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Analog Output Module

2MLF – DV4A/8A, 2MLF – DC4A/8A

User's Guide

ML200-AO
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Release 200

Honeywell

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About This Document

This document describes the specifications, handling, and programming methods for 2MLF-DV4A/8A and 2MLF-DC4A/8A type Analog Output Module used in association with CPU module of MasterLogic-200 PLC series (hereafter referred to as 2MLF-DV4A/8A or 2MLF-DC4A/8A).

Release Information

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References

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

Document Title
MasterLogic-200R User's Guide
2MLI-CPUU CPU User’s Guide

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Symbol Definitions

The following table lists the 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 can also be used to alert against unsafe practices. CAUTION symbol on the equipment refers the user to the product manual for additional information. The symbol appears next to required information in the manual.
	WARNING: Indicates a potentially hazardous situation, which, if not avoided, could result in serious injury or death. WARNING symbol on the equipment refers the user to the product manual for additional information. The symbol appears next to required information in the manual.
	WARNING, Risk of electrical shock: Potential shock hazard where HAZARDOUS LIVE voltages greater than 30 Vrms, 42.4 Vpeak, or 60 VDC may be accessible.

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

Contents

Tables

Figures

1. Introduction

1.1 Introduction to Analog Output Module

This user's guide describes the specifications, handling, and programming methods of Analog Output Module, 2MLF-DC4A/DC8A, and 2MLF-DV4A/DV8A, respectively.

The Analog Output Module uses the D/A conversion process to convert the signed 16 bit binary data from the PLC CPU to a corresponding analog signal. The modules 2MLF-DV4A and 2MLF-DV8A provide voltage output. The modules 2MLF-DC4A and 2MLF-DC8A provide current output.

The number of modules must not exceed the capacity of the power module.

1.2 Features

Following are the features of the Analog Output Module.

1. D/A conversion of 4 channels
   - 2MLF-DV4A/DV8A: D/A conversion of 4 channels (voltage output) are available in one module.
   - 2MLF-DC4A/DC8A: D/A conversion of 4 channels (current output) are available in one module.
2. High resolution of 1/16000
   - High-resolution analog output can be obtained using a digital resolution of 1/16000.
3. High accuracy
   - High accuracy of ±0.2% or less (when ambient temperature is 25ºC)
4. High-speed conversion process
   - Conversion speed is 250μs /channel
5. Output range available
   - Output range for 2MLF-DV4A/DV8A: 1–5V, 0–5V, 0–10V, -10–10V
   - Output range for 2MLF-DC4A/DC8A: 4–20mA, 0–20mA

1.3 Terminology

The following figure illustrates an example of the analog value and a Transducer.

Analog value – A

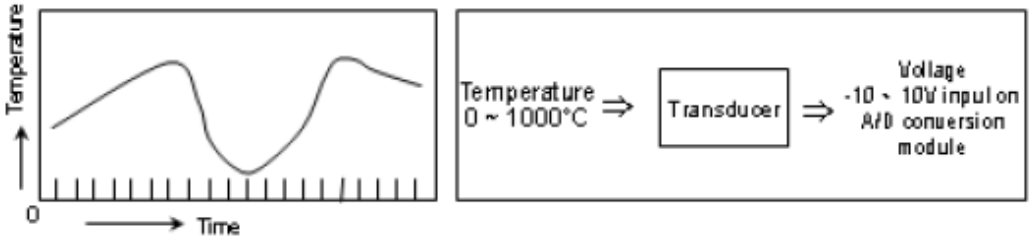


Figure 1 – Analog value and example of Transducer

An analog value is a physical quantity such as voltage, current, temperature, speed, pressure, and so on that change continuously with the time.

For example, Figure 1 illustrates that the temperature can change continuously with respect to time. The continuously changing temperature is converted to a corresponding DC voltage or current (-10 to 10V or 4-20mA) with the help of a transducer. This voltage is then given as an input to the A/D conversion module.

Digital value – D

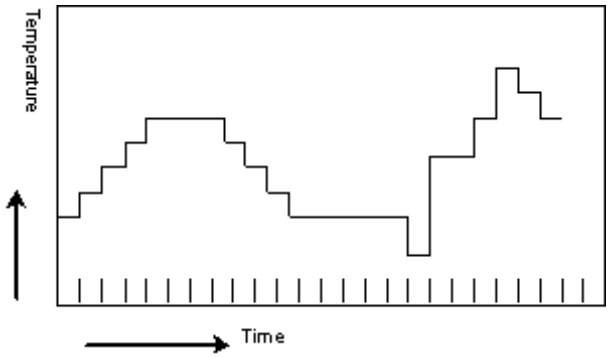


Figure 2 – Digital value

The discontinuously changing quantities that are displayed in Figures 1, 2, and 3, respectively, are called digital quantities. For example, ON and OFF signals can be represented as 0 and 1in the digital system. This is called as binary numbering system.

Decimals stored in binary format are called binary coded decimals (BCDs). BCDs and binary numbers are examples of digital values.

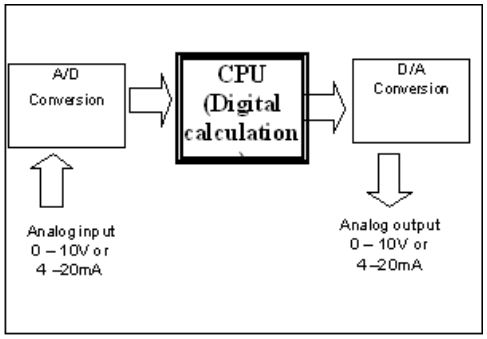


Figure 3 – Analog value conversion process in PLC

Analog signals cannot be directly given as input to the PLC CPU. Hence, analog signals are converted to digital value using A/D converters available in the Analog Input Module as shown in Figure 3.

D/A converters are used for converting the digital output from the CPU to analog value.

Characteristics of D/A conversion

Voltage output

The following figure illustrates the voltage output, which is a characteristic of D/A conversion.

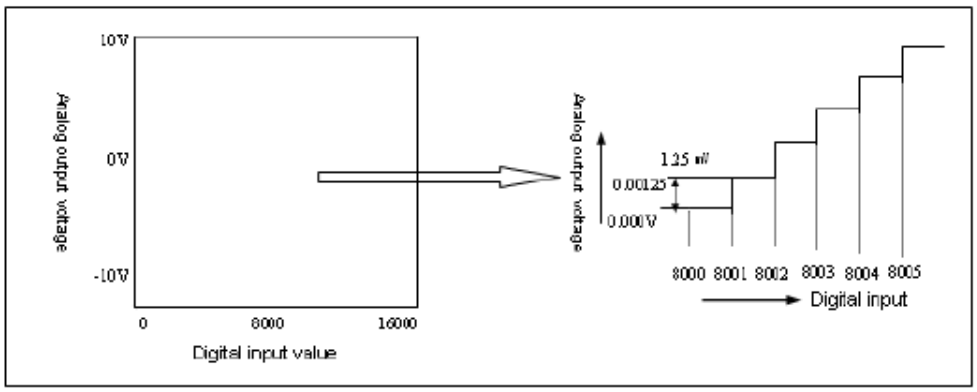


Figure 4 – Characteristics of D/A conversion (voltage output)

The D/A conversion module is used for converting digital output from CPU to analog value. When the voltage output range of D/A conversion module is in the range -10–10V, -10V is the output if the digital input is 0, and 10V is output if digital input is 16000. A change in digital value to 1 is equivalent to 1.25mV in analog.

Current output

The following figure illustrates the current output, which is a characteristic of D/A conversion.

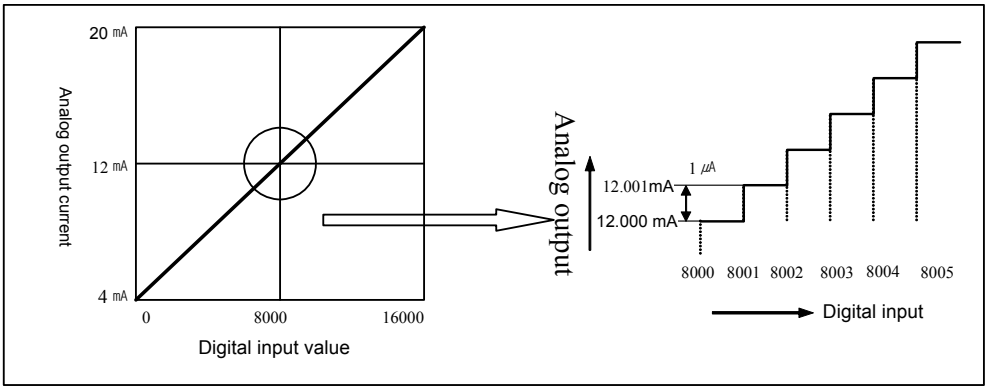


Figure 5 – Characteristics of D/A conversion (current output)

When the current output range of D/A conversion module is set to 4–20mA, 4mA is the output if digital input is 0 and 20mA is the output if digital input is 16000. A change in digital value of 1 is equivalent to 1.25mA in analog.

2. Specifications

2.1 Performance specifications

The following are the list of performance specifications of D/A conversion module.

Table 1 – Performance specifications

<table>
<tr><th rowspan="2">Item</th><th colspan="4">Specification</th></tr>
<tr><th>2MLF-DV4A (Voltage Output Type)</th><th>2MLF-DV8A (Voltage Output Type)</th><th>2MLF -DC4A (Current Output Type)</th><th>2MLF - DC8A (Current Output Type)</th></tr>
<tr><td rowspan="3">Analog output</td><td colspan="2" rowspan="2">DC 1 ~ 5V
DC 0 ~ 5V
DC 0 ~ 10V } Load resistance: 1kΩ or more
DC -10 ~ 10V</td><td colspan="2">DC 4 ~ 20mA
DC 0 ~ 20mA</td></tr>
<tr><td>Load resistance: 600Ω or less</td><td>Load resistance: 550Ω or less</td></tr>
<tr><td colspan="4">Select the Output range using applicable program or parameters (for respective channels)</td></tr>
<tr><td>Digital input</td><td colspan="4">Signed 16-bit binary value (data: 14 bits): Format of input data can be set through applicable program or parameters (for respective channels)
<table>
<tr><th>Analog output / Digital input</th><th>1 ~ 5V</th><th>0 ~ 5V</th><th>0 ~ 10V</th><th>-10 ~ 10V</th></tr>
<tr><td>Unsigned Value</td><td colspan="4">0 ~ 16000</td></tr>
<tr><td>Signed Value</td><td colspan="4">-8000 ~ 8000</td></tr>
<tr><td>Precise Value</td><td>100 ~ 5000</td><td>0 ~ 5000</td><td>0 ~ 10000</td><td>- 10000 ~10000</td></tr>
<tr><td>Percentile Value</td><td colspan="4">0 ~ 10000</td></tr>
</table>
<table>
<tr><th>Analog output / Digital input</th><th>4 ~ 20mA</th><th>0 ~ 20mA</th></tr>
</table></td></tr>
</table>

<table>
<tr><th rowspan="2">Item</th><th colspan="5">Specification</th></tr>
<tr><th>2MLF-DV4A (Voltage Output Type)</th><th>2MLF-DV8A (Voltage Output Type)</th><th colspan="2">2MLF -DC4A (Current Output Type)</th><th>2MLF - DC8A (Current Output Type)</th></tr>
<tr><td></td><td colspan="5"><table>
<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></td></tr>
<tr><td rowspan="5">Maximum resolution</td><td colspan="5">1/16000 (for respective output ranges)</td></tr>
<tr><td>1~5V</td><td>0.250mV</td><td rowspan="2">4~20mA</td><td rowspan="2">1.0μA</td><td rowspan="2"></td></tr>
<tr><td>0~5V</td><td>0.3125mV</td></tr>
<tr><td>0~10V</td><td>0.625mV</td><td rowspan="2">0~20mA</td><td rowspan="2">1.25μA</td><td rowspan="2"></td></tr>
<tr><td>±10V</td><td>1.250mV</td></tr>
<tr><td>Accuracy</td><td colspan="5">±0.2% or less (when ambient temperature is 25ºC)
±0.3% or less (when the range is within operational temperature)</td></tr>
<tr><td>Maximum conversion speed</td><td colspan="5">250μs/channel</td></tr>
<tr><td>Absolute maximum output</td><td colspan="2">±15V</td><td colspan="3">±24mA</td></tr>
<tr><td>Number of output channels</td><td>4 channels/1 module</td><td>8 channels/1 module</td><td>4 channels/1 module</td><td colspan="2">8 channels/1 module</td></tr>
<tr><td>Insulation method</td><td colspan="5">Photo-coupler insulation between input terminal and PLC power (no insulation between channels)</td></tr>
<tr><td>Terminal connected</td><td colspan="5">18-point terminal</td></tr>
</table>

Item		Specification			
		2MLF-DV4A (Voltage Output Type)	**2MLF-DV8A (Voltage Output Type)**	**2MLF -DC4A (Current Output Type)**	**2MLF - DC8A (Current Output Type)**
I/O points occupied	Changeable type: 16 points, Fixed type: 64 points				
Current consumption	DC 5V	190mA	190mA	190mA	190mA
	DC 24V	140mA	180mA	210mA	300mA
Weight (g)	150g				

2.2 Part names and functions

The following example illustrates the parts of 2MLF-DV4A and 2MLF-DC4A modules respectively.

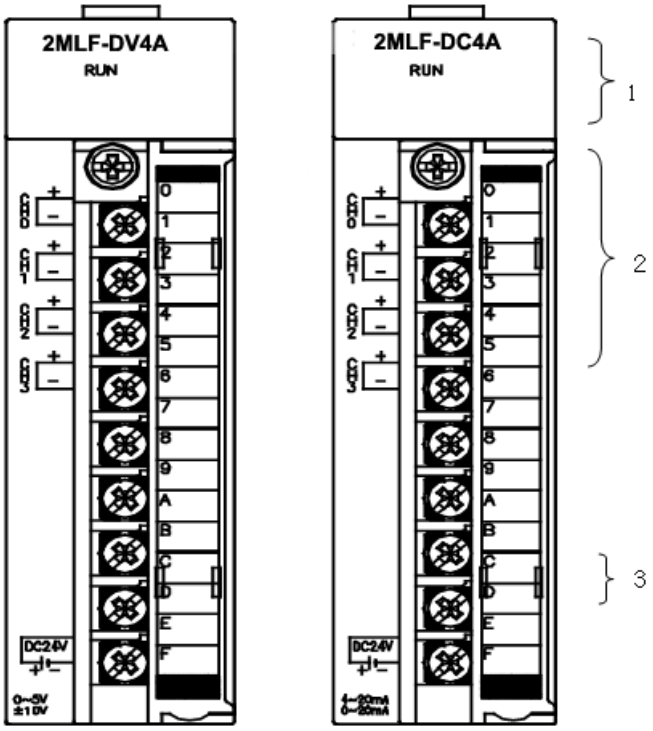


Figure 6 – Parts of 2MLF-DV4A and 2MLF-DC4A

The following table lists various LED Indicators.

Table 2 – LED indicators

No.	Description
1	RUN LED
	Displays the following operational states of the D/A conversion module. ON: Normal Operation Flickering: Error (For more information, refer to Section 7.1) OFF: DC 5V disconnected, 2MLF-DV4A/DV8A or /2MLF-DC4A/DC8A module error
2	Terminal Block
	Analog output terminal, whose respective channels can be connected with external devices.
3	Supply terminal of external power DC24V (No.17–18).

2.3 Characteristics of I/O conversion

The characteristics of I/O conversion are displayed in a straight line with an inclination as illustrated in the following figure, while converting digital signal specified in PLC to analog signal (voltage or current).

Input formats of digital data are classified into unsigned value, signed value, precise value, and percentile value. The following figure illustrates an I/O conversion characteristic for respective digital input ranges.

Characteristic of voltage output

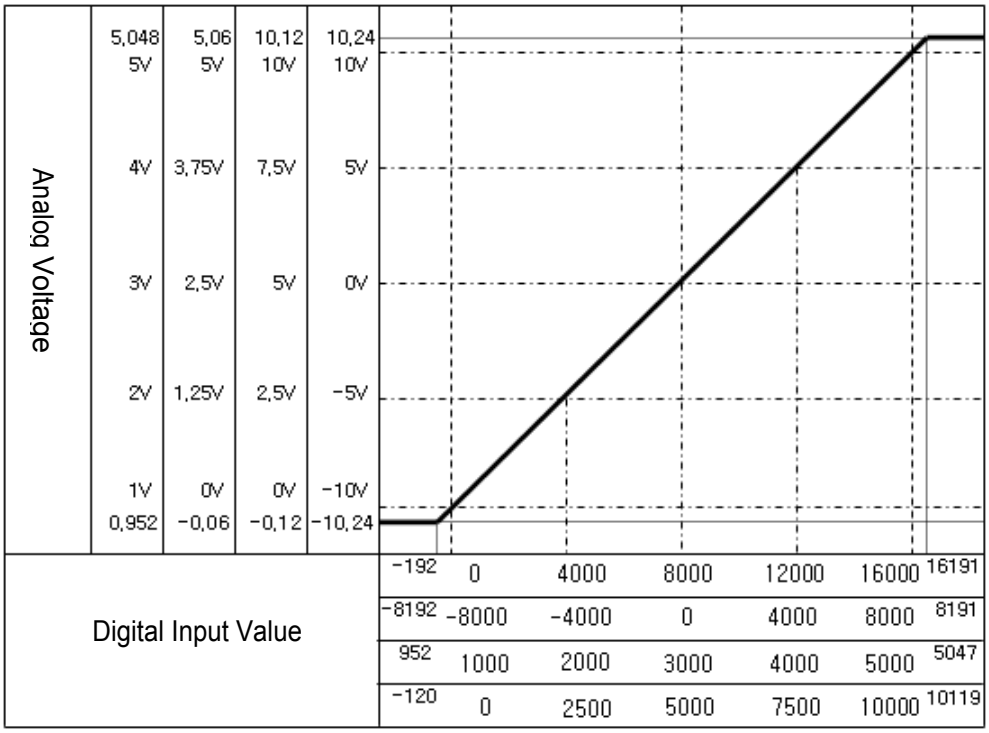


Figure 7 – Characteristics of voltage output

You can select voltage output range through a user program or special module parameters setting for respective channels.

1. If the voltage output range is 1–5V

Table 3 – Analog voltage output vs. digital input for 1-5V range

Digital Input	Analog Voltage Output							Maximum Resolution
	0.952	1.0	2.0	3.0	4.0	5.0	5.048	
Unsigned value	-192	0	4000	8000	12000	16000	16191	0.25mV
Signed value	-8192	-8000	-4000	0	4000	8000	8191	
Precise value	952	1000	2000	3000	4000	5000	5047	
Percentile value	-120	0	2500	5000	7500	10000	10119	

TIP:

For a voltage output range of 1–5V, the analog voltage output for a digital input of "1" is equivalent to "0.25mV", which is the maximum resolution for this range.

2. If the voltage output range is 0–5V

Table 4 – Analog voltage output vs. digital input for 0-5V range

Digital Input	Analog Voltage Output							Maximum Resolution
	-0.06	0.0	1.25	2.5	3.75	5.0	5.06	
Unsigned value	-192	0	4000	8000	12000	16000	16191	0.3125mV
Signed value	-8192	-8000	-4000	0	4000	8000	8191	
Precise value	-60	0	1250	2500	3750	5000	5059	
Percentile value	-120	0	2500	5000	7500	10000	10119	

3. If the voltage output range is 0–10V

Table 5 – Analog voltage output vs. digital input for 0-10V range

Digital Input	Analog Voltage Output							Maximum Resolution
	-0.12	0.0	2.5	5.0	7.5	10.0	10.12	
Unsigned value	-192	0	4000	8000	12000	16000	16191	0.625mV
Signed value	-8192	-8000	-4000	0	4000	8000	8191	
Precise value	-120	0	2500	5000	7500	10000	10119	
Percentile value	-120	0	2500	5000	7500	10000	10119	

TIP:

For a voltage output range of 0–10V, the analog voltage output for a digital input of “1” is equivalent to “0.625mV”, which is the maximum resolution for this range.

4. If the voltage output range is -10–10V

Table 6 – Analog voltage output vs. digital input for -10-+10V range

Digital Input	Analog Voltage Output							Maximum Resolution
	-10.24	-10.0	-5.0	0.0	5.0	10.0	10.24	
Unsigned value	-192	0	4000	8000	12000	16000	16191	1.25mV
Signed value	-8192	-8000	-4000	0	4000	8000	8191	
Precise value	-10240	-10000	-5000	0	5000	10000	10238	
Percentile value	-120	0	2500	5000	7500	10000	10119	

TIP:

For a voltage output range of -10–10V, the analog voltage output for a digital input of "1" is equivalent to "1.25mV", which is the maximum resolution for this range.

Characteristic of current output

You can select current output range through a user program or special module parameters setting for respective channels.

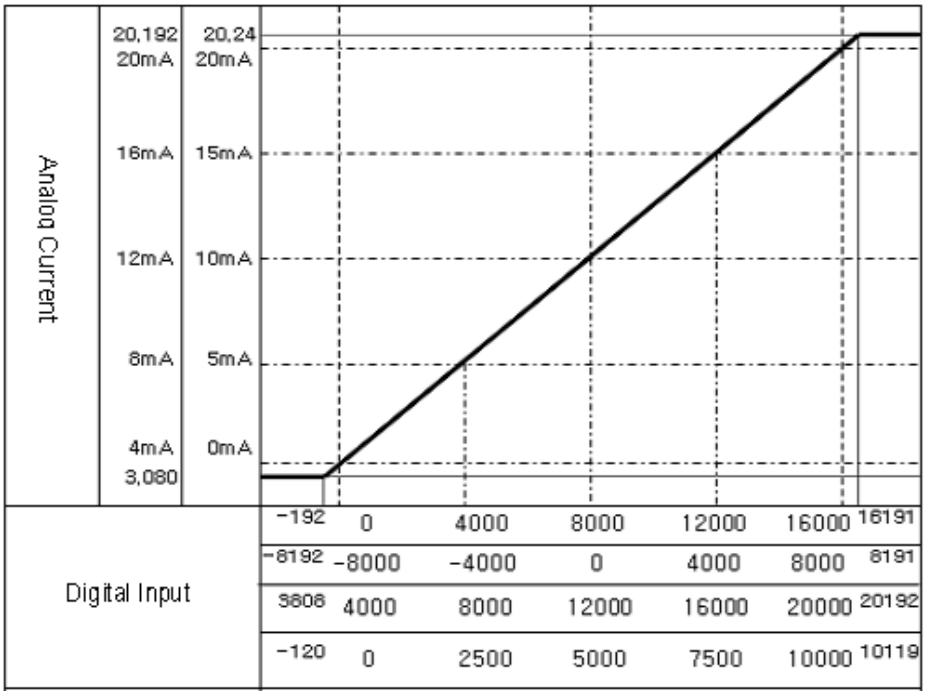


Figure 8 – Characteristics of current output

5. If the current output range is 4–20mA

Table 7 – Analog current output vs. digital input for 4-20mA range

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	1.0μA
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	

6. If the current output range is 0–20mA

Table 8 – Analog current output vs. digital input for 0-20mA range

Digital Input	Analog Current Output							Maximum Resolution
	-	3.808	5	10	15	20	20.24	
Unsigned value	-192	0	4000	8000	12000	16000	16191	1.251.0μA
Signed value	-8192	-8000	-4000	0	4000	8000	8191	
Precise value	3808	0	5000	10000	156000	20000	20192	
Percentile value	-120	0	2500	5000	7500	10000	10119	

Accuracy

The accuracy for the analog output value remains the same across all output ranges.

The Figure 9 illustrates the accuracy change range at an ambient temperature of 25 ± 5ºC. The analog output ranges is set between 4 and 20mA and select an unsigned integer for the input type. The accuracy is ±0.2% at 25 ± 5ºC ambient temperature and ±0.3% at 0 – 55ºC ambient temperature.

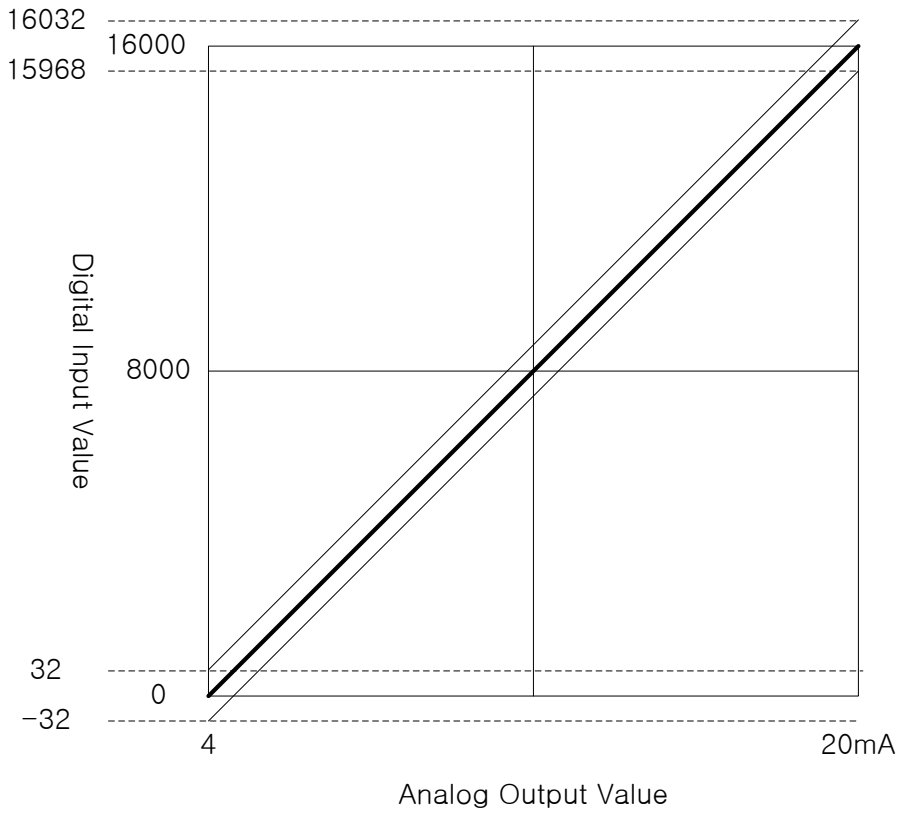


Figure 9 – Accuracy of analog output value at ambient temperature

2.4 Main functions

The following sections list the main functions of D/A conversion module.

Output status setting

1. Normal Mode

Table 9 – Output status setting in normal mode

CPU Status	Output Status	Channel		Remarks
		Run	Stop	
RUN	Enabled	Digital value	0V or 0mA	0: Previous value kept 1: Minimum value output 2: Middle value output 3: Maximum value output
	Disabled	As specified in I/O parameter setting	0V or 0mA	
STOP	Enabled	As specified in I/O parameter setting	0V or 0mA	
	Disabled	As specified in I/O parameter setting	0V or 0mA	

2. Test Mode

Table 10 – Output status setting in test mode

CPU Status	Output Status	Channel		Remarks
		Run	Stop	
STOP	Enabled	Digital value	0V or 0mA	0: previous value kept 1: minimum output 2: middle value output 3: maximum value output
	Disabled	As specified in I/O parameter setting	0V or 0mA	

Note: Test mode is available only when CPU status is “STOP”.

3. D/A module in error

Table 11 – Output status setting during D/A module error

CPU Status	Output Status	Channel		Remarks
		Run	Stop	
RUN	Enabled	See attention	0V or 0mA	0: previous value kept 1: minimum output 2: middle output 3: maximum output
	Disabled	As specified in I/O parameter setting	0V or 0mA	
STOP	Enabled	As specified in I/O parameter setting	0V or 0mA	
	Disabled	As specified in I/O parameter setting	0V or 0mA	
When Power is ON/H/W error		0V or 0mA		

ATTENTION

Digital Input setting error: upper limit or lower limit, parameter setting error: as specified CH output type.

4. If a CPU error triggers

Table 12 – Output status setting in case of CPU error

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

Display and diagnosis functions

1. Run LED: displays the operational status of D/A conversion module
   a) ON: Normal operation
   - Blinks: Error (Refer to the following table)
   - OFF: DC 5V disconnected or module error
2. Error Status: classifies and sorts errors identified during the module operation.

Table 13 – Error status in module operation

Classification		Error Details	LED	Remarks
H/W	System error	Internal memory error	Blinks every 200ms	
		ASIC I/F error	Blinks every 200ms	
S/W	Parameters setting	Output status setting error	Blinks every 1sec	
	Offset/Gain adjustment	Offset/Gain setting error	Blinks every 1sec	

ATTENTION

When D/A conversion module is released from the factory, Offset/Gain value is pre-adjusted for respective analog output ranges, which cannot be changed by the users.

3. Installation and Wiring

3.1 Installation

Installation environment

The 2MLF-DV4A/DV8A, 2MLF-DC4A/DC8A modules have high reliability regardless of their installation environment. The following factors ensure for system reliability and stability.

1. Environmental prerequisites

   Avoid installing the module in places where it is subjected or exposed to:

   a) Water leakage and dust

   - Continuous shocks or vibrations
   - Direct sunlight
   - Dew condensation due to rapid temperature change
   - Temperatures outside the range of 0 to 55°C

2. Precautions during installing and wiring

   a) Avoid any wire scraps to enter the PLC during drilling or wiring.

   - Install the PLC in a place convenient to operate.
   - Ensure that PLC is not located on the same panel where high voltage equipment is located.
   - Ensure that the distance from the walls of duct and external equipment is 50mm or more.
   - Ensure that the PLC is properly grounded to locations that have good ambient noise immunity.

Handling precautions

The following precautions must be taken when unpacking and installing the Analog Output Module.

1. Do not drop the module, and avoid any strong or sudden shocks.

2. Do not remove the PCB from its case. It can result in damage or an abnormal operation.
3. Ensure that no external materials like wire scraps enter the upper part of the PLC during wiring.
4. Do not install or remove the module to/from the base when the power supply is turned on.

3.2 Wiring

Precautions for wiring

The following precautions must be taken when wiring the Analog Output Module.

1. Separate the cable from the external output signals of Analog Output Module. The module must be kept away from the alternating current (A/C) wire to avoid surge or inductive noise produced from the A/C supply wire.
2. Select the cable considering the ambient temperature and value of the current. The maximum size of the cable must not be less than the standard cable size of AWG22 (0.3mm²).
3. The cable must not be too close to a hot device/material and in direct contact with oil for a long period, as it can result in damage or abnormal operation due to short-circuit.
4. The polarity check must be performed before wiring.
5. The cable must not be wired using high-voltage line or power line, as it can result in inductive noise, causing abnormal operation or defect.

Wiring example

The following figures illustrate a sample wiring of 2MLF-DV4A/DV8A and 2MLF-DC4A/DC8A.

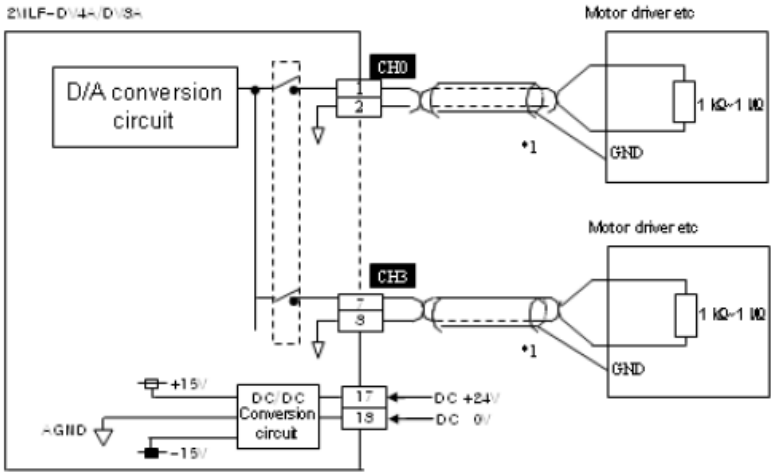


Figure 10 – 2MLF-DV4A/DV8A wiring

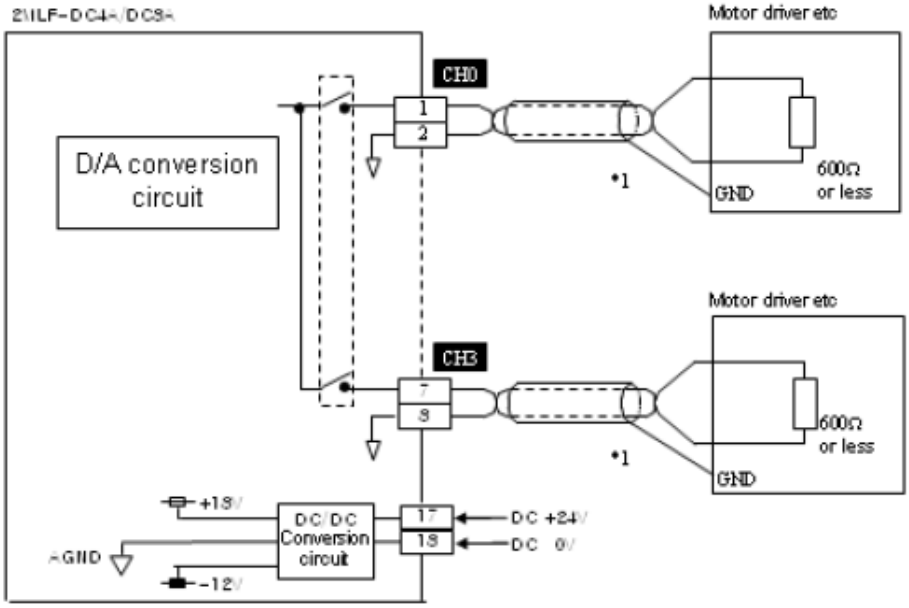


Figure 11 – 2MLF-DC4A/DC8A wiring

* 1: Use a 2-core twisted shielded wire.

3.3 Wiring the DC 24V power supply

Power supply specification

The following table lists the specifications of 2MLF-PA1A (DC24V) power supply.

Table 14 – Power supply specifications

Rated Output Voltage	DC24V
Output current	0.6A
Range of output voltage	21.6 – 26.4V
Fluctuation of output voltage	±10%

If a 2MLP-ACF1 power module is used, the following figure illustrates the corresponding wiring.

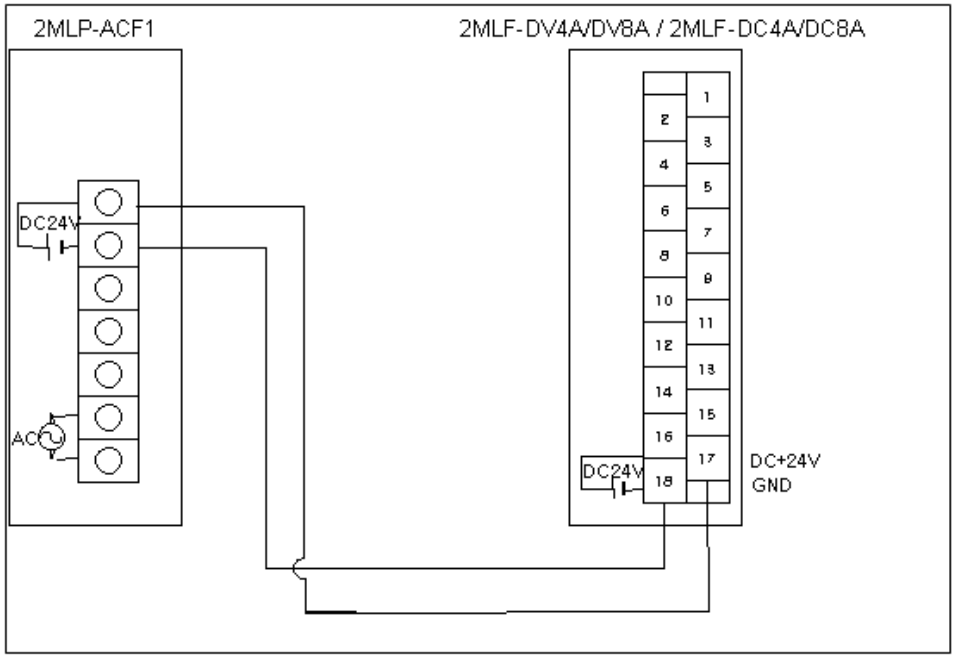


Figure 12 – Power supply wiring with 2MLP-ACF1 power module

REFERENCE - INTERNAL

If more than one Analog Output Module is used for calculating DC24V consumed power, refer section Performance Specifications for power capacity.

TIP

When using an external power module, ensure the following:

- An external power supply of DC+24V is required for connecting the D/A conversion module.
- Usage of a noise filter is recommended for D/A conversion module.

Wiring for external power supply

- If a noise filter is not used, the wiring with external power supply is as follows:

  2MLF-DV4A/DV8A / 2MLF-DC4A/DC8A

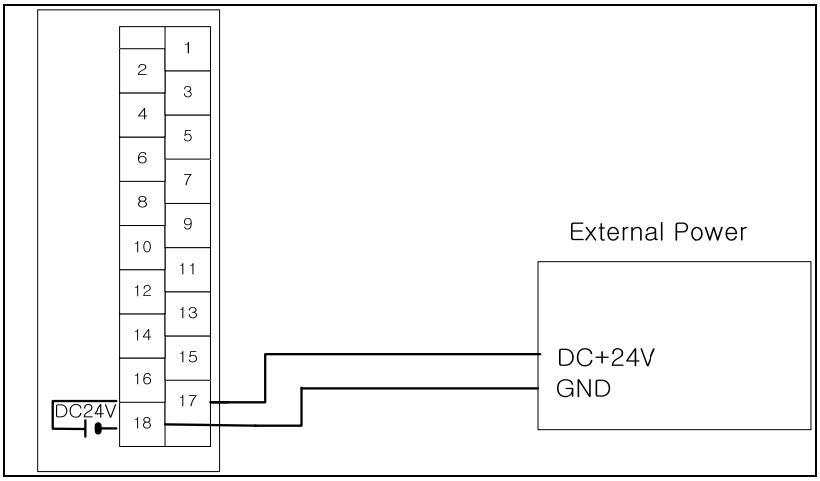


Figure 13 – DC +24V power supply wiring with external power supply

- If a noise filter is used, the wiring with external power supply is as follows:

  2MLF-DV4A/DV8A / 2MLF-DC4A/DC8A

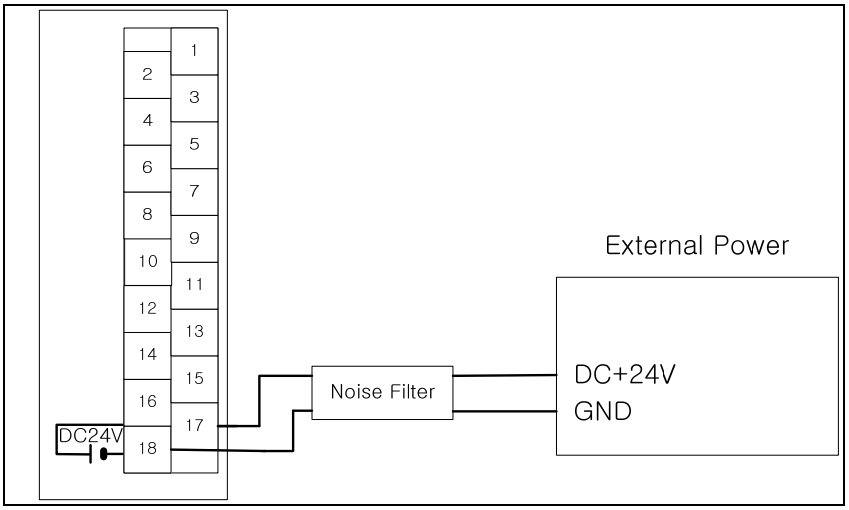


Figure 14 – DC +24 V power supply wiring through a noise filter

ATTENTION

Ensure to separate the wiring between noise filter and D/A conversion module from each other's cables.

4. Operating Procedures and Monitoring

4.1 Operating procedures

The following flowchart illustrates the procedure to initialize the operation of the Analog Output Module.

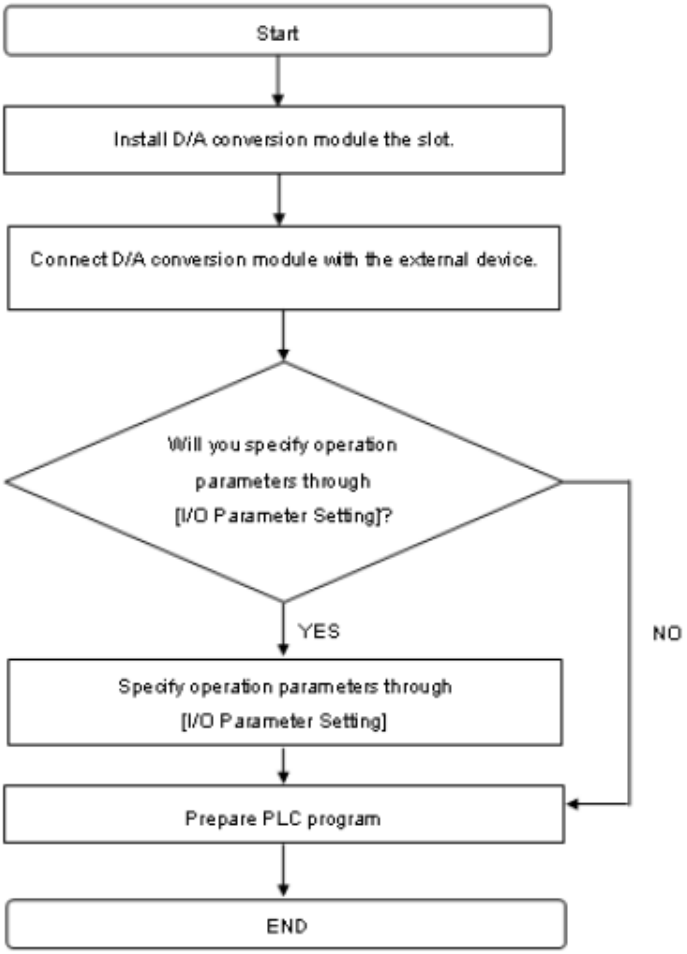


Figure 15 – Operating procedure

4.2 Run parameters setting

The Run parameters of D/A conversion module can be specified using SoftMaster's I/O parameters.

Setting items

The parameters setting and monitoring/testing function of the D/A conversion module is executed using:

1. SoftMaster menu or tool bar
2. Scan program to read/write the data of internal memory

SoftMaster provides a graphical user interface (GUI) for setting the parameters of D/A conversion module. These settings are available as I/O parameters option on the SoftMaster project window.

The following table lists the I/O parameter setting functions.

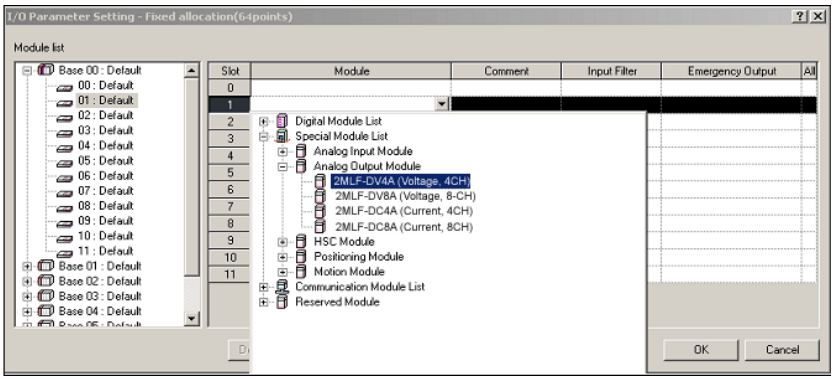
Table 15 – I/O parameter setting functions

Item	Details
I/O parameters	Specify the following setting items necessary for the module operation. • Channel disable/enable • Analog output range • Input type • Channel output type The data specified by the user through SoftMaster is saved on D/A conversion module when Special Module Parameters are downloaded. When Special Module Parameters are saved on D/A conversion module, it is independent of the PLC CPU's status (Enable/Disable).

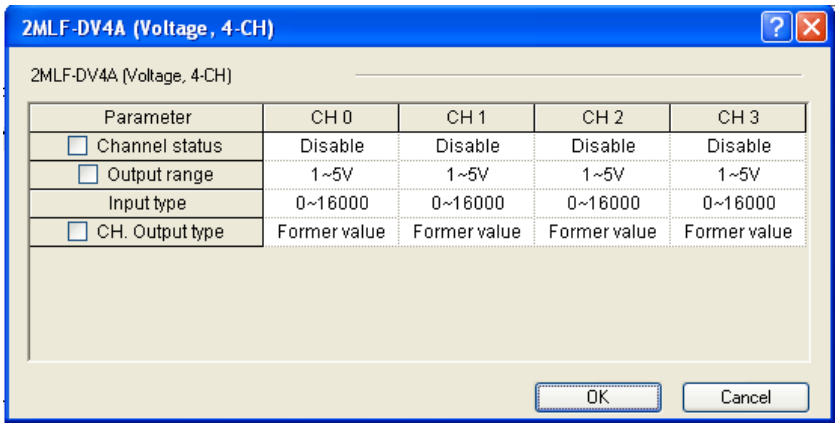
Setting I/O parameters

The procedure for setting I/O parameters based on 2MLF-DV4A/DV8A is described as follows.

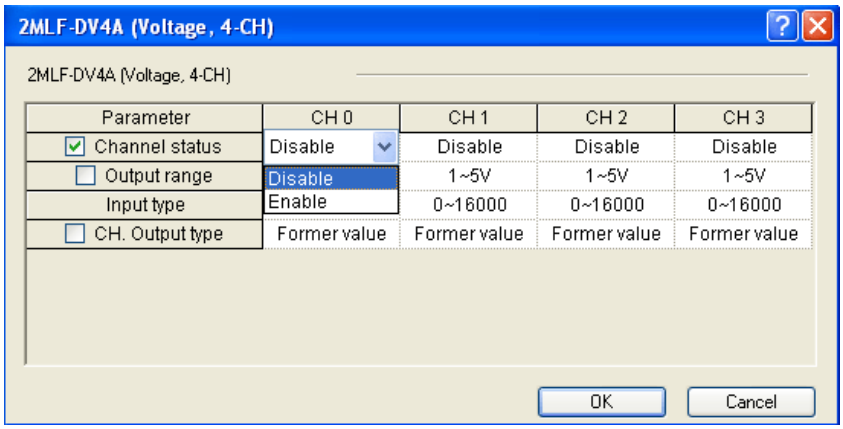
The procedure remains the same for 2MLF-DC4A/DC8A.

Step	Action
1	Run SoftMaster to create a project. (Refer to *SoftMaster User's Guide* for details on how to create the project)
2	On the Project Window, double-click **I/O Parameters**. The **I/O Parameters Setting** window appears.
3	Click the module area of the concerned slot to select the applicable module.
4	On the **I/O Parameter Setting** window, click the slot on which the D/A conversion module is installed.
5	Click the arrow button on the Module cell, to display the modules. Select the applicable module. 
5	Click the desired item to display the options for respective items. Select and double-click the applicable slot to launch the parameters setting window or click **Details**. Specify the parameters for respective channels as shown in Figure 18.

Step	Action

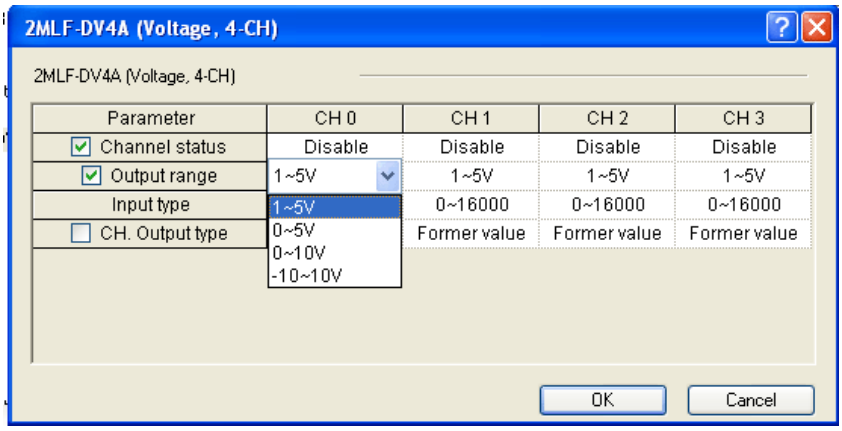


Channel status: This enables or disables the respective channel. Select either Disable or Enable from the drop-down list.

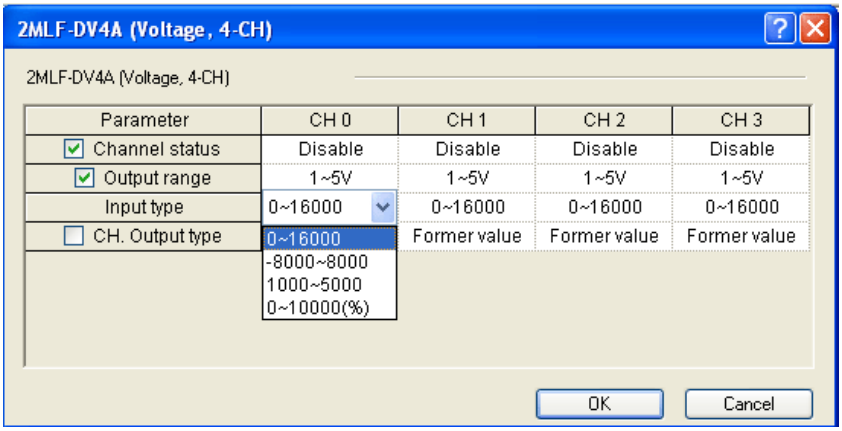


Output range: Select the range of analog output voltage as applicable. 2MLF-DV4A provides 4 voltage output ranges, and 2MLF-DC4A provides 2 current output ranges.

Step	Action

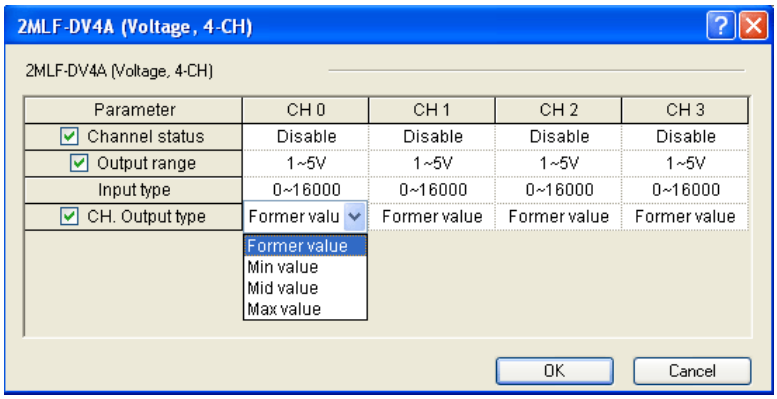


Input type: Select the format of input data from the list of available formats.



CH. output type: Select the type of output status. Total four ranges are available.

Step	Action



6 Specify parameters as applicable and click **OK**.

The Table 16 lists the default options for parameter settings.

Default options for parameter setting

Table 16 – Default options for parameter setting

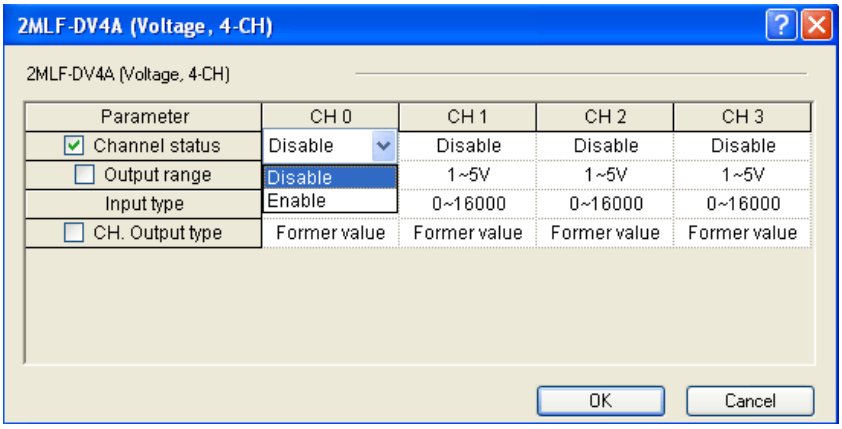
Parameter	Setting Item	Default
Channels	Enable/Disable	Stop
Analog range	1–5V/0–5V/0–10V/-10–10V (voltage type) 4–20mA/0–20mA (current type)	1–5V 4–20mA
Input type	0–16000/-8000–8000/1000-5000/0–1000% (changed based on the output range)	0–16000
Channel output type	Prev/Min/Mid/Max	Previous

7 Select all channels to change parameters.

a) Select the check box in the parameters item in order to change the parameters of all channels to identical setting value.

b) Change the parameters of any one channel to change the parameters of the whole channels at a time.

Step	Action
	The following figure shows an example of Run channel changed to whole channels by means of the Enable function.



4.3 Special module monitoring

The special module monitoring function helps you to monitor the analog output modules for testing.

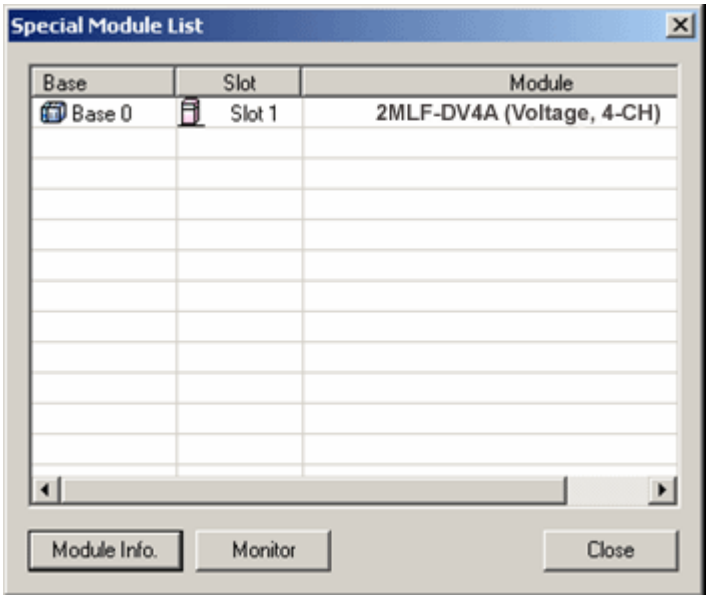
To monitor and test the module, perform the following steps.

Step	Action
1	Click **Online** > **Connect**. The SoftMaster is connected to PLC.

ATTENTION

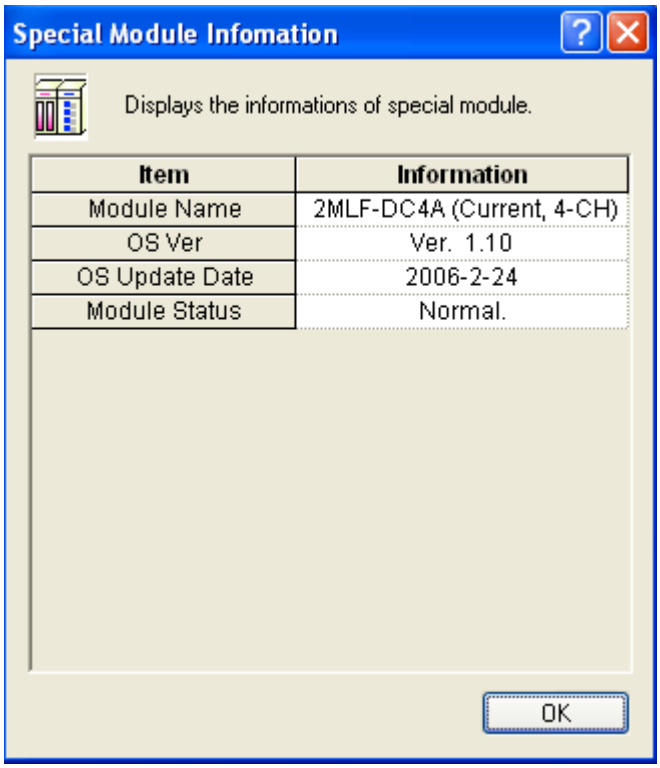
If the module status is not Online, the **Special Module Monitoring** menu is disabled.

2	Click **Monitor> Special Module Monitoring**. The **Special Module List** window appears. This window displays base/slot information in addition to special module type as below:



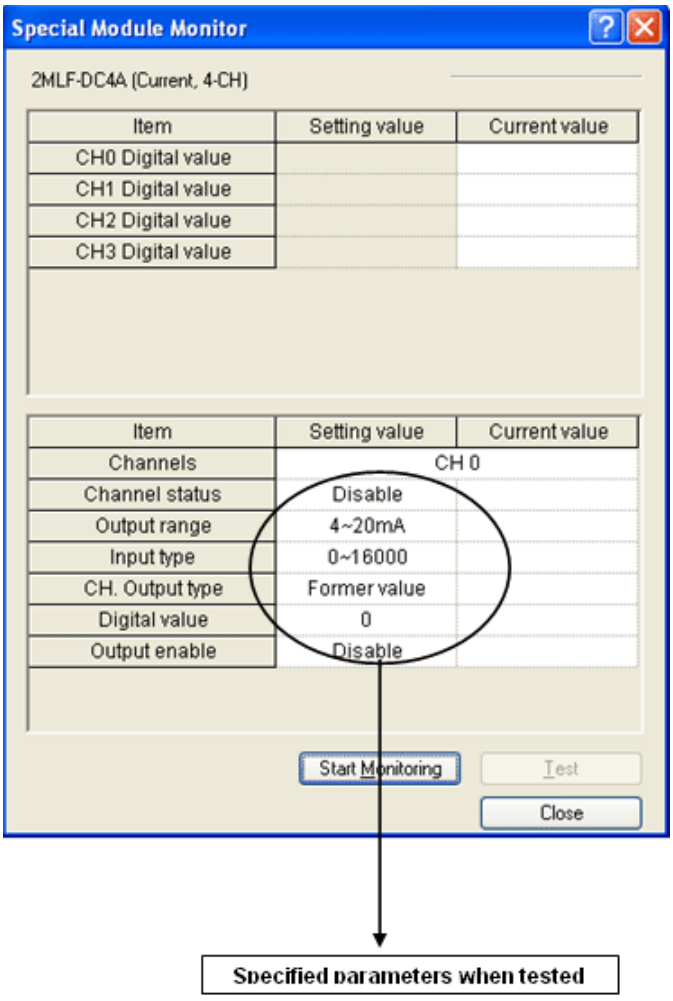
3	Click **Module Info** to display the module information as shown in the following figure.

Step	Action



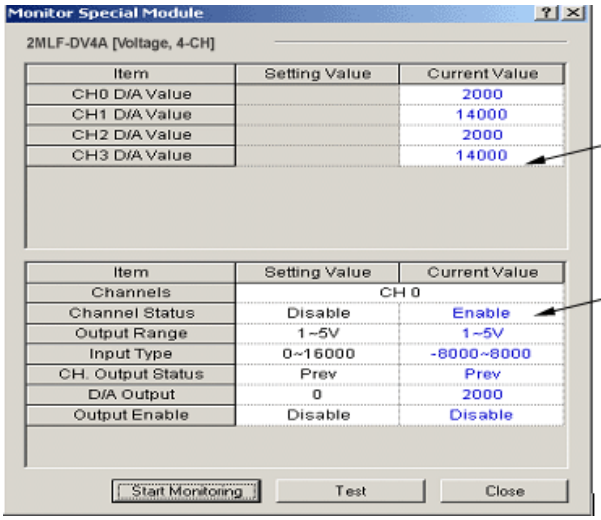
4 On the **Special Module List** window, select the module and click **Monitor.**The **Special Module Monitor** window appears.

Step	Action



5 To start monitoring, click **Start Monitoring** to display output values of the presently operated channel. The following figure shows the output values when all channels of 2MLF-DV4A are in Run mode.

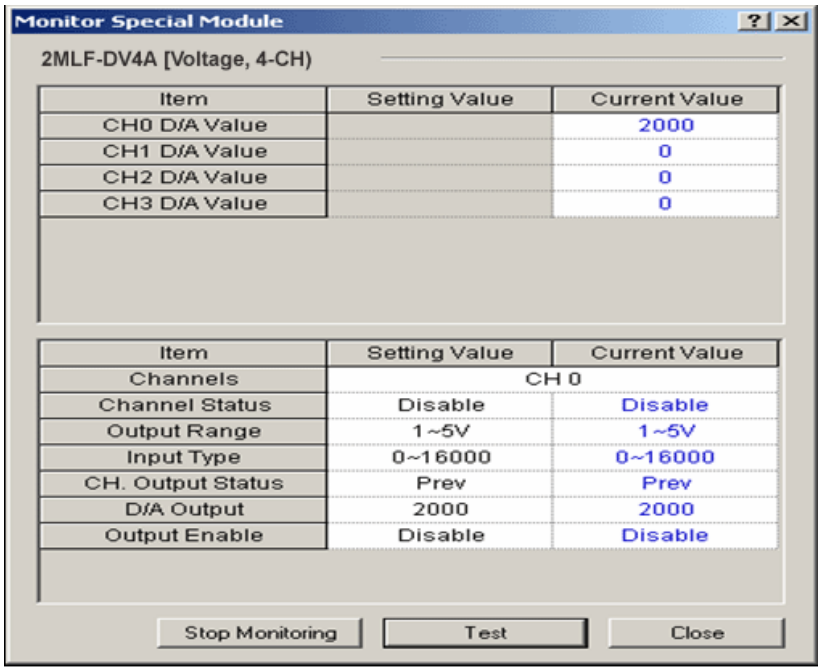
Step	Action



6 Test: This option is used for changing the currently specified parameters of D/A conversion module. Click **Test** to change parameters.

Test can be used only when the CPU operation status is in Stop Monitoring.

Step	Action



7 Click **Close** to exit the monitoring/test window.

Parameter setting by scan program

To set parameter using a scan program,

1. D/A conversion module can also be operated by using Tx. (Write) instruction of PUT/PUTP and Rx. (Read) instruction of GET/GETP. These instructions are executed from PLC CPU using a scan program.
2. For more information, refer to the section Programming.

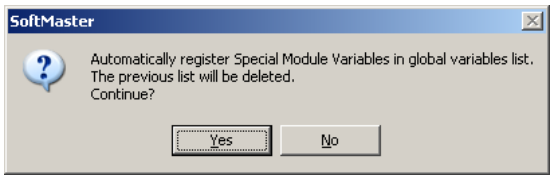
4.4 Register special module variables

This section describes the automatic registration function of the special module variable in SoftMaster.

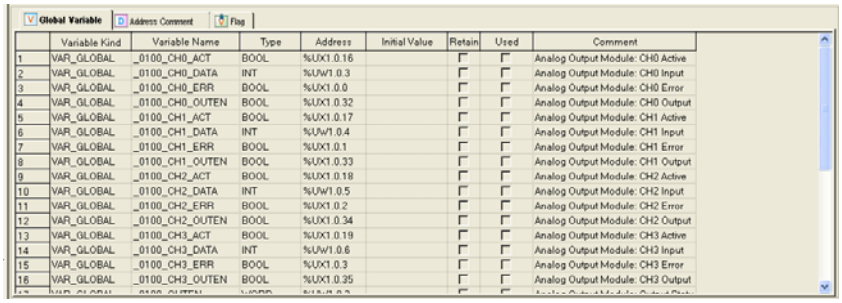
Registering special module variables

Register the variables for each module referring to the special module information set in the I/O parameters. You can modify the variables.

To modify the variables, perform the following steps.

Step	Action
1	On the Project Window, double-click **I/O parameters**. The **I/O Parameters Setting** window appears.
2	Click the module area of the concerned slot to select the applicable module and select the special module type.
3	Double-click the selected 2MLF-DV8A module or click **Details** to set parameter.
4	On the **Project Window**, double-click **Global Variables/Address**. The registered global variables are displayed in the right-pane.
5	To register special module variables automatically in the global variables list, click **Edit** > **Register Special/Communication Module Variables**. The following confirmation message appears. 

Step	Action
7	Click **Yes**. The registered variables are displayed as shown in the following figure.



Global Variable | Address Comment | Flag

	Variable Kind	Variable Name	Type	Address	Initial Value	Retain	Used	Comment
1	VAR_GLOBAL	_0100_CH0_ACT	BOOL	%UX1.0.16		☐	☐	Analog Output Module: CH0 Active
2	VAR_GLOBAL	_0100_CH0_DATA	INT	%UW1.0.3		☐	☐	Analog Output Module: CH0 Input
3	VAR_GLOBAL	_0100_CH0_ERR	BOOL	%UX1.0.0		☐	☐	Analog Output Module: CH0 Error
4	VAR_GLOBAL	_0100_CH0_OUTEN	BOOL	%UX1.0.32		☐	☐	Analog Output Module: CH0 Output
5	VAR_GLOBAL	_0100_CH1_ACT	BOOL	%UX1.0.17		☐	☐	Analog Output Module: CH1 Active
6	VAR_GLOBAL	_0100_CH1_DATA	INT	%UW1.0.4		☐	☐	Analog Output Module: CH1 Input
7	VAR_GLOBAL	_0100_CH1_ERR	BOOL	%UX1.0.1		☐	☐	Analog Output Module: CH1 Error
8	VAR_GLOBAL	_0100_CH1_OUTEN	BOOL	%UX1.0.33		☐	☐	Analog Output Module: CH1 Output
9	VAR_GLOBAL	_0100_CH2_ACT	BOOL	%UX1.0.18		☐	☐	Analog Output Module: CH2 Active
10	VAR_GLOBAL	_0100_CH2_DATA	INT	%UW1.0.5		☐	☐	Analog Output Module: CH2 Input
11	VAR_GLOBAL	_0100_CH2_ERR	BOOL	%UX1.0.2		☐	☐	Analog Output Module: CH2 Error
12	VAR_GLOBAL	_0100_CH2_OUTEN	BOOL	%UX1.0.34		☐	☐	Analog Output Module: CH2 Output
13	VAR_GLOBAL	_0100_CH3_ACT	BOOL	%UX1.0.19		☐	☐	Analog Output Module: CH3 Active
14	VAR_GLOBAL	_0100_CH3_DATA	INT	%UW1.0.6		☐	☐	Analog Output Module: CH3 Input
15	VAR_GLOBAL	_0100_CH3_ERR	BOOL	%UX1.0.3		☐	☐	Analog Output Module: CH3 Error
16	VAR_GLOBAL	_0100_CH3_OUTEN	BOOL	%UX1.0.35		☐	☐	Analog Output Module: CH3 Output

Saving variables

The variables can be saved in a text file as follows:

- On the **Global Variable/Address** window, click **Edit** > **Export Variables to File**.

Viewing variables

The following figure illustrates an example program of SoftMaster (addresses).

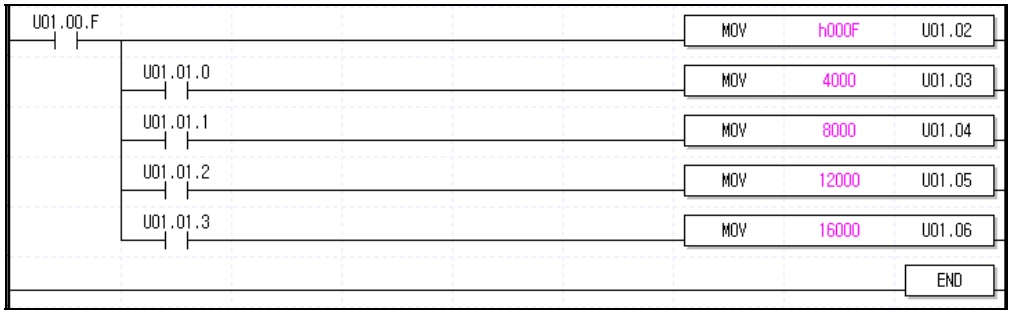


Figure 16 – Example of SoftMaster program (addresses)

- On the **Global Variable/Address** window, click **View** > **Variables**. The devices can be seen in the form of variables in the ladder.

The following figure illustrates an example program of SoftMaster (variables) that shows devices as variables.

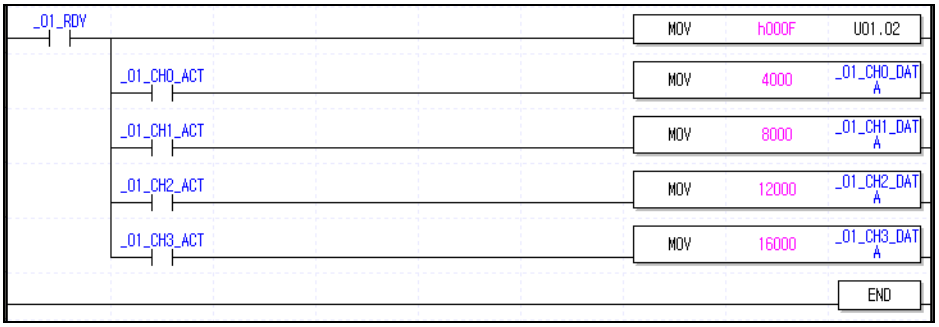


Figure 17 – Example of SoftMaster program (variables)

REFERENCE – INTERNAL

For additional information on the I/O area of D/A converted data, see Table 17.

5. Configuration and Functions of Internal Memory

5.1 Configuration of internal memory

The following table lists the details of the I/O area of D/A converted data.

Table 17 – I/O area of D/A converted data

Address	Variable Name	Description	Details	Remarks
%UXa.b.15	_ab_RDY	Module Ready	I/O area to display D/A module operation status (Module Ready/Error)	Read available
%UXa.b.0	_ab_CH0_ERR	Channel Error	I/O area to display D/A module operation status (Channel Error)	
%UXa.b.1	_ab_CH1_ERR			
%UXa.b.2	_ab_CH2_ERR			
%UXa.b.3	_ab_CH3_ERR			
%UXa.b.4	_ab_CH4_ERR			
%UXa.b.5	_ab_CH5_ERR			
%UXa.b.6	_ab_CH6_ERR			
%UXa.b.7	_ab_CH7_ERR			
%UXa.b.16	_ab_CH0_ACT	CH Active	I/O area to save operation information of respective channels	
%UXa.b.17	_ab_CH1_ACT			
%UXa.b.18	_ab_CH2_ACT			
%UXa.b.19	_ab_CH3_ACT			
%UXa.b.20	_ab_CH4_ACT			
%UXa.b.21	_ab_CH5_ACT			
%UXa.b.22	_ab_CH6_ACT			
%UXa.b.23	_ab_CH7_ACT			

Address	Variable Name	Description	Details	Remarks
%UXa.b.32	_ab_CH0_OUTEN	Output status setting		Read/ Write available
%UXa.b.33	_ ab_CH1_OUTEN			
%UXa.b.34	_ ab_CH2_OUTEN			
%UXa.b.35	_ ab_CH3_OUTEN			
%UXa.b.36	_ ab_CH4_OUTEN			
%UXa.b.37	_ ab_CH5_OUTEN			
%UXa.b.38	_ ab_CH6_OUTEN			
%UXa.b.39	_ ab_CH7_OUTEN			
%UWa.b.3	_ab_CH0_DATA	CH Input	I/O area to specify digital data for D/A conversion	
%UWa.b.4	_ab_CH1_DATA			
%UWa.b.5	_ab_CH2_DATA			
%UWa.b.6	_ab_CH3_DATA			
%UWa.b.7	_ab_CH4_DATA			
%UWa.b.8	_ab_CH5_DATA			
%UWa.b.9	_ab_CH6_DATA			
%UWa.b.10	_ab_CH7_DATA			

- For the special module variables assigned, ‘a’ refers to the Base No. and ‘b’ refers to the Slot No. on which module is installed.
- In order to read ‘CH1 digital value’ of D/A conversion module installed on Base No.0, Slot No.4, the special module variable address should be chosen as %UX0.4.3.

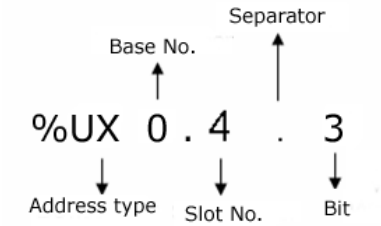


Figure 18 – Internal memory address details

Setting area of Run parameters

The following table lists the details of the setting area of D/A conversion module's Run parameters.

Table 18 – Setting area of run parameters

Address (in Decimal)	Description	Details	Remarks
0	Specify if channel is to be used	Bit ON (1): Channel used Bit OFF (0): Channel unused	Read available
1	Specify output voltage range	Bit (00): 1–5V, Bit (01): 0–5V Bit (10): 0–10V, Bit (11): -10–10V	
	Specify output current range	Bit (00): 4–20mA Bit (01): 0–20mA	Read/ write available
2	Specify input data type	Bit (00): 0–16000, Bit (01): -8000–8000, Bit (10): 0–5000, Bit (11): 0–10000	
3	Specify CH0 output type	"0": outputs the previous value "1": outputs the minimum value of output range "2": outputs the middle value of output range "3": outputs the maximum value of output range	
4	Specify CH1 output type		
5	Specify CH2 output type		
6	Specify CH3 output type		
7	-		
8	-		
9	-		
10	-		

Address (in Decimal)	Description	Details	Remarks
11	CH0 setting error	Error code area	Read available
12	CH1 setting error		
13	CH2 setting error		
14	CH3 setting error		
15	-		
16	-		
17	-		
18	-		

5.2 I/O area of D/A converted data

Module Ready/Error (Address 0)

1. %UXa.b.15: This bit is ON when PLC CPU is powered or reset with D/A conversion ready to process the digital input.
2. %UXa.b.0~7: It is a flag to display the error status of D/A conversion module for respective channels.

The flag status 1 represents an error.

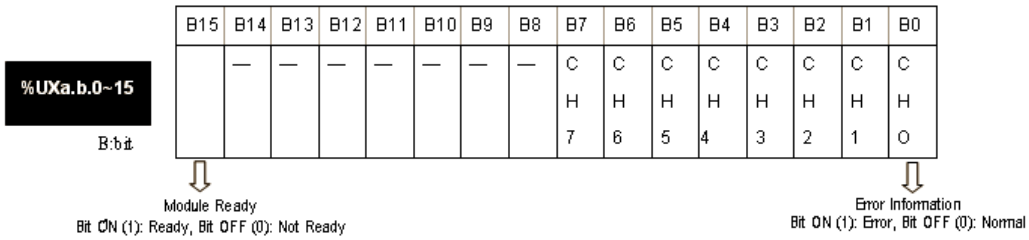


Figure 19 – %UXa.b.0~15 address area

Run channel display (Address %UXa.b.16~23)

This area is used for displaying the channel operation status. Bit 0 to Bit 3 are used for Channel 0 to Channel 3, respectively.

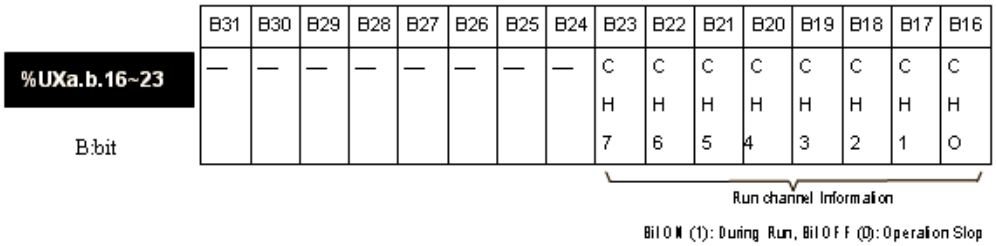


Figure 20 – %UXa.b.16~23 address area

Output setting (Address %UXa.b.32~39)

This area is used for specifying the Enable or Disable status of the channels.

1. Enable/Disable D/A output can be specified for respective channels. See Figure 37.
2. If the output is not specified, output of all the channels is set to Disable/Prohibited.

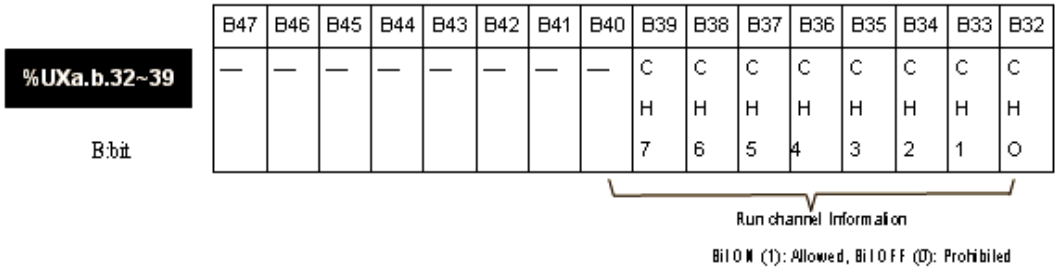


Figure 21 – %UXa.b.32~39 address areas

Digital value (Address %UWa.b.3 to %UWa.b.10)

1. Select the digital value and use in the range -192–16191, -8192–8191, 952–5047 or -120–10191 for 1–5V based on the input type.
2. If the digital value is not specified, it is set to 0.

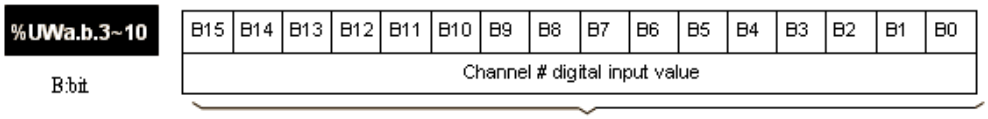


Figure 22 – %UWa.b.3 to %UWa.b.10 address area

The following table lists the I/O area of digital values.

Table 19 – I/O area for digital value

Address	Details
%UWa.b.3	CH0 digital value
%UWa.b.4	CH1 digital value
%UWa.b.5	CH2 digital value
%UWa.b.6	CH3 digital value
%UWa.b.7	CH4 digital value
%UWa.b.8	CH5 digital value
%UWa.b.9	CH6 digital value

Address	Details
%UWa.b.10	CH7 digital value

5.3 Setting of run parameters

Specifying channels to use

The address 0 is used for specifying whether a channel must be used or not. If the channel to be used is not specified, all the channels are set to stop mode.

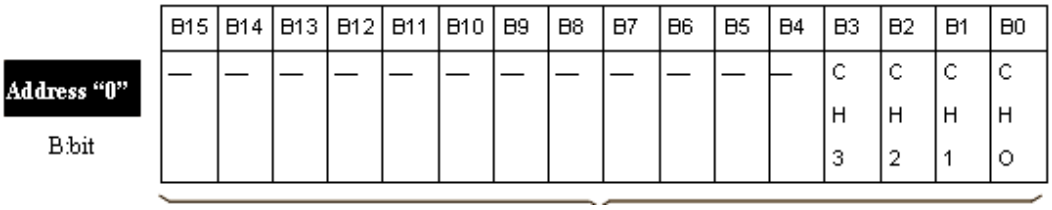


Figure 23 – Run parameters setting area address 0

The following table lists the bit details for setting area address 0.

Table 20 – Bit status details for setting area address 0

BIT	Details
0	Stop
1	Run

Setting output voltage/current range

1. The range of analog output can be specified for respective channels using address 1.
2. If the output range is not specified, the range for all the channels is set to 1–5V for voltage output, and 4–20mA for current output.
3. Setting of output range is specified as follows.

Figure 24 – Run parameters setting area address1

The following table lists the bit status details for setting area address 1.

Table 21 – Bit status details for setting area address1

BIT	Details
00	1V – 5V / 4 – 20mA
01	0V – 5V / 0 – 20mA
10	0V – 10V
11	-10V – 10V

Specifying input data type

Input data range can be specified for respective channels using address 2.

If an input data range is not specified, all the channels are set to the range 0–16000.

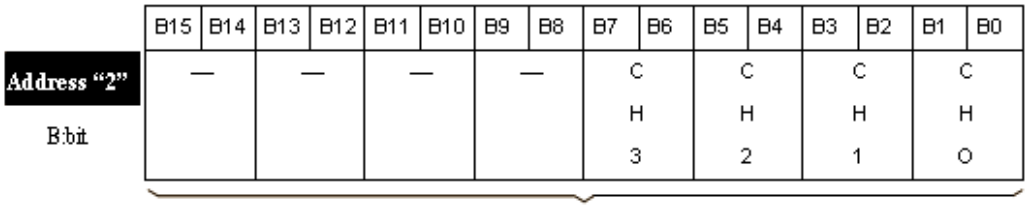


Figure 25 – Run parameters setting area address 2

The following table lists the bit status details for setting area address 2.

Table 22 – Bit status details of setting area address 2

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

This area is used for specifying D/A input type for respective channels.

The following table lists precise value which has digital input ranges.

Table 23 – Digital values

Analog output / Digital input	1 – 5V	0 – 5V	0 – 10V	10 – 10V
Precise Value	-1000 – 5000	0 – 5000	0 – 10000	-1000 – 10000

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

Setting output type

The setting area address 3 is used for specifying the output status as follows:

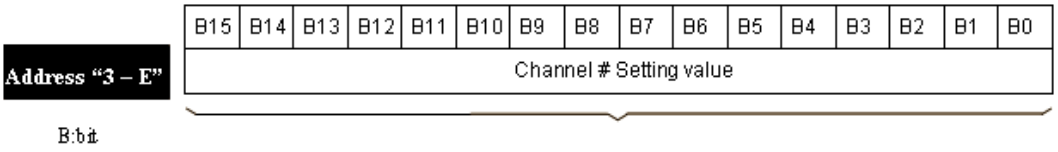


Figure 26– Run parameters setting area address 3

The following table lists the setting values and details.

Table 24 – Setting output type

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

Channel setting error code

Error codes detected from D/A conversion module are saved in the setting area address 11 to 14 for channels 0 to 3, respectively.

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

Figure 27– Run parameters setting area address 11 to 14

Refer the following table for detailed error codes.

Table 25 – Error codes

Error Code (Dec)	Details	LED Status
10	Module error (Reset Check Error)	Blinks every 0.2s
11	Module error (RAM Check Error)	
12	Module error (Register Check Error)	
13	Module error (E2PROM Check Error)	
21	Module error (D/A Conversion Error)	
31#	Current module's parameters setting error	Blinks every 1s
32#	Parameters setting error when setting current module's Offset/Gain	

Error Code (Dec)	Details	LED Status
40#	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.	
41#	Setting error of voltage module's digital input range (If input value is set less than -192, or greater than 16191) The range changes based on input type.	
50#	Offset/Gain setting error in current module's 4–20mA range (If Offset value is set greater than or equal to Gain value)	
51#	Offset/Gain setting error in current module's 0–20mA range (If Offset value is set greater than or equal to Gain value)	
52#	Offset/Gain setting error in voltage module's 1–5V range (If Offset value is set greater than or equal to Gain value)	
53#	Offset/Gain setting error in voltage module's 0–5V range (If Offset value is set greater than or equal to Gain value)	
54#	Offset/Gain setting error in voltage module's 0–10V range (If Offset value is set greater than or equal to Gain value)	
55#	Offset/Gain setting error in voltage module's -10–10V range (#: channel)(If Offset value is set greater than or equal to Gain value)	

ATTENTION

(0–3) stands for the channel with error found.

5.4 Global variable (data area)

D/A conversion data I/O area

The following table lists the D/A conversion data I/O area.

Table 26 – D/A conversion data I/O area

Memory Allocation	Global Variable	Contents	Read/Write
%UXa.b.0	_ab_CH0_ERR	CH 0 error flag	Read
%UXa.b.1	_ab_CH1_ERR	CH 1 error flag	Read
%UXa.b.2	_ab_CH2_ERR	CH 2 error flag	Read
%UXa.b.3	_ab_CH3_ERR	CH 3 error flag	Read
%UXa.b.4	_ab_CH4_ERR	CH 4 error flag	Read
%UXa.b.5	_ab_CH5_ERR	CH 5 error flag	Read
%UXa.b.6	_ab_CH6_ERR	CH 6 error flag	Read
%UXa.b.7	_ab_CH7_ERR	CH 7 error flag	Read
%UXa.b.15	_ab_RDY	Module Ready flag	Read
%UXa.b.32	_ab_CH0_OUTEN	CH 0 output status setting bit On(1) : Enable output, bit Off(0) : Disable output	Read/Write
%UXa.b.33	_ab_CH1_OUTEN	CH 1 output status setting bit On(1) : Enable output, bit Off(0) : Disable output	Read/Write
%UXa.b.34	_ab_CH2_OUTEN	CH 2 output status setting bit On(1) : Enable output, bit Off(0) : Disable output	Read/Write
%UXa.b.35	_ab_CH3_OUTEN	CH 3 output status setting bit On(1) : Enable output, bit Off(0) : Disable output	Read/Write
%UXa.b.36	_ab_CH4_OUTEN	CH 4 output status setting bit	Read/Write

Memory Allocation	Global Variable	Contents	Read/Write
		On(1) : Enable output, bit Off(0) : Disable output	
%UXa.b.37	_ab_CH5_OUTEN	CH 5 output status setting bit On(1) : Enable output, bit Off(0) : Disable output	Read/Write
%UXa.b.38	_ab_CH6_OUTEN	CH 6 output status setting bit On(1) : Enable output, bit Off(0) : Disable output	Read/Write
%UXa.b.39	_ab_CH7_OUTEN	CH 7 output status setting bit On(1) : Enable output, bit Off(0) : Disable output	Read/Write
%UWa.b.3	_ab_CH0_DATA	CH 0 Input status On(1) : Enable output, bit Off(0) : Disable output	Read/Write
%UWa.b.4	_ab_CH1_DATA	CH 1 Input status On(1) : Enable output, bit Off(0) : Disable output	
%UWa.b.5	_ab_CH2_DATA	CH 2 Input status On(1) : Enable output, bit Off(0) : Disable output	
%UWa.b.6	_ab_CH3_DATA	CH 3 Input status On(1) : Enable output, bit Off(0) : Disable output	
%UWa.b.7	_ab_CH4_DATA	CH 4 Input status On(1) : Enable output, bit Off(0) : Disable output	
%UWa.b.8	_ab_CH5_DATA	CH 5 Input status On(1) : Enable output, bit Off(0) : Disable output	

Memory Allocation	Global Variable	Contents	Read/Write
%UWa.b.9	_ab_CH6_DATA	CH 6 Input status On(1) : Enable output, bit Off(0) : Disable output	
%UWa.b.10	_ab_CH7_DATA	CH 7 Input status On(1) : Enable output, bit Off(0) : Disable output	Read

At device allocation, ‘a’ refers to the base number and ‘b’ refers to the slot number where the module is equipped.

How to use global variable

There are two ways to register a global variable.

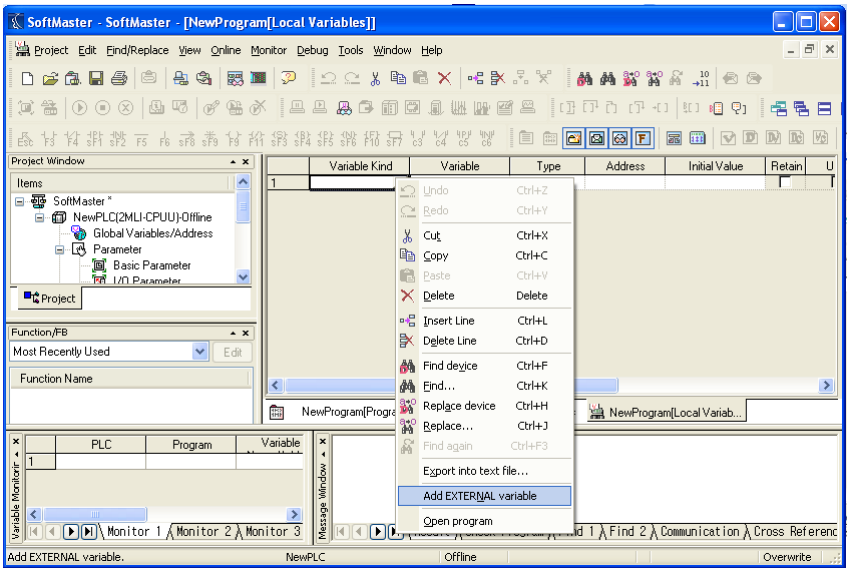
- Automatic registration after I/O parameter setting at project window
- Batch registration after I/O parameter setting

For automatic registration and batch registration, refer to section Registering special module variables.

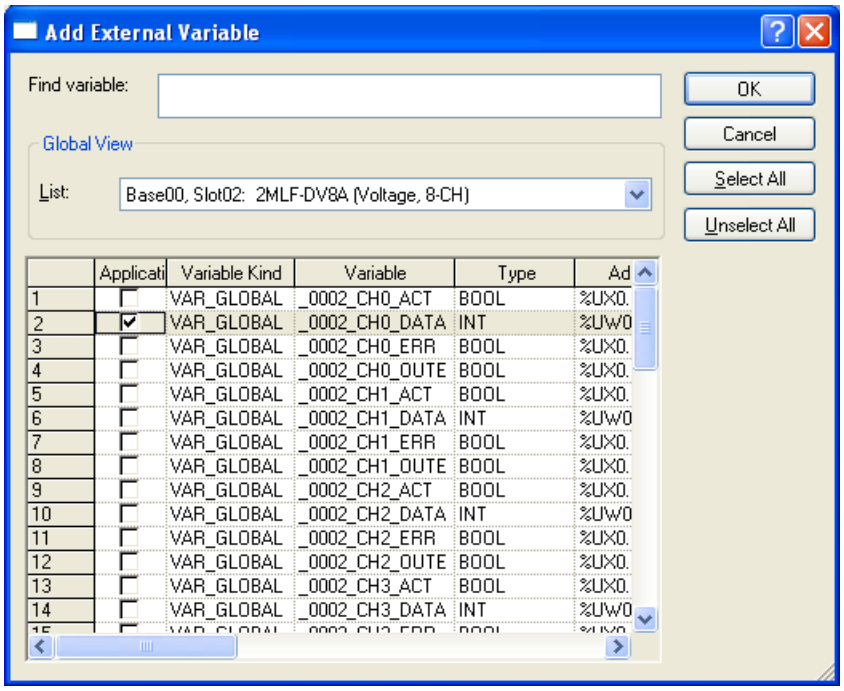
Local variable registration

To register local variables in I/O parameter, perform the following steps.

Step	Action
1	Double-click **Local Variables** under **Scan Program** in the Project Window.
2	Right-click the **Local Variables** window and click **Add EXTERNAL variable**.

Step	Action
	

SoftMaster - SoftMaster - [NewProgram[Local Variables]]
Project Edit Find/Replace View Online Monitor Debug Tools Window Help
Project Window
Items
SoftMaster *
NewPLC(2MLI-CPUU)-Offline
Global Variables/Address
Parameter
Basic Parameter
Project
Function/FB
Most Recently Used
Edit
Function Name
Variable Kind
Variable
Type
Address
Initial Value
Retain
Undo Ctrl+Z
Redo Ctrl+Y
Cut Ctrl+X
Copy Ctrl+C
Paste Ctrl+V
Delete Delete
Insert Line Ctrl+L
Delete Line Ctrl+D
Find device Ctrl+F
Find... Ctrl+K
Replace device Ctrl+H
Replace... Ctrl+J
Find again Ctrl+F3
Export into text file...
Add EXTERNAL variable
Open program
NewProgram[Local Variab...
PLC
Program
Variable
Variable Monitor
Message Window
Monitor 1
Monitor 2
Monitor 3
Find 2
Communication
Add EXTERNAL variable.
NewPLC
Offline
Overwrite

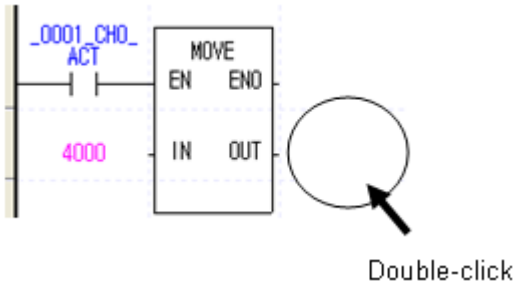
Step	Action
3	Select local variable to add at Global View on the **Add External Variable** window (“All” or “Base, slot”). Example: In the following figure, select the digital output value (_0002_CH0_DATA) of “Base00, Slot02”. 

How to use local variable

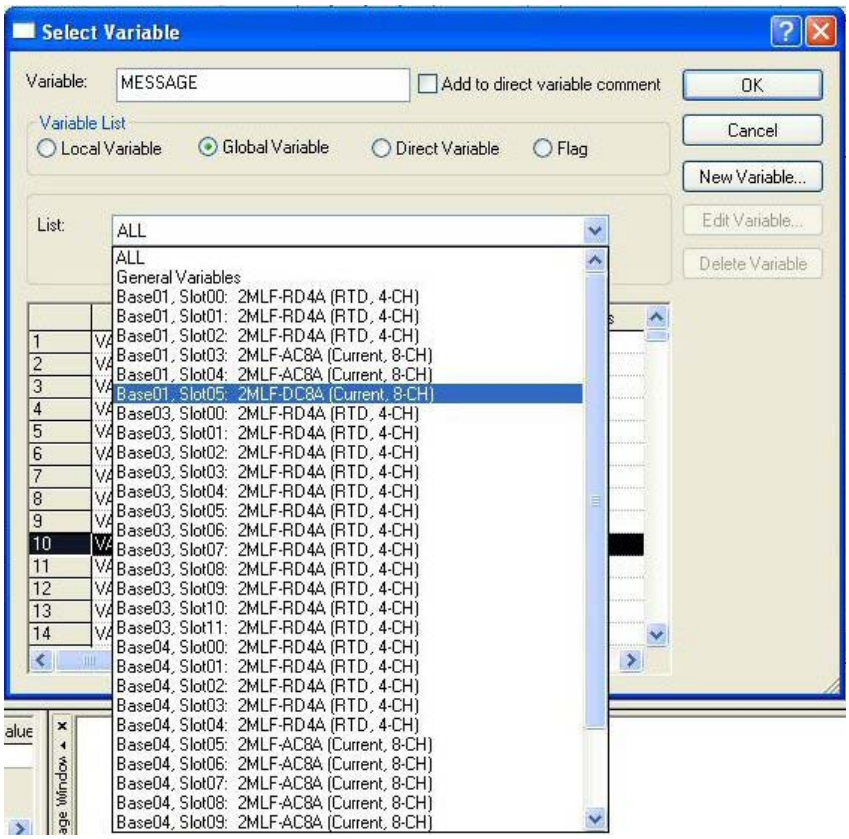
This section describes the how to add a global variable at local program.

The following is an example for writing the digital output of CH0 of D/A conversion module by using constant.

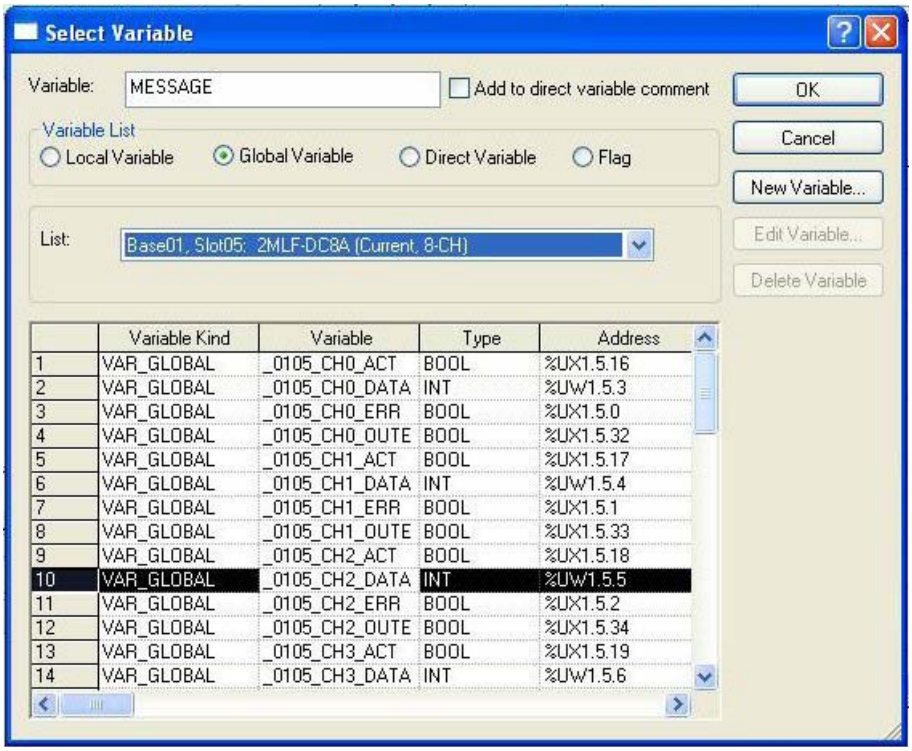
1. For writing constant (4000) at CH 0 (_0001_CH1_CH0_DATA) by using the following MOVE function, double-click the variable window part to open **Select Variable** window.



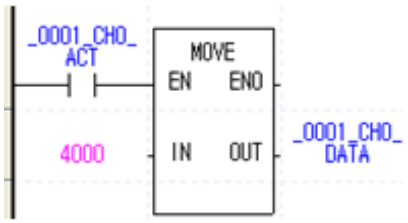
2. On **Select Variable** window, select global variable under **Variable List**. Select relevant base (1 base, 5 slot) at global variable view item.



3. Double-click or select _0105_CH2_DATA corresponding to CH2 D/A conversion data and click **OK**.



4. The following figure illustrates adding global variable corresponding to D/A conversion value.



5.5 PUT/GET function block use area (parameter area)

The following table indicates the operation parameter setting area of D/A conversion module.

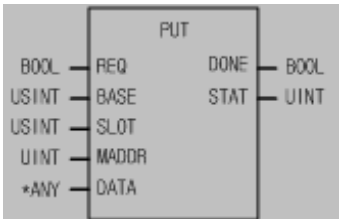
Global Variable	Contents	Type	Read/Write	Instruction
_Fab_CH_EN	Channel Enable/Disable	WORD	Read/Write	PUT
_Fab_OUT_RANGE	Range of output voltage/current		Read/Write	PUT
_Fab_DATA_TYPE	Input data type setting		Read/Write	PUT
_Fab_CH0_STAT	CH 0 output status setting value		Read/Write	PUT/GET
_Fab_CH1_STAT	CH 1 output status setting value			
_Fab_CH2_STAT	CH 2 output status setting value			
_Fab_CH3_STAT	CH 3 output status setting value			
_Fab_CH4_STAT	CH 4 output status setting value			
_Fab_CH5_STAT	CH 5 output status setting value			
_Fab_CH6_STAT	CH 6 output status setting value			
_Fab_CH7_STAT	CH 7 output status setting value			
_Fab_CH0_ERR	CH 0 error code		Read/Write	GET
_Fab_CH1_ERR	CH 1 error code			
_Fab_CH2_ERR	CH 2 error code			
_Fab_CH3_ERR	CH 3 error code			
_Fab_CH4_ERR	CH 4 error code			
_Fab_CH5_ERR	CH 5 error code			

Global Variable	Contents	Type	Read/Write	Instruction
_Fab_CH6_ERR	CH 6 error code			
_Fab_CH7_ERR	CH 7 error code			

At device allocation, ‘a’ refers to the base number and ‘b’ refers to the slot number where the module is equipped.

PUT instruction

PUT instruction is used for writing data to a special module.



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

Input

REQ : If this is 1, the function is executed

BASE : Set base position

SLOT : Set slot position

MADDR: Module address

DATA : Data to save at module

Output

DONE : If normally executed, Output is 1.

STAT : Error information

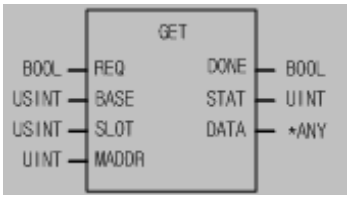
Function

This instruction is used for reading data from a designated special module.

Function Block	Input (ANY) Type	Description
PUT_WORD	WORD	Saves WORD data at the designated module address (MADDR)
PUT_DWORD	DWORD	Saves DWORD data at the designated module address (MADDR)
PUT_INT	INT	Saves INT data at the designated module address (MADDR)
PUT_UINT	UINT	Saves UINT data at the designated module address (MADDR)
PUT_DINT	DINT	Saves DINT data at the designated module address (MADDR)
PUT_UDINT	UDINT	Saves UDINT data at the designated module address (MADDR)

GET instruction

GET instruction is used for reading data from a special module.



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

Input

REQ : If this is 1, function is executed

BASE : Set base position

SLOT : Set slot position

MADDR: Module address

512(0x200) ~ 1023(0x3FF)

Output

DONE : If normally executed, output is 1

STAT : Error information

DATA : Data read from module

Function

This instruction is used for reading data from a designated special module.

Function Block	Output (ANY) Type	Description
GET_WORD	WORD	Reads WORD data from the designated module address (MADDR)
GET_DWORD	DWORD	Reads DWORD data from the designated module address (MADDR)
GET_INT	INT	Reads INT data from the designated module address (MADDR)
GET_UINT	UINT	Reads UINT data from the designated module address (MADDR)
GET_DINT	DINT	Reads DINT data from the designated module address (MADDR)
GET_UDINT	UDINT	Reads UDINT data from the designated module address (MADDR)

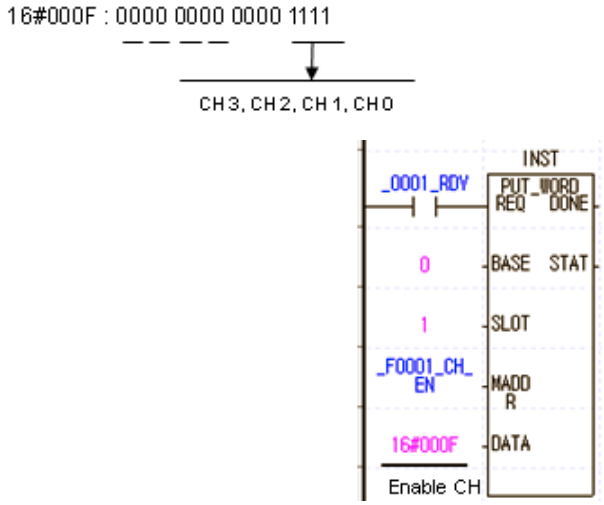
Example using PUT/GET instruction

Enable channel

1. You can enable/disable any channel.
2. Disable the unused channel to reduce the conversion period.
3. All the channels are disabled by default.
4. 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
—	—	—	—	—	—	—	—	CH7	CH6	CH5	CH4	CH3	CH2	CH1	CH0

Bit	Description
0	Disable
1	Enable



5. The values set in B4~B15 are ignored.

6. The above figure is an example that illustrates enabling CH0~CH3 of D/A module equipped at slot 1.

Input voltage/current range setting

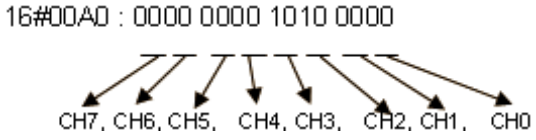
You can set input voltage/current range per channel.

1. Range of analog output voltage/current can be set per each channel

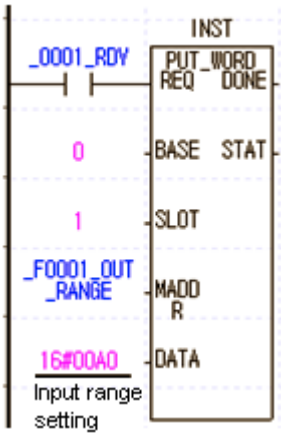
2. Default is 1~5V.
3. 2MLF-DV4A: Setting of analog output voltage/current is as follows.

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
CH7		CH6		CH5		CH4		CH3		CH2		CH1		CH0	

Bit	Description
00	1V ~ 5V
01	0V ~ 5V
10	0V ~ 10V
11	-10V ~ 10V



The following is an example where CH0~CH1 is set as 1~5V and CH2~CH3 as 0~10V.

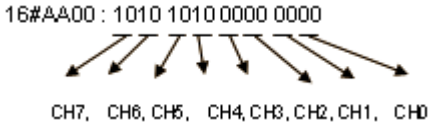


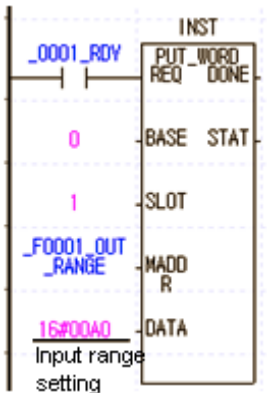
2MLF-DC4A

The following figure is an example where CH0~CH1 is set 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
CH7		CH6		CH5		CH4		CH3		CH2		CH1		CH0	

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



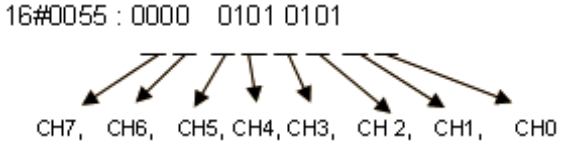


Output data range setting

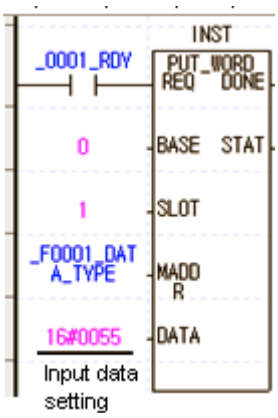
1. Range of digital output data about analog output can be set per each channel.
2. Default is 0~16000.
3. Setting of digital input data range is as follows.

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
CH7		CH6		CH5		CH4		CH3		CH2		CH1		CH0	

Bit	Description
00	Unsigned value: 0 ~ 16000
01	Signed value: -8000 ~ 8000
10	Precise Value
11	Percent value: 0 ~ 10000



The following is an example where CH0~CH1 is set as -8000~8000 and CH2~CH3 is set as 0~10000.



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

- 2MLF-DV4A

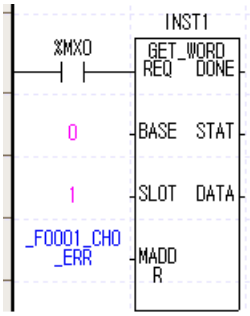
Analog output / Digital input	0 ~ 5V	1 ~ 5V	0 ~ 10V	-10 ~ 10V
Precise Value	0 ~ 5000	1000 ~ 5000	0 ~ 10000	-10000 ~ 10000

- 2MLF-DC4A

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

Output status setting

The following figure is an example where the output status of CH 0 is set as previous value.



Output status about setting value is as follows. (Setting range is 0~3 and the used device is dealt with word)

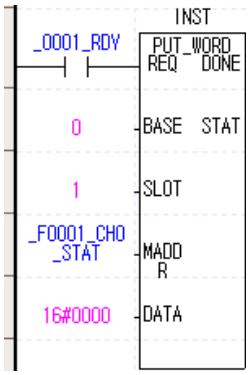
B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
CH# digital input value															

Bit	Description
0	Hold previous value
1	Minimum value of output range
2	Average value of output range
3	Maximum value of output range

Error code

Saves error code triggered at D/A conversion module

The following figure is a program reading error code.



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

The following table lists error type and contents.

Error code (Decimal)	Contents	LED status
10	Module error (Reset Check Error)	0.2s period flicker
11	Module error (Ram Check Error)	
12	Module error (Register Check Error)	
13	Module error (EEPROM Check Error)	
21	Module error (D/A Conversion Error)	
31#	Parameter setting error of current module	1s period flicker
32#	Parameter setting error when setting offset/gain of current module	

Error code (Decimal)	Contents	LED status
40#	Digital input range setting error of current module (When input value is smaller than -192 or larger than 16191) Range is different according to input data type	
50#	Offset/gain setting error at 4~20mA of current module (When offset is large or same with gain)	
51#	Offset/gain setting error at 0~20mA of current module (When offset is large or same with gain)	
52#	Offset/gain setting error at 1~5V of voltage module (When offset is large or same with gain)	
53#	Offset/gain setting error at 0~5V of voltage module (When offset is large or same with gain)	
54#	Offset/gain setting error at 0~10V of voltage module (When offset is large or same with gain)	
55#	Offset/gain setting error at -10~10V of voltage module (When offset is large or same with gain)	

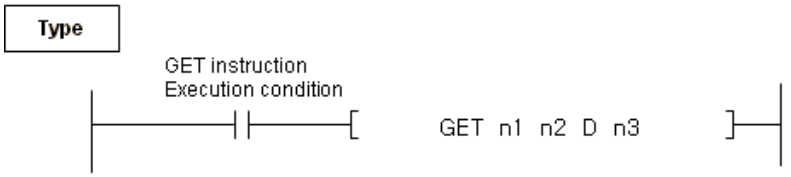
At error code, # indicates channel where error occurs.

If two errors occur at the same time, the first occurred error is saved and the second occurred error is not saved.

6. Programming

6.1 Internal memory read/write

Read internal memory (GET, GETP instruction)

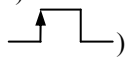


The following table describes the GET/GETP instructions.

Table 27 – Get instruction parameter details

Type	Description	Area available
n1	Slot number where the special module is installed.	Integer
n2	Start address of setting area of special module's internal memory to read data Integer.	Integer
D	Device's start address with saved data to read.	M, P, K, L, T, C, D, #D
n3	Number of words to read.	Integer

Difference between GET command and GETP command

- GET: Always executed with execution condition ON ()
- GETP: Executed with execution condition of operation start ()

Example

D/A conversion module is installed on base No.0 and slot No.3, and internal memory address No.0. Data of the 1's in a D/A conversion module is read and stored at D16 and D17 address of the D area of CPU module.

The following table lists the Get instruction example details.

Table 28 – Get instruction example details

Address	D area of CPU module		Internal memory of D/A conversion module	Address
D00015				
D00016	Run channel setting	←	Run channel setting	0
D00017	Range of output voltage/current	←	Range of output voltage/current	1
D00018				2
D00019				3

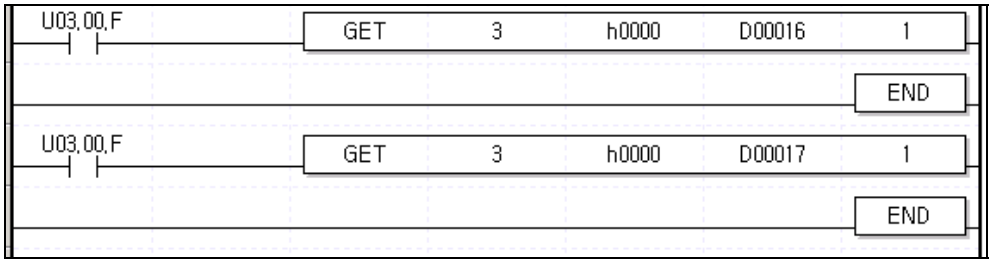


Figure 28 – Ladder diagram for Get instruction

Write to internal memory (PUT, PUTP instruction)

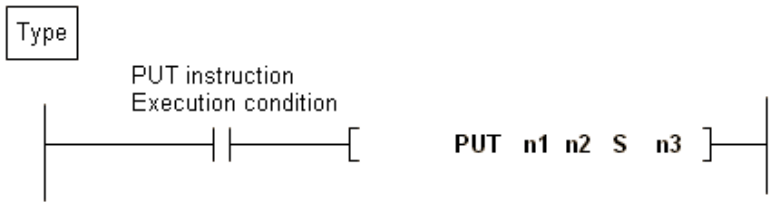


Figure 29 – Put/PUTP instruction

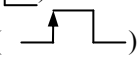
The following table lists the PUT/PUTP instruction details.

Table 29 – PUT, PUTP instruction details

Type	Description	Area available
n1	Slot number where the special module is installed.	Integer
n2	Start address of setting area of special module's internal memory to read data Integer.	Integer
S	Device's start address with saved data to write.	M, P, K, L, T, C, D, #D, Integer
n3	Number of words to write	Integer

Difference between PUT command and PUTP command

The difference between PUT command and PUTP command are as follows:

- PUT: Always executed with execution condition ON ()
- PUTP: Executed with execution condition of operation start ()

Example

D/A conversion module is installed on Base No.0 and Slot No.6. CPU module's data at D16–D17 address is written to internal memory addresses 0–1 of D/A conversion module.

Table 30 – PUT instruction example details

Address	D Area of CPU Module		Internal Memory of D/A Conversion Module	Address
D00015				
D00016	Run channel setting	→	Run channel setting	0
D00017	Range of output voltage/current	→	Range of output voltage/current	1
D00018				2
D00019				3

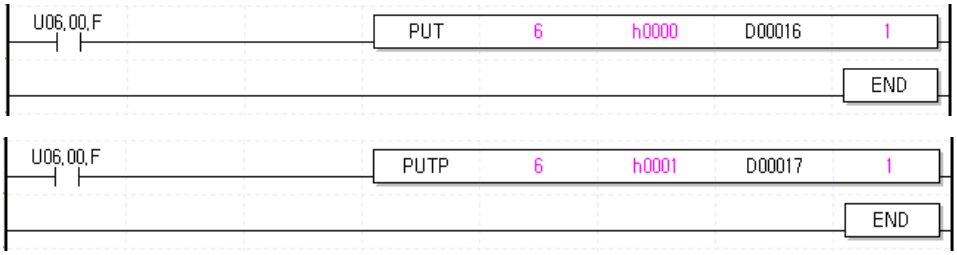


Figure 30 – Ladder diagram for PUT instruction example

6.2 Basic program

The following procedure specifies the Run condition details of D/A conversion module's internal memory.

1. D/A conversion module is installed on slot 1.
2. I/O assigned points of D/A conversion module is 16 points.

System configuration

Table 31 – System configuration

2MLP-ACF1	2MLK-CPUH	2MLF-DC4A RUN

2MLF-DC4A

The following figure illustrates the program example using I/O parameter setting.

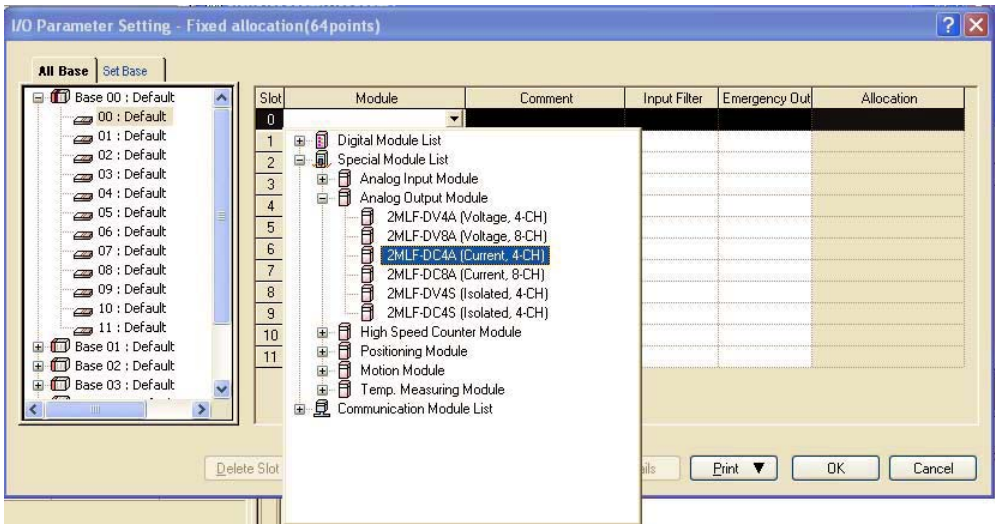


Figure 31 – I/O parameter setting

ATTENTION

- In 2MLR series, special card cannot be equipped at main base. Available bases to equip the special card are 1~31.
- Program example is written based on 2MLI CPU.

The I/O parameter setting is configured as shown in the following figure. The programming is initiated after configuring the modules.

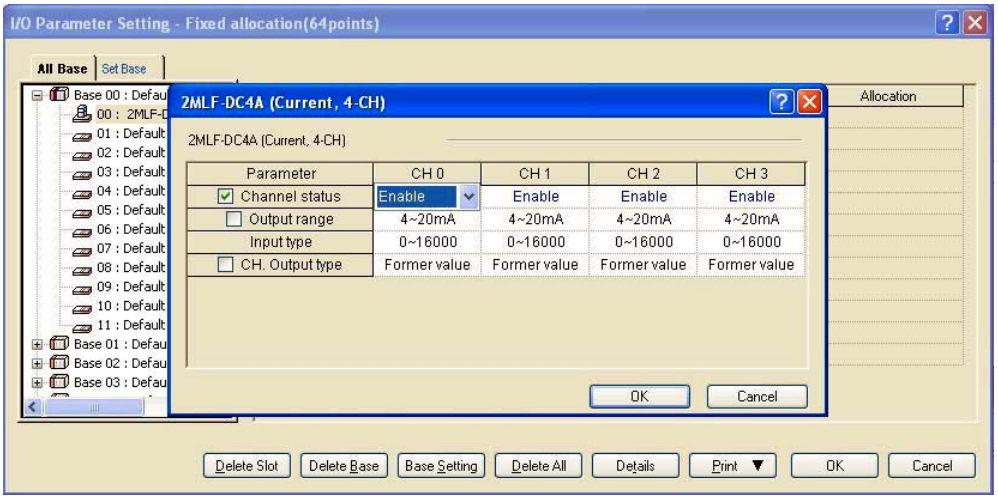


Figure 32 – I/O parameter setting (Analog Output Module)

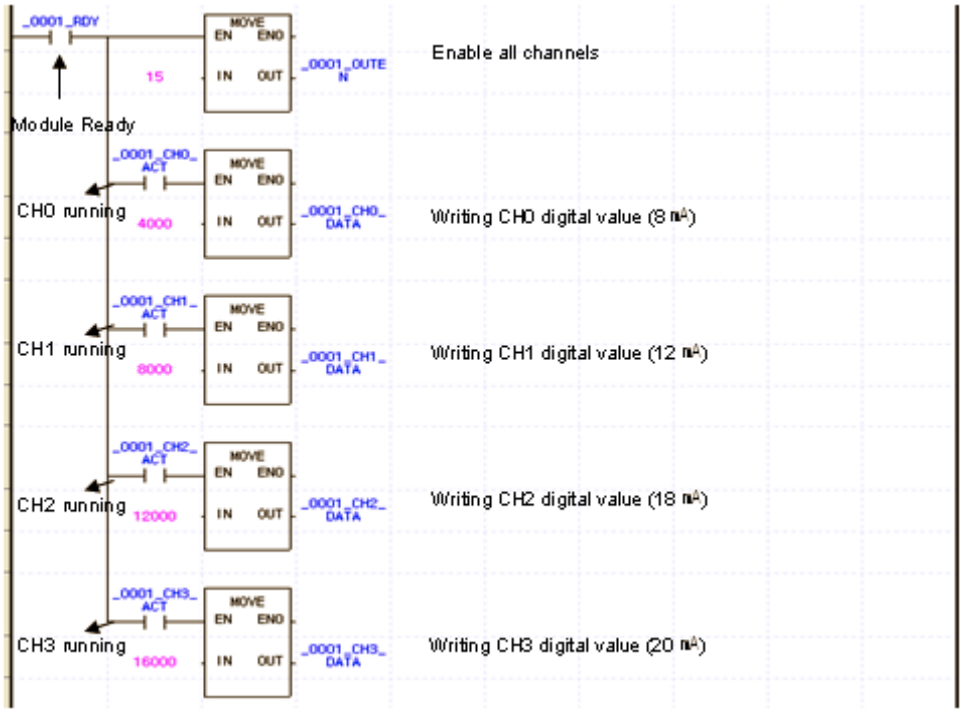


Figure 33 – CH Run Information

The following figure illustrates the program example using PUT/GET instruction.

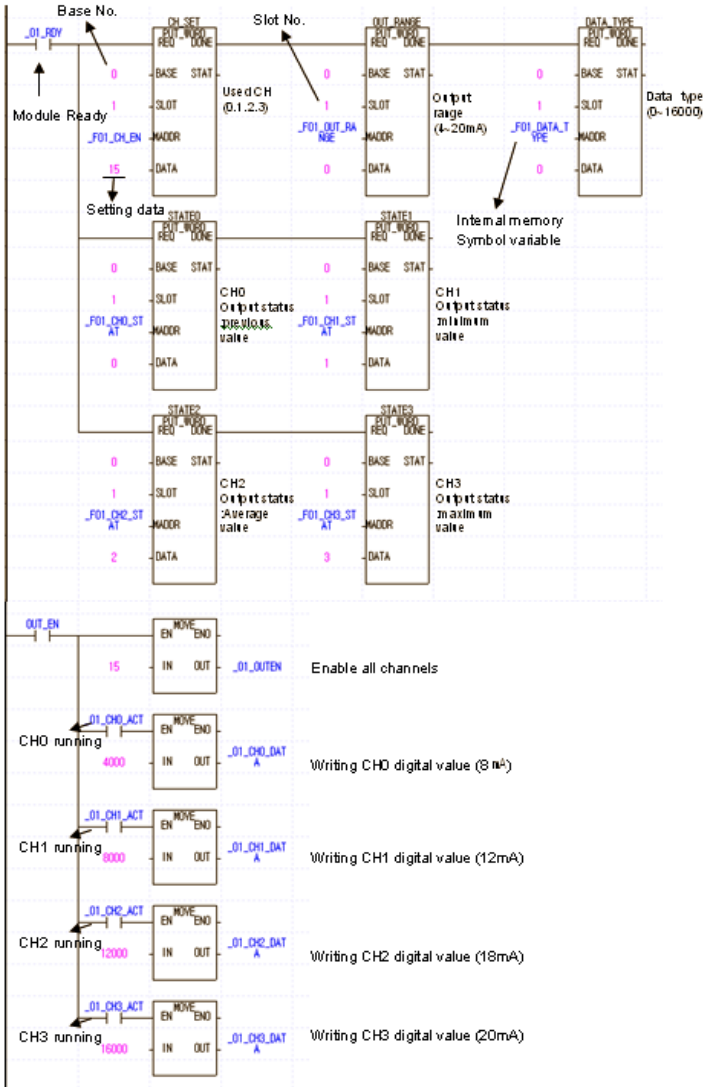


Figure 34 – PUT/GET example

ATTENTION

For additional information on address setting, refer to the section on Setting area of Run parameters.

6.3 Application program

Inverter speed control

D/A converter is connected to the three phase inverter, which in turn drives the inductive motor.

System configuration

The following figure illustrates the system architecture for Inverter Speed Control.

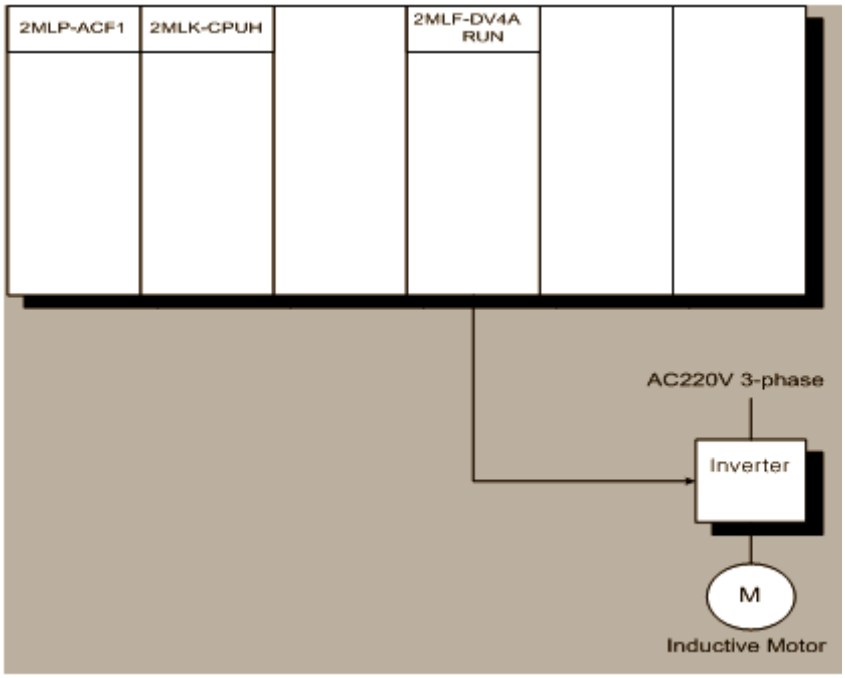


Figure 35 – System architecture for Inverter Speed Control

Details of initial settings

The following table lists the initial settings for the Inverter Speed Control application.

Table 32 – Initial settings for Inverter Speed Control application

No	Parameters	Setting Details	Internal Memory Address
1	Channels status	CH 0 – 3	0
2	Output voltage range	0– 10V	1
3	Data type	0–16,000	2
4	Channel output type	Previous /Minimum/Average/ Maximum value	3,4,5,6

Description of program

The following procedure describes the high level description of the program.

1. When Module Ready Contact is ON, the output of all the channels is set to Allowed/Enabled.
2. If CH 0 operation flag (_0001_CH0_ACT) is ON, output is 0V.
3. If CH 1 operation flag (_0001_CH1_ACT) is ON, output is 2.5V.
4. If CH 2 operation flag (_0001_CH2_ACT) is ON, output is 5V.
5. If CH 3 operation flag (_0001_CH3_ACT) is ON, output is 7.5V.

Program

The following figures illustrate the program example using I/O parameters setting.

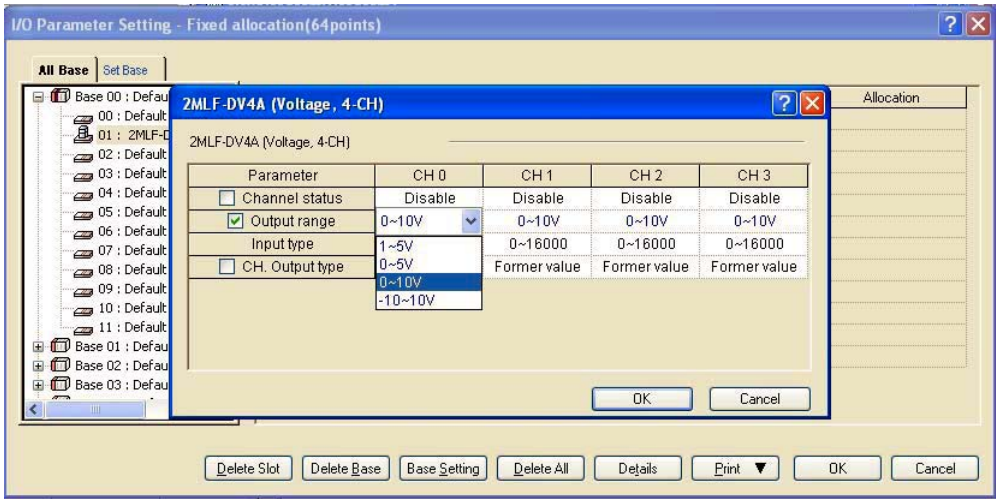


Figure 36 – Channel parameter setting window

The following figure illustrates the program example using MOV instructions.

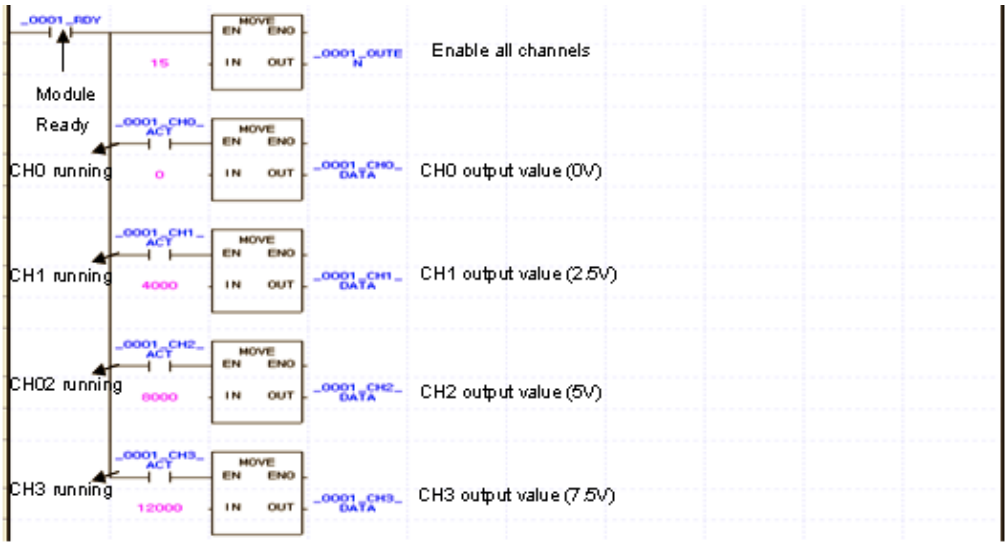


Figure 37 – Program example through MOV instructions

The following figure illustrates the program example using PUT/GET instructions.

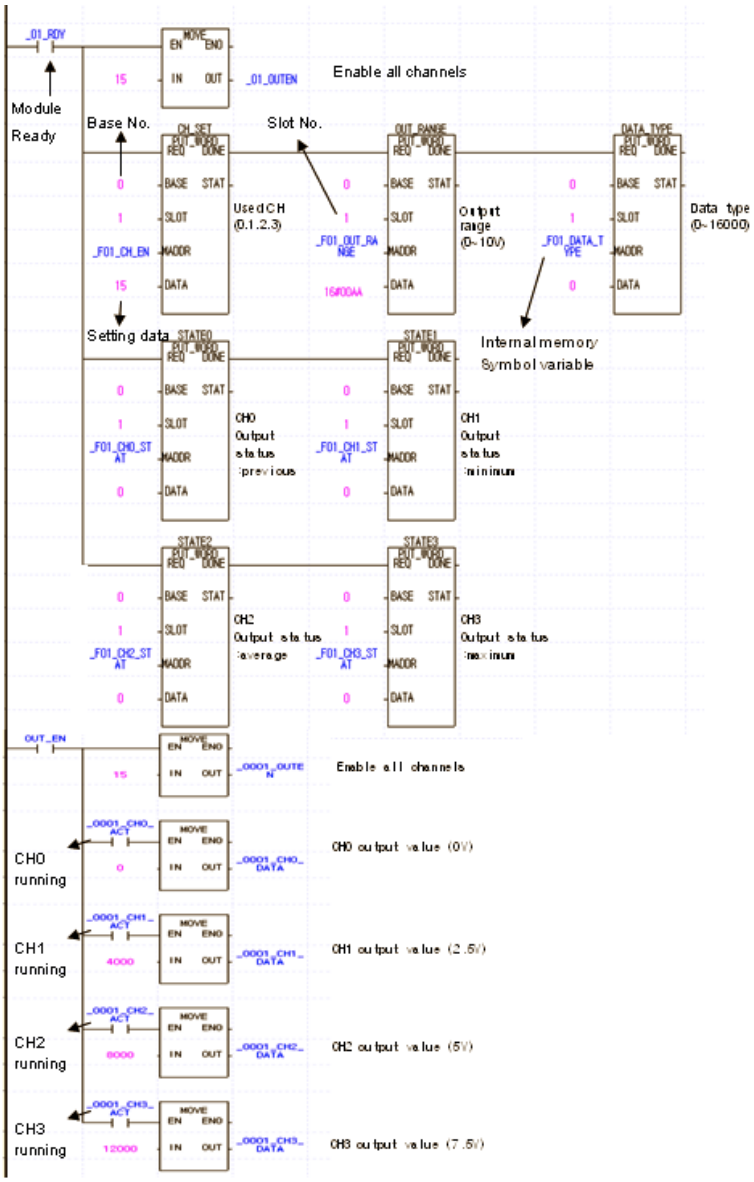


Figure 38 – Program example with PUT/GET instruction used

Error code output to BCD display

System configuration

The following figure illustrates the system architecture for BCD display output.

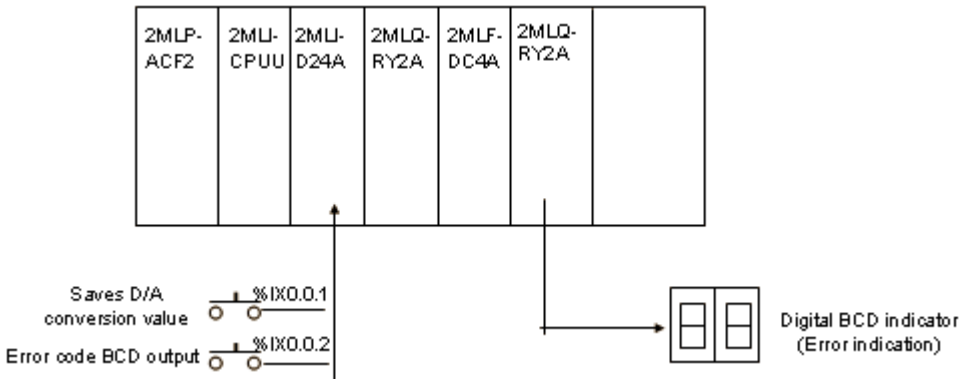


Figure 39 – System architecture for BCD display output

Details of initial setting of 2MLF-DC4A

The initial settings of 2MLF-DC4A are as follows:

- Output channel used: CH 0
- Analog output current range: DC 4 –20mA
- Digital input data range: 0 –16000

Description of program

The following procedure describes the high level description of the program.

1. If input (%IX0.0.1) is ON, D/A conversion value and error code at %MW0 and %MW1 is saved, respectively.
2. 2. If input (%IX0.0.2) is ON, corresponding error code is output to BCD display (%QW0.3.0)

Program

The following figures illustrate the program example using [I/O parameter] setting.

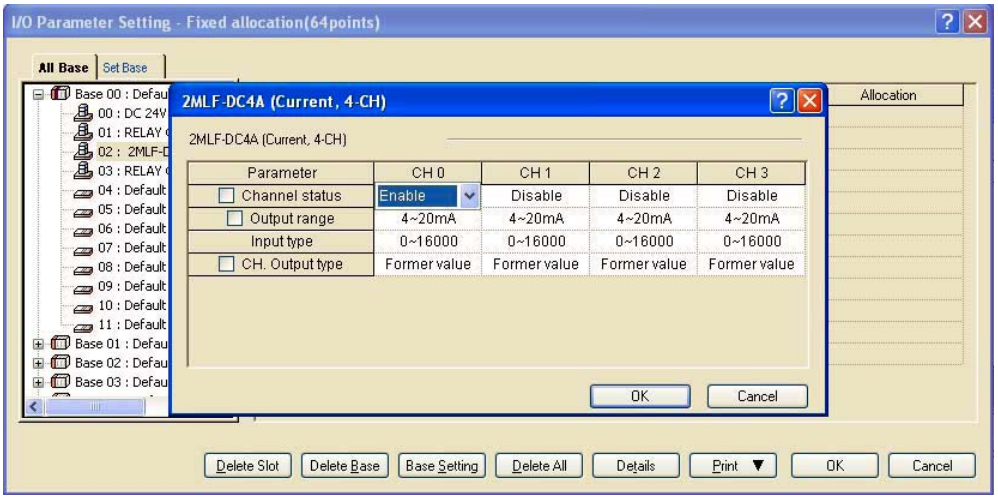


Figure 40 – Channel parameter setting window

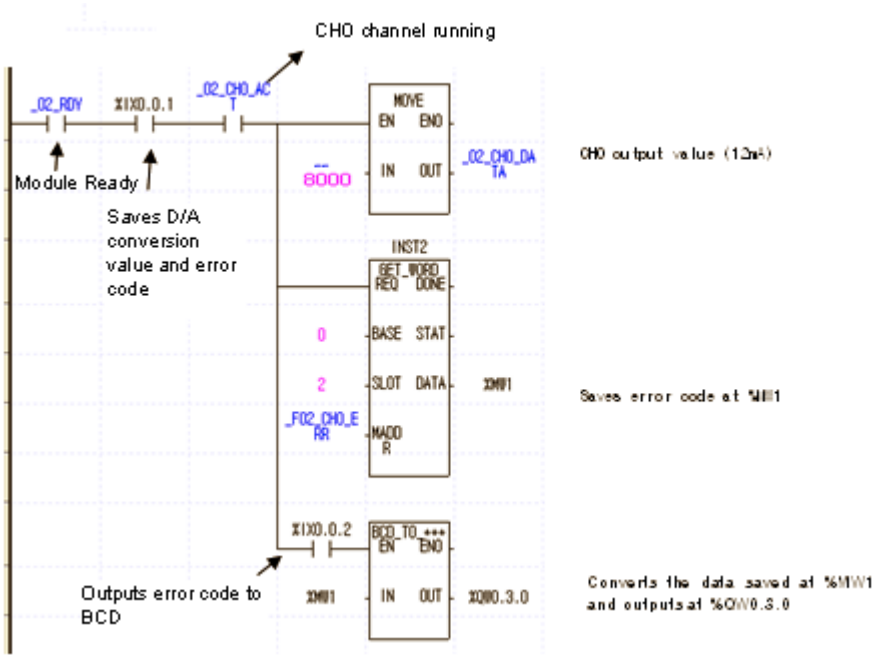


Figure 41 – Ladder diagram with MOV instruction for BCD error code output

The following figure illustrates the program example using PUT/GET instruction.

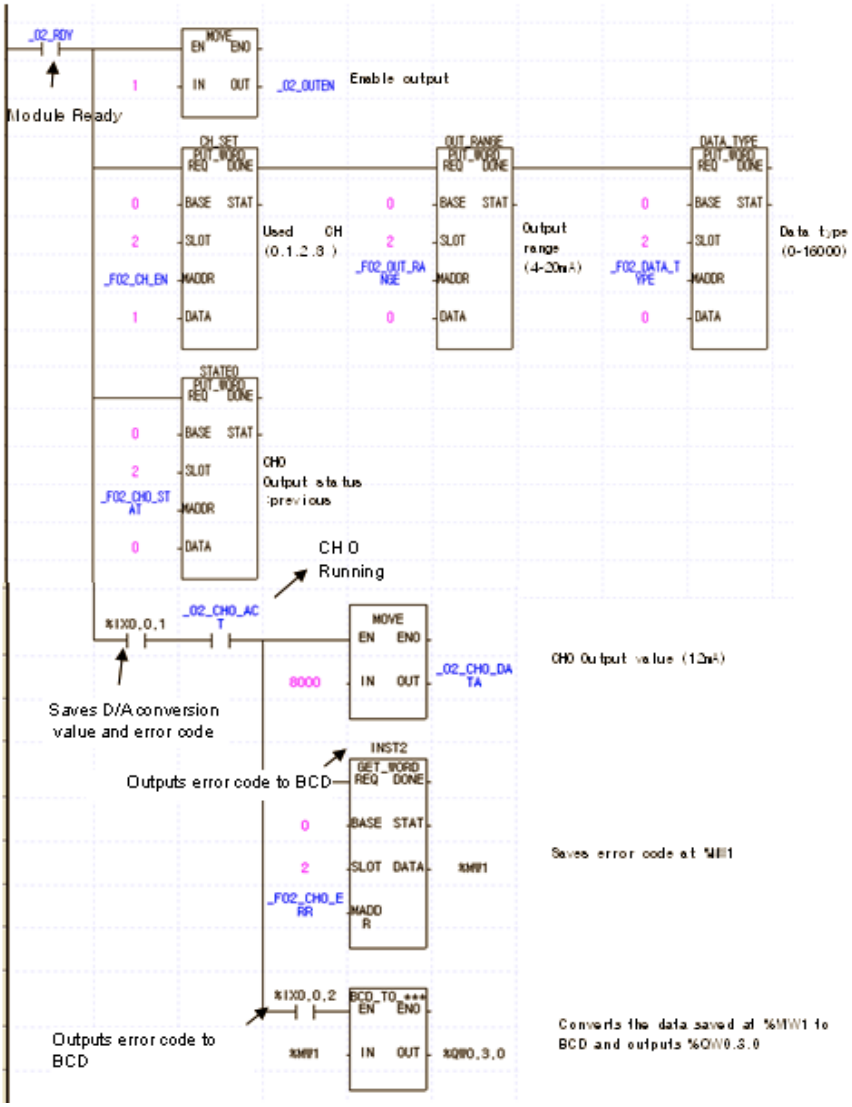


Figure 42 – Ladder diagram with PUT instruction for BCD error code output

7. Troubleshooting

7.1 Error diagnostics of D/A conversion module

The following table lists the details and diagnosis of the errors that trigger when using the D/A conversion module.

Table 33 – List of error codes

Error Code in (Decimal)	Details	LED Status
10	Module error (Reset Check Error)	Blinks every 0.2s
11	Module error (Ram Check Error)	
12	Module error (Register Check Error)	
13	Module error (E2PROM Check Error)	
21	Module error (D/A Conversion Error)	
31#	Current module's parameters setting error	Blinks every 1s.
32#	Parameters setting error when setting current module's Offset/Gain	
40#	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.	
50#	Offset/Gain setting error in current module of 4–20mA (If Offset value is set greater than or equal to Gain value)	
51#	Offset/Gain setting error in current module of 0–20mA (If Offset value is set greater than or equal to Gain value)	
52#	Offset/Gain setting error in voltage module of 1–5V(If Offset value is set greater than or equal to Gain value)	

Error Code in (Decimal)	Details	LED Status
53#	Offset/Gain setting error in voltage module of 0–5V(If Offset value is set greater than or equal to Gain value)	
54#	Offset/Gain setting error in voltage module of 0–10V (If Offset value is set greater than or equal to Gain value)	
55#	Offset/Gain setting error in voltage module of -10–10V (#: channel) (If Offset value is set greater than or equal to Gain value)	

ATTENTION

- # in the error code indicates the channel on which the error is found.
- If two or more errors trigger, then the module saves only the first error code found.

- Refer to the following table, if an error is triggered.

Table 34 – Error code Table 1

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 0.2s.
31#, 40#	Kept	Set applicable channels only	Displayed on system area	Blinks every 1s.
32#, 50#, 51#, 52#, 53#, 54#, 55#	Kept	-	Offset/Gain error code area	Blinks every 1s.

- Refer to the following table, if an error is deleted.

Table 35 – Error code Table 2

Error Code	Module Ready	Error Bit Status	Error Code	LED
10, 11, 12, 13, 21	Power ON/OFF			
31#, 40#	Kept	Clear	Clear	ON
32#, 50#, 51#, 52#, 53#, 54#, 55#	Kept	-	Clear	ON

7.2 Diagnosis of errors

RUN LED blinks

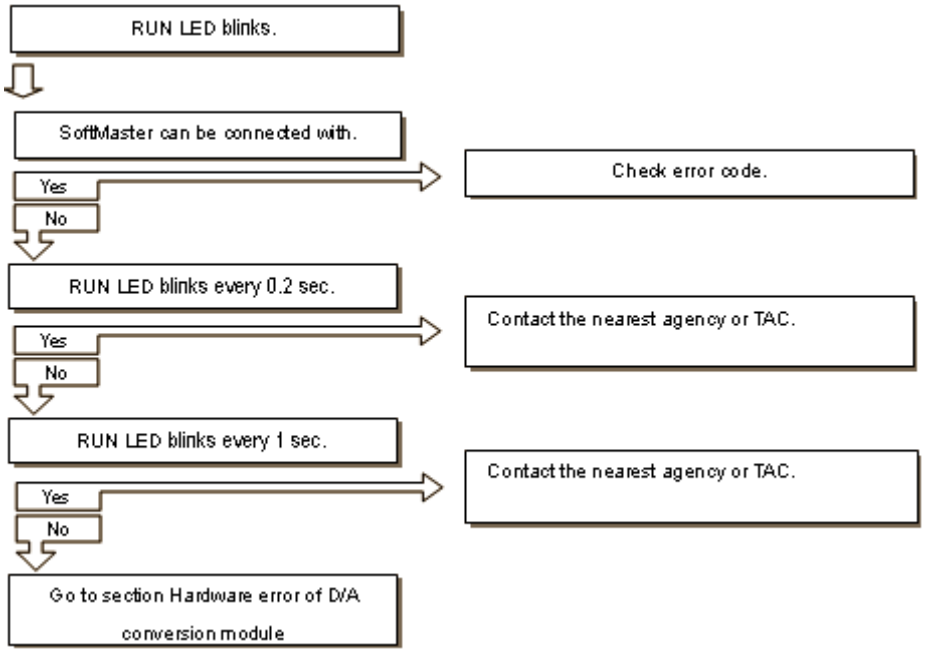


Figure 43 – Diagnosis flowchart - RUN LED blinks

RUN LED is OFF

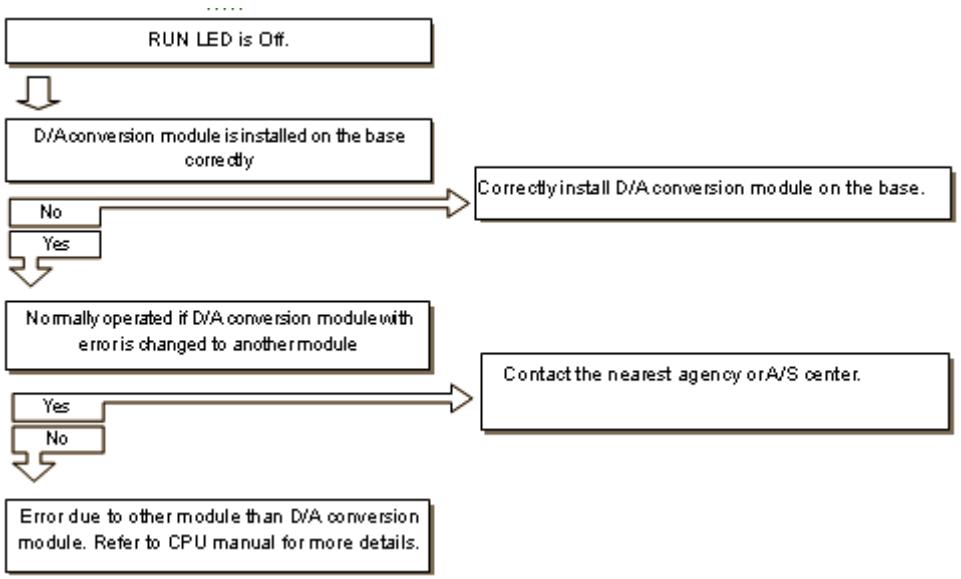


Figure 44 – Diagnosis flowchart - RUN LED is OFF

Frequent fluctuations in the D/A output value

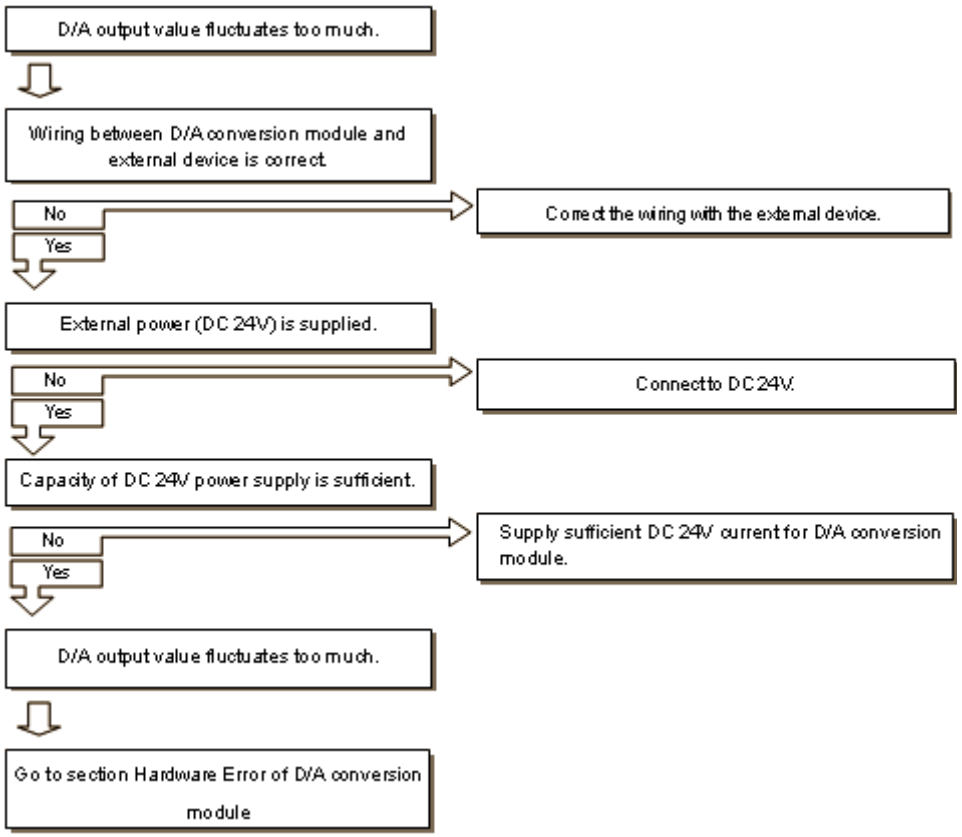


Figure 45 – Diagnosis flowchart - analog output fluctuates frequently

REFERENCE - INTERNAL

For more information, refer to the Wiring section.

Digital value and analog output value are not synchronized

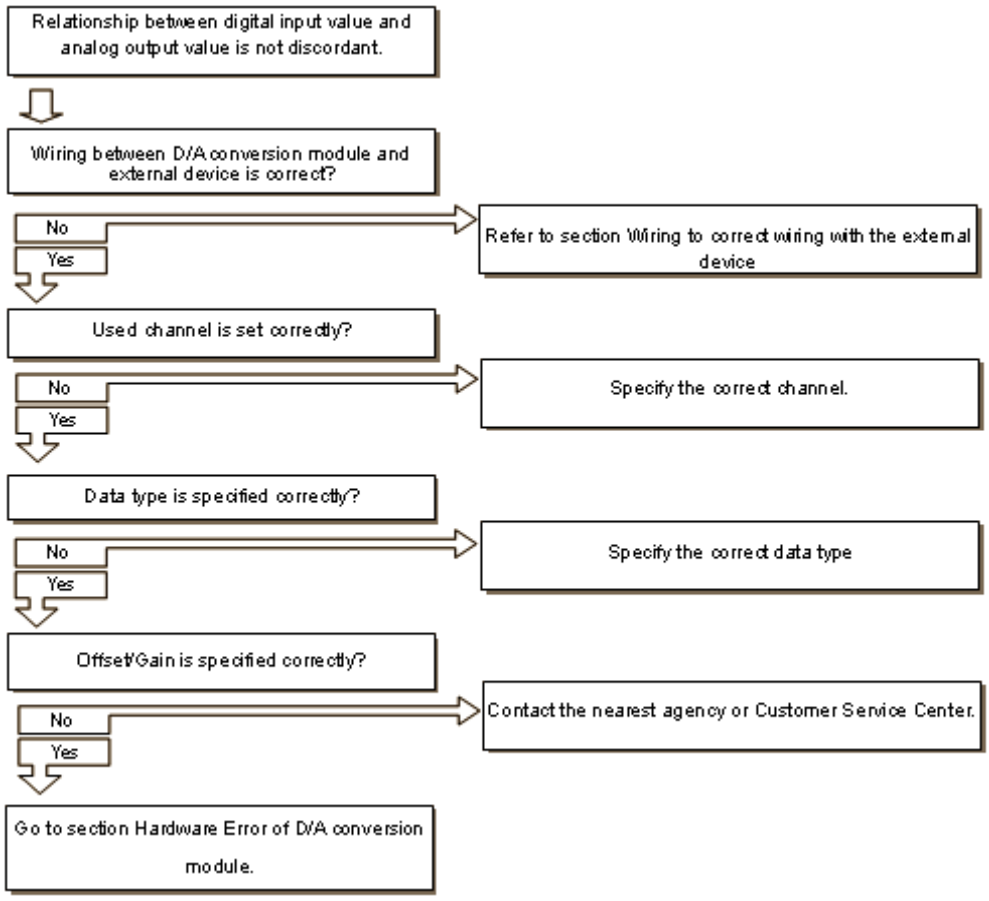


Figure 46 – Diagnosis flowchart – digital input and analog output not in tandem

D/A output value always exceeds the value specified

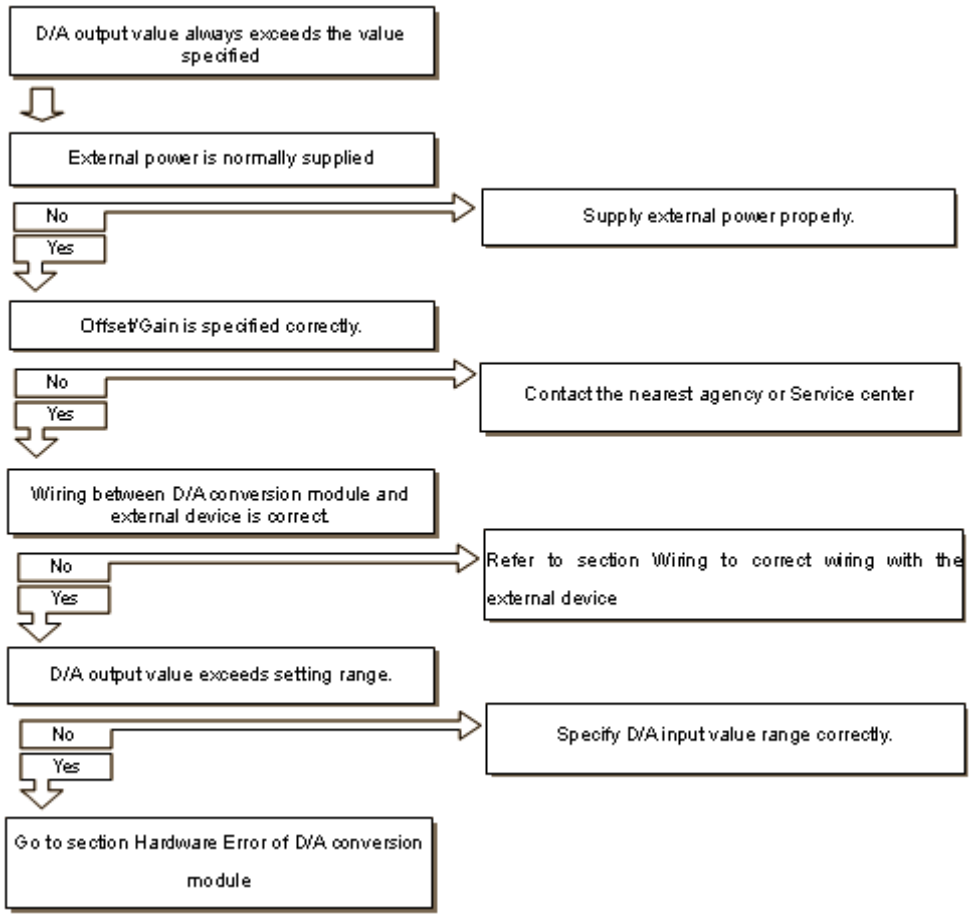


Figure 47 – Diagnosis flowchart - D/A output value always exceeds specified value

Changes in analog output value are not proportionate to the change of digital value

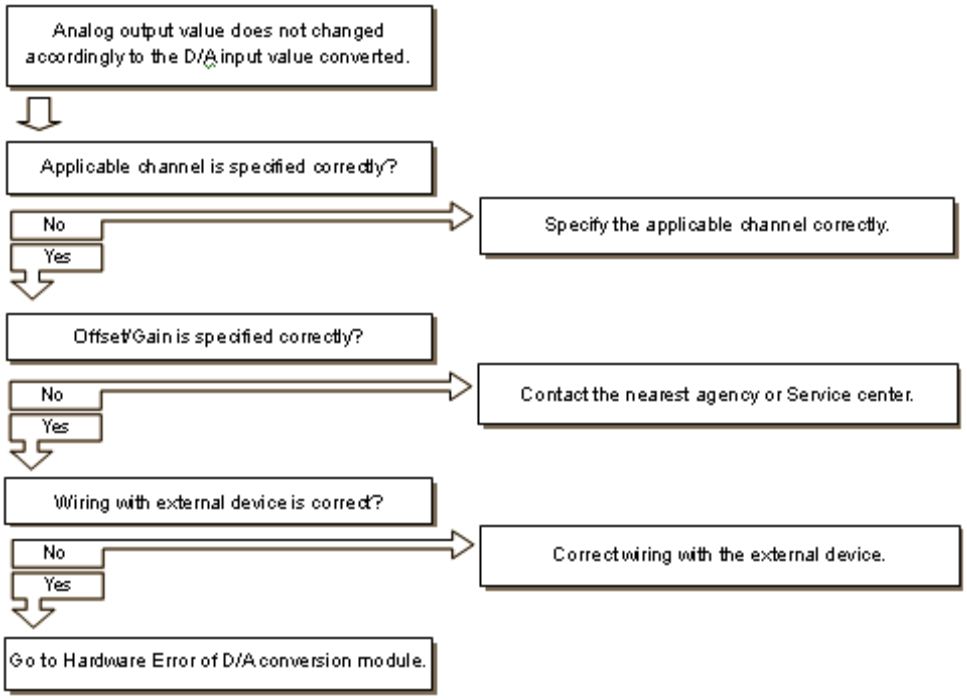


Figure 48 – Diagnosis flowchart - changes in output and input not in tandem

Hardware error of D/A conversion module

Figure 49 – Hardware error

Status check of D/A conversion module through SoftMaster system monitor

Module type, module information, O/S version and module status of D/A conversion module can be checked using SoftMaster system monitoring function.

1. Execution sequence

   There are two ways to perform the execution.

   a) From the **Monitor** menu, select **System Monitoring** and then right-click the module window to display Module Information.

   – From the **Monitor** menu, select **System Monitoring** and then double-click the module window.

2. Module information details include the following:

   a) **Module type**: displays the information of the module currently installed.

   – **Module information**: displays the O/S version information of D/A conversion module.

   – **O/S version**: displays the O/S prepared date of D/A conversion module.

   – **Module status**: displays the current error code.

3. System monitor

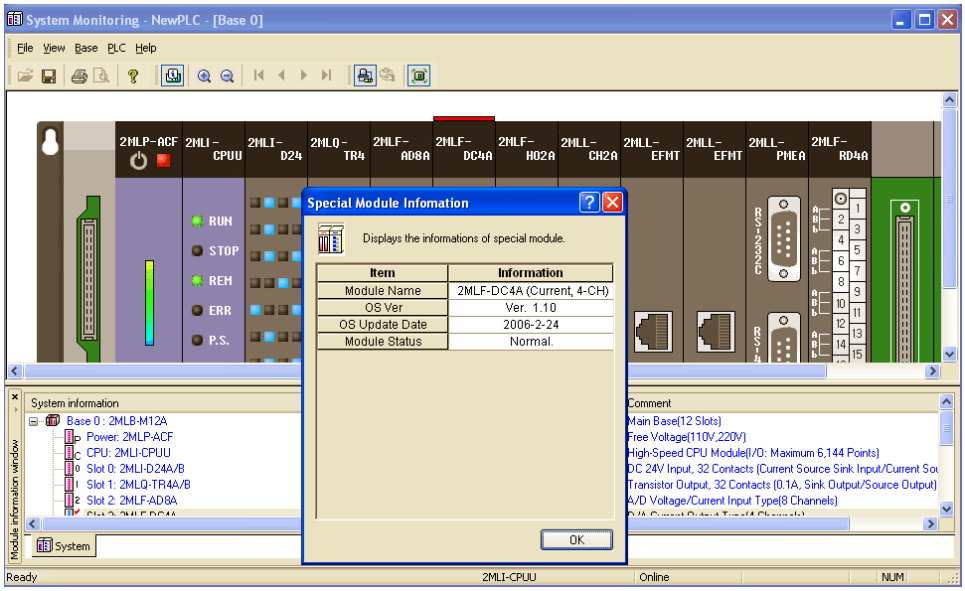


Figure 50 – System monitor

4. Monitor through program

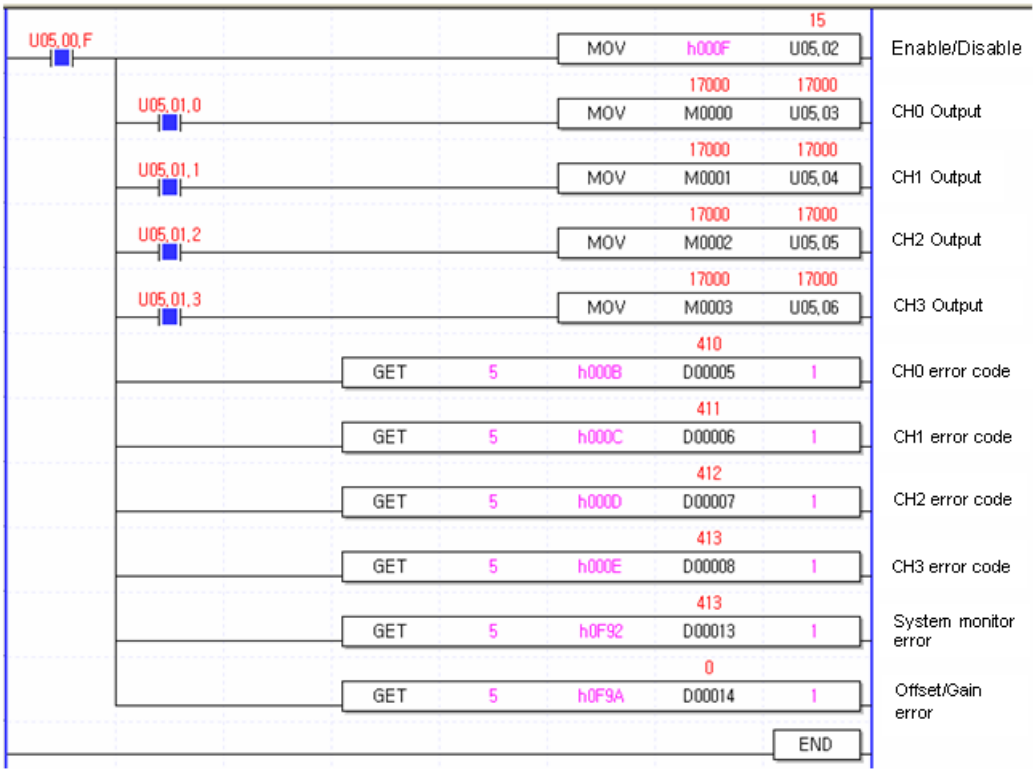


Figure 51 – Monitoring using Ladder program

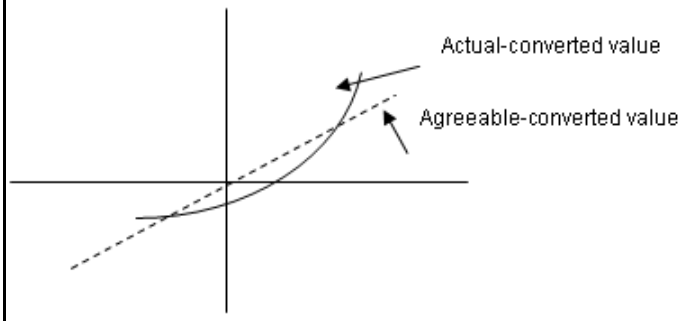
8. Appendix 1 Terminology

8.1 Terminology

The following table lists the terms and abbreviations used in analog module.

Table 36 – Terminology

Term	Description
A/D converter	Converts analog value input to digital value proportional to the size of analog input signal.
Analog input module	Hardware module used along with PLC to convert analog voltage/current input signal to binary value, it has resolution of 14 and 16 bits depending on the type of converter.
Channel	The terminal of analog I/O module which is connected to various voltage/current I/O devices, respectively, with applicable data function as well.
Conversion time	Time necessary for analog input module to sample and convert the analog signal for the processor to get digitally-converted input value. On the other hand, it is necessary for analog output module to convert the digital value output from the processor to analog output signal so to transmit to the output channel.
D/A converter	Module with circuit to convert digital values to proportionate analog out voltage or current.
Full scale	Defined as the size of voltage/current where the normal operation is executed.
Full scale error	Shows graphically the difference between agreeable analog-converted value and actual analog-converted value.
Full scale range	Displays the difference between the maximum and the minimum of the analog input.

Term	Description
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 minimum 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. 
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 minimum value recognizable by a PLC, 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 output value due to sudden change in the external noise or input for the analog circuit, using methods of software and hardware filters.
Accuracy	Displays the maximum deviation between agreeable value and output voltage or current for the whole range of output. On the other hand, it is displayed the maximum deviation between agreeable value and digital-converted input signal value for the whole range of input. Generally, percentage is displayed for the full scale. Gain, Offset and Linearity error are all included in the error type available.

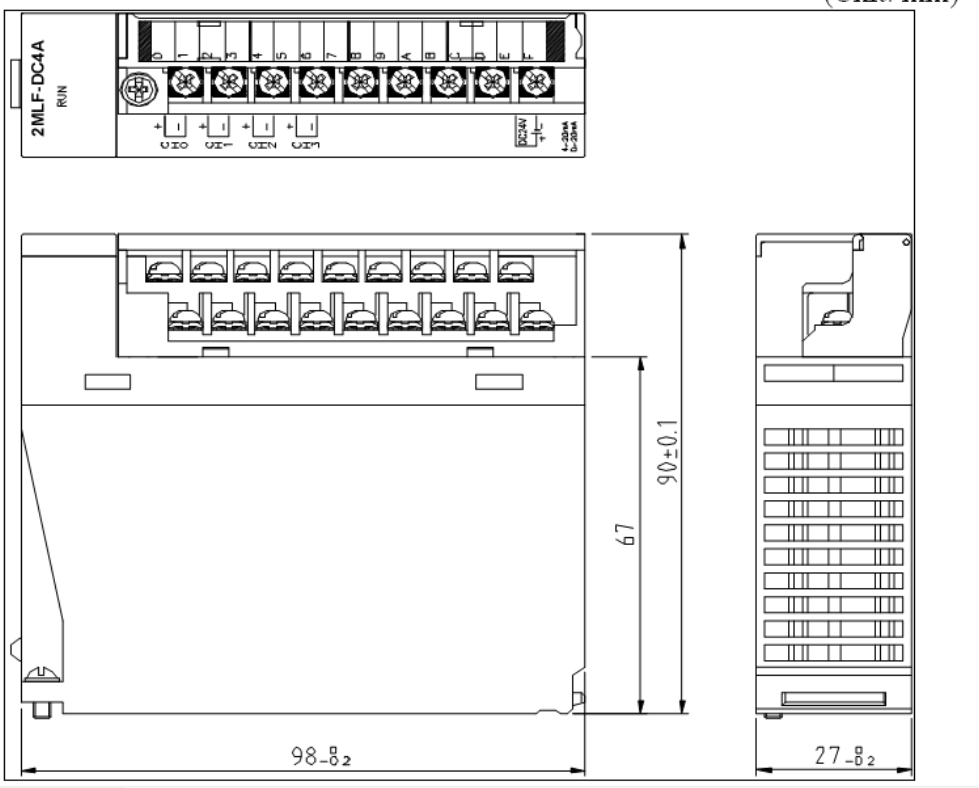
Term	Description
Output accuracy	Displays the difference between the actual analog output voltage/current value and the agreeable-converted value on the conversion graph for the full scale, with Offset, Gain and Drift error factors included as well as normal temperature (25ºC) and available temperature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

9. Appendix 2

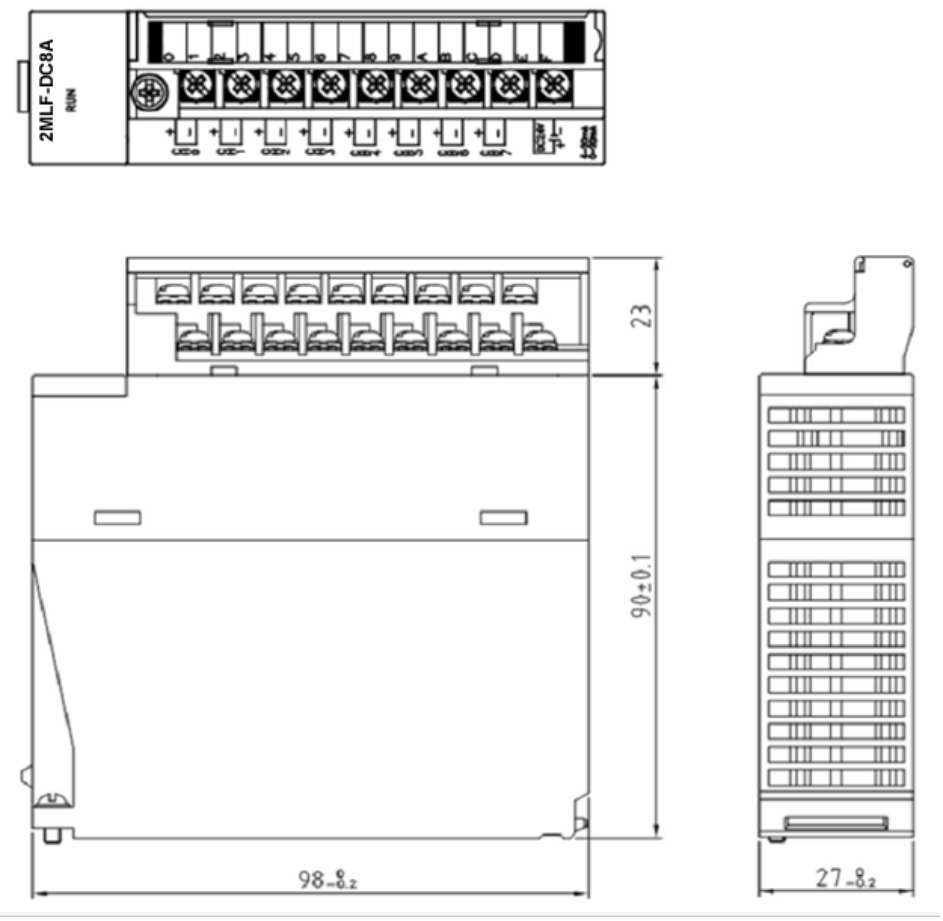
9.1 Dimensions

Dimensions of 2MLF-DC4A/DV4A

(Unit: mm)



Dimension of 2MLF-DV8A/DV8A



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