Honeywell

Honeywell Process Solutions

Analog Input Module
2MLF-AC4H
User's Guide

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Release 230

Notices and Trademarks

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About This Document

This document describes how to install and configure the 2MLF-AV8A and AC8A; Analog to digital voltage and current converters.

Release Information

Document Name	Document ID	Release Number	Publication Date
2MLF-AC4H User's Guide	ML200-HART	120	6/09

References

The following list identifies all documents that may be sources of reference for material discussed in this publication.

Document Title
SoftMaster User’s Guide

Contacts

World Wide Web

The following Honeywell web sites may be of interest to Process Solution customers.

Honeywell Organization	WWW Address (URL)
Corporate	*http://www.honeywell.com*
Process Solutions	*http:/process.honeywell.com/*

Telephone

Contact us by telephone at the numbers listed below.

Location	Organization	Phone
United States and Canada	Honeywell IAC Solution Support Center	1-800-822-7673
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Elsewhere	Call your nearest Honeywell office.	

Symbol Definitions

The following table lists those symbols used in this document to denote certain conditions.

Symbol	Definition
	**ATTENTION:** Identifies information that requires special consideration.
	**TIP:** Identifies advice or hints for the user, often in terms of performing a task.
	**REFERENCE -EXTERNAL:** Identifies an additional source of information outside of the bookset.
	**REFERENCE - INTERNAL:** Identifies an additional source of information within the bookset.
CAUTION	Indicates a situation which, if not avoided, may result in equipment or work (data) on the system being damaged or lost, or may result in the inability to properly operate the process.
	**CAUTION**: Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices. **CAUTION** symbol on the equipment refers the user to the product manual for additional information. The symbol appears next to required information in the manual.
	**WARNING**: Indicates a potentially hazardous situation, which, if not avoided, could result in serious injury or death. **WARNING** symbol on the equipment refers the user to the product manual for additional information. The symbol appears next to required information in the manual.
	**WARNING, Risk of electrical shock**: Potential shock hazard where HAZARDOUS LIVE voltages greater than 30 Vrms, 42.4 Vpeak, or 60 VDC may be accessible.

Symbol	Definition
	**ESD HAZARD:** Danger of an electro-static discharge to which equipment may be sensitive. Observe precautions for handling electrostatic sensitive devices.
	**Protective Earth (PE) terminal**: Provided for connection of the protective earth (green or green/yellow) supply system conductor.
	**Functional earth terminal**: Used for non-safety purposes such as noise immunity improvement. NOTE: This connection shall be bonded to Protective Earth at the source of supply in accordance with national local electrical code requirements.
	**Earth Ground**: **Functional earth connection.** NOTE: This connection shall be bonded to Protective Earth at the source of supply in accordance with national and local electrical code requirements.
	**Chassis Ground**: Identifies a connection to the chassis or frame of the equipment shall be bonded to Protective Earth at the source of supply in accordance with national and local electrical code requirements.

◎ Contents ◎

Chapter 1 Introduction

This instruction describes the dimension, handling and programming methods of HART analog input module (2MLF-AC4H) that can be used by combining with 2MLK/I/R PLC Series CPU module. Hereinafter, 2MLF-AC4H is referred to HART analog input module.
This module is used to convert analog signal (current input) from PLC's external device to signed 16-bit binary data of digital value and supports HART (Highway Addressable Remote Transducer) protocol used in many process field devices.

1.1 Characteristics

(1) It supports HART protocol
In the input range of 4 ~ 20mA, bi-directional digital communication is available by using analog signal wiring. If analog wiring is currently used, there is no need to add wiring for HART communication (HART communication is not supported in the range of 0 ~ 20mA)

(2) High resolution of 1/64000
High resolution digital value can be assured by 1/64000.

(3) High accuracy
High conversion accuracy of ±0.1 % (ambient temperature of 25 ℃) is available.
Temperature coefficient is high accuracy as ±0.25%.

(4) Operation parameters setting / monitoring
Operation parameters setting are available now by means of [I/O Parameters Setting] for which user interface is reinforced to increase user's convenience. With [I/O Parameters Setting] used, the sequence program can be reduced. In addition, through [Special Module Monitoring] function, A/D conversion value can be easily monitored.

(5) Various formats of digital output data provided
3 formats of digital output data are available as specified below;
- Signed Value: -32000 ~ 32000
- Precise Value: Refer to Chapter 2.2 Display based on analog input range.
- Percentile Value: 0 ~ 10000

(6) Input disconnection detection function
This function is used to detect the disconnection of input circuit when 4 ~ 20 mA of analog input signal range is used.

Chapter 2 Specifications

2.1 General Specifications

General specifications of 2MLK/I/R series are as specified in Table 2.1.

[Table 2.1] General Specifications

<table>
<tr><th>No.</th><th>Item</th><th colspan="6">Specifications</th><th>Related standards</th></tr>
<tr><td>1</td><td>Operating temp.</td><td colspan="6">0℃ ~ +65℃</td><td>-</td></tr>
<tr><td>2</td><td>Storage temp.</td><td colspan="6">-25℃ ~ +75℃</td><td>-</td></tr>
<tr><td>3</td><td>Operating humidity</td><td colspan="6">5 ~ 95%RH (Non-condensing)</td><td>-</td></tr>
<tr><td>4</td><td>Storage humidity</td><td colspan="6">5 ~ 95%RH (Non-condensing)</td><td>-</td></tr>
<tr><td rowspan="8">5</td><td rowspan="8">Vibration</td><td colspan="5">For discontinuous vibration</td><td>-</td></tr>
<tr><td>Frequency</td><td colspan="2">Acceleration</td><td>Amplitude</td><td>Number</td><td rowspan="8">IEC61131-2</td></tr>
<tr><td>5≤f< 8.4 ㎐</td><td colspan="2">-</td><td>3.5mm</td><td rowspan="6">Each 10 times in X,Y,Z directions</td></tr>
<tr><td>8.4≤f≤150 ㎐</td><td colspan="2">9.8m/s (1G)</td><td>-</td></tr>
<tr><td colspan="4">For continuous vibration</td></tr>
<tr><td>Frequency</td><td colspan="2">Acceleration</td><td>Amplitude</td></tr>
<tr><td>5≤f< 8.4 ㎐</td><td colspan="2">-</td><td>1.75mm</td></tr>
<tr><td>8.4≤f≤150 ㎐</td><td colspan="2">4.9m/s (0.5G)</td><td>-</td></tr>
<tr><td>6</td><td>Shocks</td><td colspan="6">* Max. impact acceleration: 147 ㎨(15G)
* Authorized time: 11 ㎳
* Pulse wave : Sign half-wave pulse
(Each 3 times in X,Y,Z directions)</td><td>IEC61131-2</td></tr>
<tr><td rowspan="5">7</td><td rowspan="5">Noise</td><td colspan="3">Square wave impulse noise</td><td colspan="2">AC: ±1,500V
DC: ±900V</td><td>ML standard</td></tr>
<tr><td colspan="3">Electrostatic discharging</td><td colspan="2">Voltage : 4kV
(contact discharging)</td><td>IEC61131-2
IEC61000-4-2</td></tr>
<tr><td colspan="3">Radiated electromagnetic field noise</td><td colspan="2">80 ~ 1000MHz, 10 V/m</td><td>IEC61131-2,
IEC61000-4-3</td></tr>
<tr><td rowspan="2">Fast Transient /burst noise</td><td>Class</td><td>Power module</td><td colspan="2">Digital/Analog I/O, communication interface</td><td rowspan="2">IEC61131-2
IEC61000-4-4</td></tr>
<tr><td>Voltage</td><td>2kV</td><td colspan="2">1kV</td></tr>
<tr><td>8</td><td>Ambient conditions</td><td colspan="6">Free from corrosive gasses and excessive dust</td><td>-</td></tr>
<tr><td>9</td><td>Operating height</td><td colspan="6">Up to 2000m</td><td>-</td></tr>
<tr><td>10</td><td>Pollution degree</td><td colspan="6">Less than equal to 2</td><td>-</td></tr>
<tr><td>11</td><td>Cooling</td><td colspan="6">Air-cooling</td><td>-</td></tr>
</table>

Notes

(1) IEC (International Electrotechnical Commission):
An international nongovernmental organization which promotes internationally cooperated standardization in electric/electronic fields publishes international standards and manages applicable estimation system related with.

(2) Pollution level:
An index indicating pollution level of the operating environment which decides insulation performance of the devices. For instance, Pollution level 2 indicates the state generally that only non-conductive pollution occurs. However, this state contains temporary conduction due to dew produced.

2.2 Performance Specifications

Performance specifications of HART analog input module is specified in Table 2.2.

[Table 2.2] Performance Specifications

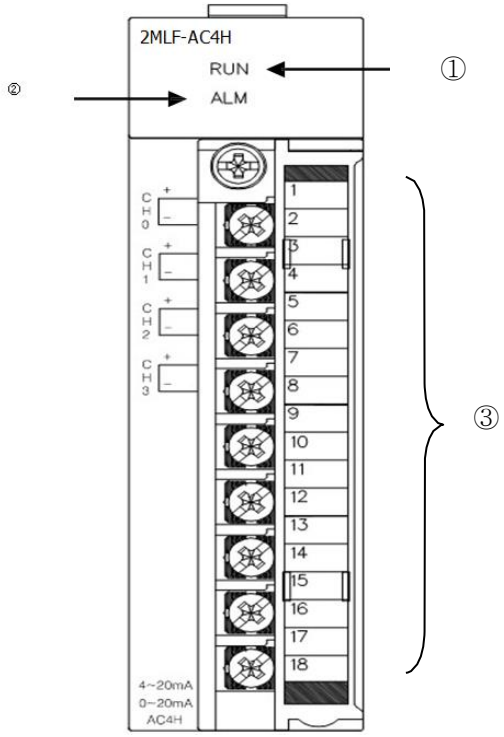
<table>
<tr><th>Item</th><th>Specifications</th></tr>
<tr><td>No. of Channels</td><td>4 channels</td></tr>
<tr><td>Analog
input range</td><td>DC 4 ~ 20 mA
DC 0 ~ 20 mA
(Input Resistance: 250 Ω)</td></tr>
<tr><td>Analog input
range setting</td><td>► Analog input range can be selected through user program or [I/O parameter].
► Respective input ranges can be set based on channels.</td></tr>
<tr><td>Digital output</td><td>
<table>
<tr><th>Analog input / Digital output</th><th>4 ~ 20 ㎃</th><th>0 ~ 20 ㎃</th></tr>
<tr><td>Signed Value</td><td colspan="2">-32000 ~ 32000</td></tr>
<tr><td>Precise Value</td><td>4000 ~ 20000</td><td>0 ~ 20000</td></tr>
<tr><td>Percentile Value</td><td colspan="2">0 ~ 10000</td></tr>
</table>
► Format of digital output data can be set through user program or [I/O Parameter setting] respectively based on channels.
</td></tr>
<tr><td>Max. resolution</td><td>
<table>
<tr><th>Analog input range</th><th>Resolution(1/64000)</th></tr>
<tr><td>4 ~ 20 ㎃</td><td>250 ㎁</td></tr>
<tr><td>0 ~ 20 ㎃</td><td>312.5 ㎁</td></tr>
</table>
</td></tr>
<tr><td>Accuracy</td><td>±0.1% or less (when ambient temperature is 25 ℃)
±0.25% or less (when ambient temperature is 0 ~ 55 ℃)</td></tr>
<tr><td>Conversion speed</td><td>Maximum of 100ms / 4 channels</td></tr>
<tr><td>Absolute Max. input</td><td>Maximum of ±30 ㎃</td></tr>
<tr><td>Analog
input points</td><td>4 channels/1 module</td></tr>
<tr><td>Isolation
specification</td><td>Photo-coupler isolation between input terminal and PLC power
(no isolation between channels)</td></tr>
<tr><td>Terminal connected</td><td>18-point terminal</td></tr>
<tr><td>I/O points occupied</td><td>Fixed type: 64 points, Non fixed type: 16 points</td></tr>
<tr><td>HART
communication
method</td><td>Monodrop only
Primary master only</td></tr>
<tr><td>Internal-consumed
current</td><td>DC 5 V: 340 ㎃</td></tr>
<tr><td>Weight</td><td>145g</td></tr>
</table>

Notes

(1) When Analog Input Module is made at factory, Offset/Gain value about analog input range is fixed and you can't change them.
(2) Offset Value: Analog input value of which digital output value becomes -32000 when you set digital output type as Unsigned Value
(3) Gain Value: Analog input value of which digital output value becomes 32000 when you set digital output type as Unsigned Value
(4) HART communication is available when input rage set to 4~20 ㎃.

2.3 Part names and Functions

Respective designations of the parts are as described below.



No.	Description
①	RUN LED
	▶ Display the operation status of 2MLF-AC4H On: In normal operation Flickering: Error occurs (Refer to 9.1 for more details) Off: DC 5V disconnected or 2MLF-AC4H module error
②	ALM LED
	▶ Display the alarm status of 2MLF-AC4H Flickering: Alarm detected(Process alarm, rate of change alarm set by SoftMaster) OFF: In normal operation
③	Terminal
	▶ Analog input terminal, whose respective channels can be connected with external devices.

2.4 Basic Characteristics of HART Analog Module

2.4.1 Summary

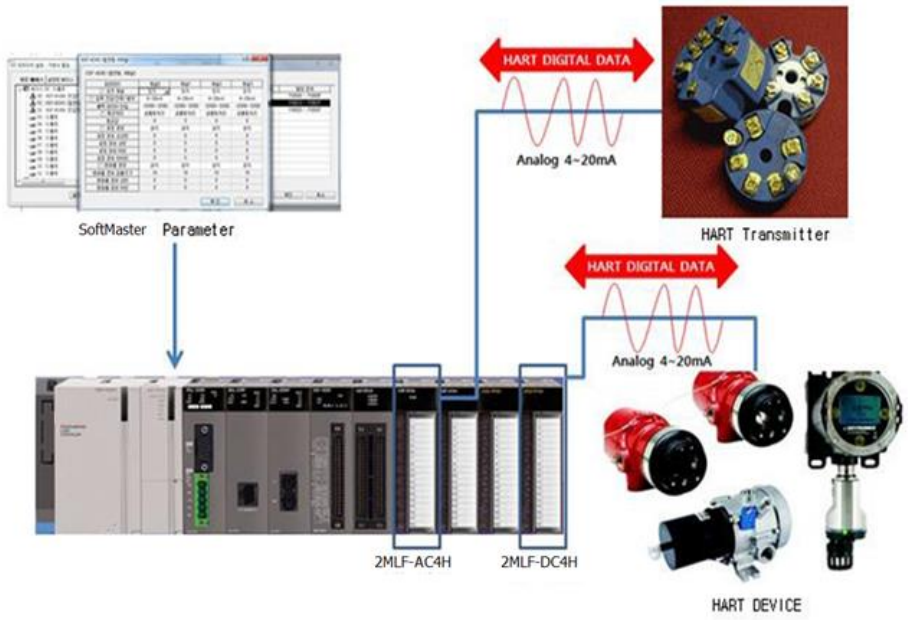
HART analog input module is a product that can use HART communication along with analog conversion. HART analog input module supports interface for communication by being connected with HART field device. Communication data provided by HART field device can be monitored via HART analog input module and status of field devices can be also diagnosed.

(1) Advantage and Purpose of HART Communication

(a) Additional wiring for communication is not needed(Communication by using 4~20mA wiring of analog module)
(b) Additional measurement information through digital communication
(c) Low power consumption
(d) Various and rich field devices that support HART communication
(e) Display of field device's information, maintenance, diagnosis

(2) HART Communication Composition

HART communication consists of masters and slaves and up to two masters can be connected. PLC HART analog input module is connected as the primary master device and communicates with field devices-slaves. A communication device is connected as the secondary master device to diagnose field devices and set its slave's parameters.



Smart mass flow meter provides flow's field measuring values with the flow meter's current signal. Along with signal current indicating flow, it sends additional measurement information measured by the flow meter to HART communication. Up to four variables are provided. For example, flow as the Primary Value (PV), stop pressure as the Secondary Value(SV), temperature as the Tertiary Value(TV) and current signal's digital value as the Quaternary Value(QV) are used as measurement information.

(3) Multidrop

Multidrop method consists of only one pair of wiring and all control values are transmitted in digital ones. All field devices have polling addresses and the current flow in each device is fixed to the minimum value (4 mA).

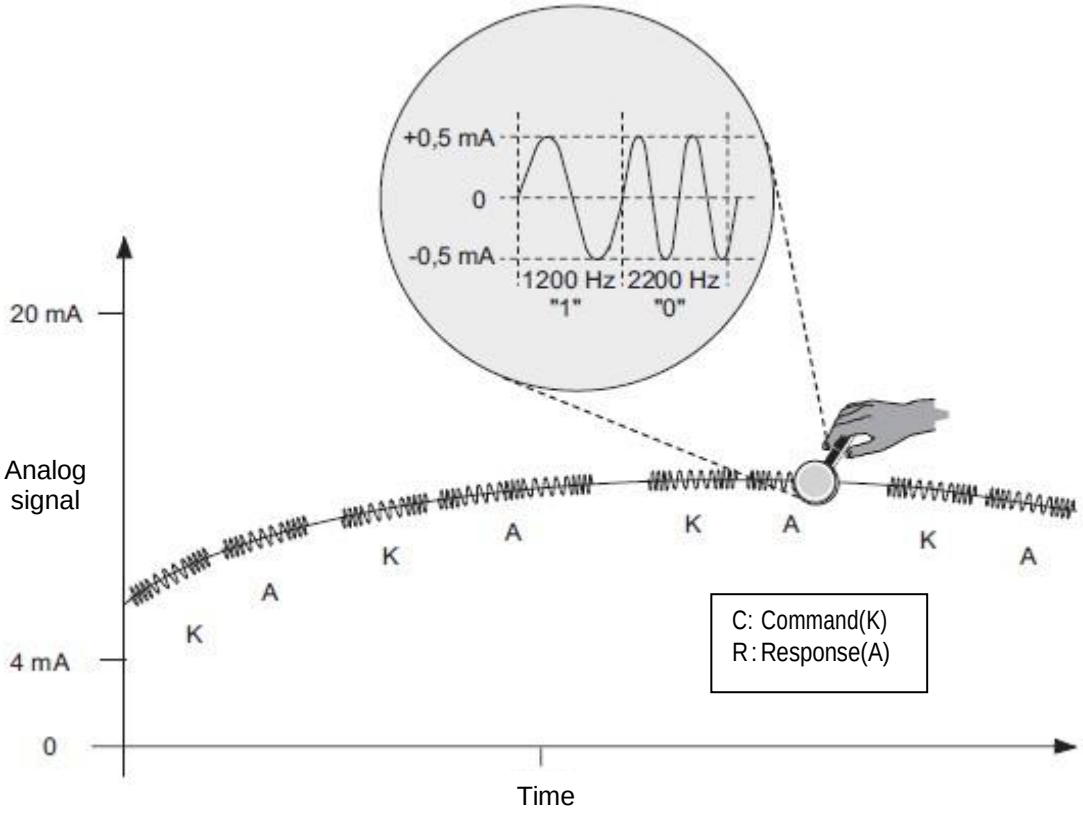
Notes

- Multidrop method is not supported on HART analog input and output module.

2.4.2 RT Operation

(1) HART signal

The figure below illustrates HART signals whose frequency is modulated to analog signal. In this figure, HART signal is shown as two kinds of signals that have frequency of 1,200 Hz and 2,200 Hz. These two kinds of signals refer to binary number 1(1,200 Hz) and 0(2,200 Hz) and they are recovered to meaningful information by being demodulated into digital signal on each device.



(2) Kind and Configuration of HART Commands

Kinds of HART commands are described. HART analog input module transmits HART commands to HART field device and HART field device transmits responses to the commands to HART analog input module. HART commands can be categorized into three command groups according to their characteristics and they are called Universal, Common Practice, and Device Specific. Universal commands shall be supported by the entire HART field device manufacturers as an essential command group. Common Practice defines only data format of commands and manufacturers support only items that are judged as essential ones for HART field device. Device Specific is a command group that has no specified data format. Each manufacturer can define it if needed.

[Table 2.3] HART Commands

Command	***Description***
Universal	An essential command group that shall be supported by all of HART field device manufacturers
Common Practice	Only data format of commands is defined and manufacturers support only items that are judged as essential ones for HART field device
Device Specific	A command group that has no specified data format. Each manufacturer can define it if needed

(3) Commands supported on HART analog input module

Commands supported on HART analog input module are described in the following.

[Table 2.4] Commands supported on HART analog input module

Command		***Function***
Universal Command	0	Read Manufacturer ID and Manufacturer device code
	1	Read Primary variable(PV) value and Unit
	2	Read percentage of current and range
	3	Read current and 4 kinds of variable values (Primary Variable, Secondary Variable, Tertiary Value, Quaternary Value)
	12	Read message
	13	Read tag, descriptor, data
	15	Read output information
	16	Read Final Assemble Number
Common Practice Command	48	Read Device Status
	50	Read Primary variable~ Quaternary Variable assignment
	57	Read Unit tag, Unit descriptor, Date
	61	Read Primary variable~ Quaternary Variable and PV analog output
	110	Read Primary variable~ Quaternary Variable

2.5 Characteristics of A/D Conversion

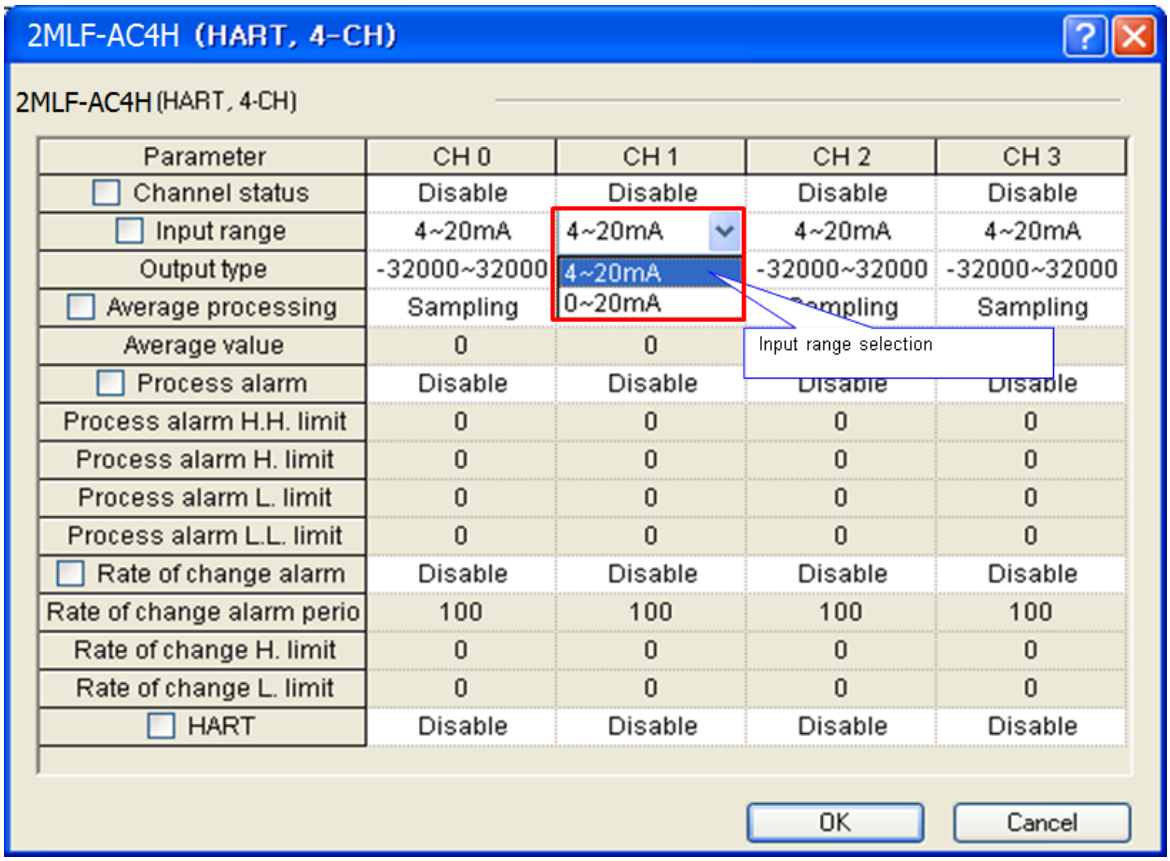
2.5.1 How to select the range of the A/D conversion

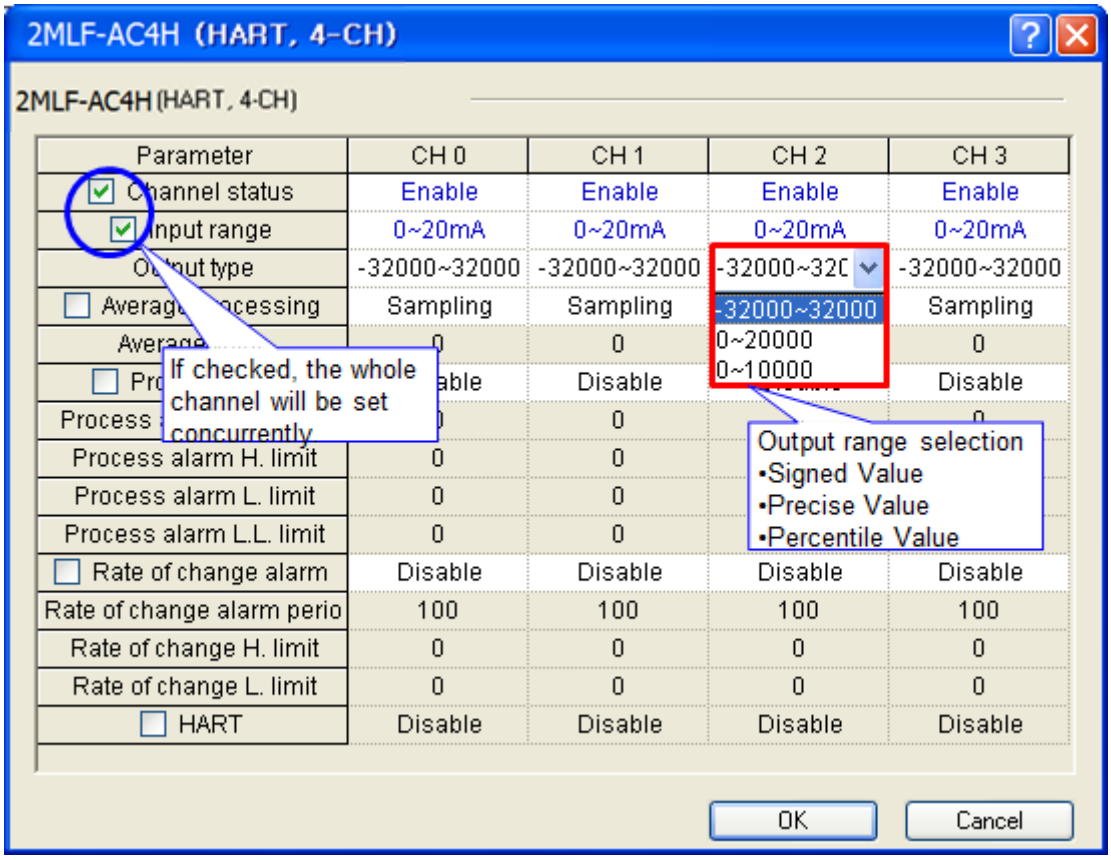
2MLF-AC4H with 4 input channels are used for current inputs, where Offset/Gain can not be adjusted by user. Current input range can be set for respective channels through user program (Refer to the Chapter) or I/O parameter setting with SoftMaster programming tool.
Digitalized output formats are specified in three types as below;

A. Signed Value
B. Precise Value
C. Percentile Value

For example, if the range is 4 ~ 20mA,

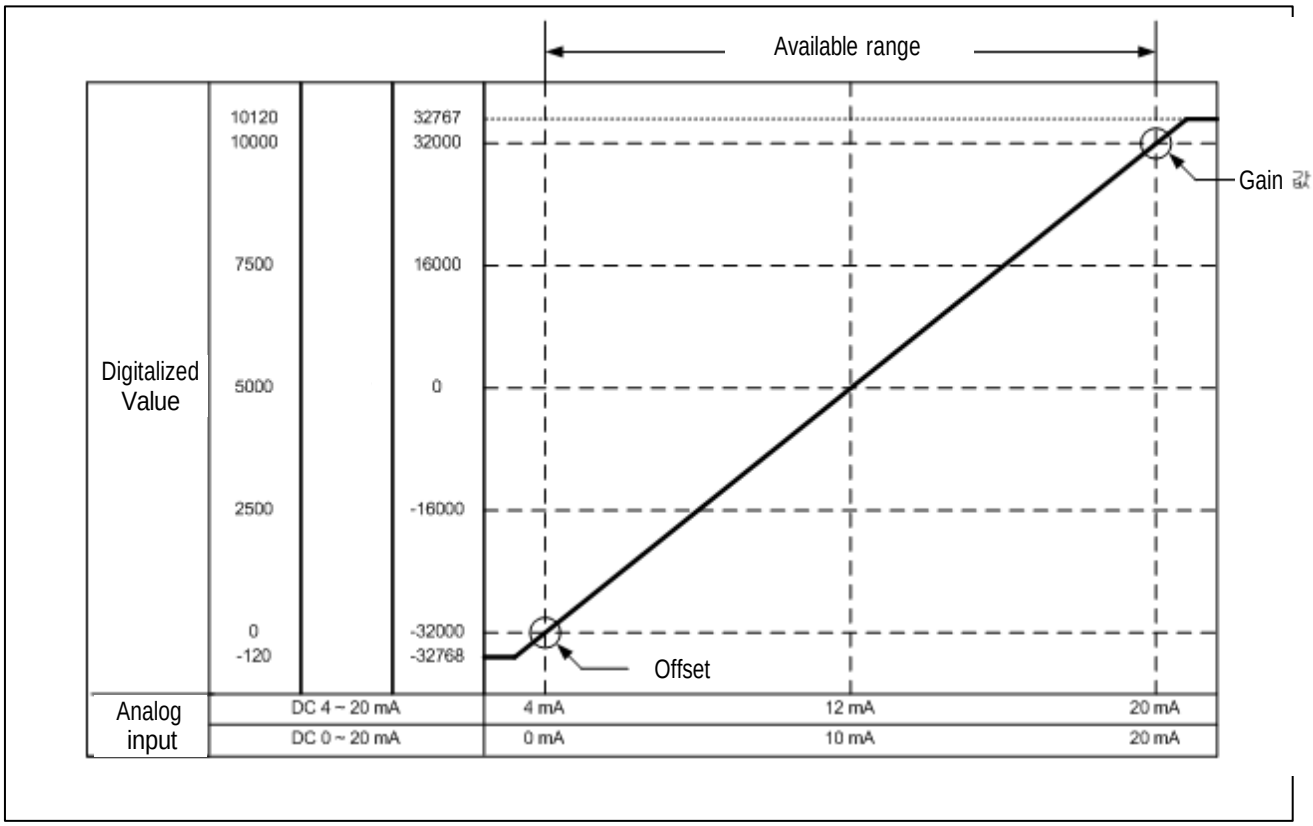
▶ On the SoftMaster menu [I/O Parameters Setting], set [Input range] to “4 ~ 20mA”.




2MLF-AC4H (HART, 4-CH)
2MLF-AC4H (HART, 4-CH)
Parameter
CH 0
CH 1
CH 2
CH 3
Channel status
Enable
Enable
Enable
Enable
Input range
0~20mA
0~20mA
0~20mA
0~20mA
Output type
-32000~32000
-32000~32000
-32000~32000
-32000~32000
Sampling
Sampling
Sampling
Disable
Disable
Process alarm H. limit
Process alarm L. limit
Process alarm L.L. limit
Rate of change alarm
Disable
Disable
Disable
Disable
Rate of change alarm perio
100
100
100
100
Rate of change H. limit
Rate of change L. limit
HART
Disable
Disable
Disable
Disable
-32000~32000
0~20000
0~10000
If checked, the whole channel will be set concurrently
Output range selection
•Signed Value
•Precise Value
•Percentile Value
OK
Cancel

2.5.2 Characteristics of the A/D conversion

Characteristics of A/D conversion are the inclination connected in a straight line between Offset and Gain values when converting analog signal (current input) to digital value. A/D conversion characteristics of HART Analog Input Modules are as described below.



Notes

1. When Analog Input Module is released from the factory, Offset/Gain value is as adjusted for respective analog input ranges, which is unavailable for user to change.
2. Offset Value: Analog input value where digitalized value is -32,000.
3. Gain Value: Analog input value where digitalized value is 32,000.

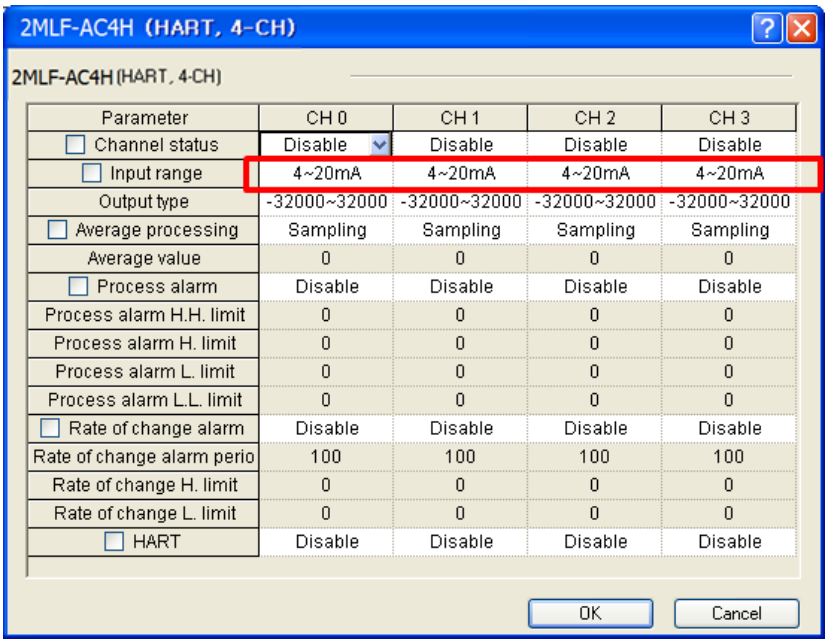
2.5.3 I/O Characteristics of 2MLF-AC4H

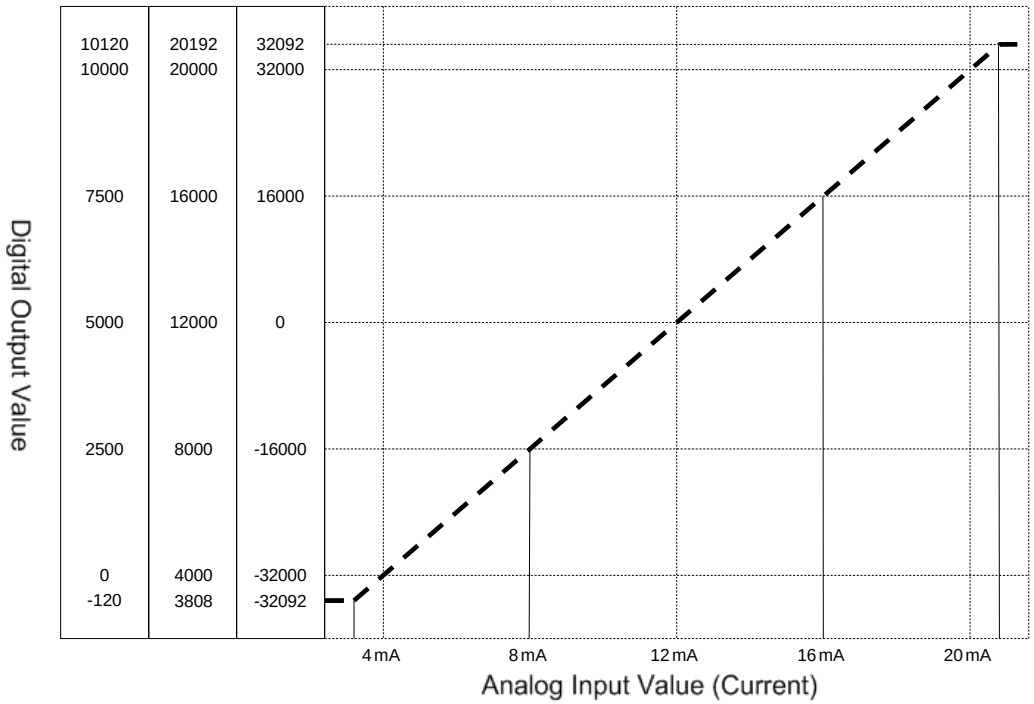
2MLF-AC4H is a HART analog input module exclusively used for 4-channel current input and HART communication, where Offset/Gain can not be adjusted by user. Current input range can be set through user program or [I/O parameter] for respective channels. Output formats of digital data are as specified below;

A. Signed Value
B. Precise Value
C. Percentile Value

(1) If the range is DC 4 ~ 20 mA

▶ On the SoftMaster menu [I/O Parameters Setting], set [Input range] to "4 ~ 20 ㎃".



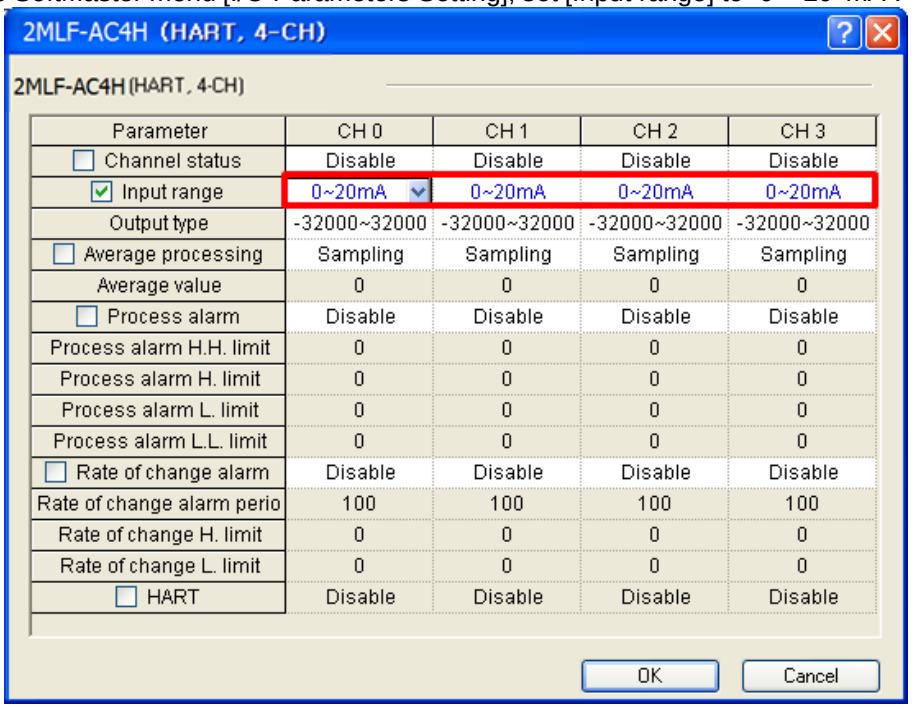


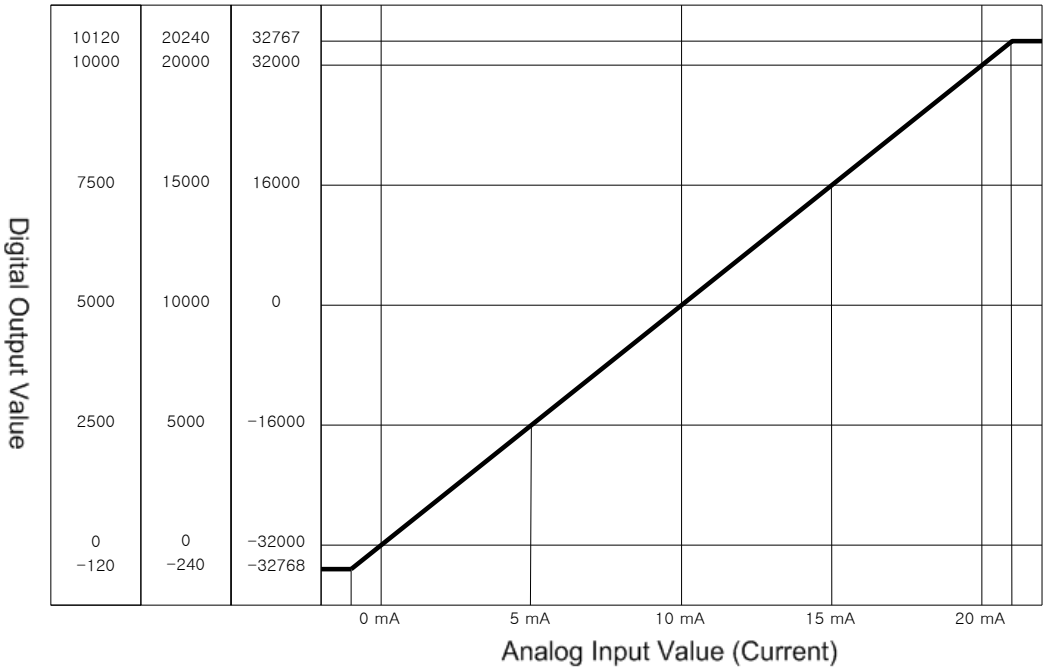
▶ Digital output value for current input characteristics is as specified below.
(Resolution (based on 1/64000): 250 nA)

Digital Output range	Analog input current (㎃)						
	3.808	4	8	12	16	20	20.192
Signed value (-32768 ~ 32767)	-32768	-32000	-16000	0	16000	32000	32767
Precise value (3808 ~ 20192)	3808	4000	8000	12000	16000	20000	20192
Percentile value (-120 ~ 10120)	-120	0	2500	5000	7500	10000	10120

(2) If the range is DC 0 ~ 20 mA

▶ On the SoftMaster menu [I/O Parameters Setting], set [Input range] to “0 ~ 20 mA”.





▶ Digital output value for current input characteristics is as specified below.
(Resolution (based on 1/64000): 312.5 nA)

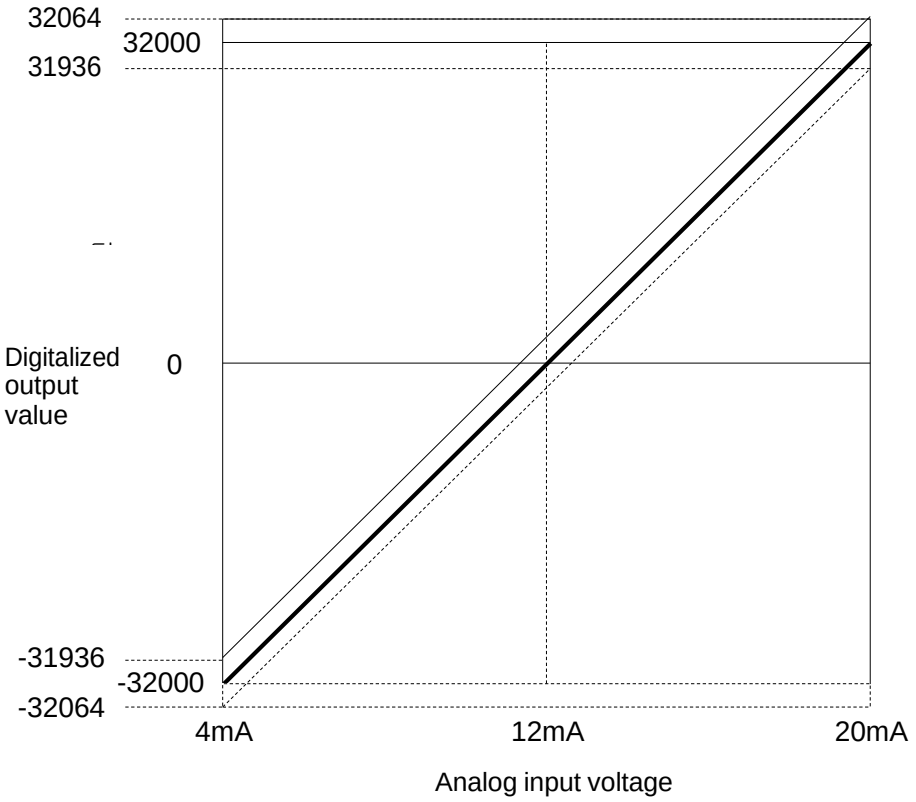
Digital Output range	Analog input current (㎃)						
	-0.24	0	5	10	15	20	20.24
Signed value (-32768 ~ 32767)	-32768	-32000	-16000	0	16000	32000	32767
Precise value (-240 ~ 20240)	-240	0	5000	10000	15000	20000	20240
Percentile value (-120 ~ 10120)	-120	0	2500	5000	7500	10000	10120

Notes

(1) If analog input value exceeding digital output range is input, the digital output value will be kept to be the max. or the min. value applicable to the output range specified. For example, if the digital output range is set to unsigned value (–32,768 ~ 32,767) and the digital output value exceeding 32,767 or analog value exceeding –32,768 is input, the digital output value will be fixed as 32,767 or –32,768.
(2) Current input shall not exceed ±30 ㎃ respectively. Rising heat may cause defects.
(3) Offset/Gain setting for 2MLF-AC4H module shall not be performed by user.
(4) If module is using to exceed input range, accuracy can not be guaranteed.

2.5.4 Accuracy

The accuracy of digital output value is not changed even when input range is changed.
Fig. 2.1 shows the changing range of the accuracy at ambient temperature of 25℃ with analog input range of 4 ~ 20 ㎃ selected and the digitalized outputs of signed value.
The error tolerance at ambient temperature of 25°C is ±0.1% and the ambient temperature 0 ~55℃ is ±0.25%.



[Fig. 2.1] Accuracy

2.6 Functions of Analog Input Module

Functions of Analog Input Module are as described below in Table 2.3.

[Table 2.3] List of Functions

Function Item	Details
Enabling the Channels	Enables the specified channels to execute A/D conversion.
Selecting the range of input	(1) Specify analog input range to be used. (2) 2 types of current inputs are available for the 2MLF-AC4H module.
Selecting the output data	(1) Specify digital output type. (2) 4 output data formats are provided in this module. (Signed, Precise and Percentile value)
A/D conversion methods	(1) Sampling processing Sampling processing will be performed when the average processing is not specified. (2) Average processing (a) Time average processing Outputs average A/D conversion value based on time. (b) Count average processing Outputs average A/D conversion value based on count times. (c) Moving average processing Outputs the newest average value in every sampling at the designated count times. (d) Weighted average processing Used to delay the sudden change of input value.
Alarm processing	Process alarm and change rate alarm processing are available.
Detecting the disconnection of input signal	If an analog input with the range of 4 ~ 20 ㎃ is disconnected, it is detected by a user program.

2.6.1. Sampling processing

The sampling period (Processing time) depends on the number of the channels in use.

Processing time = Maximum of 100ms per module

2.6.2. Average processing

This processing is used to execute A/D conversion with specified count or time and to save the average of the accumulated sum on memory. Average processing option and time/count value can be defined through user program or I/O parameters setting for respective channels.

(1) What is the average processing used for

This process is used to reduce the influence caused by abnormal analog input signal such as noise.

(2) Kinds of average processing

There are four (4) kinds of average processing, Time, Count, Moving and Weighted average.

(a) Time average processing

A. Setting range: 200 ~ 5,000 (ms)

B. Number of processing $= \frac{\text{Setting time}}{100\text{ms}}$ [times]

Ex.) Setting time: 680 ms

Number of processing $= \frac{680\text{ms}}{\text{[times](rounded) } 100\text{ms}} = 6.8 \Rightarrow 6$

*1: If setting value of time average is not specified within 200 ~ 5,000, RUN LED blinks at an interval of 1 second. In order to set RUN LED to On state, set the setting value within the range again and then change the PLC CPU from STOP to RUN mode.
Be sure to use request flag of error clear (UXY.11.0) to clear the error during RUN.
*2: If any error occurs in setting value of time average, the default value 200 will be saved.

(b) Count average processing

A. Setting range: 2 ~ 50 (times)
The average value of input data at designated times is saved as a real input data.

B. Process time = setting count x 100ms

Ex.) Average processing count time is 50.

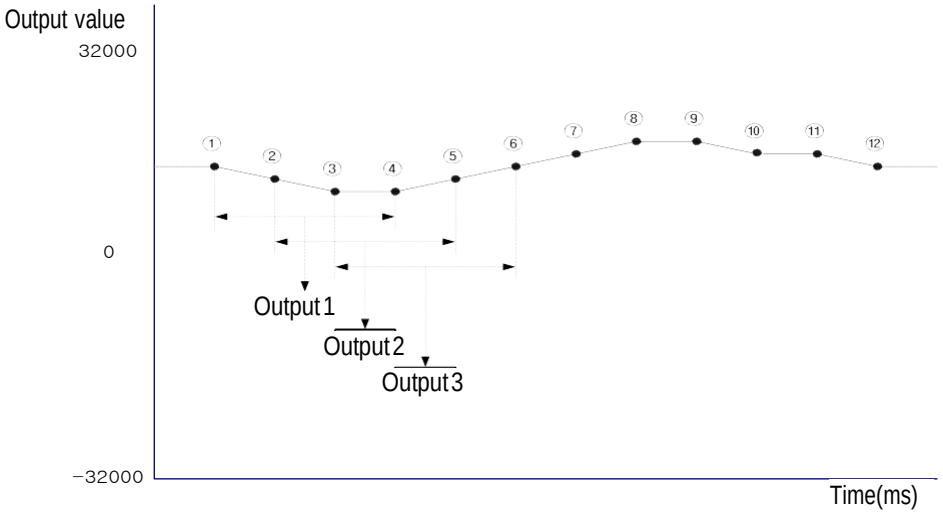
Processing time = 50 x 100ms = 5,000ms

*1: If setting value of count average is not specified within 2 ~ 50, RUN LED blinks at an interval of 1 second. In order to set RUN LED to On state, set the setting value within the range and then change PLC CPU from STOP to RUN mode.
Be sure to use request flag of error clear (UXY.11.0) to clear the error during RUN..
*2: If any error occurs in setting the value, the default value 2 will be saved.

(c) Moving average processing

A. Setting range: 2 ~ 100(times)

B. This process outputs the newest average value in every sampling at the designated count times. The Fig 2.2 shows the Moving average processing with 4 count times.



Output 1 = (① + ② + ③ + ④) / 4
Output 2 = (② + ③ + ④ + ⑤) / 4
Output 3 = (③ + ④ + ⑤ + ⑥) / 4

[Fig. 2.2] Average processing

(d) Weighted average processing

A. Setting range: 1 ~ 99(%)

$$F[n] = (1 - \alpha) \times A[n] + \alpha \times F[n - 1]$$

F[n]: Current Weighted average output
A[n]: Current A/D conversion value
F[n-1]: Former Weighted average output
α: Weighted average constant (0.01 ~ 0.99)

*1: If setting value of count average is not specified within 1 ~ 99, RUN LED blinks at an interval of 1 second. In order to set RUN LED to On status, reset the setting value of frequency average within 2 ~ 500 and then convert PLC CPU from STOP to RUN. Be sure to use request flag of error clear (UXY.11.0) to clear the error through modification during RUN.
*2: If any error occurs in setting the value, the default value 1 will be saved.

B. Current Input (for example)
- Analog input range: DC 4 ~ 20 mA, Digital output range: 0 ~ 10,000.
- When an analog input changes rapidly 4 mA to 20 mA (0 → 10,000), the outputs of Weighted average according to the constant(α) are shown below.

α	Outputs of Weighted average				비 고
	0 scan	1 scan	2 scan	3 scan	
*1) 0.01	0	9,900	9,999	9,999	Weighted 1% to former value
*2) 0.5	0	5,000	7,500	8,750	Weighted 50% to former value
*3) 0.99	0	100	199	297	Weighted 99% to former value

*1) Outputs 10,000 after about 4 scans
*2) Outputs 10,000 after about 21 scans
*3) Outputs 10,000 after 1,444 scans (144s)

- To get the stabilized output against rapid input changes (e.g. noise), this weighted average processing will be helpful.

2.5.3 Alarm processing

(1) Process Alarm

When the digital value becomes greater than process alarm HH limit value, or less than LL limit value, the alarm flag turns on and the alarm LED on the front of the module flickers.

When the digital output value becomes less than process alarm H limit value, or greater than L limit value, the alarms are cleared.

(2) Change rate alarm

This function enables to sample data cyclically with the period set in the parameter of 'Rate of change alarm period' and to compare every two sample data.

The unit used for 'Rate of change H limit' and 'Rate of change L limit' is percentage per second (%/s).

(a) Setting rate of the sampling period: 100 ~ 5,000(ms)

If '1000' is set for the period, the input data is sampled and compared every 1 second.

(b) Setting range of change rate limit: -32768 ~ 32767(-3276.8%/s ~ 3276.7%/s)

(c) Calculation of the criterion

The criterion of change rate alarm

= High limit or Low limit of change rate alarm X 0.001 X 64000 X Detection period ÷ 1000

1) An example for change rate setting 1(Rising rate detection)

a) Detection period of Ch. 0: 100(ms)
b) Alarm high(H) limit of Ch. 0: 100(10.0%)
c) Alarm low(L) limit of Ch. 0: 90(9.0%)
d) Alarm high(H) criterion of Ch.0
= 100 X 0.001 X 64000 X 100 ÷ 1000 = 640
e) Alarm low(L) criterion of Ch.0
= 90 X 0.001 X 64000 X 100 ÷ 1000 = 576
f) When the deviation value of ([n]th digital value) – ([n-1]th digital value) becomes greater than 640, high(H) change rate detection flag of Ch.0(CH0 H) turns on.
g) When the deviation value of ([n]th digital value) – ([n-1]th digital value) becomes less than 576, low(L) change rate detection flag f Ch.0(CH0 L) turns on.

2) An example for change rate setting 2(Falling rate detection)

a) Detection period of Ch. 0: 100(ms)
b) Alarm high(H) limit of Ch. 0: -10(-1.0%)
c) Alarm low(L) limit of Ch. 0: -20(-2.0%)
d) Alarm high(H) criterion of Ch.0
= -10 X 0.001 X 64000 X 100 ÷ 1000 = -64
e) Alarm low(L) criterion of Ch.0
= -20 X 0.001 X 64000 X 100 ÷ 1000 = -128
f) When the deviation value of ([n]th digital value) – ([n-1]th digital value) becomes greater than -64, high(H) change rate detection flag of Ch.0(CH0 H) turns on.
g) When the deviation value of ([n]th digital value) – ([n-1]th digital value) becomes less than -128, low(L) change rate detection flag f Ch.0(CH0 L) turns on.

3) An example for change rate setting 3 (Detection of change rate)

a) Detection period of Ch. 0: 1000(ms)

b) Alarm high(H) limit of Ch. 0: 2(0.2%)

c) Alarm low(L) limit of Ch. 0: -2(-0.2%)

d) Alarm high(H) criterion of Ch.0

= 2 X 0.001 X 64000 X 1000 ÷ 1000 = 128

e) Alarm low(L) criterion of Ch.0

= -2 X 0.001 X 64000 X 1000 ÷ 1000 = -128

f) When the deviation value of ([n]th digital value) – ([n-1]th digital value) becomes greater than 128, high(H) change rate detection flag of Ch.0(CH0 H) turns on.

g) When the deviation value of ([n]th digital value) – ([n-1]th digital value) becomes less than -128, low(L) change rate detection flag f Ch.0(CH0 L) turns on.

2.5.4 Detection of input disconnection

(1) Available inputs

This detection function is available for the analog inputs of 4 ~ 20 mA.
The detecting condition is as below.

Input range	Detecting range
4 ~ 20 mA	Less than 0.8 mA

(2) Detection status

The detection status of each channel is saved in Uxy.10.z
(x: base number, y: slot number, z: bit number)

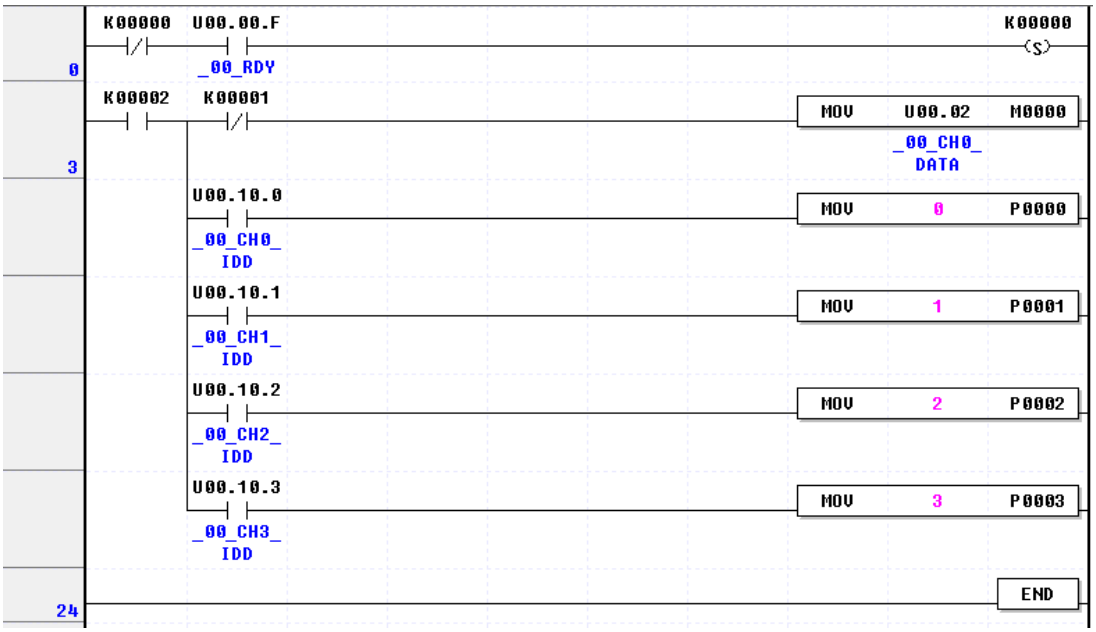
Bit number	15	14	---	5	4	***3***	***2***	***1***	***0***
Initial value	0	0	0	0	0	***0***	***0***	***0***	***0***
Channel number	-	-	-	-	-	***Ch.3***	***Ch.2***	***Ch.1***	***Ch.0***

BIT	Description
0	Normal operation
1	Disconnection

(3) Operation of the detection status

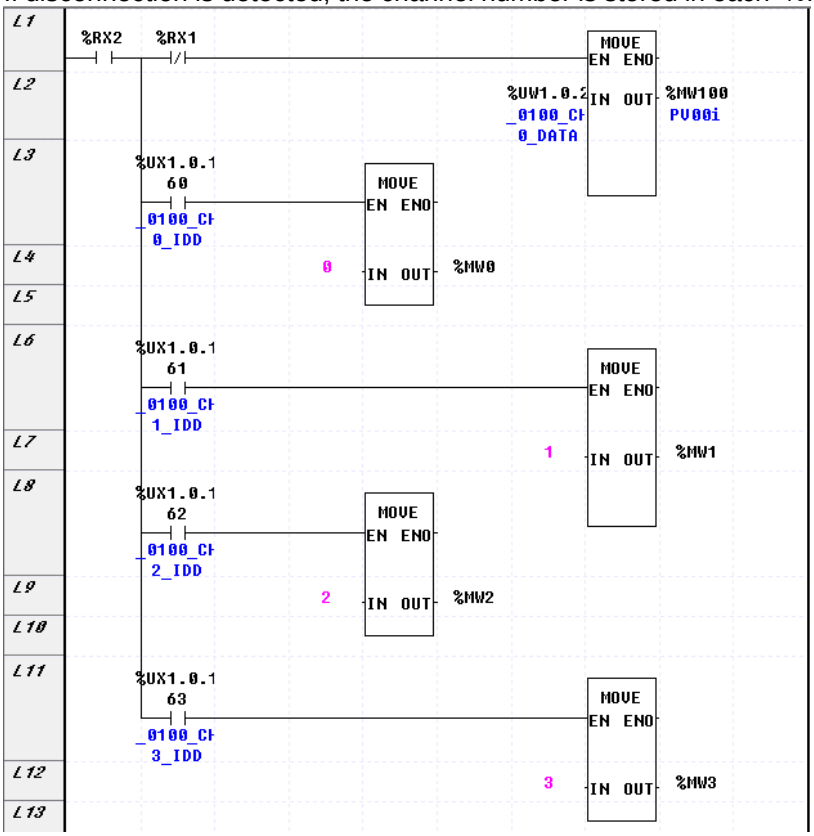
Each bit is set to ‘1’ when detecting disconnection, and returned to ‘0’ when detecting connection.
The status bits can be used in a user program for detecting the disconnection.

(4) Program example (non-IEC, 2MLK)
As for the module mounted on base 0, slot 1,
If disconnection is detected, the channel number is stored in each 'P' area.



Note. U01.10.n(n=0,1,2,3) : CHn_IDD (HART Analog input Mode : Channel disconnection Flag)

(5) Program example (IEC61131-3, 2MLR and 2MLI)
As for the module mounted on base 1, slot 0,
If disconnection is detected, the channel number is stored in each '%M' area.



Chapter 3 Installation and Wiring

3.1 Installation

3.1.1 Installation environment

This product is of high reliance regardless of installation environment. However, for the sake of reliance and stability of the system, please pay attention to the precautions described below.

(1) Environmental conditions
- To be installed on the control panel waterproof and dustproof.
- No continuous impact or vibration shall be expected.
- Not to be exposed to direct sunlight.
- No dew shall be caused by rapid temperature change.
- Ambient temperature shall be kept 0-65℃.

(2) Installation work
- Do not leave wiring waste inside the PLC after wiring or drilling screw holes.
- To be installed on a good location to work on.
- Don't let it be installed on the same panel as the high-voltage device.
- Let it be kept at least 50 ㎜ away from duct or near-by module.
- To be grounded in an agreeable place free from noise.

3.1.2 Precautions for handling

Precautions for handling 2MLF-AC4H module are as described below from the opening to the installation.

(1) Don't let it be dropped or shocked hardly.
(2) Don't remove PCB from the case. It will cause abnormal operation.
(3) Don't let any foreign materials including wiring waste inside the top of the module when wiring. Remove foreign materials if any inside.
(4) Don't install or remove the module while powered on.
(5) The attachment torque of fixed screw of module and the screw of terminal block should be within the range as below.

Attachment part	Attachment Torque range
I/O module terminal block screw (M3 screw)	42 ~ 58 N·㎝
I/O module terminal block fixed screw (M3 screw)	66 ~ 89 N·㎝

Notes

- HART analog input module can use when installed in extended base in 2MLR systems.

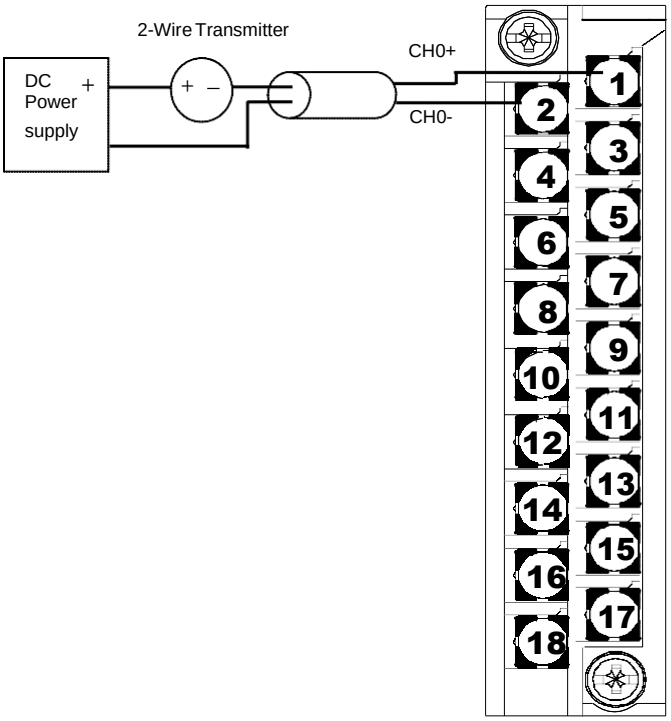
3.2 Wiring

3.2.1 Precautions for wiring

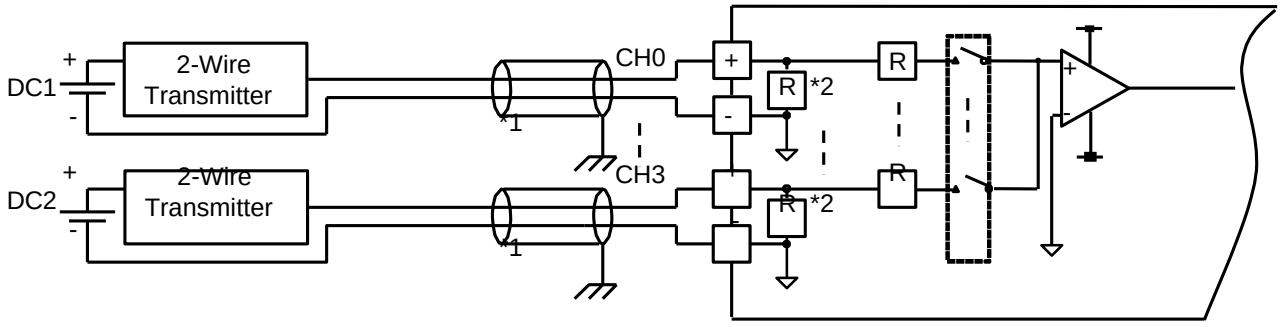
(1) Don't let AC power line near to 2MLF-AC4H Module's external input sign line. With an enough distance kept away in between, it will be free from surge or inductive noise.
(2) Cable shall be selected in due consideration of ambient temperature and allowable current, whose size is not less than the max. cable standard of AWG22 (0.3 ㎟).
(3) Don't let the cable too close to hot device and material or in direct contact with oil for long, which will cause damage or abnormal operation due to short-circuit.
(4) Check the polarity when wiring the terminal.
(5) Wiring with high-voltage line or power line may produce inductive hindrance causing abnormal operation or defect.

3.2.2 Wiring examples

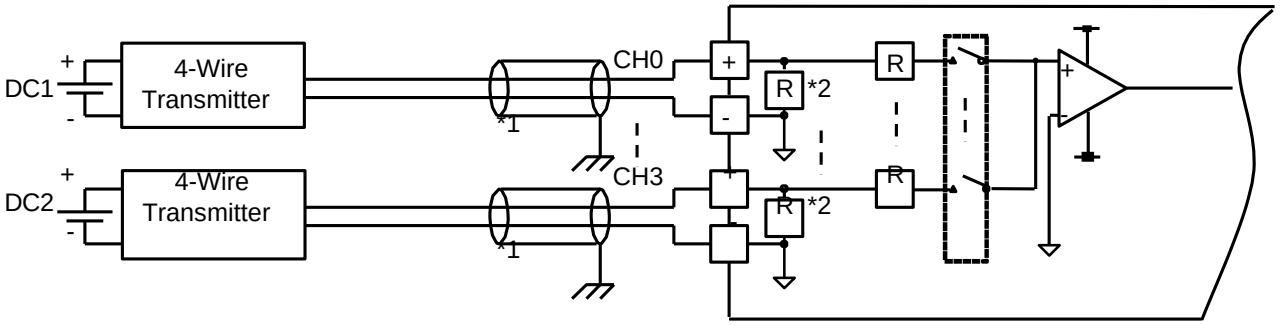
Channel	Input	Terminal no.
CH0	+	1
	-	2
CH1	+	3
	-	4
CH2	+	5
	-	6
CH3	+	7
	-	8
-	NC	9
	NC	10
	NC	11
	NC	12
	NC	13
	NC	14
	NC	15
	NC	16
	NC	17
	NC	18



(1) Wiring example of 2-wire sensor/transmitter



(2) Wiring example of 4- wire sensor/transmitter



* 1) Use a 2-core twisted shielded wire. AWG 22 is recommended for the cable standard.
* 2) Input resistance for current input is 250 Ω (typ.).

Notes

(1) In current input, there will be no accuracy tolerance caused by cable length and internal resistance of the source.
(2) Set to enable the channel only to be using.
(3) 2MLF-AC4H module does not provide power for the input device. Use an external power supplier.
(4) If you do not separate the DC power of the transmitter each channel, it can affect the accuracy.
(5) In consideration of the current consumption of the transmitter, please use the external power supply of sufficient capacity.
(6) If you configure the system to provide the power of several transmitter by a external power supply, please be careful not to exceed the allowable current of the external power supply the total current consumption of the transmitter.

3.2.2 Maximum communication distance

(1) HART communication is available up to 1 ㎞. But, if a transmitter presents the max communication distance, apply the shorter distance among the transmitter's communication distance and 1 ㎞.

(2) The max communication distance may vary according to the cable capacitance and resistance. To ensure the max communication distance, check the cable's capacitance and length.

(3) Example of cable selection to secure communication distance

(a) If the cable capacitance is less than 90pF and the cable resistance is less than 0.09Ω, the distance available for communication will be 1 ㎞.

(b) If the cable capacitance is less than 60pF and cable resistance is less than 0.18Ω, the distance available for communication will be 1 ㎞.

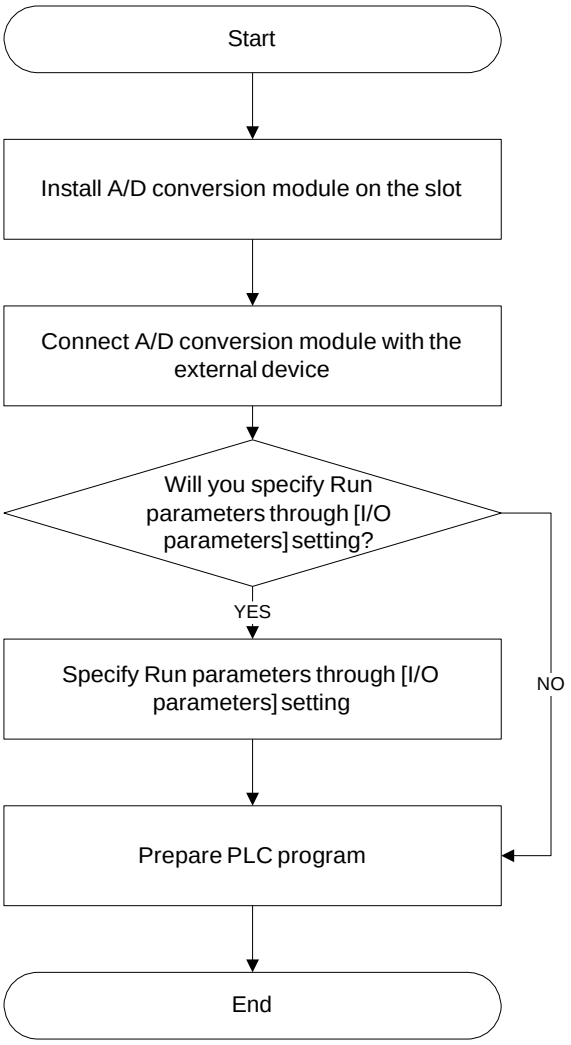
(c) If the cable capacitance is less than 210pF and cable resistance is less than 0.12Ω, the distance available for communication will be 600m.

		Resistance (Ω/m)							
		0.03	0.06	0.09	0.12	0.15	0.18	0.21	0.24
Cable Capacitance (㎊/m)	1,200	100 m	100 m	100 m	100 m	100 m	100 m	100 m	100 m
	750	100 m	100 m	100 m	100 m	100 m	100 m	100 m	100 m
	450	300 m	300 m	300 m	300 m	300 m	300 m	300 m	300 m
	300	600 m	300 m	300 m	300 m	300 m	300 m	300 m	300 m
	210	600 m	600 m	600 m	600 m	600 m	300 m	300 m	300 m
	150	900 m	900 m	600 m	600 m	600 m	600 m	600 m	600 m
	90	1,000 m	1,000 m	1,000 m	900 m	900 m	900 m	900 m	600 m
	60	1,000 m	1,000 m	1,000 m	1,000 m	1,000 m	1,000 m	900 m	900 m

Chapter 4 Operation Procedures and Monitoring

4.1 Operation Procedures

The processing for the operation is as shown in Fig. 4.1



[Fig. 4.1] Procedures for the operation

4.2 Setting the Operation Parameters

There are two ways of setting the operation parameters.
One is to set in the [I/O Parameters] of the SoftMaster, the other is to set in a user program with the internal memory of the module.(Refer to the Chapter 5 for the setting in a program)

4.2.1 Parameters for the 2MLF-AC4H module

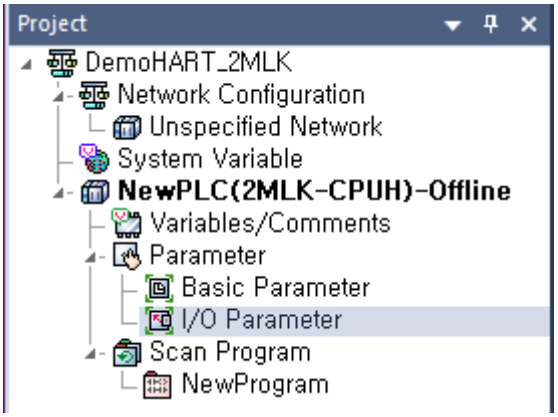
Setting items for the module are as described below in the table 4.1.

[Table 4. 1] Function of [I/O Parameters]

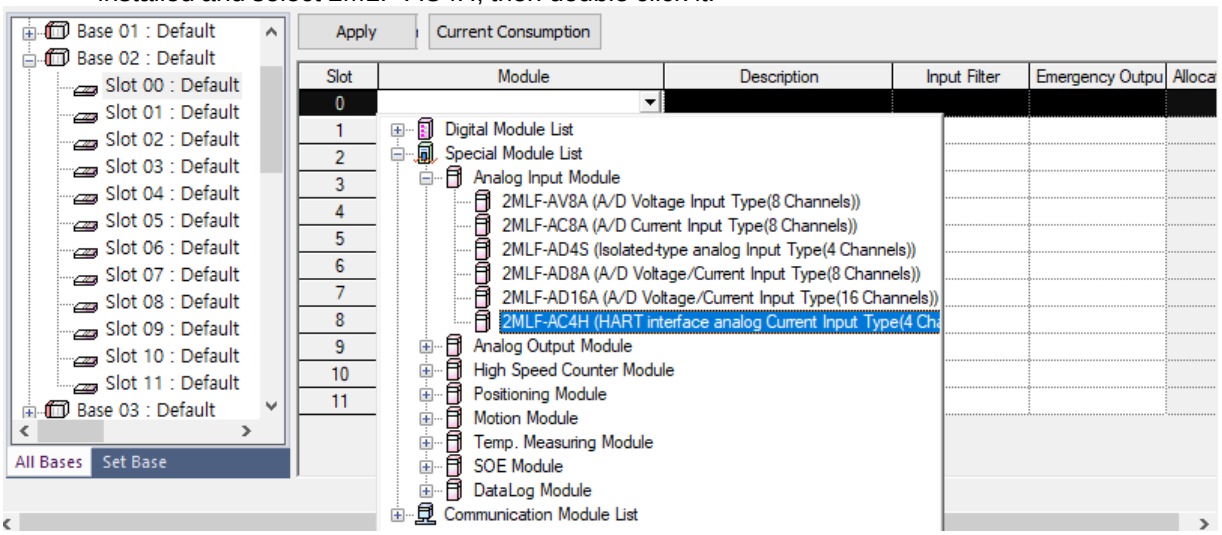
Item	Details
[I/O parameters]	(1) Specify the following items necessary for the module operation. - Channel status: Enable/Disable each channel to operate - Input range: Setting ranges of input voltage/current - Output type: Setting the type of digitalized value - Average processing: Selecting the method of average processing - Average value setting - Process alarm: Enable/disable the alarm processing - Process alarm HH, H, L and LL limit setting - Rate of change alarm: Enable/disable the alarm processing - Rate of change alarm percentile, H and L limit - HART: Enable/Disable the HART communication. (2) The data set above can be downloaded at any time regardless of the status of the CPU(Run or Stop)

4.2.2 The procedure of setting parameters with SoftMaster

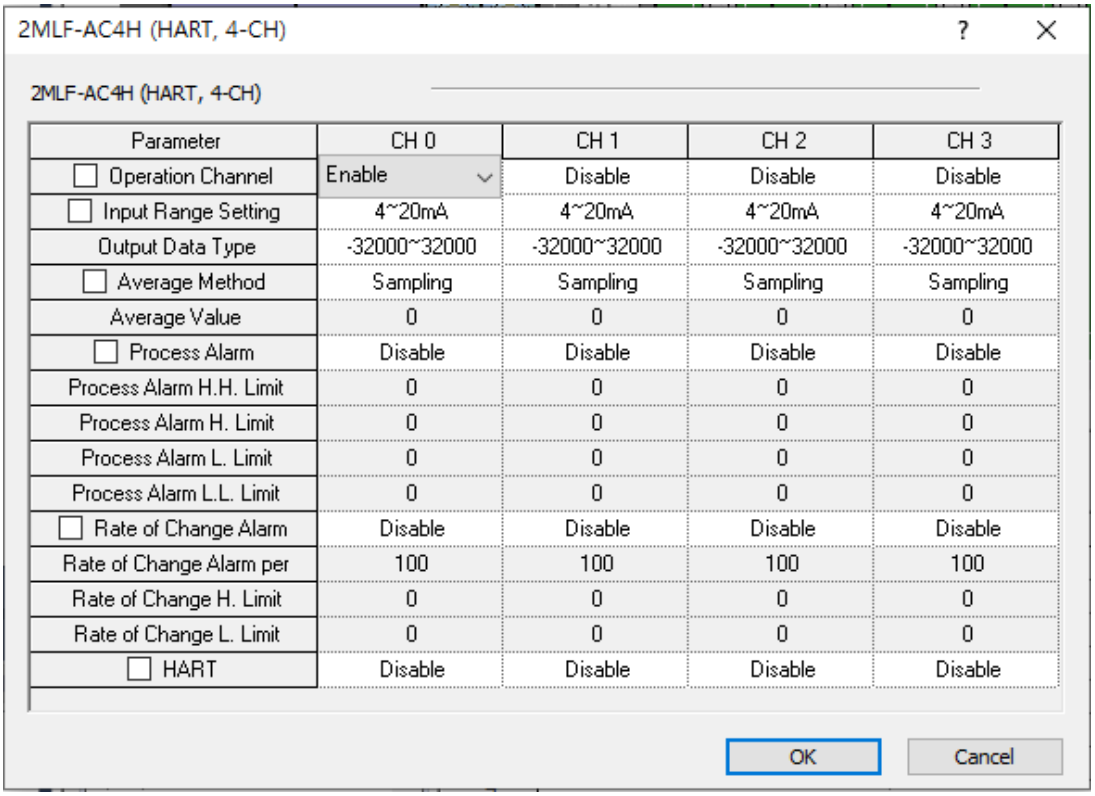
(1) Open SoftMaster to create a project. (Refer to User Guide for SoftMaster for more details)
(2) Double-click [I/O parameters] on the project window.



(3) On the 'I/O parameters setting' screen, click the slot number on which the 2MLF-AC4H module is installed and select 2MLF-AC4H, then double click it.

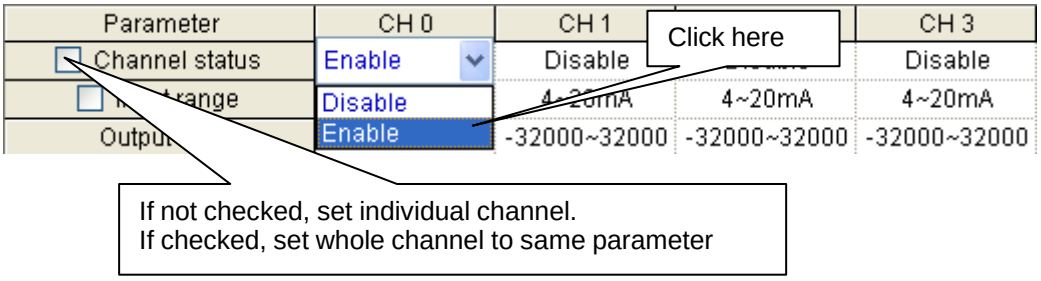


(4) After selecting the module, click [***Details***]

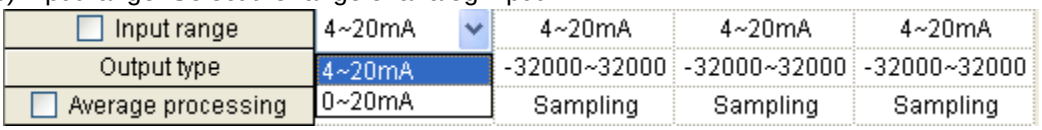


(5) Set the individual parameters.

(a) Channel status: Set to Enable or Disable.



(b) Input range: Select the range of analog input.



(c) Output type: Select the type of converted digital value.

Output type	-32000~32000	-32000~32000	-32000~32000	-32000~32000
☐ Average processing	-32000~32000	Sampling	Sampling	Sampling
Average value	4000~20000	0	0	0
☐ Process alarm	0~10000	Disable	Disable	Disable

(d) Average processing: Select the method of the average processing.

☐ Average processing	Time-Avr	Sampling	Sampling	Sampling
Average value	Sampling	0	0	0
☐ Process alarm	Time-Avr	Disable	Disable	Disable
Process alarm H.H. limit	Count-Avr	0	0	0
Process alarm H. limit	Moving-Avr	0	0	0
	Weighted-Avr			

(e) Average Value: Set number within the range shown below.

Average value	200	0	0	0
☐ Process alarm	Disable	Disable	Disable	Disable
Process alarm H.H. limit	0	0	0	0
Process alarm H. limit	0	0	0	0
Process alarm L. limit	0	0	0	0
Process alarm L.L. limit	0	0	0	0
☐ Rate of change alarm	Disable	Disable	Disable	Disable
Rate of change alarm perio	100	100	100	100
Rate of change H. limit	0	0	0	0
Rate of change L. limit	0	0	0	0
☐ HART	Disable	Disable	Disable	Disable

200~5000

OK Cancel

[Setting range of the average processing]

Average processing	*Setting range*
Time average	200 ~ 5000(㎳)
Count average	2 ~ 50
Moving average	2 ~ 100
Weighted average	1 ~ 99(%)

(f) Process alarm: Set Enable or Disable for Process alarm.

☐ Process alarm	Disable	Disable	Disable	Disable
Process alarm H.H. limit	Disable	0	0	0
Process alarm H. limit	Enable	0	0	0

(g) Process alarm limits: Set each criterion for limit within the range shown below.

Process alarm H.H. limit	0	0	0	0
Process alarm H. limit	0	0	0	0
Process alarm L. limit	0	0	0	0
Process alarm L.L. limit	0	0	0	0
☐ Rate of change alarm	Disable	Disable	Disable	Disable
Rate of change alarm perio	100	100	100	100
Rate of change H. limit	0	0	0	0
Rate of change L. limit	0	0	0	0
☐ HART	Disable	Disable	Disable	Disable

-32768~32767 OK Cancel

(h) Rate of change alarm: Set Enable or disable alarm for the change rate.

☐ Rate of change alarm	Disable	Disable	Disable	Disable
Rate of change alarm perio	Disable	100	100	100
Rate of change H. limit	Enable	0	0	0

(i) Rate of change limits: Set each criterion for limit within the range shown below.

Rate of change alarm perio	100	100	100	100
Rate of change H. limit	0	0	0	0
Rate of change L. limit	0	0	0	0
☐ HART	Disable	Disable	Disable	Disable

100~5000 OK Cancel

(j) HART: Set Enable or Disable for HART communication.

☐ HART	Disable	Disable	Disable	Disable
	Disable			
	Enable			

OK Cancel

4.3 Functions of Monitoring Special Module

Functions of Monitoring Special Module are as described below in table 4.2.

[Table 4. 2] Functions of Special Module Monitoring

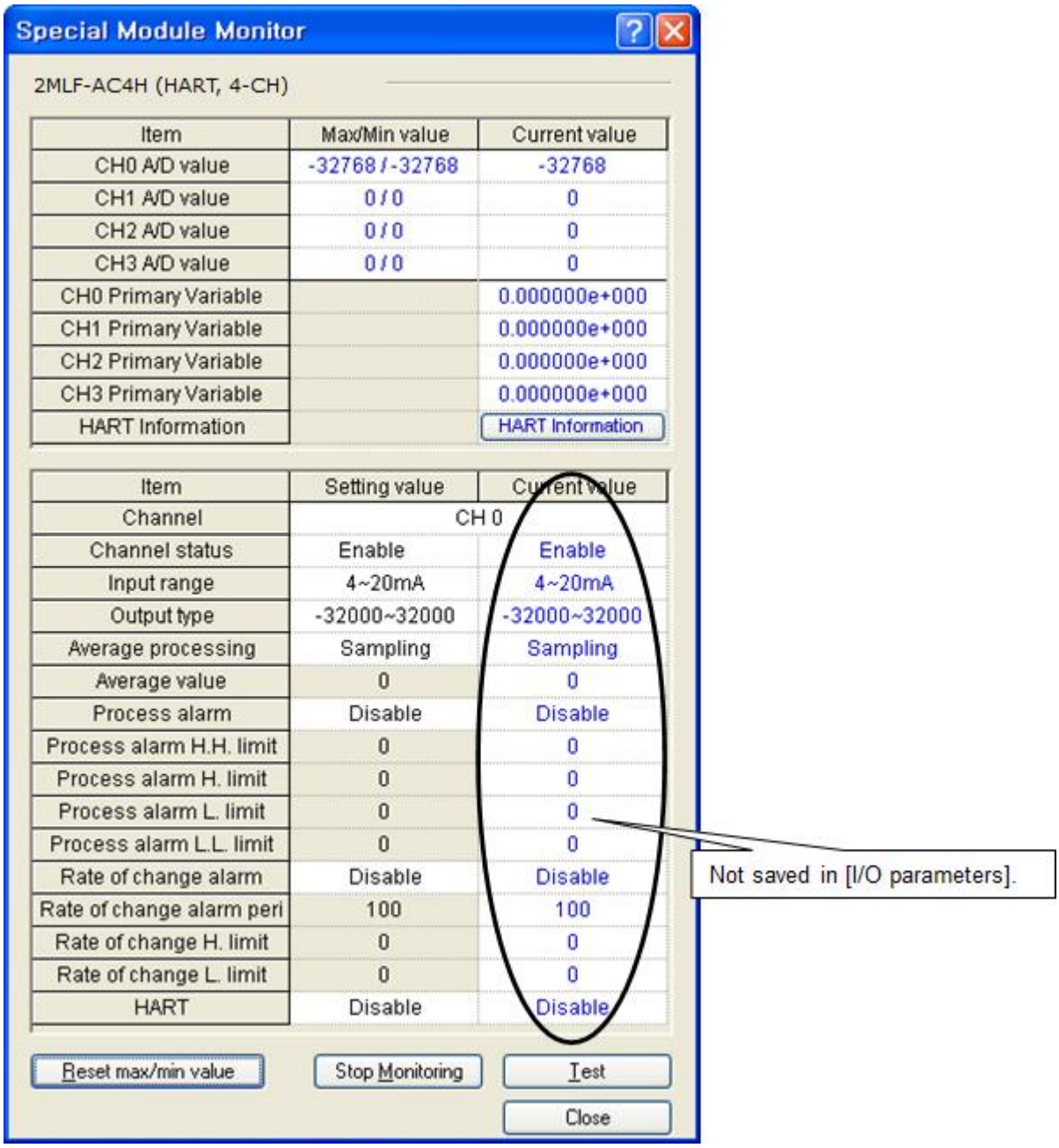
Item	Details
[Special Module Monitoring]	(1) Monitor/Test After connecting SoftMaster with the PLC, select [Special Module Monitoring] in the [Monitor] menu. The 2MLF-AD4S module can be monitored and tested. When testing the module, the CPU should be stopped. (2) Monitoring the max./min. value The max./min. value of the channel can be monitored during Run. However, when [Monitoring/Test] screen is closed, the max./min. value will not be saved. (3) The parameters specified for the test in the [Special Module Monitor] screen are not saved in the [I/O parameter] when closing the screen.

Notes

The screen may not be normally displayed due to insufficient system resource. In such a case, close the screen and finish other applications in order to restart SoftMaster.

4.4 Precautions

- The parameters specified for the test of A/D conversion module on the “Monitor Special Module” screen of [Monitor Special Module] will be deleted the moment the “Monitor Special Module” screen is closed. In other words, the parameters of A/D conversion module specified on the “Monitor Special Module” screen will not be saved in [I/O parameters] located on the left tab of SoftMaster.

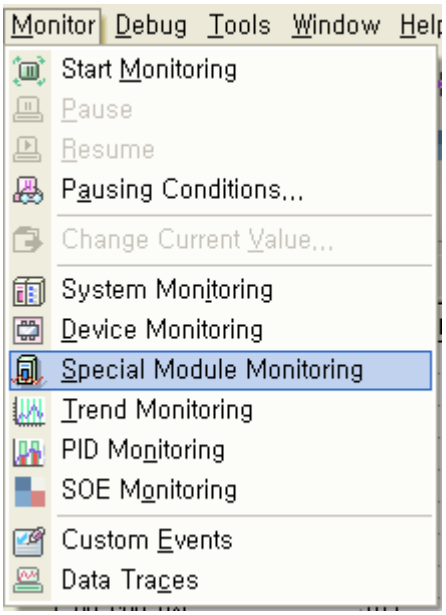


- Test function of [Monitor Special Module] is provided for user to check the normal operation of A/D conversion module even without sequence programming. If A/D conversion module is to be used for other purposes than a test, use parameters setting function in [I/O parameters].

4.5 Monitoring the Special Module

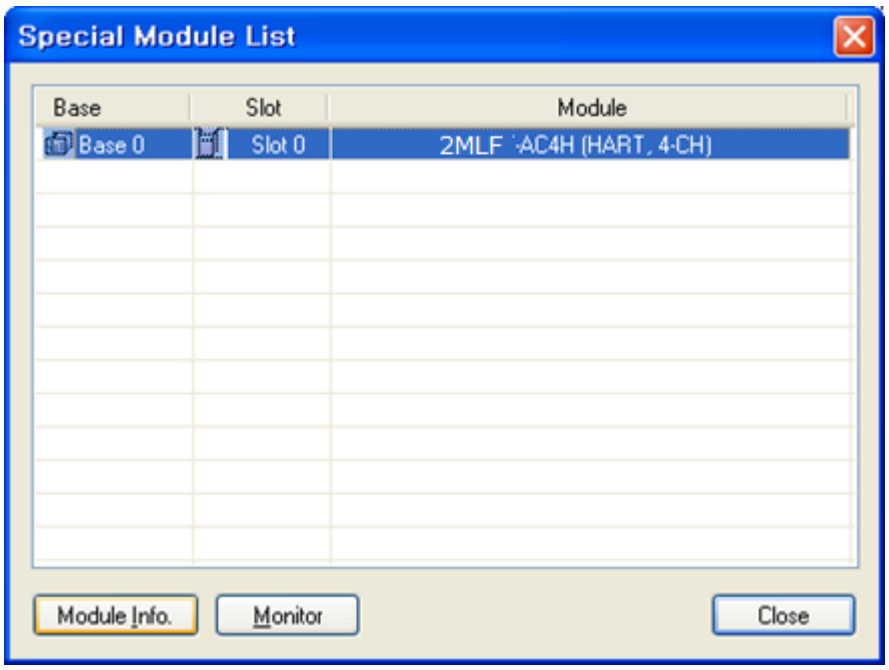
4.5.1 Start with [Special Module Monitoring]

After connecting to the PLC, click [Monitor] -> [Special Module Monitoring].
If the status is not [Online], [Special Module Monitoring] menu will not be active.



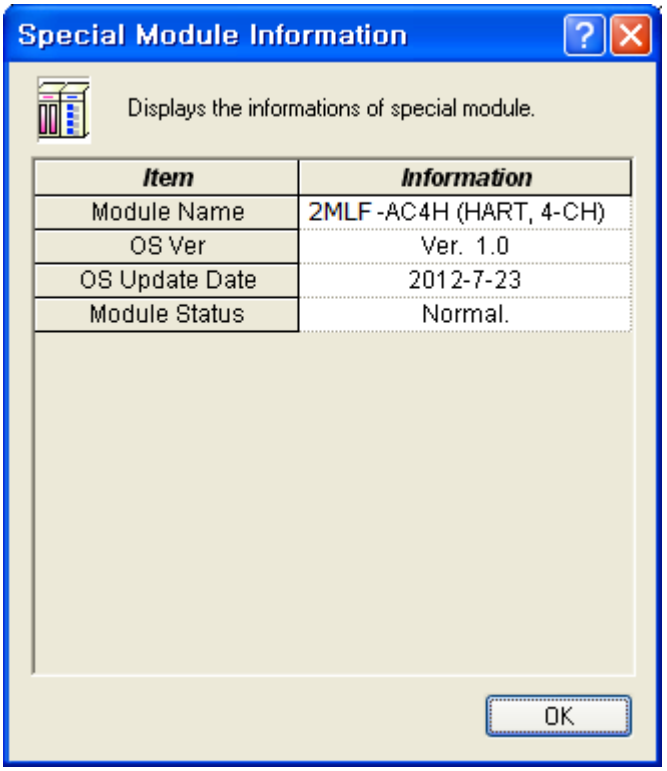
4.5.2 How to use [Special Module Monitoring]

(1) 'Special Module List' screen will be shown as Fig. 5.1. The module installed on the present PLC system will be displayed on the screen.



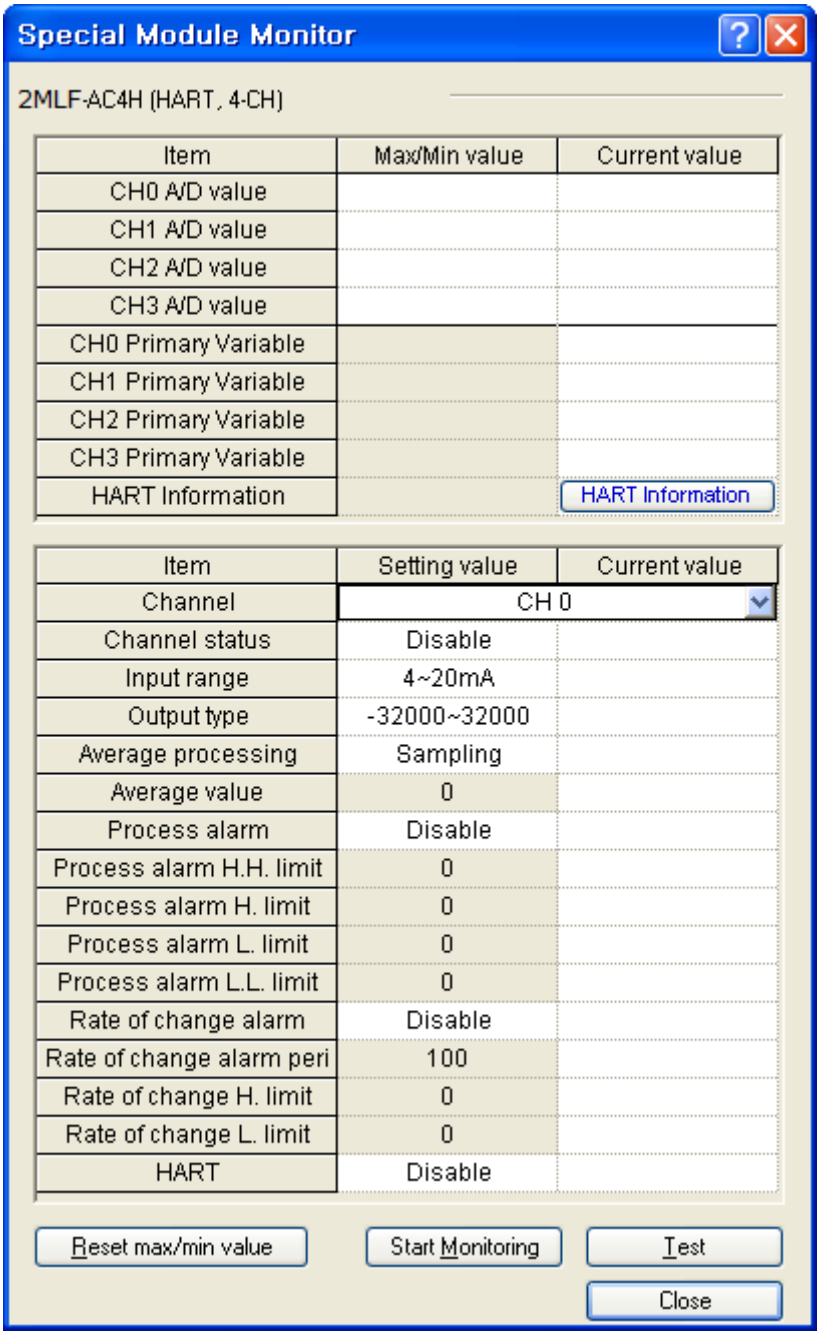
[Fig. 5. 1] [Special Module List]

(2) Select Special Module in Fig. 5.1 and click [Module Info.] to display the information as Fig. 5.2.



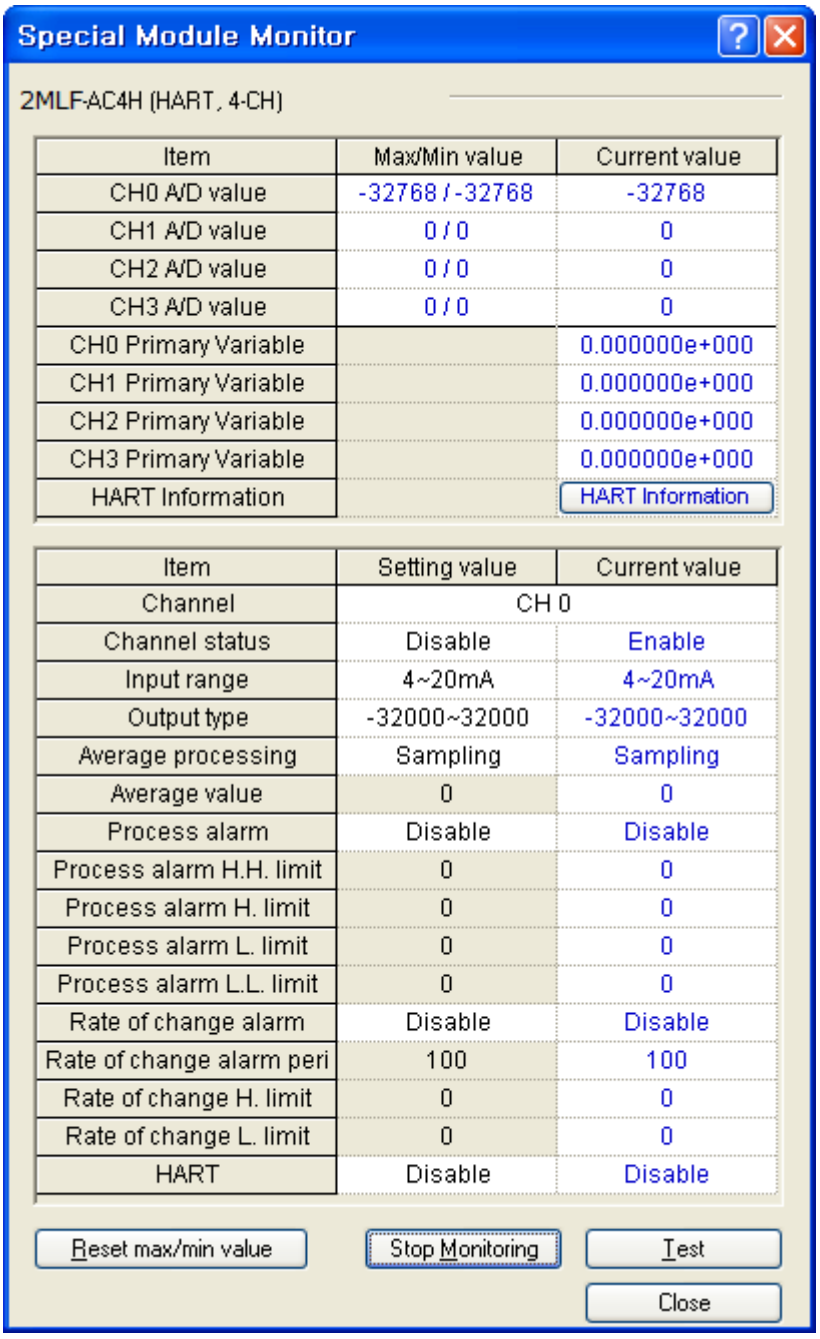
[Fig. 5. 2] [Special Module Information]

(3) In order to monitor the special module, click [Monitor] after selecting the module in the Special Module List screen (Fig. 5.1). Then [Special Module Monitoring] screen as Fig. 5.3, will be displayed.



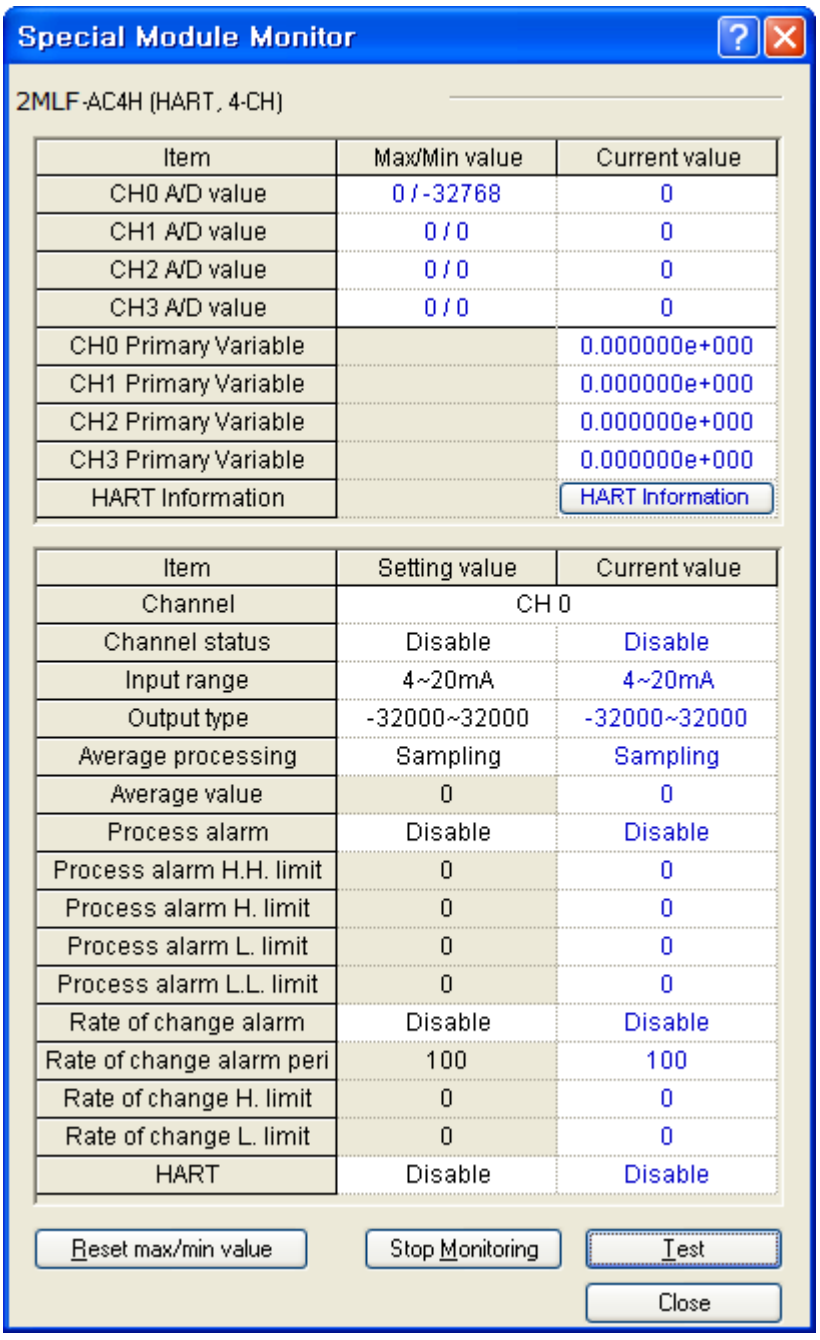
[Fig. 5. 3] [Special Module Monitor]

(a) [Start Monitoring]: Click [Start Monitoring] to display A/D converted value of the presently operated channel. Fig. 5.4 is the monitoring screen displayed when the whole channel of 2MLF-AC4H are in Stop status. In the present value field at the screen bottom, presently specified parameters of Analog Input Module are displayed.



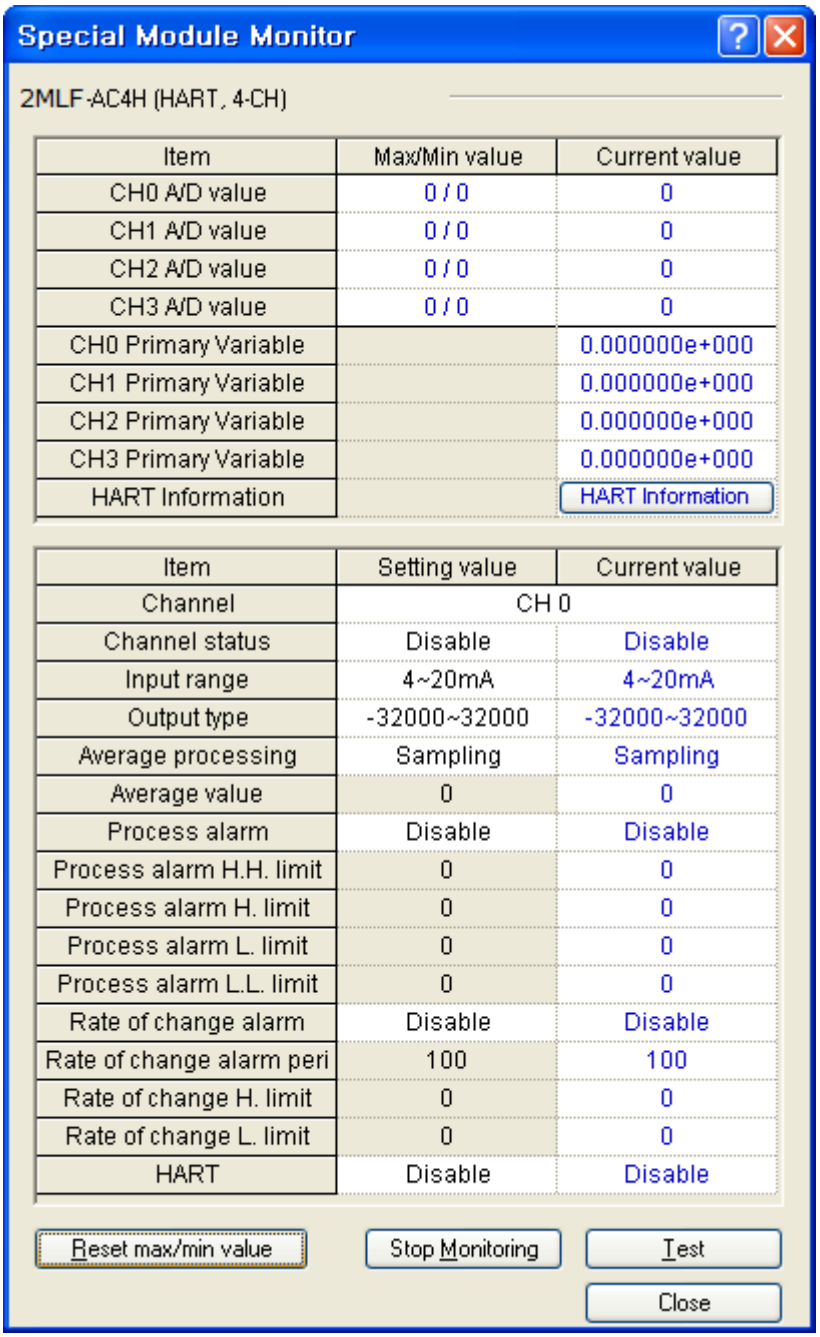
[Fig. 5. 4] Execution screen of [Start Monitoring]

(b) [Test]: [Test] is used to change the presently specified parameters of Analog Input Module. Click the setting value at the bottom field of the screen to change parameters. Fig. 5.5 will be displayed after [Test] is executed with channel 0's input voltage range changed to -10 ~ 10 V in the state of input not wired.
This function is executed in the state of CPU stop.



[Fig. 5. 5] Execution screen of [Test]

(c) [Reset Max./Min. value]: The max./min. value field at the upper screen shows the max. value and the min. value of A/D converted value. Click [Reset max./min. value] to initialize the max./min. value. Then the current value of the channel 0 is reset.

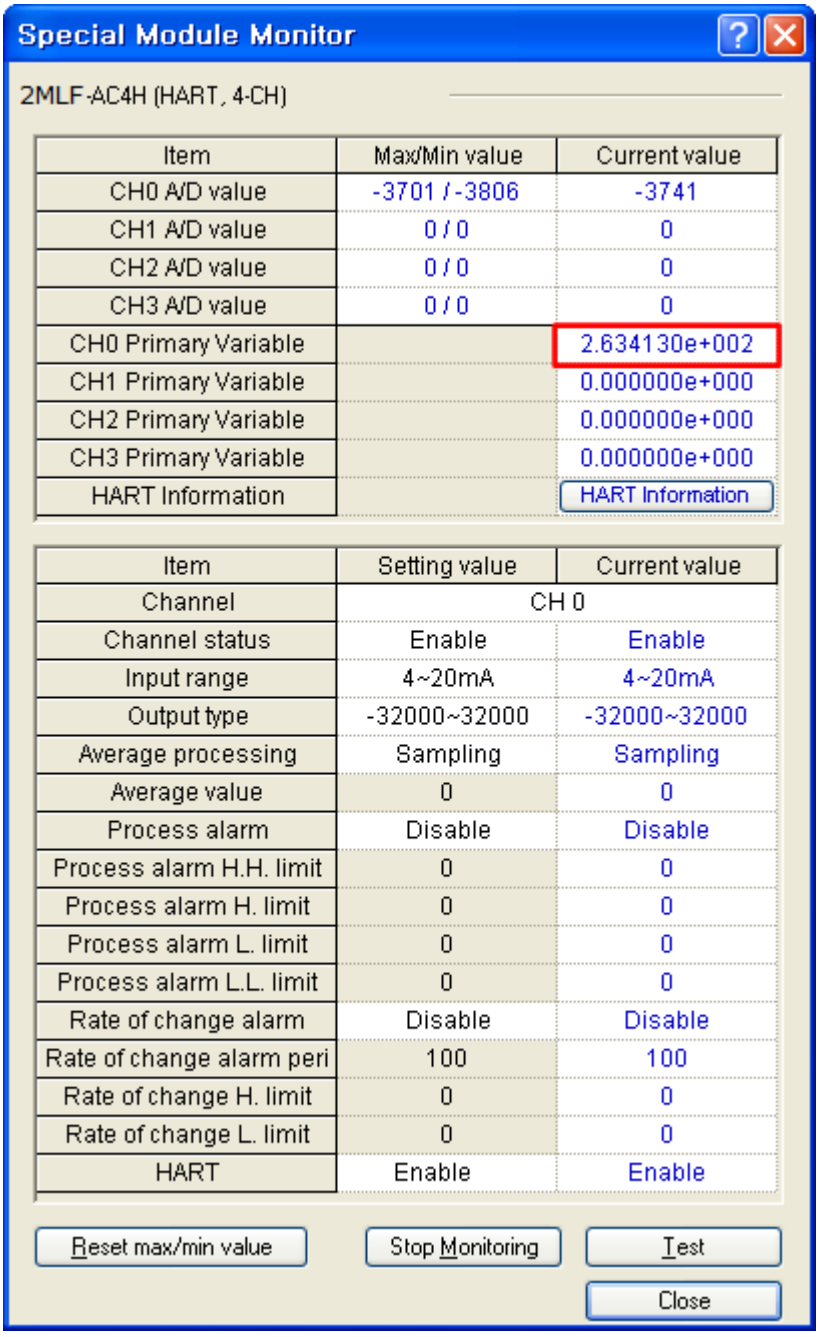


[Fig. 5. 6] Execution screen of [Reset max./min. value]

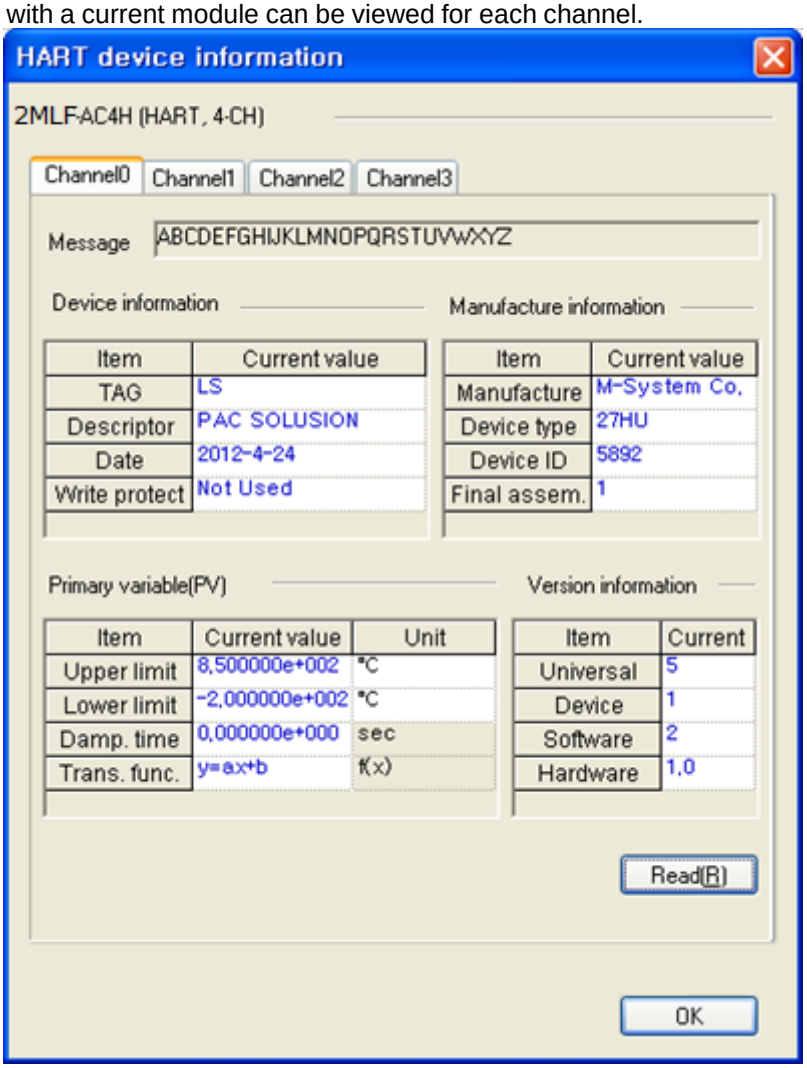
(d) [Close]: [Close] is used to escape from the monitoring/test screen. When the monitoring/test screen is closed, the max. value, the min. value and the present value will not be saved any more.

4.5.3 HART Variable Monitoring and Device Information Screen

(1) PV, Primary Variable monitor: Click [Implement Test] after setting HART communication to 'Enable' on the 'Special Module Monitor' screen to check PV transmitted from a field device connected with channel 1 to HART communication. The figure below shows a screen to view PV imported from the field device connected with channel 0.



(2) [HART device information]: Click [Read] button on the bottom after clicking [HART device information] on the 'Special Module Monitor' screen. Information on HART device that is connected with a current module can be viewed for each channel.



[Fig. 5. 6] Execution screen of [Read]

(a) Message: Texts that have been inputted to HART field device's message parameters. They can be used to describe information helpful to recognize a device.
(b) Tag: HART field device's tag name is displayed. It can be used to indicate the location of a plant.
(c) Descriptor: HART field device's descriptor field is displayed. For example, it can be used to save the name of a person who performs calibration.
(d) Date: Date inputted to the device. , it can be used to record the latest calibration date or date of maintenance/inspection.
(e) Write Setting (Write Prevented): Information on whether HART field device is protected from writing is displayed Yes or No. If Yes is set, certain parameters cannot be changed through HART communication.
(f) Manufacturer: Manufacturer name is displayed. Its code can be displayed and code information is changed to text to be displayed on the [HART device information] screen.
(g) Device Name (type): It can be used for a manufacturer to designate a device type or name. Code information is changed to text to be displayed on the [HART device information] screen.
(h) Device ID: Numbers refers to device ID are displayed. Device ID is a unique serial number issued by the manufacturer.
(i) Final Assemble Number: Numbers referring to the final assembly number are displayed. It is

used by the device manufacturer to classify changes in hardware. For example, it is used to classify part changes or drawing changes.

(j) PV Upper Range Value: It is defined according to the relationship between dynamic variable values from the device and analog channel's upper end points. That is, it is PV that will be displayed if 20 ㎃ is outputted.

(k) PV Lower Range Value: It is defined according to the relationship between dynamic variable values from the device and analog channel's lower end points. That is, it is PV that will be displayed if 4 ㎃ is outputted.

(l) Damping Time: A function to mitigate sudden changes in input (shocks) and apply them to output. Its unit is of second. Mainly it is used on the pressure transmitter.

(m) Transfer Function: A function to express which method is used by the transmitter to transfer 4~20 ㎃ signal to PV.

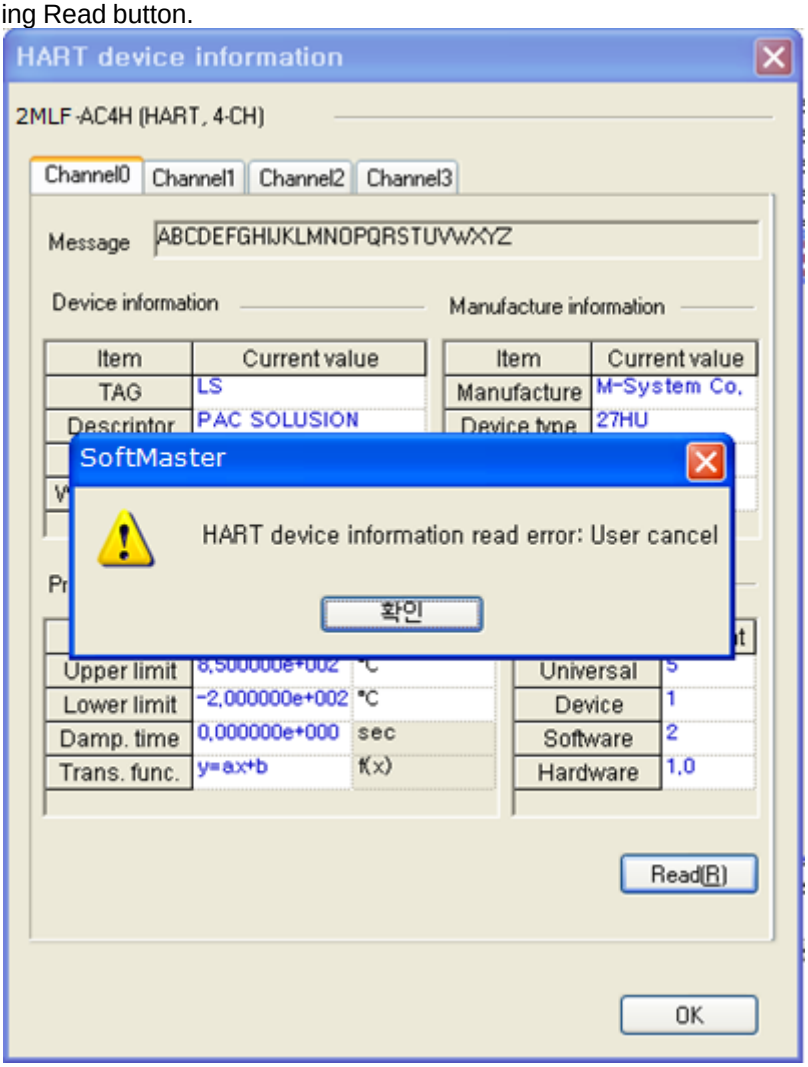
(n) Universal version: It refers to HART dimension version. In most cases, it is 5 or 6 and 7 means Wireless HART dimension.

(o) Device version: HART device's version is displayed.

(p) Software version: HART device's software version is displayed.

(q) Hardware version: HART device's hardware version is displayed.

(3) Read Cancel: Press Esc key on the keyboard to cancel importing information from HART device after pressing Read button.



[Fig. 4.8] Execution of read cancel

4.6 Registration of Analog Register [U]

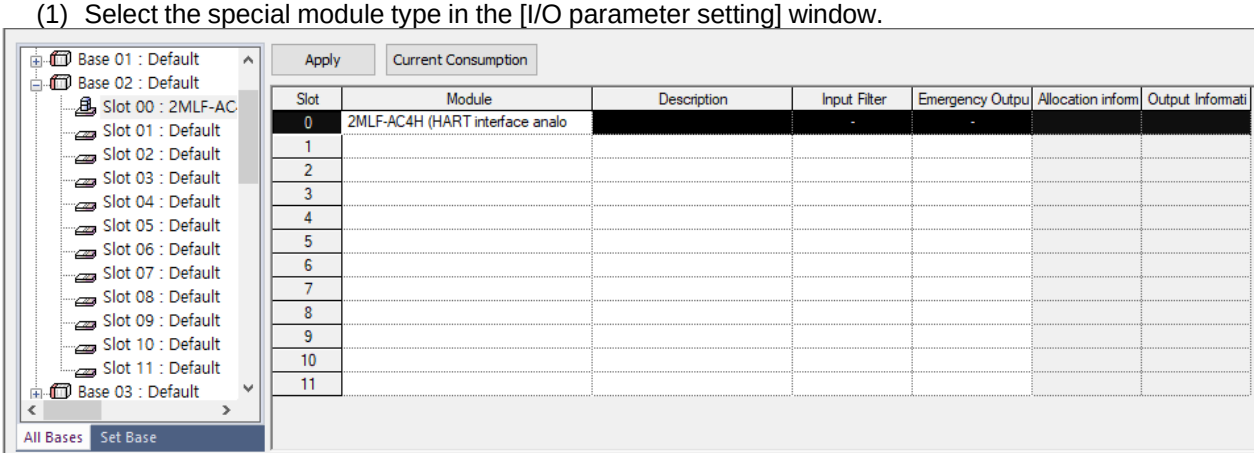
This section describes the automatic registration function of the analog register U in the SoftMaster

4.6.1 Registration of Analog Register [U]

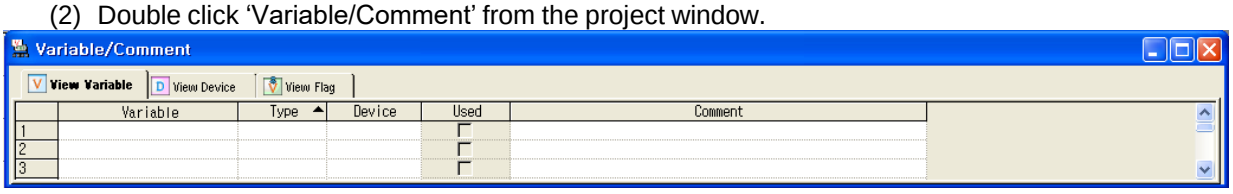
It registers the variables for each module referring to the special module information that is set in the I/O parameter. The user can modify the variables and comments.

[Procedure]

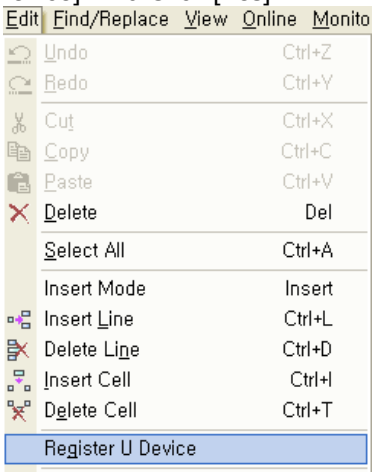
(1) Select the special module type in the [I/O parameter setting] window.



(2) Double click 'Variable/Comment' from the project window.



(3) Select [Edit] -> [Register U Device]. And Click [Yes]



(4) As shown below, the variables are registered.

Variable/Comment

View Variable | View Device | View Flag

	Variable	Type	Device	Used	Comment
1	_00_ERR	BIT	U00.00.0		HART Analog Input Module: Module Error
2	_00_RDY	BIT	U00.00.F		HART Analog Input Module: Module Ready
3	_00_CH0_ACT	BIT	U00.01.0		HART Analog Input Module: CH0 Running
4	_00_CH1_ACT	BIT	U00.01.1		HART Analog Input Module: CH1 Running
5	_00_CH2_ACT	BIT	U00.01.2		HART Analog Input Module: CH2 Running
6	_00_CH3_ACT	BIT	U00.01.3		HART Analog Input Module: CH3 Running
7	_00_CH0_PAHH	BIT	U00.08.0		HART Analog Input Module: CH0 Process Alarm High high limi
8	_00_CH0_PAH	BIT	U00.08.1		HART Analog Input Module: CH0 Process Alarm High limit
9	_00_CH0_PAL	BIT	U00.08.2		HART Analog Input Module: CH0 Process Alarm Low limit
10	_00_CH0_PALL	BIT	U00.08.3		HART Analog Input Module: CH0 Process Alarm Low low limit
11	_00_CH1_PAHH	BIT	U00.08.4		HART Analog Input Module: CH1 Process Alarm High high limi
12	_00_CH1_PAH	BIT	U00.08.5		HART Analog Input Module: CH1 Process Alarm High limit
13	_00_CH1_PAL	BIT	U00.08.6		HART Analog Input Module: CH1 Process Alarm Low limit
14	_00_CH1_PALL	BIT	U00.08.7		HART Analog Input Module: CH1 Process Alarm Low low limit
15	_00_CH2_PAHH	BIT	U00.08.8		HART Analog Input Module: CH2 Process Alarm High high limi

Global Variable | Address Comment | Flag

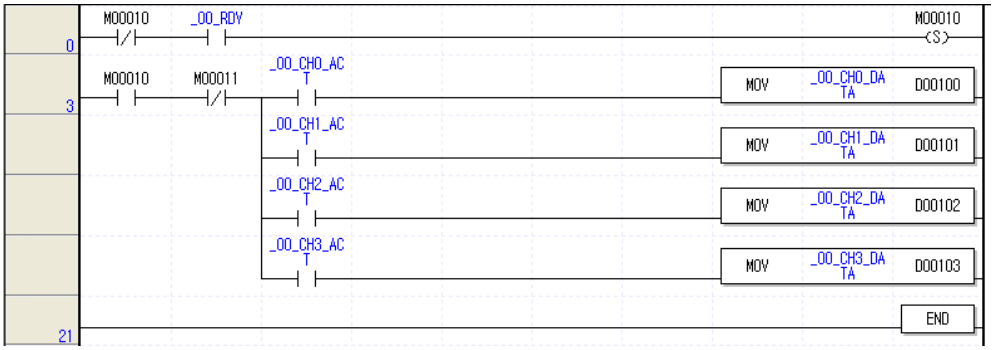
	Variable Kind	Variable	Type	Address	Initial Value	Retain	Used	EIP/OPC UA	HMI	Comment
221	VAR_GLOBAL	_0200_CH0_DATA	INT	%UW2.0.2						HART Analog Input Module: CH0 Output
222	VAR_GLOBAL	_0200_CH0_HARTERR	BOOL	%UX2.0.16						HART Analog Input Module: CH0 HART C
223	VAR_GLOBAL	_0200_CH0_IDD	BOOL	%UX2.0.16						HART Analog Input Module: CH0 Discon
224	VAR_GLOBAL	_0200_CH0_PAH	BOOL	%UX2.0.12						HART Analog Input Module: CH0 Proces
225	VAR_GLOBAL	_0200_CH0_PAHH	BOOL	%UX2.0.12						HART Analog Input Module: CH0 Proces
226	VAR_GLOBAL	_0200_CH0_PAL	BOOL	%UX2.0.13						HART Analog Input Module: CH0 Proces
227	VAR_GLOBAL	_0200_CH0_PALL	BOOL	%UX2.0.13						HART Analog Input Module: CH0 Proces
228	VAR_GLOBAL	_0200_CH0_RAH	BOOL	%UX2.0.14						HART Analog Input Module: CH0 Rate A
229	VAR_GLOBAL	_0200_CH0_RAL	BOOL	%UX2.0.14						HART Analog Input Module: CH0 Rate A
230	VAR_GLOBAL	_0200_CH1_ACT	BOOL	%UX2.0.17						HART Analog Input Module: CH1 Activa
231	VAR_GLOBAL	_0200_CH1_DATA	INT	%UW2.0.3						HART Analog Input Module: CH1 Output
232	VAR_GLOBAL	_0200_CH1_HARTERR	BOOL	%UX2.0.16						HART Analog Input Module: CH1 HART C
233	VAR_GLOBAL	_0200_CH1_IDD	BOOL	%UX2.0.16						HART Analog Input Module: CH1 Discon

4.6.2 Save variables

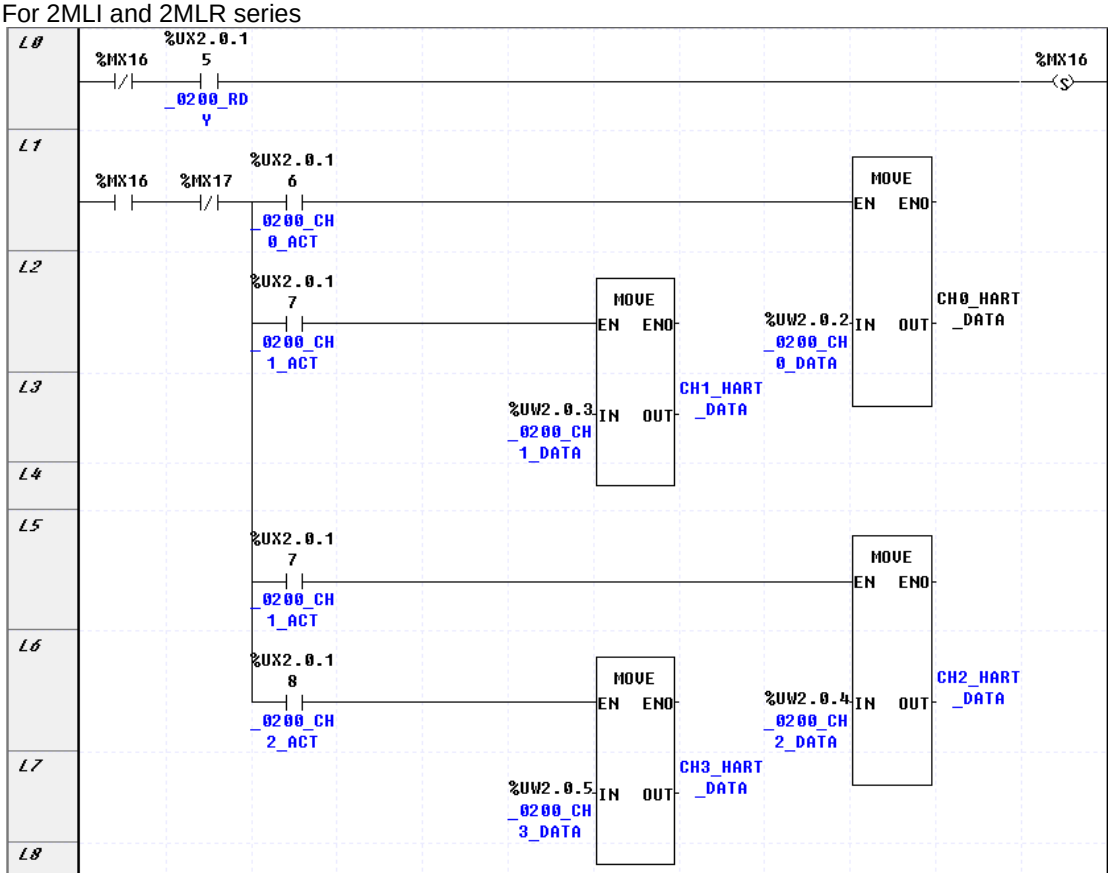
(1) The contents of 'View Variable' can be saved as a text file.
(2) Select [Edit] -> [Export to File].
(3) The contents of 'View variable' are saved as a text file.

4.6.3 View variables

(1) The example program of SoftMaster is as shown below.
(2) Select [View] -> [Variables]. The devices are changed into variables.
For 2MLK series



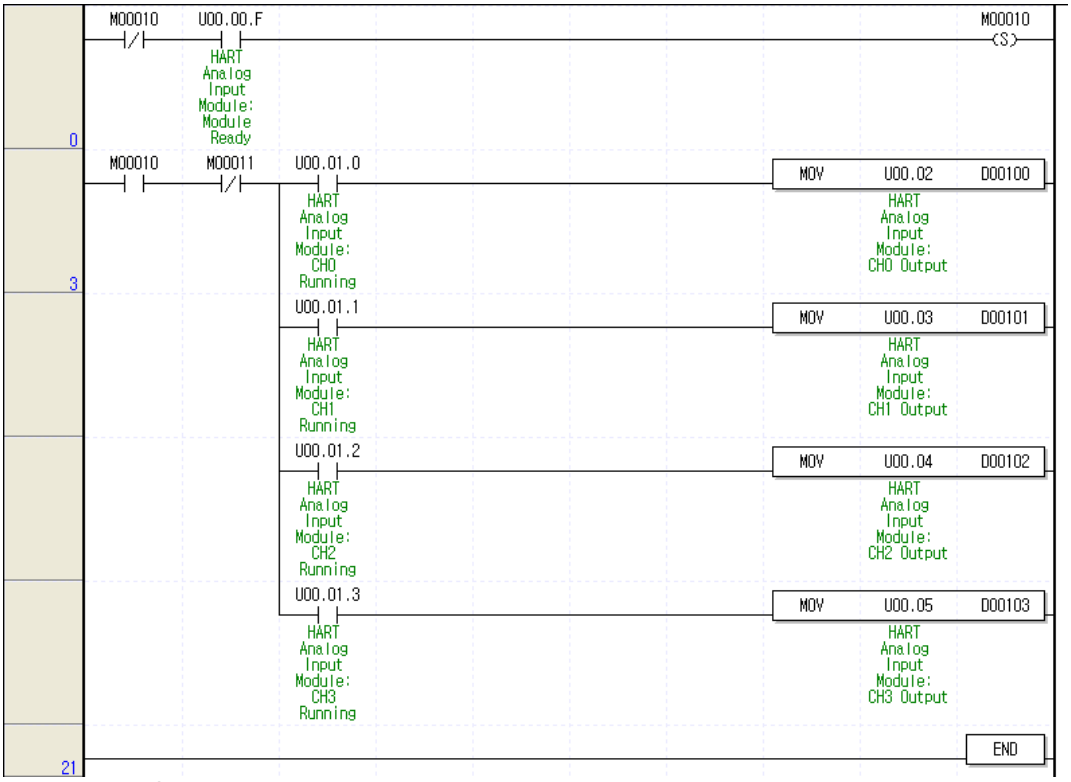
For 2MLI and 2MLR series



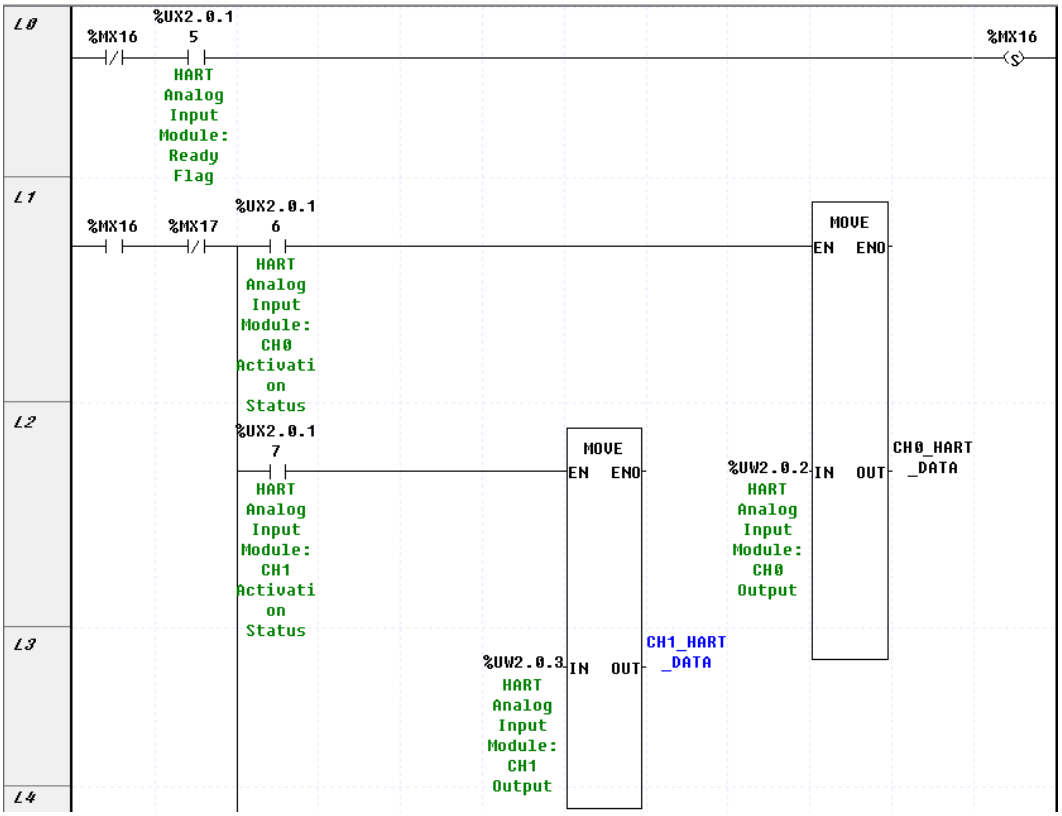
(3) Select [View] -> [Devices/Variables]. Devices and variables are both displayed.

(4) Select [View] -> [Devices/Comments]. Devices and comments are both displayed.

For 2MLK series



For 2MLI and 2MLR



Chapter 5 Configuration and Function of Internal Memory

Analog Input Module has the internal memory to transmit/receive data to/from PLC CPU.

5.1 Internal Memory Configuration

Configuration of internal memory is as described below.

5.1.1 IO area configuration of HART analog input module

I/O area of A/D converted data is as displayed in Table 5.1.

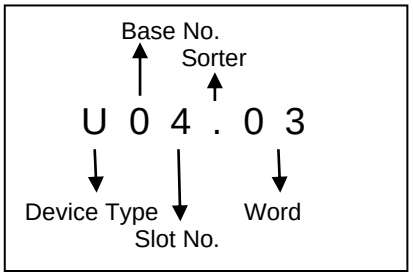
[Table 5. 1] I/O area of A/D converted data

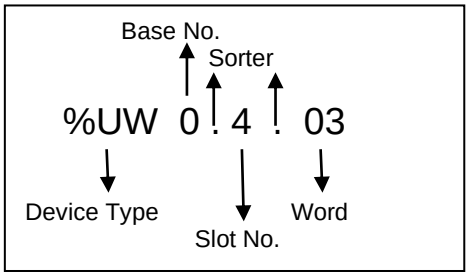
Device assigned		Details	R/W	Sign direction
Uxy.00.0 Uxy.00.F	%UXx.0.0 %UXxy.0.15	Module ERROR flag Module READY flag	R	A/D → CPU
Uxy.01.0 Uxy.01.1 Uxy.01.2 Uxy.01 3	%UXxy.0.16 %UXxy.0.17 %UXxy.0.18 %UXxy.0.19	CH0 Run flag CH1 Run flag CH2 Run flag CH3 Run flag	R	A/D → CPU
Uxy.02	%UWxy.0.2	CH0 digital output value	R	A/D → CPU
Uxy.03	%UWxy.0.3	CH1 digital output value	R	
Uxy.04	%UWxy.0.4	CH2 digital output value	R	
Uxy.05	%UWxy.0.5	CH3 digital output value	R	
Uxy.06	%UWxy.0.6	Not used area	R	
Uxy.07	%UWxy.0.7	Not used area	R	
Uxy.08.0	%UXxy.0.128	CH0 process alarm H-H limit detection flag (HH)	R	
Uxy.08.1	%UXxy.0.129	CH0 process alarm H limit detection flag (H)		
Uxy.08.2	%UXxy.0.130	CH0 process alarm L limit detection flag (L)		
Uxy.08.3	%UXxy.0.131	CH0 process alarm L-L limit detection flag (LL)		
Uxy.08.4	%UXxy.0.132	CH1 process alarm H-H limit detection flag (HH)		
Uxy.08.5	%UXxy.0.133	CH1 process alarm H limit detection flag (H)		
Uxy.08.6	%UXxy.0.134	CH1 process alarm L limit detection flag (L)		
Uxy.08.7	%UXxy.0.135	CH1 process alarm L-L limit detection flag (LL)		
Uxy.08.8	%UXxy.0.136	CH2 process alarm H-H limit detection flag		
Uxy.08.9	%UXxy.0.137	CH2 process alarm H limit detection flag (H)		
Uxy.08.A	%UXxy.0.138	CH2 process alarm L limit detection flag (L)		
Uxy.08.B	%UXxy.0.139	CH2 process alarm L-L limit detection flag (LL)		
Uxy.08.C	%UXxy.0.140	CH3 process alarm H-H limit detection flag (HH)		
Uxy.08.D	%UXxy.0.141	CH3 process alarm H limit detection flag (H)		
Uxy.08.E	%UXxy.0.142	CH3 process alarm L limit detection flag (L)		
Uxy.08.F	%UXxy.0.143	CH3 process alarm L-L limit detection flag (LL)		
Uxy.09.0	%UXxy.0.144	CH0 change rate alarm H limit detection flag (H)	R	A/D → CPU
Uxy.09.1	%UXxy.0.145	CH0 change rate alarm L limit detection flag (L)		
Uxy.09.2	%UXxy.0.146	CH1 change rate alarm H limit detection flag (H)		
Uxy.09.3	%UXxy.0.147	CH1 change rate alarm L limit detection flag (L)		
Uxy.09.4	%UXxy.0.148	CH2 change rate alarm H limit detection flag (H)		
Uxy.09.5	%UXxy.0.149	CH2 change rate alarm L limit detection flag (L)		
Uxy.09.6	%UXxy.0.150	CH3 change rate alarm H limit detection flag (H)		
Uxy.09.7	%UXxy.0.151	CH3 change rate alarm L limit detection flag (L)		

Uxy.10.0 Uxy.10.1 Uxy.10.2 Uxy.10.3 .. Uxy.10.8 Uxy.10.9 Uxy.10.A Uxy.10.B	%UXxy.0.160 %UXxy.0.161 %UXxy.0.162 %UXxy.0.163 .. %UXxy.0.168 %UXxy.0.169 %UXxy.0.170 %UXxy.0.171	CH0 disconnection detection flag (1~5V or 4~20mA) CH1 disconnection detection flag (1~5V or 4~20mA) CH2 disconnection detection flag (1~5V or 4~20mA) CH3 disconnection detection flag (1~5V or 4~20mA) .. CH0 HART communication error flag CH1 HART communication error flag CH2 HART communication error flag CH3 HART communication error flag	R	A/D → CPU
Uxy.11.0	%UXxy.0.176	Error clear request flag	W	CPU → A/D

(1) In the device assigned, X stands for the Base No. and Y for the Slot No. on which module is installed.

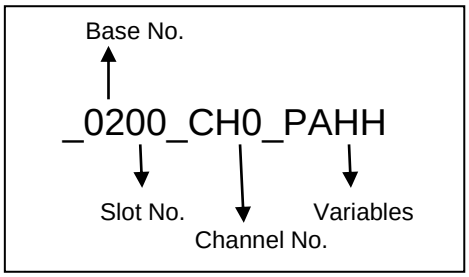
(2) In order to read 'CH1 digital output value' of Analog Input Module installed on Base No.0, Slot No.4, it shall be displayed as U04.03.





(3) In order to read 'CH3 disconnection detection flag' of Analog Input Module installed on Base No.0, Slot No.5, it shall be displayed as U05.10.3.

Variables for 2MLI and 2MLR series



5.1.2 Operation parameters setting area

Setting area of Analog Input Module's Run parameters is as described in Table 5.2.

[Table 5. 2] Setting area of Run parameters

Memory address		Description	R/W	Remarks
HEX	DEC			
0_H	0	Channel enable/disable setting	R/W	PUT
1_H	1	Setting ranges of input voltage/current	R/W	PUT
2_H	2	Output data format setting	R/W	PUT
3_H	3	Filter processing enable/disable setting	R/W	PUT
4_H	4	CH0 average value setting	R/W	PUT
5_H	5	CH1 average value setting		
6_H	6	CH2 average value setting		
7_H	7	CH3 average value setting		
8_H	8	Alarm process setting	R/W	PUT
9_H	9	CH0 process alarm H-H limit setting (HH)	R/W	PUT
A_H	10	CH0 process alarm H limit setting (H)		
B_H	11	CH0 process alarm L limit setting (L)		
C_H	12	CH0 process alarm L-L limit setting (LL)		
D_H	13	CH1 process alarm H-H limit setting (HH)		
E_H	14	CH1 process alarm H limit setting (H)		
F_H	15	CH1 process alarm L limit setting (L)		
10_H	16	CH1 process alarm L-L limit setting (LL)		
11_H	17	CH2 process alarm H-H limit setting (HH)		
12_H	18	CH2 process alarm H limit setting (H)		
13_H	19	CH2 process alarm L limit setting (L)		
14_H	20	CH2 process alarm L-L limit setting (LL)		
15_H	21	CH3 process alarm H-H limit setting (HH)		
16_H	22	CH3 process alarm H limit setting (H)		
17_H	23	CH3 process alarm L limit setting (L)		
18_H	24	CH3 process alarm L-L limit setting (LL)		
19_H	25	CH0 change rate alarm detection period setting	R/W	PUT
$1A_H$	26	CH1 change rate alarm detection period setting		
$1B_H$	27	CH2 change rate alarm detection period setting		
$1C_H$	28	CH3 change rate alarm detection period setting		
$1D_H$	29	CH0 change rate alarm H limit setting	R/W	PUT
$1E_H$	30	CH0 change rate alarm L limit setting		
$1F_H$	31	CH1 change rate alarm H limit setting		
20_H	32	CH1 change rate alarm L limit setting		
21_H	33	CH2 change rate alarm H limit setting		
22_H	34	CH2 change rate alarm L limit setting		
23_H	35	CH3 change rate alarm H limit setting		
24_H	36	CH3 change rate alarm L limit setting		
25_H	37	Error code	R/W	GET
28_H	40	HART communication Enable/Disable	R/W	PUT

* R/W is to denote Read/Write if available from PLC program.

5.1.3 HART commands information area

Status area of HART commands are as described in Table 5.3

[Table 5. 3] Status area of HART commands

Memory Address				Description	R/W	Remarks
CH0	CH1	CH2	CH3			
68	69	70	71	HART communication error count of CH#	R/W	GET
72	73	74	75	Communication/field device status of CH#		
76				Select to retain data in case of HART communication error		PUT

* R/W is to denote Read/Write if available from PLC program.

5.2 A/D Converted Data I/O Area

Regarding address for 2MLI and 2MLR series, please refer to Variable name. Page 52 'Internal Memory'

5.2.1 Module READY/ERROR flag (Uxy.00, X: Base No., Y: Slot No.)

(1) ***Uxy.00.F:*** It will be ON when PLC CPU is powered or reset with A/D conversion ready to process A/D conversion.

(2) ***Uxy.00.0:*** It is a flag to display the error status of Analog Input Module.

UXY.00

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
RDY	—	—	—	—	—	—	—	—	—	—	—	—	—	—	ERR

⇩ Module READY
Bit ON (1): READY, Bit Off (0): NOT READY

⇩ Error information
Bit ON (1): Error, Bit Off (0): Normal

5.2.2 Module RUN flag (Uxy.01, X: Base No., Y: Slot No.)

The area where Run information of respective channels is saved. %UXx.0.16+*[ch]*

UXY.01

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
—	—	—	—	—	—	—	—					CH3	CH2	CH1	CH0

Run channel information
Bit ON (1): During Run, Bit Off (0): Operation Stop

5.2.3 Digital output value (Uxy.02 ~ Uxy.05, X: Base No., Y: Slot No.)

(1) A/D converted-digital output value will be output to buffer memory addresses 2 ~ 9 (Uxy.02 ~ Uxy.09) for respective channels.

(2) Digital output value will be saved in 16-bit binary.

UXY.02 ~ UXY.09

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
Channel # digital output value															

Address	***Details***
Address No.2	CH0 digital output value
Address No.3	CH1 digital output value
Address No.4	CH2 digital output value
Address No.5	CH3 digital output value

5.2.4 Flag to detect process alarm

(Uxy.08.Z, X:Base No., Y:Slot No., Z: Alarm bit according to channel)

(1) Each process alarm detection signal about input channel is saved at Uxy.08

(2) Each bit is set as 1 when detecting process alarm and if process alarm detection is restored, each bit returns into 0. Each bit can be used to detect process alarm detection with execution condition at user program.

UXY.08

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
CH3LL	CH3L	CH3H	CH3HH	CH2LL	CH2L	CH2H	CH2HH	CH1LL	CH1L	CH1H	CH1HH	CH0LL	CH0L	CH0H	CH0HH

BIT	Details
0	Meet setting range
1	Exceed setting range

5.2.5 Flag to detect change rate alarm

(Uxy.09.Z, X: Base No, Y: Slot No, Z: Alarm according to channel)

(1) Each change rate alarm detection signal about input channel is saved at Uxy.09.

(2) Each bit is set as 1 when detecting process alarm and if process alarm detection is restored, each bit returns into 0. Each bit can be used to detect process alarm detection with execution condition at user program.

UXY.09

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
—	—	—	—	—	—	—	—	CH3L	CH3H	CH2L	CH2H	CH1L	CH1H	CH0L	CH0H

BIT	Details
0	Meet setting range
1	Exceed setting range

5.2.6 Flag to detect disconnection (Uxy.10.Z, X: Base No., Y: Slot No., Z: Channel No.)

(1) Detection sign of disconnection for respective input channels is saved in Uxy.10.
(2) Each bit will be set to 1 if an assigned channel is detected as disconnected, and it will be back to 0 if connected back. In addition, each bit can be used to detect the disconnection in the user program together with execution conditions.

UXY.10

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
—	—	—	—	—	—	—	—	—	—	—	—	CH3	CH2	CH1	CH0

BIT	Description
0	Normal
1	disconnection

5.2.7 Flag to detect HART communication error (Uxy.10.Z, X: Base No., Y: Slot No.)

(1) Detection sign of HART communication error for respective input channels is saved in Uxy.10.
(2) Each bit will be set to 1 if an assigned channel is detected as HART communication error, and it will be back to 0 if HART communication back. In addition, each bit can be used to detect the HART communication error in the user program together with execution conditions.

UXY.10

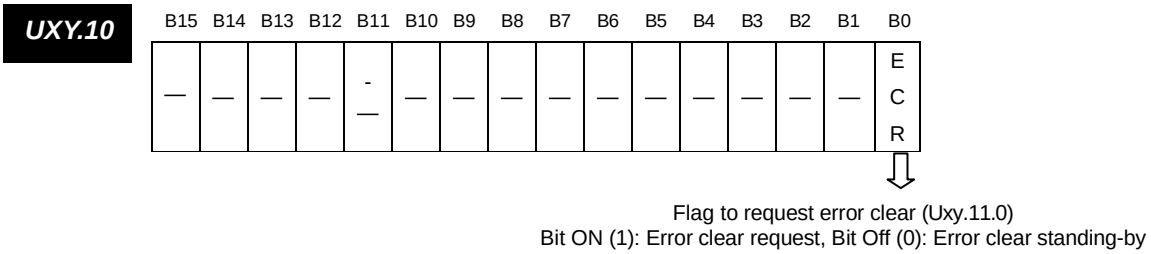
B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
—	—	—	—	CH3	CH2	CH1	CH0	—	—	—	—	—	—	—	—

BIT	Description
0	HART communication normal
1	HART communication error

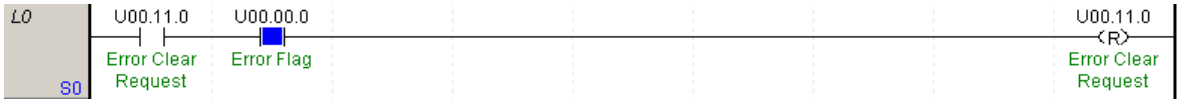
5.2.7 Flag to request error clear (Uxy.11.0, X: Base No., Y: Slot No.)

(1) If a parameters setting error occurs, address No.37's error code will not be automatically erased even if parameters are changed correctly. At this time, turn the 'error clear request' bit ON to delete address No.37's error code and the error displayed in SoftMaster's [System Monitoring]. In addition, RUN LED which blinks will be back to On status.

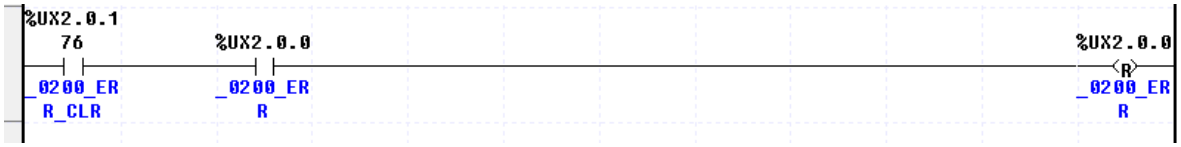
(2) 2) The 'flag to request error clear' shall be used surely together with Uxy.00.0 attached thereon for guaranteed Normal operation. Its application shall be as shown below in Fig. 5.1.



2MLK series



2MLI and 2MLR series



[Fig. 5. 1] How to use the flag

5.3 Operation Parameters Setting Area

- ▶ 1 word is assigned for each address in the internal memory, which can be displayed in 16 bits.
- ▶ If each bit of 16 bits configuring the address is On, let it set to “1”, and if it is Off, let it set to “0” so to realize the respective functions.

5.3.1 How to specify the channel to use (address No.0)

(1) Enable/Disable A/D conversion can be set for respective channels.
(2) If the channel to use is not specified, all the channels will be set to Disabled
(3) Enable/Disable A/D conversion is as specified below.

Address “0”

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
—	—	—	—	—	—	—	—	—	—	—	—	CH3	CH2	CH1	CH0

BIT	Description
0	Disable
1	Enable

(4) The value specified in B8 ~ B15 will be disregarded.

5.3.2 How to specify the range of input current (address No.1)

(1) The range of analog input current can be specified for respective channels.
(2) If the analog input range is not specified, the range of all the channels will be set to 4 ~ 20 ㎃.
(3) Setting range of analog input current is as specified below.

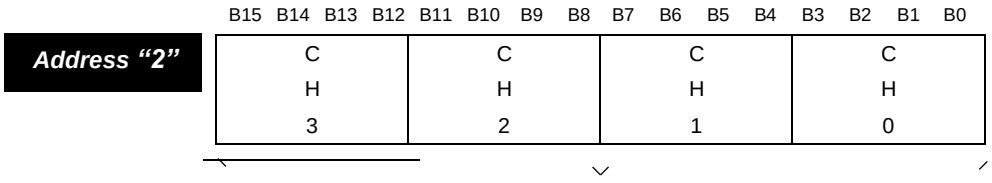
Address “1”

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
CH3				CH2				CH1				CH0			

BIT	Description
0000	4 mA ~ 20 mA
0001	0 mA ~ 20 mA

5.3.3 How to specify the range of output data (address No.2)

(1) The range of digital output data for analog input can be specified for respective channels.
(2) If the output data range is not specified, the range of all the channels will be set to -32000 ~ 32000.
(3) Setting range of digital output data range is as specified below.



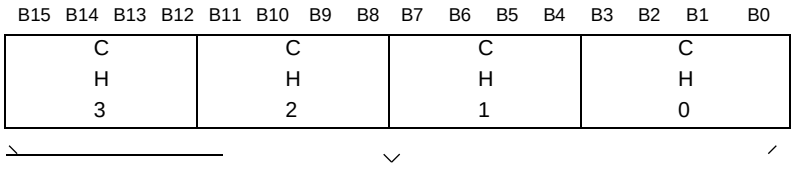
BIT	Description
0000	-32000 ~ 32000
0001	Precise Value
0010	0 ~ 10000

Precise value has the following digital output ranges for the analog input range.

Analog input / Digital output	4 ~ 20 mA	0 ~ 20 mA
Precise Value	4000 ~ 20000	0 ~ 20000

5.3.4 How to specify average process (address No.3)

(1) Enable/Disable filter process can be specified for respective channels.
(2) If the filter process is not specified, all the channels will be sampled.
(3) Setting of the filter process is as specified below.



BIT	Details
0000	Sampling process
0001	Time average
0010	Count average
0011	Moving average
0100	Weighted average

5.3.5 How to specify average value (address No.4 ~ 7)

(1) Default of the filter constant is 0.
(2) Setting ranges of average are as specified below.

Method	Setting range
Time average	200 ~ 5000(ms)
Count average	2 ~ 50(times)
Moving average	2 ~ 100(times)
Weighted average	1 ~ 99(%)

(3) If other value exceeding the setting range is specified, error code will be displayed on display address (37) of the error code. At this time, A/D converted value keeps the previous data. (# of the error code stands for the channel with error found)
(4) Setting of the filter constant is as specified below.

Address "4 ~ 7"

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
—	—	—	—	—	—	—	—	Channel# average value							

Setting range of averages differ according to the average processing method

Address	Details
Address No.4	CH0 average value
Address No.5	CH1 average value
Address No.6	CH2 average value
Address No.7	CH3 average value

5.3.6 How to specify process alarm (Address 8)

(1) This is area to set Enable/Disable of Process alarm. Each channel can be set separately
(2) Initial value of this area is 0.
(3) Setting of alarm process is as follows.

Address"8"

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
—	—	—	—	—	—	—	—	CH3	CH2	CH1	CH0	CH3	CH2	CH1	CH0
								Change rate alarm				Process alarm			

BIT	Details
0	Disable
1	Enable

5.3.7 Process alarm value setting (address 9 ~ 24)

(1) This is area to set Process alarm value. Setting range is different according to range of output data.

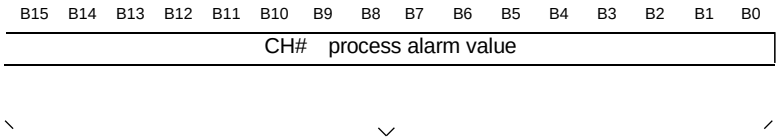
(a) Signed Value: -32768 ~ 32767
(b) Precise Value

4 ~ 20 mA	3808 ~ 20192
0 ~ 20 mA	-240 ~ 20240

(c) Percentile Value: -120 ~ 10120

(2) For detail of process alarm function, refer to CH2.5.2.

Address "9 ~ 24"



Address	Details
9	CH0 process alarm H-H limit setting
10	CH0 process alarm H limit setting
11	CH0 process alarm L limit setting
12	CH0 process alarm L-L limit setting
13	CH1 process alarm H-H limit setting
14	CH1 process alarm H limit setting
15	CH1 process alarm L limit setting
16	CH1 process alarm L-L limit setting
17	CH2 process alarm H-H limit setting
18	CH2 process alarm H limit setting
19	CH2 process alarm L limit setting
20	CH2 process alarm L-L limit setting
21	CH3 process alarm H-H limit setting
22	CH3 process alarm H limit setting
23	CH3 process alarm L limit setting
24	CH3 process alarm L-L limit setting

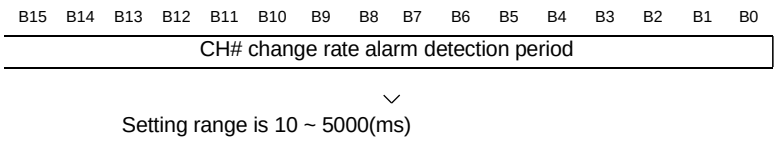
Notes

To set process alarm value, enable process alarm process in advance

5.3.8 Change rate alarm detection period setting (address 25 ~ 28)

(1) Setting range is 0 ~ 5000(ms).
(2) When value is out of range, error code 60# is displayed at error code indication address. At this time, default value (10) is applied
(3) Setting of change rate alarm detection period is as follows.

Address "25 ~ 28"

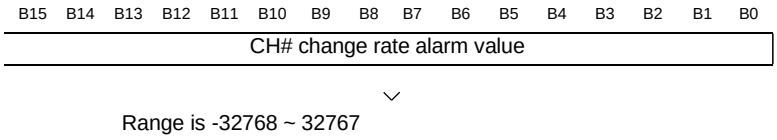


Address	Details
25	CH0 change rate alarm detection period
26	CH1 change rate alarm detection period
27	CH2 change rate alarm detection period
28	CH3 change rate alarm detection period

5.3.9 Change rate alarm value setting (Address 29 ~ 36)

(1) Range is -32768 ~ 32767(-3276.8% ~ 3276.7%).
(2) Setting is as follows.

Adress"29 ~ 36"



Address	Details
29	CH0 change rate alarm H limit setting
30	CH0 change rate alarm L limit setting
31	CH1 change rate alarm H limit setting
32	CH1 change rate alarm L limit setting
33	CH2 change rate alarm H limit setting
34	CH2 change rate alarm L limit setting
35	CH3 change rate alarm H limit setting
36	CH3 change rate alarm L limit setting

Notes

When setting change rate value, enable change rate alarm process in advance. And specify the Low/High limit of change rate alarm

5.3.10 Error code (address No.37)

(1) Error codes detected from Analog Input Module will be saved.
(2) Error types and details are as specified below.

Address "37"

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
—	—	—	—	—	—	—	—	Error code							

Refer to the table below for detailed error codes.

Error code (Dec.)	Description	RUN LED status
0	Normal operation	RUN LED ON
10	Module error (ASIC reset error)	Flickers every 0.2 sec.
11	Module error (ASIC RAM or Register error)	
20#	Time average set value error	Flickers every 1 sec.
30#	Count average set value error	
40#	Moving average set value error	
50#	Weighted average set value error	
60#	Change rate alarm detection period set value error	

* # of the error code stands for the channel with error found.
* Refer to 9.1 for more details on error codes.

(3) If 2 or more errors occur, the module will not save other error codes than the first error code found.
(4) If an error found is corrected, use the 'flag to request error clear' (refer to 5.2.5), or let power OFF → ON in order to stop LED blinking and to delete the error code.

5.3.11 HART communication Enable/Disable (address No.40)

(1) If the channel to use is not specified, all the channels will be set to Disabled
(2) HART communication is possible to set in the range of 4 ~ 20 ㎃ only.

Address "40"

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
—	—	—	—	—	—	—	—	—	—	—	—	CH3	CH2	CH1	CH0

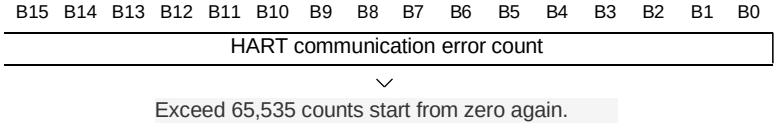
BIT	Details
0	Disable
1	Enable

5.4 HART Commands Information Area

5.4.1 HART communication error count(Address 68 ~ 71)

(1) Count of HART communication errors can be monitored.
(2) Communication error count is accumulated for each channel and up to 65,535 is displayed.
(3) Even though HART communication is recovered, error count maintains its status.

Address "68~71"

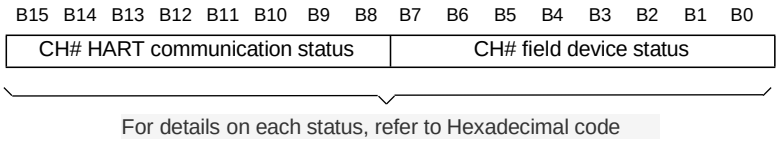


Address	Details
68	CH0 HART communication error count
69	CH1 HART communication error count
70	CH2 HART communication error count
71	CH3 HART communication error count

5.4.2 Communication/field device status(Address 72 ~ 75)

(1) Status of HART communication and field devices can be monitored.
(2) Top byte shows HART communication status while lower byte shows field device status.
(3) For details on each status, refer to (4) and (5).

Address "72~75"



Address	Details
72	CH0 communication/field device status
73	CH0 communication/field device status
74	CH0 communication/field device status
75	CH0 communication/field device status

(4) Status of HART communication

Bit	Code(Hexadecimal)	Details
7	-	Communication error
6	C0	Parity error
5	A0	Overrun error
4	90	Framing error
3	88	Checksum error
2	84	0(reserved)
1	82	Receiving buffer overflow
0	81	0(reserved)

* Hexadecimal value is shown, including the 7th bit.

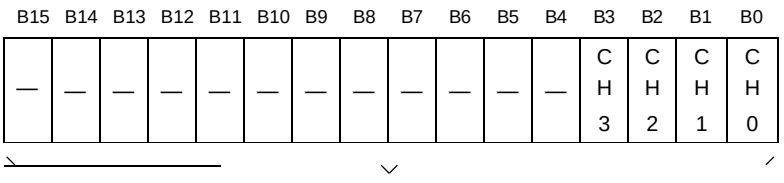
(5) Status of field device

Bit	Code(hexadecimal)	Content
7	80	Field device malfunction
6	40	Configuration changed: This bit is set when the field device' s environment configuration is changed.
5	20	Cold Start: This bit is set when power failure or device reset takes place.
4	10	More status available: It shows that more information can be obtained through No.48 command.
3	08	Analog output fixed: It shows that a device is in the Multidrop mode or output is set to a fixed value for test.
2	04	Analog output saturated: It shows that analog output is not changed since it is measured to be the upper limit or lower limit.
1	02	Primary Variable Out of Limits: It means that PV measuring value is beyond the sensor operation range. Therefore, the measuring cannot be reliable.
0	01	Non-primary Variable Out of Limits): It means that non-primary variable' s measuring value is beyond the operation range. Therefore, the measuring cannot be reliable.

5.4.3 Select to retain data in case of HART communication error (Address 76)

(1) In case of HART communication error, it is possible to set whether to retain existing communication data.
(2) Default value is set to retain existing communication data.
(3) If Enable is set, HART communication response data will be cleared in case of HART communication error.

Address "76"



BIT	Details
0	Disable
1	Enable

Chapter 6 Programming for 2MLK

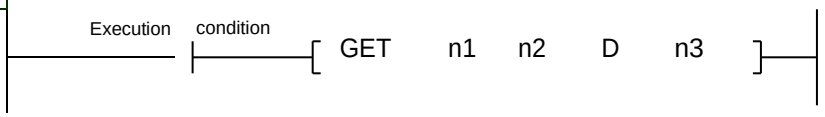
6.1 Programming for setting the Operation Parameters

Regarding programming for 2MLI and 2MLR series, please refer to Chapter 7.

6.1.1 Reading the operation parameters (GET, GETP instruction)

For 2MLK series

Type



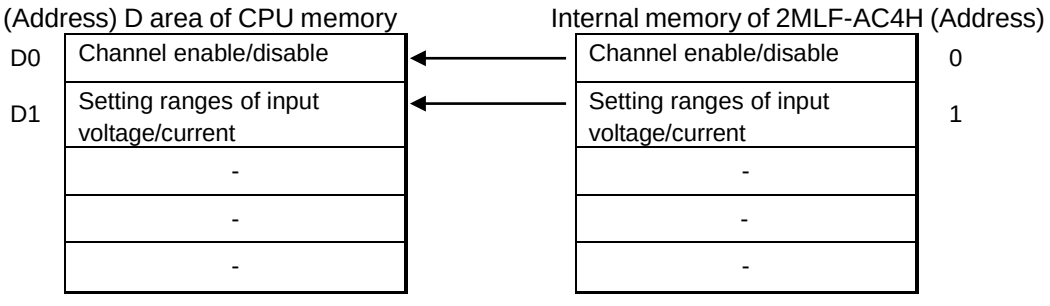
Type	Description	Area available
n1	Slot No. of the special module	Integer
n2	Top address of the buffer memory to be read from	Integer
D	Top address to save the data	M, P, K, L, T, C, D, #D
n3	Number of words to be read	Integer

< Difference between GET instruction and GETP instruction >

GET: Every scan executed while the execution condition is ON. ()

GETP: Executed only one time while the execution condition is ON. ()

Ex. If a 2MLF-AC4H module is installed on Base No.1 and Slot No.3(h13), and the data in buffer memory addresses 0 and 1 is read and stored in D0 and D1 of CPU memory,

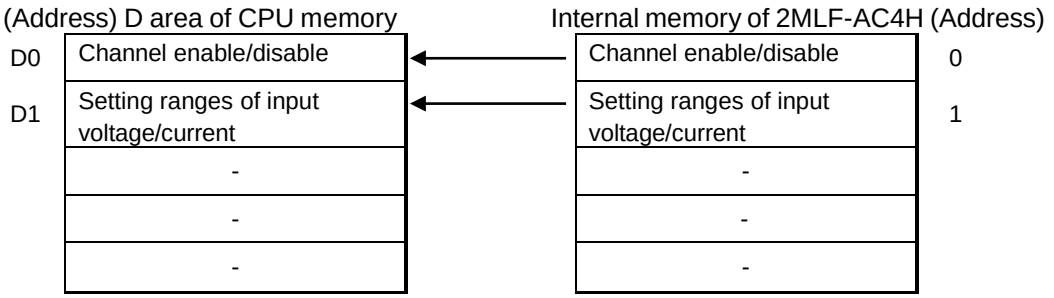


< Difference between GET instruction and GETP instruction >

GET: Every scan executed while the execution condition is ON. ()

GETP: Executed only one time while the execution condition is ON. ()

Ex. If a 2MLF-AC4H module is installed on Base No.1 and Slot No.3(h13), and the data in buffer memory addresses 0 and 1 is read and stored in D0 and D1 of CPU memory,



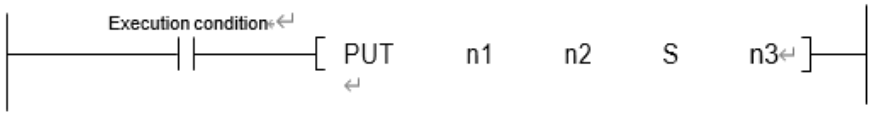
ST

```
INST_GET_WORD(REQ:=REQ_BOOL, BASE:=BASE_USINT, SLOT:=SLOT_USINT,
MADDR:=MADDR_UINT,
DONE=>DONE_BOOL, STAT=>STAT_UINT, DATA=>DATA_WORD);
```

6.1.2 Writing the operation parameters (PUT, PUTP instruction))

For 2MLK series

Type



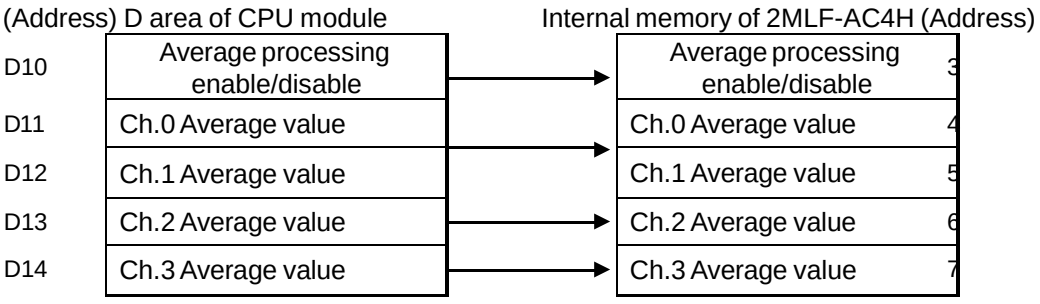
Type	Description	Area available
n1	Slot No. of the special module	Integer
n2	Top address of the buffer memory to be written from the CPU	Integer
S	Top address of the CPU memory to be sent or integer	M, P, K, L, T, C, D, #D, integer
n3	Number of words to be sent	Integer

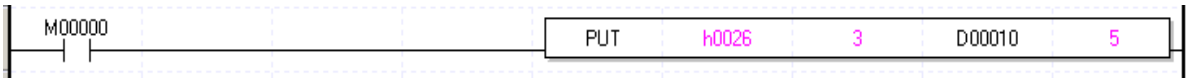
< Difference between PUT instruction and PUTP instruction**>**

PUT: Every scan executed while the execution condition is ON. (

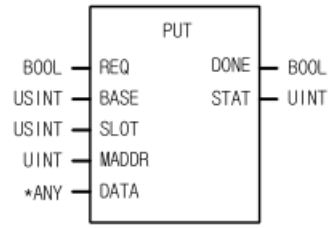
Executed only one time while the execution condition is ON. (

Ex. If a 2MLF-AC4H module is installed on Base No.2 and Slot No.6(h26), and the data in the CPU memory D10~D13 is written to the buffer memory 12~15.





For 2MLI and 2MLR series

Function Block	Description
	**Input** REQ: execute the function in case of 1 BASE: Base position setting SLOT: Slot position setting MADDR: Module address DATA: data to save into a module **Output** DONE: 1 output in case of normal execution STAT: Error information

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 UINT 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).

< Difference between PUT instruction and PUTP instruction**>**

PUT: Every scan executed while the execution condition is ON. ( ) PUTP:

Executed only one time while the execution condition is ON. ( )

Ex. If a 2MLF-AC4H module is installed on Base No.2 and Slot No.6(h26), and the data in the CPU memory D10~D13 is written to the buffer memory 12~15.

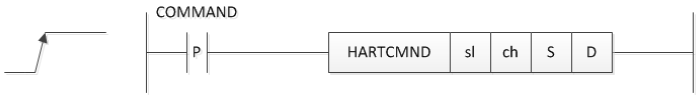
(Address) D area of CPU module		Internal memory of 2MLF-AC4H (Address)	
D10	Average processing enable/disable	Average processing enable/disable	3
D11	Ch.0 Average value	Ch.0 Average value	4
D12	Ch.1 Average value	Ch.1 Average value	5
D13	Ch.2 Average value	Ch.2 Average value	6
D14	Ch.3 Average value	Ch.3 Average value	7

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);
```

6.1.3 HART commands

(1) Commands form

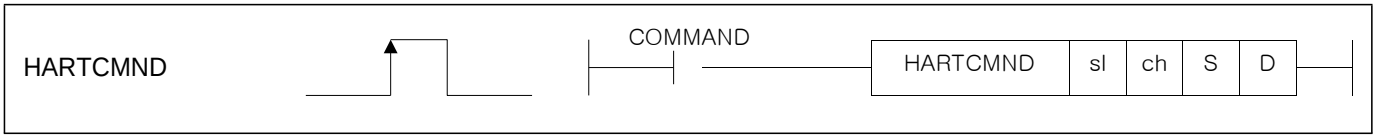
No.	Name	Details	Execution condition	Form
1	HARTCMND	Write HART commands	Pulse	
2	HARTRESP	HART response	Level	
3	HARTCLR	Clear HART commands	Pulse	

(2) Error content

Error Content	HARTCMND HART_CMND	HARTRESP HART_Cxxx	HARTCLR HART_CLR
No module is on the designated slot	O	O	O
Or more 4 is set to operand S	O	O	O
Other numbers than HART command numbers are set to operand channel(ch) HART command number: 0, 1, 2, 3, 12, 13, 15, 16, 48, 50, 57, 61, 110)	Not applicable	O	Not applicable
The device set to operand D is beyond the area Total 30 words starting from the device used as operand are beyond the maximum settable area.	Not applicable	O	Not applicable

6.1.4 HARTCMND command

command		Area available														step	Flag		
		PMK	F	L	T	C	S	Z	D.x	R.x	Constant	U	N	D	R		Error (F110)	Zero (F111)	Carry (F112)
HARTCMND	sl	-	-	-	-	-	-	-	-	-	○	-	-	-	-	-	○	-	-
	ch	-	-	-	-	-	-	-	-	-	○	-	-	-	-				
	S	○	-	-	-	-	-	-	-	-	○	-	-	○	-				
	D	○	-	-	-	-	-	-	-	-	-	-	-	○	-				



[Area Setting]

Operand	Description	Operand type	Valid size	Data size
sl	Slot number mounted to the special module	Data	Integer	Word
ch	Channel number of the special module	Data	Integer	Word
S	HART communication command setting (each bit shows each HART command)	Data	Integer (13bit)	Word
D	HART command setting status(The currently set commands are combined and written for each bit)	Address	Integer	Word

- Set of operand S

▶ HART command numbers

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
—	—	—	100	61	57	50	48	16	15	13	12	3	2	1	0

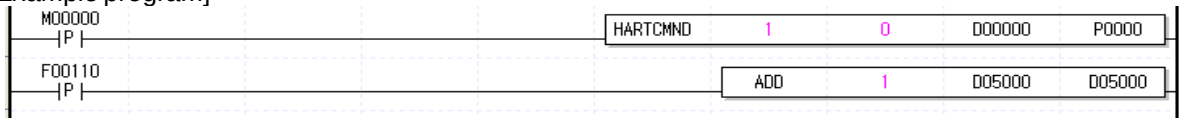
Command is executed when corresponding bit set on

- Monitoring of operand D
  Bit information of the currently set commands is displayed.
  For example, Bit 1 and 2 are displayed on D device if bit 1 and bit 2 are set.

[Flag Set]

Flag	Content	Device No.
Error	- The special module is not mounted to a designated slot or it is mounted to other module - A value inputted to a channel exceeds the range(0~3) set to the channel	F110

[Example program]

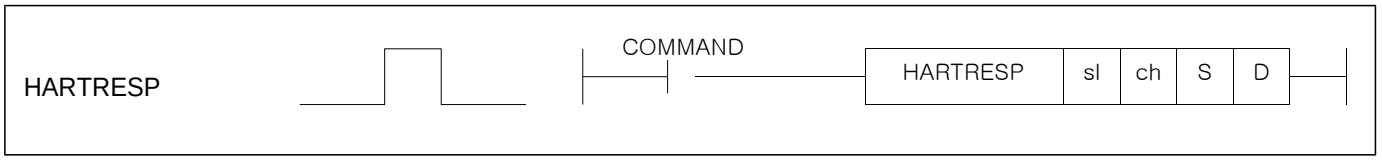


Notes

HARTCMND command or HARHCLR command is executed by setting bit of a corresponding command while HARTRESP command is set by inputting a command number.
For example, if command 57 is executed, enter H0400 (K1024) to operand S for HARTCMND command or HARHCLR command and enter command K57 to operand S for HARTRESP command. Here, H0400 is a hexadecimal to set bit10- command 57.

6.1.5 HARTRESP command

command		Area available														step	Flag		
		PMK	F	L	T	C	S	Z	D.x	R.x	constant	U	N	D	R		Error (F110)	Zero (F111)	Carry (F112)
HARTRESP	sl	-	-	-	-	-	-	-	-	-	○	-	-	-	-	-	○	-	-
	ch	-	-	-	-	-	-	-	-	-	○	-	-	-	-				
	S	○	-	-	-	-	-	-	-	-	○	-	-	○	-				
	D	○	-	-	-	-	-	-	-	-	-	-	-	○	-				



[Area setting]

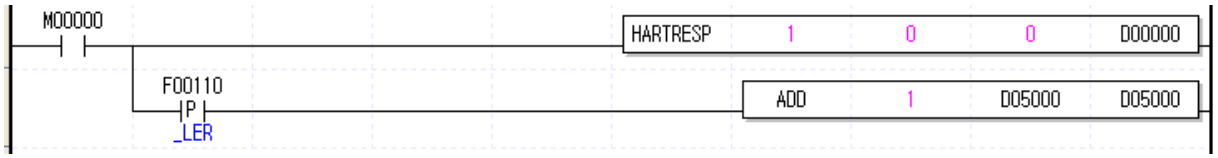
Operand	Description	Operand type	Valid size	Data size
sl	Slot number mounted to the special module	Data	Integer	Word
ch	Channel number of the special module	Data	Integer	Word
S	HART command number	Data	2byte	Word
D	Start address of a device that will display response	Address	2byte	Word

- Operand S sets a command number to receive HART communication response.
  (xx : CMD No. 0, 1, 2, 3, 12, 13, 15, 16, 48, 50, 57, 61, 110)
- 30 words are assigned to D operand when implementing Read Command.
  For example, when M2030 is designated on 2MLK-CPUH, an error takes place because M2040 is not sufficient for the maximum 30 Words.
- For details on each command, refer to Appendix 2 HART commands.

[Flag Set]

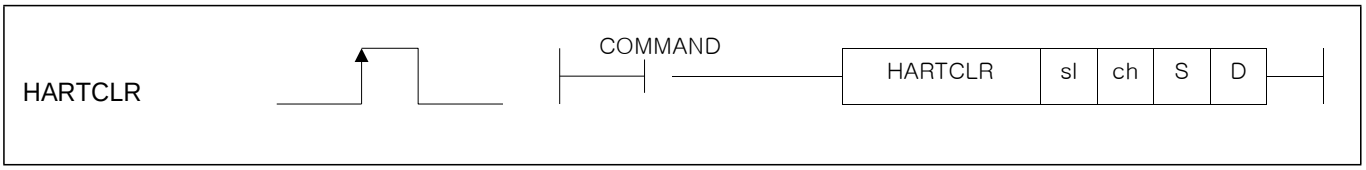
Flag	Description	Device No.
Error	- The special module is not mounted to a designated slot or it is mounted to other module - A value inputted to a channel exceeds the range(0~3) set to the channel - A command designated to S is other than 0, 1, 2, 3, 12, 13, 15, 48, 50, 57, 61, 110 - A device designated to D exceeds the device area (30 Words)	F110

[Example program]



6.1.6 HARTCLR command

command		Area available														step	Flag		
		PMK	F	L	T	C	S	Z	D.x	R.x	constant	U	N	D	R		Error (F110)	Zero (F111)	Carry (F112)
HARTCLR	sl	-	-	-	-	-	-	-	-	-	○	-	-	-	-	-	○	-	-
	Ch	-	-	-	-	-	-	-	-	-	○	-	-	-	-				
	S	○	-	-	-	-	-	-	-	-	○	-	-	○	-				
	D	○	-	-	-	-	-	-	-	-	-	-	-	○	-				



[Area setting]

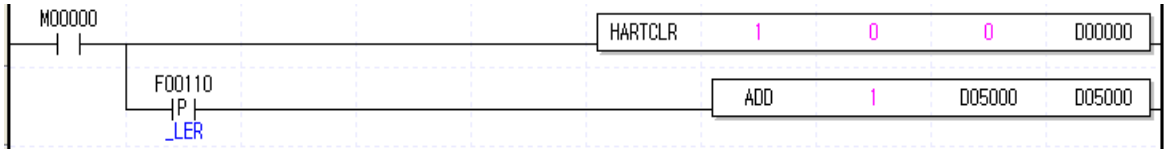
operand	Description	operand type	Valid size	data size
sl	Slot number mounted to the special module	Data	Integer	Word
ch	Channel number of the special module	Data	Integer	Word
S	HART communication command setting (each bit shows each HART command)	Data	13bit	Word
D	HART command setting status(The currently set commands are combined and written for each bit)	Address	2byte	Word

- Setting method is the same with that of HARTCMND command. But, it plays a role in cancelling other commands set differently from HARTCMND command.

[Flag Set]

Flag	Description	Device No.
Error	- The special module is not mounted to a designated slot or it is mounted to other module - A value inputted to a channel exceeds the range(0~3) set to the channel	F110

[Example program]

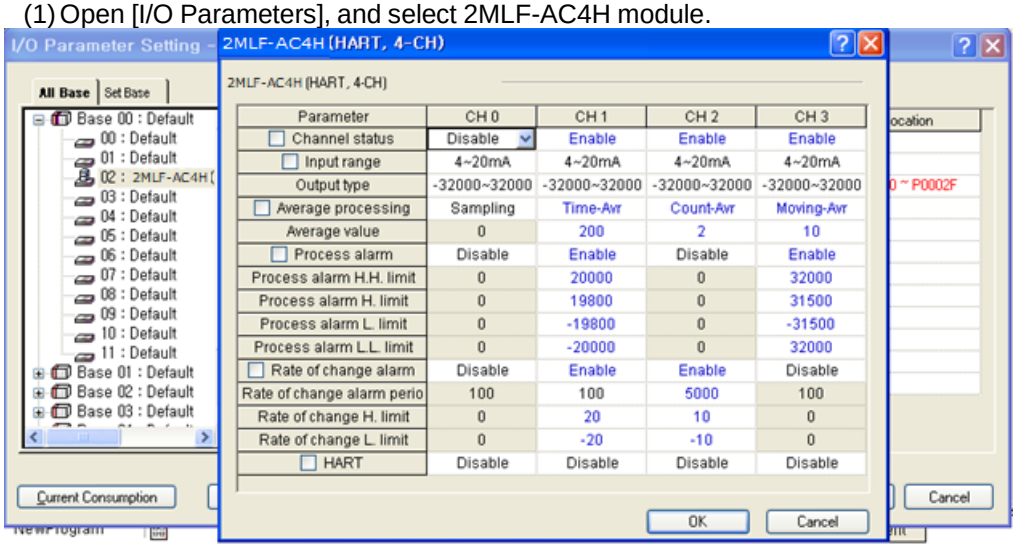


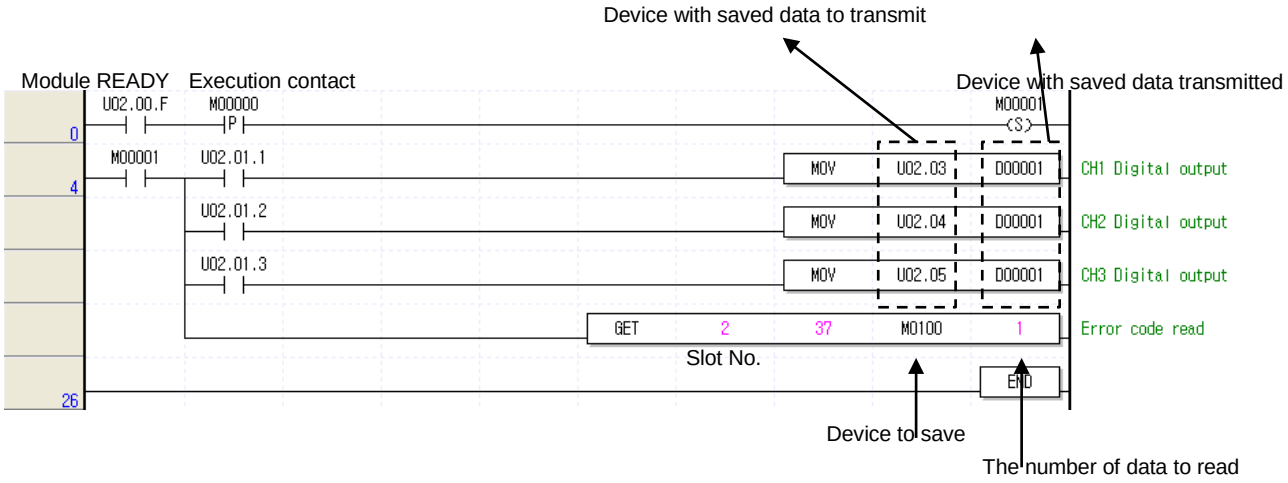
6.2 Basic Program

- How to specify Run condition details of HART analog input module's internal memory will be described.
- HART analog input module is as installed on Slot 2.
- I/O assigned points of HART analog input module is 16 points (changeable).
- Initial value specified will be saved on the internal memory of HART analog module through one time of input under the initial setting condition.

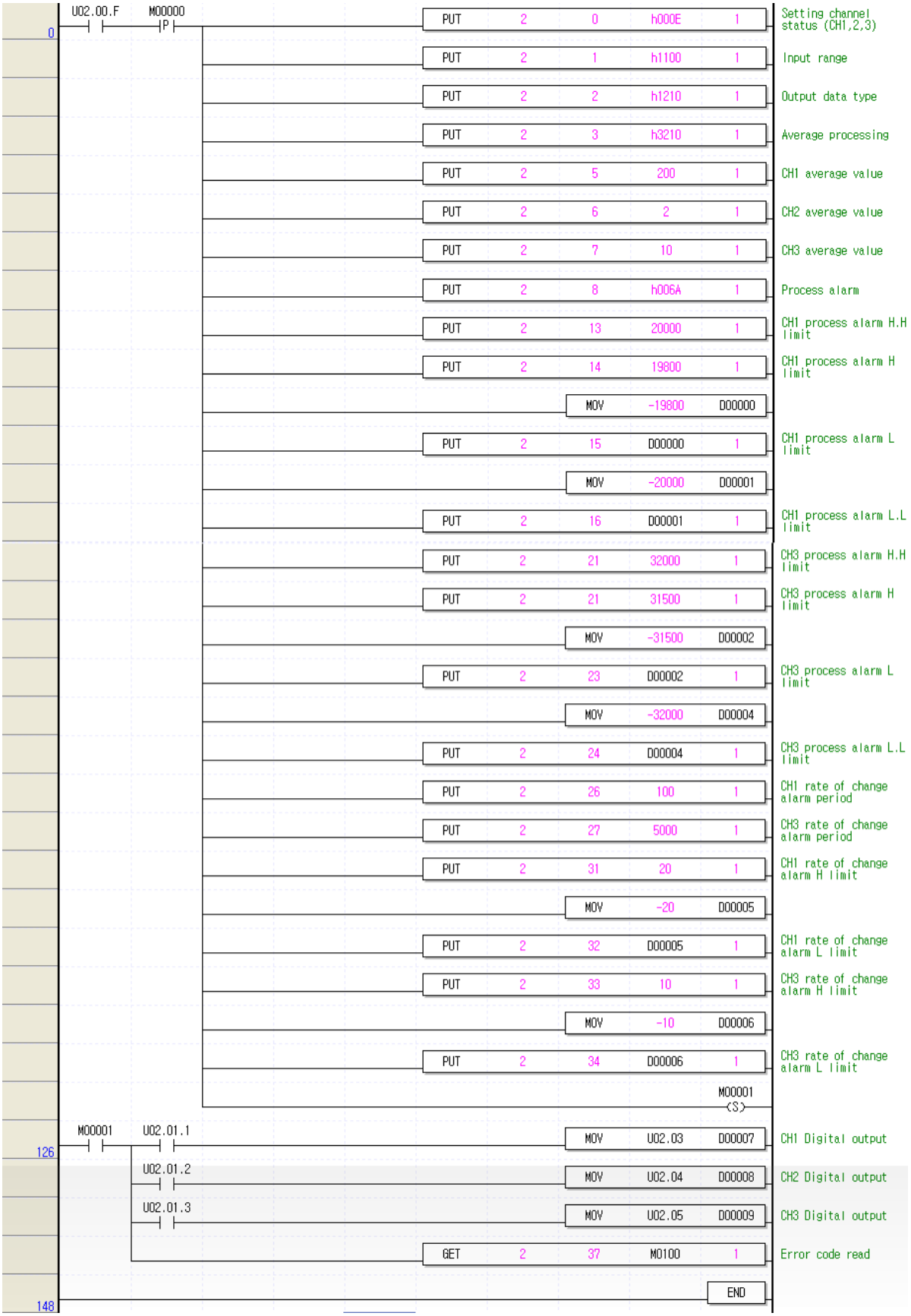
6.2.1 Setting the parameters in the [I/O Parameters]

(1) Open [I/O Parameters], and select 2MLF-AC4H module.





6.2.2 Setting the parameters in a scan program



6.3 Application Program

6.3.1 Program to sort A/D converted value in size (I/O slot fixed-points assigned: based on 64)

(1) System configuration

2MLP-ACF2	2MLK-CPUS	2MLI-D24A	2MLF-AC4H	2MLQ-TR2A	

(2) Details of initial setting

No.	Item	Details of initial setting	Internal memory address	Value to write on internal memory
1	Used CH	CH0, CH1	0	'h0003' or '3'
2	Input voltage range	4 ~ 20 ㎃	1	'h0000' or '0'
3	Output data range	-32,000 ~ 32,000	2	'h0000' or '0'
4	Average process	CH0, 1(Weighted, Count)	3	'h0024' or '36'
5	CH0 Weighted-avr value	50	4	'h0032' or '50'
6	CH1 Count-avr value	30	6	'h001E' or '30'

(3) Program description

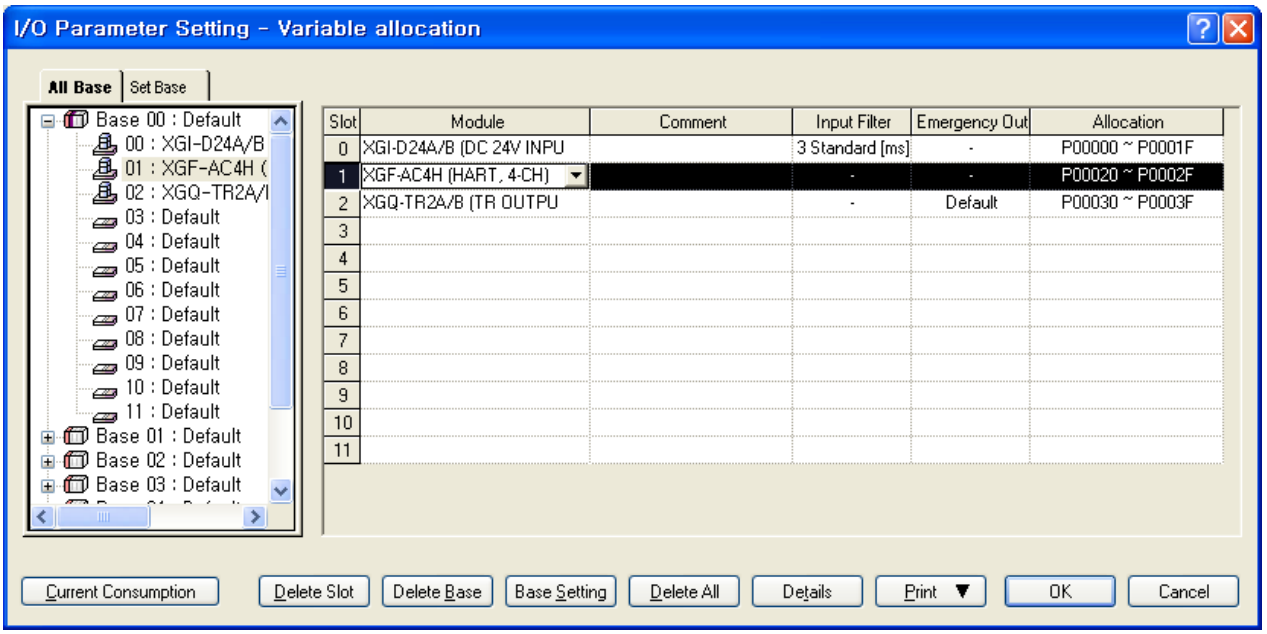
(a) If CH 0's digital value is less than 12000, Contact No.0 (P00080) of relay output module installed on Slot No.2 will be On

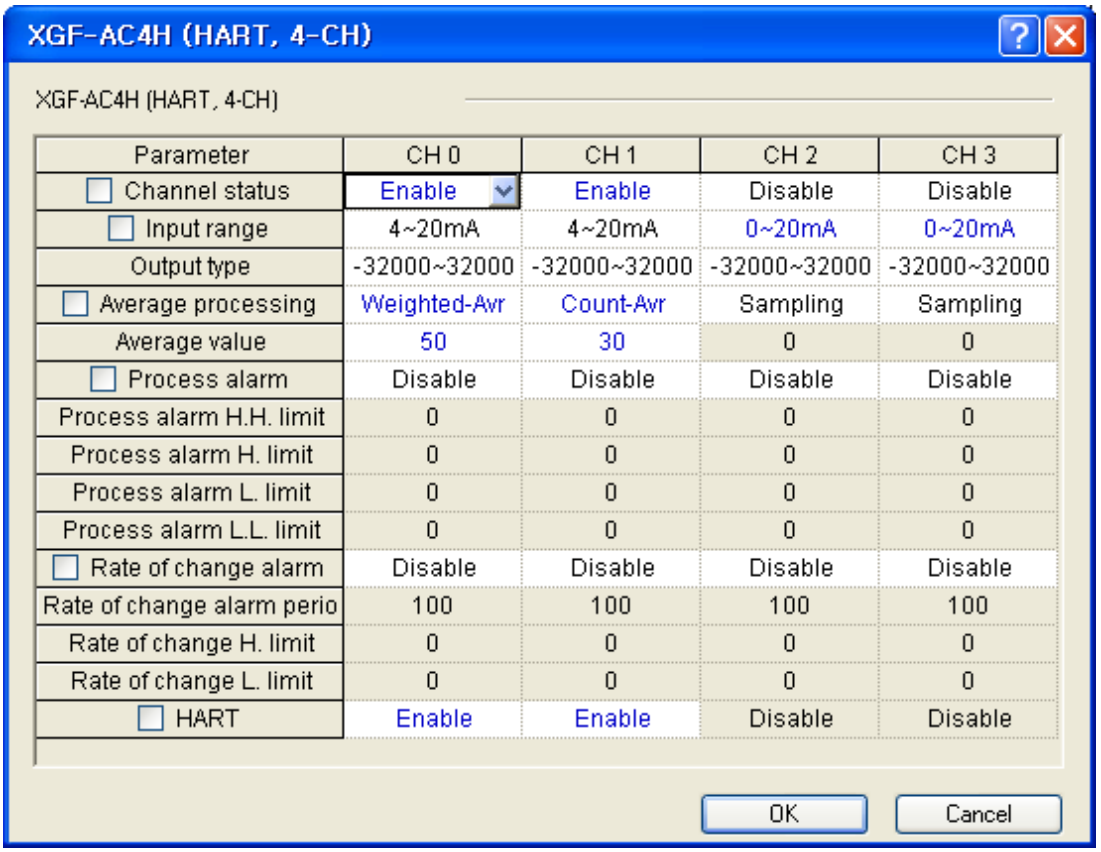
(b) If CH 2's digital value is greater than 13600, Contact No.2 (P00082) of relay output module installed on Slot No.2 will be On.

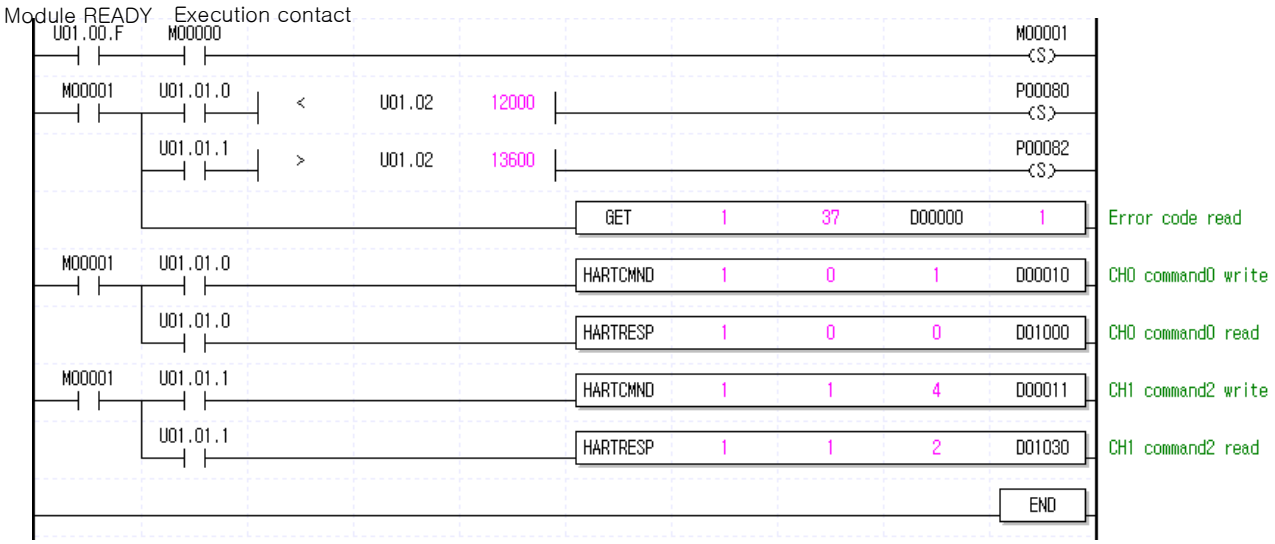
(c) This program is to check responses to each command by executing HART command 0 on channel 0 and HART command 2 on channel 1.

(4) Program

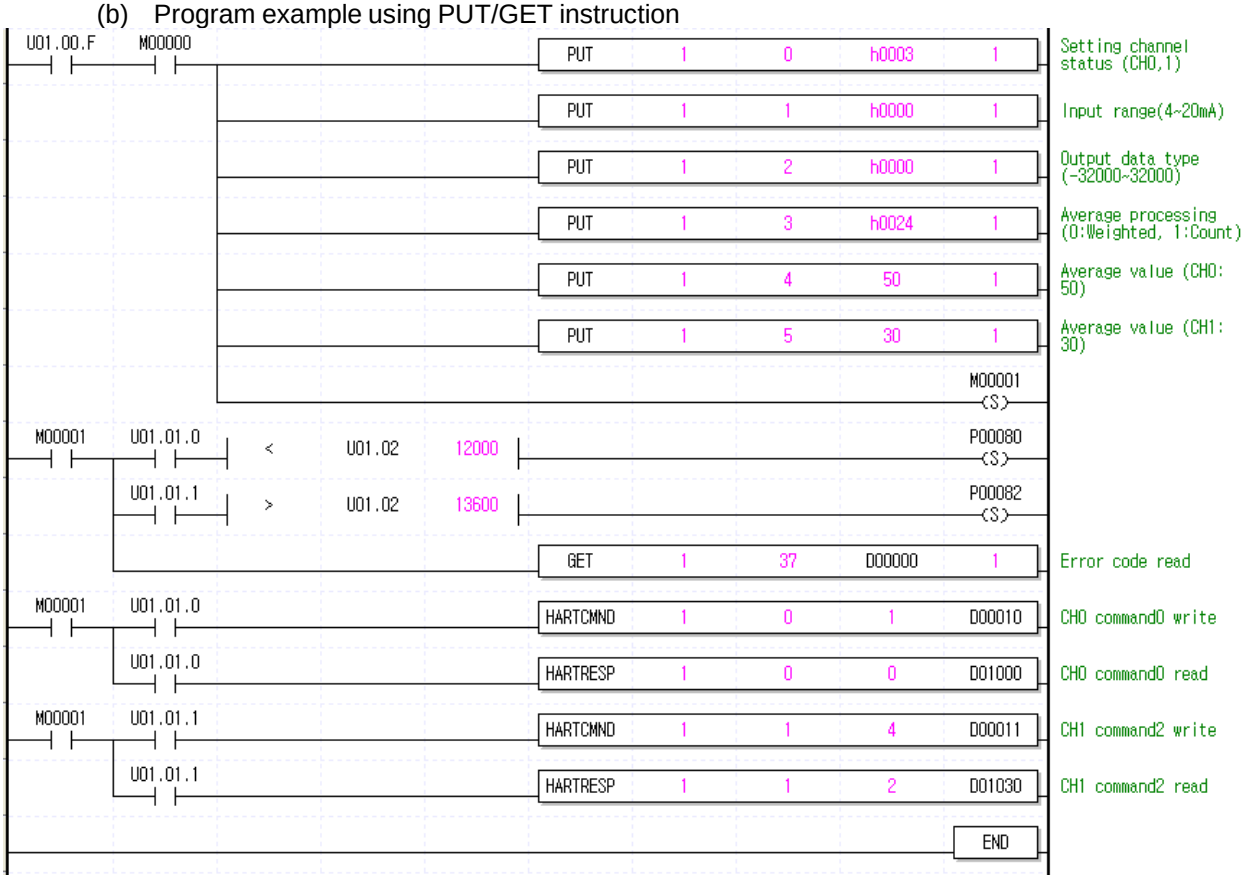
(a) Program example using [I/O parameters] setting







(b) Program example using PUT/GET instruction



- executing HART command 0 on channel 0

	PLC	Type	Device/Variable	Value	Variable/Device	Comment
1	NewPLC	WORD	D01000	29		CH0 Manufacturer ID
2	NewPLC	WORD	D01001	7427		CH0 Manufacturer Device ID
3	NewPLC	WORD	D01002	5		CH0 Mininum Number of Preamble
4	NewPLC	WORD	D01003	5		CH0 Universial Command Revision
5	NewPLC	WORD	D01004	1		CH0 Device Specific Command Revision
6	NewPLC	WORD	D01005	2		CH0 Software Revision
7	NewPLC	WORD	D01006	10		CH0 Hartware Revision(x10)
8	NewPLC	WORD	D01007	1		CH0 Device Function Flag
9	NewPLC	WORD	D01008	5892		CH0 Device ID
10	NewPLC	WORD	D01009	0		

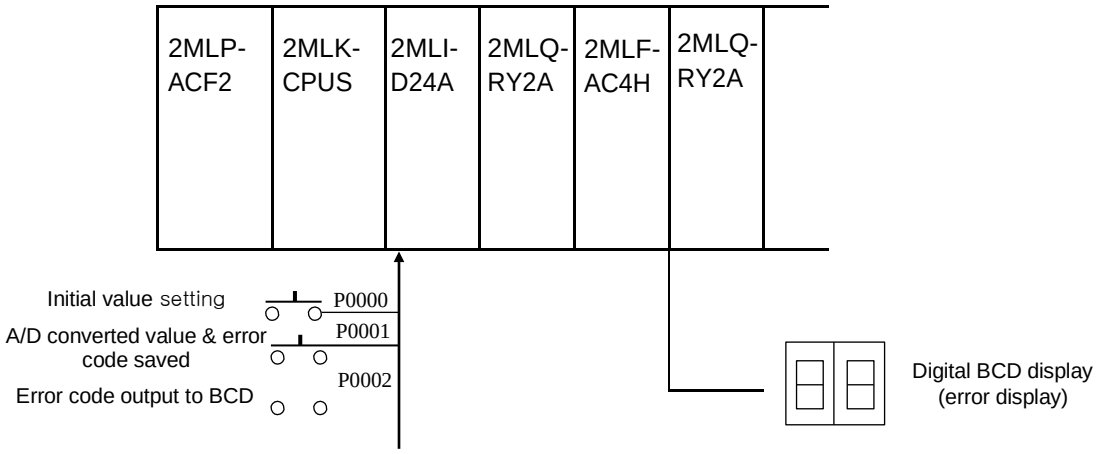
* Preamble: 5~20 byte hexadecimal FF is used in HART communication that uses characters, symbols or Frequency Shift Keying(FSK) to help synchronizing with receiving at the first part of HART message.

- executing HART command 2 on channel 2

	PLC	Type	Device/Variable	Value	Comment
1	NewPLC	REAL	D01030	7.045927525e+000	CH1 Primary Variable Loop Current(mA)
2	NewPLC	REAL	D01032	1.903704643e+001	CH1 Primary Variable Percent of Range

6.3.2 Program to output error codes of HART analog input module to BCD display

(1) System configuration

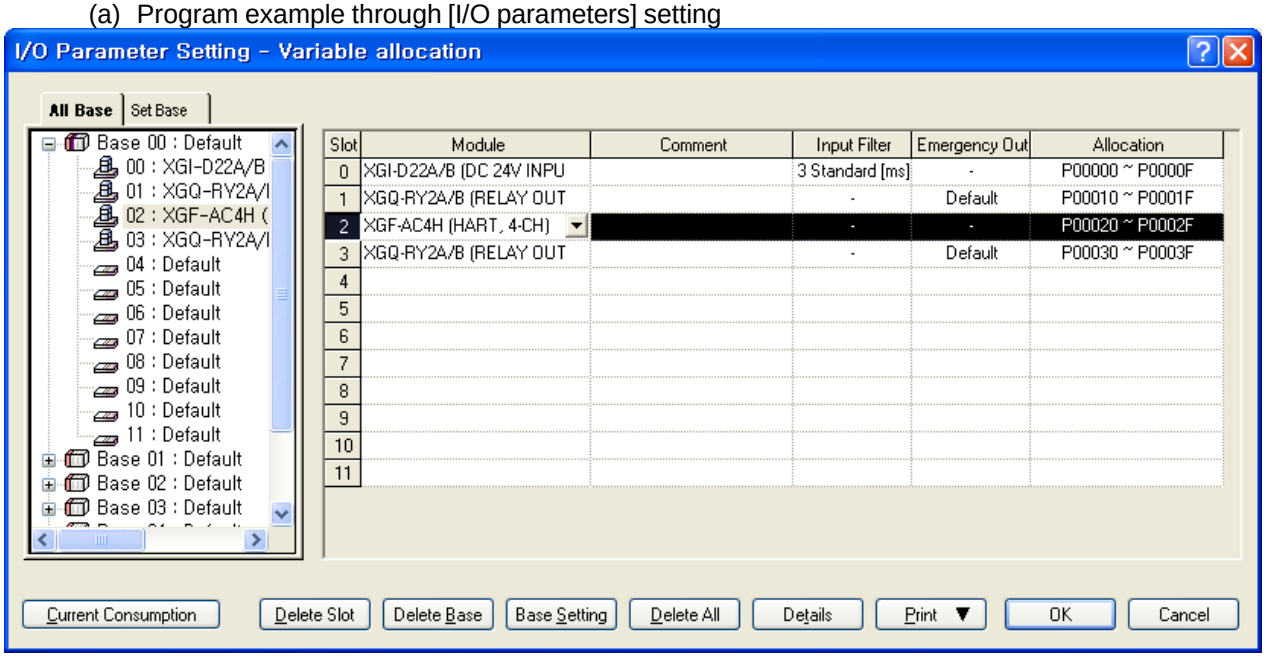


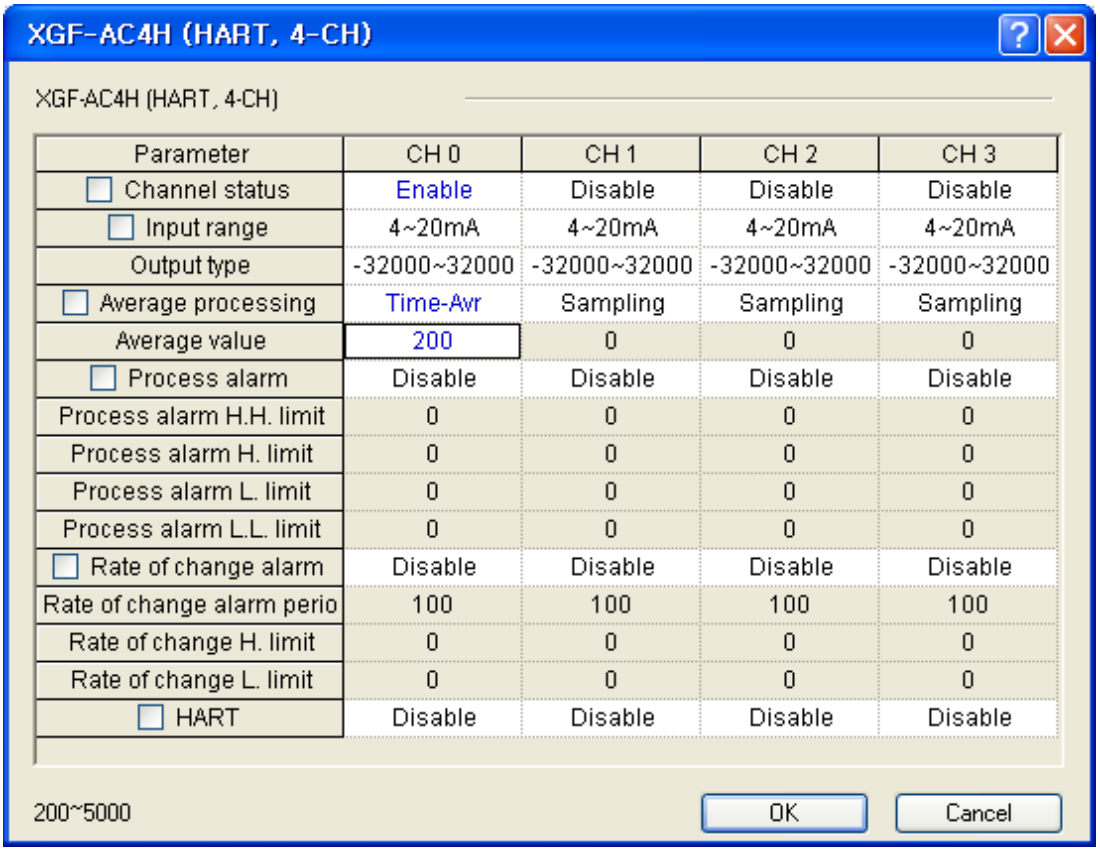
(2) Details of initial setting
- (a) Used CH: CH 0
- (b) Analog input current range: DC 4 ~ 20 mA
- (c) Time average process setting: 200 (ms)
- (d) Digital output data range: -32000 ~ 32000

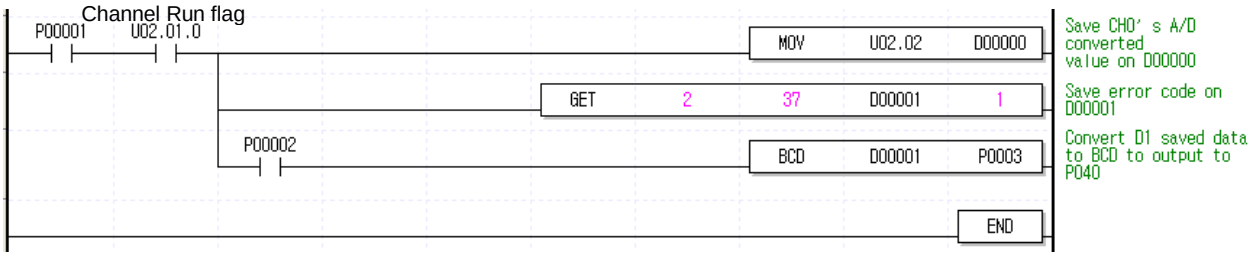
(3) Program description
- (a) If P00000 is On, A/D conversion will be initially specified.
- (b) If P00001 is On, A/D converted value and error code will be saved respectively on D00000 and D00001.
- (c) If P00002 is On, applicable error code will be output to digital BCD display. (P00030 ~ P0003F)

(4) Program

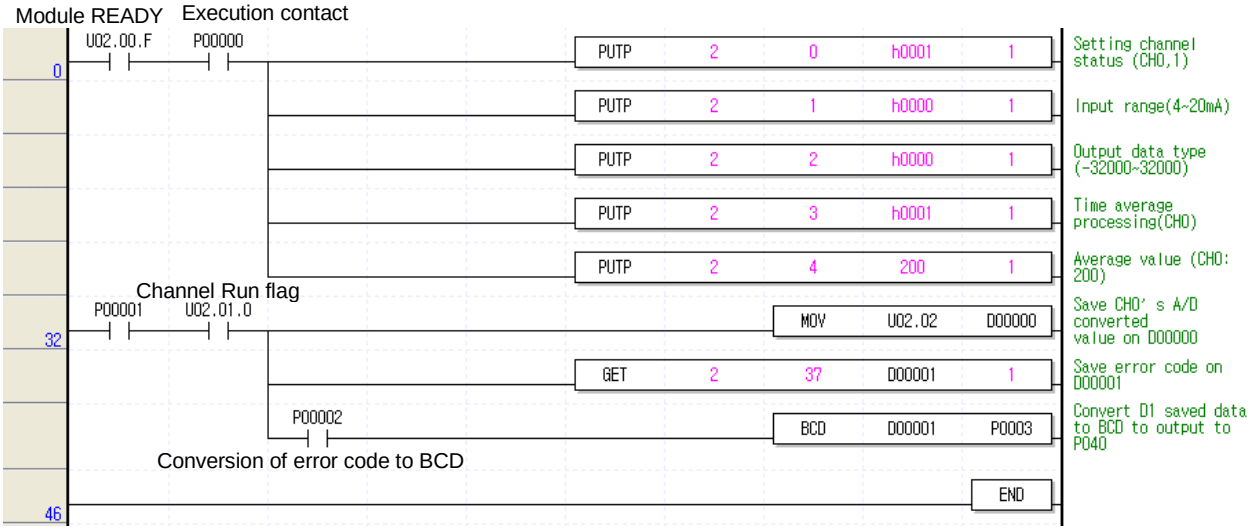
(a) Program example through [I/O parameters] setting







(b) Program example using PUT/GET instruction



Chapter 7 Configuration and Function of Internal Memory (For 2MLI/2MLR)

7.1 Global Variable (Data area)

7.1.1 A/D conversion data IO area configuration

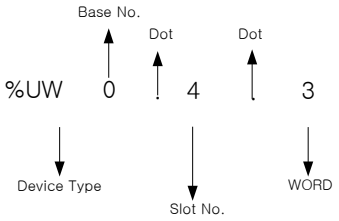
Indicates A/D conversion data IO area at table 7.1

[Table 7. 1] A/D conversion data IO area

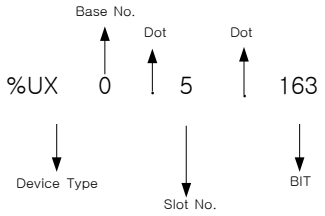
Global variable	Memory allocation	Contents	Read/Write
_xxyy_ERR	%UXxx.yy.0	Module ERROR flag	Read
_xxyy_RDY	%UXxx.yy.15	Module READY flag	
_xxyy_CH0_ACT	%UXxx.yy.16	CH 0 RUN flag	Read
_xxyy_CH1_ACT	%UXxx.yy.17	CH 1 RUN flag	
_xxyy_CH2_ACT	%UXxx.yy.18	CH 2 RUN flag	
_xxyy_CH3_ACT	%UXxx.yy.19	CH 3 RUN flag	
_xxyy_CH0_DATA	%UWxx.yy.2	CH 0 Digital output value	Read
_xxyy_CH1_DATA	%UWxx.yy.3	CH 1 Digital output value	Read
_xxyy_CH2_DATA	%UWxx.yy.4	CH 2 Digital output value	Read
_xxyy_CH3_DATA	%UWxx.yy.5	CH 3 Digital output value	Read
_xxyy_CH0_PALL	%UXxx.yy.128	CH0 process alarm LL-limit	Read
_xxyy_CH0_PAL	%UXxx.yy.129	CH0 process alarm L-limit	
_xxyy_CH0_PAH	%UXxx.yy.130	CH0 process alarm H-limit	
_xxyy_CH0_PAHH	%UXxx.yy.131	CH0 process alarm HH-limit	
_xxyy_CH1_PALL	%UXxx.yy.132	CH1 process alarm LL-limit	
_xxyy_CH1_PAL	%UXxx.yy.133	CH1 process alarm L-limit	
_xxyy_CH1_PAH	%UXxx.yy.134	CH1 process alarm H-limit	
_xxyy_CH1_PAHH	%UXxx.yy.135	CH1 process alarm HH-limit	
_xxyy_CH2_PALL	%UXxx.yy.136	CH2 process alarm LL-limit	
_xxyy_CH2_PAL	%UXxx.yy.137	CH2 process alarm L-limit	
_xxyy_CH2_PAH	%UXxx.yy.138	CH2 process alarm H-limit	
_xxyy_CH2_PAHH	%UXxx.yy.139	CH2 process alarm HH-limit	
_xxyy_CH3_PALL	%UXxx.yy.140	CH3 process alarm LL-limit	
_xxyy_CH3_PAL	%UXxx.yy.141	CH3 process alarm L-limit	
_xxyy_CH3_PAH	%UXxx.yy.142	CH3 process alarm H-limit	
_xxyy_CH3_PAHH	%UXxx.yy.143	CH3 process alarm HH-limit	
_xxyy_CH0_RAL	%UXxx.yy.144	CH0 change rate alarm L-limit	
_xxyy_CH0_RAH	%UXxx.yy.145	CH0 change rate alarm H-limit	
_xxyy_CH1_RAL	%UXxx.yy.146	CH1 change rate alarm L-limit	
_xxyy_CH1_RAH	%UXxx.yy.147	CH1 change rate alarm H-limit	
_xxyy_CH2_RAL	%UXxx.yy.148	CH2 change rate alarm L-limit	
_xxyy_CH2_RAH	%UXxx.yy.149	CH2 change rate alarm H-limit	
_xxyy_CH3_RAL	%UXxx.yy.150	CH3 change rate alarm L-limit	
_xxyy_CH3_RAH	%UXxx.yy.151	CH3 change rate alarm H-limit	

_xxyy_CH0_IDD	%UXxx.yy.160	CH0 input disconnection detection	Read
_xxyy_CH1_IDD	%UXxx.yy.161	CH1 input disconnection detection	
_xxyy_CH2_IDD	%UXxx.yy.162	CH2 input disconnection detection	
_xxyy_CH3_IDD	%UXxx.yy.163	CH3 input disconnection detection	
..	..	..	
_xxyy_CH0_HARTE	%UXxx.yy.168	CH0 HART communication error flag	
_xxyy_CH1_HARTE	%UXxx.yy.169	CH1 HART communication error flag	
_xxyy_CH2_HARTE	%UXxx.yy.170	CH2 HART communication error flag	
_xxyy_CH3_HARTE	%UXxx.yy.171	CH3 HART communication error flag	
_xxyy_ERR_CLR	%UXxx.yy.176	Error clear request flag	Write

1) In the device allocation, xx means base number where module is installed and yy means base number where module is installed.
2) To read 'CH1 digital output value' of Analog Input Module installed at base 0, slot 4, expression is %UW0.4.3.



3) To read 'CH3 disconnection detection flag' of Analog Input Module installed at base 0, slot 5, expression is %UX0.5.163.



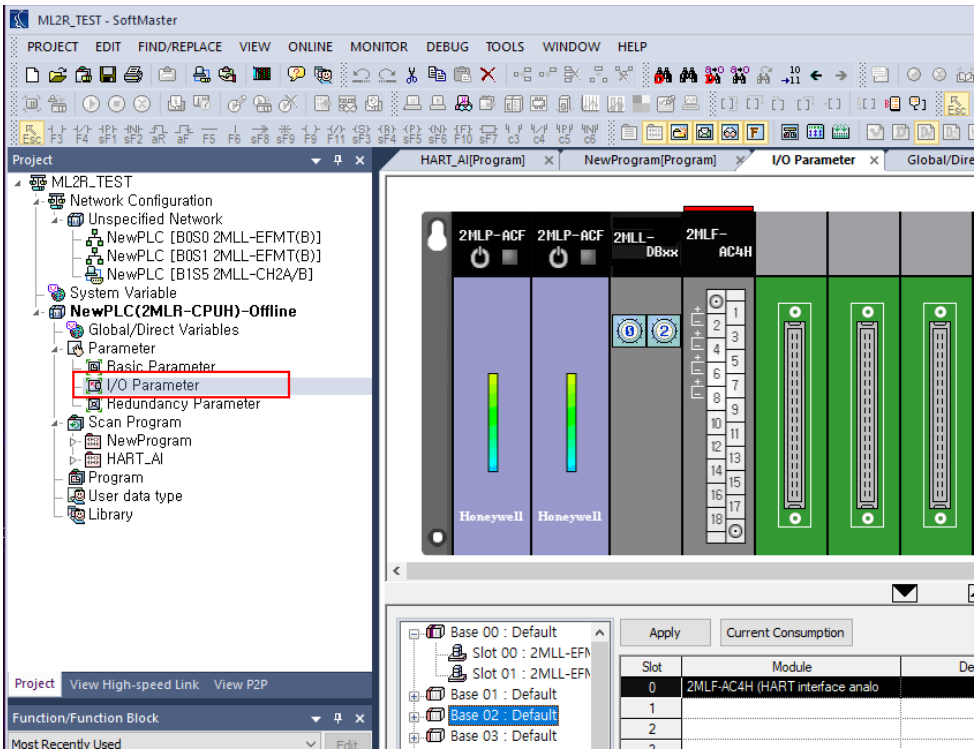
7.1.2 How to use global variable

- In order to register global variable, there are two method, auto registration after setting I/O parameter at project window and batch registration after setting I/O parameter

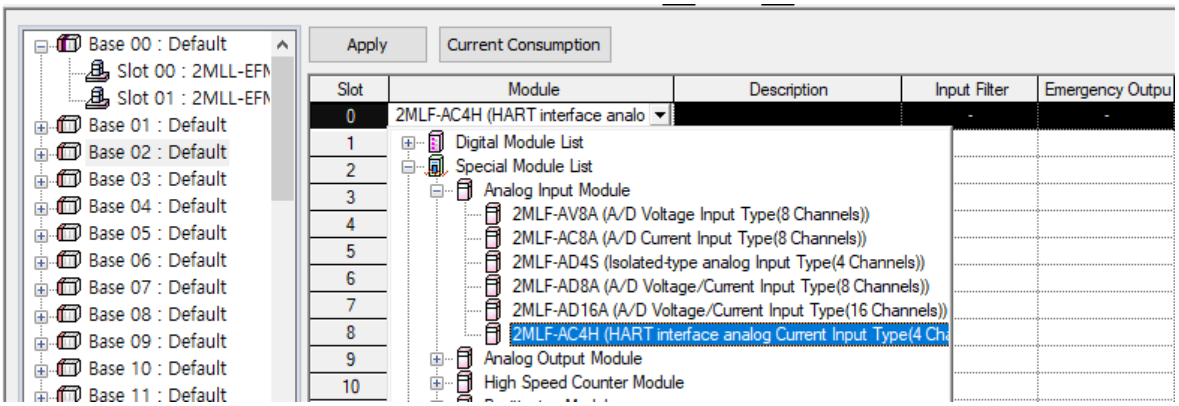
(1) I/O parameter registration

- Registers module you want to use at I/O parameter

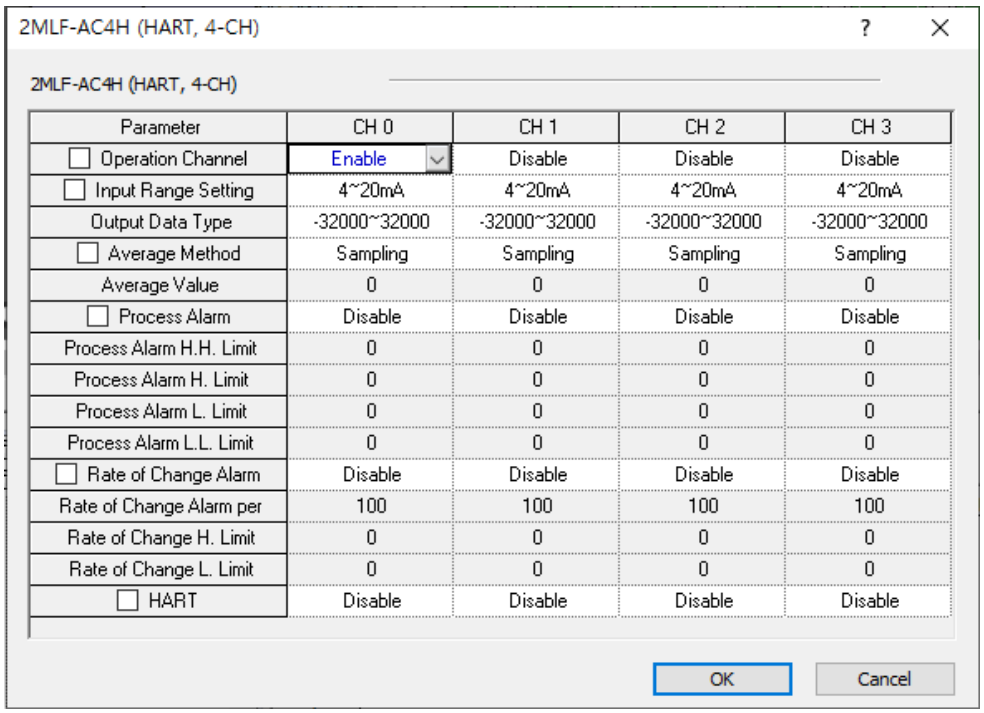
(a) Double-click I/O parameter of project window



(b) Select 2MLF-AC4H module at I/O parameter window

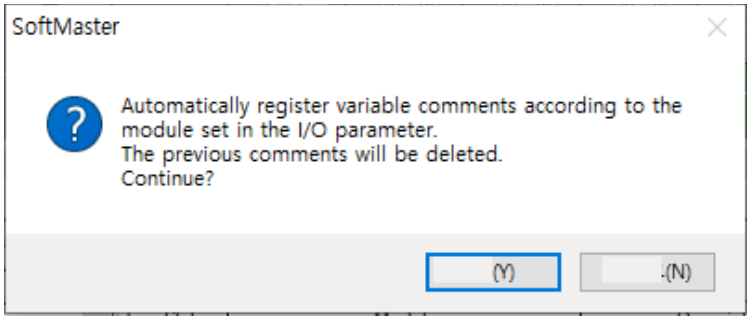


(c) Set parameter by pressing [Details] and select [OK]



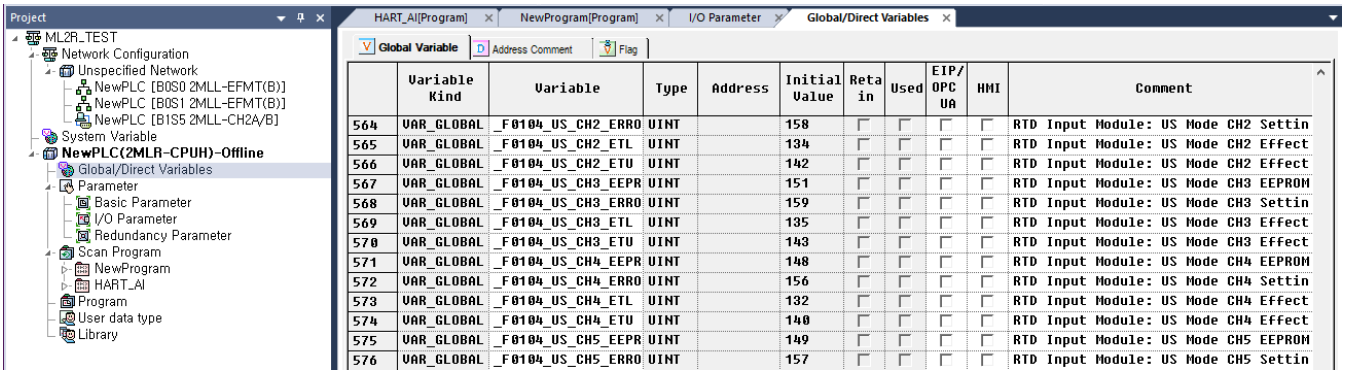
(d) Select [Yes]

- Auto-register global variable of module set in I/O parameter



(e) Global variable auto registration check

- Double-click Global/Direct Variable of project window



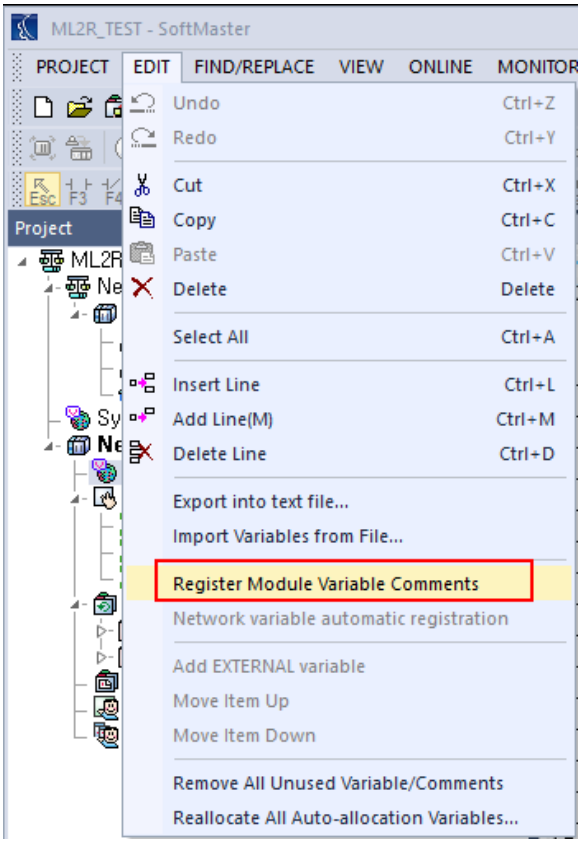
	Variable Kind	Variable	Type	Address	Initial Value	Retain	Used	EIP/OPC UA	HMI	Comment
564	VAR_GLOBAL	_F0104_US_CH2_ERRO	UINT		158					RTD Input Module: US Mode CH2 Settin
565	VAR_GLOBAL	_F0104_US_CH2_ETL	UINT		134					RTD Input Module: US Mode CH2 Effect
566	VAR_GLOBAL	_F0104_US_CH2_ETU	UINT		142					RTD Input Module: US Mode CH2 Effect
567	VAR_GLOBAL	_F0104_US_CH3_EEPR	UINT		151					RTD Input Module: US Mode CH3 EEPROM
568	VAR_GLOBAL	_F0104_US_CH3_ERRO	UINT		159					RTD Input Module: US Mode CH3 Settin
569	VAR_GLOBAL	_F0104_US_CH3_ETL	UINT		135					RTD Input Module: US Mode CH3 Effect
570	VAR_GLOBAL	_F0104_US_CH3_ETU	UINT		143					RTD Input Module: US Mode CH3 Effect
571	VAR_GLOBAL	_F0104_US_CH4_EEPR	UINT		148					RTD Input Module: US Mode CH4 EEPROM
572	VAR_GLOBAL	_F0104_US_CH4_ERRO	UINT		156					RTD Input Module: US Mode CH4 Settin
573	VAR_GLOBAL	_F0104_US_CH4_ETL	UINT		132					RTD Input Module: US Mode CH4 Effect
574	VAR_GLOBAL	_F0104_US_CH4_ETU	UINT		140					RTD Input Module: US Mode CH4 Effect
575	VAR_GLOBAL	_F0104_US_CH5_EEPR	UINT		149					RTD Input Module: US Mode CH5 EEPROM
576	VAR_GLOBAL	_F0104_US_CH5_ERRO	UINT		157					RTD Input Module: US Mode CH5 Settin

(2) Global variable registration

- Registers global variable set in I/O parameter

(a) Double-click Global/Direct Variable of project window

(b) Select [Register Special Module Variables] at menu [Edit]



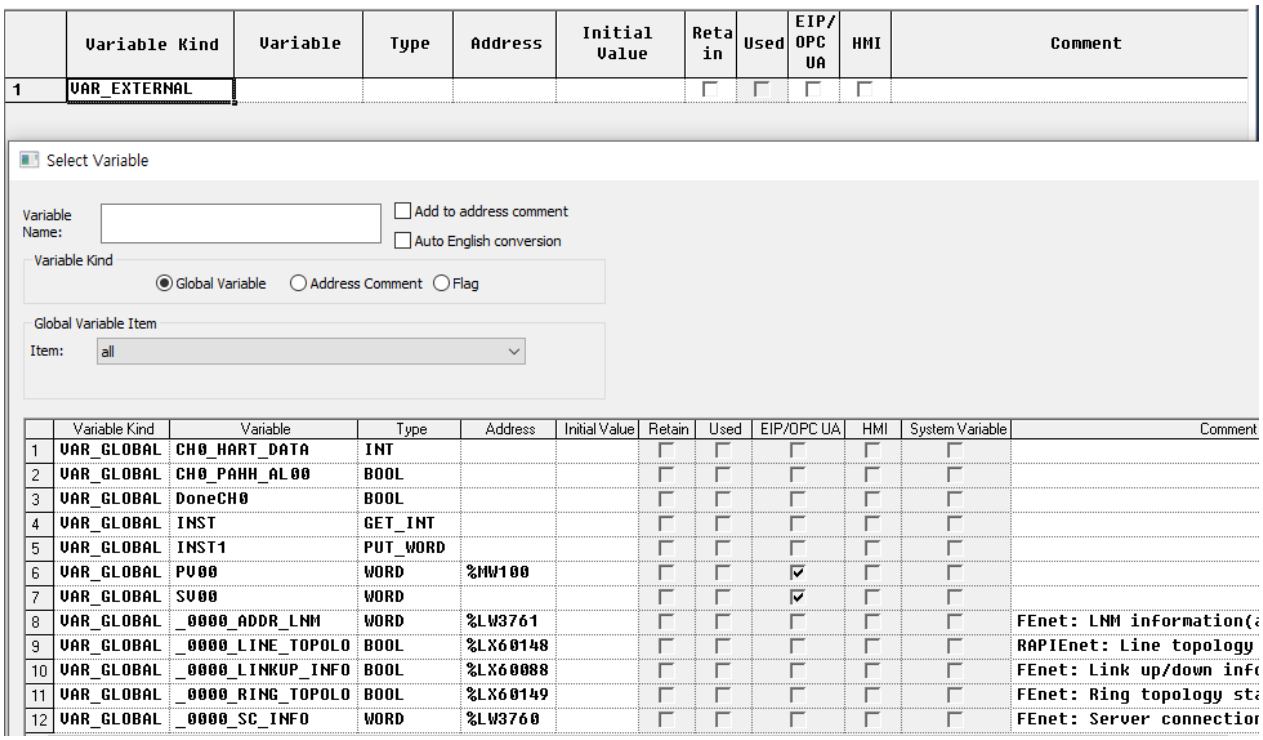
Global Variable | Address Comment | Flag

	Variable Kind	Variable	Type	Address	Initial Value	Retain	Used	EIP/OPC UA	HMI	Comment
564	VAR_GLOBAL	_F0104_US_CH2_ERRO	UINT		158					RTD Input Module: US Mode CH2 Settin
565	VAR_GLOBAL	_F0104_US_CH2_ETL	UINT		134					RTD Input Module: US Mode CH2 Effect
566	VAR_GLOBAL	_F0104_US_CH2_ETU	UINT		142					RTD Input Module: US Mode CH2 Effect
567	VAR_GLOBAL	_F0104_US_CH3_EEPR	UINT		151					RTD Input Module: US Mode CH3 EEPROM
568	VAR_GLOBAL	_F0104_US_CH3_ERRO	UINT		159					RTD Input Module: US Mode CH3 Settin
569	VAR_GLOBAL	_F0104_US_CH3_ETL	UINT		135					RTD Input Module: US Mode CH3 Effect
570	VAR_GLOBAL	_F0104_US_CH3_ETU	UINT		143					RTD Input Module: US Mode CH3 Effect
571	VAR_GLOBAL	_F0104_US_CH4_EEPR	UINT		148					RTD Input Module: US Mode CH4 EEPROM
572	VAR_GLOBAL	_F0104_US_CH4_ERRO	UINT		156					RTD Input Module: US Mode CH4 Settin
573	VAR_GLOBAL	_F0104_US_CH4_ETL	UINT		132					RTD Input Module: US Mode CH4 Effect
574	VAR_GLOBAL	_F0104_US_CH4_ETU	UINT		140					RTD Input Module: US Mode CH4 Effect
575	VAR_GLOBAL	_F0104_US_CH5_EEPR	UINT		149					RTD Input Module: US Mode CH5 EEPROM
576	VAR_GLOBAL	_F0104_US_CH5_ERRO	UINT		157					RTD Input Module: US Mode CH5 Settin
577	VAR_GLOBAL	_F0104_US_CH5_ETL	UINT		133					RTD Input Module: US Mode CH5 Effect
578	VAR_GLOBAL	_F0104_US_CH5_ETU	UINT		141					RTD Input Module: US Mode CH5 Effect
579	VAR_GLOBAL	_F0104_US_CH6_EEPR	UINT		150					RTD Input Module: US Mode CH6 EEPROM
580	VAR_GLOBAL	_F0104_US_CH6_ERRO	UINT		158					RTD Input Module: US Mode CH6 Settin
581	VAR_GLOBAL	_F0104_US_CH6_ETL	UINT		134					RTD Input Module: US Mode CH6 Effect
582	VAR_GLOBAL	_F0104_US_CH6_ETU	UINT		142					RTD Input Module: US Mode CH6 Effect
583	VAR_GLOBAL	_F0104_US_CH7_EEPR	UINT		151					RTD Input Module: US Mode CH7 EEPROM
584	VAR_GLOBAL	_F0104_US_CH7_ERRO	UINT		159					RTD Input Module: US Mode CH7 Settin

(3) Local variable registration
- Registers variable among registered global variable you want to use as local variable.

(a) Double-click local variable to use in the following scan program.

(b) Click right button of mouse in the right local variable window and select “Add EXTERNAL variable”.



	Variable Kind	Variable	Type	Address	Initial Value	Retain	Used	EIP/OPC UA	HMI	Comment
1	VAR_EXTERNAL					☐	☐	☐	☐	

Select Variable

Variable Name: ☐ Add to address comment ☐ Auto English conversion

Variable Kind: ◉ Global Variable ○ Address Comment ○ Flag

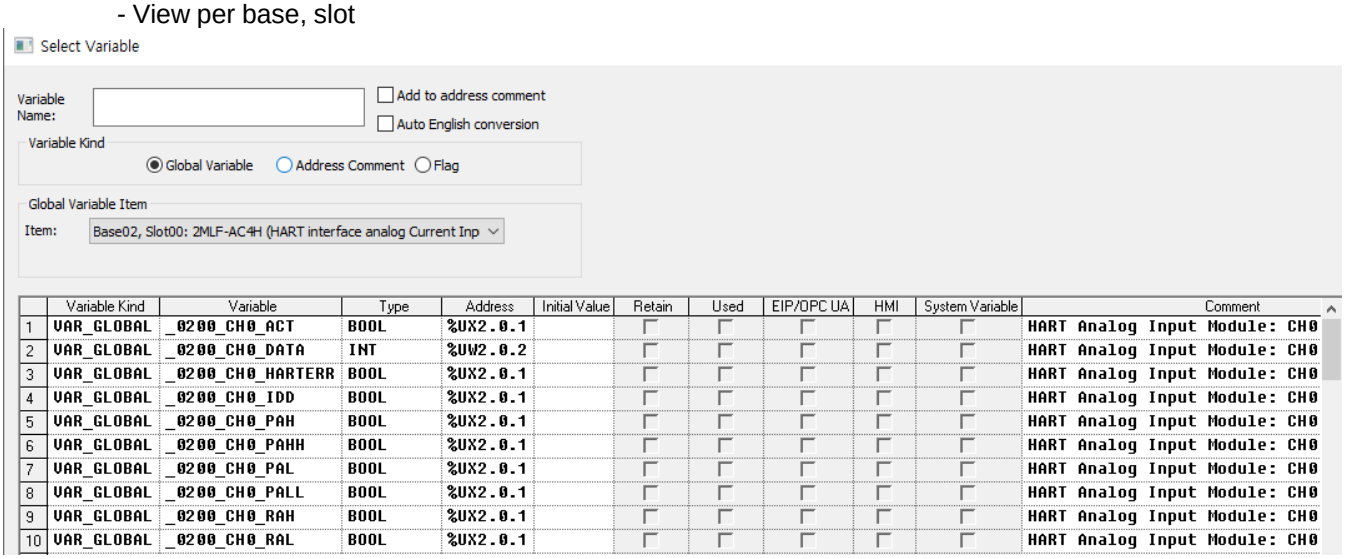
Global Variable Item — Item: all

	Variable Kind	Variable	Type	Address	Initial Value	Retain	Used	EIP/OPC UA	HMI	System Variable	Comment
1	VAR_GLOBAL	CH0_HART_DATA	INT			☐	☐	☐	☐	☐	
2	VAR_GLOBAL	CH0_PAHH_AL00	BOOL			☐	☐	☐	☐	☐	
3	VAR_GLOBAL	DoneCH0	BOOL			☐	☐	☐	☐	☐	
4	VAR_GLOBAL	INST	GET_INT			☐	☐	☐	☐	☐	
5	VAR_GLOBAL	INST1	PUT_WORD			☐	☐	☐	☐	☐	
6	VAR_GLOBAL	PV00	WORD	%MW100		☐	☐	☑	☐	☐	
7	VAR_GLOBAL	SV00	WORD			☐	☐	☑	☐	☐	
8	VAR_GLOBAL	_0000_ADDR_LNM	WORD	%LW3761		☐	☐	☐	☐	☐	FEnet: LNM information(a
9	VAR_GLOBAL	_0000_LINE_TOPOLO	BOOL	%LX60148		☐	☐	☐	☐	☐	RAPIEnet: Line topology
10	VAR_GLOBAL	_0000_LINKUP_INFO	BOOL	%LX60088		☐	☐	☐	☐	☐	FEnet: Link up/down info
11	VAR_GLOBAL	_0000_RING_TOPOLO	BOOL	%LX60149		☐	☐	☐	☐	☐	FEnet: Ring topology sta
12	VAR_GLOBAL	_0000_SC_INFO	WORD	%LW3760		☐	☐	☐	☐	☐	FEnet: Server connectior

(c) Select local variable to add at Global View on “Add External Variable” window (“All” or “Base, slot”).

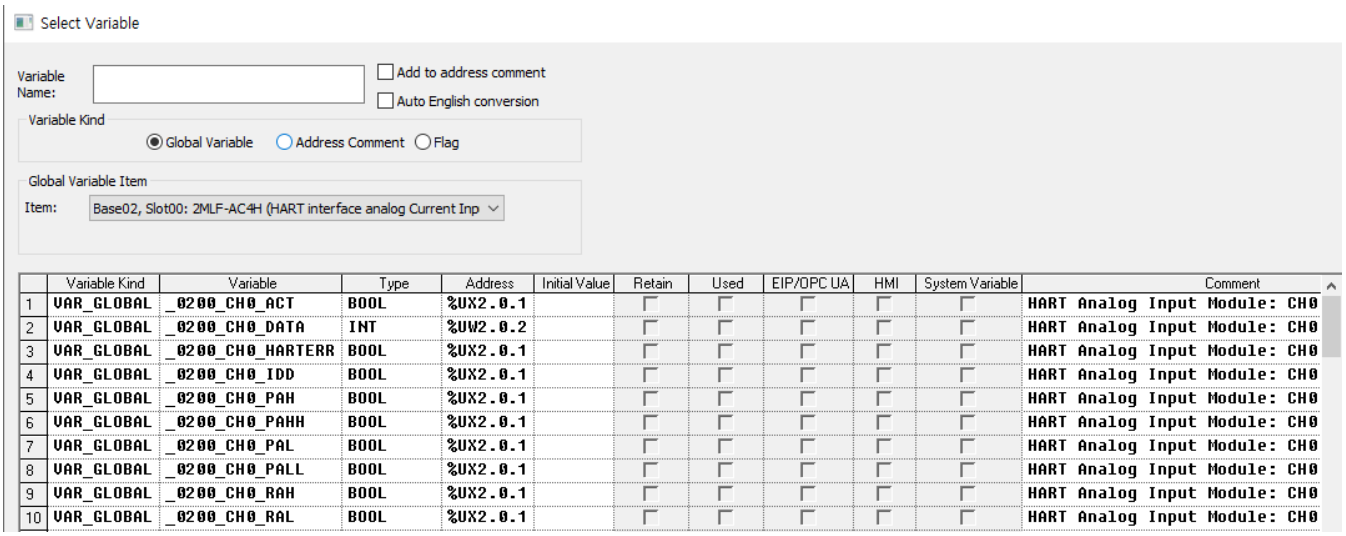
-View All

- View per base, slot



	Variable Kind	Variable	Type	Address	Initial Value	Retain	Used	EIP/OPC UA	HMI	System Variable	Comment
1	VAR_GLOBAL	_0200_CH0_ACT	BOOL	%UX2.0.1							HART Analog Input Module: CH0
2	VAR_GLOBAL	_0200_CH0_DATA	INT	%UW2.0.2							HART Analog Input Module: CH0
3	VAR_GLOBAL	_0200_CH0_HARTERR	BOOL	%UX2.0.1							HART Analog Input Module: CH0
4	VAR_GLOBAL	_0200_CH0_IDD	BOOL	%UX2.0.1							HART Analog Input Module: CH0
5	VAR_GLOBAL	_0200_CH0_PAH	BOOL	%UX2.0.1							HART Analog Input Module: CH0
6	VAR_GLOBAL	_0200_CH0_PAHH	BOOL	%UX2.0.1							HART Analog Input Module: CH0
7	VAR_GLOBAL	_0200_CH0_PAL	BOOL	%UX2.0.1							HART Analog Input Module: CH0
8	VAR_GLOBAL	_0200_CH0_PALL	BOOL	%UX2.0.1							HART Analog Input Module: CH0
9	VAR_GLOBAL	_0200_CH0_RAH	BOOL	%UX2.0.1							HART Analog Input Module: CH0
10	VAR_GLOBAL	_0200_CH0_RAL	BOOL	%UX2.0.1							HART Analog Input Module: CH0

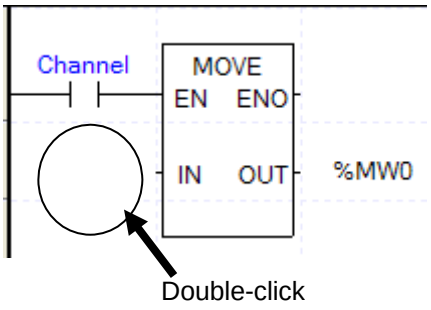
(d) The following is example selecting digital input value (_0000_CH0_DATA) of “Base00, Slot00”.



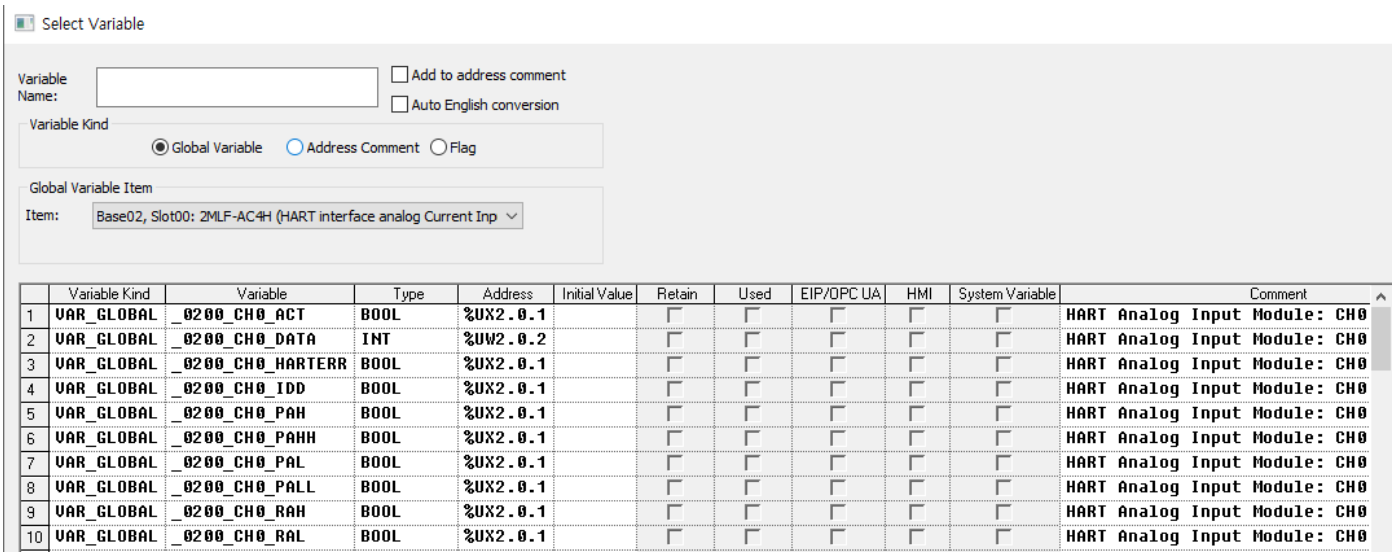
	Variable Kind	Variable	Type	Address	Initial Value	Retain	Used	EIP/OPC UA	HMI	System Variable	Comment
1	VAR_GLOBAL	_0200_CH0_ACT	BOOL	%UX2.0.1							HART Analog Input Module: CH0
2	VAR_GLOBAL	_0200_CH0_DATA	INT	%UW2.0.2							HART Analog Input Module: CH0
3	VAR_GLOBAL	_0200_CH0_HARTERR	BOOL	%UX2.0.1							HART Analog Input Module: CH0
4	VAR_GLOBAL	_0200_CH0_IDD	BOOL	%UX2.0.1							HART Analog Input Module: CH0
5	VAR_GLOBAL	_0200_CH0_PAH	BOOL	%UX2.0.1							HART Analog Input Module: CH0
6	VAR_GLOBAL	_0200_CH0_PAHH	BOOL	%UX2.0.1							HART Analog Input Module: CH0
7	VAR_GLOBAL	_0200_CH0_PAL	BOOL	%UX2.0.1							HART Analog Input Module: CH0
8	VAR_GLOBAL	_0200_CH0_PALL	BOOL	%UX2.0.1							HART Analog Input Module: CH0
9	VAR_GLOBAL	_0200_CH0_RAH	BOOL	%UX2.0.1							HART Analog Input Module: CH0
10	VAR_GLOBAL	_0200_CH0_RAL	BOOL	%UX2.0.1							HART Analog Input Module: CH0

(4) How to use local variable on program
- It describes the added global variable at local program.
- The following is example getting the conversion value of CH0 of Analog Input Module to %MW0.

(a) At part reading A/D conversion data to %MW0 by using the following MOVE function, double-click variable part ahead of IN, then “Select Variable” window shows up.

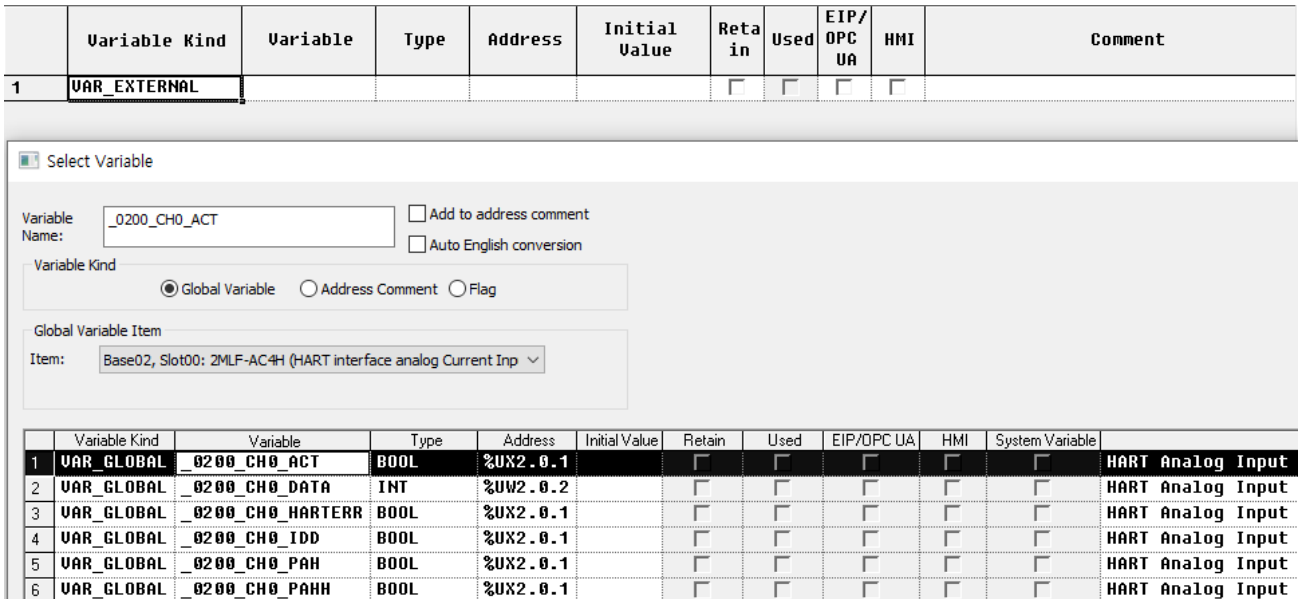


(b) Select global variable at variable type at Select Variable window. And select relevant base (0 base, 0 slot) at global variable view item.

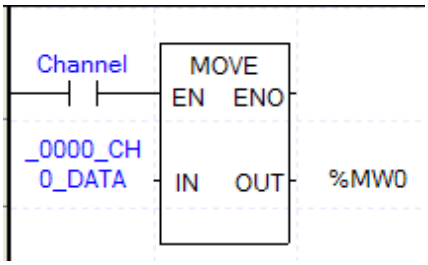


	Variable Kind	Variable	Type	Address	Initial Value	Retain	Used	EIP/OPC UA	HMI	System Variable	Comment
1	VAR_GLOBAL	_0200_CH0_ACT	BOOL	%UX2.0.1							HART Analog Input Module: CH0
2	VAR_GLOBAL	_0200_CH0_DATA	INT	%UW2.0.2							HART Analog Input Module: CH0
3	VAR_GLOBAL	_0200_CH0_HARTERR	BOOL	%UX2.0.1							HART Analog Input Module: CH0
4	VAR_GLOBAL	_0200_CH0_IDD	BOOL	%UX2.0.1							HART Analog Input Module: CH0
5	VAR_GLOBAL	_0200_CH0_PAH	BOOL	%UX2.0.1							HART Analog Input Module: CH0
6	VAR_GLOBAL	_0200_CH0_PAHH	BOOL	%UX2.0.1							HART Analog Input Module: CH0
7	VAR_GLOBAL	_0200_CH0_PAL	BOOL	%UX2.0.1							HART Analog Input Module: CH0
8	VAR_GLOBAL	_0200_CH0_PALL	BOOL	%UX2.0.1							HART Analog Input Module: CH0
9	VAR_GLOBAL	_0200_CH0_RAH	BOOL	%UX2.0.1							HART Analog Input Module: CH0
10	VAR_GLOBAL	_0200_CH0_RAL	BOOL	%UX2.0.1							HART Analog Input Module: CH0

(c) Double-click or select _0000_CH0_DATA corresponding to CH0 A/D conversion data and click [OK].



(d) The following figure is result adding global variable corresponding to CH0 A/D conversion value.



7.2 PUT/GET Function Block use area (Parameter area)

7.2.1 PUT/GET Function Block use area (Parameter area)

It indicates operation parameter setting area of Analog Input Module at table 7.2.

[Table 7. 2] Operation parameter setting area

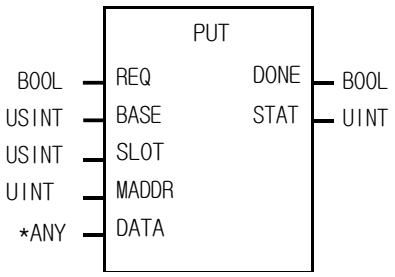
Global variable	Contents	R/W	Instruction
_Fxxyy_ALM_EN _Fxxyy_AVG_SEL _Fxxyy_CH_EN	Set alarm process Set average process method Set channel to use	R/W	PUT
_Fxxyy_CH0_AVG_VAL _Fxxyy_CH0_PAH_VAL _Fxxyy_CH0_PAHH_VAL _Fxxyy_CH0_PAL_VAL _Fxxyy_CH0_PALL_VAL _Fxxyy_CH0_RA_PERIOD _Fxxyy_CH0_RAH_VAL _Fxxyy_CH0_RAL_VAL	CH0 average value CH0 process alarm H-limit setting value CH0 process alarm HH-limit setting value CH0 process alarm L-limit setting value CH0 process alarm LL-limit setting value CH0 change rate alarm detection period setting CH0 change rate H-limit setting value CH0 change rate L-limit setting value	R/W	PUT
_Fxxyy_CH1_AVG_VAL _Fxxyy_CH1_PAH_VAL _Fxxyy_CH1_PAHH_VAL _Fxxyy_CH1_PAL_VAL _Fxxyy_CH1_PALL_VAL _Fxxyy_CH1_RA_PERIOD _Fxxyy_CH1_RAH_VAL _Fxxyy_CH1_RAL_VAL	CH1 average value CH1 process alarm H-limit setting value CH1 process alarm HH-limit setting value CH1 process alarm L-limit setting value CH1 process alarm LL-limit setting value CH1 change rate alarm detection period setting CH1 change rate H-limit setting value CH1 change rate L-limit setting value	R/W	PUT
_Fxxyy_CH2_AVG_VAL _Fxxyy_CH2_PAH_VAL _Fxxyy_CH2_PAHH_VAL _Fxxyy_CH2_PAL_VAL _Fxxyy_CH2_PALL_VAL _Fxxyy_CH2_RA_PERIOD _Fxxyy_CH2_RAH_VAL _Fxxyy_CH2_RAL_VAL	CH2 average value CH2 process alarm H-limit setting value CH2 process alarm HH-limit setting value CH2 process alarm L-limit setting value CH2 process alarm LL-limit setting value CH2 change rate alarm detection period setting CH2 change rate H-limit setting value CH2 change rate L-limit setting value	R/W	PUT
_Fxxyy_CH3_AVG_VAL _Fxxyy_CH3_PAH_VAL _Fxxyy_CH3_PAHH_VAL _Fxxyy_CH3_PAL_VAL _Fxxyy_CH3_PALL_VAL _Fxxyy_CH3_RA_PERIOD _Fxxyy_CH3_RAH_VAL _Fxxyy_CH3_RAL_VAL	CH3 average value CH3 process alarm H-limit setting value CH3 process alarm HH-limit setting value CH3 process alarm L-limit setting value CH3 process alarm LL-limit setting value CH3 change rate alarm detection period setting CH3 change rate H-limit setting value CH3 change rate L-limit setting value	R/W	PUT
_Fxxyy_DATA_TYPE _Fxxyy_IN_RANGE	Output data type setting Input current/voltage setting	R/W	PUT
_Fxxyy_ERR_CODE	Error code	R	GET

* At device allocation, xx means base number and yy means slot number where module is equipped.

7.2.2 PUT/GET instruction

(1) PUT instruction

PUT
Writing data to special module

Function Block	Description
	***Input*** REQ : Execute function when 1 BASE : Specify base position SLOT : Specify slot position MADDR : Module address DATA : Data to save module ***Output*** DONE : Output 1 when normal STAT : Error information

*ANY: WORD, DWORD, INT, USINT, DINT, UDINT type available among ANY type

■ ***Function***

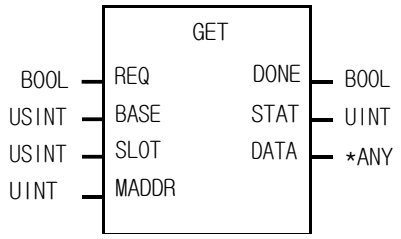
Read data from designated special module

Function Block	Input(ANY) type	Description
PUT_WORD	WORD	Save WRD data into the designated module address (MADDR).
PUT_DWORD	DWORD	Save DWORD data into the designated module address (MADDR).
PUT_INT	INT	Save INT data into the designated module address (MADDR).
PUT_UINT	UINT	Save UNIT data into the designated module address (MADDR).
PUT_DINT	DINT	Save DINT data into the designated module address (MADDR).
PUT_UDINT	UDINT	Save UDINT data into the designated module address (MADDR).

(2) GET instruction

GET

Reading from special module data

Function block	Description
	***Input*** REQ : Execute function when 1 BASE : Specify base position SLOT : Specify slot position MADDR : Module address 512(0x200) ~ 1023(0x3FF) ***Output*** DONE : Output 1 when normal STAT : Error information DATA : Data to read from module

*ANY: WORD, DWORD, INT, UINT, DINT, UDINT type available among ANY type

■ ***Function***

Read data from designated special module

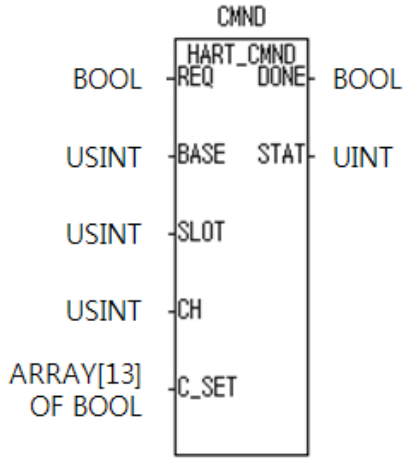
Function Block	Output(ANY) type	Description
GET_WORD	WORD	Read data as much as WORD from the designated module address (MADDR).
GET_DWORD	DWORD	Read data as much as DWORD from the designated module address (MADDR).
GET_INT	INT	Read data as much as INT from the designated Module address (MADDR).
GET_UINT	UINT	Read data as much as UNIT from the designated module address (MADDR).
GET_DINT	DINT	Read data as much as DINT from the designated module address (MADDR).
GET_UDINT	UDINT	Read data as much as UDINT from the designated module address (MADDR).

7.2.3 HART Commands

(1) HART_CMND command

HART_CMND

Writing HART command to module

Function Block	*Description*
	***Input*** REQ : Execute function when 1(rising edge) BASE : Specify base position SLOT : Specify slot position CH : Used channel number C_SET : Communication command to be written (bit mask set) ***Output*** DONE : Output 1 when normal STAT : Error information

■***Function***

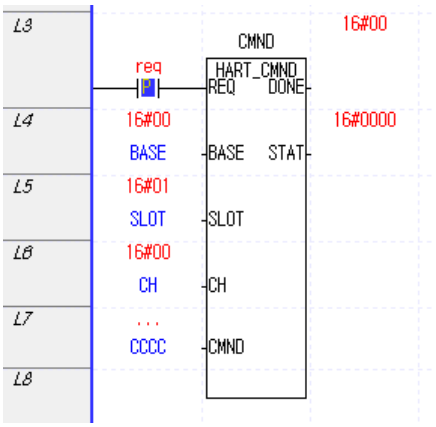
(a) It is used to set a command to be communicated regarding to the designated module's channel.

(b) Set bit(BOOL Array) corresponding to a command to be communicated on "C_SET".

Command	***110***	***61***	***57***	***50***	***48***	***16***	***15***	***13***	***12***	***3***	***2***	***1***	***0***
Array index	12	11	10	9	8	7	6	5	4	3	2	1	0

(c) If "REQ" contact is converted from 0 to 1, function block will be executed.

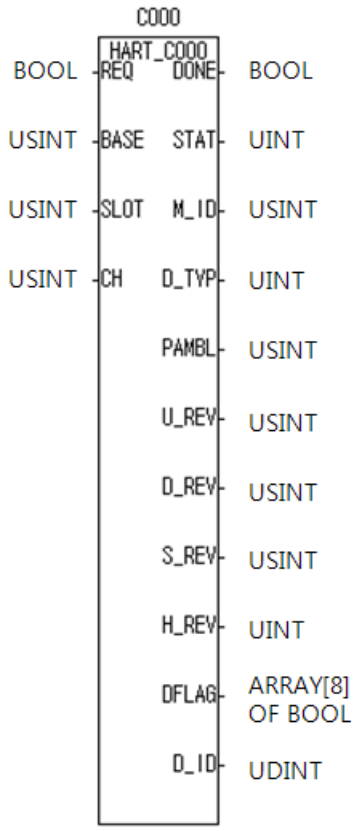
■***Example program***



(2) HART_C000 command

HART_C000

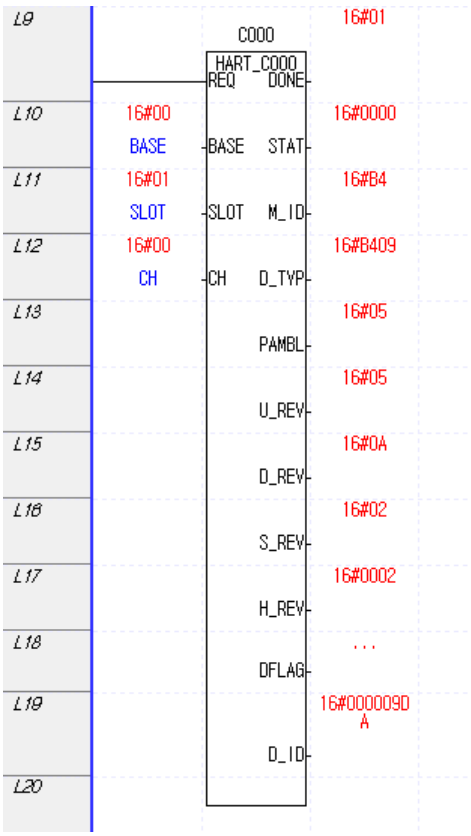
Read response to Universal Command 0

Function block	*Description*
	***Input*** REQ : Execute function when 1(rising edge) BASE : Specify base position SLOT : Specify slot position CH : Used channel number ***Output*** DONE : Output 1 when normal STAT : Error information M_ID : Manufacturer ID D_TYP : Manufacturer's device type code(If 4 digits are displayed, the first two digits refer to manufacturer ID code) PAMBL : Minimum Preamble number U_REV : Universal Command Revision D_REV : Device Specific Command Revision S_REV : Software Revision H_REV : Hardware Revision(x10) DFLAG : Device Function Flag D_ID : Device ID

■***Function***

When [Universal Command 0] command is set to the designated module's channel, this function is used to monitor response data. If HART channel is set to 'Allow' and HART communication is normally performed, response data of this area displays even though any response to Command 0 is requested through HART_CMND. But, to monitor those data continuously, set Command 0 command through HART_CMND.

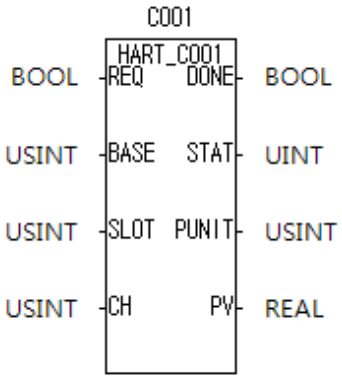
■***Example program***



(3) HART_C001 Command

HART_C001

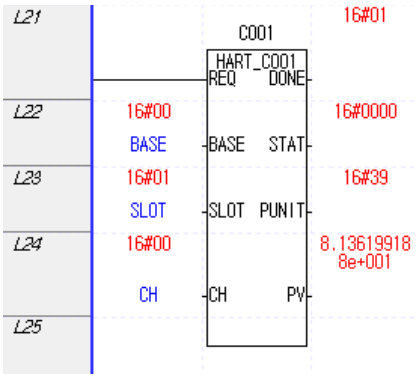
Read response to Universal Command 1

Function block	Description
	***Input*** REQ : Execute function when 1(rising edge) BASE : Specify base position SLOT : Specify slot position CH : Used channel number ***Output*** DONE : Output 1 when normal STAT : Error information PUNIT : Primary Variable Unit PV : Primary Variable

■***Function***

When [Universal Command 1] command is set to the designated module's channel, this function is used to monitor response data.

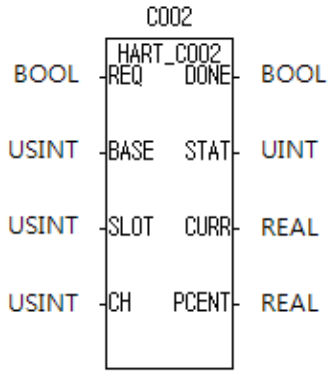
■***Example program***



(4) HART_C002 command

HART_C002

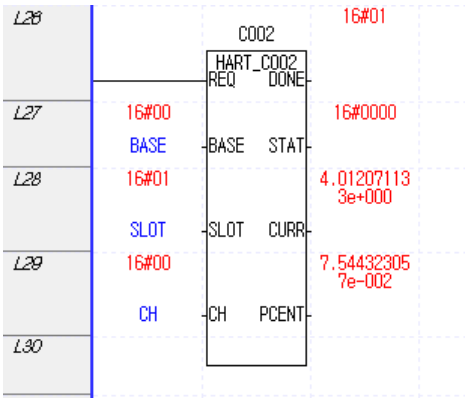
Read response to Universal Command 2

Function block	*Description*
	***Input*** REQ : Execute function when 1(rising edge) BASE : Specify base position SLOT : Specify slot position CH : Used channel number ***Output*** DONE : Output 1 when normal STAT : Error information CURR : Primary Variable loop current(mA) PCENT : Primary Variable percent of range

■***Function***

When [Universal Command 2] command is set to the designated module's channel, this function is used to monitor response data.

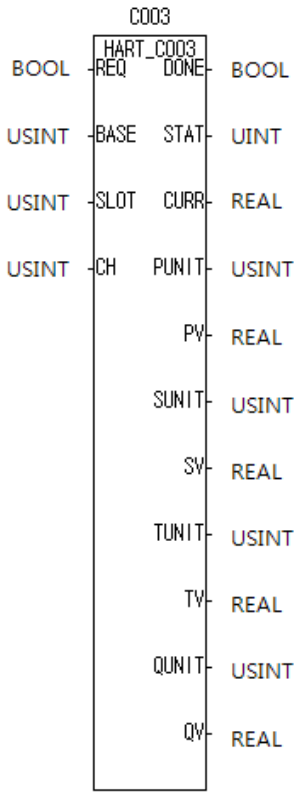
■***Example program***



(5) HART_C003 command

HART_C003

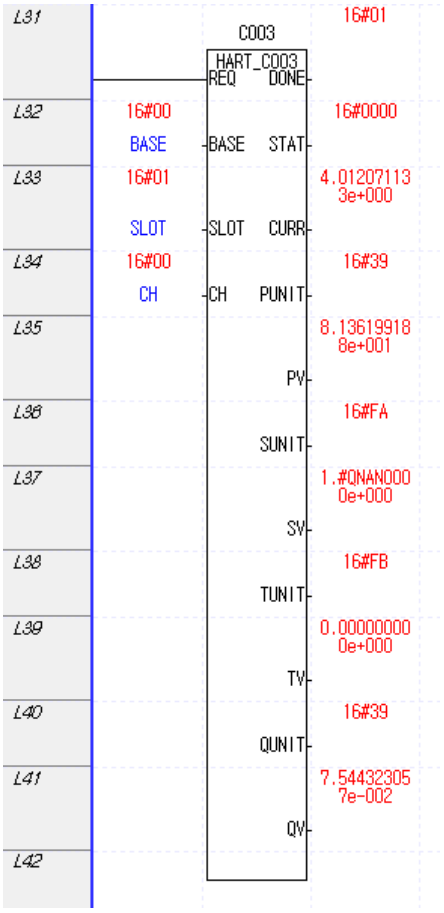
Read response to Universal Command 3

Function block	*Description*
	***Input*** REQ : Execute function when 1(rising edge) BASE : Specify base position SLOT : Specify slot position CH : Used channel number ***Output*** DONE : Output 1 when normal STAT : Error information CURR : Primary Variable loop current(mA) PUNIT : Primary Variable Unit PV : Primary Variable SUNIT : Secondary Variable Unit SV : Secondary Variable TUNIT : Tertiary Variable Unit TV : Tertiary Variable QUNIT : Quaternary Variable Unit QV : Quaternary Variable

■***Function***

When [Universal Command 3] command is set to the designated module's channel, this function is used to monitor response data.

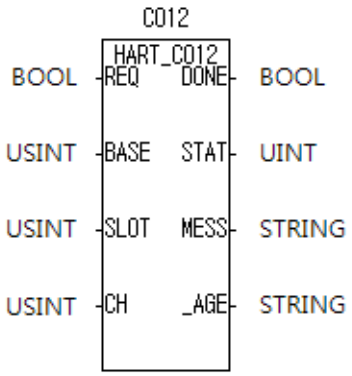
■***Example program***



(6) HART_C012 command

HART_C012

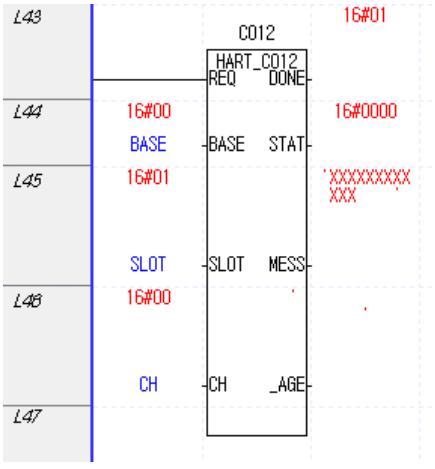
Read response to Universal Command 12

Function block	*Description*
	***Input*** REQ : Execute function when 1(rising edge) BASE : Specify base position SLOT : Specify slot position CH : Used channel number ***Output*** DONE : Output 1 when normal STAT : Error information MESS : Message(1/2) _AGE : Message(2/2)

■***Function***

When [Universal Command 12] command is set to the designated module's channel, this function is used to monitor response data.

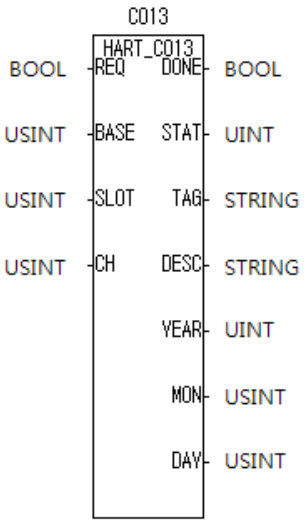
■***Example program***



(7) HART_C013 command

HART_C013

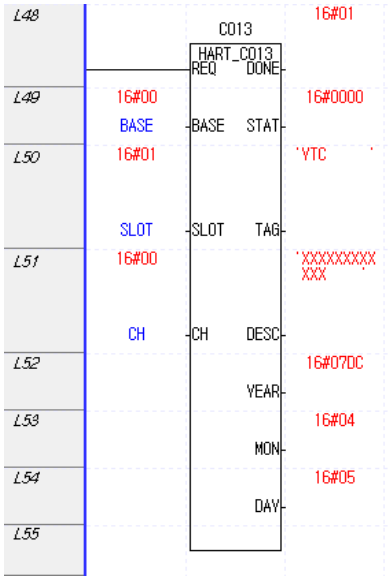
Read response to Universal Command 13

Function block	Description
	***Input*** REQ : Execute function when 1(rising edge) BASE : Specify base position SLOT : Specify slot position CH : Used channel number ***Output*** DONE : Output 1 when normal STAT : Error information TAG : Tag DESC : Descriptor YEAR : Year MON : Month DAY : Day

■***Function***

When [Universal Command 13] command is set to the designated module's channel, this function is used to monitor response data.

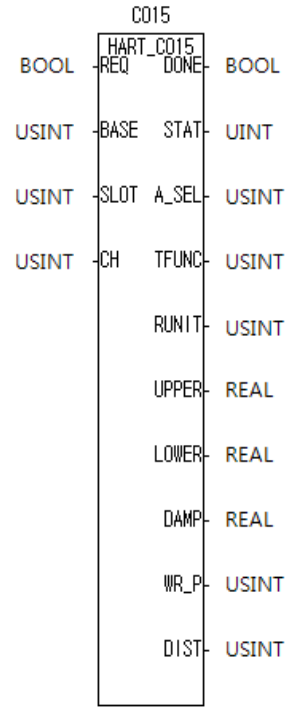
■***Example program***



(8) HART_C015 command

HART_C015

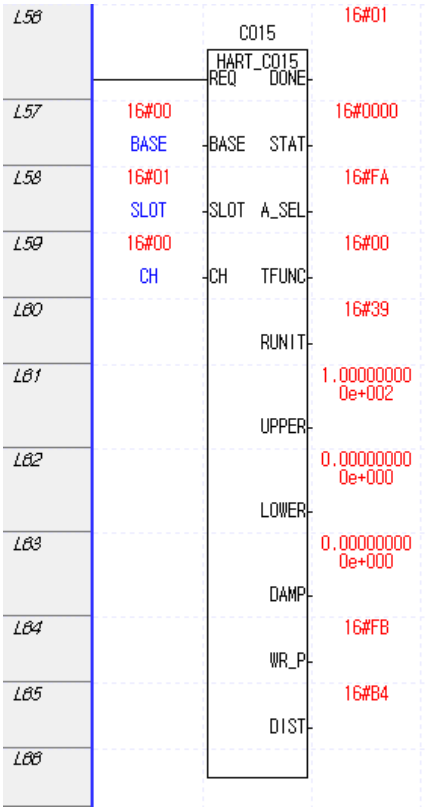
Read response to Universal Command 15

Function block	*Description*
	***Input*** REQ : Execute function when 1(rising edge) BASE : Specify base position SLOT : Specify slot position CH : Used channel number ***Output*** DONE : Output 1 when normal STAT : Error information A_SEL : PV Alarm select code TFUNC : PV transfer function code RUNIT : PV range units code UPPER : PV upper range value LOWER : PV lower range value DAMP : PV damping value(sec) WR_P : Write-protect code DIST : Private-label distributor code

■***Function***

When [Universal Command 15] command is set to the designated module's channel, this function is used to monitor response data.

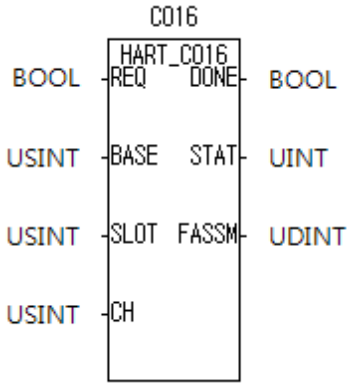
■***Example program***



(9) HART_C016 command

HART_C016

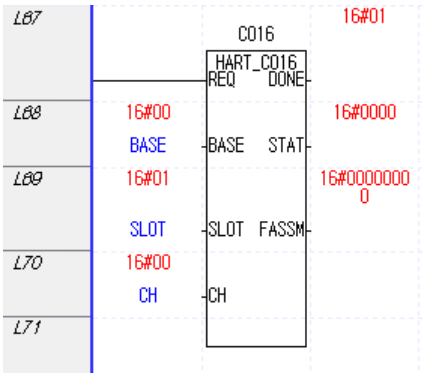
Read response to Universal Command 16

Function block	*Description*
	***Input*** REQ : Execute function when 1(rising edge) BASE : Specify base position SLOT : Specify slot position CH : Used channel number ***Output*** DONE : Output 1 when normal STAT : Error information FASSM : Final assembly number

■***Function***

When [Universal Command 16] command is set to the designated module's channel, this function is used to monitor response data.

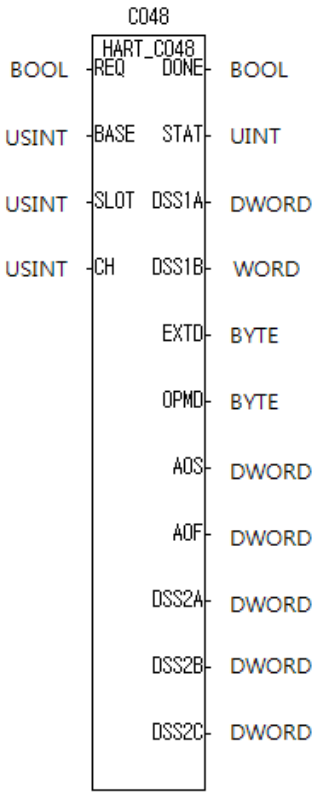
■***Example program***



(10) HART_C048 command

HART_C048

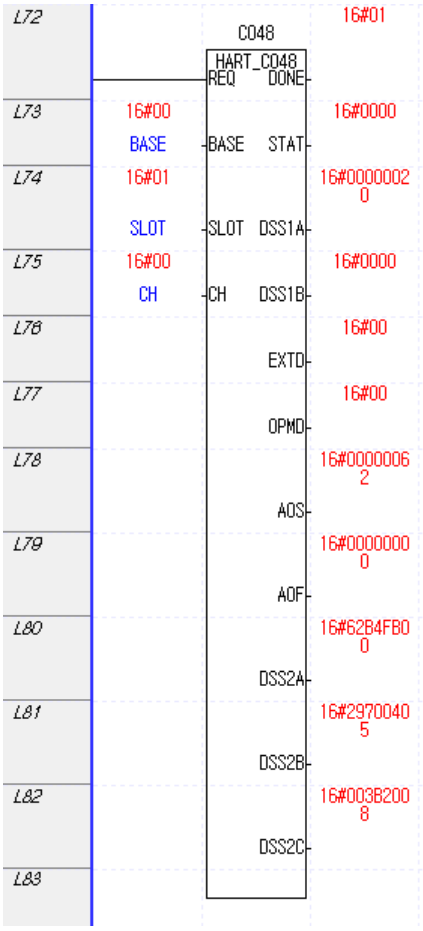
Read response to Common Practice Command 48

Function block	*Description*
	***Input*** REQ : Execute function when 1(rising edge) BASE : Specify base position SLOT : Specify slot position CH : Used channel number ***Output*** DONE : Output 1 when normal STAT : Error information DSS1A : Device-specific status1(1/2) DSS1B : Device-specific status1(2/2) EXTD : Extend device-specific status(V6.0) OPMD : Operational modes(V5.1) AOS : Analog outputs saturated (V5.1) AOF : Analog outputs fixed (V5.1) DSS2A : Device-specific status2(1/3) DSS2B : Device-specific status2 (2/3) DSS2C : Device-specific status2 (3/3)

■***Function***

When [Common Practice Command 48] command is set to the designated module's channel, this function is used to monitor response data.

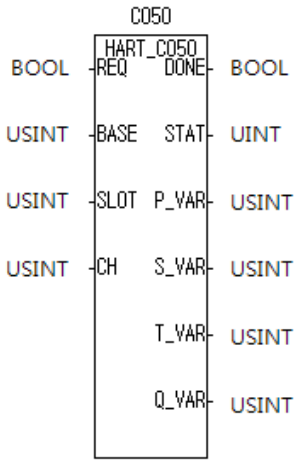
■***Example program***



(11) HART_C050 Command

HART_C050

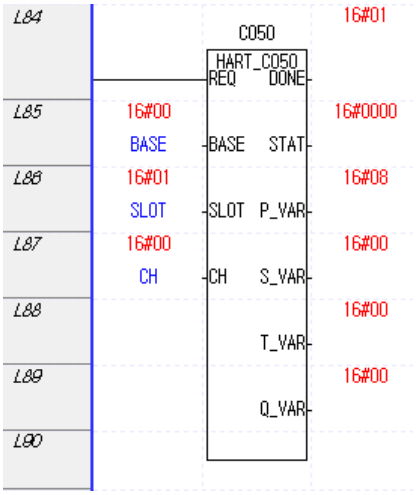
Read response to Common Practice Command 50

Function block	*Description*
	***Input*** REQ : Execute function when 1(rising edge) BASE : Specify base position SLOT : Specify slot position CH : Used channel number ***Output*** DONE : Output 1 when normal STAT : Error information P_VAR : Primary Device Variable S_VAR : Secondary Device Variable T_VAR : Tertiary Device Variable

■***Function***

When [Common Practice Command 50] command is set to the designated module's channel, this function is used to monitor response data.

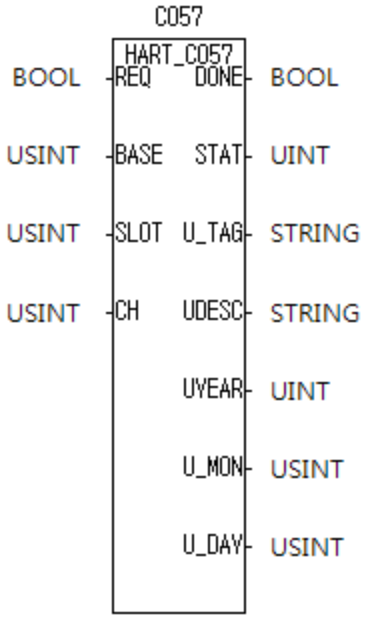
■Example program



(12) HART_C057 command

HART_C057

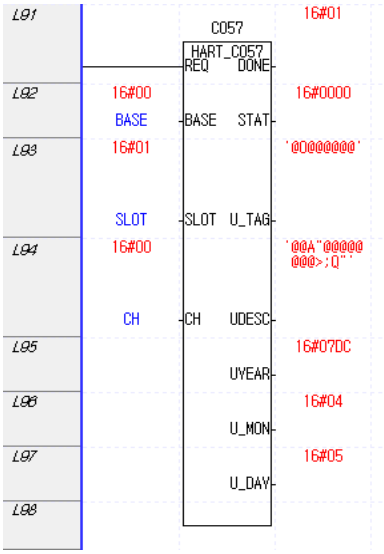
Read response to Common Practice Command 57

Function block	*Description*
	***Input*** REQ : Execute function when 1(rising edge) BASE : Specify base position SLOT : Specify slot position CH : Used channel number ***Output*** DONE : Output 1 when normal STAT : Error information U_TAG : Unit tag UDESC : Unit descriptor UYEAR : Unit year U_MON : Unit month U_DAY : Unit day

■***Function***

When [Common Practice Command 57] command is set to the designated module's channel, this function is used to monitor response data.

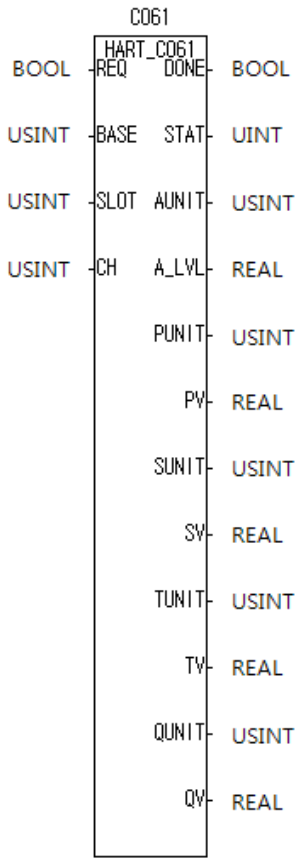
■***Example program***



(13) HART_C061 command

HART_C061

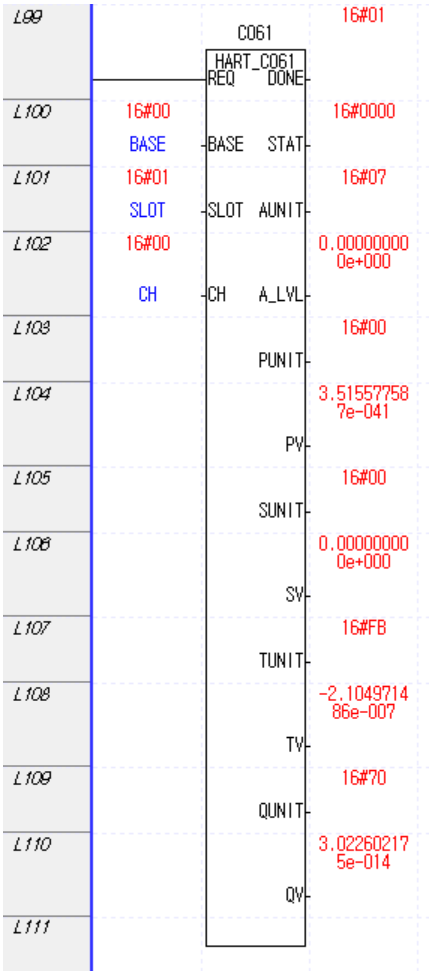
Read response to Common Practice Command 61

Function block	*Description*
	***Input*** REQ : Execute function when 1(rising edge) BASE : Specify base position SLOT : Specify slot position CH : Used channel number ***Output*** DONE : Output 1 when normal STAT : Error information AUNIT : PV Analog Output units code A_LVL : PV Analog Output level PUNIT : Primary Variable units code PV : Primary Variable SUNIT : Secondary Variable units code SV : Secondary Variable TUNIT : Tertiary Variable units code TV : Tertiary Variable QUNIT : Quaternary Variable units code QV : Quaternary Variable

■***Function***

When [Common Practice Command 61] command is set to the designated module's channel, this function is used to monitor response data.

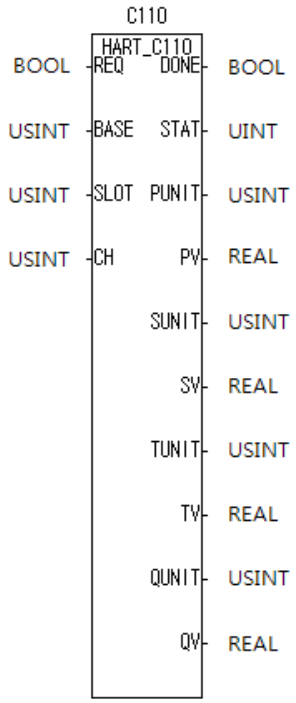
■***Example program***



(14) HART_C110 command

HART_C110

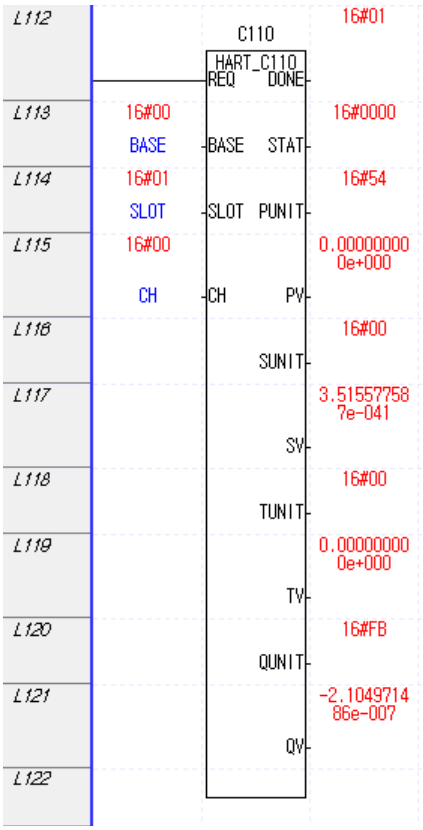
Read response to Common Practice Command 110

Function block	Description
	***Input*** REQ : Execute function when 1(rising edge) BASE : Specify base position SLOT : Specify slot position CH : Used channel number ***Output*** DONE : Output 1 when normal STAT : Error information PUNIT : Primary Variable units code PV : Primary Variable value SUNIT : Secondary Variable units code SV : Secondary Variable value TUNIT : Tertiary Variable units code TV : Tertiary Variable value QUNIT : Quaternary Variable units code QV : Quaternary Variable value

■***Function***

When [Common Practice Command 110] command is set to the designated module's channel, this function is used to monitor response data.

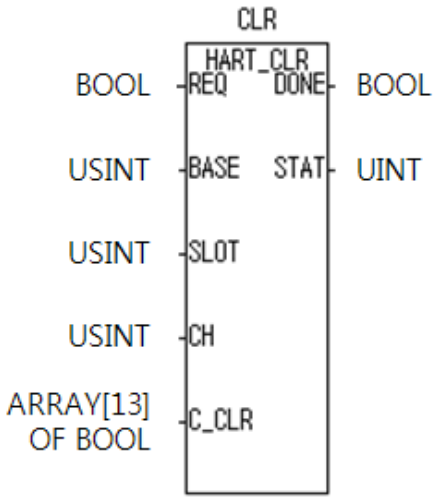
■Example program



(15) HART_CLR command

HART_CLR

Clear HART command to module

Function block	Description
	***Input*** REQ : Execute function when 1(rising edge) BASE : Specify base position SLOT : Specify slot position CH : Used channel number C_CLR : Communication command to be removed (bit mask set) ***Output*** DONE : Output 1 when normal STAT : Error information

■***Function***

(a) It is used to stop a command being communicated regarding to the designated module's channel.

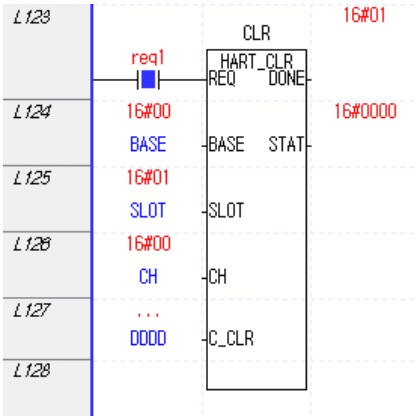
(b) Set bit(BOOL Array) corresponding to a command to be stopped on "C_SET"

Command	***110***	***61***	***57***	***50***	***48***	***16***	***15***	***13***	***12***	***3***	***2***	***1***	***0***
Array index	12	11	10	9	8	7	6	5	4	3	2	1	0

(c) If "REQ" contact is converted from 0 to 1, function block will be executed.

(d) Response data to the stopped command is maintained the status at the stopped time.

■***Example program***



7.2.4 Example using PUT/GET instruction

(1) Enable channel

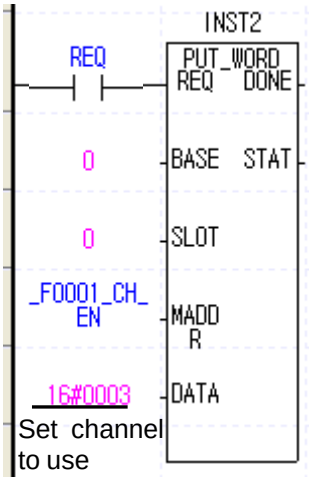
(a) You can enable/disable A/D conversion per channel
(b) Disable channel not using to reduce the conversion cycle per channel
(c) When channel is not designated, all channels are set as not used
(d) Enable/disable of A/D conversion is as follows

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
–	–	–	–	—	–	–	–	–	–	–	–	CH3	CH2	CH1	CH0

Bit	Description
0	Stop
1	Run

16#0003 : 0000 0000 0000 0011

CH3, CH2, CH1, CH0



(e) The value in B4~B15 is ignored.
(f) The right figure is example enabling CH0~CH1 of analog input module equipped at slot 0.

(2) Input current range setting

(a) You can set input current range per channel
(b) When analog input range is not set, all channels are set as 4 ~ 20mA
(c) Setting of analog input current range is as follows.

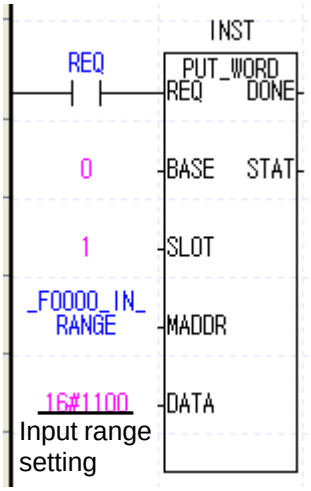
- The following is example setting CH0~CH1 as 4~20mA and CH2~CH3 as 0~20mA

B15 B14 B13 B12	B11 B10 B9 B8	B7 B6 B5 B4	B3 B2 B1 B0
CH3	CH2	CH1	CH0

Bit	Description
0000	4 mA ~ 20 mA
0001	0 mA ~ 20 mA

16#4422 : 0001 0001 0000 0000

CH3, CH2, CH1, CH0



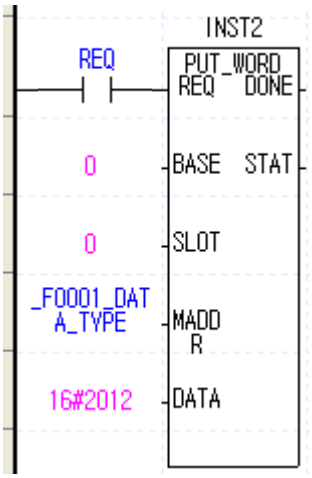
(3) Output data range setting

(a) Digital output data range about analog input can be set per channel.
(b) When output data range is not set, all channels are set as -32000~32000.
(c) Setting of digital output data range is as follows

B15 B14 B13 B12	B11 B10 B9 B8	B7 B6 B5 B4	B3 B2 B1 B0
CH3	CH2	CH1	CH0

Bit	Description
0000	-32000 ~ 32000
0001	Precise value
0010	0~10000

16#2012 : 0010 0000 0001 0010
CH3, CH2, CH1, CH0



Precise value has the following digital output range about analog input range

1) Current

Analog input / Digital output	4 ~ 20 mA	0 ~ 20 mA
Precise Value	4000 ~ 20000	0 ~ 20000

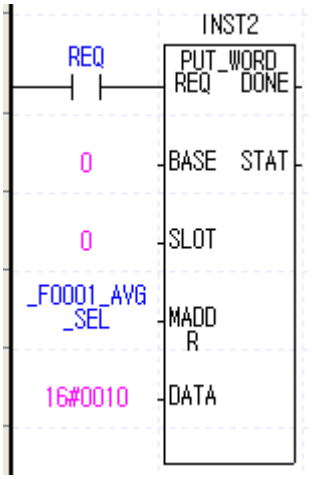
(4) Average process setting

(a) You can enable/disable average process per channel
(b) Average process is not set, all channels are set as enable
(c) Setting of filter process is as follows
(d) The following figure is example using time average about CH1

B15 B14 B13 B12	B11 B10 B9 B8	B7 B6 B5 B4	B3 B2 B1 B0
CH3	CH2	CH1	CH0

Bit	Contents
0000	Sampling process
0001	Time average
0010	Count average
0011	Moving average
0100	Weighted average

16#0010 : 0000 0000 0001 0000
CH3, CH2, CH1, CH0



(5) Average value setting

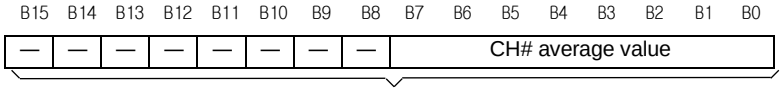
(a)Initial value of average value is 0

(b) Setting range of average value is as follows.

Average method	*Setting range*
Time average	200 ~ 5000(ms)
Count average	2 ~ 50(times)
Moving average	2 ~ 100(times)
Weighted average	0 ~ 99(%)

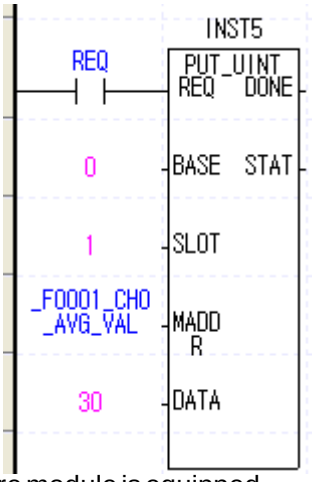
(c) When setting value other than setting range, it indicates error number at error code indication (_F0001_ERR_CODE). At this time, A/D conversion value keeps previous data. (# means the channel where error occurs at error code)

(d) Setting of average value is as follows



Setting range is different according to average method

Address	*Contents*
Fxxyy_CH0_AVG_VAL	CH0 average value setting
_Fxxyy_CH1_AVG_VAL	CH1 average value setting
_Fxxyy_CH2_AVG_VAL	CH2 average value setting
_Fxxyy_CH3_AVG_VAL	CH3 average value setting



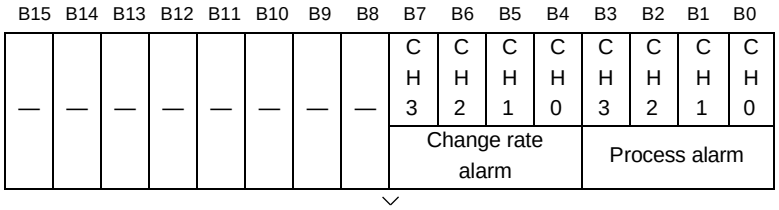
* At device allocation, x means base number, y means slot number where module is equipped.

(6) Alarm process setting

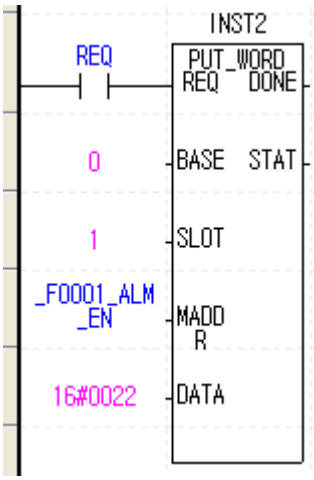
(a) This is are to enable/disable alarm process and it can be set per channels

(b) Default of this area is 0.

(c) Setting of alarm process is as follows.



BIT	Contents
0	Disable
1	Enable



Note

Before you set Time/Count average value, enable the average process and select average method (Time/Count).

(7) Process alarm value setting

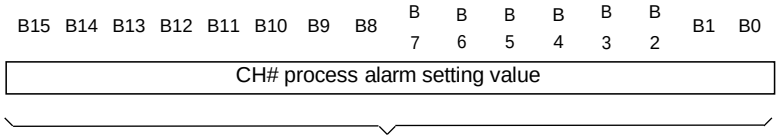
(a) This is area to set process alarm value per channels. Range of process alarm is different according to data range.

1) Signed Value: -32768 ~ 32767
1) Precise Value

Range	*Value*
4 ~ 20 mA	3808 ~ 20192
0 ~ 20 mA	-240 ~ 20240

2) Percentile Value: -120 ~ 10120

(b) For detail of process alarm, refer to 2.5.2.



Variable	*Contents*
_F0001_CH0_PAHH_VAL	CH0 process alarm HH-limit
_F0001_CH0_PAH_VAL	CH0 process alarm H-limit
_F0001_CH0_PAL_VAL	CH0 process alarm L-limit
_F0001_CH0_PALL_VAL	CH0 process alarm LL-limit
_F0001_CH1_PAHH_VAL	CH1 process alarm HH-limit
_F0001_CH1_PAH_VAL	CH1 process alarm H-limit
_F0001_CH1_PAL_VAL	CH1 process alarm L-limit
_F0001_CH1_PALL_VAL	CH1 process alarm LL-limit
_F0001_CH2_PAHH_VAL	CH2 process alarm HH-limit
_F0001_CH2_PAH_VAL	CH2 process alarm H-limit
_F0001_CH2_PAL_VAL	CH2 process alarm L-limit
_F0001_CH2_PALL_VAL	CH2 process alarm LL-limit
_F0001_CH3_PAHH_VAL	CH3 process alarm HH-limit
_F0001_CH3_PAH_VAL	CH3 process alarm H-limit
_F0001_CH3_PAL_VAL	CH3 process alarm L-limit
_F0001_CH3_PALL_VAL	CH3 process alarm LL-limit

Note

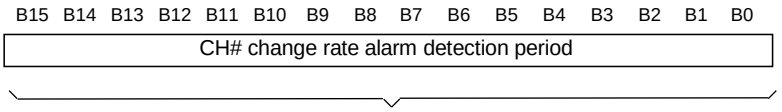
Before you set process alarm value, enable process alarm.

(8) Change rate alarm detection period setting

(a) Range of change rate alarm detection period is 100 ~ 5000(ms)

(b) If you set the value out of range, error code 60# is indicated at error code indication address. At this time, change rate alarm detection period is applied as default value (10)

(c) Setting of change rate alarm detection period is as follows.



Range of change rate alarm detection period is 100 ~ 5000(ms)

Variable	*Contents*
_F0001_CH0_RA_PERIOD	CH0 change rate alarm detection period
_F0001_CH1_RA_PERIOD	CH1 change rate alarm detection period
_F0001_CH2_RA_PERIOD	CH2 change rate alarm detection period
_F0001_CH3_RA_PERIOD	CH3 change rate alarm detection period

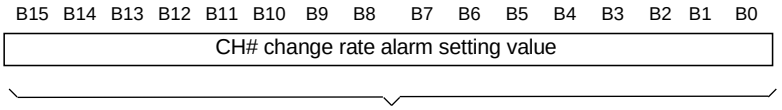
Note

Before you set the change rate alarm period, enable change rate alarm and set H/L-limit of change rate alarm.

(9) Change rate alarm setting value

(a) Range of change rate alarm value is -32768 ~ 32767(-3276.8% ~ 3276.7%).

(b) Setting of change rate alarm value is as follows.



Range of change rate alarm value is -32768 ~ 32767

Variable	*Contents*
_F0001_CH0_RAL_VAL	CH0 change rate alarm H-limit setting
_F0001_CH0_RAL_VAL	CH0 change rate alarm L-limit setting
_F0001_CH1_RAL_VAL	CH1 change rate alarm H-limit setting
_F0001_CH1_RAL_VAL	CH1 change rate alarm L-limit setting
_F0001_CH2_RAL_VAL	CH2 change rate alarm H-limit setting
_F0001_CH2_RAL_VAL	CH2 change rate alarm L-limit setting
_F0001_CH3_RAL_VAL	CH3 change rate alarm H-limit setting
_F0001_CH3_RAL_VAL	CH3 change rate alarm L-limit setting

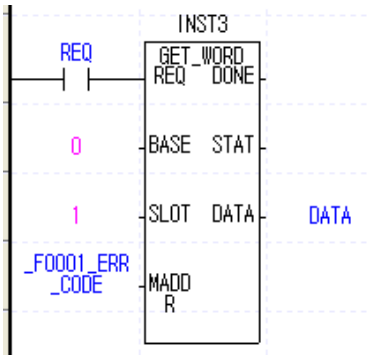
Note

Before you set the change rate alarm detection period, enable change rate alarm process and set alarm H/L- limit.

(10) Error code

(a) Saves error code detected at HART Analog Input Module.
(b) Error type and contents are as follows.
(c) The following figure is program example reading error code.

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
–	–	–	–	–	–	–	–	Error code							



Error code (Dec.)	Description	RUN LED status
0	Normal operation	RUN LED ON
10	Module error (ASIC reset error)	Flickers every 0.2 sec.
11	Module error (ASIC RAM or Register error)	
20#	Time average set value error	Flickers every 1 sec.
30#	Count average set value error	
40#	Moving average set value error	
50#	Weighted average set value error	
60#	Change rate alarm detection period set value error	

* At error code, # indicates channel where error occurs
* For more detail error code, refer to 9.1

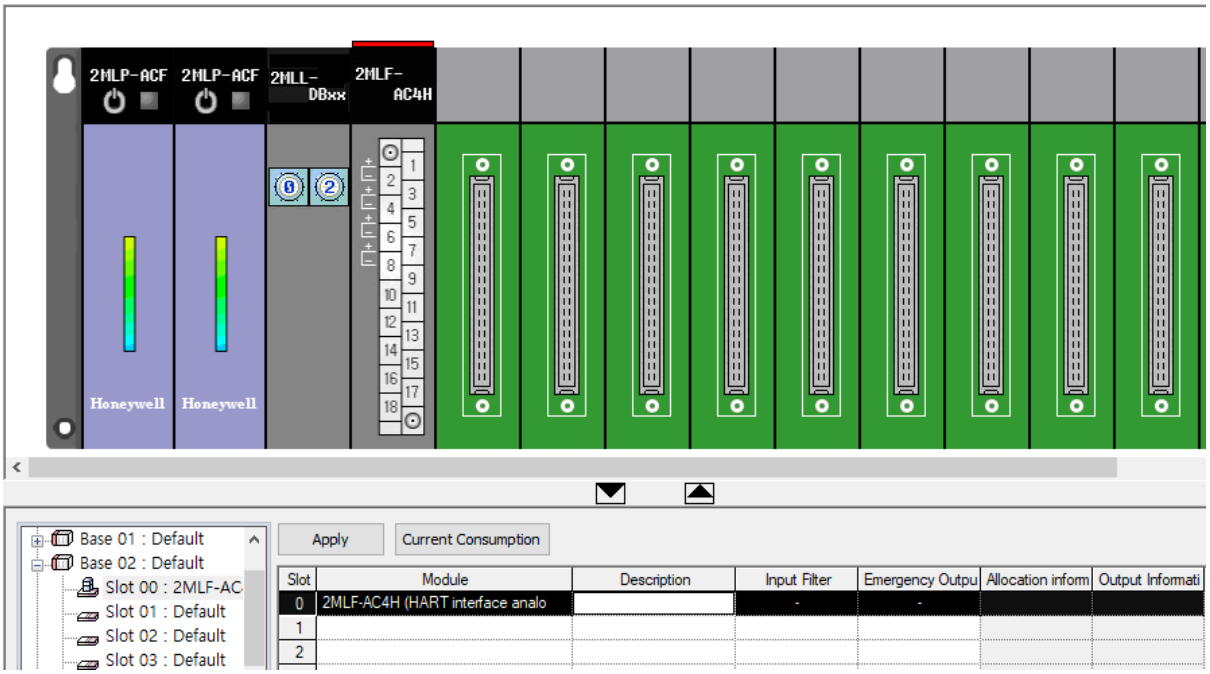
(d) In case two error codes occurs, module saves first occurred error code and later occurred error code is not saved
(e) In case error occurs, after modifying error, use “Error clear request flag”(referring to 5.2.7), restart power to delete error code and stop LED flicker

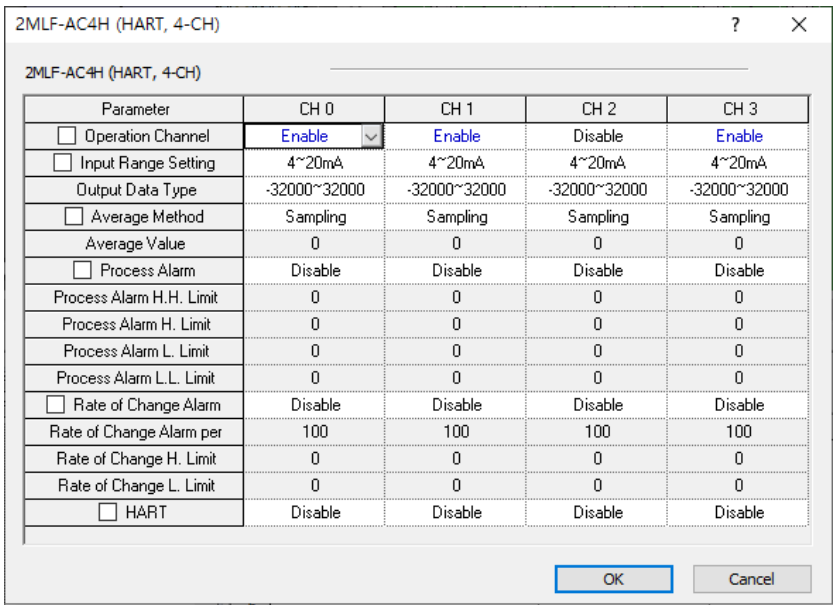
Chapter 8 Programming (For 2MLI/2MLR)

8.1 Basic Program

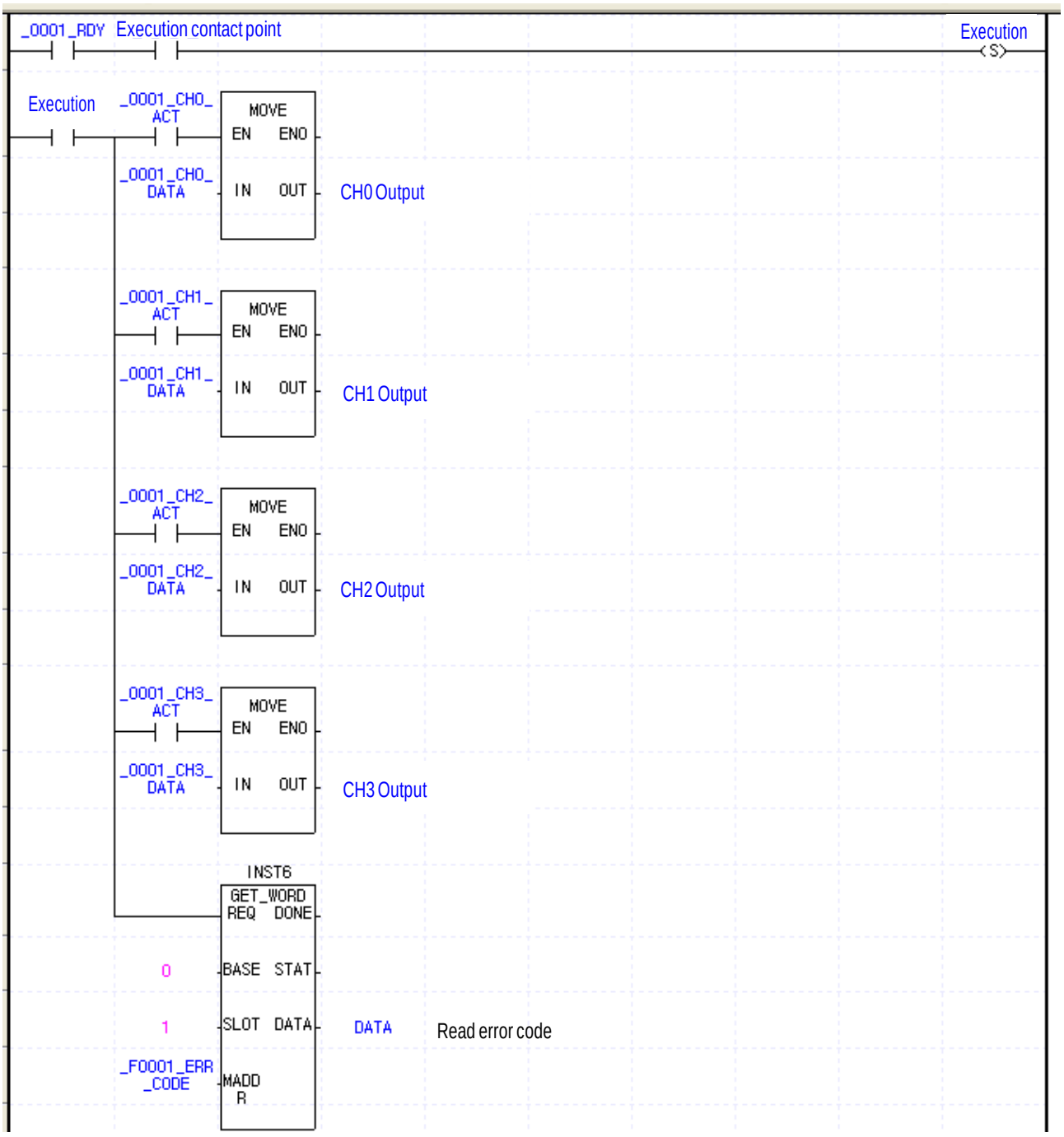
- It describes about how to set operation condition at internal memory of Analog Input Module.
- Analog Input Module is equipped at slot 2
- IO occupation points of Analog Input Module are 16 points (Flexible type)
- Initial setting condition is saved at internal memory by 1 time input

(1) Program example using [I/O Parameter]

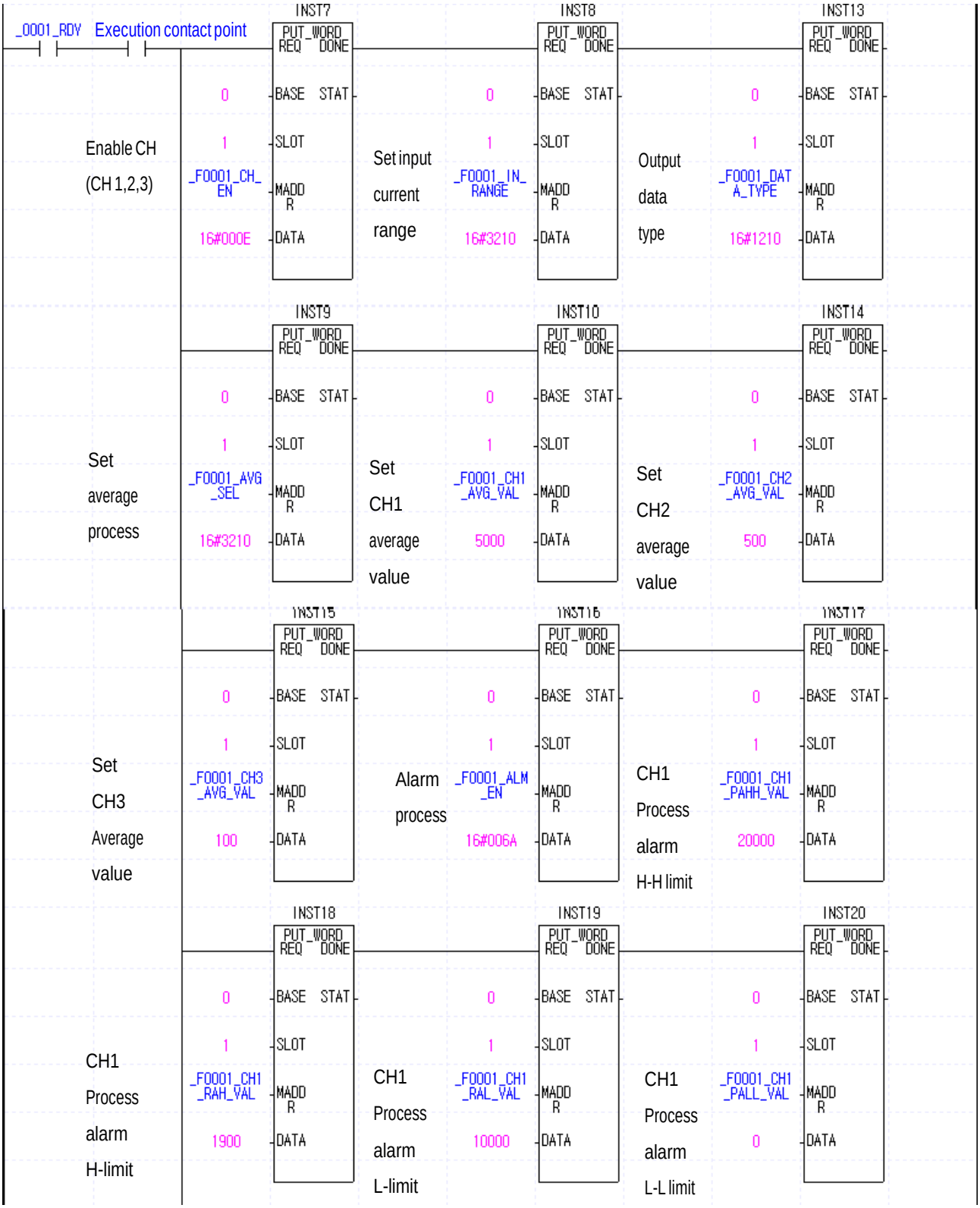


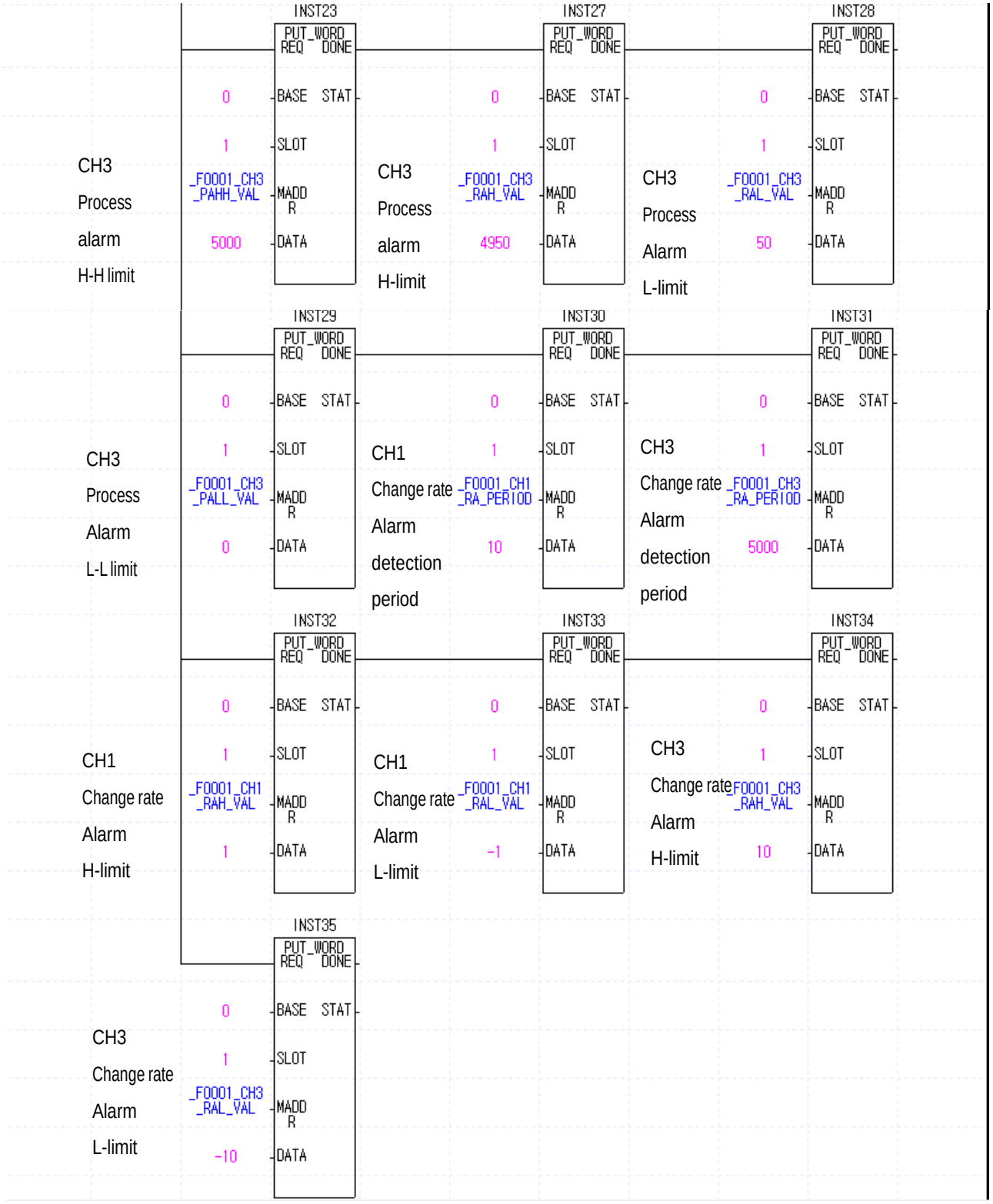


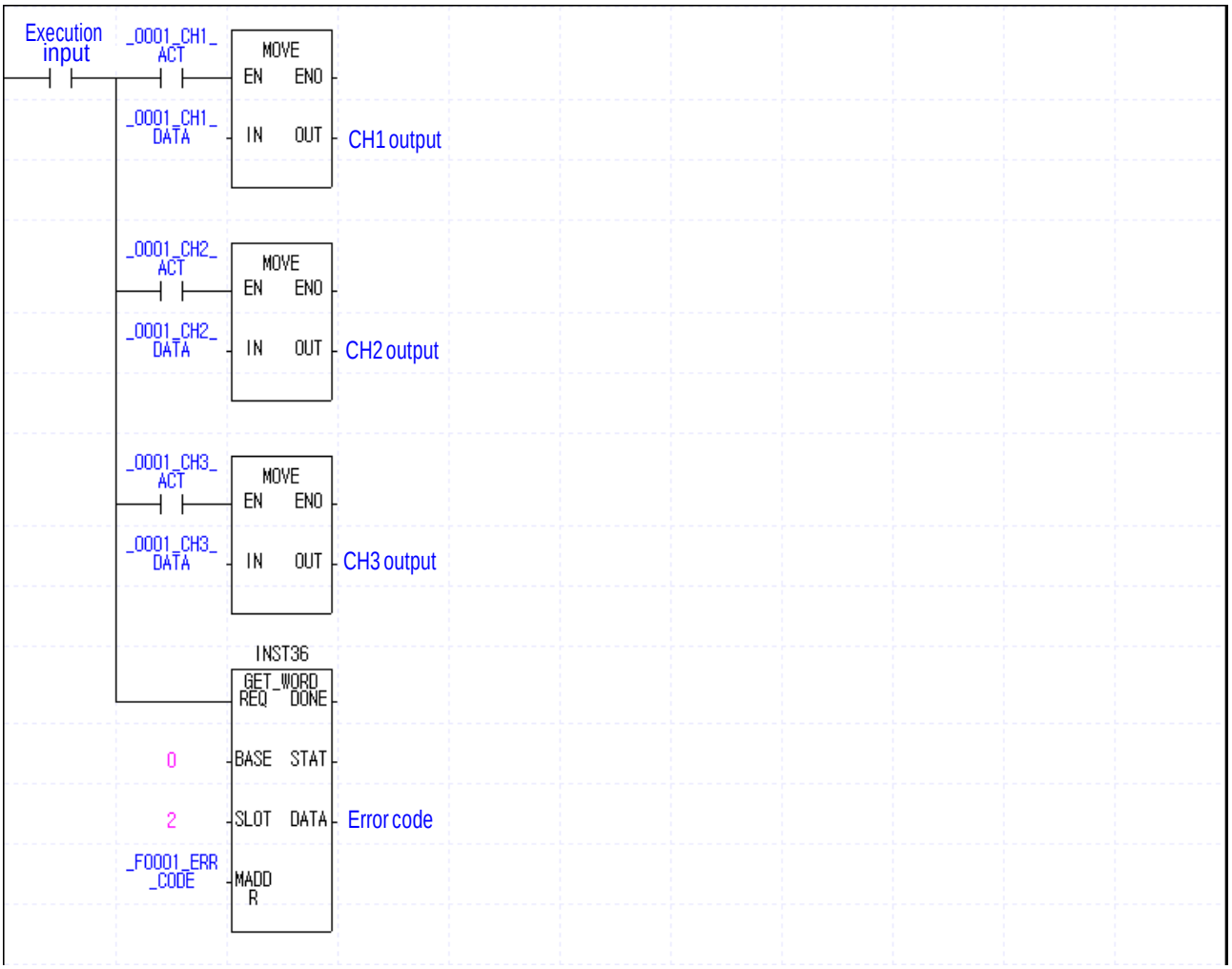
(2) Program example using [I/O Parameter]



(3) Program example using PUT/GET instruction




INST23
PUT_WORD
REQ DONE
0 BASE STAT
1 SLOT
_F0001_CH3_PAHH_VAL MADDR
5000 DATA
CH3 Process alarm H-H limit
INST27
PUT_WORD
REQ DONE
0 BASE STAT
1 SLOT
_F0001_CH3_RAH_VAL MADDR
4950 DATA
CH3 Process alarm H-limit
INST28
PUT_WORD
REQ DONE
0 BASE STAT
1 SLOT
_F0001_CH3_RAL_VAL MADDR
50 DATA
CH3 Process Alarm L-limit
INST29
PUT_WORD
REQ DONE
0 BASE STAT
1 SLOT
_F0001_CH3_PALL_VAL MADDR
0 DATA
CH3 Process Alarm L-L limit
INST30
PUT_WORD
REQ DONE
0 BASE STAT
1 SLOT
_F0001_CH1_RA_PERIOD MADDR
10 DATA
CH1 Change rate Alarm detection period
INST31
PUT_WORD
REQ DONE
0 BASE STAT
1 SLOT
_F0001_CH3_RA_PERIOD MADDR
5000 DATA
CH3 Change rate Alarm detection period
INST32
PUT_WORD
REQ DONE
0 BASE STAT
1 SLOT
_F0001_CH1_RAH_VAL MADDR
1 DATA
CH1 Change rate Alarm H-limit
INST33
PUT_WORD
REQ DONE
0 BASE STAT
1 SLOT
_F0001_CH1_RAL_VAL MADDR
-1 DATA
CH1 Change rate Alarm L-limit
INST34
PUT_WORD
REQ DONE
0 BASE STAT
1 SLOT
_F0001_CH3_RAH_VAL MADDR
10 DATA
CH3 Change rate Alarm H-limit
INST35
PUT_WORD
REQ DONE
0 BASE STAT
1 SLOT
_F0001_CH3_RAL_VAL MADDR
-10 DATA
CH3 Change rate Alarm L-limit


Execution input
_0001_CH1_ACT
MOVE
EN ENO
_0001_CH1_DATA
IN OUT
CH1 output
_0001_CH2_ACT
MOVE
EN ENO
_0001_CH2_DATA
IN OUT
CH2 output
_0001_CH3_ACT
MOVE
EN ENO
_0001_CH3_DATA
IN OUT
CH3 output
INST36
GET_WORD
REQ DONE
0
BASE STAT
2
SLOT DATA
Error code
_F0001_ERR_CODE
MADDR

8.2 Application Program

8.2.1 Program to sort A/D converted value in size

(1) System configuration

(2) Initial setting content

No.	Item	Initial setting content	Variable name	Value to write at internal memory
1	Used channel	CH0, Ch2, CH3	0	'h000D'or '13'
2	Input voltage range	0 ~ 20 mA	1	'h1101'or '4353'
3	Output data range	-32000~32000	2	'h0000'or '0'
4	Average process	CH0, 2, 3 (Weight, Count, time)	3	'h1204'or '4612'
5	Average value	CH0 weight average value: 50 (%)	4	'h0032'or '50'
6	Average value	CH2 count average value: 30	6	'h001E'or '30'
7	Average value	CH3 time average value: 200 (ms)	7	'h00C8'or'200'

(3) Program description

(a) When digital value of CH0 is smaller than 12000, turn on 0th contact point of relay output module equipped at No.2 slot (%QX0.2.0).

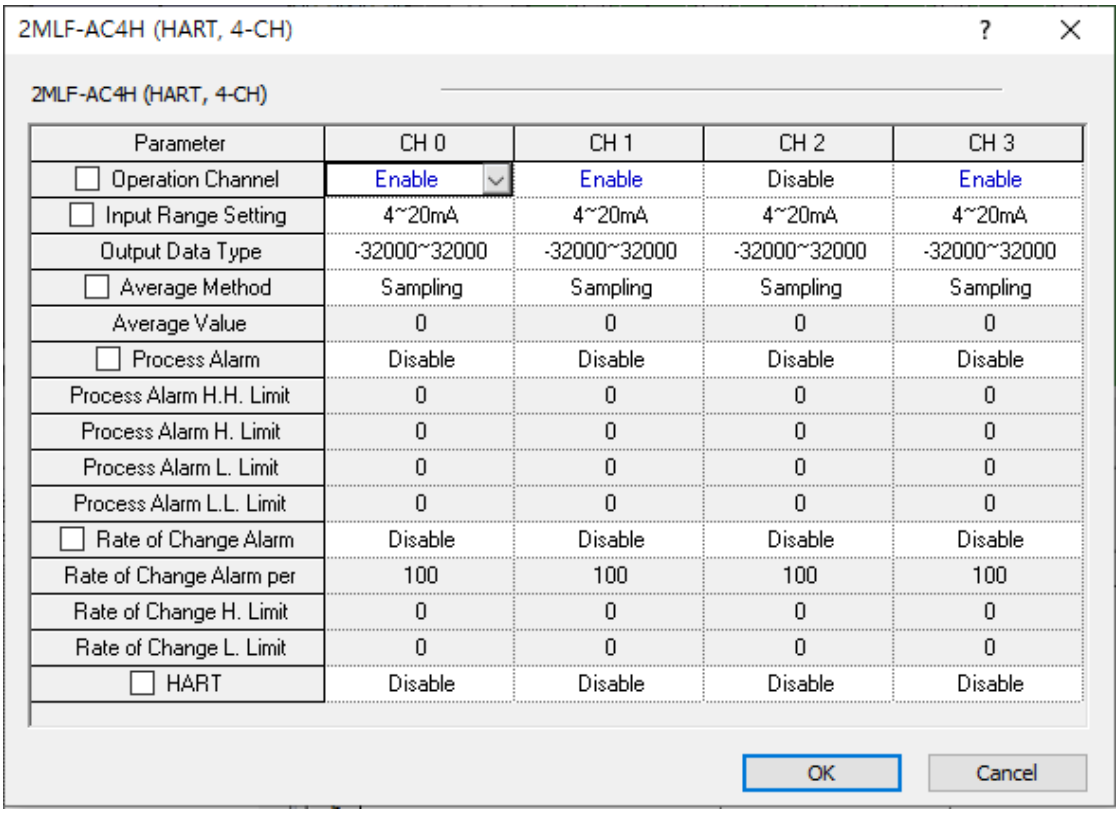
(b) When digital value of CH2 is larger than 13600, turn on second contact point of relay output module equipped at No.2 slot (%QX0.2.2).

(c) When digital value of CH4 is larger or equal than 12000 and smaller than 13600, turn on 4th contact point of relay output module equipped at No.2 slot (%QX0.2.4)

(d) When digital value of CH4 is same with 13600, turn on 5th contact point of relay output module equipped at No.2 slot (%QX0.2.5).

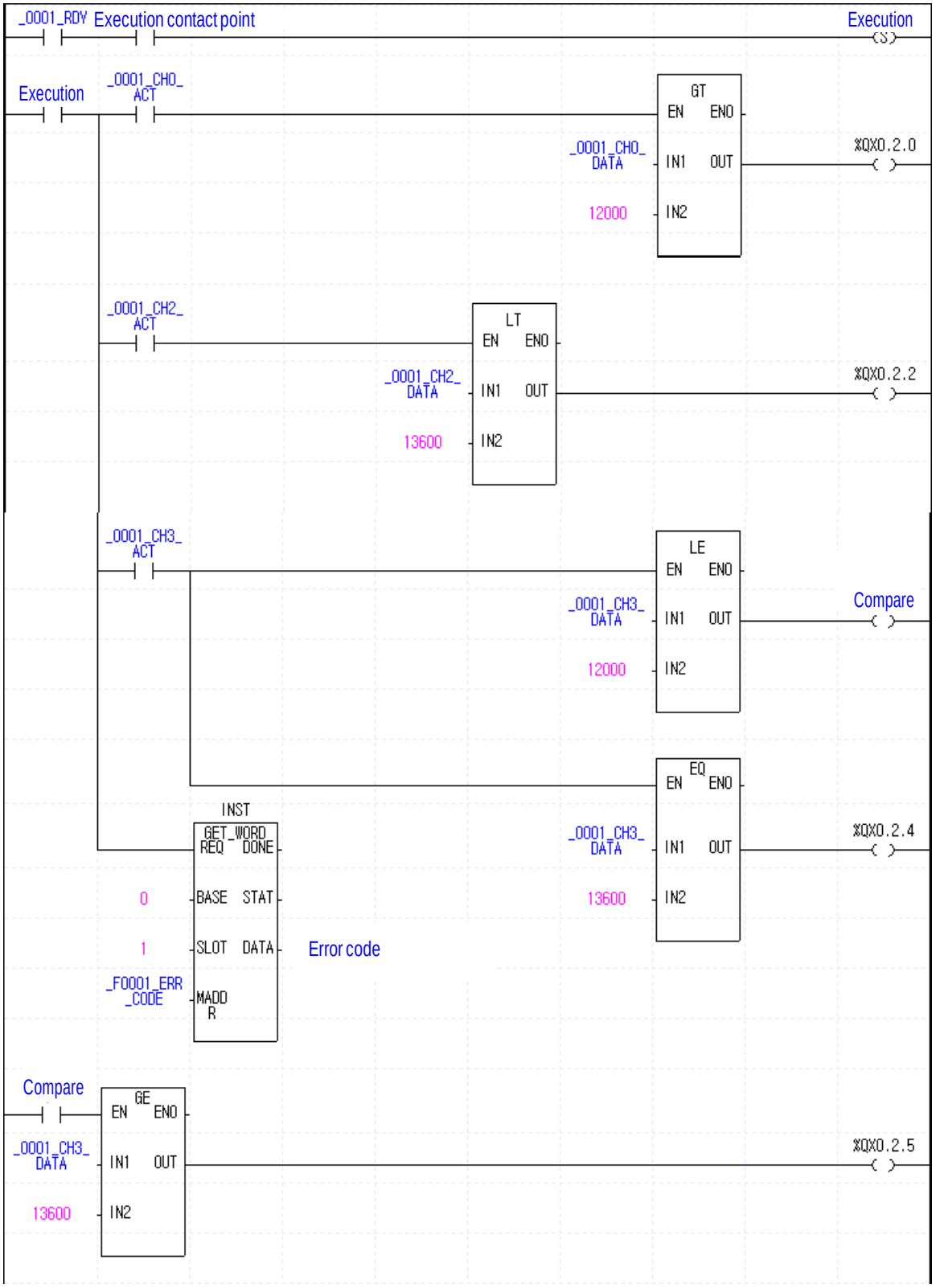
(4) Program

(a) Program example using [I/O Parameter]



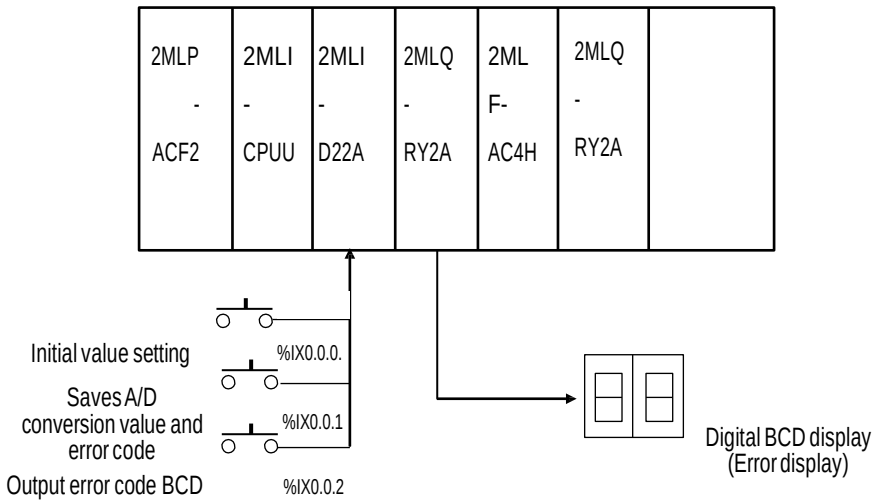
Parameter	CH 0	CH 1	CH 2	CH 3
Operation Channel	Enable	Enable	Disable	Enable
Input Range Setting	4~20mA	4~20mA	4~20mA	4~20mA
Output Data Type	-32000~32000	-32000~32000	-32000~32000	-32000~32000
Average Method	Sampling	Sampling	Sampling	Sampling
Average Value	0	0	0	0
Process Alarm	Disable	Disable	Disable	Disable
Process Alarm H.H. Limit	0	0	0	0
Process Alarm H. Limit	0	0	0	0
Process Alarm L. Limit	0	0	0	0
Process Alarm L.L. Limit	0	0	0	0
Rate of Change Alarm	Disable	Disable	Disable	Disable
Rate of Change Alarm per	100	100	100	100
Rate of Change H. Limit	0	0	0	0
Rate of Change L. Limit	0	0	0	0
HART	Disable	Disable	Disable	Disable

(b) Program example using [I/O Parameter]



8.2.2 Program to output error codes of analog input module to BCD display

(1) System configuration



(2) Details of initial setting

(a) Used CH: CH 0

(b) Analog input current range: DC 4 ~ 20 mA

(c) Time average process setting: 200 (ms)

(d) Digital output data range: -32000~32000

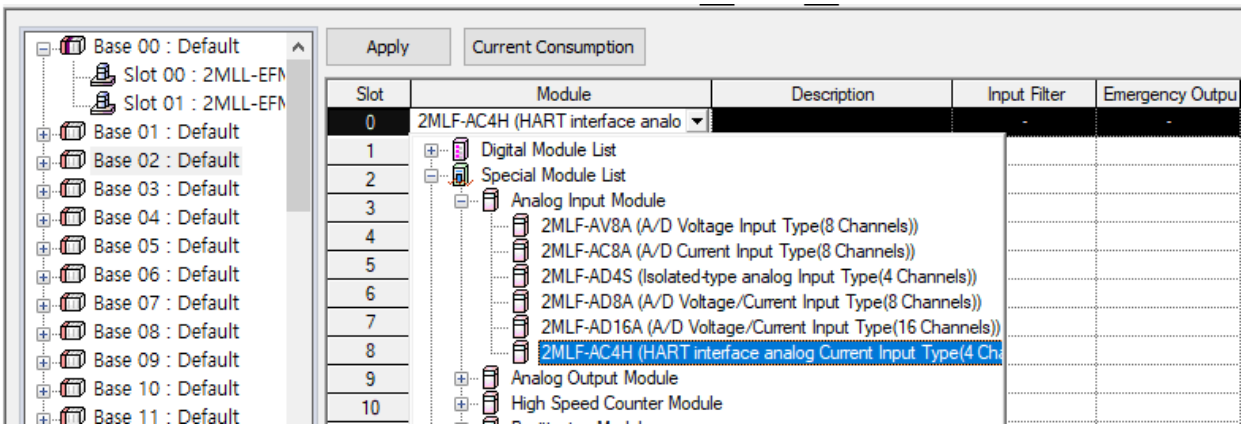
(3) Program description

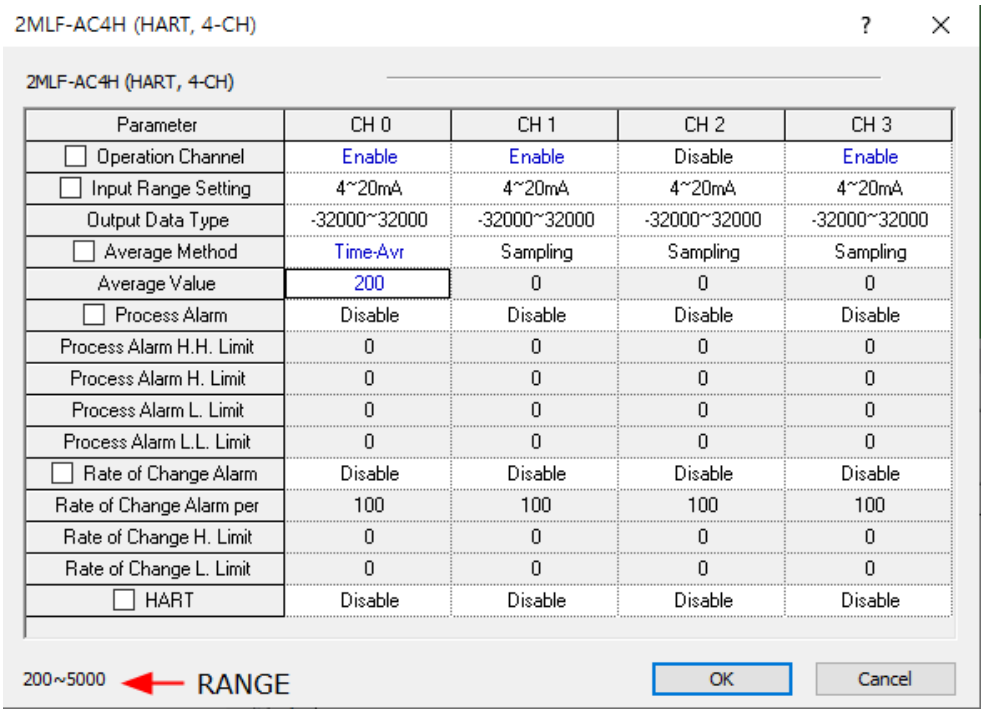
(a) If %IX0.0.0 is On, A/D converted value and error code will be saved respectively on “Conversion value” and “Error code”.

(b) If %IX0.0.2 is On, applicable error code will be output to digital BCD display. (%QW0.2.0)

(4) Program

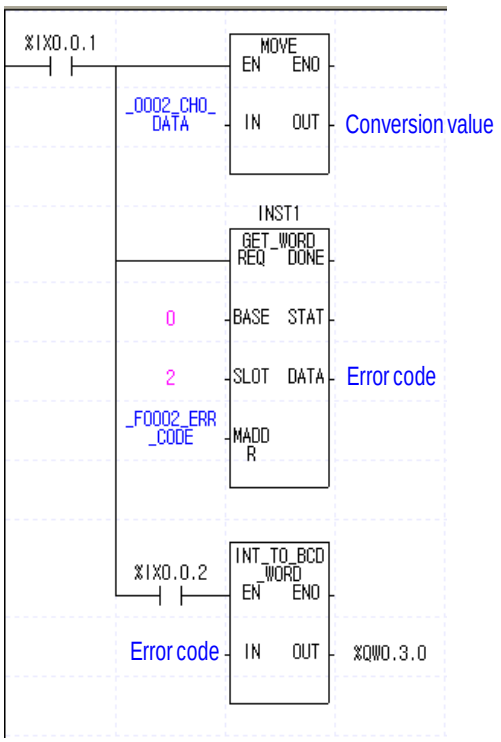
(a) Program example using [I/O Parameter]





Parameter	CH 0	CH 1	CH 2	CH 3
Operation Channel	Enable	Enable	Disable	Enable
Input Range Setting	4~20mA	4~20mA	4~20mA	4~20mA
Output Data Type	-32000~32000	-32000~32000	-32000~32000	-32000~32000
Average Method	Time-Avr	Sampling	Sampling	Sampling
Average Value	200	0	0	0
Process Alarm	Disable	Disable	Disable	Disable
Process Alarm H.H. Limit	0	0	0	0
Process Alarm H. Limit	0	0	0	0
Process Alarm L. Limit	0	0	0	0
Process Alarm L.L. Limit	0	0	0	0
Rate of Change Alarm	Disable	Disable	Disable	Disable
Rate of Change Alarm per	100	100	100	100
Rate of Change H. Limit	0	0	0	0
Rate of Change L. Limit	0	0	0	0
HART	Disable	Disable	Disable	Disable

(b) Program example using [I/O Parameter]



8.2.3 Program to monitor PV through HART communication

(1) System configuration

2ML P- ACF2	2MLI - CPUU	2MLI - D24A	2ML F- AC4H	2MLQ - RY2A		

(2) Initial setting content

No.	Item	Initial setting content	Variable name	Value to write at internal memory
1	Used channel	CH0, Ch1	0	'h0003'or '3'
2	Input voltage range	4 ~ 20 mA	1	'h0000'or '0'
3	Output data range	-32000~32000	2	'h0000'or '0'
4	Average process	CH0, 1 (Weighted, Count)	3	'h0024'or '36'
5	Average value	CH0 weight average value: 50 (%)	4	'h0032'or '50'
6	Average value	CH2 count average value: 30	6	'h001E'or '30'

(3) Program description

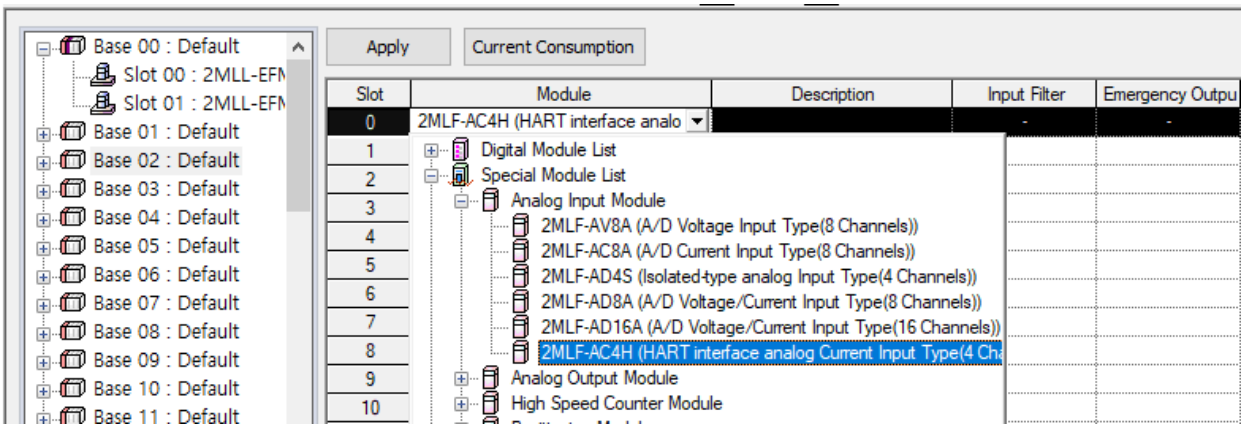
(a) When digital value of CH0 is smaller than 12000, turn on 0^{th} contact point of relay output module equipped at No.2 slot (%QX0.2.0).

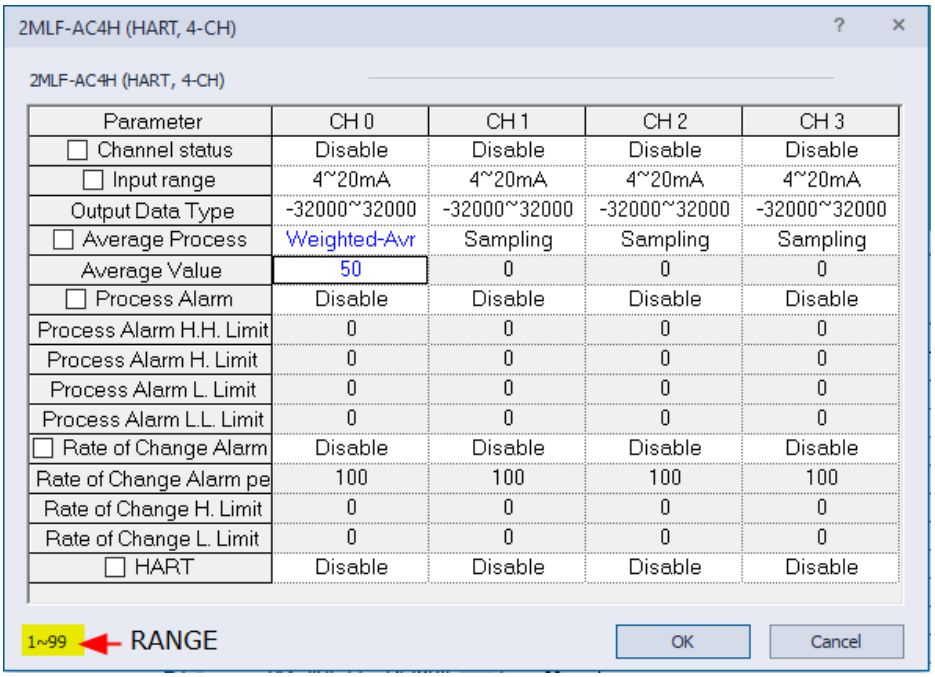
(b) When digital value of CH2 is larger than 13600, turn on second contact point of relay output module equipped at No.2 slot (%QX0.2.2).

(c) This program is to check responses to each command by executing HART command 0 on channel 0 and HART command 2 on channel 1.

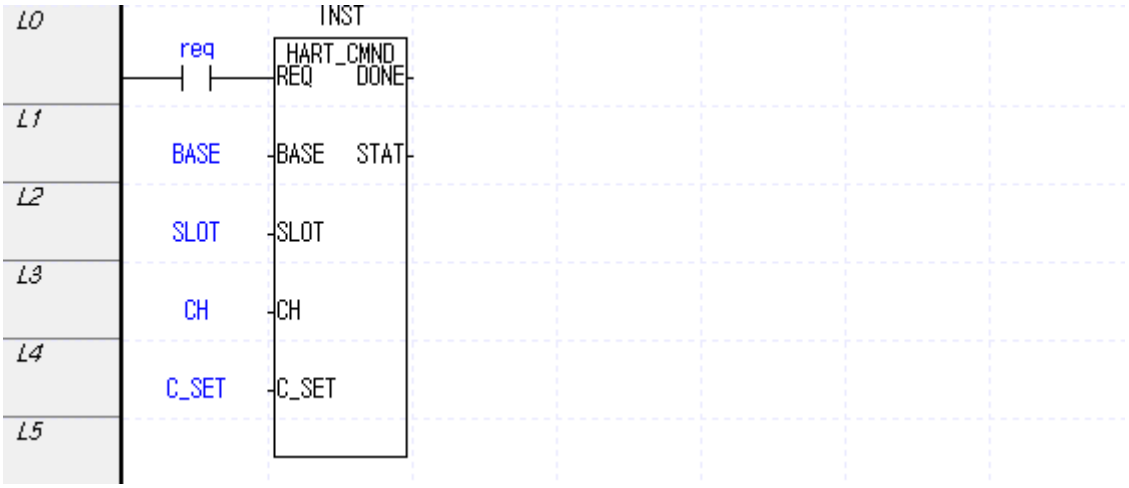
(4) Program

(a) Program example using [I/O Parameter]

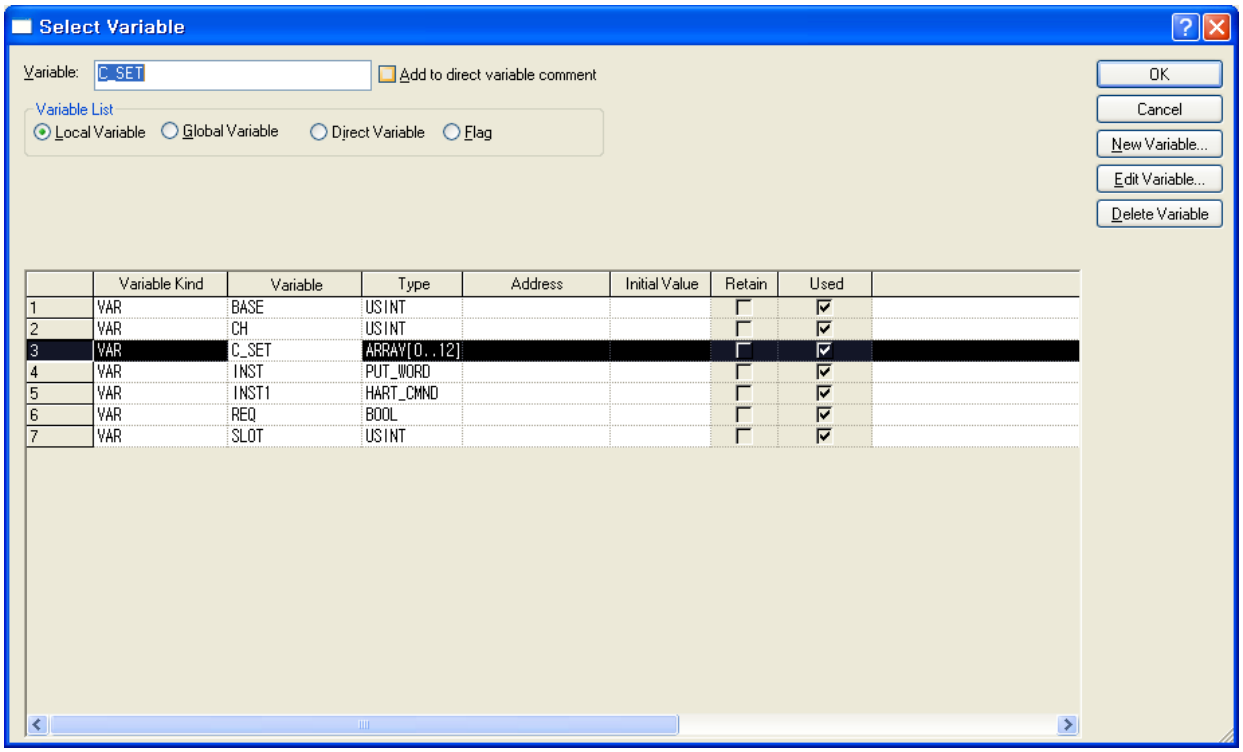




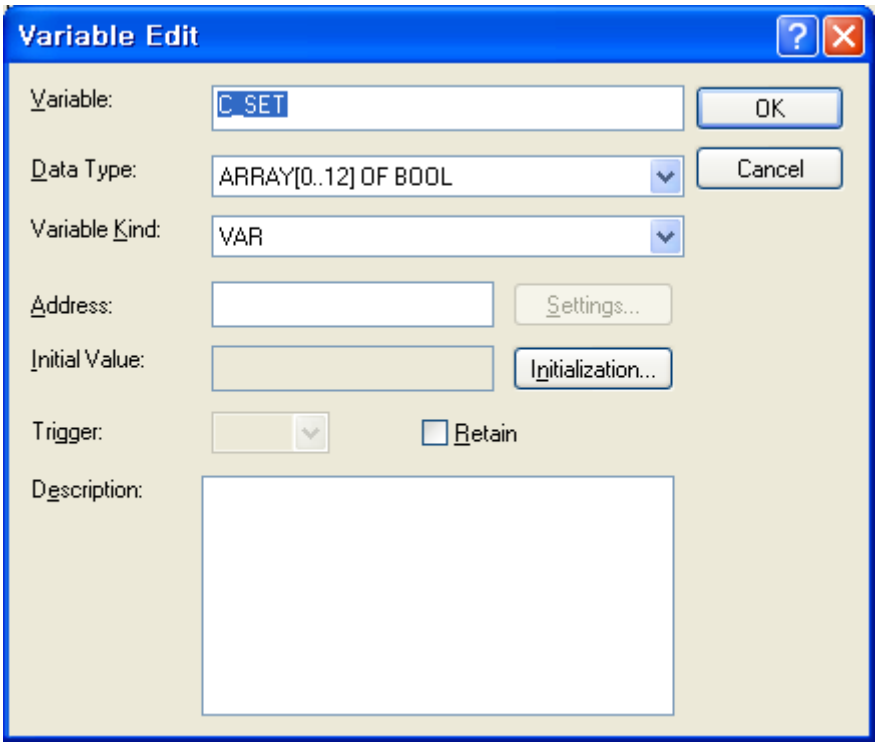
1) Allocate the variables of HARTCMND command.



2) Select the variable of C_SET.

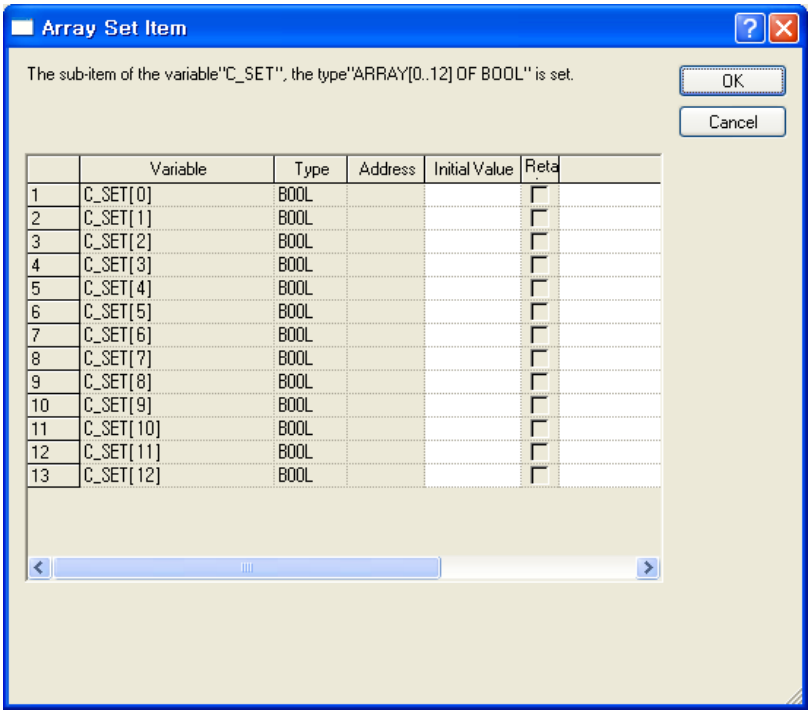


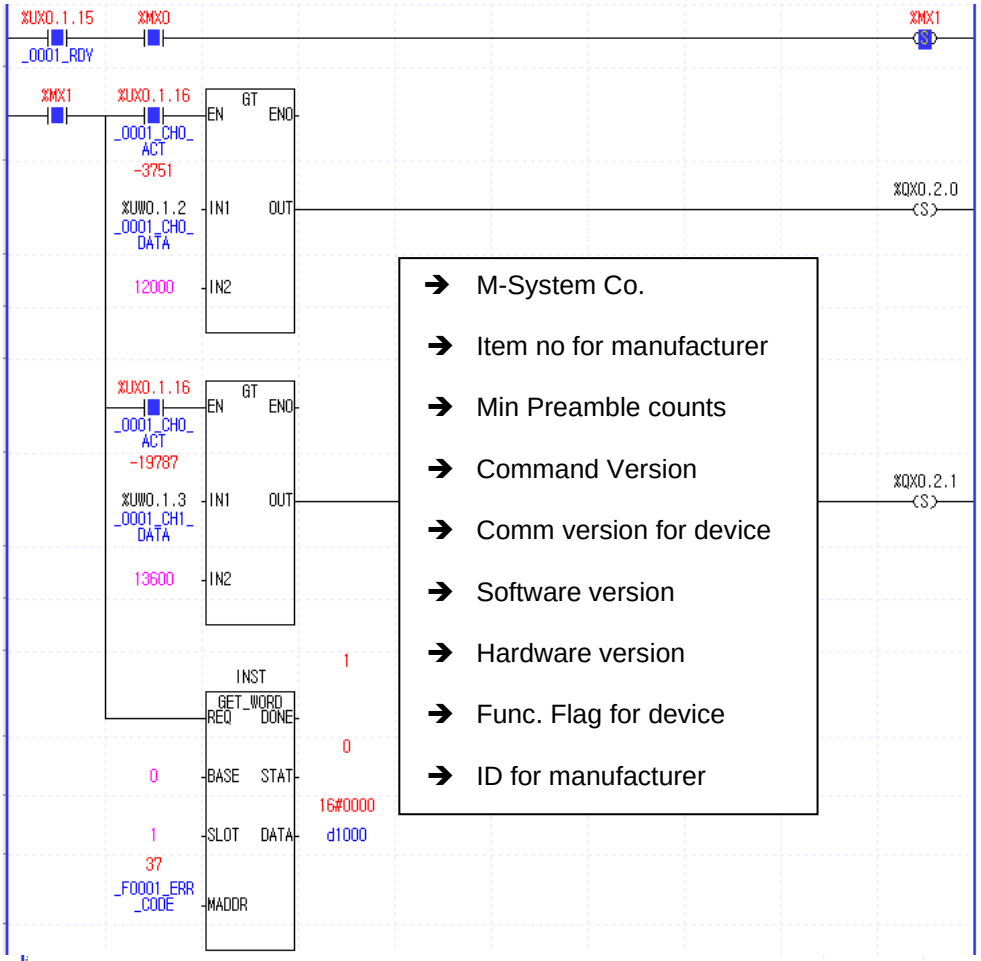
3) Click [Edit Variable]. C_SET variable is declared as 13 BOOL type arrays. Each array means 13 kinds of HART commands supported on HART input module. Therefore, set a command here to be performed through HART communication.



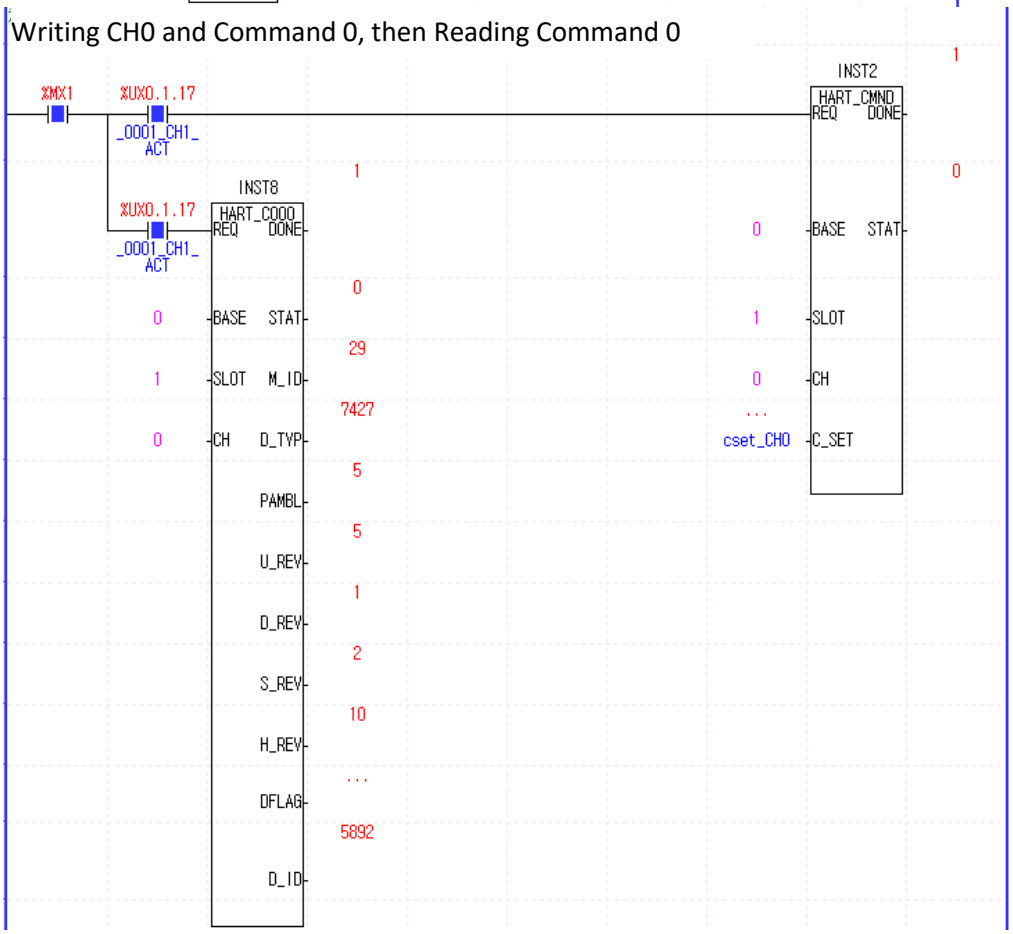
4) Click [Initialization] to set HART command bit. If 1 is set to command bit 에 1 to be communicated, communication corresponding to the command will be performed. In this example, HART command 0 and 1 is set to start communication with the Smart transmitter connected with HART input module. Command contents corresponding to each variable are shown in the following table. For details on HART commands, refer to Appendix 1.

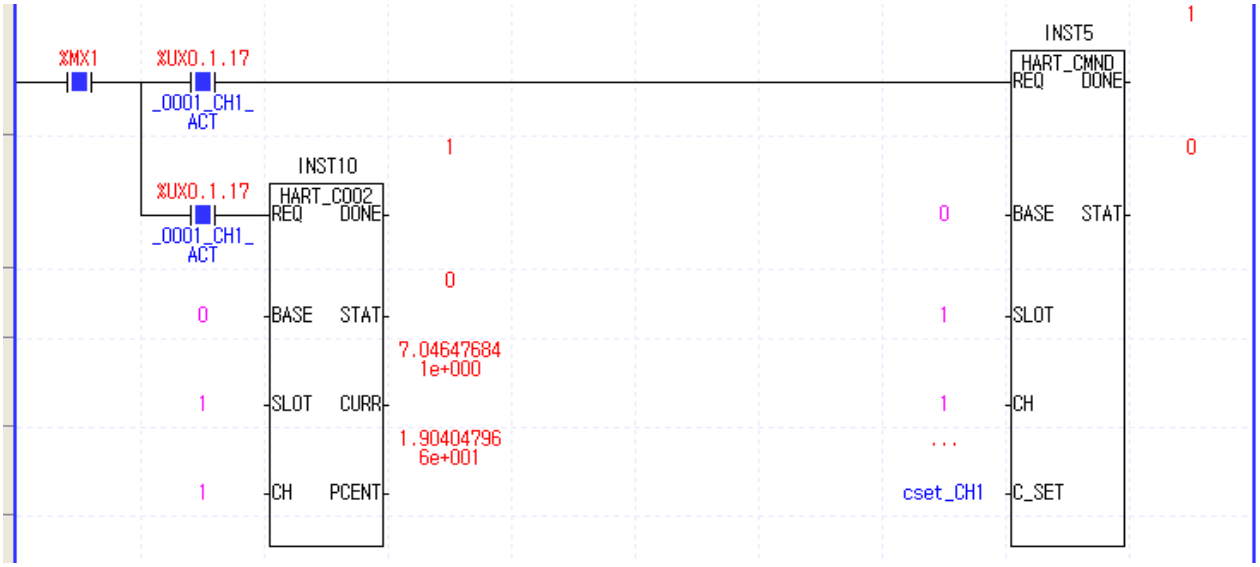
Variable	*HART command number*	*Function*
C_SET[0]	0	Read Manufacturer ID and Manufacturer device code
C_SET[1]	1	Read Primary variable(PV) value and Unit
C_SET[2]	2	Read percentage of current and range
C_SET[3]	3	Read current and 4 kinds of variable values (Primary Variable, Secondary Variable, Tertiary Value, Quaternary Value)
C_SET[4]	12	Read message
C_SET[5]	13	Read tag, descriptor, data
C_SET[6]	15	Read output information
C_SET[7]	16	Read Final Assemble Number
C_SET[8]	48	Read Device Status
C_SET[9]	50	Read Primary variable ~ Quaternary Variable assignment
C_SET[10]	57	Read Unit tag, Unit descriptor, Date
C_SET[11]	61	Read Primary variable~ Quaternary Variable and PV analog output
C_SET[12]	110	Read Primary variable~ Quaternary Variable





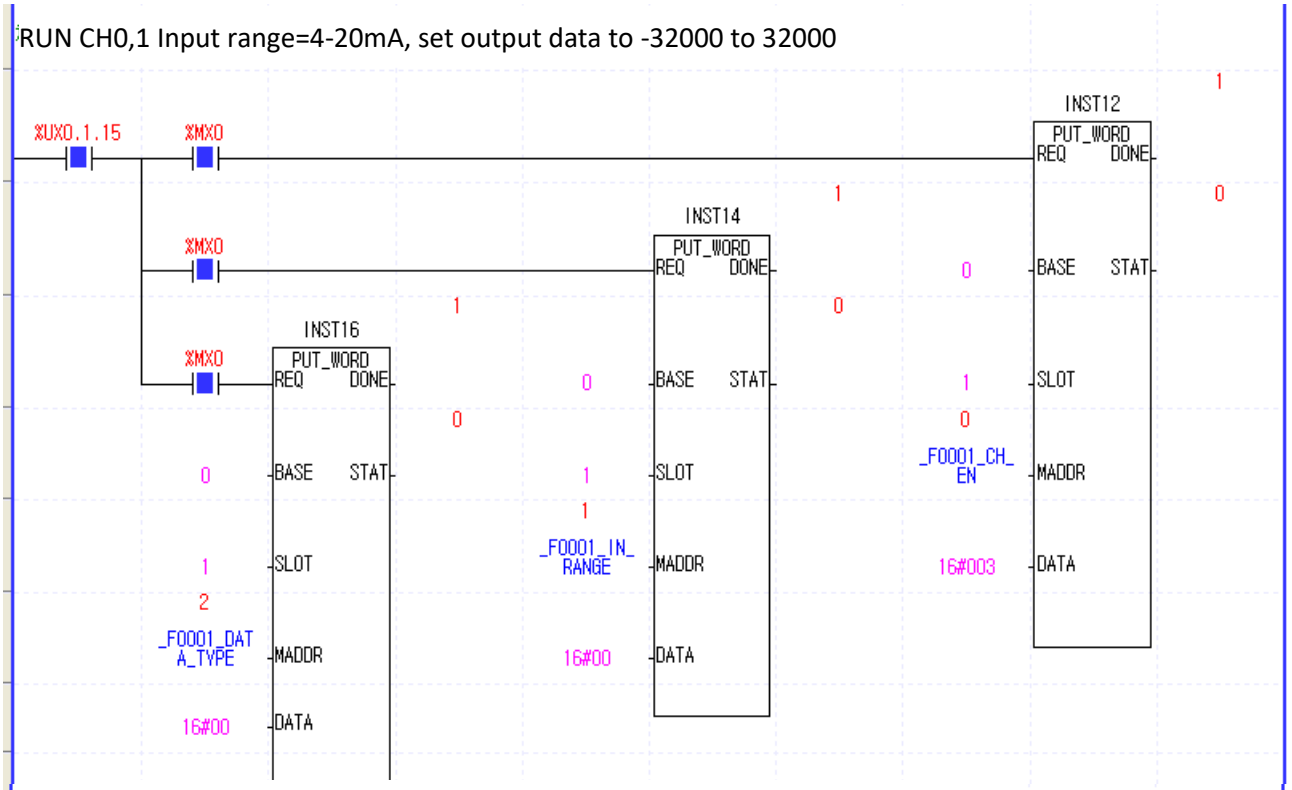
Writing CH0 and Command 0, then Reading Command 0



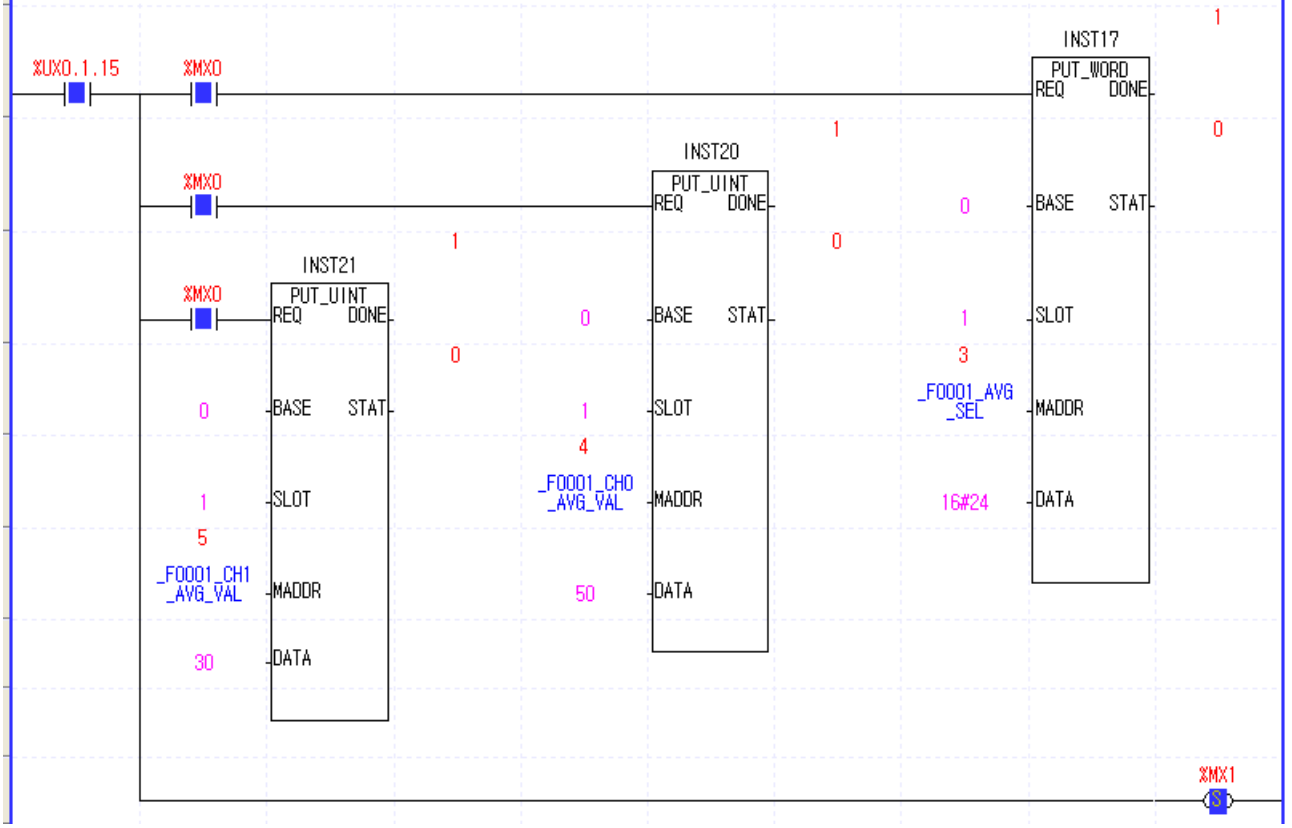


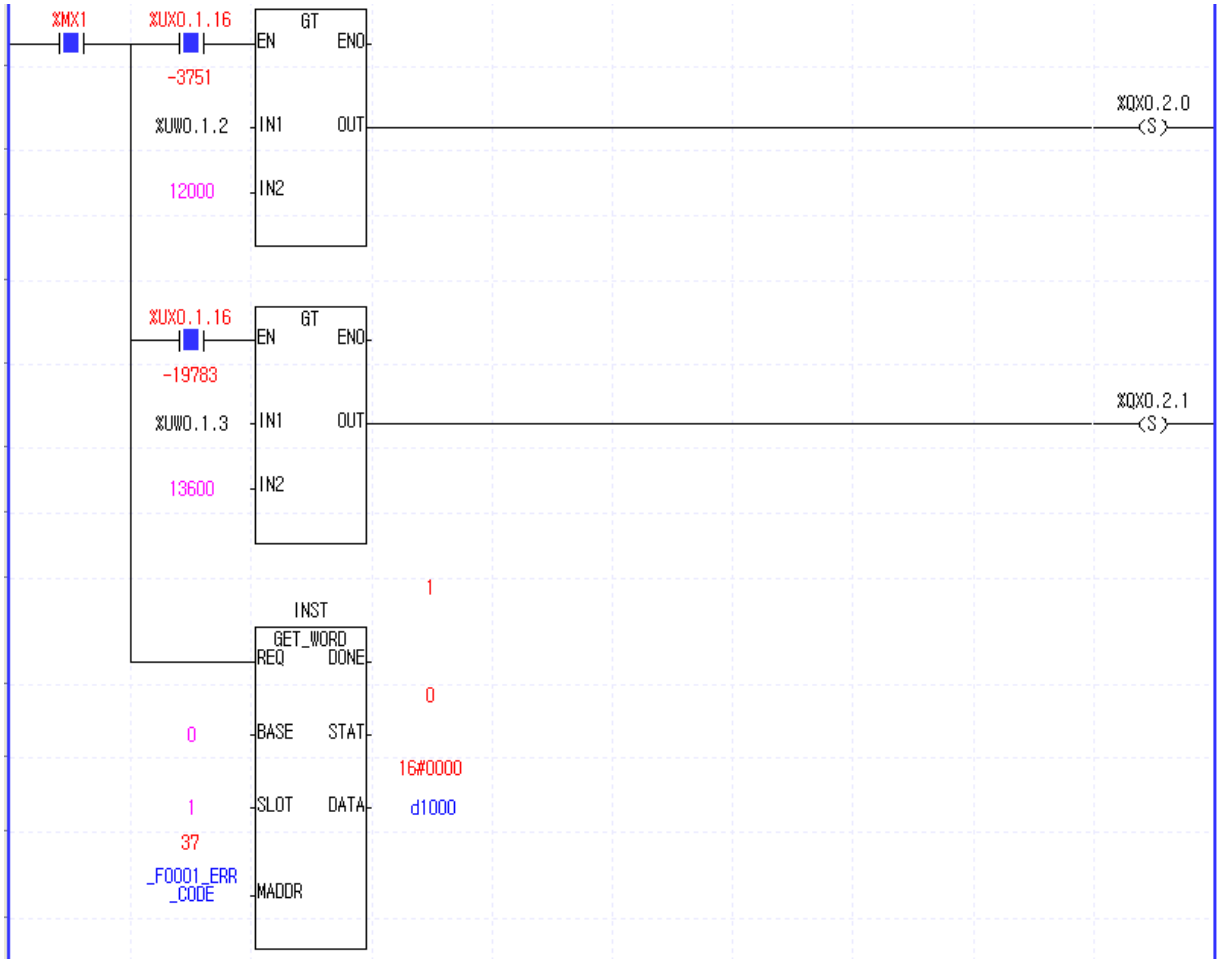
* Preamble: 5~20 byte hexadecimal FF is used in HART communication that uses characters, symbols or Frequency Shift Keying(FSK) to help synchronizing with receiving at the first part of HART message.

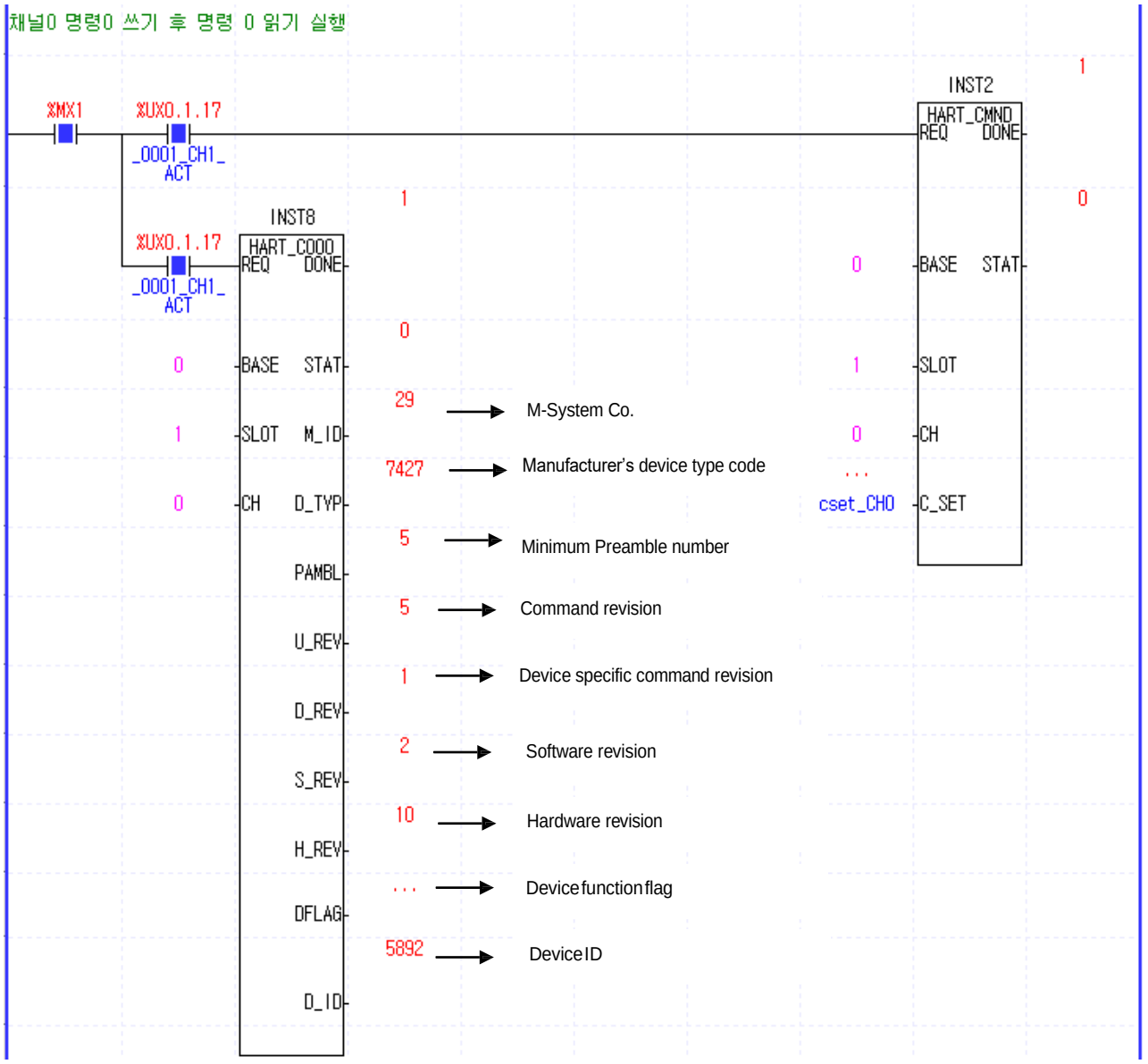
RUN CH0,1 Input range=4-20mA, set output data to -32000 to 32000

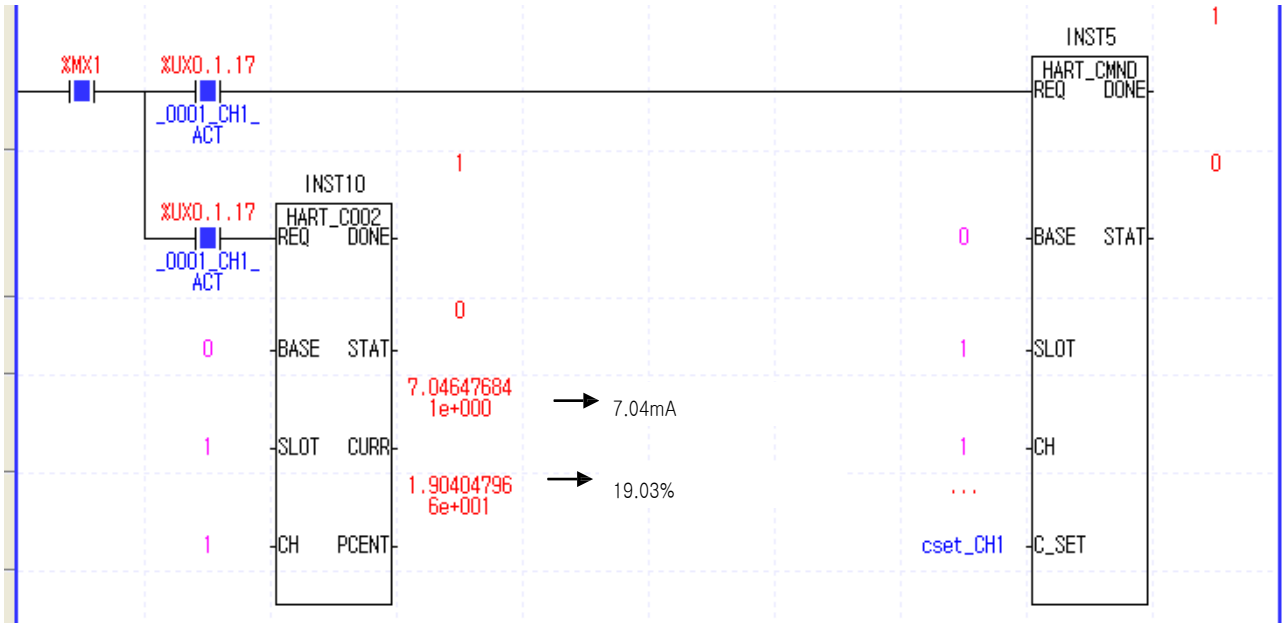


CH0 Weighted AVR and Average=50counts, CH1 Count AVR and average=30 counts




%MX1
%UX0.1.16
GT
EN
ENO
-3751
%UW0.1.2
IN1
OUT
%QX0.2.0
(S)
12000
IN2
%UX0.1.16
GT
EN
ENO
-19783
%UW0.1.3
IN1
OUT
%QX0.2.1
(S)
13600
IN2
1
INST
GET_WORD
REQ
DONE
0
0
BASE
STAT
16#0000
1
SLOT
DATA
d1000
37
_F0001_ERR
_CODE
MADDR


채널0 명령0 쓰기 후 명령 0 읽기 실행
%MX1
%UX0.1.17
_0001_CH1_ACT
INST2
HART_CMND
REQ DONE
BASE STAT
SLOT
CH
C_SET
cset_CH0
INST8
HART_C000
REQ DONE
BASE STAT
SLOT M_ID
CH D_TYP
PAMBL
U_REV
D_REV
S_REV
H_REV
DFLAG
D_ID
29 → M-System Co.
7427 → Manufacturer's device type code
5 → Minimum Preamble number
5 → Command revision
1 → Device specific command revision
2 → Software revision
10 → Hardware revision
... → Device function flag
5892 → Device ID


%MX1
%UX0.1.17
_0001_CH1_ACT
INST5
HART_CMND
REQ DONE
BASE STAT
SLOT
CH
C_SET
cset_CH1
INST10
HART_C002
REQ DONE
BASE STAT
SLOT CURR
CH PCENT
7.04647684 1e+000 → 7.04mA
1.90404796 6e+001 → 19.03%

Chapter 9 Troubleshooting

Details and diagnosis of errors which occur while this module is operating will be described.

9.1 Error Codes

Errors which occur when RUN LED of this module blinks are as described in Table 9.1. These error codes are stored in the internal memory of the 2MLF-AD4S module. (Address 37)

[Table 9. 1] List of error codes

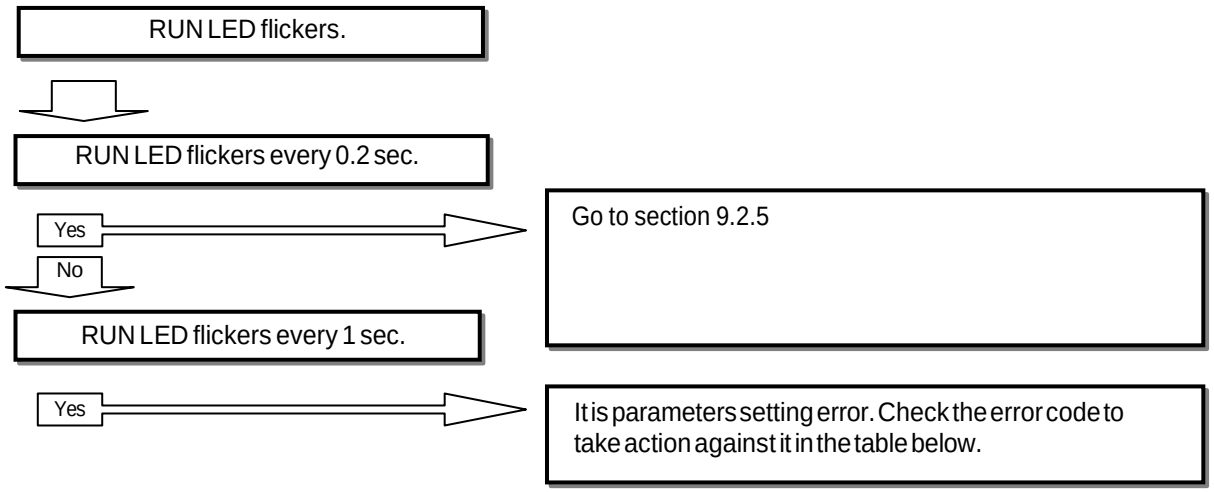
Error code (Dec.)	Description	RUN LED status
0	Normal operation	RUN LED ON
10	Module error (ASIC reset error)	Flickers every 0.2 sec.
11	Module error (ASIC RAM or Register error)	
20#	Time average set value error	Flickers every 1 sec.
30#	Count average set value error	
40#	Moving average set value error	
50#	Weighted average set value error	
60#	Change rate alarm detection period set value error	

Remark

(1) # of the error code stands for the channel number with error found.
(2) If 2 or more errors occur, the module will not save other error codes than the first error code found.
(3) Use the flag to request error clear to delete the error code from the scan program. (Refer to 5.2.5)

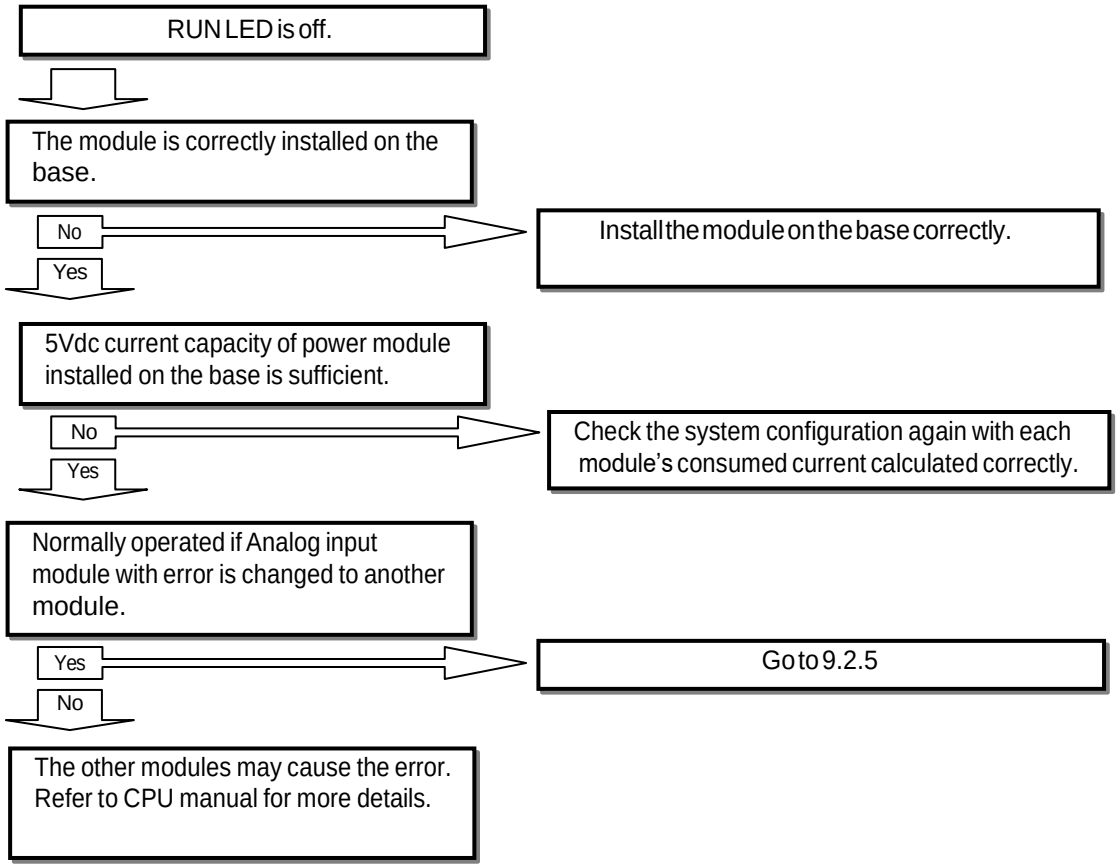
9.2 Troubleshooting

9.2.1 LED flickers

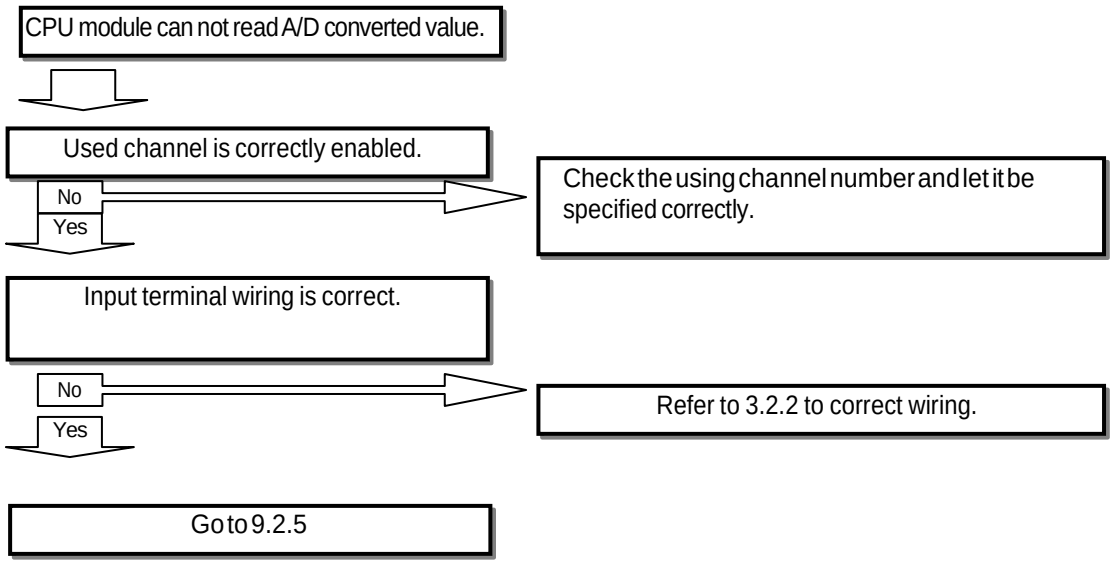


Error code (Decimal)	Contents	Measures
20#	Out of the range of the time average set value	Set within the range of 16 ~ 5000
30#	Out of the range of the count average set value	Set within the range of 2 ~ 500
40#	Out of the range of the moving average set value	Set within the range of 2 ~ 100
50#	Out of the range of the weighted average set value	Set within the range of 1 ~ 99
60#	Out of the range of the change rate alarm period set value	Set within the range of 10 ~ 5000

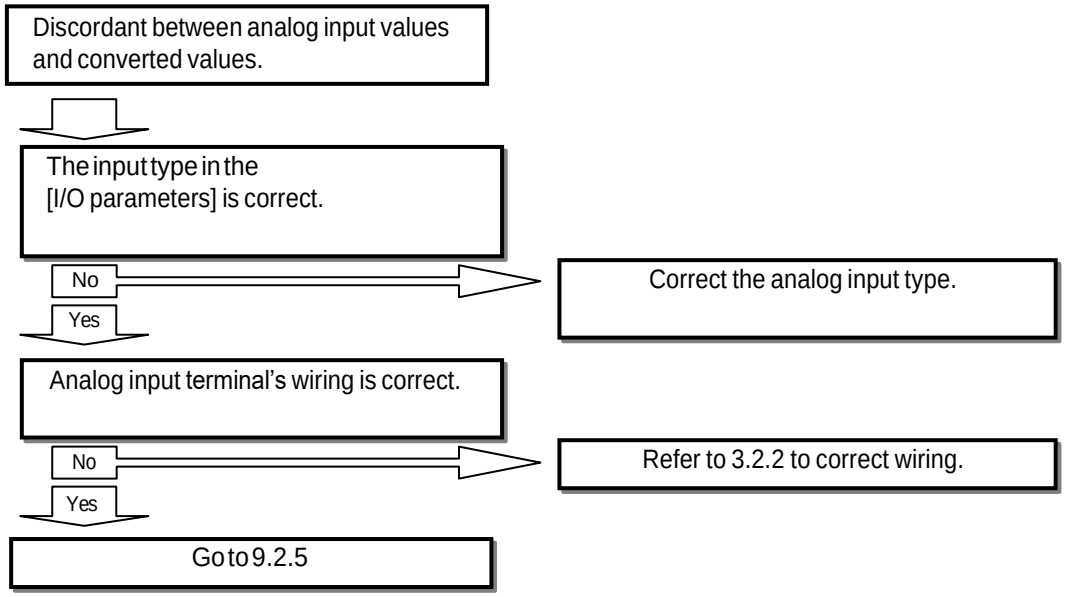
9.2.2RUN LED is off



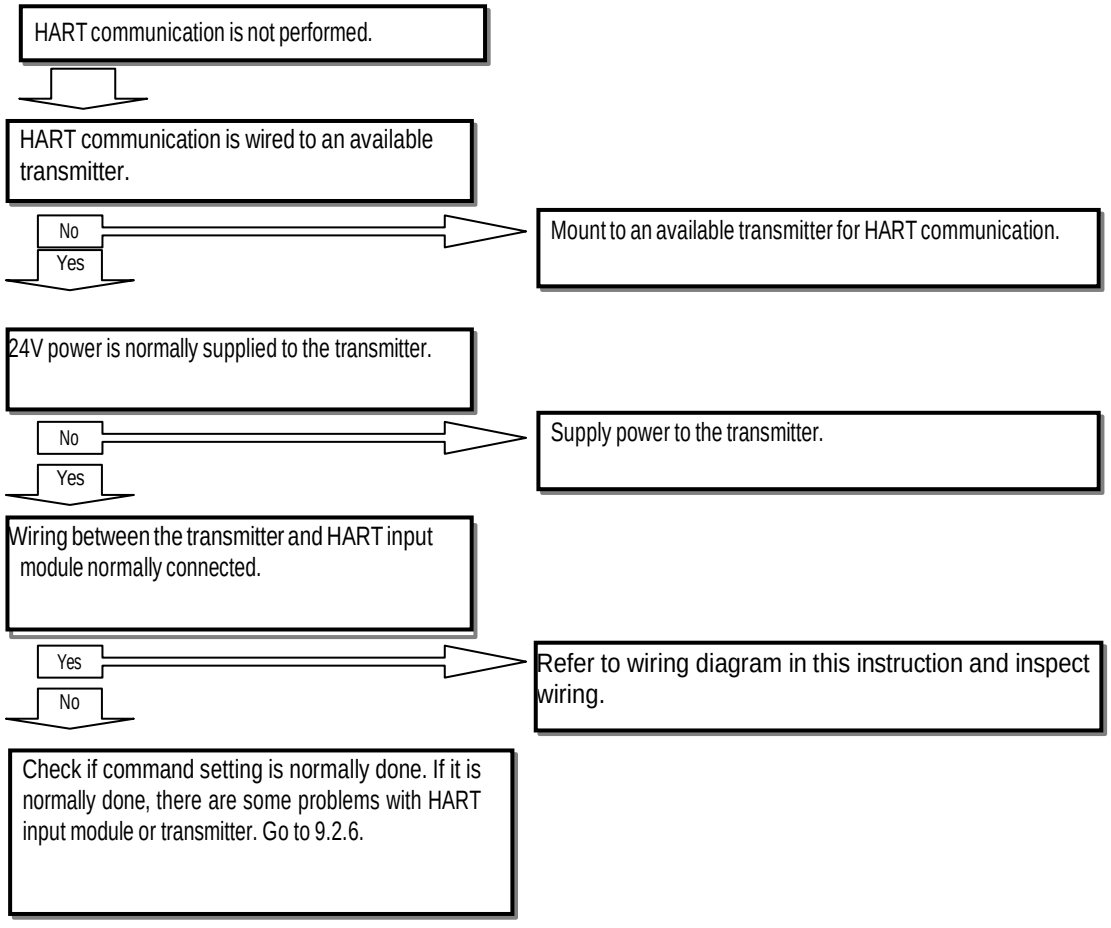
9.2.3 cannot read A/D converted value



9.2.4 Discordant between analog input value & digital output value



9.2.5 HART communication is not performed



9.2.6 H/W error of HART Analog Input Module

Let the power ON/OFF again. If the error occurs again, it seems to be a module defect. Contact the nearest agency or LS branch office.

9.2.7 Checking operation status of the module through SoftMaster system monitor

Module type, module information, O/S version and module status of the module can be checked through the SoftMaster system monitoring function.

1) Execution sequence

Two ways are available for the execution.

(1) [Monitor] -> [System Monitoring] -> And on the system screen, click the right mouse button to display [Module Information].

(2) [Monitor] -> [System Monitoring] -> And Double-click the module on the system screen.

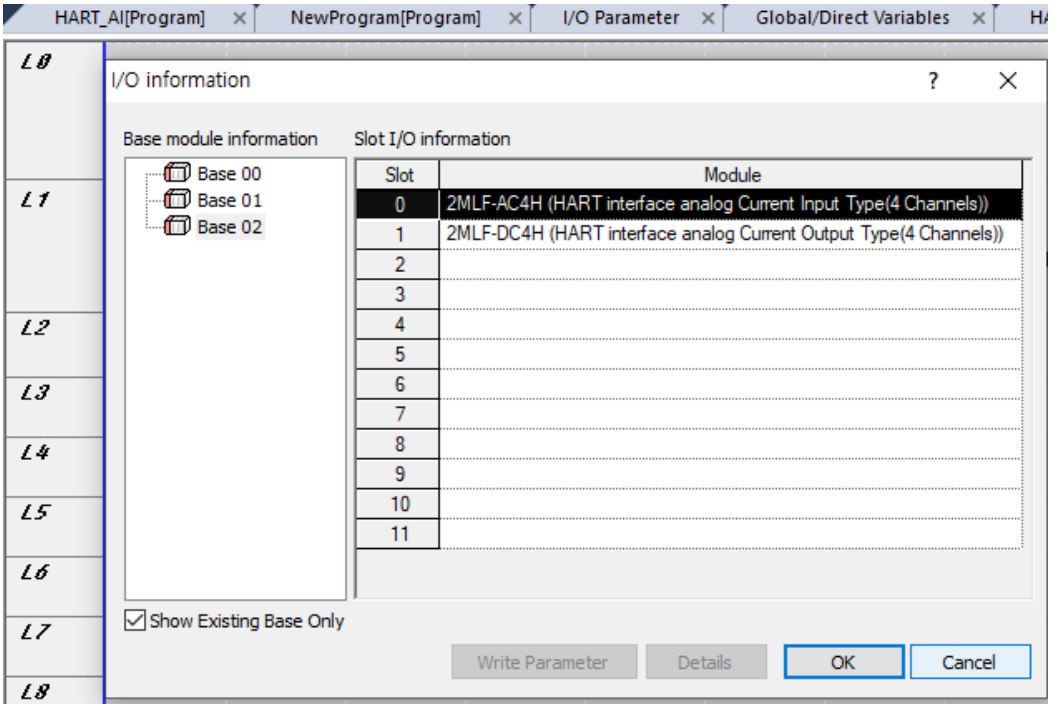
2) Module information

(1) Module info: shows type of the module.

(2) O/S version: shows the OS version of the module.

(3) O/S date: shows the preparation date of the O/S.

(4) Module status: shows the present error code. (Refer to 7.1 for detailed error codes)



Describes what you need to know when using HART analog modules in an asset management system.

10.1 Considerations

To use HART analog modules with asset management systems such as PACTware from Peper & Fuchs or Field Device Manager from Honeywell, you need to consider the following:

- To use the HART analog module in the asset management software, the [HART communication] item in the [I/Oparameters] of the HART analog module must be set to [Pass Through].

- You must use ML200 CPU module, Ethernet module, and HART analog module that support asset management software. For the OS version for each ML200 module that currently supports this function, refer to Table 10.1. The order in which commands sent from the asset management software through the pass-through function are passed to the transmitter is as follows.
  Asset Management Software → Ethernet Module → 2MLR CPU Module → HART Analog Module → Transmitter. Therefore, in order to access HART using asset management software, it is necessary to configure an appropriate system with the modules introduced in this section.

  [Table 10.1] Asset management software support version for each ML200 module

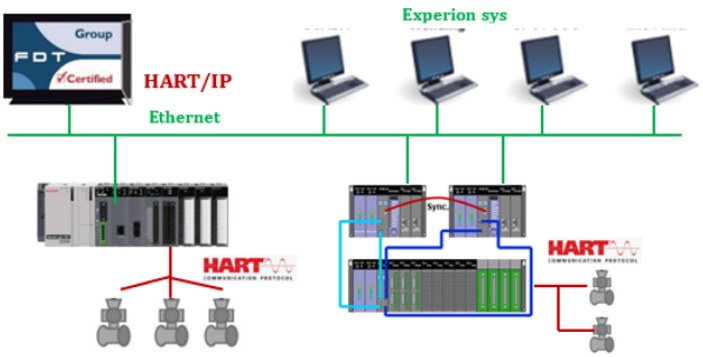
ML200 Module Type	Module OS Version	Remark
2MLR CPUH/□	Version 2.81 or higher	Pass-through
2MLL-EFM□B	Version 6.14 or higher	
2MLF-AC4H	Version 1.50 or higher	
2MLF-DC4H	Version 1.30 or higher	

- When using a portable HART transmitter, the HART transmitter must be configured as a secondary master. In some cases, communication between the HART analog module and the HART transmitter may conflict. If proper communication is not performed on the HART transmitter, set HART communication of the HART analog module to [Prohibit] and try again.
- For information on how to use the asset management software, refer to the user manual published by the manufacturer of the software. In order for asset management software to recognize the Ethernet module of ML200 PLC, DTM must be installed on the system equipped with asset management software. DTM of ML200 PLC can be downloaded from Honeywell website, contact to Honewyell.
- For details on DTM installation, refer to the pass-through function in Appendix 6.

HART communication supported by HART analog module supports two methods. The first is the [User Program] method, and the second is the [Pass Through] method. These two methods cannot be used by mixing each channel. If [Pass Through] method is set in one channel in HART analog module, [User Program] method set in other channels does not work. Therefore, do not mix the two.

10.2 Pass-Through Function

This section describes Pass-Though Function and how to install and configure the HART on ML200.
Pass through function of HART analog module is supported through HART-CommDTM for FDT frame application that complies with FDT standard 1.2.+.



FDM and Pass Thru Offer Design Flexibility

1. **HART over COM/DTM Open Standard**
   - Integration with FDM and other Asset Management System
   - Remote access to devices for device management
   - Can deliver asset information directly to SCADA/ DCS systems supporting HART-IP
2. **Investment protection through use of existing plant network infrastructure**
   - FDM can integrate devices connected to other HART supported control system at site
   - FDM supports multiple protocols and standards
     - HART, Profibus-DP
     - DFT/DTM and FDI standards in same tool
3. **Scalable** to any size of project small to large

10.2.1 About HART-CommDTM

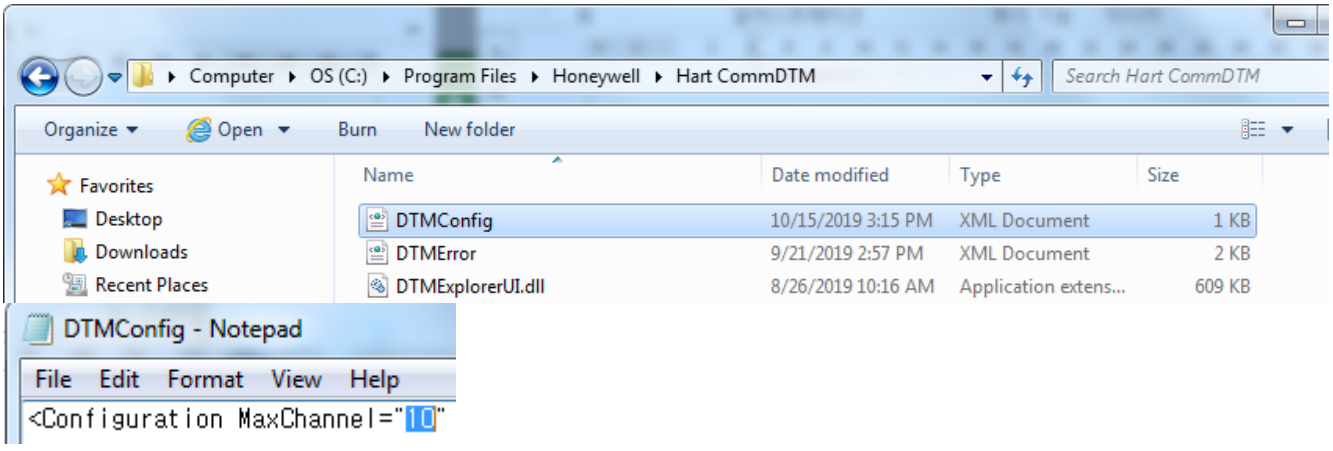
HART-CommDTM supports FDT frame applications conforming to FDT 1.2.+. HART-CommDTM is a HART communication DTM that works as a driver for communication between HART devices in the Redundant ML200(2MLR-CPU#+HART AI/AO+FEnet) system in the FDT frame application.

(1) Standard

HART-CommDTM supports up to 1,024 channels. The HART analog module can connect one HART device to one channel.
Therefore, HART devices can be connected to the number of channels in the 2MLR system.

- Maximum number of HART channels: 1,024 (configuration can be changed in XML file)
- Number of HART devices that can be connected to one channel: 1 (multi-drop not supported)
- Number of HART devices available for the 2MLR system: 1,024

The maximum number of HART channels in the FDT application can be changed as follows in the configuration file (DTMConfig.xml) of the HART-CommDTM installation path.



(2) Communication channel assignment

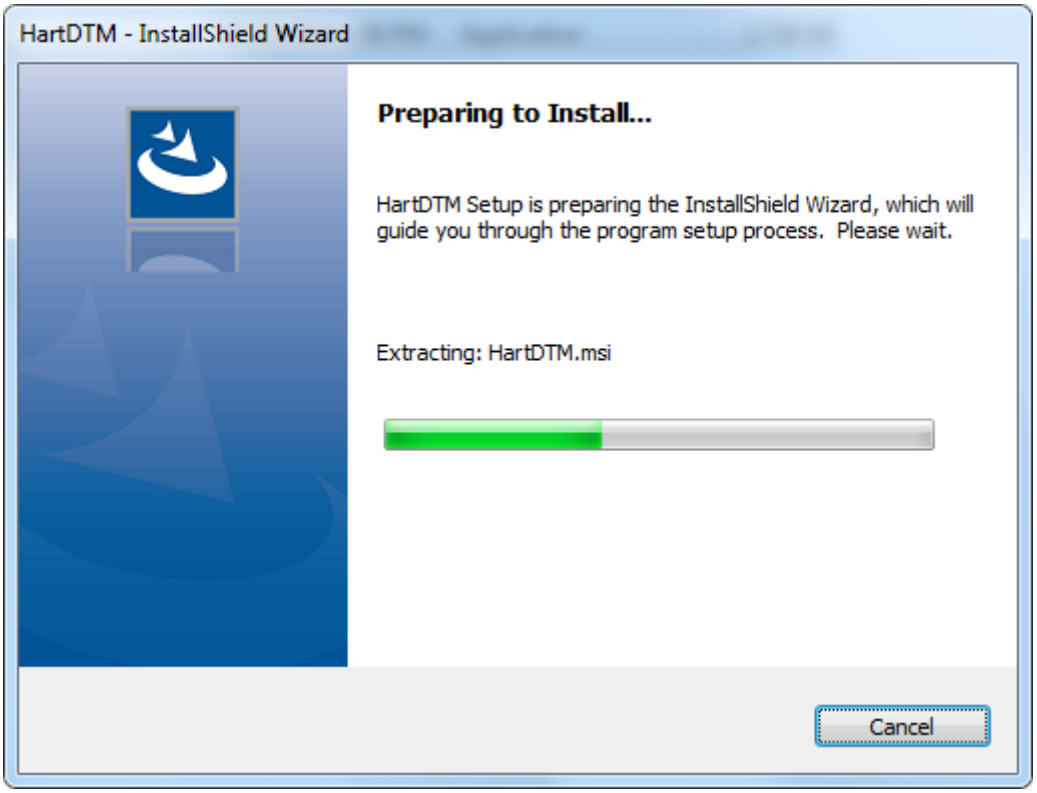
In the FDT frame application, the channel order is assigned according to the mounting order of the HART module. For example, if 4 HART analog modules are installed, the channels are allocated according to the base, slot and channel order as shown below.

No.	Base	Slot	Channel	HART Channel
1	2	2	0~3	0~3
2	2	3	0~3	4~7
3	4	0	0~3	8~11
4	4	1	0~3	12~15

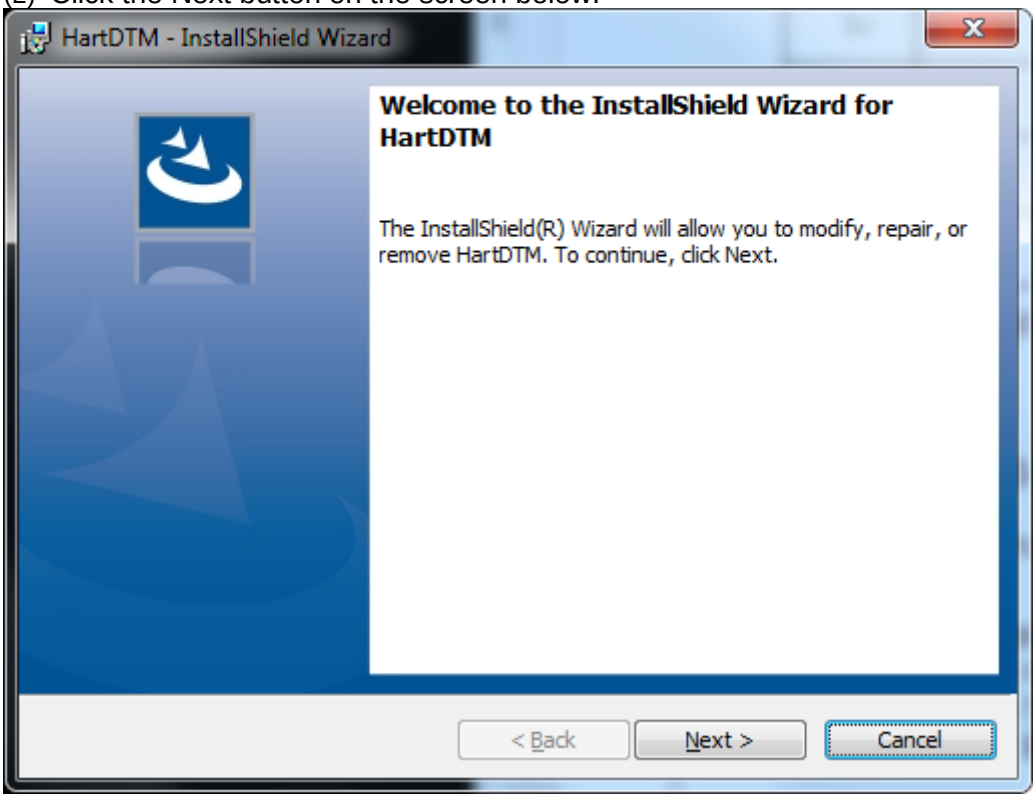
When a HART analog module is added, deleted, or the location is changed, the channel of the assigned HART device also changes.

10.2.2 How to install HART-CommDTM

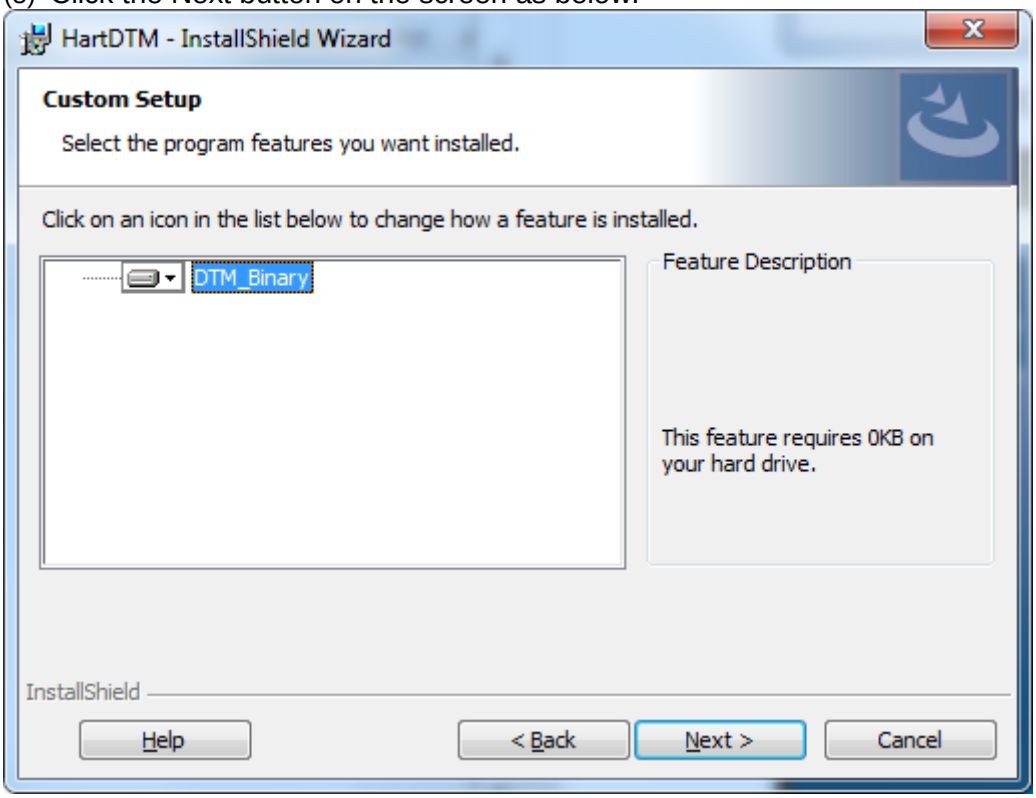
(1) Run the HART-CommDTM setup file.



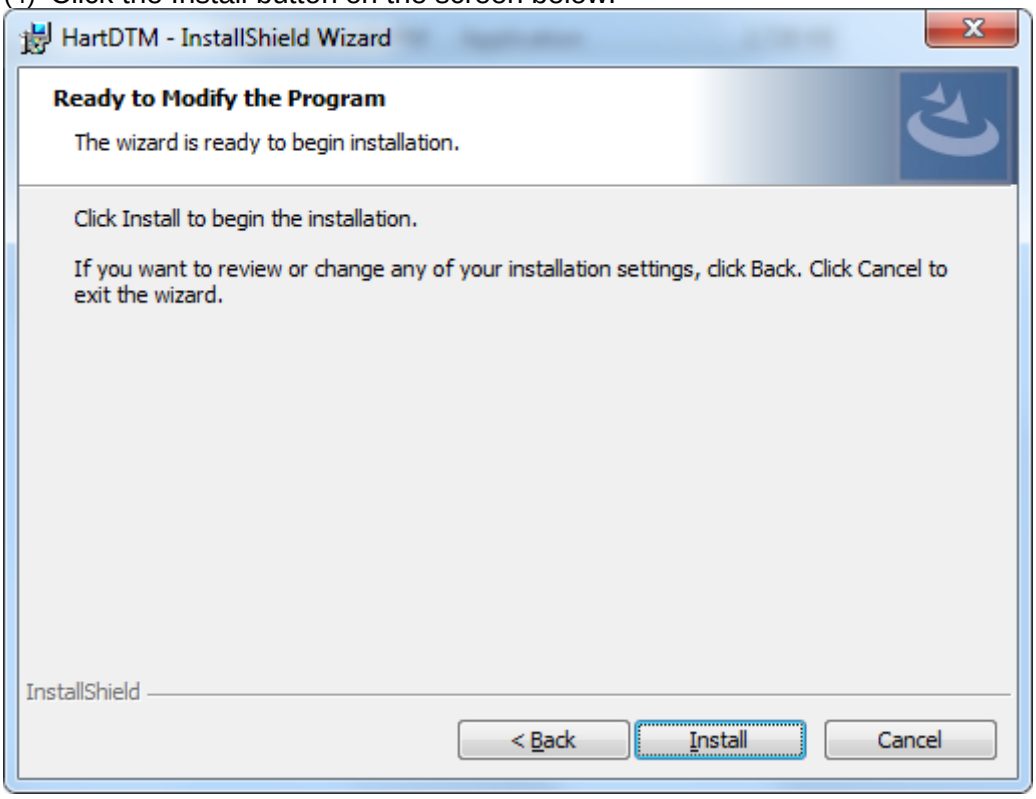
(2) Click the Next button on the screen below.



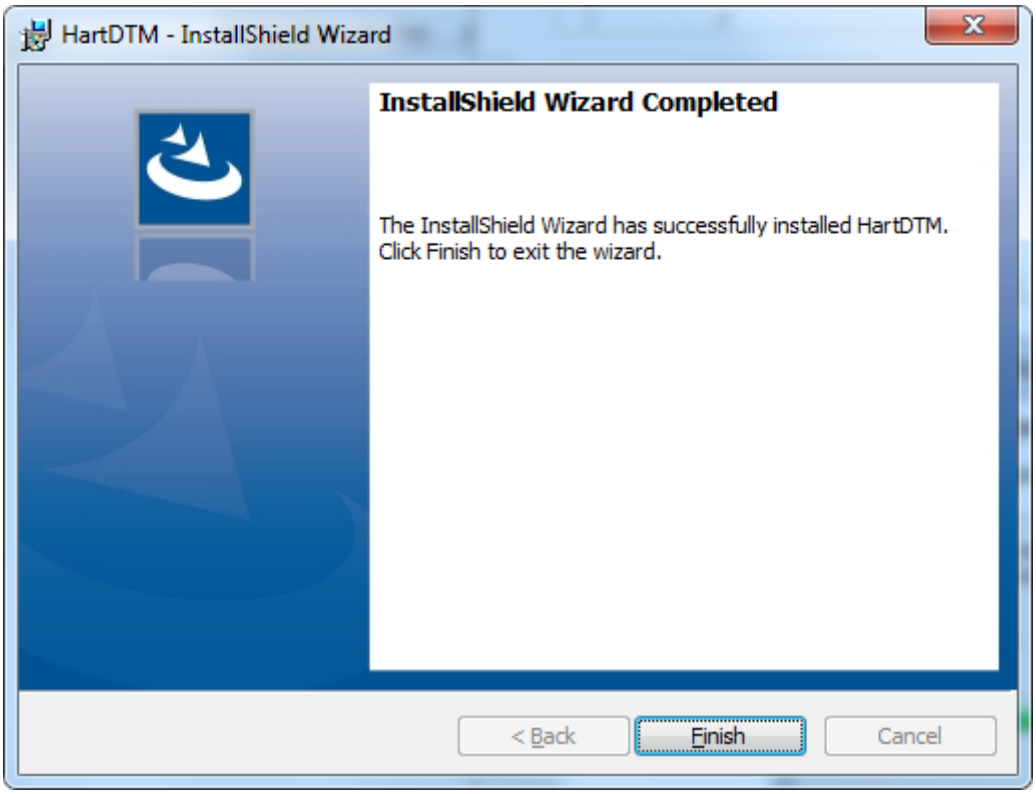
(3) Click the Next button on the screen as below.



(4) Click the Install button on the screen below.



(5) Click the Finish button on the screen below to complete the installation of HART-CommDTM

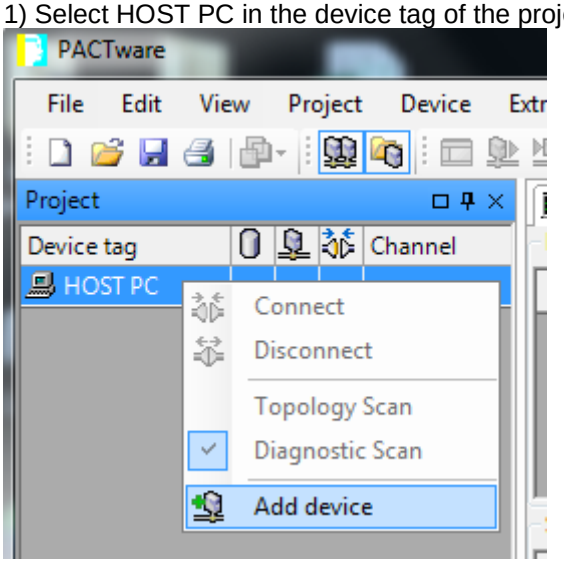


10.2.3 Uses of FDT Frame Application on PACTware

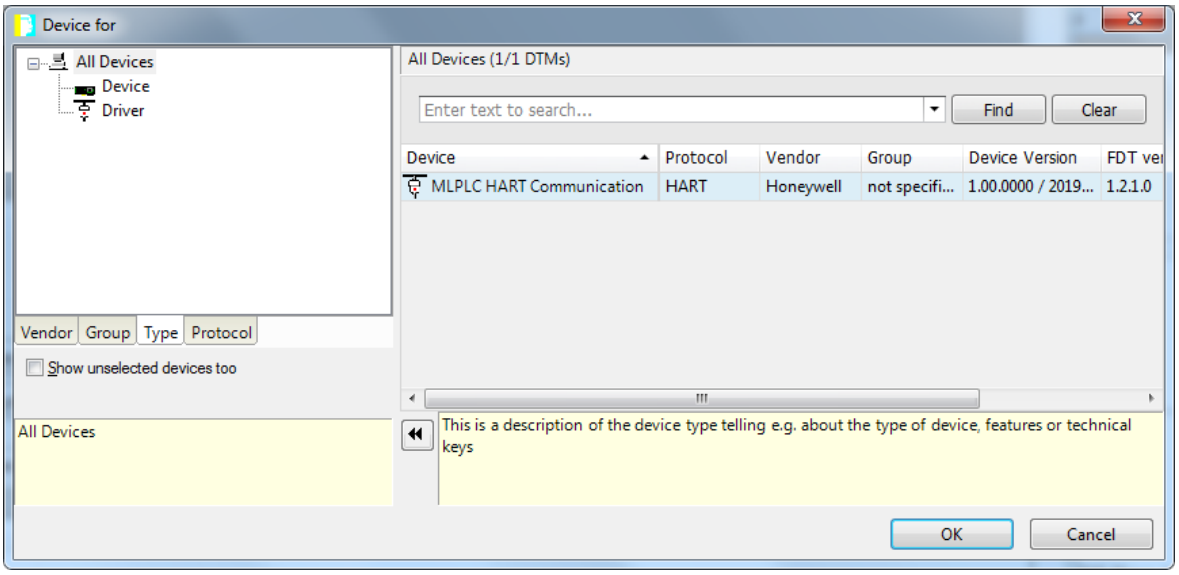
In this manual, description is based on PACTware. For downloading and installing PACTware, please refer to the PACTware homepage.

(1) Addition of HART Communication

1) Select HOST PC in the device tag of the project, right -click the mouse and execute ADD Device

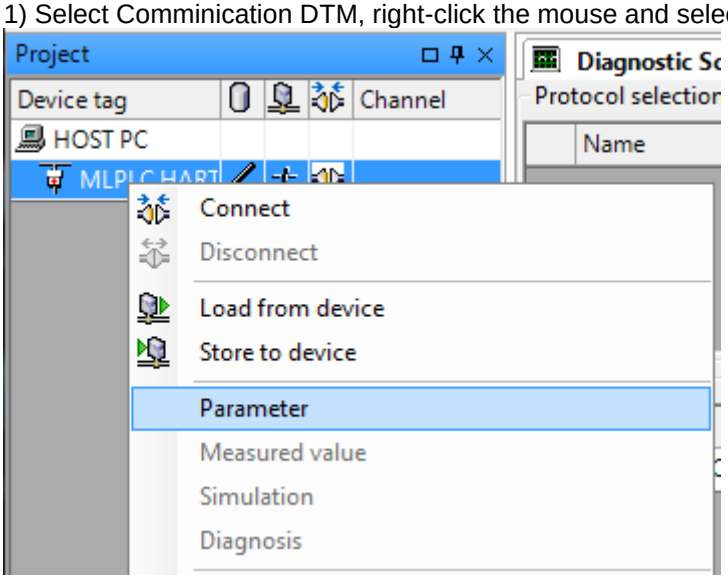


2) Select Device on the screen below and click the OK button

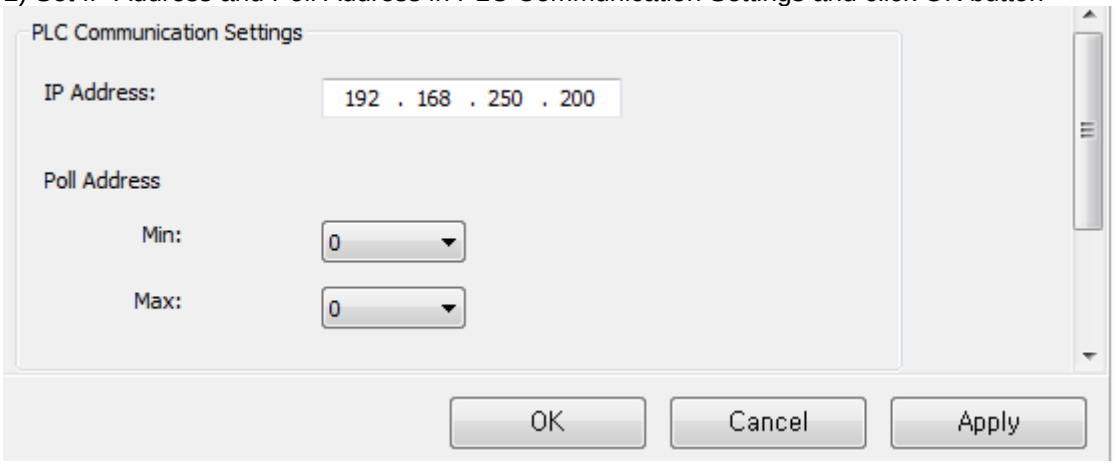


(2) Connect with PLC

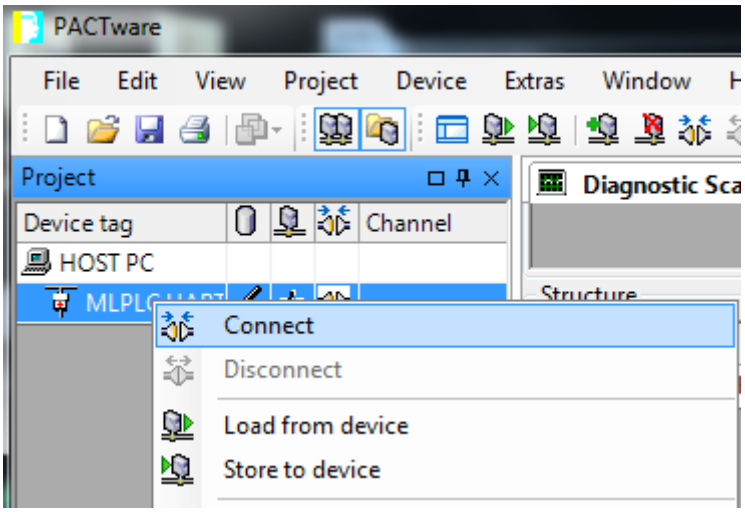
1) Select Comminication DTM, right-click the mouse and select parameter



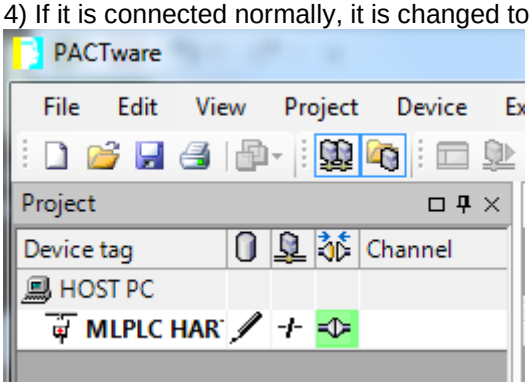
2) Set IP Address and Poll Address in PLC Communication Settings and click OK button



3) Select Communication DTM, right-click and click Connect.

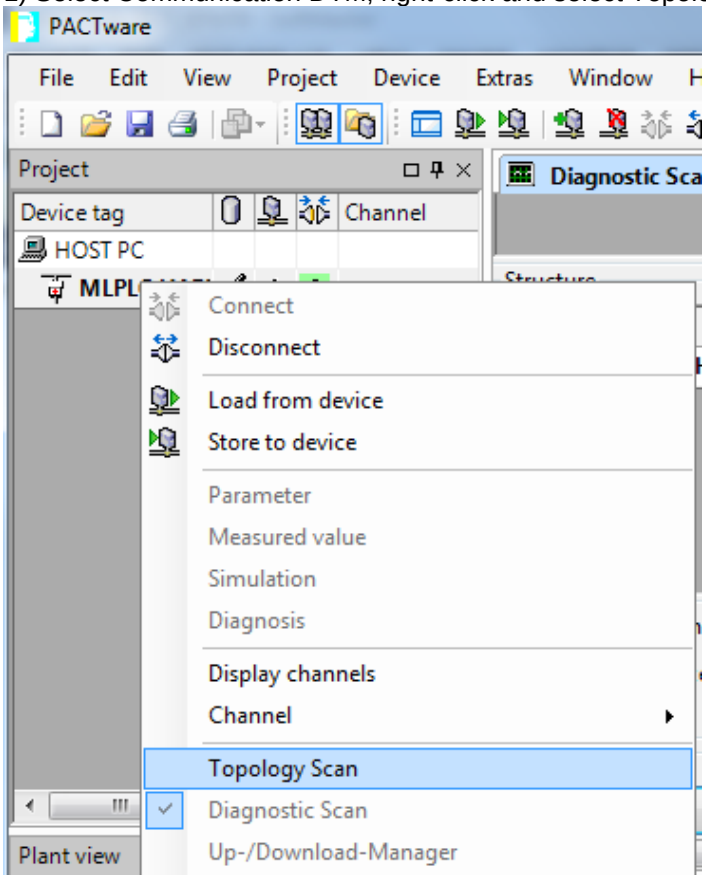


4) If it is connected normally, it is changed to bold font and the status is changed.

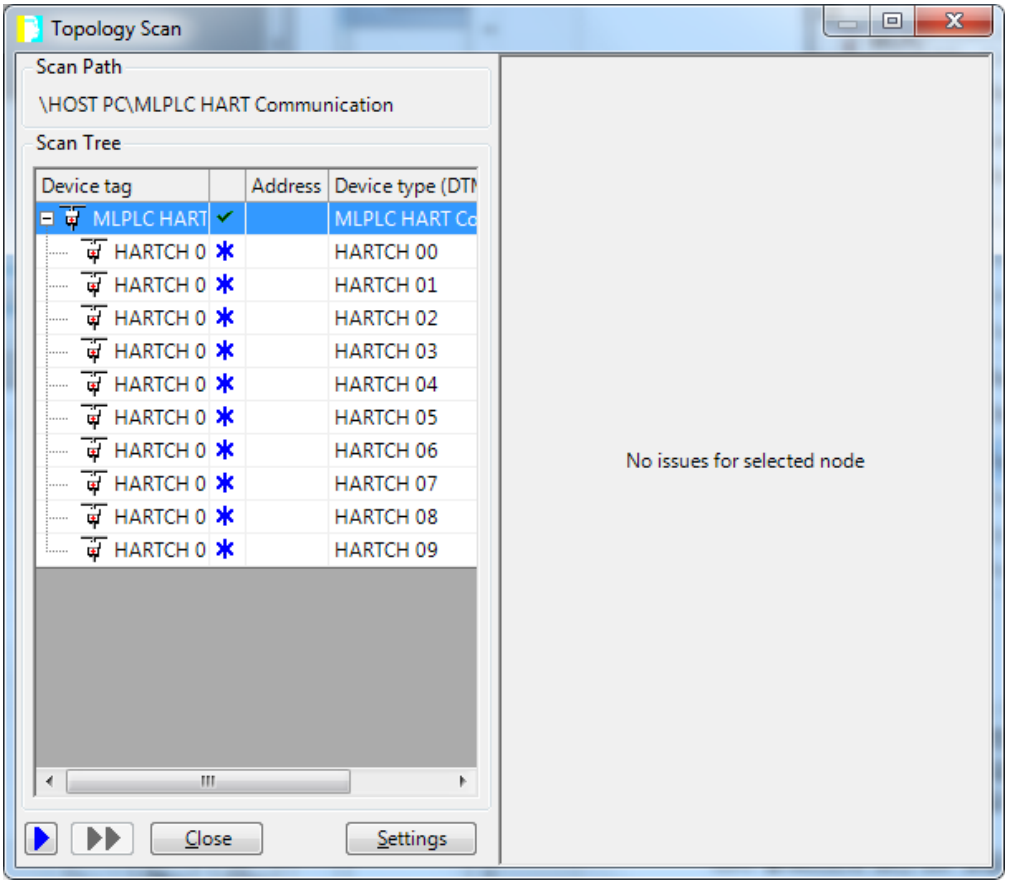


(3) HART device automatic allocation

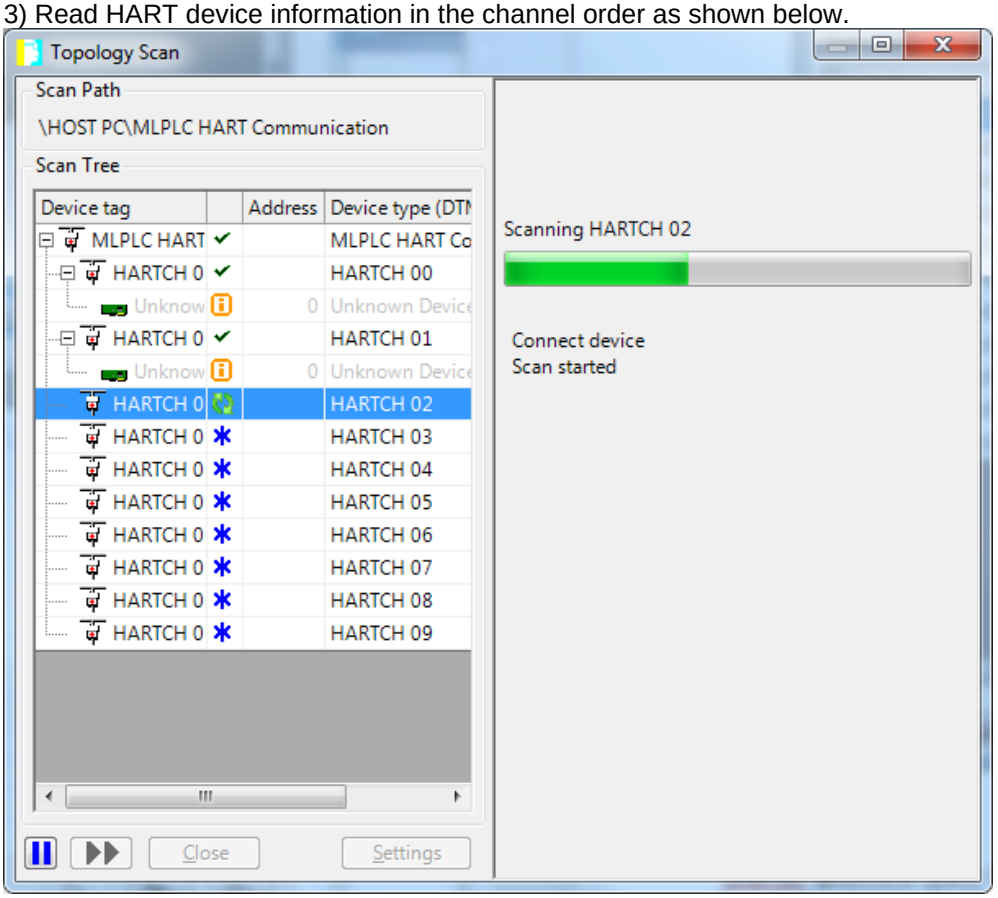
1) Select Communication DTM, right-click and select Topology Scan



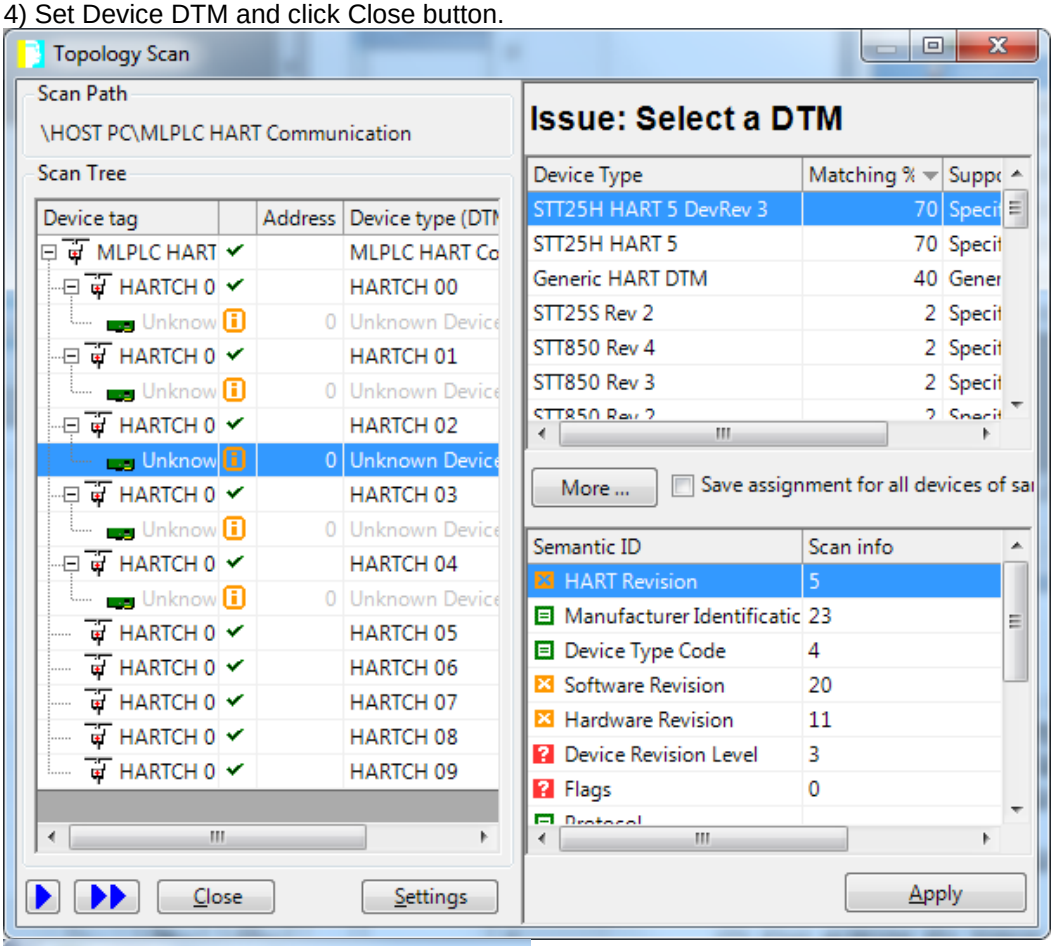
2) Click the ▶ button in the Topology Scan window

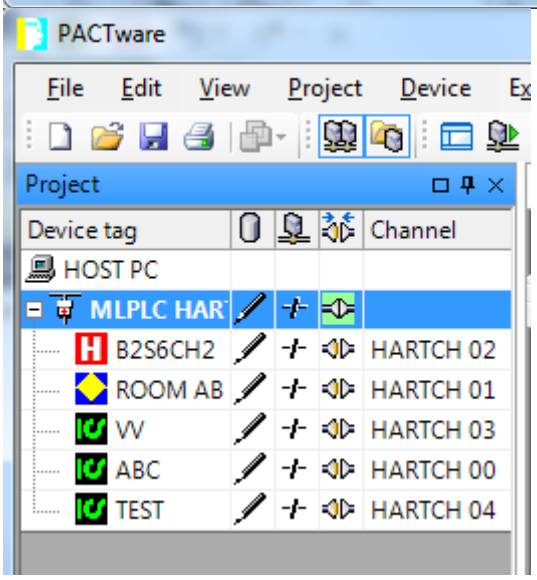


3) Read HART device information in the channel order as shown below.



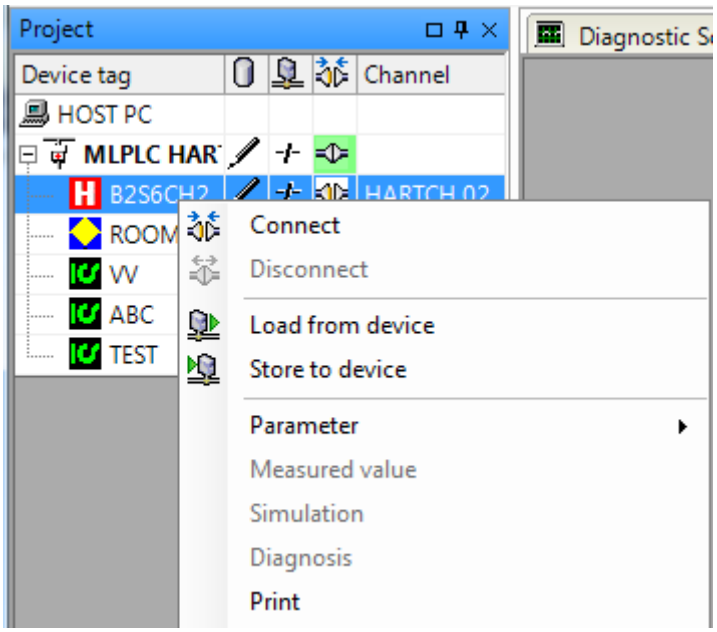
4) Set Device DTM and click Close button.



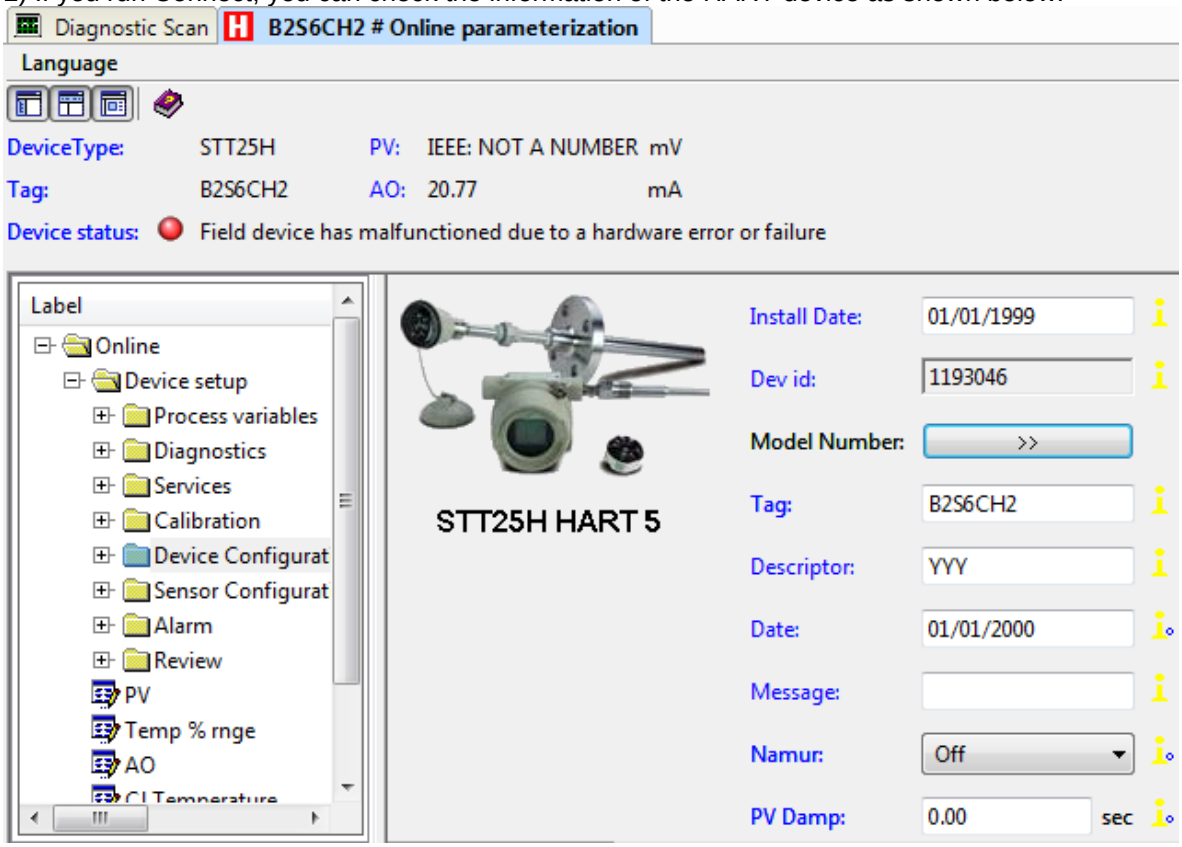


(4) HART device connection

1) Select the HART device you want to connect, right-click the mouse and click Connect.



2) If you run Connect, you can check the information of the HART device as shown below.



10.2.4 Uses of FDT Frame Application on FDM of Honeywell

In this section, it describes an application based on Honeywell FDM(Field Device Manager). Regarding this software tool, please contact Honeywell, and visit to https://process.honeywell.com .

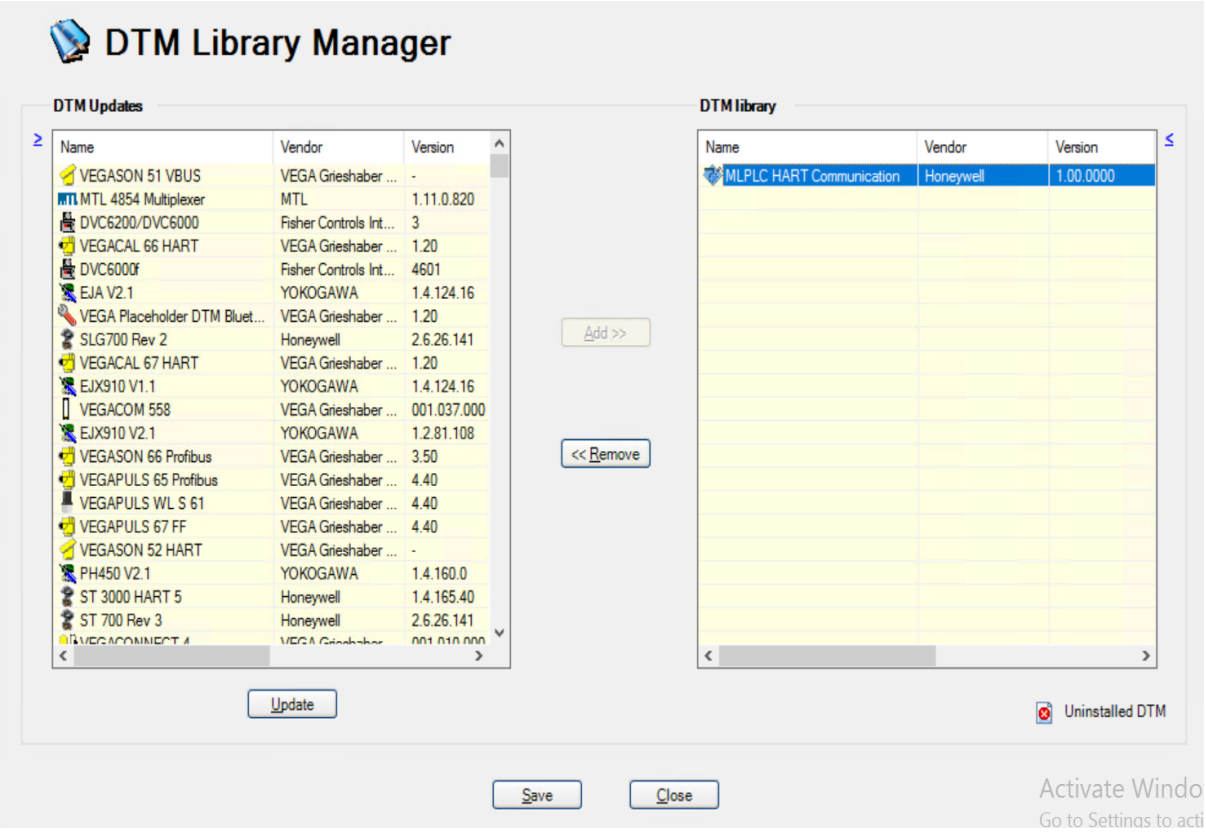
Integration on Honeywell solution;
FDM50x.x and R51x.x

Preparations of ML200 system

ML200 Module Type	Module OS Version	Remark
2MLR CPUH/□	Version 2.81 or higher	Pass-through
2MLL-EFM□B	Version 6.14 or higher	
2MLF-AC4H	Version 1.50 or higher	
2MLF-DC4H	Version 1.30 or higher	

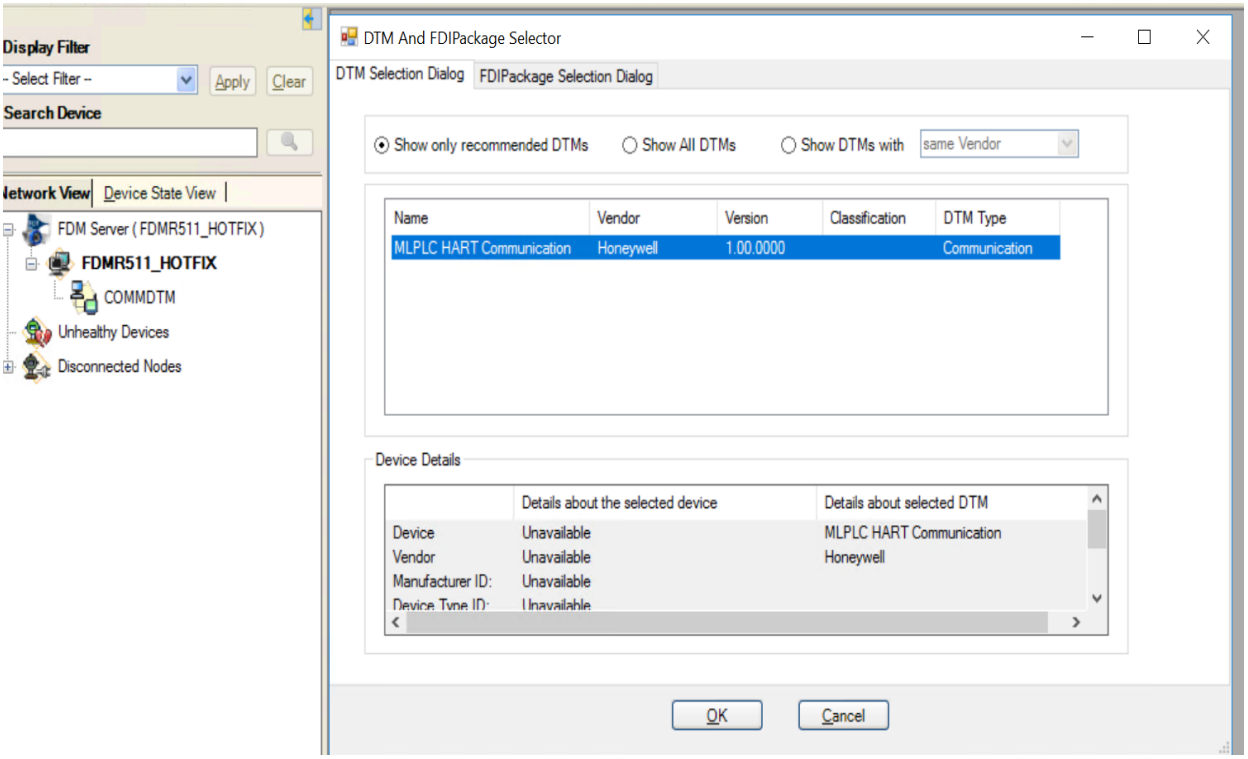
Building FDT Networks

1. On the FDT COMM console, update the DTM library and ensure that only the required (MLPLC) communication DTM selected in the DTM library. Ensure to deselect all the existing device DTMs from the DTM library.
2. In the Network View list, right-click the MLPLC COMM DTM interface name and then click Add Device. The DTM Selection Dialog appears with the list of Devices connected to channels and click on OK.



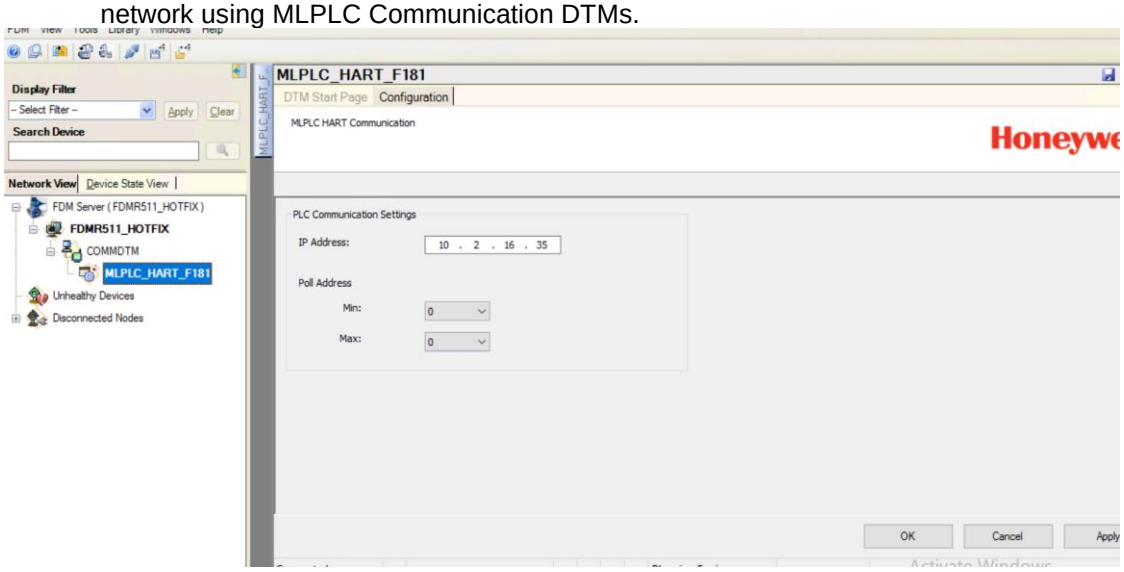
Configuring CommDTM netwok in FDM

- IP Address of MLPLC Communication module should be provided in DTM.
  - Edit the IP here and save (Highlighted below)
  - Add the MLPLC Communication DTM in FDT Comm Console Tool
  -



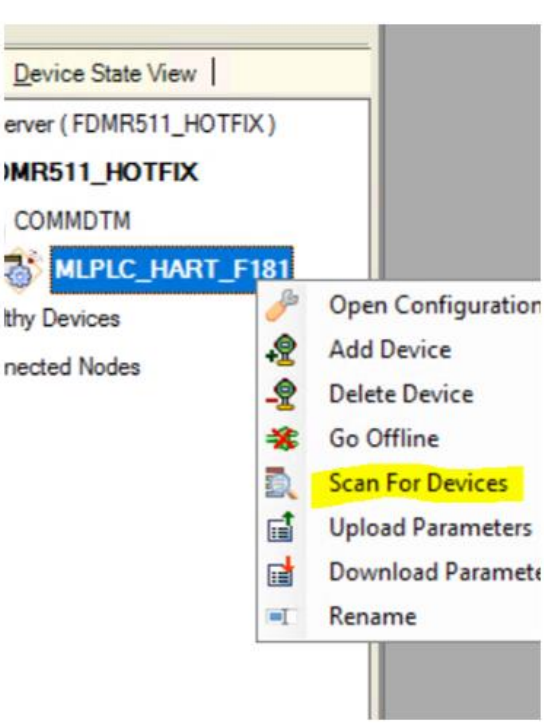
Building FDT Networks-Configuring

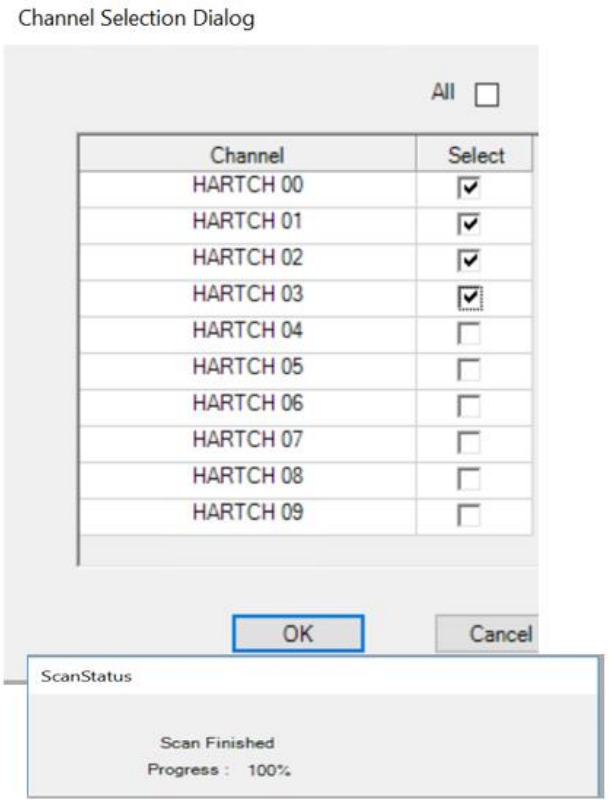
1. The FDT Comm Console allows user to configure the MLPLC networks and build the complete network using MLPLC Communication DTMs.



Building FDT Networks-Scan for Device

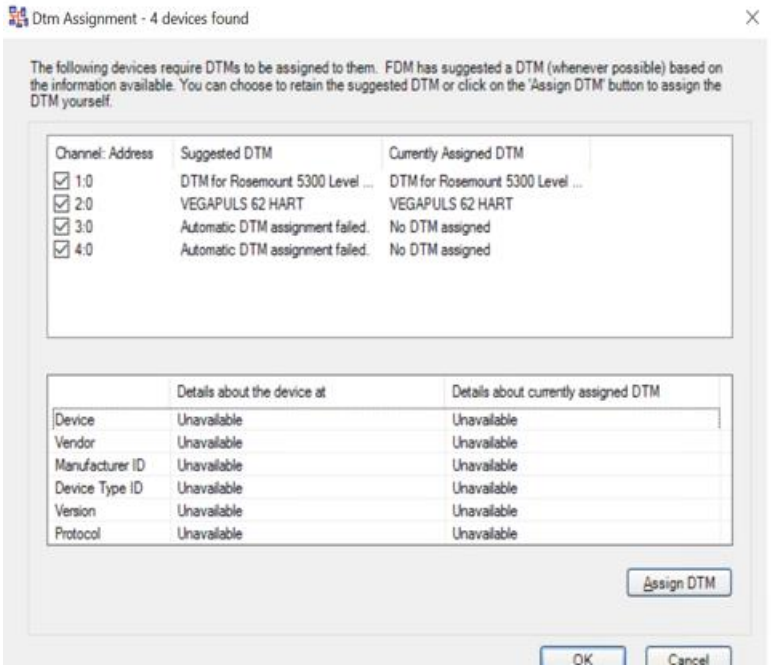
After configuring the communication DTMs and scanning the network, the MLPLC network is available on the FDT Comm Console under MLPLC Communication DTM.

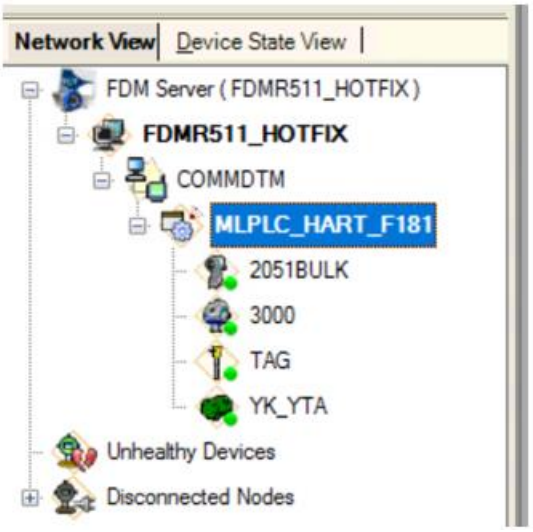




Building FDT Networks-Adding a Device

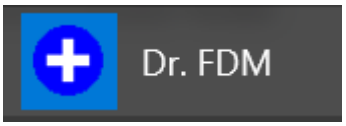
- Click OK in the DTM Assignment dialog box. The detected devices are visible in the FDT Comm Console (Network View > COMM DTM Interface).
- Launch the FDM Client and load the devices with DD/DTM.

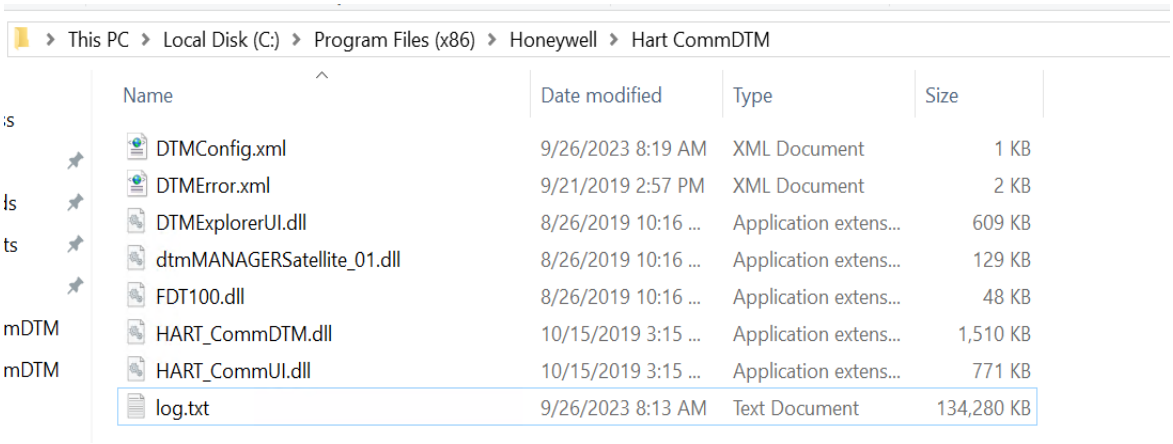




Log Files and Information's requirement

1. For FDM Log files – Collect Dr. FDM Log files
2. For Collecting log files for MLPLC Communication with DTM
   - Go to C:\Program Files (x86)\Honeywell\Hart CommDTM
   - Copy log.txt


Dr. FDM


This PC
Local Disk (C:)
Program Files (x86)
Honeywell
Hart CommDTM
Name
Date modified
Type
Size
DTMConfig.xml 9/26/2023 8:19 AM XML Document 1 KB
DTMError.xml 9/21/2019 2:57 PM XML Document 2 KB
DTMExplorerUI.dll 8/26/2019 10:16 ... Application extens... 609 KB
dtmMANAGERSatellite_01.dll 8/26/2019 10:16 ... Application extens... 129 KB
FDT100.dll 8/26/2019 10:16 ... Application extens... 48 KB
HART_CommDTM.dll 10/15/2019 3:15 ... Application extens... 1,510 KB
HART_CommUI.dll 10/15/2019 3:15 ... Application extens... 771 KB
log.txt 9/26/2023 8:13 AM Text Document 134,280 KB

Appendix1. HART Commands

Command No.	*No.*	*Data type*	*Device (D00000)*	*Description*	*Valid size*
0 (10 Word)	1	WORD	D00000	Manufacturer ID	1 Byte
	2	WORD	D00001	Manufacturer device type code	2 Byte
	3	INT	D00002	Number of preambles required	1 Byte
	4	INT	D00003	Universal Command Revision	1 Byte
	5	INT	D00004	Device Specific Command Revision	1 Byte
	6	INT	D00005	Software Revision	1 Byte
	7	INT	D00006	Hardware Revision(x10)	2 Byte
	8	WORD	D00007	Device Function Flags	1 Byte
	9	DWORD	D00008~9	Device ID number	3 Byte
1 (3 Word)	1	WORD	D00000	Primary Variable units code	1 Byte
	2	REAL	D00001~2	Primary Variable	4 Byte
2 (4 Word)	1	REAL	D00000~1	Primary Variable loop current (mA)	4 Byte
	2	REAL	D00002~3	Primary Variable percent of range	4 Byte
3 (14 Word)	1	REAL	D00000~1	Primary Variable loop current (mA)	4 Byte
	2	WORD	D00002	Primary Variable units code	1 Byte
	3	REAL	D00003~4	Primary Variable	4 Byte
	4	WORD	D00005	Secondary Variable units code	1 Byte
	5	REAL	D00006~7	Secondary Variable	4 Byte
	6	WORD	D00008	Tertiary Variable units code	1 Byte
	7	REAL	D00009~10	Tertiary Variable	4 Byte
	8	WORD	D000011	Quaternary Variable units code	1 Byte
	9	REAL	D000012~13	Quaternary Variable	4 Bytes
12 (18 Word)	1	STRING	D00000~8	Message(1/2)	16 Byte
	2	STRING	D00009~17	Message(2/2)	16 Byte
13 (17 Word)	1	STRING	D00000~4	Tag~ Null	8 Byte
	2	STRING	D00005~13	Descriptor~ Null	16 Byte
	3	INT	D000014	Year	2 Byte
	4	INT	D000015	Month	1 Byte
	5	INT	D000016	Day	1 Byte

Appendix1. HART Commands

Command No.	*No.*	*Data type*	*Device (D00000)*	*Description*	*Valid size*
15 (11 Word)	1	WORD	D00000	Primary Variable alarm select code	1 Byte
	2	WORD	D00001	Primary Variable transfer function code	1 Byte
	3	WORD	D00002	Primary Variable range units code	1 Byte
	4	REAL	D00003~4	Primary Variable upper range value	4 Byte
	6	REAL	D00005~6	Primary Variable lower range value	4 Byte
	8	REAL	D00007~8	Primary Variable damping value(sec)	4 Byte
	10	WORD	D00009	Write-protect code	1 Byte
	11	WORD	D00010	Private-label distributor	1 Byte
16 (2 Word)	1	DWORD	D00000~1	Final assembly number	3 Byte
48 (15 Word)	1	WORD	D00000~2	Device-specific status	6 Byte
	2	WORD	D00003	Extended device-specific status (V6.0)	1 Byte
	3	WORD	D00004	Operational modes (V5.1)	1 Byte
	4	DWORD	D00005~6	Analog outputs saturated (V5.1)	3 Byte
	5	DWORD	D00007~8	Analog outputs fixed (V5.1)	3 Byte
	6	DWORD	D00009~14	Device-specific status2	11 Byte
50 (4 Word)	1	WORD	D00000	Primary Device Variable	1 Byte
	2	WORD	D00001	Secondary Device Variable	1 Byte
	3	WORD	D00002	Tertiary Device Variable	1 Byte
	4	WORD	D00003	Quaternary Device Variable	1 Byte
57 (17 Word)	1	STRING	D00000~4	Unit tag~ Null	8 Byte
	2	STRING	D00005~13	Unit descriptor~ Null	16 Byte
	3	WORD	D000014	Unit year	2 Byte
	4	WORD	D000015	Unit month	1 Byte
	5	WORD	D000016	Unit day	1 Byte
61 (15 Word)	1	WORD	D00000	PV Analog Output units code	1 Byte
	2	REAL	D00001~2	PV Analog Output level	4 Byte
	3	WORD	D00003	Primary Variable units code	1 Byte
	4	REAL	D00004~5	Primary Variable	4 Byte
	5	WORD	D00006	Secondary Variable units code	1 Byte
	6	REAL	D00007~8	Secondary Variable	4 Byte
	7	WORD	D00009	Tertiary Variable units code	1 Byte
	11	REAL	D00010~11	Tertiary Variable	4 Byte
	13	WORD	D00012	Quaternary Variable units code	1 Byte
	14	REAL	D00013~14	Quaternary Variable	4 Byte

Command No.	*No.*	*Data type*	*Device (D00000)*	*Description*	*Valid size*
110 (12 Word)	1	WORD	D00000	Primary Variable units code	1 Byte
	2	REAL	D00001~2	Primary Variable value	4 Byte
	3	WORD	D00003	Secondary Variable units code	1 Byte
	4	REAL	D00004~5	Secondary Variable value	4 Byte
	5	WORD	D00006	Tertiary Variable units code	1 Byte
	6	REAL	D00007~8	Tertiary Variable value	4 Byte
	7	WORD	D00009	Quaternary Variable units code	1 Byte
	8	REAL	D00010~11	Quaternary Variable value	4 Byte

Appendix2. Manufacturer ID

The table below shows codes assigned to manufacturers and those manufacturers.

Decimal	Hex	Manufacturer	Decimal	Hex	Manufacturer
1	01	Acromagey	26	1A	ABB
2	02	Allen-Bradley	27	1B	Leeds & Northup
3	03	Ametek	28	1C	Leslie
4	04	Analog Devices	29	1D	M-System Co.
5	05	ABB	30	1E	Measurex
6	06	Beckman	31	1F	Micro Motion
7	07	Bell Microsenser	32	20	Moore Industries
8	08	Bourns	33	21	PRIME Measurement Products
9	09	Bristol Babcock	34	22	Ohkura Electric
10	0A	Brooks Instrument	35	23	Paine
11	0B	Chessell	36	24	Rochester Instrument Systems
12	0C	Combustion Engineering	37	25	Ronan
13	0D	Daniel Industries	38	26	Rosemount
14	0E	Delta	39	27	Peek Measurement
15	0F	Dieterich Standard	40	28	Actaris Neptune
16	10	Dohrmann	41	29	Sensall
17	11	Endress+Hauser	42	2A	Siemens
18	12	ABB	43	2B	Weed
19	13	Fisher Controls	44	2C	Toshiba
20	14	Foxboro	45	2D	Transmation
21	15	Fuji	46	2E	Rosemount Analytic
22	16	ABB	47	2F	Metso Automation
23	**17**	**Honeywell**	48	30	Flowserve
24	18	ITT Barton	49	31	Varec
25	19	Thermo Measure Tech	50	32	Viatran

Decimal	Hex	Manufacturer	Decimal	Hex	Manufacturer
51	33	Delta/Weed	76	4C	VAF Instruments
52	34	Westinghouse	77	4D	Westlock Controls
53	35	Xomox	78	4E	Drexelbrook
54	36	Yamatake	79	4F	Saab Tank Control
55	37	Yokogawa	80	50	K-TEK
56	38	Nuovo Pignone	81	51	SENSIDYNE, INC
57	39	Promac	82	52	Draeger
58	3A	Exac Corporation	83	53	Raytek
59	3B	Mobrey	84	54	Siemens Milltronics PI
60	3C	Arcom Control System	85	55	BTG
61	3D	Princo	86	56	Magnetrol
62	3E	Smar	87	57	Metso Automation
63	3F	Foxboro Eckardt	88	58	Siemens Milltronics PI
64	40	Measurement Technology	89	59	HELIOS
65	41	Applied System Technologies	90	5A	Anderson Instrument Company
66	42	Samson	91	5B	INOR
67	43	Sparling Instruments	92	5C	ROBERTSHAW
68	44	Fireye	93	5D	PEPPERL+FUCHS
69	45	Krohne	94	5E	ACCUTECH
70	46	Betz	95	5F	Flow Measurement
71	47	Druck	96	60	Courdon-Haenni
72	48	SOR	97	61	Knick
73	49	Elcon Instruments	98	62	VEGA
74	4A	EMCO	99	63	MTS Systems Corp
75	4B	Termiflex Corporation	100	64	Oval

Decimal	Hex	Manufacturer	Decimal	Hex	Manufacturer
101	65	Masoneilan-Dresser	126	7E	Paper Machine Components
102	66	BESTA	127	7F	LABOM
103	67	Ohmart	128	80	Danfoss
104	68	Harold Beck and Sons	129	81	Turbo
105	69	rittmeyer instrumentation	130	82	TOKYO KEISO
106	6A	Rossel Messtechnik	131	83	SMC
107	6B	WIKA	132	84	Status Instruments
108	6C	Bopp & Reuther Heinrichs	133	85	Huakong
109	6D	PR Electronics	134	86	Duon System
110	6E	Jordan Controls	135	87	Vortek Instruments, LLC
111	6F	Valcom s.r.l.	136	88	AG Crosby
112	70	US ELECTRIC MOTORS	137	89	Action Instruments
113	71	Apparatebau Hundsbach	138	8A	Keystone Controls
114	72	Dynisco	139	8B	Thermo Electronic Co
115	73	Spriano	140	8C	ISE Magtech
116	74	Direct Measurement	141	8D	Rueger
117	75	Klay Instruments	142	8E	Mettler Toledo
118	76	CiDRA CORP	143	8F	Det-Tronics
119	77	MMG AM DTR	144	90	Thermo MeasureTech
120	78	Buerkert Fluid Control Systems	145	91	DeZURIK
121	79	AALIANT Process Mgt	146	92	Phase Dynamics
122	7A	PONDUS INSTRUMENTS	147	93	WELLTECH SHANGHAI
123	7B	ZAP S.A. Ostrow Wielkopolski	148	94	ENRAF
124	7C	GLI	149	95	4tech ASA
125	7D	Fisher-Rosemount Performance Technologies	150	96	Brandt Instruments

Decimal	Hex	Manufacturer	Decimal	Hex	Manufacturer
151	97	Nivelco	176	B0	Phoenix Contact
152	98	Camille Bauer	177	B1	Andean Instruments
153	99	Metran	178	B2	American Level Instrument
154	9A	Milton Roy Co.	179	B3	Hawk
155	9B	PMV	180	B4	YTC
156	9C	Turck	181	B5	Pyromation Inc.
157	9D	Panametrics	182	B6	Satron Instruments
158	9E	R. Stahl	183	B7	BIFFI
159	9F	Analytical Technologies Inc.	184	B8	SAIC
160	A0	FINT	185	B9	BD Sensors
161	A1	BERTHOLD	186	BA	Andean Instruments
162	A2	InterCorr	187	BB	Kemotron
163	A3	China BRICONTE Co Ltd	188	BC	APLISENS
164	A4	Electron Machine	189	BD	Badger Meter
165	A5	Sierra Instruments	190	BE	HIMA
166	A6	Fluid Components Intl	191	BF	GP:50
167	A7	Solid AT	192	C0	Kongsberg Maritime
168	A8	Meriam Instrument	193	C1	ASA S.p.A.
169	A9	Invensys	194	C2	Hengesbach
170	AA	S-Products	195	C3	Lanlian Instruments
171	AB	Tyco Valves & Controls	196	C4	Spectrum Controls
172	AC	Micro Matic Instrument A/S	197	C5	Kajaani Process Measurements
173	AD	J-Tec Associates	198	C6	FAFNIR
174	AE	TRACERCO	199	C7	SICK-MAIHAK
175	AF	AGAR	200	C8	JSP Nova Paka

Decimal	Hex	Manufacturer	Decimal	Hex	Manufacturer
201	C9	MESACON	24576	6000	ExSaf
202	CA	Spirax Sarco Italy	24577	6001	SEOJIN INSTECH
203	CB	L&J TECHNOLOGIES	24578	6002	TASI FLOW
204	CC	Tecfluid S.A.	24579	6003	Daihan Control
205	CD	Sailsors Instruments	24580	6004	APM
206	CE	Roost	24581	6005	ORANGE INSTRUMENTS. UK
207	CF	KOSO	24582	6006	BARTEC
208	D0	MJK	24583	6007	Detcon
209	D1	GE Energy	24584	6008	MSA
210	D2	BW Technologies	24585	6009	METROVAL
211	D3	HEINRICHS	24586	600A	Etalon Rus
212	D4	SIC	24587	600B	JOGLER
213	D5	HACH LANGE	24588	600C	KSB
214	D6	Exalon Instruments	24589	600D	Richter CT
215	D7	FAURE HERMAN	24590	600E	NET SAFETY
216	D8	STI S.r.l.	24591	600F	ECanada
217	D9	Manometr-Kharkiv	24592	6010	SUPCON
218	DA	Dalian-Instruments	24593	6011	DKK - TOA
219	DB	Spextrex	24594	6012	Dwyer Instruments
220	DC	SIPAI Instruments	24595	6013	FineTek
221	DD	Advanced Flow	24596	6014	Top Worx Inc.
222	DE	Rexa. Koso America	24597	6015	Hoffer Flow Controls
223	EF	General Monitors, Inc.	24598	6016	Dust Networks
224	E0	Manufacturer Expansion	24599	6017	Forbes Marshall
249	F9	HART Communication Foundation	24600	6018	All Measures, Ltd.

Decimal	Hex	Manufacturer	Decimal	Hex	Manufacturer
24601	6019	MACTek	24612	6024	SkoFlo Industries, Inc.
24602	601A	CSI	24613	6025	StoneL Corporation
24603	601B	TC Fluid Control	24614	6026	EUREKA FLOW
24604	601C	Rohrback Cosasco	24615	6027	BEKA associates
24605	601D	AirSprite	24616	6028	Capstar Automation
24606	601E	Microcyber Inc.	24617	6029	Pulsar
24607	601F	TIG	24618	602A	Elemer
24608	6020	ifm prover Gmbh	24619	602B	Soft Tech Group
24609	6021	FLEXIM	-	-	-
24610	6022	TOKIMEC.INC	-	-	-
24611	6023	SBEM	-	-	-

Appendix3. Engineering Units Code

The table below shows each unit's meaning and abbreviation. These codes are used to show process variables' range.

Decimal	*Hex*	*Description*	*Symbol*	*Decimal*	*Hex*	*Description*	*Symbol*
1	01	Inches of Water (68 °F)	InH^2O 68 °F	26	1A	Cubic Feet per Second	ft^3/sec
2	02	Inches of Mercury (0°C)	InHg 0°C	27	1B	Cubic Feet per Day	ft^3/day
3	03	Feet of Water (68 °F)	FtH^2O 68 °F	28	1C	Cubic Meters per Second	m^3/sec
4	04	Millimeters of Water (68 °F)	mmH^2O 68 °F	29	1D	Cubic Meters per Day	m^3/day
5	05	Millimeters of Mercury (0°C)	mmHg 0°C	30	1E	Imperial Gallons per Hour	ImpGal/hr
6	06	Pounds per Square Inch	PSI	31	1F	Imperial Gallons per Day	ImpGal/day
7	07	Bars	bar	32	20	Degrees Celsius	°C
8	08	Millibars	mbar	33	21	Degrees Fahrenheit	°F
9	09	Grams per Square Centimeter	g/cm^2	34	22	Degrees Rankin	°R
10	0A	Kilograms per Square Centimeter	kg/cm^2	35	23	Degrees Kelvin	°K
11	0B	Pascals	PA	36	24	Millivolts	mV
12	0C	Kilopascals	kPA	37	25	Ohms	Ohm
13	0D	Torr	torr	38	26	Herts	Hz
14	0E	Atmospheres	ATM	39	27	Milliamperes	mA
15	0F	Cubic Feet per Minute	ft^3/min	40	28	Gallons	gal
16	10	Gallons per Minute (US)	gal/min	41	29	Liters	L
17	11	Liters per Minute	L/min	42	2A	Imperial Gallons	ImpGal
18	12	Imperial Gallons per Minute	ImpGal/min	43	2B	Cubic Meters	m^3
19	13	Cubic Meters per Hour	m^3/hr	44	2C	Feet	ft
20	14	Feet per Second	ft/s	45	2D	Meters	m
21	15	Meters per Second	m/s	46	2E	Barrels (1 barrel = 42 US gallons)	bbl
22	16	Gallons per Second (US)	gal/sec	47	2F	Inches	in
23	17	Million Gallons per Day	MilGal/day	48	30	Centimeters	cm
24	18	Liters per Second	L/s	49	31	Millimeters	mm
25	19	Million Liters per Day	MilL/day	50	32	Minutes	min

Appendix3. Engineering Units Code

Decimal	*Hex*	*Description*	*Symbol*	*Decimal*	*Hex*	*Description*	*Symbol*
51	33	Seconds	sec	76	4C	Kilograms per Day	kg/day
52	34	Hours	hr	77	4D	Metric Tons per Minute	MetTon/min
53	35	Days	day	78	4E	Metric Tons per Hour	MetTon/hr
54	36	Centistokes	centi stokes	79	4F	Metric Tons per Day	MetTon/day
55	37	Centipoise	centi poise	80	50	Pounds per Second	lb/s
56	38	Microsiemens	uMho	81	51	Pounds per Minute	lb/min
57	39	Percent	%	82	52	Pounds per Hour	lb/hr
58	3A	Volts	V	83	53	Pounds per Day	lb/day
59	3B	pH	pH	84	54	Short Topns per Minute	ShTon/min
60	3C	Grams	g	85	55	Short Tons per Hour	ShTon/hr
61	3D	Kilograms	kg	86	56	Short Tons per Day	ShTon/day
62	3E	Metric Tons	MetTon	87	57	Long Tons per Hour	LTon/hr
63	3F	Pounds	lb	88	58	Long Tons per Day	LTon/day
64	40	Short Tons	ShTon	89	59	Deka Therm	Dth
65	41	Long Ton	LTon	90	5A	Specific Gravity Units	SGU
66	42	Milli Siemens per Centimeter	mSiemen/cm	91	5B	Grams per Cubic Centimeter	g/cm^3
67	43	Micro Siemens per Centimeter	uSiemen/cm	92	5C	Kilograms per Cubic Meter	kg/m^3
68	44	Newton	N	93	5D	Pounds per Gallon (US)	lb/gal
69	45	Newton Meter	Nm	94	5E	Pounds per Cubic Feet	lb/ft^3
70	46	Grams per Second	g/s	95	5F	Grams per Milliliter	g/mL
71	47	Grams per Minute	g/min	96	60	Kilograms per Liter	kg/L
72	48	Grams per Hour	g/hr	97	61	Grams per Liter	g/L
73	49	Kilograms per Second	kg/s	98	62	Pounds per Cubic inch	lb/In^3
74	4A	Kilograms per Minute	kg/min	99	63	Short Topns per Cubic Yard	$ShTon/Yd^3$
75	4B	Kilograms per Hour	kg/hr	100	64	Degrees Twaddell	°Twad

Decimal	*Hex*	*Description*	*Symbol*	*Decimal*	*Hex*	*Description*	*Symbol*
101	65	Degree Brix	°Brix	126	7E	Foot Pounds Force	ft lb force
102	66	Degrees Baume Heavy	°BaumHv	127	7F	Kilo Watt	kW
103	67	Degrees Baume Light	°BaumLt	128	80	Kilo Watt Hour	kWh
104	68	Degrees API	°API	129	81	Horsepower	HP
105	69	Percent Solids per Weight	%Sol/wt	130	82	Cubic Feet per Hour	ft^3/hr
106	6A	Percent Solids per Volume	%Sol/vol	131	83	Cubic Meters per Minute	m^3/min
107	6B	Degrees Balling	°Ball	132	84	Barrels per Second (1 barrel = 42 US gallons)	bbl/s
108	6C	Proof per Volume	proof/vol	133	85	Barrels per Minute (1 barrel = 42 US gallons)	bbl/min
109	6D	Proof per Mass	proof/mass	134	86	Barrels per Hour (1 barrel = 42 US gallons)	bbl/hr
110	6E	Bushels	bush	135	87	Barrels per Day (1 barrel = 42 US gallons)	bbl/day
111	6F	Cubic Yards	yd^3	136	88	Gallons per Hour (US)	gal/hr
112	70	Cubic Feet	ft^3	137	89	Imperial Gallons per Second	ImpGal/s
113	71	Cubic Inches	in^3	138	8A	Liters per Hour	L/hr
114	72	Inches per Second	in/s	139	8B	Parts per Million	ppm
115	73	Inches per Minute	in/min	140	8C	Mega Calories per Hour	MCal/h
116	74	Feet per Minute	ft/min	141	8D	Mega Joule per Hour	MJ/h
117	75	Degrees per Second	°/s	142	8E	British Thermal Unit per Hour	BTU/h
118	76	Revolutions per Second	rev/s	143	8F	Degrees	°
119	77	Revolutions per Minute	rpm	144	90	Radian	rad
120	78	Meters per Hour	m/hr	145	91	Inches of Water (60 °F)	InH^2O 60°F
121	79	Normal Cubic Meters per Hour "MKS System"	m^3/hr	146	92	Micrograms per Liter	ug/L
122	7A	Normal Liters per Hour "MKS System"	L/hr	147	93	Micrograms per Cubic Meter	ug/m^3
123	7B	Standard Cubic Feet per Minute "US System"	ft^3/min	148	94	Percent Consistency	%consistency
124	7C	Liquid Barrel (= 31.5 US gallons)	bblLiq	149	95	Volume Percent	volume %
125	7D	Ounce	ounce	150	96	Percent Steam Quality	%StmQual

Decimal	*Hex*	*Description*	*Symbol*	*Decimal*	*Hex*	*Description*	*Symbol*
151	97	Feet-Inch-1/16ths	Ftin16	235	EB	gallons per day	usg/d
152	98	Cubic Feet per Pound	ft^3/lb	236	EC	hectoliters	hL
153	99	Picofarads	pF	237	ED	megapascals	MPa
154	9A	Millimeters per Liter	mL/L	238	EE	inches of water at 4 °C (39.2 °F)	inH2O (4 °C or 39.2 °F)
155	9B	Microliters per Liter	microliters/ L	239	EF	millimeters of water at 4 °C (39.2 °F)	mmH2O (4 °C or 39.2 °F)
156	9C	percent plato	% plato				
157	9D	percent lower explosion level	% lower explosion level				
158	9E	mega calorie	Mcal				
159	9F	Kohms	kohm				
160	A0	mega joule	MJ				
161	A1	british thermal unit	BTU				
162	A2	normal cubic meter	normal cubic m				
163	A3	normal liter	normal L				
164	A4	standard cubic feet	normal cubic ft				
165	A5	parts per billion	parts/billion				

Appendix4. Terminology

Terms and abbreviation used in the user's manual and the analog module in general are as described below.

■ A/D converter: converts analog to digital value proportionately to the size of analog input signal.

■ Analog input module: as a module with the circuit to convert analog voltage/current input signal to digital value, it has resolution of 14 and 16 bits according to converters.

■ Channel: related with the terminal of analog I/O module and connected to various voltage/current I/O devices respectively, with applicable data and diagnosis function as well.

■ Conversion time: time necessary for analog input module to sample and convert the analog signal for the processor inside the module to get digital-converted value input. On the other hand, it is time necessary for analog output module to convert the digital value output from the processor inside the module to analog output signal so to transmit to the output channel.

■ D/A converter: related with the output module, it is used to make continuous size of analog voltage and current signal proportionately to the digital value.

■ Full scale: defined as the size of voltage/current where the normal operation is executed.

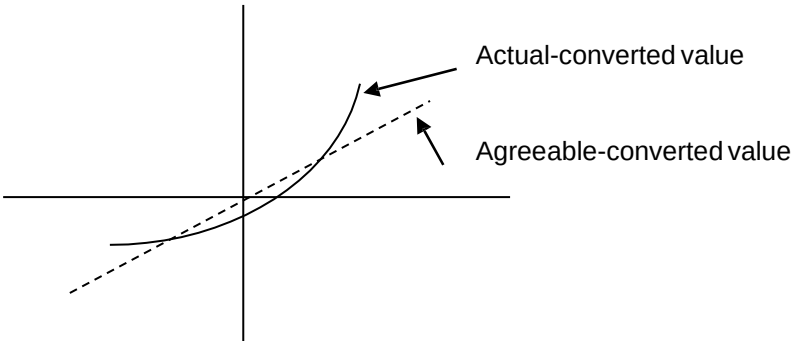
■ Full scale error: displayed with graph difference between agreeable analog-converted value and actual analog-converted value.

■ Full scale range: displayed with difference between the maximum and the minimum of the analog input.

■ LSB (Least Significant Bit): It means the minimum valid bit. Even though it means the lowest-level bit in digital code, in this instruction, it is used as the smallest unit that can be distinguished by A/D converter.

■ Transmitter: A circuit to receive analog signals or data and convert them to forms that can be transmitted via media (transmission).

■ Linearity error: analog I/O is related between continuous voltage/current value and digital value, whose agreeable I/O value is defined as a line within a distance of the min. 1LSB of voltage/current. I/O linearity error is regarded as the declination between the agreeable-converted value and the actual-converted value on the graph.



■ Multiplexer: a switching circuit where many signals share one A/D converter or D/A converter.

■ Analog output module: a module with output circuit to convert analog DC voltage or current signal proportionate to digital value delivered to the module from the processor.

■ Resolution: the min. value recognizable by a measuring instrument, which is usually displayed in the engineering unit (1mv) or the number of bits. In other words, 16383 types of output are available for 14 bits.

■ Filter: used to reduce the change of the digital-converted value output by sudden change of the external noise or input for the analog circuit, through two methods of S/W and H/W filters.

■ Accuracy: displayed with the max. declination between agreeable value and output voltage or current for the whole range of output. On the other hand, it is displayed with the max. declination between agreeable value and digital-converted input signal value for the whole range of input. Generally, percentage will be displayed for the full scale.
Gain, Offset and Linearity error are all included in the error type available.

■ Output accuracy: displayed with the difference between the actual analog output voltage/current value and the agreeable-converted value on the conversion graph for the full scale, with Offset, Gain and Drift error factors included as well as normal temperature (25℃) and available temperature range displayed respectively.

■ HART: HART stands for Highway Addressable Remote Transducer. HART field communication protocol is a standard commonly used in the world and it is also an open communication technology for smart process measurement. HART is a registered trademark of HART Communication Foundation.

■ HART Communication Foundation(HCF): HART Communication Foundation is an independent non-profit organization to support application of HART technology throughout the world. Established in 1993, this organization manages HART protocol as its technical owners. Major measurement manufacturers and users in the world support this foundation. Membership is open to any person who is interested in HART technology.

■ Universal Commands: Commands that allow the user to access essential and useful information for operating general plants such as measuring machine's manufacturer, model, tag, serial number, descriptor, range limit, process variable. All of HART devices need to realize universal commands.

■ Common Practice Commands: Commands to provide access to functions that can be performed on many HART devices. All of HART devices do not provide all of common practice commands.

■ Device specific commands: Command to provide access to functions that can be performed only on specific HART devices.

■ Monodrop: Only one field device is communicated while connected with only one transmission medium. Field device's HART Address is fixed to 0.

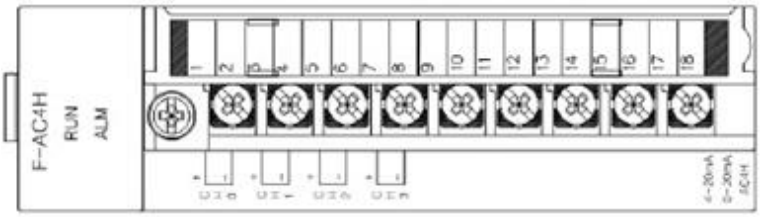
■ Multidrop: More than two field devices are connected with one transmission medium for communication. In the Multidrop mode, up to 15 field devices can be connected with HART master. In this mode, analog signal conversion is not supported. The master designates address between 0 through 15 to distinguish field devices.

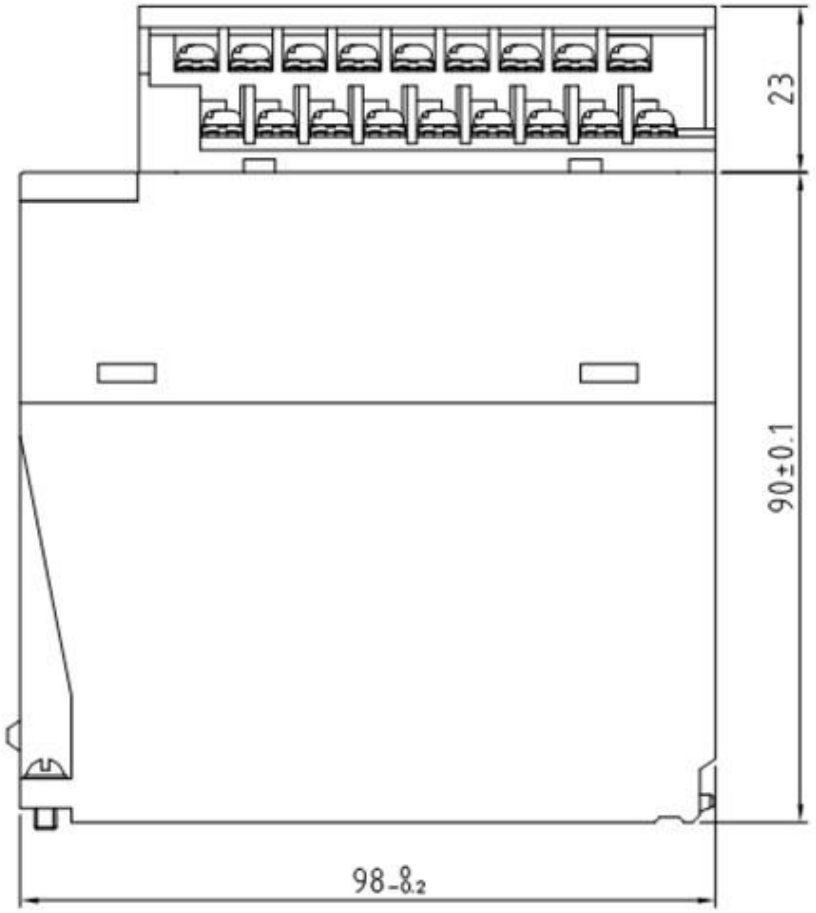
■ Primary Variable: As the first value assigned to HART dynamic variables, it the most basic measuring value.

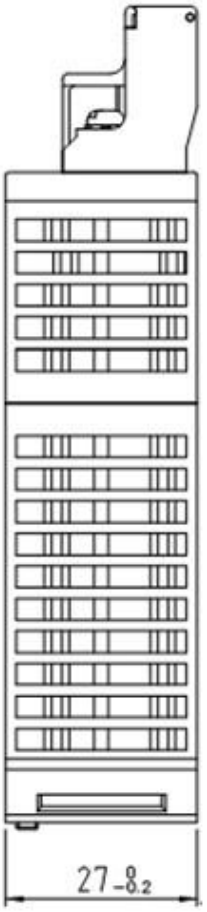
■ Frequency Shift Keying(FSK): A communication method to determine and transmit digital signal 0 and 1 by differentiating carrier wave's frequency.

Appendix5. Dimensions

(1) Dimensions of 2MLF-AC4H (unit:mm)







Honeywell

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