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Programmable Logic Controller

# XGI/XGR/XEC Instructions and Programming

**XGT Series**

**User's Manual**



## Safety Instructions

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

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### Before using the product ...

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

- ▶ Safety Instructions should always be observed in order to prevent accident or risk with the safe and proper use the product.
- ▶ Instructions are separated into “Warning” and “Caution”, and the meaning of the terms is as follows;



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



This symbol indicates the possibility of slight injury or damage to products if some applicable instruction is violated

- ▶ 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 connector 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	Chapter
V 1.0	'07. 3	First Edition	-
V 1.1	'07. 6	Process Control Library added	Ch13
V 1.2	'07. 12	ST (Structured Text) language added	Ch14
V 2.0	'08. 3	XGR CPU added	Entire
V 2.1	'09. 3	1. XEC added 2. Function for XEC added (1) APM_SSSB (2) PIDAT (3) PIDHBD	Entire  11-31 13-4 13-8
V 2.3	'10. 6	1. XPM dedicated instructions added  2. 4 Positioning instructions (VRD, VWR) added 3. Description on ST language modified 4. Example of ST language added	Ch6.4.11, Ch11.5 Ch6.4.10~6.4.11 Ch11.4~11.5 Ch14 Ch7~Ch11
V 2.4	'10. 9	1. Positioning instructions added or modified	Ch6.4.11, Ch11.5
V 2.5	'12.11	1. Positioning instructions added	Ch6.4.10~6.4.11 Ch11.4~Ch11.5
V 2.6	'13.06	1. PUTE and GETE instructions added	Ch6.4.8 Ch11.2
V 2.7	'14.04	1. UDATA instructions added 2. XPM_STC instruction added 3. CPT instruction information added	Ch11 Ch11 Ch8

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

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## About User's Manual

Congratulations on purchasing PLC of LS Industrial System Co.,Ltd.

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

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

### Relevant User's Manuals

Title	Description	No. of User's Manual
XG5000 IEC User's Manual	It describes how to use XG5000 software, which it is applied to the IEC standard language, especially about online functions such as programming, printing, monitoring and debugging by using XGT series products.	10310000834
XGK/XGB Instructions & Programming User's Manual	It is the user's manual for programming to explain how to use commands that are used PLC system with XGK/XGB CPU.	10310000833
XGI-CPUU User's Manual	It describes CPU specifications and technical terms for the XGT PLC system using a series of XGI-CPUU module.	10310000832
XGR-CPUH User's Manual	It describes CPU specifications and technical terms for the XGT PLC system using a series of XGR-CPUH module.	10310000855

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# Ch 1. Introduction

## 1.1 Overview

### 1) Background

This user's guide describes the languages supported by XGI /XGR/XEC PLC. The XGI /XGR/XEC PLC is based on the standard language of International Electrotechnical Commission (IEC).

### 2) Features of IEC 61131-3 Language

The features of the IEC language supported by the PLC are as follows

- ▷ Supports several data types.
- ▷ Offers program elements such as functions, function blocks, and programs to enable bottom-up design and top-down design and structural creation of a PLC program.
- ▷ Program storage in a library system to enable future use in other environments. This enables the reuse of the software.
- ▷ Supports various languages so that the user can select the optimal language suitable for the environment.

### 3) Types of Language

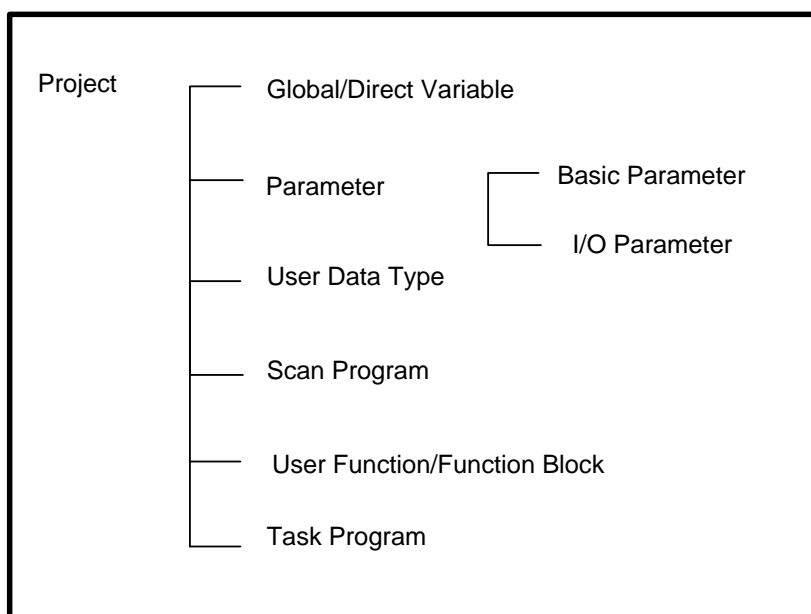
The PLC language standardized by IEC consists of two illustrated languages, two character languages and SFC.

- ▷ Illustrated language
  - a) Ladder Diagram (LD): It is a graphical language based on the ladder logic.
  - b) Function Block Diagram (FBD): It is a graphical language for depicting signal and data flows through function blocks.
- ▷ Character language
  - a) Instruction List (IL): It is a low-level 'assembly like' language based on similar instruction list languages.
  - b) Structured Text (ST): It is a high-level PASCAL type language.
- ▷ Sequential Function Chart (SFC)

## Ch 2. Software Structure

### 2.1 Introduction

Before creating a PLC program, ensure that you have an overall PLC system defined in software terms. The overall PLC system is defined as one project in XGI /XGR/XEC PLC. In the project, you must define hierarchically all composition elements necessary for the PLC system.



### 2.2 Project

For a XGI/XGR/XEC PLC program, the first priority is given to project configuration. Creating a project comprises of configuring and programming all elements necessary for a PLC system (scan programs, task definitions, basic parameters, I/O parameters, and so on).

#### 1) Global/Direct Variable

The project enables global variable setting, direct variable setting and flag, in which a user prepares or uses the necessary information.

#### 2) Parameter

The user can alter the default CPU parameters and/or configure the IO Modules

- ▷ Basic Parameter: consists of four parts; setting such as basic operation set up, time and output control, retain area setting, error operation setting and MODBUS data setting.
- ▷ I/O Parameter: Used to configure I/O modules.

#### 3) User Data Type

Data type is a classification showing its unique characteristics. For instance, ANY\_NUM contains all of LREAL, REAL, LINT, DINT, INT, SINT, ULINT, UDINT, UINT, and **USINT**. For additional information on User Data Type, refer to Common Elements

#### 4) Scan Program

The scan program is a basic method of executing a program repeatedly on a PLC. It sequentially performs the same operations as per the program starting from the first step to the last step. For example, a scan program can read input data at the input module, run a program and display the results to the output module.

#### 5) User Function/Function Block

- ▷ Function : Is an operation unit that immediately yields the operation results for an input such as four arithmetical operations and comparative operations
- ▷ Function block : Is an operation unit that memorizes the operation results within the commands such as timer and counter or results derived from several scans. Function blocks are the fundamental element for logic programs. Function blocks like timer and counter have input and output connections to indicate the flow.

#### 6) Task Program

- ▷ Task program does not repeat scanning unlike a scan program and instead, executes only when its execution condition occurs. If several tasks are waiting, a higher priority task program is processed first. Among tasks of equal priority, the processing happens by the order of occurrence
- ▷ There are fixed cycle tasks and internal contact tasks.

## Ch 3. Common Elements

### 3.1 Overview

The elements of XGI/XGR/XEC PLC program (programs, functions, function blocks) can be programmed in other languages such as LD, SFC, and so on. All the language share common grammar elements.

### 3.2 Expression

#### 3.1.1 Identifiers

- Identifiers must be mixed of alphabet, numeric and all letters starting with underlined letters.
- Identifiers are used as variable names.
- Blank (space) is not allowed in identifiers.
- In case of variable or instance name, identifiers may consist of Korean, Alphabet and Chinese characters.
- There's no difference between small letters and capitals in alphabet; all the letters of the alphabet are recognized as upper case.

Types	Examples
Capital alphabet and number	IW210, IW215Z, QX75, IDENT
Capital alphabets ,numbers and underline(_)	LIM_SW_2, LIMSW5, ABCD, AB_CD
Capital alphabet and number characters starting with an underline(_)	_MAIN, _12V7, _ABCD

#### 3.1.2 Data Expression

The data in XGI/XGR/XEC PLC is; numeric data type, character string, time data type, and so on.

Types	Examples
Integer	-12, 0, 123_456, +986
Real number	-12.0, 0.0, 0.456, 3.14159_26
Real number with an exponent	-1.34E-12, 1.0E+6, 1.234E6
Binary number	2#1111_1111, 2#11100000
Octal number	8#377(decimal 255) 8#340(decimal 224)
Hexadecimal number	16#FF(decimal 255) 16#E0(decimal 224)
BOOL data	0, 1, TRUE, FALSE

##### 1) Numeric data type

- There are integer and real numbers.
- Discontinuous underline ( \_ ) can be placed between numeric characters; and it doesn't have any meaning.
- Decimal complies with general decimal data type expression and if there is a decimal point, they are real numbers.
- In case of expressing exponent, you can use plus/minus signs can be used. The letter 'E' standing for the exponent does not distinguish capitals from small letters.

- ▷ When using real numbers with exponents, the followings are not allowed.  
**Ex)** 12E-5 ( × )    12.0E-5 ( ○ )
- ▷ Integer includes binary, octal, hexadecimal numbers and decimal, which can be distinguished by placing # in front of each numerical character.
- ▷ 0 ~ 9 and A ~ F are used (including small letters a ~ f) in expressing hexadecimal.
- ▷ There is no need have plus/minus signs in expressing hexadecimal.
- ▷ Boolean data may be expressed as an integer 0 or 1.

2) Character String

- ▷ Character string covers all the letters with single quotation marks.
- ▷ In case of the character string constant and the initialization, the length is limited up to 31 letters.  
**Ex)** 'CONVEYER'

3) Time data type

Time data types are classified as follow:

- ▷ Duration data: calculates and controls the elapsed time of a controlling event.
- ▷ Time of Day and Date data : displays the time of the starting/ending point of a controlling event.

(a) Duration

- ▷ Duration data starts with the reserved word, 'T#' or 't#'.
- ▷ Several data types such as date (d), hour (h), minute (m), second (s) and millisecond (ms) must be written in sequence. Duration data can start with any unit (d,h,m,s and ms). In case of millisecond , the minimum unit can be omitted but the medium unit between duration units must not be skipped.
- ▷ Cannot use the underline ( \_ ).
- ▷ Duration data can overflow at the maximum unit, if any, and the data with a decimal point is available except 'ms'. It does not exceed T#49d17h2m47s295ms (32bits by 'ms' unit)
- ▷ The data is limited to the third decimal place in the second unit (s).
- ▷ Decimal point is not available at 'ms' unit.
- ▷ Capital and small letters are both available.

Content	Examples
Duration (no underline)	T#14ms, T#14.7s, T#14.7m, T#14.7h t#14.7d, t#25h15m, t#5d14h12m18s356ms

(b) Time of day and date

- ▷ There are three types expressing 'Time of Day and Date' as follows: Date, Time of Day, Date and Time.

Content	Reserved word
Date prefix	D#
Time of Day prefix	TOD#
Date and time prefix	DT#

- ▷ The data of starting point is January 1, 1984.
- ▷ There's a limit on 'Time of Day' and 'Date and Time', which is up to the third decimal place in the 'ms' unit.
- ▷ The overflow is not allowed for all the units when expressing 'Time of Day' and 'Date and Time'.

Content	Examples
Date	D#1984-06-25 d#1984-06-25
Time of Day	TOD#15:36:55.36 tod#15:36:55.369
Date and Time	DT#1984-06-25-15:36:55.36 dt#1984-06-25-15:36:55.369

3.2 Data Type

Data has a data type showing its character.

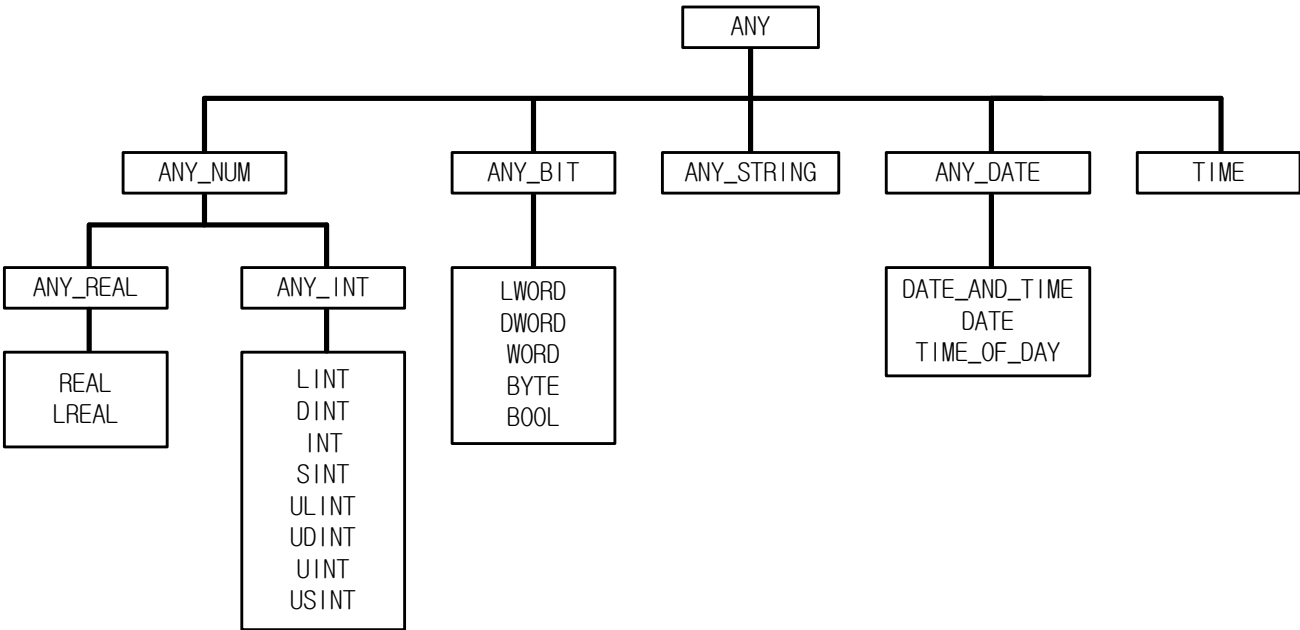
3.2.1 Basic Data Type

XGI/XGR/XEC PLC supports the following basic data types.

No.	Reserved Word	Data Type	Size (bits)	Range
1	SINT	Short Integer	8	-128 ~ 127
2	INT	Integer	16	-32,768 ~ 32,767
3	DINT	Double Integer	32	-2,147,483,648 ~ 2,147,483,647
4	LINT	Long Integer	64	-2 <sup>63</sup> ~ 2 <sup>63</sup> -1
5	USINT	Unsigned Short Integer	8	0 ~ 255
6	UINT	Unsigned Integer	16	0 ~ 65,535
7	UDINT	Unsigned Double Integer	32	0 ~ 4,294,967,295
8	ULINT	Unsigned Long Integer	64	0 ~ 2 <sup>64</sup> -1
9	REAL	Real Numbers	32	-3.402823466e+038 ~ -1.175494351e-038 or 0 or 1.175494351e-038 ~ 3.402823466e+038
10	LREAL	Long Real Numbers	64	-1.7976931348623157e+308 ~ -2.2250738585072014e-308 or 0 or 2.2250738585072014e-308 ~ 1.7976931348623157e+308
11	TIME	Duration	32	T#0S ~ T#49D17H2M47S295MS
12	DATE	Date	16	D#1984-01-01 ~ D#2163-6-6
13	TIME_OF_DAY	Time Of Day	32	TOD#00:00:00 ~ TOD#23:59:59.999
14	DATE_AND_TIME	Date and Time of Day	64	DT#1984-01-01-00:00:00 ~ DT#2163-06-06-23:59:59.999
15	STRING	Character String	32*8	-
16	BOOL	Boolean	1	0,1
17	BYTE	Bit String of Length 8	8	16#0 ~ 16#FF
18	WORD	Bit String of Length 16	16	16#0 ~ 16#FFFF
19	DWORD	Bit String of Length 32	32	16#0 ~ 16#FFFFFFFF
20	LWORD	Bit String of Length 64	64	16#0 ~ 16#FFFFFFFFFFFFFFFF

3.2.2 Data Type Hierarchy Chart

Data types used in XGI/XGR/XEC PLC are as follows:



- ▷ Data expressed as ANY\_NUM includes LREAL, REAL, LINT, DINT, INT, SINT, ULINT, UDINT, UINT and USINT.
- ▷ For example, if a data type is expressed as ANY\_BIT, it can use one of the following data types: LWORD, DWORD, WORD, BYTE and BOOL.

3.2.3 Initial Value

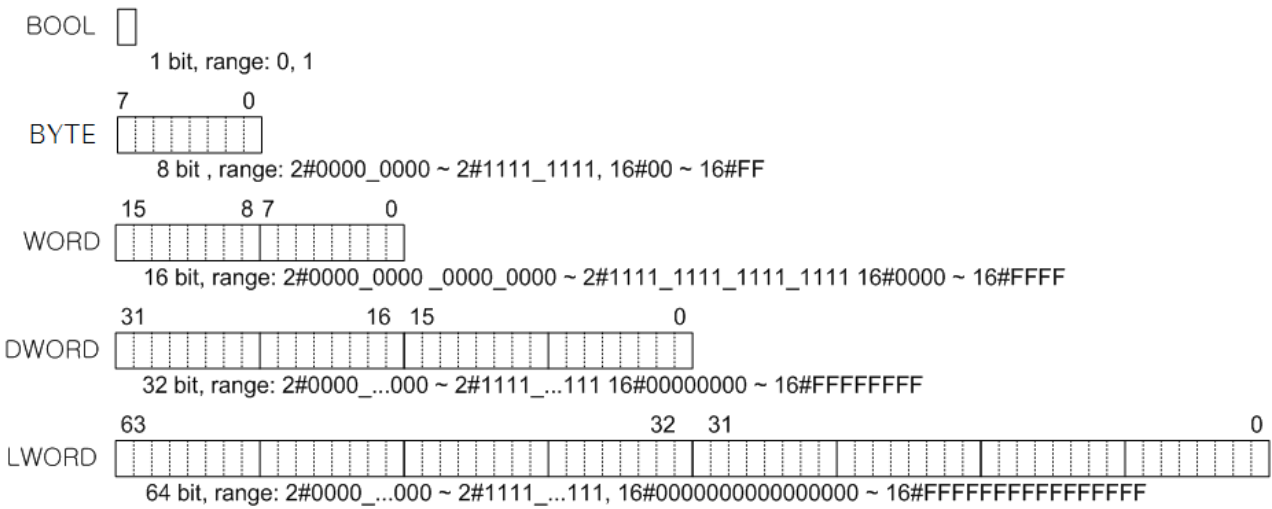
If an initial value of data is not assigned, it is automatically assigned as follows.

Data Type	Initial Value
SINT, INT, DINT, LINT	0
USINT, UINT, UDINT, ULINT	0
BOOL, BYTE, WORD, DWORD, LWORD	0
REAL, LREAL	0.0
TIME	T#0s
DATE	D#1984-01-01
TIME_OF_DAY	TOD#00:00:00
DATE_AND_TIME	DT#1984-01-01-00:00:00
STRING	' ' (empty string)

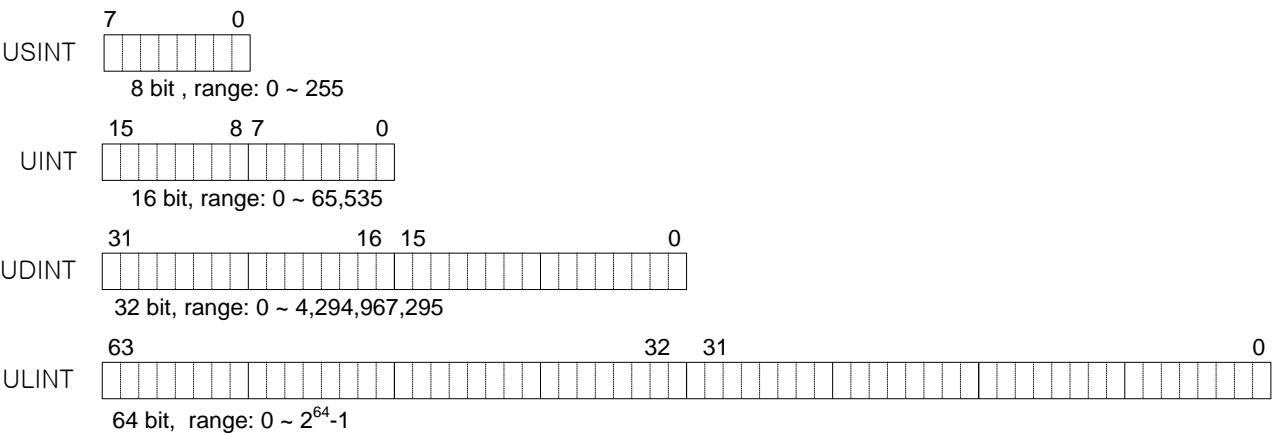


3.2.4 Data Type Structure

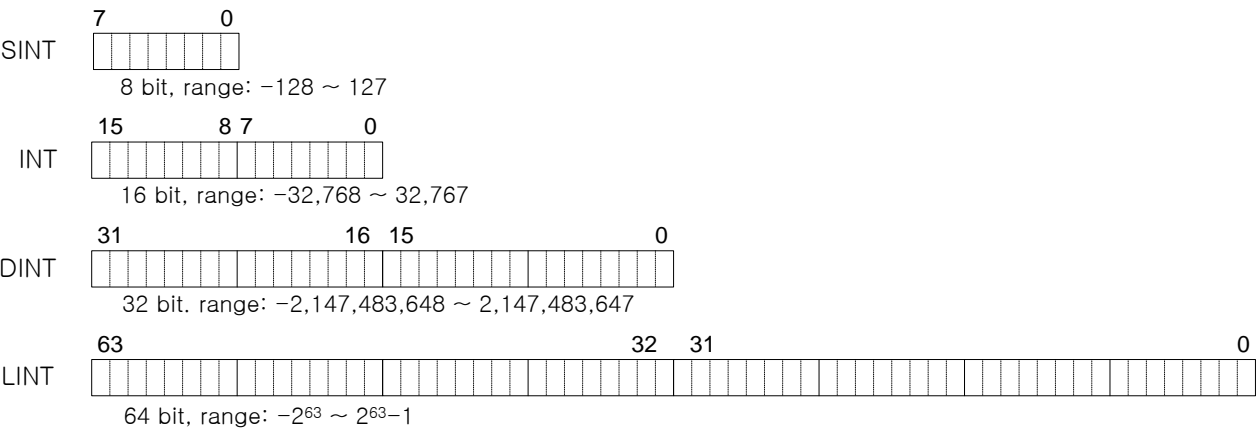
# Bit String



# Unsigned Integer



# Integer (negative number is expressed as 2's complement)





3.3 Variable

A variable has its own value and refer to data used in a program. ‘Variable’ refer to something that can vary such as an input/output of PLC, memory, and so on.

3.3.1 Variable Expression

- ▷ Variables can be expressed in two ways: by giving a name to a data element using an identifier (Variable by Identifier) or by directly assigning a memory address or an input/output of PLC to a data element (Direct Variable).
- ▷ A variable by identifier must be unique within its ‘effective scope’ (program area where the variable was declared) in order to distinguish it from other variables.
- ▷ A direct variable is expressed as one, which starts with the percent sign (%) followed by the ‘location prefix’, a prefix of the data size, and more than one unsigned integer numbers divided by a period (.). The prefixes are shown as follows.

Location prefix

No.	Prefix	Meaning
1	I	Input Location
2	Q	Output Location
3	M	Memory Location (M)
4	R	Memory Location (R)
5	W	Memory Location (W)

Size prefix

No.	Prefix	Meaning
1	X	1 bit size
2	None	1 bit size
3	B	1 byte (8 bits) size
4	W	1 word (16 bits) size
5	D	1 double word (32 bits) size
6	L	1 long word (64 bits) size

Expression format

%[Location Prefix][Size Prefix] n1.n2.n3

Number	I, Q	M, R, W
n1	Base number (starting from “0”)	The n1th data according to [size prefix] (starting from “0”)
n2	Slot number (starting from “0”)	The n2th data of the n1th data (starting from “0”) : available to omit
n3	n3 data according to the [size prefix] (starting from “0”)	Not used

Examples

%QX3.1.4 or %Q3.1.4	4 <sup>th</sup> output of no.1 slot on no.3 base (1 bit)
%IW2.4.1	1 <sup>st</sup> word input of no.4 slot on no.2 base (16bits)
%MD48	48 <sup>th</sup> double word memory
%MW40.3	3 <sup>rd</sup> bit of 40 <sup>th</sup> word memory
(internal memory does not have a base or a slot number)	

- ▷ Small alphabets are not allowed as a prefix.
- ▷ A variable without a size prefix is treated as 1 bit.
- ▷ Direct variables are available to use without a variable declaration.

3.3.2 Variable Declaration

- ▷ Program elements (programs, functions, function blocks, and so on) have parts that can be declared to edit their variables.
- ▷ Variables must be declared before using them in the program elements.
- ▷ The contents of a variable declaration are as follows.

1) Variable types

The variable type defines how to declare variables.

Variable types	Description
VAR	General variable available to read/write
VAR_RETAIN	Retaining(data-keeping) variable
VAR_CONSTANT	Read only variable
VAR_EXTERNAL	Declaration to use the variable declared as VAR_GLOBAL

2) Data type

Data type sets a variable data type.

3) Memory allocation

Memory allocation assigns memory for a variable.

- Auto ---- The compiler sets a variable location automatically (Automatic Allocation Variable).
- Assign (AT) ---- A user sets a location of variable, using a direct variable (Direct Variable).

### Reference

The location of Automatic Allocation Variable is not fixed. If variable VAL1, for example, was declared as BOOL, it is not fixed in the internal memory; the compiler and linker fix its location. If the program is compiled again after modification, the location may change.

The merit of Automatic Allocation Variable is that users do not have to care the location of the internal variables because its location is not overlapped as long as a variable name is different from others.

Use of Direct Variable is not recommended except % I and % Q because the location of a variable is fixed and it could be overlapped in a wrong-used case.

- ▷ Initial Value Assignment: assigns an initial value. A variable is set with an initial value as shown in section '3.2.3. Initial Value' if not assigned.

### Reference

The initial value is not assigned when it comes to VAR\_EXTERNAL.

In case of 'Variable Declaration', you cannot assign an initial value to % I or %Q variables.

- ▷ You can declare variable VAR\_RETAIN that keeps its data in case of power failure. Rules are:
  - 1) 'Retention Variable' retains its data when the system is set as 'Warm Restart'.
  - 2) In case of 'Cold Restart', variables are initialized as the initial values set by users or the basic initial values.
- ▷ Variables, which are not declared as VAR\_RETAIN, must be initialized as the initial values set by a user or the basic initial values in case of 'Warm Restart' or 'Cold Restart'.

### Reference

Variables, which are assigned as %I or %Q, must not to be declared as VAR\_RETAIN or VAR\_CONSTANT.

- ▷ Users can declare variables 'Array' with Elementary Data Type. When declaring the Array Variable, users are supposed to set Data Type and Array Size; 'STRING' type among Elementary Data Types is not allowed.
- ▷ Effective scope of variable declaration, the area which is available to use the variable, is limited to the program where variables are declared. And users can't use variables declared in other program in the above area. On the contrary, users can get an access to 'Global Variable' from other program elements by declaring it as 'VAR\_EXTERNAL'.

Examples of Variable Declaration

Variable Name	Variable Kind	Data Type	Initial Value	Memory Allocation
I_VAL	VAR	INT	1234	Auto
BIPOLAR	VAR_RETAIN	REAL	-	Auto
LIMIT_SW	VAR	BOOL	-	%IX1.0.2
GLO_SW	VAR_EXTERNAL	DWORD	-	Auto
READ_BUF	VAR	ARRAY OF INT[10]	-	Auto

3.3.3 Reserved Variable

- ▷ ‘Reserved Variable’ refers to variables previously declared in the system. These variables are used for special purposes and users cannot declare variables with the name of the Reserved Variables.
- ▷ Users can use the reserved variables without variable declaration.
- ▷ For additional information, refer to Appendix 2 : Flag List(XGI) Summary of Special internal flag(F) and XGI-CPUU User’s Manual.

3.3.4 Reserved Word

Reserved words are previously defined words to use in the system. And these reserved words cannot be used as an identifier.

Reserved words
ACTION ... END_ACTION
ARRAY ... OF
AT
CASE ... OF ... ELSE ... END_CASE
CONFIGURATION ... END_CONFIGURATION
Name of data type
DATE#, D#DATE_AND_TIME#, DT#
EXIT
FOR ... TO ... BY ... DO ... END_FOR
FUNCTION ... END_FUNCTION
FUNCTION_BLOCK ... END_FUNCTION_BLOCK
Name of function block
IF ... THEN ... ELSIF ... ELSE ... END_IF
OK
Operator (IL language)
Operator (ST language)
PROGRAM
PROGRAM ... END_PROGRAM
REPEAT ... UNTIL ... END_REPEAT
RESOURCE ... END_RESOURCE
RETAIN
RETURN
STEP ... END_STEP
STRUCTURE ... END_STRUCTURE
T#
TASK ... WITH
TIME_OF_DAY#, TOD#
TRANSITION ... FROM... TO ... END_TRANSITION

Reserved words
TYPE ... END_TYPE
VAR ... END_VAR
VAR_INPUT ... END_VAR
VAR_OUTPUT ... END_VAR
VAR_IN_OUT ... END_VAR
VAR_EXTERNAL ... END_VAR
VAR_ACCESS ... END_VAR
VAR_GLOBAL ... END_VAR
WHILE ... DO ... END_WHILE
WITH

3.4 Program Type

There are three types of program: function, function block and program. You cannot call its own program in the program (recursive call is prohibited)

3.4.1 Function

- ▷ A function has one output and does not have any data with status in it. That is, to be a function, consistent input must yield consistent output.
- ▷ An internal variable of a function cannot have an initial value.
- ▷ You cannot declare a function as VAR\_EXTERNAL and use it.
- ▷ You cannot use direct variables inside the function.
- ▷ You can call a function program elements and use it.
- ▷ Data transfer from program composition elements which call the function, to the function, is executed through an input of a function.
- ▷ You cannot call a function block or a program from inside a function.
- ▷ A function has a variable whose name is the same as that of the function and whose data type is the same as the data type of the result of the function. This variable is automatically creates when you make a function and the result value of the function displays in the output.

3.4.2 Function Block

- ▷ A function block can have a several outputs.
- ▷ A function block has data inside. A function block must declare the instance as it declares variables before using them. Instance is a set of variables used in a function block. A function block must have its data memory to preserve the output value as well as variables used inside, which is called as "instance." A program is a kind of a function block and also needs to declare "instance." However, users cannot call a program inside a program or a function block for use, contrary to a function block.
- ▷ You can declare a direct variable inside a function block, and moreover, you can use a direct variable declared as Global Variable and allocated according to 'Assign (AT)' after declaring it as VAR\_EXTERNAL.
- ▷ You can call a program inside the function block.

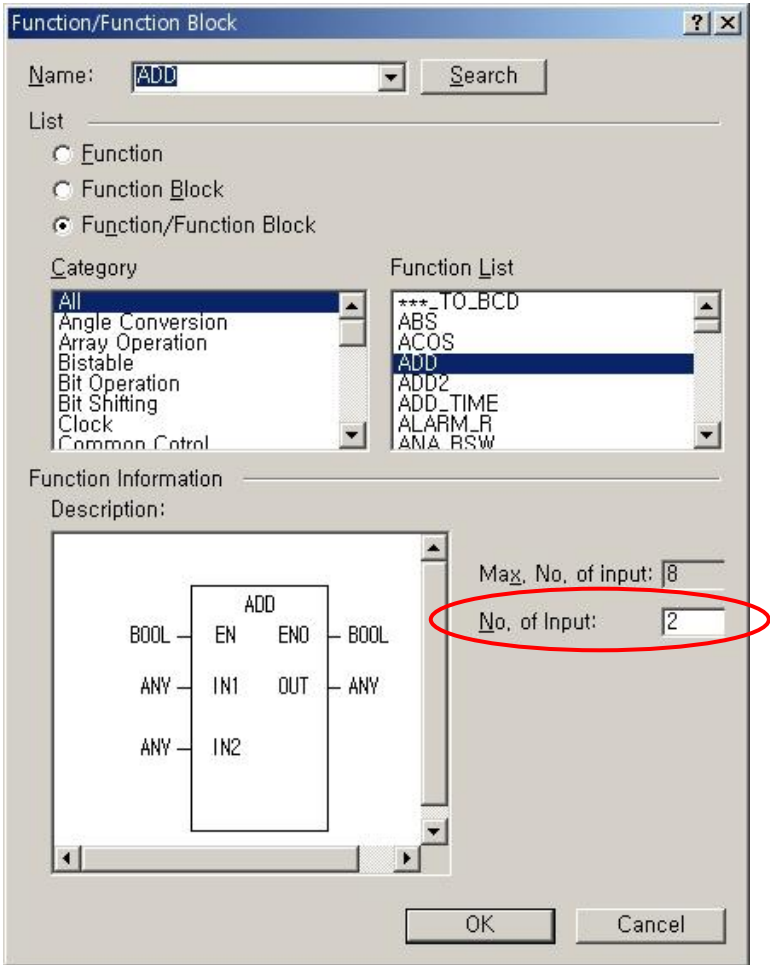
3.4.3 Program

- ▷ Users can use a program after declaring an instance like a function block.
- ▷ User can use direct variables in the program.
- ▷ A program does not have input/output variables.
- ▷ A program can call functions or function blocks.

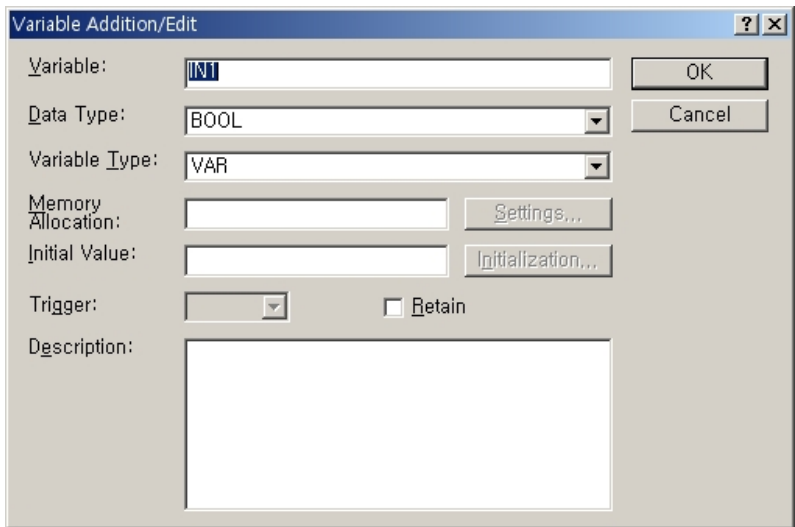
3.5 Function Selection

3.5.1 Internally Determined Function

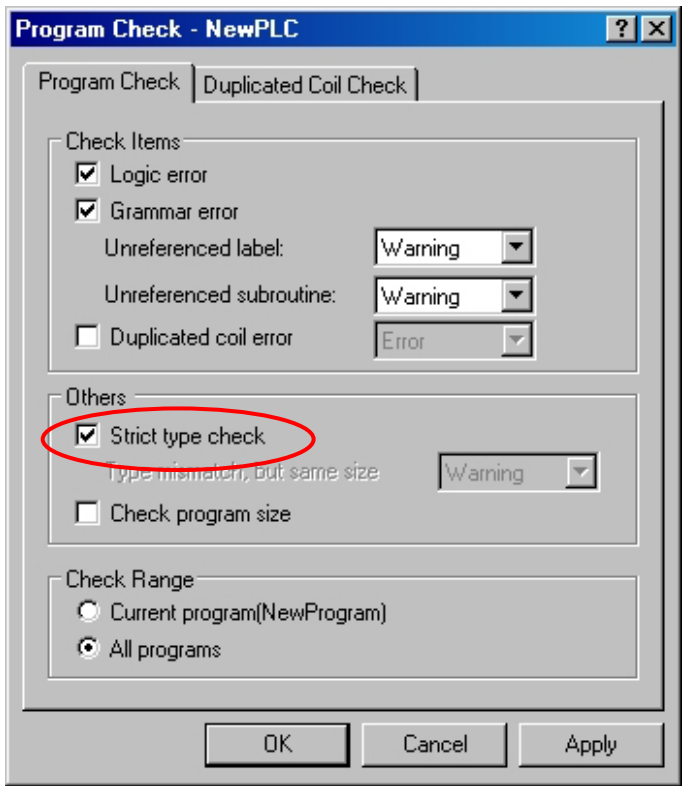
- Although a function has one name, a command in which a variety of variable types can be entered is divided into various commands, depending on available variables. For instance, ADD can be divided and processed in various kinds, depending on the number of input defined or I/O variable types. If you select in the following figure, the function shown in a ladder program is ADD but ADD2\_SINT function executes internally.







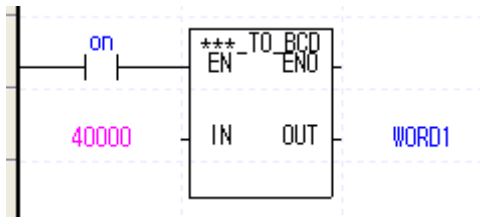
- ▷ An internally used function automatically selects in XG5000, depending on a user-selected variable type. For instance, two inputs are selected among ADD function and I/O variables are selected as DINT, ADD2\_DINT is selected as described above.
- ▷ Although IEC allows an operation between and among same types, XG5000 has a “Strict type check” (View→Program Check) option to allow an operation if its operand sizes (BYTE, WORD, DWORD, and LWORD) are same.



### 3.5.2 Function Selection Rules

- ▷ If an input variable is of multiple data type, then, an internally used function is used to determine the type of the output variable.
- ▷ If a constant is used as input in a function in which various input variable types and one output variable type are allowed, a function is determined by a constant.

For instance, `***_TO_BCD` is used as below,

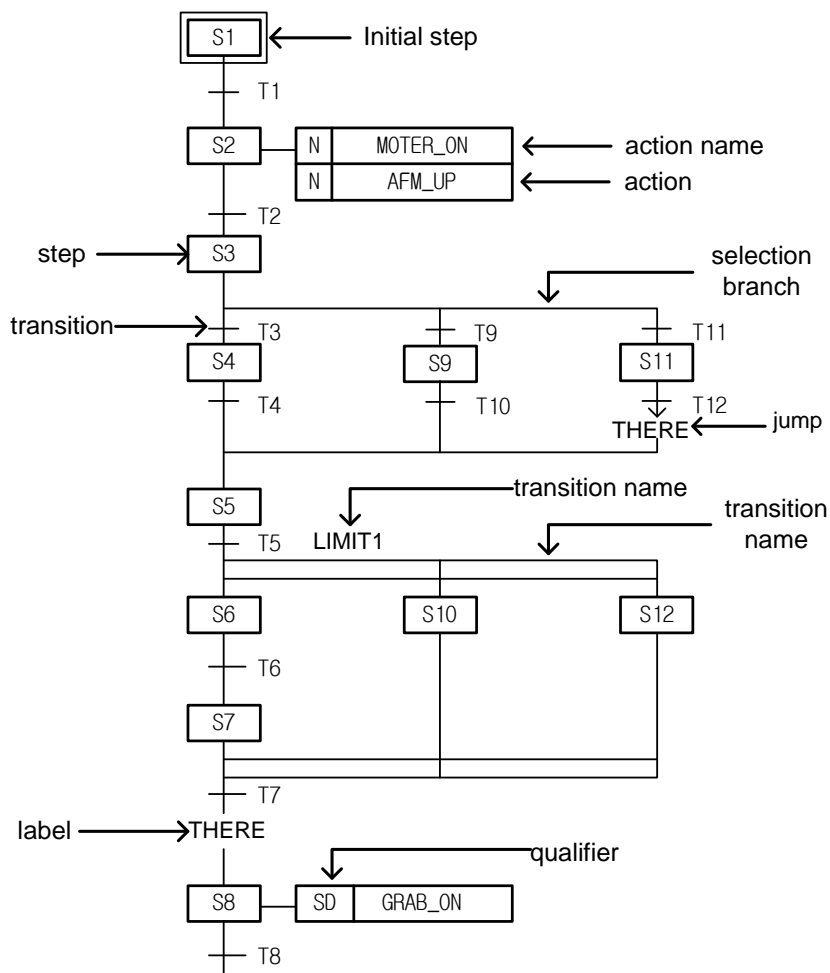


A function is determined depending on output variable type because input variable is constant; in this case, the following two functions which output is word are available (`INT_TO_BCD_WORD`/`UINT_TO_BCD_WORD`). `UINT_TO_BCD_WORD` is selected depending on constant type. Positive constant is determined as 'unsigned' while negative one is determined as 'signed'.

## Ch 4. SFC (Sequential Function Chart)

### 4.1 Introduction

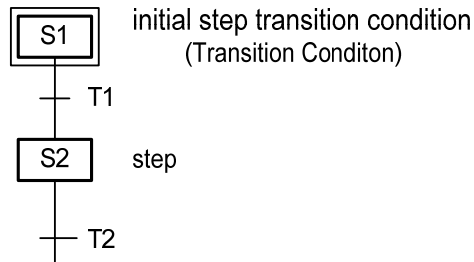
- ▷ SFC is a structured language that extends an application program in the form of flow chart according to the processing sequence, using a PLC language.
- ▷ SFC splits an application program into step and transition, and provides how to connect them each other. Each step is related to action and each transition is related to transition condition.
- ▷ As SFC should contain the state information, only program and function block among program types are available to apply this SFC.
- ▷ Type



### 4.2 SFC Structure

#### 4.2.1 Step

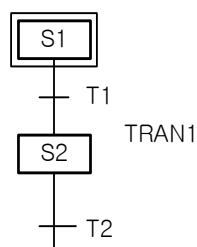
- ▷ Step indicates a sequence control unit by connecting the action.
- ▷ When step is in an active state, the attached content of action executes.
- ▷ You have to first activate the initial step.



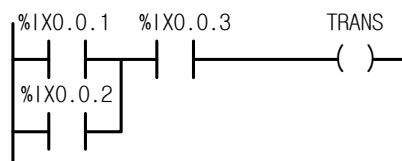
- ▷ If a next transition condition of activated initial step (S1) is established, the currently activated step 1 (S1) is inactivated and Step 2 (S2) connected to S1 becomes activated.

#### 4.2.2 Transition

- ▷ Transition indicates the execution condition between steps.
- ▷ A transition condition must be described as a PLC language such as ST(Structured text) or LD.
- ▷ The result of a transition condition must always be a BOOL type and the variable name must be TRANS for any transition.
- ▷ In case that the result of transition condition is 1, the current step is inactivated and the next step is activated.
- ▷ There must be a transition between steps.



The content of TRAN1



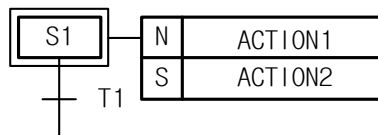
When TRANS is on, S1 is inactivated and S2 is activated.

TRANS is the internally declared variable.

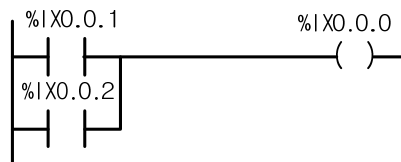
A transition condition of all transition must be output in TRANS variable.

### 4.2.3 Action

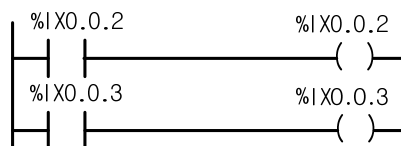
- ▷ Each step is able to connect up to two actions.
- ▷ The step without action is regarded as a waiting action and it is required to wait until the next transition condition is 1.
- ▷ Action is composed of PLC language such as LD/SFC/ST and the action execute while the step is activated.
- ▷ Action qualifier is used to control action.
- ▷ When action becomes inactivated, the state after activating the contact output in action is 0.  
However, S, R, function and function block output retain their state prior to inactivation.



The content of ACTION1



The content of ACTION2



- ACTION1 executes only when S1 is activated.
- ACTION2 executes until activated S1 meets R qualifier. It goes on executing even if S1 is inactivated.
- When action is deactivated, this action is Post Scanned and then passes to the next step.

## Ch 4. SFC (Sequential Function Chart)

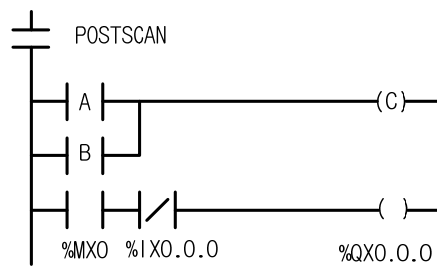
### Reference

#### Post Scan

When action is inactivated, this action is scanned again.

As it is scanned as if there is a contact (contact with the value of 0) in the early part of an action program, the program output, which is composed of contacts, is 0.

Function, function block, S, R output and so on are not included.



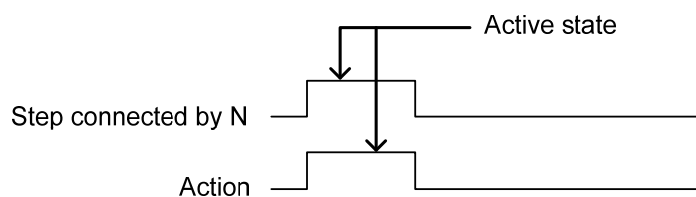
In this figure, as the contact of post scan is 0, C and %Q0.0.0 is 0.

### 4.2.4 Action Qualifier

- ▷ Whenever action is used, action qualifier follows.
- ▷ The action of step defines an executing point and time according to the assigned qualifier.
- ▷ Types of action qualifier are as follows.

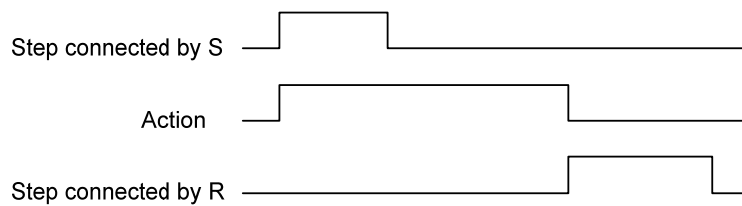
#### 1) N (Non-Stored)

Action executes only when the step is activates.



### 2) S (Set)

It continues the action after the step is activates (until the action is reset by R qualifier).

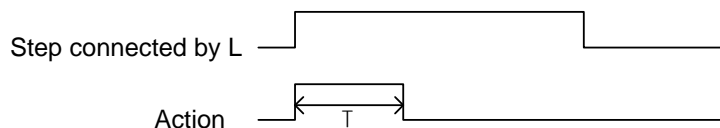
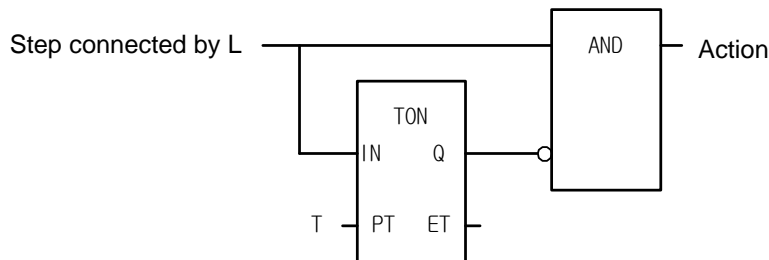


### 3) R (Overriding Reset)

It terminates the execution of an action previously started with the S, SD, SL or DS qualifier.

### 4) L (Time Limited)

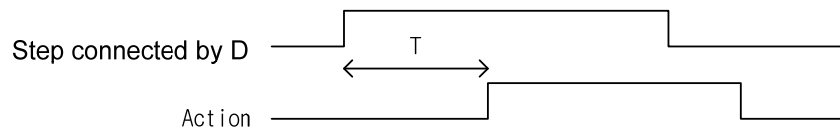
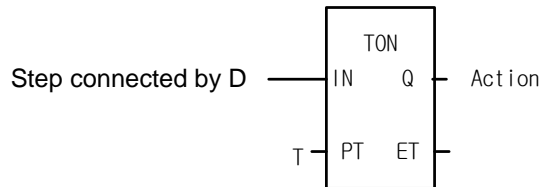
It starts the action when the step becomes active and continues until the step goes inactive or a set time elapses.



## Ch 4. SFC (Sequential Function Chart)

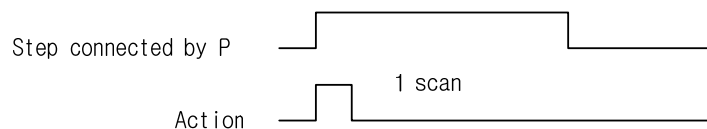
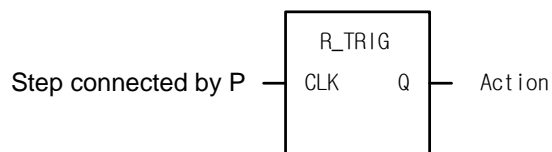
### 5) D (Time Delayed)

Start a delay timer when the step activates; after the time delay the action starts (if step is still active) and continues until inactivated.



### 6) P (Pulse)

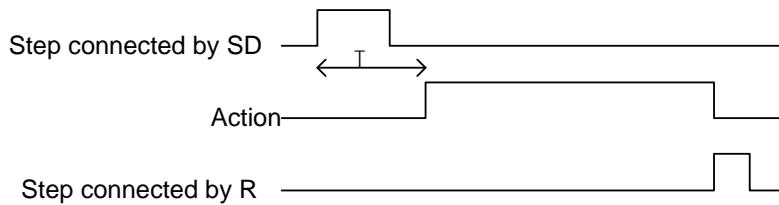
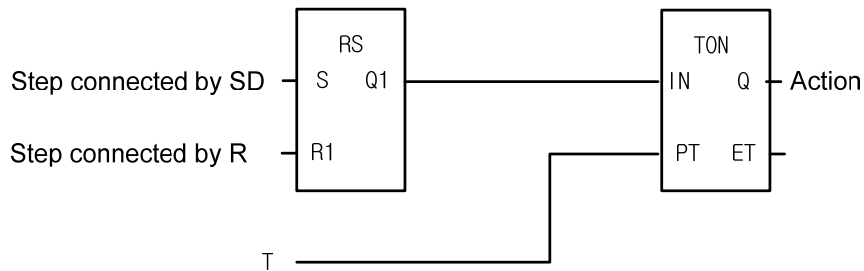
It starts the action when the step is active and executes the action only once.





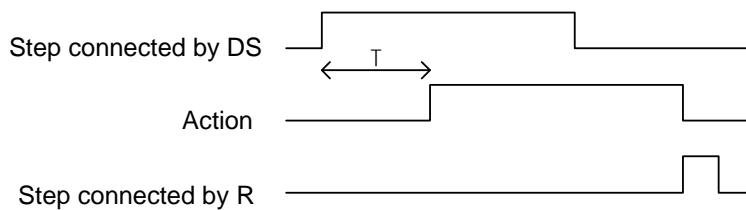
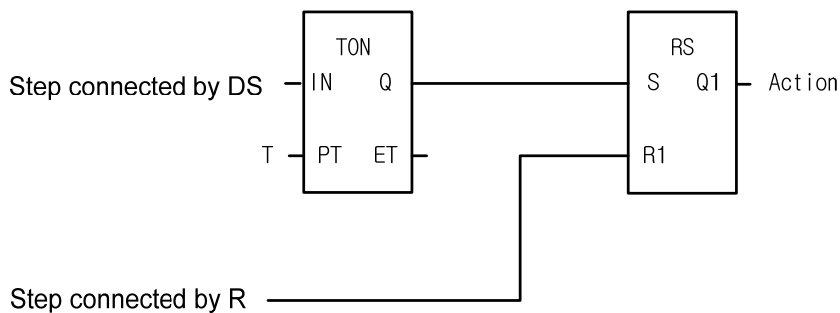
### 7) SD (Stored & Time Delayed)

It starts a delay timer when the step activates; after the time delay, the action starts and continues until reset (regardless of step activation/inactivation). If the reset activates during the time delay, the action does not start.



### 8) DS (Delayed & Stored)

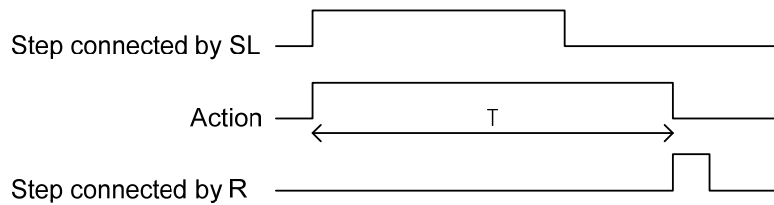
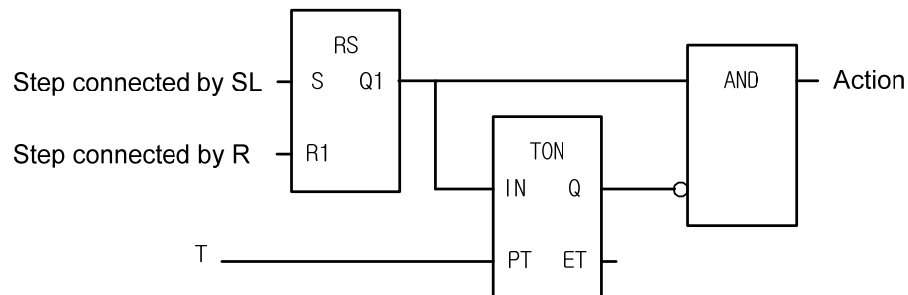
It starts a delay timer when the step activates; after the time delay the action starts (if step is still active) and continues until reset by R qualifier. If the step is inactivates or reset activates during the time delay, the action does not start.



## Ch 4. SFC (Sequential Function Chart)

### 9) SL (Stored & Timed Limited)

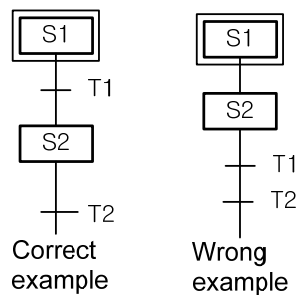
It starts the action when the step activates and continues for a set time or until the action is reset (regardless of step activation/inactivation).



## 4.3 Extension regulation

### 4.3.1 Serial connection

- ▷ steps are always divided by transitions without direct connections.
- ▷ A Step always divides two transitions without direct connections.

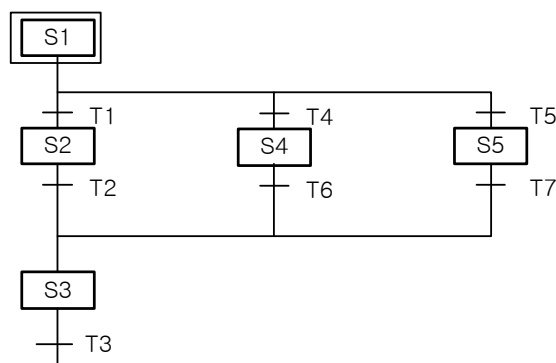


- ▷ For the transition between steps connected by serial, the lower step activates if the upper step is active and the transition condition connected to the next is 1.

### 4.3.2 Selection branch

- ▷ When a processor executes a selection branch, the processor finds the first path with a true transition in the sequence the program scan and executes the steps and transitions in that path. If more than one path in a selection branch becomes true at the same time, the processor chooses the left-most path. The following example shows a typical scan sequence.

#### Example



- \* If the transition condition of T1 is 1, the order of activation is S1 -> S2 -> S3.
- \* If the transition condition of T4 is 1, the order of activation is S1 -> S4 -> S3.

## Ch 4. SFC (Sequential Function Chart)

\* If the transition condition of T5 is 1, the order of activation is S1 -> S5 -> S3.

If the transition conditions are 1 at the same time, the processor chooses the left-most path.

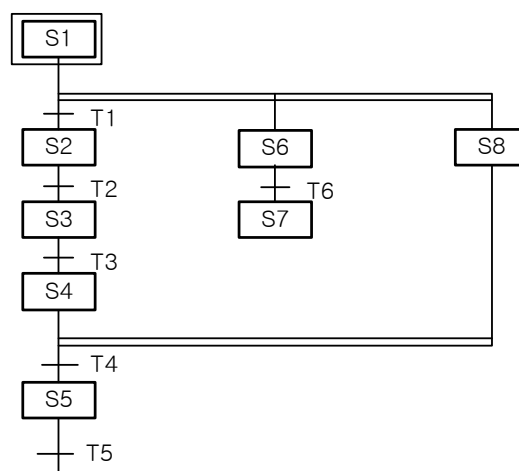
\* If the transition condition of T1 and T4 is 1 at the same time, the order of activation is S1 -> S2 -> S3..

\* If the transition condition of T4 and T5 is 1 at the same time, the order of activation is S1 -> S4 -> S3.

### 4.3.3 Parallel branch (simultaneous branch)

- ▷ When connecting using a parallel branch, if the transition condition connected to the next is 1, all steps tied to this transition activates. The extension of each branch is the same as serial connection. The steps in the state of activation are as many as the number of branches.
- ▷ In case of combining in parallel branch, if the transition condition is 1, when the state of the last steps of each branch activates, then the step connected to the next step activates.

#### Example



- If the transition condition of T1 is 1 when S1 is active, S2, S6 and S8 is activated and S1 is inactivated.

- If the transition condition of T4 is 1 when S4, S7 and S8 are activated, S5 is activated and S4, S7 and S8 are inactivated.

\* The order of activation

S1+>S2--->S3--->S4+>S5

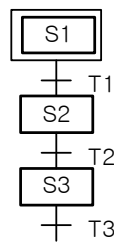
+>S6--->S7-----+

+>S8-----+

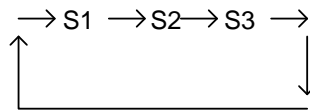
### 4.3.4 Jump

- ▷ If the transition condition connected to the next step is 1, after the last step of SFC activates, then the initial step of SFC activates.

#### Example



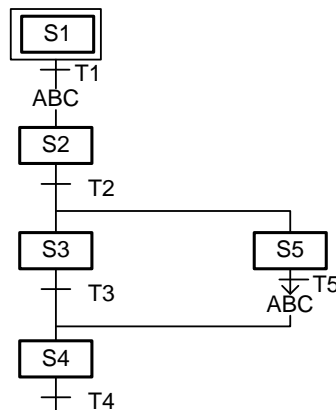
- The order of activation



- ▷ It is possible to extend to the place using a jump.
- ▷ Jump can only be placed at the end of SFC program or at the end of a selection branch.  
A jump to the inside or outside of a parallel branch is not permissible; however the jump within a parallel branch is permissible.

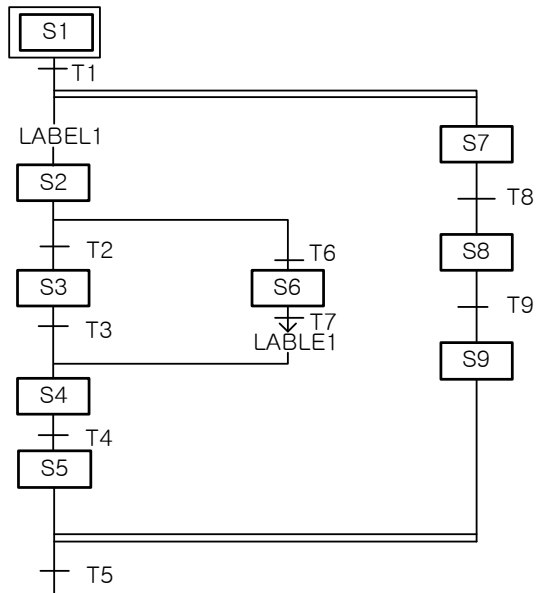
#### Example

- 1) Jump at the end of selection branch S2 activates after S5.

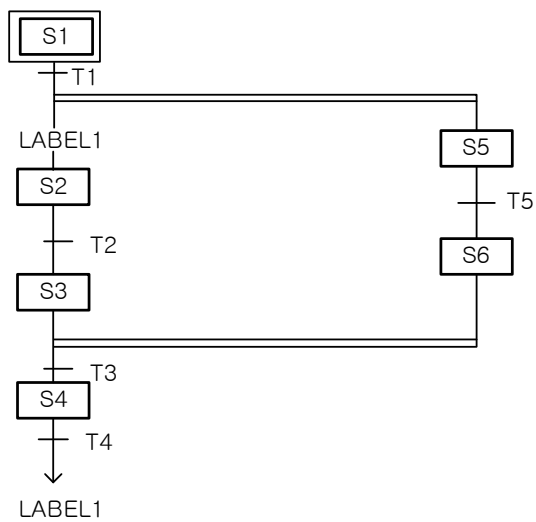


## Ch 4. SFC (Sequential Function Chart)

### 2) Jump within a parallel branch



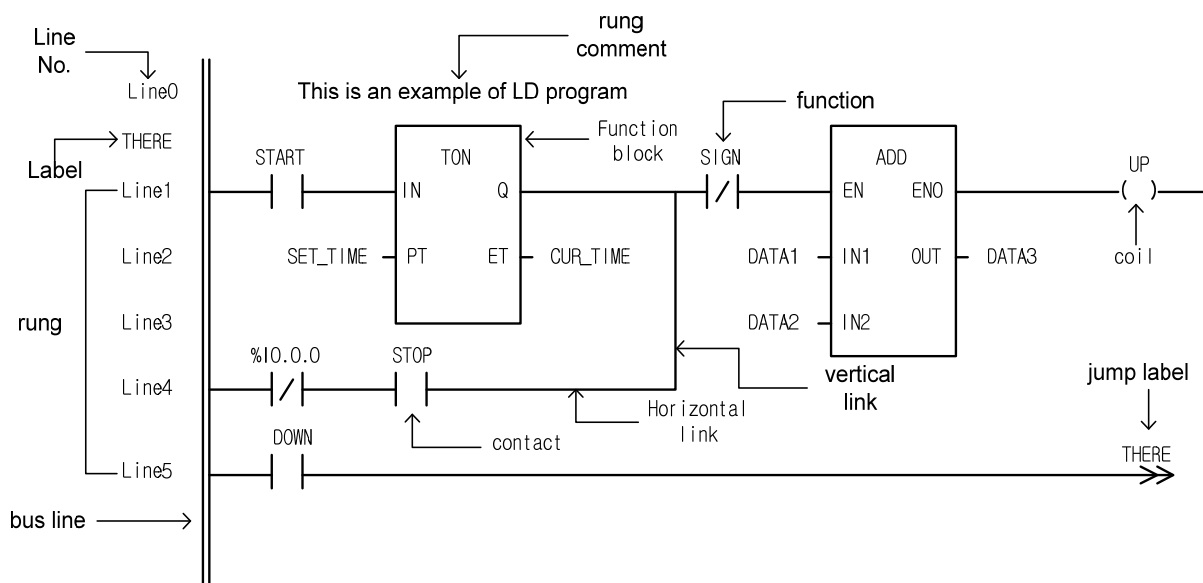
### 3) You can not jump inside a parallel branch.



## Ch 5. LD (Ladder Diagram)

### 5.1 Introduction

- ▷ LD program is the graphical representation of a PLC program using symbols such as a coil or contact used in relay logic diagram.
- ▷ Configuration





### 5.2 Bus

- ▷ Bus line as a power line is vertically placed on either sides of a LD graphic diagram.

No	Symbol	Name	Description
1		Left bus line	Its value is always 1 (BOOL).
2		Right bus line	The value is not fixed.



### 5.3 Link

- ▷ The value (BOOL 1) of left bus line transmits to the right side by the ladder diagram. The line that transmits value is called as 'power flow line' or 'connection line' which is connected to a contact or coil. Power flow line has always a BOOL value and there is only one power flow line in one rung that is connected by lines.
- ▷ There are two types of a connection line of LD: horizontal connection line and vertical connection line.


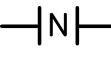
No.	Symbol	Name	Description
1		Horizontal connection line	It transmits the left side value to the right side
2		Vertical connection line	It is a logical OR of horizontal connection lines of its left side

### 5.4 Contact

- ▷ 'Contact' transmits a value to the right horizontal connection line, which is the result of logical AND operation of : the state of left horizontal connection line, Boolean input/output related to the current contact or memory variables. It does not change the value of variable related to the contact. Standard contact symbols are as follows.

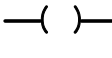
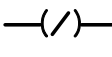
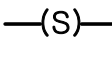
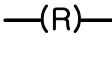
Static contact			
No	Symbol	Name	Description
1		Normally open contact	When the BOOL variable (marked with ***) is on, which transmits the state of the left connection line to the right connection line. Otherwise, the state of the right connection line is OFF.
2		Normally closed contact	When the BOOL variable (marked with ***) is off, which transmits the state of the left connection line to the right connection line. Otherwise, the state of the right connection line is off.



State transition-sensing contact			
No	Symbol	Name	Description
3	*** 	Positive Transition-Sensing Contact	When the BOOL variable (marked with ***), which was off in the previous scan is on, it maintains on state during one scan (current scan).
4	*** 	Negative Transition-Sensing Contact	When the BOOL variable (marked with ***), which was on in the previous scan is off, it maintains on state during just one scan (current scan).

## 5.5 Coil

- ▷ The coil stores the state of the left connection line or the processing result of state transition in the associated BOOL variable. Standard coil symbols are as follows.
- ▷ Coils are placed in the right extreme of LD, and its right is a right bus line.

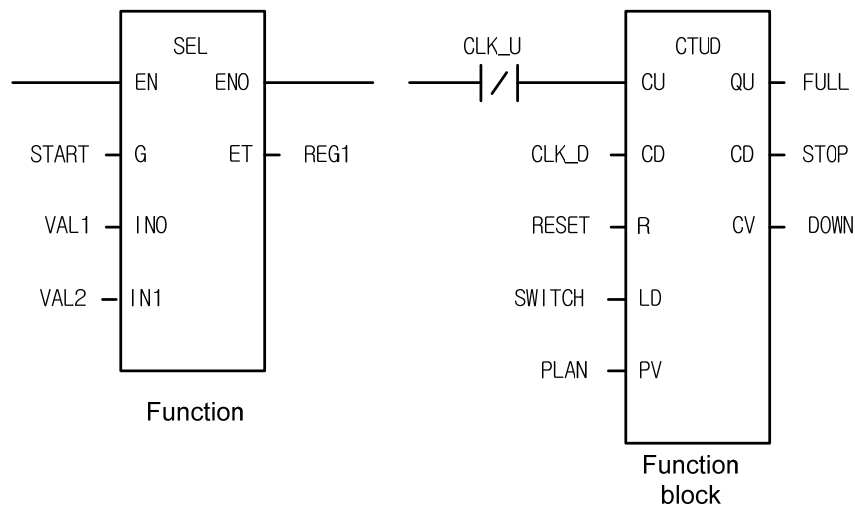
Momentary Coils			
No.	Symbol	Name	Description
1	*** 	Coil	Put the state of left connection line into the associated BOOL variable (marked with ***).
2	*** 	Negated Coil	Put the negated value of the state of left connection line into the associated BOOL variable (marked with ***). That is, if the state of left connection line is off, the associated BOOL variable is on and if the state of left connection line is on, the associated BOOL variable is off.
Latched Coils			
No.	Symbol	Name	Description
3	*** 	Set (Latch) Coil	It sets the associated BOOL variable (marked with ***) to on when the left link is in the on state and remains set until reset by a Reset coil.
4	*** 	Reset (Unlatch) Coil	It sets the associated BOOL variable (marked with ***) to off when the left link is in the on state and remains reset until set by a Set coil.

State Transition-sensing Coils			
No.	Symbol	Name	Description
5	*** —(P)—	Positive Transition-Sensing Coil	If the state of its left connection that was off in the previous scan is on in the current scan, the associated BOOL variable (marked with ***) is on during the current scan.
6	*** —(N)—	Negative Transition-Sensing Coil	If the state of its left connection that was on in the previous scan is off in the current scan, the associated BOOL variable (marked with ***) is on during the current scan.

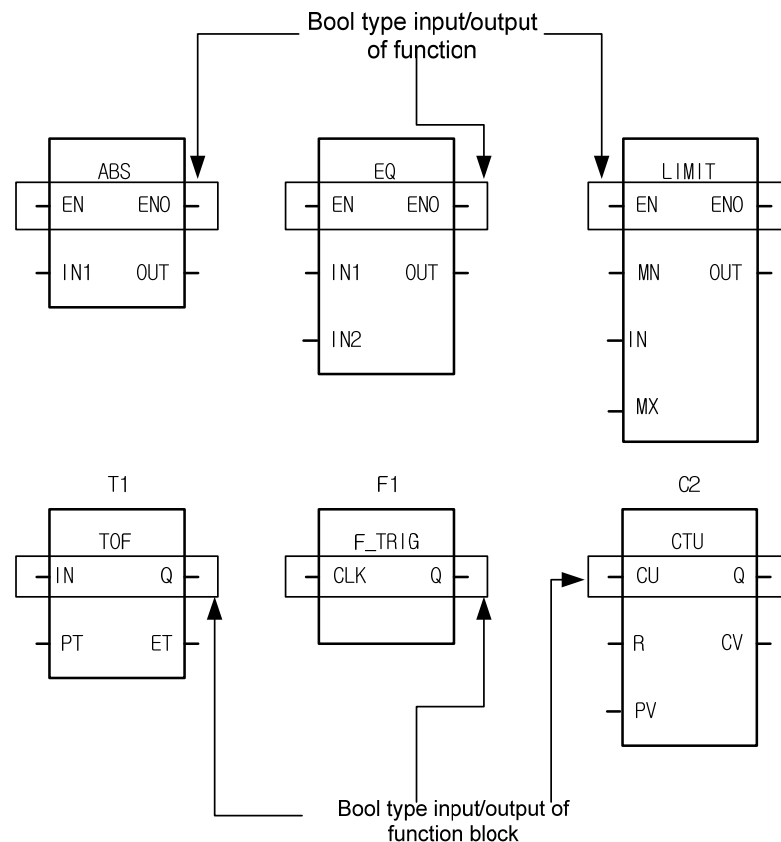
### 5.6 Calling of Function and Function Block

- ▷ The connection to a function or a function block is done by entering suitable data or variable to their input/output.

#### Example



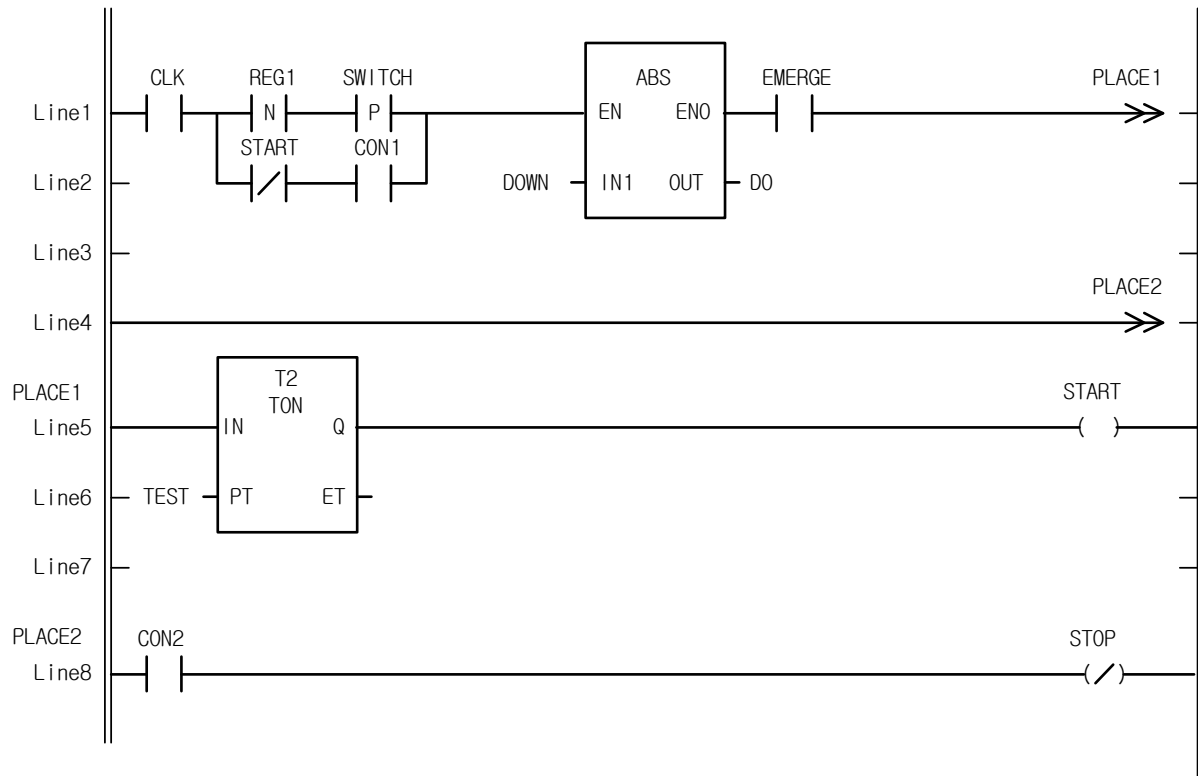
- ▷ To enable power flow inside function or function block, it must contain at least one BOOL-type input and BOOL-type output. EN and ENO are BOOL-type input/output in a function while a data type of the first input and first output are BOOL-type in a function block.

**Example**

- ▷ Conventionally, the ladder logic connecting a Boolean input to a function is called EN and the corresponding output Boolean is called ENO, or enable out. If the value of EN is 1, then the function executes, otherwise it does not execute. In all cases, the value of EN copies the output ENO.
- ▷ If an error occurs in the execution of a function, the function is responsible to set ENO to false (BOOL 0). EN is connected to the power flow line but ENO does not have to be connected to it. However, when connecting the power flow line to the function output instead of the ENO, the output data type must be a BOOL type.
- ▷ When connecting the power flow line to the function output, do not connect anything to the ENO output. All the inputs of a function are assigned by entering its data at the left side of the function. The output of a function is stored at the output variable on its right side.
- ▷ Assignment of input of a function block in a LD is the same as that of a function. The name of function block is the 'instance' name, which can be user-defined and must be unique to LD in which the function block appears.
- ▷ You do not have to assign output variables because they are in the instance. If a function block is connected to the power flow line, it always executes because there is neither EN nor ENO in it.
- ▷ Therefore, use Jump (→) to determine whether or not to execute a function block according to the logic result. When connecting the power flow line to the function block, connect it to the input/output whose data type is BOOL.

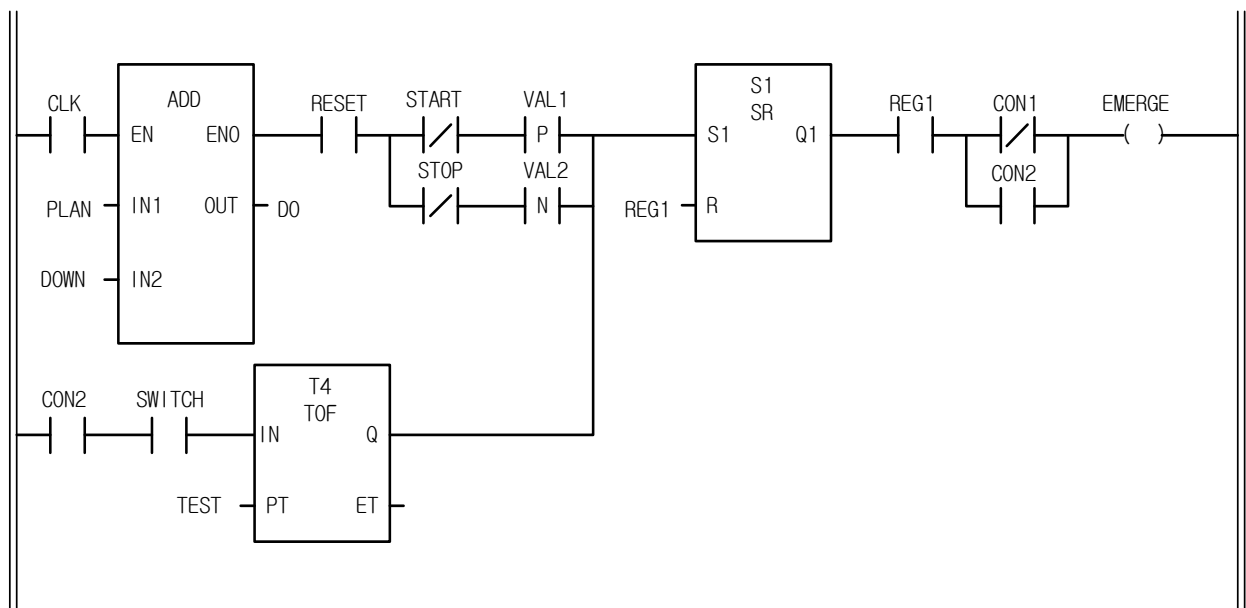
## Ch 5. LD (Ladder Diagram)

### Example



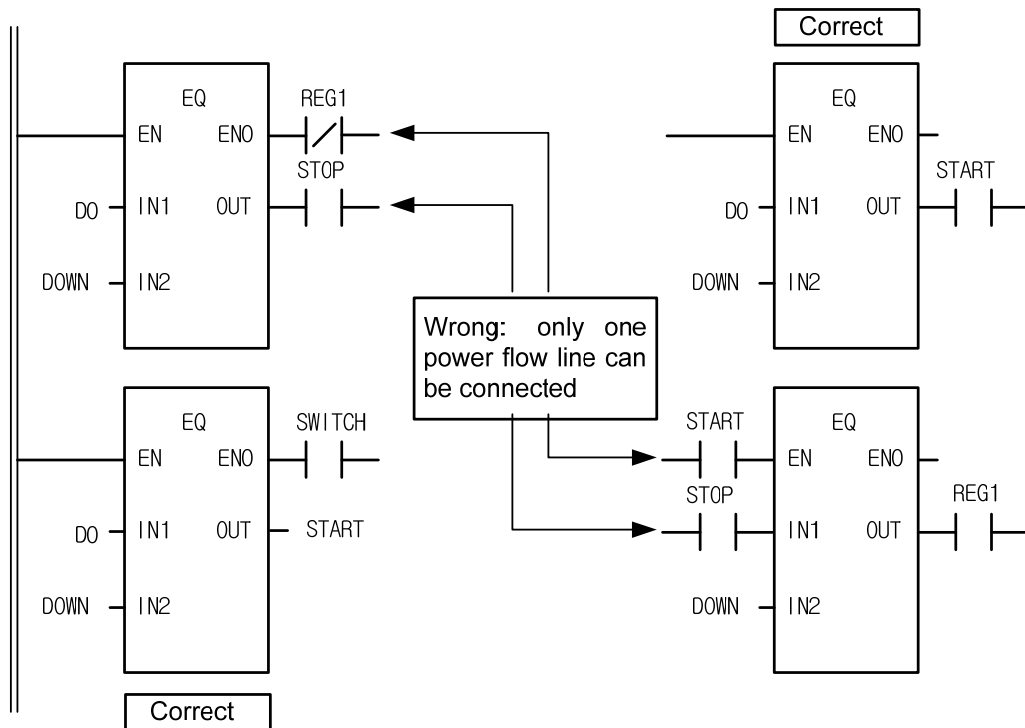
- ▷ You can place a function or a function block in any place of LD. You can create a program by connecting the power flow line to the output and then insert the contact to it.

### Example



- ▷ Only one power line connects to a function or a function block.

## Example



## Ch 6. Function and Function Block

It's a list of function and function block. For each function and function block, please refer to the next chapters (Ch .7/8 Basic/Application Functions and Ch 9/10 Basic/Application Function Blocks).

### 6.1 Functions

#### 6.1.1 Type Conversion Function

It converts each input data type into an output data type.

Function Group	Function	Input data type	Output data type	Remarks
ARY_ASC_TO_***	ARY_ASC_TO_BYTE	WORD(ASCII)	BYTE	-
	ARY_ASC_TO_BCD	WORD(ASCII)	BYTE (BCD)	-
ARY_BYTE_TO_***	ARY_BYTE_TO_ASC	BYTE	WORD(ASCII)	-
ARY_BCD_TO_***	ARY_BCD_TO_ASC	BYTE (BCD)	WORD(ASCII)	-
ASC_TO_***	ASC_TO_BCD	BYTE (BCD)	USINT	-
	ASC_TO_BYTE	WORD (BCD)	UINT	-
BCD_TO_***	BYTE_BCD_TO_SINT	BYTE (BCD)	SINT	-
	WORD_BCD_TO_INT	WORD (BCD)	INT	-
	DWORD_BCD_TO_DINT	DWORD (BCD)	DINT	-
	LWORD_BCD_TO_LINT	LWORD (BCD)	LINT	-
	BYTE_BCD_TO_USINT	BYTE (BCD)	USINT	-
	WORD_BCD_TO_UINT	WORD (BCD)	UINT	-
	DWORD_BCD_TO_UDINT	DWORD (BCD)	UDINT	-
	LWORD_BCD_TO_ULINT	LWORD (BCD)	ULINT	-
BCD_TO_ASC	BCD_TO_ASC	BYTE (BCD)	WORD	-
BYTE_TO_ASC	BYTE_TO_ASC	BYTE	ASC(BYTE)	-
TRUNC	TRUNC_REAL	REAL	DINT	-
	TRUNC_LREAL	LREAL	LINT	-
REAL_TO_***	REAL_TO_SINT	REAL	SINT	-
	REAL_TO_INT	REAL	INT	-
	REAL_TO_DINT	REAL	DINT	-
	REAL_TO_LINT	REAL	LINT	-
	REAL_TO_USINT	REAL	USINT	-
	REAL_TO_UINT	REAL	UINT	-
	REAL_TO_UDINT	REAL	UDINT	-
	REAL_TO_ULINT	REAL	ULINT	-
	REAL_TO_DWORD	REAL	DWORD	-
	REAL_TO_LREAL	REAL	LREAL	-
	REAL_TO_STRING	REAL	STRING	-
LREAL_TO_***	LREAL_TO_SINT	LREAL	SINT	-
	LREAL_TO_INT	LREAL	INT	-
	LREAL_TO_DINT	LREAL	DINT	-
	LREAL_TO_LINT	LREAL	LINT	-
	LREAL_TO_USINT	LREAL	USINT	-

Ch 6. Function and Function Block

Function Group	Function	Input data type	Output data type	Remarks
LREAL_TO_***	LREAL_TO_UINT	LREAL	UINT	-
	LREAL_TO_UDINT	LREAL	UDINT	-
	LREAL_TO_ULINT	LREAL	ULINT	-
	LREAL_TO_LWORD	LREAL	LWORD	-
	LREAL_TO_REAL	LREAL	REAL	-
	LREAL_TO_STRING	LREAL	STRING	-
SINT_TO_***	SINT_TO_INT	SINT	INT	-
	SINT_TO_DINT	SINT	DINT	-
	SINT_TO_LINT	SINT	LINT	-
	SINT_TO_USINT	SINT	USINT	-
	SINT_TO_UINT	SINT	UINT	-
	SINT_TO_UDINT	SINT	UDINT	-
	SINT_TO_ULINT	SINT	ULINT	-
	SINT_TO_BOOL	SINT	BOOL	-
	SINT_TO_BYTE	SINT	BYTE	-
	SINT_TO_WORD	SINT	WORD	-
	SINT_TO_DWORD	SINT	DWORD	-
	SINT_TO_LWORD	SINT	LWORD	-
	SINT_TO_REAL	SINT	REAL	-
	SINT_TO_LREAL	SINT	LREAL	-
	SINT_TO_STRING	SINT	STRING	-
INT_TO_***	INT_TO_SINT	INT	SINT	-
	INT_TO_DINT	INT	DINT	-
	INT_TO_LINT	INT	LINT	-
	INT_TO_USINT	INT	USINT	-
	INT_TO_UINT	INT	UINT	-
	INT_TO_UDINT	INT	UDINT	-
	INT_TO_ULINT	INT	ULINT	-
	INT_TO_BOOL	INT	BOOL	-
	INT_TO_BYTE	INT	BYTE	-
	INT_TO_WORD	INT	WORD	-
	INT_TO_DWORD	INT	DWORD	-
	INT_TO_LWORD	INT	LWORD	-
	INT_TO_REAL	INT	REAL	-
	INT_TO_LREAL	INT	LREAL	-
	INT_TO_STRING	INT	STRING	-
DINT_TO_***	DINT_TO_SINT	DINT	SINT	-
	DINT_TO_INT	DINT	INT	-
	DINT_TO_LINT	DINT	LINT	-
	DINT_TO_USINT	DINT	USINT	-
	DINT_TO_UINT	DINT	UINT	-
	DINT_TO_UDINT	DINT	UDINT	-
	DINT_TO_ULINT	DINT	ULINT	-
	DINT_TO_BOOL	DINT	BOOL	-
	DINT_TO_BYTE	DINT	BYTE	-
	DINT_TO_WORD	DINT	WORD	-

Function Group	Function	Input data type	Output data type	Remarks
DINT_TO_***	DINT_TO_DWORD	DINT	DWORD	-
	DINT_TO_LWORD	DINT	LWORD	-
	DINT_TO_REAL	DINT	REAL	-
	DINT_TO_LREAL	DINT	LREAL	-
	DINT_TO_STRING	DINT	STRING	-
LINT_TO_***	LINT_TO_SINT	LINT	SINT	-
	LINT_TO_INT	LINT	INT	-
	LINT_TO_DINT	LINT	DINT	-
	LINT_TO_USINT	LINT	USINT	-
	LINT_TO_UINT	LINT	UINT	-
	LINT_TO_UDINT	LINT	UDINT	-
	LINT_TO_ULINT	LINT	ULINT	-
	LINT_TO_BOOL	LINT	BOOL	-
	LINT_TO_BYTE	LINT	BYTE	-
	LINT_TO_WORD	LINT	WORD	-
	LINT_TO_DWORD	LINT	DWORD	-
	LINT_TO_LWORD	LINT	LWORD	-
	LINT_TO_REAL	LINT	REAL	-
	LINT_TO_LREAL	LINT	LREAL	-
	LINT_TO_STRING	LINT	STRING	-
USINT_TO_***	USINT_TO_SINT	USINT	SINT	-
	USINT_TO_INT	USINT	INT	-
	USINT_TO_DINT	USINT	DINT	-
	USINT_TO_LINT	USINT	LINT	-
	USINT_TO_UINT	USINT	UINT	-
	USINT_TO_UDINT	USINT	UDINT	-
	USINT_TO_ULINT	USINT	ULINT	-
	USINT_TO_BOOL	USINT	BOOL	-
	USINT_TO_BYTE	USINT	BYTE	-
	USINT_TO_WORD	USINT	WORD	-
	USINT_TO_DWORD	USINT	DWORD	-
	USINT_TO_LWORD	USINT	LWORD	-
	USINT_TO_REAL	USINT	REAL	-
	USINT_TO_LREAL	USINT	LREAL	-
	USINT_TO_STRING	USINT	STRING	-
UINT_TO_***	UINT_TO_SINT	UINT	SINT	-
	UINT_TO_INT	UINT	INT	-
	UINT_TO_DINT	UINT	DINT	-
	UINT_TO_LINT	UINT	LINT	-
	UINT_TO_USINT	UINT	USINT	-
	UINT_TO_UDINT	UINT	UDINT	-
	UINT_TO_ULINT	UINT	ULINT	-
	UINT_TO_BOOL	UINT	BOOL	-
	UINT_TO_BYTE	UINT	BYTE	-
	UINT_TO_WORD	UINT	WORD	-
	UINT_TO_DWORD	UINT	DWORD	-



## Ch 6. Function and Function Block

Function Group	Function	Input data type	Output data type	Remarks
UINT_TO_***	UINT_TO_LWORD	UINT	LWORD	-
	UINT_TO_REAL	UINT	REAL	-
	UINT_TO_STRING	UINT	STRING	-
	UINT_TO_LREAL	UINT	LREAL	-
	UINT_TO_DATE	UINT	DATE	-
UDINT_TO_***	UDINT_TO_SINT	UDINT	SINT	-
	UDINT_TO_INT	UDINT	INT	-
	UDINT_TO_DINT	UDINT	DINT	-
	UDINT_TO_LINT	UDINT	LINT	-
	UDINT_TO_USINT	UDINT	USINT	-
	UDINT_TO_UINT	UDINT	UINT	-
	UDINT_TO_ULINT	UDINT	ULINT	-
	UDINT_TO_BOOL	UDINT	BOOL	-
	UDINT_TO_BYTE	UDINT	BYTE	-
	UDINT_TO_WORD	UDINT	WORD	-
	UDINT_TO_DWORD	UDINT	DWORD	-
	UDINT_TO_LWORD	UDINT	LWORD	-
	UDINT_TO_REAL	UDINT	REAL	-
	UDINT_TO_LREAL	UDINT	LREAL	-
	UDINT_TO_TOD	UDINT	TOD	-
	UDINT_TO_TIME	UDINT	TIME	-
	UDINT_TO_STRING	UDINT	STRING	-
ULINT_TO_***	ULINT_TO_SINT	ULINT	SINT	-
	ULINT_TO_INT	ULINT	INT	-
	ULINT_TO_DINT	ULINT	DINT	-
	ULINT_TO_LINT	ULINT	LINT	-
	ULINT_TO_USINT	ULINT	USINT	-
	ULINT_TO_UINT	ULINT	UINT	-
	ULINT_TO_UDINT	ULINT	UDINT	-
	ULINT_TO_BOOL	ULINT	BOOL	-
	ULINT_TO_BYTE	ULINT	BYTE	-
	ULINT_TO_WORD	ULINT	WORD	-
	ULINT_TO_DWORD	ULINT	DWORD	-
	ULINT_TO_LWORD	ULINT	LWORD	-
	ULINT_TO_REAL	ULINT	REAL	-
	ULINT_TO_LREAL	ULINT	LREAL	-
	ULINT_TO_STRING	ULINT	STRING	-
BOOL_TO_***	BOOL_TO_SINT	BOOL	SINT	-
	BOOL_TO_INT	BOOL	INT	-
	BOOL_TO_DINT	BOOL	DINT	-
	BOOL_TO_LINT	BOOL	LINT	-
	BOOL_TO_USINT	BOOL	USINT	-
	BOOL_TO_UINT	BOOL	UINT	-
	BOOL_TO_UDINT	BOOL	UDINT	-
	BOOL_TO_ULINT	BOOL	ULINT	-
	BOOL_TO_BYTE	BOOL	BYTE	-

Function Group	Function	Input data type	Output data type	Remarks
BOOL_TO_***	BOOL_TO_WORD	BOOL	WORD	-
	BOOL_TO_DWORD	BOOL	DWORD	-
	BOOL_TO_LWORD	BOOL	LWORD	-
	BOOL_TO_STRING	BOOL	STRING	-
BYTE_TO_***	BYTE_TO_SINT	BYTE	SINT	-
	BYTE_TO_INT	BYTE	INT	-
	BYTE_TO_DINT	BYTE	DINT	-
	BYTE_TO_LINT	BYTE	LINT	-
	BYTE_TO_USINT	BYTE	USINT	-
	BYTE_TO_UINT	BYTE	UINT	-
	BYTE_TO_UDINT	BYTE	UDINT	-
	BYTE_TO_ULINT	BYTE	ULINT	-
	BYTE_TO_BOOL	BYTE	BOOL	-
	BYTE_TO_WORD	BYTE	WORD	-
	BYTE_TO_DWORD	BYTE	DWORD	-
	BYTE_TO_LWORD	BYTE	LWORD	-
	BYTE_TO_STRING	BYTE	STRING	-
WORD_TO_***	WORD_TO_SINT	WORD	SINT	-
	WORD_TO_INT	WORD	INT	-
	WORD_TO_DINT	WORD	DINT	-
	WORD_TO_LINT	WORD	LINT	-
	WORD_TO_USINT	WORD	USINT	-
	WORD_TO_UINT	WORD	UINT	-
	WORD_TO_UDINT	WORD	UDINT	-
	WORD_TO_ULINT	WORD	ULINT	-
	WORD_TO_BOOL	WORD	BOOL	-
	WORD_TO_BYTE	WORD	BYTE	-
	WORD_TO_DWORD	WORD	DWORD	-
	WORD_TO_LWORD	WORD	LWORD	-
	WORD_TO_DATE	WORD	DATE	-
	WORD_TO_STRING	WORD	STRING	-
DWORD_TO_***	DWORD_TO_SINT	DWORD	SINT	-
	DWORD_TO_INT	DWORD	INT	-
	DWORD_TO_DINT	DWORD	DINT	-
	DWORD_TO_LINT	DWORD	LINT	-
	DWORD_TO_USINT	DWORD	USINT	-
	DWORD_TO_UINT	DWORD	UINT	-
	DWORD_TO_UDINT	DWORD	UDINT	-
	DWORD_TO_ULINT	DWORD	ULINT	-
	DWORD_TO_BOOL	DWORD	BOOL	-
	DWORD_TO_BYTE	DWORD	BYTE	-
	DWORD_TO_WORD	DWORD	WORD	-
	DWORD_TO_LWORD	DWORD	LWORD	-
	DWORD_TO_REAL	DWORD	REAL	-
	DWORD_TO_TIME	DWORD	TIME	-
	DWORD_TO_TOD	DWORD	TOD	-

## Ch 6. Function and Function Block

Function Group	Function	Input data type	Output data type	Remarks
DWORD_TO_***	DWORD_TO_STRING	DWORD	STRING	-
LWORD_TO_***	LWORD_TO_SINT	LWORD	SINT	-
	LWORD_TO_INT	LWORD	INT	-
	LWORD_TO_DINT	LWORD	DINT	-
	LWORD_TO_LINT	LWORD	LINT	-
	LWORD_TO_USINT	LWORD	USINT	-
	LWORD_TO_UINT	LWORD	UINT	-
	LWORD_TO_UDINT	LWORD	UDINT	-
	LWORD_TO_ULINT	LWORD	ULINT	-
	LWORD_TO_BOOL	LWORD	BOOL	-
	LWORD_TO_BYTE	LWORD	BYTE	-
	LWORD_TO_WORD	LWORD	WORD	-
	LWORD_TO_DWORD	LWORD	DWORD	-
	LWORD_TO_LREAL	LWORD	LREAL	-
	LWORD_TO_DT	LWORD	DT	-
	LWORD_TO_STRING	LWORD	STRING	-
STRING_TO_***	STRING_TO_SINT	STRING	SINT	-
	STRING_TO_INT	STRING	INT	-
	STRING_TO_DINT	STRING	DINT	-
	STRING_TO_LINT	STRING	LINT	-
	STRING_TO_USINT	STRING	USINT	-
	STRING_TO_UINT	STRING	UINT	-
	STRING_TO_UDINT	STRING	UDINT	-
	STRING_TO_ULINT	STRING	ULINT	-
	STRING_TO_BOOL	STRING	BOOL	-
	STRING_TO_BYTE	STRING	BYTE	-
	STRING_TO_WORD	STRING	WORD	-
	STRING_TO_DWORD	STRING	DWORD	-
	STRING_TO_LWORD	STRING	LWORD	-
	STRING_TO_REAL	STRING	REAL	-
	STRING_TO_LREAL	STRING	LREAL	-
	STRING_TO_DT	STRING	DT	-
	STRING_TO_DATE	STRING	DATE	-
	STRING_TO_TOD	STRING	TOD	-
	STRING_TO_TIME	STRING	TIME	-
TIME_TO_***	TIME_TO_UDINT	TIME	UDINT	-
	TIME_TO_DWORD	TIME	DWORD	-
	TIME_TO_STRING	TIME	STRING	-
DATE_TO_***	DATE_TO_UINT	DATE	UINT	-
	DATE_TO_WORD	DATE	WORD	-
	DATE_TO_STRING	DATE	STRING	-
TOD_TO_***	TOD_TO_UDINT	TOD	UDINT	-
	TOD_TO_DWORD	TOD	DWORD	-
	TOD_TO_STRING	TOD	STRING	-

Function Group	Function	Input data type	Output data type	Remarks
DT_TO_***	DT_TO_LWORD	DT	LWORD	-
	DT_TO_DATE	DT	DATE	-
	DT_TO_TOD	DT	TOD	-
	DT_TO_STRING	DT	STRING	-
***_TO_BCD	SINT_TO_BCD_BYTE	SINT	BYTE (BCD)	-
	INT_TO_BCD_WORD	INT	WORD (BCD)	-
	DINT_TO_BCD_DWORD	DINT	DWORD (BCD)	-
	LINT_TO_BCD_LWORD	LINT	LWORD (BCD)	-
	USINT_TO_BCD_BYTE	USINT	BYTE (BCD)	-
	UINT_TO_BCD_WORD	UINT	WORD (BCD)	-
	UDINT_TO_BCD_DWORD	UDINT	DWORD (BCD)	-
	ULINT_TO_BCD_LWORD	ULINT	LWORD (BCD)	-

6.1.2 Numerical operation function

1) Numerical operation function with one Input

No.	Function	Function	Remarks
General Function			
1	ABS	Absolute value operation	-
2	SQRT	Square root operation	-
Logarithm			
3	LN	Natural logarithm operation	-
4	LOG	Common logarithm Base to 10 operation	-
5	EXP	Natural exponential operation	-
Trigonometric function			
6	SIN	Sine operation	-
7	COS	Cosine operation	-
8	TAN	Tangent operation	-
9	ASIN	Arc sine operation	-
10	ACOS	Arc Cosine operation	-
11	ATAN	Arc Tangent operation	-
Angle function			
12	RAD_REAL	Convert degree into radian	-
13	RAD_LREAL		
14	DEG_REAL	Convert radian into degree	-
15	DEG_LREAL		

2) Basic arithmetic function

No.	Function	Description	Remarks
Operation function whose input number (n) can be extended up to 8.			
1	ADD	Addition (OUT <= IN1 + IN2 + ... + INn)	-
2	MUL	Multiplication (OUT <= IN1 * IN2 * ... * INn)	-
Operation function of which input number is fixed.			

3	SUB	Subtraction (OUT <= IN1 - IN2)	-
4	DIV	Division (OUT <= IN1 / IN2)	-
5	MOD	Calculate remainder (OUT <= IN1 Modulo IN2)	-
6	EXPT	Exponential operation (OUT <= IN1 <sup>IN2</sup> )	-
7	MOVE	Copy data (OUT <= IN)	-
Input data exchange			
8	XCHG_***	Exchanges two input data	-

6.1.3 Bit array function

1) Bit-shift function

No.	Function	Description	Remarks
1	SHL	Shift input to the left of N bit(the right is filled with 0)	-
2	SHR	Shift input to the right of N bit (the left is filled with 0)	-
3	SHIFT_C_***	Shift input to the configured direction as much as N bit (carry)	-
4	ROL	Rotate input to the left of N bit	-
5	ROR	Rotate input to the right of N bit	-
6	ROTATE_C_***	Rotate input to the direction as much as N bit (carry)	-

2) Bit operation function

No.	Function	Description (n can be extended up to 8)	Remarks
1	AND	Logical AND (OUT <= IN1 AND IN2 AND ... AND INn)	-
2	OR	Logical OR (OUT <= IN1 OR IN2 OR ... OR INn)	-
3	XOR	Exclusive OR (OUT <= IN1 XOR IN2 XOR ... XOR INn)	-
4	NOT	Reverse logic (OUT <= NOT IN1)	-
5	XNR	Exclusive logic AND (OUT <= IN1 XNR IN2 XNR ... XNR INn)	-

### 6.1.4 Selection function

No.	Function	Description(n can be extended up to 8)	Remarks
1	SEL	Selects from two inputs (IN0 or IN1)	-
2	MAX	Produces the maximum value among input IN1,...INn	-
3	MIN	Produces the minimum value among input IN1,...INn	-
4	LIMIT	Limits upper and lower boundaries	-
5	MUX	Outputs the Kth input among input IN1,...INn	-

### 6.1.5 Data exchange function

No.	Function	Description	Remarks
1	SWAP_BYTE	Swaps upper NIBBLE for lower NIBBLE data of BYTE.	-
	SWAP_WORD	Swaps upper BYTE for lower BYTE data of WORD.	-
	SWAP_DWORD	Swaps upper WORD for lower WORD data DWORD.	-
	SWAP_LWORD	Swaps upper DWORD for lower DWORD data of LWORD.	-
2	ARY_SWAP_BYTE	Swaps upper/lower NIBBLE of BYTE elements in array.	-
	ARY_SWAP_WORD	Swaps upper/lower BYTE of WORD elements in array.	-
	ARY_SWAP_DWORD	Swaps upper/lower WORD of DWORD elements in array.	-
	ARY_SWAP_LWORD	Swaps upper/lower DWORD of LWORD elements in array.	-

### 6.1.6 Comparison function

No.	Function	Description (n can be extended up to 8)	Remarks
1	GT	'Greater than' comparison OUT <= (IN1>IN2) & (IN2>IN3) & ... & (INn-1 > INn)	-
2	GE	'Greater than or equal to' comparison OUT <= (IN1>=IN2) & (IN2>=IN3) & ... & (INn-1 >= INn)	-
3	EQ	'Equal to' comparison OUT <= (IN1=IN2) & (IN2=IN3) & ... & (INn-1 = INn)	-
4	LE	'Less than or equal to' comparison OUT <= (IN1<=IN2) & (IN2<=IN3) & ... & (INn-1 <= INn)	-
5	LT	'Less than' comparison OUT <= (IN1<IN2) & (IN2<IN3) & ... & (INn-1 < INn)	-
6	NE	'Not equal to' comparison OUT <= (IN1<>IN2) & (IN2<>IN3) & ... & (INn-1 <> INn)	-

## Ch 6. Function and Function Block

### 6.1.7 Character string function

No.	Function	Description	Remarks
1	LEN	Find a length of a character string	-
2	LEFT	Take a left side of a string (size of L) and output it	-
3	RIGHT	Take a right side of a string (size of L) and output it	-
4	MID	Take a middle side of a string (size of L from the Pth character)	-
5	CONCAT	Concatenate the input character string in order	-
6	INSERT	Insert the second string after the Pth character of the first string	-
7	DELETE	Delete a string (size of L from the Pth character)	-
8	REPLACE	Replace a size of L from the Pth character of the first string by the second string	-
9	FIND	Find a starting point of the first string which has a same pattern of the second string.	-

### 6.1.8 Date and time of day function

No.	Function	Description	Remarks
1	ADD_TIME	Add time (time/time of day/date and time addition)	-
2	SUB_TIME	Subtract time (time/time of day/date and time subtraction)	-
	SUB_DATE	Calculate time by subtracting date from date	-
	SUB_TOD	Calculate time by subtracting TOD from TOD	-
	SUB_DT	Calculate time by subtracting DT from DT	-
3	MUL_TIME	Multiply number to time	-
4	DIV_TIME	Divide time by number	-
5	CONCAT_TIME	Concatenate date to make TOD	-

### 6.1.9 System control function

No.	Function	Description	Remarks
1	DI	Invalidates interrupt (not to permit task program to start)	-
2	EI	Permits running for a task program	-
3	STOP	Stop running by a task program	-
4	ESTOP	Emergency running stop by a program	-
5	DIREC_IN	Update input data	-
6	DIREC_O	Updates output data	-
7	WDT_RST	Initialize a timer of watchdog	-

No.	Function	Description	Remarks
8	MCS	Master Control	-
9	MCSCLR	Master Control Clear	-
10	FALS	Self check(error display)	-
11	OUTOFF	Output off	-

6.1.10 File function

No.	Function	Description	Remarks
1	RSET	Setting file register block number	-
2	EBCMP	Block comparison	-
3	EMOV	Reading data from the preset flash area	-
4	EERRST	Flash memory related error flag clear	-

6.1.11 Data manipulation function

No.	Function	Description	Remarks
1	MEQ_***	Compare whether two inputs are equal after masking	-
2	DIS_***	Data distribution	-
3	UNI_***	Unite data	-
4	BIT_BYTE	Combine 8 bits into one BYTE	-
5	BYTE_BIT	Divide one BYTE into 8 bits	-
6	BYTE_WORD	Combine two bytes into one WORD	-
7	WORD_BYTE	Divide one WORD into two bytes	-
8	WORD_DWORD	Combine two WORD data into DWORD	-
9	DWORD_WORD	Divide DWORD into 2 WORD data	-
10	DWORD_LWORD	Combine two DWORD data into LWORD	-
11	LWORD_DWORD	Divide LWORD into two DWORD data	-
12	GET_CHAR	Get one character from a character string	-
13	PUT_CHAR	Puts a character in a string	-
14	STRING_BYTE	Convert a string into a byte array	-
15	BYTE_STRING	Convert a byte array into a string	-

6.1.12 Stack operation function

No.	Function	Description	Remarks
1	FIFO_***	First In First Out	-
2	LIFO_***	Last In First Out	-



6.2 MK (MASTER-K) function

No.	Function	Description(n can be extended up to 8)	Remarks
1	ENCO_B,W,D,L	Output a position of on bit by number	-
2	DECO_B,W,D,L	Turn a selected bit on	-
3	BSUM_B,W,D,L	Output a number of on bit	-
4	SEG_WORD	Convert BCD/HEX into 7-segment code	-
5	BMOV_B,W,D,L	Move part of a bit string	-
6	INC_B,W,D,L	Increase IN data	-
7	DEC_B,W,D,L	Decrease IN data	-

6.3 Array operation function

No.	Function	Description	Remarks
1	ARY_MOVE	Copy array-typed data (OUT <= IN)	-
2	ARY_CMP_***	Array comparison	-
3	ARY_SCH_***	Array search	-
4	ARY_FLL_***	Filling an array with data	-
5	ARY_AVE_***	Find an average of an array	-
6	ARY_SFT_C_***	Array bit shift left with carry	-
7	ARY_ROT_C_***	Bit rotation of array with carry	-
8	SHIFT_A_***	Shift array elements	-
9	ROTATE_A_***	Rotates array elements	-

6.4 Basic function block

6.4.1 Bistable function block

No.	Function Block	Description	Remarks
1	SR	Set preference bistable	-
2	RS	Reset preference bistable	-
3	SEMA	Semaphore	-

6.4.2 Edge detection function block

No.	Function Block	Description	Remarks
1	R_TRIG	Rising edge detector	-
2	F_TRIG	Falling edge detector	-
3	FF	Reverse output if input condition rises	-

6.4.3 Counter

No.	Function Block	Description	Remarks
1	CTU_***	Up Counter INT,DINT,LINT,UINT,UDINT,ULINT	-
2	CTD_***	Down Counter INT,DINT,LINT,UINT,UDINT,ULINT	-
3	CTUD_***	Up Down Counter INT,DINT,LINT,UINT,UDINT,ULINT	-
4	CTR	Ring Counter	-

6.4.4 Timer

No.	Function Block	Description	Remarks
1	TP	Pulse Timer	-
2	TON	On-Delay Timer	-
3	TOF	Off-Delay Timer	-
4	TMR	Integrating Timer	-
5	TP_RST	TP with reset	-
6	TRTG	Retriggerable Timer	-
7	TOF_RST	TOF with reset	-
8	TON_UINT	TON with integer setting	-
9	TOF_UINT	TOF with integer setting	-
10	TP_UINT	TP with integer setting	-
11	TMR_UINT	TMR with integer setting	-
12	TMR_FLK	Blink timer	-
13	TRTG_UINT	Integer setting retriggerable timer	-

6.4.5 File function block

No.	Function Block	Description	Remarks
1	EBREAD	Read R area data from flash area	-
1	EBWRITE	Write R area data to flash area	-

6.4.6 Other function block

No.	Function Block	Description	Remarks
1	SCON	Step Controller	-
2	DUTY	Scan setting on/off	-
3	RTC_SET	Write time data	-

6.4.7 Communication function block

No.	Function Block	Description	Remarks
1	P2PSN	Station no. setting	-
2	P2PRD	Read area setting	-
3	P2PWR	Write area setting	-
4	SEND_UDATA	User defined data send	-
5	RCV_UDATA	User defined data receive	-
6	SEND_DTR	Communication ready signal send	-
7	SEND_RTS	State signal of receive buffer send	-

6.4.8 Special function block

No.	Function Block	Description	Remarks
1	GET	Read special module data	-
2	PUT	Write special module data	-
3	ARY_GET	Read special module data(array)	-
4	ARY_PUT	Write special module data(array)	-
5	GETE	Read special module data(Access upper word)	-
6	PUTE	Write special module data(Access upper word)	-
7	ARY_GETE	Read special module data(array, Access upper word)	-
8	ARY_PUT	Write special module data(array, Access upper word)	-

6.4.9 Motion control function block

No.	Function Block	Description	Remarks
1	GETM	Read motion control module data	-
2	PUTM	Write motion control module data	-
3	ARY_GETM	Read motion control module data(array)	-
4	ARY_PUTM	Write motion control module data(array)	-

6.4.10 Positioning function block (APM)

No.	Function Block	Description	Remarks
1	APM_ORG	Return to original point	-
2	APM_FLT	Floating original point setting	-
3	APM_DST	Direct run	-
4	APM_IST	Indirect run	-
5	APM_LIN	Linear interpolation run	-
6	APM_CIN	Circular interpolation run	-
7	APM_SST	Simultaneous run	-
8	APM_VTP	Speed/position control conversion	-
9	APM_PTV	Position/speed control conversion	-
10	APM_STP	Decelerating stop	-
11	APM_SKP	Skip run	-
12	APM_SSP	Position synchronization	-
13	APM_SSS	Speed synchronization	-
14	APM_SSSP	Positioning speed synchronization	-
15	APM_POR	Position override	-
16	APM_SOR	Speed override	-
17	APM_PSO	Positioning speed override	-
18	APM_NMV	Continuous run	-
19	APM_INC	Inching run	-
20	APM_RTP	Return run to the previous position of manual operation	-
21	APM_SNS	Run step no. change	-
22	APM_SRS	Repeat step no. change	-
23	APM_MOF	M code cancel	-
24	APM_PRS	Present position preset	-

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No.	Function Block	Description	Remarks
25	APM_ZONE	Zone output allowed/prohibited	-
26	APM_EPRES	Encoder value preset	-
27	APM_TEA	Singular teaching(ROM, RAM)	-
28	APM_ATEA	Plural teaching(ROM, RAM)	-
29	APM_SBP	Basic parameter setting	-
30	APM_SEP	Extension parameter setting	-
31	APM_SHP	Original point return parameter setting	-
32	APM_SMP	Manual operation parameter setting	-
33	APM_SIP	Input signal parameter setting	-
34	APM_SCP	Common parameter setting	-
35	APM_SMD	Operation data setting	-
36	APM_EMG	Emergency stop	-
37	APM_RST	Error reset/output prohibition cancel	-
38	APM_PST	Point run	-
39	APM_WRT	Saving parameter/run data	-
40	APM_CRD	Reading run info	-
41	APM_SRD	Reading run info	-
42	APM_ENCRD	Reading encoder value	-
43	APM_JOG	Jog run	-
44	APM_MPG	Manual pulse generator(MPG) run	-
45	APM_RCP	Repeating current position section	
46	APM_VRD	Read Variable Data	-
47	APM_VWR	Write Variable Data	-
48	APM_VTPP	Positioning speed/position conversion control	-

### 6.4.11 Positioning function block (XPM)

No.	Function Block	Description	Remarks
1	XPM_ORG	Return to original point	-
2	XPM_FLT	Floating original point setting	-
3	XPM_DST	Direct run	-
4	XPM_IST	Indirect run	-
5	XPM_SST	Simultaneous run	-
6	XPM_VTP	Speed/position control conversion	-
7	XPM_VTPP	Position specified speed/position control conversion	

No.	Function Block	Description	Remarks
8	XPM_PTV	Position/speed control conversion	-
9	XPM_PTT	Position/torque control conversion	XGF-PN8A/B
10	XPM_STP	Decelerating stop	-
11	XPM_SKP	Skip run	-
12	XPM_SSP	Position synchronization	-
13	XPM_SSS	Speed synchronization	-
14	XPM_SSSP	Position specified speed synchronization	
15	XPM_POR	Position override	-
16	XPM_SOR	Speed override	-
B 17	XPM_PSO	Positioning speed override	-
18	XPM_NMV	Continuous run	-
19	XPM_INC	Inching run	-
20	XPM_RTP	Return run to the previous position of manual operation	-
21	XPM_SNS	Run step no. change	-
22	XPM_SRS	Repeat step no. change	-
23	XPM_MOF	M code cancel	-
24	XPM_PRS	Present position preset	-
25	XPM_EPRES	Encoder value preset	-
26	XPM_ATEA	Plural teaching(ROM, RAM)	-
27	XPM_SBP	Basic parameter setting	-
28	XPM_SEP	Extension parameter setting	-
29	XPM_SHP	Original point return parameter setting	XPM
30	XPM_SMP	Manual operation parameter setting	-
31	XPM_SIP	Input signal parameter setting	XPM
32	XPM_SCP	Common parameter setting	-
33	XPM_SMD	Operation data setting	-
34	XPM_EMG	Emergency stop	-
35	XPM_RST	Error reset/output prohibition cancel	-
36	XPM_HRST	Error history reset	
37	XPM_PST	Point run	-
38	XPM_WRT	Saving parameter/run data	-
39	XPM_CRD	Reading operation information	-
40	XPM_SRD	Reading operation state	-
41	XPM_ENCRD	Reading encoder value	-

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No.	Function Block	Description	Remarks
42	XPM_SVERD	Reading servo error information	XGF-PN8A/B
43	XPM_JOG	Jog run	-
44	XPM_CAM	CAM run	-
45	XPM_CAMD	Main axis option de specified CAM run	-
46	XPM_ELIN	Ellipse interpolation	-
47	XPM_VRD	Read variable data	-
48	XPM_VWR	Write variable data	-
49	XPM_ECON	Connect servo communication	XGF-PN8A/B
50	XPM_DCON	Disconnect servo communication	XGF-PN8A/B
51	XPM_SVON	Servo on	XGF-PN8A/B
52	XPM_SVOFF	Servo off	XGF-PN8A/B
53	XPM_SRST	Reset servo error	XGF-PN8A/B
54	XPM_SHRST	Reset servo error history	XGF-PN8A/B
55	XPM_RSTR	Restart	-
56	XPM_POE	Setting position output allowed / prohibited	XPM
57	XPM_TRQ	Torque control	XGF-PN8A/B
58	XPM_SVIRD	Servo external input information read	XGF-PN8B
59	XPM_SVPRD	Servo parameter read	XGF-PN8B
60	XPM_SVPWR	Servo parameter write	XGF-PN8B
61	XPM_SVSAVE	Servo parameter save	XGF-PN8B
62	XPM_PTT	Position/torque switching control	XGF-PN8A/B
63	XPM_LRD	Latch position data read	XGF-PN8A/B
64	XPM_LCLR	Latch reset	XGF-PN8A/B
65	XPM_LSET	Latch set	XGF-PN8B
66	XPM_STC	Torque synchronization	XGF-PN8A/B

### 6.5 Expanded function

No.	Function Block	Description	Remarks
1	FOR	Repeat a block of FOR ~ NEXT n times	-
2	NEXT		-
3	BREAK	Escape a block of FOR ~ NEXT	-
4	CALL	Call a SBRT routine	-
5	SBRT	Assign a routine to be called by the CALL function	-

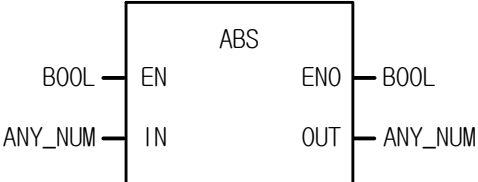
No.	Function Block	Description	Remarks
6	RET	RETURN	-
7	JMP	Jump to a place of LABEL	-
8	INIT_DONE	Terminate an initial task	-
9	END	Terminate a program	-



## Ch. 7 Basic Functions

1. This chapter describes basic functions.
2. Before using basic functions it is recommended to understand 3.4.1 Function and to apply to function library on a program for easy writing a program.

<b>ABS</b>	<b>Absolute value operation</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: input value of absolute value operation</p> <p><b>Output</b> ENO: 1 OUT: absolute value IN, OUT should be the same data type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN						○	○	○	○	○	○	○	○	○	○					
	OUT						○	○	○	○	○	○	○	○	○	○					

### ■ Function

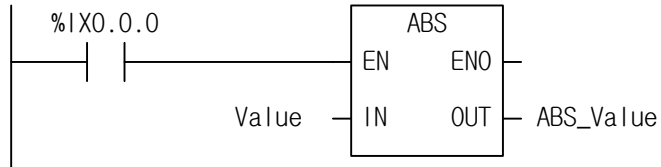
- (1) Output the absolute value of IN as 'OUT'.  
OUT = | IN |
- (2) X's absolute value, | X | ;
  - A. If  $X \geq 0$ ,  $|X| = X$ ,
  - B. If  $X < 0$ ,  $|X| = -X$ .

### ■ Flag

Flag	Description
_ERR	If IN value is (-)min value, _ERR and _LER flags are set. ex) if data type is SINT and IN and value is -128, an error is activated.

### ■ Program Example

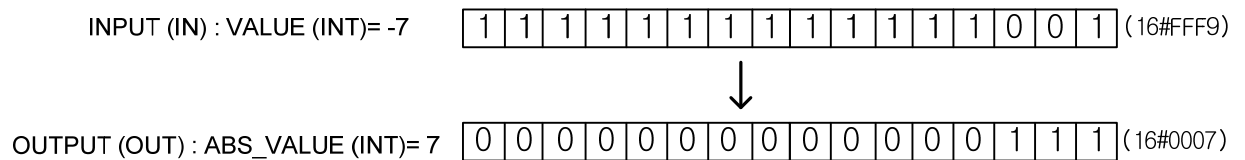
#### 1. LD



#### 2. ST

ABS\_Value := ABS(EN:=%IX0.0.0, IN:=Value);

- (1) If the transition condition (%IX0.0.0) is on, ABS function executes.
- (2) If VALUE = -7, ABS\_VALUE =  $|-7| = 7$ .  
If VALUE = 200, ABS\_VALUE =  $|200| = 200$ .
- (3) The negative number of INT type is represented as the 2's compliment form (refer to 3.2.4. Data type structure)



<b>ACOS</b>	<b>Arc Cosine operation</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: input value of Arc Cosine operation</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: Arc Cosine (radian) IN, OUT must be the same data type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN														○	○					
	OUT														○	○					

### ■ Function

It converts input IN into its Arc Cosine value and produces output OUT. The output range is between 0 and  $\pi$ .

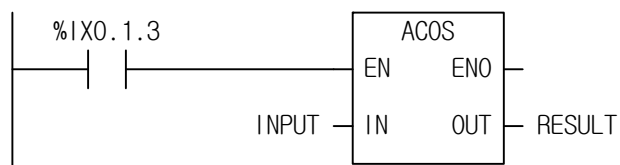
$$\text{OUT} = \text{ACOS}(\text{IN})$$

### ■ Flag

Flag	Description
_ERR	Unless an IN value is between -1.0 and 1.0, _ERR, _LER flags are set.

## ■ Program Example

## 1) LD



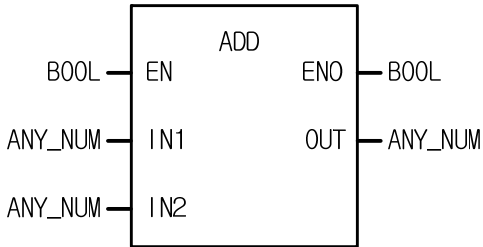
## 2) ST

```
RESULT := ACOS(EN:=%IX0.1.3, IN:=INPUT);
```

(1) If the transition condition (%IX0.1.3) is on, Arc Cosine operation function, ACOS executes

(2) If INPUT is  $0.8660... (\sqrt{3} / 2)$ , RESULT will be  $0.5235... (\pi/6 \text{ rad} = 30^\circ)$ .

<b>ADD</b>	<b>Addition</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1  IN1: value to be add  IN2: value to add  Input variable number can be extended up to 8</p> <p><b>Output</b> ENO: without an error, it is 1  OUT: added value</p> <p>IN1, IN2, ..., OUT must be the same data type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN1						○	○	○	○	○	○	○	○	○	○					
	IN2						○	○	○	○	○	○	○	○	○	○					
	OUT						○	○	○	○	○	○	○	○	○	○					

### ■ Function

- It adds input variables up (IN1, IN2, ..., and INn, n: number of inputs) and produces output ,OUT.  

$$OUT = IN1 + IN2 + \dots + INn$$

### ■ Flag

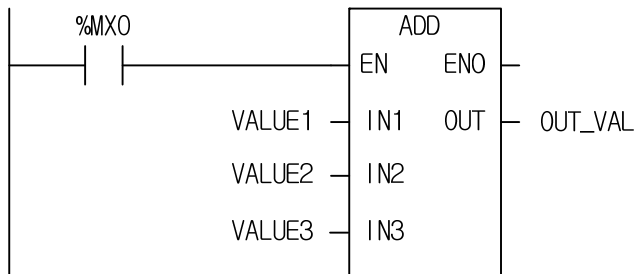
Flag	Description
_ERR	When the output value is out of its data type, _ERR, _LER flags are set.

☆ If REAL (or LREAL) type operation exceeds the max. or min. value of REAL (or LREAL) in the middle of operation because it performs operation sequentially from IN1 to IN8, \_ERR, \_LER flag are set and the result is unlimited or abnormal value.

(1.#INF000000000000e+000, 1.#SNAN000000000000e+000, 1.#QNAN000000000000e+000).

## ■ Program Example

### 1) LD



### 2) ST

OUT\_VAL := ADD(EN:=%MX0, IN1:= VALUE1, IN2:= VALUE2, IN3:= VALUE3);

- (1) If the transition condition (%MX0) is on, ADD function executes
- (2) If input variable VALUE1 = 300, VALUE2 = 200, and VALUE3 = 100, output variable OUT\_VAL = 300 + 200 + 100 = 600

INPUT (IN1) : VALUE1 (INT) = 300(16#012C)	0 0 0 0 0 0 0 1 0 0 1 0 1 1 0 0
	+(ADD)
(IN2) : VALUE2(INT) = 200(16#00C8)	0 0 0 0 0 0 0 0 0 1 1 0 0 1 0 0 0
	+(ADD)
(IN3) : VALUE3(INT) = 100(16#0064)	0 0 0 0 0 0 0 0 0 0 1 1 0 0 1 0 0
	↓
(OUT): OUT_VAL(INT) = 600(16#0258)	0 0 0 0 0 0 1 0 0 0 1 0 1 1 0 0 0

<b>ADD_TIME</b>	<b>Time addition</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN1: reference time, time of date IN2: time to add</p> <p><b>Output</b> ENO: without an error, it is 1 OUT: added result of TOD or time</p> <p>IN1, IN2, and OUT must be of the same data type: If IN1 type is TIME_OF_DAY, OUT type is also TIME_OF_DAY.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN1																○		○	○	
	OUT																○		○	○	

### ■ Function

- 1) If IN1 is TIME, added TIME is an output.
- 2) IN1 is TIME\_OF\_DAY, it adds TIME to reference TIME\_OF\_DAY and produces output TIME\_OF\_DAY.
- 3) If IN1 is DATE\_AND\_TIME, the output data type is DT (Date and Time of Day) adding the time to the standard date and time of day.

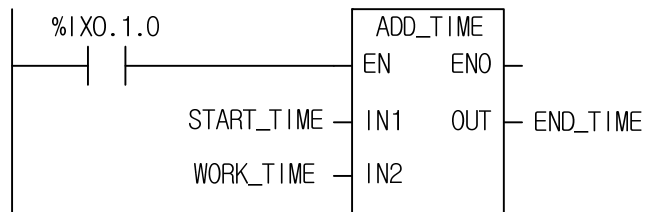
### ■ Flag

Flag	Description
_ERR	<p>If an output value is out of range of related data type, _ERR, _LER flag are set. An error occurs:</p> <ol style="list-style-type: none"> <li>1) When the result of adding the time and the time is out of range of TIME data type : T#49D17H2M47S295MS</li> <li>2) The result of adding TOD (Time of Day) and the time exceeds 24h;</li> <li>3) The result of adding the date and DT (Date and the Time of Day) exceeds the year, 2163.</li> </ol>



## ■ Program Example

### 1) LD



### 2) ST

```
END_TIME := ADD_TIME(EN:= %IX0.1.0, IN1:= START_TIME, IN2:= WORK_TIME);
```

- (1) If the transition condition (%IX0.1.0) is on, ADD\_TIME function is executes.
- (2) If START\_TIME is TOD#08:30:00 and WORK\_TIME is T#2H10M20S500MS, END\_TIME is TOD#10:40:20.5.

INPUT (IN1) : START\_TIME (TOD) = TOD#08:30:00

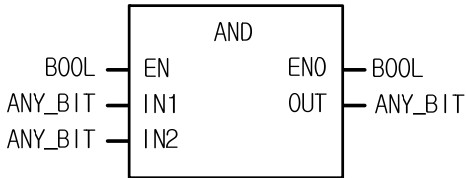
+ (ADD\_TIME)

(IN2) : WORK\_TIME(TIME) = T#2H10M20S500MS



OUTPUT (OUT) : END\_TIME (TOD) = TOD#10:40:20.5

<b>AND</b>	<b>Logical AND (Logical multiplication)</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1  IN1: input 1  IN2: input 2  Input variables can be extended up to 8.</p> <p><b>Output</b> ENO: outputs EN value as it is  OUT: AND result</p> <p>IN1, IN2, and OUT must be of the same data type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN1	○	○	○	○	○															
	IN2	○	○	○	○	○															
	OUT	○	○	○	○	○															

### ■ Function

It performs a logical AND operation on the input variables by bit and produces output ,OUT.

IN1    1111 ..... 0000

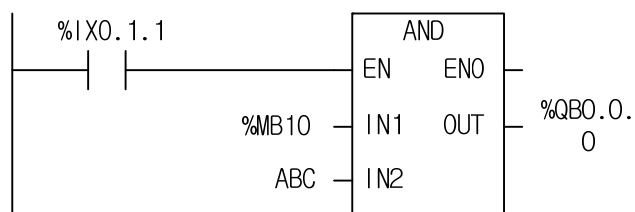
&

IN2    1010 ..... 1010

OUT    1010 ..... 0000

## ■ Program Example

### 1. LD



### 2. ST

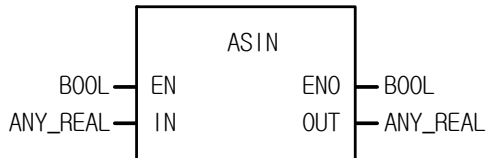
ST doesn't support AND.

In case of AND2\_BYTE

```
%QB0.0.0 := AND2_BYTE(EN:=%IX0.1.1, IN1:= %MB10, IN2:= ABC);
```

- (1) If the transition condition (%IX0.1.1) is on, the AND function executes.
- (2) If IN1 = %MB10 and IN2 = ABC, the result of AND is shown in OUT (%QB0.0.0).

<b>ASIN</b>	<b>Arc Sine operation</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: input value of Arc Sine operation</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: radian output value after Arc Sine operation</p> <p>IN and OUT must be of the same data type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN														○	○					
	OUT														○	○					

### ■ Function

It produces an output (Arc Sine value) of IN. The output value is between  $-\pi/2$  and  $\pi/2$ .

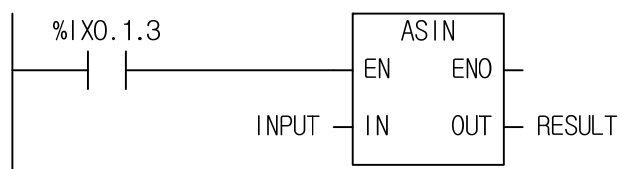
OUT = ASIN (IN)

### ■ Error

Flag	Description
_ERR	If an input value exceeds the range from -1.0 to 1.0, _ERR and _LER flags are set.

## ■ Program Example

## 1. LD



## 2. ST

```
RESULT := ASIN(EN:=%IX0.1.3, IN1:= INPUT);
```

(1) If the transition condition (%IX0.1.3) is on, ASIN function executes.

(2) If INPUT variable is 0.8660.... ( $\sqrt{3}/2$ ), the RESULT will be 1.0471.... ( $\pi/3$  radian =  $60^\circ$ ).

ATAN	Arc Tangent operation	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: Input value of Arc Tangent operation</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: radian output value after Arc Tangent operation</p> <p>IN, OUT must be of the same data type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN														○	○					
	OUT														○	○					

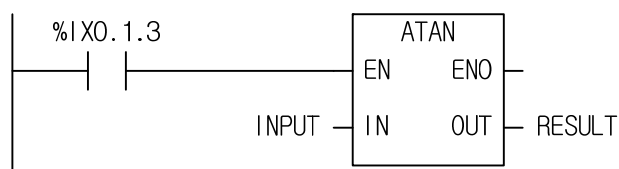
### ■ Function

It produces an output (Arc Tangent value) of IN value. The output value is between  $-\pi/2$  and  $\pi/2$ .

$$\text{OUT} = \text{ATAN}(\text{IN})$$

### ■ Program Example

#### 1. LD



#### 2. ST

```
RESULT := ATAN(EN:=%IX0.1.3, IN1:= INPUT);
```

- (1) If the transition condition (%IX0.1.3) is on, ATAN function executes.
- (2) If INPUT = 1.0, then output RESULT will be 0.7853... (  $\pi/4$  rad =  $45^\circ$  ).

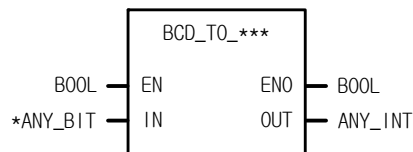
**BCD\_TO\_\*\*\*****Converts BCD data into an integer number**

Availability

XGI, XGR, XEC

Flags

\_ERR, \_LER

**Function****Description**

**Input** EN: executes the function in case of 1  
IN: ANY\_BIT (BCD)

**Output** ENO: outputs EN value as it is  
OUT: type-converted data

ANY type variable

Variable

BOOL

BYTE

WORD

DWORD

LWORD

SINT

INT

DINT

LINT

USINT

UINT

UDINT

ULINT

REAL

LREAL

TIME

DATE

TOD

DT

STRING

IN

OUT

\*ANY\_BIT : exclude BOOL from ANY\_BIT type.

■ **Function**

It converts input IN type and produces output ,OUT.

Function	Input type	Output type	Description
BYTE_BCD_TO_SINT	BYTE	SINT	It converts BCD data into an output data type. It converts only when the input data type is a BCD value. If an input data type is WORD, only the part of its data (0 ~ 16#9999) is normally converted.
WORD_BCD_TO_INT	WORD	INT	
DWORD_BCD_TO_DINT	DWORD	DINT	
LWORD_BCD_TO_LINT	LWORD	LINT	
BYTE_BCD_TO_USINT	BYTE	USINT	
WORD_BCD_TO_UINT	WORD	UINT	
DWORD_BCD_TO_UDINT	DWORD	UDINT	
LWORD_BCD_TO_ULINT	LWORD	ULINT	

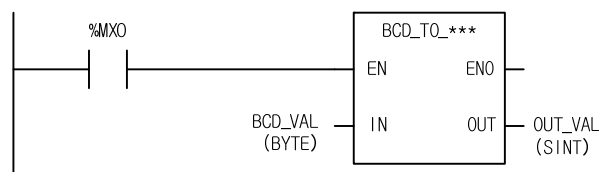
## Ch. 7 Basic Functions

### ■ Flag

Flag	Description
_ERR	If IN is not a BCD data type, then the output will be 0 and _ERR, _LER flags are set.

### ■ Program Example

#### 1. LD



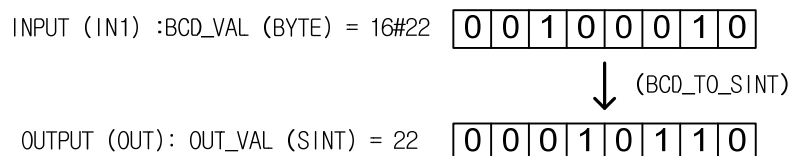
#### 2. ST

ST language doesn't support BCD\_TO\_\*\*\*

In case of BYTE\_BCD\_TO\_SINT

```
OUT_VAL := BYTE_BCD_TO_SINT(EN:=%MX0, IN:= BCD_VAL);
```

- (1) If the transition condition (%MX0) is on, BCD\_TO\_\*\*\* function executes.
- (2) If BCD\_VAL (BYTE) = 16#22 (2#0010\_0010), then the output variable OUT\_VAL (SINT) = 22 (2#0001\_0110).





BOOL_TO_***	BOOL type conversion	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
<pre> graph LR     subgraph BOOL_TO_***         EN[EN] --&gt; ENO[ENO]         IN[IN] --&gt; OUT[OUT]     end     ENO --- B1[BOOL]     OUT --- B2["*ANY_BIT ANY_INT STRING"]           </pre>	<p><b>Input</b> EN: executes the function in case of 1 IN: bit to convert (1 bit)</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: type-converted data</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	OUT		o	o	o	o	o	o	o	o	o	o	o	o							o

\*ANY\_BIT: exclude BOOL from ANY\_BIT type.

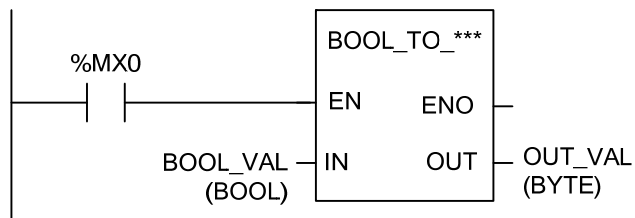
#### ■ Function

It converts input IN type and produces output ,OUT.

Function	Output type	Description
BOOL_TO_SINT	SINT	If the input value (BOOL) is 2#0, it produces the integer number '0' and if it is 2#1, it produces the integer number '1' according to the output data type.
BOOL_TO_INT	INT	
BOOL_TO_DINT	DINT	
BOOL_TO_LINT	LINT	
BOOL_TO_USINT	USINT	
BOOL_TO_UINT	UINT	
BOOL_TO_UDINT	UDINT	
BOOL_TO_ULINT	ULINT	
BOOL_TO_BYTE	BYTE	It converts BOOL into the output data type whose upper bits are filled with 0.
BOOL_TO_WORD	WORD	
BOOL_TO_DWORD	DWORD	
BOOL_TO_LWORD	LWORD	
BOOL_TO_STRING	STRING	It converts BOOL into a STRING type, which is '0' or '1'.

### ■ Program Example

#### 1. LD



#### 2. ST

ST language doesn't support BOOL\_TO\_\*\*\*

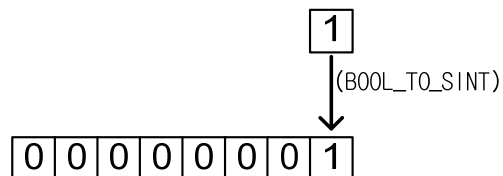
In case of BOOL\_TO\_BYTE

```
OUT_VAL := BOOL_TO_BYTE(EN:=%MX0, IN:= BOOL_VAL);
```

- (1) If the transition condition (%MX0) is on, BOOL\_TO\_\*\*\* function executes.
- (2) If input BOOL\_VAL (BOOL) = 2#1, then output, OUT\_VAL (BYTE) = 2#0000\_0001.

INPUT (IN) : BOOL\_VAL (BOOL) = 2#1

OUTPUT (OUT): OUT\_VAL (BYTE) = 16#1



BYTE_TO_***	BYTE type conversion	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
<pre> graph LR     subgraph "BYTE_TO_***"         EN[EN]         IN[IN]         ENO[ENO]         OUT[OUT]     end     EN --&gt; ENO     IN --&gt; OUT   </pre>	<p><b>Input</b> EN: executes the function in case of 1 IN: bit String to convert (8 bits)</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: type-converted data</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	OUT		○	○	○	○	○	○	○	○	○	○	○	○							○

\*ANY\_BIT: exclude BOOL from ANY\_BIT type.

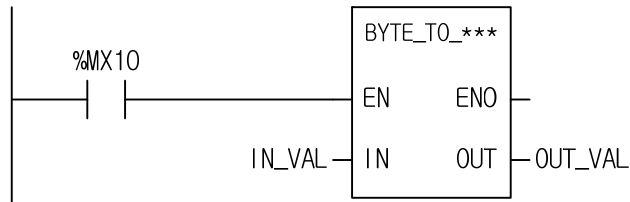
#### ■ Function

It converts input IN type and produces output ,OUT.

Function	Output type	Description
BYTE_TO_SINT	SINT	Converts into SINT type without changing its internal bit array.
BYTE_TO_INT	INT	Converts into INT type filling the upper bits with 0.
BYTE_TO_DINT	DINT	Converts into DINT type filling the upper bits with 0.
BYTE_TO_LINT	LINT	Converts into LINT type filling the upper bits with 0.
BYTE_TO_USINT	USINT	Converts into USINT type without changing its internal bit array.
BYTE_TO_UINT	UINT	Converts into UINT type filling the upper bits with 0.
BYTE_TO_UDINT	UDINT	Converts into UDINT type filling the upper bits with 0.
BYTE_TO_ULINT	ULINT	Converts into ULINT type filling the upper bits with 0.
BYTE_TO_BOOL	BOOL	Takes the lower 1 bit and converts it into BOOL type.
BYTE_TO_WORD	WORD	Converts into WORD type filling the upper bits with 0.
BYTE_TO_DWORD	DWORD	Converts into DWORD type filling the upper bits with 0.
BYTE_TO_LWORD	LWORD	Converts into LWORD type filling the upper bits with 0.
BYTE_TO_STRING	STRING	Converts the input type value into STRING.

### ■ Program Example

#### 1. LD



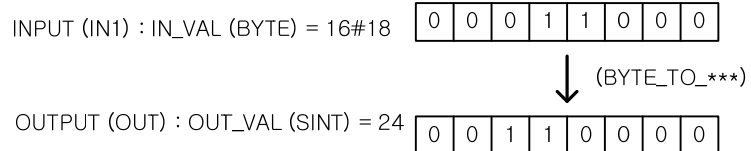
#### 2. ST

ST language doesn't support BYTE\_TO\_\*\*\*

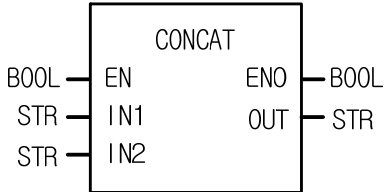
In case of BYTE\_TO\_SINT

```
OUT_VAL := BYTE_TO_SINT(EN:=%MX10, IN:= IN_VAL);
```

- (1) If the transition condition (%MX10) is on, BYTE\_TO\_\*\*\* function executes.
- (2) If IN\_VAL (BYTE) = 2#0001\_1000, OUT\_VAL (SINT) = 24 (2#0011\_0000).



CONCAT	Concatenates a String	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
 <pre> graph LR     I1[IN_TEXT1] --&gt; IN1     I2[IN_TEXT2] --&gt; IN2     ENO --&gt; BOOL     OUT --&gt; STR   </pre>	<p><b>Input</b> EN: executes the function in case of 1  IN1: input String  IN2: input String  Input variable number can be extended up to 8.</p> <p><b>Output</b> ENO: without an error, it is 1.  OUT: output String</p>

#### ■ Function

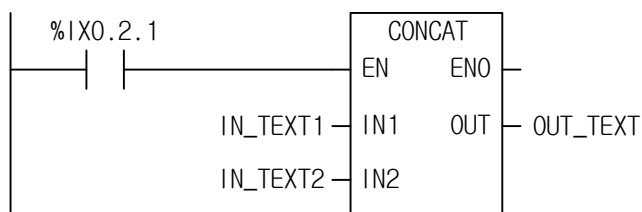
It concatenates the input String IN1, IN2, IN3, ..., INn (n: number of inputs) in order and produces output String OUT.

#### ■ Flag

Flag	Description
_ERR	If the sum of character number of each input String is greater than 31, then the output CONCAT is the concatenate String of each input String (up to 31 letters), and _ERR, _LER flags are set.

#### ■ Program Example

##### 1. LD



### 2. ST

OUT\_TEXT := CONCAT(EN:=%IX0.2.1, IN1:= IN\_TEXT1, IN2:= IN\_TEXT2);

- (1) If the transition condition (%IX0.2.1) is on, CONCAT function executes.
- (2) If input variable IN\_TEXT1 = 'ABCD' and IN\_TEXT2 = 'DEF', then OUT\_TEXT = 'ABCDDEF'.

INPUT (IN1) :	IN_TEXT1 (STRING) =	`ABCD`
		(CONCAT)
(IN2) :	IN_TEXT2(STRING) =	`DEF`
		↓
OUTPUT (OUT) :	OUT_TEXT (STRING) =	'ABCDDEF'

<b>CONCAT_TIME</b>	<b>Concatenates date and time of day</b>	
	Availability	XGI, XGR, XEC
	Flags	

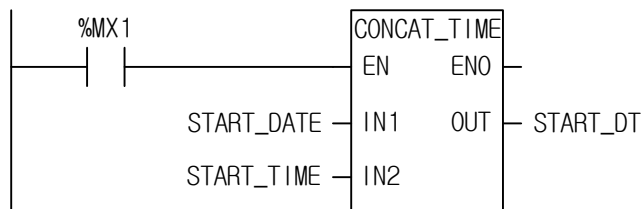
Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN1: date data input IN2: Time of day data input</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: DT (Date and Time of Day) output</p>

### ■ Function

It concatenates IN1 (date) and IN2 (time of day) and produces output, OUT (DT).

### ■ Program Example

#### 1. LD



#### 2. ST

```
START_DT := CONCAT_TIME(EN:=%MX1, IN1:= START_DATE, IN2:= START_TIME);
```

- (1) If the transition condition (%MX1) is on, CONCAT\_TIME function executes.
- (2) If START\_DATE = D#1995-12-06 and START\_TIME = TOD#08:30:00, then, output START\_DT = DT#1995-12-06-08:30:00.

INPUT (IN1) : START\_DATE (DATE) = D#1995-12-06

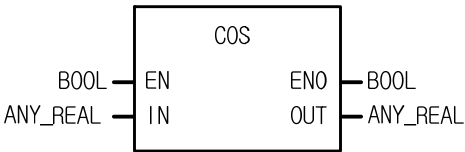
(CONCAT\_TIME)

INPUT (IN2) : START\_TIME (TOD) = TOD#08:30:00



OUTPUT (OUT) : START\_DT (DT) = DT#1995-12-06-08:30:00

COS	Cosine operation	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b>    EN: executes the function in case of 1               IN: radian input value of Cosine operation</p> <p><b>Output</b>   ENO: outputs EN value as it is               OUT: result value of Cosine operation</p> <p>IN and OUT must be the same data type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN														○	○					
	OUT														○	○					

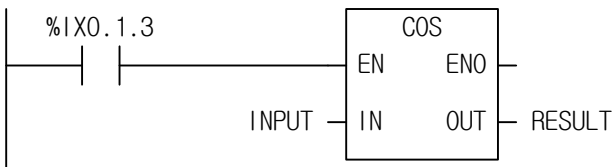
■ Function

It produces IN's Cosine operation value.

OUT = COS (IN)

■ Program Example

1. LD






## 2. ST

RESULT := COS(EN:=%IX0.1.3, IN:= INPUT);

(1) If the transition condition (%IX0.1.3) is on, COS function executes.

(2) If input INPUT = 0.5235 ( $\pi/6$  rad =  $30^\circ$ ), output RESULT = 0.8660 ... ( $\sqrt{3}/2$ ).

$$\cos(\pi/6) = \sqrt{3}/2 = 0.866$$

INPUT (IN) : INPUT (REAL) = 0.5235  
 (COS)

OUTPUT (OUT) : RESULT (REAL) = 8.66074800E-01

<b>DATE_TO_***</b>	<b>Date type conversion</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: date data to convert</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: type-converted data</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN			○								○									○

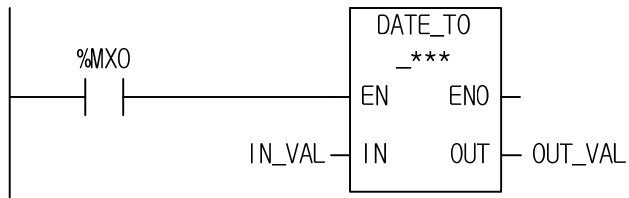
### ■ Function

It converts an input IN type and produces output, OUT.

Function	Output type	Description
DATE_TO_UINT	UINT	Converts DATE into UINT type.
DATE_TO_WORD	WORD	Converts DATE into WORD type.
DATE_TO_STRING	STRING	Converts DATE into STRING type.

## ■ Program Example

### 1. LD



### 2. ST

ST language doesn't support DATE\_TO\_\*\*\*

In case of DATE\_TO\_STRING

```
OUT_VAL := DATE_TO_STRING(EN:=%MX0, IN:= IN_VAL);
```

- (1) If the transition condition (%MX0) is on, DATE\_TO\_\*\*\* function executes.
- (2) If IN\_VAL (DATE) = D#1995-12-01, OUT\_VAL (STRING) = D#1995-12-01.

INPUT (IN) : IN\_VAL (DATE) = D#1995-12-01

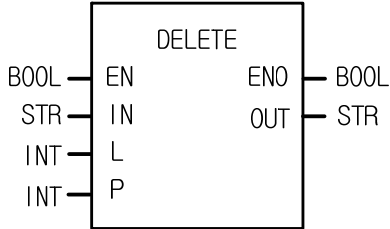


(DATE\_TO\_STRING)

OUTPUT (OUT) : OUT\_VAL (STRING) = 'D#1995-12-01'

<b>DELETE</b>	<b>Delete a string</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
 <pre> graph LR     subgraph DELETE_Box [DELETE]         EN[EN]         IN[IN]         L[L]         P[P]         ENO[ENO]         OUT[OUT]     end     EN --- ENO     IN --- OUT     L --- OUT     P --- OUT </pre>	<p><b>Input</b> EN: executes the function in case of 1 IN: input String L: length of String to delete P: position of String to delete</p> <p><b>Output</b> ENO: without an error, it is 1 OUT: output String</p>

### ■ Function

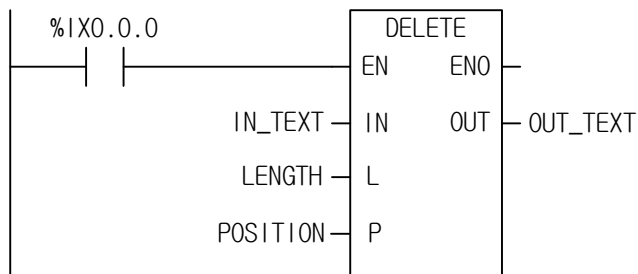
After deleting a String (L) from the P character of IN, produces output, OUT.

### ■ Flag

Flag	Description
_ERR	If $P \leq 0$ or $L < 0$ , or if $P >$ character number of IN, _ERR and _LER flags are set.

## ■ Program Example

### 1. LD



### 2. ST

```
OUT_TEXT := DELETE(EN:= %IX0.0.0, IN:= IN_TEXT, L:= LENGTH, P:= POSITION);
```

- (1) If the transition condition (%IX0.0.0) is on, DELETE function executes.
- (2) If input variable IN\_TEXT = 'ABCDEF', LENGTH = 3, and POSITION = 3, then OUT\_TEXT (STRING) will be 'ABF'.

INPUT (IN) : IN\_TEXT (STRING) = `ABCDEF`

(L) : LENGTH(INT) = 3

(P) : POSITION(INT) = 3

↓ (DELETE)

OUTPUT (OUT): OUT\_TEXT (STRING) = `ABF`

<b>DINT_TO_***</b>	<b>DINT type conversion</b>	
	Availability	XGI, XGR, XEC
	Flags	ERR, LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: double integer value to convert</p> <p><b>Output</b> ENO: without an error, it is 1. OUT: type-converted data</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	OUT	○	○	○	○	○	○	○		○	○	○	○	○	○	○			○	○	○

\*ANY: exclude DINT, TIME and DATE from ANY type.

### ■ Function

It converts Input IN type and produces output, OUT.

Function	Output type	Description
DINT_TO_SINT	SINT	If input is -128 ~ 127, normal conversion. Except this, an error occurs.
DINT_TO_INT	INT	If input is -32,768 ~ 32,767, normal conversion. Except this, an error occurs.
DINT_TO_LINT	LINT	Converts normally into LINT type.
DINT_TO_USINT	USINT	If input is 0 ~ 255, normal conversion. Otherwise an error occurs.
DINT_TO_UINT	UINT	If input is 0 ~ 65,535, normal conversion. Otherwise an error occurs.
DINT_TO_UDINT	UDINT	If input is 0 ~ 2,147,483,647, normal conversion. Otherwise an error occurs.
DINT_TO_ULINT	ULINT	If input is 0 ~ 2,147,483,647, normal conversion. Otherwise an error occurs.
DINT_TO_BOOL	BOOL	Takes the low 1 bit and converts into BOOL type.
DINT_TO_BYTE	BYTE	Takes the low 8 bit and converts into BYTE type.

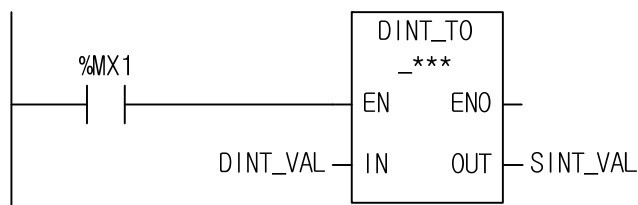
Function	Output type	Description
DINT_TO_WORD	WORD	Takes the low 16 bit and converts into WORD type.
DINT_TO_DWORD	DWORD	Converts into DWORD type without changing the internal bit array.
DINT_TO_LWORD	LWORD	Converts into LWORD type filling the upper bytes with 0.
DINT_TO_REAL	REAL	Converts DINT into REAL type. During conversion, an error caused by the precision may occur.
DINT_TO_LREAL	LREAL	Converts DINT into LREAL type. During conversion, an error caused by the precision may occur.
DINT_TO_STRING	STRING	Converts the input value into STRING type.

### ■ Flag

Flag	Description
_ERR	If a conversion error occurs, _ERR, _LER flags are set. When an error occurs, it takes as many lower bits as the bit number of the output type and produces an output without changing the internal bit array.

### ■ Program Example

#### 1. LD



#### 2. ST

ST language doesn't support DINT\_TO\_\*\*\*

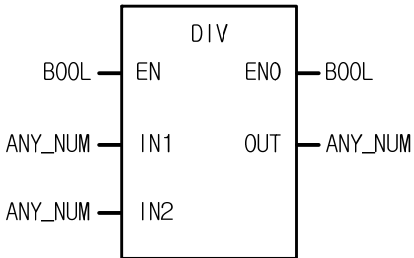
In case of DINT\_TO\_SINT

```
SINT_VAL := DINT_TO_SINT(EN:= %MX1, IN:= DINT_VAL);
```

- (1) If the transition condition (%MX1) is on, DINT\_TO\_\*\*\* function executes.
- (2) If INI = DINT\_VAL (DINT) = -77, SINT\_VAL (SINT) = -77.

## Ch. 7 Basic Functions

<b>DIV</b>	<b>Division</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN1: the value to be divided (dividend) IN2: the value to divide (divisor)</p> <p><b>Output</b> ENO: without an error, it is 1. OUT: the divided result (quotient)</p> <p>The variable connected to IN1, IN2 and OUT must be of the same data type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN1						○	○	○	○	○	○	○	○	○	○					
	IN2						○	○	○	○	○	○	○	○	○	○					
	OUT						○	○	○	○	○	○	○	○	○	○					

### ■ Function

It divides IN1 by IN2 and produces an output omitting decimal fraction from the quotient.

$$\text{OUT} = \text{IN1} / \text{IN2}$$

IN1	IN2	OUT	Remarks
7	2	3	Decimal fraction omitted
7	-2	-3	
-7	2	-3	
-7	-2	3	
7	0	×	Error

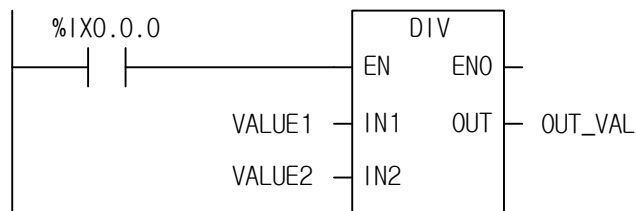
### ■ Flag

Flag	Description
_ERR	If the value to divide (divisor) is '0', and the results exceeds the maximum value of each type, _ERR, _LER flags are set.



## ■ Program Example

### 1. LD

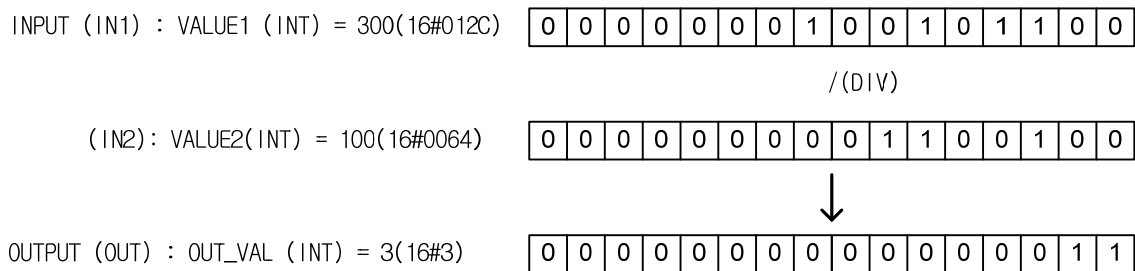


### 2. ST

OUT\_VAL := DIV(EN:= %IX0.0.0, IN1:= VALUE1, IN2:= VALUE2);

(1) If the transition condition (%IX0.0.0) is on, DIV function executes.

(2) If input VALUE1 = 300 and VALUE2 = 100, then output, OUT\_VAL = 300/100 = 3.



DIV_TIME		Time division	
		Availability	XGI, XGR, XEC
		Flags	_ERR, _LER

Function	Description
<div><div><div>DIV_TIME</div><div><div>EN</div><div>ENO</div><div>IN1</div><div>OUT</div><div>IN2</div></div><div><div>BOOL</div><div>TIME</div><div>ANY_NUM</div><div>BOOL</div><div>TIME</div></div></div></div>	<div><div>Input</div><div>EN: executes the function in case of 1</div><div>IN1: Time to divide</div><div>IN2: The value to divide</div><div>Output</div><div>ENO: without an error, it is 1.</div><div>OUT: divided result time</div></div>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN2						○	○	○	○	○	○	○	○	○	○					

### ■ Function

1. It divides IN1 (time) by IN2 (number) and produces output OUT (divided time).

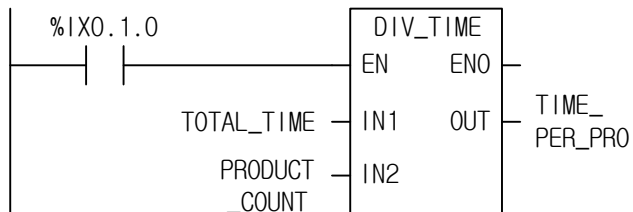
### ■ Flag

Flag	Description
_ERR	<p>If a divisor (IN2) is 0 or less than 0, _ERR and _LER flags are set.</p> <p>If a negative number is entered into IN2, _ERR and _LER flags are on and the outputs is 0.</p>

### ■ Program Example

This is the program that calculates the time required to produce one product in some product line if the working time of day is 12hr 24min 24sec and product quantity of a day is 12 in a product line.

#### 1. LD



#### 2. ST

```
TIME_PER_PRO := DIV_TIME(EN:= %IX0.1.0, IN1:= TOTAL_TIME, IN2:= PRODUCT_COUNT);
```

(1) If the transition condition (%IX0.1.0) is on, DIV\_TIME function executes.

(2) If it divides TOTAL\_TIME (T#12H24M24S) by PRODUCT\_COUNT (12), the time required to produce one product TIME\_PER\_PRO (T#1H2M2S) is an output. That is, it takes 1hr: 2min :2sec to produce one product.

INPUT (IN1) : TOTAL_TIME (TIME) = T#12H24M24S
/(DIV_TIME)
(IN2) : PRODUCT_COUNT(INT) = 12
↓
OUTPUT (OUT) : TIME_PER_PRO (TIME) = T#1H2M2S

DT_TO_***	DT type conversion	
	Availability	XGI, XGR, XEC
	Flags	ERR, LER

Function	Description
<pre> graph LR     EN[EN] --&gt; ENO[ENO]     IN[IN] --&gt; OUT[OUT]     OUT --&gt; LWORD[LWORD, DATE, TOD, STRING] </pre>	<p><b>Input</b> EN: executes the function in case of 1 IN: date and time of day data to convert</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: type-converted data</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	OUT					○												○	○		○

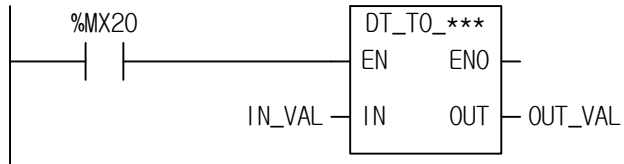
### ■ Function

It converts Input IN type and produces output, OUT.

Function	Output type	Description
DT_TO_LWORD	LWORD	Converts DT into LWORD type. (The inverse conversion is available as there is no internal data change).
DT_TO_DATE	DATE	Converts DT into DATE type.
DT_TO_TOD	TOD	Converts DT into TOD type.
DT_TO_STRING	STRING	Converts DT into STRING type.

### ■ Program Example

#### 1. LD



#### 2. ST

ST language doesn't support DT\_TO\_\*\*\*

In case of DT\_TO\_DATE

```
OUT_VAL := DT_TO_DATE(EN:= %MX20, IN1:= IN_VAL);
```

(1) If the transition condition (%MX20) is on, DT\_TO\_\*\*\* function executes.

(2) If input IN\_VAL (DT) = DT#1995-12-01-12:00:00, output ,OUT\_VAL (DATE) = D#1995-12-01

INPUT (IN) : IN\_VAL (DT) = DT#1995-12-01-12:00:00



(DT\_TO\_DATE)

OUTPUT (OUT) : OUT\_VAL (DATE) = D#1995-12-01

DWORD_TO_***	DWORD type conversion	
	Availability	XGI, XGR, XEC
	Flags	ERR, LER

Function	Description
<pre> graph LR     EN[EN] --&gt; F1     IN[IN] --&gt; F1     F1 --&gt; ENO[ENO]     F1 --&gt; OUT[OUT]     style F1 fill:#fff,stroke:#000,stroke-width:1px     subgraph F1 [DWORD_TO_***]         direction TB         EN         IN         ENO         OUT     end </pre>	<p><b>Input</b> EN: executes the function in case of 1 IN: bit String to convert (32bit)</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: type-converted data</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	OUT	○	○	○		○	○	○	○	○	○	○	○	○	○		○		○	○	○

\*ANY: exclude DWORD, LREAL and DATE from ANY type.

### ■ Function

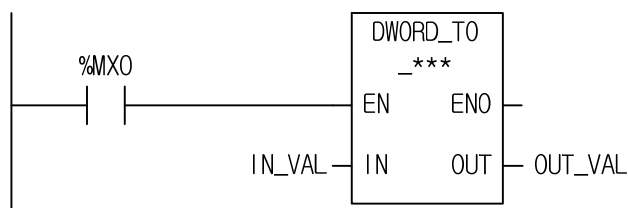
It converts Input IN type and produces output. OUT.

Function	Output type	Description
DWORD_TO_SINT	SINT	Takes the lower 8 bits and converts into SINT type.
DWORD_TO_INT	INT	Takes the lower 16 bits and converts into INT type.
DWORD_TO_DINT	DINT	Converts into DINT type without changing the internal bit array.
DWORD_TO_LINT	LINT	Converts into LINT type filling the upper bits with 0
DWORD_TO_USINT	USINT	Takes the lower 8 bits and converts into USINT type.
DWORD_TO_UINT	UINT	Takes the lower 16 bits and converts into UINT type.
DWORD_TO_UDINT	UDINT	Converts into UDINT type without changing the internal bit array.
DWORD_TO_ULINT	ULINT	Converts into ULINT type filling the upper bits with 0.
DWORD_TO_BOOL	BOOL	Takes the lower 1 bit and converts into BOOL type.
DWORD_TO_BYTE	BYTE	Takes the lower 8 bits and converts into BYTE type.
DWORD_TO_WORD	WORD	Takes the lower 16 bits and converts into WORD type.
DWORD_TO_LWORD	LWORD	Converts into LWORD type filling the upper bits with 0.
DWORD_TO_REAL	REAL	Converts into REAL type without changing the internal bit array.
DWORD_TO_TIME	TIME	Converts into TIME type without changing the internal bit array.

Function	Output type	Description
DWORD_TO_TOD	TOD	Converts into TOD type without changing the internal bit array. However, with a value out of TOD range (TOD#23:59:59.999), _ERR, _LER flags are set and it is alternately converted within the range of TOD.
DWORD_TO_STRING	STRING	Changes input value into decimal and converts into STRING type.

### ■ Program Example

#### 1. LD



#### 2. ST

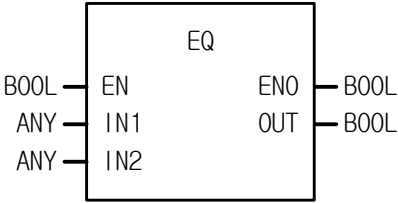
ST language doesn't support DWORD\_TO\_\*\*\*

In case of DWORD\_TO\_TOD

```
OUT_VAL := DWORD_TO_***(EN:= %MX0, IN1:= IN_VAL);
```

- (1) If the transition condition (%MX0) is on, DWIRD\_TO\_TOD function executes.
- (2) If output IN\_VAL (DWORD) = 16#3E8 (1000), output , OUT\_VAL (TOD) = TOD#1S.
- (3) Calculates TIME, TOD by converting decimal into MS unit. That is, 1000 is 1000ms = 1s.  
(Refer to 3.2.4. Data Type Structure)

EQ	'Equal to' comparison	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
<div></div>	<p><b>Input</b> EN: executes the function in case of 1 IN1: the value to be compared IN2: the value to compare Input variable number can be extended up to 8. IN1, IN2, ... must be the same type.</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: comparison result value</p>

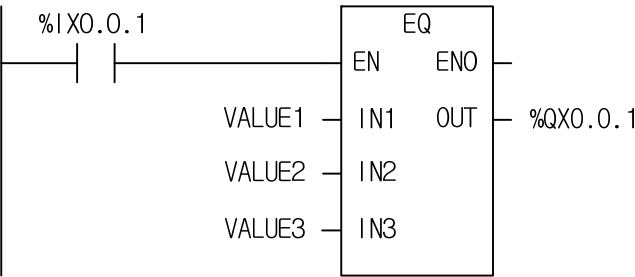
ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	IN2	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

■ Function

- 1. If IN1 = IN2 = IN3 ... = INn (n : number of inputs), output , OUT is 1.
- 2. In other cases, OUT is 0.

■ Program Example

1. LD

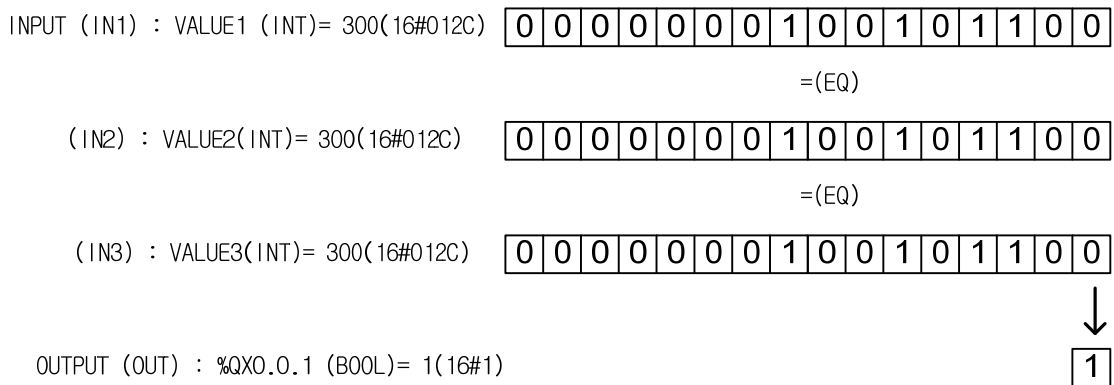




## 2. ST

%QX0.0.1 := EQ(EN:= %IX0.0.1, IN1:= VALUE1, IN2:= VALUE2, IN3:= VALUE3);

- (1) If the transition condition (%IX0.0.1) is on, EQ function executes.
- (2) If VALUE1 = 300, VALUE2 = 300, VALUE3 = 300 (comparison result VALUE1 = VALUE2 = VALUE3), output %QX0.0.1 = 1.



<b>EXP</b>	<b>EXP operation</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: input value of exponent operation</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: result value of exponent operation</p> <p>IN, OUT must be of the same data type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN														○	○					
	OUT														○	○					

### ■ Function

It calculates the natural exponent with exponent IN and produces output, OUT.

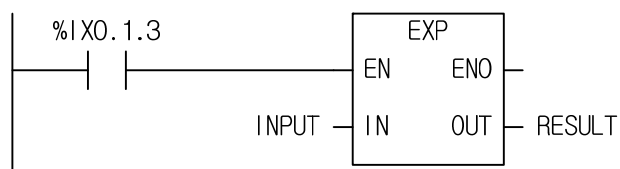
$$OUT = e^{IN}$$

### ■ Error

Flag	Description
_ERR	If output is out of the range of a type, _ERR and _LER flags are set.

## ■ Program Example

### 1. LD



### 2. ST

```
RESULT := EXP(EN:= %IX0.1.3, IN1:= INPUT);
```

(1) If the transition condition (%IX0.1.3) is on, EXP function executes.

(2) If INPUT is 2.0, RESULT is 7.3890....

$$\text{RESULT} = e^{\text{INPUT}}$$

INPUT = 2.0, RESULT = 7.3890...

<b>EXPT</b>	<b>Exponential operation</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1  IN1: real number  IN2: exponent</p> <p><b>Output</b> ENO: outputs EN value as it is  OUT: result value</p> <p>IN1 and OUT must be of the same data type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN1														○	○					
	IN2														○	○					
	OUT														○	○					

### ■ Function

It calculates IN1 with exponent IN2 and produces output, OUT.

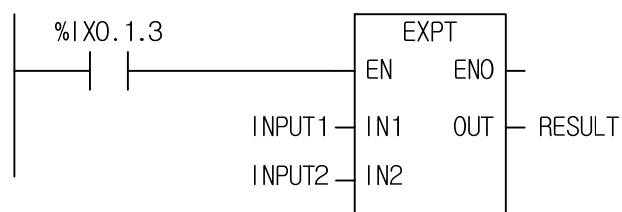
$$OUT = IN1^{IN2}$$

### ■ Error

Flag	Description
_ERR	If an output is out of range of related data type, _ERR and _LER flags are set.

## ■ Program Example

### 1. LD



### 2. ST

```
RESULT := EXPT(EN:= %IX0.1.2, IN1:= INPUT1, IN2:= INPUT2);
```

- (1) If the transition condition (%IX0.1.3) is on, 'EXPT' exponential function executes.
- (2) If input INPUT1= 1.5, INPUT2 = 3, output RESULT =  $1.5^3 = 1.5 \times 1.5 \times 1.5 = 3.375$ .

$$3.375 = 1.5^3$$

<b>FIND</b>	<b>Find a string</b>	
	Availability	XGI, XGR, XEC
	Flags	

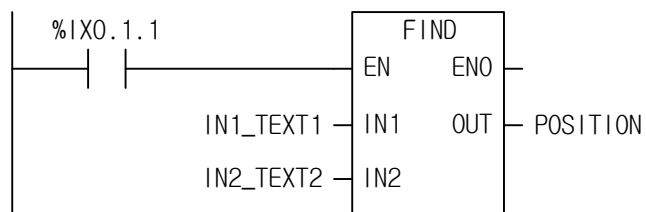
Function	Description
<pre> graph LR     I1[IN1_TEXT1] --&gt; IN1     I2[IN2_TEXT2] --&gt; IN2     ENO --&gt; COIL1[POSITION]     OUT --&gt; COIL2[POSITION] </pre>	<p><b>Input</b> EN: executes the function in case of 1 IN1: input String IN2: String to find</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: location of String to be found</p>

### ■ Function

It finds the location of String IN2 from input String IN1. If the location is found, it shows a position of a first character of String IN2 from String IN1. Otherwise, output is 0.

### ■ Program Example

#### 1. LD



**2. ST**

```
POSITION := FIND(EN:= %IX0.1.2, IN1:= IN1_TEXT1, IN2:= IN2_TEXT2);
```

- (1) If the transition condition (%IX0.1.2) is on, FIND function executes
- (2) If input String IN\_TEXT1='ABCEF' and IN\_TEXT2='BC', then output variable POSITION = 2.
- (3) The first location of IN\_TEXT2 ('BC') from input String IN\_TEXT1 ('ABCEF') is 2<sup>nd</sup>.

```

INPUT (IN1) : IN_TEXT1 (STRING) = 'ABCEF'

              (IN2) : IN_TEXT2 (STRING) = 'BC'
                      ↓ (FIND)
OUTPUT (OUT) : POSITION (INT)    = 2

```

<b>GE</b>	<b>'Greater than or equal to' comparison</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
<pre> graph LR     MX77[%MX77] --&gt; EN     subgraph GE         EN         IN1         IN2         IN3         ENO         OUT     end     ENO --- R1[ ]     OUT --- QX01[%QX0.0.1]     style R1 fill:none,stroke:none     </pre>	<p><b>Input</b> EN: executes the function in case of 1  IN1: the value to be compared  IN2: the value to compare  Input variable number can be extended up to 8.  IN1, IN2, ... must be of the same data type.</p> <p><b>Output</b> ENO: outputs EN value as it is  OUT: comparison result value</p>

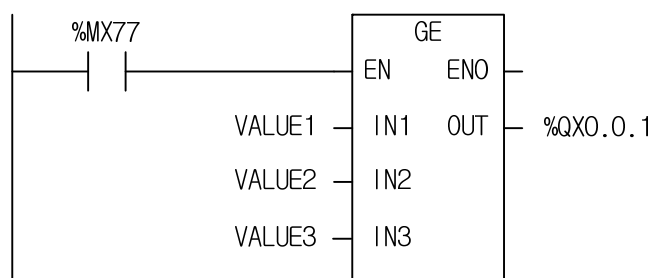
ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
IN1		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
IN2		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

### ■ Function

If  $IN1 \geq IN2 \geq IN3 \dots \geq INn$  ( $n$ : number of inputs), an output is 1.  
Otherwise it is 0.

### ■ Program Example

#### 1. LD



#### 2. ST

```
%QX0.0.1 := GE(EN:= %MX77, IN1:= VALUE1, IN2:= VALUE2, IN3:= VALUE3);
```



(1) If the transition condition (%MX77) is on, GE function executes.

(2) If input variable VALUE1 = 300, VALUE3 = 200, comparison result is  $\text{VALUE1} \geq \text{VALUE2} \geq \text{VALUE3}$ . The output %QX0.01 = 1.

INPUT (IN1) : VALUE1 (INT) = 300(16#012C) 

0	0	0	0	0	0	0	1	0	0	1	0	1	1	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

≥ (GE)

(IN2) : VALUE2 (INT) = 200(16#00C8) 

0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

≥ (GE)

(IN3) : VALUE3 (INT) = 100(16#0064) 

0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---



OUTPUT (OUT): %QX0.0.1 (BOOL) = 1(16#1)

1
---

<b>GT</b>	<b>'Greater than' comparison</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1  IN1: the value to be compared  IN2: the value to compare  Input variable number can be extended up to 8.  IN1, IN2, ... must be of the same data type.</p> <p><b>Output</b> ENO: outputs EN value as it is  OUT: comparison result value</p>

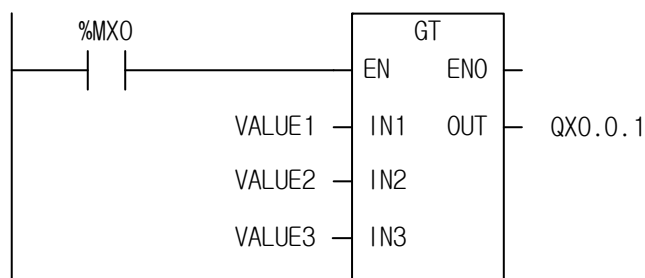
ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	IN2	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

### ■ Function

1. If  $IN1 > IN2 > IN3 \dots > INn$  (n: number of inputs), an output is 1.
2. Otherwise it is 0.

### ■ Program Example

#### 1. LD



#### 2. ST

`%QX0.0.1 := GT(EN:= %MX0, IN1:= VALUE1, IN2:= VALUE2, IN3:= VALUE3);`

- (1) If the transition condition (%MX0) is on, GT function executes.
- (2) If input variable VALUE1 = 300, VALUE2 = 200, and VALUE3 = 100, comparison result is  $VALUE1 > VALUE2 > VALUE3$ . The output %QX0.0.1 = 1.

INSERT	Inserts a String	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
<pre> graph LR     MX0[%MX0] --&gt; EN[EN]     subgraph INSERT_BLOCK [INSERT]         EN --&gt; ENO[ENO]         IN1[IN1] --&gt; OUT[OUT]         IN2[IN2]         P[P]     end     ENO --&gt; ENO_OUT[ENO]     OUT --&gt; OUT_STR[OUT] </pre>	<p><b>Input</b> EN: executes the function in case of 1</p> <p>IN1: String to be inserted</p> <p>IN2: String to insert</p> <p>P: position to insert a String</p> <p><b>Output</b> ENO: without an error, it is 1.</p> <p>OUT: output String</p>

#### ■ Function

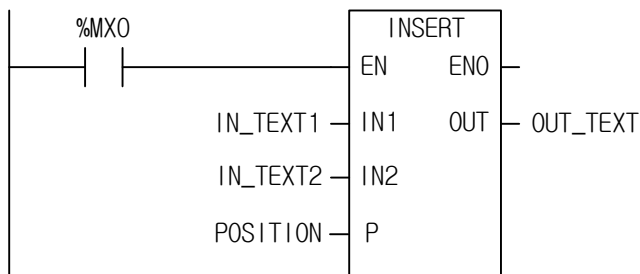
It inserts String IN2 after the P character of IN1 and produces output, OUT.

#### ■ Flag

Flag	Description
_ERR	If $P \leq 0$ , 'character number of variable IN1' < P, or if the character number of result exceeds 31 (just 32 characters are produced), then _ERR, _LER flags are set.

#### ■ Program Example

##### 1. LD



### 2. ST

OUT\_TEXT := INSERT(EN:= %MX0, IN1:= IN\_TEXT1, IN2:= IN\_TEXT2, P:= POSITION);

(1) If the transition condition (%M0) is on, INSERT function executes.

(2) If input variable IN\_TEXT1 = 'ABCD', IN\_TEXT2 = 'XY', and POSITON = 2, output variable OUT\_TEXT = 'ABXYCD'.

INPUT (IN1) :	IN_TEXT1 (STRING)	=	'ABCD'
(IN2) :	IN_TEXT2 (STRING)	=	'XY'
(P) :	POSITION (INT)	=	2
			↓ (FIND)
OUTPUT (OUT) :	OUT_TEXT	=	'ABXYCD'

<b>INT_TO_***</b>	<b>INT type conversion</b>	
	Availability	XGI, XGR, XEC
	Flags	ERR, LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: integer value to convert</p> <p><b>Output</b> ENO: without an error, it is 1. OUT: type-converted data</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	OUT	○	○	○	○	○	○		○	○	○	○	○	○	○	○					○

\*ANY: exclude INT, TIME, DATE, TOD and DT from ANY type.

#### ■ Function

It converts input IN type and produces output, OUT.

Function	Output Type	Description
INT_TO_SINT	SINT	If input is -128 ~ 127, normal conversion. Otherwise an error occurs.
INT_TO_DINT	DINT	Converts into DINT type normally.
INT_TO_LINT	LINT	Converts into LINT type normally.
INT_TO_USINT	USINT	If input is 0 ~ 255, normal conversion. Otherwise an error occurs.
INT_TO_UINT	UINT	If input is 0 ~ 32767, normal conversion. Otherwise an error occurs.
INT_TO_UDINT	UDINT	If input is 0 ~ 32767, normal conversion. Otherwise an error occurs.
h INT_TO_ULINT	ULINT	If input is 0 ~ 32767, normal conversion. Otherwise an error occurs.
INT_TO_BOOL	BOOL	Takes the lower 1 bit and converts into BOOL type.
INT_TO_BYTE	BYTE	Takes the lower 8 bits and converts into BYTE type.
INT_TO_WORD	WORD	Converts into WORD type without changing the internal bit array.
INT_TO_DWORD	DWORD	Converts into DWORD type filling the upper bits with 0.
INT_TO_LWORD	LWORD	Converts into LWORD type filling the upper bits with 0.
INT_TO_REAL	REAL	Converts INT into REAL type normally.
INT_TO_LREAL	LREAL	Converts INT into LREAL type normally.
INT_TO_STRING	STRING	Converts INT into STRING type normally.

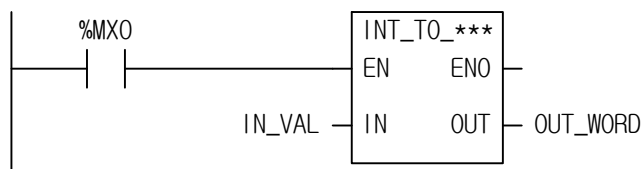
## Ch. 7 Basic Functions

### ■ Flag

Flag	Description
_ERR	If a conversion error occurs, _ERR_LER flags are set. If an error occurs, take as many lower bits as the bit number of the output type and produces an output without changing the internal bit array.

### ■ Program Example

#### 1. LD



#### 2. ST

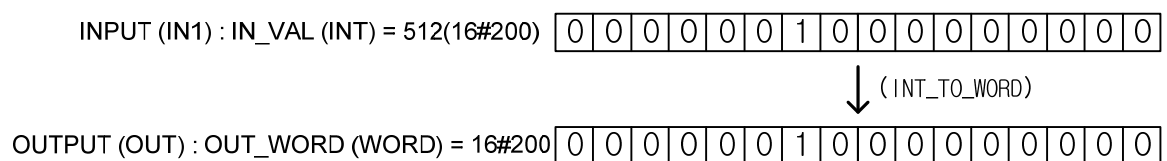
ST language doesn't support INT\_TO\_\*\*\*

In case of INT\_TO\_WORD

```
OUT_WORD := INT_TO_WORD(EN:= %MX0, IN1:= IN_VAL);
```

(1) If the input condition (%MX0) is on, INT\_TO\_\*\*\* function executes.

(2) If input variable IN\_VAL (INT) = 512 (16#200), output variable OUT\_WORD (WORD) = 16#200.



<b>LE</b>	<b>'Less than or equal to' comparison</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1</p> <p>IN1: the value to be compared</p> <p>IN2: the value to compare</p> <p>Input variable number can be extended up to 8.</p> <p>IN1, IN2, ...must be of the same data type.</p> <p><b>Output</b> ENO: outputs EN value as it is</p> <p>OUT: comparison result value</p>

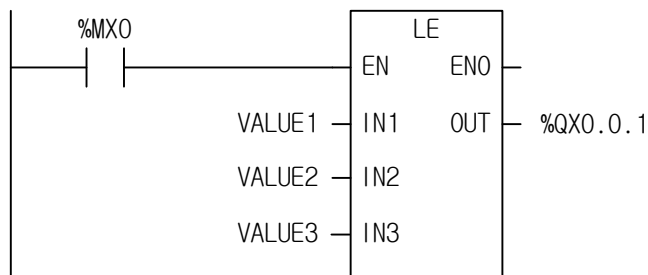
ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	IN2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### ■ Function

1. If  $IN1 \leq IN2 \leq IN3 \dots \leq INn$  (n: number of inputs), output OUT is 1.
2. Otherwise it is 0.

### ■ Program Example

#### 1. LD



### 2. ST

%QX0.0.1 := LE(EN:= %MX0, IN1:= VALUE1, IN2:= VALUE2, IN3:= VALUE3);

(1) If the transition condition (%MX0) is on, LE function executes.

(2) If input variable VALUE1 = 100, VALUE2 = 200, and VALUE3 = 200, output %QX0.0.1 = 1  
(VALUE1 ≤ VALUE2 ≤ VALUE3).

INPUT (IN1) : VALUE1 (INT) = 100(16#0064) 

0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

(IN2) : VALUE2 (INT) = 200(16#00C8) 

0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

(IN3) : VALUE3 (INT) = 300(16#012C) 

0	0	0	0	0	0	0	1	0	0	1	0	1	1	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---



OUTPUT (OUT): %QX0.0.1 (BOOL) = 1(16#1)

1
---



<b>LEFT</b>	<b>Takes the left side of a String</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b></p> <p>EN: executes the function in case of 1</p> <p>IN: input String</p> <p>L: length of a String</p> <p><b>Output</b></p> <p>ENO: without an error, it is 1.</p> <p>OUT: output String</p>

#### ■ Function

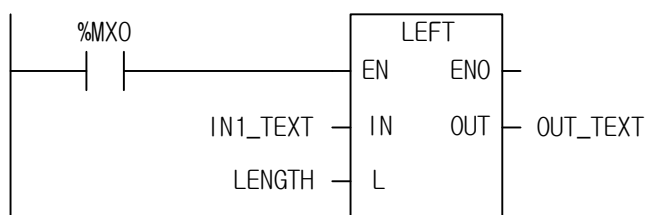
It takes a left String (L) of IN and produces output, OUT.

#### ■ Flag

Flag	Description
_ERR	If $L < 0$ , _ERR and _LER flags are set.

#### ■ Program Example

##### 1. LD



### 2. ST

OUT\_TEXT:= LEFT(EN:= %MX0, IN:= IN1\_TEXT, L:= LENGTH);

(1) If the transition condition (%MX0) is on, function LEFT function executes.

(2) If input variable IN\_TEXT = 'ABCDEFGH' and LENGTH = 3, output String OUT\_TEXT = 'ABC'.

INPUT( IN1) :	IN_TEXT(STRING)	=	'ABCDEFGH'
( IN2) :	LENGTH(INT)	=	3
			↓ (LEFT)
OUTPUT(OUT) :	OUT_TEXT(STRING)	=	'ABC'

<b>LEN</b>	<b>Finds a length of a String</b>	
	Availability	XGI, XGR, XEC
	Flags	

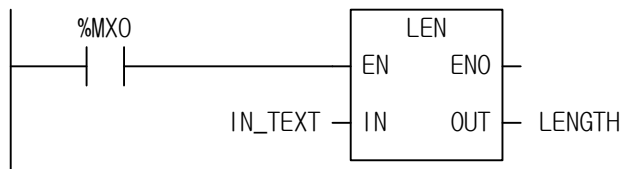
Function	Description
<pre> graph LR     EN[EN] --&gt; LEN[LEN]     IN[IN] --&gt; LEN     LEN --&gt; ENO[ENO]     LEN --&gt; OUT[OUT]     style EN fill:none,stroke:none     style IN fill:none,stroke:none     style ENO fill:none,stroke:none     style OUT fill:none,stroke:none           </pre>	<p><b>Input</b> EN: executes the function in case of 1 IN: input String</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: the length of a String</p>

#### ■ Function

It produces a length (character number) of the input String (IN).

#### ■ Program Example

##### 1. LD



##### 2. ST

```
LENGTH := LEN(EN:= %MX0, IN1:= IN_TEXT);
```

- (1) If the transition condition (%MX0) is on, LEN function executes.
- (2) If input variable IN\_TEXT = 'ABCD', output variable LENGTH = 4.

INPUT (IN) : IN\_TEXT(STRING) = 'ABCD'



OUTPUT (OUT) : LENGTH(INT) = 4

<b>LIMIT</b>	<b>Limits upper and lower boundaries</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1  MN: minimum value  IN: the value to be limited  MX: maximum value</p> <p><b>Output</b> ENO: outputs EN value as it is  OUT: value in the range</p> <p>MN, IN, MX, OUT must be of the same data type.</p>

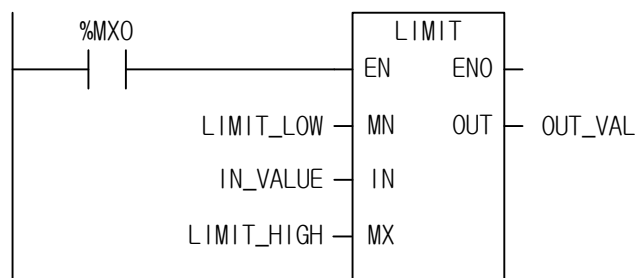
ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	MN	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
	IN	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
	MX	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
	OUT	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

### ■ Function

- If input IN value is between MN and MX, the IN is an output. That is, if  $MN \leq IN \leq MX$ ,  $OUT = IN$ .
- If input IN value is less than MN, MN is an output. That is, if  $IN < MN$ ,  $OUT = MN$ .
- If input IN value is greater than MX, MX is an output. That is, if  $IN > MX$ ,  $OUT = MX$ .

### ■ Program Example

#### 1. LD



## 2. ST

```
OUT_VAL := LIMIT(EN:= %MX0, MX:= LIMIT_LOW, IN:= IN_VALUE, MX:= LIMIT_HIGH);
```

(1) If the transition condition (%MX0) is on, LIMIT function executes.

(2) Output variable OUT\_VAL for lower limit input LIMIT\_LOW, upper limit input (LIMIT\_HIGH) and limited value input IN\_VALUE is as follows.

LIMIT_LOW	IN_VALUE	LIMIT_HIGH	OUT_VAL
1000	2000	3000	2000
1000	500	3000	1000
1000	4000	3000	3000

INPUT (MN) : LIMIT\_LOW (INT) = 1000

(IN) : IN\_VALUE (INT) = 4000

(MX) : LIMIT\_HIGH(INT) = 3000

↓ (LIMIT)

OUTPUT (OUT) : OUT\_VAL (INT) = 3000

<b>LINT_TO_***</b>	<b>LINT type conversion</b>	
	Availability	XGI, XGR, XEC
	Flags	ERR, LER

Function	Description
<pre> graph LR     subgraph LINT_TO_***         EN[EN]         IN[IN]         ENO[ENO]         OUT[OUT]     end     EN --&gt; ENO     IN --&gt; OUT         </pre>	<p><b>Input</b> EN: executes the function in case of 1 IN: long integer value to convert</p> <p><b>Output</b> ENO: without an error, it is 1 OUT: type converted data</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	OUT	○	○	○	○	○	○	○	○		○	○	○	○	○	○					○

\*ANY: exclude LINT, TIME, DATE, TOD, and DT from ANY type.

## ■ Function

It converts input IN type and produces output, OUT.

Function	Output type	Description
LINT_TO_SINT	SINT	If input is -128 ~ 127, normal conversion. Otherwise an error occurs.
LINT_TO_INT	INT	If input is -32,768 ~ 32,767, normal conversion. Otherwise an error occurs.
LINT_TO_DINT	DINT	If input is $-2^{31} \sim 2^{31}-1$ , normal conversion. Otherwise an error occurs.
LINT_TO_USINT	USINT	If input is 0 ~ 255, normal conversion. Otherwise an error occurs.
LINT_TO_UINT	UINT	If input is 0 ~ 65,535, normal conversion. Otherwise an error occurs.
LINT_TO_UDINT	UDINT	If input is $0 \sim 2^{32}-1$ , normal conversion. Otherwise an error occurs.
LINT_TO_ULINT	ULINT	If input is $0 \sim 2^{63}-1$ , normal conversion. Otherwise an error occurs.
LINT_TO_BOOL	BOOL	Takes the lower 1 bit and converts into BOOL type.
LINT_TO_BYTE	BYTE	Takes the lower 8 bits and converts into BYTE type.
LINT_TO_WORD	WORD	Takes the lower 16 bits and converts into WORD type.
LINT_TO_DWORD	DWORD	Takes the lower 32 bits and converts into DWORD type.
LINT_TO_LWORD	LWORD	Converts into LWORD type without changing the internal bit array.
LINT_TO_REAL	REAL	Converts LINT into REAL type. During the conversion, an error caused by the precision may occur.

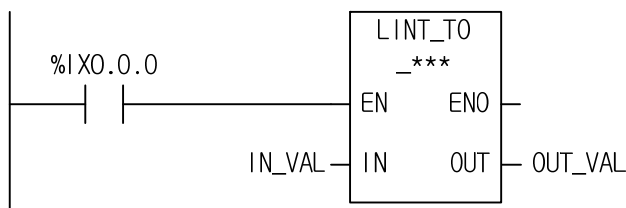
Function	Output type	Description
LINT_TO_LREAL	LREAL	Converts LINT into LREAL type. During the conversion, an error caused by the precision may occur.
LINT_TO_STRING	STRING	Converts the input value into STRING type.

#### ■ Flag

Flag	Description
_ERR	If a conversion error occurs, _ERR and _LER flags are set. If an error occurs, lower bits equal to the bit number of the output type are taken to produces an output without changing the Internal bit array.

#### ■ Program Example

##### 1. LD



##### 2. ST

ST language doesn't support LINT\_TO\_\*\*\*

In case of LINT\_TO\_DINT

```
OUT_VAL := LINT_TO_DINT(EN:= %IX0.0.0, IN:= IN_VAL);
```

(1) If the input condition (%IX0.0.0) is on, LINT\_TO\_\*\*\* function executes.

(2) If input variable IN\_VAL (LINT) = 123,456,789, output variable OUT\_VAL (DINT) = 123,456,789.

## Ch. 7 Basic Functions

INOUT (IN) : IN\_VAL (LINT) = 123,456,789 (16#00000000075BCD15)

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

0	0	0	0	0	1	1	1	0	1	0	1	1	0	1	1
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

1	1	0	0	1	1	0	1	0	0	0	1	0	1	0	1
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

↓ (LINT\_TO\_DINT)

OUTPUT (OUT) : OUT\_VAL (DINT) = 123,456,789 (16#075BCD15)

0	0	0	0	0	1	1	1	0	1	0	1	1	0	1	1
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

1	1	0	0	1	1	0	1	0	0	0	1	0	1	0	1
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---



<b>LN</b>	<b>Natural logarithm operation</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: input value of natural logarithm operation</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: natural logarithm value</p> <p>IN, OUT must be of the same data type</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN														○	○					
	OUT														○	○					

#### ■ Function

It finds a natural logarithm value of IN and produces output, OUT.

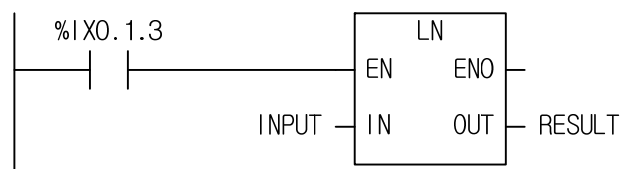
$$\text{OUT} = \ln(\text{IN})$$

#### ■ Error

Flag	Description
_ERR	If an input is 0 or a negative number, _ERR and _LER flags are set.

### ■ Program Example

#### 1. LD



#### 2. ST

```
RESULT := LN(EN:= %UX0.1.3, IN1:= INPUT);
```

- (1) If the transition condition (%IX0.1.3) is on, LN function executes.
- (2) If input variable INPUT is 2.0, output variable RESULT is 0.6931 ....  
 $\ln(2.0) = 0.6931...$

<b>LOG</b>	<b>Base 10 Logarithm operation</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: input value of common logarithm operation</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: the value of common logarithm operation</p> <p>IN, OUT must be of the same data type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN														○	○					
	OUT														○	○					

#### ■ Function

It finds the value of Base 10 Logarithm of IN and produces output, OUT.

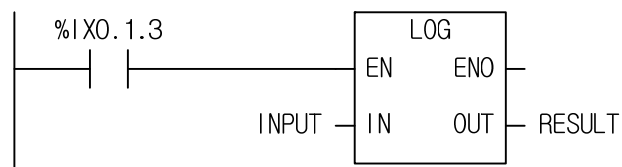
$$OUT = \log_{10} (IN) = \log (IN)$$

#### ■ Error

Flag	Description
_ERR	If input value IN is 0 or a negative number, _ERR and _LER flags are set.

### ■ Program Example

#### 1. LD



#### 2. ST

```
RESULT := LOG(EN:= %IX0.1.3, IN:= INPUT);
```

- (1) If the transition condition (%IX0.1.3) is on, LOG function executes.
- (2) If input variable INPUT is 2.0, output variable RESULT is 0.3010 .....

$$\text{Log}_{10}(2.0) = 0.3010...$$

LREAL_TO_***	LREAL type conversion	
	Availability	XGI, XGR, XEC
	Flags	ERR, LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: LREAL value to convert</p> <p><b>Output</b> ENO: without an error, it is 1. OUT: type converted data</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	OUT					○	○	○	○	○	○	○	○	○	○						○

### ■ Function

It converts input IN type and produces output, OUT.

Function	Output type	Operation
LREAL_TO_SINT	SINT	If integer number of input is -128 ~ 127, normal conversion. Otherwise an error occurs (decimal round off).
LREAL_TO_INT	INT	If integer number of input is -32,768 ~ 32,767, normal conversion. Otherwise an error occurs (decimal round off).
LREAL_TO_DINT	DINT	If integer number of input is $-2^{31} \sim 2^{31}-1$ , normal conversion. Otherwise an error occurs (decimal round off).
LREAL_TO_LINT	LINT	If integer number of input is $-2^{63} \sim 2^{63}-1$ , normal conversion. Otherwise an error occurs (decimal round off).
LREAL_TO_USINT	USINT	If integer number of input is 0 ~ 255, normal conversion. Otherwise an error occurs (decimal round off).
LREAL_TO_UINT	UINT	If integer number of input is 0 ~ 65,535, normal conversion. Otherwise an error occurs (decimal round off).
LREAL_TO_UDINT	UDINT	If integer number of input is $0 \sim 2^{32}-1$ , normal conversion. Otherwise an error occurs (decimal round off).

## Ch. 7 Basic Functions

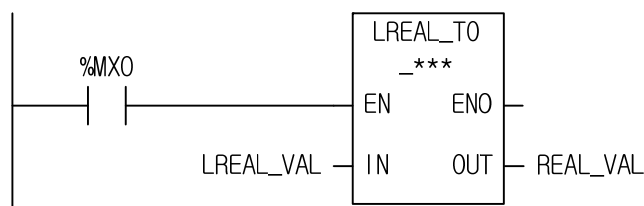
Function	Output type	Operation
LREAL_TO_ULINT	ULINT	If integer number of input is $0 \sim 2^{64}-1$ , normal conversion. Otherwise an error occurs (decimal round-off).
LREAL_TO_LWORD	LWORD	Converts into LWORD type without changing the internal bit array.
LREAL_TO_REAL	REAL	Converts LREAL into REAL type normally. During the conversion, an error caused by the precision may occur.
LREAL_TO_STRING	STRING	Converts LREAL into STRING type normally.

### ■ Flag

Flag	Description
_ERR	If an overflow occurs because an input value is greater than the value available for the output type, _ERR and _LER flags are set. If an error occurs, an output is 0.

### ■ Program Example

#### 1. LD



#### 2. ST

ST language doesn't support LREAL\_TO\_\*\*\*

In case of LREAL\_TO\_REAL

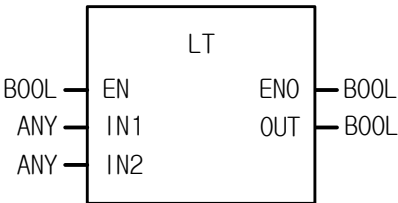
```
REAL_VAL := LREAL_TO_REAL(EN:= %MX0, IN:= LREAL_VAL);
```

(1) If the input condition (%MX0) is on, LREAL\_TO\_\*\*\* function executes.

(2) If input variable LREAL\_VAL (LREAL) = -1.34E-12, output variable REAL\_VAL (REAL) = -1.34E-12.

INPUT (IN) : LREAL_VAL (LREAL) =	-1.34E-12
	↓ (LREAL_TO_REAL)
OUTPUT (OUT) : REAL_VAL (REAL) =	-1.34E-12

<b>LT</b>	<b>'Less than' comparison</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
 <p>Diagram showing the LT function block with inputs EN (BOOL), IN1 (ANY), IN2 (ANY), and outputs ENO (BOOL), OUT (BOOL).</p>	<p><b>Input</b> EN: executes the function in case of 1  IN1: the value to be compared  IN2: the value to compare  Input variable number can be extended up to 8  IN1, IN2, ...must be of the same data type</p> <p><b>Output</b> ENO: outputs EN value as it is  OUT: comparison result value</p>

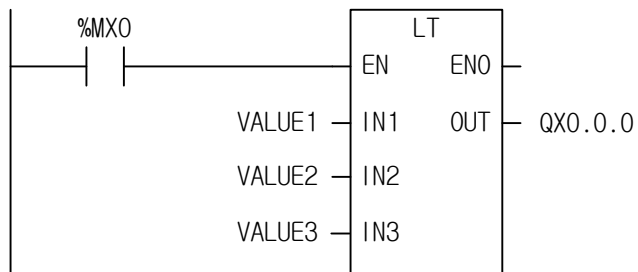
ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	IN2	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

### ■ Function

1. If  $IN1 < IN2 < IN3 \dots < INn$  (n: number of inputs), output value OUT is 1.
2. Otherwise output, OUT is 0.

### ■ Program Example

#### 1. LD

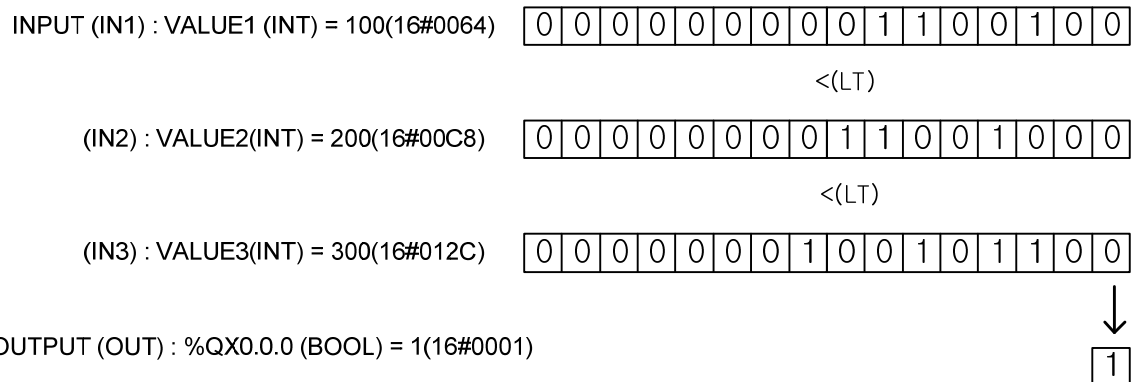


### 2. ST

%QX0.0.0 := LT(EN:= %MX0, IN1:= VALUE1, IN2:= VALUE2, IN3:= VALUE3);

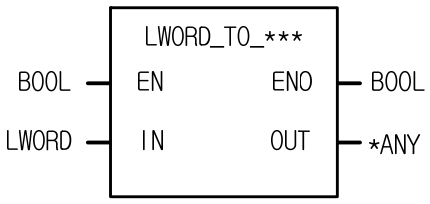
(1) If the transition condition (%MX0) is on, LT function executes.

(2) If input variable VALUE1 = 100, VALUE2 = 200, and VALUE3 = 300, output %Q0.0.0 = 1 because of VALUE1 < VALUE 2 < VALUE 3 as a result of the comparison.





LWORD_TO_***	LWORD type conversion	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: bit String to convert (64bit)</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: type-converted data</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	OUT	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○				○	○

\*ANY: exclude LWORD, REAL, TIME, DATE and TOD from ANY type.

#### ■ Function

It converts input IN type and produces output, OUT.

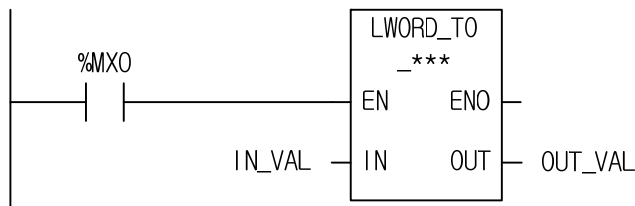
Function	Output type	Description
LWORD_TO_SINT	SINT	Takes the lower 8 bits and converts into SINT type.
LWORD_TO_INT	INT	Takes the lower 16bits and converts into INT type.
LWORD_TO_DINT	DINT	Takes the lower 32bits and converts into DINT type.
LWORD_TO_LINT	LINT	Converts into LINT type without changing the internal bit array.
LWORD_TO_USINT	USINT	Takes the lower 8 bits and converts into USINT type.
LWORD_TO_UINT	UINT	Takes the lower 16 bits and converts into UINT type.
LWORD_TO_UDINT	UDINT	Takes the lower 32bits and converts into UDINT type.
LWORD_TO_ULINT	ULINT	Converts into ULINT type without changing the internal bit array.
LWORD_TO_BOOL	BOOL	Takes the lower 1 bit and converts into BOOL type.
LWORD_TO_BYTE	BYTE	Takes the lower 8 bits and converts into BYTE type.
LWORD_TO_WORD	WORD	Takes the lower 16 bits and converts into WORD type.
LWORD_TO_DWORD	DWORD	Takes the lower 32 bits and converts into DWORD type.
LWORD_TO_LREAL	LREAL	Converts LWORD into LREAL type.
LWORD_TO_DT	DT	Converts into DT type without changing the internal bit array. However,

## Ch. 7 Basic Functions

Function	Output type	Description
		with a value out of DT range (DT#2163-12-31-23:59:59:999), _ERR, _LER flags are set and it is alternately converted within the range of DT.
LWORD_TO_STRING	STRING	Converts input value into STRING type.

### ■ Program Example

#### 1. LD



#### 2. ST

ST language doesn't support LWORD\_TO\_\*\*\*

In case of LWORD\_TO\_LINT

```
OUT_VAL := LWROD_TO_LINT(EN:= %MX0, IN:= IN_VAL);
```

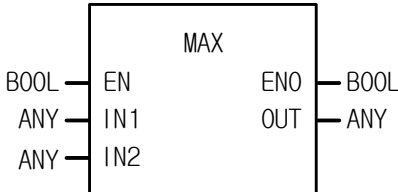
(1) If the input condition (%MX0) is on, LWORD\_TO\_\*\*\* function executes.

(2) If input variable IN\_VAL (LWORD) = 16#FFFF\_FFFF\_FFFF\_FFFF, output variable OUT\_VAL (LINT) is -1 (16#FFFF\_FFFF\_FFFF\_FFFF).

```

INPUT (IN) : IN_VAL (LWORD) = 16#FFFFFFFFFFFFFFFF
                        ↓ (LWORD_TO_LINT)
OUTPUT (OUT) : OUT_VAL (LINT) = -1
  
```

<b>MAX</b>	<b>Maximum value</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b></p> <p>EN: executes the function in case of 1</p> <p>IN1: the value to be compared</p> <p>IN2: the value to compare</p> <p>Input variable number can be extended up to 8.</p> <p><b>Output</b></p> <p>ENO: outputs EN value as it is</p> <p>OUT: maximum value among input</p> <p>IN1, IN2,..., OUT must be of the same data type</p>

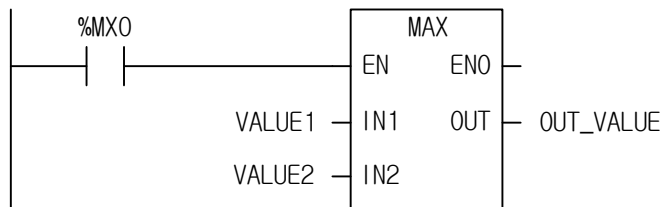
ANY type Variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	IN2	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	OUT	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

### ■ Function

It produces the maximum value among input IN1, IN2,..., INn (n: number of inputs).

### ■ Program Example

#### 1. LD



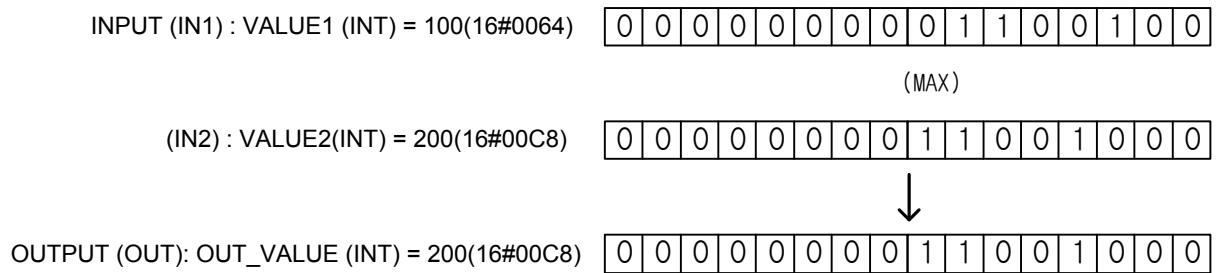
### 2. ST

OUT\_VALUE := MAX(EN:= %MX0, IN1:= VALUE1, IN2:= VALUE2);

(1) If the transition condition (%MX0) is on, MAX function executes.

(2) As the result of comparing input variable (VALUE1 = 100 and VALUE2 = 200), maximum value is 200.

Output OUT\_VAL is 200.



<b>MID</b>	<b>Takes the middle part of a String</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
<pre> graph LR     subgraph MID_Box [MID]         EN[EN]         IN[IN]         L[L]         P[P]         ENO[ENO]         OUT[OUT]     end     EN --- ENO     IN --- OUT     L --- OUT     P --- OUT </pre>	<p><b>Input</b> EN: executes the function in case of 1 IN: input String L: the length of String to output P: starting location of String to output</p> <p><b>Output</b> ENO: without an error, it is 1. OUT: output String</p>

#### ■ Function

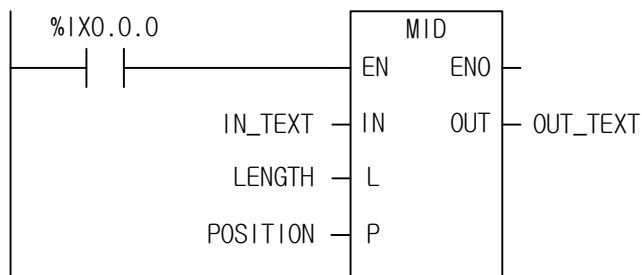
It produces a String (L) of IN from the P character.

#### ■ Flag

Flag	Description
_ERR	If (character number of variable IN) < P, P <= 0 or L < 0, then _ERR and _LER flags are set.

#### ■ Program Example

##### 1. LD



### 2. ST

OUT\_TEXT := MID(EN:= %IX0.0.0, IN:= IN\_TEXT, L:= LENGTH, P:= POSITION);

(1) If the transition condition (%IX0.0.0) is on, MID function executes.

(2) If input String IN\_TEXT = 'ABCDEFGH', the length of String LENGTH = 3, and starting location of character starting POSITION = 2, output variable OUT\_TEXT = 'BCD'.

INPUT (IN) : IN\_TEXT (STRING) = 'ABCDEFGH'

(L) : LENGTH (INT) = 3

(P) : POSITION (INT) = 2

↓ (MID)

OUTPUT (OUT) : OUT\_TEXT = 'BCD'

<b>MIN</b>	<b>Minimum value</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1  IN1: value to be compared  IN2: value to compare  Input variable number can be extended up to 8</p> <p><b>Output</b> ENO: outputs EN value as it is  OUT: minimum value among input values</p> <p>IN1, IN2, ..., OUT must be of all the same data type.</p>

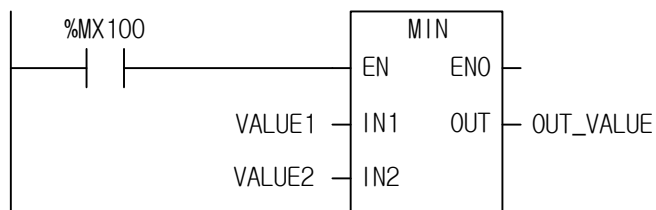
ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	IN2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	OUT	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### ■ Function

Produces the minimum value among input IN1, IN2, ... , INn (n: number of inputs).

### ■ Program Example

#### 1. LD



### 2. ST

OUT\_VALUE := MIN(EN:= %MX100, IN1:= VALUE1, IN2:= VALUE2);

- (1) If the transition condition (%MX100) is on, MIN function executes.
- (2) The output is OUT\_VALUE = 100 because its minimum value is 100 as the result of comparing VALUE1 = 100 to VALUE2 = 200.

INPUT (IN1) : VALUE1 (INT) = 100(16#0064) 

0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

(MIN)

(IN2) : VALUE2 (INT) = 200(16#00C8) 

0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---



OUTPUT(OUT): OUT\_VALUE (INT) = 100(16#0064) 

0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---



<b>MOD</b>	<b>Dividing result (remainder)</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN1: dividend IN2: divisor</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: dividing result (remainder)</p> <p>IN1, IN2, ..., OUT must be of all the same data type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN1						○	○	○	○	○	○	○	○							
	IN2						○	○	○	○	○	○	○	○							
	OUT						○	○	○	○	○	○	○	○							

#### ■ Function

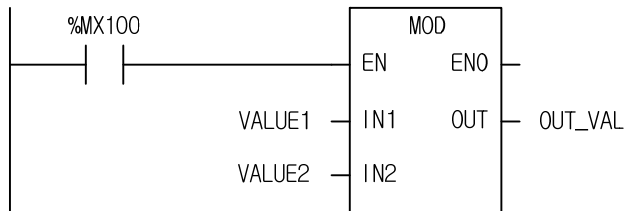
1. Divides IN1 by IN2 and outputs its remainder as OUT.

$$\text{OUT} = \text{IN1} - (\text{IN1}/\text{IN2}) \times \text{IN2} \quad (\text{If } \text{IN2} = 0, \text{OUT} = 0)$$

IN1	IN2	OUT
7	2	1
7	-2	1
-7	2	-1
-7	-2	-1
7	0	0

### ■ Program Example

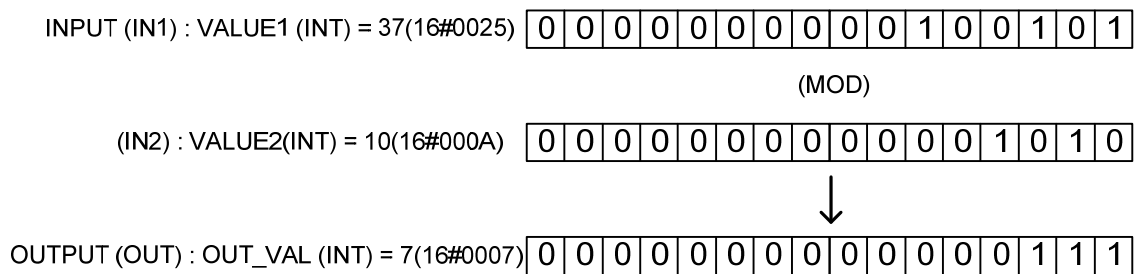
#### 1. LD



#### 2. ST

OUT\_VAL := MOD(EN:= %MX100, IN1:= VALUE1, IN2:= VALUE2);

- (1) If the transition condition (%MX100) is on, MOD function executes.
- (2) If the dividend VALUE1 = 37 and the divisor VALUE2 = 10, the remainder value OUT\_VAL is 7 as a result of dividing 37 by 10.



MOVE	Data movement (Copy data)	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: value to be moved</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: moved value</p> <p>Variables connected to IN and OUT are of the same type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	OUT	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

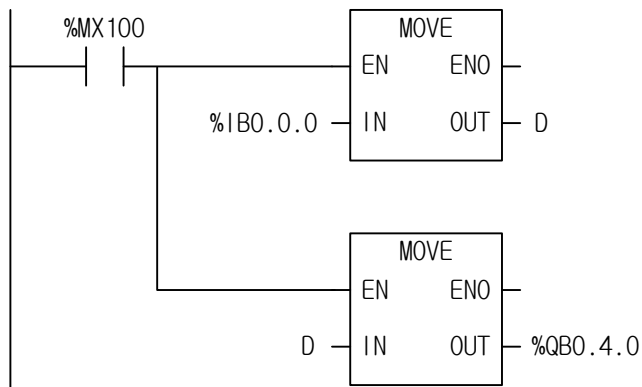
### ■ Function

Moves an IN value to OUT.

### ■ Program Example

This is a program that transfers the 8-contact inputs %I0.0.0~%I0.0.7 to the variable D and then moves them to output %Q0.4.0~%Q0.4.7.

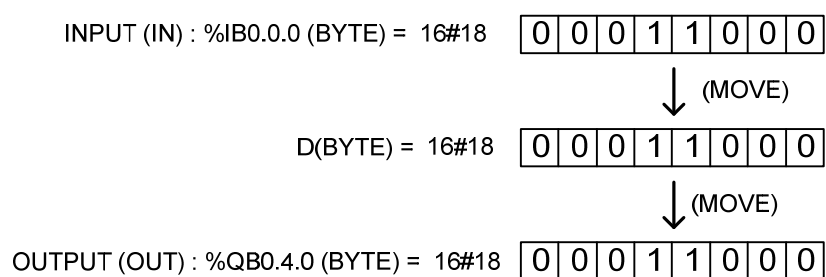
#### 1. LD



### 2. ST

```
D := MOVE(EN:= %MX100, IN:= %IB0.0.0);  
%QB0.4.0 := MOVE(EN:= %MX100, IN:= D);
```

- (1) If the transition condition (%MX100) is on, MOVE function executes.  
(2) It moves 8-contact input module data to the variable D by the first MOVE function and moves them to %Q0.4.0~%Q0.4.7 by the second one.



<b>MUL</b>	<b>Multiplication</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1  IN1: multiplicand  IN2: multiplier  Input is available to extend up to 8.</p> <p><b>Output</b> ENO: without an error, it is 1  OUT: multiplied value</p> <p>Variables connected to IN1, IN2, ..., OUT are all of the same data type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN1						○	○	○	○	○	○	○	○	○	○					
	IN2						○	○	○	○	○	○	○	○	○	○					
	OUT						○	○	○	○	○	○	○	○	○	○					

#### ■ Function

Multiplies an IN1, IN2,..., INn (n: number of inputs) and outputs the result as OUT.

$$\text{OUT} = \text{IN1} \times \text{IN2} \times \dots \times \text{INn}$$

#### ■ Flag

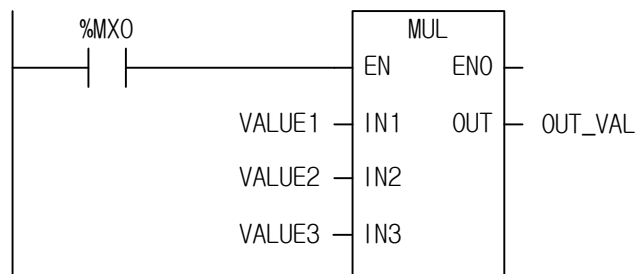
Flag	Description
_ERR	If an output value is beyond the range of its data-type, _ERR and _LER flags are set.

☆ If REAL, LREAL type operation exceeds the maximum or minimum value in the middle of the operation because it performs the operation sequentially from IN1 to IN8, \_ERR, \_LER flag are set and the result is an unlimited or abnormal value.

(1.#INF000000000000e+000, 1.#SNAN000000000000e+000, 1.#QNAN000000000000e+000).

### ■ Program Example

#### 1. LD



#### 2. ST

OUT\_VAL := MUL(EN:= %MX0, IN1:= VALUE1, IN2:= VALUE2, IN3:= VALUE3);

(1) If the transition condition (%MX0) is on, MUL function executes.

(2) If input variables of MUL function, VALUE1 = 30, VALUE2 = 20, VALUE3 = 10, then the output variable OUT\_VAL =  $30 \times 20 \times 10 = 6000$ .

INPUT (IN1) : VALUE1 (INT) = 30(16#001E) 

0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

  
+(MUL)

(IN2) : VALUE2 (INT) = 20(16#0014) 

0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

  
+(MUL)

(IN3) : VALUE3 (INT) = 10(16#000A) 

0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

  
↓

OUTPUT (OUT) : OUT\_VAL (INT) = 6,000(16#1770) 

0	0	0	1	0	1	1	1	0	1	1	1	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

<b>MUL_TIME</b>	<b>Time multiplication</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
<pre> graph LR     subgraph MUL_TIME         EN[EN]         IN1[IN1]         IN2[IN2]         ENO[ENO]         OUT[OUT]     end     EN --&gt; ENO     IN1 --&gt; OUT     IN2 --&gt; OUT </pre>	<p><b>Input</b> EN: executes the function in case of 1 IN1: time to be multiplied IN2: multiplying value</p> <p><b>Output</b> ENO: without an error, it is 1 OUT: multiplied result</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN2						○	○	○	○	○	○	○	○	○	○					

#### ■ Function

Multiplies the IN1 (time) by IN2 (number) and outputs the result time as OUT.

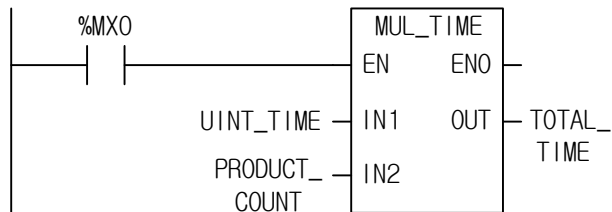
#### ■ Flag

Flag	Description
_ERR	If an output value is out of its TIME-data range, _ERR and _LER flags are set. If a negative value is entered to IN2, _ERR and _LER flags are on and IN2 is converted to hexadecimal, producing the multiplication result.

### ■ Program Example

This is the program that sets the required working time: the average estimated time per unit product is 20min 2sec and the number of product to produce a day is 20 in one product line.

#### 1. LD



#### 2. ST

```
TOTAL_TIME := MUL_TIME(EN:= %MX0, IN1:= UNIT_TIME, IN2:= PRODUCT_COUNT);
```

- (1) Write input variable (IN1: the estimated time per unit product) UNIT\_TIME: T#20M2S.
- (2) Write input variable (IN2: quantity of production) PRODUCT\_COUNT: 20.
- (3) Write TOTAL\_TIME to the output variable (OUT: total required working time).
- (4) If the transition condition (%MX0) is on, T#6H40M40S is produced in output TOTAL\_TIME.

```
INPUT (IN1): UNIT_TIME (TIME) = T#20MS2S
                                (MUL_TIME)
(IN2): PRODUCT_COUNT(INT) = 16#18
                                ↓
OUTPUT (OUT): TOTAL_TIME (TIME) = T#6H40M40S
```



<b>MUX</b>	<b>Selection from multiple inputs</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b></p> <p>EN: executes the function in case of 1</p> <p>K: selection</p> <p>IN0: the value to be selected</p> <p>IN1: the value to be selected</p> <p>Input variable number can be extended up to 7(IN0, IN1, ..., IN6)</p> <p><b>Output</b></p> <p>ENO: without an error, it is 1.</p> <p>OUT: the selected value</p> <p>IN0, IN1, ..., OUT must be of the same data type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN0	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	IN1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	OUT	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

#### ■ Function

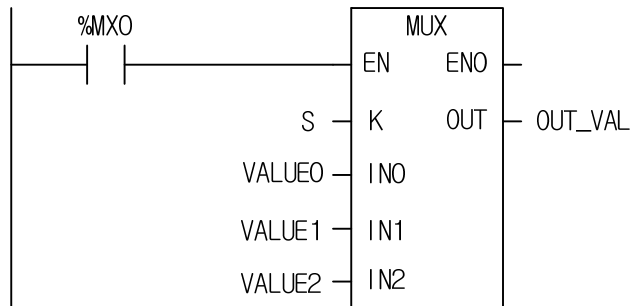
1. Selects one among several inputs (IN0, IN1, ..., INn) with K value and produces it.
2. If K = 0, IN0 is an output; if K = 1, IN1 is an output; if K = n, INn is an output.

#### ■ Flag

Flag	Description
_ERR	If K is greater than or equal to 'n' which is the number of input variable INn, then IN0 is an output and _ERR, _LER flags are set. If K is negative, _ERR and _LER flags are set

### ■ Program Example

#### 1. LD



#### 2. ST

```
OUT_VAL := MUX(EN:= %MX0, K:= S, IN0:= VALUE0, IN1:= VALUE1, IN2:= VALUE2);
```

(1) If the transition condition (%MX0) is on, MUX function executes.

(2) Input variable is selected by selection variable S and is moved to OUT.

```

INPUT (K) : S (INT) = 2
(IN0) : VALUE0(WORD) = 16#0011
(IN1) : VALUE1(WORD) = 16#0022
(IN2) : VALUE2(WORD) = 16#0033

```

↓ (MUX)

```
OUTPUT (OUT) : OUT_VAL (WORD) = 16#0033
```

<b>NE</b>	<b>'Not equal to' comparison</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1  IN1: The value to be compared  IN2: The value to be compared  IN1, IN2 must be of the same data type.</p> <p><b>Output</b> ENO: outputs EN value as it is  OUT: the compared result value</p>

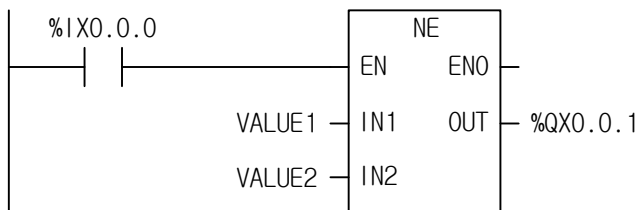
ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	IN2	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

### ■ Function

1. If IN1 is not equal to IN2, output, OUT is 1.
2. If IN1 is equal to IN2, output, OUT is 0.

### ■ Program Example

#### 1. LD



#### 2. ST

```
%QX0.0.1 := NE(EN:= %IX0.0.0, IN1:= VALUE1, IN2:= VALUE2);
```

- (1) If the transition condition (%IX0.0.0) is on, NE function executes.
- (2) If input variable VALUE1 = 300, VALUE2 = 200 (the compared result VALUE1 and VALUE2 are different), output result value is %QX0.0.1 = 1.

## Ch. 7 Basic Functions

INPUT (IN1) : VALUE1 (INT) = 300(16#012C) 

0	0	0	0	0	0	0	0	1	0	0	1	0	1	1	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---



(IN2) : VALUE2(INT) = 200(16#0C8) 

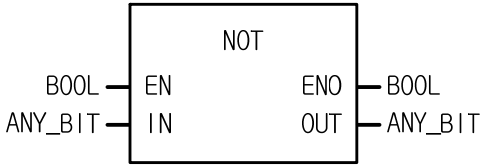
0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---



OUTPUT (OUT) : %QX0.0.1 (BOOL) = 1(16#1)

1
---

<b>NOT</b>	<b>Reverse Logic (Logic inversion)</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b>    EN: executes the function in case of 1                      IN: the value to be logically inverted</p> <p><b>Output</b>    ENO: outputs EN value as it is                      OUT: the inversed (NOT) value</p> <p>IN, OUT must be of the same data type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN	○	○	○	○	○															
	OUT	○	○	○	○	○															

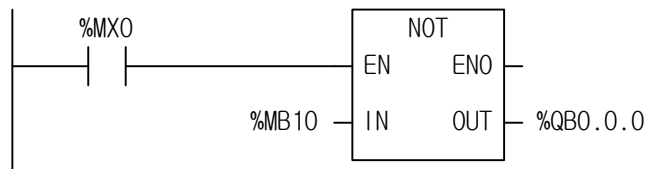
### ■ Function

It inverts the IN (by bit) and produces output, OUT.

```
IN      1100 ..... 1010
OUT     0011 ..... 0101
```

### ■ Program Example

#### 1. LD



#### 2. ST

```
%QB0.0.0 := NOT_BYTE(EN:= %MX0, IN1:=MB10);
```

(1) If the transition condition (%MX0) is on, NOT function executes.

(2) If NOT function executes, input data value of %MB10 is inversed and is written in %QB0.0.0.

## Ch. 7 Basic Functions

INPUT (IN) : %MB10 (BYTE) = 16#CC 

1	1	0	0	1	1	0	0
---	---	---	---	---	---	---	---

↓ (NOT)

OUTPUT (OUT) : %QB0.0.0 (BYTE) = 16#33 

0	0	1	1	0	0	1	1
---	---	---	---	---	---	---	---

<b>OR</b>	<b>Logic Sum</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1  IN1: input 1  IN2: input 2  Input variables extend up to 8.</p> <p><b>Output</b> ENO: outputs EN value as it is  OUT: OR result</p> <p>IN1, IN2, OUT must be of all the same data type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN	○	○	○	○	○															
	OUT	○	○	○	○	○															

### ■ Function

It performs a logical OR on the input variables by bit and produces output, OUT.

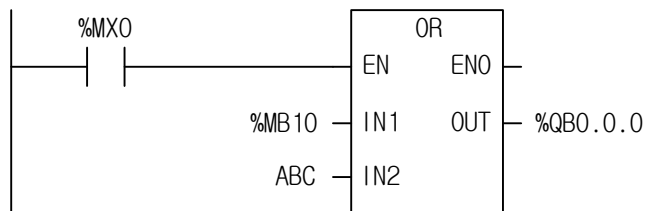
```

IN1      1111 ..... 0000
OR
IN2      1010 ..... 1010
OUT      1111 ..... 1010

```

### ■ Program Example

#### 1. LD

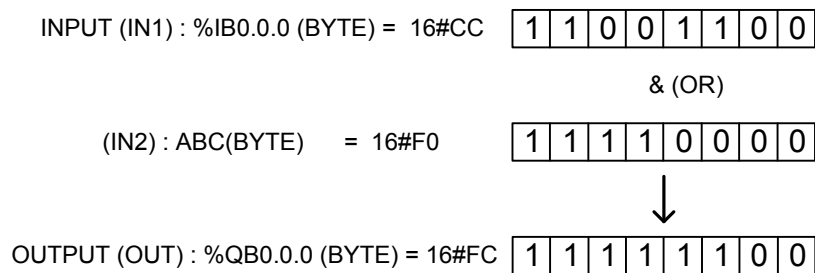


#### 2. ST

```
%QB0.0.0 := OR2_BYTE(EN:=%MX0, IN1:=%MB10, IN2:=ABC);
```

(1) If the transition condition (%MX0) is on, function OR executes.

(2) The result of a logic sum (OR) for %MB10 = 2#1100\_1100 and ABC = 2#1111\_0000 is produced in %QB0.0.0 = 2#1111\_1100





REAL_TO_***		REAL type conversion																	
		Availability						XGI, XGR, XEC											
		Flags						_ERR, _LER											

Function		Description																	
<div><div>REAL_TO_***</div><div><div>BOOL</div><div>EN</div><div>ENO</div><div>BOOL</div><div>REAL</div><div>IN</div><div>OUT</div><div>ANY_INT,DWORD LREAL,STRING</div></div></div>		<div><div>Input</div><div>EN: executes the function in case of 1 IN: the REAL value to be converted</div></div> <div><div>Output</div><div>ENO: without an error, it is 1. OUT: type-converted data</div></div>																	

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	OUT				○		○	○	○	○	○	○	○	○		○					○

#### ■ Function

It converts the IN type and outputs it as OUT.

Function	Output Type	Description
REAL_TO_SINT	SINT	If integer part of input is -128 ~ 127, normal conversion. Otherwise an error occurs. (Decimals round-off)
REAL_TO_INT	INT	If integer part of input is -32,768 ~ 32,767, normal conversion. Otherwise an error occurs. (Decimals round-off)
REAL_TO_DINT	DINT	If integer part of input is $-2^{31} \sim 2^{31}-1$ , normal conversion. Otherwise an error occurs. (Decimals round-off)
REAL_TO_LINT	LINT	If integer part of input is $-2^{63} \sim 2^{63}-1$ , normal conversion. Otherwise an error occurs. (Decimals round-off)
REAL_TO_USINT	USINT	If integer part of input is 0 ~ 255, normal conversion. Otherwise an error occurs. (Decimals round-off)
REAL_TO_UINT	UINT	If integer part of input is 0 ~ 65,535, normal conversion. Otherwise an error occurs. (Decimals round-off)
REAL_TO_UDINT	UDINT	If integer part of input is $0 \sim 2^{32}-1$ , normal conversion. Otherwise an error occurs. (Decimals round-off)
REAL_TO_ULINT	ULINT	If integer part of input is $0 \sim 2^{64}-1$ , normal conversion. Otherwise an error occurs. (Decimals round-off)
REAL_TO_DWORD	DWORD	Converts into DWORD type without changing the internal bit array.

## Ch. 7 Basic Functions

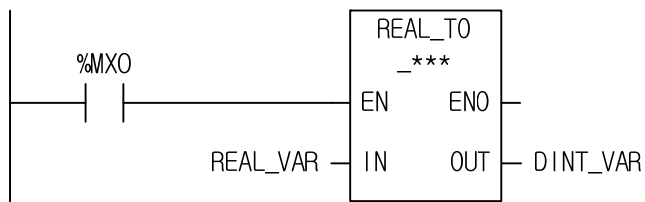
Function	Output Type	Description
REAL_TO_LREAL	LREAL	Converts REAL into LREAL type normally.
REAL_TO_STRING	STRING	Converts REAL into STRING type normally.

### ■ Flag

Flag	Description
_ERR	If overflow occurs (input value is greater than the value to be stored in output type), _ERR, _LER flags are set. If an error occurs, the output is 0.

### ■ Program Example

#### 1. LD



#### 2. ST

ST language doesn't support REAL\_TO\_\*\*\*

In case of REAL\_TO\_DINT

```
DINT_VAR := REAL_TO_DINT(EN:=%MX0, IN:=REAL_VAR);
```

(1) If the transition condition (%MX0) is on, function REAL\_TO\_\*\*\* executes.

(2) If REAL\_VAL (REAL type) = 1.234E4, DINT\_VAL (DINT) = 12,340.

INPUT (IN) : REAL\_VAL (REAL) = 1.234E4  
 ↓ (REAL\_TO\_DINT)  
 OUTPUT (OUT) : DINT\_VAL (DINT) = 12,340

# REPLACE

## String replacement

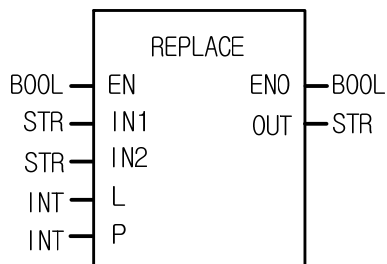
Availability

XGI, XGR, XEC

Flags

\_ERR, \_LER

### Function



### Description

#### Input

EN: executes the function in case of 1  
 IN1: character string to be replaced  
 IN2: character string to replace  
 L: the length of character string to be replaced  
 P: position of character string to be replaced

#### Output

ENO: without an error, it is 1  
 OUT: output character string

### Function

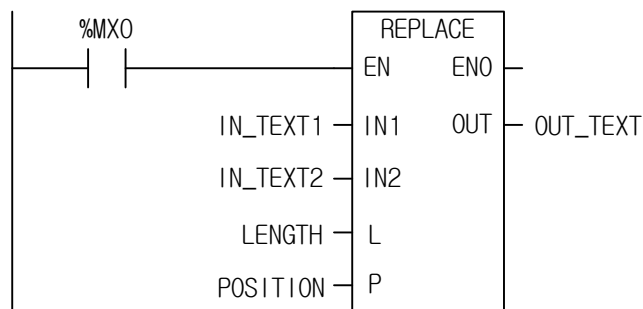
1. Its function is to remove the L-length character from IN1 (starting from P) and put IN2 in the removed position as output OUT.

### Flag

Flag	Description
_ERR	_ERR, _LER flags are set if $P \leq 0$ or $L < 0$ , $P > (\text{input character number of IN1})$ or character number of result $> 30$

### Program Example

#### 1. LD



### 2. ST

OUT\_TEXT := REPLACE(EN:=%MX0, IN1:=IN\_TEXT1, IN2:= IN\_TEXT2, L:=LENGTH, P:=POSITION);

- (1) If the transition condition (%MX0) is on, function REPLACE (character string replacement) executes.
- (2) If input variable of character string to be replaced IN\_TEXT1 = `ABCDEF`, input variable of character string to replace is IN\_TEXT2 = `X`, input variable of character string length to be replaced LENGTH = 3 and input variable of character string position designation to be replaced is POSITION = 2, then `BCD` of IN\_TEXT1 is replaced with `X` of IN\_TEXT2 and output variable OUT\_TEXT is `AXEF`.

```
INPUT (IN1) : IN_TEXT1 (STRING) = `ABCDEF`  
            (IN2) : IN_TEXT2 (STRING) = ` X`  
            (L) : LENGTH (INT) =      3  
            (P) : POSITION (INT) =      2  
                                     ↓  
OUTPUT (OUT) : OUT_TEXT (STRING) = `AXEF`
```

<b>RIGHT</b>	<b>To take the right of character string</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
<pre> graph LR     subgraph RIGHT         EN[EN]         IN[IN]         L[L]         ENO[ENO]         OUT[OUT]     end     EN --- ENO     IN --- OUT     L --- OUT           </pre>	<p><b>Input</b></p> <p>EN: If EN is 1, function executes</p> <p>IN: input character string</p> <p>L: length of character string</p> <p><b>Output</b></p> <p>ENO: without an error, it is 1</p> <p>OUT: output character string</p>

#### ■ Function

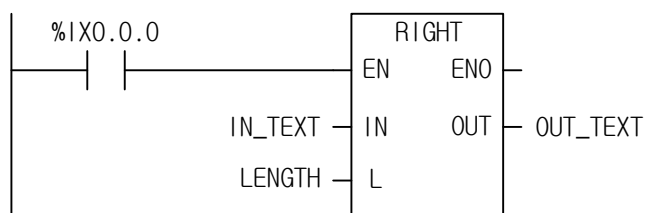
It takes a right L-length character string of IN and produces output, OUT.

#### ■ Flag

Flag	Description
_ERR	If $L < 0$ , _ERR and _LER flags are set.

#### ■ Program Example

##### 1. LD



### 2. ST

```
OUT_TEXT := RIGHT(EN:=%IX0.0.0, IN:=IN_TEXT, L:=LENGTH);
```

(1) If the transition condition (%IX0.0.0) is on, function RIGHT (to take the right of character string) executes.

(2) If character string declared as input variable IN\_TEXT = `ABCDEFGH` and the length of character string to output is

LENGTH = 3, output character string variable is OUT\_TEXT = `EFG`.

INPUT (IN) : IN\_TEXT (STRING) = `ABCDEFGH`

(L) : LENGTH(INT) = 3

↓ (RIGHT)

OUTPUT (OUT) : OUT\_TEXT (STRING) = `EFG`

ROL	Rotate to Left	
	Availability	XGI, XGR, XEC
	Flags	

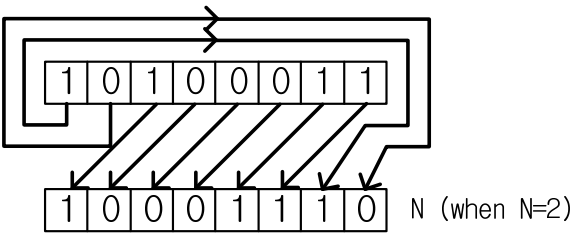
Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: the value to be rotated N: bit number to rotate</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: the rotated value</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN		○	○	○	○															
	OUT		○	○	○	○															

\*ANY\_BIT: exclude BOOL from ANY\_BIT.

■ Function

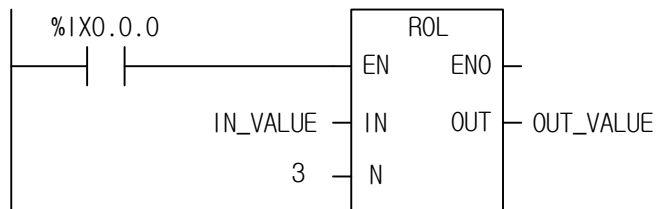
It rotates input IN to the left as many as N bit number.



### ■ Program Example

This is the program that rotates the value of input data (2#1100\_1100\_1100\_1100:16#CCCC) to the left by 3 bits if input %IX0.0.0 is on.

#### 1. LD



#### 2. ST

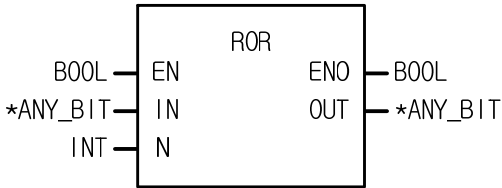
```
OUT_VALUE := ROL(EN:=%IX0.0.0, IN:=IN_VALUE, N:=3);
```

- (1) Set input variable IN\_VALUE to rotate.
- (2) Set the value to be rotated.
- (3) Set output variable to output the rotated data value as OUT\_VALUE.
- (4) If the transition condition (%IX0.0.0) is on, function ROL executes and a data bit set as input variable is rotated to the left by 3 bits and produces output, OUT\_VALUE..

INPUT (IN) : IN_VALUE (WORD) = 16#CCCC	<table border="1" style="display: inline-table; border-collapse: collapse; text-align: center;"> <tr> <td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td> </tr> </table>	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0
1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0		
(N) : 3	<div style="display: inline-block; text-align: center;"> <div style="font-size: 2em;">↓</div> <div>(ROL)</div> </div>																
OUTPUT (OUT) : OUT_VALUE (WORD) = 16#6666	<table border="1" style="display: inline-table; border-collapse: collapse; text-align: center;"> <tr> <td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td> </tr> </table>	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0
0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0		



ROR	Rotate to right	
	Availability	XGI, XGR, XEC
	Flags	

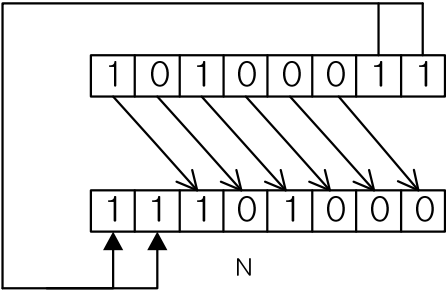
Function	Description
	<p><b>Input</b>    EN: executes the function in case of 1               IN: the value to be rotated               N: bit number to rotate</p> <p><b>Output</b>   ENO: outputs EN value as it is               OUT: the rotated value</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN		○	○	○	○															
	OUT		○	○	○	○															

\*ANY\_BIT: exclude BOOL from ANY type.

■ Function

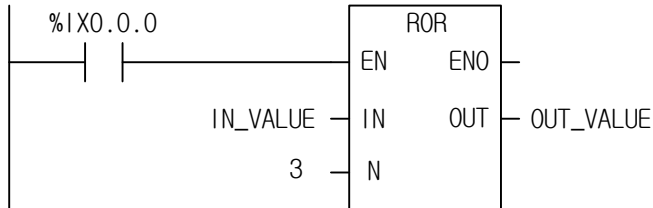
It rotates input IN to the right as many as N bit number.



### ■ Program Example

This is the program that rotates input data value (2#1110\_0011\_0011\_0001: 16#E331) to the right by 3 bits if input %IX0.0.0 is on.

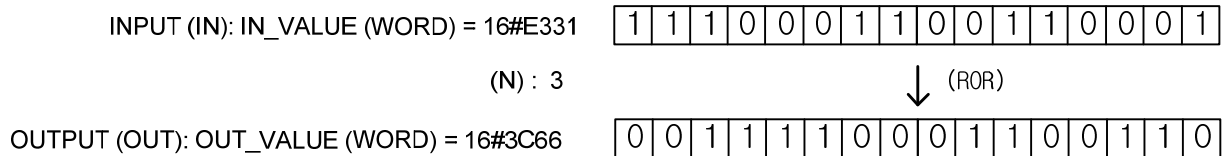
#### 1. LD



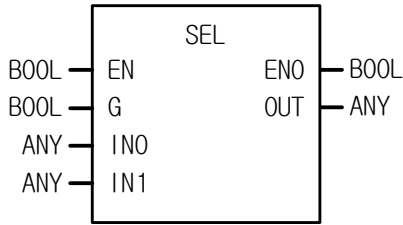
#### 2. ST

```
OUT_VALUE := ROR(EN:=%IX0.0.0, IN:=IN_VALUE, N:=3);
```

- (1) Set input variable of a data value to rotate as IN\_VALUE.
- (2) Insert bit number 3 into bit number input N.
- (3) If the transition condition (%IX0.0.0) is on, function ROR (rotate Right) executes and data bit set as input variable is rotated to the right by 3 bits and produces output ,OUT\_VALUE.



<b>SEL</b>	<b>Selection from two inputs</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b></p> <p>EN: executes the function in case of 1</p> <p>G: selection</p> <p>IN0: the value to be selected</p> <p>IN1: the value to be selected</p> <p><b>Output</b></p> <p>ENO: outputs EN value as it is</p> <p>OUT: the selected value</p> <p>IN1, IN2, OUT must be of all the same type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN0	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	IN1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	OUT	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

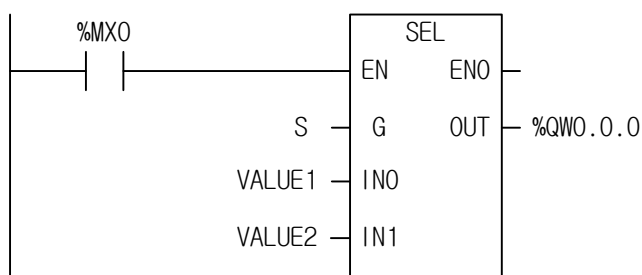
### ■ Function

If G is 0, IN0 is an output and if G is 1, IN1 is an output.

### ■ Program Example

If the input (%MX0) is on, this program selects an input between the two (VALUE1, VALUE2) and outputs the value as described in S.

#### 1. LD



### 2. ST

%QW0.0.0 := SEL(EN:=%MX0, G:=S, IN0:=VALUE1, IN1:=VALUE2);

(1) If the transition condition (%MX0) is on, function SEL executes.

(2) If S = 1 and VALUE1 = 16#1110, VALUE2 = 16#FF00, then output variable %QW0.0.0 = 16#FF00.

INPUT (G) : S = 1

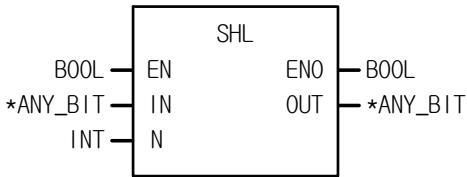
(IN0) : VALUE1(WORD) = 16#1110

(IN1) : VALUE2(WORD) = 16#FF00

↓ (SEL)

OUTPUT (OUT) : %QW0.0.0 (WORD) = 16#FF00

<b>SHL</b>	<b>Shift Left</b>	
	Availability	XGI, XGR, XEC
	Flags	

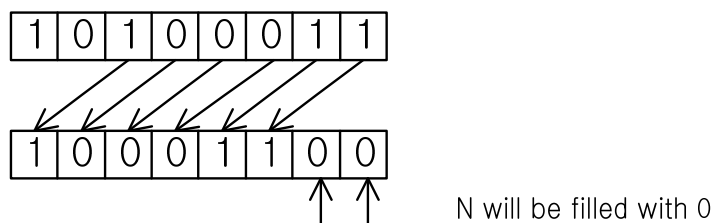
Function	Description
	<p><b>Input</b></p> <p>EN: If EN is 1, function is executes.</p> <p>IN: bit string to be shifted</p> <p>N: bit number to be shifted</p> <p><b>Output</b></p> <p>ENO: outputs EN value as it is</p> <p>OUT: the shifted value</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN		○	○	○	○															
	OUT		○	○	○	○															

\*ANY\_BIT: exclude BOOL from ANY\_BIT.

#### ■ Function

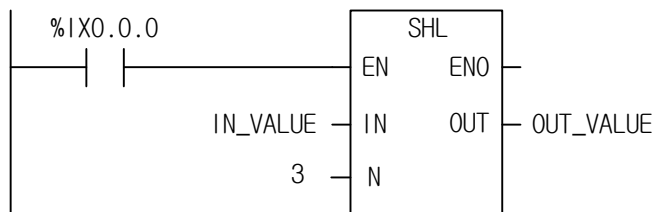
1. It shifts input IN to the left as many as N bit number.
2. N number bit on the rightmost of input IN is filled with 0.



### ■ Program Example

This is the program that shifts input data value (2#1100\_1100\_1100\_1100:16#CCCC) to the left by 3 bits if input %IX0.0.0 is on

#### 1. LD



#### 2. ST

```
OUT_VALLUE := SHL(EN:=%IX0.0.0, IN:=IN_VALUE, N:=3);
```

- (1) Set the input variable IN\_VALUE (2#1100\_1100\_1100\_1100: 16#CCCC).
- (2) Insert bit number 3 into N.
- (3) If the transition condition (%IX0.0.0) is on, function SHL (shift Left) executes and data bit set as input variable shifts to the left by 3 bits and produces output, OUT\_VALUE.

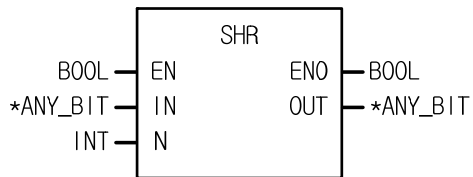
INPUT (IN) : IN_VALUE (WORD) = 16#CCCC	<table border="1" style="display: inline-table; border-collapse: collapse; text-align: center;"> <tr> <td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td> </tr> </table>	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0
1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0		
(N) : 3	<div style="display: inline-block; text-align: center;"> ↓ (ROL) </div>																
OUTPUT (OUT) : OUT_VALUE (WORD) = 16#6660	<table border="1" style="display: inline-table; border-collapse: collapse; text-align: center;"> <tr> <td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> </table>	0	1	1	0	0	1	1	0	0	1	1	0	0	0	0	0
0	1	1	0	0	1	1	0	0	1	1	0	0	0	0	0		

**SHR****Shift Right**

Availability

XGI, XGR, XEC

Flags

**Function****Description**

**Input** EN: executes the function in case of 1  
 IN: bit string to be shifted  
 N: bit number to be shifted

**Output** ENO: outputs EN value as it is  
 OUT: the shifted value

ANY type variable

Variable

BOOL

BYTE

WORD

DWORD

LWORD

SINT

INT

DINT

LINT

USINT

UINT

UDINT

ULINT

REAL

LREAL

TIME

DATE

TOD

DT

STRING

IN

OUT

○

○

○

○

○

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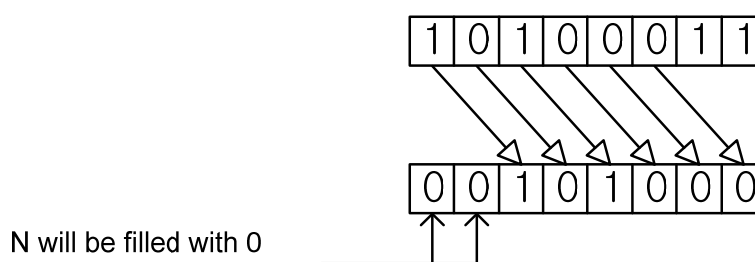
○

○

\*ANY\_BIT: exclude BOOL from ANY\_BIT.

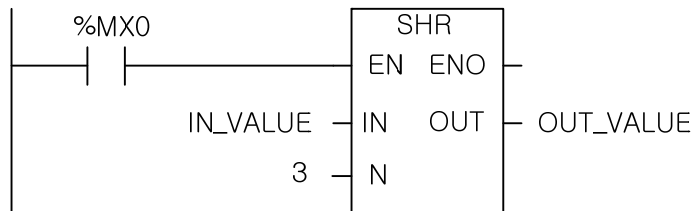
**■ Function**

1. It shifts input IN to the right as many as N bit number.
2. N number bit on the leftmost of input IN is filled with 0.



### ■ Program Example

#### 1. LD

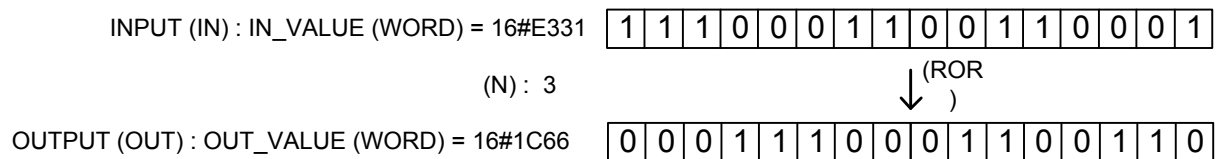


#### 2. ST

OUT\_VALUE := SHR(EN:=%MX0, IN:=IN\_VALUE, N:=3);

(1) If the transition condition (%MX0) is on, function SHL (Shift Left) executes.

(2) Data bit set as input variable shift to the right by 3 bits and produces outputs, OUT\_VALUE.





<b>SIN</b>	<b>Sine operation</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: input value of Sine operation (radian)</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: Sine operation result value</p> <p>IN, OUT must be of the same data type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN														○	○					
	OUT														○	○					

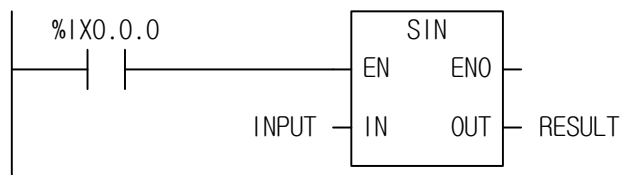
### ■ Function

Finds the Sine operation value of IN and produces output, OUT.

$$OUT = SIN(IN)$$

### ■ Program Example

#### 1. LD



### 2. ST

RESULT := SIN(EN:=IX0.0.0, IN:=INPUT);

(1) If the transition condition (%IX0.0.0) is on, function SIN (Sine operation) executes.

(2) If the value of input variable INPUT is 1.0471 .. . ( $\pi/3$  rad =  $60^\circ$ ), RESULT declared as output variable is 0.8660 ....

$$(\sqrt{3}/2). \quad \text{SIN}(\pi/3) = \sqrt{3}/2 = 0.8660$$

INPUT (IN) : INPUT (REAL) = 1.0471

↓ (SIN)

OUTPUT (OUT) : RESULT (REAL) = 8.65976572E-01

SINT_TO_***	SINT type conversion	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
<div><div>SINT_TO_***</div><div>BOOL — EN                      ENO — BOOL</div><div>SINT — IN                      OUT — *ANY</div></div>	<div><div>Input</div><div>EN: executes the function in case of 1</div><div>IN: short Integer value</div></div> <div><div>Output</div><div>ENO: without an error, it is 1.</div><div>OUT: type-converted data</div></div>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	OUT	○	○	○	○	○		○	○	○	○	○	○	○	○	○					○

\*ANY: exclude SINT, TIME, DATE, TOD and DT from ANY type.

#### ■ Function

It converts the IN type and outputs it as OUT.

Function	Output type	Description
SINT_TO_INT	INT	Converts into INT type normally.
SINT_TO_DINT	DINT	Converts into DINT type normally.
SINT_TO_LINT	LINT	Converts into LINT type normally.
SINT_TO_USINT	USINT	If input is 0 ~ 127, normal conversion. Otherwise an error occurs.
SINT_TO_UINT	UINT	If input is 0 ~ 127, normal conversion. Otherwise an error occurs.
SINT_TO_UDINT	UDINT	If input is 0 ~ 127, normal conversion. Otherwise an error occurs.
SINT_TO_ULINT	ULINT	If input is 0 ~ 127, normal conversion. Otherwise an error occurs.
SINT_TO_BOOL	BOOL	Takes the lower 1 bit and converts into BOOL type.
SINT_TO_BYTE	BYTE	Converts into BYTE type without changing the internal bit array.
SINT_TO_WORD	WORD	Converts into WORD type filling the upper bits with 0.
SINT_TO_DWORD	DWORD	Converts into DWORD type filling the upper bits with 0.
SINT_TO_LWORD	LWORD	Converts into LWORD type filling the upper bits with 0.
SINT_TO_REAL	REAL	Converts SINT into REAL type normally.
SINT_TO_LREAL	LREAL	Converts SINT into LREAL type normally.
SINT_TO_STRING	STRING	Converts SINT into STRING type normally.

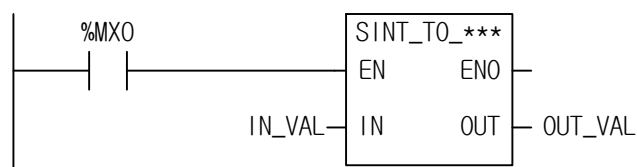
## Ch. 7 Basic Functions

### ■ Flag

Flag	Description
_ERR	If a conversion error occurs, _ERR and _LER flags are set. If an error occurs, take the lower bits as many as bit number of output type and output it without changing the internal bit array.

### ■ Program Example

#### 1. LD



#### 2. ST

ST language doesn't support SINT\_TO\_\*\*\*

In case of SINT\_TO\_BYTE

```
OUT_VAL := SINT_TO_BYTE(EN:=%MX0, IN:=IN_VAL);
```

(1) If the input condition (%MX0) is on, function SINT\_TO\_\*\*\* executes.

(2) If input variable IN\_VAL (SINT type) = 64 (2#0100\_0000), output variable OUT\_VAL (BYTE type) = 16#40 (2#0100\_0000).

INPUT (IN) : IN\_VAL (SINT) = 64(16#40)    

0	1	0	0	0	0	0	0
---	---	---	---	---	---	---	---

↓ (SINT\_TO\_BYTE)

OUTPUT (OUT) : OUT\_VAL (BYTE) = 16#64(16#64)    

0	1	1	0	0	1	0	0
---	---	---	---	---	---	---	---

<b>SQRT</b>	<b>Square root operation</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: input value of square root operation</p> <p><b>Output</b> ENO: without an error, it is 1. OUT: square root value</p> <p>IN, OUT must be of the same data type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN														○	○					
	OUT														○	○					

### ■ Function

It finds the square root value of IN and output it as OUT.

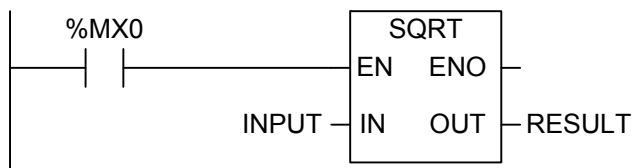
$$OUT = \sqrt{IN}$$

### ■ Flag

Flag	Description
_ERR	If the value of IN is a negative number, _ERR and _LER flag are set.

### ■ Program Example

#### 1. LD



### 2. ST

RESULT := Sqrt(EN:=%MX0, IN:=INPUT);

(1) If the transition condition (%MX0) is on, function Sqrt (square root operation) executes.

(2) If the value of input variable declared as INPUT is 9.0, RESULT declared as output variable is 3.0.

$$\sqrt{9.0} = 3.0$$

INPUT (IN) : INPUT (REAL) = 9.0

↓ (Sqrt)

OUTPUT (OUT) : RESULT (REAL) = 3.0

STRING_TO_***	STRING type conversion	
	Availability	XGI, XGR, XEC
	Flags	ERR, LER

Function	Description
	<p><b>Input</b> EN: If EN is 1, function converts. IN: character string</p> <p><b>Output</b> ENO: without an error, it is 1. OUT: type-converted data</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	

\*ANY: exclude STRING from ANY type.

## ■ Function

- Converts the IN type and outputs it as OUT.

Function	Output type	Description
STRING_TO_SINT	SINT	Converts STRING into SINT type.
STRING_TO_INT	INT	Converts STRING into INT type.
STRING_TO_DINT	DINT	Converts STRING into DINT type.
STRING_TO_LINT	LINT	Converts STRING into LINT type.
STRING_TO_USINT	USINT	Converts STRING into USINT type.
STRING_TO_UINT	UINT	Converts STRING into UINT type.
STRING_TO_UDINT	UDINT	Converts STRING into UDINT type.
STRING_TO_ULINT	ULINT	Converts STRING into ULINT type.
STRING_TO_BOOL	BOOL	Converts STRING into BOOL type.
STRING_TO_BYTE	BYTE	Converts STRING into BYTE type.
STRING_TO_WORD	WORD	Converts STRING into WORD type.
STRING_TO_DWORD	DWORD	Converts STRING into DWORD type.
STRING_TO_LWORD	LWORD	Converts STRING into LWORD type.
STRING_TO_REAL	REAL	Converts STRING into REAL type.
STRING_TO_LREAL	LREAL	Converts STRING into LREAL type.
STRING_TO_DT	DT	Converts STRING into DT type.
STRING_TO_DATE	DATE	Converts STRING into DATE type.

## Ch. 7 Basic Functions

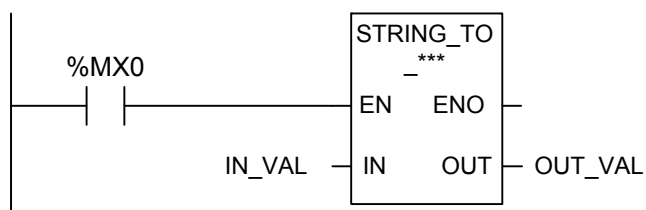
Function	Output type	Description
STRING_TO_TOD	TOD	Converts STRING into TOD type.
STRING_TO_TIME	TIME	Converts STRING into TIME type.

### ■ Flag

Flag	Description
_ERR	If input character type does not match with output data type, _ERR and _LER flags are set.

### ■ Program Example

#### 1. LD



#### 2. ST

ST language doesn't support STRING\_TO\_\*\*\*

In case of STRING\_TO\_REAL

```
OUT_VAL := STRING_TO_REAL(EN:=%MX0, IN:=IN_VAL);
```

(1) If the input condition (%MX0) is on, function STRING\_TO\_\*\*\* executes.

(2) If input variable IN\_VAL (STRING) = '-1.34E12', output variable OUT\_VAL (REAL) = -1.34E12.

INPUT (IN) : IN_VAL (STRING)	=	'-1.34E12'
		↓ (STRING_TO_REAL)
OUTPUT (OUT) : OUT_VAL (REAL)	=	-1.34E12



SUB	Subtraction	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1  IN1: the value to be subtracted  IN2: the value to subtract</p> <p><b>Output</b> ENO: without an error, it is 1.  OUT: the subtracted result value</p> <p>The variables connected to IN1, IN2 and OUT must be of all the same data type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN1						○	○	○	○	○	○	○	○	○	○					
	IN2						○	○	○	○	○	○	○	○	○	○					
	OUT						○	○	○	○	○	○	○	○	○	○					

#### ■ Function

It subtracts IN2 from IN1 and outputs it as OUT.

$$\text{OUT} = \text{IN1} - \text{IN2}$$

#### ■ Flag

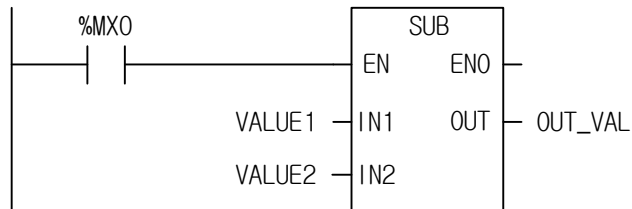
Flag	Description
_ERR	If output value is out of range of related data type, _ERR and _LER flags are set.

☆ If LREAL type operation exceeds the maximum or minimum value in the middle of operation because it performs operation serially from IN1 to IN8, \_ERR, \_LER flag is set and the result is an unlimited or abnormal value.

(1.#INF000000000000e+000, 1.#SNAN000000000000e+000, 1.#QNAN000000000000e+000)

### ■ Program Example

#### 1. LD



#### 2. ST

OUT\_VAL := SUB(EN:=%MX0, IN1:=VALUE1, IN2:=VALUE2);

(1) If the transition condition (%MX0) is on, function SUB executes.

(2) If input variables VALUE1 = 300, VALUE2 = 200, OUT\_VAL is 100 after the operation.

INPUT (IN1) : VALUE1 (INT) = 300(16#012C) 

0	0	0	0	0	0	0	1	0	0	1	0	1	1	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

  
-(SUB)

(IN2) : VALUE2 (INT) = 200(16#00C8) 

0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---



OUTPUT (OUT) : OUT\_VAL (INT) = 100(16#0064) 

0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

SUB_DATE	Date subtraction	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b></p> <p>EN: executes the function in case of 1</p> <p>IN1: standard date</p> <p>IN2: the date to subtract</p> <p><b>Output</b></p> <p>ENO: without an error, it is 1.</p> <p>OUT: produces the difference between two dates as time data.</p>

#### ■ Function

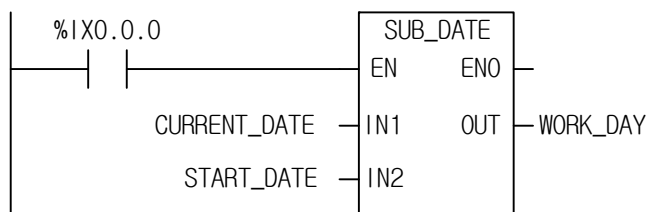
It subtracts IN2 (specific date) from IN1 (standard date) and outputs the difference between two dates as OUT.

#### ■ Flag

Flag	Description
_ERR	<p>If output value is out of range (TIME data type), _ERR and _LER flags are set.</p> <p>An error occurs: 1) when date difference exceeds the range of TIME data type (T#49D17H2M47S295MS); 2) the result of date operation is a negative number.</p>

#### ■ Program Example

##### 1. LD



### 2. ST

WORK\_DAY := SUB\_DATE(EN:=%IX0.0.0, IN1:=CURRENT\_DATE, IN2:=START\_DATE);

(1) If the transition condition (%IX0.0.0) is on, function SUB\_DATE executes.

(2) If input variable CURRENT\_DATE is D#1995-12-15 and START\_DATE is D#1995-11-1, the working days declared as output variable WORK\_DAY is T#44D.

INPUT (IN1) : CURRENT\_DATE (DATE) = D#1995-12-15  
(SUB\_DATE)

(IN2) : START\_DATE(DATE) = D#1995-11-1



OUTPUT (OUT) : WORK\_DAY (TIME) = T#44D

<b>SUB_DT</b>	<b>Date and Time subtraction</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1  IN: standard date and time of day  IN2: date and time of day to subtract</p> <p><b>Output</b> ENO: without an error, it is 1.  OUT: the subtracted result time</p>

#### ■ Function

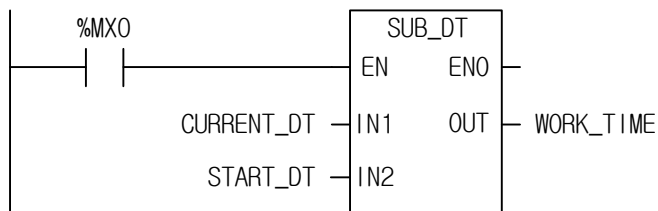
It subtracts IN2 (specific date and time of day) from IN1 (standard date and time of day) and outputs the time difference as OUT.

#### ■ Flag

Flag	Description
_ERR	<p>If output value is out of range of TIME data type, _ERR and _LER flags are set.</p> <p>If the result of date and time of day subtraction operation is a negative number, an error occurs.</p>

#### ■ Program Example

##### 1. LD



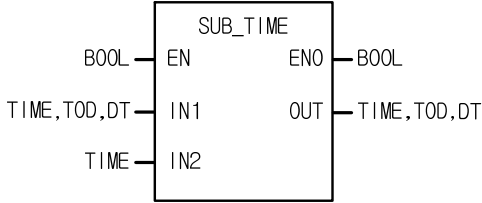
### 2. ST

WORK\_TIME := SUB\_DT(EN:=%MX0, IN1:=CURRNET\_DT, IN2:=START\_DT);

- (1) If the transition condition (%MX0) is on, function SUB\_DT (Time and Date subtraction) executes.
- (2) If the current date and time of day CURRENT\_DT is DT#1995-12-15-14:30:00 and the starting date and the time of day to work START\_DT is DT#1995-12-13-12:00:00, the continuous working time declared as output variable WORK\_TIME is T#2D2H30M.

INPUT (IN1) : CURRENT\_DT (DT) = DT#1995-12-15-14:30:00  
(SUB\_DATE)  
(IN2) : START\_DT(DT) = DT#1995-12-13-12:00:00  
↓  
OUTPUT (OUT) : WORK\_TIME (TIME) = T#2D2H30M

<b>SUB_TIME</b>	<b>Time subtraction</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN1: standard time of day IN2: the time to subtract</p> <p><b>Output</b> ENO: without an error, it is 1. OUT: the subtracted result time or time of day</p> <p>OUT data type is the same as the input IN1 type. That is, if IN1 type is TIME, OUT type must be TIME.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN1																○		○	○	
	OUT																○		○	○	

#### ■ Function

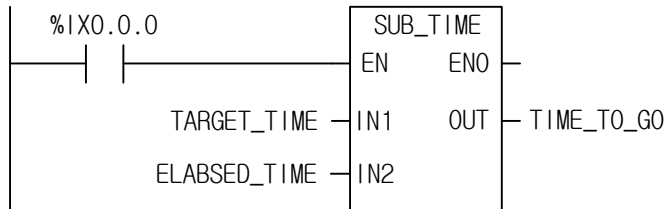
1. If IN1 is TIME, it subtracts the time from the standard time and produces OUT (time difference).
2. If IN1 is TIME\_OF\_DAY, it subtracts the time from the standard time of day and outputs the time of a day as OUT.
3. If IN1 is DATE\_AND\_TIME, it subtracts the time from the standard date and the time of day and produces the date and the time of day as OUT.

#### ■ Flag

Flag	Description
_ERR	<p>If the output value is out of range of related data type, _ERR and _LER flags are set.</p> <p>If the result subtracting the time from the standard time is a negative number or the result subtracting the time from the time of day is a negative number, an error occurs.</p>

### ■ Program Example

#### 1. LD



#### 2. ST

```
TIME_TO_GO := SUB_TIME(EN:=%IX0.0.0, IN1:=TARGET_TIME, IN2:=ELAPSED_TIME);
```

(1) If the transition condition (%IX0.0.0) is on, function SUB\_TIME (time subtraction) executes.

(2) If total working time declared as input variable TARGET\_TIME is T#2H30M, the elapsed time ELAPSED\_TIME is T#1H10M30S300MS, the remaining working time declared as output variable TIME\_TO\_GO is T#1H19M29S700MS.

INPUT (IN1) : TARGET\_TIME (TIME) = T#2H30M  
(SUB\_DATE)

(IN2) : ELAPSED\_TIME(TIME) = T#1H10M30S300MS

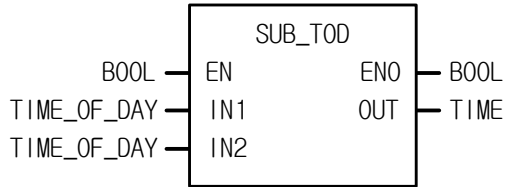


OUTPUT (OUT) : TIME\_TO\_GO (TIME) = T#1H19M29S700MS



SUB_TOD	TOD Subtraction	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b></p> <p>EN: executes the function in case of 1</p> <p>IN1: standard time of day</p> <p>IN2: the time of day to subtract</p> <p><b>Output</b></p> <p>ENO: without an error, it is 1</p> <p>OUT: the subtracted result time</p>

#### ■ Function

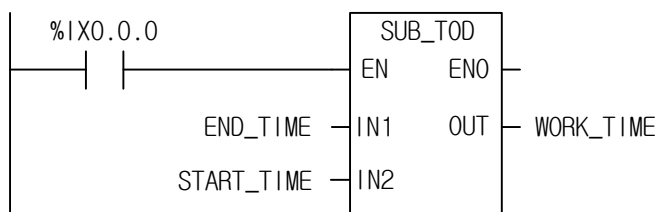
It subtracts the IN2 (specific time of day) from IN1 (standard time of day) and outputs the time difference as OUT.

#### ■ Flag

Flag	Description
_ERR	If the result subtracting the time of day from the time of day is a negative number, an error occurs.

#### ■ Program Example

##### 1. LD



## 2. ST

```
WORK_TIME := SUB_TOD(EN:=%IX0.0.0, IN1:=END_TIME, IN2:=START_TIME);
```

- (1) If the transition condition (%IX0.0.0) is on, function SUB\_TOD (time of day subtraction) executes.
- (2) If END\_TIME declared as input variable is TOD#14:20:30.500 and the starting time to work, START\_TIME is TOD#12:00:00, the required time to work, WORK\_TIME declared as output variable is T#2H20M30S500MS.

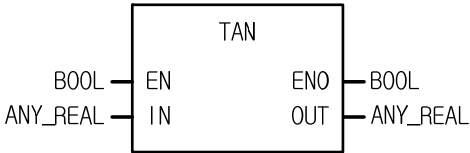
```

INPUT (IN1) : END_TIME (TOD) =  TOD#14:20:30.500
                                (SUB_TOD)
      (IN2) : START_TIME(TOD) =  TOD#12:00:00

```

OUTPUT (OUT) : WORK\_TIME (TIME) = T#2H20M30S500MS

TAN	Tangent Operation	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b>    EN: executes the function in case of 1               IN: tangent input value (radian)</p> <p><b>Output</b>   ENO: outputs EN value as it is               OUT: the result value of Tangent operation</p> <p>IN, OUT must be of the same data type</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN														o	o					
	OUT														o	o					

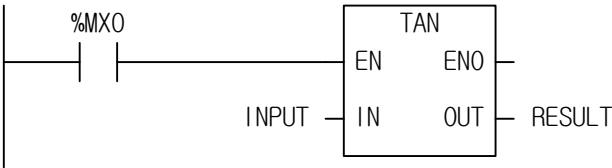
■ Function

It performs Tangent operation of IN and produces output, OUT.

OUT = TAN(IN)

■ Program Example

1. LD



### 2. ST

RESULT := TAN(EN:=%MX0, IN:=INPUT);

- (1) If the transition condition (%MX0) is on, function TAN (Tangent operation) executes.
- (2) If the value of input variable declared as INPUT is 0.7853... ( $\pi/4$  rad =  $45^\circ$ ), RESULT declared as output variable is 1.0000.

$\text{TAN}(\pi/4) = 1$

INPUT (IN) : INPUT (REAL) = 0.7853

↓ (TAN)

OUTPUT (OUT) : RESULT (REAL) = 9.99803722E-01

TIME_TO_***	TIME type conversion	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
<div><div>TIME_TO_***</div><div><div>BOOL</div><div>EN</div><div>ENO</div><div>BOOL</div></div><div><div>TIME</div><div>IN</div><div>OUT</div><div>DWORD, UDINT STRING</div></div></div>	<div><div>Input</div><div>EN: executes the function in case of 1</div><div>IN: time data to be converted</div></div> <div><div>Output</div><div>ENO: outputs EN value as it is</div><div>OUT: type-converted data</div></div>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	OUT				○								○								○

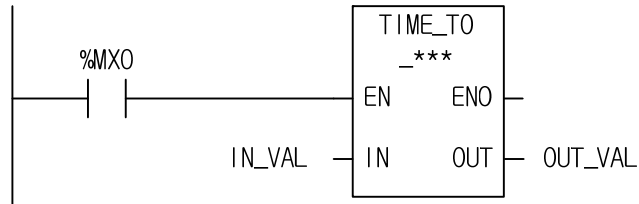
#### ■ Function

It converts the IN type and produces OUT.

Function	Output type	Description
TIME_TO_UDINT	UDINT	Converts TIME into UDINT type. It converts only data type without changing the data (internal bit array state).
TIME_TO_DWORD	DWORD	Converts TIME into DWORD type. It converts only data type without changing the data (internal bit array state).
TIME_TO_STRING	STRING	Converts TIME into STRING type.

### ■ Program Example

#### 1. LD



#### 2. ST

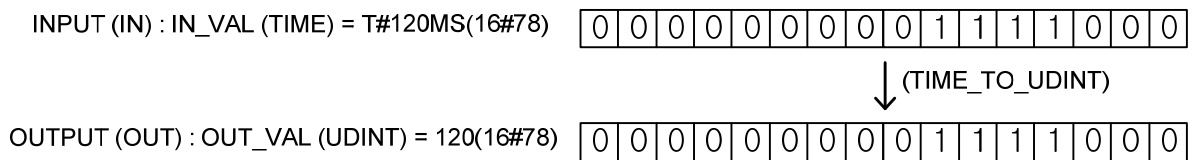
ST language doesn't support TIME\_TO\_\*\*\*

In case of TIME\_TO\_UDINT

```
OUT_VAL := TIME_TO_UDINT(EN:=%MX0, IN:=IN_VAL);
```

(1) If the transition condition (%MX0) is on, function TIME\_TO\_\*\*\* executes.

(2) If input variable IN\_VAL (TIME) = T#120MS, output variable OUT\_VAL (UDINT) = 120.



TOD_TO_***	TOD type conversion	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
<div><div><div>TOD_TO_***</div><div>BOOL — EN      ENO — BOOL</div><div>TIME OF DAY — IN      OUT — DWORD, UDINT STRING</div></div></div>	<div><div><b>Input</b></div><div>EN: executes the function in case of 1</div><div>IN: time of a day data to be converted</div></div> <div><div><b>Output</b></div><div>ENO: outputs EN value as it is</div><div>OUT: type-converted data</div></div>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	OUT				○								○								○

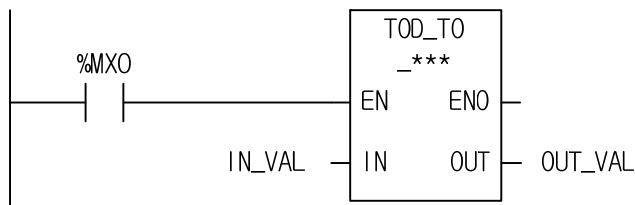
#### ■ Function

It converts the IN type and outputs it as OUT.

Function	Output type	Description
TOD_TO_UDINT	UDINT	Converts TOD into UDINT type. Converts only data type without changing a data (internal bit array state).
TOD_TO_DWORD	DWORD	Converts TOD into DWORD type. Converts only data type without changing a data (internal bit array state).
TOD_TO_STRING	STRING	Converts TOD into STRING type.

### ■ Program Example

#### 1. LD



#### 2. ST

ST language doesn't support TIME\_TO\_\*\*\*

In case of TIME\_TO\_UDINT

```
OUT_VAL := TOD_TO_STRING(EN:=%MX0, IN:=IN_VAL);
```

(1) If the transition condition (%MX0) is on, function TOD\_TO\_\*\*\* executes.

(2) If input variable IN\_VAL (TOD) = TOD#12:00:00, output variable OUT\_VAL (STRING) = 'TOD#12:00:00'.

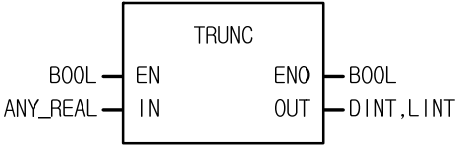
INPUT (IN) : IN\_VAL (TOD) = TOD#12:00:00

↓ (TOD\_TO\_STRING)

OUTPUT (OUT) : OUT\_VAL (STRING) = 'TOD#12:00:00'



<b>TRUNC</b>	<b>Round off the decimal fraction of IN and converts into integer number</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: REAL value to be converted</p> <p><b>Output</b> ENO: without an error, it is 1. OUT: the Integer converted value</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN														○	○					
	OUT								○	○											

#### ■ Function

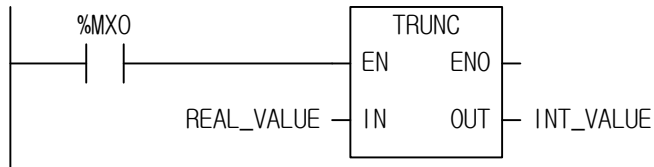
Function	Input type	Output type	Description
TRUNC	REAL	DINT	Round off the decimal fraction of input IN and outputs the Integer value as OUT.
	LREAL	LINT	

#### ■ Flag

Flag	Description
_ERR	_ERR, _LER flags is set: 1) if the converted value is greater than maximum value of data type connected to OUT; 2) if the variable connected to OUT is an Unsigned Integer and the converted output value is a negative number, the output is 0.

### ■ Program Example

#### 1. LD



#### 2. ST

INT\_VALUE:=TRUNC(EN:=%MX0, IN:=REAL\_VALUE);

(1) If the transition condition (%MX0) is on, function TRUNC executes.

(2) If input variable REAL\_VALUE (REAL) = 1.6, output variable INT\_VALUE (INT) = 1. If REAL\_VALUE (REAL) = -1.6, INT\_VALUE (INT) = -1.

INPUT (IN) : REAL\_VALUE (REAL) = 1.6

↓ (TRUNC)

OUTPUT (OUT) : INT\_VALUE (INT) = 1

UDINT_TO_***	UDINT type conversion	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
<div><div>UDINT_TO_***</div><div><div>BOOL</div>EN<div>ENO</div><div>UDINT</div>IN<div>OUT</div><div>BOOL</div><div>*ANY</div></div></div>	<div><div>Input</div>EN: executes the function in case of 1 IN: Unsigned Double Integer value to be converted</div> <div><div>Output</div>ENO: outputs EN value as it is OUT: type-converted data</div>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	OUT	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		○		○

\*ANY: exclude UDINT, DATE and DT from ANY type.

#### ■ Function

It converts the IN type and outputs it as OUT.

Function	Output type	Description
UDINT_TO_SINT	SINT	If input is 0~127, normal conversion. Otherwise an error occurs.
UDINT_TO_INT	INT	If input is 0~32,767, normal conversion. Otherwise an error occurs.
UDINT_TO_DINT	DINT	If input is 0~2,147,483,647, normal conversion. Otherwise an error occurs.
UDINT_TO_LINT	LINT	Converts UDINT into LINT type normally.
UDINT_TO_USINT	USINT	If input is 0~255, normal conversion. Otherwise an error occurs.
UDINT_TO_UINT	UINT	If input is 0~65,535, normal conversion. Otherwise an error occurs.
UDINT_TO_ULINT	ULINT	Converts UDINT into ULINT type normally.
UDINT_TO_BOOL	BOOL	Takes the lower 1 bit and converts into BOOL type.
UDINT_TO_BYTE	BYTE	Takes the lower 8 bits and converts into BYTE type.
UDINT_TO_WORD	WORD	Takes the lower 16 bits and converts into WORD type.
UDINT_TO_DWORD	DWORD	Converts into DWORD type without changing the internal bit array.
UDINT_TO_LWORD	LWORD	Converts into LWORD type filling the upper bits with 0.
UDINT_TO_REAL	REAL	Converts UDINT into REAL type. During the conversion, an error caused by the precision may occur.

## Ch. 7 Basic Functions

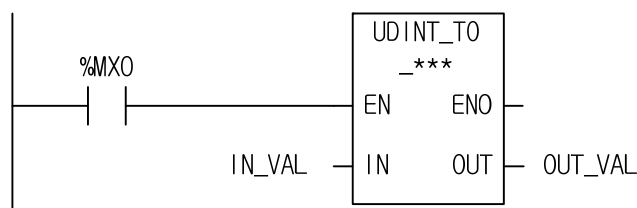
Function	Output type	Description
UDINT_TO_LREAL	LREAL	Converts UDINT into LREAL type. During the conversion, an error caused by the precision may occur.
UDINT_TO_TOD	TOD	Converts into TOD type without changing the internal bit array. However, with a value out of TOD range (TOD#23:59:59.999), _ERR, _LER flags are set and it is alternately converted within the range of TOD.
UDINT_TO_TIME	TIME	Converts into TIME type without changing the internal bit array.
UDINT_TO_STRING	STRING	Converts UDINT into STRING type.

### ■ Flag

Flag	Description
_ERR	If a conversion error occurs, _ERR and _LER flags are set. If an error occurs, take the lower bits as many as a bit number of an output data type and produces the output without changing the internal bit array.

### ■ Program Example

1. LD



2. ST

ST language doesn't support UDINT\_TO\_\*\*\*

In case of UDINT\_TO\_TIME

```
OUT_VAL := UDINT_TO_TIME(EN:=%MX0, IN:=IN_VAL);
```

(1) If the input condition (%MX0) is on, function UDINT\_TO\_\*\*\* will be executed.

(2) If input variable IN\_VAL (UDINT) = 123, output variable OUT\_VAL (TIME) = T#123MS.

INPUT (IN) : IN\_VAL (UDINT) = 123



OUTPUT (OUT) : OUT\_VAL (TIME) = T#123MS

UINT_TO_***	UINT type conversion	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
<div><div>UINT_TO_***</div><div><div>BOOL</div><div>EN</div><div>ENO</div><div>BOOL</div></div><div><div>UINT</div><div>IN</div><div>OUT</div><div>*ANY</div></div></div>	<div><b>Input</b>    EN: executes the function in case of 1</div> <div>          IN: Unsigned Integer value to be converted</div> <div><b>Output</b>   ENO: outputs EN value as it is</div> <div>          OUT: type-converted data</div>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	OUT	○	○	○	○	○	○	○	○	○	○		○	○	○	○		○			○

\*ANY: exclude UINT, TIME, TOD and DT from ANY type.

#### ■ Function

It converts the IN type and outputs it as OUT.

Function	Output type	Description
UINT_TO_SINT	SINT	If input is 0~127, normal conversion. Otherwise an error occurs.
UINT_TO_INT	INT	If input is 0~32,767, normal conversion. Otherwise an error occurs.
UINT_TO_DINT	DINT	Converts UINT into UDINT type normally.
UINT_TO_LINT	LINT	Converts UINT into ULINT type normally.
UINT_TO_USINT	USINT	If input is 0~255, normal conversion. Otherwise an error occurs.
UINT_TO_UDINT	UDINT	Converts UINT into UDINT type normally.
UINT_TO_ULINT	ULINT	Converts UINT into ULINT type.
UINT_TO_BOOL	BOOL	Takes the lower 1 bit and converts into BOOL type.
UINT_TO_BYTE	BYTE	Takes the lower 8 bits and converts into BYTE type.
UINT_TO_WORD	WORD	Converts into WORD type without changing the internal bit array.
UINT_TO_DWORD	DWORD	Converts into DWORD type filling the upper bits with 0.
UINT_TO_LWORD	LWORD	Converts into LWORD type filling the upper bits with 0.
UINT_TO_REAL	REAL	Converts UINT into REAL type.
UINT_TO_LREAL	LREAL	Converts UINT into LREAL type.
UINT_TO_DATE	DATE	Converts into DATE type without changing the internal bit array.
UINT_TO_STRING	STRING	Converts UINT into STRING type.

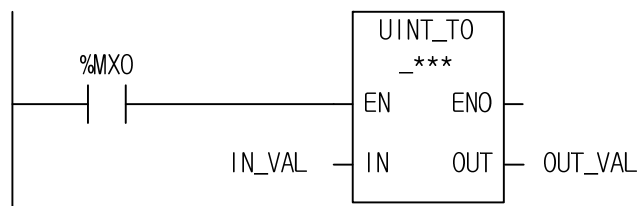
## Ch. 7 Basic Functions

### ■ Flag

Flag	Description
_ERR	If a conversion error occurs, _ERR and _LER flags are set. If error occurs, it takes as many lower bits as a bit number of output type and produces an output without changing its internal bit array.

### ■ Program Example

#### 1. LD



#### 2. ST

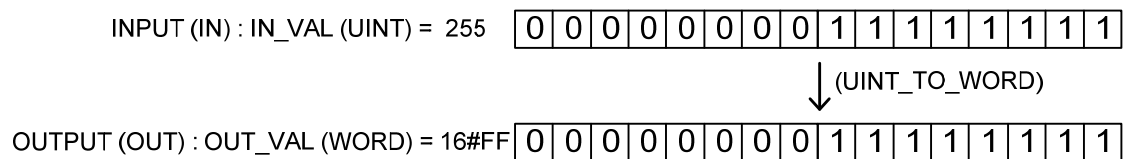
ST language doesn't support UINT\_TO\_\*\*\*

In case of UINT\_TO\_WORD

```
OUT_VAL := UINT_TO_WORD(EN:=%MX0, IN:=IN_VAL);
```

(1) If the input condition (%MX0) is on, function UINT\_TO\_\*\*\* executes.

(2) If input variable IN\_VAL (UINT) = 255 (2#0000\_0000\_1111\_1111), output variable OUT\_VAL (WORD) = 2#0000\_0000\_1111\_1111.



ULINT_TO_***	ULINT type conversion	
	Availability	XGI, XGR, XEC
	Flags	ERR, LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: Unsigned Long Integer value to be converted</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: type-converted data</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	OUT	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

\*ANY: exclude UINT, TIME, TOD and DT from ANY type.

## ■ Function

It converts the IN type and outputs it as OUT.

Function	Output type	Description
ULINT_TO_SINT	SINT	If input is 0~127, normal conversion. Otherwise an error occurs.
ULINT_TO_INT	INT	If input is 0~32,767, normal conversion. Otherwise an error occurs.
ULINT_TO_DINT	DINT	If input is 0~2 <sup>31</sup> -1, normal conversion. Otherwise an error occurs.
ULINT_TO_LINT	LINT	If input is 0~2 <sup>63</sup> -1, normal conversion. Otherwise an error occurs.
ULINT_TO_USINT	USINT	If input is 0~255, normal conversion. Otherwise an error occurs.
ULINT_TO_UINT	UINT	If input is 0~65,535, normal conversion. Otherwise an error occurs.
ULINT_TO_UDINT	UDINT	If input is 0~2 <sup>32</sup> -1, normal conversion. Otherwise an error occurs.
ULINT_TO_BOOL	BOOL	Takes the lower 1 bit and converts into BOOL type.
ULINT_TO_BYTE	BYTE	Takes the lower 8 bits and converts into BYTE type.
ULINT_TO_WORD	WORD	Takes the lower 16 bits and converts into WORD type.
ULINT_TO_DWORD	DWORD	Takes the lower 32 bits and converts into DWORD type.
ULINT_TO_LWORD	LWORD	Converts into LWORD type without changing the internal bit array.
ULINT_TO_REAL	REAL	Converts ULINT into REAL type. During the conversion, an error caused by the precision may occur.
ULINT_TO_LREAL	LREAL	Converts ULINT into LREAL type. During the conversion, an error caused by the precision may occur.

## Ch. 7 Basic Functions

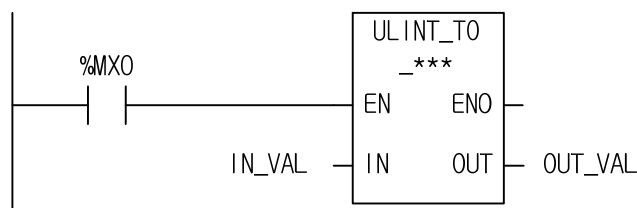
Function	Output type	Description
ULINT_TO_STRING	STRING	Converts ULINT into STRING type.

### ■ Flag

Flag	Description
_ERR	If a conversion error occurs, _ERR and _LER flags are set. If error occurs, it takes as many lower bits as a bit number of output type and produces an output without changing its internal bit array

### ■ Program Example

#### 1. LD



#### 2. ST

ST language doesn't support ULINT\_TO\_\*\*\*

In case of ULINT\_TO\_LINT

```
OUT_VAL := ULINT_TO_LINT(EN:=%MX0, IN:=IN_VAL);
```

(1) If the input condition (%MX0) is on, function ULINT\_TO\_\*\*\* executes.

(2) If input variable IN\_VAL (ULINT) = 123,567,899, then output variable OUT\_VAL (LINT) = 123,567,899.

INPUT (IN) : IN\_VAL (ULINT) = 123,567,899



(ULINT\_TO\_LINT)

OUTPUT (OUT) : OUT\_VAL (LINT) = 123,567,899



USINT_TO_***	USINT type conversion	
	Availability	XGI, XGR, XEC
	Flags	ERR, LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: To convert Unsigned Short Integer value.</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: type-converted data</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	OUT	○	○	○	○	○	○	○	○	○		○	○	○	○	○					○

\*ANY: exclude USINT, TIME, DATE, TOD and DT from ANY type.

## ■ Function

It converts the IN type and outputs it as OUT.

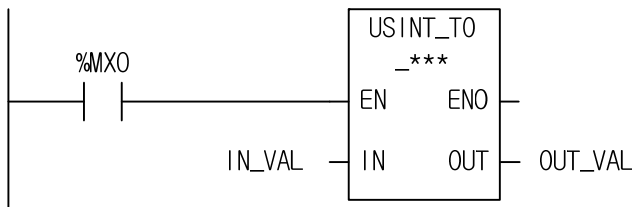
Function	Output type	Description
USINT_TO_SINT	SINT	If input is 0~127, normal conversion. Otherwise an error occurs.
USINT_TO_INT	INT	Converts USINT into INT type normally.
USINT_TO_DINT	DINT	Converts USINT into DINT type normally.
USINT_TO_LINT	LINT	Converts USINT into LINT type normally.
USINT_TO_UINT	UINT	Converts USINT into UINT type normally.
USINT_TO_UDINT	UDINT	Converts USINT into UDINT type normally.
USINT_TO_ULINT	ULINT	Converts USINT into ULINT type normally.
USINT_TO_BOOL	BOOL	Takes the lower 1 bit and converts into BOOL type.
USINT_TO_BYTE	BYTE	Converts into BYTE type without changing the internal bit array.
USINT_TO_WORD	WORD	Converts into WORD type filling the upper bits with 0.
USINT_TO_DWORD	DWORD	Converts into DWORD type filling the upper bits with 0.
USINT_TO_LWORD	LWORD	Converts into LWORD type filling the upper bits with 0.
USINT_TO_REAL	REAL	Converts USINT into REAL type.
USINT_TO_LREAL	LREAL	Converts USINT into LREAL type.
USINT_TO_STRING	STRING	Converts USINT into STRING type.

■ Flag

Flag	Description
_ERR	If a conversion error occurs, _ERR and _LER flags are set. If error occurs, it takes as many lower bits as a bit number of output type and produces an output without changing its internal bit array.

■ Program Example

1. LD

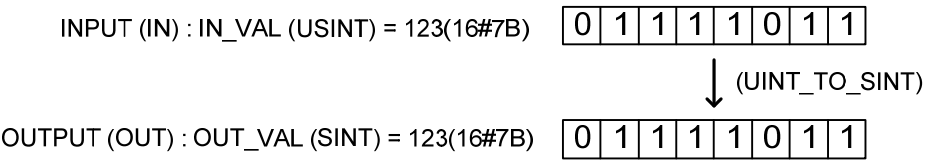


2. ST

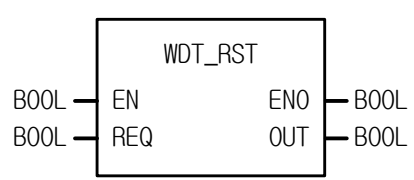
ST language doesn't support USINT\_TO\_\*\*\*  
In case of USINT\_TO\_SINT

```
OUT_VAL := USINT_TO_SINT(EN:=%MX0, IN:=IN_VAL);
```

- (1) If the input condition (%MX0) is on, function ULINT\_TO\_\*\*\* executes.
- (2) If input variable IN\_VAL (USINT) = 123, output variable OUT\_VAL (SINT) = 123.

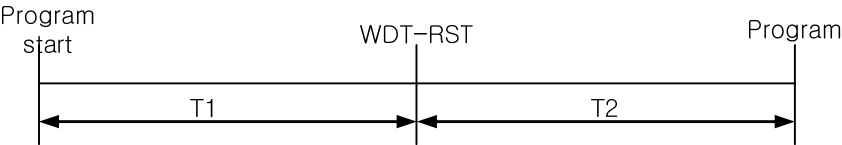


WDT_RST	Initialize Watch_Dog timer	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b>    EN: executes the function in case of 1               REQ: requires to initialize watchdog timer</p> <p><b>Output</b>    ENO: outputs EN value as it is               OUT: After Watch_Dog timer initialization, output is 1</p>

■ Function

- 1. It resets Watch-Dog Timer among the programs.
- 2. Available to use in case that scan time exceeds Watch-Dog Time set by the condition in the program.
- 3. If scan time exceeds the scan Watch\_Dog Time, change the scan time with the setting value of scan Watch\_Dog Timer.
- 4. Care must be taken so that either the time from 0 line of program to WDT\_RST function T1 or the time from WDT\_RST function to the time by the end of program T2 does not exceed the setting value of scan Watch\_Dog Timer.

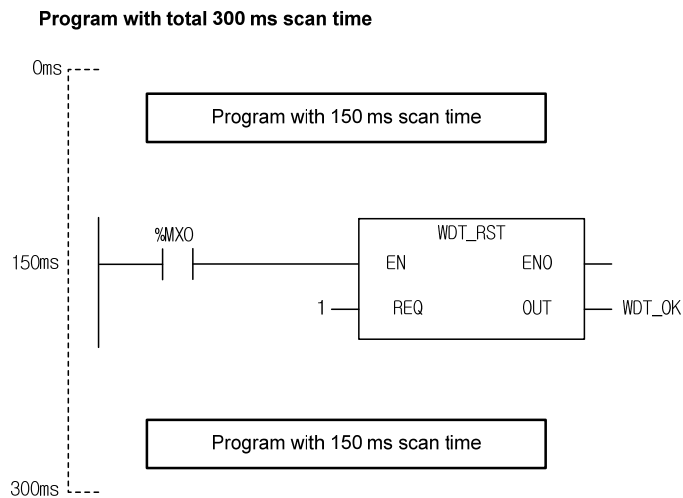


- 5. WDT\_RST function is available to use several times during 1 scan.

### ■ Program Example

This is the program that the time to execute the program becomes 300ms according to the transition condition in the program of which scan Watch\_Dog timer is set as 200ms.

#### 1. LD

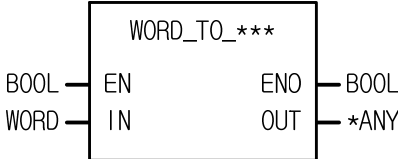


#### 2. ST

```
WDT_OK := WDT_RST(EN:=%MX0, REQ:=%MX0);
```

- (1) If the transition condition (%MX0) is on, function WDT-RST executes.
- (2) If WDT-RST function executes, it is available to set the program that extends the scan time to 300ms according to the transition condition of program within the scan Watch\_Dog Time (200ms).

WORD_TO_***	WORD type conversion	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: Bit string to be converted (16 bit)</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: type-converted data</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	OUT	○	○		○	○	○	○	○	○	○	○	○	○				○			○

\*ANY: exclude WORD, REAL, LREAL, TIME, TOD and DT from ANY type.

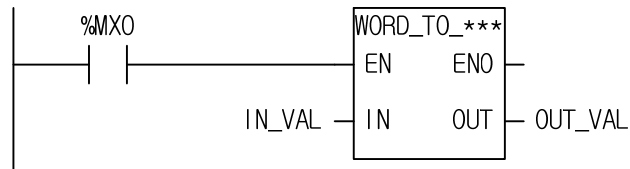
#### ■ Function

It converts the IN type and outputs it as OUT.

Function	Output type	Description
WORD_TO_SINT	SINT	Takes the lower 8 bits and converts into SINT type.
WORD_TO_INT	INT	Converts into INT type without changing the internal bit array.
WORD_TO_DINT	DINT	Converts into DINT type filling the upper bits with 0.
WORD_TO_LINT	LINT	Converts into LINT type filling the upper bits with 0.
WORD_TO_USINT	USINT	Takes the lower 8 bits and converts into SINT type.
WORD_TO_UINT	UINT	Converts into INT type without changing the internal bit array.
WORD_TO_UDINT	UDINT	Converts into DINT type filling the upper bits with 0.
WORD_TO_ULINT	ULINT	Converts into LINT type filling the upper bits with 0.
WORD_TO_BOOL	BOOL	Takes the lower 1 bit and converts into BOOL type.
WORD_TO_BYTE	BYTE	Takes the lower 8 bits and converts into SINT type.
WORD_TO_DWORD	DWORD	Converts into DWORD type filling the upper bits with 0.
WORD_TO_LWORD	LWORD	Converts into LWORD type filling the upper bits with 0.
WORD_TO_DATE	DATE	Converts into DATE type without changing the internal bit array.
WORD_TO_STRING	STRING	Converts WORD into STRING type.

### ■ Program Example

#### 1. LD



#### 2. ST

ST language doesn't support WORD\_TO\_\*\*\*

In case of WORD\_TO\_INT

```
OUT_VAL := WORD_TO_INT(EN:=%MX0, IN:=IN_VAL);
```

(1) If the input condition (%MX0) is on, function WORD-TO-\*\*\* executes.

(2) If input variable IN\_VAL (WORD) = 2#0001\_0001\_0001\_0001, output variable OUT\_VAL (INT) = 4,096 + 256 + 16 + 1 = 4,369

INPUT (IN) : IN\_VAL (WORD) = 16#1111 

0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

↓ (WORD\_TO\_INT)

OUTPUT (OUT) : OUT\_VAL (INT) = 4,369 (16#1111) 

0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

<b>XOR</b>	<b>Exclusive OR</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1  IN1: the value to be XOR  IN2: the value to be XOR  Input variable number can be extended up to 8.</p> <p><b>Output</b> ENO: outputs EN value as it is  OUT: the result of XOR operation</p> <p>IN1, IN2, OUT must be of all the same data type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN	○	○	○	○	○															
	OUT	○	○	○	○	○															

#### ■ Function

- Do XOR operation for IN1 and IN2 per bit and to produces OUT.

IN1      1111 ..... 0000

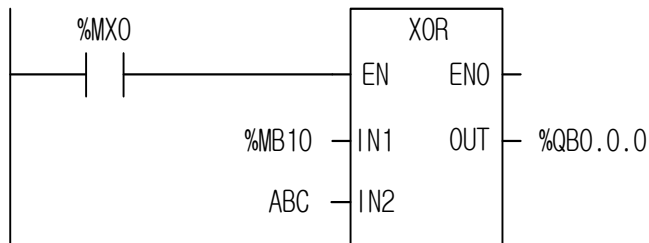
XOR

IN2      1010 ..... 1010

OUT     0101 ..... 1010

### ■ Program Example

#### 1. LD



#### 2. ST

ST language doesn't support XOR

In case of XOR2\_BYTE

```
%QB0.0.0 := XOR2_BYTE(EN:=%MX0, IN1:=%MB10, IN2:=ABC);
```

(1) If the transition condition (%MX0) is on, function XOR executes.

(2) If input variable %MB10 = 1100\_1100, ABC = 1111\_0000, the result of XOR operation for two inputs is %QB0.0.0 = 0011\_1100.

INPUT (IN1) : %MB10 (BYTE) = 16#CC	<table><tr><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td></tr></table>	1	1	0	0	1	1	0	0
1	1	0	0	1	1	0	0		
	XOR								
(IN2) : ABC(BYTE) = 16#F0	<table><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td></tr></table>	1	1	1	1	0	0	0	0
1	1	1	1	0	0	0	0		
	↓								
OUTPUT (OUT) : %QB0.0.0 (BYTE) = 16#3C	<table><tr><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td></tr></table>	0	0	1	1	1	1	0	0
0	0	1	1	1	1	0	0		



***_TO_BCD	Converting ANY Type to BCD type	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: execute the function in case of 1 IN: enter ANY_BIT with BCD type data</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: type converted data</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN						○	○	○	○	○	○	○	○							
	OUT		○	○	○	○															

\*ANY\_BIT: exclude BOOL type from ANY\_BIT.

#### ■ Function

It converts the IN type and outputs it as OUT

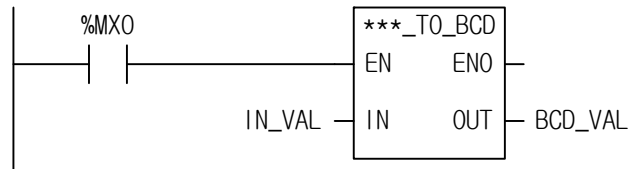
Function	Input type	Output type	Description
SINT_TO_BCD_BYTE	SINT	BYTE	Converting ANY type to BCD type. Normally converted as long as it is BCD value. (if input data type is WORD, the values, 0~16#9999 are normally converted)
INT_TO_BCD_WORD	INT	WORD	
DINT_TO_BCD_DWORD	DINT	DWORD	
LINT_TO_BCD_LWORD	LINT	LWORD	
USINT_TO_BCD_BYTE	USINT	BYTE	
UINT_TO_BCD_WORD	UINT	WORD	
UDINT_TO_BCD_DWORD	UDINT	DWORD	
ULINT_TO_BCD_LWORD	ULINT	LWORD	

#### ■ Flag

Flag	Description
_ERR	If IN is not the data within BCD range, output is 0; _ERR and _LER flags are set.

### ■ Program Example

#### 1. LD



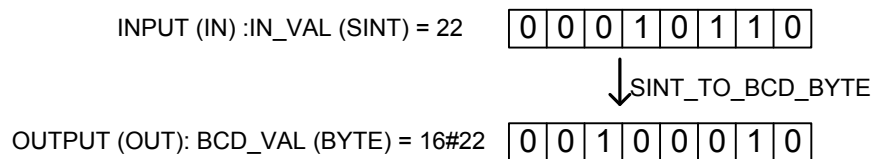
#### 2. ST

ST language doesn't support \*\*\*\_TO\_BCD

In case of SINT\_TO\_BCD\_BYTE

```
BCD_VAL := SINT_TO_BCD_BYTE(EN:=%MX0, IN:=IN_VAL);
```

- (1) If the execution condition (%MX0) is on, SINT\_TO\_BCD function executes.
- (2) If IN\_VAL (SINT type) = 16#22 (2#0001\_0110), BCD\_VAL (BYTE type) = 16#22 (2#0010\_0010) declared as a function's output variable is produced.



## Ch 8. Application Functions

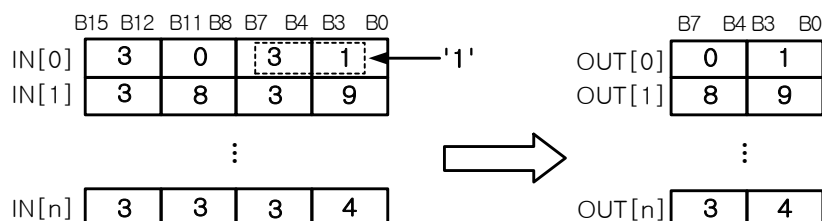
This chapter describes application functions unlike the basic functions described in the previous chapter.

<b>ARY_ASC_TO_BCD</b>	<b>Input : ASCII Array, Output: BCD Array</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: ASCII Array input</p> <p><b>Output</b> ENO: without an error, it is 1 OUT: BCD Array output</p>

### ■ Function

It converts a word array input (ASCII data) to a byte array output (BCD data).



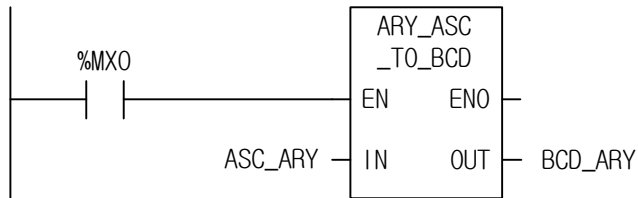
### ■ Flag

Flag	Description
_ERR	If the number of each input/output array is different, there's no change in OUT data, and _ERR and _LER flags are set. If the elements of IN array are not between 0 and 9 (hexadecimal), its responding elements of OUT array are 16#00 (while other elements of IN1 are normally converted), and _ERR and _LER flags are set.

☆ If the number of each input/output array is different, \_ERR and \_LER flags occur; if output array variable is omitted, the number of array is regarded as '0' and \_ERR and \_LER flags occur.

### ■ Program Example

#### 1. LD



#### 2. ST

```
CD_ARY := ARY_ASC_TO_BCD(EN:=%MX0, IN:=ASC_ARY);
```

- (1) If the transition condition (%MX0) is on, ARY\_ASC\_TO\_BCD function executes.  
 (2) If the input ASC\_ARY data is

ASC_ARY[0]	3031
ASC_ARY[1]	3839
ASC_ARY[2]	3334

Output BCD\_ARY data is as follows.

BYTE_ARY[0]	01
BYTE_ARY[1]	89
BYTE_ARY[2]	34

# ARY\_ASC\_TO\_BYTE

Input: ASCII Array, Output: BYTE Array

Availability

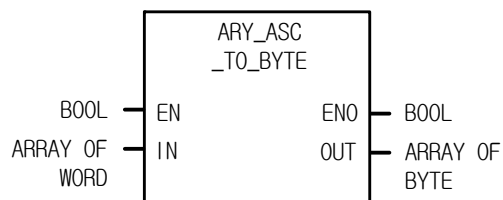
XGI, XGR, XEC

Flags

\_ERR, \_LER

### Function

### Description

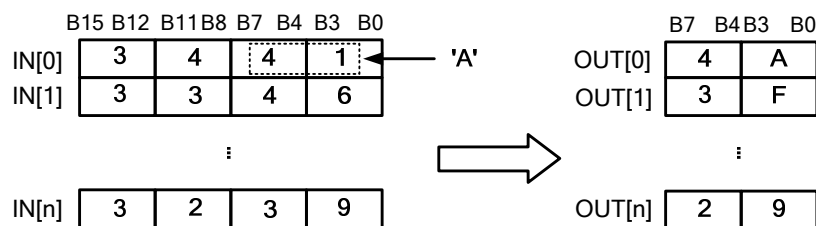


**Input** EN: executes the function in case of 1  
IN1: ASCII Array input

**Output** ENO: without an error, it is 1  
OUT: BYTE Array output

### Function

It converts a word array input (ASCII data) to a byte array output (hexadecimal).



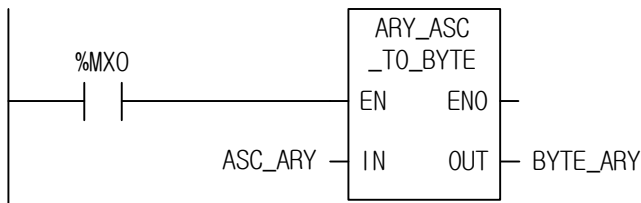
### Flag

Flag	Description
_ERR	If the number of each input/output array is different, there's no change in OUT data, and _ERR and _LER flags are set. If the elements of IN array are not between 0 and F (hexadecimal), its responding elements of OUT array are 0 (while other elements of IN1 are normally converted), and _ERR and _LER flags are set.

☆ If the number of each input/output array is different, \_ERR and \_LER flags occur; if output array variable is omitted, the number of array is regarded as '0' and \_ERR and \_LER flags occur.

■ Program Example

1. LD



2. ST

```
YTE_ARRAY := ARY_ASC_TO_BYTE(EN:=%MX0, IN:=ASC_ARRAY);
```

- (1) If the transition condition is (%MX0) is on, ARY\_ASC\_TO\_BYTE function executes.
- (2) If Input ASC\_ARRAY is as below;

ASC_ARRAY[0]	3441
ASC_ARRAY[1]	3346
ASC_ARRAY[2]	3239

Output BYTE\_ARRAY data is as follows.

BYTE_ARRAY[0]	4A
BYTE_ARRAY[1]	3F
BYTE_ARRAY[2]	29

<b>ARY_AVE</b>	<b>Finds an average of an array</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b></p> <p>EN: executes the function in case of 1  IN: data array for average  INDX: starting point to average in an array  LEN: number of array elements for average</p> <p><b>Output</b></p> <p>ENO: without an error, it will be 1  OUT: average of an array</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN						○	○	○	○	○	○	○	○	○	○					
	OUT						○	○	○	○	○	○	○	○	○	○					

### ■ Function

1. ARY\_AVE function finds an average for a specified length of an array.
2. Input and output array is the same type.
3. If LEN is a negative number, it finds an average between INDX (Array index) and 'INDX – |LEN|'. Its output is rounded off.

Function	Output type	Description
ARY_AVE	SINT	Finds an average for SINT value (decimal is rounded off)
ARY_AVE	INT	Finds an average for INT value (decimal is rounded off)
ARY_AVE	DINT	Finds an average for DINT value (decimal is rounded off)
ARY_AVE	LINT	Finds an average for LINT value (decimal is rounded off)
ARY_AVE	USINT	Finds an average for USINT value (decimal is rounded off)
ARY_AVE	UINT	Finds an average for UINT value (decimal is rounded off)
ARY_AVE	UDINT	Finds an average for UDINT value (decimal is rounded off)
ARY_AVE	ULINT	Finds an average for ULINT value (decimal is rounded off)
ARY_AVE	REAL	Finds an average for REAL value.
ARY_AVE	LREAL	Finds an average for LREAL value.

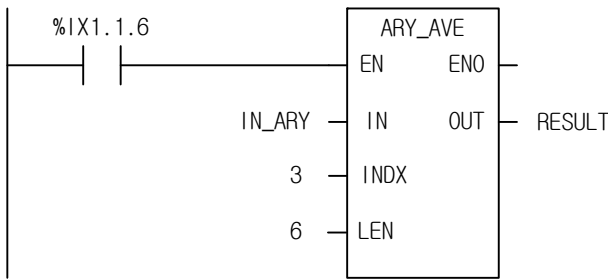


■ Flag

Flag	Description
_ERR	<p>If it is designated beyond the array range, _ERR and _LER flags are set.</p> <p>If an error occurs, the output is 0.</p> <p>※ An error occurs when:</p> <p>INDX &lt; 0 or INDX &gt; max. number of IN</p> <p>INDX + LEN &gt; max. number of IN</p>

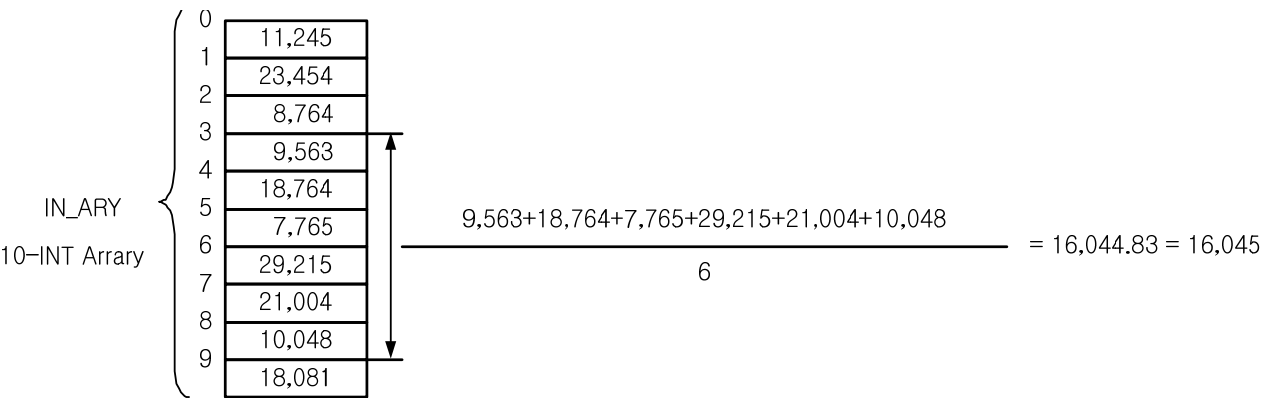
■ Program Example

1. LD



2. ST

RESULT := ARY\_AVE(EN:=%IX1.1.6, IN:=IN\_ARY, INDX:=3, LEN:=6);



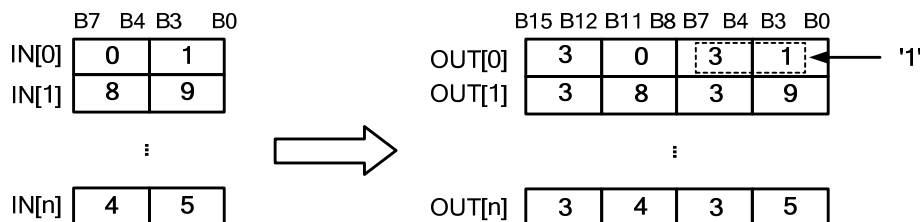
- (1) If input transition condition (%IX1.1.6) is On, ARY\_AVE\_INT function executes.
- (2) If the value within ARRAY is as same as the above-presented picture, it calculates the average value of 6 from the 3rd of Array Index.
- (3) Since the mean value is 16,044.8 but its output type is INT, it rounds off and outputs 16,045.

<b>ARY_BCD_TO_ASC</b>	<b>Input: BCD Array, Output: ASCII Array</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: BCD array input</p> <p><b>Output</b> ENO: without an error, it is 1 OUT: ASCII array output</p>

### ■ Function

It converts a byte array input (BCD) to a word array (ASCII).



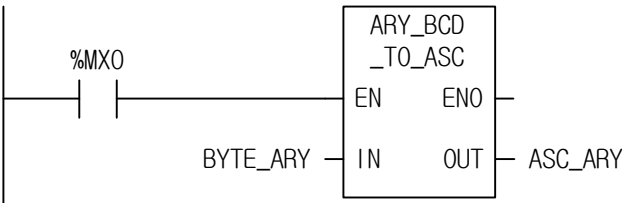
### ■ Flag

Flag	Description
_ERR	If the number of each input/output array is different, there's no change in OUT data, and _ERR and _LER flags are set. If the elements of IN array are not between 0 and 9 (hexadecimal), its responding elements of OUT array are 0 (while other elements of IN1 are normally converted), and _ERR and _LER flags are set.

☆ If the number of each input/output array is different, \_ERR and \_LER flags occur; if output array variable is omitted, the number of array is regarded as '0' and \_ERR and \_LER flags occur.

■ Program Example

1. LD



2. ST

ASC\_ARRAY := ARY\_BCD\_TO\_ASC(EN:=%MX0, IN:=BCD\_ARRAY);

- (1) If the transition condition (%MX0) is on, ARY\_BCD\_TO\_ASC function executes.  
(2) If the input BCD\_ARRAY is as below:

BYTE_ARRAY[0]	01
BYTE_ARRAY[1]	89
BYTE_ARRAY[2]	45

Output ASC\_ARRAY is as follows:

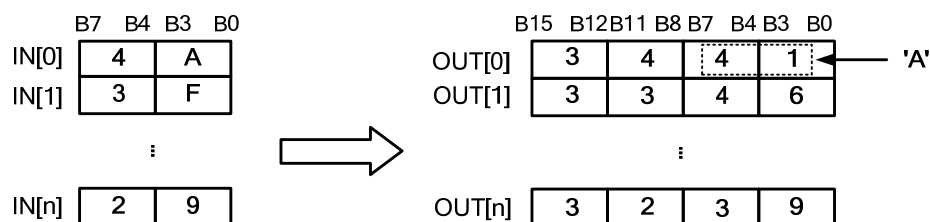
ASC_ARRAY[0]	3031
ASC_ARRAY[1]	3839
ASC_ARRAY[2]	3435

<b>ARY_BYTE_TO_ASC</b>	<b>Input: BYTE Array, Output: ASCII Array</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: BYTE array input</p> <p><b>Output</b> ENO: without an error, it is 1 OUT: ASCII Array output</p>

### ■ Function

It converts a byte array input (HEX) to a word array (ASCII).



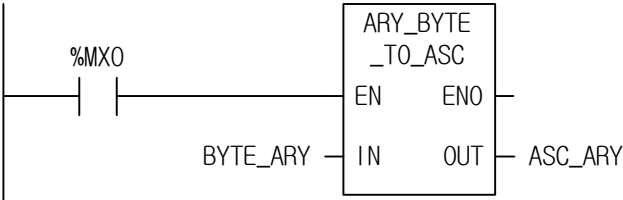
### ■ Flag

Flag	Description
_ERR	If the number of each input/output array is different, there's no change in OUT data, and _ERR and _LER flags are set.

☆ If the number of each input/output array is different, \_ERR and \_LER flags occur; if output array variable is omitted, the number of array is regarded as '0' and \_ERR and \_LER flags occur.

■ Program Example

1. LD



2. ST

```
ASC_ARRAY := ARY_BYTE_TO_ASC(EN:=%MX0, IN:=BYTE_ARRAY);
```

- (1) If the transition condition (%MX0) is on, ARY\_BYTE\_TO\_ASC function executes.
- (2) If the input BYTE\_ARRAY is as below:

BYTE_ARRAY[0]	4A
BYTE_ARRAY[1]	3F
BYTE_ARRAY[2]	29

The output ASC\_ARRAY is as follows:

ASC_ARRAY[0]	3441
ASC_ARRAY[1]	3346
ASC_ARRAY[2]	3239

ARY_CMP	Array comparison	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
<pre> graph LR     subgraph ARY_CMP         EN[EN]         IN1[IN1]         IN1_INDXX[IN1_INDXX]         IN2[IN2]         IN2_INDXX[IN2_INDXX]         LEN[LEN]     end     EN --&gt; ENO[ENO]     IN1 --&gt; OUT[OUT]     IN2 --&gt; OUT     IN1_INDXX --&gt; OUT     IN2_INDXX --&gt; OUT     LEN --&gt; OUT     </pre>	<p><b>Input</b></p> <p>EN: executes the function in case of 1</p> <p>IN1: first array to compare</p> <p>IN1_INDXX : starting point in 1<sup>st</sup> array for comparison</p> <p>IN2: second array to compare</p> <p>IN2_INDXX : starting point in 2<sup>nd</sup> array for comparison</p> <p>LEN: number of elements to compare</p> <p><b>Output</b></p> <p>ENO: without an error, it is 1</p> <p>OUT: if two arrays are equal, it is 1</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	IN2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

\*ARRAY OF ANY: exclude STRING from ANY type.

### ■ Function

1. It compares two arrays whether they have the same value.
2. If LEN is a negative number, it compares two arrays between IN\*\_INDXX (Array INDXX) and "Array INDXX – |LEN|."

Function	Input array type	Description
ARY_CMP	BOOL	Compares two BOOL Arrays.
ARY_CMP	BYTE	Compares two BYTE Arrays.
ARY_CMP	WORD	Compares two WORD Arrays.
ARY_CMP	DWORD	Compares two DWORD Arrays.
ARY_CMP	LWORD	Compares two LWORD Arrays.
ARY_CMP	SINT	Compares two SINT Arrays.
ARY_CMP	INT	Compares two INT Arrays.
ARY_CMP	DINT	Compares two DINT Arrays.
ARY_CMP	LINT	Compares two LINT Arrays.
ARY_CMP	USINT	Compares two USINT Arrays.

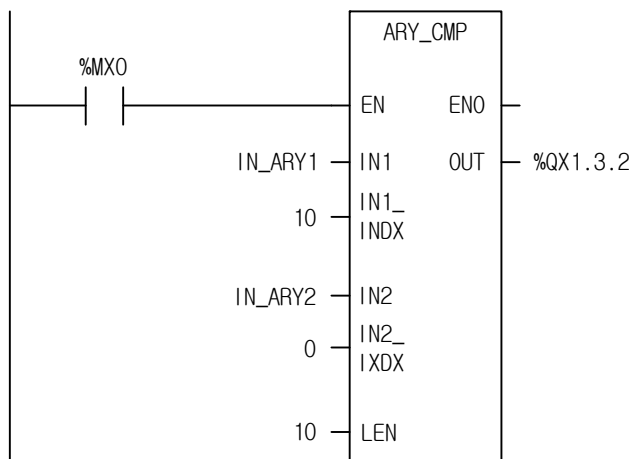
Function	Input array type	Description
ARY_CMP	UINT	Compares two UINT Arrays.
ARY_CMP	UDINT	Compares two UDINT Arrays.
ARY_CMP	ULINT	Compares two ULINT Arrays.
ARY_CMP	REAL	Compares two REAL Arrays.
ARY_CMP	LREAL	Compares two LREAL Arrays.
ARY_CMP	TIME	Compares two TIME Arrays.
ARY_CMP	DATE	Compares two DATE Arrays.
ARY_CMP	TOD	Compares two TOD Arrays.
ARY_CMP	DT	Compares two DT Arrays.

#### ■ Flag

Flag	Description
_ERR	<p>If it is designated beyond the array range, _ERR and _LER flags are set.</p> <p>※ An error occurs when:</p> <p>IN1_INDX &lt; 0 or IN1_INDX &gt; max. number of IN1</p> <p>IN2_INDX &lt; 0 or IN2_INDX &gt; max. number of IN2</p> <p>IN1_INDX + LEN ≥ max. number of IN1</p> <p>IN2_INDX + LEN ≥ max. number of IN2</p>

#### ■ Program Example

##### 1. LD



##### 2. ST

```
%QX1.3.2 := ARY_CMP(EN:=%MX0, IN1:=IN_ARRAY1, IN1_INDX:=10, IN2:=IN_ARRAY2, IN2_INDX:=0, LEN:=10);
```

(1) If the input transition condition (%MX0) is on, ARY\_CMP function executes.

(2) When IN\_ARRAY1 is a time array with 100 elements and IN\_ARRAY2 is a time array with 10 elements, if the elements from 11<sup>th</sup> to 20<sup>th</sup> of IN\_ARRAY1 and the elements of IN\_ARRAY 2 are equal, the output %Q1.3.2 is on.

<b>ARY_FLL</b>	<b>Filling an array with data</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
<pre> graph LR     subgraph ARY_FLL         EN[EN] --&gt; ENO[ENO]         DATA[DATA] --&gt; OUT[OUT]         SRC[SRC]         INDX[INDX]         LEN[LEN]     end     ENO --- ENO_BOOL[BOOL]     OUT --- OUT_BOOL[BOOL]     SRC --- SRC_ARRAY[*ARRAY OF ANY]         </pre>	<p><b>Input</b> EN: executes the function in case of 1  DATA: the data to fill an array  INDX: starting point of an array to be filled  LEN: number of array elements to be filled</p> <p><b>Output</b> ENO: without an error, it is 1  OUT: without an error, it is 1</p> <p><b>In/Out</b> SRC: an array to be filled</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	DATA	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
	SRC	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	

\*ARRAY OF ANY: exclude STRING from ANY type.

### ■ Function

1. It fills an array with the input data.
2. If LEN is minus, it fills an array from INDX to "INDX - |LEN|."

Function	In/out array type	Description
ARY_FLL	BOOL	Fills a BOOL Array with the input data.
ARY_FLL	BYTE	Fills a BYTE Array with the input data.
ARY_FLL	WORD	Fills a WORD Array with the input data.
ARY_FLL	DWORD	Fills a DWORD Array with the input data.
ARY_FLL	LWORD	Fills a LWORD Array with the input data.
ARY_FLL	SINT	Fills a SINT Array with the input data.
ARY_FLL	INT	Fills a INT Array with the input data.
ARY_FLL	DINT	Fills a DINT Array with the input data.
ARY_FLL	LINT	Fills a LINT Array with the input data.
ARY_FLL	USINT	Fills a USINT Array with the input data.
ARY_FLL	UINT	Fills a UINT Array with the input data.



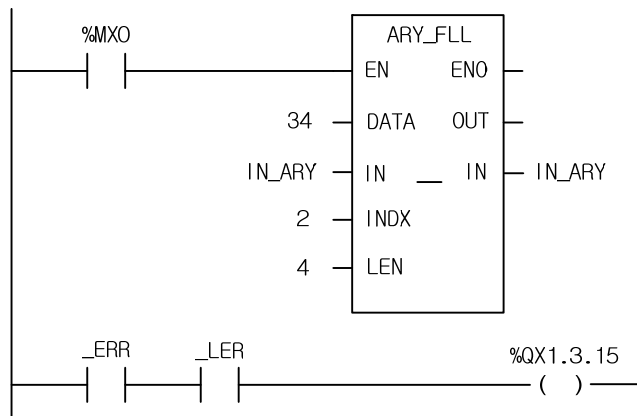
Function	In/out array type	Description
ARY_FLL	UDINT	Fills a UDINT Array with the input data.
ARY_FLL	ULINT	Fills a ULINT Array with the input data.
ARY_FLL	REAL	Fills a REAL Array with the input data.
ARY_FLL	LREAL	Fills a LREAL Array with the input data.
ARY_FLL	TIME	Fills a TIME Array with the input data.
ARY_FLL	DATE	Fills a DATE Array with the input data.
ARY_FLL	TOD	Fills a TOD Array with the input data.
ARY_FLL	DT	Fills a DT Array with the input data.

### ■ Flag

Flag	Description
_ERR	<p>If it is designated beyond the array range, _ERR and _LER flags are set.</p> <p>If an error occurs, there's no change in arrays and OUT is Off.</p> <p>※ An error occurs when:</p> <p style="padding-left: 20px;"><math>INDX &lt; 0</math> or <math>INDX &gt; \text{max. element number of IN}</math></p> <p style="padding-left: 20px;"><math>INDX + LEN \geq \text{max. element number of IN}</math></p>

### ■ Program Example

#### 1. LD

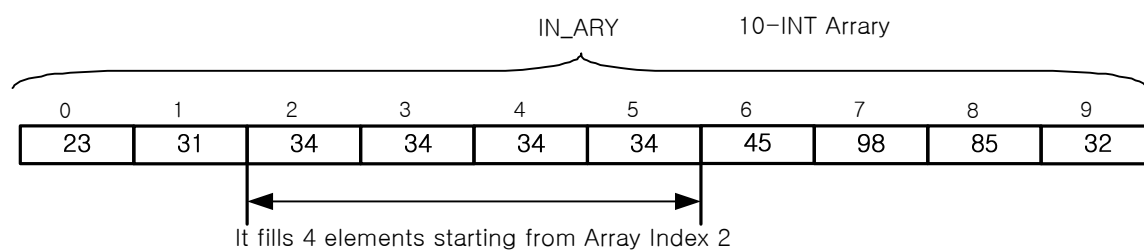


#### 2. ST

```

OUT := ARY_FLL(EN:=%MX0, DATA:=34, SRC:=IN_ARRAY, INDX:=2, LEN:=4);
IF _ERR = 1 AND _LER = 1 THEN %QX1.3.15 := 1;
END_IF;

```



- (1) If input condition (%MX0) is on, ARY\_FLL function executes.
- (2) It fills 4 elements of IN\_ARY starting from INDX with 34.
- (3) If LEN is 9, it is beyond the array range and an error occurs; \_ERR and \_LER flags are on and the output (%QX1.13.15) is on.

<b>ARY_MOVE</b>	<b>Array move</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
<pre> graph LR     subgraph ARY_MOVE         EN[EN] --&gt; ENO[ENO]         MOVE_NUM[MOVE_NUM] --&gt; OUT[OUT]         IN[IN]         IN_INDX[IN_INDX]         OUT_INDX[OUT_INDX]     end     ENO --- ENO_OUT[ENO]     OUT --- OUT_ARRAY[*ARRAY OF ANY]         </pre>	<p><b>Input</b></p> <p>EN : executes the function in case of 1</p> <p>MOVE_NUM: array number to move</p> <p>IN: array variable to move (STRING type, unavailable)</p> <p>IN_INDX: starting pointer of array to move</p> <p>OUT_INDX: starting pointer of array to be moved</p> <p><b>Output</b></p> <p>ENO: without an error, it is 1</p> <p>OUT: array variable to be moved (STRING type, unavailable)</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	OUT	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

\*ARRAY OF ANY: exclude STRING from ANY type.

### ■ Function

1. If EN is 1, it moves IN data to OUT.
2. It copies MOVE\_NUM elements of IN (from IN\_INDX) and pastes it in OUT (from OUT\_INDX).
3. IN and OUT are the same data type (the number of each array can be different).
4. The data size is as follows:

Data size	Variable type
1 Bit	BOOL
8 Bit	BYTE/ SINT/ USINT
16 Bit	WORD / INT / UINT / DATE
32 Bit	DWORD / DINT / UDINT / TIME / TOD
64 Bit	DT

## Ch 8. Application Functions

### ■ Flag

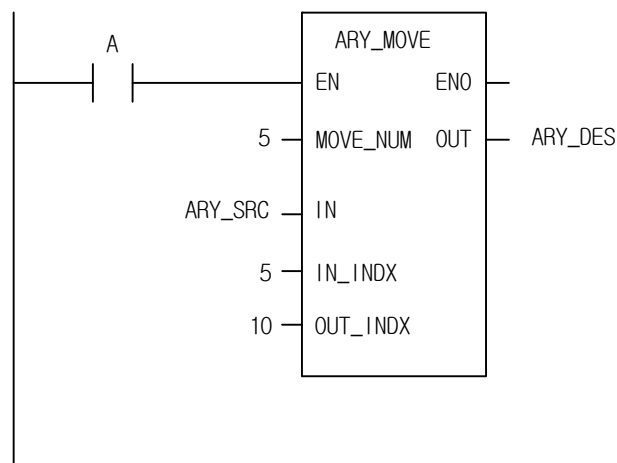
Flag	Description
_ERR	An error occurs when IN and OUT array data sizes are different. An error occurs when 1) the array number of IN Array < (IN_INDX + MOVE_NUM) and 2) the array number of OUT Array < (OUT_INDX + MOVE_NUM). Then ARY_MOVE function is not executed, and OUT is 0. EN0 is Off and _ERR and _LER flags are set.

☆ If the number of each input/output array is different, \_ERR and \_LER flags occur; if output array variable is omitted, the number of array is regarded as '0' and \_ERR and \_LER flags occur.

### ■ Program Example

Variable name	Variable type	Array number
ARY_SRC	INT	10
ARY_DES	WORD	15

#### 1. LD



#### 2. ST

```
ARY_DES := ARY_MOVE(EN:=A, MOVE_NUM:=5, IN:=ARY_SRC, IN_INDX:=5, OUT_INDX:=10);
```

(1) If the transition condition (A) is on, ARY\_MOVE function executes.

(2) It moves 5 elements from ARY\_SRC[5] to ARY\_DES[10].

Now the data type of ARY\_DES is WORD, it's a hexadecimal.

Before				After			
ARY_SRC[0]	0	ARY_DES[0]	16#0	ARY_SRC[0]	0	ARY_DES[0]	16#0
ARY_SRC[1]	11	ARY_DES[1]	16#1	ARY_SRC[1]	11	ARY_DES[1]	16#1
ARY_SRC[2]	22	ARY_DES[2]	16#2	ARY_SRC[2]	22	ARY_DES[2]	16#2

Before				After			
ARY_SRC[3]	33	ARY_DES[3]	16#3	ARY_SRC[3]	33	ARY_DES[3]	16#3
ARY_SRC[4]	44	ARY_DES[4]	16#4	ARY_SRC[4]	44	ARY_DES[4]	16#4
ARY_SRC[5]	55	ARY_DES[5]	16#5	ARY_SRC[5]	55	ARY_DES[5]	16#5
ARY_SRC[6]	66	ARY_DES[6]	16#6	ARY_SRC[6]	66	ARY_DES[6]	16#6
ARY_SRC[7]	77	ARY_DES[7]	16#7	ARY_SRC[7]	77	ARY_DES[7]	16#7
ARY_SRC[8]	88	ARY_DES[8]	16#8	ARY_SRC[8]	88	ARY_DES[8]	16#8
ARY_SRC[9]	99	ARY_DES[9]	16#9	ARY_SRC[9]	99	ARY_DES[9]	16#9
-	-	ARY_DES[10]	16#A	-	-	ARY_DES[10]	16#37
-	-	ARY_DES[11]	16#B	-	-	ARY_DES[11]	16#42
-	-	ARY_DES[12]	16#C	-	-	ARY_DES[12]	16#4D
-	-	ARY_DES[13]	16#D	-	-	ARY_DES[13]	16#58
-	-	ARY_DES[14]	16#E	-	-	ARY_DES[14]	16#63

<b>ARY_ROT_C</b>	<b>Array Bit Rotate with Carry</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

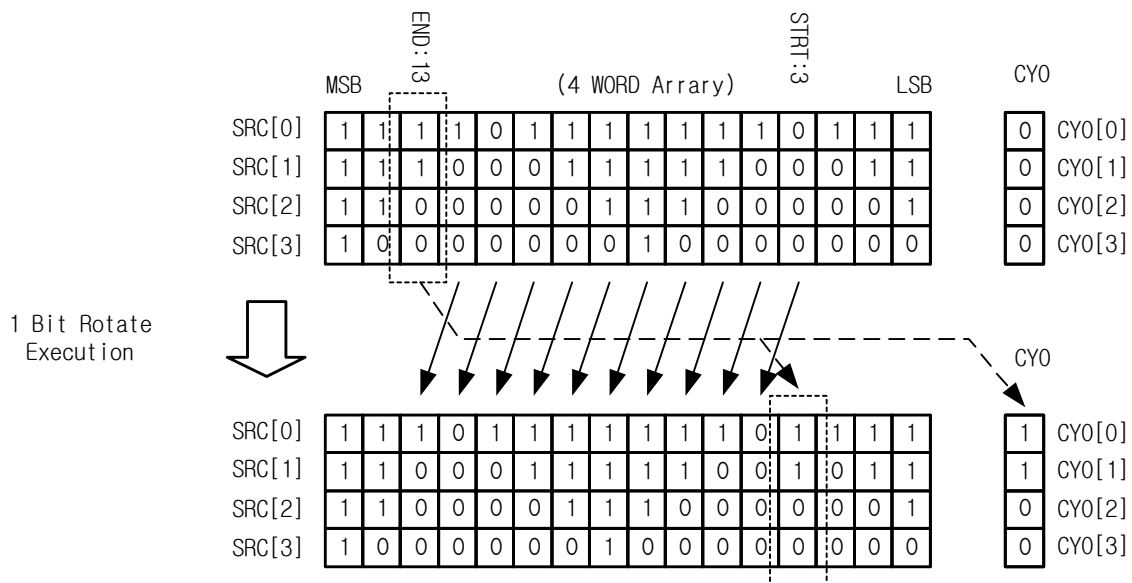
Function	Description
	<p><b>Input</b>      EN: executes the function in case of 1  STRT: starting bit to rotate  END: ending bit to rotate  N: number to rotate</p> <p><b>Output</b>      ENO: without an error, it is 1  CYO: Output Carry bit Array after rotate</p> <p><b>Input/Output</b>      SRC: Source Array to rotate</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	SRC		○	○	○	○															

\*ARRAY OF ANY\_BIT: exclude BOOL from ANY\_BIT type.

### ■ Function

1. It rotates as many bits of array elements as they're specified.
2. Setting
  - Scope: it sets a rotation scope with STRT and END.
  - Rotation direction and time: it rotates N times from STRT to END.
  - Output: the result is stored in configured array in SRC and a bit array data from END to STRT is written at CYO.



Function	In/Out Array Type	Description
ARY_ROT_C	BYTE	It rotates elements of an array as many bits as specified.
ARY_ROT_C	WORD	
ARY_ROT_C	DWORD	
ARY_ROT_C	LWORD	

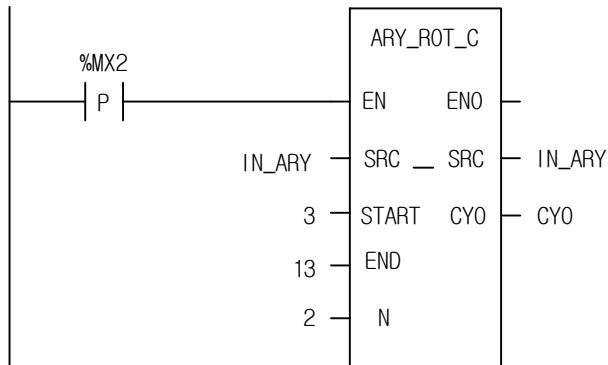
## ■ Flag

Flag	Description
_ERR	<p>If the number of SRC and CYO Arrays are different, _ERR and _LER flags are set.</p> <p>If STRT and END are out of bit range of SRC, an error occurs.</p> <p>When an error occurs, there's no change in SRC and CYO.</p>

- ☆ If the number of each input/output array is different, \_ERR and \_LER flags occur; if output array variable is omitted, the number of array is regarded as '0' and \_ERR and \_LER flags occur.

### ■ Program Example

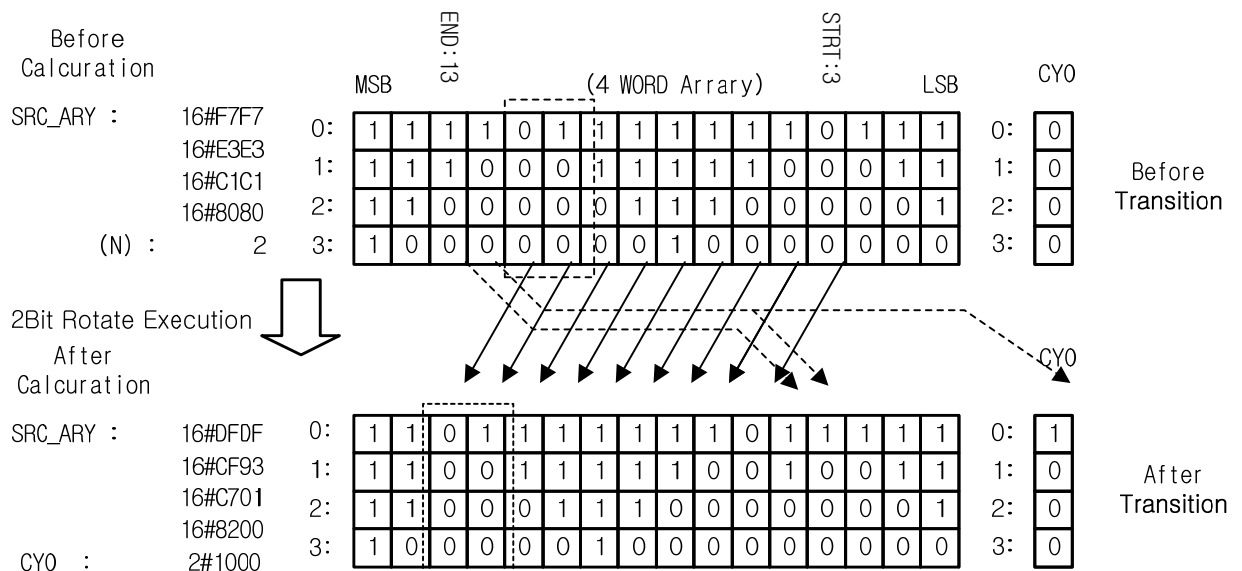
#### 1. LD



#### 2. ST

ARY\_ROT\_C(EN:=%MX2, SRC:=IN\_ARY, STRT:=3, END:=13, N:=2, CYO=>CYO);

- (1) If the input condition (%MX2) is on, ARY\_ROT\_C function executes.
- (2) It rotates 2 times the bit (from 3 to 13 bit) arrays of IN\_ARY from STRT to END.
- (3) The result is stored at IN\_ARY and the carry bit arrays are written in CYO Array.



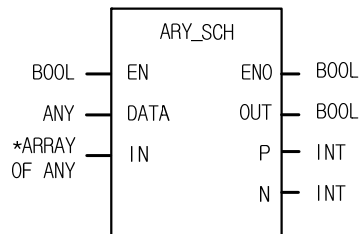


**ARY\_SCH****Array search**

Availability

XGI, XGR, XEC

Flags

**Function****Description****Input**

EN: executes the function in case of 1  
 DATA: data to search  
 IN: array to search

**Output**

ENO: outputs EN value as it is  
 OUT: if it finds, it is 1  
 P: first position of an object array  
 N: total number of array elements equal to an object

ANY type variable

Variable

BOOL

BYTE

WORD

DWORD

LWORD

SINT

INT

DINT

LINT

USINT

UINT

UDINT

ULINT

REAL

LREAL

TIME

DATE

TOD

DT

STRING

DATA

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\*ARRAY OF ANY: exclude STRING from ANY type.

■ **Function**

It finds an equal value of input in arrays and produces its first position and total number. When it finds at least one which is equal to an object in arrays, OUT is 1.

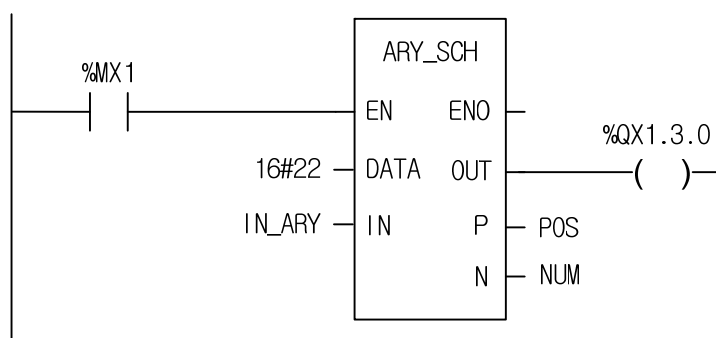
Function	Input Array type	Description
ARY_SCH	BOOL	Search in BOOL Array.
ARY_SCH	BYTE	Search in BYTE Array.
ARY_SCH	WORD	Search in WORD Array.
ARY_SCH	DWORD	Search in DWORD Array.
ARY_SCH	LWORD	Search in LWORD Array.
ARY_SCH	SINT	Search in SINT Array.
ARY_SCH	INT	Search in INT Array.
ARY_SCH	DINT	Search in DINT Array.
ARY_SCH	LINT	Search in LINT Array.
ARY_SCH	USINT	Search in USINT Array.
ARY_SCH	UINT	Search in UINT Array.

## Ch 8. Application Functions

Function	Input Array type	Description
ARY_SCH	UDINT	Search in UDINT Array.
ARY_SCH	ULINT	Search in ULINT Array.
ARY_SCH	REAL	Search in REAL Array.
ARY_SCH	LREAL	Search in LREAL Array.
ARY_SCH	TIME	Search in TIME Array.
ARY_SCH	DATE	Search in DATE Array.
ARY_SCH	TOD	Search in TOD Array.
ARY_SCH	DT	Search in DT Array.

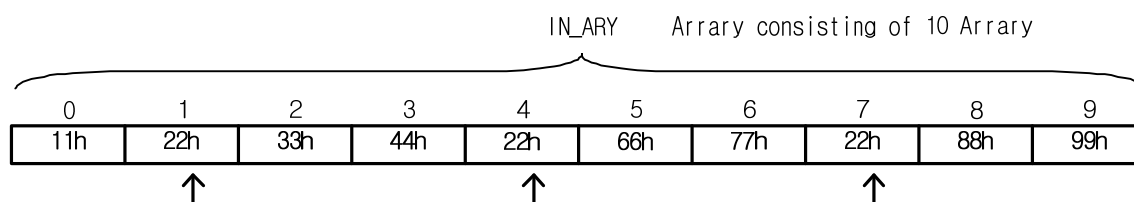
### ■ Program Example

#### 1. LD



#### 2. ST

```
%QX1.3.0 := ARY_SCH(EN:=%MX1, DATA:=16#22, IN:=IN_ARY, P=>POS, N=>NUM);
```



- (1) If the input condition (%MX1) is on, ARY\_SCH function executes.
- (2) When IN\_ARY is a 10-byte array, if you search for “22h” in this array, three bytes are found as the above.
- (3) The result is: 1) 1, the first position of an array, is stored at POS; 2) 3, the total number, is stored at NUM. The total number is 3, so the output %Q1.3.0 is on.

# ARY\_SFT\_C

## Array of Bit Shift Left with Carry

Availability

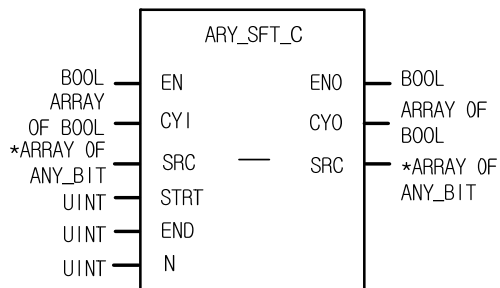
XGI, XGR, XEC

Flags

\_ERR, \_LER

### Function

### Description



#### Input

EN: executes the function in case of 1  
 CYI: Input Carry bit Array  
 STRT: starting bit to shift  
 END: ending bit to shift  
 N: bit number to shift

#### Output

ENO: without an error, it is 1  
 CYO: Output Carry bit Array after shift

#### In/Out

SRC: Source Array to shift

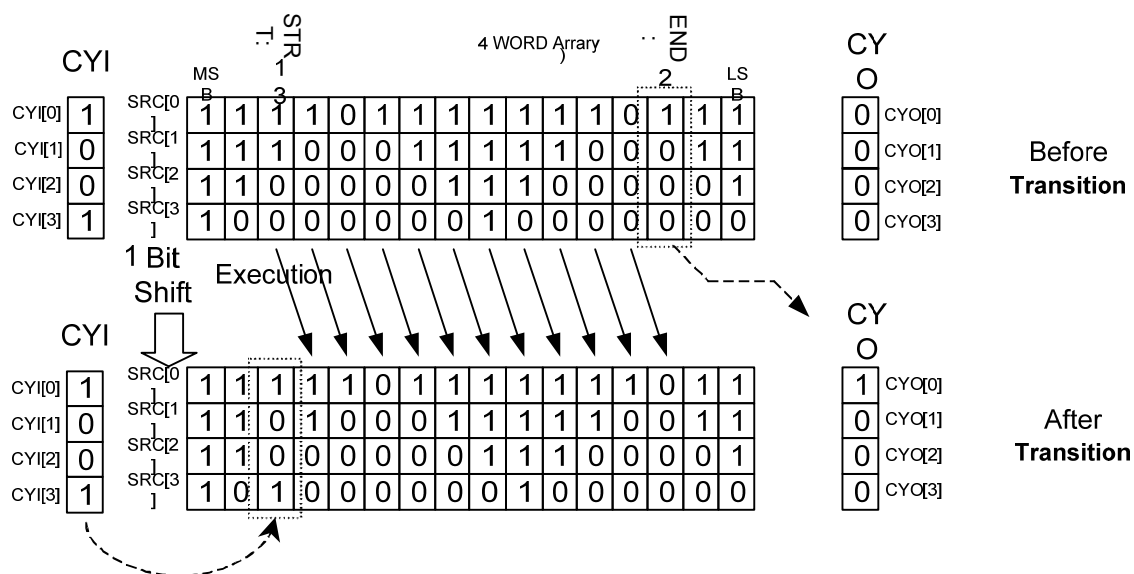
ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	SRC		○	○	○	○															

\*ARRAY OF ANY\_BIT: exclude BOOL from ANY\_BIT type.

### ■ Function

- It shifts as many bits of array elements as specified.
- Setting
  - Scope: it sets a shifting scope with STRT and END.
  - Shifting direction and time: it shifts N times from STRT to END.
  - Input data: it fills the empty bits with input data (CYI).
  - Output: the result is stored in ANY\_BIT\_ARRAY and an overflowing bit array data from END is written at CYO.

## Ch 8. Application Functions



Function	In/Out array type	Description
ARY_SFT_C	BYTE	It shifts as many bits of array elements as specified.
ARY_SFT_C	WORD	
ARY_SFT_C	DWORD	
ARY_SFT_C	LWORD	

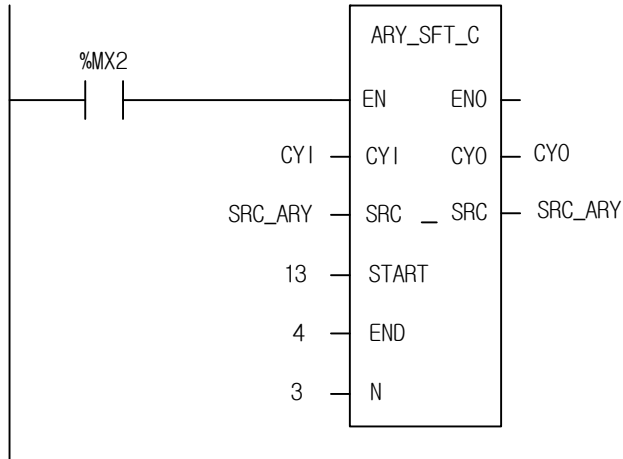
### ■ Flag

Flag	Description
_ERR	<p>If the number of CYI, SRC and CYO Array are different, _ERR and _LER flags are set.</p> <p>An error occurs if STRT and END are out of SRC range.</p> <p>When an error occurs, there's no change in SRC and CYO.</p>

- ☆ If the number of each input/output array is different, \_ERR and \_LER flags occur; if output array variable is omitted, the number of array is regarded as '0' and \_ERR and \_LER flags occur.

## ■ Program Example

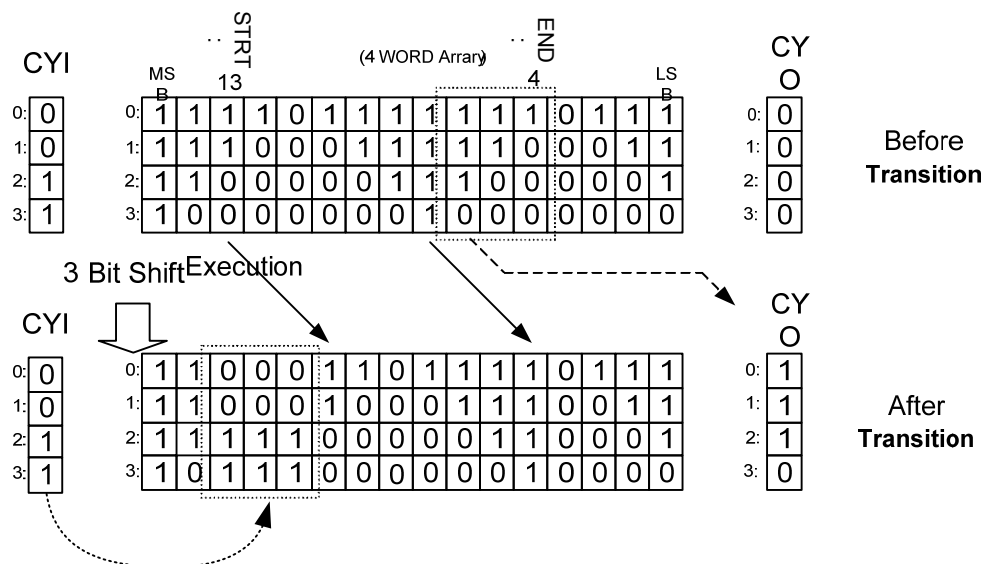
### 1. LD



### 2. ST

```
ARY_SFT_C(EN:=%MX2, CYI:=CYO, SRC:=SRC_ARY, STRT:=13, END:=4, N:=2, CYO=>CYO);
```

- (1) If input condition (%MX2) is on, ARY\_SFT\_C function executes.
- (2) It shifts a bit array (from 4 to 13 bit) of SRC 3 times from STRT to END.
- (3) The bit array after shifting is filled with CYI (2#0011).
- (4) It produces its shifting result at SRC\_ARY and a carry bit array is written at CYO.



<b>ARY_SWAP</b>	<b>Upper/Lower elements swapping of an array</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN1: array input</p> <p><b>Output</b> ENO: without an error, it is 1 OUT: array output after swapping</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN		○	○	○	○															
	OUT		○	○	○	○															

\*ARRAY OF ANY\_BIT: exclude BOOL from ANY\_BIT type.

### ■ Function

It swaps upper/lower elements after dividing an array.

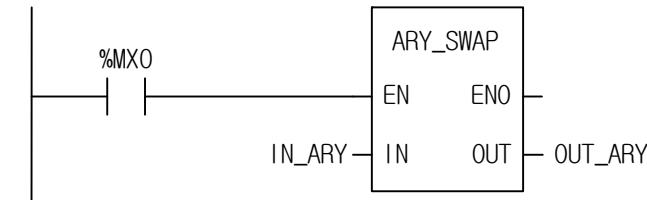
### ■ Flag

Flag	Description
_ERR	_ERR and _LER flags are set if two arrays are different; there's no change in an OUT array.

☆ If the number of each input/output array is different, \_ERR and \_LER flags occur; if output array variable is omitted, the number of array is regarded as '0' and \_ERR and \_LER flags occur.

■ Program Example

1. LD



2. ST

```
OUT_ARY := ARY_SWAP(EN:=%MX0, IN:=IN_ARY);
```

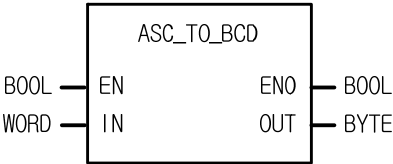
- (1) If the transition condition (%MX0) is on, ARY\_SWAP function with WORD type executes.
- (2) If IN\_ARY data is as below:

IN_ARY[0]	12AB
IN_ARY[1]	23BC
IN_ARY[2]	34CD

OUT\_ARY data is as follows:

OUT_ARY[0]	AB12
OUT_ARY[1]	BC23
OUT_ARY[2]	CD34

ASC_TO_BCD	Converts ASCII to BCD	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

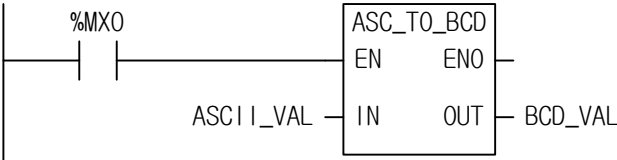
Function	Description
	<p><b>Input</b>      EN: executes the function in case of 1.                  IN: ASCII input</p> <p><b>Output</b>     ENO: without an error, it is 1                  OUT: BCD output</p>

■ **Function**  
It converts two ASCII data into two-digit BCD (Binary Coded Decimal) data.

Flag	Description
_ERR	If IN is not a hexadecimal number between 0 ~ 9, the output is 0 and _ERR and _LER flags are set.

■ **Program Example**

1. LD



2. ST

```
BCD_VAL := ASC_TO_BCD(EN:=%MX0, IN:=ASCII_VAL);
```

- (1) If the transition condition (%MX0) is on, ASC\_TO\_BCD function executes.
- (2) If input variable ASCII\_VAL (WORD) = 16#3732 = “72”, output variable BCD\_VAL (BYTE) = 16#72.



ASC_TO_BYTE	Converts ASCII to BYTE data	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
<div><div>ASC_TO_BYTE</div><div><div>BOOL</div><div>EN</div><div>WORD</div><div>IN1</div><div>ENO</div><div>OUT</div><div>BOOL</div><div>BYTE</div></div></div>	<div><b>Input</b> EN: executes the function in case of 1. IN: ASCII input</div> <div><b>Output</b> ENO: without an error, it is 1 OUT: BYTE Output</div>

■ Function

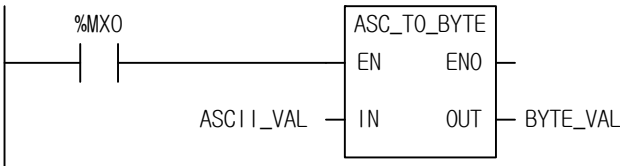
It converts two ASCII data to 2-digit hexadecimal (HEX).

■ Flag

Flag	Description
_ERR	If IN is not between '0' and 'F', its output is 0 and _ERR and _LER flags are set.

■ Program Example

1. LD



2. ST

BYTE\_VAL := ASC\_TO\_BYTE(EN:=%MX0, IN:=ASCII\_VAL);

- (1) If the transition condition (%MX0) is on, ASC\_TO\_BYTE function executes.
- (2) If input ASCII\_VAL (WORD) = 16#4339, output BYTE\_VAL (BYTE) = 16#C9.

BCD_TO_ASC	Converts BCD to ASCII data	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

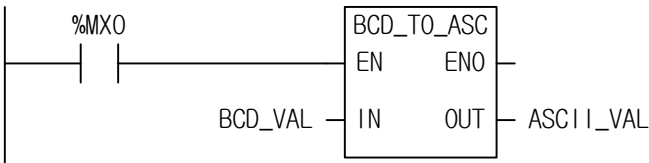
Function	Description
	<p><b>Input</b> EN: executes the function in case of 1. IN: BCD input</p> <p><b>Output</b> ENO: without an error, it is 1 OUT: ASCII Output</p>

■ **Function**  
It converts 2-digit BCD data to two ASCII data.

Flag	Description
_ERR	If IN is not a hexadecimal number between 0 and 9, its output is 16#3030 ("00") and _ERR/_LER flags are set.

■ **Program Example**

1. LD



2. ST

```
ASCII_VAL := BCD_TO_ASC(EN:=%MX0, IN:=BCD_VAL);
```

- (1) If the transition condition (%MX0) is on, BCD\_TO\_ASC function executes.
- (2) If input BCD\_VAL (BYTE) = 16#85, output ASCII\_VAL (WORD) = 16#3835 = "85."

BIT_BYTE	Combines 8 bits into BYTE	
	Availability	XGI, XGR, XEC
	Flags	

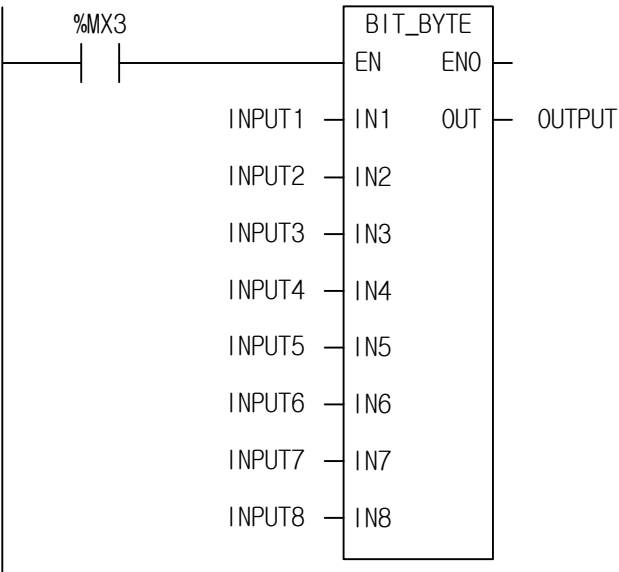
Function	Description
<div><div>BIT_BYTE</div><div><div>BOOL — EN</div><div>BOOL — IN1</div><div>BOOL — IN2</div><div>BOOL — IN3</div><div>BOOL — IN4</div><div>BOOL — IN5</div><div>BOOL — IN6</div><div>BOOL — IN7</div><div>BOOL — IN8</div><div>ENO — BOOL</div><div>OUT — BYTE</div></div></div>	<p><b>Input</b> EN: executes the function in case of 1. IN1 ~ IN8: Bit input</p> <p><b>Output</b> ENO: without an error, it is 1 OUT: Byte output</p>

■ Function

It combines 8 bits into one byte.  
IN8: MSB (Most Significant Bit), IN1: LSB (Least Significant Bit).

■ Program Example

1. LD



### 2. ST

OUTPUT := BIT\_BYTE(EN:=%MX3, IN1:=INPUT1, IN2:=INPUT2, IN3:=INPUT3, IN4:=INPUT4, IN5:=INPUT5, IN6:=INPUT6, IN7:=INPUT7, IN8:=INPUT8);

(1) If the transition condition (%MX3) is on, BIT\_BYTE function executes.

(2) If 8 input are (from INPUT1 to INPUT 8) {0,1,1,0,1,1,0,0}, OUTPUT (BYTE) = 2#0110\_1100.

<b>BMOV</b>	<b>Moves part of a bit string</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
<pre> graph LR     EN[EN] --- BMOV[BMOV]     BMOV --- OUT[OUT]     IN1[IN1] --- BMOV     IN2[IN2] --- BMOV     IN1_P[IN1_P] --- BMOV     IN2_P[IN2_P] --- BMOV     N[N] --- BMOV     </pre>	<p><b>Input</b></p> <p>EN: executes the function in case of 1.</p> <p>IN1: String data having bit data to be combined</p> <p>IN2: String data having bit data to be combined</p> <p>IN1_P: Start bit position on IN1 set data</p> <p>IN2_P: Start bit position on IN2 set data</p> <p>N: Bit number to be combined</p> <p><b>Output</b></p> <p>ENO: without an error, it is 1</p> <p>OUT: Combined bit string data output</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN1		○	○	○	○															
	IN2		○	○	○	○															
	OUT		○	○	○	○															

\*ANY\_BIT: exclude BOOL from ANY\_BIT type.

#### ■ Function

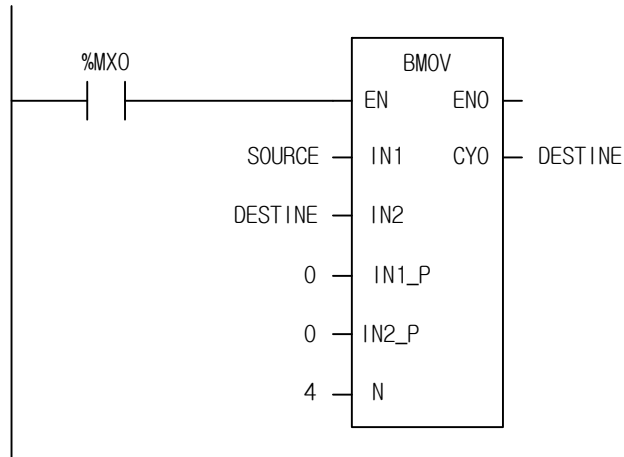
- If EN is 1, it takes N bits of IN1 starting from the IN1\_P bit and moves it to IN2 starting from IN2\_P bit.
- If IN1 = 1111\_0000\_1111\_0000, IN2 = 0000\_1010\_1010\_1111, IN1\_P = 4, IN2\_P = 8, N = 4, then output data is 0000\_1111\_1010\_1111. Input data types are B (BYTE), W (WORD), D (DWORD), L (LWORD).

#### ■ Flag

Flag	Description
_ERR	If IN1_P and IN2_P exceed the data range or N is negative or N bit of IN1_P and IN2_P exceeds the data range, _ERR and _LER flags are set.

### ■ Program Example

#### 1. LD



#### 2. ST

DESTINE := BMOV(EN:=%MX0, IN1:=SOURCE, IN2:=DESTINE, IN1\_P:=0, IN2\_P:=0, N:=4);

- (1) If the transition condition (%MX0) is on, BMOV function executes.
- (2) Since SOURCE = 2#0101\_1111\_0000\_1010, DESTINE = 2#0000\_0000\_0000\_0000 as declared as input variable and IN1\_P = 0, IN2\_P = 8, N = 4, the operations yields 2#0000\_1010\_0000\_0000, and it is changed to DESTINE = 2#0000\_1010\_0000\_0000 because output is designated as DESTINE.

INPUT (IN1) : SOURCE (WORD) = 16#5FOA  
 (IN2) : DESTINE (WORD) = 16#0000  
 (IN1\_P) = 0  
 (IN2\_P) = 8  
 (N) = 4

0	1	0	1	1	1	1	1	0	0	0	0	1	0	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

↓ (BMOV)

OUTPUT (OUT) : DESTINE (WORD) = 16#0A00

0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

<b>BSUM</b>	<b>Counts on-bit number of input</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1. IN: input data to detect on bit</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: Result data (sum of on-bit number)</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN		○	○	○	○															

\*ANY\_BIT: exclude BOOL from ANY\_BIT type.

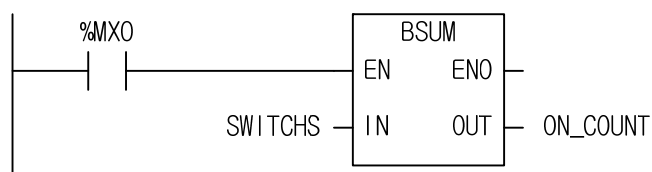
#### ■ Function

1. If EN is 1, it counts bit number of 1 among IN bit string and produces output, OUT.
2. Input data types are BYTE, WORD, DWORD and LWORD.

Function	IN type	Description
BSUM	BYTE	You can select one of these functions according to input data.
BSUM	WORD	
BSUM	DWORD	
BSUM	LWORD	

### ■ Program Example

#### 1. LD



#### 2. ST

```
ON_COUNT := BSUM(EN:=%MX0, IN:=SWITCHS);
```

(1) If the transition condition (%MX0) is on, BSUM function executes.

(2) If input SWITCHS (WORD) = 2#0000\_0100\_0010\_1000, then it counts on-bit number, 3. So the output ON\_COUNT (INT) = 3.



BYTE_BIT	Divides byte into 8 bits	
	Availability	XGI, XGR, XEC
	Flags	

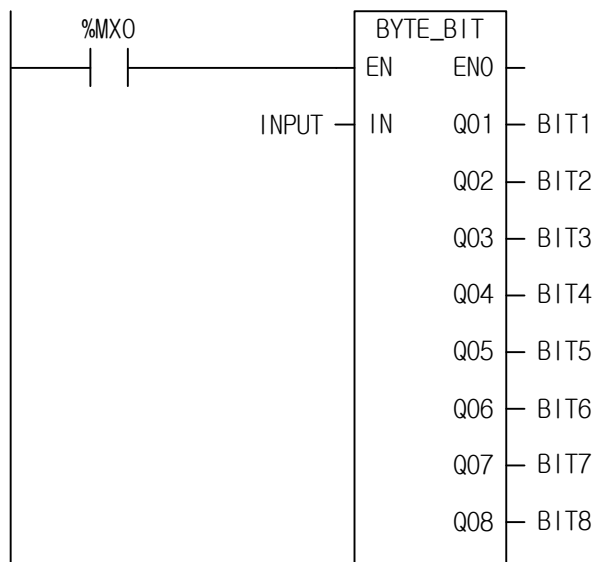
Function		Description	
<div><div><div>BYTE_BIT</div><div><div>BOOL</div><div>EN</div><div>BYTE</div><div>IN</div></div><div><div>ENO</div><div>Q01</div><div>Q02</div><div>Q03</div><div>Q04</div><div>Q05</div><div>Q06</div><div>Q07</div><div>Q08</div></div></div></div>		<b>Input</b>	EN: executes the function in case of 1. IN: BYTE input
		<b>Output</b>	ENO: outputs EN value as it is QO1~8: bit output

■ Function

- 1. It divides one byte into 8 bits (QO1~QO2).
- 2. QO8: MSB (Most Significant Bit), QO1: LSB (Least Significant Bit)

### ■ Program Example

#### 1. LD



#### 2. ST

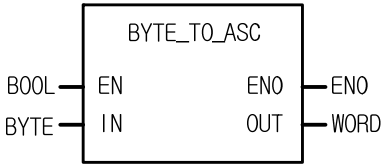
BYTE\_BIT(EN:=%MX0, IN:= INPUT, Q01=> BIT1, Q02=> BIT2, Q03=> BIT3, Q04=> BIT4, Q05=> BIT5, Q06=> BIT6, Q07=> BIT7, Q08=> BIT8);

(1) If the execution condition (%MX0) is on, BYTE\_BIT function executes.

(2) If INPUT = 16#AC = 2#1010\_1100, it distributes INPUT from Q01 to Q08 in order. The order is 2#{0, 0, 1, 1, 0, 1, 0, 1}.

BYTE_TO_ASC	Converts BYTE to ASCII data	
	Availability	XGI, XGR, XEC
	Flags	

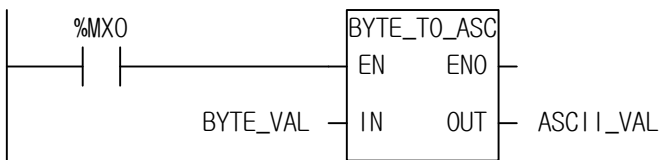
Function	Description
 <pre> graph LR     MX0[%MX0] --&gt; EN[EN]     subgraph BYTE_TO_ASC [BYTE_TO_ASC]         EN --&gt; ENO[ENO]         IN[IN] --&gt; OUT[OUT]     end     BYTE_VAL[BYTE_VAL] --&gt; IN     ENO --&gt; ENO_VAR[ENO]     OUT --&gt; ASCII_VAL[ASCII_VAL] </pre>	<p><b>Input</b> EN: executes the function in case of 1. IN: BYTE input</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: ASCII output</p>

#### ■ Function

1. It converts 2-digit hexadecimal into two ASCII data.  
Ex) 16#12 -> 3132
2. In case of 16#A~F, it produces ASCII data for character.

#### ■ Program Example

##### 1. LD

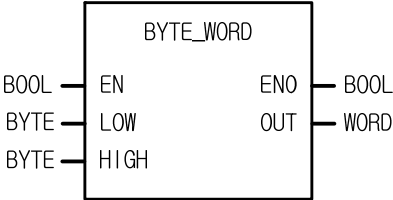


##### 2. ST

```
ASCII_VAL := BYTE_TO_ASC(EN:=%MX0, IN:=BYTE_VAL);
```

- (1) If the transition condition (%MX0) is on, BYTE\_TO\_ASC function executes.
- (2) If input BYTE\_VAL (BYTE) = 16#3A, output ASCII\_VAL (WORD) = 16#3341 = '3', 'A'.

BYTE_WORD	Combines 2 bytes into WORD	
	Availability	XGI, XGR, XEC
	Flags	

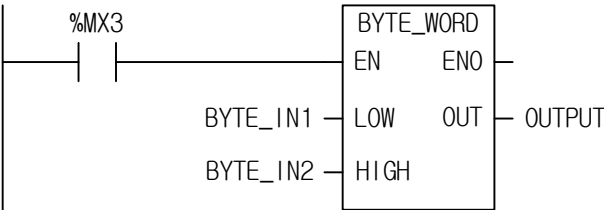
Function	Description
	<p><b>Input</b> EN: executes the function in case of 1. LOW: lower BYTE input HIGH: upper BYTE input</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: WORD output</p>

■ Function

It combines two bytes into one word.  
LOW: lower BYTE input, HIGH: upper BYTE input

■ Program Example

1. LD



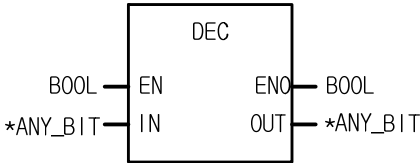
2. ST

OUTPUT := BYTE\_WORD(EN:=%MX3, LOW:=BYTE\_IN1, HIGH:=BYTE\_IN2);

- (1) If the transition condition (%MX3) is on, BYTE\_WORD function executes.
- (2) If input BYTE\_IN1 = 16#56 and BYTE\_IN2 = 16#AD, output variable OUTPUT = 16#AD56.



<b>DEC</b>	<b>Decrease IN data by 1 bit</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1. IN: input data to decrease</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: result data</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN		○	○	○	○															
	OUT		○	○	○	○															

\*ANY\_BIT: exclude BOOL from ANY\_BIT type.

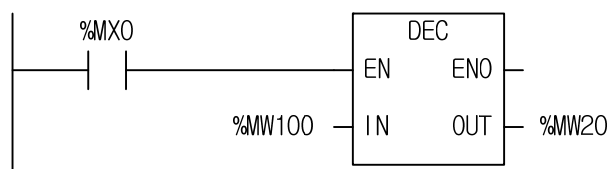
### ■ Function

1. If EN is 1, it produces an output after decreasing bit-string data of IN by 1.
2. Even though the underflow occurs, an error won't occur and if the result is 16#0000, then the output result data is 16#FFFF.
3. Input data types are BYTE, WORD, DWORD and LWORD.

FUNCTION	IN/OUT type	Description
DEC	BYTE	You can select one of these functions according to in/out data type.
DEC	WORD	
DEC	DWORD	
DEC	LWORD	

## ■ Program Example

## 1. LD



## 2. ST

```
%MW20 := DEC(EN:=%MX0, IN:=%MW100);
```

- (1) If the transition condition (%MX0) is on, DEC function executes.
- (2) If input variable %MW100 = 16#0007 (2#0000\_0000\_0000\_0111), output variable %MW20 = 16#0006 (2#0000\_0000\_0000\_0110).

<b>DECO</b>	<b>Decodes the designated bit position</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1. IN: input data for Decoding</p> <p><b>Output</b> ENO: without an error, it is 1 OUT: Decoding result data</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN		○	○	○	○															
	OUT		○	○	○	○															

\*ANY\_BIT: exclude BOOL from ANY\_BIT type.

### ■ Function

1. If EN is 1, it turns on 'the designated position bit of output bit-string data' according to the value of IN, and produces an output.
2. Output data types are BYTE, WORD, DWORD and LWORD.

FUNCTION	OUT type	Description
DECO	BYTE	You can select one of these functions according to output data type.
DECO	WORD	
DECO	DWORD	
DECO	LWORD	

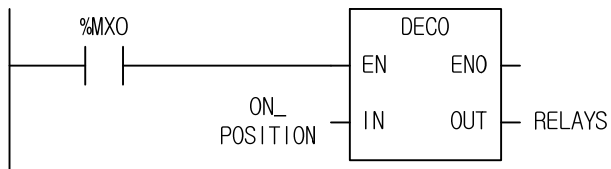
### ■ Flag

Flag	Description
_ERR	If input data is a negative number or bit position data is out of output-type range, (in case of DECO_WORD, it's more than 16), then OUT is 0 and _ERR/_LER flags are set.



## ■ Program Example

### 1. LD



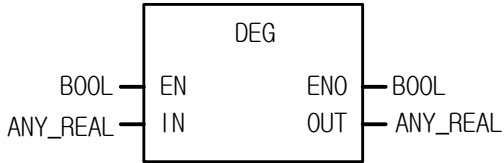
### 2. ST

```
RELAYS := DECO(EN:=%MX0, IN:=ON_POSITION);
```

(1) If the transition condition (%MX0) is on, DECO function executes.

(2) Since the only 5th bit of output is on if ON\_POSITON(INT) = 5 as declared as input variable, RELAYS(WORD type) = 2#0000\_0000\_0010\_0000.

<b>DEG</b>	<b>Converts radian into degree</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1. IN: radian input</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: degree output</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN														○	○					
	OUT														○	○					

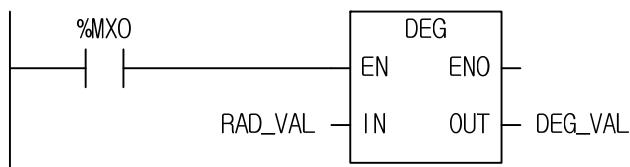
### ■ Function

It converts radian input into degree output.

Function	Input type	Output type	Description
DEG	REAL	REAL	It converts input (radian) into output (degree).
DEG	LREAL	LREAL	

### ■ Program Example

#### 1. LD

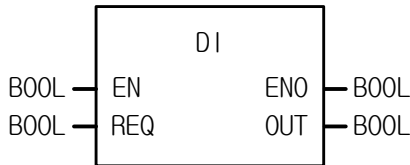


#### 2. ST

```
DEG_VAL := DEG(EN:=%MX0, IN:=RAD_VAL);
```

- (1) If the transition condition (%M0) is on, DEG function executes.
- (2) If input variable RAD\_VAL = 1.0, then output variable DEG\_VAL = 5.7295779513078550e+001.

<b>DI</b>	<b>Disable start of task program</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b>      EN: executes the function in case of 1                         REQ: requires to invalidate when task program starts</p> <p><b>Output</b>     ENO: outputs EN value as it is                         OUT: if DI executes, it is 1</p>

#### ■ Function

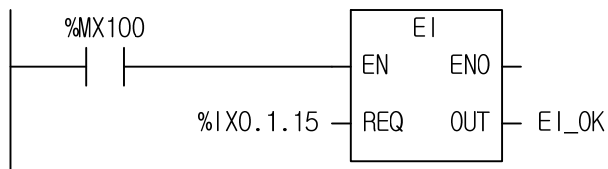
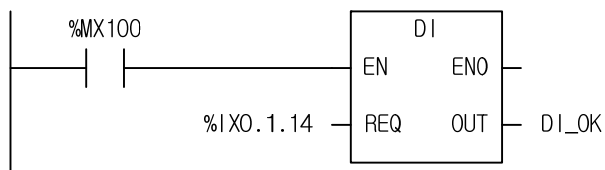
1. If EN = 1 and REQ = 1, it stops a task program (single, interval, interrupt).
2. Once DI function executes, a task program does not start even if REQ input is 0.
3. In order to start a task program normally, use 'EI' function.  
 If you want to partially stop the task program for the troubled part, (otherwise, the continuity of operation process due to the execution of other task program), you can to use this function.
4. The task programs created while its execution is not invalidated is executed according to task program types as follows:
  - Single task: It executes after 'EI' function or current-running task program executes. In this case, it repeats a task program as many as the state of single variable changes.
  - Interval task, interrupt: the task occurred when it is not permitted to execute and executes after 'EI' function or the current-running task program executes. But, if it occurs more than 2 times, TASK\_ERR is on and TC\_CNT (the number of task collision) is counted.

### ■ Program Example

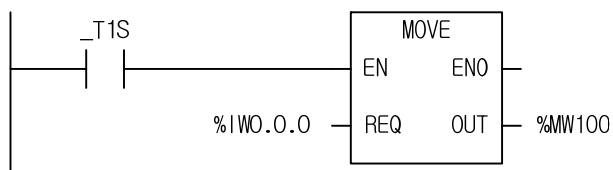
This is the program that controls the task program, increasing the value per second by using DI (Invalidates task program) and EI (permits running for task program).

#### 1. LD

Scan program (TASK program control)



Task program increasing every second



#### 2. ST

Scan program (TASK program control)

```
%IX0.1.14 := DI(EN:=%MX100, REQ:=DI_OK);  
%IX0.1.15 := EI(EN:=%MX100, REQ:=EI_OK);
```

Task program increasing every second

```
%MW100 := MOVE(EN:=_T1S, IN:=%IW0.0.0);
```

- (1) If REQ (assigned as direct variable %IX0.1.14) of DI is on, DI function executes and output DI\_OK is 1.
- (2) If DI function executes, the task program to be executed per second stops.
- (3) If REQ (assigned as direct variable %IX0.1.15) of EI is on, EI function executes and output EI\_OK is 1.
- (4) If EI function executes, the task program stops and the function DI restarts.

<b>DIREC_IN</b>	<b>Update input data immediately</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
<pre> graph LR     EN[BOOL] --&gt; DIREC_IN[DIREC_IN]     BASE[USINT] --&gt; DIREC_IN     SLOT[USINT] --&gt; DIREC_IN     MASK_L[DWORD] --&gt; DIREC_IN     MASK_H[DWORD] --&gt; DIREC_IN     DIREC_IN --&gt; ENO[BOOL]     DIREC_IN --&gt; OUT[BOOL] </pre>	<p><b>Input</b></p> <p>EN: executes the function in case of 1</p> <p>BASE: base number of an input module installed</p> <p>SLOT: slot number of an input module installed</p> <p>MASK_L: designates bits not to be updated among lower 32-bit data of input</p> <p>MASK_H: designates bits not to be updated among upper 32-bit data of input</p> <p><b>Output</b></p> <p>ENO: without an error, it is 1.</p> <p>OUT: if update is completed, output is 1.</p>

#### ■ Function

1. If EN is 1 during the scan, DIREC\_IN function reads 64-bit data of an input module from the designated position of a BASE and a SLOT, and updates them.
2. Only the actual contacts of an input module updates in the image scope.
3. DIREC\_IN function is available to use when you want to change the On/Off state of input (%I) during the scan.
4. Generally, it's impossible to update input data during 1 scan (executing a scan program) because a scan-synchronized batch processing mode executes the batch processing to read input data and produce output data after a scan program.
5. If you use DIREC\_IN function during program execution, related input data updates.

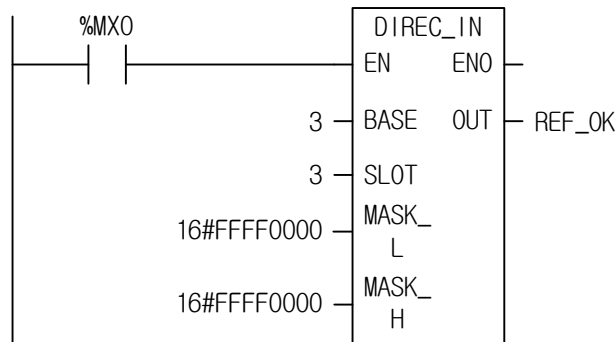
#### ■ Flag

Flag	Description
_ERR	If BASE, SLOT input range is exceeded, or if an error is occurred while input/output data refresh, the output is 0 and _ERR and _LER flags are set.

### ■ Program Example

1. This program updates a 16-contact module installed in the slot no.3 of the 3rd extension base for which input data are 2# 1010\_1010\_1110\_1011.

#### 1. LD



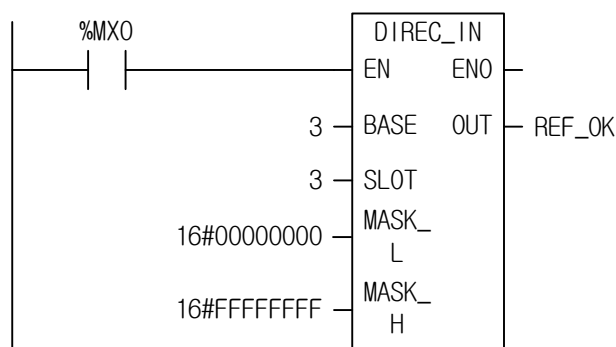
#### 2. ST

```
REF_OK := DIREC_IN(EN:=%MX0, BASE:=3, SLOT:=3, MASK_L:=16#FFFF0000, MASK_H:=16#FFFF0000);
```

- (1) If the input condition (%MX0) is on, DIREC\_IN function executes.
- (2) The image scope to update is %IW3.3.0 because a 16-contact module installs. %IW3.3.0 is updated with 2#1010\_1010\_1110\_1011 during the scan because a lower 16-bit data of MASK\_L (lower 32-bit input) which is not going to be changed is updatable.
- (3) It does not matter what data are set in MASK\_H (upper 32-bit input) because a 16-contact module is installed on the slot and base.

2. This program updates the lower 32-bit data of the 32-contact module installed in the slot no.3 of the 3rd extension base for which input data are 2#0000\_0000\_1111\_1111\_1100\_1100\_0011\_0011.

#### 1. LD



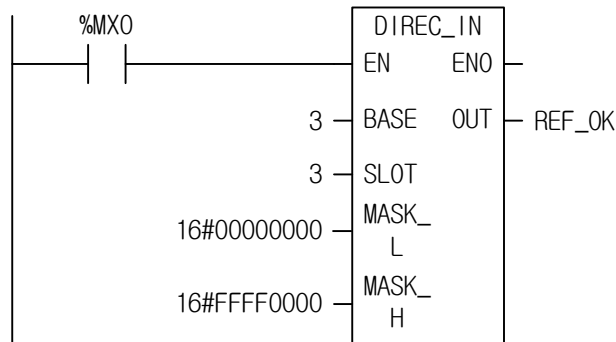
#### 2. ST

```
REF_OK := DIREC_IN(EN:=%MX0, BASE:=3, SLOT:=3, MASK_L:=16#00000000, MASK_H:=16#FFFFFFF);
```

- (1) If input condition (%MX0) is on, function DIREC\_IN executes.
- (2) The image scope to update is %ID3.3.0 because a 32-contact module installs. %ID3.3.0 is updated with 2#0000\_0000\_1111\_1111\_1100\_1100\_0011\_0011 during the scan because a lower 32-bit data of MASK\_L (lower 32-bit input) which is not going to be changed is updatable.

3. This program updates the lower 48-bit data of the 64-contact module installed in the slot no.3 of the 3rd extension base for which input data are 16#0000\_FFFF\_AAAA\_7777 (2#0000\_0000\_0000\_0000\_1111\_1111\_1111\_1111\_1010\_1010\_1010\_1010\_0111\_0111\_0111\_0111).

### 1. LD



### 2. ST

```
REF_OK := DIREC_IN(EN:=%MX0, BASE:=3, SLOT:=3, MASK_L:=16#00000000, MASK_H:=16#0000FFFF);
```

- (1) If the input condition (%MX0) is on, function DIREC\_IN function executes.
- (2) The installed module is a 64-contact module and the image scope to update is %IL3.3.0 (%ID3.3.0 and ID3.3.1).
- (3) %ID3.3.0 updated because the lower 32-bit data (MASK\_L) update is allowed.
- (4) %IW3.3.2 of %ID3.3.1 is updated because only the lower 16-bit data update among upper 32 bits (MASK\_H) is allowed.
- (5) Accordingly, the data update of the image scope is as follows..
 

{	{	%IL3.3.0	%ID3.3.0	%IW3.3.0: 2#0111_0111_0111_0111
				%IW3.3.1: 2#1010_1010_1010_1010
	{	{	%ID3.3.1	%IW3.3.2: 2#1111_1111_1111_1111
				%IW3.3.3: maintains the previous value
- (6) If the input update is completed, output REF\_OK is 1.

<b>DIREC_O</b>	<b>Update output module data immediately</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
<pre> graph LR     subgraph DIREC_O_Box [DIREC_O]         EN[EN]         BASE[BASE]         SLOT[SLOT]         MASK_L[MASK_L]         MASK_H[MASK_H]     end     EN --&gt; ENO[ENO]     OUT[OUT]     </pre>	<p><b>Input</b></p> <p>EN: executes the function in case of 1</p> <p>BASE: base number of an input module installed</p> <p>SLOT: slot number of an input module installed</p> <p>MASK_L: designates bits not to be updated among lower 32-bit data of output</p> <p>MASK_H: designates a bit not to update among upper 32-bit data of output</p> <p><b>Output</b></p> <p>ENO: without an error, it is 1.</p> <p>OUT: if update is completed, output is 1.</p>

### ■ Function

1. If EN is 1 during the scan, DIREC\_O function reads 64-bit data of an output module from the configured position of BASE and SLOT and updates the unmasked (MASK (1)) data.
2. DIREC\_O is available to use when you want to change the on/off state of output (%Q) during the scan.
3. Generally, it is impossible to update input data during 1 scan (executing a scan program) because a scan-synchronized batch processing mode executes the batch processing to read input data and produce output data after a scan program.
4. It is available to update related output data, if you use DIREC\_O function during program execution.
5. If the base/slot number is wrong or it is not available to write data normally in an output module, ENO and OUT are '0' (without an error, it is 1).

### ■ Flag

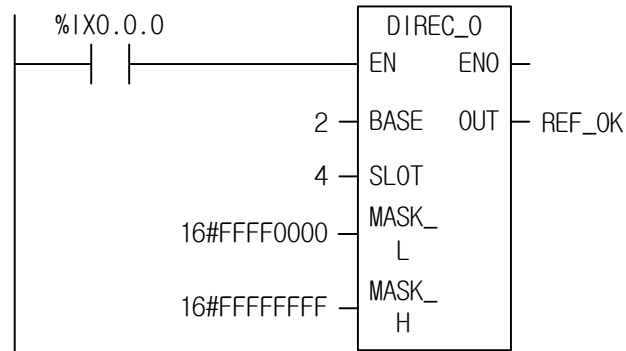
Flag	Description
_ERR	If BASE, SLOT input range is exceeded, or if an error is occurred while input/output data refresh, the output is 0 and _ERR and _LER flags are set.



## ■ Program Example

1. This is the program that produces output data 2#0111\_0111\_0111\_0111 in a 32-contact relay output module installed in the slot no.4 of the 2nd extension base.

### 1. LD



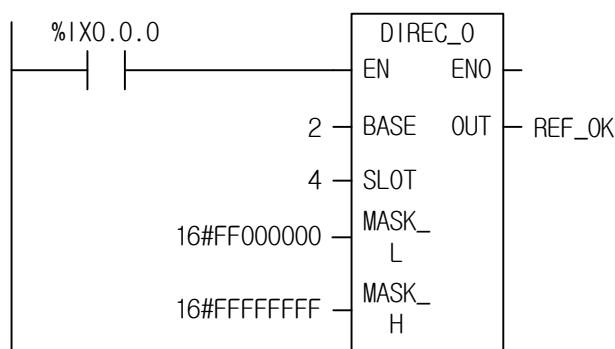
### 2. ST

```
REF_OK := DIREC_O(EN:=%IX0.0.0, BASE:=2, SLOT:=4, MASK_L:=16#FFFF0000, MASK_H:=16#FFFFFFFF);
```

- (1) Input the base number 2 and slot number 4 in which an output module is installed.
- (2) Set MASK\_L as 16#FFFF0000 because the output data to produce are the lower 16 bits among the output contacts.
- (3) If the transition condition (%IX0.0.0) is on, DIREC\_O executes and the data of the output module is updated as 2#0111\_0111\_0111\_0111 during the scan.

2. This is the program that updates the lower 24 bits of the 32-contact transistor output module, installed in the slot no.4 of the 2nd extension base, with 2#1111\_0000\_1111\_0000\_1111\_0000 during the scan.

### 1. LD



### 2. ST

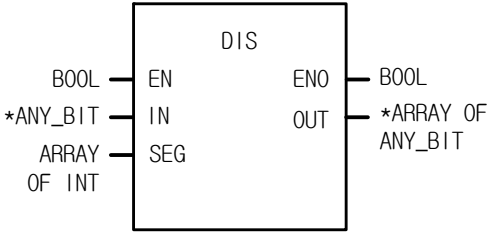
```
REF_OK := DIREC_O(EN:=%IX0.0.0, BASE:=2, SLOT:=4, MASK_L:=16#00000000, MASK_H:=16#FFFFFFFF);
```

- (1) Input the base number 2 and slot number 4 in which an output module is installed.
- (2) Set MASK\_L as 16#FF000000 because the output data to produce are the lower 24 bits among the output contacts.
- (3) If the transition condition (%IX0.0.0) is off, function DIREC\_O executes and the data of the output module is updated.

2#□□□□\_□□□□\_1111\_0000\_1111\_0000\_1111\_0000 during the scan.

Maintains the previous value.

<b>DIS</b>	<b>Data distribution</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b></p> <p>EN: executes the function in case of 1. IN: input data SEG: configured bit array for data distribution</p> <p><b>Output</b></p> <p>ENO: without an error, it is 1 OUT: distributed array output</p>

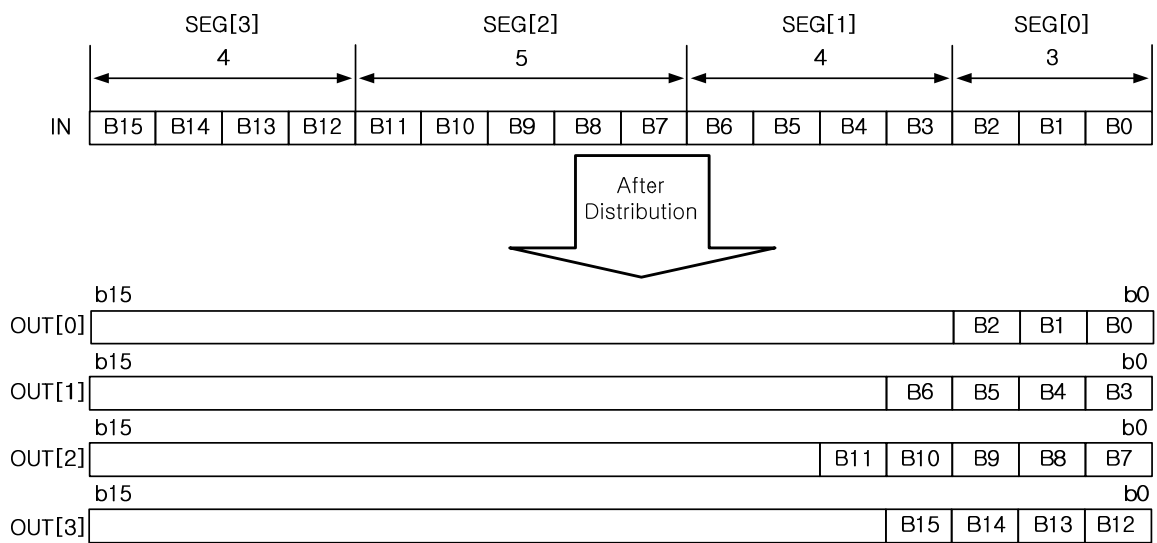
ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN		○	○	○	○															
	OUT		○	○	○	○															

\*ANY\_BIT: exclude BOOL from ANY\_BIT type.

### ■ Function

It distributes input data over OUT after segmenting input data by bit number set by SEG.

Function	Input	Description
DIS	BYTE	It distributes IN input by bit number set with SEG array and outputs, OUT array which is the same type as IN.
DIS	WORD	
DIS	DWORD	
DIS	LWORD	



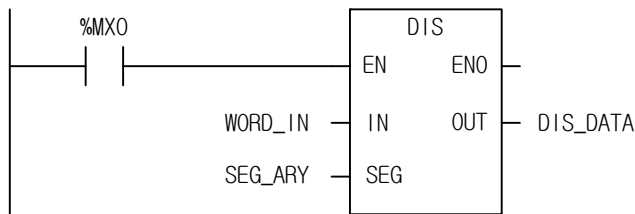
■ Flag

Flag	Description
_ERR _LER	If the sum of configured number of SEG exceeds input variable bit number, _ERR and _LER flags are set.

☆ If output array is omitted, it assumes the number of array as 0, producing \_ERR and \_LER flags.

■ Program Example

1. LD



2. ST

DIS\_DATA := DIS(EN:=%MX0, IN:= WORD\_IN, SEG:=SEG\_ARY);

- (1) If the transition condition (%MX0) is o, DIS function executes.  
(2) If input variable WORD\_IN = 16#3456, SEG\_ARY = {3, 4, 5, 4}, then, output variable DIS\_DATA is:

DIS\_DATA[0]=16#0006  
DIS\_DATA[1]=16#000A  
DIS\_DATA[2]=16#0008  
DIS\_DATA[3]=16#0003

<b>DWORD_LWORD</b>	<b>Combines two DWORD data into LWORD</b>	
	Availability	XGI, XGR, XEC
	Flags	

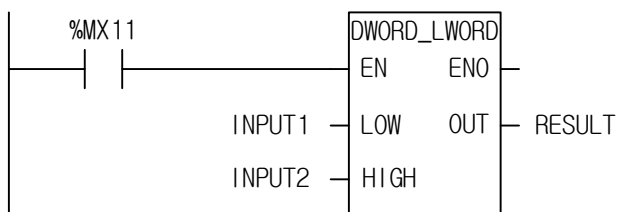
Function	Description
	<p><b>Input</b> EN: executes the function in case of 1. LOW: lower DWORD Input HIGH: upper DWORD Input</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: LWORD Output</p>

### ■ Function

It combines 2 DWORD data into one LWORD data.  
LOW: lower DWORD Input, HIGH: upper DWORD Input

### ■ Program Example

#### 1. LD



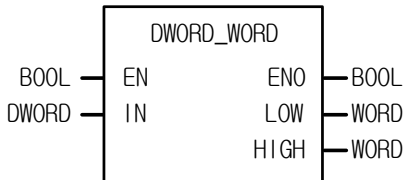
#### 2. ST

```
RESULT := DWORD_LWORD(EN:=%MX11, LOW:=INPUT1, HIGH:=INPUT2);
```

- (1) If the transition condition (%MX11) is on, DWORD\_LWORD function executes.
- (2) If input variable INPUT1 = 16#1A2A\_3A4A and INPUT2 = 16#8C7C\_6C5C, then, output variable RESULT = 16#8C7C\_6C5C\_1A2A\_3A4A.

DWORD_WORD	Divides DWORD into 2 WORD data	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: DWORD Input</p> <p><b>Output</b> ENO: outputs EN value as it is LOW: lower WORD Output HIGH: upper WORD Output</p>

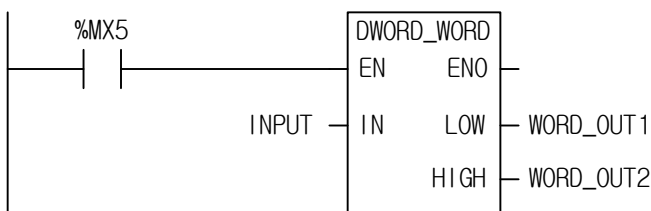
### ■ Function

It divides one DWORD into two WORD data.

LOW: lower WORD Output, HIGH: upper WORD Output

### ■ Program Example

#### 1. LD



#### 2. ST

```
DWORD_WORD(EN:=%MX5, IN:=INPUT, LOW=>WORD_OUT1, HIGH=>WORD_OUT2);
```

(1) If the transition condition (%MX5) is on, DWORD\_WORD function executes.

(2) If input variable INPUT = 16#1122\_AABB, then, WORD\_OUT1 = 16#AABB and WORD\_OUT2= 16#1122.

<b>EMOV</b>	<b>Reading data from the preset flash area</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b></p> <p>REQ : executes the function in case of 1</p> <p>F_NO: Block NO(0~31) with the data to move</p> <p>ADDR: Byte address of a block set with B_NO.</p> <p><b>Output</b></p> <p>ENO: produces 1 if executing without error</p> <p>DATA: data saving area</p> <p>(all variables except BOOL and STRING available)</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	DATA		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	

\*ANY: exclude BOOL and STRING from ANY type.

### ■ Function

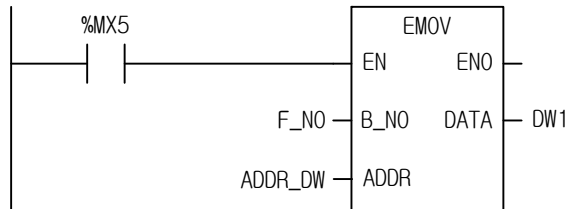
1. The command moves one data among 32 block data in flash memory.
2. It moves the data in ADDR of the F\_NO (flash number) block according to the type set in DATA. then the moved data is entered to DATA variable.
3. If the variable type declared as DATA and the ADDR variable type are not identical, it does not produce any error but any undesirable data may be moved; set ADDR value according to DATA type. For instance, if declaring 4BYTE type variables (DWORD, UDINT, DINT, REAL ...) to DATA, ADDR variable must also use 4BYTE type variable.
4. If F\_NO is 31 and greater or ADDR value exceeds 65,535, \_ERR and \_LER are set.

### ■ Flag

Flag	Description
_ERR	If F_NO value is 31 and over or ADDR value exceeds 65,535

### ■ Program Example

#### 1. LD

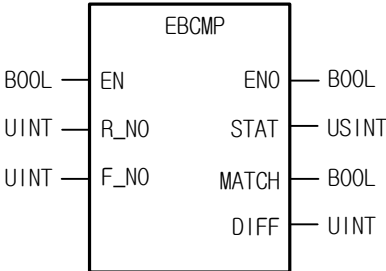


#### 2. ST

```
EMOV(EN:=%MX5, F_NO:= F_NO, ADDR:= ADDR_DW, DATA=> DW1);
```

- (1) If the execution condition (%MX5) is on, EMOV function executes.
- (2) If setting F\_NO = 1, ADDR\_DW(DWORD type) = 4, move DWORD DATA in 4BYTE OFFSET of No.1 Flash Block to DW1(DWORD).

<b>EBCMP</b>	<b>Check the consistency after comparing content</b>	
	Availability	XGI, XGR, XEC
	Flags	

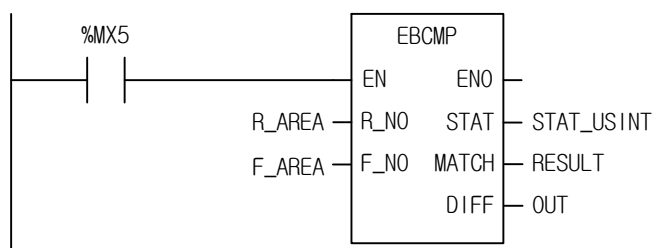
Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 R_NO: R device block no. F_NO: Flash memory block no.</p> <p><b>Output</b> ENO: On if comparison is complete STAT: Error status MATCH: On if comparison results are consistent DIFF: No. of inconsistency (DWORD)</p>

### ■ Function

1. The command to check the consistency by comparing a block of R device and another block of flash memory while input contact is on; it compares data in DWORD.
2. STAT shows error status; if it is greater than 1 in R\_NO input, STAT = 1; if it is greater than 31 in F\_NO input, STAT = 2. Even though there is only one error after the entire comparison, it shows an error; STAT = 3.
3. In case of inconsistency, it saves the number in DIFF.

### ■ Program Example

#### 1. LD



#### 2. ST

```
EBCMP(EN:=%MX5, R_NO:=R_AREA, F_NO:=F_AREA, STAT=>STAT_USINT, MATCH=>RESULT, DIFF=>OUT);
```

- (1) If the execution condition (%MX5) is on, EBCMP function executes.
- (2) If setting R\_AREA = 0, F\_AREA = 1 and if R device block no.0 and flash block no.1 are consistent, RESULT(BOOL) is on and shows OUT(no. of inconsistency) = 0.



<b>ENCO</b>	<b>Produces On bit position as number</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: input data to encode</p> <p><b>Output</b> ENO: without an error, it is 1 OUT: Encoding result data</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN		○	○	○	○															
	OUT							○													

\*ANY\_BIT: exclude BOOL from ANY\_BIT type.

#### ■ Function

1. If EN is 1, it produces the most priority bit position among bits of 1 to OUT.
2. Input data types are B(BYTE), W(WORD), D(DWORD) and L(LWORD).

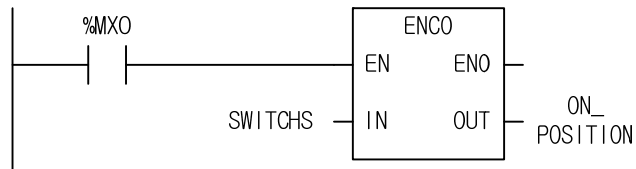
FUNCTION	IN type	Description
ENCO	BYTE	Uses a desirable ENCO function type depending on input variable type.
ENCO	WORD	
ENCO	DWORD	
ENCO	LWORD	

#### ■ Flag

Flag	Description
_ERR	OUT is -1 if no bit among input data is 1; _ERR and _LER flags are set.

### ■ Program Example

#### 1. LD



#### 2. ST

```
ON_POSITION := ENCO(EN:=%MX0, IN:=SWITCHS);
```

- (1) If the execution condition (%MX0) is on, ENCO function executes.
- (2) If SWITCHS (WORD type) = 2#0000\_1000\_0000\_0010, it produces the positions of 2 bits with on, that is, '11' out of '11' and '1', so that '11' is saved into ON\_POSITION(INT Type).

<b>EI</b>	<b>Permits running for task program (Cancel of DI)</b>	
	Availability	XGI, XGR, XEC
	Flags	

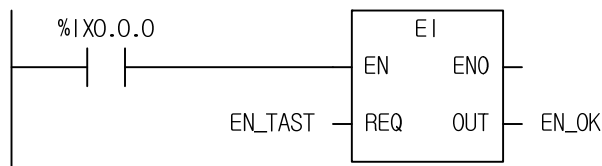
Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 REQ: requires to permit running for task program</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: If EI is executed, an output is 1</p>

#### ■ Function

1. If EN is 1 and REQ input is 1, task program blocked by 'DI' function starts normally.
2. Once 'EI' command executes, task program starts normally even if REQ input is 0.
3. Task programs created when they are not permitted to operate executes after 'EI' function or the current-running task program execution.

#### ■ Program Example

##### 1. LD

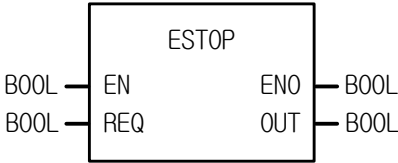


##### 2. ST

```
EN_OK := EI(EN:=%IX0.0.0, REQ:=EN_TAST);
```

- (1) If EN\_TASK is 1, a task program starts normally.
- (2) If EI function permits running for a task program, output EN\_OK is 1.

<b>ESTOP</b>	Emergency running stop by program	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
 <pre> graph LR     EN_BOOL[BOOL] --&gt; EN     REQ_BOOL[BOOL] --&gt; REQ     subgraph ESTOP         EN --&gt; ENO         REQ --&gt; OUT     end     ENO --&gt; ENO_BOOL[BOOL]     OUT --&gt; OUT_BOOL[BOOL] </pre>	<p><b>Input</b></p> <p>EN: executes the function in case of 1</p> <p>REQ: requires the emergency running stop</p> <p><b>Output</b></p> <p>ENO: outputs EN value as it is. Refer to function 1</p> <p>OUT: if ESTOP executes, an output is 1</p>

### ■ Function

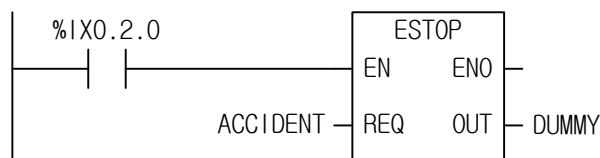
1. If transition condition EN is 1 and the signal to require the emergency running stop by program REQ is 1, program operation stops immediately and returns to STOP mode.
2. In case that a program stops by 'ESTOP' function, it does not start despite of power re-supply.
3. If operation mode moves from STOP to RUN, it restarts.
4. If 'ESTOP' function executes, it stops the running program during operation; if it is not a cold restart mode, an error may occur when restarts.

### ■ Flag

Flag	Description
_ESTOP_ON	It turns On if the program is stopped by ESTOP command. It is off when the program enters into RUN in the status.

### ■ Program Example

#### 1. LD



#### 2. ST

```
DUMMY := ESTOP(EN:=%IX0.2.0, REQ:=ACCIDENT);
```

- (1) If the transition condition (%IX0.2.0) is on, ESTOP function executes.
- (2) If ACCIDENT = 1, the running program stops immediately and returns to STOP mode.

※ In case of emergency, it is available to use it as a double safety device with mechanical interrupt.

FALS	Saving a user-defined constant(N) to the designated address in F( _FALS_NUM)	
	Availability	XGI, XGR
	Flags	

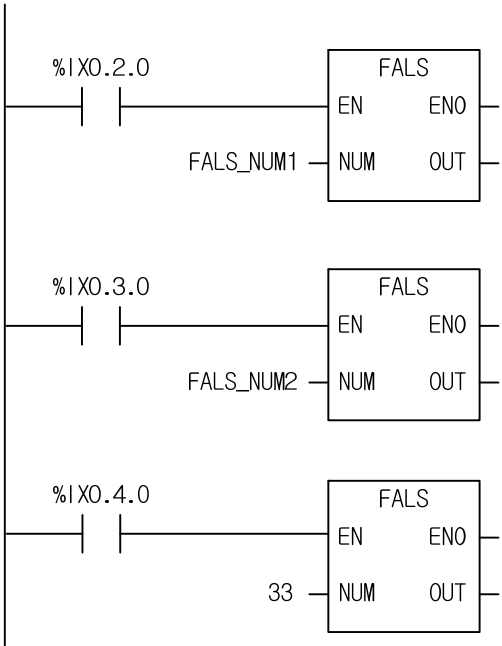
Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 NUM: number to be saved in F</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: produces on if it normally works</p>

■ Function

- 1. The command saves a user-defined constant (N) to the designated address in F( \_FALS\_NUM).
- 2. NUM can be designated between 16#0000 ~ 16#FFFF and the first generated number is saved until it is cancelled.
- 3. To cancel FALS, FALS 0000 executes.

■ Program Example

1. LD



### 2. ST

OUT1 := FALS(EN:=%IX0.2.0, NUM:=FALS\_NUM1);

OUT2 := FALS(EN:=%IX0.3.0, NUM:=FALS\_NUM2);

OUT3 := FALS(EN:=%IX0.4.0, NUM:=33);

- (1) If the execution condition is on, each FALS function executes (ex: FALS\_NUM1=31, FALS\_NUM2=32).
- (2) The value is saved in \_FALS\_NUM Flag according to the execution condition (%IX0.2.0, %IX0.3.0, %IX0.4.0), the value is saved into the first \_FALS\_NUM\_Flag, and the next value is not saved until FALS is canceled.
- (3) To cancel FALS, 0000 must be set in NUM.
- (4) It is convenient to view the status if executing the program by setting a value of special condition and checking \_FALS\_NUM Flag.

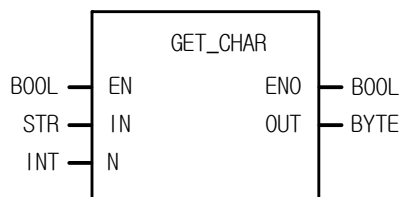
**GET\_CHAR****Gets one character from a String**

Availability

XGI, XGR, XEC

Flags

\_ERR, \_LER

**Function****Description****Input**

EN: executes the function in case of 1  
 IN: STRING input  
 N: position in a String

**Output**

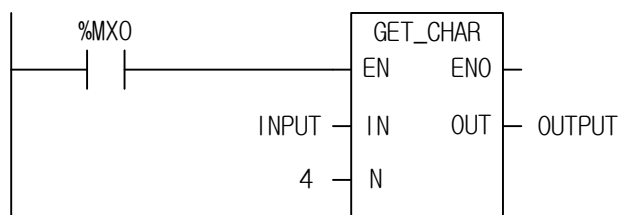
ENO: outputs EN value as it is  
 OUT: Byte Output

**■ Function**

1. It extracts one byte from a String starting from N.

**■ Flag**

Flag	Description
_ERR	_ERR/_LER flags are set if N exceeds the number of byte in STRING. If an error occurs, the output is 16#00.

**■ Program Example****1. LD****2. ST**

```
OUTPUT := GET_CHAR(EN:=%MX0, IN:=INPUT, N:=4);
```

- (1) If the transition condition (%MX0) is on, GET\_CHAT function executes.
- (2) When input INPUT (STRING) = "LS XGI PLC," if you extract 4<sup>th</sup> character from this string, output variable OUTPUT is 16#58 ("X").

<b>INC</b>	<b>Increase IN data by 1</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: Input data to increase</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: result data after increase</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN		○	○	○	○															
	OUT		○	○	○	○															

\*ANY\_BIT: exclude BOOL from ANY\_BIT type.

### ■ Function

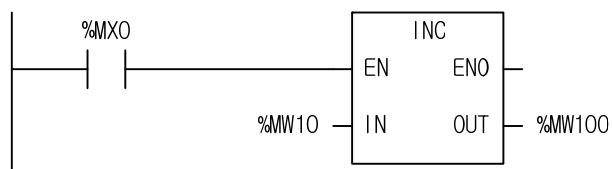
1. If EN is 1, it increases IN bit string data by 1 and produces an output.
2. An error does not occur when there's an overflow; the result is 16#0000 in case of 16#FFFF.
3. Input data types are BYTE, WORD, DWORD and LWORD.

FUNCTION	IN/OUT type	Description
INC	BYTE	You can select one of these functions according to the in/out data type.
INC	WORD	
INC	DWORD	
INC	LWORD	



## ■ Program Example

## 1. LD

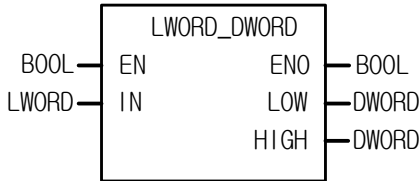


## 2. ST

```
%MW100 := INC(EN:=%MX0, IN:=%MW10);
```

- (1) If the transition condition (%MX0) is on, INC function executes.
- (2) If input variable %MW10 = 16#0007 (2#0000\_0000\_0000\_0111), then output variable %MW100 = 16#0008 (2#0000\_0000\_0000\_1000).

<b>LWORD_DWORD</b>	<b>Divides LWORD into two DWORD data</b>	
	Availability	XGI, XGR, XEC
	Flags	

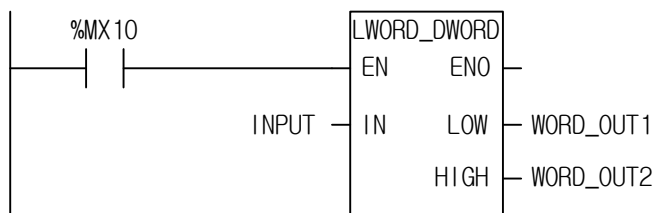
Function	Description
 <p>The diagram shows a function block labeled 'LWORD_DWORD'. It has two inputs on the left: a Boolean input 'EN' and a 16-bit input 'IN'. It has three outputs on the right: a Boolean output 'ENO', a 16-bit output 'LOW', and a 16-bit output 'HIGH'.</p>	<p><b>Input</b> EN: executes the function in case of 1 IN: LWORD Input</p> <p><b>Output</b> ENO: outputs EN value as it is LOW: lower DWORD Output HIGH: upper DWORD Output</p>

### ■ Function

1. It divides one LWORD into two DWORD data.  
LOW: lower DWORD Output, HIGH: upper DWORD Output

### ■ Program Example

#### 1. LD



#### 2. ST

```
LWORD_DWORD(EN:=%MX10, IN:=INPUT, LOW=>DWORD_OUT1, HIGH=>DWORD_OUT2);
```

- (1) If the transition condition (%MX10) is on, LWORD\_DWORD function executes.
- (2) If the input variable INPUT = 16#AAAA\_BBBB\_CCCC\_DDDD, then  
 DWORD\_OUT1 = 16#CCCC\_DDDD  
 DWORD\_OUT2 = 16#AAAA\_BBBB.

<b>MCS</b>	<b>Master Control</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1. NUM: Nesting (0~15)</p> <p><b>Output</b> ENO: If MCS is executed, it is 1</p>

#### ■ Function

1. If EN is on, MCS function executes and the program between MCS and MCSCLR function is normally executes.
2. If EN is off, the program between MCS and MCSCLR function executes as follows:

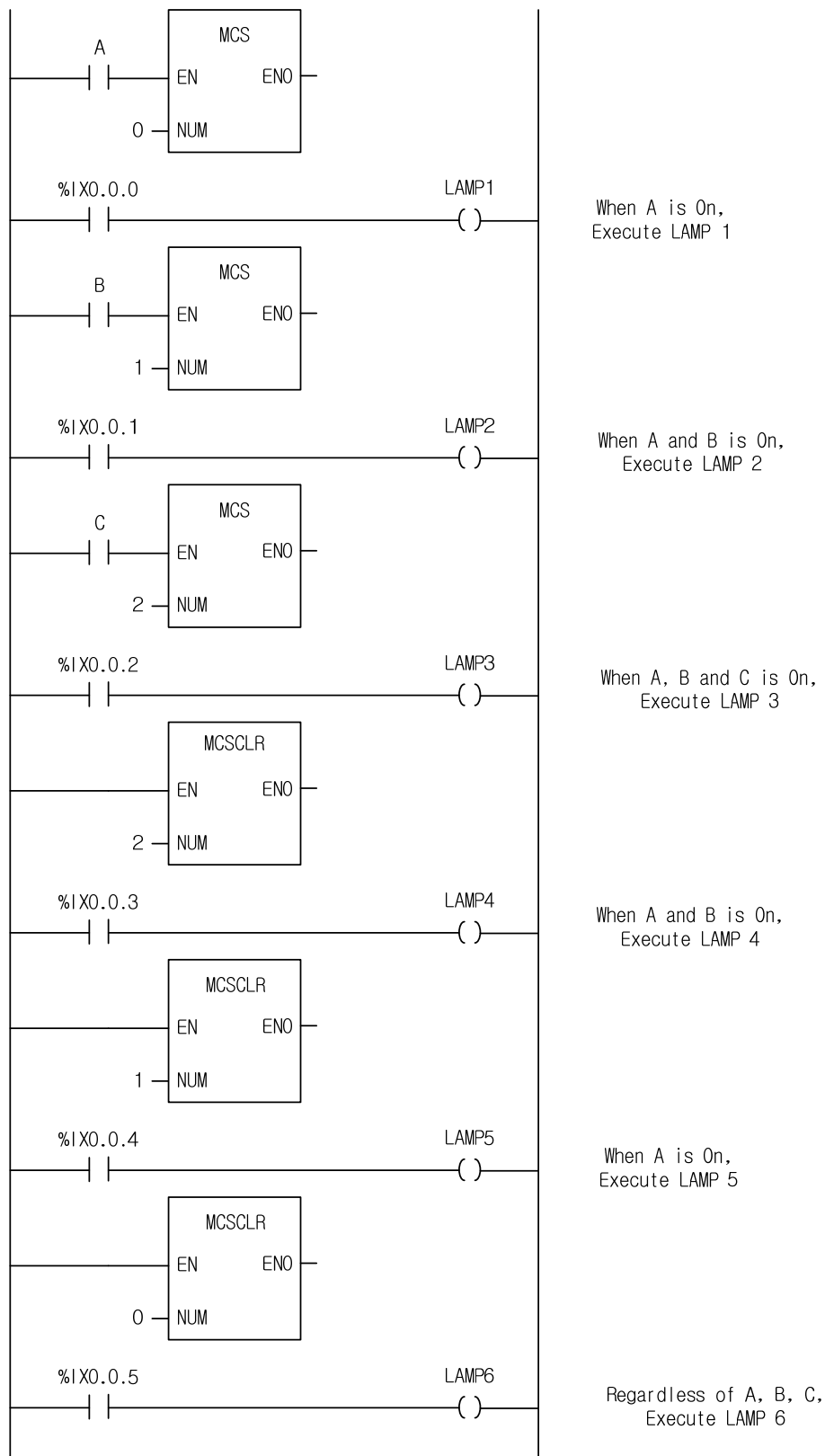
Instruction	Description
Timer	Current value (CV) becomes 0 and the output (Q) becomes off.
Counter	Output (Q) becomes off and CV retains its present state.
Coil	All becomes off.
Negated coil	All becomes off.
Set coil, reset coil	All retains its current value.
Function, function block	All retains its current value.

3. Even when EN is off, scan time is not shortened because the instructions between MCS and MCSCLR function are executed as the above.
4. Nesting is available in MCS. That is to say, Master Control is divided by Nesting (NUM). You can set up Nesting (NUM) from 0 to 15 and if you set it more than 16, MCS is not executed normally.

\* Note: if you use MCS without 'MCSCLR', MCS function executes till the end of the program.

## ■ Program Example

### 1. LD

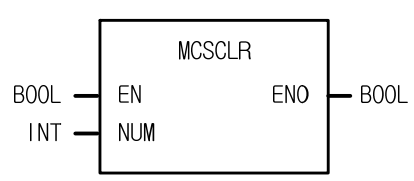


## 2. ST

```
MCS(EN:=A, NUM:=0);  
LAMP1 := %IX0.0.0;           // When A is on, execute LAMP1  
  
MCS(EN:=B, NUM:=1);  
LAMP2 := %IX0.0.1;           // When A and B are on, execute LAMP2  
  
MCS(EN:=C, NUM:=2);  
LAMP3 := %IX0.0.2;           // When A, B and C are on, execute LAMP3  
  
MCSCCLR(NUM:=2);  
LAMP4 := %IX0.0.3;           // When A and B are on, execute LAMP4  
  
MCSCCLR(NUM:=1);  
LAMP5 := %IX0.0.4;           // When A is on, execute LAMP5  
  
MCSCCLR(NUM:=0);  
LAMP6 := %IX0.0.5;           //Regardless of A, B, C, execute LAMP6
```

- (1) The value corresponding to NUM of each MCS function sets an area with its counterpart, MCSCCLR of the number. NESTING (NUM) can be set between 0~15 and the higher number is not allowed. Unless MCS and MCSCCLR are combined as a pair, MCS function executes to the end of the program.

MCSCCLR	Master Control Clear	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 NUM: Nesting (0~15)</p> <p><b>Output</b> ENO: if MCSCCLR is executed, it will be 1</p>

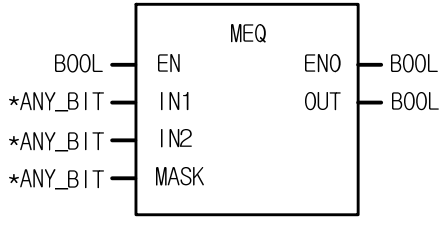
■ Function

- 1. It clears a Master Control instruction. And it indicates the end of the Master Control.
- 2. If MCSCCLR function executes, it clears all the MCS instructions which are less than or equal to Nesting (NUM).
- 3. There's no contact before MCSCCLR function.

■ Program Example

Refer to the MCS function example.

<b>MEQ</b>	<b>Masked Equal</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b></p> <p>EN: executes the function in case of 1.  IN1: Input1  IN2: Input2  MASK: input data to mask</p> <p><b>Output</b></p> <p>ENO: outputs EN value as it is  OUT: when equal, it is 1</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN1		○	○	○	○															
	IN2		○	○	○	○															
	MASK		○	○	○	○															

\*ANY\_BIT: exclude BOOL from ANY\_BIT type.

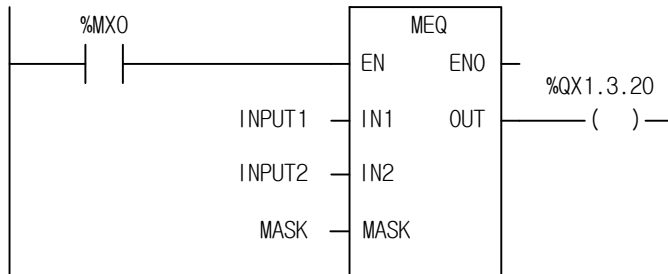
#### ■ Function

1. It compares whether two input variables are equal after masking. If it masks an 8-bit variable with 2#11111100, then, lower 2 bits are excluded when it compares input values.
2. It's available to see whether or not specific bits are on in a variable. For example, in case of comparing 8-bit variables, IN1 is an input variable, IN2 is 16#FF, and MASK for masking is a bit array 2#00101100. If IN1 and IN2 after masking are equal, then output OUT is 1.

Function	Input type	Description
MEQ	BYTE	It compares whether two variables are equal after making.
MEQ	WORD	
MEQ	DWORD	
MEQ	LWORD	

### ■ Program Example

#### 1. LD



#### 2. ST

```
%QX1.3.20 := MEQ(EN:=%MX0, IN1:=INPUT1, IN2:=INPUT2, MASK:=MASK);
```

(1) If the transition condition (%MX0) is on, MEQ function executes.

(2) Input variable

INPUT1 (BYTE) = 2#01011100

INPUT2 (BYTE) = 2#01110101

MASK (BYTE) = 2#11010110

Then, the compared bits of input variables after masking are as follows:

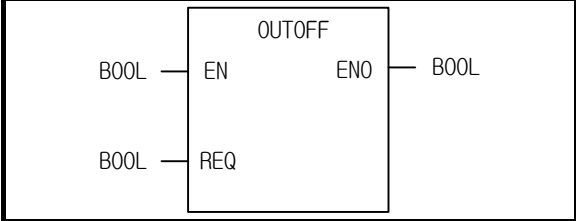
INPUT1 (BYTE) = 2#01010100

INPUT2 (BYTE) = 2#01010100

INPUT1 and INPUT2 are equal; therefore, output contact %QX1.3.20 is on.



OUTOFF	Every Output Off if input condition is On	
	Availability	XGI, XGR, XEC
	Flags	

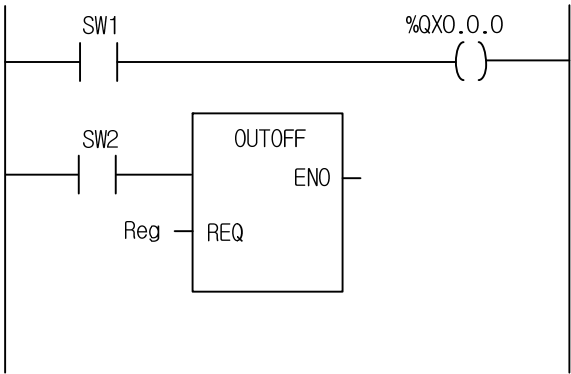
Function	Description
	<p><b>Input</b> EN : executes the function in case of 1 REQ: stop every output by program</p> <p><b>Output</b> ENO: check the operation</p>

■ Function

- 1. Every output is off if EN = 1 and REQ = 1.
- 2. Clear all the output off when EN = 1, REQ = 0.
- 3. Above and beyond these cases, it keeps the previous state.

■ Program Example

1. LD

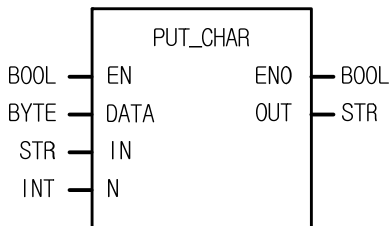


2. ST

```
%QX0.0.0 := SW1;  
OUTOFF(EN:=SW2, REQ:= Reg);
```

- (1) It sets a program as the above example after output module establishes.
- (2) if SW1 is on, the output (%QX0.0.0) is set.
- (3) If operating with Reg = 1 after setting SW2 On, OUTOFF function is executed and every output module is off.  
The actual output module is off although it seems to be set on the program monitor.

<b>PUT_CHAR</b>	<b>Puts a character in a string</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
 <pre> graph LR     subgraph PUT_CHAR         EN[EN]         DATA[DATA]         IN[IN]         N[N]         ENO[ENO]         OUT[OUT]     end     EN --&gt; ENO     DATA --&gt; OUT     IN --&gt; IN     N --&gt; N     </pre> <p>Diagram showing the PUT_CHAR function block with inputs: EN (BOOL), DATA (BYTE), STR (STRING), and N (INT). Outputs: ENO (BOOL) and OUT (STRING).</p>	<p><b>Input</b></p> <p>EN: executes the function in case of 1  DATA: BYTE input to insert a STRING  IN: STRING input  N: setting position in a STRING</p> <p><b>Output</b></p> <p>ENO: outputs EN value as it is  OUT: STRING output</p>

### ■ Function

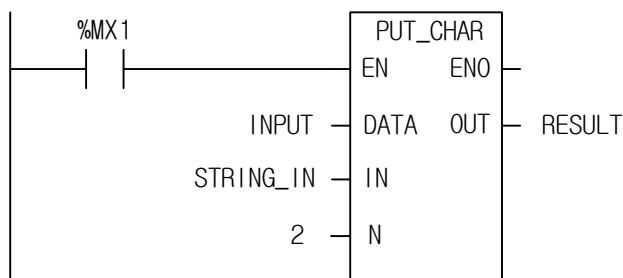
1. It overwrites one BYTE input on a specific position (N) string.

### ■ Flag

Flag	Description
_ERR	If N value exceeds a byte number of a string, _ERR and _LER flags are set. If an error occurs, the output is 16#00.

### ■ Program Example

#### 1. LD

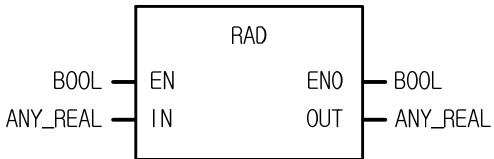


#### 2. ST

```
RESULT := PUT_CHAR(EN:=%MX1, DATA:= INPUT, IN:= STRING_IN, N:=2);
```

- (1) If the transition condition (%MX1) is on, PUT\_CHAR function executes.
- (2) If input variable INPUT = 16#41 ("A") and STRING\_IN = "TOKEN", and N = 2, then, output RESULT is "TAKEN".

RAD	Converts degree into radian	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<b>Input</b> EN: executes the function in case of 1. IN: degree Input <b>Output</b> ENO: outputs EN value as it is OUT: radian output

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN														○	○					
	OUT														○	○					

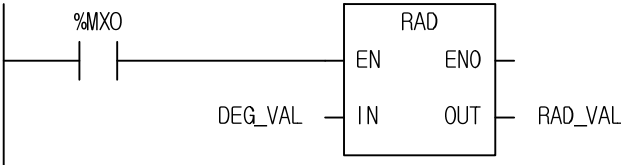
■ Function

- 1. It converts a degree value ( ° ) into a radian value.
- 2. If the degree is over 360°, it converts normally.  
For example, if input is 370°, output is radian value corresponding to 370° - 360° = 10°.

Function	Input type	Output type	Description
RAD	REAL	REAL	It converts a degree value ( ° ) into a radian value.
RAD	LREAL	LREAL	

■ Program Example

1. LD



2. ST

```
RAD_VAL := RAD(EN:=%MX0, IN:= DEG_VAL);
```

- (1) If the transition condition (%MX0) is on, RAD\_REAL function executes.
- (2) If input variable DEG\_VAL = 127( ° ), its output RAD\_VAL = 2.21656823.

<b>ROTATE_A</b>	<b>Rotates designated array elements</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

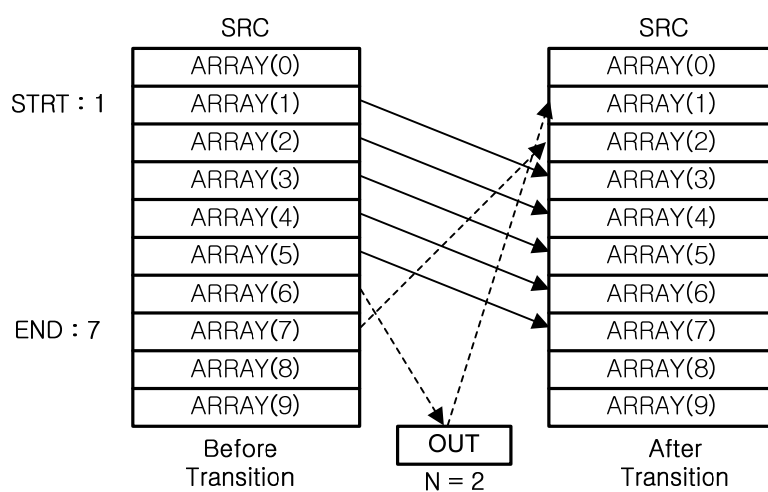
Function	Description
<pre> graph LR     subgraph ROTATE_A         EN[EN]         SRC[SRC]         STRT[STRT]         END[END]         N[N]         ENO[ENO]         OUT[OUT]     end     EN --- ENO     SRC --- OUT     STRT --- OUT     END --- OUT     N --- OUT         </pre>	<p><b>Input</b> EN: executes the function in case of 1 N: element number to rotate STRT: starting position to rotate in an array block END: ending position to rotate in an array block</p> <p><b>Output</b> ENO: without an error, it is 1 OUT: overflowing data</p> <p><b>In/Out</b> SRC: array block to rotate</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	SRC	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
	OUT	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	

\*ANY: exclude STRING from ANY type.

### ■ Function

- It rotates designated elements of an array block in the chosen direction.
- Setting:
  - Scope: STRT and END set a data array to rotate.
  - Rotation direction and time: rotates N times in the chosen direction set by STRT and END (STRT → END)
  - Input data setting: fills an empty element with data pushed from END after rotation with Input data (IN)
  - Output: the result is written at the ARRAY configured by SRC, and the data to rotate from END to STRT is written at OUT.



Function	In/Out array type	Description
ROTATE_A	BOOL	It rotates configured elements of an array block in the chosen direction.
ROTATE_A	BYTE	
ROTATE_A	WORD	
ROTATE_A	DWORD	
ROTATE_A	LWORD	
ROTATE_A	SINT	
ROTATE_A	INT	
ROTATE_A	DINT	
ROTATE_A	LINT	
ROTATE_A	USINT	
ROTATE_A	UINT	
ROTATE_A	UDINT	
ROTATE_A	ULINT	
ROTATE_A	REAL	
ROTATE_A	LREAL	
ROTATE_A	TIME	
ROTATE_A	DATE	
ROTATE_A	TOD	
ROTATE_A	DT	

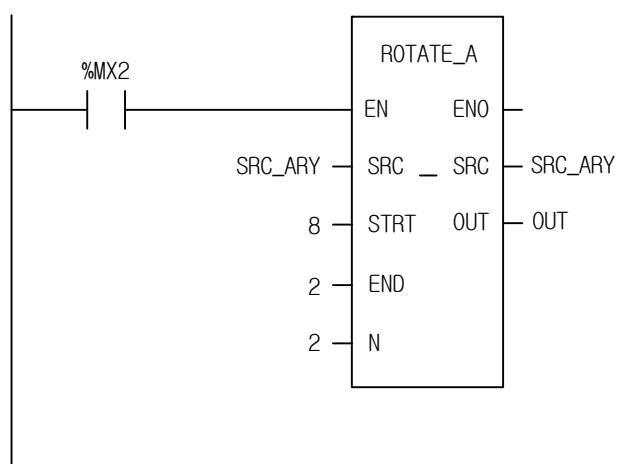
### ■ Flag

Flag	Description
_ERR	<p>If STRT or END exceed the range of SRC array element, _ERR and _LER flags are set.</p> <p>If an error occurs, there's no change in SRC and output OUT is the initial value of each variable type(i.e. INT=0, TIME=T#0S).</p>

☆ If output array variable is omitted, it assumes the output array number as 0, producing \_ERR and \_LER flags.

### ■ Program Example

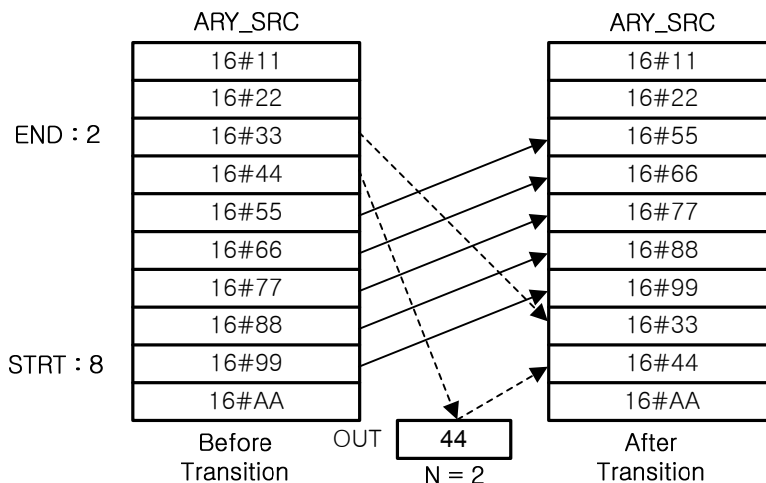
#### 1. LD



#### 2. ST

OUT := ROTATE\_A(EN:=%MX2, SRC:=SRC\_ARY, STRT:=8, END:=2, N:=2);

- (1) If input condition (%MX2) is on, ROTATE\_A function executes.
- (2) It rotates designated elements (from 2nd to 8th elements) of SRC\_ARY in the chosen direction set by STRT and END (from index 8 to index 2).
- (3) The overflowing data (16#44) is written at OUT.



# ROTATE\_C

## Rotate with Carry

Availability

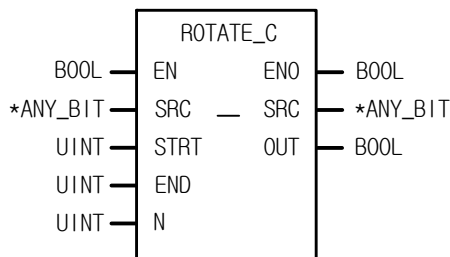
XGI, XGR, XEC

Flags

\_ERR, \_LER

## Function

## Description



### Input

EN: executes the function in case of 1.  
STRT: starting bit position of SRC bit array to rotate  
END: ending bit position of SRC bit array to rotate  
N: bit number to shift

### Output

ENO: without an error, it is 1  
OUT: carry output

### In/Out

SRC: variable for rotation

ANY type variable

Variable

BOOL

BYTE

WORD

DWORD

LWORD

SINT

INT

DINT

LINT

USINT

UINT

UDINT

ULINT

REAL

LREAL

TIME

DATE

TOD

DT

STRING

SRC

o

o

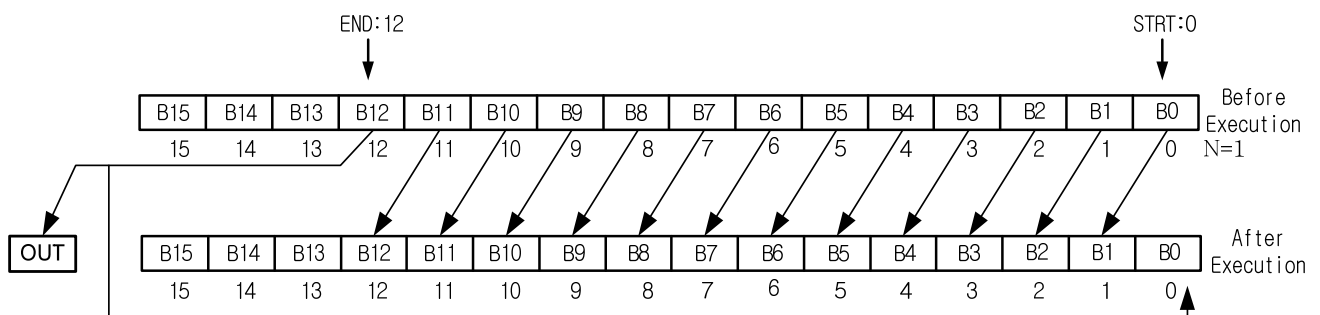
o

o

\*ANY\_BIT: exclude BOOL from ANY\_BIT type.

## Function

1. It rotates a configured bit array of SRC bit arrays in the chosen direction.
2. Setting:
  - A. Scope: STRT and END set a bit data to rotate.
  - B. Rotation direction and time: rotates N times in the chosen direction set by STRT and END (STRT → END)
  - C. Output: the result is written at ANY\_BIT configured by SRC, and the data to rotate from END to STRT is written at OUT.



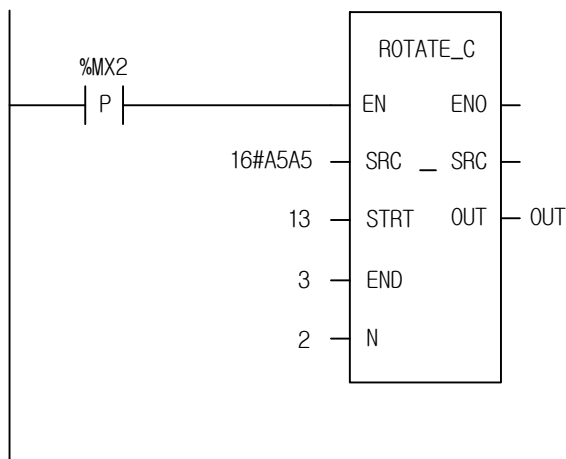
Function	SRC type	Description
ROTATE_C	BYTE	It rotates a designated bit array of SRC bit arrays N times in the chosen direction.
ROTATE_C	WORD	
ROTATE_C	DWORD	
ROTATE_C	LWORD	

### ■ Flag

Flag	Description
_ERR	If STRT or END exceed the bit number of SRC variable type, there's no change in SRC and _ERR and _LER flags are set

### ■ Program Example

#### 1. LD

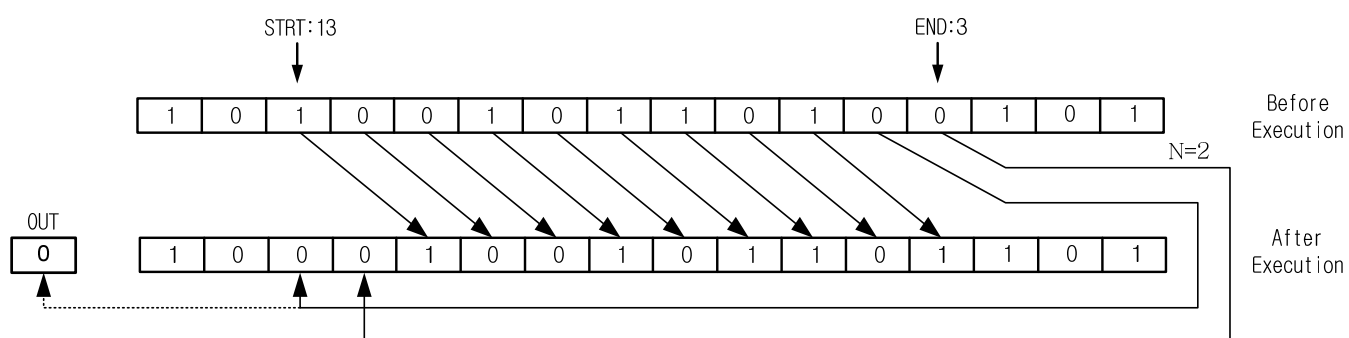


#### 2. ST

```
OUT := ROTATE_C(EN:=%MX2, SRC:=16#A5A5, STRT:=13, END:=3, N:=2);
```

- (1) If the transition condition (%MX2) is on, ROTATE\_C function executes.
- (2) It rotates the designated bit array, from STRT (13) to END (3), of SRC (16#A5A5) 2 times in the chosen direction set by STRT and END (from STRT to END): refer to the diagram below.
- (3) The result data after rotation is written at SRC (16#896D), and the overflowing bit (0) is written at OUT.





RSET	Converting the set block number to the designated block number	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b>      EN: executes the function in case of 1</p> <p>                 B_NO: block NO(0~1) to convert</p> <p><b>Output</b>     ENO: without an error, it is 1</p>

■ Function

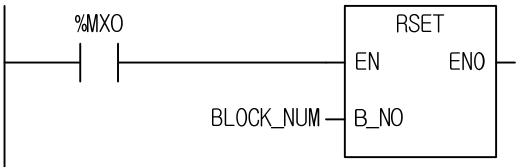
- 1. Convert the set block number (\_RBANK\_NUM) to the designated block number.
- 2. Block number is initialized to 0 if converting stop to run.
- 3. If S is over the max block number, error flag (\_ERR) is set.

■ Flag

Flag	Description
_ERR	If B_NO value is over 2, _ERR and _LER Flags are set.

■ Program Example

1. LD



2. ST

```
RSET(EN:=%MX0, B_NO:=BLOCK_NUM);
```

- (1) If the execution condition (%MX0) is on, RSET function executes.
- (2) BLOCK\_NUM (UINT type) can be 0 or 1 and convert it to the designated R block.

<b>SEG_WORD</b>	<b>Converts BCD or HEX into 7 segment display code</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b></p> <p>EN: executes the function in case of 1. IN: Input data to covert into 7 segment code</p> <p><b>Output</b></p> <p>ENO: outputs EN value as it is OUT: result data converted into 7 segment data</p>

#### ■ Function

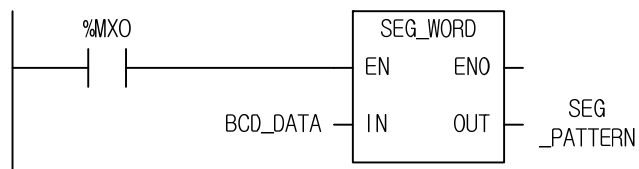
1. If EN is 1, it converts BCD or HEX (hexadecimal) of IN into 7 segment display code as follow and produces output, OUT.
2. If an input is BCD type, it is available to display a number between 0000 and 9999. And in case of HEX input, it's available to display a number between 0000 and FFFF on 4-digit 7 segment display.

##### Display example

- 1) 4-digit BCD -> 4-digit 7 segment code: use SEG function.
- 2) 4-digit HEX -> 4-digit 7 segment code: use SEG function.
- 3) INT -> 4-digit BCD-type 7 segment code: use INT\_TO\_BCD function first and SEG function.
- 4) INT -> 4-digit HEX-type 7 segment code: use INT\_TO\_WORD function first and SEG function.
- 5) When 7 segment display digits are more than 4.
  - A) In case of BCD, HEX type, use SEG function, after dividing them into 4 digits.
  - B) INT -> 8-digit BCD-type 7 segment code:  
Divide INT by 10,000 and convert 'quotient' and 'remainder' into upper/lower 4-digit 7 segment code using INT\_TO\_BCD and SEG function.

### ■ Program Example

#### 1. LD



#### 2. ST

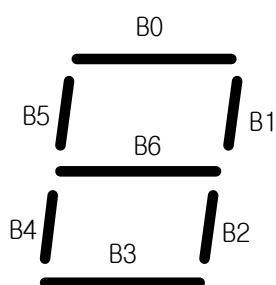
```
SEG_PATTERN := SEG_WORD(EN:=%MX0, IN:=BCD_DATA);
```

(1) If the transition condition (%MX0) is on, SEG\_WORD function executes.

(2) If input variable BCD\_DATA (WORD) = 16#1234, the output is '2#00000110\_01011011\_01001111\_01100110' which is displayed as a 7 segment code (1234) and written at SEG\_PATTERN (DWORD).

INPUT(IN) :	
BCD_DATA(WORD)	0 0 0 1 0 0 1 0 0 0 1 1 0 1 0 0
= 16#1234	
	↓ (SEG)
OUTPUT(OUT) :	
SEG_PATTERN(DWORD)	0 0 0 0 0 1 1 0 0 1 0 1 1 0 1 1
= 16#065B4F66	
	Upper
	0 1 0 0 1 1 1 1 0 1 1 0 0 1 1 0
	Lower

### ■ 7 Segment Configuration



## ■ Conversion table for 7 segment code

Input (BCD)	Input (Hex)	INT	Output								Display Data
			B7	B6	B5	B4	B3	B2	B1	B0	
0	0	0	0	0	1	1	1	1	1	1	0
1	1	1	0	0	0	0	0	1	1	0	1
2	2	2	0	1	0	1	1	0	1	1	2
3	3	3	0	1	0	0	1	1	1	1	3
4	4	4	0	1	1	0	0	1	1	0	4
5	5	5	0	1	1	0	1	1	0	1	5
6	6	6	0	1	1	1	1	1	0	1	6
7	7	7	0	0	1	0	0	1	1	1	7
8	8	8	0	1	1	1	1	1	1	1	8
9	9	9	0	1	1	0	1	1	1	1	9
-	A	10	0	1	1	1	0	1	1	1	A
-	B	11	0	1	1	1	1	1	0	0	B
-	C	12	0	0	1	1	1	0	0	1	C
-	D	13	0	1	0	1	1	1	1	0	D
-	E	14	0	1	1	1	1	0	0	1	E
-	F	15	0	1	1	1	0	0	0	1	F

<b>SHIFT_A</b>	<b>Shifts designated array elements</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

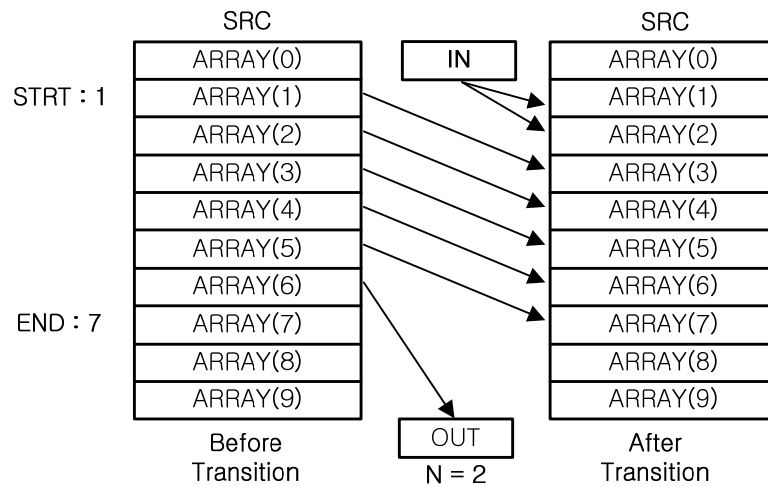
Function	Description
<pre> graph LR     subgraph SHIFT_A         EN[EN] --&gt; ENO[ENO]         IN[IN] --&gt; OUT[OUT]         SRC[Src] --&gt; SRC[Src]         STRT[STRT]         END[END]         N[N]     end     ENO --- ENO_BOOL[BOOL]     OUT --- OUT_ANY[*ANY]     SRC --- SRC_ARRAY[*ARRAY OF ANY]         </pre>	<p><b>Input</b></p> <p>EN: executes the function in case of 1.  IN: Input data to empty element after shifting  N: number to shift  STRT: starting position to shift in an array block  END: ending position to shift in an array block</p> <p><b>Output</b></p> <p>ENO: without an error, it is 1  OUT: overflowing data</p> <p><b>In/Out</b></p> <p>SRC: array block to shift</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
	IN2	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
	OUT	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	

\*ANY: exclude STRING from ANY type.

### ■ Function

1. It shifts designated elements of an array block in the chosen direction.
2. Setting:
  - Scope: STRT and END set a data array to rotate.
  - Shifting direction and time: rotates N times in the chosen direction set by STRT and END (STRT → END).
  - Input data setting: fills an empty element after shifting with input data (IN).
  - Output: the result is written at ARRAY configured by SRC, and the overflowing data by shifting from END to STRT is written at OUT.



Function	In/Out Array Type	Description
SHIFT_A	BOOL	It shifts configured elements of an array block in the chosen direction.
SHIFT_A	BYTE	
SHIFT_A	WORD	
SHIFT_A	DWORD	
SHIFT_A	LWORD	
SHIFT_A	SINT	
SHIFT_A	INT	
SHIFT_A	DINT	
SHIFT_A	LINT	
SHIFT_A	USINT	
SHIFT_A	UINT	
SHIFT_A	UDINT	
SHIFT_A	ULINT	
SHIFT_A	REAL	
SHIFT_A	LREAL	
SHIFT_A	TIME	
SHIFT_A	DATE	
SHIFT_A	TOD	
SHIFT_A	DT	

## Ch 8. Application Functions

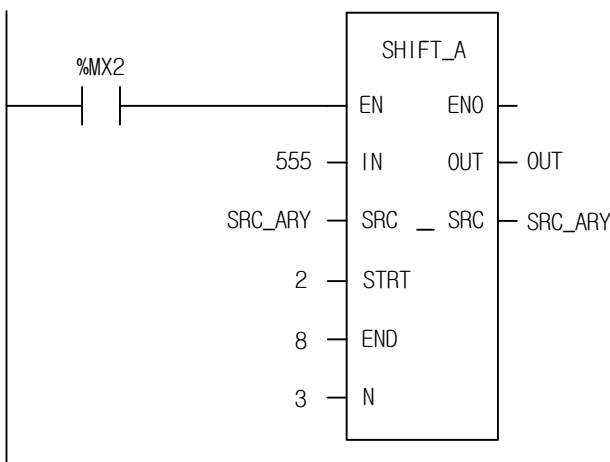
### ■ Flag

Flag	Description
_ERR	If STRT or END exceed the range of SRC array element, _ERR and _LER flags are set. If an error occurs, there's no change in SRC and output, OUT is the initial value of each variable type(i.e. INT=0, TIME=T#0S).

☆ If output array is omitted, it assumes the number of array as 0, producing \_ERR and LER flags.

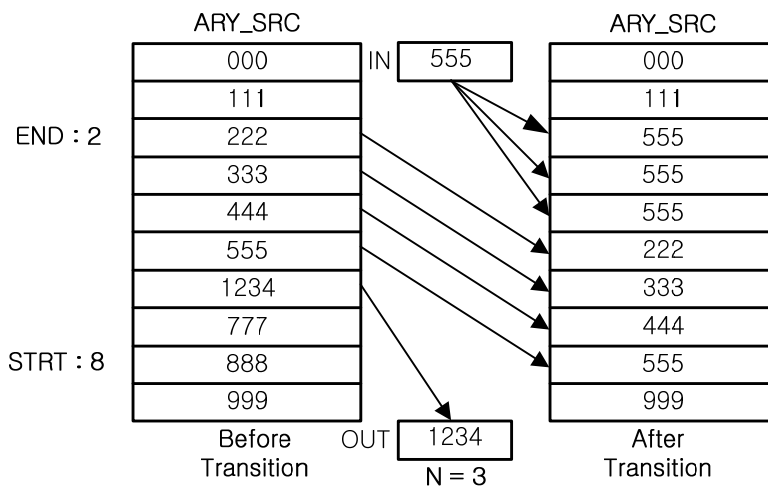
### ■ Program Example

#### 1. LD



#### 2. ST

- (1) If the input condition (%MX2) is on, SHIFT\_A function executes.
- (2) It shifts designated elements (from 2nd to 8th elements) of SRC\_ARY.
- (3) It shifts three times the configured elements.
- (4) The empty elements after shifting, from array index 2 to array index 3, are filled with input '555'.
- (5) The overflowing data (1234), carry output, is written at OUT.





# SHIFT\_C

## Shift with Carry

Availability

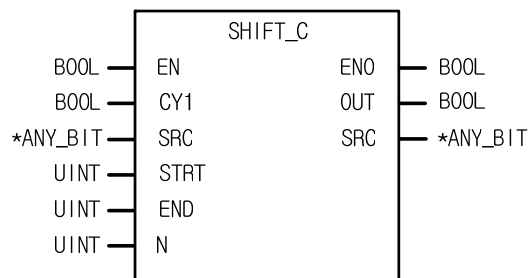
XGI, XGR, XEC

Flags

\_ERR, \_LER

## Function

## Description



### Input

EN: executes the function in case of 1  
 CY1: Carry Input  
 STRT: starting bit position of SRC bit array to shift  
 END: ending bit position of SRC bit array to shift  
 N: bit number to shift

### Output

ENO: without an error, it is 1  
 OUT: carry output

### In/Out

SRC: variable to shift

ANY type variable

Variable

BOOL

BYTE

WORD

DWORD

LWORD

SINT

INT

DINT

LINT

USINT

UINT

UDINT

ULINT

REAL

LREAL

TIME

DATE

TOD

DT

STRING

OUT

o

o

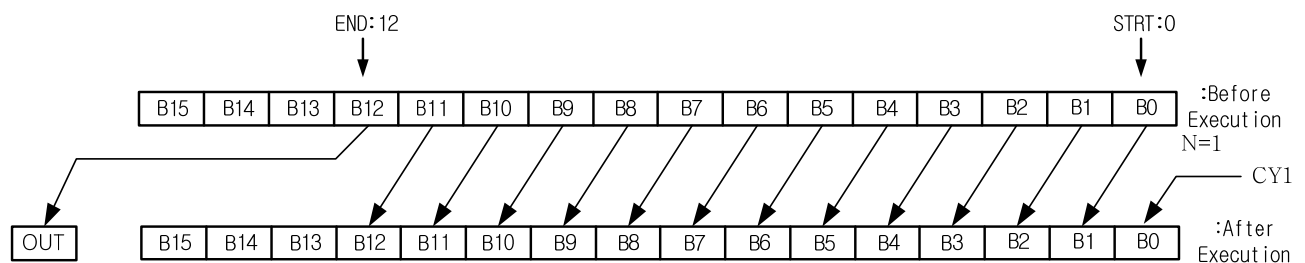
o

o

\*ANY\_BIT: exclude BOOL from ANY\_BIT type.

## Function

1. It shifts a configured bit array of SRC bit arrays N times in the chosen direction.
2. Setting:
  - Scope: STRT and END set a bit data to shift.
  - Shifting direction and time: shifts N times from STRT to END.
  - Input data setting: fills empty bit after shifting with input data (CY1).
  - Output: the result is written at ANY\_BIT configured by SRC, and the overflowing bit data by shifting from END to STRT is written at OUT.



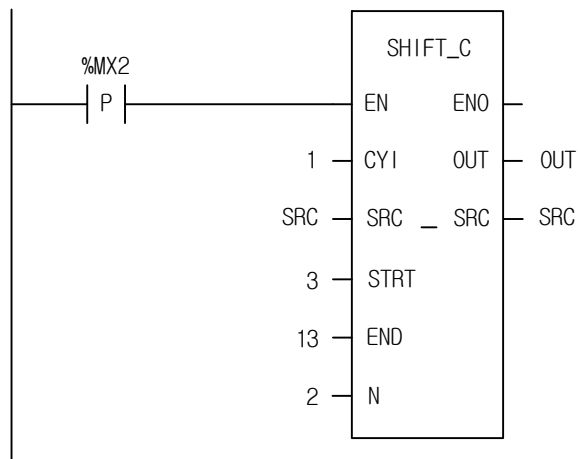
Function	SRC type	Description
SHIFT_C	BYTE	It shifts a configured bit array of SRC bit arrays N times.
SHIFT_C	WORD	
SHIFT_C	DWORD	
SHIFT_C	LWORD	

### ■ Flag

Flag	Description
_ERR	If STRT or END exceed the bit number of SRC variable type, there's no change in SRC and _ERR and _LER flags are set.

### ■ Program Example

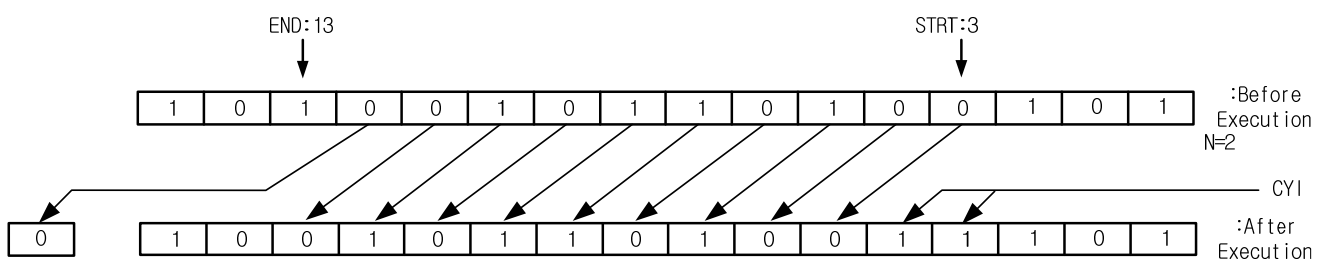
#### 1. LD



#### 2. ST

OUT := SHIFT\_C(EN:=%MX2, CYI:=1, SRC:=SRC, STRT:=3, END:=13, N:=2);

- (1) If the transition condition (%MX2) is on, SHIFT\_C function executes.
- (2) 16#A5A5 is shifted from STRT to END by 2 bits and the empty bits after shifting are filled with 1 (CYI).
- (3) SRC after shifting is 16#969D and the overflowing bit data (0) is written at OUT after 2-bit shifting.



<b>STOP</b>	<b>Stop running by program</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 RE: requires the operation stop by program</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: If STOP function executes, it is 1.</p>

#### ■ Function

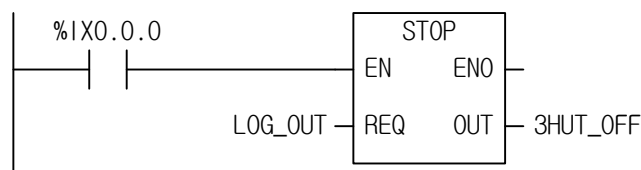
1. If EN and REQ are 1, stop running and return to STOP mode.
2. If function 'STOP' executes, the program stops after completing scan program in executing.
3. Program restarts in case of power re-supply or the change of operation mode from STOP to RUN.

#### ■ Flag

Flag	Description
_USTOP_ON	On if stopped by STOP instruction. It is off if entering into RUN.

#### ■ Program Example

##### 1. LD

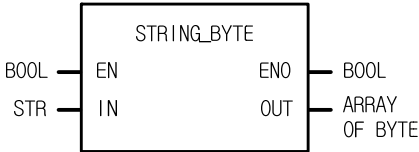


##### 2. ST

```
3HUT_OFF := STOP(EN:=%IX0.0.0, REQ:=LOG_OUT);
```

- (1) If the transition condition (%IX0.0.0) and LOG\_OUT is 1, it enters to STOP mode after completing the scan program in executing.
- (2) It is recommended to turn off the power of PLC in the stable state after executing 'STOP' function declared as input variable.

STRING_BYTE	Convert a string into a byte array	
	Availability	XGI, XGR, XEC
	Flags	

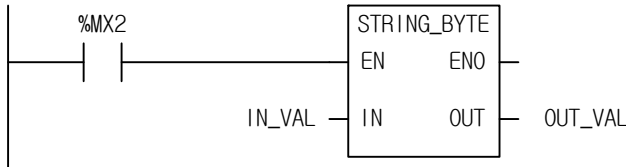
Function	Description
	<p><b>Input</b> EN: if EN is 1, function converts. IN: string input</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: outputs converted Byte Array</p>

■ Function

It converts a string into 31 byte arrays.

■ Program Example

1. LD



2. ST

OUT\_VAL := STRING\_BYTE(EN:=%MX2, IN:=IN\_VAL);

- (1) If the transition condition (%MX2) is on, STRING\_BYTE function executes.
- (2) If IN\_VAL = 'ABC', OUT\_VAL[0] = 16#41, OUT\_VAL[1] = 16#42, OUT\_VAL[2] = 16#43.

<b>SWAP</b>	<b>Swaps upper data for lower data</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1. IN: Input</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: swapped data</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN		○	○	○	○															
	OUT		○	○	○	○															

\*ANY\_BIT: exclude BOOL from ANY\_BIT type.

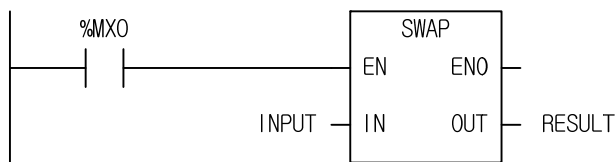
## ■ Function

It swaps upper data for lower data.

Function	Input type	Description
SWAP	BYTE	Swaps upper nibble for lower nibble data.
SWAP	WORD	Swaps upper byte for lower byte data.
SWAP	DWORD	Swaps upper word for lower word data.
SWAP	LWORD	Swaps upper double word for lower double word data.

## ■ Program Example

### 1. LD



### 2. ST

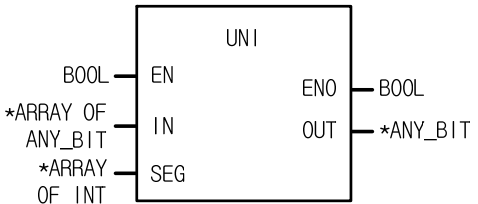
```
RESULT := SWAP(EN:=%MX0, IN:=INPUT);
```

(1) If the transition condition (%MX0) is on, SWAP function executes.

(2) If INPUT (BYTE) = 16#5F, RESULT (BYTE) = 16#F5.

## Ch 8. Application Functions

<b>UNI</b>	<b>Unites data</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	<p><b>Input</b></p> <p>EN: executes the function in case of 1  IN: input data array  SEG: bit-number-designate array to united data</p> <p><b>Output</b></p> <p>ENO: without an error, it is 1  OUT: united data output</p>

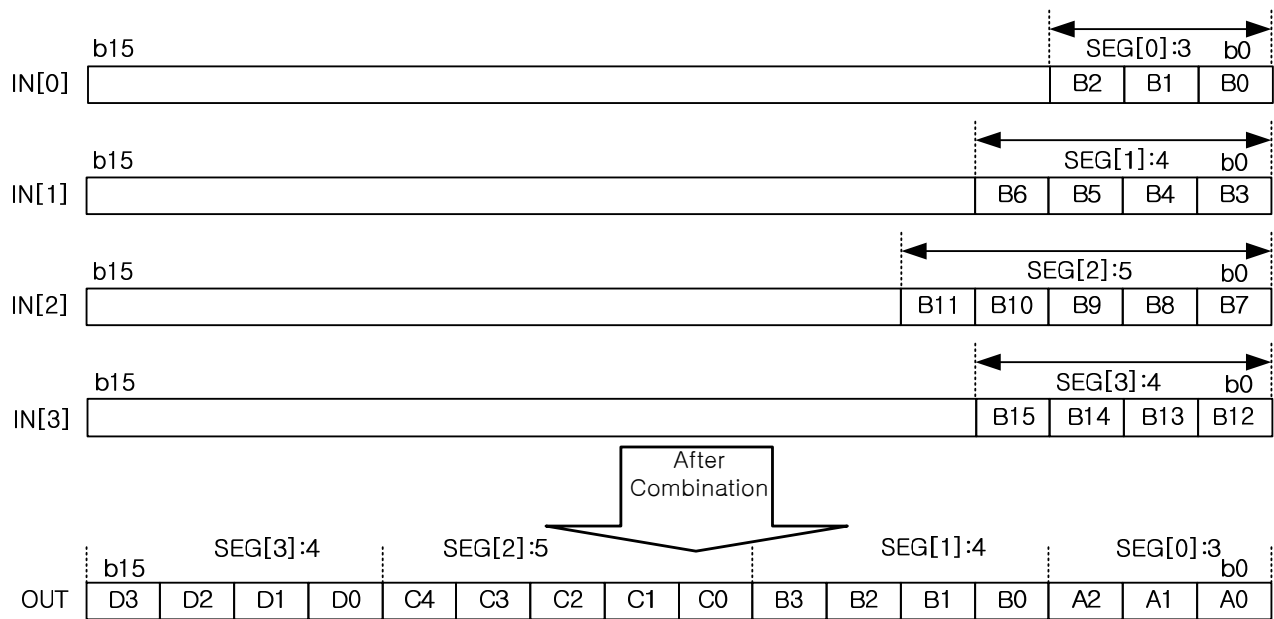
ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN		○	○	○	○															
	OUT		○	○	○	○															

\*ANY\_BIT: exclude BOOL from ANY\_BIT type.

### ■ Function

1. It unites an input data array from the lower bit to a configured bit set by SEG and produces an output.

Function	Input type	Output type	Description
UNI	BYTE	BYTE	It cuts an input array into bit data set by SET and produces an output (united data) with the same array type of input.
UNI	WORD	WORD	
UNI	DWORD	DWORD	
UNI	LWORD	LWORD	



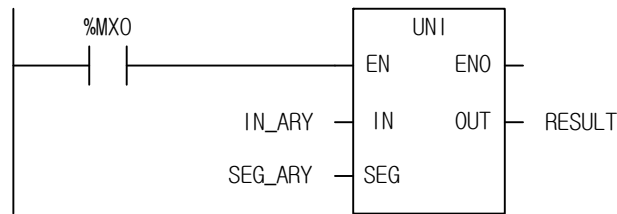
If the sum of value set by SEG exceeds the bit number of input data type, \_ERR and \_LER flags are set.

■ Flag

Flag	Description
_ERR	If the sum of value set by SEG exceeds the bit number of input data type, _ERR and _LER flags are set. If the number of arrays of IN and SEG is different, output OUT is 0 and _ERR and _LER flags are set.

■ Program Example

1. LD



2. ST

```
RESULT := UNI(EN:=%MX0, IN:=IN_ARY, SEG:=SEG_ARY);
```

(1) If the transition condition (%MX0) is on, UNI function executes.

(2) If input IN\_ARY and SEG\_ARY are as below

IN_ARY[0]	A3B5	SEG_ARY[0]	3
IN_ARY[1]	B4C6	SEG_ARY[1]	4
IN_ARY[2]	C5D7	SEG_ARY[2]	7
IN_ARY[3]	D6E8	SEG_ARY[3]	2

output RESULT = 2#0010\_1011\_1011\_0101 = 16#2BB5.

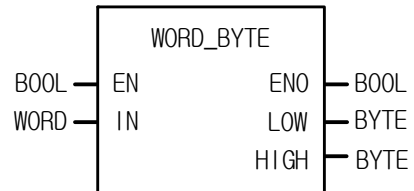
IN_ARY[0]	2#1010 0011 1011 0 <u>101</u>	SEG_ARY[0]	3
IN_ARY[1]	2#1011 0100 1100 0 <u>110</u>	SEG_ARY[1]	4
IN_ARY[2]	2#1100 0101 1 <u>101</u> 0111	SEG_ARY[2]	7
IN_ARY[3]	2#1101 0110 1110 10 <u>00</u>	SEG_ARY[3]	2



RESULT : 2#00 1010111 0110 101



WORD_BYTE	Divides WORD into two bytes	
	Availability	XGI, XGR, XEC
	Flags	

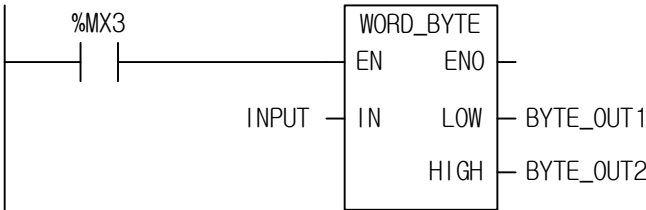
Function	Description
	<p><b>Input</b> EN: executes the function in case of 1 IN: WORD Input</p> <p><b>Output</b> ENO: outputs EN value as it is LOW: lower BYTE output HIGH: upper BYTE output</p>

■ Function

- 1. It divides one word data into two byte data.  
LOW: lower byte output, HIGH: upper byte output

■ Program Example

1. LD



2. ST

```
WORD_BYTE(EN:=%MX3, IN:=INPUT, LOW=>BYTE_OUT1, HIGH=>BYTE_OUT2);
```

- (1) If the transition condition (%MX3) is on, WORD\_BYTE function executes.
- (2) If input variable INPUT is 16#ABCD, then BYTE\_OUT1 = 16#CD and BYTE\_OUT2 = 16#AB.

<b>WORD_DWORD</b>	<b>Combines two WORD data into DWORD</b>	
	Availability	XGI, XGR, XEC
	Flags	

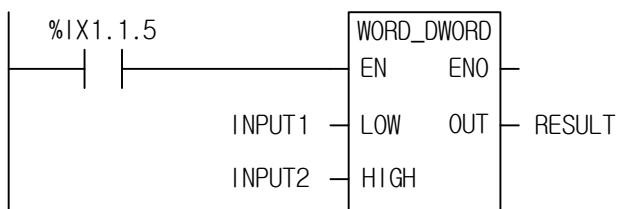
Function	Description
<pre> graph LR     subgraph WORD_DWORD         EN[EN]         LOW[LOW]         HIGH[HIGH]         ENO[ENO]         OUT[OUT]     end     EN --&gt; ENO     LOW --&gt; OUT     HIGH --&gt; OUT         </pre>	<p><b>Input</b> EN: executes the function in case of 1. LOW: lower WORD input HIGH: upper WORD input</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: DWORD output</p>

### ■ Function

It combines two WORD data into one DWORD.  
LOW: lower WORD input, HIGH: upper WORD input.

### ■ Program Example

#### 1. LD



#### 2. ST

```
RESULT := WORD_DWORD(EN:=%IX1.1.5, LOW:=INPUT1, HIGH:=INPUT2);
```

- (1) If the transition condition (%IX1.1.5) is on, WORD\_DWORD function executes.
- (2) If input variable INPUT1 = 16#1020 and INPUT2 = 16#A0B0, output variable RESULT=16#A0B0\_1020.

<b>XCHG</b>	<b>Exchanges two input data</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1</p> <p><b>Output</b> ENO: outputs EN value as it is</p> <p><b>In/Out</b> SRC1: In/Output 1 SRC2: In/Output 2</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	SRC1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	SRC2	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

## ■ Function

1. Exchanges input1 data with input2 data.

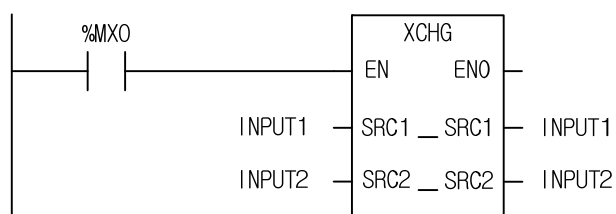
Function	In/Out type	Description
XCHG	BOOL	Exchanges two BOOL input data.
XCHG	BYTE	Exchanges two BYTE input data.
XCHG	WORD	Exchanges two WORD input data.
XCHG	DWORD	Exchanges two DWORD input data.
XCHG	LWORD	Exchanges two LWORD input data.
XCHG	SINT	Exchanges two SINT input data.
XCHG	INT	Exchanges two INT input
XCHG	DINT	Exchanges two DINT input data.
XCHG	LINT	Exchanges two LINT input data.
XCHG	USINT	Exchanges two USINT input data.
XCHG	UINT	Exchanges two UINT input data.
XCHG	UDINT	Exchanges two UDINT input data.
XCHG	ULINT	Exchanges two ULINT input data.
XCHG	REAL	Exchanges two REAL input data.
XCHG	LREAL	Exchanges two LREAL input data.

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Function	In/Out type	Description
XCHG	TIME	Exchanges two TIME input data.
XCHG	DATE	Exchanges two DATE input data.
XCHG	TOD	Exchanges two TOD input data.
XCHG	DT	Exchanges two DT input data.
XCHG	STRING	Exchanges two STRING input data.

### ■ Program Example

#### 1. LD



#### 2. ST

```
XCHG(EN:=%MX0, SRC1:=INPUT1, SRC2:=INPUT2);
```

- (1) If the transition condition (%MX0) is on, XCHG function executes.
- (2) If INPUT1 = 0 and INPUT2 = 1, it will exchange two input data. After the function execution, INPUT1 = 1 and INPUT2 = 0.

XNR	Exclusive Logical AND	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b>      EN: executes the function in case of 1                  IN1: XNR-to-be value                  IN2: XNR-to-be value                  Input variables can be extended up to 8.</p> <p><b>Output</b>      ENO: outputs EN value as it is                  OUT: XNR result</p> <p>IN1, IN2, and OUT must be of the same data type.</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>															
	IN2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>															
	OUT	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>															

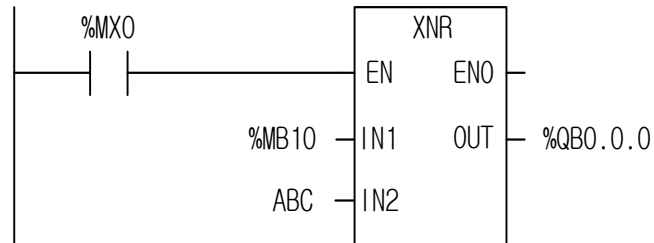
■ Function

1. It performs XNR operation on the input variables by bit and produces output, OUT.

IN1      1111 ..... 0000  
XNR  
IN2      1010 ..... 1010  
OUT      1010 ..... 0101

### ■ Program Example

#### 1. LD



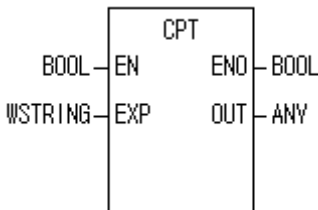
#### 2. ST

```
%QB0.0.0 := XNR(EN:=%MX0, IN1:=%MB10, IN2:=ABC);
```

(1) If the transition condition (%MX0) is on, XNR function executes.

(2) If %MB10 = 16#F0 = 2#1111\_0000 and ABC(BYTE type) = 16#AA = 2#1010\_1010, the result of XNR is shown in OUT (%QB0.0.0 = 16#A5 = 2#1010\_0101).

CPT	ST expression computation	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	<p><b>Input</b> EN: executes the function in case of 1. EXP: ST expression</p> <p><b>Output</b> ENO: outputs EN value as it is OUT: result data</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	WSTRING
	IN																				
	OUT	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○					○

### ■ Function

- If EN is 1, it produces an output after computation of EXP input ST expression.
- Maximum size of input expression is 100 Byte. (English : 100 character)
- Available functions to expression are only comparison, numerical operation, degree conversion and type conversion.
  - (1) Comparison: EQ, GE, GT, LE, LT, NE
  - (2) Numerical operation: ABS, ACOS, ADD, ASIN, ATAN, COS, DIV, EXP, EXPT, LN, LOG, MOVE, MUL, SIN, SQRT, SUB, TAN, TRUNC (but MOD is not available, operated as a keyword)
  - (3) Degree conversion: DEG, RAD
  - (4) Type conversion: Type conversion functions without special symbol (\*\*\*)
- Refer to ST instruction manual for the information of ST expression

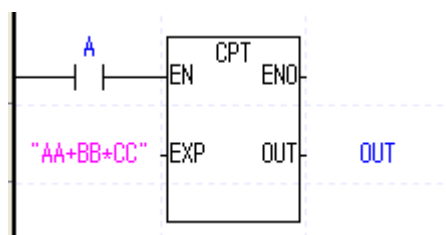
FUNCTION	IN/OUT type	Description
CPT	BOOL	Output value must be BOOL type.
CPT	BYTE	Output value must be BYTE type.
CPT	WORD	Output value must be WORD type.
CPT	DWORD	Output value must be DWORD type.
CPT	LWORD	Output value must be LWORD type.
CPT	SINT	Output value must be SINT type.
CPT	INT	Output value must be INT type.

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CPT	DINT	Output value must be DINT type.
CPT	LINT	Output value must be LINT type.
CPT	USINT	Output value must be USINT type.
CPT	UINT	Output value must be UINT type.
CPT	UDINT	Output value must be UDINT type.
CPT	ULINT	Output value must be ULINT type.
CPT	REAL	Output value must be REAL type.
CPT	LREAL	Output value must be LREAL type.

### ■ Program Example

#### 1. LD



#### 2. ST

-CPT function is not available. But ST expression is available directly.

```
IF A THEN
  OUT := AA+BB *CC ;
END_IF;
```

- (1) If the transition condition (A) is on, CPT function executes.
- (2) If input variable AA = 10, BB = 10, CC = 2, output variable OUT = 30



## Ch 9. Basic Function Blocks

1. This chapter describes basic function block library.
2. Before using basic function block, it is recommended to understand 3.4.2 Function Block and apply function block library to a program, it is facilitative to write a program.

<b>CTD</b>	<b>Down Counter (function block)</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
<pre> graph LR     subgraph CTD         direction TB         CD[CD]         LD[LD]         PV[PV]     end     CTD --&gt; Q[Q]     CTD --&gt; CV[CV]     </pre>	<p><b>Input</b></p> <ul style="list-style-type: none"> <li>CD: down counter pulse input</li> <li>LD: loads a preset value</li> <li>PV: preset value</li> </ul> <p><b>Output</b></p> <ul style="list-style-type: none"> <li>Q: down counter output</li> <li>CV: current value</li> </ul>

Any type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	PV							○	○	○		○	○	○							
	CV							○	○	○		○	○	○							

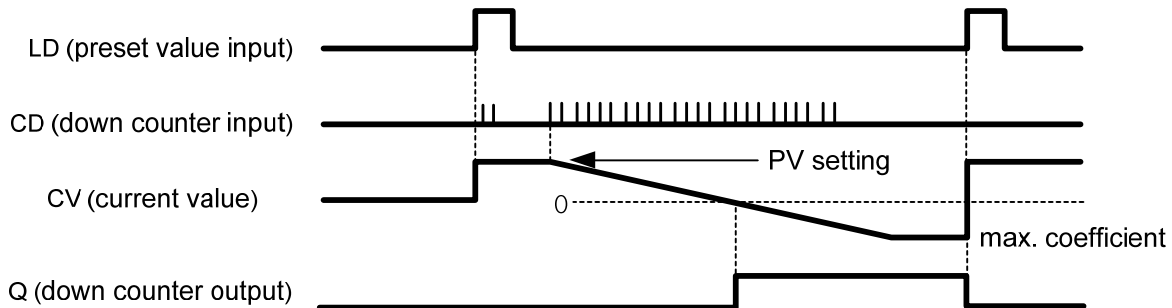
\*ANY\_INT: exclude SINT and USINT from ANY\_INT type.

### ■ Function

- Down counter function block CTD decreases the current value (CV) by 1 with every rising pulse input.
- CV decreases only when CV is more than the minimum value of INT (-32,768); after reaching it, CV does not change its value.
- When LD is 1, PV is loaded into CV (CV=PV).
- Output Q is 1 when CV is 0 or a negative number.

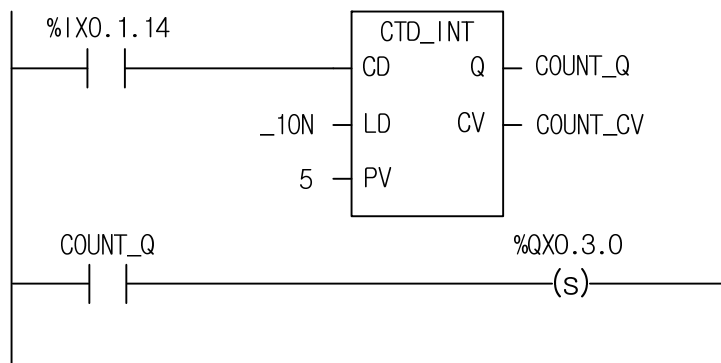
Function Block	PV	Description
CTD_INT	INT	Decrease as much as the min INT(-32,768).
CTD_DINT	DINT	Decrease as much as the min DINT(-2,147,483,648).
CTD_LINT	LINT	Decrease as much as the min LINT(-9,223,372,036,854,775,808).
CTD_UINT	UINT	Decrease as much as the min UINT(0).
CTD_UDINT	UDINT	Decrease as much as the min UDINT(0).
CTD_ULINT	ULINT	Decrease as much as the min ULINT(0).

### ■ Time Chart



### ■ Program Example

#### 1. LD



#### 2. ST

```
INST_CTD_INT(CD:=%IX0.1.14, LD:=_10N, PV:=5, Q=>COUNT_Q, CV=>COUNT_CV);
```

```
%QX0.3.0 := COUNT_Q
```

This is the program that sets the output contact (%QX0.3.0) when the down counter pulse input enters the input contact (%IX0.1.14) five times.

- (1) Register the name of CTD function block (COUNT\_D).
- (2) Make the input contact (%IX0.1.14) attached to CD.
- (3) Make the flag \_10N (1 scan On contact) that loads PV into CV.
- (4) Set the PV value as 5 in range of INT ((-32,768~32,767).
- (5) Set the CV value as the random output variable (COUNT\_CV).
- (6) Set the Q value as the random output variable (COUNT\_Q).
- (7) Compile and write your program to the PLC after completing the program.
- (8) After writing, change the PLC mode (Stop -> Run).
- (9) If program runs, PV 5 will be loaded into CV (Count\_CV).
- (10) The current value CV (COUNT\_CV) decreases by 1 when the pulse input enters the input contact (%IX0.1.14).

- (11) When the down counter pulse input enters the input contact (%IX0.1.14) five times, CV (COUNT\_CV) will be 0 and Q (COUNT\_Q) will be 1.
- (12) If Q (COUNT\_Q) is 1, the output contact (%Q0.3.0) will be set.

<b>CTU</b>	<b>Up Counter (function block)</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b> CU: up counter pulse input R: reset input PV: loads a preset value</p> <p><b>Output</b> Q: increase counter output CV: current value</p>

Any type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	PV							○	○	○		○	○	○							
	CV							○	○	○		○	○	○							

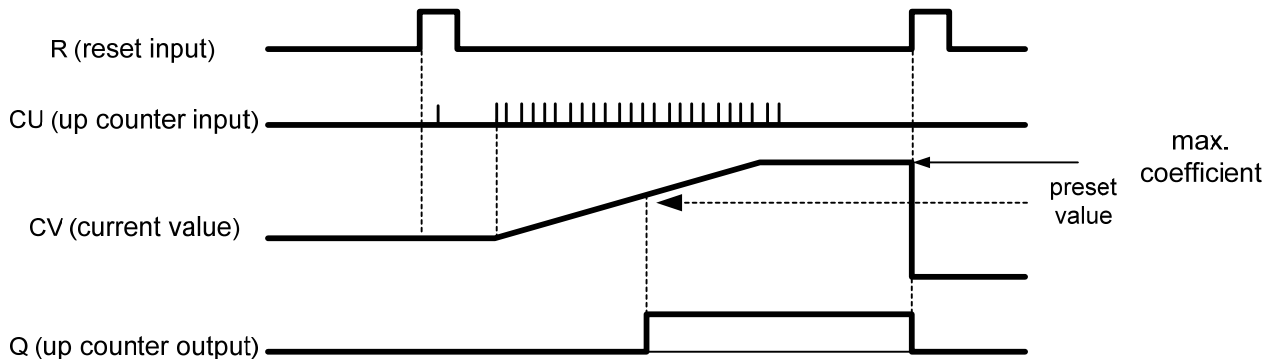
\*ANY\_INT: exclude SINT and USINT from ANY\_INT type.

#### ■ Function

- Up counter function block CTU increases the current value (CV) by 1 with every rising pulse input.
- CV increases only when CV is less than the maximum value of INT (32767); after reaching it, CV does not change its value.
- When the reset input (R) is 1, CV is cleared (0).
- Output Q is 1 when CV is equal to or more than PV.
- PV value reloads the preset value and operate it when CTU function block executes.

Function Block	PV	Description
CTU_INT	INT	Increase as much as the max INT (32767).
CTU_DINT	DINT	Increase as much as the max DINT (2147483647).
CTU_LINT	LINT	Increase as much as the max LINT (9223372036854775807).
CTU_UINT	UINT	Increase as much as the max UINT (0).
CTU_UDINT	UDINT	Increase as much as the max UDINT (0).
CTU_ULINT	ULINT	Increase as much as the max ULINT (0).

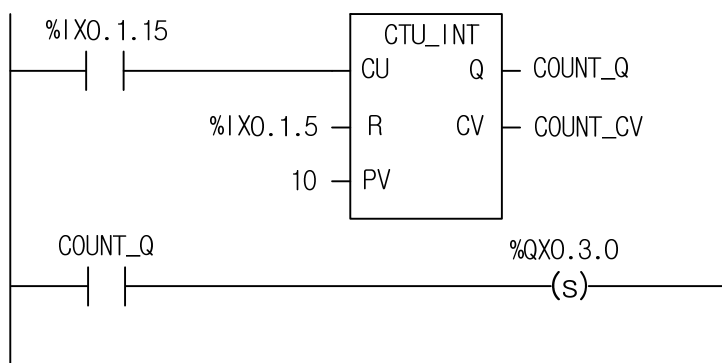
### ■ Time Chart



### ■ Program Example

- This is the program that sets the output contact (%QX0.3.0) when the increase counter pulse input enters the input contact (%IX0.1.15) ten times

#### 1. LD



#### 2. ST

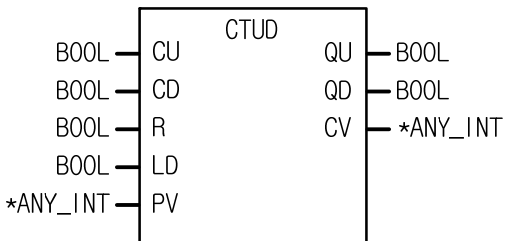
```
INST_CTU_INT(CU:=%IX0.1.15, R:=%IX0.1.5, PV:=10, Q=>COUNT_Q, CV=>COUNT_CV);
```

```
%QX0.3.0 := COUNT_Q;
```

- Register the name of CTU function block (COUNT\_U).
- Make the input contact %I0.1.15 attach to CU.
- Set the PV value as 10.
- Assign input contact %IX0.1.5 to the reset input R.
- Set the CV value as the random output variable (COUNT\_CV).
- Set the Q value as the random output variable (COUNT\_Q).
- Compile and write your program to the PLC after completing the program.

- (8) After writing, change the PLC mode (Stop → Run).
- (9) The current value CV (COUNT\_CV) increases by 1 when the pulse input enters the input contact (%IX0.1.15).
- (10) When the up counter pulse input enters the input contact (%IX0.1.15) ten times, CV (COUNT\_CV) is 10 and Q (COUNT\_Q) is 1.
- (11) If Q (COUNT\_Q) is 1, the output contact (%QX0.3.0) is set.

CTUD	Up/Down Counter (function block)	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>CU: up counter pulse input</p> <p>CD: down counter pulse input</p> <p>R: reset</p> <p>LD: loads a preset value</p> <p>PV: preset value</p> <p><b>Output</b></p> <p>QU: up counter output</p> <p>QD: down counter output</p> <p>CV: current value</p>

Any type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	PV							○	○	○		○	○	○							
	CV							○	○	○		○	○	○							

\*ANY\_INT: excluding SINT and USINT from ANY\_INT types

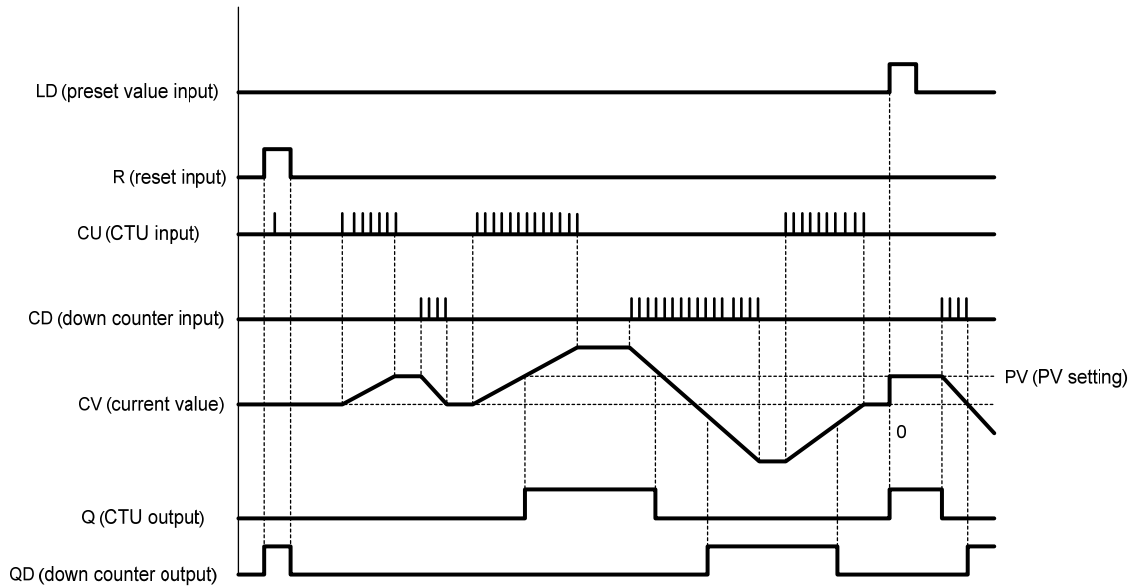
### ■ Function

- Up/Down counter function block CTUD increases the current value (CV) by 1 with every rising up-counter pulse input (CU) and decreases CV by 1 with every rising down-counter pulse input (CD).
- Note that CV is between -32768 and 32767 (INT).
- When LD is 1, PV is loaded into CV (CV=PV).
- When the reset input R is 1, CV is cleared (0).
- When CV reaches PV, the output QU is 1; when CV is 0 or a negative integer, the output QD is 1.
- The operation for each input signal executes in order of R > LD > CU > CD. Note that if the input signals are fed to the input (CU, CD, R, and LD) of CTUD at the same time, the operation of CTU follows the above priority.

Function Block	PV	Description
CTUD_INT	INT	Increase/decrease as much as INT(-32768 ~ 32767)
CTUD_DINT	DINT	Increase/decrease as much as DINT(0 ~ 2 <sup>31</sup> -1)
CTUD_LINT	LINT	Increase/decrease as much as LINT(0 ~ 2 <sup>63</sup> -1)
CTUD_UINT	UINT	Increase/decrease as much as UINT(0 ~ 65535)
CTUD_UDINT	UDINT	Increase/decrease as much as UDINT(0 ~ 2 <sup>32</sup> -1)
CTUD_ULINT	ULINT	Increase/decrease as much as ULINT(0 ~ 2 <sup>63</sup> -1)

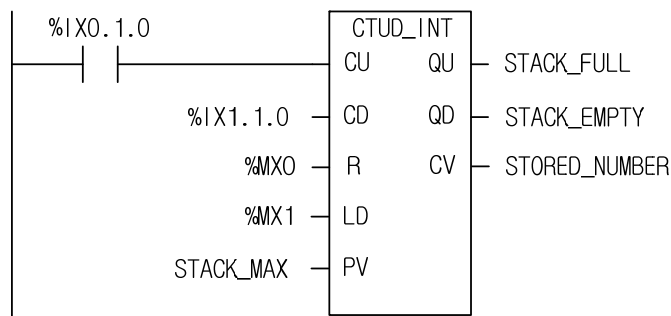


■ Time Chart



■ Program Example

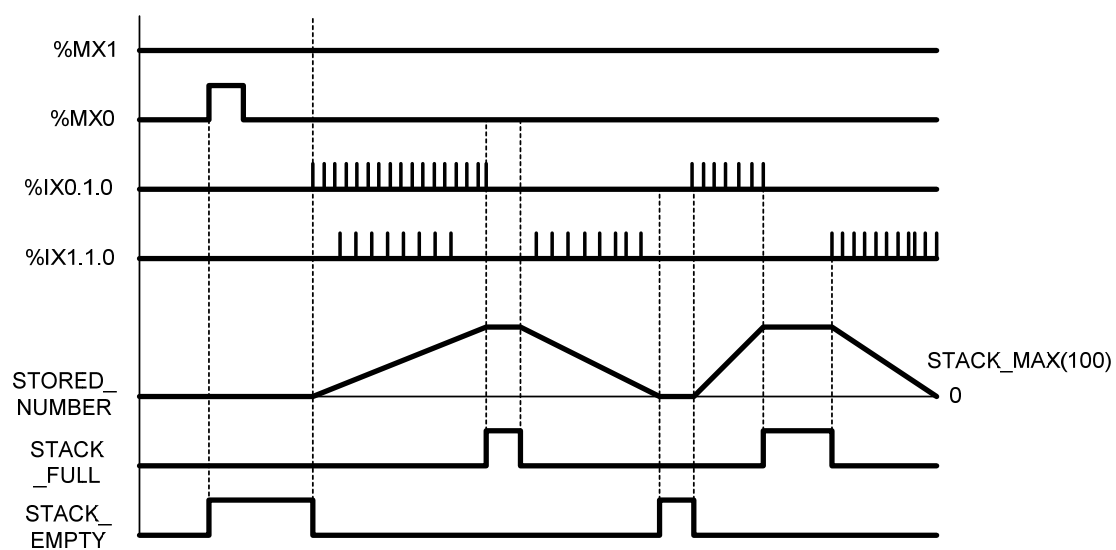
1. LD



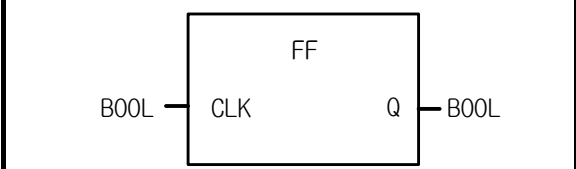
2. ST

INST\_CTUD\_INT(CU:=%IX0.1.0, CD:=%IX1.1.0, R:=%MX0, LD:=%MX1, PV:=STACK\_MAX, QU=>STACK\_FULL, QD=>STACK\_EMPTY, CV=>STORED\_NUMBER);

Conditions are: the temporary loading part STACK\_MAX is 100; IN is 1 with every material-input signal while OUT is 1 with every material-output signal. If the material input process is faster than the material-output one and every material is loaded so that the STACK\_MAX is equal to or more than 100, then QU is 1 (STACK\_FULL = 1); if there's no material left in the loading part, QD is 1 (STACK\_EMPTY = 1). At the STORED\_NUMBER, the number of remaining material in the loading part is shown.



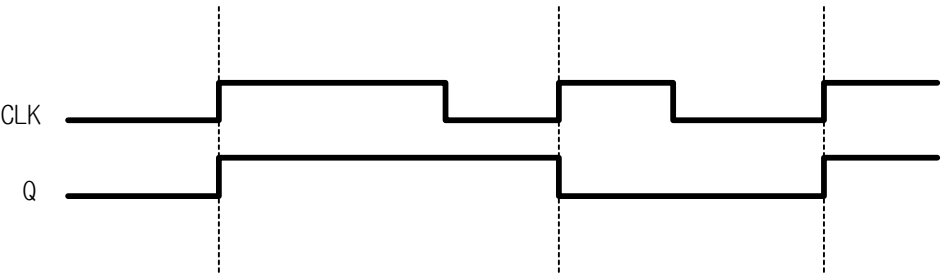
FF	Reverse output bit	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<b>Input</b> CLK : input signal <b>Output</b> Q    : reverse output by instruction

■ Function

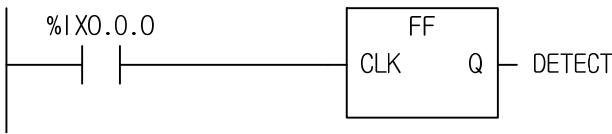
FF reverses output Q as the input status connected to CLK is changed from 0 to 1.

■ Time Chart



■ Program Example

1. LD

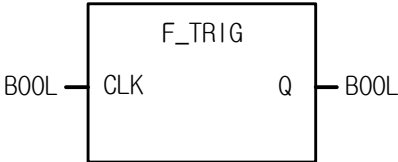


2. ST

```
INST_FF(CLK:=%IX0.0.0, Q=>DETECT);
```

(1) By watching the status of input variable, %IX0.0.0, when the input is changed from 0 to 1, the DETECT is reversed.

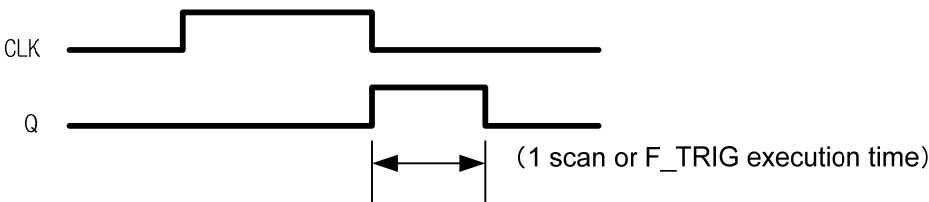
F_TRIG	Falling Edge Detection (function block)	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b> CLK: input signal</p> <p><b>Output</b> Q: falling edge detection result</p>

■ Function

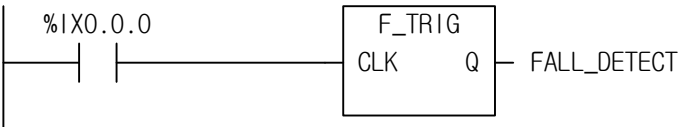
- 1. The output Q of function block F\_TRIG is 1 with the falling pulse input to CLK. And 1 scan later, without further falling pulse input, the output Q is 0 ever after.

■ Time Chart



■ Program Example

1. LD



2. ST

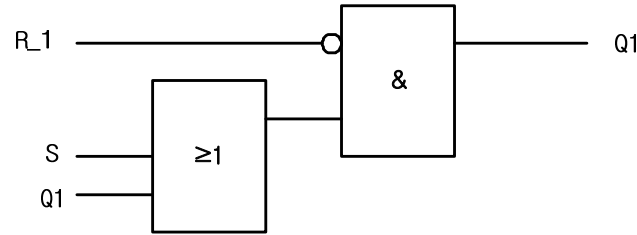
```
INST_F_TRIG(CLK:=%IX0.0.0, Q=>FALL_DETECT);
```

- (1) If the input variable (%IX0.0.0) changes from 1 to 0, while detecting its state, the output variable FALL\_DETECT is 1. And 1 scan later, the output variable FALL\_DETECT is 0.

RS	Reset Priority Bistable (function block)	
	Availability	XGI, XGR, XEC
	Flags	

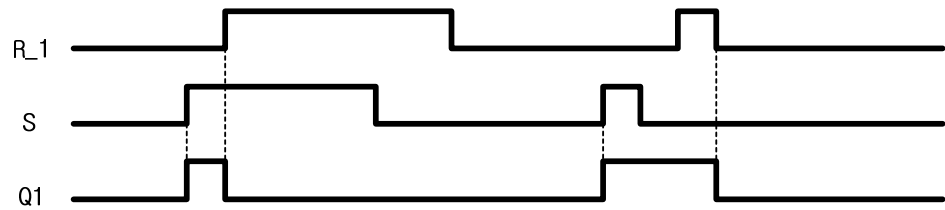
Function Block	Description
	<p><b>Input</b>    R_1: Reset condition              S: Set condition</p> <p><b>Output</b>    Q1: operation result</p>

■ Function



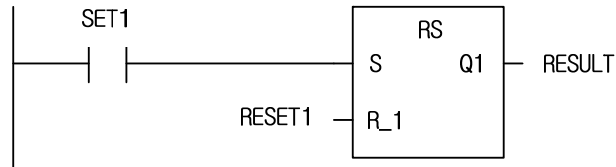
If R1 is 1, output Q1 is 0 regardless of the state of S. The output variable Q1 is 1 when it maintains the previous state, R1 is 0, and S is 1, it is 1. The initial state of Q1 is 0.

■ Time Chart



### ■ Program Example

#### 1. LD



#### 2. ST

```
INST_RS(S:=SET1, R_1:=RESET1, Q=>RESULT);
```

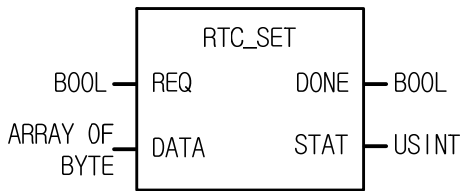
It outputs the operation results with RESET1 as Reset condition and SET1 as Set condition to RESULT.

Replace the operation conditions; as the above time chart, R\_1 to RESET1, S to SET1 and Q1 to RESULT.

- (1) If SET1 declared as input variable is on, output variable RESULT is 1.
- (2) If RESET1 declared as output variable is on, output variable declared as RESULT is 0.
- (3) If SET1 and RESET1 declared as input variables are on, the output variable RESULT is 0.

<b>RTC_SET</b>	<b>Writes Time data</b>	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function Block	Description
	<p><b>Input</b> REQ: executes the function with rising pulse input DATA: TIME data to input</p> <p><b>Output</b> DONE: without an error, it is 1 STAT: If an error occurs, an error code is written</p>

#### ■ Function

1. It writes RTC data to Clock Device with a rising pulse input.

Variable	Content	Example	Variable	Content	Example
DATA[0]	Year	16#01	DATA[4]	Minute	16#30
DATA[1]	Month	16#03	DATA[5]	Second	16#45
DATA[2]	Dates	16#15	DATA[6]	No check	-
DATA[3]	Hours	16#18	DATA[7]	Year	16#20

\* The above example is "2001-03-15 18:30:45, Thursday".

\* Day of the week data is not separately entered. The day of the week will be automatically set.

2. The above DATA variables are declared as array Byte variables and set as BCD data.

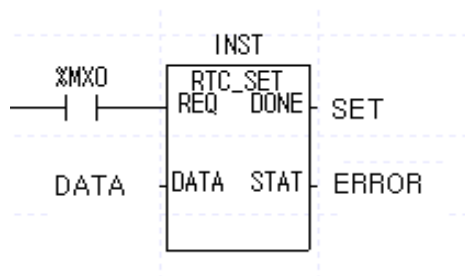
#### ■ Flag

Flag	Description
_ERR	If CPU does not support RTC function or RTC data is out of range, the output is 0 and the error code is written at STAT.

Error code	Description
00	No error
02	Wrong RTC data. Example: 14 (Months) 32 (Dates) 25 (Hours) * Modify RTC data.

### ■ Program Example

#### 1. LD



#### 2. ST

```
INST_RTC_SET(REQ:=%MX0, DATA:=DATA, DONE=>SET, STAT=>ERROR);
```

Its RTC data is Dec 5, 2006. 10:39:45, Tuesday.

(1) When SET\_SW is on, RTC\_SET function block renews or modifies the SET\_data (RTC data).

(2) Variable setting is shown as below.

Variable	Content	Example	Variable	Content	Example
DATA[0]	Year	16#06	DATA[4]	Minute	16#39
DATA[1]	Month	16#12	DATA[5]	Second	16#45
DATA[2]	Date	16#05	DATA[6]	No check	-
DATA[3]	Hour	16#10	DATA[7]	Year	16#20

(3) In addition to the method set by allowing initial value to DATA variable, it may be set by saving each preset value to DATA[] variable, using function MOVE.


(4) Use the following flags to read RTC data.

e.g. 1998-12-22 19:37:46, Tuesday



Flag	Type	Content	Description	Data
_RTC_TOD	TOD	Current time	Current time of RTC	TOD#19:37:46
_RTC_WEEK	UINT	Current day	Current day of RTC *(0: Sun, 1: Mon, 2: Tue, 3: Wed, 4: Thu, 5: Fri, 6: Sat)	2
_RTC_DATE	DATE	Current date	Current date of RTC (1984-01-01 ~ 2063-06-06)	D#1998-12-22
_HUND_WK	WORD	Hundred year/day	Discriminated by BYTE	16#1902
_TIME_DAY	WORD	Time/date		16#1922
_MON_YEAR	WORD	Month/year		16#1298
_SEC_MIN	WORD	Second/minute		16#4637

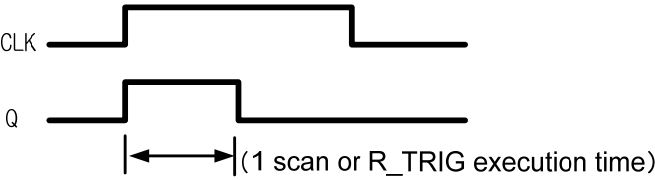
R_TRIG	Rising Edge Detection (function block)	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b> CLK: input signal</p> <p><b>Output</b> Q: rising edge detection result</p>

■ Function

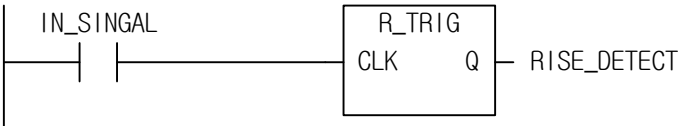
The output Q of function block R\_TRIG is 1 with the rising pulse input to CLK. And 1 scan later, without further rising pulse input, the output Q is 0.

■ Time Chart



■ Program Example

1. LD



2. ST

```
INST_R_TRIG(CLK:=IN_SIGNAL, Q=>RISE_DETECT);
```

If the input variable IN\_SIGNAL changes from 0 to 1, while detecting its state, the output variable RISE\_DETECT is 1.  
And 1 scan later, the output variable RISE\_DETECT is 0.

<b>SEMA</b>	<b>Semaphore (System resource allocation)</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
<pre> graph LR     subgraph SEMA_FuncBlock [SEMA]         direction TB         CLAIM[CLAIM]         RELEASE[RELEASE]     end     CLAIM --- SEMA_FuncBlock     RELEASE --- SEMA_FuncBlock     SEMA_FuncBlock --- BUSY[BUSY]     style CLAIM fill:none,stroke:none     style RELEASE fill:none,stroke:none     style BUSY fill:none,stroke:none </pre>	<p><b>Input</b> CLAIM: signal to claim a resource monopoly RELEASE: release signal</p> <p><b>Output</b> BUSY: waiting signal not to obtain the claimed resource</p>

#### ■ Function

This function block is used to get an exclusive control right for system resources.

BUSY that is using the resource in other program is 1 when SEMA function executes (CLAIM = 1 or 0, RELEASE = 0). If you want to obtain the resource control right, wait until BUSY is 0 after executing SEMA function block (CLAIM = 1, RELEASE = 0). When BUSY is 0, it controls the associate resource and after completing the control, it transfers the control right executing SEMA function block once again with CLAIM = 0 and RELEASE = 1. (At this time, only the program that has the control right can execute SEMA function block with CLAIM = 0 and RELEASE = 1)

1. The instance of SEMA must be declared as "GLOBAL" so that its access is available in the programs requiring the resource.
2. Each program to claim the same resource must be designated as the same priority.
3. Internal execution structure of SEMA function block.

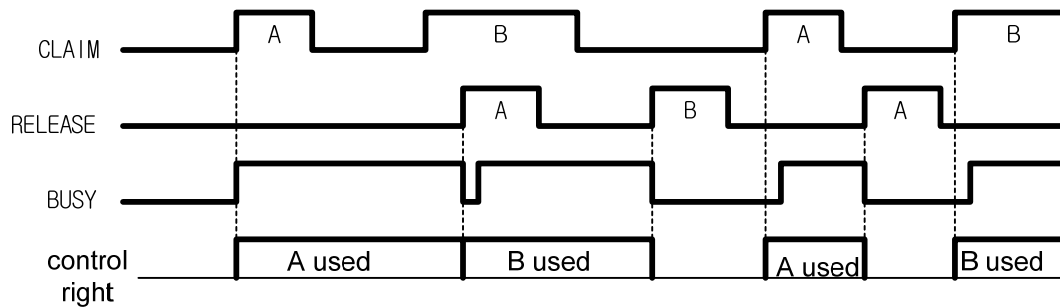
```

VAR X:BOOL := 0; END_VAR
BUSY := X;
IF CLAIM THEN X := 1;
ELSIF RELEASE THEN BUSY := 0; X := 0;
END_IF

```

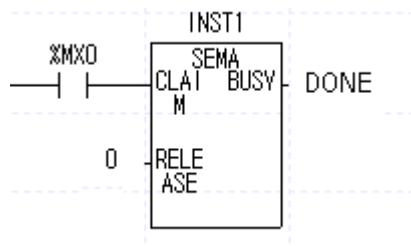
### ■ Time Chart

The access right to control the same resource is transferred between the program block A and the program block B.



### ■ Program Example

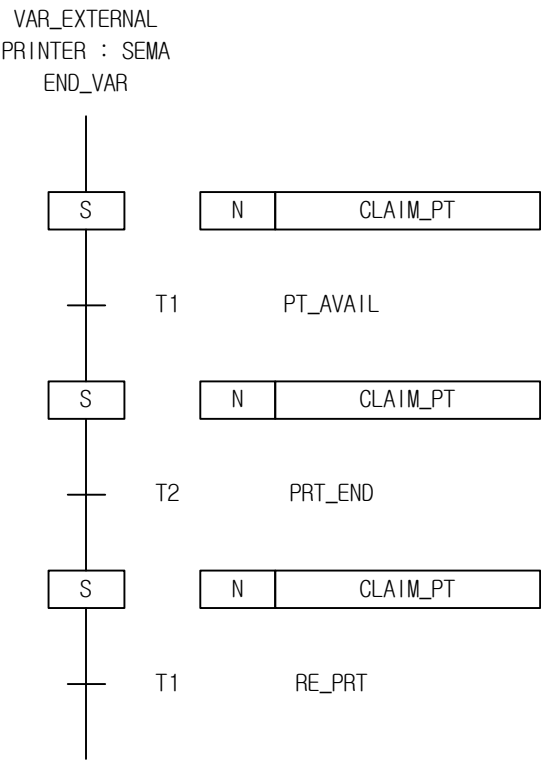
#### 1. LD



#### 2. ST

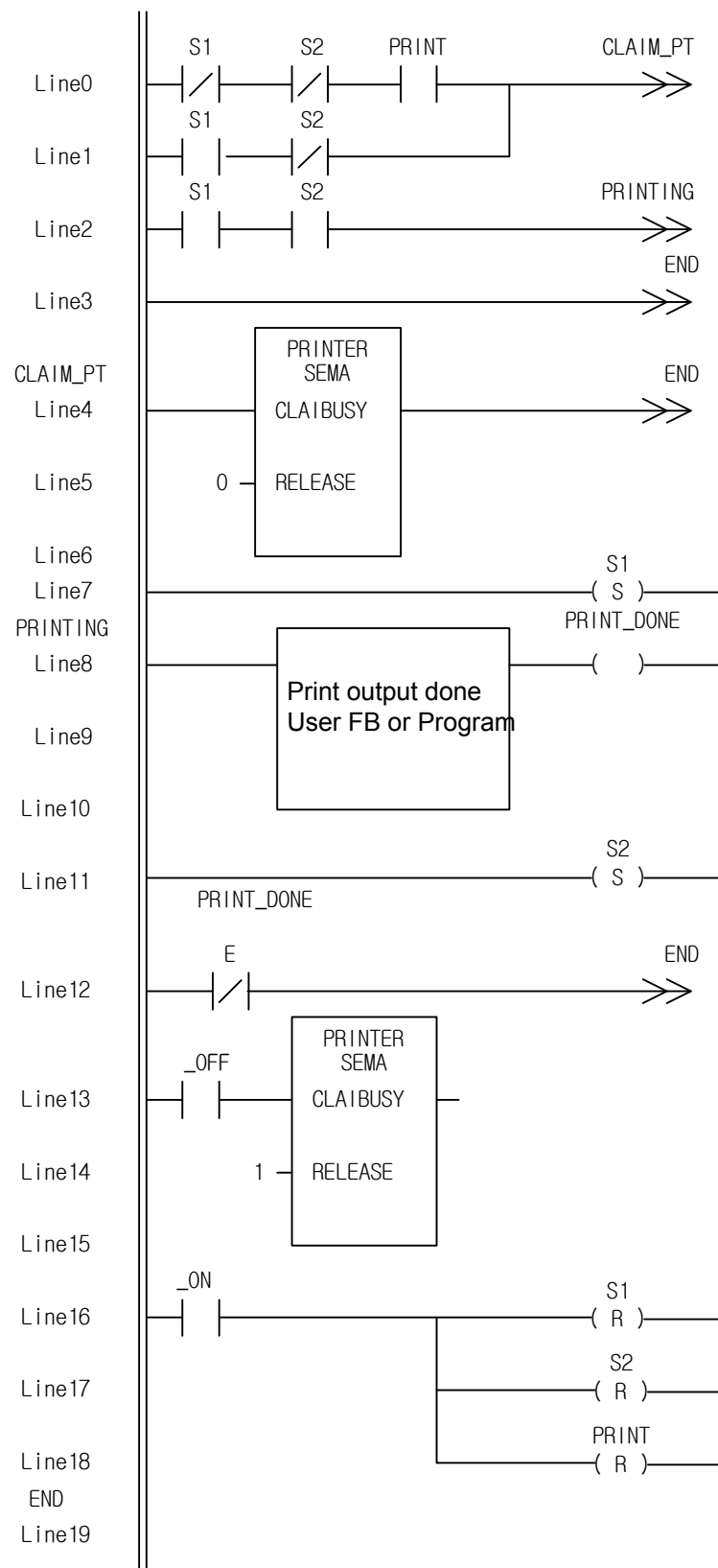
```
INST_SEMA(CLAIM:=%MX0, RELEASE:=0, BUSY=>DONE);
```

When you want to produce a printer output in different program blocks with the printer attached to the PLC system, you can easily control it by declaring the instance 'PRINTER' as a 'GLOBAL' and using Sema function block named as 'PRINTER' in each program. If you execute Sema function block (PRINTER), when START is 1 and END is 0, and claim the right to control the printer, while the printer is used in other program block, BUSY is 1 then outputs 1 to OT\_AVAIL. If the printer is not used in other program block, BUSY is 0, which means you can start the program to produce the printer output with it. After completing the print control, execute Sema with START = 0 and END = 1 so that other program can get the right to control it.

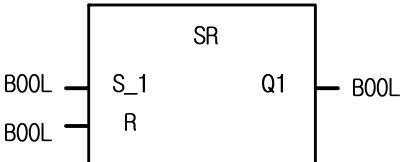


S	CLAIM_PT;Claim the printer control right
	CAL SEMA PRINTER CLAIM:= 1 RELEASE:= 0
T	PT_AVAIL;Print control right check
	LDN PRINTER.BUSY ST TRANS
S	PRINTING;Printer output
	Printer control program If print is completed, PRINT_CODE:=1
T	PRT_END;Print completion check
	LD PRINTER_DONE ST TRANS
S	REL_PRT;Transfer printer control
	CAL SEMA PRINTER CLAIM:= 0 RELEASE:= 1
T	RE_PRT;Printer request again
	LD PRT_REQ ST TRANS

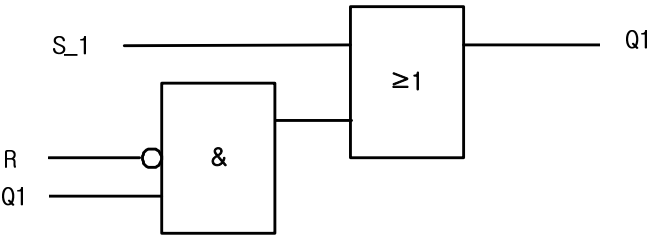
[REDACTED]



SR	Set Priority Bistable (function block)	
	Availability	XGI, XGR, XEC
	Flags	

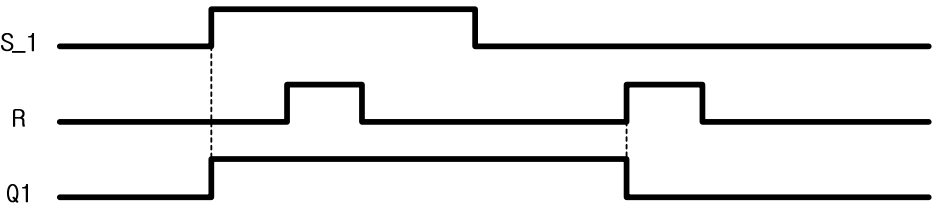
Function Block	Description
	<p><b>Input</b>    S1: set condition              R: reset condition</p> <p><b>Output</b>   Q1: operation result</p>

■ Function



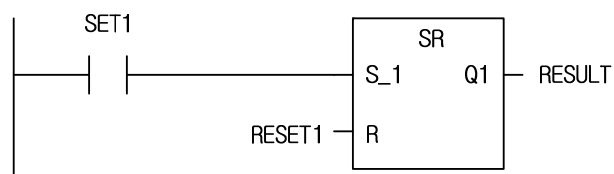
- 1. If S1 is 1, output Q1 is 1 regardless of the state of R.
- 2. The output variable Q1 is 0 and it maintains the previous state when S1 is 0, and R is 1.
- 3. The initial state of Q1 is 0.

■ Time Chart



### ■ Program Example

#### 1. LD



#### 2. ST

```
INST_SR(S_1:=SET1, R:=RESET1, Q=>RESULT);
```

- (1) If input variable SET1 becomes on, output variable RESULT is 1.
- (2) The output variable RESULT becomes 0 when input variable SET1 becomes off and RESET on.



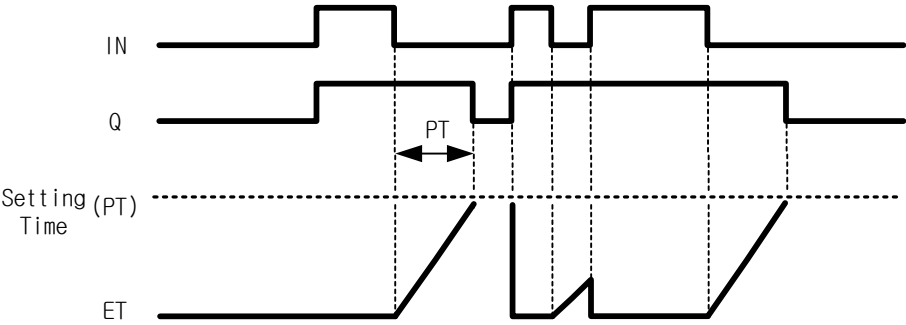
TOF	Off Delay Timer (function block)	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b> IN: timer operation condition PT: preset time</p> <p><b>Output</b> Q: timer output ET: elapsed time</p>

■ Function

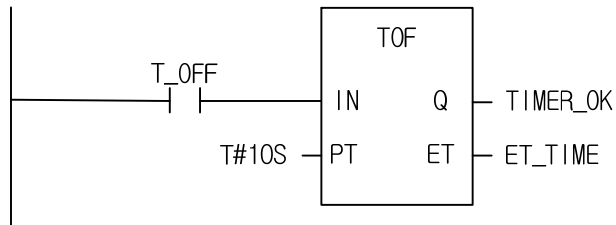
1. If IN is 1, Q is 1. And after IN becomes 0 and the preset time (PT) of TOF passes, Q becomes 0.
2. After IN becomes 0, the elapsed time (ET) is shown.
3. If IN becomes 1 before ET reaches the preset time, ET is 0 again.

■ Time Chart



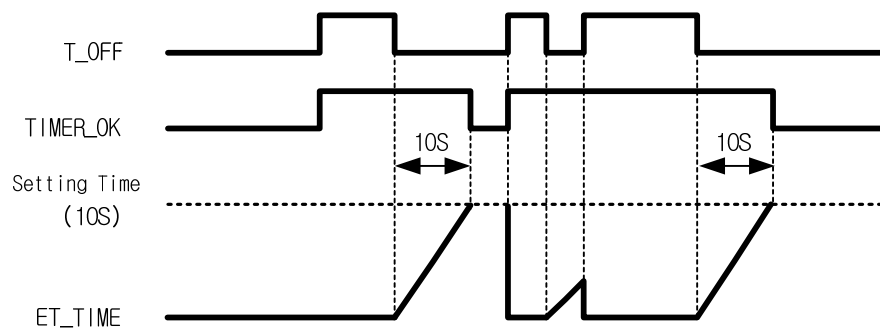
### ■ Program Example

#### 1. LD



#### 2. ST

```
INST_TOF(IN:=T_OFF, PT:=T#10S, Q=>TIMER_OK, ET=>ET_TIME);
```



- (1) Output variable TIMER\_OK is 1 when input variable T\_OFF becomes 1. TIMER\_OK is 0 only if 10 seconds passes after T\_OFF becomes 0.
- (2) If T\_OFF becomes 1 again in 10 seconds after it turned off, TOF is initialized (TIMER\_OK is 1).
- (3) After T\_OFF becomes 0, the elapsed time (ET\_TIME) is measured and shown.

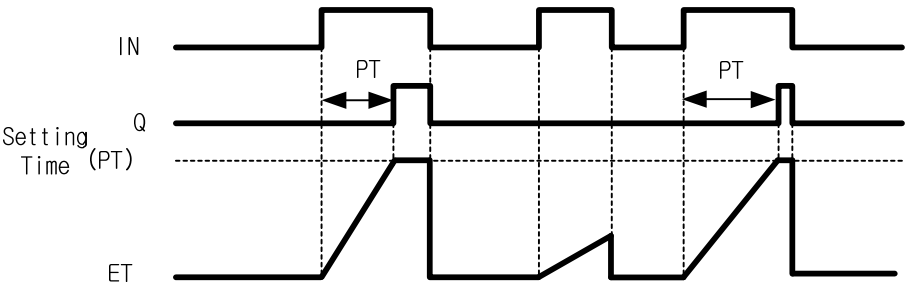
TON	On Delay Timer (function block)	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b> IN: timer operation condition PT: preset time</p> <p><b>Output</b> Q: timer output ET: elapsed Time</p>

■ Function

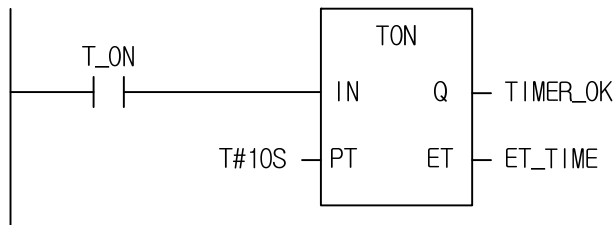
1. Elapsed time (ET) is measured and shown after IN becomes 1.
2. When IN becomes 0 before ET reaches the preset time, ET is 0.
3. If IN becomes 0 after Q is 1, Q is 0.

■ Time Chart



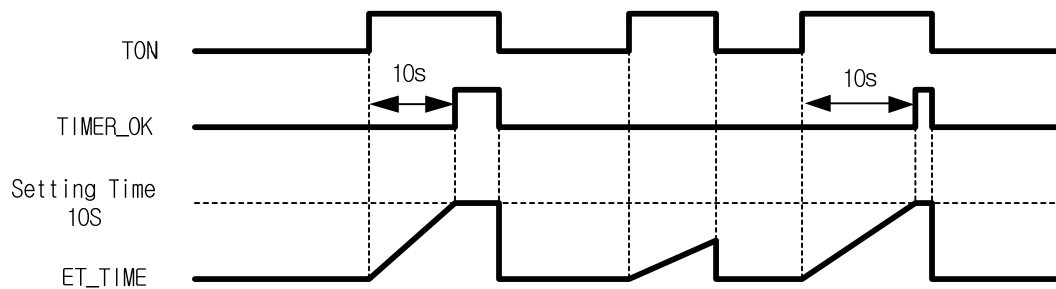
### ■ Program Example

#### 1. LD



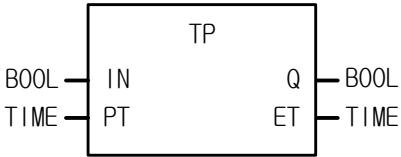
#### 2. ST

```
INST_TON(IN:=T_ON, PT:=T#10S, Q=>TIMER_OK, ET=>ET_TIME);
```



- (1) The output `TIMER_OK = 1` ten seconds later after the input `T_ON` is asserted (`T_ON = 1`).
- (2) After input variable `T_ON` is 1, the elapsed time is output to output variable, `ET_TIME`.
- (3) When `T_ON = 0` before `ET_TIME` reaches the preset time (10s), `ET_TIME` is 0.
- (4) If `T_ON = 0` after `TIMER_OK = 1`, then `TIMER_OK = 0` and `ET_TIME = 0`.

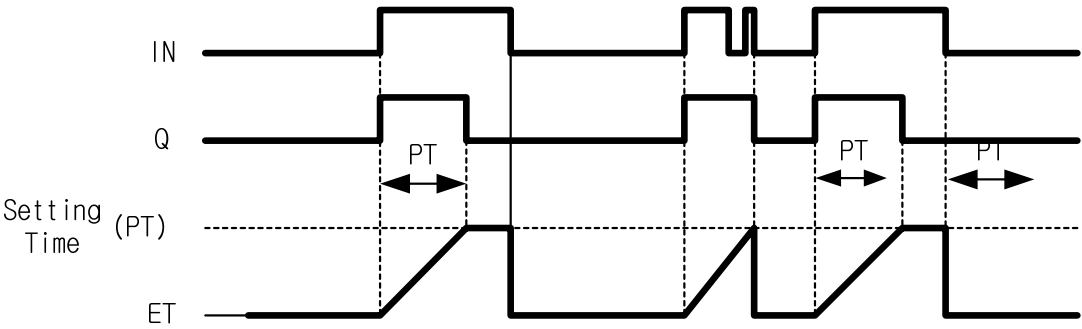
TP	Pulse timer (function block)	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b> IN: timer operation condition PT: preset time</p> <p><b>Output</b> Q: timer output ET: elapsed Time</p>

■ Function

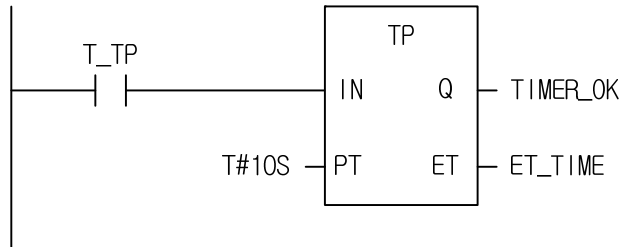
1. If IN = 1, Q is 1 only during the preset time PT; if ET reaches PT, Q is 0.
2. If IN = 1, elapsed time ET starts to be measured and maintains its value after when it reaches PT; if IN = 0 after ET reaches PT, ET = 0.
3. The state of IN doesn't matter while ET is measured (increased).

■ Time Chart



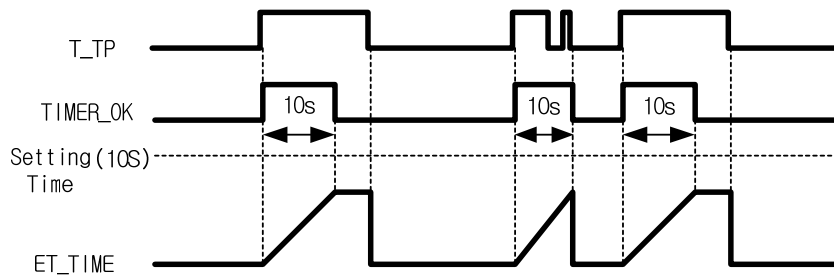
### ■ Program Example

#### 1. LD



#### 2. ST

```
INST_TP(IN:=T_TP, PT:=T#10S, Q=>TIMER_OK, ET=>ET_TIME);
```



- (1) TIMER\_OK is 1 during 10 seconds after input T\_TP was asserted (T\_TP = 1). While ET\_TIME increases during 10 seconds, the state of input T\_TP doesn't affect TIMER\_OK.
- (2) ET\_TIME increases when it reaches T#10S and then it becomes 0 when T\_TP = 0.

#### ☆ Note

TP function block keeps operating until its operation is complete even if the contact is changed from on to off. In case of a variable using array index, array index error occurs only when the contact is on. Therefore, TP function block does not produce any array index error as long as the contact is off although function block is operating.

### Ch 10. Application Function Blocks

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

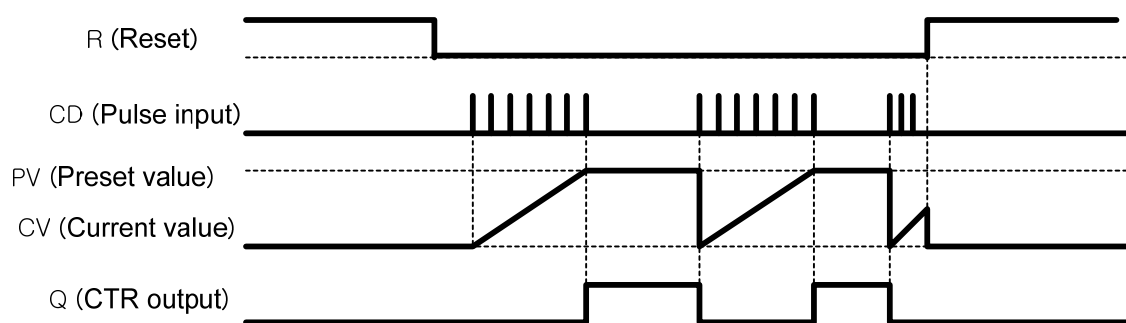
CTR	Ring Counter	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
<pre> graph LR     subgraph CTR         direction TB         CD[CD]         PV[PV]         RST[RST]         Q[Q]         CV[CV]     end     CD --&gt; CTR     PV --&gt; CTR     RST --&gt; CTR     CTR --&gt; Q     CTR --&gt; CV         </pre>	<p><b>Input</b></p> <p>CD: pulse input of Ring Counter PV: preset value RST: reset</p> <p><b>Output</b></p> <p>Q: Ring Counter output CV: current value</p>

### ■ Function

- CTR function block (Ring Counter) functions: current value (CV) increases with the rising pulse input (CD) and if, after CV reaches PV, CD becomes 1, then CV is 1.
- When CV reaches PV, output Q is 1.
- If CV is less than PV or reset input (RST) is 1, output Q is 0.

### ■ Time Chart

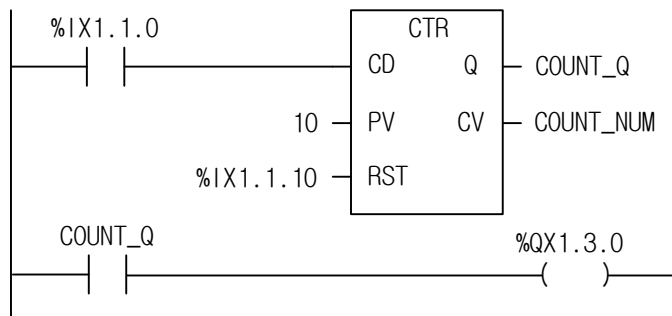




### ■ Program Example

Output %QX1.3.1 is on with 10-time rising pulse input of %IX1.1.0 is depicted as follows:

#### 1. LD



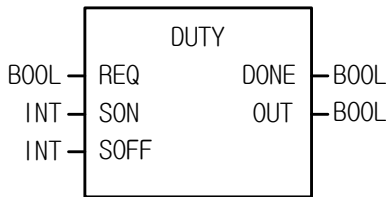
#### 2. ST

```
INST_CTR(CD:=%IX1.1.0, PV:=10, RST:=%IX1.1.10, Q=>COUNT_Q, CV=>COUNT_NUM);
```

```
%QX1.3.0 := COUNT_Q;
```

- (1) Define CTR function block as INS\_CTR.
- (2) Set %IX1.1.0 to the input contact of CD referring to the above.
- (3) Set 10 to PV.
- (4) Set %IX1.1.10 to RST resetting CV.
- (5) Set random variable COUNT\_NUM to CV
- (6) Set random output variable COUNT\_Q to Q.
- (7) After a program is complete, compile and write it to PLC.
- (8) When 'Write' is complete, do 'Mode Change' (Stop → Run).
- (9) CV (COUNT\_NUM) increases by 1 in number with the rising input pulse of %IX1.1.0.
- (10) With 10-time rising input pulse of input contact, CV is 10 which is the same as PV and output variable COUNT\_Q is 1.
- (11) If Q (COUNT\_Q) is 1, output contact %QX1.3.0 is on
- (12) If the rising input pulse is loaded into input contact %IX1.1.0, then Q (COUNT\_Q) is 0 and output contact %QX1.3.0 is off.

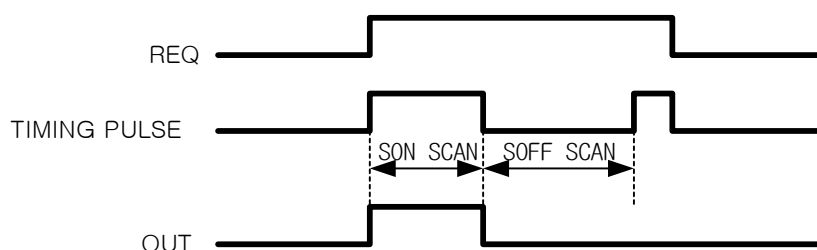
<b>DUTY</b>	Scan setting On/Off	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
 <p>The diagram shows a rectangular function block labeled 'DUTY'. It has three inputs on the left: 'REQ' (labeled 'BOOL'), 'SON' (labeled 'INT'), and 'SOFF' (labeled 'INT'). It has two outputs on the right: 'DONE' (labeled 'BOOL') and 'OUT' (labeled 'BOOL').</p>	<p><b>Input</b></p> <p>REQ: requires to execute the function block  SON: scan number to turn on  SOFF: scan number to turn off</p> <p><b>Output</b></p> <p>DONE: it is 1 when REQ is on and both input variables are not less than 0.  OUT: output is 1 during on scan time</p>

### ■ Function

1. DUTY function block produces a pulse which is on during the SON scan time and off during the SOFF scan time while REQ is on.
2. If SON = 0, OUT is always off.
3. If SON > 0 and SOFF = 0, OUT is always on.
4. If REQ is off, OUT is off.
5. If SON < 0 or SOFF < 0, then DONE is off and OUT is 0.

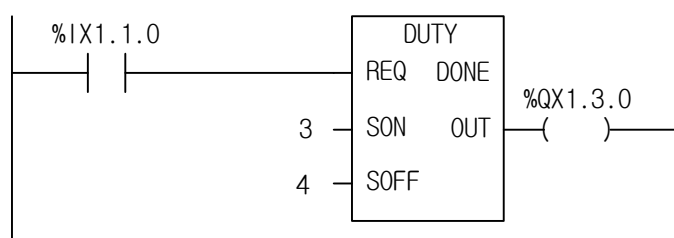
### ■ Time Chart



## ■ Program Example

If input contact %IX1.1.0 is set, output contact %QX1.3.0 is on during 3 scan times and off during 4 scan times.

### 1. LD

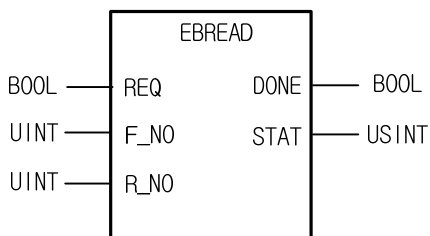


### 2. ST

```
INST_DUTY(REQ:=%IX1.1.0, SON:=3, SOFF:=4, OUT=>%QX1.3.0);
```

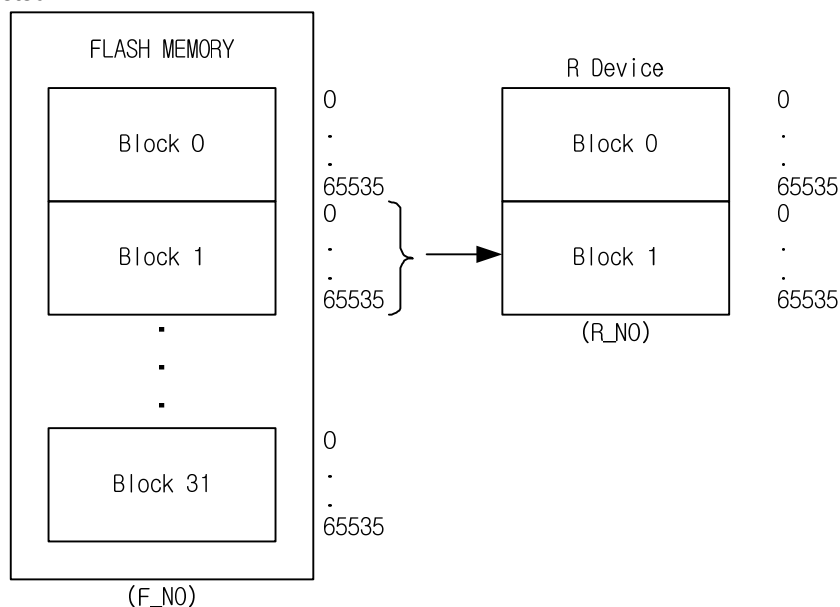
- (1) Define DUTY function block as DUTY\_C.
- (2) Set %IX1.1.0 to REQ (the input contact) of DUTY.
- (3) Set 3 to SON.
- (4) Set 4 to SOFF.
- (5) Set %QX1.3.0 to output, OUT.
- (6) After a program is complete, compile and write it to PLC.
- (7) When 'Write' is complete, do 'Mode Change' (Stop → Run).
- (8) If input contact %IX1.1.0 is on, output contact %QX1.3.0 is on during 3 scan times and off during 4 scan times.

EBREAD	Write R area data to Flash area	
	Availability	XGI, XEC
	Flags	

Function Block	Description
 <p>The diagram shows the EBREAD function block with the following connections:</p> <ul style="list-style-type: none"> <li><b>Inputs:</b> REQ (BOOL), F_NO (UINT), R_NO (UINT).</li> <li><b>Outputs:</b> DONE (BOOL), STAT (USINT).</li> </ul>	<p><b>Input</b></p> <p>REQ: requires to execute Function Block  F_NO: Flash block no. when reading data  R_NO: R area block number</p> <p><b>Output</b></p> <p>DONE: maintains 1 after normally working  STAT: displaying error info</p>

### ■ Function

(1) Transfer 1 block (64Kbyte) of a designated R device to a block of flash area to save. DONE is 1 if it is normally completed.



(2) If R\_NO is 2 and over, STAT = 1 and if F\_NO is 32 and over, STAT = 2, while \_ERR and \_LER is on. In addition, if reading data from flash, DONE = 0 and STAT = 5. DONE = 0 and STAT = 10 if Read/Write operation on a flash area is in progress during the operation is running.

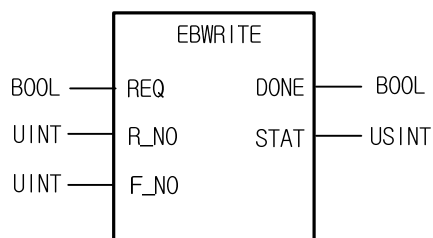
(3) While processing an instruction, the bit corresponds to F\_NO of \_RBLOCK\_RD\_FLAG is on.

**EBWRITE****Write R area data to Flash area**

Availability

XGI, XEC

Flags

**Function Block****Description****Input**

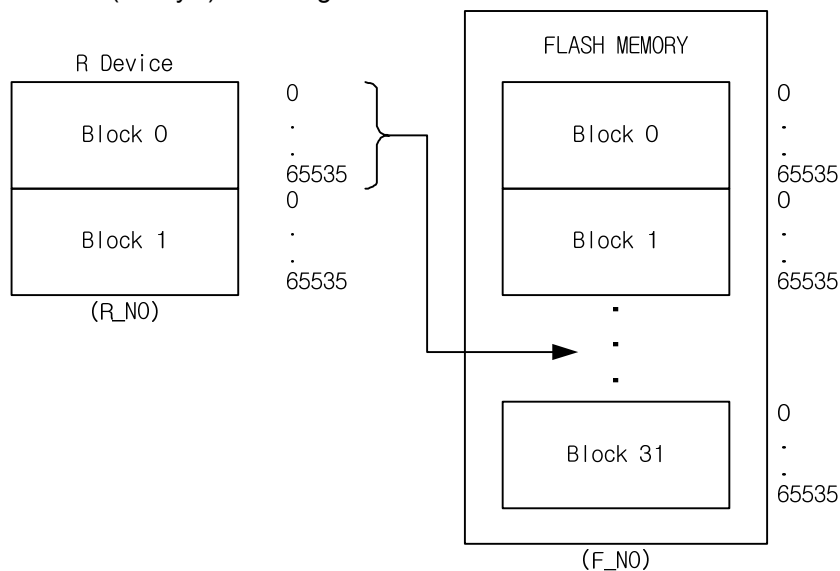
REQ: requires to execute Function Block  
 R\_NO: block number of R device(internal RAM)  
 E\_NO: block number of flash area to save

**Output**

DONE: maintains 1 after normally working  
 STAT: ERR info

■ **Function**

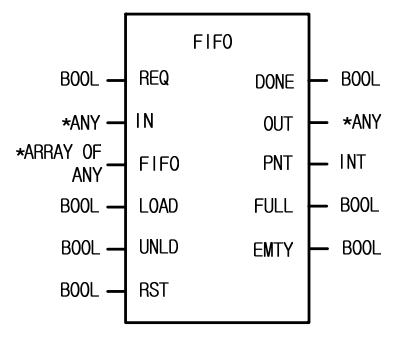
(1) Transfer 1 block (64Kbyte) of a configured R device to a block of flash area to save. DONE is 1 if normally completed.



(2) If R\_NO is 2 and over, STAT = 1 and if F\_NO is 32 and over, STAT = 2, while \_ERR and \_LER is on. In addition, if writing to flash, DONE = 0 and STAT = 5. DONE = 0 and STAT = 10 if Read/Write operation on a flash area is in progress during the operation is running.

(3) While processing an instruction, the bit corresponding to F\_NO of \_RBLOCK\_WR\_FLAG is on.

<b>FIFO</b>	<b>Load/Unload data to FIFO stack (First In First Out)</b>	
	Availability	XGI, XGR, XEC
	Flags	

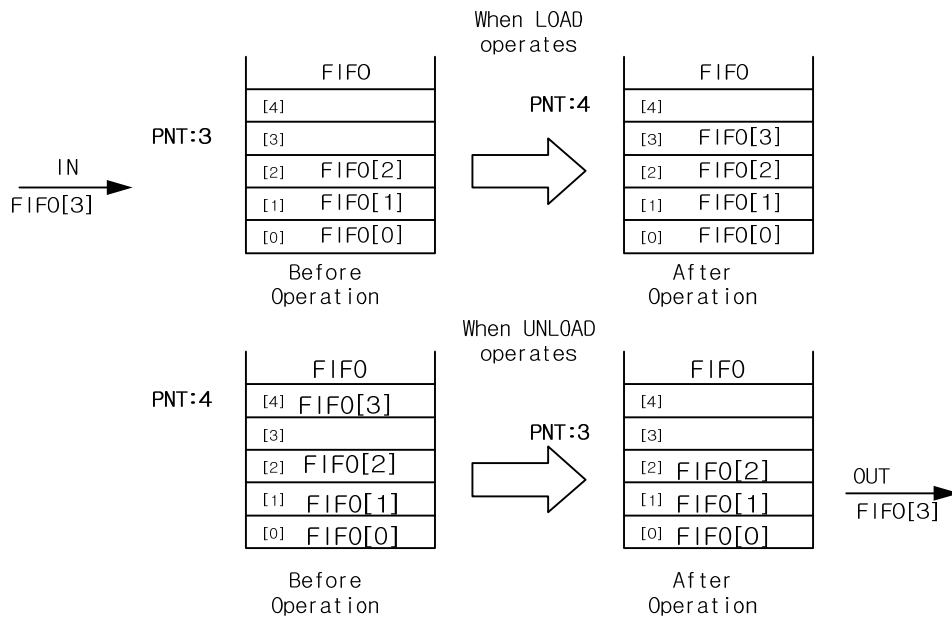
Function Block	Description
 <pre> graph LR     subgraph FIFO         REQ[REQ]         IN[IN]         FIFO[FIFO]         LOAD[LOAD]         UNLD[UNLD]         RST[RST]         DONE[DONE]         OUT[OUT]         PNT[PNT]         FULL[FULL]         EMTY[EMTY]     end     REQ --- B1[BOOL]     IN --- A1[*ANY]     A2[*ARRAY OF ANY] --- FIFO     LOAD --- B2[BOOL]     UNLD --- B3[BOOL]     RST --- B4[BOOL]     DONE --- B5[BOOL]     OUT --- A2     PNT --- I1[INT]     FULL --- B6[BOOL]     EMTY --- B7[BOOL]         </pre>	<p><b>Input</b></p> <p>REQ: requires to execute the function block  IN: input data to be stored at FIFO stack  LOAD: FB is on the input mode, if it's on.  UNLD: FB is On the output mode, if it's on,  RST: pointer value reset  FIFO : Array used as FIFO stack</p> <p><b>Output</b></p> <p>DONE: it's 1 after first execution  OUT: on output mode, it's the data from FIFO stack  PNT: pointer for input data of FIFO stack  FULL: if FIFO stack is full, it is 1  EMTY: if FIFO stack is empty, It is 1</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
	FIFO	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
	OUT	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	

\*ANY: exclude STRING from ANY types; \*ARRAY OF ANY: excluding STRING from ARRAY\_ANY type.

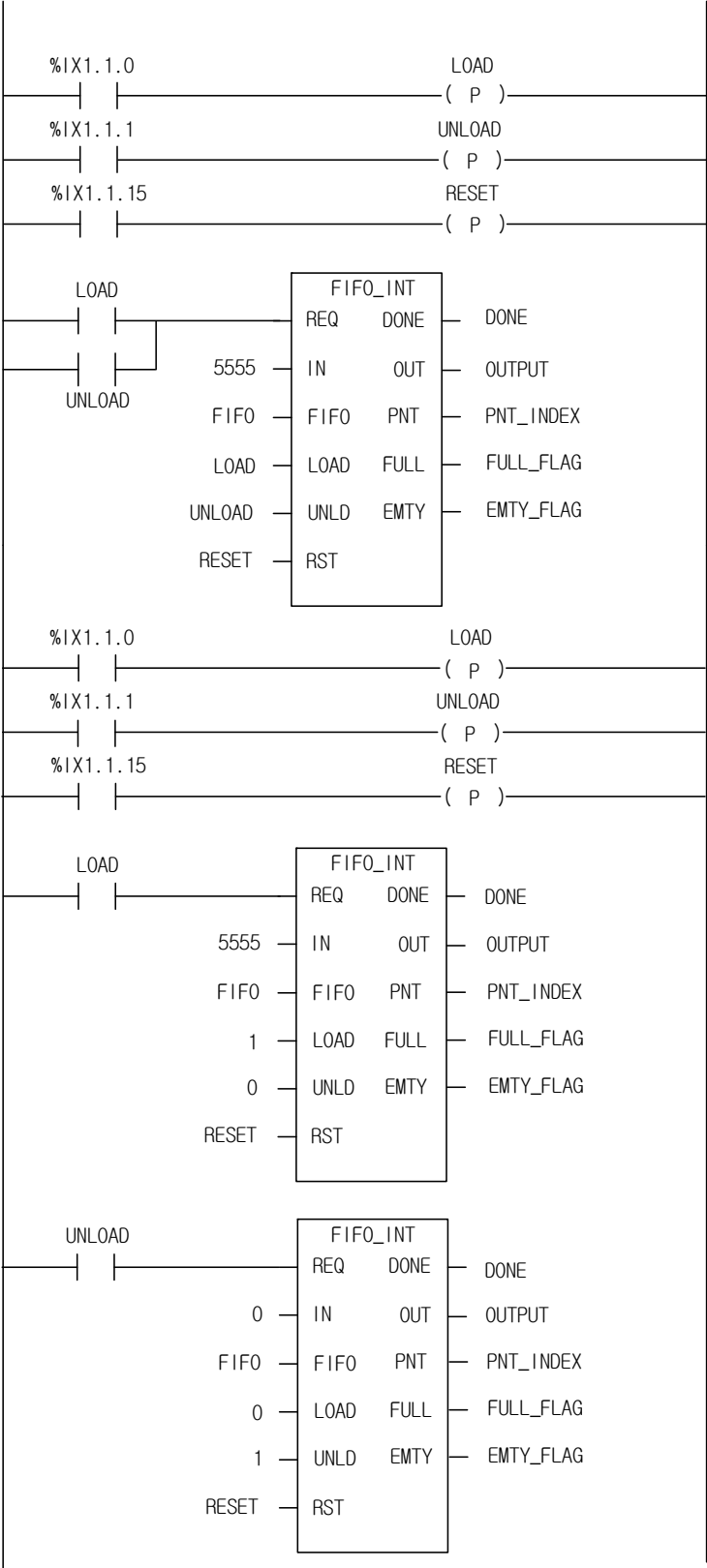
### ■ Function

- (1) It loads IN to FIFO or unloads data from FIFO.
- (2) If Input and Output mode are set on at the same time, it executes In/Output simultaneously.
- (3) If data is unloaded from FIFO, then the output is the lowest element of stack, the rest elements are shifts, PNT value is decreased by 1, and the element position of PNT is cleared (0).
- (4) If RST is loaded to FIFO, PNT is initialized as 0, EMTY is on and all the data of FIFO stack are cleared as 0.
- (5) The stack number is the input array number set by In/Output variable FIFO.
- (6) If you want to keep the data of FIFO array variables and FIFO function block instance in case that power is off or power failure occurs, set them as 'RETAIN'.
- (7) Reset functions are able to operate without REQ input.
- (8) PNT shows the position of IN to be loaded next time, or the number of pointers to be loaded.
- (9) If it's on the input mode, OUT is 0. But OUT at the output mode is retained in the converted input mode after output mode operation.



Function Block	FIFO variable type	Description
FIFO_BOOL	BOOL	It functions as FIFO for BOOL-type data
FIFO_BYTE	BYTE	It functions as FIFO for BYTE-type data
FIFO_WORD	WORD	It functions as FIFO for WORD-type data
FIFO_DWORD	DWORD	It functions as FIFO for DWORD-type data
FIFO_LWORD	LWORD	It functions as FIFO for LWORD-type data
FIFO_SINT	SINT	It functions as FIFO for SINT-type data
FIFO_INT	INT	It functions as FIFO for INT-type data
FIFO_DINT	DINT	It functions as FIFO for DINT-type data
FIFO_LINT	LINT	It functions as FIFO for LINT-type data
FIFO_USINT	USINT	It functions as FIFO for USINT-type data
FIFO_UINT	UINT	It functions as FIFO for UINT-type data
FIFO_UDINT	UDINT	It functions as FIFO for UDINT-type data
FIFO_ULINT	ULINT	It functions as FIFO for ULINT-type data
FIFO_REAL	REAL	It functions as FIFO for REAL-type data
FIFO_LREAL	LREAL	It functions as FIFO for LREAL-type data
FIFO_TIME	TIME	It functions as FIFO for TIME-type data
FIFO_DATE	DATE	It functions as FIFO for DATE-type data
FIFO_TOD	TOD	It functions as FIFO for TOD-type data
FIFO_DT	DT	It functions as FIFO for DT-type data

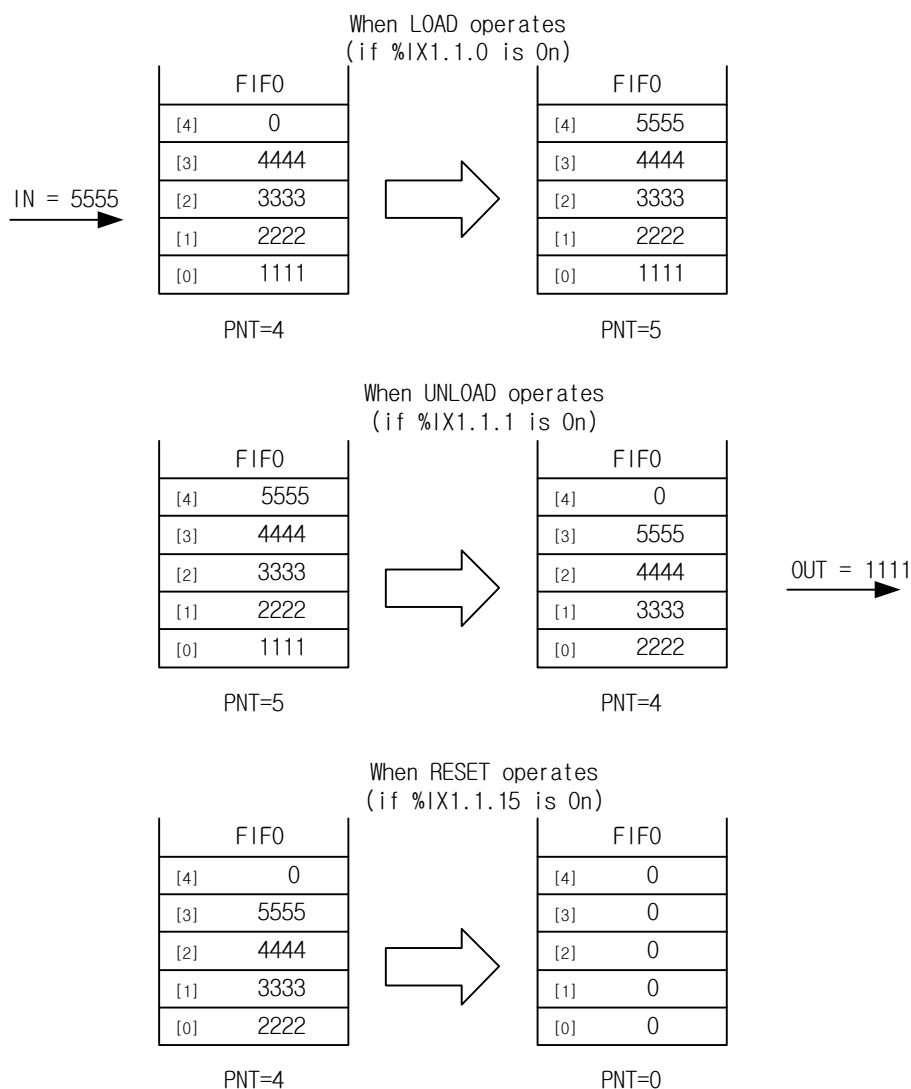
■ Program Example  
1. LD





FIFO\_INT function block is used as the above. The two examples of the above execute the same operation. The above figure illustrate a program which executes input and output functions at the same time using only one function block and following figure illustrates a program which executes input and output functions independently, using input function and output function, respectively. Note that both instance names must be the same.

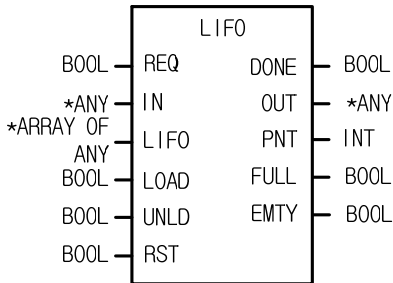
- (1) If the input conditions (%IX1.1.0, %IX1.1.1, %IX1.1.15) are on, FIFO\_INT executes.
- (2) If input contact %IX1.1.0 is on, load function is executed. 5555 is loaded to FIFO stack and PNT\_INDEX increased by 1.
- (3) If input contact %IX1.1.1 is on, unload function executes. 1111 is unloaded from FIFO stack and PNT\_INDEX is decreased by 1.
- (4) If input contact %IX1.1.15 is on, reset function executes. All the stack of FIFO is cleared as 0, PNT\_INDEX is initialized as 0 and EMTY\_FLAG is on.



### 2. ST

```
INST_FIFO_INT(REQ:=LOAD OR UNLOAD, IN:=5555, FIFO:=FIFO, LOAD:=LOAD, UNLD:=UNLOAD,  
RST:=RESET, DONE=>DONE, OUT=>OUTPUT, PNT=>PNT_INDEX, FULL=>FULL_FLAG, EMTY=>EMPTY_FLAG);
```

<b>LIFO</b>	<b>Load/Unload data to LIFO stack (Last In First Out)</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
 <pre> graph LR     subgraph LIFO_FB [LIFO]         REQ[REQ]         IN[IN]         LIFO[LIFO]         LOAD[LOAD]         UNLD[UNLD]         RST[RST]         DONE[DONE]         OUT[OUT]         PNT[PNT]         FULL[FULL]         EMY[EMY]     end     REQ --- BREQ[BOOL]     IN --- IN_ANY[*ANY]     LIFO --- LIFO_ARRAY[*ARRAY OF ANY]     LOAD --- LOAD_BOOL[BOOL]     UNLD --- UNLD_BOOL[BOOL]     RST --- RST_BOOL[BOOL]     DONE --- DBOOL[BOOL]     OUT --- OUT_ANY[*ANY]     PNT --- PNT_INT[INT]     FULL --- FULL_BOOL[BOOL]     EMY --- EMY_BOOL[BOOL]         </pre>	<p><b>Input</b></p> <p>REQ: to execute the function block  IN: input data to be stored at LIFO stack  LOAD: FB is on, the input mode, if it is on  UNLD: FB is on the output mode, if it is on  RST: pointer value reset  LIFO : Array used as LIFO stack.</p> <p><b>Output</b></p> <p>DONE: it is 1 after first execution  OUT: on output mode, it is the data from LIFO stack  PNT: pointer for input data of LIFO stack  FULL: if LIFO stack is full, it is 1  EMY: if LIFO stack is empty, it is 1</p>

ANY type variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	IN	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
	LIFO	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
	OUT	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	

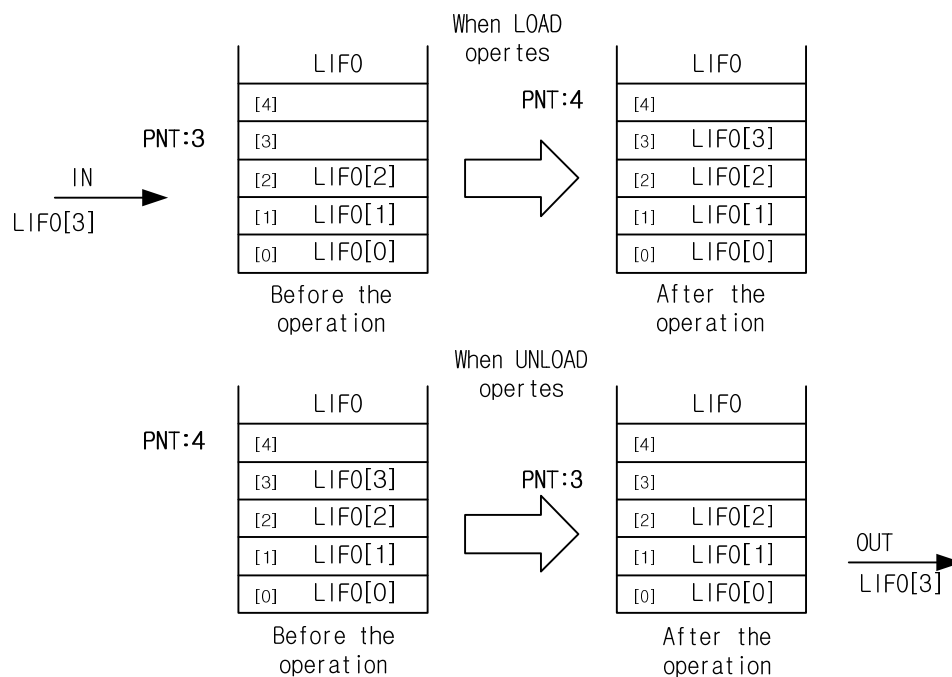
\*ANY: exclude STRING from ANY type, \*ARRAY OF ANY: exclude STRING from ARRAY OF ANY type.

## ■ Function

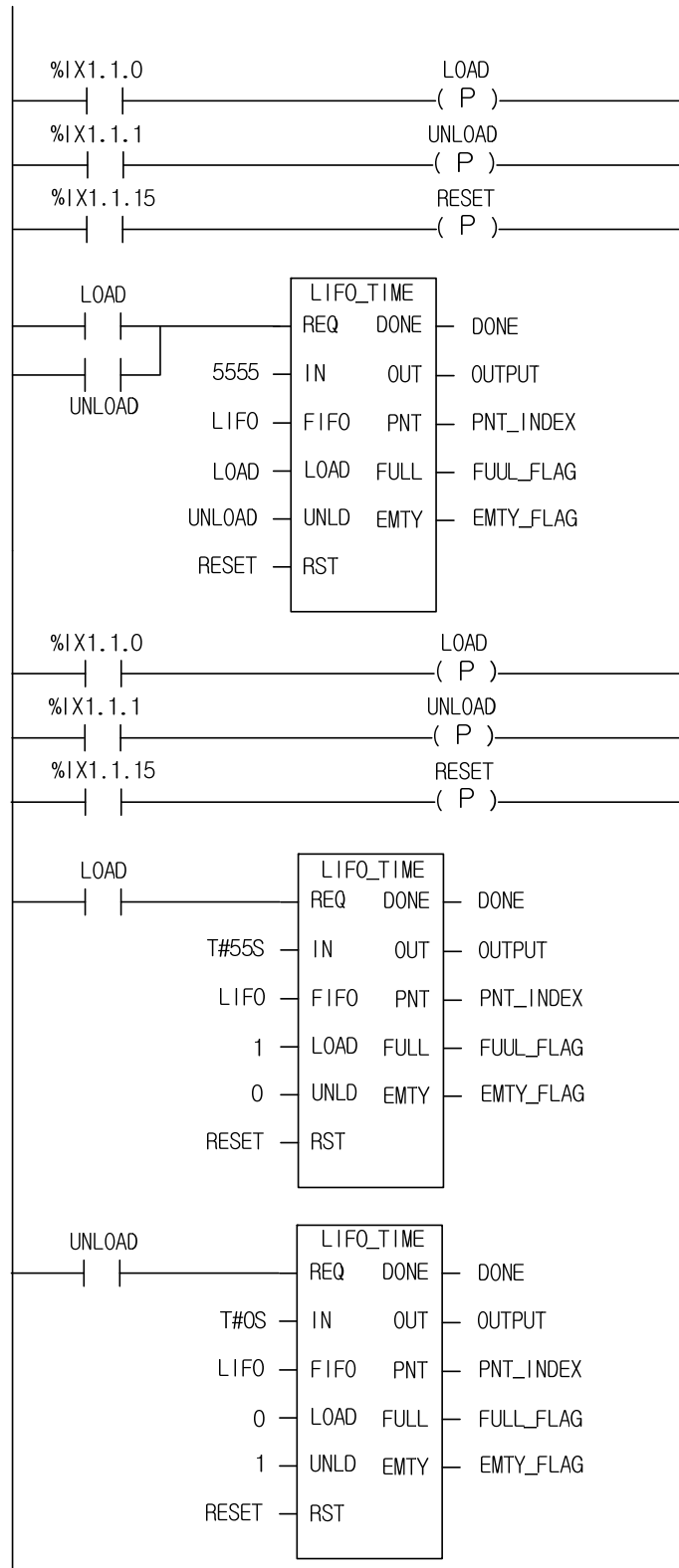
- (1) It loads IN to LIFO or unloads data from LIFO.
- (2) If LOAD and UNLD are on at the same time, input IN is produced as output ,OUT.
- (3) If data is unloaded from LIFO by unload function of LIFO\_\*\*\*, unloaded data is deleted in stack and initialized as 0.
- (4) If RST is loaded to LIFO, PNT is initialized as 0, EMY is on and all the data of LIFO stack are cleared as 0.
- (5) The stack number is the array number set by In/Output variable LIFO.
- (6) If you want to keep the data of LIFO array variables and LIFO function block instance, in case that power is off or power failure occurs, set them as 'RETAIN'.
- (7) Reset functions are able to operate without REQ input.
- (8) PNT shows the position of IN to be loaded next time, or the number of pointers to be loaded.
- (9) If it is on the input mode, output ,OUT is 0.
- (10) If load and unload signals are entered simultaneously, IN is produced to OUT.
- (11) In case of input mode, OUT is 0. However, if the input mode converted after output mode operation, OUT value of output mode is maintained

## Ch 10. Application Function Blocks

Function Block	FIFO variable type	Description
LIFO_BOOL	BOOL	It functions as LIFO for BOOL-type data
LIFO_BYTE	BYTE	It functions as LIFO for BYTE-type data
LIFO_WORD	WORD	It functions as LIFO for WORD-type data
LIFO_DWORD	DWORD	It functions as LIFO for DWORD-type data
LIFO_LWORD	LWORD	It functions as LIFO for LWORD-type data
LIFO_SINT	SINT	It functions as LIFO for SINT-type data
LIFO_INT	INT	It functions as LIFO for INT-type data
LIFO_DINT	DINT	It functions as LIFO for DINT-type data
LIFO_LINT	LINT	It functions as LIFO for LINT-type data
LIFO_USINT	USINT	It functions as LIFO for USINT-type data
LIFO_UINT	UINT	It functions as LIFO for UINT-type data
LIFO_UDINT	UDINT	It functions as LIFO for UDINT-type data
LIFO_ULINT	ULINT	It functions as LIFO for ULINT-type data
LIFO_REAL	REAL	It functions as LIFO for REAL-type data
LIFO_LREAL	LREAL	It functions as LIFO for LREAL-type data
LIFO_TIME	TIME	It functions as LIFO for TIME-type data
LIFO_DATE	DATE	It functions as LIFO for DATE-type data
LIFO_TOD	TOD	It functions as LIFO for TOD-type data
LIFO_DT	DT	It functions as LIFO for DT-type data



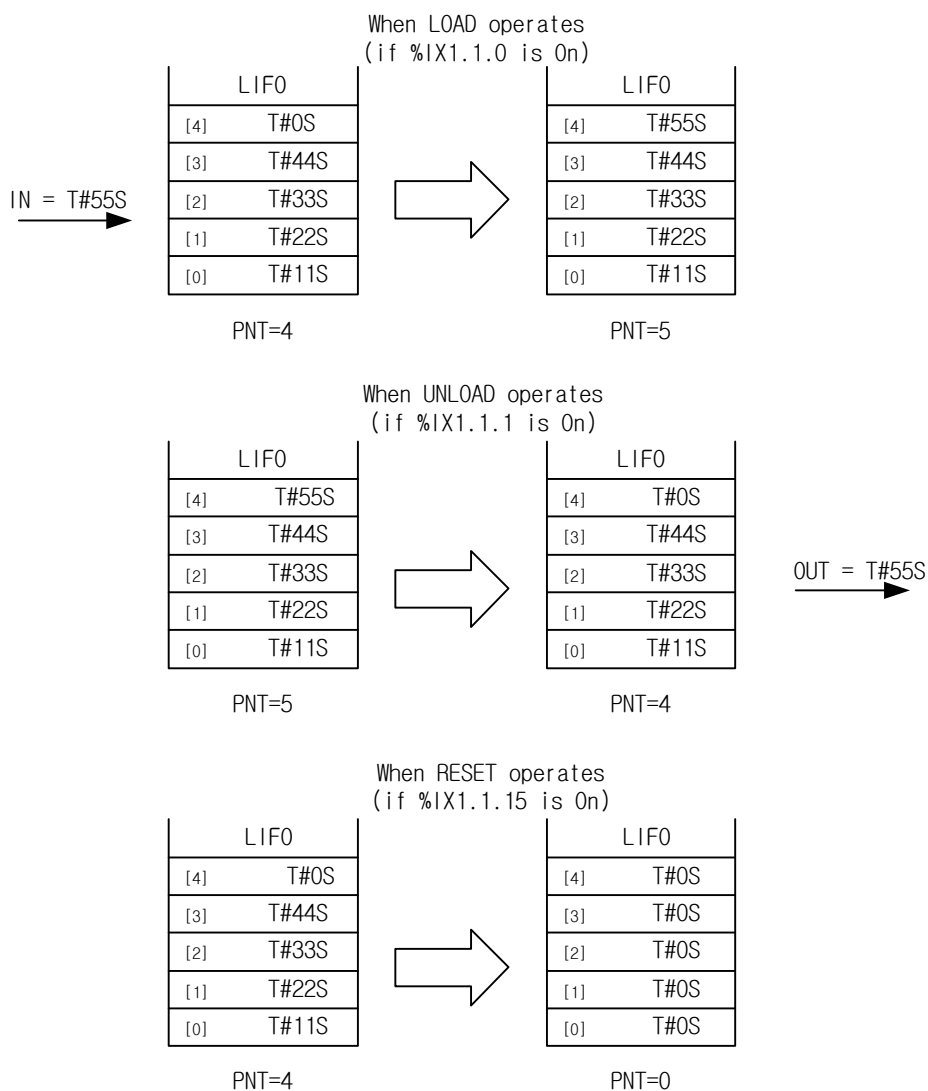
■ Program Example  
1. LD



## Ch 10. Application Function Blocks

LIFO\_TIME function block is used as the above. The two examples of the above execute the same operation. The above figure illustrate a program which executes input and output functions at the same time using only one function block and the below figure illustrates a program which executes input and output functions independently, using input function and output function, respectively. Note that both instance names must be the same.

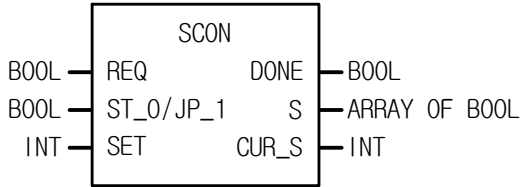
- (1) If the input conditions (%IX1.1.0, %IX1.1.1, %IX1.1.15) are on, LIFO\_TM executes.
- (2) If input contact %IX1.1.0 is on, load function executes. T#55S is loaded to LIFO stack and PNT\_INDEX is increased by 1.
- (3) If input contact %IX1.1.1 is on, unload function executes. T#55S is unloaded from LIFO stack and PNT\_INDEX is decreased by 1.
- (4) If input contact %IX1.1.15 is on, reset function executes. All the stack of LIFO is cleared as T#0S, PNT\_INDEX is initialized as 0 and EMTY\_FLAG is on.



### 2. ST

```
INST_LIFO_TIME(REQ:=LOAD OR UNLOAD, IN:=T#55S, LIFO:=LIFO, LOAD:=LOAD, UNLD:=UNLOAD, RST:=RST,  
DONE=>DONE, OUT=>OUTPUT, PNT=>PNT_INDEX, FULL=>FULL_FLAG, EMTY=>EMTY_FLAG);
```

SCON	Step Controller (Step in order and jump of step)	
	Availability	XGI, XGR, XEC
	Flags	_ERR , _LER

Function Block	Description
 <pre> graph LR     subgraph SCON         REQ[REQ]         ST0[ST_0/JP_1]         SET[SET]         DONE[DONE]         S[S]         CUR_S[CUR_S]     end     REQ --- B1[BOOL]     ST0 --- B2[BOOL]     SET --- I1[INT]     DONE --- B3[BOOL]     S --- A1[ARRAY OF BOOL]     CUR_S --- I2[INT]         </pre>	<p><b>Input</b></p> <p>REQ: if it is 1, the function block executes  S/O: if 0, SET function is enabled;  if 1, OUT function is enabled.  SET: step number (0 ~ 99)</p> <p><b>Output</b></p> <p>DONE: without an error, it is on. If error is occurred or there is no request of execution, it is off  S: produces an set bit array  CUR_S: produces a current step number</p>

### ■ Function

#### (1) Setting of step controller group

The instance name of function block is the name of step controlling group.

(Examples of FB declaration: S00, G01, Manu1, Examples of step contacts: S00.S[1], G01.S[1], Manu1.S[1])

#### 2. In case of SET function (ST\_0/JP\_1 = 0)

In the same step controller group, the present step number can be on when the previous step number is on.

If the present step number is on, it keeps its state even when the input is off.

Only one step number is on even when several input conditions are on at the same time.

If Sxx.S[0] is on, all the SET output is cleared.

#### 3. In case of JUMP function (ST\_0/JP\_1 = 1)

In the same step controller group, only one step number is on, even when several input conditions are on.

If input conditions are on at the same time, last programmed one is produced.

If the present step number is on, it keeps its state even when the input is off..

If Sxx.S[0] is on, it returns to its first step.

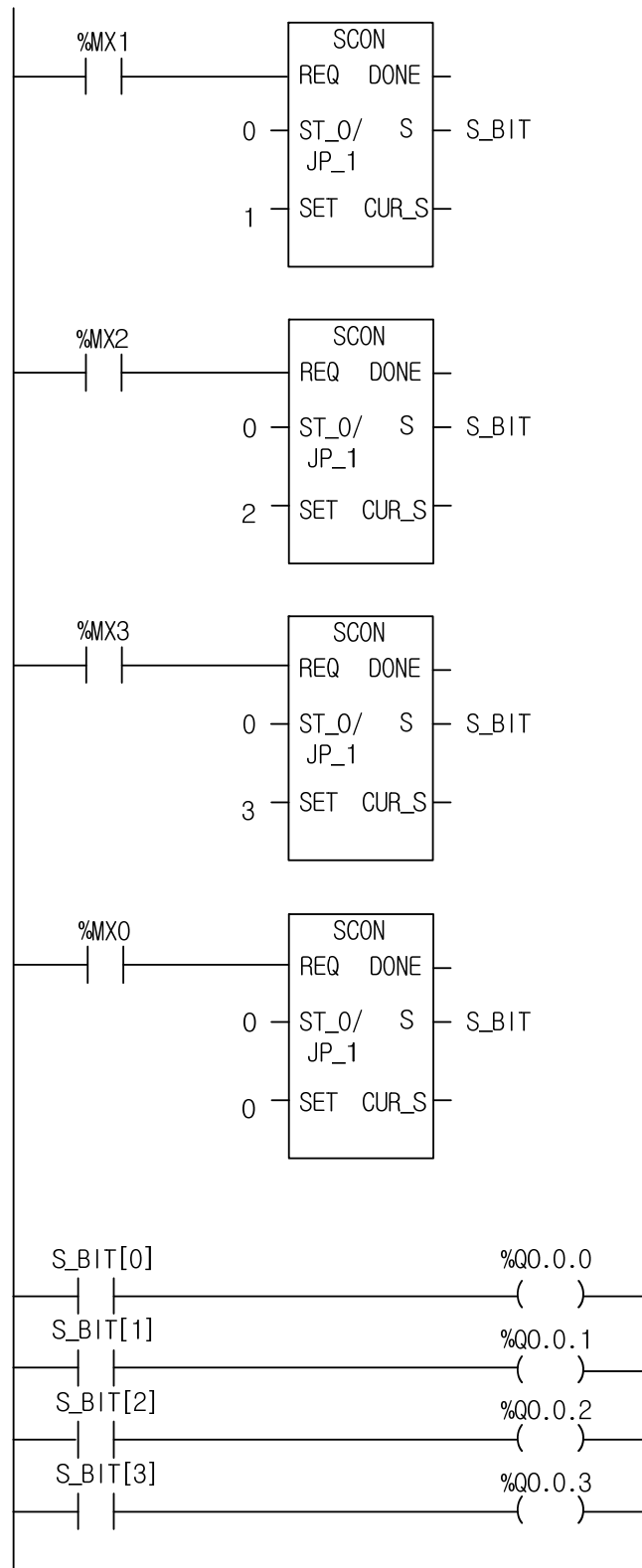
### ■ Flag

Flag	Description
_ERR	An error occurs when step setting (SET) is out of its range (0 ~ 99). If an error occurs, DONE is off and step output maintains its previous step.



- In case of SET function (ST\_0/JP\_1 = 0), using SC1 group

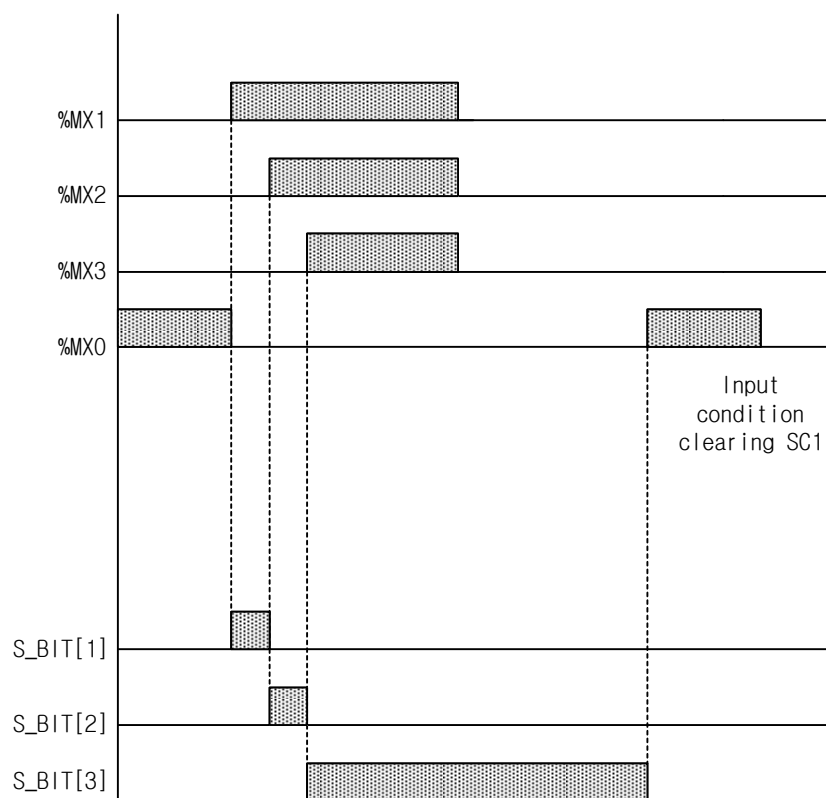
## 1. LD

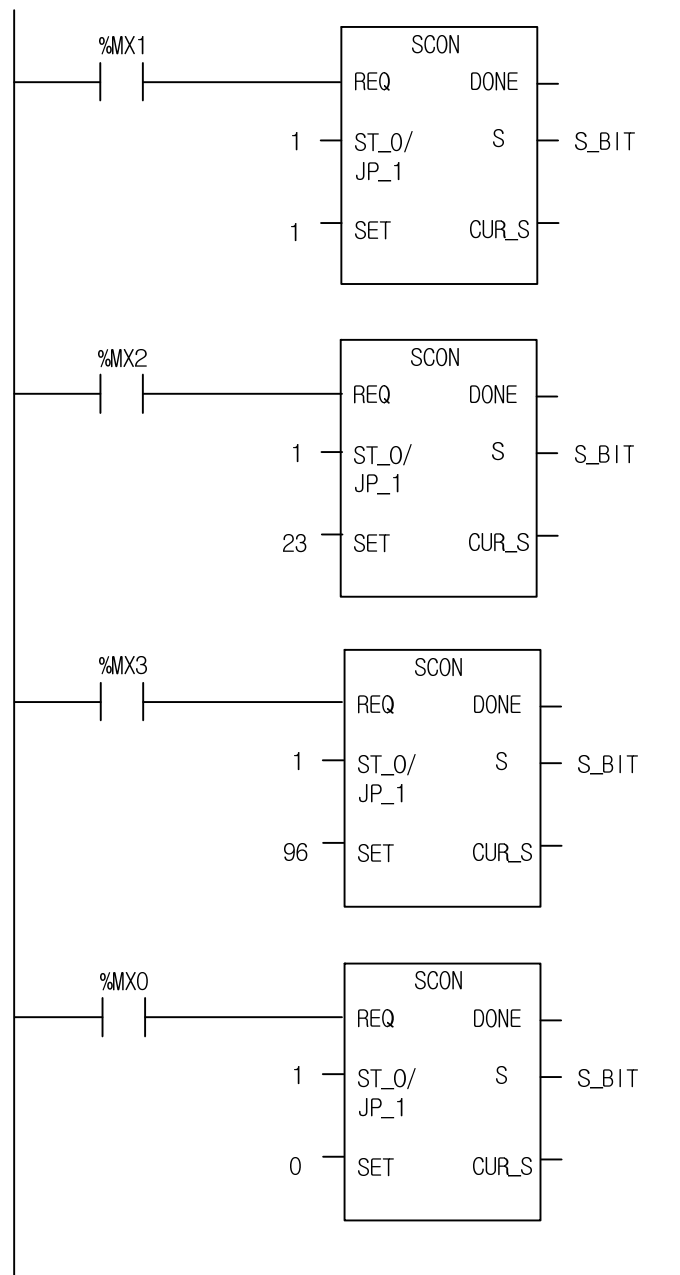


### 2. ST

```
INST_SCON(REQ:=%MX1, ST0_JP1:=0, SET:=1, S=>S_BIT);  
INST_SCON1(REQ:=%MX2, ST0_JP1:=0, SET:=2, S=>S_BIT);  
INST_SCON2(REQ:=%MX3, ST0_JP1:=0, SET:=3, S=>S_BIT);  
INST_SCON3(REQ:=%MX4, ST0_JP1:=0, SET:=0, S=>S_BIT);
```

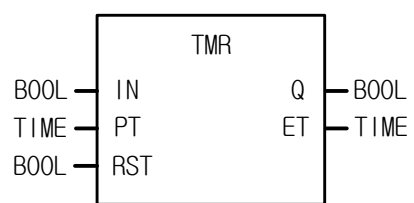
```
%QX0.0.0 := S_BIT[0];  
%QX0.0.1 := S_BIT[1];  
%QX0.0.2 := S_BIT[2];  
%QX0.0.3 := S_BIT[3];
```





NO	%MX 1	%MX 2	%MX 3	%MX 4	S_O [1]	S_O [23]	S_O [98]	S_O [0]
1	On	Off	Off	Off	○			
2	On	On	Off	Off		○		
3	On	On	On	Off			○	
4	On	On	On	On				○

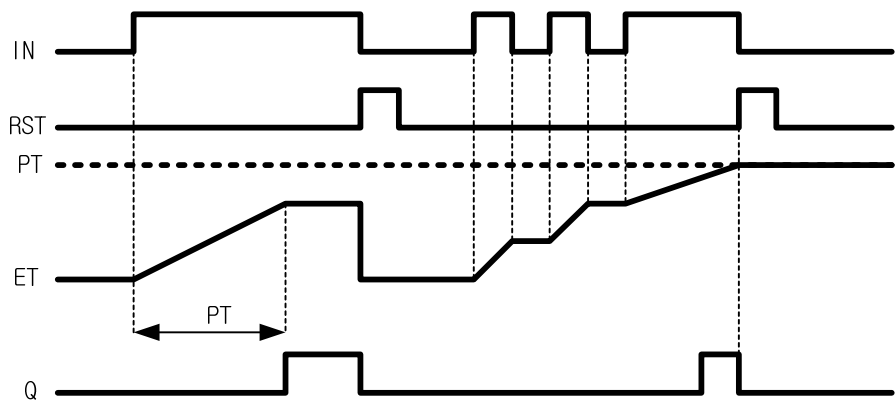
TMR	Integration Timer	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
 <p>The diagram shows a square block labeled 'TMR'. On the left side, there are three inputs: 'IN' (labeled 'BOOL'), 'PT' (labeled 'TIME'), and 'RST' (labeled 'BOOL'). On the right side, there are two outputs: 'Q' (labeled 'BOOL') and 'ET' (labeled 'TIME').</p>	<p><b>Input</b></p> <p>IN: operation condition for Timer PT: preset time RST: reset</p> <p><b>Output</b></p> <p>Q: timer output ET: elapsed time</p>

■ Function

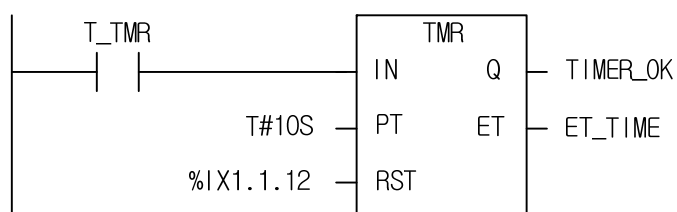
- 1. When IN is 1, elapsed time is produced at ET.
- 2. Even if IN is 0 before ET reaches PT, ET keeps its value. If IN is 1 again, elapsed time is produced at ET integrating its previous value.
- 3. If ET reaches PT, Q is 1.
- 4. If RST is 1, Q and ET are 0.

■ Time Chart



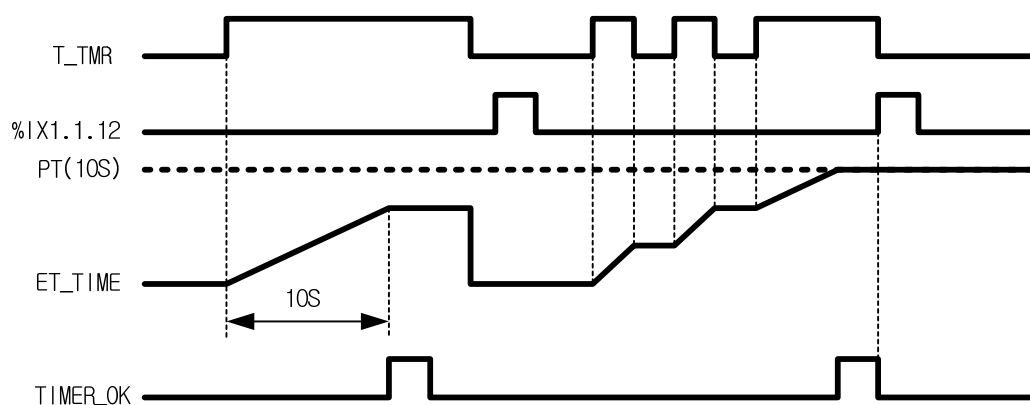
## ■ Program Example

### 1. LD



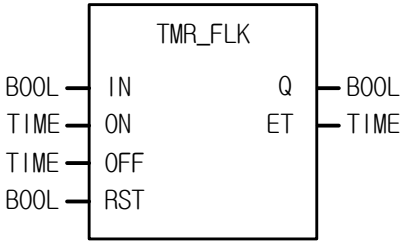
### 2. ST

```
INST_TMR(IN:=T_TMR, PT:=T#10S, RST:=%IX1.1.12, Q=>TIMER_OK, ET=>ET_TIME);
```



- (1) If 10 seconds passes after input variable T\_TMR is 1, output variable TIMER\_OK is 1.
- (2) Elapsed time is produced at ET\_TIME after T\_TMR is 1.
- (3) ET\_TIME keeps its value even if T\_TMR is 0 before ET\_TIME reaches its preset time 10 seconds.
- (4) If T\_TMR is 1, elapsed time is produced at ET\_TIME integrating its previous value.
- (5) If input contact %IX1.1.12 is 1, elapsed time ET\_TIME and output variable TIMER\_OK are all cleared.

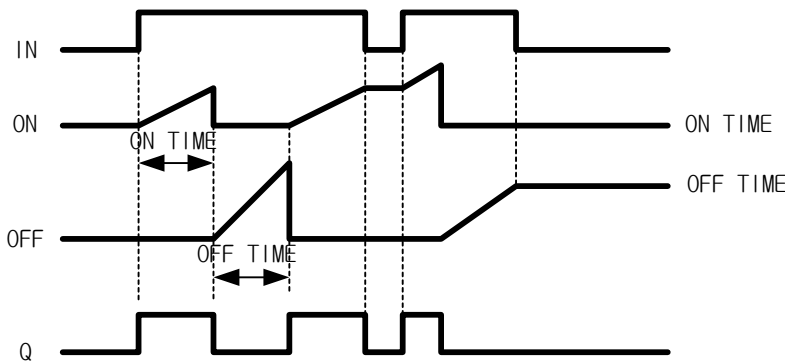
TMR_FLK	TMR with Flicker	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
<div></div>	<p><b>Input</b></p> <p>IN: operation condition for Timer ON: on setting time of timer OFF: off setting time of timer RST: reset</p> <p><b>Output</b></p> <p>Q: Timer output ET: elapsed time</p>

■ Function

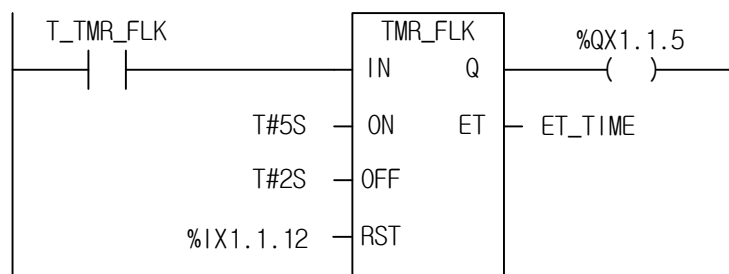
- (1) As soon as IN gets 1, Q becomes 1 and Q maintains its value during on setting time.
- (2) After setting time which is set by on, Q is 0 during the time which is set by off.
- (3) If IN is 0, it stops its function of either on or off operation and keeps its time. If IN is 1 again, it executes with its previous data.
- 4. Output Q is 0 while IN is 0.
- 5. If ON is 0, output Q is always 0.

■ Time Chart



## ■ Program Example

### 1. LD

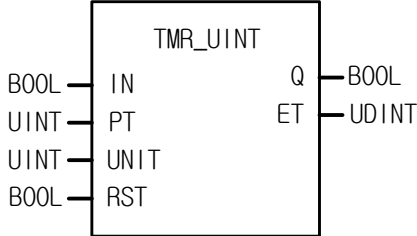


### 2. ST

```
INST_TMR_Flk(IN:=T_TMR_Flk, ON:=T#5S, OFF:=T#2S, RST:=%IX1.1.12, Q=>%QX1.1.5, ET=>ET_TIME);
```

- (1) If input variable T\_TMR\_Flk is 1, TMR\_Flk function block executes.
- (2) Output contact %QX1.1.5 is 1 during 5 seconds set by on after input variable T\_TMR\_Flk is 1.
- (3) Output contact %QX1.1.5 is 0 during 2 seconds set by off after 5 seconds set by on.
- (4) TON time (On) when Q is 1 and TOF time (Off) when Q is 0 are produced at ET\_TIME by turns while T\_TMR\_Flk is 1.
- (5) If input variable T\_TMR\_Flk is 0, then it keeps its time and output contact %QX1.1.5 is 0. If T\_TMR\_Flk is 1, it executes again.
- (6) If input %IX1.1.12 is 1, elapsed time ET\_TIME and output contact %QX1.1.5 are all cleared.

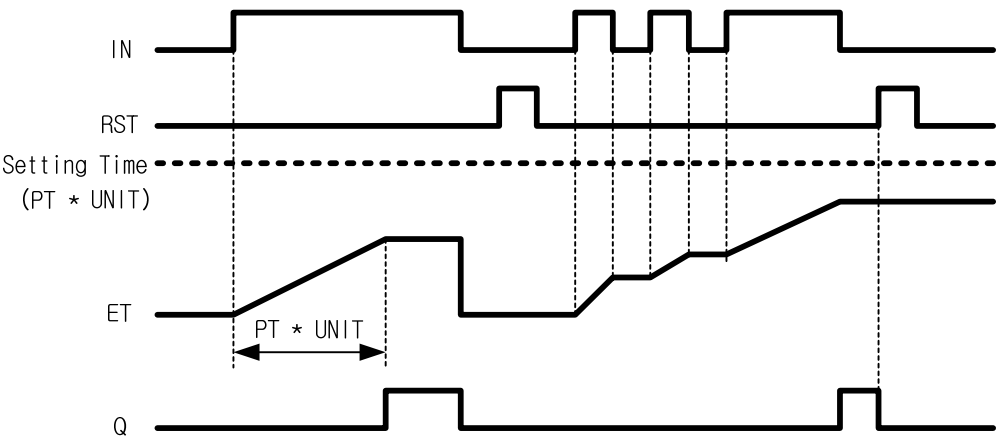
TMR_UINT	TMR with Integer setting	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
 <p>The diagram shows the TMR_UINT function block with inputs IN (BOOL), PT (UINT), UNIT (UINT), and RST (BOOL) on the left, and outputs Q (BOOL) and ET (UDINT) on the right.</p>	<p><b>Input</b></p> <p>IN: operation condition for Timer PT: preset time UNIT: time unit of setting time RST: reset input</p> <p><b>Output</b></p> <p>Q: timer output ET: elapsed time</p>

■ Function

- (1) Elapsed time is produced at ET after IN is 1.
- (2) Even if IN is 0 before ET reaches PT, ET keeps its value. If IN is 1 again, elapsed time is increased.
- (3) Q is 1 when elapsed time reaches preset time.
- (4) If RST is 1, Q and ET are 0.
- (5) Setting time is PT x UNIT (ms).

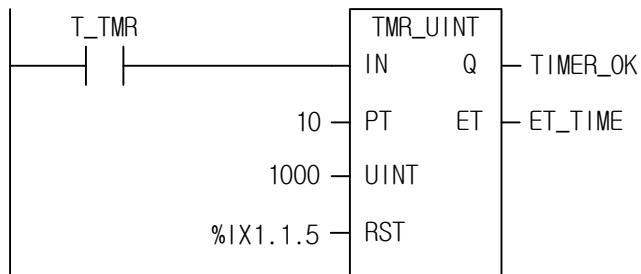
■ Time Chart





### ■ Program Example

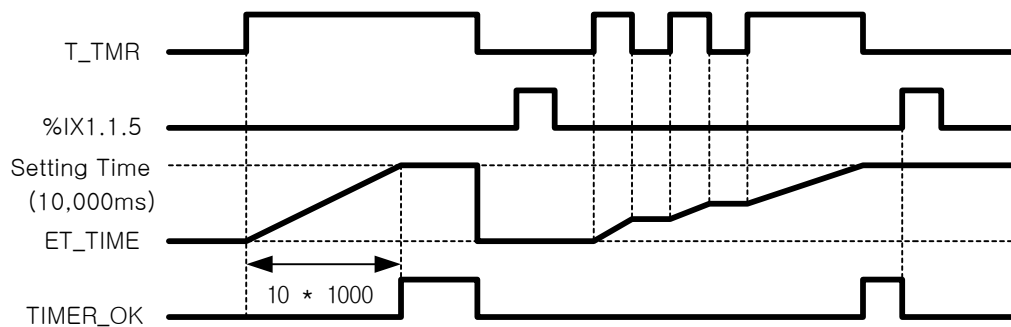
#### 1. LD



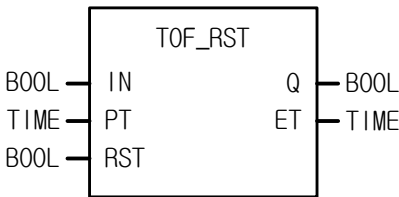
#### 2. ST

```
INST_TMR_UINT(IN:=T_TMR, PT:=10, UNIT:=1000, RST:=%IX1.1.5, Q=>TIMER_OK, ET=>ET_TIME);
```

- (1) Setting time is  $PT \times UNIT[ms] = 10 \times 1000[ms] = 10[s]$ .
- (2) Output variable **TIMER\_OK** is 1, if 10 seconds passes after input variable **T\_TMR** is 1.
- (3) Elapsed time is produced at **ET\_TIME** after input variable **T\_TMR** is 1.
- (4) Even if **T\_TMR** is 0 before **ET\_TIME** reaches preset time, 10 seconds, **ET\_TIME** keeps its value.
- (5) If input variable **T\_TMR** is 1 again, elapsed time is produced at **ET** integrating its previous value.
- (6) If input contact **%IX1.1.5** is 1, elapsed time **ET\_TIME** and output contact **TIMER\_OK** are all cleared.



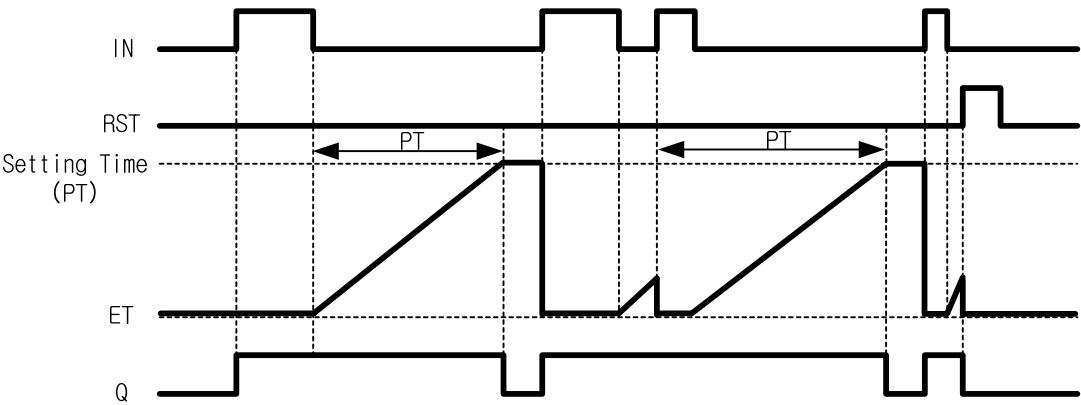
TOF_RST	Delay Timer is able to output Off in operation	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>IN: operation condition for Timer PT: preset time RST: reset</p> <p><b>Output</b></p> <p>Q: Timer output ET: elapsed time</p>

■ Function

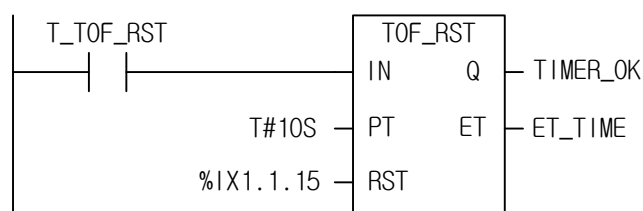
- (1) Q is 1 when IN is 1 and Q is 0 when preset time (PT) elapses after IN became 0.
- (2) Elapsed time is produced at ET after IN is 0.
- (3) Elapsed time is 0 if IN is 1 before ET reaches PT.
- (4) If RST is 1, Q and ET are 0.

■ Time Chart



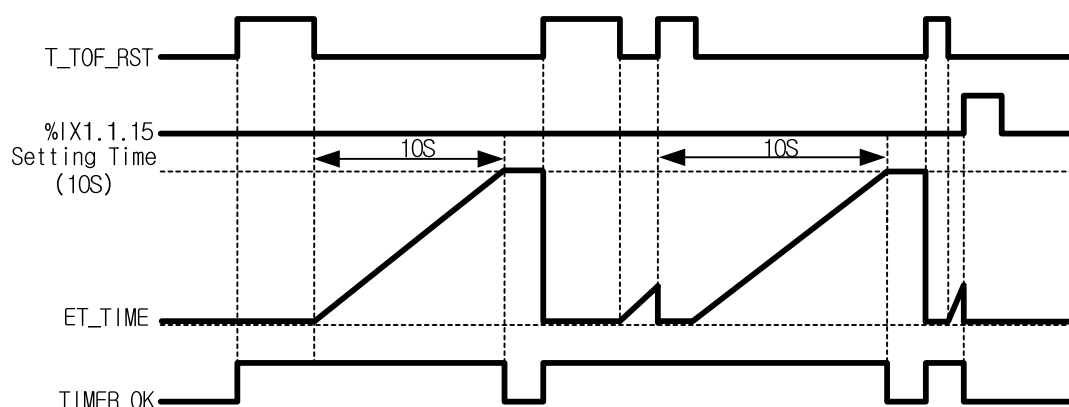
## ■ Program Example

### 1. LD



### 2. ST

```
INST_TOF_RST(IN:=T_TOF_RST, PT:=T#10S, RST:=%IX1.1.15, Q=>TIMER_OK, ET=>ET_TIME);
```

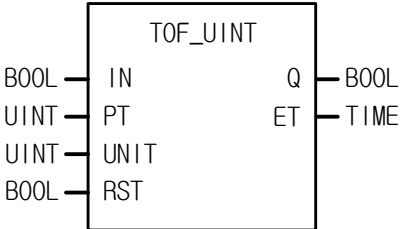


- (1) If input variable T\_TOF\_RST is 1, output variable TIMER\_OK is 1. And TIMER\_OK is 0 when 10 seconds elapse after T\_TOF\_RST became 0.
- (2) If T\_TOF\_RST is 1 within 10 seconds after it turns off, TOF\_RST is initialized.
- (3) Elapsed time is produced at ET\_TIME.
- (4) If input contact %IX1.1.15 is 1, elapsed time ET\_TIME and output contact TIMER\_OK are all cleared.

### ☆ Note

TOF\_RST Function Block keeps operating after the contact is on until its operation is complete. In case of a variable using array index, array index error occurs only when the contact is on. Therefore, TOF\_RST Function Block does not produce any array index error as long as the contact is off ,although function block is operating.

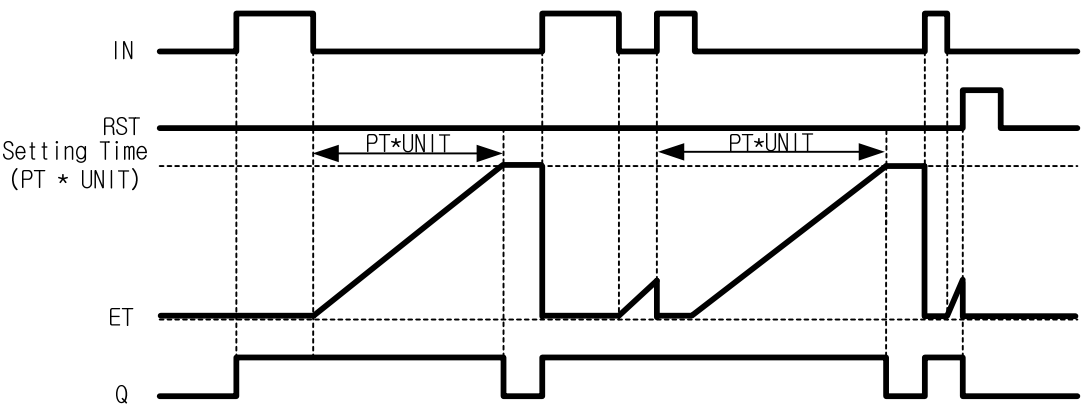
TOF_UINT	Off Timer of Integer setting	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
<div></div>	<p><b>Input</b> IN: operation condition for Timer PT: preset time UNIT: time unit of setting time RST: reset</p> <p><b>Output</b> Q: Timer output ET: elapsed time</p>

■ Function

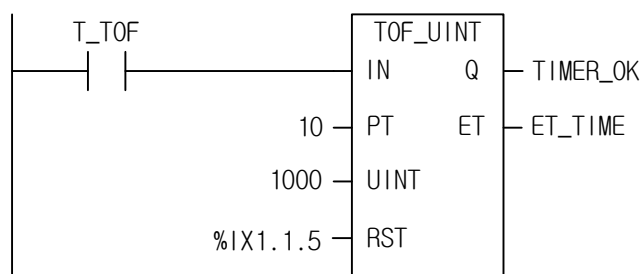
- (1) Q is 1 when IN is 1. And Q is 0, if setting time (PT) passes after IN is 0.
- (2) Elapsed time is produced at ET after IN is 0.
- (3) If IN is 1 before ET reaches PT, ET becomes 0 again.
- (4) If RST is 1, Q and ET are 0.
- (5) Setting time is PT x UNIT (ms).

■ Time Chart



### ■ Program Example

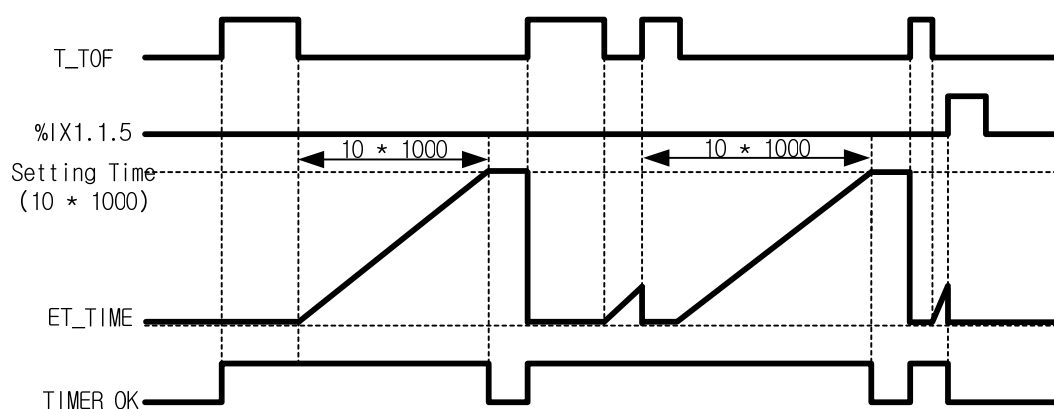
#### 1. LD



#### 2. ST

```
INST_TOF_UINT(IN:=T_TOF, PT:=10, UNIT:=1000, RST:=%IX1.1.5, Q=>TIMER_OK, ET=>ET_TIME);
```

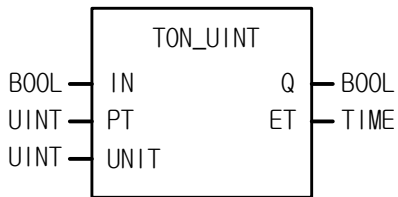
- (1) Preset time  $PT \times UNIT[ms] = 10 \times 1000[ms] = 10[s]$ .
- (2) If input variable T\_TOF is 1, output variable TIMER\_OK is 1. TIMER\_OK is 0, if 10 seconds pass after T\_TOF is 0.
- (3) If T\_TOF becomes 1 again within 10 seconds, TOF\_UINT initializes.
- (4) Elapsed time is produced at ET\_TIME.
- (5) If input contact %IX1.1.5 is 1, TIMER\_OK and ET\_TIME are all cleared



#### ☆ Note

TOF\_UINT Function Block keeps operating after the contact is on until its operation is complete. In case of a variable using array index, array index error occurs only when the contact is on. Therefore, TOF\_UINT Function Block does not produce any array index error as long as the contact is off although function block is operating.

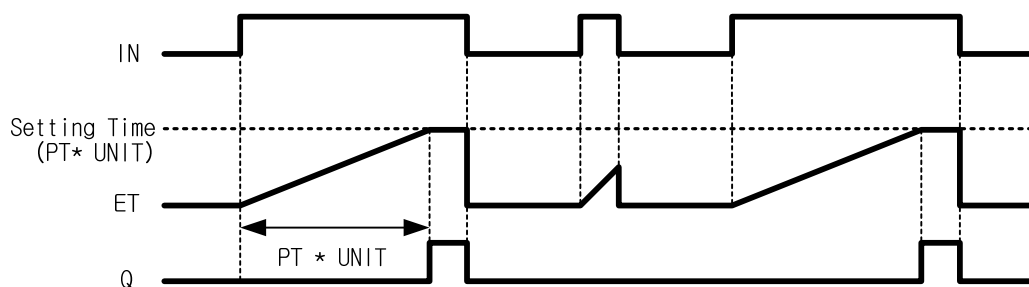
<b>TON_UINT</b>	<b>On Timer of Integer setting</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
 <p>The diagram shows a rectangular block labeled 'TON_UINT'. It has three inputs on the left: 'IN' (labeled 'BOOL'), 'PT' (labeled 'UINT'), and 'UNIT' (labeled 'UINT'). It has two outputs on the right: 'Q' (labeled 'BOOL') and 'ET' (labeled 'TIME').</p>	<p><b>Input</b> IN: operation condition for Timer PT: preset time UNIT: time unit of setting time</p> <p><b>Output</b> Q: timer output ET: elapsed time</p>

### ■ Function

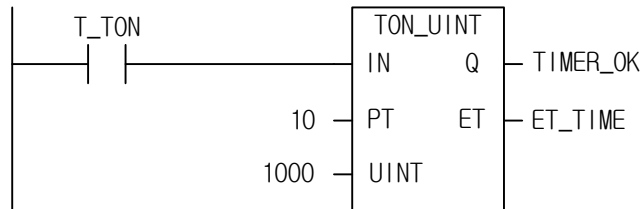
- (1) Elapsed time is produced at ET after IN is 1.
- (2) Elapsed time ET is 0, if IN is 0 before ET reaches PT.
- (3) Q is 0, if IN is 0 after Q is 1.
- (4) Preset time is  $PT \times UNIT[ms]$ .

### ■ Time Chart



## ■ Program Example

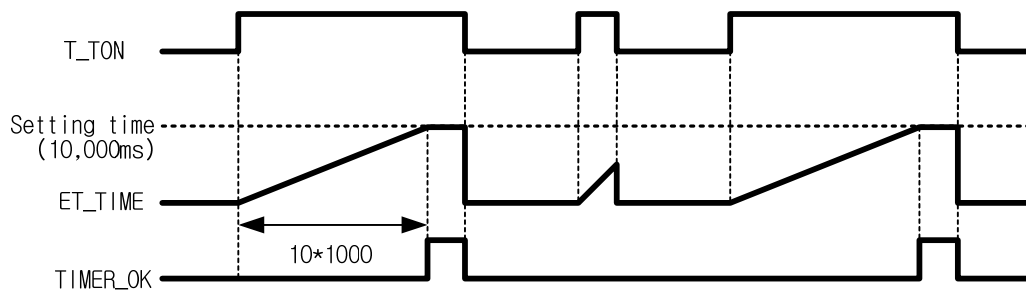
### 1. LD



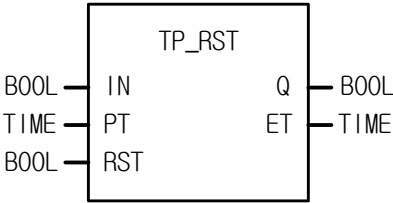
### 2. ST

```
INST_TON_UINT(IN:=T_TON, PT:=10, UNIT:=1000, Q=>TIMER_OK, ET=>ET_TIME);
```

- (1) Preset time is  $PT \times UNIT[ms] = 10 \times 1000[ms] = 10[s]$ .
- (2) If 10 seconds passes after input variable T\_TON is on, output variable TIMER\_OK is 1.
- (3) Elapsed time is produced at ET\_TIME after input variable T\_TON is on.
- (4) If T\_TON is 0 before elapsed time ET\_TIME reaches 10 seconds, ET\_TIME is 0.
- (5) If T\_TON is 0 after TIMER\_OK is 1, TIMER\_OK and ET\_TIME are 0.



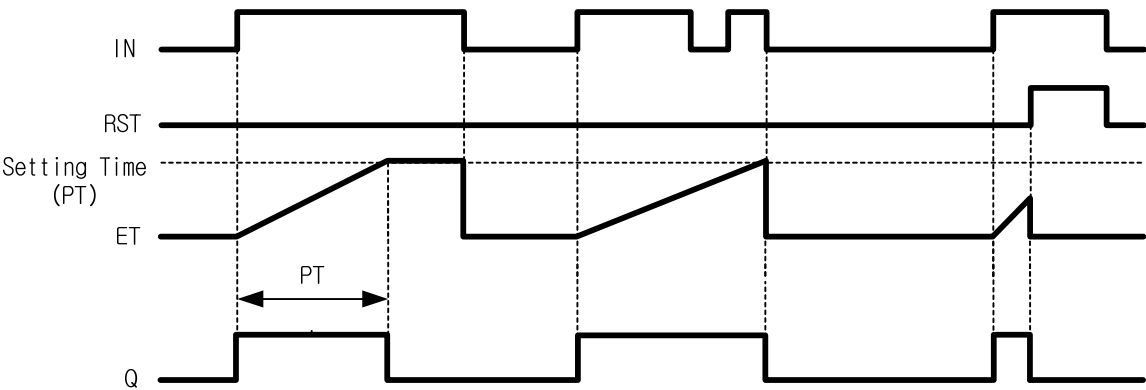
TP_RST	Pulse timer is able to Off output of contact.	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b> IN: operation condition for Timer PT: preset time RST: reset</p> <p><b>Output</b> Q: timer output ET: elapsed time</p>

■ Function

- (1) If IN is 1, Q is 1. And if elapsed time reaches preset time, timer output Q is 0.
- (2) ET increases its value from when IN is 1, keeps its value at PT and is cleared when IN is 0.
- (3) It doesn't matter whether IN changes its state or not while timer output Q is 1 (during a pulse output).
- (4) If RST is 1, output Q and ET are 0.

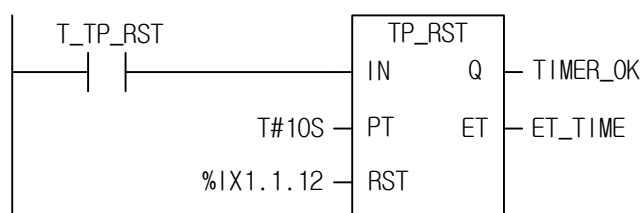
■ Time Chart





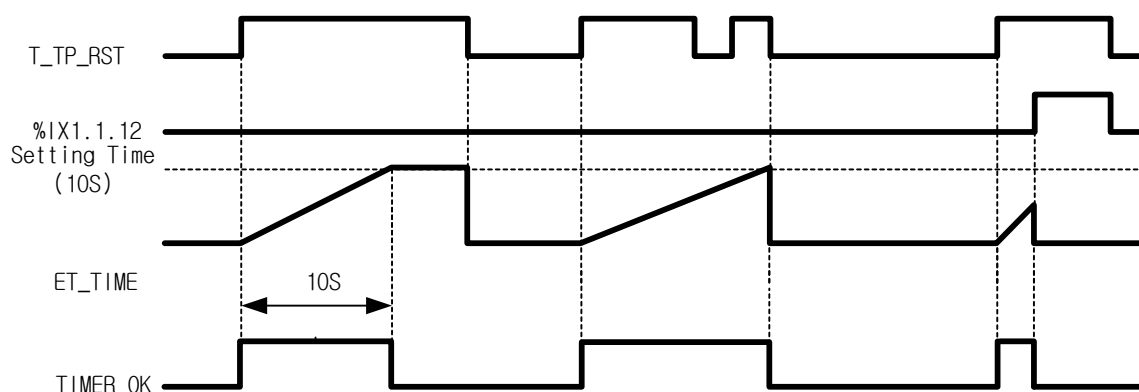
## ■ Program Example

### 1. LD



### 2. ST

```
INST_TP_RST(IN:=T_TP_RST, PT:=T#10S, RST:=%IX1.1.12, Q=>TIMER_OK, ET=>ET_TIME);
```



- (1) If input variable T\_TP\_RST is 1, output variable TIMER\_OK is 1. And 10 seconds later, TIMER\_OK is 0. Once TP\_RST timer executes, input T\_TP\_RST doesn't matter during 10 seconds.
- (2) ET\_TIME value increases and stops at 10S. And if T\_TP\_RST is 0, ET\_TIME becomes 0.
- (3) If input contact %IX1.1.12 is 1, TIMER\_OK and ET\_TIME are all cleared.

### ☆ Note

TP\_RST Function Block keeps operating after the contact is on until its operation is complete. In case of a variable using array index, array index error occurs only when the contact is on. Therefore, TP\_RST Function Block does not produce any array index error as long as the contact is off although function block is operating.

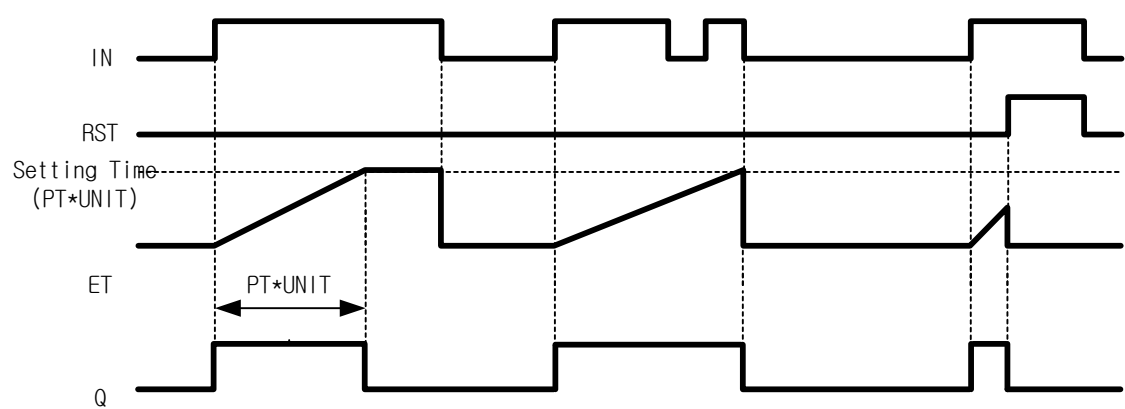
TP_UINT	Pulse Timer with Integer setting	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
<div><div><div>TP_UINT</div><div><div>BOOL</div>IN<div>Q</div><div>BOOL</div></div><div><div>UINT</div>PT<div>ET</div><div>TIME</div></div><div><div>UINT</div>UNIT</div><div><div>BOOL</div>RST</div></div></div>	<div><div><b>Input</b></div><div>IN: operation condition for Timer PT: preset time UNIT: time unit of setting time RST: reset</div></div> <div><div><b>Output</b></div><div>Q: timer output ET: elapsed time</div></div>

■ Function

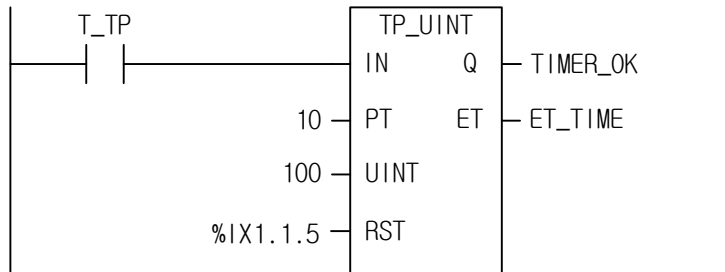
- (1) If IN is 1, Q is 1. And if elapsed time reaches preset time, timer output Q is 0.
- (2) ET increases its value from when IN is 1, keeps its value at PT and is cleared when IN is 0.
- (3) It does not matter whether IN changes its state or not while timer output Q is 1 (during a pulse output).
- (4) If RST is 1, output Q and ET are 0.
- (5) Preset time is PT x UNIT[ms].

■ Time Chart



## ■ Program Example

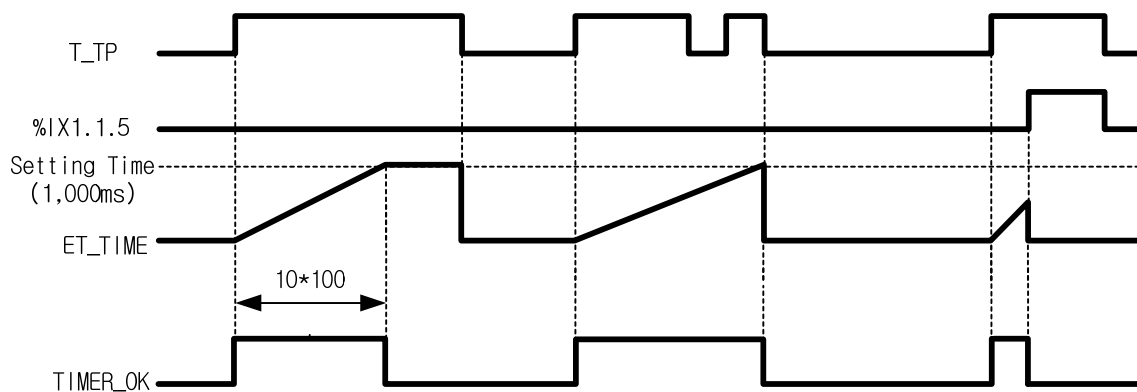
### 1. LD



### 2. ST

```
INST_TP_UINT(IN:=T_TP, PT:=10, UNIT:=100, RST:=%IX1.1.5, Q=>TIMER_OK, ET=>ET_TIME);
```

- (1) Preset time is  $PT \times UNIT[s] = 10 \times 100[ms] = 1[s]$ .
- (2) If input variable T\_TP is 1, output variable TIMER\_OK is 1. And 10 seconds later, TIMER\_OK is 0. Once TP\_UINT timer executes, input T\_TP does not matter.
- (3) ET\_TIME value increases and stops at 1,000. And if T\_TP is 0, it is 0.
- (4) If input contact %IX1.1.5 is 1, TIMER\_OK and ET\_TIME are all cleared.



### ☆ Note

TP\_UINT Function Block keeps operating after the contact is on until its operation is complete. In case of a variable using array index, array index error occurs only when the contact is on. Therefore, TP\_UINT Function Block does not produce any array index error as long as the contact is off although function block is operating.

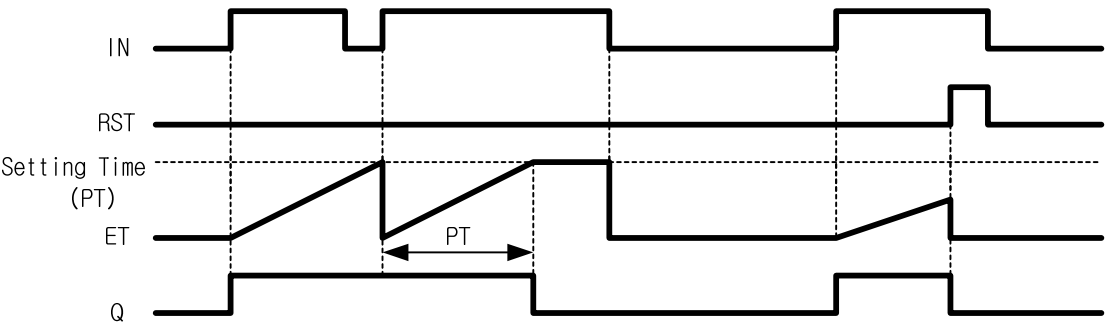
TRTG	Retriggerable Timer	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>IN: operation condition for Timer PT: preset time RST: reset</p> <p><b>Output</b></p> <p>Q: timer output ET: elapsed time</p>

■ Function

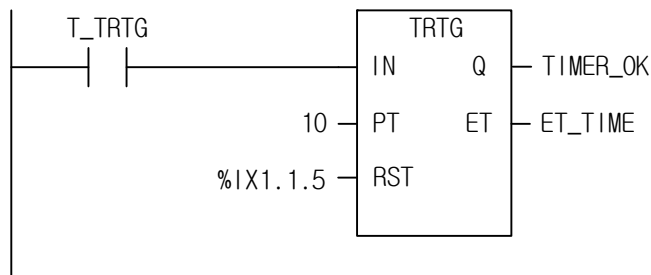
- (1) Q is 1 as soon as IN becomes 1. And if elapsed time reaches preset time, timer output Q is 0.
- (2) If IN turns on again before elapsed time reaches preset time, then elapsed time is set as 0 and increased again. And if it reaches PT, Q is 0.
- (3) If RST is 1, timer output Q and elapsed time ET are 0.

■ Time Chart



### ■ Program Example

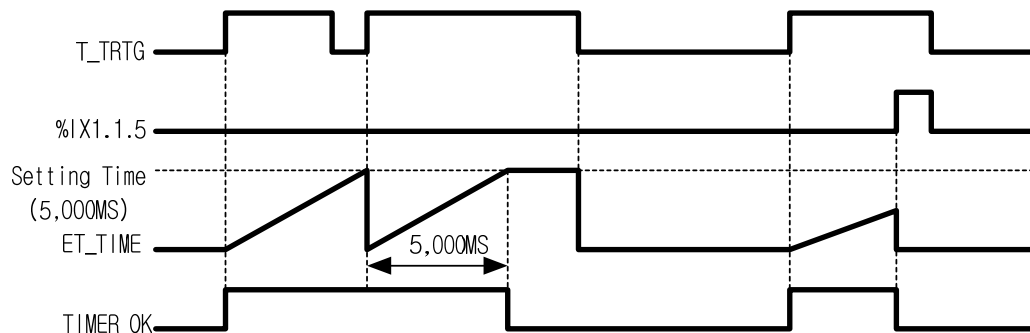
#### 1. LD



#### 2. ST

```
INST_TRTG(IN:=T_TRTG, PT:=10, RST:=%IX1.1.5, Q=>TIMER_OK, ET=>ET_TIME);
```

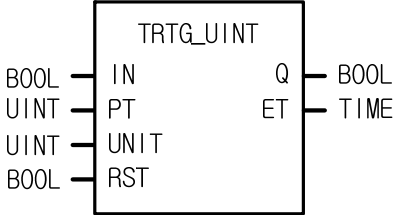
- (1) TIMER\_OK is 1 during 10 seconds after input variable T\_TRTG becomes 1 from 0. If T\_TRTG becomes 1 from 0 after timer executes, ET\_TIME is set as 0 and increased again.
- (2) TIMER\_OK is 1 during 10 seconds even when T\_TRTG becomes 0 from 1.
- (3) ET\_TIME value increases and stops at T#10S. And it is 0 when T\_TRTG is 0.
- (4) If input contact %IX1.1.5 is 1, TIMER\_OK and ET\_TIME are all cleared.



#### ☆ Note

TRTG Function Block keeps operating after the contact is on until its operation is complete. In case of a variable using array index, array index error occurs only when the contact is on. Therefore, TRTG Function Block does not produce any array index error as long as the contact is off although function block is operating.

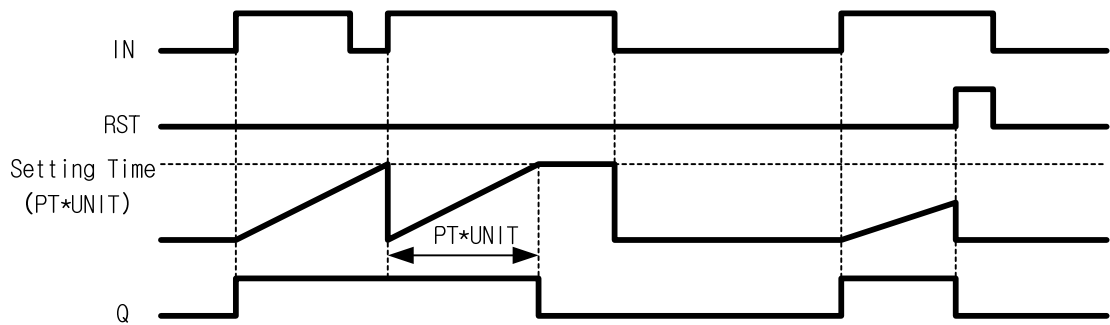
TRTG_UINT	Retriggerable Timer with Integer setting	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
<div></div>	<p><b>Input</b></p> <p>IN: operation condition for Timer PT: preset time UNIT: time unit of setting time RST: reset</p> <p><b>Output</b></p> <p>Q: timer output ET: elapsed time</p>

■ Function

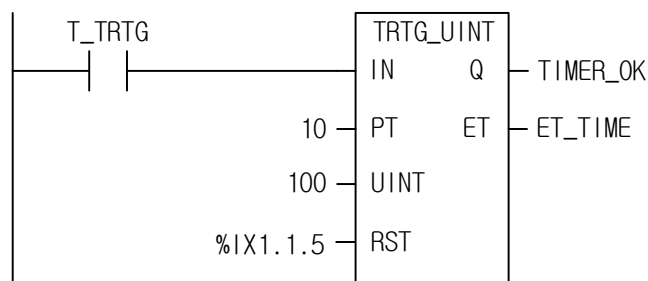
- (1) Q is 1 as soon as IN becomes 1. And if elapsed time reaches preset time, timer output Q is 0.
- (2) If IN turns on again before elapsed time reaches preset time, then elapsed time is set as 0 and increased again. And if it reaches PT, Q is 0.
- (3) If RST is 1, timer output Q and elapsed time ET are 0.
- (4) Preset time is  $PT \times UNIT[ms]$ .

■ Time Chart



## ■ Program Example

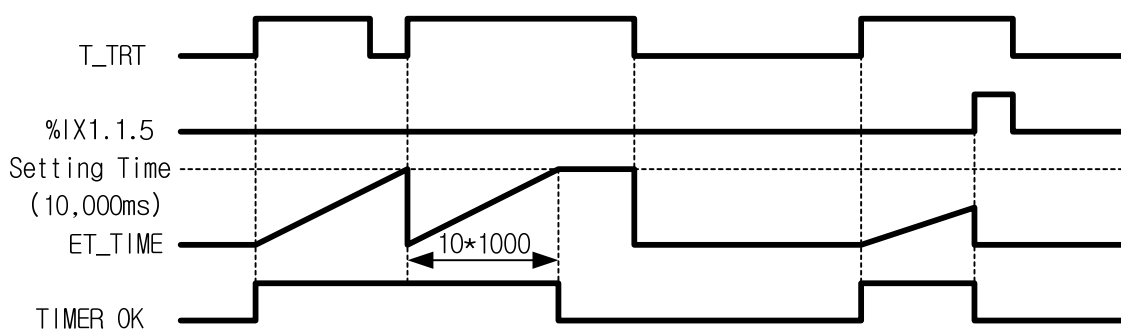
### 1. LD



### 2. ST

```
INST_TRTG_UINT(IN:=T_TRTG, PT:=10, UNIT:=100, RST:=%IX1.1.5, Q=>TIMER_OK, ET=>ET_TIME);
```

- (1) Preset time is  $PT \times UNIT[ms] = 10 \times 1000[ms] = 10[s]$ .
- (2) TIMER\_OK is 1 during 10 seconds after input variable T\_TRTG becomes 1 from 0. If T\_TRTG becomes 1 from 0 after timer executes, ET\_TIME is set as 0 and increased again.
- (3) TIMER\_OK is 1 during 10 seconds even when T\_TRTG becomes 0 from 1.
- (4) ET\_TIME value increases and stops at 10000. And it is 0 when T\_TRTG is 0.
- (5) If input contact %IX1.1.5 is 1, TIMER\_OK and ET\_TIME are all cleared.



### ☆ Note

TRTG\_UINT Function Block keeps operating after the contact is on until its operation is complete. In case of a variable using array index, array index error occurs only when the contact is on. Therefore, TRTG\_UINT Function Block does not produce any array index error as long as the contact is off, although function block is operating.

<b>MST_CHG</b>	Converting master by program	
	Availability	XGR
	Flags	_MASTER_CHG

Function Block	Description
	<p><b>Input</b> REQ : requests converting master by program</p> <p><b>Output</b> DONE : keeps on after conversion STAT : indicates result. 0 means no error.</p>

### ■ Function

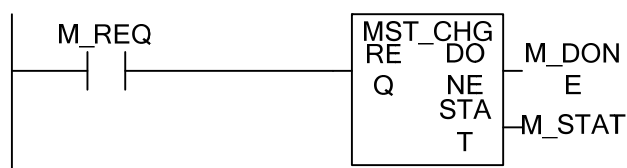
- (1) If REQ (requests converting master by program) becomes 0 → 1, master is converted after finishing currently executed scan.
- (2) DONE keeps on from when master is converted until REQ becomes off.
- (3) STAT yields the following information after finishing execution of FB
  - 0 : normal
  - 1 : stand - by CPU power is off
  - 2 : stand - by CPU power is stop
  - 3 : stand - by CPU power is error
  - 4 : Online Editing status

### ■ Flag

Flag	Description
_MASTER_CHG	Write-able bit flag In case of On, master is converted and flag becomes off.

### ■ Program example

#### 1. LD





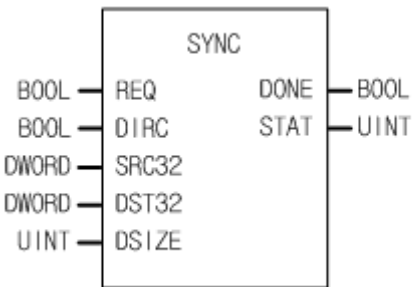
### 2. ST

```
INST_MST_CHG(REQ:=M_REQ, DONE=>M_DONE, STAT=>M_STAT);
```

(1) M\_REQ becomes 0→1, master is converted.

(2) After conversion, M\_DONE becomes on. If error occurs, error code is displayed in M\_STAT.

<b>SYNC</b>	Synchronizing data between master CPU and stand-by CPU	
	Availability	XGR
	Flags	_MASTER_CHG

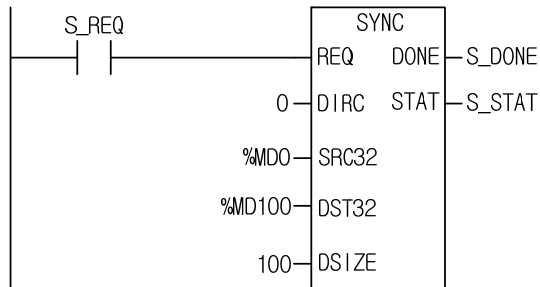
Function Block	Description
	<p><b>Input</b></p> <p>REQ : requests execution of FB</p> <p>DIRC : 0: synchronizes data of master CPU to stand-by CPU 1: synchronizes data of stand-by CPU to master CPU</p> <p>SRC32 : direct variable to send data. DWORD type</p> <p>DST32 : direct variable to receive data. DWORD type</p> <p>DSIZE : number of DWORD data to synchronize</p> <p><b>Output</b></p> <p>DONE : in case of normal execution, on</p> <p>STAT : indicates result of execution. 0 means no error</p>

### ■ Function

- (1) It is used to synchronize device area between master CPU and stand-by CPU.
- (2) If DIRC variable is off, DWORD data as many as number set in DSIZE are moved promptly from master CPU's device set in SRC32 to stand-by CPU's device set in DST32
- (3) If DIRC variable is on, DWORD data as many as number set in DSIZE are moved promptly from stand-by CPU's device set in SRC32 to master CPU's device set in DST32
- (4) Only direct variable can be declared in the location of SRC32 and DST32.
- (5) Synchronization is done tough stand-by CPU is STOP, ERROR status.
- (6) STAT yields the following information after finishing execution of FB
  - 0 : normal
  - 1 : device area of destination is exceeded when moving DWORD data
  - 2 : There is no stand-by CPU or SYNC FB can not be executed.

## ■ Program example

### 1. LD



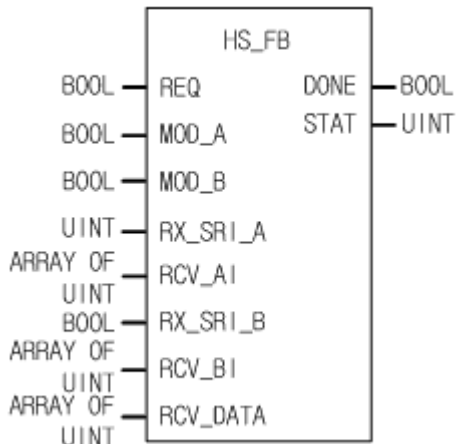
### 2. ST

```

INST_SYNC(REQ:=S_REQ, DIRC:=0, SRC32:=%MD0, DST32:=%MD100, DSIZE:=100, DONE=>S_DONE,
STAT=>S_STAT);
  
```

- (1) If S\_REQ becomes 0→1, data synchronization executes between master CPU and stand-by CPU
- (2) 200 DWORD data is copied from %MD0 of master CPU to %MD100 of stand-by CPU.
- (3) After synchronization, S\_DONE becomes on. If error occurs, error code is displayed in S\_STAT.

<b>HS_FB</b>	Synchronizing data between master CPU and stand-by CPU	
	Availability	XGI, XGR
	Flags	_HSn_STATEm [n:1~12, m:0~127]

Function Block	Description
	<p><b>Input</b></p> <p>REQ : requests execution of FB</p> <p>MOD_A: HS link STATE flag of A side</p> <p>MOD_B: HS link STATE flag of B side</p> <p>RX_SRI_A: SEQ no. of A side</p> <p>RCV_AI: array variable to save A side data</p> <p>RX_SRI_B: B side SEQ no.</p> <p>RCV_BI: array variable to save B side data</p> <p>RCV_DATA: array variable to save input data</p> <p><b>Output</b></p> <p>DONE : in case of normal execution, on</p> <p>STAT : indicates result of execution. 0 means no error</p>

### ■ Function

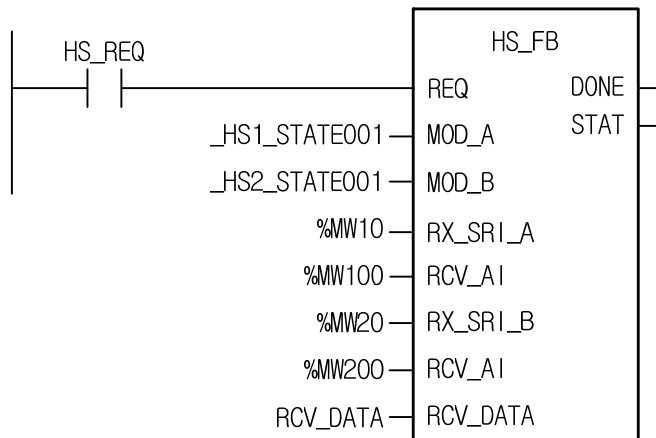
- (1) If REQ of FB for executing redundant HS link service becomes 0 → 1, instruction is executed.
- (2) DONE is kept on until REQ is off.
- (3) Input HS link flag (\_HSn\_STATEm: total status display flag) into MOD\_A, MOD\_B according to block index and parameter no. of HS link set in XG-PD.
- (4) Set SEQ number increased by one every scan at transmission side
- (5) Input SEQ no. storage area set in XG-PD into RX\_SRI\_A, RX\_SRI\_B (SEQ no. uses 1 WORD).
- (6) Input DATA storage area set in XG-PD into RCV\_AI, RCV\_BI.
- (7) Input data storage area according to array type and number set in RCV\_AI, RCV\_BI.
- (8) STAT provides the following information during execution.
  - (1) 0 : Normal
  - (2) 1 : The number of array of input side is different (RCV\_AI, RCV\_BI, RCV\_DATA)
  - (3) 2 : HS links of A/B side are in error

### ■ Related flag

Flag	Description
_HSn_STATEm [n:1~12, m:0~127]	Total status display of HS link Nth Mth block

## ■ Program example

### 1. LD



### 2. ST

```

INST_HS_FB(REQ:=HS_REQ, MOD_A:=_HS1_STATE001, MOD_B:=_HS2_STATE001, RX_SRI_A:=%MW10,
RCV_AI:=%MW100, RX_SRI_B:=%MW20, RCV_AI:=%MW200, RCV_DATA:=RCV_DATA);
  
```

- (1) If HS\_REQ becomes 0→1, HS\_FB executes.
- (2) SEQ no. of A side is received into %MW10 and SEQ no. of B side is received into %MW20. (Set in XG-PD)
- (3) Data of A side is received into %MW100 and data of B side is received into %MW200. (Set in XG-PD)
- (4) In case communication module error of A side occurs, B side data is saved in RCV\_DATA.
- (5) In case communication module error of B side occurs, A side data is saved in RCV\_DATA.

# Ch 11. Communication and Special Function Blocks

This chapter describes communication function blocks, special function blocks, motion control function blocks and positioning function blocks.

For the details of communication function blocks, refer to User's Manual about each communication block. For the directions of special function blocks, motion control function blocks and positioning function blocks, refer to User's Manual of each special module, motion control module and positioning module.

## 11.1 Communication Function Blocks

It describes each communication function block.

<b>P2PSN</b>	<b>Station No. setting</b>	
	Availability	XGI
	Flags	

Function Block	Description
<pre> graph LR     subgraph P2PSN         REQ[REQ]         P_NUM[P_NUM]         BL_NUM[BL_NUM]         NUM[NUM]         DONE[DONE]         STAT[STAT]     end     REQ --- DONE     P_NUM --- STAT     BL_NUM --- STAT     NUM --- STAT         </pre>	<p><b>Input</b></p> <p>REQ: to execute the function block  P_NUM: P2P number  BL_NUM: block number  NUM: station number</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: completion and ERR info</p>

### ■ Function

- (1) You can change the station number of P2P destination while running by using P2PSN instruction.
- (2) Change the block station number of P2P BL\_NUM block of P\_NUM to NUM.  
communication modules: FDEnet, Cnet.

### ■ Error

1. If an error occurs, it displays the error number in STAT.

STAT_NUM	Message	Description
1	P2P no. setting	If a value except P_NUM(1~8) is set
2	Block No. setting	If a value except BL_NUM(0~63) is set < In case of Cnet, 0~31 >
4	No slot	-
5	Module inconsistency	Not a communication module
6	Module inconsistency	communication module not available in the instruction
7	Error of station No. setting	It is occurred, when it is set out of value NUM(0~63) < In case of Cnet, 0~31 >

### ■ Program example

#### 1. ST

```

INST_P2PSN(REQ:=REQ_BOOL, P_NUM:=P_NUM_USINT, BL_NUM:=BL_NUM_USINT, NUM:=NUM_USINT,
DONE=>DONE_BOOL, STAT=>STAT_USINT);
        
```

<b>P2PRD</b>	<b>Read area setting</b>	
	Availability	XGI
	Flags	

Function Block	Description
<pre> graph LR     REQ[REQ] --&gt; P2PRD[P2PRD]     P_NUM[P_NUM] --&gt; P2PRD     BL_NUM[BL_NUM] --&gt; P2PRD     VAL_NUM[VAL_NUM] --&gt; P2PRD     VAL_SIZE[VAL_SIZE] --&gt; P2PRD     DEV[DEV] --&gt; P2PRD     P2PRD --&gt; DONE[DONE]     P2PRD --&gt; STAT[STAT]         </pre>	<p><b>Input</b> REQ: requires to execute the function block  P_NUM: P2P number  BL_NUM: block number  VAL_NUM: variable number  VAL_SIZE: variable size  DEV: device(input only for a direct variable)</p> <p><b>Output</b> DONE: maintains 1 after the first operation  STAT: completion and ERR info</p>

ANY Type Variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	DEV	○	○	○	○	○															

## ■ Function

(1) P2PRD instruction changes the variable size and READ device area of P2P parameter block.

(both individual/continuous reads are changeable)

(2) After designating P2P parameter, block and variable by using P\_NUM, BL\_NUM, VAL\_NUM, it changes the variable size and device to VAL\_SIZE(if continuous, VAL\_SIZE means variable size and if individual, it means the size of variable type), where DEV can be input only for a direct variable(ex, %MW100).

Communication modules: FEnet, FDEnet, Cnet.

## ■ Error

If it is out of the allowable scope of P2P parameter set in PD, the error number occurs as follows.

STAT	Message	Description
1	P2P number setting error	If a value except P_NUM(1~8) is set
2	Block number setting error	If a value except BL_NUM(0~63) is set < In case of Cnet, 0~31 >
3	Variable number setting error	If a variable number not allowed in P2P parameter set in PD is input
4	No slot	-
5	Module inconsistency	No communication module



## Ch 11. Communication and Special Function Blocks

STAT	Message	Description
6	Module inconsistency	Communication module not available in the instruction
10	MODBUS setting error	MODBUS offset can not be input(ex, h10000). Because DEV can be input only for a direct variable
11	Variable size setting error	If a variable size not allowed in P2P parameter set in PD is input
12	Data type setting error	If a variable type not allowed in P2P parameter set in PD is input

### ■ Program example

ST

```
INST_P2PRD_BOOL(REQ:=REQ_BOOL, P_NUM:=P_USINT, BL_NUM:=BL_USINT, VAL:=VAL_USINT,  
VAL_SIZE:=SIZE_UINT, DEV_NUM:=DEV_BOOL, DONE=>DONE_BOOL, STAT=>STAT_USINT);
```

<b>P2PWR</b>	<b>Write area setting</b>	
	Availability	XGI
	Flags	

Function Block	Description
	<p><b>Input</b> REQ: requires to execute the function block  P_NUM: P2P number  BL_NUM: block number  VAL_NUM: variable number  VAL_SIZE: variable size  DEV: device(input only for a direct variable)</p> <p><b>Output</b> DONE: maintains 1 after the first operation  STAT: completion and ERR info</p>

ANY Type Variable	Variable	BOOL	BYTE	WORD	DWORD	LWORD	SINT	INT	DINT	LINT	USINT	UINT	UDINT	ULINT	REAL	LREAL	TIME	DATE	TOD	DT	STRING
	DEV	○	○	○	○	○															

## ■ Function

(1) P2PRD instruction changes the variable size and WRITE device area of P2P parameter block.

(both individual/continuous reads are changeable)

(2) After designating P2P parameter, block and variable by using P\_NUM, BL\_NUM, VAL\_NUM, it changes the variable size and device to VAL\_SIZE(if continuous, VAL\_SIZE means variable size and if individual, it means the size of variable type), where DEV can be input only for a direct variable(ex, %MW100).

Communication modules: FEnet, FDEnet, Cnet.

## ■ Error

If it is out of the allowable scope of P2P parameter set in PD, the error number occurs as follows.

STAT	Message	Description
1	P2P number setting error	If a value except P_NUM(1~8) is set
2	Block number setting error	If a value except BL_NUM(0~63) is set <In case of Cnet, 0~31>
3	Variable number setting error	If a variable number not allowed in P2P parameter set in PD is input
4	No slot	-

## Ch 11. Communication and Special Function Blocks

STAT	Message	Description
5	Module inconsistency	No communication module
6	Module inconsistency	Communication module not available in the instruction
10	MODBUS setting error	MODBUS offset can not be input(ex, h10000). Because DEV can be input only for a direct variable
11	Variable size setting error	If a variable size not allowed in P2P parameter set in PD is input
12	Data type setting error	If a variable type not allowed in P2P parameter set in PD is input

### ■ Program example

**ST**

```
INST_P2PWR_BOOL(REQ:=REQ_BOOL, P_NUM:=P_USINT, BL_NUM:=BL_USINT, VAL:=VAL_USINT,  
VAL_SIZE:=SIZE_UINT, DEV_NUM:=DEV_BOOL, DONE=>DONE_BOOL, STAT=>STAT_USINT);
```

<b>SEND_UDATA</b>	<b>User defined data send</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     subgraph SEND_UDATA         REQ[REQ] --&gt; DONE[DONE]         BASE[BASE] --&gt; STAT[STAT]         SLOT[SLOT]         CH[CH]         DATA[DATA]         SIZE[SIZE]     end     </pre>	<p><b>Input</b></p> <p>REQ: requires to execute the function block          BASE : base number          SLOT: slot number          CH: channel(1 or 2)          DATA: data area to send          SIZE: data size to send</p> <p><b>Output</b></p> <p>DONE: maintains 1 after operation          STAT: completion and ERR info</p>

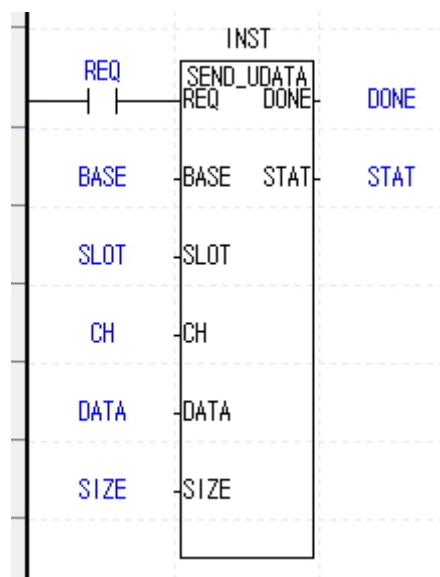
## ■ Function

- (1) SEND\_UDATA instruction sends user defined data(UDATA).
- (2) DATA must be declared only ARRAY OF BYTE type.
- (3) Array size is 1 ~ 1024 byte.
- (4) Save to transmit buffer as number as SIZE from DATA[0]. (Limit of data size is 1024 at once)

## ■ Error

STAT	Message	Description
0	Initial state	Initial state before instruction operation
1	No error	normal operation
2	Module setting error	Module is not installed or CNET module trouble
3	Channel setting error	Input range(1, 2) is exceeded
4	Array size error	Transmit data size exceed 1024
5	Parameter setting error	CNET module's parameter is not set as User defined or link enable is not set
6	Instruction timeout error	No response from module or maximum scan time is exceeded(10 scan)
7	Version mismatch error	XGI CPU version is under V3.9, XGR CPU version is under V2.6 or CNET module version is under V3.2

### ■ Program example



<b>RCV_UDATA</b>	<b>User defined data receive</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     subgraph RCV_UDATA         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         CH[CH]         DATA[DATA]         DONE[DONE]         STAT[STAT]         SIZE[SIZE]     end     REQ --- DONE     BASE --- STAT     SLOT --- SIZE     CH --- CH     DATA --- DATA         </pre>	<p><b>Input</b></p> <p>REQ: requires to execute the function block          BASE : base number          SLOT: slot number          CH: channel(1 or 2)          DATA: data area to save</p> <p><b>Output</b></p> <p>DONE: maintains 1 after operation          STAT: completion and ERR info          SIZE: received data size</p>

## ■ Function

- (1) RCV\_UDATA instruction saves received user defined data(UDATA) from CNET module.
- (2) DATA must be declared only ARRAY OF BYTE type.
- (3) Array size is 1 ~ 1024 byte.

## ■ Error

STAT	Message	Description
0	Initial state	Initial state before instruction operation
1	No error	normal operation
2	Module setting error	Module is not installed or CNET module trouble
3	Channel setting error	Input range(1, 2) is exceeded
4	Array size error	Transmit data size exceed 1024
5	Parameter setting error	CNET module's parameter is not set as User defined or link enable is not set
6	Instruction timeout error	No response from module or maximum scan time is exceeded(10 scan)
7	Version mismatch error	XGI CPU version is under V3.9, XGR CPU version is under V2.6 or CNET module version is under V3.2

<b>SEND_DTR</b>	<b>User defined data send</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     subgraph SEND_DTR         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         CH[CH]         DTR[DTR]         DONE[DONE]         STAT[STAT]     end     REQ_IN[REQ] --&gt; REQ     BASE_IN[BASE] --&gt; BASE     SLOT_IN[SLOT] --&gt; SLOT     CH_IN[CH] --&gt; CH     DTR_IN[DTR] --&gt; DTR     DONE --&gt; DONE_OUT[DONE]     STAT --&gt; STAT_OUT[STAT]         </pre> <p>Diagram of the SEND_DTR function block. It has five input ports on the left: REQ (BOOL), BASE (USINT), SLOT (USINT), CH (USINT), and DTR (USINT). It has two output ports on the right: DONE (BOOL) and STAT (UINT).</p>	<p><b>Input</b></p> <p>REQ: requires to execute the function block          BASE : base number          SLOT: slot number          CH: channel(1 or 2)          DTR: 0 or 1</p> <p><b>Output</b></p> <p>DONE: maintains 1 after operation          STAT: completion and ERR info</p>

### ■ Function

(1)SEND\_DTR instruction send DTR(Data Terminal Ready) signal that means communication ready complete.

### ■ Error

STAT	Message	Description
0	Initial state	Initial state before instruction operation
1	No error	normal operation
2	Module setting error	Module is not installed or CNET module trouble
3	Channel setting error	Input range(1, 2) is exceeded
4	DTR setting error	Input range(0, 1) is exceeded
5	Parameter setting error	CNET module's parameter is not set as User defined or link enable is not set
6	Instruction timeout error	No response from module or maximum scan time is exceeded(10 scan)
7	Version mismatch error	XGI CPU version is under V3.9, XGR CPU version is under V2.6 or CNET module version is under V3.2

SEND_RTS	User defined data send	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE : base number  SLOT: slot number  CH: channel(1 or 2)  RTS: 0 or 1</p> <p><b>Output</b></p> <p>DONE: maintains 1 after operation  STAT: completion and ERR info</p>

## ■ Function

(1)SEND\_RTS instruction send RTS(Request To Send) signal that means state of receive buffer.

## ■ Error

STAT	Message	Description
0	Initial state	Initial state before instruction operation
1	No error	normal operation
2	Module setting error	Module is not installed or CNET module trouble
3	Channel setting error	Input range(1, 2) is exceeded
4	RTS setting error	Input range(0, 1) is exceeded
5	Parameter setting error	CNET module's parameter is not set as User defined or link enable is not set
6	Instruction timeout error	No response from module or maximum scan time is exceeded(10 scan)
7	Version mismatch error	XGI CPU version is under V3.9, XGR CPU version is under V2.6 or CNET module version is under V3.2



### 11.2 Special Function Block

<b>GET</b>	<b>Read special module data</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: executes the function in case of 1</p> <p>BASE: Base position setting</p> <p>SLOT: Slot position setting</p> <p>MADDR: Module address 512(h200) ~ 1023(h3FF)</p> <p><b>Output</b></p> <p>DONE: 1 output in case of normal execution</p> <p>STAT: Error information</p> <p>DATA: Data read from a module</p>

\*ANY: Among ANY types, WORD, DWORD, INT, UINT, DINT and UDINT types are available

#### ■ Function

Read data from a configured special module.

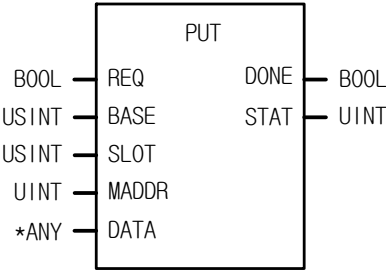
Function Block	Output(ANY) type	Description
<b>GET_WORD</b>	WORD	Read data as much as WORD from the configured module address (MADDR).
<b>GET_DWORD</b>	DWORD	Read data as much as DWORD from the configured module address (MADDR).
<b>GET_INT</b>	INT	Read data as much as INT from the configured Module address (MADDR).
<b>GET_UINT</b>	UINT	Read data as much as UNIT from the configured module address (MADDR).
<b>GET_DINT</b>	DINT	Read data as much as DINT from the configured module address (MADDR).
<b>GET_UDINT</b>	UDINT	Read data as much as UDINT from the configured module address (MADDR).

#### ■ Program example

ST

```
INST_GET_WORD(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, MADDR:=MADDR_UINT,
DONE=>DONE_BOOL, STAT=>STAT_UINT, DATA=>DATA_WORD);
```

<b>PUT</b>	<b>Write data to a special module</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: execute the function in case of 1</p> <p>BASE: Base position setting</p> <p>SLOT: Slot position setting</p> <p>MADDR: Module address</p> <p>DATA: data to save into a module</p> <p><b>Output</b></p> <p>DONE: 1 output in case of normal execution</p> <p>STAT: Error information</p>

\*ANY: Among ANY types, WORD, DWORD, INT, USINT, DINT and UDINT types are available

## ■ Function

Read data from the designated special module.

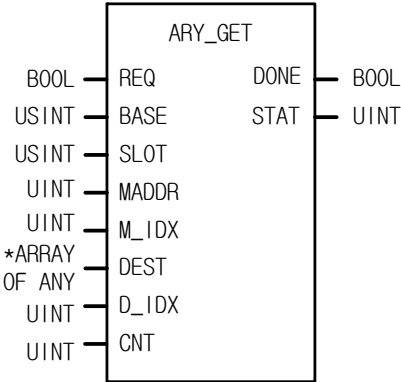
Function Block	Input(ANY) type	Description
PUT_WORD	WORD	Save WORD data into the configured module address (MADDR).
PUT_DWORD	DWORD	Save DWORD data into the configured module address (MADDR).
PUT_INT	INT	Save INT data into the configured module address (MADDR).
PUT_UINT	UINT	Save UNIT data into the configured module address (MADDR).
PUT_DINT	DINT	Save DINT data into the configured module address (MADDR).
PUT_UDINT	UDINT	Save UDINT data into the configured module address (MADDR).

## ■ Program example

ST

```
INST_PUT_WORD(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, MADDR:=MADDR_UINT,
DATA:=DATA_WORD, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>ARY_GET</b>	<b>Read special module data(Array)</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: execute the function in case of 1</p> <p>BASE: Base position setting</p> <p>SLOT: Slot position setting</p> <p>MADDR: Module address</p> <p>M_IDX: distance away from MADDR</p> <p>DEST: array variable to save read data</p> <p>D_IDX: Start index of DEST variable</p> <p>CNT: Number of data to read</p> <p><b>Output</b></p> <p>DONE: 1 output in case of normal execution</p> <p>STAT: Error information</p>

\*ARRAY OF ANY: among ANY types, WORD, DWORD, INT, UINT, DINT and UDINT types are available

### ■ Function

Read data from the designated special module.

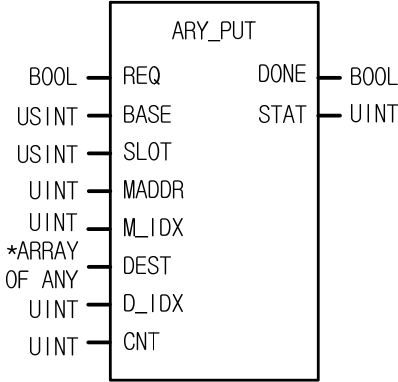
Function Block	Output(DEST) Type	Description
ARY_GET_WORD	WORD	Read data as much as CNT in WORD from the configured module address (MADDR)
ARY_GET_DWORD	DWORD	Read data as much as CNT in DWORD from the configured module address (MADDR)
ARY_GET_INT	INT	Read data as much as CNT in INT from the configured module address (MADDR).
ARY_GET_UINT	UINT	Read data as much as CNT in UINT from the configured module address (MADDR).
ARY_GET_DINT	DINT	Read data as much as CNT in DINT from the configured module address (MADDR).
ARY_GET_UDINT	UDINT	Read data as much as CNT in UDINT from the configured module address (MADDR).

### ■ Program example

ST

```
INST_ARY_GET_WORD (REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT,
MADDR:=MADDR_UINT, M_IDX:=M_UINT, DEST:=ARY_DEST, D_IDX:=D_UINT, CNT:=CNT_UINT,
DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>ARY_PUT</b>	<b>Write special module data(Array)</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
 <pre> graph LR     subgraph ARY_PUT         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         MADDR[MADDR]         M_IDX[M_IDX]         DEST[DEST]         D_IDX[D_IDX]         CNT[CNT]     end     REQ --&gt; ARY_PUT     BASE --&gt; ARY_PUT     SLOT --&gt; ARY_PUT     MADDR --&gt; ARY_PUT     M_IDX --&gt; ARY_PUT     DEST --&gt; ARY_PUT     D_IDX --&gt; ARY_PUT     CNT --&gt; ARY_PUT     ARY_PUT --&gt; DONE     ARY_PUT --&gt; STAT         </pre>	<p><b>Input</b></p> <p>REQ: execute the function in case of 1</p> <p>BASE: Base position setting</p> <p>SLOT: Slot position setting</p> <p>MADDR: Module address</p> <p>M_IDX: distance away from MADDR</p> <p>DEST: Data array variable to save</p> <p>D_IDX: Start index of DEST variable</p> <p>CNT: Number of data to read</p> <p><b>Output</b></p> <p>DONE: 1 output in case of normal execution</p> <p>STAT: Error information</p>

\*ARRAY OF ANY: among ANY types, WORD, DWORD, INT, UINT, DINT and UDINT types are available

## ■ Function

Read data from the designated special module.

Function Block	Input(DEST) type	Description
ARY_PUT_WORD	WORD	Save data as much as CNT in WORD into the configured module address (MADDR)
ARY_PUT_DWORD	DWORD	Save data as much as CNT in DWORD into the configured module address (MADDR)
ARY_PUT_INT	INT	Save data as much as CNT in INT into the configured module address (MADDR).
ARY_PUT_UINT	UINT	Save data as much as CNT in UINT into the configured module address (MADDR)
ARY_PUT_DINT	DINT	Save data as much as CNT in DINT into the configured module address (MADDR)
ARY_PUT_UDINT	UDINT	Save data as much as CNT in LDINT into the configured module address (MADDR)

## ■ Program example

ST

```

INST_ARY_PUT_WORD(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, MADDR:=MADDR_UINT,
M_IDX:=M_UINT, DEST:=ARY_DEST, D_IDX:=D_UINT, CNT:=CNT_UINT, DONE=>DONE_BOOL,
STAT=>STAT_UINT);
        
```

<b>GETE</b>	<b>Read special module data(Access upper word)</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: executes the function in case of 1</p> <p>BASE: Base position setting</p> <p>SLOT: Slot position setting</p> <p>MADDR: Module address 0~1023</p> <p>MASK: Word position setting 0(Lower word), 1(Upper word)</p> <p><b>Output</b></p> <p>DONE: 1 output in case of normal execution</p> <p>STAT: Error information</p> <p>DATA: Data read from a module(WORD/DWORD)</p>

### ■ Function

- 1) Read data from a configured special module.
- 2) Select WORD / DWORD type according to data type.
- 3) Position of data selected according to MASK setting.  
0 -> Lower word of module address at MADDR  
1 -> Upper word of module address at MADDR

Function Block	Output type	Description
GETE_WORD	WORD	Read WORD data from the configured module address (MADDR).
GETE_DWORD	DWORD	Read DWORD data from the configured module address (MADDR).

### ■ Program example

#### ST

```
INST_GETE_WORD(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, MADDR:=MADDR_UINT,
MASK:=MASK_UINT, DONE=>DONE_BOOL, STAT=>STAT_UINT, DATA=>DATA_WORD);
```

<b>PUTE</b>	<b>Write data to a special module(Access upper word)</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     subgraph PUTE         REQ[REQ] --&gt; PUTE         BASE[BASE] --&gt; PUTE         SLOT[SLOT] --&gt; PUTE         MADDR[MADDR] --&gt; PUTE         MASK[MASK] --&gt; PUTE         DATA[DATA] --&gt; PUTE         PUTE --&gt; DONE[DONE]         PUTE --&gt; STAT[STAT]     end         </pre>	<p><b>Input</b></p> <p>REQ: execute the function in case of 1</p> <p>BASE: Base position setting</p> <p>SLOT: Slot position setting</p> <p>MADDR: Module address</p> <p>MASK: Word position setting</p> <p>0(Lower word), 1(Upper word)</p> <p>DATA: data to save into a module(WORD/DWORD)</p> <p><b>Output</b></p> <p>DONE: 1 output in case of normal execution</p> <p>STAT: Error information</p>

## ■ Function

- 1) Write data to the designated special module.
- 2) Select WORD or DWORD type according to data type.
- 3) Position of data selected according to MASK setting.
  - 0 -> Lower word of module address at MADDR
  - 1 -> Upper word of module address at MADDR

Function Block	Input type	Operation description
PUTE_WORD	WORD	Write WORD data at the designated module address (MADDR)
PUTE_DWORD	DWORD	Write DWORD data at the designated module address (MADDR)

## ■ Program example

### ST

```

INST_PUTE_WORD(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, MADDR:=MADDR_UINT,
MASK:=MASK_UINT, DATA:=DATA_WORD, DONE=>DONE_BOOL, STAT=>STAT_UINT);
    
```

<b>ARY_GETE</b>	<b>Read special module data(Array, Access upper word)</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     subgraph ARY_GETE [ARY_GETE]         REQ[REQ] --&gt; ARY_GETE         BASE[BASE] --&gt; ARY_GETE         SLOT[SLOT] --&gt; ARY_GETE         MADDR[MADDR] --&gt; ARY_GETE         MASK[MASK] --&gt; ARY_GETE         SIZE[SIZE] --&gt; ARY_GETE         ARY_GETE --&gt; DONE[DONE]         ARY_GETE --&gt; STAT[STAT]         ARY_GETE --&gt; DATA[DATA]     end         </pre>	<p><b>Input</b></p> <p>REQ: executes the function in case of 1</p> <p>BASE: Base position setting</p> <p>SLOT: Slot position setting</p> <p>MADDR: Module address</p> <p>0~1023</p> <p>MASK: Word position setting</p> <p>0(Lower word), 1(Upper word)</p> <p>SIZE: Quantity of data</p> <p>( 1~64[WORD], 1~32[DWORD] )</p> <p><b>Output</b></p> <p>DONE: 1 output in case of normal execution</p> <p>STAT: Error information</p> <p>DATA: Data(Array) read from a module</p> <p>(WORD/DWORD)</p>

### ■ Function

- 1) Read data as quantity user set from a configured special module.
- 2) Select WORD / DWORD type according to data type(Array).
- 3) Position of data selected according to MASK setting.
  - 0 -> Lower word of module address at MADDR
  - 1 -> Upper word of module address at MADDR

Function Block	Output Type	Description
ARY_GETE_WORD	WORD	Read data as much as SIZE in WORD from the configured module address (MADDR)
ARY_GETE_DWORD	DWORD	Read data as much as SIZE in DWORD from the configured module address (MADDR)

### ■ Program example

ST

```

INST_ARY_GETE_WORD (REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, MADDR:=MADDR_UINT,
MASK:=MASK_UINT, SIZE:=SIZE_UINT, DONE=>DONE_BOOL, STAT=>STAT_UINT, DATA:=ARY_DATA);
        
```

<b>ARY_PUTE</b>	<b>Write special module data(Array, Access upper word)</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     subgraph ARY_PUTE         REQ[REQ] --&gt; FB[ARY_PUTE]         BASE[BASE] --&gt; FB         SLOT[SLOT] --&gt; FB         MADDR[MADDR] --&gt; FB         MASK[MASK] --&gt; FB         DATA[DATA] --&gt; FB         SIZE[SIZE] --&gt; FB         FB --&gt; DONE[DONE]         FB --&gt; STAT[STAT]     end         </pre>	<p><b>Input</b></p> <p>REQ: execute the function in case of 1</p> <p>BASE: Base position setting</p> <p>SLOT: Slot position setting</p> <p>MADDR: Module address 0~1023</p> <p>MASK: Word position setting 0(Lower word), 1(Upper word)</p> <p>DATA: Data(Array) to save into a module (WORD/DWORD)</p> <p>SIZE: Quantity of data ( 1~64[WORD], 1~32[DWORD] )</p> <p><b>Output</b></p> <p>DONE: 1 output in case of normal execution</p> <p>STAT: Error information</p>

## ■ Function

- 1) Write data as quantity user set to the designated special module.
- 2) Select WORD / DWORD type according to data type(Array).
- 3) Position of data selected according to MASK setting.  
0 -> Lower word of module address at MADDR  
1 -> Upper word of module address at MADDR

Function Block	Input type	Description
ARY_PUTE_WORD	WORD	Save data as much as SIZE in WORD into the configured module address (MADDR)
ARY_PUTE_DWORD	DWORD	Save data as much as SIZE in DWORD into the configured module address (MADDR)

## ■ Program example

ST

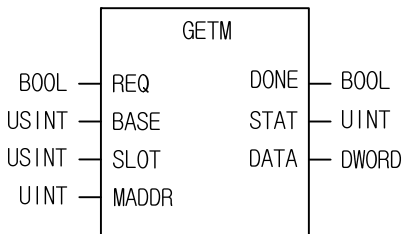
```

INST_ARY_PUTE_WORD(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, MADDR:=MADDR_UINT,
MASK:=MASK_UINT, DATA:=ARY_DATA, DONE=>DONE_BOOL, STAT=>STAT_UINT);
        
```



### 11.3 Motion Control Function Block

<b>GETM</b>	<b>Read motion control module data</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
 <pre> graph LR     subgraph GETM         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         MADDR[MADDR]         DONE[DONE]         STAT[STAT]         DATA[DATA]     end     REQ_BOOL[BOOL] --- REQ     BASE_USINT[USINT] --- BASE     SLOT_USINT[USINT] --- SLOT     MADDR_UINT[UINT] --- MADDR     DONE_BOOL[BOOL] --- DONE     STAT_UINT[UINT] --- STAT     DATA_DWORD[DWORD] --- DATA           </pre>	<p><b>Input</b></p> <p>REQ: execute the function in case of 1</p> <p>BASE: Base position setting</p> <p>SLOT: Slot position setting</p> <p>MADDR: Module address 512(0x200) ~ 1023(0x3FF)</p> <p><b>Output</b></p> <p>DONE: 1 output in case of normal execution</p> <p>STAT: Error information</p> <p>DATA: Data read from a module</p>

#### ■ Function

Read data from the shared read memory address MADDR of the configured motion control module.

Function Block	Output(DATA) type	Description
GETM	DWORD	Read data as much as DWORD from the configured module address (MADDR).

#### ■ Program example

ST

```

INST_GETM(REQ:=REQ_BOOL,  BASE:=BASE_USINT,  SLOT:=SLOT_USINT,  MADDR:=MADDR_UINT,
DONE=>DONE_BOOL, STAT=>STAT_UINT, DATA=>DATA_DWORD);

```

<b>PUTM</b>	<b>Write data into a special module(motion module)</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     subgraph PUTM         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         MADDR[MADDR]         DATA[DATA]         DONE[DONE]         STAT[STAT]     end     REQ --- PUTM     BASE --- PUTM     SLOT --- PUTM     MADDR --- PUTM     DATA --- PUTM     PUTM --- DONE     PUTM --- STAT         </pre>	<p><b>Input</b></p> <p>REQ: execute the function in case of 1</p> <p>BASE: Base position setting</p> <p>SLOT: Slot position setting</p> <p>MADDR: Module address 0(0x00) ~ 511(0x1FF)</p> <p>DATA: data to save into a module</p> <p><b>Output</b></p> <p>DONE: 1 output in case of normal execution</p> <p>STAT: Error information</p>

## ■ Function

Save data into the shared write memory MADDR of the configured motion control module.

Function Block	DATA type	Description
PUTM	DWORD	Save DWORD data into the configured module address (MADDR).

## ■ Program example

ST

```

INST_PUTM(REQ:=REQ_BOOL,  BASE:=BASE_USINT,  SLOT:=SLOT_USINT,  MADDR:=MADDR_UINT,
DATA:=DATA_DWORD, DONE=>DONE_BOOL, STAT=>STAT_UINT);
        
```

ARY_GETM	Read motion control module data (Array)	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<div><div>ARY_GETM</div><div><div>BOOL — REQ</div><div>USINT — BASE</div><div>USINT — SLOT</div><div>UINT — MADDR</div><div>UINT — SIZE</div><div>DONE — BOOL</div><div>STAT — UINT</div><div>DATA — ARRAY OF DWORD</div></div></div>	<div><div>Input</div><div>REQ: execute the function in case of 1</div><div>BASE: Base position setting</div><div>SLOT: Slot position setting</div><div>MADDR: Address to start reading</div><div>512(0x200) ~ 1023(0x3FF)</div><div>SIZE: Number of data to read (1 ~ 512)</div></div> <div><div>Output</div><div>DONE: 1 output in case of normal execution</div><div>STAT: Error information</div><div>DATA: Array variable to save read data</div><div>(ARRAY of DWORD)</div></div>

■ Function

Read data as much as the size from the shared read memory MADDR of the configured motion control module.

■ Program example

ST

```
INST_ARY_GETM(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, MADDR:=MADDR_UINT,
SIZE:=SIZE_UINT, DONE=>DNOE_BOOL, STAT=>STAT_UINT, DATA=>ARY_DATA);
```

<b>ARY_PUTM</b>	<b>Write motion control module data(Array)</b>	
	Availability	XGI
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: execute the function in case of 1</p> <p>BASE: Base position setting</p> <p>SLOT: Slot position setting</p> <p>MADDR: Address to start writing; 0(h0) ~ 511(h1FF)</p> <p>DATA: Array variable to save data (ARRAY OF DWORD)</p> <p>SIZE: No. of data to write (1 ~ 512)</p> <p><b>Output</b></p> <p>DONE: 1 output in case of normal execution</p> <p>STAT: Error information</p>

### ■ Function

Save data as much as the size to the shared write memory addresses MADDR of the configured motion control module.

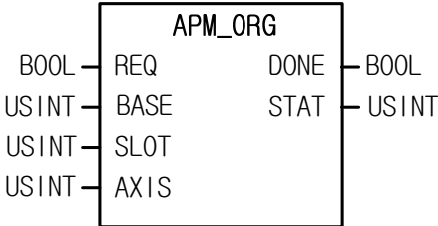
### ■ Program example

ST

```
INST_ARY_PUTM(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, MADDR:=MADDR_UINT,
DATA:=ARY_DATA, SIZE:=SIZE_UINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

## 11.4 Positioning Function Block (APM)

<b>APM_ORG</b>	<b>Homing Start</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: output error number that occurs while executing the function block</p>

### ■ Function

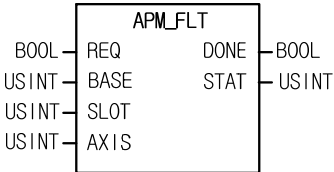
- (1) The instruction commands origin return run to the positioning module.
- (2) Run instruction to find origin by means of the direction, compensation, speed (high speed/low speed) and dwell time set in origin return parameter of each axis.
- (3) Instruct origin return instruction to the designated AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis (In case of XEC, Z axis is not supported)

### ■ Program example

ST

```
INST_APM_ORG(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
DONE=>DNOE_BOOL, STAT=>STAT_UINT);
```

<b>APM_FLT</b>	<b>Floating origin setting</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
 <pre> graph LR     subgraph APM_FLT         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         DONE[DONE]         STAT[STAT]     end     REQ --- APM_FLT     BASE --- APM_FLT     SLOT --- APM_FLT     AXIS --- APM_FLT     APM_FLT --- DONE     APM_FLT --- STAT         </pre>	<p><b>Input</b></p> <p>REQ: requires to execute the function block          BASE: Setting the base number with a module          SLOT: Setting the slot number with a module          AXIS: Setting an axis to instruct                0:X axis, 1:Y axis, 2:Z axis</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation          STAT: Output the error number that occurs while executing the function block.</p>

## ■ Function

- (1) The instruction commands executing floating origin setting to the positioning module.
- (2) As the command used to set the current position as origin, instead of executing return of a machine, the address configured in origin return address is set as the current position.
- (3) It commands floating origin command to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) It can set an axis to instruct and value is as follows. If other value is set, it produces "Error6."  
       0: X axis,   1: Y axis,   2: Z axis

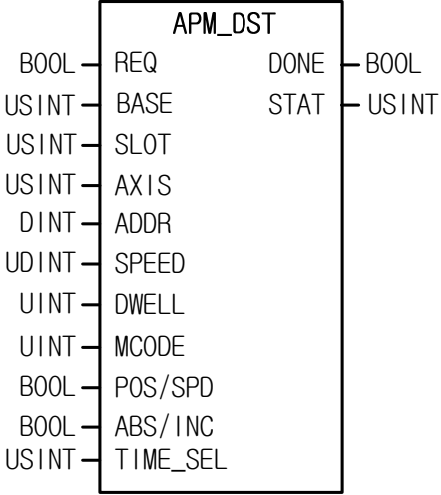
## ■ Program example

ST

```

INST_APM_FLT(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
DONE=>DONE_BOOL, STAT=>STAT_UINT);
    
```

<b>APM_DST</b>	<b>Direct Start</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block</p> <p>BASE: Setting the base number with a module</p> <p>SLOT: Setting the slot number with a module</p> <p>AXIS: Setting an axis to instruct 0:X axis, 1:Y axis, 2:Z axis</p> <p>ADDR: Setting target position address -2,147,483,648 ~ +2,147,483,647</p> <p>SPEED: Setting target speed Open Collector : 1 ~ 200,000[pps] Line Driver : 1 ~ 1,000,000[pps]</p> <p>DWELL: dwell time 0 ~ 50000[ms]</p> <p>MCODE: Setting M Code</p> <p>POS/SPD: Setting position control/speed control 0 : position control, 1 : speed control</p> <p>ABS/INC: Setting absolute/relative coordinates 0 : absolute, 1 : relative</p> <p>TIME_SEL: setting acc./dec. time number 0 : acc./dec. time 1 1 : acc./dec. time 2 2 : acc./dec. time 3 3 : acc./dec. time 4</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation</p> <p>STAT: Output the error number that occurs while executing the function block</p>

### ■ Function

- (1) The instruction commands direct run to the positioning module.
  - (2) It used when running by designating the run step number of the axis configured as run data.
  - (3) It command direct run instruction to the configured axis of the positioning module where it is configured at BASE (base number of positioning module) and SLOT(slot number of positioning module).
- It can set an axis to instruct and the value is as follows. If other value is set, it produces 'Error6'.
- If can value set in SPEED,DWELL, and TIME\_SEL is out of the range, it generates 'Error11' to STAT.

### ■ Program example

ST

```
INST_APM_DST(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
ADDR:=ADDR_DINT, SPEED:=SPEED_UDINT, DWELL:=DWELL_UINT, MCODE:=MCODE_UINT,
POS_SPD:=POS_BOOL, ABS_INC:=ABS_BOOL, TIME_SEL:=TIME_USINT, DONE=>DNOE_BOOL,
STAT=>STAT_UINT);
```

<b>APM_IST</b>	<b>Indirect Start</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
<pre> graph LR     subgraph APM_IST         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         STEP[STEP]         DONE[DONE]         STAT[STAT]     end     REQ --&gt; APM_IST     BASE --&gt; APM_IST     SLOT --&gt; APM_IST     AXIS --&gt; APM_IST     STEP --&gt; APM_IST     APM_IST --&gt; DONE     APM_IST --&gt; STAT         </pre>	<p><b>Input</b></p> <p>REQ: requires to execute the function block          BASE: Setting the base number with a module          SLOT: Setting the slot number with a module          AXIS: Setting an axis to instruct                0:X axis, 1:Y axis, 2:Z axis          STEP: Step number to run 0 ~ 400</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation          STAT: Output the error number that occurs while executing the function block.</p>

## ■ Function

1. The instruction commands direct run to the positioning module.
2. It used when running by designating the run step number of the axis configured as run data.
3. It commands indirect run to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
4. It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
       0: X axis, 1: Y axis, 2: Z axis (in case of XEC, Z axis is not supported)
5. If the value set in STEP is out of the range (0 ~ 400 (in case of XEC, 0 ~ 80)), it generates "Error11" to STAT.
6. If 0 is set in STEP, it operates the current step.

## ■ Program example

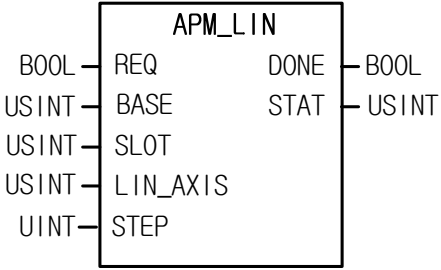
### 1. ST

```

INST_APM_IST(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
STEP:=STEP_UINT, DONE=>DNOE_BOOL, STAT=>STAT_UINT);
    
```



<b>APM_LIN</b>	<b>Linear interpolation run</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  LIN_AXIS: Setting interpolation run axis  3 : X/Y axis  5 : X/Z axis  6 : Y/Z axis  7 : X/Y/Z axis  STEP: Step number to run 0 ~ 400</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

### ■ Function

- (1) The instruction commands linear interpolation run instruction to the positioning module.
- (2) It commands for linear interpolation run in the 2 or 3 axes positioning module.
- (3) It commands linear interpolation run instruction to the designated AXIS of the positioning module where it is designated at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) If other value is set in LIN\_AXIS, it produces "Error6." It can be set by setting each bit as follows.

15 ~ 4	2	1	0
-	Z axis (in case of XEC, Z axis is not supported)	Y axis	X axis

- (5) If the value is out of the range, set in STEP (0 ~ 400 (In case of XEC, 0~80)), it generates "Error11" to STAT.
- (6) If 0 is set in STEP, it operates the current step.

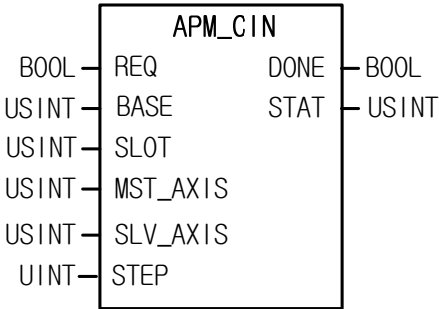
### ■ Program example

#### 1. ST

```
INST_APM_LIN(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, LIN_AXIS:=LIN_USINT,
STEP:=STEP_UINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_CIN</b>	<b>Circular interpolation run</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  MST_AXIS: Setting circular interpolation main axis  0:X axis, 1:Y axis, 2:Z axis  SLV_AXIS: Setting linear interpolation sub axes  0:X axis, 1:Y axis, 2:Z axis  STEP: Step number to run 0 ~ 400</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

## ■ Function

- (1) The instruction commands circular interpolation run instruction to the positioning module.
  - (2) It commands for circular interpolation run in 2 or 3 axes positioning module.
  - (3) It commands circular interpolation run instruction to the designated AXIS of the positioning module where it is designated at BASE (base number of positioning module) and SLOT (slot number of positioning module).
  - (4) MST\_AXIS sets the main axis of circular interpolation run and the following values can be set.  
0: X axis, 1: Y axis, 2: Z axis
  - (5) SLV\_AXIS sets the sub axis of circular interpolation run and the following values can be set.  
0: X axis, 1: Y axis, 2: Z axis
- If the values of MST\_AXIS and SLV\_AXIS are set out of the range, it generates "Error6."
  - If other value set in STEP (0 ~ 400), it generates "Error11" to STAT.
  - If 0 is set in STEP, it operates the current step.

## ■ Program example

### 1. ST

```
INST_APM_CIN(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, MST_AXIS:=MST_USINT,
SLV_AXIS:=SLV_USINT, STEP:=STEP_UINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_SST</b>	<b>Simultaneous Start</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
<pre> graph LR     subgraph APM_SST         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         SST_AXIS[SST_AXIS]         X_STEP[X_STEP]         Y_STEP[Y_STEP]         Z_STEP[Z_STEP]     end     REQ --&gt; DONE     BASE --&gt; STAT     </pre>	<p><b>Input</b></p> <p>REQ: requires to execute the function block          BASE: Setting the base number with a module          SLOT: Setting the slot number with a module          SST_AXIS : Setting simultaneous run axes              3 : X/Y axis              5 : X/Z axis              6 : Y/Z axis              7 : X/Y/Z axis          X_STEP: Setting the simultaneous run step number of X axis(0 ~ 400)          Y_STEP: Setting the simultaneous run step number of Y axis(0 ~ 400)          Z_STEP: Setting the simultaneous run step number of Z axis(0 ~ 400)</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation          STAT: Output the error number that occurs while executing the function block.</p>

### ■ Function

- (1) The instruction commands simultaneous run instruction to the positioning module.
- (2) It is executed when simultaneously running 2 or 3 axes
- (3) It commands the simultaneous run instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) If the value is set out of the range to SST\_AXIS, it generates "Error6." It can be set as follows by setting each bit.

15 ~ 4	2	1	0
-	Z axis (in case of XEC, Z axis is not supported)	Y axis	X axis

- (5) Set the step number run by X axis, Y axis and Z axis simultaneously to X\_STEP, Y\_STEP and Z\_STEP .
- (6) If the value set in X\_STEP, Y\_STEP and Z\_STEP is out of the range (0 ~ 400(in case of XEC, 0~80)), it generates "Error11" to STAT.
- (7) If 0 is set in X\_STEP, Y\_STEP and Z\_STEP, it operates the current step.

### ■ Program example

#### 1. ST

```

INST_APM_SST(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, SST_AXIS:=SST_USINT,
X_STEP:=X_UINT, Y_STEP:=Y_UINT, Z_STEP:=Z_UINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);

```

<b>APM_VTP</b>	<b>Speed/Position switching</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

## ■ Function

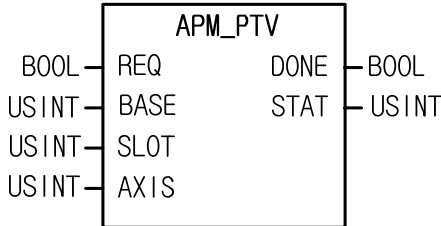
- (1) The instruction commands speed/position control conversion instruction to the positioning module.
- (2) A configured axis converts speed control to position control if receiving speed/position control instruction while being run by speed control run.
- (3) As soon as the instruction is executed, the origin is determined and it moves to the target position by the previous speed control, completing positioning.
- (4) It commands speed/position control instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (5) It can set an axis to instruct and the following value. If other value set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis (in case of XEC, Z axis is not supported)

## ■ Program example

### 1. ST

```
INST_APM_VTP(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
DONE=>DONE_BOOL, STAT=>STAT_UINT)
```

<b>APM_PTV</b>	<b>Position/Speed switching</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

### ■ Function

- (1) The instruction commands position/speed control conversion instruction to the positioning module.
- (2) A configured axis converts speed control to position control if receiving position/speed control instruction while being run by speed control run.
- (3) As soon as the instruction is executed, the origin is not determined and it moves the target position by the previous speed control and completes positioning.
- (4) It commands speed/position control instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (5) It can set an axis to instruct and the value is as follows. If other value is set out of range, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis (In case of XEC, Z axis is not supported)

### ■ Program example

#### 1. ST

```
INST_APM_PTV(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_STP</b>	<b>Decelerating stop</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis  DEC_TIME: Decelerating stop time  0: Acc./dec. time applied when it starts running  1 ~ 65,535 : 1 ~ 65,535ms</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

## ■ Function

- (1) Instruction executing decelerating stop to the positioning module.
- (2) It decelerates and stops when it receives the stop command while running by run data and resumes running by run command.
- (3) It is used to exit each speed/position synchronization in speed synchronization or position synchronization.
- (4) It command decelerating stop to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (5) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis (In case of XEC, Z axis is not supported)

## ■ Program example

### 1. ST

```
INST_APM_STP(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
DEC_TIME:=DEC_UINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_SKP</b>	<b>Skip run</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

### ■ Function

- (1) The instruction commands skip run instruction to the positioning module.
- (2) It executes when moving to the next step without run step.
- (3) Every time the instruction executes, it skips the current run step and starts the next run step.
- (4) It commands skip run instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (5) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis

### ■ Program example

#### 1. ST

```
INST_APM_SKP(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_SSP</b>	<b>Position synchronization</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
<pre> graph LR     subgraph APM_SSP         REQ[REQ] --&gt; DONE[DONE]         BASE[BASE] --&gt; STAT[STAT]         SLOT[SLOT]         AXIS[AXIS]         STEP[STEP]         MST_AXIS[MST_AXIS]         MST_ADDR[MST_ADDR]     end     </pre>	<p><b>Input</b></p> <p>REQ: requires to execute the function block          BASE: Setting the base number with a module          SLOT: Setting the slot number with a module          AXIS: Setting an axis to instruct                0:X axis, 1:Y axis, 2:Z axis          STEP: Step number to run 0 ~ 400          MST_AXIS: Setting position synchronization main axis                0:X axis, 1:Y axis, 2:Z axis          MST_ADDR: Setting main axis to execute position synchronization                -2,147,483,648 ~ 2,147,483,647</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation          STAT: Output the error number that occurs while executing the function block.</p>

## ■ Function

- (1) The instruction commands position synchronization instruction to the positioning module
- (2) If an axis with the instruction is set as sub axis and the axis set as main axis reaches to the set synchronization position, it starts run step set in instruction axis.
- (3) It commands positioning instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) It can set an axis to instruct and the following value. If other value is set, it produces "Error6."  
       0: X axis,   1: Y axis,   2: Z axis (In case of XEC, Z axis is not supported)
- (5) It sets the position synchronization main axis to MST\_AXIS and the following values can be set. If other value is set, it generates "Error6."  
       0: X axis,   1: Y axis,   2: Z axis (In case of XEC, Z axis is not supported)

## ■ Program example

### 1. ST

```

INST_APM_SSP(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
STEP:=STEP_UINT, MST_AXIS:=AXIS_USINT, MST_ADDR:=ADDR_DINT, DONE=>DONE_BOOL,
STAT=>STAT_UINT);

```



APM_SSS	Speed synchronization	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     subgraph APM_SSS         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         MST_AXIS[MST_AXIS]         MST_RAT[MST_RAT]         SLV_RAT[SLV_RAT]         DONE[DONE]         STAT[STAT]     end     REQ --- APM_SSS     BASE --- APM_SSS     SLOT --- APM_SSS     AXIS --- APM_SSS     MST_AXIS --- APM_SSS     MST_RAT --- APM_SSS     SLV_RAT --- APM_SSS     APM_SSS --- DONE     APM_SSS --- STAT         </pre>	<p><b>Input</b></p> <p>REQ: requires to execute the function block              BASE: Setting the base number with a module              SLOT: Setting the slot number with a module              AXIS: Setting an axis to instruct                    0:X axis, 1:Y axis, 2:Z axis              MST_AXIS: Setting main axis of speed synchronization                    0:X axis, 1:Y axis, 2:Z axis, 3:Encoder              MST_RAT: Setting speed rate of main axis                    1 ~ 65,535              SLV_RAT: Setting speed rate of sub axis                    1 ~ 65,535</p> <p><b>Output</b></p> <p>DONE : maintains 1 after the first operation              STAT : Output the error number that occurs while executing the function block.</p>

### ■ Function

- (1) The instruction commands speed synchronization instruction to the positioning module.
- (2) It is executes when controlling at the rate of run speed between both axes.
- (3) It must be set to be "speed rate of sub axis/speed rate of main axis ≤ 1" if using speed synchronization run.
- (4) It commands speed synchronization instruction to the assigned AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (5) It can set an axis to instruct and the following value. If other value is set, it produces "Error6."  
 0: X axis, 1: Y axis, 2: Z axis
- (6) It can set an main axis in MST\_AXIS and the following value. If other value is set, it produces "Error6."  
 0: X axis, 1: Y axis, 2: Z axis, 3: Encoder

### ■ Program example

#### 1. ST

```

INST_APM_SSS(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
MST_AXIS:=AXIS_USINT, MST_RAT:=MST_UINT, SLV_RAT:=SLV_UINT, DONE=>DONE_BOOL,
STAT=>STAT_UINT);
        
```

<b>APM_SSSP</b>	Positioning speed synchronization	
	Availability	XGI , XGR
	Flags	

Function Block	Description																								
<div><div>APM_SSSP</div><div><div>REQ</div><div>DONE</div><div>BASE</div><div>STAT</div><div>SLOT</div><div>AXIS</div><div>MST_AXIS</div><div>SVL_RATE</div><div>DELAY</div></div><div><div>BOOL</div><div>USINT</div><div>USINT</div><div>USINT</div><div>USINT</div><div>UINT</div><div>UINT</div></div><div><div>BOOL</div><div>USINT</div></div></div>	<p><b>Input</b> REQ : requires to execute the function block BASE : Setting the base number with a module SLOT : Setting the slot number with a module AXIS : Setting an axis to instruct 0:X axis, 1:Y axis MST_AXIS : Setting main axis of speed synchronization</p> <table><tr><th>Setting value</th><th>Main axis setting</th><th>Setting value</th><th>Main axis setting</th></tr><tr><td>0</td><td>X axis</td><td>5</td><td>High Speed Counter Ch3</td></tr><tr><td>1</td><td>Y axis</td><td>6</td><td>High Speed Counter Ch4</td></tr><tr><td>2</td><td>High Speed Counter Ch0</td><td>7</td><td>High Speed Counter Ch5</td></tr><tr><td>3</td><td>High Speed Counter Ch1</td><td>8</td><td>High Speed Counter Ch6</td></tr><tr><td>4</td><td>High Speed Counter Ch2</td><td>9</td><td>High Speed Counter Ch7</td></tr></table> <p>SVL_RATE : Setting speed rate of main axis 1 ~ 65,535 DELAY : Setting speed rate of sub axis 1 ~ 65,535</p> <p><b>Output</b> DONE : maintains 1 after the first operation STAT : Output the error number that occurs while executing the function block.</p>	Setting value	Main axis setting	Setting value	Main axis setting	0	X axis	5	High Speed Counter Ch3	1	Y axis	6	High Speed Counter Ch4	2	High Speed Counter Ch0	7	High Speed Counter Ch5	3	High Speed Counter Ch1	8	High Speed Counter Ch6	4	High Speed Counter Ch2	9	High Speed Counter Ch7
Setting value	Main axis setting	Setting value	Main axis setting																						
0	X axis	5	High Speed Counter Ch3																						
1	Y axis	6	High Speed Counter Ch4																						
2	High Speed Counter Ch0	7	High Speed Counter Ch5																						
3	High Speed Counter Ch1	8	High Speed Counter Ch6																						
4	High Speed Counter Ch2	9	High Speed Counter Ch7																						

## ■ Function

- (1) The instruction commands speed synchronization instruction to the positioning module
- (2) At the rising edge of input condition, axis set in AXIS is set as subsidiary axis and axis set in MST\_AXIS is set as main axis and speed synchronization instruction is executed.
- (3) If instruction executes, subsidiary axis doesn't yield pulse. (At this time, operation status flag (X axis: %KX6720, Y axis: %KX6880) is on). At this time, if axis set in MST\_AXIS starts, subsidiary axis starts with speed synchronization rate set in AXIS.
- (4) Synchronization rate can be set in SVL\_RATE is 0.01% ~ 100.00% (setting value 1 ~ 10,000). If synchronization speed rate exceeds this range, error code 356 occurs.
- (5) Delay time of DEAYL means how long it takes for speed of subsidiary axis to get equal with current main axis speed. In XGB built-in positioning, when speed synchronization control, it detects the current speed of main axis every 500  $\mu$ s and adjust speed of subsidiary axis. At this time, if speed of subsidiary axis changes rapidly by speed synchronization, rapid change of subsidiary axis may cause damage of motor and noise.

For example, we assume that synchronization speed rate is 100.00% and delay time is 5(ms). In case speed of main axis is 10,000[pps], after 5ms, XGB adjusts speed of subsidiary axis to be 10,000[pps] every 500[ $\mu$ s] according to current speed of main axis.

The more delay time is large, the more stability increases. When you want high stability of motor, increase the delay time.

(6) The range of delay time can be set in DELAY n2 is 1 ~ 10[ms]. If it exceeds the range, error code 357 occurs.

(7) The range of MST\_AXIS is 0~9. If it exceeds the range, error code 355 occurs.

(8) You can specify axis for command at AXIS, The following setting is available. If you input invalid value, error code 6 occurs.

0: X axis, 1: Y axis

(9) You can specify main axis of speed synchronization at MST\_AXIS. If you input invalid value, error code 6 occurs.

### ■ Program example

#### 1. ST

```
INST_APM_SSSP(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,  
MST_AXIS:=AXIS_USINT, MST_RAT:=MST_UINT, SLV_RAT:=SLV_UINT, POS:=POS_DINT, DONE=>DONE_BOOL,  
STAT=>STAT_UINT);
```

<b>APM_SSSB</b>	Positioning speed synchronization	
	Availability	XEC
	Flags	-

Function Block	Description																								
<div><div>APM_SSSB</div><div><div>REQ</div><div>DONE</div><div>BASE</div><div>STAT</div><div>SLOT</div><div>AXIS</div><div>MST_AXIS</div><div>SVL_RAT</div><div>DELAY</div></div><div><div>BOOL</div><div>USINT</div><div>USINT</div><div>USINT</div><div>USINT</div><div>UINT</div><div>UINT</div></div><div><div>BOOL</div><div>USINT</div></div></div>	<p><b>Input</b></p> <p>REQ : requires to execute the function block</p> <p>BASE : Setting the base number with a module</p> <p>SLOT : Setting the slot number with a module</p> <p>AXIS : Setting an axis to instruct 0:X axis, 1:Y axis</p> <p>MST_AXIS : Setting main axis of speed synchronization</p> <table><tr><th>Setting value</th><th>Main axis setting</th><th>Setting value</th><th>Main axis setting</th></tr><tr><td>0</td><td>X axis</td><td>5</td><td>High Speed Counter Ch3</td></tr><tr><td>1</td><td>Y axis</td><td>6</td><td>High Speed Counter Ch4</td></tr><tr><td>2</td><td>High Speed Counter Ch0</td><td>7</td><td>High Speed Counter Ch5</td></tr><tr><td>3</td><td>High Speed Counter Ch1</td><td>8</td><td>High Speed Counter Ch6</td></tr><tr><td>4</td><td>High Speed Counter Ch2</td><td>9</td><td>High Speed Counter Ch7</td></tr></table> <p>SVL_RAT : Setting speed rate of sub axis 1 ~ 10,000(0.01 ~ 100.00%)</p> <p>DELAY : Delay time of sub axis 1 ~ 10(1 ~ 10ms)</p> <p><b>Output</b></p> <p>DONE : maintains 1 after the first operation</p> <p>STAT : Output the error number that occurs while executing the function block.</p>	Setting value	Main axis setting	Setting value	Main axis setting	0	X axis	5	High Speed Counter Ch3	1	Y axis	6	High Speed Counter Ch4	2	High Speed Counter Ch0	7	High Speed Counter Ch5	3	High Speed Counter Ch1	8	High Speed Counter Ch6	4	High Speed Counter Ch2	9	High Speed Counter Ch7
Setting value	Main axis setting	Setting value	Main axis setting																						
0	X axis	5	High Speed Counter Ch3																						
1	Y axis	6	High Speed Counter Ch4																						
2	High Speed Counter Ch0	7	High Speed Counter Ch5																						
3	High Speed Counter Ch1	8	High Speed Counter Ch6																						
4	High Speed Counter Ch2	9	High Speed Counter Ch7																						

## Function

- (1) The instruction commands speed synchronization instruction to the positioning module
- (2) At the rising edge of input condition, axis set in AXIS is set as subsidiary axis and axis set in MST\_AXIS is set as main axis and speed synchronization instruction is executed.
- (3) If instruction executes, subsidiary axis doesn't yield pulse. (At this time, operation status flag (X axis: %KX6720, Y axis: %KX6880) is on). At this time, if axis set in MST\_AXIS starts, subsidiary axis starts with speed synchronization rate set in AXIS.
- (4) Synchronization rate can be set in SVL\_RAT is 0.01% ~ 100.00% (setting value 1 ~ 10,000). If synchronization speed rate exceeds this range, error code 356 occurs.
- (5) Delay time of DEAYL means how long it takes for speed of subsidiary axis to get equal with current main axis speed. In XGB built-in positioning, when speed synchronization control, it detects the current speed of main axis every 500  $\mu$ s and adjust speed of subsidiary axis. At this time, if speed of subsidiary axis changes rapidly by speed synchronization, rapid change of subsidiary axis may cause damage of motor and noise.

For example, we assume that synchronization speed rate is 100.00% and delay time is 5(ms). In case speed of main axis is 10,000[pps], after 5ms, XGB adjusts speed of subsidiary axis to be 10,000[pps] every 500[ $\mu$ s] according to current speed of main axis.

The more delay time is large, the more stability increases. When you want high stability of motor, increase the delay time.

(6) The range of delay time can be set in DELAY n2 is 1 ~ 10[ms]. If it exceeds the range, error code 357 occurs.

(7) The range of MST\_AXIS is 0~9. If it exceeds the range, error code 355 occurs.

(8) You can specify axis for command at AXIS, The following setting is available. If you input invalid value, error code 6 occurs.

0: X axis, 1: Y axis

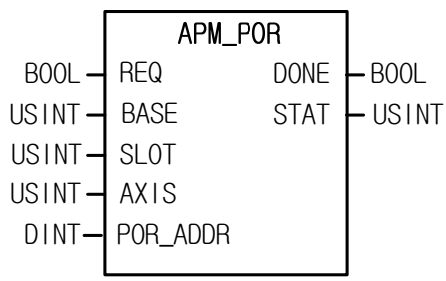
(9) You can specify main axis of speed synchronization at MST\_AXIS. If you input invalid value, error code 6 occurs.

### ■ Program example

#### 2. ST

```
INST_APM_SSSB(REQ:=REQ_BOOL,    BASE:=BASE_USINT,    SLOT:=SLOT_USINT,    AXIS:=AXIS_USINT,  
MST_AXIS:=AXIS_USINT,  
MST_RAT:=MST_UINT, SLV_RAT:=SLV_UINT, POS:=POS_DINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_POR</b>	<b>Position override</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis  POR_ADDR : Setting new target position  -2,147,483,648 ~ 2,147,483,647</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

## ■ Function

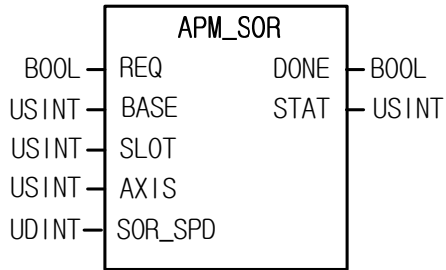
- (1) The instruction commands position override instruction to the positioning module.
- (2) It used when changing target position while instruction axis is running.
- (3) It commands position override instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis (in case of XEC, Z axis is not supported)
- (5) Set the target position to change in POR\_ADDR.

## ■ Program example

### 1. ST

```
INST_APM_POR(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
POR_ADDR:=POR_DINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_SOR</b>	<b>Speed override</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
 <pre> graph LR     subgraph APM_SOR         REQ[REQ] --&gt; DONE[DONE]         BASE[BASE] --&gt; STAT[STAT]         SLOT[SLOT]         AXIS[AXIS]         SOR_SPD[SOR_SPD]     end     REQ --- REQ_in[REQ]     BASE --- BASE_in[BASE]     SLOT --- SLOT_in[SLOT]     AXIS --- AXIS_in[AXIS]     SOR_SPD --- SOR_SPD_in[SOR_SPD]     DONE --- DONE_out[DONE]     STAT --- STAT_out[STAT] </pre>	<p><b>Input</b></p> <p>REQ: requires to execute the function block          BASE: Setting the base number with a module          SLOT: Setting the slot number with a module          AXIS: Setting an axis to instruct                0:X axis, 1:Y axis, 2:Z axis          SOR_SPD: Setting new run speed value          Open Collector: 0 ~ 200,000[pps]          Line Driver: 0 ~ 1,000,000[pps]</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation          STAT: Output the error number that occurs while executing the function block.</p>

### ■ Function

- (1) The instruction commands speed override instruction to the positioning module.
- (2) It used when changing run speed while instruction axis is running.
- (3) It commands speed override instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
 0: X axis, 1: Y axis, 2: Z axis (in case of XEC, Z axis is not supported)
- (5) Set the target speed to change in SOR\_SPD. If the value is set out of the range, it generates "Error11."  
 Open Collector: 0 ~ 200,000[pps] (in case of XEC, Z axis is not supported)  
 Line Driver: 0 ~ 1,000,000[pps]

### ■ Program example

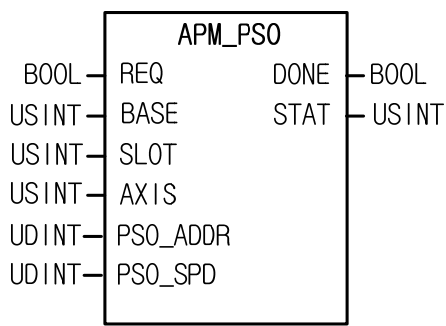
#### 1. ST

```

INST_APM_SOR(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
SOR_SPD:=SOR_UDINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);

```

<b>APM_PSO</b>	<b>Positioning speed override</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis  PSO_ADDR: Position to change speed  -2,147,483,648 ~ 2,147,483,647  PSO_SPD: Setting new run speed value  Open Collector: 0 ~ 200,000[pps]  Line Driver: 0 ~ 1,000,000[pps]</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

## ■ Function

- (1) The instruction commands positioning speed override instruction to the positioning module.
- (2) It executes when changing run speed after the axis reaches to a certain position while it is running.
- (3) It commands speed override instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis (in case of XEC, Z axis is not supported)
- (6) Set the target speed to change in PSO\_SPD. The value is as follows. If the value is set out of the range, it generates "Error11."  
Open Collector: 0 ~ 200,000[pps] (in case of XEC, Z axis is not supported)  
Line Driver: 0 ~ 1,000,000[pps]

## ■ Program example

### 1. ST

```
INST_APM_PSO(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
PSO_ADDR:=ADDR_UDINT, PSO_SPD:=SPD_UDINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```



<b>APM_NMV</b>	<b>Continuous run</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

### ■ Function

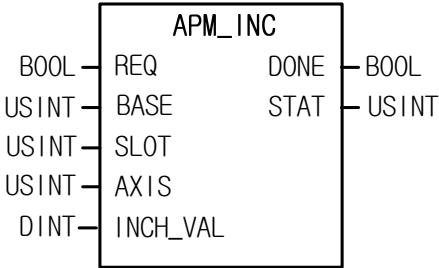
- (1) The instruction commands continuous run instruction to the positioning module.
- (2) It executes to change the current step to the next step without stop.
- (3) It commands continuous run instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis

### ■ Program example

#### 1. ST

```
INST_APM_NMV(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_INC</b>	<b>Inching run</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis  INCH_VAL: Setting the movement to move to  inching run  -2,147,483,648 ~ 2,147,483,647</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while  executing the function block.</p>

## ■ Function

- (1) The instruction commands inching run instruction to the positioning module.
- (2) Inching run is a type of manual run, used to process minute movement as quantitative run.
- (3) The inching run speed is set in manual run parameter.
- (4) It commands inching run floating origin instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (5) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis (In case of XEC, Z axis is not supported)

## ■ Program example

### 1. ST

```
INST_APM_INC(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
INCH_VAL:=INCH_DINT, DONE=>DNOE_BOOL, STAT=>STAT_UINT);
```

<b>APM_RTP</b>	<b>Return to the position before manual run</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

### ■ Function

- (1) The instruction commands return to the position before manual run to the positioning module.
- (2) It executes to return to the position before manual run when the position is changed by manual run after positioning.
- (3) It commands Return to the position before manual run instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis

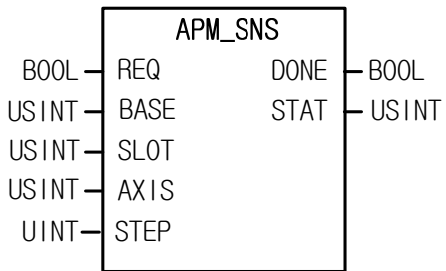
### ■ Program example

#### 1. ST

```
INST_APM_RTP(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_SNS</b>	<b>Run step number change</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis  STEP: Setting run step number to run  1 ~ 400</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

## ■ Function

- (1) The instruction commands run step number change instruction to the positioning module.
- (2) It executes to change run step of the axis
- (3) It commands run step number change instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis (In case of XEC, Z axis is not supported)
- (5) Set the step number to run in STEP between 1 ~ 400; if other value is set, it generates "Error11."

## ■ Program example

### 1. ST

```
INST_APM_SNS(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
STEP:=STEP_UINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_SRS</b>	<b>Repeat step number change</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis  STEP: Setting repeat step number to change  1 ~ 400</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

### ■ Function

- (1) The instruction commands repeat step number change instruction to the positioning module.
- (2) It executes to start run in a certain run step by configuring start step number of repeat run in case of repeat run in which it returns to repeat run step if it meets repeat run while running by run data.
- (3) It commands repeat step change instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis
- (5) Set the step number to start repeat run in STEP between 1 ~ 400; if other value is set, it generates "Error11."

### ■ Program example

#### 1. ST

```
INST_APM_SRS(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
STEP:=STEP_UINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_MOF</b>	<b>M code cancellation</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

## ■ Function

- (1) The instruction commands M code cancellation instruction to the positioning module.
- (2) If M code is set in the parameter of each axis to With or After mode, it executes to turn off the signal when the M code signal of the axis is on.
- (3) It commands M code cancellation instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis (in case of XEC, Z axis is not supported)

## ■ Program example

### 1. ST

```
INST_APM_MOF(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_PRS</b>	<b>Current position preset</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis  PRS_ADDR: Setting the current position value to change  -2,147,483,648 ~ 2,147,483,647</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

### ■ Function

- (1) The instruction commands current position preset instruction to the positioning module.
- (2) As the command used to change the current position to a temporary position, the origin is determined if executing the command.
- (3) It commands current position preset instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis (in case of XEC, Z axis is not supported)

### ■ Program example

#### 1. ST

```
INST_APM_PRS(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
PRS_ADDR:=ADDR_DINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_ZONE</b>	<b>Zone Output allowed/prohibited</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis  ZONE_EN: Zone Output allowed/prohibited  0: prohibited, 1: allowed</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

## ■ Function

- (1) The instruction commands Zone Output allowed/prohibited instruction to the positioning module.
- (2) It commands to allow or prohibit Zone Output by using the position data of zone set in common parameter and the position data value set in Zone1, Zone2 and Zone3.
- (3) It commands Zone Output allowed/prohibition instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis

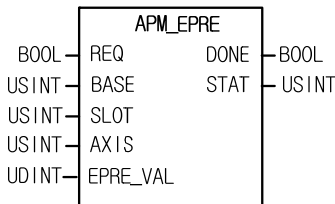
## ■ Program example

### 1. ST

```
INST_APM_ZONE(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
ZONE_EN:=ZONE_BOOL, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```



<b>APM_EPRES</b>	<b>Encoder value preset</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis  EPRE_VAL: Setting encoder preset value  0 ~ 4,294,967,295</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

### ■ Function

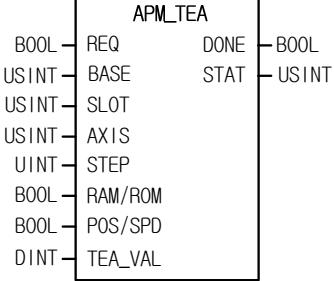
- (1) The instruction commands encoder value preset instruction to the positioning module.
- (2) It commands to preset the current encoder value set in EPRE\_VAL.
- (3) It commands encoder value preset instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis

### ■ Program example

#### 1. ST

```
INST_APM_EPRES(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
EPRE_VAL:=EPRE_UDINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_TEA</b>	<b>Singular teaching</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis  STEP: Setting step number for teaching  0 ~ 400  RAM/ROM: Selecting RAM teaching/ROM teaching type  0 : RAM teaching, 1 : ROM teaching  POS/SPD: Selecting position teaching/speed teaching type  0 : position teaching, 1 : speed teaching  TEA_VAL: Setting teaching value  Position teaching: -2,147,483,648 ~ 2,147,483,647  Speed teaching: Open Collector 0 ~ 200,000[pps]  Line Driver 0 ~ 1,000,000[pps]</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

## ■ Function

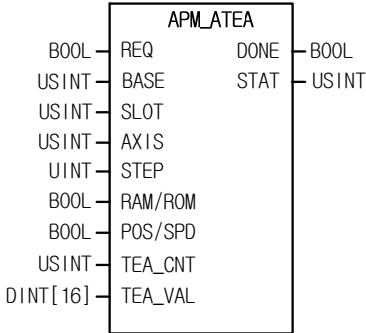
- (1) The instruction commands singular teaching instruction to the positioning module.
- (2) Speed teaching can be used when using a temporary speed for run data of a certain step while position teaching is used to set a temporary position for run data of a certain run step.
- (3) It commands singular teaching instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis
- (5) It can set the step number of run data for teaching in STEP between 0 ~ 400. If other value is set, it generates "Error11."
- (6) In case of position teaching, a position value for teaching is set in TEA\_VAL while speed value for teaching is set, the setting ranges are as follows. If other value is set, it generates "Error11."
  - Position teaching range: -2,147,483,648 ~ 2,147,483,647
  - Speed teaching range: Open Collector Output -> 0 ~ 200,000 [pps]  
Line Driver Output -> 0 ~ 1,000,000 [pps]

### ■ Program example

#### 1. ST

```
INST_APM_TEA(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,  
STEP:=STEP_UINT, RAM_ROM:=RAM_BOOL, POS_SPD:=SPD_BOOL);
```

<b>APM_ATEA</b>	<b>Singular teaching</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0 : X axis, 1:Y axis, 2:Z axis  STEP: Setting step number for teaching, 0 ~ 400  RAM/ROM: Selecting RAM teaching/ROM teaching  0 : RAM teaching, 1 : ROM teaching  POS/SPD: Selecting position teaching/speed teaching type  0 : position teaching, 1 : speed teaching  TEA_CNT : Setting the no. of data for teaching, 1 ~ 16  TEA_VAL : Setting teaching value  Position teaching: -2,147,483,648 ~ 2,147,483,647  Speed teaching : Open Collector 0 ~ 200,000[pps]  Line Driver 0 ~ 1,000,000[pps]</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

## ■ Function

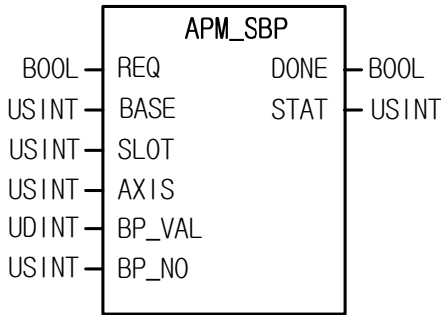
- (1) The instruction commands plural teaching instruction to the positioning module.
- (2) Speed teaching can be used when using a temporary speed for run data of a certain step while position teaching is used to set a temporary position for run data of a certain run step.
- (3) Using the teaching plural function block, up to 16 target positions and speed values can be changed.
- (4) It commands plural teaching instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (5) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis
- (6) It can set the step number of run data for teaching in STEP between 0 ~ 400. If other value is set, it generates "Error11."
- (7) The number of data is set in TEA\_CNT up to 16. If other value is set out of the range, it generates "Error11."
- (8) In case of position teaching, a position value for teaching is set in TEA\_VAL while speed value for teaching is set, the setting ranges are as follows.
  - Position teaching range: -2,147,483,648 ~ 2,147,483,647
  - Speed teaching range: Open Collector Output -> 0 ~ 200,000 [pps]  
Line Driver Output -> 0 ~ 1,000,000 [pps]

### ■ Program example

#### 1. ST

```
INST_APM_ATEA1(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,  
STEP:=STEP_UINT, RAM_ROM:=RAM_BOOL, POS_SPD:=SPD_BOOL, TEA_CNT:=CNT_USINT,  
ATEA_VAL:=ARY_ATEA, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_SBP</b>	<b>Basic parameter teaching</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
 <pre> graph LR     subgraph APM_SBP         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         BP_VAL[BP_VAL]         BP_NO[BP_NO]         DONE[DONE]         STAT[STAT]     end     REQ --- APM_SBP     BASE --- APM_SBP     SLOT --- APM_SBP     AXIS --- APM_SBP     BP_VAL --- APM_SBP     BP_NO --- APM_SBP     APM_SBP --- DONE     APM_SBP --- STAT </pre>	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis  BP_VAL: basic parameter value to change  BP_NO: basic parameter item number to change</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

## ■ Function

- (1) The instruction commands basic parameter teaching instruction to the positioning module.
- (2) The parameter modified by basic parameter setting instruction is valid only when the power is on. To save the parameter modified by basic parameter setting instruction, it is necessary to save the parameter value modified by save parameter/run data save instruction (WRT) to ROM after setting basic parameter.
- (3) It commands basic parameter setting instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis
- (5) The following values can be set in the basic parameter item number.
  - 1: speed limit
  - 2: bias speed
  - 3: acc./dec. time 1
  - 4: acc./dec. time 2
  - 5: acc./dec. time 3
  - 6: acc./dec. time 4
  - 7: no. of pulse per rotation
  - 8: conveyance distance per rotation
  - 9: pulse output mode
  - 10: unit
  - 11: unit allocation

### ■ Program example

#### 1. ST

```
INST_APM_SBP(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,  
BP_NO:=EP_USINT*), BP_VAL:=BP_UDINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_SEP</b>	<b>Extension parameter teaching</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis  EP_VAL: Extension parameter value to change  EP_NO: Extension parameter number to change</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

## ■ Function

- (1) The instruction commands extension parameter teaching instruction to the positioning module.
- (2) The parameter modified by extension parameter setting instruction is valid only when the power is on. To save the parameter modified by extension parameter setting instruction, it is necessary to save the parameter value modified by save parameter/run data save instruction (WRT) to ROM after setting extension parameter.
- (3) It commands extension parameter setting instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis
- (5) The following values can be set in the extension parameter item number.
  - 1: Software upper limit
  - 2: Software lower limit
  - 3: Backlash compensation
  - 4: Position completion output time
  - 5: S-Curve rate
  - 6: External instruction selection
  - 7: Pulse output direction
  - 8: Acc./dec. pattern
  - 9: M code number
  - 10: Position display during uniform run
  - 11: Upper/lower limit display during uniform run
  - 12: External speed/position control conversion allowed
  - 13: External instruction allowed
  - 14: External stop allowed
  - 15: External simultaneous run allowed



16: Positioning completion condition

17: Driver ready/in-position

### ■ Program example

#### 1. ST

```
INST_APM_SEP(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,  
EP_NO:=NO_USINT, EP_VAL:=EP_DINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_SHP</b>	<b>Origin return parameter setting</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis  HP_VAL: origin return parameter value to change  HP_NO: origin return parameter item number to change</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

## ■ Function

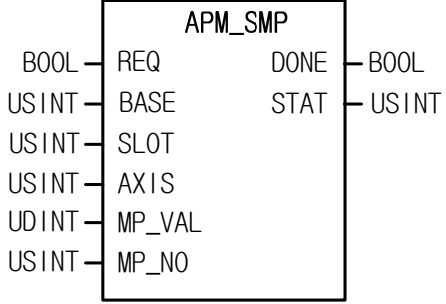
- (1) The instruction commands an origin return parameter teaching instruction to the positioning module.
- (2) The parameter modified by origin return parameter setting instruction is valid only when the power is on. To save the parameter modified by origin return parameter setting instruction, it is necessary to save the parameter value modified by save parameter/run data save instruction (WRT) to ROM after setting origin return parameter.
- (3) It commands origin return parameter teaching instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis
- (5) The values to set to origin return parameter items are as follows.
  - 1: Origin address
  - 2: Origin return high speed
  - 3: Origin return low speed
  - 4: Acc./dec. time of origin return
  - 5: Dwell time of origin return
  - 6: Origin compensation
  - 7: Re-run time of origin return
  - 8: Origin return mode
  - 9: Origin return direction

### ■ Program example

#### 1. ST

```
INST_APM_SHP(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,  
HP_NO:=NO_USINT, HP_VAL:=HP_DINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_SMP</b>	<b>Manual run parameter teaching</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis  MP_VAL: Manual run parameter value to change  MP_NO: Manual run parameter item number to change</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

## ■ Function

- (1) The instruction commands manual run parameter teaching instruction to the positioning module.
- (2) The parameter modified by manual run parameter teaching instruction is valid only when the power is on. To save the parameter modified by manual run parameter teaching instruction, it is necessary to save the parameter value modified by parameter/run data save instruction (WRT) to ROM after setting manual run parameter teaching.
- (3) It commands manual run parameter teaching instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis
- (5) The values to set in manual run parameter item number are as follows.  
1: Jog high speed  
2: Jog low speed  
3: Jog acc./dec. time  
4: Inching speed

## ■ Program example

1. ST

```
INST_APM_SMP(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
MP_NO:=NO_USINT, MP_VAL:=MP_UDINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_SIP</b>	<b>Input signal parameter teaching</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     subgraph APM_SIP         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         IP_VAL[IP_VAL]         DONE[DONE]         STAT[STAT]     end     REQ --- APM_SIP     BASE --- APM_SIP     SLOT --- APM_SIP     AXIS --- APM_SIP     IP_VAL --- APM_SIP     APM_SIP --- DONE     APM_SIP --- STAT         </pre>	<p><b>Input</b></p> <p>REQ: requires to execute the function block          BASE: Setting the base number with a module          SLOT: Setting the slot number with a module          AXIS: Setting an axis to instruct                0:X axis, 1:Y axis, 2:Z axis          IP_VAL: External signal parameter value to change / setting the signal allocated by each bit.</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation          STAT: Output the error number that occurs while executing the function block.</p>

### ■ Function

- The instruction commands input signal parameter teaching to the positioning module.
- The parameter modified by input signal parameter teaching instruction is valid only when the power is on. To save the parameter modified by input signal parameter setting instruction, it is necessary to save the parameter value modified by save parameter/run data save instruction (WRT) to ROM after setting external signal parameter.
- It commands input signal parameter teaching to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
 0: X axis, 1: Y axis, 2: Z axis
- The setting of each input signal setting area has the following meaning.  
 0: contact A, 1: contact B

The signals allocated to each bit of input signal parameter value to change are as follows.

Bit	Input signal	Bit	Q signal
0	Upper limit signal	6	Instruction signal
1	Lower limit signal	7	Sub instruction signal
2	Approx. origin signal	8	Speed/position conversin signal
3	Origin signal	9	Driver ready/in-position signal
4	Emergency stop signal	10	External simultaneous run signal
5	Dec. stop signal	15 ~ 11	-

### ■ Program example

1. ST

```
INST_APM_SIP(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,  
IP_VAL:=IP_WORD, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

APM_SCP	Common parameter teaching	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     subgraph APM_SCP         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         CP_VAL[CP_VAL]         CP_NO[CP_NO]         DONE[DONE]         STAT[STAT]     end     REQ --&gt; APM_SCP     BASE --&gt; APM_SCP     SLOT --&gt; APM_SCP     AXIS --&gt; APM_SCP     CP_VAL --&gt; APM_SCP     CP_NO --&gt; APM_SCP     APM_SCP --&gt; DONE     APM_SCP --&gt; STAT         </pre>	<p><b>Input</b></p> <p>REQ: requires to execute the function block          BASE: Setting the base number with a module          SLOT: Setting the slot number with a module          AXIS: Setting an axis to instruct                0:X axis, 1:Y axis, 2:Z axis          CP_VAL: Common parameter value to change          CP_NO: Common parameter item number to change</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation          STAT: Output the error number that occurs while executing the function block.</p>

### ■ Function

- The instruction commands common parameter teaching instruction to the positioning module.
- The parameter modified by common parameter setting instruction is valid only when the power is on. To save the parameter modified by common parameter setting instruction, it is necessary to save the parameter value modified by using save parameter/run data instruction (WRT) to ROM after common parameter teaching.
- It commands common parameter teaching instruction to the axis configured as the positioning axis configured as BASE (base number of positioning module) and SLOT (slot number of positioning module).
- It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
   0: X axis,   1: Y axis,   2: Z axis
- The values to set in common parameter item number are as follows.
  - Pulse Output level
  - Circular interpolation method
  - Encoder Input mode
  - Encoder Auto Reload value
  - ZONE Output mode
  - ZONE1 axis setting
  - ZONE2 axis setting
  - ZONE3 axis setting
  - ZONE1 On area
  - ZONE1 Off area
  - ZONE2 On area
  - ZONE2 Off area
  - ZONE3 On area
  - ZONE3 Off area

### ■ Program example

1. ST

```
INST_APM_SCP(REQ:=REQ_BOOL,    BASE:=BASE_USINT,    SLOT:=SLOT_USINT,    AXIS:=AXIS_USINT,  
CP_NO:=NO_USINT, CP_VAL:=CP_DINT, ENC_LD:=ENC_UDINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```



<b>APM_SMD</b>	<b>Run data teaching</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     subgraph APM_SMD         REQ[REQ] --&gt; DONE[DONE]         BASE[BASE] --&gt; STAT[STAT]         SLOT[SLOT]         AXIS[AXIS]         STEP[STEP]         MD_VAL[MD_VAL]         MD_NO[MD_NO]     end     REQ --- REQ_BOOL[REQ BOOL]     BASE --- BASE_USINT[BASE US INT]     SLOT --- SLOT_USINT[SLOT US INT]     AXIS --- AXIS_USINT[AXIS US INT]     STEP --- STEP_USINT[STEP US INT]     MD_VAL --- MD_VAL_DINT[MD_VAL D INT]     MD_NO --- MD_NO_USINT[MD_NO US INT]     DONE --- DONE_BOOL[DONE BOOL]     STAT --- STAT_USINT[STAT US INT]         </pre>	<p><b>Input</b></p> <p>REQ: requires to execute the function block          BASE: Setting the base number with a module          SLOT: Setting the slot number with a module          AXIS: Setting an axis to instruct                0:X axis, 1:Y axis, 2:Z axis          STEP: Run step number to change                0 ~ 400          MD_VAL: Run data value to change          MD_NO: Run data item number to change</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation          STAT: Output the error number that occurs while executing the function block.</p>

### ■ Function

- (1) The instruction commands run data teaching instruction to the positioning module.
- (2) The parameter modified by run data teaching instruction is valid only when the power is on. To save the parameter modified by run data setting instruction, it is necessary to save the parameter value modified by using save parameter/run data instruction to ROM.
- (3) It commands run data teaching instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
       0: X axis,   1: Y axis,   2: Z axis
5. The following values can be set into the run data item number.
  - 1: target position
  - 2: circular interpolation sub point
  - 3: target speed
  - 4: dwell time
  - 5: M code
  - 6: control method
  - 7: run mode
  - 8: run pattern
  - 9: coordinate
  - 10: acc./dec. number
  - 11: circular interpolation direction

### ■ Program example

1. ST

```
INST_APM_SMD(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,  
STEP:=STEP_UINT, MD_NO:=NO_USINT, MD_VAL:=MD_DINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_EMG</b>	<b>Emergency stop</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

### ■ Function

- (1) The instruction commands emergency stop instruction to the positioning module.
- (2) It commands Emergency stop instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (3) It is executed when stopping running due to emergency situation and every axis receiving the instruction would stop.
- (4) Since it is converted to output prohibition and origin not determined, to resume running, it needs to cancel output prohibition and determine the origin again.

### ■ Program example

1. ST

```
INST_APM_EMG(REQ:=REQ_BOOL,    BASE:=BASE_USINT,    SLOT:=SLOT_USINT,    DONE=>DONE_BOOL,
STAT=>STAT_UINT);
```

<b>APM_RST</b>	<b>Error reset/Output prohibition cancel</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis  INH_OFF: Output prohibition cancellation  0: Error reset  1: Error reset/Output prohibition cancellation</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

## ■ Function

- (1) The instruction commands error reset/output prohibition cancellation to the positioning module.
- (2) It commands error reset/output prohibition cancel instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis (in case of XEC, Z axis is not supported)
- (4) It is executed when canceling the status of pulse output prohibited by external emergency stop or upper/lower limit detection or resetting an error that occurs when parameter is out of the range or while running.

## ■ Program example

### 1. ST

```
INST_APM_RST(REQ:=REQ_BOOL,    BASE:=BASE_USINT,    SLOT:=SLOT_USINT,    AXIS:=AXIS_USINT,
INH_OFF:=INH_BOOL, DONE=>DOONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_PST</b>	<b>Point run</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis  PST_CMT: Setting the number of point run step  0 ~ 19  PST_VAL: Setting the point run step number  0 ~ 400</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

### ■ Function

- (1) The instruction commands point run instruction to the positioning module.
- (2) It commands point run instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis
- (4) It executes when continuously running without stop by one instruction by setting max. 20 run steps in case of PTP (point to point) run.
- (5) If other value is set in PST\_CNT or PST\_VAL, it generates "Error6."

### ■ Program example

1. ST

```
INST_APM_PST(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
PST_CNT:=CNT_USINT, PST_VAL:=ARY_PST, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_WRT</b>	<b>Save parameter/run data</b>	
	Availability	XGI, XGR, XEC
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis  WRT_AXIS: Setting save axis(by setting each bit)  0bit:X axis, 1bit:Y axis, 2bit:Z axis</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

## ■ Function

- (1) The instruction commands save parameter/run data instruction to the positioning module.
- (2) It commands save parameter/run data instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis
- (4) It commands the instruction to save the current run parameter and run data of the axis set in WRT\_AXIS to Flash ROM.

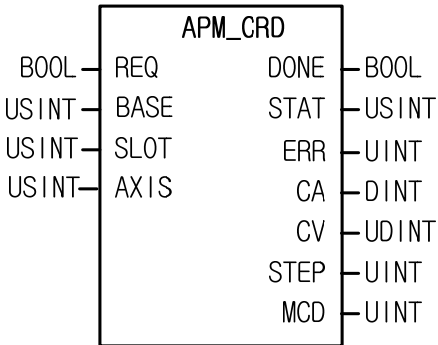
## ■ Program example

1. ST

```
INST_APM_WRT(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
WRT_AXIS:=WRT_USINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

APM_CRD	Read run info	
	Availability	XGI, XGR
	Flags	

Function Block	Description
 <pre> graph LR     subgraph APM_CRD [APM_CRD]         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         DONE[DONE]         STAT[STAT]         ERR[ERR]         CA[CA]         CV[CV]         STEP[STEP]         MCD[MCD]     end     REQ --- APM_CRD     BASE --- APM_CRD     SLOT --- APM_CRD     AXIS --- APM_CRD     APM_CRD --- DONE     APM_CRD --- STAT     APM_CRD --- ERR     APM_CRD --- CA     APM_CRD --- CV     APM_CRD --- STEP     APM_CRD --- MCD         </pre>	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.  ERR: display error during operation  CA: display current position address  CV: display current run speed  STEP: display current run data step number  MCD: display current MCode value</p>

### ■ Function

- (1) The instruction commands read run info instruction to the positioning module.
- (2) It commands Read current run info instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis
- (4) It can monitor by reading the current position address, run speed, run data number and M code number of the preset axis or be used in a user program.

### ■ Program example

1. ST

```

NST_APM_CRD(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
DONE=>DONE_BOOL, STAT=>STAT_UINT, ERR=>ERR_UINT, CA=>CA_DINT, CV=>CV_UDINT,
STEP=>STEP_UINT, MCD=>MCD_UINT);
    
```

<b>APM_SRD</b>	<b>Read run state</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.  ST1: state 1  ST2: state 2  ST3: state 3  ST4: state 4  ST5: state 5  ST6: state 6  ST7: state 7</p>

## ■ Function

- (1) The instruction commands read run state run instruction to the positioning module.
- (2) It commands Read run state instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis
- (4) The content of ST1 ~ ST7, the output variables of current run state bit read function block is important information that should be applied in the program.
- (5) Each bit of ST1 ~ ST4 has the following meaning.

	B i t	Description	B i t	Description
ST1	[ 0 ]	Running(0: stop, 1: BUSY)	[ 4 ]	Origin determined (0: not determined, 1: completed)
	[ 1 ]	Error state	[ 5 ]	Pulse Output prohibited (0: allowed, 1: prohibited)
	[ 2 ]	Positioning complete	[ 6 ]	Stop



## Ch 11. Communication and Special Function Blocks

	Bit	Description	Bit	Description
	]		]	
	[ 3 ]	M Code On signal (0: Off, 1: On)	[ 7 ]	-
ST2	[ 0 ]	Upper limit detected	[ 4 ]	Accelerating
	[ 1 ]	Lower limit detected	[ 5 ]	Constant speed
	[ 2 ]	Emergency stop state	[ 6 ]	Decelerating
	[ 3 ]	Direction (0: forward, 1: reverse)	[ 7 ]	Dwelling
ST3	[ 0 ]	1 axis position control	[ 4 ]	2 axes circular interpolating
	[ 1 ]	1 axis speed control	[ 5 ]	Origin return running
	[ 2 ]	2 axes linear interpolation	[ 6 ]	Position synchronization running
	[ 3 ]	3 axes linear interpolation	[ 7 ]	Speed synchronization running
ST4	[ 0 ]	Jog low speed running	[ 4 ]	Returning to the position before manual run
	[ 1 ]	Jog high speed running	[ 5 ]	-
	[ 2 ]	Inching running	[ 6 ]	-
	[ 3 ]	MPG running	[ 7 ]	-

(6) Each bit of ST5 ~ ST7 has the following meaning, respectively.

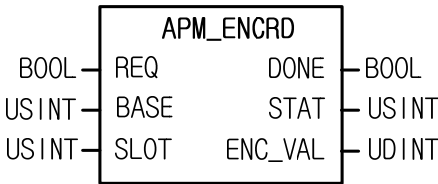
	Bit	Description	Bit	Description
ST5	[0]	Axis state(0: sub, 1: main)	[4]	Main axis info[Encoder]
	[1]	Main axis info(X axis)	[5]	-
	[2]	Main axis info(Y axis)	[6]	-
	[3]	Main axis info(Z axis)	[7]	-
ST6	[0]	Emergency stop signal	[4]	Upper limit signal
	[1]	External stop signal	[5]	Lower limit signal
	[2]	External command signal	[6]	Origin signal
	[3]	Jog high speed reverse signal	[7]	Approx. origin signal
ST7	[0]	Speed/position control conversion signal	[4]	-
	[1]	Driver ready/in-position signal	[5]	-
	[2]	External simultaneous run signal	[6]	-
	[3]	-	[7]	-

### ■ Program example

#### 1. ST

```
INST_APM_SRD(REQ:=REQ_BOOL,    BASE:=BASE_USINT,    SLOT:=SLOT_USINT,    AXIS:=AXIS_USINT,
DONE=>DONE_BOOL, STAT=>STAT_UINT, ST1=>ARY_ST1, ST2=>ARY_ST2, ST3=> ARY_ST3, ST4=> ARY_ST4,
ST5=> ARY_ST5, ST6=> ARY_ST6, ST7=> ARY_ST7);
```

<b>APM_ENCRD</b>	<b>Read encoder value</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.  ENC_VAL: current encoder value</p>

### ■ Function

- (1) The instruction commands read encoder value instruction to the positioning module.
- (2) It commands Read encoder value instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).

### ■ Program example

ST

```
INST_APM_ENCRD(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, DONE=>DONE_BOOL,
STAT=>STAT_UINT, ENC_VAL=>ENC_UDINT);
```

<b>APM_JOG</b>	<b>Jog run</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis  JOG_DIR: Setting rotation direction of jog run  0: forward, 1: reverse  LOW/HIGH: Setting jog run speed  0: low speed jog run  1: high speed jog run</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block.</p>

### ■ Function

- (1) The instruction commands jog run instruction to the positioning module.
- (2) The manual run function for test is used to verify the address for system operation, wiring state and teaching.
- (3) If connection condition of input variable REQ is on, pulse is output by the value; it stops in case of off.
- (4) It commands jog run instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (5) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
0: X axis, 1: Y axis, 2: Z axis

### ■ Program example

#### 1. ST

```
INST_APM_JOG(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
JOG_DIR:=JOG_BOOL, LOW_HIGH:=LOW_HIGH_BOOL, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>APM_MPG</b>	<b>Manual pulse generator(MPG) run</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis  MPG_EN: MPG run allowed/prohibited setting  0: prohibited, 1: allowed</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block</p>

### ■ Function

- (1) It commands to instruct positioning module to execute MPG run.
  - (2) Instruct positioning module to be ready for running when it is necessary to run by using externally installed MPG.
  - (3) It commands MPG run instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
  - (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."
- 0: X axis, 1: Y axis, 2: Z axis

### ■ Program example

ST

```
INST_APM_MPG(REQ:=REQ_BOOL,    BASE:=BASE_USINT,    SLOT:=SLOT_USINT,    AXIS:=AXIS_USINT,
MPG_EN:=MPG_BOOL, DONE=>DONE_BOOL, STAT=>STAT_USINT);
```

<b>APM_RCP</b>	<b>Current position section repetition</b>	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<div style="display: flex; align-items: center; justify-content: center;"> <div style="display: flex; flex-direction: column; align-items: center;"> <div>BOOL</div> <div>USINT</div> <div>USINT</div> <div>USINT</div> <div>DINT</div> <div>BOOL</div> </div> <div style="border: 1px solid black; padding: 10px; text-align: center; margin: 0 10px;"> <b>APM_RCP</b>  <div style="display: flex; justify-content: space-between;"> <div>REQ</div> <div>DONE</div> </div> <div style="display: flex; justify-content: space-between;"> <div>BASE</div> <div>STAT</div> </div> <div>SLOT</div> <div>AXIS</div> <div>POS</div> <div>EN</div> </div> <div style="display: flex; flex-direction: column; align-items: center;"> <div>BOOL</div> <div>USINT</div> </div> </div>	<p><b>Input</b></p> <p>REQ: requires to execute the function block</p> <p>BASE: Setting the base number with a module</p> <p>SLOT: Setting the slot number with a module</p> <p>AXIS: Setting an axis to instruct 0:X axis, 1:Y axis, 2:Z axis</p> <p>POS: Setting repetition position(address): -2,147,483,648 ~ 2,147,483,647</p> <p>EN : Enable current position section repetition 0: Prohibit current position section repetition 1: Enable current position section repetition</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation</p> <p>STAT: Output the error number that occurs while executing the function block</p>

## ■ Function

- (1) It commands to instruct positioning module to set or prohibit current position section repetition.
- (2) It only operates at direct start.
- (3) It commands RCP run instruction to the configured AXIS of the positioning module where it is configured at BASE (base number of positioning module) and SLOT (slot number of positioning module).
- (4) For "AXIS", you can configure the axis to give an instruction. If other value is set, it produces "Error6."

## ■ Program example

ST

```
INST_APM_RCP(REQ:=(*BOOL*),   BASE:=(*USINT*),   SLOT:=(*USINT*),   AXIS:=(*USINT*),   POS:=(*DINT*),
DONE=>(*BOOL*), STAT=>(*UINT*))
```

APM_VRD	Read Variable Data	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<div style="display: flex; align-items: center;"> <div style="margin-right: 10px;">             BOOL — REQ              USINT — BASE              USINT — SLOT              USINT — AXIS              UDINT — S_ADDR              UDINT — OFFSET              UINT — SIZE              UINT — CNT           </div> <div style="border: 1px solid black; padding: 5px; text-align: center; flex-grow: 1;"> <b>APM_VRD</b>              DONE — BOOL              STAT — UINT              VAR — UINT[128]           </div> </div>	<p><b>Input</b></p> <p>REQ: requires to execute the function block            BASE: Setting the base number with a module            SLOT: Setting the slot number with a module            AXIS: Setting an axis to instruct                  0:X axis, 1:Y axis, 2:Z axis            S_ADDR: Head address of data in module internal memory to read (0 ~ 12147)            OFFSET: Offset between Read data blocks                  0 ~ 53329            SIZE : Size of Read data block : 1 ~ 128            CNT : No. of Read data block : 1 ~ 128</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation            STAT: Output the error number that occurs while executing the function block            VAR : PLC device where Read data is saved</p>

### ■ Function

- (1) It commands to instruct positioning module to read parameter, operation data directly
- (2) You can read data you want by designating the module internal memory address of parameter and operation data
- (3) It reads the positioning module internal memory from the position set by "S\_ADDR" by WORD unit and save them in the device set by "VAR". The number of data to read is the number set by "Size". In case "CNT" is larger than 2, it reads multiple data blocks and save them in the device set by "VAR" in order. At this time, head address of next block is "Offset" apart from head address of current block.
- (4) Max. data size one instruction can read (SIZE x CNT) is 128 WORD
- (5) "VRD" instruction can be executed during operation
- (6) For "AXIS", you can configure the axis to give an instruction. If other value is set, it produces "Error6."
- (7) If Read data size (SIZE x CNT) is 0 or larger than 128 WORD, error "11" occurs at STAT.

### ■ Program example

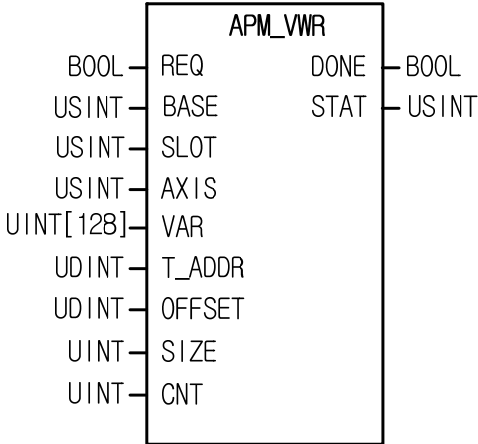
#### 1. ST

```

INST_APM_VRD(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*),
S_ADDR:=(*UINT*), OFFSET:=(*UINT*), SIZE:=(*UINT*), CNT:=(*UINT*), DONE=>(*BOOL*), STAT=>(*UINT*),
R=>(*ARRAY[0..127]_OF_UINT*))
  
```

APM_VWR	Write Variable Data	
	Availability	XGI, XGR
	Flags	

Function Block	Description
 <pre> graph LR     subgraph APM_VWR         REQ[REQ] --&gt; FB         BASE[BASE] --&gt; FB         SLOT[SLOT] --&gt; FB         AXIS[AXIS] --&gt; FB         VAR[VAR] --&gt; FB         T_ADDR[T_ADDR] --&gt; FB         OFFSET[OFFSET] --&gt; FB         SIZE[SIZE] --&gt; FB         CNT[CNT] --&gt; FB         FB[ ]     end     FB --&gt; DONE[DONE]     FB --&gt; STAT[STAT]         </pre>	<p><b>Input</b></p> <p>REQ: requires to execute the function block  BASE: Setting the base number with a module  SLOT: Setting the slot number with a module  AXIS: Setting an axis to instruct  0:X axis, 1:Y axis, 2:Z axis  VAR : PLC device where data to write is saved  T_ADDR: module internal memory head address to write data 0 ~ 12147</p> <p>OFFSET : Offset between Write data blocks  0 ~ 53329  SIZE : Size of Write data block : 1 ~ 128  CNT : No. of Write data block : 1 ~ 128</p> <p><b>Output</b></p> <p>DONE: maintains 1 after the first operation  STAT: Output the error number that occurs while executing the function block</p>

## ■ Function

- (1) It commands to instruct positioning module to write parameter, operation data directly
- (2) You can read data you want by configure the module internal memory address of parameter and operation data
- (3) It writes the WORD data in "VAR" to module internal memory. The data are saved from internal memory position set by "T\_ADDR" and the number of data is the number set by "Size". In case the number of block "CNT" is larger than 2, multiple blocks are made. At this time, head address of next block is "Offset" apart from head address of current block.
- (4) Max. data size one instruction can read (SIZE x CNT) is 128 WORD
- (5) "VWR" instruction can executes during operation
- (6) For "AXIS", you can designate the axis to give an instruction. If other value is set, it produces "Error6."
- (7) If Write data size (SIZE x CNT) is 0 or larger than 128 WORD, error "11" occurs at STAT.

## ■ Program example

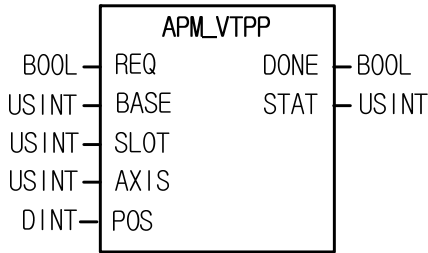
### 1. ST

```

INST_APM_VWR(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*),
VAR:=(*ARRAY[0..127]_OF_UINT*), T_ADDR:=(*UINT*), OFFSET:=(*UINT*), SIZE:=(*UINT*), CNT:=(*UINT*),
DONE=>(*BOOL*), STAT=>(*UINT*))
        
```



<b>APM_VTPP</b>	Position specified Speed/Position Switching Control	
	Availability	XGI, XGR
	Flags	

Function Block	Description
 <pre> graph LR     subgraph APM_VTPP         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         POS[POS]         DONE[DONE]         STAT[STAT]     end     REQ --&gt; APM_VTPP     BASE --&gt; APM_VTPP     SLOT --&gt; APM_VTPP     AXIS --&gt; APM_VTPP     POS --&gt; APM_VTPP     APM_VTPP --&gt; DONE     APM_VTPP --&gt; STAT         </pre>	<p><b>Input</b></p> <p>REQ : Request for execution of function block          BASE : Set the base no. with module          SLOT : Set the slot no. with module          AXIS : Axis to command                  0:X axis, 1:Y axis, 2:Z axis          POS: transfer amount                  1 ~2,147,483,647</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating          STAT : Output the error no. in operation</p>

### ■ Function

- (1) Give "Position specified Speed/Position Switching Control" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) When the configured axis receives speed/position control switching command in speed control operation, speed control changes to position control and move by transfer amount configured by POS.
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
         0:X axis, 1:Y axis, 2:Z axis

### ■ Program example

#### 1. ST

```

INST_APM_VTPP(REQ:=(*BOOL*),   BASE:=(*USINT*),   SLOT:=(*USINT*),   AXIS:=(*USINT*),   POS:=(*DINT*),
DONE=>(*BOOL*), STAT=>(*UINT*));
    
```

## 11.5 Positioning Function Block (XPM)

<b>XPM_ORG</b>	Homing Start	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  XPM: 1 ~ 4 (1-axis ~4-axis)  XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operation  STAT : Output the error no in operation</p>

### ■ Function

- (1) This is the command that give homing command to XPM module.
- (2) This is the command to find the origin of machine by Direction, Correction, Speed, Address and Dwell set on parameter of each axis for homing according to the homing access.
- (3) Give “Homing” command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces “Error6.”  
XPM: 1 ~ 4 ( 1-axis ~ 4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)
- (5) If homing command executes normally, it starts homing according to “homing method” of “homing parameter”.

### ■ Program example

1. ST

```
INST_XPM_ORG(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), DONE=>(*BOOL*),  
STAT=>(*UINT*))
```

<b>XPM_FLT</b>	Floating Origin Setting	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     subgraph XPM_FLT         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         DONE[DONE]         STAT[STAT]     end     REQ_IN[BOOL] --&gt; REQ     BASE_IN[USINT] --&gt; BASE     SLOT_IN[USINT] --&gt; SLOT     AXIS_IN[USINT] --&gt; AXIS     DONE --&gt; DONE_OUT[BOOL]     STAT --&gt; STAT_OUT[UINT]         </pre>	<p><b>Input</b></p> <p>REQ : Request for execution of function block          BASE : Set the base no. with module          SLOT : Set the slot no. with module          AXIS : Axis to command              XPM: 1 ~ 4 (1-axis ~4-axis)              XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating          STAT : Output the error no. in operation</p>

### ■ Function

- (1) Give "Floating Origin" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) This command is for setting the current position as the origin by compulsion. The address value saved on homing address will be the current position.
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
 XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

### ■ Program example

1. ST

```
INST_XPM_FLT(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), DONE=>(*BOOL*),
STAT=>(*UINT*))
```

<b>XPM_DST</b>	Direct Start	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     subgraph XPM_DST         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         ADDR[ADDR]         SPEED[SPEED]         DWELL[DWELL]         MCODE[MCODE]         CTRL[CTRL]         ABS_INC[ABS/INC]         ACC_SEL[ACC_SEL]         DEC_SEL[DEC_SEL]         DONE[DONE]         STAT[STAT]     end     REQ_BOOL[BOOL] --- REQ     BASE_USINT[USINT] --- BASE     SLOT_USINT[USINT] --- SLOT     AXIS_USINT[USINT] --- AXIS     ADDR_DINT[DINT] --- ADDR     SPEED_UDINT[UDINT] --- SPEED     DWELL_UINT[UINT] --- DWELL     MCODE_UINT[UINT] --- MCODE     CTRL_USINT[USINT] --- CTRL     ABS_INC_BOOL[BOOL] --- ABS_INC     ACC_SEL_USINT[USINT] --- ACC_SEL     DEC_SEL_USINT[USINT] --- DEC_SEL     DONE_BOOL[BOOL] --- DONE     STAT_UINT[UINT] --- STAT         </pre>	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  XPM: 1 ~ 4 (1-axis ~4-axis)  XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)  ADDR : Destination position address setting  -2147483648 ~ +2147483647  SPEED : Destination speed setting  DWELL : Dwell time setting  0 ~ 65535[ms]  M code : M code value setting  CTRL : Control method setting  0: Position, 1: Speed, 2: Feed  ABS/INC: Absolute/Relative coordinates setting  0: Absolute, 1: Relative  ACC_SEL: Acc.time no. setting  0: Acc. Time 1, 1: Acc. Time 2  2: Acc. Time 3, 3: Acc. Time 4  DCC_SEL: Dec.time no. setting  0: Dec. time 1, 1: Dec. time 2  2: Dec. time 3, 3: Dec. time 4</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operation  STAT : Output the error no in operation</p>

## ■ Function

- (1) Give "Direct Start" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) This is for operating by setting destination position address, operation speed, dwell time, M code, control method, coordinates setting and no. of Acc./Dec time, not by operation data.
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)
- (4) If the value set on SPEED, CTRL, TIME\_SEL is out of setting range, "Error11" occur on STAT.

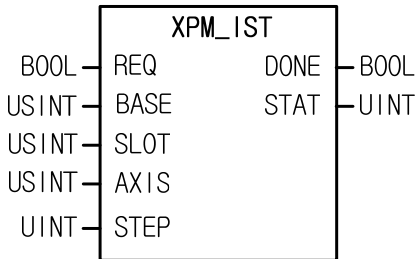
## ■ Program example

### 1. ST

```

INST_XPM_DST(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), ADDR:=(*DINT*),
SPEED:=(*UDINT*), DWELL:=(*UINT*), MCODE:=(*UINT*), CTRL:=(*USINT*), ABS_INC:=(*BOOL*),
ACC_SEL:=(*USINT*), DEC_SEL:=(*USINT*), DONE=>(*BOOL*), STAT=>(*UINT*))
    
```

<b>XPM_IST</b>	Direct Start	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  XPM: 1 ~ 4 (1-axis ~4-axis)  XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)  STEP : Set the step no. to do teaching  0 ~ 400</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operation  STAT : Output the error no in operation</p>

### ■ Function

- (1) Give "Indirect Start" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) This is for operating by setting operation step no. of axis which set as an operation data.
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)
- (4) If the value set on STEP is out of the setting range (0~400), "Error11" arises on STAT.
- (5) If the value set on STEP is 0, it operates the current step.
- (6) Linear interpolation, circular interpolation and helical interpolation execute in indirect start by setting the control method.

### ■ Program example

#### 1. ST

```
INST_APM_IST(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), STEP:=(*UINT*),
DONE=>(*BOOL*), STAT=>(*UINT*))
```

<b>XPM_SST</b>	Simultaneous Start	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> <p style="text-align: center;"><b>XPM_SST</b></p> <pre>       BOOL  REQ      DONE  BOOL     USINT  BASE      STAT  USINT     USINT  SLOT     USINT  SST_AXIS     UINT   A1_STEP     UINT   A2_STEP     UINT   A3_STEP     UINT   A4_STEP     UINT   A5_STEP     UINT   A6_STEP     UINT   A7_STEP     UINT   A8_STEP           </pre> </div>	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  SST_AXIS : Simultaneous axis setting            XPM: 0bit ~ 3bit: (1-axis ~4-axis)            XGF-PN8A/B: 0bit~7bit (1-axis~8-axis)            Set bit of each axis to select</p> <p>A1_STEP : step no. of axis1 to start  A2_STEP : step no. of axis2 to start  A3_STEP : step no. of axis3 to start  A4_STEP : step no. of axis4 to start  A5_STEP : Not use  A6_STEP : Not use  A7_STEP : Not use  A8_STEP : Not use</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operation  STAT : Output the error no in operation</p>

## ■ Function

- Give "Simultaneous Start" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- This is for starting 2~4 axes for XPM, 2~8 axes for XGF-PN8A at once..
- If you set a value out of setting range, "Error6" arises. Set with each bit as follows.

7bit	6bit	5bit	4bit	3bit	2bit	1bit	0bit
8-axis	7-axis-	6-axis	5-axis	4-axis	3-axis	2-axis	1-axis
- Set the step no. of each axis to execute simultaneous start on A1\_STEP ~ A4\_STEP.

## ■ Program example

### 1. ST

```

INST_XPM_SST1(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), SST_AXIS:=(*USINT*),
A1_STEP:=(*UINT*), A2_STEP:=(*UINT*), A3_STEP:=(*UINT*), A4_STEP:=(*UINT*), A5_STEP:=(*UINT*),
A6_STEP:=(*UINT*), A7_STEP:=(*UINT*), A8_STEP:=(*UINT*), DONE=>(*BOOL*), STAT=>(*UINT*))

```

<b>XPM_VTP</b>	Speed/Position Switching Control	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     REQ[REQ] --&gt; XPM_VTP     BASE[BASE] --&gt; XPM_VTP     SLOT[SLOT] --&gt; XPM_VTP     AXIS[AXIS] --&gt; XPM_VTP     XPM_VTP --&gt; DONE[DONE]     XPM_VTP --&gt; STAT[STAT]         </pre>	<p><b>Input</b></p> <p>REQ : Request for execution of function block          BASE : Set the base no. with module          SLOT : Set the slot no. with module          AXIS : Axis to command                  XPM: 1 ~ 4 (1-axis ~4-axis)                  XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating          STAT : Output the error no. in operation</p>

### ■ Function

- (1) Give “Speed/Position Switching Control” command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) When the configured axis receives speed/position control switching command in speed control operation, speed control changes to position control and keep operating by the position value at the beginning.
- (3) If this command executes, origin would be decided at the same time and it finishes the positioning after arrive at the destination position.
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces “Error6.”  
         XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

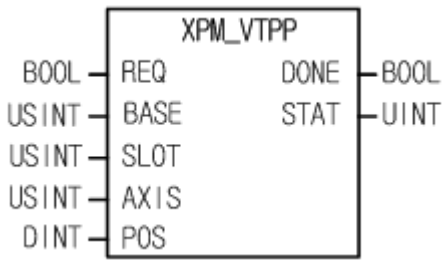
### ■ Program example

#### 1. ST

```

INST_XPM_VTP(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), DONE=>(*BOOL*),
STAT=>(*UINT*))
    
```

<b>XPM_VTPP</b>	Position specified Speed/Position Switching Control	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  XPM: 1 ~ 4 (1-axis ~4-axis)  XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)  POS: transfer amount  -2,147,483,648~2,147,483,647</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating  STAT : Output the error no. in operation</p>

## ■ Function

- (1) Give “Position specified Speed/Position Switching Control” command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) When the configured axis receives speed/position control switching command in speed control operation, speed control changes to position control and move by transfer amount configured by POS.
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces “Error6.”  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

## ■ Program example

### 1. ST

```
INST_XPM_VTPP(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), POS:=(*DINT*),
DONE=>(*BOOL*), STAT=>(*UINT*))
```



<b>XPM_PTV</b>	Position/Speed Switching Control	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     REQ[REQ] --&gt; XPM_PTV     BASE[BASE] --&gt; XPM_PTV     SLOT[SLOT] --&gt; XPM_PTV     AXIS[AXIS] --&gt; XPM_PTV     XPM_PTV --&gt; DONE[DONE]     XPM_PTV --&gt; STAT[STAT]         </pre>	<p><b>Input</b></p> <p>REQ : Request for execution of function block          BASE : Set the base no. with module          SLOT : Set the slot no. with module          AXIS : Axis to command              XPM: 1 ~ 4 (1-axis ~4-axis)              XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating          STAT : Output the error no. in operation</p>

### ■ Function

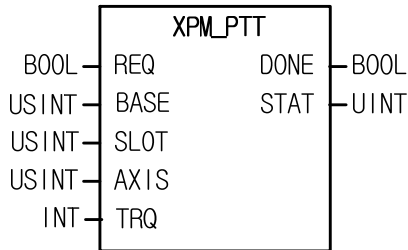
- (1) Give "Position/Speed Switching Control" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) When the configured axis is in positioning control operation, if it receives position/speed control switching command, positioning control operation changes into speed control operation and continue to operate until stop command.
- (3) Once the command executes, origin would not be assigned and then operate in speed control.
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
 XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

### ■ Program example

1. ST

```
INST_XPM_PTV(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), DONE=>(*BOOL*),
STAT=>(*UINT*))
```

<b>XPM_PTT</b>	Position/Torque Switching Control	
	Availability	XGI, XGR
	Flags	

Function Block	Description
 <pre> graph LR     subgraph XPM_PTT         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         TRQ[TRQ]         DONE[DONE]         STAT[STAT]     end     REQ_IN[BOOL] --&gt; REQ     BASE_IN[USINT] --&gt; BASE     SLOT_IN[USINT] --&gt; SLOT     AXIS_IN[USINT] --&gt; AXIS     TRQ_IN[INT] --&gt; TRQ     DONE --&gt; DONE_OUT[BOOL]     STAT --&gt; STAT_OUT[UINT]         </pre>	<p><b>Input</b></p> <p>REQ : Request for execution of function block          BASE : Set the base no. with module          SLOT : Set the slot no. with module          AXIS : Axis to command                  1 ~ 8 (1-axis ~ 8-axis)          TRQ: Torque value                -300~300</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating          STAT : Output the error no. in operation</p>

## ■ Function

- (1) Give "Position/Speed Switching Control" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) When the configured axis is in positioning control operation, if it receives the position/torque control switching command, the positioning control operation changes into the torque control operation with the torque value in TRQ and continues to operate until stop command.
- (3) The range of torque value is -300~300 and unit is [%]
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
1 ~ 8 (1-axis ~ 8-axis)
- (5) This instruction is only for XGF-PN8A/B.

## ■ Program example

1. ST

```

INST_XPM_PTT(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), TQR:=(*INT*),
DONE=>(*BOOL*), STAT=>(*UINT*))
    
```

<b>XPM_STP</b>	Deceleration Stop	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  XPM: 1 ~ 4 (1-axis ~4-axis)  XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)  DEC_TIME : Decelerating stop time  0: Acc./Dec. time applied when start operating  1 ~ 2147483647: 1 ~ 2147483647ms</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operation  STAT : Output the error no in operation</p>

### ■ Function

- (1) Give “Decelerating Stop” command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) If receive the stop command by operation data, it will stop operating and continue to operate by start command.
- (3) If “Decelerating Stop” executes in speed/position synchronization or CAM operation, speed/position synchronization or CAM operation stops depending on the state of the current operation control.
- (4) “Decelerating Stop” executes in not only acc./dec. area but also steady speed area.
- (5) Deceleration time means the time between the point of start decelerating and the point of stop and may be set to 0 ~ 2,147,483,647ms. But, if it is set to “0”, it stops by the time set at the starting of operation.
- (6) Decelerating time means the time between the speed limit of basic parameter and stop.
- (7) It can set an axis to instruct and the value is as follows. If other value is set, it produces “Error6.”  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

### ■ Program example

1. ST

```
INST_XPM_STP(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), DEC_TIME:=(*UDINT*),
DONE=>(*BOOL*), STAT=>(*UINT*))
```

<b>XPM_SKP</b>	Skip Operation	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  XPM: 1 ~ 4 (1-axis ~4-axis)  XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating  STAT : Output the error no. in operation</p>

## ■ Function

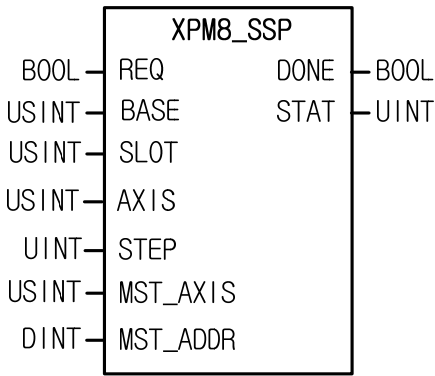
- (1) Give “Skip Operation” command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) This command is for operating the next step. That is, stop operating of the current step and then start operating the next step.
- (3) Skip a step at once.
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces “Error6.”  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

## ■ Program example

1. ST

```
INST_XPM_SKP(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), DONE=>(*BOOL*),
STAT=>(*UINT*))
```

<b>XPM_SSP</b>	Position Synchronization	
	Availability	XGI, XGR
	Flags	

Function Block	Description
 <pre> graph LR     subgraph XPM8_SSP         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         STEP[STEP]         MST_AXIS[MST_AXIS]         MST_ADDR[MST_ADDR]         DONE[DONE]         STAT[STAT]     end     REQ --- REQ_IN[REQ]     BASE --- BASE_IN[BASE]     SLOT --- SLOT_IN[SLOT]     AXIS --- AXIS_IN[AXIS]     STEP --- STEP_IN[STEP]     MST_AXIS --- MST_AXIS_IN[MST_AXIS]     MST_ADDR --- MST_ADDR_IN[MST_ADDR]     DONE --- DONE_OUT[DONE]     STAT --- STAT_OUT[STAT] </pre>	<p><b>Input</b></p> <p>REQ : Request for execution of function block</p> <p>BASE : Set the base no. with module</p> <p>SLOT : Set the slot no. with module</p> <p>AXIS : Axis to command</p> <p style="padding-left: 20px;">XPM: 1 ~ 4 (1-axis ~4-axis)</p> <p style="padding-left: 20px;">XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)</p> <p>STEP : Step no. to operate</p> <p style="padding-left: 20px;">0 ~ 400</p> <p>MST_AXIS : Set the main axis</p> <p style="padding-left: 20px;">XPM: 1 ~ 4 (1-axis ~4-axis)</p> <p style="padding-left: 20px;">XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)</p> <p style="padding-left: 20px;">9: Encoder</p> <p>MST_ADDR : Set the position of main axis</p> <p style="padding-left: 20px;">-2,147,483,648 ~ 2,147,483,647</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating</p> <p>STAT : Output the error no. in operation</p>

### ■ Function

- (1) Give "Synchronization Start" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) Operate operation step set by command axis after main axis comes to the position of synchronization.
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)
- (4) You may set the main axis on MST\_AXIS with following values. If other value is set, it produces "Error6."  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis), 9: Encoder

### ■ Program example

#### 1. ST

```

INST_XPM_SSP(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), STEP:=(*UINT*),
MST_AXIS:=(*USINT*), MST_ADDR:=(*DINT*), DONE=>(*BOOL*), STAT=>(*UINT*))

```

<b>XPM_SSS</b>	Speed Synchronization	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  XPM: 1 ~ 4 (1-axis ~4-axis)  XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)  MST_AXIS : Set main axis  XPM: 1 ~ 4 (1-axis ~4-axis)  XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis),  9: Encoder  MST_RAT : Set speed rate of main axis  -32768 ~ 32767  SLV_RAT : Set speed rate of sub axis  -32768 ~ 32767</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating  STAT : Output the error no. in operation</p>

## ■ Function

- (1) Give "Speed Synchronization" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) This command is for operating at the operation speed ratio between main axis and subordinate axis.
- (3) There is no rule about size of the speed ratio between main/sub axis. If the speed ratio of main axis is bigger than sub's, the main axis moves faster than sub axis. If the speed ratio of sub axis is bigger than main's, the sub axis moves faster than main.
- (4) Set an axis to command. If other value is set, it produces "Error6."  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)
- (5) You may set the main axis on MST\_AXIS with following values. If other value is set, it produces "Error6."  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis), 9: Encoder
- (6) The operating direction of subordinate depends on speed synchronization ratio ( $\frac{Sub}{Main}$ ). If it is positive, operate in direction of main axis. If it is negative, operate in reverse direction of main axis.

### ■ Program example

1. ST

```
INST_XPM_SSS(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), MST_AXIS:=(*USINT*),  
MST_RAT:=(*INT*), SLV_RAT:=(*INT*), DONE=>(*BOOL*), STAT=>(*UINT*))
```

<b>XPM_POR</b>	Position Override	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     REQ[REQ] --&gt; XPM_POR     BASE[BASE] --&gt; XPM_POR     SLOT[SLOT] --&gt; XPM_POR     XPM_POR --&gt; DONE[DONE]     XPM_POR --&gt; STAT[STAT]     POR_ADDR[DINT] --&gt; XPM_POR         </pre>	<p><b>Input</b></p> <p>REQ : Request for execution of function block          BASE : Set the base no. with module          SLOT : Set the slot no. with module          AXIS : Axis to command              XPM: 1 ~ 4 (1-axis ~4-axis)              XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)          POR_ADDR : Set a new goal position              -2,147,483,648 ~ 2,147,483,647</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating          STAT : Output the error no. in operation</p>

## ■ Function

- (1) Give "Position Override" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) This command is for changing the goal position in operation.
- (3) after passing override destination position, if position override command executes position module stops and turn back to the position set on POR\_ADDR.
- (4) Set the destination position to modify on POR\_ADDR.'
- (5) Override position set on position override is absolute coordinates.
- (6) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
 XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

## ■ Program example

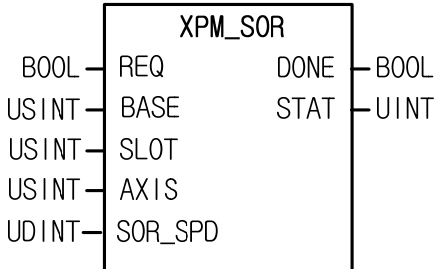
### 1. ST

```

INST_XPM_POR(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), POR_ADDR:=(*DINT*),
DONE=>(*BOOL*), STAT=>(*UINT*))
    
```



<b>XPM_SOR</b>	Speed Override	
	Availability	XGI, XGR
	Flags	

Function Block	Description
 <pre> graph LR     REQ[REQ] --&gt; XPM_SOR     BASE[BASE] --&gt; XPM_SOR     SLOT[SLOT] --&gt; XPM_SOR     AXIS[AXIS] --&gt; XPM_SOR     SOR_SPD[SOR_SPD] --&gt; XPM_SOR     XPM_SOR --&gt; DONE[DONE]     XPM_SOR --&gt; STAT[STAT]         </pre>	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  XPM: 1 ~ 4 (1-axis ~4-axis)  XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)  SOR_SPD : Set a new operation speed value</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating  STAT : Output the error no. in operation</p>

### ■ Function

- (1) Give “Speed Override” command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) This command is for changing the operating speed in operation.
- (3) It may be set to “%” or “Speed value (unit/time)” according to “Speed Override” value of common parameter.
- (4) If unit of Speed override is %, setting range is from 1 to 65,535. It means 0.01% ~ 655.35%.
- (5) If unit of speed override is speed value, the setting range is from 1 to speed limit. The speed limit is the value set on “Speed Limit” item of basic parameter and the unit of speed override is the same as unit of axis.
- (6) It can set an axis to instruct and the value is as follows. If other value is set, it produces “Error6.”  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

### ■ Program example

1. ST

```

INST_XPM_SOR(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), SOR_SPD:=(*UDINT*),
DONE=>(*BOOL*), STAT=>(*UINT*))
    
```

<b>XPM_PSO</b>	Position Assigned Speed Override	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  XPM: 1 ~ 4 (1-axis ~4-axis)  XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)  PSO_ADDR : The position to change speed  -2,147,483,648 ~ 2,147,483,647  PSO_SPD : Set new speed value</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating  STAT : Output the error no. in operation</p>

## ■ Function

- (1) Give “Position Assigned Speed Override” command to the axis designated as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) This command is for changing operating speed in operation after command axis arrive at definite position.
- (3) The speed value set on PSO\_SPD will be “% Designation” or “Speed value Designation” depending on the value set on “Speed Override” of common parameter.
- (4) If unit of speed value is %, the setting range is from 1 ~ 65,535 and it means 0.01% ~ 655.35%.
- (5) It can set an axis to instruct and the value is as follows. If other value is set, it produces “Error6.”  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

## ■ Program example

1. ST

```
INST_XPM_PSO(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), PSO_ADDR:=(*DINT*),
PSO_SPD:=(*UDINT*), DONE=>(*BOOL*), STAT=>(*UINT*))
```

<b>XPM_NMW</b>	Continuous Operation	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  XPM: 1 ~ 4 (1-axis ~4-axis)  XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating  STAT : Output the error no. in operation</p>

### ■ Function

- (1) Give “Continuous Operation” command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) This command is for command axis to continue to operate the next step without stop.
- (3) If this command executes, the current step no. would be changed to the next step no. and continue to execute positioning operation at the next step speed to the goal position.
- (4) Continuous Operation command only changes the current operation pattern, not changes operation data.
- (5) It can set an axis to instruct and the value is as follows. If other value is set, it produces “Error6.”  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

### ■ Program example

1. ST

```
INST_XPM_NMV(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), DONE=>(*BOOL*),  
STAT=>(*UINT*))
```

<b>XPM_INC</b>	Inching Operation	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  XPM: 1 ~ 4 (1-axis ~4-axis)  XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)  INCH_VAL: Amount of movement by Inching Operation  -2,147,483,648 ~ 2,147,483,647</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating  STAT : Output the error no. in operation</p>

## ■ Function

- (1) Give “Inching Operation” command to the axis designated as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) This command is a kind of manual operation for process a minute movement as an operation of fixed amount.
- (3) Speed of inching operation is set on manual operation parameter.
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces “Error6.”  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

## ■ Program example

1. ST

```
INST_XPM_INC(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), INCH_VAL:=(*DINT*),
DONE=>(*BOOL*), STAT=>(*UINT*))
```

<b>XPM_RTP</b>	Returning to Previous Manual Operation Position	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  XPM: 1 ~ 4 (1-axis ~4-axis)  XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating  STAT : Output the error no. in operation</p>

### ■ Function

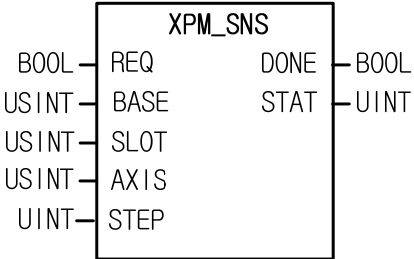
- (1) Give “Returning to previous manual operation” command to the axis designated as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) When the position is changed by manual operation, this command may move the axis to previous manual operation position.
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces “Error6.”  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

### ■ Program example

1. ST

```
INST_XPM_RTP(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), DONE=>(*BOOL*),
STAT=>(*UINT*))
```

<b>XPM_SNS</b>	Start Step Number Change	
	Availability	XGI, XGR
	Flags	

Function Block	Description
 <pre> graph LR     subgraph XPM_SNS         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         STEP[STEP]         DONE[DONE]         STAT[STAT]     end     REQ --- DONE     BASE --- STAT     SLOT --- STAT     AXIS --- STAT     STEP --- STAT         </pre>	<b>Input</b> REQ : Request for execution of function block BASE : Set the base no. with module SLOT : Set the slot no. with module AXIS : Axis to command XPM: 1 ~ 4 (1-axis ~4-axis) XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis) STEP : Set the operation step no. to operate 1 ~ 400  <b>Output</b> DONE : Maintain 1 after first operating STAT : Output the error no. in operation

## ■ Function

- (1) Give "Start Step no. Change" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) This command is for changing the operation step of command axis.
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)
- (4) Set the step no. on STEP. The setting range is 1 ~ 400, If other value is set, it produces "Error11."

## ■ Program example

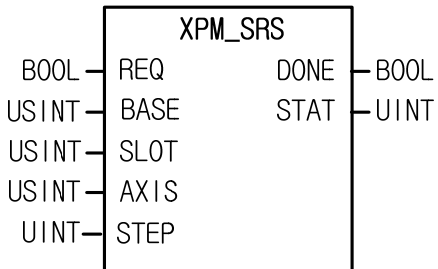
1. ST

```

INST_XPM_SNS(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), STEP:=(*UINT*),
DONE=>(*BOOL*), STAT=>(*UINT*))

```

<b>XPM_SRS</b>	Repeat Step No. Change	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block</p> <p>BASE : Set the base no. with module</p> <p>SLOT : Set the slot no. with module</p> <p>AXIS : Axis to command</p> <p style="padding-left: 20px;">XPM: 1 ~ 4 (1-axis ~4-axis)</p> <p style="padding-left: 20px;">XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)</p> <p>STEP : Set the repeat step no. to change</p> <p style="padding-left: 20px;">1 ~ 400</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating</p> <p>STAT : Output the error no. in operation</p>

### ■ Function

- (1) Give "Repeat Step no. Change" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) This command is for configuring the starting step no. of repeat operation and operating from the configured operation step.
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)
- (4) Set the step no. to operate repeatedly on STEP. The setting range is 1 ~ 400, If other value is set, it produces "Error11".

### ■ Program example

1. ST

```
INST_XPM_SRS(REQ:=(*BOOL*),   BASE:=(*USINT*),   SLOT:=(*USINT*),   AXIS:=(*USINT*),   STEP:=(*UINT*),
DONE=>(*BOOL*), STAT=>(*UINT*))
```

<b>XPM_MOF</b>	M code Release	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  XPM: 1 ~ 4 (1-axis ~4-axis)  XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating  STAT : Output the error no. in operation</p>

## ■ Function

- (1) Give “M code Release” command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) In the case that M code of parameter of each axis is set as “With” of “After”, you may turn the M code off with this command.  
That is, M code signal is off, M code no. is 0.
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces “Error6.”  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

## ■ Program example

1. ST

```
INST_XPM_MOF(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), DONE=>(*BOOL*),
STAT=>(*UINT*))
```



<b>XPM_PRS</b>	Current Position Change	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     subgraph XPM_PRS         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         PRS_ADDR[PRS_ADDR]         DONE[DONE]         STAT[STAT]     end     REQ_in[REQ] --&gt; REQ     BASE_in[BASE] --&gt; BASE     SLOT_in[SLOT] --&gt; SLOT     AXIS_in[AXIS] --&gt; AXIS     PRS_ADDR_in[PRS_ADDR] --&gt; PRS_ADDR     DONE --&gt; DONE_out[DONE]     STAT --&gt; STAT_out[STAT]             </pre> <p>                 The diagram shows the XPM_PRS function block with the following connections:                  Inputs: REQ (BOOL), BASE (USINT), SLOT (USINT), AXIS (USINT), PRS_ADDR (DINT).                  Outputs: DONE (BOOL), STAT (UINT).             </p>	<b>Input</b> REQ : Request for execution of function block BASE : Set the base no. with module SLOT : Set the slot no. with module AXIS : Axis to command XPM: 1 ~ 4 (1-axis ~4-axis) XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis) PRS_ADDR : Set the current position value to change. -2,147,483,648 ~ 2,147,483,647  <b>Output</b> DONE : Maintain 1 after first operating STAT : Output the error no. in operation

### ■ Function

- (1) Give “Basic Parameter Setting” command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) This command is for changing the current position to random position. If it executes in the state of non-origin, the origin signal would be on and the current position would be set as setting value (PRS\_ADDR).
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces “Error6.”  
 XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

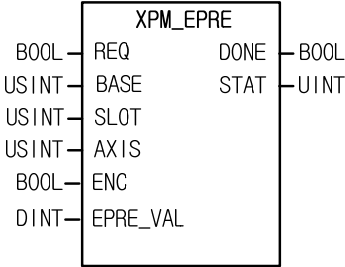
### ■ Program example

1. ST

```

INST_XPM_PRS(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), PRS_ADDR:=(*DINT*),
DONE=>(*BOOL*), STAT=>(*UINT*))
    
```

<b>XPM_EPRES</b>	Encoder Value Preset	
	Availability	XGI, XGR
	Flags	

Function Block	Description
 <pre> graph LR     subgraph XPM_EPRES         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         ENC[ENC]         EPRES_VAL[EPRES_VAL]     end     REQ --&gt; DONE     BASE --&gt; STAT     SLOT --&gt; STAT     AXIS --&gt; STAT     ENC --&gt; STAT     EPRES_VAL --&gt; STAT     </pre>	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  XPM: 1 ~ 4 (1-axis ~4-axis)  XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)  ENC : Encoder no. (Always 0)  0: Encoder  EPRES_VAL : Set the value of encoder preset  -2147483648 ~ 2147483647</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating  STAT : Output the error no. in operation</p>

## ■ Function

- (1) Give "Encoder Preset" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) This command is for changing the current value of encoder to the value set on EPRES\_VAL
- (3) Set the encoder to preset on ENC and it has to be 0 in APM module of XPM.
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

## ■ Program example

1. ST

```

INST_XPM_EPRES(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), ENC:=(*BOOL*),
EPRES_VAL:=(*DINT*), DONE=>(*BOOL*), STAT=>(*UINT*))

```

<b>XPM_ATEA</b>	Teaching Array	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     subgraph XPM_ATEA         REQ[REQ] --&gt; XPM_ATEA         BASE[BASE] --&gt; XPM_ATEA         SLOT[SLOT] --&gt; XPM_ATEA         AXIS[AXIS] --&gt; XPM_ATEA         STEP[STEP] --&gt; XPM_ATEA         RAM_ROM[RAM/ROM] --&gt; XPM_ATEA         POS_SPD[POS/SPD] --&gt; XPM_ATEA         TEA_CNT[TEA_CNT] --&gt; XPM_ATEA         TEA_VAL[TEA_VAL] --&gt; XPM_ATEA         XPM_ATEA --&gt; DONE[DONE]         XPM_ATEA --&gt; STAT[STAT]     end         </pre>	<b>Input</b> REQ : Request for execution of function block BASE : Set the base no. with module SLOT : Set the slot no. with module AXIS : Axis to command XPM: 1 ~ 4 (1-axis ~4-axis) XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis) STEP : Set the step no. to do teaching 0 ~ 400 RAM/ROM : Selection of RAM/ROM teaching 0 : RAM teaching, 1 : ROM teaching POS/SPD : Selection of position/speed teaching 0 : Position, 1 : Speed TEA_CNT : Set the no. of data to do teaching 1 ~ 16 TEA_VAL : Set the teaching value <b>Output</b> DONE : Maintain 1 after first operation STAT : Output the error no in operation

### ■ Function

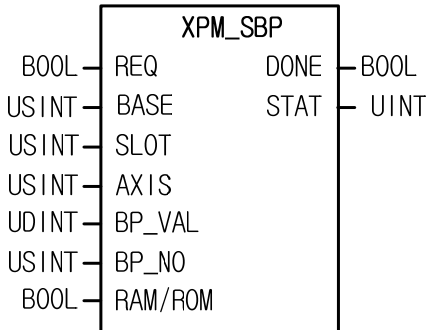
- (1) Give "Teaching Array" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) Speed teaching is for user to use random speed value in a operation data of specified step and position teaching is for user to use random position value in a operation data of specified operation step.
- (3) This command is for modifying maximum 16 destination positions/speed value at once with teaching array function block.
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)
- (5) You may set step no.(0~400) of operation data on STEP. If other value is set, it produces "Error11."
- (6) You may set the no. of data to do teaching on TEA\_CNT and do teaching max. 16. If other value is set, it produces "Error11."
- (7) Parameter value modified by teaching command and setting RAM/ROM as "0" is valid within power connection. If you want to keep the parameter without power connection, execute teaching command with setting "1" on RAM/ROM or save the modified parameter value on FRAM with XPM\_WRT (Parameter/Operation Data Saving command) after teaching.

### ■ Program example

1. ST

```
INST_XPM_ATEA(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), STEP:=(*UINT*),  
RAM_ROM:=(*BOOL*), POS_SPD:=(*BOOL*), TEA_CNT:=(*USINT*), TEA_VAL:=(*ARRAY[0..15]_OF_DINT*),  
DONE=>(*BOOL*), STAT=>(*UINT*))
```

<b>XPM_SBP</b>	Basic Parameter Teaching	
	Availability	XGI, XGR
	Flags	

Function Block	Description
 <pre> graph LR     subgraph XPM_SBP         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         BP_VAL[BP_VAL]         BP_NO[BP_NO]         RAM_ROM[RAM/ROM]         DONE[DONE]         STAT[STAT]     end     REQ_BOOL[BOOL] --- REQ     BASE_UINT[USINT] --- BASE     SLOT_UINT[USINT] --- SLOT     AXIS_UINT[USINT] --- AXIS     BP_VAL_UDINT[UDINT] --- BP_VAL     BP_NO_USINT[USINT] --- BP_NO     RAM_ROM_BOOL[BOOL] --- RAM_ROM     DONE_BOOL[BOOL] --- DONE     STAT_UINT[UINT] --- STAT         </pre>	<p><b>Input</b></p> <p>REQ : Request for execution of function block          BASE : Set the base no. with module          SLOT : Set the slot no. with module          AXIS : Axis to command              XPM: 1 ~ 4 (1-axis ~4-axis)              XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)          BP_VAL : Basic parameter to change          BP_NO : Item no. of basic parameter to change          RAM/ROM : Method of parameter save              0: save on RAM              1: save on ROM</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating          STAT : Output the error no. in operation</p>

### ■ Function

- (1) Give "Basic Parameter Teaching" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) Parameter value modified by basic parameter teaching command and setting RAM/ROM to "0" is valid within power connection. If you want to keep the parameter without power connection, execute basic parameter teaching command with setting RAM/ROM as "1" or save the modified parameter value on FRAM with XPM\_WRT (Parameter/Operation Data Saving command) after basic parameter teaching.
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
 XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

(4) The value that needs to be set in basic parameter is as follows.

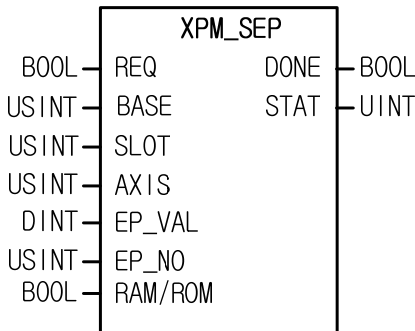
Value	Items	Setting Range
1	Speed Limit	mm : 1 ~ 2,147,483,647 [ $\times 10^2$ mm/min] Inch : 1 ~ 2,147,483,647 [ $\times 10^3$ Inch/min] degree : 1 ~ 2,147,483,647 [ $\times 10^3$ degree/min] pulse : 1 ~ 2,147,483,647 [pulse/sec]
2	Acc. Time 1	1 ~ 2,147,483,647 [ms]
3	Acc. Time 2	
4	Acc. Time 3	
5	Acc. 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	Urgent stop Dec. Time	1 ~ 2,147,483,647 [ms]
11	Demultiply output pulse/rotation	1 ~ 200,000,000
12	Transferring Distance/rotation	
13	Unit	0:Pulse, 1:mm, 2:Inch, 3:Degree
14	Unit assignment	0: x 1, 1: x 10, 2: x 100, 3: x 1000
15	Unit for speed command	0: unit/time, 1: rpm
16	Bias speed	1 ~ speed limit
17	Pulse output mode	0: CW/CCW, 1: PLS/DIR, 2: PHASE

## ■ Program example

### 1. ST

```
INST_XPM_SBP(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
BP_VAL:=BP_UDINT, BP_NO:=BP_USINT, RAM_ROM:=RAM_ROM_BOOL, DONE=>DONE_BOOL,
STAT=>STAT_UINT);
```

<b>XPM_SEP</b>	Extended Parameter Teaching	
	Availability	XGI, XGR
	Flags	

Function Block	Description
 <pre> graph LR     subgraph XPM_SEP         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         EP_VAL[EP_VAL]         EP_NO[EP_NO]         RAM_ROM[RAM/ROM]         DONE[DONE]         STAT[STAT]     end     REQ_BOOL[BOOL] --- REQ     BASE_UINT[USINT] --- BASE     SLOT_UINT[USINT] --- SLOT     AXIS_UINT[USINT] --- AXIS     EP_VAL_DINT[DINT] --- EP_VAL     EP_NO_UINT[USINT] --- EP_NO     RAM_ROM_BOOL[BOOL] --- RAM_ROM     DONE_BOOL[BOOL] --- DONE     STAT_UINT[UINT] --- STAT         </pre>	<p><b>Input</b></p> <p>REQ : Request for execution of function block          BASE : Set the base no. with module          SLOT : Set the slot no. with module          AXIS : Axis to command              XPM: 1 ~ 4 (1-axis ~4-axis)              XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)          EP_VAL : Parameter value to modify          EP_NO : Item no. of parameter to modify          RAM/ROM : Method for saving parameter              0: Save on RAM              1: Save on ROM</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating          STAT : Output the error no. in operation</p>

### ■ Function

- (1) Give "Extended Parameter Teaching" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) Parameter value modified by extended parameter teaching command and setting RAM/ROM to "0" is valid within power connection. If you want to keep the parameter without power connection, execute extended parameter teaching command with setting RAM/ROM as "1" or save the modified parameter value on FRAM with XPM\_WRT (Parameter/Operation Data Saving command) after extended parameter teaching.
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
 XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

(4) The extended parameter items and setting values are as follows.

Value	Item	Setting Range
1	Software high limit	mm : -2147483648 ~ 2147483647[X10 <sup>-4</sup> mm] Inch: -2147483648 ~ 2147483647[X10 <sup>-5</sup> Inch] degree: -2147483648 ~ 2147483647[X10 <sup>-5</sup> degree] pulse: -2147483648 ~ 2147483647[pulse]
2	Software low limit	
3	Backlash compensation amount	mm: 0 ~ 65,535[X10 <sup>-4</sup> mm] inch: 0 ~ 65,535[X10 <sup>-5</sup> Inch] degree: 0 ~ 65,535[X10 <sup>-5</sup> degree] pulse: 0 ~ 65,535[pulse]
4	Positioning end output time	0 ~ 65,535[ms]
5	S-Curve ratio	1 ~ 100
6	Position to interpolate circular arc of 2axis linear interpolation	mm: 0 ~ 2147483647[X10 <sup>-4</sup> mm] Inch: 0 ~ 2147483647[X10 <sup>-5</sup> Inch] degree: 0 ~ 2147483647[X10 <sup>-5</sup> degree] pulse: 0 ~ 2147483647[pulse]
7	Acc./dec. pattern	0: Trapezoid operating, 1: S-curve operating
8	M code mode	0: None, 1: With, 2: After
9	Detection of High/Low limit in speed control	0: Not detect, 1: Detect
10	Condition for positioning completion	0: Dwell time 1: In-position 2: Dwell time AND In-position 3: Dwell time OR In-position
11	Positioning method of interpolation continuous operation	0: passage of goal position, 1: passage of near position
12	2axis linear interpolation continuous operation circular arc interpolating	0: No circular interpolating, 1: Circular interpolating continuous operation
13	External speed/position control switching	0: Not permit, 1: Permit
14	Selection of external emergent stop/dec stop	0: Emergent stop, 1: Dec. Stop
15	Coordinates of positioning speed override	0: Absolute, 1: Relative
16	Pulse output direction	0: Forward, 1: Reverse

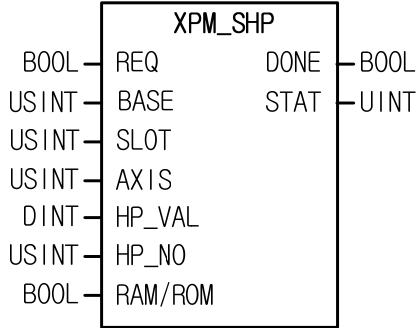
## ■ Program example

### 1. ST

```
INST_XPM_SEP(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
EP_VAL:=EP_DINT, EP_NO:=NO_USINT, RAM_ROM:=RAM_ROM_BOOL, DONE=>DONE_BOOL,
STAT=>STAT_UINT);
```



<b>XPM_SHP</b>	Homing Parameter Teaching	
	Availability	XGI, XGR
	Flags	

Function Block	Description
 <pre> graph LR     subgraph XPM_SHP         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         HP_VAL[HP_VAL]         HP_NO[HP_NO]         RAM_ROM[RAM/ROM]         DONE[DONE]         STAT[STAT]     end     REQ_BOOL[BOOL] --- REQ     BASE_UINT[USINT] --- BASE     SLOT_UINT[USINT] --- SLOT     AXIS_UINT[USINT] --- AXIS     HP_VAL_DINT[DINT] --- HP_VAL     HP_NO_UINT[USINT] --- HP_NO     RAM_ROM_BOOL[BOOL] --- RAM_ROM     DONE_BOOL[BOOL] --- DONE     STAT_UINT[UINT] --- STAT         </pre>	<p><b>Input</b></p> <p>REQ : Request for execution of function block          BASE : Set the base no. with module          SLOT : Set the slot no. with module          AXIS : Axis to command              XPM: 1 ~ 4 (1-axis ~4-axis)              XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)          HP_VAL : Homing parameter value to modify          HP_NO : Item no. of homing parameter to modify          RAM/ROM : Method for saving parameter              0: Save on RAM              1: Save on ROM</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating          STAT : Output the error no. in operation</p>

### ■ Function

- (1) Give "Homing Parameter Setting" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) Parameter value modified by homing parameter teaching command and setting RAM/ROM to "0" is valid within power connection. If you want to keep the parameter without power connection, execute homing parameter teaching command with setting RAM/ROM as "1" or save the modified parameter value on FRAM with XPM\_WRT (Parameter/Operation Data Saving command) after homing parameter teaching.
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
 XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

(4) The homing parameter items and setting ranges are as follows.

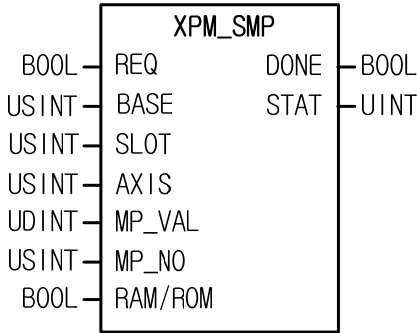
Setting value	Items	Setting Range
1	Homing position	mm : -2147483648 ~ 2147483647 [ $\times 10^{-4}$ mm] Inch : -2147483648 ~ 2147483647 [ $\times 10^{-5}$ Inch] degree : -2147483648 ~ 2147483647 [ $\times 10^{-5}$ degree] pulse : -2147483648 ~ 2147483647 [pulse]
2	High speed for homing	mm : 1 ~ 2,147,483,647 [ $\times 10^{-2}$ mm/min] Inch : 1 ~ 2,147,483,647 [ $\times 10^{-3}$ Inch/min] degree : 1 ~ 2,147,483,647 [ $\times 10^{-3}$ degree/min] pulse : 1 ~ 2,147,483,647 [pulse/sec]
3	Low speed for homing	
4	Homing Acc. Time	0 ~ 2,147,483,647 [ms]
5	Homing Dec. Time	
6	Homing Dwell Time	0 ~ 65,535[ms]
7	Revision amount of origin	mm : -2147483648 ~ 2147483647 [ $\times 10^{-3}$ mm] Inch : -2147483648 ~ 2147483647 [ $\times 10^{-5}$ Inch] degree : -2147483648 ~ 2147483647 [ $\times 10^{-5}$ degree] pulse : -2147483648 ~ 2147483647 [pulse]
8	Restart time for homing	0 ~ 65,535[ms]
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	Homing direction	0:Forward, 1:Reverse

## ■ Program example

### 1. ST

```
INST_XPM_SHP(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
HP_VAL:=HP_DINT, HP_NO:=NO_USINT, RAM_ROM:=RAM_ROM_BOOL, DONE=>DONE_BOOL,
STAT=>STAT_UINT);
```

<b>XPM_SMP</b>	Manual Operation Parameter Teaching	
	Availability	XGI, XGR
	Flags	

Function Block	Description
 <pre> graph LR     subgraph XPM_SMP         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         MP_VAL[MP_VAL]         MP_NO[MP_NO]         RAM_ROM[RAM/ROM]         DONE[DONE]         STAT[STAT]     end     REQ --- REQ_IN[REQ]     BASE --- BASE_IN[BASE]     SLOT --- SLOT_IN[SLOT]     AXIS --- AXIS_IN[AXIS]     MP_VAL --- MP_VAL_IN[MP_VAL]     MP_NO --- MP_NO_IN[MP_NO]     RAM_ROM --- RAM_ROM_IN[RAM/ROM]     DONE --- DONE_OUT[DONE]     STAT --- STAT_OUT[STAT]         </pre> <p>Diagram of the XPM_SMP function block. It has seven inputs on the left: REQ (BOOL), BASE (USINT), SLOT (USINT), AXIS (USINT), MP_VAL (UDINT), MP_NO (USINT), and RAM/ROM (BOOL). It has two outputs on the right: DONE (BOOL) and STAT (UINT).</p>	<p><b>Input</b></p> <p>REQ : Request for execution of function block          BASE : Set the base no. with module          SLOT : Set the slot no. with module          AXIS : Axis to command              XPM: 1 ~ 4 (1-axis ~4-axis)              XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)          MP_VAL : Manual operation parameter value to modify          MP_NO : Item no. of manual operation parameter to modify          RAM/ROM : Method for saving parameter              0: Save on RAM              1: Save on ROM</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operation          STAT : Output the error no in operation</p>

### ■ Function

- (1) Give "Manual Operation Parameter Setting" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) Parameter value modified by manual operation parameter teaching command and setting RAM/ROM to "0" is valid within power connection. If you want to keep the parameter without power connection, execute manual operation parameter teaching command with setting RAM/ROM as "1" or save the modified parameter value on FRAM with XPM\_WRT (Parameter/Operation Data Saving command) after manual operation parameter teaching.
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
 XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

(4) The manual operation parameter items and setting ranges are as follows.

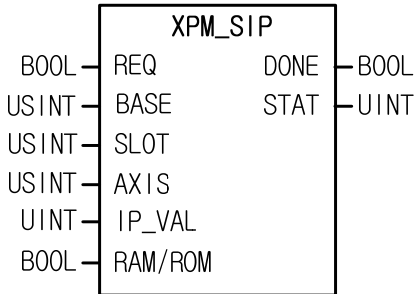
Setting Value	Items	Setting Range
1	JOG high speed	mm : 1 ~ 2,147,483,647 [ $\times 10^{-2}$ mm/min] Inch : 1 ~ 2,147,483,647 [ $\times 10^{-3}$ Inch/min]
2	JOG low speed	degree : 1 ~ 2,147,483,647 [ $\times 10^{-3}$ degree/min] pulse : 1 ~ 2,147,483,647 [pulse/sec]
3	JOG acc. time	0 ~ 2,147,483,647 [ms]
4	JOG dec. time	
5	Inching speed	mm : 1 ~ 65,535 [ $\times 10^{-2}$ mm/min] Inch : 1 ~ 65,535 [ $\times 10^{-3}$ Inch/min] degree : 1 ~ 65,535 [ $\times 10^{-3}$ degree/min] pulse : 1 ~ 65,535 [pulse/sec]

### ■ Program example

1. ST

```
INST_XPM_SMP(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
MP_VAL:=MP_UDINT, MP_NO:=NO_USINT, RAM_ROM:=RAM_ROM_BOOL, DONE=>DONE_BOOL,
STAT=>STAT_UINT);
```

<b>XPM_SIP</b>	I/O Signal Parameter Teaching	
	Availability	XGI, XGR
	Flags	

Function Block	Description
 <pre> graph LR     subgraph XPM_SIP         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         IP_VAL[IP_VAL]         RAM_ROM[RAM/ROM]         DONE[DONE]         STAT[STAT]     end     REQ_IN[BOOL] --&gt; REQ     BASE_IN[USINT] --&gt; BASE     SLOT_IN[USINT] --&gt; SLOT     AXIS_IN[USINT] --&gt; AXIS     IP_VAL_IN[UINT] --&gt; IP_VAL     RAM_ROM_IN[BOOL] --&gt; RAM_ROM     DONE_OUT[DONE] --&gt; BOOL_OUT[BOOL]     STAT_OUT[STAT] --&gt; UINT_OUT[UINT]         </pre>	<p><b>Input</b></p> <p>REQ : Request for execution of function block          BASE : Set the base no. with module          SLOT : Set the slot no. with module          AXIS : Axis to command              XPM: 1 ~ 4 (1-axis ~4-axis)              XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)          IP_VAL : External signal parameter value to modify              Set the corresponding signal for each Bit          RAM/ROM : Method for saving parameter              0: Save on RAM              1: Save on ROM</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operation          STAT : Output the error no in operation</p>

### ■ Function

- (1) Give "Input Signal Parameter Setting" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) Parameter value modified by input signal parameter teaching command and setting RAM/ROM to "0" is valid within power connection. If you want to keep the parameter without power connection, execute input signal parameter teaching command with setting RAM/ROM as "1" or save the modified parameter value on FRAM with XPM\_WRT (Parameter/Operation Data Saving command) after input signal parameter teaching.
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
     XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)
- (4) The setting value of each setting area of external signal has the meaning as below.  
     0 : A contact, 1 : B contact

(5) The manual operation parameter items and setting values are as follows.

Bit	Signal
0	High limit signal
1	Low limit signal
2	Near origin signal
3	Origin signal
4	Emergent stop/Dec. stop signal
5	Speed/Position control switching signal
6	Drive ready signal
7	In-position signal
8	Deviation counter clear output signal
9 ~ 15	Not Use

### ■ Program example

1. ST

```
INST_XPM_SIP(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,  
IP_VAL:=IP_WORD, RAM_ROM:=RAM_ROM_BOOL, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>XPM_SCP</b>	Common Parameter Teaching	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     subgraph XPM8_SCP         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         CP_VAL[CP_VAL]         CP_NO[CP_NO]         RAM_ROM[RAM/ROM]         DONE[DONE]         STAT[STAT]     end     REQ --- REQ_IN[BOOL]     BASE --- BASE_IN[US INT]     SLOT --- SLOT_IN[US INT]     AXIS --- AXIS_IN[US INT]     CP_VAL --- CP_VAL_IN[D INT]     CP_NO --- CP_NO_IN[US INT]     RAM_ROM --- RAM_ROM_IN[BOOL]     DONE --- DONE_OUT[BOOL]     STAT --- STAT_OUT[U INT]         </pre>	<p><b>Input</b></p> <p>REQ : Request for execution of function block          BASE : Set the base no. with module          SLOT : Set the slot no. with module          AXIS : Axis to command              XPM: 1 ~ 4 (1-axis ~4-axis)              XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)          CP_VAL : Common parameter value to modify          CP_NO : Item no. of common parameter to modify          RAM/ROM : Method for saving parameter              0: Save on RAM              1: Save on ROM</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operation          STAT : Output the error no in operation</p>

## ■ Function

- (1) Give "Common Parameter Setting" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) Parameter value modified by common parameter teaching command and setting RAM/ROM to "0" is valid within power connection. If you want to keep the parameter without power connection, execute common parameter teaching command with setting RAM/ROM as "1" or save the modified parameter value on FRAM with XPM\_WRT (Parameter/Operation Data Saving command) after common parameter teaching.
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
 XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

- (4) The common parameter items and setting values are as follows.

Setting Value	Items	Setting values
1	Speed override	0 : % designation, 1 : speed designation
2	Mode for encoder pulse input	0: CW/CCW 1 multiply, 1: CW/CCW 2 multiply 2: PULSE/DIR 1 multiply, 3: PULSE/DIR 2 multiply 4: PHASE A/B 1 multiply, 5: PHASE A/B 2 multiply 6: PHASE A/B 4 multiply
3	Maximum value of encoder	-2147483648 ~ 2147283647
4	Minimum value of encoder	
5	Pulse output level	0 : Low Active, 1 : High Active

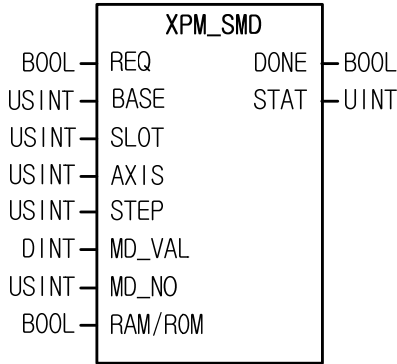
### ■ Program example

1. ST

```
INST_XPM_SCP(REQ:=REQ_BOOL,    BASE:=BASE_USINT,    SLOT:=SLOT_USINT,    AXIS:=AXIS_USINT,  
CP_VAL:=CP_DINT,    CP_NO:=NO_USINT,    RAM_ROM:=RAM_ROM_BOOL,    DONE=>DONE_BOOL,  
STAT=>STAT_UINT);
```



<b>XPM_SMD</b>	Operation Data Teaching	
	Availability	XGI, XGR
	Flags	

Function Block	Description
 <pre> graph LR     subgraph XPM_SMD         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         STEP[STEP]         MD_VAL[MD_VAL]         MD_NO[MD_NO]         RAM_ROM[RAM/ROM]         DONE[DONE]         STAT[STAT]     end     REQ_in[REQ] --- REQ     BASE_in[BASE] --- BASE     SLOT_in[SLOT] --- SLOT     AXIS_in[AXIS] --- AXIS     STEP_in[STEP] --- STEP     MD_VAL_in[MD_VAL] --- MD_VAL     MD_NO_in[MD_NO] --- MD_NO     RAM_ROM_in[RAM/ROM] --- RAM_ROM     DONE --- DONE_out[DONE]     STAT --- STAT_out[STAT]             </pre> <p>The diagram shows the XPM_SMD function block with the following connections:</p> <ul style="list-style-type: none"> <li><b>Inputs:</b> REQ (BOOL), BASE (USINT), SLOT (USINT), AXIS (USINT), STEP (USINT), MD_VAL (DINT), MD_NO (USINT), RAM/ROM (BOOL).</li> <li><b>Outputs:</b> DONE (BOOL), STAT (UINT).</li> </ul>	<p><b>Input</b></p> <ul style="list-style-type: none"> <li>REQ : Request for execution of function block</li> <li>BASE : Set the base no. with module</li> <li>SLOT : Set the slot no. with module</li> <li>AXIS : Axis to command <ul style="list-style-type: none"> <li>XPM: 1 ~ 4 (1-axis ~4-axis)</li> <li>XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)</li> </ul> </li> <li>STEP : Step no. to modify <ul style="list-style-type: none"> <li>0 ~ 400</li> </ul> </li> <li>MD_VAL : Operation data value to modify</li> <li>MD_NO : Item no. of operation data to modify</li> <li>RAM/ROM : Method for saving parameter <ul style="list-style-type: none"> <li>0: Save on RAM</li> <li>1: Save on ROM</li> </ul> </li> </ul> <p><b>Output</b></p> <ul style="list-style-type: none"> <li>DONE : Maintain 1 after first operation</li> <li>STAT : Output the error no in operation</li> </ul>

### ■ Function

- (1) Give "Operation Data Teaching" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) Parameter value modified by operation data teaching command and setting RAM/ROM to "0" is valid within power connection. If you want to keep the parameter without power connection, execute operation data teaching command with setting RAM/ROM as "1" or save the modified parameter value on FRAM with XPM\_WRT (Parameter/Operation Data Saving command) after operation data teaching.
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."
  - XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

(4) The operation data items and setting range are as follows.

Setting value	Items	Setting Range																								
1	Goal position	mm : -2147483648 ~ 2147483647 [X10 <sup>-4</sup> mm] Inch : -2147483648 ~ 2147483647 [X10 <sup>-5</sup> Inch] degree : -2147483648 ~ 2147483647 [X10 <sup>-5</sup> degree] pulse : -2147483648 ~ 2147483647 [pulse]																								
2	Auxiliary position for circular interpolation	-2147483648 ~ 2147483647																								
3	Operating speed	mm : 1 ~ 2,147,483,647 [X10 <sup>-2</sup> mm/min] Inch : 1 ~ 2,147,483,647 [X10 <sup>-3</sup> Inch/min] degree : 1 ~ 2,147,483,647 [X10 <sup>-3</sup> degree/min] pulse : 1 ~ 2,147,483,647 [pulse/sec]																								
4	Dwell time	0 ~ 65,535[ms]																								
5	M code no.	0 ~ 65,535																								
6	Sub axis setting	<table><tr><td colspan="8">Bit unit setting</td></tr><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>axis8</td><td>axis7</td><td>axis6</td><td>axis5</td><td>axis4</td><td>axis3</td><td>axis2</td><td>axis1</td></tr></table>	Bit unit setting								Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	axis8	axis7	axis6	axis5	axis4	axis3	axis2	axis1
Bit unit setting																										
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0																			
axis8	axis7	axis6	axis5	axis4	axis3	axis2	axis1																			
7	Helical interpolation axis	0, axis1 ~ axis4 (0: General circular interpolation)																								
8	The no. of turn for circular interpolation	0~65,535																								
9	Coordinates	0:absolute, 1:relative																								
10	Control method	0:Abbreviation position control, 1:Abbreviation speed control, 2:Abbreviation Feed control, 3:linear interpolation, 4:circular interpolation																								
11	Operating method	0:single, 1:repeat																								
12	Operating pattern	0:end, 1:go on, 2:continue																								
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																								

## ■ Program example

### 1. ST

```
INST_APM_SMD(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
STEP:=STEP_UINT, MD_VAL:=MD_DINT, MD_NO:=NO_USINT, RAM_ROM:=RAM_ROM_BOOL,
DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>XPM_EMG</b>	Emergency Stop	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  XPM: 1 ~ 4 (1-axis ~4-axis)  XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating  STAT : Output the error no. in operation</p>

### ■ Function

- (1) Give “Emergency Stop” command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) This command is for immediate stop. The axis to execute this command will stop.
- (3) Dec. time of emergent stop is the time set on “Dec. time of Emergent stop” of basic parameter.
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces “Error6.”  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

### ■ Program example

#### 1. ST

```
INST_XPM_EMG(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>XPM_RST</b>	Error Reset	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     REQ[REQ] --&gt; XPM_RST     BASE[BASE] --&gt; XPM_RST     SLOT[SLOT] --&gt; XPM_RST     AXIS[AXIS] --&gt; XPM_RST     SEL[SEL] --&gt; XPM_RST     XPM_RST --&gt; DONE[DONE]     XPM_RST --&gt; STAT[STAT]         </pre>	<b>Input</b> REQ : Request for execution of function block BASE : Set the base no. with module SLOT : Set the slot no. with module AXIS : Axis to command XPM: 1 ~ 4 (1-axis ~4-axis) XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis) SEL : Select axis error/common error 0:axis error (Always 0)  <b>Output</b> DONE : Maintain 1 after first operating STAT : Output the error no. in operation

## ■ Function

- (1) Give “Error Reset” command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) It can set an axis to instruct and the value is as follows. If other value is set, it produces “Error6.”  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)
- (3) This is for resetting the errors.
- (4) Select the kind of error to reset on SEL. If it is set to 0, reset the errors of each axis. XGF series has to be set 0.

## ■ Program example

1. ST

```

INST_XPM_RST(REQ:=REQ_BOOL,    BASE:=BASE_USINT,    SLOT:=SLOT_USINT,    AXIS:=AXIS_USINT,
SEL:=SEL_BOOL, DONE=>DONE_BOOL, STAT=>STAT_UINT);
  
```

<b>XPM_HRST</b>	Error History Reset	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  XPM: 1 ~ 4 (1-axis ~4-axis)  XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating  STAT : Output the error no. in operation</p>

### ■ Function

- (1) Give “Error History Reset” command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) It can set an axis to instruct and the value is as follows. If other value is set, it produces “Error6.”  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)
- (3) If errors arise, Max.10 errors are saved on module. This command is for resetting error history.

### ■ Program example

1. ST

```
INST_XPM_HRST(REQ:=REQ_BOOL,    BASE:=BASE_USINT,    SLOT:=SLOT_USINT,    AXIS:=AXIS_USINT,
DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>XPM_PST</b>	Point Start	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     subgraph XPM_PST         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         PST_CNT[PST_CNT]         PST_VAL[PST_VAL]         DONE[DONE]         STAT[STAT]     end     REQ --&gt; XPM_PST     BASE --&gt; XPM_PST     SLOT --&gt; XPM_PST     AXIS --&gt; XPM_PST     PST_CNT --&gt; XPM_PST     PST_VAL --&gt; XPM_PST     XPM_PST --&gt; DONE     XPM_PST --&gt; STAT         </pre>	<b>Input</b> REQ : Request for execution of function block BASE : Set the base no. with module SLOT : Set the slot no. with module AXIS : Axis to command XPM: 1 ~ 4 (1-axis ~4-axis) XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis) PST_CMT : Set the no. of step for point operation 1 ~ 20 PST_VAL : Set the step no. for point operation 0 ~ 400  <b>Output</b> DONE : Maintain 1 after first operation STAT : Output the error no in operation

## ■ Function

- (1) Give "Point start" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
 XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)
- (3) This is for when operating PTP(Point to Point), operate continuously by setting max. 20 operation steps.
- (4) Point operation may be executed with max. 20 point steps. Therefore, you may use the parameter which has 20 elements and like UNIT arrangement.
- (5) If other value is set , it produces "Error6."

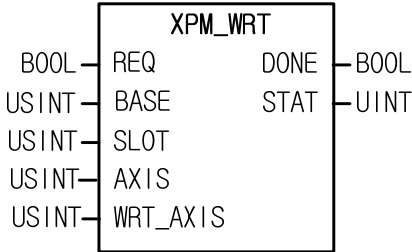
## ■ Program example

1. ST

```

INST_XPM_PST(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
PST_CNT:=CNT_USINT, PST_VAL:=ARY_PST, DONE=>DONE_BOOL, STAT=>STAT_UINT);
    
```

<b>XPM_WRT</b>	Saving Parameter/Operation Data	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  XPM: 1 ~ 4 (1-axis ~4-axis)  XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)  XPM_WRT_AXIS : Saving axis setting  (by setting bit)  XPM: 0bit ~ 3bit: 1-axis ~ 4-axis  XGF-PN8A: 0bit ~ 7bit (1-axis ~ 8-axis)</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operation  STAT : Output the error no in operation</p>

### ■ Function

- (1) Give “Basic Parameter Setting” command to the axis designated as the axis of positioning module with BASE (Base no. of positioning module) and SLOT (Slot no. of positioning module).
- (2) It can set an axis to instruct and the value is as follows. If other value is set, it produces “Error6.”  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)
- (3) If function block executes normally, the current operation parameter and data which saved on WRT\_AXIS are saved on FRAM and maintain the data without the power connection.
- (4) In case of modifying the CAM data with XPM\_VWR instruction, when you execute XPM\_WRT, the modified data saves in FLASH.

### ■ Program example

#### 1. ST

```
INST_XPM_WRT(REQ:=REQ_BOOL,    BASE:=BASE_USINT,    SLOT:=SLOT_USINT,    AXIS:=AXIS_USINT,
WRT_AXIS:=WRT_USINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

XPM_CRD	Operation Information Read	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<div><div>XPM_CRD</div><div><div>BOOL — REQ</div><div>USINT — BASE</div><div>USINT — SLOT</div><div>USINT — AXIS</div><div>DONE — BOOL</div><div>STAT — UINT</div><div>ERR — UINT</div><div>CERR — UINT</div><div>CA — DINT</div><div>CV — DINT</div><div>SA — DINT</div><div>SV — DINT</div><div>TRQ — INT</div><div>STEP — UINT</div><div>MCD — UINT</div></div></div>	<div><div>Input</div><div>REQ : Request for execution of function block</div><div>BASE : Set the base no. with module</div><div>SLOT : Set the slot no. with module</div><div>AXIS : Axis to command</div><div>XPM: 1 ~ 4 (1-axis ~4-axis)</div><div>XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)</div><div>Output</div><div>DONE : Maintain 1 after first operating</div><div>STAT : Output the error no. in operation</div><div>ERR : Display axis error</div><div>CERR : Display common error</div><div>CA : Display the command position</div><div>CV : Display the command speed</div><div>SA : Display the current position</div><div>SV : Display the current speed</div><div>TRQ : Display the current torque</div><div>STEP : Display step no. of the current operation data</div><div>MCD : Display the current M code value</div></div>

## ■ Function

- (1) Read the axis state of current operation configured in the axis of configured positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) The operation information is saved in parameter set on output of function block.
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)
- (4) You can monitor command position, command speed, current position, current speed, torque, operation data no. and M code value of axis already set through reading them or use them as a condition in user's program.
- (5) "-" speed displayed as command speed(CV) or current speed(SV) means reverse direction.

## ■ Program example

1. ST

```
INST_XPM_CRD(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
DONE=>DONE_BOOL, STAT=>STAT_UINT, ERR=>ERR_UINT, CERR=>CERR_UINT, CA=>CA_DINT,
CV=>CV_UDINT, SA=>SA_DINT, SV=>SV_DINT, TRQ=>TRQ_INT, STEP=>STEP_UINT, MCD=>MCD_UINT);
```



<b>XPM_SRD</b>	Operation State Read	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<div><div><div>XPM_SRD</div><div><div>REQ</div><div>DONE</div><div>BASE</div><div>STAT</div><div>SLOT</div><div>ST1</div><div>ST2</div><div>ST3</div><div>ST4</div><div>ST5</div><div>ST6</div><div>ST7</div></div><div><div>BOOL</div><div>USINT</div><div>USINT</div><div>USINT</div><div>BOOL</div><div>BOOL[8]</div><div>BOOL[8]</div><div>BOOL[8]</div><div>BOOL[8]</div><div>BOOL[8]</div><div>BOOL[8]</div><div>BOOL[8]</div><div>BOOL[8]</div></div></div></div>	<div><div>Input</div><div>REQ : Request for execution of function block</div><div>BASE : Set the base no. with module</div><div>SLOT : Set the slot no. with module</div><div>AXIS : Axis to command</div><div>XPM: 1 ~ 4 (1-axis ~4-axis)</div><div>XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)</div><div>Output</div><div>DONE : Maintain 1 after first operating</div><div>STAT : Output the error no. in operation</div><div>ST1 : State 1</div><div>ST2 : State 2</div><div>ST3 : State 3</div><div>ST4 : State 4</div><div>ST5 : State 5</div><div>ST6 : State 6</div><div>ST7 : State 7</div></div>

### ■ Function

- (1) Give "Bit Information of Current operation reading" command to the axis designated as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) The bit information about the state of current operation is saved in parameter set on ST1 ~ ST7.
- (3) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

(4) The contents of output parameters, ST1 ~ ST7 are important information necessarily applied in the program.

	Bit	Description	Bit	Description
ST1	[0]	Operating(0:STOP, 1:BUSY)	[4]	Origin fix state (0:Uncompletion, 1:Completion)
	[1]	Error state	[5]	-
	[2]	Positioning completion	[6]	Stop
	[3]	Mcode On signal(0:Off, 1:On)	[7]	-
ST2	[0]	High limit detection	[4]	In acceleration
	[1]	Low limit detection	[5]	In stable speed
	[2]	Emergent Stop	[6]	In deceleration
	[3]	Direction(0:Forward, 1:Reverse)	[7]	In dwell
ST3	[0]	Axis1 in positioning control	[4]	In circular interpolation operation
	[1]	Axis1 in speed control	[5]	In homing operation
	[2]	In linear interpolation	[6]	In position synchronous start operation
	[3]	-	[7]	In speed synchronous start operation
ST4	[0]	In jog operation	[4]	In previous position of manual operation returning operation
	[1]	-	[5]	In CAM control operation
	[2]	In inching operation	[6]	In Feed control operation
	[3]	-	[7]	In ellipse interpolation operation
ST5	[0]	Main axis information	[4]	Axis state(0:Main axis, 1: sub axis)
	[1]	1 ~ 4: axis1 ~ axis4	[5]	-
	[2]	9: Encoder	[6]	-
	[3]		[7]	-
ST6	[0]	Emergent stop/Dec. stop signal	[4]	High limit signal
	[1]	-	[5]	Low limit signal
	[2]	-	[6]	Origin signal
	[3]	-	[7]	Near origin signal
ST7	[0]	Switching signal of Speed/Position control	[4]	In-position signal
	[1]	-	[5]	Declination counter clear output signal
	[2]	-	[6]	-
	[3]	Drive ready signal	[7]	-

### ■ Program example

#### 1. ST

```
INST_XPM_SRD(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
DONE=>DONE_BOOL, STAT=>STAT_UINT, ST1=>ARY_ST1, ST2=>ARY_ST2, ST3=> ARY_ST3, ST4=> ARY_ST4,
ST5=> ARY_ST5, ST6=> ARY_ST6, ST7=> ARY_ST7);
```

<b>XPM_ENCRD</b>	Encoder Value Read	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     subgraph XPM_ENCRD         REQ[REQ] --&gt; XPM_ENCRD         BASE[BASE] --&gt; XPM_ENCRD         SLOT[SLOT] --&gt; XPM_ENCRD         ENC[ENC] --&gt; XPM_ENCRD         XPM_ENCRD --&gt; DONE[DONE]         XPM_ENCRD --&gt; STAT[STAT]         XPM_ENCRD --&gt; ENC_VAL[ENC_VAL]     end         </pre>	<p><b>Input</b></p> <p>REQ : Resquest for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  ENC : Encoder no. (Always 0)  0: Encoder</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating  STAT : Output the error no. in operation  ENC_VAL : Current value of encoder</p>

### ■ Function

- (1) Give “Encoder Reading” command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) The current encoder value is displayed on ENC\_VAL
- (3) Set the encoder want to read on ENC, it has to be always 0 in XPM positioning module.

### ■ Program example

1. ST

```
INST_XPM_ENCRD(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, ENC:=ENC_BOOL,
DONE=>DONE_BOOL, STAT=>STAT_UINT, ENC_VAL=>ENC_UDINT);
```

<b>XPM_JOG</b>	JOG Operation	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> <p style="text-align: center;"><b>XPM_JOG</b></p> <pre>           BOOL  REQ      DONE  BOOL         USINT  BASE      STAT  UINT         USINT  SLOT         USINT  AXIS         BOOL   JOG_DIR         BOOL   LOW/HIGH           </pre> </div>	<p><b>Input</b></p> <p>REQ : Request for execution of function block</p> <p>BASE : Set the base no. with module</p> <p>SLOT : Set the slot no. with module</p> <p>AXIS : Axis to command</p> <p style="padding-left: 20px;">XPM: 1 ~ 4 (1-axis ~4-axis)</p> <p style="padding-left: 20px;">XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)</p> <p>JOG_DIR : Set the direction of JOG operation</p> <p style="padding-left: 20px;">0:Forward, 1:Reverse</p> <p>LOW/HIGH : Set the speed of JOG operation</p> <p style="padding-left: 20px;">0:Low speed, 1:High speed</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating</p> <p>STAT : Output the error no. in operation</p>

## ■ Function

- (1) Give "JOG Operation" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) This command is for checking operation of system, wiring and address for teaching. It may be used in High/Low speed.
- (3) The operating condition of JOG operation function block is Level type. That is, when the condition of input parameter (REQ) is ON, pulse is outputted by setting value.
- (4) If the value of LOW/HIGH is changed, the speed changes without stop and if the value of JOG\_DIR is changed, it changes the direction after decelerating stop.
- (5) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

## ■ Program example

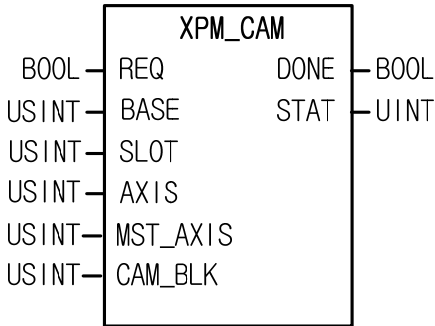
### 1. ST

```

INST_XPM_JOG(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT, JOG_DIR:=JOG_BOOL,
LOW_HIGH:=LOW_HIGH_BOOL, DONE=>DONE_BOOL, STAT=>STAT_UINT);

```

<b>XPM_CAM</b>	CAM Operation	
	Availability	XGI, XGR
	Flags	

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  XPM: 1 ~ 4 (1-axis ~4-axis)  XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)  MST_AXIS : Set main axis  XPM: 1 ~ 4 (1-axis ~4-axis)  XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)  9: Encoder  CAM_BLK : Set CAM block  1 ~ 8: Block1 ~ Block8</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating  STAT : Output the error no. in operation</p>

### ■ Function

- (1) Give "CAM Operation" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) Execute CAM operation with CAM main axis and CAM data block.
- (3) When executing CAM operation, sub axis indicates that it is in operation but it does not work actually. When main axis starts, the motor starts working according to the data value of CAM data block which already set on CAM block (CAM\_BLK)
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)
- (5) Set main axis of CAM operation at MST\_AXIS. If other value is set, it produces "Error11."
- (6) Set CAM block number in CAM\_BLK and available value is as follows. If other value is set, it produces "Error11."  
1 ~ 8 : block1 ~ block8
- (7) CAM data sets on positioning package and you sets max. 8 blocks.

### ■ Program example

#### 1. ST

```
INST_XPM_CAM(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
MST_AXIS:=MST_AXIS_USINT, CAM_BLK:=CAM_BLK_USINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);
```

<b>XPM_ELIN</b>	Ellipse Interpolation	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     subgraph XPM_ELIN         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         STEP[STEP]         RATIO[RATIO]         DEG[DEG]         DONE[DONE]         STAT[STAT]     end     REQ_BOOL[BOOL] --- REQ     BASE_USINT[USINT] --- BASE     SLOT_USINT[USINT] --- SLOT     AXIS_USINT[USINT] --- AXIS     STEP_UINT[UINT] --- STEP     RATIO_UINT[UINT] --- RATIO     DEG_UINT[UINT] --- DEG     DONE --- DONE_BOOL[BOOL]     STAT --- STAT_UINT[UINT]         </pre>	<b>Input</b> REQ : Request for execution of function block BASE : Set the base no. with module SLOT : Set the slot no. with module AXIS : Axis to command XPM: 1 ~ 4 (1-axis ~4-axis) XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis) STEP : Step no. to operate RATIO : Ellipse ratio(%) DEG : Operating angle  <b>Output</b> DONE : Maintain 1 after first operation STAT : Output the error no in operation

## ■ Function

- (1) Give "Ellipse Interpolation" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) This is the command that execute ellipse interpolation to the configured step as much as the angle set on DEG in the ratio of it which set on RATIO.
- (3) Ellipse interpolation is that distort operation data of the step already set at the rate already set on RATIO to execute ellipse interpolation. Therefore, the step of operation data set on STEP has to be set in accordance with circular interpolation control.
- (4) Ellipse rate range from 1 to 65535, it has [ $\times 10^{-2}\%$ ] as its unit. If you set 65535, the rates is 655.35%.
- (5) Operation angle range from 1 to 65535, it has [ $\times 10^{-1}$  degree] as its unit. If you set 3650, the angle is 365.0
- (6) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
 XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)

## ■ Program example

1. ST

```

INST_XPM_ELIN(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,
STEP:=STEP_UINT, RATIO:=RATIO_UINT, DEG:=DEG_UINT, DONE=>DONE_BOOL, STAT=>STAT_UINT);
    
```

<b>XPM_SSSP</b>	Position Assigned Speed Synchronization	
	Availability	XGI, XGR
	Flags	

Function Block	Description
<pre> graph LR     subgraph XPM_SSSP         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         MST_AXIS[MST_AXIS]         MST_RAT[MST_RAT]         SLV_RAT[SLV_RAT]         POS[POS]     end     REQ --- REQ_OUT[REQ]     BASE --- BASE_OUT[BASE]     SLOT --- SLOT_OUT[SLOT]     AXIS --- AXIS_OUT[AXIS]     MST_AXIS --- MST_AXIS_OUT[MST_AXIS]     MST_RAT --- MST_RAT_OUT[MST_RAT]     SLV_RAT --- SLV_RAT_OUT[SLV_RAT]     POS --- POS_OUT[POS]     DONE[DONE]     STAT[STAT]     </pre> <p>Diagram of XPM_SSSP function block showing inputs and outputs:</p> <ul style="list-style-type: none"> <li>Inputs: REQ (BOOL), BASE (USINT), SLOT (USINT), AXIS (USINT), MST_AXIS (USINT), MST_RAT (UINT), SLV_RAT (UINT), POS (DINT)</li> <li>Outputs: DONE (BOOL), STAT (UINT)</li> </ul>	<p><b>Input</b></p> <ul style="list-style-type: none"> <li>REQ : Request for execution of function block</li> <li>BASE : Set the base no. with module</li> <li>SLOT : Set the slot no. with module</li> <li>AXIS : Axis to command <ul style="list-style-type: none"> <li>XPM: 1 ~ 4 (1-axis ~4-axis)</li> <li>XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)</li> </ul> </li> <li>MST_AXIS : Set main axis <ul style="list-style-type: none"> <li>XPM: 1 ~ 4 (1-axis ~4-axis)</li> <li>XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)</li> <li>9: Encoder</li> </ul> </li> <li>MST_RAT : Set speed rate of main axis <ul style="list-style-type: none"> <li>-32768 ~ 32767</li> </ul> </li> <li>SLV_RAT : Set speed rate of sub axis <ul style="list-style-type: none"> <li>-32768 ~ 32767</li> </ul> </li> <li>POS : Destination position <ul style="list-style-type: none"> <li>-2,147,483,648 ~ 2,147,483,647</li> </ul> </li> </ul> <p><b>Output</b></p> <ul style="list-style-type: none"> <li>DONE : Maintain 1 after first operating</li> <li>STAT : Output the error no. in operation</li> </ul>

### ■ Function

- (1) Give "Position Assigned Speed Synchronization" command to the axis configured as the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) This command is for operating at the operation speed ratio between main axis and subordinate axis. It stops operating when the position of sub axis come to the position set on POS.
- (3) There is no rule about size of the speed ratio between main/sub axis. If the speed ratio of main axis is bigger than sub's, the main axis moves faster than sub. If the speed ratio of sub axis is bigger than main's, the sub axis moves faster than main.
- (4) It can set an axis to instruct and the value is as follows. If other value is set, it produces "Error6."  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)
- (5) You may set the main axis on MST\_AXIS with following values. If other value is set, it produces "Error6"  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis), 9: Encoder
- (6) The operating direction of subordinate depends on speed synchronization ratio  $(\frac{Sub}{Main})$ . If it is positive, operate in direction of main axis. If it is negative, operate in reverse direction of main axis.

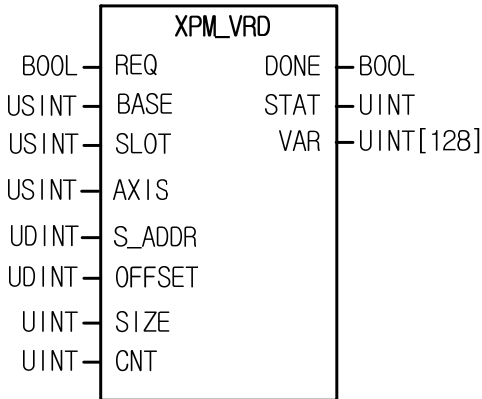
### ■ Program example

#### 1. ST

```
INST_XPM_SSSP(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT, AXIS:=AXIS_USINT,  
MST_AXIS:=AXIS_USINT, MST_RAT:=MST_INT, SLV_RAT:=SLV_INT, POS:=POS_DINT, DONE=>DONE_BOOL,  
STAT=>STAT_UINT);
```



<b>XPM_VRD</b>	Position Assigned Speed Synchronization	
	Availability	XGI, XGR
	Flags	

Function Block	Description
 <pre> graph LR     subgraph XPM_VRD         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         S_ADDR[S_ADDR]         OFFSET[OFFSET]         SIZE[SIZE]         CNT[CNT]         DONE[DONE]         STAT[STAT]         VAR[VAR]     end     REQ --- REQ_IN[REQ]     BASE --- BASE_IN[BASE]     SLOT --- SLOT_IN[SLOT]     AXIS --- AXIS_IN[AXIS]     S_ADDR --- S_ADDR_IN[S_ADDR]     OFFSET --- OFFSET_IN[OFFSET]     SIZE --- SIZE_IN[SIZE]     CNT --- CNT_IN[CNT]     DONE --- DONE_OUT[BOOL]     STAT --- STAT_OUT[UINT]     VAR --- VAR_OUT[UINT128]         </pre> <p>The diagram shows the XPM_VRD function block with the following connections:</p> <ul style="list-style-type: none"> <li><b>Inputs:</b> REQ (BOOL), BASE (USINT), SLOT (USINT), AXIS (USINT), S_ADDR (UDINT), OFFSET (UDINT), SIZE (UINT), CNT (UINT).</li> <li><b>Outputs:</b> DONE (BOOL), STAT (UINT), VAR (UINT[128]).</li> </ul>	<p><b>Input</b></p> <p>REQ : Request for execution of function block</p> <p>BASE : Set the base no. with module</p> <p>SLOT : Set the slot no. with module</p> <p>AXIS : Axis to command XPM: 1 ~ 4 (1-axis ~4-axis) XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)</p> <p>S_ADDR : Module internal memory head address of Read Data 0 ~ 53329</p> <p>OFFSET : Offset between Read Data blocks 0 ~ 53329</p> <p>SIZE : Block size of Read data 1 ~ 128</p> <p>CNT : No. of Read Data block 1 ~ 128</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operation</p> <p>STAT : Output the error no. in operation</p> <p>VAR : PLC device where Read Data is saved</p>

### ■ Function

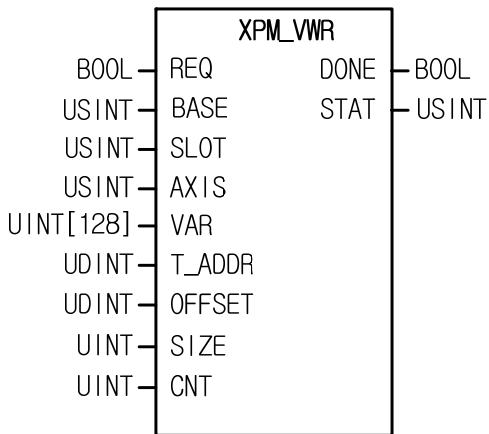
- (1) Gives "Read parameter, operation data, CAM data directly" command to positioning module.
- (2) You read data you want by configuring module internal memory address of parameter, operation data, CAM data directly.
- (3) It reads the positioning module internal memory from the position set by "S\_ADDR" by WORD unit and save them in the device set by "VAR". The number of data to read is the number set by "Size". In case "CNT" is larger than 2, it reads multiple data blocks and save them in the device set by "VAR" in order. At this time, head address of next block is "Offset" apart from head address of current block.
- (4) Max. data size (SIZE x CNT) you can read with one command is 128 word.
- (5) "Read Variable Data" command can execute in operation.
- (6) You can set an axis to command in "AXIS" and the following value is available. If other value is set, it produces "Error6." appears.  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)
- (7) In case Read Data size (SIZE x CNT) is 0 or higher than 128 word, error code "11" appears in STAT.

### ■ Program example

#### 1. ST

```
INST_XPM_VRD(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), S_ADDR:=(*UDINT*),  
OFFSET:=(*UINT*), SIZE:=(*UINT*), CNT:=(*UINT*), DONE=>(*BOOL*), STAT=>(*UINT*),  
VAR=>(*ARRAY[0..127]_OF_UINT*))
```

<b>XPM_VWR</b>	Write Variable Data	
	Availability	XGI, XGR
	Flags	

Function Block	Description
 <pre> graph LR     subgraph XPM_VWR         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         VAR[VAR]         T_ADDR[T_ADDR]         OFFSET[OFFSET]         SIZE[SIZE]         CNT[CNT]         DONE[DONE]         STAT[STAT]     end     REQ_in[REQ] --&gt; REQ     BASE_in[BASE] --&gt; BASE     SLOT_in[SLOT] --&gt; SLOT     AXIS_in[AXIS] --&gt; AXIS     VAR_in[VAR] --&gt; VAR     T_ADDR_in[T_ADDR] --&gt; T_ADDR     OFFSET_in[OFFSET] --&gt; OFFSET     SIZE_in[SIZE] --&gt; SIZE     CNT_in[CNT] --&gt; CNT     DONE --&gt; DONE_out[DONE]     STAT --&gt; STAT_out[STAT]         </pre> <p>Diagram of the XPM_VWR function block. Inputs on the left: REQ (BOOL), BASE (USINT), SLOT (USINT), AXIS (USINT), VAR (UINT[128]), T_ADDR (UDINT), OFFSET (UDINT), SIZE (UINT), CNT (UINT). Outputs on the right: DONE (BOOL), STAT (USINT).</p>	<p><b>Input</b></p> <p>REQ : Request for execution of function block</p> <p>BASE : Set the base no. with module</p> <p>SLOT : Set the slot no. with module</p> <p>AXIS : Axis to command XPM: 1 ~ 4 (1-axis ~4-axis) XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)</p> <p>VAR : PLC device where Write Data is saved</p> <p>T_ADDR : Module internal memory head address where data is written 0 ~ 53329</p> <p>OFFSET : Offset between Write data blocks 0 ~ 53329</p> <p>SIZE : Size of block to write 1 ~ 128</p> <p>CNT : No. of Write data block 1 ~ 128</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operation</p> <p>STAT : Output the error no. in operation</p>

### ■ Function

- (1) Gives "Write parameter, operation data, CAM data directly" command to positioning module.
- (2) You can write data you want by configuring module internal memory address of parameter, operation data, CAM data directly.
- (3) It writes the WORD data in "VAR" to module internal memory. The data are saved from internal memory position set by "T\_ADDR" and the number of data is the number set by "Size". In case the number of block "CNT" is larger than 2, multiple blocks are made. At this time, head address of next block is "Offset" apart from head address of current block.
- (4) Max. data size (SIZE x CNT) you can write with one command is 128 word.
- (5) "Write Variable Data" command can't execute in operation.
- (6) You can set an axis to command in "AXIS" and the following value is available. If other value is set, it produces "Error6."  
XPM: 1 ~ 4 (1-axis ~4-axis), XGF-PN8A/B: 1 ~ 8 (1-axis ~ 8-axis)
- (7) In case Read Data size (SIZE x CNT) is 0 or higher than 128 WORD, error code "11" appears in STAT
- (8) In case no. of block (CNT) is higher than 2, and block offset is smaller than block size, error code "11" appears in STAT because module internal memory block to write is overlapped each other.

### ■ Program example

#### 1. ST

```
INST_XPM_VWR(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*),  
VAR:=(*ARRAY[0..127]_OF_USINT*), T_ADDR:=(*UDINT*), OFFSET:=(*UINT*), SIZE:=(*UINT*), CNT:=(*UINT*),  
DONE=>(*BOOL*), STAT=>(*UINT*))
```

<b>XPM_ECON</b>	Connect Servo Communication	
	Availability	XGI, XGR
	Flags	-

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operation  STAT : Output the error no. in operation</p>

### ■ Function

- (1) Gives "EtherCAT Communication Connection" command to positioning module.
- (2) Instruct the positioning module configured by BASE (base number of positioning module) and SLOT (slot number of positioning module) to connect communication with Servo
- (3) If Servo driver is connected normally, the bit corresponding to the connected axis is set.

	Global variable	Contents
1-axis	<code>_xxyy_A1_RDY</code>	1-axis operation ready
2-axis	<code>_xxyy_A2_RDY</code>	2-axis operation ready
3-axis	<code>_xxyy_A3_RDY</code>	3-axis operation ready
4-axis	<code>_xxyy_A4_RDY</code>	4-axis operation ready
5-axis	<code>_xxyy_A5_RDY</code>	5-axis operation ready
6-axis	<code>_xxyy_A6_RDY</code>	6-axis operation ready
7-axis	<code>_xxyy_A7_RDY</code>	7-axis operation ready
8-axis	<code>_xxyy_A8_RDY</code>	8-axis operation ready

(For xxyy, "xx" means base number and "yy" means slot number where module is installed)

- (4) This instruction is only for XGF-PN8A/B.

### ■ Program example

#### 1. ST

```
INST_XPM_ECON(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), DONE=>(*BOOL*), STAT=>(*UINT*))
```

<b>XPM_DCON</b>	Disconnect Servo Communication	
	Availability	XGI, XGR
	Flags	-

Function Block	Description
<pre> graph LR     REQ[REQ] --&gt; XPM_DCON     BASE[BASE] --&gt; XPM_DCON     SLOT[SLOT] --&gt; XPM_DCON     XPM_DCON --&gt; DONE[DONE]     XPM_DCON --&gt; STAT[STAT]         </pre>	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operation  STAT : Output the error no. in operation</p>

## ■ Function

- (1) Gives "EtherCAT Communication Disconnection" command to positioning module.
- (2) Instruct the positioning module configured by BASE (base number of positioning module) and SLOT (slot number of positioning module) to disconnect communication with Servo
- (3) If Servo driver is connected normally, the bit corresponding to the disconnected axis is cleared.

	Global variable	Contents
1-axis	<u>_xxyy_A1_RDY</u>	1-axis operation ready
2-axis	<u>_xxyy_A2_RDY</u>	2-axis operation ready
3-axis	<u>_xxyy_A3_RDY</u>	3-axis operation ready
4-axis	<u>_xxyy_A4_RDY</u>	4-axis operation ready
5-axis	<u>_xxyy_A5_RDY</u>	5-axis operation ready
6-axis	<u>_xxyy_A6_RDY</u>	6-axis operation ready
7-axis	<u>_xxyy_A7_RDY</u>	7-axis operation ready
8-axis	<u>_xxyy_A8_RDY</u>	8-axis operation ready

(For xxyy, "xx" means base number and "yy" means slot number where module is installed)

- (4) This instruction is only for XGF-PN8A/B.

## ■ Program example

### 1. ST

```
INST_XPM_DCON(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), DONE=>(*BOOL*), STAT=>(*UINT*))
```

<b>XPM_SVON</b>	Servo On	
	Availability	XGI, XGR
	Flags	-

Function Block	Description
<pre> graph LR     subgraph XPM_SVON         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         DONE[DONE]         STAT[STAT]     end     REQ --&gt; XPM_SVON     BASE --&gt; XPM_SVON     SLOT --&gt; XPM_SVON     AXIS --&gt; XPM_SVON     XPM_SVON --&gt; DONE     XPM_SVON --&gt; STAT         </pre>	<p><b>Input</b></p> <p>REQ : Request for execution of function block</p> <p>BASE : Set the base no. with module</p> <p>SLOT : Set the slot no. with module</p> <p>AXIS : Axis to command</p> <p>1~8: 1-axis ~ 8-axis</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operation</p> <p>STAT : Output the error no. in operation</p>

### ■ Function

- (1) Give "Servo On" command to positioning module.
- (2) Instruct the positioning module configured by BASE (base number of positioning module) and SLOT (slot number of positioning module) to disconnect communication with Servo
- (3) In order to start a motor, Servo On signal should be on.
- (4) You can set an axis to command in "AXIS" and the following value is available. If other value is set, it produces "Error6."  
1 ~ 8 (1-axis ~ 8-axis)
- (5) This instruction is only for XGF-PN8A/B.

### ■ Program example

#### 1. ST

```

INST_XPM_SVON(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), DONE=>(*BOOL*),
STAT=>(*UINT*))
    
```

<b>XPM_SVOFF</b>	Servo Off	
	Availability	XGI, XGR
	Flags	-

Function Block	Description
<pre> graph LR     REQ[REQ] --&gt; XPM_SVOFF     BASE[BASE] --&gt; XPM_SVOFF     SLOT[SLOT] --&gt; XPM_SVOFF     XPM_SVOFF --&gt; DONE[DONE]     XPM_SVOFF --&gt; STAT[STAT]     AXIS[AXIS] --&gt; XPM_SVOFF </pre>	<p><b>Input</b></p> <p>REQ : Request for execution of function block</p> <p>BASE : Set the base no. with module</p> <p>SLOT : Set the slot no. with module</p> <p>AXIS : Axis to command 1~8: 1-axis ~ 8-axis</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operation</p> <p>STAT : Output the error no. in operation</p>

#### ■ Function

- (1) Gives "Servo Off" command to positioning module.
- (2) Instruct the positioning module configured by BASE (base number of positioning module) and SLOT (slot number of positioning module) to disconnect communication with Servo
- (3) You can set an axis to command in "AXIS" and the following value is available. If other value is set, it produces "Error6."  
1 ~ 8 (1-axis ~ 8-axis)
- (4) This instruction is only for XGF-PN8A/B.

#### ■ Program example

##### 1. ST

```

INST_XPM_SVOFF(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), DONE=>(*BOOL*),
STAT=>(*UINT*))

```



<b>XPM_SRST</b>	Servo Error Reset	
	Availability	XGI, XGR
	Flags	-

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  1~8: 1-axis ~ 8-axis</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operation  STAT : Output the error no. in operation</p>

### ■ Function

- (1) Gives “Servo Error Reset” command to positioning module.
- (2) Instruct the positioning module configured by BASE (base number of positioning module) and SLOT (slot number of positioning module) to disconnect communication with Servo
- (3) If you give a “Servo Error Reset” command without removing the reason of server drive alarm, servo driver alarm may not be cleared. So remove the reason of servo driver alarm and then execute a “Servo Error Reset” command.
- (4) You can set an axis to command in “AXIS” and the following value is available. If other value is set, it produces “Error6.”  
1 ~ 8 (1-axis ~ 8-axis)
- (5) This instruction is only for XGF-PN8A/B.

### ■ Program example

#### 1. ST

```
INST_XPM_SRST(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), DONE=>(*BOOL*),
STAT=>(*UINT*))
```

<b>XPM_SHRST</b>	Servo Error History Reset	
	Availability	XGI, XGR
	Flags	-

Function Block	Description
<pre> graph LR     REQ[REQ] --&gt; XPM_SHRST     BASE[BASE] --&gt; XPM_SHRST     SLOT[SLOT] --&gt; XPM_SHRST     XPM_SHRST --&gt; DONE[DONE]     XPM_SHRST --&gt; STAT[STAT]         </pre>	<b>Input</b> REQ : Request for execution of function block BASE : Set the base no. with module SLOT : Set the slot no. with module AXIS : Axis to command 1~8: 1-axis ~ 8-axis  <b>Output</b> DONE : Maintain 1 after first operation STAT : Output the error no. in operation

## ■ Function

- (1) Gives "Servo Error History Reset" command to positioning module.
- (2) Instruct the positioning module configured by BASE (base number of positioning module) and SLOT (slot number of positioning module) to disconnect communication with Servo
- (3) Instruct the servo corresponding to the selected axis among the servos connected to the module to reset alarm histories
- (4) Servo drive can save up to 10 server alarm histories
- (5) You can set an axis to command in "AXIS" and the following value is available. If other value is set, it produces "Error6."  
1 ~ 8 (1-axis ~ 8-axis)
- (6) This instruction is only for XGF-PN8A/B.

## ■ Program example

### 1. ST

```

INST_XPM_SHRST(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), DONE=>(*BOOL*),
STAT=>(*UINT*))
  
```

<b>XPM_RSTR</b>	Restart	
	Availability	XGI, XGR
	Flags	-

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  1 ~ 8: axis1 ~ axis8</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating  STAT : Output the error no. in operation</p>

### ■ Function

- (1) Give “Restart” command to the axis of positioning module designated by BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) This command is used when restarting the axis which stops by EMG stop command. If this command is executed, the axis operates again with previous operating information.
- (3) If you start the axis with commands other than “Restart” after it stops with DEC. stop, “Restart” will not be executed
- (4) Set an axis to command from 1 ~ 8. If you set wrongly, “Error6” arises.  
1 ~ 8: axis1 ~ axis8
- (5) For detailed information on “Restart”, refer to “9.2.20. Restart”.

### ■ Program example

#### 1. ST

```
INST_XPM_RSTR(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), DONE=>(*BOOL*), STAT=>(*UINT*));
```

<b>XPM_POE</b>	Setting Position Output Enable/Disable	
	Availability	XGI, XGR
	Flags	-

Function Block	Description
<pre> graph LR     subgraph XPM_POE         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]         DATA_NUM[DATA_NUM]         TIME[TIME]         ENABLE[ENABLE]         DONE[DONE]         STAT[STAT]     end     REQ --- DONE     BASE --- STAT     SLOT --- STAT     AXIS --- STAT     DATA_NUM --- STAT     TIME --- STAT     ENABLE --- STAT         </pre>	<b>Input</b> REQ : Request for execution of function block BASE : Set the base no. with module SLOT : Set the slot no. with module AXIS : Axis to command 1 ~ 4: aixe1 ~ aixe4 DATA_NUM : The number of setting position output (0~50) TIME : Keeping time of setting position output (0~65,535ms) ENABLE : Setting position output enable/disable 0: Disable , 1: Enable  <b>Output</b> DONE : Maintain 1 after first operating STAT : Output the error no. in operation

## ■ Function

- (1) Give "Setting Position Output Enable/Disable" command to the axis of positioning module designated by BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) When Setting position output enable and current position come to setting position output ,the position module outputs signal to deviation count clear pin or setting position output pin.
- (3) Setting the number of data on DATA\_NUM. The number of data can set between 0 to 50, If other value is set, it produces "Error11" and if the number of data on DATA\_NUM is zero, the function block operates disable.
- (4) During setting time on Time of F/B, Setting Position Output signal is on.
- (5) If disables the F/B, Current output signal changes off immediately.
- (6) Set an axis to command from 1 ~ 4. If you set wrongly, "Error6" arises.  
        1 ~ 4: aixe1 ~ aixe4
- (7) This instruction is only for XPM Module.

## ■ Program example

### 1. ST

```

INST_XPM_POE(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), DATA_NUM:=(*USINT*), TIME:=(*UINT*),
ENABLE:=(*BOOL*), DONE=>(*BOOL*), STAT=>(*UINT*));
    
```

<b>XPM_SVIRD</b>	Servo External Input Information Read	
	Availability	XGI, XGR
	Flags	-

Function Block	Description
<pre> graph LR     subgraph Inputs         REQ[REQ]         BASE[BASE]         SLOT[SLOT]         AXIS[AXIS]     end     subgraph Outputs         DONE[DONE]         SV_IN[SV_IN]     end     XPM_SVIRD[XPM_SVIRD]     REQ --&gt; XPM_SVIRD     BASE --&gt; XPM_SVIRD     SLOT --&gt; XPM_SVIRD     AXIS --&gt; XPM_SVIRD     XPM_SVIRD --&gt; DONE     XPM_SVIRD --&gt; SV_IN         </pre>	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  1 ~ 8: axis1 ~ axis8</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating  STAT : Output the error no. in operation  SV_IN: Servo input signal information</p>

### ■ Function

- (1) Give “Servo External Input Information Read” command to the axis of positioning module designated with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) This is command reading input signal state of the servo driver corresponding to the selected axis among servos connected to the module
- (3) Input signal state is outputted at SV\_IN.
- (4) Set an axis to command from 1 ~ 8. If you set wrongly, “Error6” arises.  
1 ~ 8 : axis1 ~ axis8

### ■ Program example

#### 1. ST

```

INST_XPM_SVIRD(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), DONE=>(*BOOL*), STAT=>(*UINT*),
SV_IN=>(*UDINT*));

```

<b>XPM_SVPRD</b>	Servo Parameter Read	
	Availability	XGI, XGR
	Flags	-

Function Block	Description
<div><div><div>XPM_SVPRD</div><div><div>BOOL — REQ</div><div>DONE — BOOL</div><div>USINT — BASE</div><div>STAT — UINT</div><div>USINT — SLOT</div><div>DATA — DINT</div><div>USINT — AXIS</div><div>UINT — INDEX</div><div>USINT — SUBINDEX</div><div>USINT — LENGH</div></div></div></div>	<div><div>Input</div><div>REQ : Request for execution of function block</div><div>BASE : Set the base no. with module</div><div>SLOT : Set the slot no. with module</div><div>AXIS : Axis to command</div><div>1 ~ 8: aixs1 ~ axis8</div><div>INDEX:</div><div>SUBINDEX:</div><div>LENGTH:</div><div>Output</div><div>DONE : Maintain 1 after first operating</div><div>STAT : Output the error no. in operation</div><div>DATA: Read servo parameter data</div></div>

## ■ Function

- (1) Only for XGF-PN8B, this is the command that reads parameters (CoE object) of the servo driver connected to positioning module.
- (2) Give “Servo Parameter Read” command to the axis of positioning module designated with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (3) Save in DATA to read value of LENGTH size at the servo parameter object designated with INDEX, SUBINDEX, at the axis designated with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (4) Set an axis to command from 1 ~ 8. If you set wrongly, “Error6” arises.  
1 ~ 8 : axis1 ~ axis8

- (5) INDEX can be set as follows. If you set wrongly, “Error11” arises at STATE.

Set value	Description
0x1000 ~ 0x1FFF	Communication Profile Area
0x2000 ~ 0x5FFF	Manufacturer Specific Profile Area
0x6000 ~ 0x9FFF	Standardized Device Profile Area

- (6) SUBINDEX can be set as follows. If you set wrongly, “Error11” arises at STATE.

Set value	Description
0x0 ~ 0xFF	Object Subindex of servo parameter

- (7) LENGTH can be set as follows. If you set wrongly, “Error11” arises at STATE.

Set value	Description
1 ~ 4	Object Byte Length of servo parameter

- (8) This instruction is only for XGF-PN8B.

### ■ Program example

#### 1. ST

```
INST_XPM_SVPRD(REQ:=(*BOOL*),    BASE:=(*USINT*),    SLOT:=(*USINT*),    AXIS:=(*USINT*),    INDEX:=(*UINT*),  
SUBINDEX:=(*USINT*), LENGTH:=(*USINT*), DONE=>(*BOOL*), STAT=>(*UINT*), DATA=>(*DINT*));
```

<b>XPM_SVPWR</b>	Servo Parameter Write	
	Availability	XGI, XGR
	Flags	-

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block</p> <p>BASE : Set the base no. with module</p> <p>SLOT : Set the slot no. with module</p> <p>AXIS : Axis to command 1 ~ 8: aixs1 ~ axis8</p> <p>INDEX : Servo parameter object Index</p> <p>SUBINDEX : Servo paramter object subindex</p> <p>LENGTH : Servo parameter object size</p> <p>DATA: Servo parameter value</p> <p>RAM/ROM : how to save parameter 0: save at RAM, 1: save at ROM</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating</p> <p>STAT : Output the error no. in operation</p>

## ■ Function

- (1) This is the function block only for XGF-PN8B and that changes parameters (CoE object) of the servo driver connected to positioning module
- (2) Give “Servo Parameter Write” command to the axis of positioning module designated with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (3) If you want to save at the internal ROM of the servo driver with “Servo parameter write” command, set up 1 at RAM/ROM and execute the command, or set up 0 at RAM/ROM and execute the command and later save them at servo driver EEPROM with XPM\_SVSAVE command.
- (4) Save DATA of LENGTH size at the servo parameter object designated with INDEX, SUBINDEX, at the axis designated with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (5) Set an axis to command from 1 ~ 8. If you set wrongly, “Error6” arises.  
1 ~ 8 : axis1 ~ axis8
- (6) You can set INDEX as follows. If you set wrongly, “Error11” arises

Setting value	Description
0x2000 ~ 0x5FFF	Manufacturer Specific Profile Area
0x6000 ~ 0x9FFF	Standardized Device Profile Area

- (7) You can set SUBINDEX as follows. If you set wrongly, “Error11” arises

Setting value	Description
0x0~0xFF	Servo parameter Object Subindex

- (8) You can set SUBINDEX as follows. If you set wrongly, “Error11” arises

Setting value	Description
---------------	-------------



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1~4	Servo parameter Object Byte Length
-----	------------------------------------

(9) You can set SUBINDEX as follows.

Setting value	Teaching method
0	RAM teaching
1	ROM teaching

(10) This instruction is only for XGF-PN8B.

### ■ Program example

#### 1. ST

```
INST_XPM_SVPWR(REQ:=(*BOOL*),    BASE:=(*USINT*),    SLOT:=(*USINT*),    AXIS:=(*USINT*),    INDEX:=(*UINT*),  
SUBINDEX:=(*USINT*), LENGTH:=(*USINT*), DATA:=(*DINT*), RAM_ROM:=(*BOOL*), DONE=>(*BOOL*), STAT=>(*UINT*));
```

<b>XPM_SVSAVE</b>	Servo Parameter Save	
	Availability	XGI, XGR
	Flags	-

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  1 ~ 8: aixs1 ~ axis8  SAVE_AXIS: Set the axis to save by setting each bit  (bit 0~7: 1-axis~8-axis)</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating  STAT : Output the error no. in operation</p>

## ■ Function

- (1) This is the function block only for XGF-PN8B and that saves parameters of the servo driver connected to positioning module at the EEPROM of the servo driver.
- (2) Give “Servo Parameter Save” command to the axis of positioning module designated with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (3) Set up the axis to give a command at AXIS and you can set as follows. If you set wrongly, “Error6” arises. Command axis is different with the axis for saving servo parameter. If you want to save servo parameter of the command axis, set the corresponding bit at SAVE\_AXIS.  
1 ~ 8: 1-axis ~ 8-axis
- (4) Set up the servo driver axis at SAVE\_AXIS. If you set wrongly, “Erro11” arises  
Bit 0 ~ 7 : 1-axis ~ 8-axis
- (5) This instruction is only for XGF-PN8B.

## ■ Program example

### 1. ST

```
INST_XPM_SVSAVE(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), SAVE_AXIS:=(*USINT*),  
DONE=>(*BOOL*), STAT=>(*UINT*));
```

<b>XPM_TRQ</b>	Torque Control	
	Availability	XGI, XGR
	Flags	-

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  1 ~ 8: axis1 ~ axis8  TRQ_VAL: Torque value  (unit: %, -32768 ~ 32767)  TIME: Torque gradient (unit: ms, 0 ~ 65535 ms)</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating  STAT : Output the error no. in operation</p>

### ■ Function

- (1) Give “Torque Control” command to the axis of positioning module designated by BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (2) Torque control executes if torque value and torque gradient are set and a command is issued.
- (3) Set torque value (%) to TRQ\_VAL. Torque values work in % rated torque. (1 = 1% of rated torque)  
For example, set 200 if the user wants to control torque in 200% of torque.  
※ The allowable range of torque value may vary according to the connected servo drive. In general, target torque value is limited to the maximum torque setting.
- (4) Set time to take in reaching the target torque to TIME. If a command is executed, torque increases in this gradient until it reaches the set torque value.
- (5) Any command cannot be executed, the relevant axis is being operated for functions other than torque control.
- (6) Set an axis to command from 1 ~ 8. If you set wrongly, “Error6” arises.  
1 ~ 8: axis1 ~ axis8
- (7) For detailed information on “Torque Control”, refer to “9.2.21. Torque Control”.
- (8) This instruction is only for XGF-PN8B.

### ■ Program example

#### 1. ST

```
INST_XPM_TRQ(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), TRQ_VAL:=(*INT*), TIME:=(*UINT*),
DONE=>(*BOOL*), STAT=>(*UINT*));
```

<b>XPM_LRD</b>	Servo External Input Information Read	
	Availability	XGI, XGR
	Flags	-

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  1 ~ 8: axis1 ~ axis8</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating  STAT : Output the error no. in operation  L_CNT: Number of latch position data  L_DATA: Latch position data 1 ~ 10</p>

## ■ Function

- (1) This command is used to read data count and latch position data saved and latched by the positioning module's external latch command.
- (2) Save the position data count read and latched the latch data of the axis designated as the positioning module's AXIS(Command axis) designated as BASE(Base number of the positioning module) and SLOT(Slot number of the positioning module) to L\_CNT and save the latch position data to L\_DATA.
- (3) Set an axis to which Command is issued to Axis and one among 1 through 8 can be set. If any other value except the setting value is set, "Error 6" arises.
- (4) This instruction is only for XGF-PN8A/B.

## ■ Program example

### 1. ST

```
INST_XPM_LRD(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), DONE=>(*BOOL*), STAT=>(*UINT*),
L_CNT=>(*UINT*), L_DATA=>(*ARRAY[0..9]_OF_UDINT*));
```

<b>XPM_LCLR</b>	Latch Reset	
	Availability	XGI, XGR
	Flags	-

Function Block	Description
<pre> graph LR     REQ[REQ] --&gt; XPM_LCLR     BASE[BASE] --&gt; XPM_LCLR     SLOT[SLOT] --&gt; XPM_LCLR     AXIS[AXIS] --&gt; XPM_LCLR     SEL[SEL] --&gt; XPM_LCLR     XPM_LCLR --&gt; DONE[DONE]     XPM_LCLR --&gt; STAT[STAT]         </pre>	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  1 ~ 8: aixs1 ~ axis8  SEL: Latch reset item selection</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating  STAT : Output the error no. in operation</p>

### ■ Function

- (1) This command is used to initialize the data count and latch position data saved and latched on the positioning module or the state when latch is completed.
- (2) Give "Latch Reset" command to the positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (3) The following items are reset according to the Reset Latch items designated to SEL.
  - 0: Reset the state when latch is completed
  - 1: Reset latch position data and the state when latch is completed  
(Values high than "1" are processed equally with "1")
- (4) If latch position data are read through the "Read Latch Position Data (XPM\_LRD)" command after 1 is set to SEL and the "Reset Latch" command is executed, all of data become 0.
- (5) Set an axis to command from 1 ~ 8. If you set wrongly, "Error6" arises.  
1 ~ 8 : axis1 ~ axis8
- (6) This instruction is only for XGF-PN8A/B.

### ■ Program example

#### 1. ST

```

INST_XPM_LCLR(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), SEL:=(*BOOL*), DONE=>(*BOOL*),
STAT=>(*UINT*));
    
```

<b>XPM_LSET</b>	Servo External Input Information Read	
	Availability	XGI, XGR
	Flags	-

Function Block	Description
<pre> graph LR     subgraph XPM_LSET         REQ[REQ] --- BASE[BASE]         BASE --- SLOT[SLOT]         SLOT --- AXIS[AXIS]         AXIS --- ENABLE[ENABLE]         ENABLE --- MODE[MODE]         REQ --- DONE[DONE]         BASE --- STAT[STAT]     end     REQ --- REQ_L[REQ]     BASE --- BASE_L[BASE]     SLOT --- SLOT_L[SLOT]     AXIS --- AXIS_L[AXIS]     ENABLE --- ENABLE_L[ENABLE]     MODE --- MODE_L[MODE]     DONE --- DONE_L[DONE]     STAT --- STAT_L[STAT]         </pre>	<b>Input</b> REQ : Request for execution of function block BASE : Set the base no. with module SLOT : Set the slot no. with module AXIS : Axis to command 1 ~ 8: aixs1 ~ axis8 ENABLE: Latch enable/disable MODE: Latch mode  <b>Output</b> DONE : Maintain 1 after first operating STAT : Output the error no. in operation

## ■ Function

- (1) This command is used to initialize the data count and latch position data saved and latched on the positioning module or the state when latch is completed.
- (2) Give “Latch Set” command to the positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (3) Actions according to the Enable/Disable Latch item designated to ENABLE are as following.  
 0: latch prohibition 1: latch permission  
 (Values high than “1” are processed equally with “1”)
- (4) Actions according to the latch mode item designated to MODE are as following.  
 0: Single trigger (The current position latch is available only the touch probe 1 signal inputted at first after latch is enabled)  
 1: Continuous trigger (The current position latch is available at every touch probe 1 signal after latch is enabled)  
 (Values high than “1” are processed equally with “1”)
- (5) Set an axis to command from 1 ~ 8. If you set wrongly, “Error6” arises.  
 1 ~ 8 : axis1 ~ axis8
- (6) “Latch Set” command is applied to only XGF-PN8B.
- (7) This instruction is only for XGF-PN8B.

## ■ Program example

### 1. ST

```

INST_XPM_LSET(REQ:=(*BOOL*), BASE:=(*USINT*), SLOT:=(*USINT*), AXIS:=(*USINT*), ENABLE:=(*BOOL*), MODE:=(*BOOL*),
DONE=>(*BOOL*), STAT=>(*UINT*));
    
```

<b>XPM_STC</b>	Torque Synchronization	
	Availability	XGI, XGR
	Flags	-

Function Block	Description
	<p><b>Input</b></p> <p>REQ : Request for execution of function block  BASE : Set the base no. with module  SLOT : Set the slot no. with module  AXIS : Axis to command  1 ~ 8: aixs1 ~ axis8  MST_TRQ : Torque rate of main axis  0 ~ 65535  SLV_TRQ : Torque rate of sub axis  0 ~ 65535  MST_RAT : Speed rate of main axis  0 ~ 65535  SLV_RAT : Speed rate of sub axis  0 ~ 65535  MST_AXIS : Torque synchronization main axis  1 ~ 8: aixs1 ~ axis8</p> <p><b>Output</b></p> <p>DONE : Maintain 1 after first operating  STAT : Output the error no. in operation</p>

### ■ Function




- (1) This command is used to order torque synchronization to axis of servo drive that is connected to positioning module.
- (2) Give "Torque synchronization" command to the axis of positioning module with BASE (Base no. of Positioning module) and SLOT (Slot no. of Positioning module).
- (3) The axis to performing a command operates torque synchronization with main axis set as MST\_AXIS.
- (4) The axis to performing a command operates torque synchronization with torque rate set as MST\_TRQ, SLV\_TRQ and speed rate set as MST\_RAT, SLV\_RAT.  
Torque of sub axis = (SLV\_TRQ/MST\_TRQ) \* torque of main axis  
Torque synchronization speed of sub axis = (SLV\_RAT/MST\_RAT) \* speed of main axis
- (5) Set an axis to AXIS from 1 ~ 8. If you set wrongly, "Error 6" arises.  
1 ~ 8 : axis1 ~ axis8
- (6) Set an main axis of torque synchronization to MST\_AXIS from 1 ~ 8. If you set wrongly, "Error 11" arises.  
1 ~ 8 : axis1 ~ axis8

## Ch 12. Expanded Functions

This chapter describes each expanded function.. It is used for a specific processing (ex. FOR ~ NEXT, CALL, etc.) of a part of program during user program run.



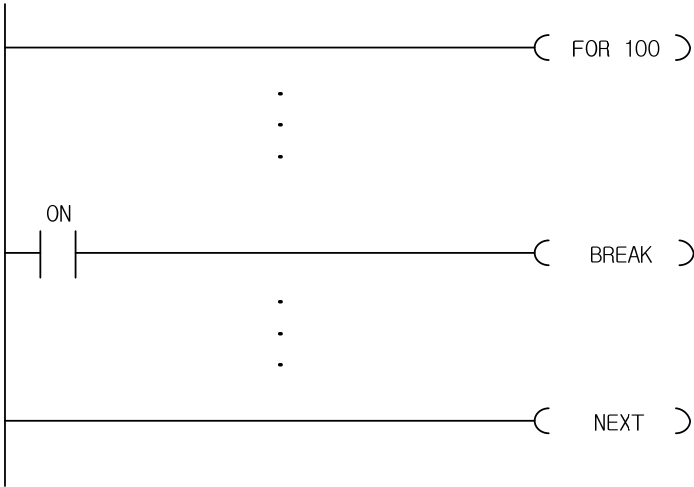
FOR/NEXT/BREAK	LOOP command	
	Availability	XGI, XGR, XEC
	Flags	_ERR, _LER

Function	Description
	Repeat a block of FOR ~ NEXT n times
	
	Escape a block of FOR ~ NEXT

■ Function


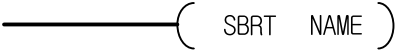

- (1) PLC repeats FOR ~ NEXT command n times and then processes the next step of NEXT command.
- (2) n is available 1 ~ 65,535.
- (3) FOR ~ NEXT command is able to use 16 NESTINGS.
- (4) REAK command is the instruction to escape FOR ~ NEXT loop.
- (5) Keep the range of WDT value to avoid delaying the scan time.

■ Program Example



- (1) It operates FOR ~ NEXT loop 100 times repeatedly.
- (2) To escape the loop during a repetition, turn the switch on and run the BREAK command.

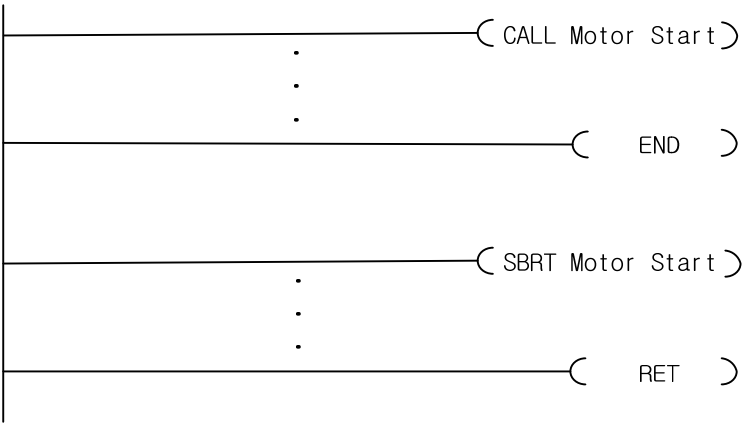
CALL/SBRT/RET	Command of function call	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	Call a SBRT routine
	Assign a routine to be called by the CALL function
	RETURN

■ Function


- (1) With an input condition and the CALL n command, it operates a program among the SBRT n ~ RET command.
- (2) Nested CALL n command is usable, and the program among SBRT n ~ RET must be placed after END command.
- (3) A program which is in SBRT can call another SBRT. In this case, END command is impossible to use in the SBRT.
- (4) A program can escape the FOR ~ NEXT loop with a BREAK command.

■ Program Example



- (1) It calls a SBRT (Motor Start) if the program operates CALL command.
- (2) SBRT command must be placed after the END command.
- (3) When SBRT (Motor Start) is called, a program is run in the SBRT until RET command. It goes to the position again where CALL command is called.

JMP	JUMP command	
	Availability	XGI, XGR, XEC
	Flags	

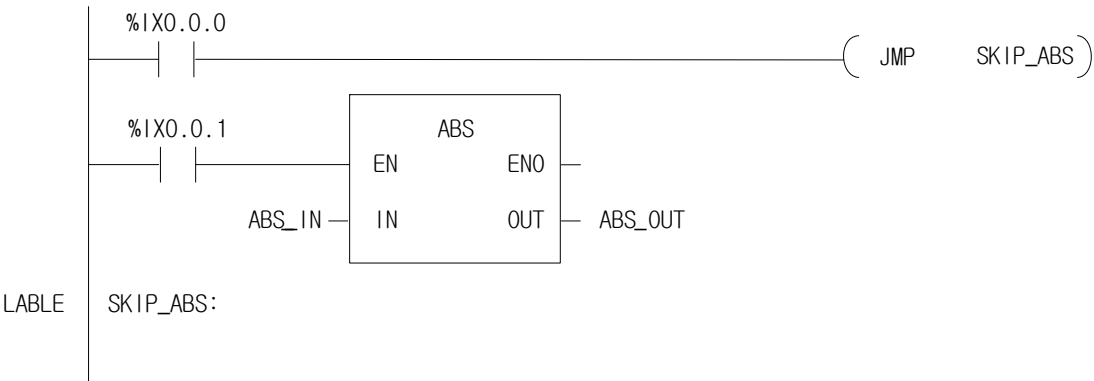
Function	Description
	Jump to a place of LABEL

■ Function


- (1) If a switch of JMP (LABEL) command is on, it jumps to the next of the assigned LABEL. All the commands between JMP and LABEL are not processed.
- (2) LABEL must not be duplicated, but JMP can be repeated.
- (3) It is recommended that the program which must not be run in a state of emergency is placed between JMP and LABEL.

■ Program Example

- (1) When %IX0.0.0 is on, it does not operate ABS function.



INIT_DONE	Command to terminate an initial task	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	Terminate an initial task

■ Function


- (1) It terminates an initial task.
- (2) You have to terminate an initial task program using this command when you program an initial task program. Otherwise, you neither terminate the initial task program nor enter a scan program.

■ Program Example

- (1) When %IX0.0.0 is on, it terminates an initial task.



END	END command	
	Availability	XGI, XGR, XEC
	Flags	

Function	Description
	Terminate a program

■ Function

- (1) It indicates the end of a program.
- (2) After the processing of the END command, the program goes to the beginning of itself and process again.

## Chapter 13 Process Control Library

This chapter describes the process control library relating to process control, data process, arithmetic instruction, data measurement and data creation.

### 13.1 Process Control Library

1) STAT  
Some process control library functions and function blocks have STAT, which is used to notify of any error of instruction. If STAT has any other value, other than 0, it means that the instruction has an error; the content of STAT code is as follows.

STAT	Name	Operation on occurrence	Description
1	T_s error	Scan cycle operation	In case it may not work as previously set because T_s setting is earlier than the current scan time, it operates with the earliest time as possible and displays it.
2	X_min, X_max inversion	Operation stop Output reset	Input is designed to be X; it displays if X_min is larger than X_max while it is limited to max./min.
4	Y_min, Y_max inversion	Operation stop Output reset	Output is designed to be X; it displays if Y_min is larger than Y_max while it is limited to max./min.
8	Other setting error	Operation stop Output reset	It means any other erroneous state of setting except the above statements

If two and more are detected in the above, the sum of two STATs is output. That is, if 2 should be the output to STAT as X\_min and X\_max are inversed while 4 should be output to STAT as Y\_min and Y\_max are inversed, the sum of 2 and 4, 6 should be output.

Errors except T\_s error in which STAT is 1 stop function or function block, outputs 0 and make, if any, DONE and ENO off.

2) T\_s  
T\_s existing in some instructions represents operation cycle of instruction and if setting T\_s, the instruction operates every T\_s time. As being structured to execute an operation if passing T\_s time after comparing the previous operation time and the present time as it approaches to the instruction, it has temporal error  $E(T_s)$  and the error is not accumulated ordinarily because it reflects the error in the next operation cycle.

$$0 \leq E(T_s) < T_{scan}$$

In the case, T\_s error is accumulated, and the instruction executes operation every time it scans to solve accumulated error and it outputs 1 to STAT value. Therefore, if setting T\_s as 0, it processes the instruction every time it scans.

3) Setting same max. limit and min. limit  
Process library keeps several min./max. limits of X or Y. In general, if max./min. values are limited, a bit displaying on the bottom of output that such limits are valid exists (i.e.: X\_max\_AL) and especially, if max. limit and min. limit are set alike, both alarms are turned on, which is the way displaying that it is limited both to max. and min. limits.

4) Abnormal input  
It may not work properly if an instruction to have real numbers had abnormal input such as 1.#inf00000 E+000, -1.#inf00000 E+000 or 1.#QNAN0000 E+000.

### Notes

#### **Blinking STAT 1 (T\_S error)**

Since every scan of PLC may have different data volume, the execution speed may not be same per scan. In case, it may work with STAT 1 indicated or STAT 1 blinks unless T\_s setting does not have tolerance properly. For instance, if a user sets T\_s as 3ms and its scan cycle fluctuates between 2 ~ 4ms, it may work properly if its scan cycle is 2ms or 3ms but the instruction may not work normally if it reaches to 4ms, so it should indicate 1 in STAT and the scan operates with 4ms. If scan is shortened to 2ms or 3ms, STAT 1 is turned off and blinks.

## 13.2 Process Control Function and Function Block



PIDAT	PID Auto tuning	
	Availability	XEC
	Flags	-

Function block	Description
<div><div><div>PIDAT</div><div><div>REQ</div><div>BLOCK</div><div>LOOP</div></div><div><div>DONE</div><div>AT_STAT</div></div></div><div><div>BOOL</div><div>UINT</div><div>UINT</div></div><div><div>BOOL</div><div>WORD</div></div></div>	<p><b>Input</b> REQ : Function block execution request BLOCK : Block number (0) LOOP : Loop number (0~15)</p> <p><b>Output</b> DONE : On if done without error PID_STAT : PID state alarm</p>

Functions

- (1) It executes PID operation of the related block and loop.
- (2) Totally 16 PID loops are available independently because BLOCK is fixed as 0 and LOOP can take input as 0~15
- (3) Output AT\_STAT is hexadecimal and each PID loop shows the state as presented in <Table 13.1>.

<Table 13.1>

Class	Display	Flag	Description
STATE	16#0001	PID_STAT	A loop is being operated.
	16#0080	AT_DONE	AT (Auto-tuning) ends.
	16#0100	MV_MIN_MAX_ERR	Max. MV is smaller than Min. MV
	16#0300	PWM_PERIOD_ERR	Output period of PWM output is smaller than 100 (10ms).
	16#0400	SV_RANGE_ERR	In case of forward operation, Set value at the start of auto-tuning is smaller than present value. In case of reverse operation, Set value at the start of auto-tuning is larger than present value
	16#0500	PWM_ADDRESS_ERR	The value other than %QX0.0.0~0.0.31 is set as PWM output
	16#0A00	TUNE_DIR_CHG	Operation direction is changed while auto-tuning
	16#0B00	AT_PERIOD_ERR;	Operation period of auto-tuning is smaller than 100(10ms)
	16#0E00	LOOP_EXCEED	Auto-tuning LOOP number is larger than 15

- (4) Each state may be presented simultaneously.

PIDRUN	PID Operator	
	Availability	XGI, XGR, XEC
	Flags	-

Function block	Description
<div><div><div>PIDRUN</div><div><div>REQ</div><div>BLOCK</div><div>LOOP</div></div><div><div>DONE</div><div>PID_STAT</div></div></div><div><div>BOOL</div><div>UINT</div><div>UINT</div></div><div><div>BOOL</div><div>WORD</div></div></div>	<div><b>Input</b> REQ : Function block execution request BLOCK : Block number (0~7) LOOP : Loop number (0~31)</div> <div><b>Output</b> DONE : On if done without error PID_STAT : PID state alarm</div>

■ Functions

- (1) It executes PID operation of the related block and loop.
- (2) Totally 256 PID loops are available independently because block may be 0 ~ 7 (In case of XEC), and loop of each block may be 0 ~ 31. (In case of XEC 0~15)
- (3) Output PID\_STAT is hexadecimal and each PID loop shows the state as presented in the following table.

<Table 13.2>  
In case of XGI, XGR

Class	Display	Flag	Description
ALARM	16#0001	T_s ERR	It may not execute every T_s because T_s setting is too small.
	16#0002	K_p ERR	Note that K_p is 0.
	16#0004	dPV_AL	PV is limited by dPV_max setting.
	16#0008	dMV_AL	MV is limited by dMV_max setting.
	16#0010	MVmax_AL	MV is limited by MV_max setting.
	16#0020	MVmin_AL	MV is limited by MV_min setting.
	16#0040	AT_fail	AT (Auto-tuning) is abnormally ended.
	16#0080	Unused	Unused
STATE	16#0100	PID_STAT	A loop is being operated.
	16#0200	AT_STAT	AT (Auto-tuning) in progress
	16#0400	AT_DONE	AT (Auto-tuning) ends.
	16#0800	EX_RUN	Started by external run signal.
	16#1000	MAN_OUT	Manual output in progress
	16#2000	CAS_STAT	CAS (Cascade) in progress
	16#4000	CAS_MST	CAS (Cascade) operates as master.
	16#8000	AW_STAT	AW1(Anti wind-up) or AW2 is operating.

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In case of XEC

Class	Display	Flag	Description
ALARM	16#0001	PV_MIN_MAX_ALM	Present value exceeds the range
	16#0002	PID_SCANTIME_ALM	Operation period is too small
	16#0003	PID_dPV_WARN	Delta present value of this PID period exceeds Delta PV limit
	16#0004	PID_dMV_WARN	Delta manipulated value of this PID period exceeds Delta MV limit
	16#0005	PID_MV_MAX_WARN	MV of this PID period exceeds Max. MV
	16#0006	PID_MV_MIN_WARN	MV of this PID period exceeds Min. MV
ERROR	16#0100	MV_MIN_MAX_ERR	Max. MV is smaller than Min. MV
	16#0200	PV_MIN_MAX_ERR	Max. PV is smaller than Min. MV
	16#0300	PWM_PERIOD_ERR	PWM output period is smaller than 100 (10ms)
	16#0400	SV_RANGE_ERR	In case of forward operation, Set value at the start of auto-tuning is smaller than present value. In case of reverse operation, Set value at the start of auto-tuning is larger than present value
	16#0500	PWM_ADDRESS_ERR	The value other than %QX0.0.0~0.0.31 is set as PWM output
	16#0600	P_GAIN_SET_ERR	Proportional Gain is smaller than 0
	16#0700	I_TIME_SET_ERR	Integral Time is smaller than 0
	16#0800	D_TIME_SET_ERR	Derivative Time is smaller than 0
	16#0900	CONTROL_MODE_ERR	Control mode is other than P, PI and PID.
	16#0B00	PID_PERIOD_ERR;	PID operation period is smaller than 100(10ms)
	16#0C00	HBD_WRONG_DIR	In case of combined operation, direction parameter of forward operation loop is set as reverse or direction parameter of reverse operation loop is set as forward
	16#0D00	HBD_SV_NOT_MATCH	In case of combined operation, Set values of two loops are different.
	16#0E00	LOOP_EXCEED	PID LOOP number is larger than 15

(4) Each state may be presented simultaneously.

PIDCAS	Cascade PID Operator	
	Availability	XGI, XGR, XEC
	Flags	-

Function block	Description
<div></div>	<p><b>Input</b></p> <p>REQ :Function block execution request BLOCK :Block number LOOP_MST :Master loop number LOOP_SLV :Slave loop number</p> <p><b>Output</b></p> <p>DONE : On if done without error MST_STAT : Master loop state alarm SLV_STAT : Slave loop state alarm</p>

■ Functions

- (1) Executes Cascade PID operation with a combination of two loops for a block.
- (2) Block may be 0 ~ 7 (In case of XEC, 0), and master loop and slave loop should be between 0 ~ 31 (in case of XEC, 0~15) in a same block and differently.
- (3) MST\_STAT and SLV\_STAT for output are hexadecimal and represent the states of master and slave respectively as presented in the above table.
- (4) Each state may be presented simultaneously.

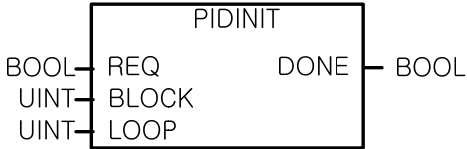
PIDHBD	Forward-reverse combined output PID operator	
	Availability	XEC
	Flags	-

Function block	Description
<div><div><div>PIDHBD</div><div><div>REQ</div><div>DONE</div><div>BLOCK</div><div>FWD_STAT</div><div>LOOP_FWD</div><div>REV_STAT</div><div>LOOP_REV</div></div></div><div><div>BOOL</div><div>UINT</div><div>UINT</div><div>UINT</div></div><div><div>BOOL</div><div>WORD</div><div>WORD</div></div></div>	<div><b>Input</b> REQ : Function block execution request BLOCK : Block number LOOP_FWD : Forward direction loop number LOOP_REV : reverse direction loop number</div> <div><b>Output</b> DONE : On if done without error FWD_STAT : Forward direction loop state alarm REV_STAT : Reverse direction loop state alarm</div>

■ Function

- (1) Combines two related loops of related block and executes Forward/reverse combined output PID operation.
- (2) Block is 0 and master loop and slave loop should use different number of 0~ 15 in the same block.
- (3) Output FWD\_STAT, REV\_STAT are hexadecimal and each represents the status like <Table 13.2> of forward direction and reverse direction.
- (4) Each state may be presented simultaneously

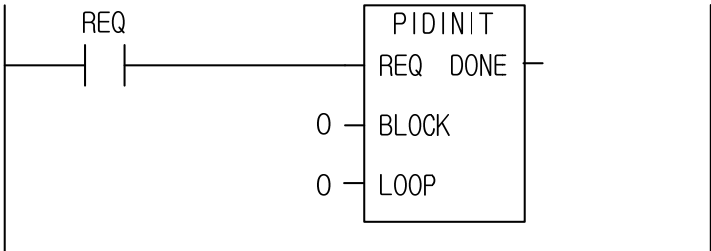
PIDINIT	PID Initialize	
	Availability	XGI, XGR
	Flags	-

Function block	Description
	<p><b>Input</b> REQ : Function block execution request BLOCK : Block number LOOP : Loop number</p> <p><b>Output</b> DONE : On if done without error</p>

■ Function

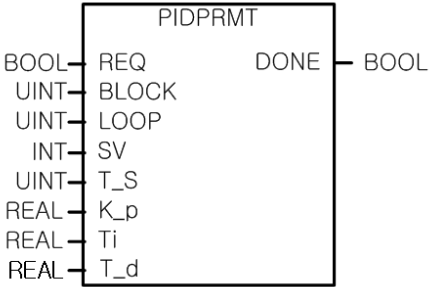
(1) Initializes all loop PID settings of a block to 0.

■ Program Example



Once input contact REQ is set, it initializes every setting of PID block 0 and loop 0 to 0.

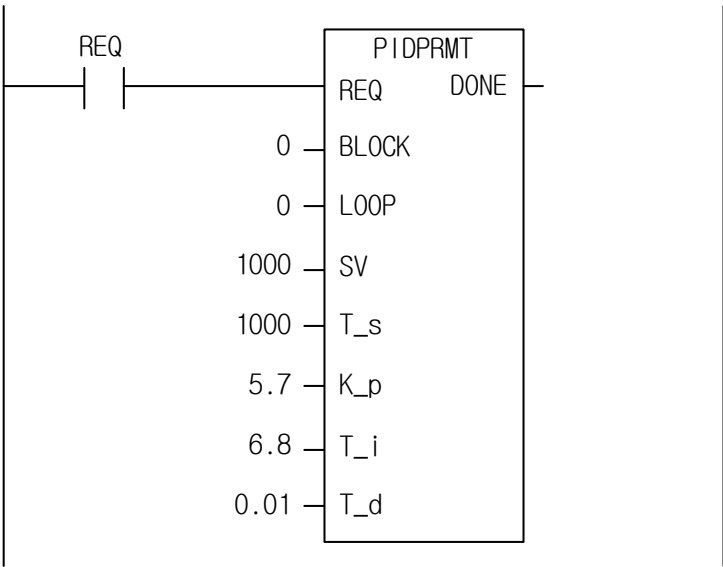
PIDPRMT	PID Parameter Change	
	Availability	XGI, XGR
	Flags	-

Function block	Description
	<p><b>Input</b></p> <p>REQ : Function block execution request BLOCK : Block number LOOP : Loop number SV : Set value T_s : Operation cycle K_p : Proportional constant T_i : Integral constant T_d : Differential constant</p> <p><b>Output</b></p> <p>DONE : On if done without error</p>

■ Functions

- (1) It changes PID settings of loop and block to input value.
- (2) The setting items to be changed are SV, T\_s, K\_p, T\_i and T\_d as expressed in input.
- (3) Since applying PIDPPMT instruction may change coefficient according to the conditions of a PID loop, pattern control may be executed in accordance with system response.

■ Program Example



Main setting of PID block 0 and loop 0 is changed with the input values as seen in the above figure.

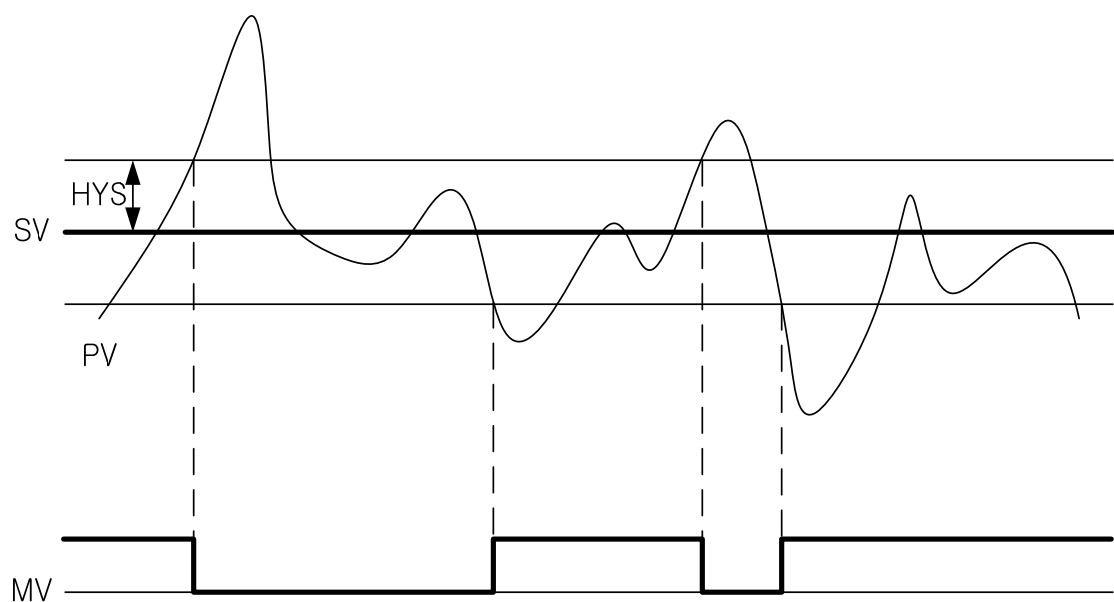
ONOFF	ON / OFF Control	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div><div>ONOFF</div><div><div>BOOL — REQ</div><div>BOOL — MAN</div><div>BOOL — MAN_MV</div><div>REAL — SV</div><div>REAL — PV</div><div>BOOL — PH_OFF</div><div>BOOL — PL_OFF</div><div>REAL — PH</div><div>REAL — PL</div><div>TIME — PH_DT</div><div>TIME — PL_DT</div><div>REAL — HYS</div><div>REAL — PV_max</div><div>REAL — PV_min</div><div>DONE — BOOL</div><div>STAT — USINT</div><div>MV — BOOL</div><div>EV — REAL</div><div>PH_AL — BOOL</div><div>PL_AL — BOOL</div><div>PV_max_AL — BOOL</div><div>PV_min_AL — BOOL</div></div></div>	<div><div>Input</div><div>REQ : Function block execution request</div><div>MAN : Manual mode conversion bit</div><div>MAN_MV : Manual mode conversion value</div><div>SV : Set value</div><div>PV : Present value</div><div>PH_OFF : PV High section cancel bit</div><div>PL_OFF : PV Low section cancel bit</div><div>PH : PV High section set value</div><div>PL : PV Low section set value</div><div>PH_DT : PV High section set delay time</div><div>PL_DT : PV Low section set delay time</div><div>HYS : Hysterisis radius setting</div><div>PV_max : PV max. limit</div><div>PV_min : PV min. limit</div><div>Output</div><div>DONE : On if done without error</div><div>STAT : State alarm</div><div>MV : Output value</div><div>EV : Error value</div><div>PH_AL : PV High alarm</div><div>PL_AL : PV Low alarm</div><div>PV_max_AL : PV max. high alarm</div><div>PV_min_AL : PV min. low alarm</div></div>

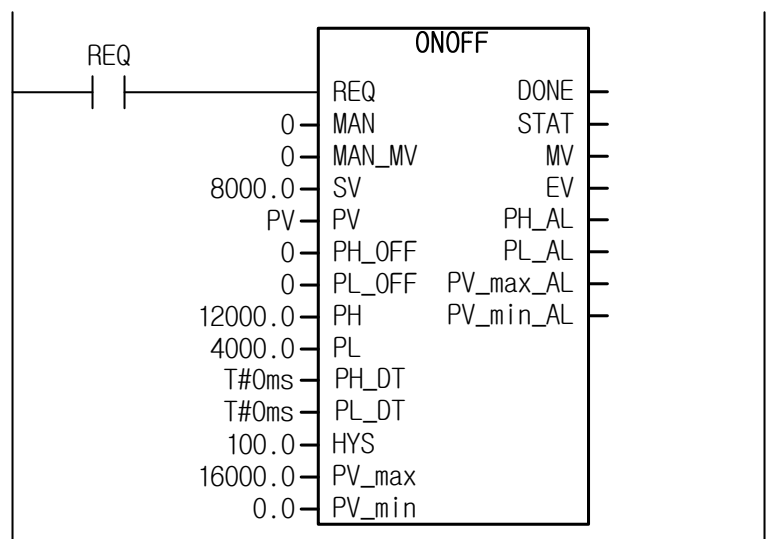
■ Functions

- (1) ON/OFF control creating Booltype output MV
- (2) If PV is received from AD, it is necessary to convert the data type to REAL prior to use.
- (3) Once setting MAN, it is converted to manual mode and MAN\_MV value is output to MV, irrespective of the operation results.
- (4) In case of (SV – HYS) > PV, MV = On
- (5) In case of (SV + HYS) < PV, MV = Off
- (6) In case of (SV – HYS) ≤ PV ≤ (SV + HYS), MV = MV(previous)
- (7) It represents 'Error value EV = SV – PV'.
- (8) If setting each up/down section of PV to PH/PL, it displays the corresponding PH\_AL/PL\_AL alarm when it is beyond the sections.
- (9) However, if PH\_OFF/PL\_OFF bit is on, it does not execute each PH\_AL/PL\_AL operation.
- (10) In PH\_DT/PL\_DT, the output delay time of PH\_AL/PL\_AL may be set.
- (11) PV input may be limited by setting the max./min. value of each PV in PV\_max/PV\_min. When it reaches the limits, PV\_max\_AL/PV\_min\_AL alarms are on.
- (12) If EV is out of the real number data range, the output displays with '1.#inf00000 E+000' or '-1.#inf00000 E+000'but the output except EV is normally operates.



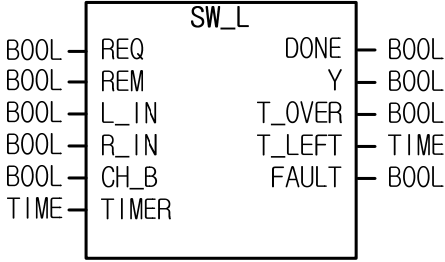


■ Program Example



- If PV is over 8100 (8000+100), MV is off while if PV is less than 7900 (8000-100), MV is on.
- If PV is not less than 16000, it is regarded as 16000 and PV\_max\_AL is set; if it is not more than 0, it is regarded as 0 and PV\_min\_AL is set.
- If PV is not less than 12000, PH\_AL is set; in case of not more than 4000, PL\_AL is set.

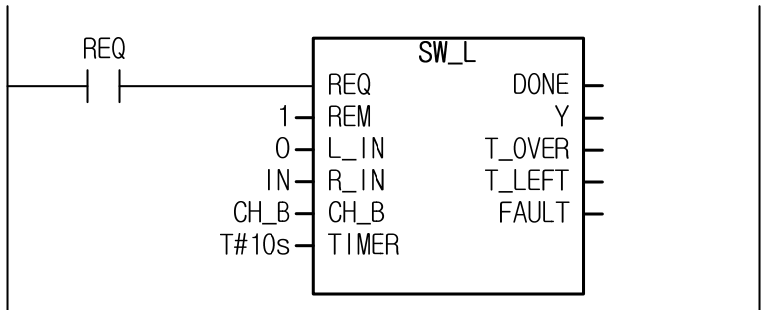
SW_L	1 Input latch	
	Availability	XGI, XGR
	Flags	-

Function block	Description
	<p><b>Input</b></p> <p>REQ : Function block execution request</p> <p>REM : Remote input setting</p> <p>L_IN : Local input</p> <p>R_IN : Remote input</p> <p>CH_B : Check back input</p> <p>TIMER : Check back queue time</p> <p><b>Output</b></p> <p>DONE : On if done without error</p> <p>Y : Output value</p> <p>T_OVER : Time over alarm</p> <p>T_LEFT : Left time display</p> <p>FAULT : Check back failure alarm</p>

■ Functions

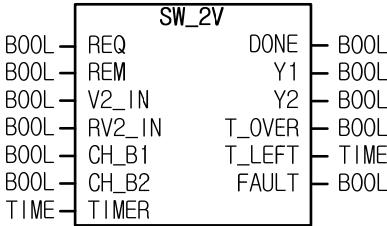
- (1) If using pump control, it may not work due to a fault/trouble or it may cause an accident due to any other reasons, as it outputs continuous operation instruction unless it is checked whether a pump actually works with a check back signal after receiving pump operation instruction. Against it, it is designed that it determines a trouble and outputs fault without any operation instruction unless CHECK\_BACK signal (RUN signal of a pump) is input after an operation instruction Y is output.
- (2) If REM is off, it receives L\_IN as its input; in case of on, it receives R\_IN as its input.
- (3) Once the first input is on, output Y is on and it waits for CH\_B (check back) signal for a time set in TIMER.
- (4) At the moment, T\_LEFT shows the left time and T\_OVER is on after the left time passes.
- (5) If CH\_B and input are on after a time set in TIMER, Y continues to be on; if CH\_B is off even for a while, it regards it as system fault, outputs off to Y and turns FAULT on. Then it outputs off to Y even though CH\_B is on again.
- (6) If input is off, it operates from the first step.

■ Program Example



If IN is on with REQ set, Y is on and timer works for 10s, during while T\_LEFT shows the left time. In 10 s, T\_OVER is on; if CH\_B is on, Y is maintained as on while if CH\_B is off, Y is off and Fault is on.

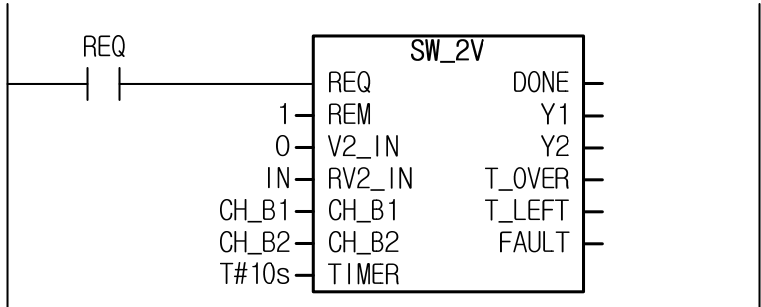
SW_2V	2-Way Valve Control	
	Availability	XGI, XGR
	Flags	-

Function block	Description
	<p><b>Input</b></p> <p>REQ : Function block execution request REM : Remote input setting V2_IN : Select local valve2/1 RV2_IN : Select remote valve2/1 CH_B1 : Input valve 1 check back CH_B2 : Input valve 2 check back TIMER : Check back queue time</p> <p><b>Output</b></p> <p>DONE : On if done without error Y1 : Output 1 Y2 : Output 2 T_OVER : Time over T_LEFT : Left time display FAULT : Check back failure alarm</p>

■ Functions

- (1) In case of 2-way valve, the only selected side should be open and the other side should be closed. In addition, if check back signal is inputted, a valve may work properly unless it generates any output. If check back signal is not input in a check back input delay time after open instruction, fault is output.
- (2) If REM is off, it receives V2\_IN as its input ;if REM is on, it receives RV2\_IN as its input.
- (3) If input is changed from/to off -> on, output Y2 is on and it waits for CH\_B2 signal for a time set in timer.
- (4) If input is reversely changed from/to on -> off, output Y1 is on and it waits for CH\_B1 signal for a time set in timer.
- (5) At the moment, T\_LEFT shows the left time and T\_OVER is on once the queue time passes.
- (6) if a time set in timer, the output is off; if CH\_B is on, fault is off. If CH\_B is off, fault is on.
- (7) It works from the first with input changed, and the output may be secured as long as timer setting is set more than twice of scan cycle.

■ Program Example



If IN is on with REQ set, Y2 is on and the timer works for 10s, during which T\_LEFT shows the left time. In 10s, T\_OVER is on, and the output, Y1 and Y2 are off. if CH\_B2 is on, fault is off; if CH\_B2 is off, the fault is on.

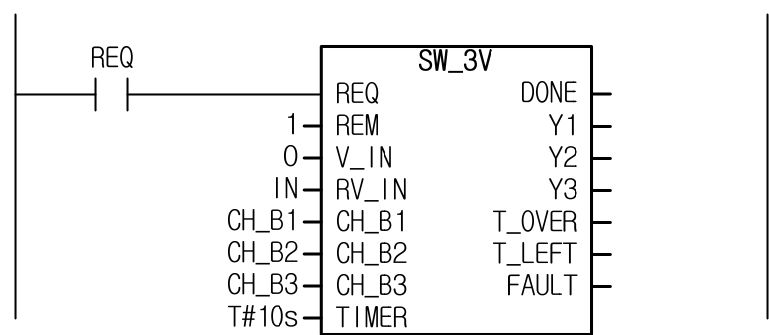
SW_3V	3-Way Valve Control	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div><div>SW_3V</div><div><div>BOOL REQ</div><div>BOOL REM</div><div>USINT V_IN</div><div>USINT RV_IN</div><div>BOOL CH_B1</div><div>BOOL CH_B2</div><div>BOOL CH_B3</div><div>TIME TIMER</div><div>DONE</div><div>STAT</div><div>Y1</div><div>Y2</div><div>Y3</div><div>T_OVER</div><div>T_LEFT</div><div>FAULT</div><div>BOOL</div><div>USINT</div><div>BOOL</div><div>BOOL</div><div>BOOL</div><div>BOOL</div><div>TIME</div><div>BOOL</div></div></div>	<div><div>Input</div><div>REQ : Function block execution request</div><div>REM : Remote input setting</div><div>V_IN : Local input selection (1~3)</div><div>RV_IN : Remote input selection (1~3)</div><div>CH_B1 : Input valve1 check back</div><div>CH_B2 : Input valve2 check back</div><div>CH_B2 : Input valve3 check back</div><div>TIMER : Check back queue time</div><div>Output</div><div>DONE : On if done without error</div><div>Y1 : Output 1</div><div>Y2 : Output 2</div><div>Y3 : Output 3</div><div>T_OVER : Time over</div><div>T_LEFT : Left time display</div><div>FAULT : Check back failure alarm</div></div>

■ Functions

- (1) In case of 3-way valve, the only selected side should be open and the other side should be closed. In addition, if check back signal is input, a valve may work properly unless it generates any output. If check back signal is not input in a check back input delay time after open instruction, fault is output.
- (2) If REM is off, it receives V\_IN as its input ;if REM is on, it receives RV\_IN as its input.
- (3) If input is changed from/to Vm -> Vn, output Yn is on and it waits for CH\_Bn signal for a time set in timer.
- (4) T\_LEFT shows the left time and T\_OVER is on once the queue time passes.
- (5) If a time set in timer, the output is off; if CH\_Bn is on, fault is off. If CH\_Bn is off, fault is on.
- (6) It works from the first with input changed, and the output may be secured as long as timer setting is set more than twice of scan cycle.
- (7) Input should have a value between 1 ~ 3, and if it is not in the range, it outputs 8 to STAT.

■ Program Example



If IN is changed to 4 with REQ set, Y3 is on and timer works for 10s.  
During the time, T\_LEFT shows the left time.  
In 10s, T\_OVER is on and the output, Y1, Y2 and Y3 are off.  
If CH\_B3 is on, fault is off; if CH\_B3 is off, fault is on.

13.3 Data Process Function, Function Block

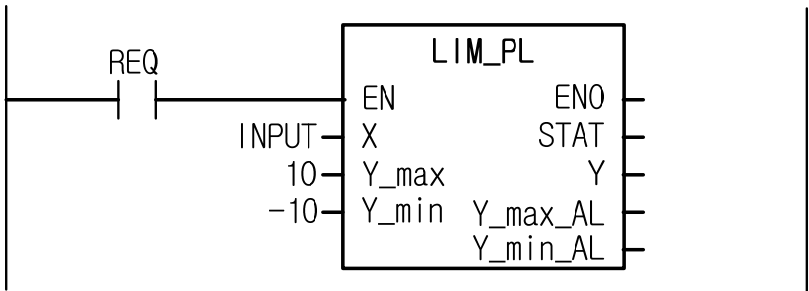
LIM_PL(_R)	Max./Min. value limit	
	Availability	XGI, XGR
	Flags	-

Function	Description
<div><div>LIM_PL(_R)</div><div><div>BOOL</div>EN<div>EN0</div><div>USINT</div>STAT<div>INT(REAL)</div>Y<div>INT(REAL)</div>Y_max<div>INT(REAL)</div>Y_min<div>Y_max_AL</div><div>Y_min_AL</div><div>Y</div><div>BOOL</div><div>BOOL</div></div></div>	<div><div>Input</div><div>EN</div>: Function execution request</div> <div><div>X</div>: Input</div> <div><div>Y_max</div>: Max. output limit</div> <div><div>Y_min</div>: Min. output limit</div> <div><div>Output</div><div>EN0</div>: On if done without error</div> <div><div>STAT</div>: State alarm</div> <div><div>Y</div>: Output</div> <div><div>Y_max_AL</div>: Over max. output alarm</div> <div><div>Y_min_AL</div>: Less min. output alarm</div>

■ Functions

- (1) It generates output Y by limiting input X within the max./min. values.
- (2) A value between Y\_max and Y\_min passes without restriction.
- (3) If max. limit is not less than Y\_max, Y\_max\_AL is on and it outputs Y\_max to Y.
- (4) If min. limit is not more than Y\_min, Y\_min\_AL is on and it outputs Y\_min to Y.
- (5) If Y\_max is not more than Y\_min, STAT indicates 4 and it outputs 0.

■ Program Example



- (1) If INPUT is 20 : it outputs 10 (Y\_max) to Y and Y\_max\_AL is on.
- (2) If INPUT is 3 : it outputs 3 to Y without restriction.
- (3) If INPUT is -12 : it outputs -10 (Y\_min) to Y and Y\_min\_AL is on.

LIMR(_R)	Max./Min. value, max. variance limit	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div><div><div>LIMR(_R)</div><div><div><div>BOOL</div><div>REQ</div><div>DONE</div><div>BOOL</div></div><div><div>BOOL</div><div>MAN</div><div>STAT</div><div>USINT</div></div><div><div>INT(REAL)</div><div>MAN_Y</div><div>Y</div><div>INT(REAL)</div></div><div><div>BOOL</div><div>RESET</div><div>RATE_AL</div><div>BOOL</div></div><div><div>INT(REAL)</div><div>X</div><div>Y_max_AL</div><div>BOOL</div></div><div><div>REAL</div><div>RATE</div><div>Y_min_AL</div><div>BOOL</div></div><div><div>INT(REAL)</div><div>Y_max</div><div></div><div></div></div><div><div>INT(REAL)</div><div>Y_min</div><div></div><div></div></div></div></div></div>	<div><div><div>Input</div><div>REQ</div><div>:</div><div>Function block execution request</div></div><div><div>MAN</div><div>:</div><div>Manual mode setting</div></div><div><div>MAN_Y</div><div>:</div><div>Manual output</div></div><div><div>RESET</div><div>:</div><div>Block operation reset</div></div><div><div>X</div><div>:</div><div>Input</div></div><div><div>RATE</div><div>:</div><div>Max. variance rate limit</div></div><div><div>Y_max</div><div>:</div><div>Max. output limit</div></div><div><div>Y_min</div><div>:</div><div>Min. output limit</div></div></div> <div><div><div>Output</div><div>DONE</div><div>:</div><div>On if done without error</div></div><div><div>STAT</div><div>:</div><div>State alarm</div></div><div><div>Y</div><div>:</div><div>Output value</div></div><div><div>RATE_AL</div><div>:</div><div>Max. variance rate limit state alarm</div></div><div><div>Y_max_AL</div><div>:</div><div>Over max. output alarm</div></div><div><div>Y_min_AL</div><div>:</div><div>Less min. output alarm</div></div></div>

**Input**

REQ : Function block execution request

MAN : Manual mode setting

MAN\_Y : Manual output

RESET : Block operation reset

X : Input

RATE : Max. variance rate limit

Y\_max : Max. output limit

Y\_min : Min. output limit

**Output**

DONE : On if done without error

STAT : State alarm

Y : Output value

RATE\_AL : Max. variance rate limit state alarm

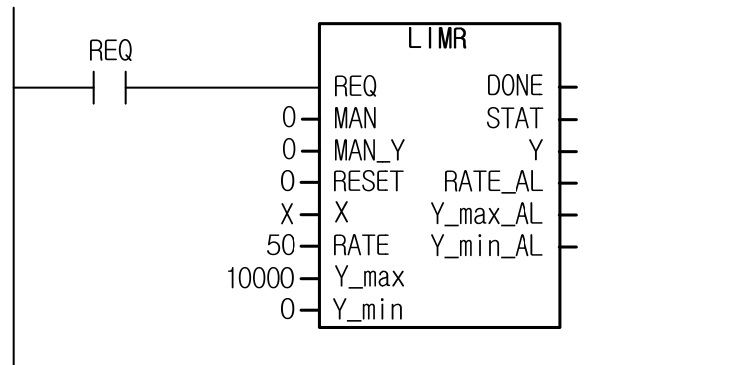
Y\_max\_AL : Over max. output alarm

Y\_min\_AL : Less min. output alarm

■ Functions

- (1) It limits the max. variance rate of input X and outputs by limiting the max./min. value.
- (2) The function block saves the internal state even though REQ is off and it resumes the previous operation if REQ is on again.
- (3) Variance limit equation : 
$$Y_{old} - \frac{RATE(Y_{max} - Y_{min})}{100} \leq Y \leq Y_{old} + \frac{RATE(Y_{max} - Y_{min})}{100}$$
- (4) If variation is limited, it indicates RATE\_AL; if max./min. values are limited, it indicates Y\_max\_AL or Y\_min\_AL.
- (5) If MAN is on, it outputs the value of MAN\_Y to Y; if MAN is off again, the variance is limited from the state.
- (6) If RESET is on, it initializes the output Y to 0.
- (7) It may work at a desirable cycle if using the volume conversion detection contact of clock (i.e. \_T1s) or other volume conversion detection contact (that is, P contact) to REQ.

## ■ Program Example



- (1) X is changed from/to 0 → 3000 : the max. variance is allowed up to  $\frac{\text{RATE}(Y_{\max} - Y_{\min})}{100} = 5000$ , so it passes the variance limit and max./min. value limits and outputs Y = 3000.
- (2) X is changed from/to 0 → 10000 : the max. variance is allowed up to 5000, so it is restricted to the variance limit for 2 scans. Then, it increases by 5000, outputs Y = 10000 and Y\_max\_AL is on.
- (3) X is changed from/to 0 → 30000 : the max. variance is allowed up to 5000, so it is restricted to the variance limit for 6 scans. Then, it increases by 5000, outputs Y = 10000 due to max. value limit and Y\_max\_AL is on.



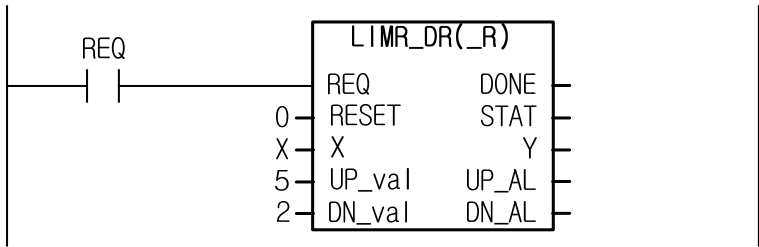
LIMR_DR(_R)	Directional max. variance limit	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div><div><div>LIMR_DR(_R)</div><div><div>BOOL</div>REQ<div>BOOL</div>DONE</div><div><div>BOOL</div>RESET<div>USINT</div>STAT</div><div><div>INT(REAL)</div>X<div>INT(REAL)</div>Y</div><div><div>INT(REAL)</div>UP_val<div>BOOL</div>UP_AL</div><div><div>INT(REAL)</div>DN_val<div>BOOL</div>DN_AL</div></div></div>	<div><div><div>Input</div><div>REQ : Function block execution request</div><div>RESET : Block operation reset</div><div>X : Input</div><div>UP_val : Up limit</div><div>DN_val : Down limit</div></div><div><div><div>Output</div><div>DONE : On if done without error</div><div>STAT : State alarm</div><div>Y : Output value</div><div>UP_AL : Up limit alarm</div><div>DN_AL : Down limit alarm</div></div></div></div>

■ Functions

- (1) It outputs by limiting the max. up/down variation of input X, respectively.
- (2) The function block saves the internal state even though REQ is off and it resumes the previous operation if REQ is on again.
- (3) For the variation of X, Y may be increased or decreased as much as UP\_val or DN\_val.
- (4) In case the Up/Dn limits are applied, it displays with UP\_AL or DN\_AL bit.
- (5) In case of RESET, the input X is directly reflected to Output Y.
- (6) If UP\_val or DN\_val is negative, it outputs 8 to STAT.
- (7) It may work at a desirable cycle if using the volume conversion detection contact of clock (i.e. \_T1s) or other volume conversion detection contact (i.e. P contact) to REQ.

■ Program Example



- (1) X is changed from/to 0 → 3000 : since the max. up variation is 5, Y increases by 5 for 600 scans, during which UP\_AL is on ; if it outputs Y = 3000, UP\_AL is off.
- (2) X is changed from/to 1000 → 0 : since the max. down variation is 2, Y decreases by 2 for 500 scans, during which DN\_AL is on; if it outputs Y = 0, DN\_AL is off.

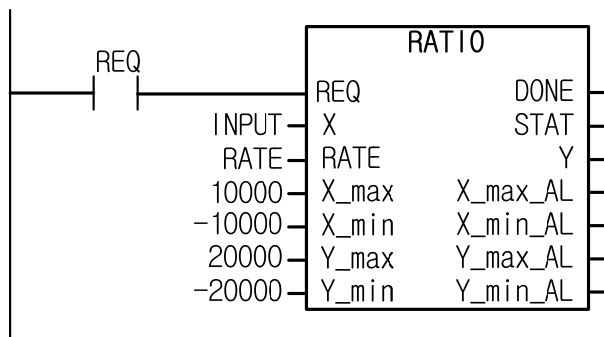
RATIO(_R)	Ratio converter	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div><div><div>RATIO(_R)</div><div><div><div>BOOL</div><div>INT (REAL)</div><div>REAL</div><div>INT (REAL)</div><div>INT (REAL)</div><div>INT (REAL)</div><div>INT (REAL)</div></div><div><div>REQ</div><div>X</div><div>RATE</div><div>X_max</div><div>X_min</div><div>Y_max</div><div>Y_min</div></div><div><div>DONE</div><div>STAT</div><div>Y</div><div>X_max_AL</div><div>X_min_AL</div><div>Y_max_AL</div><div>Y_min_AL</div></div><div><div>BOOL</div><div>USINT</div><div>INT (REAL)</div><div>BOOL</div><div>BOOL</div><div>BOOL</div><div>BOOL</div></div></div></div></div>	<div><div><div><b>Input</b></div><div>REQ</div><div>:</div><div>Function block execution request</div></div><div><div>X</div><div>:</div><div>Input</div></div><div><div>RATE</div><div>:</div><div>Rate</div></div><div><div>X_max</div><div>:</div><div>Max. input limit</div></div><div><div>X_min</div><div>:</div><div>Min. input limit</div></div><div><div>Y_max</div><div>:</div><div>Max. output limit</div></div><div><div>Y_min</div><div>:</div><div>Min. output limit</div></div></div> <div><div><div><b>Output</b></div><div>DONE</div><div>:</div><div>On if done without error</div></div><div><div>STAT</div><div>:</div><div>State alarm</div></div><div><div>Y</div><div>:</div><div>Output value</div></div><div><div>X_max_AL</div><div>:</div><div>Input high alarm</div></div><div><div>X_min_AL</div><div>:</div><div>Input low alarm</div></div><div><div>Y_max_AL</div><div>:</div><div>Output high alarm</div></div><div><div>Y_min_AL</div><div>:</div><div>Output low alarm</div></div></div>

■ Functions

- (1) It outputs a certain ratio of input X to Y.
- (2) Note that the reference point is not 0 but X\_min.
- (3) Output Y is calculated from the equation,  $Y = (X - X_{min}) \times \frac{RATE}{100} + X_{min}$ .
- (4) X\_max and X\_min limit the max./min. values of X; it operates with X\_max, instead of X if X is not less than X\_max, and vice versa.
- (5) Y\_max and Y\_min limit the max./min. values of Y; it operates with Y\_max if Y is not less than Y\_max, and vice versa.
- (6) In case of not less than the max. value or not more than the min. value set in I/O, it displays X\_max\_AL, X\_min\_AL, Y\_max\_AL or Y\_min\_AL alarm.

### ■ Program Example



1. **In case of X = 20000 & RATE = 50** : If X is not less than X\_max, X\_max, 10000 is input,

$$Y = (10000 - (-10000)) \times \frac{50}{100} + (-10000), \quad X\_max\_AL = \text{on}$$

**Y = 0**

2. **In case of X=1000 & RATE=20** : X is input with 1000,

$$Y = (1000 - (-10000)) \times \frac{20}{100} + (-10000)$$

**Y = -7800**

3. **In case of X = 20000, RATE = -250** : since X is not less than X\_max, it is operated with X\_max, 10000,

$$-60000 = (10000 - (-10000)) \times \frac{-250}{100} + (-10000), \quad X\_max\_AL = \text{on}, \quad Y\_min\_AL = \text{on}$$

Since Y is not more than Y\_min, it is output with Y\_min,

**Y = -20000**

SCALE(_UI, _R)	Scale converter	
	Availability	XGI, XGR
	Flags	-

Function	Description
<div><div><div>SCALE(_UI,_R)</div><div><div>BOOL</div><div>EN</div><div>ENO</div><div>BOOL</div></div><div><div>I(UI,R)</div><div>X</div><div>STAT</div><div>USINT</div></div><div><div>I(UI,R)</div><div>X_max</div><div>Y</div><div>I(UI,R)</div></div><div><div>I(UI,R)</div><div>X_min</div><div></div><div></div></div><div><div>I(UI,R)</div><div>Y_max</div><div></div><div></div></div><div><div>I(UI,R)</div><div>Y_min</div><div></div><div></div></div></div></div>	<div><div><div>Input</div><div>EN</div><div>:</div><div>Function execution request</div></div><div><div>X</div><div>:</div><div>Input</div></div><div><div>X_max</div><div>:</div><div>Max. input limit</div></div><div><div>X_min</div><div>:</div><div>Min. input limit</div></div><div><div>Y_max</div><div>:</div><div>Max. output scale</div></div><div><div>Y_min</div><div>:</div><div>Min. output scale</div></div></div> <div><div><div>Output</div><div>ENO</div><div>:</div><div>On if done without error</div></div><div><div>STAT</div><div>:</div><div>State alarm</div></div><div><div>Y</div><div>:</div><div>Output value</div></div></div>

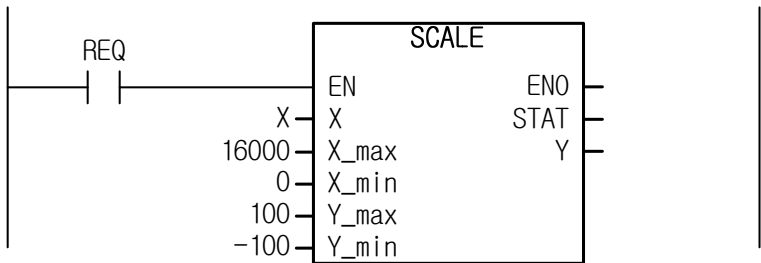
■ Functions

- (1) It changes input X to the scale set after limiting the max./min. values.
- (2) It sets the range of input X to X\_max, X\_min and that of Y to Y\_max, Y\_min.
- (3) The output equation is as follows.

$$Y = (X - X_{min}) \frac{Y_{max} - Y_{min}}{X_{max} - X_{min}} + Y_{min}$$

- (4) If X\_max and X\_min are same, it outputs 8 to STAT because the denominator of the equation is 0.
- (5) If X input value exceeds X\_min ~ X\_max, it outputs 2 to STAT.

■ Program Example



It scales the value between 0 ~ 16000 to a value between -100 ~ 100.

- (1) If X is 4000:  $Y = (4000 - 0) \frac{100 + 100}{16000 - 0} - 100 = -50$
- (2) If X is 20000: it limits X to 16000,  $Y = (20000 - 0) \frac{100 + 100}{16000 - 0} - 100 = 150$   
Despite of Y = 150, it outputs Y = 100 because of Y\_max = 100.

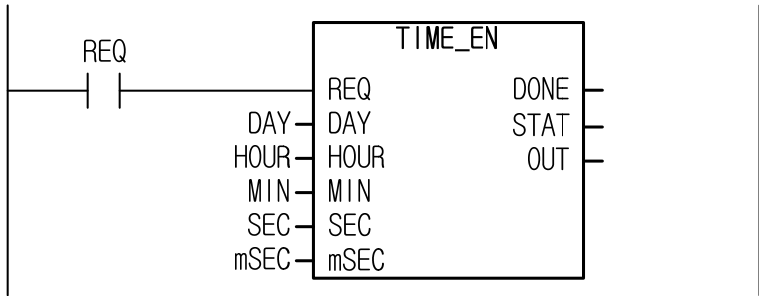
TIME_EN(_UI)	Converting day, hour, minute, second and 1/1000 sec to TIME type data	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div><div>TIME_EN(_UI)</div><div><div>BOOL — REQ</div><div>INT(USINT) — DAY</div><div>INT(USINT) — HOUR</div><div>INT(USINT) — MIN</div><div>INT(USINT) — SEC</div><div>INT(USINT) — mSEC</div><div>DONE — BOOL</div><div>STAT — USINT</div><div>OUT — TIME</div></div></div>	<div><div>Input</div><div>REQ : Function block execution request</div><div>DAY : day</div><div>HOUR : hour</div><div>MIN : minute</div><div>SEC : second</div><div>mSEC : 1/1000 second</div><div>Output</div><div>DONE : On if done without error</div><div>STAT : State alarm</div><div>OUT : Time output value</div></div>

■ Functions

- (1) It converts day, hour, minute, second and 1/1000 second data to TIME type parameter.
- (2) If input is negative or if output result is output of the data expression range (0~49d17h2m47s295ms) of TIME type data, it generates STAT 8 and does not execute any operation.

■ Program Example



- (1) In case of DAY=1, HOUR=1, MIN= 1, SEC=1, mSEC=1, it is OUT = T#1d1h1m1s1ms
- (2) In case of DAY=0, HOUR=0, MIN=30000, SEC=0, mSEC=0, it is OUT = T#0d20h20m0s0ms

TIME_DE(_UI)	Separating TIME type data to day, hour, minute, second and 1/1000 second	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div><div><div>TIME_DE(_UI)</div><div><div><div>BOOL</div><div>TIME</div><div>USINT</div></div><div><div>REQ</div><div>IN</div><div>MODE</div></div><div><div>DONE</div><div>STAT</div><div>DAY</div><div>HOUR</div><div>MIN</div><div>SEC</div><div>mSEC</div><div>OVER_AL</div></div><div><div>BOOL</div><div>USINT</div><div>INT(USINT)</div><div>INT(USINT)</div><div>INT(USINT)</div><div>INT(USINT)</div><div>INT(USINT)</div><div>BOOL</div></div></div></div></div>	<div><div><div>Input</div><div>REQ</div><div>:</div><div>Function block execution request</div></div><div><div>IN</div><div>:</div><div>Time input</div></div><div><div>MODE</div><div>:</div><div>Output mode(0~4)</div></div></div> <div><div><div>Output</div><div>DONE</div><div>:</div><div>On if done without error</div></div><div><div>STAT</div><div>:</div><div>State alarm</div></div><div><div>DAY</div><div>:</div><div>Day</div></div><div><div>HOUR</div><div>:</div><div>Hour</div></div><div><div>MIN</div><div>:</div><div>Minute</div></div><div><div>SEC</div><div>:</div><div>Second</div></div><div><div>mSEC</div><div>:</div><div>1/1000 second</div></div><div><div>OVER_AL</div><div>:</div><div>Overflow alarm</div></div></div>

**Input**

REQ : Function block execution request

IN : Time input

MODE : Output mode(0~4)

**Output**

DONE : On if done without error

STAT : State alarm

DAY : Day

HOUR : Hour

MIN : Minute

SEC : Second

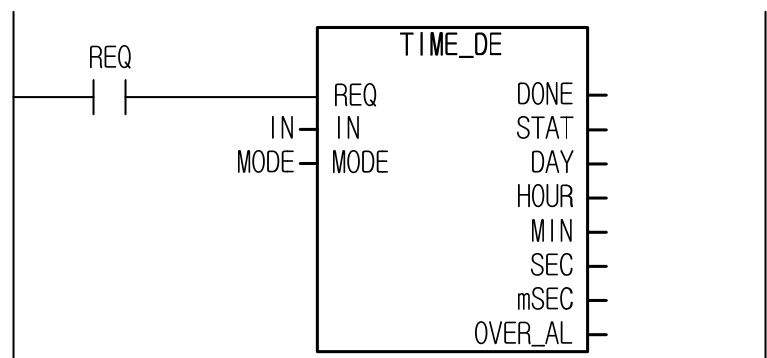
mSEC : 1/1000 second

OVER\_AL : Overflow alarm

■ Functions

- (1) It outputs TIME type input separately by day, hour, minute, second and 1/1000 second.
- (2) It outputs as follows, depending on mode.
  - A. MODE 0 : display all day/hour/minute/second/ms
  - B. MODE 1 : display hour/minute/second/ms
  - C. MODE 2 : display minute/second/ms
  - D. MODE 3 : display second/ms
  - E. MODE 4 : display ms only
- (3) If it is out of the range of output data, it outputs the max. value, (65535 in case of TIME\_DE\_UI) and sets OVER\_AL.
- (4) If MODE is more than 5, it indicates STAT 8 and does not work.

■ Program Example



- (1) In case of IN =T#1d1h1m1s1ms, MODE = 0; DAY =1, HOUR= 1, MIN= 1, SEC= 1, mSEC= 1, OVER\_AL=off
- (2) In case of IN =T#1d1h1m1s1ms, MODE = 1; DAY =0, HOUR=25, MIN= 1, SEC= 1, mSEC= 1, OVER\_AL=off
- (3) IN case of IN =T#1d1h1m1s1ms, MODE = 2; DAY =0, HOUR= 0, MIN=1501, SEC= 1, mSEC= 1, OVER\_AL=off
- (4) In case of IN =T#1d1h1m1s1ms, MODE = 3; DAY =0, HOUR= 0, MIN= 0, SEC=32767, mSEC= 1, OVER\_AL=on
- (5) In case of IN =T#1d1h1m1s1ms, MODE = 4; DAY =0, HOUR= 0, MIN= 0, SEC= 0, mSEC=32767, OVER\_AL=on
- (6) In case of IN =T#90061001ms, MODE = 0; input is modified and displayed as T#1d1h1m1s1ms.

The results are DAY=1, HOUR=1, MIN=1, SEC=1, mSEC=1, OVER\_AL=off.

CUT(_R)	Small signal cut filter	
	Availability	XGI, XGR
	Flags	-

Function	Description
<div><div><div>CUT(_R)</div><div><div><div>BOOL</div><div>EN</div><div>ENO</div><div>BOOL</div></div><div><div>INT(REAL)</div><div>X</div><div>STAT</div><div>USINT</div></div><div><div>REAL</div><div>CUT</div><div>Y</div><div>INT(REAL)</div></div><div><div>INT(REAL)</div><div>X_max</div><div>CUT_ACT</div><div>BOOL</div></div><div><div>INT(REAL)</div><div>X_min</div><div>X_max_AL</div><div>BOOL</div></div><div><div></div><div></div><div>X_min_AL</div><div>BOOL</div></div></div></div></div>	<div><div><div>Input</div><div>EN</div><div>:</div><div>Function execution request</div></div><div><div>X</div><div>:</div><div>Input</div></div><div><div>CUT</div><div>:</div><div>Small signal cut range (%)</div></div><div><div>X_max</div><div>:</div><div>Max. input limit</div></div><div><div>X_min</div><div>:</div><div>Min. input limit</div></div></div> <div><div><div>Output</div><div>ENO</div><div>:</div><div>On if done without error</div></div><div><div>STAT</div><div>:</div><div>State alarm</div></div><div><div>Y</div><div>:</div><div>Output value</div></div><div><div>CUT_ACT</div><div>:</div><div>CUT operation in progress.</div></div><div><div>X_max_AL</div><div>:</div><div>Input max. limit alarm</div></div><div><div>X_min_AL</div><div>:</div><div>Input min. limit alarm</div></div></div>

**Input**

EN : Function execution request

X : Input

CUT : Small signal cut range (%)

X\_max : Max. input limit

X\_min : Min. input limit

**Output**

ENO : On if done without error

STAT : State alarm

Y : Output value

CUT\_ACT : CUT operation in progress.

X\_max\_AL : Input max. limit alarm

X\_min\_AL : Input min. limit alarm

■ Functions

- (1)

If input is a value between [X\_min] and [CUT% of X\_min ~ X\_max], it is ignored and the system outputs X\_min.
- (2)

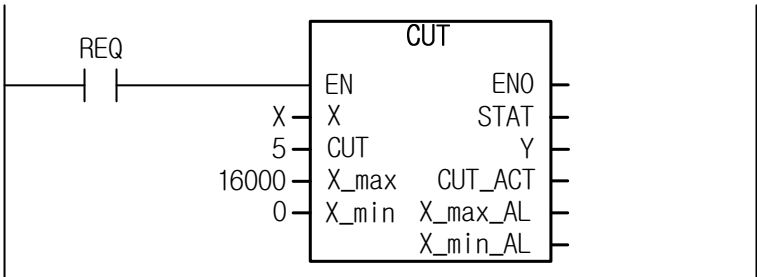
Note that the reference point is not 0 but [X\_min].
- (3)

For input, the max/min. values are limited by X\_max/X\_min, which is notified by alarm: X\_max\_AL and X\_min\_AL.
- (4)

If the input of max./min. limit is  $X \leq X_{min} + CUT \frac{X_{max} - X_{min}}{100}$ , it outputs Y = X\_min and CUT\_ACT is on.
- (5)

If X\_min is larger than X\_max, STAT indicates 2 and outputs 0.

■ Program Example



- (1)

If X is 4000 : since it is not in 5% (CUT) of 16000 (Xmax - Xmin), 4000 is output with no change.
- (2)

If X is 18000 : since it is limited to 16000, the value of 16000 is output and X\_max\_AL is on.
- (3)

If X is 100 : since it is not more than 800, 5% of 16000, it outputs 0(X\_min) and CUT\_ACT is on.

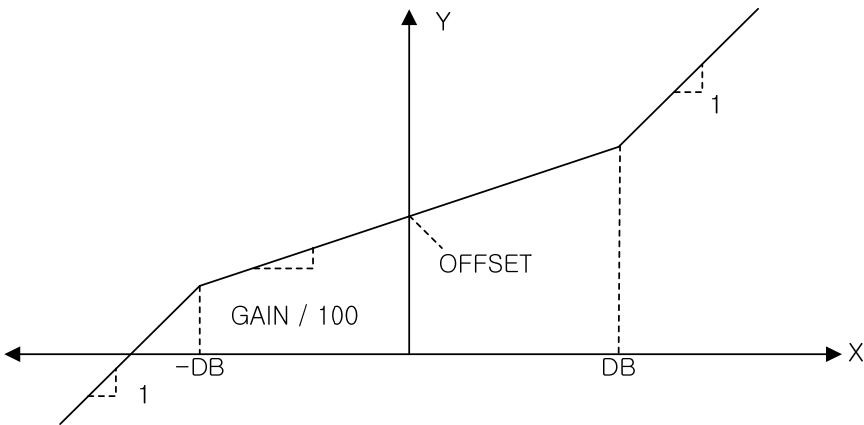


D_BAND(_R)	Deadband Application Output	
	Availability	XGI, XGR
	Flags	-

Function	Description
<div><div><div>D_BAND(_R)</div><div><div>BOOL</div><div>INT (REAL)</div><div>INT (REAL)</div><div>UINT</div><div>INT</div></div><div><div>EN</div><div>X</div><div>OFFSET</div><div>DB</div><div>GAIN</div></div><div><div>ENO</div><div>Y</div><div>DB_ACT</div></div><div><div>BOOL</div><div>INT (REAL)</div><div>BOOL</div></div></div></div>	<p><b>Input</b></p> <p>EN : Function execution request</p> <p>X : Input</p> <p>OFFSET : Output offset</p> <p>DB : Deadband half width</p> <p>GAIN : GAIN(%) of Deadband section</p> <p><b>Output</b></p> <p>ENO : On if done without error</p> <p>Y : Output value</p> <p>DB_ACT : Alarm if input is within DB</p>

■ Functions

- (1) Output Y is calculated by applying deadband to input X.
- (2) Since DB represents scale, it should be used through absolute value operation like |DB|.
- (3) Deadband is set with a range of -|DB| ~ |DB|.
- (4) DB\_ACT bit is on if input X is within deadband.
- (5) Both ends of deadband affect the output outside the deadband.
- (6) If operation result is out of the data expression range of integer(INT), the output is limited to INT (-32768 ~ 32767).
- (7) If operation result is out of the data expression range of real number (REAL), output is indicated '1.#inf00000 E+000' or '-1.#inf00000 E+000'and in the case, ENO bit is off.
- (8) The I/O equation of deadband is as follows.



A. UNDER THE BAND (X is not more than -|DB|) :

$$Y = X - (\frac{GAIN}{100} \times DB) + DB + OFFSET$$

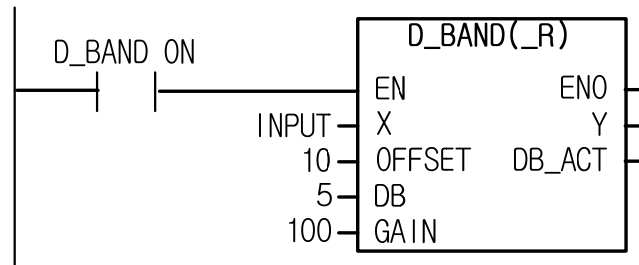
B. IN THE BAND (X is within -|DB| ~ |DB|) :

$$Y = (\frac{GAIN}{100} \times X) + OFFSET$$

C. OVER THE BAND (X is larger than |DB|) :

$$Y = X + \left( \frac{GAIN}{100} \times DB \right) - DB + OFFSET$$

#### ■ Program Example



1. If INPUT is -8 :

$$-8_{(X)} - \left( \frac{100_{(GAIN)}}{100} \times 5_{(DB)} \right) + 5_{(DB)} + 10_{(OFFSET)} = 2_{(Y)}$$

2. If INPUT is 3 : X is within DB = 5, DB\_ACT is on

$$\left( \frac{100_{(GAIN)}}{100} \times 3_{(X)} \right) + 10_{(OFFSET)} = 13_{(Y)}$$

3. If INPUT is 16 :

$$16_{(X)} + \left( \frac{100_{(GAIN)}}{100} \times 5_{(DB)} \right) - 5_{(DB)} + 10_{(OFFSET)} = 26_{(Y)}$$

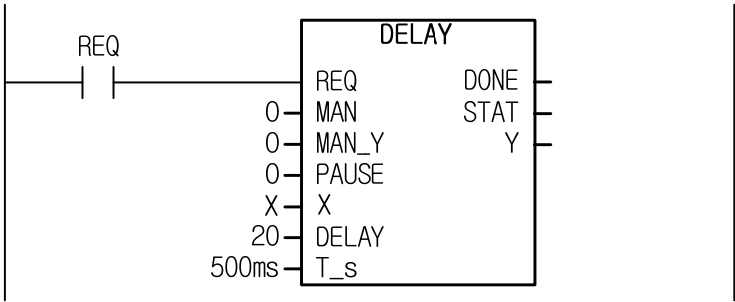
DELAY(_R)	Delay Output	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div></div>	<p><b>Input</b></p> <ul style="list-style-type: none"><li>REQ : Function block execution request</li><li>MAN : Manual mode</li><li>MAN_Y : Manual mode output</li><li>PAUSE : Pause</li><li>X : Input</li><li>DELAY : No. of Delay sample</li><li>T_s : Operation cycle</li></ul> <p><b>Output</b></p> <ul style="list-style-type: none"><li>DONE : On if done without error</li><li>STAT : State alarm</li><li>Y : Output value</li></ul>

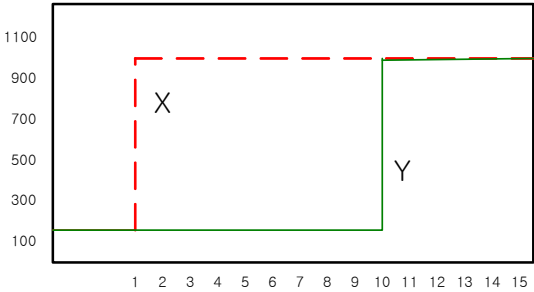
■ Functions

- (1) It generates output X of which input X is delayed as much as T\_s \* DELAY (T\_s unit : [sec]).
- (2) It saves the current input every scan cycle and outputs the previous input at the same time.
- (3) If the first operation is permitted, it outputs 0 as much as T\_s \* DELAY because there is no previous value.
- (4) It is possible to input DELAY scan up to 100 scans; if more value is input, it outputs 8 to the STAT and does not work.
- (5) If PAUSE is on, output pauses and the current data are saved.
- (6) If MAN is on, it outputs MAN\_Y in manual mode and it does not save the current data, so it outputs 0 as much as T\_s \* DELAY when it returns to auto mode.

■ Program Example



- (1) Since DELAY is 20 and T\_s is 500ms, Y outputs X value 10s before.



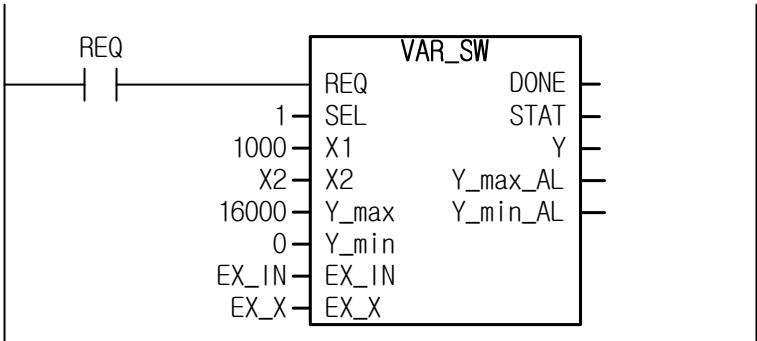
VAR_SW(_R)	Constant selection switch	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div><div>VAR_SW(_R)</div><div><div>BOOL REQ</div><div>BOOL SEL</div><div>INT(REAL) X1</div><div>INT(REAL) X2</div><div>INT(REAL) Y_max</div><div>INT(REAL) Y_min</div><div>BOOL EX_IN</div><div>INT(REAL) EX_X</div><div>BOOL DONE</div><div>USINT STAT</div><div>INT(REAL) Y</div><div>BOOL Y_max_AL</div><div>BOOL Y_min_AL</div></div></div>	<div><b>Input</b> REQ : Function block execution request SEL : Select Input 1/2 X1 : Input 1 X2 : Input 2 Y_max : Max. output limit Y_min : Min. output limit EX_IN : Select external input EX_X : External input</div> <div><b>Output</b> DONE : On if done without error STAT : State alarm Y : Output value Y_max_AL : Over max. output alarm Y_min_AL : Less min. output alarm</div>

■ Functions

- (1) It outputs X1 or X2 depending on SEL bit setting.
- (2) The max./min value of output may be limited by setting Y\_max and Y\_min.
- (3) It is possible to output EX\_IN by connecting external devices (MMI and etc) to EX\_X.
- (4) EX\_X is also limited by the max./min. values.
- (5) If Y\_min is larger than Y\_max, STAT outputs 4.

■ Program Example



- Since SEL is 1, it outputs X2 if EX\_IN is off.
- (1) If X2 is 10000 and EX\_IN is off: X2 is applied and it outputs 10000.
  - (2) If X2 is 20000 and EX\_IN is off: X2 is applied and after being limited by the max. value, it outputs 16000 and Y\_max\_AL is on.
  - (3) If X2 is 1000 and in case of EX\_IN=on, EX\_X=-1000: EX\_IN is applied and after being limited by the min. value, it outputs 0 and Y\_min\_AL is on.

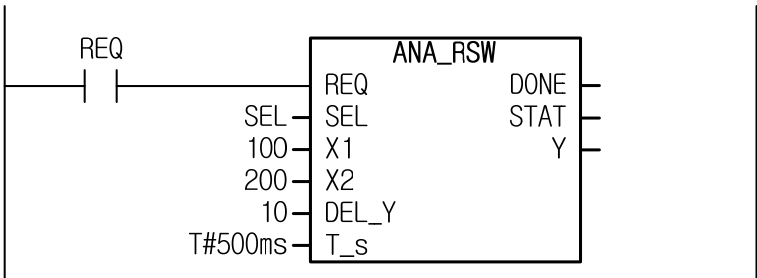
ANA_RSW(_R)	Analog increment limit switch	
	Availability	XGI, XGR
	Flags	-

Function block	Description
	<p><b>Input</b></p> <p>REQ : Function block execution request</p> <p>SEL : Select input</p> <p>X1 : Input 1</p> <p>X2 : Input 2</p> <p>DEL_Y : Output increment limit</p> <p>T_s : Operation cycle</p> <p><b>Output</b></p> <p>DONE : On if done without error</p> <p>STAT : State alarm</p> <p>Y : Output value</p>

■ Functions

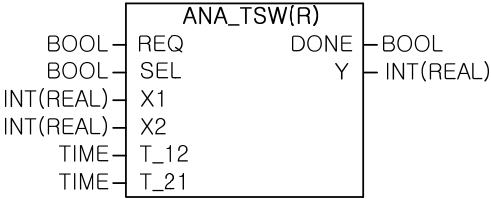
- (1) It selectively outputs X1 or X2 depending on SEL bit setting.
- (2) RESET works as soon as REQ is on. Therefore, it outputs the input selected by SEL as its initial value.
- (3) If SEL bit is changed, it reaches to the value ( X1 / X2 ) selected as Y increases or decreases as much as DEL\_Y every T\_s.
- (4) Even though SEL bit is not changed, it reaches to the value selected as Y increases or decreases as much as DEL\_Y every T\_s if the value selected by SEL (X1 / X2) is changed.

■ Program Example



- (1) If it is changed from SEL=off to SEL=on, Y increases by 10 every 500ms and it reaches to Y=200.
- (2) If X1 is changed to 300 with SEL=off, Y increases by 10 every 500ms and it reaches to Y=300 in 10s.

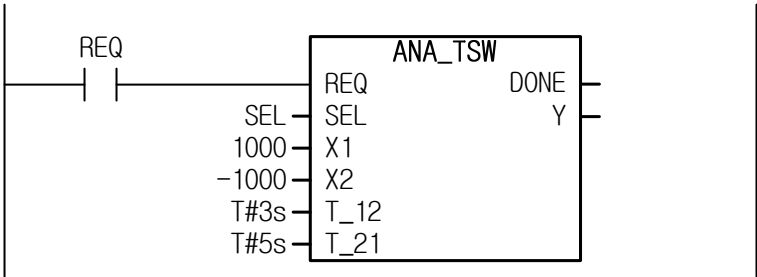
ANA_TSW(_R)	Analog time limit switch	
	Availability	XGI, XGR
	Flags	-

Function block	Description
	<p><b>Input</b></p> <p>REQ : Function block execution request</p> <p>SEL : Select input</p> <p>X1 : Input 1</p> <p>X2 : Input 2</p> <p>T_12 : Input 1-&gt;2 conversion time</p> <p>T_21 : Input 2-&gt;1 conversion time</p> <p><b>Output</b></p> <p>DONE : On if done without error</p> <p>Y : Output value</p>

■ Functions

- (1) It selectively outputs X1 or X2 depending on SEL bit setting.
- (2) RESET works as soon as REQ is on. Therefore, it outputs the input selected by SEL as its initial value.
- (3) It changes the data before SEL change to the data after SEL change gradually (RAMP), based on the pre-determined time.
- (4) If it is changed from X1 to X2, depending on SEL selection, it follows T\_12 time; if it is conversely changed from X2 to X1, it follows T\_21 time.
- (5) An integer type instruction, ANA\_TSW is subject to round-off during the conversion, so it has an error up to 0.5. therefore, it may reach to the target input earlier than the pre-determined time.
- (6) If the operation result is out of the data expression range of integer (INT), the output is limited to INT (-32768 ~ 32767).
- (7) If the operation result is out of the data expression range of real number (REAL), the output displays as '1.#inf00000 E+000'or '-1.#inf00000 E+000' and in the case, DONE bit is off.

■ Program Example



- (1) In case of SEL=off → on : it decreases toward Y=1000 → -1000 for 3s.
- (2) In case of SEL=on → off: it increases toward Y=-1000 → 1000 for 5s.

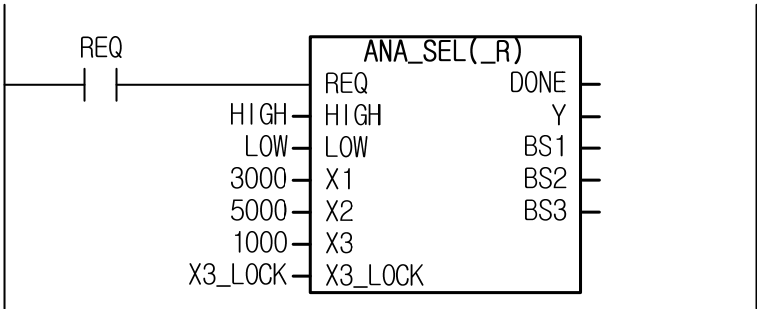
ANA_SEL(_R)	Analog scale comparative switch	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div></div>	<p><b>Input</b></p> <p>REQ : Function block execution request HIGH : Select scale-based input LOW : Select scale-based input X1 : Input 1 X2 : Input 2 X3 : Input 3 X3_LOCK : Input 3 effective bit</p> <p><b>Output</b></p> <p>DONE : On if done without error Y : Output value BS1 : Block select1 BS2 : Block select2 BS3 : Block select3</p>

■ Functions

- (1) In case of HIGH = on, LOW = off, it outputs the highest one among X1 ~ X3 and the corresponding BS is on.
- (2) In case of HIGH = off, LOW = on, it outputs the lowest one among X1 ~ X3 and the corresponding BS is on.
- (3) If HIGH = low (both on or off) is set, it selects a middle one. It outputs a middle value among X1 ~ X3 and the corresponding BS is on.
- (4) After selecting a middle value as above, if two inputs are same, it outputs the two values to output Y and the corresponding two BS are on.
- (5) After selecting a middle value, if three inputs are same, it outputs these three values to output Y and every BS is on.
- (6) In case of X3\_LOCK = on, X3 among the inputs is disregarded. In the case, it is equal to 2 input, so the middle value is defined as a larger one between them.

■ Program Example



- (1) In case of HIGH = on, LOW = off, X3\_LOCK = off, it outputs Y = 5000 and BS2 is on.
- (2) In case of HIGH = on, LOW = on, X3\_LOCK = off, it outputs Y = 3000 and BS1 is on.
- (3) In case of HIGH = off, LOW = off, X3\_LOCK = off, it outputs Y = 3000 and BS1 is on.
- (4) In case of HIGH = off, LOW = on, X3\_LOCK = off, it outputs Y = 1000 and BS3 is on.
- (5) In case of HIGH = off, LOW = on, X3\_LOCK = on, it outputs Y = 3000 and BS1 is on.
- (6) In case of HIGH = on, LOW = on, X3\_LOCK = on, it outputs Y = 5000 and BS2 is on.

LAG(_R)	HF limit filter	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div><div><div>LAG(_R)</div><div><div>BOOL</div><div>REQ</div><div>DONE</div><div>BOOL</div></div><div><div>BOOL</div><div>FILT_ON</div><div>STAT</div><div>USINT</div></div><div><div>INT(REAL)</div><div>X</div><div>Y</div><div>INT(REA</div></div><div><div>INT</div><div>GAIN</div><div></div><div></div></div><div><div>TIME</div><div>LAG</div><div></div><div></div></div><div><div>INT(REAL)</div><div>OFFSET</div><div></div><div></div></div><div><div>TIME</div><div>T_s</div><div></div><div></div></div></div></div>	<div><div><b>Input</b></div><div>REQ : Function block execution request</div><div>FILT_ON : Filter ON</div><div>X : Input</div><div>GAIN : Filter gain (%)</div><div>LAG : LAG filter coefficient</div><div>OFFSET : Output offset</div><div>T_s : Operation cycle</div><div><b>Output</b></div><div>DONE : On if done without error</div><div>STAT : State alarm</div><div>Y : Output value</div></div>

**Input**

REQ : Function block execution request

FILT\_ON : Filter ON

X : Input

GAIN : Filter gain (%)

LAG : LAG filter coefficient

OFFSET : Output offset

T\_s : Operation cycle

**Output**

DONE : On if done without error

STAT : State alarm

Y : Output value

■ Functions

- (1) It processes with filter limiting HF components.
- (2) Input X is outputted to output Y via LAG filter.
- (3) The input-output procedure may have an error lower than 0.001%.
- (4) If FILT\_ON bit is off, LAG filter does not filtrate input and the output equation is as follows.

$$Y' = \frac{GAIN}{100} \times X$$

- (5) If FILT\_ON bit is on, LAG filter operates and the output equation is as follows.

$$Y' = Y'_{old} + \frac{T_s}{LAG + T_s} \times (\frac{GAIN}{100} \times \frac{X + X_{old}}{2} - Y'_{old})$$

T\_s : [sec]

- (6) After the filter operation, OFFSET is added to the internal output value and the offset does not pass the filter.

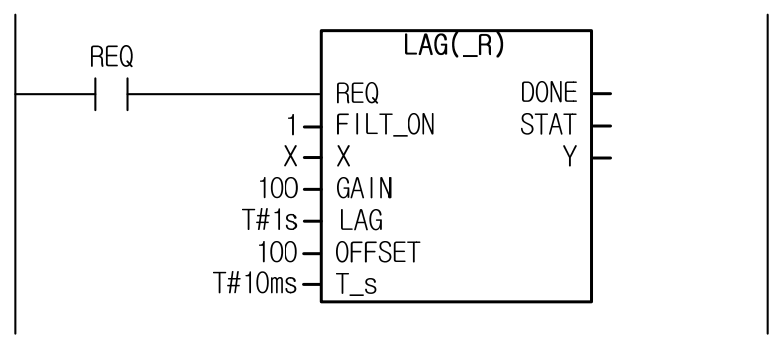
$$Y = Y' + OFFSET$$

Note) in the above equation, Y represents actual output while Y' represents internal output.

- (7) If in the LAG\_R operation, the data are out of the expression range of real number parameter(REAL), it indicates STAT 8 and outputs 0.



■ Program Example



If input X is changed with REQ and FILT\_ON turned on, it filtrates HF component and outputs. It is operated by I/O equation every 10ms (T\_s), it generates output.

LEADLAG(_R)	HF/LF limit filter	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div><p>The diagram shows a central box labeled LEADLAG(_R). On the left, there are inputs: REQ (BOOL), FILT_ON (BOOL), X (INT(REAL)), GAIN (INT), LEAD (TIME), LAG (TIME), OFFSET (INT(REAL)), and T_s (TIME). On the right, there are outputs: DONE (BOOL), STAT (USINT), and Y (INT(REAL)).</p></div>	<p><b>Input</b></p> <p>REQ : Function block execution request</p> <p>FILT_ON : Filter ON</p> <p>X : Input</p> <p>GAIN : Filter gain (%)</p> <p>LEAD : LEAD filter coefficient</p> <p>LAG : LAG filter coefficient</p> <p>OFFSET : Output offset</p> <p>T_s : Operation cycle</p> <p><b>Output</b></p> <p>DONE : On if done without error</p> <p>STAT : State alarm</p> <p>Y : Output value</p>

■ Functions

- (1) It processes with filter limiting HF/LF components
- (2) Output is generated through LEAD filter and LAG filter.
- (3) The input-output procedure may have an error lower than 0.001%.
- (4) If FILT\_ON bit is off, LEADLAG filter does not filtrate input and the output equation is as follows.

$$Y' = \frac{GAIN}{100} \times X$$

- (5) If FILT\_ON bit is on, LEADLAG filter operates and the output equation is as follows.

$$Y' = \frac{LAG \times Y'_{old} + GAIN((LEAD + T_s)X - LEAD \times X_{old})}{LAG + T_s}$$

T\_s : [sec]

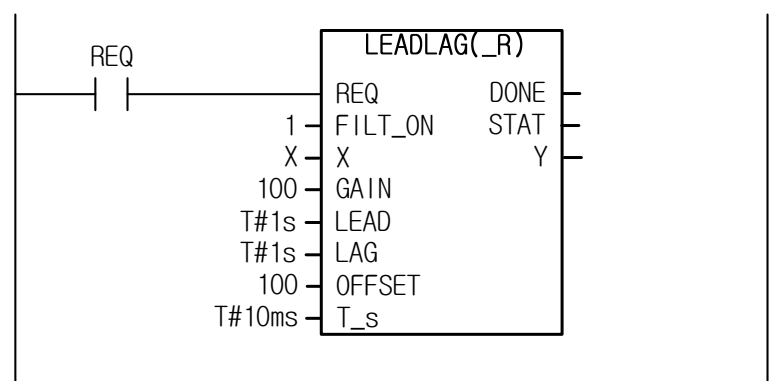
- (6) After the filter operation, OFFSET is added to the internal output value and the offset does not pass the filter.

$$Y = Y' + OFFSET$$

Note) in the above equation, Y represents actual output while Y' represents internal output.

- (7) If in the LEADLAG\_R operation, the data are out of the expression range of real number parameter (REAL), it indicates STAT 8 and outputs 0.


■ Program Example



If input X is changed with REQ and FILT\_ON turned on, it filters HF/LF component and outputs. It is operated by I/O equation every 10ms (T\_s), it generates output.

13.4 Arithmetic Operation Function, Function Block

ADD2	Y = G1X1 + G2X2	
	Availability	XGI, XGR
	Flags	-

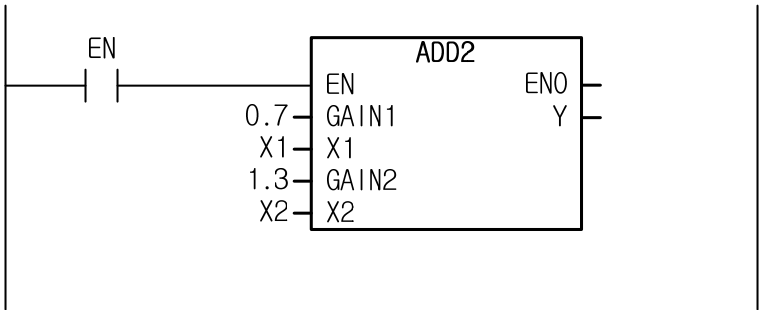
Function	Description
	<p><b>Input</b></p> <p>EN : Function execution request</p> <p>GAIN1 : Operation gain 1</p> <p>X1 : Input 1</p> <p>GAIN2 : Operation gain 2</p> <p>X2 : Input 2</p> <p><b>Output</b></p> <p>ENO : On if done without error</p> <p>Y : Output value</p>

■ Function

- (1) It executes the pre-determined arithmetic operations.
- (2) If the operation result is out of the data expression range of Y (REAL), ENO is off and it is displayed as 1.#inf00000 E+000', '-1.#inf00000 E+000', '1.#QNAN0000e+000'and in the case, DONE bit is off.

Y = GAIN1\* X1 + GAIN2 \* X2

■ Program Example



In case of X1 = 10.0, X2 = 20.0, it results in 'Y = 0.7 (10.0) + 1.3 (20.0) = 7.0 + 26.0 = 33.0.

DIV2	Y = Gain (X1 / X2)	
	Availability	XGI, XGR
	Flags	-

Function	Description
<div><div>BOOL EN      ENO BOOL REAL GAIN      Y REAL REAL X1 REAL X2</div><div>DIV2</div></div>	<div><b>Input</b> EN : Function execution request GAIN : Operation gain X1 : Input 1 X2 : Input 2</div> <div><b>Output</b> ENO : On if done without error Y : Output value</div>

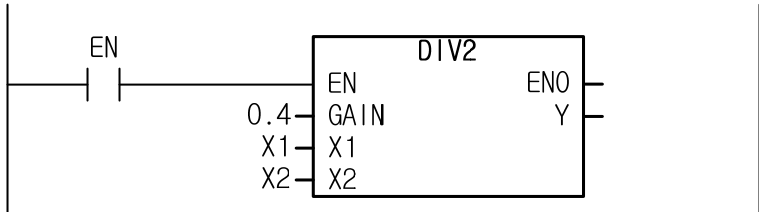
■ Functions

(1) It executes the pre-determined arithmetic operations.

$Y = \text{GAIN} (X1 / X2)$

- (2) If X2 value is 0, it outputs '1.#QNAN0000 E+000'because its denominator is 0.
- (3) If the operation result is out of the data expression range of Y(REAL), ENO is off and it is displayed as 1.#inf00000 E+000'or '-1.#inf00000 E+000'and in the case, DONE bit is off.

■ Program Example



In case of X1 = 10.0, X2 = 20.0, it results in 'Y = 0.4 (10.0 / 20.0) = 0.2.

ARITH1	Y = (G1X1+G2X2)G3 + G4	
	Availability	XGI, XGR
	Flags	-

Function	Description
<div><div><div>ARITH1</div><div><div>BOOL EN</div><div>REAL GAIN1</div><div>REAL X1</div><div>REAL GAIN2</div><div>REAL X2</div><div>REAL GAIN3</div><div>REAL GAIN4</div></div><div><div>ENO</div><div>Y</div><div>BOOL</div><div>REAL</div></div></div></div>	<div><div><div>Input</div><div>EN</div><div>:</div><div>Function execution request</div></div><div><div>GAIN1</div><div>:</div><div>Operation gain 1</div></div><div><div>X1</div><div>:</div><div>Input 1</div></div><div><div>GAIN2</div><div>:</div><div>Operation gain 2</div></div><div><div>X2</div><div>:</div><div>Input 2</div></div><div><div>GAIN3</div><div>:</div><div>Operation gain 3</div></div><div><div>GAIN4</div><div>:</div><div>Operation gain 4</div></div></div> <div><div><div>Output</div><div>ENO</div><div>:</div><div>On if done without error</div></div><div><div>Y</div><div>:</div><div>Output value</div></div></div>

**Input**

EN : Function execution request

GAIN1 : Operation gain 1

X1 : Input 1

GAIN2 : Operation gain 2

X2 : Input 2

GAIN3 : Operation gain 3

GAIN4 : Operation gain 4

**Output**

ENO : On if done without error

Y : Output value

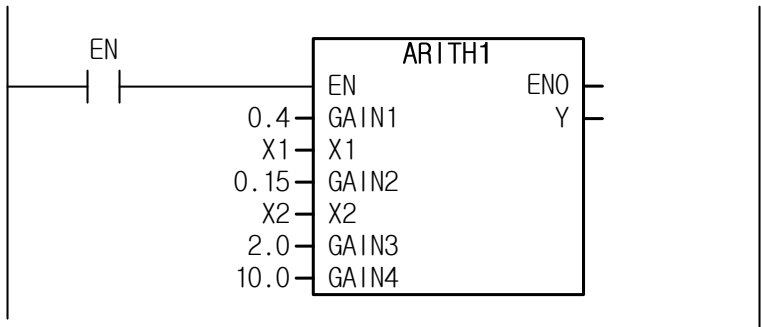
■ Functions

(1) It executes the pre-determined arithmetic operations.

Y = (GAIN1×X1+ GAIN2× X2)GAIN3 + GAIN4

(2) If the operation result is out of the data expression range of Y(REAL), ENO is off and it is displayed as '1.#inf00000 E+000', '-1.#inf00000 E+000', '1.#QNAN0000e+000'and in the case, DONE bit is off.

■ Program Example



In case of X1 = 10.0, X2 = 20.0, it results in Y = (0.4(10.0)+0.15(20.0))2.0+10.0 = (4.0+3.0)2.0+10.0 = 24.0.

ARITH2	Y = (G1X1+G2X2+G3X3+G4X4)G5 + G6	
	Availability	XGI, XGR
	Flags	-

Function	Description
<div><div><div>ARITH2</div><div><div><div>EN</div><div>ENO</div></div><div><div>REAL GAIN1</div><div>REAL X1</div><div>REAL GAIN2</div><div>REAL X2</div><div>REAL GAIN3</div><div>REAL X3</div><div>REAL GAIN4</div><div>REAL X4</div><div>REAL GAIN5</div><div>REAL GAIN6</div></div></div><div><div>BOOL</div><div>Y</div><div>REAL</div></div></div></div>	<div><div><div>Input</div><div>EN</div><div>GAIN1</div><div>X1</div><div>GAIN2</div><div>X2</div><div>GAIN3</div><div>X3</div><div>GAIN4</div><div>X4</div><div>GAIN5</div><div>GAIN6</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div></div><div><div>:</div><div>:</div><div>:</div><div>:</div><div>:</div><di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**Input**

EN : Function execution request

GAIN1 : Operation gain 1

X1 : Input 1

GAIN2 : Operation gain 2

X2 : Input 2

GAIN3 : Operation gain 3

X3 : Input 3

GAIN4 : Operation gain 4

X4 : Input 4

GAIN5 : Operation gain 5

GAIN6 : Operation gain 6

**Output**

ENO : On if done without error

Y : Output value

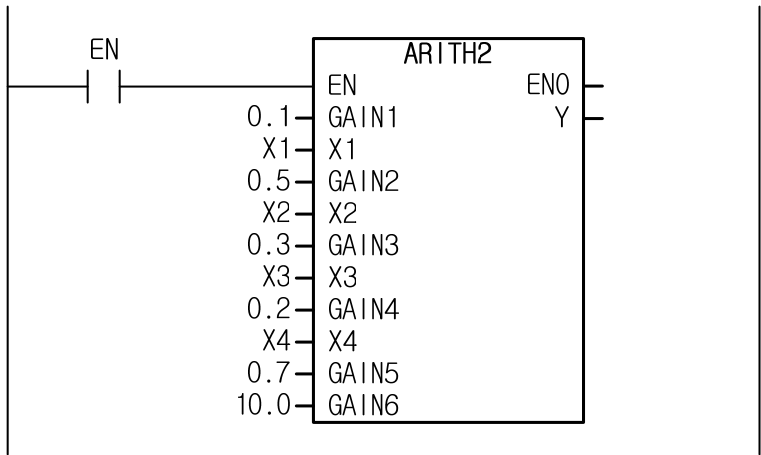
■ Functions

(1) It executes the pre-determined arithmetic operations.

$$Y = (GAIN1 \times X1 + GAIN2 \times X2 + GAIN3 \times X3 + GAIN4 \times X4)GAIN5 + GAIN6$$

(2) If the operation result is out of the data expression range of Y (REAL), ENO is off and it is displayed as '1.#inf00000 E+000', '-1.#inf00000 E+000', '1.#QNAN0000e+000'and in the case, DONE bit is off.

■ Program Example



In case of X1 = 10.0, X2 = 20.0, X3 = 10.0, x4 = 30.0, it results in Y = (0.1(10.0)+0.5(20.0)+0.3(10.0)+0.2(30.0))0.7+10.0 = (1+10+3+6)0.7+10.0= 24.0.

SUMA(_R)	Analog Summer	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div><div><div>SUMA(_R)</div><div><div>BOOLREQDONEYUSINT</div><div>BOOLESETSTATREAL</div><div>REALY_RESETYREAL</div><div>BOOLEMANT_LEFTTIME</div><div>REALY_MANFINBOOL</div><div>INT(REAL)X</div><div>INT(REAL)CUTOFF</div><div>BOOLESQRT</div><div>REALGAIN</div><div>TIMETIMER</div><div>TIMET_s</div></div></div></div>	<div><div>Input</div><div>REQ: Function block execution request</div><div>RESET: Block operation reset</div><div>Y_RESET: reset value</div><div>MAN: manual mode</div><div>Y_MAN: Manual output value</div><div>X: Input</div><div>CUTOFF: Small signal cut width</div><div>SQRT: Square root setting</div><div>GAIN: Input gain (%)</div><div>TIMER: Timer setting</div><div>T_s: Operation cycle</div></div> <div><div>Output</div><div>DONE: On if done without error</div><div>STAT: State alarm</div><div>Y: Output value</div><div>T_LEFT: Timer left time</div><div>FIN: Timer finish display</div></div>

Input

REQ

:

Function block execution request

RESET

:

Block operation reset

Y\_RESET

:

reset value

MAN

:

manual mode

Y\_MAN

:

Manual output value

X

:

Input

CUTOFF

:

Small signal cut width

SQRT

:

Square root setting

GAIN

:

Input gain (%)

TIMER

:

Timer setting

T\_s

:

Operation cycle

Output

DONE

:

On if done without error

STAT

:

State alarm

Y

:

Output value

T\_LEFT

:

Timer left time

FIN

:

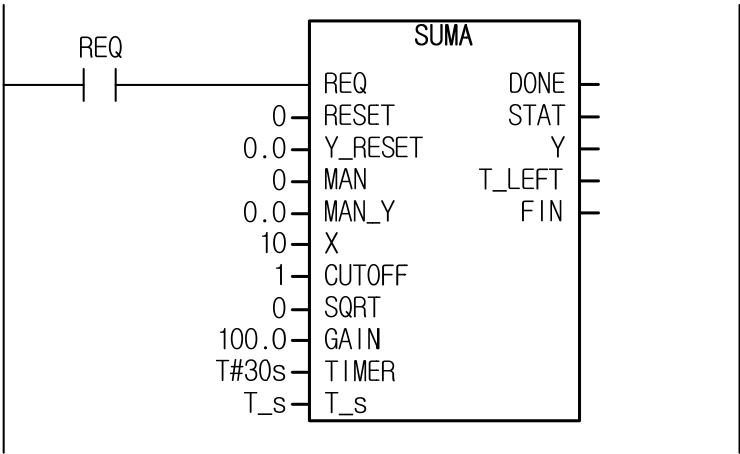
Timer finish display

■ Functions

- (1) It sums up analog data inputted to X at the preset interval and outputs the result to Y.
- (2) SUMA (INT type) instruction supports real number type output to prevent too fast saturation that may occur when output rapidly increases if it is summed up to a direction, whether negative or positive.
- (3) If RESET bit is on, it outputs Y\_RESET value; if RESET bit is off, it resumes the operation from Y\_RESET value.
- (4) If MAN bit is on, MAN\_Y value is output but if the bit is off, it operates from the first as much as from Y\_RESET to TIMER time.
- (5) If |X| is equal to or not more than |CUTOFF|, it processes it as X = 0.
- (6) If SQRT bit is on, it operates with square-rooted X.
- (7) If program scan time is longer than 1m, it may have a skipping section of operation. Therefore, it may have an error less than T\_s set time when the timer is finished.
- (8) If the operation results is out of the data expression range of Y(REAL), it is indicated with '1.##inf00000 E+000' or '-1.##inf00000 E+000' and in the case, DONE bit is off but the internal state(T\_LEFT, FIN and etc) will be normally processed.



■ Program Example



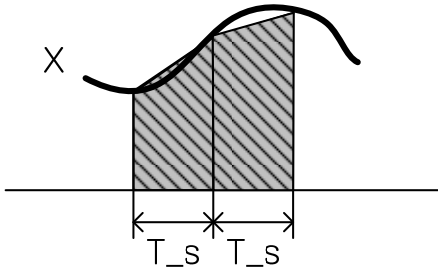
- (1) In case of X=10, T\_s= T#1s : If REQ is on, Y increases by 10 every second and it outputs Y = 300. Then, it results in 'FIN = on'.
- (2) In case of X=10, T\_s= T#2s : If REQ is on, Y increases by 10 every 2 seconds and it outputs Y = 150. Then, it results in 'FIN = on'.

TOTAL(_R)	Analog totalizer	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div></div>	<p><b>Input</b></p> <p>REQ : Function block execution request</p> <p>RESET : Block operation reset</p> <p>Y_RESET : Reset value</p> <p>TARGET : Set value</p> <p>X : Input value</p> <p>CUTOFF : Small signal cut width</p> <p>SQRT : Square root setting</p> <p>GAIN : Input gain (%)</p> <p>TIMER : Operation time</p> <p>TP1 : Trip point 1</p> <p>TP2 : Trip point 2</p> <p>TP3 : Trip point 3</p> <p>TP4 : Trip point 4</p> <p>T_s : Operation cycle</p> <p><b>Output</b></p> <p>DONE : On if done without error</p> <p>STAT : State alarm</p> <p>Y : Output value</p> <p>TARG_AL : Set value alarm</p> <p>FIN : Operation finish alarm</p> <p>T_LEFT : Operation time end alarm</p> <p>TP1_AL : Trip point 1 alarm</p> <p>TP2_AL : Trip point 2 alarm</p> <p>TP3_AL : Trip point 3 alarm</p> <p>TP4_AL : Trip point 4 alarm</p>

■ Functions

- (1) It totals analog data input to X.
- (2) Totaling is executed from Y\_RESET.
- (3) As in the below figure, it totals by means of the operation of trapezoid addition, in which the shaded area is added every T\_s of operation cycle, and it applies the delivery rate through gain.



$$Y = Y_{old} + GAIN/100 (X_{old} + X)T_s / 2$$

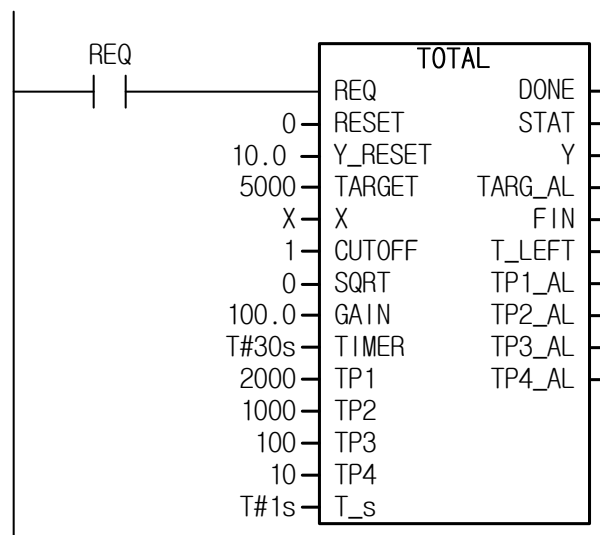
$T_s : [sec]$

- (4) If RESET bit is on, it becomes reset and outputs Y\_RESET.

## Ch 13. Process Control Library

- (5) If RESET is canceled as RESET bit is off, it restarts the operation from Y\_RESET value.
- (6) After the set value is set, it notifies a user that output value is more than the set value by means of TARG\_AL.
- (7) If output value is within  $TARGET - TP[n] \leq Y \leq TARGET + TP[n]$ , it turns on TP[n]\_AL and shows how close it approaches to the set value.
- (8) Output Y increases or decreases with no influence of target.
- (9) If  $|X|$  is not more than  $|CUTOFF|$ , it processes it as  $X = 0$ .
- (10) If SQRT bit is on, it operates with square-rooted X.
- (11) If program scan time is not less than 1m, it may have a skipping section of operation, so it may have an error less than T\_s time.
- (12) Input-output may have an error less than 0.001%.
- (13) If  $|GAIN * X|$  has a huge range over  $1.0e+38$ , it may result in incorrect operation procedure.
- (14) If operation result is out of the data expression range of integer(INT), the output is limited to INT (-32768 ~ 32767).
- (15) If operation result is out of the data expression range of real number (REAL), output is displayed as '1.#inf00000 E+000' or '-1.#inf00000 E+000'. In the case, DONE bit is off but the internal state (T\_LEFT, FIN and etc) is normally processed.

### ■ Program Example



- (1) In case of  $X=200$ ,  $T_s=T\#1s$ : output Y increases from 10 (Y\_RESET) by 100 for the first cycle (trapezoid addition). Then, it increases by 200 per second from the next cycle and it outputs 5910 in 30s.  
 TARG\_AL is on in case of  $Y \geq 5000$   
 TP1\_AL is on in case of  $5000 - TP1 \leq Y \leq 5000 + TP1$   
 TP2\_AL is on in case of  $5000 - TP2 \leq Y \leq 5000 + TP2$   
 TP3\_AL is on in case of  $5000 - TP3 \leq Y \leq 5000 + TP3$   
 TP4\_AL is on in case of  $5000 - TP4 \leq Y \leq 5000 + TP4$
- (2) In case of  $X=200$ ,  $T_s=T\#5s$ : output Y increases from 10 (Y\_RESET) by 500 for the first cycle (trapezoid addition). Then, it increases by 1000 per 5 seconds from the next cycle and it outputs 5510 in 30s.  
 TARG\_AL is on in case of  $Y \geq 5000$   
 TP1\_AL is on in case of  $5000 - TP1 \leq Y \leq 5000 + TP1$   
 TP2\_AL is on in case of  $5000 - TP2 \leq Y \leq 5000 + TP2$   
 TP3\_AL is on in case of  $5000 - TP3 \leq Y \leq 5000 + TP3$   
 TP4\_AL is on in case of  $5000 - TP4 \leq Y \leq 5000 + TP4$

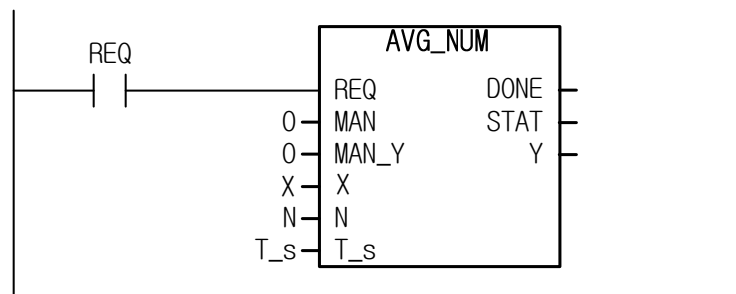
AVG_NUM(_R)	Average number output	
	Availability	XGI, XGR
	Flags	_LER

Function block	Description
	<p><b>Input</b></p> <p>REQ : Function block execution request</p> <p>MAN : Manual mode setting</p> <p>MAN_Y : Manual output</p> <p>X : Input</p> <p>N : Average number</p> <p>T_s : Operation cycle</p> <p><b>Output</b></p> <p>DONE : On if done without error</p> <p>STAT : State alarm</p> <p>Y : Output value</p>

## ■ Functions

- (1) It receives input X every T\_s and outputs N average value.
- (2) Output Y is updated with a new average every N \* T\_s.
- (3) If MAN bit is on, T\_s is disregarded; output Y has MAN\_Y.
- (4) If N is 0 or not less than 30001, it outputs 8 to STAT.
- (5) If operation result is out of the data expression of integer(INT), the output is limited to INT (-32768 ~ 32767).
- (6) If in the operation procedure, X \* N is out of the data expression range of real number (REAL), the output is indicated as '1.#inf00000 E+000' or '-1.#inf00000 E+000' and \_LER flag is set. In the case, DONE bit is off.

## ■ Program Example



- (1) X increases by 1 per second from 0,  $T_s = T\#1s$ ,  $N=3$ : Y increases by 3 per 3s
- (2) X increases by 1 per second from 0,  $T_s = T\#2s$ ,  $N=3$ : Y increases by 6 per 6s
- (3) X increases by 1 per second from 0,  $T_s = T\#1s$ ,  $N=6$ : Y increases by 6 per 6s

AVG_MOV(_R)	Moving average output	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div><div><div>AVG_MOV(_R)</div><div><div><div>BOOL</div><div>REQ</div><div>DONE</div><div>BOOL</div></div><div><div>BOOL</div><div>MAN</div><div>STAT</div><div>USINT</div></div><div><div>INT(REAL)</div><div>MAN_Y</div><div>Y</div><div>INT(REAL)</div></div><div><div>INT(REAL)</div><div>X</div><div></div><div></div></div><div><div>UINT</div><div>N</div><div></div><div></div></div><div><div>TIME</div><div>T_s</div><div></div><div></div></div></div></div></div>	<div><div><div>Input</div><div>REQ</div><div>:</div><div>Function block execution request</div></div><div><div>MAN</div><div>:</div><div>Manual mode setting</div></div><div><div>MAN_Y</div><div>:</div><div>Manual output</div></div><div><div>X</div><div>:</div><div>Input</div></div><div><div>N</div><div>:</div><div>Average number</div></div><div><div>T_s</div><div>:</div><div>Operation cycle</div></div></div> <div><div><div>Output</div><div>DONE</div><div>:</div><div>On if done without error</div></div><div><div>STAT</div><div>:</div><div>State alarm</div></div><div><div>Y</div><div>:</div><div>Output value</div></div></div>

**Input**

REQ : Function block execution request

MAN : Manual mode setting

MAN\_Y : Manual output

X : Input

N : Average number

T\_s : Operation cycle

**Output**

DONE : On if done without error

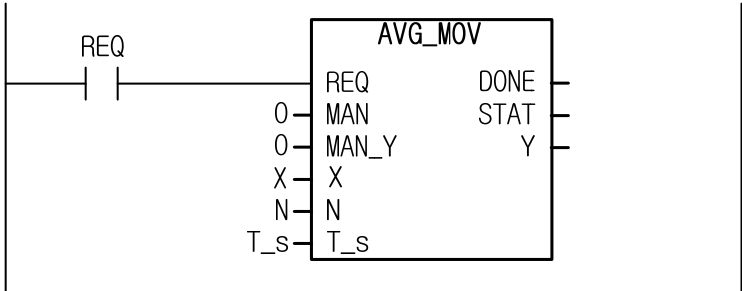
STAT : State alarm

Y : Output value

■ Functions

- (1) It receives input X every T\_s and outputs the values before the present time and N average value.
- (2) Output Y is updated with a new average every T\_s.
- (3) If MAN bit is on, T\_s is disregarded; output Y has MAN\_Y.
- (4) If N is 0 or not less than 101, it outputs 8 to STAT.
- (5) If operation result is out of the data expression of integer (INT), the output is limited to INT (-32768 ~ 32767).
- (6) If in the operation procedure, X \* N is out of the data expression range of real number (REAL), the output is indicated as '1.#inf00000 E+000' or '-1.#inf00000 E+000' and in the case, DONE bit is off.

■ Program Example



- (1) X increases by 1 from 0, T\_s= T#1s, N=3 : Y increases by 1 per second
- (2) X increases by 1 from 0, T\_s= T#2s, N=3 : Y increases by 2 per 2 seconds
- (3) X increases by 1 from 0, T\_s= T#1s, N=6 : Y increases by 1 per second

13.5 Data Measuring Function, Function Block

ALARM_R	Alarm indicator	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div><div>ALARM_R</div><div><div>BOOL</div><div>INT</div><div>BOOL</div><div>BOOL</div><div>BOOL</div><div>REAL</div><div>REAL</div><div>REAL</div><div>TIME</div><div>TIME</div><div>TIME</div><div>TIME</div><div>INT</div><div>INT</div><div>REAL</div><div>REAL</div></div><div><div>DONE</div><div>Y</div><div>STAT</div><div>YH1_AL</div><div>YH2_AL</div><div>YL1_AL</div><div>YL2_AL</div><div>X_max_AL</div><div>X_min_AL</div></div><div><div>BOOL</div><div>REAL</div><div>USINT</div><div>BOOL</div><div>BOOL</div><div>BOOL</div><div>BOOL</div><div>BOOL</div><div>BOOL</div><div>BOOL</div><div>BOOL</div><div>BOOL</div><div>BOOL</div><div>BOOL</div><div>BOOL</div><div>BOOL</div></div></div>	<div><div>Input</div><div>REQ : Function block execution request</div><div>X : Input</div><div>YH1_OFF : Output value high 1 section off bit</div><div>YH2_OFF : Output value high 2 section off bit</div><div>YL1_OFF : Output value low 1 section off bit</div><div>YL2_OFF : Output value low 2 section off bit</div><div>YH1 : Output high 1 section value</div><div>YH2 : Output high 2 section value</div><div>YL1 : Output low 1 section value</div><div>YL2 : Output low 2 section value</div><div>YH1_DT : Output high 1 section waiting time (sec)</div><div>YH2_DT : Output high 2 section waiting time (sec)</div><div>YL1_DT : Output low 1 section waiting time (sec)</div><div>YL2_DT : Output low 2 section waiting time (sec)</div><div>X_MAX : Max. input limit</div><div>X_MIN : Min. input limit</div><div>Y_sMAX : Max. output scale</div><div>Y_sMIN : Min. output scale</div></div> <div><div>Output</div><div>DONE : On if done without error</div><div>Y : Output value</div><div>STAT : State alarm</div><div>YH1_AL : Output high 1 section alarm</div><div>YH2_AL : Output high 2 section alarm</div><div>YL1_AL : Output low 1 section alarm</div><div>YL2_AL : Output low 2 section alarm</div><div>X_max_AL : Input high alarm</div><div>X_max_AL : Input high alarm</div></div>

**Input**

REQ : Function block execution request

X : Input

YH1\_OFF : Output value high 1 section off bit

YH2\_OFF : Output value high 2 section off bit

YL1\_OFF : Output value low 1 section off bit

YL2\_OFF : Output value low 2 section off bit

YH1 : Output high 1 section value

YH2 : Output high 2 section value

YL1 : Output low 1 section value

YL2 : Output low 2 section value

YH1\_DT : Output high 1 section waiting time (sec)

YH2\_DT : Output high 2 section waiting time (sec)

YL1\_DT : Output low 1 section waiting time (sec)

YL2\_DT : Output low 2 section waiting time (sec)

X\_MAX : Max. input limit

X\_MIN : Min. input limit

Y\_sMAX : Max. output scale

Y\_sMIN : Min. output scale

**Output**

DONE : On if done without error

Y : Output value

STAT : State alarm

YH1\_AL : Output high 1 section alarm

YH2\_AL : Output high 2 section alarm

YL1\_AL : Output low 1 section alarm

YL2\_AL : Output low 2 section alarm

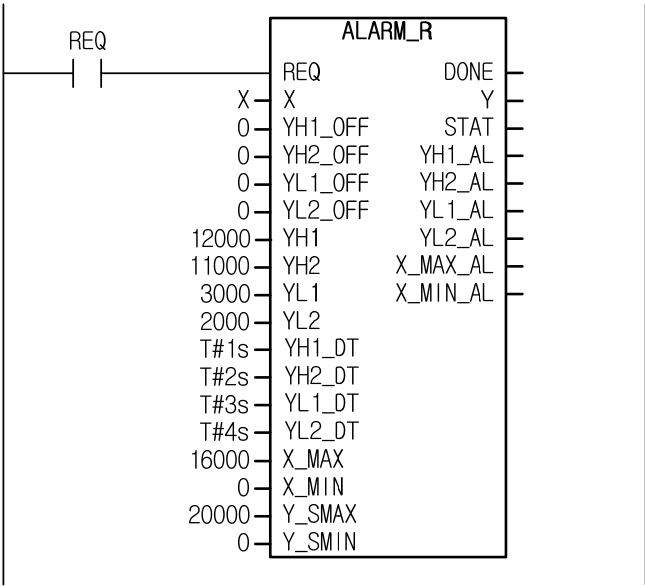
X\_max\_AL: Input high alarm

X\_min\_AL: Input low alarm

■ Functions

- (1) It changes and outputs integer input X to real number; it can execute the operations of 2 upper limits, 2 lower limits and scale.
- (2) Since input is integer type, it receives input from special module or external device and uses it as its input with no conversion.
- (3) It executes scale operation from the value between X\_MIN ~ X\_MAX to the value between Y\_sMIN ~ Y\_sMAX.
- (4) YH1 and YH2 may set high limits and notify an operator of any fault; with it, an operator may set whether to use the function (YH\_OFF) and the delay time (YH\_DT).
- (5) YL1 and YL2 may set low limits and notify an operator of when it is not more than it; with it, an operator may set whether to use the function (YL\_OFF) and the delay time (YL\_DT).
- (6) In case of X\_max = X\_min, it does not work because the denominator is 0 and STAT outputs 8.

■ Program Example



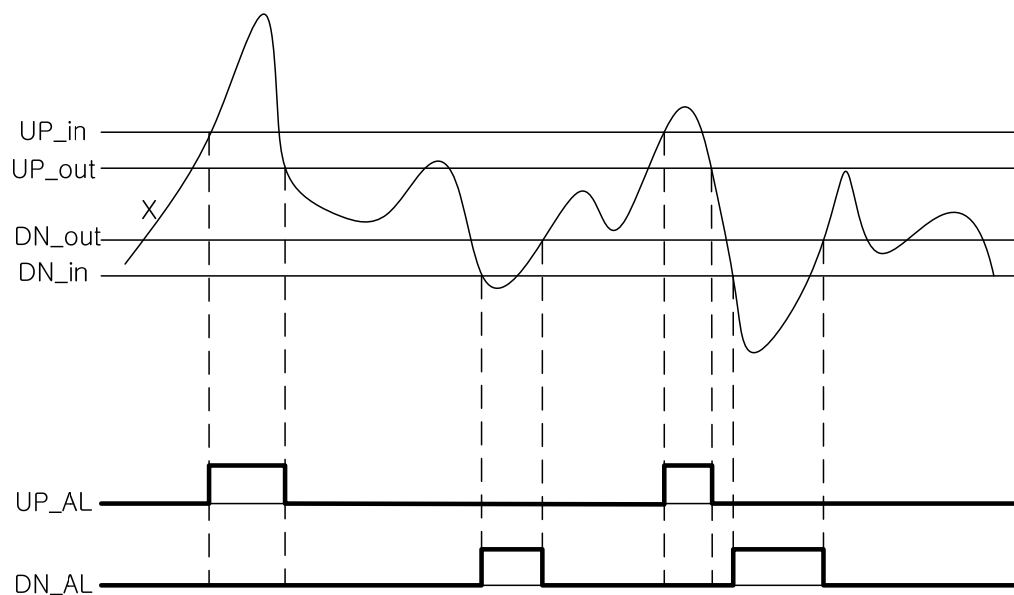
- (1) In case of X = 8900: Y = 11125, YH2\_AL on in 2s
- (2) In case of X = 11000: Y = 13750, YH1\_AL on in a second, YH2\_AL on in 2s
- (3) In case of X = 2100: Y = 2625, YL1\_AL on in 3s
- (4) In case of X = 1200: Y = 1500, YL1\_AL on in 3s, YL2\_AL on in 4s.

<b>HYS(_R)</b>	Directional deadband	
	Availability	XGI, XGR
	Flags	-

Function block	Description
	<p><b>Input</b></p> <ul style="list-style-type: none"> <li>REQ : Function block execution request</li> <li>X : Input</li> <li>UP_in : Up set trigger</li> <li>UP_out : Up reset trigger</li> <li>DN_out : Down reset trigger</li> <li>DN_in : Down set trigger</li> </ul> <p><b>Output</b></p> <ul style="list-style-type: none"> <li>DONE : On if done without error</li> <li>STAT : State alarm</li> <li>UP_AL : Max. value high alarm</li> <li>DN_AL : Min. value high alarm</li> </ul>

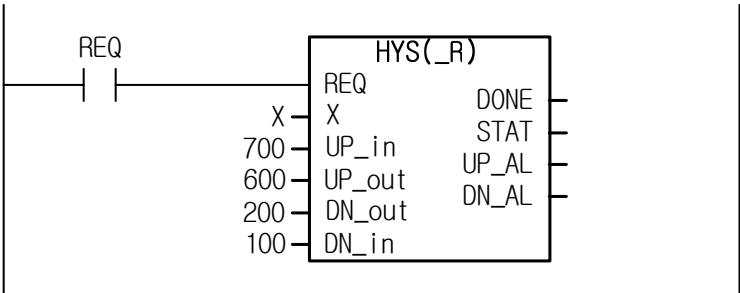
## ■ Functions

- (1) It receives input X, applies directional deadband (hysteresis) to it and notifies an operator of UP/DOWN state.
- (2) In case of  $UP\_in < X$ ,  $UP\_AL$  is on.
- (3) In case of  $UP\_out \leq X \leq UP\_in$ , it maintains the previous  $UP\_AL$  state.
- (4) In case of  $X < UP\_out$ ,  $UP\_AL$  is off.
- (5) In case of  $X < DN\_in$ ,  $DN\_AL$  is on.
- (6) In case of  $DN\_in \leq X \leq DN\_out$ , it maintains the previous  $DN\_AL$  state.
- (7) In case of  $DN\_out < X$ ,  $DN\_AL$  is off.
- (8) In case  $UP\_in$  value is not more than  $UP\_out$  value, it outputs 8 to STAT.
- (9) In case  $DN\_out$  value is not more than  $DN\_in$  value, it outputs 8 to STAT.





■ Program Example



- (1) If X is changed from 0 to 800: UP\_AL on, DN\_AL off
- (2) If X is changed from 800 to 650: UP\_AL on, DN\_AL off
- (3) If X is changed from 650 to 300: UP\_AL off, DN\_AL off
- (4) If X is changed from 300 to 50: UP\_AL off, DN\_AL on
- (5) If X is changed from 50 to 150: UP\_AL off, DN\_AL on

RATE(_R)	Measuring Variation Per Section	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div><div><div>RATE(_R)</div><div><div>BOOL REQ</div><div>BOOL MAN</div><div>INT (REAL) MAN_Y</div><div>BOOL PAUSE</div><div>INT (REAL) X</div><div>TIME LAG</div><div>TIME T_s</div><div>BOOL DONE</div><div>STAT</div><div>INT (REAL) Y</div><div>INT (REAL) X_old</div></div></div></div>	<div><div><b>Input</b></div><div>REQ : Function block execution request</div><div>MAN : Converting to Manual mode</div><div>MAN_Y : Manual output value</div><div>PAUSE : Pause</div><div>X : Input</div><div>LAG : LAG filter coefficient</div><div>T_s : Operation cycle</div><div><b>Output</b></div><div>DONE : On if done without error</div><div>STAT : State alarm</div><div>Y : Output value</div><div>X_old : Previous X</div></div>

■ Functions

- (1) RATE function is the instruction indicating the variation per second of input X.
- (2) If MAN bit is on, it outputs MAN\_Y.
- (3) If PAUSE bit is on, the block pauses.
- (4) If setting time constant in LAG, it processes it with low pass filter of input.
- (5) The I/O equation of RATE instruction including LAG is as follows.

$$Y = Y_{old} + \frac{T_s}{LAG + T_s} \times (\frac{X + X_{old}}{T_s} - Y_{old})$$

[T\_s : sec]

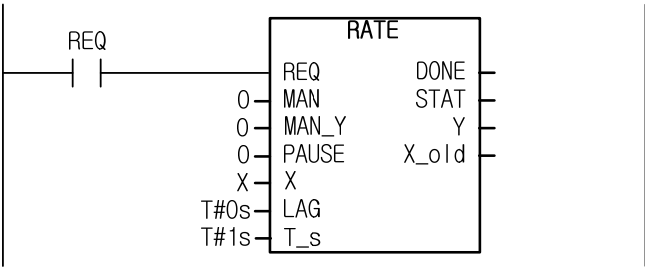
- (6) The above equation may be summarized as follows if LAG is 0.

$$Y = \frac{X - X_{old}}{T_s}$$

[T\_s : sec]

- (7) If the operation result is out of the data expression range of integer (INT), the output is limited to INT (-32768 ~ 32767).
- (8) If the operation result is out of the data expression range of real number (REAL), the output displays as '1.#inf00000 E+000' or '-1.#inf00000 E+000'. In the case, DONE bit is off but the internal state (i.e. X\_old) is normally processed.

■ Program Example



- (1) If X increases by 1 per second, Y outputs 1
- (2) If X increases from 10 by 1 per second, Y outputs 1
- (3) If X decreases from 10 by 30 per second, Y outputs -30

DMON(_***)	Saving input array as much as output array	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div><div><div>DMON(_***)</div><div><div>BOOL</div><div>REQ</div><div>DONE</div><div>BOOL</div></div><div><div>BOOL</div><div>SNG_LOOP</div><div>STAT</div><div>USINT</div></div><div><div>INT(***)</div><div>X</div><div>FULL</div><div>BOOL</div></div><div><div>TIME</div><div>T_s</div><div>LOOP</div><div>UINT</div></div><div><div>INT(***)ARRAY</div><div>Y</div><div>INDEX</div><div>UINT</div></div></div></div>	<div><div><div>Input</div><div>REQ</div><div>:</div><div>Function block execution request</div></div><div><div>SNG/LOOP</div><div>:</div><div>Single/Loop operation</div></div><div><div>X</div><div>:</div><div>Input</div></div><div><div>T_s</div><div>:</div><div>Operation cycle</div></div><div><div>Y</div><div>:</div><div>Output value</div></div></div> <div><div><div>Output</div><div>DONE</div><div>:</div><div>On if done without error</div></div><div><div>STAT</div><div>:</div><div>State alarm</div></div><div><div>FULL</div><div>:</div><div>Output array full</div></div><div><div>LOOP</div><div>:</div><div>No. of full output array</div></div><div><div>INDEX</div><div>:</div><div>Array No. of location to save</div></div></div>

Input

REQ

: Function block execution request

SNG\_LOOP

: Single/Loop operation

X

: Input

T\_s

: Operation cycle

Y

: Output value

Output

DONE

: On if done without error

STAT

: State alarm

FULL

: Output array full

LOOP

: No. of full output array

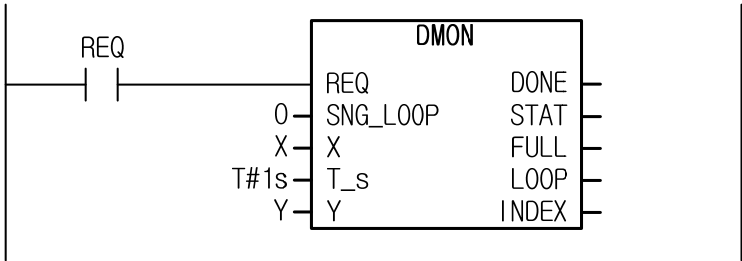
INDEX

: Array No. of location to save

■ Functions

- (1) It is used to save the data that are changing temporally.
- (2) It saves input X to Y (Array) every operation cycle (T\_s).
- (3) DMON function block is INT type instruction; the data type started with DMON such as \_DI (DINT), \_R (REAL), \_UI (UINT), \_UDI (UDINT), \_W (WORD) and \_DW (DWORD) may be used selectively, depending on I/O data.
- (4) If SNG\_LOOP is off, it is engaged in single operation, saves as much as no. of array and stops with FULL on.
- (5) If SNG\_LOOP is on, it is engaged in loop operation, saves as much as no. of array and continues to rewrite the original values from the first.
- (6) If SNG\_LOOP is converted to single/loop, it is necessary to allow REQ again and initialize it prior to use.
- (7) During loop operation, LOOP increases ever time array is full. If LOOP value is over 65535, it is reset to 0.

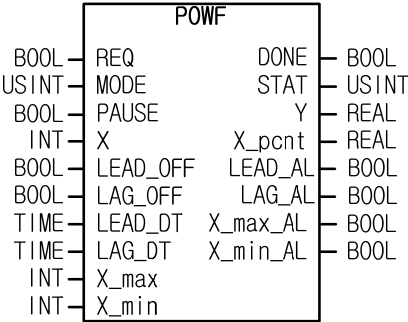
■ Program Example



- Y is set to ARRAY [0..10] of INT type.
- (1) X increases from 0 by 1 per second Y[0]=0 ... a value is saved in good order of Y[10]=10 and it results in FULL=on from 12s.
  - (2) X increases from 10 by 1 per second : a value is saved per second in good order of Y[0]=10 ... Y[10]=20 and it results in FULL=on from 12s.
  - (3) X decreases from 10 by 3 per seconds : a value is saved per second in good order of Y[0]=10 ... Y[10]=-20 and it results in FULL=on from 12s.

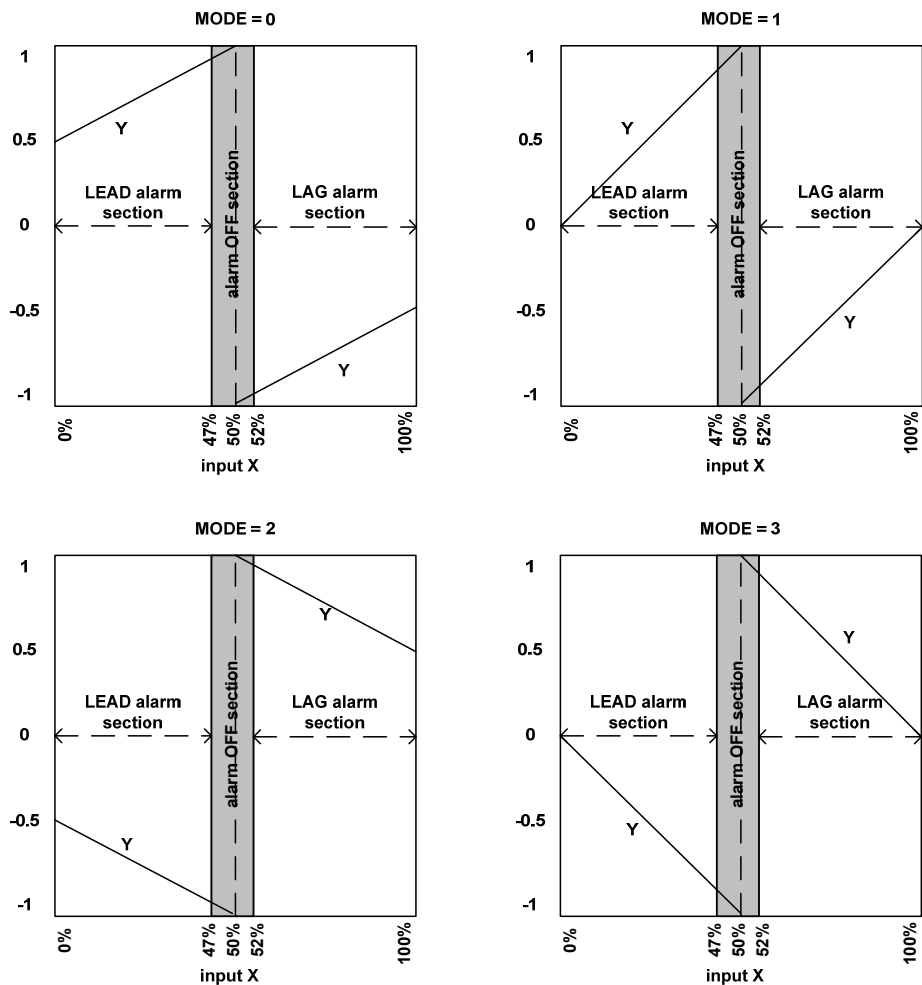
13.6 Data Function Block, Function Block

POWF	PF Instrument	
	Availability	XGI, XGR
	Flags	-

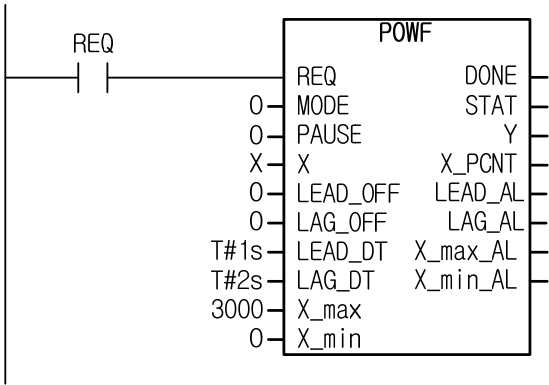
Function block	Description
	<p><b>Input</b></p> <p>REQ : Function block execution request MODE : Mode conversion PAUSE : Pause X : Input LEAD_OFF : Lead alarm off LAG_OFF : Lag alarm off LEAD_DT : Lead alarm ON delay time LAG_DT : Lag alarm ON delay time X_max : Max. input limit X_min : Min. input limit</p> <p><b>Output</b></p> <p>DONE : On if done without error STAT : State alarm Y : Output value X_pcnt : Percent output LEAD_AL : Lead alarm LAG_AL : Lag alarm X_max_AL : Max. value high alarm X_min_AL : Min. value low alarm</p>

■ Functions

- (1) By referring to the input X receiving from PF sensor, it generates output Y along the PF profile.
- (2) The max./min. value of input X is limited by setting X\_max and X\_min.
- (3) Input X is converted to the unit of % by setting X\_max and X\_min, indicated in X\_PCNT and executes operation with %.
- (4) Profile type is selected depending on mode (0 ~ 3 selectable). The outputs by modes are as presented in the figure below.
  - a) MODE 0 : inclination 0.5, lead offset 1 and lag offset -1.
  - b) MODE 1 : inclination 1, lead offset 1 and lag offset -1.
  - c) MODE 2 : inclination -0.5, lead offset -1 and lag offset 1.
  - d) MODE 3 : inclination -1, lead offset -1 and lag offset 1.
- (5) At a point where X is 50%(center of the graph), output Y is defined as 0.
- (6) If PAUSE is on, operation stops and it does not indicate alarm bit until operation resumes.
- (7) It indicates lead and lag in LEAD\_AL and LAG\_AL and it is possible to set indication (\_OFF) and delay time (\_DT).
- (8) It is possible to set the max./min. value of input X in X\_max and X\_min.
- (9) When MODE is more than 3, it outputs 8 to STAT.
- (10) In case of X\_max = X\_min, it does not operate because the denominator is 0 and STAT indicates 8.
- (11) Input-output may have an error less than 0.001%.



■ Program Example



- (1) If X is 0 : X\_PCNT = 0 and Y = 0.5, in 1 second, LEAD\_AL = on, LAG\_AL = off
- (2) If X is 1500 : X\_PCNT = 50 and Y = 0, LEAD\_AL = off, LAG\_AL = off
- (3) If X is 2000 : X\_PCNT = 66 and Y = -0.84, LEAD\_AL = off, in 2 seconds LAG\_AL = on

LOOKUP(_R)	LOOK-UP Table output	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div><div><div>LOOKUP(_R)</div><div><div><div>BOOL</div>REQ<div>BOOL</div>DONE</div><div><div>INT(REAL)</div>X<div>USINT</div>STAT</div><div><div>INT(REAL)ARRAY</div>REF_X<div>INT(REAL)</div>Y</div><div><div>INT(REAL)ARRAY</div>REF_Y<div>BOOL</div>X_max_AL</div><div><div></div>X_min_AL<div>BOOL</div></div></div></div></div>	<div><div><div>Input</div><div>REQ</div><div>:</div><div>Function block execution request</div></div><div><div>X</div><div>:</div><div>Input</div></div><div><div>REF_X</div><div>:</div><div>X coordinate array of LOOK-UP table</div></div><div><div>REF_Y</div><div>:</div><div>Y coordinate array of LOOK-UP table</div></div><div><div><div>Output</div><div>DONE</div><div>:</div><div>On if done without error</div></div><div><div>STAT</div><div>:</div><div>State alarm</div></div><div><div>Y</div><div>:</div><div>Output value</div></div><div><div>X_max_AL</div><div>:</div><div>REF_X high alarm</div></div><div><div>X_min_AL</div><div>:</div><div>REF_X low alarm</div></div></div></div>

■ Functions

- (1)

By using input array (REF\_X) and output array (REF\_Y), it creates LOOK-UP table by sections and gets output by applying input X.
- (2)

Input array REF\_X should be arranged in ascending order, and if the elements of array are same, it generates alarm.
- (3)

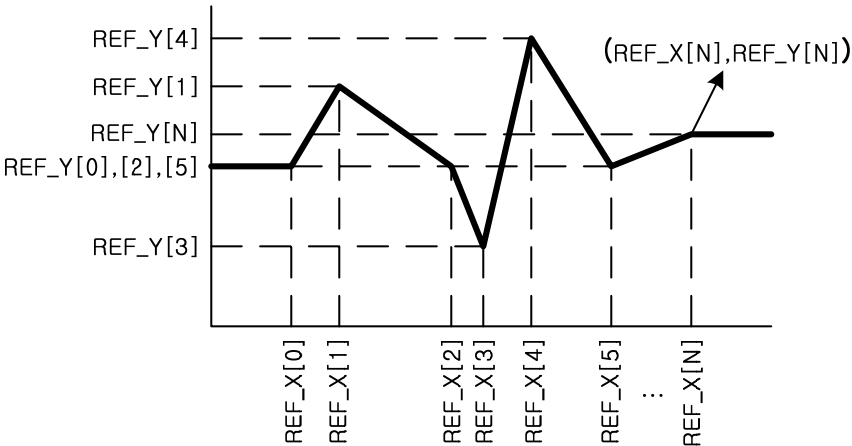
If the value inputted through input X is same or out of the range of input array (REF\_X), it indicates X\_max\_AL and X\_min\_AL.
- (4)

If the elements of REF\_X are not arranged in ascending order, STAT outputs 8.
- (5)

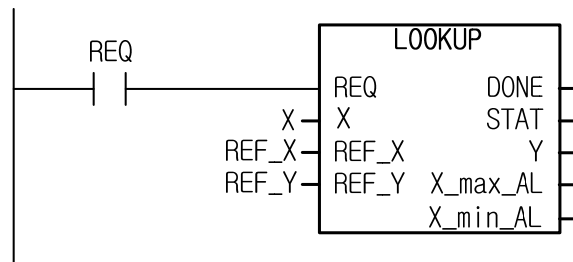
If the no. of REF\_X and REF\_Y arrays are different, STAT outputs 8.
- (6)

If operation result is out of the data expression range of integer (INT), the output is limited to INT (-32768 ~ 32767).
- (7)

If operation result is out of the data expression range of real number (REAL), it is indicated as '1.#inf00000 E+000' or '-1.#inf00000 E+000', and in the case, DONE bit is off but the internal state (i.e. X\_max\_AL, X\_min\_AL) is normally processed.



## ■ Program Example



It sets REF\_X as ARRAY [0..4] of INT and also sets the element of array as [10, 20, 30, 40, 50].

It sets REF\_Y as ARRAY [0..4] of INT and also sets the elements of array as [10, 20, 10, 50, 20].

- (1) If X is 5: Y = 10, X\_min\_AL = on, X\_max\_AL = off
- (2) If X is 15 : Y = 15, X\_min\_AL = off, X\_max\_AL = off
- (3) If X is 45 : Y = 35, X\_min\_AL = off, X\_max\_AL = off
- (4) If X is 100 : Y = 20, X\_min\_AL = off, X\_max\_AL = on

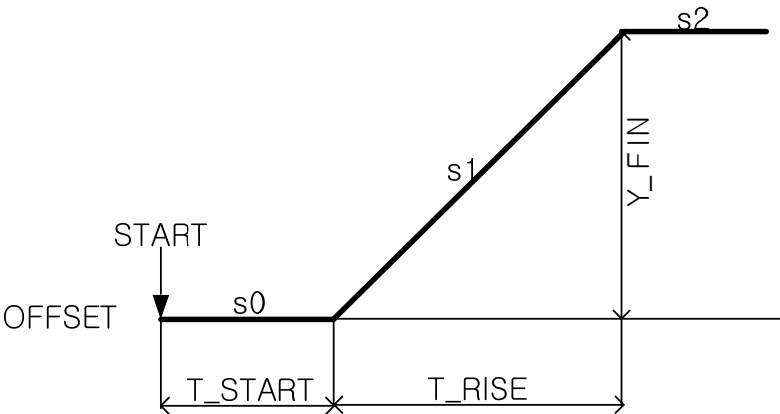


F_RAMP(_R)	Singular RAMP Function output	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div><div><div>F_RAMP(_R)</div><div><div>BOOL REQ</div><div>BOOL START</div><div>INT (REAL) Y_FIN</div><div>TIME T_START</div><div>TIME T_RISE</div><div>INT (REAL) Y_OFFSET</div></div><div><div>DONE</div><div>Y</div><div>FIN</div></div><div><div>BOOL</div><div>INT (REAL)</div><div>BOOL</div></div></div></div>	<p><b>Input</b></p> <p>REQ : Function block execution request</p> <p>START : Operation start</p> <p>Y_FIN : RAMP function target value</p> <p>T_START : Operation waiting time</p> <p>T_RISE : Total rise section</p> <p>Y_OFFSET : Output offset</p> <p><b>Output</b></p> <p>DONE : On if done without error</p> <p>Y : Output</p> <p>FIN : Normal state alarm</p>

■ Functions

- (1) It outputs RAMP function.
- (2) In case of START on, it starts waveform output.
- (3) If REQ is off, it maintains the value of last state in an operation.
- (4) If START is off with REQ on, it initializes with its initial value and waits for operation start (START on).
- (5) it sets RAMP function target value in Y\_FIN, waiting time after start in T\_START, waveform rise time in T\_RISE and offset in Y\_OFFSET.
- (6) If waveform rise is finished, FIN is on.
- (7) F\_RAMP: if  $Y\_FIN + Y\_OFFSET$  is out of the data expression range of Y (INT), it is limited to  $-32768 \leq Y \leq 32767$ .
- (8) F\_RAMP\_R: if  $Y\_FIN + Y\_OFFSET$  is out of the data expression range of Y (REAL), the result is indicated as '1.#inf00000 E+000' or '-1.#inf00000 E+000' during operation and in the case, DONE bit is off but the internal state(that is, FIN) is normally processed.



The equation of each section is as follows.

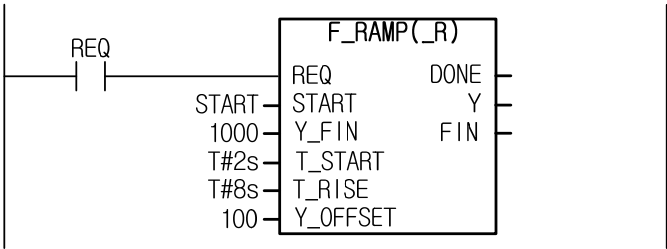
$s0: Y = Y\_OFFSET$

$s1: Y = Y\_FIN * (t - T\_START) / T\_RISE + Y\_OFFSET$

$s2: Y = Y\_FIN + Y\_OFFSET$

(where, t is the time passed after START)

■ Program Example



If setting START on with the above setting, it is possible to get a waveform increasing from 100 to 1000 in 2s.

F_SAWS_R	SAW Tooth Wave Output	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div><div><div>F_SAWS_R</div><div><div><div>REQ</div><div>DONE</div></div><div><div>START</div><div>Y</div></div><div><div>AMP</div><div>CNT</div></div><div><div>T_HALF</div><div></div></div><div><div>T_REST1</div><div></div></div><div><div>T_REST2</div><div></div></div><div><div>UNIPOLAR</div><div></div></div><div><div>Y_OFFSET</div><div></div></div></div><div><div>BOOL</div><div>REAL</div><div>REAL</div><div>TIME</div><div>TIME</div><div>TIME</div><div>BOOL</div><div>REAL</div></div><div><div>BOOL</div><div>REAL</div><div>UINT</div></div></div></div>	<div><div>Input</div><div><div>REQ</div><div>START</div><div>AMP</div><div>T_HALF</div><div>T_REST1</div><div>T_REST2</div><div>UNIPOLAR</div><div>Y_OFFSET</div></div><div><div>: Function block execution request</div><div>: Operation start</div><div>: SAWS function target value</div><div>: Function half cycle</div><div>: Waveform waiting time 1</div><div>: Waveform waiting time 2</div><div>: Unipolar function output</div><div>: Output offset</div></div></div> <div><div>Output</div><div><div>DONE</div><div>Y</div><div>CNT</div></div><div><div>: On if done without error</div><div>: Output value</div><div>: Output repeat frequency</div></div></div>

**Input**

REQ

: Function block execution request

START

: Operation start

AMP

: SAWS function target value

T\_HALF

: Function half cycle

T\_REST1

: Waveform waiting time 1

T\_REST2

: Waveform waiting time 2

UNIPOLAR

: Unipolar function output

Y\_OFFSET

: Output offset

**Output**

DONE

: On if done without error

Y

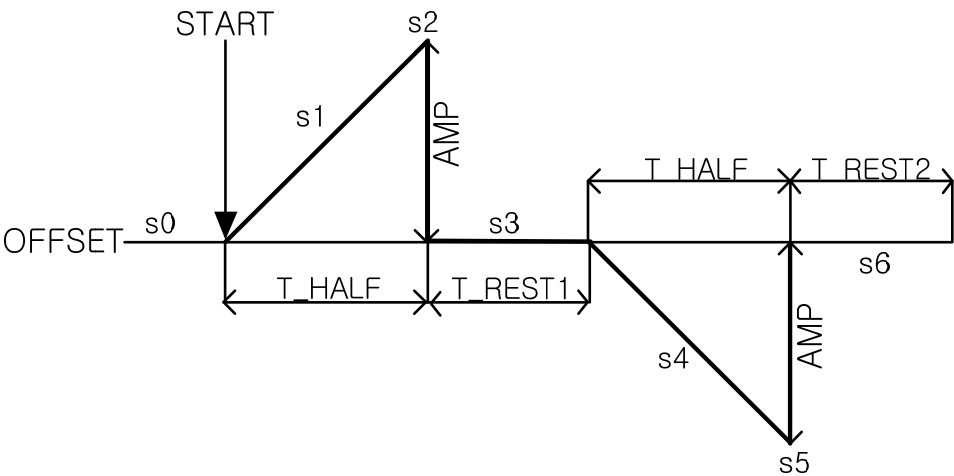
: Output value

CNT

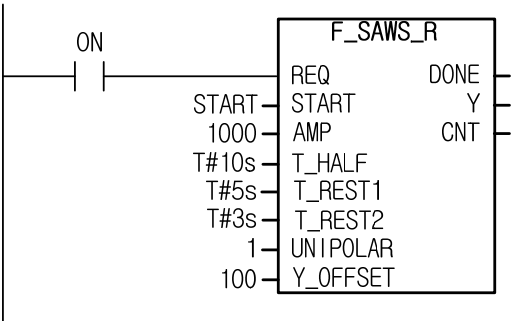
: Output repeat frequency

■ Functions

- (1) It outputs saw tooth wave.
- (2) In case of START on, it starts waveform output.
- (3) If REQ is off, it maintains the value of last state in an operation.
- (4) If START is off with REQ on, it initializes with its initial value and waits for operation start (START on).
- (5) It sets amplitude of SAWS function in AMP, rise time of saw tooth wave in T\_HALF and offset in Y\_OFFSET.
- (6) If UNIPOLAR is on, it outputs unipolar function; in case of off, it outputs bipolar function.
- (7) Function's output count CNT increases once a cycle output ends; if it is over 65535, the range of UINT, it increases from 0 again.
- (8) In case it skips a scan (if scan is longer than 1msec), scan may have an error at S2 and S5, the max./min. values; an error is larger because as smaller H\_HALF value as larger the inclination of a graph.
- (9) F\_SAWS: if Y\_FIN + Y\_OFFSET is out of the data expression range of Y (INT), it is limited to  $-32768 \leq Y \leq 32767$ .
- (10) F\_SAWS\_R: if Y\_FIN + Y\_OFFSET is out of the data expression range of Y (REAL), it indicates as '1.#inf00000 E+000' or '-1.#fnf00000 E+000'during operation and in the case, DONE bit is off but the internal state (that is, CNT) is normally processed.



■ Program Example



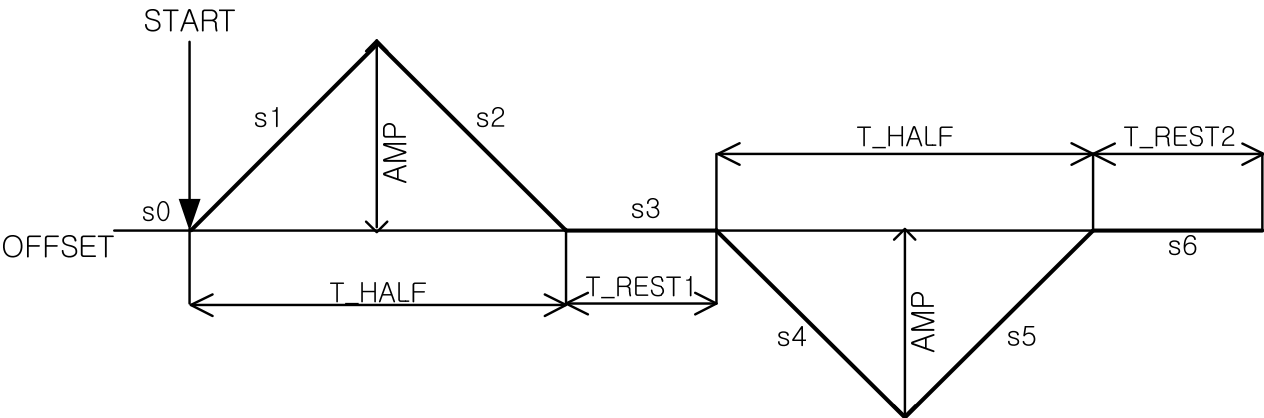
In case of START on in the above setting, it outputs the waveform.

F_TRIA_R	Triangular wave output	
	Availability	XGI, XGR
	Flags	-

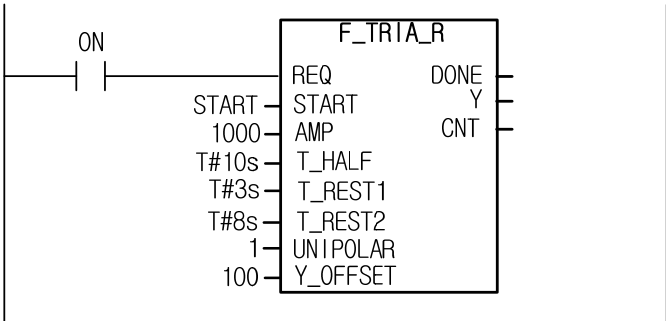
Function block	Description
<div><div><div>F_TRIA_R</div><div><div>BOOL REQ</div><div>BOOL START</div><div>REAL AMP</div><div>TIME T_HALF</div><div>TIME T_REST1</div><div>TIME T_REST2</div><div>BOOL UNIPOLAR</div><div>REAL Y_OFFSET</div></div><div><div>DONE</div><div>Y</div><div>CNT</div></div><div><div>BOOL</div><div>REAL</div><div>UINT</div></div></div></div>	<div><div><div><b>Input</b></div><div>REQ : Function block execution request</div><div>START : Operation start</div><div>AMP : TRIA function target value</div><div>T_HALF : Function half cycle</div><div>T_REST1 : Waveform waiting time 1</div><div>T_REST2 : Waveform waiting time 2</div><div>UNIPOLAR : Unipolar function output</div><div>Y_OFFSET : Output offset</div></div><div><div><b>Output</b></div><div>DONE : On if done without error</div><div>Y : Output value</div><div>CNT : Output repeat frequency</div></div></div>

■ Functions

- (1) It outputs triangular wave.
- (2) In case of START on, it starts waveform output.
- (3) If REQ is off, it maintains the value of last state in an operation.
- (4) If START is off with REQ on, it initializes with its initial value and waits for operation start (START on).
- (5) It sets amplitude of TRIA function in AMP, triangular rise time in T\_HALF and offset in Y\_OFFSET.
- (6) If UNIPOLAR is on, it outputs unipolar function; in case of off, it outputs bipolar function.
- (7) Function's output count CNT increases once a cycle output ends; if it is over 65535, the range of UINT, it increases from 0 again.
- (8) In case it skips a scan (if scan is longer than 1m), scan may have an error at S2 and S5, the max./min. values; an error is larger because as smaller H\_HALF value as larger the inclination of a graph.
- (9) F\_TRIA: if Y\_FIN + Y\_OFFSET is out of the data expression range of Y (INT), it is limited to  $-32768 \leq Y \leq 32767$ .
- (10) F\_TRIA\_R: if Y\_FIN + Y\_OFFSET is out of the data expression range of Y (REAL), it indicates as '1.#inf00000 E+000' or '-1.#inf00000 E+000'during operation and in the case, DONE bit is off but the internal state (that is, CNT) is normally processed.



■ Program Example



In case of START on in the above setting, it outputs the waveform.

F_SQUR_R	Square wave output	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div><div><div>F_SQUR_R</div><div><div>BOOL</div><div>REQ</div><div>DONE</div><div>BOOL</div></div><div><div>BOOL</div><div>START</div><div>Y</div><div>REAL</div></div><div><div>REAL</div><div>AMP</div><div>CNT</div><div>UINT</div></div><div><div>TIME</div><div>T_HALF</div><div></div><div></div></div><div><div>TIME</div><div>T_REST1</div><div></div><div></div></div><div><div>TIME</div><div>T_REST2</div><div></div><div></div></div><div><div>BOOL</div><div>UNIPOLAR</div><div></div><div></div></div><div><div>REAL</div><div>Y_OFFSET</div><div></div><div></div></div></div></div>	<div><div>Input</div><div>REQ</div><div>:</div><div>Function block execution request</div></div> <div><div>START</div><div>:</div><div>Operation start</div></div> <div><div>AMP</div><div>:</div><div>SQUR function target value</div></div> <div><div>T_HALF</div><div>:</div><div>Function half cycle</div></div> <div><div>T_REST1</div><div>:</div><div>Waveform waiting time 1</div></div> <div><div>T_REST1</div><div>:</div><div>Waveform waiting time 2</div></div> <div><div>UNIPOLAR</div><div>:</div><div>Unipolar function output</div></div> <div><div>Y_OFFSET</div><div>:</div><div>Output offset</div></div> <div><div>Output</div><div>DONE</div><div>:</div><div>On if done without error</div></div> <div><div>Y</div><div>:</div><div>Output value</div></div> <div><div>CNT</div><div>:</div><div>Output repeat frequency</div></div>

■ Functions

- (1)

It outputs square waveform.
- (2)

In case of START on, it starts waveform output.
- (3)

If REQ is off, it maintains the value of last state in an operation.
- (4)

If START is off with REQ on, it initializes with its initial value and waits for operation start (START on).
- (5)

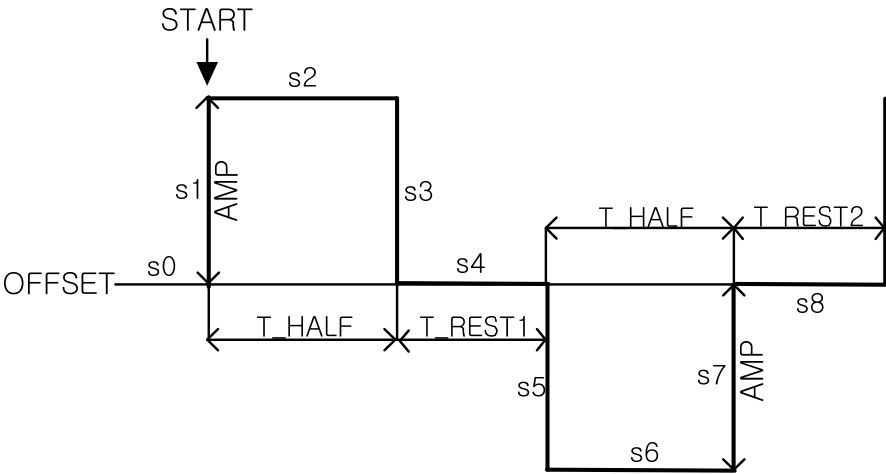
It sets amplitude of SQUR function in AMP, rise half cycle of square wave in T\_HALF and offset in Y\_OFFSET.
- (6)

If UNIPOLAR is on, it outputs unipolar function; in case of off, it outputs bipolar function.
- (7)

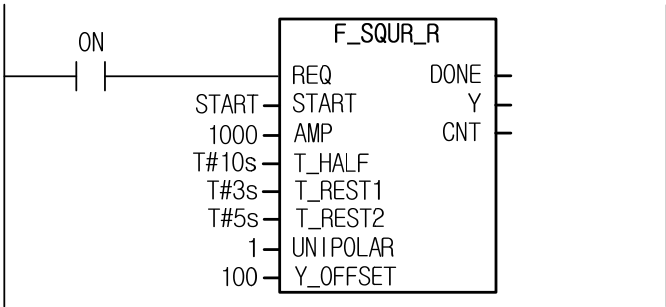
Function's output count CNT increases once a cycle output ends; if it is over 65535, the range of UINT, it increases from 0 again.
- (8)

F\_SQUR: if Y\_FIN + Y\_OFFSET is out of the data expression range of Y (INT), it is limited to  $-32768 \leq Y \leq 32767$ .
- (9)

F\_SQUR\_R: if Y\_FIN + Y\_OFFSET is out of the data expression range of Y (REAL), it is indicates as '1.#inf00000 E+000' or '-1.#inf00000 E+000'during operation and in the case, DONE bit is off but the internal state (that is, CNT) is normally processed.



■ Program Example



In case of START on in the above setting, it outputs the waveform.



F_TRAP_R	Trapezoid wave output	
	Availability	XGI, XGR
	Flags	-

Function block	Description
<div><div><div>F_TRAP_R</div><div><div><div>REQ</div><div>DONE</div></div><div><div>START</div><div>Y</div></div><div><div>AMP</div><div>CNT</div></div><div><div>T_HALF</div><div></div></div><div><div>T_RISE</div><div></div></div><div><div>T_REST1</div><div></div></div><div><div>T_REST2</div><div></div></div><div><div>UNIPOLAR</div><div></div></div><div><div>Y_OFFSET</div><div></div></div></div><div><div>BOOL</div><div></div><div>BOOL</div></div><div><div>BOOL</div><div></div><div>REAL</div></div><div><div>REAL</div><div></div><div>UINT</div></div><div><div>TIME</div><div></div><div></div></div><div><div>TIME</div><div></div><div></div></div><div><div>TIME</div><div></div><div></div></div><div><div>TIME</div><div></div><div></div></div><div><div>BOOL</div><div></div><div></div></div><div><div>REAL</div><div></div><div></div></div></div></div>	<div><div>Input</div><div>REQ : Function block execution request</div><div>START : Operation start</div><div>AMP : TRAP function target value</div><div>T_HALF : Function half cycle</div><div>T_RISE : Trapezoid output time</div><div>T_REST1 : Waveform waiting time 1</div><div>T_REST1 : Waveform waiting time 2</div><div>UNIPOLAR : Unipolar function output</div><div>Y_OFFSET : Output offset</div></div> <div><div>Output</div><div>DONE : On if done without error</div><div>Y : Output value</div><div>CNT : Output repeat frequency</div></div>

Input

REQ

: Function block execution request

START

: Operation start

AMP

: TRAP function target value

T\_HALF

: Function half cycle

T\_RISE

: Trapezoid output time

T\_REST1

: Waveform waiting time 1

T\_REST1

: Waveform waiting time 2

UNIPOLAR

: Unipolar function output

Y\_OFFSET

: Output offset

Output

DONE

: On if done without error

Y

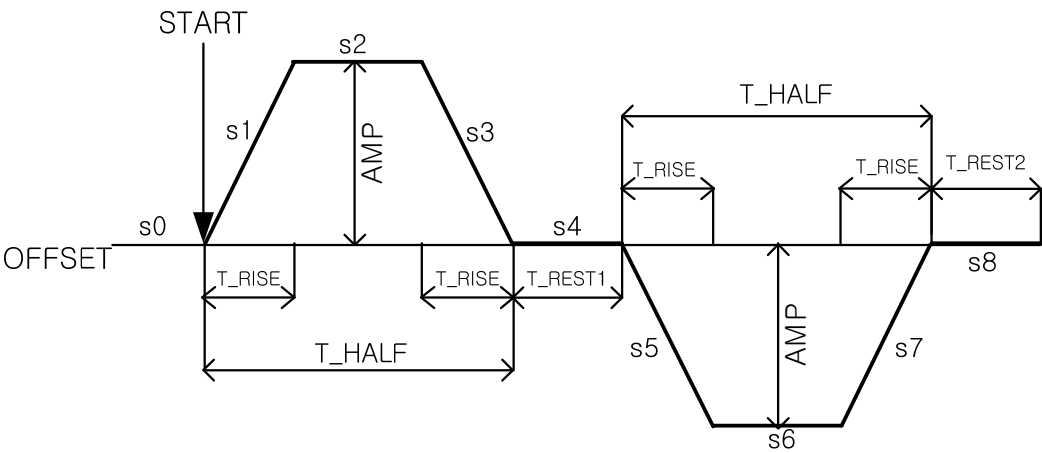
: Output value

CNT

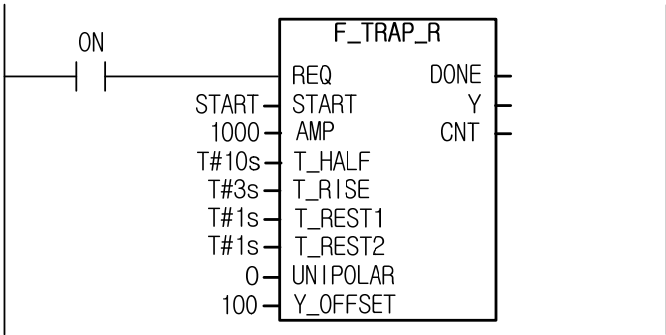
: Output repeat frequency

■ Functions

- (1) It outputs trapezoid wave.
- (2) In case of START on, it starts waveform output.
- (3) If REQ is off, it maintains the value of last state in an operation.
- (4) If START is off with REQ on, it initializes with its initial value and waits for operation start (START on).
- (5) It sets amplitude of TRAP function in AMP, trapezoid output time in T\_RISE, half cycle of waveform in T\_HALF and offset in Y\_OFFSET.
- (6) If UNIPOLAR is on, it outputs unipolar function; in case of off, it outputs bipolar function.
- (7) Function's output count CNT increases once a cycle output ends; if it is over 65535, the range of UINT, it increases from 0 again.
- (8) If T\_RISE is more than half of T\_HALF, it outputs triangular wave and the output of AMP scale is not secured.
- (9) F\_TRAP: if Y\_FIN + Y\_OFFSET is out of the data expression range of Y (INT), it is limited to  $-32768 \leq Y \leq 32767$ .
- (10) F\_TRAP\_R: if Y\_FIN + Y\_OFFSET is out of the data expression range of Y (REAL), it indicates as '1.#inf00000 E+000' or '-1.#inf00000 E+000'during operation and in the case, DONE bit is off but the internal state (that is, CNT) is normally processed.



■ Program Example



In case of START on in the above setting, it outputs the waveform.

F_SINE_R	Sine wave output	
	Availability	XGI, XGR
	Flags	_LER

Function block	Description
<div><div><div>F_SINE_R</div><div><div><div>REQ</div><div>DONE</div></div><div><div>START</div><div>Y</div></div><div><div>AMP</div><div>CNT</div></div><div><div>T_HALF</div><div></div></div><div><div>T_REST1</div><div></div></div><div><div>T_REST2</div><div></div></div><div><div>UNIPOLAR</div><div></div></div><div><div>Y_OFFSET</div><div></div></div></div></div><div><div>BOOL</div><div>REAL</div><div>TIME</div><div>TIME</div><div>TIME</div><div>BOOL</div><div>REAL</div></div><div><div>BOOL</div><div>REAL</div><div>UINT</div></div></div>	<div><div>Input</div><div>REQ : Function block execution request</div><div>START : Operation start</div><div>AMP : SINE function target value</div><div>T_HALF : Function half cycle</div><div>T_REST1 : Waveform waiting time 1</div><div>T_REST2 : Waveform waiting time 2</div><div>UNIPOLAR: Unipolar function output</div><div>Y_OFFSET: Output offset</div></div> <div><div>Output</div><div>DONE : On if done without error</div><div>Y : Output value</div><div>CNT : Output repeat frequency</div></div>

**Input**

REQ : Function block execution request

START : Operation start

AMP : SINE function target value

T\_HALF : Function half cycle

T\_REST1 : Waveform waiting time 1

T\_REST2 : Waveform waiting time 2

UNIPOLAR : Unipolar function output

Y\_OFFSET : Output offset

**Output**

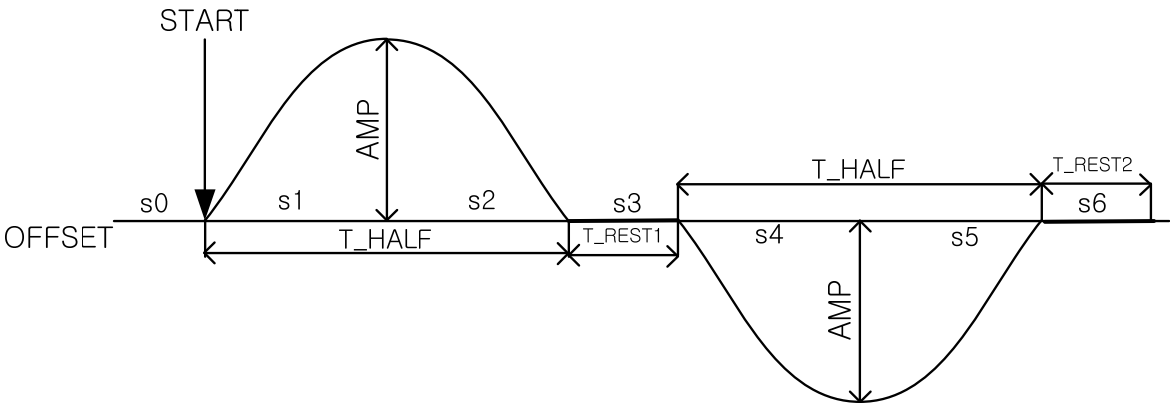
DONE : On if done without error

Y : Output value

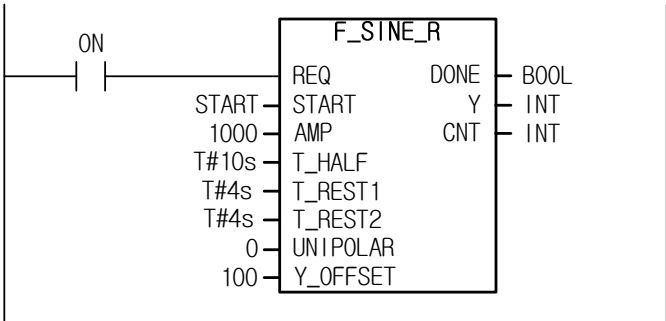
CNT : Output repeat frequency

■ Functions

- (1) It outputs sine wave.
- (2) In case of START on, it starts waveform output.
- (3) If REQ is off, it maintains the value of last state in an operation.
- (4) If START is off with REQ on, it initializes with its initial value and waits for operation start (START on).
- (5) It sets amplitude of SINE function in AMP, half cycle of sine wave in T\_HALF and offset in Y\_OFFSET.
- (6) If UNIPOLAR is on, it outputs unipolar function; in case of off, it outputs bipolar function.
- (7) Function's output count CNT increases once a cycle output ends; if it is over 65535, the range of UINT, it increases from 0 again.
- (8) In case it skips a scan (if scan is longer than 1m), scan may have an error at S2 and S5, the max./min. values; an error is larger because as smaller H\_HALF value as larger the inclination of a graph.
- (9) F\_SINE: if Y\_FIN + Y\_OFFSET is out of the data expression range of Y (INT), it is limited to  $-32768 \leq Y \leq 32767$ .
- (10) F\_SINE\_R: if Y\_FIN + Y\_OFFSET is out of the data expression range of Y (REAL), it indicates as '1.#inf00000 E+000' or '-1.#inf00000 E+000'during operation and \_LER flag is set. In the case, DONE bit is off but the internal state (that is, CNT) is normally processed.



■ Program Example



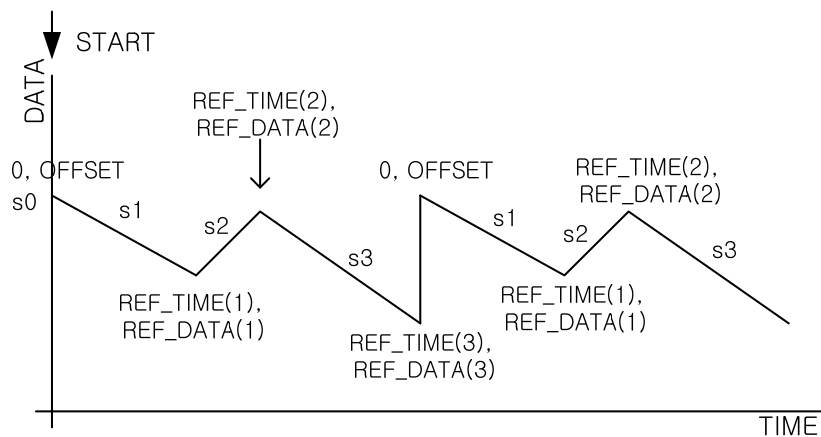
In case of START on in the above setting, it outputs the waveform.

F_USER(_DI, _R)	User-defined wave output	
	Availability	XGI, XGR
	Flags	-

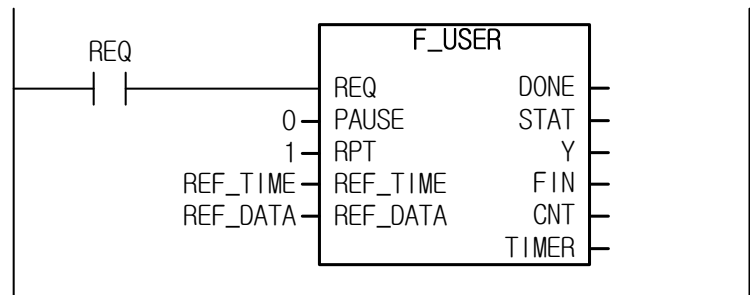
Function block	Description
<div></div>	<p><b>Input</b></p> <p>REQ : Function block execution request</p> <p>PAUSE : Pause</p> <p>RPT : Repeat</p> <p>REF_TIME : Time array</p> <p>REF_DATA : Data array</p> <p><b>Output</b></p> <p>DONE : On if done without error</p> <p>STAT : State alarm</p> <p>Y : Output value</p> <p>FIN : Output complete (if not repetitive)</p> <p>CNT : Repeat frequency</p> <p>TIMER : Timer value within FB</p>

■ Functions

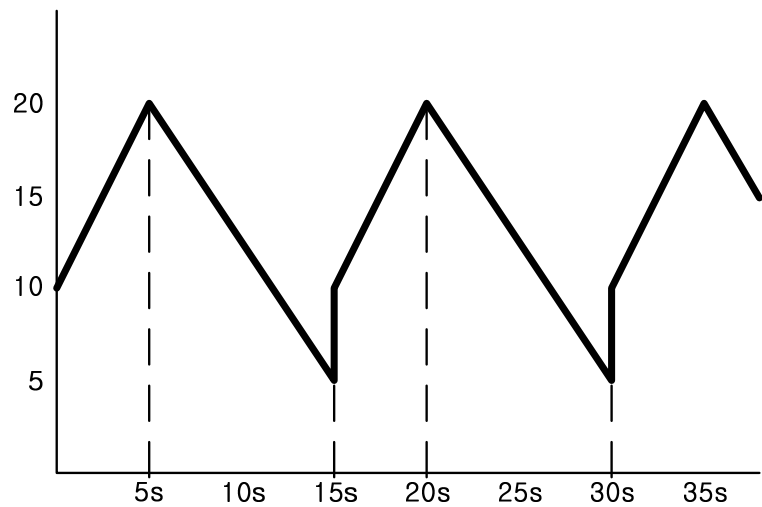
- (1) It outputs user-defined waveform.
- (2) If REQ is off, it maintains the value of last state in an operation.
- (3) If the data of initial state (0 second) is not defined, it is regarded as the first value of REF\_DATA. That is, if it is defined as the first data (2 seconds, 3000), it outputs 3000 for 2 seconds just after wave start.
- (4) Output pauses if PAUSE bit is on. However, the initialize output with REQ on is not limited by PAUSE.
- (5) If RPT bit is on, the wave is repetitively output.
- (6) A user defines the wave by using REF\_TIME and REF\_DATA.
- (7) In case of singular (RPT = off), FIN is on after output is complete and TIMER indicates the progress time.
- (8) In case of repetitive (RPT = on), it outputs repetitively from the first after output is complete. CNT indicates function output count while timer displays the progress time of the cycle.
- (9) The output count CNT of repetitive function increases if a cycle of output ends; if it is over 65535, the range of UINT, it increases from 0 again.
- (10) As soon as a waveform ends, RPT is checked; if RPT is on, it is regarded as repetitive function, and in case of off, it is regarded as singular function. Even in case of repetitive waveform, it is regarded as singular function if RPT is off when the waveform ends.
- (11) If waveform output ends in singular function, FIN is on and waveform output does not resume even though RPT is changed. It may be initialized after REQ is off.
- (12) In case the elements of REF\_TIME are not arranged in ascending order, STAT outputs 8.
- (13) In case the number of REF\_TIME and REF\_DATA are different, STAT outputs 8.



■ Program Example



It sets REF\_TIME as ARRAY [0..2] of INT and also sets the element of array as [T#0s, T#5s, T#15s].  
It sets REF\_DATA as ARRAY [0..2] of INT and also sets the element of array as [10, 20, 5].  
If you executes the above, the following waveform is outputted when REQ is allowed in the following block.



# MEMO

## Ch 14. ST (Structured Text)

### 14.1 General

- ▷ ST program can use all of text editor and has high portability.
- ▷ It can express complicated expression and algorithm well
- ▷ A person skilled at computer language can use easily.

```

1
2 //FUNCTION
3 CMD_TMR(IN:=%IX5.0.0, PT:=T#300ms) ;
4 bb := CMD_TMR.Q ;
5
6 // IF
7 A := 1.0;
8 B := 1.000e+3;
9 C := 2.0;
10 D := B*B - 4*A*C ;
11 IF D < 0.0 THEN NROOTS := 0 ;
12 ELSIF D = 0.0 THEN
13     NROOTS := 1 ;
14     X1 := - B/(2.0*A) ;
15 ELSE
16     NROOTS := 2 ;
17     X1 := (- B + SQRT(D))/(2.0*A) ;
18     X2 := (- B - SQRT(D))/(2.0*A) ;
19 END_IF ;
20

```

### 14.2 Comments

There are two types in comments, one line comment and block comment.

- One line comment uses “//” , that line is used as comment line.
- Block comment considers text between “\*” and “\*” .

For example)

```

1 //one line comment
2 (*Block
3 comment
4 *)
5

```



### 14.3 Expression

- 1) Expression always has result value.
- 2) Expression consists of operator and operand. Operand may be constant, character, character string, time character, defined variable (named variable, direct variable), defined function (function, function block). Operator of ST is described in the follow table. And also expression is calculated according to order of operator of ST language table.
- 3) Among same operations which have same order, operation in left of expression has higher order.

For example:  $A+B-C$ : first, adds A to B and subtracts C from result of  $A+B$ .

If operator has two operands, left operand executes first.

For example,  $SIN(A)*COS(B)$ :  $SIN(A)$  executes first and  $COS(B)$  executes last.

- 4) When executing operation, the following condition is dealt with error.

- Division by 0

- Operand is not applicable data type for operation.

For example,  $ADD(1,2,3)$ : unable to determine the data type of number so compile error occurs

- Result of arithmetic operation exceeds range of data type.

For example,  $B*C$ : When B, C are UINT type, result is higher than 65,535, operation error occurs.

Number	Operation	Symbol	Order
1	Parenthesis	(Expression)	<div style="display: flex; align-items: center; justify-content: center;"> <div style="margin-right: 10px;">High</div> <div style="flex-grow: 1; border-left: 1px solid black; position: relative;"> <div style="position: absolute; top: -10px; left: 50%; transform: translateX(-50%);">↑</div> <div style="position: absolute; bottom: -10px; left: 50%; transform: translateX(-50%);">↓</div> </div> <div style="margin-left: 10px;">Low</div> </div>
2	Function	Function name (Parameter list) Ex.) $ADD(X, Y)$	
3	not Complement	- NOT	
4	Exponent	**	
5	Multiplication Division Remain	* / MOD	
6	Add Subtract	+ -	
7	Compare	<, >, <=, >=	
8	same Not same	= <>	
9	Bool logical AND	& AND	
10	Bool logical Exclusive OR	XOR	
11	Bool logical OR	OR	

<Table 1> Operator of ST language

- 5) Bool type expression is calculated until determining the result value.
- 6) Function is recalled as an expression factor which has function name and parenthesis including parameter. When function is used in the expression, operand and conversion of result follows as in the following table.

Method	Characteristic			OUT := LIMIT(MIN, IN, MX);
	Variable Assignment	Variable Order	No. of Variable	
Fixed type	Available	Changeable	Changeable	Function Ex. A:= LIMIT(IN:= B, MX:= 5, MIN:= 1); Function block Ex. INST_TOF (BOOL_IN, TIME_PT, BOOL_Q, TIME_ET)
Non-fixed type	Unavailable	Fixed	Fixed	Function Ex A:= LIMIT(1, B, 5); Function block Ex. INST_TOF (BOOL_IN, TIME_PT, BOOL_Q, TIME_ET)

- EN, ENO parameter cannot be used.
- VAR\_IN\_OUT can be used one time.
- Function block uses instant name. Ex: **INST\_TON1**(IN := TRUE, PT := T#100MS, Q => Q\_OUT, ET => ET\_OUT).
- In fixed type, in case, inner parameter is VAR\_INPUT, VAR\_IN\_OUT, ':= ' is used.
- In fixed type, in case, inner parameter is VAR\_OUTPUT, '=>' is used.

### 14.3.1 + Operator

- 1) + Operator is used to add two operands.
- 2) Expression

***result := expression1 + expression2***

Items	Description
<b><i>Result</i></b>	Named variable or direct variable
<b><i>expression1</i></b>	ANY_NUM type
<b><i>expression2</i></b>	ANY_NUM type

Example	Description
Val1 := 20;	Adds Val1(20) to Val2(4) and inputs result
Val2 := 4;	Value of Result becomes 24.
Result := Val1 + Val2;	Constant and variable can be used as operands (Val1, Val2).

#### Note

ANY\_NUM includes ANY\_REAL type and ANY\_INT. For more detail, refer to data type layer of ch.3.2.2

### 14.3.2 - Operator

- 1) Subtracts right value from left value.
- 2) Expression

***result := expression1 - expression2***

Items	Description
<b><i>result</i></b>	Named variable or direct variable
<b><i>expression1</i></b>	ANY_NUM
<b><i>expression2</i></b>	ANY_NUM

Example	Description
Val1 := 20;	Subtracts right value(Val2) from left value(Val1) and inputs result.
Val2 := 4;	Value of result becomes 16
Result := Val1 - Val2;	Constant and variable can be used as operands (Val1, Val2).

### 14.3.3 \* Operator

- 1) Multiplies two operands
- 2) Expression

***result := expression1 \* expression2***

Items	Description
<b><i>result</i></b>	Named variable or direct variable
<b><i>expression1</i></b>	ANY_NUM type
<b><i>expression2</i></b>	ANY_NUM type

Example	Description
In1 := 2 ; Result := 20 * In1 ;	Multiplies 20 by In1(2) and inputs result. Value of result becomes 40. Constant and variable can be used as operands (Val1, Val2).

### 14.3.4 / Operator

- 1) Divides left value by right value.
- 2) Data type of result is different according to data type of operand. If operand is REAL type, result is also REAL type. If operand is integer, result is also integer. If 5 (int) is divided by 3 (int), result is real but number less than decimal point is removed.

```
7 Result := 20 / INT_TYPE ;
8
9 Result1 := 20 / REAL_TYPE ;
```

```
7 Result = 6, INT_TYPE = 3
8
9 Result1 = 6.666666508e+000, REAL_TYPE = 3.000000000e+000
```

- 3) Expression

***result := expression1 / expression2***

Item	Description
<b><i>result</i></b>	Named variable or direct variable
<b><i>expression1</i></b>	ANY_NUM type
<b><i>expression2</i></b>	ANY_NUM type

Example	Description
In1 := 2 ; Result := 20 / In1 ;	Divides 20 by 2(In1) and inputs result. Result becomes 10. Constant and variable can be used as operands.

### Notes

If some value is divided by 0, operation error flag (\_ERR) is on and CPU is in RUN mode.

### 14.3.5 MOD operation

- 1) Finds remain when dividing left value by right value
- 2) Expression

***result := expression1 MOD expression2***

Item	Description
<b><i>result</i></b>	Named variable or direct variable
<b><i>expression1</i></b>	ANY_NUM type
<b><i>expression2</i></b>	ANY_NUM type

Example	Description
In1 := 10 ; Result := 12 MOD In1 ;	Divides 12 by 10(In1) and inputs remain into result Constant and variable can be used as operands.

### Notes

If some value is divided by 0, operation error flag (\_ERR) is on and CPU is in RUN mode.

### 14.3.6 \*\* Operator

- 1) Exponential operator is used to multiply left number as many as right number times
- 2) Expression

***result := expression1 \*\* expression2***

Items	Description
<b><i>result</i></b>	Named variable or direct variable
<b><i>expression1</i></b>	ANY_REAL type
<b><i>expression2</i></b>	ANY_REAL type

Example	Description
In1 := 3 ; Result := 10 ** In1 ;	Multiplies 10 as many as 3 times and inputs it to result. Result becomes 1000. Constant and variable can be used as operands.

### 14.3.7 AND or & Operator

- 1) Executes logical bit AND operation.
- 2) Expression

***result := expression1 AND expression2 or result := expression1 & expression2***

Item	Description
<b><i>result</i></b>	Named variable or direct variable
<b><i>expression1</i></b>	ANY_BIT type
<b><i>expression2</i></b>	ANY_BIT type

Result of logical bit AND operation is as follows.

<b><i>expression1</i></b>	<b><i>expression2</i></b>	<b><i>result</i></b>
0	0	0
0	1	0
1	0	0
1	1	1

Example	Description
Result := 2#10010011 AND 2#00111101 ;	Since first bit and 5 <sup>th</sup> bit of two operands are both 1, result is 2#00010001.  Constant and variable can be used as operands.

### 14.3.8 OR operator

- 1) Executes logical bit OR operation.
- 2) Expression

***result := expression1 OR expression2***

Items	Description
<b><i>result</i></b>	Named variable or direct variable
<b><i>expression1</i></b>	ANY_BIT type
<b><i>expression2</i></b>	ANY_BIT type

Result of logical bit OR operation is as follows.

<b><i>expression1</i></b>	<b><i>expression2</i></b>	<b><i>result</i></b>
0	0	0
0	1	1
1	0	1
1	1	1

Example	Description
Result := 2#10010011 OR 2#00111101 ;	Since there are 1 except 7th bit in two operands, result is 2#10111111.

### 14.3.9 XOR operator

- 1) If bits of two operands are different, result bit is 1.
- 2) Expression

**result := expression1 XOR expression2**

Item	Description
<b>result</b>	Named variable or direct variable
<b>expression1</b>	ANY_BIT type
<b>expression2</b>	ANY_BIT type

Result of logical bit XOR operation is as follows.

expression1	expression2	result
0	0	0
0	1	1
1	0	1
1	1	0

Example	Description
Result := 2#10010011 XOR 2#00111101;	Since first bits of two operands are 1, first bit of result is 0. Result is 2#10101110.

### 14.3.10 Operator

- 1) Compares two operands if they are same.
- 2) Expression

**result := expression1 = expression2**

Item	Description
<b>result</b>	Named variable or direct variable
<b>expression1</b>	ANY type
<b>expression2</b>	ANY type

Result of logical bit = operation is as follows.

<i>expression1</i>	<i>expression2</i>	<i>result</i>
0	0	1
0	1	0
1	0	0
1	1	1

Example	Description
Val1 := 20; Val2 := 20 ; Result := Val1 = Val2 ;	Compares Val1 and Val2 and output result. Result is 1.

#### 14.3.11 <> operator

- 1) Compares two operands if they are not same.
- 2) Expression

*result := expression1 <> expression2*

Item	Description
<i>result</i>	Named variable or direct variable
<i>expression1</i>	ANY type
<i>expression2</i>	ANY type

Result of logical bit <> operation is as follows.

<i>expression1</i>	<i>expression2</i>	<i>result</i>
0	0	0
0	1	1
1	0	1
1	1	0

Example	Description
Val1 := 20; Val2 := 20 ; Result := Val1 <> Val2 ;	Compares Val1 and Val2 and output result. Result is 0.

#### 14.3.12 > operator

- 1) Compares two operands if left one is larger than right one.
- 2) Expression

*result := expression1 > expression2*



Item	Description
<b>result</b>	Named variable or direct variable
<b>expression1</b>	ANY type
<b>expression2</b>	ANY type

Result of logical bit > operation is as follows.

<b>expression1</b>	<b>expression2</b>	<b>result</b>
0	0	0
0	1	0
1	0	1
1	1	0

Example	Description
Val1 := 20; Val2 := 10; Result := Val1 > Val2;	Compares two operands if left one is larger than right one. Result is 1.

### 14.3.13 < operator

- 1) Compares two operands if left one is smaller than right one.
- 2) Expression

**result := expression1 < expression2**

Item	Description
<b>result</b>	Named variable or direct variable
<b>expression1</b>	ANY type
<b>expression2</b>	ANY type

Result of logical bit < operation is as follows.

<b>expression1</b>	<b>expression2</b>	<b>result</b>
0	0	0
0	1	1
1	0	0
1	1	0

Example	Description
Val1 := 20; Val2 := 10; Result := Val1 < Val2;	Compares two operands if left one is smaller than right one. Result is 0.

### 14.3.14 >= operator

- 1) Compares two operands if left one is larger than right one or same.
- 2) Expression

***result := expression1 >= expression2***

Item	Description
<b><i>result</i></b>	Named variable or direct variable
<b><i>expression1</i></b>	ANY type
<b><i>expression2</i></b>	ANY type

Result of logical bit >= operation is as follows.

<b><i>expression1</i></b>	<b><i>expression2</i></b>	<b><i>result</i></b>
0	0	1
0	1	0
1	0	1
1	1	1

Example	Description
Val1 := 20; Val2 := 20 ; Result := Val1 >= Val2 ;	Compares two operands if left one is larger than right one or same. Result is 1.

### 14.3.15 <= operator

- 1) Compares two operands if left one is smaller than right one or same.
- 2) Expression

***result := expression1 <= expression2***

Item	Description
<b><i>result</i></b>	Named variable or direct variable
<b><i>expression1</i></b>	ANY type
<b><i>expression2</i></b>	ANY type

Result of logical bit <= operation is as follows.

<b><i>expression1</i></b>	<b><i>expression2</i></b>	<b><i>result</i></b>
0	0	1
0	1	0
1	0	1
1	1	1

Example	Description
Val1 := 2; Val2 := 20 ; Result := Val1 <= Val2 ;	Compares two operands if left one is smaller than right one or same. Result is 1.

### 14.3.16 NOT operator

- 1) Changes bit value from 1 to 0 or from 0 to 1.
- 2) Expression

**result := NOT expression**

Item	Description
<b>result</b>	Named variable or direct variable
<b>expression</b>	ANY_BIT type

Example	Description
Val1 = 2#1100; Result:= NOT Val1 ;	Changes Val1 and output Result. Result is 2#0011.

### 14.3.17 - operator

- 1) Adds negative sign into value.
- 2) Expression

**result := - expression**

item	Description
<b>result</b>	Named variable or direct variable
<b>expression</b>	ANY_NUM type

Example	Description
Val1 = 10; Result:= - Val1 ;	Adds negative sign into value and output is result. Result is -10.

## 14.4 Statements

Statement is ended by semi colon(;).

### 14.4.1 Assignment statements

- 1) Assignment statement consists of Variable, operator(:=) and expression.

Ex.)  $A := B + C$  ;

- 2) It is available to assign return value of function.

### 14.4.2 Selection statements

- 1) There are two types: IF and CASE.
- 2) According to specific condition, selection statement executes one statement or one group of statements among diverse statements.
  - IF
    - (1) If condition of Bool expression is 1, it executes a group of statements.
    - (2) If condition is not 1, it does not execute group of statements. But there is ELSE, it executes a group of statements following ELSE. If condition of ELSEIF is 1, a group of statements following ELSEIF executes.
  - CASE
    - (1) It consists of list of groups of statements and expression that calculates variable of INT type.
    - (2) Each group can be set as integer and range of integer.
    - (3) A group of statements in range of Selector executes and if any value is not in range of Selector, a group of statements following ELSE executes. If there is no ELSE, group of statements is not executed.

### 14.4.3 Iteration statements

- 1) There are three types, FOR, WHILE and REPEAT.
- 2) Some group executes repeatedly by iteration statement.
  - FOR
    - (1) It is used when number of repetition is already determined.
    - (2) In FOR statement, a group of statements executes repeatedly until END\_FOR and status of repetition is saved in control variable of FOR loop.
    - (3) Control variable, initial value and final value is expressed as integer type (SINT, INT, DINT) and does not change by repeated statement. Checking the condition for the end executes at the start of each repetition. If initial value exceeds the final value, a group of statements is not executed any more.
  - WHILE and REPEAT
    - (1) WHILE statement (ended by END\_WHILE) executes repeatedly until Bool expression is 0.
    - (2) REPEAT statement (ended by UNTIL) executes repeatedly until Bool expression is 1.

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(A group of statements executes at least one time)

- (3) WHILE and REPEAT is not used for synchronizing process like “wait loop” which has the end condition determined exteriorly.
- (4) EXIT statement is used to end iteration statements before meeting the end condition.
- (5) EXIT statement is used to stop repetition before meeting the condition. When EXIT statement is used in overlapped repetition statements, relevant EXIT is applied to the loop in which EXIT exists. So, statements after first loop terminator (END\_FOR, END\_WHILE, END\_REPEAT) are executed.
- (6) IF WHILE and REPEAT are executed in unlimited loop, error occurs.

Number	Command	Example
1	Assignment	A:=B; CV:= CV+1; C:=SIN(X);
2	Recall of FB Using output of FB	CMD_TMR(IN:=%IX5, PT:= T#300ms); A:=CMD_TMR.Q;
3	RETURN	<b>RETURN;</b>
4	IF	D:=B*B -4*A*C; <b>IF</b> D<1.0 <b>THEN</b> NROOTS :=0; <b>ELSIF</b> D= 0.0 <b>THEN</b> NROOTS := 1; X1:= -B/(2.0*A); <b>ELSE</b> X1:= (-B+SQRT(D))/(2.0*A); X2:= (-B-SQRT(D))/(2.0*A); <b>END_IF;</b>
5	CASE	TW := BCD_TO_INT(THUMBWHEEL); TW_ERROR := 0; <b>CASE</b> TW <b>OF</b> 1, 5: DISPLAY := OVEN_TEMP; 2: DISPLAY := MOTOR_SPEED; 3: DISPLAY := GROSS – TARE; 4,6..10: DISPLAY := STATUS(TW-4); <b>ELSE</b> DISPLAY := 0; TW_ERROR := 1; <b>END_CASE;</b> QW100 := INT_TO_BCD(DISPLAY);
6	FOR	J := 101; <b>FOR</b> I := 1 <b>TO</b> 100 <b>BY</b> 2 <b>DO</b> <b>IF</b> WORDS[I] = 'KEY' <b>THEN</b>

Number	Command	Example
		<pre> J := I; EXIT; END_IF; END_FOR ; </pre>
7	WHILE	<pre> J := 1; <b>WHILE</b> J &lt;= 100 &amp; WORDS[J] &lt;&gt; 'KEY' <b>DO</b>   J := J+2; <b>END_WHILE</b>; </pre>
8	REPEAT	<pre> J := -1; <b>REPEAT</b>   J := J+2; <b>UNTIL</b> J = 101 OR WORDS[J] = 'KEY' <b>END_REPEAT</b> ; </pre>
9	EXIT	<b>EXIT</b> ;
10	Null/Space command text	;
EXIT is used for all repetition texts (FOR, WHILE, REPEAT).		

&lt;Table 3&gt; Command for ST

#### 14.4.4 IF

- 1) It is used for program to select more than one
- 2) Expression

**IF** *condition* **THEN** *statements* [**ELSE** *elstatements*] **END\_IF**

Or

**IF** *condition* **THEN**  
*statements*  
**[ELSIF** *condition-n* **THEN**  
*elseifstatements*] ...  
**[ELSE**  
*elstatements*]  
**END\_IF**

Item	Description
<b><i>condition</i></b>	If <b><i>condition</i></b> is TRUE, a <b><i>statement</i></b> following THEN is executed. In case of FALSE, ELSIF or ELSE executes.
<b><i>statements</i></b>	If <b><i>condition</i></b> is TRUE, a statement more than one executes.
<b><i>condition-n</i></b>	N <b><i>conditions</i></b> can be used.

Item	Description
<b>elseifstatements</b>	If <b>condition-n</b> is TRUE, a statement more than one executes.
<b>elsestatements</b>	If <b>condition</b> or <b>condition-n</b> is false, a statement more than one executes.

Example	Description
<b>IF</b> Val1 <= 10 <b>THEN</b> Result := 10; <b>END_IF;</b>	If condition (Val1 <= 10) is TRUE, 10 is assigned into result.
<b>IF</b> Val1 <= 10 <b>THEN</b> Result := 10; <b>ELSE</b> Result := 20; <b>END_IF;</b>	If condition (Val1 <= 10) is TRUE, 10 is assigned into result. If condition is FALSE, 20 is assigned into result.
<b>IF</b> Val1 <= 10 <b>THEN</b> Result := 10; <b>ELSIF</b> Val1 <= 20 <b>THEN</b> Result := 20; <b>ELSE</b> Result := 30; <b>END_IF;</b>	If condition (Val1 <= 10) is TRUE, 10 is assigned into result. If condition is FALSE, ELSEIF executes. If second condition (Val <= 20) is TRUE, 20 is assigned into result. If second is FALSE, a statement under ELSE executes. Namely, 30 is assigned into result.

### 14.4.5 CASE

- 1) Diverges according to value of expression following CASE. Expression should be integer. When value of expression is not included in case list, a statement after ELSE executes. If there is no ELSE, no statement list executes.
- 2) Expression

**CASE** *expression* **OF**

*case\_list* : *statement\_list*

{ *case\_list* : *statement\_list* }

**[ELSE**

*statement\_list*]

**END\_CASE**

Item	Description
<b>expression</b>	Only INT type is available.
<b>case_list</b>	<i>case_list_element</i> { ',' <i>case_list_element</i> }
	There are diverse statement like above.
<b>case_list_element</b>	<i>Subrange</i> or <i>signed_integer</i> are available
<b>subrange</b>	<i>signed_integer</i> .. <i>signed_integer</i> type

Item	Description
<b><i>statement_list</i></b>	Executes more than one statements

Example	Description
<b>CASE</b> Val1 <b>OF</b> 1     : Result := 10 ; 2..5  : Result := 20 ; 7, 10 : Result := 30 ; <b>ELSE</b> Result := 40 ; <b>END_CASE ;</b>	If value of Val1 is 1, 10 is assigned into result. If value of Val1 is 2~5, 20 is assigned into result. If value of Val1 is 7 or 10, 30 is assigned into result. In case of other values, 40 is assigned into result.

#### 14.4.6 FOR

- 1) It is used to deal with repetition and uses three control statements. First, statement for initialization is necessary. If To expression is TRUE (present counter value is less than end value), loop executes one time. Then counter values increases as many as BY value and condition is checked again. In FOR statement, condition is checked first and loop executes later. So no loop may be executed.

2) Expression

```

FOR counter := start TO end [BY step] DO
    statements
END_FOR
  
```

Item	Description
<b><i>counter</i></b>	Integer (SINT, INT, DINT) s start, end, step should be the same type.
<b><i>start</i></b>	Initial value of <i>counter</i>
<b><i>end</i></b>	Last value of <i>counter</i>
<b><i>step</i></b>	Indicates increment of <i>count</i> variable whenever loop executes. If this is not used, increment is 1.
<b><i>statements</i></b>	It executes according to three control texts.

Example	Description
SUM := 0; <b>FOR</b> counter := 0 <b>TO</b> 10 <b>DO</b> SUM := SUM + 1; <b>END_FOR ;</b>	Counter variable increases from 0 to 10 as many as 1. 1 is added into SUM variable repeatedly. Final value of SUM is 11.



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```
SUM := 0;  
FOR counter = 0 TO 10 BY 2 DO  
    SUM := SUM + 1;  
END_FOR ;
```

*Counter* variable increases from 0 to 10 as many as 2. 1 is added into SUM variable repeatedly. Final value of SUM is 6.

### Note

- 1) Because of long scan time, watch - dog may be on.
- 2) BY part can be skipped. In case of skip, it increases as many as 1.
- 3) If *start* is larger than *end*, FOR text is not executed.

### 14.4.7 WHILE

1) It executes repeatedly until condition is 0. In WHILE statement, condition is checked first and loop is executed later. So no loop executes.

2) Expression

```
WHILE condition DO  
    statements  
END_WHILE
```

Item	Description
<b><i>condition</i></b>	If <i>condition</i> is TRUE, statements after DO executes. In case of FALSE, it goes out from loop.
<b><i>statements</i></b>	If <i>condition</i> is TRUE, statements more than one executes.

Example	Description
Counter := 0 <b>WHILE</b> Counter < 20 <b>DO</b> Counter := Counter + 1; <b>END_WHILE</b> ;	If condition that counter is less than 20 is TRUE, a statement executes. If condition is FALSE, it goes out from loop.

### Note

In WHILE statement, in case, condition does not become 0, it cannot go out from loop. In this case, due to long scan time, watch-dog is on. So be careful so that condition is not always TRUE.

### 14.4.8 REPEAT

1) Statement executes repeatedly until condition is TRUE. In REPEAT statement, loop executes first and condition is checked later. So loop executes at least one time.

2) Expression

**REPEAT***statements***UNTIL** *condition***END\_REPEAT**

Item	Description
<b><i>condition</i></b>	If <i>condition</i> is FALSE, it executes repeatedly and if <i>TRUE</i> , goes out from loop.
<b><i>statements</i></b>	Loop executes repeatedly until condition is TRUE.

Example	Description
Counter := 0; <b>REPEAT DO</b> Counter := Counter + 1; <b>UNTIL</b> Counter > 20 <b>END_REPEAT ;</b>	First, Counter variable is set to 1. If the condition that Counter variable is larger than 2 is met, it goes out from loop or it executes loop. If Counter variable is 21, condition is TRUE and it goes out from loop.

**Note**

In REPEAT statement, in case condition doesn't become 1, it cannot go out from loop. In this case, due to long scan time, watch-dog is on. So be careful so that condition is not always FALSE.

### 14.4.9 EXIT

- 1) It is used to go out from iteration statements (WHILE, FOR, REPEAT).
- 2) If it is used outside iteration statements, error occurs.
- 3) Expression

#### EXIT

Example	Description
<pre>SUM := 0; <b>FOR</b> Counter := 0 TO 10 <b>DO</b>     SUM := SUM + 1;     <b>EXIT</b>; <b>END_FOR</b> ;</pre>	Counter variable increases from 0 to 10 as many as 1. But because of EXIT, loop ends. Counter variable becomes 0 and SUM becomes 1.
<pre>Counter := 0; <b>WHILE</b> Counter &lt; 20 <b>DO</b>     Counter := Counter + 1 ;     <b>IF</b> Counter = 10 <b>THEN</b>         <b>EXIT</b>;     <b>END_IF</b>; <b>END_WHILE</b> ;</pre>	Text executes repeatedly when Counter is less than 20 and if Counter is larger than 20, loop ends. But because of IF statement and EXIT statement, loop ends when Counter is 10.
<pre>Counter := 0; <b>REPEAT DO</b>     Counter := Counter + 1 ;     <b>IF</b> Counter = 10 <b>THEN</b>         <b>EXIT</b>;     <b>END_IF</b>; <b>UNTIL</b> Counter &gt; 20 <b>END_REPEAT</b> ;</pre>	Counter variable increase as many as 1. If Counter is larger than 20, loop ends otherwise loop executes repeatedly. But because of IF statement and EXIT statement, loop ends when Counter is 10.

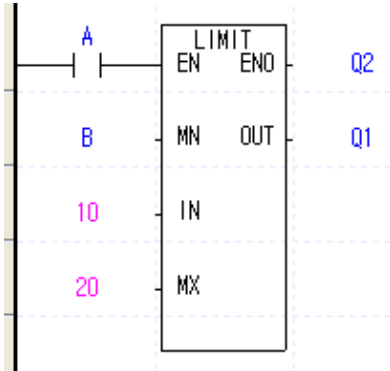
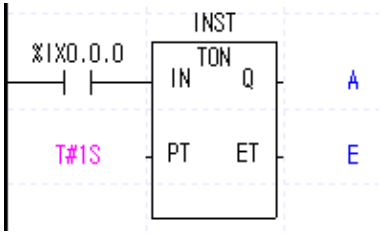
## 14.5 Function and Function Block

### 14.5.1 How to use

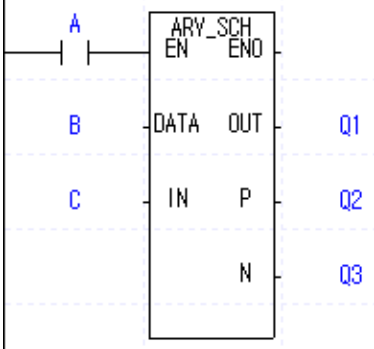
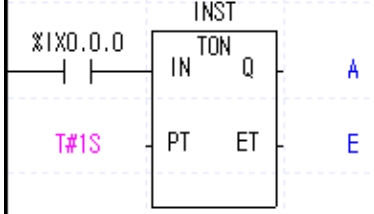
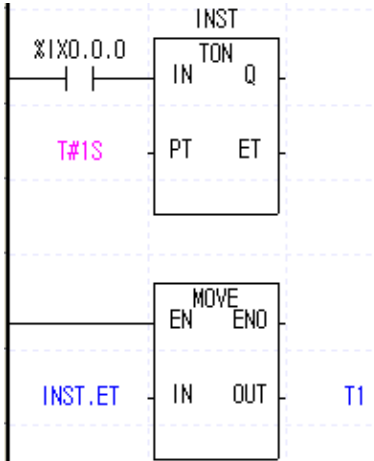
- 1) There are two types (Standard type, nonstandard type) for use of function and function block. Both are available according to environment.

- (1) Standard type:

It writes the input, output parameter name of function and function block

Parameter	Function	Function Block
Common	<p>Order of parameter does not matter.</p> <p>Q1 := LIMIT(MN := B, MX := 20, IN := 10) ;</p> <p>Q1 := LIMIT(MX := 20, MN := B, IN := 10) ;</p> <p>EN, ENO can be omitted.</p> <p>Q1 := LIMIT(<b>EN</b> := A, MN := B, MX := 20, IN := 10, ENO =&gt; Q2) ;</p> 	<p>Order of parameter does not matter.</p> <p>INST(IN := %IX0.0.0, PT := T#1s, Q =&gt; A, ET =&gt; E) ;</p> <p>INST(PT := T#1s, IN := %IX0.0.0, Q =&gt; A, ET =&gt; E) ;</p> 
Input	<p>Use “:=” for input parameter allocation.</p> <p>C := LIMIT(<b>MN := B, MX := 20</b>, IN := 10) ;</p>	<p>Use “:=” for input parameter allocation..</p> <p>INST(<b>IN := %IX0.0.0, PT := T#1s</b>, Q =&gt; A, ET =&gt; B) ;</p>
Output	<p>If output parameter name is OUT or Y (For user defined function, function name), allocate as the return value.</p> <p>For other output parameters, use “=&gt;” .</p> <p><b>Q1</b> := ARY_SCH(DATA := B, IN := C, <b>P =&gt; Q2, N =&gt; Q3</b>) ;</p>	<p>Use “=&gt;” for out parameter allocation</p> <p>Output parameter allocation can be omitted.</p> <p>INST(IN := %IXfunction 0.0.0, PT := T#1s, <b>Q =&gt; A, ET =&gt; E</b>) ;</p>

## Ch 14. ST (Structured Text)

Parameter	Function	Function Block
	 <p>Not used output parameter can be omitted as follows. (Q2, Q3 have been omitted)  <code>Q1 := ARV_SCH(DATA := B, IN := C);</code></p>	 <pre> INST(IN := %IX0.0.0, PT := T#1s); T1 := INST.ET; </pre> 

### Note

To use the function block, write instance name of function block. Declare the function block as how to declare the variable and write this variable name (instance name)

Ex.) Use of timer

	Variable Kind	Variable	Type
1	VAR	INST_TON1	TON

```
INST_TON1(IN := TRUE, PT := T#100MS, Q => Q_OUT, ET => ET_OUT);
```

## (2) Nonstandard type

In this type, I/O parameter name of function and function block is omitted

Parameter	Function	Function Block
Common	<p>You cannot change the order of all parameters.</p> <p>You cannot omit any parameter</p> <p>Q1 := LIMIT(B, 20, 10);</p> <p>You cannot use EN, ENO</p>	<p>You cannot change the order of all parameters.</p> <p>You cannot omit any parameter</p> <p>INST(%IX0.0.0, T#1s, A, E);</p>
Input	<p>You cannot change the order of input parameter.</p> <p>C := LIMIT(B, 20, IN := 10);</p>	<p>You cannot change the order of input parameter.</p> <p>INST(%IX0.0.0, T#1s, A, E);</p>
Output	<p>If output parameter name is OUT or Y (For user defined function, function name), allocate as the return value.</p> <p>For other output parameters, input in order of position</p> <p>Q1 := ARY_SCH(B, C, Q2, Q3);</p>	<p>For all output parameters, input in order of position</p> <p>INST(%IX0.0.0, T#1s, A, E);</p>

## Ch 14. ST (Structured Text)

### Note

For function whose parameter type is variable, input parameter type should be determined.

Example	Description
INT1 := ADD(1, 2, 3);	Error occurs while determining function type

For normal operation, choose one among below three examples

Example	Description
INT1 := ADD( <b>INT#1</b> , 2, 3);	Sets the type of constant
INT1 := ADD( <b>B</b> , 2, 3);	Uses variable (B)
INT1 := <b>ADD_INT</b> (1, 2, 3);	Uses the type-defined function

### Note

- Input parameter EN is condition to execute the function. If you use the EN as follows, LIMIT function executes when A is 1.

OUT := LIMIT(EN := A, MX := 20, MN := B, IN := 10) ;

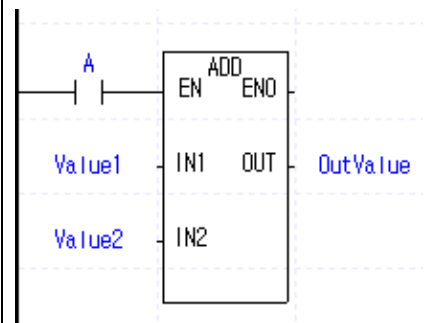
ENO parameter becomes 1 when function executes without error. It cannot be used in ST and available in LD

### Note

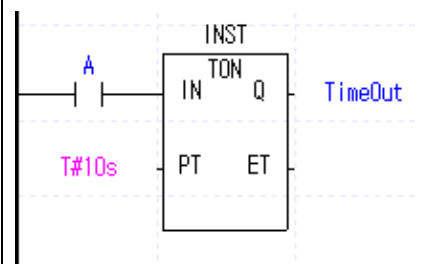
1. ST does not support the extension functions(BREAK, CALL, END, FOR, INIT\_DONE, JMP, NEXT, RET, SBRT)
2. You cannot use the function whose name is same as operator name. (OR, XOR, AND, MOD, NOT)

14.5.2 Example

1) Function

Use of LD	Use of ST
	<p>1) Standard type</p> <p>EN used</p> <pre>OutValue := ADD(EN := A, IN1 := Value1, IN2 := Value2);</pre> <p>EN not used</p> <pre>OutValue := ADD(IN1 := Value1, IN2 := Value2);</pre> <p>2) Nonstandard type</p> <pre>OutValue := ADD(Value1, Value2);</pre> <p>EN, ENO cannot be used</p>

2) Function Block

Use of LD	Use of ST
	<p>1) Standard type</p> <pre>INST(IN := A, PT := T#10S, Q =&gt; TimeOut);</pre> <p>2) Nonstandard type</p> <pre>INST(A, T#10S, TimeOut, TimeValue);</pre> <p>Output variable cannot be omitted. So you have to allocate the applicable variable to output parameter ET. (TimeValue)</p>



3) Application

Use of LD	Use of ST
<p>The diagram shows a ladder logic network with two rungs. The first rung contains a normally open contact labeled <code>_T1S</code> in blue, followed by a coil for the <code>INST1</code> counter. The <code>INST1</code> block has inputs <code>CD</code> (Control Disable), <code>PV</code> (Set Point) with a value of <code>10</code> in pink, and <code>RST</code> (Reset). It has outputs <code>Q</code> (labeled <code>Complete</code> in blue) and <code>CV</code> (labeled <code>CURRENT VALUE</code> in blue). The second rung contains a normally open contact labeled <code>Complete</code> in blue, followed by a coil for the <code>%QX0.1.0</code> output. Below this, there is a <code>LT</code> (Limit Switch) block with inputs <code>EN</code> (Enable) and <code>IN2</code> with a value of <code>5</code> in pink. It has outputs <code>ENO</code> (Enable Output) and <code>OUT</code> (labeled <code>NOTENOUGH</code> in blue). The <code>IN1</code> input of the <code>LT</code> block is connected to the <code>CURRENT VALUE</code> output of the <code>INST1</code> block.</p>	<pre>INST1(CD := _T1S, PV := 10, RST := RESET, Q =&gt; COMPLETE, CV =&gt; CURRENTVALUE);  %XQ0.1.0 := Complete;  NOTENOUGH := LT(IN1 := CURRENTVALUE, IN2 := 5);</pre>

## Appendix 1 Numerical System and Data Structure

### A1.1 Numerical (data) Representation

PLC CPU remembers and processes every data as the states of on and off or '1' and '0'. Therefore, any numerical operation is processed by binary system (1 or 0). On the other hand, we conveniently use the decimal system, so decimal or hexadecimal number systems must be converted to hexadecimal or decimal number systems, respectively in order to write or read numerical data to/from PLC. This chapter describes the representation of decimal, binary, hexadecimal and binary-coded decimal notation and the relations.

#### 1) Decimal

Decimal number system means the "number expressing an order or size (volume) using 0~9. And, followed by 0, 1, 2, 3, 4...9, it is carried to '10' and keeps counting. For instance, a decimal number, 153 can be expressed as follows in the view of line and "weight of line."

$$\begin{aligned}
 153 &= 100 + 50 + 3 \\
 &= 1 \cdot 100 + 5 \cdot 10 + 3 \cdot 1 \\
 &= \overbrace{1 \cdot 10^2} + \overbrace{5 \cdot 10^1} + \overbrace{3 \cdot 10^0}
 \end{aligned}$$

Decimal number system symbols (0~9)

Weight of line

#### 2) Binary

Binary numeral presents a numeral meaning an order and size by using two symbols, 0 and 1. Therefore, it is carried to '10' followed by 0 and 1 and keeps counting. That is, a cipher of 0, 1 is called bit.

## Appendix 1 Numerical System and Data Structure

Binary	Decimal
0	0
1	1
10	2
11	3
100	4
101	5
110	6
111	7
1000	8
.....	.....

For instance, let us think that the given binary numeral can be expressed in decimal number system.

“10011101”

As considering line number and the weight of line in decimal number system, try to attach bit number and bit weight from the very right.

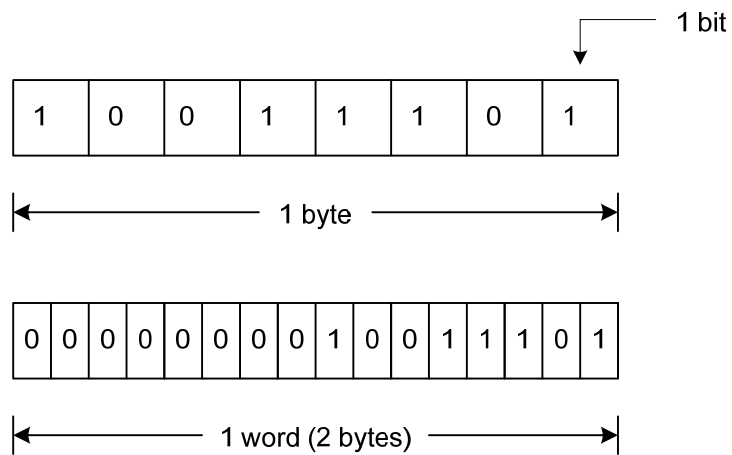
7	6	5	4	3	2	1	0	← Bit number binary numeral
1	0	0	1	1	1	0	1	
$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$	
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	
128	64	32	16	8	4	2	1	weight of bit

How about summing the multiplication of weights of each bit code like decimal number system?

$$\begin{aligned} &= 1 \times 128 + 0 \times 64 + 0 \times 32 + 1 \times 16 + 1 \times 8 + 1 \times 4 + 0 \times 2 + 1 \times 1 \\ &= 128 + 16 + 8 + 4 + 1 \\ &= 157 \end{aligned}$$

That is, as the above, a binary numeral is converted to a decimal numeral by adding the weights of bits of which code is 1.

In general, 1 byte consists of 8 bits while 1 word consists of 16 bits (2 bytes).



### 3) Hexadecimal

Like decimal or binary numeral, hexadecimal numeral means the 'number representing an order and size by using 0~9 and A~F.'

Then, followed by 0, 1, 2, ...D, E, F, it is carried to '10' and keeps counting.

Decimal	Hexadecimal	Binary
0	0	0
1	1	1
2	2	10
3	3	11
4	4	100
5	5	101
6	6	110
7	7	111
8	8	1000
9	9	1001
10	A	1010
11	B	1011
12	C	1100
13	D	1101
14	E	1110
15	F	1111
16	10	10000
17	11	10001
18	12	10010

$$1\ 9\ 1\ 0\ 1 = \overset{4}{\text{4}}\ \overset{\text{A}}{\text{A}}\ \overset{9}{\text{9}}\ \overset{\text{D}}{\text{D}} = \overset{0100}{0100}\ \overset{1010}{1010}\ \overset{1001}{1001}\ \overset{1101}{1101}$$

3	2	1	0	
4	A	9	D	← Number of line hexadecimal numeral

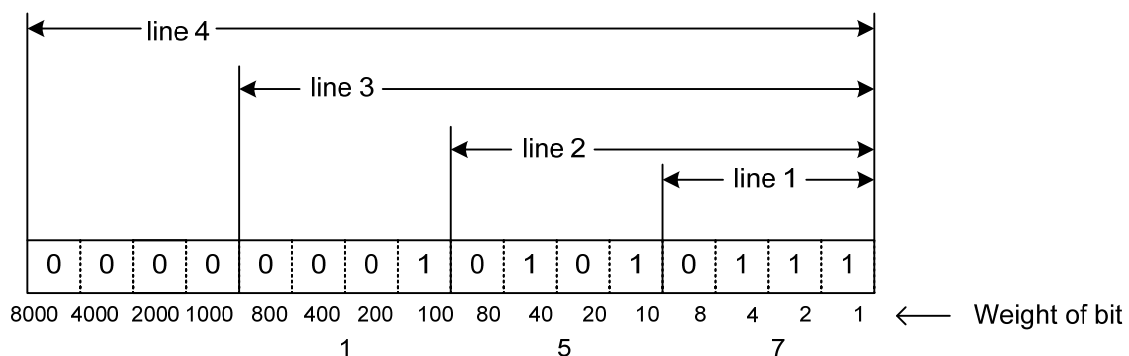
$$\begin{aligned}
 &= (4) \times 16^3 + (A) \times 16^2 + (9) \times 16^1 + (D) \times 16^0 \\
 &= 4 \times 4096 + 10 \times 256 + 9 \times 16 + 13 \times 1 \\
 &= 19101
 \end{aligned}$$

A digit of hexadecimal number corresponds to 4 bits of binary numeral.

#### 4) Binary Coded Decimal (BCD)

Binary coded decimal means the “number expressing each line of a decimal numeral in binary number system.” Therefore, binary coded decimal represents 0 ~ 9,999(max of 4 lines) of decimal numeral in 16 bits.

For instance, a decimal numeral, 157 can be expressed as follows and the weight of each bit can be also expressed as follows.



## Appendix 1 Numerical System and Data Structure

### 5) Table of Numeral Systems

Binary coded Decimal (BCD)		Binary (BIN)		Decimal	Hexadecimal (H)
00000000	00000000	00000000	00000000	0	0000
00000000	00000001	00000000	00000001	1	0001
00000000	00000010	00000000	00000010	2	0002
00000000	00000011	00000000	00000011	3	0003
00000000	00000100	00000000	00000100	4	0004
00000000	00000101	00000000	00000101	5	0005
00000000	00000100	00000000	00000100	6	0006
00000000	00000111	00000000	00000111	7	0007
00000000	00001000	00000000	00001000	8	0008
00000000	00001001	00000000	00001001	9	0009
00000000	00010000	00000000	00001010	10	000A
00000000	00010001	00000000	00001011	11	000B
00000000	00010010	00000000	00001100	12	000C
00000000	00010011	00000000	00001101	13	000D
00000000	00010100	00000000	00001110	14	000E
00000000	00010101	00000000	00001111	15	000F
00000000	00000110	00000000	00010000	16	0010
00000000	00000111	00000000	00010001	17	0011
00000000	00001000	00000000	00010010	18	0012
00000000	00001001	00000000	00010011	19	0013
00000000	00100000	00000000	00010100	20	0014
00000000	00100001	00000000	00010101	21	0015
00000000	00100010	00000000	00010110	22	0016
00000000	00100011	00000000	00010111	23	0017
00000001	00000000	00000000	01100100	100	0064
00000001	00100111	00000000	01111111	127	007F
00000010	01010101	00000000	11111111	255	00FF
00010000	00000000	00000000	11100000	1,000	03E8
00100000	01000111	00000000	11111111	2,047	07FF
01000000	10010101	00000000	11111111	4,095	0FFF
10011001	10011001	00000111	00001111	9,999	270F
		00100111	00010000	10,000	2710
		01111111	11111111	32,767	7FFF

### A1.2 Integer Representation

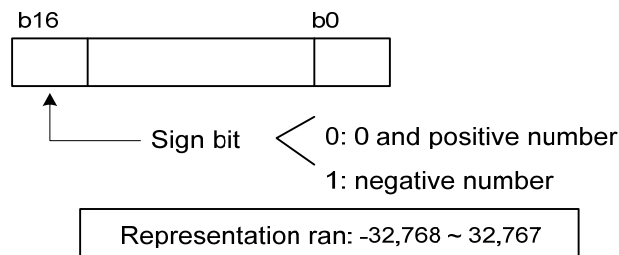
XGI command is based on negative number system operation (Signed)

If the top level bit (MSB) is 0, it represents 'positive number' while if it is 1, it is expressed as 'negative number'.

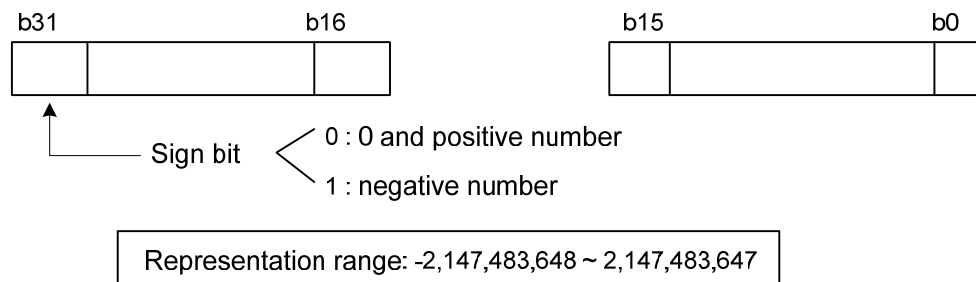
The top level bit expressing negative/positive is called 'sign bit.'

Because of different position of MSB in 16 or 32 bits, be cautious of sign bit position.

★ If 16 bits



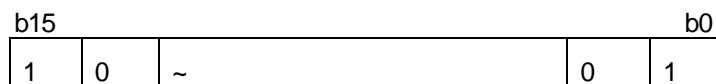
★ If 32 bits



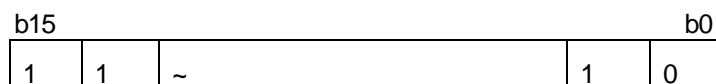
### A1.3 Negative Number Representation

Ex) How to express -0001

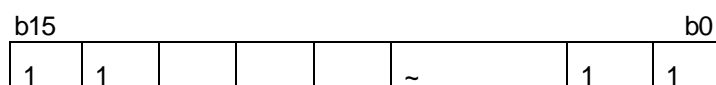
(1) Represent 0001 in case of negative number (b15 = 1).



(2) Reverse the result of (1) (b15 = excluded).



(3) Plus 1 to the result of (2).



-0001 = 16#FFFF

## Appendix 2 Flag List (XGI)

### A2.1 Modes and Status

Reserved Variable	Data Type	Description
_SYS_STATE	BOOL	PLC mode and operation status
_RUN	BOOL	RUN status
_STOP	BOOL	STOP status
_ERROR	BOOL	ERROR status
_DEBUG	BOOL	DEBUG status
_LOCAL_CON	BOOL	Local control mode
_REMOTE_CON	BOOL	Remote control mode
_RUN_EDIT_ST	BOOL	Downloading edit program during run
_RUN_EDIT_CHK	BOOL	Processing edit program during run
_RUN_EDIT_DONE	BOOL	Complete edit program during run
_RUN_EDIT_NG	BOOL	Abnormally complete edit program during run
_CMOD_KEY	BOOL	Run mode changed by key
_CMOD_LPADT	BOOL	Run mode changed by local PADT
_CMOD_RPADT	BOOL	Run mode changed by remote PADT
_CMOD_RLINK	BOOL	Run mode changed by remote COM module
_FORCE_IN	BOOL	Forced input status
_FORCE_OUT	BOOL	Forced output status
_SKIP_ON	BOOL	I/O skip
_EMASK_ON	BOOL	Error mask on
_MON_ON	BOOL	Monitor on
_USTOP_ON	BOOL	Stop by STOP function
_ESTOP_ON	BOOL	Stop by ESTOP function
_INIT_RUN	BOOL	Initialization task is running
_PB1	BOOL	Select program code 1
_PB2	BOOL	Select program code 2
_USER_WRITE_F	WORD	Contact available by program
_RTC_WR	BOOL	Write/read data in RTC
_SCAN_WR	BOOL	Initialize scan value
_CHK_ANC_ERR	BOOL	Error detection from external device
_CHK_ANC_WAR	BOOL	Warning detection from external device



## Appendix 2 Flag List (XGI)

Reserved Variable	Data Type	Description
_INIT_DONE	BOOL	Initialization task complete
_KEY	DWORD	Current status of local key

### A2.2 System Error

Reserved Variable	Data Type	Description
_CNF_ER	WORD	System warning
_AB_SD_ER	BOOL	Stop by abnormal operation
_IO_TYER	BOOL	Module type inconsistency error
_IO_DEER	BOOL	Module installation error
_IO_TYER_N	WORD	Slot number of module type inconsistency error
_IO_DEER_N	WORD	Slot number of module installation error
_FUSE_ER	BOOL	Fuse disconnection
_FUSE_ER_N	WORD	Slot number of fuse blown
_FUSE_ERR	ARRAY [0..7] OF WORD	Detail information of fuse blown (base and slot number)
_ANNUM_ER	BOOL	Heavy trouble detection error of external device
_BPRM_ER	BOOL	Basic parameter error
_IOPRM_ER	BOOL	IO configuration parameter error
_SPPRM_ER	BOOL	Special module parameter error
_CPPRM_ER	BOOL	Communication module parameter error
_PGM_ER	BOOL	Program error
_CODE_ER	BOOL	Program code error
_SWDT_ER	BOOL	System watch-dog on
_BASE_POWER_ER	BOOL	Base power error
_WDT_ER	BOOL	Scan watch-dog timer on
_IO_TYERR	ARRAY [0..7] OF WORD	Main base and extension base module type error
_IO_DEERR	ARRAY [0..7] OF WORD	Main base and extension base module installation error

## A2.3 System Warning

Reserved Variable	Data Type	Description
_CNF_WAR	DWORD	System error status
_RTC_ER	BOOL	RTC data error
_TASK_ER	BOOL	Task conflict
_BAT_ER	BOOL	Battery error
_ANNUM_WAR	BOOL	External device warning detected
_BASE_INFO_ER	BOOL	Base information error
_HS_WAR1	BOOL	Over high-speed link parameter 1
_HS_WAR2	BOOL	Over high-speed link parameter 2
_HS_WAR3	BOOL	Over high-speed link parameter 3
_HS_WAR4	BOOL	Over high-speed link parameter 4
_HS_WAR5	BOOL	Over high-speed link parameter 5
_HS_WAR6	BOOL	Over high-speed link parameter 6
_HS_WAR7	BOOL	Over high-speed link parameter 7
_HS_WAR8	BOOL	Over high-speed link parameter 8
_HS_WAR9	BOOL	Over high-speed link parameter 9
_HS_WAR10	BOOL	Over high-speed link parameter 10
_HS_WAR11	BOOL	Over high-speed link parameter 11
_HS_WAR12	BOOL	Over high-speed link parameter 12
_P2P_WAR1	BOOL	Over P2P – parameter 1
_P2P_WAR2	BOOL	Over P2P – parameter 2
_P2P_WAR3	BOOL	Over P2P – parameter 3
_P2P_WAR4	BOOL	Over P2P – parameter 4
_P2P_WAR5	BOOL	Over P2P – parameter 5
_P2P_WAR6	BOOL	Over P2P – parameter 6
_P2P_WAR7	BOOL	Over P2P – parameter 7
_P2P_WAR8	BOOL	Over P2P – parameter 8
_CONSTANT_ER	BOOL	Fixed cycle error
_ANC_ERR	WORD	Error info of external device
_ANC_WAR	WORD	Warning info of external device

### A2.4 User Flag

Reserved Variable	Data Type	Description
_T20MS	BOOL	20ms cycle clock
_T100MS	BOOL	100ms cycle clock
_T200MS	BOOL	200ms cycle clock
_T1S	BOOL	1s cycle clock
_T2S	BOOL	2s cycle clock
_T10S	BOOL	10s cycle clock
_T20S	BOOL	20s cycle clock
_T60S	BOOL	60s cycle clock
_ON	BOOL	All time on bit
_OFF	BOOL	All time off bit
_1ON	BOOL	The only first scan on bit
_1OFF	BOOL	The only first scan off bit
_STOG	BOOL	Reversal at every scanning

### A2.5 Operation Result Flag

Reserved Variable	Data Type	Description
_ERR	BOOL	Operation error flag
_LER	BOOL	On for 1 scan if any operation error
_ARY_IDX_ERR	BOOL	Out of arrangement index error flag
_ARY_IDX_LER	BOOL	Out of arrangement index latch error flag
_ALL_OFF	BOOL	On if every output is off
_PUTGET_ERR	WORD	PUT/GET error
_PUTGET_NDR	WORD	PUT/GET complete

## A2.6 System Run Status Information

Reserved Variable	Data Type	Description
_CPU_TYPE	WORD	CPU type information
_CPU_VER	WORD	CPU version
_OS_VER	DWORD	OS version
_OS_DATE	DWORD	OS distribution date
_SCAN_MAX	WORD	Max. scan time after run in 0.1ms
_SCAN_MIN	WORD	Min. scan time after run in 0.1ms
_SCAN_CUR	WORD	Present scan time in 0.1ms
_RTC_TIME	ARRAY [0..7] OF BYTE	Present time data of PLC
_RTC_TIME[0]	BYTE	Year data of present time
_RTC_TIME[1]	BYTE	Month data of present time
_RTC_TIME[2]	BYTE	Day data of present time
_RTC_TIME[3]	BYTE	Hour data of present time
_RTC_TIME[4]	BYTE	Minute data of present time
_RTC_TIME[5]	BYTE	Second data of present time
_RTC_TIME[6]	BYTE	Day of the week data of present time
_RTC_TIME[7]	BYTE	Year of hundred data of present time
_RTC_TIME_USER	ARRAY [0..7] OF BYTE	Time data to set
_RTC_TIME_USER[0]	BYTE	Year data of time to set
_RTC_TIME_USER[1]	BYTE	Month data of time to set
_RTC_TIME_USER[2]	BYTE	Day data of time to set
_RTC_TIME_USER[3]	BYTE	Hour data of time to set
_RTC_TIME_USER[4]	BYTE	Minute data of time to set
_RTC_TIME_USER[5]	BYTE	Second data of time to set
_RTC_TIME_USER[6]	BYTE	Day of the week data of time to set
_RTC_TIME_USER[7]	BYTE	Year of hundred data of time to set
_RTC_DATE	WORD	Present data of RTC
_RTC_WEEK	WORD	Present a day of the week of RTC
_RTC_TOD	DWORD	Present time of RTC (ms unit)
_BASE_INFO	ARRAY [0..7] OF WORD	Slot information of main and extension base

## Appendix 2 Flag List (XGI)

Reserved Variable	Data Type	Description
_RBANK_NUM	WORD	Block number currently used
_AC_F_CNT	WORD	Instantaneous AC failure frequency
_FALS_NUM	WORD	FALS number

**A2.7 High-speed Link Flag (\* = 0 ~ 12, \*\*\* = 000 ~ 127)**

Reserved Variable	Data Type	Description
_HS*_RLINK	BOOL	Every station of high speed link no.* normally works
_HS*_LTRBL	BOOL	Abnormal status after _HS*_RLINK on
_HS*_STATE***	BOOL	General status of *** block of high speed link no.*
_HS*_MOD***	BOOL	Run operation mode of *** block of high speed link no.*
_HS*_TRX***	BOOL	Normal communication with *** block station of high speed link no.*
_HS*_ERR***	BOOL	Run error mode of *** block station of high speed link no.*
_HS*_SETBLOCK***	BOOL	*** block setting of high speed link no.*

**A2.8 P2P Flag (\* = 0 ~ 8, \*\* = 0 ~ 63)**

Reserved Variable	Data Type	Description
_P2P*_NDR**	BOOL	** block service of P2P no.* completed successfully
_P2P*_ERR**	BOOL	** block service of P2P no.* completed abnormally
_P2P*_STATUS**	WORD	Error code in case of ** block service of P2P no.*
_P2P*_SVCCNT**	DWORD	** block normal service frequency of P2P no.*
_P2P*_ERRCNT**	DWORD	** block abnormal service frequency of P2P no.*

**A2.9 PID Flag (\* = 0 ~ 7, \*\* = 0 ~ 31)**

Reserved Variable	Data Type	Description
_PID*_MAN	DWORD	PID output selection(0:auto ,1:manual) – block*
_PID*_**MAN	BOOL	PID output selection(0:auto ,1:manual) - block* loop**
_PID*_PAUSE	DWORD	PID pause (0:STOP/RUN ,1:PAUSE) – block*
_PID*_**PAUSE	BOOL	PID pause (0:STOP/RUN ,1:PAUSE) – block* loop**
_PID*_REV	DWORD	PID operation selection(0:forward ,1:reverse) – block*
_PID*_**REV	BOOL	PID operation selection(0:forward ,1:reverse) – block* loop**
_PID*_AW2D	DWORD	PID Anti Wind-up2 prohibited(0:enable ,1:disable) – block*
_PID*_**AW2D	BOOL	PID Anti Wind-up2 prohibited(0:enable ,1:disable) – block* loop**
_PID*_REM_RUN	DWORD	PID remote(HMI) execution bit (0:STOP ,1:RUN) – block*
_PID*_**REM_RUN	DWORD	PID remote(HMI) execution bit (0:STOP ,1:RUN) – block* loop**
_PID*_P_on_PV	DWORD	PID proportional(P) cal source selection (0:ERR, 1:PV) – block*
_PID*_**P_on_PV	BOOL	PID proportional(P) cal source selection (0:ERR, 1:PV) - block* loop**
_PID*_D_on_ERR	DWORD	PID differential(D) cal source selection (0:PV, 1:ERR) – block*

## Appendix 2 Flag List (XGI)

Reserved Variable	Data Type	Description
_PID*_**D_on_ERR	BOOL	PID differential(D) cal source selection (0:PV, 1:ERR) - block* loop**
_PID*_AT_EN	DWORD	PID auto tuning setting (0:Disable, 1:Enable) – block*
_PID*_**AT_EN	BOOL	PID auto tuning setting (0:Disable, 1:Enable) – block* loop**
_PID*_MV_BMPL	DWORD	PID mode change(A/M) - MV no impact change setting (0:Disable, 1:Enable) – block*
_PID*_**MV_BMPL	BOOL	PID mode change(A/M) - MV smoothing setting (0:Disable, 1:Enable) – block* loop**
_PID*_**SV	INT	PID target value (SV) – block* loop**
_PID*_**T_s	WORD	PID operation cycle (T_s)[0.1ms] – block* loop**
_PID*_**K_p	REAL	PID P - constant (K_p) – block* loop**
_PID*_**T_i	REAL	PID I - constant (T_i)[sec] – block* loop**
_PID*_**T_d	REAL	PID D - constant (T_d)[sec] – block* loop**
_PID*_**d_PV_max	WORD	PID PV variation limit – block* loop**
_PID*_**d_MV_max	WORD	PID MV variation limit – block* loop**
_PID*_**MV_max	INT	PID MV max. value limit – block* loop**
_PID*_**MV_min	INT	PID MV min. value limit – block* loop**
_PID*_**MV_man	INT	PID manual output (MV_man) – block* loop**
_PID*_**STATE	WORD	PID State – block* loop**
_PID*_**ALARM0	BOOL	PID Alarm 0 (1:T_s setting is low) – block* loop**
_PID*_**ALARM1	BOOL	PID Alarm 1 (1:K_p is 0) – block* loop**
_PID*_**ALARM2	BOOL	PID Alarm 2 (1:PV variation is limited) – block* loop**
_PID*_**ALARM3	BOOL	PID Alarm 3 (1:MV variation is limited) – block* loop**
_PID*_**ALARM4	BOOL	PID Alarm 4 (1:MV max. value is limited) – block* loop**
_PID*_**ALARM5	BOOL	PID Alarm 5 (1:MV min. value is limited) – block* loop**
_PID*_**ALARM6	BOOL	PID Alarm 6 (1:AT abnormal cancellation ) – block* loop**
_PID*_**ALARM7	BOOL	PID Alarm 7 – block* loop**
_PID*_**STATE0	BOOL	PID State 0 (0:PID_STOP, 1:PID_RUN) – block* loop**
_PID*_**STATE1	BOOL	PID State 1 (0:AT_STOP, 1:AT_RUN) – block* loop**
_PID*_**STATE2	BOOL	PID State 2 (0:AT_UNDONE, 1:DONE) – block* loop**
_PID*_**STATE3	BOOL	PID State 3 (0:REM_STOP, 1:REM_RUN) – block* loop**
_PID*_**STATE4	BOOL	PID State 4 (0:AUTO_OUT, 1:MAN_OUT) – block* loop**
_PID*_**STATE5	BOOL	PID State 5 (0:CAS_STOP, 1:CAS_RUN) – block* loop**
_PID*_**STATE6	BOOL	PID State 6 (0:SLV/SINGLE, 1:CAS_MST) – block* loop**
_PID*_**STATE7	BOOL	PID State 7 (0:AW_STOP, 1:AW_ACT) – block* loop**

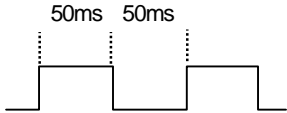
Reserved Variable	Data Type	Description
_PID* **PV	INT	PID present value (PV) – block* loop**
_PID* **PV_old	INT	PID previous value (PV_old) – block* loop**
_PID* **MV	INT	PID output value (MV) – block* loop**
_PID* **MV_BMPL_val	INT	PID no impact operation memory (user setting prohibited) – block* loop**
_PID* **ERR	DINT	PID control error value – block* loop**
_PID* **MV_p	REAL	PID output P element – block* loop**
_PID* **MV_i	REAL	PID output I element – block* loop**
_PID* **MV_d	REAL	PID output D element – block* loop**
_PID* **DB_W	WORD	PID deadband setting (operation after stabilization) – block* loop**
_PID* **Td_lag	WORD	PID differential function LAG filter – block* loop**
_PID* **AT_HYS_val	WORD	PID auto tuning hysteresis setting – block* loop**
_PID* **AT_SV	INT	PID auto tuning SV setting – block* loop**
_PID* **AT_step	WORD	PID auto tuning status (user setting prohibited) – block* loop**
_PID* **INT_MEM	WORD	PID internal memory (user setting prohibited) – block* loop**



## Appendix 3 Flag list (XGR)

### Appendix 3.1 User Flag

#### 1. User flag

Address	Flag name	Type	Writable	Contents	Description
%FX6144	_T20MS	BOOL	-	20ms cycle clock	Clock signal used in user program reverses on/off per half cycle Use more enough long clock signal than PLC scan time. Clock signal starts from off condition when initialization program starts or scan program starts. _T100ms clock example 
%FX6145	_T100MS	BOOL	-	100ms cycle clock	
%FX6146	_T200MS	BOOL	-	200ms cycle clock	
%FX6147	_T1S	BOOL	-	1s cycle clock	
%FX6148	_T2S	BOOL	-	2s cycle clock	
%FX6149	_T10S	BOOL	-	10s cycle clock	
%FX6150	_T20S	BOOL	-	20s cycle clock	
%FX6151	_T60S	BOOL	-	60s cycle clock	Always on state flag, used when writing user program. Always off state flag, used when writing user program. Only first scan on after operation start Only first scan off after operation start On/Off reversed flag per every scan when user program is working. (on state for first scan) On in case all outputs are off
%FX6153	_ON	BOOL	-	Ordinary time On	
%FX6154	_OFF	BOOL	-	Ordinary time Off	
%FX6155	_1ON	BOOL	-	1'st scan On	
%FX6156	_1OFF	BOOL	-	1'st scan Off	
%FX6157	_STOG	BOOL	-	Reversal every scan (scan toggle)	
%FX6163	_ALL_OFF	BOOL	-	All output Off	
%FX30720	_RTC_WR	BOOL	Available	Writing data to RTC	Write data to RTC and read
%FX30721	_SCAN_WR	BOOL	Available	Initialize scan value	Initialize scan value
%FX30722	_CHK_ANC_ERR	BOOL	Available	Request for detecting heavy fault of external device	Flag that requests detecting heavy fault of external
%FX30723	_CHK_ANC_WAR	BOOL	Available	Request for detecting light fault of external device	Flag that requests detecting light fault (warning) of external
%FX30724	_MASTER_CHG	BOOL	Available	Master/Standby switching	Flag used when switching master/standby
%FW3860	_RTC_TIME_USER	ARRAY[0..7] OF BYTE	Available	Time to set	Flag for user to set time (year, month, hour, minute, second, day, century available)

## Appendix 3 Flag List (XGR)

### Appendix 3.2 System Error Representative Flag

Master CPU system error representative flag

Address	Flag name	Type	Bit position	Contents	Description
%FD65	_CNF_ER	DWORD	Representative flag	System error (heavy fault error)	Handles error flags about non-operation fault error as below.
%FX2081	_IO_TYER	BOOL	BIT 1	Error when Module type mismatched	Representative flag displays when I/O configuration parameter for each slot is not matched with practical module configuration or a specific module is applied in the wrong location. (Refer to “_IO_TYER_N, _IO_TYER[n]”)
%FX2082	_IO_DEER	BOOL	BIT 2	Module detachment error	Representative flag displays when the module configuration for each slot is changed while running. (Refer to “_IO_DEER_N, _IO_DEER[n]”)
%FX2083	_FUSE_ER	BOOL	BIT 3	Fuse cutoff error	Representative flag displays when the fuse of module is cut off. (Refer to “_FUSE_ER_N, _FUSE_ER[n]”)
%FX2086	_ANNUM_ER	BOOL	BIT 6	Heavy fault detection error in external device	Representative flag displays when heavy fault error detected by user program is recorded in “_ANC_ERR[n]”.
%FX2088	_BPRM_ER	BOOL	BIT 8	Basic parameter error	Basic parameter does not match CPU type.
%FX2089	_IOPRM_ER	BOOL	BIT 9	I/O parameter error	It is abnormal to the I/O configuration parameter.
%FX2090	_SPPRM_ER	BOOL	BIT 10	Special module parameter error	It is abnormal to the special module parameter.
%FX2091	_CPPRM_ER	BOOL	BIT 11	Communication module parameter error	It is abnormal to the communication module parameter.
%FX2092	_PGM_ER	BOOL	BIT 12	Program error	Indicates that there is problem with user-made program.
%FX2093	_CODE_ER	BOOL	BIT 13	Program code error	Indicates that while user program is running, the program code cannot be interpreted.
%FX2094	_SWDT_ER	BOOL	BIT 14	CPU abnormal ends.	Displays when the saved program gets damages by an abnormal end of CPU or program does not work.
%FX2095	_BASE_POWER_ER	BOOL	BIT 15	Abnormal base power	Base power off or power module error
%FX2096	_WDT_ER	BOOL	BIT 16	Scan watchdog error	Indicates that the program scan time exceeds the scan watchdog time specified by a parameter.
%FX2097	_BASE_INFO_ER	BOOL	BIT 17	Base information error	Base information is abnormal
%FX2102	_BASE_DEER	BOOL	BIT 22	Extension base detachment error	Extension base is detached
%FX2103	_DUPL_PRME_R	BOOL	BIT 23	Redundant parameter error	Abnormal Redundant parameter
%FX2104	_INSTALL_ER	BOOL	BIT 24	Module attachment position error	The module which cannot be inserted into main base is inserted in to main base or The module which cannot be inserted into extension base is inserted in to extension base

## Appendix 3 Flag List (XGR)

Address	Flag name	Type	Bit position	Contents	Description
%FX2105	_BASE_ID_ER	BOOL	BIT 25	Overlapped extension base number	extension base number is overlapped
%FX2106	_DUPL_SYNC_ER	BOOL	BIT 26	Redundant operation Sync. error	Synchronization between master and standby CPU is abnormal
%FX2107	_AB_SIDEKEY_ER	BOOL	BIT 27	A/B SIDE key overlap error	A,B side key of master, standby CPU are overlapped. They should be different.

### Standby CPU System error representative flag

Address	Flag name	Type	Bit position	Contents	Description
%FD129	_SB_CNF_ER	DWORD	Representative flag	System error (heavy fault error)	Handles error flags about non-operation fault error .
%FX4129	_SB_IO_TYER	BOOL	BIT 1	Module type mismatch error	Attached module is different with I/O parameter or some module which cannot be inserted into some slot is inserted some slot. Representative flag that detects them and displays (refer to _SB_IO_TYER_N, _SB_IO_TYERR)
%FX4130	_SB_IO_DEER	BOOL	BIT 2	Module detachment error	Representative flag displays when the module configuration for each slot is changed while running. (refer to _SB_IO_DEER_N, _SB_IO_DEERR)
%FX4131	_SB_FUSE_ER	BOOL	BIT 3	Fuse cutoff error	Representative flag displays when the fuse of module is cut off.
%FX4134	_SB_ANNUM_ER	BOOL	BIT 6	Heavy fault detection error in external device	Representative flag displays when heavy fault error detected by user program is recorded in “_ANC_ERR[n]”.
%FX4136	_SB_BPRM_ER	BOOL	BIT 8	Basic parameter error	Basic parameter does not match CPU type.
%FX4137	_SB_IOPRM_ER	BOOL	BIT 9	I/O parameter error	It is abnormal to the I/O configuration parameter
%FX4138	_SB_SPPRM_ER	BOOL	BIT 10	Special module parameter error	It is abnormal to the special module parameter.
%FX4139	_SB_CPPRM_ER	BOOL	BIT 11	Communication module parameter error	It is abnormal to the communication module parameter.
%FX4141	_SB_CODE_ER	BOOL	BIT 13	Program code error	Indicates that while user program is running, the program code cannot be interpreted.
%FX4142	_SB_SWDT_ER	BOOL	BIT 14	CPU abnormal ends.	Displays when the saved program gets damages by an abnormal end of CPU or program cannot work.
%FX4143	_SB_BASE_POWER_ER	BOOL	BIT 15	Abnormal base power	Base power off or power module error
%FX4144	_SB_WDT_ER	BOOL	BIT 16	Scan watchdog error	Indicates that the program scan time exceeds the scan watchdog time specified by a parameter.
%FX4145	_SB_BASE_INFO_ER	BOOL	BIT 17	Base information error	Base information is abnormal

## Appendix 3 Flag List (XGR)

Address	Flag name	Type	Bit position	Contents	Description
%FX4150	_SB_BASE_DEER	BOOL	BIT 22	Extension base detachment error	Extension base is detached.
%FX4151	_SB_DUPL_PRME ER	BOOL	BIT 23	Abnormal redundant parameter	Redundant parameter is abnormal
%FX4152	_SB_INSTALL_ER	BOOL	BIT 24	Module attachment position error	The module which cannot be inserted into main base is inserted in to main base or the module which cannot be inserted into extension base is inserted in to extension base
%FX4153	_SB_BASE_ID_ER	BOOL	BIT 25	Overlapped extension base number	Extension base number overlaps.
%FX4154	_SB_DUPL_SYNC ER	BOOL	BIT 26	Redundant operation Sync. error	Synchronization between master and standby CPU is abnormal
%FX4156	_SB_CPU_RUN_ER R	BOOL	BIT 28	Standby CPU run error	Standby CPU fails to join redundant operation when MASTER CPU is error

### Appendix 3.3 System Error Detail Flag

Master CPU system error detail flag

Address	Flag name	Type	Writable	Contents	Description
%FW424	_IO_TYERR	ARRAY[0..31] OF WORD	-	Module type mismatch error	Indicates slot and base where module mismatch error occurs.
%FW456	_IO_DEERR	ARRAY[0..31] OF WORD	-	Module detachment error	Indicates slot and base where module detachment error occurs.
%FW488	_FUSE_ERR	ARRAY[0..31] OF WORD	-	Fuse cutoff error	Indicates slot and base where fuse cutoff error occurs.
%FD83	_BASE_DEERR	DWORD	-	Extension base detachment error	Indicates base where extension base is detached.
%FD574	_BASE_POWER _FAIL	DWORD	-	Information of base where power module error occurs	Indicates base where power module error occurs.
%FW416	_IO_TYER_N	WORD	-	Module type mismatch slot number	Indicates slot number where module type mismatch error occurs. When two or more occurs, first slot indicates.
%FW417	_IO_DEER_N	WORD	-	Module detachment slot number	Indicates slot number where module detachment error occurs. When two or more occurs, first slot indicates.
%FW418	_FUSE_ER_N	WORD	-	Fuse cutoff slot number	Indicates slot number Fuse cutoff error occurs. When two or more occurs, first slot indicates.
%FW1922	_ANC_ERR	WORD	Available	Heavy fault information of external device	Classifies the type of user-defined error and writes value except 0. If detection of heavy fault is requested, it develops an external heavy fault detection error. By monitoring this flag, the user can know a reason of heavy fault.

## 2. Standby CPU system error detail flag

Address	Flag name	Type	Writable	Contents	Description
%FD147	_SB_BASE_DEERR	DWORD	-	Extension base detachment error	Indicates base where extension base is detached.
%FW588	_SB_IO_TYERR	WORD	-	Module type mismatch error	Indicates slot and base where module mismatch error occurs.
%FW589	_SB_IO_DEERR	WORD	-	Module detachment error	Indicates slot and base where module detachment error occurs.

## Appendix 3.4 System Warning Representative Flag

## MASTER CPU System warning representative flag

Address	Flag name	Type	Bit position	Contents	Description
%FD66	_CNF_WAR	DWORD	Representative flag	System warning	Representative flag displayed the system warning state.
%FX2112	_RTC_ER	BOOL	BIT 0	RTC error	Indicates that RTC data is abnormal.
%FX2114	_BASE_EXIST_WAR	BOOL	BIT 2	Not joined base	Warns there is base which doesn't join operation.
%FX2115	_AB_SD_ER	BOOL	BIT 3	Stop by operation error	Stopped by abnormal operation.
%FX2116	_TASK_ER	BOOL	BIT 4	Task collision	It is collided to the task.
%FX2117	_BAT_ER	BOOL	BIT 5	Battery error	It has the error in the battery state.
%FX2118	_ANNUM_WAR	BOOL	BIT 6	External device fault	Indicates that the light fault in the external device is detected.
%FX2120	_HS_WAR	BOOL	BIT 8	High speed link	Abnormal HS parameter
%FX2121	_REDUN_WAR	BOOL	BIT 9	Redundant configuration warning	The single CPU RUN mode and redundant configuration is not configured
%FX2122	_OS_VER_WAR	BOOL	BIT 10	O/S version mismatch	OS versions between CPUs, extension managers, extension drive modules are different.
%FX2123	_RING_WAR	BOOL	BIT 11	Ring topology configuration warning	Configure an extension cable as the Ring topology.
%FX2132	_P2P_WAR	BOOL	BIT 20	P2P parameter	Abnormal P2P parameter
%FX2140	_CONSTANT_ER	BOOL	BIT 28	Fixed cycle error	Fixed cycle error
%FX2141	_BASE_POWER_WAR	BOOL	BIT 29	Power module error warning	One or two power module is error
%FX2142	_BASE_SKIP_WAR	BOOL	BIT 30	Base skip cancelation warning	In case of canceling the base skip, base is different with IO parameter
%FX2143	_BASE_NUM_OVER_WAR	BOOL	BIT 31	Base number setting error	Base number of extension drive module is not 1~31

## Appendix 3 Flag List (XGR)

Standby CPU System warning representative flag

Address	Flag name	Type	Bit position	Contents	Description
%FD130	_SB_CNF_WAR	DWORD	Representative flag	System warning	Representative flag displayed the system warning state
%FX4160	_SB_RTC_ER	BOOL	BIT 0	RTC error	Indicates that RTC data is abnormal
%FX4162	_SB_BASE_EXIST_WAR	BOOL	BIT 2	Not joined base	Warns there is base which does not join operation.
%FX4163	_SB_AB_SD_ER	BOOL	BIT 3	Stop by operation error	Stopped by abnormal operation
%FX4164	_SB_TASK_ER	BOOL	BIT 4	Task collision	It is collided to the task
%FX4165	_SB_BAT_ER	BOOL	BIT 5	Battery error	It is to the error in the battery state
%FX4166	_SB_ANNUM_WAR	BOOL	BIT 6	External device fault	Indicates that the light fault in the external device is detected.
%FX4168	_SB_HS_WAR	BOOL	BIT 8	High speed link	Abnormal HS parameter
%FX4170	_SB_OS_VER_WAR	BOOL	BIT 10	O/S version mismatch	OS versions between CPUs, extension managers, extension drive modules are different
%FX4171	_SB_RING_WAR	BOOL	BIT 11	Ring topology configuration warning	Configure an extension cable as the Ring topology
%FX4180	_SB_P2P_WAR	BOOL	BIT 20	P2P parameter	Abnormal P2P parameter
%FX4188	_SB_CONSTANT_ER	BOOL	BIT 28	Fixed cycle error	Fixed cycle error
%FX4189	_SB_BASE_POWER_WAR	BOOL	BIT 29	Power module error warning	One or two power module is error
%FX4190	_SB_BASE_SKIP_WAR	BOOL	BIT 30	Base skip cancelation warning	In case of canceling the base skip, base is different with IO parameter
%FX4191	_SB_BASE_NUM_OVER_WAR	BOOL	BIT 31	Base number setting error	Base number of extension drive module is not 1~31

## Appendix 3.5 System Warning Detail Flag

Master CPU system warning detail flag

Address	Flag name	Type	Writable	Contents	Description
%FX2624	_HS_WARN	ARRAY[0..11] OF BOOL	-	Abnormal HS parameter	Relevant flag is on in case Hs parameter is abnormal
%FX2640	_P2P_WARN	ARRAY[0..7] OF BOOL	-	Abnormal P2P parameter	Relevant flag is on in case P2P parameter is abnormal P2P
%FD587	_BASE_ACPF WAR	DWORD	-	Instantaneous power cutoff occurrence warning information	Indicates base where Instantaneous power cutoff occurs
%FW164	_HS_WAR_W	WORD	-	Abnormal HS parameter	Indicates abnormal HS link number by bit
%FW165	_P2P_WAR_W	WORD	-	Abnormal P2P parameter	Indicates abnormal P2P link number by bit
%FW1923	_ANC_WAR	WORD	-	Light fault information external device	Classifies the type of user-defined error and writes value except 0. If detection of heavy fault is requested, it develops an external light fault detection error. By monitoring this flag, the user can know the reason of light fault.

Standby CPU system warning detail flag

Address	Flag name	Type	Writable	Contents	Description
%FX4672	_SB_HS_WA RN	ARRAY[0..11] OF BOOL	-	Abnormal HS parameter	Relevant flag is on, in case Hs parameter is abnormal
%FX4688	_SB_P2P_WA RN	ARRAY[0..7] OF BOOL	-	Abnormal P2P parameter	Relevant flag is on, in case P2P parameter is abnormal P2P
%FW292	_SB_HS_WA R_W	WORD	-	Abnormal HS parameter	Indicates abnormal HS link number by bit
%FW293	_SB_P2P_WA R_W	WORD	-	Abnormal P2P parameter	Indicates abnormal P2P link number by bit

## Appendix 3 Flag List (XGR)

### Appendix 3.6 System Operation Status Information Flag

Master CPU system operation status information flag

Address	Flag name	Type	Bit position	Contents	Description
%FD64	_SYS_STATE	DWORD	Representative flag	PLC Mode and operation state	Indicates PLC mode and operation state of system.
%FX2048	_RUN	BOOL	BIT 0	RUN	Indicates CPU's operation status
%FX2049	_STOP	BOOL	BIT 1	STOP	
%FX2050	_ERROR	BOOL	BIT 2	ERROR	
%FX2051	_DEBUG	BOOL	BIT 3	DEBUG	
%FX2052	_LOCAL_CON	BOOL	BIT 4	Local control	Indicates operation mode changeable state only by the Mode key and XG5000.
%FX2054	_REMOTE_CON	BOOL	BIT 6	Remote Mode On	It is Remote control mode
%FX2058	_RUN_EDIT_DONE	BOOL	BIT 10	Editing during Run completed	Indicates completion of editing during Run
%FX2059	_RUN_EDIT_NG	BOOL	BIT 11	Editing during Run abnormally completed	Edit is ended abnormally during Run
%FX2060	_CMOD_KEY	BOOL	BIT 12	Operation mode change by key	Indicates Operation mode change by key
%FX2061	_CMOD_LPADT	BOOL	BIT 13	Operation mode change by local PADT	Indicates operation mode change by local PADT
%FX2062	_CMOD_RPADT	BOOL	BIT 14	Operation mode change by remote PADT	Indicates operation mode change by remote PADT
%FX2063	_CMOD_RLINK	BOOL	BIT 15	Operation mode change by remote communication module	Indicates operation mode change by remote communication module
%FX2064	_FORCE_IN	BOOL	BIT 16	Forced Input	Forced On/Off state about input contact
%FX2065	_FORCE_OUT	BOOL	BIT 17	Forced Output	Forced On/Off state about output contact
%FX2066	_SKIP_ON	BOOL	BIT 18	Input/Output Skip	I/O Skip on execution
%FX2067	_EMASK_ON	BOOL	BIT 19	Fault mask	Fault mask on execution
%FX2069	_USTOP_ON	BOOL	BIT 21	Stopped by STOP function	Stopped after scan completion by 'STOP' function while RUN mode operation.
%FX2070	_ESTOP_ON	BOOL	BIT 22	Stopped by ESTOP function	Instantly stopped by 'ESTOP' function while RUN mode operation.
%FW192	_SL_OS_VER	ARRAY[0..31] OF WORD	-	O/S version of extension drive module	Indicates O/S version of extension drive module
%FW600	_BASE_INFO	ARRAY[0..31] OF WORD	-	Base information	Indicates how many base is installed
%FB12	_RTC_TIME	ARRAY[0..7] OF BYTE	-	Current clock	Indicates current clock
%FX2072	_INIT_RUN	BOOL	-	Initialization task on execution	User-defined Initialization program on execution.
%FX2074	_AB_SIDE	BOOL	-	CPU position	CPU position (A-SIDE: ON, B-SIDE: OFF)



## Appendix 3 Flag List (XGR)

Address	Flag name	Type	Bit position	Contents	Description
%FX2076	_PB1	BOOL	-	Program Code 1	Program code 1 is selected
%FX2077	_PB2	BOOL	-	Program Code 2	Program code 1 is selected
%FX30736	_INIT_DONE	BOOL	writable	Initialization task execution completion	If this flag is set by user's initial program, it is started to execution of scan program after initial program completion.
%FW584	_RTC_DATE	DATE	-	RTC's current date	Indicates RTC's current date
%FD67	_OS_VER	DWORD	-	O/S version	Indicates CPU O/S version
%FD68	_OS_DATE	DWORD	-	O/S data	Indicates CPU O/S data
%FD69	_CP_OS_VER	DWORD	-	Extension manager O/S version	Indicates extension manager O/S version
%FD573	_OS_TYPE	DWORD	-	For PLC classification	Whether it is provided to other division
%FW1081	_FALS_NUM	INT	-	FALS number	Indicates FALS number
%FD293	_RTC_TOD	TIME_OF_DAY	-	RTC's current clock	Indicates RTC's current clock RTC. (ms unit)
%FD582	_RUN_EDIT_CNT	UDINT	-	The no. of editing during Run	Indicates the no. of editing during Run
%FW140	_AC_F_CNT	UINT	-	The no. of instantaneous power cutoff	Indicates the no. of instantaneous power cutoff
%FW158	_POWER_OFF_CNT	UINT	-	The no. of power cutoff	Indicates the no. of power cutoff
%FW386	_SCAN_MAX	UINT	writable	Max. scan time	Indicates max. scan time after(unit: 0.1ms)
%FW387	_SCAN_MIN	UINT	writable	Min. scan time	Indicates min. scan time after Run
%FW388	_SCAN_CUR	UINT	writable	Current scan time	Indicates current scan time (unit 0.1ms)
%FW585	_RTC_WEEK	UINT	-	RTC's current day	Indicates RTC's current day
%FW141	_CPU_TYPE	WORD	-	CPU ID (XGR - 0xA801)	Indicates CPU type
%FW633	_RBANK_NUM	WORD	-	Currently used block no.	Indicates currently used block no.

### Standby CPU system operation status information flag

Address	Flag name	Type	Bit position	Contents	Description
%FD128	_SB_SYS_STATE	DWORD	Representative flag	System information	Handles system information
%FX4096	_SB_RUN	BOOL	BIT 0	RUN	Indicates CPU's operation status
%FX4097	_SB_STOP	BOOL	BIT 1	STOP	
%FX4098	_SB_ERROR	BOOL	BIT 2	ERROR	
%FX4100	_SB_LOCAL_CON	BOOL	BIT 4	Local control	Local control mode
%FX4102	_SB_REMOTE_CON	BOOL	BIT 6	Remote mode On	Remote control mode

## Appendix 3 Flag List (XGR)

Address	Flag name	Type	Bit position	Contents	Description
%FX4106	_SB_RUN_EDIT_D ONE	BOOL	BIT 10	Editing during Run completed	Indicates completion of editing during Run
%FX4107	_SB_RUN_EDIT_N G	BOOL	BIT 11	Editing during Run abnormally completed	Edit is ended abnormally during Run
%FX4108	_SB_CMOD_KEY	BOOL	BIT 12	Operation mode change by key	Indicates Operation mode change by key
%FX4109	_SB_CMOD_LPAD T	BOOL	BIT 13	Operation mode change by local PADT	Indicates operation mode change by local PADT
%FX4110	_SB_CMOD_RPAD T	BOOL	BIT 14	Operation mode change by remote PADT	Indicates operation mode change by remote PADT
%FX4111	_SB_CMOD_RLINK	BOOL	BIT 15	Operation mode change by remote communication module	Indicates operation mode change by remote communication module
%FX4112	_SB_FORCE_IN	BOOL	BIT 16	Forced Input	Forced On/Off state about input contact
%FX4113	_SB_FORCE_OUT	BOOL	BIT 17	Forced Output	Forced On/Off state about output contact
%FX4114	_SB_SKIP_ON	BOOL	BIT 18	Input/Output Skip	I/O Skip on execution
%FX4115	_SB_EMASK_ON	BOOL	BIT 19	Fault mask	Fault mask on execution
%FX4117	_SB_USTOP_ON	BOOL	-	Stopped by STOP function	Stopped after scan completion by 'STOP' function while RUN mode operation.
%FX4118	_SB_ESTOP_ON	BOOL	-	Stopped by ESTOP function	Instantly stopped by 'ESTOP' function while RUN mode operation.
%FD131	_SB_OS_VER	DWORD	-	O/S version	Indicates CPU O/S version
%FD132	_SB_OS_DATE	DWORD	-	O/S data	Indicates CPU O/S data
%FD133	_SB_CP_OS_VER	DWORD	-	O/S version of extension drive module	Indicates O/S version of extension drive module
%FW286	_SB_POWER_OFF CNT	UINT	-	The no. of power cutoff	Indicates the no. of power cutoff
%FW269	_SB_CPU_TYPE	WORD	-	CPU ID (XGR - 0xA801)	Indicates CPU type
%FW632	_SB_BASE_INFO	WORD	-	Base information	Indicates how many base installed.

## Appendix 3.7 Redundant Operation Mode Information Flag

### Redundant operation mode information

Address	Flag name	Type	Bit position	Contents	Description
%FD0	_REDUN_STATE	DWORD	Representative flag	Redundant operation information	Representative flag that indicates Redundant operation information
%FX0	_DUAL_RUN	BOOL	BIT 0	Redundant operation	Now Redundant operation CPU A, CPU B are normal
%FX1	_RING_TOPOLOGY	BOOL	BIT 1	Ring topology status	Extension base is configure as ring
%FX2	_LINE_TOPOLOGY	BOOL	BIT 2	Line topology status	Extension base is configure as line
%FX4	_SINGLE_RUN_A	BOOL	BIT 4	A-SIDE single Run mode	Indicates A-SIDE single Run mode
%FX5	_SINGLE_RUN_B	BOOL	BIT 5	B-SIDE single Run mode	Indicates B-SIDE single Run mode
%FX6	_MASTER_RUN_A	BOOL	BIT 6	A-SIDE is master Run mode (Incase standby CPU exists)	Indicates A-SIDE is master Run mode
%FX7	_MASTER_RUN_B	BOOL	BIT 7	B-SIDE is master Run mode (Incase standby CPU exists)	Indicates B-SIDE is master Run mode

## Appendix 3.8 Operation Result Information Flag

### Operation Result Information Flag

Address	Flag name	Type	Writable	Contents	Description
%FX672	_ARY_IDX_ERR	BOOL	Writable	Index range excess error in case of using array	In case of using array, index is out of setting value's range
%FX704	_ARY_IDX_LER	BOOL	Writable	Index range excess error latch in case of using array	Error occurred when index is out of setting value's range, in case of using array, is kept and the user erases this by program
%FX6160	_ERR	BOOL	Writable	Operation error flag	As an operation error flag by unit of operation function (FN) or function block (FB), it is renewed every operation
%FX6165	_LER	BOOL	Writable	Operation error latch flag	Operation error latch flag by program block (PB) unit. Error is kept until relevant program ends and the user erases this by program.

## Appendix 3 Flag List (XGR)

### Appendix 3.9 Operation mode Key Status Flag

#### Operation mode key status flag

Address	Flag name	Type	Writable	Contents	Description
%FX291	_REMOTE_KEY	BOOL	-	Remote key status information	CPU key position status information (remote: off, not remote: On)
%FX294	_STOP_KEY	BOOL	-	Stop key status information	CPU key position status information (Stop: off, not stop: On)
%FX295	_RUN_KEY	BOOL	-	Run key status information	CPU key position status information (Run: off, not Run: On)

## Appendix 3.10 Link Flag (L) List

It describes data link (L) flag

[Table 1.10.1] Communication Flag List according to High speed link no. (High speed link no. 1 ~ 12)

Item	Keyword	Type	Content	Description
HS link	_HSn_RLINK	Bit	High speed link parameter "n" 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. 3. The parameter set in each station itself is communicated normally. Once RUN_LINK is On, it keeps On unless stopped by LINK_DISABLE.
	_HSn_LTRBL	Bit	Abnormal state after _HSn_RLINK ON	In the state of _HSnRLINK 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.
	_HSn_STATE[k] (k=000~127)	Bit Array	High speed link parameter "n", k block general state	Indicates the general state of communication information for each data block of setting parameter.  HS1STATEk=HS1MODk&_HS1TR X k&(~_HSnERRk)
	_HSn_MOD[k] (k=000~127)	Bit Array	High speed link parameter "n", k block station RUN operation mode	Indicates operation mode of station set in k data block of parameter.
	_HSn_TRX[k] (k=000~127)	Bit Array	Normal communication with High speed link parameter "n", k block station	Indicates if communication state of k data of parameter is communicated smoothly according to the setting.
	_HSn_ERR[k] (k=000~127)	Bit Array	High speed link parameter "n", k block station operation error mode	Indicates if the error occurs in the communication state of k data block of parameter.
	_HSn_SETBLOCK[k]	bit Array	High speed link parameter "n", k block setting	Indicates whether or not to set k data block of the parameter.

## Appendix 3 Flag List (XGR)

### Notes

High Speed Link no.	L area address	Remarks
1	L000000~L00049F	Comparing with High speed link 1 from [Table 1], the flag address of different high speed link station no. is as follows by a simple calculation formula.  * Calculation formula : L area address = L000000 + 500 x (High speed link no. – 1)
2	L000500~L00099F	
3	L001000~L00149F	
4	L001500~L00199F	In case of using high speed line flag for program and monitoring, you can use the flag map registered in XG5000 conveniently.
5	L002000~L00249F	
6	L002500~L00299F	
7	L003000~L00349F	
8	L003500~L00399F	
9	L004000~L00449F	
10	L004500~L00499F	
11	L005000~L00549F	

k means block no. and appears 8 words by 16 per 1 word for 128 blocks from 000~127.  
For example, mode information (\_HS1MOD) appears from block 0 to block 15 for L00010, and block 16~31, 32~47, 48~63, 64~79, 80~95, 96~111, 112~127 information for L00011, L00012, L00013, L00014, L00015, L00016, L00017. Thus, mode information of block no. 55 appears in L000137.

[Table 2] Communication Flag List according to P2P Service Setting

P2P parameter no.(n) : 1~8, P2P block(xx) : 0~63

No.	Keyword	Type	Contents	Description
P2P	_P2Pn_NDRxx	Bit	P2P parameter n, xx Block service normal end	Indicates P2P parameter n, xx Block service normal end
	_P2Pn_ERRxx	Bit	P2P parameter n, xx Block service abnormal end	Indicates P2P parameter n, xx Block service abnormal end
	_P2Pn_STATUSxx	Word	P2P parameter n, xx Block service abnormal end error Code	Indicates error code in case of P2P parameter n, xx Block service abnormal end
	_P2Pn_SVCCNTxx	Double word	P2P parameter n, xx Block service normal count	Indicates P2P parameter n, xx Block service normal count
	_P2Pn_ERRCNTxx	Double word	P2P parameter n, xx Block service abnormal count	Indicates P2P parameter n, xx Block service abnormal count

## Appendix 3.11 Communication Flag (P2P) List

Link Register List according to P2P No.

P2P Parameter No. (n) : 1~8, P2P Block(xx) : 0~63

No.	Flags	Type	Contents	Description
N00000	_PnBxxSN	Word	P2P parameter n, xx block another station no	Saves another station no. of P2P parameter 1, 00 block. In case of using another station no. at XG-PD, it is possible to edit during RUN by using P2PSN command.
N00001 ~ N00004	_PnBxxRD1	Device structure	Area device 1 to read P2P parameter n, xx block	Saves area device 1 to read P2P parameter n, xx block.
N00005	_PnBxxRS1	Word	Area size 1 to read P2P parameter n, xx block	Saves area size 1 to read P2P parameter n, xx block.
N00006 ~ N00009	_PnBxxRD2	Device structure	Area device 2 to read P2P parameter n, xx block	Saves area device 2 to read P2P parameter n, xx block.
N00010	_PnBxxRS2	Word	Area size 2 to read P2P parameter n, xx block	Saves area size 2 to read P2P parameter n, xx block.
N00011 ~ N00014	_PnBxxRD3	Device structure	Area device 3 to read P2P parameter n, xx block	Saves area device 3 to read P2P parameter n, xx block.
N00015	_PnBxxRS3	Word	Area size 3 to read P2P parameter n, xx block	Saves area size 3 to read P2P parameter n, xx block.
N00016 ~ N00019	_PnBxxRD4	Device structure	Area device 4 to read P2P parameter n, xx block	Saves area device 4 to read P2P parameter n, xx block.
N00020	_PnBxxRS4	Word	Area size 4 to read P2P parameter n, xx block	Saves area size 4 to read P2P parameter n, xx block.
N00021 ~ N00024	_PnBxxWD1	Device structure	Area device 1 to save P2P parameter n, xx block	Saves area device 1 to save P2P parameter n, xx block.
N00025	_PnBxxWS1	Word	Area size 1 to save P2P parameter n, xx block	Saves area size 1 to save P2P parameter n, xx block.
N00026 ~ N00029	_PnBxxWD2	Device structure	Area device 2 to save P2P parameter n, xx block	Saves area device 2 to save P2P parameter n, xx block.
N00030	_PnBxxWS2	Word	Area size 2 to save P2P parameter n, xx block	Saves area size 2 to save P2P parameter n, xx block.
N00031 ~ N00034	_PnBxxWD3	Device structure	Area device 3 to save P2P parameter n, xx block	Saves area device 3 to save P2P parameter n, xx block.
N00035	_PnBxxWS3	Word	Area size 3 to save P2P parameter n, xx block	Saves area size 3 to save P2P parameter n, xx block.
N00036 ~ N00039	_PnBxxWD4	Device structure	Area device 4 to save P2P parameter n, xx block	Saves area device 4 to save P2P parameter n, xx block.
N00040	_PnBxxWS4	WORD	Area size 4 to save P2P parameter n, xx block	Saves area size 4 to save P2P parameter n, xx block.

## Notes

N area shall be set automatically when setting P2P parameter by using XG-PD and available to modify during RUN by using P2P dedicated command.

N area has a different address classified according to P2P parameter setting no., block index. The area not used by P2P service as address is divided and can be used by internal device.

### Appendix 3.12 Reserved Word

The reserved words are predefined words to use in the system.  
Therefore, it is impossible to use them as the identifier.

Reserved Words
ACTION ... END_ACTION
ARRAY ... OF
AT
CASE ... OF ... ELSE ... END_CASE
CONFIGURATION ... END_CONFIGURATION
Name of Data Type
DATE#, D#
DATE_AND_TIME#, DT#
EXIT
FOR ... TO ... BY ... DO ... END_FOR
FUNCTION ... END_FUNCTION
FUNCTION_BLOCK ... END_FUNCTION_BLOCK
Names of Function Block
IF ... THEN ... ELSIF ... ELSE ... END_IF
OK
Operator (IL Language)
Operator (ST Language)
PROGRAM
PROGRAM ... END_PROGRAM
REPEAT ... UNTIL ... END_REPEAT
RESOURCE ... END_RESOURCE
RETAIN
RETURN
STEP ... END_STEP
STRUCTURE ... END_STRUCTURE
T#
TASK ... WITH
TIME_OF_DAY#, TOD#
TRANSITION ... FROM... TO ... END_TRANSITION
TYPE ... END_TYPE
VAR ... END_VAR
VAR_INPUT ... END_VAR
VAR_OUTPUT ... END_VAR
VAR_IN_OUT ... END_VAR
VAR_EXTERNAL ... END_VAR
VAR_ACCESS ... END_VAR
VAR_GLOBAL ... END_VAR
WHILE ... DO ... END_WHILE
WITH

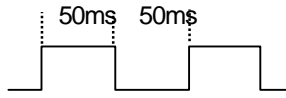


## Appendix 4 Flag List (XEC)

### A4.1 Special Relay (F) List

Reserved variable	Data type	Contents
_SYS_STATE	Mode and state	Indicates PLC mode and operation State.
_RUN	Run	Run state.
_STOP	Stop	Stop state.
_ERROR	Error	Error state.
_DEBUG	Debug	Debug state.
_LOCAL_CON	Local control	Local control mode.
_REMOTE_CON	Remote mode	Remote control mode.
_RUN_EDIT_ST	Online editing	Editing program download during RUN.
_RUN_EDIT_CHK		Internal edit processing during RUN.
_RUN_EDIT_DONE		Edit is done during RUN.
_RUN_EDIT_NG		Edit is ended abnormally during RUN.
_CMOD_KEY	Change Operation Mode	Operation mode changed by key.
_CMOD_LPADT		Operation mode changed by local PADT.
_CMOD_RPADT		Operation mode changed by Remote PADT.
_CMOD_RLINK		Operation mode changed by Remote communication module.
_FORCE_IN	Forced input	Forced input state.
_FORCE_OUT	Forced output	Forced output state.
_MON_ON	Monitor	Monitor on execution.
_USTOP_ON	Stop by STOP function	PLC stops by STOP function after finishing current scan
_ESTOP_ON	Stop by Estop function	PLC stops by ESTOP function promptly
_INIT_RUN	Initialize	Initialization task on execution.
_PB1	Program Code 1	Select Program Code 1.
_PB2	Program Code 2	Select Program Code 2.
_CB1	Compile Code 1	Select Compile Code 1.
_CB2	Compile Code2	Select Compile Code 2.
_CNF_ER	System error	Reports heavy error state of system.
_IO_TYER	Module Type error	Module Type does not match.
_IO_DEER	Module detachment error	Module is detached.
_IO_RWER	Module I/O error	Module I/O error.
_IP_IFER	Module interface error	Special/communication module interface error.
_ANNUM_ER	External device error	Detected heavy error in external device.
_BPRM_ER	Basic parameter	Basic parameter error.

## Appendix 4 Flag List (XEC)

Reserved variable	Data type	Contents
_IOPRM_ER	IO parameter	I/O configuration parameter error.
_SPPRM_ER	Special module parameter	Special module parameter is abnormal.
_CPPRM_ER	Communication module parameter	Communication module parameter is abnormal.
_PGM_ER	Program error	There is error in Check Sum of user program
_CODE_ER	Program code error	Meets instruction can not be interpreted
_SWDT_ER	CPU abnormal stop Or malfunction	The saved program is damaged because of CPU abnormal end or program can not be executed.
_WDT_ER	Scan watchdog	Scan watchdog operated.
_CNF_WAR	System warning	Reports light error state of system.
_RTC_ER	RTC data error	RTC data Error occurred
_DBCK_ER	Backup error	Data backup error.
_HBCK_ER	Restart error	Hot Restart is not available
_ABSD_ER	Operation shutdown error	Stop by abnormal operation.
_TASK_ER	Task collision	Tasks are under collision
_BAT_ER	Battery error	There is error in battery status
_ANNUM_WAR	External device error	Detected light error of external device.
_HS_WAR1	High speed link 1	High speed link – parameter 1 error.
_HS_WAR2	High speed link 2	High speed link – parameter 2 error.
_P2P_WAR1	P2P parameter 1	P2P – parameter 1 error.
_P2P_WAR2	P2P parameter 2	P2P – parameter 2 error.
_P2P_WAR3	P2P parameter 3	P2P – parameter 3 error.
_CONSTANT_ER	Constant error	Constant error.
_USER_F	User contact	Timer used by user.
_T20MS	20ms	<p>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.</p> <p>_T100ms clock</p>  <p>_T100ms clock</p>
_T100MS	100ms	
_T200MS	200ms	
_T1S	1s Clock	
_T2S	2 s Clock	
_T10S	10 s Clock	
_T20S	20 s Clock	
_T60S	60 s Clock	
	Ordinary time On	Always on state Bit.
_Off	Ordinary time Off	Always off state Bit.
_1On	1scan On	First scan on Bit.

Reserved variable	Data type	Contents
_1Off	1scan Off	First scan off bit.
_STOG	Reversal	Reversal every scan.
_USER_CLK	User Clock	Clock available for user setting.
_USR_CLK0	Setting scan repeat	On/off as much as set scan Clock 0.
_USR_CLK1	Setting scan repeat	On/off as much as set scan Clock 1.
_USR_CLK2	Setting scan repeat	On/off as much as set scan Clock 2.
_USR_CLK3	Setting scan repeat	On/off as much as set scan Clock 3.
_USR_CLK4	Setting scan repeat	On/off as much as set scan Clock 4.
_USR_CLK5	Setting scan repeat	On/off as much as set scan Clock 5.
_USR_CLK6	Setting scan repeat	On/off as much as set scan Clock 6.
_USR_CLK7	Setting scan repeat	On/off as much as set scan Clock 7.
_LOGIC_RESULT	Logic result	Indicates logic results.
_ERR	operation error	On during 1 scan in case of operation error.
_LER	Operation error latch	Continuously on in case of operation error
_FALS_NUM	FALS no.	Indicates FALS no.
_PUTGET_ERR0	PUT/GET error 0	Main base Put / Get error.
_PUTGET_NDR0	PUT/GET end 0	Main base Put/Get end.
_CPU_TYPE	CPU Type	Indicates information for CPU Type.
_CPU_VER	CPU version	Indicates CPU version.
_OS_VER	OS version	Indicates OS version.
_OS_DATE	OS date	Indicates OS distribution date.
_SCAN_MAX	Max. scan time	Indicates max. scan time.
_SCAN_MIN	Min. scan time	Indicates min. scan time.
_SCAN_CUR	Current scan time	Current scan time.
_MON_YEAR	Month/year	Clock data (month/year)
_TIME_DAY	Hour/date	Clock data (hour/date)
_SEC_MIN	Second/minute	Clock data (Second/minute)
_HUND_WK	Hundred year/week	Clock data (Hundred year/week)
_REF_COUNT	Refresh count	Increase when module Refresh.
_REF_OK_CNT	Refresh OK	Increase when module Refresh is normal.
_REF_NG_CNT	Refresh NG	Increase when module Refresh is abnormal.
_REF_LIM_CNT	Refresh Limit	Increase when module Refresh is abnormal (Time Out).
_REF_ERR_CNT	Refresh Error	Increase when module Refresh is abnormal.
_BUF_FULL_CNT	Buffer Full	Increase when CPU internal buffer is full.
_PUT_CNT	Put count	Increase when Put count.

## Appendix 4 Flag List (XEC)

Reserved variable	Data type	Contents
_GET_CNT	Get count	Increase when Get count.
_KEY	Current key	Indicates the current state of local key.
_KEY_PREV	Previous key	Indicates the previous state of local key
_IO_TYER_N	Mismatch slot	Module Type mismatched slot no.
_IO_DEER_N	Detach slot	Module detached slot no.
_IO_RWER_N	RW error slot	Module read/write error slot no.
_IP_IFER_N	IF error slot	Module interface error slot no.
_IO_TYER0	Module Type 0 error	Main base module Type error.
_IO_DEER0	Module Detach 0 error	Main base module Detach error.
_IO_RWER0	Module RW 0 error	Main base module read/write error.
_IO_IFER_0	Module IF 0 error	Main base module interface error.
_AC_FAIL_CNT	Current time of RTC (unit: ms)	As time data based on 00:00:00 within one day, unit is ms
_ERR_HIS_CNT	Power shutdown times	Saves the times of power shutdown.
_MOD_HIS_CNT	Error occur times	Saves the times of error occur.
_SYS_HIS_CNT	Mode conversion times	Saves the times of mode conversion.
_LOG_ROTATE	History occur times	Saves the times of system history.
_BASE_INFO0	Slot information 0	Main base slot information.
_RBANK_NUM	Currently used block No.	Indicates currently used block no.
_RBLOCK_STATE	Currently used block status	Indicates Currently used block status (Read/Write/Error)
_RBLOCK_RD_FLAG	Read flash N block	When reading data of flash N block, Nth bit is on.
_RBLOCK_WR_FLAG	Write flash N block	When writing data of flash N block, Nth bit is on.
_RBLOCK_ER_FLAG	Flash N block error	When error occurs during flash N block service, Nth bit is on.
_USER_WRITE_F	Available contact point	Contact point available in program.
_RTC_WR	RTC RW	Data write and read in RTC.
_SCAN_WR	Scan WR	Initializing the value of scan.
_CHK_ANC_ERR	Request detection of external serious error	Request detection of external error.
_CHK_ANC_WAR	Request detection of external slight error (warning)	Request detection of external slight error (warning).
_USER_STAUS_F	User contact point	User contact point.
_INIT_DONE	Initialization completed	Initialization complete displayed.
_ANC_ERR	Display information of external serious error	Display information of external serious error
_ANC_WAR	Display information of external slight error (warning)	Display information of external slight error (warning)

## Appendix 4 Flag List (XEC)

Reserved variable	Data type	Contents
_MON_YEAR_DT	Month/year	Clock data (month/year)
_TIME_DAY_DT	Hour/date	Clock data (hour/date)
_SEC_MIN_DT	Second/minute	Clock data (Second/minute)
_HUND_WK_DT	Hundred year/week	Clock data (Hundred year/week)
_ARY_IDX_ERR	Array –index- range exceeded- error flag	Error flag is indicated when exceeding the no. of array
_ARY_IDX_LER	Array –index- range exceeded- latch-error flag	Error latch flag is indicated when exceeding the no. of array

## Appendix 4 Flag List (XEC)

### A4.2 High Speed Link Flag (\* = 1~2, \*\*\* = 000~063)

Reserved variable	Data type	Contents
_HS*_RLINK	BOOL	Every station of high speed link no.* normally works
_HS*_LTRBL	BOOL	Abnormal status after _HS*_RLINK on
_HS*_STATE***	BOOL	General status of *** block of high speed link no.*
_HS*_MOD***	BOOL	Run operation mode of *** block of high speed link no.*
_HS*_TRX***	BOOL	Normal communication with *** block station of high speed link no.*
_HS*_ERR***	BOOL	Run error mode of *** block station of high speed link no.*
_HS*_SETBLOCK***	BOOL	*** block setting of high speed link no.*

### A4.3 P2P Flag (\* = 0 ~ 8, \*\* = 0 ~ 63)

Reserved variable	Data type	Contents
_P2P*_NDR**	BOOL	** block service of P2P no.* completed successfully
_P2P*_ERR**	BOOL	** block service of P2P no.* completed abnormally
_P2P*_STATUS**	WORD	Error code in case of ** block service of P2P no.*
_P2P*_SVCCNT**	DWORD	** block normal service frequency of P2P no.*
_P2P*_ERRCNT**	DWORD	** block abnormal service frequency of P2P no.*

### A4.4 PID flag (\* = 0 ~ 15, \*\* = 0 ~ 15)

Reserved variable	Data type	Contents
_PID_MAN	WORD	PID output selection(0:auto ,1:manual)
_PID*_MAN	BOOL	PID output selection(0:auto ,1:manual) - loop**
_PID_PAUSE	WORD	PID pause (0:STOP/RUN ,1:PAUSE)
_PID*_PAUSE	BOOL	PID pause (0:STOP/RUN ,1:PAUSE) - loop**
_PID_REV	WORD	PID operation selection(0:forward ,1:reverse)
_PID*_REV	BOOL	PID operation selection(0:forward ,1:reverse) - loop**
_PID_AW2D	WORD	PID Anti Wind-up2 prohibited (0:enable ,1:disable)
_PID*_AW2D	BOOL	PID Anti Wind-up2 prohibited (0:enable ,1:disable) - loop**
_PID_REM_RUN	WORD	PID remote (HMI) execution bit (0:STOP ,1:RUN)
_PID*_REM_RUN	BOOL	PID remote (HMI) execution bit (0:STOP ,1:RUN) - loop**
_PID_P_on_PV	WORD	PID proportional(P) cal source selection (0:ERR, 1:PV)
_PID*_P_on_PV	BOOL	PID proportional(P) cal source selection (0:ERR, 1:PV) - loop**
_PID_D_on_ERR	WORD	PID differential(D) cal source selection (0:PV, 1:ERR)
_PID*_D_on_ERR	BOOL	differential(D) cal source selection (0:PV, 1:ERR) - loop**
_PID_AT_EN	WORD	PID auto tuning setting (0:Disable, 1:Enable)

Reserved variable	Data type	Contents
_PID*_AT_EN	BOOL	PID auto tuning setting (0:Disable, 1:Enable) –loop**
_PID_PWM_EN	WORD	PID PWM operation enable ( 0:Disable, 1:Enable)
_PID*_PWM_EN	BOOL	PID PWM operation enable ( 0:Disable, 1:Enable) - loop**
_PID_STD	WORD	PID operation status indication (0:Stop, 1:Run)
_PID*_STD	WORD	PID operation status indication (0:Stop, 1:Run) – loop 00**
_PID_ALARM	BOOL	PID P - constant (K_p) - block* loop**
_PID*_ALARM	REAL	PID I - constant (T_i)[sec] - loop**
_PID_ERROR	WORD	PID error occurs (0: normal 1: error occurs)
_PID*_ERROR	BOOL	PID error occurs (0: normal 1: error occurs) – loop 01
_PID*_SV	INT	PID Set value (SV) - loop**
_PID*_T_s	WORD	PID operation period (T_s)[0.1msec] - loop**
_PID*_K_p	REAL	PID P - constant (K_p) - loop**
_PID*_T_i	REAL	PID I - constant (T_i)[sec] - loop**
_PID*_T_d	REAL	PID D - constant (T_d)[sec] - loop**
_PID*_d_PV_max	WORD	PID PV change limit - loop**
_PID*_d_MV_max	WORD	PID MV change limit - loop**
_PID*_MV_max	INT	PID MV Max limit - loop**
_PID*_MV_min	INT	PID MV Min limit – loop**
_PID*_MV_man	INT	PID manual output (MV_man) - loop**
_PID*_PV	INT	PID present value (PV) - loop**
_PID*_PV_old	INT	PID previous present value (PV_old) - loop**
_PID*_MV	INT	PID Manipulated value (MV) - loop**
_PID*_ERR	DINT	PID control error value - loop**
_PID*_MV_p	REAL	PID MV P component - loop**
_PID*_Mv_i	REAL	PID MV I component - loop**
_PID*_MV_d	REAL	PID MV D component - loop**
_PID*_DB_W	WORD	PID dead band setting (operation after stabilization) - loop**
_PID*_Td_lag	WORD	PID derivative function LAG filter - loop**
_PID*_PWM	WORD	PID PWM contact point setting value - loop**
_PID*_PWM_Prd	WORD	PID PWM output period - loop**
_PID*_SV_RAMP	WORD	PID Set value ramp value - loop**
_PID*_PV_Track	WORD	PID Set value track value - loop**
_PID*_PV_MIN	INT	PID Present value input Min. limit – loop**
_PID*_PV_MAX	INT	PID Present value input Min. limit – loop**
_PID*_ALM_CODE	WORD	PID alarm code – loop**

## Appendix 4 Flag List (XEC)

Reserved variable	Data type	Contents
_PID*_ERR_CODE	WORD	PID error code - loop**
_PID00_CUR_SV	INT	PID current Set value (SV) – loop**
_AT_REV	WORD	AT operation selection (0:Forward, 1:Reverse)
_AT*_REV	BOOL	AT operation selection (0:Forward, 1:Reverse) - loop**
_AT_PWM_EN	WORD	AT PWM operation enable (0:Disable, 1:Enable)
_AT*_PWM_EN	BOOL	AT PWM operation enable (0:Disable, 1:Enable) - loop**
_AT_ERROR	WORD	AT error occurrence indication (0:normal, 1:error occurrence)
_AT*_ERROR	BOOL	AT error occurrence indication (0:normal, 1:error occurrence) - loop**
_AT*_SV	INT	AT Set value (SV) – loop**
_AT*_T_s	WORD	AT operation period (T_s)[0.1msec] – loop**
_AT*_MV_max	INT	AT MV Max. limit – loop**
_AT00_MV_min	INT	AT MV Min. limit – loop**
_AT*_PWM	WORD	AT PWM contact point setting value – loop**
_AT*_PWM_Prd	WORD	AT PWM output period – loop **
_AT*_HYS_val	WOPD	AT hysteresis setting– loop**
_AT*_STATUS	WORD	AT auto-tuning status indication (prohibited for user to set) – loop**
_AT*_ERR_CODE	WORD	AT error code - (prohibited for user to set) – loop**
_AT*_K_p	REAL	AT result P – constant (K_p) – loop**
_AT*_T_i	REAL	AT result I - constant (T_i)[sec] – loop**
_AT*_T_d	REAL	AT result D - constant (T_d)[sec] - loop00
_AT*_PV	INT	AT present value – loop**
_AT*_MV	INT	AT manipulated value – loop**

### A4.5 High Speed Counter flag (\* = 0 ~ 7, \*\* = 0 ~ 7)

Reserved variable	Data type	Contents
_HSC*_Cnt_En	BOOL	CH** enable Counter
_HSC*_IntPrs_En	BOOL	CH** use counter internal preset
_HSC*_DecCnt_En	BOOL	CH** set decreasing counter
_HSC*_Cmp0_En	BOOL	CH** enable comparison output 0
_HSC*_Rpu_En	BOOL	CH** use revolution per unit time
_HSC*_Latch_En	BOOL	CH** use latch counter
_HSC*_Cmp1_En	BOOL	CH** enable comparison output
_HSC*_Carry	BOOL	CH** carry signal
_HSC*_Borrow	BOOL	CH** borrow signal



Reserved variable	Data type	Contents
_HSC*_CmpOut0	BOOL	CH** comparison output 0 signal
_HSC*_CmpOut1	BOOL	CH** comparison output 1 signal
_HSC*_CurCnt	DINT	CH** current count value
_HSC*_CurRpu	DINT	CH** revolution per unit time
_HSC*_ErrCode	DINT	CH** error code
_HSC*_CntMode	INT	CH** counter mode
_HSC*_PlsMode	INT	CH** pulse input mode
_HSC*_CmpMode0	WORD	CH** comparison output 0 type
_HSC*_CmpMode1	WORD	CH** comparison output 1 type
_HSC*_IntPrs_Val	DINT	CH** internal preset setting value
_HSC*_ExtPrs_Val	DINT	CH** external preset setting value
_HSC*_RingMin_Val	DINT	CH** ring counter min. setting value
_HSC*_RingMax_Val	DINT	CH** ring counter max. setting value
_HSC*_CmpMin_Val0	DINT	CH** comparison output 0 min. setting value
_HSC*_CmpMax_Val0	DINT	CH** comparison output 0 max. setting value
_HSC*_CmpMin_Val1	DINT	CH** comparison output 1 min. setting value
_HSC*_CmpMax_Val1	DINT	CH** comparison output 1 max. setting value
_HSC*_CmpContact0	WORD	CH** designate comparison output 0 output contact point
_HSC*_CmpContact1	WORD	CH** designate comparison output 1 output contact point
_HSC*_UnitTime	WORD	CH** unit time setting value
_HSC*_PlsPerRev	INT	CH** pulse number per revolution

#### A4.6 Positioning flag (\* = 0 ~ 80, \*\* = 0 ~ 80)

Reserved variable	Data type	Contents
_POS_X_Busy	BOOL	X axis BUSY
_POS_Y_Busy	BOOL	Y axis BUSY
_POS_X_Err	BOOL	X axis error
_POS_Y_Err	BOOL	Y axis error
_POS_X_Done	BOOL	X axis position complete
_POS_Y_Done	BOOL	Y axis position complete
_POS_X_McodeOn	BOOL	X axis M code on
_POS_Y_McodeOn	BOOL	Y axis M code on
_POS_X-OriginFix	BOOL	X axis origin fix
_POS_Y-OriginFix	BOOL	Y axis origin fix
_POS_X_OutInhibit	BOOL	X axis output inhibit

## Appendix 4 Flag List (XEC)

Reserved variable	Data type	Contents
_POS_Y_OutInhibit	BOOL	Y axis output inhibit
_POS_X_Stop	BOOL	X axis stop
_POS_Y_Stop	BOOL	Y axis stop
_POS_X_ULimit	BOOL	X axis upper limit detection
_POS_Y_ULimit	BOOL	Y axis upper limit detection
_POS_X_LLimit	BOOL	X axis lower limit detection
_POS_Y_LLimit	BOOL	Y axis lower limit detection
_POS_X_Estop	BOOL	X axis emergency stop
_POS_Y_Estop	BOOL	Y axis emergency stop
_POS_X_Dir	BOOL	X axis CW/CCW
_POS_Y_Dir	BOOL	Y axis CW/CCW
_POS_X_Acc	BOOL	X axis move status (acceleration)
_POS_Y_Acc	BOOL	Y axis move status (acceleration)
_POS_X_Const	BOOL	X axis move status (constant)
_POS_Y_Const	BOOL	Y axis move status (constant)
_POS_X_Dec	BOOL	X axis move status (deceleration)
_POS_Y_Dec	BOOL	Y axis move status (deceleration)
_POS_X_Dwell	BOOL	X axis move status (dwell)
_POS_Y_Dwell	BOOL	Y axis move status (dwell)
_POS_X_Position	BOOL	X axis control pattern (Position)
_POS_Y_Position	BOOL	Y axis control pattern (Position)
_POS_X_Speed	BOOL	X axis control pattern (Speed)
_POS_Y_Speed	BOOL	Y axis control pattern (Speed)
_POS_X_LinearInt	BOOL	X axis control pattern (Linear Int.)
_POS_Y_LinearInt	BOOL	Y axis control pattern (Linear Int.)
_POS_X_Home	BOOL	X axis home return
_POS_Y_Home	BOOL	Y axis home return
_POS_X_PosSync	BOOL	X axis position sync.
_POS_Y_PosSync	BOOL	Y axis position sync.
_POS_X_SpdSync	BOOL	X axis speed sync
_POS_Y_SpdSync	BOOL	Y axis speed sync
_POS_X_JogLow	BOOL	X axis JOG low speed
_POS_Y_JogLow	BOOL	Y axis JOG low speed
_POS_X_JogHigh	BOOL	X axis JOG high speed
_POS_Y_JogHigh	BOOL	Y axis JOG high speed

Reserved variable	Data type	Contents
_POS_X_Inching	BOOL	X axis inching
_POS_Y_Inching	BOOL	Y axis inching
_POS_X_CurPos	DWORD	X axis current position
_POS_Y_CurPos	DWORD	Y axis current position
_POS_X_CurSpd	DWORD	X axis current speed
_POS_Y_CurSpd	DWORD	Y axis current speed
_POS_X_CurStep	WORD	X axis step number
_POS_Y_CurStep	WORD	Y axis step number
_POS_X_ErrCode	WORD	X axis error code
_POS_Y_ErrCode	WORD	Y axis error code
_POS_X_Mcode	WORD	X axis M code
_POS_Y_Mcode	WORD	Y axis M code
_POS_X_Start	BOOL	X axis start
_POS_Y_Start	BOOL	Y axis start
_POS_X_CwJogStart	BOOL	X axis CW JOG START
_POS_Y_CwJogStart	BOOL	Y axis CW JOG START
_POS_X_CcwJogStart	BOOL	X axis CCW JOG START
_POS_Y_CcwJogStart	BOOL	Y axis CCW JOG START
_POS_X_JogLowHigh	BOOL	X axis JOG Low Speed/High Speed
_POS_Y_JogLowHigh	BOOL	Y axis JOG Low Speed/High Speed
_POS_X_BiasSpd	DWORD	X axis bias speed
_POS_Y_BiasSpd	DWORD	X axis bias speed
_POS_X_SpdLimit	DWORD	X axis speed limit
_POS_Y_SpdLimit	DWORD	Y axis speed limit
_POS_X_AccTime1	WORD	X axis acceleration time 1
_POS_Y_AccTime1	WORD	Y axis acceleration time 1
_POS_X_DecTime1	WORD	X axis deceleration time 1
_POS_Y_DecTime1	WORD	Y axis deceleration time 1
_POS_X_AccTime2	WORD	X axis acceleration time 2
_POS_Y_AccTime2	WORD	Y axis acceleration time 2
_POS_X_DecTime2	WORD	X axis deceleration time 2
_POS_Y_DecTime2	WORD	Y axis deceleration time 2
_POS_X_AccTime3	WORD	X axis acceleration time 3
_POS_Y_AccTime3	WORD	Y axis acceleration time 13
_POS_X_DecTime3	WORD	X axis deceleration time 3

## Appendix 4 Flag List (XEC)

Reserved variable	Data type	Contents
_POS_Y_DecTime3	WORD	Y axis deceleration time 3
_POS_X_AccTime4	WORD	X axis acceleration time 4
_POS_Y_AccTime4	WORD	Y axis acceleration time 4
_POS_X_DecTime4	WORD	X axis deceleration time 4
_POS_Y_DecTime4	WORD	Y axis deceleration time 4
_POS_X_SwULimit	DWORD	X axis S/W upper limit
_POS_Y_SwULimit	DWORD	Y axis S/W upper limit
_POS_X_SwLLimit	DWORD	X axis S/W lower limit
_POS_Y_SwLLimit	DWORD	Y axis S/W lower limit
_POS_X_Backlash	WORD	X axis backlash compensation
_POS_Y_Backlash	WORD	Y axis backlash compensation
_POS_X_McodeMode_L	BOOL	X axis M-Code output mode (Low Bit)
_POS_Y_McodeMode_L	BOOL	Y axis M-Code output mode (Low Bit)
_POS_X_McodeMode_H	BOOL	X axis M-Code output mode (High Bit)
_POS_Y_McodeMode_H	BOOL	Y axis M-Code output mode (High Bit)
_POS_X_LimitDetect	BOOL	X axis S/W limit detection
_POS_Y_LimitDetect	BOOL	Y axis S/W limit detection
_POS_X_HomeAddr	DWORD	X axis Home Address
_POS_Y_HomeAddr	DWORD	Y axis Home Address
_POS_X_HomeHSpd	DWORD	X axis Home High Speed
_POS_Y_HomeHSpd	DWORD	Y axis Home High Speed
_POS_X_HomeLSpd	DWORD	X axis Home Low Speed
_POS_Y_HomeLSpd	DWORD	Y axis Home Low Speed
_POS_X_HomeAccTime	WORD	X axis Homing acceleration time
_POS_Y_HomeAccTime	WORD	Y axis Homing acceleration time
_POS_X_HomeDccTime	WORD	X axis Homing deceleration time
_POS_Y_HomeDccTime	WORD	Y axis Homing deceleration time
_POS_X_HomeDwTime	WORD	X axis Homing dwell time
_POS_Y_HomeDwTime	WORD	Y axis Homing dwell time
_POS_X_HomeMethod_L	BOOL	X axis Homing Method (Low Bit)
_POS_Y_HomeMethod_L	BOOL	Y axis Homing Method (Low Bit)
_POS_X_HomeMethod_H	BOOL	X axis Homing Method (High Bit)
_POS_Y_HomeMethod_H	BOOL	Y axis Homing Method (High Bit)
_POS_X_HomeDir	BOOL	X axis homing direction
_POS_Y_HomeDir	BOOL	Y axis homing direction

Reserved variable	Data type	Contents
_POS_X_JogHSpd	DWORD	X axis JOG high speed
_POS_Y_JogHSpd	DWORD	Y axis JOG high speed
_POS_X_JogLSpd	DWORD	X axis JOG low speed
_POS_Y_JogLSpd	DWORD	Y axis JOG low speed
_POS_X_JogAccTime	WORD	X axis JOG Acceleration Time
_POS_Y_JogAccTime	WORD	Y axis JOG Acceleration Time
_POS_X_JogDecTime	WORD	X axis JOG Deceleration Time
_POS_Y_JogDecTime	WORD	Y axis JOG Deceleration Time
_POS_X_JogInchSpd	WORD	X axis inching speed
_POS_Y_JogInchSpd	WORD	Y axis inching speed
_POS_X_Position_En	BOOL	X axis position enable
_POS_Y_Position_En	BOOL	Y axis position enable
_POS_X_OutLevel	BOOL	X axis pulse output level
_POS_Y_OutLevel	BOOL	Y axis pulse output level
_POS_X_Limit_En	BOOL	X axis upper limit/lower limit enable
_POS_Y_Limit_En	BOOL	Y axis upper limit/lower limit enable
_POS_X_OutMode	BOOL	X axis pulse output mode
_POS_Y_OutMode	BOOL	Y axis pulse output mode
_POS_X_ST*_Addr	DWORD	X axis step** position
_POS_Y_ST*_Speed	DWORD	Y axis step** speed
_POS_X_ST*_Dwell	WORD	X axis step** dwell time
_POS_Y_ST*_Dwell	WORD	Y axis step** dwell time
_POS_X_ST*_Mcode	WORD	X axis step** M code number
_POS_Y_ST*_Mcode	WORD	Y axis step** M code number
_POS_X_ST*_Method	BOOL	X axis step** method
_POS_Y_ST*_Method	BOOL	Y axis step** method
_POS_X_ST*_Control	BOOL	X axis step** control
_POS_Y_ST*_Control	BOOL	Y axis step** control
_POS_X_ST*_Pattern_L	BOOL	X axis step** pattern (Low Bit)
_POS_Y_ST*_Pattern_L	BOOL	Y axis step** pattern (Low Bit)
_POS_X_ST*_Pattern_H	BOOL	X axis step** pattern (High Bit)
_POS_Y_ST*_Pattern_H	BOOL	Y axis step** pattern (High Bit)
_POS_X_ST*_Cordi	BOOL	X axis step** coordinates
_POS_Y_ST*_Cordi	BOOL	Y axis step** coordinates
_POS_X_ST*_AccDecN_L	BOOL	X axis step** AEC/DEC number (Low Bit)

## Appendix 4 Flag List (XEC)

Reserved variable	Data type	Contents
_POS_Y_ST*_AccDecN_L	BOOL	Y axis step**AEC/DEC number (Low Bit)
_POS_X_ST*_AccDecN_H	BOOL	X axis step** AEC/DEC number (High Bit)
_POS_Y_ST*_AccDecN_H	BOOL	Y axis step** AEC/DEC number (High Bit)
_POS_X_ST01_RptStep	BOOL	X axis step**Repeat Step
_POS_Y_ST01_RptStep	BOOL	Y axis step**Repeat Step

### Warranty

#### 1. Warranty Period

The product you purchased will be guaranteed for 18 months from the date of manufacturing.

#### 2. Scope of Warranty

Any trouble or defect occurring for the above-mentioned period will be partially replaced or repaired. However, please note the following cases will be excluded from the scope of warranty.

- (1) Any trouble attributable to unreasonable condition, environment or handling otherwise specified in the manual,
- (2) Any trouble attributable to others' products,
- (3) If the product is modified or repaired in any other place not designated by the company,
- (4) Due to unintended purposes
- (5) Owing to the reasons unexpected at the level of the contemporary science and technology when delivered.
- (6) Not attributable to the company; for instance, natural disasters or fire

3. Since the above warranty is limited to PLC unit only, make sure to use the product considering the safety for system configuration or applications.

### Environmental Policy

LS Industrial Systems Co., Ltd supports and observes the environmental policy as below.

#### Environmental Management

LS Industrial Systems considers the environmental preservation as the preferential management subject and every staff of LS Industrial Systems use the reasonable endeavors for the pleasurable environmental preservation of the earth.

#### About Disposal

LS Industrial Systems' 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.



**LS values every single customers.**  
**Quality and service come first at LSIS.**  
**Always at your service, standing for our customers.**

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