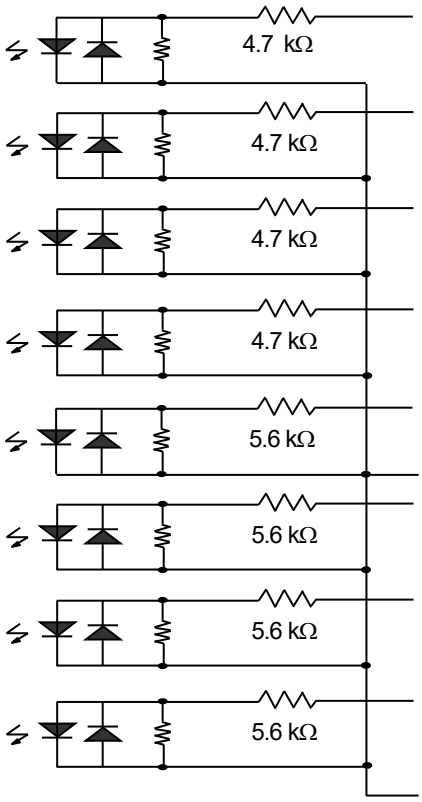




Terminal No.		Names		Usage	
32-point model	14/16-point model	1-phase	2-phase	1-phase	2-phase
B20	00	Ch0 counter input	Ch0 A-phase input	Counter input terminal	A-phase input
B19	01	Ch1 counter input	Ch0 B-phase input	Counter input terminal	B-phase input
B18	02	Ch2 counter input	Ch2 A-phase input	Counter 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 Pulse input	Ch 0 A-phase input	On	20.4~28.8V
						Off	6V or less
		B19	01	Ch 1 Pulse input	Ch 0 B-phase input	On	20.4~28.8V
						Off	6V or less
		B18	02	Ch 2 Pulse input	Ch 2 A-phase input	On	20.4~28.8V
						Off	6V or less
		B17	03	Ch 3 Pulse input	Ch 2 B-phase input	On	20.4~28.8V
						Off	6V or less
		B16	04	Ch 0 Preset input	Ch 0 Preset input	On	20.4~28.8V
						Off	6V or less
		B15	05	Ch 1 Preset input	-	On	20.4~28.8V
						Off	6V or less
		B14	06	Ch 2 Preset input	Ch 2 Preset input	On	20.4~28.8V
						Off	6V or less
		B13	07	Ch 2 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

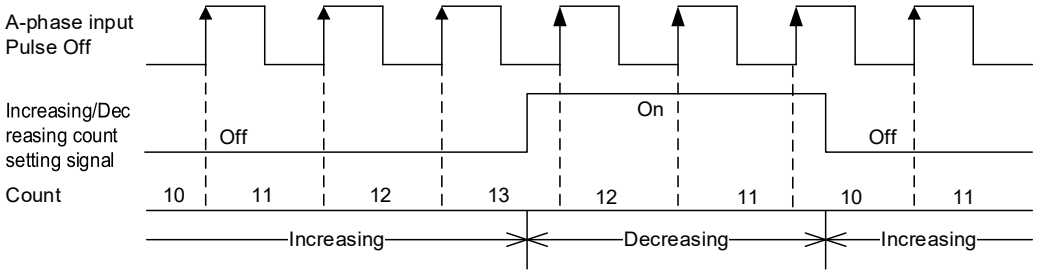
a) Increasing / Decreasing count operation by programming setting

• 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



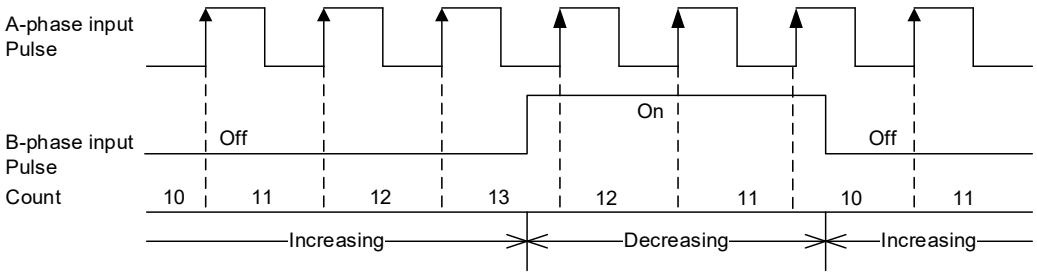
b) Increasing/decreasing count operation by B-phase input signal

• 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

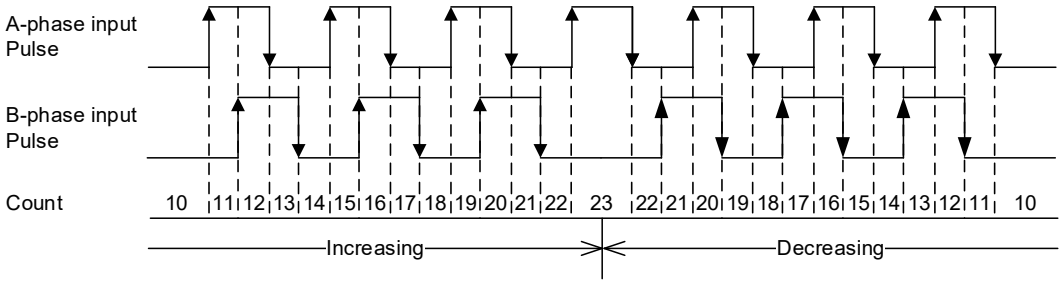


2) 2-Phase Count Mode

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



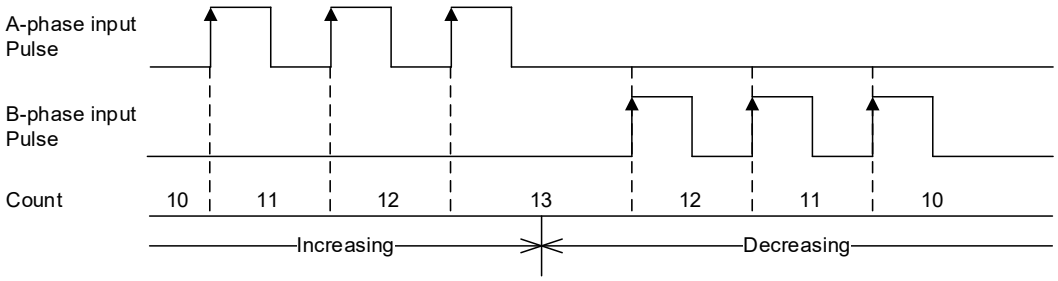
3) CW(Clockwise) / CCW(Counter Clockwise) operation mode

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.

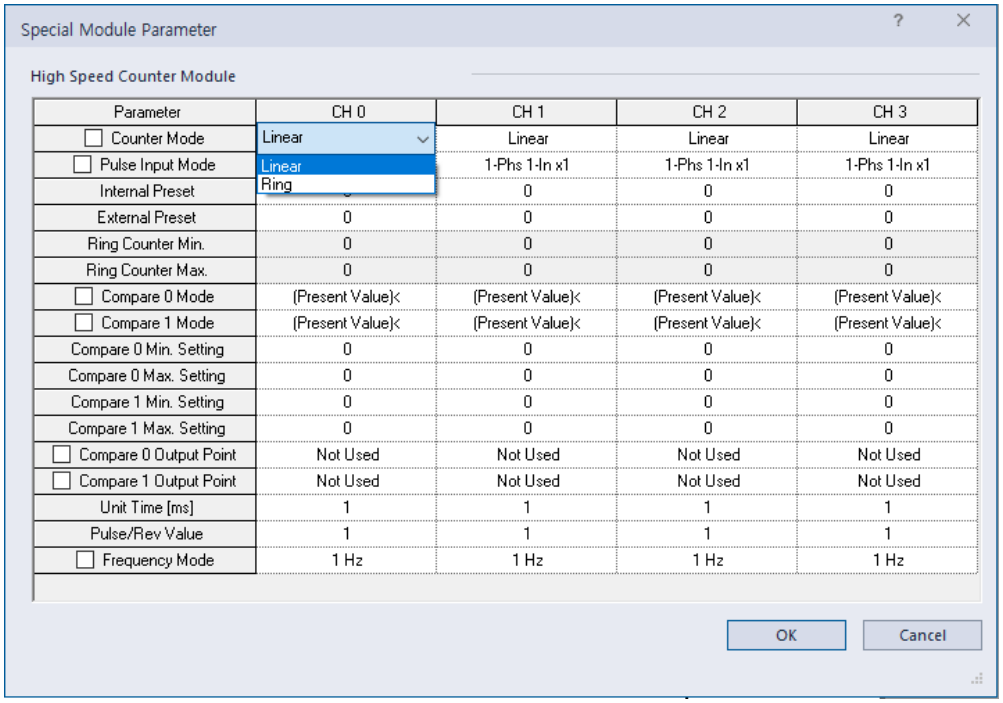
Increasing/Decreasing classification	A-phase input pulse High	A-phase input pulse Low
B-phase input pulse High	-	decreasing count
B-phase input pulse Low	Increasing count	-

▪ Operation example



(2) Counter type

2 types of count (Linear counter, Ring counter) can be selected for the applicable use.



▪ 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 1 : ring

*1) If counter mode is set as value other than 0, 1, error code '20' will occur.

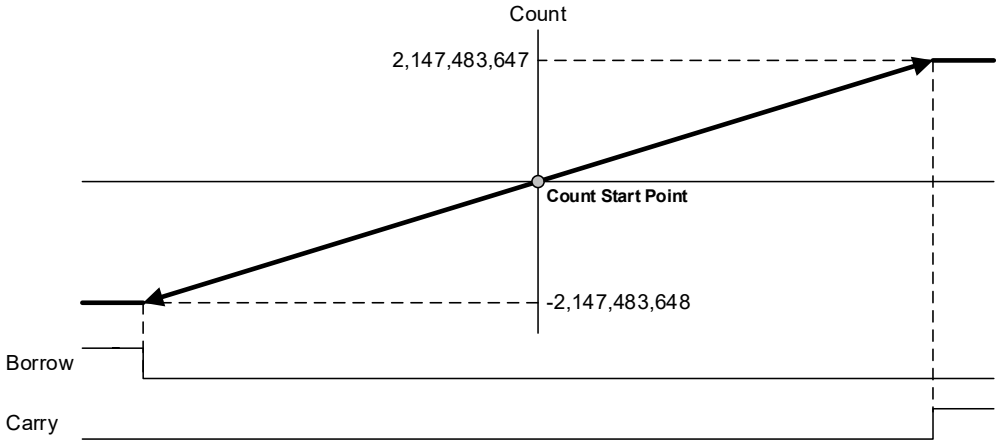
(a) Linear counter

■ 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.

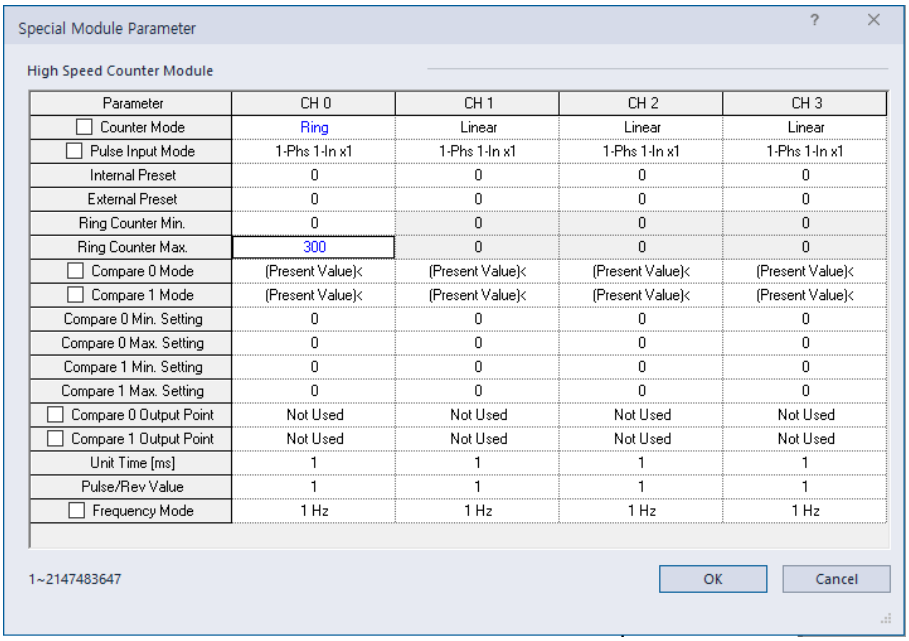
■ If Borrow occurs, count stops and decreasing is not available but increasing is available.



(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.



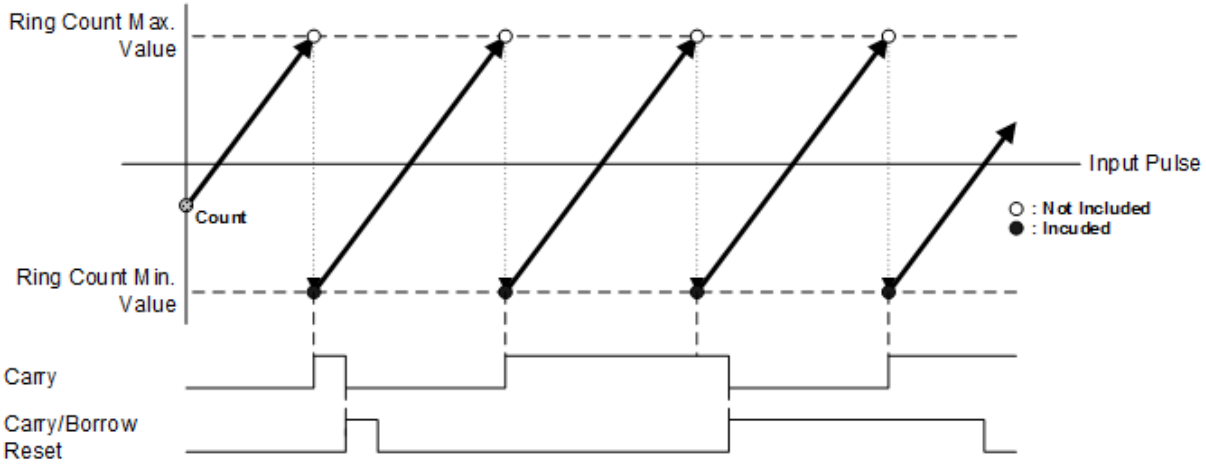
Parameter	CH 0	CH 1	CH 2	CH 3
Counter Mode	Ring	Linear	Linear	Linear
Pulse Input Mode	1-Phs 1-In x1	1-Phs 1-In x1	1-Phs 1-In x1	1-Phs 1-In x1
Internal Preset	0	0	0	0
External Preset	0	0	0	0
Ring Counter Min.	0	0	0	0
Ring Counter Max.	300	0	0	0
Compare 0 Mode	(Present Value)<	(Present Value)<	(Present 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

• 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	

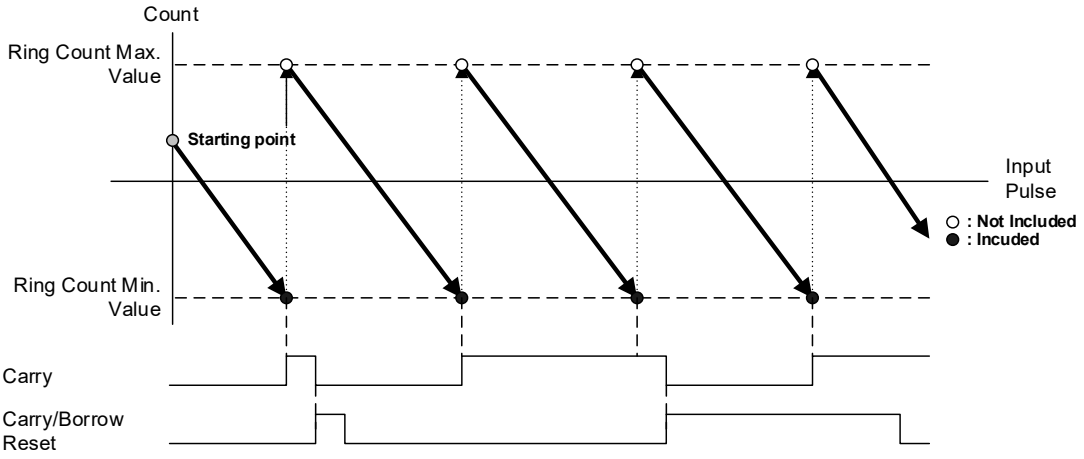
1) During increasing count

■ 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.

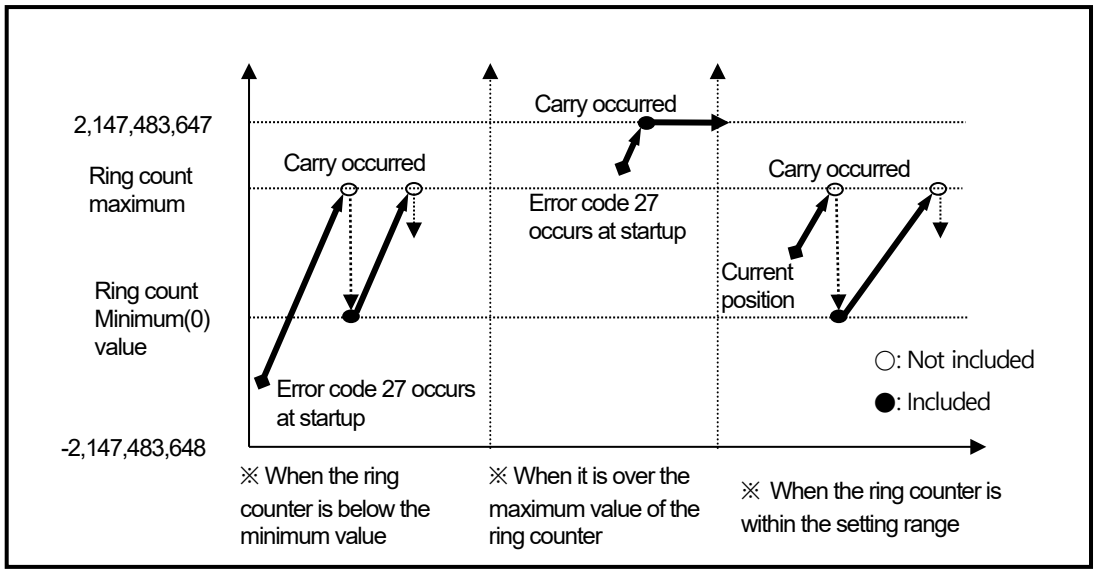
- Opens an error (Code No. 27), operates as a linear counter, and operates as a ring count when the current count value falls within the range of the ring count (error codes are not cleared).

■ When setting the ring count, the current count value is above the maximum value of the ring counter.

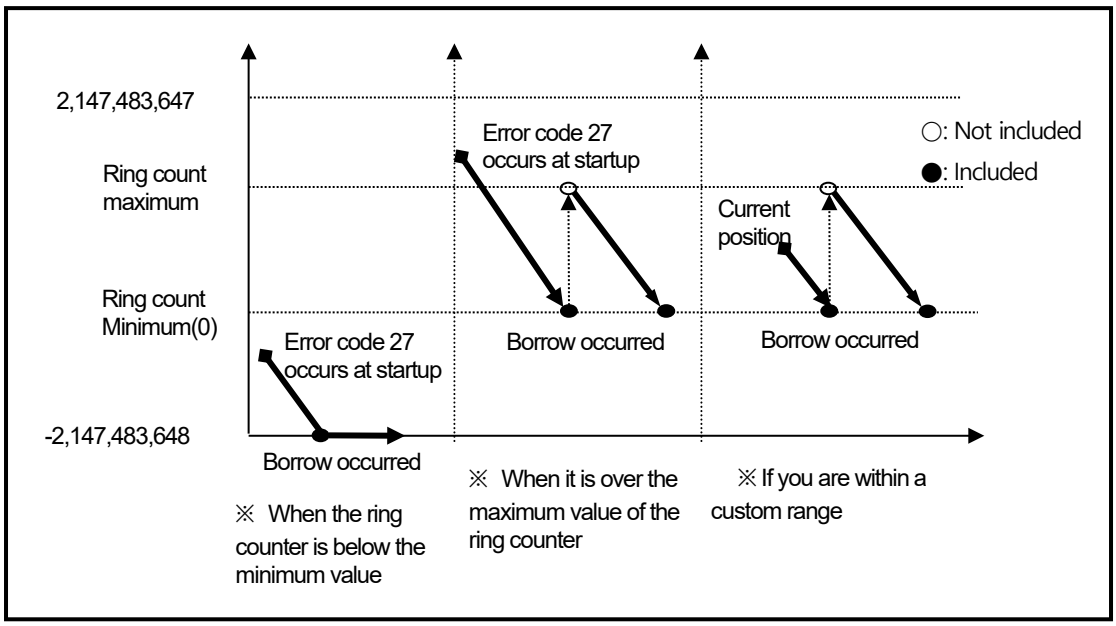
- Displays an error (Code No. 27), operates as a linear counter, and stops counting when the current count value reaches the maximum count value (error code is not cleared).

■ 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

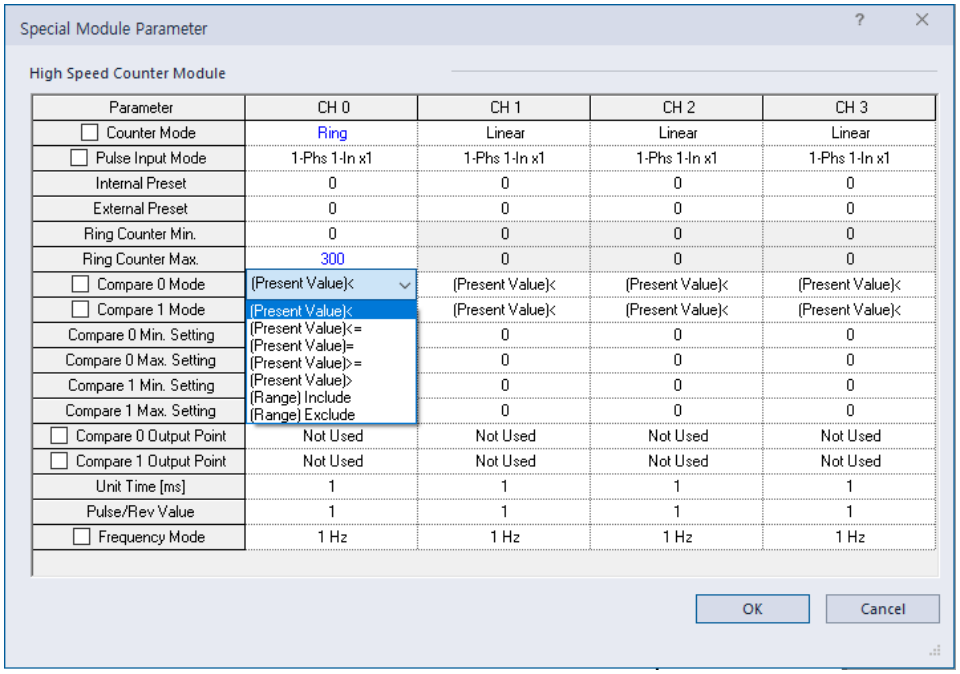
(a) High Speed counter module has a compared output function used to compare present count value with compared value in size to output as compared.

(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



■ Upper setting value is saved in special K area.

Compared output condition	Memory address (word)		Value*1)
Present Value < Compared Value	Channel 0 : K302 Channel 1 : K332 Channel 2 : K362 Channel 3 : K392	Channel 0 : K303 Channel 1 : K333 Channel 2 : K363 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, 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.

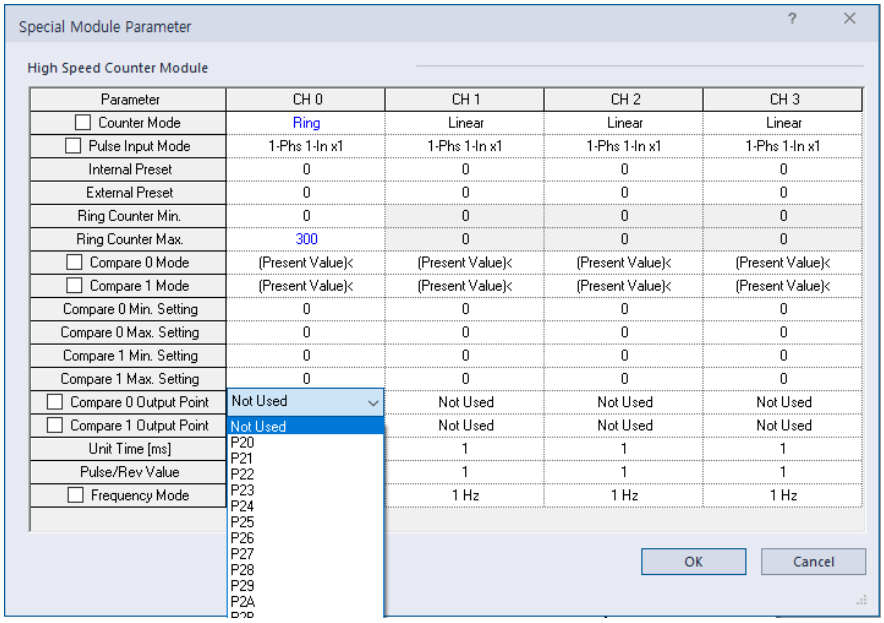
■ In order to make actual comparison enabled after compared output condition set, the compared enable signal is to be On.

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 1: Compared output equivalent
Comparator output signal1	K2613	K2713	K2813	K2913	0: Compared output not equivalent 1: Compared output equivalent

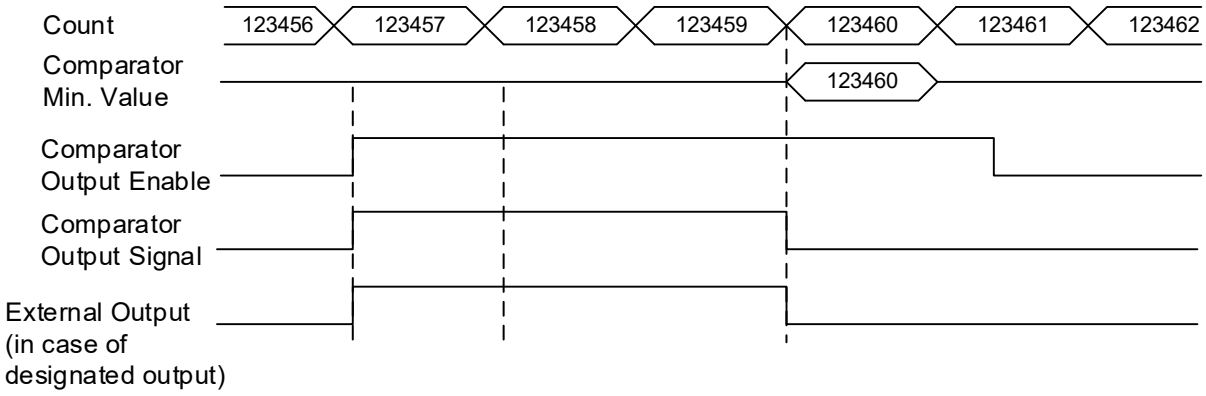
• Comp output point (P20 ~ P2F) setting



(e) Detailed description for compared output (Based On Comp0 output mode)

1) Mode 0 (Present value < Compared value)

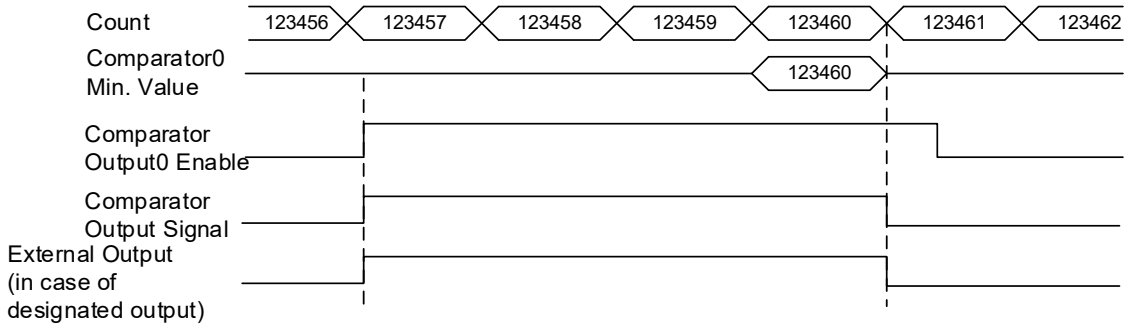
■ If counted present value is less than compared value, output is sent out, and if present value increases to be equal to or greater than compared value, output is not sent out.



2) Mode1 (Count value ≤ Compared value)

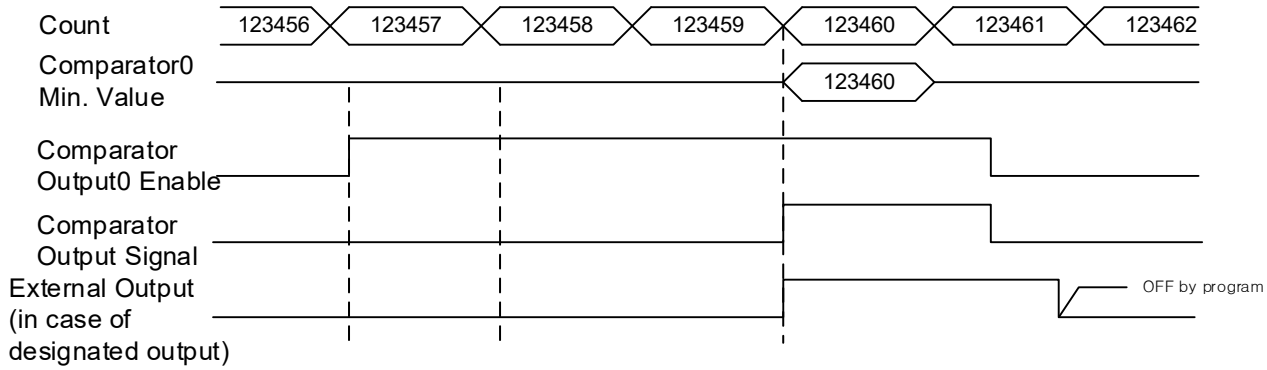
■ If present count value is less than or equal to compared value, output is sent out, and if count value increases

to be greater than compared value, output is not sent out.



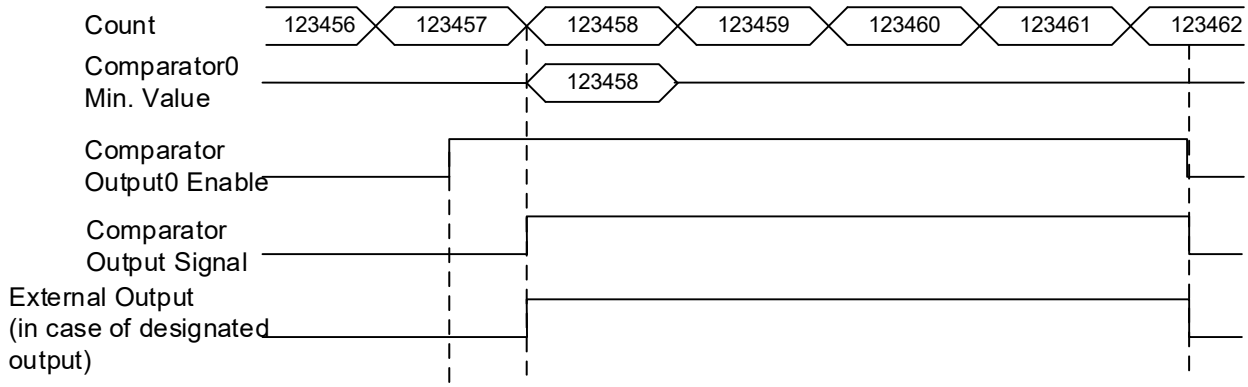
3) Mode 2 (Count value = Compared value)

■ 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.



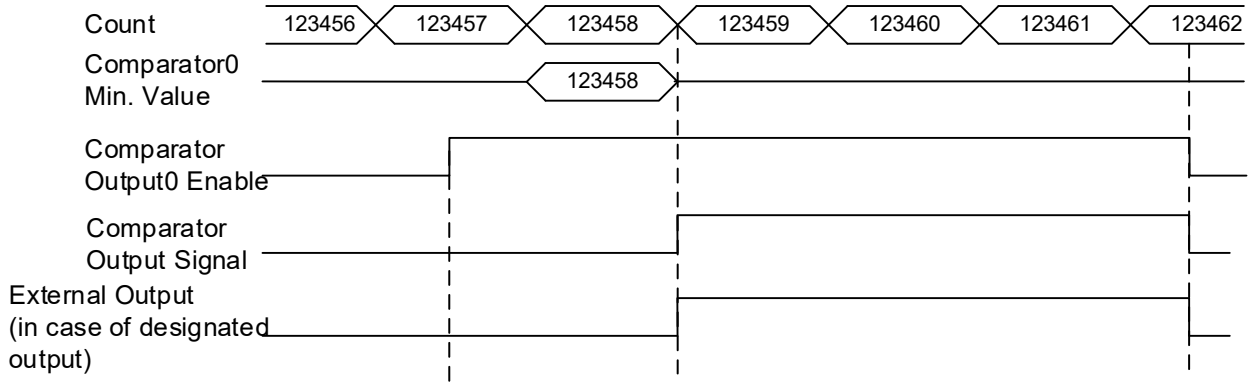
4) Mode 3 (Count value ≥ Compared value)

■ 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)

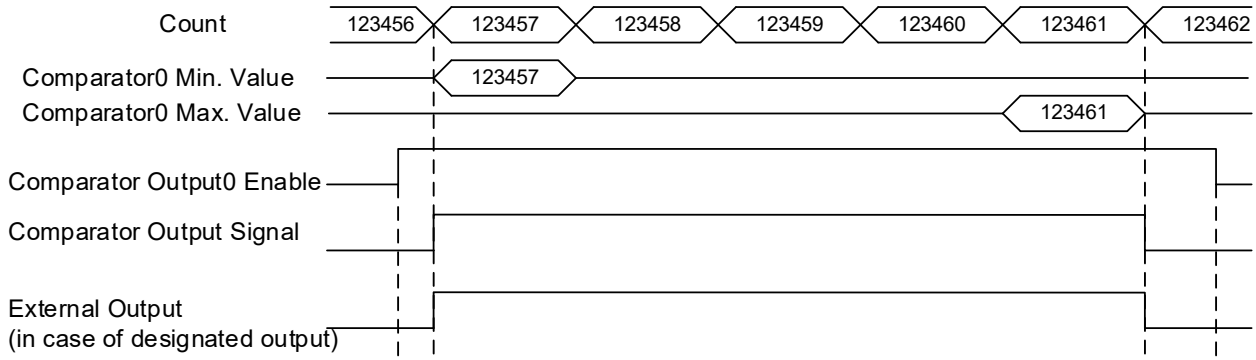
■ If present count value is greater than compared value, output is sent out, and if count value decreases to be less than or equal to compared value, output is not sent out.



6) Mode 5

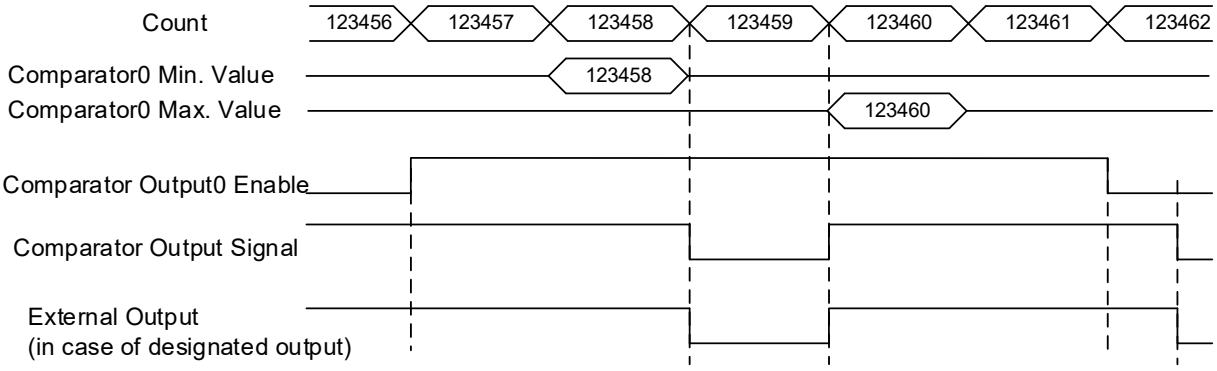
(Compared output Min. set value ≤ Count value ≤ Compared output Max. set value)

■ 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..

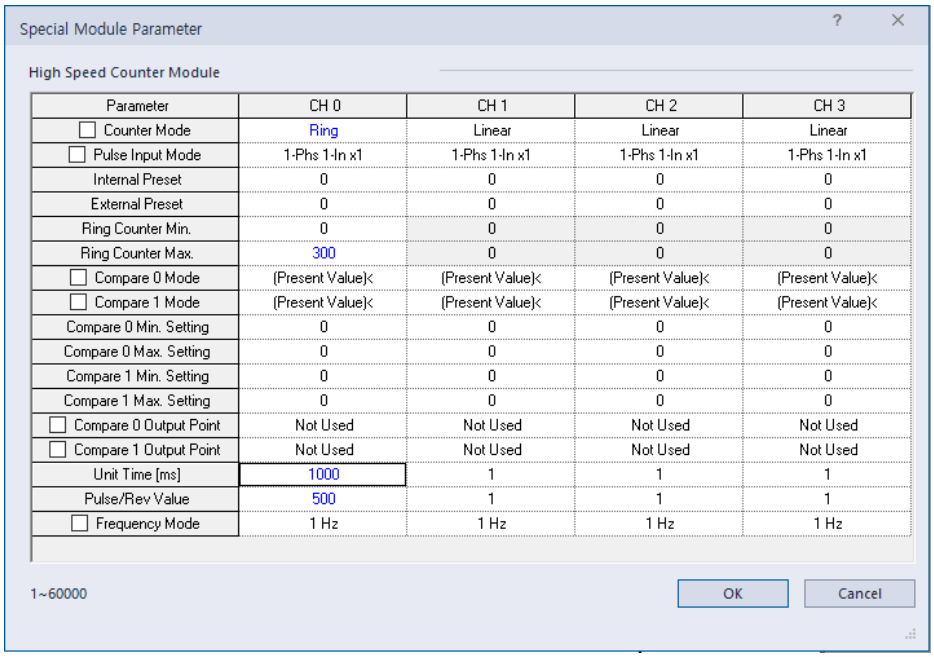
Classification	Device area per channel (BIT)			
	Channel 0	Channel 1	Channel 2	Channel 3
Borrow signal	K2611	K2711	K2811	K2911

(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



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 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

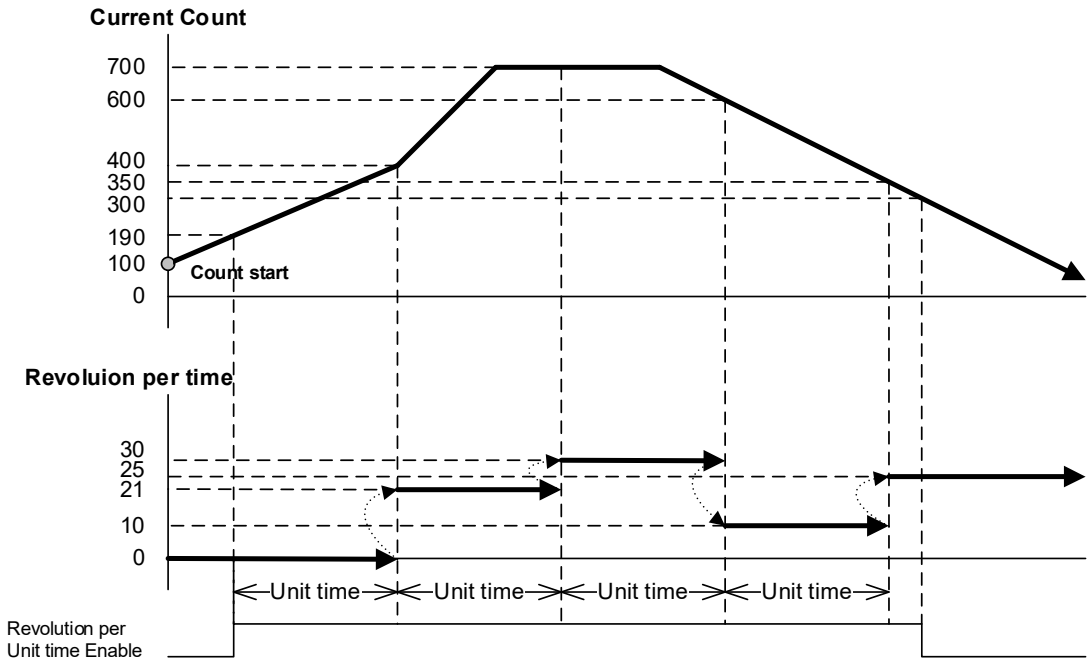
(b) Count function of Revolution per Unit time is used to count the number of pulses for a specified time while Enable signal is On.

$$Input\ pulse\left(\frac{\text{pls}}{\text{sec}}\right) \times \frac{Unit\ time(\text{ms}) \times \frac{1}{1000}}{Pulse/REV(\text{pls})} = \text{pulse per 1 revolution}$$

(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 1 : enabled

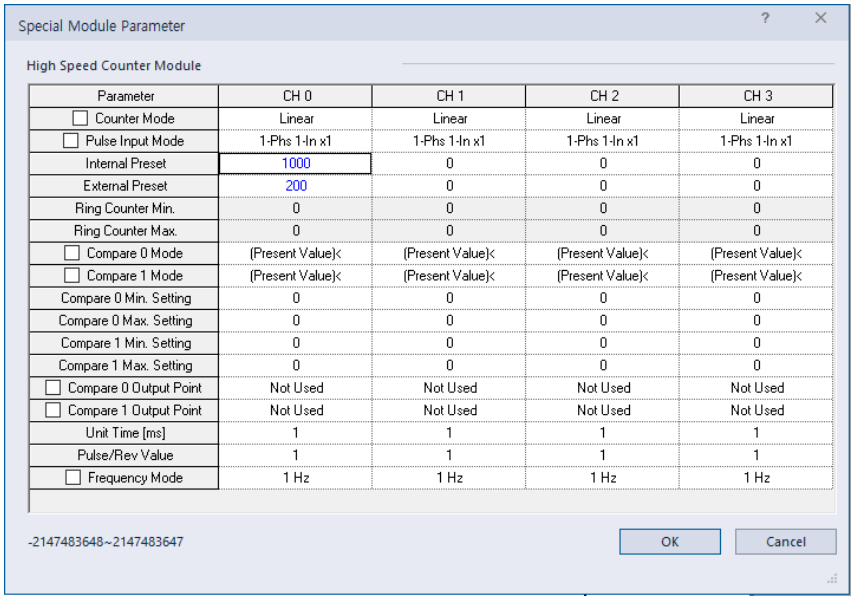
■ The latch counter function operates when the Count Latch Signal is On. In other words, the counter value is not cleared when the power is turned Off and then On, or during a mode change; it continues counting from the previous value.

■ 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).



• 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.

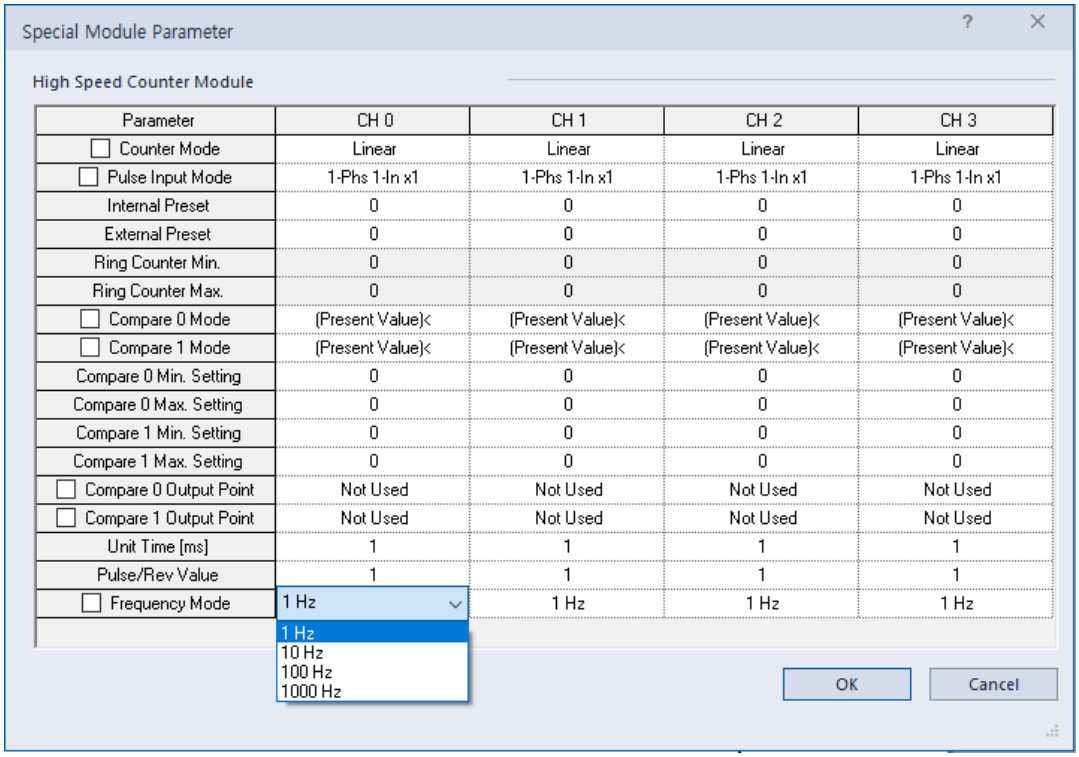
Type	Area per each channel (BIT)				Ref.
	Ch.0	Ch.1	Ch.2	Ch.3	
Internal preset command	K2601	K2701	K2801	K2901	-
External preset allowance	K2602	K2702	K2802	K2902	-
External preset command	P004	P005	P006	P007	-

(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



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 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

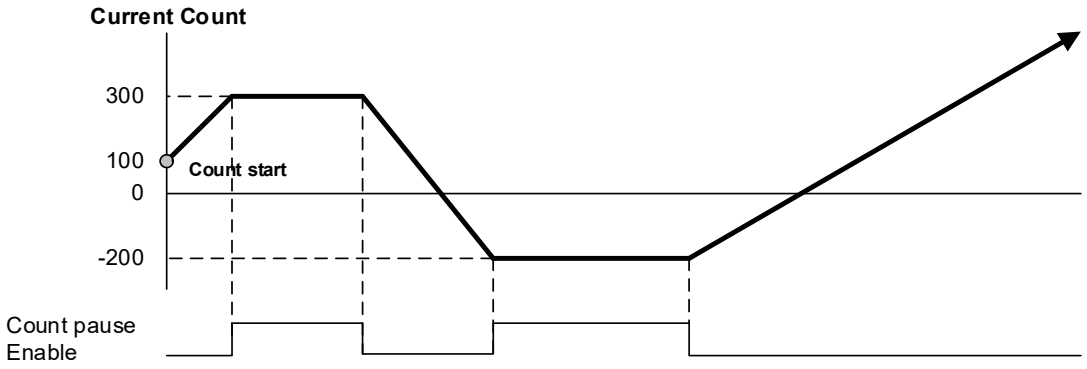
Set number	Hz	Freq. update period[ms]
0	1	1000
1	10	100
2	100	10
3	1000	1

(10) Count pause

Count will not operate during Count pause flag is on.

To use Count pause, set below device as “On”

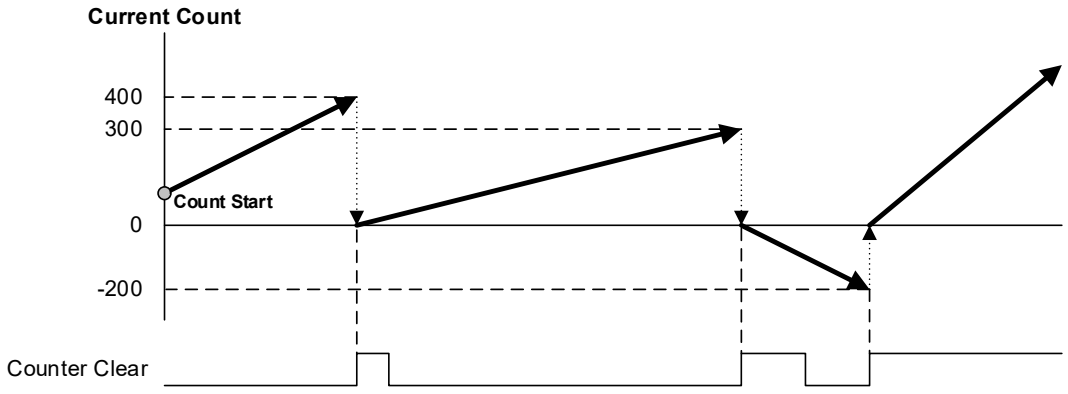
Type	Area per each channel (BIT)				Operation
	Ch.0	Ch.1	Ch.2	Ch.3	
Count pause	K260A	K270A	K280A	K290A	0: Disable 1: Enable



(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 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.

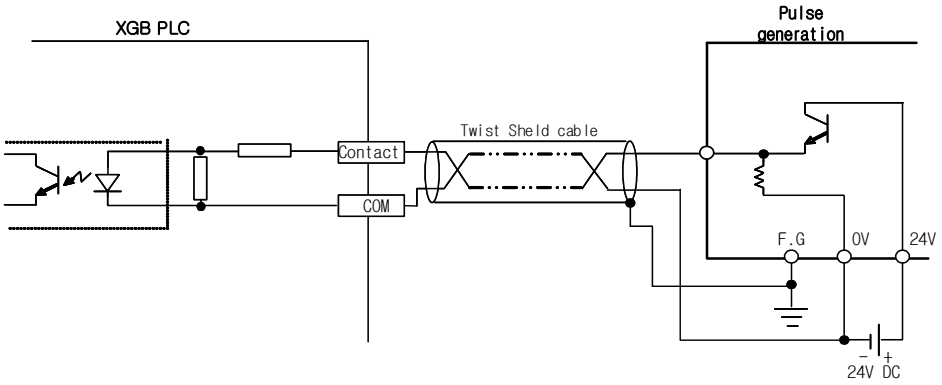
(8) For Phase 1 input, connect only A-Phase.

(9) Route the maximum output distance of the pulse generator and allow it to be as short as possible.

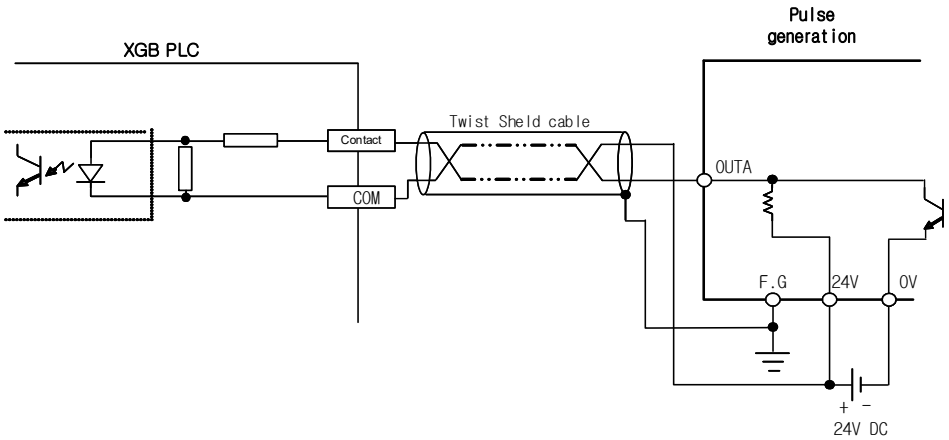
(10) For grounding, perform type 3 grounding.

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) * 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 * 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.

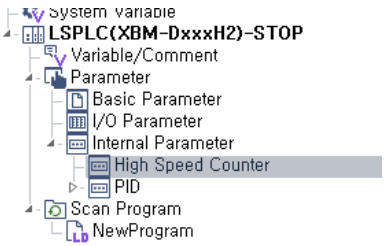
4.4 Examples: Using High-speed Counter

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.

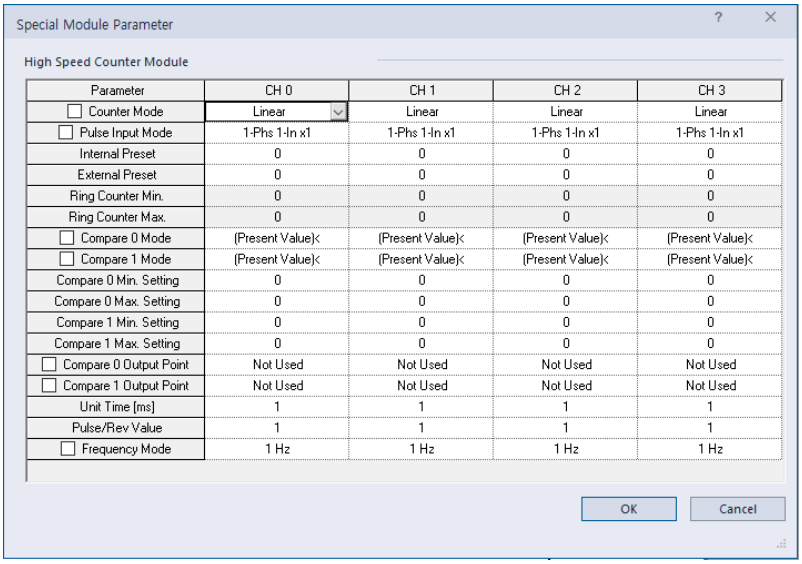
A) Set 『Internal Parameters』 in the basic project window.



B) Selecting high-speed counter opens a window to set high-speed counter parameters as follows.

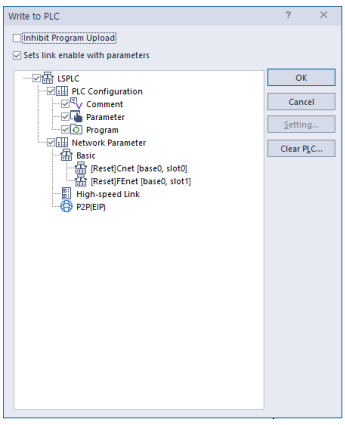
For details regarding each parameter setting, refer to 8.1~8.3.

(Every parameter settings are saved in the K device area.)

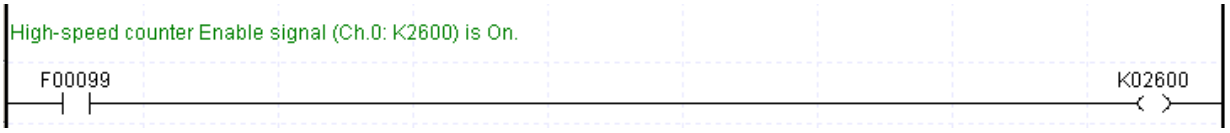


Parameter	CH 0	CH 1	CH 2	CH 3
Counter Mode	Linear	Linear	Linear	Linear
Pulse Input Mode	1-Phs 1-In x1	1-Phs 1-In x1	1-Phs 1-In x1	1-Phs 1-In x1
Internal Preset	0	0	0	0
External Preset	0	0	0	0
Ring Counter Min.	0	0	0	0
Ring Counter Max.	0	0	0	0
Compare 0 Mode	(Present Value)<	(Present Value)<	(Present 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.

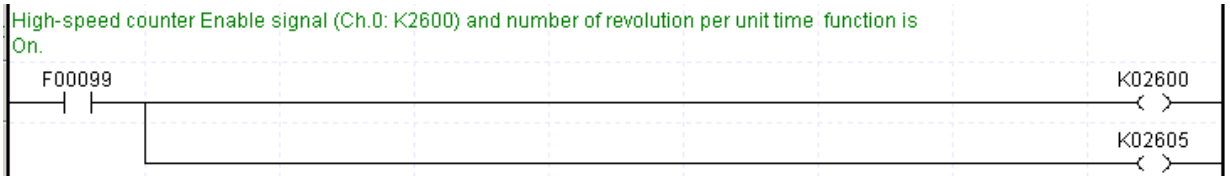


D) Turn on the high-speed counter Enable signal(CH0 : K2600) in the program.



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>

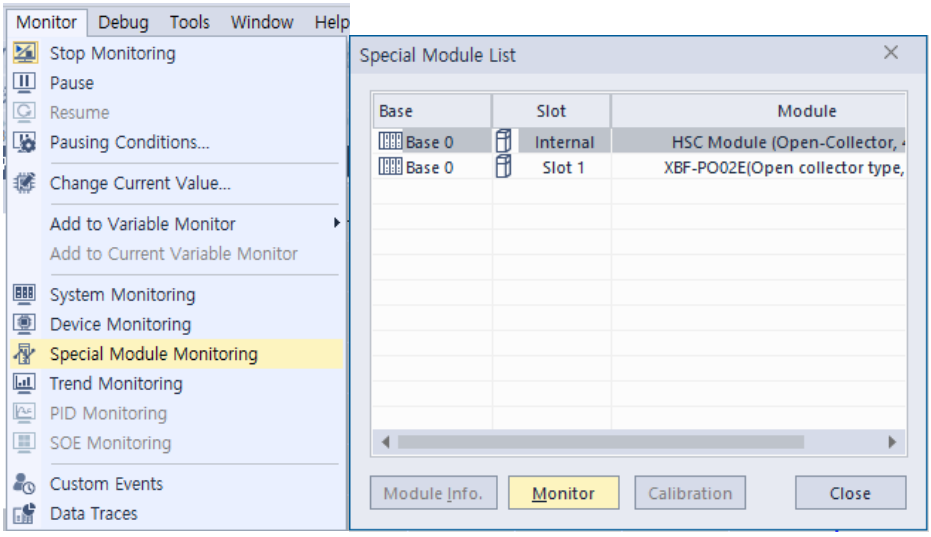
For instance, to use revolution per unit time function, turn on K2605 bit.



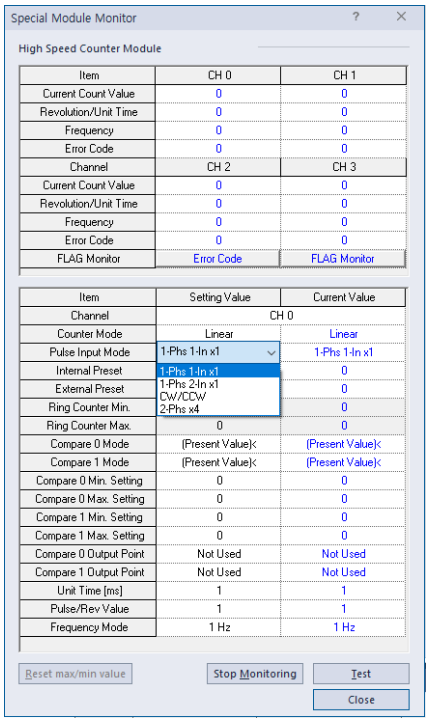
2) Monioring and setting command

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.



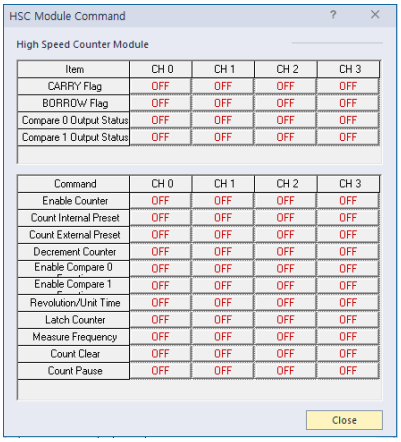
B) Clicking 『Monitor』 shows monitor and test window of high-speed counter.



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)



Chapter 5. Built-in PID Function

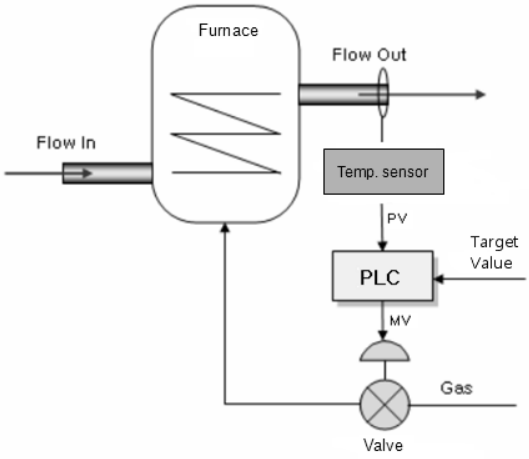
5.1 Features of Built-in PID Function

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.

$$E = SV - PV \quad (5.2.1)$$

$$MV_P = K_P E \quad (5.2.2)$$

$$MV_i = \frac{K_P}{T_i}\int Edt \quad (5.2.3)$$

$$MV_d = K_P T_d \frac{dE}{dt} \quad (5.2.4)$$

$$MV = MV_P + MV_i + MV_d \quad (5.2.5)$$

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.

$$\text{Transfer function} = \frac{32}{(2s+1)(3s+5))} \quad (5.2.6)$$

$$\frac{6}{32}\frac{d^2y(t)}{dt^2} + \frac{13}{32}\frac{dy(t)}{dt} + 5y(t) = x(t) \quad (5.2.7)$$

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.

$$MV_P = E \times K_P \quad (5.2.8)$$

(a) If P control starts, output of controller by initial P operation is as follows.

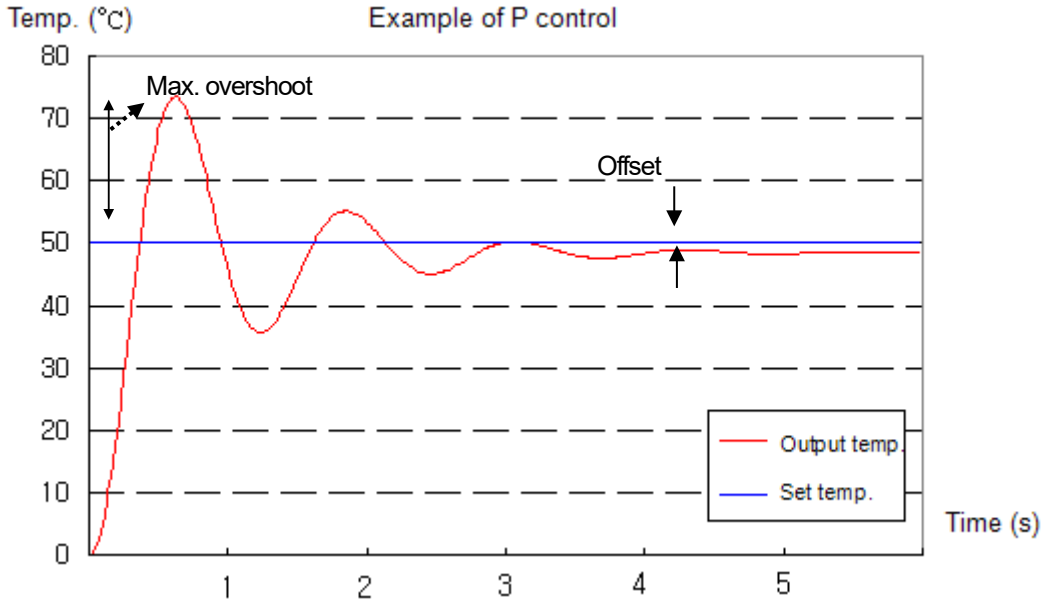
$$MV_0 = 50 \times 5 = 250$$

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 >



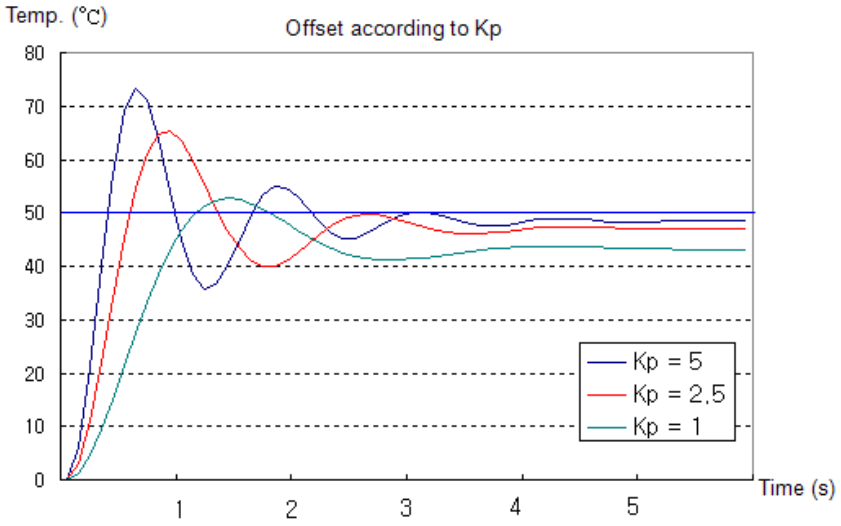
< Figure5.2 simulation of proportional control >

(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.

$$MV = MV_P + MV_i = E \times K_P + \frac{K_P}{T_i}\int Edt \qquad (5.2.10)$$

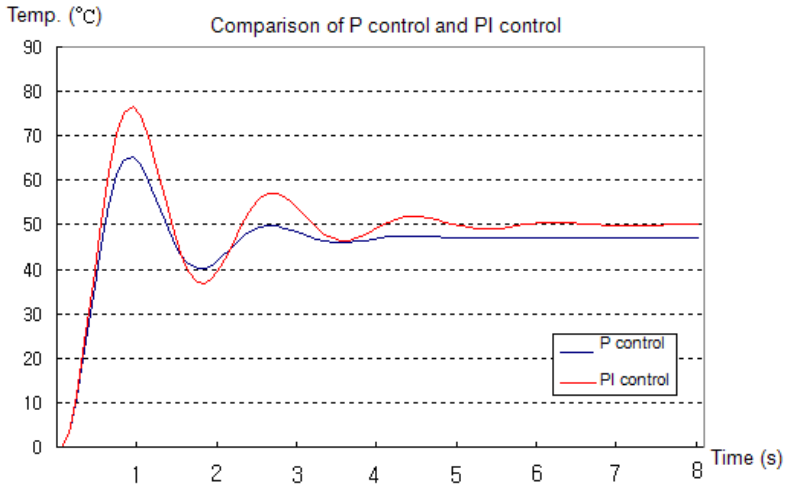
(c) In the above heating system, the simulation results are as shown in the table 5.4 when proportional coefficient is 2.5 and integral time is 1.5s.

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

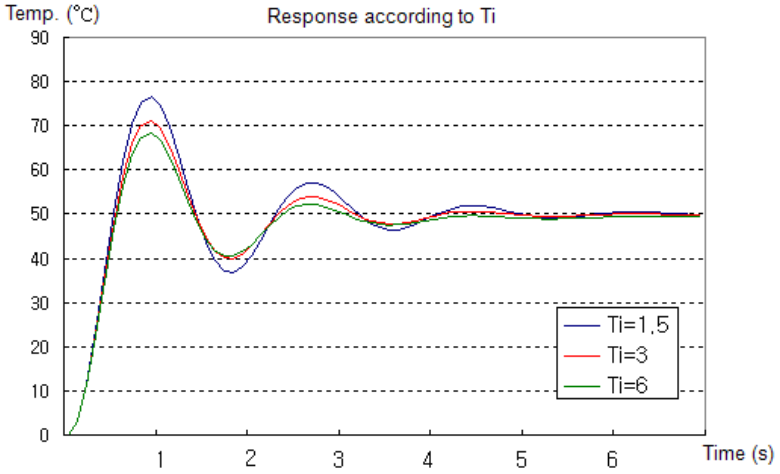
< Table 5.4 Temperature- time table according to P coefficient >

(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.

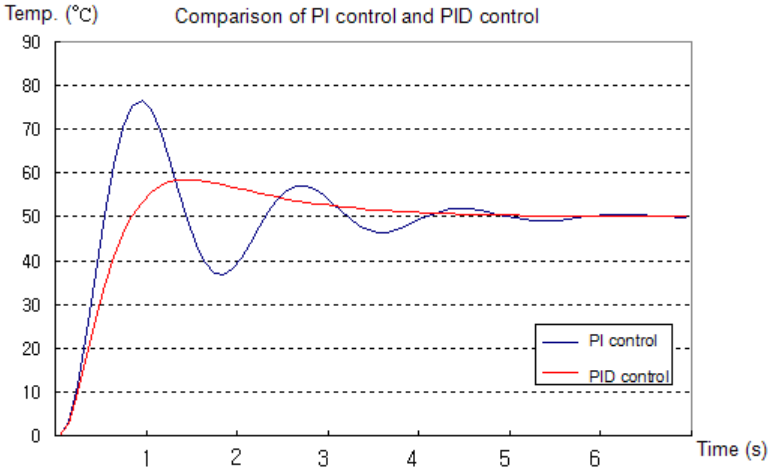
(b) Generally, D control is not used solely but with PD control. So PID control is expressed as expression 5.2.12.

$$MV = MV_P + MV_i + MV_d = E \times K_P + \frac{K_P}{T_i}\int Edt + K_p T_d \frac{dE}{dt} \qquad (5.2.12)$$

(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) Stop: PID RUN Flag Off (by loops)
	Error	Normal: PID Error Flag Off (by loops) Error: PID Error Flag On, Error code occurrence (by loops)
	Warning	Normal: PID Warning Flag Off (by loops) 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

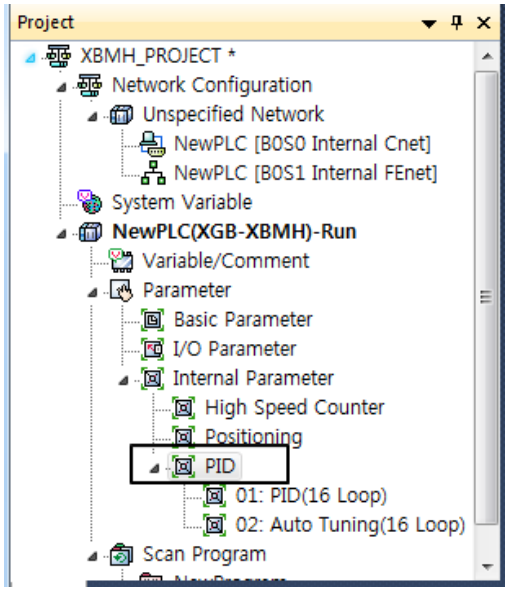
5.4.1 PID Control Parameter Setting

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

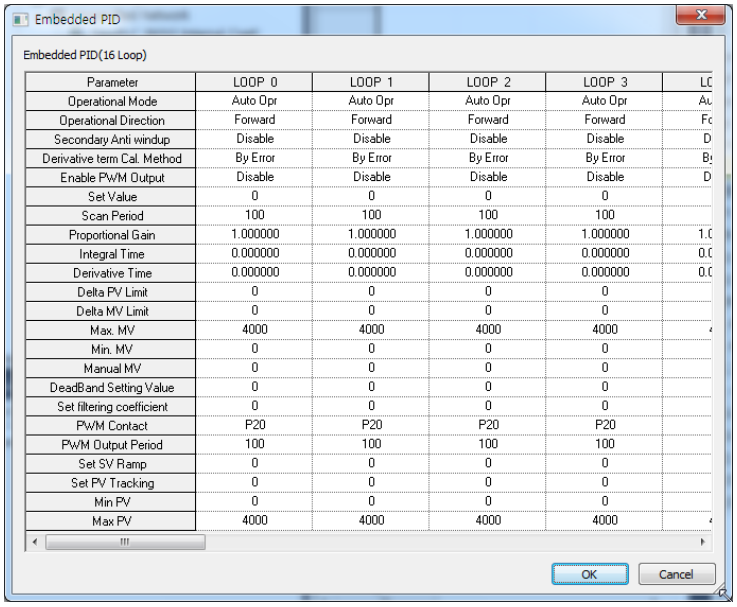
Follow the steps below to set the PID control function parameters of XGB series.

(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	LO
Operational Mode	Auto Opr	Auto Opr	Auto Opr	Auto Opr	Au
Operational Direction	Forward	Forward	Forward	Forward	Fo
Secondary Anti windup	Disable	Disable	Disable	Disable	D
Derivative term Cal. Method	By Error	By Error	By Error	By Error	By
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	1.0
Integral Time	0.000000	0.000000	0.000000	0.000000	0.0
Derivative Time	0.000000	0.000000	0.000000	0.000000	0.0
Delta PV Limit	0	0	0	0	
Delta MV Limit	0	0	0	0	
Max. MV	4000	4000	4000	4000	4
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	4

[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.

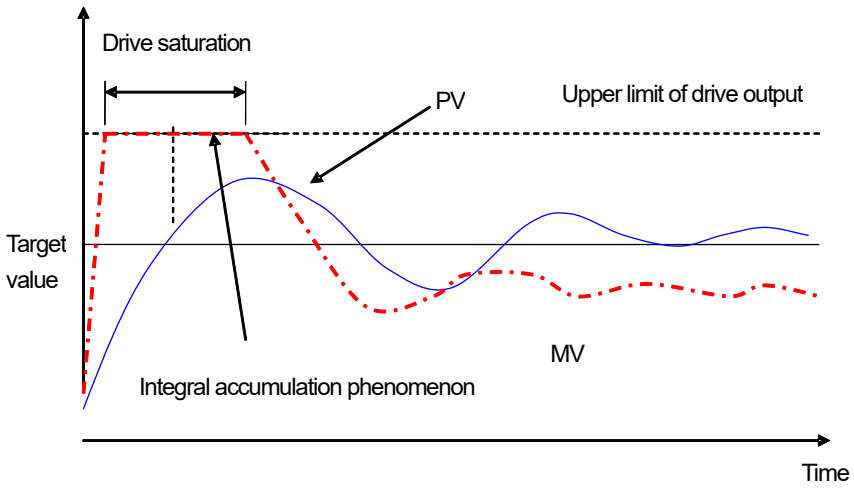
(b) Operation direction

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

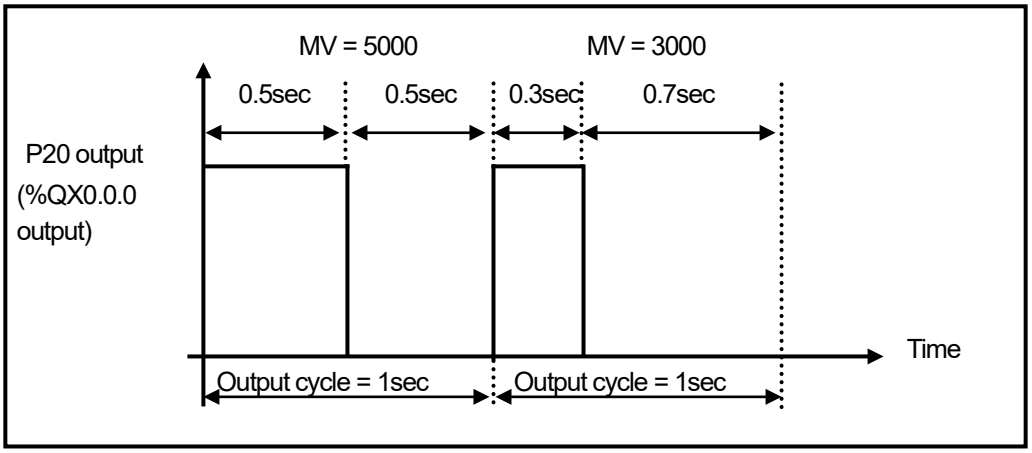
PWM output means an output method to turn a junction on – off with a duty proportional to control output calculated by a uniform output cycle. If PWM output is enabled, it realizes PWM output in accordance with PWM output cycle set in the parameter of PWM output junction(P20 ~ P3F) designated in the 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

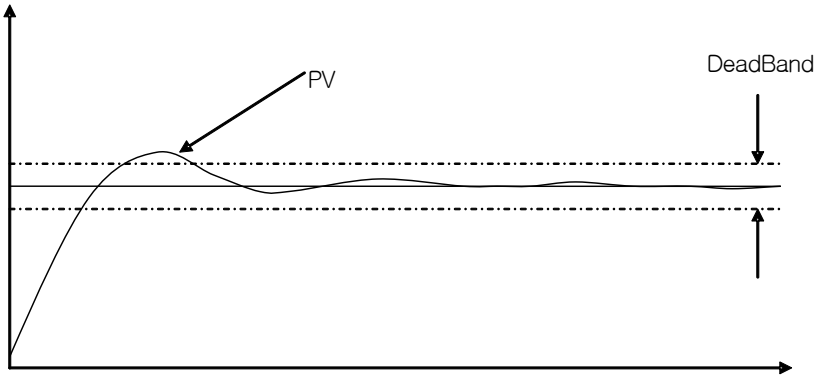
It sets the min. value of control output that may be output by the result of PID operation. The available scope is between -32,768 ~ 32,767. If it is smaller than the min. output value designated by PID operation result, it outputs the set min. MV and alerts the min. output shortage warning. For the 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.

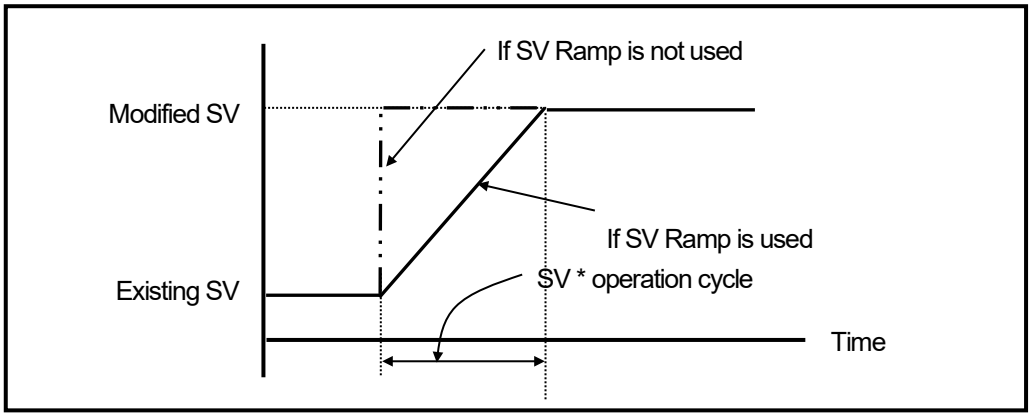
That is, in this case, the change of MV is reduced. The available scope of setting is between 0 ~ 65,535 and if it is set as 0, it does not work.

(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 (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 (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 (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 (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 (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 t _PIDxx_SV (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 (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 (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 (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 (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 (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 (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 (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 (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 (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 (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 (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 (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 (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 (MV proportional control component)	K1246+16*xx	%KW1246+16*xx	INT	-32,768 ~ 32,767
_PIDxx_MV_i (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 (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 (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 (SV of the present cycle)	K1250+16*xx	%KW1250+16*xx	INT	Unavailable

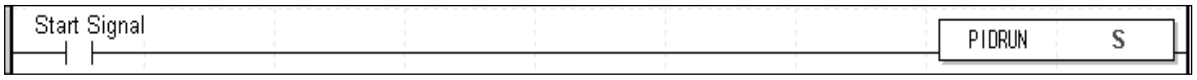
It indicates SV currently running of 'xx' th loop. If SV is changing due to SV ramp or PV follow-up function, it shows the currently changing PV. The flag, as a dedicated monitoring, is updated although a user directly enters it.

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

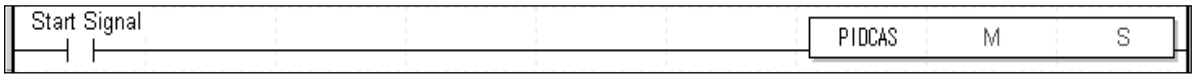
PIDRUN is used to execute PID control by loops.



- 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.

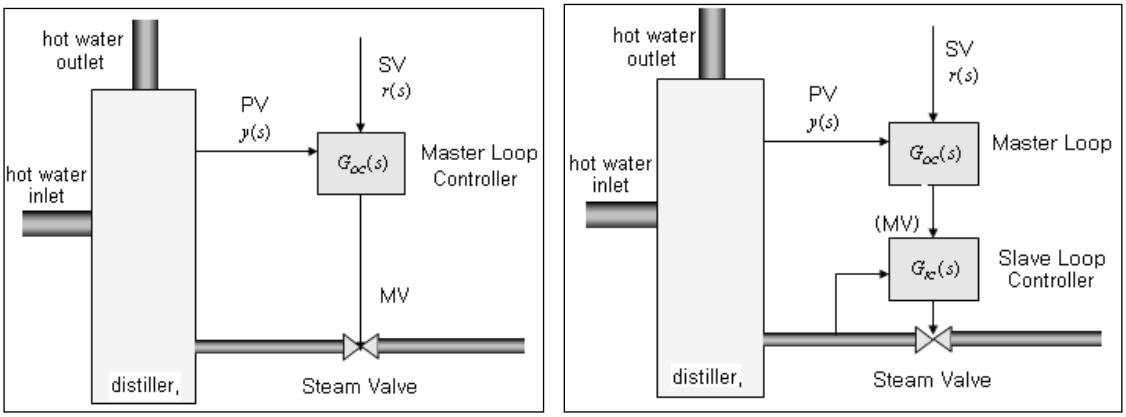
(2) PIDCAS

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.



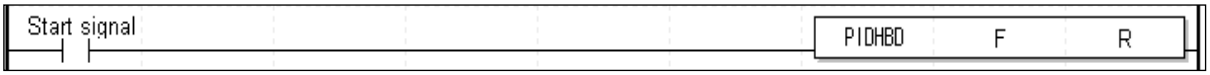
[Figure 5.13 Comparison of single loop control and cascade control]

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.

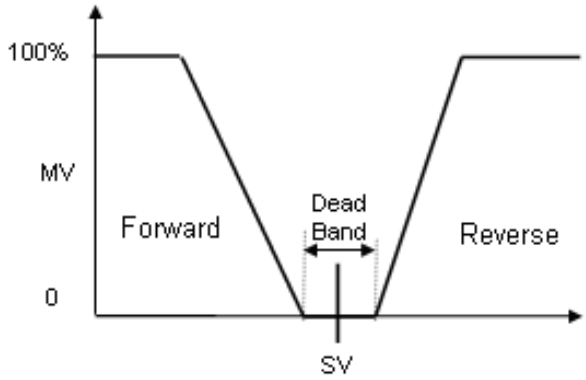
The mixed forward/reverse control is called a control method to control forward operation control output and reverse operation control operation alternatively to a single control process. The XGB built-in PID control enables the mixed forward/reverse control by connecting two PID control loops set as 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

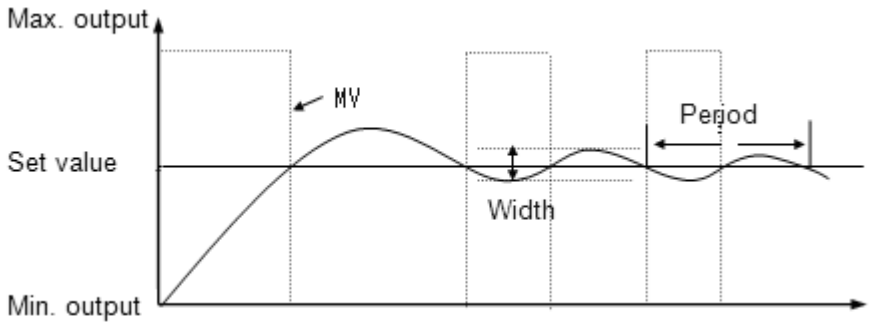
5.6.1 Basic Theory of PID Auto-tuning

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 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]

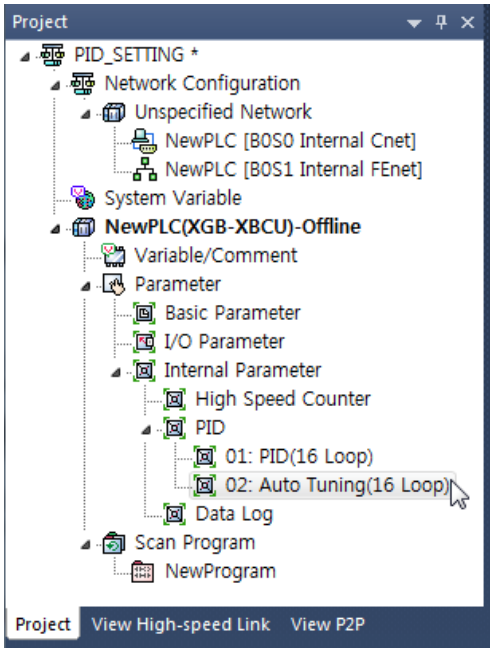
5.6.3 Auto-tuning Parameter Setting

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

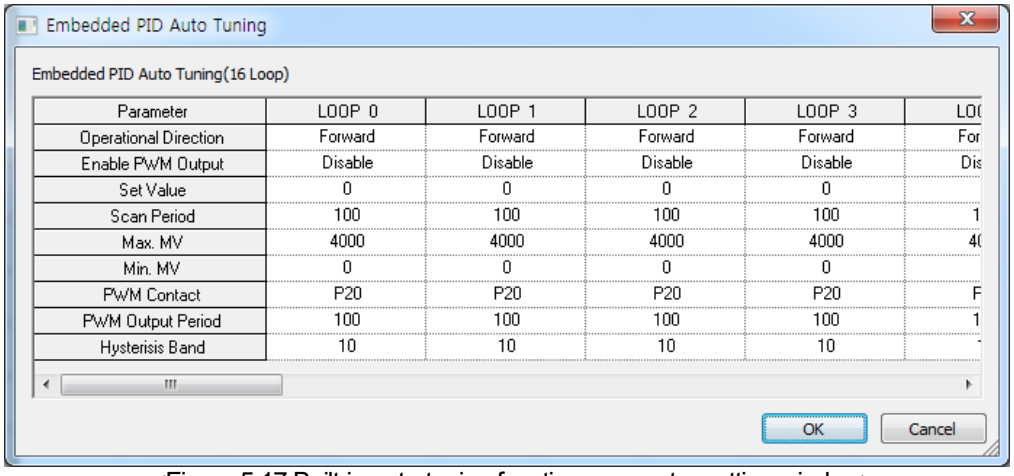
To set the parameters of XGB series auto-tuning function, follow the steps.

(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.



<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

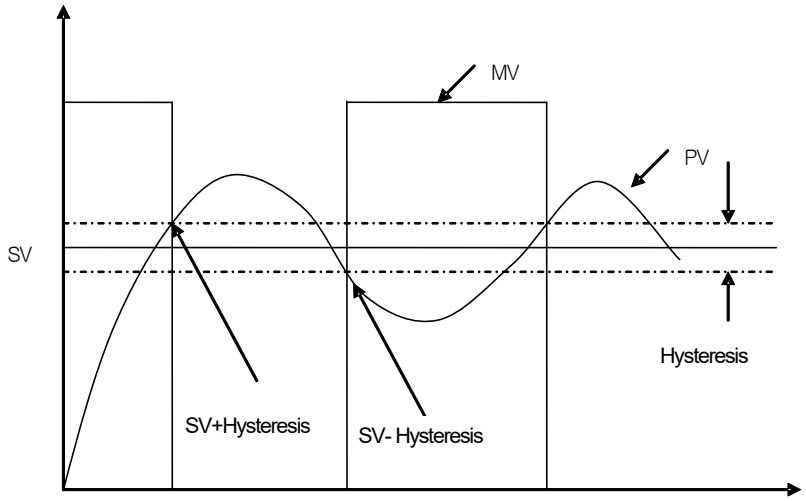
It sets the cycle to execute operation for auto-tuning. The setting cycle is 0.1ms and available between 10ms ~ 6553.5ms (setting value: 100 ~ 65,535) while it is set at a unit of integer per 0.1ms.

(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 ~%KX29711	_AT_REV	Bit	Forward	Auto-tuning direction(0:forward, 1:reverse)
	K18570~F	%KX29712 ~%KX29727	_AT_PWM_EN	Bit	Disable	PWM output enable(0:disable, 1:enable)
	K18580~F	%KX29728 ~%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 ~%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 (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 (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 (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 (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 (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 (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 (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 (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 (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 (proportional coefficient)	K1869+16*xx	%KD934+20*xx	Real	Unavailable
_ATxx_T_i (integral time)	K1871+16*xx	%KD1004+20*xx		
_ATxx_T_d (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

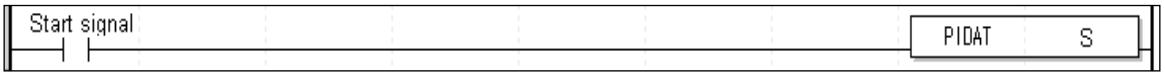
It is the area to output MV of 'xx' th auto-tuning loop. Every auto-tuning cycle, it saves XGB auto-tuning and it delivers the value in the area by using commands like MOV in a program and operates a drive every scanning.

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.

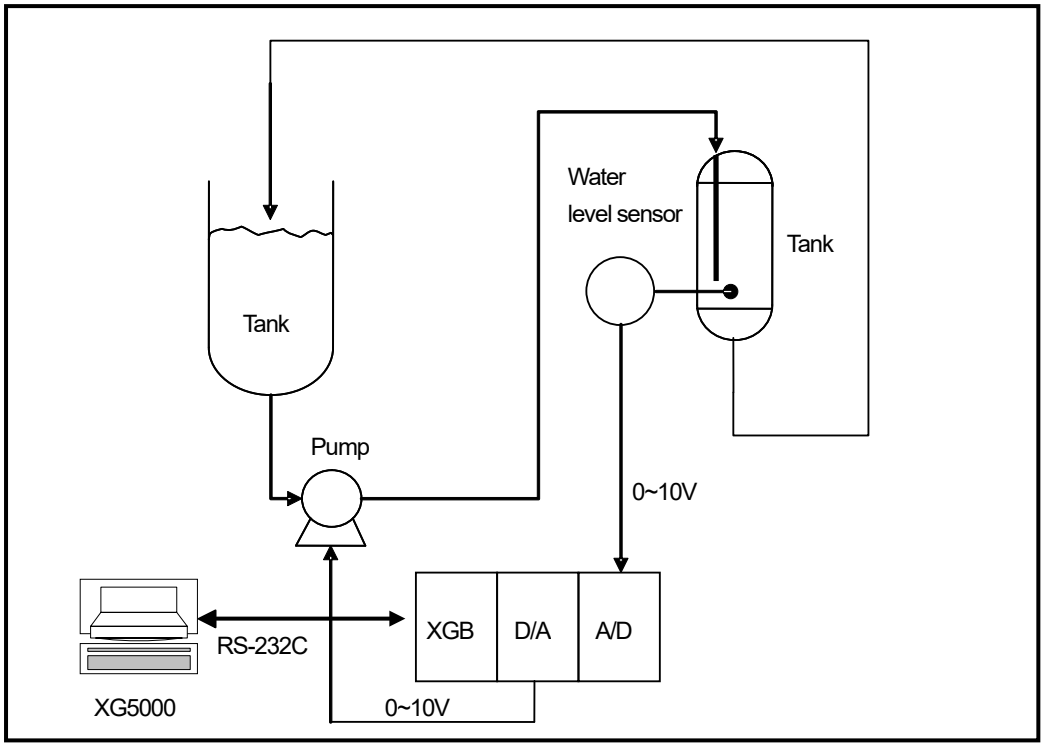


- Operand S means the loop no. to execute auto-tuning and avaiable only for constant(0~15).
- If start signal contact is on, the PID control of a loop starts.

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)

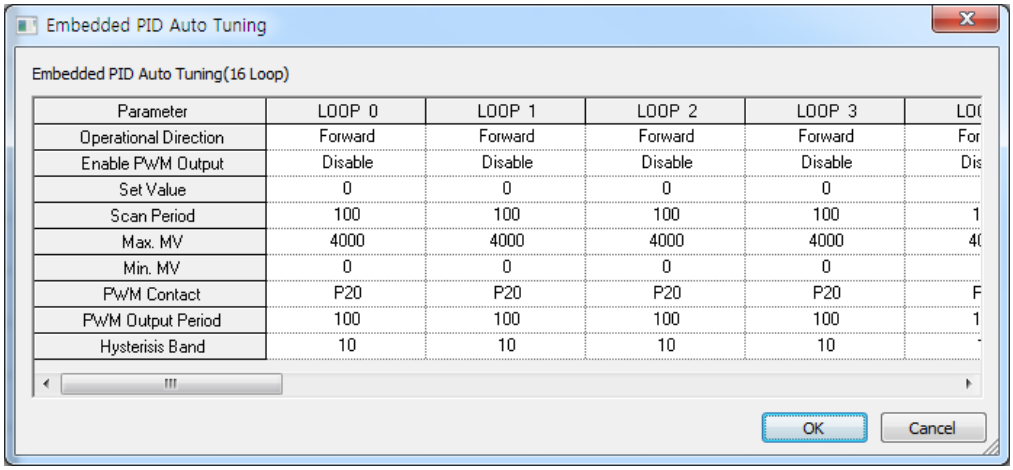
A drive uses a pump that receives control output of XGF-DV04A and of which rotation velocity is variable. For accurate PID control, the output scope of XBF-DV04A (0~10V) should be same with that of a pump's control input. The example uses a pump that receives its control input between 0 ~ 10V.

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.



[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.

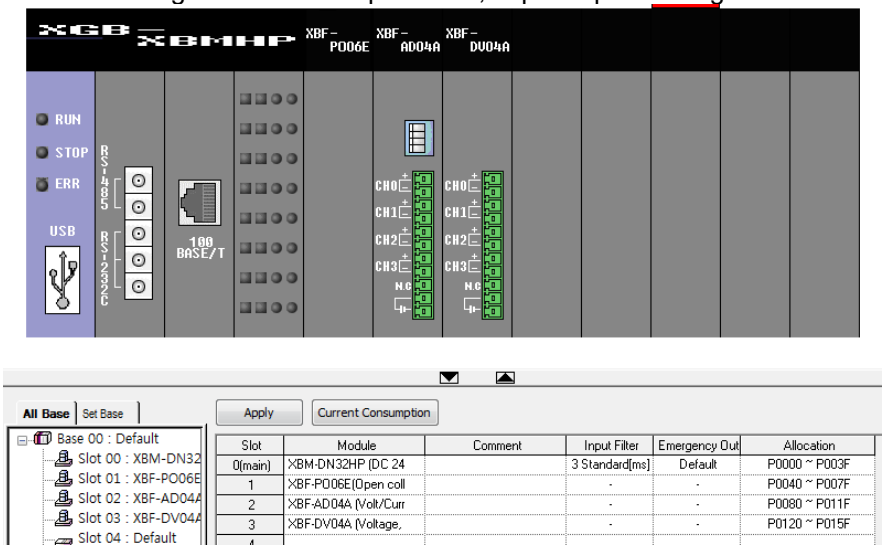
• Min. MV: 0
  - Min. MV is set as 0. If MV is 0, XBF-DV04A outputs 0V.

• PWM junction, PWM output cycle
  - It is not necessary to set it because the example does not use PWM output.

• Hysteresis setting: 10

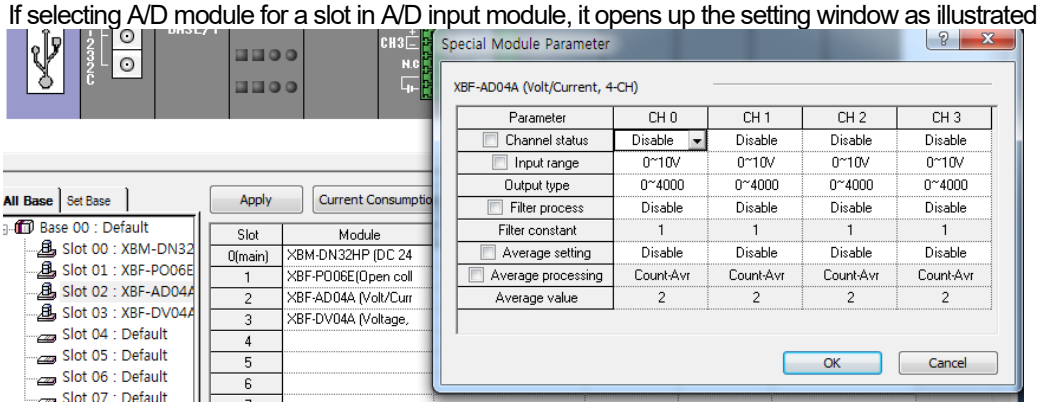
(2) A/D input module parameter setting

(a) If double-clicking Parameter – I/O parameter, it opens up the setting window as illustrated in figure 5.19.



[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.



[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.

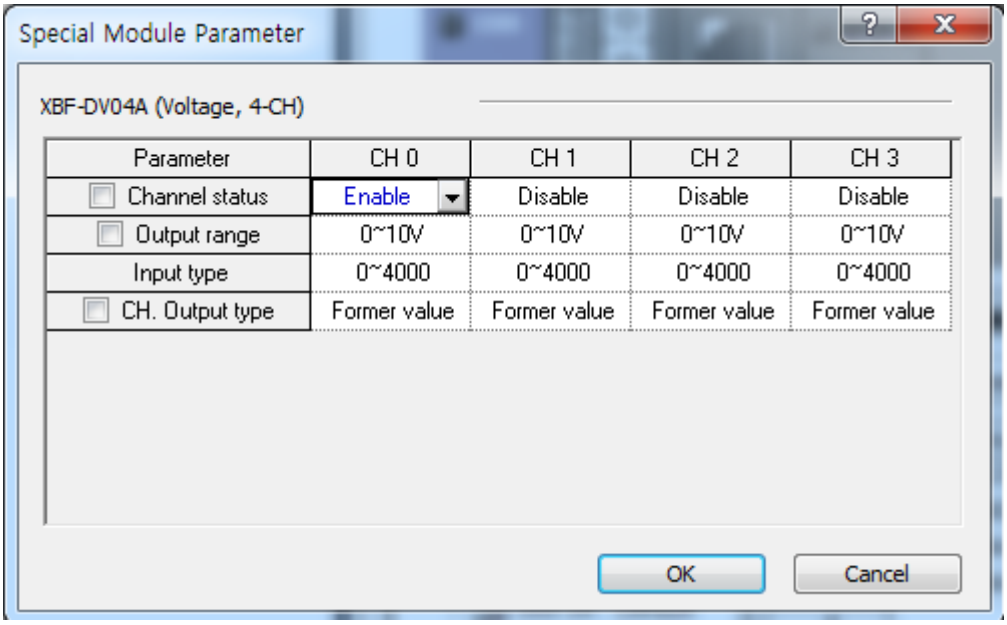
- Input scope: 0 ~ 10V
  - Set XBF-AD04A input scope as 0 ~ 10V so that it should be identical with the output scope of water level sensor.

- 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

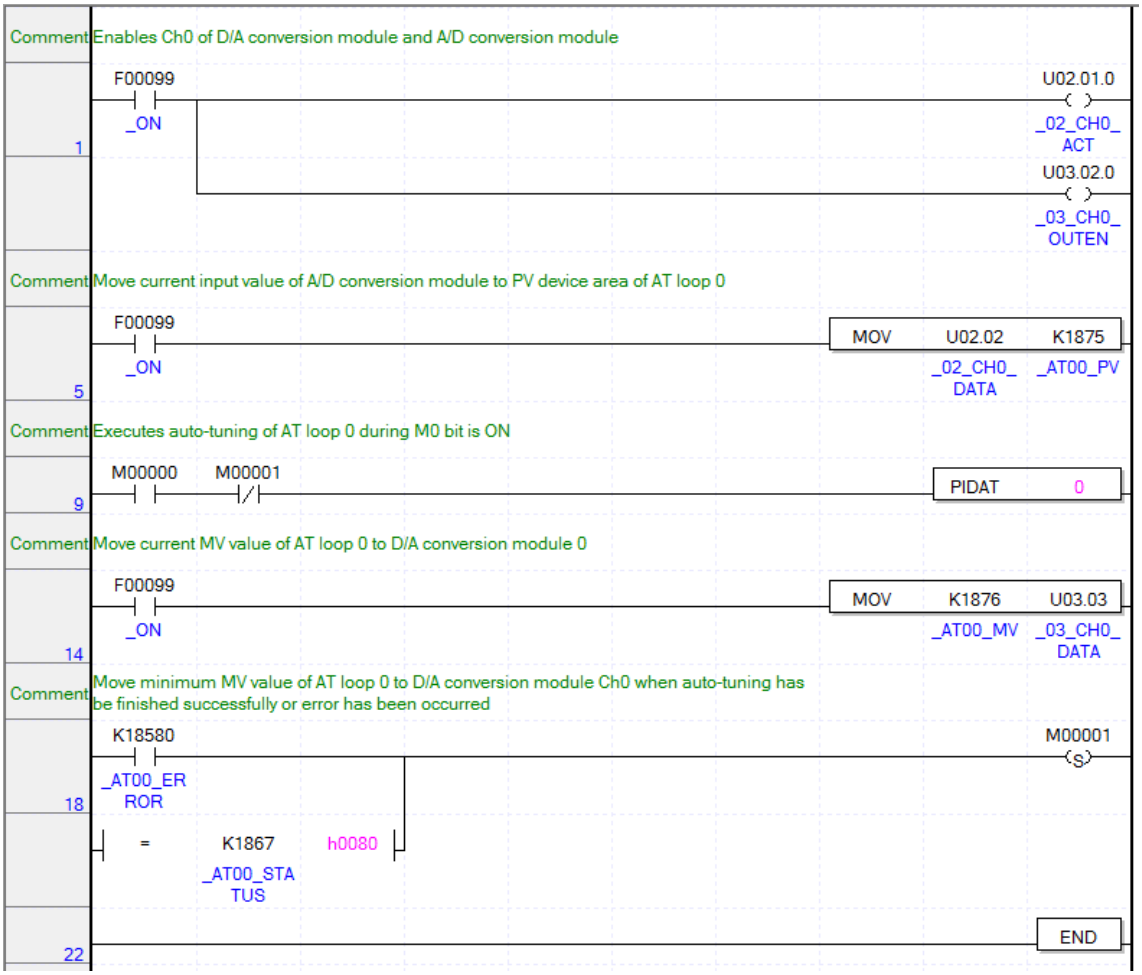
(a) Set the parameter of D/A output module(XBF-DV04A) that output MV to a drive.
How to set them is as same as A/D input module. In the example, it is set as follows.



- 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.



< 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.

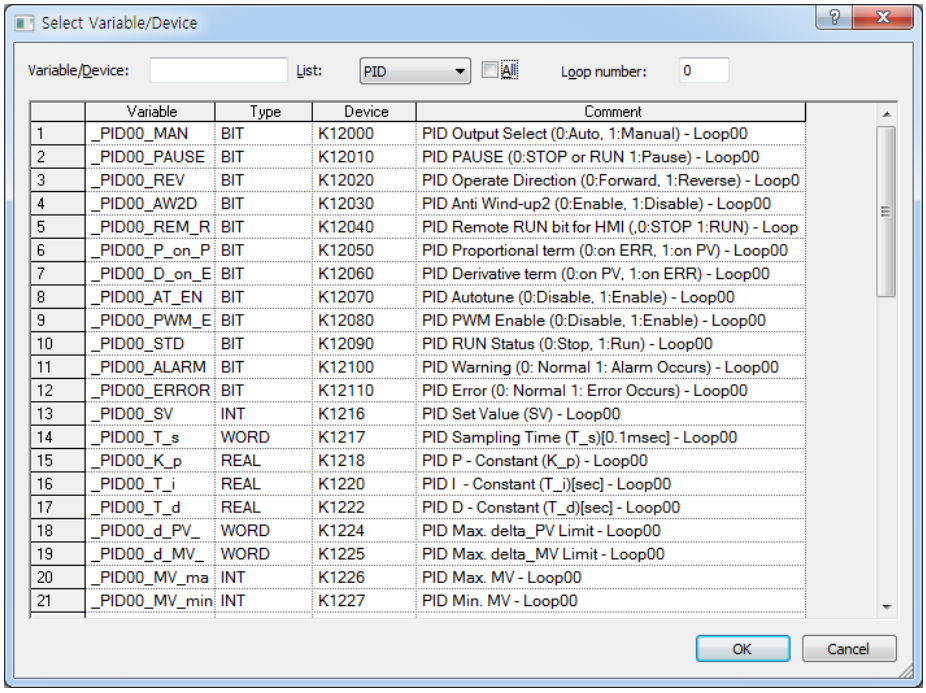
3) Once M0000 junction is on, the auto-tuning of loop 0 starts.
4) The auto-tuning MV of loop 0 that is output by PIDAT command is output to D/A output module by line 14 MOV command.
5) If auto-tuning is complete or there is any error during auto-tuning, M0001 junction is set, blocking operation of PIDAT 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]

Monitor 2

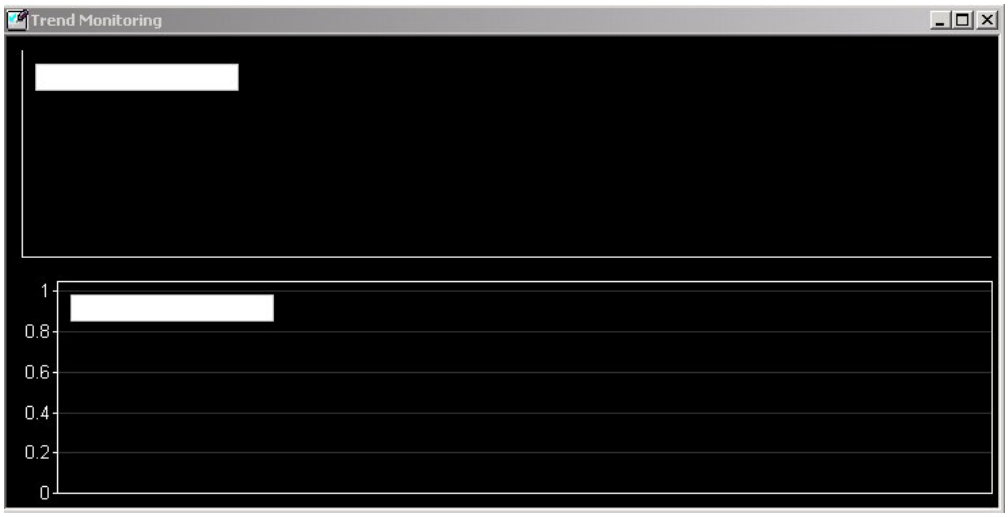
	PLC	Program	Device/Variable	Value	Type	Variable/Device	Comment
1	NewPLC	<GLOBAL>	K18560		BIT	_AT00_REV	AT Direction (0:Forward, 1:Re
2	NewPLC	<GLOBAL>	K18570		BIT	_AT00_PWM_EN	AT PWM Enable (0:Disable, 1
3	NewPLC	<GLOBAL>	K18580		BIT	_AT00_ERROR	AT Error (0: Normal 1: Error Oc
4	NewPLC	<GLOBAL>	K1860		INT	_AT00_SV	AT Set Value (SV) - Loop00
5	NewPLC	<GLOBAL>	K1861		WORD	_AT00_T_s	AT Sampling Time (T_s)[0.1ms
6	NewPLC	<GLOBAL>	K1862		INT	_AT00_MV_max	AT Max. MV - Loop00
7	NewPLC	<GLOBAL>	K1863		INT	_AT00_MV_min	AT Min. MV - Loop00
8	NewPLC	<GLOBAL>	K1864		WORD	_AT00_PWM	AT PWM Output Point - Loop
9	NewPLC	<GLOBAL>	K1865		WORD	_AT00_PWM_Prd	AT PWM Output Period - Loo
10	NewPLC	<GLOBAL>	K1866		WORD	_AT00_HYS_val	AT Hysteresis value - Loop00
11	NewPLC	<GLOBAL>	K1867		WORD	_AT00_STATUS	AT Status (Do not Set) - Loop
12	NewPLC	<GLOBAL>	K1868		WORD	_AT00_ERR_CODE	AT Error Code - (Do not Set) -
13	NewPLC	<GLOBAL>	K1869		REAL	_AT00_K_p	AT Result P - Constant (K_p)
14	NewPLC	<GLOBAL>	K1871		REAL	_AT00_T_i	AT Result I - Constant (T_i)[s
15	NewPLC	<GLOBAL>	K1873		REAL	_AT00_T_d	AT Result D - Constant (T_d)[
16	NewPLC	<GLOBAL>	K1875		INT	_AT00_PV	AT Process Value (PV) - Loop
17	NewPLC	<GLOBAL>	K1876		INT	_AT00_MV	AT Manipulated Value (MV) -

[Figure 5.23 Auto-tuning variables registered]

(5) Observing RUN status by using trend monitor function

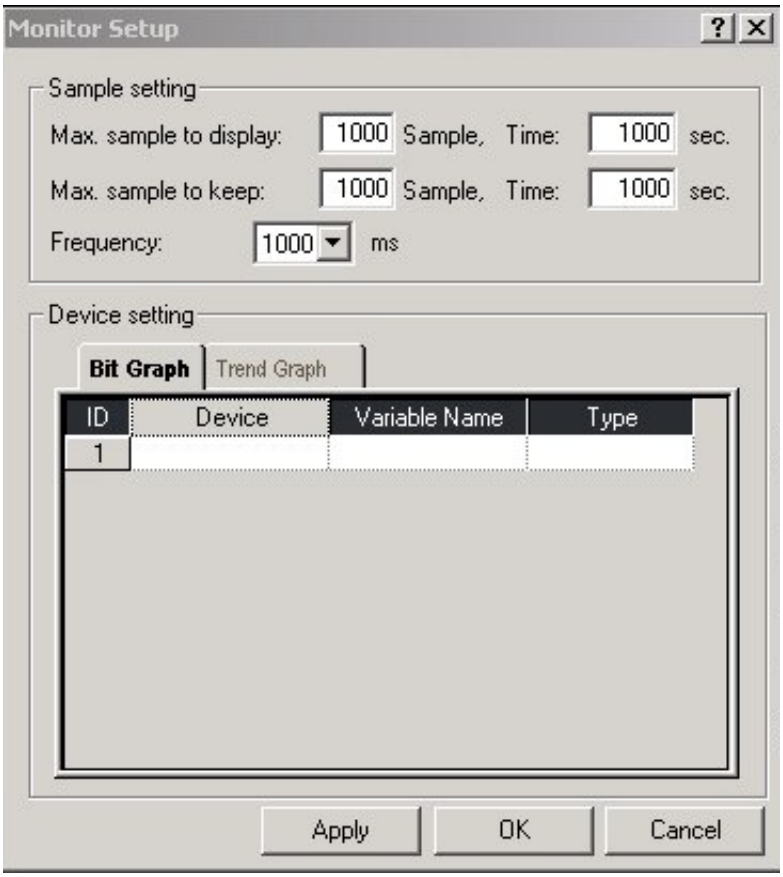
Since it is possible to monitor the operation status of XGB series built-in auto-tuning graphically, it is useful to monitor the operation status of auto-tuning clearly.

(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.



[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

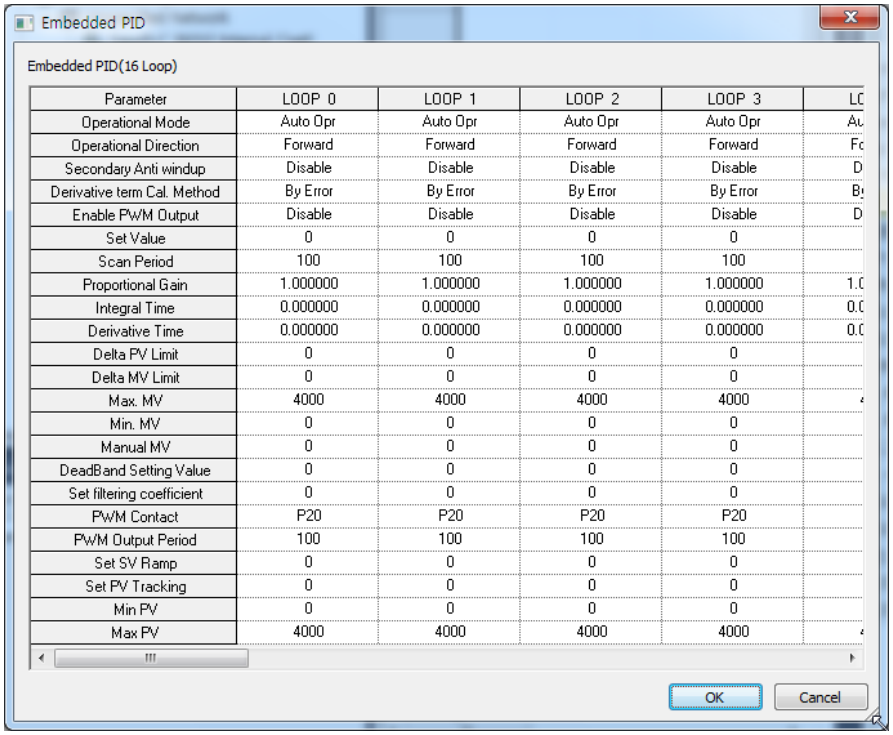
▪ PID auto-tuning parameters are set as same as examples of 5.4.2 Example of PID Auto-tuning.

(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.



Parameter	LOOP 0	LOOP 1	LOOP 2	LOOP 3	LO
Operational Mode	Auto Opr	Auto Opr	Auto Opr	Auto Opr	Au
Operational Direction	Forward	Forward	Forward	Forward	Fo
Secondary Anti windup	Disable	Disable	Disable	Disable	D
Derivative term Cal. Method	By Error	By Error	By Error	By Error	By
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	1.0
Integral Time	0.000000	0.000000	0.000000	0.000000	0.0
Derivative Time	0.000000	0.000000	0.000000	0.000000	0.0
Delta PV Limit	0	0	0	0	
Delta MV Limit	0	0	0	0	
Max. MV	4000	4000	4000	4000	4
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	4

[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.

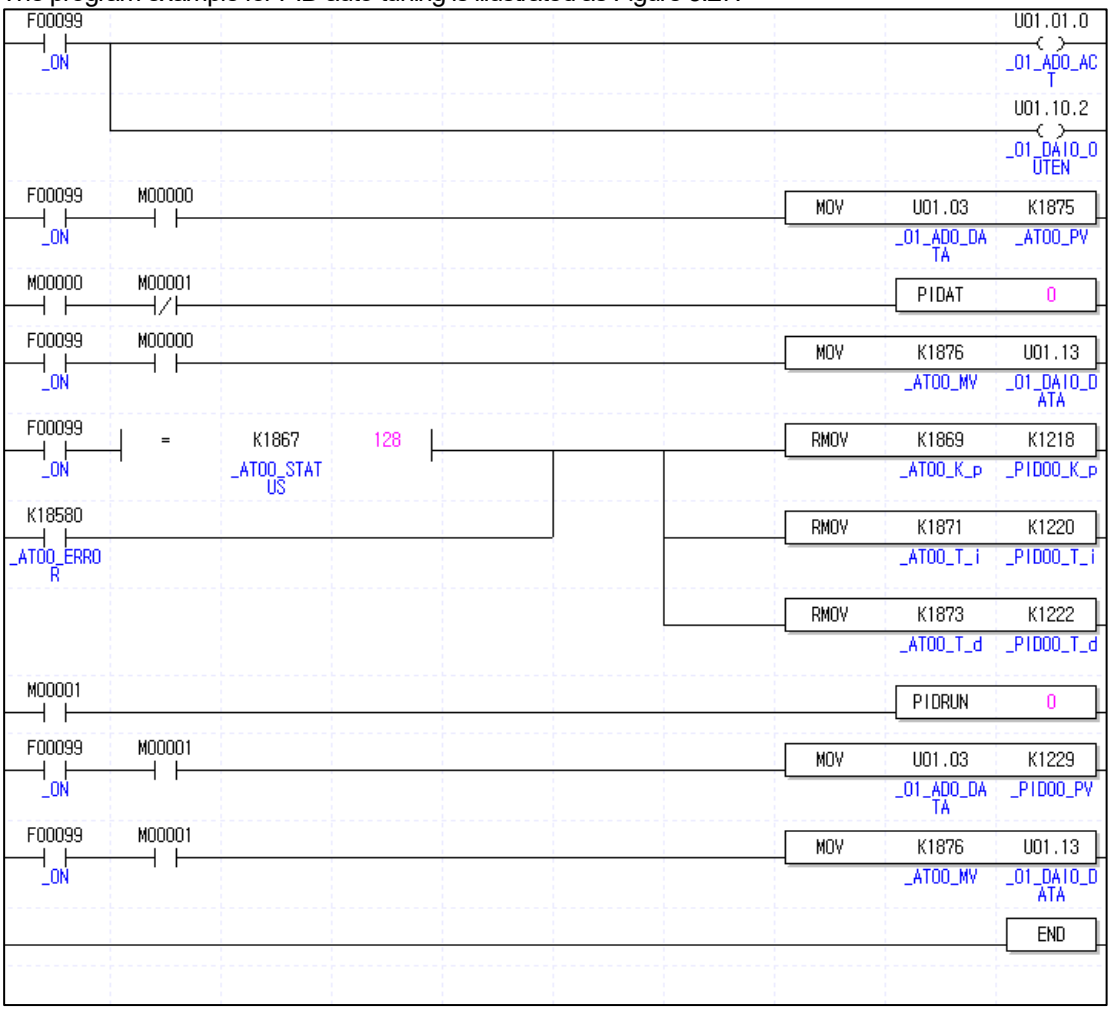
- PWM junction, PWM output cycle
  - It is not necessary to set them because the example does not use PWM output.

- 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. 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.

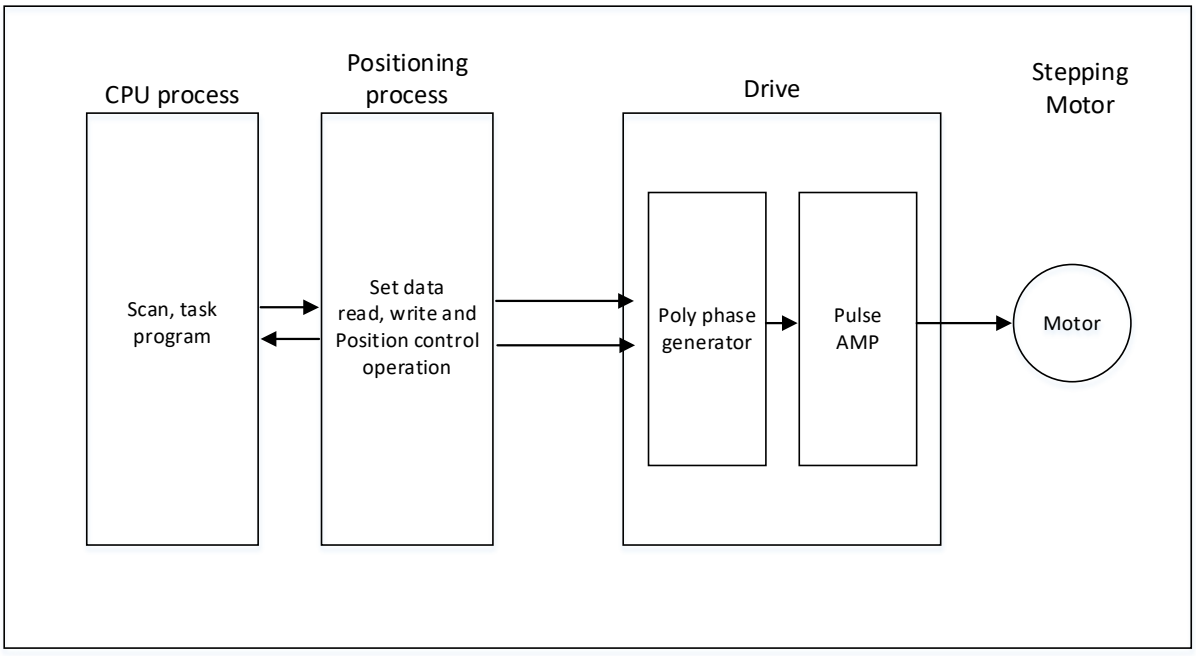


Fig. 1.1 Overview of Position Control for Stepping Motor

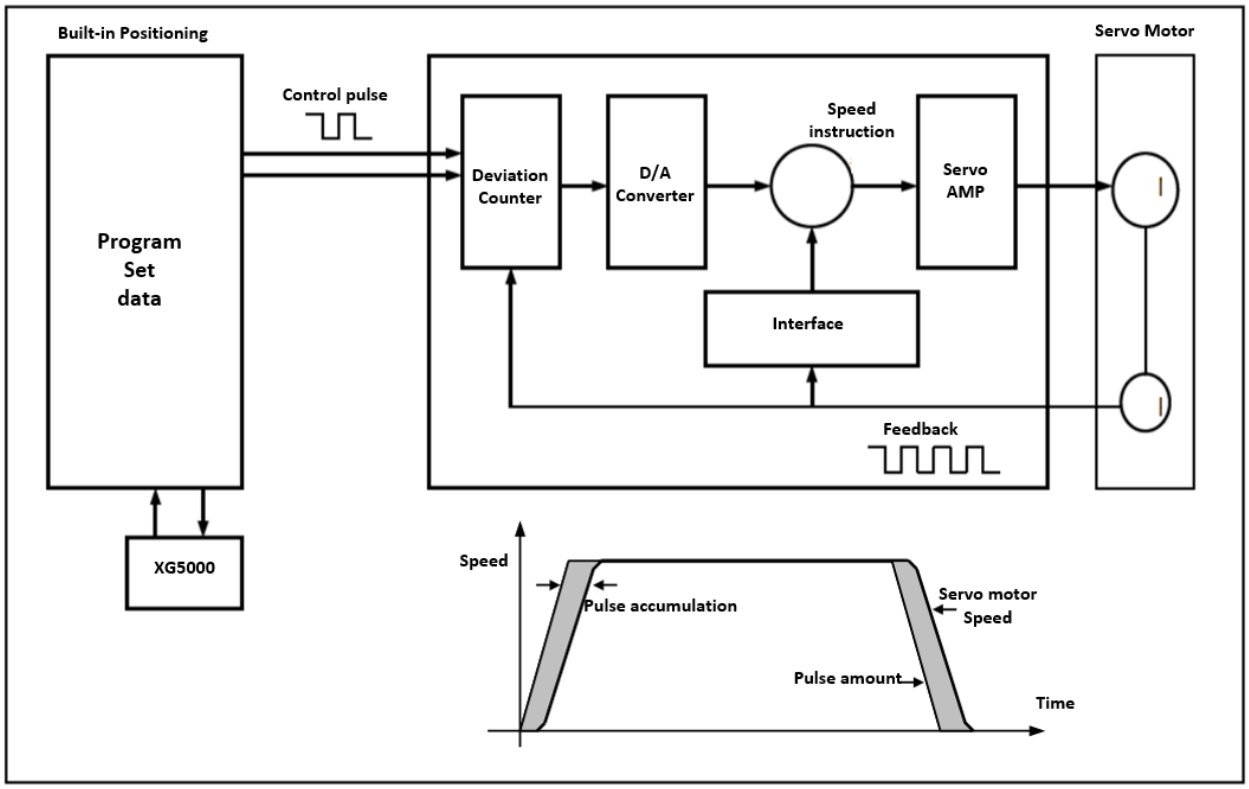
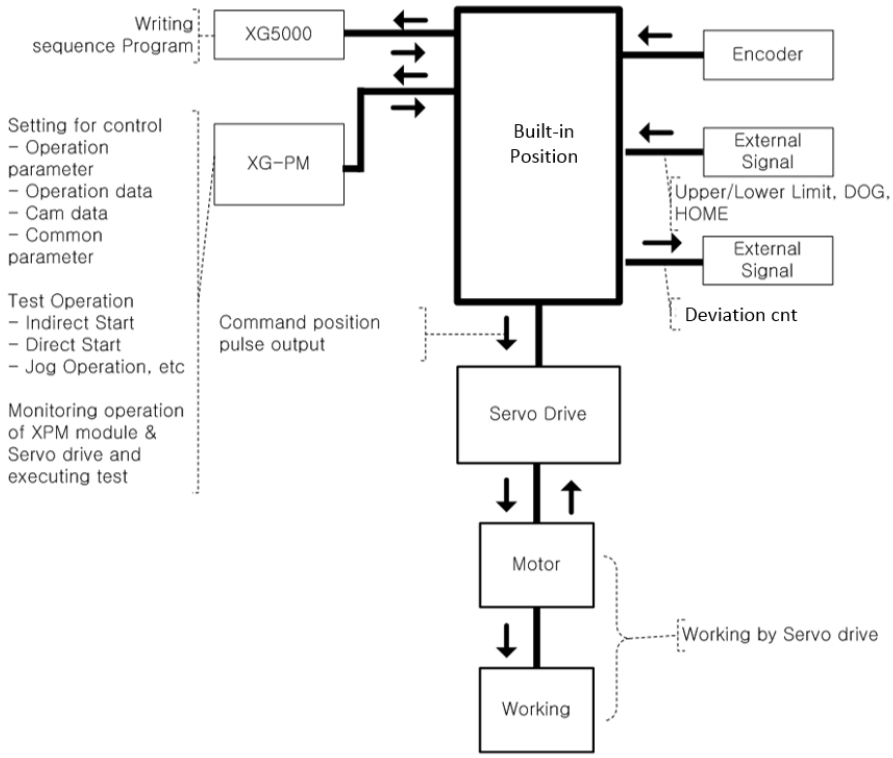


Fig. 1.2 Overview of Position Control for Servo Motor



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

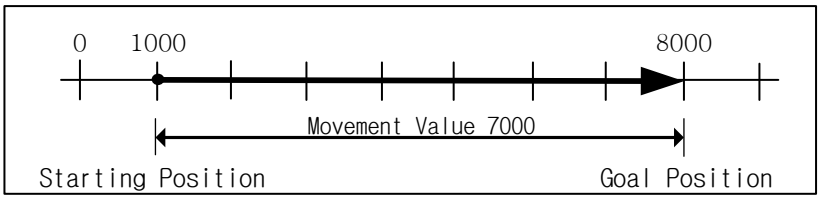
■Starting Position > Goal Position : Reverse Positioning Operation

[Example]

■Starting Position : 1000

■Goal Position : 8000

Value of Forward movement is 7000 (7000=8000-1000)



(2) Control by Incremental Coordinates

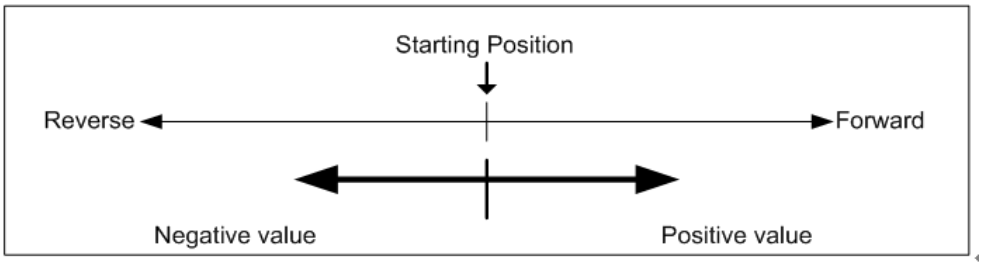
(a) Execute positioning control from starting position as much as goal movement value.

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

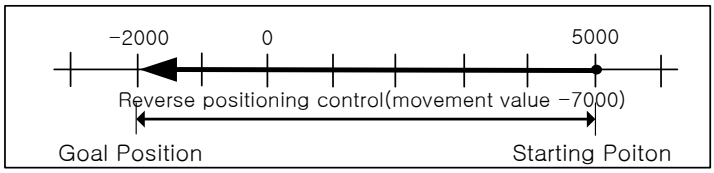


[Example]

■ 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

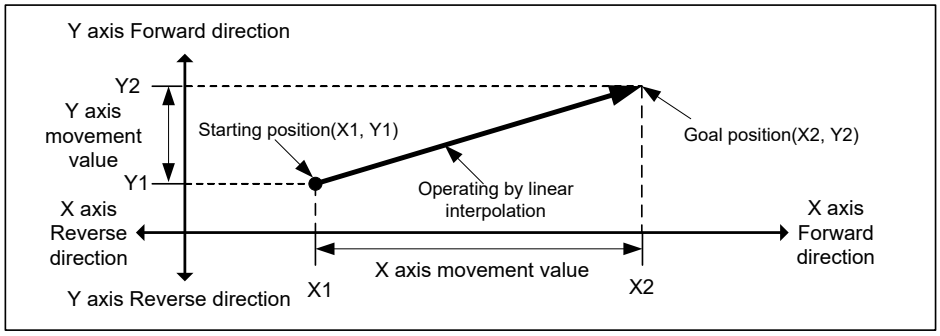
1) Execute linear interpolation from starting position to goal position designated by positioning data.

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

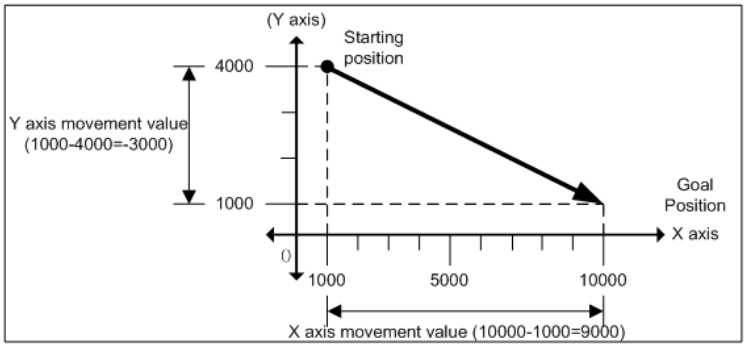


[Example]

■ Starting Position (1000, 4000)

■ Goal Position (10000, 1000)

In this condition, operation is as follows.



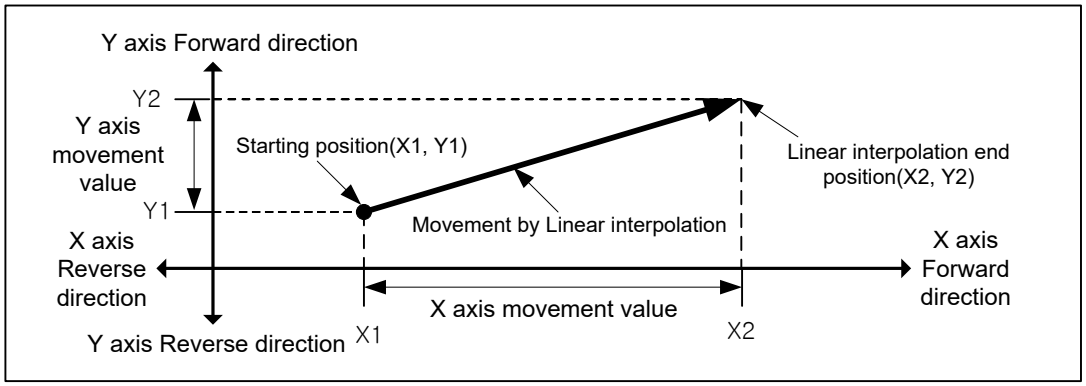
(b) Linear Interpolation by incremental coordinates

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

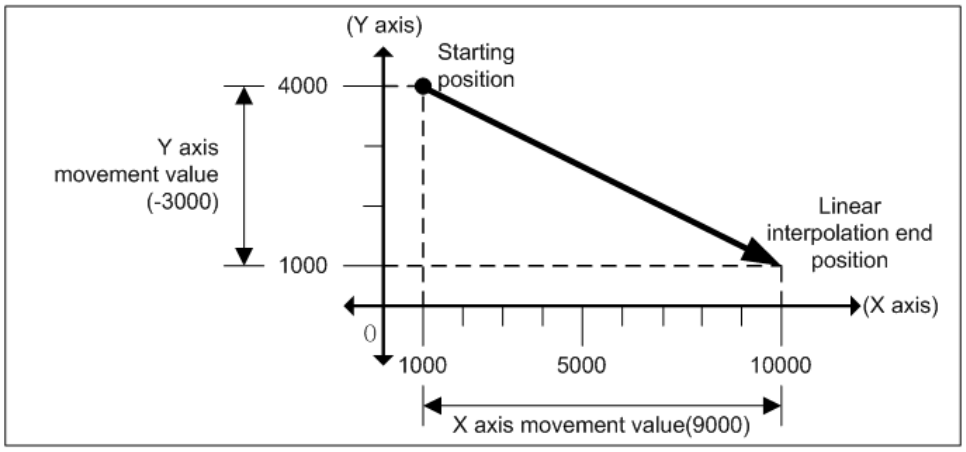


[Example]

■ Starting position (1000, 4000)

■ Goal position (9000, -3000)

In this condition, operation is as follows.

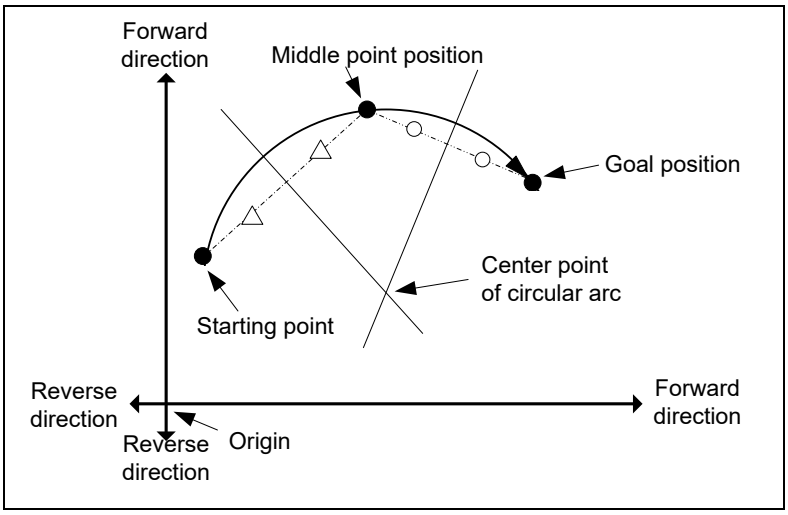


(2) Circular Interpolation Control

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.

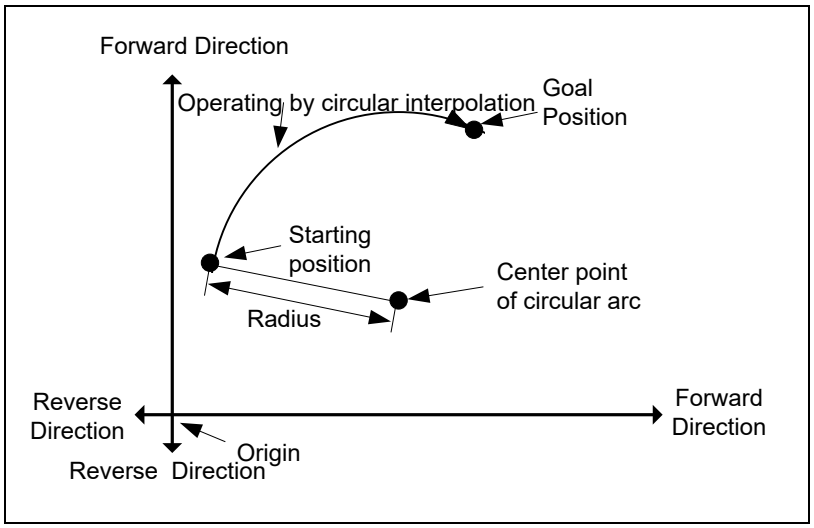
1) Starts operating at starting position and execute circular interpolation through the designated middle point.
2) There will be a circular arc whose center point is crossing point of perpendicular bisection between starting position and middle point or middle point and goal position.



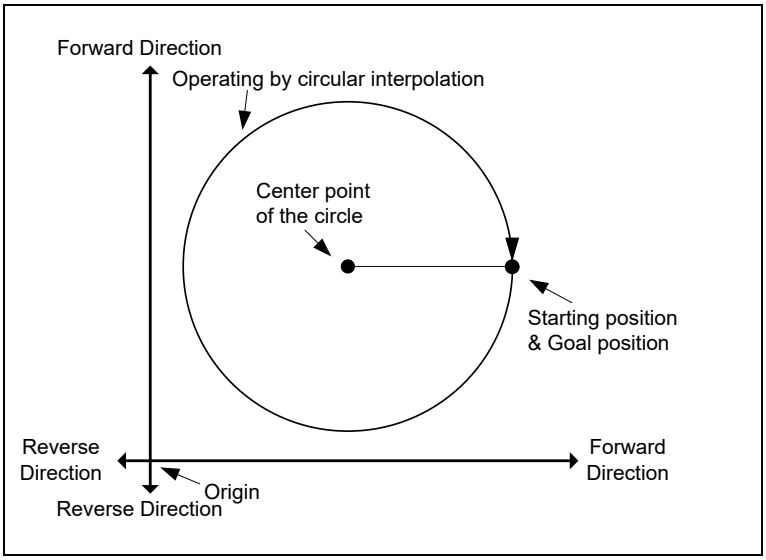
3) Control unit "degree" is not available to be used for circular interpolation control.
4) Movement direction is automatically designated by goal position and auxiliary point of circular interpolation

(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

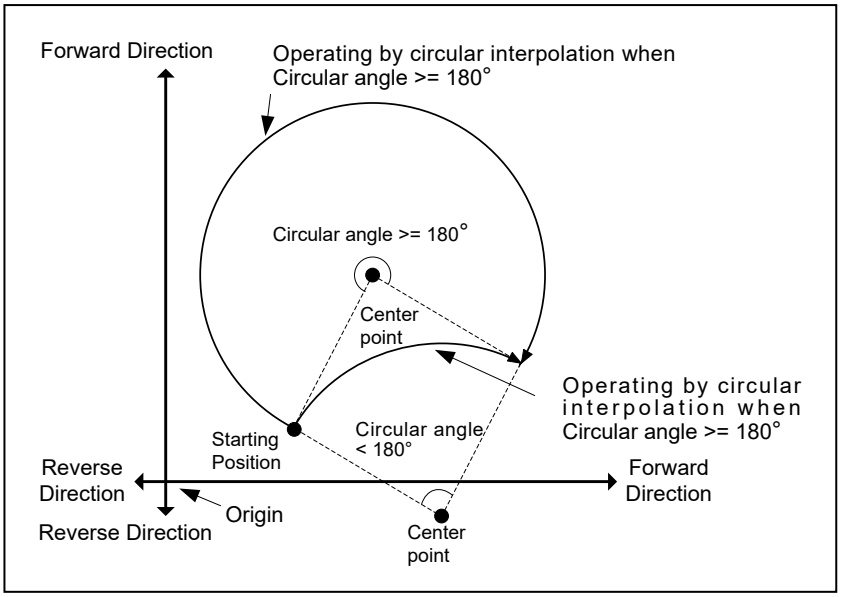


3) Control unit "degree" is not available to be used for circular interpolation control.

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.



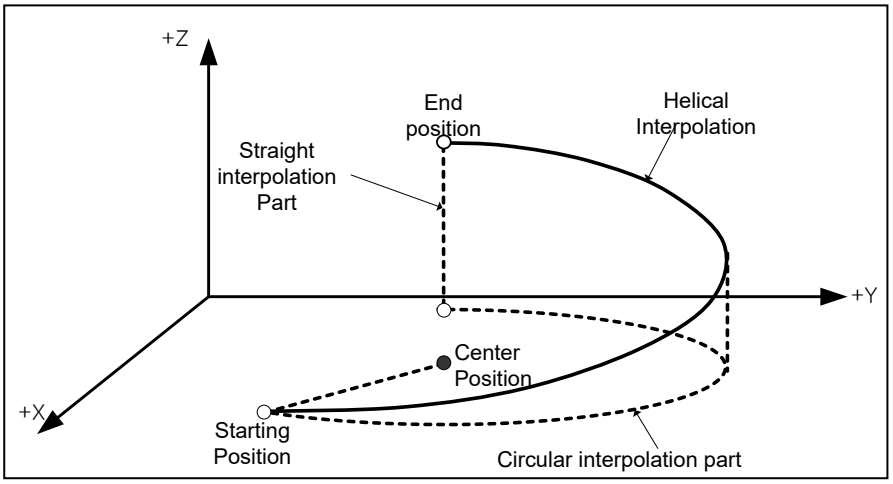
2) In radius designation form, goal position can't be set the same as starting position.

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.

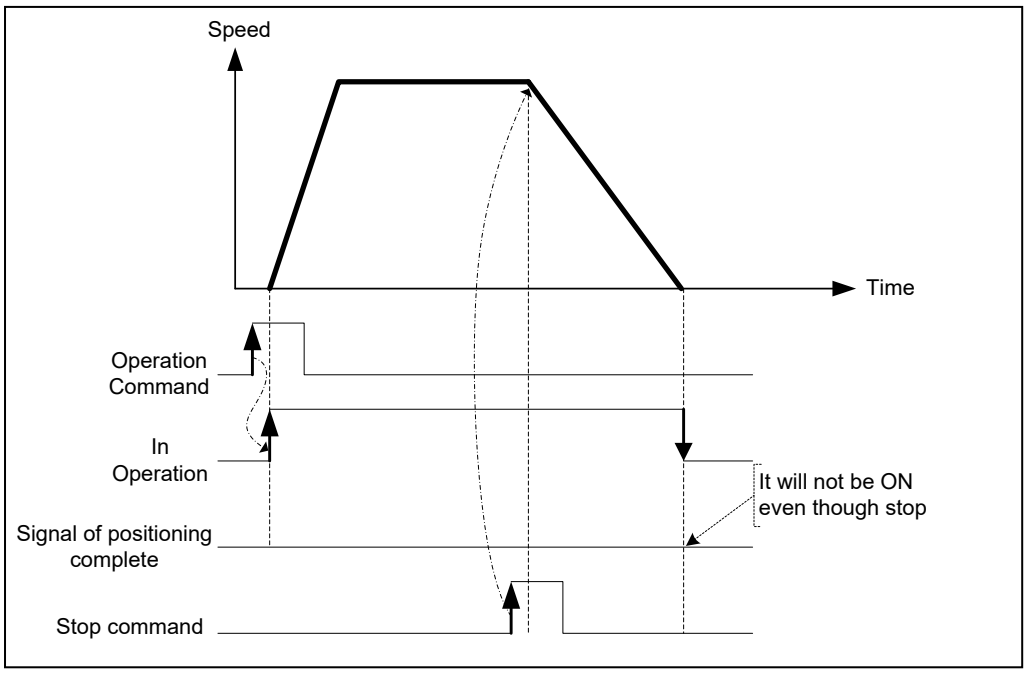
(2) Speed control has forward operation and reverse operation.

(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.

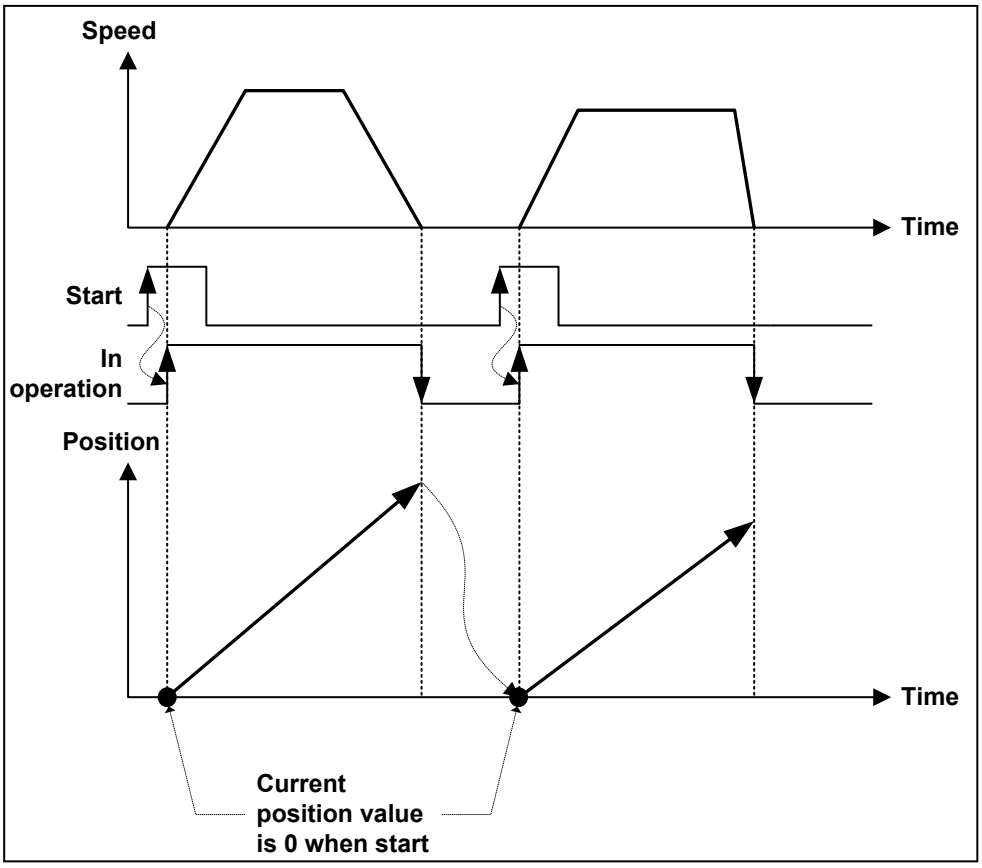
(2) Movement direction is decided by movement value.

(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="3">Items \ Model</th><th>XBM-DN16H2, XBM-DP16H2
XBM-DN32H2, XBM-DP32H2</th><th>XBM-DN32HP, XBM-DP32HP</th></tr>
<tr><td colspan="3">No. of control axis</td><td>2</td><td>6</td></tr>
<tr><td colspan="3">Interpolation function</td><td>▪2 axis linear interpolation
▪2 axis circular interpolation</td><td>▪2/3/4/5/6 axis linear interpolation
▪2 axis circular interpolation
▪3 axis helical interpolation</td></tr>
<tr><td colspan="3">Control method</td><td colspan="2">Position control, Speed control, Speed/Position control, Position/Speed control, Feed control</td></tr>
<tr><td colspan="3">Control unit</td><td colspan="2">Pulse, mm, inch, degree</td></tr>
<tr><td colspan="3">Positioning data</td><td colspan="2">Each axis can have up to 400 operation data . (Operation step number : 1 ~ 400)
Available to set with software package (XG-PM) or program</td></tr>
<tr><td rowspan="3">XG-PM</td><td colspan="2">Connection</td><td colspan="2">USB port</td></tr>
<tr><td colspan="2">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 colspan="2">Monitor</td><td colspan="2">Operation information, Trace, Input terminal information, Error information</td></tr>
<tr><td colspan="3">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 colspan="2">Positioning method</td><td colspan="2">Absolute address / Incremental address</td></tr>
<tr><td colspan="2">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 colspan="2">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 colspan="2">Acc./Dec. process</td><td colspan="2">Trapezoid type, S-Curve</td></tr>
<tr><td colspan="2">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="3">Manual Operation</td><td colspan="2">Jog Operation, MPG Operation, Inching Operation</td></tr>
<tr><td colspan="3">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="3">Speed change function</td><td colspan="2">Speed change (Percent / Absolute value)</td></tr>
<tr><td colspan="3">Control period</td><td colspan="2">1ms ~ 10ms</td></tr>
<tr><td colspan="3">Maximum speed</td><td colspan="2">200 kpps</td></tr>
<tr><td colspan="3">Connector</td><td colspan="2">32 point models : 40 Pin connector / 16 point models : 10 Pin Terminal block connector</td></tr>
<tr><td colspan="3">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)

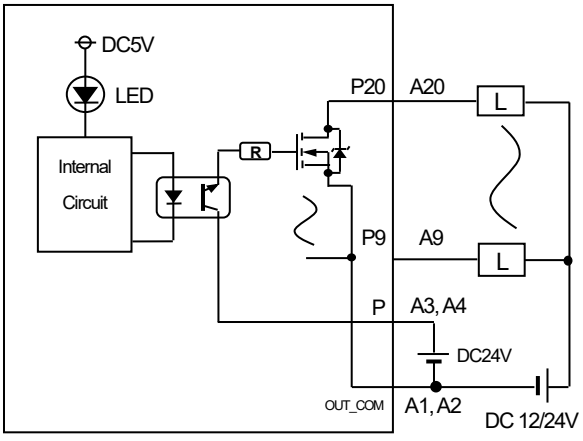
2.2.2 Output Specifications

Deviation signal can be set by P area where user can set the device in Extended parameter.

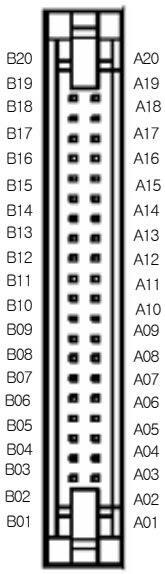
2.2.3 Positioning output

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

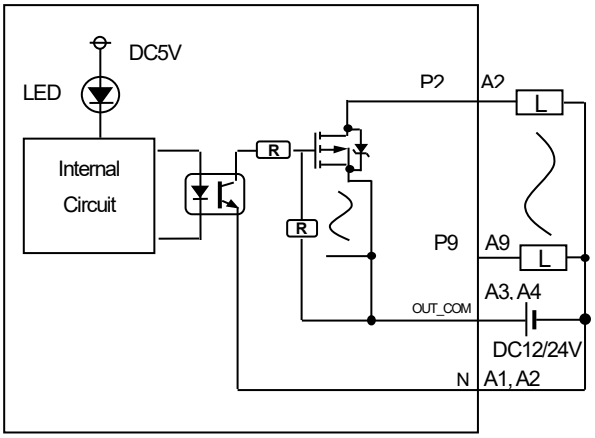


No.	Contact	No.	Contact
B20	00	**A20**	**20**
B19	01	**A19**	**21**
B18	02	**A18**	**22**
B17	03	**A17**	**23**
B16	04	**A16**	**24**
B15	05	**A15**	**25**
B14	06	**A14**	**26**
B13	07	**A13**	**27**
B12	08	**A12**	**28**
B11	09	**A11**	**29**
B10	0A	**A10**	**2A**
B9	0B	**A9**	**2B**
B8	0C	A8	2C
B7	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

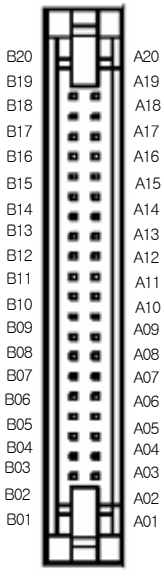


Type		XBM-DP32H2 / XBM-DP32HP (Source)		
Contact no.	1axis	P00020	P00026	Ref.
	2axis	P00021	P00027	
	3axis	P00022	P00028	
	4axis	P00023	P00029	
	5axis	P00024	P0002A	
	6axis	P00025	P0002B	
Signal name		Pulse train output (PLS)	Direction output (DIR)	
Rated load voltage		DC12~24V (DC10.2~26.4V)		
Max. 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

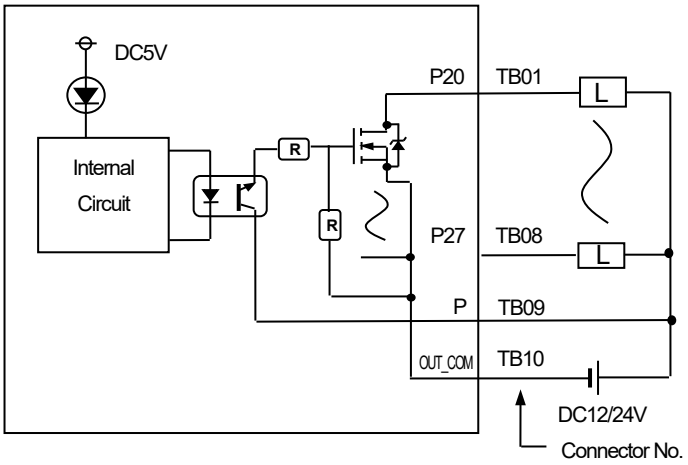


No.	Contact	No.	Contact
B20	00	**A20**	**20**
B19	01	**A19**	**21**
B18	02	**A18**	**22**
B17	03	**A17**	**23**
B16	04	**A16**	**24**
B15	05	**A15**	**25**
B14	06	**A14**	**26**
B13	07	**A13**	**27**
B12	08	**A12**	**28**
B11	09	**A11**	**29**
B10	0A	**A10**	**2A**
B9	0B	**A9**	**2B**
B8	0C	A8	2C
B7	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

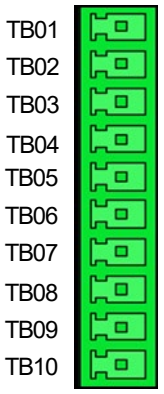


Spec. \ Type		XBM-DN16H2 (Sink)		
Contact No.	1axis	P00020	P00026	Ref.
	2axis	P00021	P00027	
Signal name		Pulse train output (PLS)	Direction output (DIR)	
Rated load voltage		DC12~24V (DC10.2 ~ 26.4V)		
Max. load voltage		0.1A/ 1 point or below	0.5A/ 1 point or below	
Insulation method		Photocoupler 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

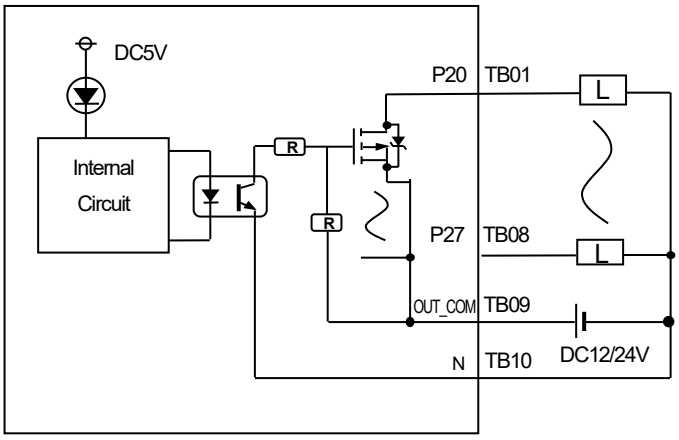


No.	Contact
TB01	**20**
TB02	**21**
TB03	22
TB04	23
TB05	24
TB06	25
TB07	**26**
TB08	**27**
TB09	P
TB10	OUT_COM

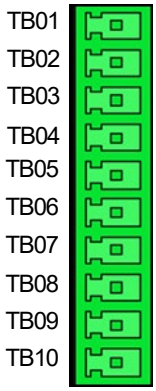


Spec. \ Type		XBM-DP16H2 (Source)		
Contact No.	1axis	P00020	P00026	Ref.
	2axis	P00021	P00027	
Signal name		Pulse train output (PLS)	Direction output (DIR)	
Rated load voltage		DC12~24V (DC10.2 ~ 26.4V)		
Max. load current		0.1A/ 1 point or below	0.5A/ 1 point or below	
Insulation method		Photocoupler 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

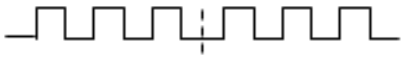
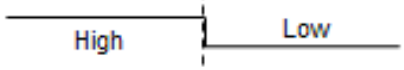


No.	Contact
TB01	**20**
TB02	**21**
TB03	22
TB04	23
TB05	24
TB06	25
TB07	**26**
TB08	**27**
TB09	OUT_COM
TB10	N



2.2.4 External Equipment and Interface Specifications

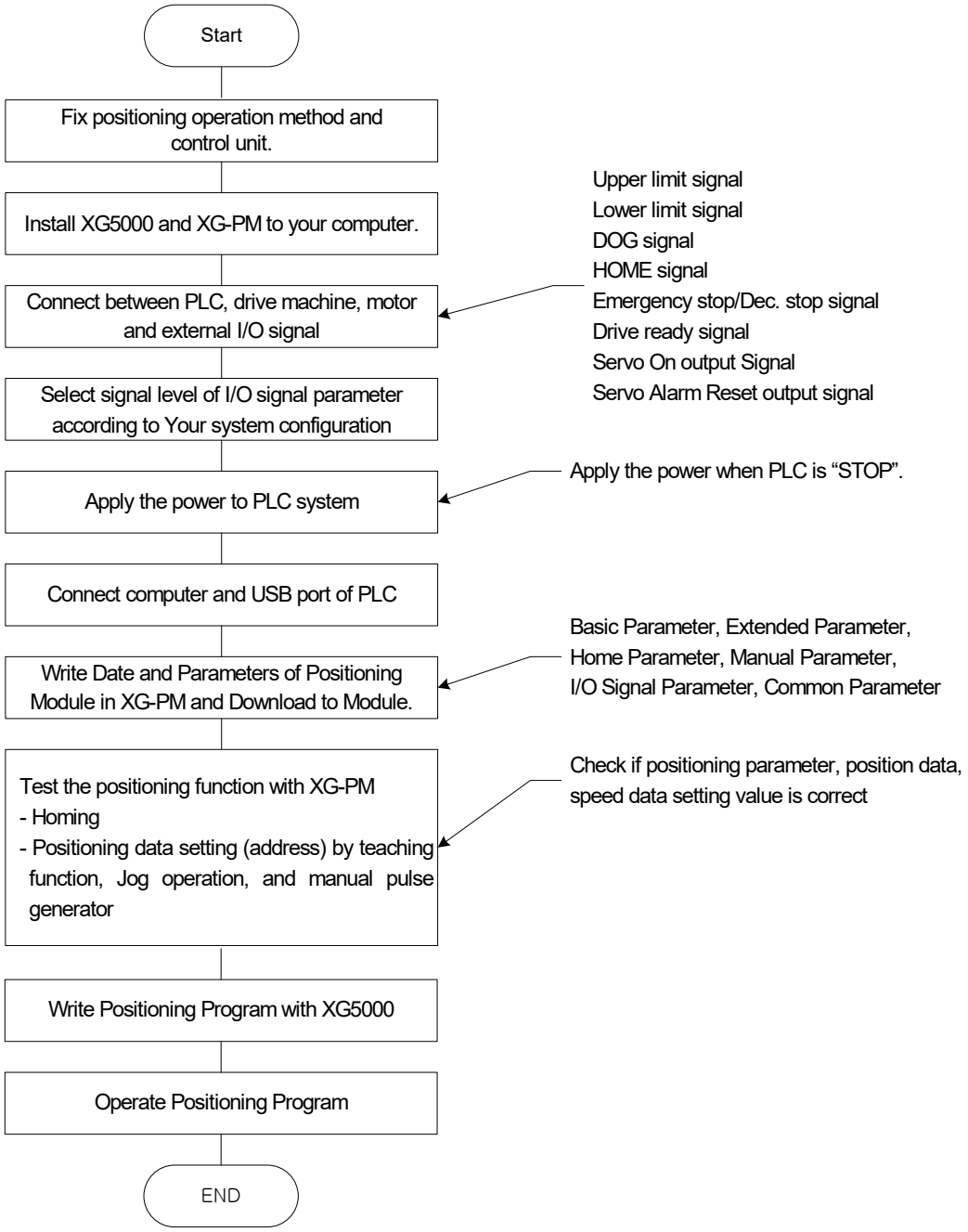
Output pulse of XGB built-in positioning consists of Pulse + Direction like figure below.
Output level of Low Active and High Active can be specified by common parameter.

Pulse output type	Output signal	Output signal level			
		High Active mode		Low Active mode	
		Forward	Reverse	Forward	Reverse
Pulse + direction mode	Pulse				
	Direction				

Chapter 3 Operation Order and Installation

3.1 Operation Order

This chapter describes the operation order in case of positioning operation by embedded positioning.



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

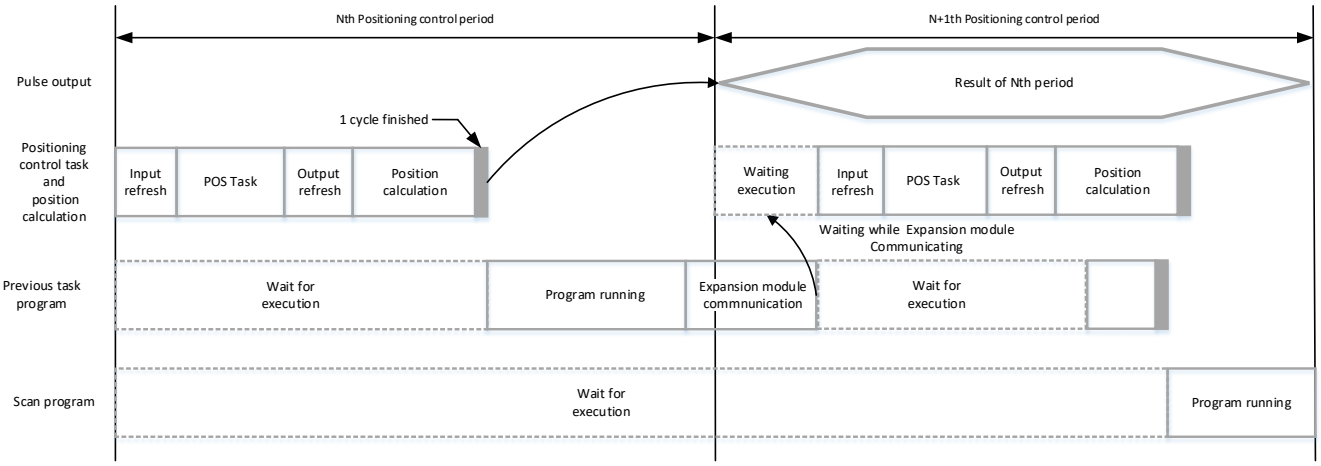
The XBM-H2/HP has a position control task that synchronizes with the positioning control period. Position control task operates with a period of control period set in common parameters.

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

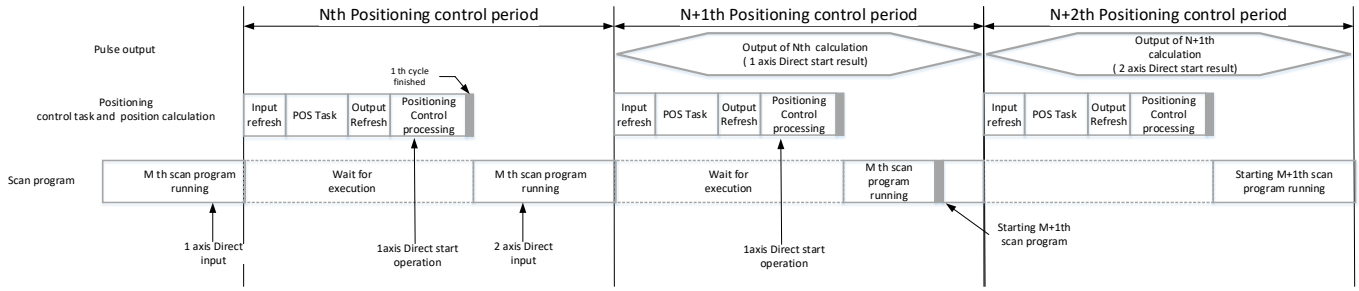
▶ systems using expansion units, set the position control cycle to at least 3 ms. Expansion unit communication time takes several hundreds of us to 2ms. Therefore, if the control period is set to 1 ms and an expansion unit is used, control cycle errors may occur frequently.

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

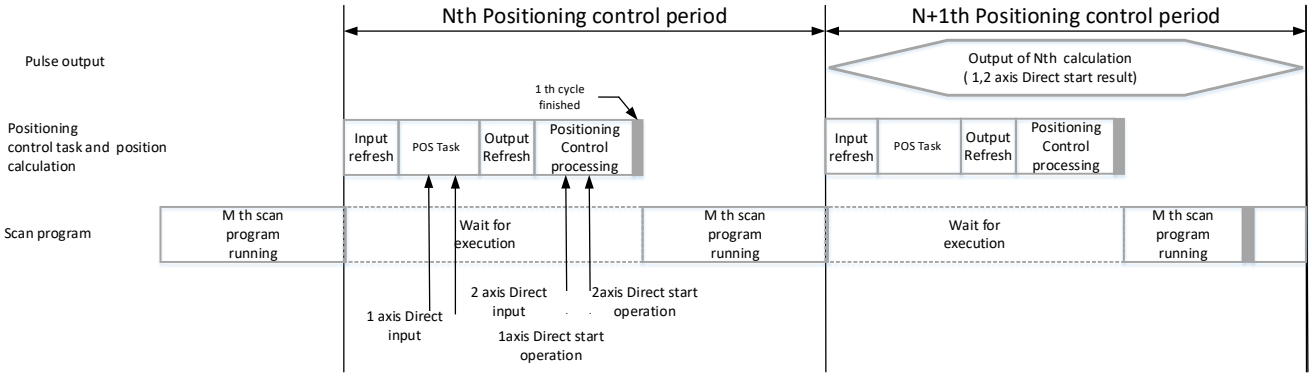
The scan program has a lower priority than the position control operation. Therefore, when the position control processing period is reached during the operation of the scan program, the scan program processing enters the execution standby state and processes the position control operation.



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.

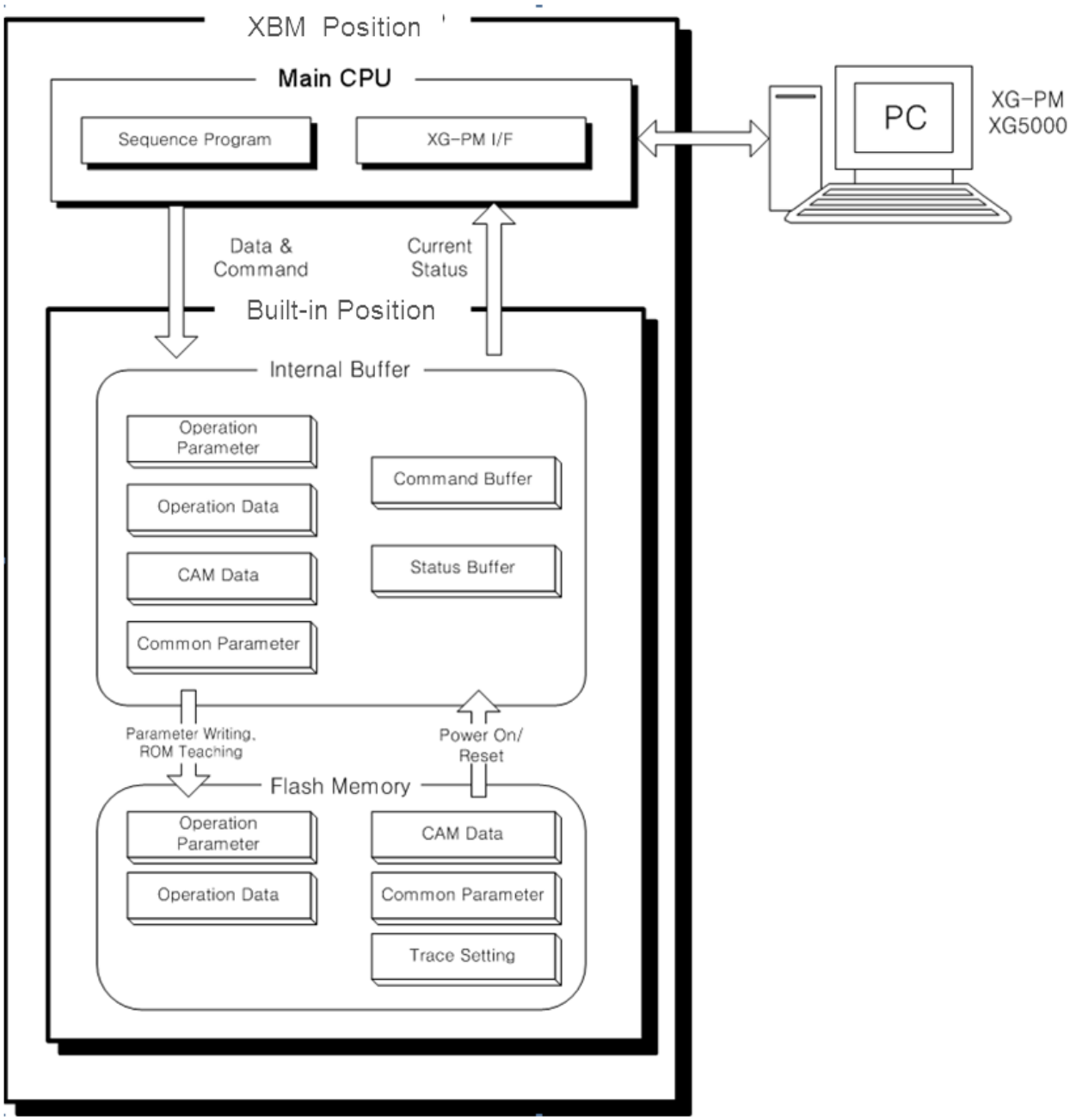


Chapter 5 Positioning Parameter & Operation Data

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}㎜] (1 ~ 200,000,000 [X10^{-1}㎛]) Inch : 1 ~ 200,000,000 [X10^{-5}Inch] 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] Inch : 1 ~ 2,147,483,647 [X10^{-3}Inch/ min] degree : 1 ~ 2,147,483,647 [X10^{-3} degree/ min] pulse : 1 ~ 200,000 [pulse/Sec]
Speed limit 2)	㎜ : 1 ~ 2,147,483,647 [X10^{-2}㎜ / min] Inch : 1 ~ 2,147,483,647 [X10^{-3}Inch / min] degree : 1 ~ 2,147,483,647 [X10^{-3} degree / min] 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

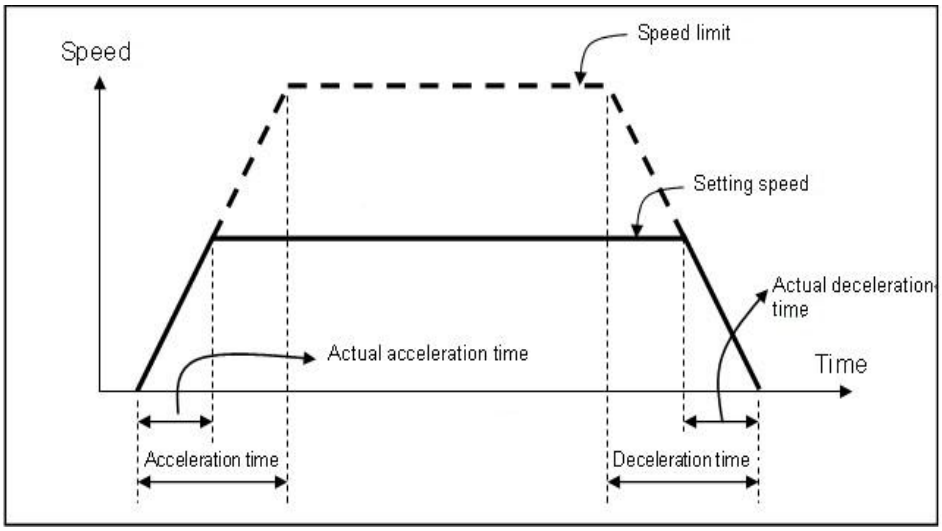
Acceleration Time is the time required to reach the limit speed which is set by parameter from zero speed(stop state).

(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

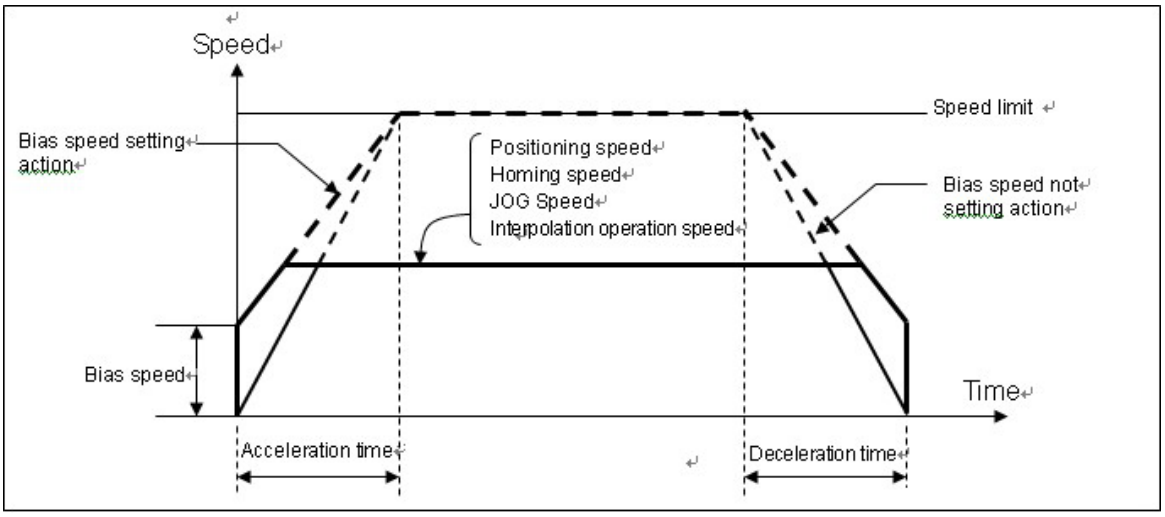
Available minimum bias speed can be calculated as below.

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

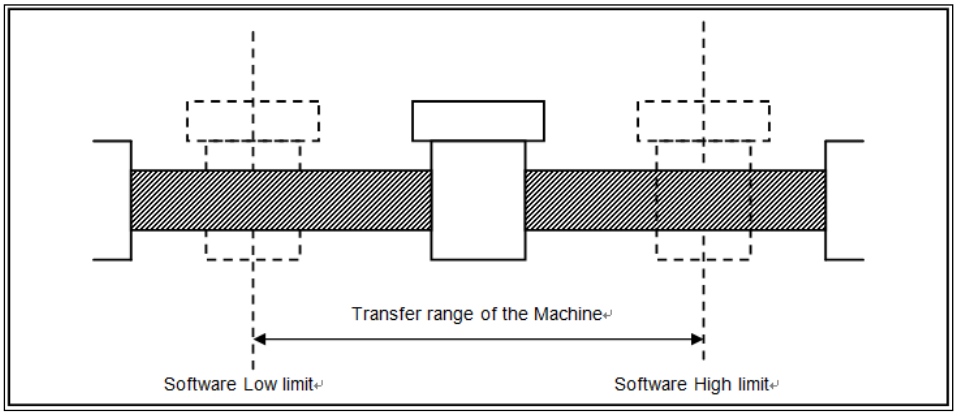
Extended parameter Items	Setting Range
Software upper limit	㎜ :-2,147,483,648 ~ 2,147,483,647[X10^{-4}㎜] (-2,147,483,648 ~ 2,147,483,647[X10^{-1}㎛]) Inch:-2,147,483,648 ~ 2,147,483,647[X10^{-5}Inch] degree:-2,147,483,648 ~ 2,147,483,647[X10^{-5}degree] pulse:-2,147,483,648 ~ 2,147,483,647[pulse]
Software lower limit	
Infinite running repeat position	mm: 1 ~ 2,147,483,647[X10^{-4}㎜] (1 ~ 2,147,483,647[X10^{-1}㎛]) Inch: 1 ~ 2,147,483,647[X10^{-5}Inch] degree: 1 ~ 2,147,483,647[X10^{-5}degree] pulse: 1 ~ 2,147,483,647[pulse]
Infinite running repeat	0: Disable, 1: Enable
Backlash compensation amount	mm: 0 ~ 65,535[X10^{-4}㎜] (0 ~ 65,535[X10^{-1}㎛]) inch: 0 ~ 65,535[X10^{-5}Inch] degree: 0 ~ 65,535[X10^{-5}degree] 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[X10^{-4}㎜] (0 ~ 2,147,483,647[X10^{-1}㎛]) Inch: 0 ~ 2,147,483,647[X10^{-5}Inch] degree: 0 ~ 2,147,483,647[X10^{-5}degree] 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[X10^{-4}㎜]
Inch	-2,147,483,648～2,147,483,647[X10^{-5}Inch]
degree	-2,147,483,648～2,147,483,647[X10^{-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.

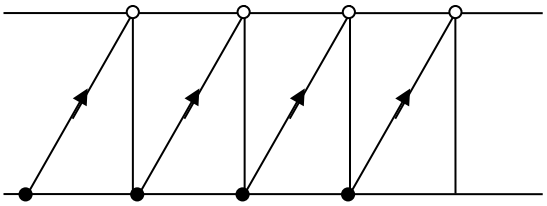
(g) The software upper and lower limits, when exceeded, will move the additional distance required for an emergency stop before stopping. The time required for the emergency stop can be set in the 'Dec. time for emg. stop' in the Basic Parameter.

(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

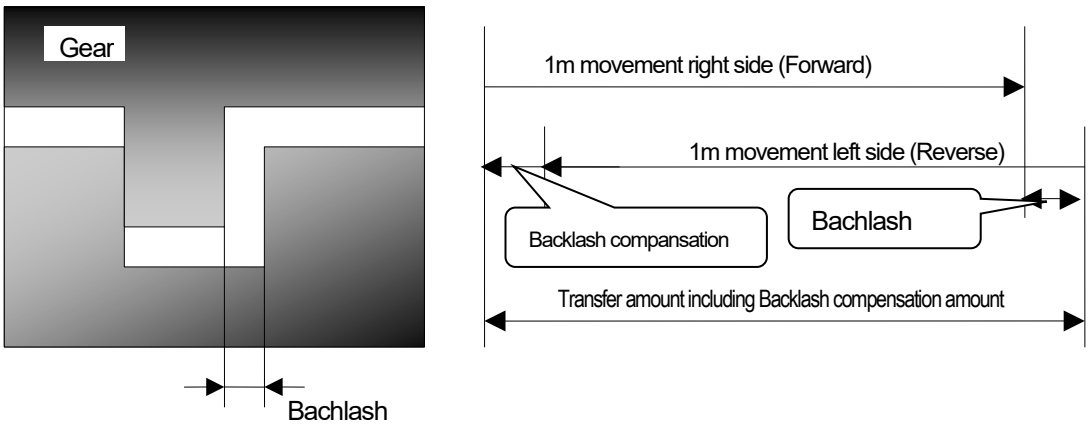
(a) In case that a gear, screw etc is combined to the motor axis, The tolerance that the machine does not work by the wear, when the rotation direction changes, is called as ‘Backlash”. Therefore, when you change the rotation direction, it is required to add the backlash compensation amount to the positioning amount for output.

(b) This is used for positioning operation, inching operation and jog operation

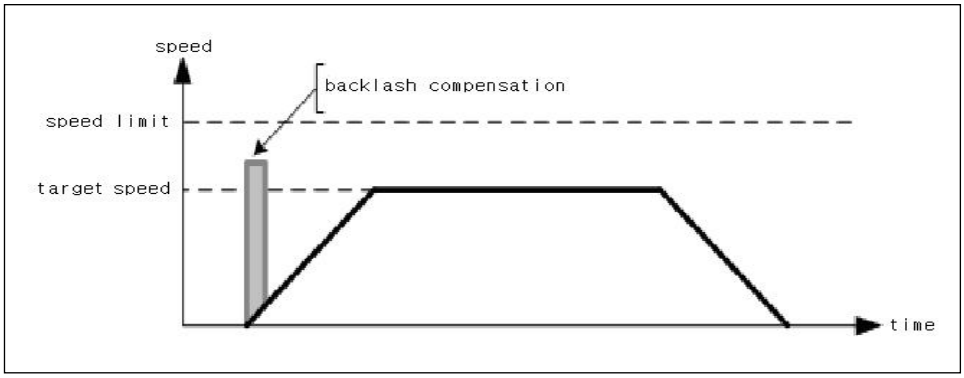
(c) Setting range

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.

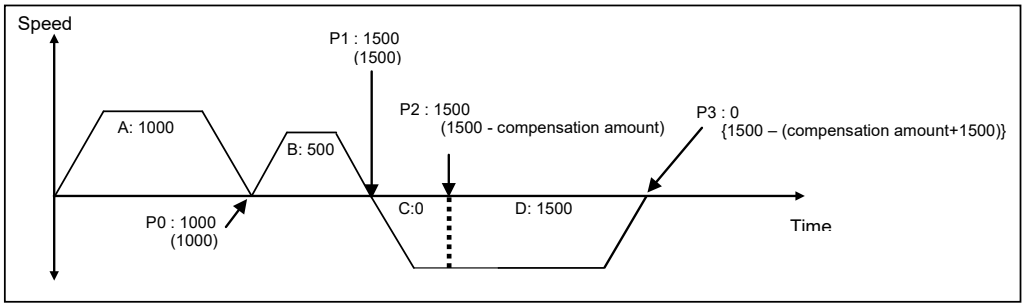


(e) It compensates by adding backlash compensation pulse to current output pulse within speed limit.
In case backlash compensation amount is bigger than Max. output Pulse (Speed limit × Control cycle) for one control cycle, distribute compensation amount to several control cycles



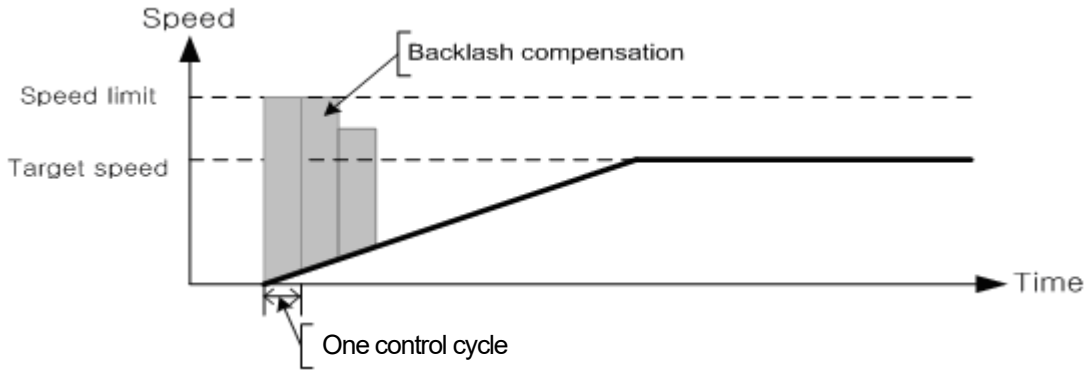
A,B,C,D : Relative position

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.



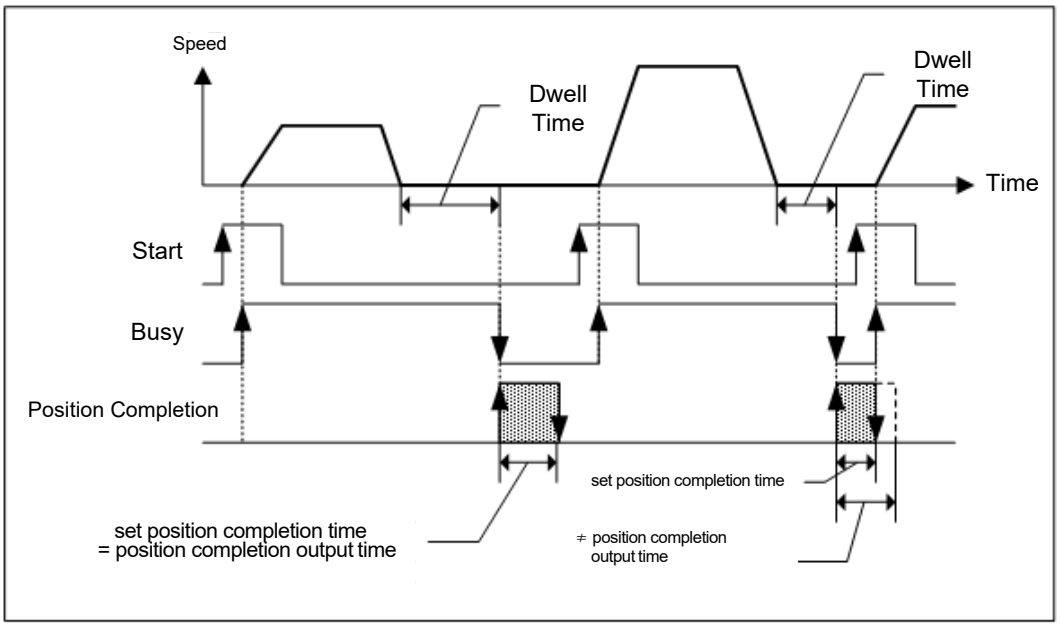
(5) Positioning Completion Time

(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

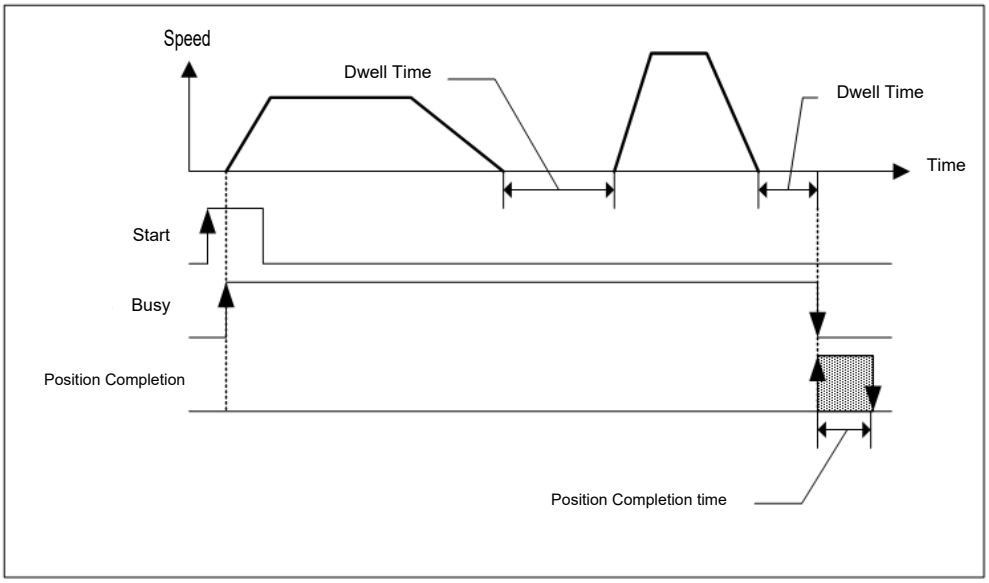
At this time, if all start command is executed while positioning completion signal is ON, completion signal shall be OFF immediately. In case of keep operation and continuous mode operation, positioning completion signal will be on after all steps end.

(b) The setting range is 0 ~ 65,535 (unit: 1㎳).

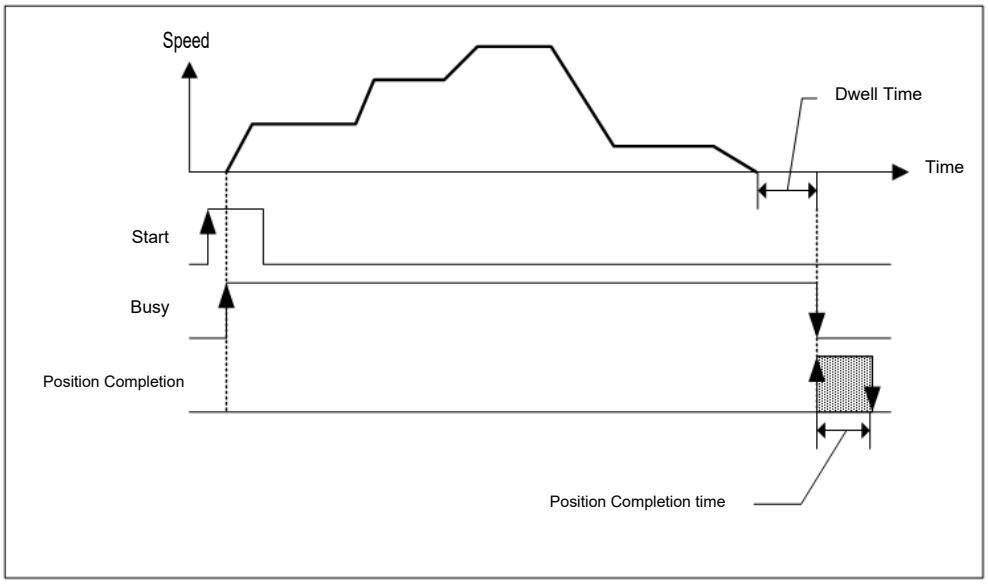
(c) The action of single operation mode is as follows.



(d) The action of Keep operation mode is as follows :



(e) The action of Continuous operation mode is as follows.



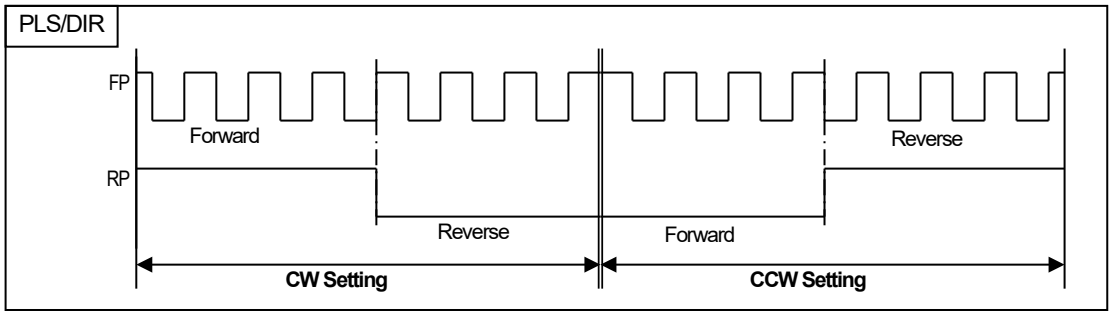
(6) Pulse output direction

(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 op eration, it is set correctly.

(c) If pulse output direction is set as "CW" and machine moves reverse direction in case of forward direction op eration, 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).

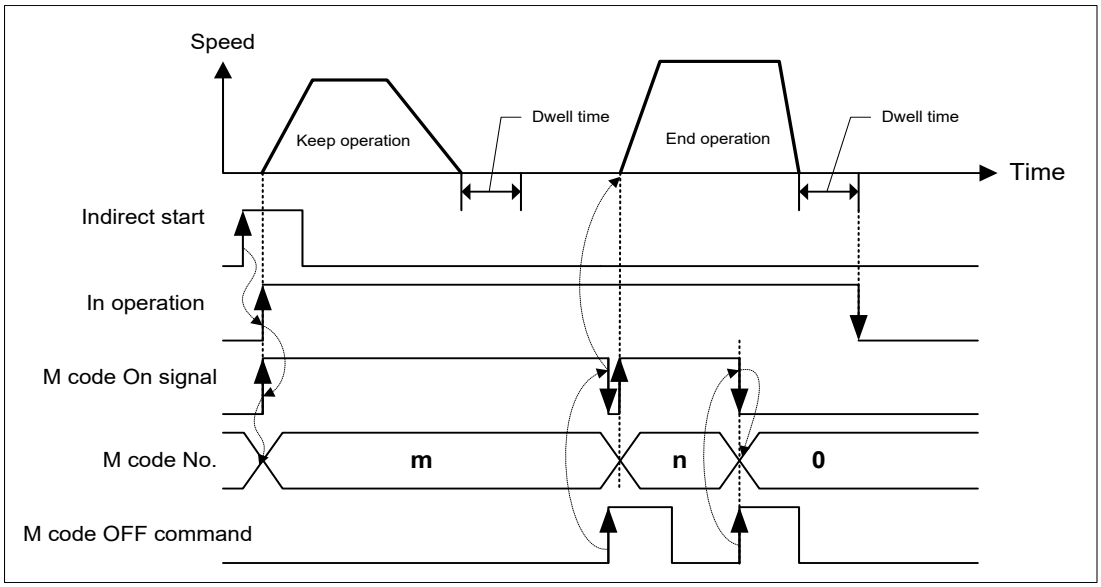
(e) M code signal occurring during the operation shall be reset by "MOF" command.

Notes

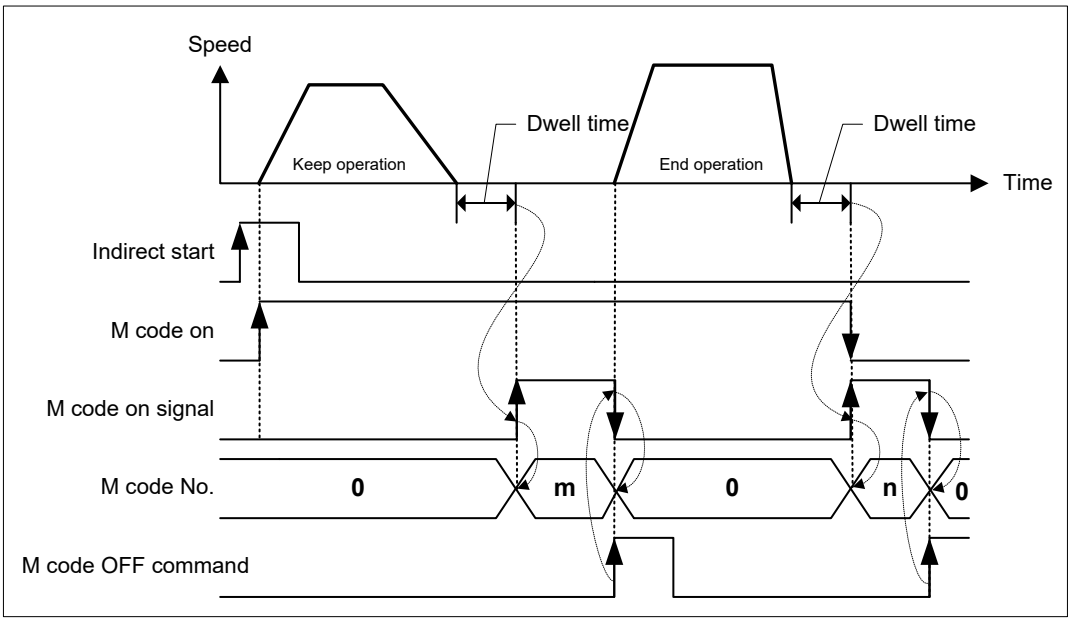
If you execute the next step after the positioning is completed and M code signal is "ON", the next operation step no. does not work and the error code(233) will occur. Therefore, in order to execute the positioning of the next operation step number, M code signal should be "OFF" by "MOF" command

(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].

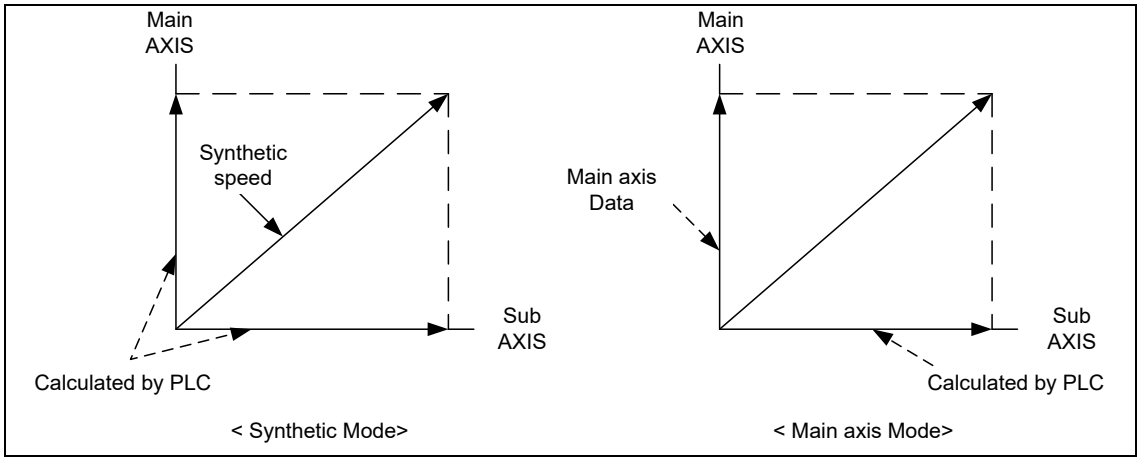


2) After mode
It turns on the M code signal and outputs M code number after completion of positioning
[indirect start, direct start and simultaneous start].



(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.

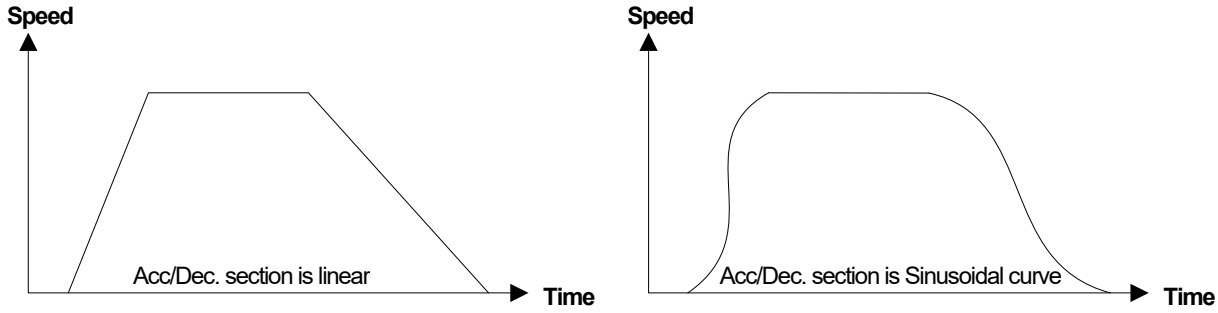
(10) Acceleration/Deceleration Pattern

(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>

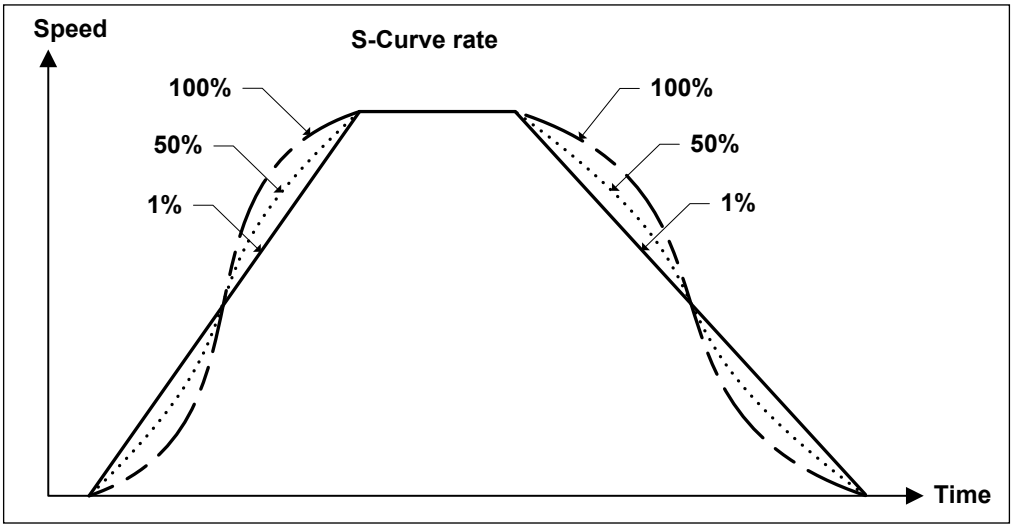
(11) S-curve rate

(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] Inch : 1 ~ 2,147,483,647 [X10^{-3}Inch/ min] degree : 1 ~ 2,147,483,647 [X10^{-3} degree/min] 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] Inch : 1 ~ 65,535[X10^{-3}Inch/min] degree : 1 ~ 65,535[X10^{-3} degree/min] 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}㎜] (-2147483648 ~ 2147483647 [X10^{-1}㎛]) Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch] degree : -2147483648 ~ 2147483647 [X10^{-5}degree] pulse : -2147483648 ~ 2147483647 [pulse]
Homing-high speed		㎜ : Bias Speed ~ Speed Limit(Homing Low Speed<=Homing high Speed) Inch : Bias Speed ~ Speed Limit(Homing Low Speed<=Homing high Speed) degree : Bias Speed ~ Speed Limit(Homing Low Speed<=Homing high Speed) 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}㎜] (-2147483648 ~ 2147483647 [X10^{-1}㎛]) Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch] degree : -2147483648 ~ 2147483647 [X10^{-5}degree] 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)

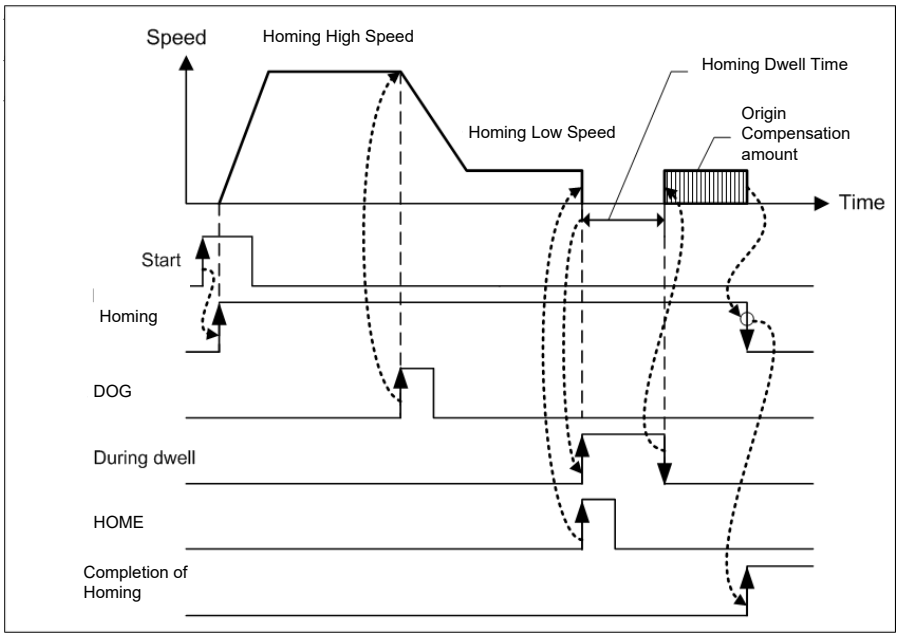
(4) Origin compensation amount

(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.

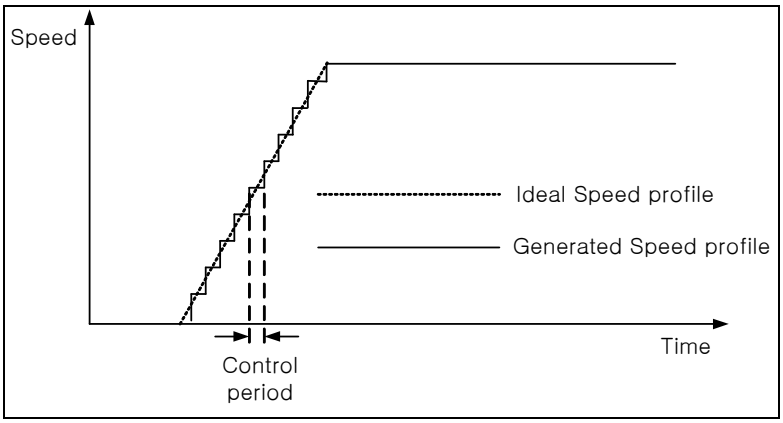
(b) In case of setting percentage (%) can set each from 0.01% to 655.35%(unit: 0.01%)

(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
Absolute, Single axis speed control
Absolute, Single axis feed control
Absolute, linear interpolation
Absolute, circular interpolation
incremental, Single axis positioning
incremental, Single axis speed control
incremental, Single axis feed control
incremental, linear interpolation
incremental, circular interpolation</td></tr>
<tr><td>Operation type</td><td>Singular, End
Singular, Keep
Singular, Continuous
Repeat, End
Repeat, Keep
Repeat, Continuous</td></tr>
<tr><td>Target position</td><td>㎜ : -2147483648 ~ 2147483647 [X10^{-4}㎜]
(-2147483648 ~ 2147483647 [X10^{-4}㎜])
Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch]
degree : -2147483648 ~ 2147483647 [X10^{-5}degree]
pulse : -2147483648 ~ 2147483647 [pulse]</td></tr>
<tr><td>Operation speed</td><td>㎜ : Bias Speed ~ Speed Limit
Inch : Bias Speed ~ Speed Limit
degree : Bias Speed ~ Speed Limit
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}㎜]
(-2147483648 ~ 2147483647 [X10^{-4}㎜])
Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch]
degree : -2147483648 ~ 2147483647 [X10^{-5}degree]
pulse : -2147483648 ~ 2147483647 [pulse]</td></tr>
<tr><td>Circular interpolation mode</td><td>Middle-point
Center-point, Clockwise
Center-point, CounterClockwise
Radius, CW, Arc<180
Radius, CW, Arc >=180
Radius, CCW, Arc <180
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).

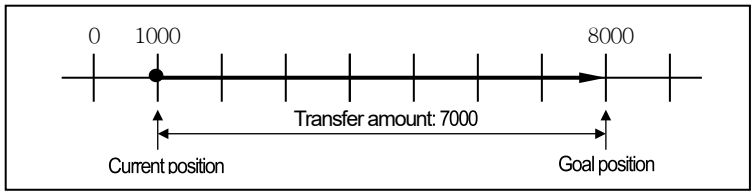
b) Positioning is carried out based on the assigned position of homing (origin address).

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.

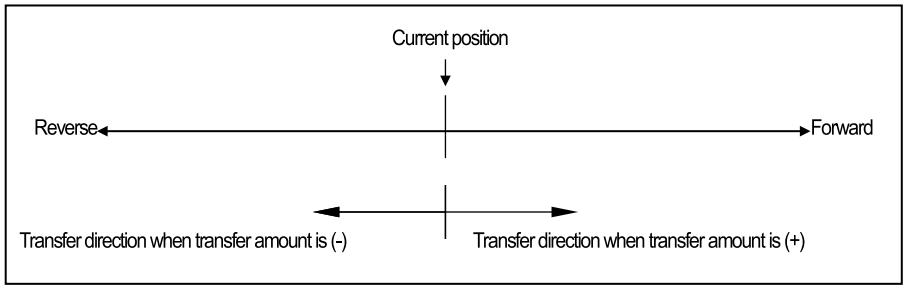
2) Incremental method

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..

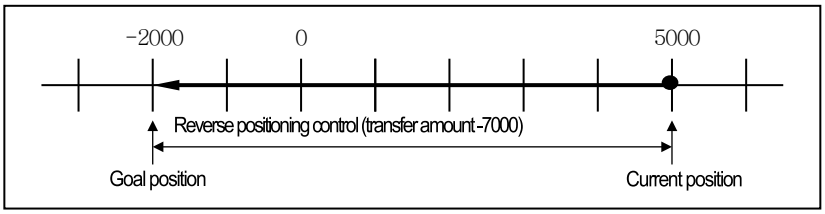
■ When transfer direction is (+) or no sign : forward direction positioning (position increase direction)

■ 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, 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]

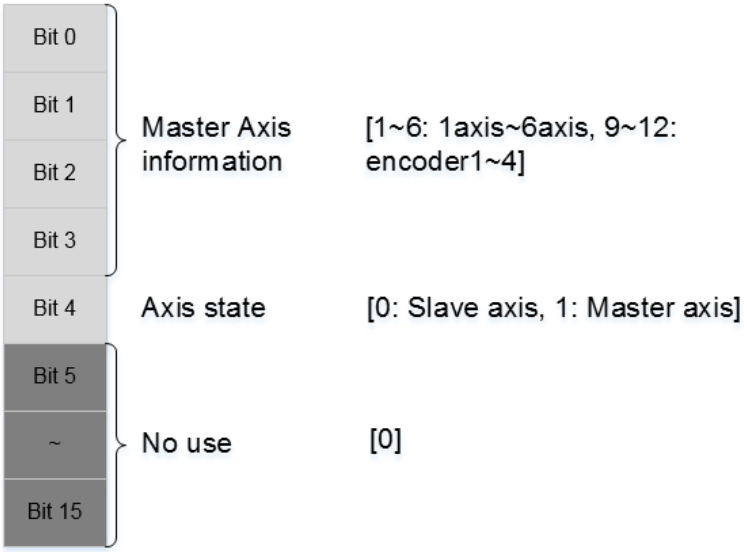
2) Operation State Bit Information (Upper)

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]

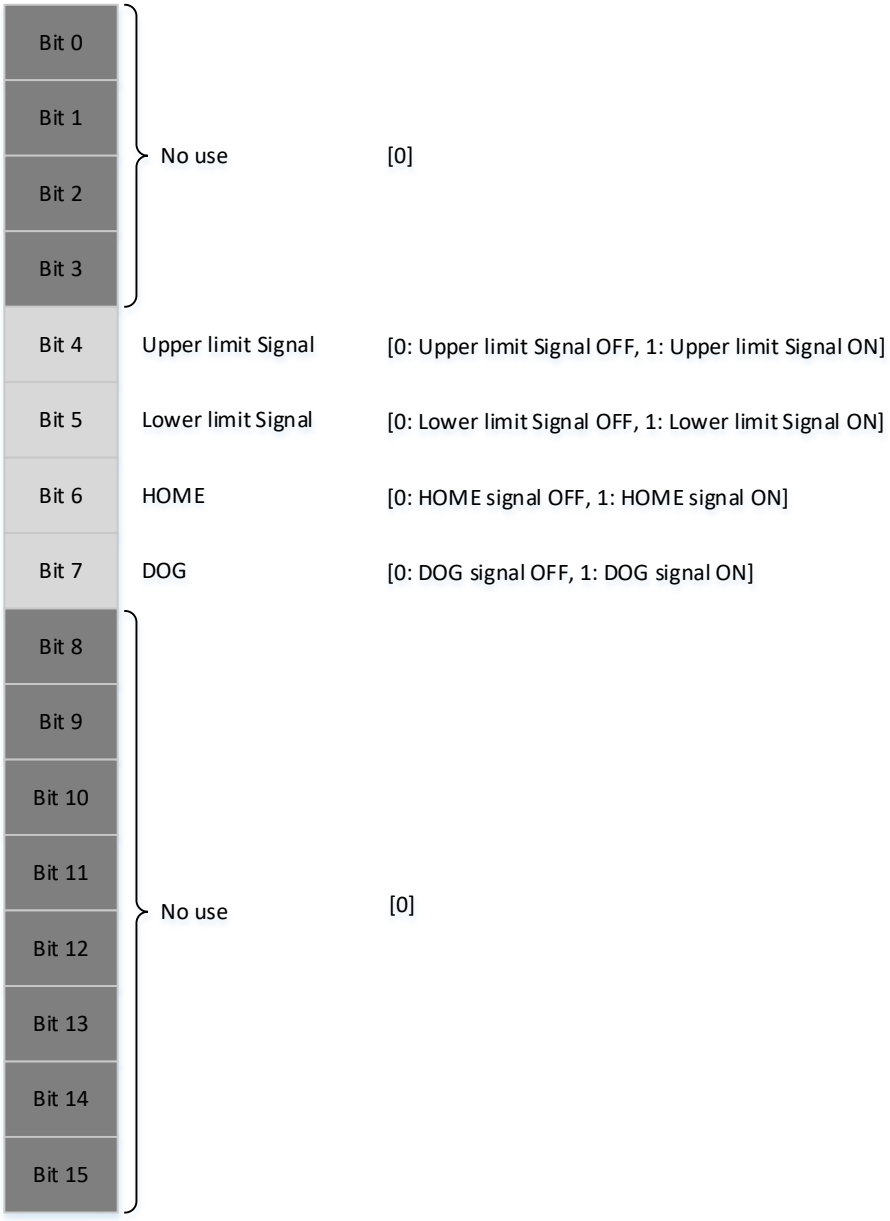
3) Axis Information

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



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

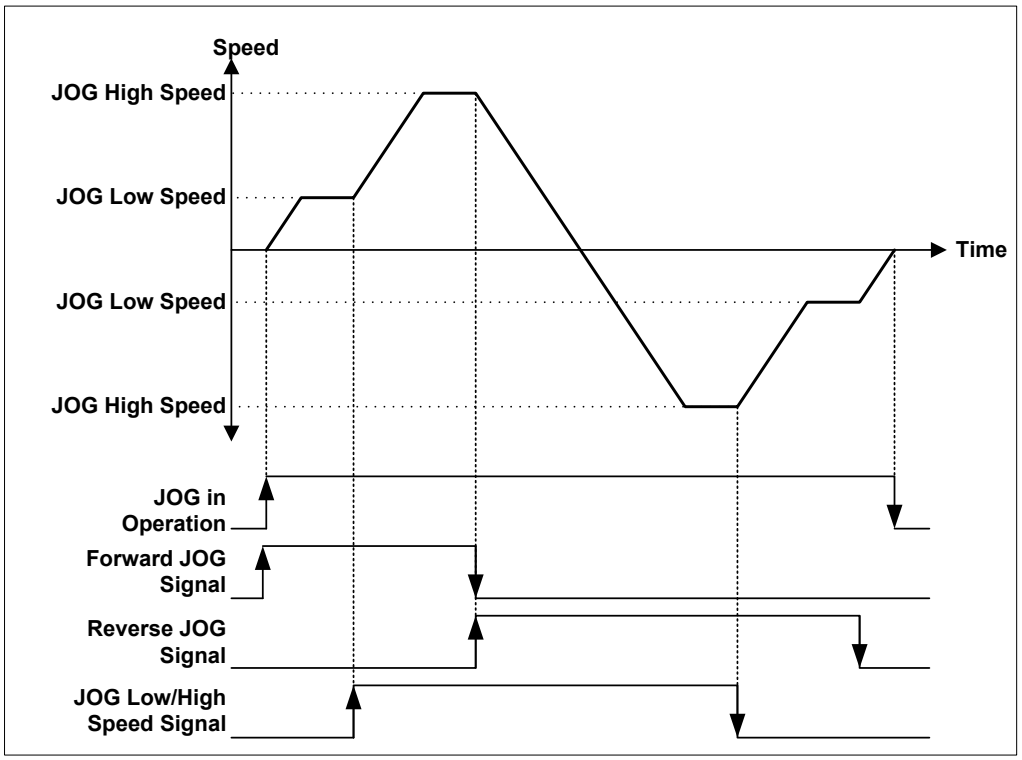
(a) Forward/Reverse Jog Signals show the direction of Jog Operation. The Jog operation shall be divided into Forward/Reverse direction according to the On/Off signals. When Forward Jog Signal is On, it starts Forward Operation and When Jog Signal is Off, it starts Reverse Operation. When both signals 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

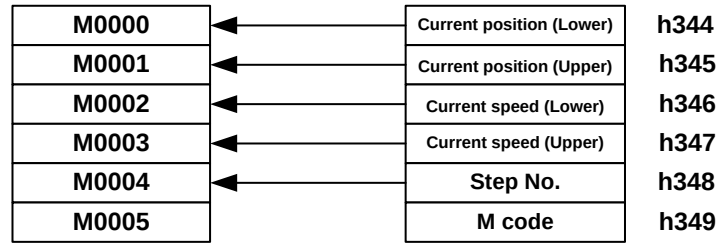
Execute with operation start of execute condition. (Edge).

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

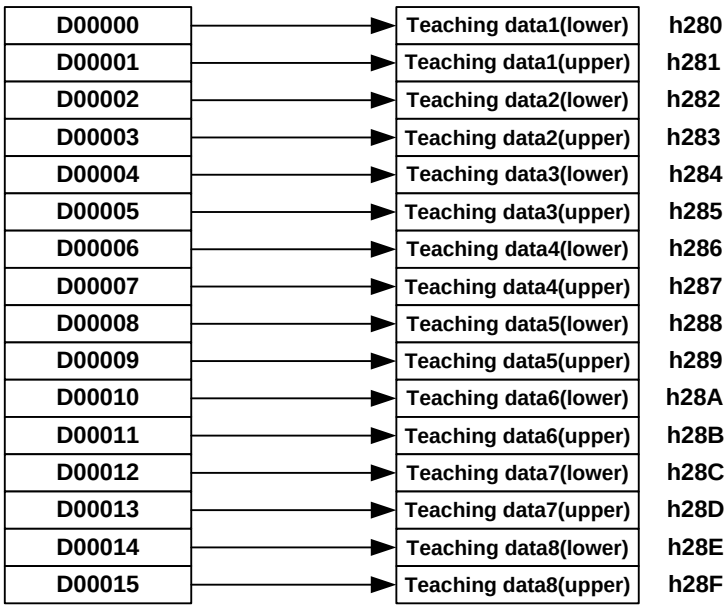
Execute with operation start of execute condition. (Edge).

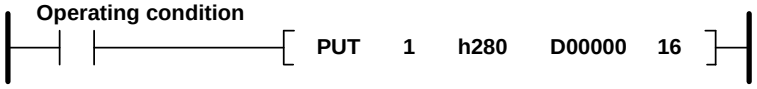
That is, when execute condition is ON, it operates only one time.

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





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

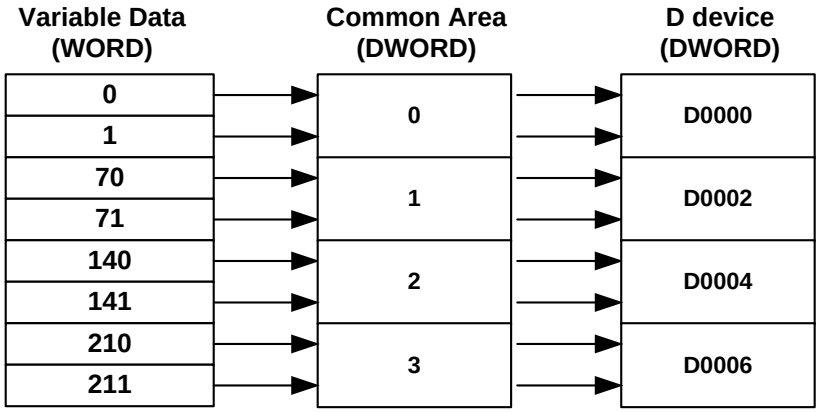
executed.

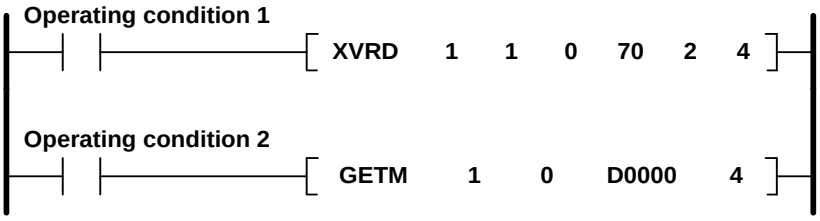
[Example]

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.





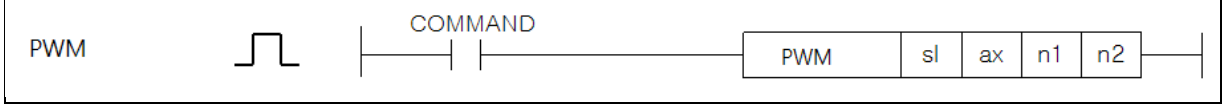
7.1.4 Pulse Width Modulation

- 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, XBMHP are fixed to 1	WORD
ax	axes(output point) 0: P00020 1: P00021 2: P00022 3: P00023 4: P00024 5: P00025	0~1(XBMH2) 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.

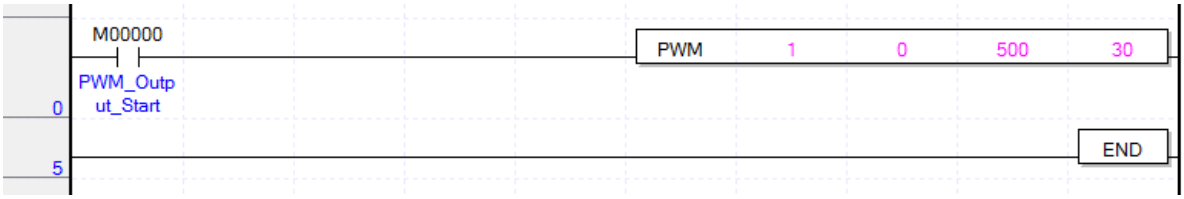
Notice

- 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

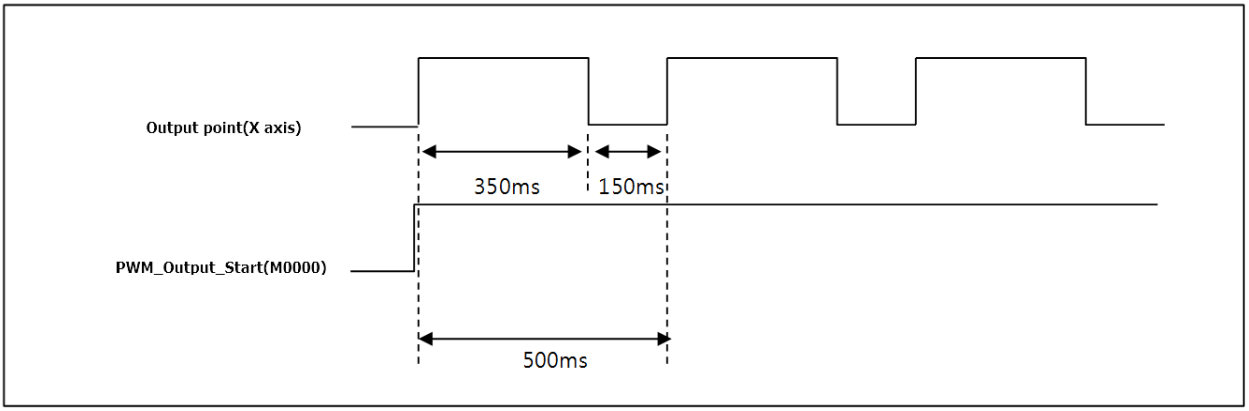
- M0000: PWM output start signal.

(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 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.

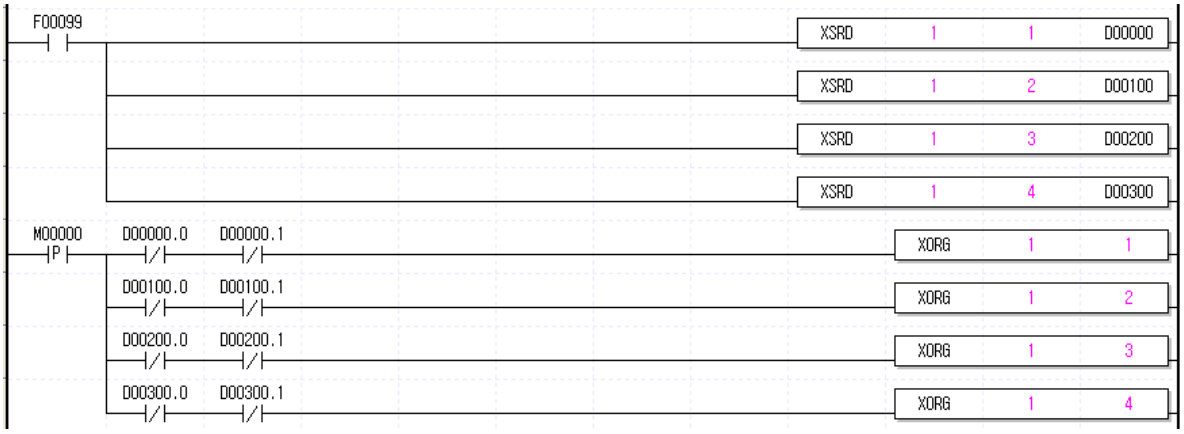
3. The XWRT instruction is not a start instruction that requires a position control operation but requires processing time. Therefore, the position control operation unit does not process the instruction immediately after inputting a command like other non-start. XWRT operation time is max. 2s. If XWRT 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



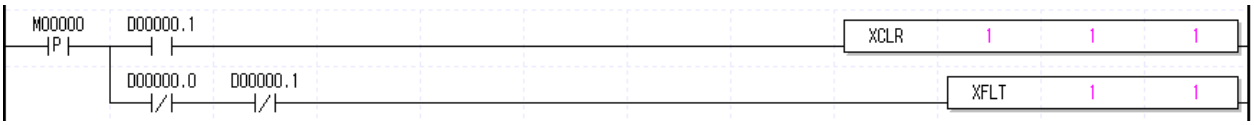
※ D00000.0: 1 axis in operation, D00000.1: 1 axis error state
D00100.0: 2 axis in operation, D00100.1: 2 axis error state
D00200.0: 3 axis in operation, D00200.1: 3 axis error state
D00300.0: 4 axis in operation, D00300.1: 4 axis error state

▶ The example program for command in this Chapter 8 also uses the operation state bit as the program operation condition as the above

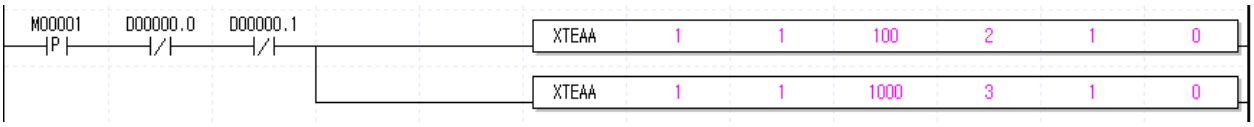
Notes

▶ 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.

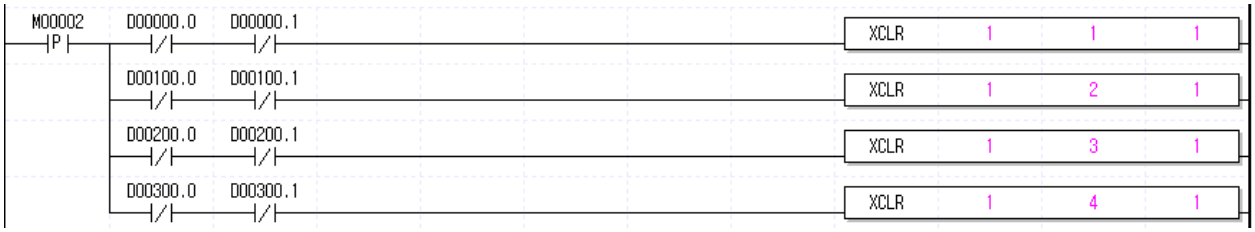
If executing other command



If executing same command

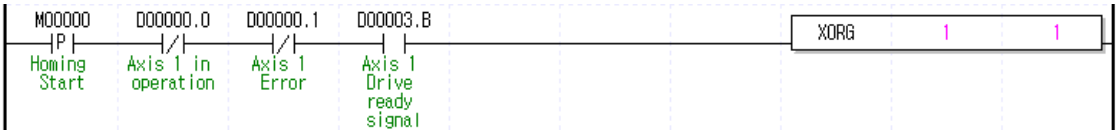


▶ A same command can not be executed for other axis.



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

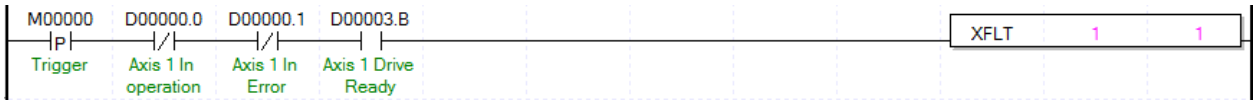
(a) If homing start command is executed, it carries out homing operation by the setting homing parameter and if homing is complete by external input signal, the origin determination end signal is “ON”.

(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

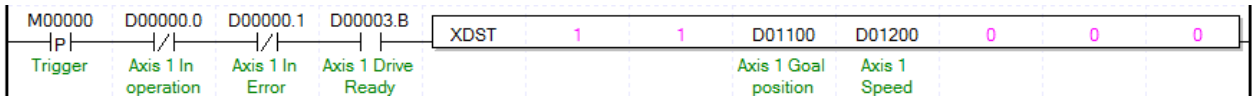
(a) If the floating origin setting command is executed, the current position is changed to the origin address of homing parameter and the origin determination signal (bit) is ON.

(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 (Embedded positioning :Fixed to 1)
	OP2	Axis	PMLK,constant,D,Z,R,ZR	WORD	Command axis (1 ~ 6 : axis1 ~ axis6)
	OP3	Goal position	PMLK,constant,D,Z,R,ZR	DINT	Goal position (-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 1:Relative	-	0:Position Control 1:Speed control 2:Feed Control 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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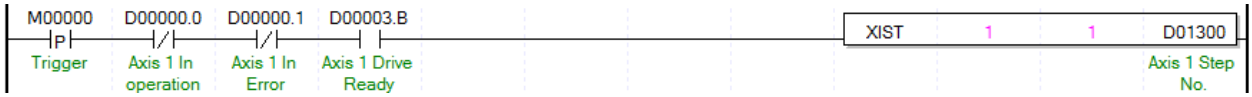
7.3.4 Indirect start (Command : XIST)

(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 (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 operate (0~400)

※ PMLK means P, M, L and K areas

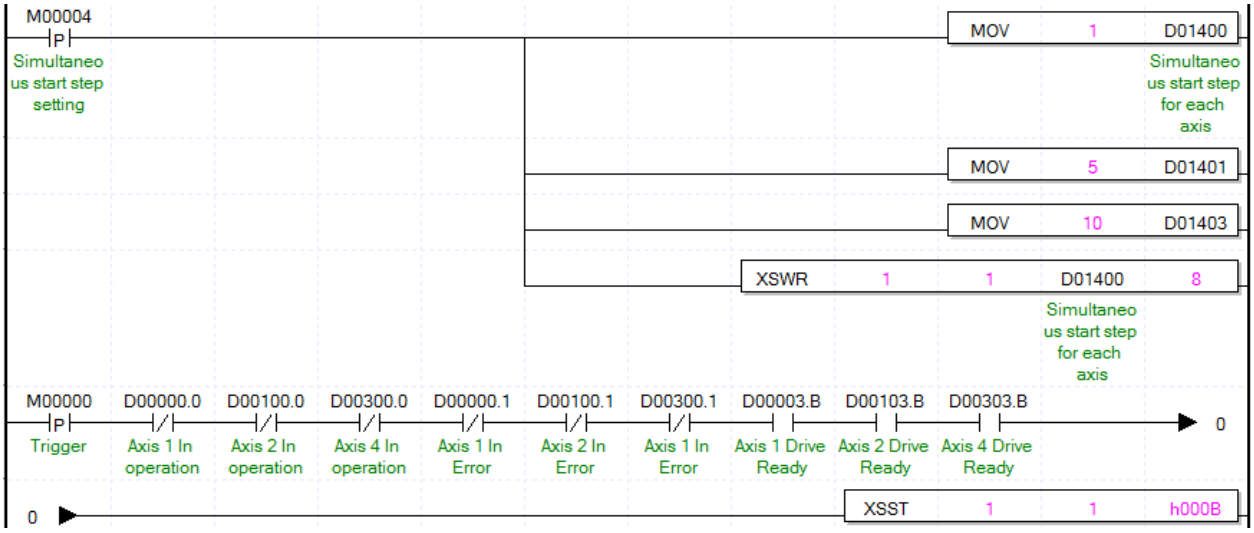
(a) If operation step No. is set as “0” in indirect start, it will be operated as current step No. If other number except 0 is set as the operation step number, it operates only for step no. set.

(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 (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 (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.

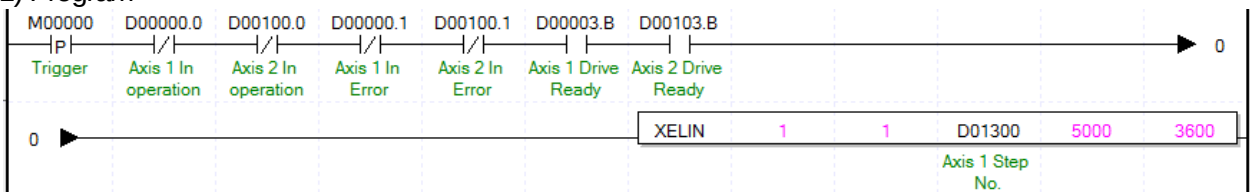
(b) In the example program above, save 8 WORD data from D1400 address as simultaneous start step

(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 (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.

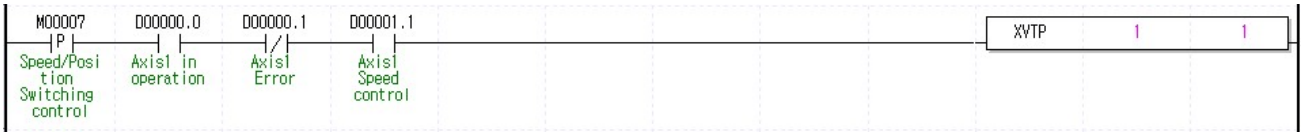
(b) Ellipse ratio is able to be set from 1 to 65535, has [$X10^{-2}$ %] unit. That is, 65535 will be 655.35%.

(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 (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

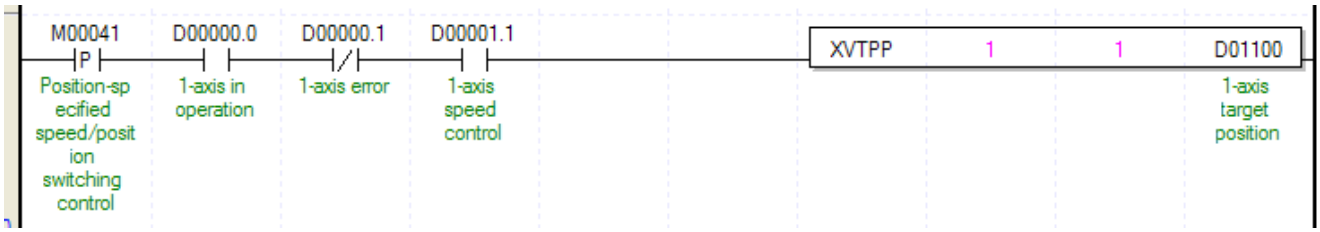
(a) If speed/position switching control is executed in the state of speed control operation, it shall be switched to position control and positioning operation is executed with the position set in the speed control.

(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 (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

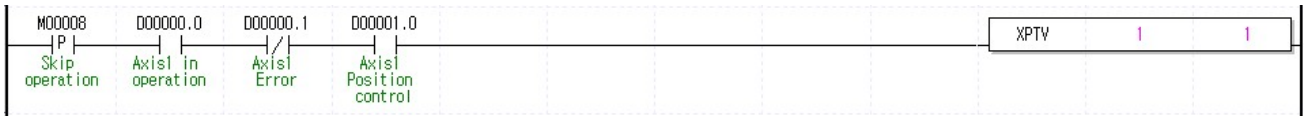
(a) If speed/position switching control is executed in the state of speed control operation, it shall be switched to position control and positioning operation is executed with the position set in the speed control.

(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 (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

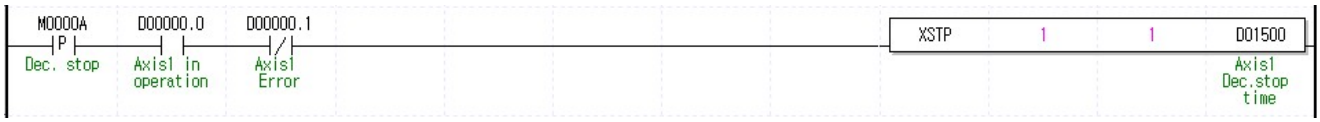
(a) If position/speed switching control is executed during position control operation, it is converted to speed control, operates at the speed set during position control and stops by executing deceleration stop.

(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 (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 (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 (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

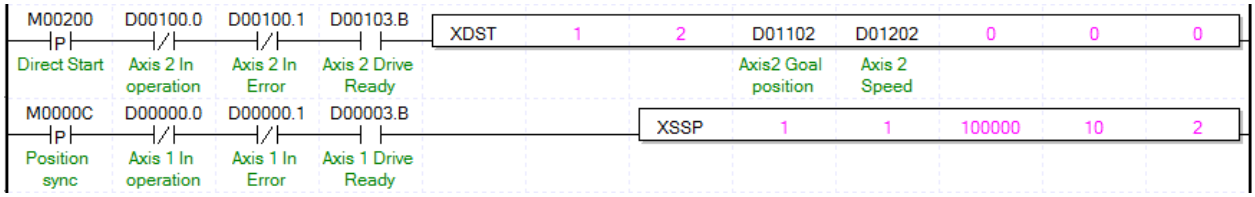
(a) This ends and stops the operation of step which is in operation currently and then continues to operate the next step.

(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 (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 (1 ~ 6 : axis1 ~ axis6, 9 ~ 12 : Encoder1 ~ Encoder4)

※ PMLK means P, M, L and K areas

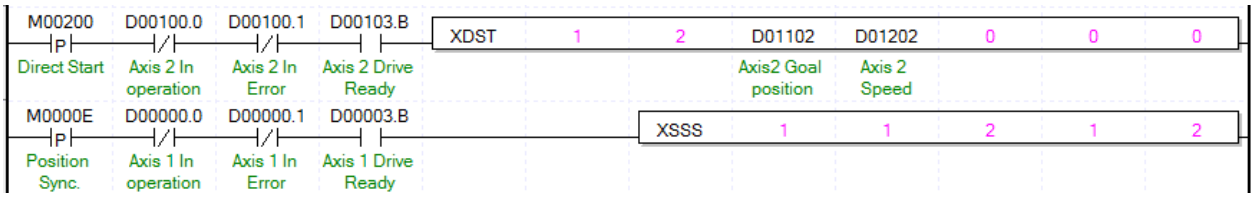
(a) If the command of synchronous start by position is executed, it becomes in operation state but motor does not operate actually. At the point that axis2 as main axis setting starts and its current position is 1000, axis1 will start and the motor will operate.

(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 (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 (-32768 ~ 32767)
	OP4	Subordinate axis ratio	PMLK,constant,D,Z,R,ZR	WORD	Speed sync. sub axis ratio (-32768 ~ 32767)
	OP5	Main axis	PMLK,constant,D,Z,R,ZR	WORD	Main axis (1 ~ 6 : axis1 ~ axis6, 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.

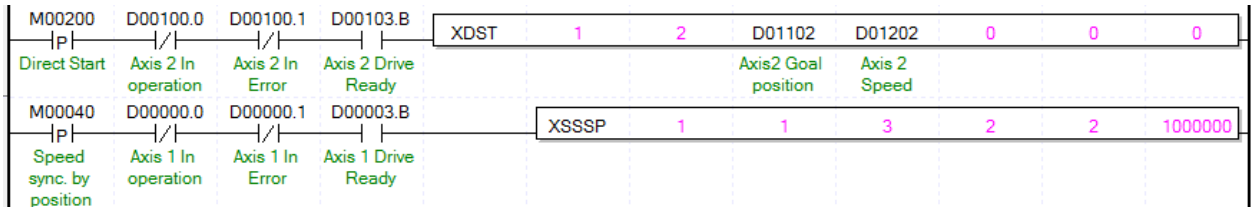
(c) For example, if main axis ratio is 3, sub axis ratio is 2, when main axis moves by 3000, sub axis moves 2000.

(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 (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 (-32768 ~ 32767)
	OP4	Sub axis ratio	PMLK,constant,D,Z,R,ZR	INT	Speed sync. sub axis ratio (-32768 ~ 32767)
	OP5	Main axis	PMLK,constant,D,Z,R,ZR	WORD	Main axis (1 ~ 6 : axis1 ~ axis6, 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.

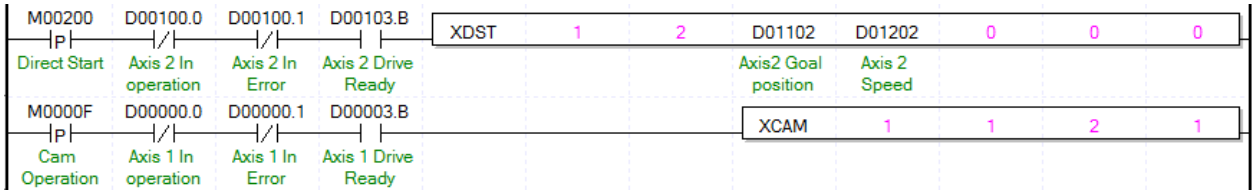
(c) For example, if main axis ratio is 3, sub axis ratio is 2 and target position is 1,000,000, when main axis moves by 3000, sub axis moves 2000. It stops by where position of main axis is at 1,000,000.

(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 (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 (1 ~ 6 : axis1 ~ axis6, 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).

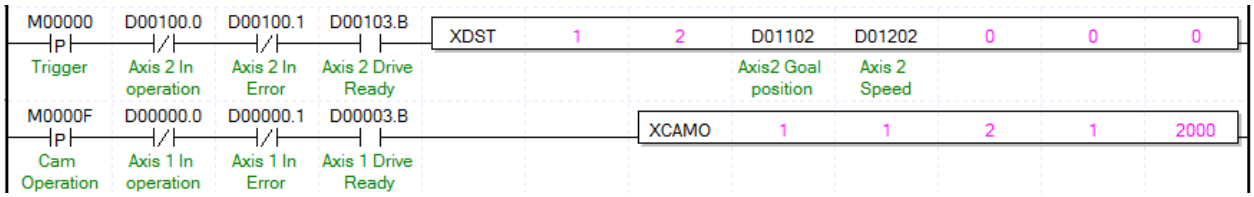
(e) D device signal (axis1 Signal in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

(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 (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 (1 ~ 6 : axis1 ~ axis6, 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).

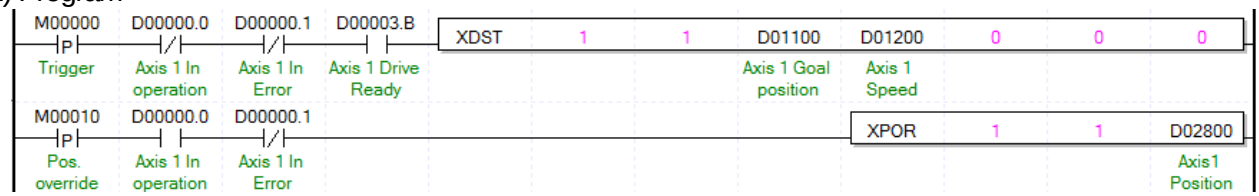
(e) D device signal (axis1 in Operation, etc) which used in the example above is an assumption that saving the axis state value in D device area with XSRD command.

(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 (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 (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.

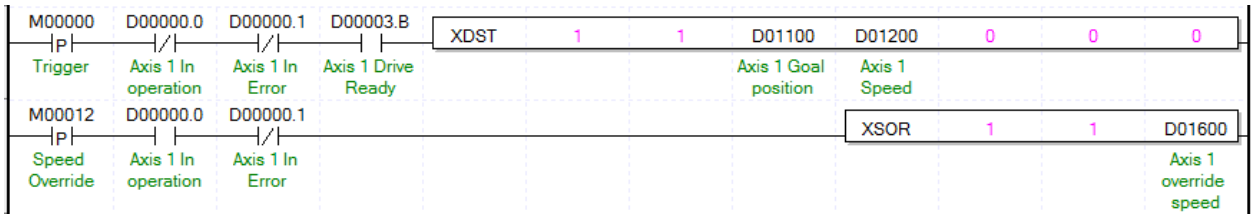
(b) Position override set on position override value is absolute coordinate position.

(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 (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%.

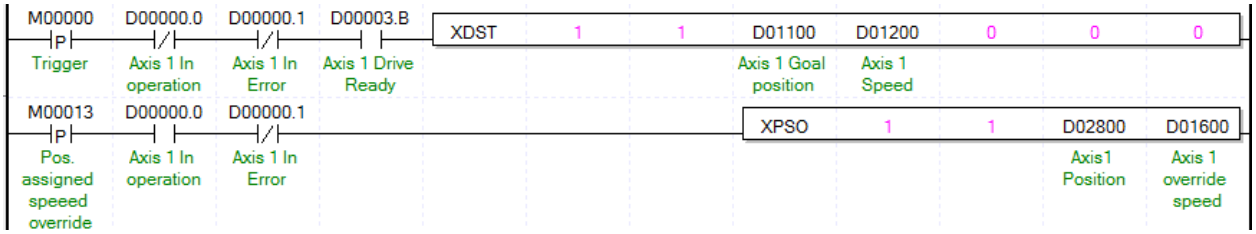
(c) If unit of speed override value is speed value, setting area is from 1 to speed limit value. The speed limit value is set on "Speed limit value" of basic parameter and unit of speed override value depends on unit of axis.

(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 (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.

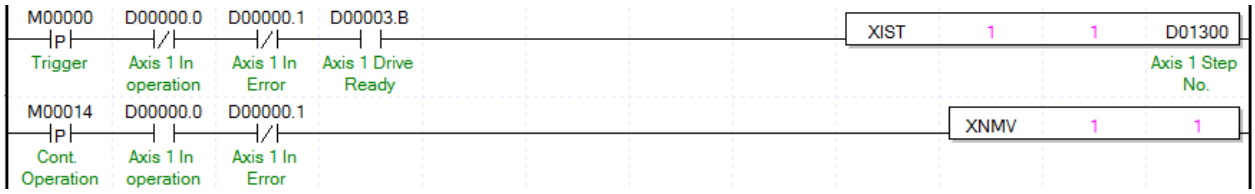
(d) In the example program above, axis1 position assigned speed override input(M00013) become "on" to execute position assigned speed override after axis1 direct start input (M0000) become "on". When the position of axis1 is located at the position where set at D02800, the speed will be changed to the 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 (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.

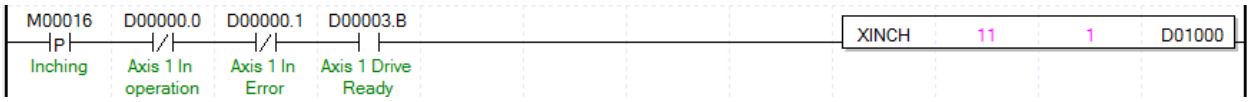
(b) Continuous operation command changes the only current operation pattern in operation, not the operation data.

(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 (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

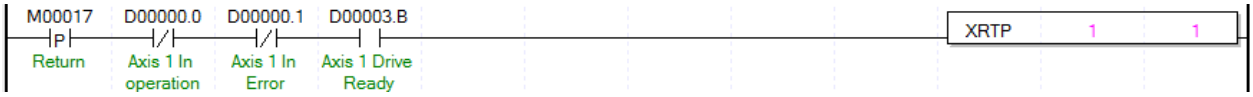
(a) It carries out the relative coordinate operation by inching operation speed set in manual operation parameter as much as position value (OP3).

(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 (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 (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 (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.

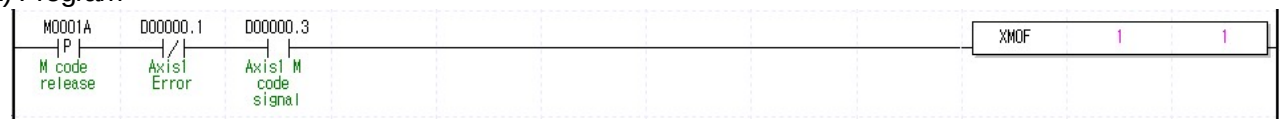
(c) Set the next step after finish operating designated repeat step.

(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 (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

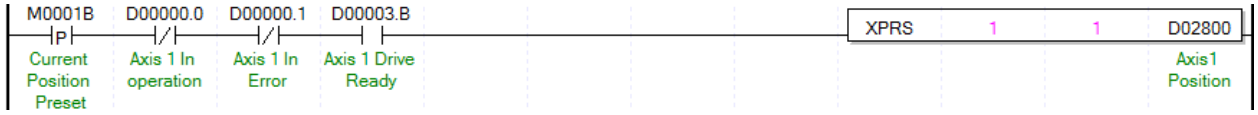
(a) When M code occurs, M code signal and M code No. are released at the same time (M code and M code No. are changed to OFF and 0, respectively).

(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 (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

(2) Description

Device	Description
M0001C	Encoder preset input
D02900	Encoder preset position value

Command	XEPRS				Encoder preset
Operand	OP1	Slot	Constant	WORD	Slot No (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

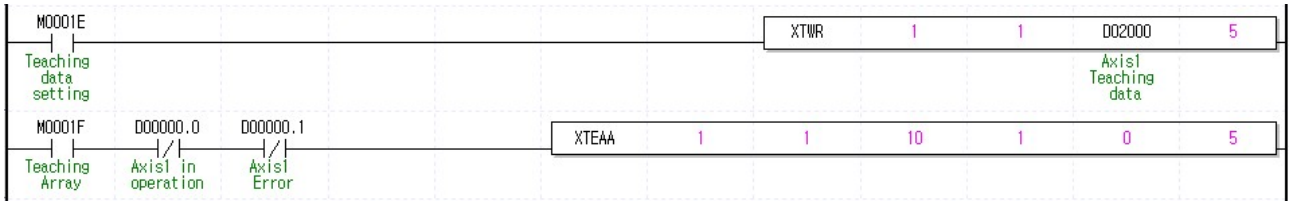
(a) This is the command that changes the current position to the designated position.

(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 (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.

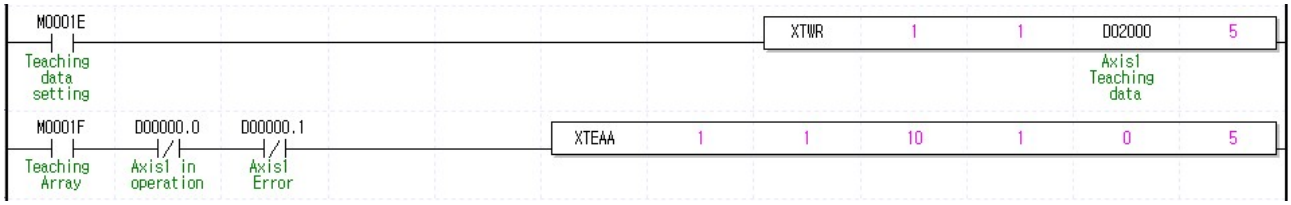
(e) In the example program above, execute ROM teaching for position data between no.10 step and no.14 step of axis1 operation data using 5 axis1 teaching data.

(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 (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.

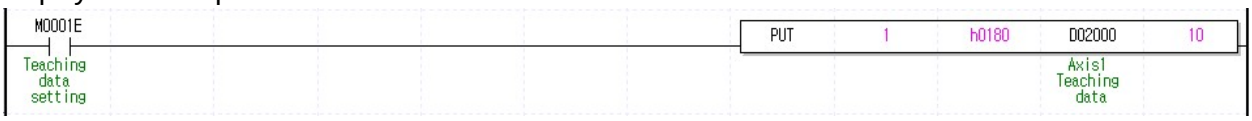
(b) Teaching array is not executed only by executing teaching array data setting command. Please refer to teaching array command (TEAA).

(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

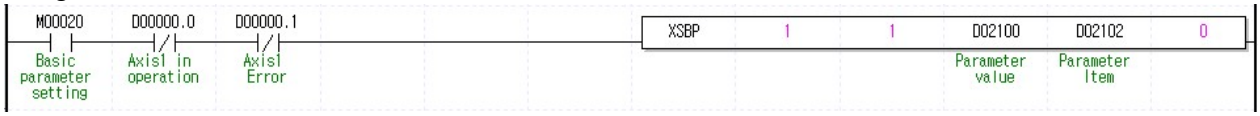
(e) Teaching array data can be set by using PUT command. For this, refer to memory address of “5.1.2 Teaching data” and “7.1.2 Internal Memory Writing”. If use PUT command in the example program above, it displayed like the picture below.



(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



(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 (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] Inch : 1 ~ 2,147,483,647 [X10^{-3}Inch/min] degree : 1 ~ 2,147,483,647 [X10^{-3} degree/min] 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

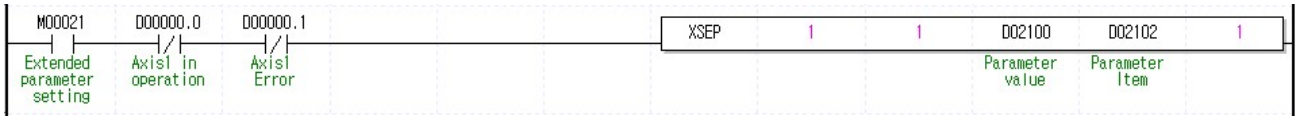
(e) For the change value (OP3) setting range of each basic parameter item (OP4) which already set, refer to “4.1.1 Basic Parameter Content”

(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 (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}㎜] Inch:-2147483648 ~ 2147483647[X10^{-5}Inch] degree:-2147483648~2147483647[X10^{-5}degree] pulse:-2147483648 ~ 2147483647[pulse]
2	S/W low limit	
3	Backlash compensation amount	mm: 0 ~ 65,535[X10^{-4}㎜] inch: 0 ~ 65,535[X10^{-5}Inch] degree: 0 ~ 65,535[X10^{-5}degree] 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}㎜] Inch: 0 ~ 2147483647[X10^{-5}Inch] degree: 0 ~ 2147483647[X10^{-5}degree] 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, 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㎜] Inch: 1 ~ 2147483647[X10-5Inch] degree: 1 ~ 2147483647[X10-5degree] 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

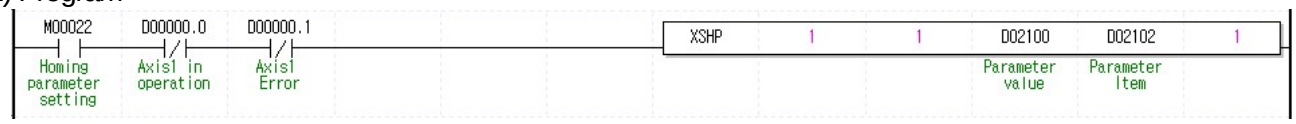
(e) For the change value (OP3) setting range of each extended parameter item (OP4) which already set, refer to “4.2.1 Extended Parameter Content”

(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.

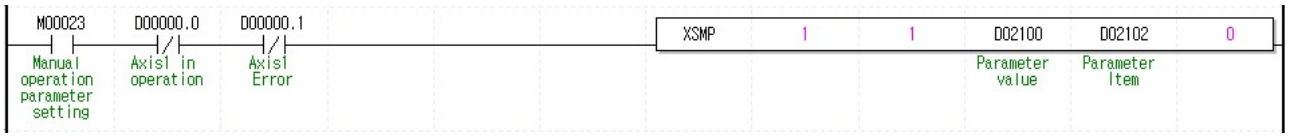
Setting Value	Items	Setting value
1	Origin address	㎜ : -2147483648 ~ 2147483647 [X10^{-4}㎜] Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch] degree : -2147483648 ~ 2147483647 [X10^{5}degree] pulse : -2147483648 ~ 2147483647 [pulse]
2	Homing high speed	㎜ : 1 ~ 2,147,483,647 [X10^{-2}㎜/min] Inch : 1 ~ 2,147,483,647 [X10^{-3}Inch/min] degree : 1 ~ 2,147,483,647 [X10^{-3} degree/min] 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}㎜] Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch] degree : -2147483648 ~ 2147483647 [X10^{-5}degree] pulse : -2147483648 ~ 2147483647 [pulse]
8	Homing restart time	0 ~ 65,535[ms]
9	Homing mode	0:Approximate origin/Origin (Off), 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.

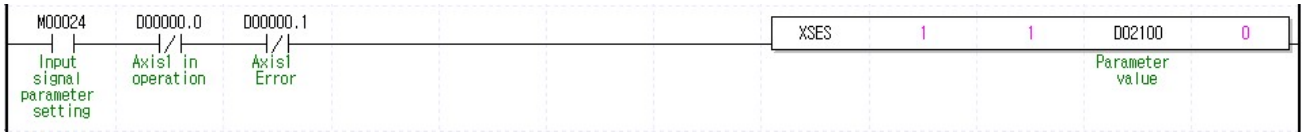
Setting value	Items	Setting value
1	Jog high speed	㎜ : 1 ~ 2,147,483,647 [X10^{-2}㎜/min] Inch : 1 ~ 2,147,483,647 [X10^{-3}Inch/min] degree : 1 ~ 2,147,483,647 [X10^{-3} degree/min] pulse : 1 ~ 200,000 [pulse/sec]
2	Jog low speed	
3	Jog acc. time	0 ~ 2,147,483,647 [ms]
4	Jog dec. time	
5	Inching speed	㎜ : 1 ~ 65,535[X10^{-2}㎜/min] Inch : 1 ~ 65,535[X10^{-3}Inch/min] degree : 1 ~ 65,535[X10^{-3} degree/sec] 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.

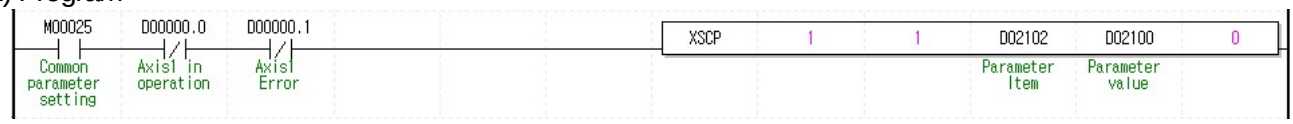
(d) The input signal applied with each bit of the value to be set in parameter item is as follows. If each bit are set, it operates as “B contact point”. If they are clear, it operates as “A contact point”

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

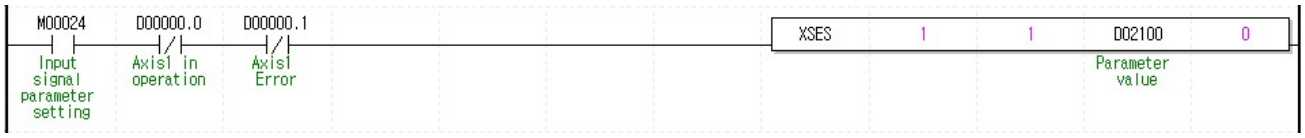
(d) For the change value (OP3) setting range of each common parameter item (OP4) which already set, refer to “4.7.1 Common Parameter Content”

(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

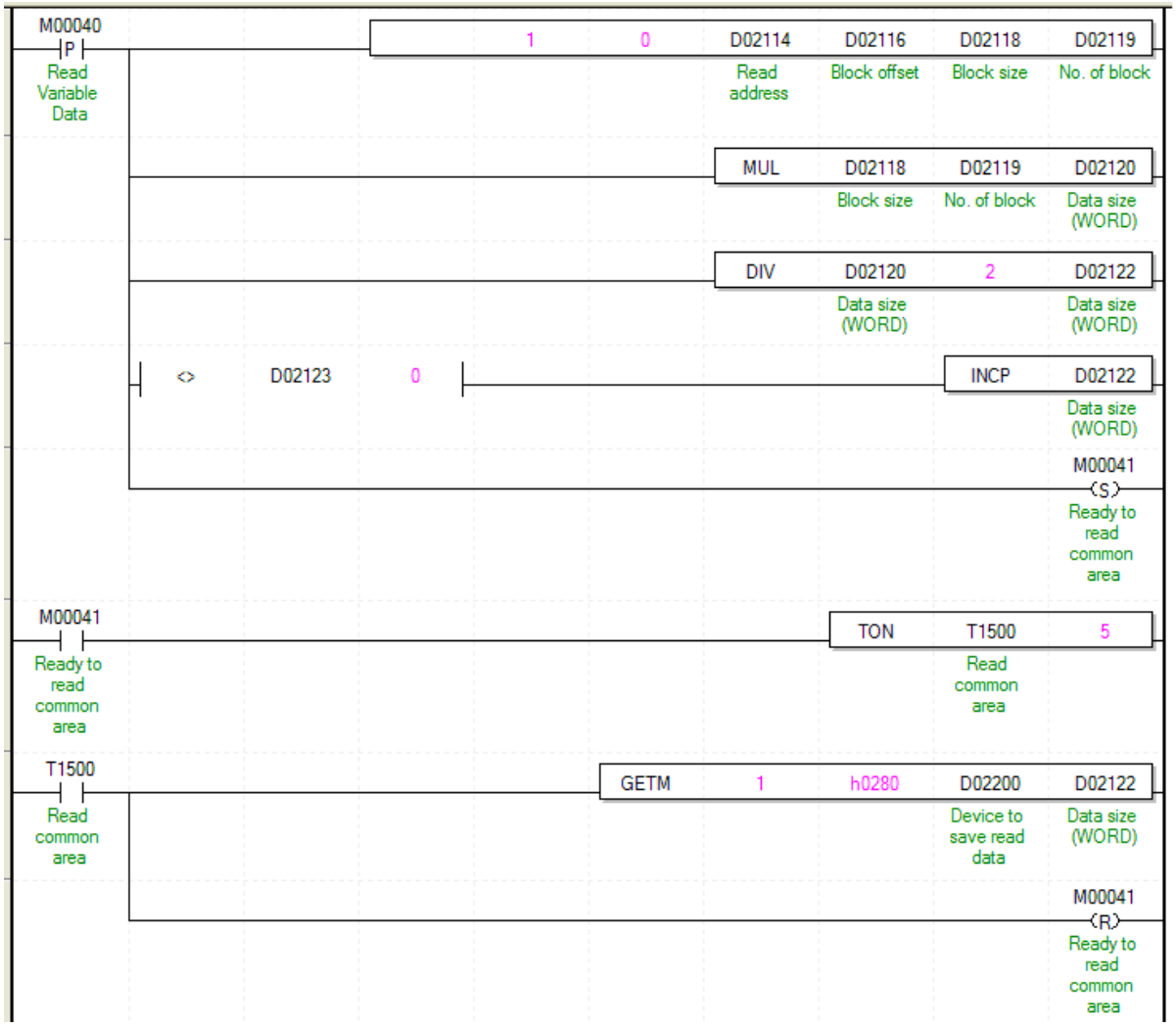
Setting value	Items	Setting value
1	Goal position	㎜ : -2147483648 ~ 2147483647 [X10^{-4}㎜] Inch : -2147483648 ~ 2147483647 [X10^{-5}Inch] degree : -2147483648 ~ 2147483647 [X10^{-5}degree] pulse : -2147483648 ~ 2147483647 [pulse]
2	Circular interpolation subordinate position	-
3	Operation speed	㎜ : 1 ~ 2,147,483,647 [X10^{-2}㎜/min] Inch : 1 ~ 2,147,483,647 [X10^{-3}Inch/min] degree : 1 ~ 2,147,483,647 [X10^{-3} degree/min] pulse : 1 ~ 200,000 [pulse/sec]
4	Dwell time	0 ~ 65,535[ms]
5	M code No.	0 ~ 65,535
6	Sub coordinate setting	Bit unit setting Bit 3 | Bit 2 | Bit 1 | Bit 0 axis4 | axis3 | axis2 | axis1
7	Helical interpolation axis	0, axis1 ~ axis4 (0: General circular arc interpolation)
8	Number of circular arc interpolation turn	0~65,535
9	Coordinate	0:absolute, 1:relative
10	Control method	0:Unit position control, 1:, Shortening speed control 2:Shortening Feed control, 3:Linear interpolation, 4:Circular arc interpolation
11	Operation method	0:Single, 1:Repeat
12	Operation Pattern	0:End, 1:Continuous, 2:Go on
13	Circular arc size	0:Circular arc<180 1:Circular arc>=180
14	Acc. No.	0 ~ 3
15	Dec. No.	0 ~ 3
16	Circular arc interpolation method	0:Middle point, 1:Center point, 2:Radius
17	Circular arc interpolation direction	0:CW, 1:CCW

(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 (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.

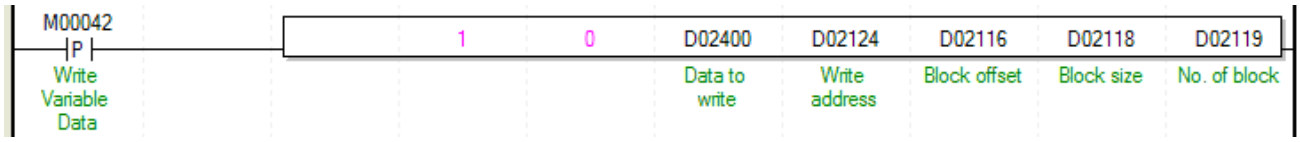
(c) “Read variable data” can be executed in operation.

(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 (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.

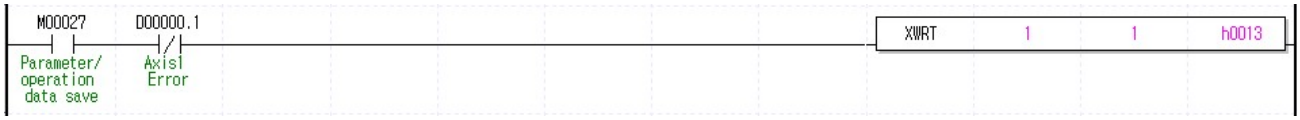
(c) “Write variable data” command can’t be executed in operation.

(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 (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

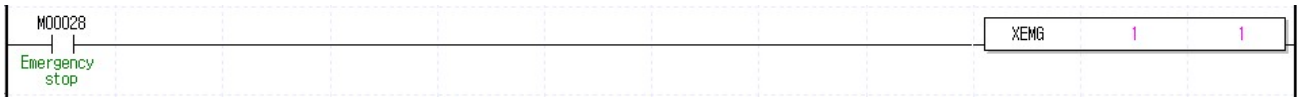
That is, if set h0003, axis2, axis1 will be set to execute parameter/operation data save.

(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

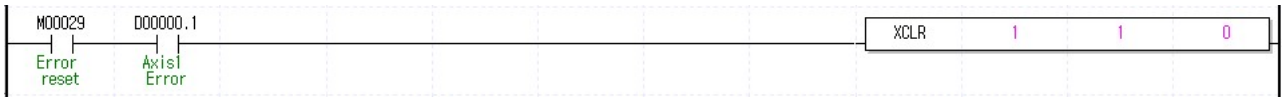
(a) Execute internal emergency stop command to command axis.

(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 (Ignored inembedded positioning)

※ PMLK means P, M, L and K areas

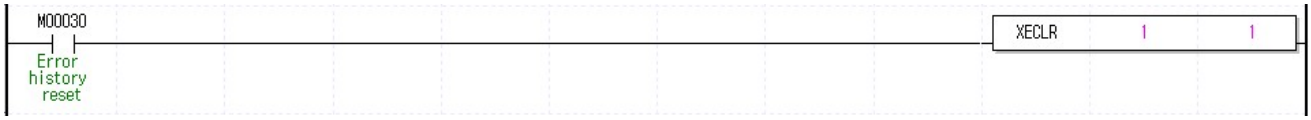
(a) This is the command that reset the error occurred on command axis.

(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.

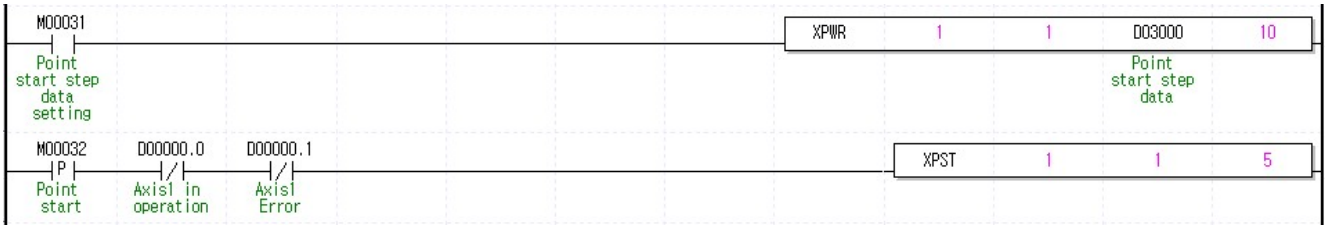
(d) Step data must be set in point start data area before execute point start. For the point start step data setting, refer to the next page about XPWR command.

(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.

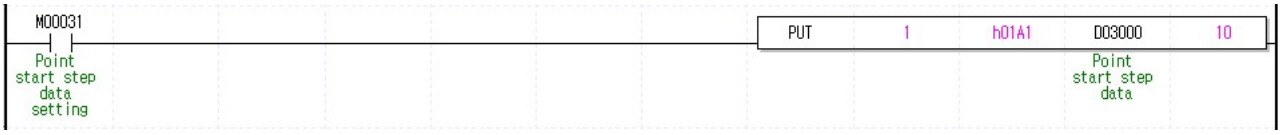
No.	Device No.	POINT start step data
1	Device + 0	POINT start step data 1
2	Device + 1	POINT start step data 2
3	Device + 2	POINT start step data 3
4	Device + 3	POINT start step data 4
5	Device + 4	POINT start step data 5
6	Device + 5	POINT start step data 6
7	Device + 6	POINT start step data 7
8	Device + 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”.

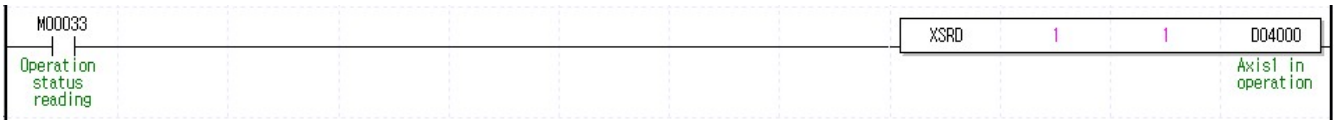
(g) The example program above sets 10 point steps from D03000 on axis1 and executes point start to 5 point steps which already set.

(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.



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

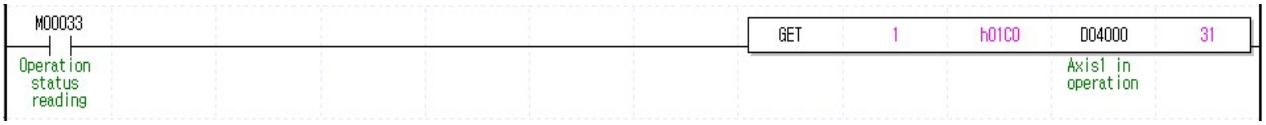
※ PMLK means P, M, L and K areas.

(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.

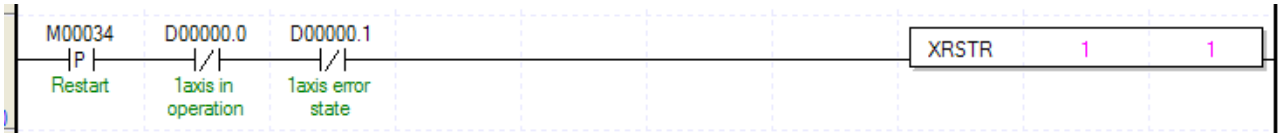
Device No.	Size	State
Device	WORD	Operation State Information (Lower)
Device + 1	WORD	Operation State Information (Upper)
Device + 2	WORD	Axis Information
Device + 3	WORD	External Input/Output Signal State
Device + 4	DINT	Current Position
Device + 6	DWORD	Current Speed
Device + 8	WORD	Step No.
Device + 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

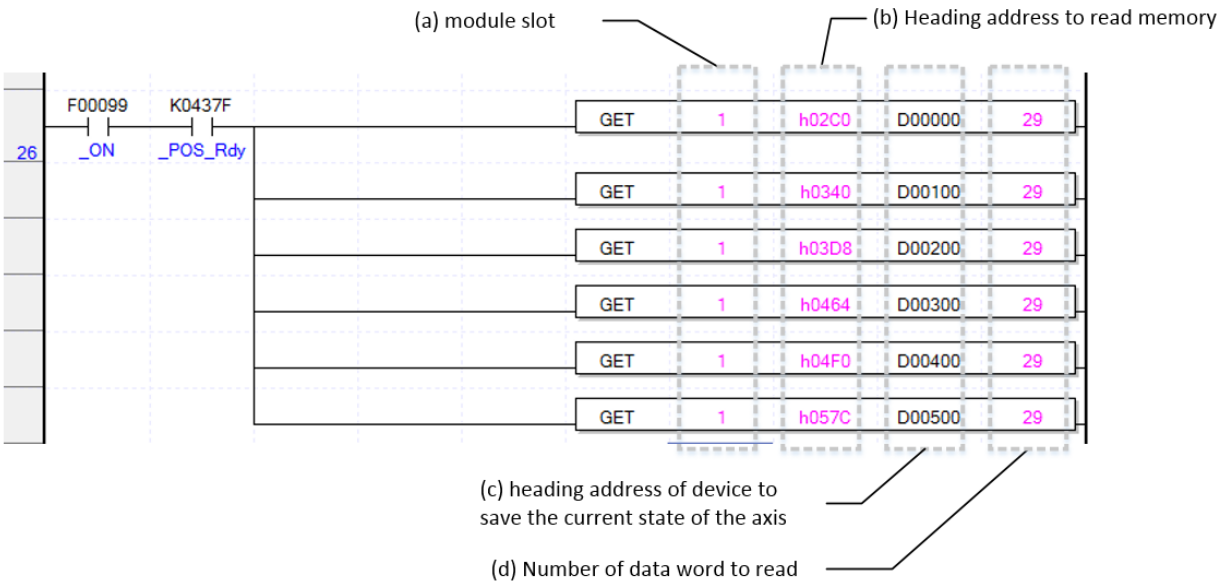
(a) Address of Embedded Positioning
Before operation, you need to configure its position by numbers. In this example, The slot number of embedded positioning is fixed to Slot 1.

(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) 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

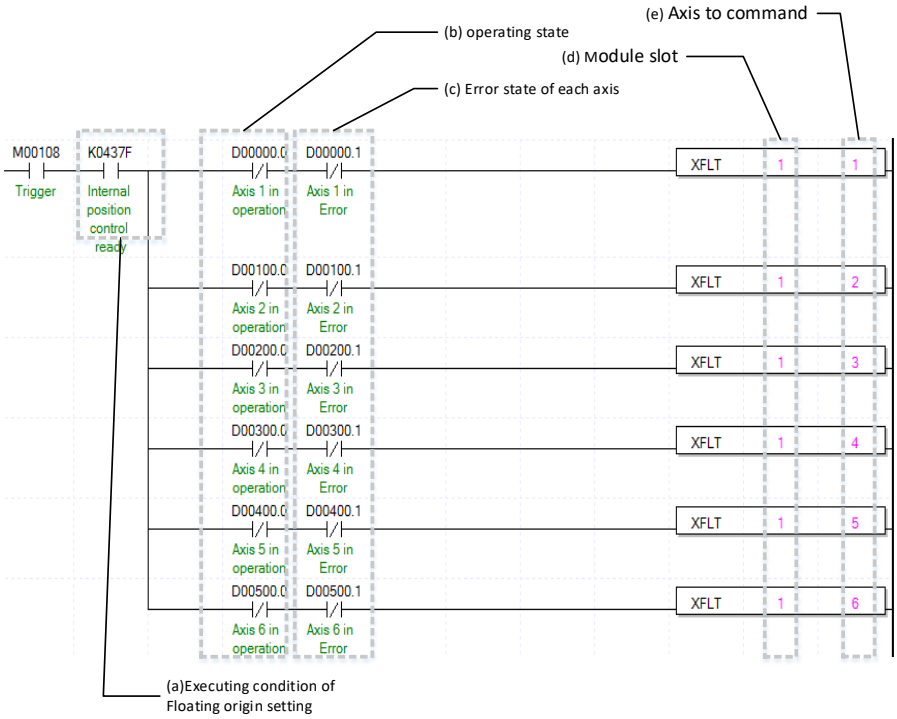
Using command GET to read condition information, can save number of data by WORD, hence you only chosen data will be saved.

(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.

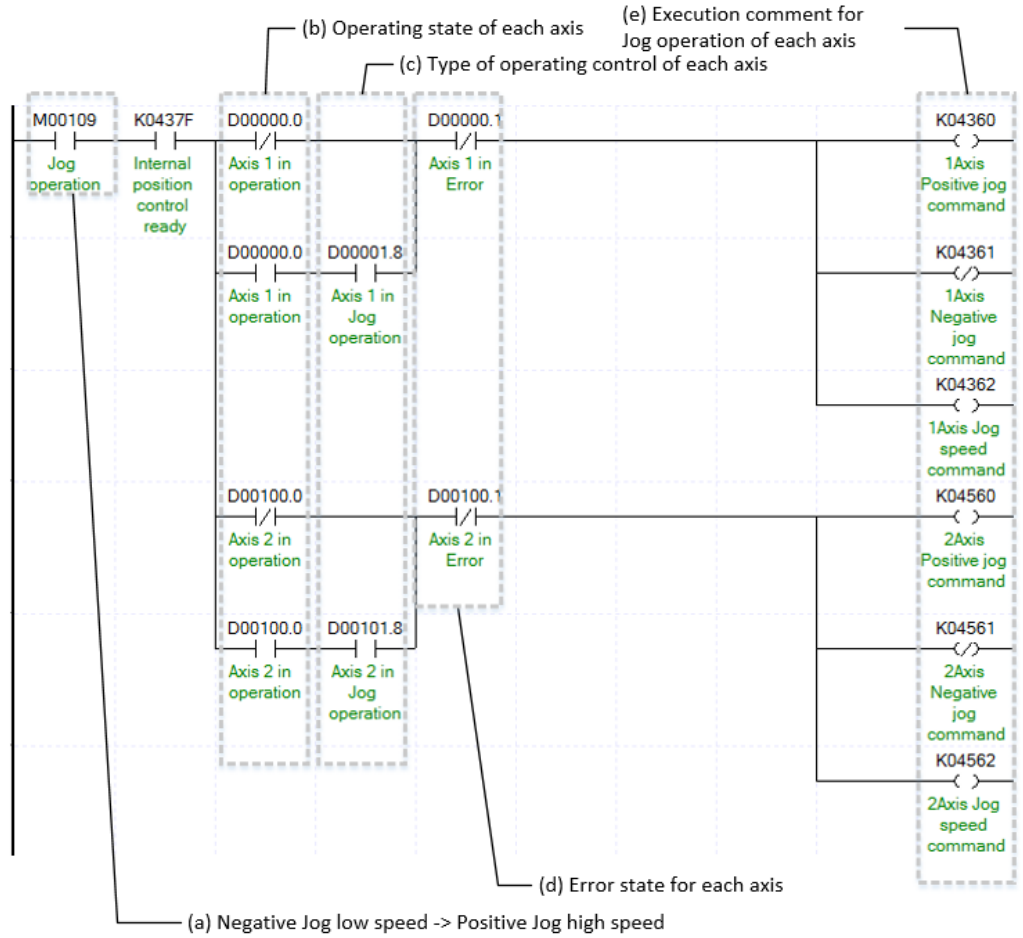
(e) Address of Positioning Module

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.

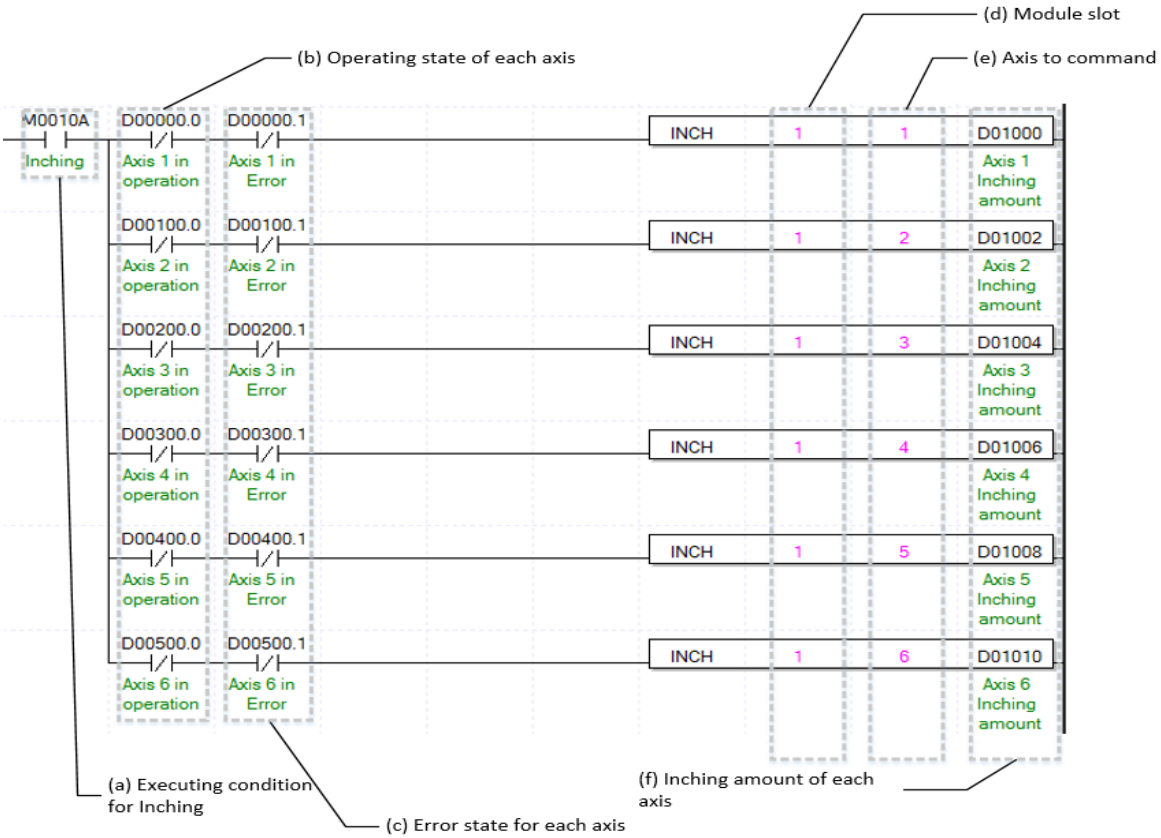
(d) Error state for each axis

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

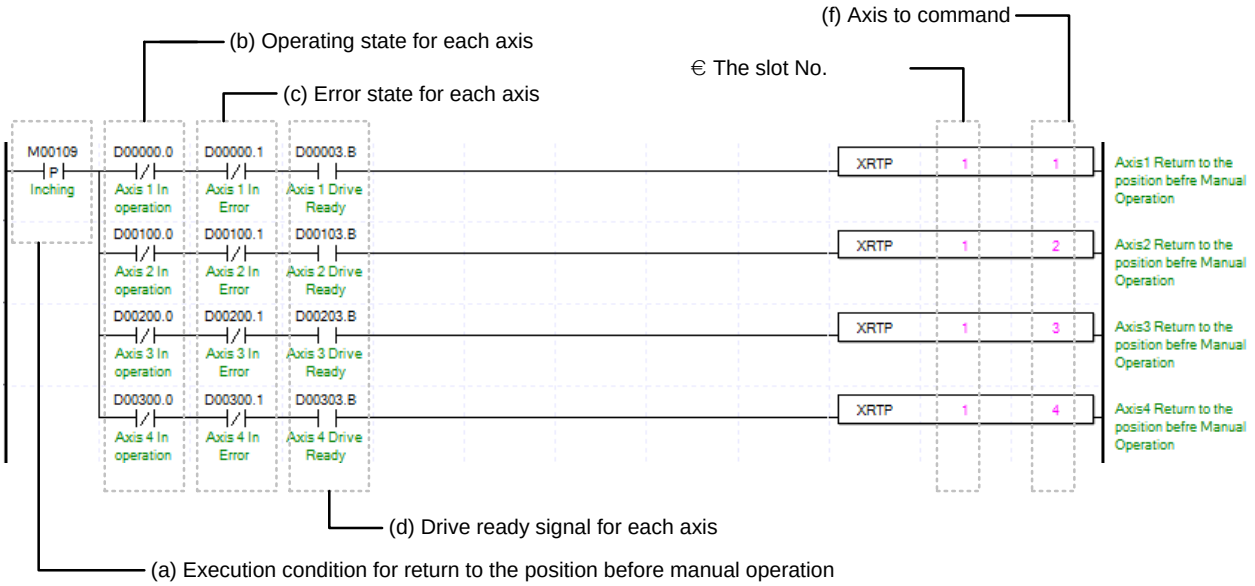
You can set an axis for Inching Operation. XBM-HP supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Inching Operation, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(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.

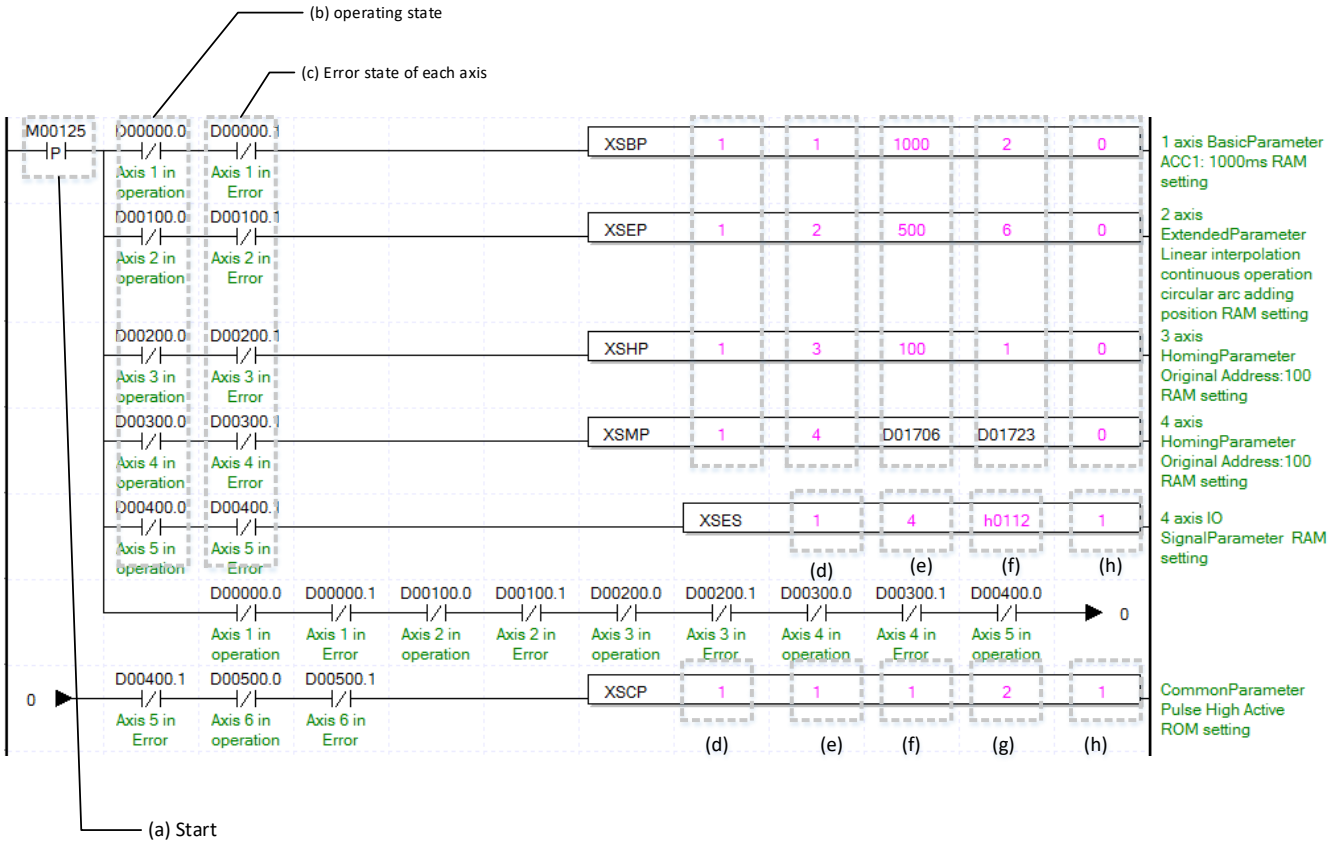
(f) Axis of command execution

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.

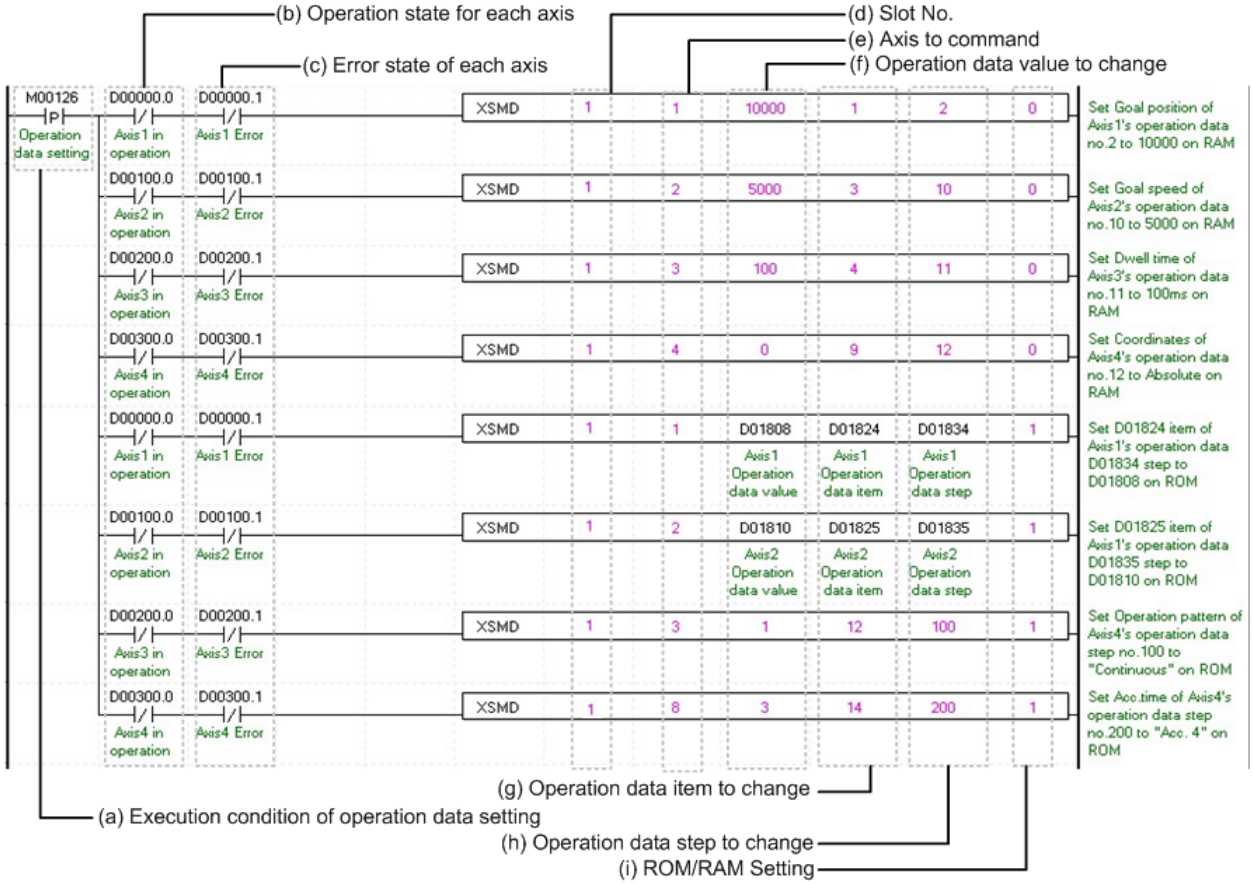
(g) List of Changing Parameter

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



(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

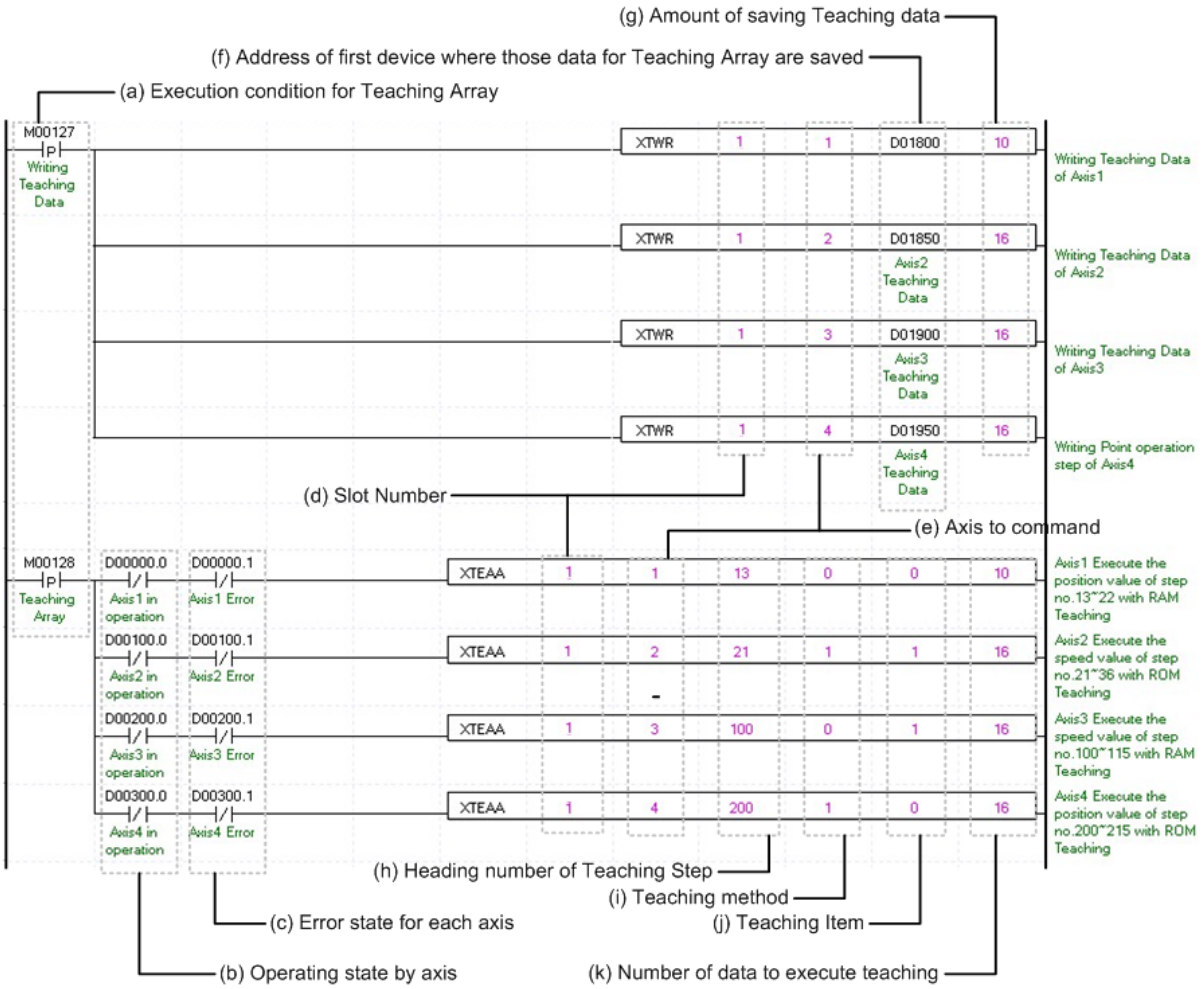
(h) Changing Operating Data Step

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

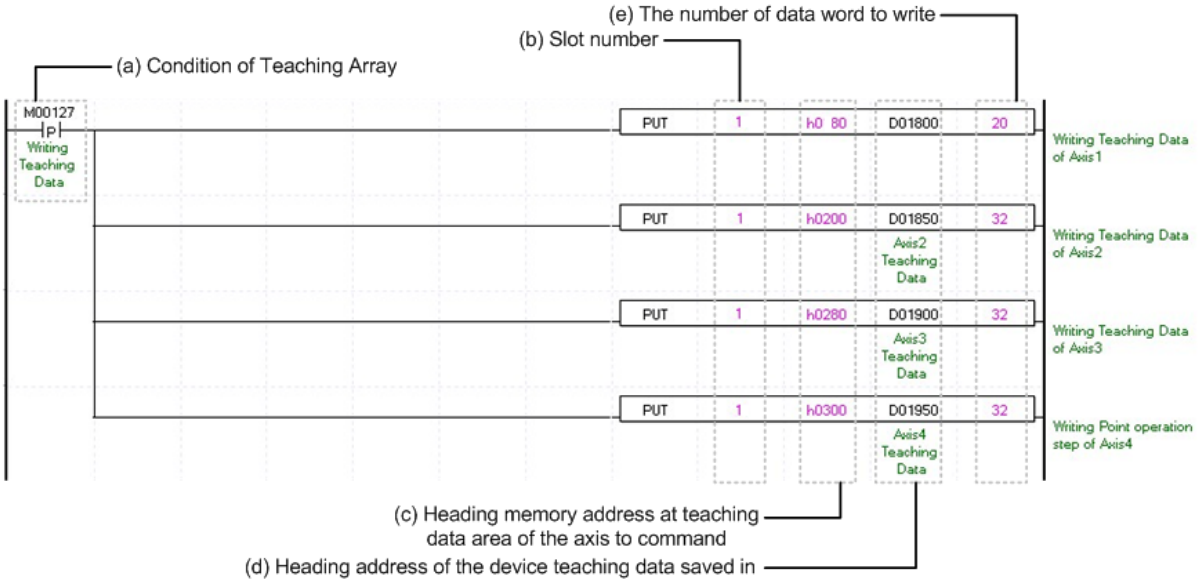
(j) List of Teaching

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

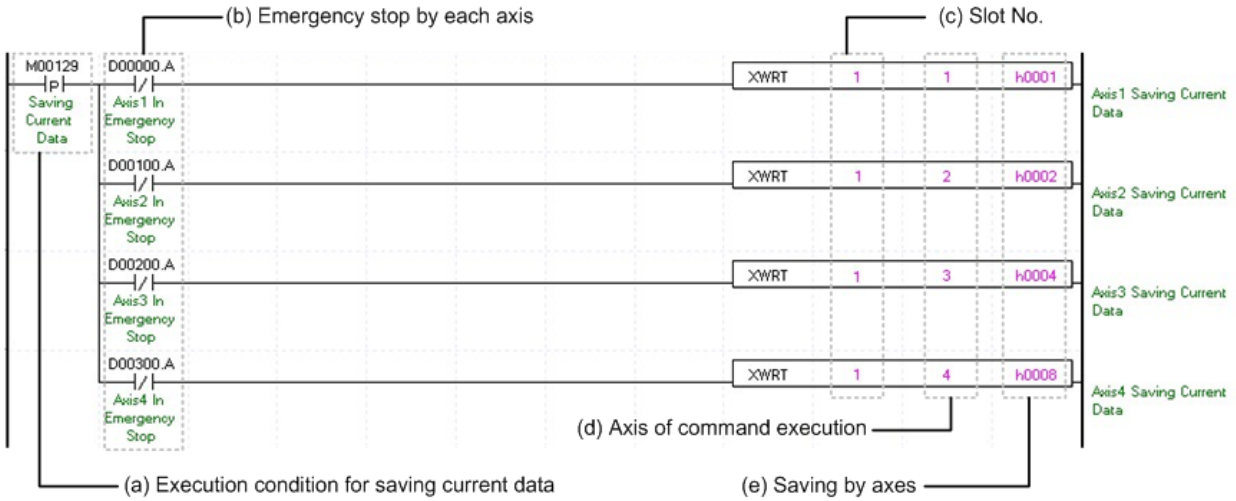
Decide how many steps will be operated using by Teaching Method. Maximum 16 Teaching Array data can be used. For more information about Teaching Array Operation, look for reference from “Chapter 8.7.1”

(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).

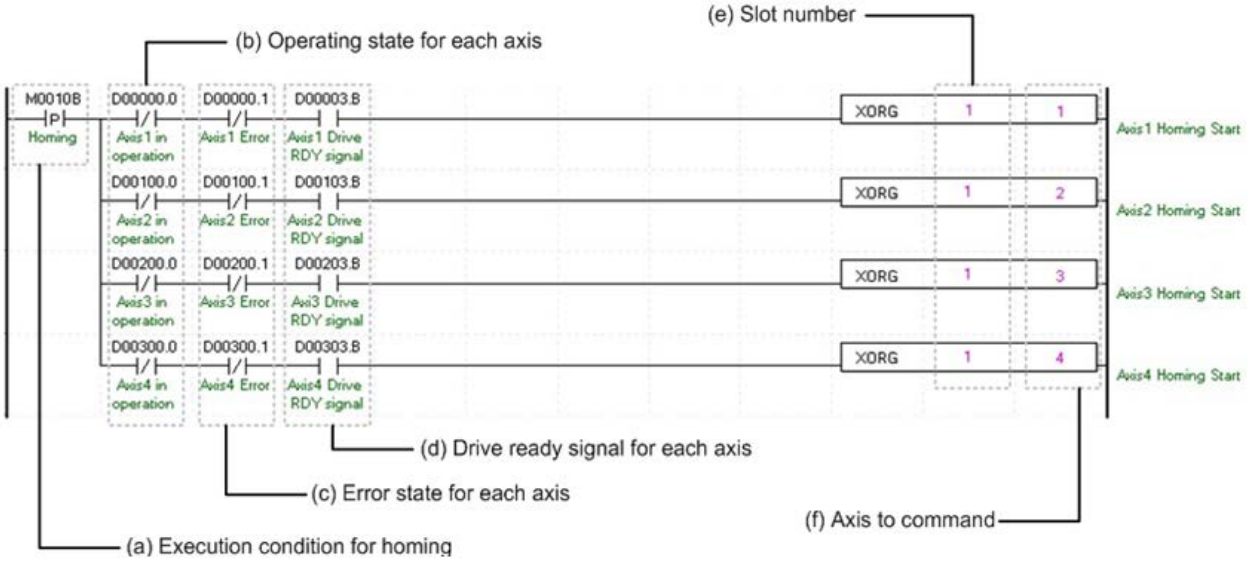
(e) Saving by axes

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

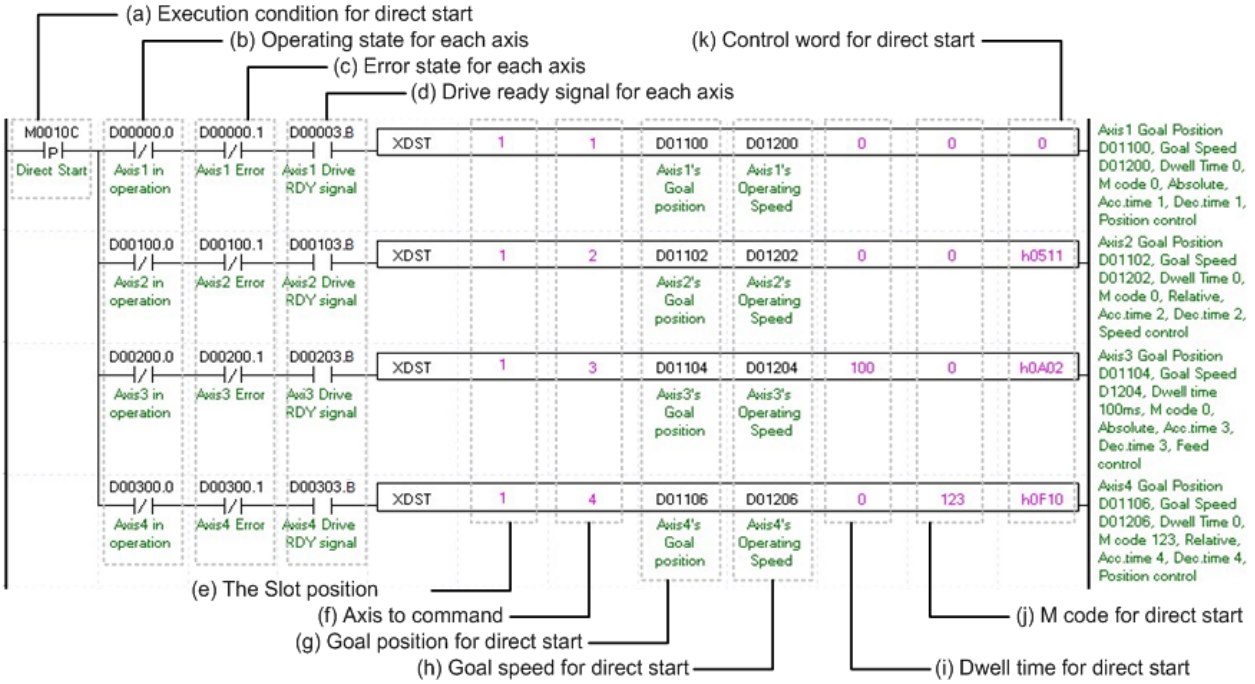
The slot number of embedded positioning is fixed to Slot 1.

(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

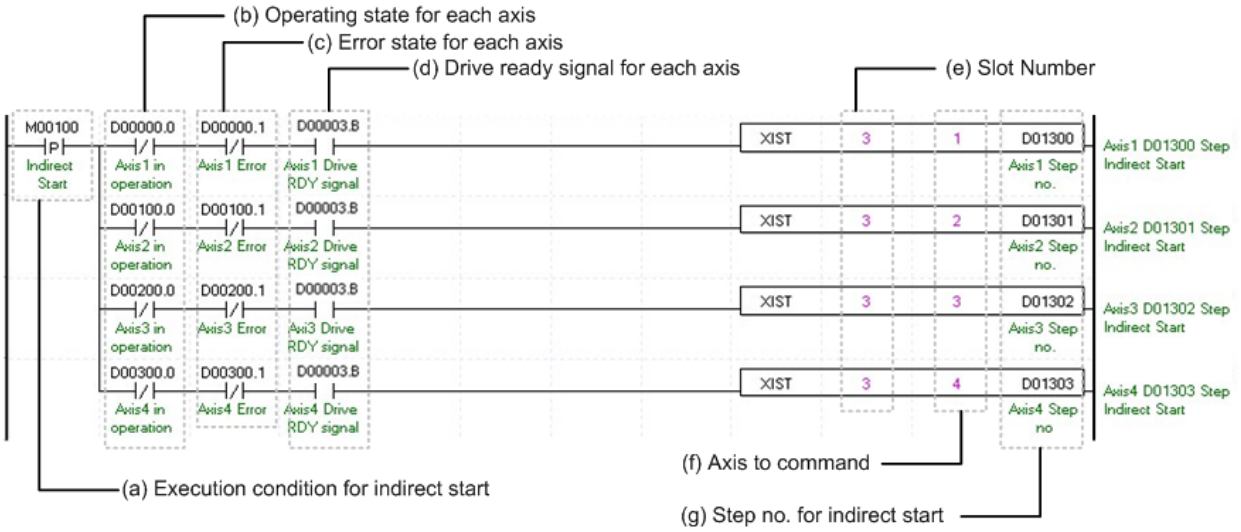
You can set a value of M code which are displaying of Operating Parameter by Direct Start. The way of M code outputs are “Parameter Expansion, M code Mode,” within the “None, With, After.” It will make an M code besides you choose “None” for its parameter. For more information, reference for M code is 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 1:Ralative	-	0:Position control 1:Speed control 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

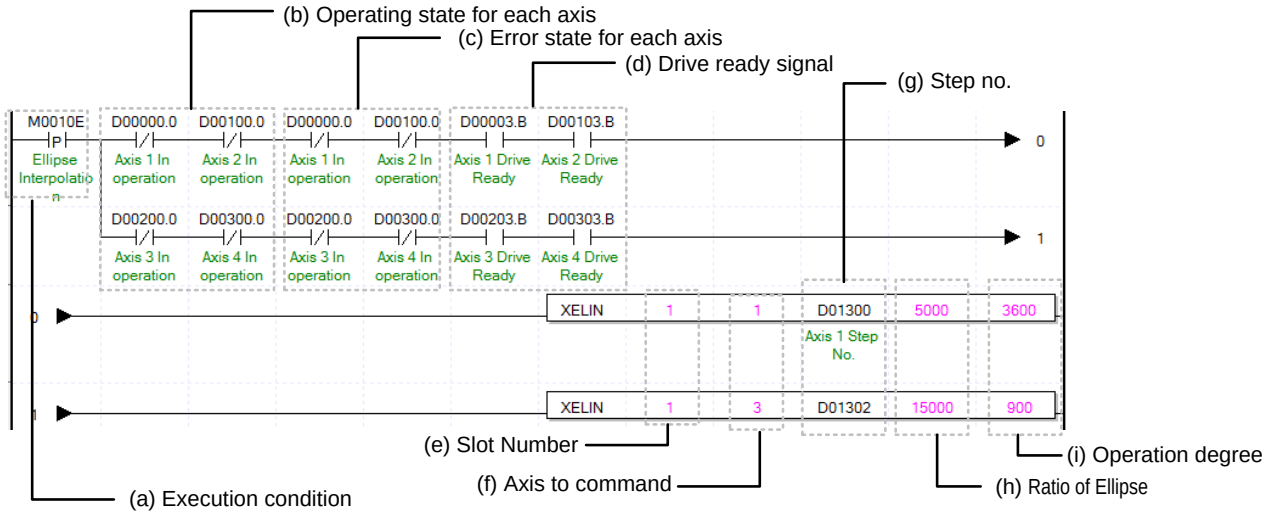
You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(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.

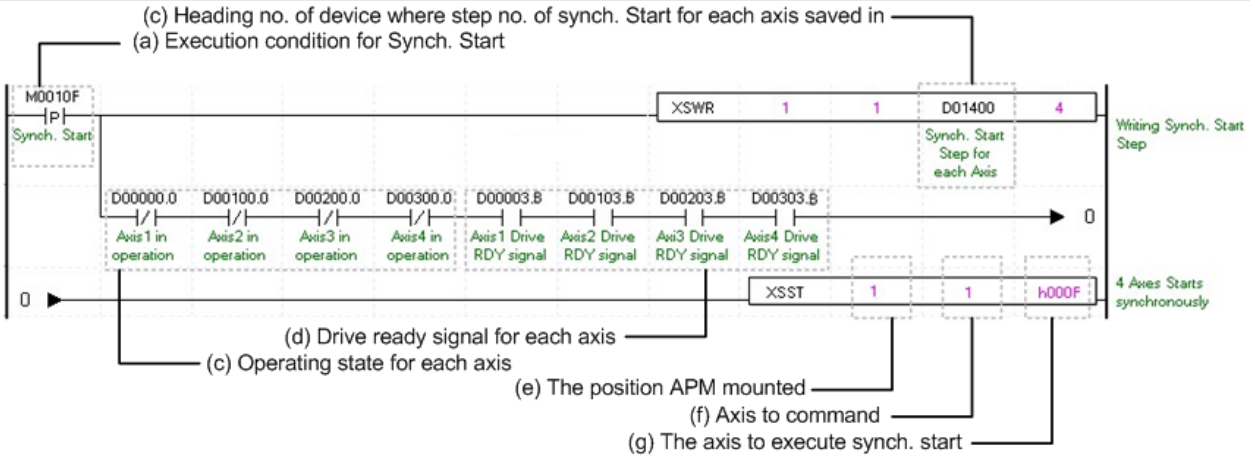
(h) Ratio of Ellipse Interpolation Axis

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 [$X10^{-1}$ 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

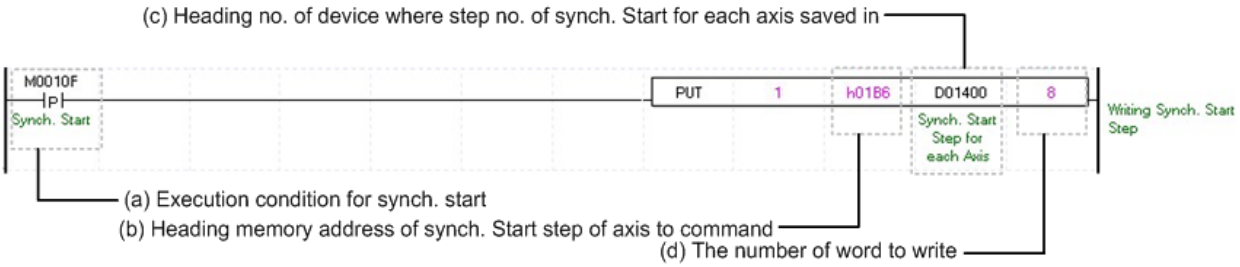
You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(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.

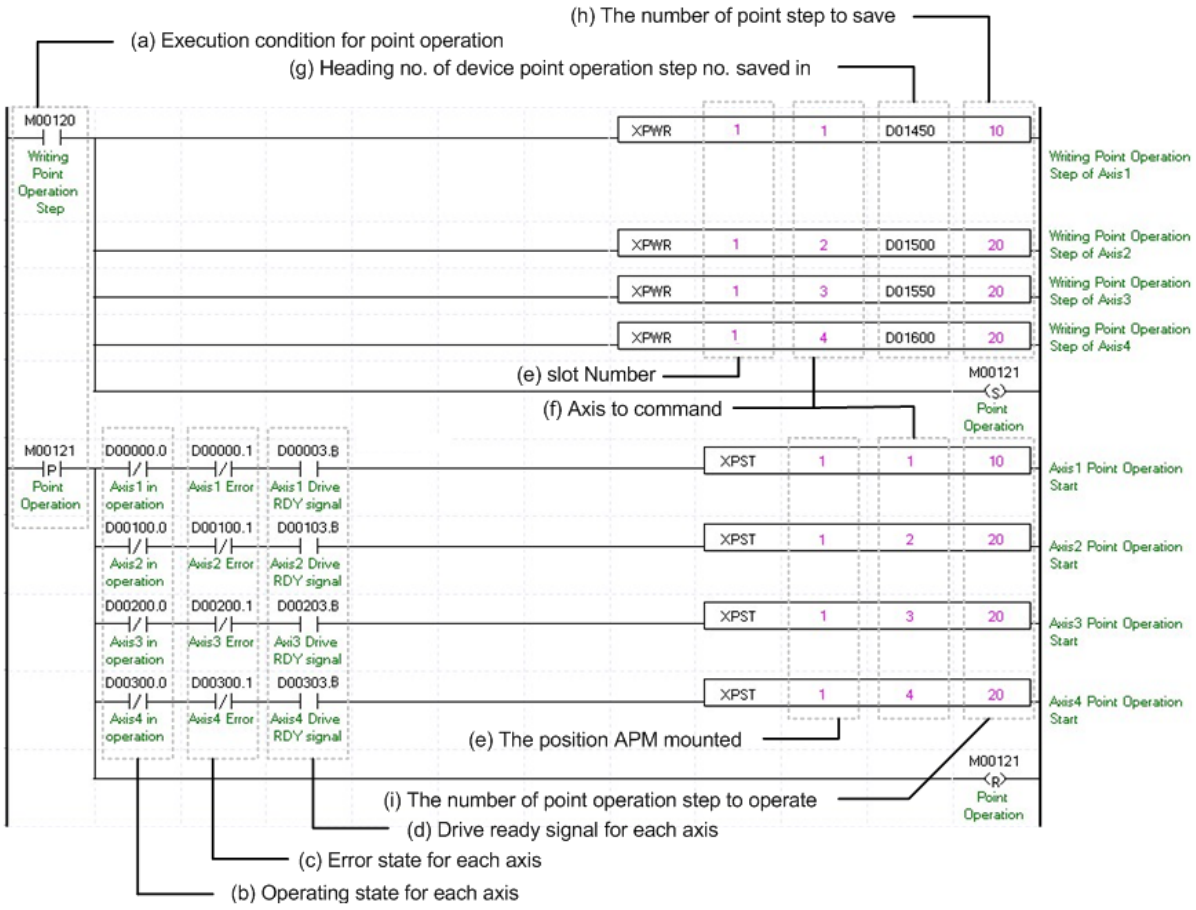
15 ~ 4 Bit	3Bit	2Bit	1Bit	0Bit
Not use	Axis4	Axis3	Axis2	Axis1

(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

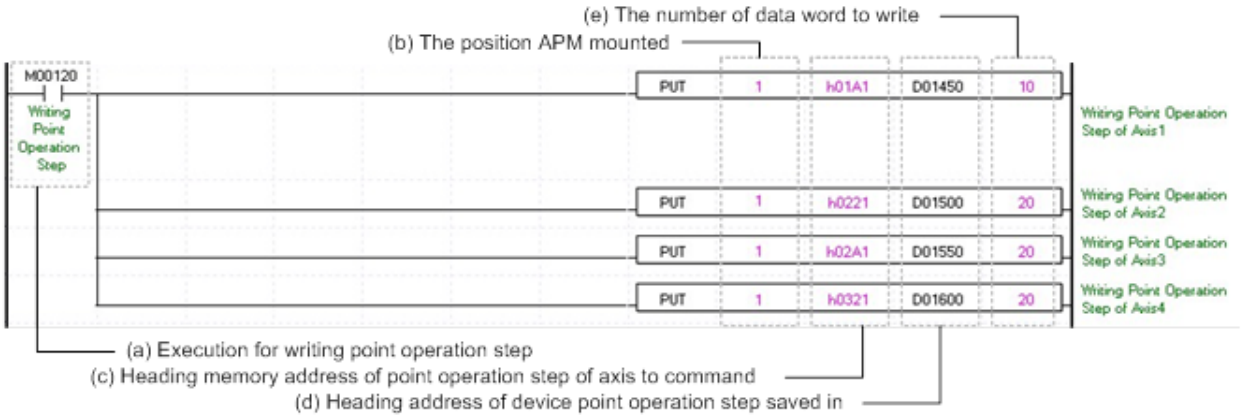
(h) Amount of Saving Point Operation Steps

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

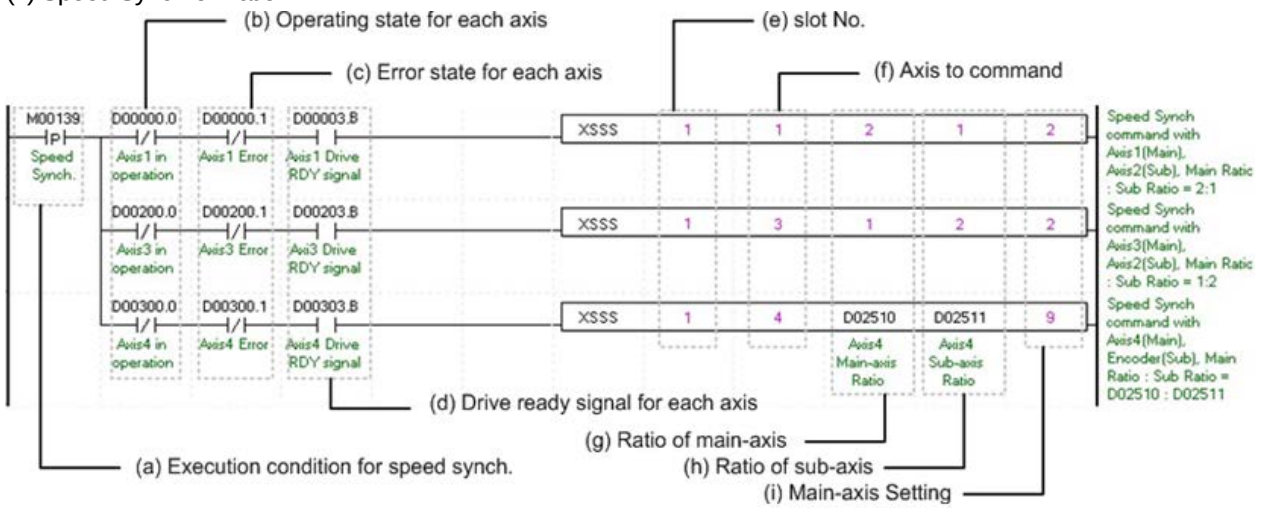
Set the number of saving Step numbers by Point Operating Writing command. For more information, reference for Setting of Point Operation is in the “Chapter 8.2.17.”

(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.

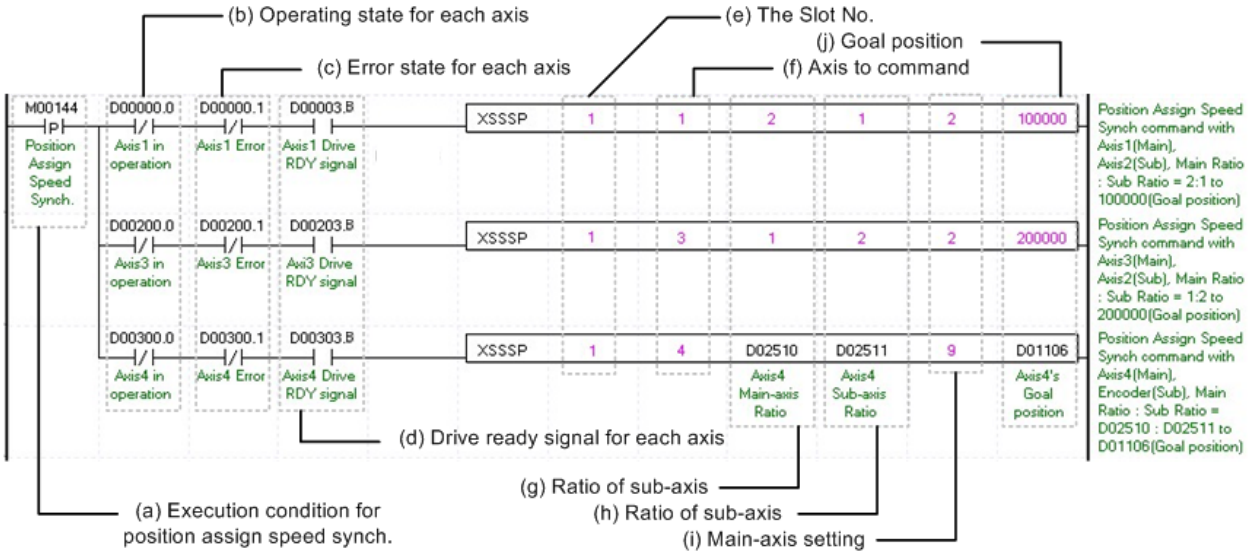
(i) Main Axis Setting

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.

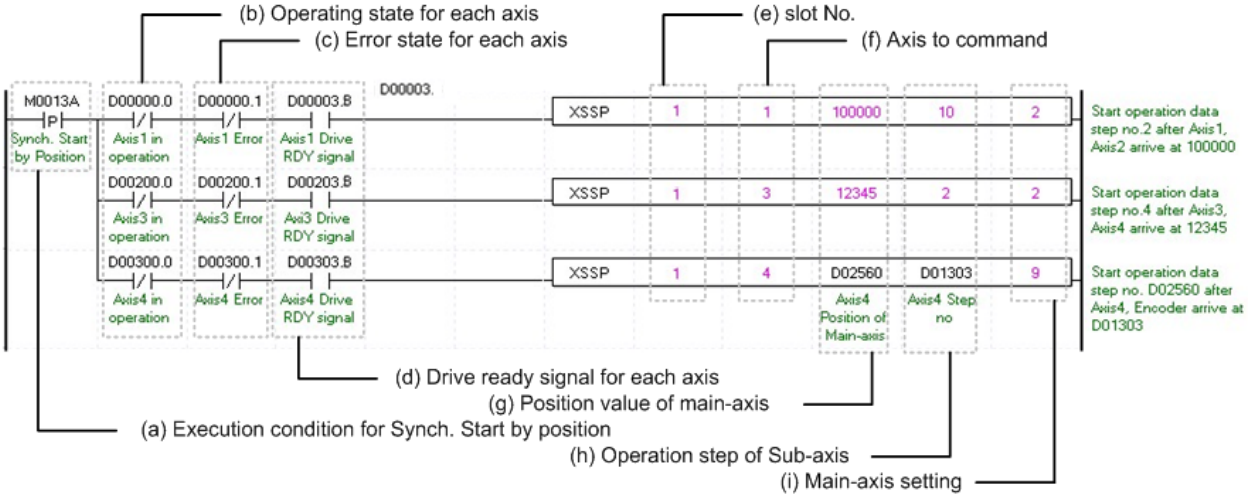
Setting value	Main Axis
1	Axis1
2	Axis2
3	Axis3
4	Axis4
5	-
6	-
7	-
8	-
9	Encoder

(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.

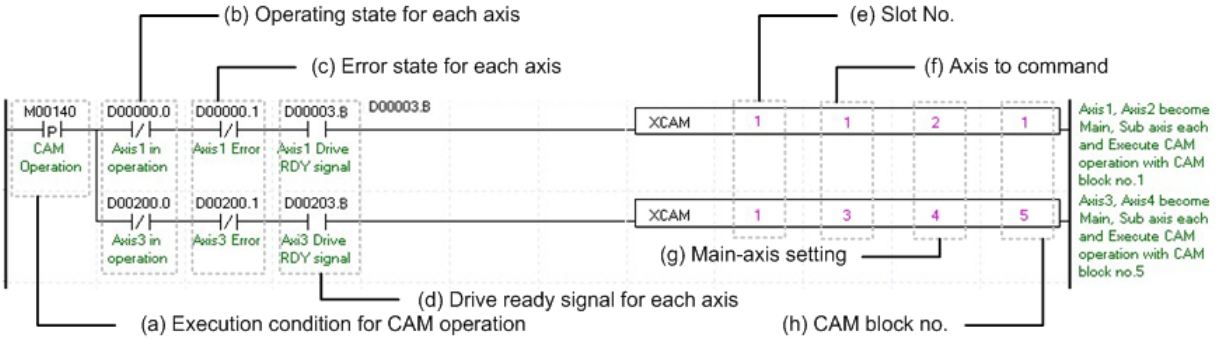
(i) Main Axis Setting

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

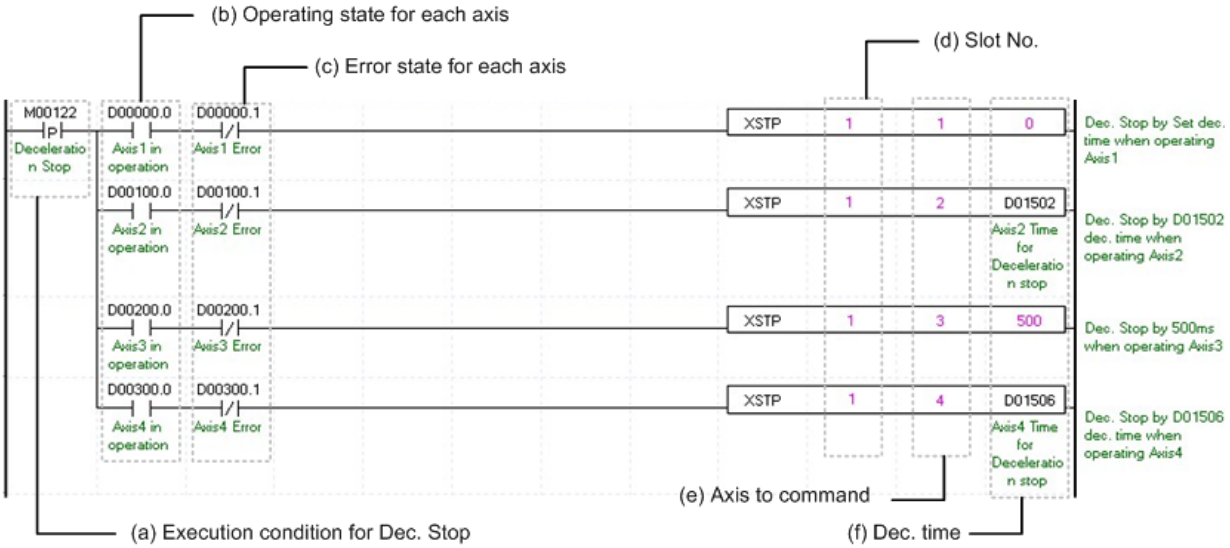
Setting of main axis to operate .This setting is for main axis of CAM Operating. This setting cannot be set as same value as command axis. Can set a value 1~4, meaning from axis 1 to axis 4 or 8(Encoder).

(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

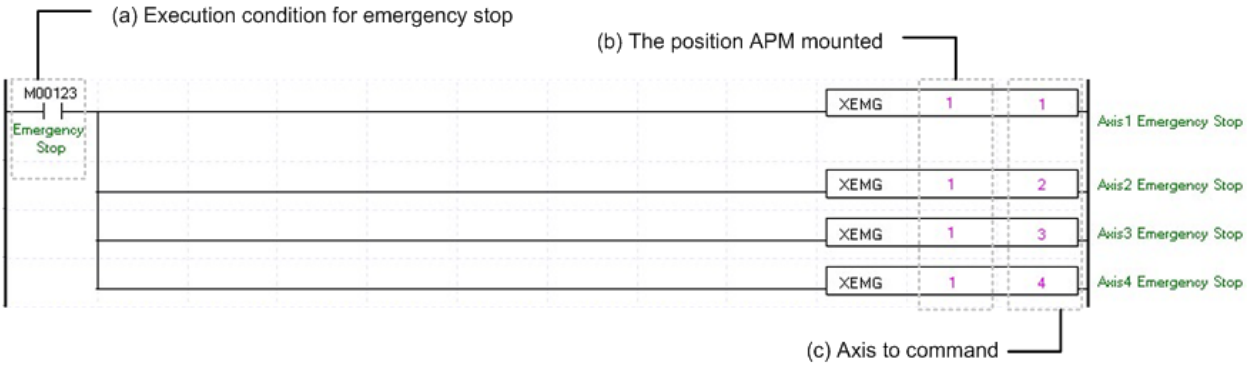
You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(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

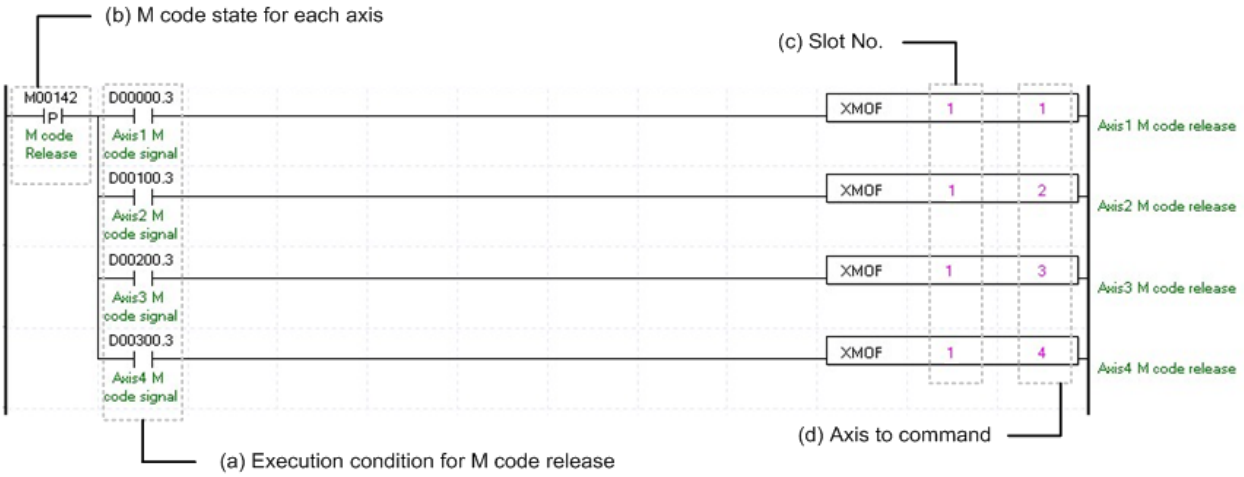
You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the "execution of axis" from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(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.

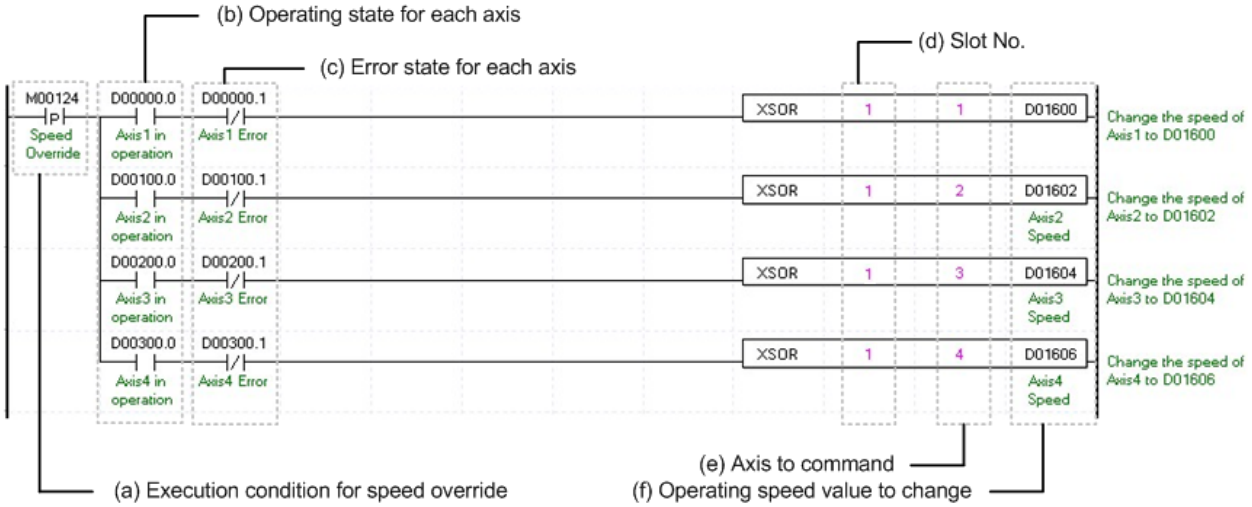
(d) Axis of command execution

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

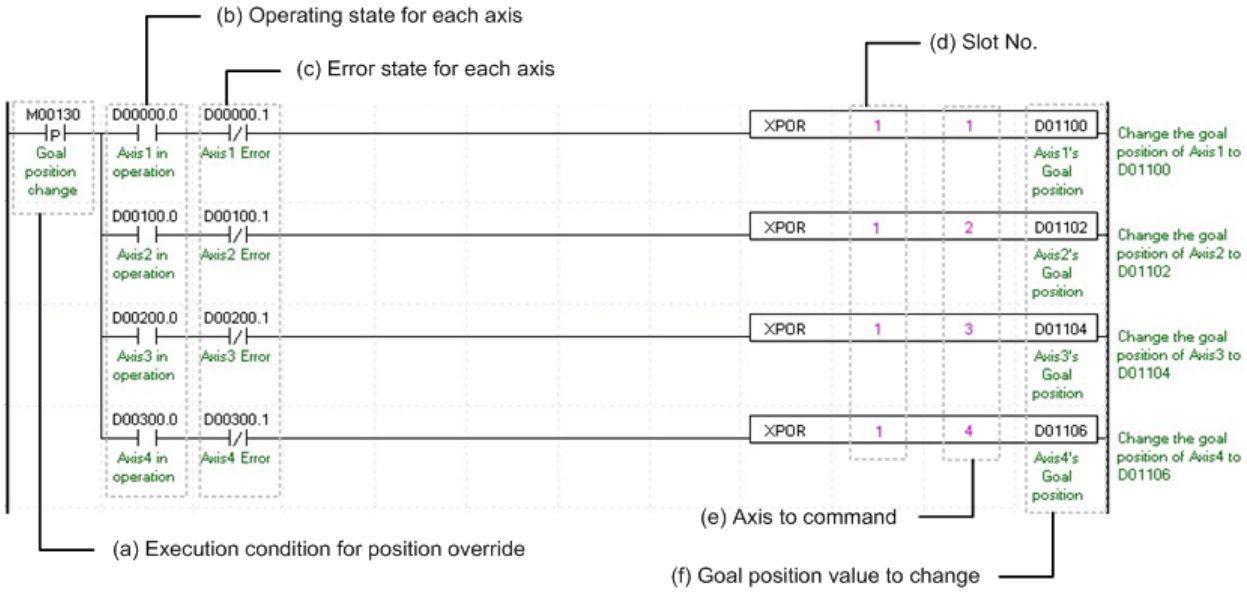
You can set an axis for Speed Override command. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(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 [$X10^{-2}$%]. If it is “rpm, “then the unit would be $X10^{-1}$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

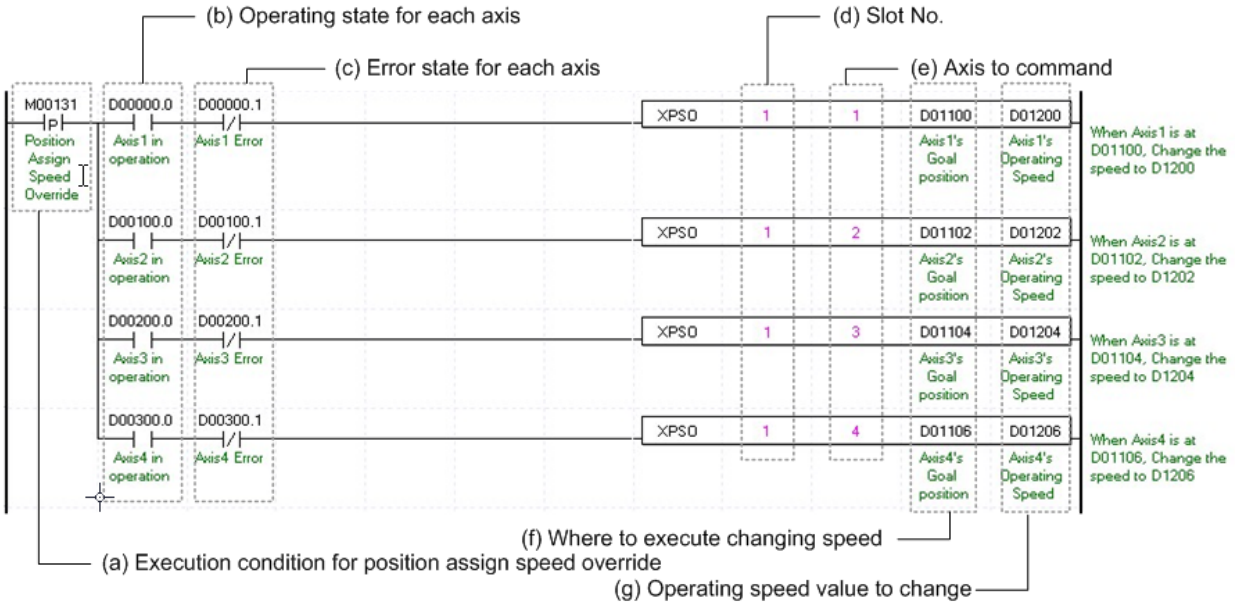
You can set an axis for Parameter Setting. Embedded positioning supports supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(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

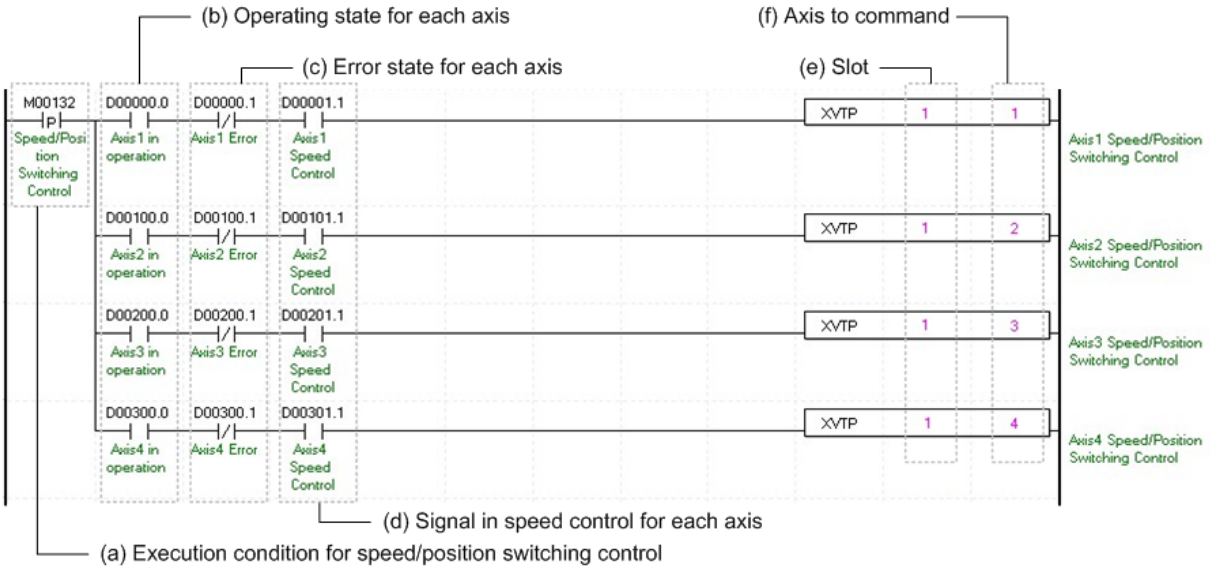
Setting position of Speed Change. Once the actual position located at set position with speed override command running, the speed change commands are executed.

(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

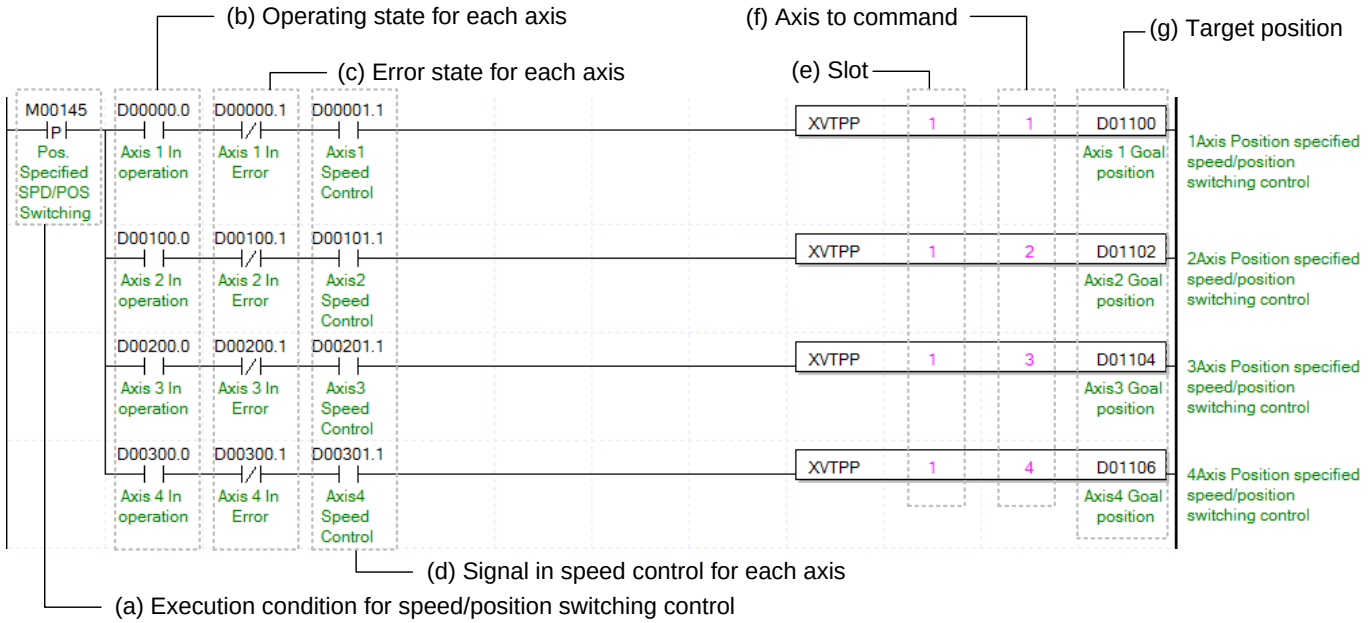
The slot number of embedded positioning is fixed to Slot 1.

(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

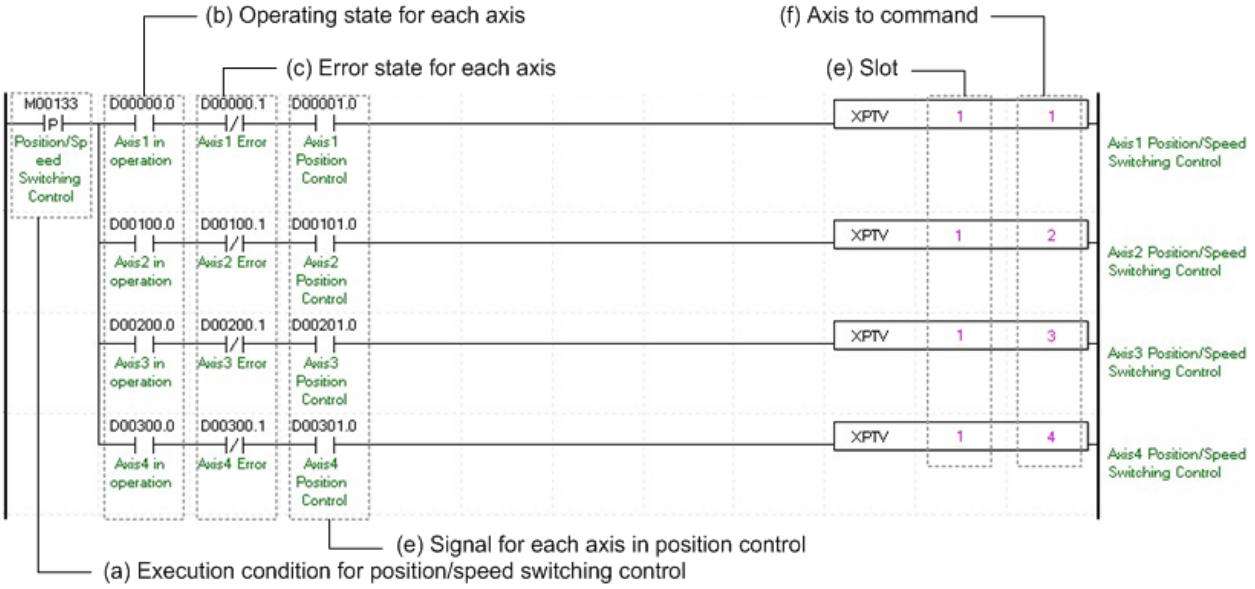
Decide an axis that will execute the control command. Embedded positioning can control up to four axes and assign 1 through 4 referring to 1-axis through 4-axis for this item.

(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

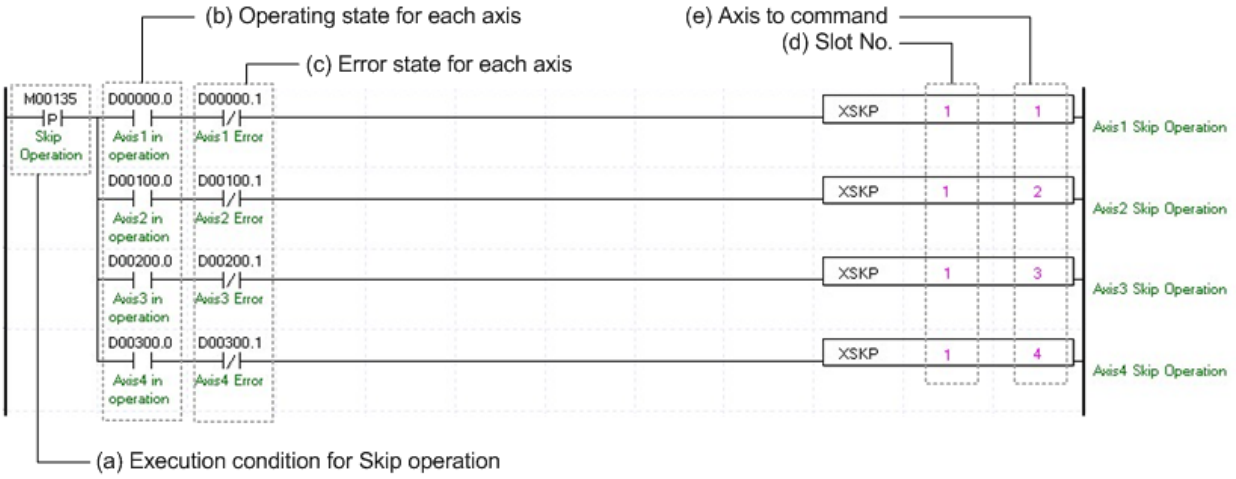
The slot number of embedded positioning is fixed to Slot 1

(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

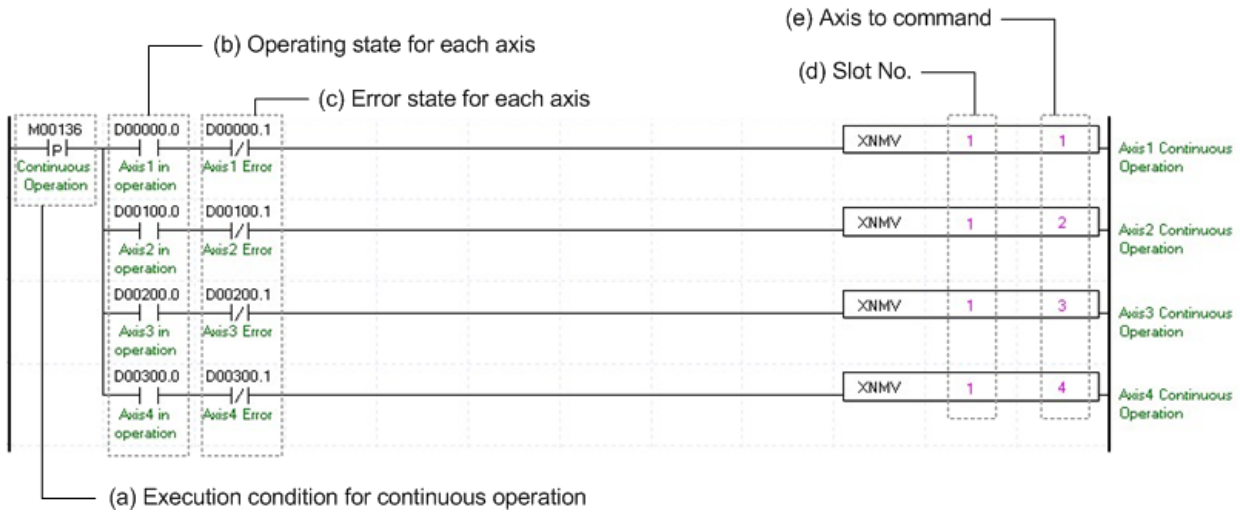
The slot number of embedded positioning is fixed to Slot 1

(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

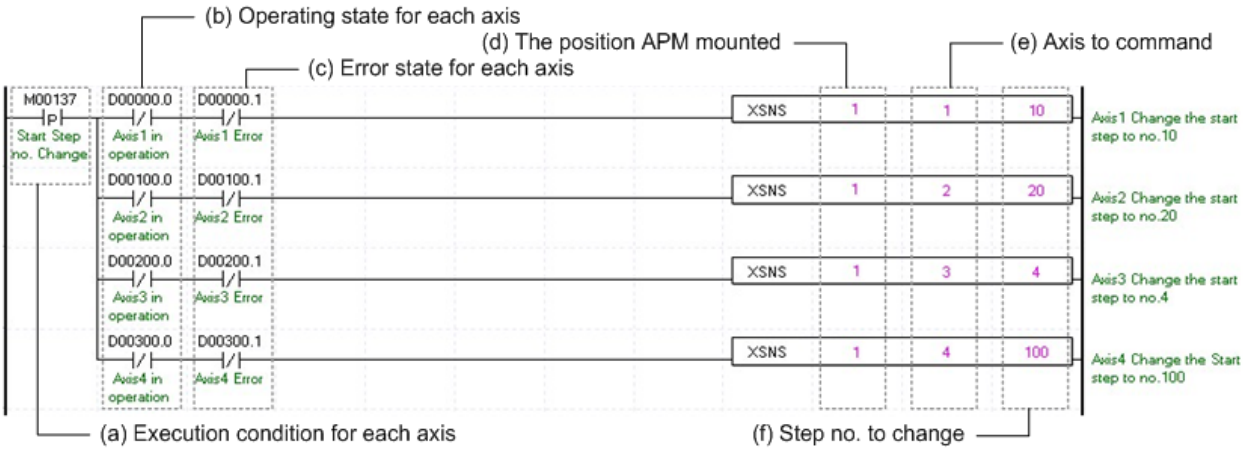
The slot number of embedded positioning is fixed to Slot 1.

(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

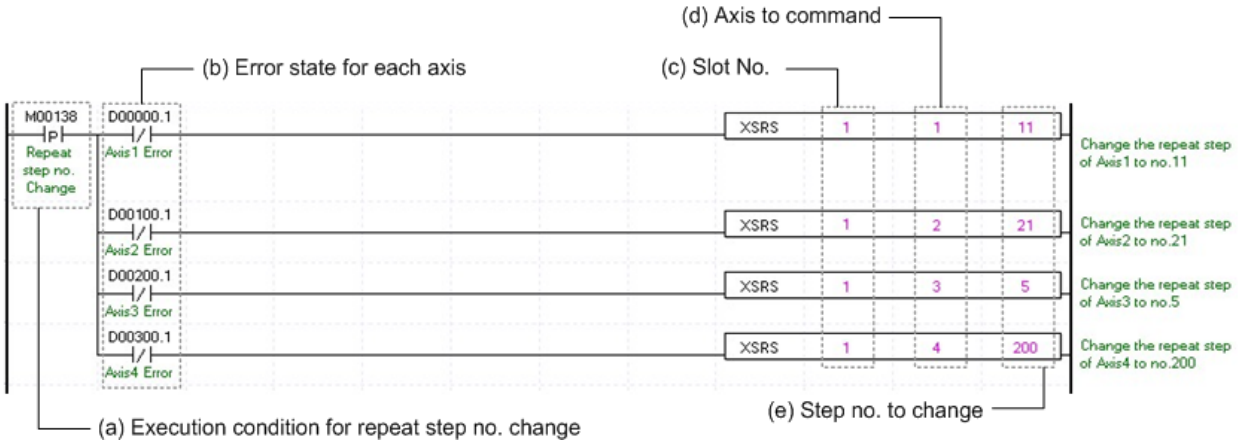
You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(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

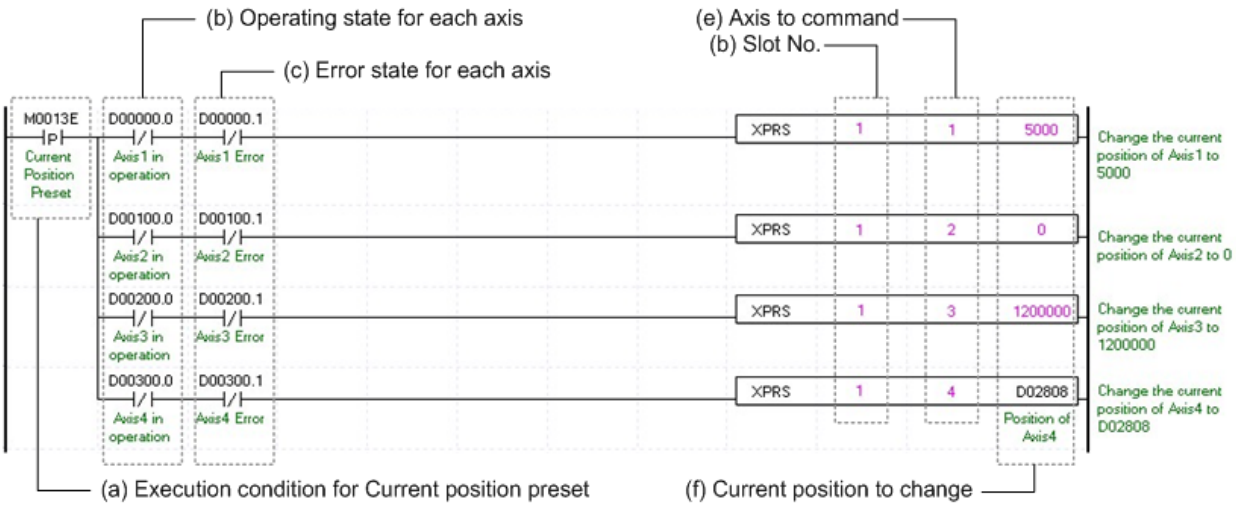
You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(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

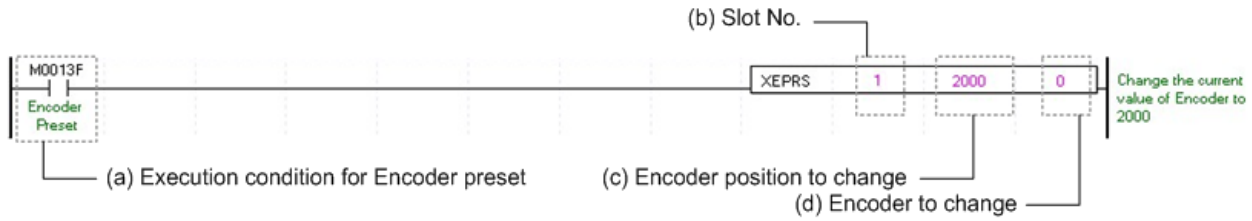
You can set an axis for Parameter Setting. Embedded positioning supports for 6 axes(XBM-DNxxxH: 2axes). In the “execution of axis” from the configuration of Parameter Setting, you can set a value for axis 1 through 6 axes(XBM-DNxxxH: 2axes).

(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

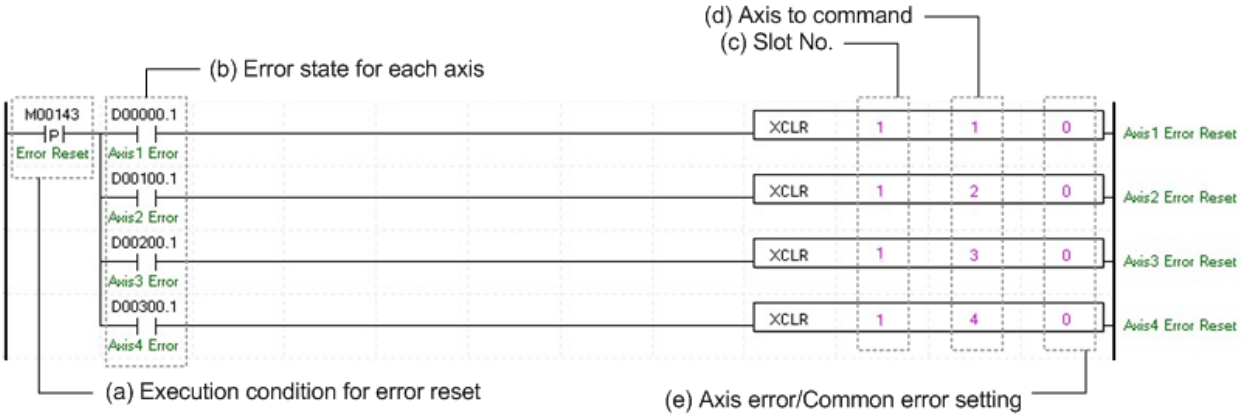
(d) Changing Encoder

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.

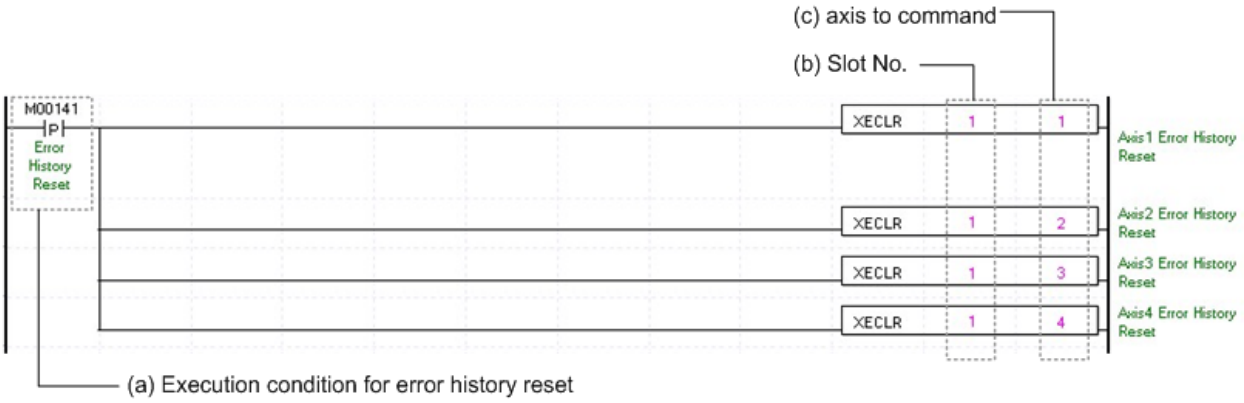
(d) Axis of command execution

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.

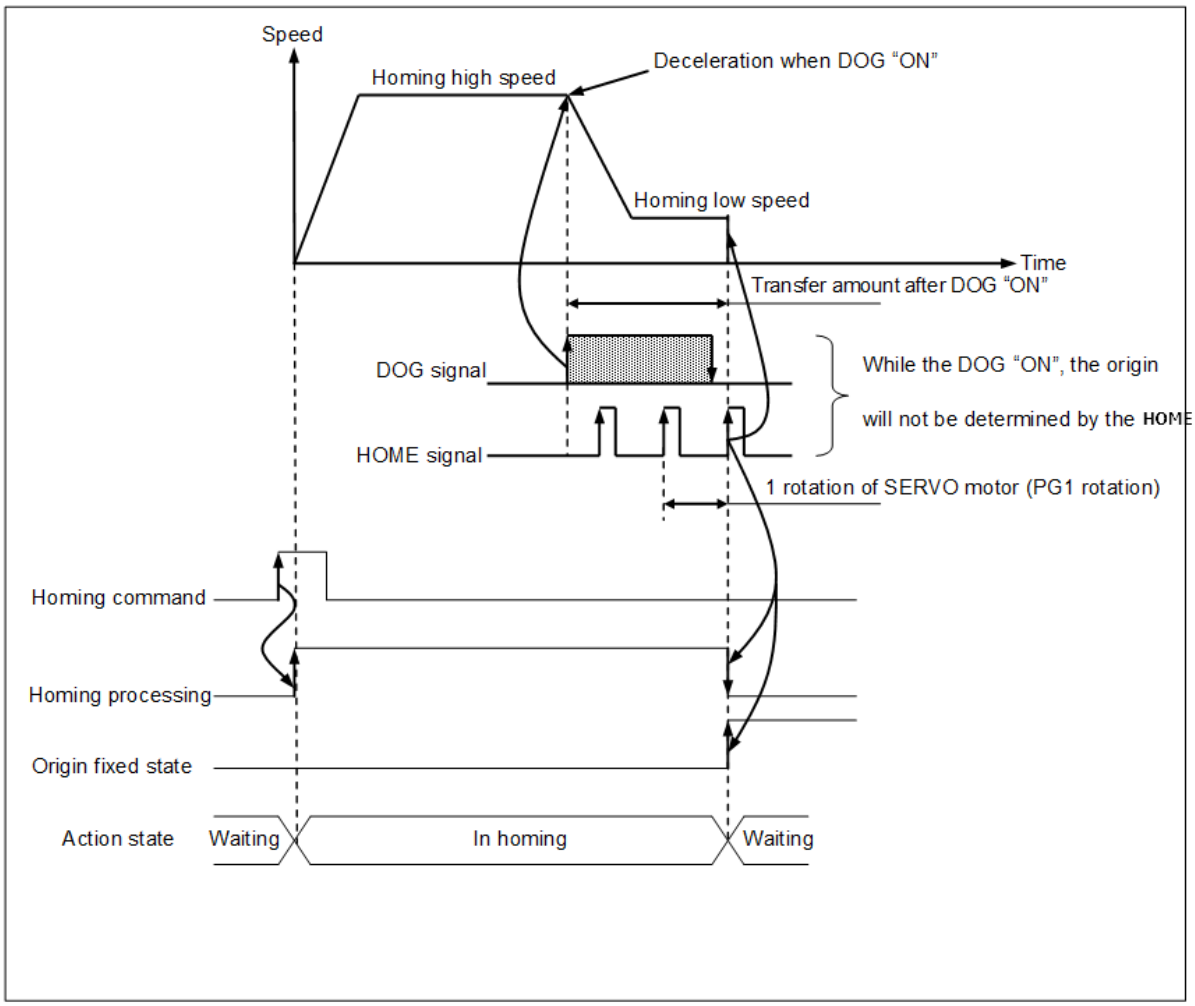
(1) Operation

(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.

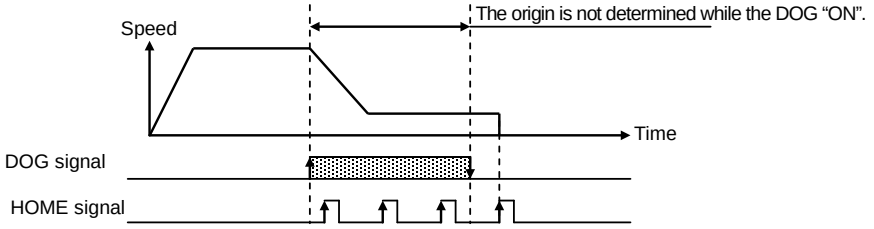
(c) If HOME signal is entered after the DOG signal has changed from “On” to “Off”, the origin shall be determined and it stops pulse output.

■ Operating Pattern

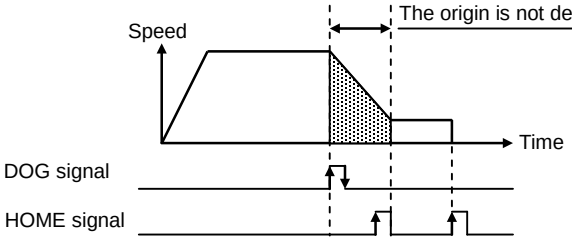


NOTE

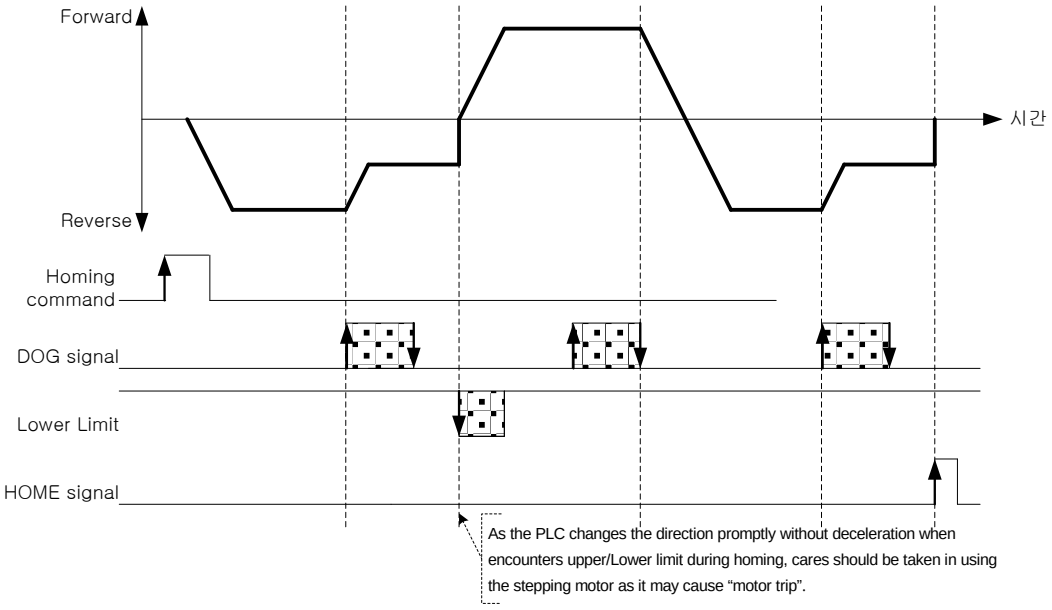
1. While DOG signal maintains “On”, the origin will not be determined by HOME signal.
   That is, when DOG signal changes from “Off” to “On”(acceleration section -> homing high speed) , from “On” to “Off” (deceleration section -> homing low speed) and then when the HOME changes from “Off” to “On”, the origin will be determined.



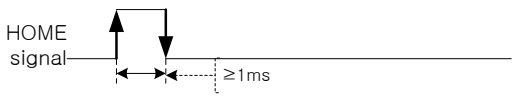
2. While the homing speed acts to the deceleration section by homing high speed after the DOG signal is changed from “Off” to “On”, from “On” to “Off”, the origin will not be determined even if encounters the HOME input.



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.



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.

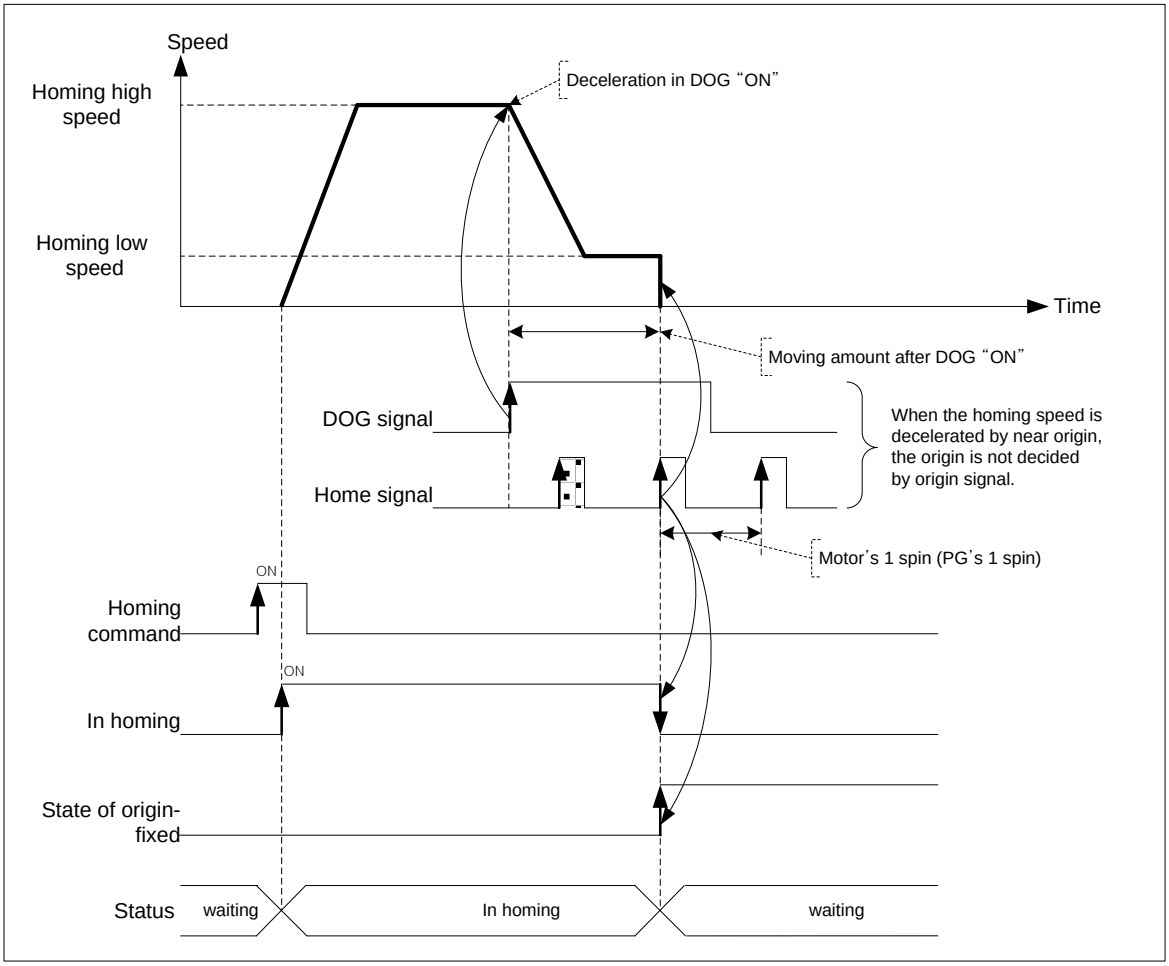
(1) Operation

(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.

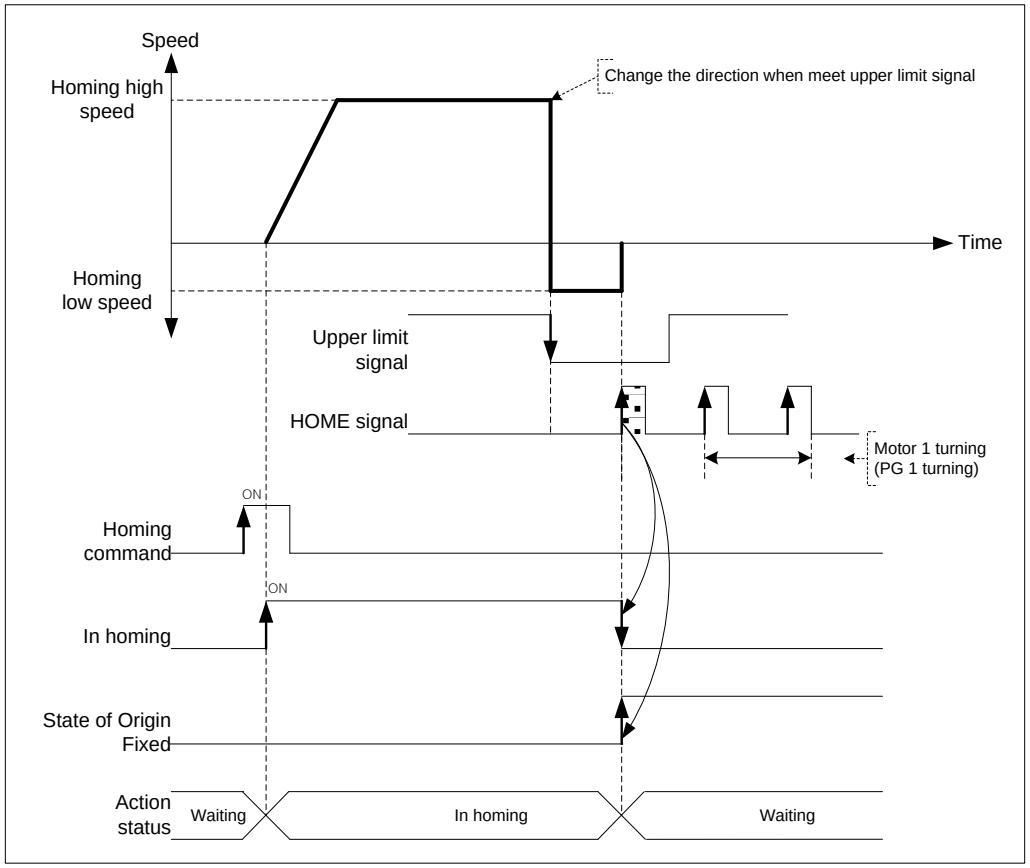
(1) Operation

(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.

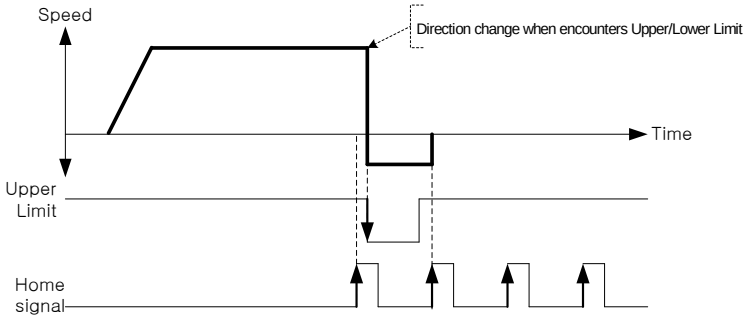
(c) If encounters the HOME signals while the homing low speed is active, the origin would be determined and it stops..

■ 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

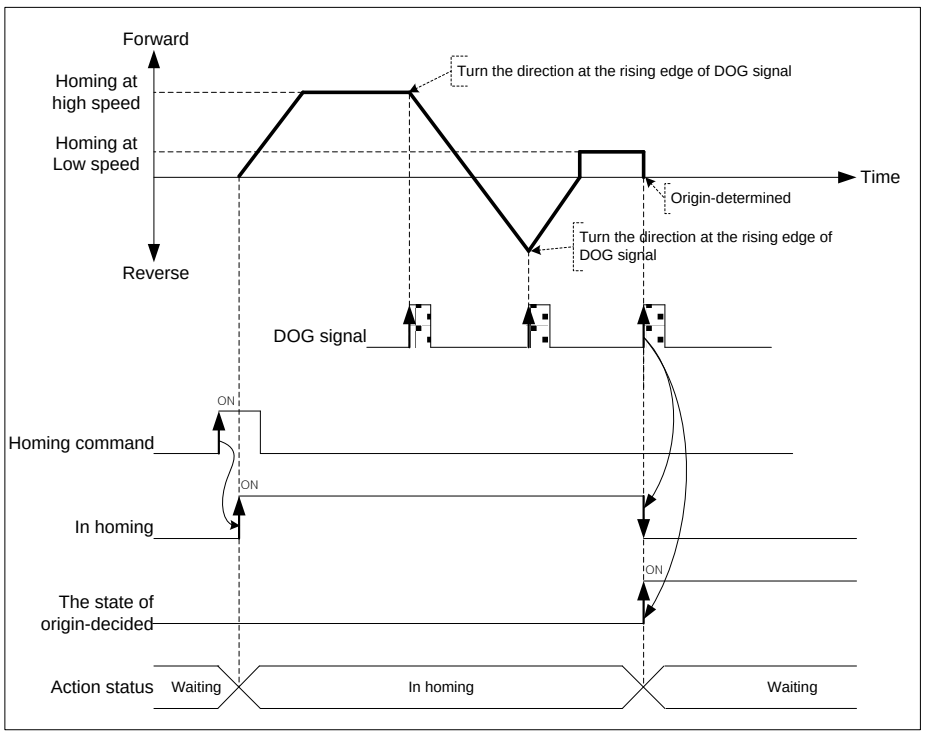
(a) Accelerates to the setting homing direction and acts by homing high speed.

(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.

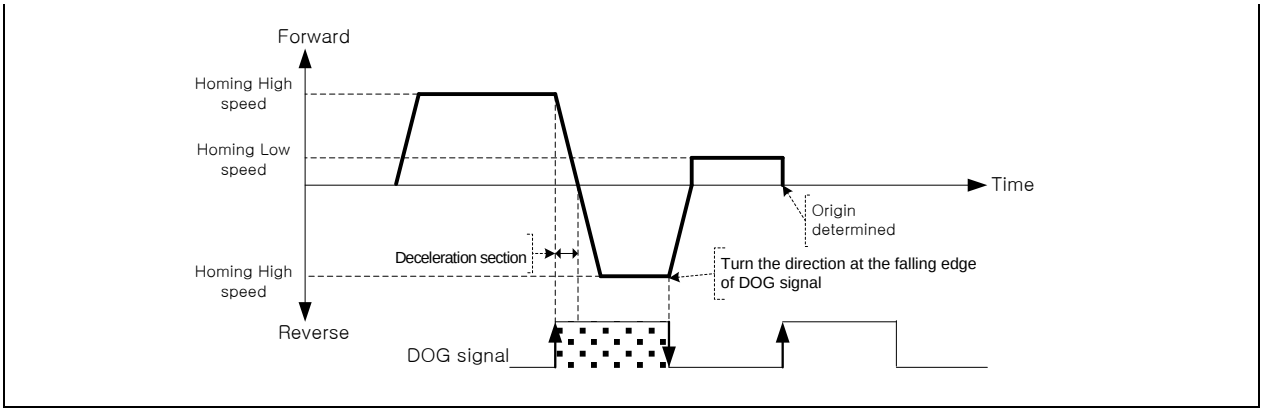
(d) If encounters the DOG signals again while the homing low speed is active, the origin would be determined and it stops..

■ 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)

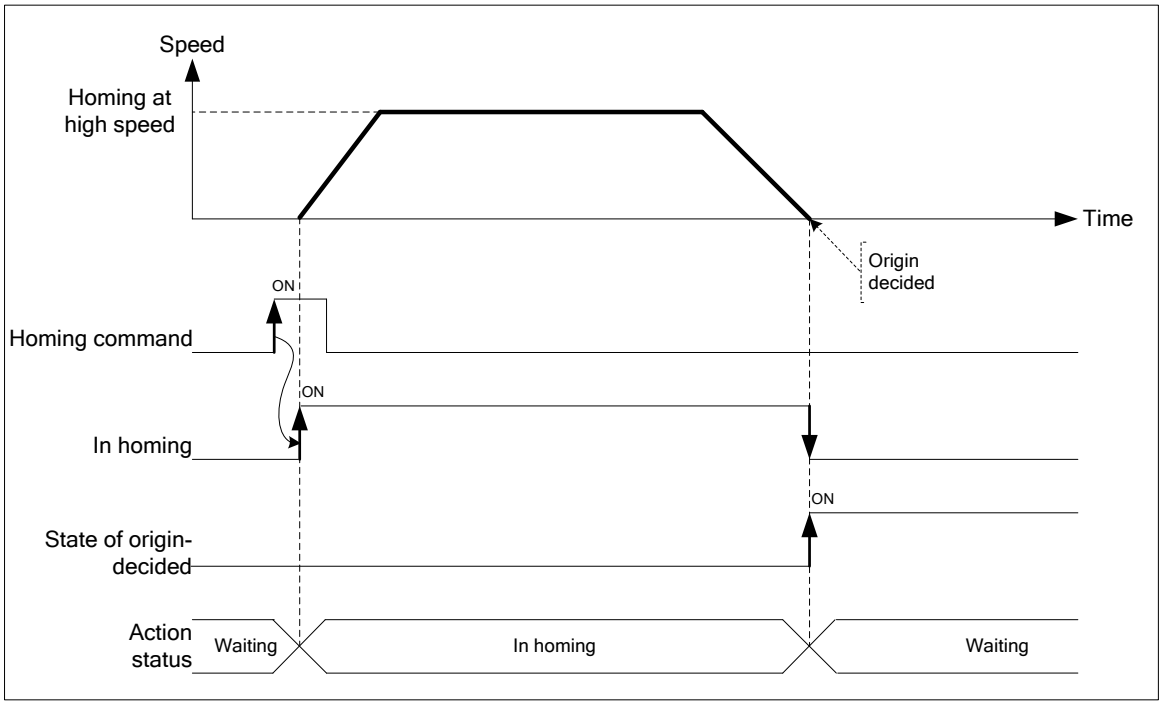
High speed origin detection is one of the homing methods that returns to the origin determination position without detection of external signal (DOG, HOME, Upper/Lower limit) when returning to the mechanical origin position after completion of the mechanical homing.

(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 .

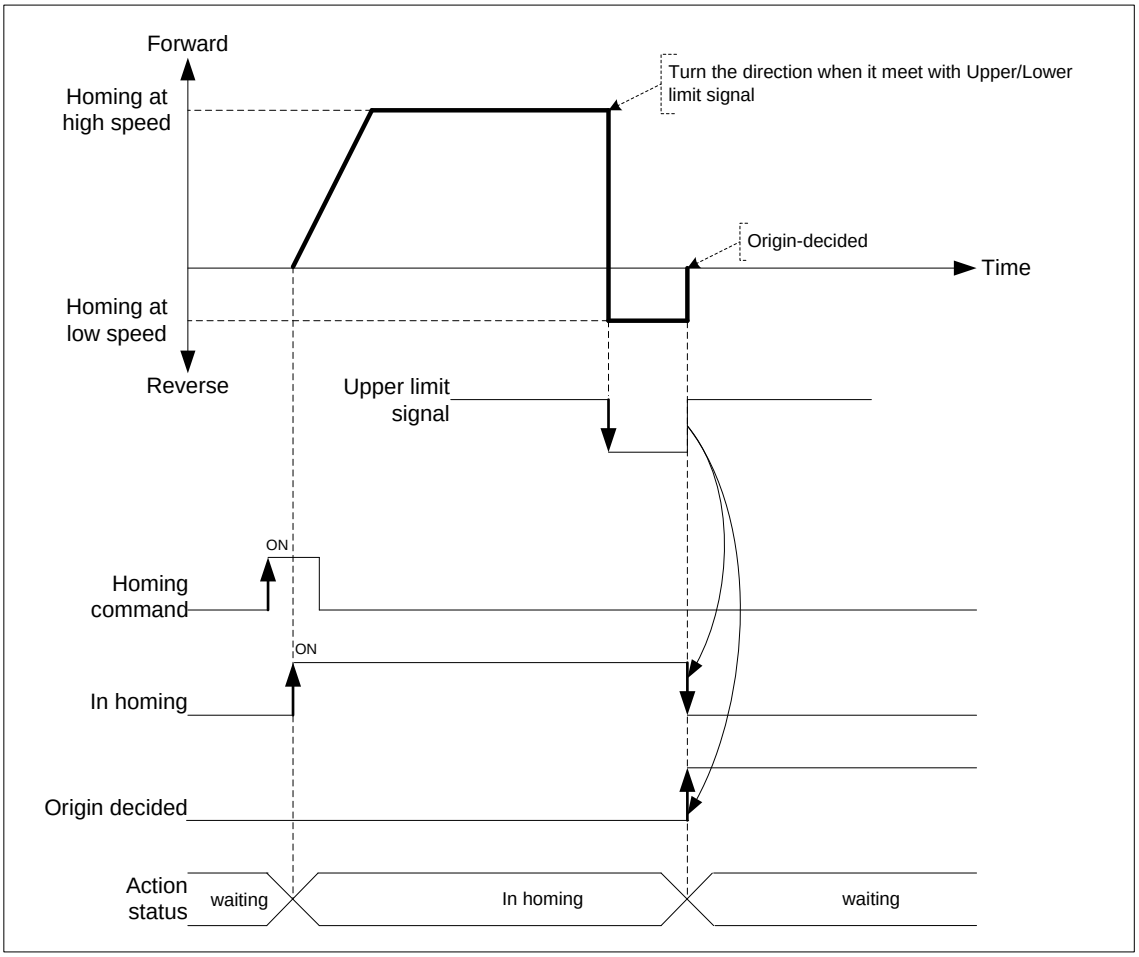
(1) Operation

(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



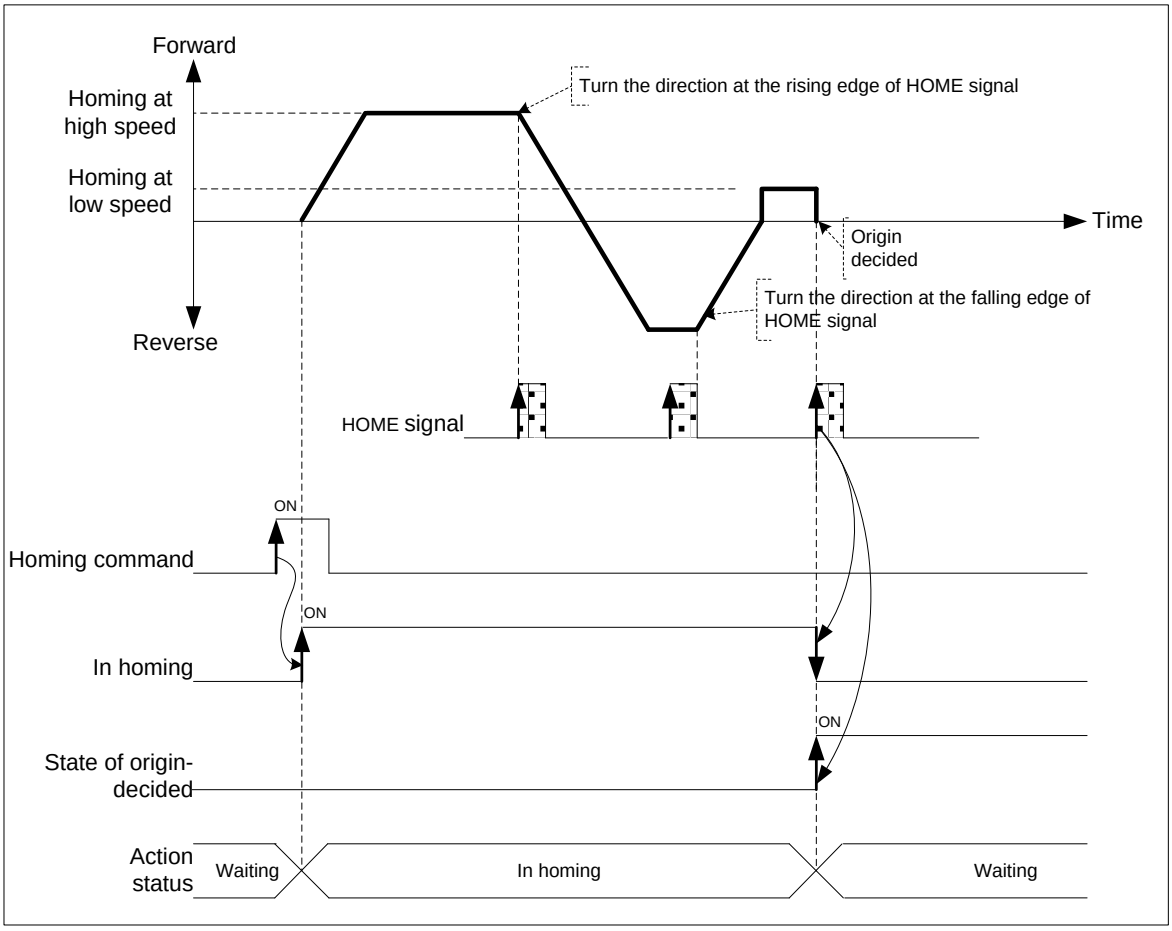
9.1.9 Origin Detection by HOME (6: Home)

This is used when determines the origin only by using the HOME signal.

(1) Operation

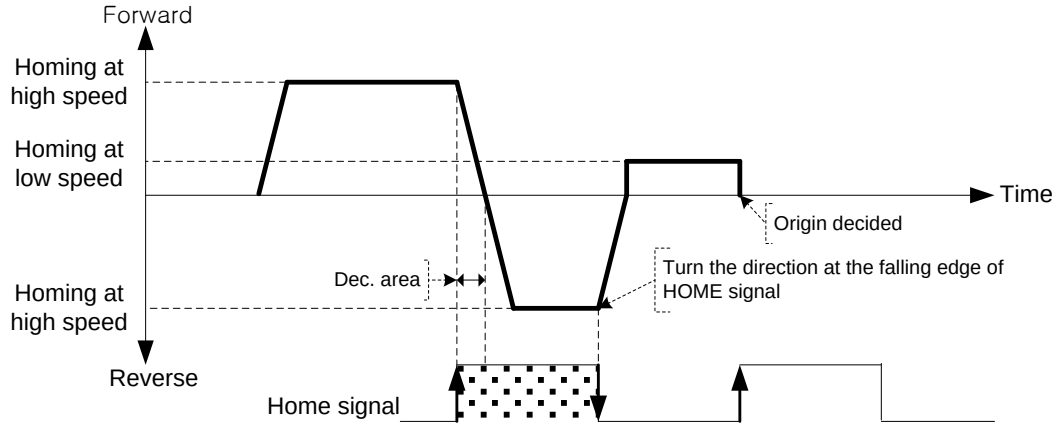
(a) It accelerates to the setting homing direction and acts by homing high speed.
(b) In this case, if HOME signal is entered, it decelerates and transferred to opposite direction acts by homing high speed.
(c) When it operates in opposite direction, if HOME is entered again, it decelerates and transferred 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

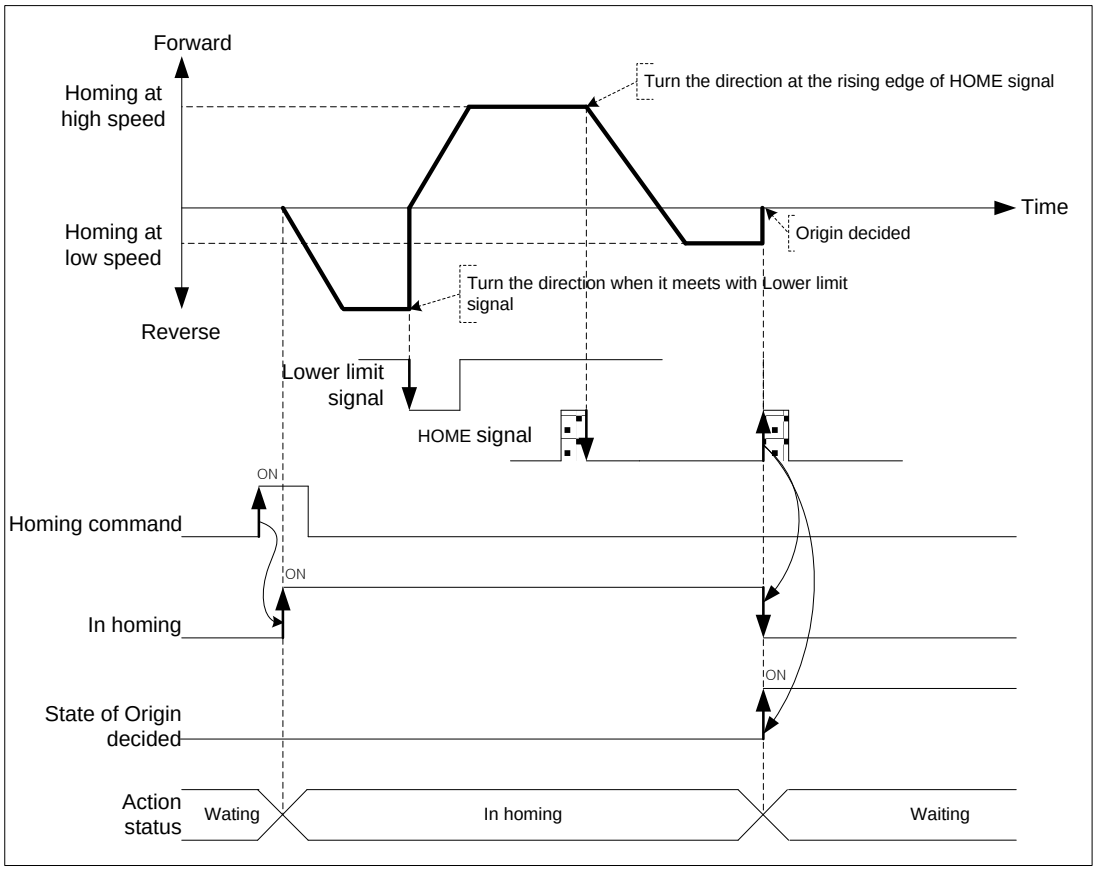


Note

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 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 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 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 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 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 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 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. 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. 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. 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. 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)

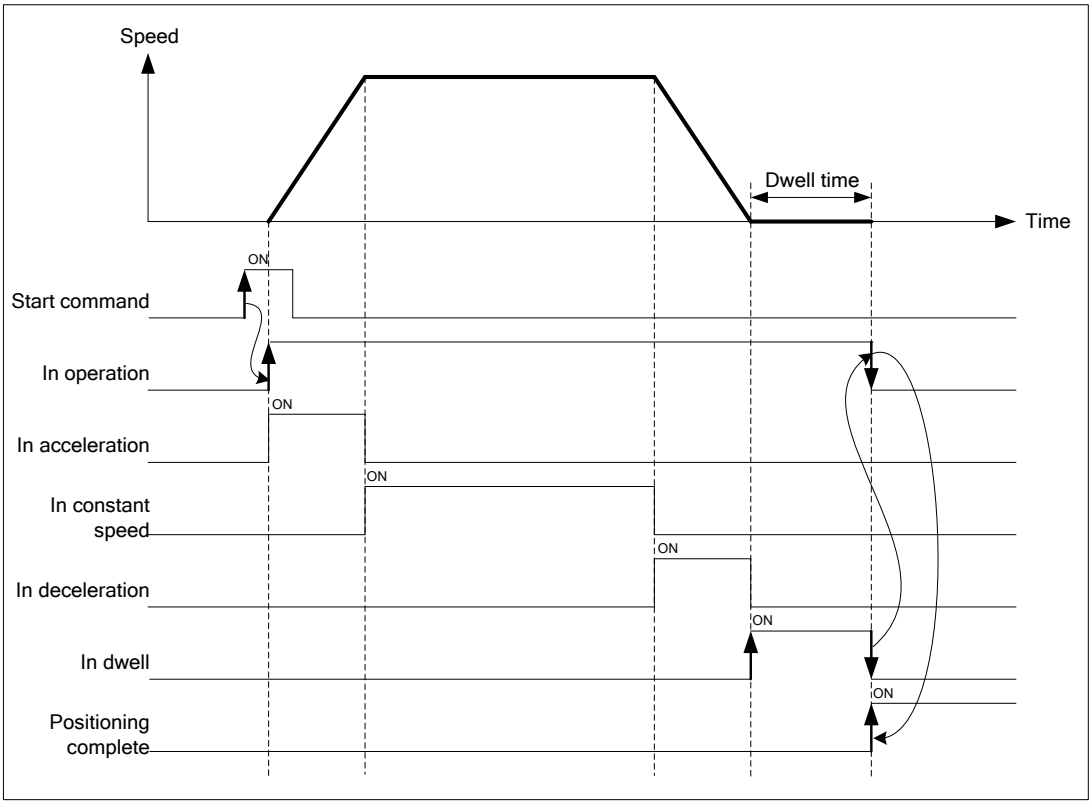
(a) With one time start command, the positioning to the goal position is executed and the positioning shall be completed at the same time as the dwell time proceeds.

(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.

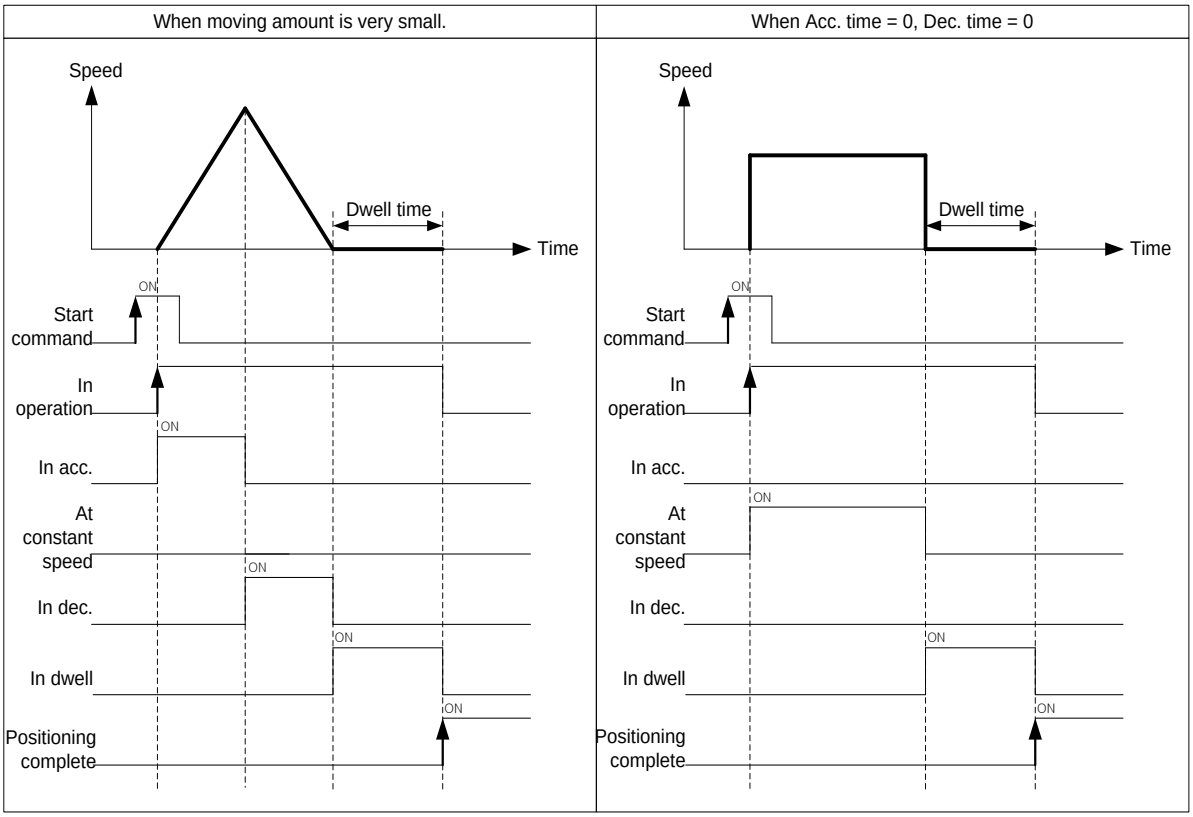
(c) Operation direction shall be determined by the value of address.

(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



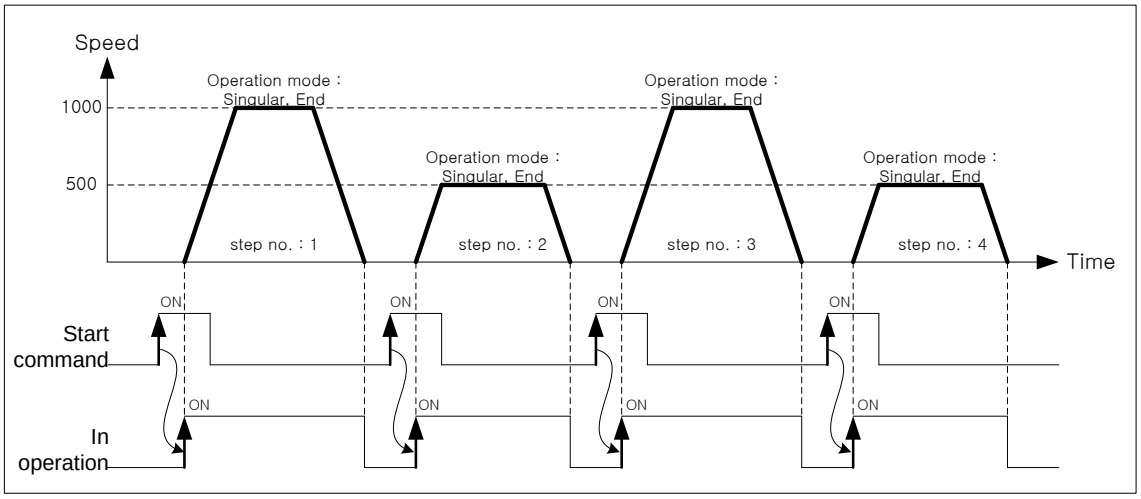
[Example]

- 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.

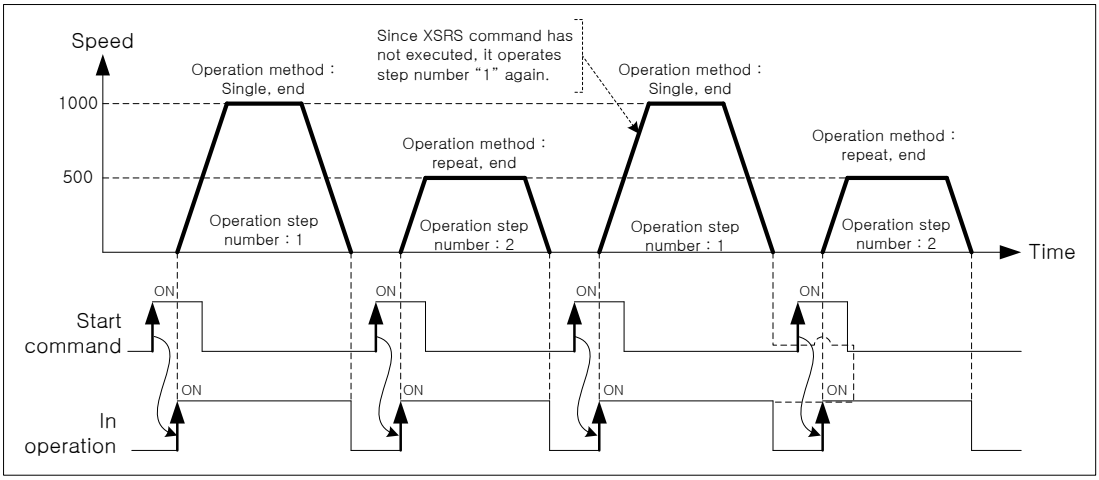
[Example 1]

- 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

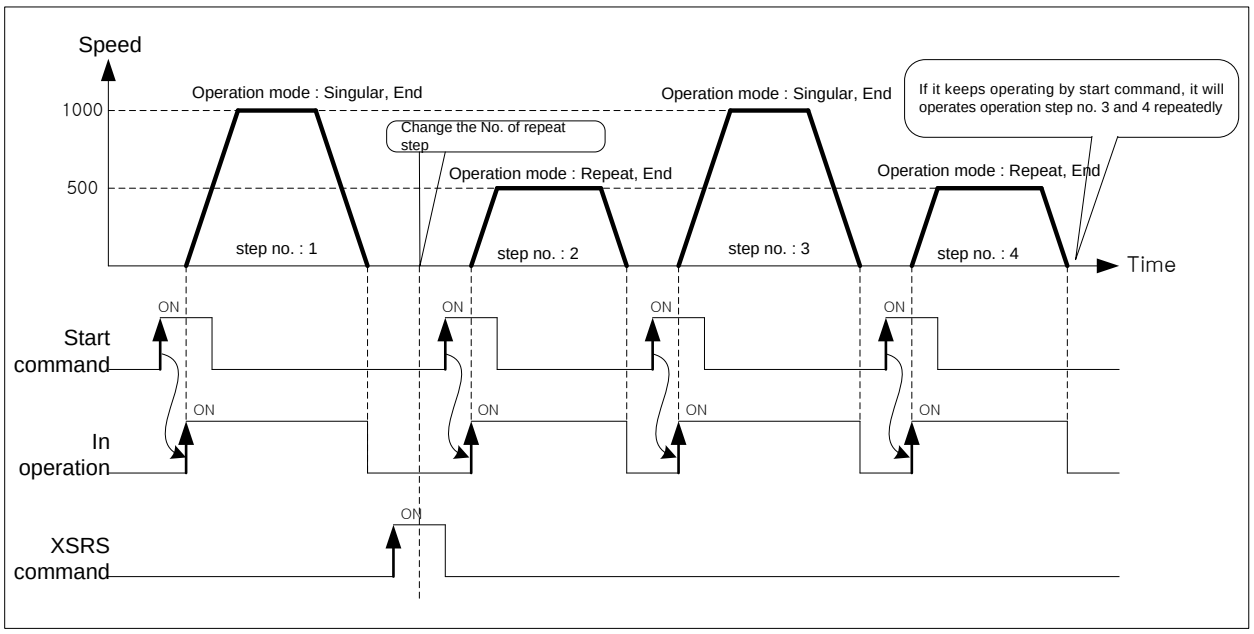
[Example 2]

- 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.

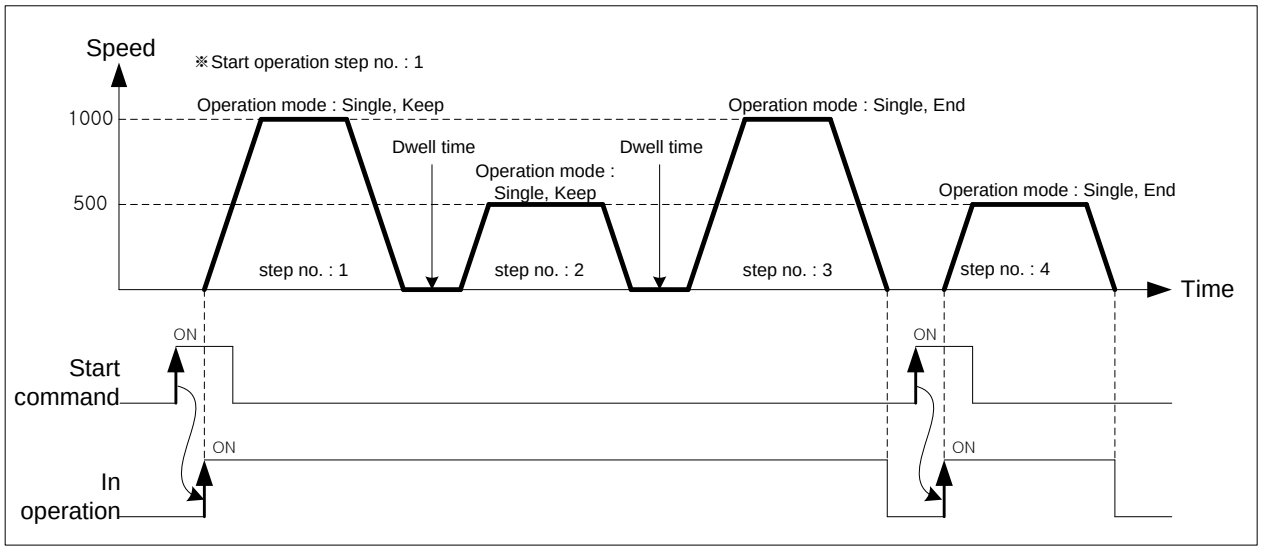
[Example]

- 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.

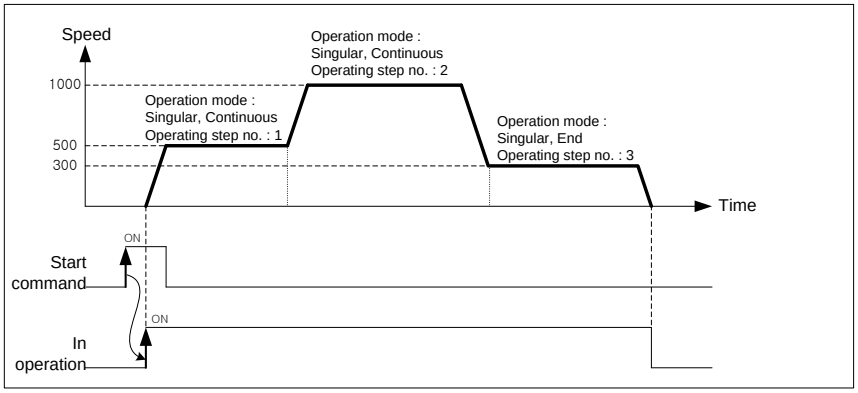
[Example]

- 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].

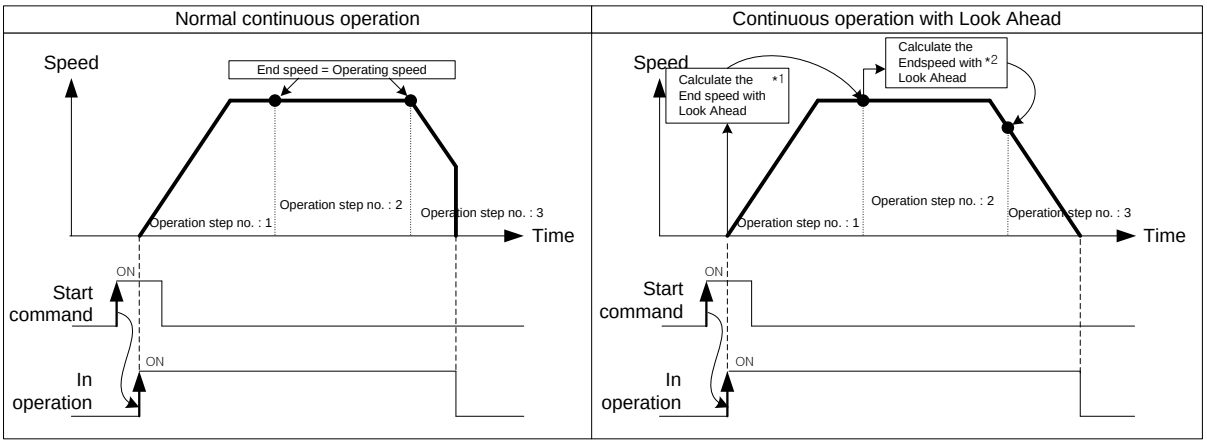
Note

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.

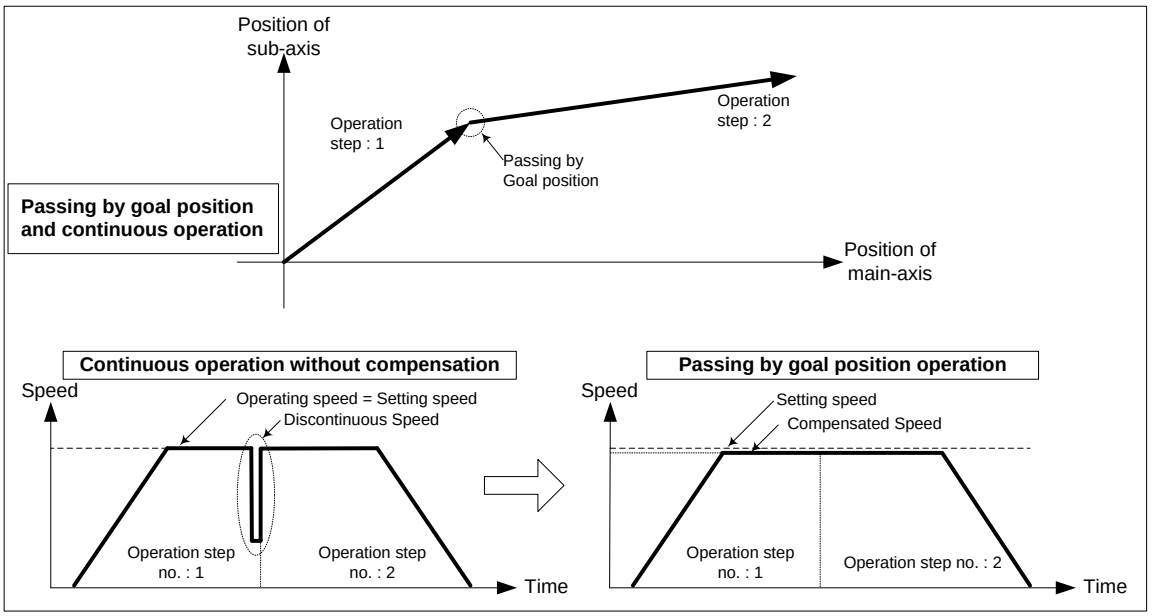
Item	Setting Value	Contents
Continuous interpolation positioning method	0 : Passing Goal Position	Execute Continuous Operation which passes exact goal position of current step which set on operation data.
	1 : Near Passing	Execute Continuous operation which passes near position not to exceed a current 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.

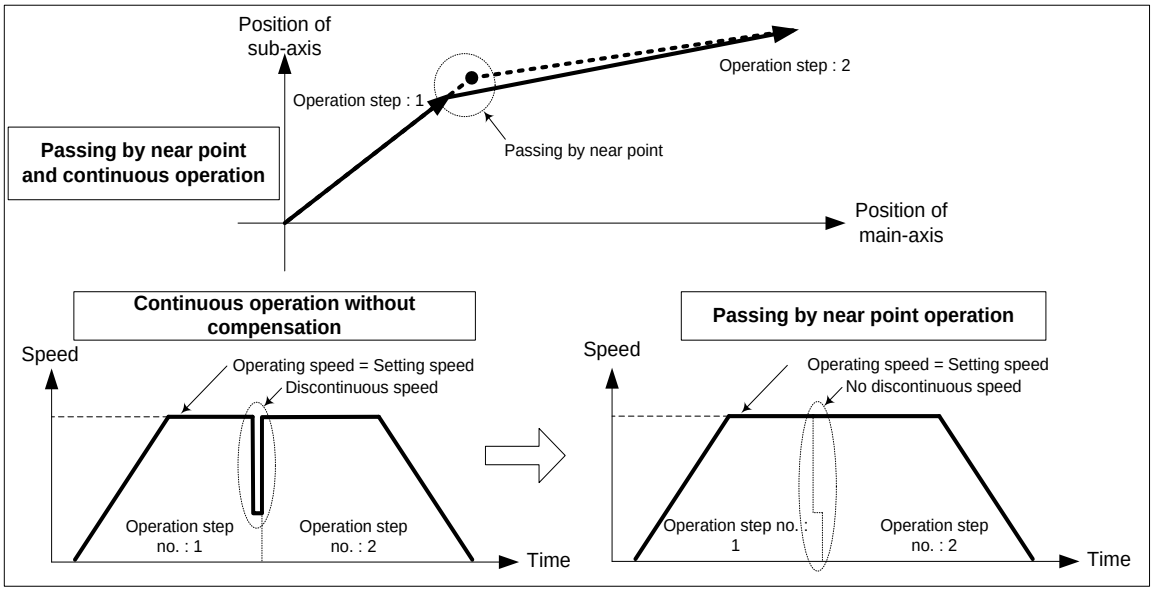
Because next step can start with compensated speed, can avoid occurrence of discontinuous operating speed.

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

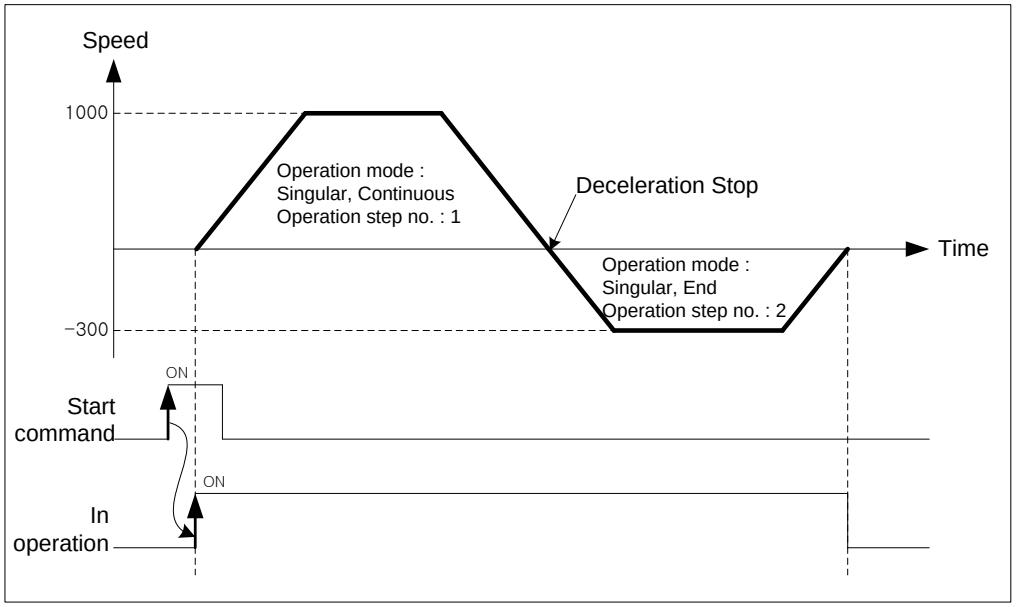
Continuous operation control is decelerating and positioning completed during the 'End' operation step. However, next time, it keeps next step operation after decelerating as bias speed

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.

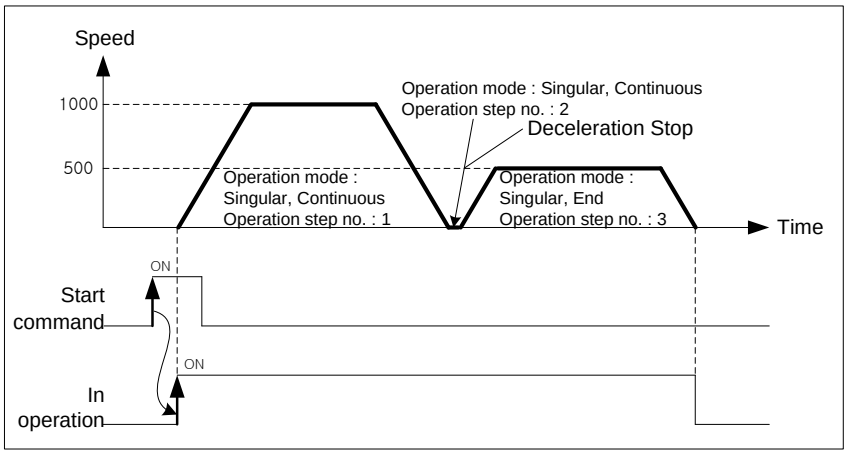
2) When the moving amount of next step is 0

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.

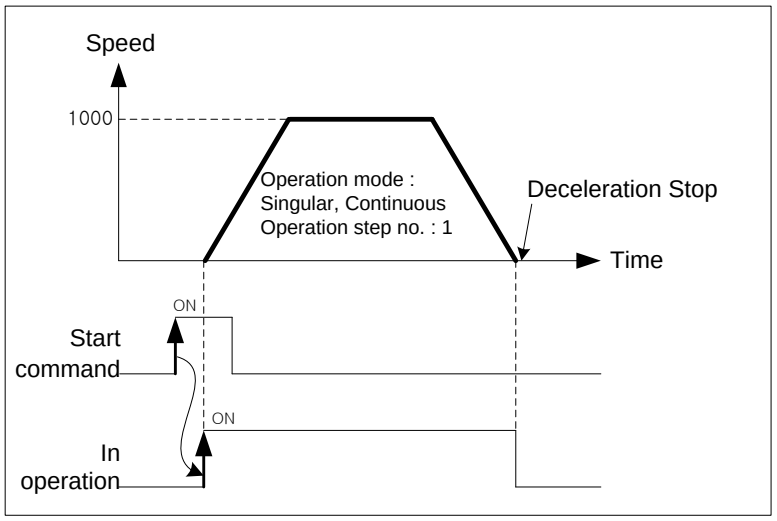
3) If there is an error on the operation data of next step

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

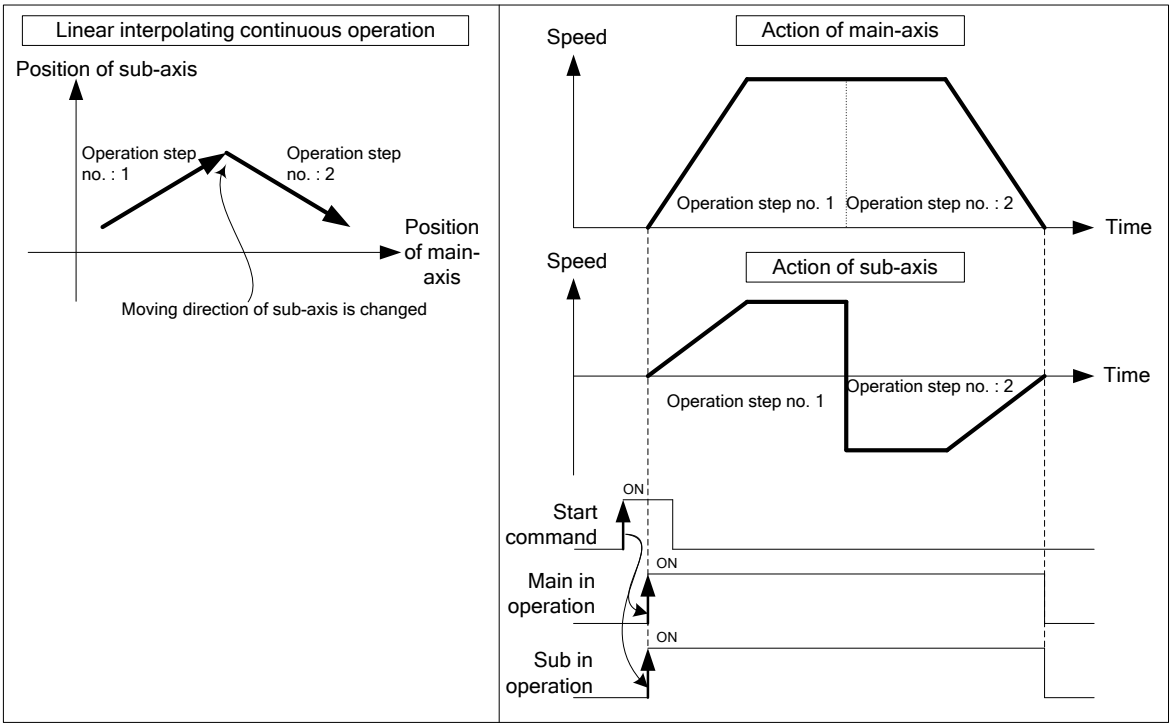
Step NO.	Control Method	Operation Method	Goal Position [pls]	Operation Speed [pls/s]	Accel NO.	Decel NO.	M Code	Dwell Time
1	Absolute Single-axis Positioning Control	Signle Continuous	10000	1000	1	1	0	0
2	Absolute Single-axis Feed Control	Signle Continuous	20000	1000	1	1	0	0
3	Absolute Single-axis Positioning 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.

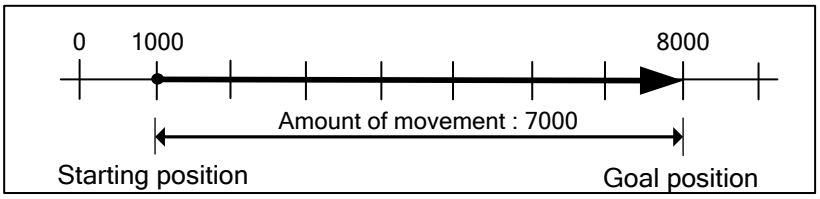
- ▶ Start position < Goal position: forward direction positioning
- ▶ Start position > Goal position: reverse direction positioning

[Example] Set the Absolute Coordinates as follow, Operate single-axis positioning control.

▷Start position: 1000,

▷Goal position: 8000

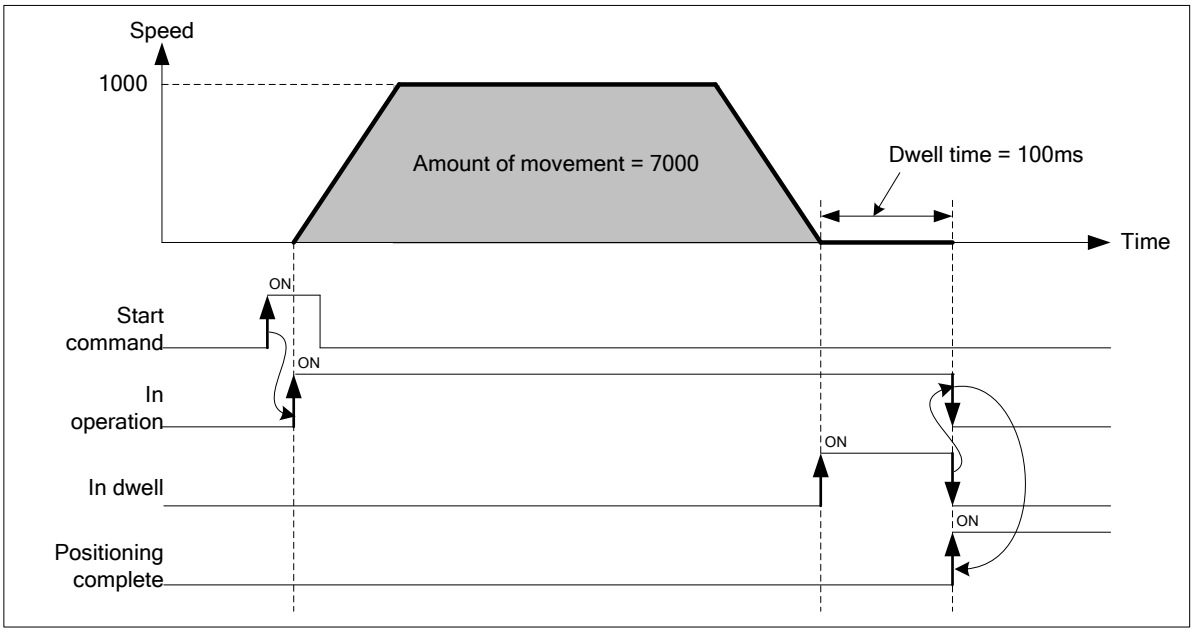
The transfer amount to forward direction shall be 7000 (7000=8000-1000).



■ 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



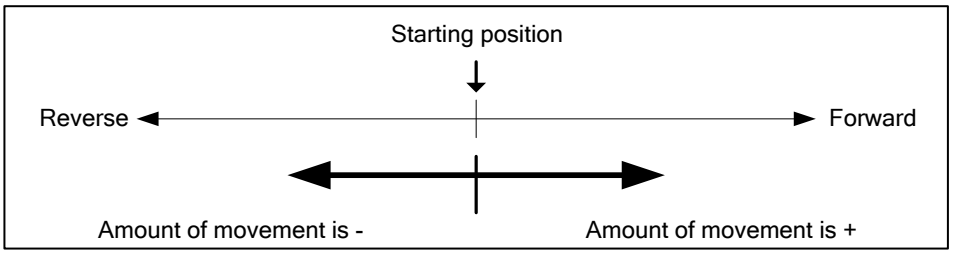
(2) Control by Incremental method (Relative coordinate) (「Relative, Single-axis Positioning Control」)

(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

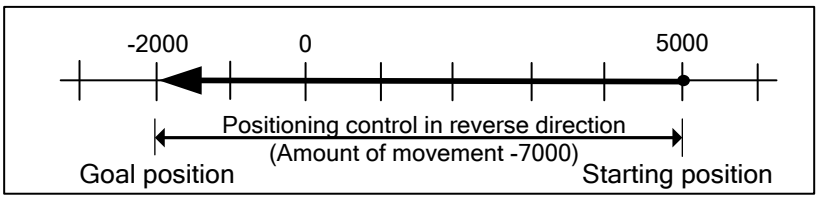


[Example] Set the Relative Coordinates as follow, Operate single-axis positioning control.

▷Start position: 5000,

▷Goal position: -7000

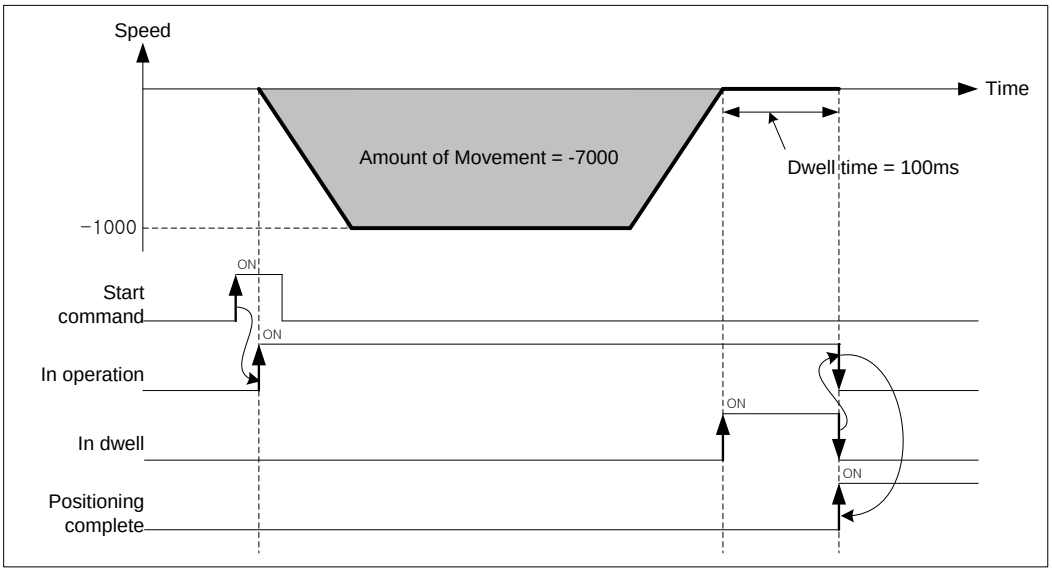
This will be reverse direction and positioning will be at the point of –2000.



■ 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 (-)

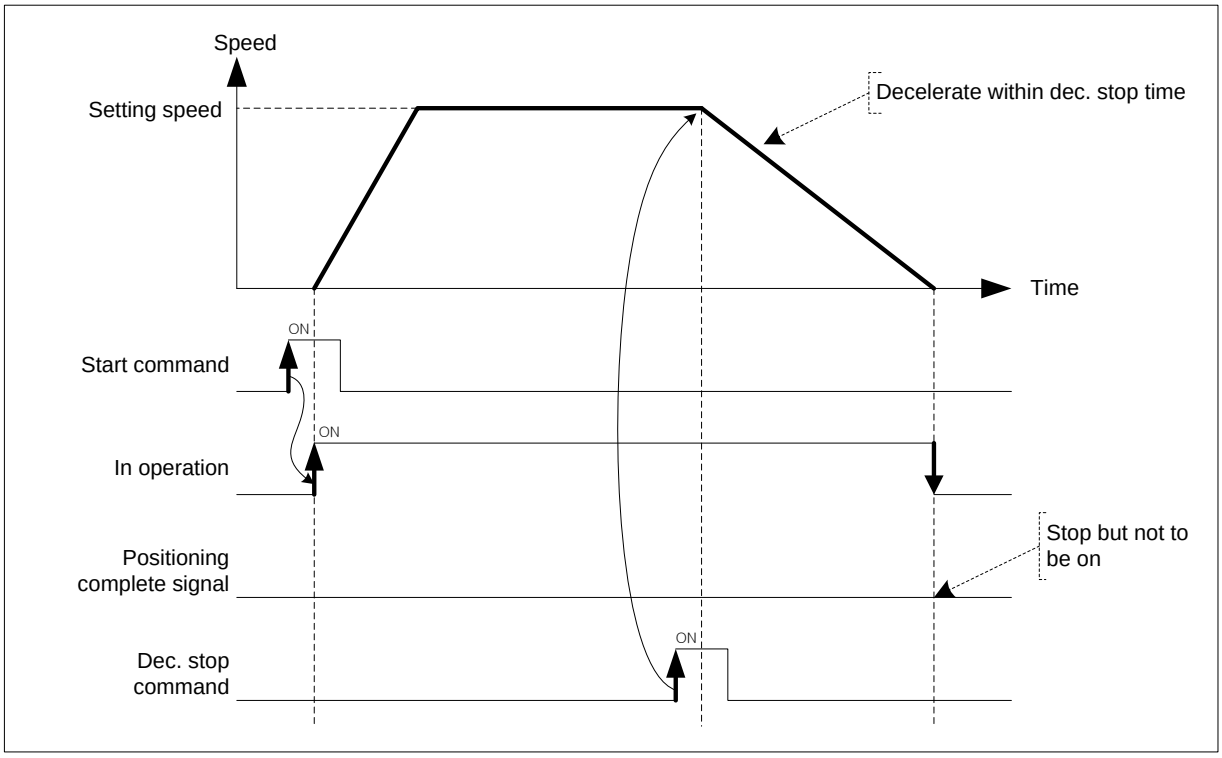
(b) In case of using speed control, the following items of operation data do not affect.

▷ 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)

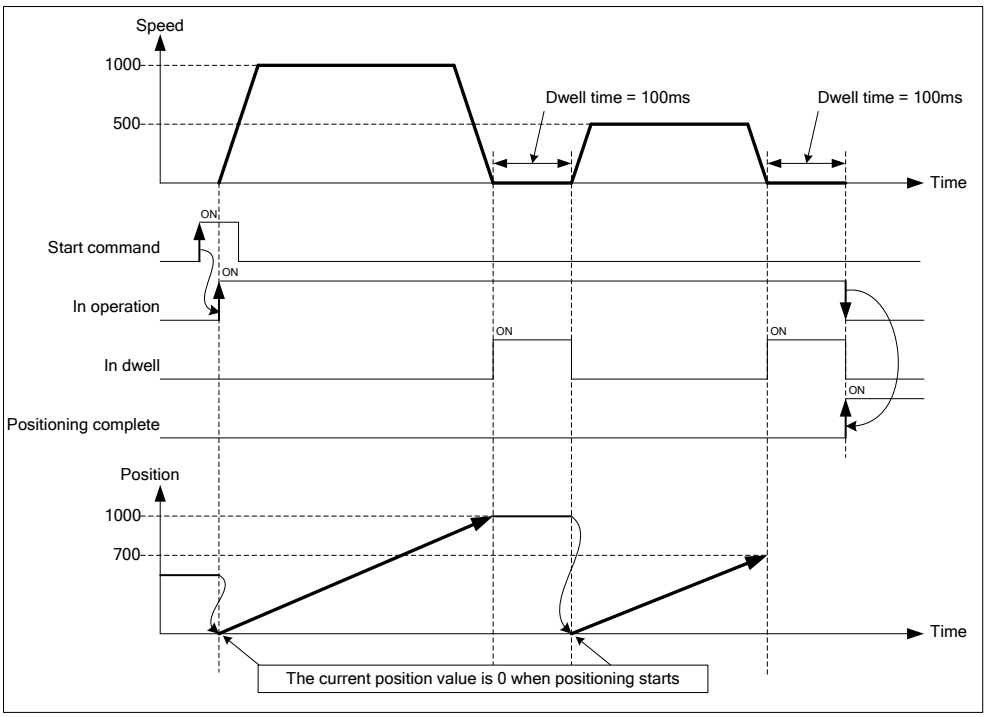
▷Reverse direction : when position address is negative number (-)

(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.

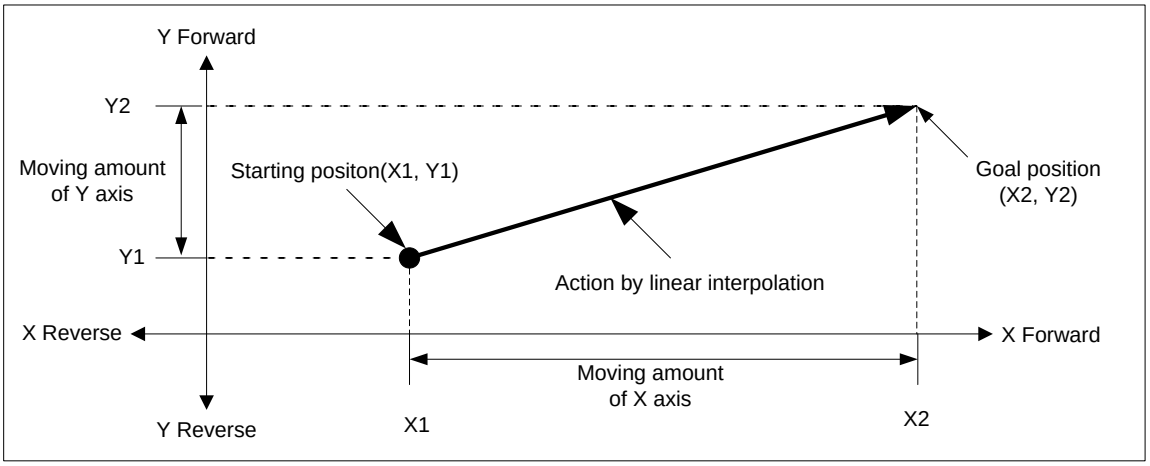
(1) Linear interpolation control with absolute coordinates (「Absolute, Linear Interpolation」)

(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

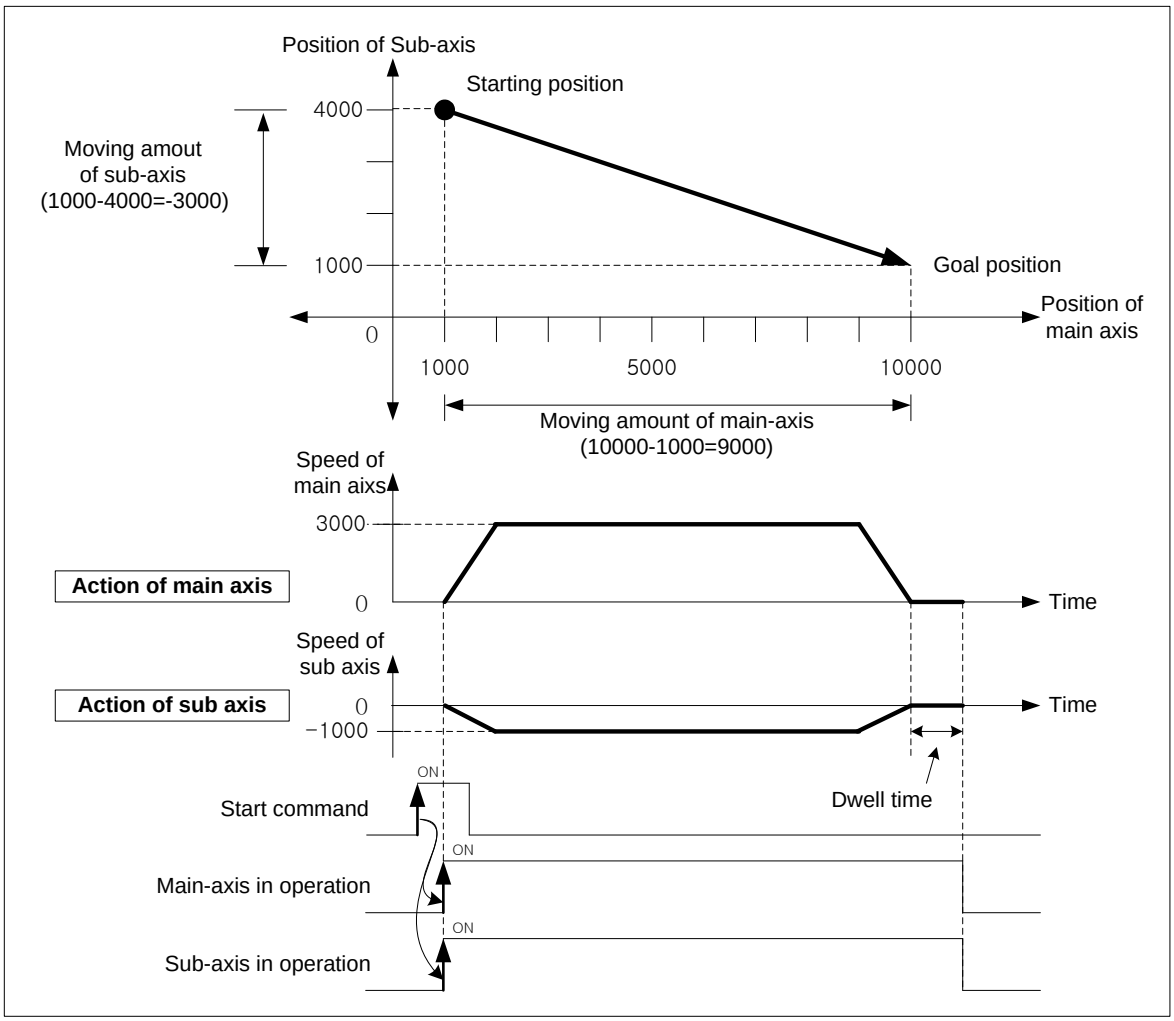
▪ Operating data of main-axis(axis1)

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



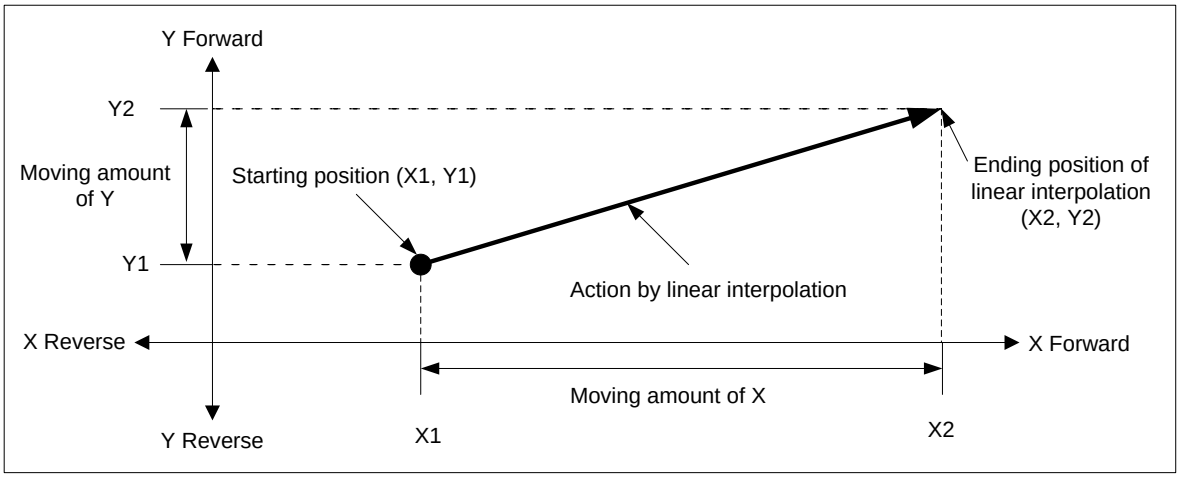
(2) Linear interpolation control with relative coordinates (「Relative, Linear Interpolation」)

(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

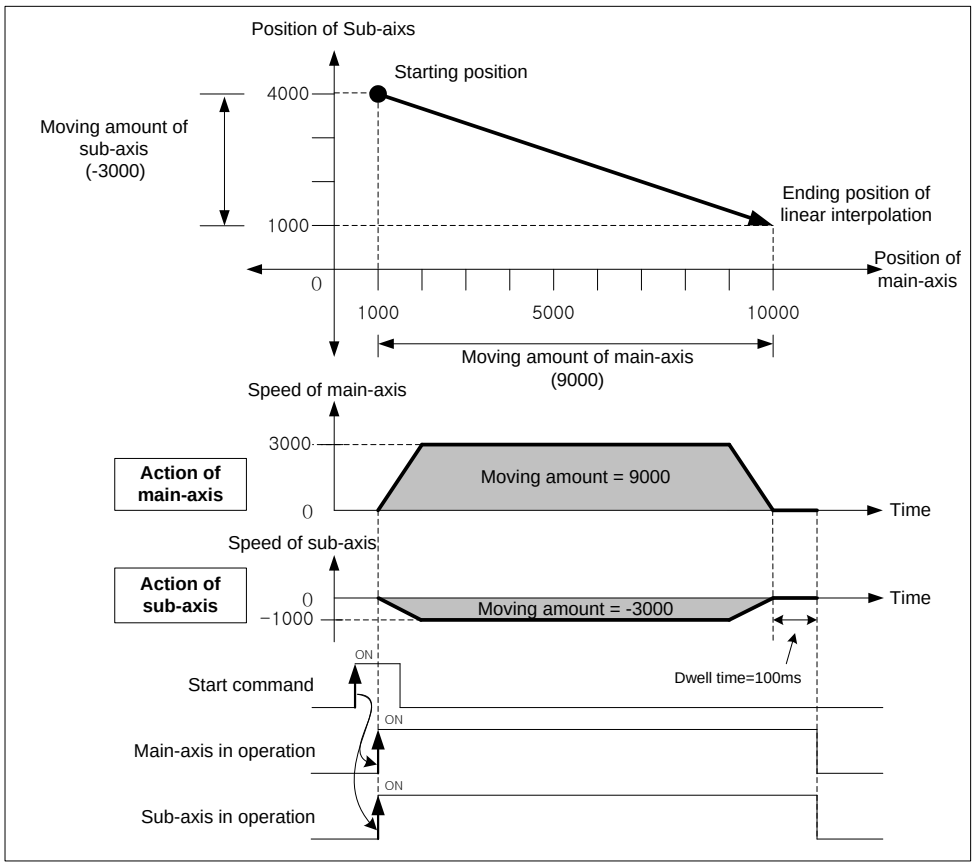
▪ Operating data of main-axis(axis1)

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

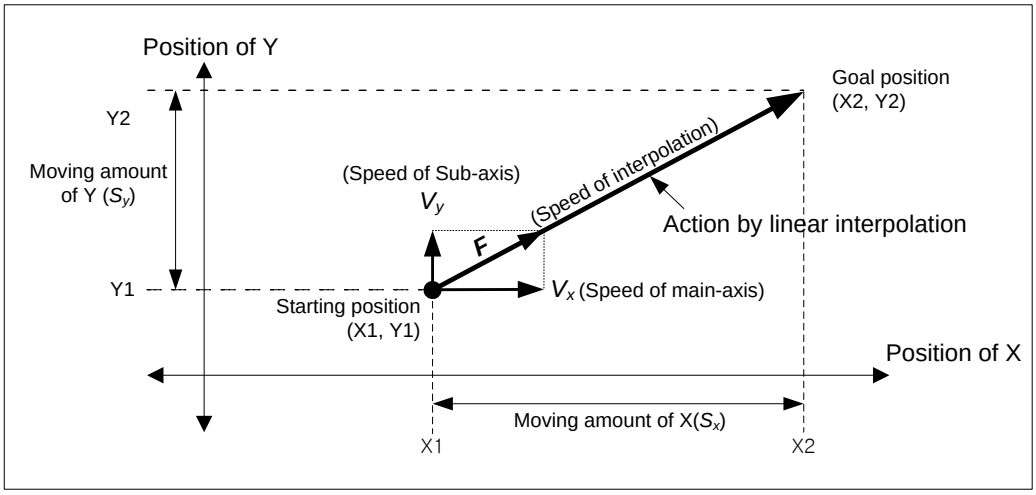
■ Operating pattern



(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)

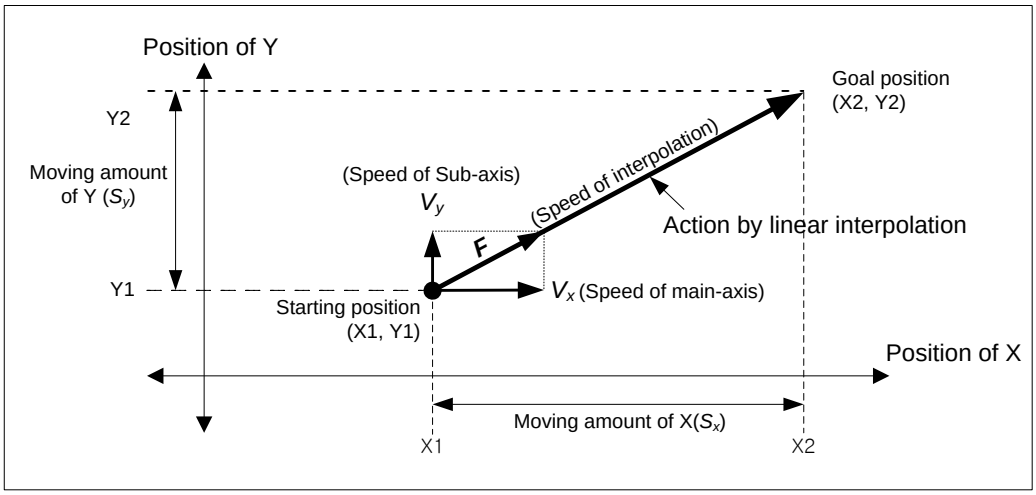
■ Operating speed : 400 [pls/s]

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)= $\sqrt{S_x^{\,2} + S_y^{\,2}}$

$$\text{Speed of main-axis} = \text{Interpolating speed(F)} \times \frac{\text{Main axis moving amount}(S_x)}{\text{Synthetic axis moving amount(S)}}$$

$$\text{Speed of sub-axis} = \text{Interpolating speed(F)} \times \frac{\text{Sub axis moving amount}(S_y)}{\text{Synthetic axis moving amount(S)}}$$

[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 = $400 \times \frac{4000}{5000} = 320$

Speed of sub-axis = $400 \times \frac{3000}{5000} = 240$ [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

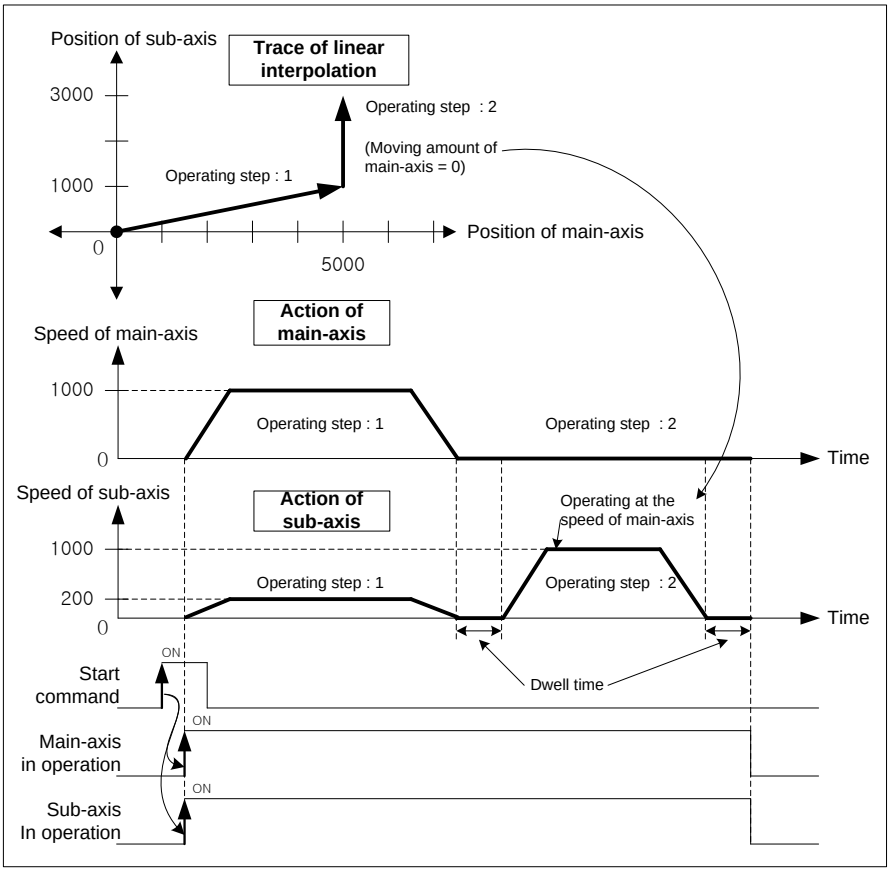
▪ Operating data of Main-axis

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.

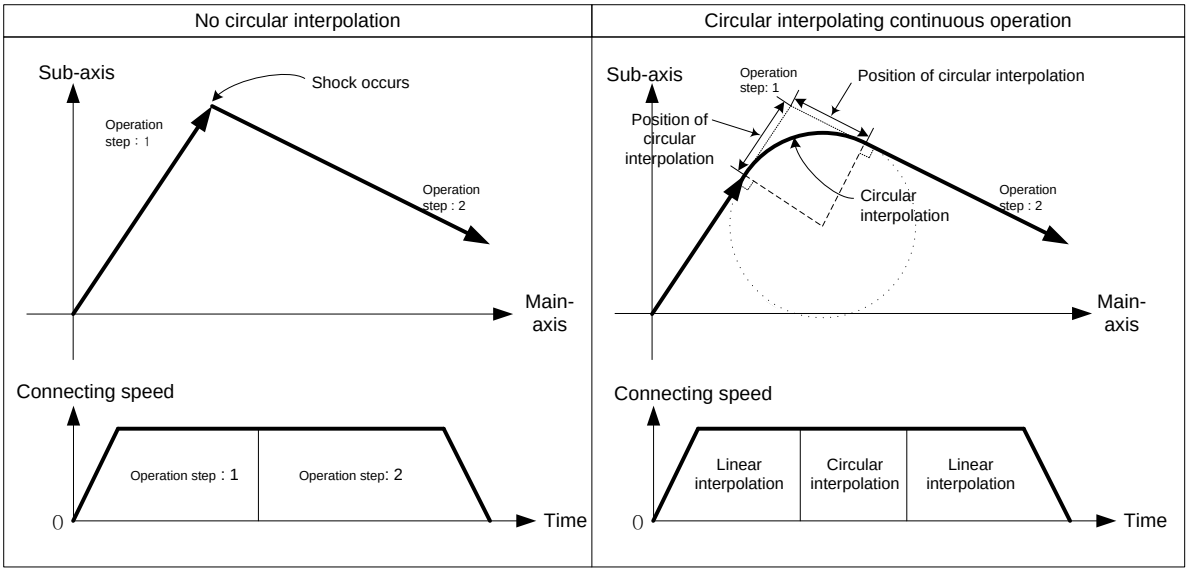
Setting items	Setting value	Description
2 axes linear interpolating continuous operation with circular arc interpolation	0 : Not to execute	When executing it, not to interpolate circular arc
	1 : To execute	When executing it, interpolate circular arc

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

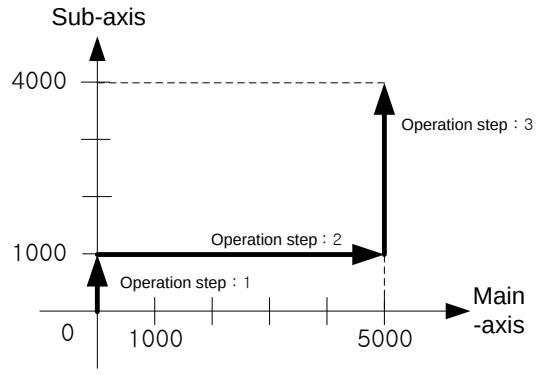
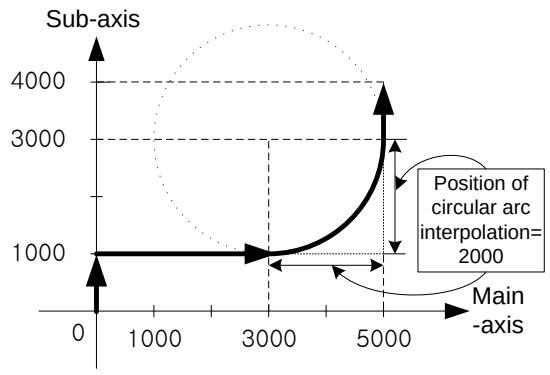
▪ Operating data of Main-axis

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.

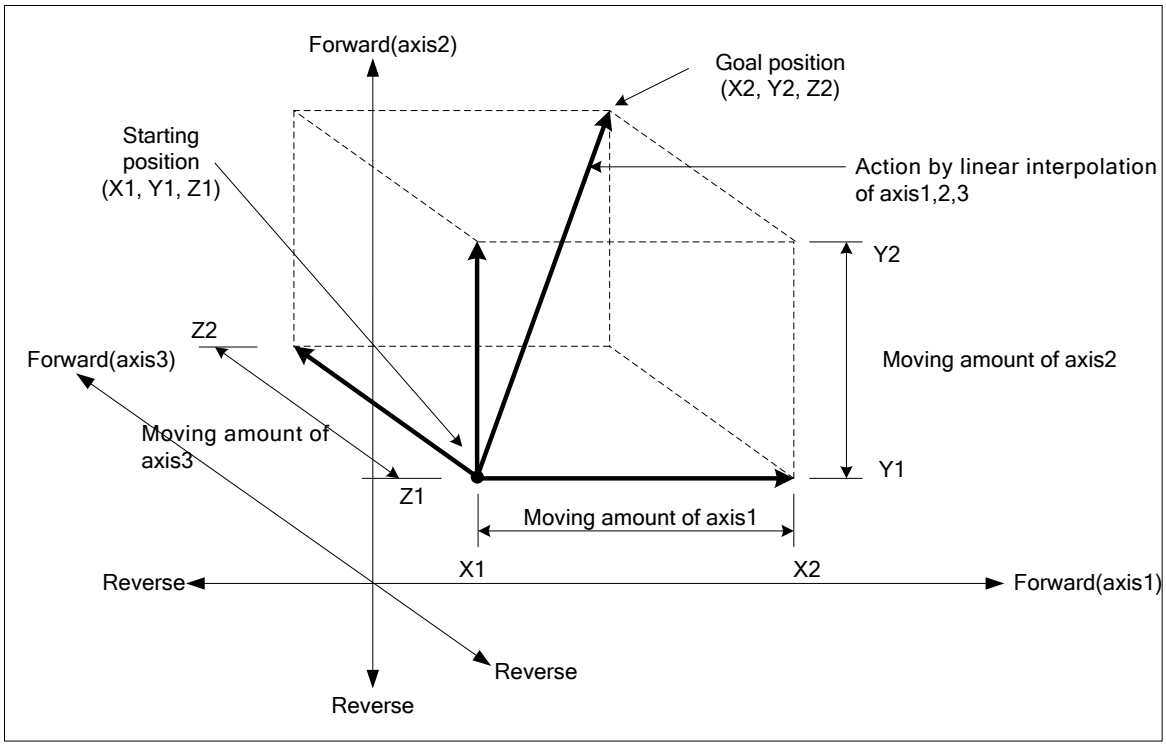
(1) Linear interpolation control with absolute coordinates (「Absolute, Linear Interpolation」)

(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 (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 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

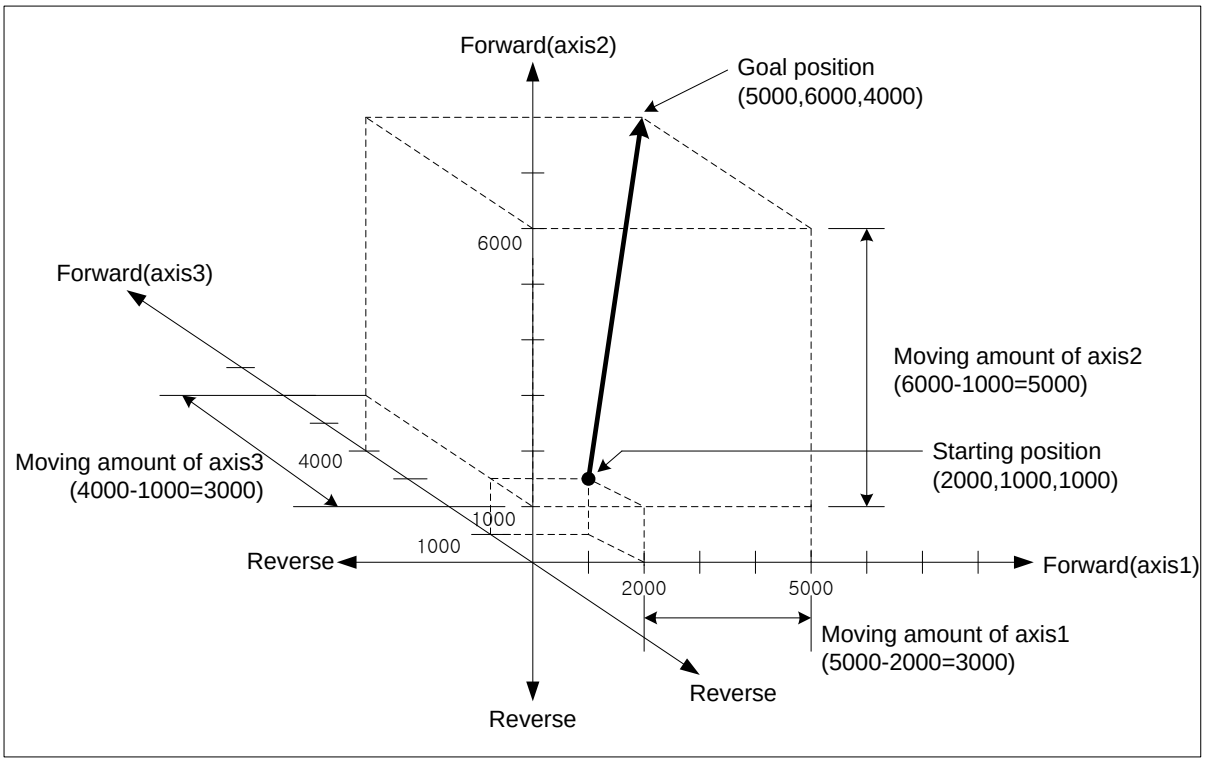
▪ Operating data of sub-axis1(axis2)

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



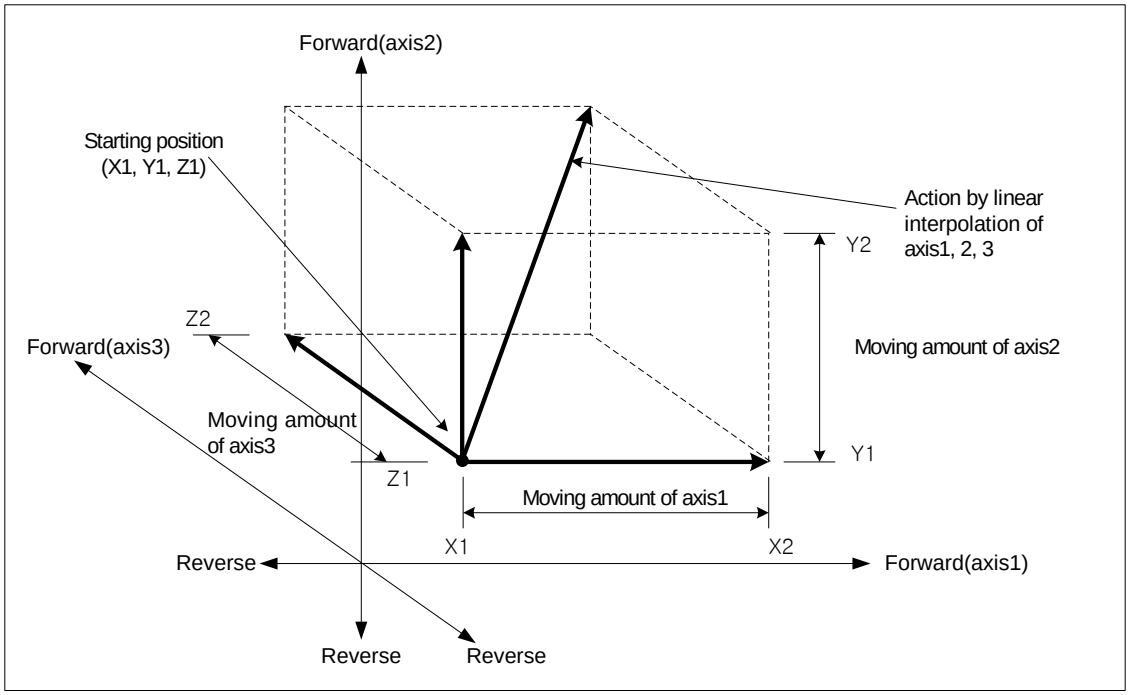
(2) Linear interpolation control with relative coordinates (「Relative, Linear Interpolation」)

(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

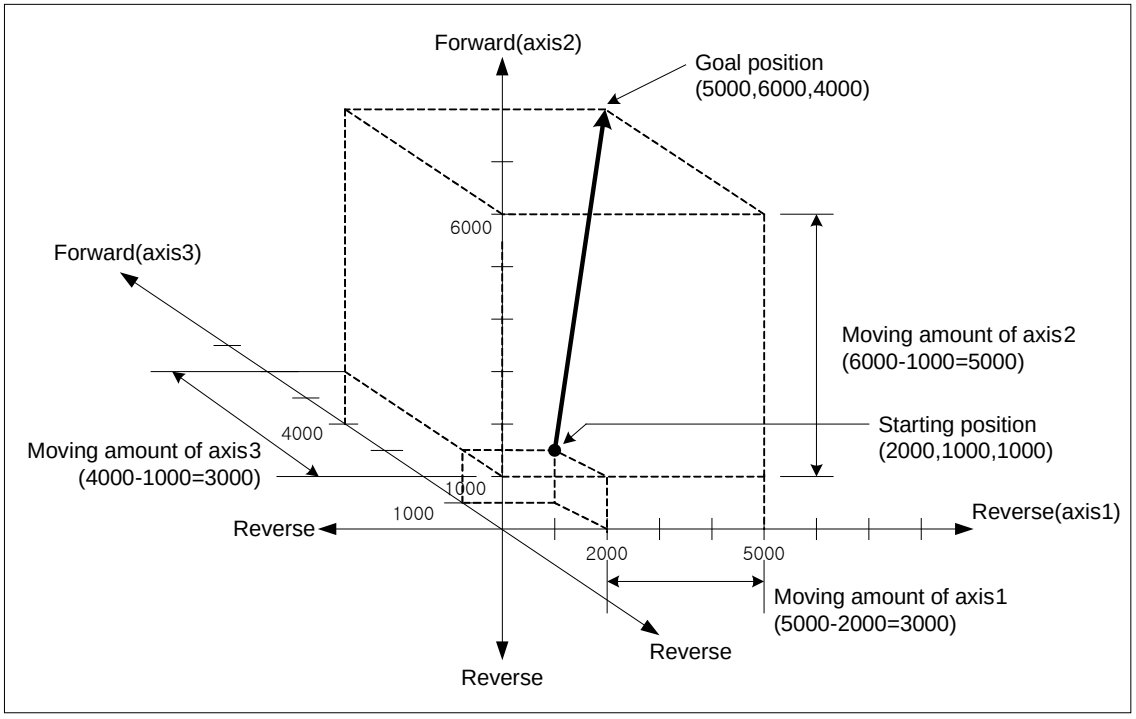
▪ Operating data of sub-axis1(axis2)

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

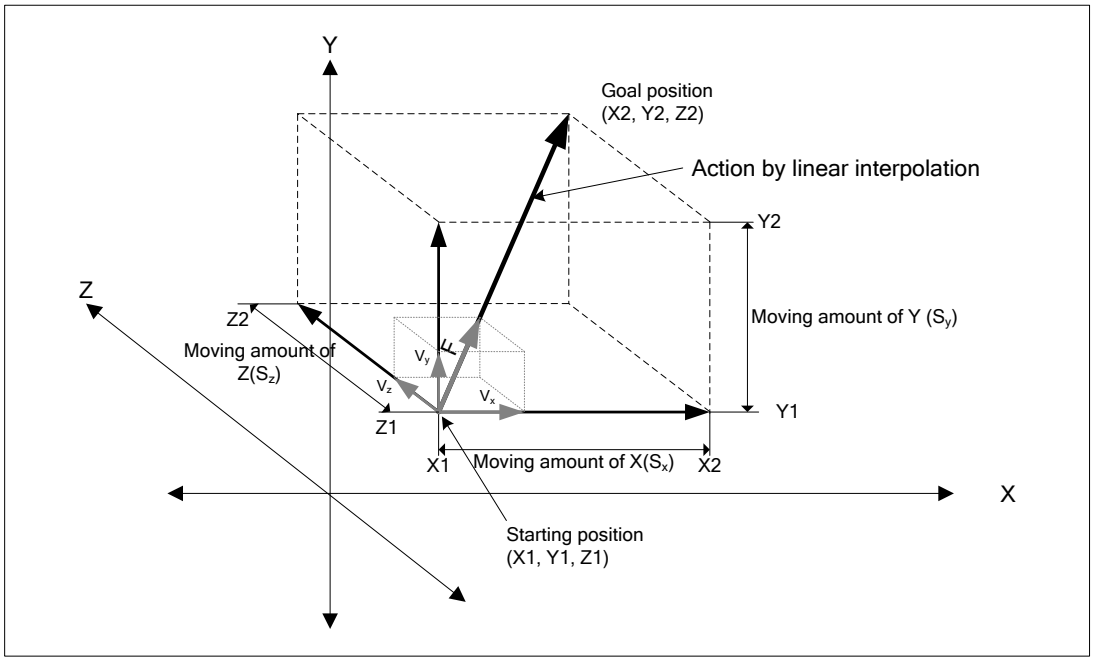
■ Operating pattern



(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]

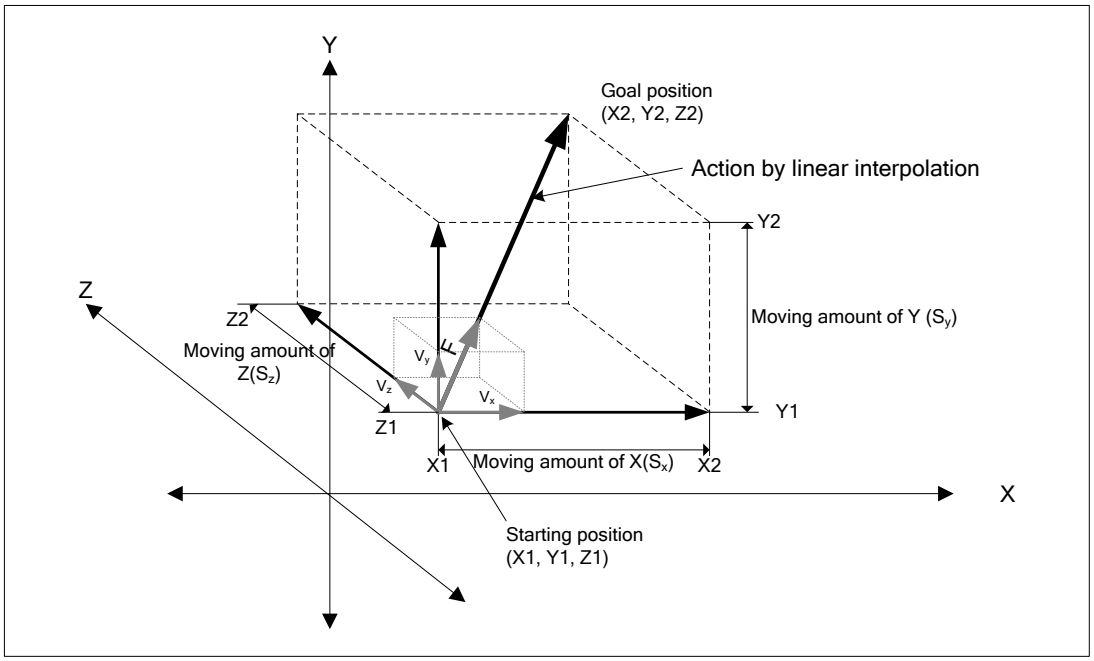
Speed of sub-axis and interpolating speed are as follows.

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

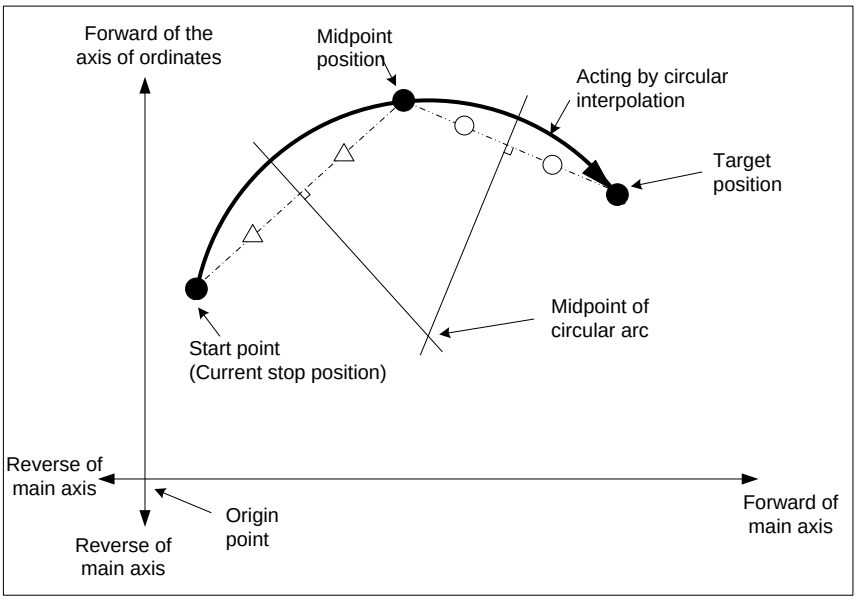
It was progressed by start command of positioning operation (「Indirect start」, 「direct start」) and operate interpolation following the path of circular which is through midpoint that is set by 2 axes.
And, Can progress circular interpolation of over 360 degrees by the set number of circular interpolation.
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

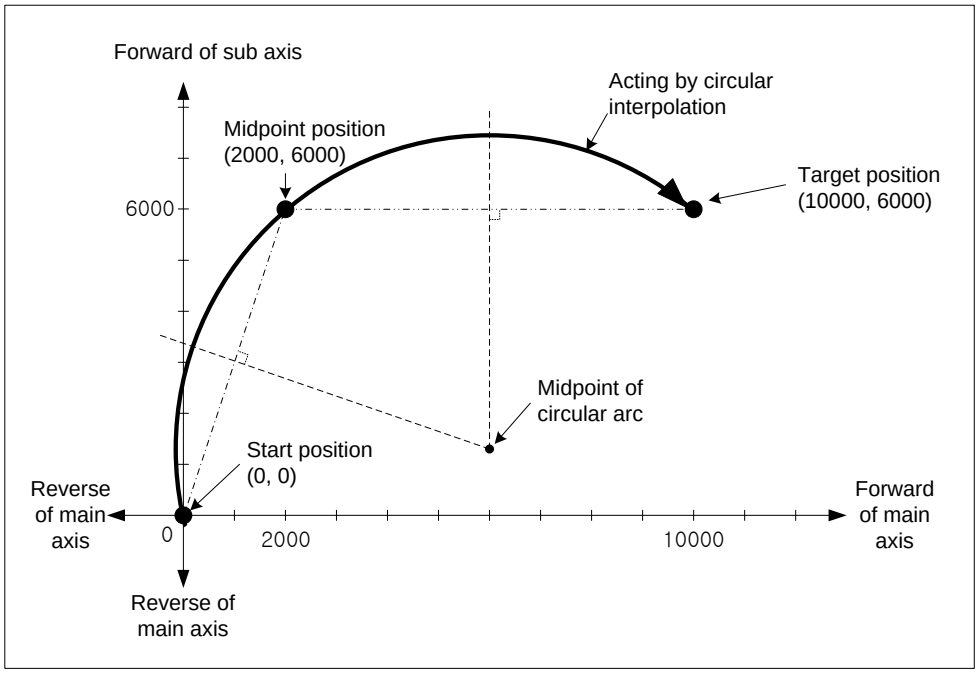
▪ Main axis(axis1) operation data

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



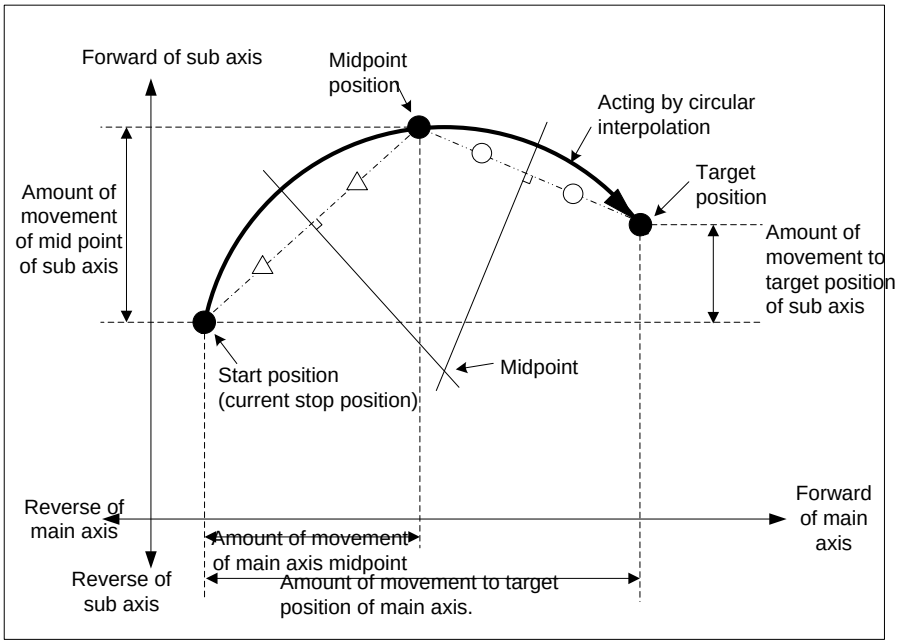
(2) Circular interpolation by relative coordinates, the method of designating midpoint (Relative, circular interpolation)

(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. (No.1 ~ No.4)
Deceleration speed	No. 2	-	Set deceleration time No. for deceleration. (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

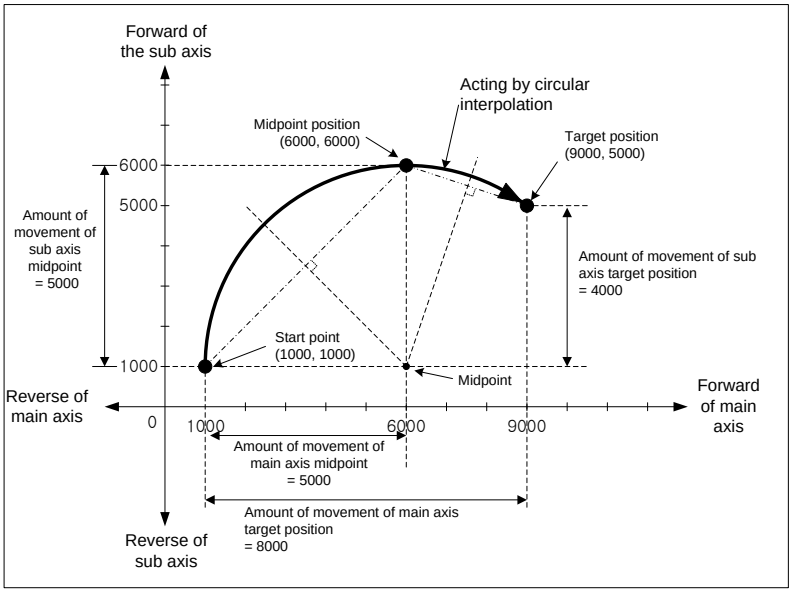
▪ Main axis(axis 1) Operation data

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.

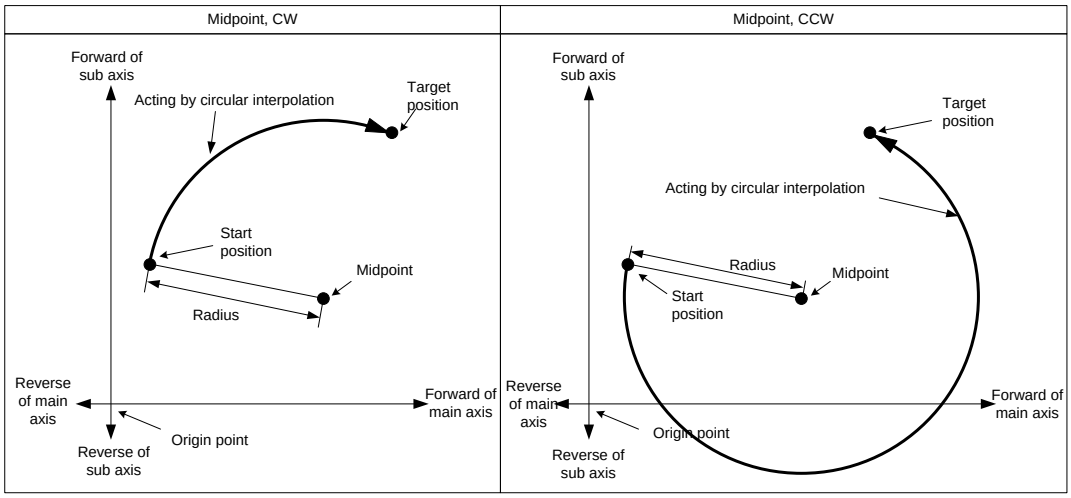
There is no limit for composition of axis 2 that it needs to use circular interpolation control. User can select 2 axes from axis1 to axis 6 randomly.

(1) Circular interpolation by method of absolute coordinate, designating midpoint (Absolute, Circular interpolation)

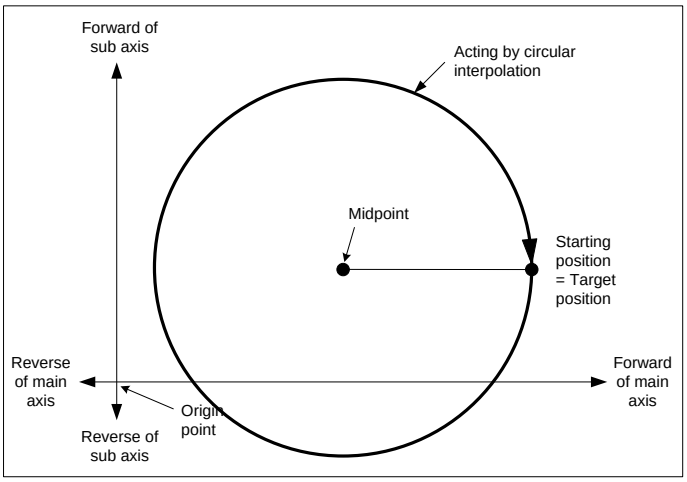
(a) Operate from start position and circular interpolate to target position with the trace of circle. And the circle has radius which distance is to set midpoint position. 「Circular interpolation auxiliary point」is midpoint of this circle.

(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. (No.1 ~ No.4)
Deceleration speed	No.2	-	Set deceleration time No. for deceleration. (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

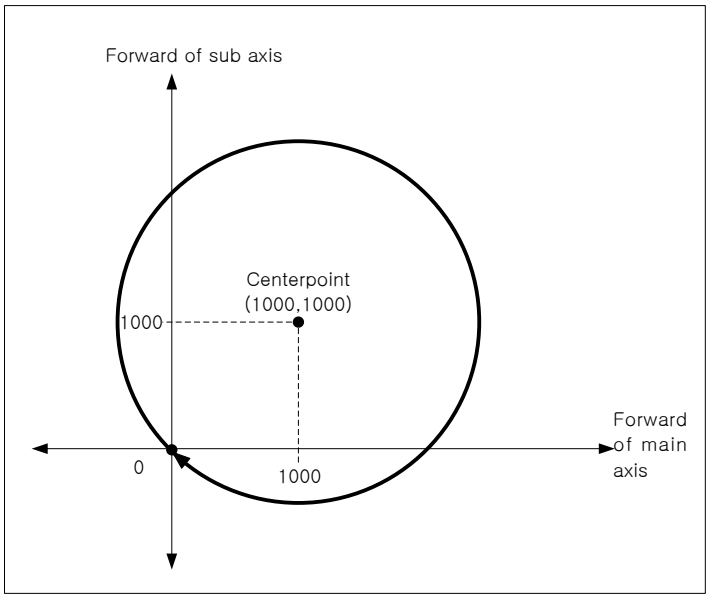
▪ Main axis(axis1) operation data

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

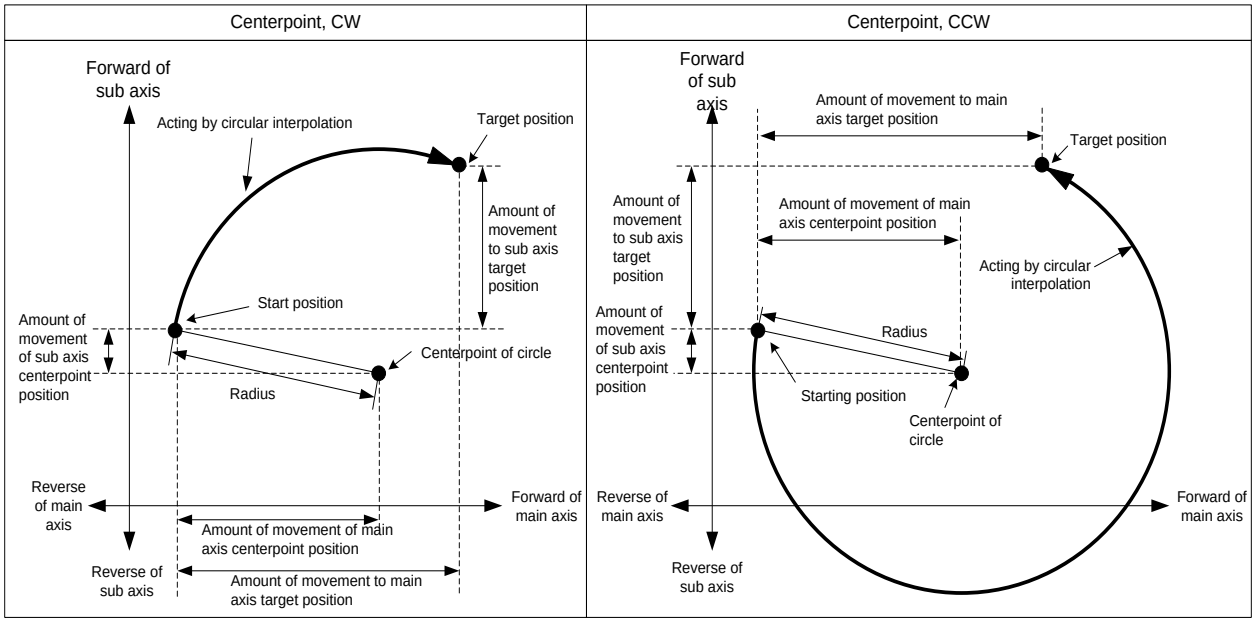


(2) Circular interpolation control by the method of relative coordinate, designating center-point (「Relative, Circular interpolation」)

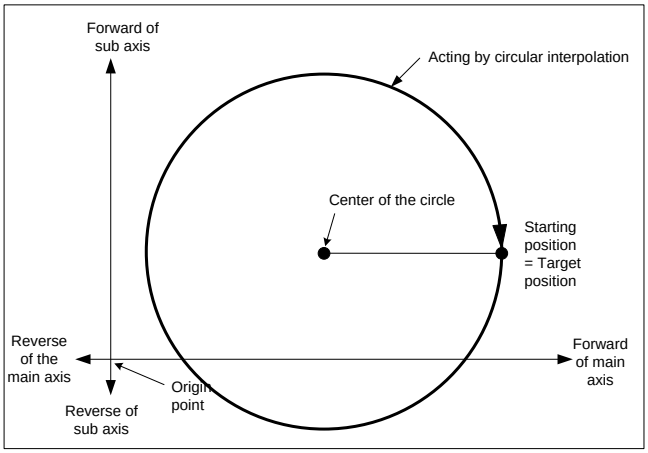
(a) Start operating at starting position and then execute circular interpolation by moving amount already set, along the trace of the arc which has a distance between starting position and designated mid-point as radius. 「Circular interpolation auxiliary point」 means the moving amount between the current 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.



(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. (No.1 ~ No.4)
Deceleration speed	No.2	-	Set deceleration time No. for deceleration. (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

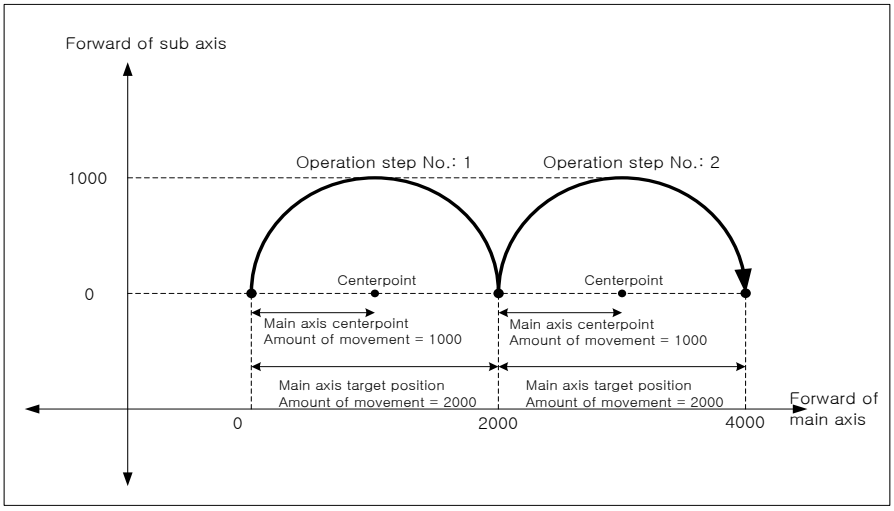
▪ Main axis (axis 1) Operation data

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.

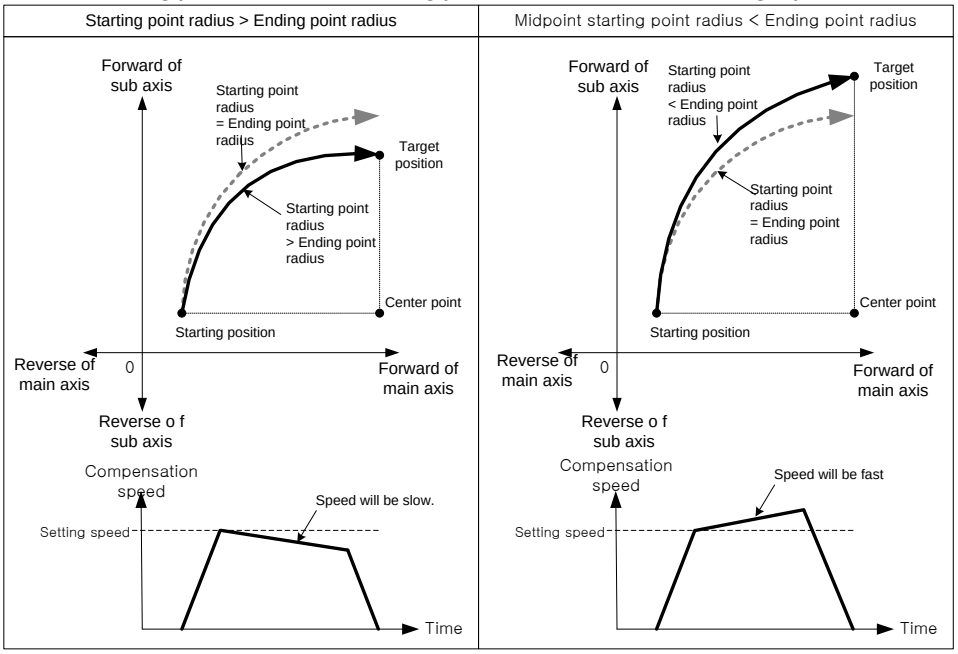
(「Relative, Circular interpolation」)

(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:

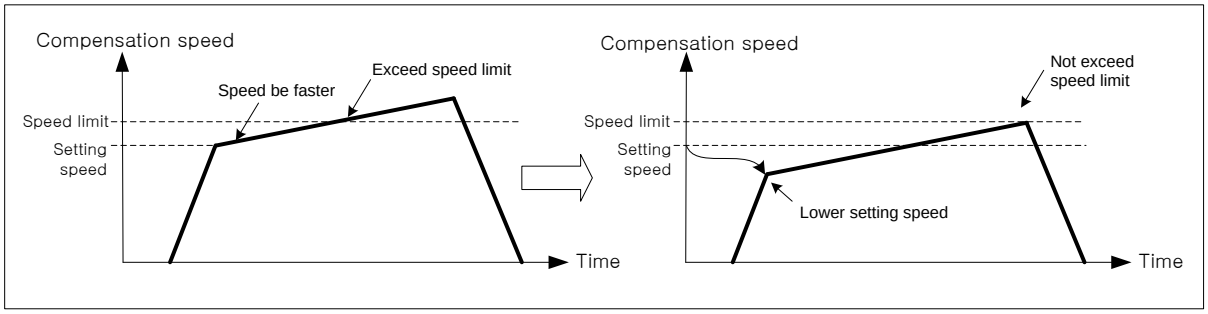
- Radius of starting point > Radius of ending point: The more near from target position, the slower.
- Radius of starting point < Radius of ending point: The more near from target position, the faster.



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

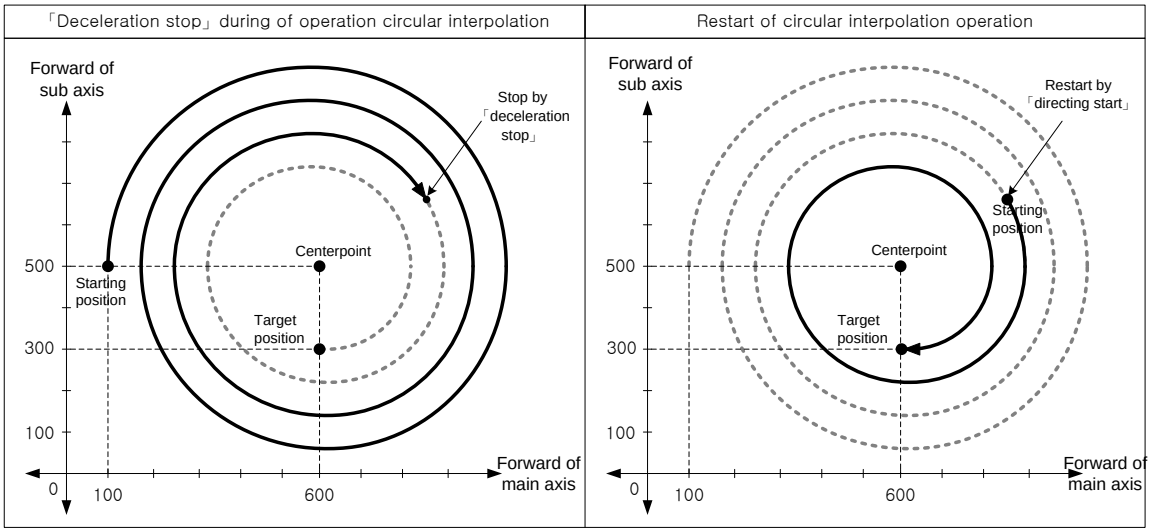
- Main axis (axis 1) operation data

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

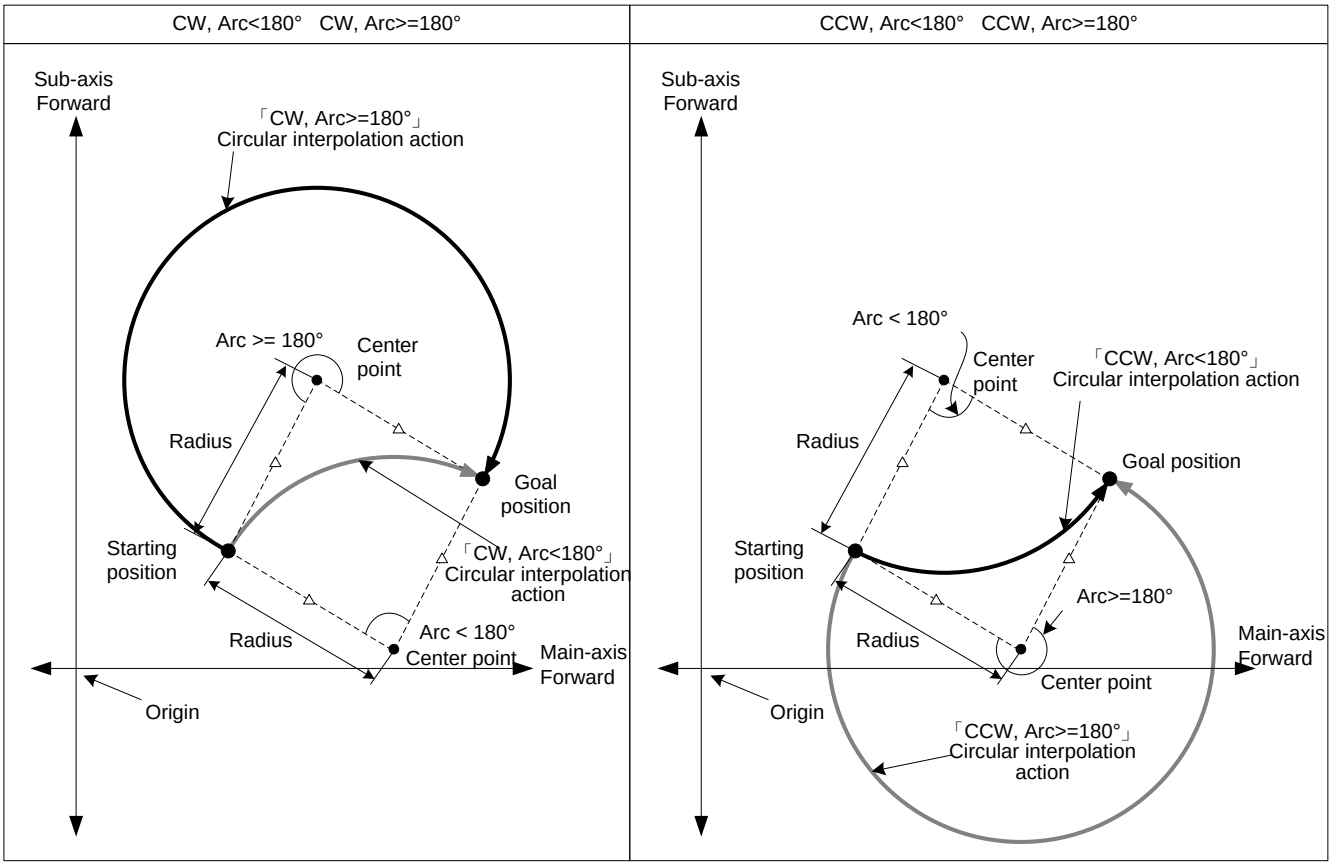
After being executed by positioning operation start (「Indirect start」, 「Sync. start」), then it operates along the trace of the circle made by circular interpolation with 2 axes. According to「The turn no. of circular interpolation」, circular interpolation which is bigger than 360° is available to be executed.

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, 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

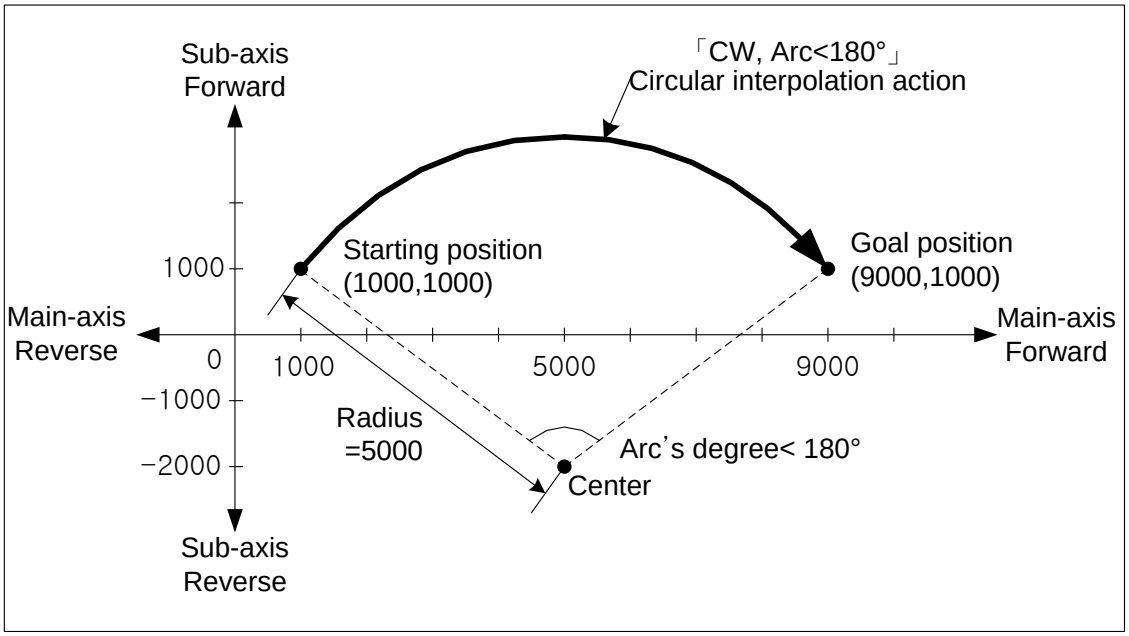
▪ Main-axis(Axis1) Operating data

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

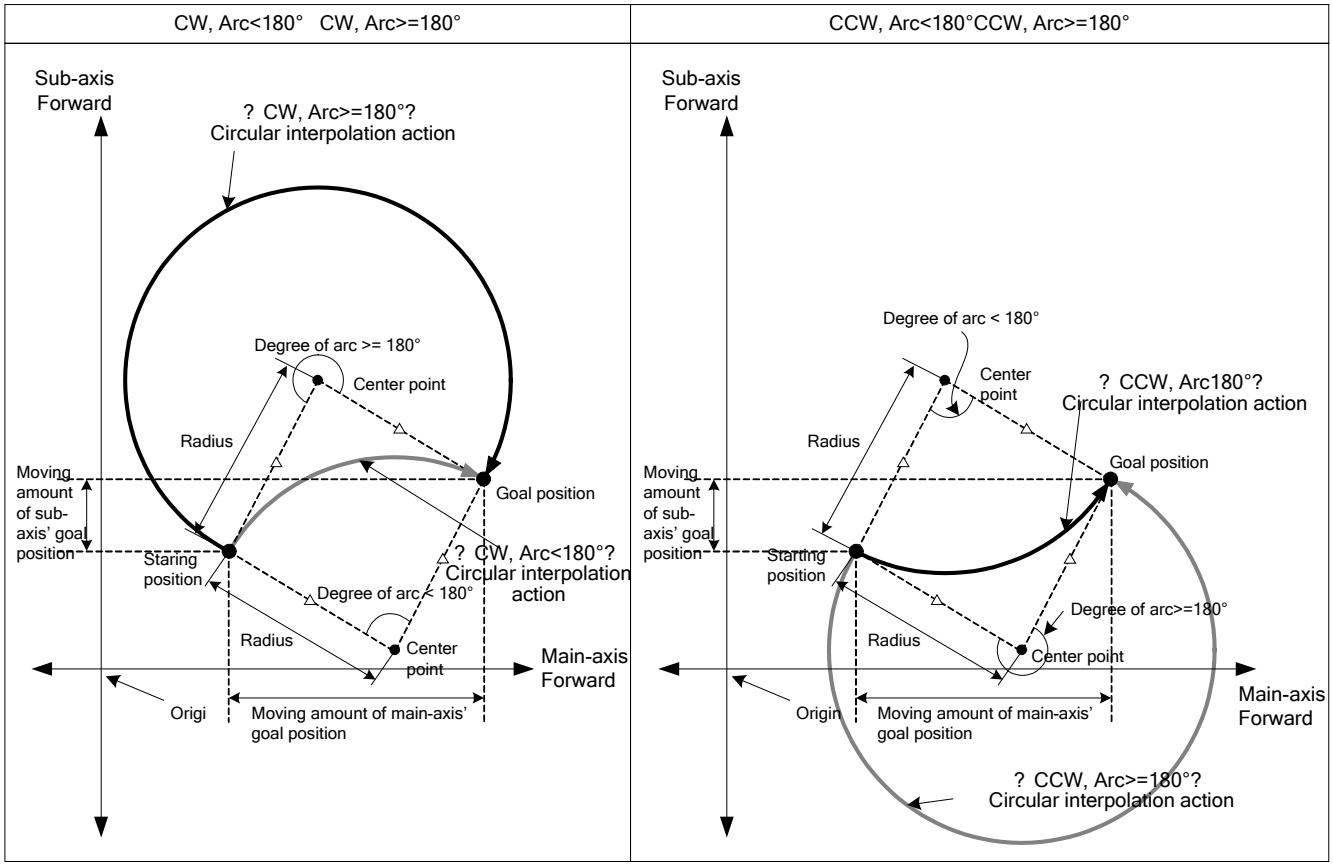
■ Operation pattern



(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, 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

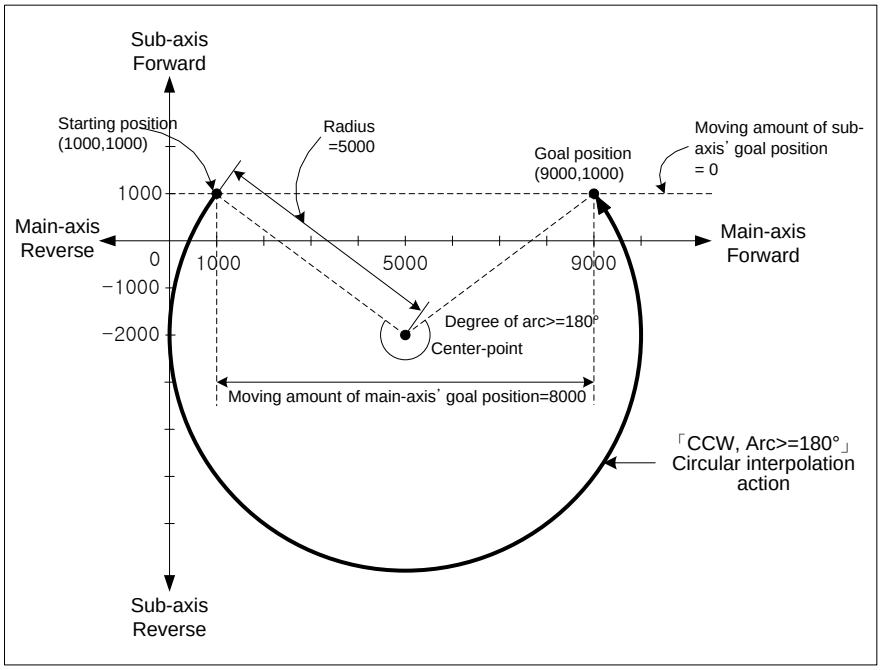
▪ Main-axis(Axis1) Operating data

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.

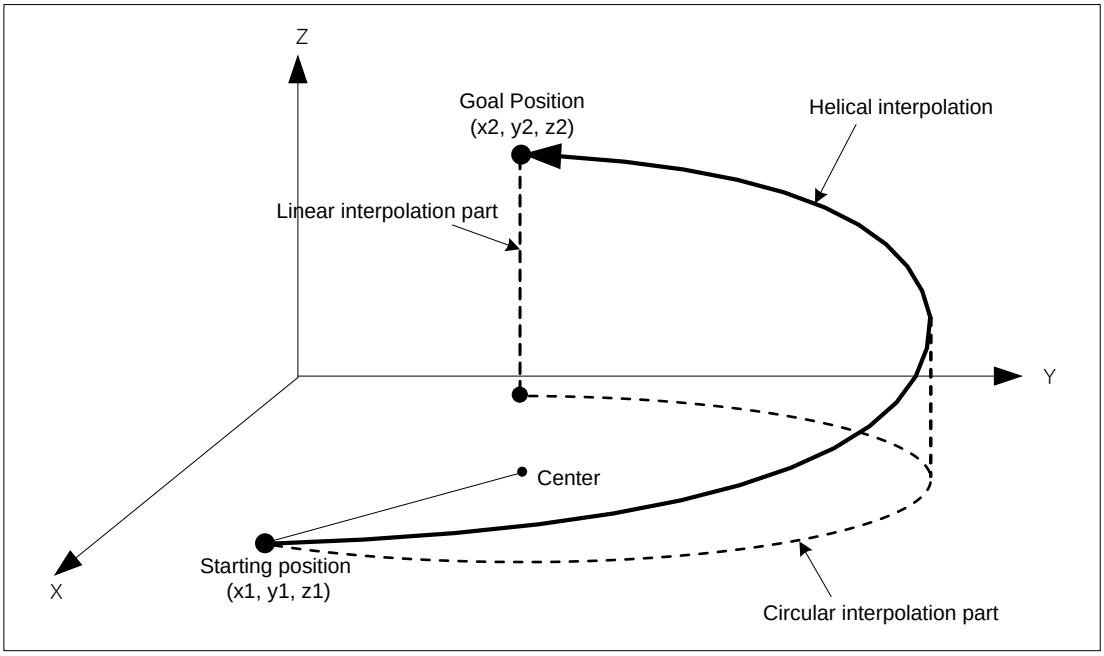
(1) Characteristics of control

(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

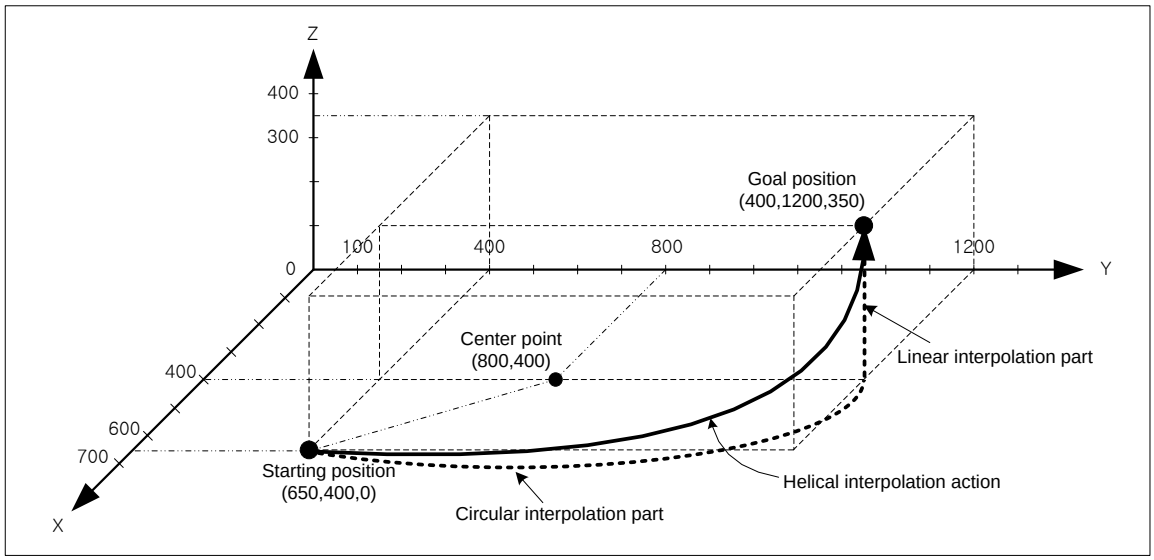
▪ Operation data of sub axis(axis2)

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.

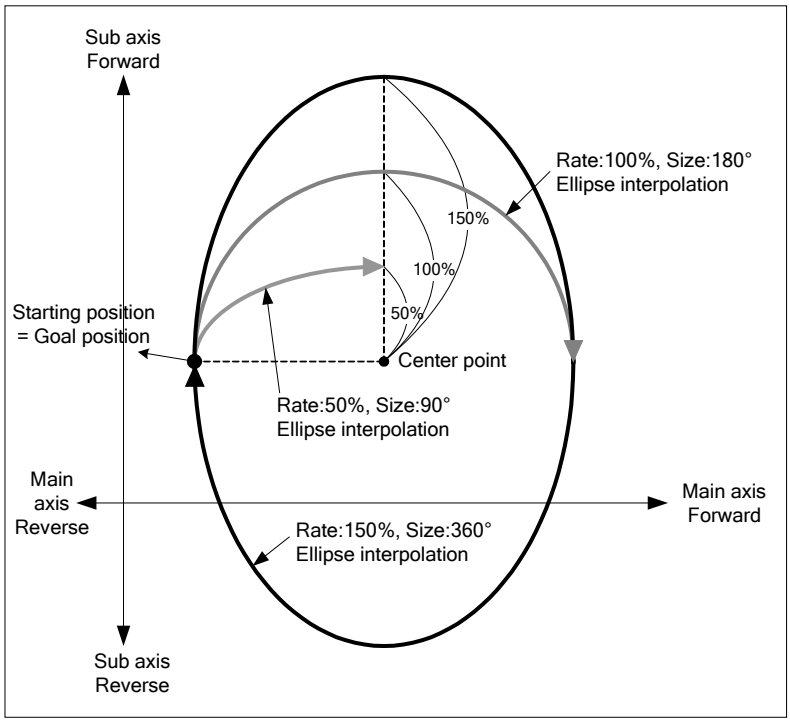
(1) Characteristics of Control

(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 (1 = 0.01%)
Size(Degree) of ellipse	0 ~ 65535	Set the degree of ellipse's movement (1 = 0.1°)

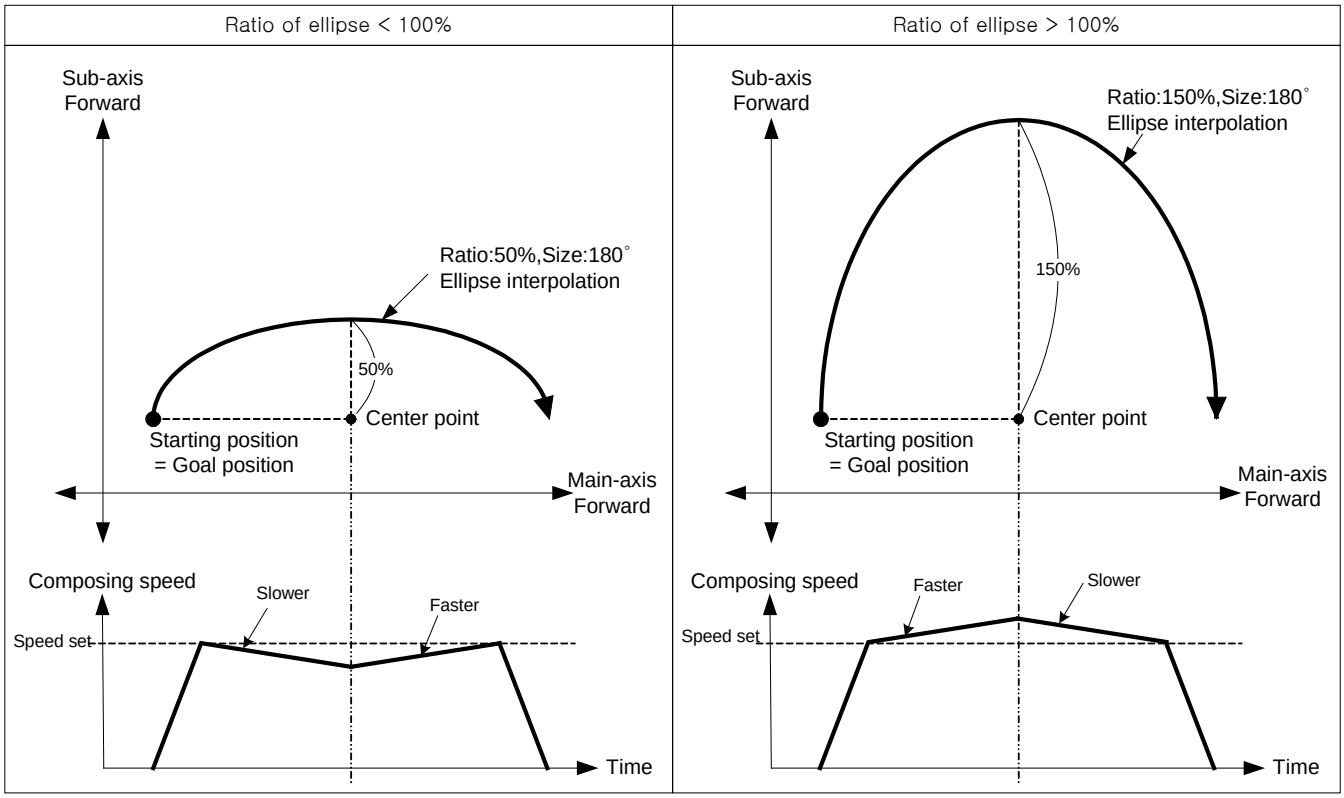
(b) Moving direction of ellipse is decided by the direction set on "circular interpolation mode" of operation data.

- 「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

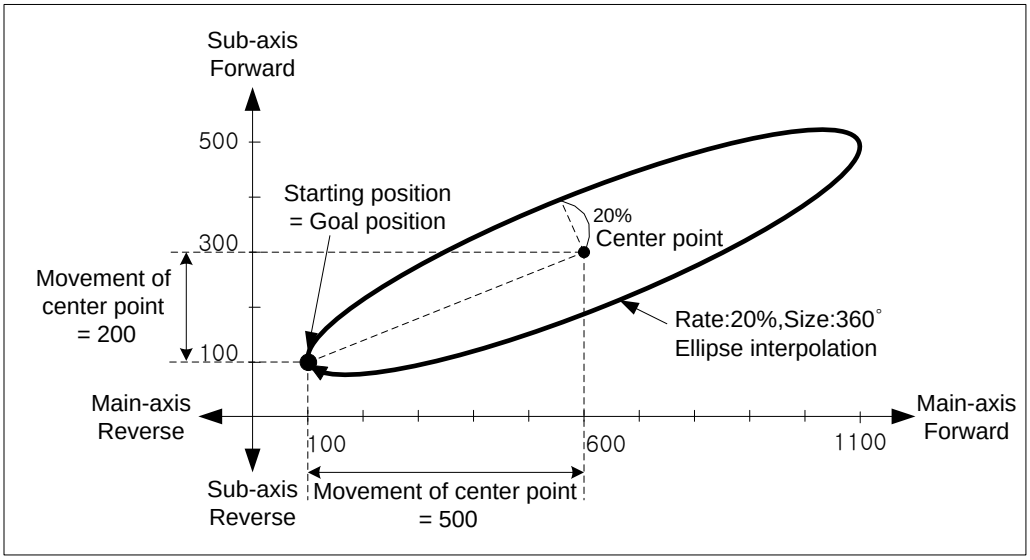
▪ Operation data of Main-axis(axis1)

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(+)

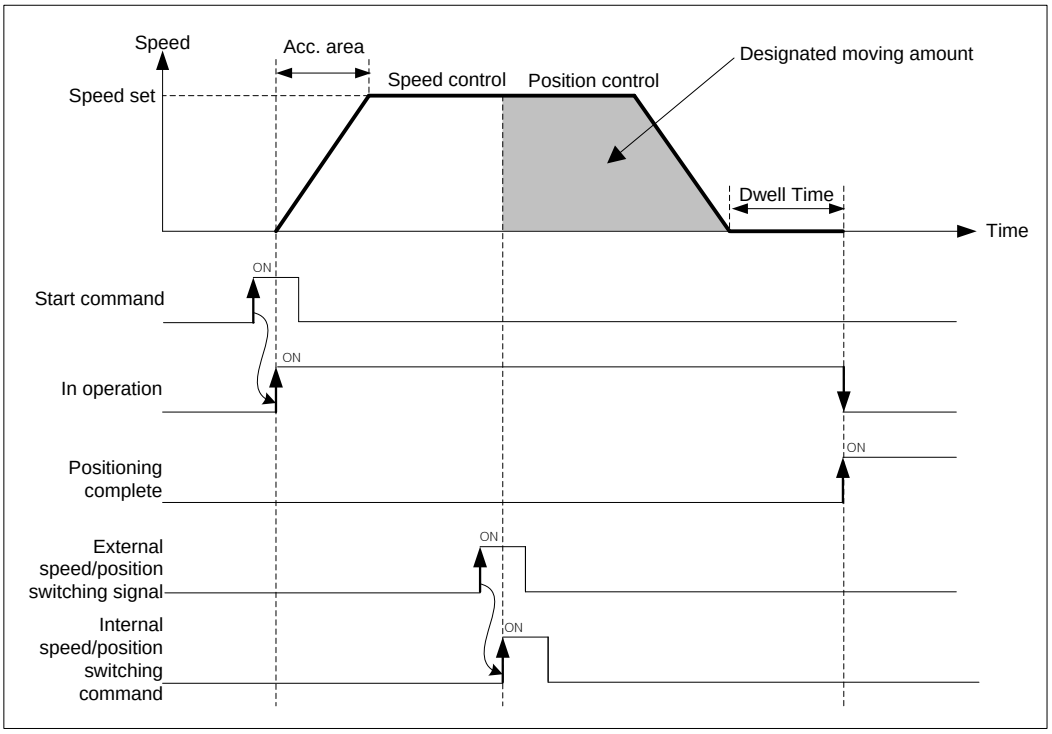
■ Reverse : The position value is Negative(-)

(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.

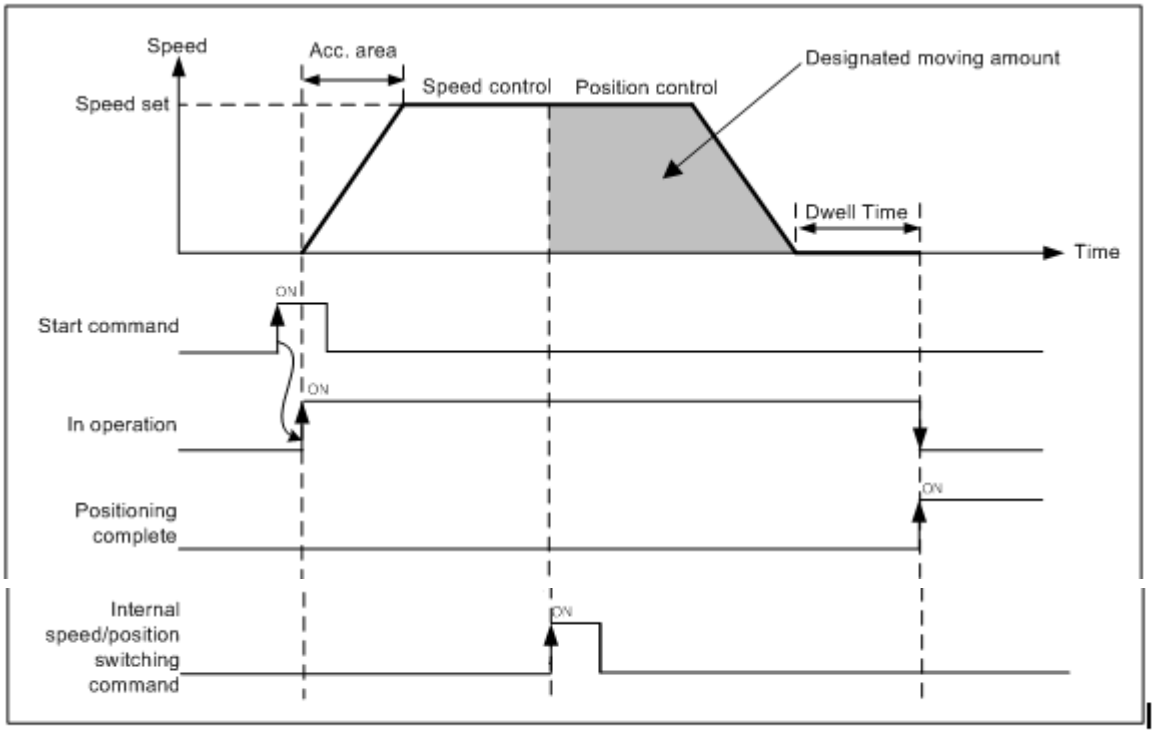
(b) Set the speed/position switching coordinate

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

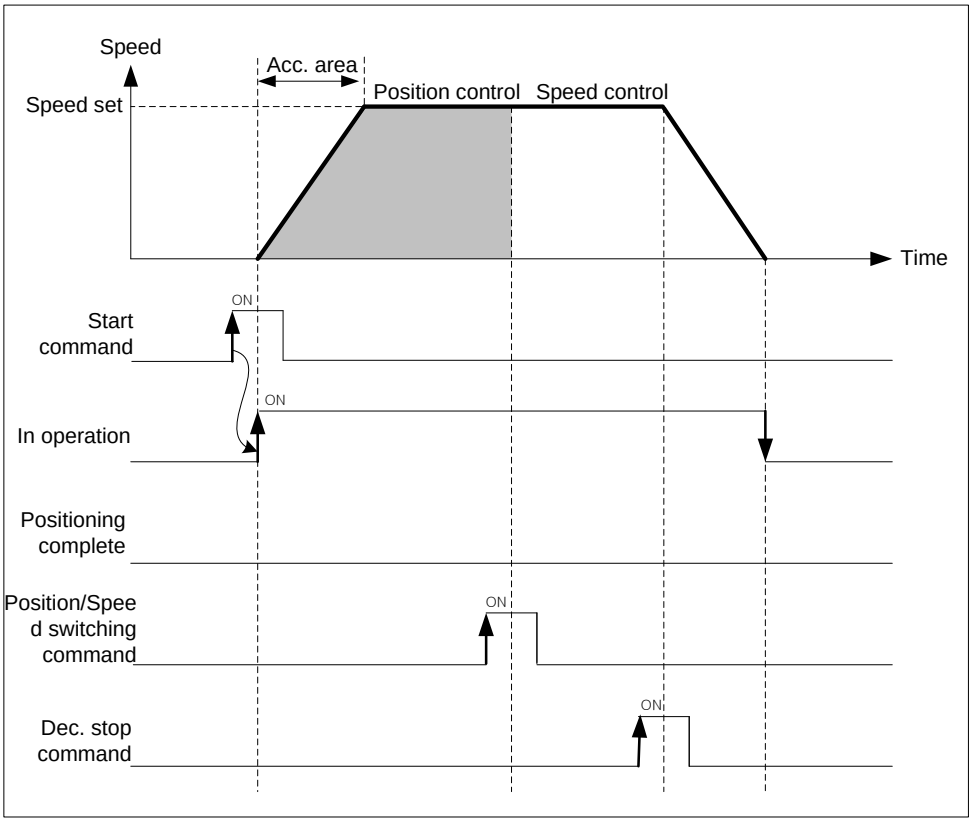
■ 「Absolute, Single axis position control」

- 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. (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

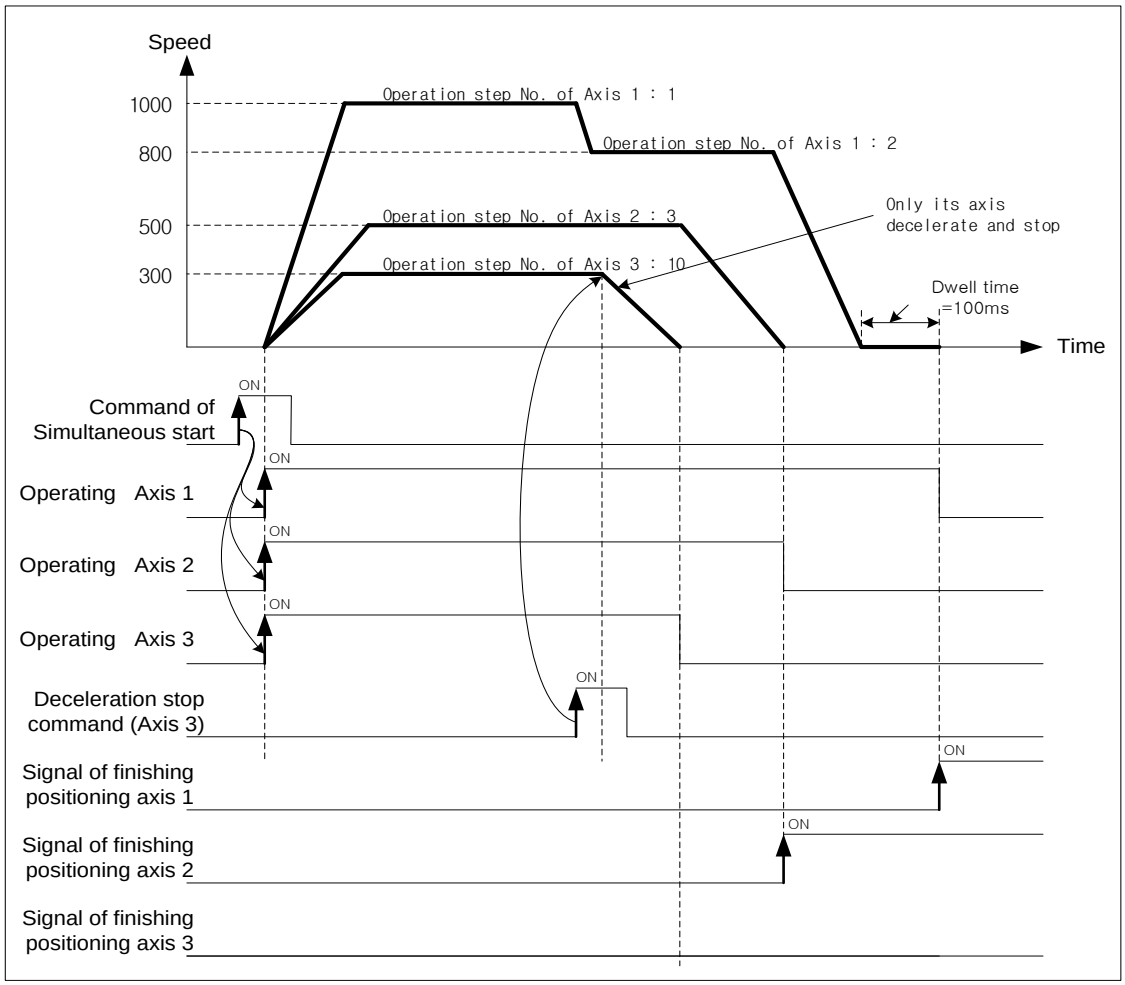
- Operation data of axis 2

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;

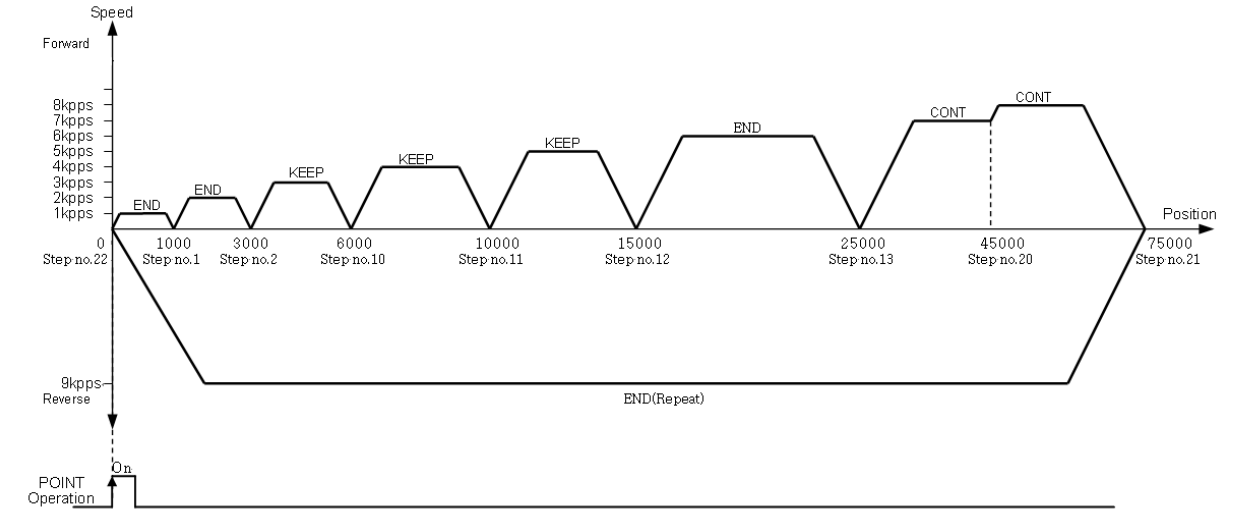
■ The number of point operation: 4

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.

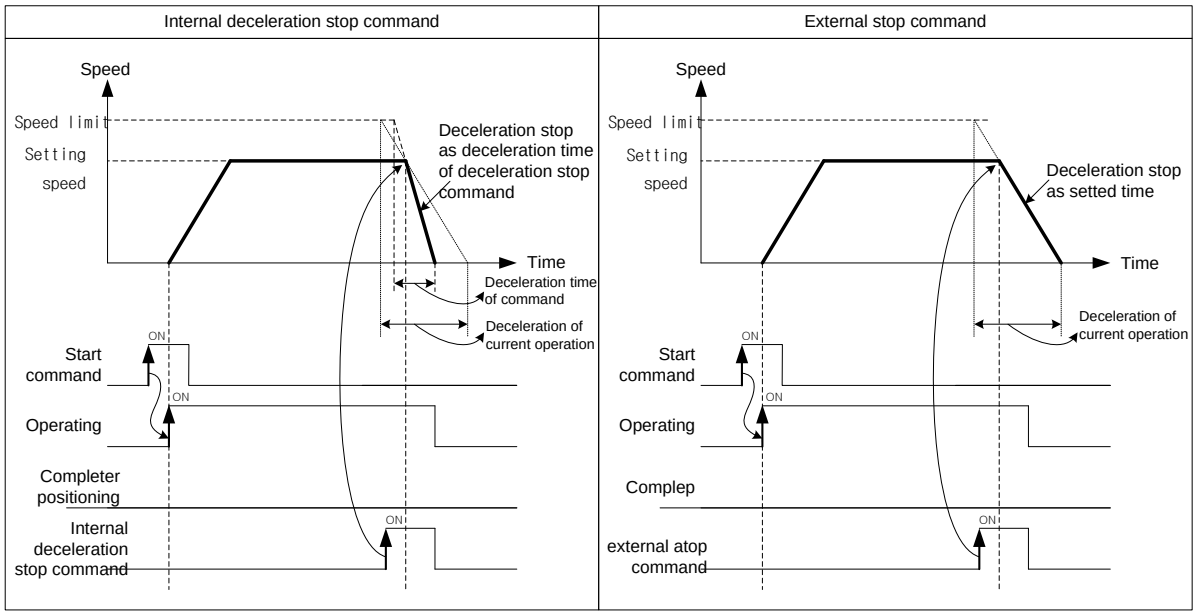
- Internal deceleration stop command
  It decelerate and stop by XG-PM and 「deceleration stop」 command of sequence program as set support data.
- External deceleration stop signal
  In case of input signal of external emergency stop/deceleration stop to be "On", it will be decelerated and stopped by 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.

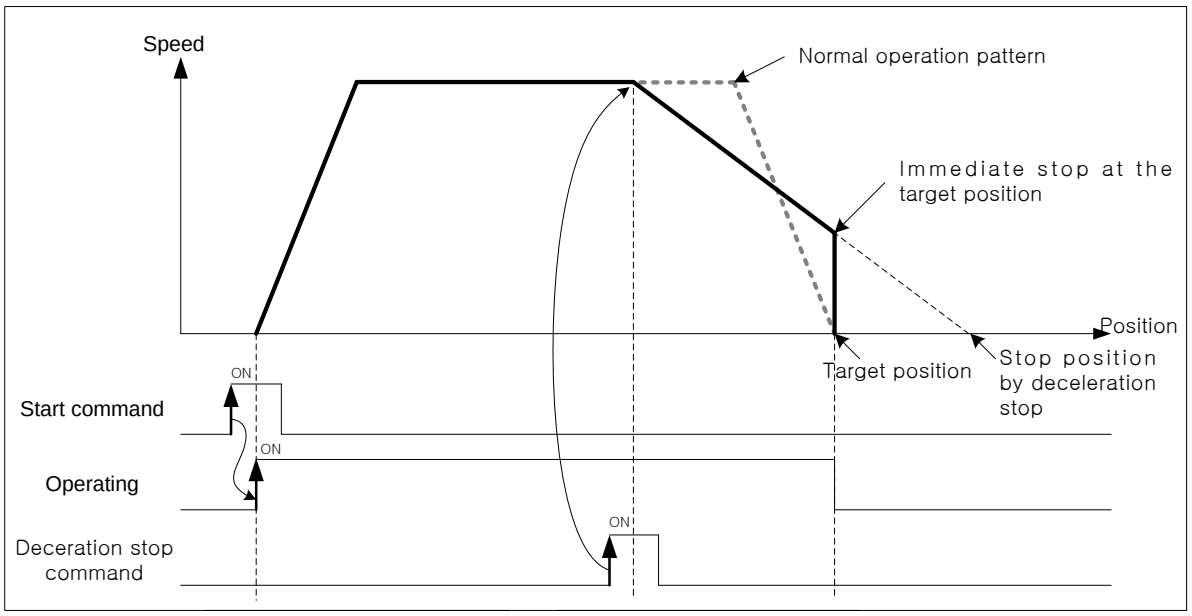
(f) Condition

- 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.

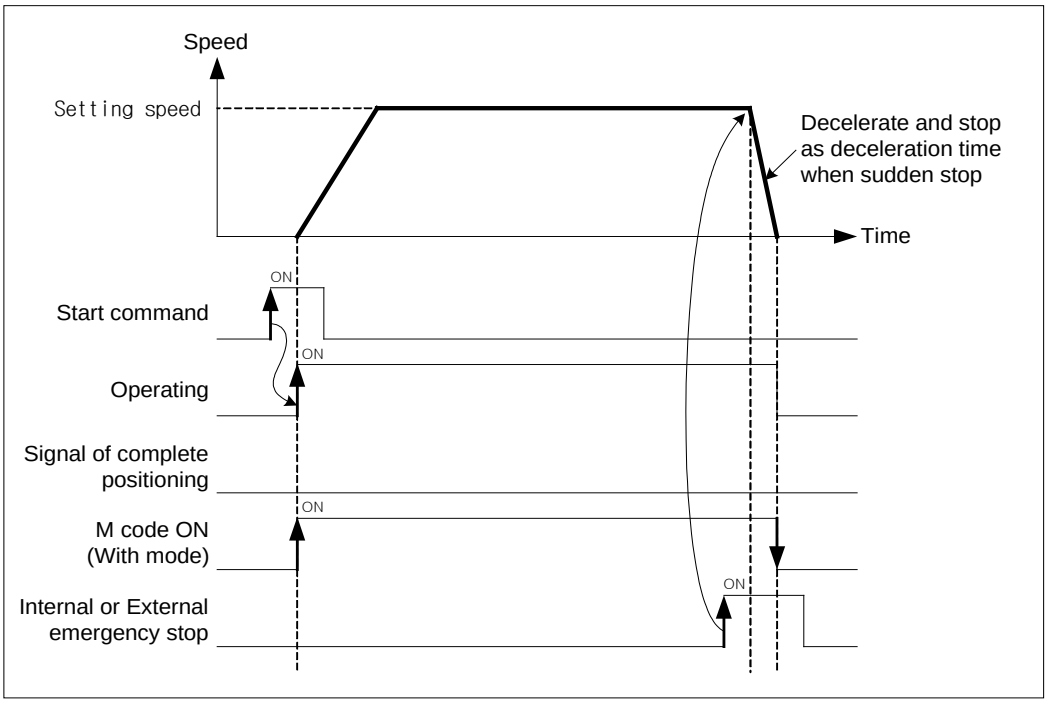
(d) Internal emergency stop command

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

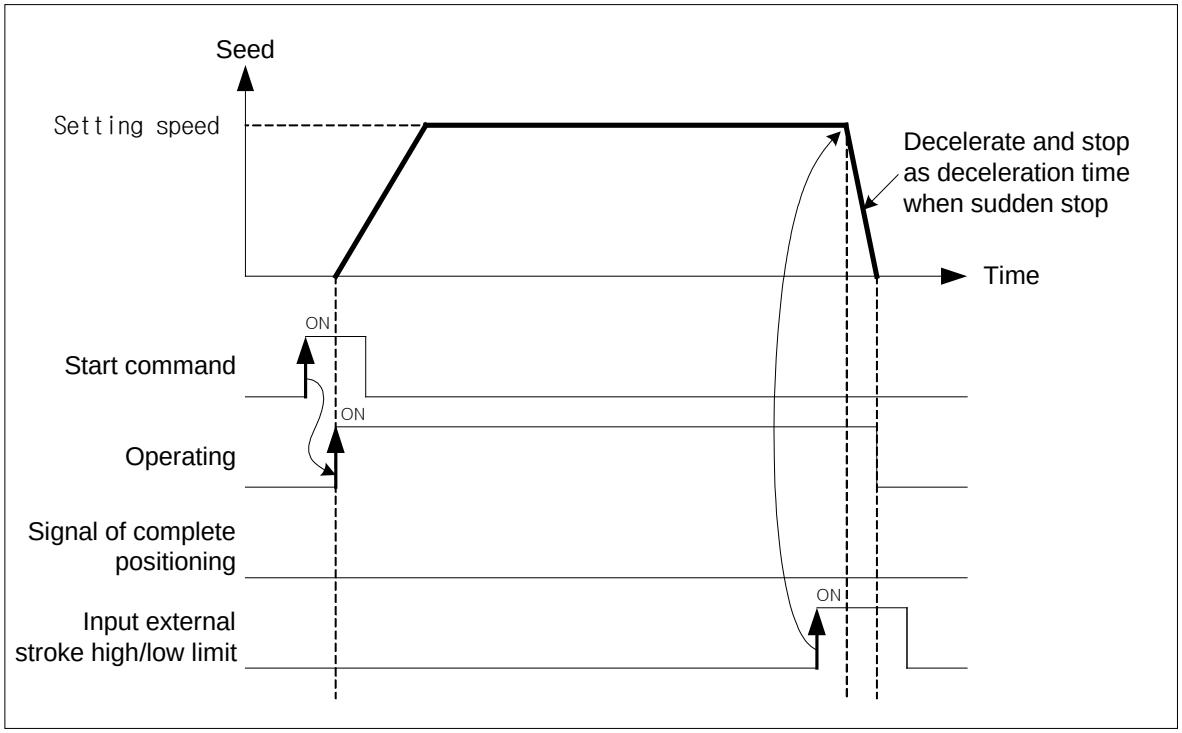
(a) When positioning control, if the signal of hardware high/low limit is inputted, then stop positioning control and it will be decelerated and stopped as set time at 「deceleration time when it is suddenly stopped」, and error will be occurred.

(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)

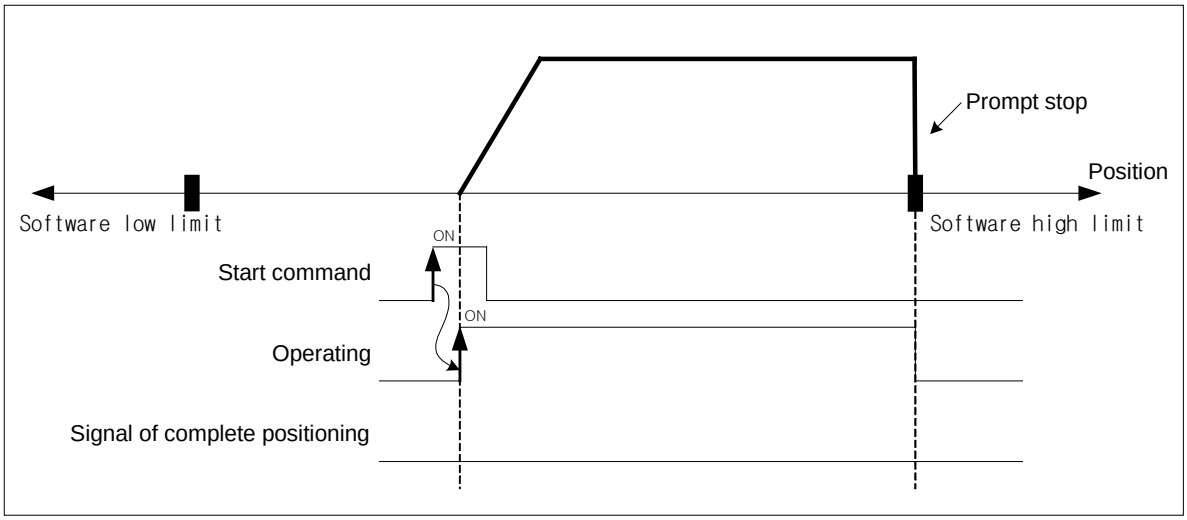
Item	Setting value	Contents
Software high limit	-2147483648 ~ 2147483647	Set position of software high limit.
Software low limit	-2147483648 ~ 2147483647	Set position of software low limit.

(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

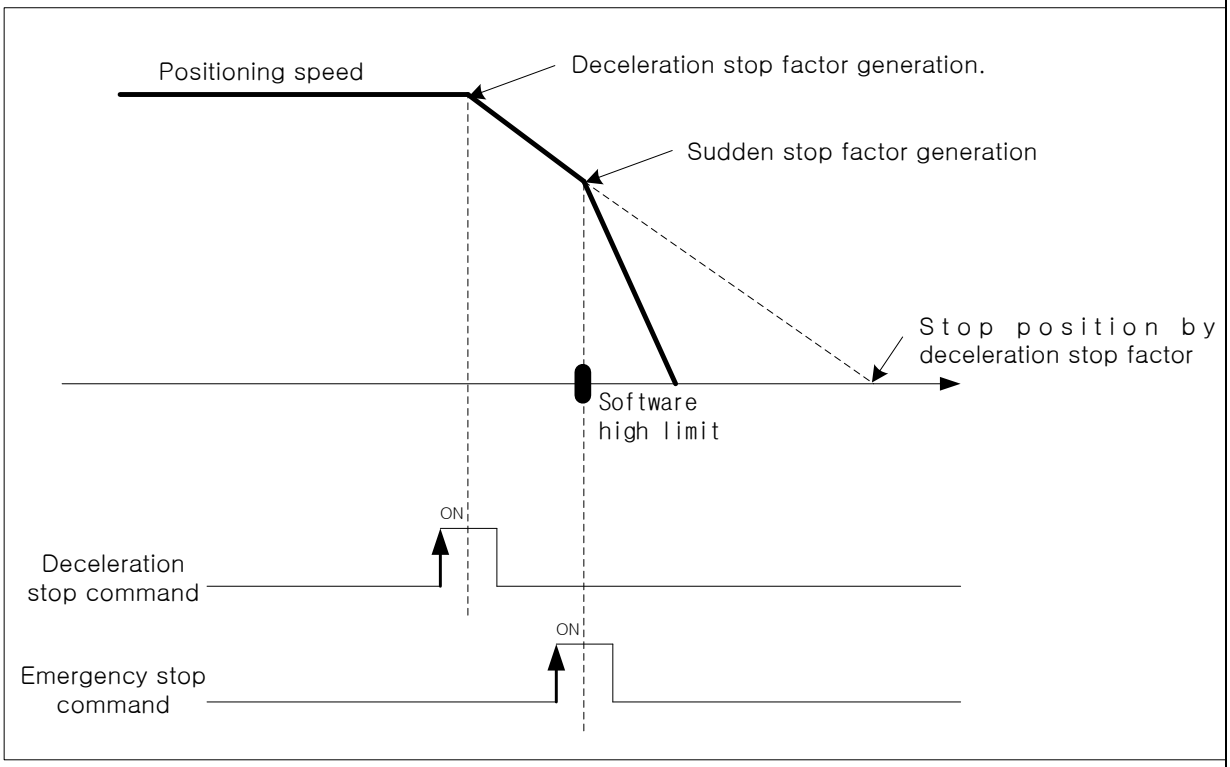
The priority of stop process of positioning module is as follows:

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

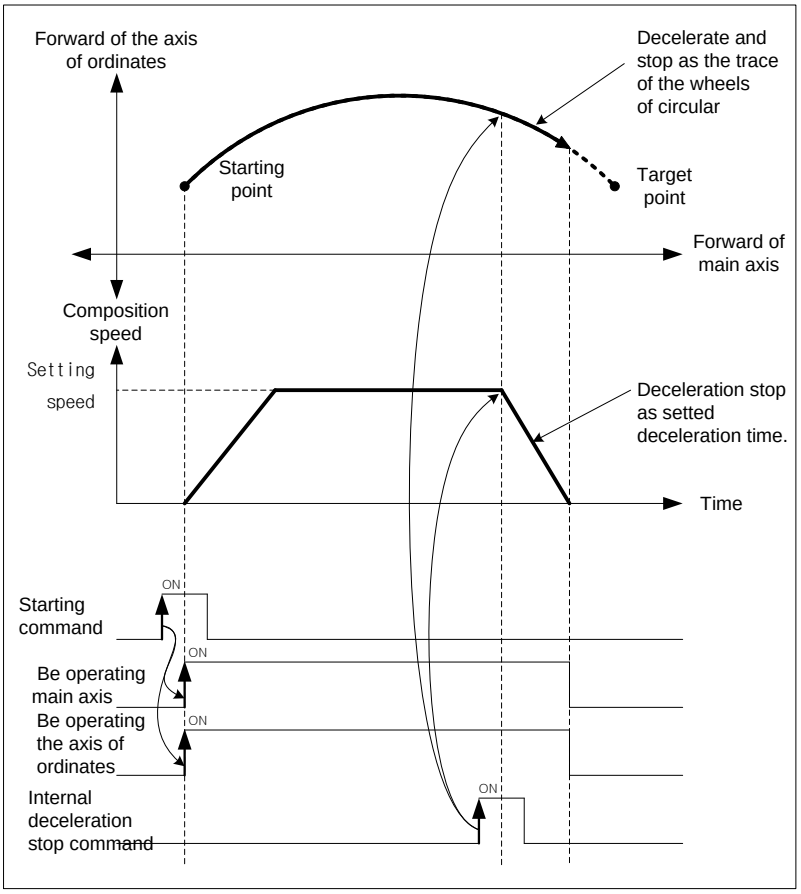
(a) If encounters stop command during interpolation operation (linear interpolation, circular interpolation, helical interpolation, elliptic interpolation), it carries out the deceleration stop. It depends on the trace of wheels of origin.

(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.

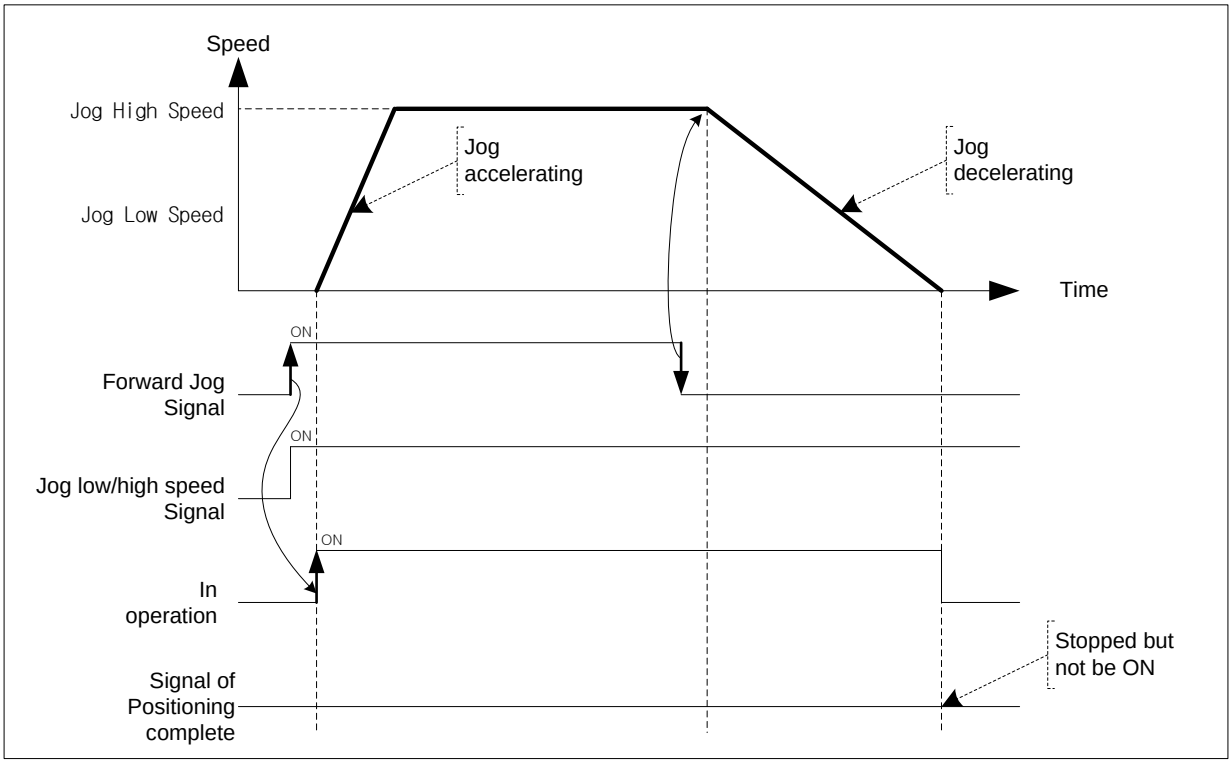
■ Parameter setting (Manual Parameter)

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.

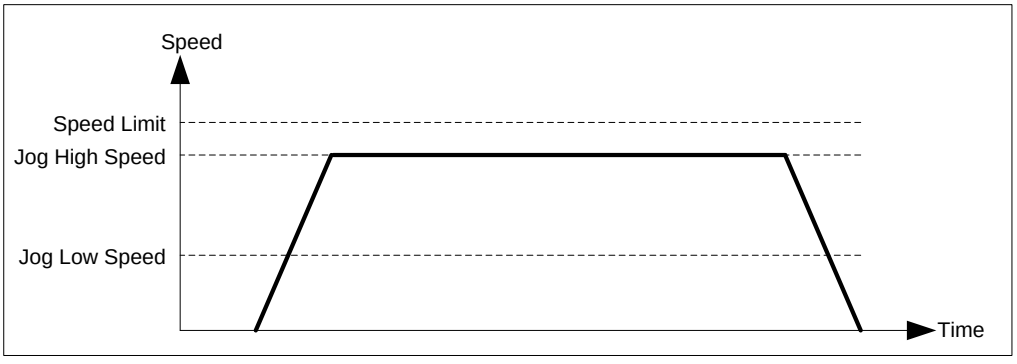
(2) Operation Timing



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)

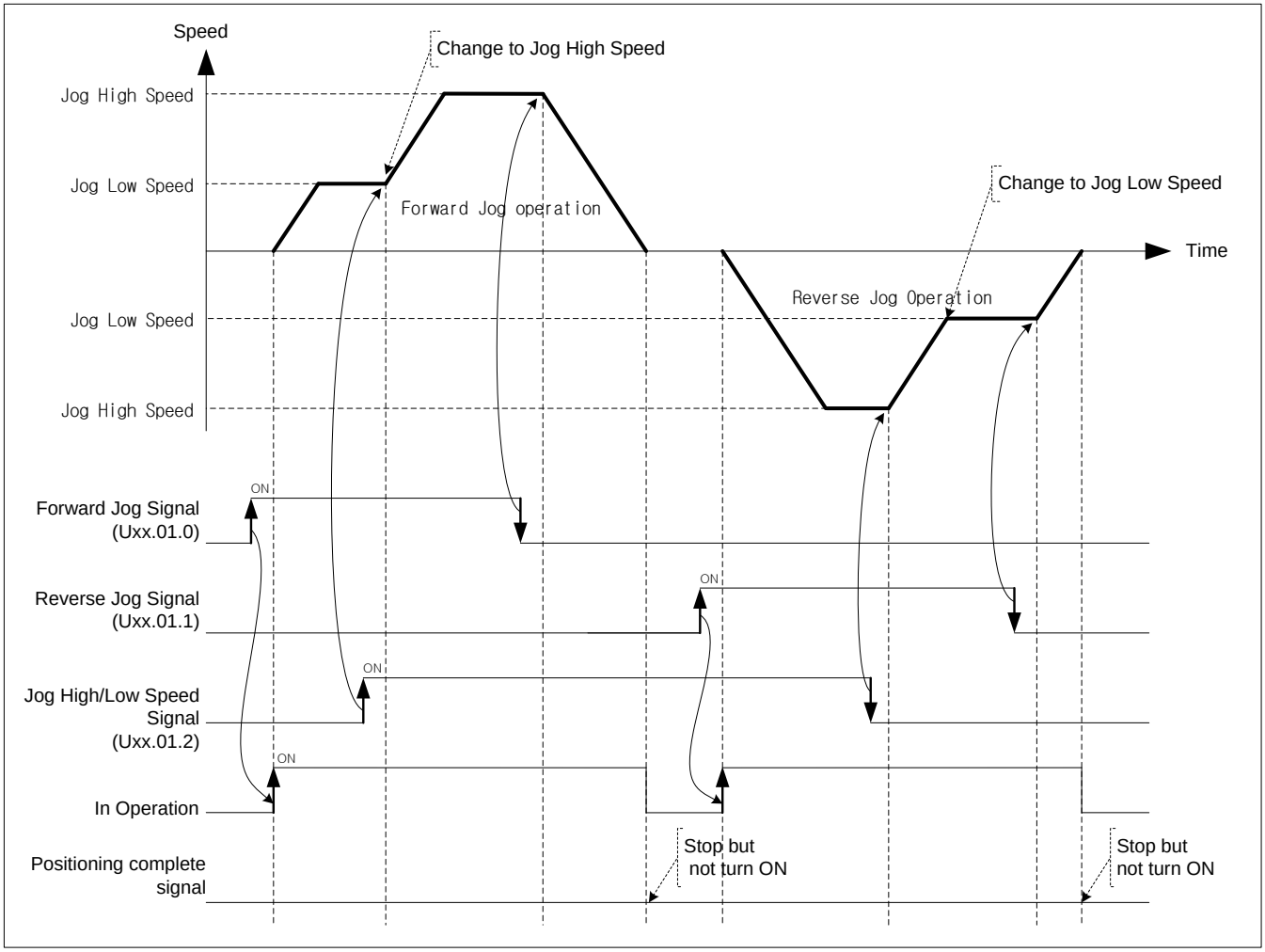
(4) Jog Operation Start

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.

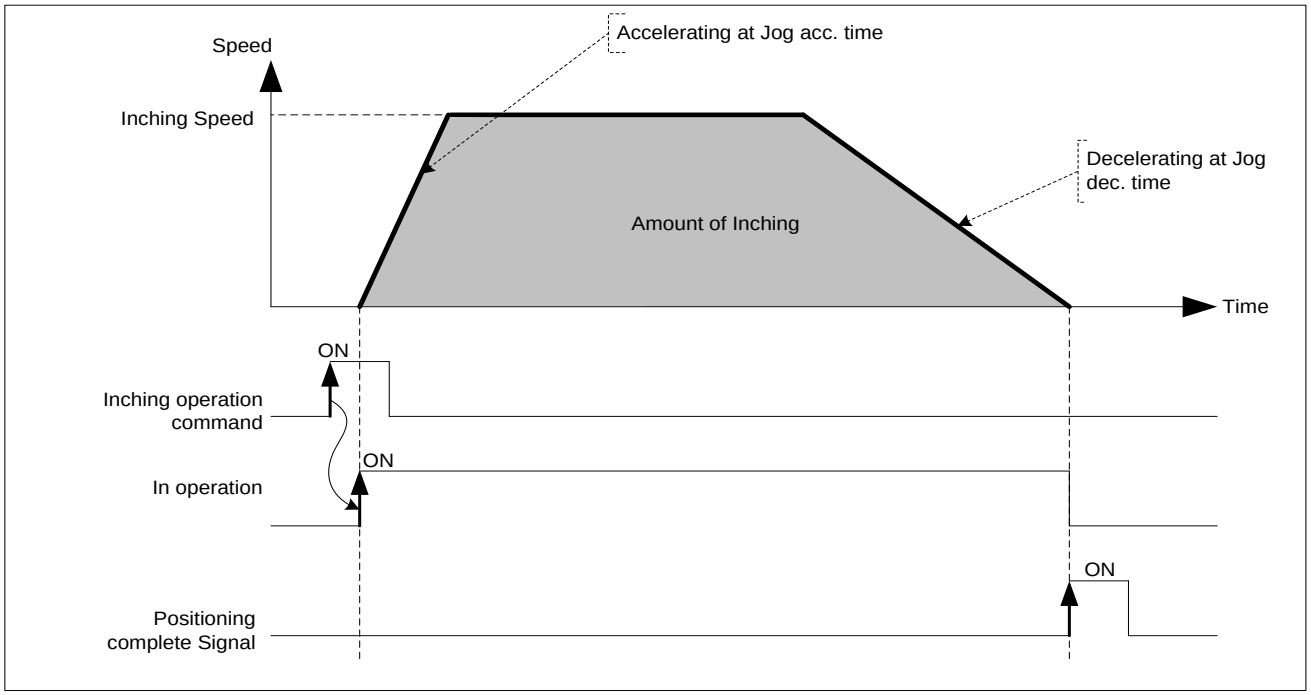
Set Inching speed on “Inching speed” of manual operation parameter setting.

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

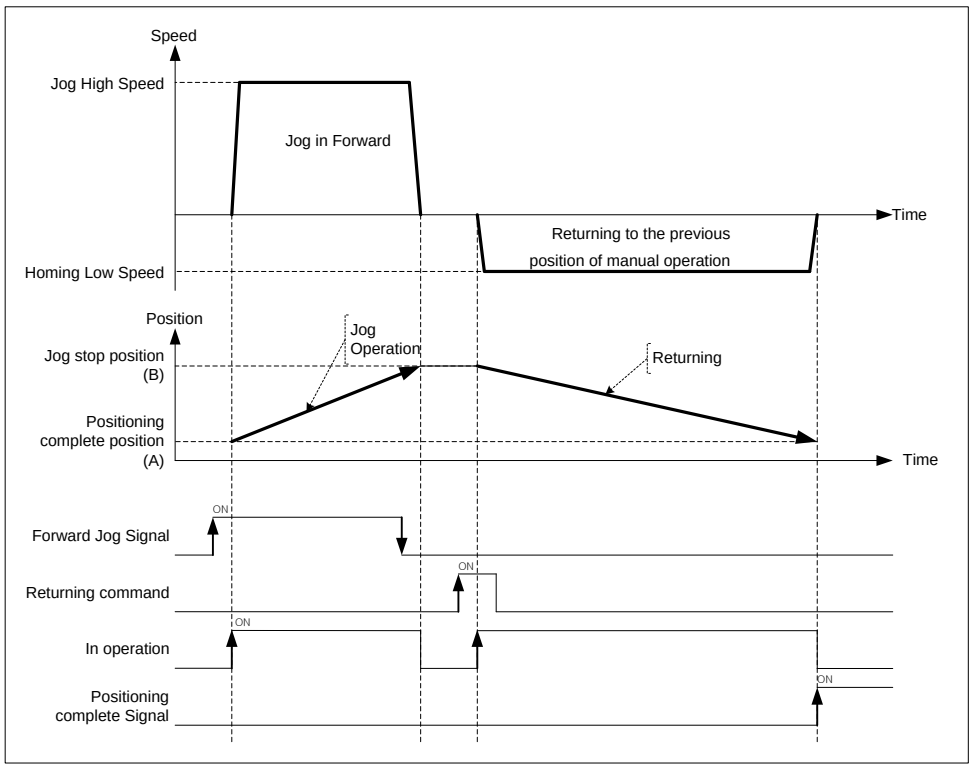
(b) Acc./Dec. process and the speed of return

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), 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.

$$Ratio = \frac{SubAxis}{MainAxis}$$

It is possible to set like "Ratio of Main axis(Absolute) < Ratio of Sub axis(Absolute)" at setting ratio of speed sync.

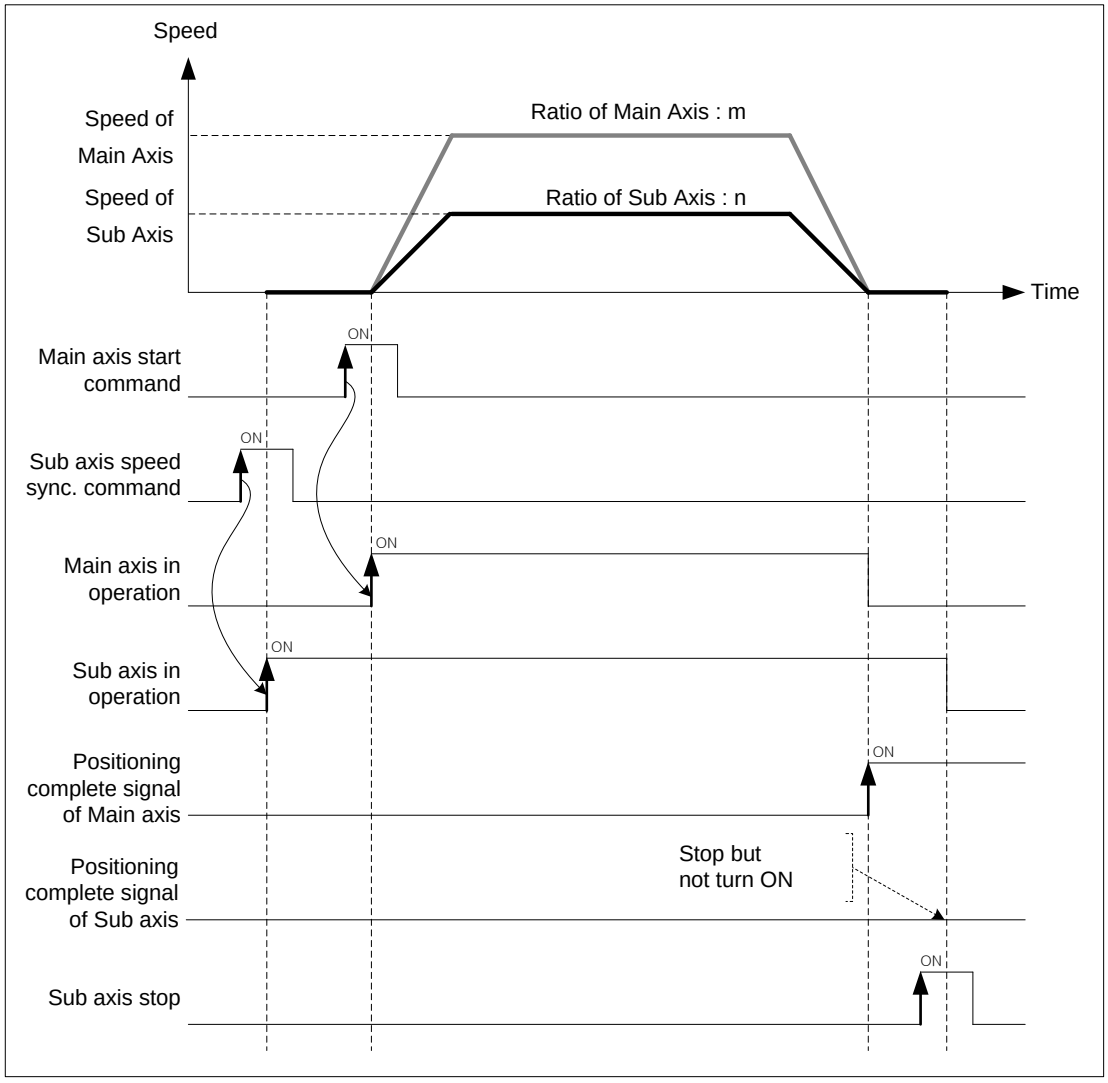
Operating speed of sub axis is calculated as follows.

$$\begin{aligned} Operaing\ \ speed\ \ of\ \ SubAxis\ &= Operating\ \ Speed\ \ of\ \ MainAxis \times Ratio\ \ of\ \ speed\ \ sync. \\ &= Operating\ \ Speed\ \ of\ \ MianAxis \times \frac{Ratio\ \ of\ \ SubAxis}{Ratio\ \ of\ \ MainAxis} \end{aligned}$$

(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.

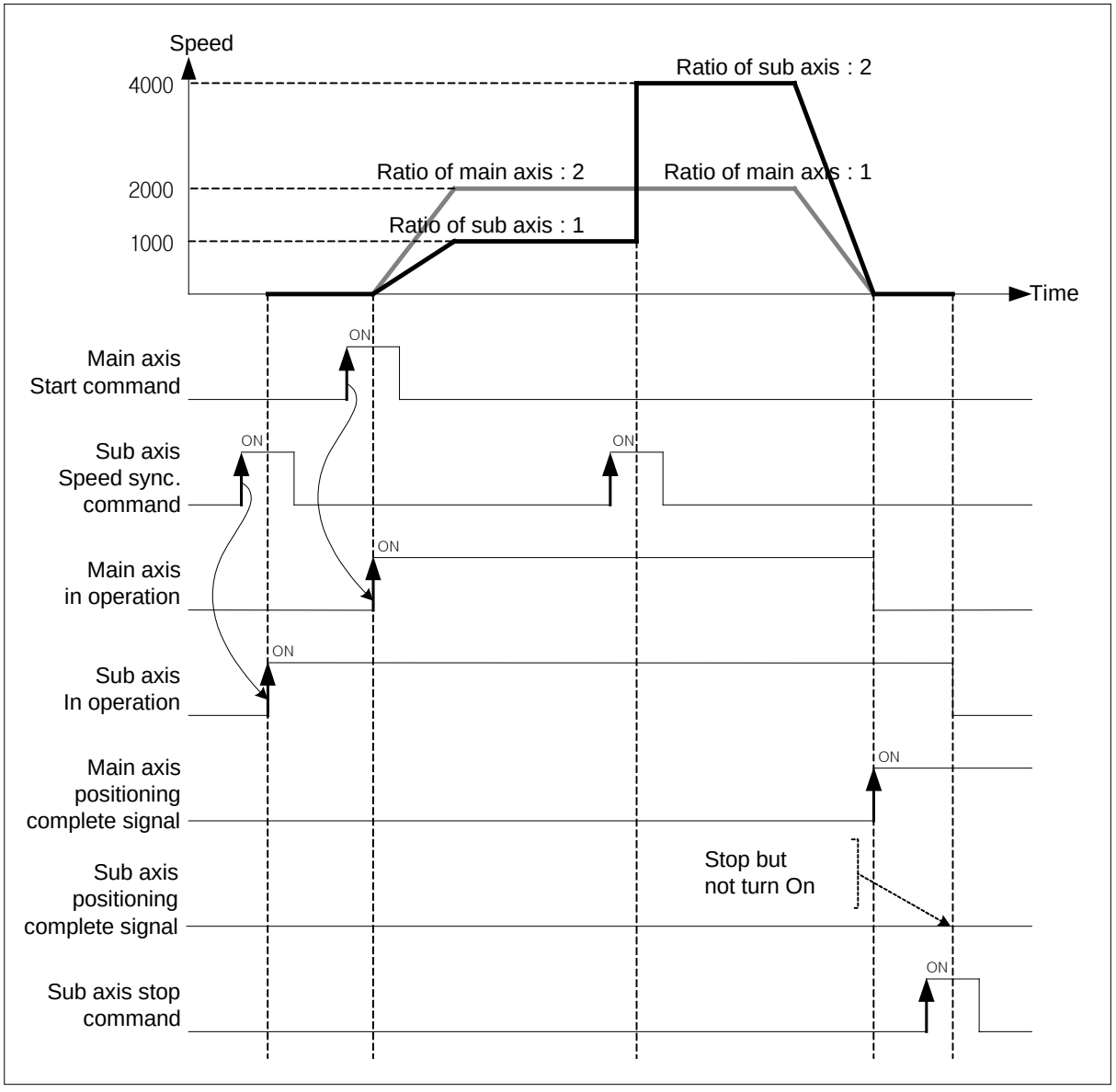
[Example] axis1 is main axis, axis2 is sub axis. Operate at "ratio of main axis : ratio of sub axis = 2 : 1" at the beginning and then execute speed sync. control changing the ratio to "ratio of main axis : ratio of sub axis = 1 : 2"

■ 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

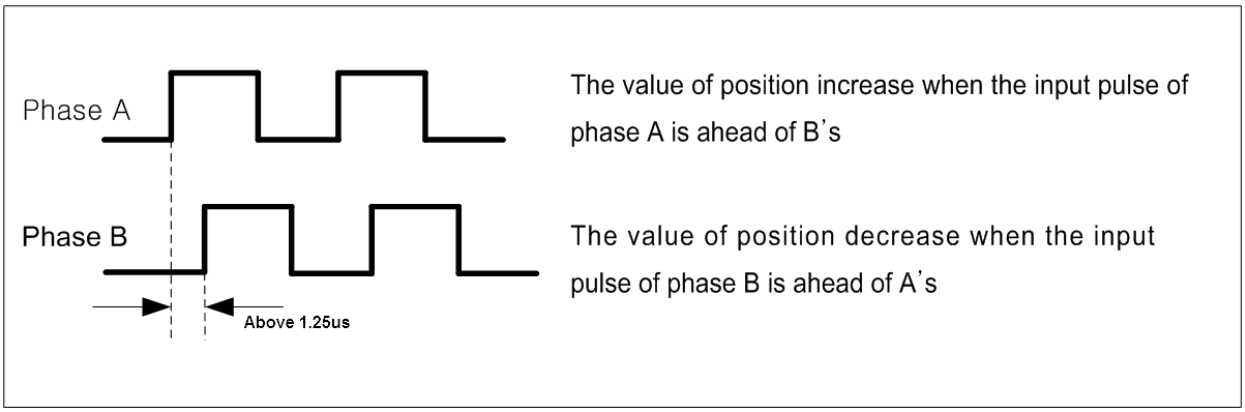


(4) Speed synchronous control with encoder

(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

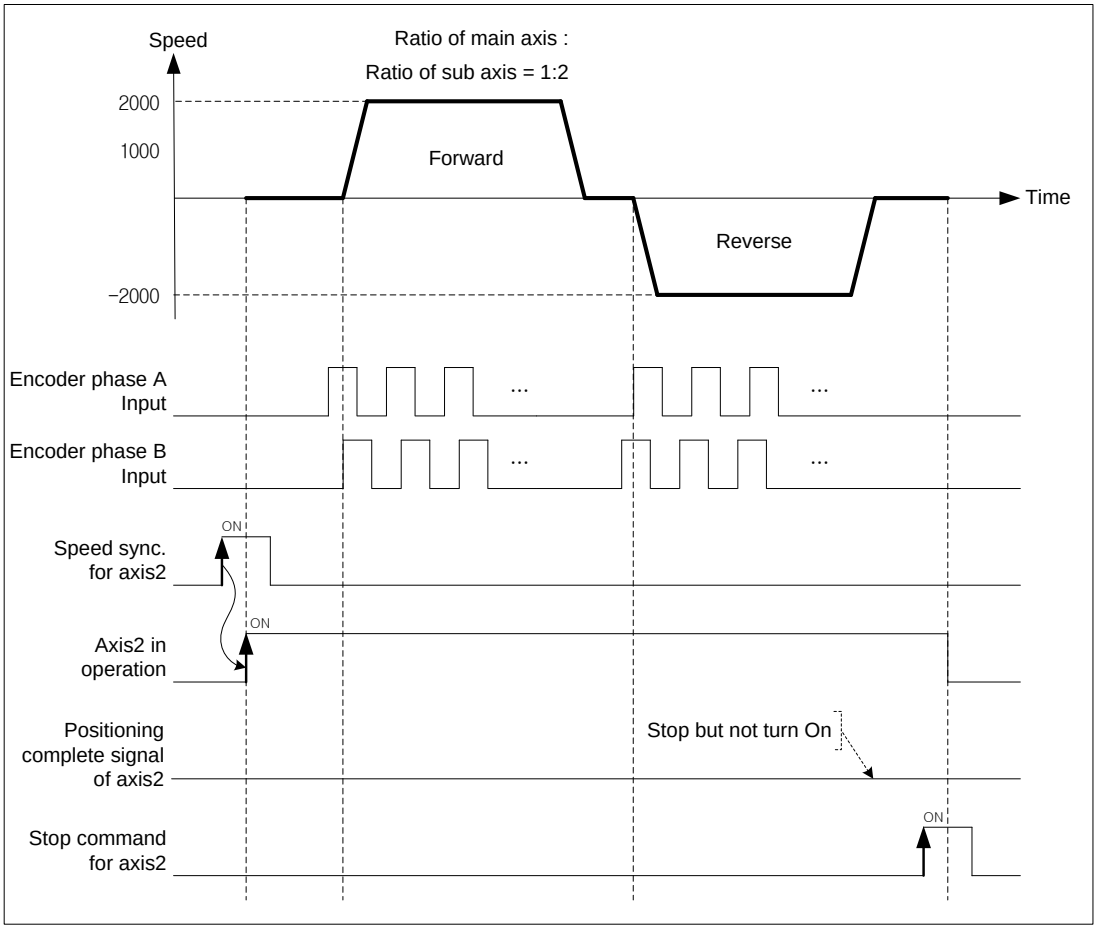


- The operating direction of sub axis depends on $Ratio\ of\ speed\ sync.(\frac{Ratio\ of\ SubAxis}{Ratio\ of\ MainAxis})$. If it is positive, operating direction will be forward direction of encoder. If it is negative, operating direction will be reverse direction of encoder.

[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.

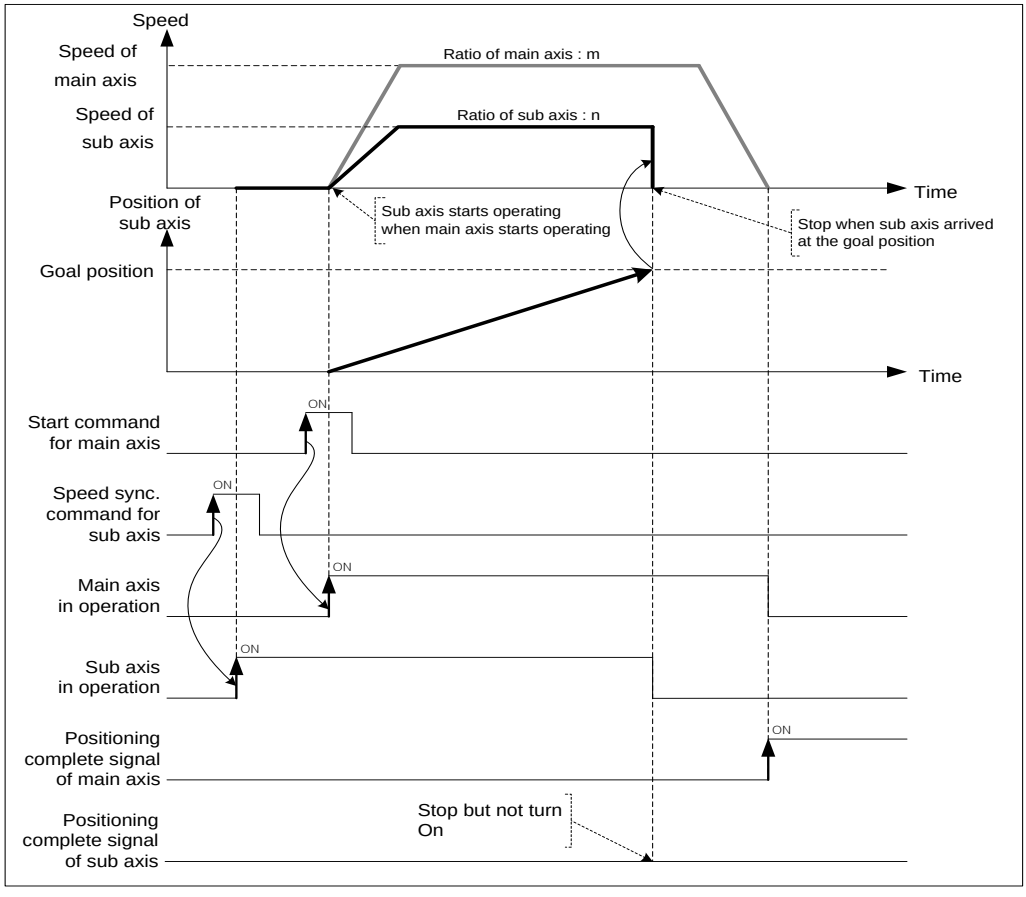
(d) If the current position of sub axis become the goal position, it stops speed sync. and stay there. For the details, refer to "Speed sync. control".

(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

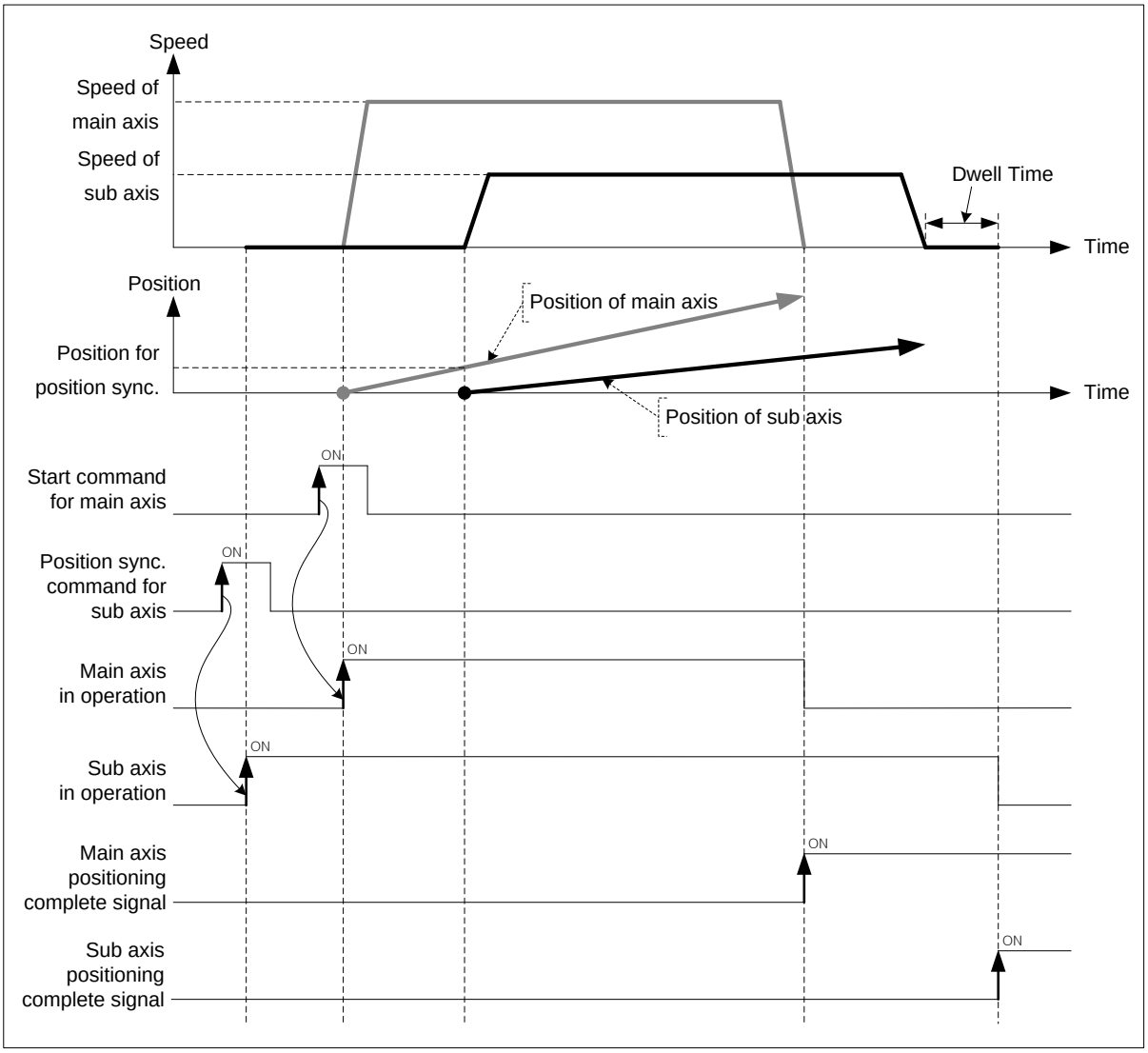
The auxiliary data used in position sync. is as follows.

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), 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

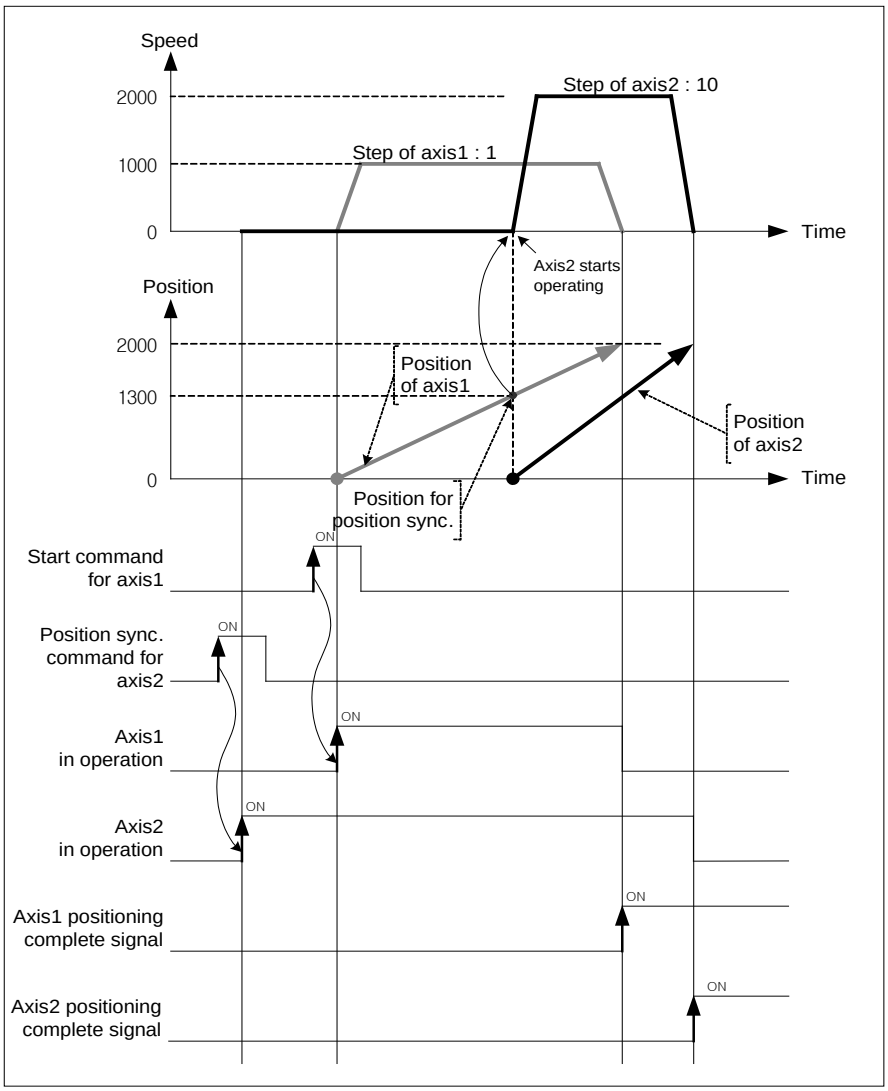
▪ Main axis (axis1) Operation data

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

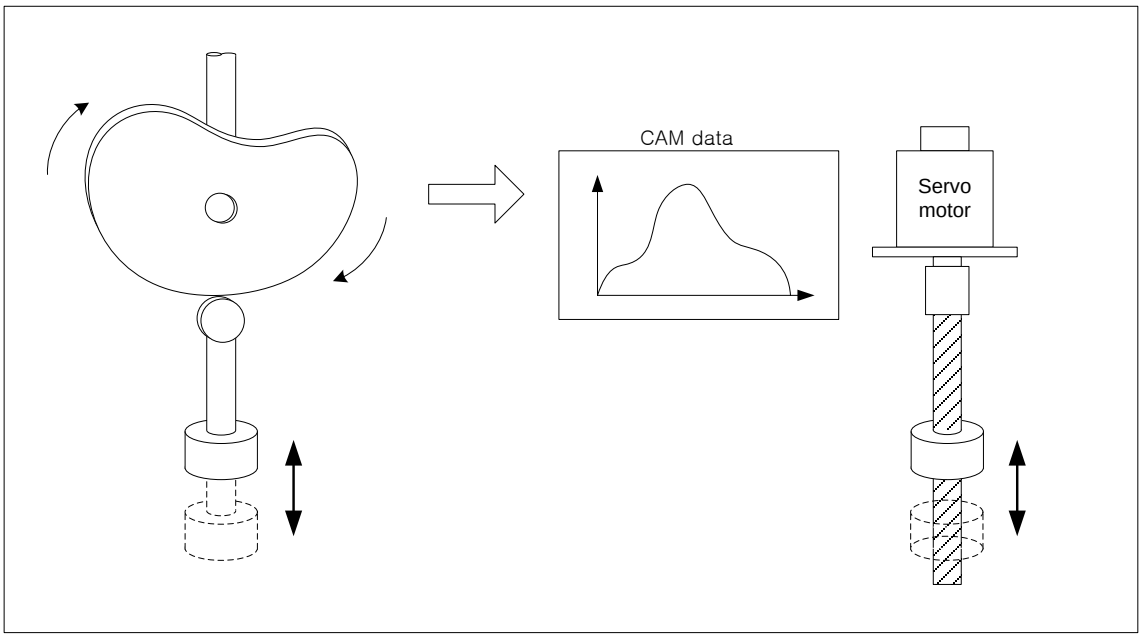


9.4.3 CAM Operation

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 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

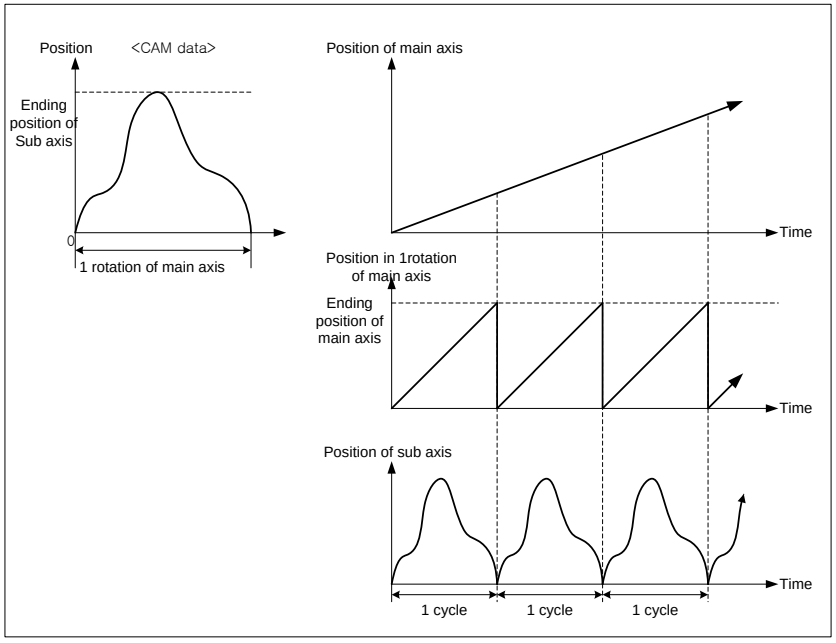
1) Control method

Set the form of CAM repeat pattern. “Repeat mode” and “Increase mode” may be set.

▪ Repeat (Two-way mode)

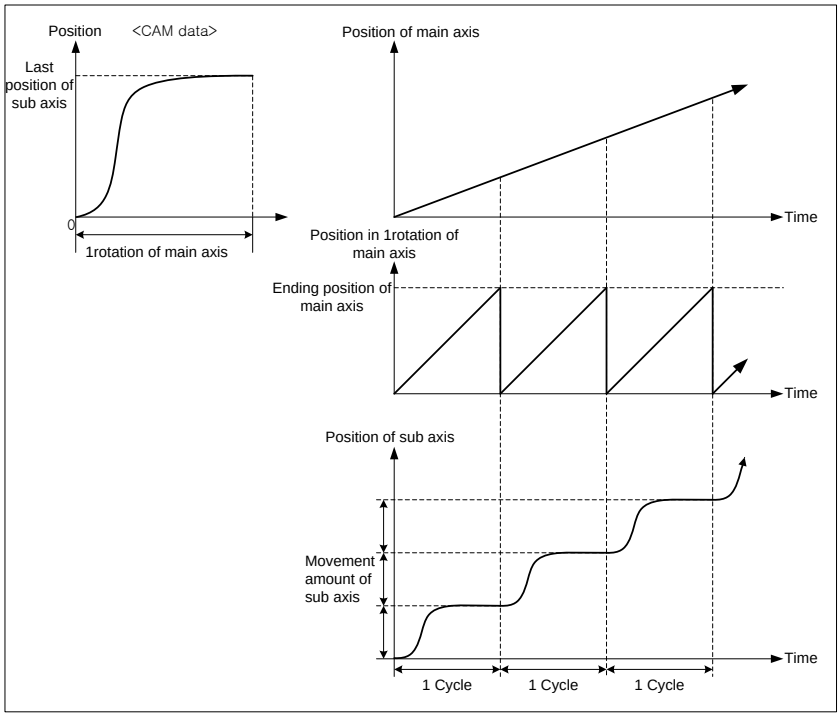
Execute round-trip motion repeatedly in the range already set from starting position of sub axis to ending position according to the position of main axis in 1 rotation.

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.



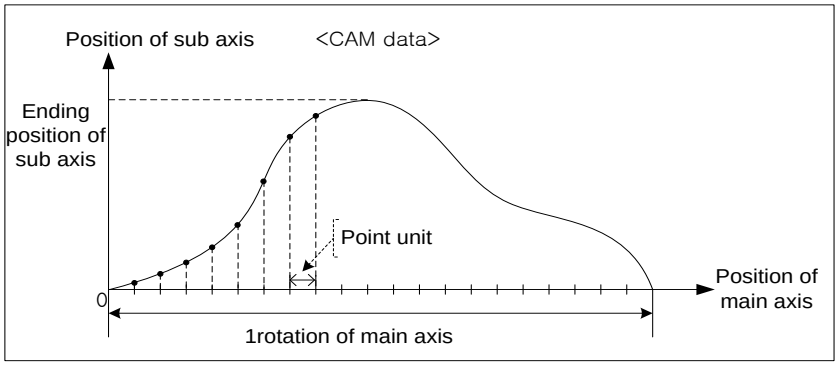
▪ Increase (Feed mode)

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

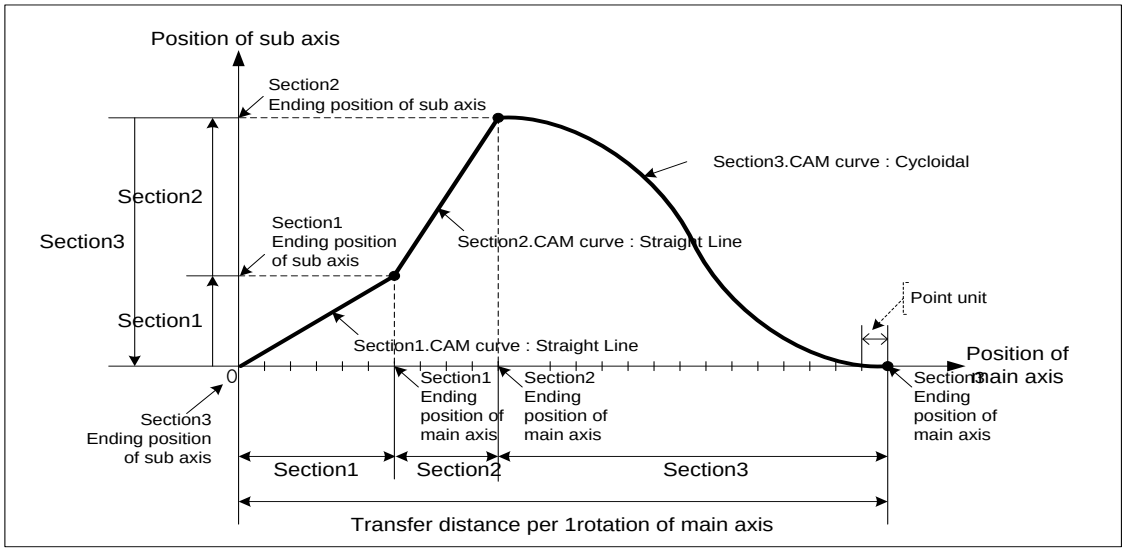
Set the starting position of sub axis corresponding to the starting position of main axis in the designated section. Starting position of sub axis is the same as the ending position of sub axis in previous section.

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

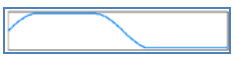
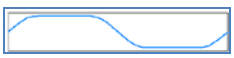
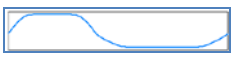
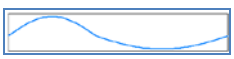
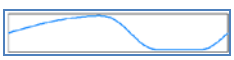
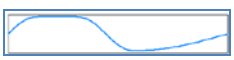
Set CAM specific curve to create data ranging from starting position of sub axis to ending position of sub axis in the designated section. The position of sub axis is calculated by characteristic of selected CAM curve, the position of main axis increase by point unit at the same time.



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.

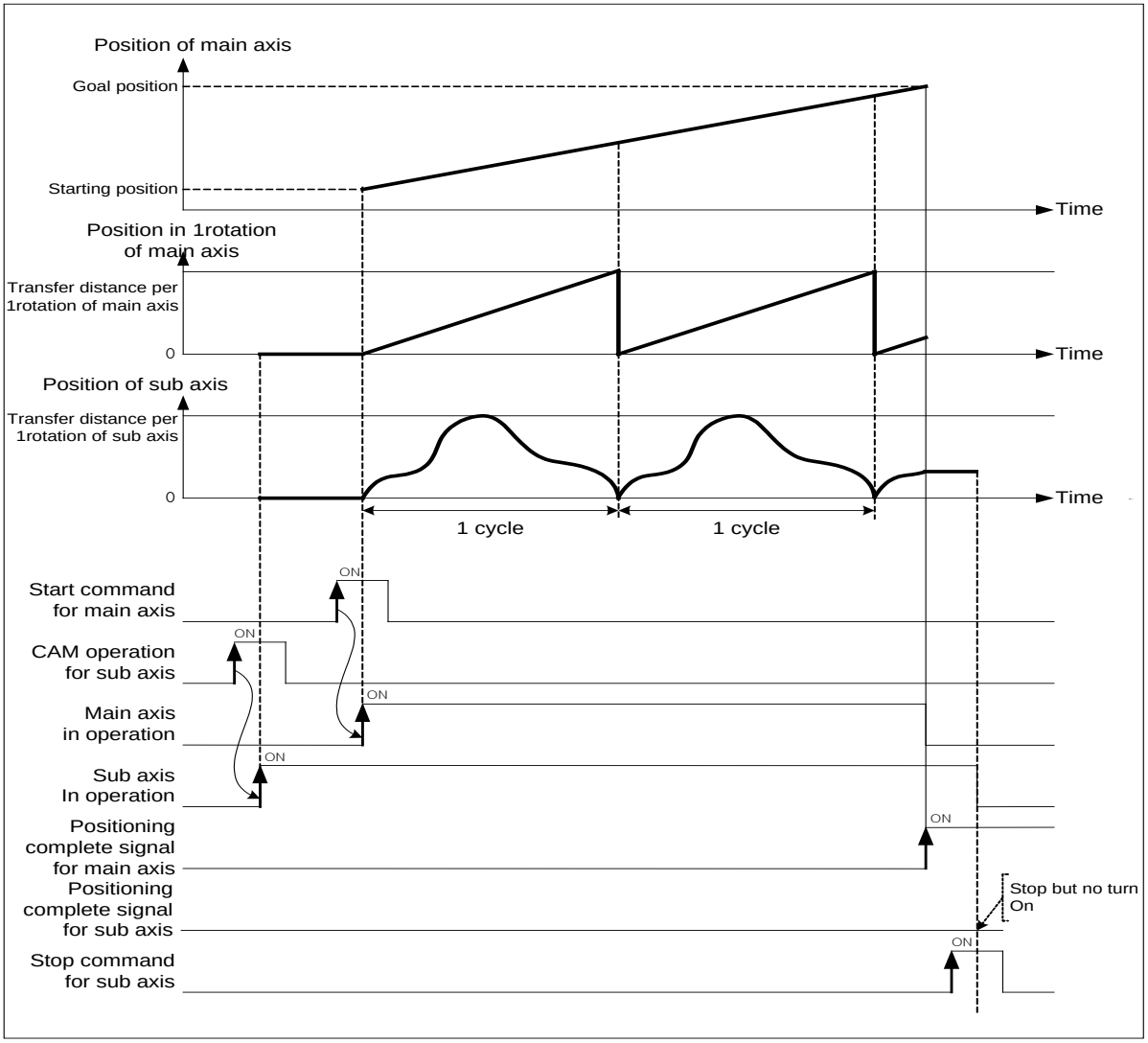
$$\text{Position of sub axis} = 395 + (475 - 395) \times 0.3$$

$$= 395 + 24$$

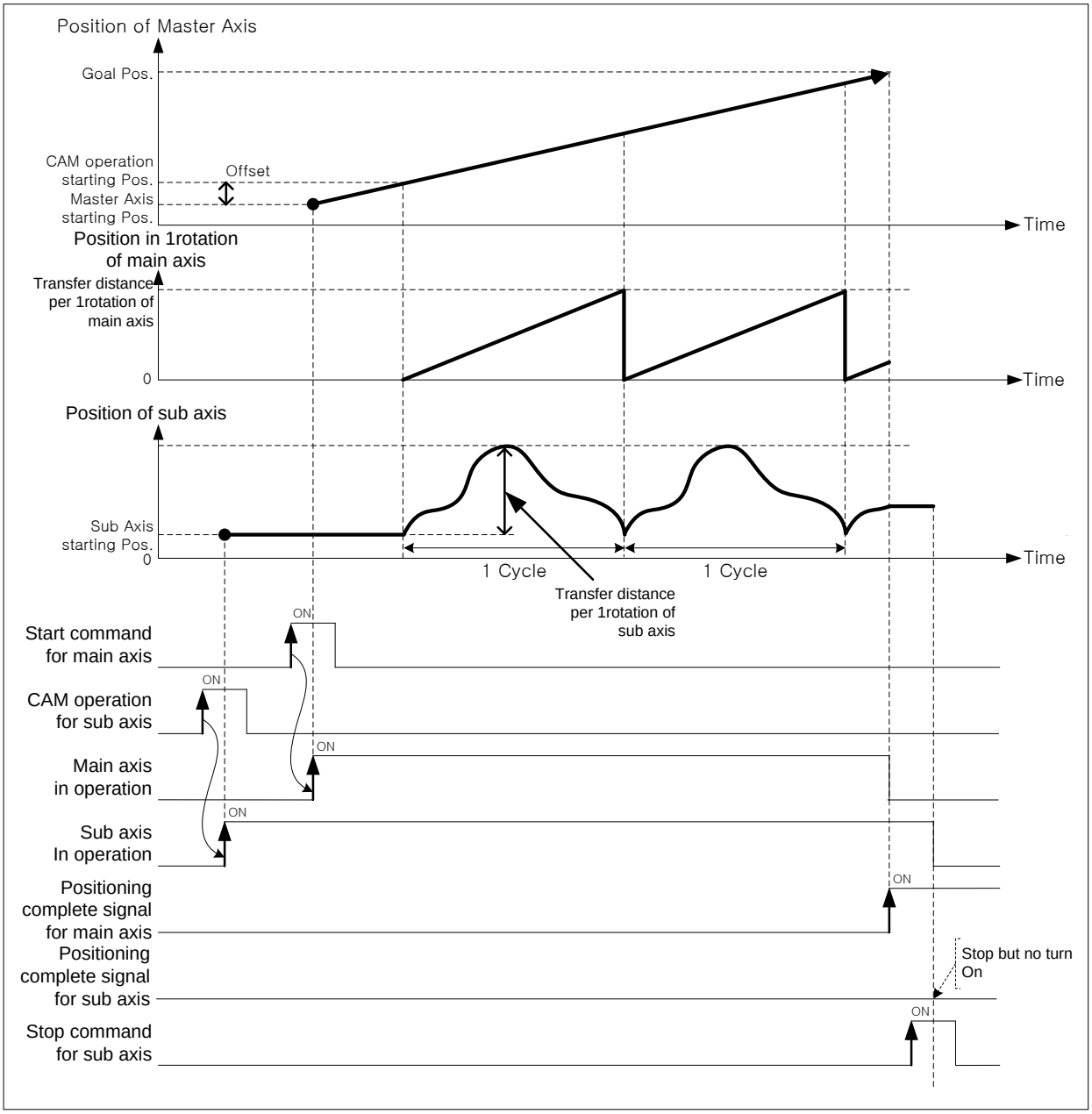
$$= 419$$

(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.

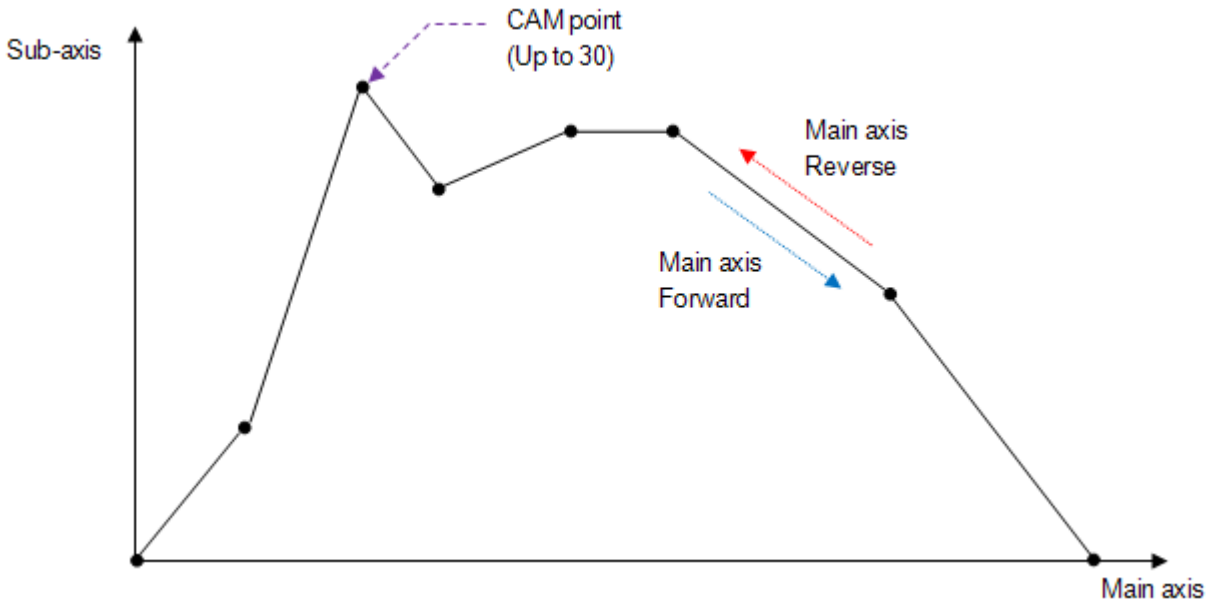
(b) If the current main axis is not the axis can be set on the current module or main axis and command axis are the same axis, error (code:704) arises. Set the main axis among one of the axis can be set on module.

(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

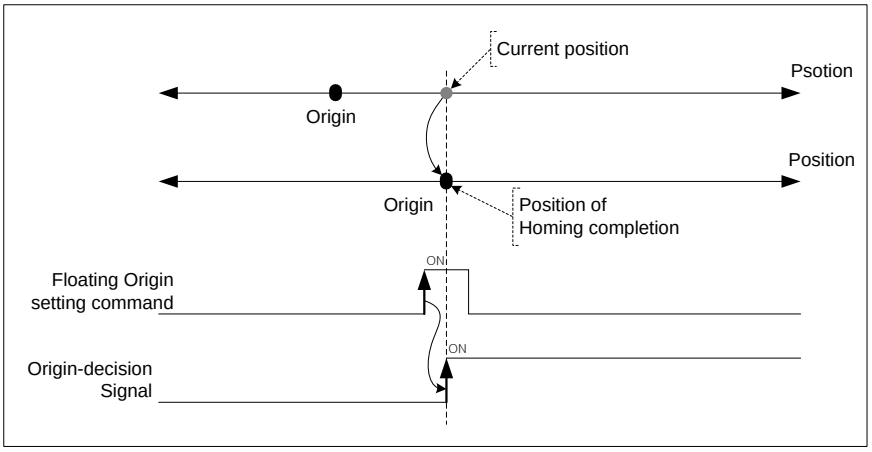
(a) Modify the current position into “Homing end position” of homing parameter and become Origin-decided status.
(b) After floating origin setting command is executed, the current position is changed to “The position of homing completion” of homing parameter.
(c) Related parameter (Homing Parameter)

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.

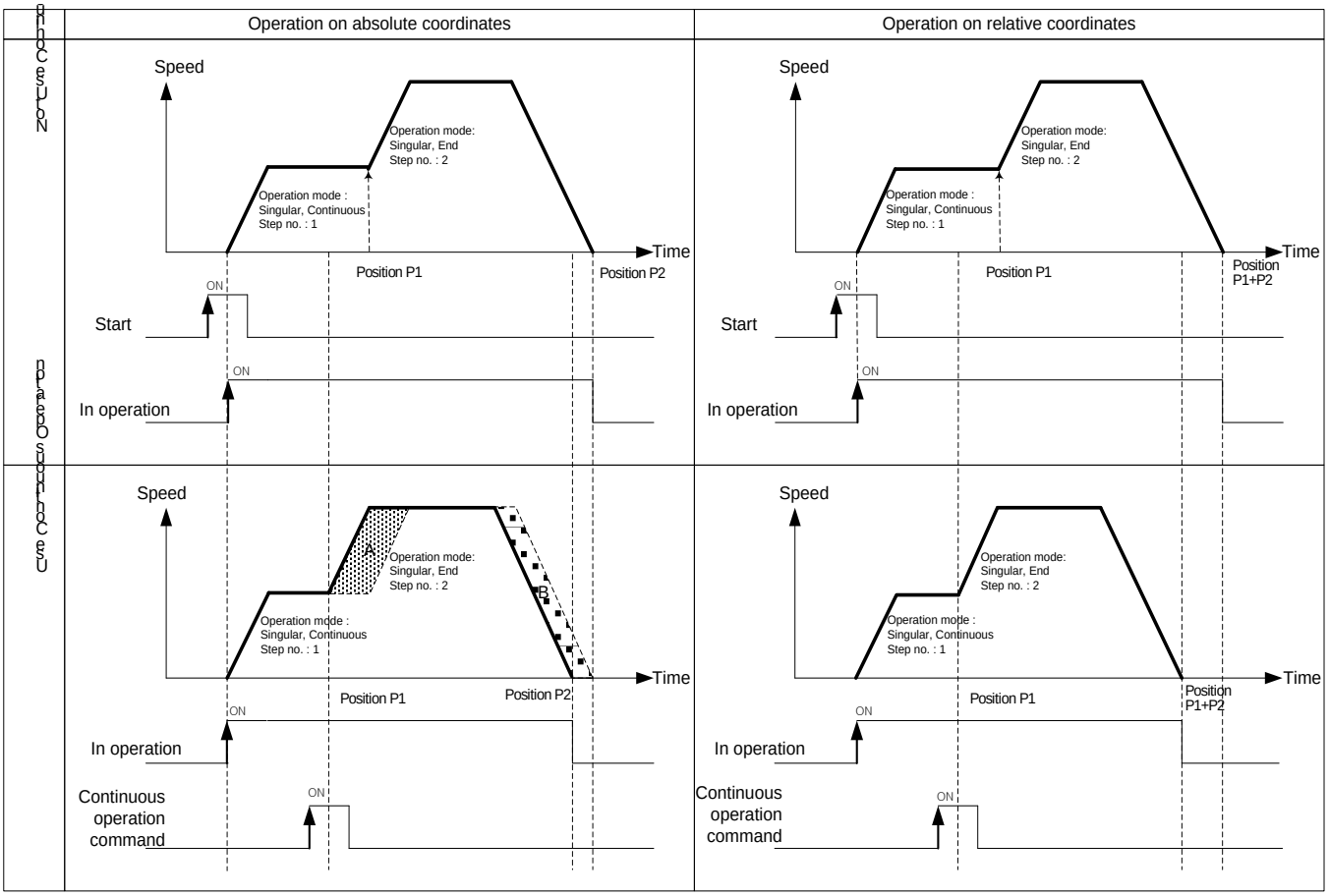
9.5.2 Continuous Operation

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

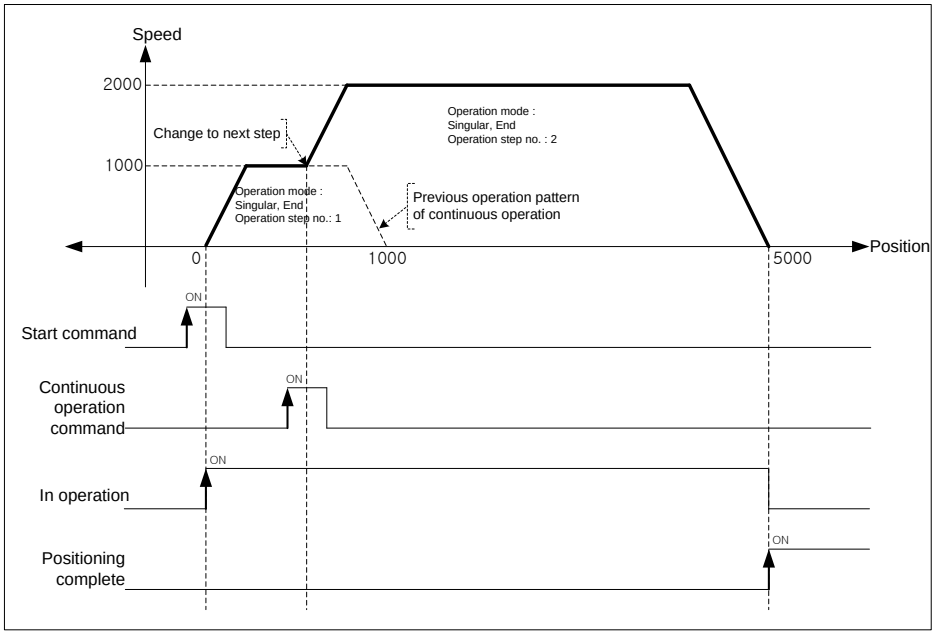
■ Current position of Axis1 : 0

■ 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

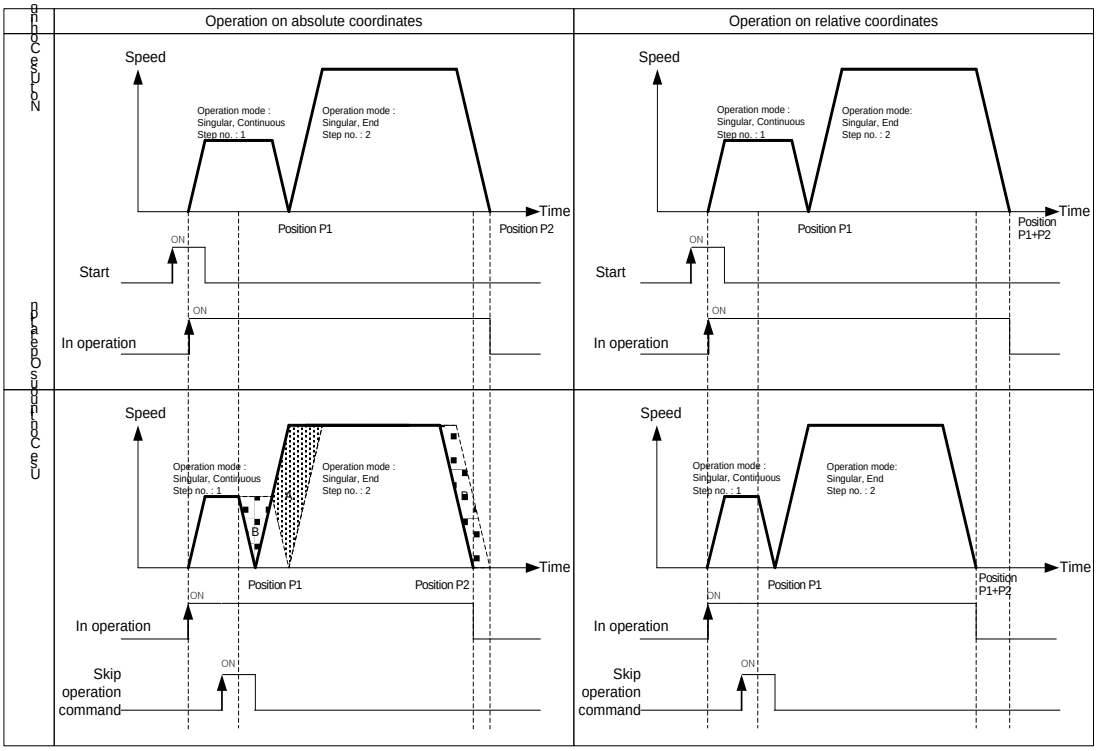
(a) SKIP operation command stops the operation and carries out the operation of next step after executing the command other than Continuous operation command (Next Move).

(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.

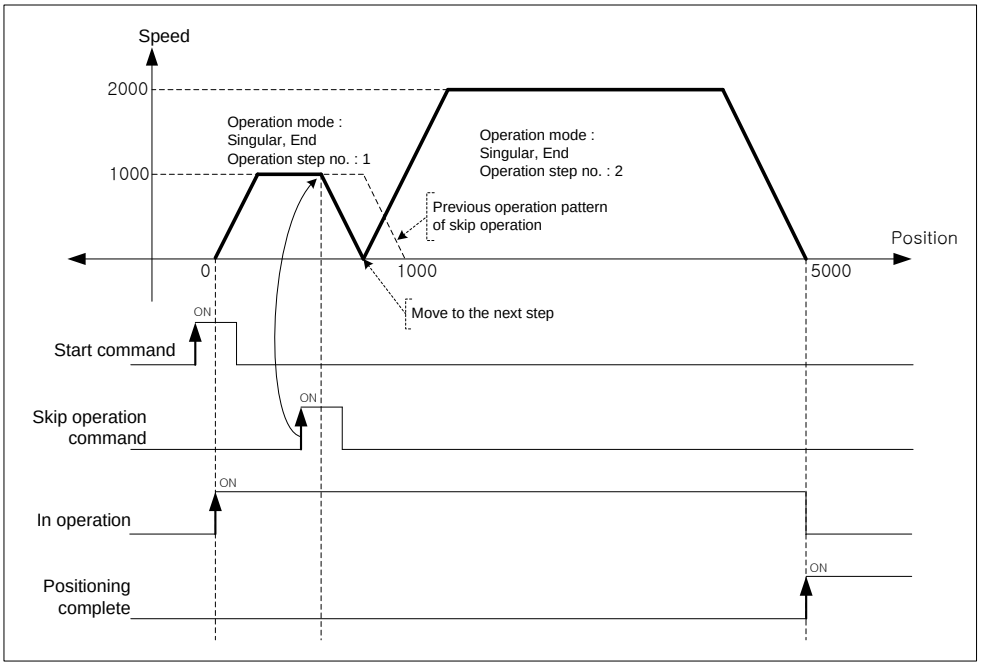
■ Current position of axis1 : 0

■ 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

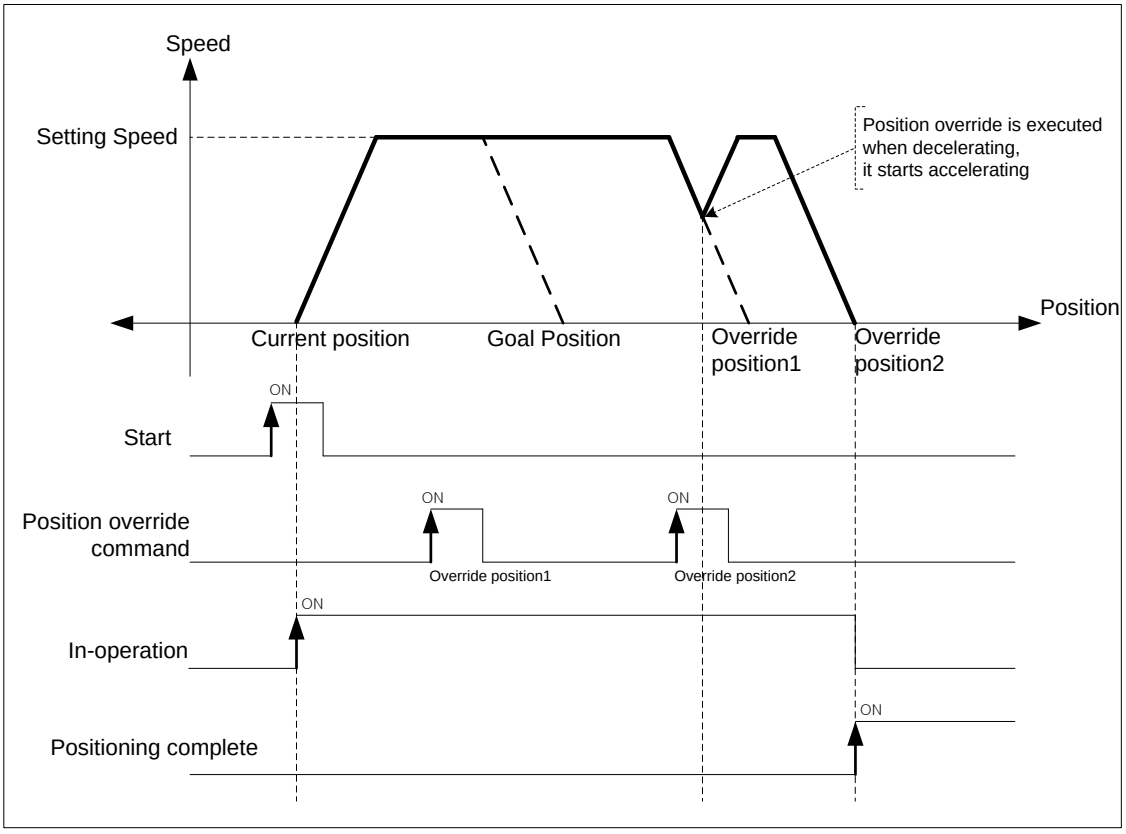
(a) Position override command is used in the operation pattern (Acceleration, Constant speed, Deceleration section) and the available operation mode is End operation, Keep operation, Continuous operation.

(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.

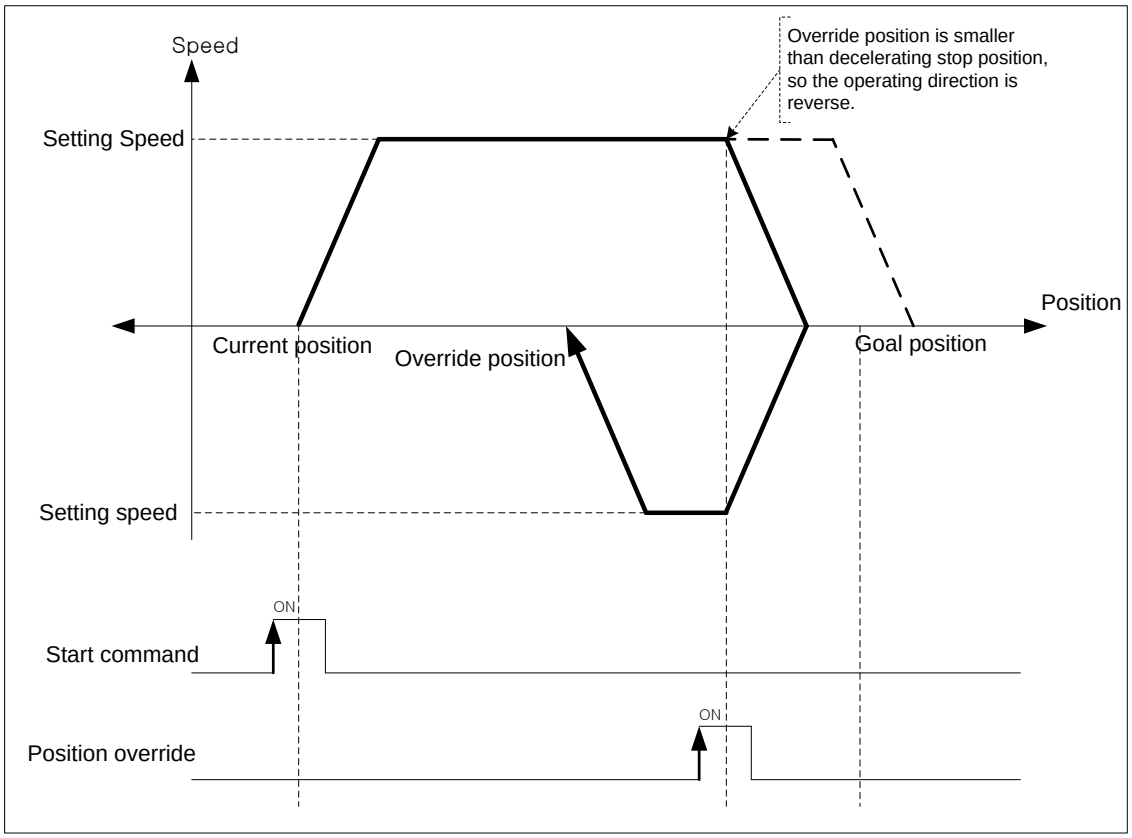
(d) This command may be executed several times in operation.

(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.

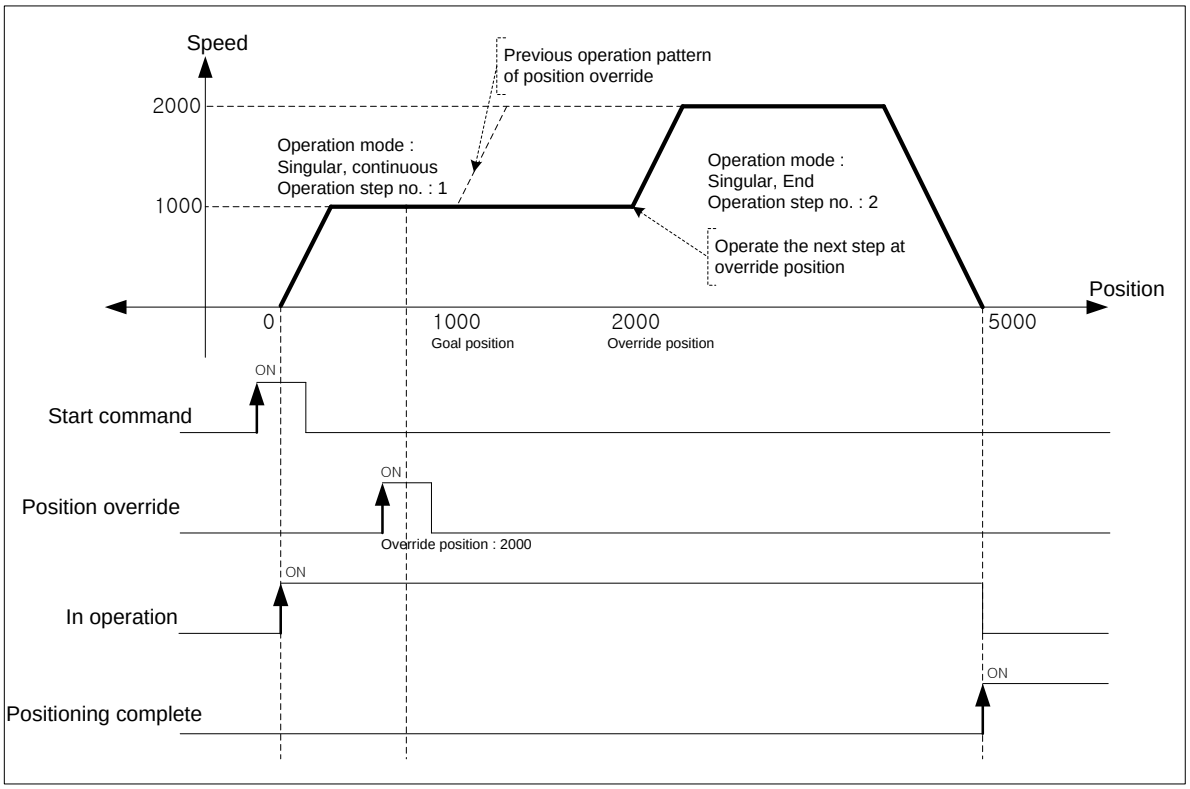
■ Current position of axis1 : 0

■ 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.

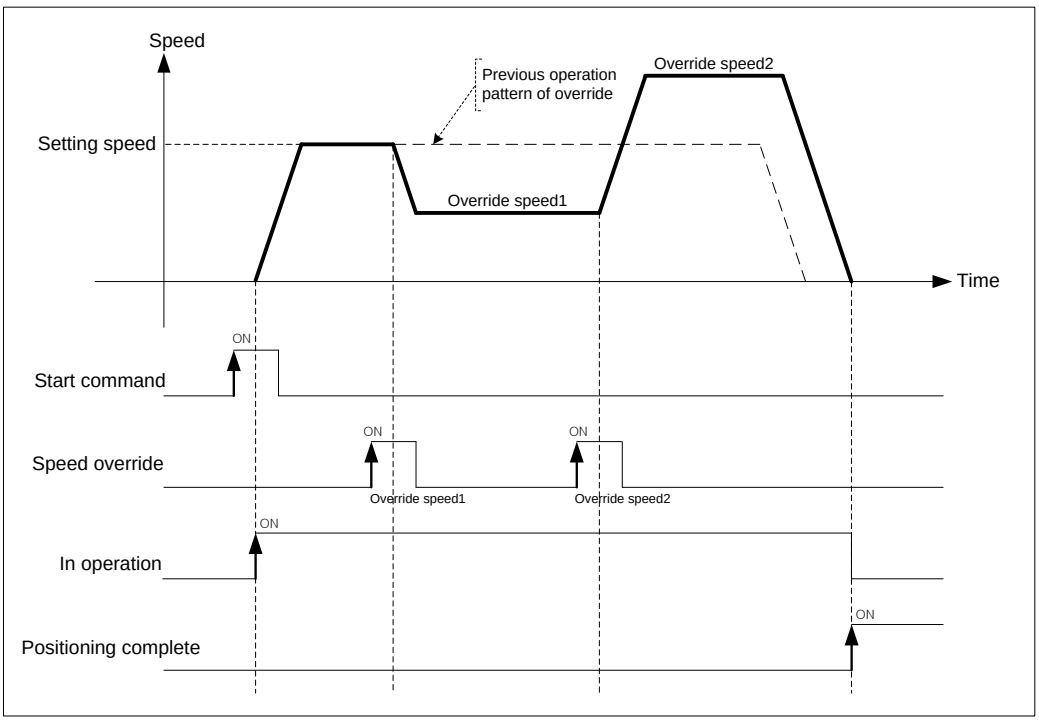
(d) Related parameter setting (common parameter)

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 (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)

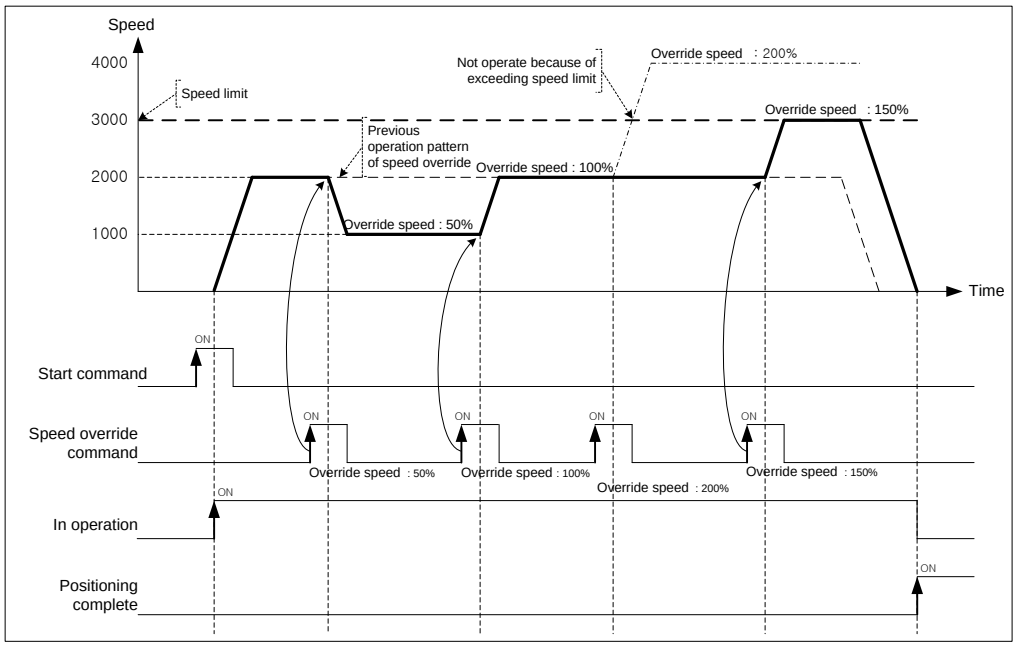
[Example] Execute speed override(50%→100%→200%→150%) on axis1 operating by absolute, single axis position control.

■ 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

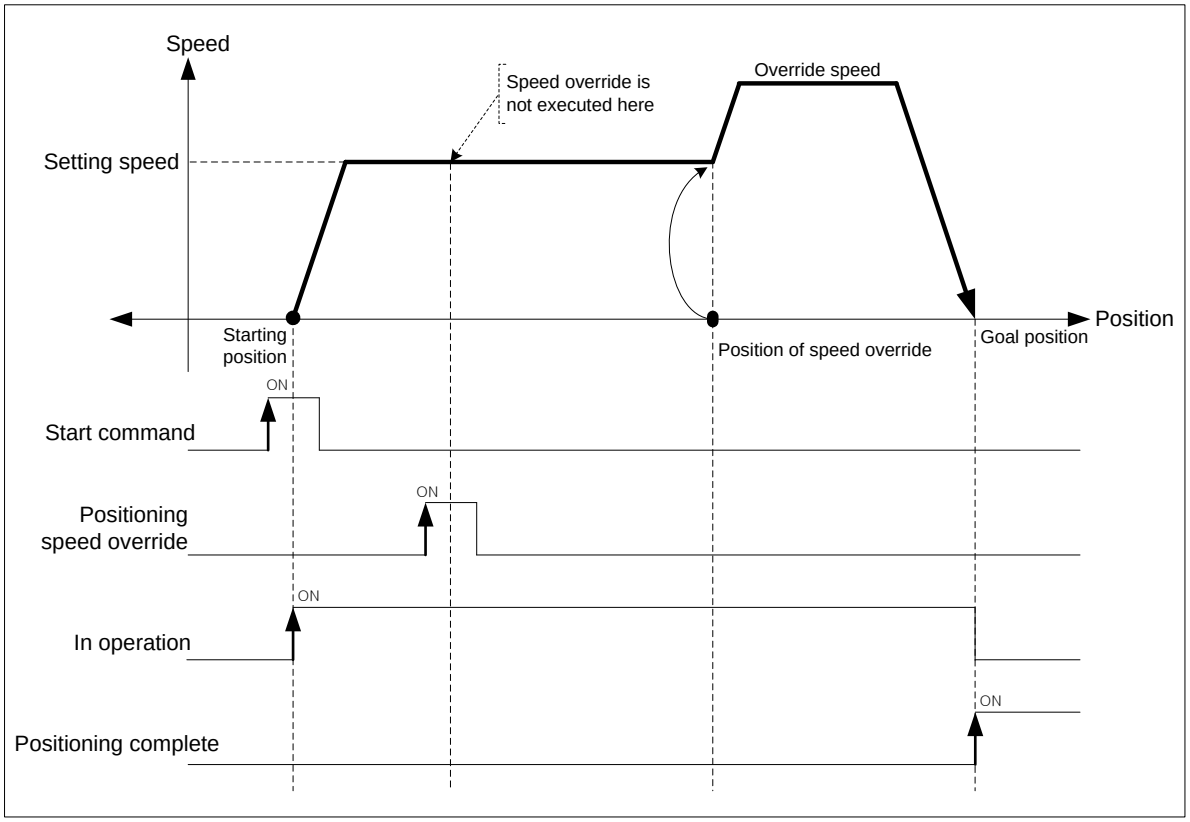
(g) Auxiliary data setting of positioning speed override command

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 % (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]

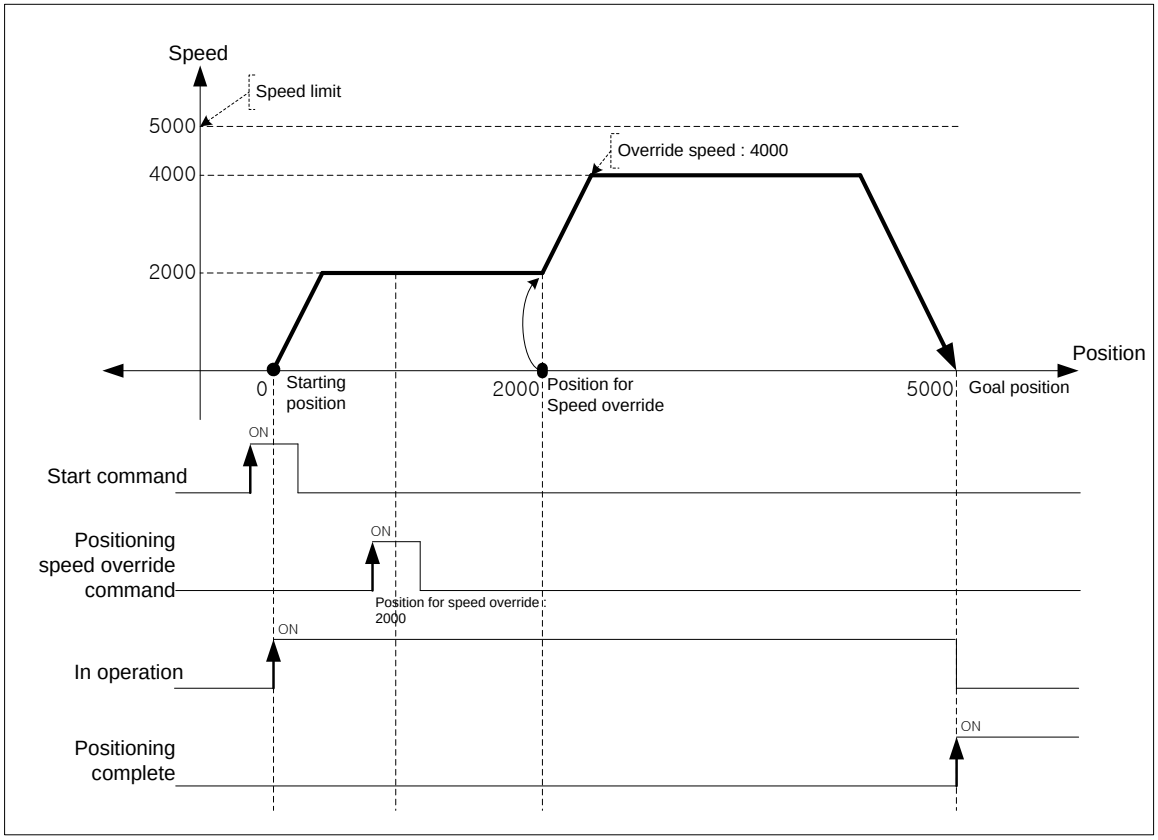
「Coordinates of positioning speed override」of extended parameter : Absolute

■ 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

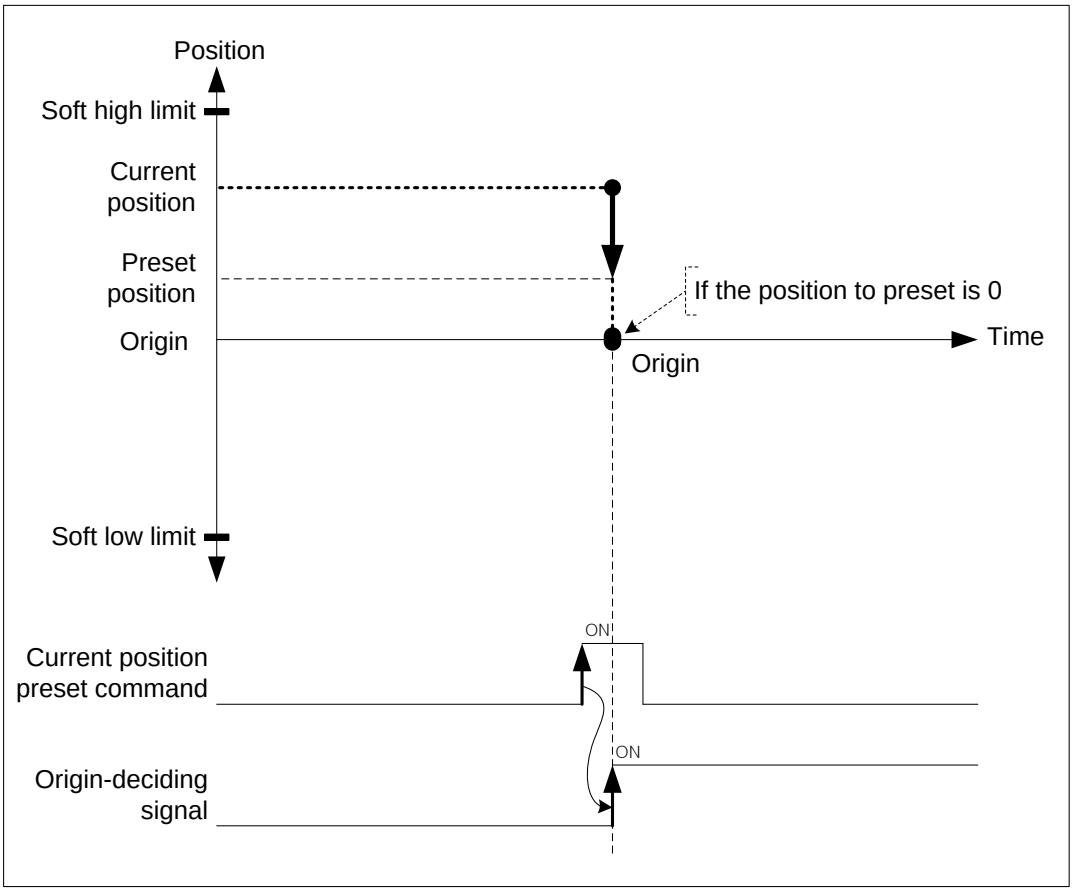
This command is for changing the current position value to the value at user's pleases.

(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

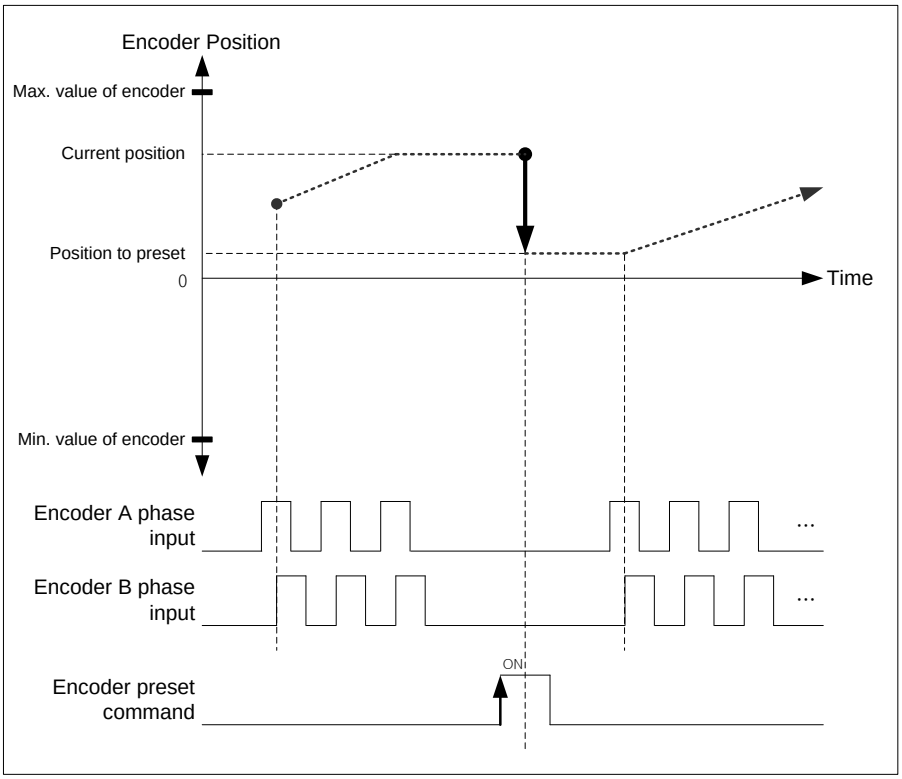
This command is for changing the value of current encoder position to the value at user's pleases.

(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

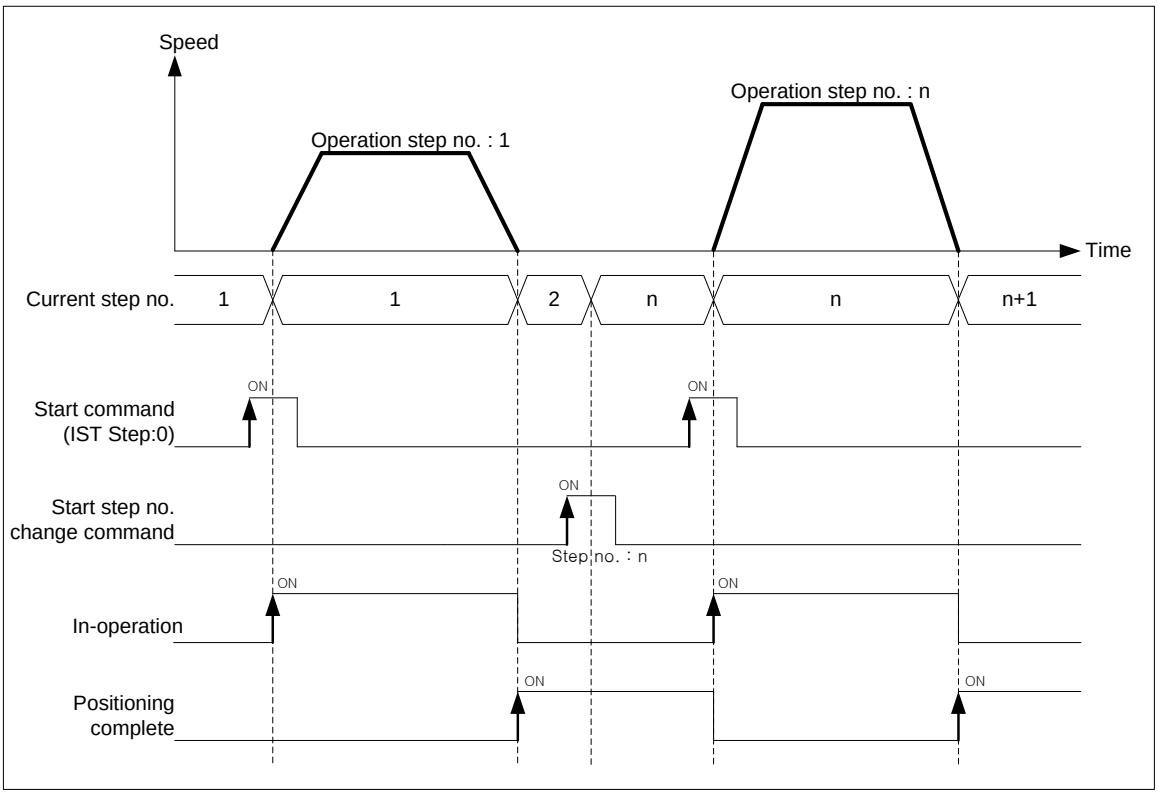
This command is for changing the current step no. when executing indirect start command.

(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

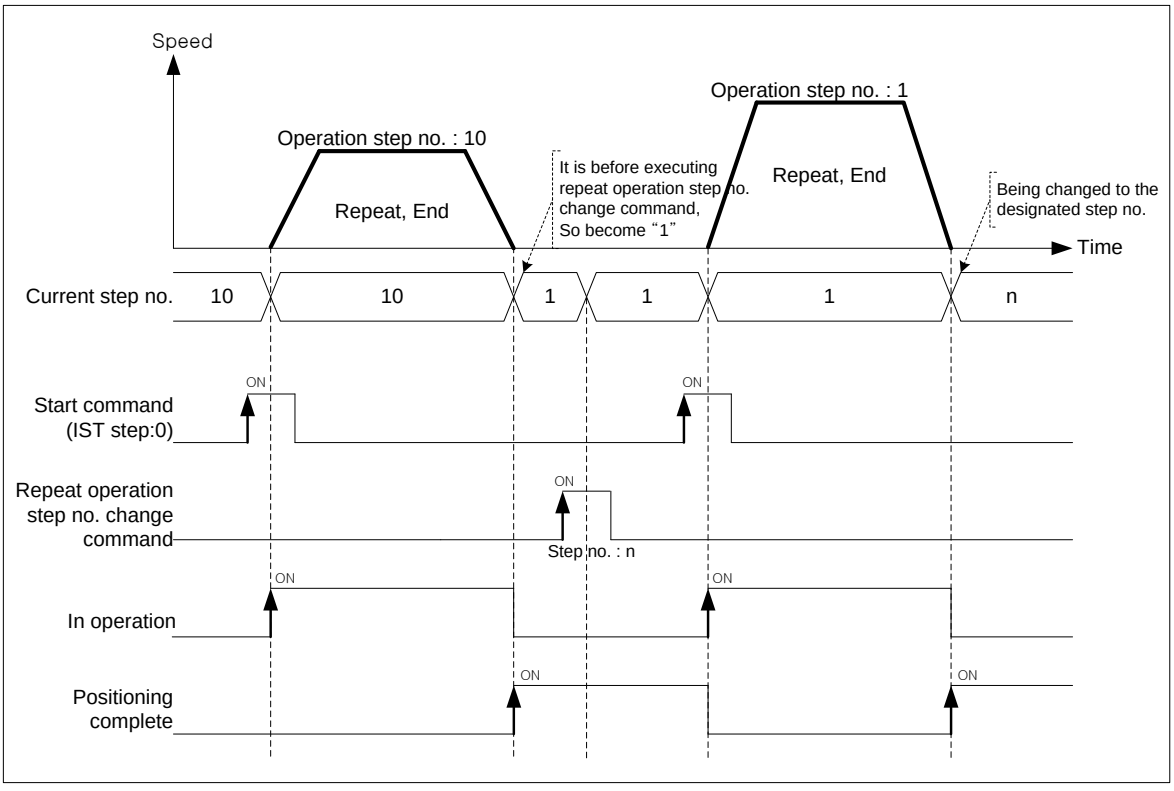
(a) In case of repeat operation mode setting (End, Keep, Continuous operation), the current operation step no. will be changed automatically to operate the step no.1 when repeat operation mode setting step completes the positioning operation but if start step no. change command is executed in repeat 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.

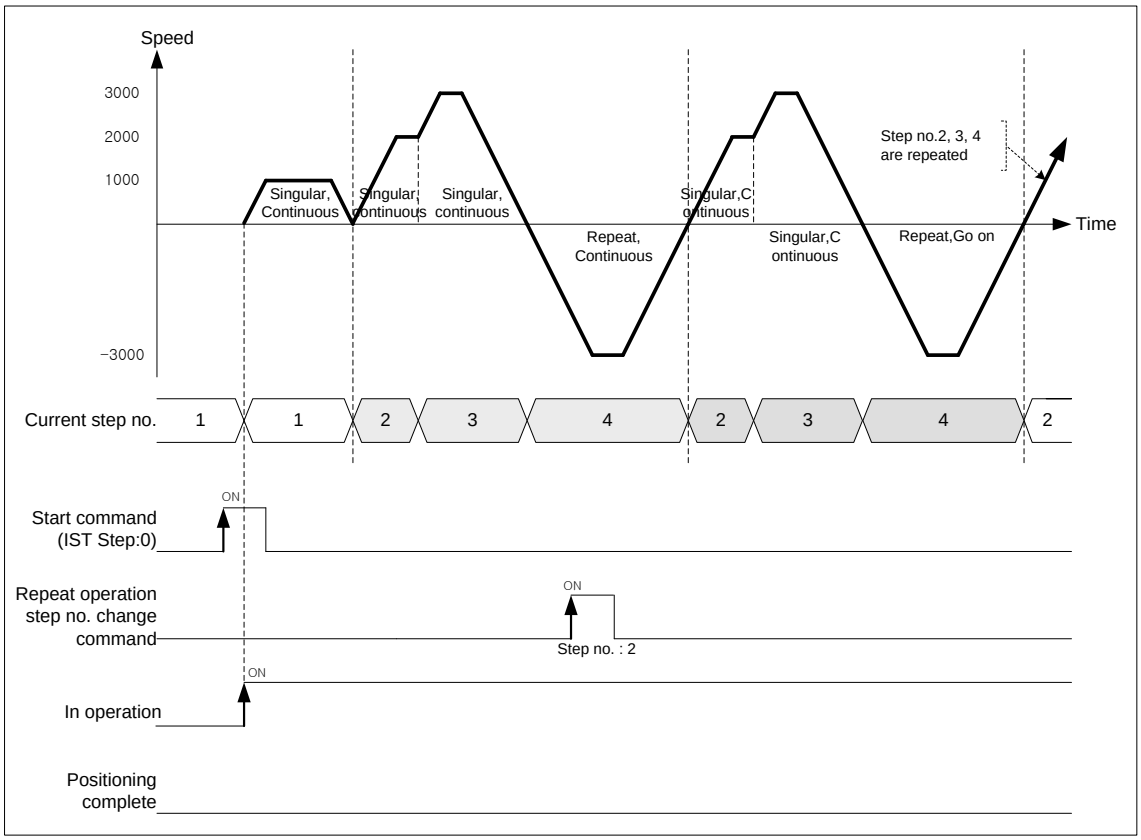
■ Current position of axis1 : 0

■ 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

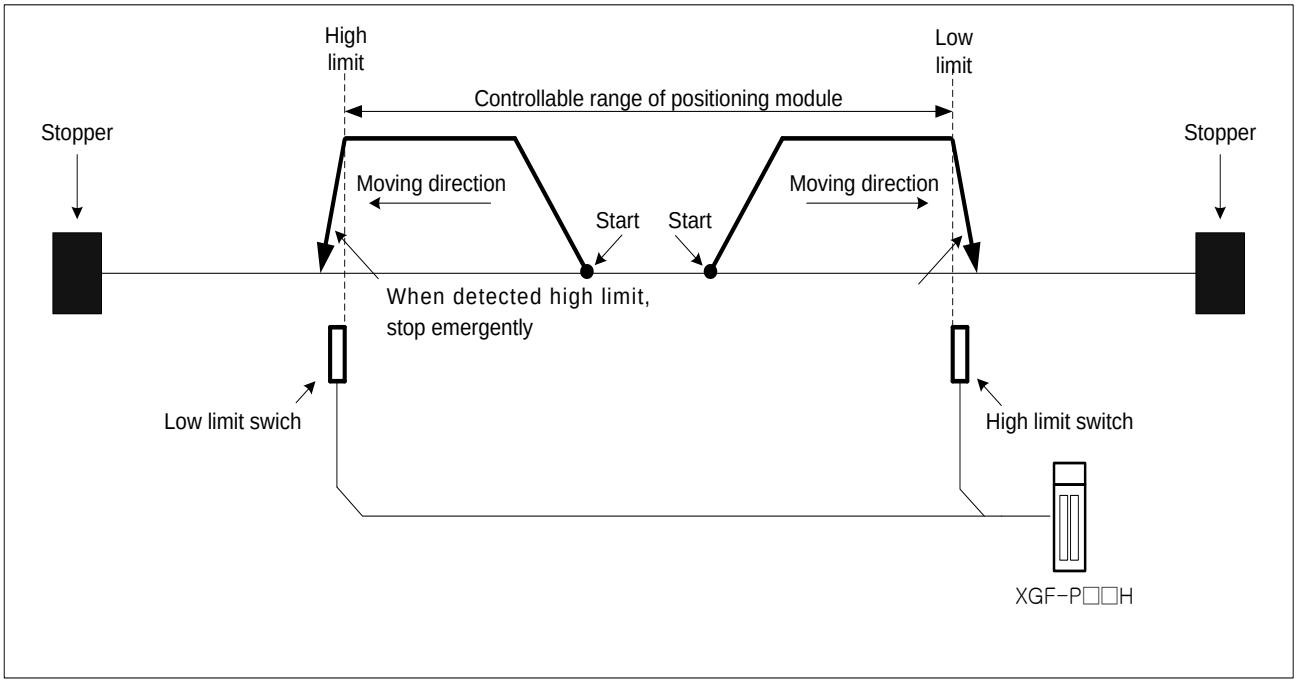
(a) This is used to stop the positioning module promptly before reaching Stroke limit/Stroke End of the Driver by installing the stroke limit of positioning module inside Stroke limit/Stroke end of the Driver. In this case, if it is out of the high limit, Error 492 will occur and if it is out of the 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.

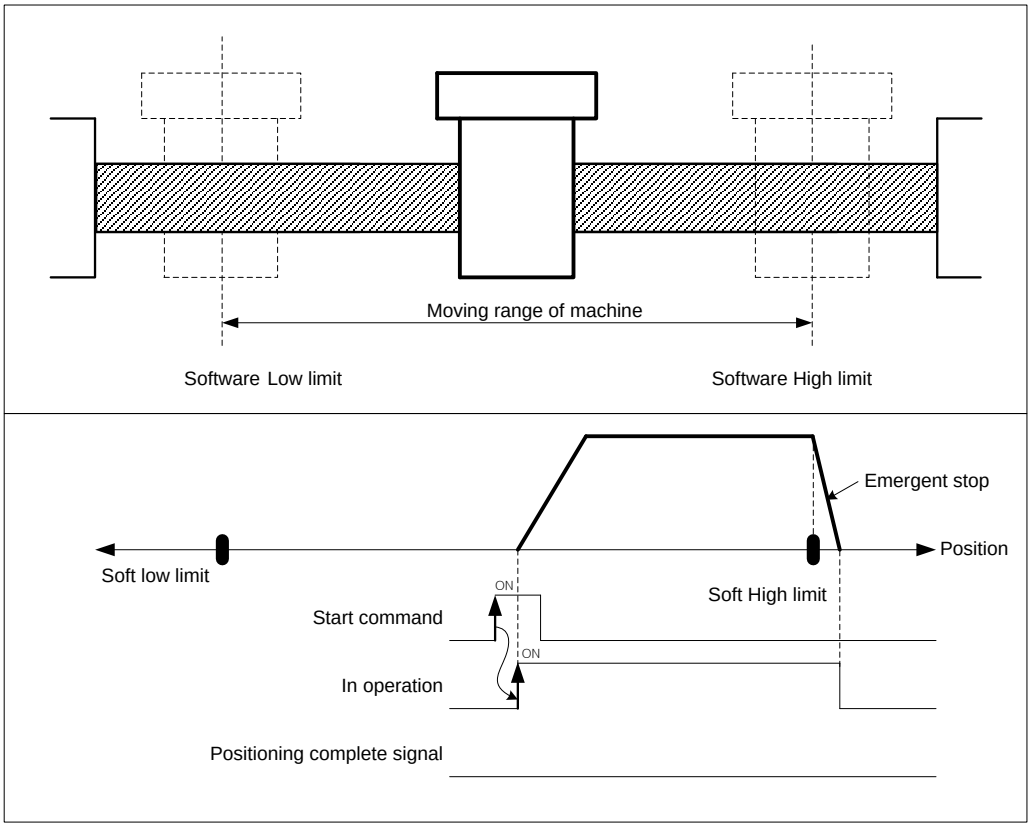
(2) Software High/Low Limit

(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.

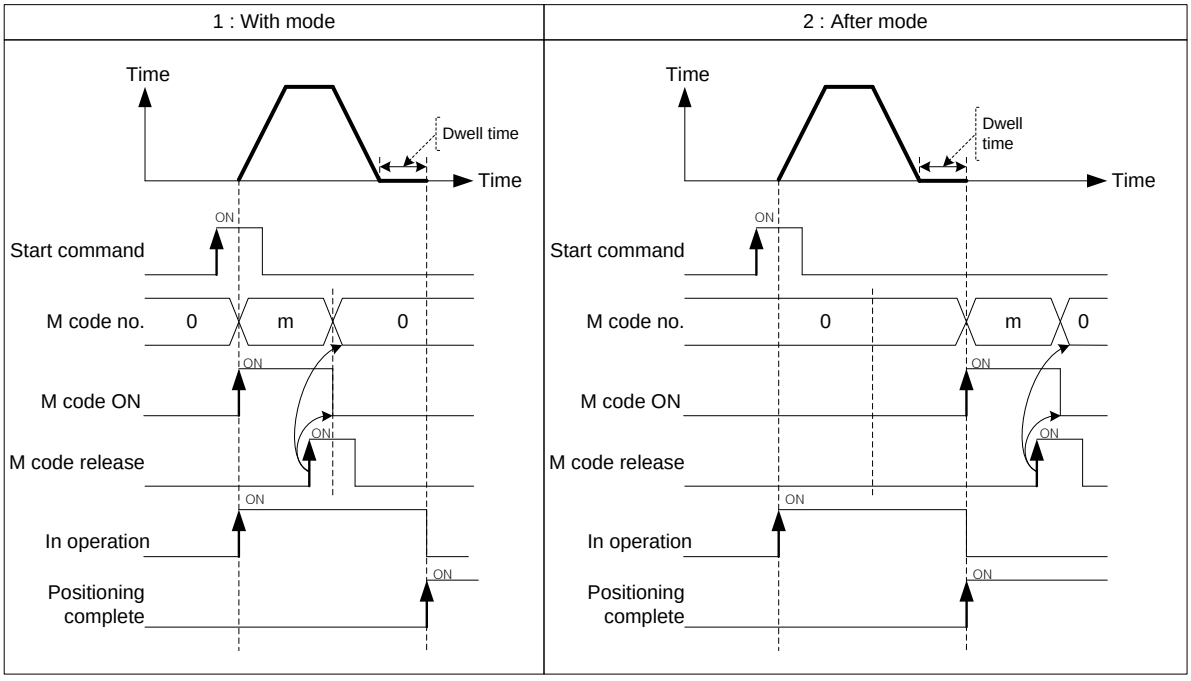
(1) Characteristics of Control

(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

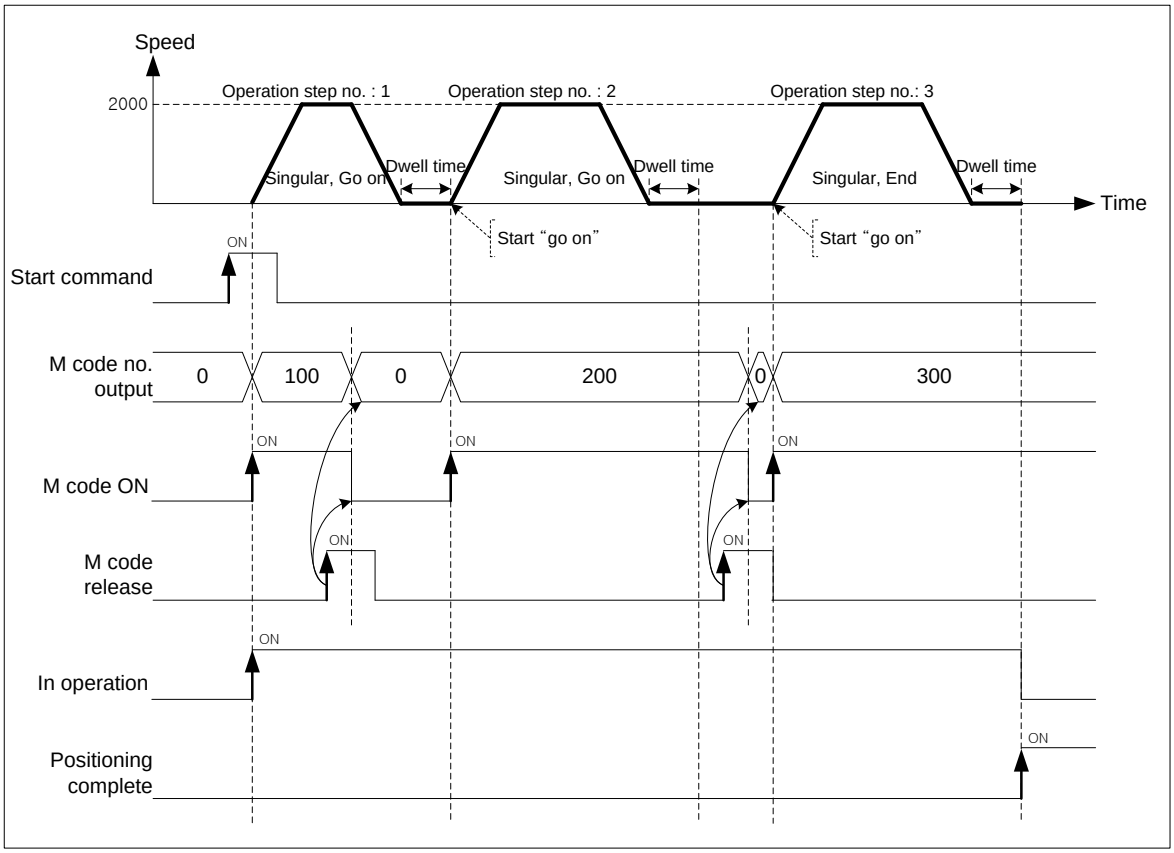
M code mode of basic parameter : With

■ 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



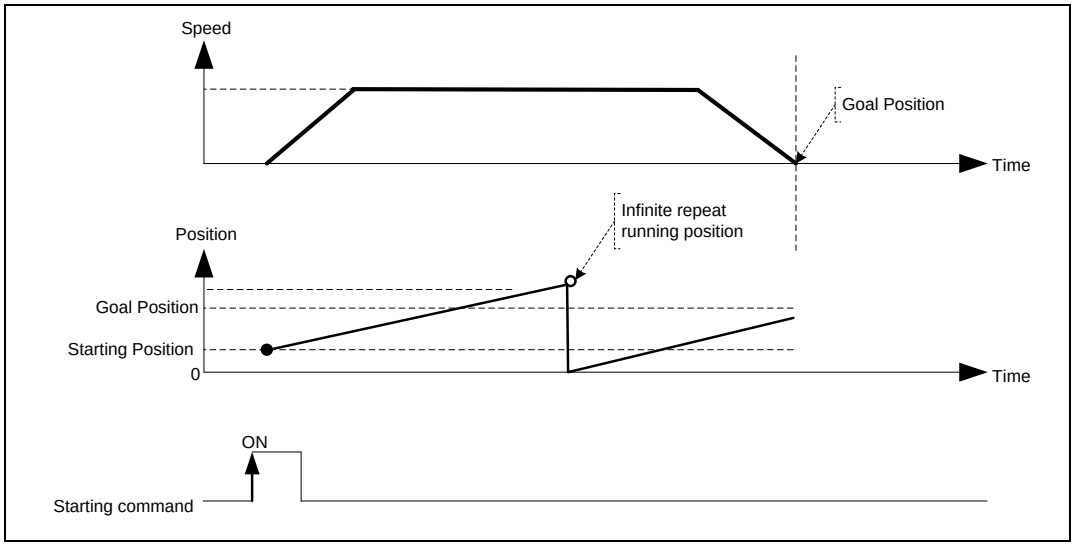
9.6.3 Infinite running repeat function

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 1 : ROM teaching	Set the method of teaching
Data	0 : Position 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 1:mm 2:inch 3:degree	
	14	Double precision of unit	0:x1 1:x10 2:x100 3:x1000	
	15	Speed unit	0: unit/time 1: rpm	
	16	Bias speed	1 ~ Speed limit	
	17	Pulse output mode	0:CW/CCW 1:PLS/DIR 2:PHASE	
Teaching method	0 : RAM Teaching 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 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 1 : Detect	
	10	Servo reset retention time	1 ~ 5000[ms]	
	11	Positioning method of interpolation continuous operation	0 : Pass the goal position 1 : Pass near position	
	12	Circular interpoation of 2 axes linear interpolating continuous operation	0 : No circular interpolation 1 : Circular interpolating continuous operation	
	13	External emergent/dec. stop	0 : Emergent stop 1 : Dec. stop	
	14	Coordinates of positioning speed override	0 : Absolte 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, 1: Enable	
	18	Speed/Position switching coordinate	0: Incremental 1: Absolute	
	19	Interpolation speed selection	0: Main axis speed 1: Synthetic speed	
Teaching method	0 : RAM teaching 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) 1 : Near Origin /Origin (On) 2 : High/Low limit Origin 3 : Near Origin 4 : High speed origin 5 : High/Low limit 6 : Origin	
	10	Direction for homing	0 : Forward 1 : Reverse	
Teaching method	0 : RAM teaching 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

Items	Setting value		Description	
Teaching data	Refer to “setting range”		Set the teaching value of parameter selected	
			Setting range	
Teaching items	1	Jog high speed	Bias speed ~ Speed limit	Select the parameter item to execute teching
	2	Jog low speed	Bias speed ~ Jog high speed	
	3	Jog acc. time	0 ~ 2147483647	
	4	Jog dec. time		
	5	Inching speed	Bias speed ~ Speed limit	
Teaching method	0 : RAM teaching 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”.

(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

Items	Setting value		Description
Teaching data	Bit 0	High limit signal	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.
	Bit 1	Low limit signal	
	Bit 2	DOG signal	
	Bit 3	HOMEsignal	
	Bit 4	Emergent stop/Dec. stop signal	
	Bit 5	Drive ready signal	
	Bit 6	Servo On output signal	
	Bit 7	Servo reset output signal	
	Bit 8 ~ Bit 15	-	
Teaching method	0 : RAM teaching 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”.

(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 1 : speed setting	Select the parameter item to execute teching
	2	Encoder pulse input	0 : CW/CCW 1 multiplying 1 : PULSE/DIR 1 multiplying 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 1 : High Active	
	6	Continuous operation	0: Disable 1:Enable	
Teaching method	0 : RAM teaching 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 0 : Not be set 1 : Be set	
	7	Helical interpolation (Only XBM-HP)	0 : Not use 1 ~6 : axis1 ~ axis6	
	8	No. of circular interpolation turn	0 ~ 65535	
	9	Coordinates	0 : Absolute 1 : Relative	
	10	Control method	0 : single axis position control 1 : single axis speed control 2 : single axis Feed control 3 : Linear interpolation control 4 : Circular interpolation control	
	11	Operating method	0 : Singular 1 : Repeat	
	12	Operating pattern	0 : End 1 : Keep 2 : Continuous	
	13	Size of circular arc	0 : Circular arc < 180 1 : Circular arc >= 180	
	14	Acc. no.	0 ~ 3	
	15	Dec. no.	0 ~ 3	
	16	Method of circular interpolation	0 : Middle point 1 : Center point 2 : Radius	
	17	Direction of circular interpolation	0 : CW 1 : CCW	
Step no.	0 ~ 400		Set the step no. of operation data to execute teaching	
Teaching method	0 : RAM Teaching 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.

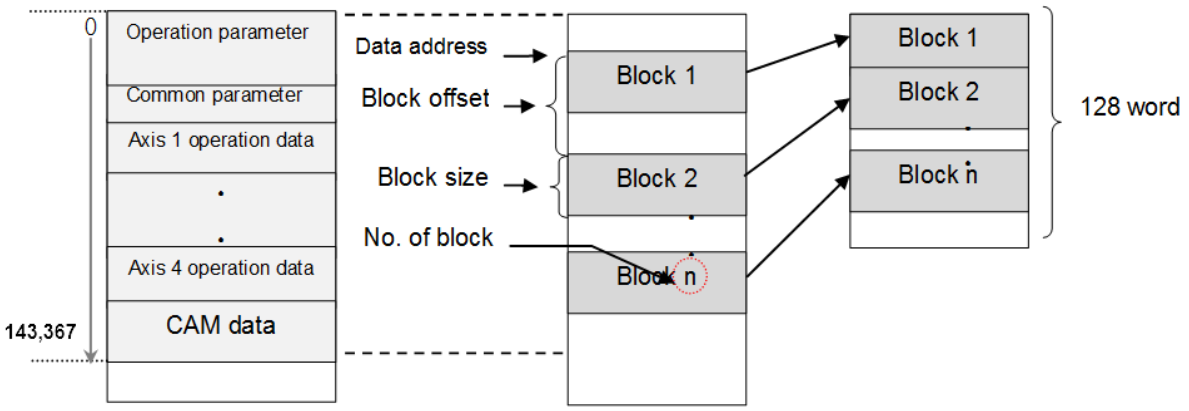
(b) Reads data as many as “Block size” starting position set in “Read address” with WORD unit to CPU among parameter, operation data, CAM data. In case “CNT” is higher than 2, reads blocks with interval of “Block offset” starting “Read address” as many as “CNT”-1.

(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.

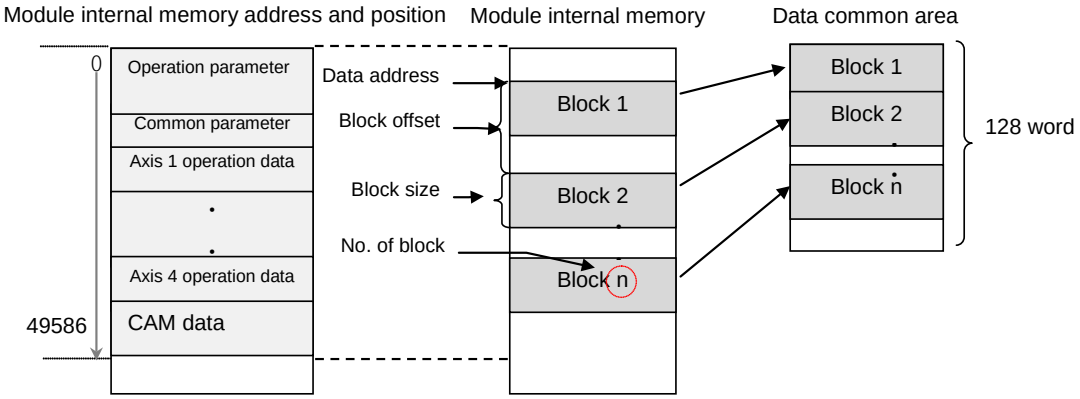
(c) Max. data size (Block size x No. of block) you can write with one command is 128 WORD.

(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 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

	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 Common parameter is set as middle point and 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°, correct circle cannot be drawn.	Set operation speed lower than 90° for circular 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 start operating.	Execute synchronous start after eliminate an error 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

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

	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. (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 lager than number of possible operating axis.	Execute after set a possible operating number 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 1: A 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 1 : Single axis speed control 2 : Single axis Feed control 3 : Linear interpolation 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) Bit 0~1: Main axis Unit Bit 2~3: Sub axis Unit 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

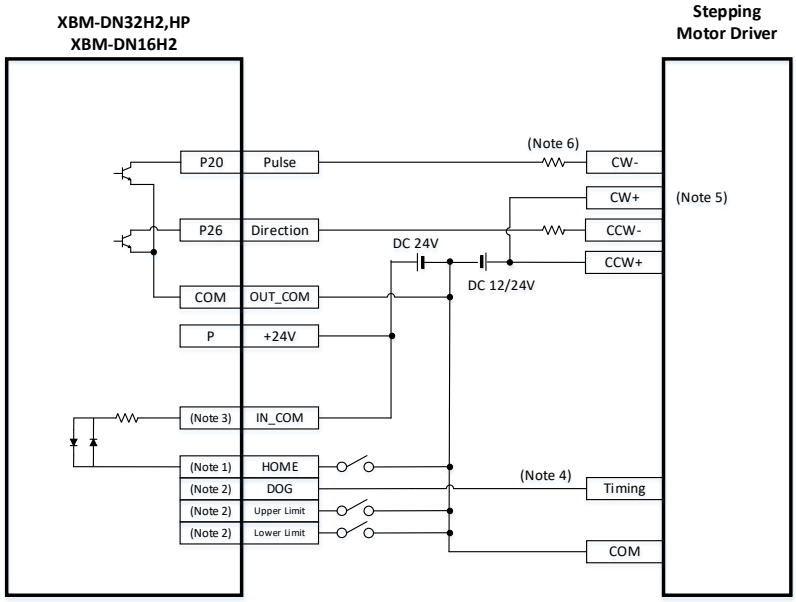
Chapter 12 Motor Wiring Example

12.1 Stepping Motor Wiring Example

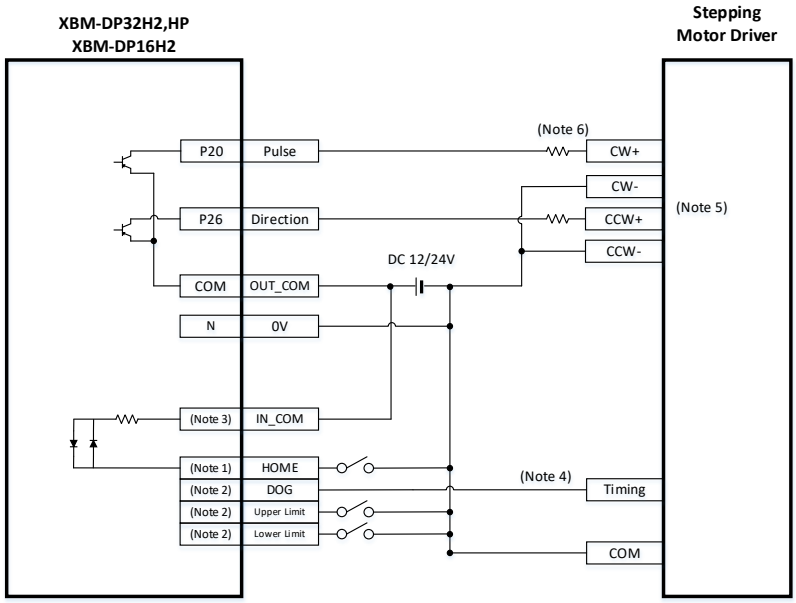
Here describes wiring example between XBM positioning output and stepping motor.
In case of using stepping motor not described in here, please refer to corresponding motor driver's user manual.

(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).

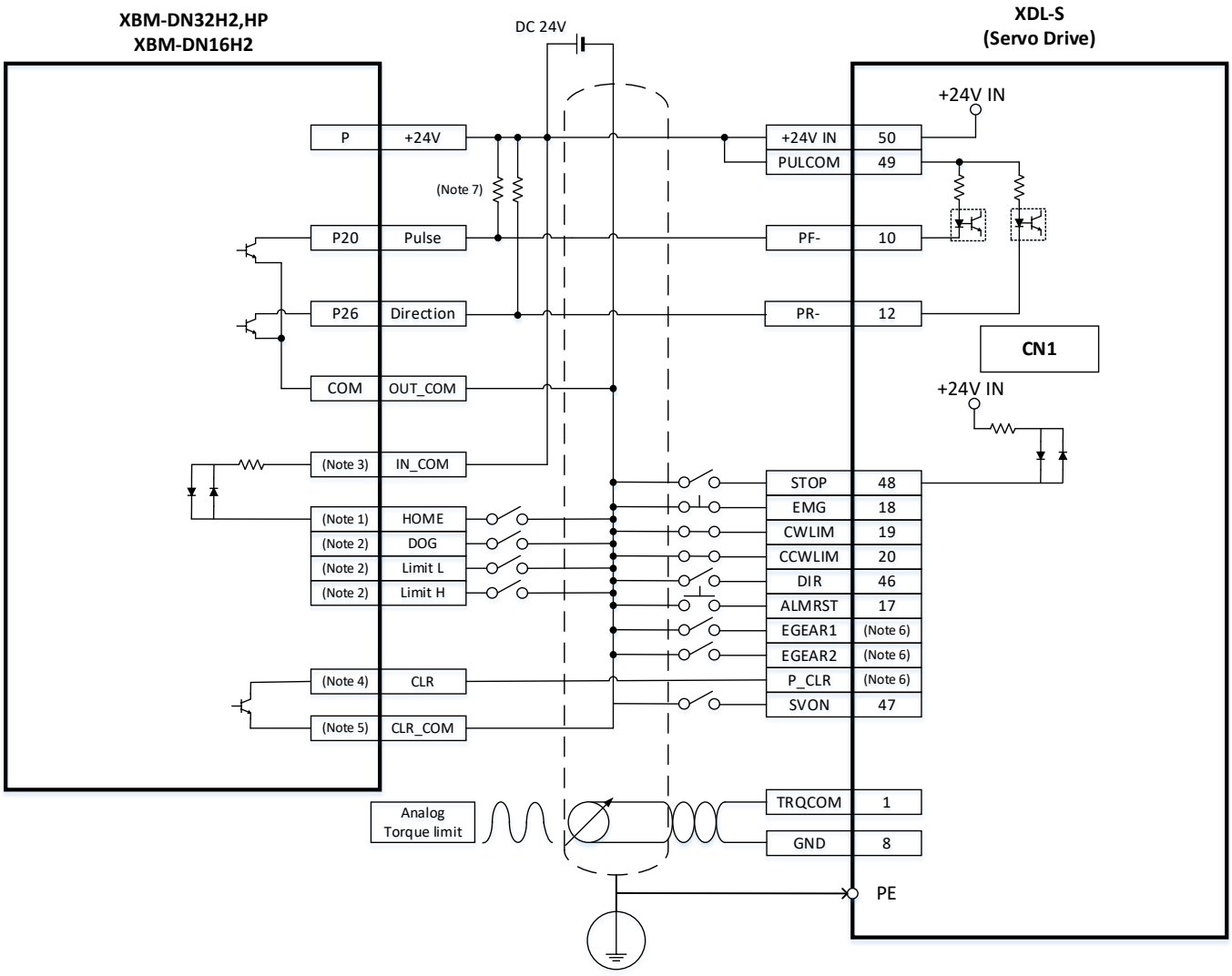
(Note 3) For each input, please connect the input COM to the COM contact corresponding to the set P device contact.

(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.

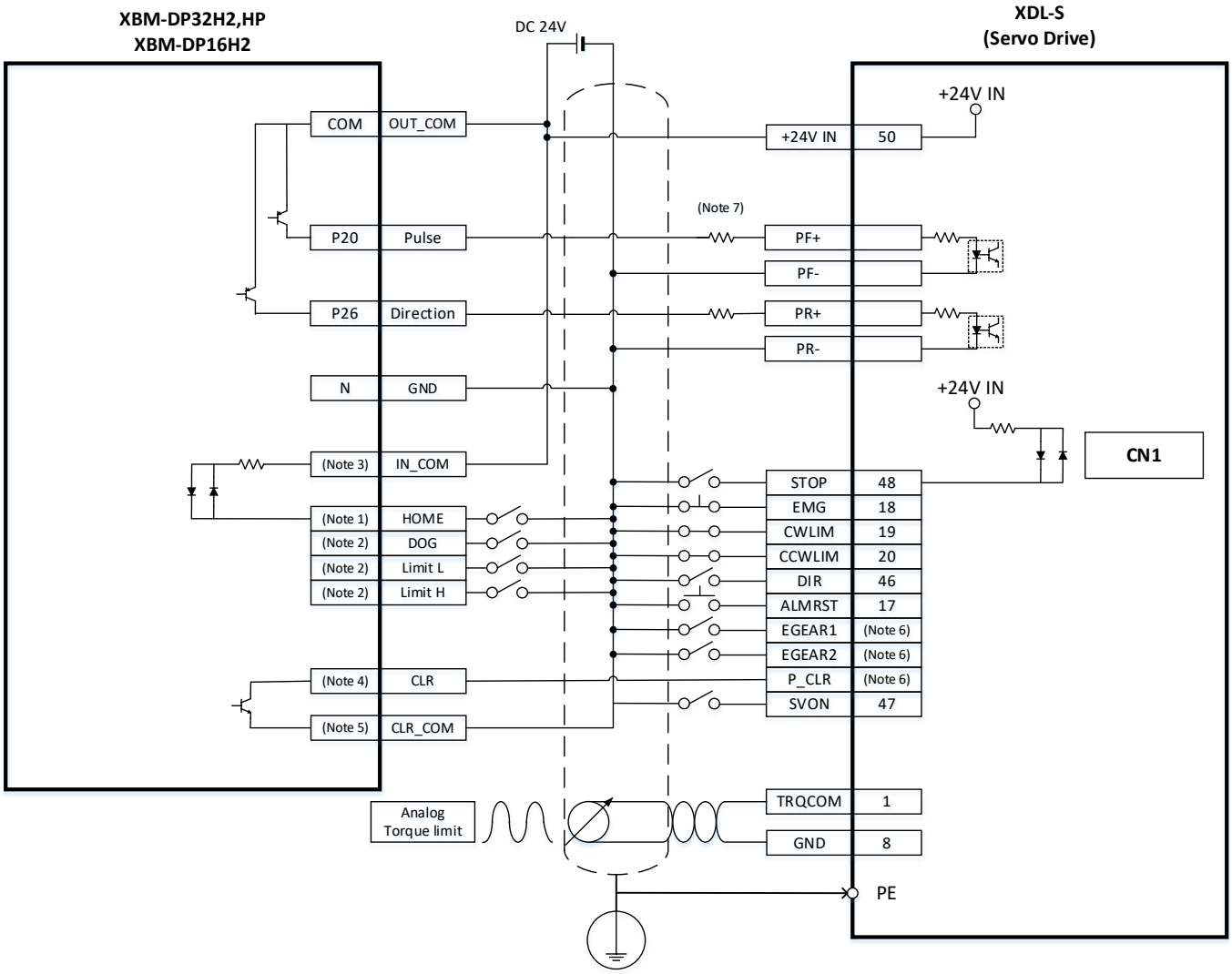
12.2 Servo Motor Wiring Example

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.

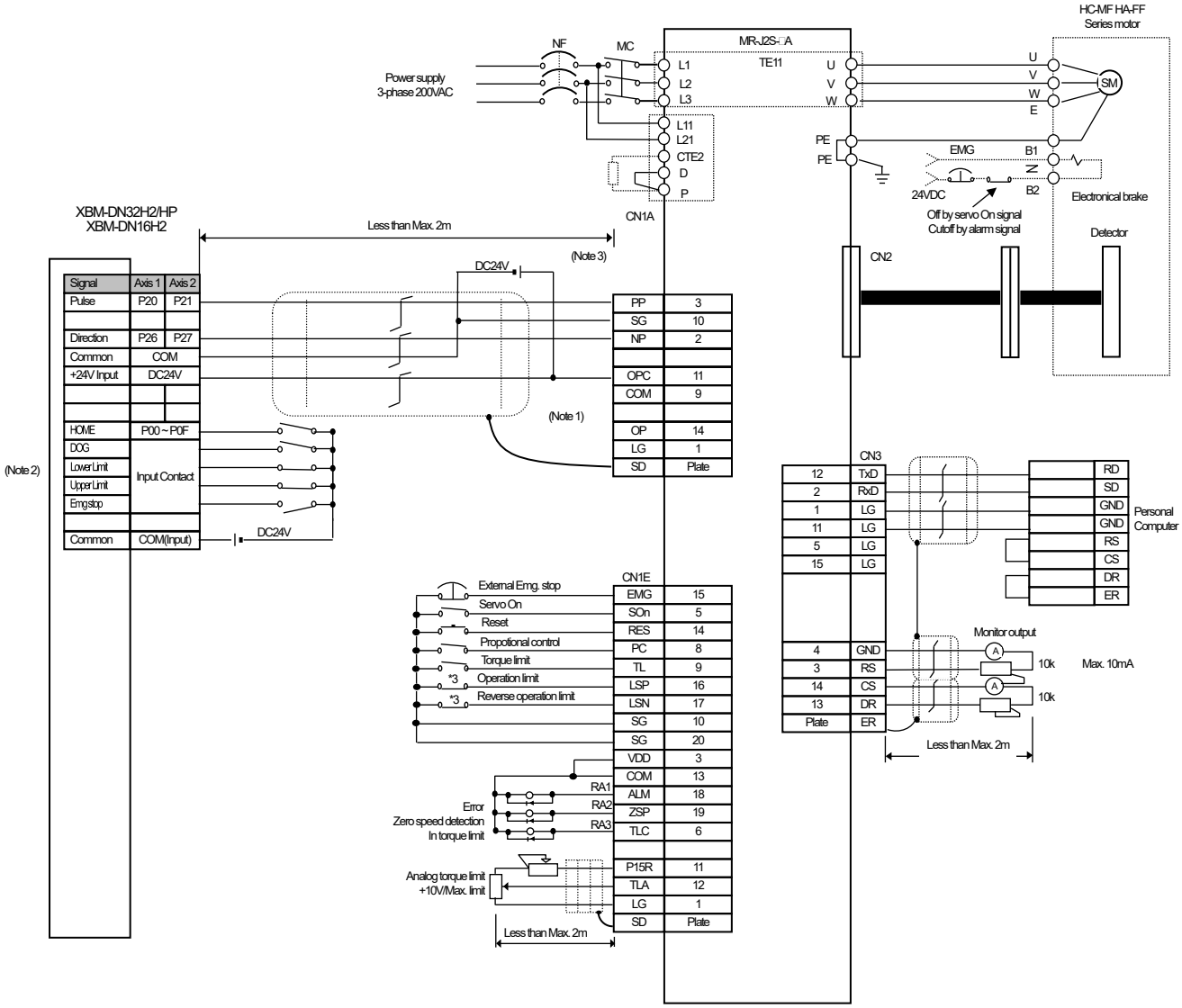
(Note 4) The deviation clear signal can be set within the entire range of P device. Set P devices that are designated as inputs because it is not checked whether it is input or output.

(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)

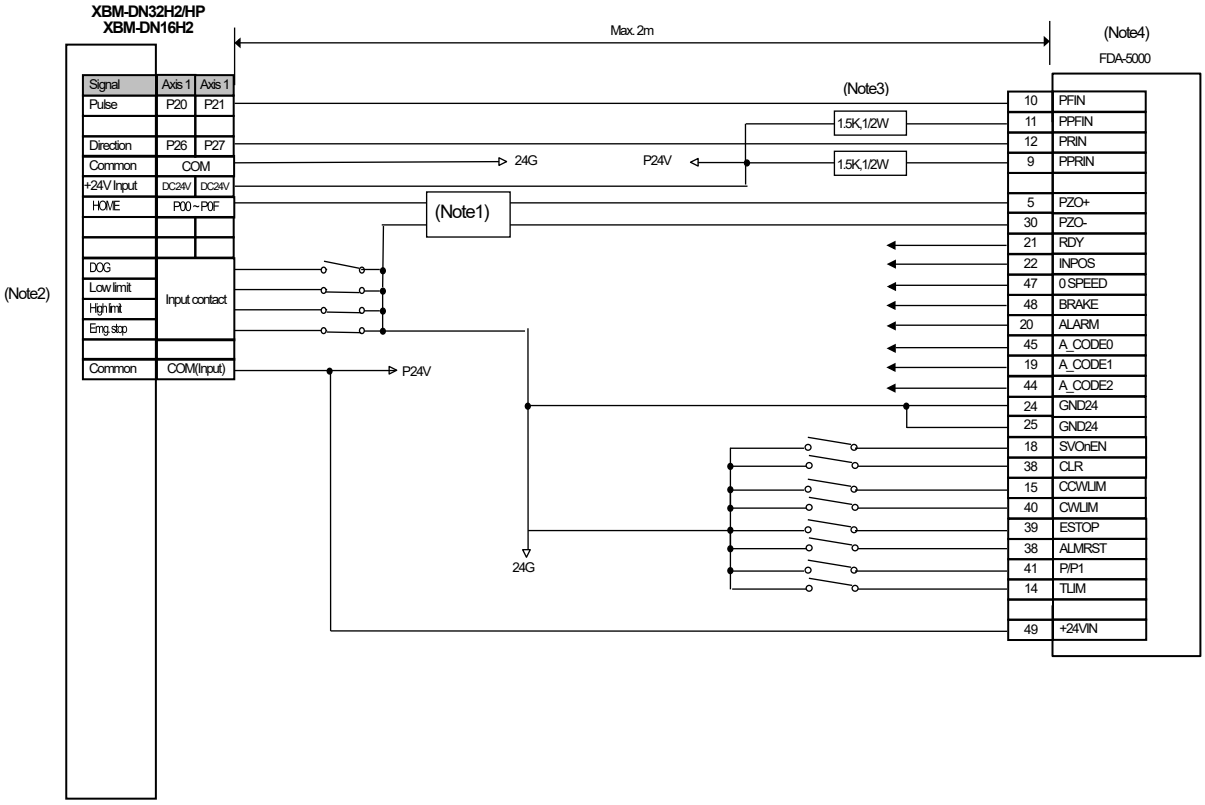


(Note 1) HOME signal can be set from P00 to P0F through the I/O Signal Parameter settings in the XG-PM software. The HOME signal input rating of XGB product is DC 24V. Be sure to connect it to the open collector output of the driver.

(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 UDP dedicated server: 1channel(UDP) High speed link: 1channel(UDP) Remote 1,2: each 2channel(TCP) Auto Scan: 2channels(UDP) SMTP: 2channels (including relay server 1channel)(TCP) 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 ▪ Up to 512 bytes
			UDP/IP	2005	
		Modbus TCP server	TCP/IP	502	
	High speed link	-	UDP/IP	2006	▪ Up to 64 blocks ▪ 200 words per block
	P2P	XGT client	TCP/IP	2004	▪ Up to 15 channels ▪ 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), 2008(inforamtion0	▪ Up to 2channel
	SNTP	Client	UDP/IP	Customized	▪Up to 1channel
	SMTP	Client	TCP/IP	25(relay) Customized	▪Up to 2channel

4) Performance specifications of diagnosis function

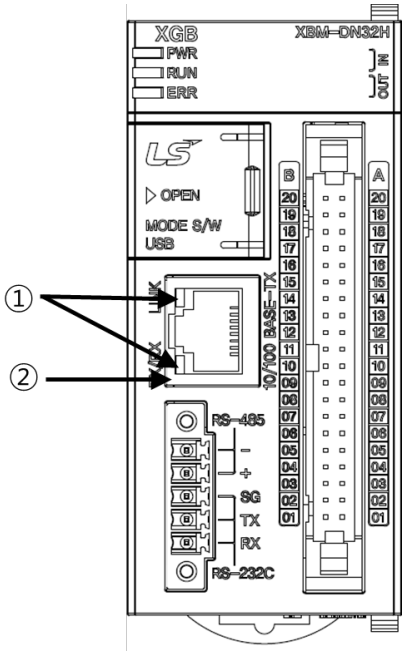
Items			Specifications
Diagnosis function	Information of built-in communication functions		high speed link exchange number/whether using DHCP IP address/MAC address module status/presence of system parameters Group status/media setting value hardware/software version
	Status by service	Dedicated service	Number of transmitted packets/ Number of received packets / Number of error packets / status drive setting
		High speed link	Number of transmitted/received packets high speed link flag (RUN, link, Mode, Status, TRX, Error)
		P2Pservice	Connection status / service status 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

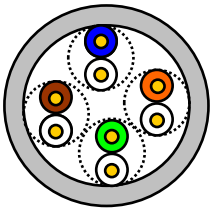
1.2.2 Names and roles of built-in FEnet parts



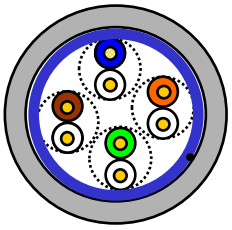
No.	Name	Details
①	LED display part	Displays the status of modules and communication. Item / Color / Operation details of each status RX/TX / Yellow / OFF / Connection error / No connected device RX/TX / Yellow / Flickering / During communication / Flickering in case RX, TX occur SPEED / Green / ON / 100BASE-T / In progress at 100Mbps SPEED / Green / OFF / 10BASE-T / In progress at 10Mbps
②	FEnet communication connector	FEnet communication connector (RJ 45)

1.2.3 Cable Specifications

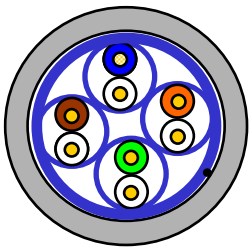
1) Classification of cables



UTP



FTP



STP

Items	Names	Remarks
UTP (or U.UTP)	Cable for unshielded high speed signal	Up to 200MHz Sound + information (Data)+low-grade video signal
FTP (or S.UTP)	Cable with shielded core only	Up to 100MHz Considering electromagnetic interference (EMI) and electronic stability 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 Sound + information (Data)+Video signal 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 ▪Low-loss communication cable
Category 5 and expanded category 5	100	100	▪Digital telephone network +computer network ▪Low-loss, broadband cable ▪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.

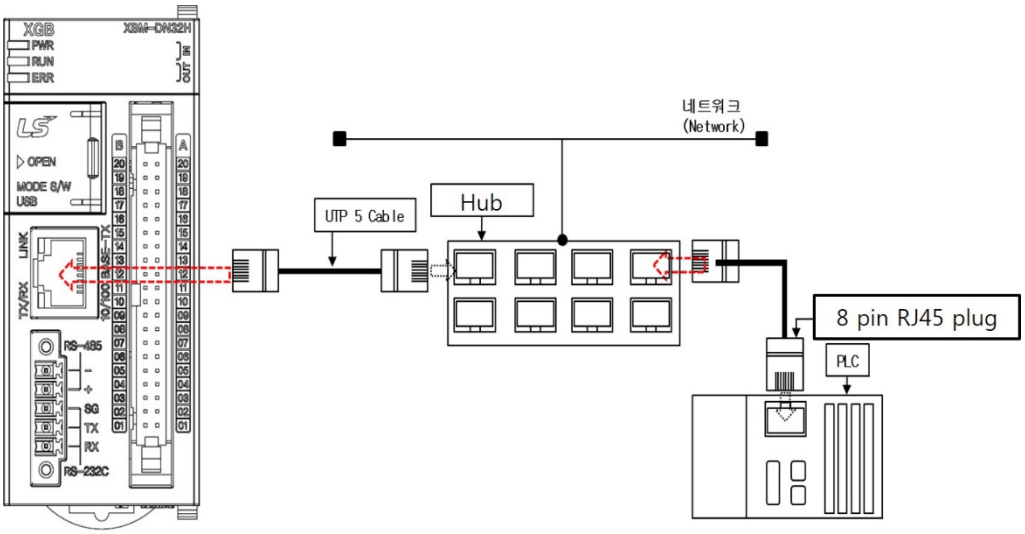
3) Example of Category 5e cable(LS cable, UTP-E-C5G-E1VN-M 0.5X004P/GY)

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

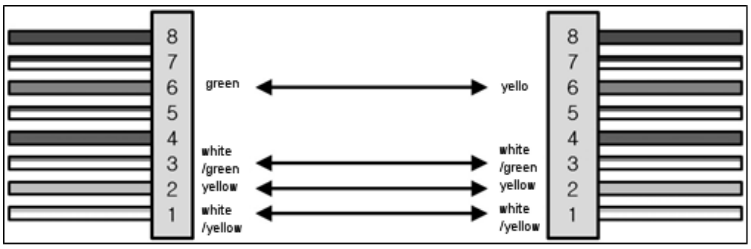
1.3.1 Example of FEnet installation



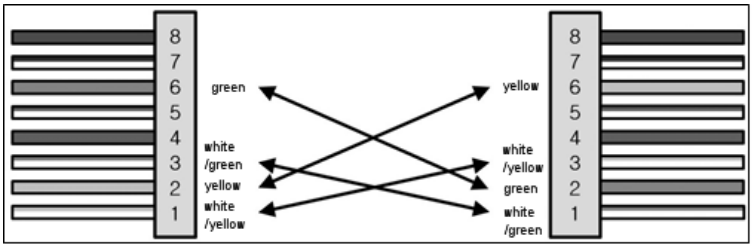
1.3.2 Instructions to install cables

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: (1) Check input power. (2) Check the communication cable access. (3) Apply the power. (4) Check whether the power LED is turned on. (5) Check the LED status of the basic unit → In case of abnormal status, refer to 'Troubleshooting' of the basic unit manual. (6) Check whether the status of the LINK LED is normal. → In case the LED is turned off despite connecting the line to the cable, refer to 'Troubleshooting' of the basic unit manual. (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

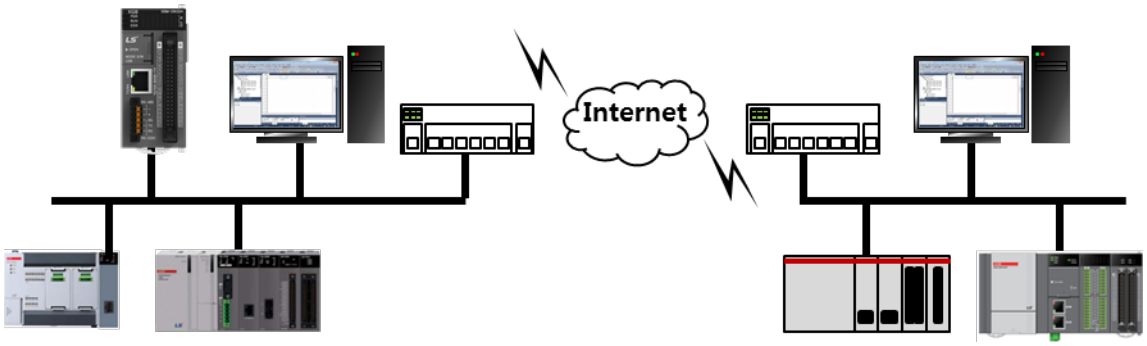
(5) When installing modules, lock the modules after equipping the relevant slot without accessing the communication cable. In case the device is not locked up, interface error with the basic unit may occur.

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.

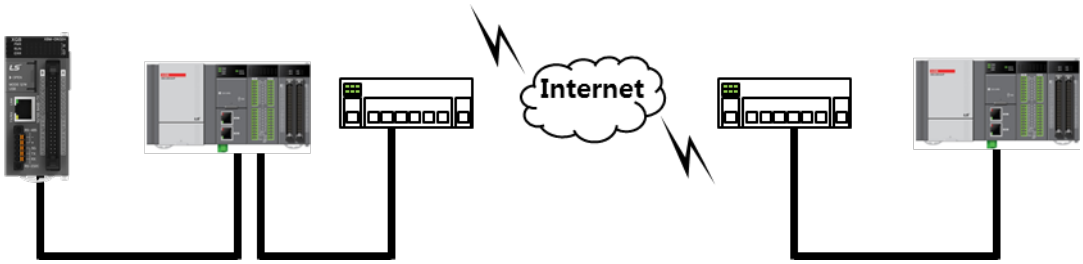
1.4.1 Mixed network configuration



[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.

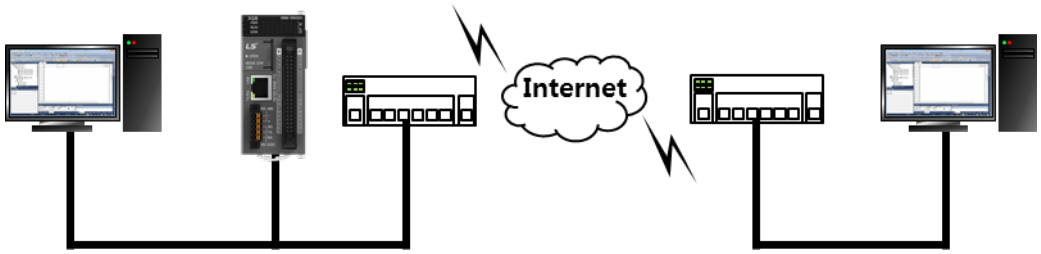
1.4.2 Network configuration through XGB PLC



[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.

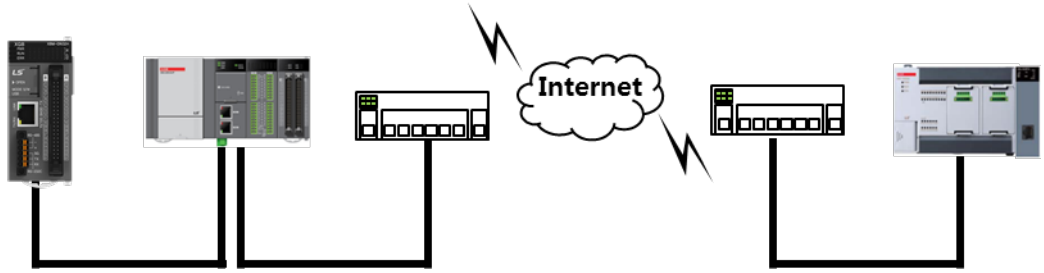
1.4.3 Network configuration through XGB PLC and MMI



[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.

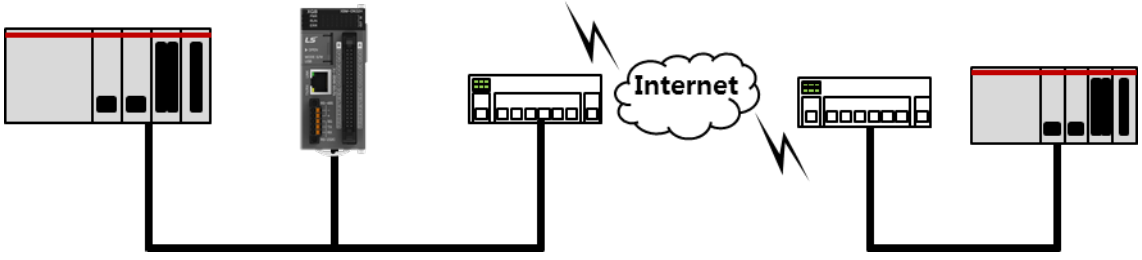
1.4.4 Network configuration between LS ELECTRIC modules



[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 Up to 512 bytes
			UDP/IP	2005	
		Modbus TCP server	TCP/IP	502	
	P2P	XGT client	TCP/IP	2004	Up to 15channels 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) 2008(Information)	Up to 2channels
	SNTP	Client	UDP/IP	Customized	Up to 1channels
	SMTP	Client	TCP/IP	25(Relay) 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.

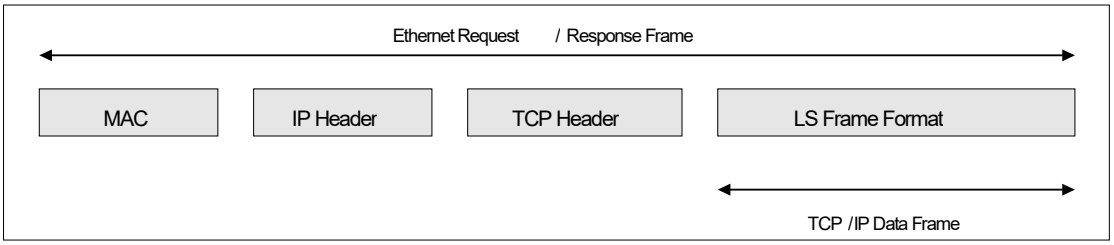
Protocol	Communication Method	Port No.
For XGT only	TCP/IP	2004
	UDP/IP	2005

[Table 1.5.2] Classification of dedicated protocols for XGT

2) Frame structure

(1) XGT dedicated packet's structure through Ethernet

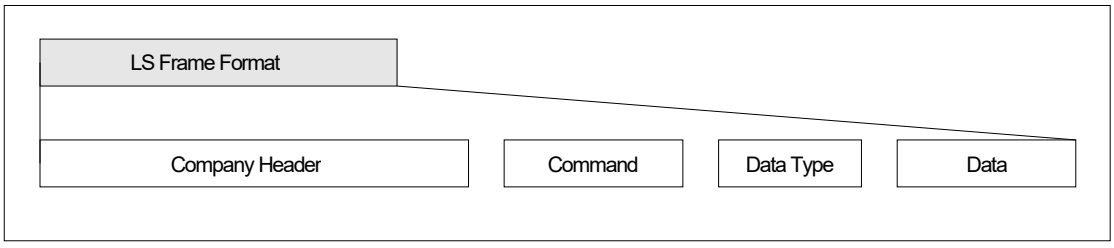
When communicating with dedicated protocols for XGT, MAC, IP header (IP Header), TCP Header and LS frames containing data are included for Ethernet communication. [Fig. 1.5.1] shows the frame structure for Ethernet communication.



[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 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

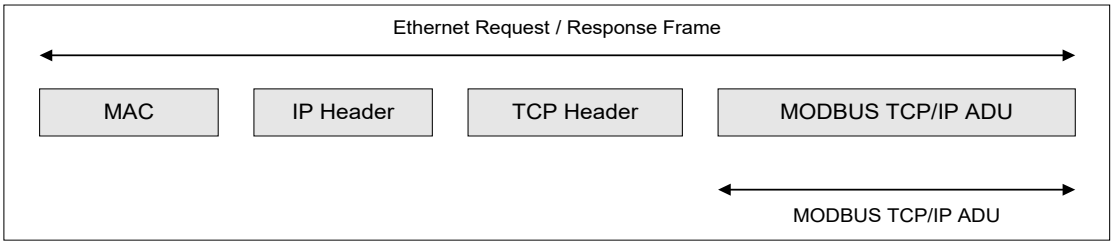
1.5.2 Modbus TCP/IP protocol

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.

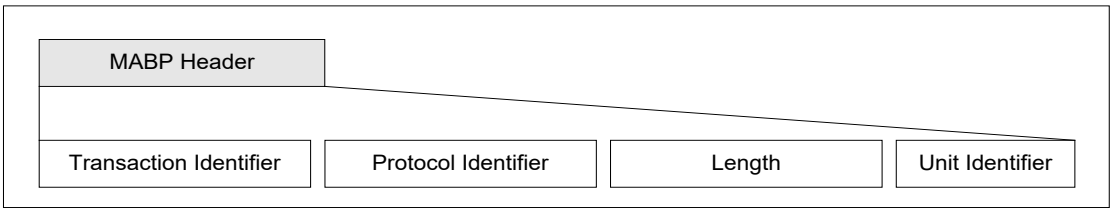
1) ADU: Application Data Unit
2) MBAP: Modbus Application Protocol
3) PDU: Protocol Data Unit

1) Frame structure of Modbus TCP/IP

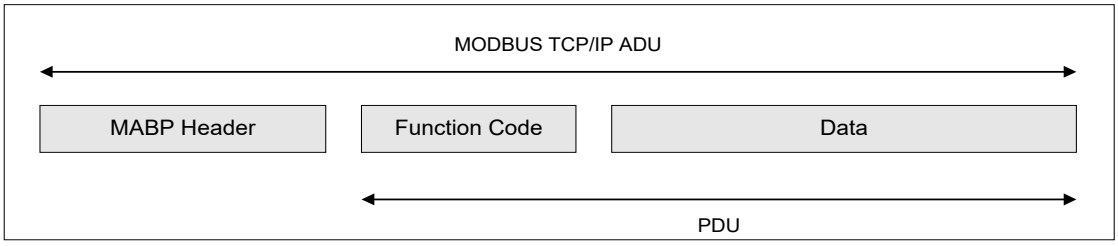
(1) Modbus TCP/IP's frame structure through Ethernet



[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

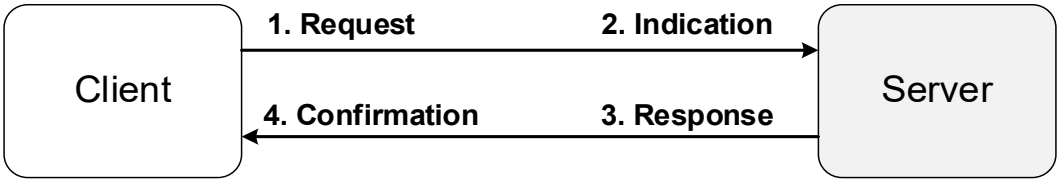
1.6.1 Outline

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.

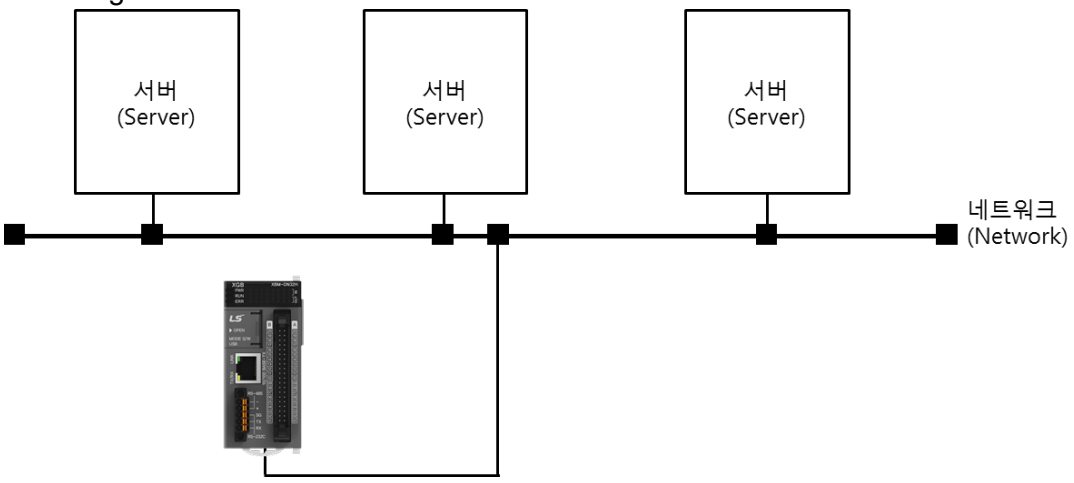
(1) Client/server model

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

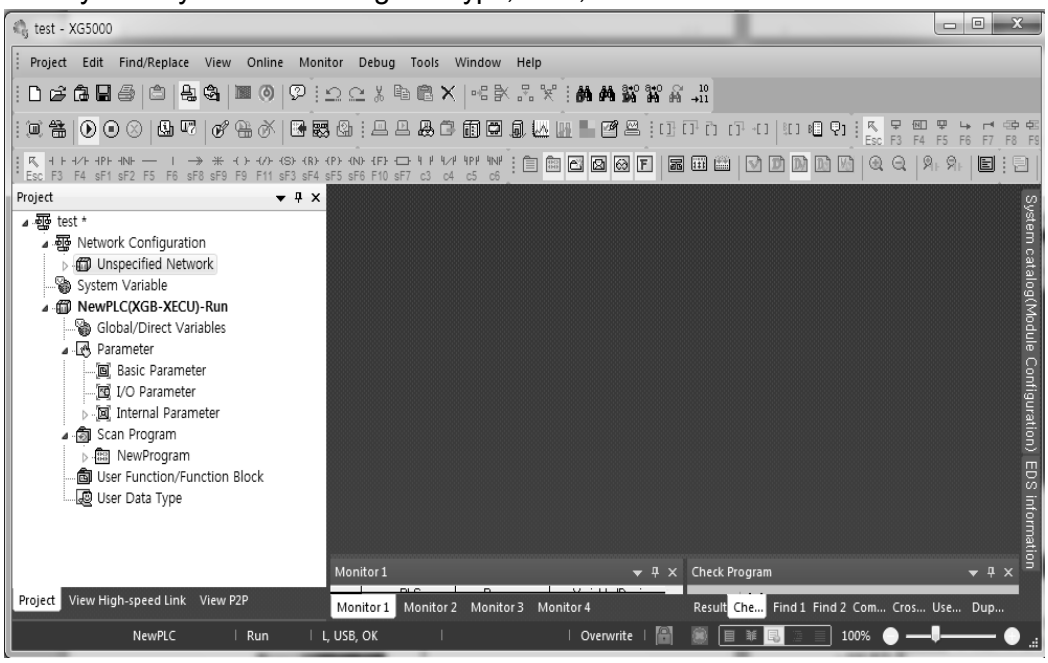
Dedicated services		Port No.	Protocol	Max./Min. number of accesses
XGT server	TCP XGT server	2004	TCP	1/16
	UDP XGT server	2005	UDP	1/16
Modbus TCP/IP server		502	TCP	1/16

1.6.2 Setting the basic parameters

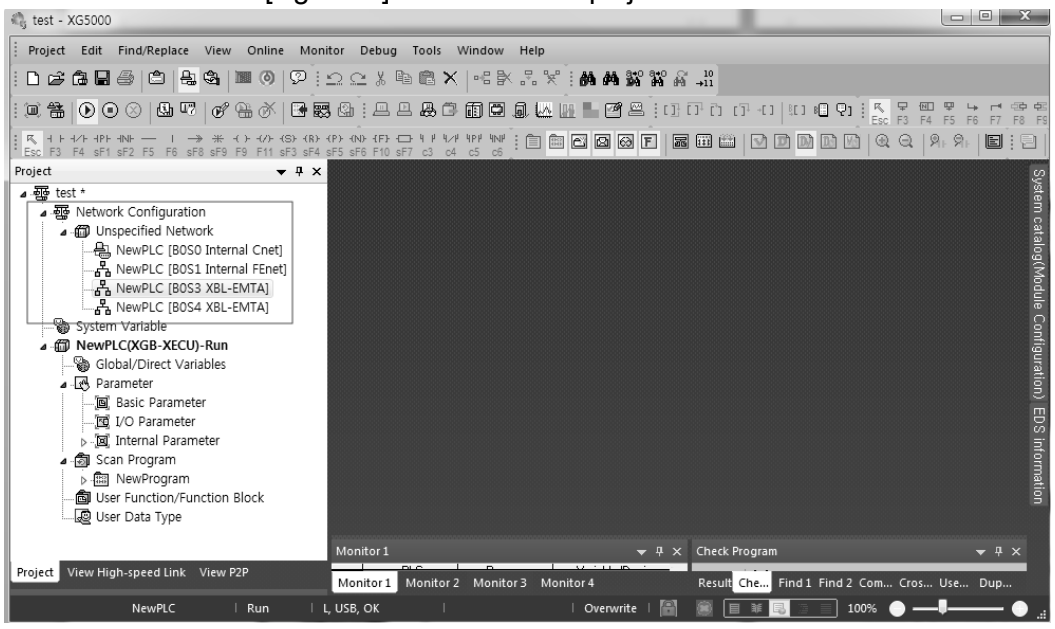
1) Confirming registration of built-in communication

(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.



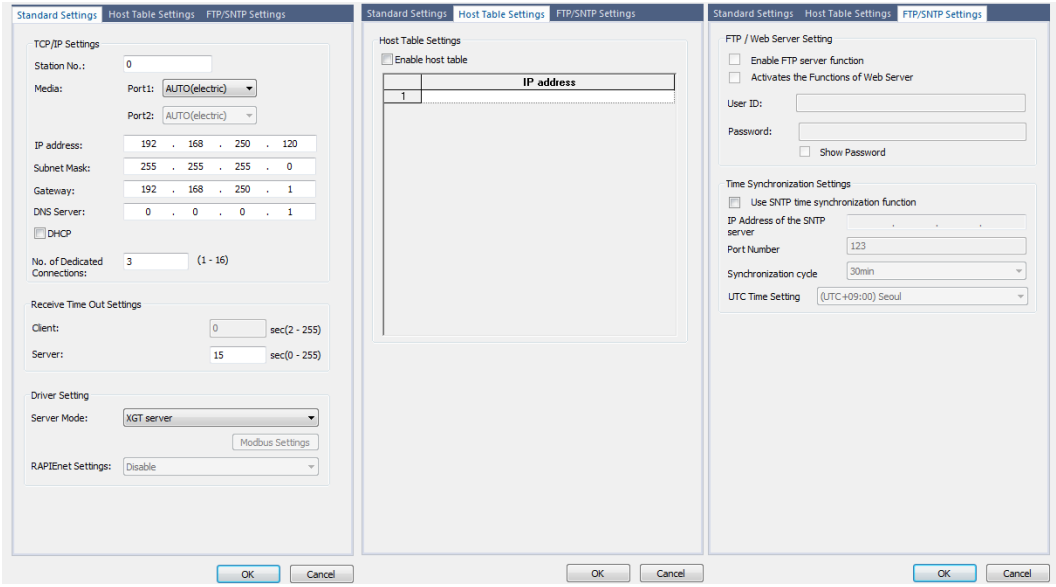
[Fig. 1.6.2] Creation of new project in XG5000



[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].



[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. ▷ AUTO (electricity): It sets the media of the currently equipped module automatically. ▷ 10M/HALF: Half Duplex electricity of 10Mbps ▷ 10M/FULL: Full Duplex electricity of 10Mbps ▷ 100M/HALF: Half Duplex electricity of 100Mbps ▷ 100M/FULL: Full Duplex electricity of 10Mbps 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. (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

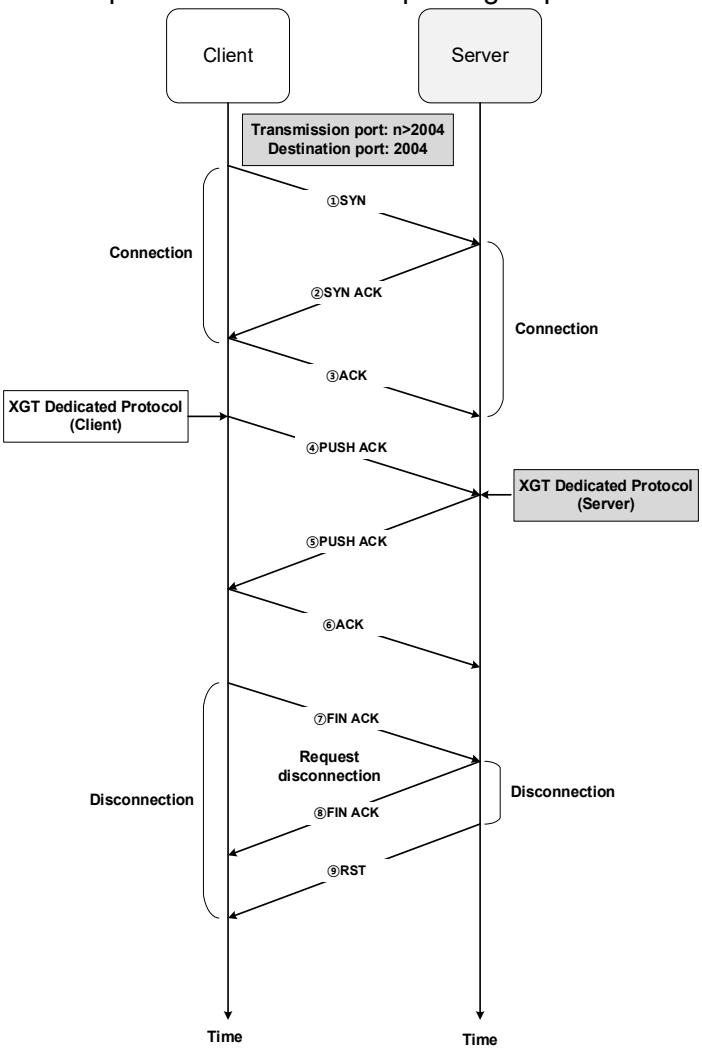
Item	Description
Enable host table	In case of Enable host table, it allows assess for the client who has the IP address registered to the host table.

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

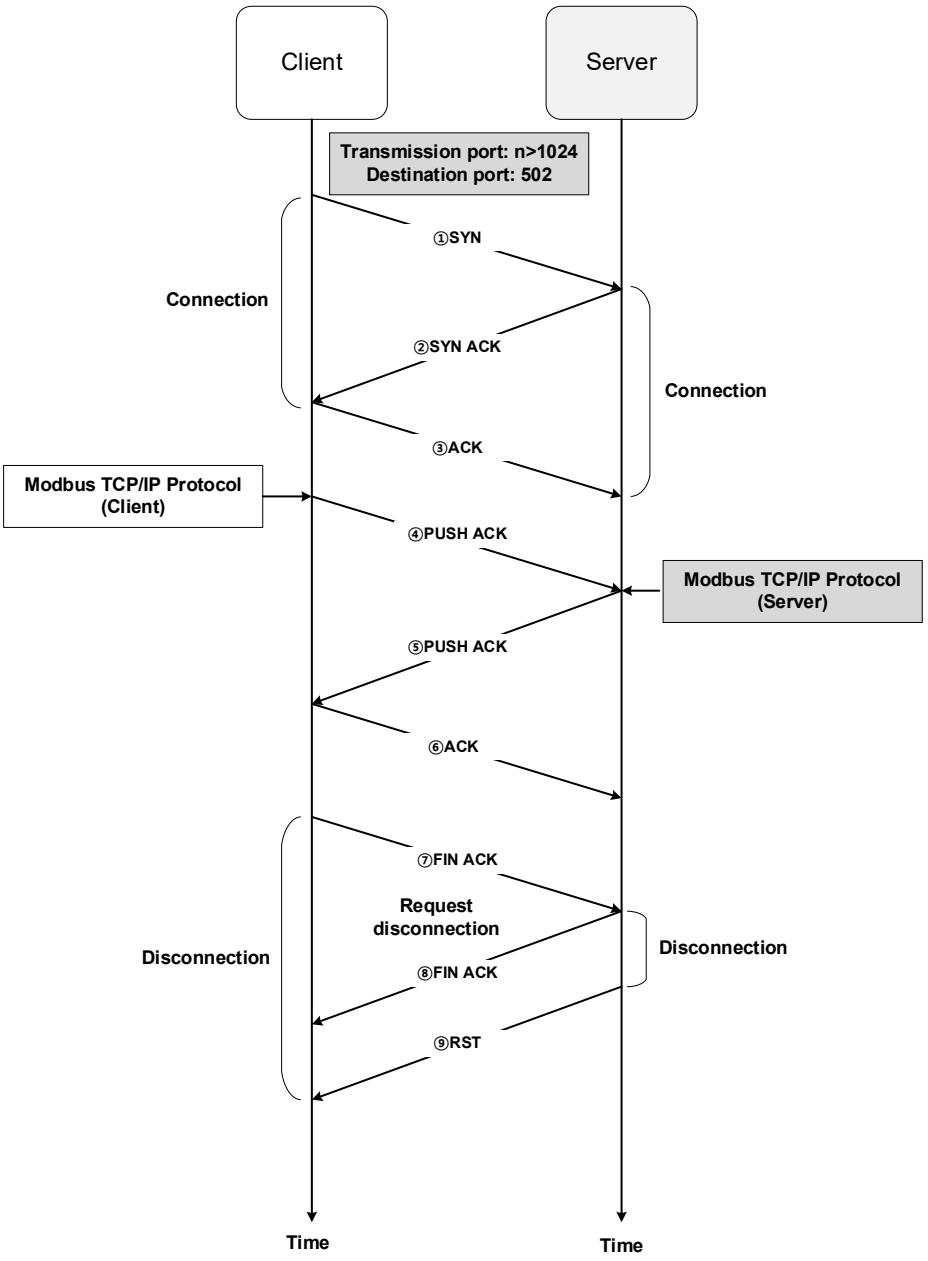
UDP XGT server uses a non-connection-oriented communication method.

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].

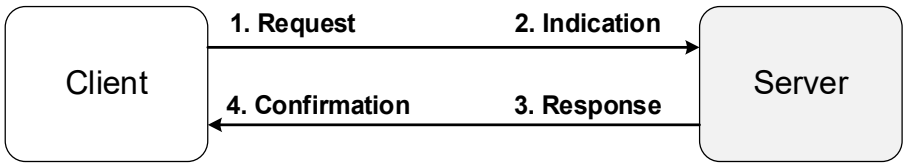


[Fig.1.6.6] Operating sequence of the Modbus TCP/IP server

1.7 P2P service

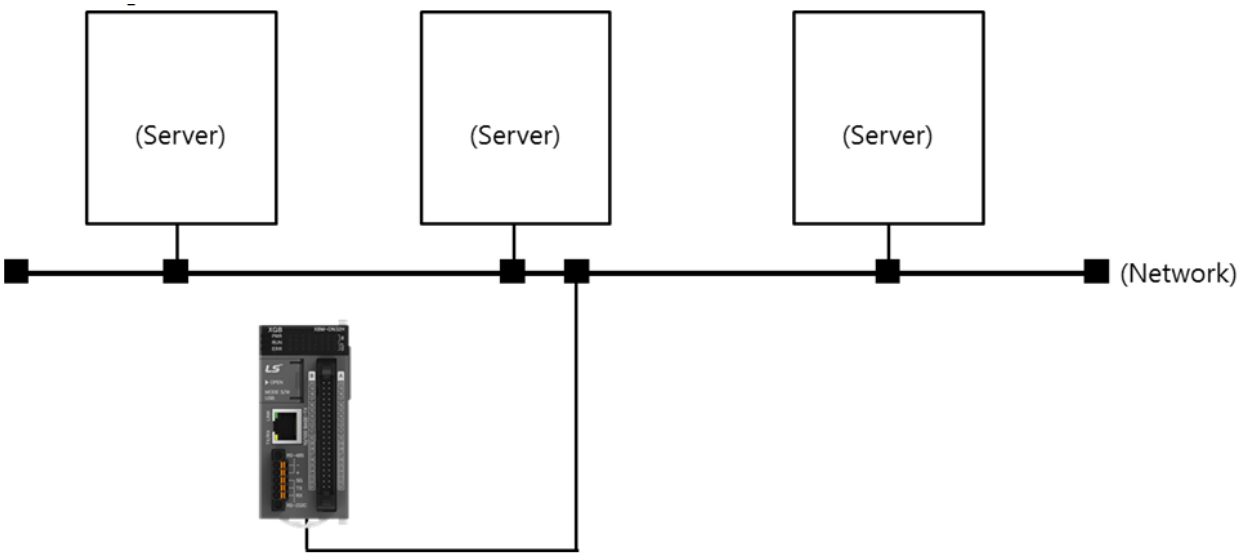
1.7.1 Outline

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

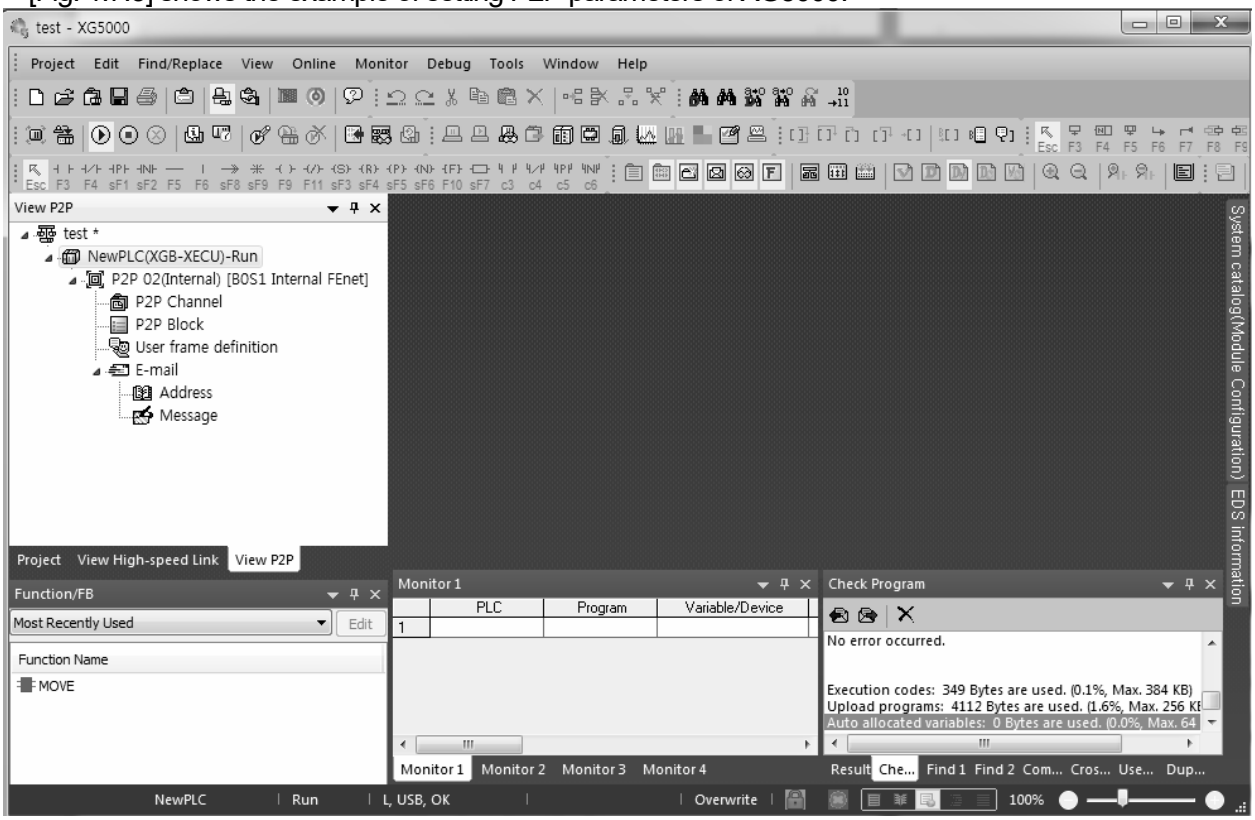
The Client performs the functions of ① transmission of request ④ confirmation.



[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.



[Fig. 1.7.3] Window for P2P setting of XG5000

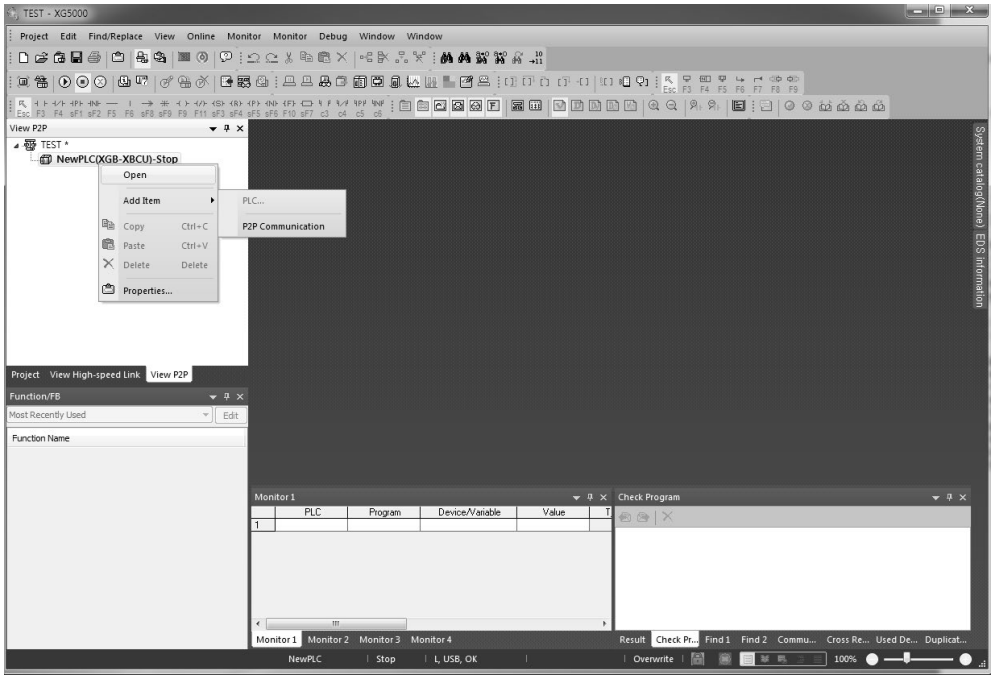
- Window for registering P2P parameters
  - You can set the P2P parameters up to 6.
  - Each P2P is composed of P2P channel, P2P block, user-defined frame, E-mail.

- Window for editing P2P
  - You can register and edit P2P block up to 32.
  - You can separately register frames by driver.

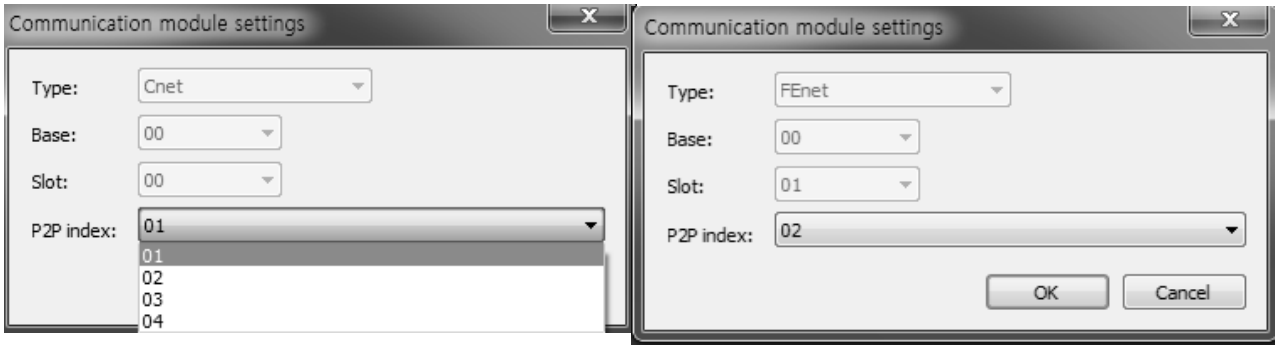
1) Setting FEnet communication

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.



(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.

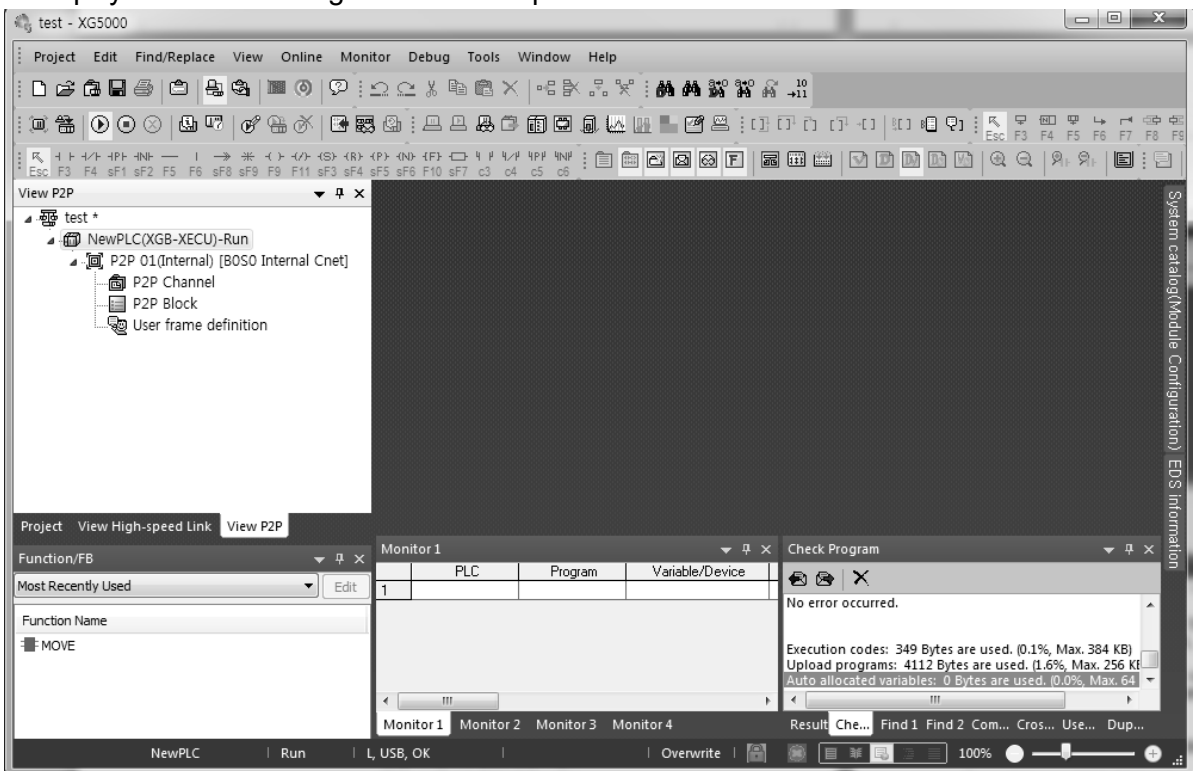
(7) The slot is automatically designated as slot 2 that has the built-in FEnet.

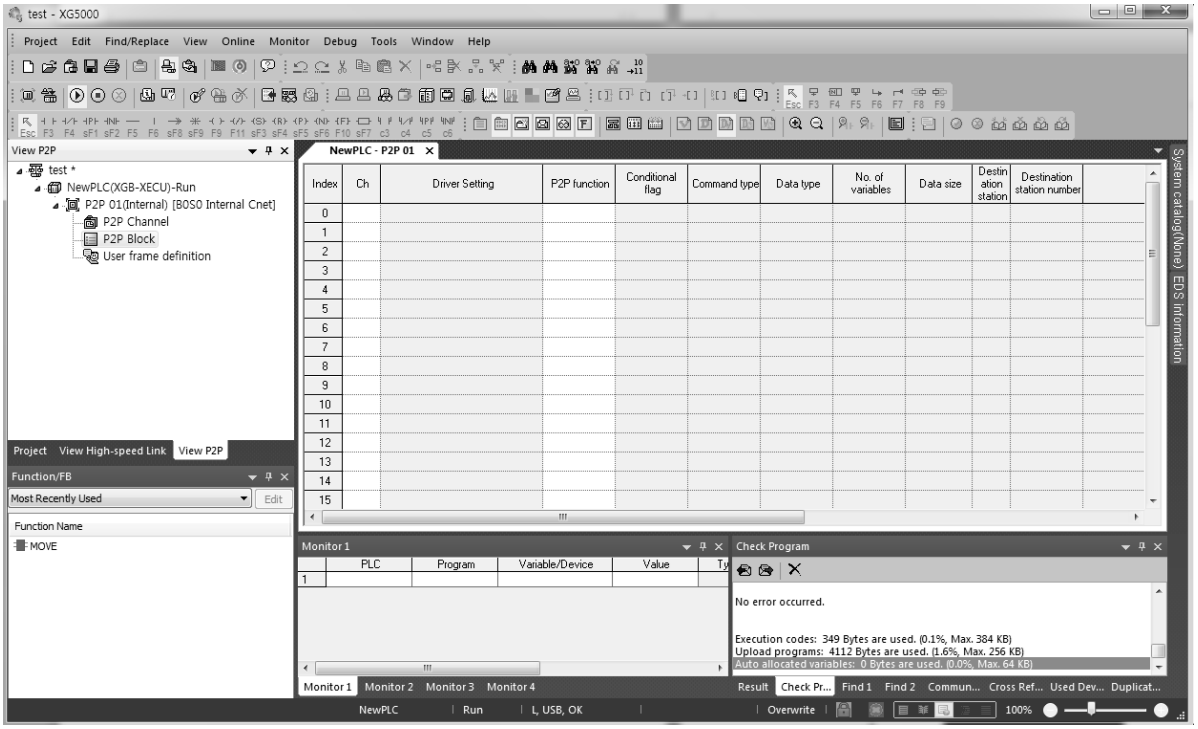
(8) If communication settings are completed, click the 'OK' button.

(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.





(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

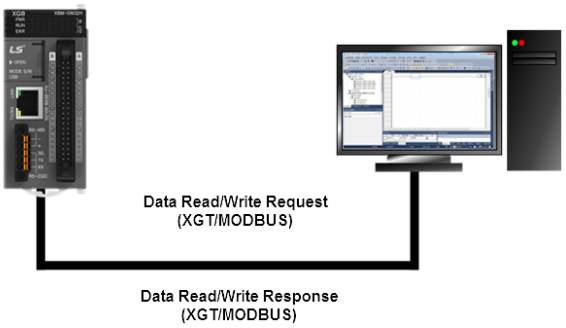
XGB FEnet supports the Modbus protocol that is the industrial standards. The Port No. is fixed as 502.

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

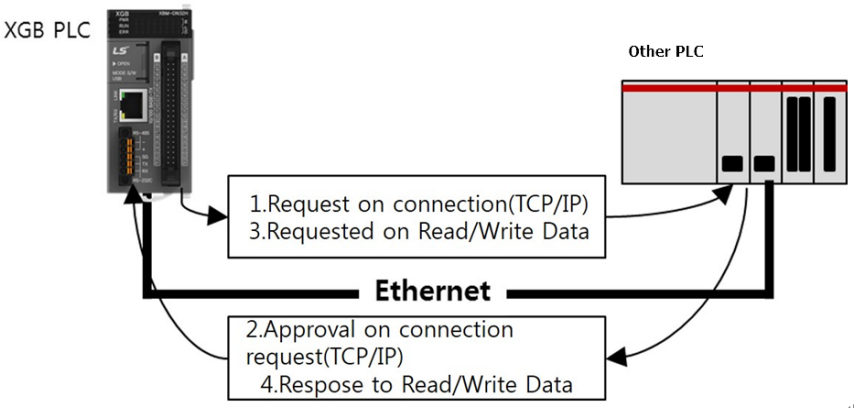
Notice

(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>

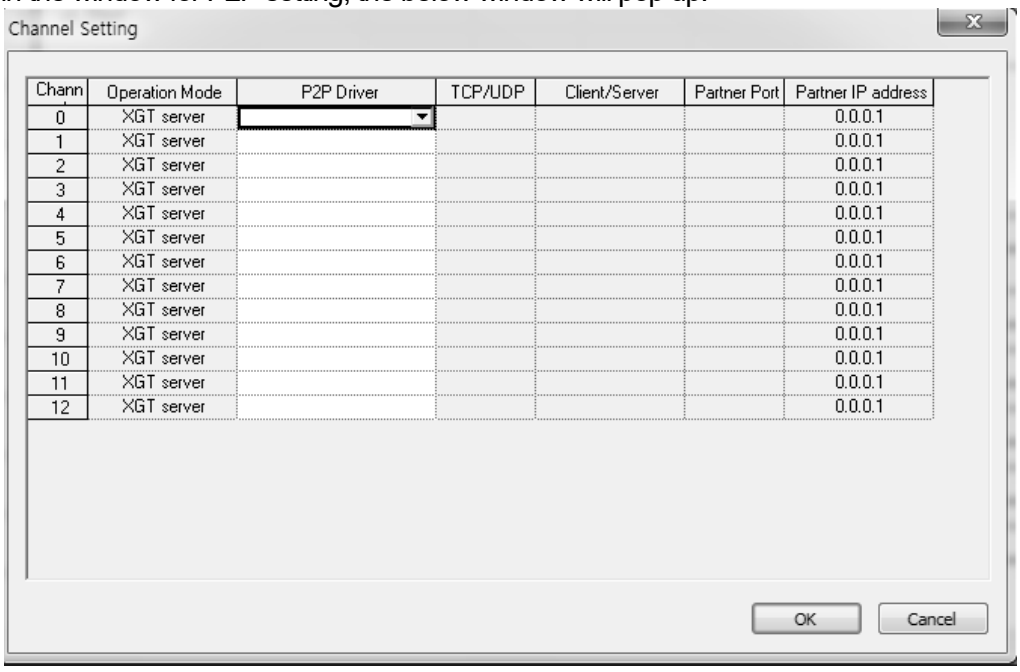
(1) P2P channel setting

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.

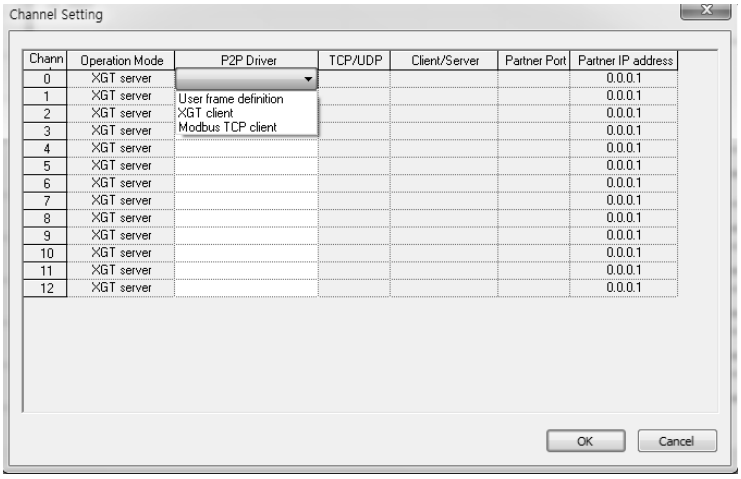
The number of available channels in P2P is the number that subtracts the number of dedicated accesses in the basic parameter from the total number of channels (16). (Number of P2P channels=16– number of dedicated accesses)

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.



You can define the P2P driver type by selecting the'P2P Driver' of the desired channel.



<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. (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. If you select the Modbus TCP, it will be fixed as TCP.
Client/Server		You can select between the Client/Server. 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. 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.

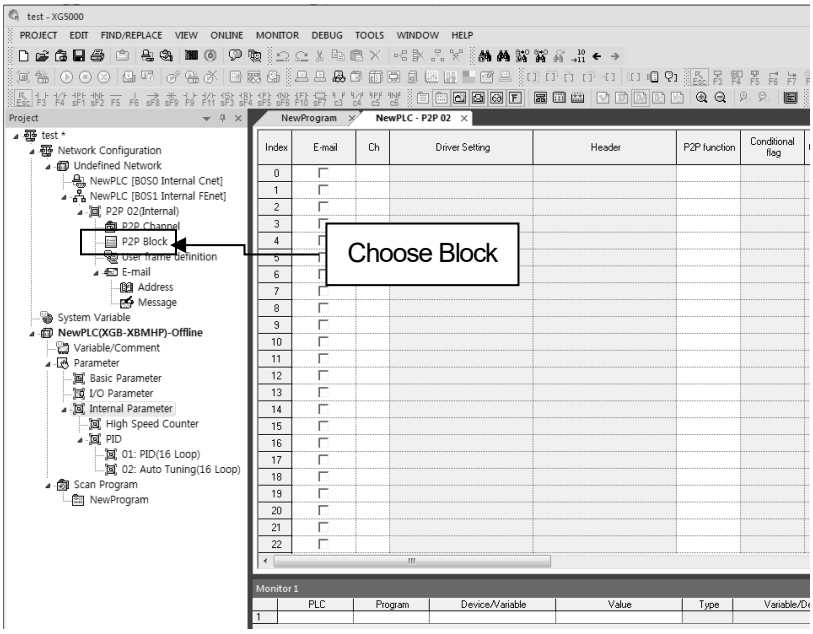
3) How to use the Modbus Driver

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 (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

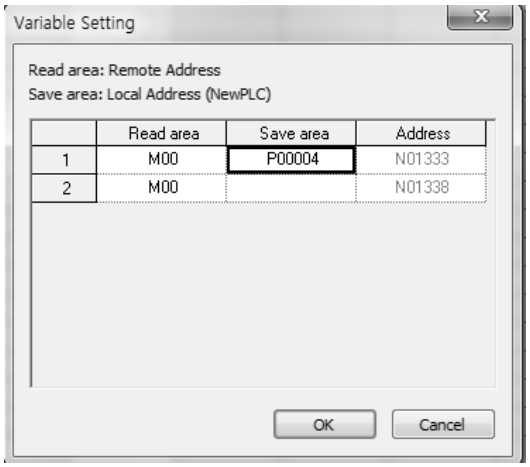
It defines the size of the data to be read when you choose Sequential Read and the data size is different depending on the data type.

(10) Frame

You can select the relevant frame (group) setting that will perform communication when defining the user frame.

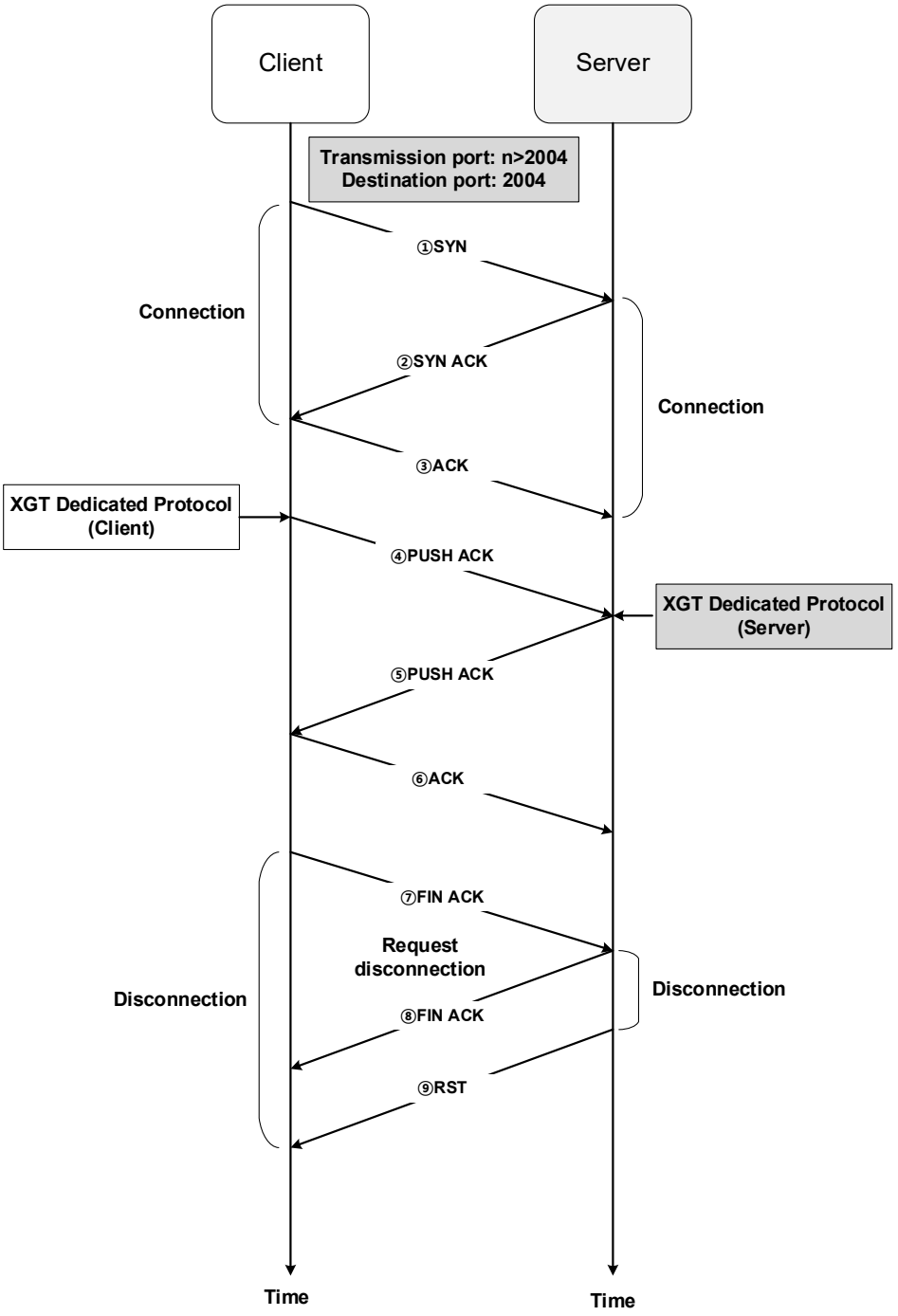
(11) Setting

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.



1.7.5 XGT client

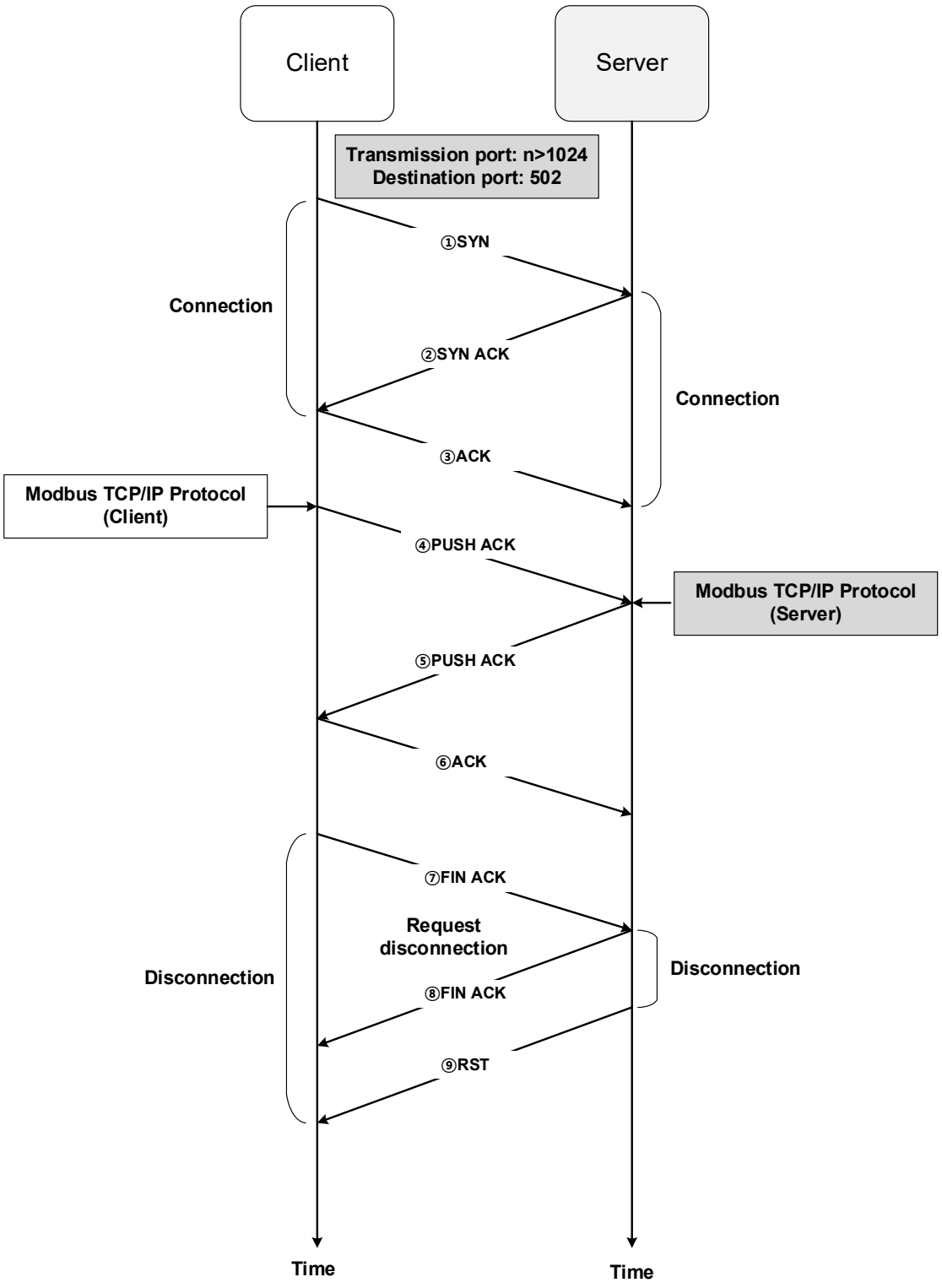
XGT client is the function to Read/Write Data, which transmits the request frame to the server through XGT dedicated protocols. It transmits the frame when the startup conditions of each block set in parameters are On. In the case of XBL-EMTA, you can use the XGT client function in two ways; TCP and 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.



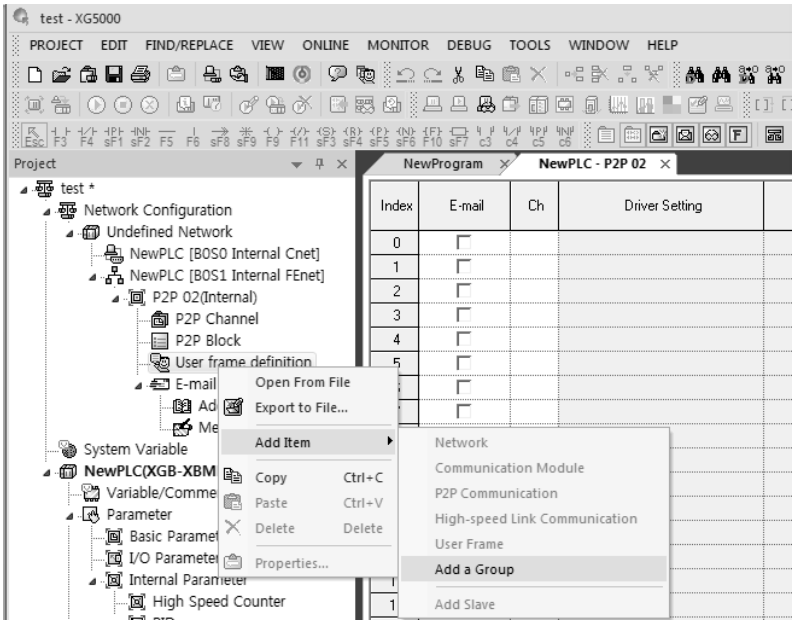
<Setting Modbus TCP client channel>

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.

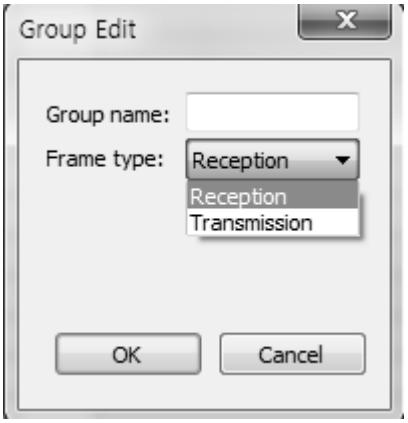
1) Group
It is the set of frames having the same Headers and Tails. To register frames, you need to register groups.

(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.



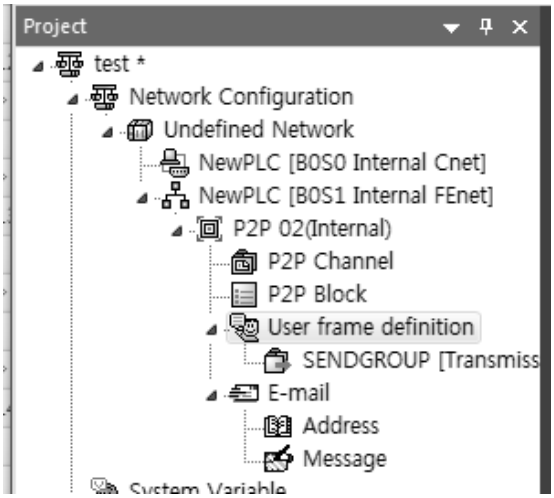
(2) Selecting group names and frame types of the user-defined frame

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.



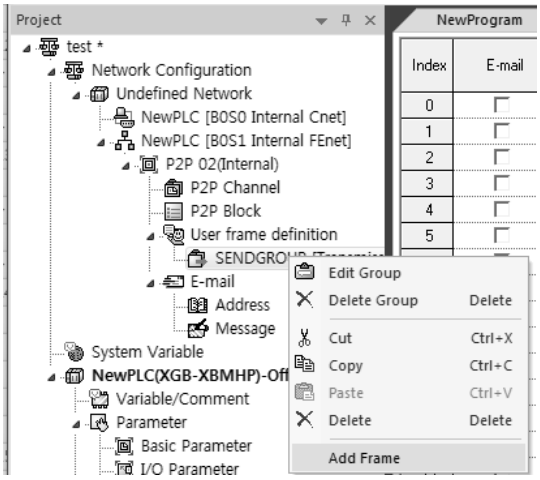
< Completion of adding groups of the user-defined frame>

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.

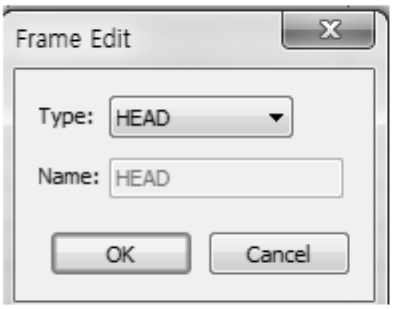
(1) Adding frames to the groups

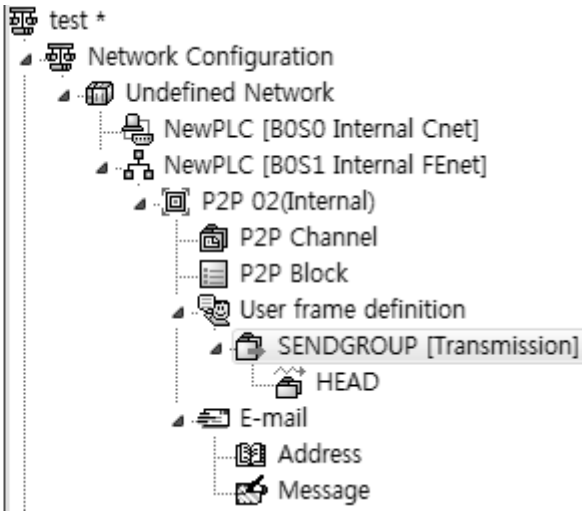
If you click the right mouse button on the added group as below, the popup menu will come on. Choose 'Add Frames' and choose the frame types. The below figure represents the added frames to the group when you select HEAD, TAIL, BODY respectively.



< Adding the transmission frame of the user-defined frame>

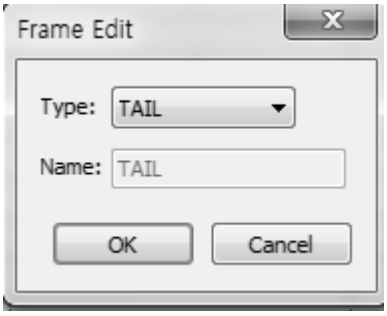
a) Adding the user-defined frame's HEAD



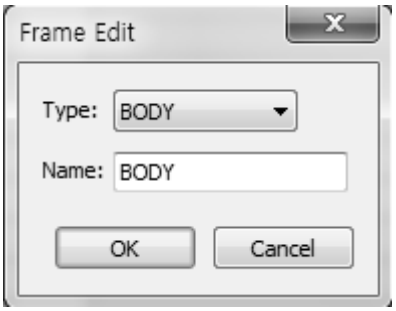


<Adding the use defined frame's HEAD>

(2) Adding the user-defined frame's TAIL



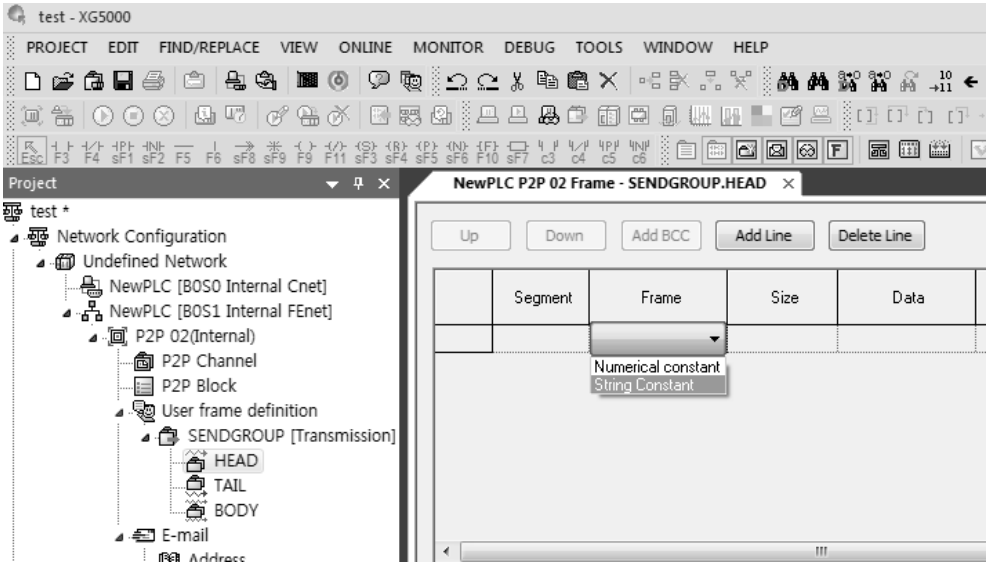
(3) Adding the user-defined frame's BODY

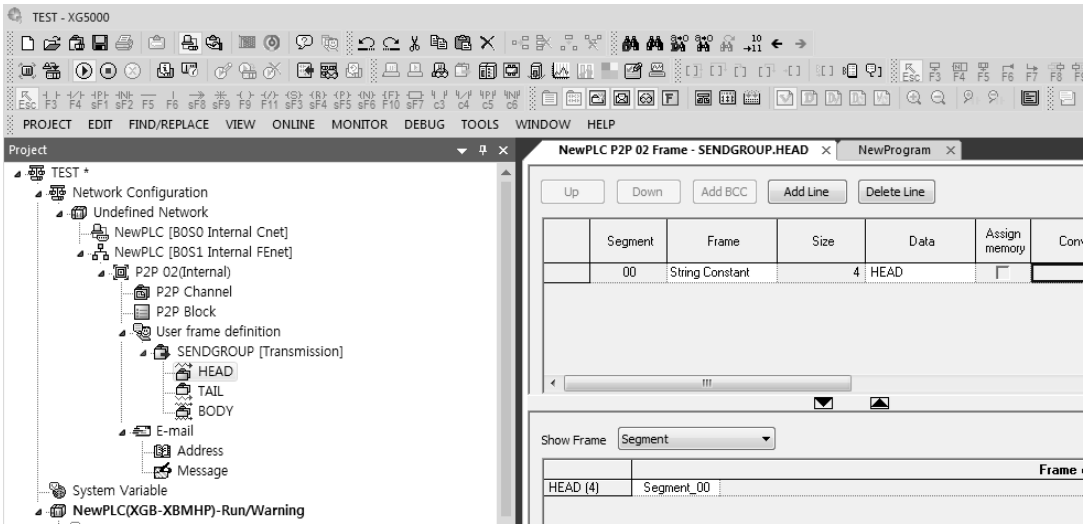


3) Segments

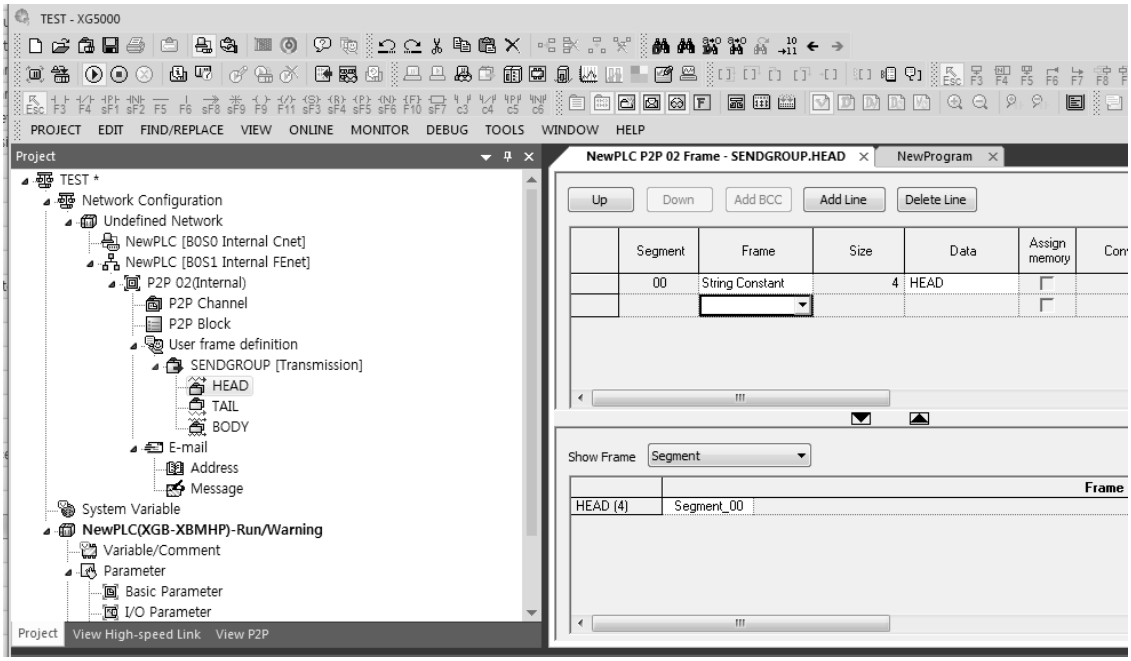
(1) Kind of segments

The frame's Headers, Bodies, Tails are composed of multiple segments. You can add segments by clicking the right mouse button.



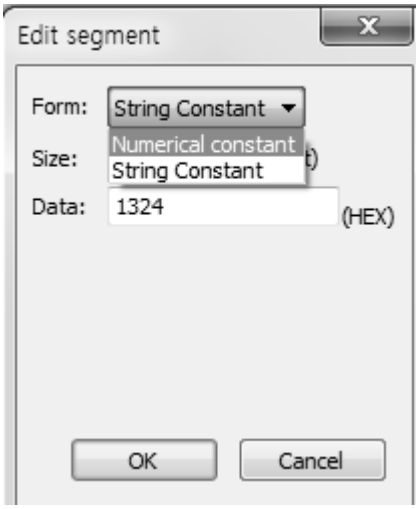


< Example of the window where the segment is registered>



<Example of add line>

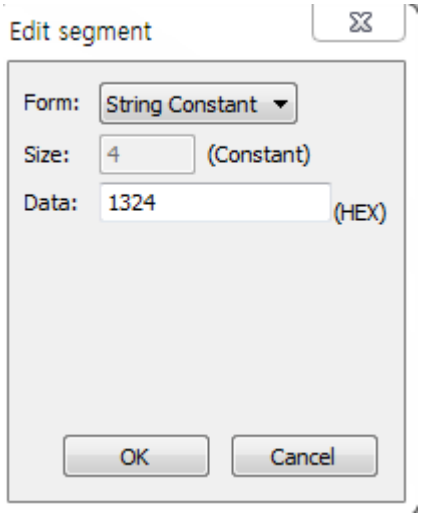
There are the numerical constant, string constant, fixed · variable sized variables for the segments forming the frames.



<Adding segment>

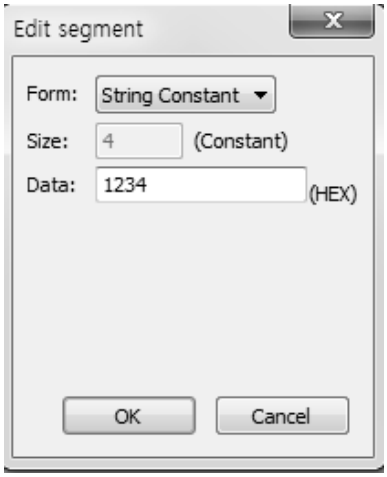
a) Numerical constant

It defines the part that is fixed as the constant among frames and the value of data term should be designated as Hex.



b) String constant

Register the string constant among frames and designate the value of data term as ASCII.



c) Fixed size variables

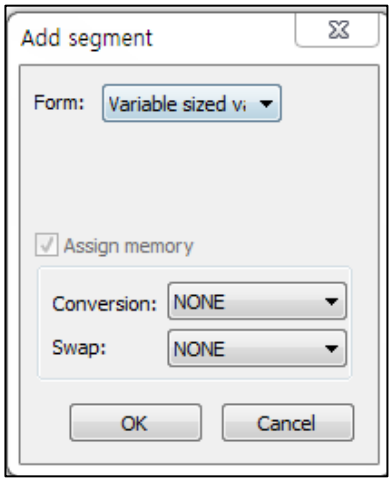
The fixed size variables can be used for the frame's Body area only. It is used when you process the data as much as the defied size among the received frames. If you check memory specification, it can be saved to the PLC memory. At this time, data values can be changed, swapped.

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)



(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.

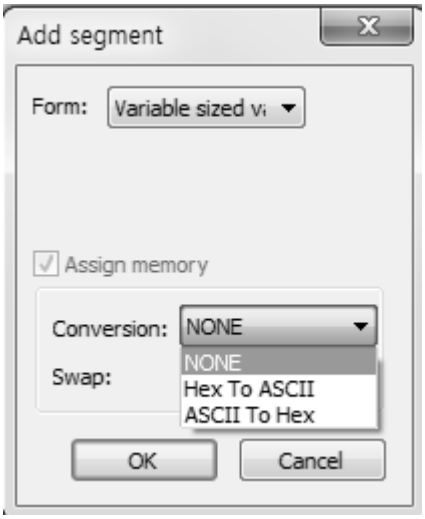
a) Conversion

(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

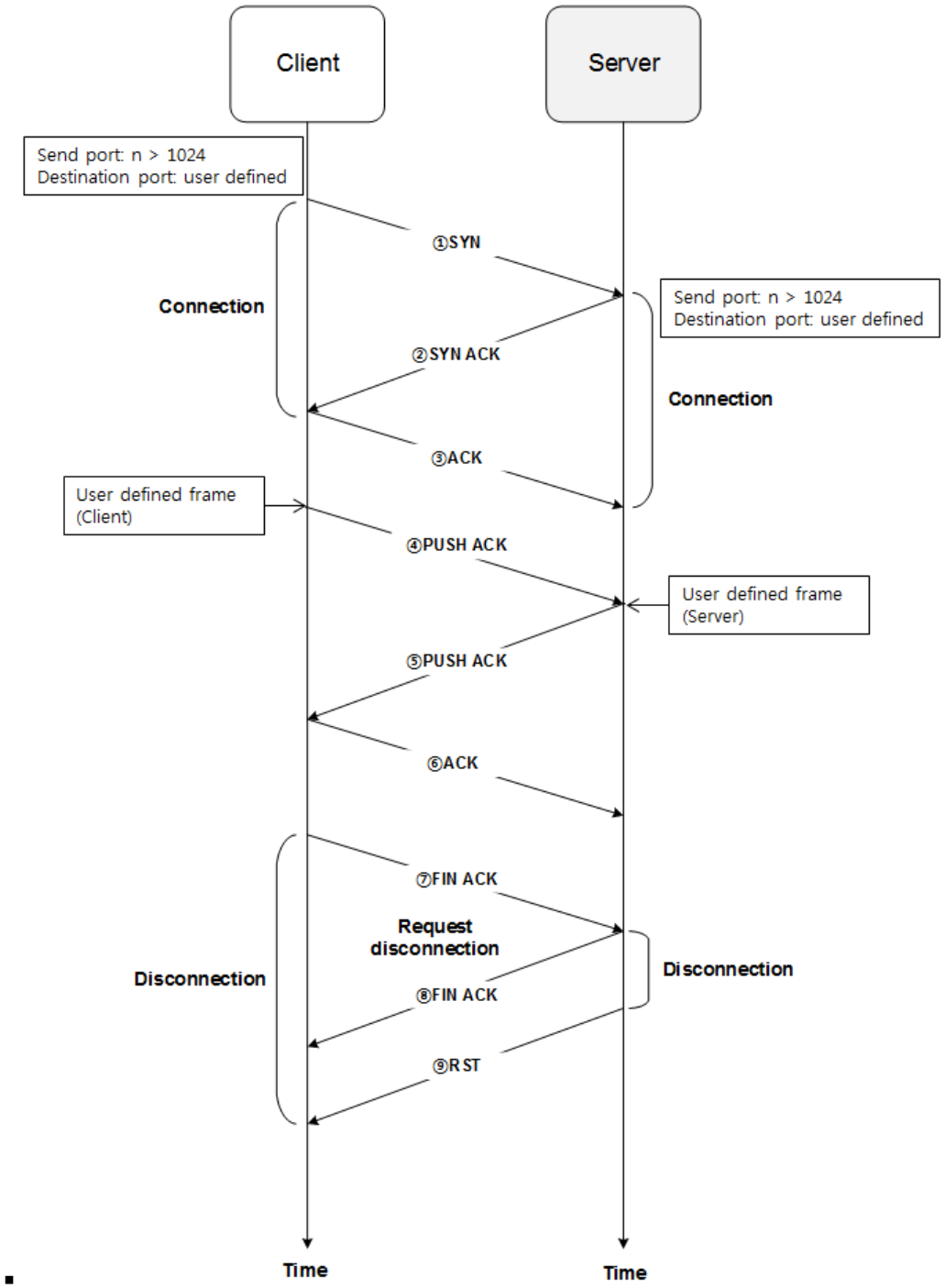
- Swapping the corresponding part of transmission · reception frames by 4 bytes

(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

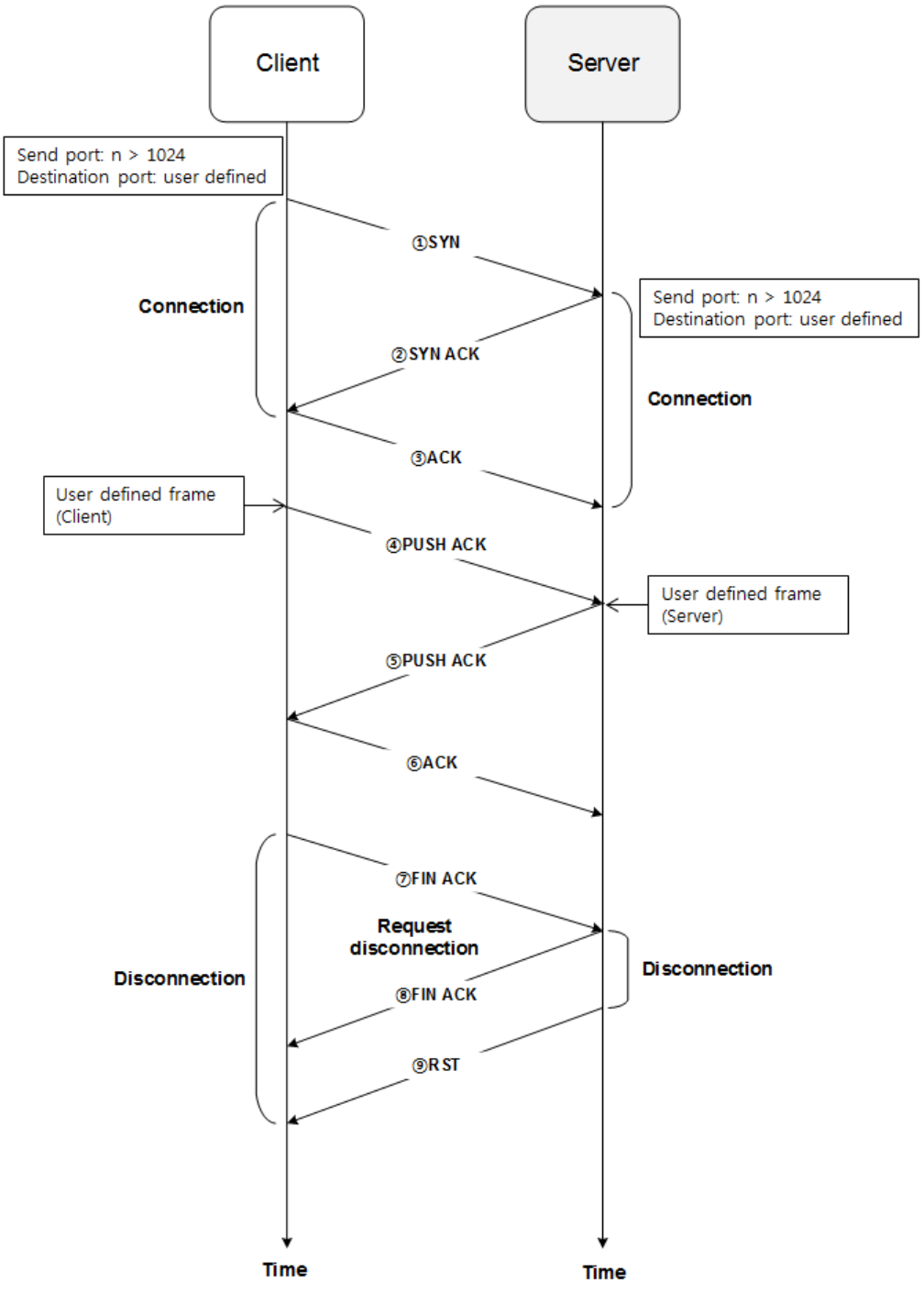
4) TCP/UDP user-defined frame server



▪<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>

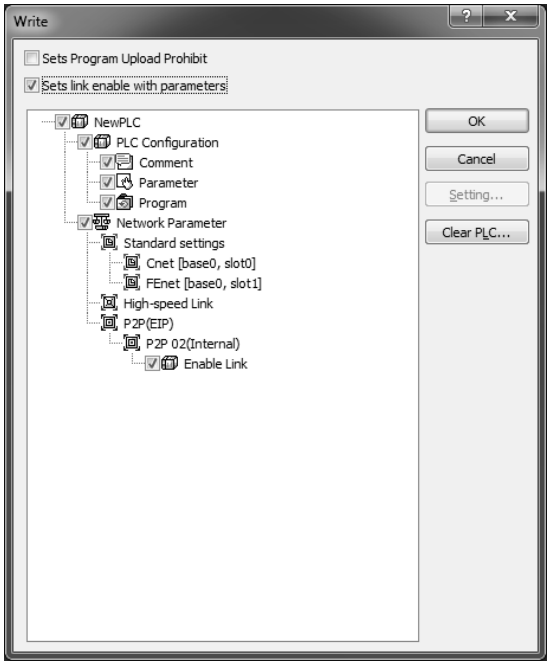
1) It is the function to transmit the frame that is registered in the transmission block to the port designated by a user.
2) If the startup conditions of the block are On, the connection request will be sent to the server and the frame registered in the transmission block will be sent to the corresponding 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.

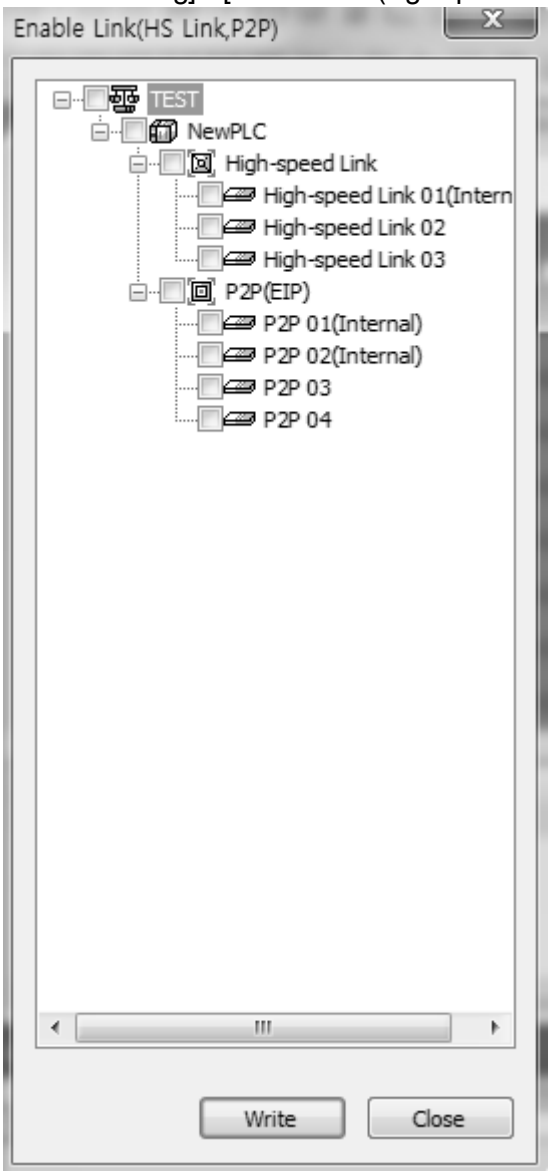
1) P2P parameter download

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.



(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.

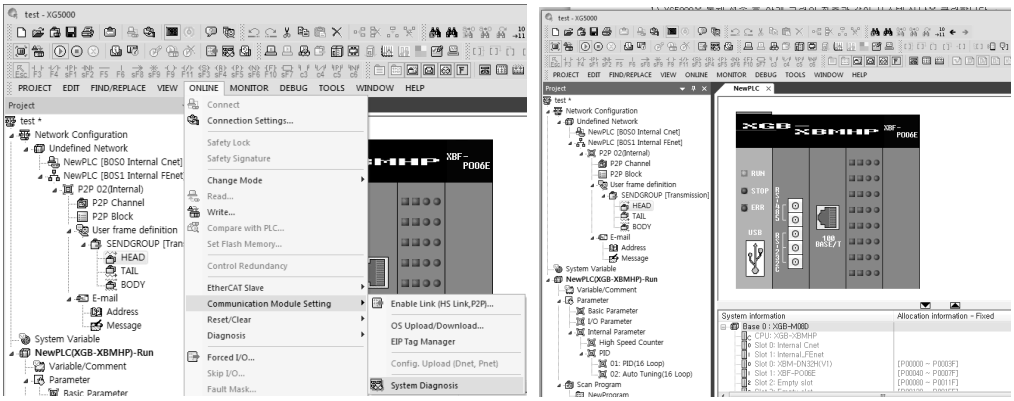


Choose the P2P parameters to be started in the [link Enable (high speed link, P2P)] window. If you cancel the already checked P2P parameter, the relevant P2P service will stop.

1.7.9 P2P diagnosis function

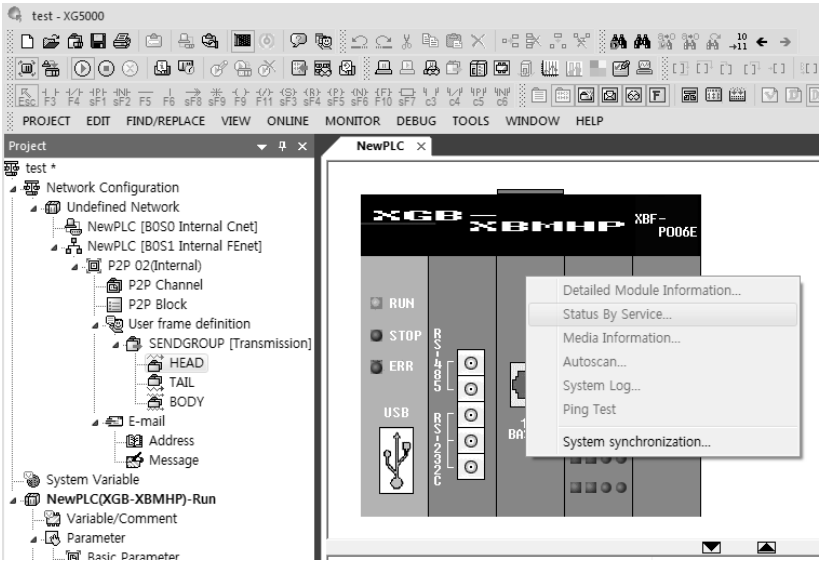
1) Click the System Diagnosis as shown in the left figure after access through XG5000.

2) Then, the current system is displayed as shown in the right figure.

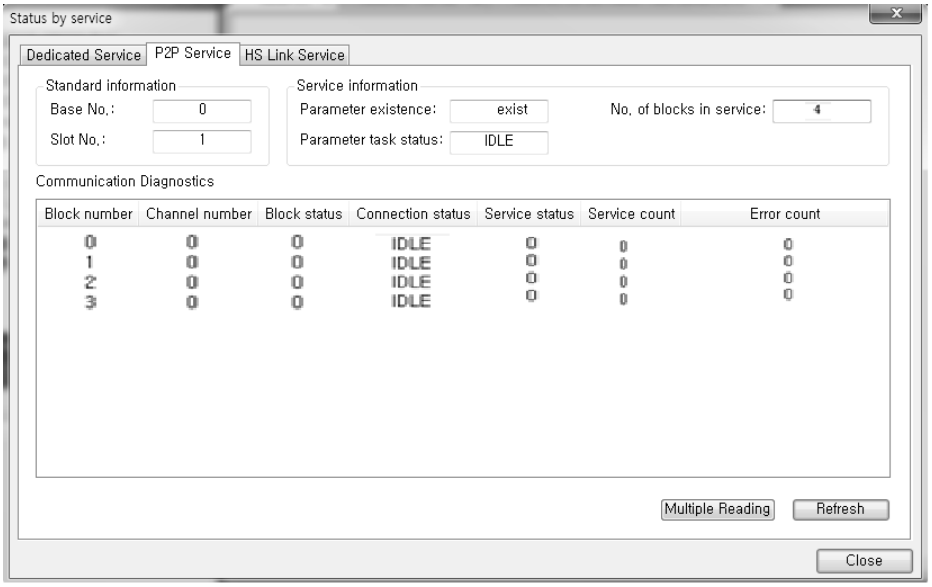


3) Put the mouse on the figure of the module and click the right mouse button as shown in the left side of the below figure.

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.



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

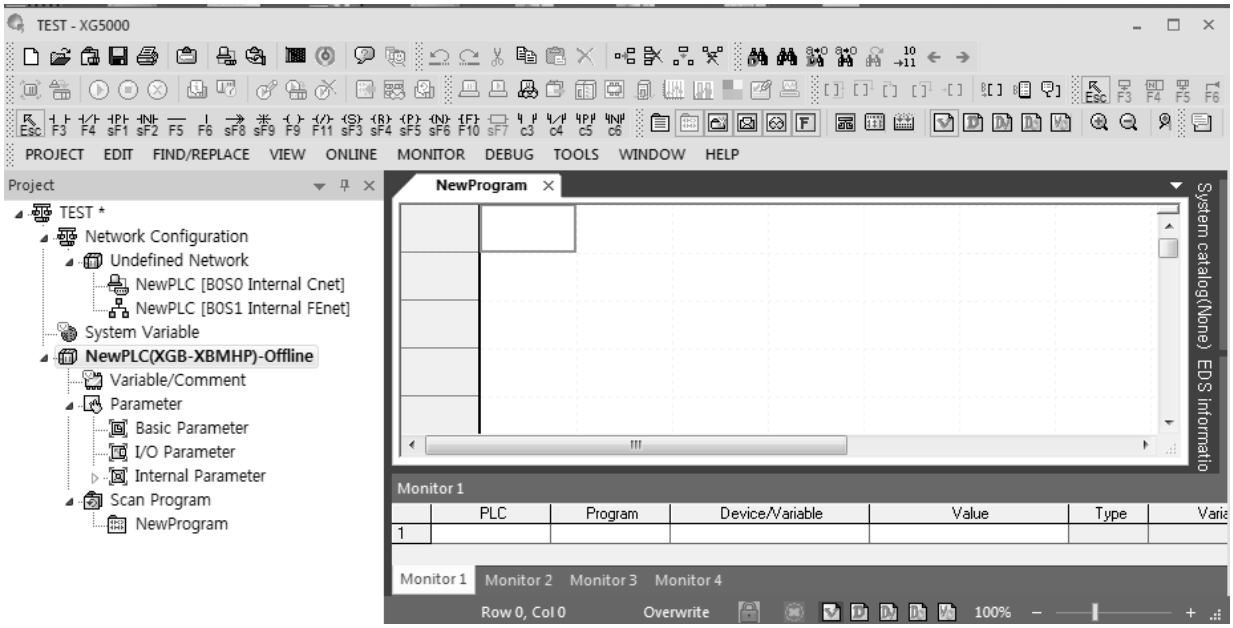
1.8.1 Outline

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.

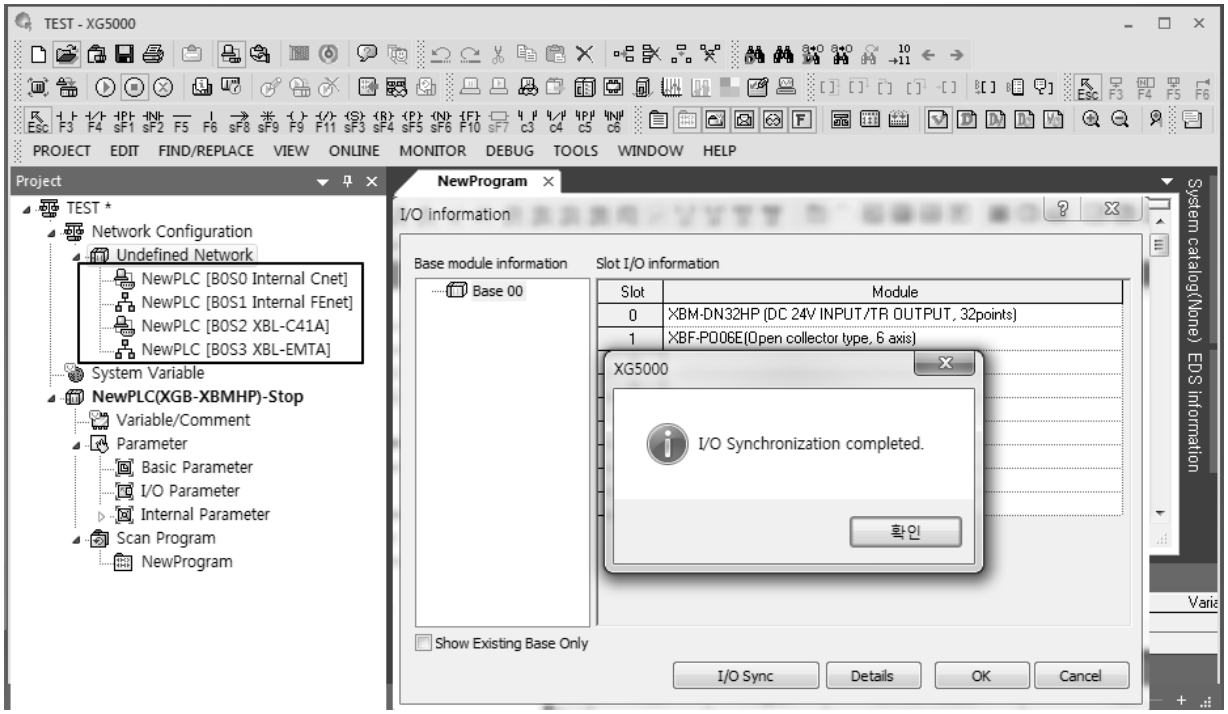
1.8.2 Parameters setting

1) Basic parameters
(1) When creating the XG5000 project, any RUN communication modules are not registered in the basic network.



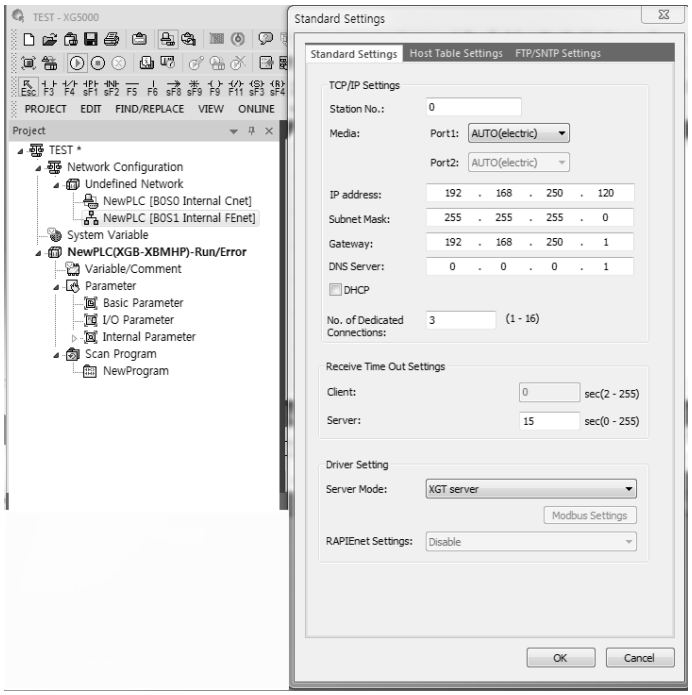
[Fig. 1.8.1] Creation of XG5000 project

(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.



[Fig. 1.8.2] Registration of XG5000 project communication module

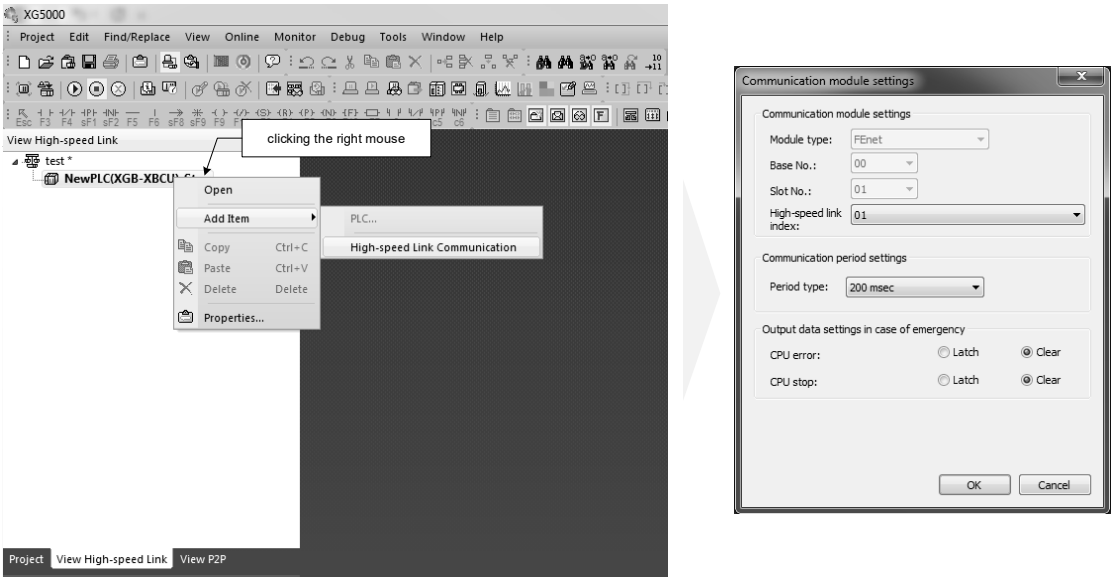
(3) Double-click the built-in Fenet and input high speed link's exchange number and network parameter information.



[Fig. 1.8.3] Setting the basic communication module

2) High speed link parameter

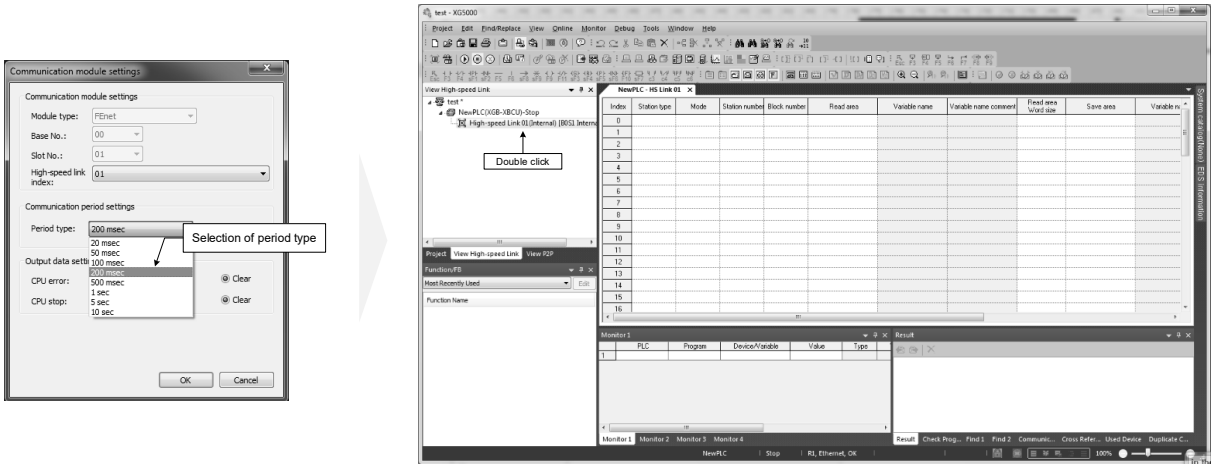
(1) Communication setting



[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].

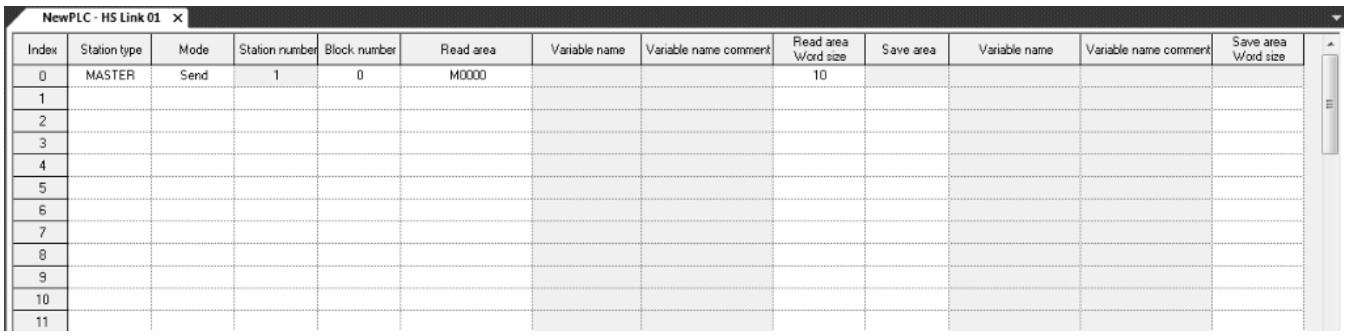
b) Then, the window for setting communication modules is activated as shown in the right side of the figure[1.8.4] and you can set the basic high speed link. No.01 high speed link is the built-in FEnet and No. 02 and 03 .high speed links can be used for expansion communication modules as before.



[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


NewPLC - HS Link 01

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

NewPLC - HS Link 01

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

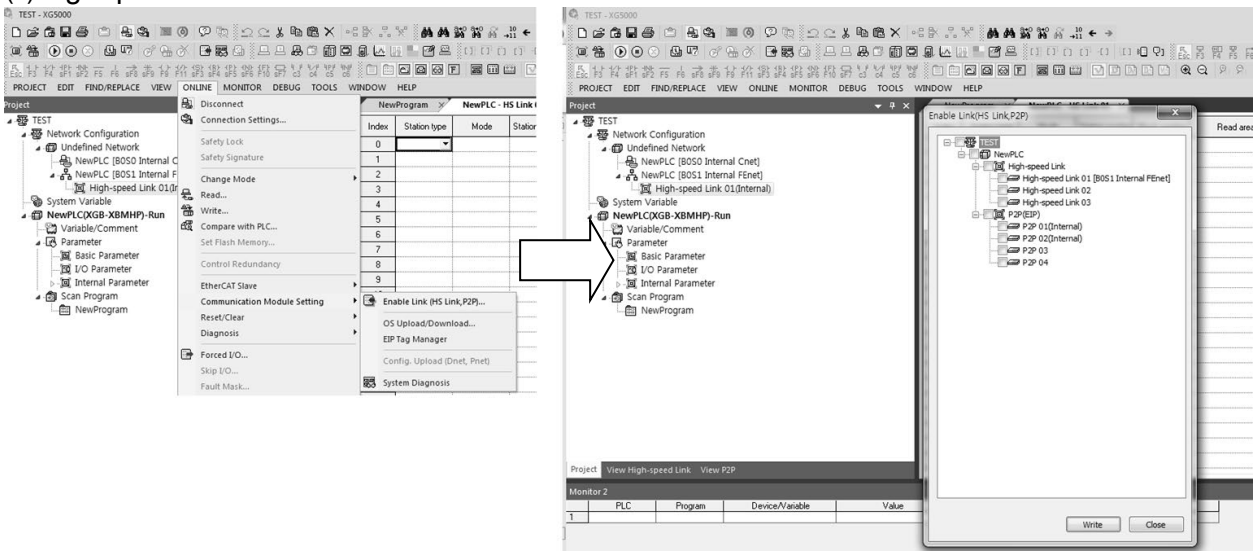
g) Numbers are received to each area of XGB CPU modules.

h) If you input the word size of the data to be read, setting reception block is completed.

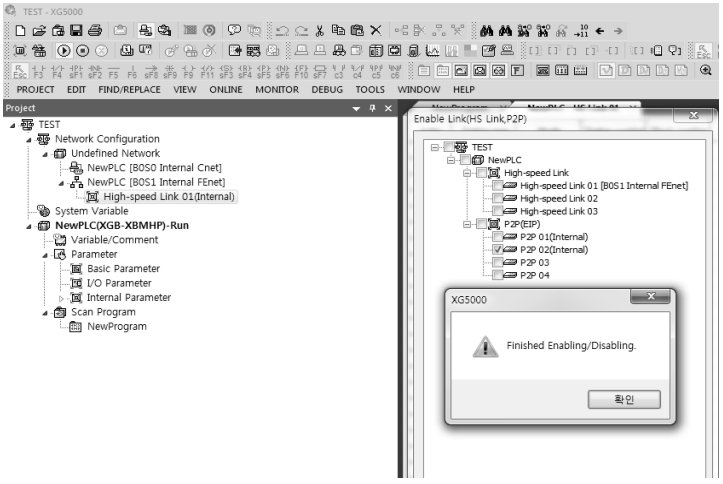
(4) HS parameter download

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



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

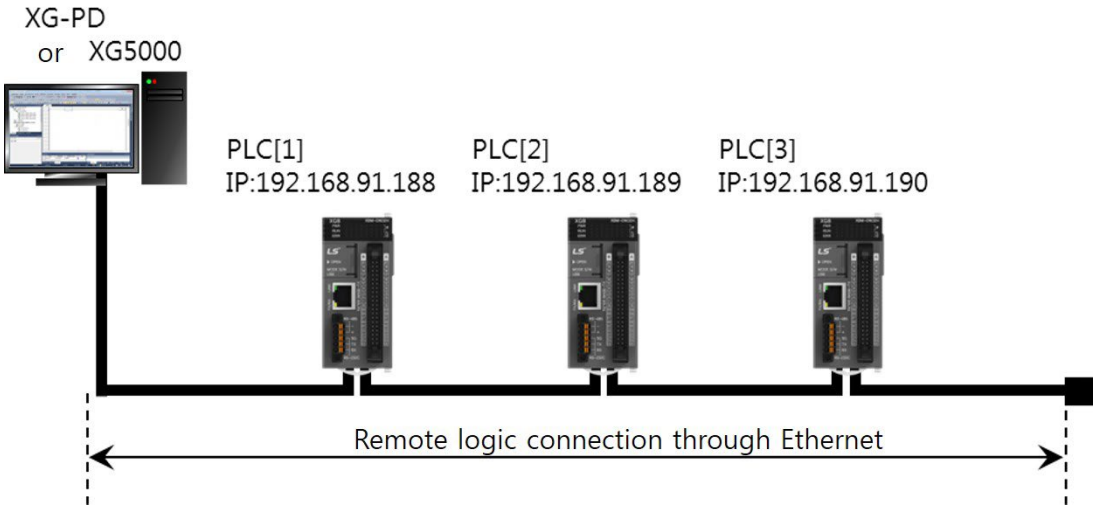
※ The above values are based on using high speed link only.

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.

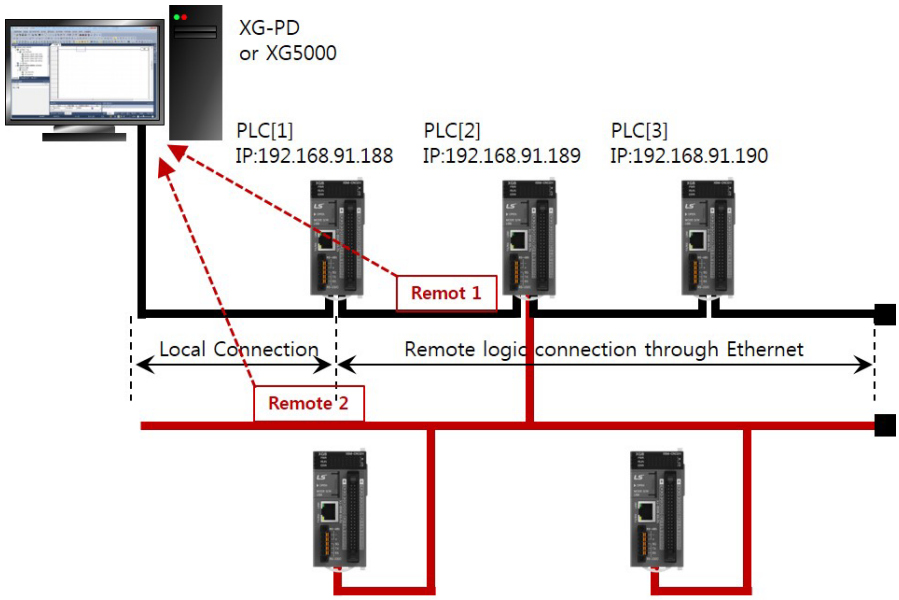
To access the details of the PLC #N station in the above figure, set the access method as Ethernet in access setting of XG5000's online menu and input the relevant PLC #N station's IP and remote stage. In this status, you can realize all functions in the PLC #1 such as programming, download, debugging 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.

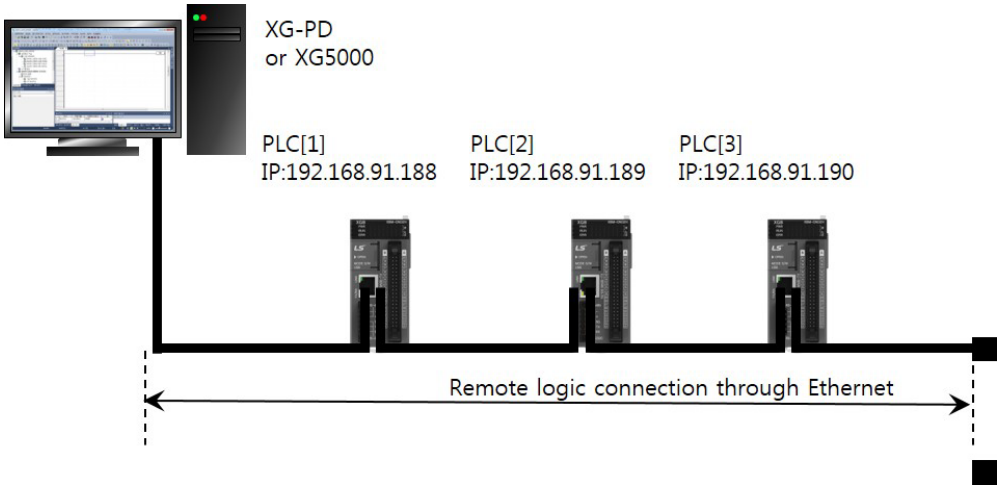
The below figure describes the remote 1-stage and 2-stage access methods.



The above figure shows the example of 1-stage (PLC B) and 2-stage (PLC E) access in the system composed of two networks.

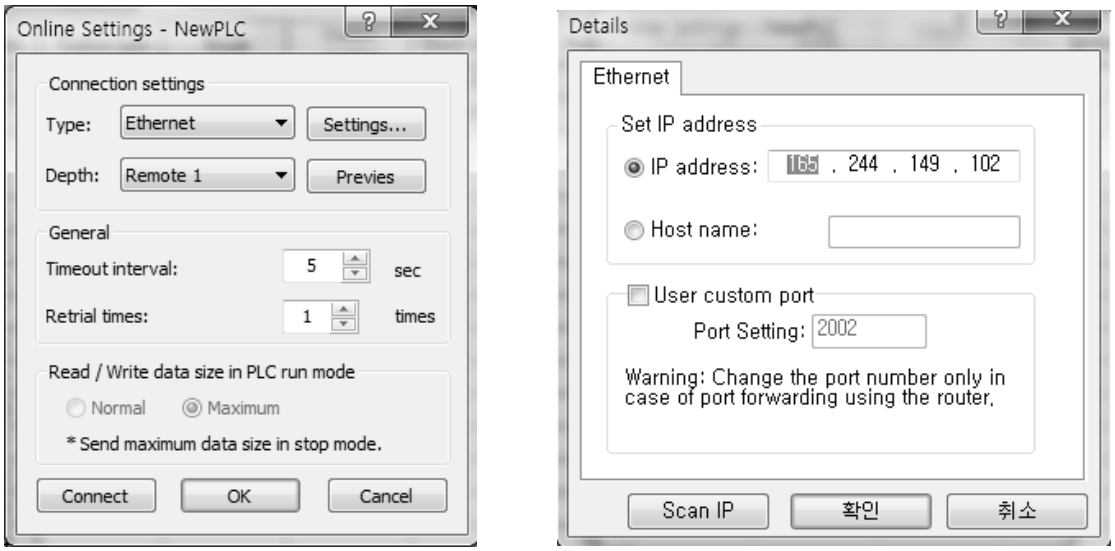
1) Direct and remote 1-stage access in the PC connected to Ethernet

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.



[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

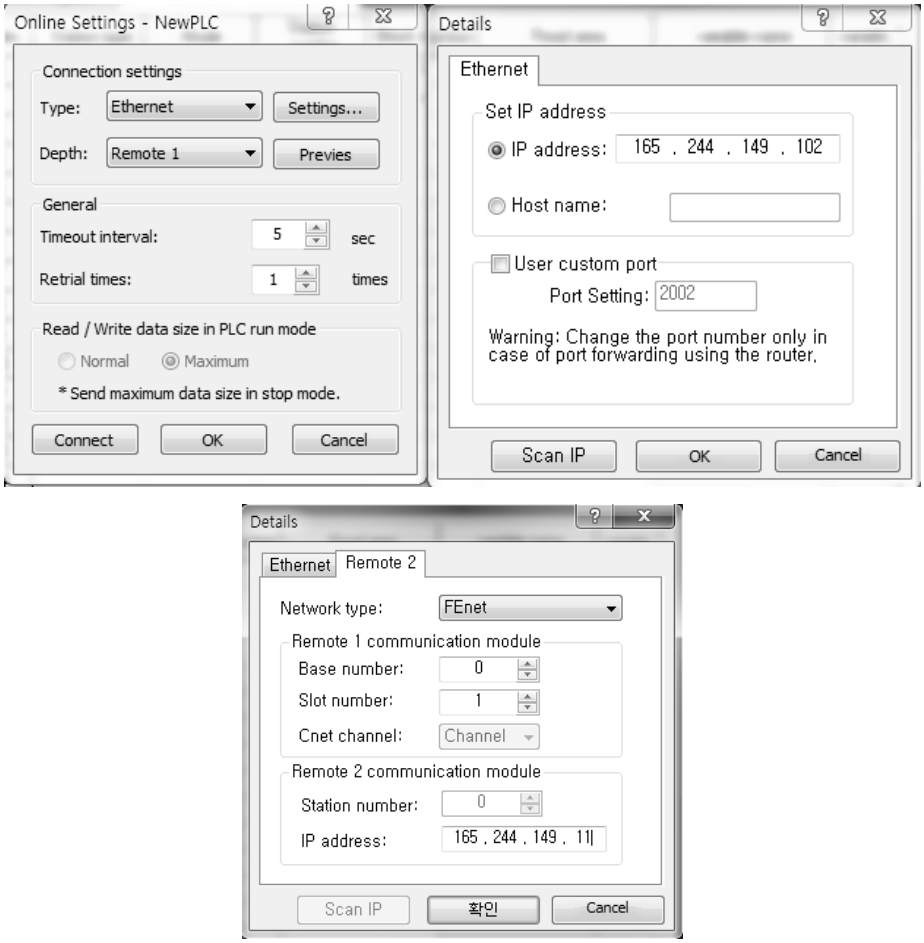
Record the IP address of the FEnet I/F module to be accessed.

(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.



[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.

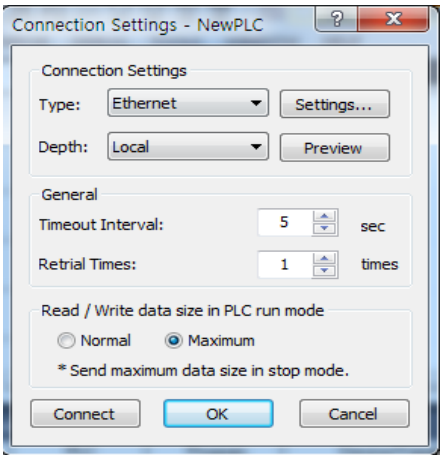
1) Local Ethernet connection from PC connected to Ethernet

-If PC with XG5000 is connected and PLC is connected, you can connect Ethernet locally to PLC without connecting USB.

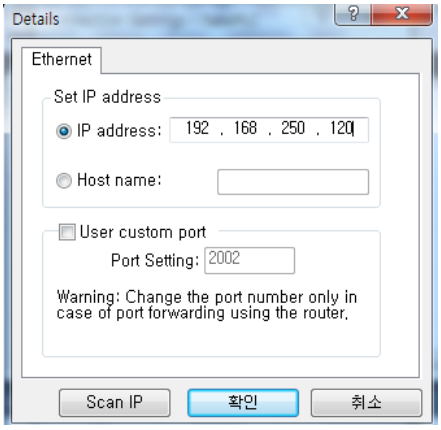
Local connection by Ethernet

2)Local Ethernet connection

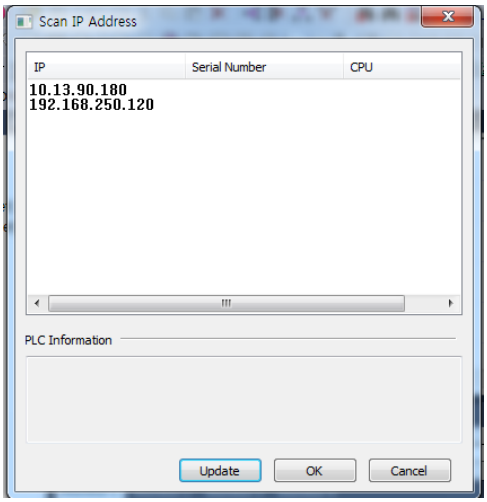
XG5000-[ONLINE]-[Connection setting] and choose local



Click [Setting] and input IP Address. Initial IP adress is 192.168.250.120 .



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.



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)

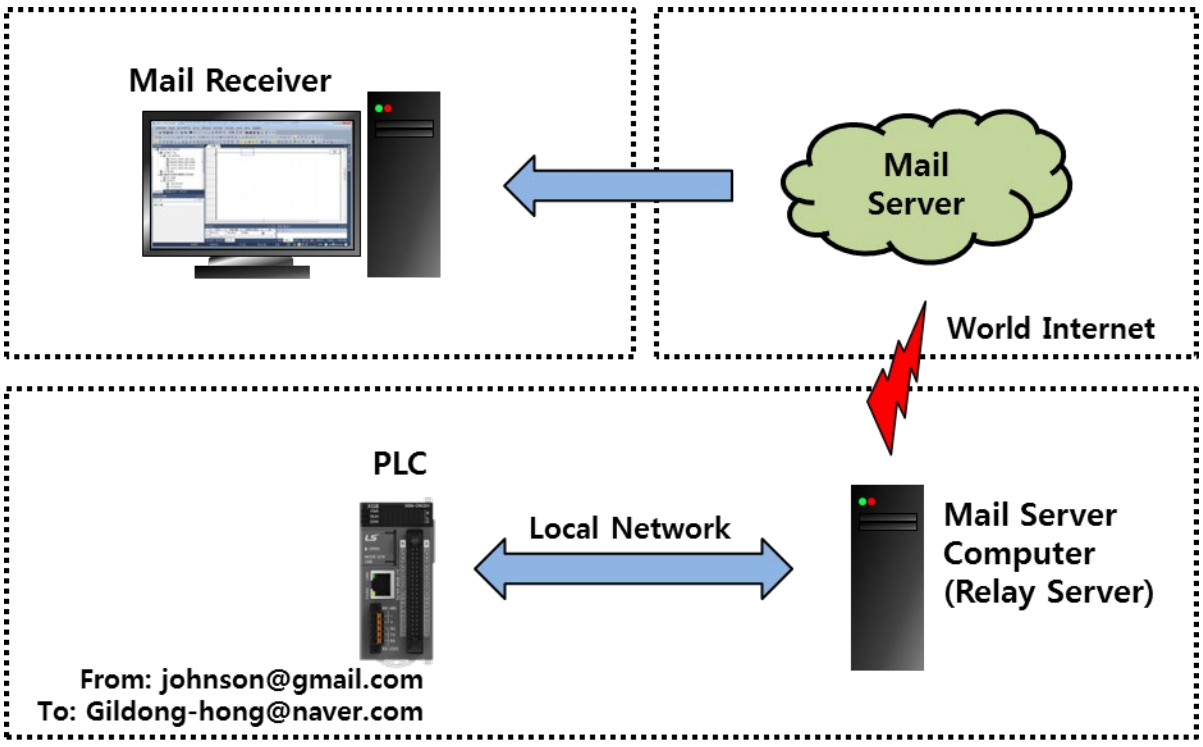
XGB high-performance module PLC supports the Simple Mail Transfer Protocol (SMTP). The SMTP is the protocol to send the E-mail on the Internet. The using TCP Port is No.25. In the SMTP that is the text-based protocol, not only request/response messages but also all characters should be 7 bit ACSII.

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.



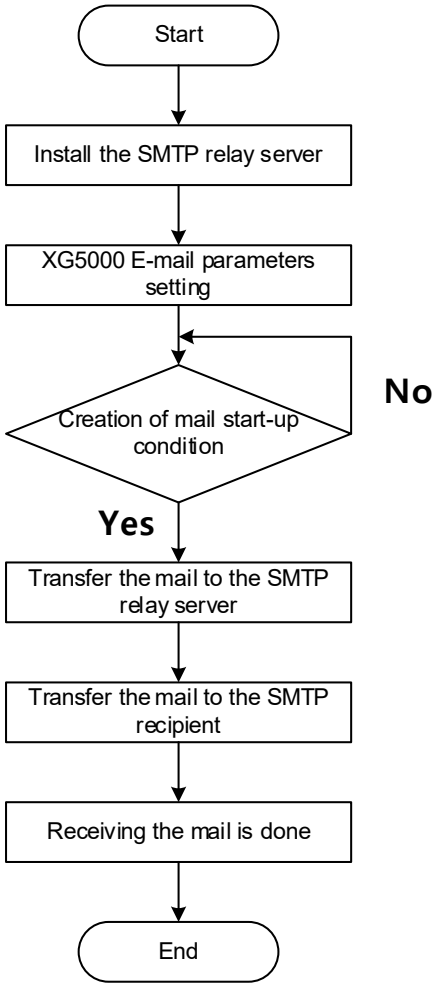
[Fig. 11.1.1.1] E-mail transfer process

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

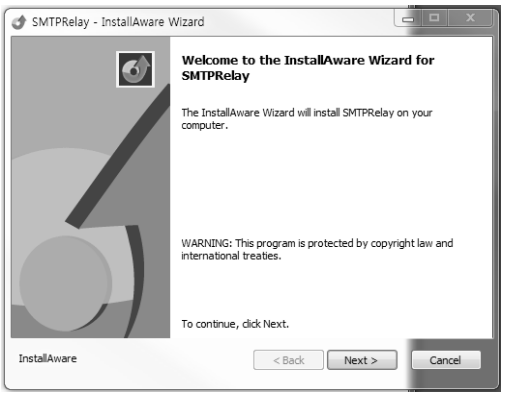
In order to use the common E-mail function, you need to set up the E-mail parameters and relay server.

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).

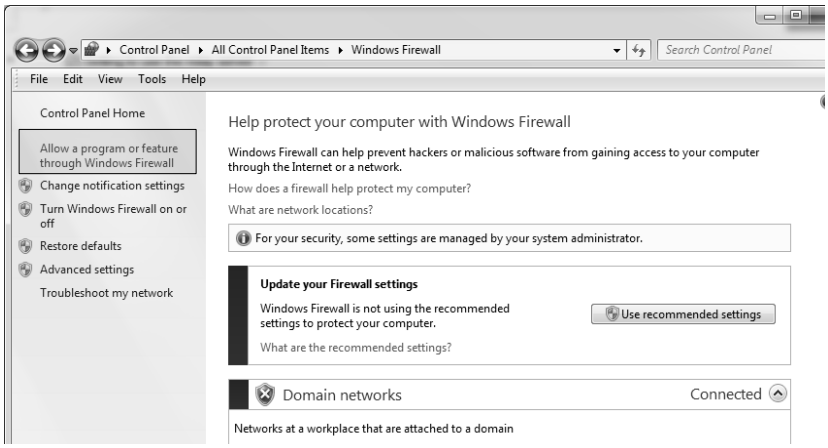
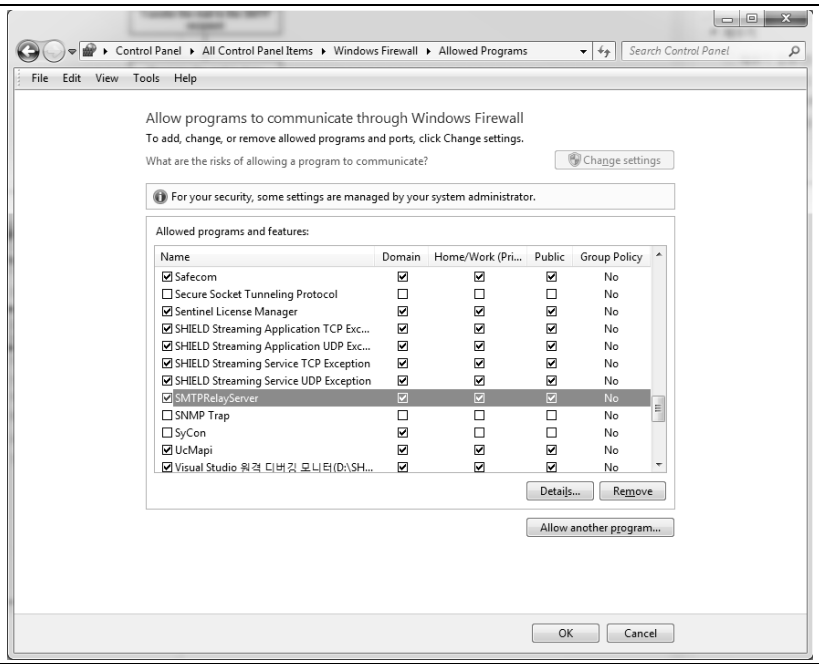
-website: https://sol.ls-electric.com/ww/en/main

(1) Installaiton of the relay server

<table>
<tr><th>Procedures</th><th colspan="2">Description</th></tr>
<tr><td rowspan="2">1</td><td>Program execution</td><td> 
</td></tr>
<tr><td colspan="2">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.
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.</td></tr>
<tr><td rowspan="2">2</td><td>SMTP relay server operations</td><td>
</td></tr>
<tr><td colspan="2">1) If you double-click the ‘SMTPRelayServer’ icon on the desktop, the program will run as shown in the SMTP Relay server window.</td></tr>
</table>

(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.

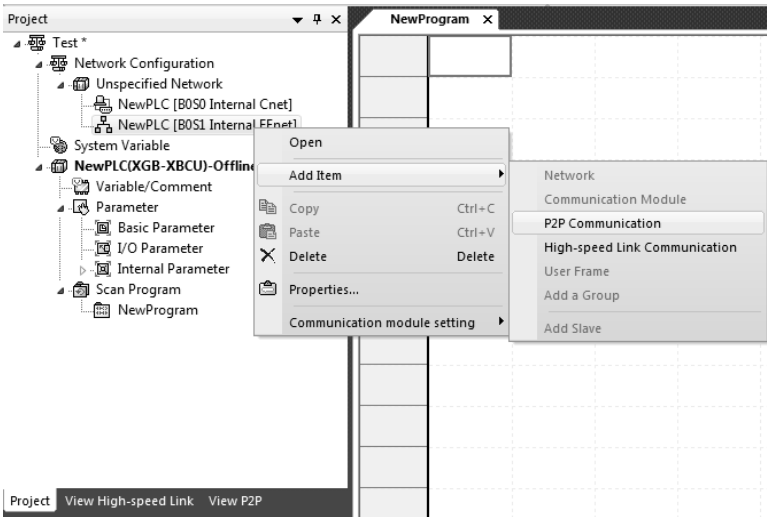
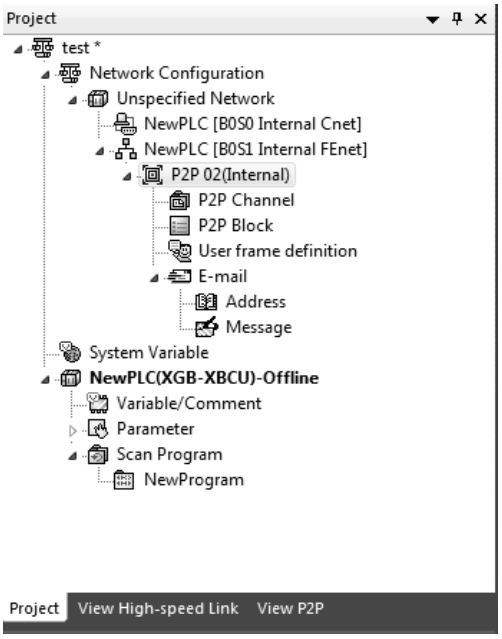
Procedures	Description	
1	Firewall setting	
	1) Click Windows – Control Panel – Windows firewall. 2) Through 'Windows Firewall' in the upper-left of the Windows firewall setting screen, click the Program or Firewall Enable.	
2	Firewall Enable	
	Find the program called 'SMTPRelayServer' and check all items of domain, home/company(individual), common areas and then, click the 'OK' button.	

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	
	1) Double-click 'E-mail' in the P2P setting project window. 2) Set up the values referring to each E-mail's set value. 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.

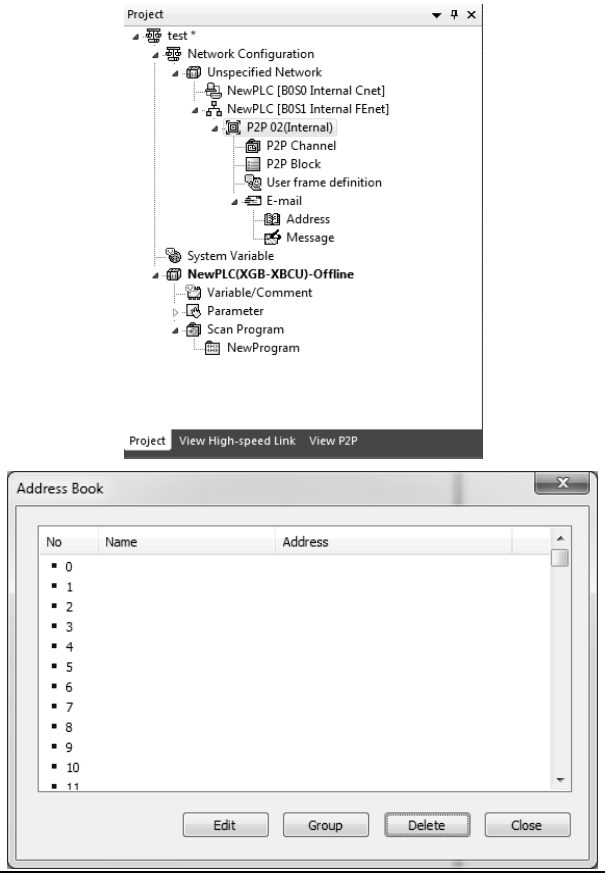
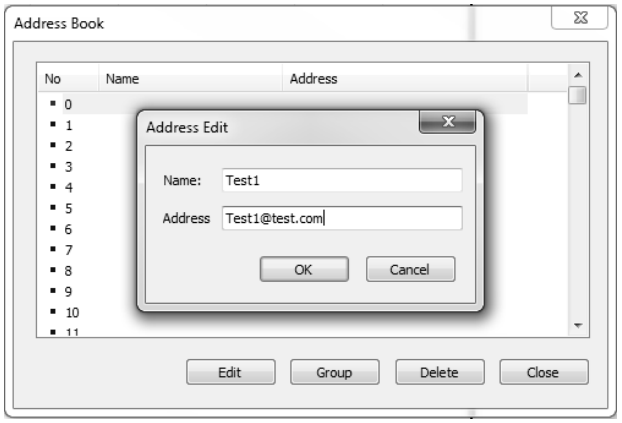
(2) The account name and password of the SMTP server information should be registered in the SMTP server. If you do not have any account, please register the account in the mail server for use.

(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

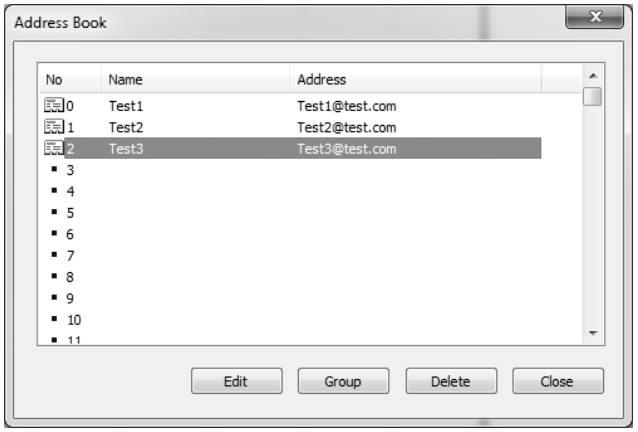
(1) (3) Wirting an address book

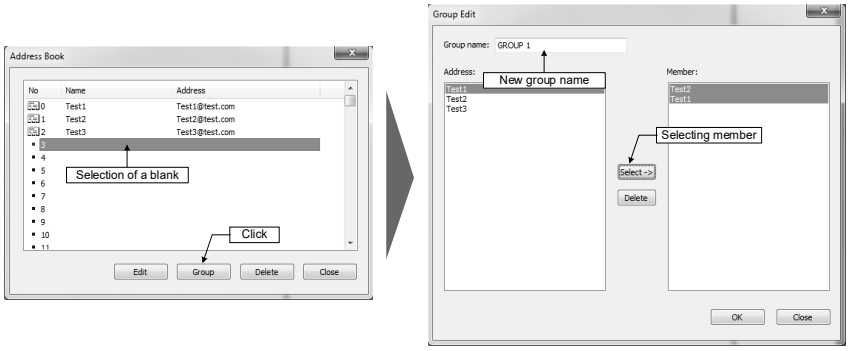
You can write the recipient's mail address used for the E-mail service as shown below.

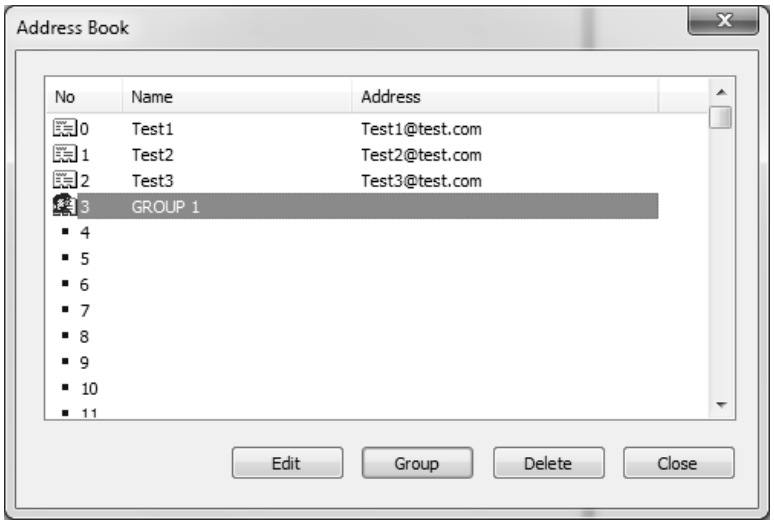
<table>
<tr><th>Procedures</th><th colspan="2">Description</th></tr>
<tr><td rowspan="2">1</td><td>Create the address book</td><td> 
</td></tr>
<tr><td colspan="2">After selecting [Embedded FEnet] in XG5000's project window, double-click the address of [P2P 02(embedded)] or double-click the address of P2P No.2 in [P2P View].</td></tr>
<tr><td rowspan="2">2</td><td>Register the address</td><td> 
</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.

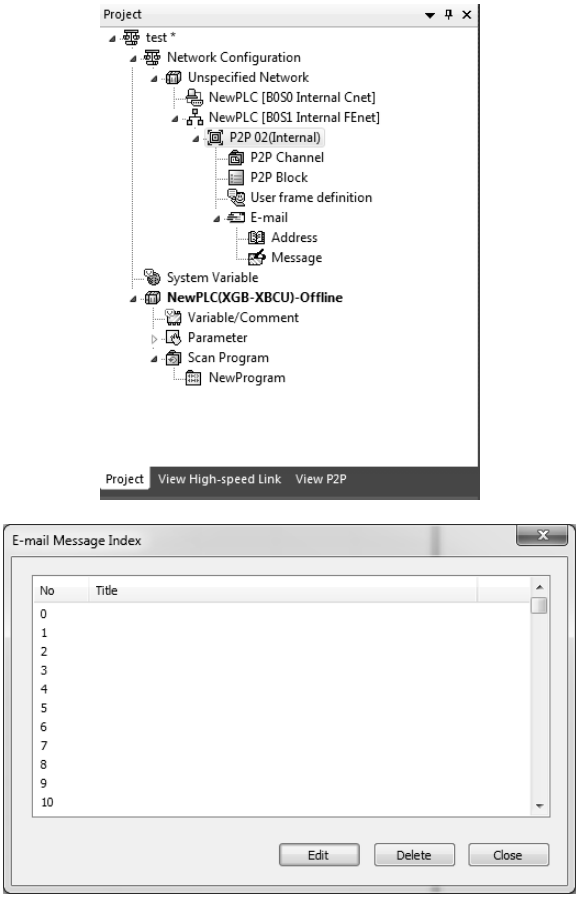
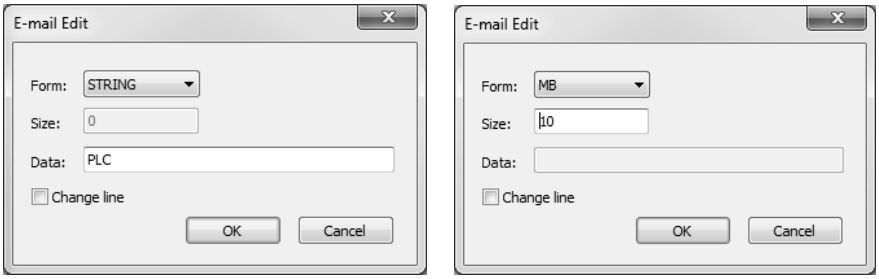
<table>
<tr><th>Procedures</th><th colspan="2">Description</th></tr>
<tr><td rowspan="2">1</td><td>Create group</td><td> 

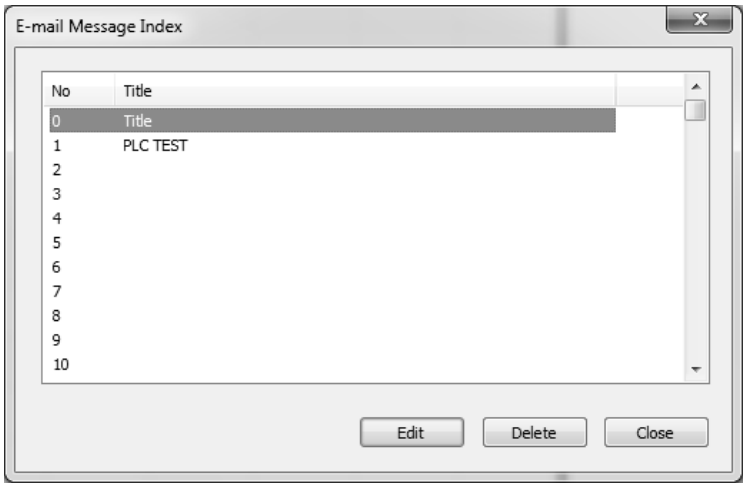
<Address book></td></tr>
<tr><td colspan="2">1) Double-click the address of P2P No.2.</td></tr>
<tr><td rowspan="2">2</td><td>Register group</td><td> 
</td></tr>
<tr><td colspan="2">After selecting to a blank of [Address book], select [Address book]- [group], the edition window for E-mail address book's group will be created. The details of the group edition window are as shown below.
1) Group name: Name of the group to create newly
2) Contact information: Currently registered addresses
3) Members: Addresses to be included to the group
4) Select: It adds the addresses selected from the Contact Information to the Members.
5) Delete: It deletes the addresses selected in the Members from the Group.
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.</td></tr>
</table>

Procedures	Description	
3	Confirm creation of the group	
	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.	

(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> 
</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> 
</td></tr>
<tr><td colspan="2">Click the 'Add' button in the E-mail message editing window and input the details to send.
The configuration and details of E-mail edition are as shown below.
1) Format: Selection of the message type
- STRING: Selected when the transferred message is a string type
- MB: Selected when the transferred message is a device type
2) Size: It is activated only when the format is [MB]. It means the size of Byte.
3) Data: It is activated only when the format is [STRING]. You can input the test to send.
4) Line break: Means the break of a message line.</td></tr>
</table>

Procedures	Description	
3	Confirm creation of messages	
	When the creation of the message is complete, the title will be added to the list of e-mail messages index.	

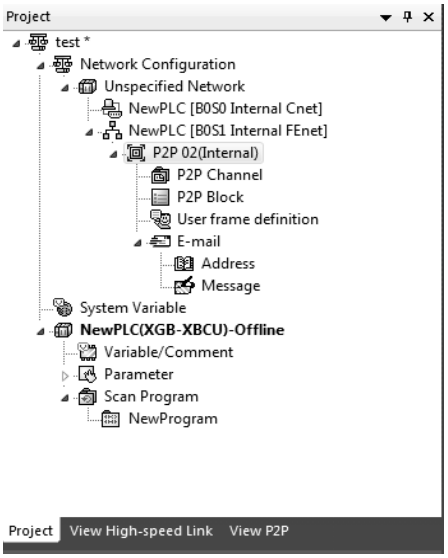
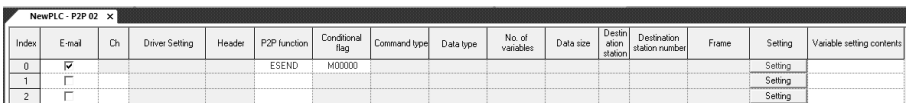
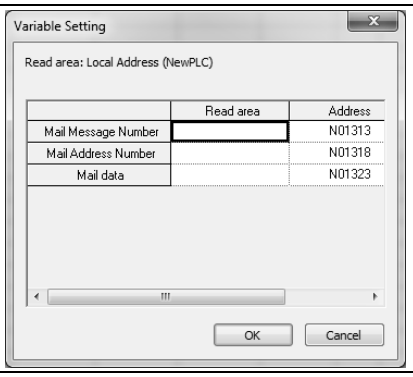
Notice

(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> 
</td></tr>
<tr><td colspan="2">1) In the P2P parameter setting window, tick the [E-mail] checkbox.
2) Select [ESEND] in P2P functions.
3) Set up the start-up conditions to transfer E-mail.</td></tr>
<tr><td rowspan="2">3</td><td>Setting</td><td> 
</td></tr>
<tr><td colspan="2">Click the setting button to set up each variable.
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.

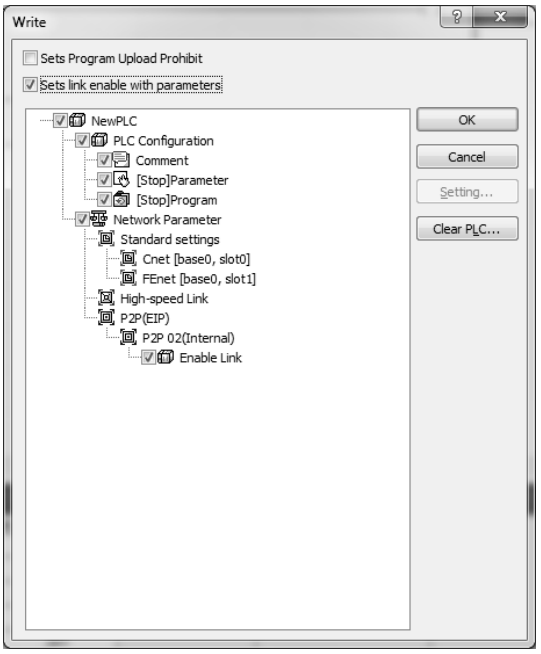
Item			Description
E-mail			It enables you to use the E-mail service.
P2P function		ESEND	It sends the E-mail.
		ERECEIVE	It receives the E-mail.
Setting	Transmission	Mail message No.	Enter the index No. of the message list among E-mail settings of P2P and determine the mail tile and data.
		Mail address No.	Establish the registration No. set in the address book and decide to whom. * 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	
	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

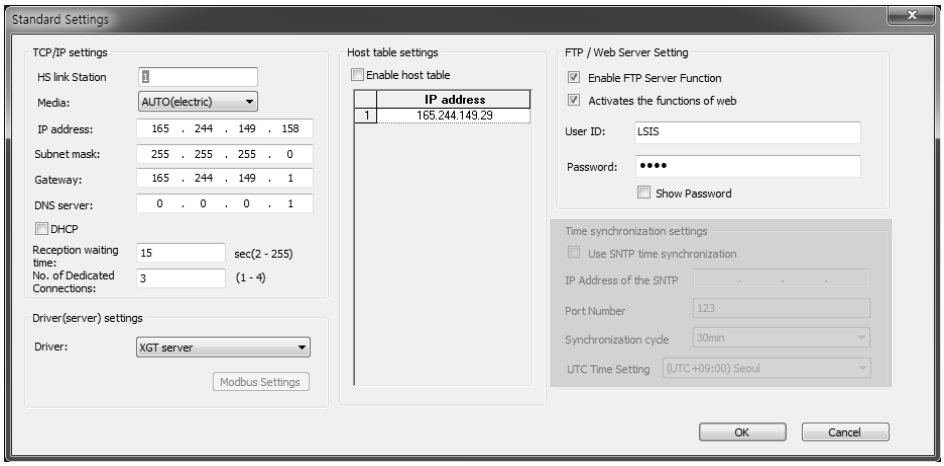
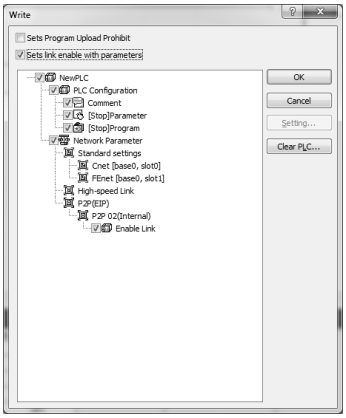
1.11 Time synchronization(SNTP)

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 for SNTP</td><td> 
</td></tr>
<tr><td colspan="2">1)Input the [TCP/IP setting] parameters in the FEnet basic setting window.
- Enter the IP address, subnet mask, gateway, DNS server address.
- This address is commonly used for P2P service, high speed link service, remote service, FTP, SNTP service, etc.
2) Check [SNTP Time Synchronization Enable].
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 parameters and Link Enable</td><td> 
</td></tr>
<tr><td colspan="2">1) Select [Online] → [Write] in XG5000's project window.
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..

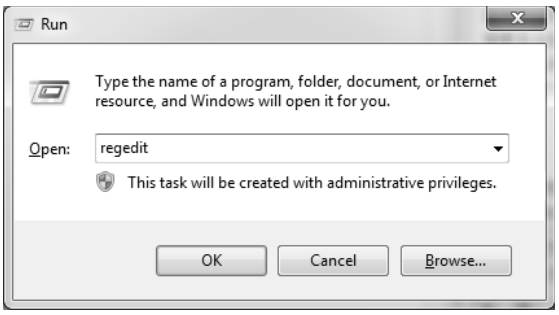
Server address	IP	Port	Support
time.apple.com	17.253.6.243	123	Apple
time.asia.apple.com	17.83.253.7	123	Apple
time.euro.apple.com	17.72.148.52	123	Apple
ntp.kornet.net	168.126.3.6	123	KT(Korea)
time.kriss.re.kr	210.98.16.100	123	KRISS(Korea)
time.nuri.net	211.115.194.21	123	inethosting(Korea)
time.nist.gov	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.



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.

5) Check the below path.
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\W32Time\Config
6) Change the value of '**AnnounceFlags**' to '5' in the folder.

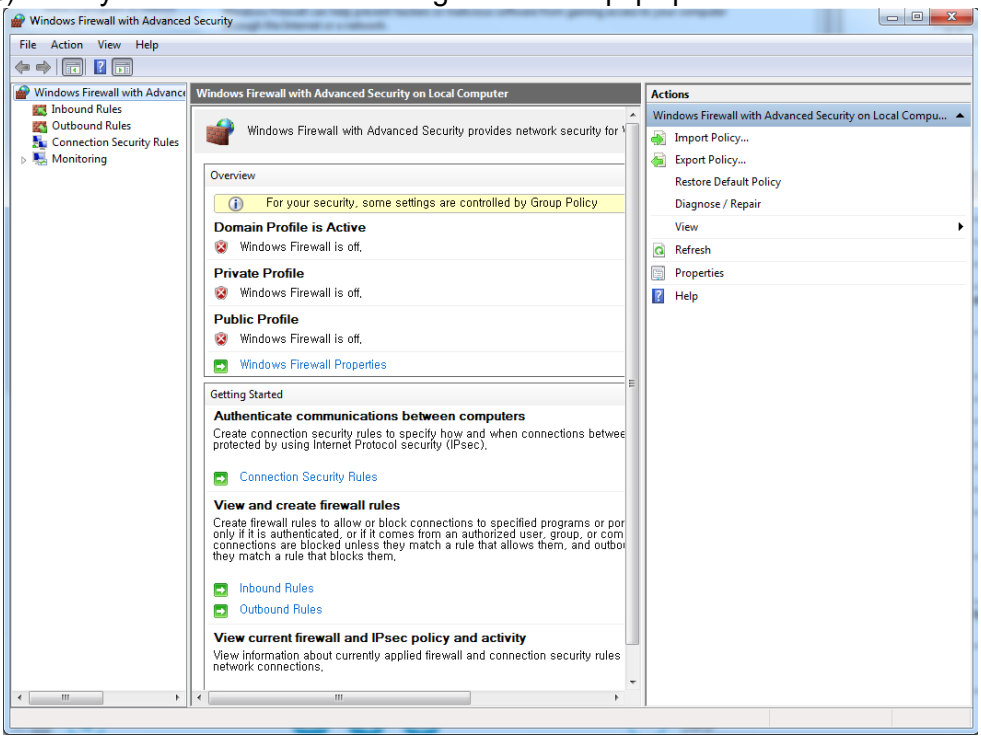
7) Reboot the computer.

8) Setup inbound firewall rules.

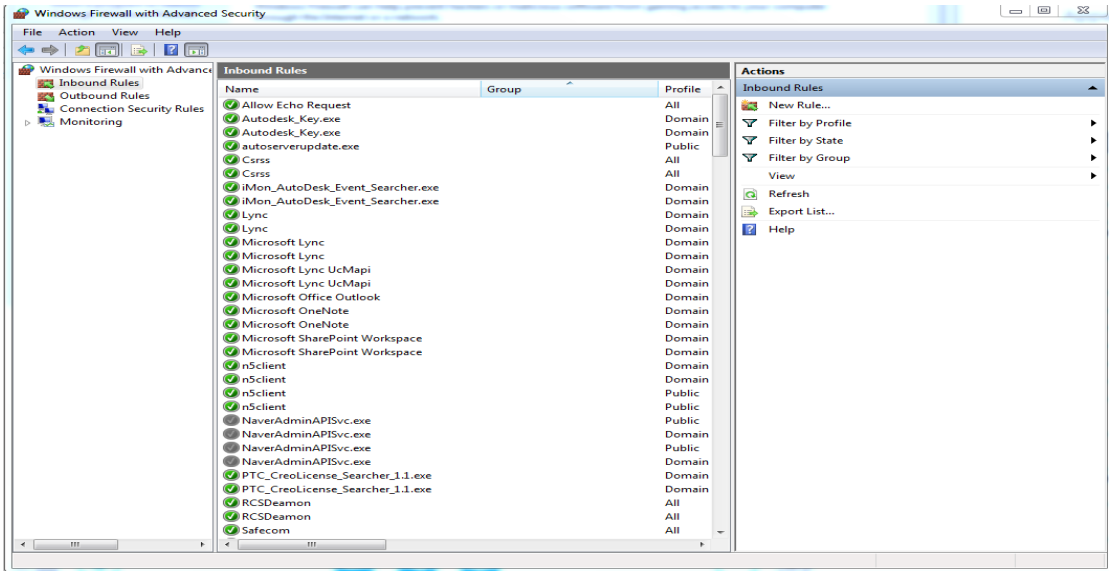
(1) Run the Control Panel.

(2) Run the Window Firewall

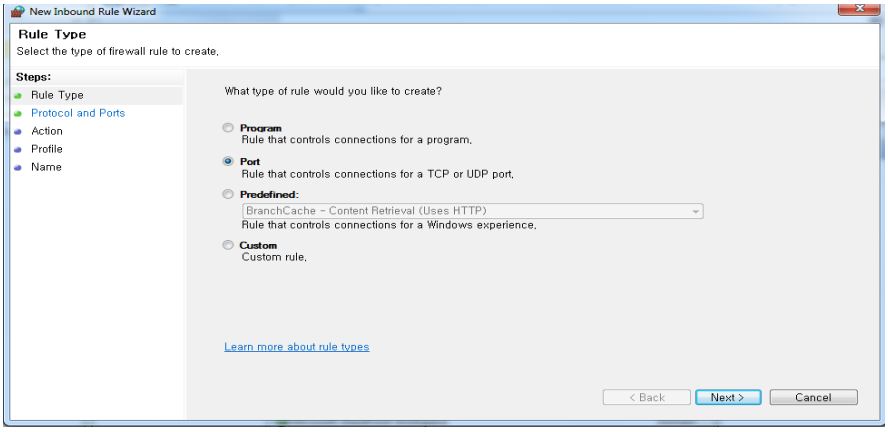
(3) When you run the Advanced Settings. screen will pop up as shown below.



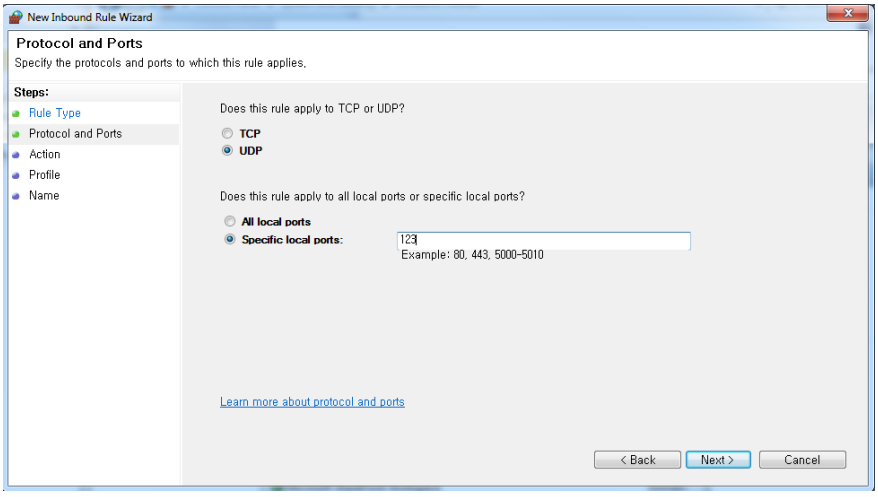
(4) Select inbound rules.



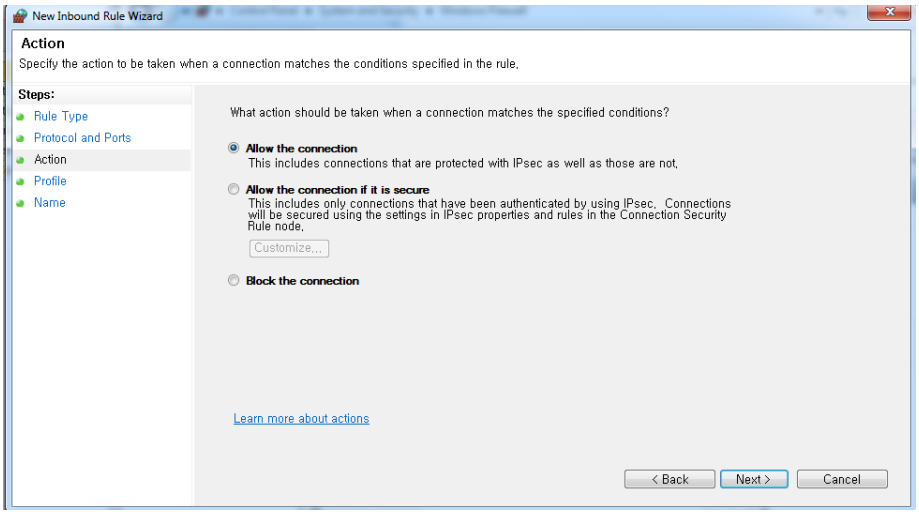
(5) Select the new rule in the top right.(New Rules)



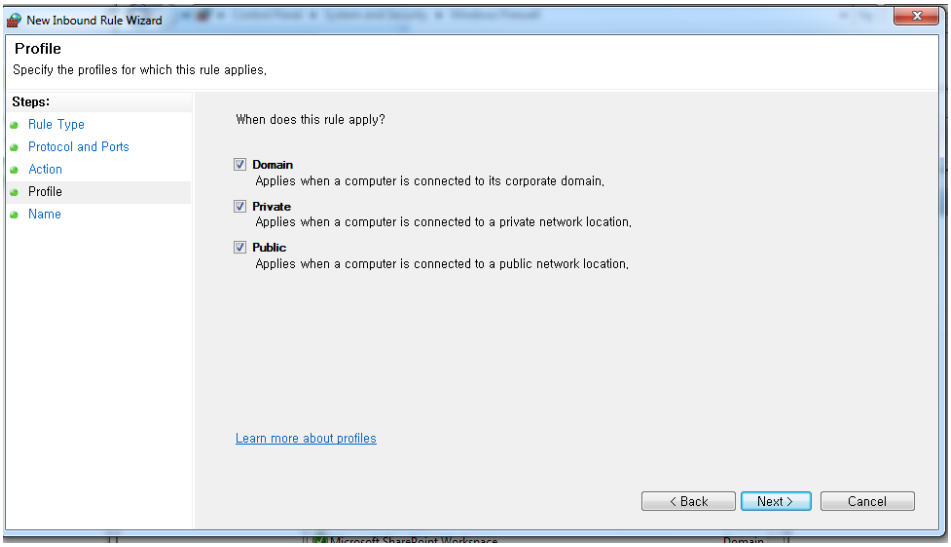
(6) Select the port and click Next button.



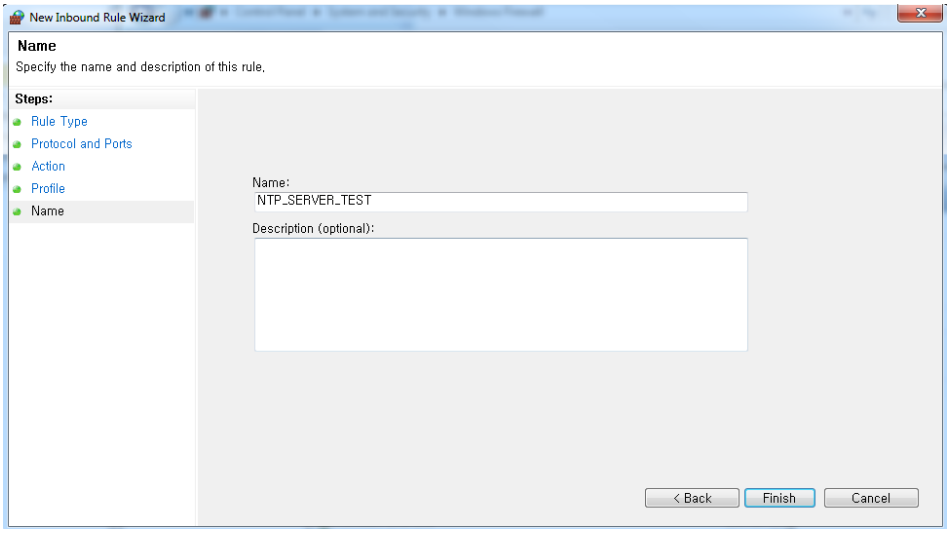
(7) Select **UDP(U)** and **Special local port(S).** Input '**123**' and click Next button.



(8) Select **Allow connections(A)** and click Next button.



(9) Please select the checkbox to meet your security policy, and click Next button.



(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. ☞ 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) . It should have the same communication speed with the opposing device to be communicated. ☞ 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. ☞ 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. ☞ You should apply the same protocols with the opposing device.
	4. Check whether the opposing device's IP is registered in the host table. ☞ When the opposing device's IP address is not registered under host table Enable, communication does not work.
	5. Check the MAC Address ☞ 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. ☞ 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. ☞ 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. ☞ 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 ☞ 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) ☞Communication is possible if the communication speed on the network is the same or set to Auto.
	2.Verify IP address settings ☞Communication is not possible if the IP address is duplicated on the network or is invalid.
	3.Confirm whether P2P parameter setting ☞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 ☞Communication is not possible if the IP address of the other device is not valid
	5.Check Driver Settings ☞The communication protocol must be set the same as that of the other device of the corresponding channel.
	6.Check Link Enable Settings Send frame when link enable is set
	7.Confirm whether operation condition is working ☞If the activation condition set in the block is ON,
	8.Check base unit operation mode ☞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

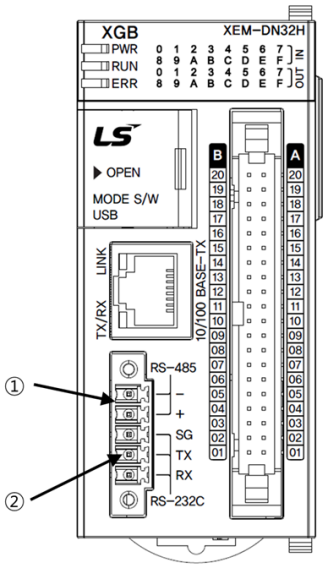
2.2.1 Performance Specification

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 - XGT dedicated protocol client - Modbus ASCII/RTU client - User defined communication - LS Bus Client Notes 1)	
		Server	- XGT dedicated protocol server - 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) 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 connection terminal	Built-in RS-485 connection connector
②	RS-232C 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

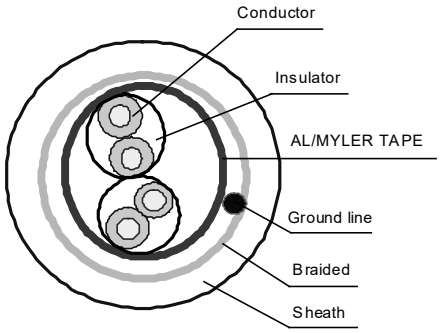
(1) Electrical characteristic

Item	Standard	Test conditions
Withstanding voltage	No destruction	500V/1min
Insulation resistance	1,000 MΩ.km or above	20 ℃
Static electricity capacity	45 pF/M or less	1 kHz
Characteristics impedance	120 ± 5 Ω	10 MHz

(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

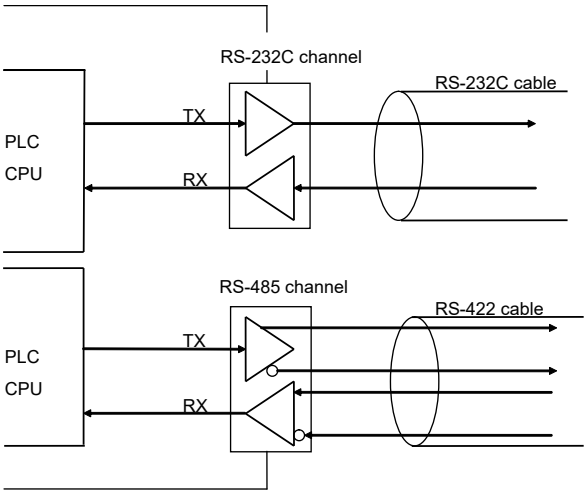
[Table 2.2.1] Cnet twisted pair cable specification



[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.



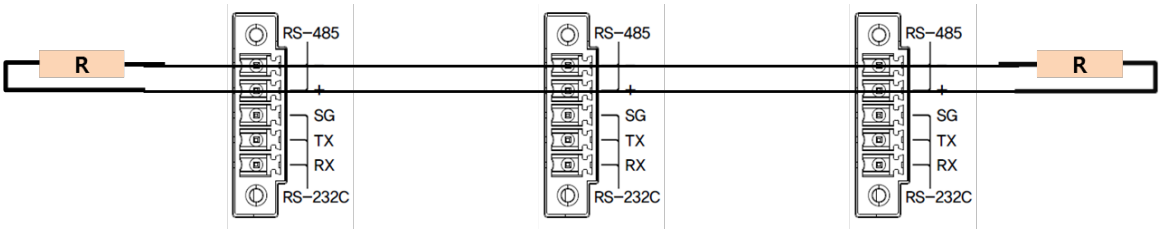
Note

(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.

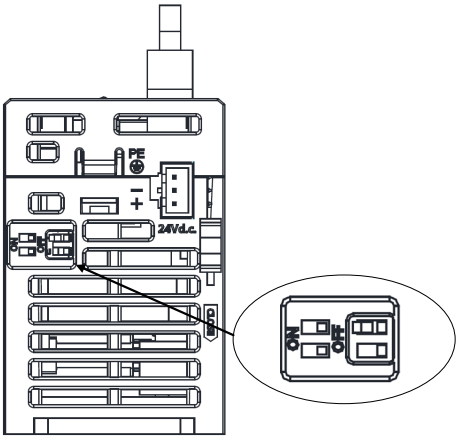
2.2.5 Termination Resistor

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.

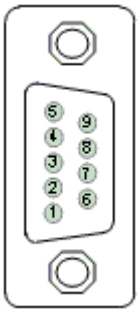
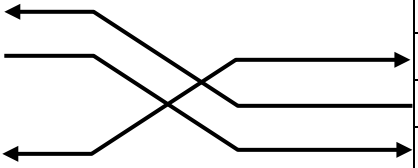
2.3.1 1:1 Connection to PC (HMI) (No Modem)

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

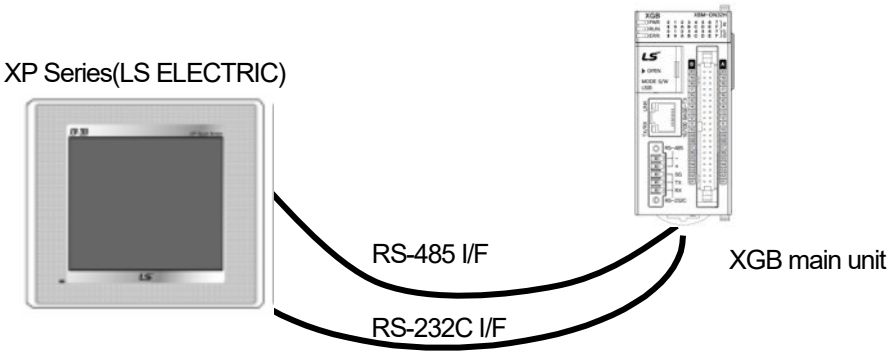
XGB main unit
built-in communication

• Wiring method

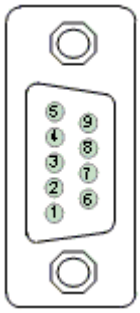
External form of PC	PC	Connection number and signal direction	XGB main unit		XGB external form
	Pin no.		Pin no.	Signal name	
 Female Type	1		1	485-	
	2 (RXD)		2	485+	
	3(TXD)		3	SG	
	4		4	TX	
	5(GND)		5	RX	
	6				
	7				
	8				
	9				

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)

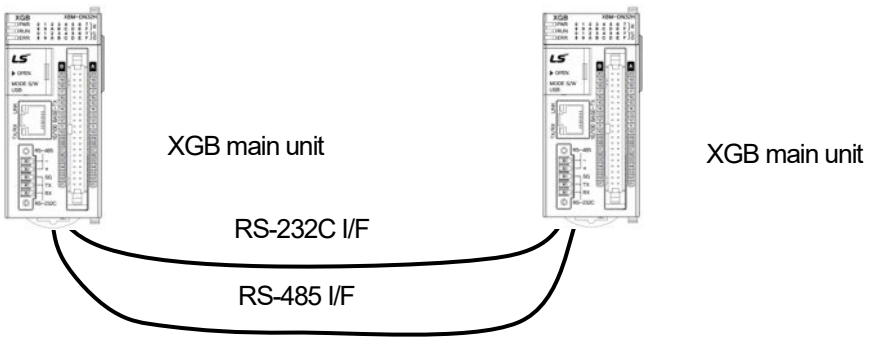
XP external form	XP	Connection number and signal direction	XGB main unit		XGB external form
	Pin No.		Pin No.	Signal Name	
 Female Type	1		1	485-	
	2(RXD)		2	485+	
	3(TXD)		3	SG	
	4		4	TX	
	5(GND)		5	RX	
	6				
	7				
	8				
	9				

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

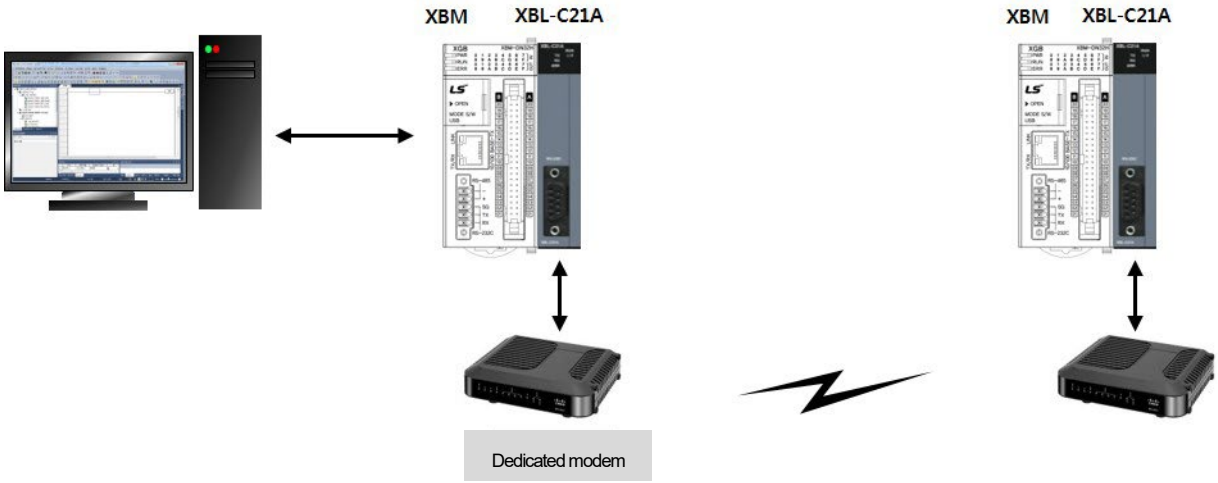


• Wiring method

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

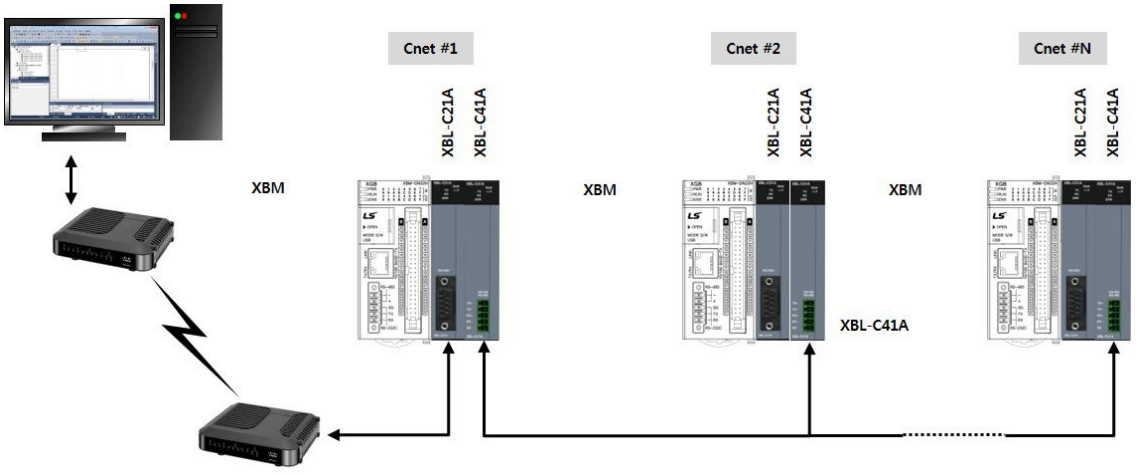
2.3.2 Dedicated Modem Connection with PC(HMI)

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

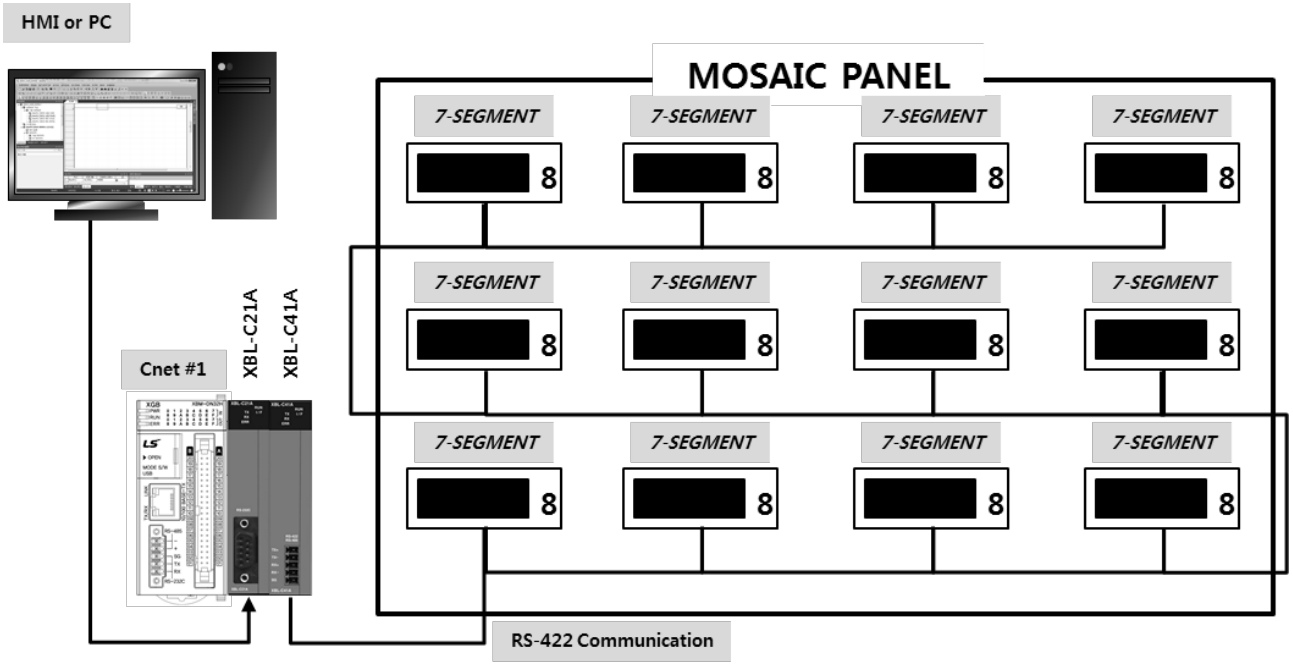
- PC and Cnet #1 station is connected by modem through RS-232C channel
- Cnet #1 station ~ N station is communication between Cnet I/F module through RS-422 channel
- Cnet #1 station ~ N station is Communication between Cnet I/F modules through RS-422 channel
- PC acts as client station of Cnet #1 station
- 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

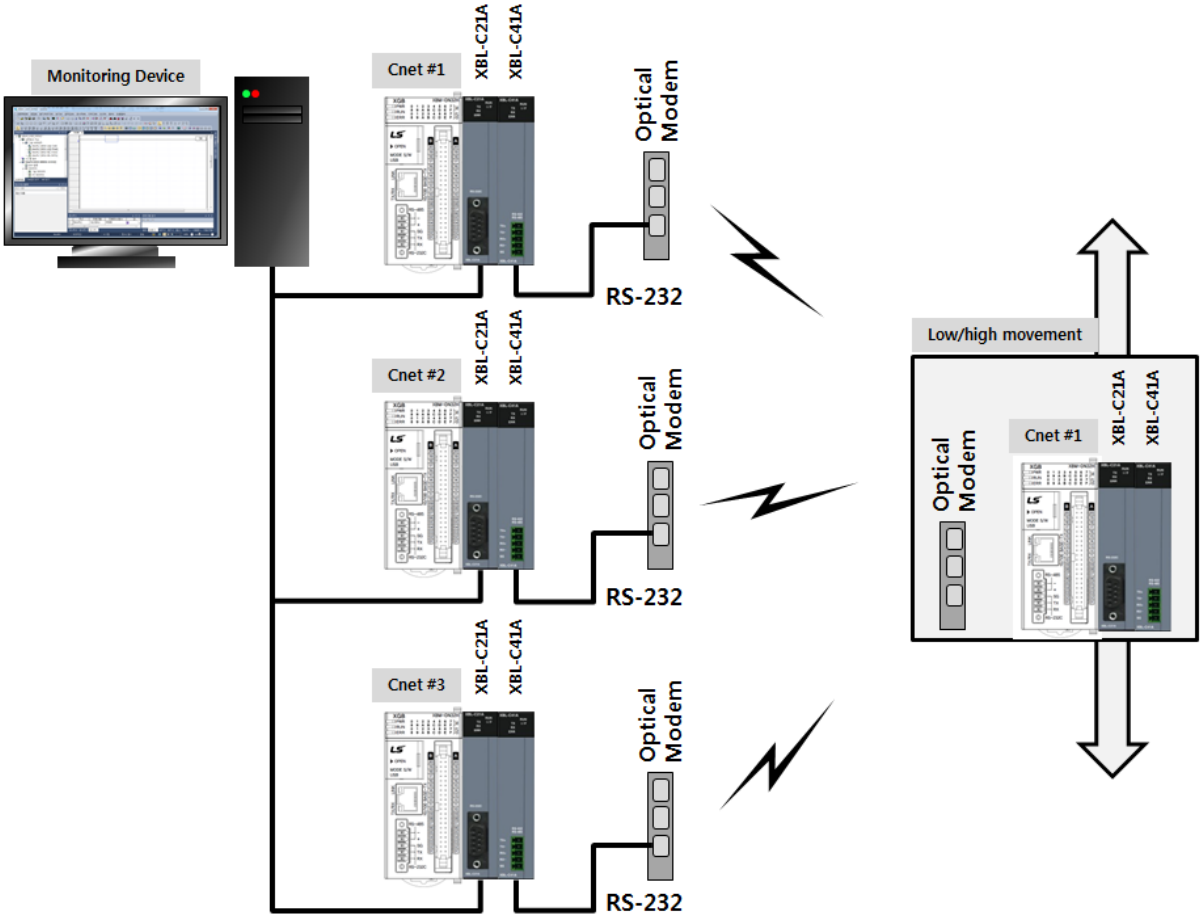
- Null-modem communication by using PC (HMI) and RS-232C channel
- PC (HMI) acts as client station, Cnet I/F module acts as server, at this time, module setting acts as RS-232C XGT server
- Cnet I/F module RS-422 channel acts as P2P mode.
- It transmits indication data to display module of mosaic panel through RS-422 channel
- Reading display transmission data from PC



Type	Module setting		
	XBL-C21A	XBL-C41A	Station no.
PLC Cnet #1	XGT server	P2P	1

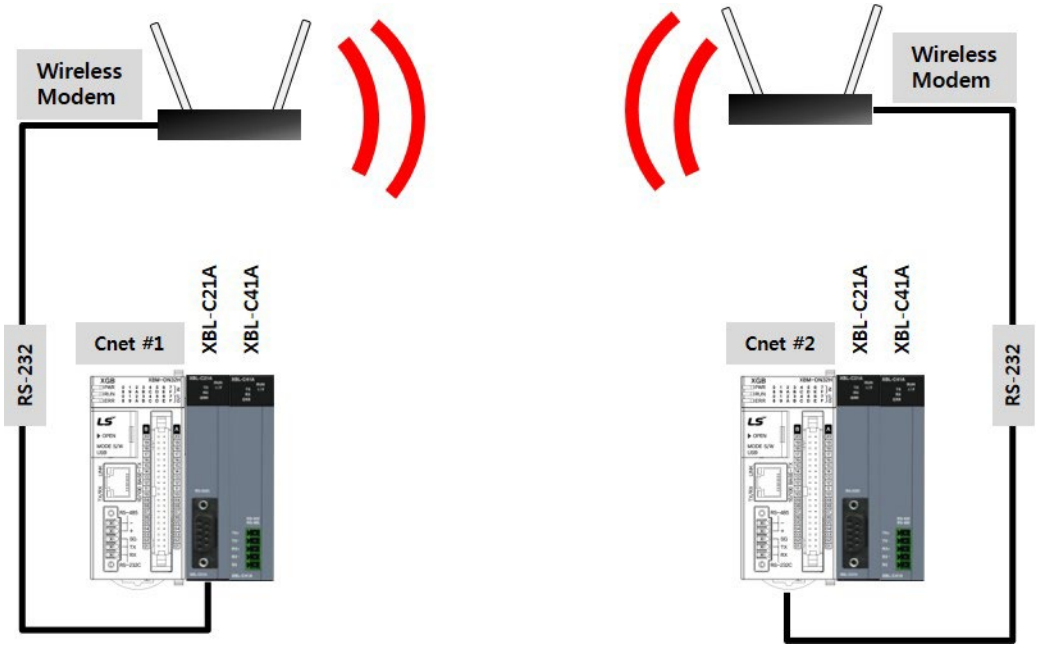
2.3.5 Optical Modem Communication for Moving Material Communication

- 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	Not used	2 station
	User mode		

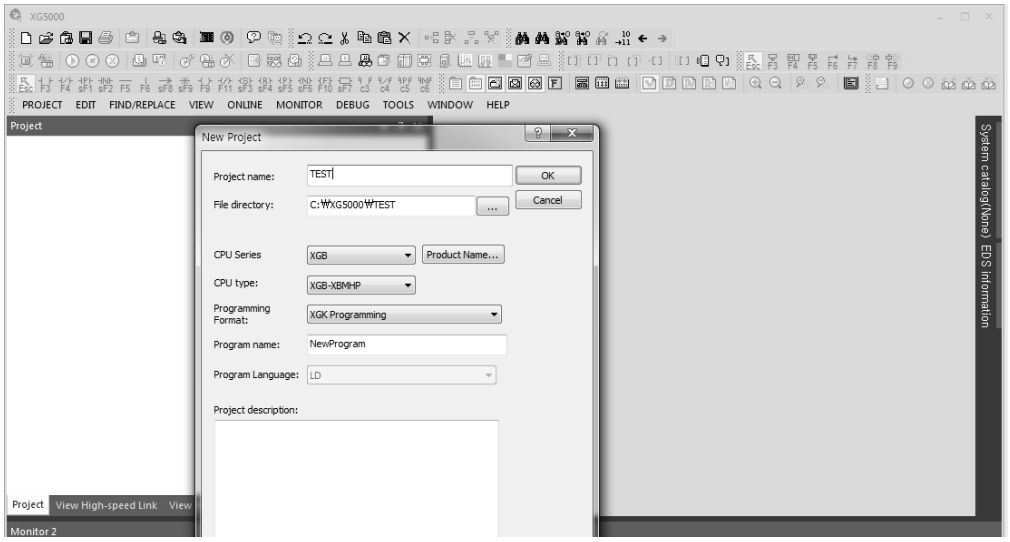
2.4 Basic Setting for Communication

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

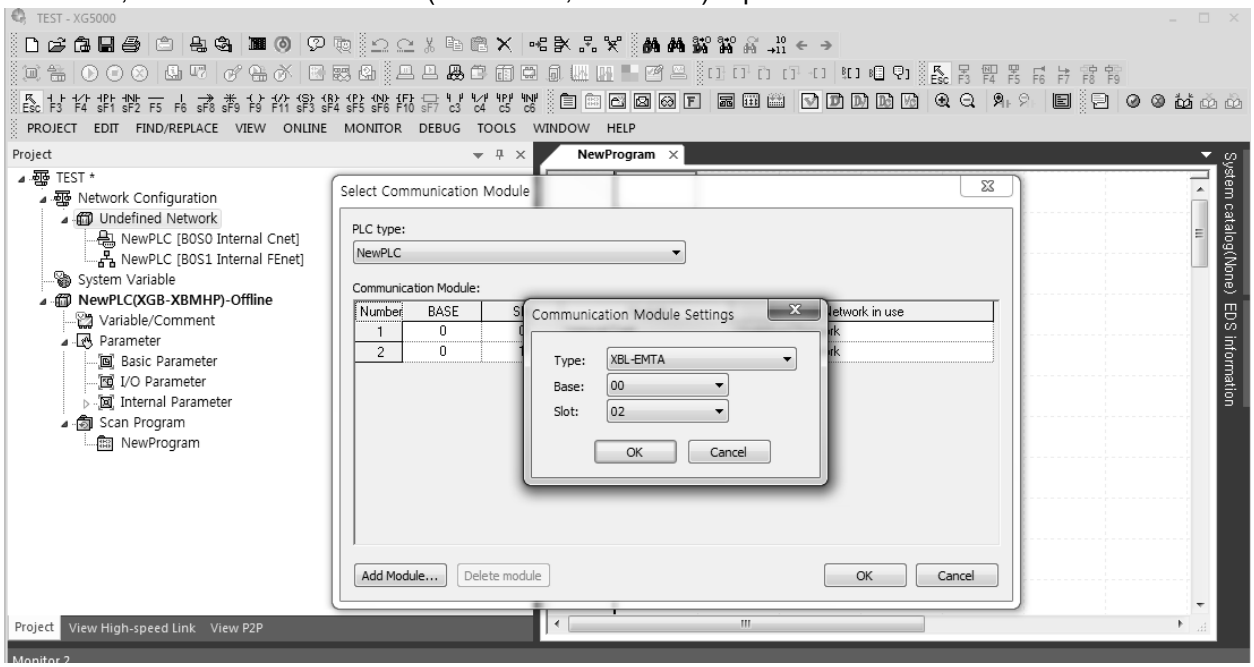
First, after click Project-New Project and input project name, select XGB as CPU series.



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.

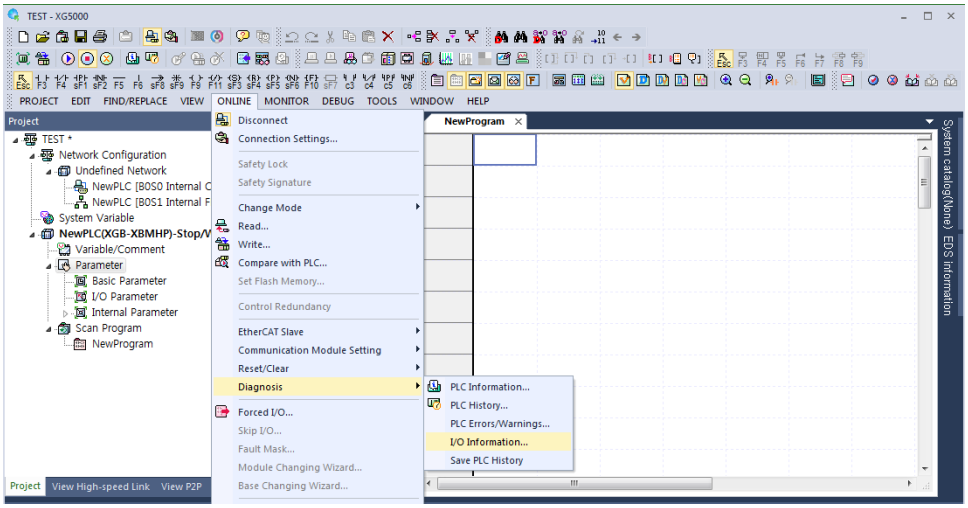
At this time, slot 0 is set as built-in Cnet. (Slot 0 : Cnet, Slot 1: Enet) Expansion module starts from slot 2.

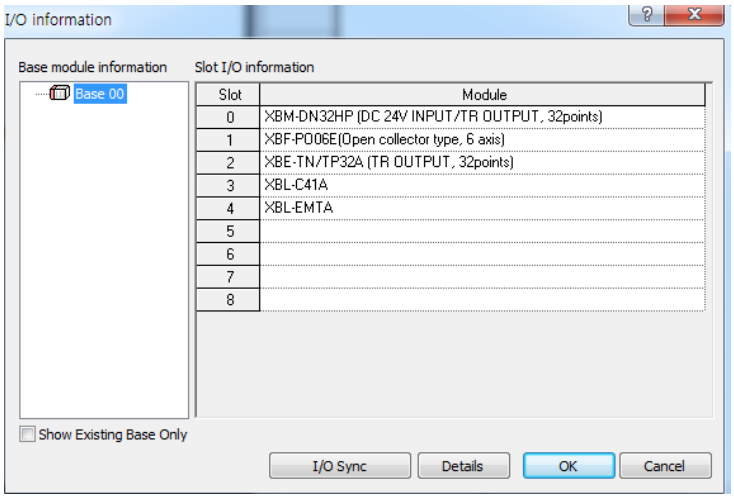


[Cnet module registration]

3) In case of on-line, method on Cnet I/F module registration

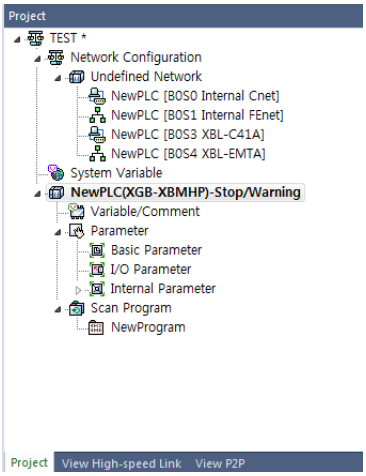
If you register communication module at online status by using XG5000, you should connect basic unit. After [Online]-> [Connect] after doing communication setting by using “Online -> Connection settings” and doing local connection. After setting PLC to STOP status, select [Online] → [Diagnosis] → [I / O Information] and perform I / O synchronization.





[I/O information change message]

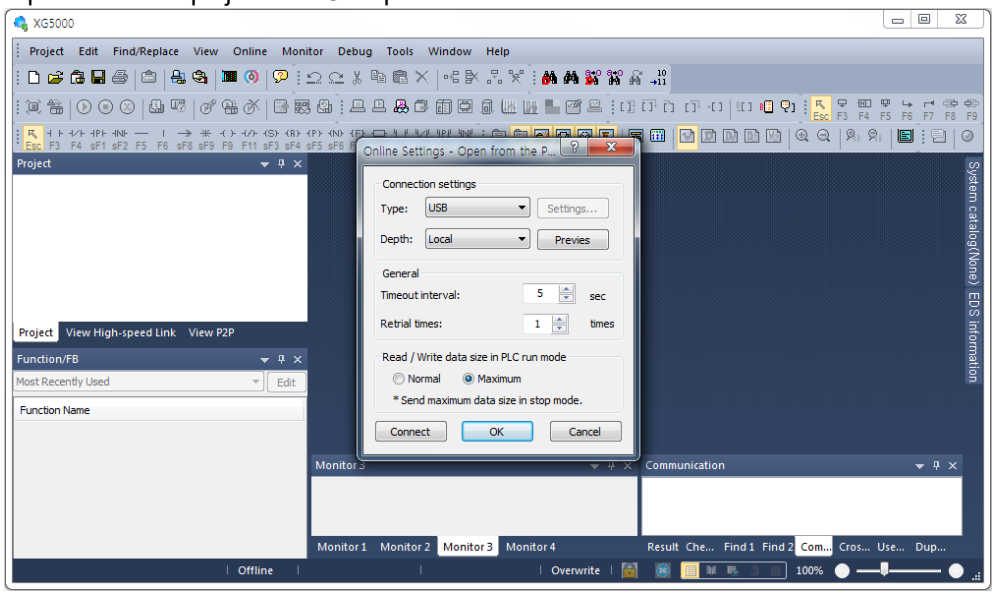
If you Synchronize I/O, communication module will be registered.



[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.



[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

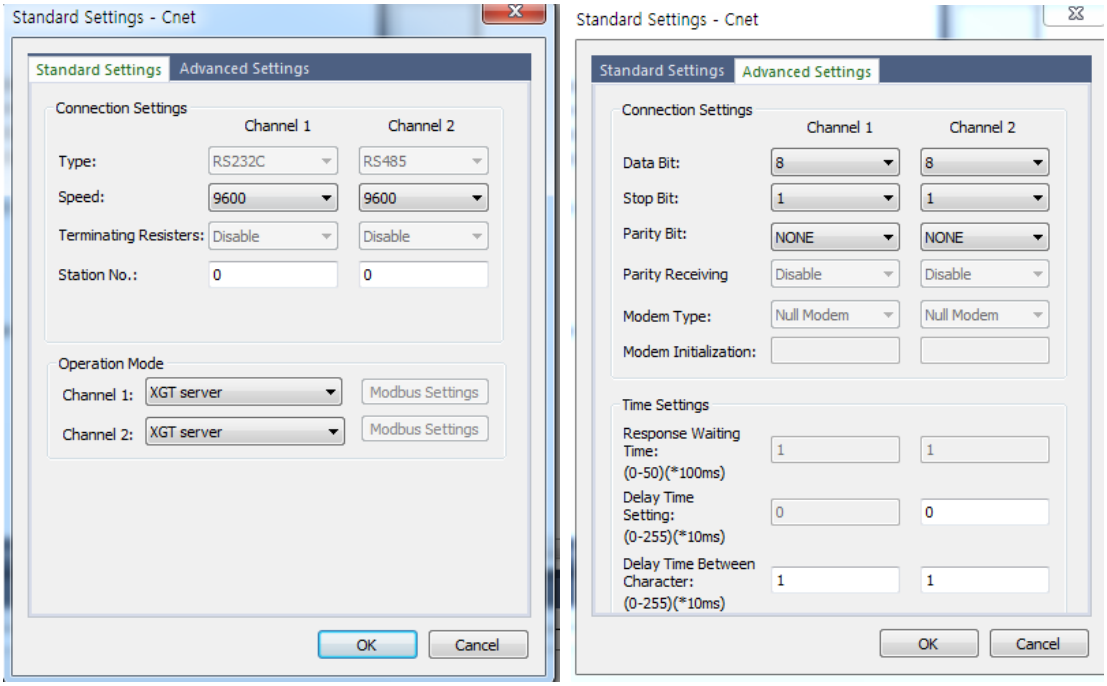
By using remote 1/2, you can monitor/download program about remote PLC.

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.



[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, " 0 " 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
1) Built-in communication → channel 1 : RS-232C , channel 2 : RS-485
2) XBL-C41A → channel 1 : not used, channel 2: RS-422/RS-485
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.
1) operation setting : it is available when active mode is set to “Use P2P”.
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.
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.
1) operation setting : it is always available regardless of active mode.
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

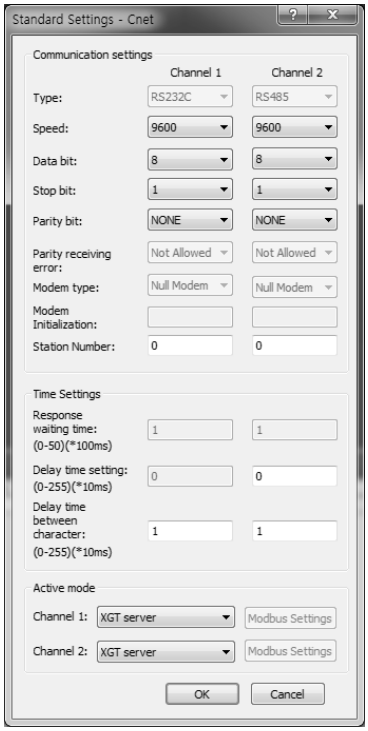
You should do like following to operate Cnet I/F module according to communication specification defined by user. In case of setting like the followings about XBL-C41A (RS-422/485 1 port) installed slot 3, setting method is as follows.

(1) Communication specification

■ Channel 2: RS-485, 115200Bps, 8/1/Odd, Null modem, P2P, station 0, Response waiting time 100ms, Delay time 10ms, 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.

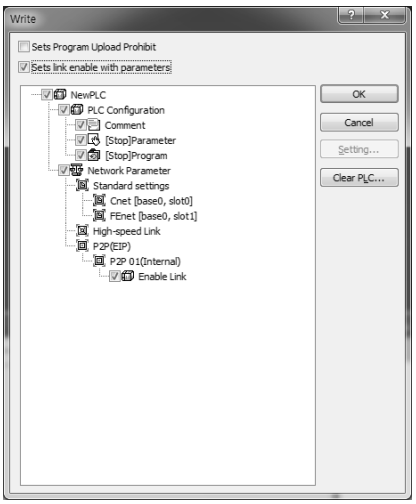


[Communication module setting screen]

(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.



2.5 Remote Connection

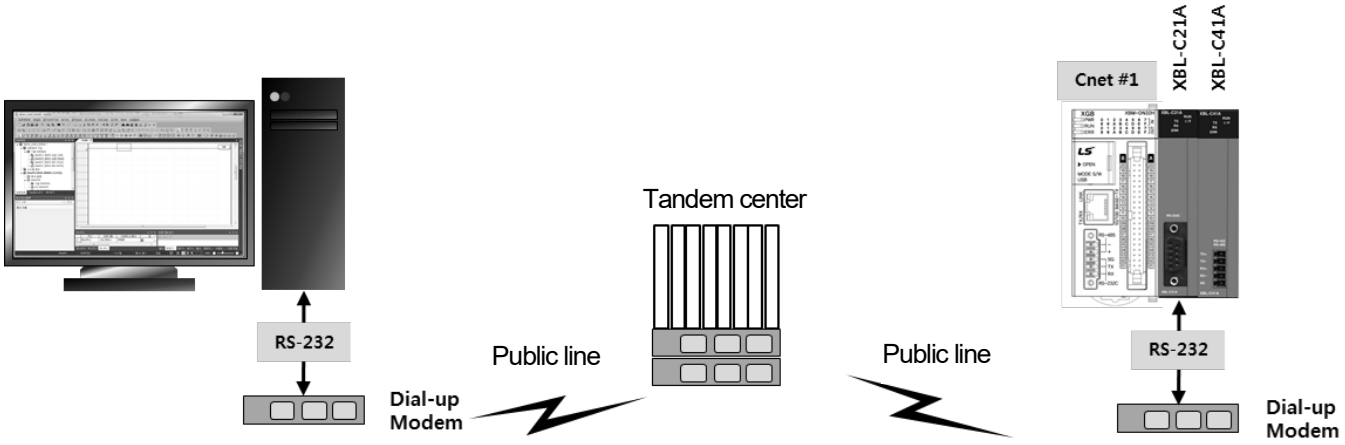
In case PC executing XG5000 is far from XGB PLC, if you use remote connection function of Cnet I/F module, you can control remote PLC such as program download, upload, program debugging and monitor. Especially, in case XG5000 is far from PLC, if you use XG5000 remote connection function and modem connection 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.



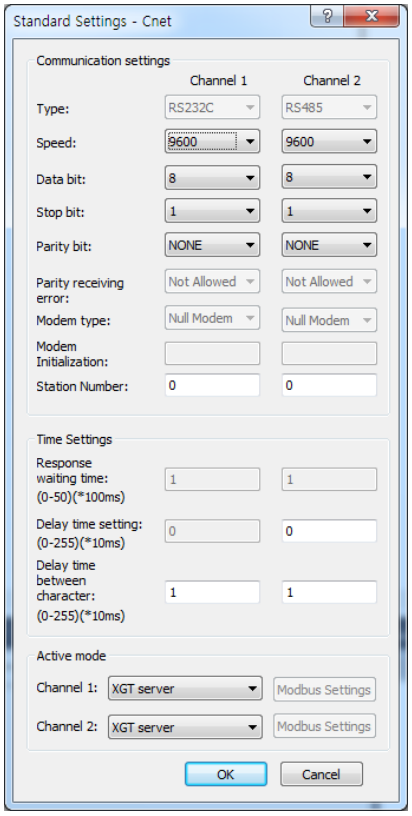
[Figure 2.5.1] XG5000 remote connection example by dial-up modem

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.

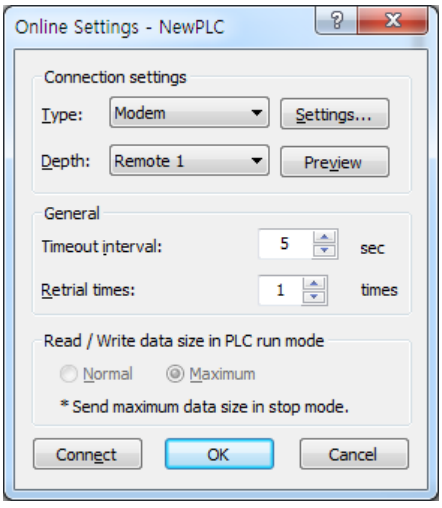


[Figure 2.5.2] XG5000 setting example

(2) XG5000 setting

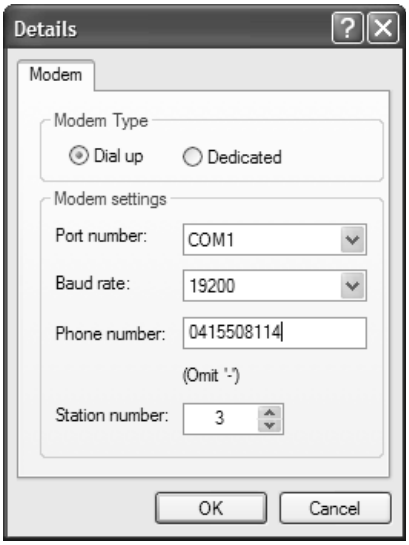
a) Execute XG5000 and pop up online settings window by selecting “Online -> Connection settings”.

Here selects “Connection settings -> Type” as Modem.



(3) Dial up modem setting

a) Select settings of “Connection settings” and set detail of modem



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.

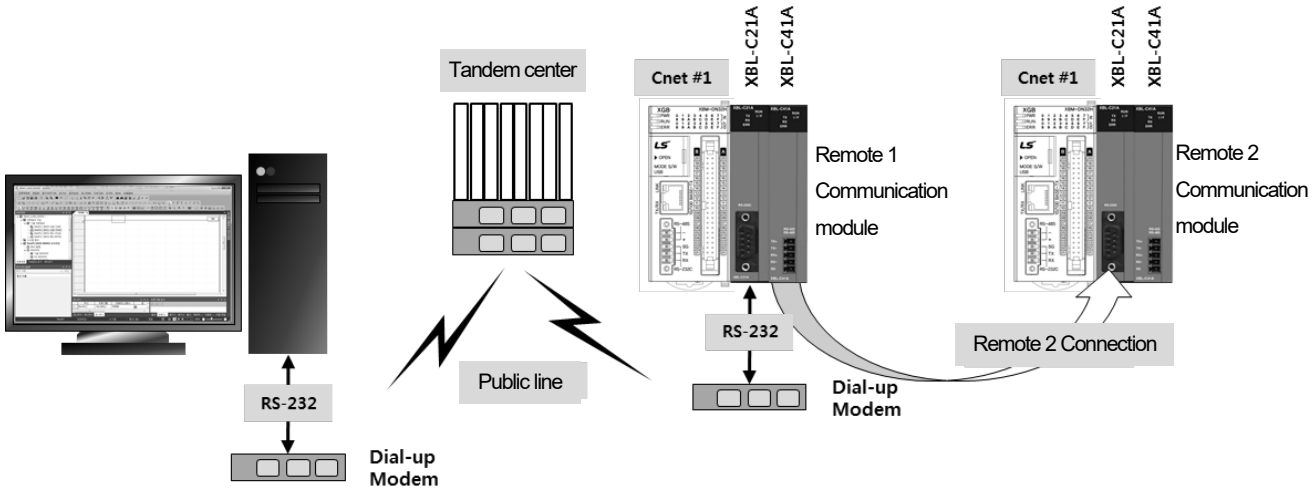
(Ex) In case extension number is ‘9’: set as 9, 0343-398-xxxx

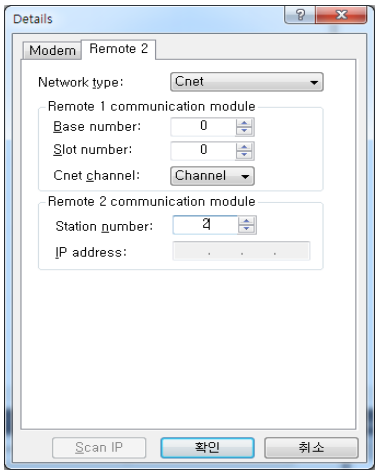
Note

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.

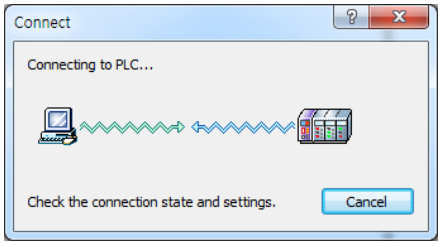
For XG5000 remote connection at XGB PLC, you should use RS-232C channel. At communication standard setting, set “RS-232C dial-up modem” and write it to XGB Cnet I/F module.

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.

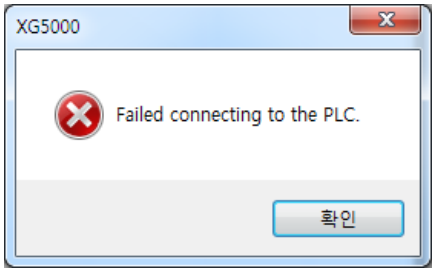




d) Select connection on online after setting connection option, modem initialization dialog box shows and modem is initialized.



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.



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.

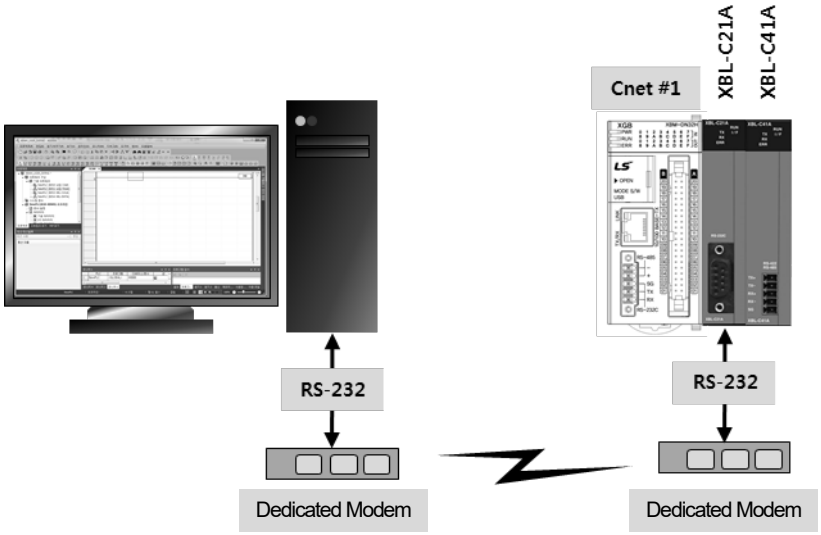
j) If it is success to quit call normally, local and remote modems return to initialization status. You can establish remote connection through making phone call.

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

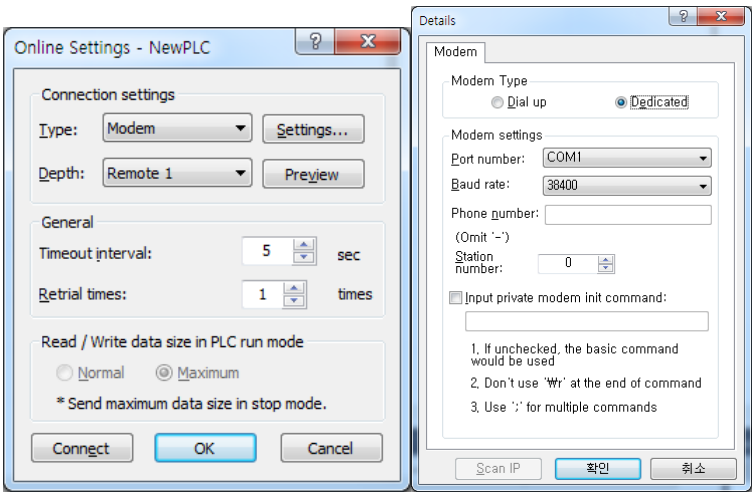
(2) Cnet I/F module setting connected at remote PLC

a) Sets RS-232C channel of Cnet I/F module as XGT server.

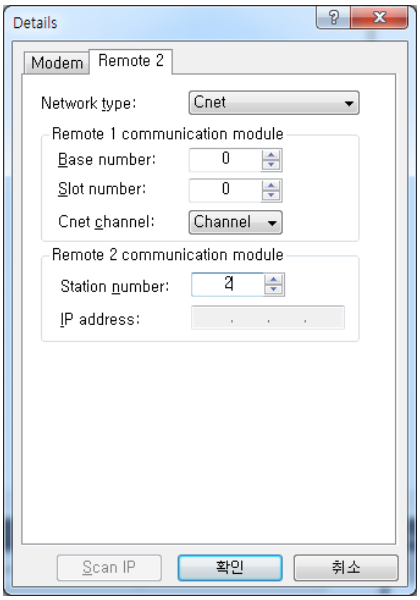
b) Sets RS-232C channel operation of Cnet I/F module as dedicated modem.

(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.



b) In case of setting depth as remote 2, set settings related with remote 1, 2 at the “Detail” window like the followings.



[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.

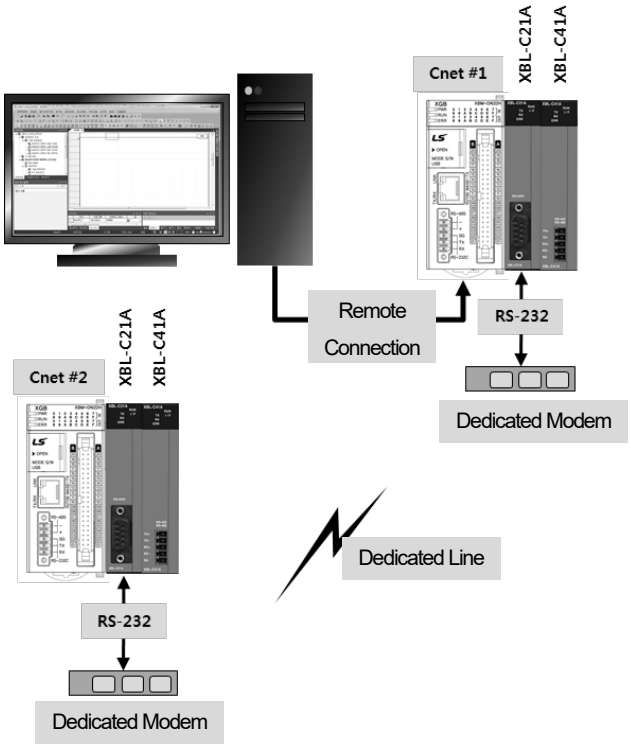
Note

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

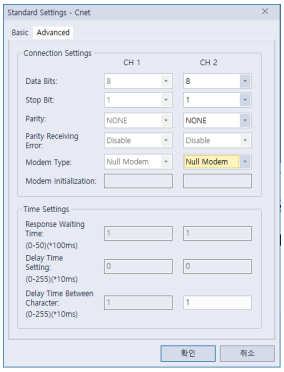
Figure below indicates that XG5000 and local PLC is connected through RS-232C cable and in case RS-232C channel of Cnet I/F module equipped at local PLC communicates with Cnet I/F module of remote PLC through dedicated modem. Figure is example indicating remote connection with remote PLC. Like figure, 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.



(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

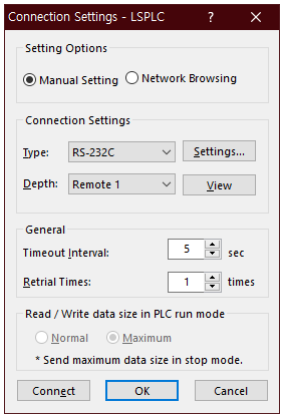
Basic parameter of remote server connected through XG5000 should be set as server. In case of remote client, it should be set as P2P client.

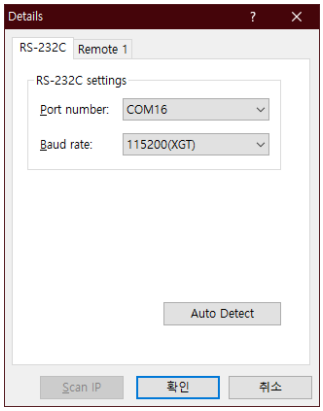
In case there are many communications, if you try to remote connection, you may fail. Be sure to convert local PLC to stop mode and stop communication before remote connection.

(3) XG5000 setting for remote connection

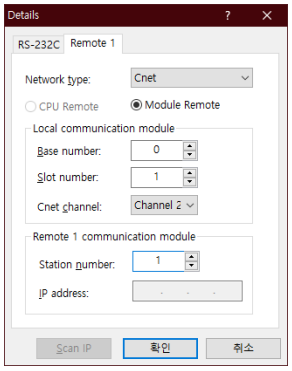
a) Execute XG5000 and select “Online – Connection Settings” and set connection method.

Select Type as RS-232C and communication channel. This is same in case of local connection.





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.



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.

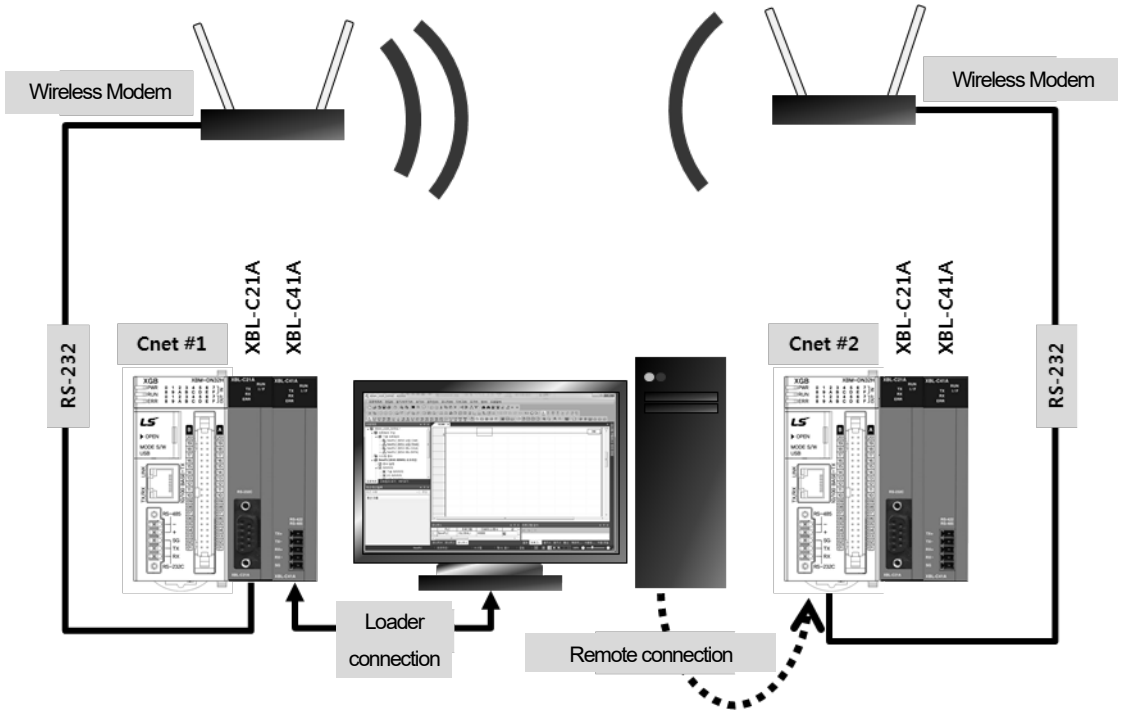
e) In case you want to disconnect remote connection, select disconnect at online menu. Disconnection menu box shows and remote connection is disconnected.

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.

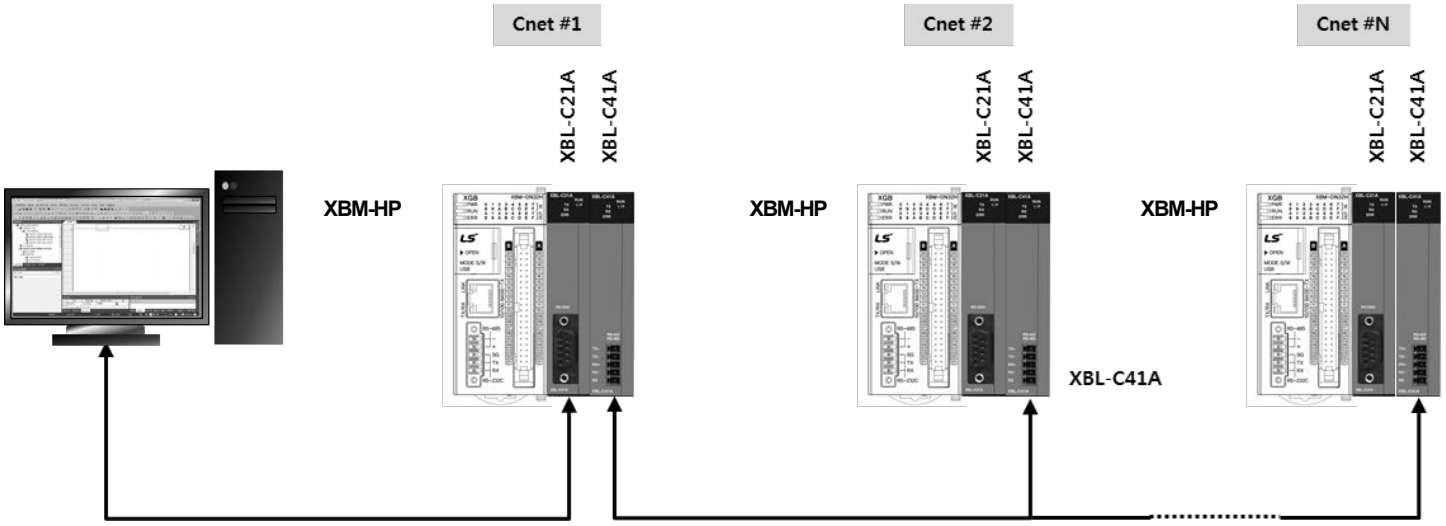
g) Figure below indicates remote connection by wireless modem. As for connection method, it is same with method of remote connection between Cnet I/F module by using communication. In case of using wireless modem, 1:N remote

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

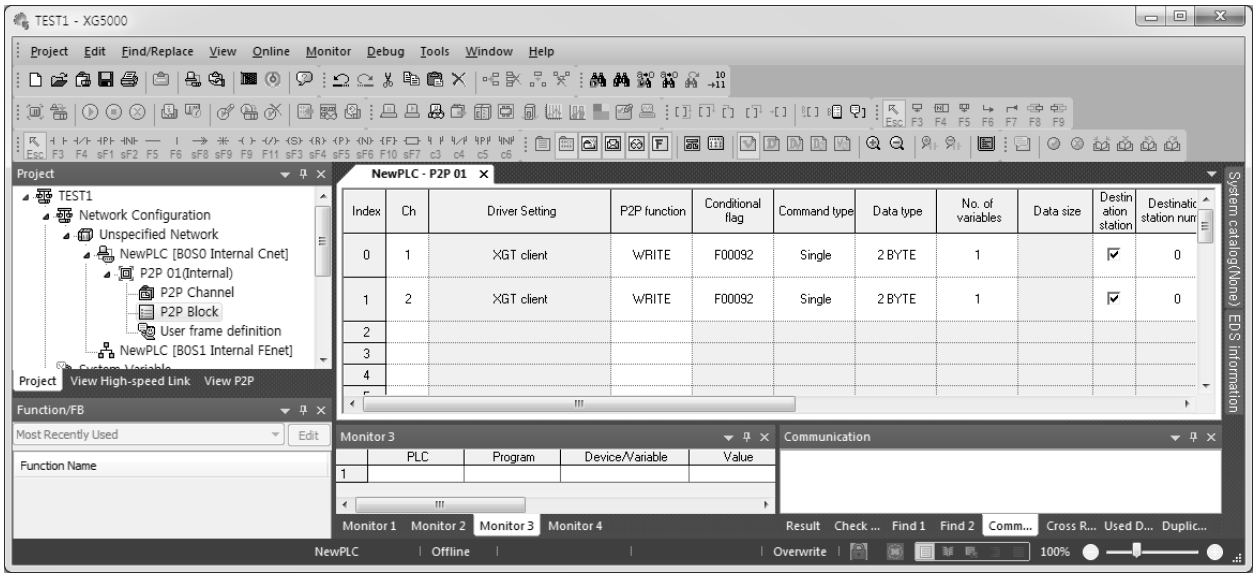
It is used in case partner device acts as Modbus client.
ASCII mode and RTU mode of Modbus are all supported. You can define in standard settings active mode. For more detail protocol, refer to “chapter 2.9 Modbus protocol”.

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.

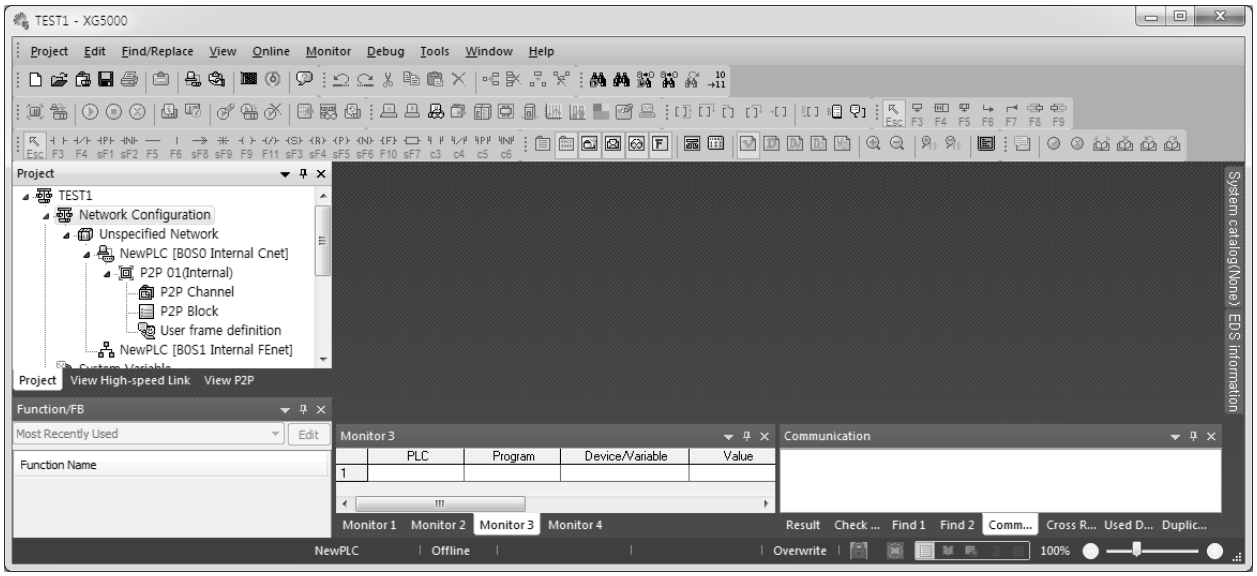


Note

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.



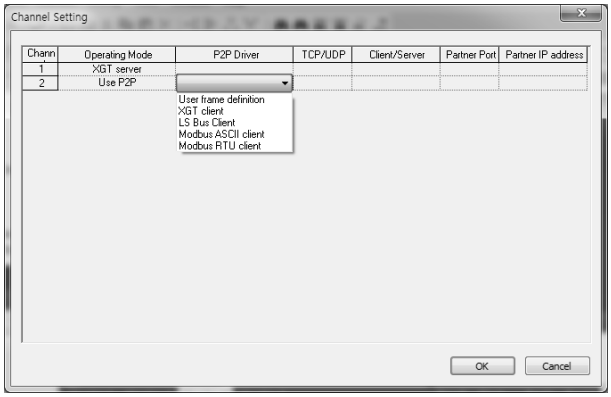
Types	Descriptions	Remark
P2P channel	- P2P channel setting defining communication protocol of P2P service to execute - XGT/Modbus available - Each channel is independent. It is applied when active mode is “Use P2P settings”	
P2P Block	Setting P2P block of 32 acting independently	
User frame definition	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.



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.

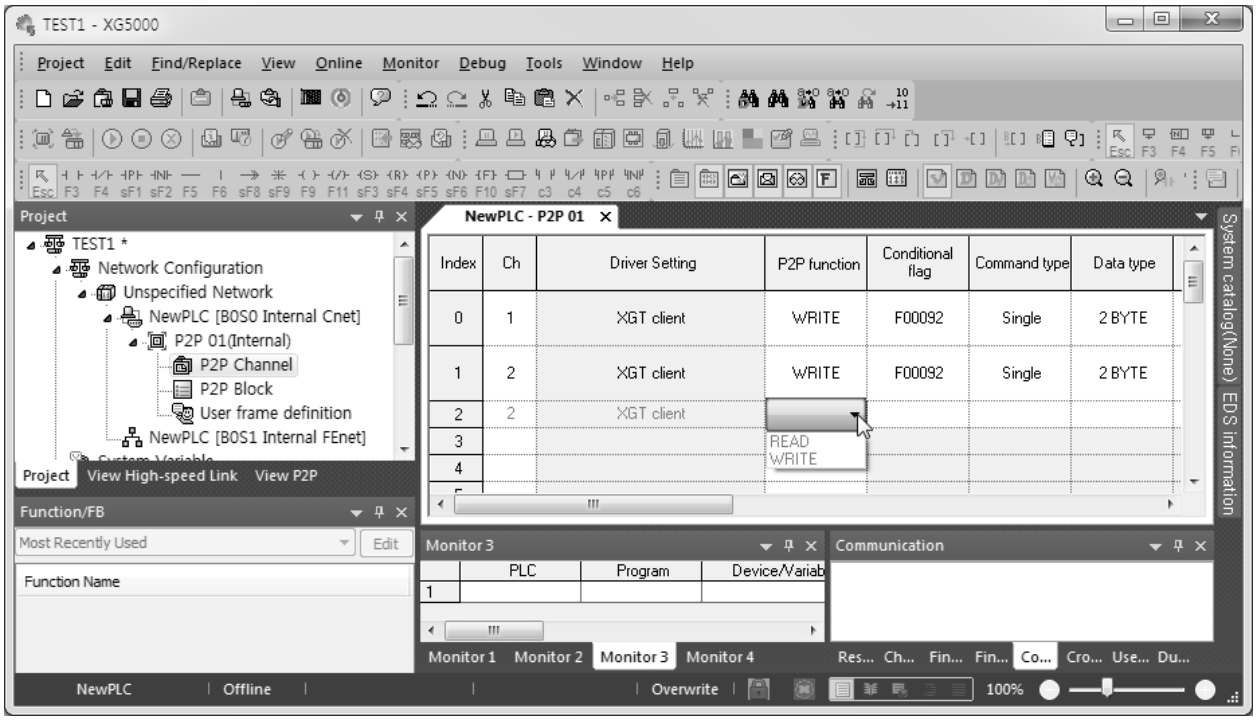
3) Block information

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.

P2P Channel	P2P Block Setting
Chann: 1 / Operation Mode: Use P2P / P2P Driver: XGT client	NewPLC - P2P 01 — Index 0, Ch 1, Driver Setting: XGT client
Chann: 1 / Operation Mode: Use P2P / P2P Driver: (blank); 2 / Use P2P / LS Bus Client	Index 0, Ch 2, Driver Setting: LS BUS Client, Command type: 2 Continuous, Data type: WORD, No. of variables: 1, Destination station number: 0
Channel: 1 / Operating Mode: Use P2P / P2P Driver: Modbus ASCII client	NewPLC - P2P 01 — Index 0, Ch 1, Driver Setting: Modbus ASCII client, No. of variables: 1, Destination station number: 0
Channel: 2 / Operating Mode: Use P2P / P2P Driver: Modbus RTU client	NewPLC - P2P 01 — Index 0, Ch 2, Driver Setting: Modbus RTU client, No. of variables: 1, Destination station number: 0
Channel: 2 / Operating Mode: Use P2P / P2P Driver: User frame definition	NewPLC - P2P 01 — Index 0, Ch 2, Driver Setting: User frame definition

[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.



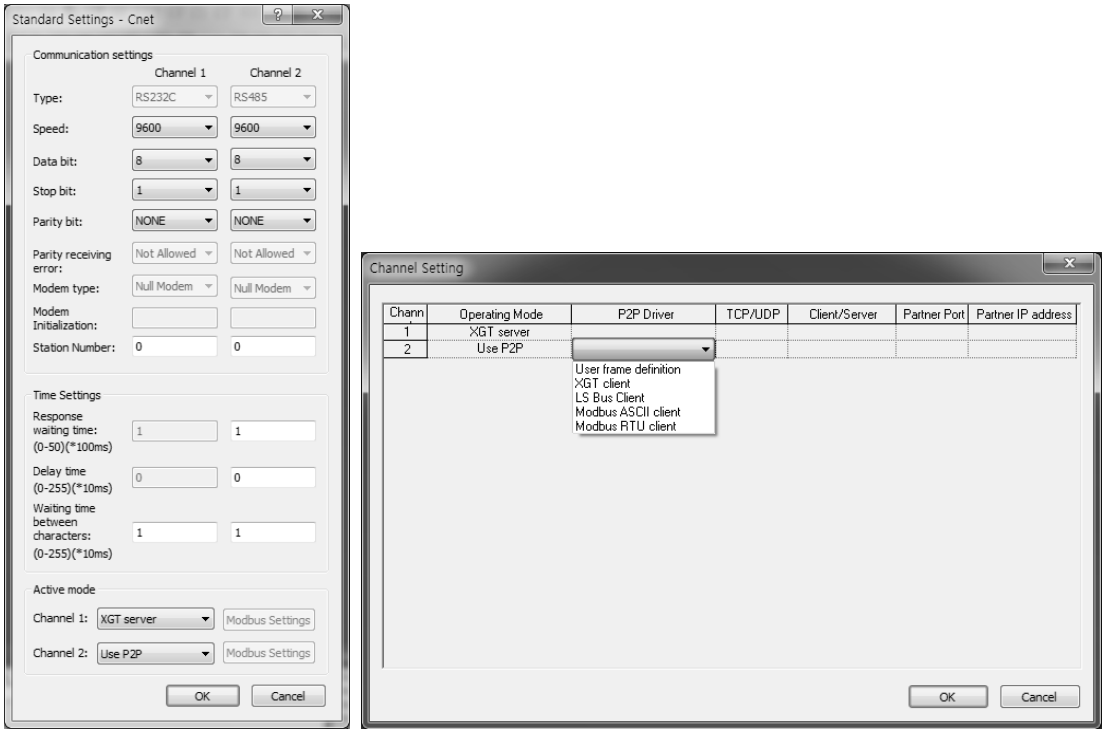
[P2P instruction screen]

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.



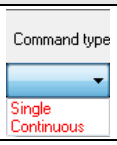
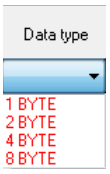
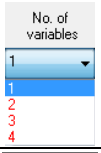
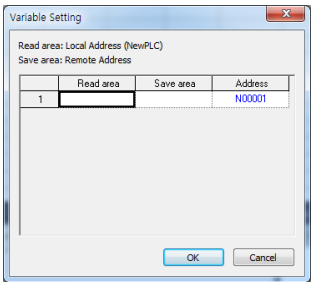
2) P2P block setting

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
	①		②	③	④	⑤	⑥	⑦	⑧	⑨		⑩

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 2. Write: when writing self-station’s memory to destination station’s memory.
3	Conditional flag		1. Determines when Cnet sends request frame 2. In case of XBC type Ex. : F90(20ms flag), M01 3. In case of XEC type Ex. : _T20MS(20ms flag), %MX01

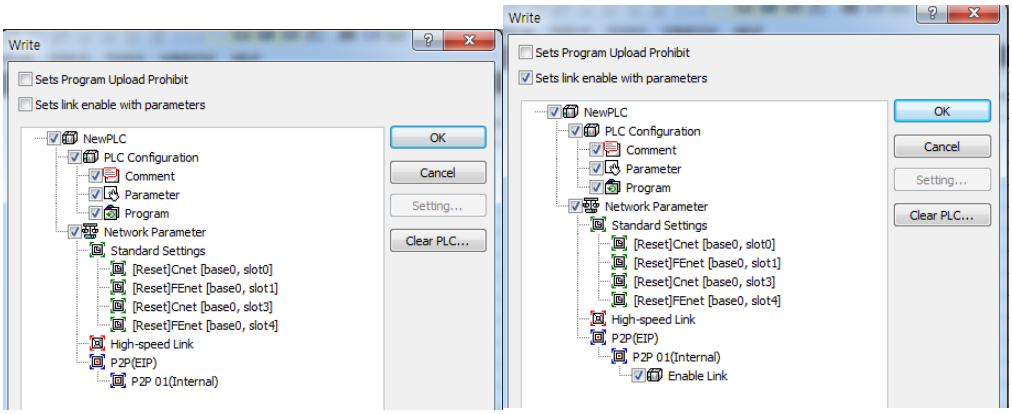
No.	Type	Block form	Contents
4	Command type		1. Single: When reading/writing max. 4 memory areas. (Ex. : M01, M10, M20, M30) 2. Continuous: When reading/writing continuous memory areas. (Ex. : M01~M10)
5	Data type		1. In case that command type is single: bit, 1 byte, 2byte, 4 byte, 8 byte available 2. In case that command type is continuous: 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. 2. When command type is continuous, it is fixed as 1.
7	Data size		1. This is activated when command type is continuous. 2. When data type is 1 byte, available max. no. is 120 byte
8	Destination station		1. Check: Specify the destination station 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		1. When P2P function is Read 1)Read area : device area of server 2)Save area : client's device to save the data from server 2. When P2P function is Write 1)Read area : device area of client 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.

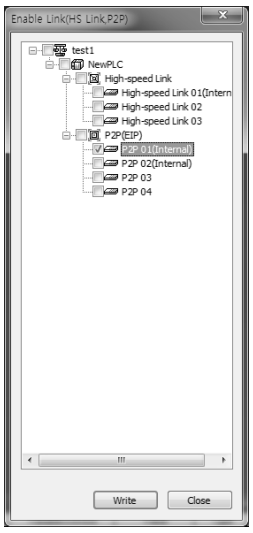
After download, the parameter is applied immediately. If you check 'Set up with Link Enable', Link Enable can be applied with writing P2P/HS parameters at the same time.



[Not checking link enable] [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.

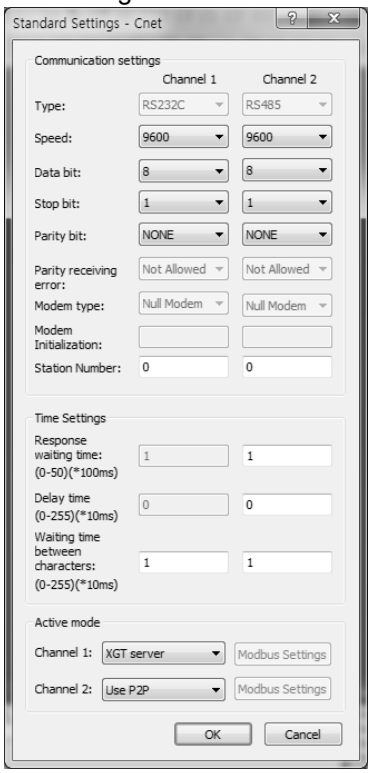
Select [Online] – [Communication module setting] – [System Diagnosis]. Click the module and then click mouse right-button. If you select Frame Monitor or Status by Service, it can be checked whether the communication is normal or not. For more detail, refer to chapter 2.9 Diagnosis Function.

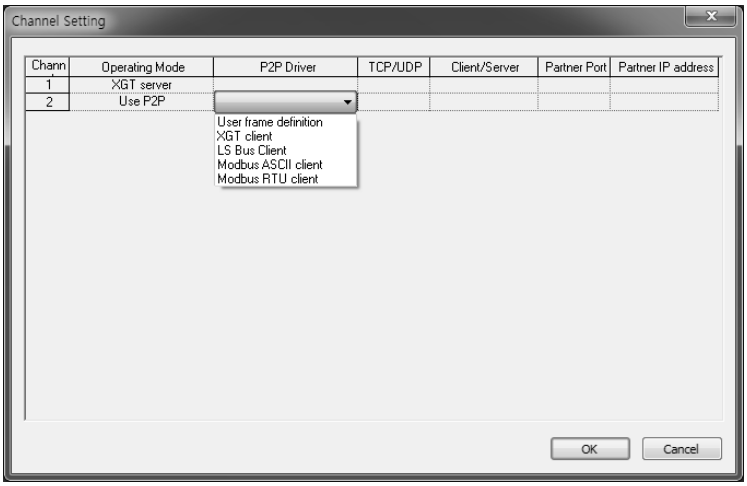
2.6.4 Modbus Client Service

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”.





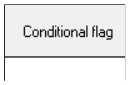
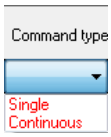
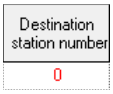
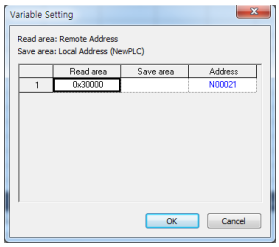
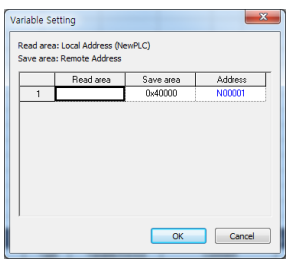
2) P2P block setting

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
	①		②	③	④	⑤		⑥	⑦	⑧		⑨

No.	Type	Block type	Meaning
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 2. Write: when writing self-station’s memory to destination station’s memory.

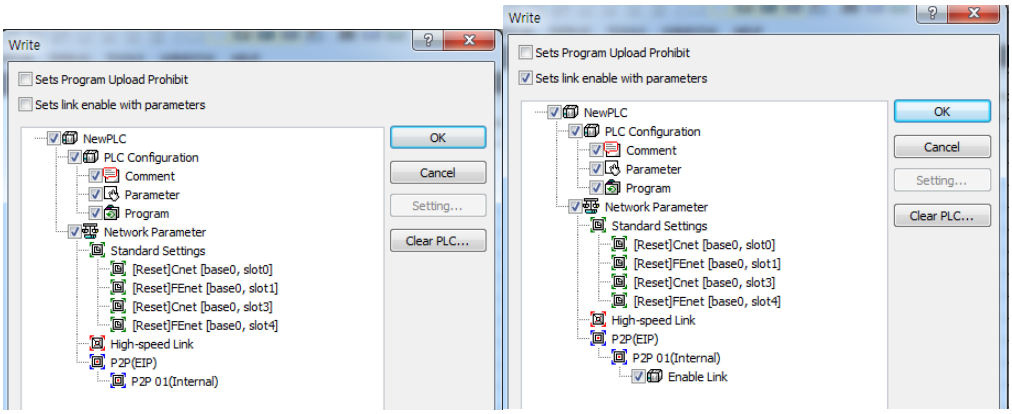
No.	Type	Block type	Meaning
3	Conditional flag		1. Determines when Cent sends frame 2. In case of XBC type Ex. : F90(20ms flag), M01 3. In case of XEC type Ex. : _T20MS(20ms flag), %MX01
4	Command type		1. single: When reading/writing max. 4 memory areas. (Ex. : M01, M10, M20, M30) 2. continuous: When reading/writing continuous memory areas. (Ex. : M01~M10)
5	Data type		Data type can be bit or word.
6	Data size		▷Determines size of data to communicate and it is activated when command type is continuous. 1. when P2P function is Read 1) Modbus RTU client (1)Bit type : 1~2000 (2)Word type : 1~125 2) Modbus ASCII client (1)Bit type : 1~976 (2)Word type : 1~61 2. when P2P function is Write 1) Modbus RTU client (1)Bit type : 1~1968 (2)Word type : 1~123 2) Modbus ASCII client (1)Bit type : 1~944 (2)Word type : 1~125
7	Destination station		1. It is checked automatically. 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		1. Destination station number, setting range is 0~31.
9	Setting		▶ When P2P function is Read 1. Read area: device area of server 1) Bit: bit input (0x10000), bit output (0x00000) 2) Word: word input (0x30000), word output (0x40000) 2. Save area: client's device to save the data
			▶ When P2P function is Write 1. Read area: device area of self station 2. Save area: server's device area to save the data 1) Bit: bit input (0x10000), bit output (0x00000) 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.

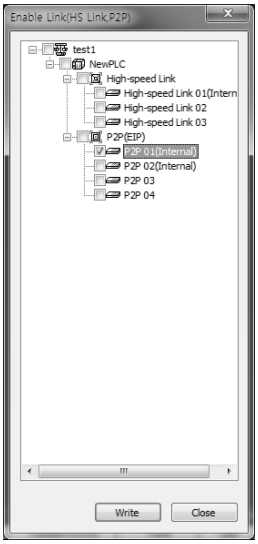
After download, the parameter is applied immediately. If you check 'Set up with Link Enable', Link Enable can be applied with writing P2P/HS parameters at the same time.



[Not checking link enable] [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.



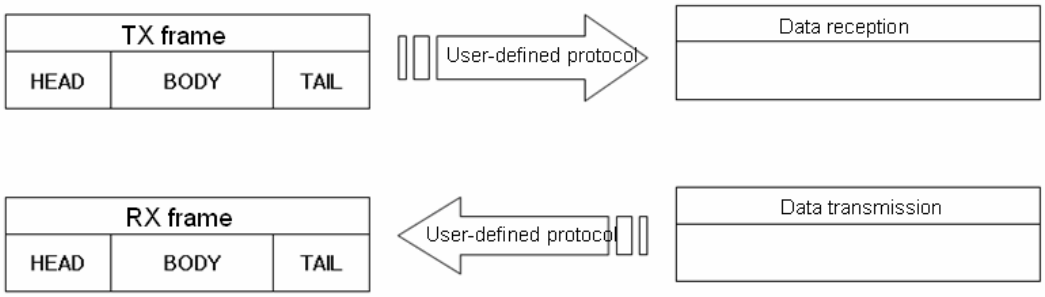
5) Diagnosis service

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.

2.6.5 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)

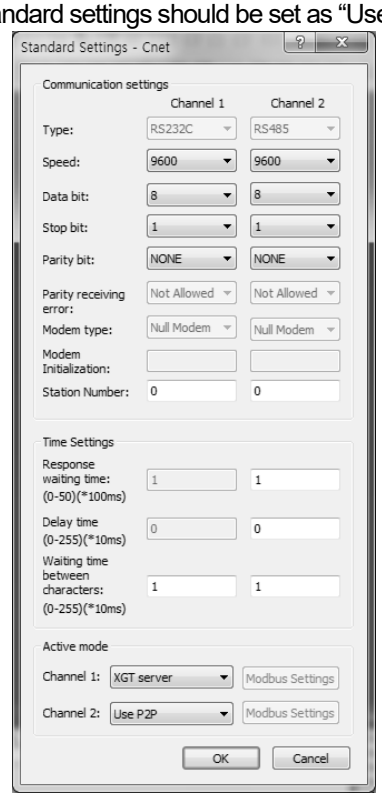
Frame part where size is fixed but contents changes are defined as Fix sized variable. It can be set in the BODY. In case of Fix sized variable, the user can register up to 4.

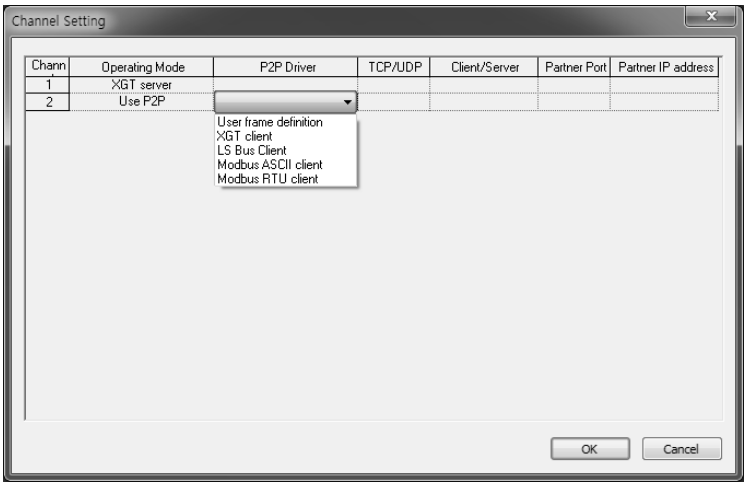
TRX frame standard for user - defined communication of XGB Cnet I/F module is as follows.

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 Fix sized variable 3, variable sized variable 1 are available
		Variable sized variable	Only one variable sized variable available After variable sized variable, adding segment is impossible

2) Channel setting

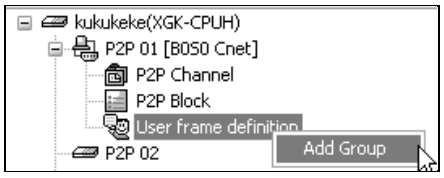
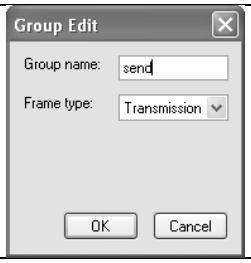
Cnet I/F module is available to define driver type for P2P service about each channel. However, active mode in the standard settings should be set as “Use P2P settings”.

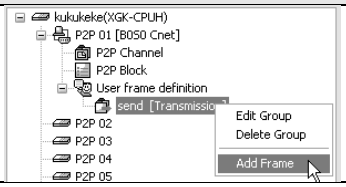
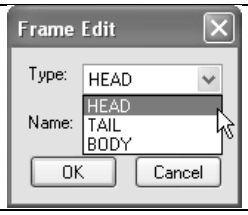
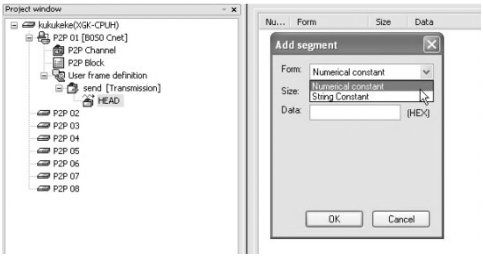


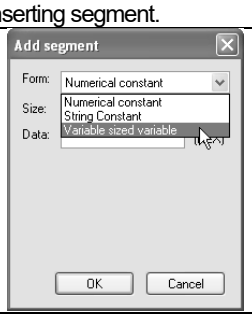


3) Set-up transmission frame

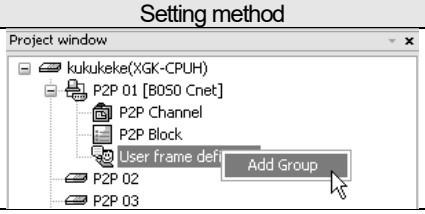
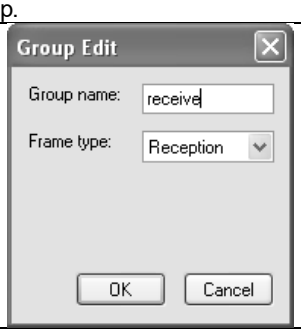
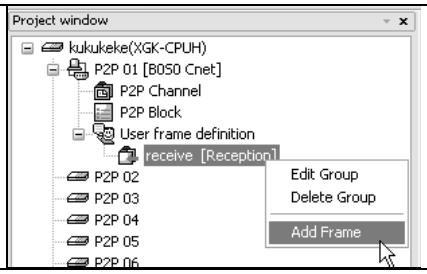
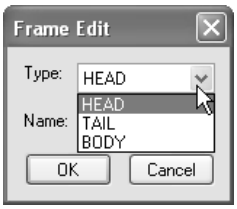
Frame is composed of HEAD indicating start, TAIL indicating end and BODY which is data area. How to write transmission frame is as follows.

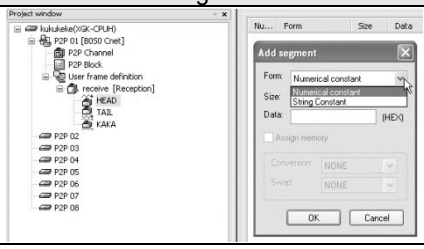
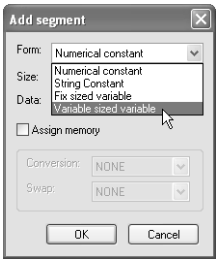
Sequence	Setting contents	Setting method
1	Writing user frame definition	
	1. Select User frame definition. 2. Click right button of mouse and click Add Group	
2	Creating frame	
	1. Group name is name of frame for user to write. 2. Select Transmission as frame type.	

<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.
2. Select frame name and click right button of mouse.
3. Click Add Frame to create HEAD, TAIL and BODY.
4. Group Edit: when changing frame name.
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.
2. type: HEAD,TAIL,BODY
3. Select HEAD.
4. To create TAIL, BODY, repeat step 3.
5. Name of frame edit window is activated when frame type is BODY.
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.
2. Double-click edit window or click right button and select Add segment.
3. Select Form.
1) Numerical constant
(1) Defines numerical constant among frame
(2) Data value is always Hex (Hexadecimal)
2) String constant
(1) Registers string constant among frame
(2) Data value is always ASCII
4. Input value into Data.
Ex.) Form: Numerical constant
Data: 5(ENQ)
* 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.
2. Setting method is same with step 5.
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.
1) Numerical constant and string constant are same as described above.
2) Variable sized variable
(1) used when frame length change
(2) available to insert up to 4 for one body
(3) ‘Assign memory’ is checked automatically
(4) Control by byte unit
3) Conversion
▶Hex To ASCII: converts the data red from PLC into ASCII and configures transmission frame
▶ASCII To Hex: converts the data red from PLC into Hex and configures transmission frame
4) Swap
▶2 Byte swap: 2 byte swap of data (ex.: 0x1234->0x3412)
▶4 Byte swap: 4 byte swap of data (ex.: 0x12345678->0x78564321)
▶8 Byte swap: 8 byte swap of data</td></tr>
</table>

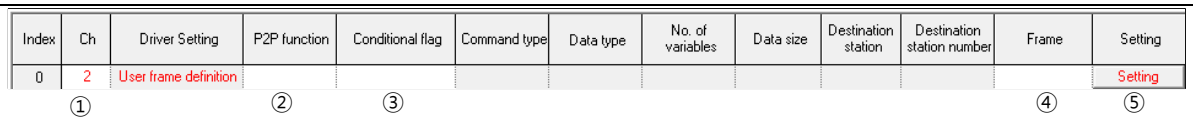
4) Set-up reception frame

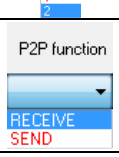
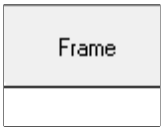
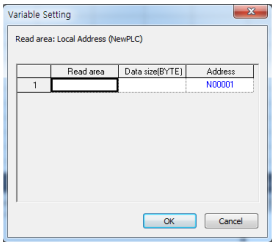
Sequence	Setting method	Setting method
1	Writing user-defined frame	
	1. Select User frame definition. 2. Click the right button of mouse and select Add Group.	
2	Creating frame	
	1. Group name is name of frame for user to write. 2. Select Reception as frame type.	
3	Creating frame	
	1. Check creation of frame. 2. Select frame name and click right button of mouse. 3. Click Add Frame to create HEAD, TAIL and BODY. 4. Group Edit: when changing frame name. 5. Delete Group: when deleting frame.	
4	Creating HEAD, TAIL, BODY	
	1. After clicking Add Frame, select type of frame. 2. type: HEAD, TAIL, BODY 3. Select HEAD. 4. To create TAIL, BODY, repeat step 3. 5. Name of frame edit window is activated when frame type is BODY. 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.
2. Double-click edit window or click right button and select Add segment.
3. Select Form.
1) Meaning of each form is same as described in the transmission.
4. Input value into Data.</td></tr>
<tr><td>6</td><td>TAIL registration</td><td>1. If double-click TAIL, edit window shows.
2. Setting method is same with step 5.
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.
1) Numerical constant and string constant are same as described above.
2) Variable sized variable
(1) used when frame length changes
(2) Available to insert only one variable sized variable and it is impossible to add segment after variable sized variable
(3) When checking [Assign memory], it is available to save in the PLC memory
(4) Control by byte unit
3) Fix sized variable
(1) Used when frame size is fixed.
(2) available to insert up to 4 for one body
(3) When checking [Assign memory], it is available to save in the PLC memory
4) Assign memory: when setting the device area of PLC to save data.
5) Conversion
▶Hex To ASCII: converts the data received into ASCII and configures reception frame
▶ASCII To Hex: converts the data received into Hex and configures reception frame
6) Swap
▶2 Byte swap: 2 byte swap of data (ex.: 0x1234->0x3412)
▶4 Byte swap: 4 byte swap of data (ex.: 0x12345678->0x78564321)
▶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.



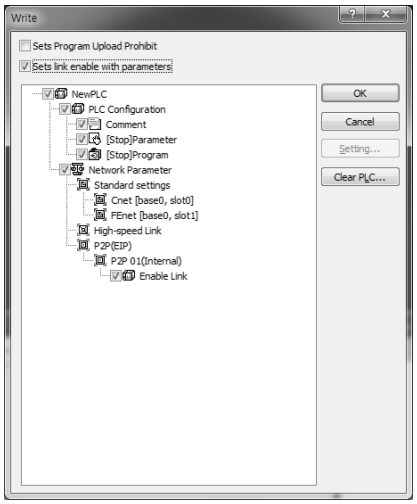
No.	Type	Block type	Meaning
1	Channel		Driver name changes according to driver set in the P2P Driver.
2	P2P Function		1. Receive: used when receiving the frame written according to partner's protocol 2. Send: used when sending the frame written according to partner's protocol
3	Conditional flag		1. Determines when Cent sends frame 2. It is activated when P2P function is [Send]. 3. In case of XBC type Ex.: F90(20ms flag), M01 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. 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.

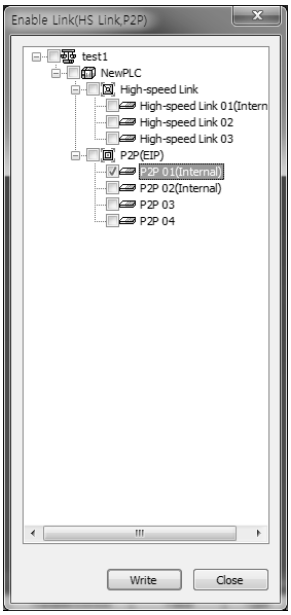
After download, the parameter is applied immediately. If you check 'Set up with Link Enable', Link Enable can be applied with writing P2P/HS parameters at the same time.



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.



8) Diagnosis service

In order to check the setting parameter operates normally, diagnosis service is available.

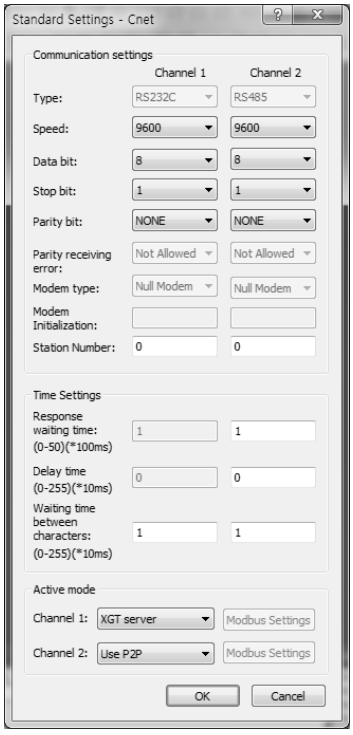
Select [Online] – [Communication module setting] – [System Diagnosis]. Click the module and then click mouse right-button. If you select Frame Monitor or Status by Service, it can be checked whether the communication is normal or not. For more detail, refer to chapter 2.9 Diagnosis Function.

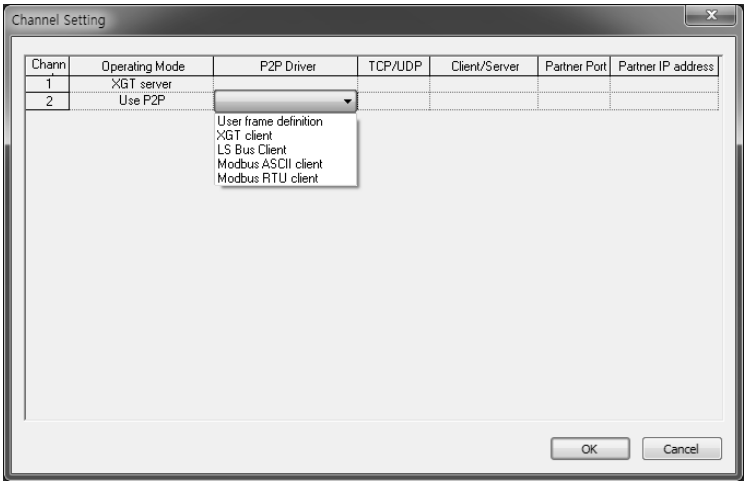
2.6.6 LS Bus Client

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.





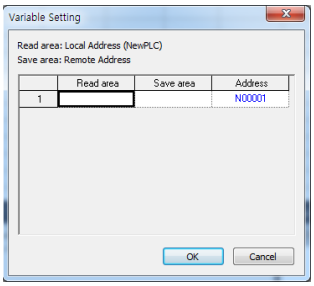
2) P2P block setting

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
	①		②	③				④	⑤	⑥		⑦

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 2. Write: when writing self-station’s memory to destination station’s memory.
3	Conditional flag		1. Determines when Cnet sends request frame 2. In case of XBC type Ex. : F90(20ms flag), M01 3. In case of XEC type Ex. : _T20MS(20ms flag), %MX01

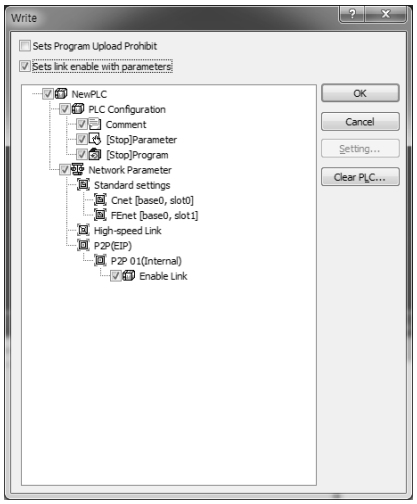
No.	Type	Block form	Contents
4	Data size		1. This is activated when command type is continuous. 2. When data type is 1 word, available max. no. is 8 word
5	Destination station		1. Check: Specify the destination station
6	Destination station number		1. Destination station number, setting range is 0~63.
7	Setting		1. When P2P function is Read 1)Read area : device area of server 2)Save area : client's device to save the data from server 2. When P2P function is Write 1)Read area : device area of client 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.

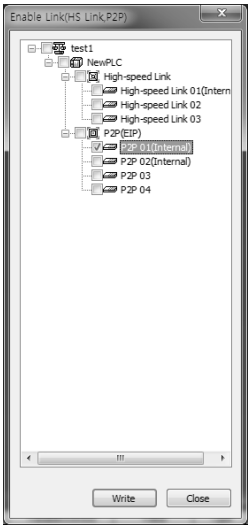
Select [Online] – [Connect] – [Write], and click OK in parameter download window, and then it will be downloaded.

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 (H52)	SS	5353	Reads direct variable of Bit, Byte, Word, Dword, Lword type.
	Continuous	r(R)	H72 (H52)	SB	5342	Read direct variable of Byte, Word, Dword, Lword with block unit (Bit continuous read is not allowed)
Writing device	Individual	w(W)	H77 (H57)	SS	5353	Write data of Bit, Byte, Word, Dword, Lword at direct variable
	Continuous	w(W)	H77 (H57)	SB	5342	Write data of Byte, Word, Dword, Lword at direct variable with block unit (Bit continuous read is not allowed)

Classification / Item	Command			Treatment
	Main command		Register No	
	Code	ASCII code		
Monitoring variable register	x(X)	H78 (H58)	H00~H0F	Register device to monitor.
Execution of monitoring	y(Y)	H79 (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: 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)

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.
Number of data	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. • Number of data in accordance with its data type is as follows: ※R area is supported at XBC-DXXXU
Data	• In data area, there are the values of hex data converted to ASCII code saved.

Data type	Available variable	Number of data
Bit(X)	%(P,M,L,K,F,T,C,D,R,I,Q,W)X	1
Byte(B)	%(P,M,L,K,F,T,C,D,R,I,Q,W)B	1
Word(W)	%(P,M,L,K,F,T,C,D,R,I,Q,W)W	2

▪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

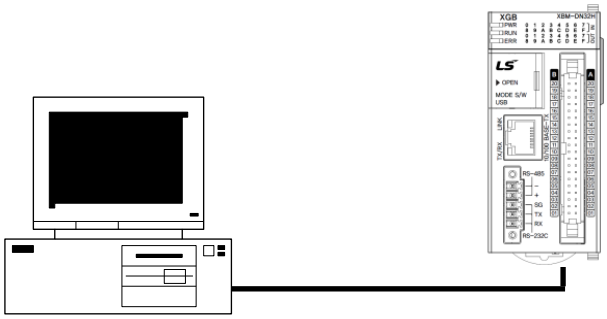
If number of data is H04 and the data is H12345678, ASCII code converted value of this is "31 32 33 34 35 36 37 38," and this contents is entered in data area. Name directly, highest value is entered first, lowest value last.

(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



XGB main unit

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	H254D573032 30	H3036	H255057303030 31	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	H303 1	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	

Item	Description
Number of data	It means byte number of hex type, and is converted into ASCII Data type / Available device / Data size (Byte) BYTE(B) / %(P,M,L,K,F,T,C,D,R,I,Q,W)B / 1 WORD(W) / %(P,M,L,K,F,T,C,D,R,I,Q,W)W / 2 DWord(D) / %(P,M,L,K,F,T,C,D,R,I,Q,W)D / 4 LWord(L) / %(P,M,L,K,F,T,C,D,I,Q,W)L / 8 ※R area is supported at XBC-DXXXU

▪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	H254D573130 30	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	H254D573233 30	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	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	H2554573030 30	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). 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). 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.

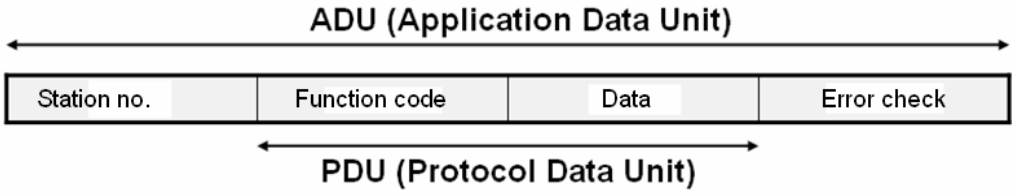
2.9.1 Modbus Protocol

There are two communication modes of Modbus, ASCII and RTU.

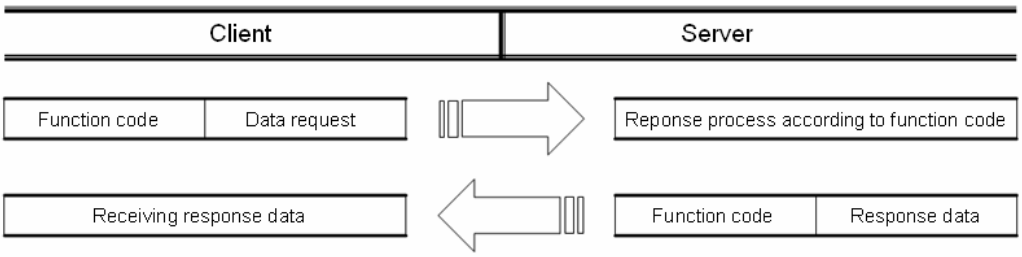
Characteristic		ASCII mode	RTU mode
Coding method		ASCII code	8 bit binary code
No. of data per one character	Start bit	1	1
	Data bit	7	8
	Parity bit	Even,Odd,None	Even,Odd,None
	Stop bit	1 or 2	1 or 2
Error check		LRC(Longitudinal Redundancy Check)	CRC (Cyclical Redundancy Check)
Start of frame		Colon (:)	3.5 Character no response time

1) Structure of Modbus protocol

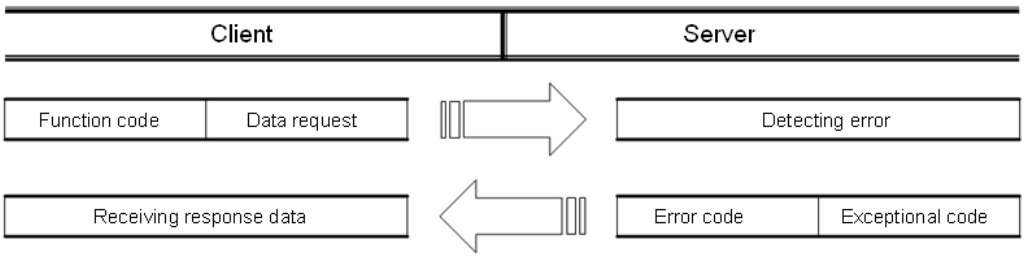
Modbus protocol's structure is as follows.



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

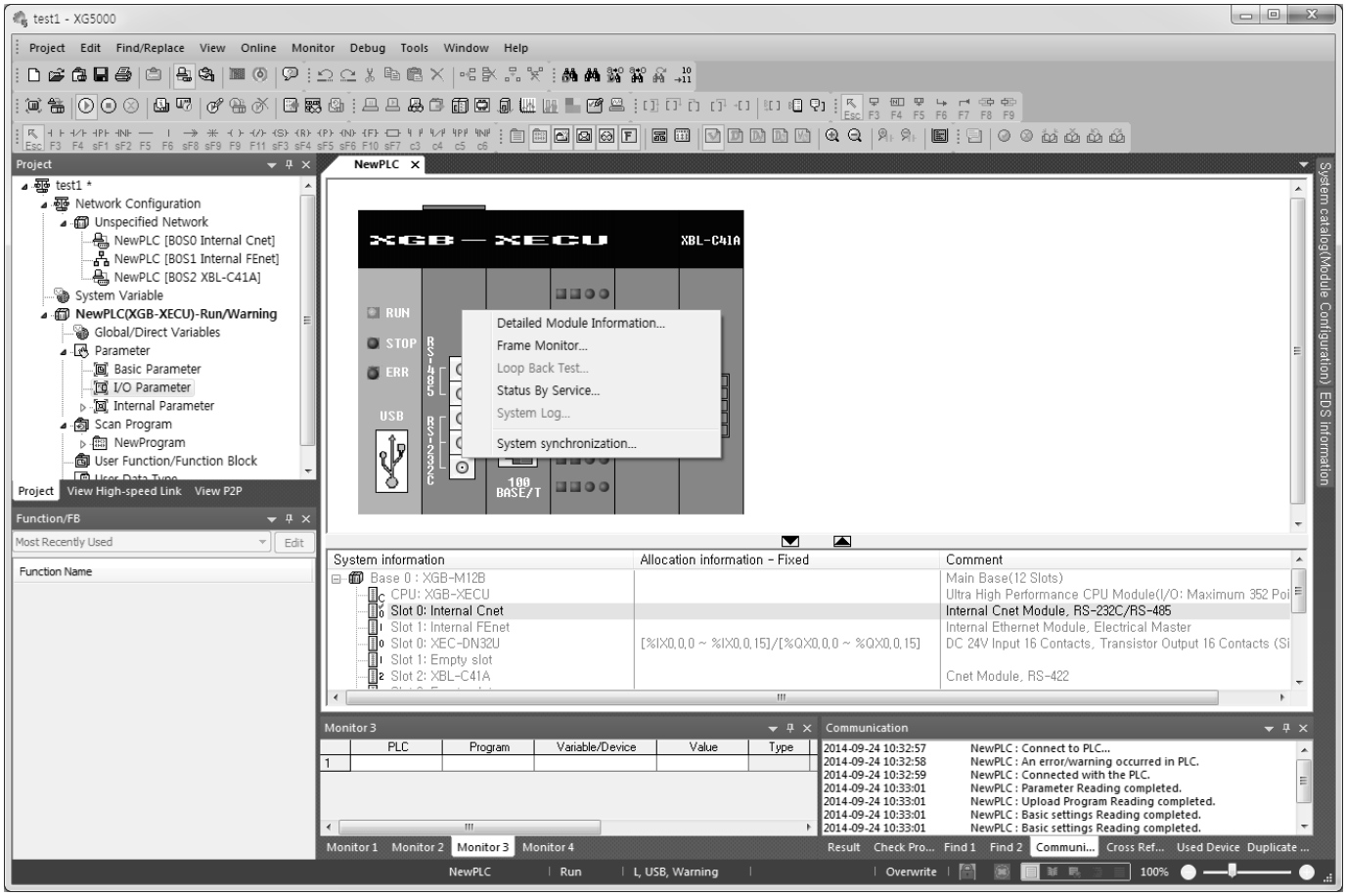
2.10 Diagnosis Function

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

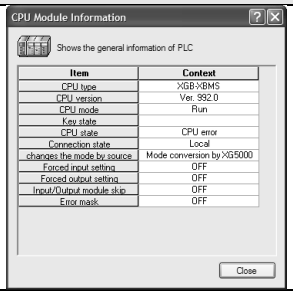
2.10.1 Diagnosis Function of XG5000

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.



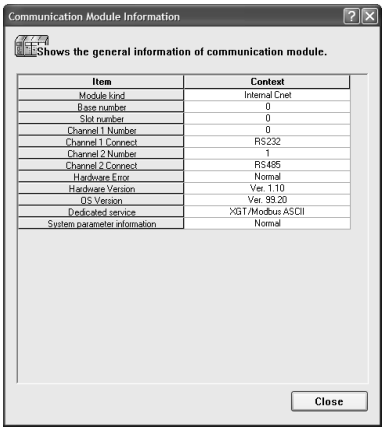
• Select [Online] – [Communication module setting] – [System Dianosis] and click the icon ( ).
• Click the right button on the the relevant module and click Frame Monitor or Status By Service to check.

1) Checking status of main unit

Check list	Detail result
CPU Module information	

1. Select [Online] – [Communication module setting] – [System Diagnosis] or click the icon ( ).
2. You can check the status of main unit by clicking CPU module information after clicking main unit.

1) Communication module information

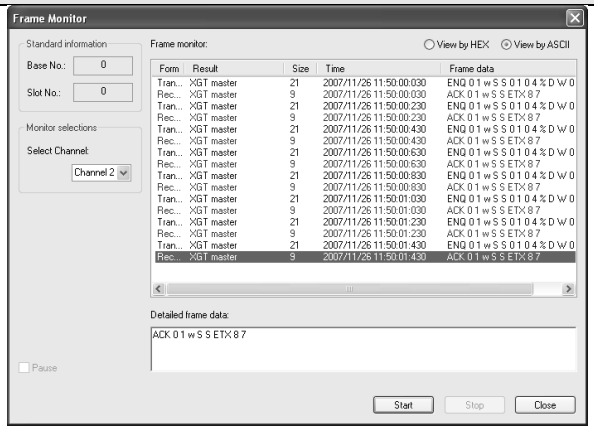
Check list	Detail result
Communication module information	

1. Select [Online] – [Communication module setting] – [System Diagnosis] or click the icon ( ).
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.
3. Meaning of each item of communication module information is as follows.

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 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 Standard communication parameter error information expression	

2) Frame monitor

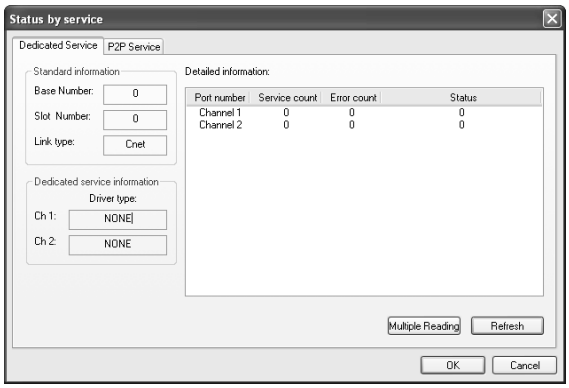
The user can check whether frame is normal or not by monitoring TRX frame through Cnet I/F module by XG-PD's frame monitor.

Check list	Detail result
Frame monitor	

1. Select [Online] – [Communication module setting] – [System Diagnosis] or click the icon ( ).
2. If you click right button after clinking Cnet I/F module and click frame monitor, you can monitor current communication data.
3. If you use frame monitor function, you can check frame of TRX data between Cnet I/F module and external communication device easily.
4. Detailed content of information indicated frame monitor window is as follows.

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 1) XGT server 2) XGT client 3) Modbus server 4) Modbus client 5) User definition frame 6) Unknown: frame that Cnet can't deal with	
	Size	Size of frame	
	Time	Time when sending/receiving the frame 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	

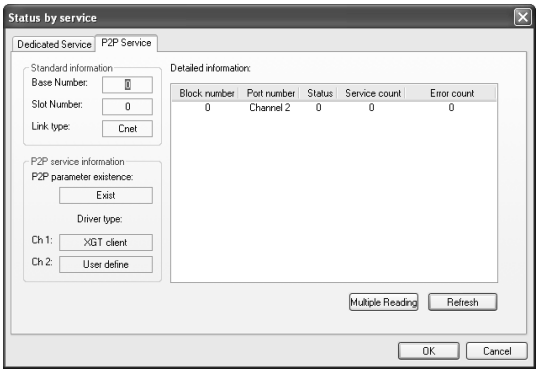
3) Status by service(Dedicated Service)

Check list	Detail result
Dedicated service	

1. Select [Online] – [Communication module setting] – [System Diagnosis] or click the icon ( ).
2. Click the right button on the the Cnet I/F module and click Status By Service.
3. Click Dedicated Service tap.
4. Check the status by service by clicking Multiple Reading and Refresh
5. Detailed content of information indicated in dedicated service window is as follows.

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)

Check list	Detail result
P2P service	

1. Select [Online] – [Communication module setting] - [System diagnosis] or click the icon ( ).
2. Click the right button on the the Cnet I/F module and click Status By Service.
3. Click P2P service of Status by Service
4. Click mutiple reading and check Status by Service.

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 XGT/Modbus/User definition frame
	Detailed information	Block number	Available range:0~63 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.

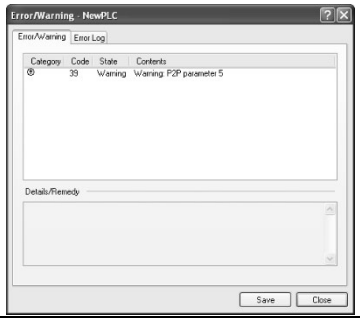
5) Service status code

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 (There is no ACK/NAK.)	4	Error of max. station number (Available range: 0~255)
2	Error of RX frame tail (There is no tail.)	5	Time out
3	BCC error of RX frame	FFFE	1. Modbus address error 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 	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. 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. 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. 2. Communication time: transmission time + reception time - transmission time: conditional flag+CPU Scan Time+reaction time of communication module+data transmission time - 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 Transmission XGT master 17 2007/12/4 ... ENQ 01rSS0104%MW0EOT40 Reception Unknown 17 2007/12/4 ... ENQ 01rSS0104%MW0EOT40 Reception Unknown 17 2007/12/4 ... ACK 01rSS0102000 0ETX05 Transmission XGT master 17 2007/12/4 ... ENQ 01rSS0104%MW0EOT40	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. 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 - Check module's equipment status - Check wiring 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. 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, it requests next process of transmission 2. When reception is not complete, it requests next process of reception	Use handshake in program thoroughly

2.11 Example Program

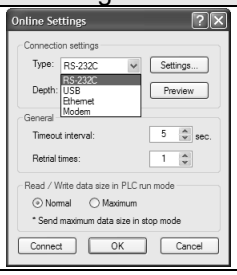
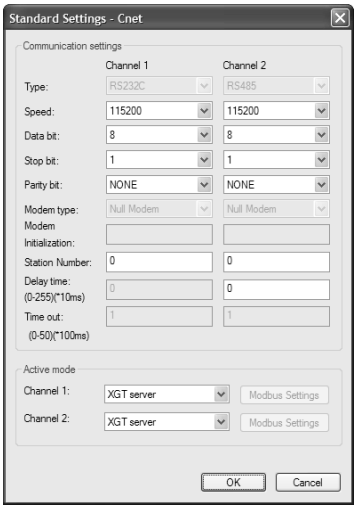
2.11.1 Setting of Cnet I/F Module in the XG5000

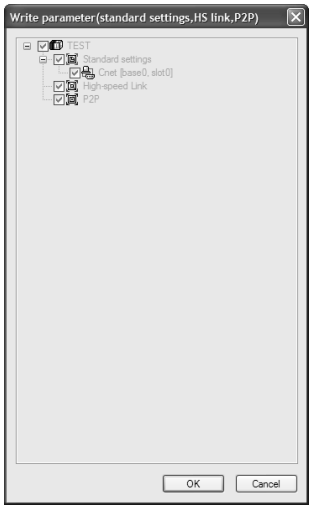
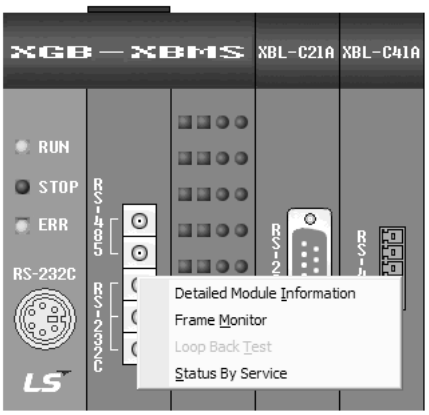
Operation of XGT Cnet I/F is divided into P2P service and Server.

• P2P service: acts as client (master) and request reading/writing.
- XGT client
- Modbus RTU/ASCII client
- User frame definition

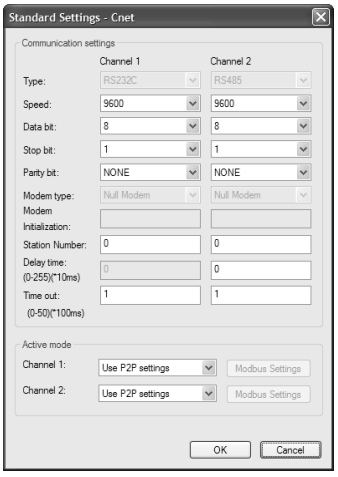
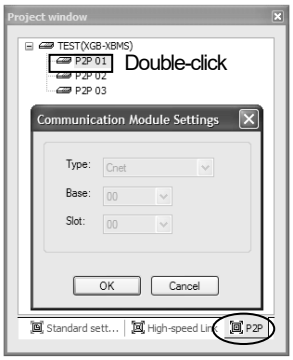
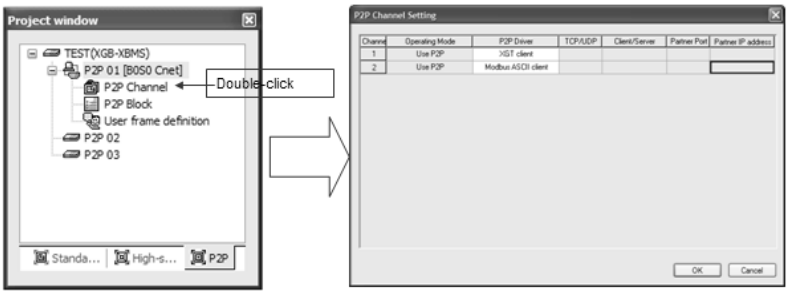
• Server: acts as server (slave) and acts according to request
- XGT server
- Modbus RTU server
- Modbus ASCII server

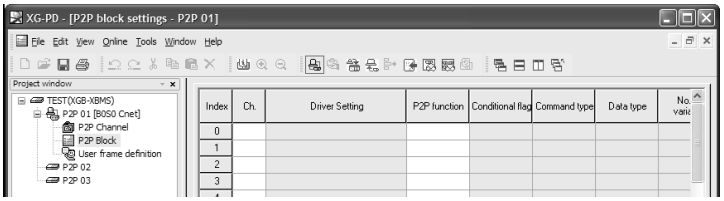
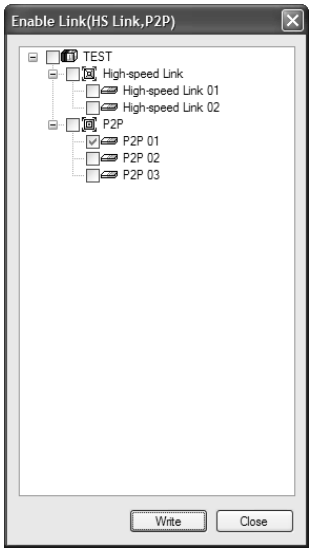
1) In case of acting as server

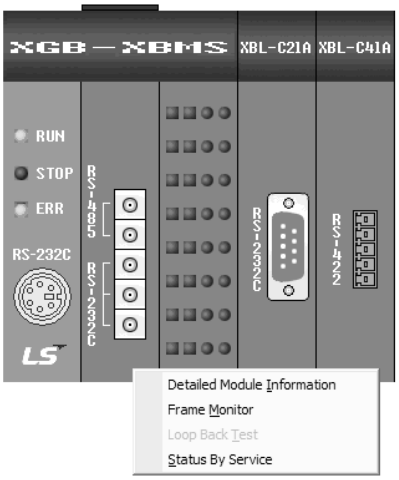
Sequence	Procedure	Setting method
1	Connection setting	
	1. Select [Online]-[Connection Settings] or click icon( ) 2. Click [Connect] after setting.	
2	Read I/O information	Select [Online] – [Read I/O Information] or click icon ( ) Reads the information about currently equipped module.
3	Standard Settings	
	1. Double-click Cnet I/F module and execute standard setting window. Set Type, Speed, Data bit, Stop bit, station no. of connection menu. 2. Modem initialization is available in case of dial modem, not null modem. 3. Delay time setting: when sending frame, it sends frame after specific delay time. (a) Operation setting: Available when type is RS-422/485. * When using as Modbus ASCII server, data bit should be 7.	

Sequence	Procedure	Setting method
4	Selecting the active mode	1. Select active mode of server for user to use. 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 ( ) 2. Click [OK]. 3. If you click [OK] button, parameter is sent to PLC. 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 ( ). 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.
*In case of ASCII client, data bit should be 7.</td></tr>
<tr><td rowspan="2">2</td><td>Active mode</td><td> 
</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> 
</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.
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> 
</td></tr>
<tr><td colspan="2">1. Double-click P2P driver and select protocol according to each channel.
2. P2P driver supports user definition frame, XGT client, Modbus RTU/ASCII client.</td></tr>
</table>

Sequence	Procedure	Setting method
5	P2P block setting	
	1. P2P items are activated differently according to type of client set in the channel. 2. Write shell according to protocol * In case of user definition frame, P2P block can be set when user definition frame is written.	
6	Writing parameter	
	1. Select [Online] – [Write Parameter] or click icon ( ). 2. Click [OK]. 3. If you press [OK], parameter is sent to PLC. If you don't reset relevant module, XGB Cnet I/F module acts as changed parameter.	
7	Enabling the link	
	1. Select [Online] – [Enable Link] or click icon ( ). 2. Click the P2P to enable and click Write.	

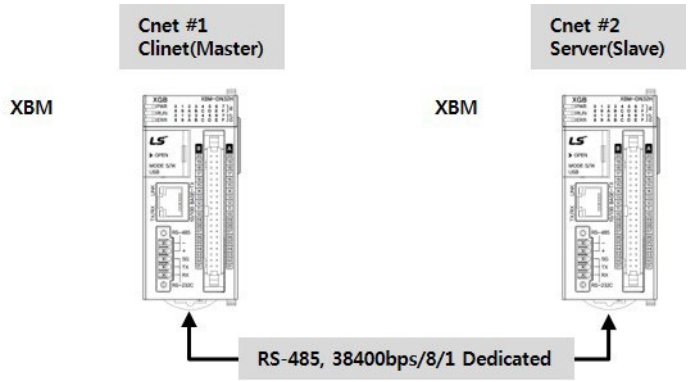
Sequence	Procedure	Setting method
8	Checking the operation	
	1. Select [Online] – [System Diagnosis] or click icon ( ). 2. Click the right button on the relevant module and click Frame Monitor or Status By Service to check.	

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

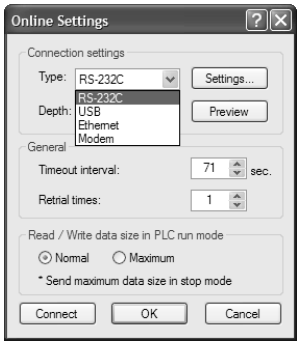
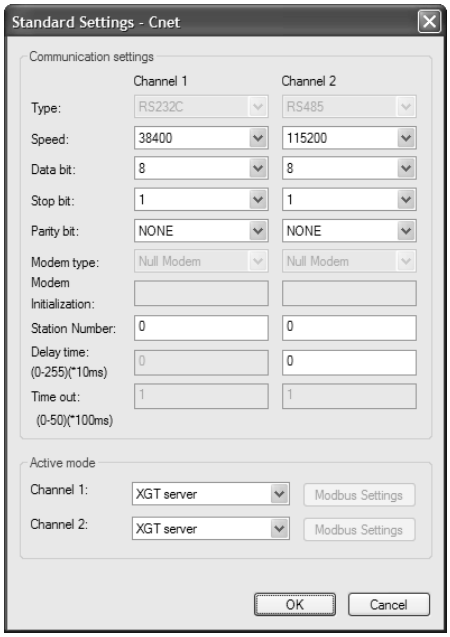
1) Server setting

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

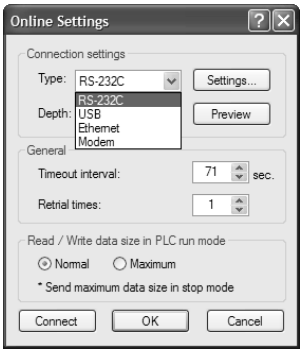
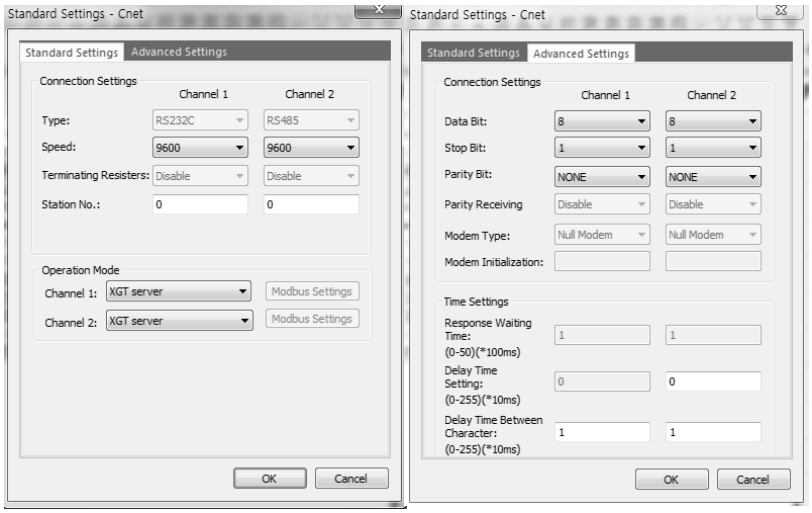
2) Settings of XGT server

Setting method to operate built-in RS-232C communication channel of Built-n Cnet as server is as follows.

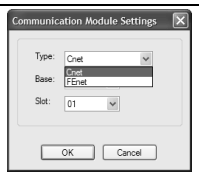
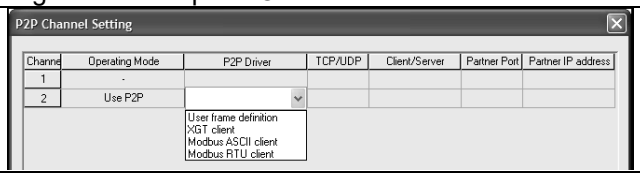
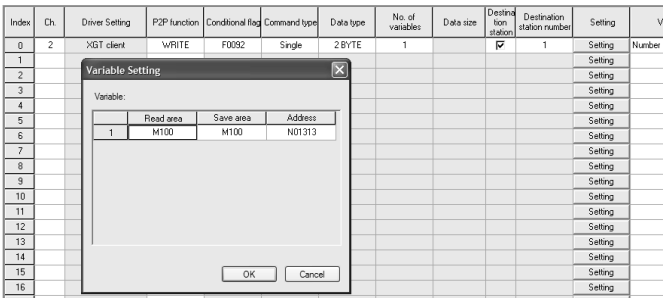
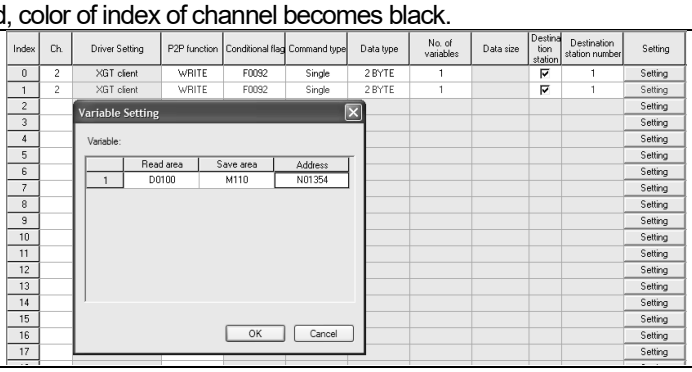
<table>
<tr><th>Sequence</th><th>Procedure</th><th>Setting method</th></tr>
<tr><td rowspan="2">1</td><td>Connection settings</td><td> 
</td></tr>
<tr><td colspan="2">1. Select [Online]-[Connection settings] and click ( ).
2. After setting the connection option according to user, click the ‘connection’.</td></tr>
<tr><td>2</td><td>Reading IO information</td><td>Select [Online]-[Read IO Information] and click icon ( ).
IO information of currently mounted is shown on the project window.</td></tr>
<tr><td rowspan="2">3</td><td>Standard settings</td><td> 
</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.
2. Since active mode acts as dedicated communication server, set as XGT server.</td></tr>
</table>

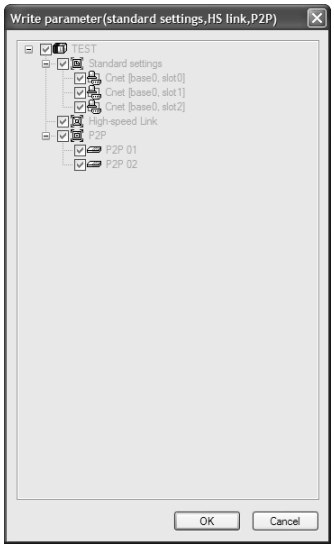
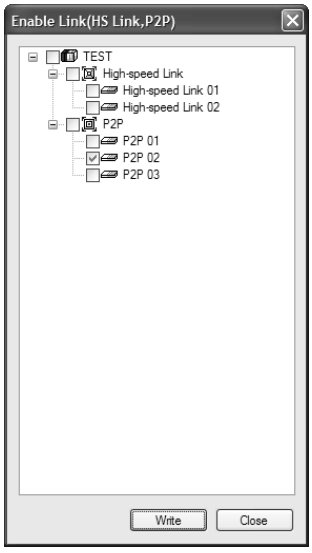
3) Settings of XGT client

To operate XBL-C21A of client as XGT client, set Cent I/F module as follows.

<table>
<tr><th>Sequence</th><th>Procedure</th><th>Setting method</th></tr>
<tr><td rowspan="2">1</td><td>Connection settings</td><td> 
</td></tr>
<tr><td colspan="2">1. Select [Online]-[Connection settings] or click icon ( ).
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 ( ).
IO information of currently mounted is shown on the project window.</td></tr>
<tr><td rowspan="2">3</td><td>Standard settings</td><td> 
</td></tr>
<tr><td colspan="2">1. Select Cnet described in [Table 2.11.1].
2. In case of acting as client, station setting doesn’t have the meaning so set temporary station (0~255).
3. When acting as client, active mode should be [Use P2P settings].</td></tr>
</table>

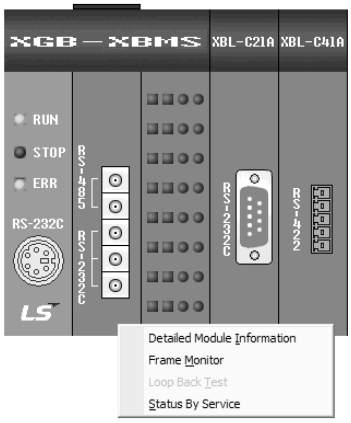
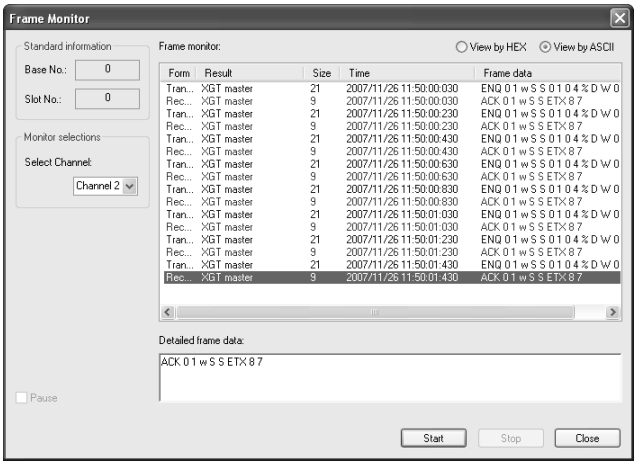
After standard settings, P2P channel and P2P block should be set. Setting methods are as follows.

<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> 
</td></tr>
<tr><td colspan="2">1. Double-click [P2P 02] of project window.
(P2P 01 is fixed as built-in communication module)
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> 
</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> 
</td></tr>
<tr><td colspan="2">1. Channel: Select ch.2 set as XGT client set in P2P channel.
2. Since it executes write operation, select WRITE.
3. Conditional flag: to send frame every 200ms, use flag F92.
4. Command type, Data type: to write 1 word, select single and 2 byte.
5. No. of variable: since no. of word is 1, select 1.
6. Destination station number: input 1 as station number of server.
7. Setting: after setting Read area and Save area, click OK.
1) Read area: device address of data saved in the client
2) Save area: device address of server to save data
* 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> 
</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.
2. P2P function: select READ.
3. Setting: after setting Read area and Save area, click [OK].
1) Read area: device address of data saved in server
2) Save area: device address of client to save</td></tr>
</table>

<table>
<tr><th>Sequence</th><th>Procedure</th><th>Setting method</th></tr>
<tr><td rowspan="2">7</td><td>Writing parameter</td><td> 
</td></tr>
<tr><td colspan="2">1. Select [Online] – [Write Parameter] or click icon ( ).
2. Click [OK].
3. If writing parameter is complete After clicking [OK], changed parameter is applied automatically.</td></tr>
<tr><td rowspan="2">8</td><td>Enabling the link</td><td> 
</td></tr>
<tr><td colspan="2">1. Select [Online] – [Enable Link] or click icon ( )
2. Click the P2P to enable and click Write.</td></tr>
</table>

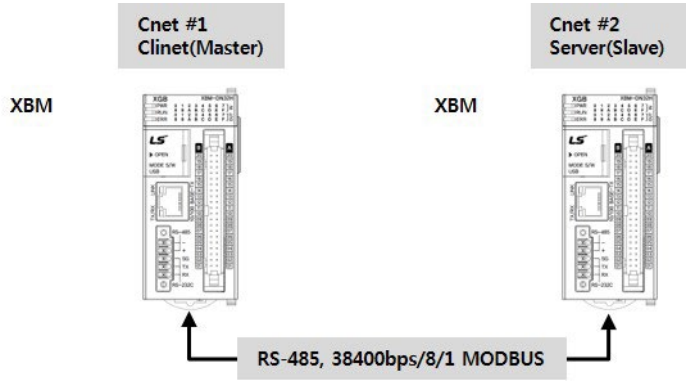
4) Checking the operation

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.

Sequence	Procedure	Setting method
1	System Diagnosis	
	1. Connect with cilent by XG-PD and select [Online] – [System Diagnosis] or click ( ). 2. Click the right button on the relevant module and click Frame Monitor or Status By Service.	
2	Frame monitor	
	1. Select channel 2 and click Start. 2. Since dedicated service is ASCII communication, select View by ASCII. * In case of Modbus RTU, select View by HEX and in case of Modbus ASCII, select View by ASCII.	

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 ▶Write 4 words from D0 of client to M2~M5 of server ▶Write 15th bit of M2 to 2nd bit of M20 of server ▶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 ▶Read 4 words from P0 of server and save it at M150~M153 ▶Read 1st bit of P2 of server and save it at 1st bit of M170. ▶Read 0th ~ 15th bit of M10 of server and save it at 0th ~ 15th of M180 of client.

[client setting]

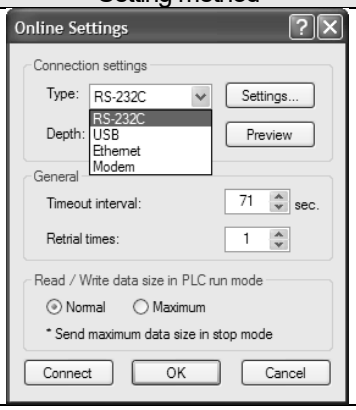
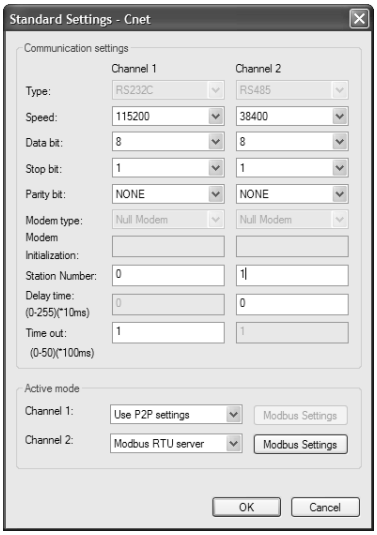
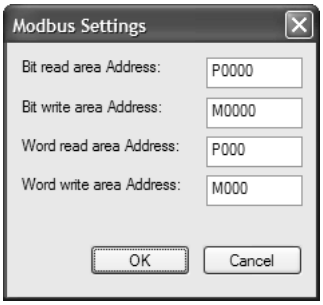
1) Server setting

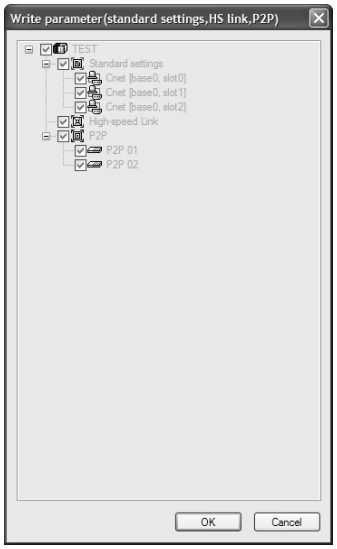
Main unit		XBC-DN32H
Communication type		Built-in RS-485
Communication speed		38,400
Data bit		8
Stop bit		1
Parity bit		None
Station no.		1
Start address	Bit read area Address	P0
	Bit write area Address	M0
	Word write area Address	P0
	Word write area Address	M0

[server setting]

2) Modbus RTU server setting

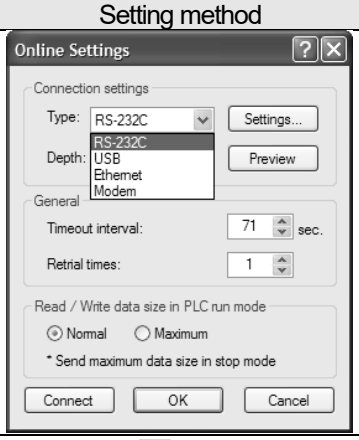
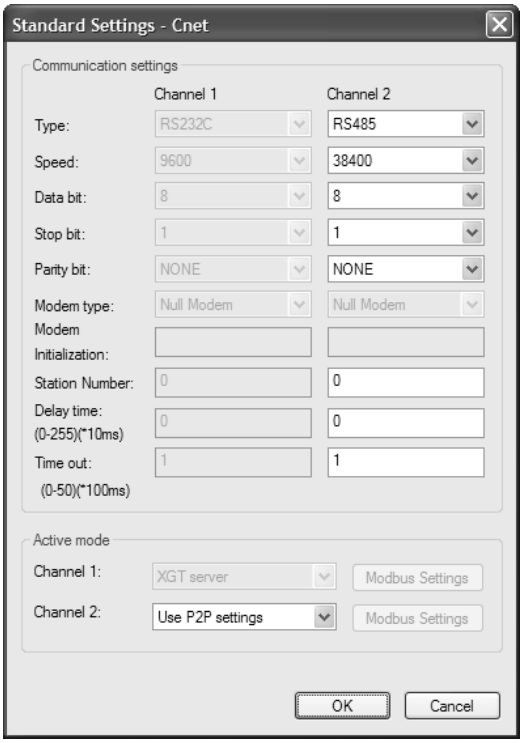
Standard settings are as follows to act built-in RS-485 communication channel of XBC-DN32H as Modbus RTU server.

<table>
<tr><th>Sequence</th><th>Procedure</th><th>Setting method</th></tr>
<tr><td rowspan="2">1</td><td>Connection setting</td><td> 
</td></tr>
<tr><td colspan="2">1. Select [Online]-[Connection settings] or click icon ( )
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 ( ).
IO information of currently mounted is shown on the project window.</td></tr>
<tr><td rowspan="2">3</td><td>Standard settings</td><td> 
</td></tr>
<tr><td colspan="2">1. Write setting value as same with [Table 2.11.2] at built-in communication channel 1.
2. Set active mode as Modbus RTU server.</td></tr>
<tr><td rowspan="2">4</td><td>Modbus setting</td><td> 
</td></tr>
<tr><td colspan="2">1. Bit read area Address: P00000 2. Bit write area Address: M0000
3. Word read area Address: P0000 4. Word write area Address: M0000
* 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)</td></tr>
</table>

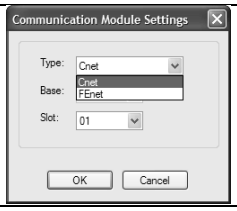
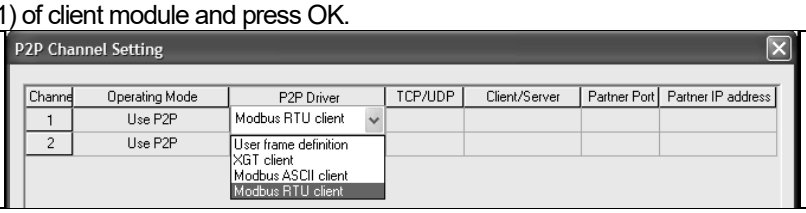
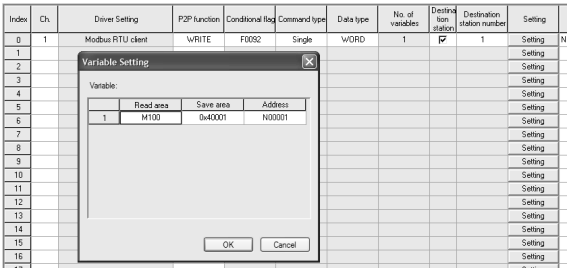
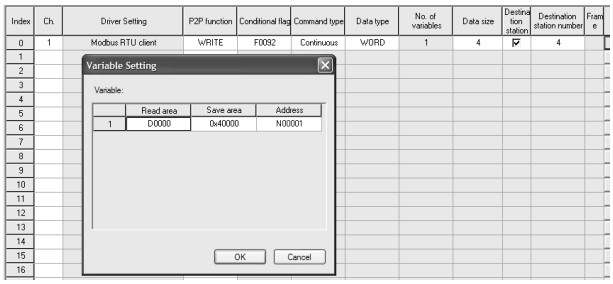
Sequence	Procedure	Setting method
5	Writing parameter	
	1. Select [Online] – [Write Parameter] or click icon ( ). 2. Click [OK] 3. If writing parameter is complete after clicking [OK] button, changed parameter is applied automatically.	

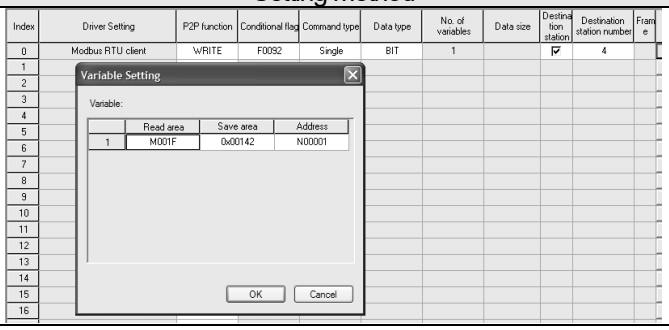
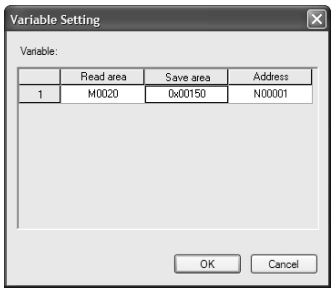
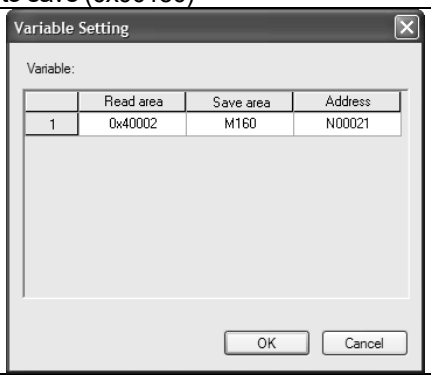
3) Setting of Modbus RTU client

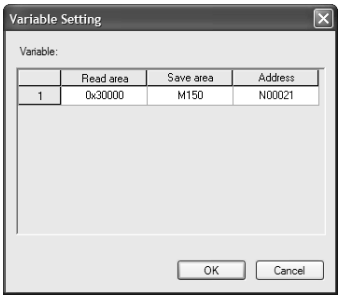
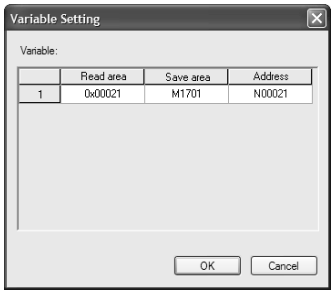
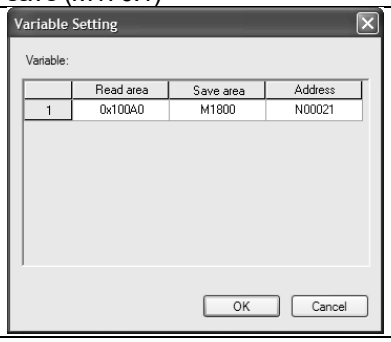
Standard settings are as follows to act XBL-C41A of client as Modbus RTU client.

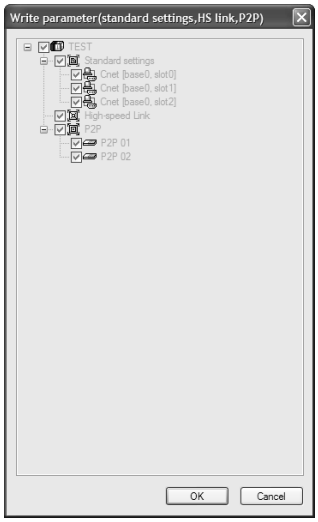
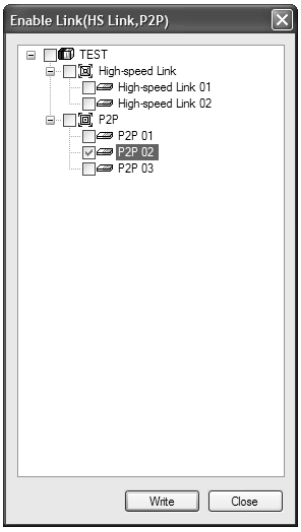
<table>
<tr><th>Sequence</th><th>Procedure</th><th>Setting method</th></tr>
<tr><td rowspan="2">1</td><td>Connection setting</td><td> 
</td></tr>
<tr><td colspan="2">1. Select [Online]-[Connection settings] or click icon ( ).
2. After setting the connection option according to user, click the ‘connection’.</td></tr>
<tr><td>2</td><td>Reading IO information</td><td>Select [Online]-[Read IO Information] and click icon ( ).
IO information of currently mounted is shown on the project window.</td></tr>
<tr><td rowspan="2">3</td><td>Standard settings</td><td> 
</td></tr>
<tr><td colspan="2">1. Select XBL-C41A and write standard settings to be same with [Table 2.11.1] at channel
2. Since station setting doesn’t have meaning when acting as client, set as temporary station number (0~255).
3. When acting as client mode, active mode should be Use P2P settings.</td></tr>
</table>

After standard settings, P2P channel and P2P block should be set. Setting methods are as follows.

Sequence	Procedure	Setting method
1	P2P setting	Click P2P bottom of project window.
2	Communication module setting	
	1. Double-click P2P 02 of project window. (P2P 01 is fixed as built-in communication) 2. Select slot no. (No. 1) of client module and press OK.	
3	P2P channel setting	
	1. Double-click P2P Channel of P2P 01 and set P2P driver of channel 1 as Modbus RTU client and click [OK].	
4	1. Double-click P2P Block of P2P 02.	
5	Setting of writing operation (1)	
	▶ Write 1 word of M100 of client to M1 of server 1. Ch.: Select ch.2 set as Modbus RTU client set in P2P channel. 2. P2P function: select WRITE. 3. Conditional flag: to send frame every 200ms, use flag F92. 4. Command type, Data type: to write 1 word, select single and 2 byte. 5. Destination station number: select station number of server. 6. Setting: after setting Read area and Save area, click OK. (1) Read area: device address saved in the client (M100) (2) Save area: deice address of server to save (0x40001: M1) * If all settings are completed, color of index of channel becomes black.	
6	Setting of writing operation (2)	
	▶ Write 4 words from D0 of client to M2~M5 of server 1. Ch., P2P function, conditional flag, destination station no.: same with step 5 2. Command type, Data type: because of writing continuous 4words, select Continuous, WORD 3. Data size: because of 4 words, input 4. 4. Setting: after setting Read area and Save area, click OK. (1) Read area: device address saved in the client (D0) (2) Save area: deice address of server to save (0x40002 : M2)	

<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> 
</td></tr>
<tr><td colspan="2">▶ Write 15th bit of M2 to 2nd bit of M20 of server
1. Ch., P2P function, conditional flag, destination station no.: same with step 5
2. Data type: select bit
3. Setting: after setting Read area and Save area, click OK.
(1) Read area: device address saved in the client (M1.F : 15th bit of M1)
(2) Save area: deice address of server to save (0x00142: 2nd bit of M20)
* When inputting M1.F, it is converted into M0001F in the XG-PD.
* Device address of server is Hex value.</td></tr>
<tr><td rowspan="2">8</td><td>Setting of writing operation (4)</td><td> 
</td></tr>
<tr><td colspan="2">▶ Write 0~15th bit of M2 to 0~15th bit of M21 of server
1. Ch., P2P function, conditional flag, destination station no.: same with step 7
2. Command type: select continuous.
3. Setting: after setting Read area and Save area, click OK.
(1) Read area: device address saved in the client (M2.0)
(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> 
</td></tr>
<tr><td colspan="2">▶ Read 1 word of M2 of server and save it at M160 of client
1. Ch., Conditional flag, Command type, Data type, Destination station no.: same with step 5
2. P2P function: select READ
3. Setting: after setting Read area and Save area, click OK.
(1) Read area: device address saved in server (0x40002)
(2) Save area: device address of client to save (M0160)</td></tr>
</table>

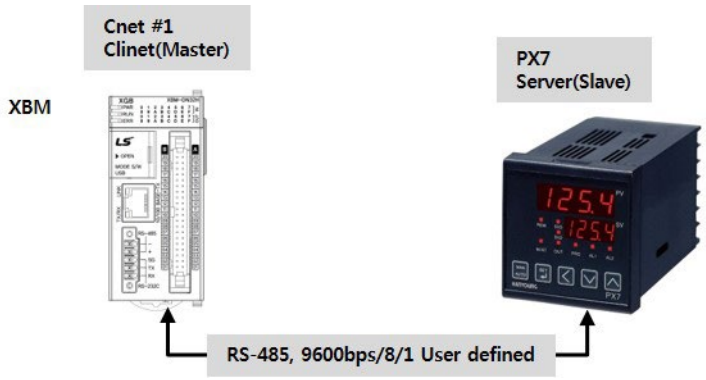
<table>
<tr><th>Sequence</th><th>Procedure</th><th>Setting method</th></tr>
<tr><td rowspan="2">10</td><td>Setting of reading operation (2)</td><td> 
</td></tr>
<tr><td colspan="2">▶ Read 4 words from P0 of server and save it at M150~M153
1. Ch., Conditional flag, Command type, Data type, Destination station no.: same with step 6
2. P2P function: select READ.
3. Setting: after setting Read area and Save area, click OK.
(1) Read area: device address saved in server (0x30000)
(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> 
</td></tr>
<tr><td colspan="2">▶ Read 1st bit of P2 of server and save it at 1st bit of M170.
1. Ch., Conditional flag, Command type, Data type, Destination station no.: same with step 7
2. P2P function: select READ
3. Setting: after setting Read area and Save area, click OK.
(1) Read area: device address saved in server (0x00021)
(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> 
</td></tr>
<tr><td colspan="2">▶ Read 0th ~ 15th bit of M10 of server and save it at 0th ~ 15th of M180 of client.
1. Ch., Conditional flag, Command type, Data type, Destination station no.: same with step 8
2. P2P function: select READ
3. Setting: after setting Read area and Save area, click OK.
(1) Read area: device address saved in server (0x100A0)
(2) Save area: device address of client to save (M180.0)</td></tr>
</table>

Sequence	Procedure	Setting method
13	Writing parameter	
	1. Select [Online] – [Write Parameter] or click icon ( ). 2. Click [OK]. 3. If writing parameter is complete after click OK, changed parameter is applied automatically.	
14	Enabling the link	
	1. Select [Online] – [Enable Link] or click icon ( ) 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

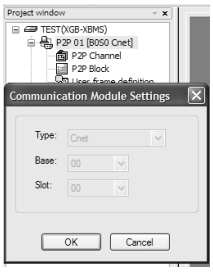
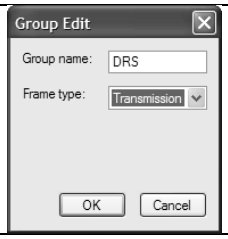
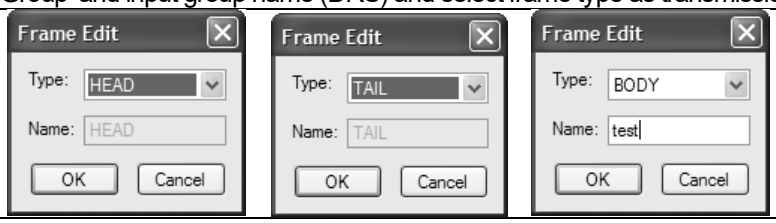
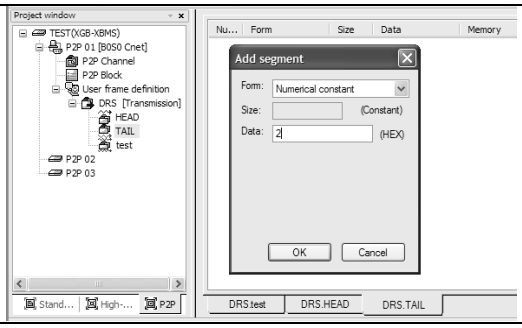
2) User definition communication parameter setting

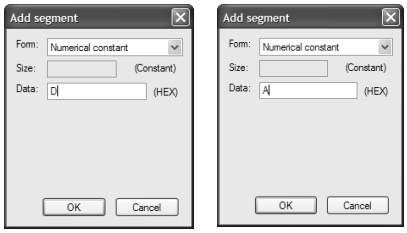
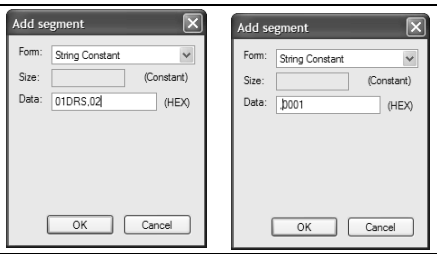
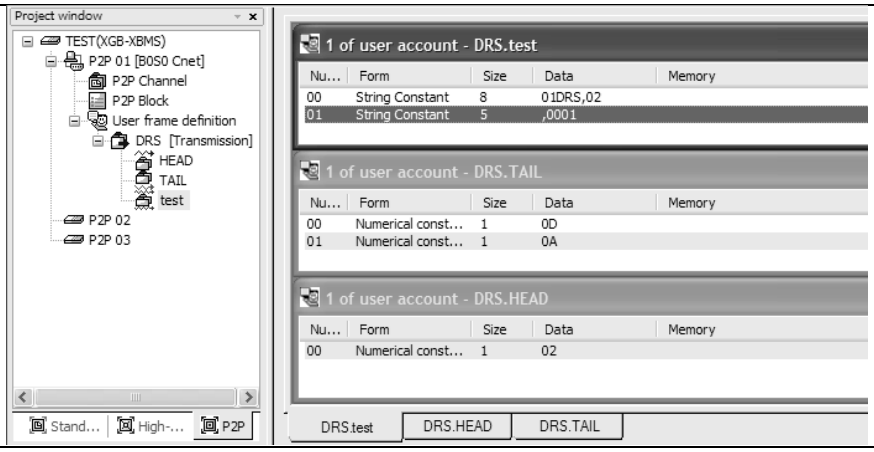
(1) Communication standard parameter setting

For standard setting, refer to setting method when acting as P2P service of 2.10.2 and configure above system [Table 2.11.1].

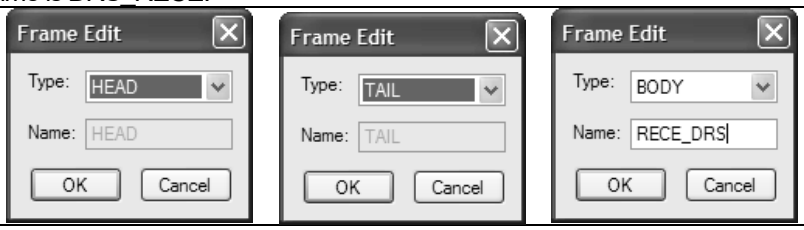
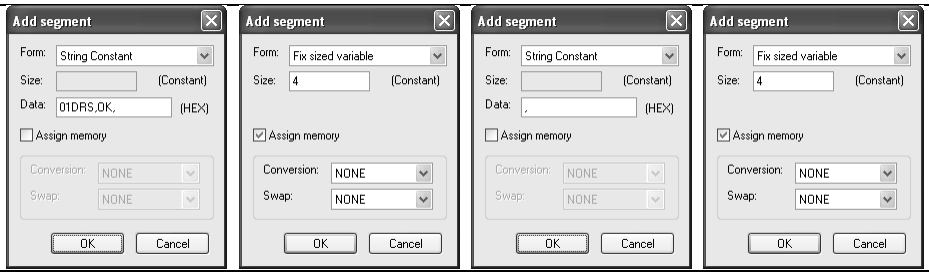
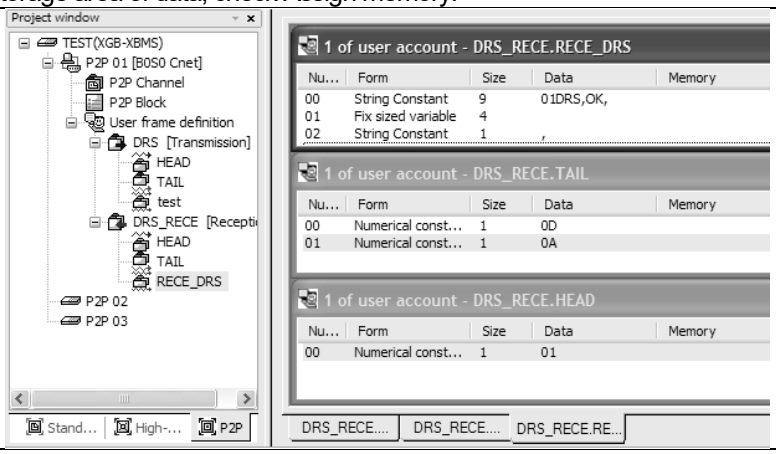
(2) Writing frame that requests reading data

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> 
</td></tr>
<tr><td>1. After standard settings, double-click P2P 01 in the P2P window.
2. As for built-in communication, base and slot is fixed as 0. Click OK.
3. Double-click P2P Channel and select User frame definition in Channel 2.</td></tr>
<tr><td rowspan="2">2</td><td> 
</td></tr>
<tr><td>1. Click user definition frame and click right button of mouse.
2. Click ‘Add Group’ and input group name (DRS) and select frame type as transmission.</td></tr>
<tr><td rowspan="2">3</td><td> 
</td></tr>
<tr><td>1. Click ‘Add Frame’ and select type HEAD, TAIL, BODY and input BODY name
2. BODY’s name is test here.</td></tr>
<tr><td rowspan="2">4</td><td> 
</td></tr>
<tr><td>1. If you double-click editor window after selecting DRS.HEAD tap at right screen, segment setting screen is created.
2. Select Numerical constant which indicates Hex as ASCII code as Form. Input Hex value 2 which indicates STX.</td></tr>
</table>

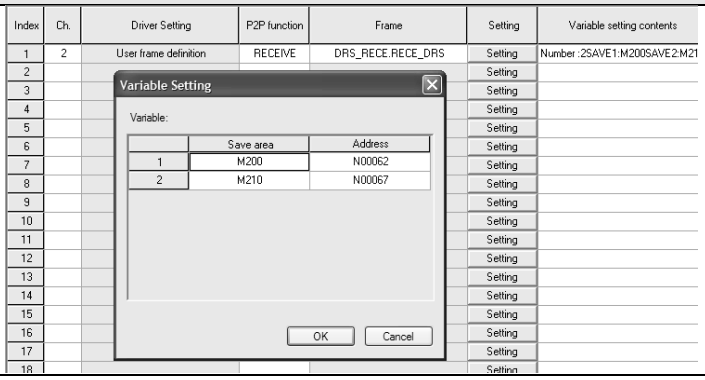
Sequence	Setting method
5	
	1. Select Numerical constant which indicates Hex as ASCII code as Form. Input Hex value D, A which indicates CR and LF.
6	
	1. Double-click DRS.test tap and edit segment like the following. 2. Write frame requesting reading data of continuous 2 areas starting first of D register of station no.1. 3. When double-clicking editor screen and writing frame through segment edition, size of one segment is less than 10.
7	
	1. Result writing entire frame of data reading request frame.

3) Writing frame to receive response frame of temperature controller

Writing response frame (Reception frame)	
Sequence	Setting method
1	 1. Write like step 2 of frame that request reading data. At this time, set Frame type as reception. 2. Frame name is DRS_RECE.
2	 1. Click 'Add Frame' and select HEAD, TAIL, BODY as type and input BODY name. 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	 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]. 2. Since data size of data 1 and 2 is 4 byte, select Fix sized variable and input 4 in Size 3. To select storage area of data, check Assign memory.
5	 1. This is entire frame to receive response data of temperature controller.

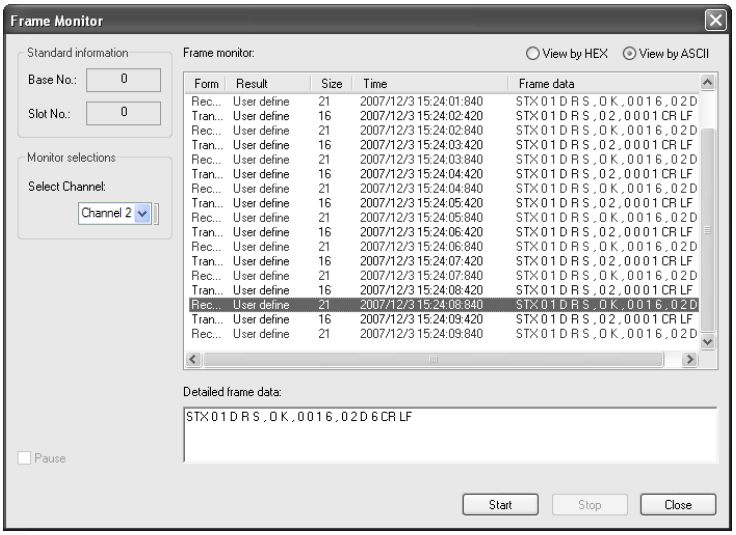
4) Writing P2P transmission/reception block

Write P2P TX/RX block as follows by using user definition communication segment written ahead.

Sequence	Setting method
1	
	1. Double-click P2P block of P2P 01. 2. Input channel selected at P2P channel (user frame definition). 3. In case P2P function is TX frame, select SEND. In case P2P function is RX, select RECEIVE. 4. Conditional flag is activated when P2P function is SEND. 5. Since it reads data every 1 second, use F93 as conditional flag. 6. Click Setting of RX frame and set save area of current temperature and setting value.
2	Execute Write Parameter and Enable Link.

5) Checking TRX data

Check whether written frame is transmitted/received properly

Sequence	Setting method
1	
	1. Select [Online]-[System Diagnsis] or click icon ( ) 2. After clicking relevant module and click right button of mouse, select Status by service or frame monitor. 3. When frame is not dealt with properly, unknown message is displayed.
2	Check device area by device monitor of XG-5000.

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

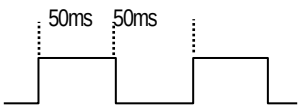
2.12.3 P2P Client Error Code

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. _T100ms clock 
	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.

Appendix1 Flag List

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) Supported when using RTC option module
F0054	-	_TIME_DAY	Hour/date	Clock data (hour/date) Supported when using RTC option module
F0055	-	_SEC_MIN	Second/minute	Clock data (Second/minute) Supported when using RTC option module
F0056	-	_HUND_WK	Hundred year/week	Clock data (Hundred year/week) 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.

Appendix1 Flag List

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) Supported when using RTC option module
F211	-	_TIME_DAY_DT	Hour/date	Clock data (hour/date) Supported when using RTC option module
F212	-	_SEC_MIN_DT	Second/minute	Clock data (Second/minute) Supported when using RTC option module
F213	-	_HUND_WK_DT	Hundred year/week	Clock data (Hundred year/week) 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. 1. In case that all station set in parameter is RUN mode and no error, 2. All data block set in parameter is communicated normally, and 3. The parameter set in each station itself is communicated normally. 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. 1. In case that the station set in the parameter is not RUN mode, or 2. There is an error in the station set in the parameter, or 3. The communication state of data block set in the parameter is not good. 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. _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 Parameter: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)

Appendix1 Flag List

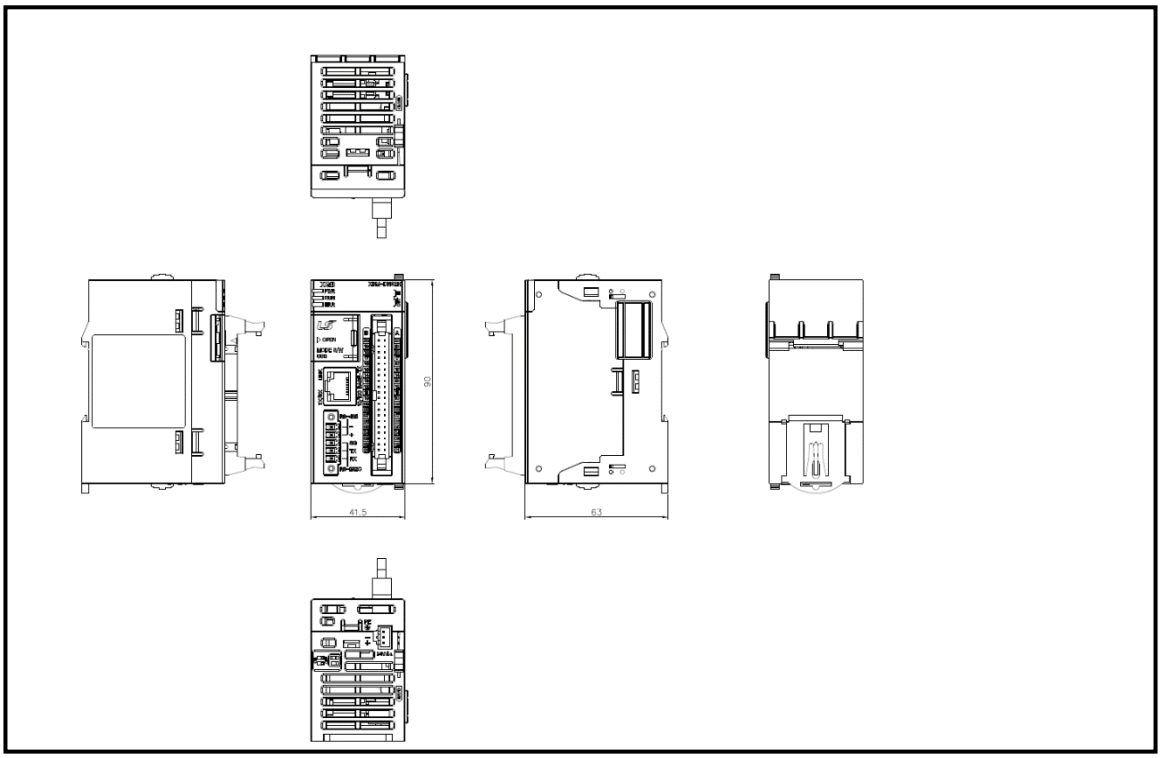
(5) ASCII(American National Standard Code for Information Interchange)

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	□

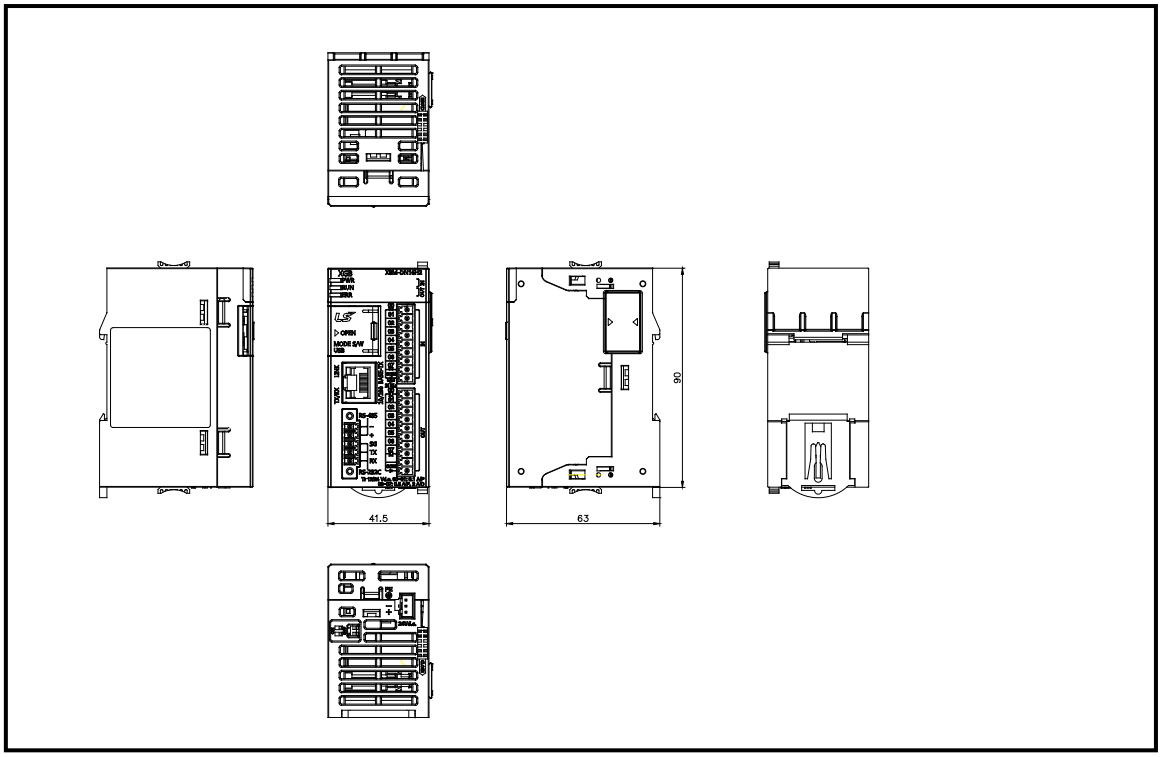
Appendix 2 Dimension (Unit : mm)

(1) CPU Type

- XBM-DN32H2/P, XBM-DP32H2/P

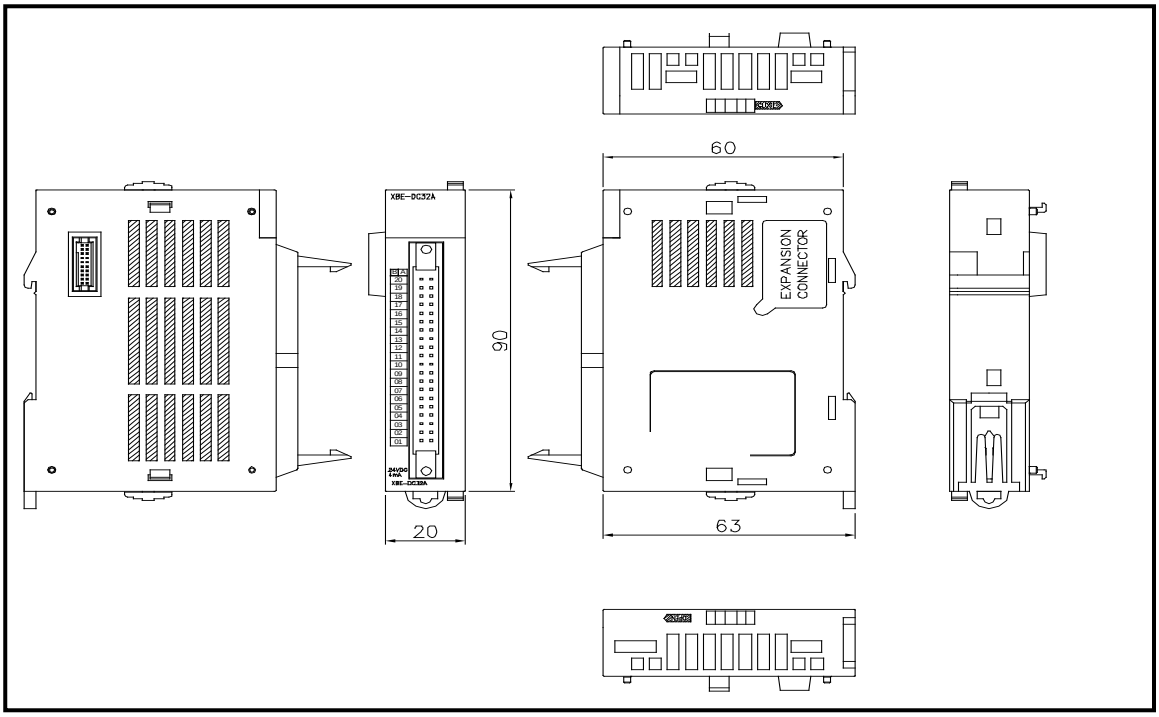


- XBM-DN16H2, XBM-DP16H2, XBM-DR14H2

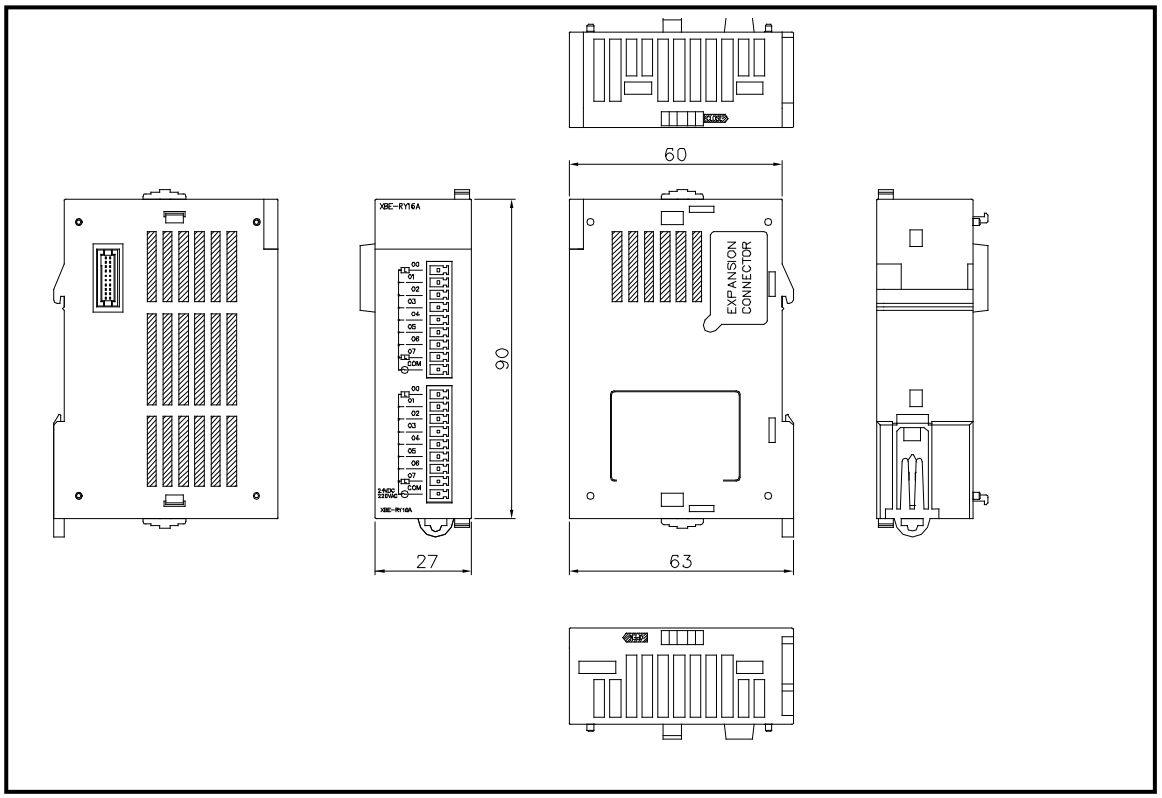


(2) Extension I/O module

- XBE-DC32A, XBE-TR32A

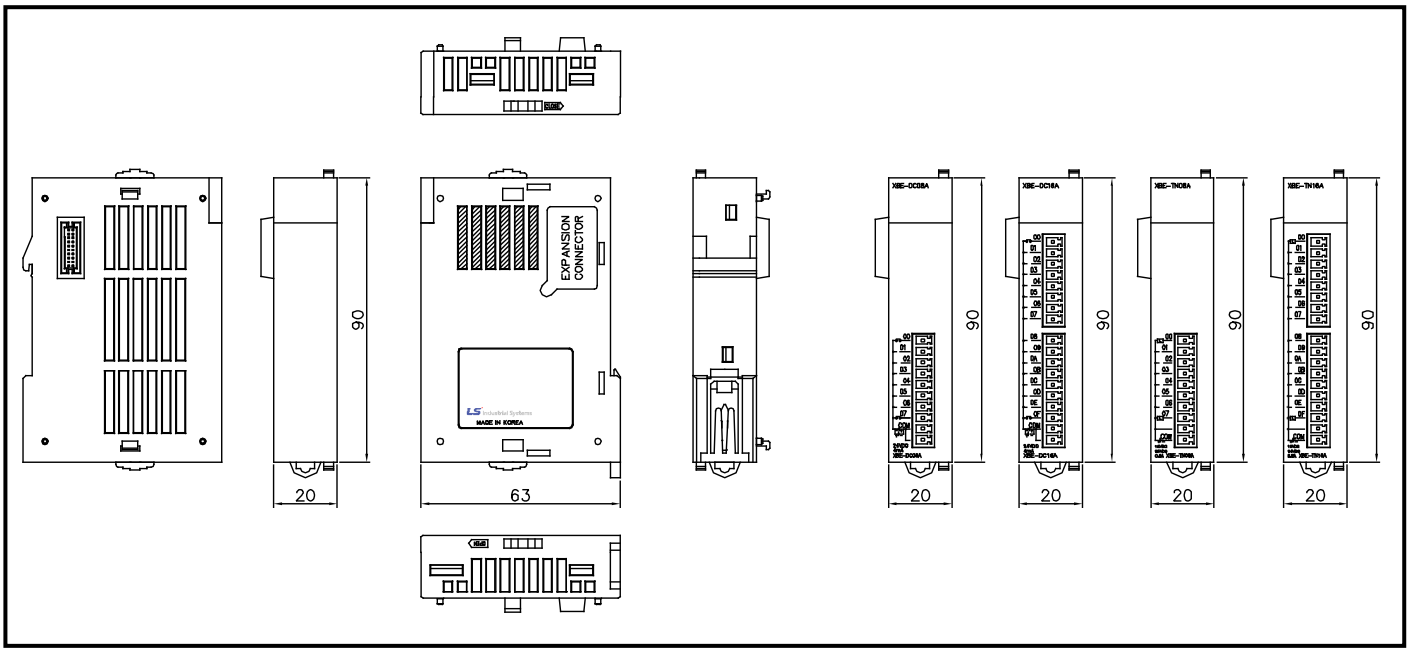


- XBE-RY16A

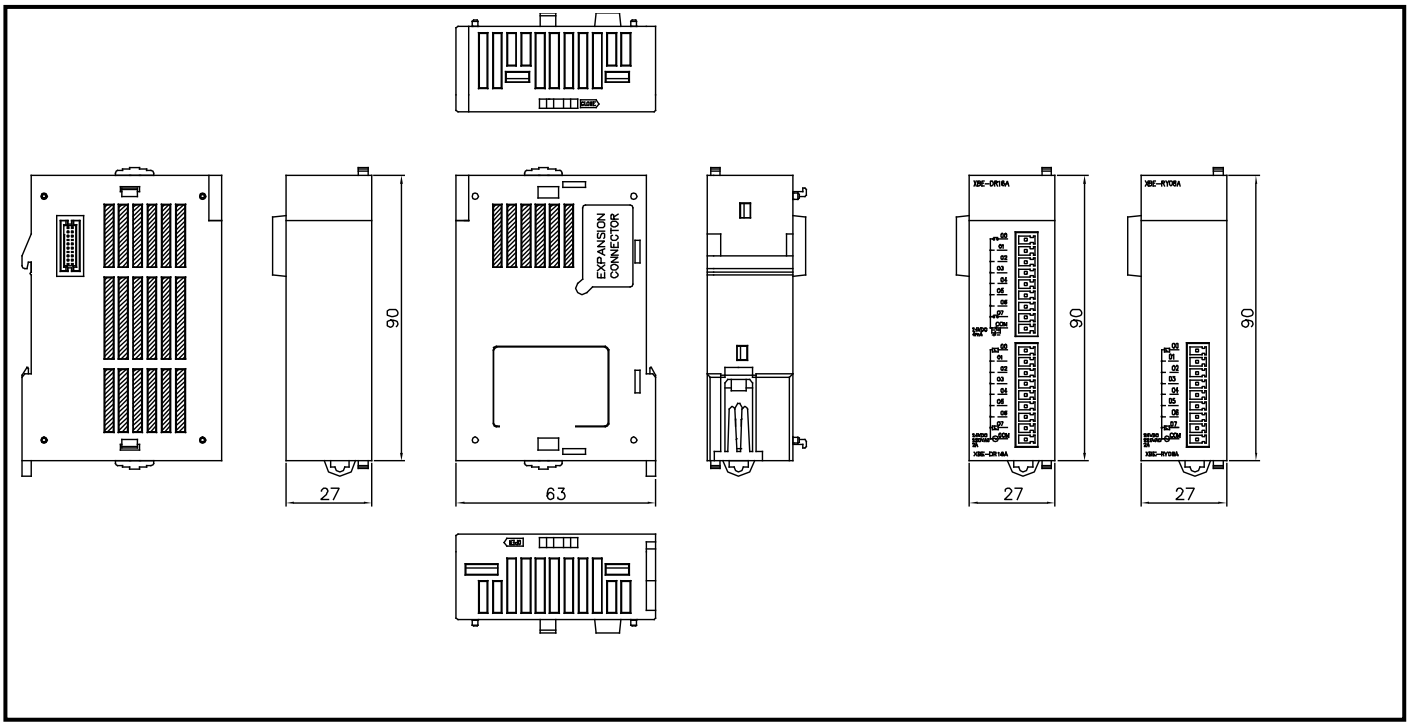


Appendix2 Dimension

- XBE-DC08A, XBE-DC16A, XBE-TN08A, XBE-TP08A, XBE-TN16A, XBE-TP16A, XBE-AC08A

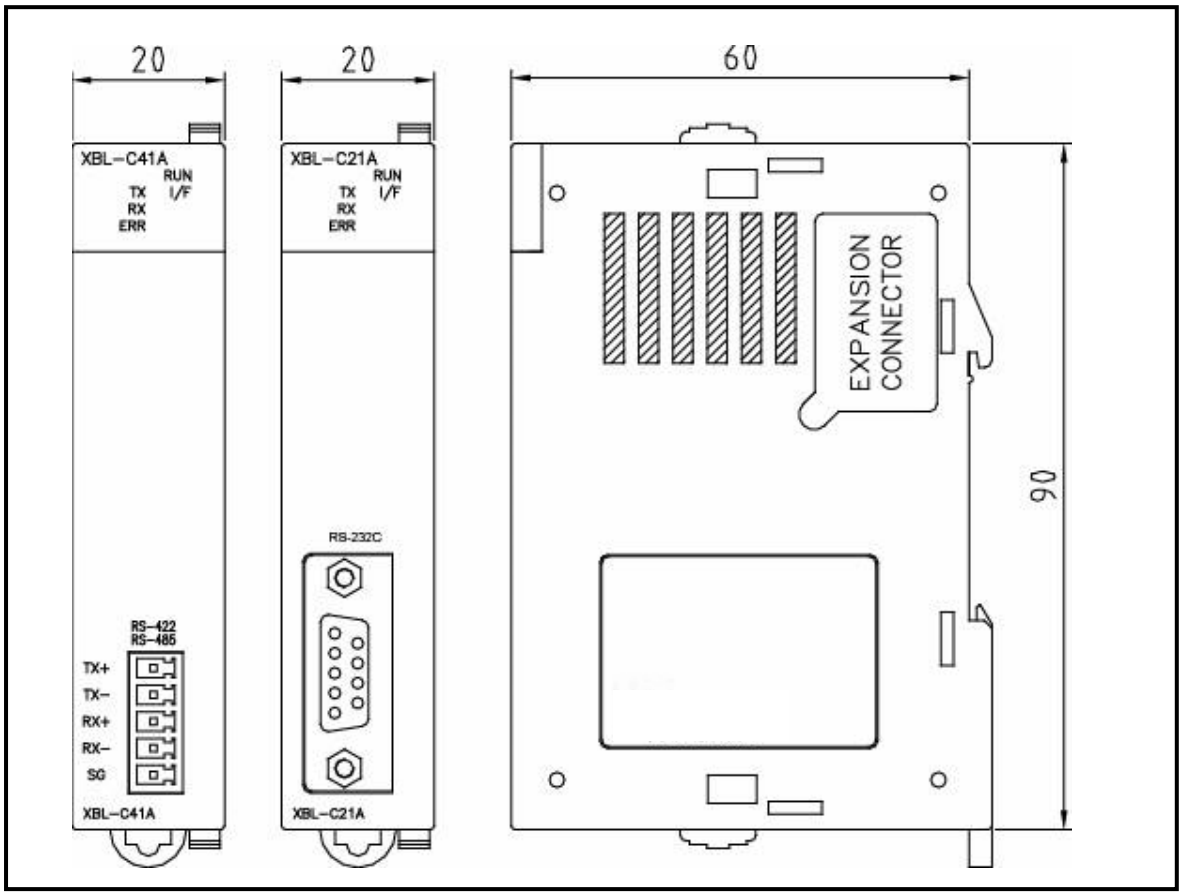


-. XBE-DR16A, XBE-RY08A



(4) Extension Cnet I/F Module

. XBL-C41A, XBL-C21A



Appendix 3 Instruction List

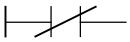
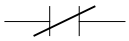
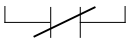
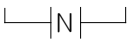
Appendix 3.1 Classification of Instructions

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	

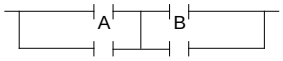
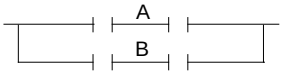
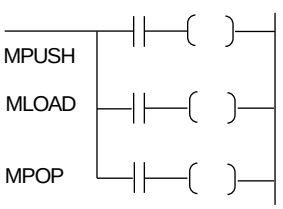
	Loop Instruction	FOR/NEXT/BREAK	
	Flag related Instruction	Carry Flag Set/Reset, Error Flag Clear	
	Special/Communication related Instruction	Data Read/Write by BUSCON Direct Access	
	Interrupt related Instruction	Interrupt Enable/Disable	
	Sign Reverse Instruction	Reverse Integer/Real Signs, Absolute 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

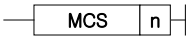
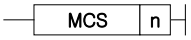
(2) Union instruction

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

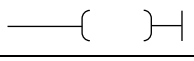
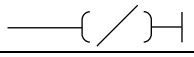
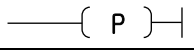
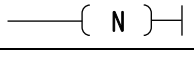
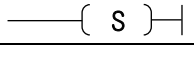
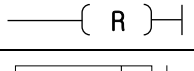
(3) reversion instruction

Classification	Designations	Symbol	Description	Support	
				XGK	XGB
Reverse	NOT		Previous Operation results Reverse	O	O

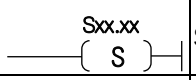
(4) Master Control instruction

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

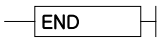
(5) Output instruction

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	Input, t, T	O	O
	TOFF	TOFF T t	Input, t, T	O	O
	TMR	TMR T t	Input, t1+t2 = t, t1, t2, T	O	O
	TMON	TMON T t	Input, t, T	O	O
	TRTG	TRTG T t	Input, t, T	O	O

(10) Counter instruction

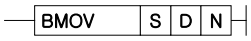
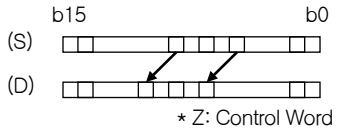
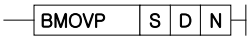
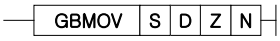
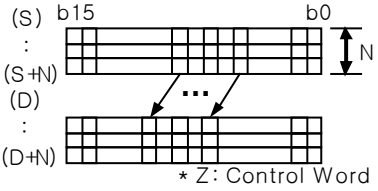
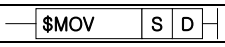
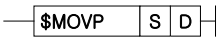
Classification	Designations	Symbol	Description	Support	
				XGB	XGB
카운터	CTD	CTD C c	Reset, Count Pulse, Setting, Present, Output	O	O
	CTU	CTU C c	Reset, Count Pulse, Setting, Present, Output	O	O
	CTUD	CTUD C U D c	Reset, Increased Pulse, Decreased Pulse, Setting, Present, Output	O	O
	CTR	CTR C c	Reset, Count Pulse, Setting, Present, Output	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) → (D)	O	O
	MOVP	MOVP S D			
32 bits Transfer	DMOV	DMOV S D	(S+1,S) → (D+1,D)	O	O
	DMOVP	DMOVP S D			
Short Real Number Transfer	RMOV	RMOV S D	(S+1,S) → (D+1,D)	O	O
	RMOVP	RMOVP S D			
Long Real Number Transfer	LMOV	LMOV S D	(S+3,S+2,S+1,S) → (D+3,D+2,D+1,D)	O	O
	LMOVP	LMOVP S D			
4 bits Transfer	MOV4	MOV4 Sb Db	(Sb): Bit Position, b15, b0, 4bit trans, (Db): Bit Position	O	O
	MOV4P	MOV4P Sb Db			
8 bits Transfer	MOV8	MOV8 Sb Db	(Sb): Bit Position, b15, b0, 8bit trans, (Db): Bit Position	O	O
	MOV8P	MOV8P Sb Db			
1's complement Transfer	CMOV	CMOV S D	1's complement (S) → (D)	O	O
	CMOVP	CMOVP S D			
	DCMOV	DCMOV S D	1's complement (S+1,S) → (D+1,D)	O	O
	DCMOVP	DCMOVP S D			
16 bits Group Transfer	GMOV	GMOV S D N	(S), (D), N	O	O
	GMOVP	GMOVP S D N			
Multiple Transfer	FMOV	FMOV S D N	(S), (D), N	O	O
	FMOVP	FMOVP S D N			
	GBMOVP	GBMOVP S D Z N			

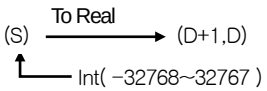
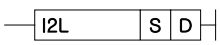
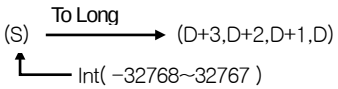
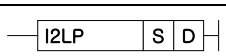
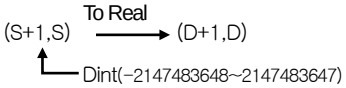
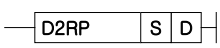
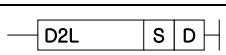
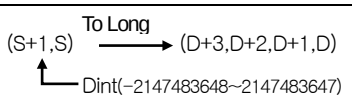
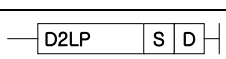
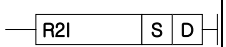
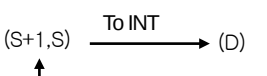
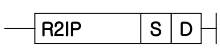
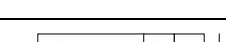
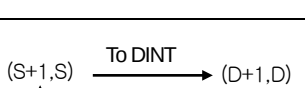
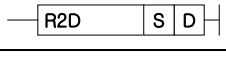
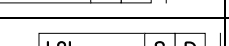
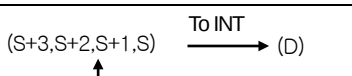
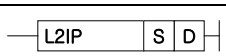
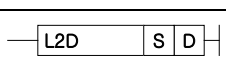
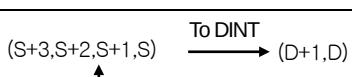
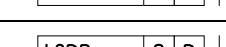
(continue)

Classification	Designations	Symbol	Description	Support	
				XGK	XGK
Specified Bits Transfer	BMOV			O	O
	BMOVP				
Specified Bits Group Transfer	GBMOV			O	O
String Transfer	$MOV		String started from (S) → String started from (D)	O	O
	$MOVP			O	O

(2) BCD/BIN conversion instruction

Classification	Designations	Symbol	Description	Support	
				XGK	XGB
BCD Conversion	BCD	BCD S D	(S) To BCD (D); BIN(0~9999)	O	O
	BCDP	BCDP S D			
	DBCD	DBCD S D	(S+1,S) To BCD (D+1,D); BIN(0~99999999)	O	O
	DBCDP	DBCDP S D			
4/8 Bits BCD Conversion	BCD4	BCD4 Sb Db	(Sb):Bit, BIN(0~9); b15 b0; To 4bit BCD; (Db): Bit	O	O
	BCD4P	BCD4P Sb Db			
	BCD8	BCD8 Sb Db	(Sb):Bit, BIN(0~99); b15 b0; To 8bit BCD; (Db):Bit	O	O
	BCD8P	BCD8P Sb Db			
BIN Conversion	BIN	BIN S D	(S) To BIN (D); BCD(0~9999)	O	O
	BINP	BINP S D			
	DBIN	DBIN S D	(S+1,S) To BIN (D+1,D); BCD(0~99999999)	O	O
	DBINP	DBINP S D			
4/8 Bits BIN Conversion	BIN4	BIN4 Sb Db	(Sb):Bit, BCD(0~9); b15 b0; To 4bit BIN; (Db):Bit	O	O
	BIN4P	BIN4P Sb Db			
	BIN8	BIN8 Sb Db	(Sb):Bit, BCD(0~99); b15 b0; To bit BIN; (Db):Bit	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			O	O
	I2RP				
	I2L			O	O
	I2LP				
32 Bits Integer/Real Conversion	D2R			O	O
	D2RP				
	D2L			O	O
	D2LP				
Short Real/Integer Conversion	R2I			O	O
	R2IP				
	R2D			O	O
	R2DP				
Long Real/Integer Conversion	L2I			O	O
	L2IP				
	L2D			O	O
	L2DP				

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)): CMP(S1+15,S2+15) 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)) CMP((S1+31,S1+30),(S2+31,S2+30) 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			

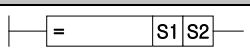
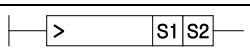
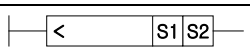
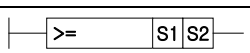
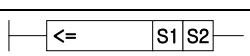
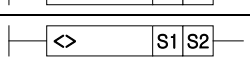
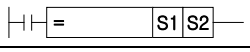
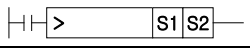
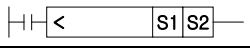
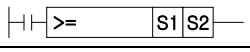
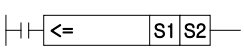
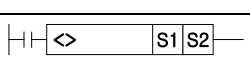
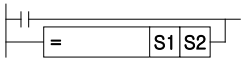
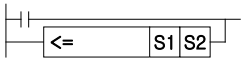
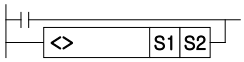
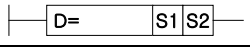
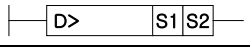
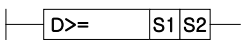
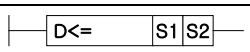
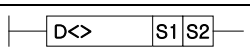
Remark

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 (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

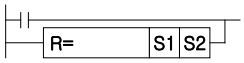
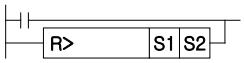
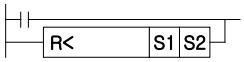
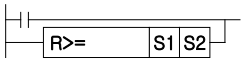
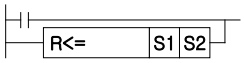
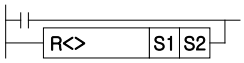
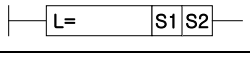
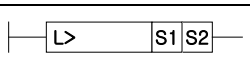
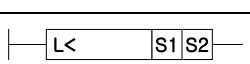
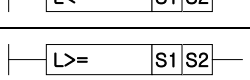
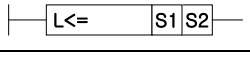
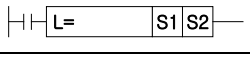
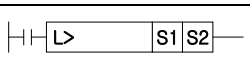
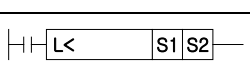
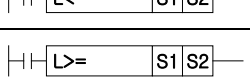
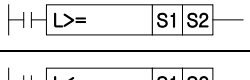
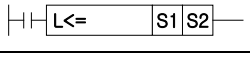
(continued)

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<>				

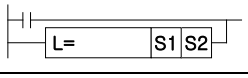
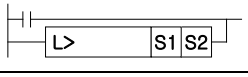
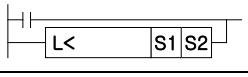
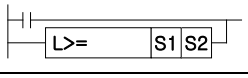
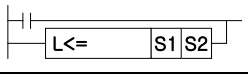
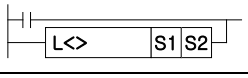
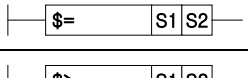
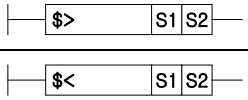
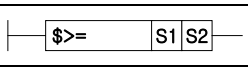
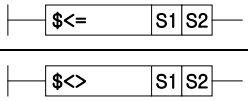
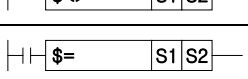
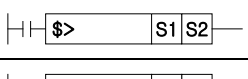
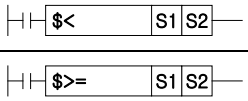
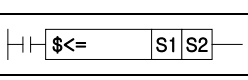
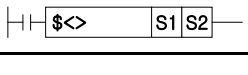
(continued)

Classification	Designations	Symbol	Description	Support	
				XGK	XGB
32bit 데이터 비교 (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 Data Compare (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 Real Number Compare (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 Real Number Compare (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			

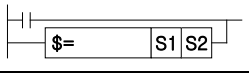
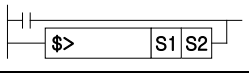
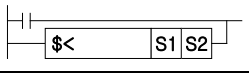
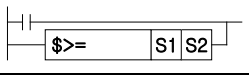
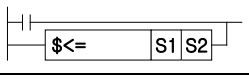
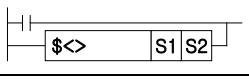
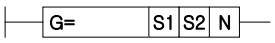
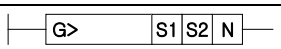
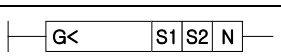
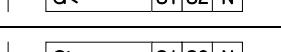
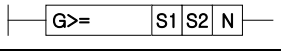
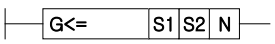
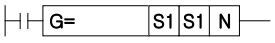
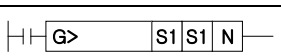
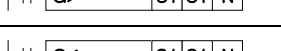
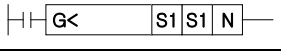
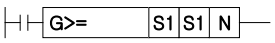
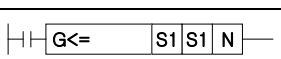
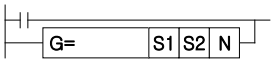
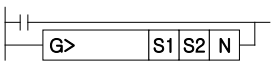
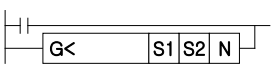
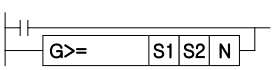
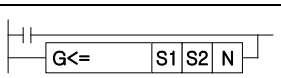
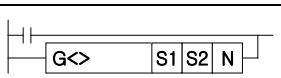
(continued)

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<>				

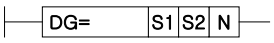
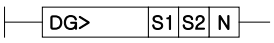
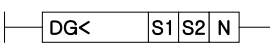
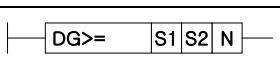
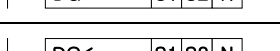
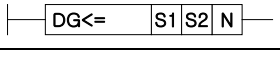
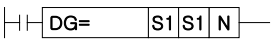
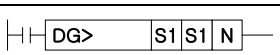
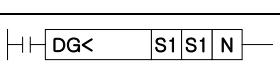
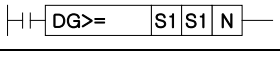
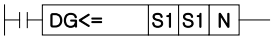
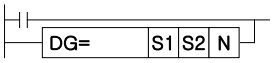
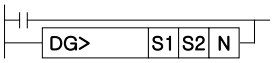
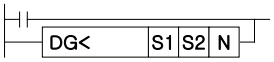
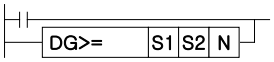
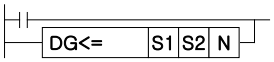
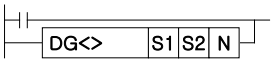
(continued)

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 (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$<=				
	AND$<>				

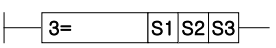
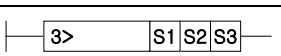
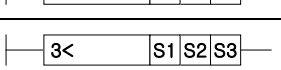
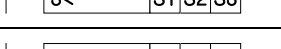
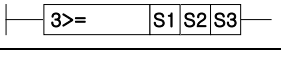
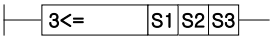
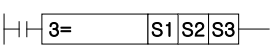
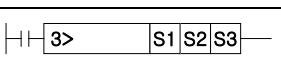
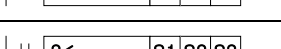
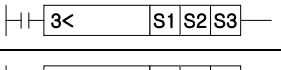
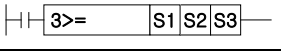
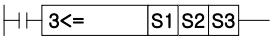
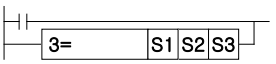
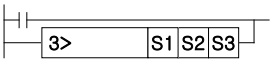
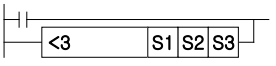
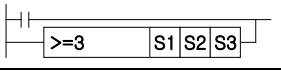
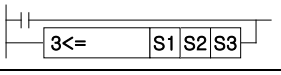
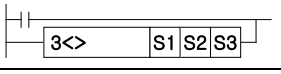
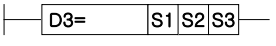
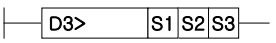
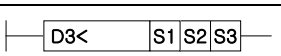
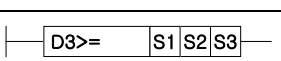
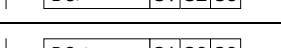
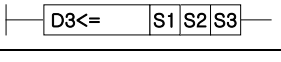
(continued)

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=		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>				
	LOADDG<				
	LOADDG>=				
	LOADDG<=				
	LOADDG<>				
32 Bits Data Group Compare (AND)	ANDDG=		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>				
	ANDDG<				
	ANDDG>=				
	ANDDG<=				
	ANDDG<>				
32 Bits Data Group Compare (OR)	ORDG=		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>				
	ORDG<				
	ORDG>=				
	ORDG<=				
	ORDG<>				

(continued)

Classification	Designations	Symbol	Description	Support	
				XGK	XGB
Three 16-Bit Data Compare (LOAD)	LOAD3=		Saves 1 in Bit Result(BR) if each value of (S1), (S2), (S3) meets given condition	O	O
	LOAD3>				
	LOAD3<				
	LOAD3>=				
	LOAD3<=				
	LOAD3<>				
Three 16-Bit Data Compare (AND)	AND=		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>				
	AND<				
	AND>=				
	AND<=				
	AND<>				
Three 32-Bit Data Compare (OR)	OR3=		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>				
	OR3<				
	OR3>=				
	OR3<=				
	OR3<>				
Three 16-Bit Data Compare (LOAD)	LOADD3=		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>				
	LOADD3<				
	LOADD3>=				
	LOADD3<=				
	LOADD3<>				

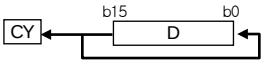
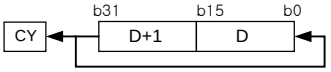
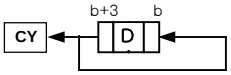
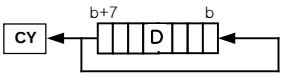
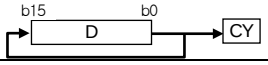
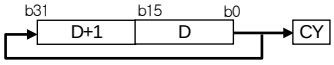
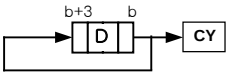
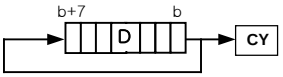
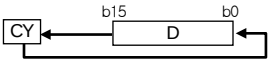
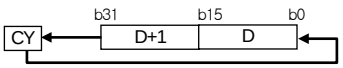
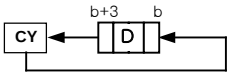
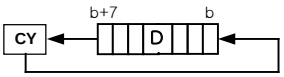
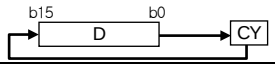
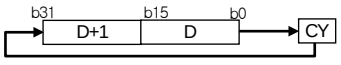
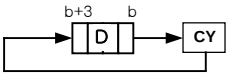
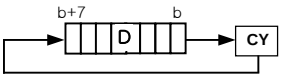
(continued)

Classification	Designations	Symbol	Description	Support	
				XGK	XGB
Three 32-Bit Data Compare (AND)	ANDD3=	D3= S1 S2 S3	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>	D3> S1 S2 S3			
	ANDD3<	D3< S1 S2 S3			
	ANDD3>=	D3>= S1 S2 S3			
	ANDD3<=	D3<= S1 S2 S3			
	ANDD<>	D3<> S1 S2 S3			
Three 32-Bit Data Compare (OR)	ORD3=	D3= S1 S2 S3	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>	D3> S1 S2 S3			
	ORD3<	D3< S1 S2 S3			
	ORD3>=	D3>= S1 S2 S3			
	ORD3<=	D3<= S1 S2 S3			
	ORD3<>	D3<> S1 S2 S3			

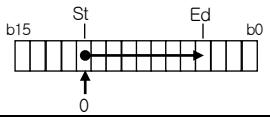
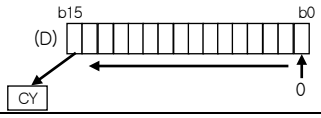
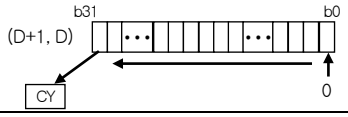
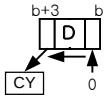
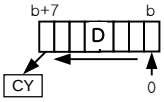
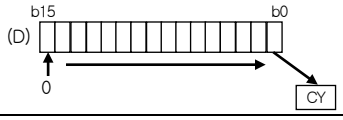
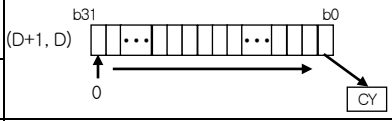
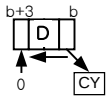
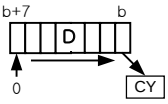
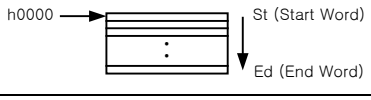
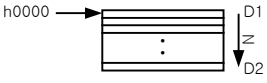
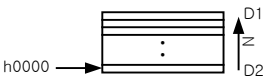
(5) Increase/Decrease instruction

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 → (D:x bit ~ D:x bit+4)	O	O
	INC4P	INC4P Db			
	INC8	INC8 Db	(D:x bit ~ D:x bit+8) + 1 → (D:x bit ~ D:x bit+8)		
	INC8P	INC8P Db			
	DEC4	DEC4 Db	(D:x bit ~ D:x bit+4) − 1 → (D:x bit ~ D:x bit+4)	O	O
	DEC4P	DEC4P Db			
	DEC8	DEC8 Db	(D:x bit ~ D:x bit+8) − 1 → (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			

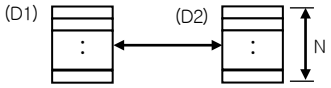
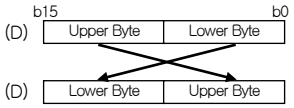
(6)Rotation instruction

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, (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, (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, (D+1) 나머지	O	O
	DIVUP	DIVUP S1 S2 D			
	DDIVU	DDIVU S1 S2 D	(S1+1,S1)÷(S2+1,S2) → (D+1,D) 몫, (D+3,D+2) 나머지		
	DDIVUP	DDIVUP S1 S2 D			
Real Number Addition	RADD	RADD S1 S2 D	(S1+1,S1)+(S2+1,S2) → (D+1,D)	O	O
	RADDP	RADDP S1 S2 D			
	LADD	LADD S1 S2 D	(S1+3,S1+2,S1+1,S1) +(S2+3,S2+2,S2+1,S2) → (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) → (D+1,D)	O	O
	RSUBP	RSUBP S1 S2 D			
	LSUB	LSUB S1 S2 D	(S1+3,S1+2,S1+1,S1) −(S2+3,S2+2,S2+1,S2) → (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) → (D+1,D)	O	O
	RMULP	RMULP S1 S2 D			
	LMUL	LMUL S1 S2 D	(S1+3,S1+2,S1+1,S1) ×(S2+3,S2+2,S2+1,S2) → (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) → (D+1,D)	O	O
	RDIVP	RDIVP S1 S2 D			
	LDIV	LDIV S1 S2 D	(S1+3,S1+2,S1+1,S1) ÷(S2+3,S2+2,S2+1,S2) → (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	(S1) + (S2) = (D) N	O	O
	GADDP	GADDP S1 S2 D N			
Group Subtraction	GSUB	GSUB S1 S2 D N	(S1) − (S2) = (D) N	O	O
	GSUBP	GSUBP S1 S2 D N			

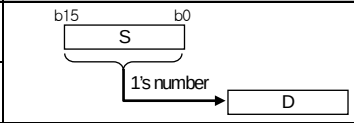
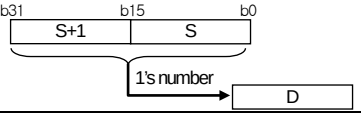
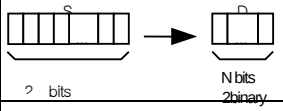
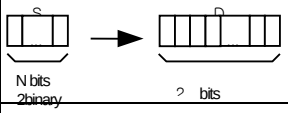
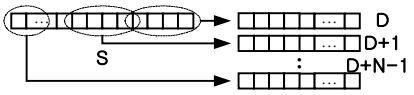
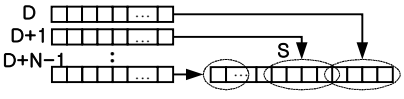
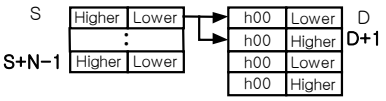
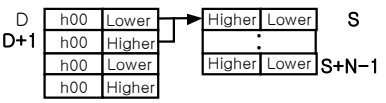
(10) BCD operation instruction

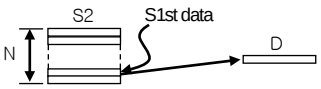
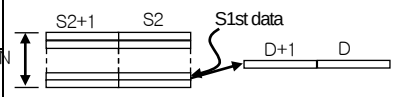
Classification	Designations	Symbol	Description	Support	
				XGK	XGB
BCD Addition	ADDB	ADDB S1 S2 D	(S1)+(S2) → (D)	O	O
	ADDBP	ADDBP S1 S2 D			
	DADDB	DADDB S1 S2 D	(S1+1,S1)+(S2+1,S2) → (D+1,D)		
	DADDBP	DADDBP S1 S2 D			
BCD Subtraction	SUBB	SUBB S1 S2 D	(S1)-(S2) → (D)	O	O
	SUBBP	SUBBP S1 S2 D			
	DSUBB	DSUBB S1 S2 D	(S1+1,S1)-(S2+1,S2) → (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) → (D+3,D+2,D+1,D)		
	DMULBP	DMULBP S1 S2 D			
BCD Division	DIVB	DIVB S1 S2 D	(S1)÷(S2) → (D) Quotient, (D+1) Remainder	O	O
	DIVBP	DIVBP S1 S2 D			
	DDIVB	DDIVB S1 S2 D	(S1+1,S1)÷(S2+1,S2) → (D+1,D) Quotient, (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 (S1) ∧ (S2) ——(D)	O	O
	WANDP	WANDP S1 S2 D			
	DWAND	DWAND S1 S2 D	DWord AND (S1+1,S1) ∧ (S2+1,S2) ——(D+1,D)		
	DWANDP	DWANDP S1 S2 D			
Logic Addition	WOR	WOR S1 S2 D	Word OR (S1) ∨ (S2) ——(D)	O	O
	WORP	WORP S1 S2 D			
	DWOR	DWOR S1 S2 D	DWord OR (S1+1,S1) ∨ (S2+1,S2) ——(D+1,D)		
	DWORP	DWORP S1 S2 D			
Exclusive OR	WXOR	WXOR S1 S2 D	Word Exclusive OR (S1) ⊻ (S2) ——(D)	O	O
	WXORP	WXORP S1 S2 D			
	DWXOR	DWXOR S1 S2 D	DWord Exclusive OR (S1+1,S1) ⊻ (S2+1,S2) ——(D+1,D)		
	DWXORP	DWXORP S1 S2 D			
Exclusive NOR	WXNR	WXNR S1 S2 D	Word Exclusive NOR $\overline{(S1) \veebar (S2)}$ ——(D)	O	O
	WXNRP	WXNRP S1 S2 D			
	DWXNR	DWXNR S1 S2 D	DWord Exclusive NOR $\overline{(S1+1,S1) \veebar (S2+1,S2)}$ ——(D+1,D)		
	DWXNRP	DWXNRP S1 S2 D			
Group Logic Operation	GWAND	GWAND S1 S2 D N	(S1) ∧ (S2) = (D) N	O	O
	GWANDP	GWANDP S1 S2 D N			
	GWOR	GWOR S1 S2 D N	(S1) ∨ (S2) = (D) N	O	O
	GWORP	GWORP S1 S2 D N			
	GWXOR	GWXOR S1 S2 D N	(S1) ⊻ (S2) = (D) N	O	O
	GWXORP	GWXORP S1 S2 D N			
	GWXNR	GWXNR S1 S2 D N	$\overline{(S1)} \veebar (S2)$ = (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 n1 : Number of Words to sort n1+1 : Sorting Method n2: Operation number per Scan D1 : ON if complete 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 Write	FIWR	FIWR S D	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	FIWRP S D			
First-input Data Read	FIFRD	FIFRD S D	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	FIFRDP S D			
Last-Input Data Read	FILRD	FILRD S D	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	FILRDP S D			
Data Insert	FIINS	FINS S D n	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	FINSP S D n			
Data Pull	FIDEL	FDEL S D n	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	FDELP S D n			

(14) Display instruction

Classification	Designations	Symbol	Description	Support	
				XGK	XGB
7 Segment Display	SEG	SEG S D Z	Converts S Data to 7-Segment as adjusted in Z Format so to save in D	O	O
	SEGP	SEGP S D Z			

(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 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			
	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) Converts angle to radian	O	O
	RADP	RADP S D			
Angle Conversion	DEG	DEG S D	(S+1,S) → (D+1,D) 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 D = S2 If S2 < S1 < S3, then D = S1 If S3 < S1, then 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 D = S1+S2-S2(S3/100) If –S2 < S1 < S2, then D = (S3/100)S1 If S1 < S2, then 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 D = S1 – S2
			If S3 < S1, then D = S1 –S3
			If S2 <= S1 <= S3, then D = 0
			If (S2 == S3) < S1, then D = S1 –S3
			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 D = S1-S2+S2(S3/100) If –S2(S3/100) <S1< S2(S3/100), then D = (100/S3)S1 If S1 < S2(S3/100), then 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. (SV(word) / Ts(word) / Kp(real) / 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 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

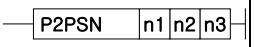
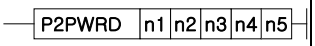
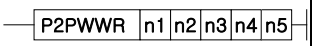
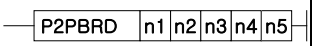
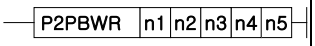
Classification	Designations	Symbol	Description	Support	
				XGK	XGB
2's complement	NEG	NEG D	Saves D value again in D with 2's complement taken	○	○
	NEGP	NEGP D			
	DNEG	DNEG D	Saves (D+1,D) value again in (D+1,D) with 2's complement taken		
	DNEGP	DNEGP D			
Real Number Data Sign Reverse	RNEG	RNEG D	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

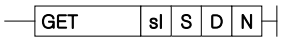
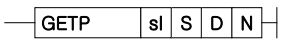
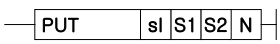
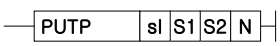
Classification	Designations	Symbol	Description	Support	
				XGK	XGB
Block Conversion	RSET	RSET S	Changes Block Number of file register to S Number	○	X
	RSETP	RSETP S			
Flash Word Data Transfer	EMOV	EMOV S1 S2 D	Transfers S2 word data in S1 Block to D	○	X
	EMOVP	EMOVP S1 S2 D			
Flash Double Word Data 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		Sets opposite station No. for P2P Communication. n1:P2P No., n2:Block, n3:Station No.	○	X
Read Area Set (WORD)	P2PWRD		Sets word data Read Area n1:P2P No., n2:Block, n3:Variable sequence, n4:Variable Size, n5:Device	○	X
Write Area Set (WORD)	P2PWWR		Sets word data Write Area n1:P2P No., n2:Block, n3:Variable sequence, n4:Variable Size, n5:Device	○	X
Read Area Set (BIT)	P2PBRD		Sets bit data Read Area n1:P2P No., n2:Block, n3:Variable sequence, n4: Variable Size, n5:Device	○	X
Write Area Set (BIT)	P2PBWR		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		Reads data of special module memory is installed on	○	○
	GETP				
	PUT		Writes data on special module memory is installed on	○	○
	PUTP				

(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.

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