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HART Analog Output Module

2MLF-DC4H User's Guide

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Notices and Trademarks

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About This Document

This user’s guide describes the how to install, configure, and use the 2MLF-DC4H module.

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References

The following table lists the documents that may be sources of reference for material discussed in this publication.

Document Title
ML200 CPU and SoftMaster User’s Guide

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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.

◎ Table of Content ◎

Chapter 1 Introduction

This instruction describes the dimension, handling and programming methods of HART analog output module (2MLF-DC4H) that can be used by combining with 2MLK/I/R PLC Series CPU module. Hereinafter, 2MLF-DC4H is referred to HART analog output module.
This module is used to convert the digital value of signed 16-bit binary data (data: 14 bits) specified in PLC CPU to analog signal (current output) and supports HART (Highway Addressable Remote Transducer) protocol used in many process field devices.

1.1 Characteristics

.

(1) It supports HART protocol
In the output 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 1/16000
Through the digital value resolution of 1/16000, high resolution of analog value can be obtained.

(3) High accuracy
High accuracy of ±0.1% or less (when ambient temperature is 25℃)

(4) Various output ranges available
4~20mA, 0~20mA

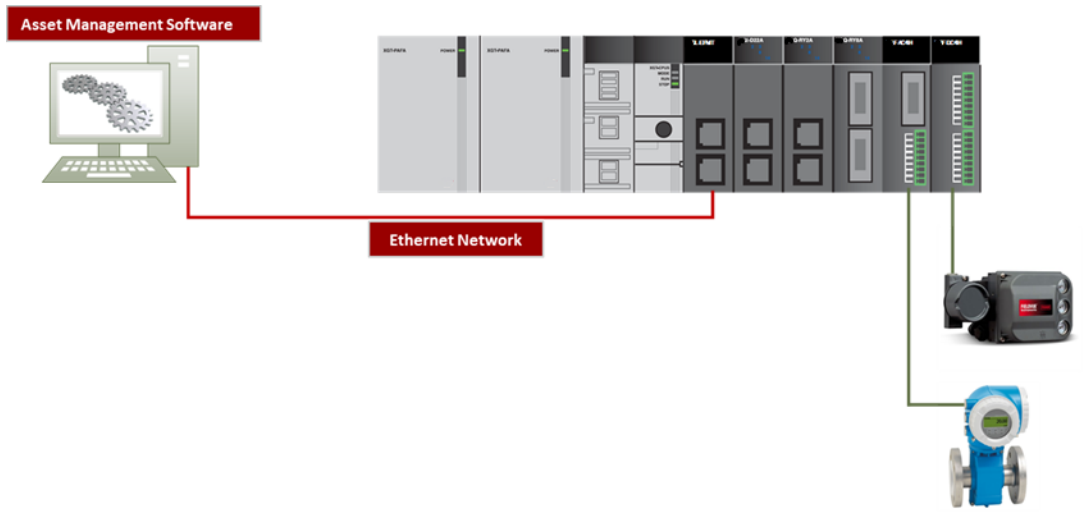
(5) Output limit setting is available.
The range of digital input value can be limited.

(6) Rate control setting is available.
The rate or digital input value can be set.

(7) Various formats of digital input data provided.
4 formats of digital input data are available as specified below.
(a) Unsigned Value: 0 ~ 16000
(b) Signed Value: -8000 ~ 8000
(c) Precise Value: Refer to Chapter 2.2 Display based on analog input range.
(d) Percentile Value: 0 ~ 10000

1.2 Asset Management Software

The HART analog module can be used with Asset Management Software such as a tool like PACTware software of P+F and FDM(Field Device Manager) of Honeywell as shown below.



It's combined the HART AI/AO module which is installed on MasterLogic PLC and conveyed the captured data to upside of Asset Management over COM/DTM, to integrate with FDM for Honeywell.

Chapter 2 Specifications

2.1 General Specifications

General specifications of 2MLK/2MLI/2MLR series are as specified below.

<table>
<tr><th>No.</th><th>Item</th><th colspan="6">Specifications</th><th>Related specifications</th></tr>
<tr><td>1</td><td>Ambient temperature</td><td colspan="6">0 ~ 55 °C</td><td>-</td></tr>
<tr><td>2</td><td>Storage temperature</td><td colspan="6">−25 ~ +70 °C</td><td>-</td></tr>
<tr><td>3</td><td>Ambient 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 resistance</td><td colspan="4">Occasional vibration</td><td>-</td><td>-</td></tr>
<tr><td>Frequency</td><td colspan="2">Acceleration</td><td>Amplitude</td><td>How many times</td><td rowspan="8">IEC61131-2</td></tr>
<tr><td>5 ≤ f < 8.4Hz</td><td colspan="2">-</td><td>3.5mm</td><td rowspan="5">10 times each directions (X, Y and Z)</td></tr>
<tr><td>8.4 ≤ f ≤ 150Hz</td><td colspan="2">9.8 ㎨ (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 < 8.4Hz</td><td colspan="2">-</td><td>1.75mm</td></tr>
<tr><td>8.4 ≤ f ≤ 150Hz</td><td colspan="2">4.9 ㎨ (0.5G)</td><td>-</td></tr>
<tr><td>6</td><td>Shock resistance</td><td colspan="6">• Peak acceleration: 147 m/s^2(15G)
• Duration: 11ms
• Half-sine, 3 times each direction per each axis</td><td>IEC61131-2</td></tr>
<tr><td rowspan="4">7</td><td rowspan="4">Noise resistance</td><td>Square wave Impulse noise</td><td colspan="5">AC: ± 1,500V
DC: ± 900V</td><td></td></tr>
<tr><td>Electrostatic discharge</td><td colspan="5">Voltage : 4kV (contact discharging)</td><td>IEC 61131-2, IEC 61000-4-2</td></tr>
<tr><td>Radiated electromagnetic field noise</td><td colspan="5">80 ~ 1,000 MHz, 10V/m</td><td>IEC 61131-2, IEC 61000-4-3</td></tr>
<tr><td rowspan="2">Fast transient /bust noise</td><td>Segment</td><td>Power supply module</td><td colspan="3">Digital/analog input/output communication interface</td><td rowspan="2">IEC 61131-2, IEC 61000-4-4</td></tr>
<tr><td>Voltage</td><td>2kV</td><td colspan="3">1kV</td></tr>
<tr><td>8</td><td>Environment</td><td colspan="6">Free from corrosive gasses and excessive dust</td><td>-</td></tr>
<tr><td>9</td><td>Altitude</td><td colspan="6">Up to 2,000 ms</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 output module are as specified in table below.

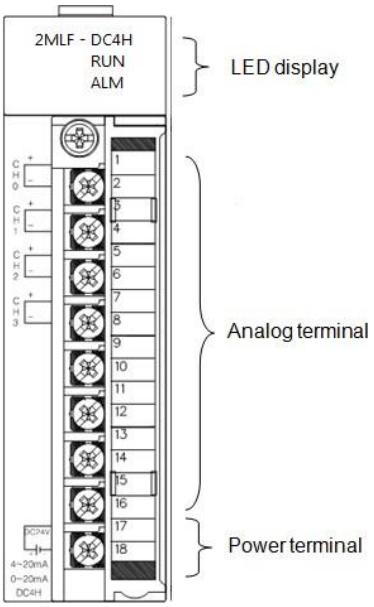
<table>
<tr><th>Item</th><th>Specification</th></tr>
<tr><td rowspan="2">Analog output</td><td>DC 4 ~ 20 mA
DC 0 ~ 20 mA
(Load resistance: 600Ω or less)</td></tr>
<tr><td>► Analog output range can be selected through user program or [I/O parameter].
► Respective output ranges can be set based on channels.</td></tr>
<tr><td>Digital input</td><td>
<table>
<tr><th>Analog output / Digital input</th><th>4 ~ 20mA</th><th>0 ~ 20mA</th></tr>
<tr><td>Unsigned Value</td><td colspan="2">0 ~ 16000</td></tr>
<tr><td>Signed Value</td><td colspan="2">-8000 ~ 8000</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 input data can be set through user program or [I/O Parameter setting] respectively based on channels.
</td></tr>
<tr><td rowspan="3">Maximum resolution</td><td colspan="2">1/16000 (for respective output ranges)</td></tr>
<tr><td>4~20 ㎃</td><td>1.0 ㎂</td></tr>
<tr><td>0~20 ㎃</td><td>1.25 ㎂</td></tr>
<tr><td rowspan="2">Accuracy</td><td colspan="2">±0.1% or less (when ambient temperature is 25℃)</td></tr>
<tr><td colspan="2">±0.3% or less (when ambient temperature is 0℃ ~ 55℃)</td></tr>
<tr><td>Maximum conversion speed</td><td colspan="2">100 ㎳/4 channels</td></tr>
<tr><td>Absolute maximum output</td><td colspan="2">DC 24 ㎃</td></tr>
<tr><td>Number of output channels</td><td colspan="2">4 channels/1 module</td></tr>
<tr><td>Isolation method</td><td colspan="2">Photo-coupler isolation between input terminal and PLC power
(no isolation between channels)</td></tr>
<tr><td>Terminal connected</td><td colspan="2">18-point terminal</td></tr>
<tr><td>I/O points occupied</td><td colspan="2">Fixed type: 64 points, Non fixed type: 16 points</td></tr>
<tr><td>HART communication method</td><td colspan="2">Monopoly only
Primary master only</td></tr>
<tr><td rowspan="2">Current consumption</td><td>Internal</td><td>DC5V : 200 ㎃</td></tr>
<tr><td>External</td><td>DC24V : 220 ㎃</td></tr>
<tr><td>Weight (g)</td><td colspan="2">150g</td></tr>
</table>

Notes

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

2.3 Respective Designations and Functions

Respective designations of the parts are as described below.



No.	Description
LED Display	RUN LED Displays the operation status of 2MLF-DC4H module • On: Operation normal • Flickering: Error occurs (Refer to 7.1 for more details) • Off: DC 5V disconnected, 2MLF-DC4H module error
	ALM LED Displays the warning status of 2MLF-DC4H module • Flickering: Error occurs (Control of change rate, limitation of output setting) • Off: Operation normal
Analog Terminal	Analog Terminal Analog terminal, whose respective channels can be connected with external devices
Power Terminal	Power Terminal Supply terminal of external power DC24V (No.17~18)

2.4 Basic Characteristics of HART Analog Module

2.4.1 Summary

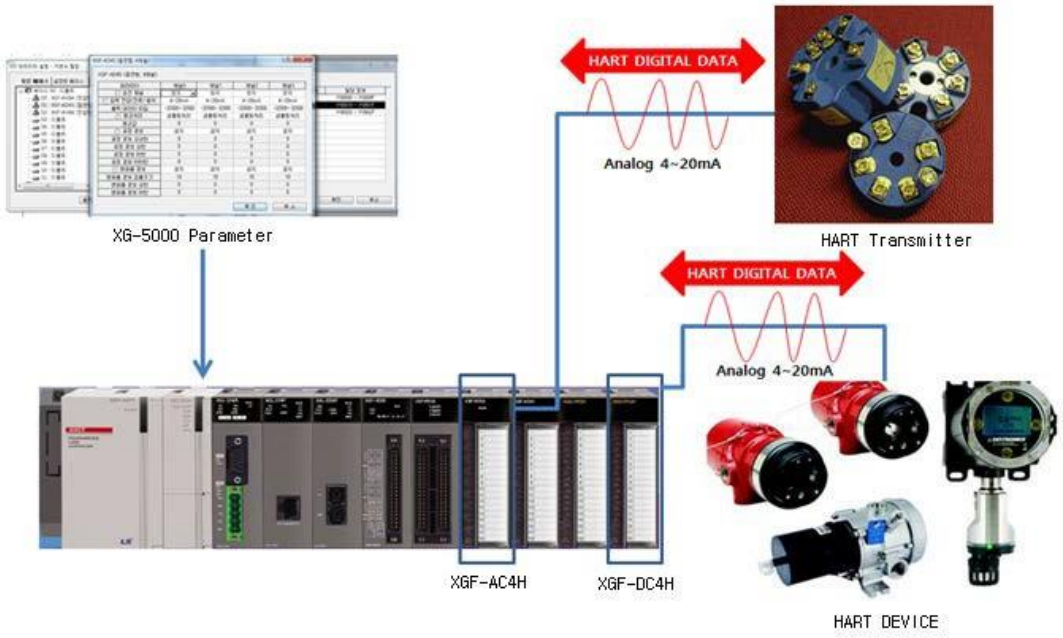
HART analog output module is a product that can use HART communication along with analog conversion. HART analog output module supports interface for communication by being connected with HART field device. Communication data provided by HART field device can be monitored via HART analog output module 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 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 output 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).

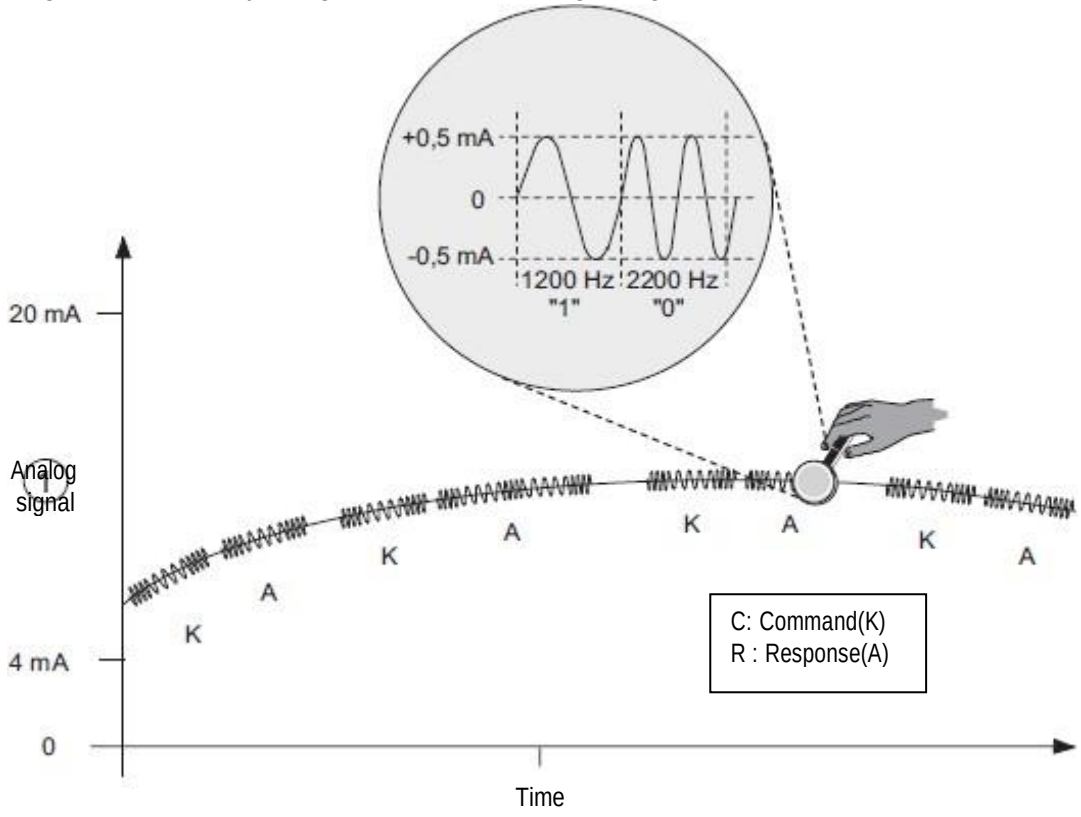
Notes

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

2.4.2 HART 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 output module transmits HART commands to HART field device and HART field device transmits responses to the commands to HART analog output 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 output module

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

[Table 2.4] Commands supported on HART analog input module

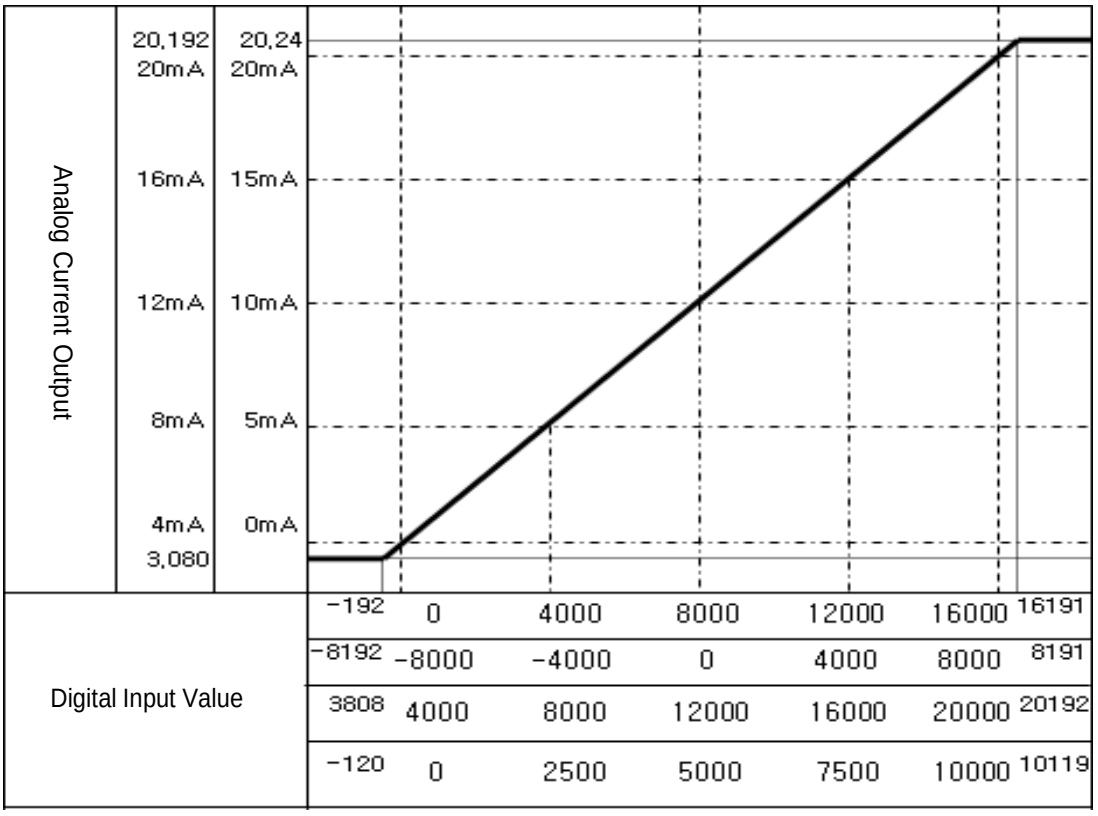
Command		Function
Universal Command	0	Read Manufacturer ID and Manufacturer device code
	1	Read Primary variable(PV) value and Unit
	2	Read percentage of current and range
	3	Read current and 4 kinds of variable values (Primary Variable, Secondary Variable, Tertiary Value, Quaternary Value)
	12	Read 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 I/O Conversion

Characteristics of I/O conversion are displayed in a straight line with the inclination as shown below when converting digital signal specified in PLC to analog signal (current).
Input formats of digital data are classified into Unsigned Value, Signed Value, Precise Value and Percentile Value, and I/O conversion characteristics for respective digital input ranges are as described below.

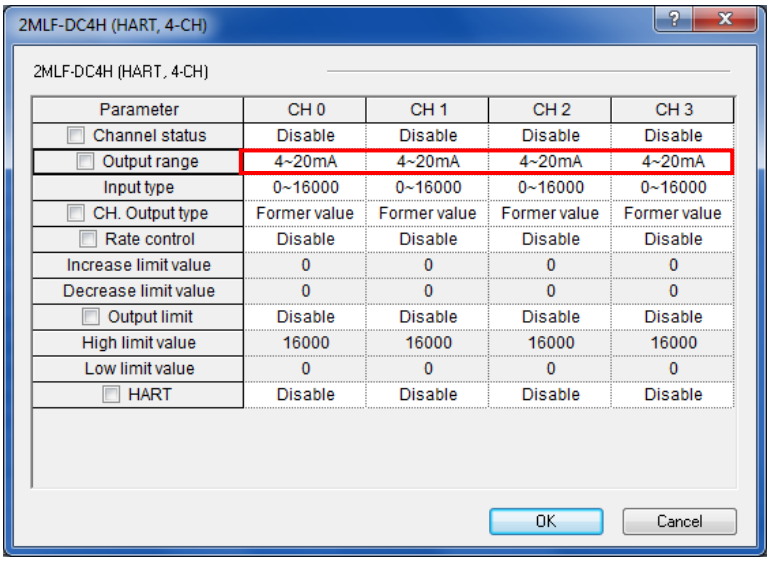
2.5.1 Characteristic of current output

Current output range can be selected through user program or special module parameters setting for respective channels.



(1) If the range is 4~20㎃

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

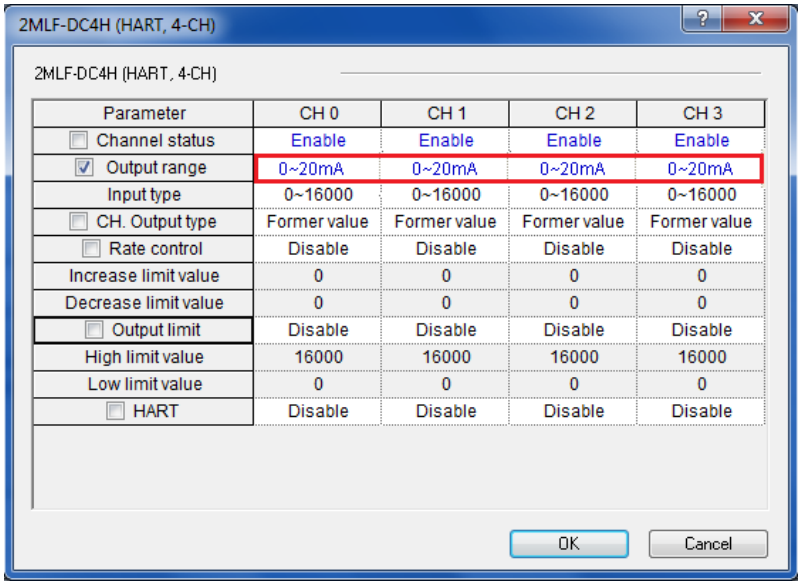


Digital Input	Analog Current Output							Maximum Resolution
	3.808	4	8	12	16	20	20.192	
Unsigned value	-192	0	4000	8000	12000	16000	16191	1.0 ㎂
Signed value	-8192	-8000	-4000	0	4000	8000	8191	
Precise value	3808	4000	8000	12000	16000	20000	20192	
Percentile value	-120	0	2500	5000	7500	10000	10119	1.6 ㎂

※ In the case of 4~20 ㎃ current output, analog current output for digital value of “1” is equivalent to 1.0 ㎂.

(2) If the range is 0~20㎃

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

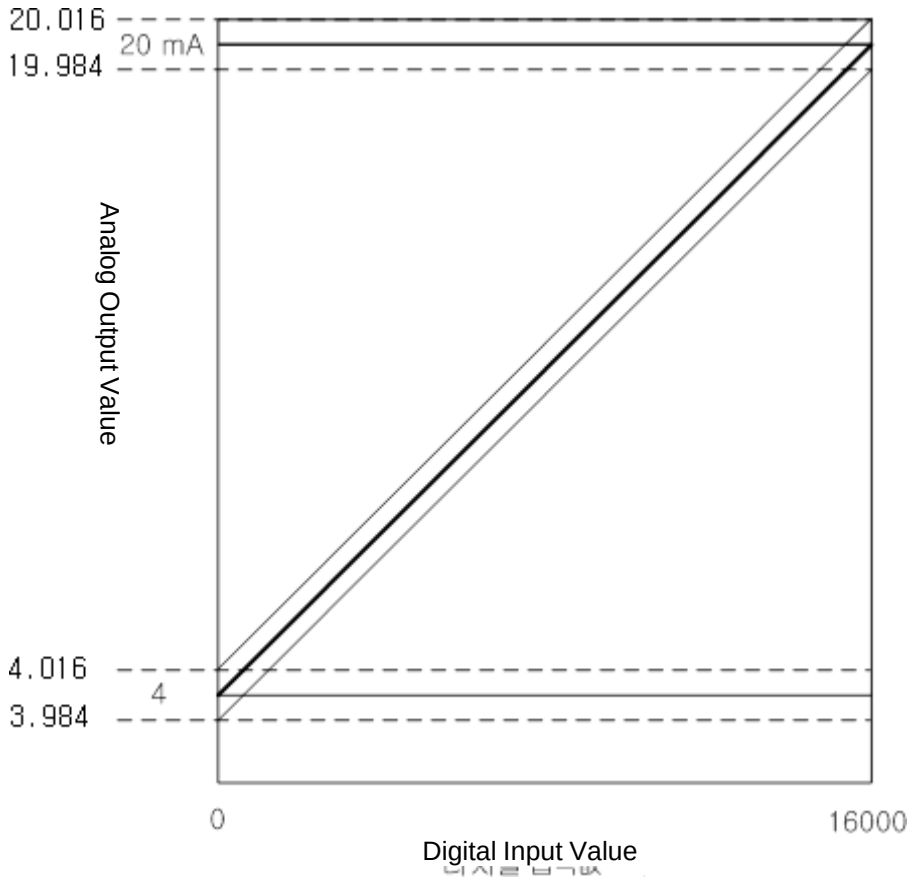


Digital Input	Analog Current Output							Maximum Resolution
	-	0	5	10	15	20	20.24	
Unsigned value	0	0	4000	8000	12000	16000	16191	1.25 ㎂
Signed value	0	-8000	-4000	0	4000	8000	8191	
Precise value	0	0	5000	10000	15000	20000	20192	1.0 ㎂
Percentile value	0	0	2500	5000	7500	10000	10119	2.0 ㎂

※ In the case of 0~20 ㎃ current output, analog current output for digital value of "1" is equivalent to 1.25 ㎂.

2.5.2 Accuracy

Although the output range is changed, the accuracy for the analog output value does not change. Fig. 2.1 shows the accuracy change range at the ambient temperature of 25 ± 5 ℃. The analog output range is set between 4 to 20 mA and an unsigned integer is selected for the input type. (±0.1% at 25 ± 5 ℃, ±0.3% at 0 ~ 55 ℃)



[Fig 2.1] Accuracy

2.6 Functions of Analog Output Module

2.6.1 Output status setting

In case of CPU module's stop or abnormal status, set analog output status.

(1) Function description

If any error occurs on the module's Initialize or PLC system, this function is used to output HART analog output module's output current with the designated value.

(2) Setting kind

Each channel's output status can be set one among Previous Value, Minimum, Median and Maximum.

(a) Previous Value: Retain the last output that runs normally.
(b) Minimum: Minimum value output for each output range
(c) Median: Median output for each output range
(d) Maximum: Maximum output for each output range

(3) Setting example

If any error occurs on the system when output range is set to 4 ~ 20 ㎃ and analog output value of 10 ㎃ is outputted, analog output status will work as following:

(a) Previous Value: Retain 10 ㎃ output-the previous output
(b) Minimum: 4 ㎃ output-the minimum value of the relevant range
(c) Median: 12 ㎃ output-the median of the relevant range
(d) Maximum: 20 ㎃ output-the maximum value of the relevant range

(4) Analog output value of each operation mode

(a) Normal Mode

CPU status	Output Status	Channel		Remarks
		Run	Stop	
RUN	Enabled	Digital Input Value	0V or 0 ㎃	0 : previous value kept 1 : minimum value output 2 : middle value output 3 : maximum value output
	Disabled	As specified Setting output type	0V or 0 ㎃	
STOP	Enabled	As specified Setting output type	0V or 0 ㎃	
	Disabled	As specified Setting output type	0V or 0 ㎃	

(b) Test Mode

CPU status	Output Status	Channel		Remarks
		Run	Stop	
STOP	Enabled	Digital Input Value	0V or 0 ㎃	0 : previous value kept 1 : minimum output 2 : middle output 3 : maximum output
	Disabled	As specified Setting output type	0V or 0 ㎃	

※ Test Mode is available only when CPU is in STOP status.

(c) If any isolated DA module error occurs

CPU status	Output Status	Channel		Remarks
		Run	Stop	
RUN	Enabled	Note1)	0V or 0 ㎃	0 : previous value kept 1 : minimum output 2 : middle output 3 : maximum output
	Disabled	As specified Setting output type	0V or 0 ㎃	
STOP	Enabled	As specified Setting output type	0V or 0 ㎃	
	Disabled	As specified Setting output type	0V or 0 ㎃	
When Power is on /H/W error		0V or 0 ㎃		

Note1) Output value setting error: upper limit or lower limit, Parameter setting error: as specified CH output type

(d) If any CPU error occurs

CPU status	Output Status	Channel		Remarks
		Run	Stop	
ERROR	Enabled	0V or 0 ㎃		
	Disabled			

2.6.2 Output limit setting

Output limit function limits the High/Low output limit for digital input value which is defined by user. When the Output limit function is set, if the setting value of High limit value is more than digital input value which is defined by user, analog output value is High limit value. And, if the digital input value which is defined by user is smaller than Low limit value, analog output value is Low limit value.

(1) Output limit: Disable/Enable
(2) High limit value: -192~16191 (Actual range is from Low limit value to 16191.)
(3) Low limit value: -192~16191 (Actual range is from -192 to Low limit value.)
(4) I/O parameter setting is as shown below.

(a) Set the Output limit to Enable.

Parameter	CH 0	CH 1	CH 2	CH 3
Channel status	Disable	Disable	Disable	Disable
Output range	4~20mA	4~20mA	4~20mA	4~20mA
Input type	0~16000	0~16000	0~16000	0~16000
CH. Output type	Former value	Former value	Former value	Former value
Rate control	Disable	Disable	Disable	Disable
Increase limit value	0	0	0	0
Decrease limit value	0	0	0	0
Output limit	Disable	Disable	Disable	Disable
High limit value	Disable	16000	16000	16000
Low limit value	Enable	0	0	0
HART	Disable	Disable	Disable	Disable

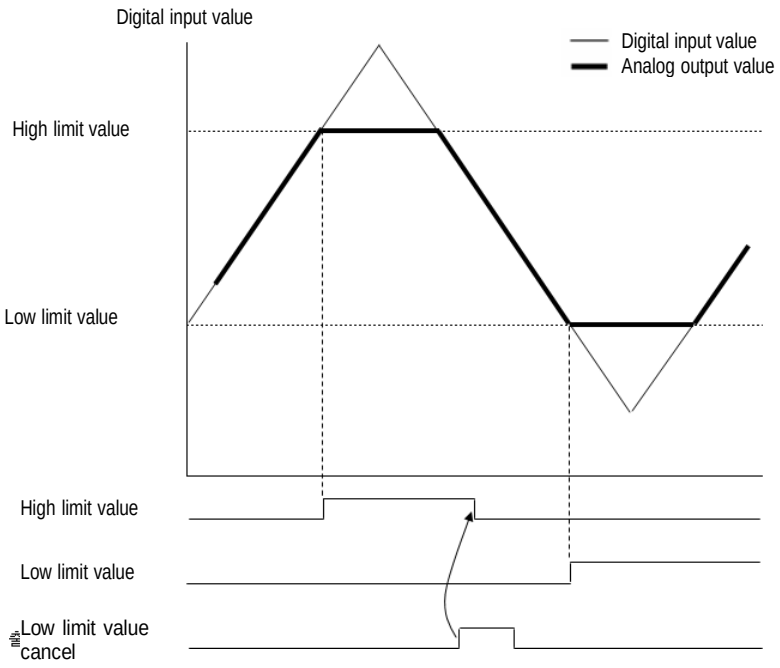
(b) Set the High limit value.

Parameter	CH 0	CH 1	CH 2	CH 3
Channel status	Disable	Disable	Disable	Disable
Output range	4~20mA	4~20mA	4~20mA	4~20mA
Input type	0~16000	0~16000	0~16000	0~16000
CH. Output type	Former value	Former value	Former value	Former value
Rate control	Disable	Disable	Disable	Disable
Increase limit value	0	0	0	0
Decrease limit value	0	0	0	0
Output limit	Enable	Disable	Disable	Disable
High limit value	14000	16000	16000	16000
Low limit value	0	0	0	0
HART	Disable	Disable	Disable	Disable

(c) Set the Low limit value.

Parameter	CH 0	CH 1	CH 2	CH 3
Channel status	Disable	Disable	Disable	Disable
Output range	4~20mA	4~20mA	4~20mA	4~20mA
Input type	0~16000	0~16000	0~16000	0~16000
CH. Output type	Former value	Former value	Former value	Former value
Rate control	Disable	Disable	Disable	Disable
Increase limit value	0	0	0	0
Decrease limit value	0	0	0	0
Output limit	Enable	Disable	Disable	Disable
High limit value	14000	16000	16000	16000
Low limit value	200	0	0	0
HART	Disable	Disable	Disable	Disable

(d) Analog output value is as shown below when set the Output limit.



2.6.3 Rate control setting

Rate control specifies the increase/decrease rate of analog output value for digital input value which is defined by user.

(1) Rate control: Disable/Enable
(2) Increase limit value: 0~16000
(3) Decrease limit value: 0~16000
(4) I/O parameter setting is as shown below.

(a) Set the Rate control setting to Enable.

Parameter	CH 0	CH 1	CH 2	CH 3
Channel status	Disable	Disable	Disable	Disable
Output range	4~20mA	4~20mA	4~20mA	4~20mA
Input type	0~16000	0~16000	0~16000	0~16000
CH. Output type	Former value	Former value	Former value	Former value
Rate control	Disable	Disable	Disable	Disable
Increase limit value	Disable / Enable	0	0	0
Decrease limit value	Enable	0	0	0
Output limit	Disable	Disable	Disable	Disable
High limit value	16000	16000	16000	16000
Low limit value	0	0	0	0
HART	Disable	Disable	Disable	Disable

(b) Set the Increase limit value.

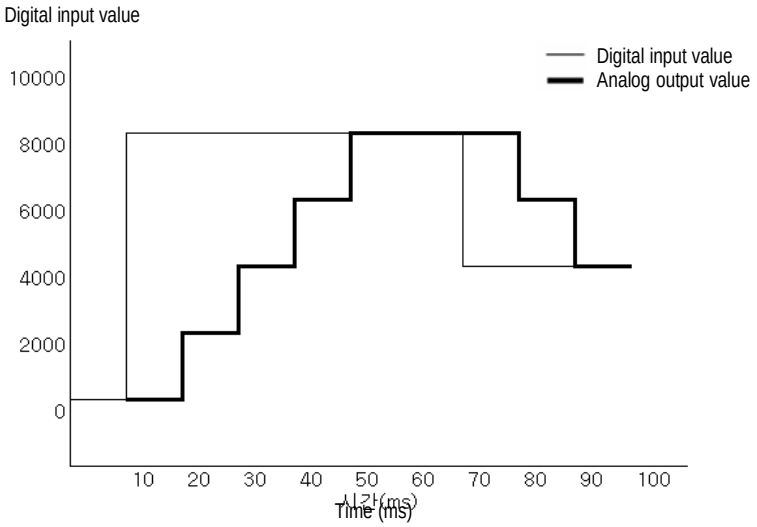
Parameter	CH 0	CH 1	CH 2	CH 3
Channel status	Disable	Disable	Disable	Disable
Output range	4~20mA	4~20mA	4~20mA	4~20mA
Input type	0~16000	0~16000	0~16000	0~16000
CH. Output type	Former value	Former value	Former value	Former value
Rate control	Enable	Disable	Disable	Disable
Increase limit value	2000	0	0	0
Decrease limit value	0	0	0	0
Output limit	Disable	Disable	Disable	Disable
High limit value	16000	16000	16000	16000
Low limit value	0	0	0	0
HART	Disable	Disable	Disable	Disable

(c) Set the Decrease limit value.

Parameter	CH 0	CH 1	CH 2	CH 3
Channel status	Disable	Disable	Disable	Disable
Output range	4~20mA	4~20mA	4~20mA	4~20mA
Input type	0~16000	0~16000	0~16000	0~16000
CH. Output type	Former value	Former value	Former value	Former value
Rate control	Enable	Disable	Disable	Disable
Increase limit value	2000	0	0	0
Decrease limit value	2000	0	0	0
Output limit	Disable	Disable	Disable	Disable
High limit value	16000	16000	16000	16000
Low limit value	0	0	0	0
HART	Disable	Disable	Disable	Disable

(d) Analog output value is as shown below when set the rate control

Ex.) Increase limit value: 2000
Decrease limit value: 2000



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 those 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 the direct sunlight.
- No dew shall be caused by rapid temperature change.
- Ambient temperature shall be kept 0-55℃.

(2) Installation
- No wiring waste is allowed inside PLC when wiring or drilling screw holes.
- To be installed on a good location to work on.
- Don't let it installed on the same panel as a high-voltage device is on.
- Let it 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-DC4H module are as described below from the opening to the installation.

(1) Don't let it dropped or shocked hard.
(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 output module can use when installed in extended base in 2MLR systems.

3.2 Wiring

3.2.1 Precautions for wiring

(1) Use a cable for external output sign of 2MLF-DC4H module separate from the alternating current soto be free from surge or inductive noise produced from the alternating current side.

(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㎟).

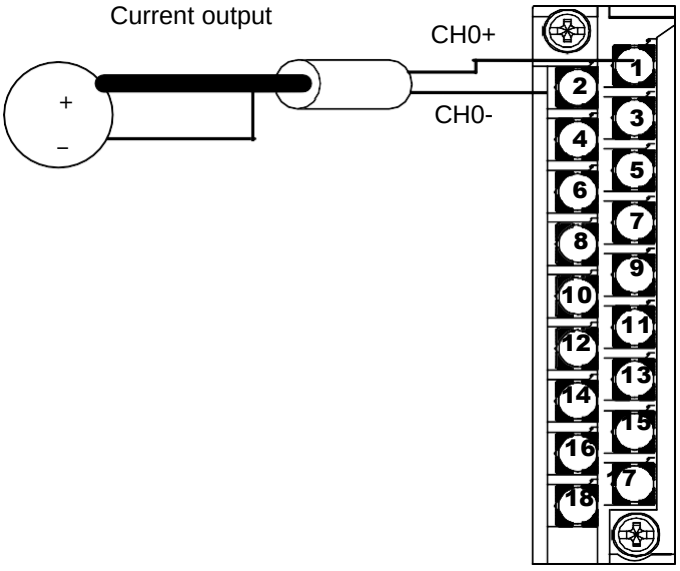
(3) Don't let the cable too close to hot device and material or in direct contact with oil for long, which will cause damage or abnormal operation due to short-circuit.

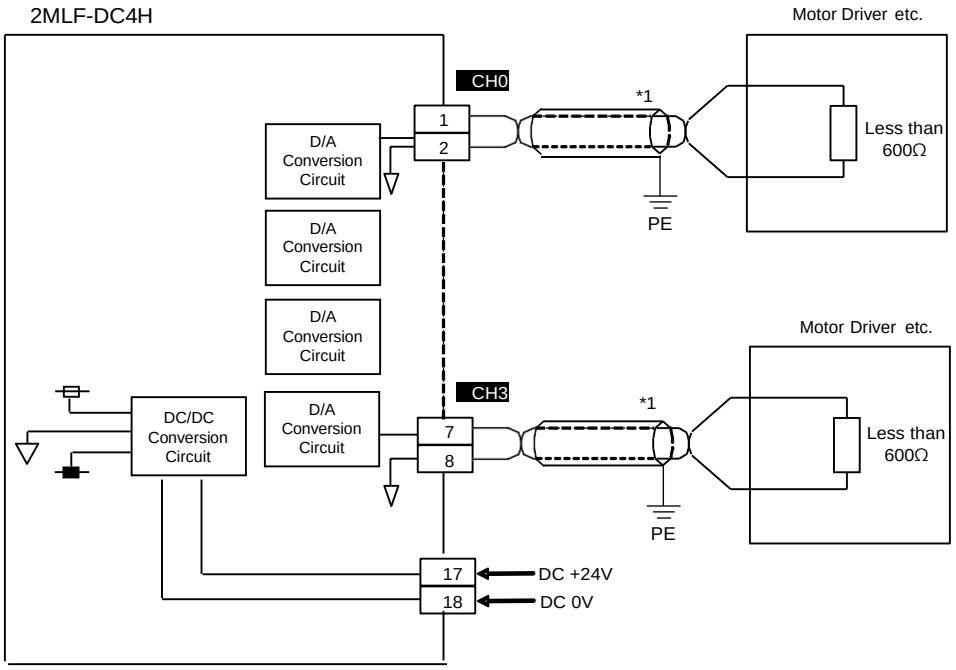
(4) Check the polarity before external power is supplied to the terminal.

(5) Wiring with high-voltage line or power line may produce inductive hindrance causing abnormal operation or defect.

3.2.2 Wiring examples

Channel	Polarity	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 : Use a 2-core twisted shielded wire.

TIP

- In current output, there is no accuracy tolerance caused by cable lengthand internal resistance of the source.
- Set to enable the channel only to be using.

3.2.3 Maximum communication distance

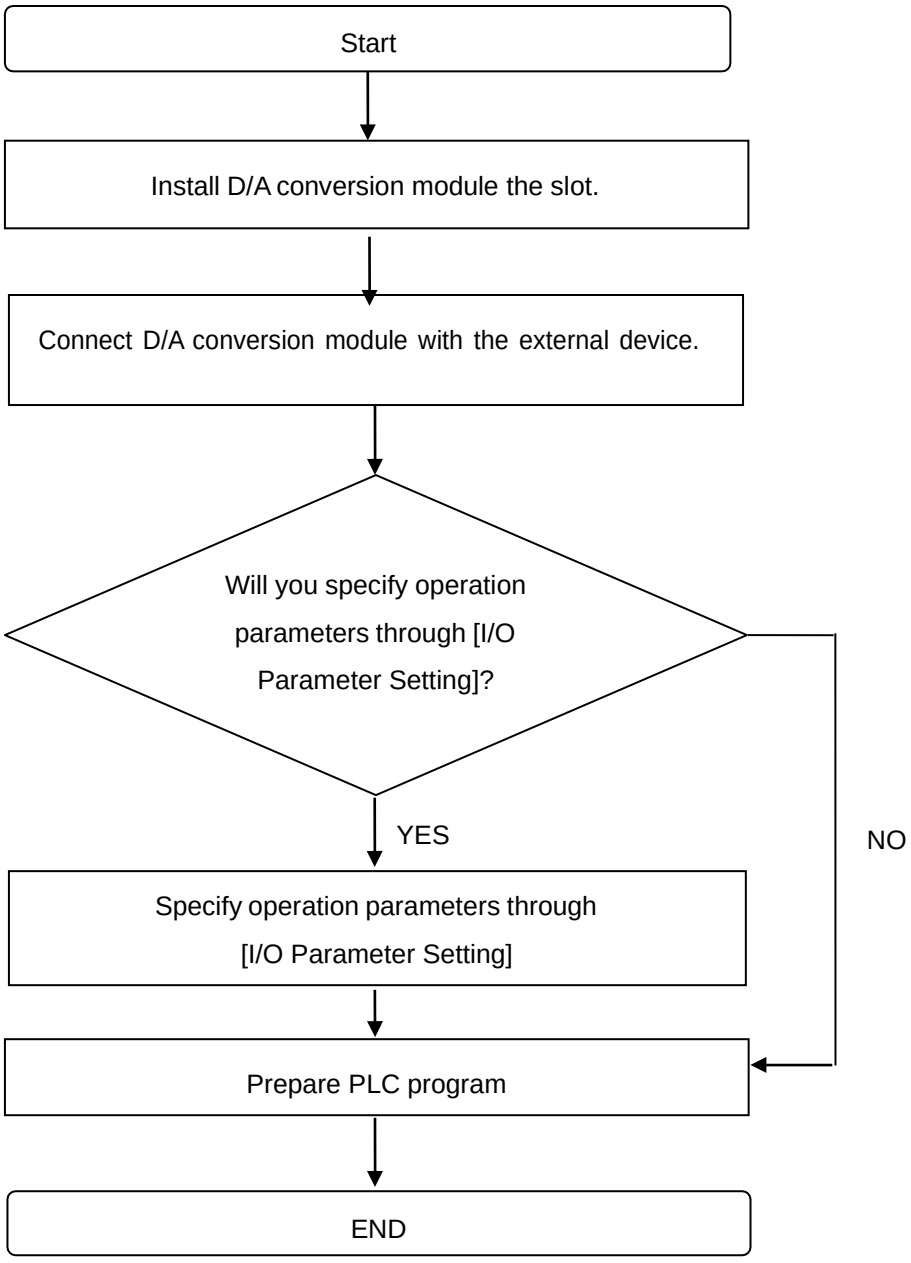
(1) HART communication is available up to 1㎞. But, if a transmitter presents the max communication distance, apply the shorter distance among the transmitter's communication distance and 1㎞.
(2) The max communication distance may vary according to the cable capacitance and resistance. To ensure the max 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 Operation Parameter Setting

4.2.1 Setting items

Module's operation parameters can be specified through SoftMaster's [I/O parameters].

Analog Output module is used to execute parameters setting and monitoring/test functionof the applicable module through SoftMaster menu or tool bar, or read/write the data of internal memory by means of the scan program.

Setting I/O parameters

Step	Action
1	Run SoftMaster to create a project. (Refer to *ML200 CPU and SoftMasterUser's Guide*, for details on creating the project).
2	In the Project Window, double-click **I/O Parameters**.
3	On the **I/O Parameters Setting** screen, click the slot number on which thebase module is installed.
4	Click the arrow button on the screen above to display the screen where anapplicable module can be selected.
5	Search for the applicable module to select. The I/O Parameter Setting – Variable allocation dialog box appears whereyou can specify the parameters for the respective channels.
6	Click the required item to view the parameters to be set for the respectiveitems.
7	Double-click the applicable slot selected for parameters setting or click[Details].
8	Specify the individual parameters as follows: a) Channel status: Select Disable or Enable. b) **Analog output range**: Select the range of analog output voltage asdesired. 2MLF-DC4H module provides 2 current output ranges. c) **Input data type**: Select the format of input data. 4 formats are availablein total. d) **Setting output type**: Select the type of output status. 4 ranges areavailable in total. e) **Rate control**: Select Disable or Enable. f) **Increase/Decrease limit value**: The setting range is from 0 to 16000.
	g) **Output limit setting**: Select Disable or Enable. h) **High/Low limit value**: The setting range is from -192 to 16191. i) **HART**: Select Enable or Disable.
9	Specify parameters as necessary. After setting, click [OK].

.

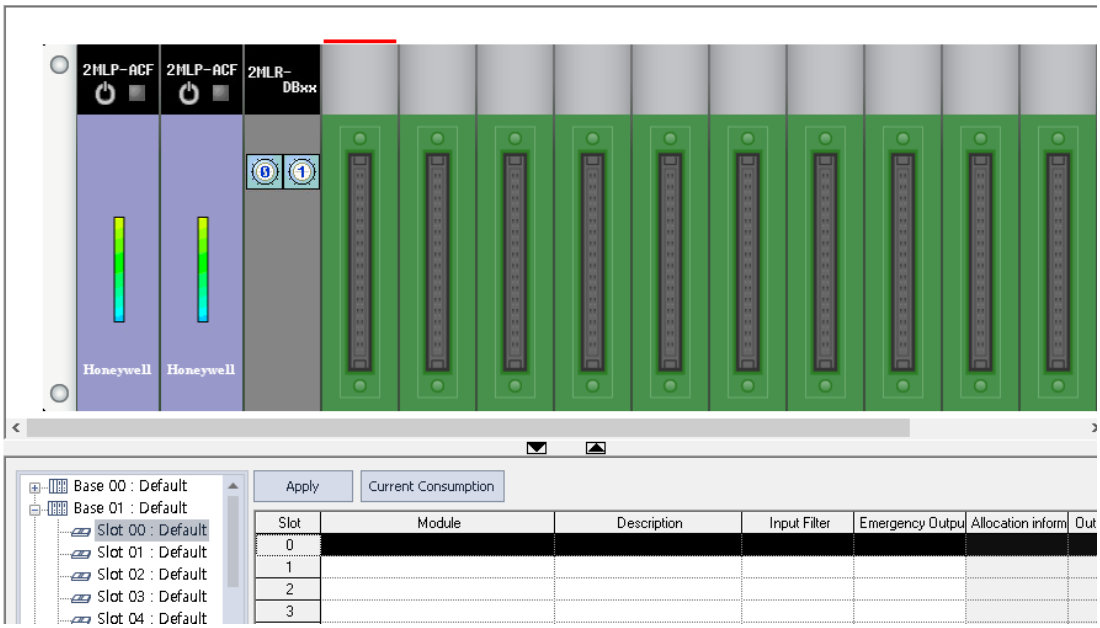
4.2.2 How to use [I/O parameters]

How to use [I/O parameters] will be described below.

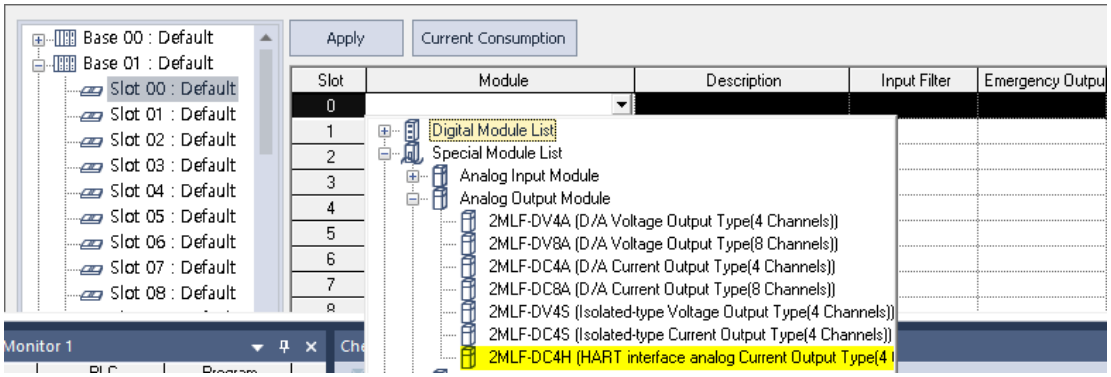
(1) Run SoftMaster to create a project. (Refer to SoftMaster program manual for details on how to create the project)

(2) Double-click [I/O parameters] on the project window.

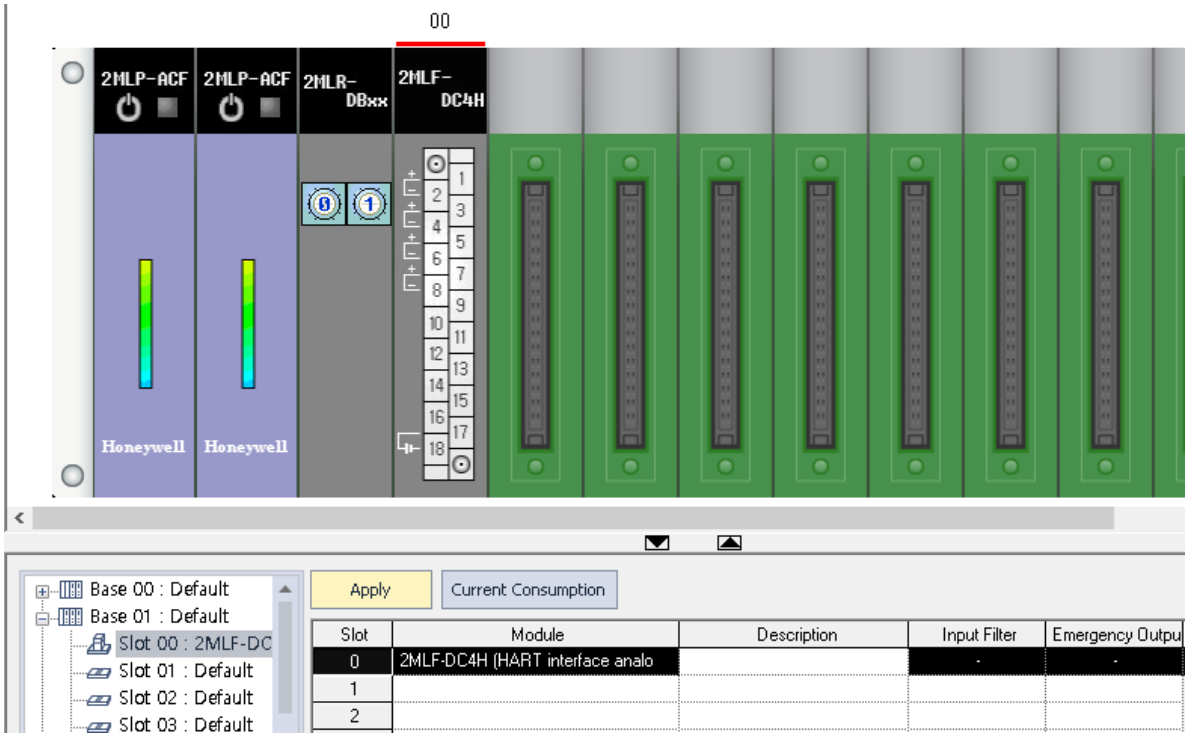
(3) On the 'I/O Parameter Setting' screen, find and click the slot of the base module is installed on.



(4) Click the arrow button on the screen above to display the screen where an applicable module can be selected. Search for the applicable module to select.



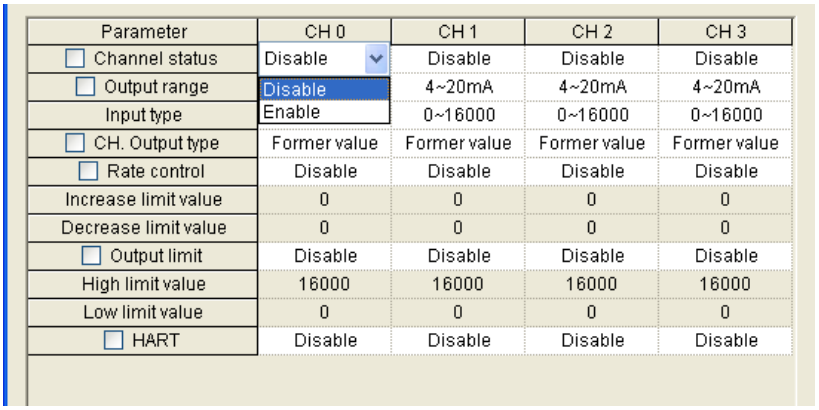
(5) A screen will be displayed for you to specify parameters for respective channels as shown below.



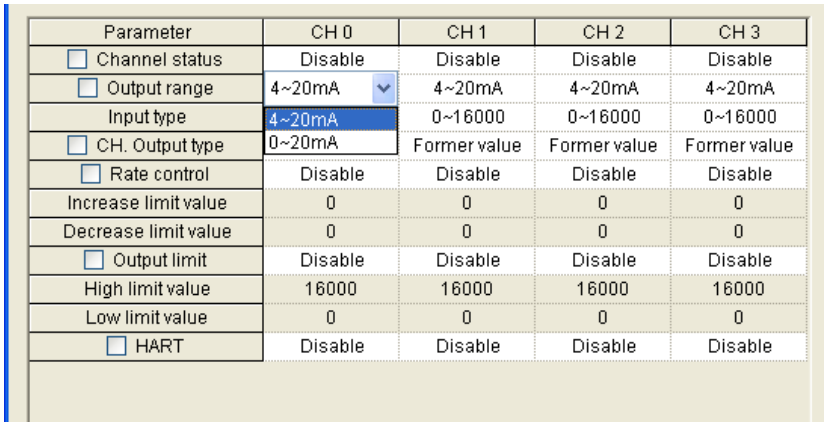
Click a desired item to display parameters to set for respective items.

Double-click the applicable slot selected for parameters setting or click [Details].

(a) Channels: Select Disable or Enable.



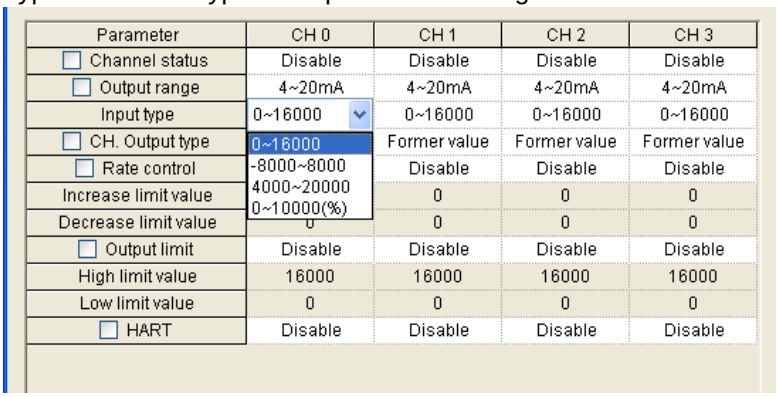
(b) Analog output range: Select the range of analog output voltage as desired. 2MLF-DC4H moduleprovides 2 current output ranges.



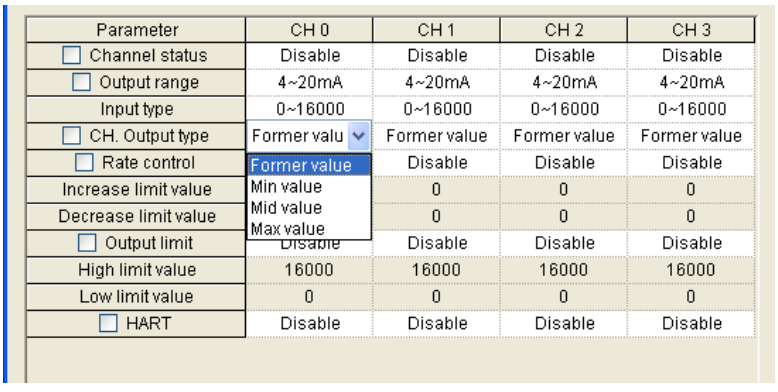
Parameter	CH 0	CH 1	CH 2	CH 3
Channel status	Disable	Disable	Disable	Disable
Output range	4~20mA	4~20mA	4~20mA	4~20mA
Input type	4~20mA	0~16000	0~16000	0~16000
CH. Output type	0~20mA	Former value	Former value	Former value
Rate control	Disable	Disable	Disable	Disable
Increase limit value	0	0	0	0
Decrease limit value	0	0	0	0
Output limit	Disable	Disable	Disable	Disable
High limit value	16000	16000	16000	16000
Low limit value	0	0	0	0
HART	Disable	Disable	Disable	Disable

(c) Input data type: Select the format of input data. 4 formats are available in total.

(d) Setting output type: Select the type of output status. 4 ranges are available in total.



Parameter	CH 0	CH 1	CH 2	CH 3
Channel status	Disable	Disable	Disable	Disable
Output range	4~20mA	4~20mA	4~20mA	4~20mA
Input type	0~16000	0~16000	0~16000	0~16000
CH. Output type	0~16000	Former value	Former value	Former value
Rate control	-8000~8000	Disable	Disable	Disable
Increase limit value	4000~20000	0	0	0
Decrease limit value	0~10000(%)	0	0	0
Output limit	Disable	Disable	Disable	Disable
High limit value	16000	16000	16000	16000
Low limit value	0	0	0	0
HART	Disable	Disable	Disable	Disable



Parameter	CH 0	CH 1	CH 2	CH 3
Channel status	Disable	Disable	Disable	Disable
Output range	4~20mA	4~20mA	4~20mA	4~20mA
Input type	0~16000	0~16000	0~16000	0~16000
CH. Output type	Former valu	Former value	Former value	Former value
Rate control	Former value	Disable	Disable	Disable
Increase limit value	Min value	0	0	0
Decrease limit value	Mid value	0	0	0
Output limit	Max value	Disable	Disable	Disable
High limit value	16000	16000	16000	16000
Low limit value	0	0	0	0
HART	Disable	Disable	Disable	Disable

(e) Rate control: Select Disable or Enable

Parameter	CH 0	CH 1	CH 2	CH 3
Channel status	Disable	Disable	Disable	Disable
Output range	4~20mA	4~20mA	4~20mA	4~20mA

Parameter	CH 0	CH 1	CH 2	CH 3
Channel status	Disable	Disable	Disable	Disable
Output range	4~20mA	4~20mA	4~20mA	4~20mA
Input type	0~16000	0~16000	0~16000	0~16000
CH. Output type	Former value	Former value	Former value	Former value
Rate control	Enable	Disable	Disable	Disable
Increase limit value	2000	0	0	0
Decrease limit value	0	0	0	0
Output limit	Disable	Disable	Disable	Disable
High limit value	16000	16000	16000	16000
Low limit value	0	0	0	0
HART	Disable	Disable	Disable	Disable

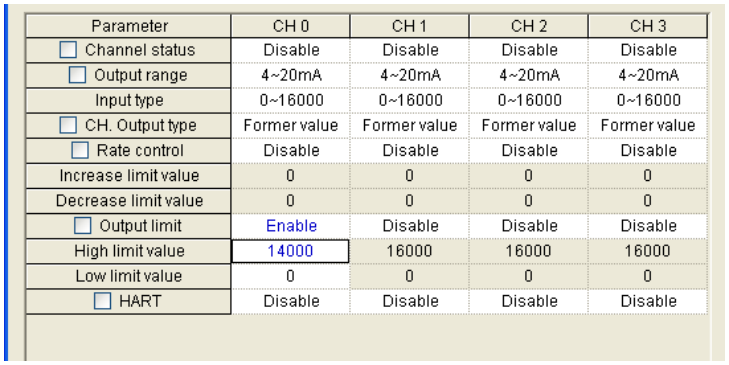
(f) Increase/Decrease limit value: The setting range is from 0 to 16000.

(g) Output limit setting: Select Disable or Enable.

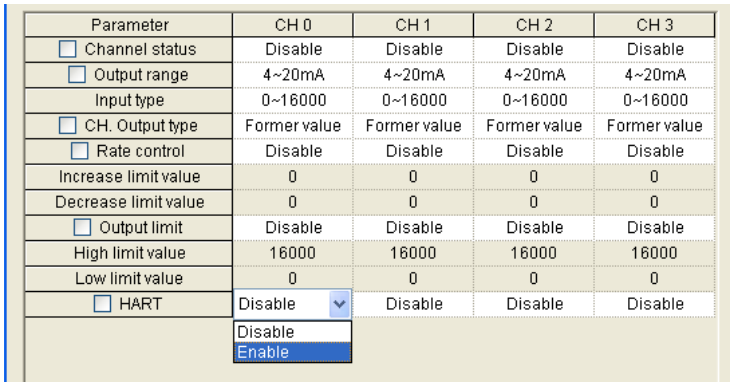
Parameter	CH 0	CH 1	CH 2	CH 3
Channel status	Disable	Disable	Disable	Disable
Output range	4~20mA	4~20mA	4~20mA	4~20mA
Input type	0~16000	0~16000	0~16000	0~16000
CH. Output type	Former value	Former value	Former value	Former value
Rate control	Disable	Disable	Disable	Disable
Increase limit value	0	0	0	0
Decrease limit value	0	0	0	0
Output limit	Disable	Disable	Disable	Disable
High limit value	Disable / Enable	16000	16000	16000
Low limit value		0	0	0
HART	Disable	Disable	Disable	Disable

(h) High/Low limit value: The setting range is from -192 to 16191.

(i) HART: Select Enable or Disable



Parameter	CH 0	CH 1	CH 2	CH 3
Channel status	Disable	Disable	Disable	Disable
Output range	4~20mA	4~20mA	4~20mA	4~20mA
Input type	0~16000	0~16000	0~16000	0~16000
CH. Output type	Former value	Former value	Former value	Former value
Rate control	Disable	Disable	Disable	Disable
Increase limit value	0	0	0	0
Decrease limit value	0	0	0	0
Output limit	Enable	Disable	Disable	Disable
High limit value	14000	16000	16000	16000
Low limit value	0	0	0	0
HART	Disable	Disable	Disable	Disable



Parameter	CH 0	CH 1	CH 2	CH 3
Channel status	Disable	Disable	Disable	Disable
Output range	4~20mA	4~20mA	4~20mA	4~20mA
Input type	0~16000	0~16000	0~16000	0~16000
CH. Output type	Former value	Former value	Former value	Former value
Rate control	Disable	Disable	Disable	Disable
Increase limit value	0	0	0	0
Decrease limit value	0	0	0	0
Output limit	Disable	Disable	Disable	Disable
High limit value	16000	16000	16000	16000
Low limit value	0	0	0	0
HART	Disable	Disable	Disable	Disable

Disable
Enable

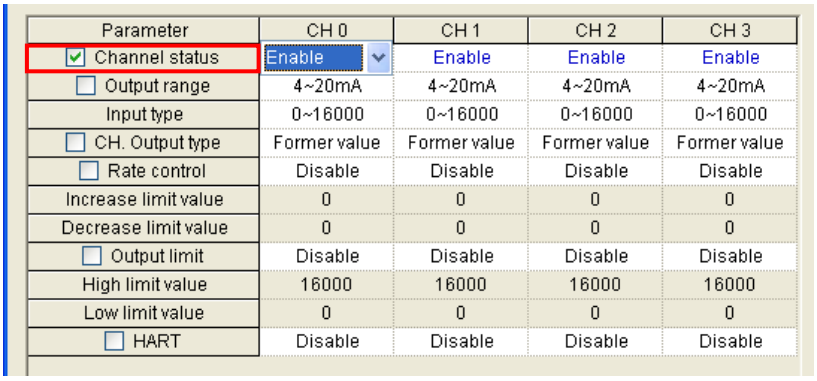
(6) Specify parameters as necessary. After setting, click [OK].

(7) Default of parameters setting

Parameter	Setting Item	Default
Channel status	Disable/Enable	Disable
Output range	4~20 mA/0~20 mA	4~20 mA
Input type	0~16000/-8000~8000/ 4000~20000/0~10000% (Changed based on the output range)	0~16000
Ch. Output type	Prev/Min/Mid/Max	Previous
Rate control	Disable/Enable	Disable
Increase limit value	0~16000	0
Decrease limit value	0~16000	0
Output limit	Disable/Enable	Disable
High limit value	-192~16191	16000
Low limit value	-192~16191	0
HART	Disable/Enable	Disable

(8) How to select the whole channels to change parameters.

Click and check the button in the parameters item in order to change the whole channels to identical setting value. And then change the parameters of an optional channel to change the parameters of the whole channels at a time. The Figure below shows an example that the channel is changed to whole channels 'Enable' by means of this function.

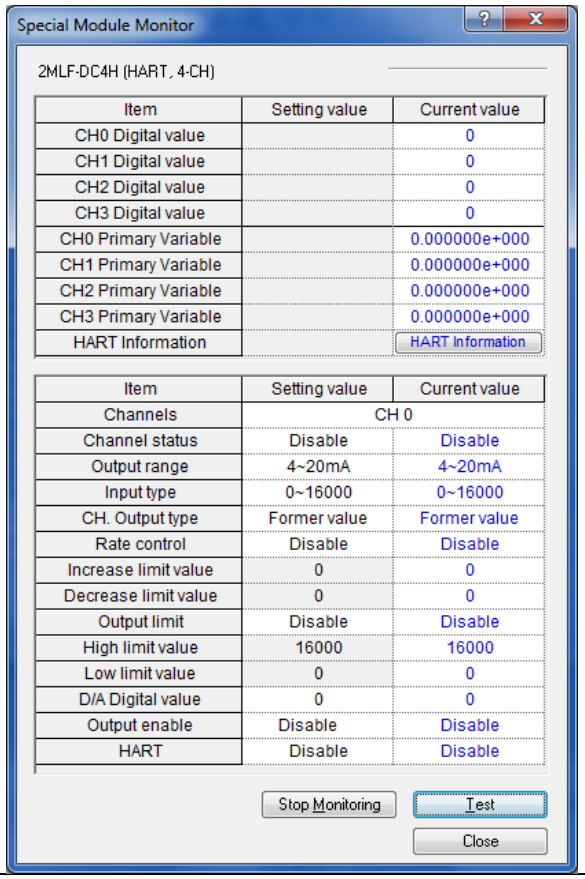


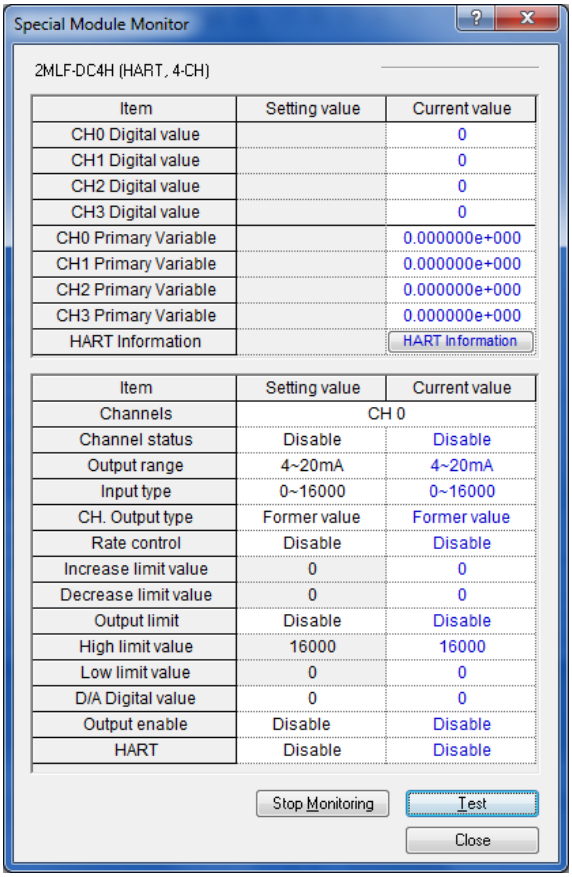
4.3 Monitoring /Test

4.3.1 Monitoring / Test screen

The special module monitoring function helps you to monitor the Analog Output modules for testing. It also helps in tuning parameters like average processing constants.

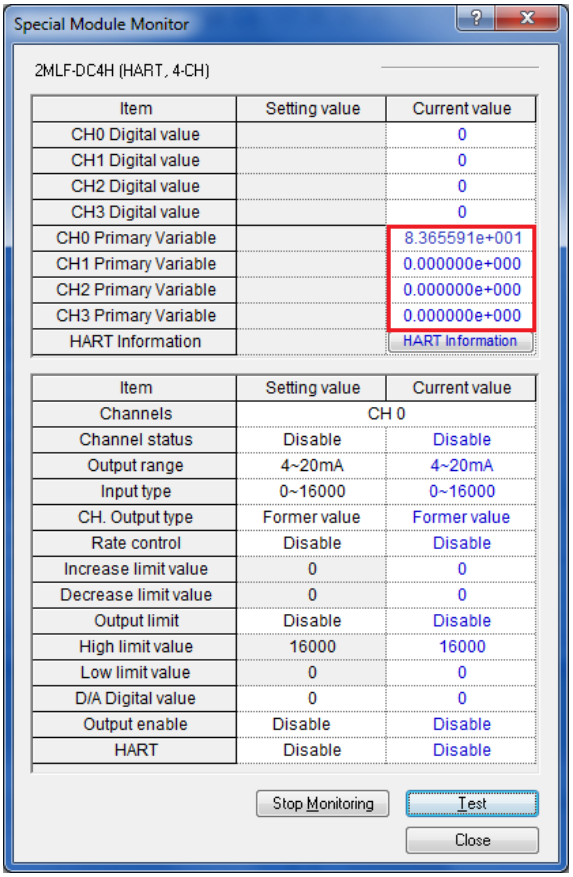
To monitor and test the module, perform the following steps.

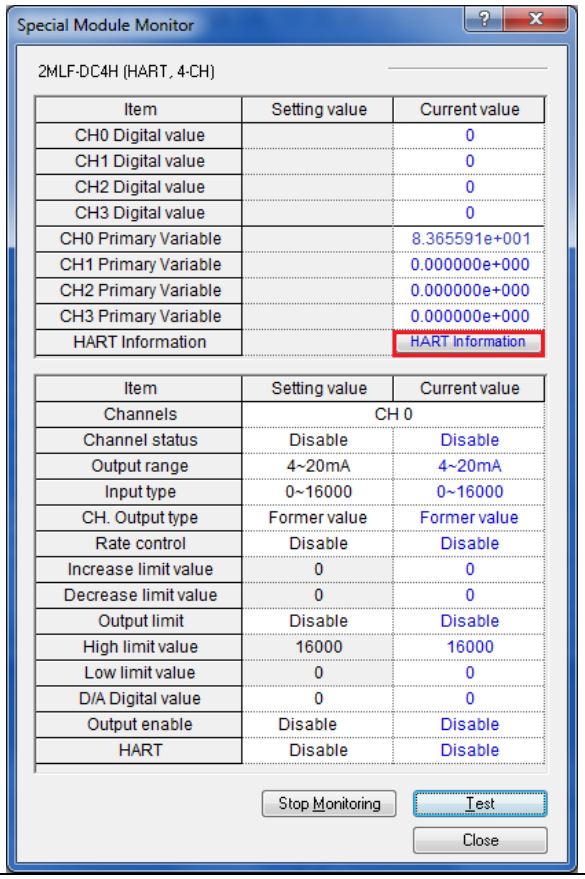
Step	Action
1	Click [Online] -> [Connect] and [Monitor] -> [Special Module Monitoring] to start. If the status is not [Online], [Special Module Monitoring] menu is not available.
2	With SoftMaster connected to PLC CPU (Online status), click [Monitor] -> [Special Module Monitoring] to display the 'Special Module List' screen, displaying the base/slot information in addition to special module type. Themodule installed on the present PLC system displays on the list dialog box.
3	Select Special Module and then click [Module Info.] to display the information.
4	After the module is selected, click [Monitor] to display the monitoring screen.
5	[Start Monitoring]: Click [Start Monitoring] to view analog output value of thepresently operated channel.
	
6	[Test]: [Test] is used to change the presently specified parameters of HART Analog Output module. Click the setting value at the bottom field of the screen to change parameters. [Test] can be set only when CPU operation status is in [Stop].

Step	Action
	
7	[Setting Value Change] -> [Test] -> Change current value [Close]: Click [Close] to exit.

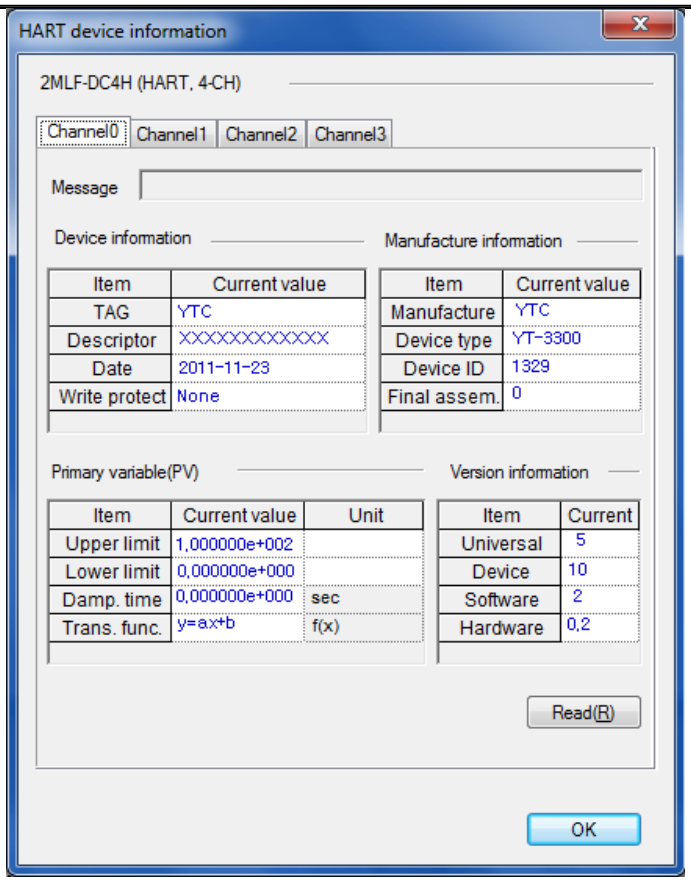
4.3.2 HART Variable Monitoring and Device Information Screen.

Step	Action
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 following figure displays the 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 connect with a current module can beviewed for each channel.

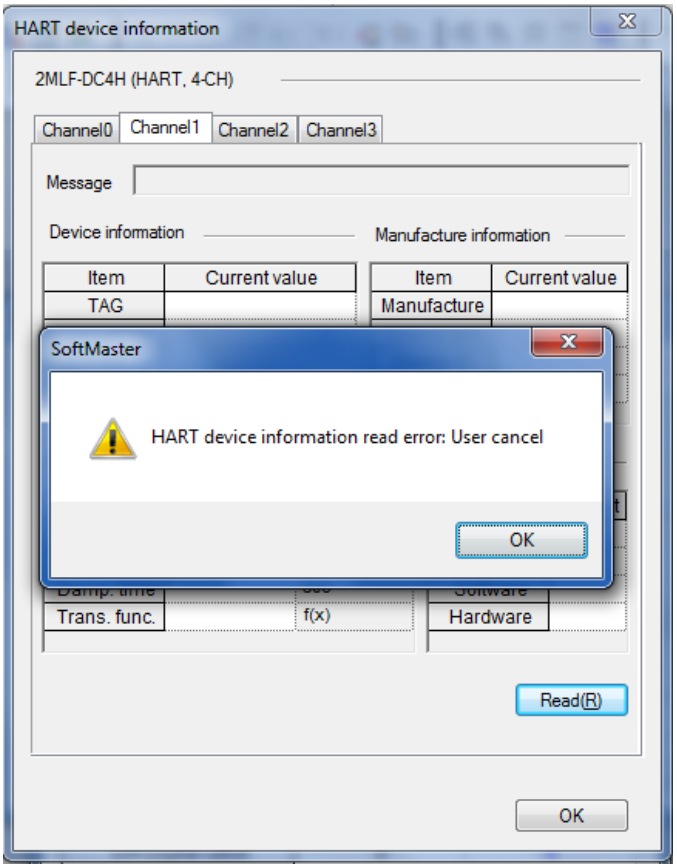




3	If the current value cannot be seen completed on HART device information screen because the value is too long, click and drag the current value to view. In case of [Monitor] -> [Monitor Special Module] -> [HART Device Information] -> [Read], h00F1 is written on the actual HART command setting status because command h00F1 is written inside of SoftMaster. To delete, use HARTCLR command. In case of [Monitor] -> [Monitor Special Module] -> [Start Monitor] -> [HART Device Information] -> [Read], h00F3 is written on the actual HART command setting status because command h00F3 is writteninside of SoftMaster. To delete, use HARTCLR command.



- **Message**: Texts that are inputted to HART field device's message parameters. They can be used to describe information helpful to recognize a device.
- **Tag**: HART field device's tag name is displayed. It can be used to indicate the location of a plant.
- **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.
- **Date**: Date inputted to the device. It can be used to record the latest calibration date or date of maintenance/inspection.
  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.
- **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.
- **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.
- **Device ID**: Numbers refers to device ID are displayed. Device ID is a unique serial number issued by the manufacturer.
- **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.
- **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, PV is displayed if the output value is 20mA.
- **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, PV is displayed if the output value is 4mA.
- **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. • **Transfer Function**: A function to express which method is used by the transmitter to transfer 4~20mA signal to PV. • **Universal version**: It refers to HART dimension version. In most cases, it is 5 or 6 and 7 means Wireless HART dimension. • **Device version**: HART device's version is displayed. • **Software version**: HART device's software version is displayed. • **Hardware version**: HART device's hardware version is displayed.
4	Read Cancel: Press **ESC** on the keyboard to cancel importing information from HART device after pressing Read button. 

4.3.3 Operation by program

(1) HART analog output module can be operated with Tx. (Write) instruction of PUT/PUTP and Rx. (Read) instruction of GET/GETP executed from PLC CPU by means of the scan program.

(2) Refer to Chapter 6 Programming for more details.

4. 4 Register U Devices

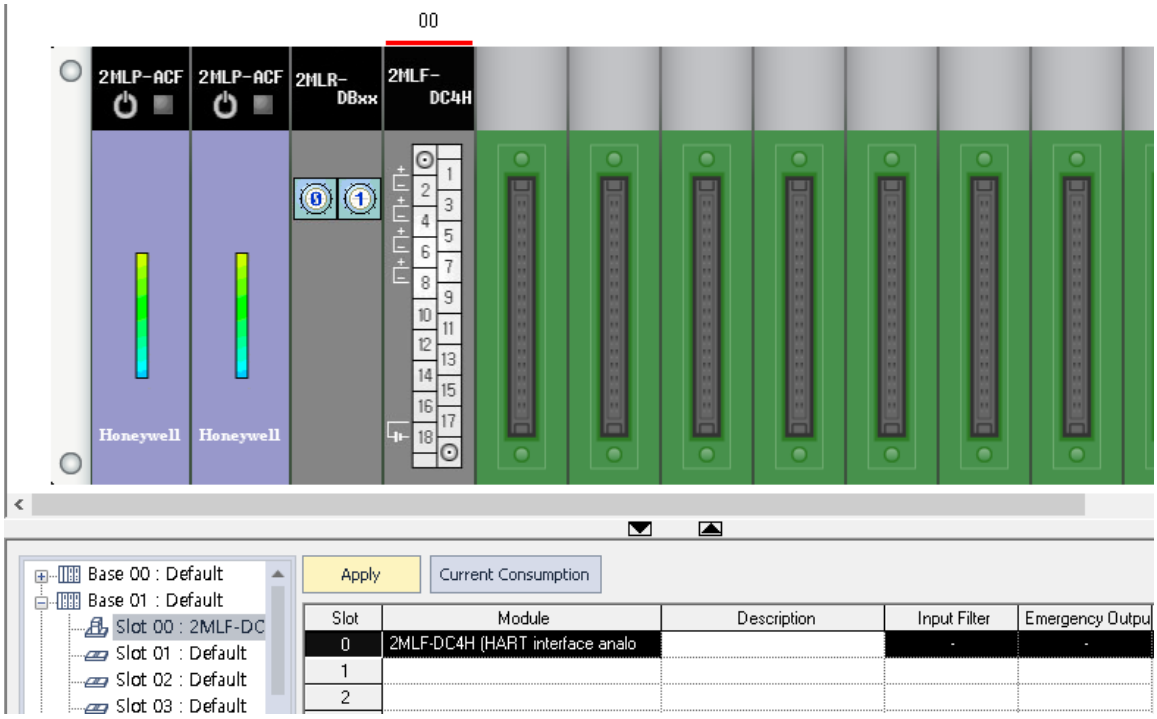
This section describes the automatic registration function of the U device in the SoftMaster

4.4.1 Register U Devices

Register 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.

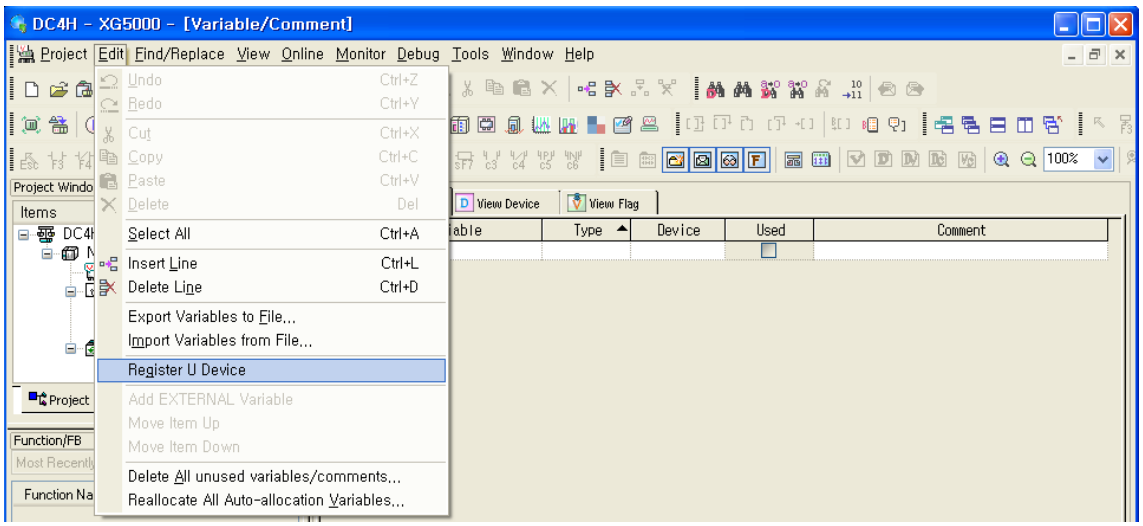
[Procedure]

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

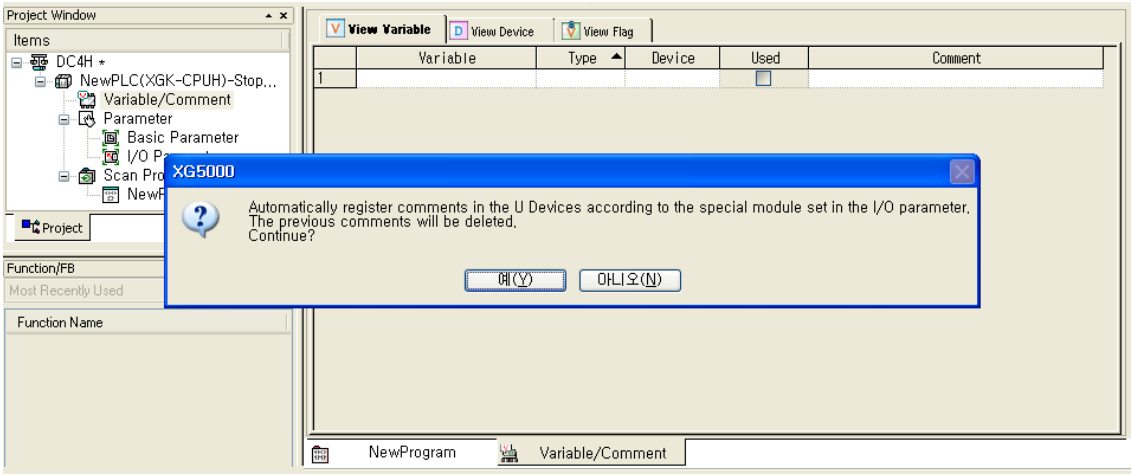


Registering variables manually

(2) Select [Edit] -> [Register U Device].



(3) Click 'Yes'.



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

	Variable	Type	Device	Used	Comment
1	_04_CH0_ERR	BIT	U04.00.0		HART Analog Output Module: CH0 Error
2	_04_CH1_ERR	BIT	U04.00.1		HART Analog Output Module: CH1 Error
3	_04_CH2_ERR	BIT	U04.00.2		HART Analog Output Module: CH2 Error
4	_04_CH3_ERR	BIT	U04.00.3		HART Analog Output Module: CH3 Error
5	_04_CH0_HARTERR	BIT	U04.00.8		HART Analog Output Module: HART Analog Output Module
6	_04_CH1_HARTERR	BIT	U04.00.9		HART Analog Output Module: HART Analog Output Module
7	_04_CH2_HARTERR	BIT	U04.00.A		HART Analog Output Module: HART Analog Output Module
8	_04_CH3_HARTERR	BIT	U04.00.B		HART Analog Output Module: HART Analog Output Module
9	_04_RDY	BIT	U04.00.F		HART Analog Output Module: Module Ready
10	_04_CH0_ACT	BIT	U04.01.0		HART Analog Output Module: CH0 Running
11	_04_CH1_ACT	BIT	U04.01.1		HART Analog Output Module: CH1 Running
12	_04_CH2_ACT	BIT	U04.01.2		HART Analog Output Module: CH2 Running
13	_04_CH3_ACT	BIT	U04.01.3		HART Analog Output Module: CH3 Running
14	_04_CH0_OUTH	BIT	U04.01.8		HART Analog Output Module: CH0 Output High Limit
15	_04_CH0_OUTL	BIT	U04.01.9		HART Analog Output Module: CH0 Output Low Limit
16	_04_CH1_OUTH	BIT	U04.01.A		HART Analog Output Module: CH1 Output High Limit
17	_04_CH1_OUTL	BIT	U04.01.B		HART Analog Output Module: CH1 Output Low Limit
18	_04_CH2_OUTH	BIT	U04.01.C		HART Analog Output Module: CH2 Output High Limit
19	_04_CH2_OUTL	BIT	U04.01.D		HART Analog Output Module: CH2 Output Low Limit
20	_04_CH3_OUTH	BIT	U04.01.E		HART Analog Output Module: CH3 Output High Limit
21	_04_CH3_OUTL	BIT	U04.01.F		HART Analog Output Module: CH3 Output Low Limit
22	_04_CH0_OUTEN	BIT	U04.02.0		HART Analog Output Module: CH0 Output Status
23	_04_CH1_OUTEN	BIT	U04.02.1		HART Analog Output Module: CH1 Output Status
24	_04_CH2_OUTEN	BIT	U04.02.2		HART Analog Output Module: CH2 Output Status
25	_04_CH3_OUTEN	BIT	U04.02.3		HART Analog Output Module: CH3 Output Status
26	_04_OUTEN	WORD	U04.02		HART Analog Output Module: Output Status Setting
27	_04_CH0_DATA	WORD	U04.03		HART Analog Output Module: CH0 Input Value
28	_04_CH1_DATA	WORD	U04.04		HART Analog Output Module: CH1 Input Value
29	_04_CH2_DATA	WORD	U04.05		HART Analog Output Module: CH2 Input Value
30	_04_CH3_DATA	WORD	U04.06		HART Analog Output Module: CH3 Input Value

Register U devices

Register 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.

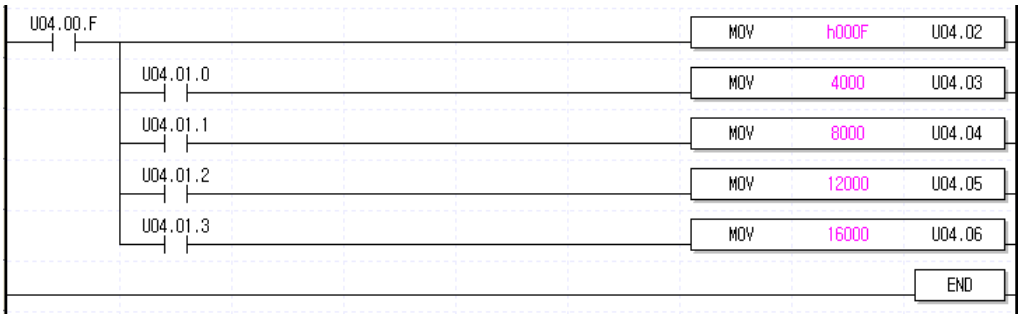
Step	Action
1	Select the special module type from the [I/O parameter] setting window.
2	Double-click [Variable/Comment] in the project window.
3	Select [Edit] -> [Register U Device].
4	Click 'Yes'. The variables are registered.

Save variables

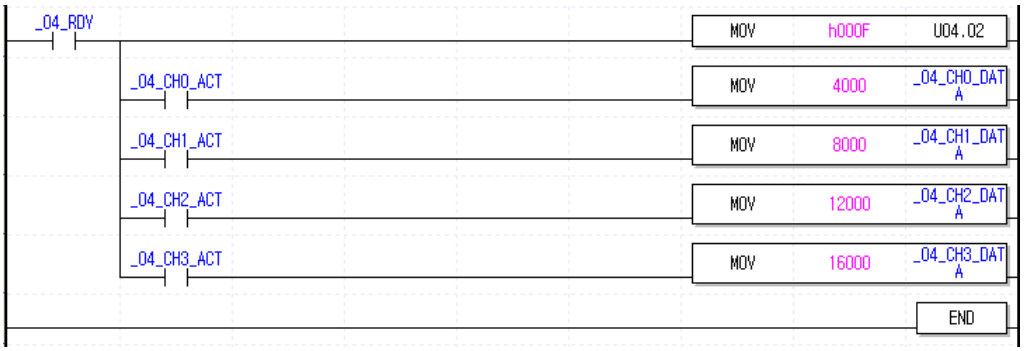
Step	Action
1	The contents of 'View Variable' can be saved as a text file.
2	Select [Edit] -> [Export to File].
3	The contents of 'View variable' are saved as a text file.

4.4.2 View variables

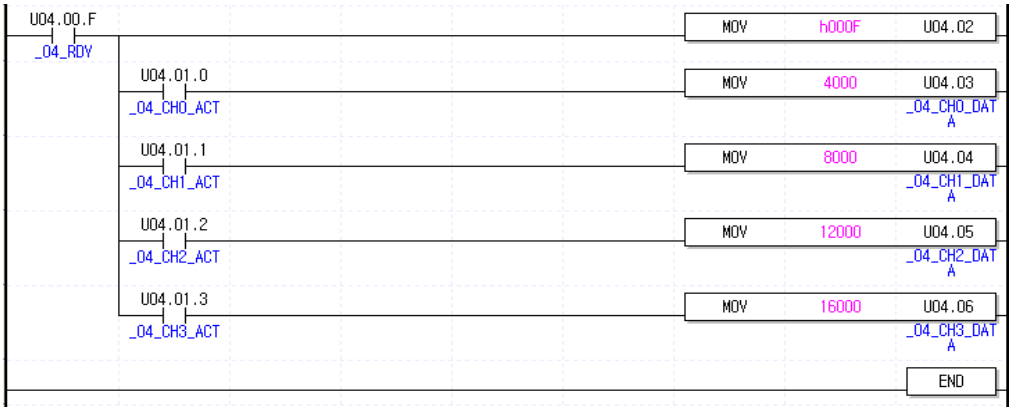
(1) The example program of SoftMaster is shown below.



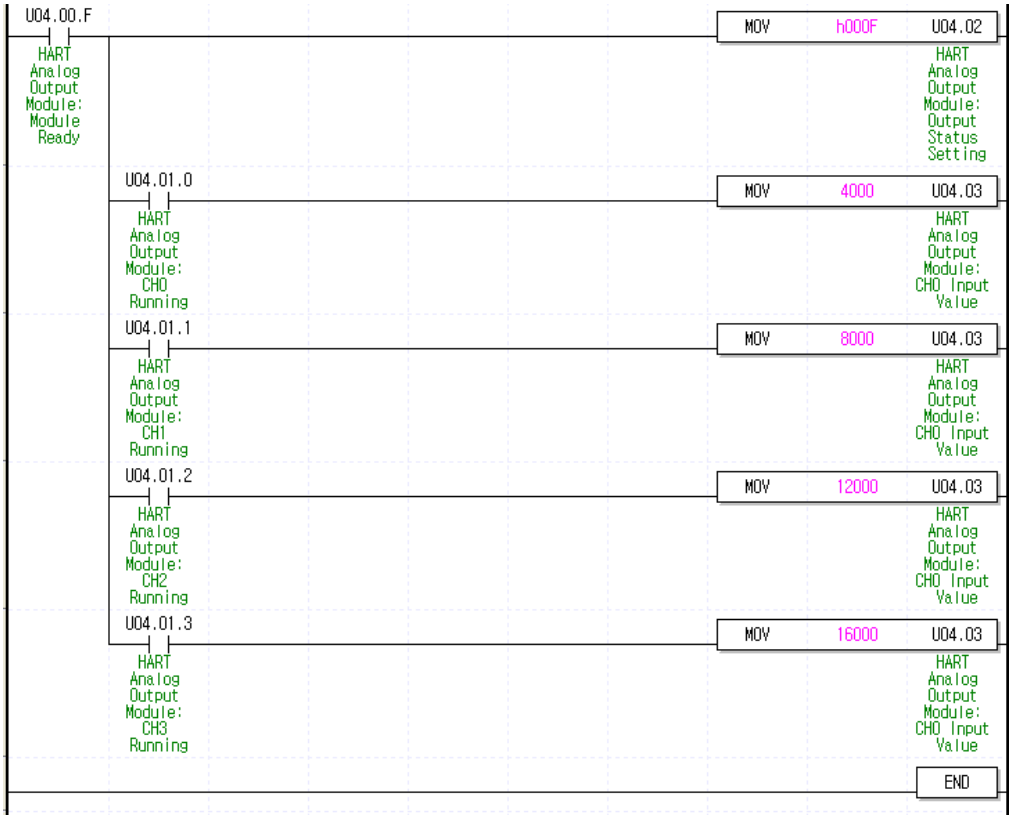
(2) Select [View] -> [Variables]. The devices are changed into variables.



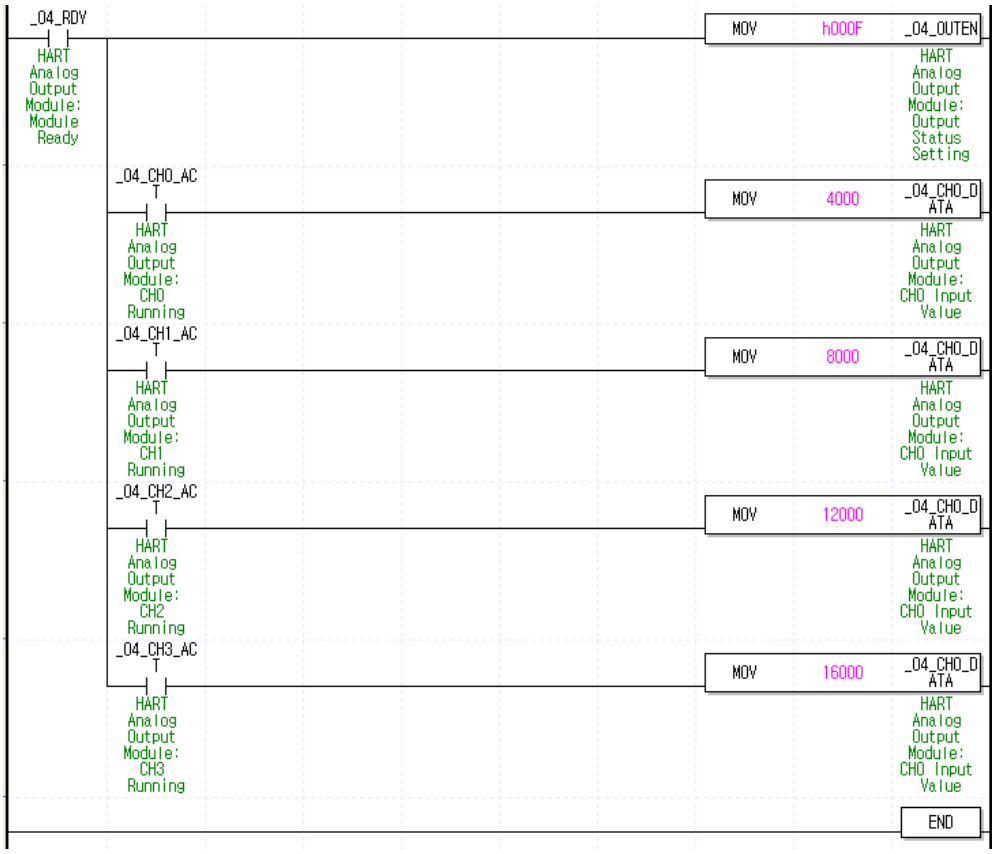
(3) Select [View] -> [Devices/Variables]. Devices and variables are both displayed.


U04.00.F
_04_RDY
MOV
h000F
U04.02
U04.01.0
_04_CH0_ACT
MOV
4000
U04.03
_04_CH0_DATA
U04.01.1
_04_CH1_ACT
MOV
8000
U04.04
_04_CH1_DATA
U04.01.2
_04_CH2_ACT
MOV
12000
U04.05
_04_CH2_DATA
U04.01.3
_04_CH3_ACT
MOV
16000
U04.06
_04_CH3_DATA
END

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



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



Chapter 5 Configuration and Function of Internal Memory (For 2MLK)

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

5.1 Configuration of Internal Memory

Configuration of internal memory is as described below.

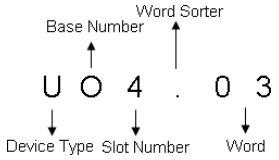
5.1.1 I/O area configuration of HART analog output module.

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

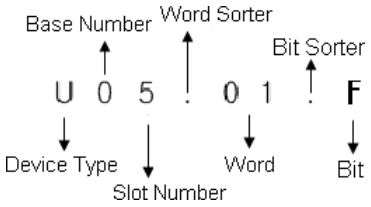
[Table 5. 1] I/O area of D/A converted data

Device assigned	Details	R/W	Sign direction
UXY.00.0 UXY.00.1 UXY.00.2 UXY.00.3 .. UXY.00.8 UXY.00.9 UXY.00.A UXY.00.B .. UXY.00.F	CH0 error CH1 error CH2 error CH3 error .. CH0 HART communication error CH1 HART communication error CH2 HART communication error CH3 HART communication error .. Module READY flag	R	D/A → CPU
UXY.01.0 UXY.01.1 UXY.01.2 UXY.01 3 .. UXY.01 8 UXY.01 9 UXY.01 A UXY.01 B UXY.01 C UXY.01 D UXY.01 E UXY.01 F	CH0 run flag CH1 run flag CH2 run flag CH3 run flag .. CH0 output high limit detection flag CH0 output low limit detection flag CH1 output high limit detection flag CH1 output low limit detection flag CH2 output high limit detection flag CH2 output low limit detection flag CH3 output high limit detection flag CH3 output low limit detection flag	R	D/A → CPU
UXY.02	Output status setting	W	CPU → D/A
UXY.02.0 UXY.02.1 UXY.02.2 UXY.02.3	CH0 output enable CH1 output enable CH2 output enable CH3 output enable	W	
UXY.03	CH0 digital input value	W	
UXY.04	CH1 digital input value	W	
UXY.05	CH2 digital input value	W	
UXY.06	CH3 digital input value	W	

(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 input value' of HART analog output module installed on Base No.0, Slot No.4, it should be displayed as U04.03.



(3) In order to read 'CH3 output low limit detection flag' of HART analog output module installed on Base No.0, Slot no.5, it should be displayed as U5.01.F.



5.1.2 Setting area of operation parameters

Setting area of D/A conversion module's operation parameters is as described in Table 5.2.

[Table 5. 2] Setting area of operation 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 output current	R/W	PUT
2_H	2	Input data format setting	R/W	PUT
3_H	3	CH0 output status setting	R/W	PUT
4_H	4	CH1 output status setting		
5_H	5	CH2 output status setting		
6_H	6	CH3 output status setting		
-	-	-	-	-
B_H	11	CH0 error code	R	GET
C_H	12	CH1 error code		
D_H	13	CH2 error code		
E_H	14	CH3 error code		
-	-	-	-	-
13_H	19	Channel output limit setting	R/W	PUT
14_H	20	CH0 output H limit	R/W	PUT
15_H	21	CH0 output L limit		
16_H	22	CH1 output H limit		
17_H	23	CH1 output L limit		
18_H	24	CH2 output H limit		
19_H	25	CH2 output L limit		
$1A_H$	26	CH3 output H limit		
$1B_H$	27	CH3 output L limit		
$1C_H$	28	Channel change rate control setting	R/W	PUT
$1D_H$	29	CH0 change rate increase limit value	R/W	PUT
$1E_H$	30	CH0 change rate decrease limit value		
$1F_H$	31	CH1 change rate increase limit value		
20_H	32	CH1 change rate decrease limit value		
21_H	33	CH2 change rate increase limit value		
22_H	34	CH2 change rate decrease limit value		
23_H	35	CH3 change rate increase limit value		
24_H	36	CH3 change rate decrease limit value		
-	-	-	-	-
28_H	40	HART communication Enable/Disable	R/W	PUT

5.1.3 HART commands information area

Information area of HART commands are as described in Table 5.3

[Table 5. 3] Information 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.

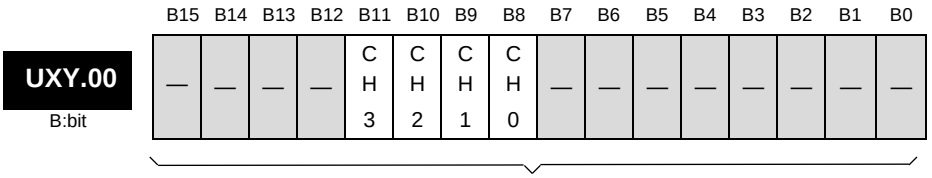
5.2 I/O area of D/A Converted Data

5.2.1 Module Ready/Error (UXY.00, X: Base No., Y: Slot No. Z: Channel no.)

(1) **Uxy.00.F:** It will be ON when PLC CPU is powered or reset with D/A conversion ready to process D/A conversion.
(2) **Uxy.00.0~3:** It is a flag to display the error status of D/A conversion module for respective channels.

5.2.2 HART communication error (UXY.00, X: Base No., Y: Slot No. Z: Channel no.)

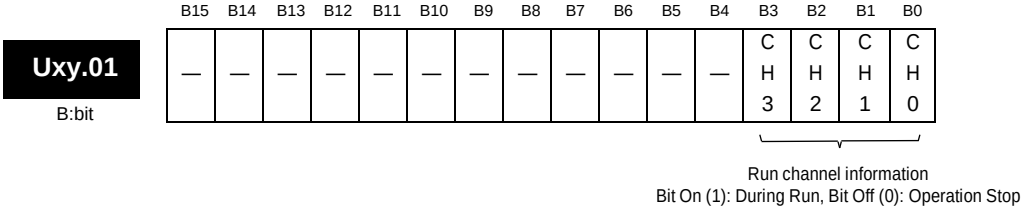
(1) Detection sign of HART communication error for respective output channels is saved in UXY.00.8 ~ 00.B.
(2) Each bit will be set to 1 if an assigned channel is detected as HART communication error, and it will be back to 0 if HART communication back. In addition, each bit can be used to detect the HART communication error in the user program together with execution conditions.



BIT	Description
0	HART communication normal
1	HART communication error

5.2.3 Channel operation information (UXY.00, X: Base No., Y: Slot No. Z: Channel no.)

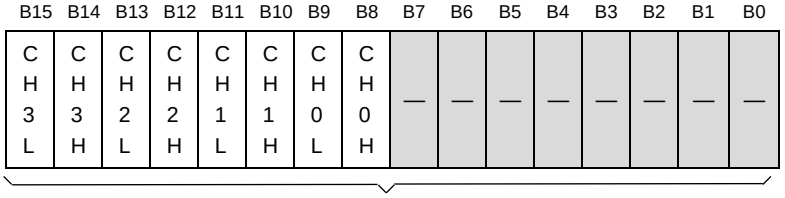
(1) This area is used to display the channel being used.



5.2.4 Flag to detect output limit (UXY.00, X: Base No., Y: Slot No. Z: Alarm bit according to channel.)

(1) Detection sign of output limit for respective output channels is saved in UXY.01.8 ~ 01.F.
(2) Each bit will be set to 1 if an assigned channel is detected as output limit alarm, and it will be back to 0 if output limit alarm back. In addition, each bit can be used to detect the output limit in the user program together with execution conditions.

UXY.00



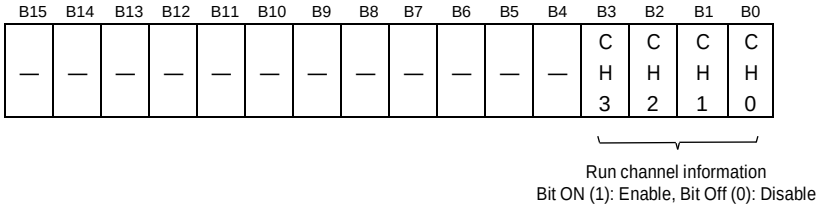
BIT	Description
0	Meet setting range
1	Exceed setting range

5.2.5 Output setting (UXY.00, X: Base No., Y: Slot No. Z: Channel no.)

(1) Enable/Disable D/A output can be specified for respective channels.
(2) If the output is not specified, output of all the channels will be disabled.
(3) Enable/Disable D/A output is as specified below.

Uxy.02

B:bit

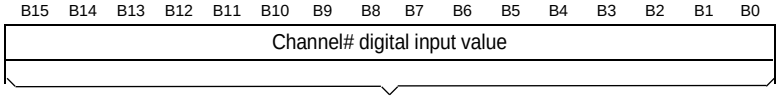


5.2.6 Digital input (UXY.00, X: Base No., Y: Slot No. Z: Channel no.)

(1) Digital input value can be selected and used within the range of -192~16191, -8192~8191, 3808~20192 or -120~10191 for 4 ~ 20mA based on input type.
(2) If the digital input value is not specified, it will be set to 0.

Uxy.03 ~ Uxy.6

B:bit



Address	Details
3	CH0 digital output value
4	CH1 digital output value
5	CH2 digital output value
6	CH3 digital output value

5.3 Operation Parameters Settings

5.3.1 Specifying channels to use (Address no.0)

If the channel to use is not specified, all the channels will be set to disable.

Address "0"

B:bit

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

BIT	Details
0	Stop
1	Run

5.3.2 Setting Output Current range (Address no.1)

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

Address "1"

B:bit

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

BIT	Details
00	4 ~ 20mA
01	0 ~ 20mA

5.3.3 Specifying Input data type (Address no.2)

(1) Input type can be specified for respective channels.
(2) If input type is not specified, all the channels will be set to the range of 0~16000.

Address "2"

B:bit

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

BIT	Details
00	0 ~ 16000
01	-8000 ~ 8000
10	Precise Value
11	0 ~ 10000

(3) This area is used to specify D/A input type for respective channels.
The precise value has the digital input ranges as follows;

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

5.3.4 Setting Output type (Address no.3 ~ 6)

Based on setting value, the output status is as follows.

Address "3~6"

B: bit

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

Setting value	Details
0	Keeps the previous value as it is
1	Outputs the minimum value of output range
2	Outputs the middle value of output range
3	Outputs the maximum value of output range

5.3.5 Error code (Address no.11 ~ 14)

Error codes detected from HART analog output module will be saved.

Address "11~14"

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

Refer to the table below for detailed error codes

Error Code (Dec)	Details	RUN LED	ALM LED
10	Module error (Reset Check Error)	Blinks every 0.2 sec.	Off
11	Module error (Ram Check Error)		
12	Module error (Register Check Error)		
13	Module error (E^2PROM Check Error)		
21	Module error (D/A Conversion Error)		
31# Note)	Current module's parameters setting error	Blinks every 1 sec.	Off
32# Note)	Parameters setting error when setting current module's Offset/Gain		
40# Note)	Setting error of current module's digital input range (If input value is set less than -192, or greater than 16191) The range changes based on input type		
60# Note)	Compare error of output limit H/L value (If output limit low value is set greater than output limit high value)	On	Blinks every 1 sec.
70# Note)	Setting error of change rate control setting (If change rate control setting value is set greater than input range value)		

Note) # (0~3) stands for the channel with error found.

5.3.6 Output limit setting (Address no.19)

The Output limit setting is not used, all channels is set by Disable.

Address "19"

B:bit

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

5.3.7 CH0 High/Low output limit setting (Address no.20 ~ 27)

(1) The value of high/low output limit can be set when output limit setting is set to 'Enable'.
(2) The value of high/low output limit can be set within -192~16191.
(3) The value of high output limit should be greater than the value of low output limit.

Address "20~27"

B:bit

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
CH# High/Low output limit															

Address	Description
20	CH0 High output limit
21	CH0 Low output limit
22	CH1 High output limit
23	CH1 Low output limit
24	CH2 High output limit
25	CH2 Low output limit
26	CH3 High output limit
27	CH4 Low output limit

5.3.8 Rate control setting (Address no.28)

All channels are to set ‘Disable’ when rate control setting is not set.

Address “28”

B:bit

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

5.3.9 Increase/Decrease limit value setting (Address no.29 ~ 36)

(1) Increase/Decrease limit value can be set when rate control setting is to set ‘Enable’.
(2) Increase/Decrease limit value can be set within 0~16000.

Address “29~36”

B:bit

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
CH# increase/Decrease limit value															

Address	Description
29	CH0 increase limit value
30	CH0 decrease limit value
31	CH1 increase limit value
32	CH1 decrease limit value
33	CH2 increase limit value
34	CH2 decrease limit value
35	CH3 increase limit value
36	CH3 decrease limit value

5.3.10 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”
B:bit

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

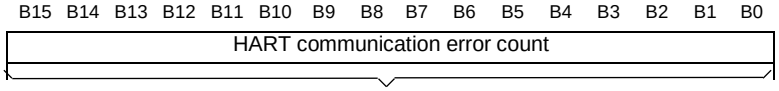
BIT	Details
0	Disable
1	Enable

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"



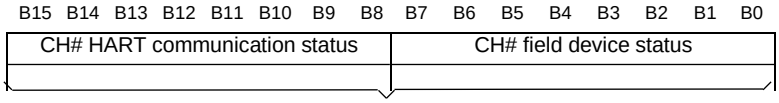
Exceed 65,535 counts start from zero again.

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"



For details on each status, refer to Hexadecimal code

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”

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

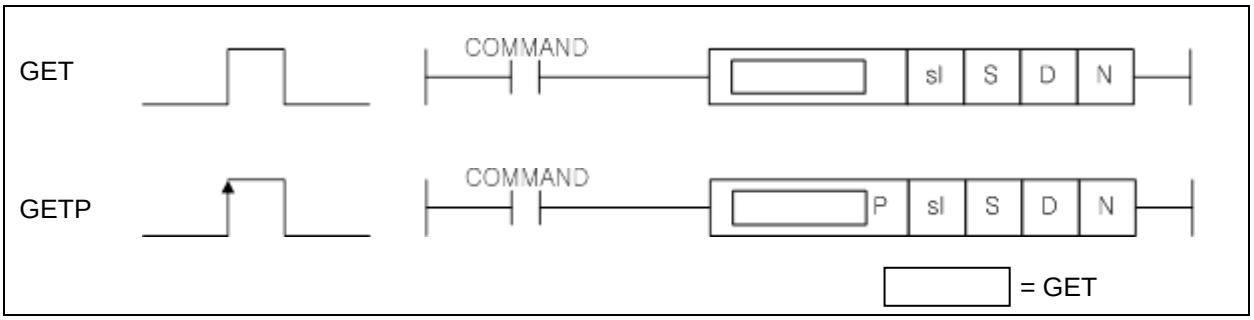
BIT	Details
0	Disable
1	Enable

Chapter 6 Programming (For 2MLK)

6.1 Internal Memory Read/Write

6.1.1 Read of internal memory (GET, GETP instruction)

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)
GET(P)	sl	-	-	-	-	-	-	-	-	-	○	-	-	-	-	4~7	-	-	-
	S	-	-	-	-	-	-	-	-	-	○	-	-	-	-				
	D	○	-	○	-	-	-	-	-	-	-	○	○	○	○				
	N	○	-	○	-	-	-	-	-	-	○	○	○	○	○				



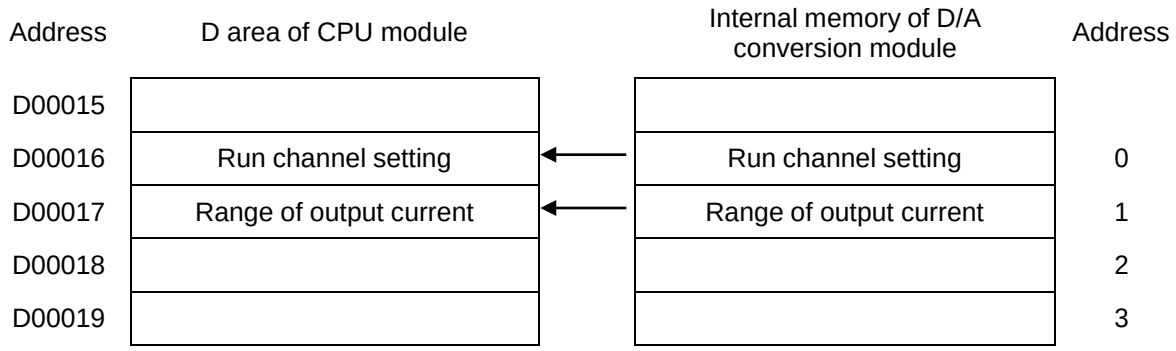
[Area Setting]

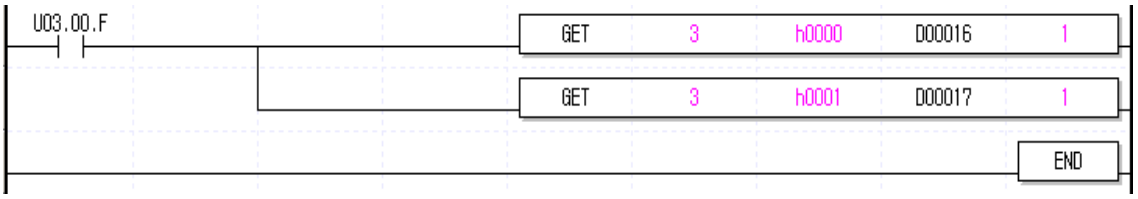
Operand	Description	Data size
sl	Slot number mounted to the special module	WORD
S	Channel number of the special module	WORD
D	Top address to save the data	WORD
N	Number of words to be read	WORD

[Flag Set]

Flag	Content	Device No.
PUT/GET error	- The special module is not mounted to a designated slot or it is mounted to other module - PUT/GET command did not execute properly.	F0015~F0022

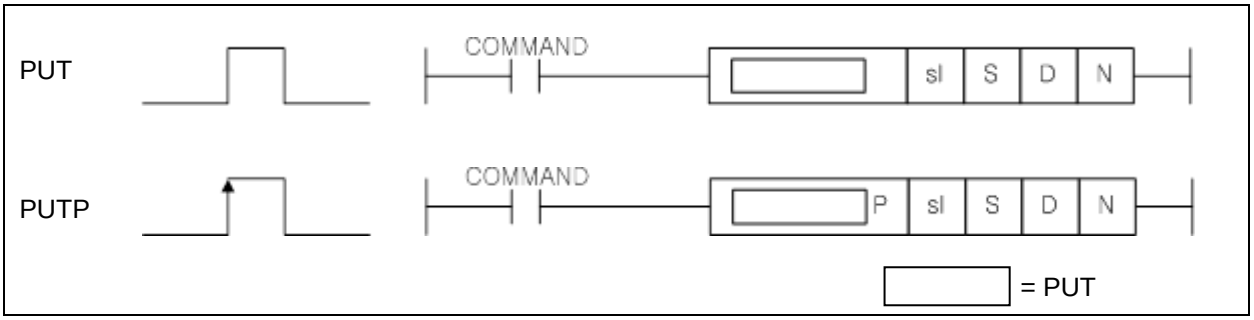
Example If HART analog output module is installed on base No.0 and slot No.3, and internal memory address No.0 & 1's data in module is read to D16 and D17 of CPU module.





6.1.2 Write of internal memory (PUT, PUTP instruction)

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)
PUT(P)	sl	-	-	-	-	-	-	-	-	-	○	-	-	-	-	4~7	-	-	-
	S	-	-	-	-	-	-	-	-	-	○	-	-	-	-				
	D	○	-	○	-	-	-	-	-	-	-	○	○	○	○				
	N	○	-	○	-	-	-	-	-	-	○	○	○	○	○				



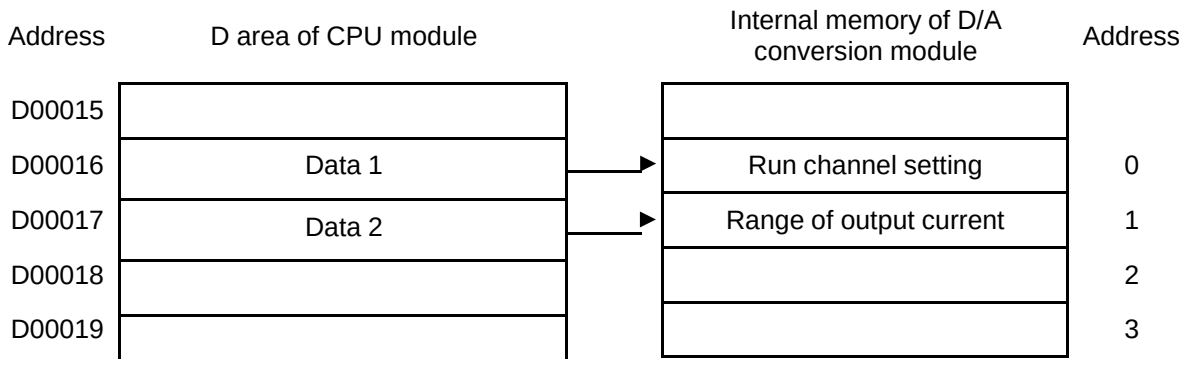
[Area Setting]

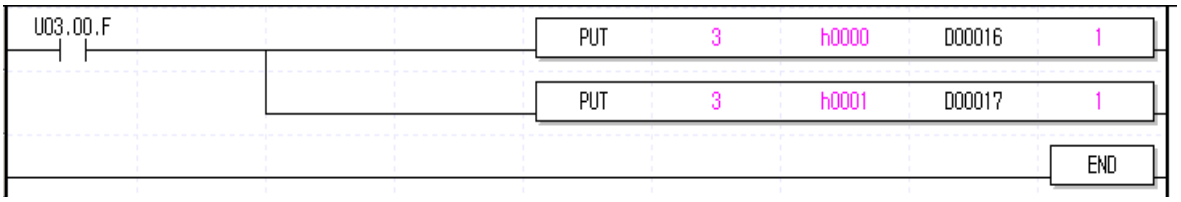
Operand	Description	Data size
sl	Slot number mounted to the special module	WORD
S	Channel number of the special module	WORD
D	Top address to save the data	WORD
N	Number of words to be read	WORD

[Flag Set]

Flag	Content	Device No.
PUT/GET error	- The special module is not mounted to a designated slot or it is mounted to other module - PUT/GET command did not execute properly.	F0015~F0022

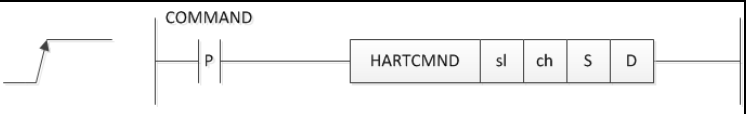
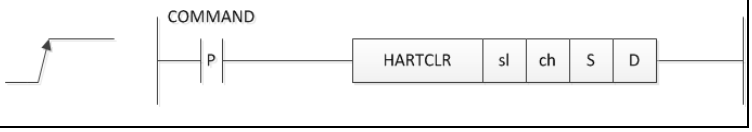
Example If D/A conversion module is installed on Base No.0 and Slot No.6, and CPU module's data of D16~D17 is written on internal memory addresses 0~1 of D/A conversion module,





6.1.3 HART commands

(1) Commands form

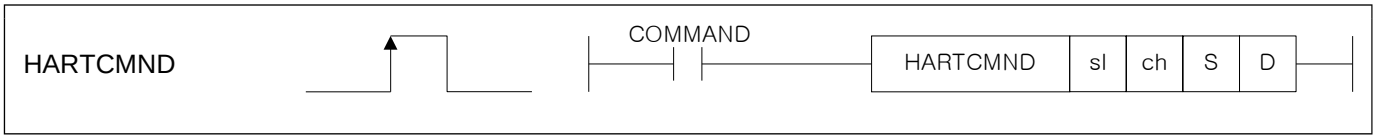
No.	Name	Details	EXECution condition	Form
1	HARTCMND	Write HART commands	Pulse	
2	HARTRESP	HART response	Level	
3	HARTCLR	Clear HART commands	Pulse	

(2) Error content

Error Content	HARTCMND	HARTRESP	HARTCLR
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	○	-	-	-	-	-	-	-	-	-	-	-	○	-				

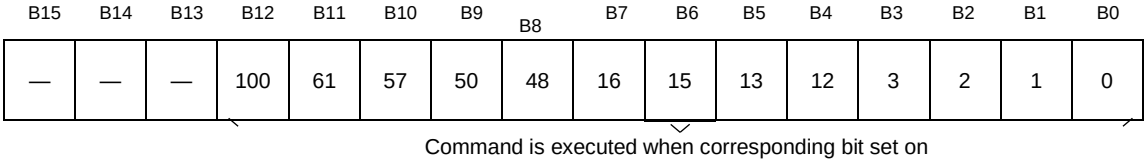


[Area Setting]

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

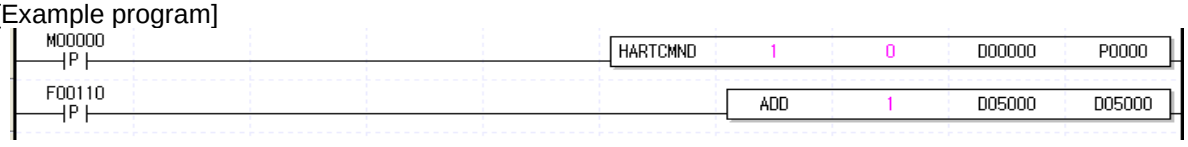


- Monitoring of operand D
  Bit information of the currently set commands is displayed.
  For example, Bit 1 and 2 are displayed on D device if bit 1 and bit 2 are set.

[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	○	-	-	-	-	-	-	-	-	-	-	-	○	-				

HARTRESP

[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. (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 notsufficient for the maximum 30 Words.
- For details on each command, refer to Appendix 2 HART commands.

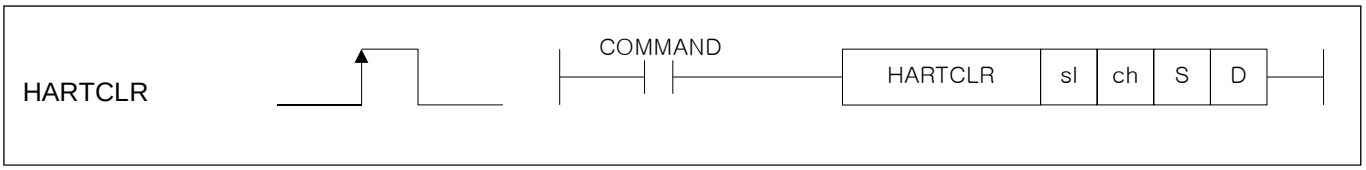
[Flag Set]

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]

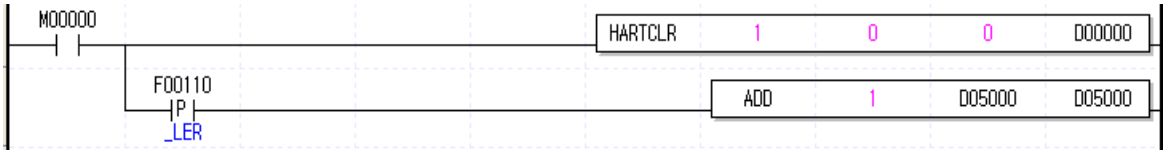
operand	Description	operand type	Valid size	data size
sl	Slot number mounted to the special module	Data	Integer	Word
ch	Channel number of the special module	Data	Integer	Word
S	HART communication command setting (each bit shows each HART command)	Data	13bit	Word
D	HART command setting status(The currently 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]



TIP

- If [Monitor] -> [Monitor Special Module] -> [Start Monitor] works on SoftMaster either in CPU STOP or RUN mode, ‘h0003’ is saved in HARTcommand (HARTCMND).
- If [Monitor] -> [Monitor Special Module] -> [HART Device Information] ->[Read] works under the same condition with (1), ‘h00F1’ is saved in HART command (HARTCMND).
- If [Monitor] -> [Monitor Special Module] -> [Start Monitor] -> [HART Device Information] -> [Read] works under the same condition with (1),‘h00F3’ is saved in HART command (HARTCMND).

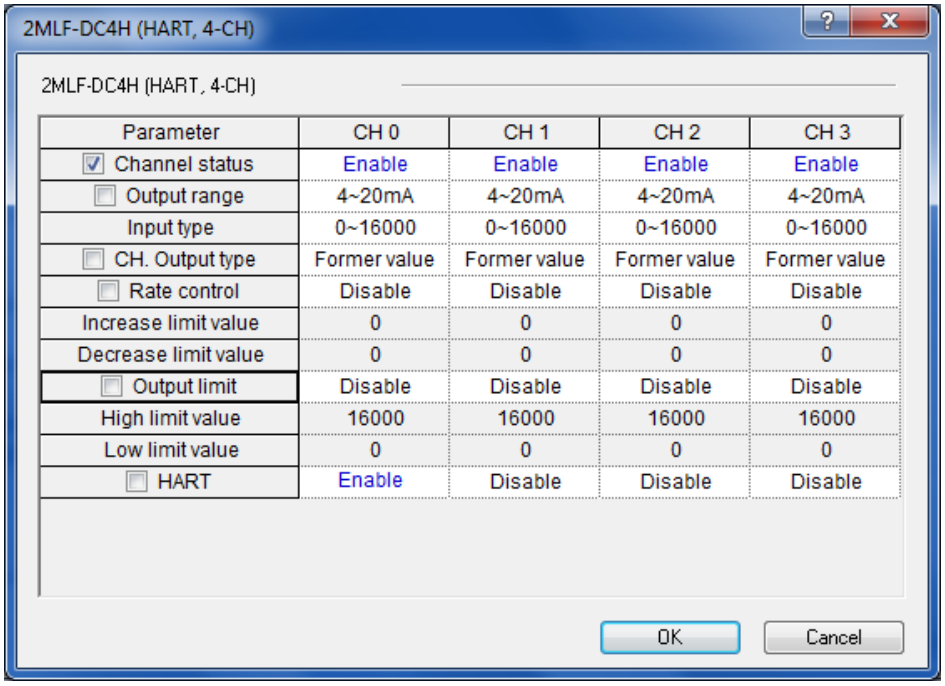
  Therefore, use HARTCLR command to delete HART command values.

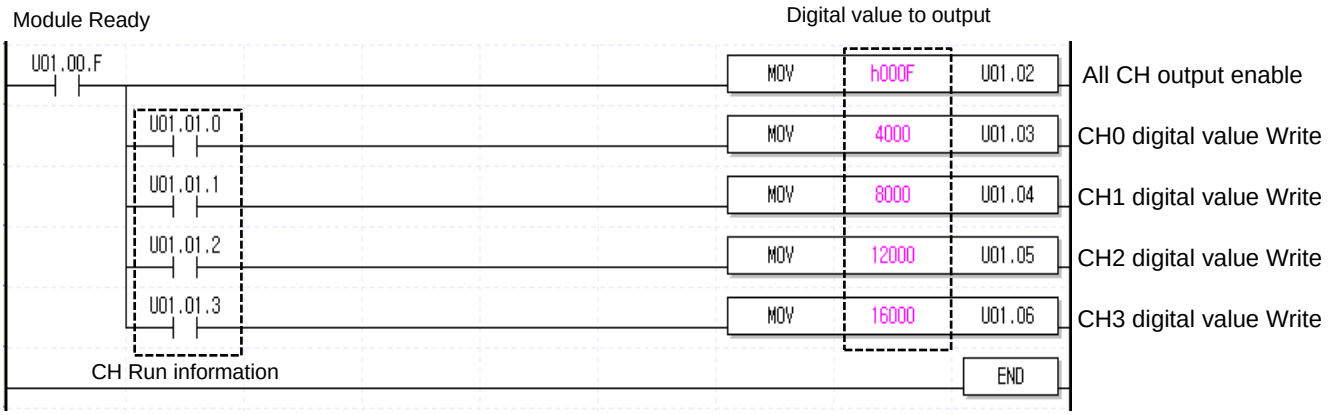
6.2 Basic Program

(1) How to specify Run condition details of HART analog output module's internal memory will be described.
(2) HART analog output module is as installed on slot 1.
(3) I/O assigned points of HART analog output module is 16 points.

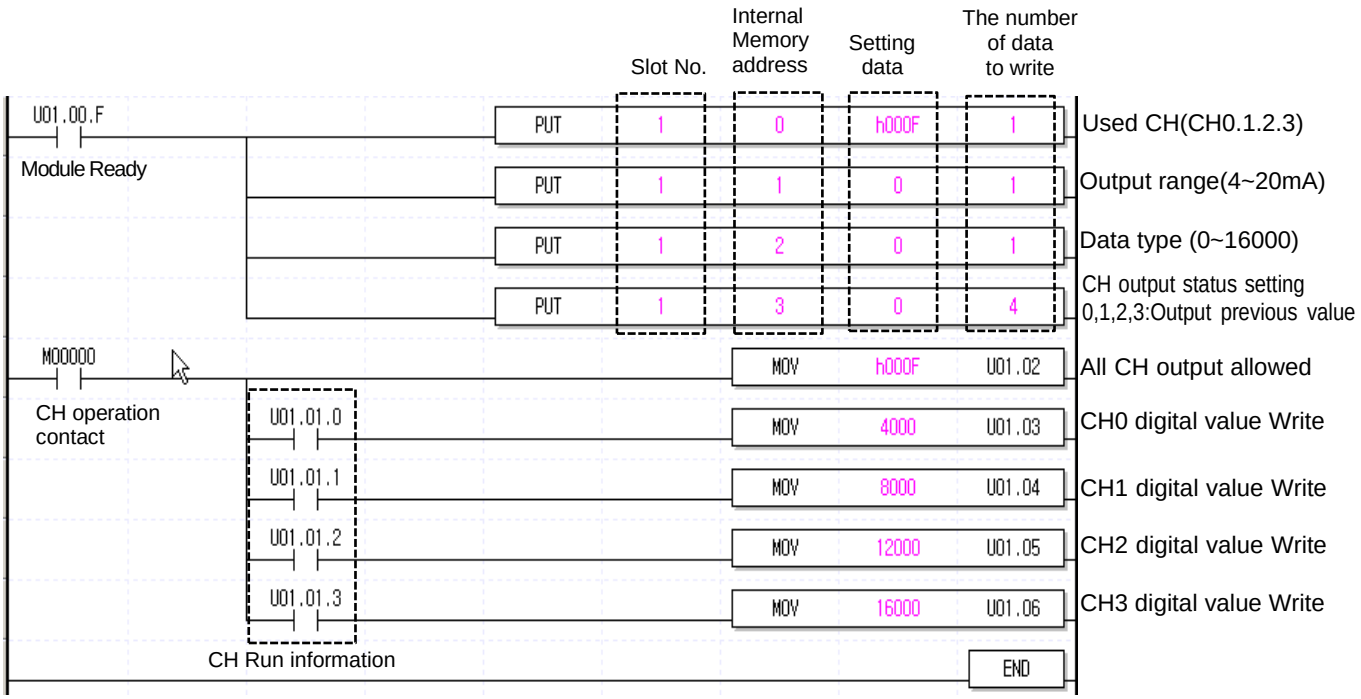
6.2.1 Basic program of 2MLF-DC4H

(1) Program example through [I/O parameter] setting





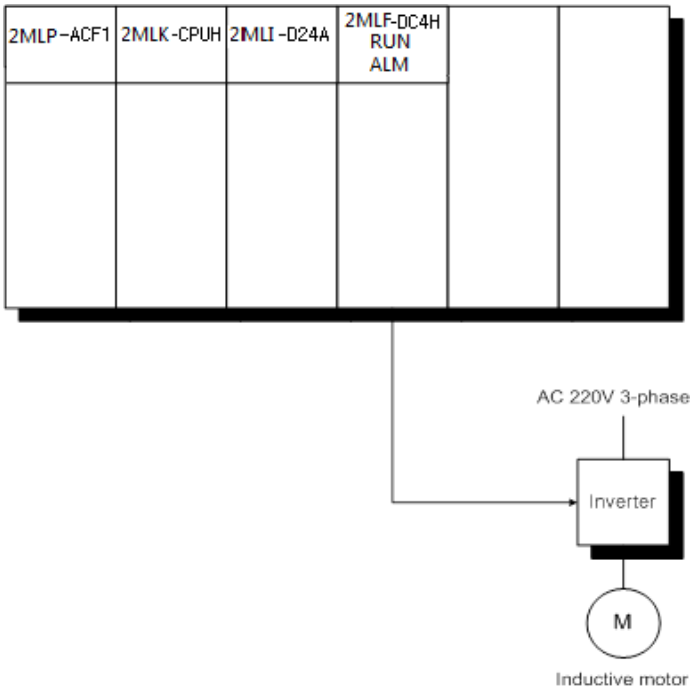
(2) Program example with PUT/GET instruction used



6.3 Application Program

6.3.1 Inverter speed control

(1) System Configuration



(2) Details of initial setting

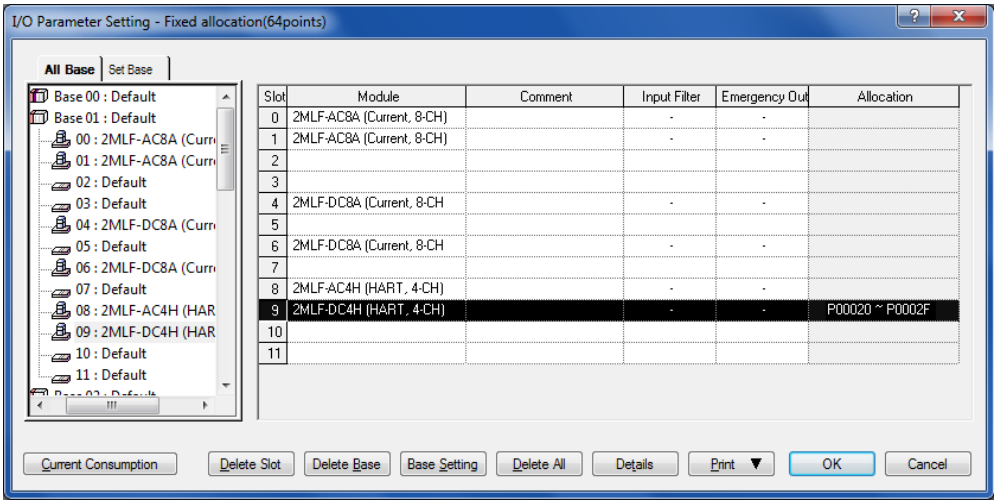
No	Parameters	Setting Details	Internal Memory Address
1	Channels	CH 0	0
2	Output voltage range	0 ~ 20 ㎃	1
3	Data type	0 ~ 16,000	2
4	Channel Output type	Previous value	3

(3) Description of program

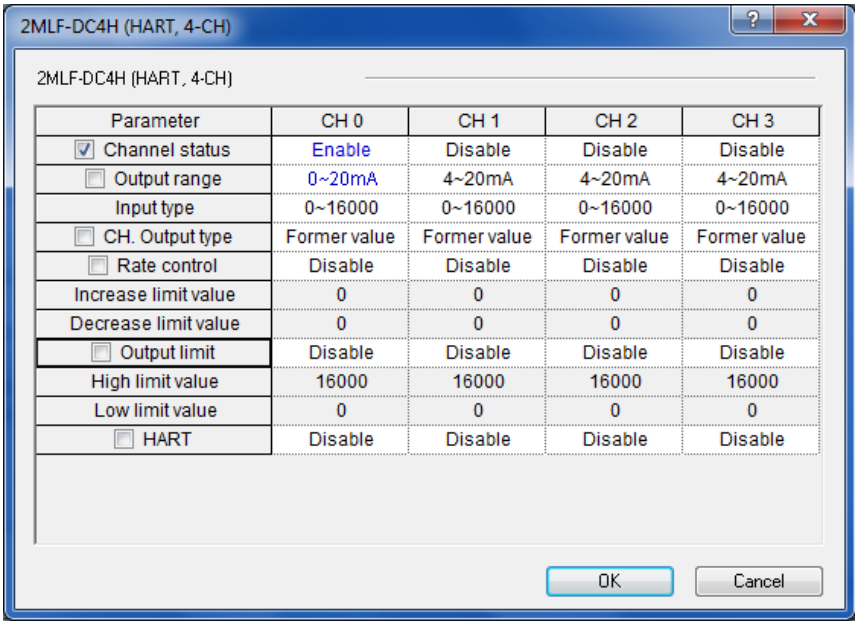
(a) At the same time Module Ready Contact is On, output of all the channels will be set to Allowed.
(b) If P0001 is On, 0 ㎃ will be output.
(c) If P0002 is Off and P0002 is On, 5 ㎃ will be output.
(d) If P0003 is Off and P0003 is On, 10 ㎃ will be output.
(e) If P0004 is Off and P0004 is On, 15 ㎃ will be output.

(4) Program

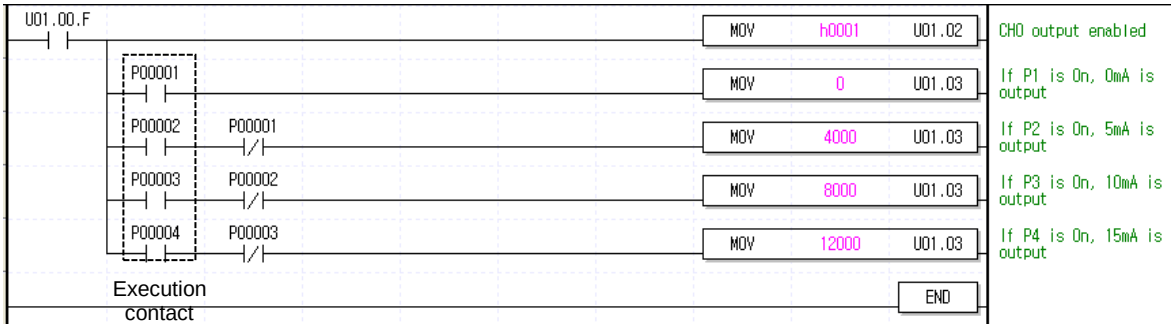
(a) Program example through I/O Parameters Setting.



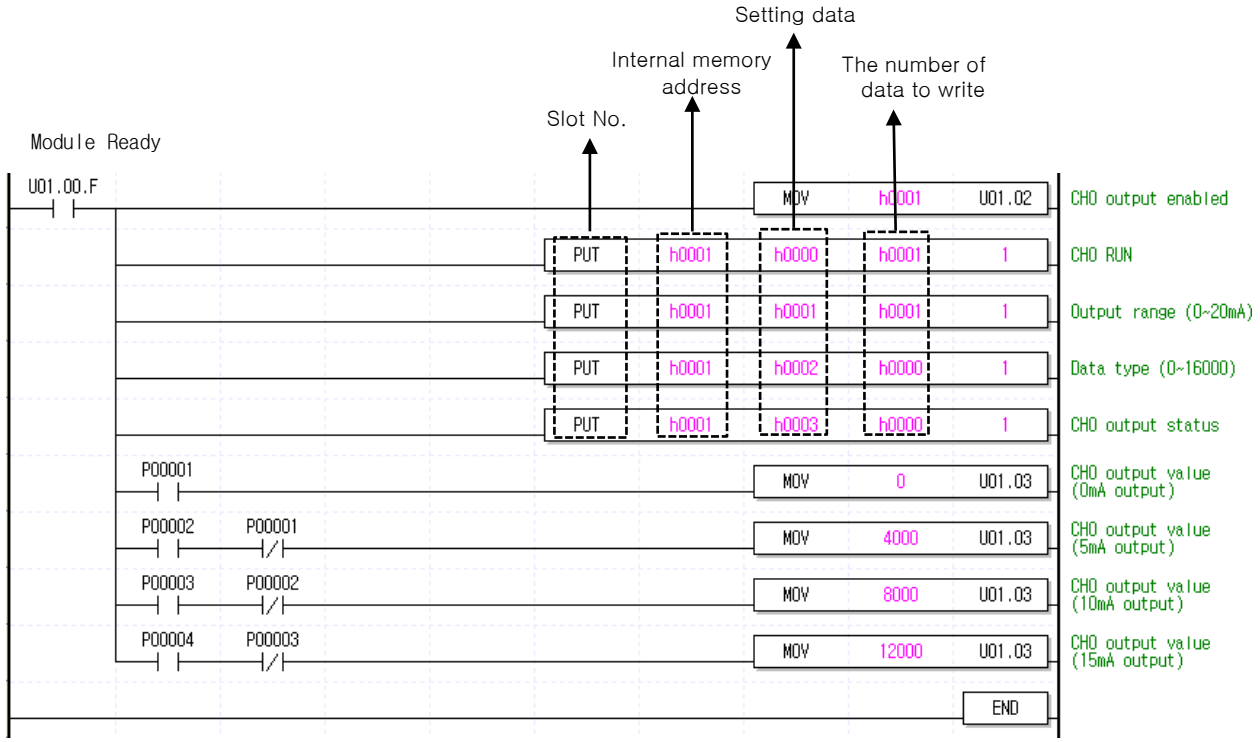
(b) Program



Module Ready

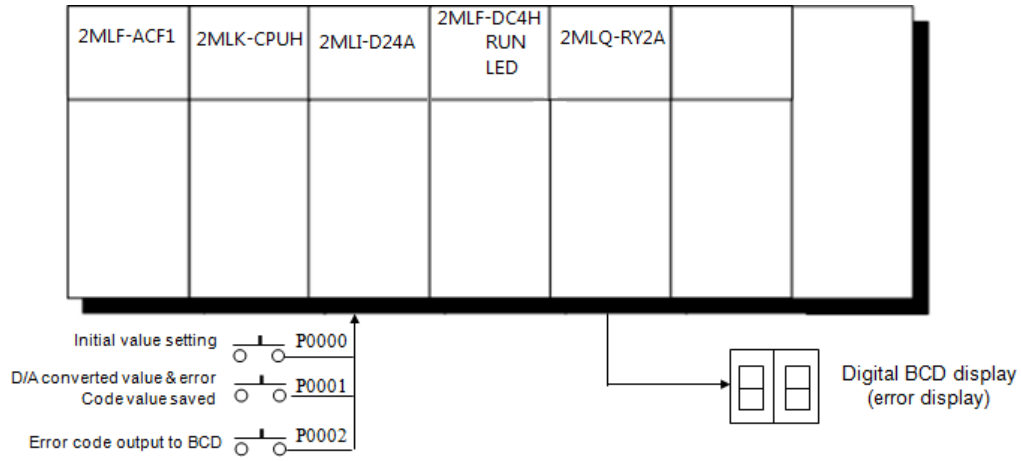


(c) Program example with PUT/GET instruction used



6.3.2 BCD output of error code

(1) System Configuration



(2) Details of initial setting

a) Used CH: CH 0, 1

b) Analog output current range: DC 4 ~ 20 mA

c) Digital input data range: 0 ~ 16000

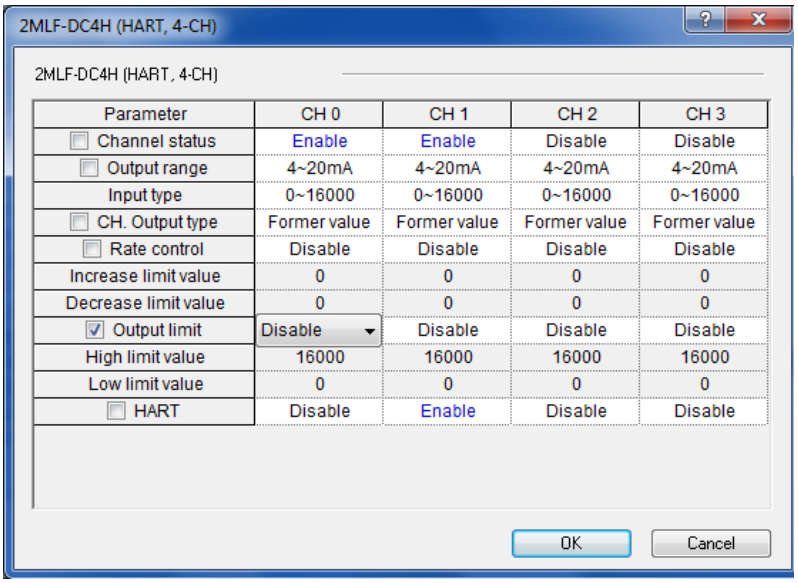
d) HART communication : CH1

(3) Description of program

a) If P00000 is On, D/A conversion will be initially specified.
b) If P00001 is On, save 8000 on channel0 output value and D00001 on error code.
c) If P00002 is On, applicable error code will be output to digital BCD display. (P00040 ~ P0004F)
d) If P00003 is On, save 12000 on channel1 output value and check commands after reading HART command 12 message.

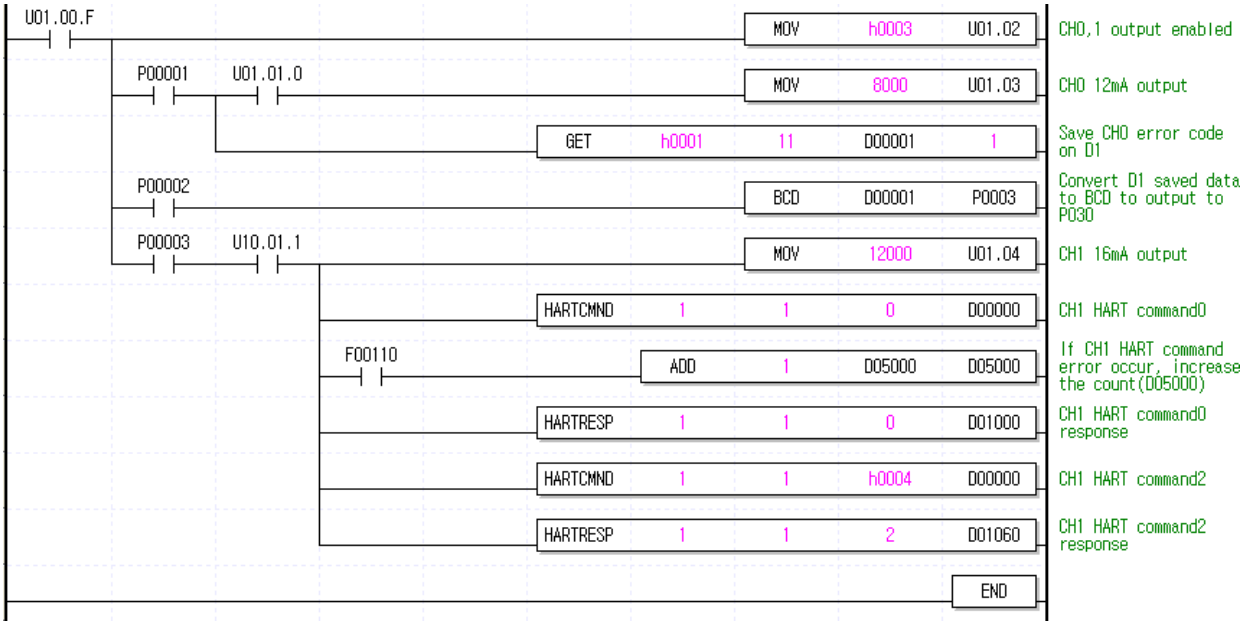
(4) Program

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

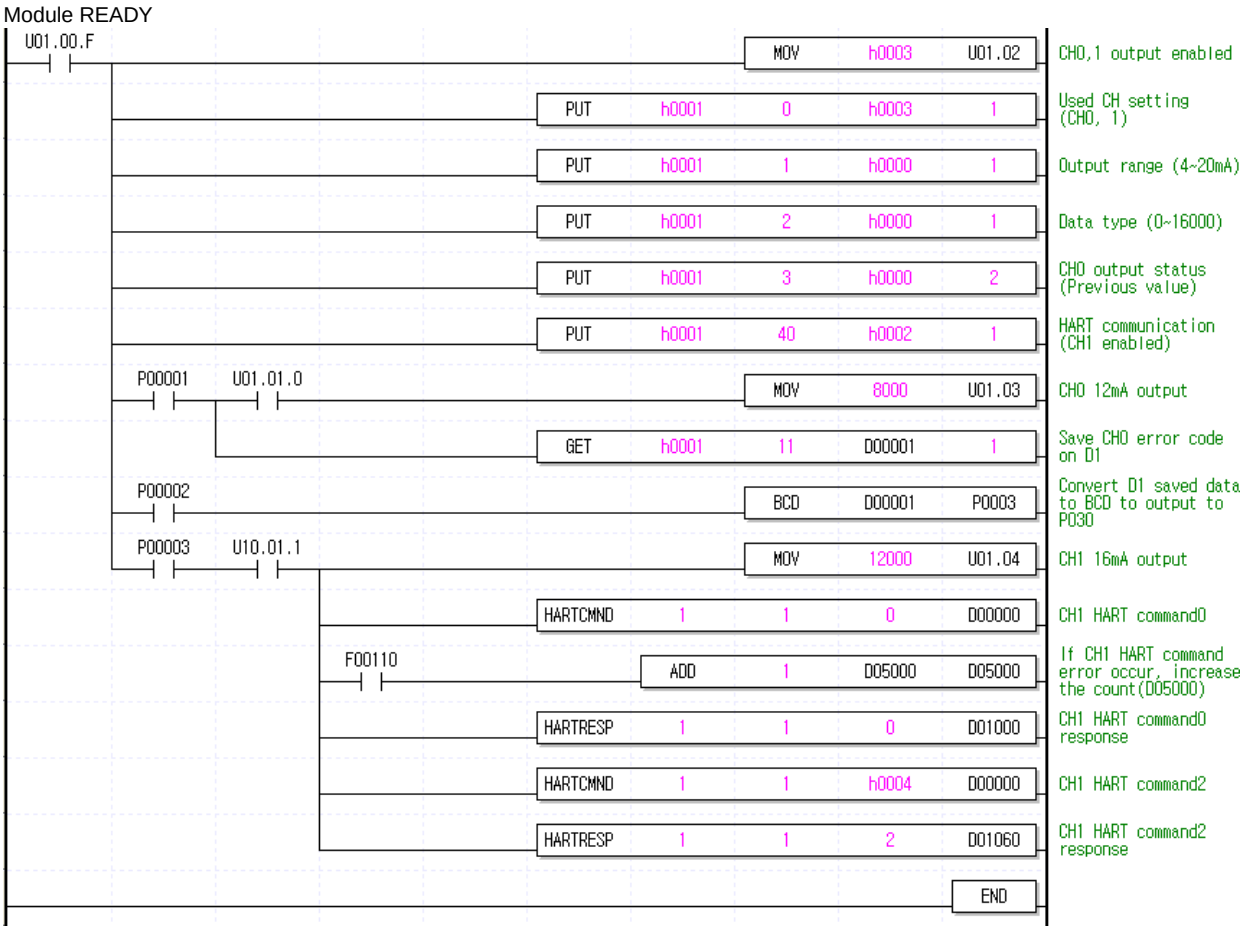


Parameter	CH 0	CH 1	CH 2	CH 3
Channel status	Enable	Enable	Disable	Disable
Output range	4~20mA	4~20mA	4~20mA	4~20mA
Input type	0~16000	0~16000	0~16000	0~16000
CH. Output type	Former value	Former value	Former value	Former value
Rate control	Disable	Disable	Disable	Disable
Increase limit value	0	0	0	0
Decrease limit value	0	0	0	0
Output limit	Disable	Disable	Disable	Disable
High limit value	16000	16000	16000	16000
Low limit value	0	0	0	0
HART	Disable	Enable	Disable	Disable

Module READY



(b) Program example with PUT/GET instruction used



- executing HART command 0 on channel 1

	PLC	Type	Device/Variable	Value	Comment
1	NewPLC	WORD	D01000	h00B4	CH0 Manufacturer ID
2	NewPLC	WORD	D01001	hB409	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	10	CH0 Device Specific Command Revision
6	NewPLC	WORD	D01005	2	CH0 Software Revision
7	NewPLC	WORD	D01006	2	CH0 Hartware Revision(x10)
8	NewPLC	WORD	D01007	0	CH0 Device Function Flag
9	NewPLC	WORD	D01008	h0A72	CH0 Device ID

* 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 1

	PLC	Type	Device/Variable	Value	Comment
1	NewPLC	REAL	D01030	1.998497391e+001	CH1 Primary Variable Loop Current(mA)
2	NewPLC	REAL	D01032	9.990608215e+001	CH1 Primary Variable Percent of Range

Chapter 7 Configuration and Function of Global Variable (For 2MLI/2MLR)

7.1 Global Variable (Data area)

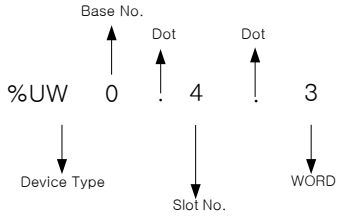
7.1.1 IO area configuration of HART analog output module

Indicates D/A conversion data IO area at table 7.1

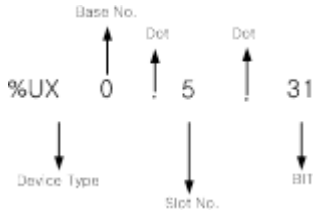
[Table 7. 1] A/D conversion data IO area

Global variable	Memory allocation	Contents	Read/Write
_xxyy_CH0_ERR	%UXxx.yy.0	CH0 error	Read
_xxyy_CH1_ERR	%UXxx.yy.1	CH1 error	
_xxyy_CH2_ERR	%UXxx.yy.2	CH2 error	
_xxyy_CH3_ERR	%UXxx.yy.3	CH3 error	
..	..	..	
_xxyy_CH0_HARTERR	%UXxx.yy.8	CH0 HART communication error	
_xxyy_CH1_HARTERR	%UXxx.yy.9	CH1 HART communication error	
_xxyy_CH2_HARTERR	%UXxx.yy.10	CH2 HART communication error	
_xxyy_CH3_HARTERR	%UXxx.yy.11	CH3 HART communication error	
..	..	..	
_xxyy_RDY	%UXxx.yy.15	Module READY flag	
_xxyy_CH0_ACT	%UXxx.yy.16	CH0 run flag	Read
_xxyy_CH1_ACT	%UXxx.yy.17	CH1 run flag	
_xxyy_CH2_ACT	%UXxx.yy.18	CH2 run flag	
_xxyy_CH3_ACT	%UXxx.yy.19	CH3 run flag	
..	..	..	
_xxyy_CH0_OUTH	%UXxx.yy.24	CH0 output high limit detection flag	
_xxyy_CH0_OUTL	%UXxx.yy.25	CH0 output low limit detection flag	
_xxyy_CH0_OUTH	%UXxx.yy.26	CH1 output high limit detection flag	
_xxyy_CH0_OUTL	%UXxx.yy.27	CH1 output low limit detection flag	
_xxyy_CH0_OUTH	%UXxx.yy.28	CH2 output high limit detection flag	
_xxyy_CH0_OUTL	%UXxx.yy.29	CH2 output low limit detection flag	
_xxyy_CH0_OUTH	%UXxx.yy.30	CH3 output high limit detection flag	
_xxyy_CH0_OUTL	%UXxx.yy.31	CH3 output low limit detection flag	
_xxyy_OUTEN	%UWxx.yy.2	Output status setting	Write
_xxyy_CH0_OUTEN	%UXxx.yy.31	CH0 output enable	
_xxyy_CH1_OUTEN	%UXxx.yy.32	CH1 output enable	
_xxyy_CH2_OUTEN	%UXxx.yy.33	CH2 output enable	
_xxyy_CH3_OUTEN	%UXxx.yy.34	CH3 output enable	
_xxyy_CH0_DATA	%UWxx.yy.3	CH0 Digital input value	
_xxyy_CH1_DATA	%UWxx.yy.4	CH1 Digital input value	
_xxyy_CH2_DATA	%UWxx.yy.5	CH2 Digital input value	
_xxyy_CH3_DATA	%UWxx.yy.6	CH3 Digital input value	

(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 'CH0 digital input value' of HART Analog Output Module installed at base 0, slot 4, expression is %UW0.4.3.



(3) To read 'CH3 output low limit detection flag' of Analog Input Module installed at base 0, slot 5, expression is %UX0.5.31.



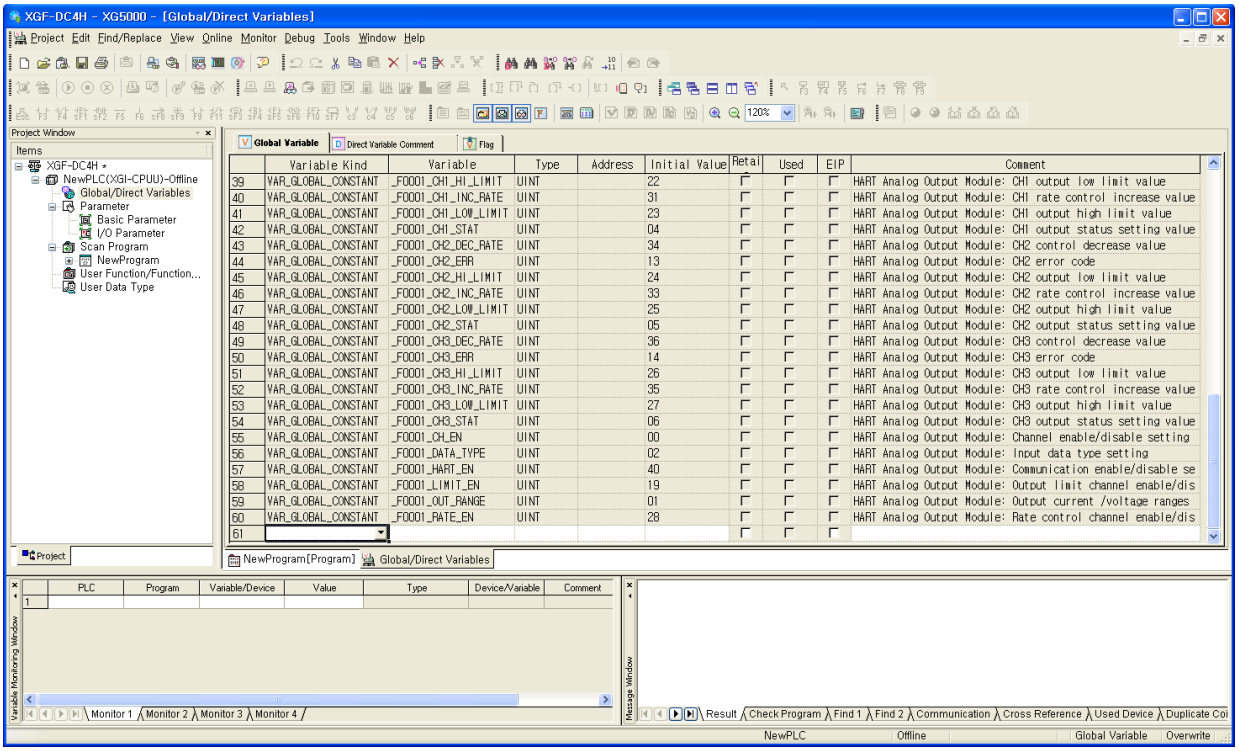
7.1.2 How to use global variable

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

In order to register global variable, there are two method, auto registration after settingI/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- DC4H 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
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]
3. Local variable registration
   - Registers variable among registered global variable you want to use as localvariable.
     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 “AddEXTERNAL variable”.
     c) Select local variable to add at Global View on “Add External Variable” window(“All” or “Base, slot”).

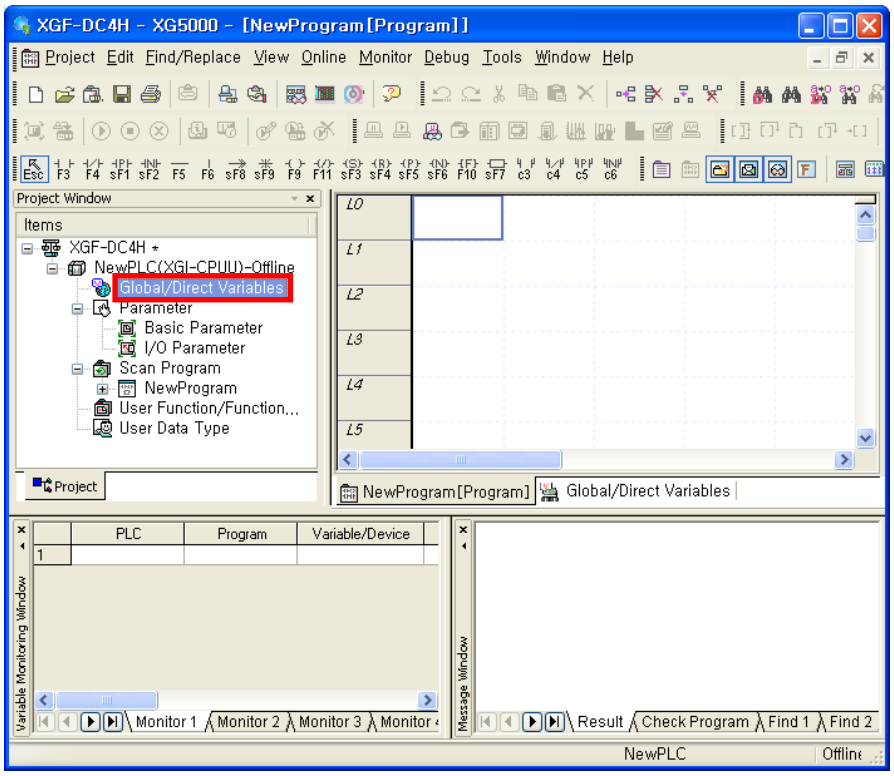
- View All
- View per base, slot
  a) The following is an example for selecting digital input value(_0000_CH0_DATA) of “Base00, Slot01”.


XGF-DC4H - XG5000 - [Global/Direct Variables]
Project Edit Find/Replace View Online Monitor Debug Tools Window Help
Project Window
Items
XGF-DC4H *
NewPLC(XGI-CPUU)-Offline
Global/Direct Variables
Parameter
Basic Parameter
I/O Parameter
Scan Program
NewProgram
User Function/Function...
User Data Type
Global Variable
Direct Variable Comment
Flag
Variable Kind | Variable | Type | Address | Initial Value | Retai | Used | EIP | Comment
39 VAR_GLOBAL_CONSTANT _F0001_CH1_HI_LIMIT UINT 22 HART Analog Output Module: CH1 output low limit value
40 VAR_GLOBAL_CONSTANT _F0001_CH1_INC_RATE UINT 31 HART Analog Output Module: CH1 rate control increase value
41 VAR_GLOBAL_CONSTANT _F0001_CH1_LOW_LIMIT UINT 23 HART Analog Output Module: CH1 output high limit value
42 VAR_GLOBAL_CONSTANT _F0001_CH1_STAT UINT 04 HART Analog Output Module: CH1 output status setting value
43 VAR_GLOBAL_CONSTANT _F0001_CH2_DEC_RATE UINT 34 HART Analog Output Module: CH2 control decrease value
44 VAR_GLOBAL_CONSTANT _F0001_CH2_ERR UINT 13 HART Analog Output Module: CH2 error code
45 VAR_GLOBAL_CONSTANT _F0001_CH2_HI_LIMIT UINT 24 HART Analog Output Module: CH2 output low limit value
46 VAR_GLOBAL_CONSTANT _F0001_CH2_INC_RATE UINT 33 HART Analog Output Module: CH2 rate control increase value
47 VAR_GLOBAL_CONSTANT _F0001_CH2_LOW_LIMIT UINT 25 HART Analog Output Module: CH2 output high limit value
48 VAR_GLOBAL_CONSTANT _F0001_CH2_STAT UINT 05 HART Analog Output Module: CH2 output status setting value
49 VAR_GLOBAL_CONSTANT _F0001_CH3_DEC_RATE UINT 36 HART Analog Output Module: CH3 control decrease value
50 VAR_GLOBAL_CONSTANT _F0001_CH3_ERR UINT 14 HART Analog Output Module: CH3 error code
51 VAR_GLOBAL_CONSTANT _F0001_CH3_HI_LIMIT UINT 26 HART Analog Output Module: CH3 output low limit value
52 VAR_GLOBAL_CONSTANT _F0001_CH3_INC_RATE UINT 35 HART Analog Output Module: CH3 rate control increase value
53 VAR_GLOBAL_CONSTANT _F0001_CH3_LOW_LIMIT UINT 27 HART Analog Output Module: CH3 output high limit value
54 VAR_GLOBAL_CONSTANT _F0001_CH3_STAT UINT 06 HART Analog Output Module: CH3 output status setting value
55 VAR_GLOBAL_CONSTANT _F0001_CH_EN UINT 00 HART Analog Output Module: Channel enable/disable setting
56 VAR_GLOBAL_CONSTANT _F0001_DATA_TYPE UINT 02 HART Analog Output Module: Input data type setting
57 VAR_GLOBAL_CONSTANT _F0001_HART_EN UINT 40 HART Analog Output Module: Communication enable/disable se
58 VAR_GLOBAL_CONSTANT _F0001_LIMIT_EN UINT 19 HART Analog Output Module: Output limit channel enable/dis
59 VAR_GLOBAL_CONSTANT _F0001_OUT_RANGE UINT 01 HART Analog Output Module: Output current /voltage ranges
60 VAR_GLOBAL_CONSTANT _F0001_RATE_EN UINT 28 HART Analog Output Module: Rate control channel enable/dis
61
Project
NewProgram[Program]
Global/Direct Variables
PLC | Program | Variable/Device | Value | Type | Device/Variable | Comment
Monitor 1 Monitor 2 Monitor 3 Monitor 4
Result Check Program Find 1 Find 2 Communication Cross Reference Used Device Duplicate Coi
NewPLC
Offline
Global Variable
Overwrite

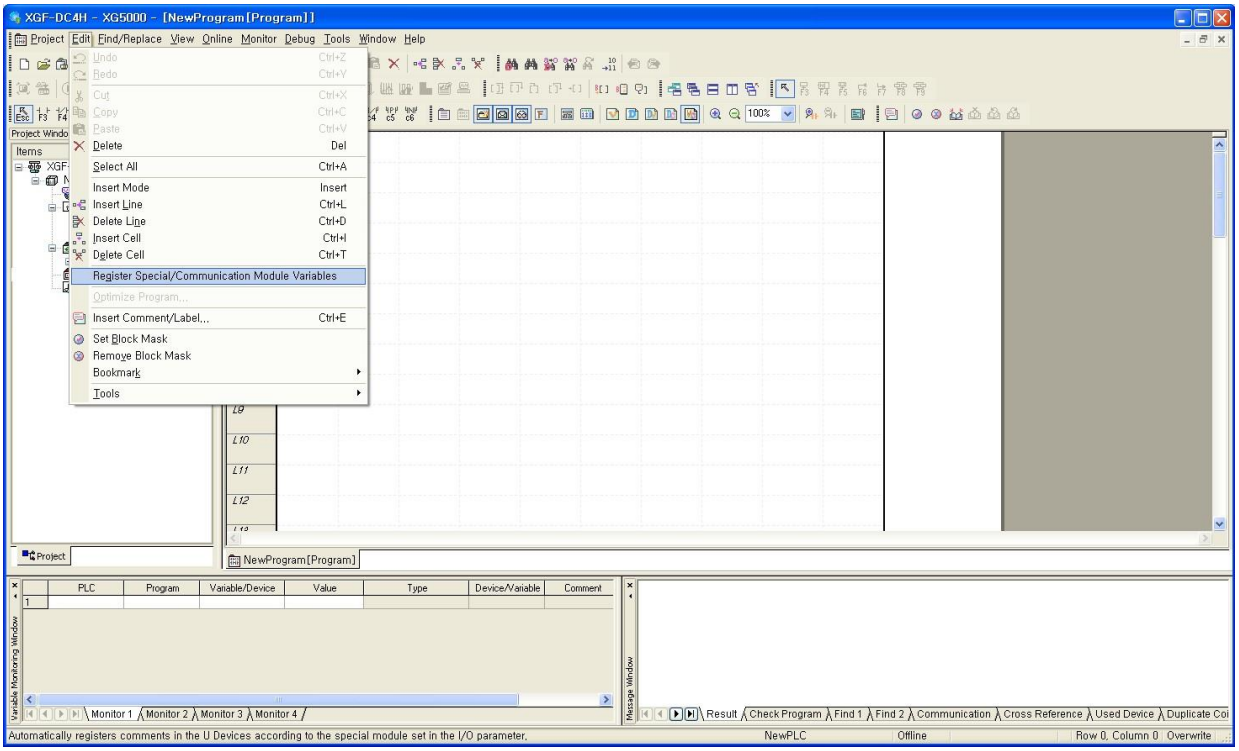
(1) Global variable registration

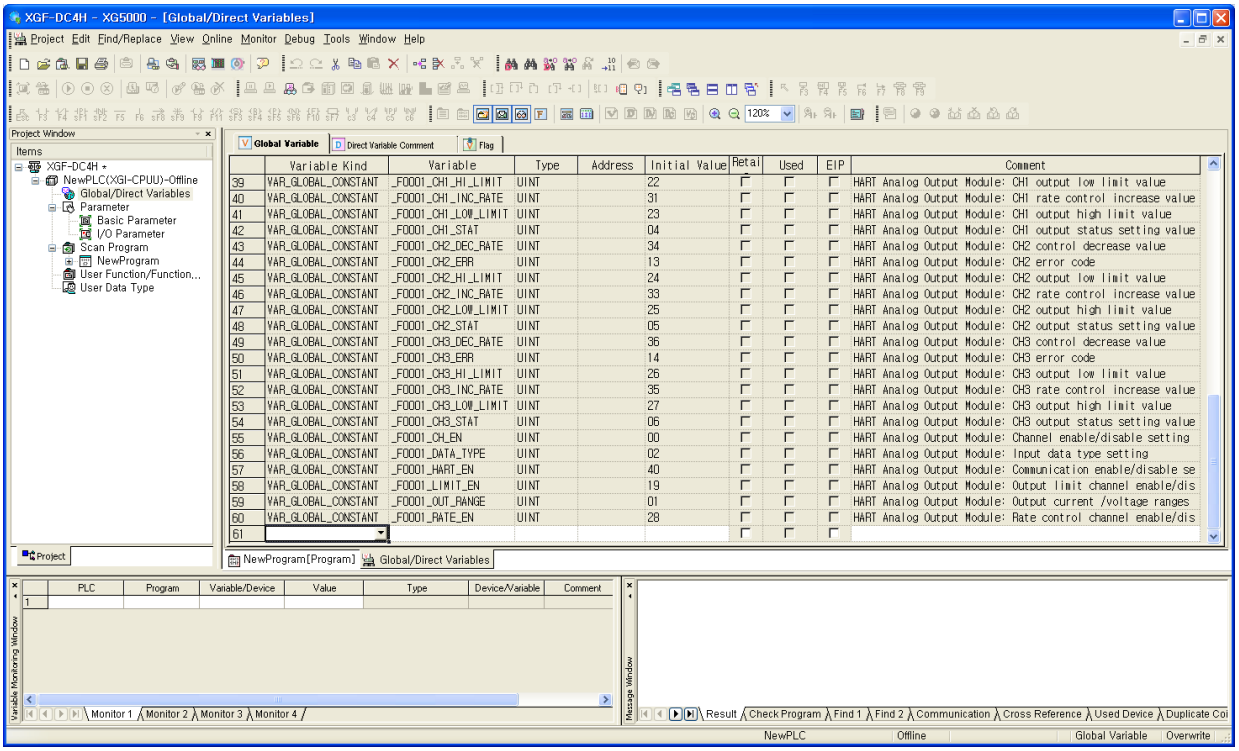
- Registers global variable set in I/O parameter

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



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

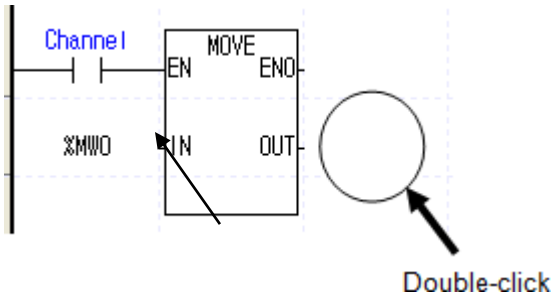



XGF-DC4H - XG5000 - [Global/Direct Variables]
Project Edit Find/Replace View Online Monitor Debug Tools Window Help
Project Window
Items
XGF-DC4H +
NewPLC(XGI-CPUU)-Offline
Global/Direct Variables
Parameter
Basic Parameter
I/O Parameter
Scan Program
NewProgram
User Function/Function...
User Data Type
Global Variable
Direct Variable Comment
Flag
Variable Kind | Variable | Type | Address | Initial Value | Retai | Used | EIP | Comment
39 VAR_GLOBAL_CONSTANT _FOOD1_CH1_HI_LIMIT UINT 22 HART Analog Output Module: CH1 output low limit value
40 VAR_GLOBAL_CONSTANT _FOOD1_CH1_INC_RATE UINT 31 HART Analog Output Module: CH1 rate control increase value
41 VAR_GLOBAL_CONSTANT _FOOD1_CH1_LOW_LIMIT UINT 23 HART Analog Output Module: CH1 output high limit value
42 VAR_GLOBAL_CONSTANT _FOOD1_CH1_STAT UINT 04 HART Analog Output Module: CH1 output status setting value
43 VAR_GLOBAL_CONSTANT _FOOD1_CH2_DEC_RATE UINT 34 HART Analog Output Module: CH2 control decrease value
44 VAR_GLOBAL_CONSTANT _FOOD1_CH2_ERR UINT 13 HART Analog Output Module: CH2 error code
45 VAR_GLOBAL_CONSTANT _FOOD1_CH2_HI_LIMIT UINT 24 HART Analog Output Module: CH2 output low limit value
46 VAR_GLOBAL_CONSTANT _FOOD1_CH2_INC_RATE UINT 33 HART Analog Output Module: CH2 rate control increase value
47 VAR_GLOBAL_CONSTANT _FOOD1_CH2_LOW_LIMIT UINT 25 HART Analog Output Module: CH2 output high limit value
48 VAR_GLOBAL_CONSTANT _FOOD1_CH2_STAT UINT 05 HART Analog Output Module: CH2 output status setting value
49 VAR_GLOBAL_CONSTANT _FOOD1_CH3_DEC_RATE UINT 36 HART Analog Output Module: CH3 control decrease value
50 VAR_GLOBAL_CONSTANT _FOOD1_CH3_ERR UINT 14 HART Analog Output Module: CH3 error code
51 VAR_GLOBAL_CONSTANT _FOOD1_CH3_HI_LIMIT UINT 26 HART Analog Output Module: CH3 output low limit value
52 VAR_GLOBAL_CONSTANT _FOOD1_CH3_INC_RATE UINT 35 HART Analog Output Module: CH3 rate control increase value
53 VAR_GLOBAL_CONSTANT _FOOD1_CH3_LOW_LIMIT UINT 27 HART Analog Output Module: CH3 output high limit value
54 VAR_GLOBAL_CONSTANT _FOOD1_CH3_STAT UINT 06 HART Analog Output Module: CH3 output status setting value
55 VAR_GLOBAL_CONSTANT _FOOD1_CH_EN UINT 00 HART Analog Output Module: Channel enable/disable setting
56 VAR_GLOBAL_CONSTANT _FOOD1_DATA_TYPE UINT 02 HART Analog Output Module: Input data type setting
57 VAR_GLOBAL_CONSTANT _FOOD1_HART_EN UINT 40 HART Analog Output Module: Communication enable/disable se
58 VAR_GLOBAL_CONSTANT _FOOD1_LIMIT_EN UINT 19 HART Analog Output Module: Output limit channel enable/dis
59 VAR_GLOBAL_CONSTANT _FOOD1_OUT_RANGE UINT 01 HART Analog Output Module: Output current /voltage ranges
60 VAR_GLOBAL_CONSTANT _FOOD1_RATE_EN UINT 28 HART Analog Output Module: Rate control channel enable/dis
61
Project
NewProgram[Program]
Global/Direct Variables
PLC | Program | Variable/Device | Value | Type | Device/Variable | Comment
Variable Monitoring Window
Monitor 1 Monitor 2 Monitor 3 Monitor 4
Message Window
Result Check Program Find 1 Find 2 Communication Cross Reference Used Device Duplicate Coi
NewPLC
Offline
Global Variable
Overwrite

4. How to use local variable on program

- It describes the added global variable at local program.
- The following is an example for getting the conversion value of CH0 of AnalogInput Module to %MW0.

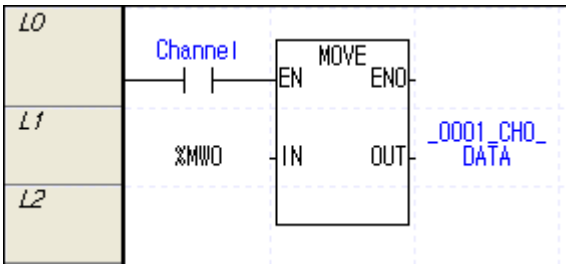
a) At part reading A/D conversion data to %MW0 by using the following MOVEfunction, double-click variable part ahead of IN, then “Select Variable” window shows up.



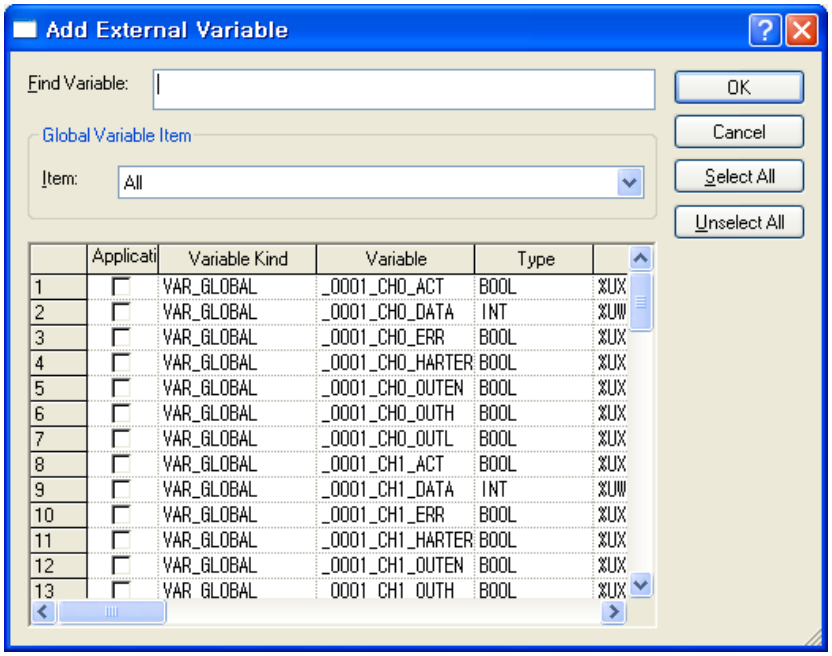
b) Select global variable at variable type at Select Variable window. And selectrelevant base (0 base, 0 slot) at global variable view item.

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

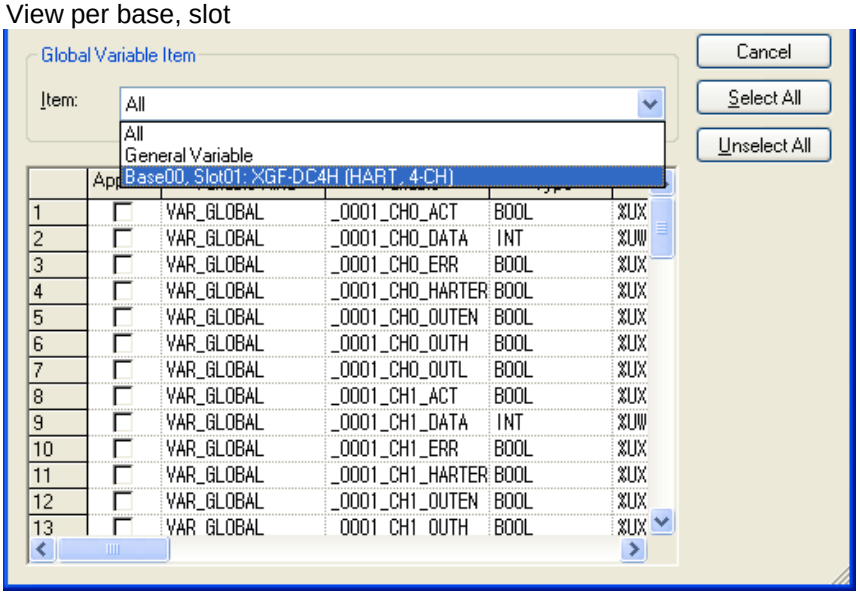
d) The following figure is result adding global variable corresponding to CH0A/D conversion value.



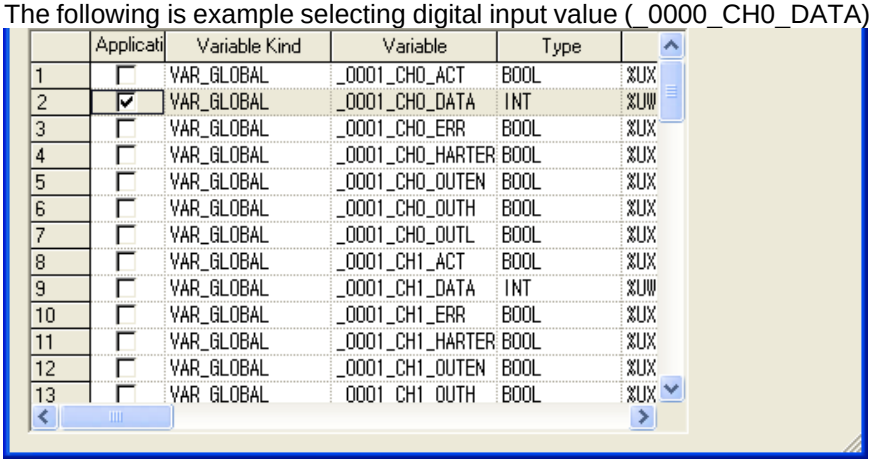
-View All

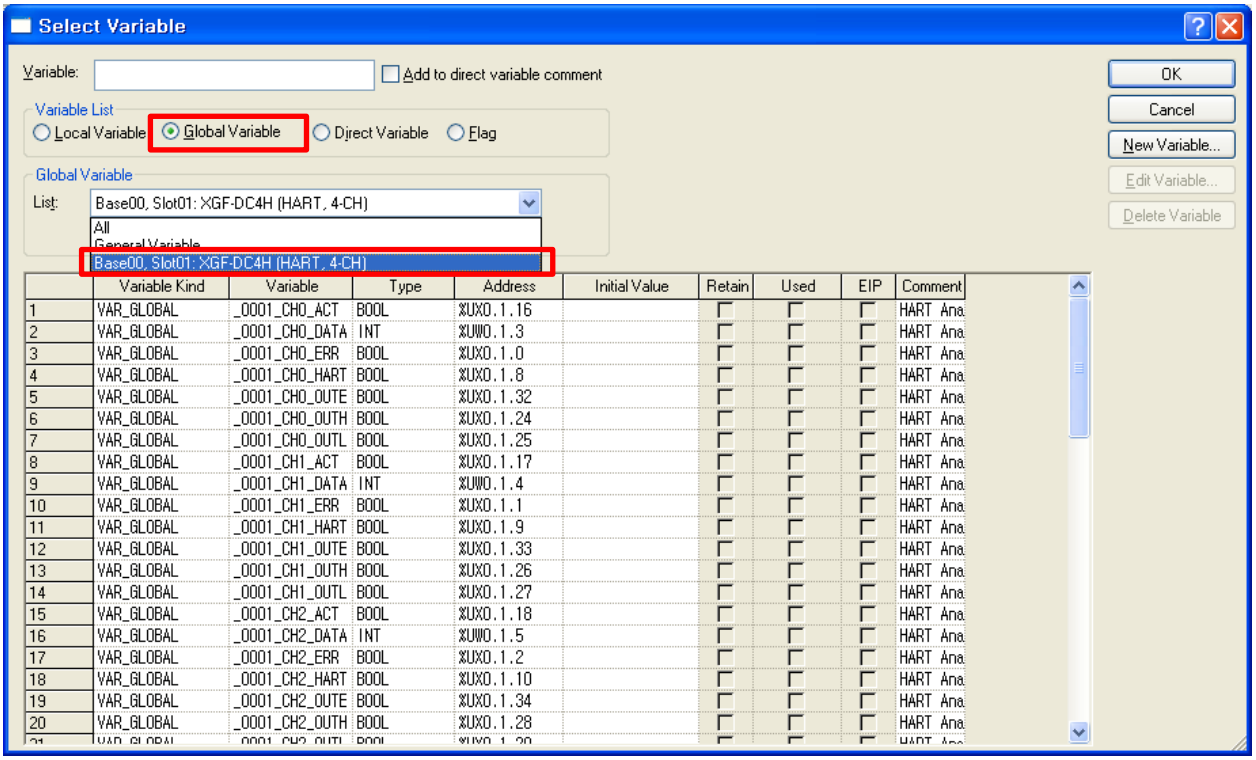


- View per base, slot



(c) The following is example selecting digital input value (_0000_CH0_DATA) of “Base00, Slot01”.





	Variable Kind	Variable	Type	Address	Initial Value	Retain	Used	EIP	Comment
1	VAR_GLOBAL	_0001_CH0_ACT	BOOL	%UX0.1.16					HART Ana
2	VAR_GLOBAL	_0001_CH0_DATA	INT	%UW0.1.3					HART Ana
3	VAR_GLOBAL	_0001_CH0_ERR	BOOL	%UX0.1.0					HART Ana
4	VAR_GLOBAL	_0001_CH0_HART	BOOL	%UX0.1.8					HART Ana
5	VAR_GLOBAL	_0001_CH0_OUTE	BOOL	%UX0.1.32					HART Ana
6	VAR_GLOBAL	_0001_CH0_OUTH	BOOL	%UX0.1.24					HART Ana
7	VAR_GLOBAL	_0001_CH0_OUTL	BOOL	%UX0.1.25					HART Ana
8	VAR_GLOBAL	_0001_CH1_ACT	BOOL	%UX0.1.17					HART Ana
9	VAR_GLOBAL	_0001_CH1_DATA	INT	%UW0.1.4					HART Ana
10	VAR_GLOBAL	_0001_CH1_ERR	BOOL	%UX0.1.1					HART Ana
11	VAR_GLOBAL	_0001_CH1_HART	BOOL	%UX0.1.9					HART Ana
12	VAR_GLOBAL	_0001_CH1_OUTE	BOOL	%UX0.1.33					HART Ana
13	VAR_GLOBAL	_0001_CH1_OUTH	BOOL	%UX0.1.26					HART Ana
14	VAR_GLOBAL	_0001_CH1_OUTL	BOOL	%UX0.1.27					HART Ana
15	VAR_GLOBAL	_0001_CH2_ACT	BOOL	%UX0.1.18					HART Ana
16	VAR_GLOBAL	_0001_CH2_DATA	INT	%UW0.1.5					HART Ana
17	VAR_GLOBAL	_0001_CH2_ERR	BOOL	%UX0.1.2					HART Ana
18	VAR_GLOBAL	_0001_CH2_HART	BOOL	%UX0.1.10					HART Ana
19	VAR_GLOBAL	_0001_CH2_OUTE	BOOL	%UX0.1.34					HART Ana
20	VAR_GLOBAL	_0001_CH2_OUTH	BOOL	%UX0.1.28					HART Ana

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 HART Analog Output Module at table 7.2.

[Table 7. 2] Operation parameter setting area

Global variable	Contents	R/W	Instruction
_Fxxyy_CH_EN _Fxxyy_OUT_RANGE _Fxxyy_DATA_TYPE	Set alarm process Set average process method Set channel to use	R/W	PUT
_Fxxyy_CH0_STAT _Fxxyy_CH0_HI_LIMIT _Fxxyy_CH0_LOW_LIMIT _Fxxyy_CH0_INC_RATE _Fxxyy_CH0_DEC_RATE	CH0 output status setting CH0 output high limit CH0 output low limit CH0 change rate increase value CH0 change rate decrease value	R/W	PUT
_Fxxyy_CH0_STAT _Fxxyy_CH0_HI_LIMIT _Fxxyy_CH0_LOW_LIMIT _Fxxyy_CH0_INC_RATE _Fxxyy_CH0_DEC_RATE	CH0 output status setting CH0 output high limit CH0 output low limit CH0 change rate increase value CH0 change rate decrease value	R/W	PUT
_Fxxyy_CH0_STAT _Fxxyy_CH0_HI_LIMIT _Fxxyy_CH0_LOW_LIMIT _Fxxyy_CH0_INC_RATE _Fxxyy_CH0_DEC_RATE	CH0 output status setting CH0 output high limit CH0 output low limit CH0 change rate increase value CH0 change rate decrease value	R/W	PUT
_Fxxyy_CH0_STAT _Fxxyy_CH0_HI_LIMIT _Fxxyy_CH0_LOW_LIMIT _Fxxyy_CH0_INC_RATE _Fxxyy_CH0_DEC_RATE	CH0 output status setting CH0 output high limit CH0 output low limit CH0 change rate increase value CH0 change rate decrease value	R/W	PUT
_Fxxyy_LIMIT_EN _Fxxyy_RATE_EN _Fxxyy_HART_EN	Channel output limit setting Channel change rate control setting HART communication setting	R/W	PUT
_Fxxyy_CH0_ERR _Fxxyy_CH1_ERR _Fxxyy_CH2_ERR _Fxxyy_CH3_ERR	CH0 error code CH1 error code CH2 error code CH3 error code	R	GET

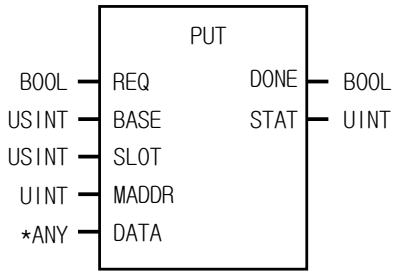
※ At device allocation, xx means base number and yy means slot number where module is equipped.

7.2.2 PUT/GET instruction

(1) PUT instruction

PUT

Writing data to special module

Function Block	Description
	**Input** REQ : EXECute function when 1BASE : 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**

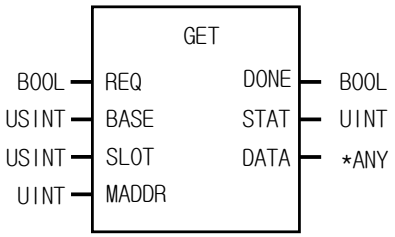
Read data from designated special module

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 1BASE : 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

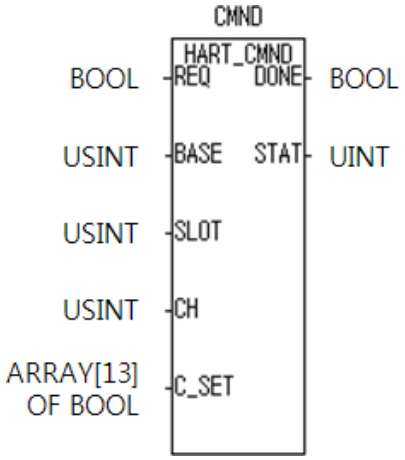
Function Block	Output(ANY) type	Description
GET_WORD	WORD	Read data as much as WORD from the designated module address (MADDR).
GET_DWORD	DWORD	Read data as much as DWORD from the designated module address (MADDR).
GET_INT	INT	Read data as much as INT from the designated Module address (MADDR).
GET_UINT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

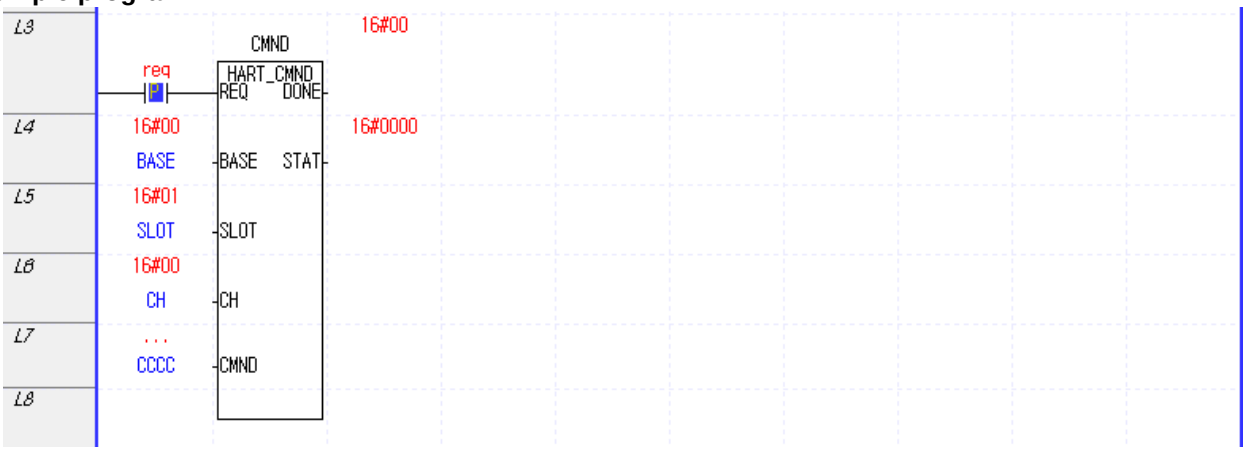
(a) It is used to set a command to be communicated regarding to the designated module's channel.

(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.

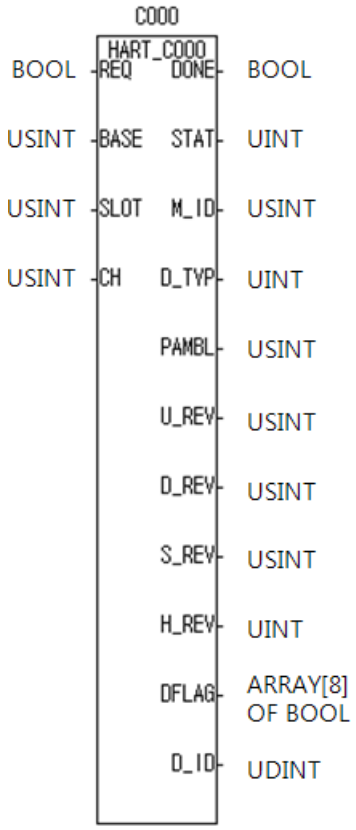
■Example program



(2) HART_C000 command

HART_C000

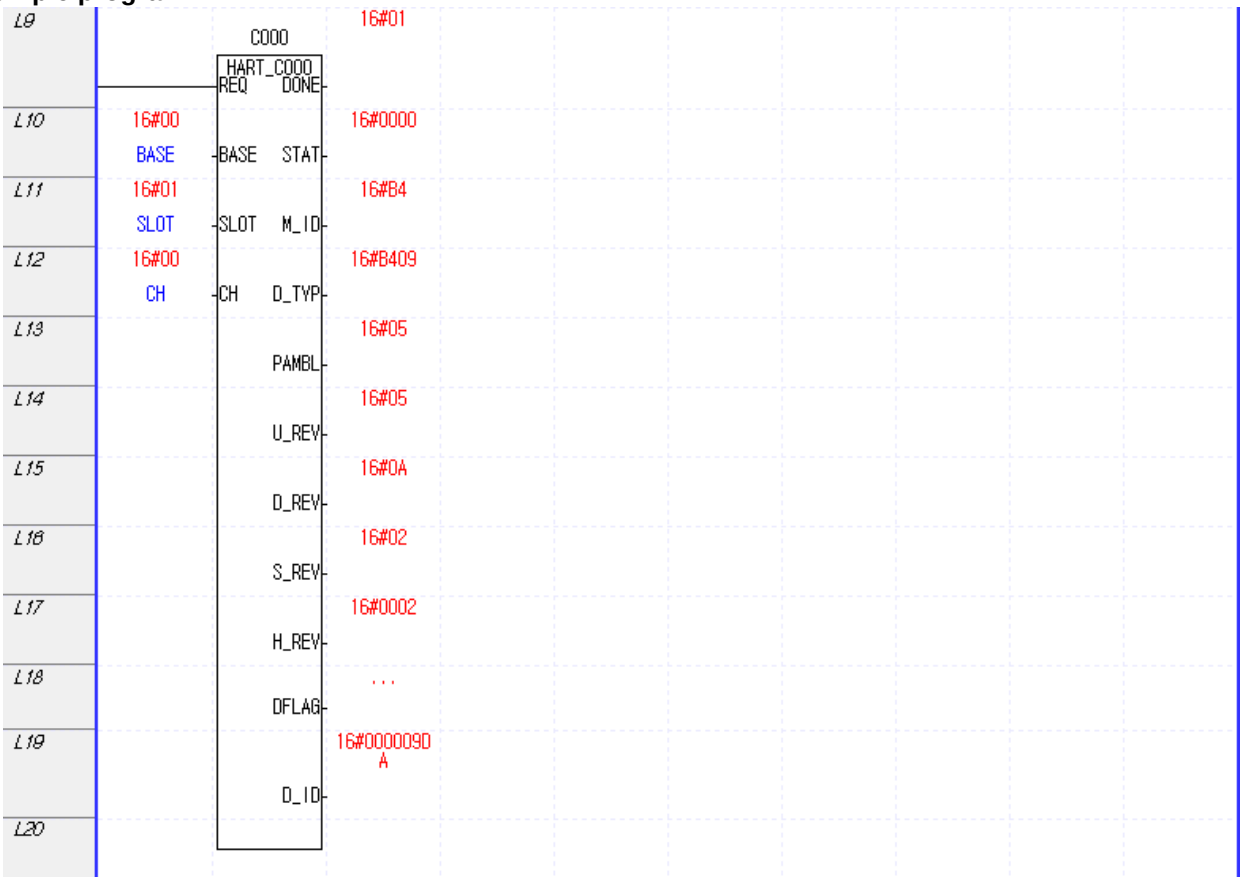
Read response to Universal Command 0

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 will be displayed 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.

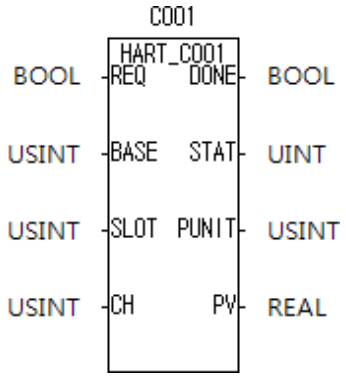
■**Example program**



(3) HART_C001 Command

HART_C001

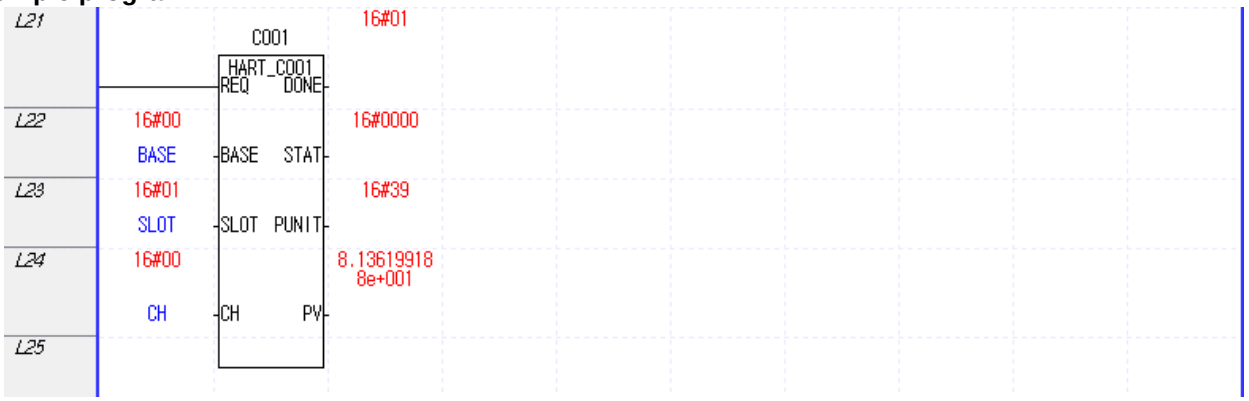
Read response to Universal Command 1

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.

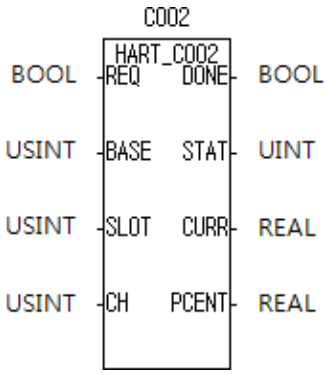
■**Example program**



(4) HART_C002 command

HART_C002

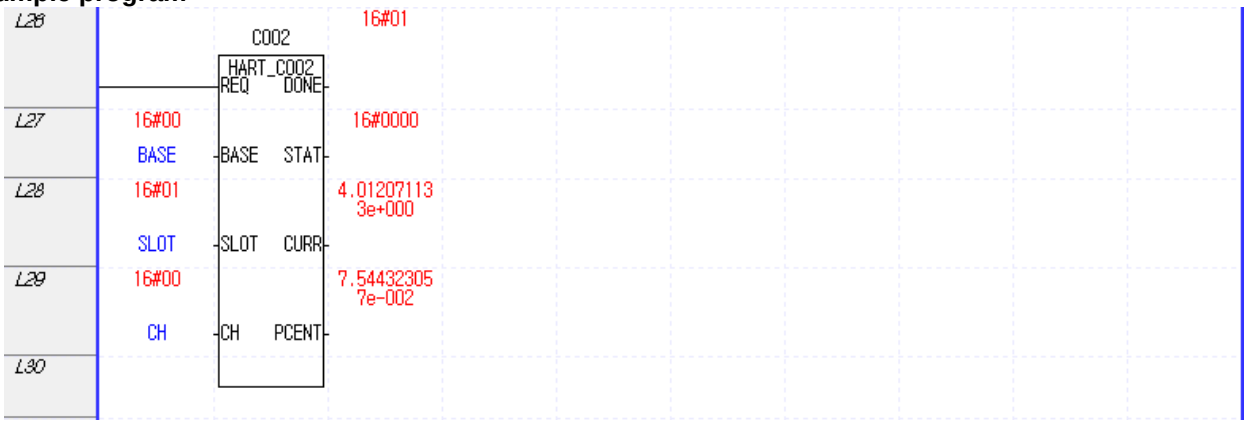
Read response to Universal Command 2

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.

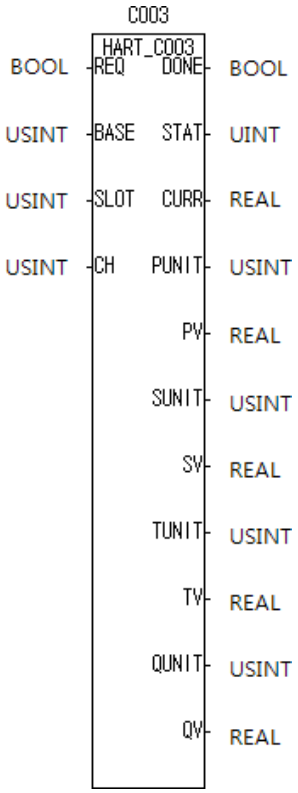
■**Example program**



(5) HART_C003 command

HART_C003

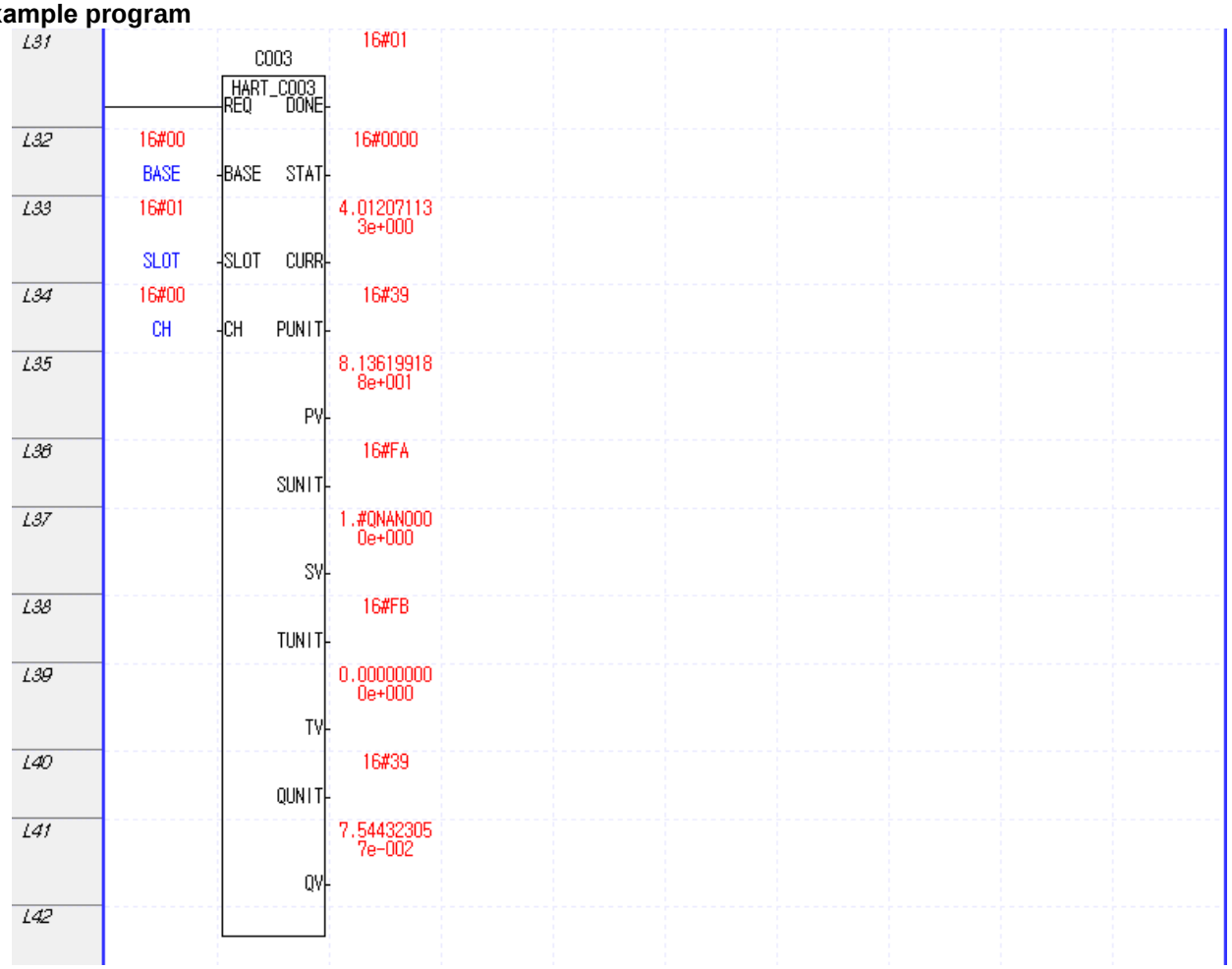
Read response to Universal Command 3

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.

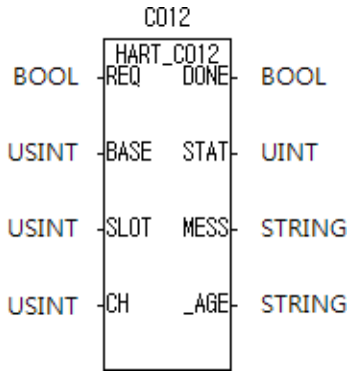
■**Example program**



(6) HART_C012 command

HART_C012

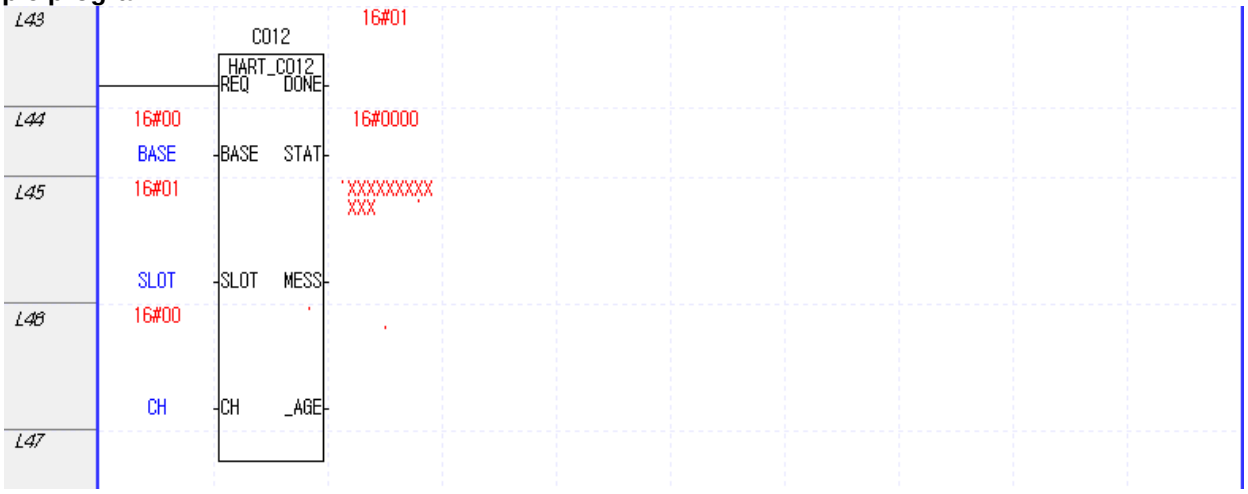
Read response to Universal Command 12

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.

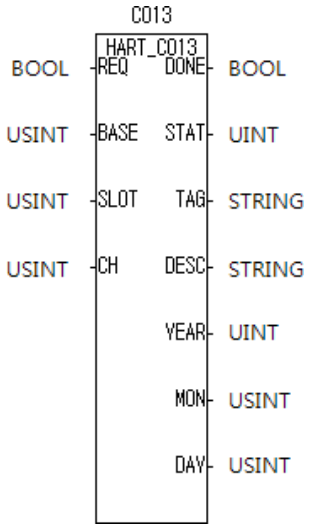
■**Example program**



(7) HART_C013 command

HART_C013

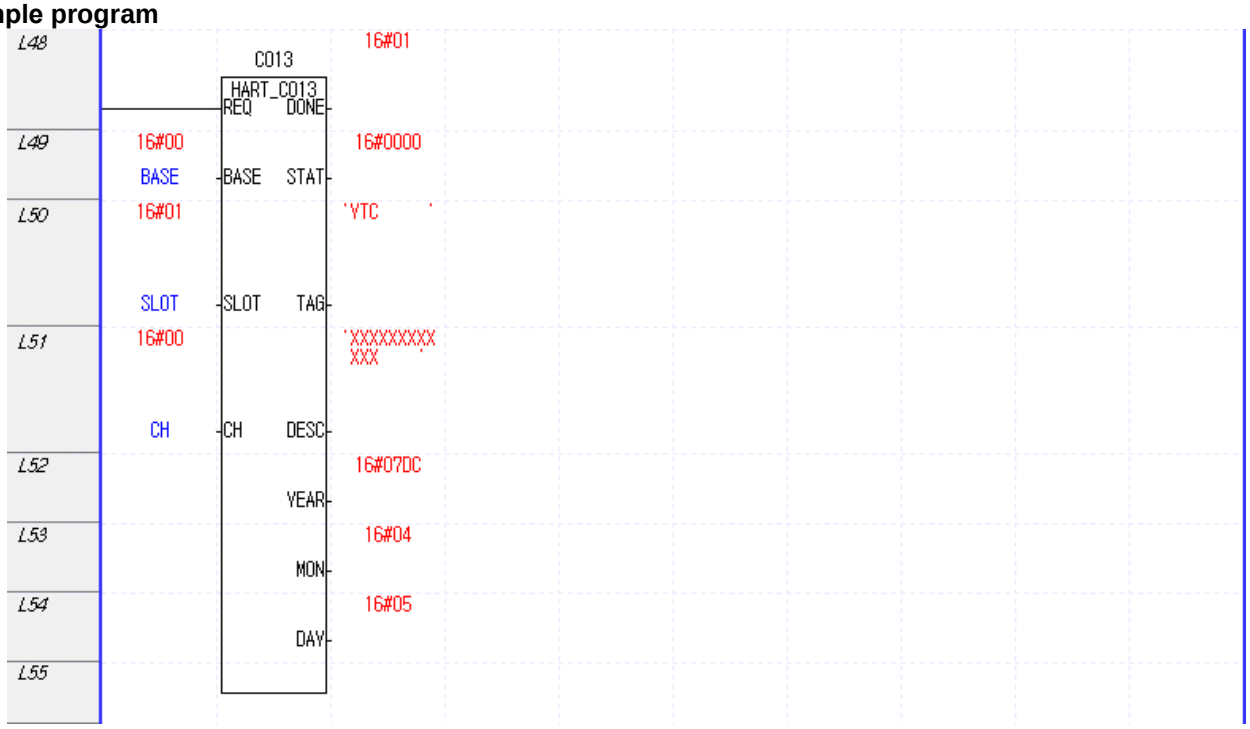
Read response to Universal Command 13

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.

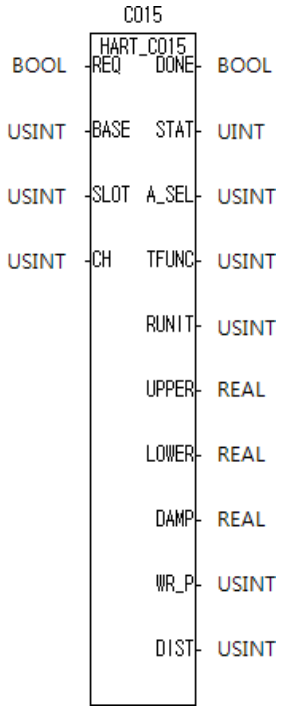
■**Example program**



(8) HART_C015 command

HART_C015

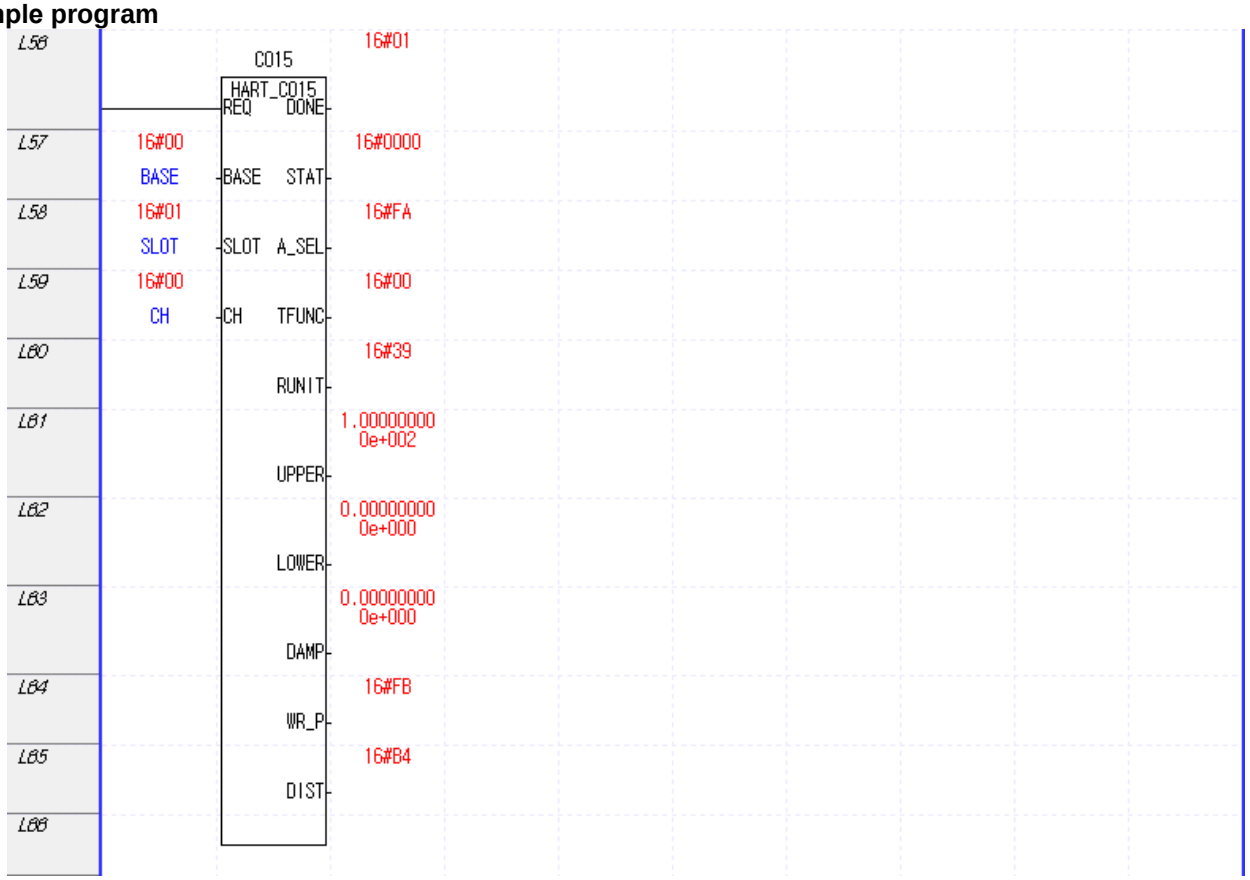
Read response to Universal Command 15

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.

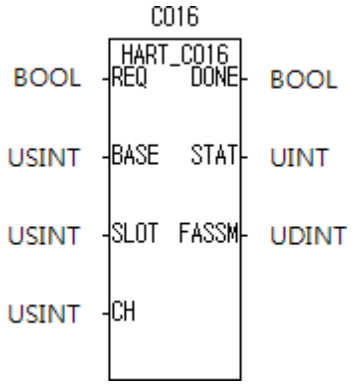
■**Example program**



(9) HART_C016 command

HART_C016

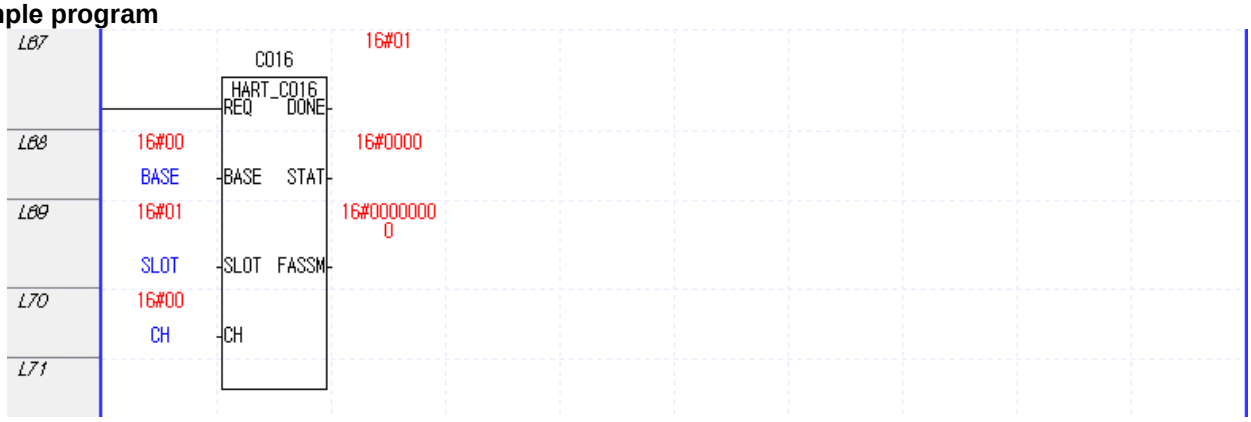
Read response to Universal Command 16

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.

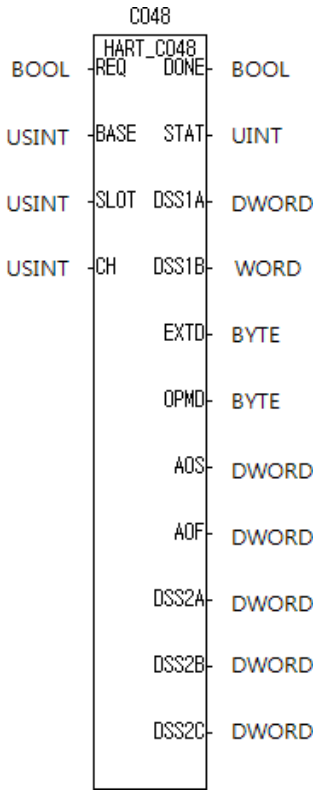
■**Example program**



(10) HART_C048 command

HART_C048

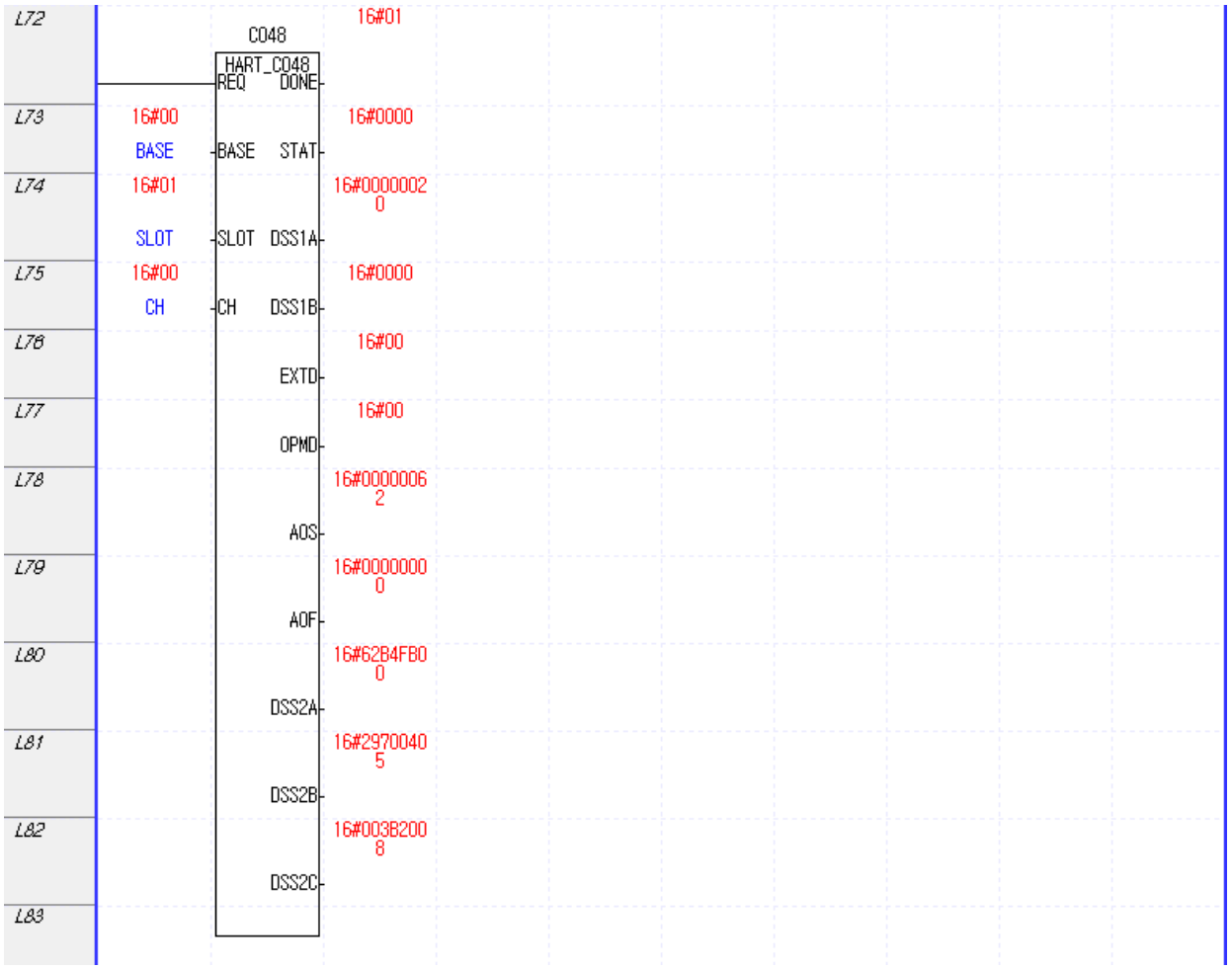
Read response to Common Practice Command 48

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.

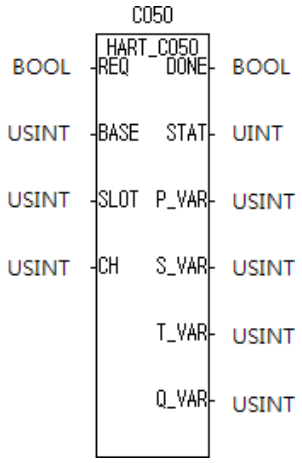
■**Example program**



(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 Q_VAR : Quaternary Device Variable

■**Function**

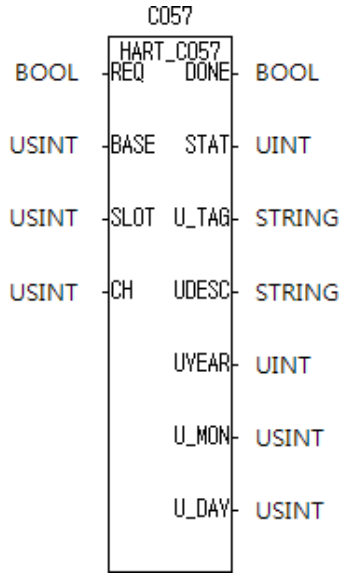
When [Common Practice Command 50] command is set to the designated module's channel, this function is used to monitor response data.

■Example program

(12) HART_C057 command

HART_C057

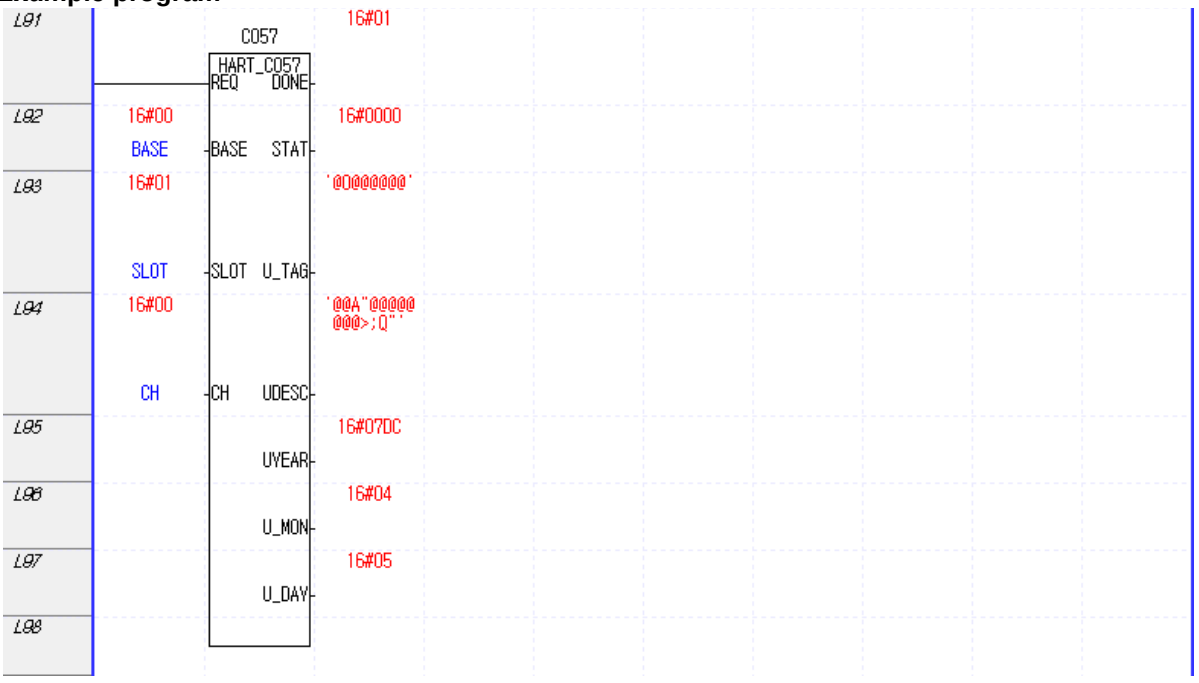
Read response to Common Practice Command 57

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.

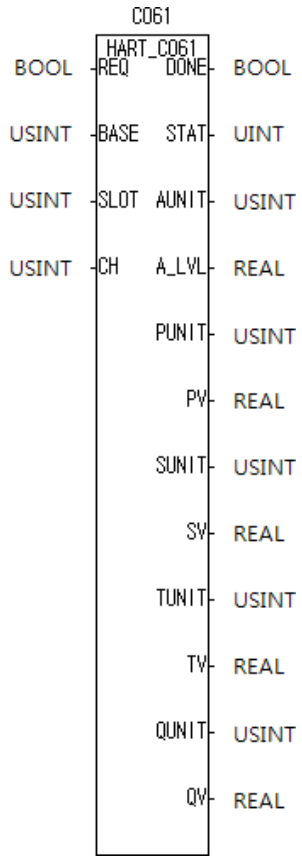
■**Example program**



(13) HART_C061 command

HART_C061

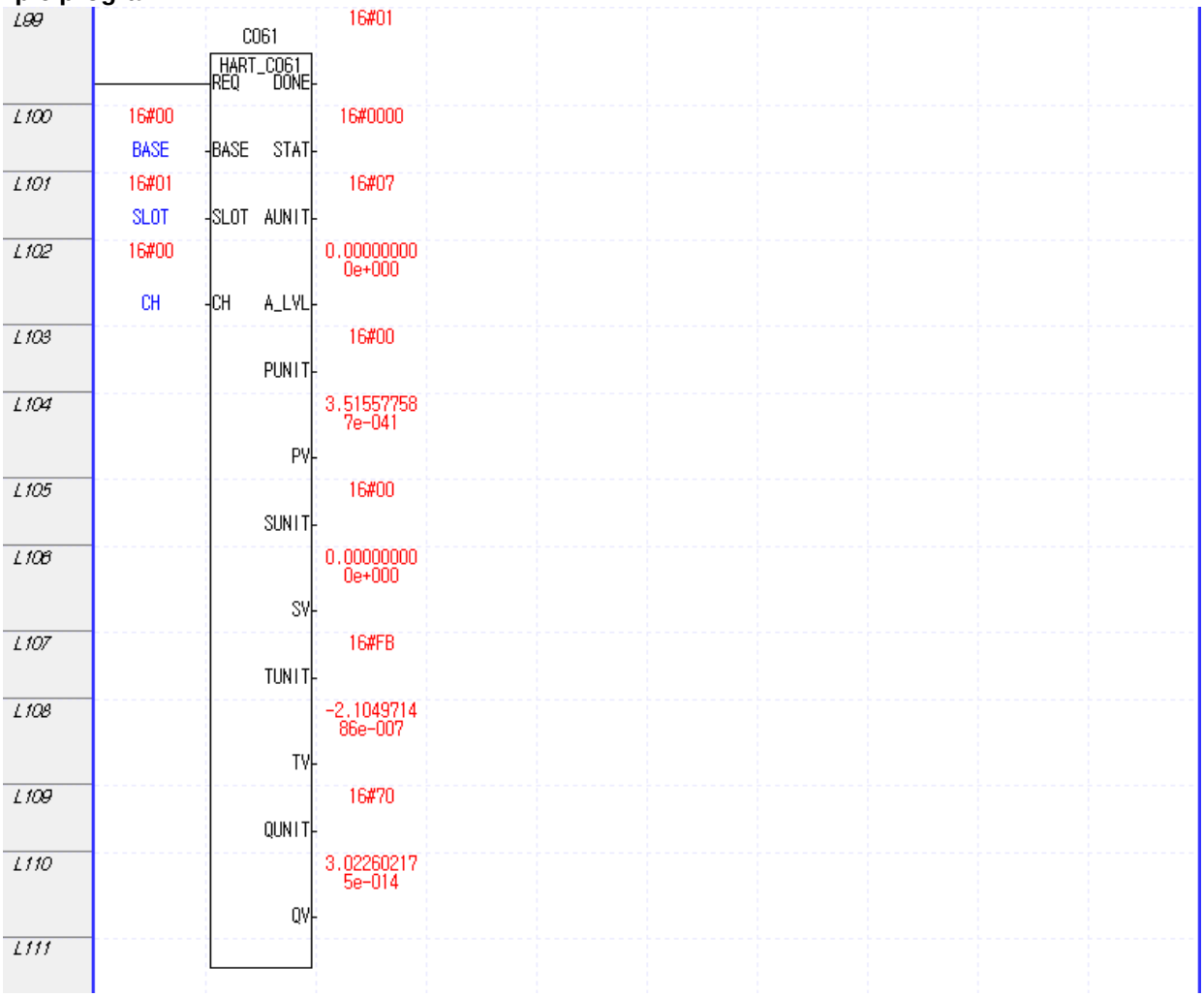
Read response to Common Practice Command 61

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.

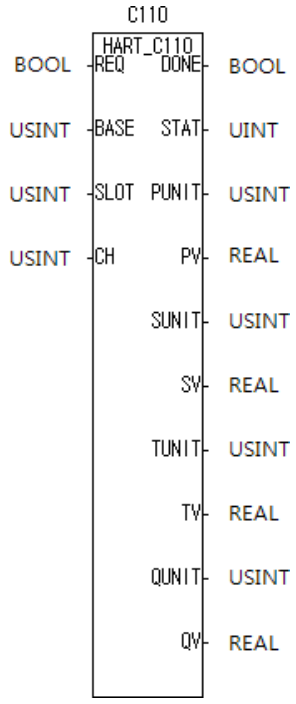
■**Example program**



(14) HART_C110 command

HART_C110

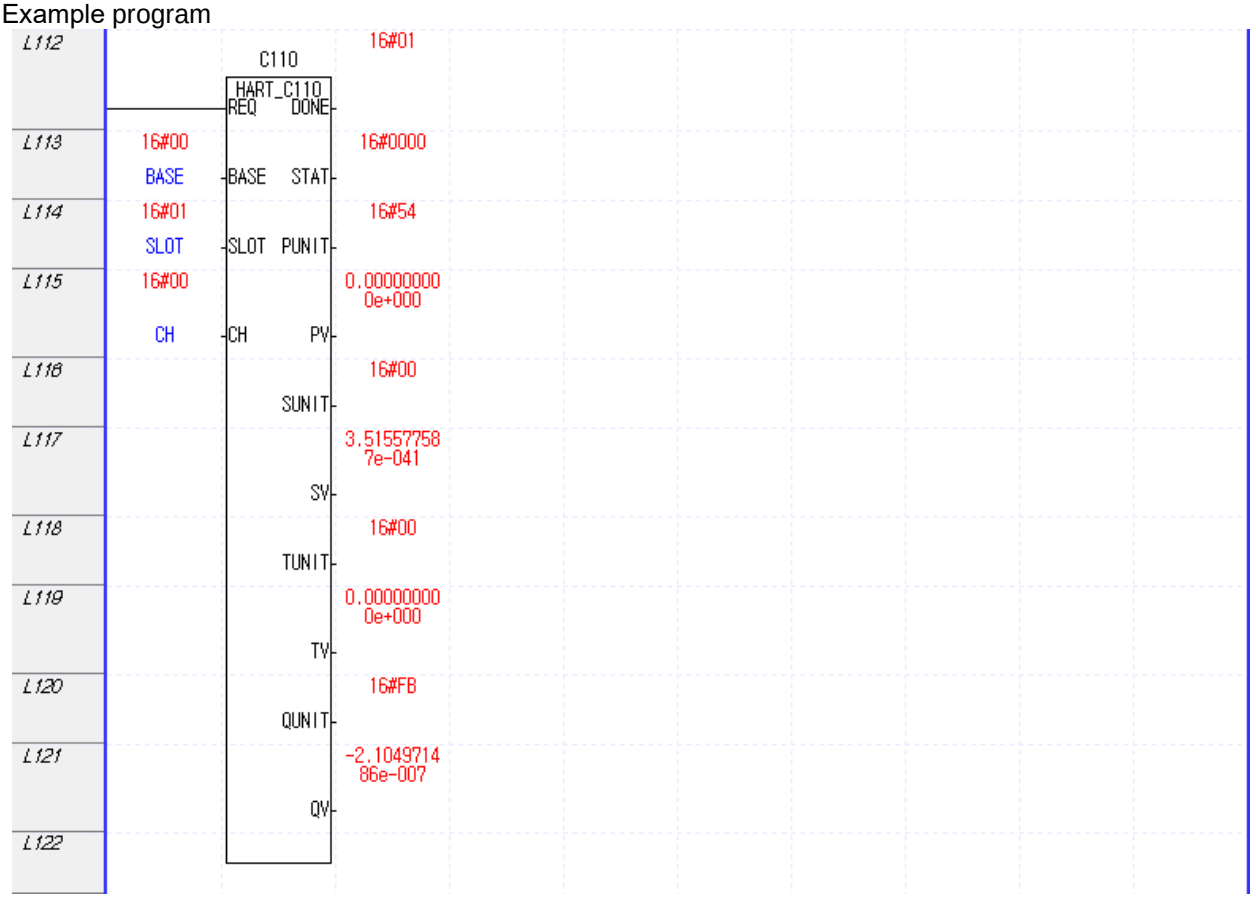
Read response to Common Practice Command 110

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.

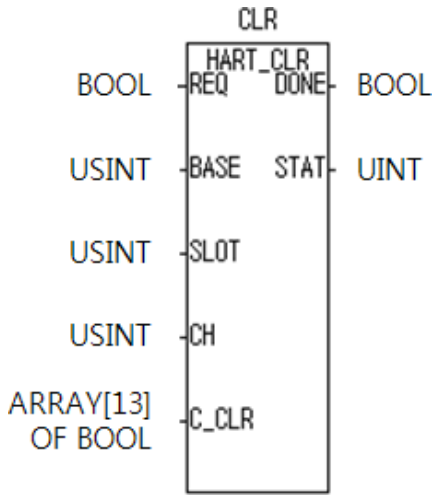
■Example program



(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.

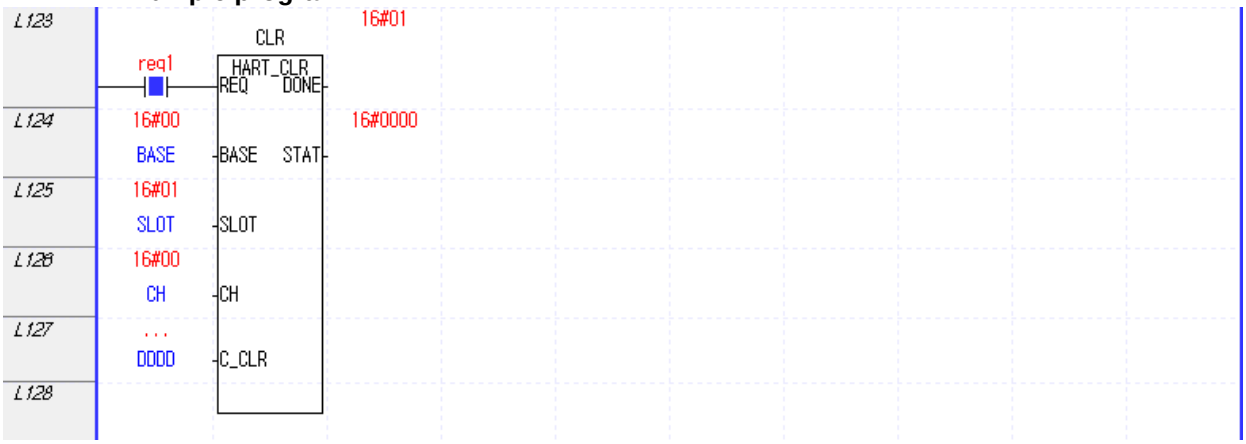
(b) Set bit(BOOL Array) corresponding to a command to be stopped on "C_SET"

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

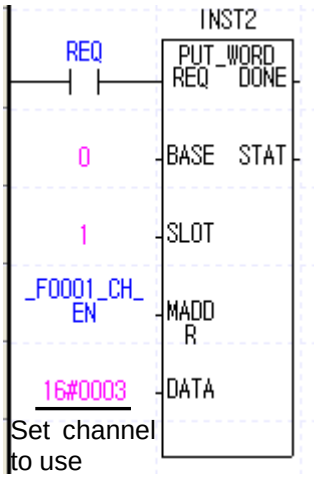
(a) You can enable/disable D/A conversion per channel
(b) Disable channel not using to reduce the conversion cycle per channel
(c) When channel is not designated, all channels are set as not used
(d) Enable/disable of D/A conversion is as follows

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) Output current range setting

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

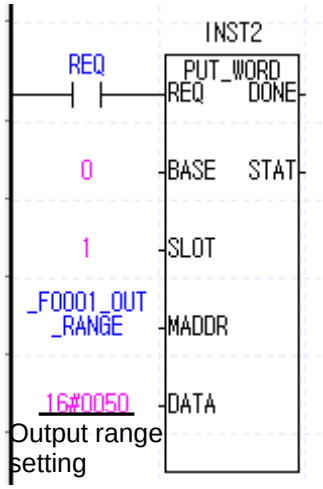
- The following is example setting CH0~CH1 as 4~20mA and CH2~CH3 as 0~20mA

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

Bit	Description
00	4 mA ~ 20 mA
01	0 mA ~ 20 mA

16#4422 : 0000 0000 0101 0000

CH3, CH2 CH1, CH0



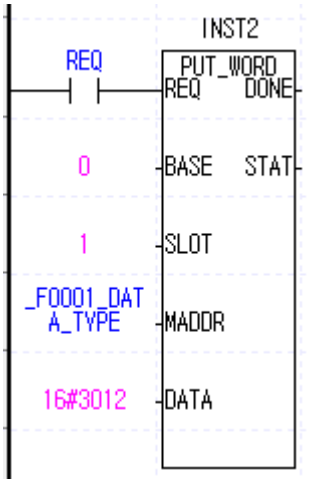
(3) Input data range setting

(a) Digital input data range about analog output can be set per channel.
(b) When input data range is not set, all channels are set as 0~16000.
(c) Setting of digital input 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	0 ~ 16000
0001	-8000 ~ 8000
0010	Precise value
0011	0~10000

16#3012 : 0011 0000 0001 0010
CH3, CH2, CH1, CH0



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

1) Current

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

(4) Output status setting

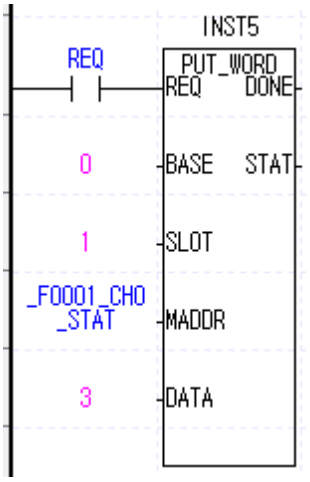
(a) Default value of output status is 0
(b) Output statuses according to setting values of output status set area are as following

Setting Value	Content
0	Retain the previous value
1	Output the minimum value from the output range
2	Output the median value from the output range
3	Output the maximum value from the output range

(c) When setting value other than setting range, error number will display on error code indication (_F0001_CH0_ERR). (# means the channel where error occurs at error code)

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
Output status setting															

Variable	Contents
_Fxxyy_CH0_STAT	CH0 output status setting
_Fxxyy_CH1_STAT	CH1 output status setting
_Fxxyy_CH2_STAT	CH2 output status setting
_Fxxyy_CH3_STAT	CH3 output status setting

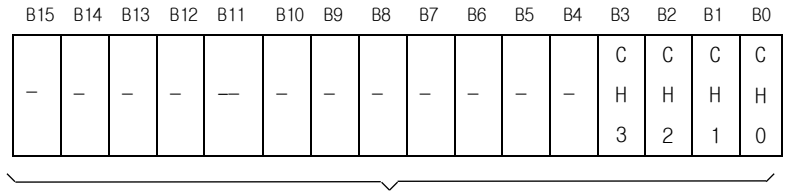


(5) Output limit setting

(a) This area to set enable/disable output limit. It is available to specify it for each channel.

(b) Default value of output limit set area is 0.

(b) Setting range of output limit is as follows.



Bit	Description
0	Disable
1	Enable

16#0009: 0000 0000 0000 1001

CH3, CH2, CH1, CH0

(6) Output high/low limit value setting

(a) This area to specify output high/low limit for each channel. Setting range varies according to input data range.

1) Unsigned Value: -192~16191

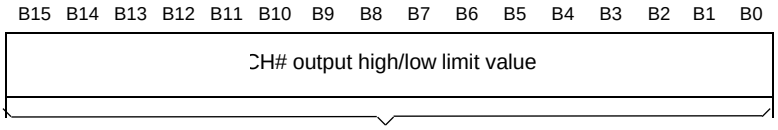
2) Signed Value: -32768 ~ 32767

3) Precise Value

Range	Setting value
4 mA ~ 20 mA	3808 ~ 20192
0 mA ~ 20 mA	-240 ~ 20240

4) Percentile Value: -120 ~ 10120

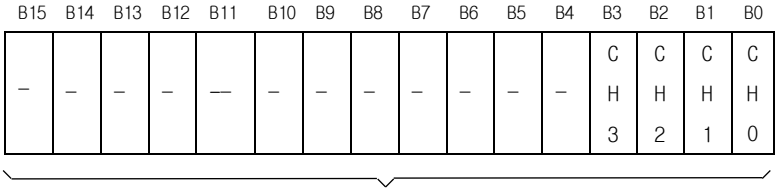
(b) For details on output limit set function, refer to 2.5.2.



Variable	Contents
_Fxxyy_CH0_HI_LIMIT	CH0 output high limit
_Fxxyy_CH0_LOW_LIMIT	CH0 output low limit
_Fxxyy_CH0_HI_LIMIT	CH0 output high limit
_Fxxyy_CH0_LOW_LIMIT	CH0 output low limit
_Fxxyy_CH0_HI_LIMIT	CH0 output high limit
_Fxxyy_CH0_LOW_LIMIT	CH0 output low limit
_Fxxyy_CH0_HI_LIMIT	CH0 output high limit
_Fxxyy_CH0_LOW_LIMIT	CH0 output low limit

(7) Change rate control setting

(a) This is area to set enable/disable change rate control. It is available to specify it for each channel.
(b) Default value of change rate control is 0.
(c) Setting range of change rate control is as follows.

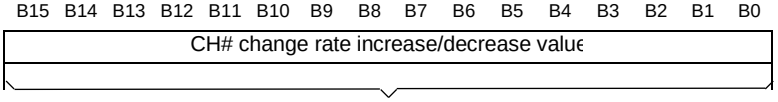


Bit	Description
0	Disable
1	Enable

16#0009: 0000 0000 0000 1001

(8) Change rate increase/decrease limit value

(a) Change rate increase/decreasing value can be set only when Change Rate Control is set to Enable.
(b) Change Rate Alarm setting values are ranged between 0 ~ 16000.
(c) Change Rate Alarm setting values are specified as following.



Range of change rate value is 0 ~ 16000

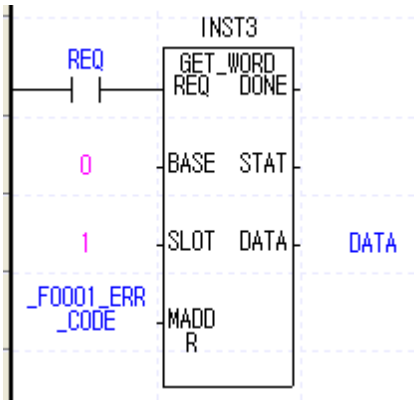
Variable	Contents
Fxxyy_CH0_INC_RTE	CH0 change rate increase value
Fxxyy_CH0_DEC_RTE	CH0 change rate decrease value
Fxxyy_CH0_INC_RTE	CH0 change rate increase value
Fxxyy_CH0_DEC_RTE	CH0 change rate decrease value
Fxxyy_CH0_INC_RTE	CH0 change rate increase value
Fxxyy_CH0_DEC_RTE	CH0 change rate decrease value
Fxxyy_CH0_INC_RTE	CH0 change rate increase value
Fxxyy_CH0_DEC_RTE	CH0 change rate decrease value

(9) Error code

(a) Saves error code detected at HART Analog Input Module.

(b) 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							



Variable	Contents
_Fxxyy_CH0_ERR	CH0 error code
_Fxxyy_CH0_ERR	CH1 error code
_Fxxyy_CH0_ERR	CH2 error code
_Fxxyy_CH0_ERR	CH3 error code

(c) Error type and contents are as follows.

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)	
13	Module error (EEPROM check error)	
21	Module error (D/A conversion error)	
31#	Parameter set error	Flickers every 1 sec.
40#	Digital input range set error	
60#	Output limit high/low value compare error	
70#	Change rate control set value error	

※ At error code, # indicates channel where error occurs

※ For more detail error code, refer to 9.1

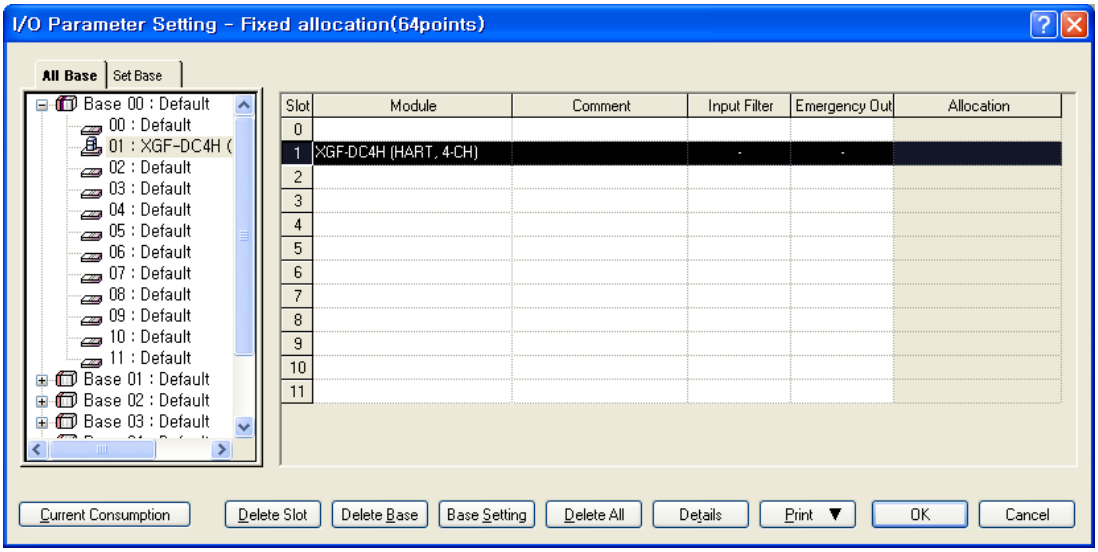
(d) In case two error codes occurs, module saves first occurred error code and later occurred error code is not saved.

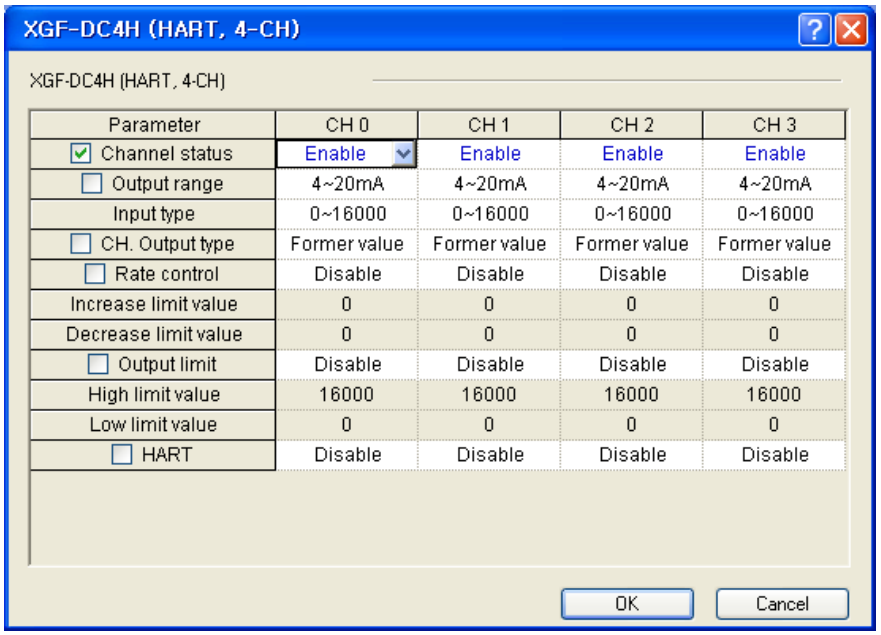
Chapter 8 Programming (For 2MLI/2MLR)

8.1 Basic Program

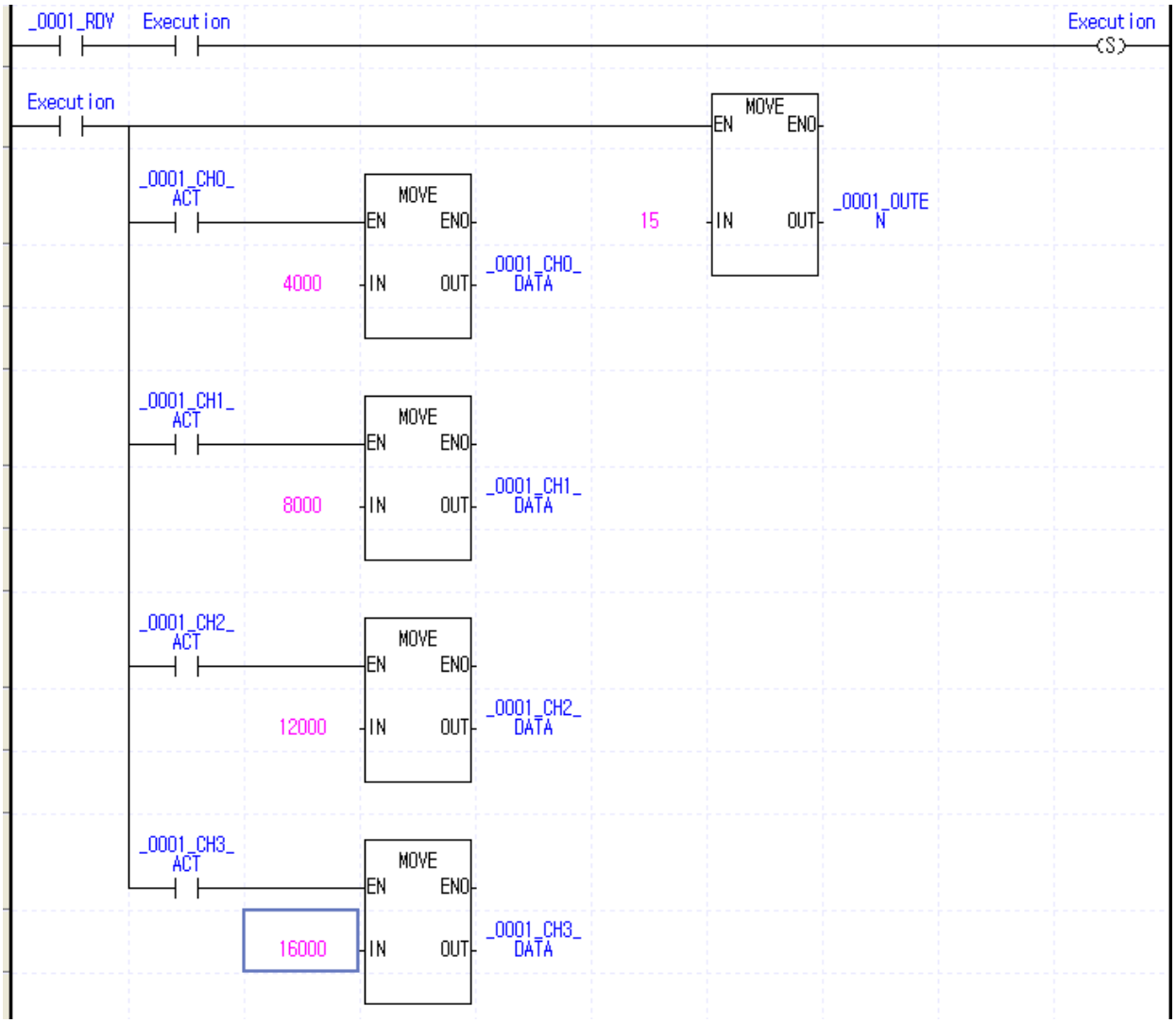
- It describes about how to set operation condition at internal memory of HART Analog Output Module.
- HART Analog Output Module is equipped at slot 2
- IO occupation points of HART Analog Input Module are 64 points (Non fixed type)
- Initial setting condition is saved at internal memory by 1 time input

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

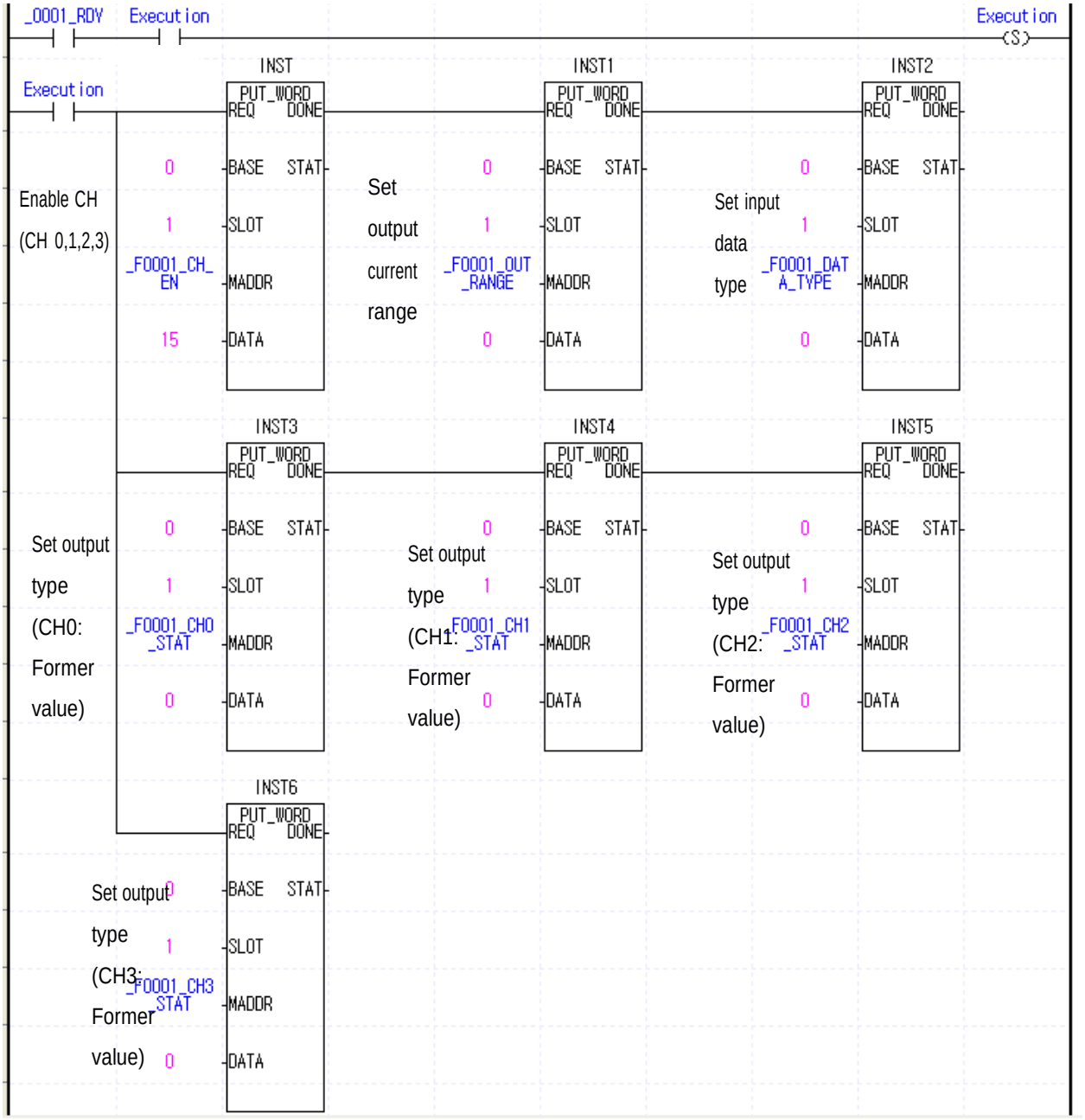


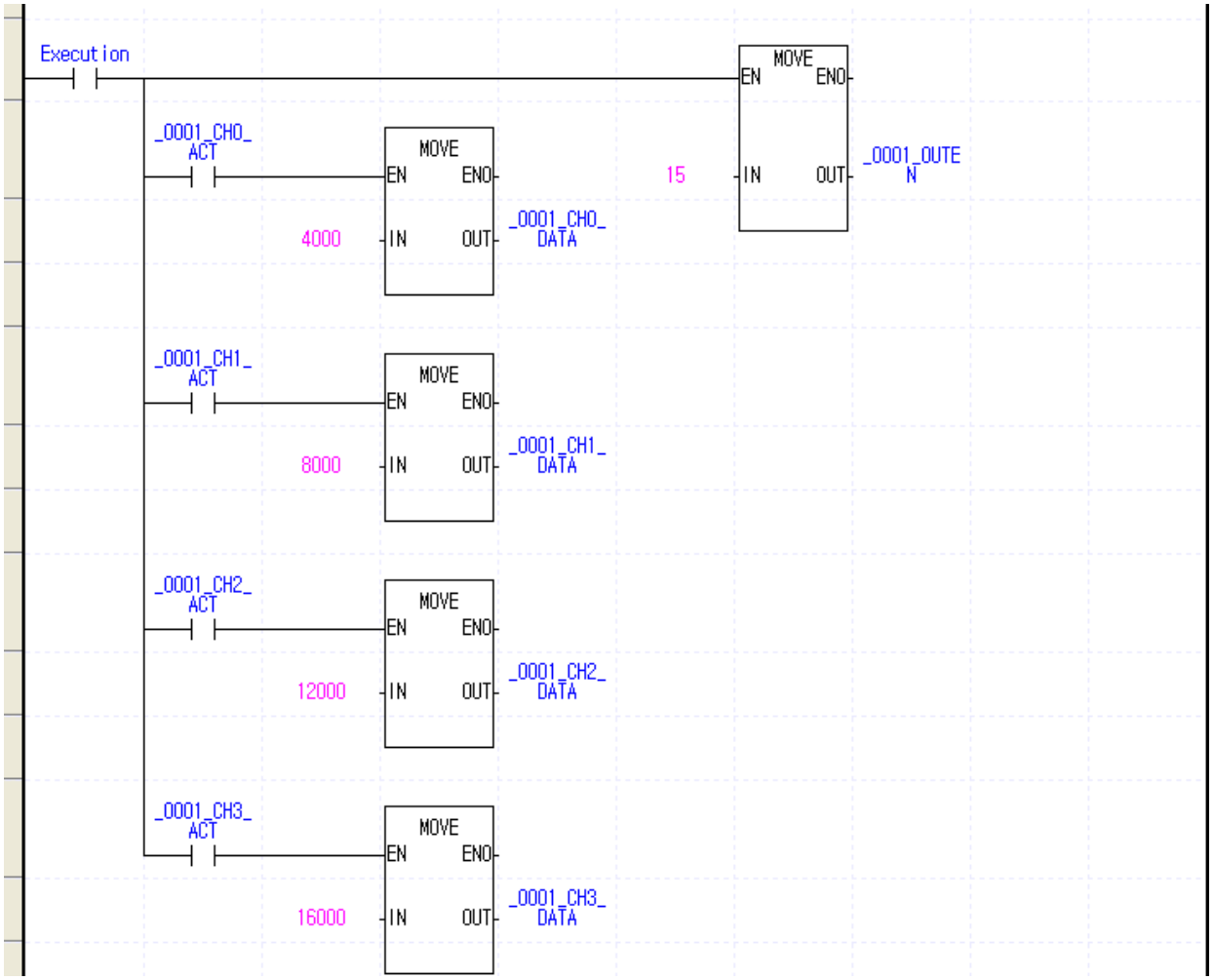


(2) Program example using [I/O Parameter]



(3) Program example using PUT/GET instruction

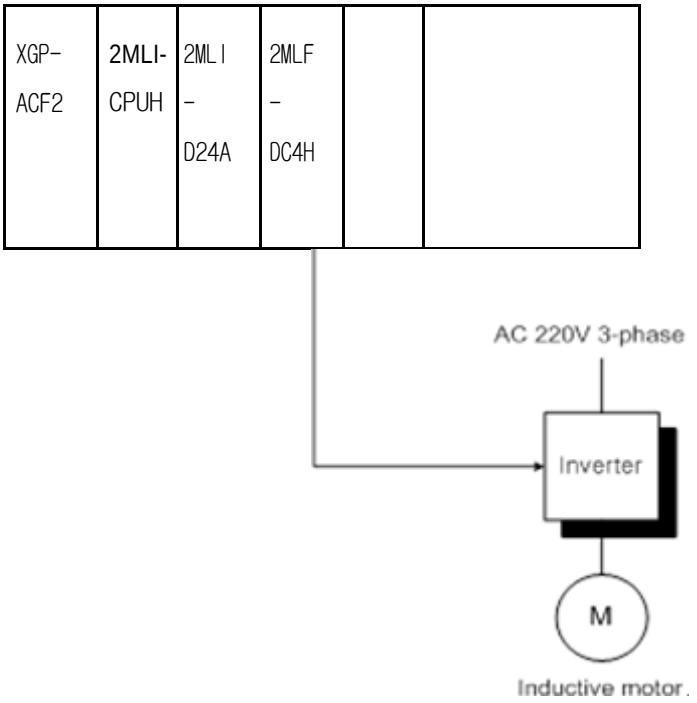



Execution
MOVE
EN
ENO
15
IN
OUT
_0001_OUTEN
_0001_CH0_ACT
MOVE
EN
ENO
4000
IN
OUT
_0001_CH0_DATA
_0001_CH1_ACT
MOVE
EN
ENO
8000
IN
OUT
_0001_CH1_DATA
_0001_CH2_ACT
MOVE
EN
ENO
12000
IN
OUT
_0001_CH2_DATA
_0001_CH3_ACT
MOVE
EN
ENO
16000
IN
OUT
_0001_CH3_DATA

8.2 Application Program

8.2.1 Inverter speed control

(1) System configuration



(2) Initial setting content

No.	Item	Initial setting content	Variable name
1	Used channel	CH0	0
2	Input voltage range	0 ~ 20 ㎃	1
3	Output data range	0~16000	2
4	Ch. output type	Former value	3

(3) Program description

(a) At the same time Module Ready Contact is On, output of all the channels will be set to Enable.

(b) If %IX0.0.1 is On, 0 ㎃ will be output.

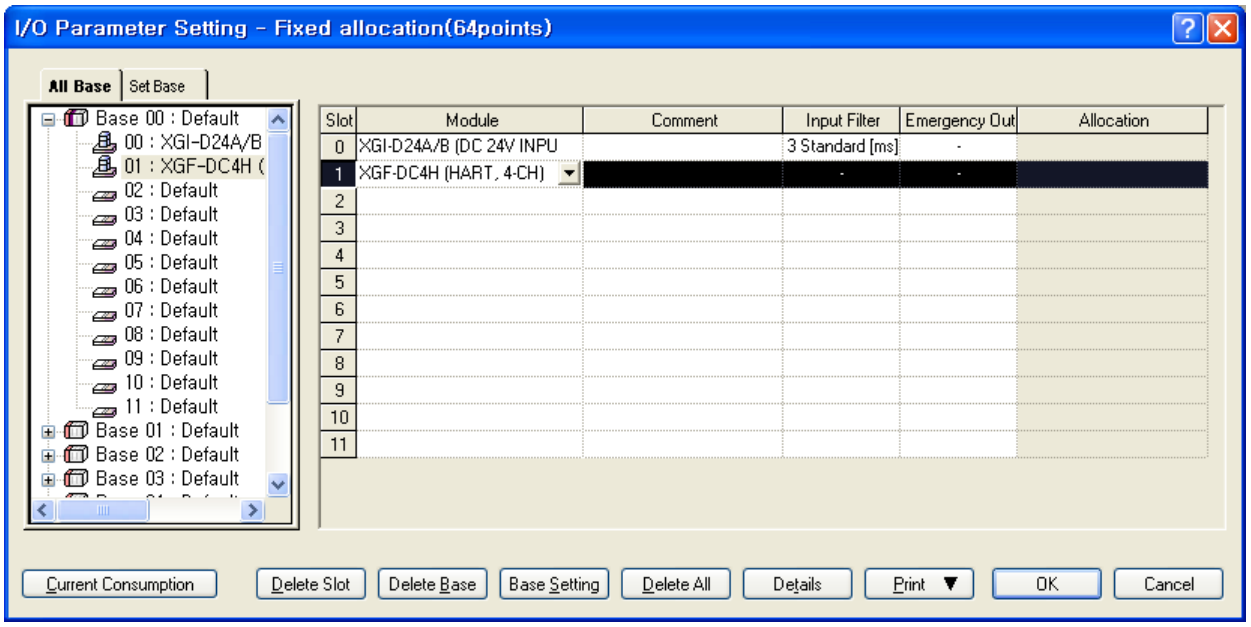
(c) If %IX0.0.1 is Off and %IX0.0.2 is On, 5 ㎃ will be output.

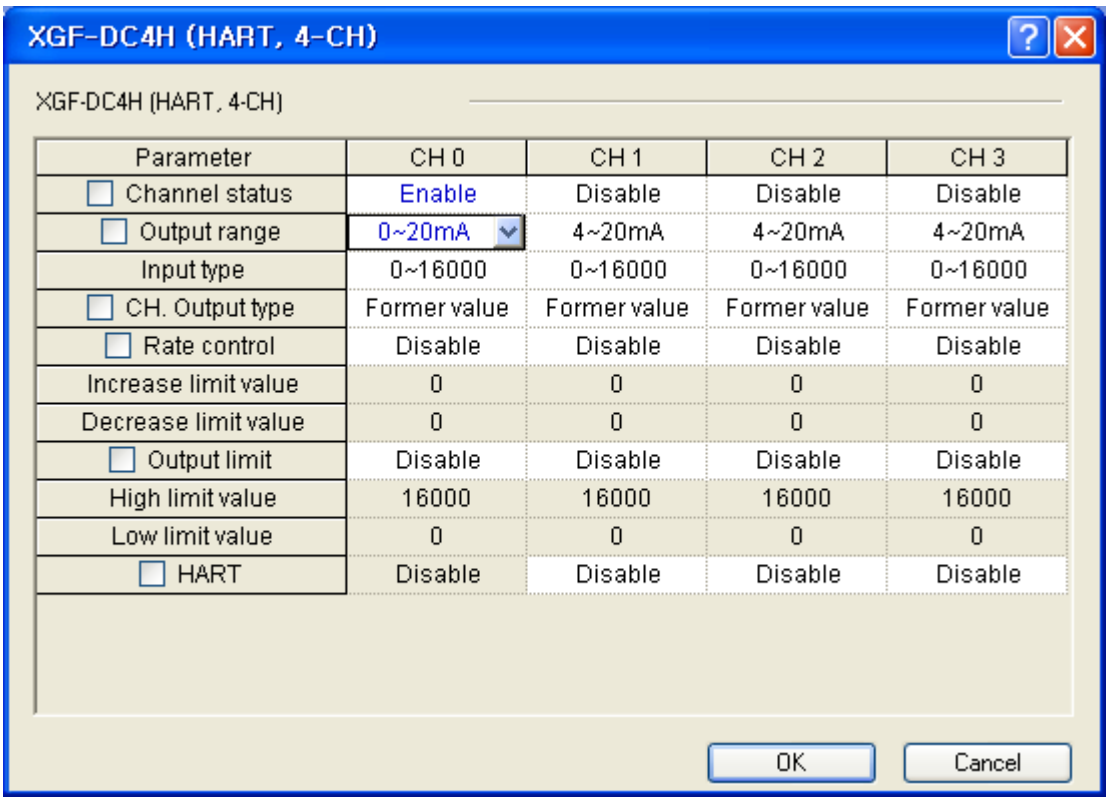
(d) If %IX0.0.2 is Off and %IX0.0.3 is On, 10 ㎃ will be output.

(e) If %IX0.0.3 is Off and %IX0.0.4 is On, 15 ㎃ will be output.

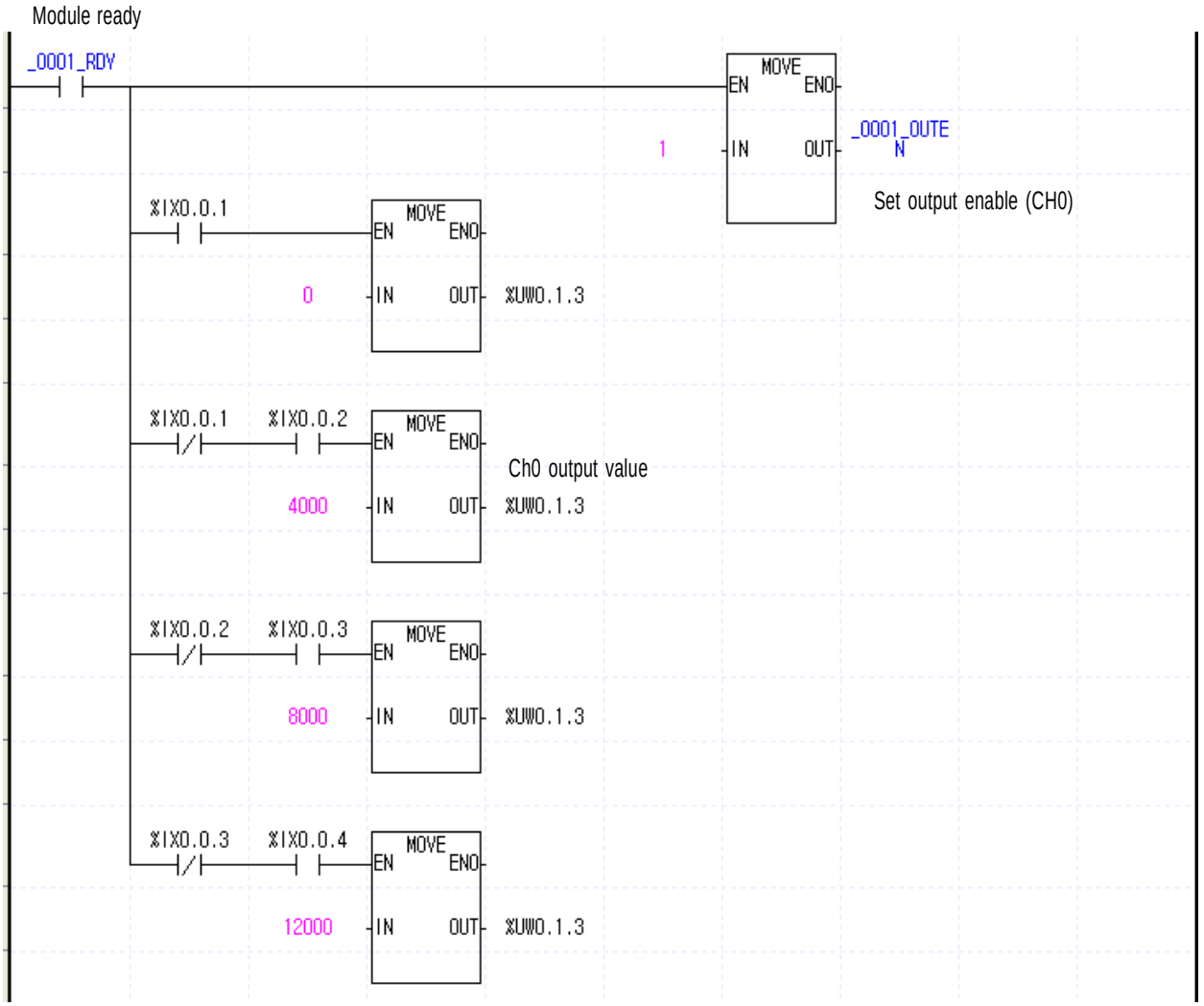
(4) Program

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



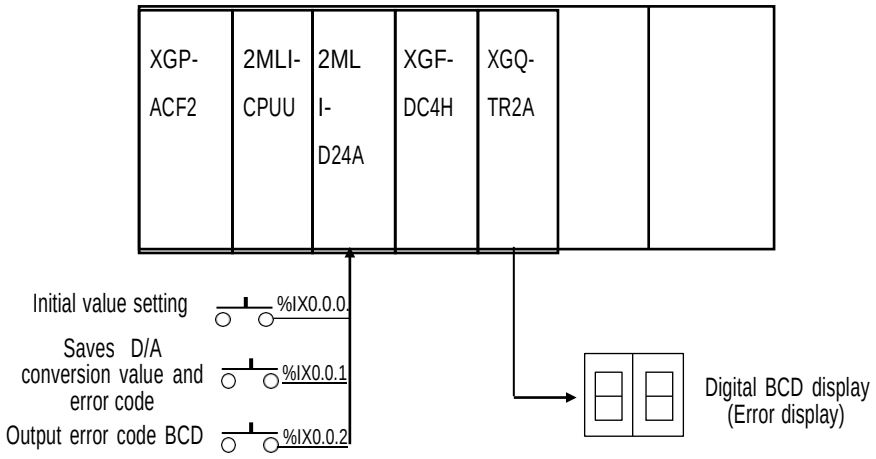


(b) Program example using [I/O Parameter]



8.2.2 Program to output error codes of analog output 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) Digital output data range: 0~16000

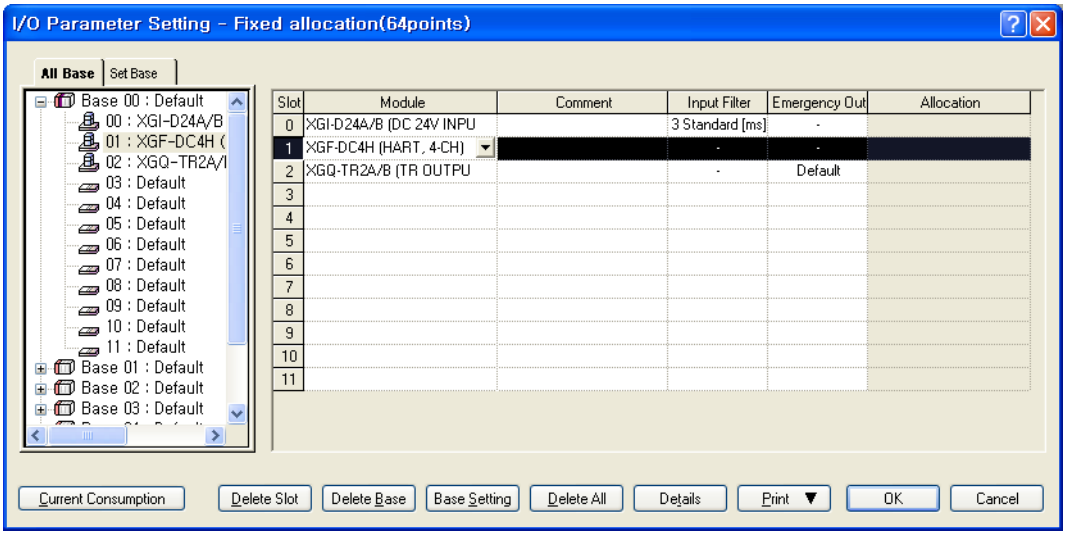
(3) Program description

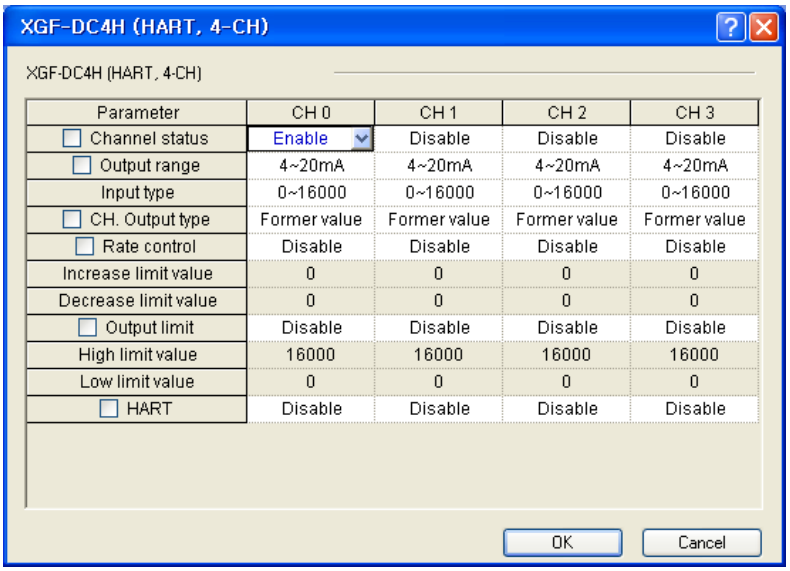
(a) If %IX0.0.1 is On, “OutputValue” and error code will be saved respectively on D/A conversion value and “Error Code”.

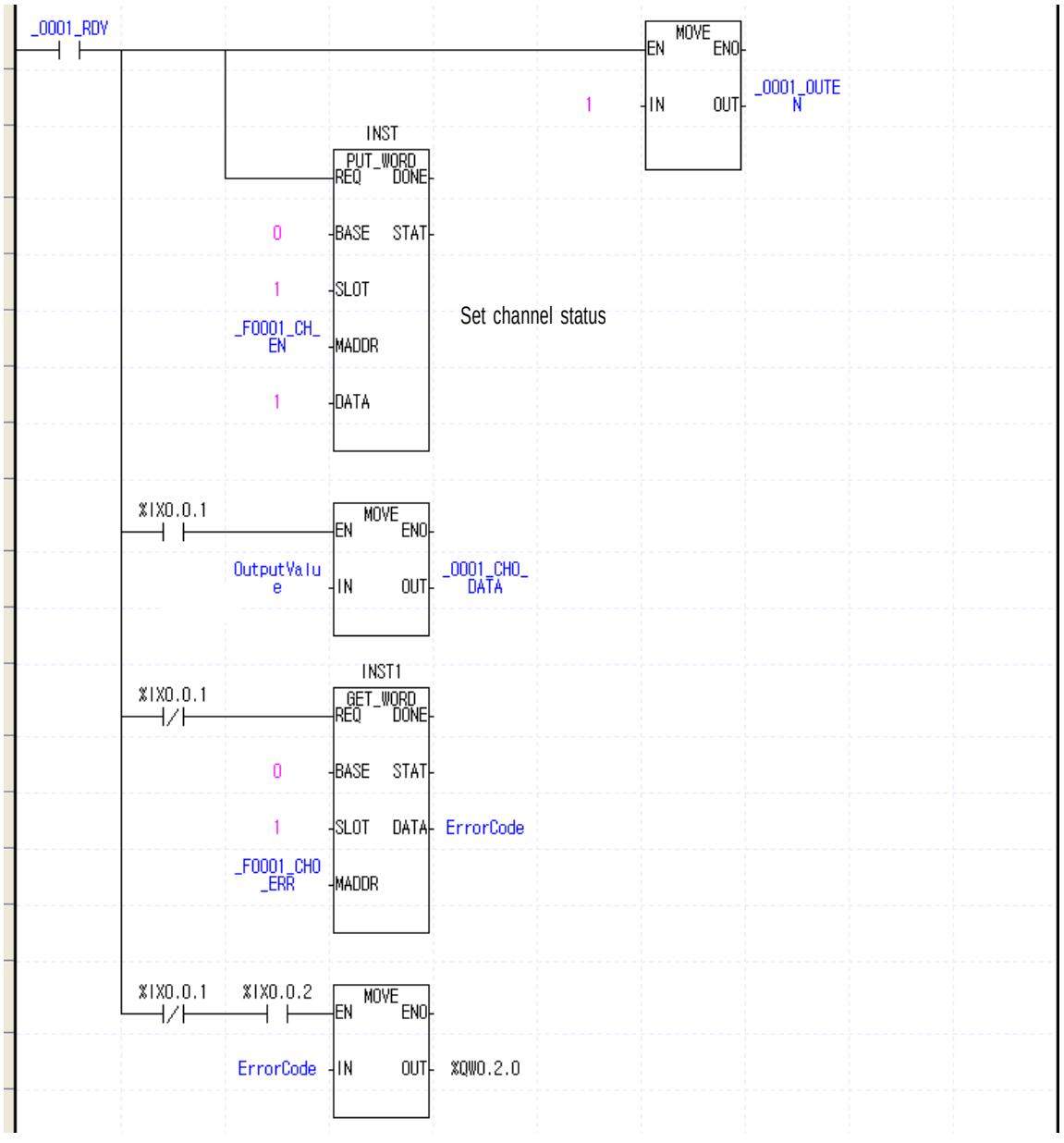
(b) If %IX0.0.2 is On, applicable error code will be output to digital BCD display. (%QW0.2.0)

(4) Program

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

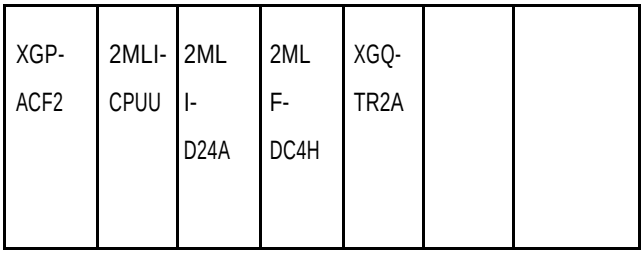



XGF-DC4H (HART, 4-CH)
XGF-DC4H (HART, 4-CH)
Parameter
CH 0
CH 1
CH 2
CH 3
Channel status
Enable
Disable
Disable
Disable
Output range
4~20mA
4~20mA
4~20mA
4~20mA
Input type
0~16000
0~16000
0~16000
0~16000
CH. Output type
Former value
Former value
Former value
Former value
Rate control
Disable
Disable
Disable
Disable
Increase limit value
0
0
0
0
Decrease limit value
0
0
0
0
Output limit
Disable
Disable
Disable
Disable
High limit value
16000
16000
16000
16000
Low limit value
0
0
0
0
HART
Disable
Disable
Disable
Disable
OK
Cancel


_0001_RDY
MOVE
EN
ENO
1
IN
OUT
_0001_OUTEN
INST
PUT_WORD
REQ
DONE
0
BASE
STAT
1
SLOT
_F0001_CH_EN
MADDR
1
DATA
Set channel status
%IX0.0.1
MOVE
EN
ENO
OutputValue
IN
OUT
_0001_CH0_DATA
INST1
%IX0.0.1
GET_WORD
REQ
DONE
0
BASE
STAT
1
SLOT
DATA
ErrorCode
_F0001_CH0_ERR
MADDR
%IX0.0.1
%IX0.0.2
MOVE
EN
ENO
ErrorCode
IN
OUT
%QW0.2.0

8.2.3 Program to monitor PV through HART communication

(1) System configuration



(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 ㎃	1	'h0000'or '0'
3	Output data range	0~16000	2	'h0000'or '0'
4	HART communication	CH0, 1	40	'h0024'or '36'

(3) Program description

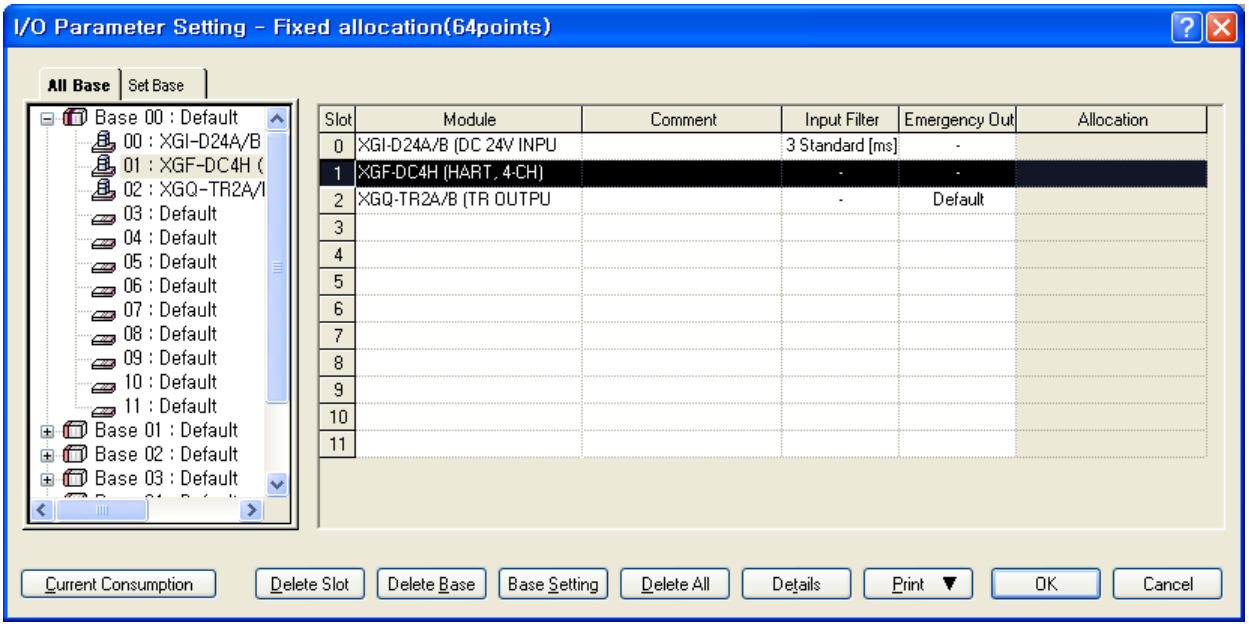
(a) If %MX1 is on, save 12,000 on channel0 output value.

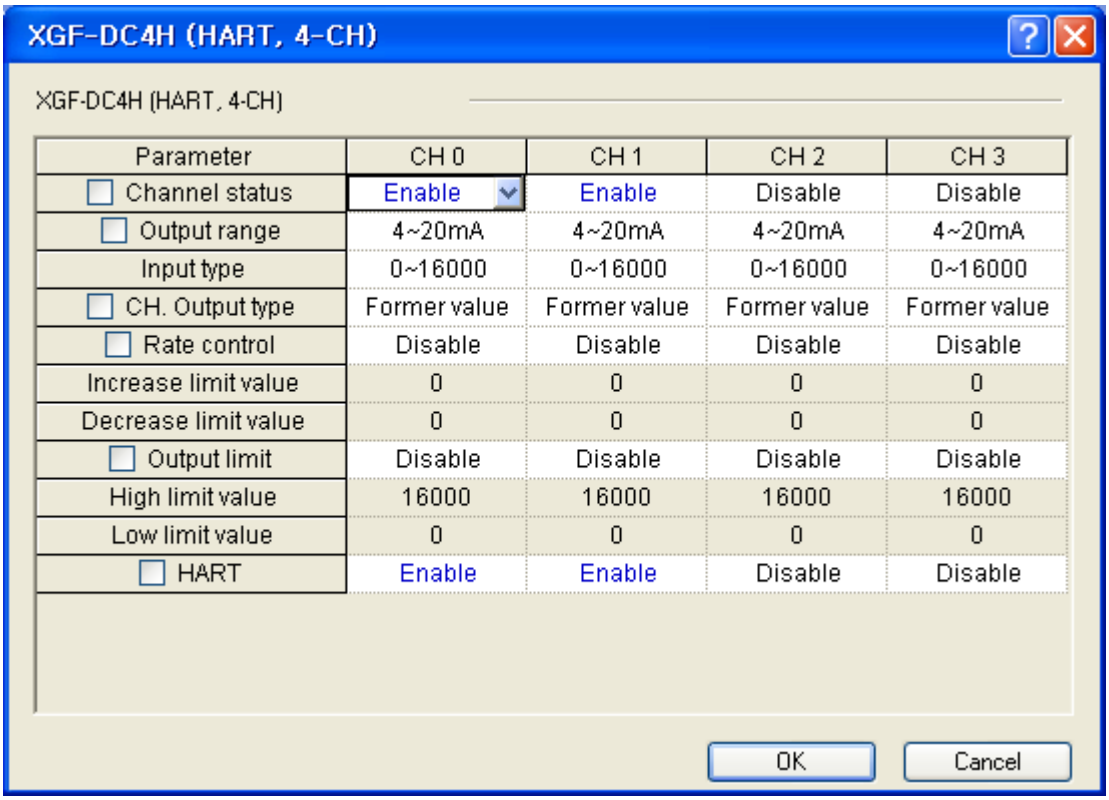
(b) If %MX2 is on, save 13,600 on channel1 output value.

(c) This program is to check responses to each command by executing HART command0 on channel 0 and HART command 2 on channel 1.

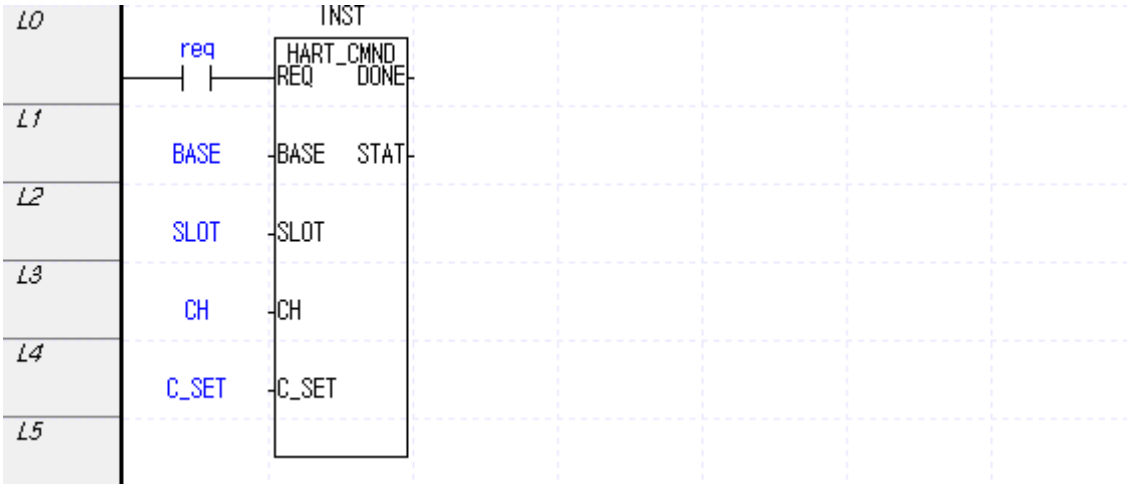
(4) Program

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

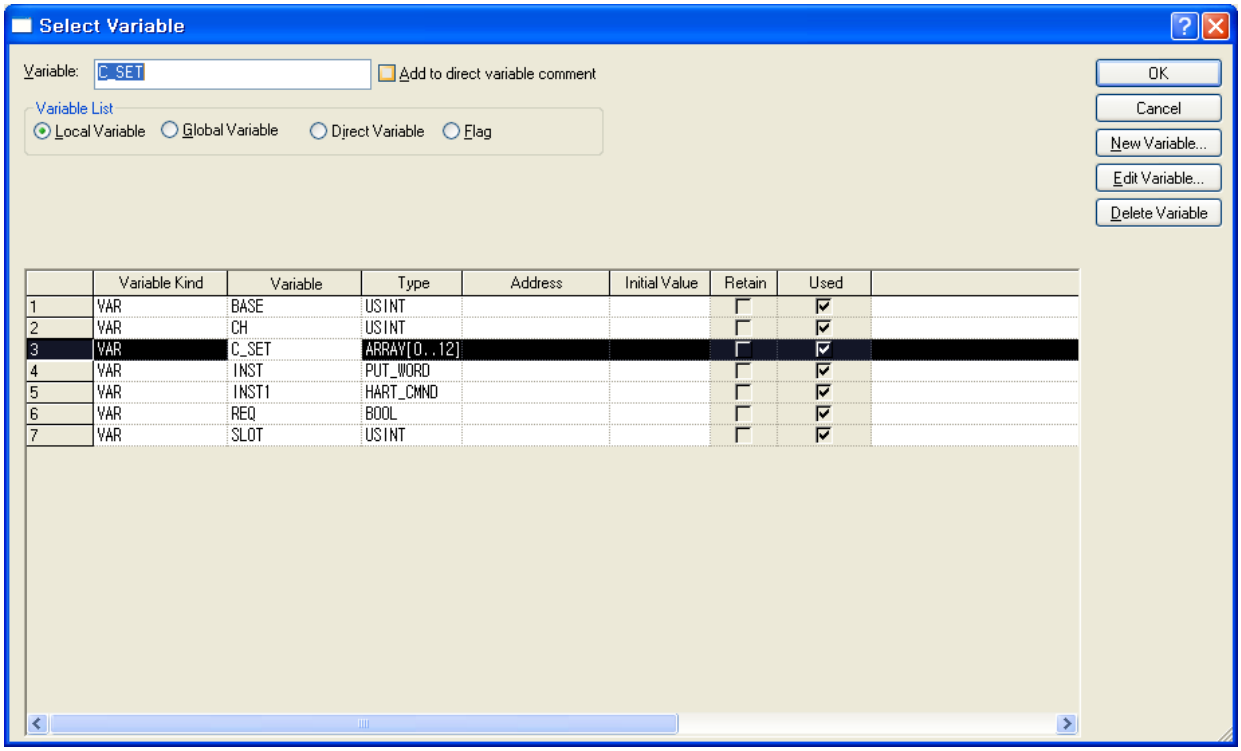




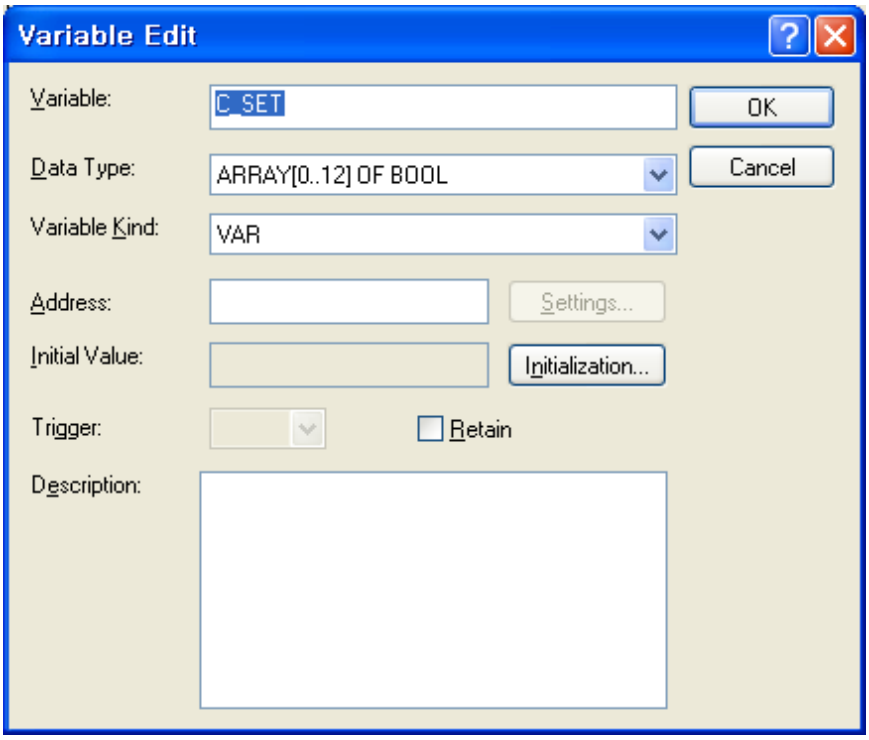
(b) Allocate the variables of HARTCMND command.



(c) Select the variable of C_SET.

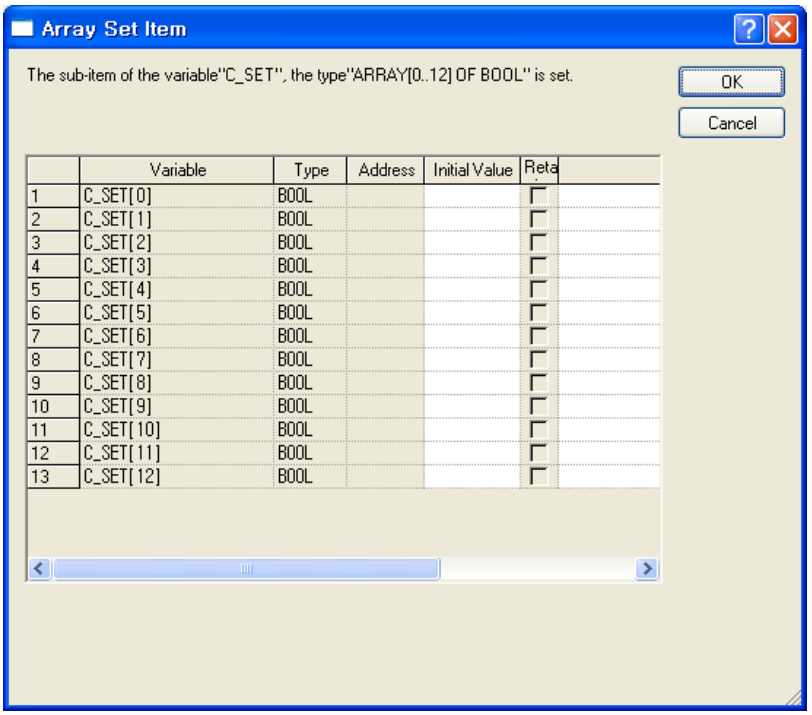


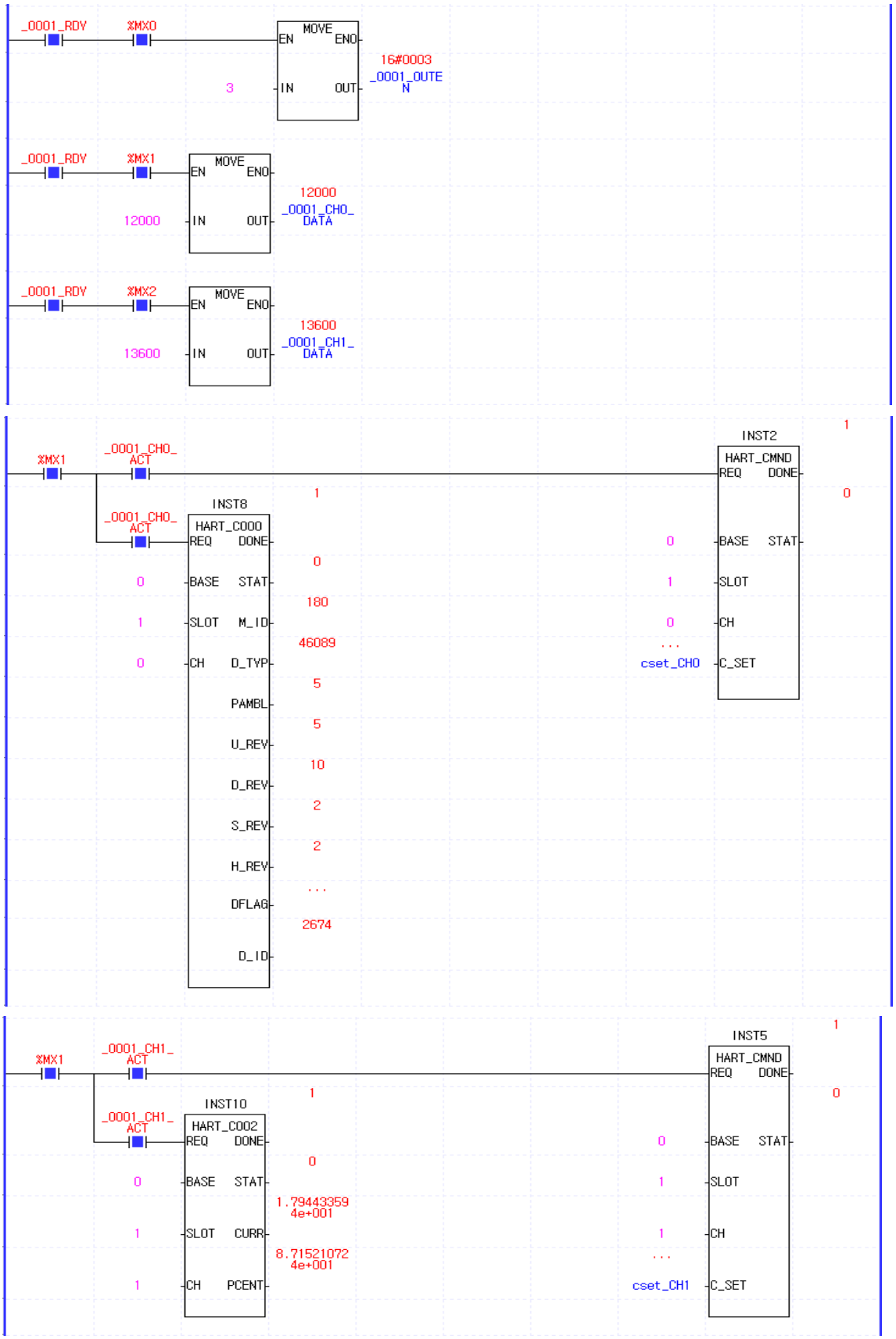
1) Click [Edit Variable]. C_SET variable is declared as 13 BOOL type arrays. Each array means 13 kinds of HART commands supported on HART input module. Therefore, set a command here to be performed through HART communication.



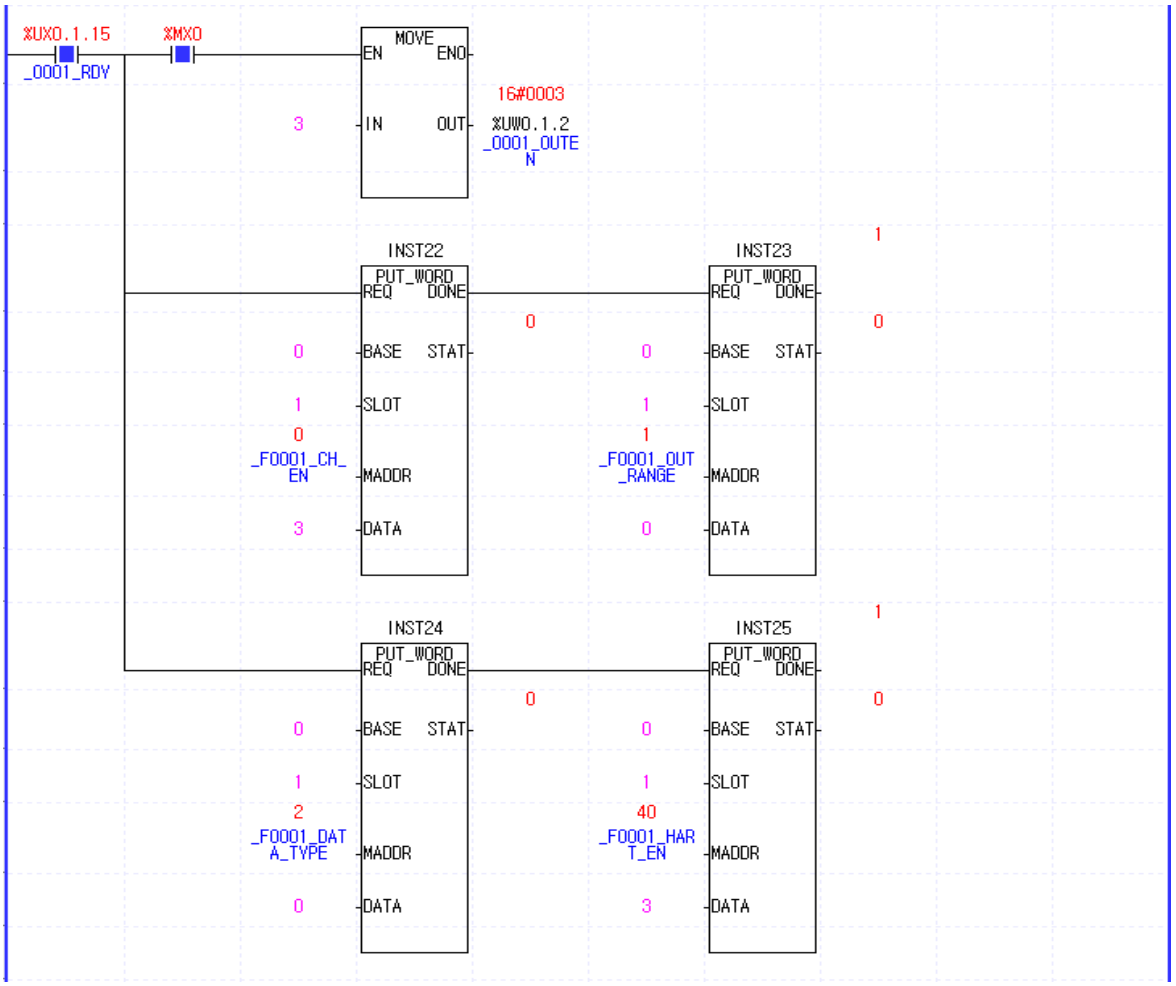
2) Click [Initialization] to set HART command bit. If 1 is set to command bit 에 1 to be communicated, communication corresponding to the command will be performed. In this example, HART command 0 and 1 is set to start communication with the Smart transmitter connected with HART input module. Command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

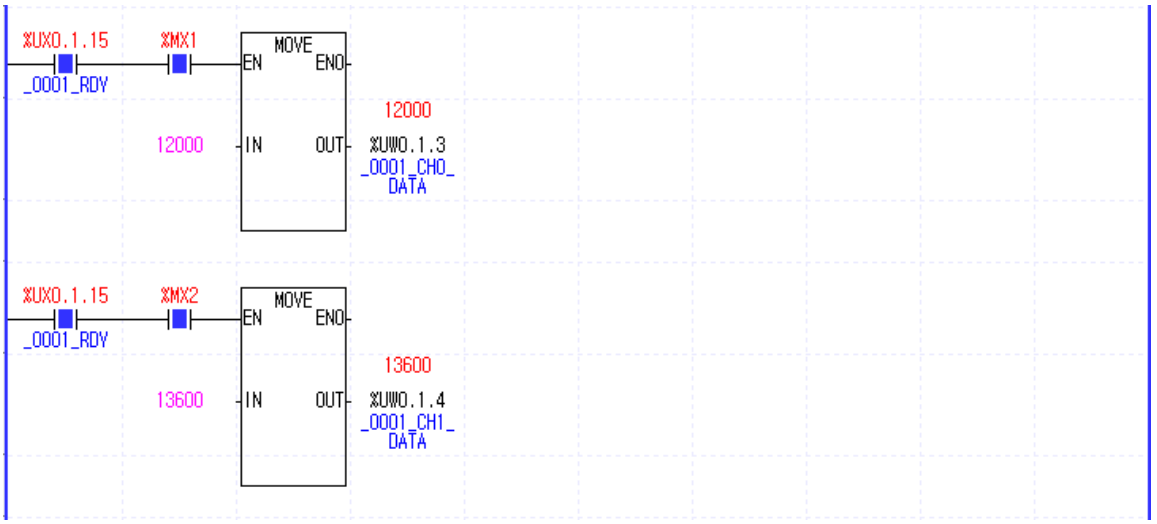
Variable	HART command number	Function
C_SET[0]	0	Read Manufacturer ID and Manufacturer device code
C_SET[1]	1	Read Primary variable(PV) value and Unit
C_SET[2]	2	Read percentage of current and range
C_SET[3]	3	Read current and 4 kinds of variable values (Primary Variable, Secondary Variable, Tertiary 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

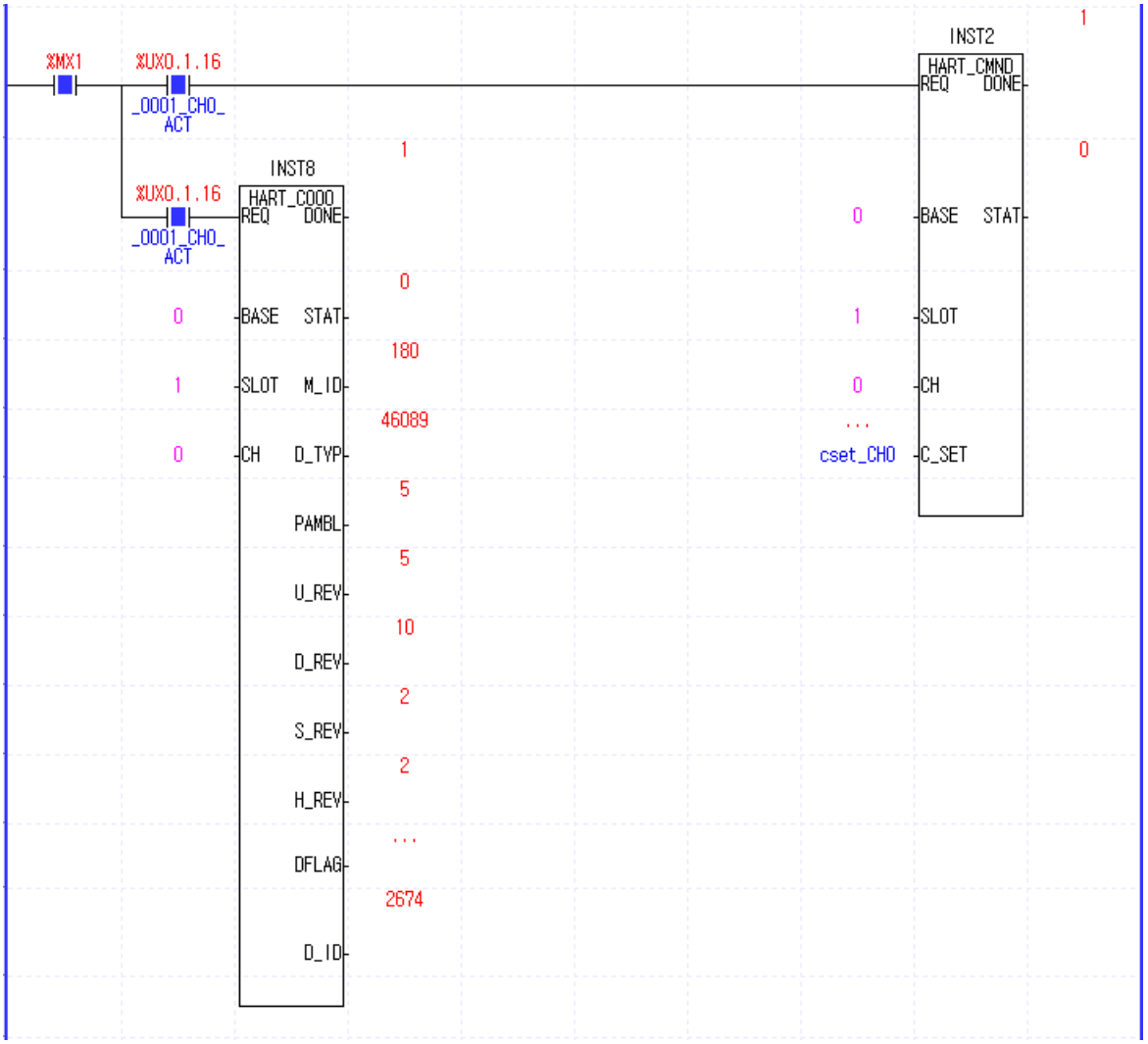


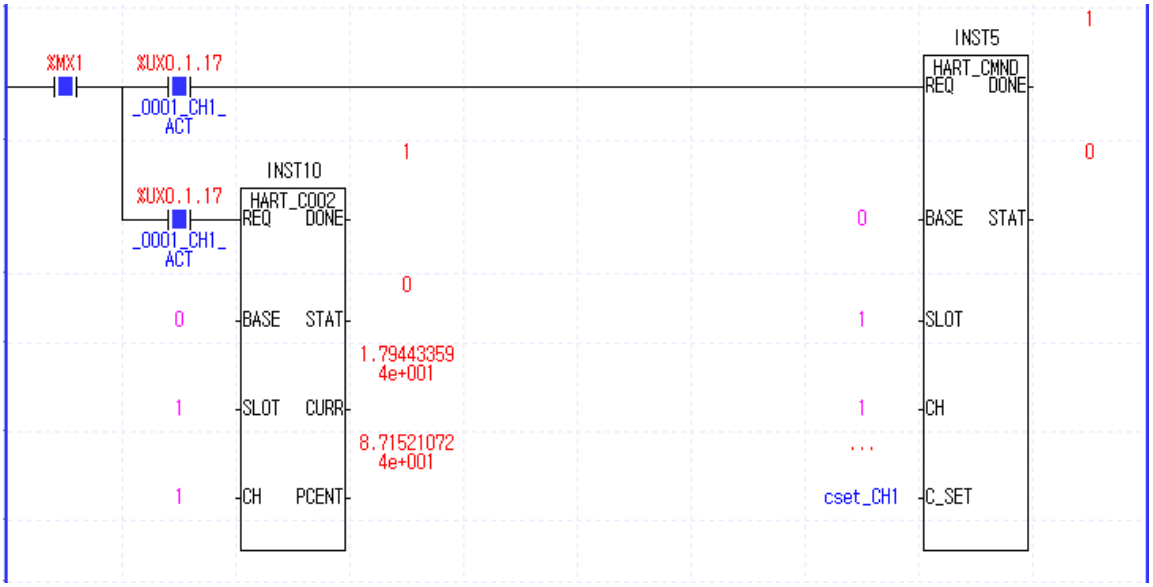

_0001_RDY
%MX0
MOVE
EN
ENO
3
IN
OUT
16#0003
_0001_OUTEN
%MX1
12000
_0001_CH0_DATA
%MX2
13600
_0001_CH1_DATA
_0001_CH0_ACT
INST8
HART_COOO
REQ
DONE
BASE
STAT
SLOT
M_ID
CH
D_TYP
PAMBL
U_REV
D_REV
S_REV
H_REV
DFLAG
D_ID
180
46089
5
10
2
2674
INST2
HART_CMND
C_SET
cset_CH0
_0001_CH1_ACT
INST10
HART_CO02
CURR
PCENT
1.79443359 4e+001
8.71521072 4e+001
INST5
cset_CH1

(d) Program example using PUT/GET command






%MX1
%UX0.1.16
_0001_CH0_ACT
%UX0.1.16
_0001_CH0_ACT
INST8
HART_C000
REQ DONE
1
BASE STAT
0
SLOT M_ID
180
CH D_TYP
46089
PAMBL
5
U_REV
5
D_REV
10
S_REV
2
H_REV
2
DFLAG
...
D_ID
2674
INST2
HART_CMND
REQ DONE
1
0
BASE STAT
0
SLOT
1
CH
0
C_SET
...
cset_CH0


%MX1
%UX0.1.17
_0001_CH1_ACT
%UX0.1.17
_0001_CH1_ACT
INST10
HART_C002
REQ DONE
1
BASE STAT
0
SLOT CURR
1.79443359
4e+001
CH PCENT
8.71521072
4e+001
1
INST5
HART_CMND
REQ DONE
0
BASE STAT
0
SLOT
1
CH
1
C_SET
...
cset_CH1

Chapter 9 Diagnosis of Errors

9.1 Error codes

Details and diagnosis of errors which occur while D/A conversion module is used will be described.

Error Code (Dec)	Description	RUN LED	ALM LED
10	Module error (Reset Check Error)	Blinks every 0.2 sec.	Off
11	Module error (RAM Check Error)		
12	Module error (Register Check Error)		
13	Module error (E^2PROM Check Error)		
21	Module error (D/A Conversion Error)		
31#note)	Parameters setting error of current module	Blinks every 1 sec.	Off
40#note)	Setting error of current module's digital input range (If input value is set less than -192 or greater than 16191). The range changes based on input data type.		
60# note)	Setting error of output limit high/low limit value (If output limit low value is set greater than output limit high value)	On	Blinks every 1 sec
70# note)	Setting error of change rate control value (If change control setting value is set less than 0 or greater than 16000)		

Notes

(1) # of the error code stands for the channel with error found.

(2) If 2 or more errors occur, the module will not save other error codes than the first error code found.

(1) If errors occur

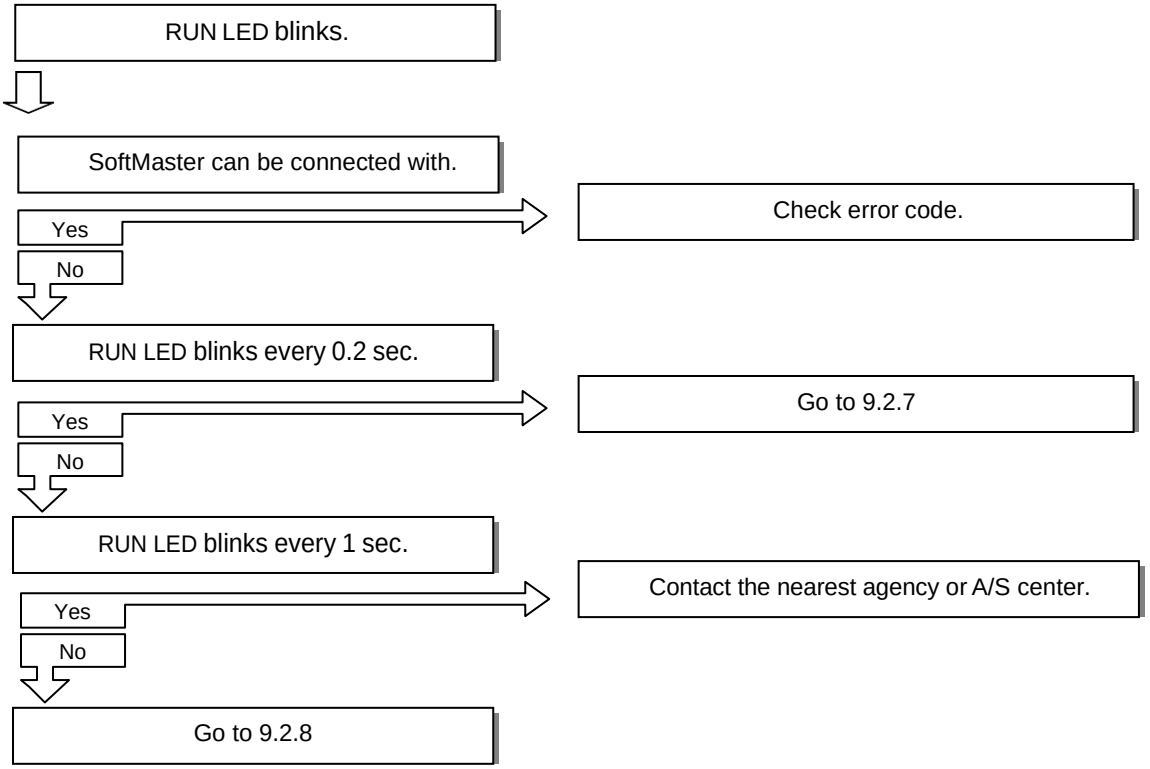
Error Code	Module Ready	Error Bit Status	Error Code	LED
10, 11, 12, 13, 21	Deleted (OFF)	Set all the channels	Displayed on system area	Blinks every 0.2 sec.
31#, 40#, 60#, 70#	Kept	Set applicable channel only	Displayed on system area	Blinks every 1 sec

(2) If errors deleted

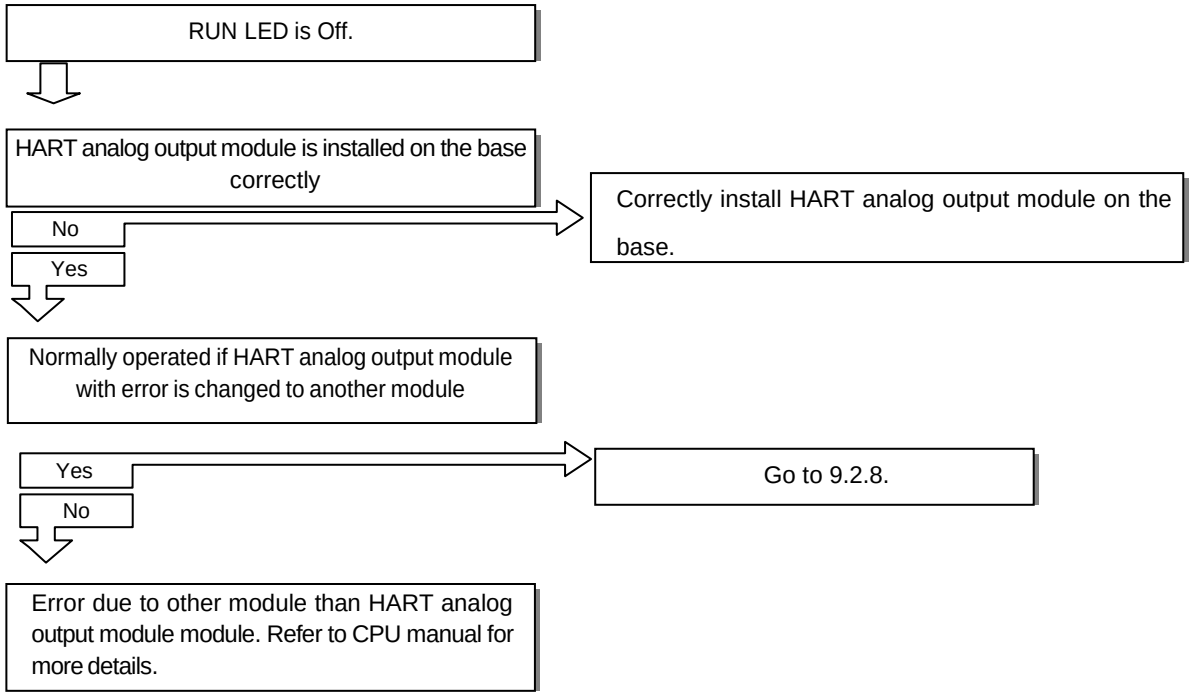
Error Code	Module Ready	Error Bit Status	Error Code	LED
10, 11, 12, 13, 21	Power On/Off	-	-	-
31#, 40#, 60#, 70#	Kept	Clear	Clear	On

9.2 Diagnosis of errors

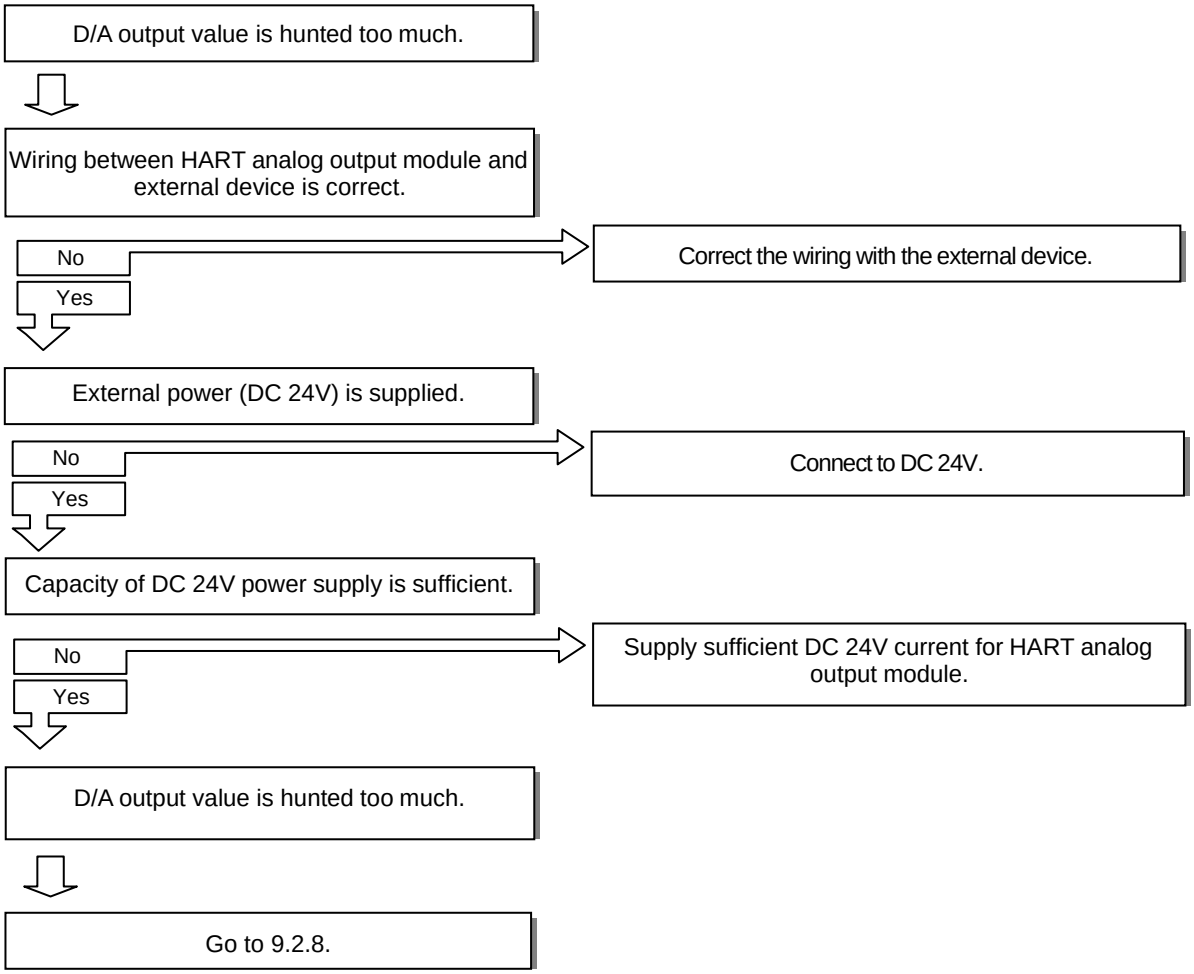
9.2.1 RUN LED blinks



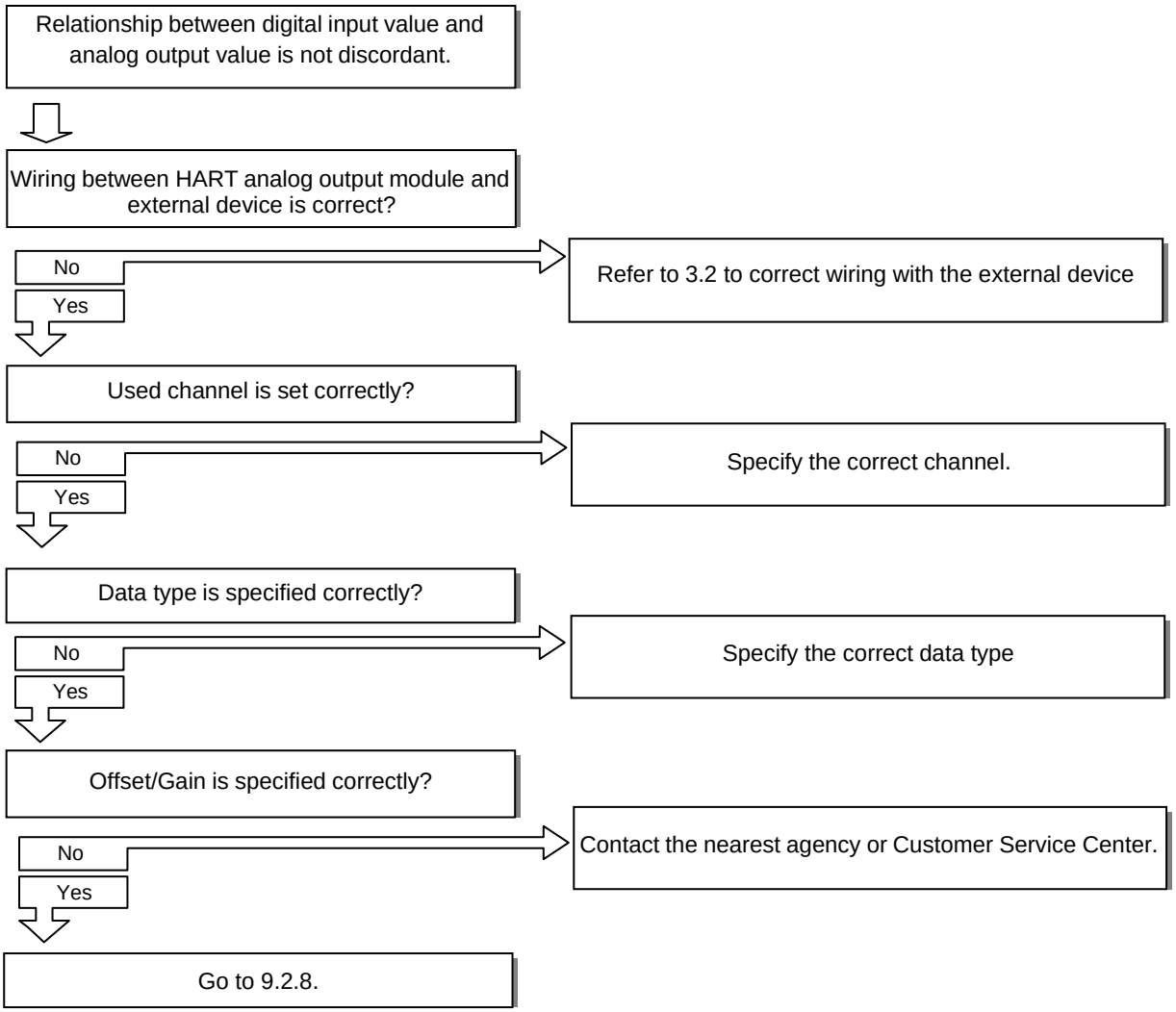
9.2.2 RUN LED is Off



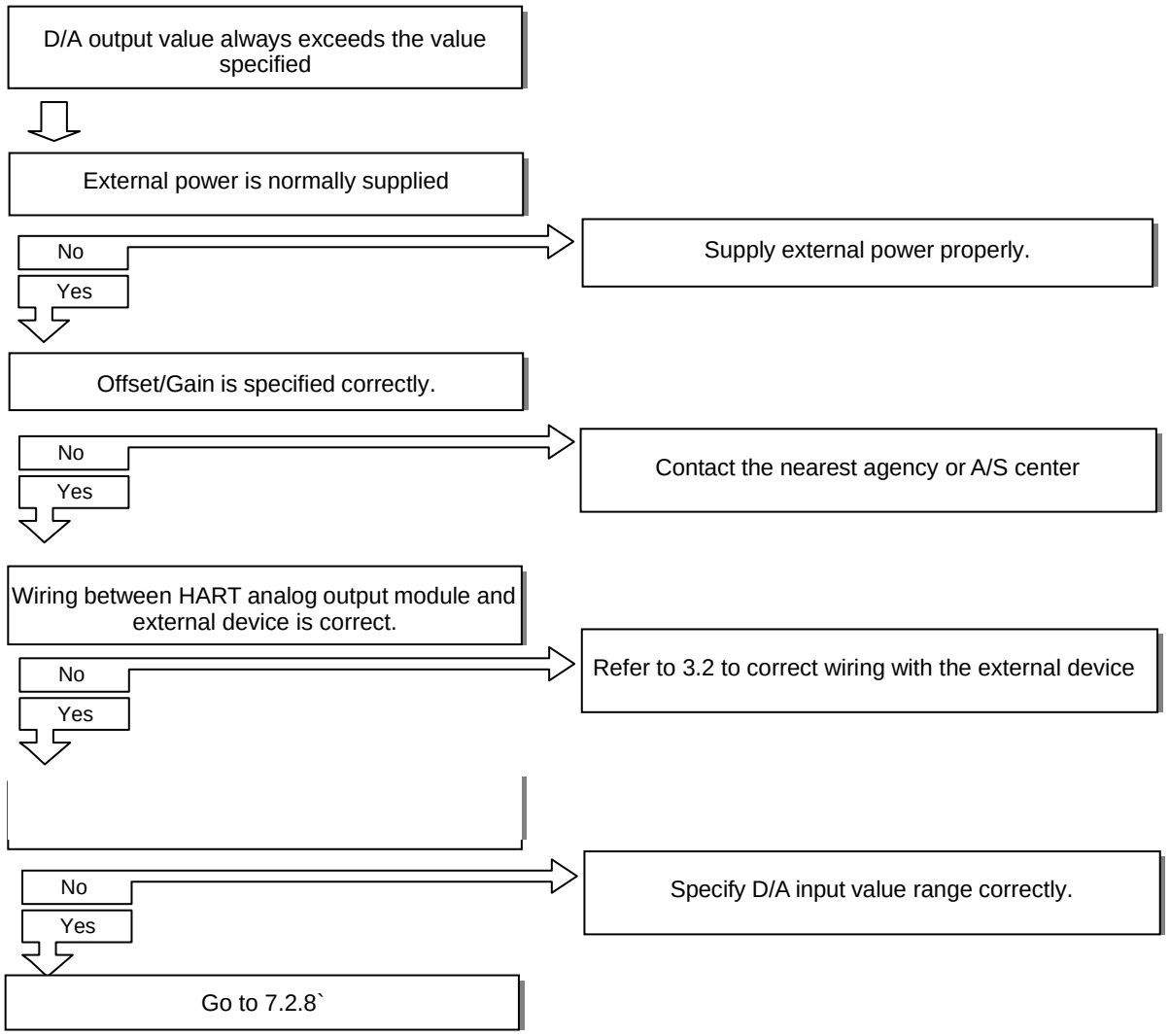
9.2.3 D/A Output Value hunted too much



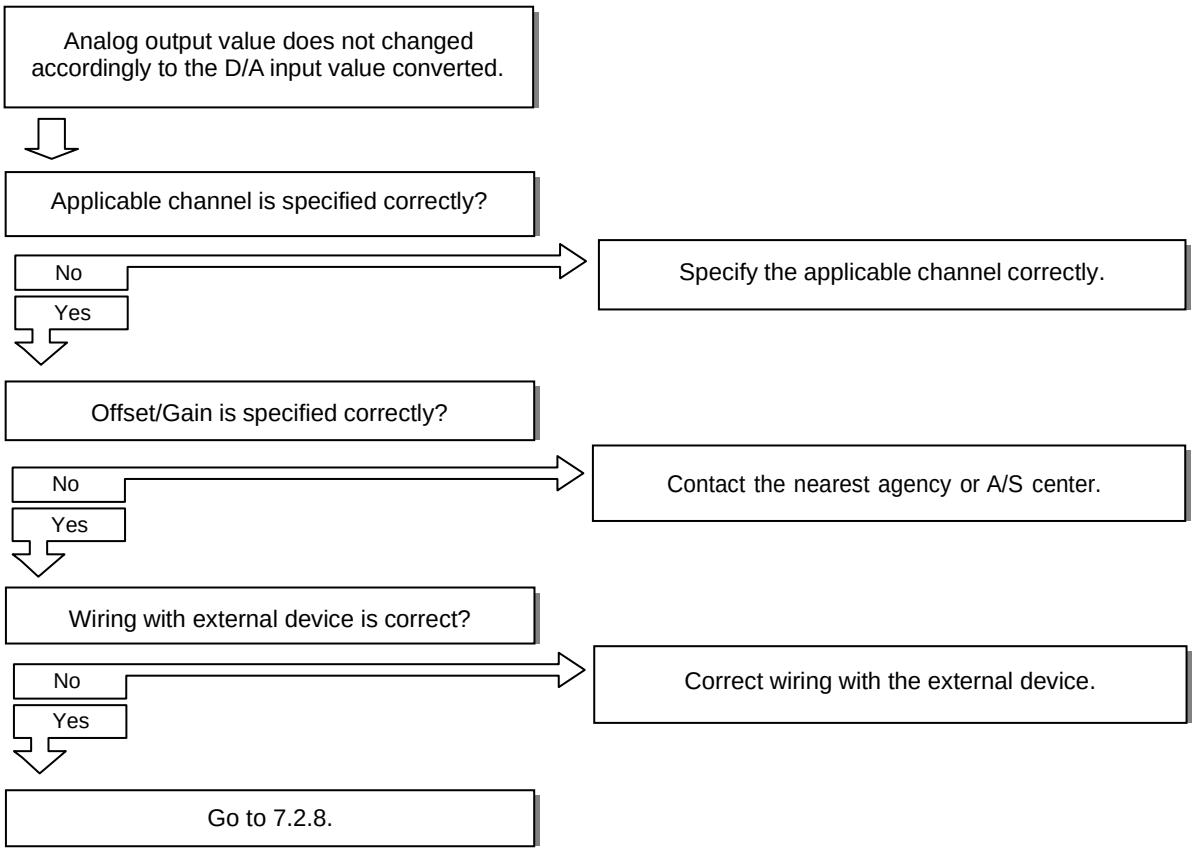
9.2.4 Relationship discordant between Digital Input Value & Analog Output Value



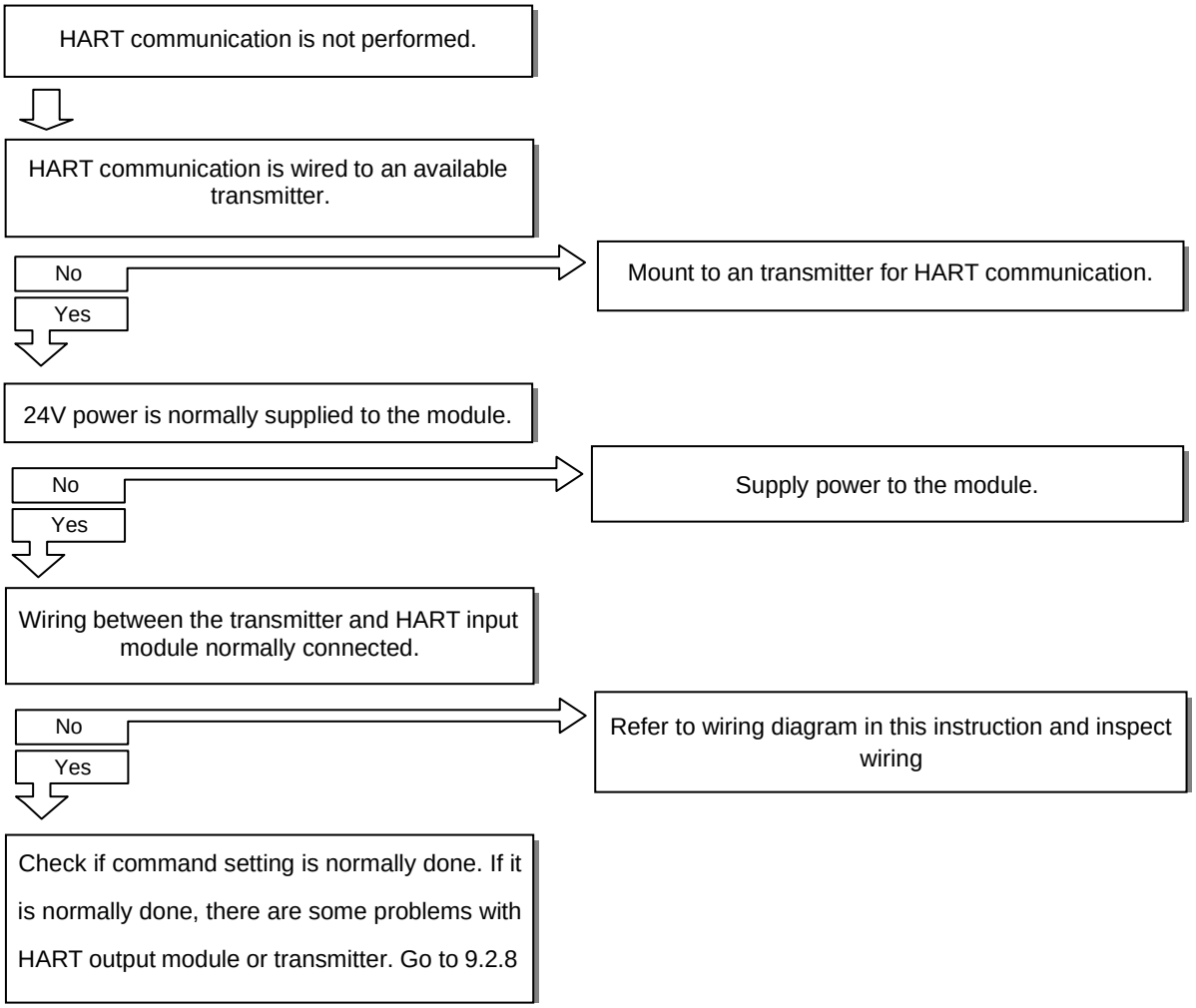
9.2.5 D/A Output Value always exceeds the value specified



9.2.6 Analog Output Value does not changed according to the change of Digital Input Value



9.2.7 HART communication is not performed



9.2.8 Hardware error of HART analog output module

It is HART analog output module's Hardware error.

Contact the nearest Customer Service Center.

9.2.9 Status check of HART analog output module through SoftMaster System Monitoring

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

(1) EXECution sequence

Two routes are available for the execution.

(a) [Monitor] -> [System Monitoring] -> And on the module screen, click the right mouse button to display [Module Info.].

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

(2) Module Information

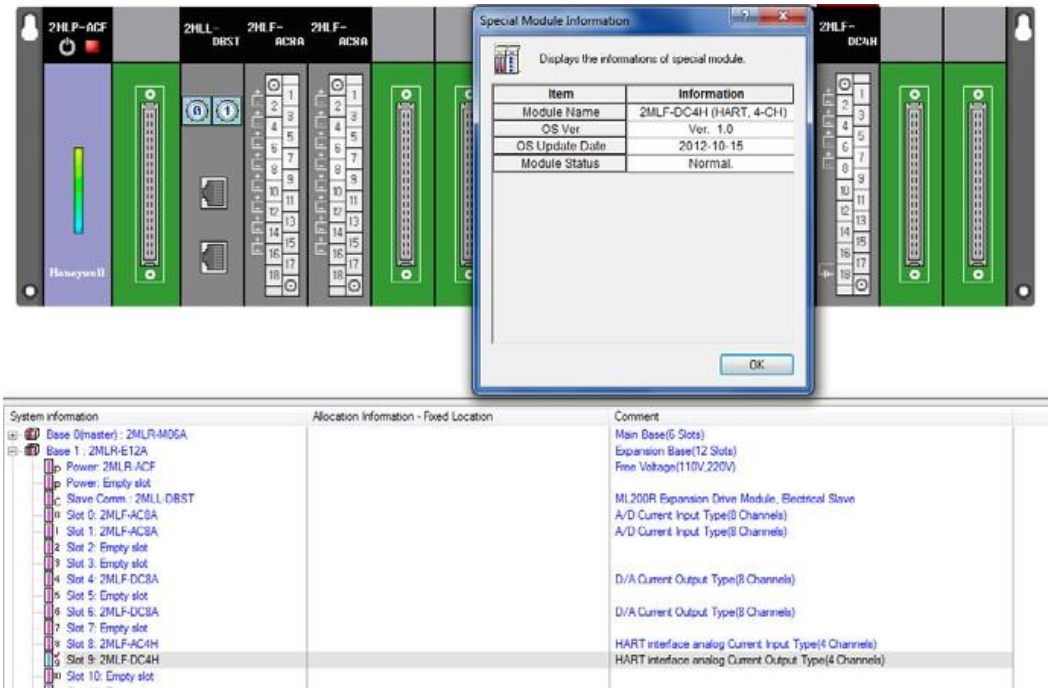
(a) Module type: shows the information of the module presently installed.

(b) Module information: shows the O/S version information of HART analog output module.

(c) O/S version: shows the O/S prepared date of HART analog output module.

(d) Module status: shows the present error code.

(3) System Monitor



Chapter 10 Asset Management System

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/O parameters] 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 isas 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

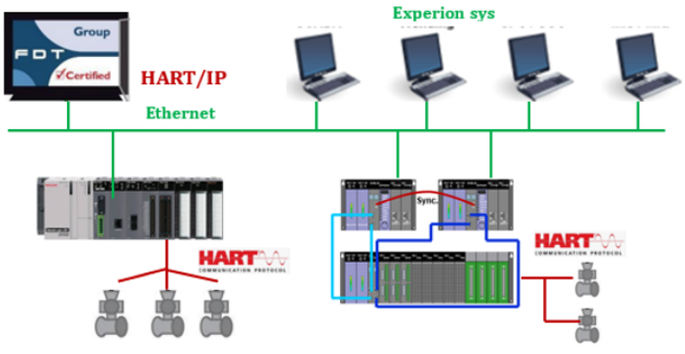
ML200 Module Type	Module OS Version	Remark
2MLR CPUH/□	Version 2.81 or higher	Pass-through
2MLL-EFM□B	Version 6.14 or higher	
2MLF-AC4H	Version 1.50 or higher	
2MLF-DC4H	Version 1.30 or higher	

- 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, CommDTM must be installed on the system equipped with asset management software. CommDTM of ML200 PLC, please contact Honeywell.
- 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 setin 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

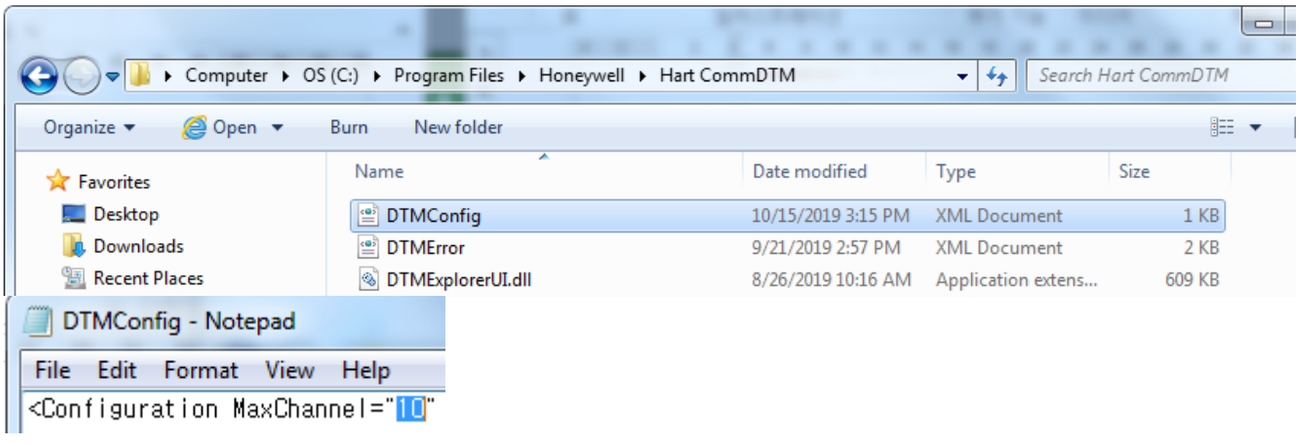
HART-CommDTM supports FDT frame applications conforming to FDT 1.2.+. HART-CommDTM is a HART communication DTM that works as a driver for communication between HART devices in the Redundant ML200(2MLR-CPU#+HART AI/AO+FEnet) system in the FDT frame application.

(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.



(1) Communication channel assignment

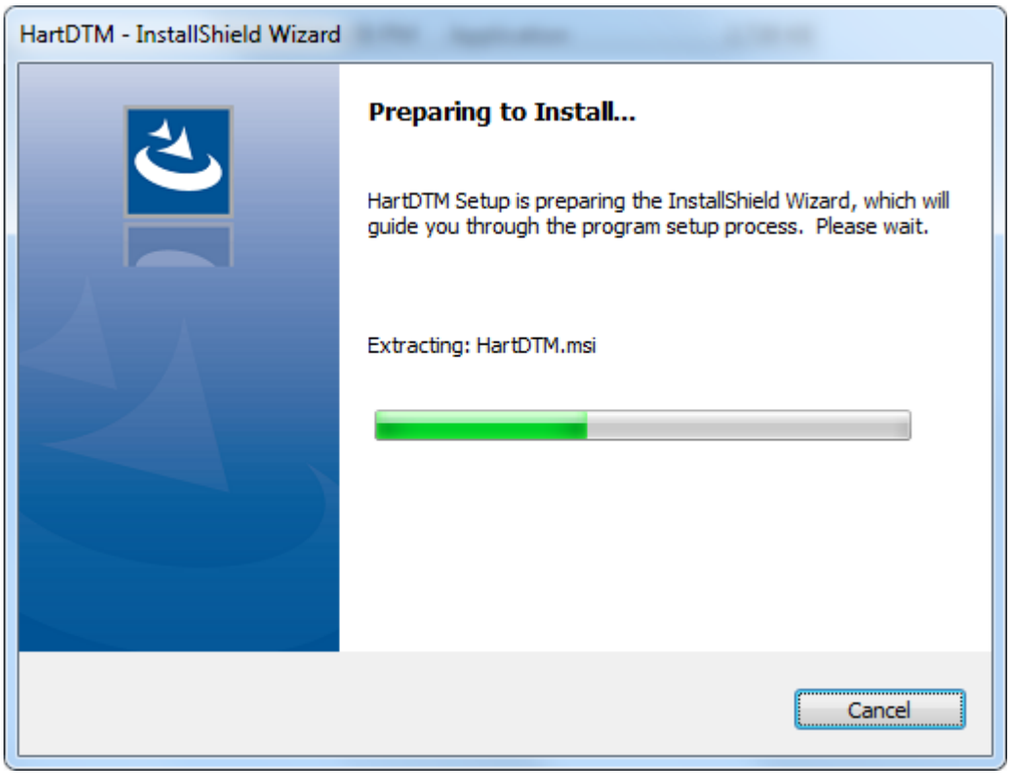
In the FDT frame application, the channel order is assigned according to the mounting order of the HART module. For example, if 4 HART analog modules are installed, the channels are allocated according to the base, slot and channel order as shown below.

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.

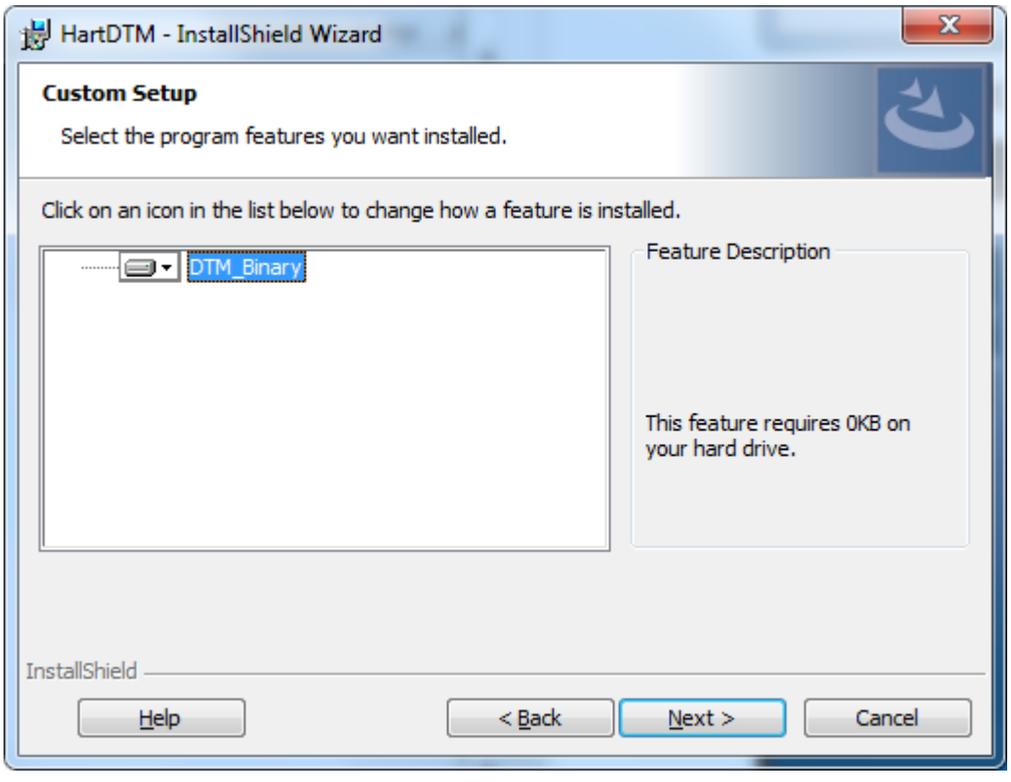
10.2.2 How to install HART-CommDTM

(1) Run the HART-CommDTM setup file.

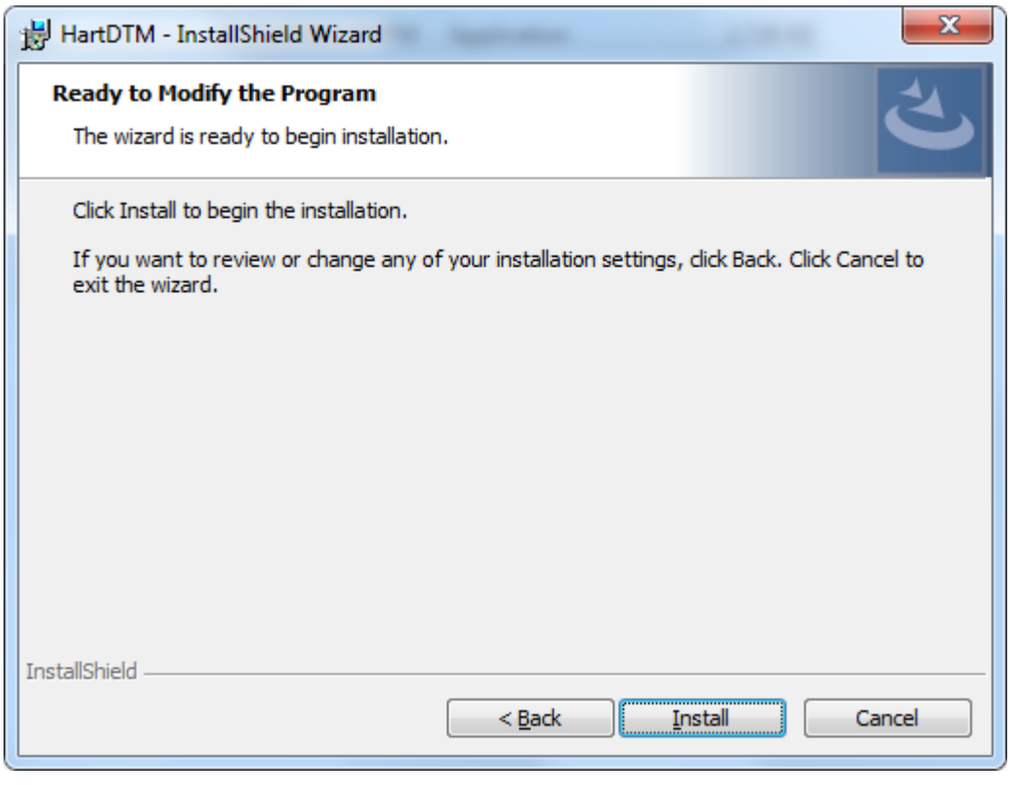


(2) Click the Next button on the screen below.

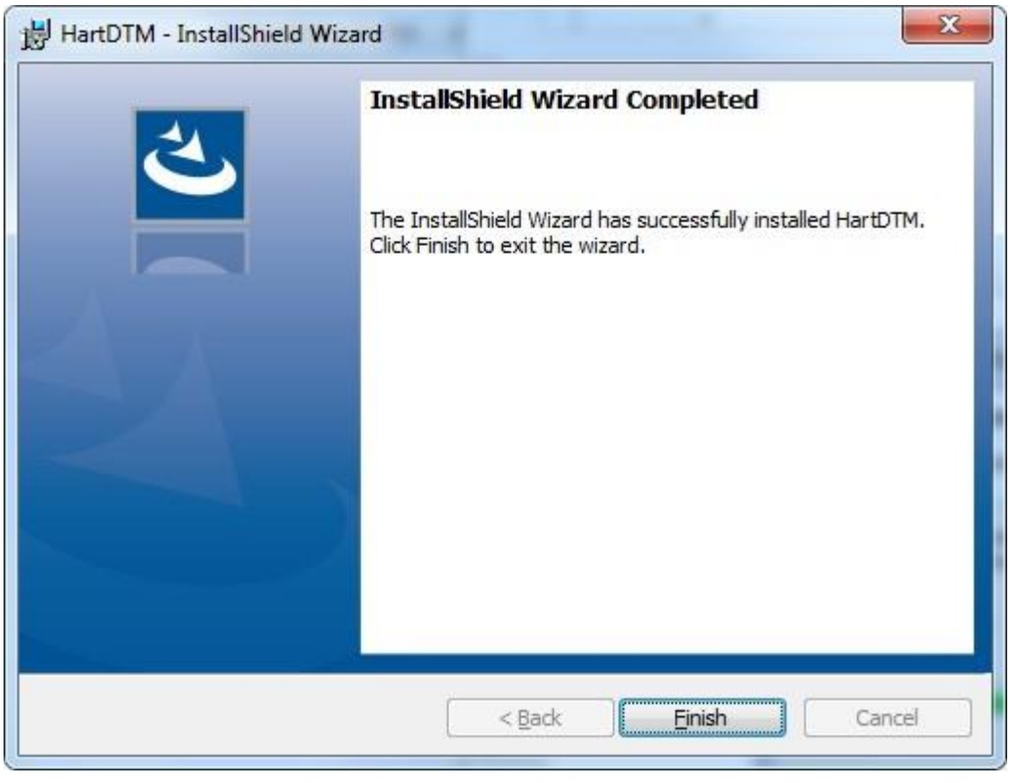
(3) Click the Next button on the screen as below.



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



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

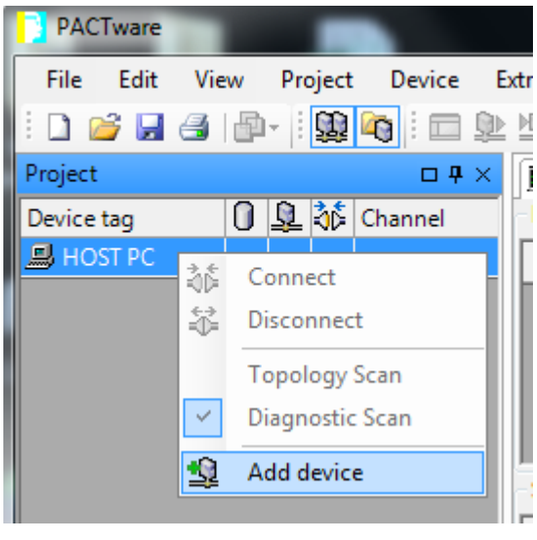


10.2.3 Uses of FDT Frame Application

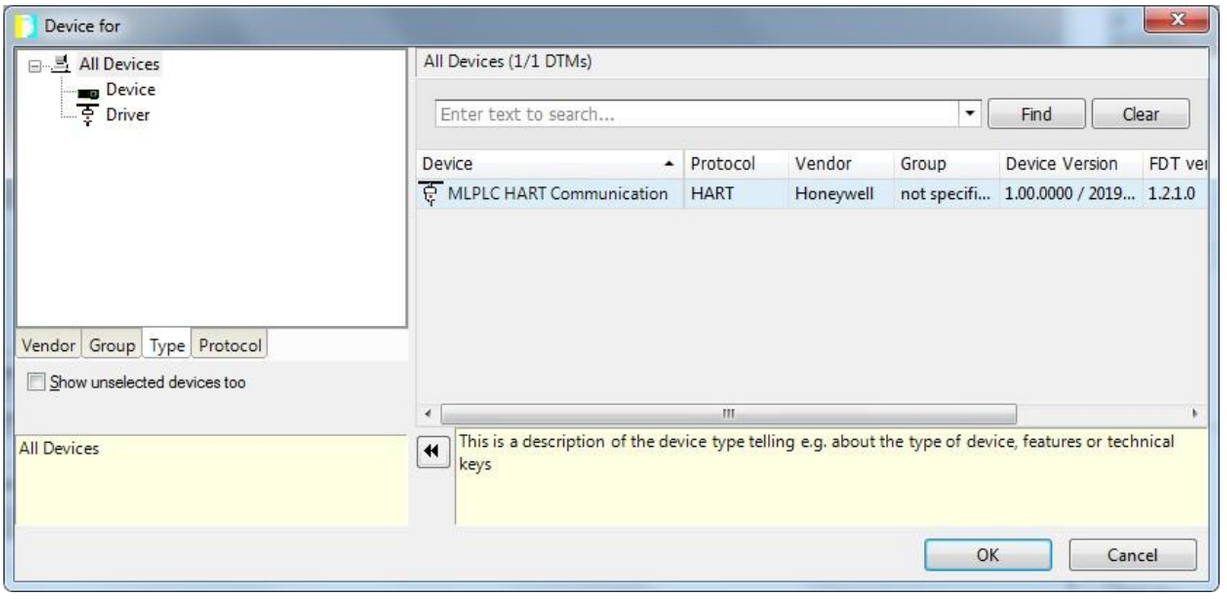
In this manual, description is based on PACTware. For downloading and installing PACTware, please refer to the PACTware homepage.

(1) Addition of HART Communication

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

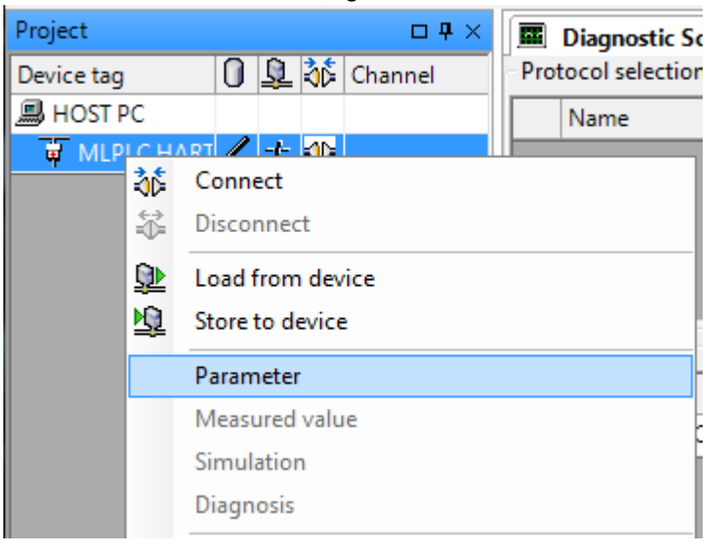


2) Select Device on the screen below and click the OK button.

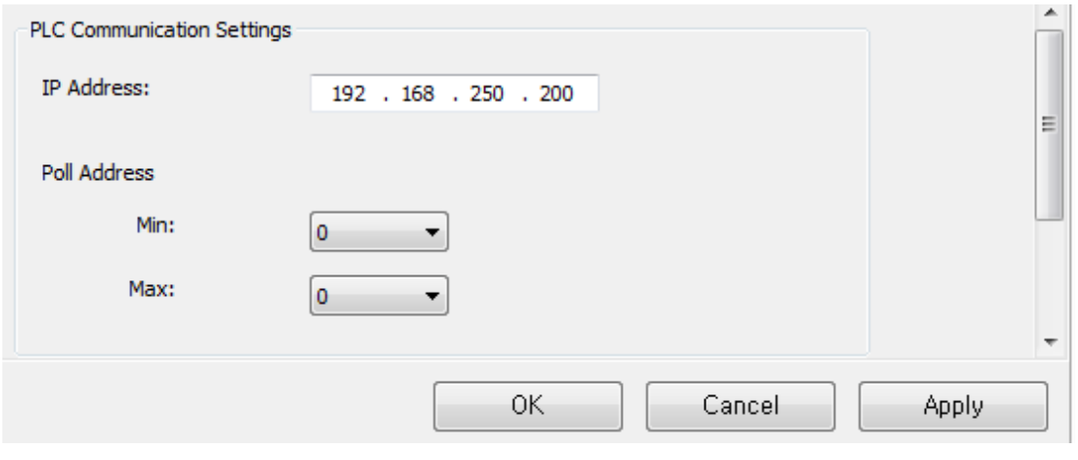


(2) Connect with PLC

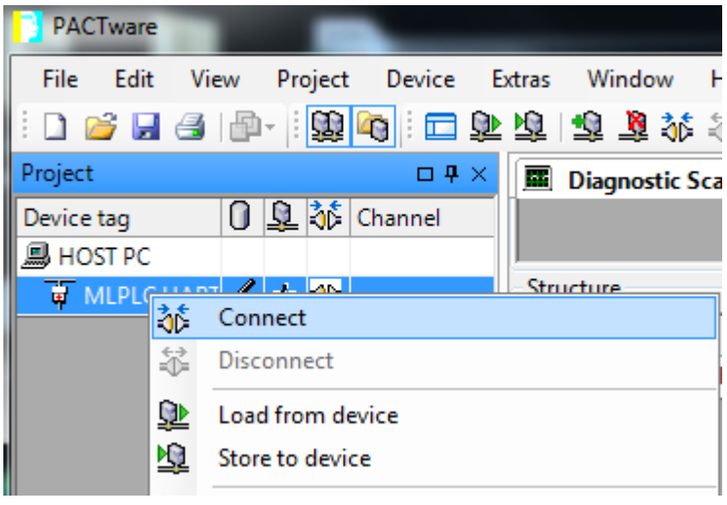
1) Select Communication DTM, right-click the mouse and select Parameter.



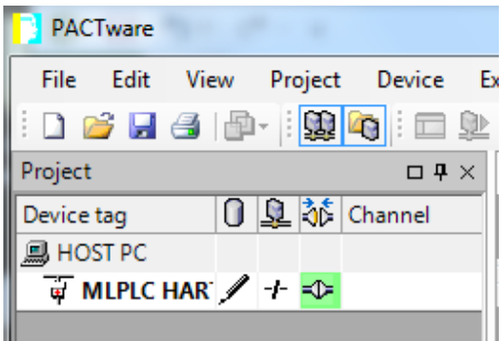
2) Set IP Address and Poll Address in PLC Communication Settings and click OK button.



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



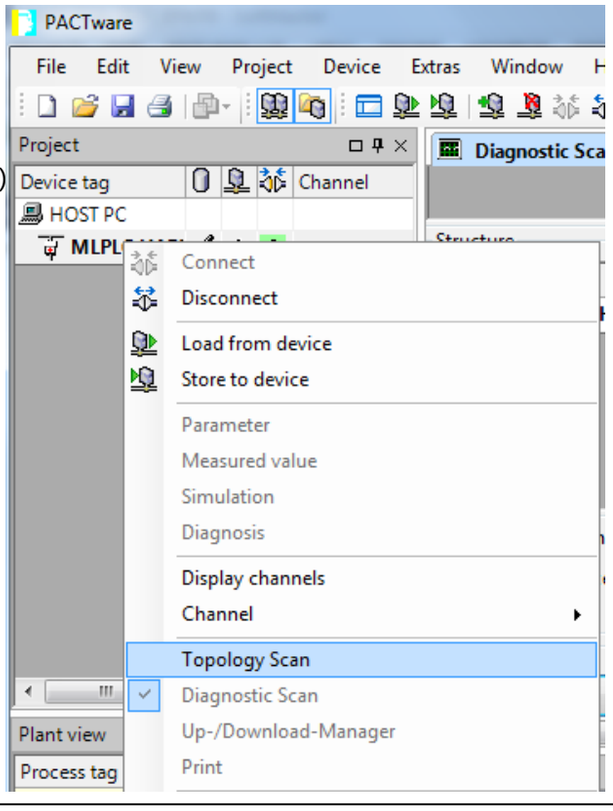
4) If it is connected normally, it is changed to bold font and the status is changed.

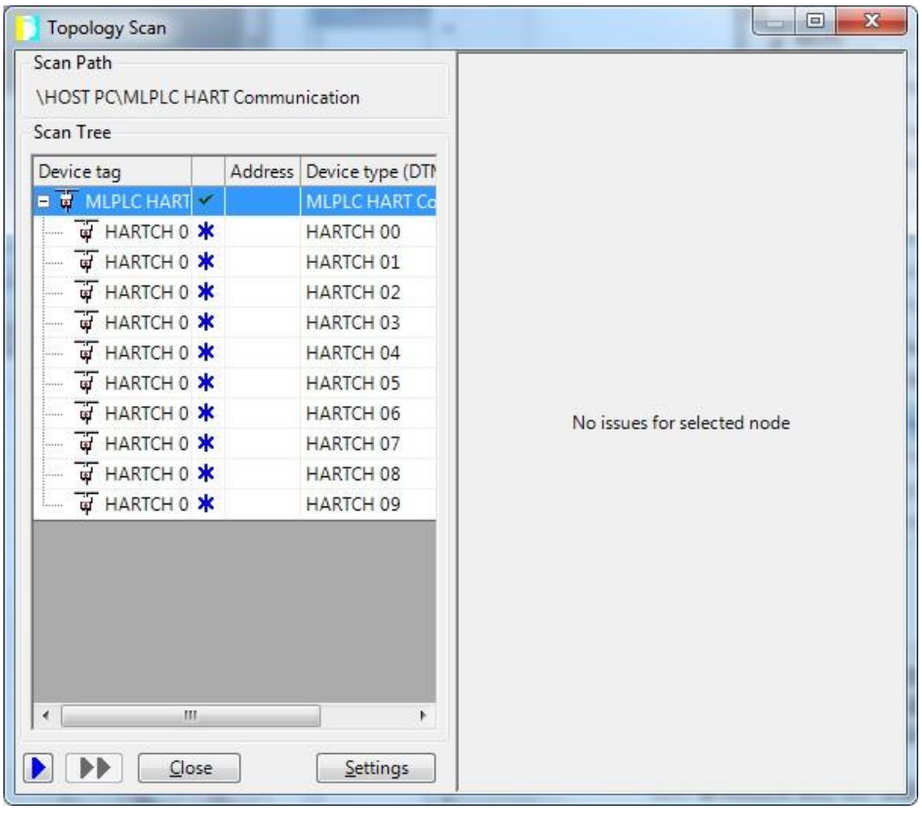


(3) HART device automatic allocation

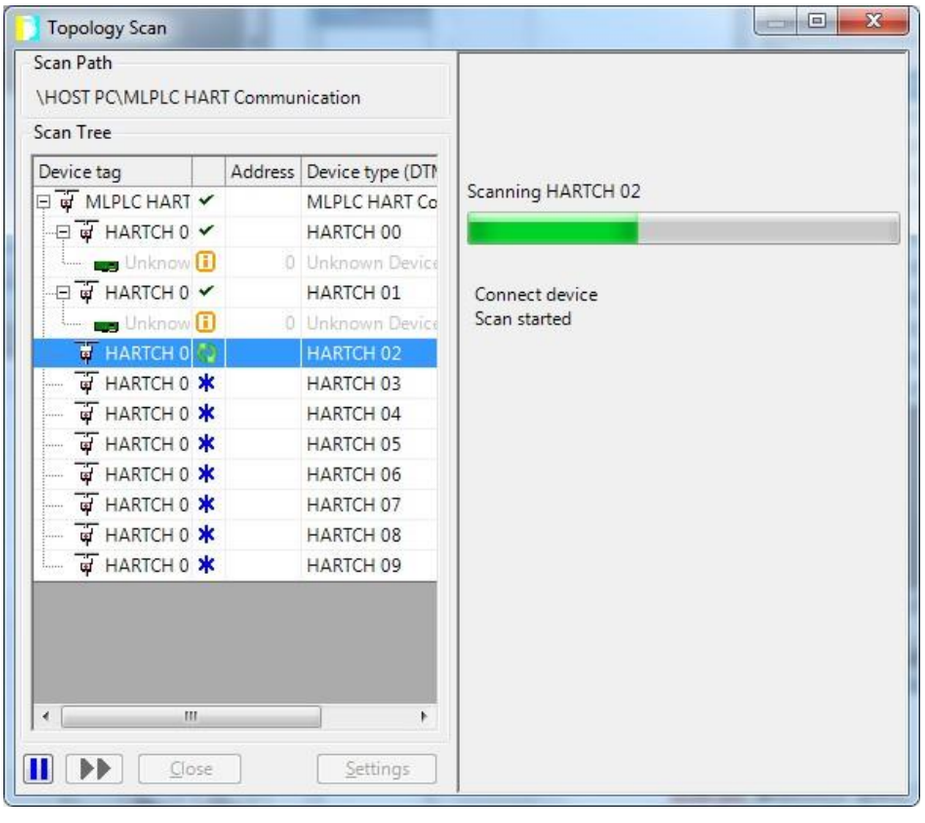
1) Select Communication DTM, right-click and select Topology Scan.

2)

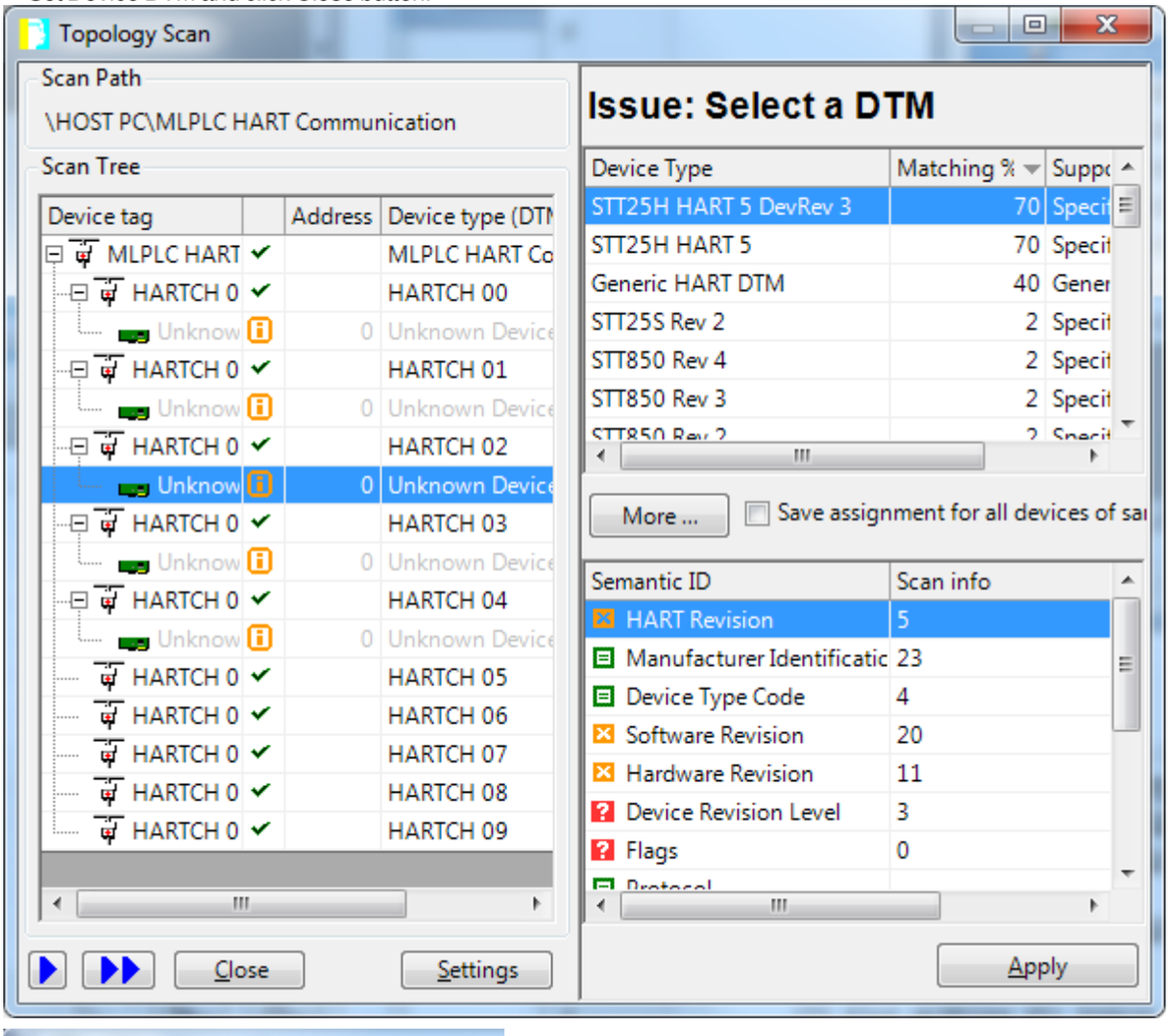


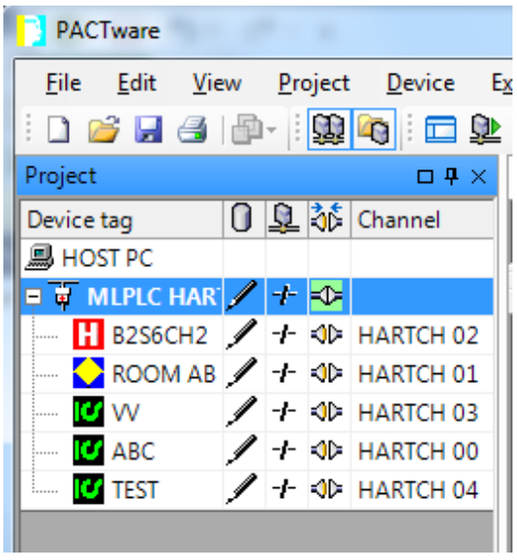


3) Read HART device information in the channel order as shown below.



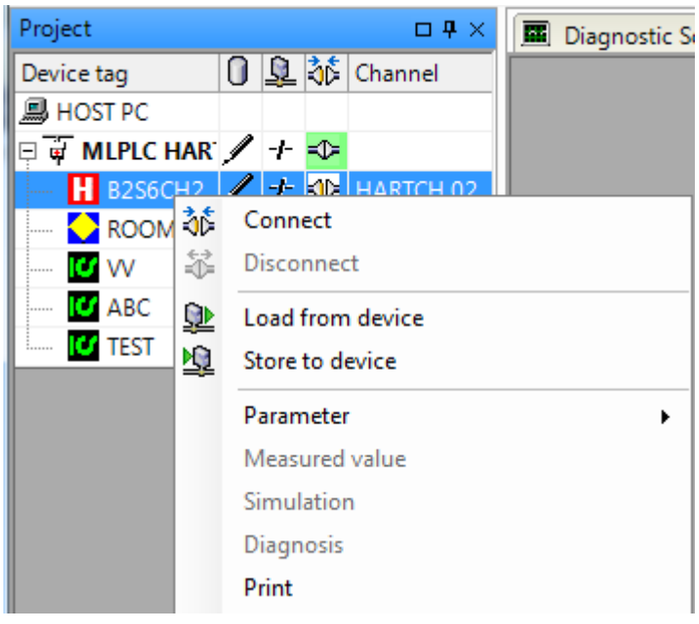
4) Set Device DTM and click Close button.



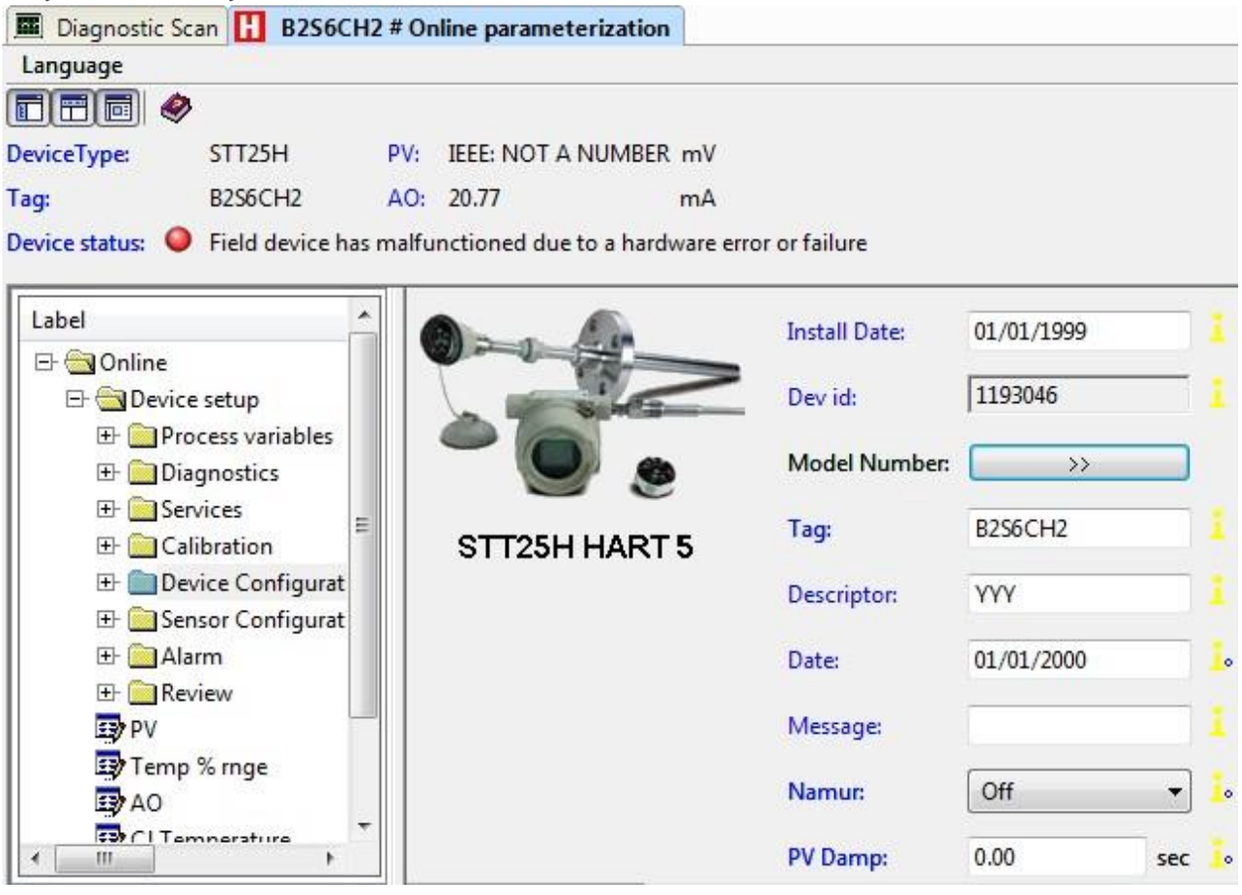


(4) HART device connection

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 .

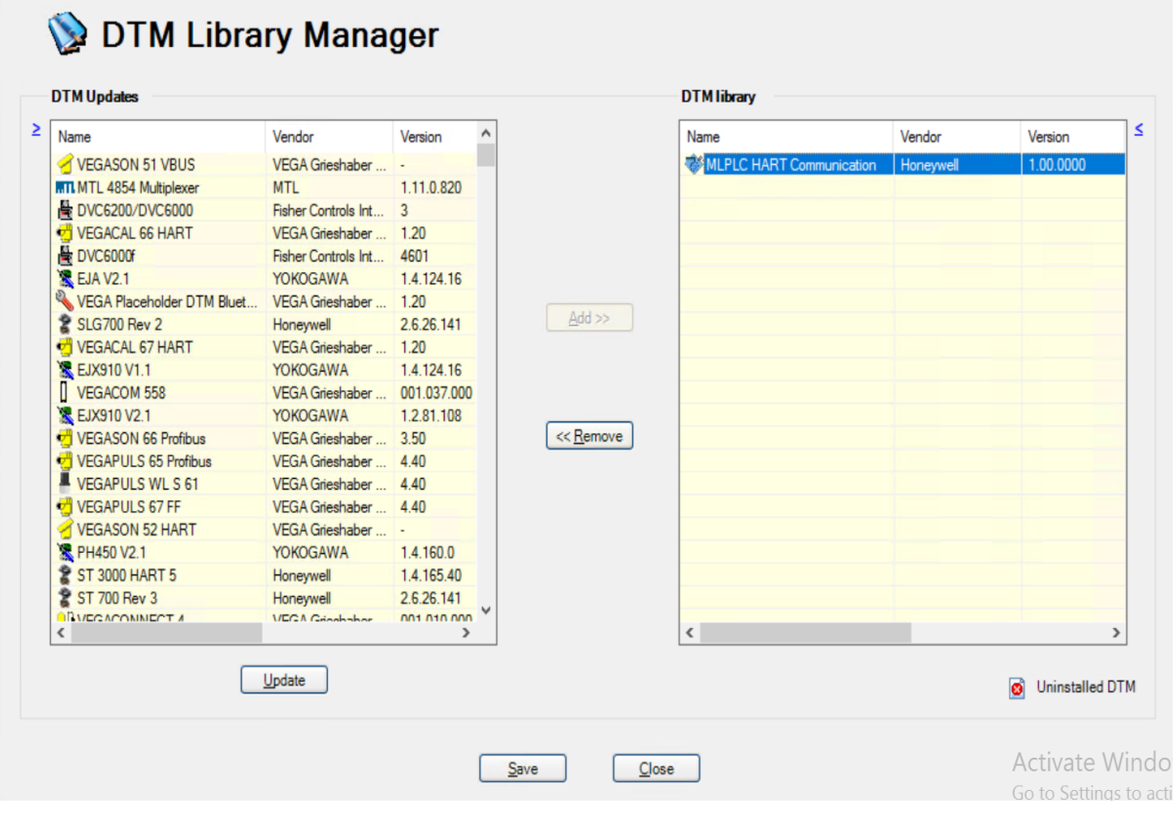
Integration on Honeywell solution;
FDM50x.x and R51x.x

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	

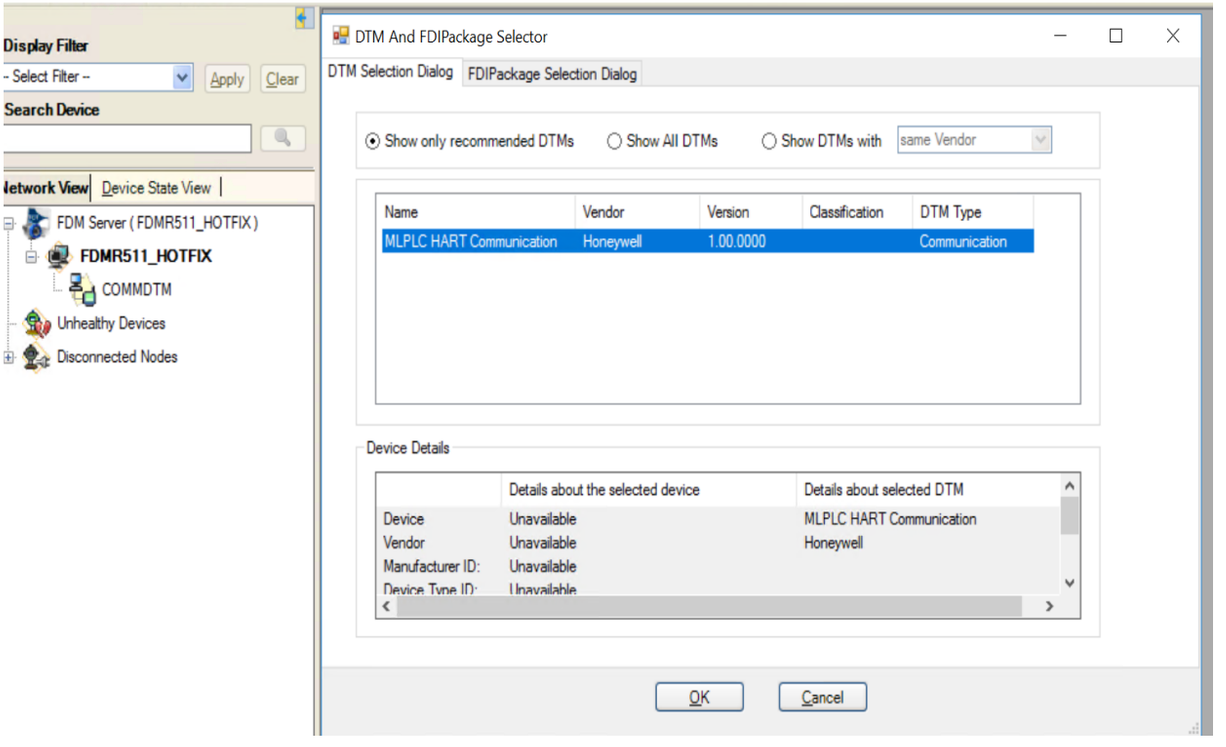
Building FDT Networks

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.



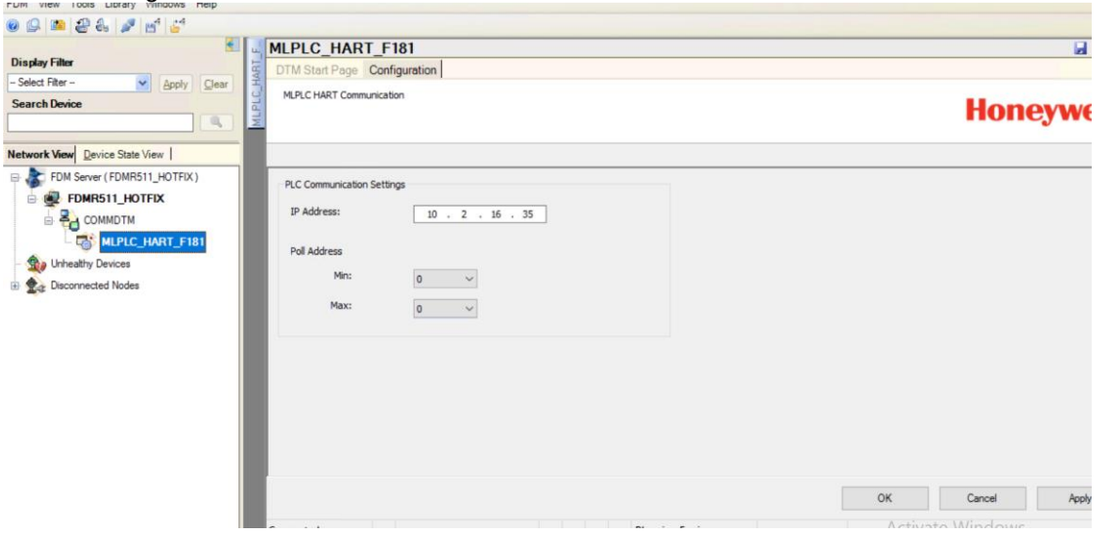
Configuring CommDTM netwok in FDM

- 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
  -



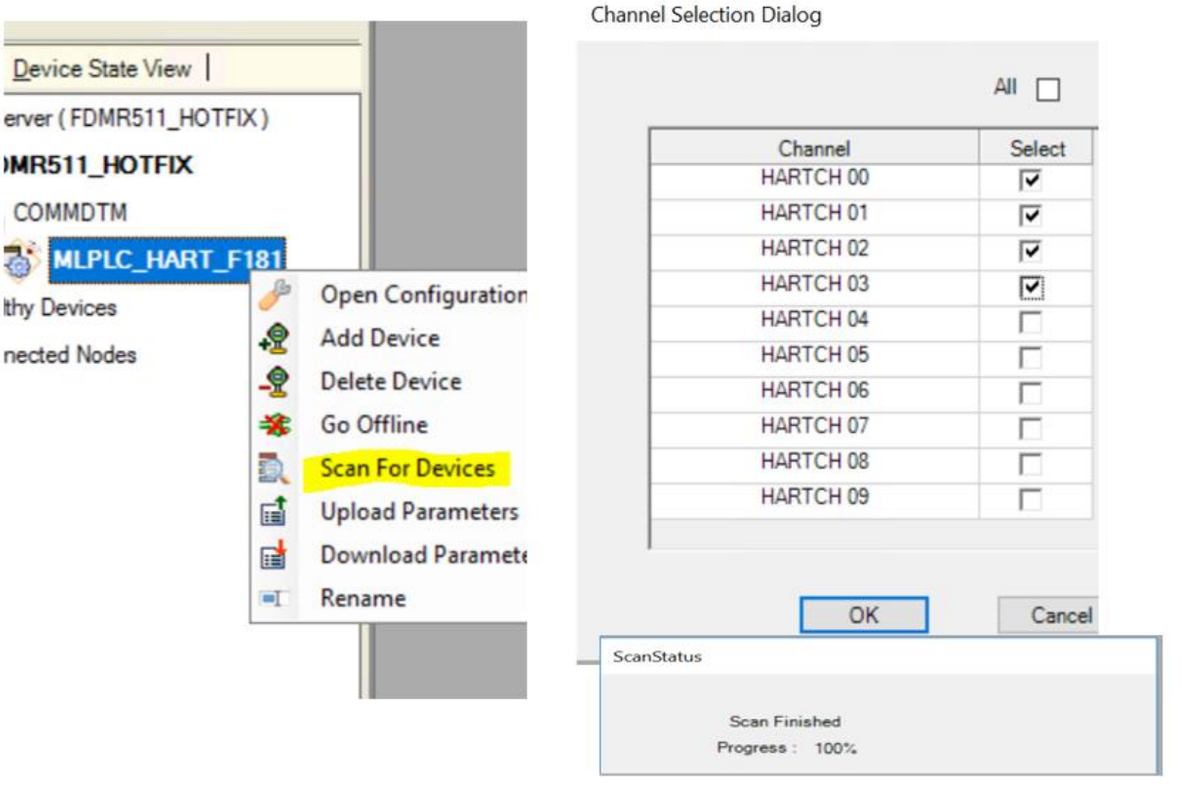
Building FDT Networks-Configuring

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



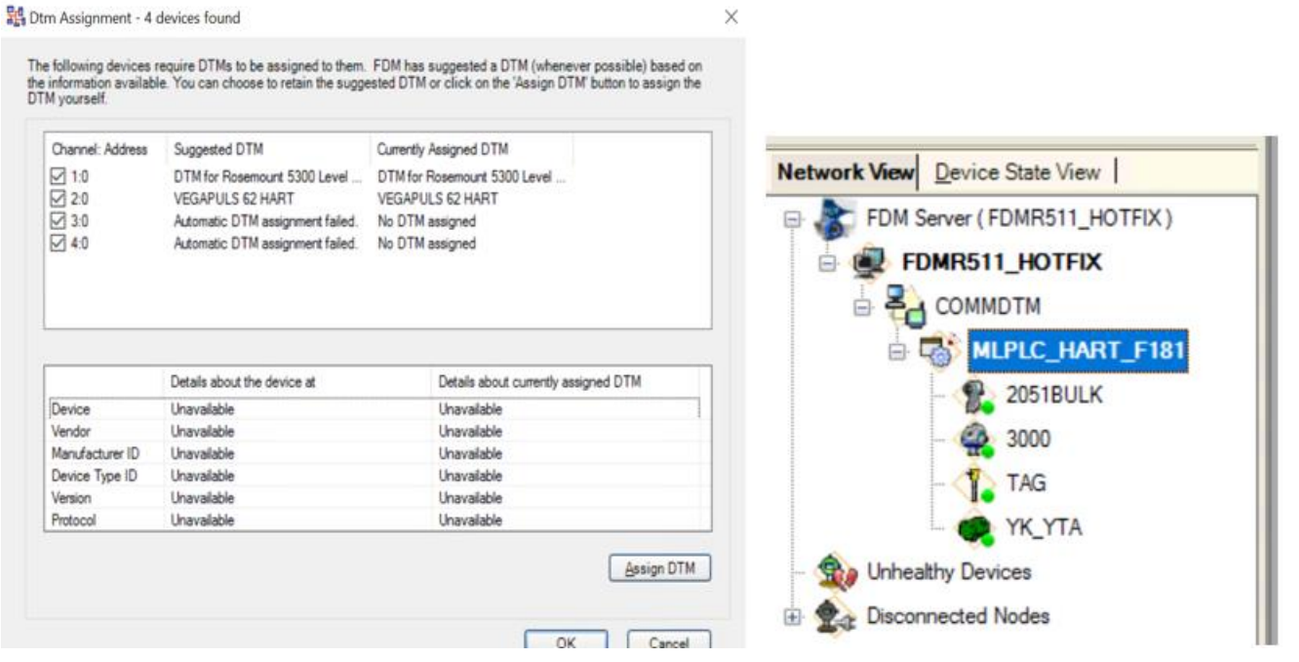
Building FDT Networks-Scan for Device

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



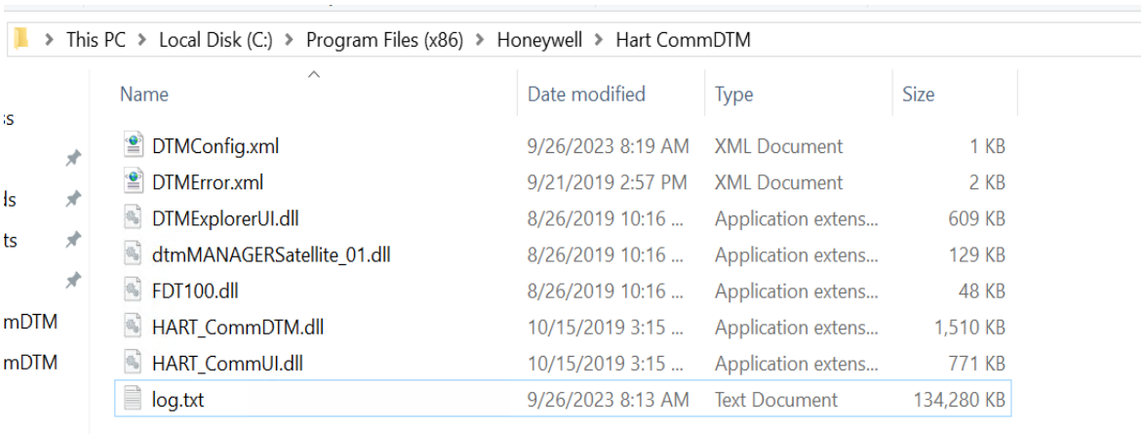
Building FDT Networks-Adding a Device

- 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

Appendix2. Manufacturer ID

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

Appendix2. Manufacturer ID

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.

Appendix2. Manufacturer ID

`	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

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

Appendix3. Engineering Units Code

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.

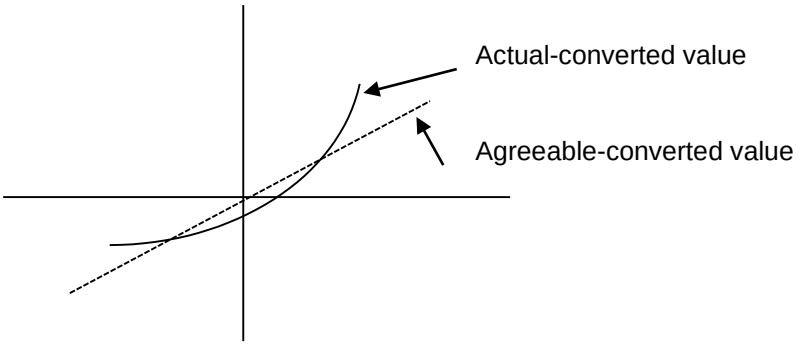
■ Full scale error: displayed with graph difference between agreeable analog-converted value and actual analog-converted value.

■ 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.

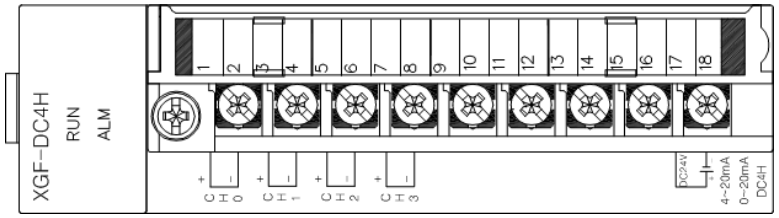
■ Primary Variable: As the first value assigned to HART dynamic variables, it the most basic measuring value.

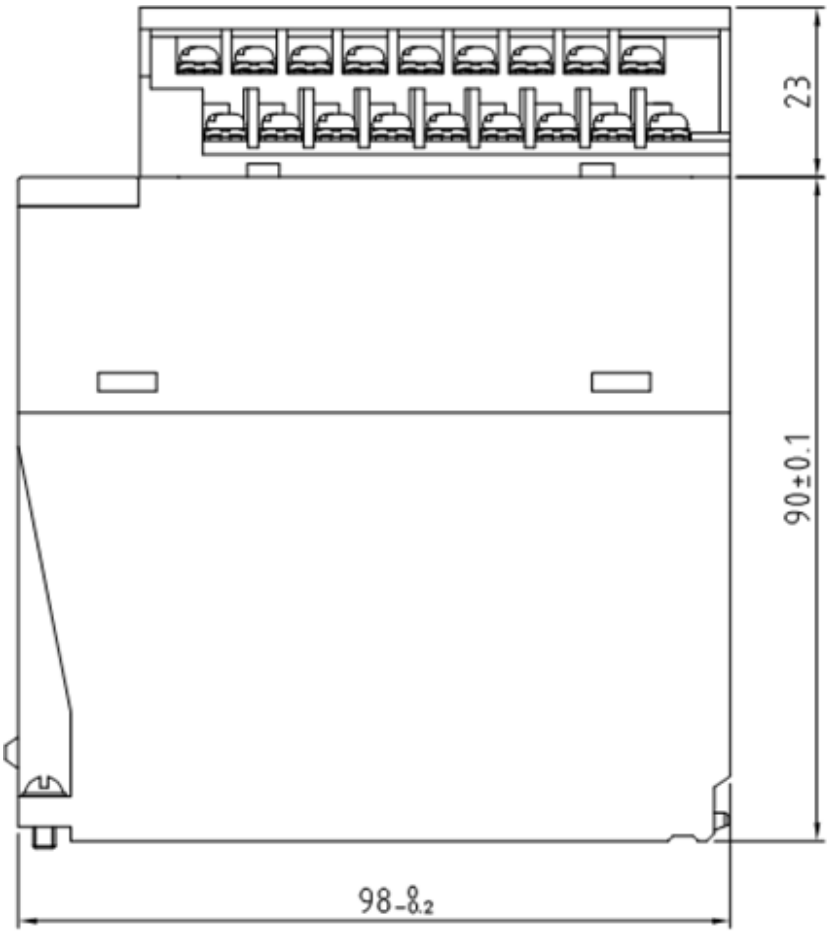
■ Frequency Shift Keying(FSK): A communication method to determine and transmit digital signal 0 and 1 by differentiating carrier wave's frequency.

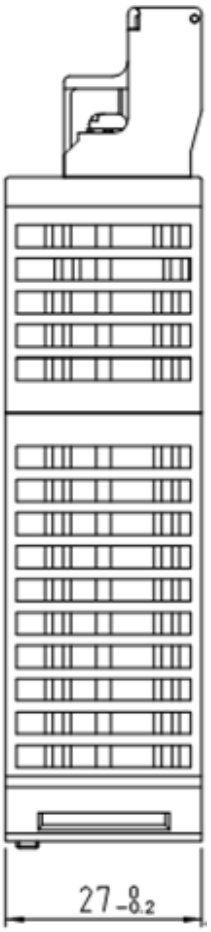
Appendix5. Dimensions

(1) Dimensions of 2MLF-DC4H

(Unit : mm)







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