CIMON
Total Solution for Industrial Automation

User's Manual for CM3-SP32PWM

CIMON-PWM Output Module

Before using this product, please read this manual carefully and pay full attention to safety in order to handle the product correctly.
Store this manual in a noticeable place so that it can be read whenever necessary.

Before You Start

This manual contains important information on the use and operation of this device. Please read all the information carefully for optimal performance and to prevent any damage or misuse of the device.

Safety symbols are classified into two categories, “WARNING” and “CAUTION”.

⚠Warning Situations that could cause major or fatal injury to the user.

⚠Caution Situations that may cause minor injury or damage to the device.

SAFETY SYMBOLS USED IN THIS PRODUCT MEANS:

⚠This symbol warns the user of hazardousness.

⚠This symbol warns the user of uninsulated voltage within the unit that can cause dangerous electric shock.

Keep this manual nearby the user operating devices so it can be easily checked.

A-class equipment (Broadcasting communication equipment for business)

This product registered in conformity assessment of electromagnetic wave for business use, and has not designed or manufactured to be incorporated in a device or system used in purposes related to human life.

Design Precautions (⚠Warning)

Install a safety circuit to protect entire control system when off-site power or PLC module have been occurred error. Otherwise, accident could result in major injury on safety of whole system by malfunctions.

Outside the PLC, construct mechanical damage preventing interlock circuits such as emergency stop, protective circuits, upper and lower limits switches, forward/reverse direction interlocking circuits, etc.

When the PLC detects either of the following failure conditions, it may stop operation and turn off all outputs.

- The overcurrent protection or overvoltage protection of the power supply module is activated.
- The PLC CPU detected a failure, such as the watchdog timer error or module installation failure, with its self-diagnostic function.

In addition, all outputs may be turned on when there is a failure that the PLC CPU cannot detect, such as in the relay or TR terminal. Build an extra monitoring circuit that will monitor any output signal that could cause serious accidents.

Either long-period overcurrent beyond the rating or that caused by short-circuited load flows in the output module may lead to fire.

Build a circuit that turns on the external power supply after the PLC power supply is turned on. If the external power supply is turned on first, it could result in output failure or malfunctions.

Configure an interlock circuit in the scan program so that the system operates safely in following situations.

- Exchanging of data with computer or extra devices.
- Operated by computer or extra devices through communication.

Not doing so could result in output failure or malfunctions.

Precautions for design (⚠Caution)

Do not bundle the input/output signal or communications cables with the main circuit and power cables. They should be installed at least more than 100 mm (3.94inches). Not doing so could result in output failure or malfunction.

Precautions for mounting (⚠Caution)

Use the PLC in the environment that meets the general specifications given in this manual. Using this PLC in any environment outside the range of the general specifications could result in electric shock, fire, malfunction, or damage to or deterioration of the product.

Make sure each module is fixed exactly. Fixing loosely or inexactly could result in malfunction, trouble, or falling.

Power supply in PLC should be turned off before mounting the module. Not doing so could cause an electric shock or damage to the device.

Fix I/O or an extension connector exactly. If they are fixed inaccurately, it could result in input or output failure.

Do not convey direct vibration into PLC. Not doing so could cause electric shock, fire or malfunctions.

Make sure that metallic debris do not enter the device. Failure to do so may cause electric shock, fire or malfunctions.

Precautions for wiring (⚠Warning)

Make sure to cut off all phases of the power supply externally before attempting installation or wiring work. Failure to do so may cause electric shock or damage on the device.

Make sure to close the terminal cover before turning on the power of PLC system after wiring work. Failure to do so may cause electric shock.

Precautions for wiring (⚠Caution)

Make sure to check device's regular voltage and sequence of terminals. Failure to do so may cause fire, electric shock and malfunctions.

Make sure to tighten the screw with standard torque. Loose connections may cause short, fire or malfunctions.

In grounding the FG ground terminals, be sure to carry out at least D type (Class 3) grounding. Not doing so could result in electric shock or malfunctions.

When wiring, make sure that wiring debris do not enter the module. Failure to do so may cause fire, equipment damage or malfunctions.

Precautions for test run and repair (⚠Warning)

Do not touch terminal when the power is ON. Doing so could cause an electric shock or malfunctions.

When cleaning or tighten the screw, make sure to turn off all power of PLC supply and external. Failure to do so could cause an electric shock or malfunctions.

Do not charge, disassemble, heat up, short, or solder the battery. Doing so could cause injury for user or fire from the heat, rupture or ignition.

Precautions for test run and repair (⚠Caution)

Do not separate PCB from the module's case or convert the device. Doing so may cause fire, electric shock or malfunctions.

When mounting or separating the module, make sure to turn off all power of PLC supply and external. Failure to do so could cause an electric shock or malfunctions.

Use radio or cellphone at least 30cm away from PLC. Not doing so could result in malfunctions.

CONTENTS

1 Introduction

This manual will guide the reader in the correct installation, functions, safety use and operation of the PWM output module (CM3-SP32PWM) of the PLC-S. Also should be read and understood before attempting to install or use the unit. Store this manual in a noticeable place so that you can take it out and read it whenever necessary.
Contents of this manual is as below:

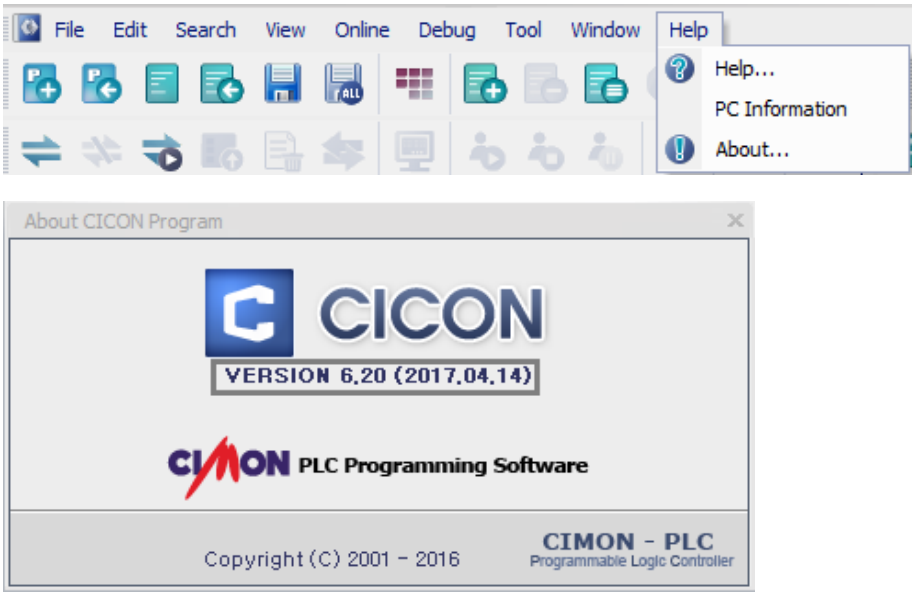
- Chapter 1 informs features of the product and the overview of the manual.
- Chapter 2 explains general and performances specification of the product.
- Chapter 3 explains types and features of the Data memory stored in the product.
- Chapter 4 explains capacities of the product and how to control the system.
- Chapter 5 informs programming the product with practices.
- Chapter 6 explains repairing and methods to operate the device safely.

For running the device properly, you are required to preparing specifications as below.

Product	Version
Software(CICON)	V6.20 or over is recommended
PLC-S CPU	V6.13 or over is recommended

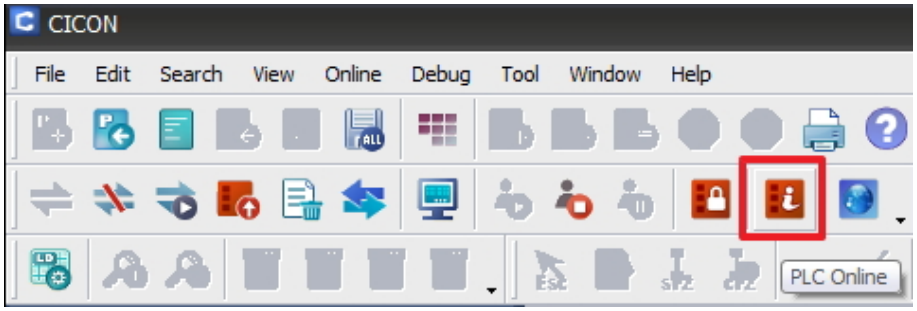
Below is an instruction about how you can check the specification of software and the version of CPU.

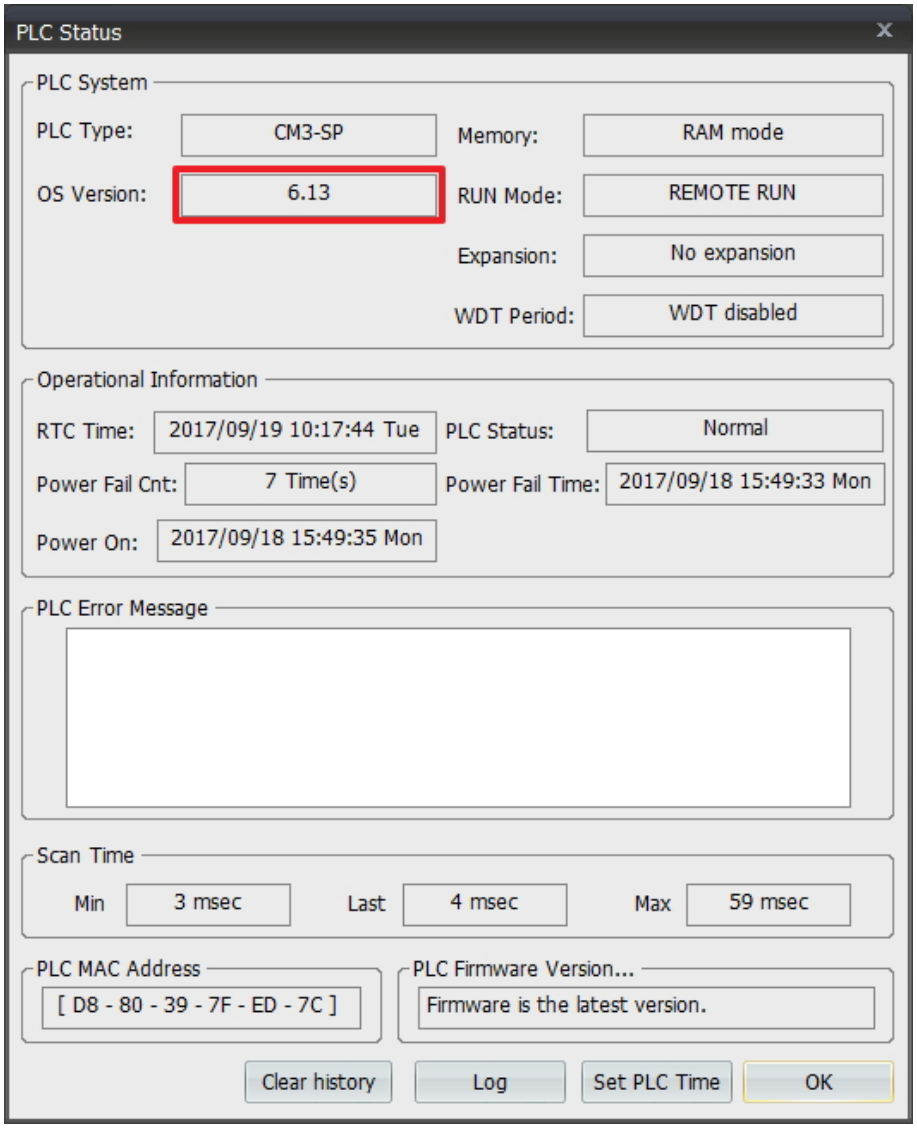
Run the CICON and click the [Help] - [About CICON information] located in the upper right side of a menu bar. You can check the specification of software in the dialog box.



[Figure 1] Route to check software version

Run the CICON and make a connection with PLC. Click the [Online] - [About PLC information] or the icon below. You can check the version of CPU firmware in the dialog box.





[Figure 2] Route to check CPU firmware

1.1 Features

PWM (Pulse-Width Modulation) stands for digital output that can be operated as a general output, by controlling the duty cycle that contains regular frequencies.

CIMON PWM Output Module added a pulse output function upon general digital output, so it provides the same specifications as CM3-SP32EOC when used as general digital output. It offers:

- Provides general digital outputs up to 32 points.
- Supports for PWM pulse outputs up to 12 channels.

The PWM Output Module supports configurable tasks such as controlling frequencies and duty cycles. You can control the frequency in group with 4 channels as a unit, total of 3 groups. Remind that 4 channels in each group are managed in a same frequency.

It allows to programming PWM pulse frequency up to 4000pps, duty cycle of output pulse range for 0.0% to 100.0%, in 1/1000 resolution.

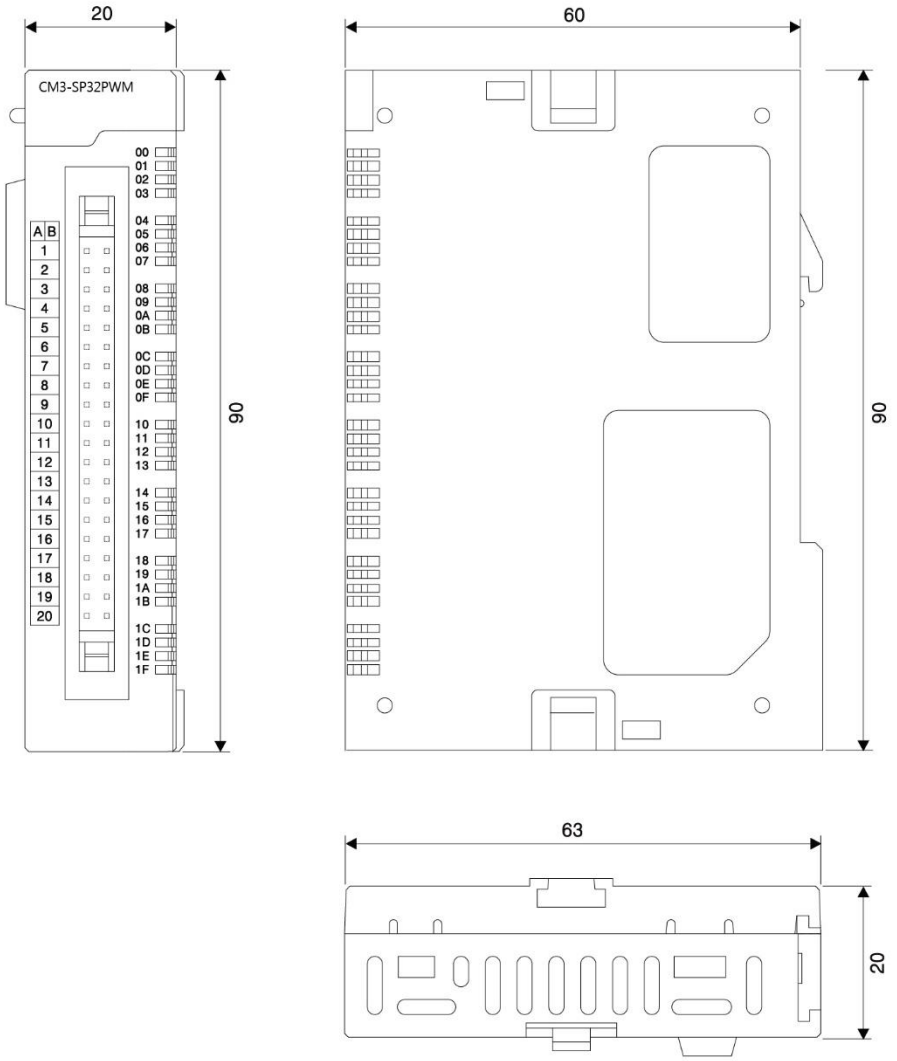
Likewise, the duty cycle can be controlled per each channel, and total of 12 duty cycles are able to be controlled individually. In addition, the device supports the ramp control on the frequency and duty cycle.

<Summary>

- Programmable duty cycle of output pulse range of 0.0% to 100.0%, in 1/1000 resolution.
- Programmable PWM pulse frequency up to 4000pps.
- Frequencies can be controlled in group with 4 channels as a unit, total of 3 groups.
- Total of 12 duty cycles are able to be controlled individually.
- Supports ramp control on frequency and duty cycle.

1.2 Design and Dimensions

(mm)

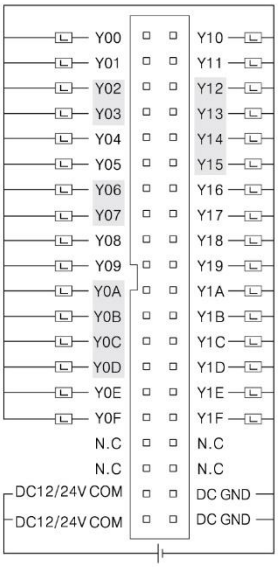


[Figure 3] PWM module appearance and measurement

1.3 Configuring terminal blocks and names

CM3-SP32PWM + CM0-SCBnnE + CM0-TB32M

Output Pin Map



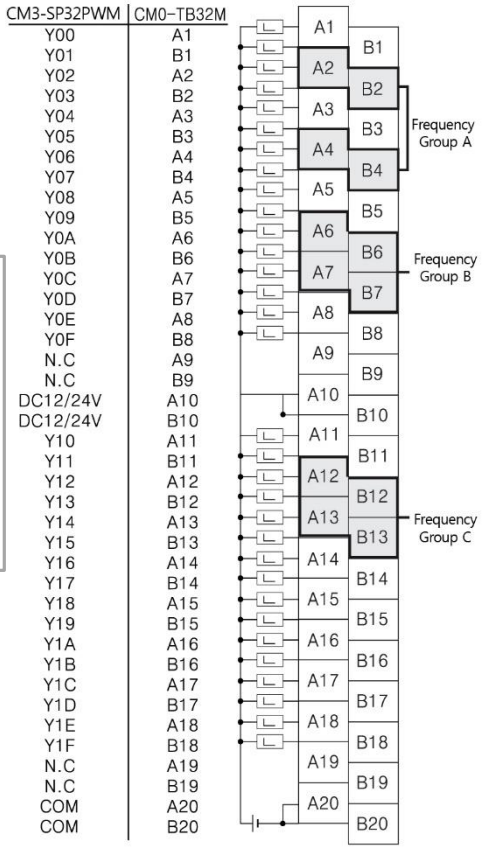
Each DC12/24V and DC GND are connected to the corresponding terminal internally.

CM0-SCBnnE Model Name

Model Number	Cable Length
CM0-SCB10E	1.0M
CM0-SCB15E	1.5M
CM0-SCB20E	2.0M
CM0-SCB30E	3.0M

⚠ When the length of cable is long, it might cause unintended control by distortion of PWM pulse. Therefore, 1.0M cable is strongly recommended.

External Connection



[Figure 4] PWM module socket arrangement and notations

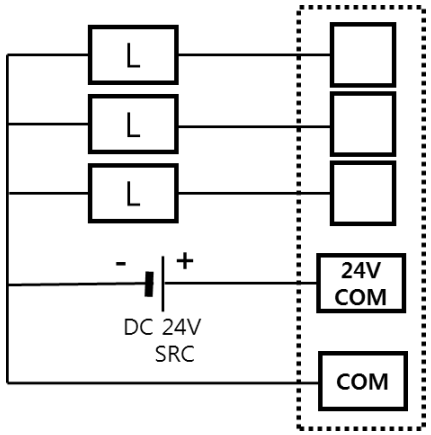
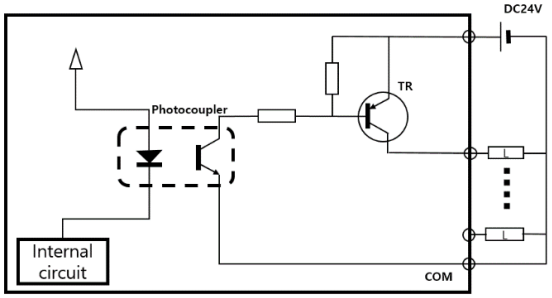
2 Specification

2.1 General specification

<table>
<tr><th>Items</th><th colspan="7">Specification</th><th>Standards</th></tr>
<tr><td>Operating Temperature</td><td colspan="7">-10 ~ 55 ℃ (14 ~ 131℉)</td><td></td></tr>
<tr><td>Preserving Temperature</td><td colspan="7">-25 ~ 80 ℃ (-13 ~ 176℉)</td><td></td></tr>
<tr><td>Operating Humidity</td><td colspan="7">Relative Humidity 5 ~ 95%, Avoid condensation</td><td></td></tr>
<tr><td>Preserving Humidity</td><td colspan="7">Relative Humidity 5 ~ 95%, Avoid condensation</td><td></td></tr>
<tr><td rowspan="3">Inner Vibration</td><td rowspan="2">Frequency (Hz)</td><td colspan="2">Continual Vibration</td><td colspan="2">Intermittent Vibration</td><td rowspan="2">Number</td><td rowspan="3">IEC61131-2</td></tr>
<tr><td>Acceleration (㎨)</td><td>Amplitude (mm)</td><td>Acceleration (㎨)</td><td>Amplitude (mm)</td></tr>
<tr><td>10 ≤ f < 57
57 ≤ f ≤150Hz</td><td>4.9 {0.5G}</td><td>0.035</td><td>9.8 {1G}</td><td>0.075</td><td>10 times for each direction X, Y, Z</td></tr>
<tr><td>Inner Impact</td><td colspan="7">Maximum impact acceleration : 147 ㎨ (15G)
Impression time : 11ms
Pulse wave : a sine half-wave pulse (3 times for each direction ±X, ±Y, ±Z, total on 3 times)</td><td>IEC61131-2</td></tr>
<tr><td rowspan="6">Inner Noise</td><td>Square wave impulse noise</td><td colspan="5">±2kV(10 minutes)</td><td>Test coding standards internal CIMON</td></tr>
<tr><td>Electromagnetism discharge</td><td colspan="5">Voltage : 4kV(Contact Discharge)</td><td>IEC61131-2
IEC61000-4-2</td></tr>
<tr><td>Radiation EMF Noise</td><td colspan="5">27 ~ 500 MHz 10V/m</td><td>IEC61131-2
IEC61000-4-3</td></tr>
<tr><td rowspan="4">FAST transient burst Noise</td><td colspan="3">Power supply Module</td><td colspan="2">2kV</td><td rowspan="4">IEC61131-2
IEC61000-4-4</td></tr>
<tr><td colspan="3">Digital input output (≥24V)</td><td colspan="2">1kV</td></tr>
<tr><td colspan="3">Digital input output (<24V)</td><td colspan="2" rowspan="2">0.25kV</td></tr>
<tr><td colspan="3">Analog input output
Communication interface</td></tr>
<tr><td>Ambient Conditions</td><td colspan="7">Avoid Corrosive gas and dusts</td><td></td></tr>
<tr><td>Operating Altitude</td><td colspan="7">≤2000m</td><td>IEC61131-2</td></tr>
<tr><td>Pollution level</td><td colspan="7">≤2</td><td>IEC61131-2</td></tr>
<tr><td>Colling System</td><td colspan="7">Air natural cooled</td><td></td></tr>
</table>

[Table 1] General specification of PWM module

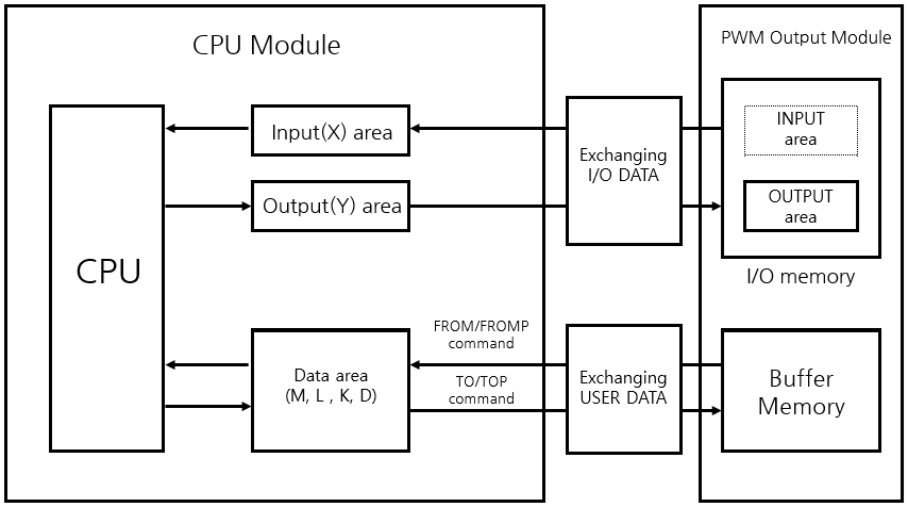
2.2 I/O Specification

Types	Specifications of item
Rated input/output voltage	DC 12V ~ 24V
Response time	≤1ms
Operating indicator	LED lighting when the power ON
Insulation for anticorrosion	Photocoupler
Input method	-
Output method	Source
External connection circuit	
Internal circuit	

[Table 2] I/O Specification of PWM module

3 Data Memory

Data memory is classified into I/O memory and buffer memory. I/O memory exchanges I/O data with CPU through the X and Y area. Buffer memory exchanges user data with data areas in CPU module using FROM·FROMP/TO·TOP command.



[Figure 5] Data exchange between PWM module and CPU

3.1 I/O Memory

I/O memory is an input/output memory area which is provided by the module, configured with X or Y area in scan program. The addresses of X and Y area are allocated by the location module mounted. Refer to the Appendix 2 for details. PWM output module can operate 32-pin output through the I/O memory area. See the table in 3.1.1 to check the detail functions of each point.

3.1.1 Output area

An output area located in digital output module is used for outputting data from CPU module.

- External indicator: LED (1 on Power supply, a LED per channel)
- 32 Y points (Yn0 ~ YnF) ('n' states a number that can be decided by mounted in slots.

Signal Direction : CPU → PWM Output Module			
Input	Signal Name	Output	Signal Name
Y20	General output	Y30	General output
Y21	General output	Y31	General output
Y22	**Frequency A, CH1, PWM output (or a general output)**	**Y32**	**Frequency C, CH9, PWM output (or a general output)**
Y23	**Frequency A, CH2, PWM output (or a general output)**	**Y33**	**Frequency C, CH10, PWM output (or a general output)**
Y24	General output	**Y34**	**Frequency C, CH11, PWM output (or a general output)**
Y25	General output	**Y35**	**Frequency C, CH12, PWM output (or a general output)**
Y26	**Frequency A, CH3, PWM output (or a general output)**	Y36	General output
Y27	**Frequency A, CH4, PWM output (or a general output)**	Y37	General output
Y28	General output	Y38	General output
Y29	General output	Y39	General output
Y2A	**Frequency B, CH5, PWM output (or a general output)**	Y3A	General output
Y2B	**Frequency B, CH6, PWM output (or a general output)**	Y3B	General output
Y2C	**Frequency B, CH7, PWM output (or a general output)**	Y3C	General output
Y2D	**Frequency B, CH8, PWM output (or a general output)**	Y3D	General output
Y2E	General output	Y3E	General output
Y2F	General output	Y3F	General output

[Table 3] Usage of each point of PWM module

※ Sited points above table are the case of mounted in the first slot.

※ All points can be used as general output. The PWM output can only be used on the item where it says 'PMW output'.

3.2 Buffer Memory

The PWM output module is equipped with shared memories inside to exchange the data with CPU. One of these is called buffer memory, which is a collection of word (16Bit)-unit data. This buffer memory is readable and configurable on scan program, using FROM·FROMP/TO·TOP commands. Refer to the Appendix 1 to get information about FROM·FROMP/TO·TOP commands.

The PWM output module offers 64words of buffer memory in total. Following table shows the meaning and usage of each data.

OFFSET	Item	Set-up value parameter	Initial value	Authority
0	PWM output Enable	BIT #0~#11 (Total 12 channels)	0	R/W
1	CH1,2,3,4 Frequency	0~4000(pps)	0	R/W
2	CH5,6,7,8 Frequency	0~4000	0	R/W
3	CH9,10,11,12 Frequency	0~4000	0	R/W
4	*Function will be added later*			
5	CH1,2,3,4 Frequency ramp control time(x10ms) Ex) When Frequency ramp control time is set to 100, 100 x 10ms = 1,000ms (1sec)	0~65535 (x 10ms)	0	R/W
6	CH5,6,7,8 Frequency ramp control time(x10ms)	0~65535	0	R/W
7	CH9,10,11,12 Frequency ramp control time(x10ms)	0~65535	0	R/W
8	*Function will be added later*			
9	*Function will be added later*			
10	CH1 duty cycle ratio Ex) When duty cycle ratio is set to 100, 100 x 0.1% = 10.0%	0~1000 (x 0.1%)	0	R/W
11	CH2 duty cycle ratio	0~1000	0	R/W
12	CH3 duty cycle ratio	0~1000	0	R/W
13	CH4 duty cycle ratio	0~1000	0	R/W
14	CH5 duty cycle ratio	0~1000	0	R/W
15	CH6 duty cycle ratio	0~1000	0	R/W
16	CH7 duty cycle ratio	0~1000	0	R/W
17	CH8 duty cycle ratio	0~1000	0	R/W
18	CH9 duty cycle ratio	0~1000	0	R/W
19	CH10 duty cycle ratio	0~1000	0	R/W

OFFSET	Item	Set-up value parameter	Initial value	Authority
20	CH11 duty cycle ratio Ex) When duty cycle ratio is set to 100, 100 x 0.1% = 10.0%	0~1000 (x 0.1%)	0	R/W
21	CH12 duty cycle ratio	0~1000	0	R/W
22	*Function will be added later*			
30	CH1 duty cycle ramp time(x10ms) Ex) When Frequency ramp control time is set to 100, 100 x 10ms = 1,000ms (1sec)	0~65535 (x 10ms)	0	R/W
31	CH2 duty cycle ramp time(x10ms)	0~65535	0	R/W
32	CH3 duty cycle ramp time(x10ms)	0~65535	0	R/W
33	CH4 duty cycle ramp time(x10ms)	0~65535	0	R/W
34	CH5 duty cycle ramp time(x10ms)	0~65535	0	R/W
35	CH6 duty cycle ramp time(x10ms)	0~65535	0	R/W
36	CH7 duty cycle ramp time(x10ms)	0~65535	0	R/W
37	CH8 duty cycle ramp time(x10ms)	0~65535	0	R/W
38	CH9 duty cycle ramp time(x10ms)	0~65535	0	R/W
39	CH10 duty cycle ramp time(x10ms)	0~65535	0	R/W
40	CH11 duty cycle ramp time(x10ms)	0~65535	0	R/W
41	CH12 duty cycle ramp time(x10ms)	0~65535	0	R/W
…	*Function will be added later*			
63	OS Version		0	R
…	*Function will be added later*			

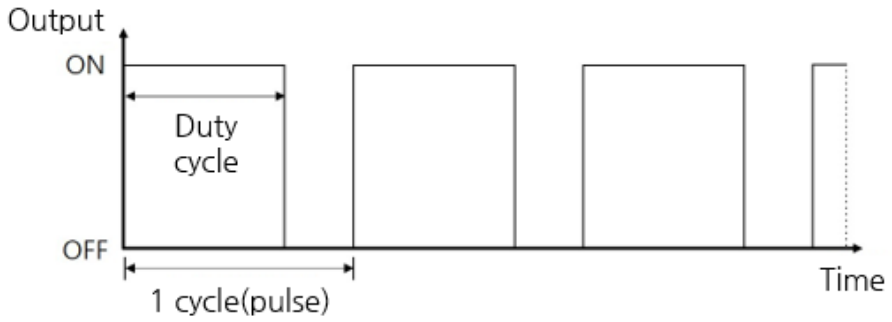
[Table 4] Usage and meaning of each buffer memory (PWM module)

※ R/W represents for the module's Reading/Writing authorities from the CPU. (R: Read W: Write)

※ All set values in buffer memories which can write are initialized to 0 when the CPU power is reset or stopped.

4 Functions

PWM (Pulse Width Modulation) stands for digital output which has capacity of controlling the duty cycle that contains regular frequencies. Duty cycle is a ratio of ON status in 1 cycle(pulse).



[Figure 6] Definition of PWM output and duty cycle

As illustrated above, PWM control is controlling output between maximum value and minimum value by changing the duty cycle of the pulse.

CIMON PWM output module can be operated as both general digital output and PWM output. The general digital output can be used up to 32-pin points. Total on 12-pin points support PWM output among them. Also, you can prevent sharp change of the frequency and duty cycle by using the ramp control.

4.1 Enable of PMW output (Buffer Memory No. 0)

When you set the value of points which are capable of PWM output to 0, you can use them as general output points. Otherwise you set them to 1, points will be operated as PWM output. The PWM output function can be enabled by using TO command in the buffer memory No. 0. Refer to the 3.2 for information of the buffer memory.

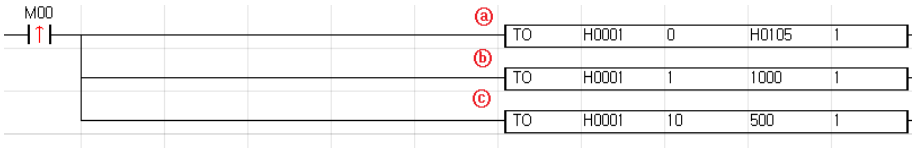
BIT 15	BIT 14	BIT 13	BIT 12	BIT 11	BIT 10	BIT 9	BIT 8	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0	Buffer Memory No. 0
Disable				CH 12	CH 11	CH 10	CH 9	CH 8	CH 7	CH 6	CH 5	CH 4	CH 3	CH 2	CH 1	Channel No.

[Table 5] Available point of PWM output

Example 1: Enable PWM Output

Example to enable PWM output of CH1, 3, 9 and output the frequency of CH1 to 1000pps and duty cycle to 50.0%.

BIT 15	BIT 14	BIT 13	BIT 12	BIT 11	BIT 10	BIT 9	BIT 8	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0	Buffer Memory No. 0
0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	Binary (H0105)
Disable				CH 12	CH 11	CH 10	CH 9	CH 8	CH 7	CH 6	CH 5	CH 4	CH 3	CH 2	CH 1	Channel No.



Operates as below when M00 is ON:

a) Enable the PWM output in CH1, CH3, CH9.
b) Set the frequency of CH1 as 1000pps.
c) Set the duty cycle of CH1 as 50.0%.

⚠ In case of power reset or CPU stop, permit the PWM output again by using TO command as all value of the buffer memory will be initialized to 0.

4.2 Controlling frequency (Buffer Memory No. 1 ~ 3)

The PWM supports functions to control the frequency range from 0pps to 4000pps, able to be controlled 4 channels per group, total on 3 groups. The frequencies of each group are set by TO command at OFFSET 1~3 area of buffer memory.

Frequency A (or a general output)		Frequency B (or a general output)		Frequency C (or a general output)	
CH1	Y02	CH5	Y0A	CH9	Y12
CH2	Y03	CH6	Y0B	CH10	Y13
CH3	Y06	CH7	Y0C	CH11	Y14
CH4	Y07	CH8	Y0D	CH12	Y15

[Table 6] Terminal no. of the frequency group

Every four PWM output included in a group is operated in same frequency. Three different frequency output are available at same time, since three groups are offered.

When TO command is operated on the buffer memory, the output terminal outputs the designated frequency instantly. To prevent sharp change of frequency, refer to the ramp control at 3.4.

⚠ The case of the frequency value is over 4000pps, both valid range of the duty cycle and degree of precision are decreased. Remind this when you want to control PWM over 4000pps. This product guarantees presented performance standard up to 4000pps.

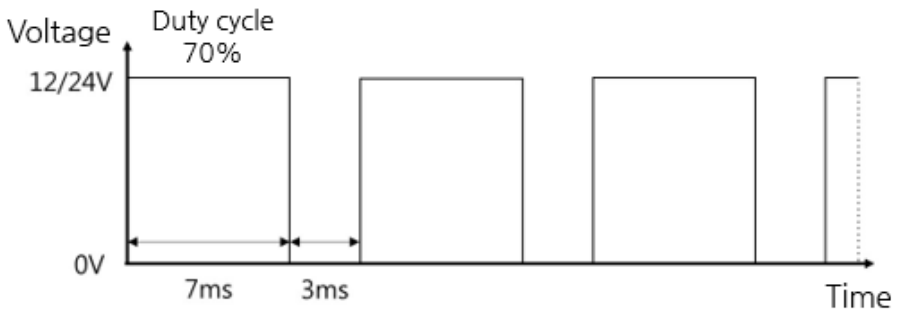
Frequency(pps)	Minimum value of duty cycle(%)	Maximum value of duty cycle(%)
5000	1.0	98.0
10000	1.5	95.0
15000	3.0	94.0
20000	4.0	93.0
25000	5.0	91.0
30000	6.0	89.0
35000	7.0	87.0
40000	9.0	85.0
45000	10.0	83.0
50000	12.0	82.0
55000	13.0	80.0
60000	14.0	78.0
65000	15.0	75.0

[Table 7] Valid setting range of duty cycle per frequency area

4.3 Controlling duty cycle (PWM) (Buffer Memory No. 10 ~ 21)

The PWM provides functions to control the duty cycle 0.0 ~ 100.0% within 1/1000 resolution. The duty cycles are able to be controlled per channel, total on 12 channels. Duty cycle can be set by using TO command at OFFSET 10~21 area of buffer memory. For more information, refer to the 3.2.

When TO command is operated on the buffer memory, the output terminal will be configured to set the duty cycle and being output. To prevent the sharp change of duty cycle, refer to the ramp control at 4.4.



[Figure 7] Example of duty cycle control (PWM)

If digital signal of 12V/24V voltage is set to duty cycle 70.0% as above, voltage output of 8.4V/16.8V in average is available. Duty cycle control(PWM) can be utilized in various way to substitute analog signal. Controlling speed of motor, controlling switch or ratio of valve can be examples.

⚠ When you set value of the duty cycle over 100.0%, it will be applied for 100.0%.

4.4 Ramp control

Ramp control could serve the purpose of preventing sharp change of the frequency and the duty cycle. The output will be gradually changed during the ramp control time from the point of time which value of frequency or duty cycle have configured. When the set value of the ramp control time of buffer memory is 0, output will be changed immediately.

Following description offers the method of ramp control for the frequency and duty cycle.

⚠ Change ramp control time before the value to control as user intended.

⚠ In case of power reset or CPU STOP during ramp operation, reset the value again by using TO command as all set value of buffer memory will be set back to initial value(0).

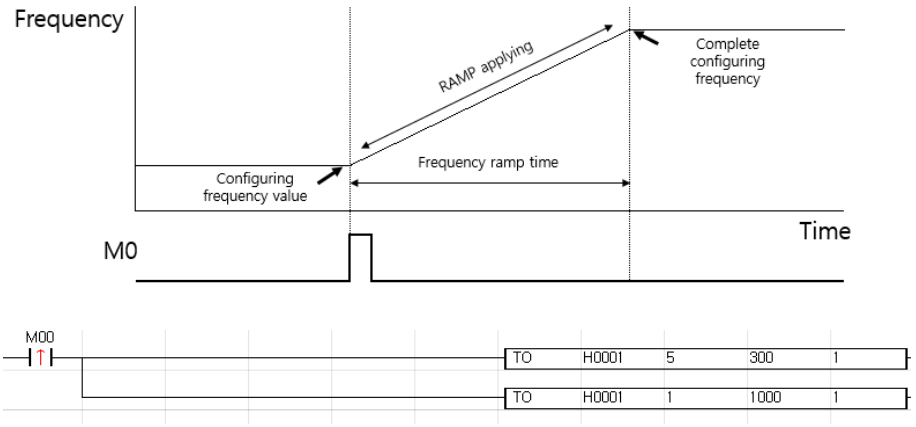
4.4.1 Frequency ramp control (Buffer memory No. 5 ~ 7)

Frequency will be changed through set ramp control time when the frequency value is changed after setting frequency ramp control time. Frequency ramp control time can be set to buffer memory No. 5~7 by using TO command.

⚠ In case frequency ramp control time is changed during ramp operation, it will be applied not to current ramp operation but to next ramp operation.

⚠ In case of power reset or CPU STOP reset the value again by using TO command as all set value of buffer memory will be set back to initial value(0).

Example 2: Frequency Ramp Control



When M00 turns on, operate as below:

a) Input the frequency ramp control time value 300(3seconds) to buffer memory No. 5 by using TO command.

b) Once input 1000pps to buffer memory No. 1, the frequency value will be configured during set the frequency ramp control time(3 seconds).

⚠ Set ramp control time value beforehand.

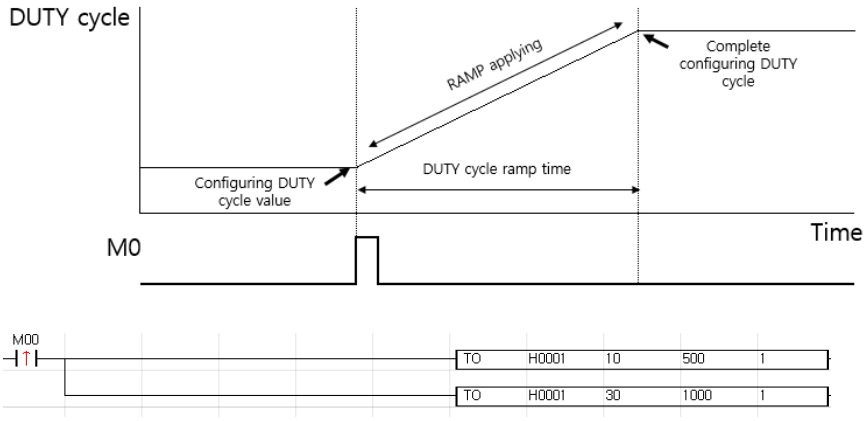
4.4.2 Duty cycle ramp control (Buffer memory No. 30 ~ 41)

If duty cycle's value is configured after setting the duty cycle ramp control time, the duty cycle will be gradually changed during set ramp control time. The duty cycle ratio can be set to buffer memory No. 30~41 by using TO command.

⚠ In case duty cycle ramp control time is configured during ramp operation, it will be applied not to current ramp operation but to next ramp operation.

⚠ In case of power reset or CPU STOP reset the value again by using TO command as all set value of buffer memory will be set back to initial value(0).

Example 3: Duty Cycle Ramp Control



When M00 turns on, operate as below

a) Input duty cycle ramp control time value 500(5seconds) to buffer memory No. 30 by using TO command.

b) Once input ramp cycle value 1000(100.0%) to buffer memory No. 10, the duty cycle value will be configured during set duty cycle ramp control time(5seconds).

⚠ Set ramp control time value beforehand.

5 Operating the PWM Output Module

This chapter explains a method about programming based on the function of the PWM output module through example.

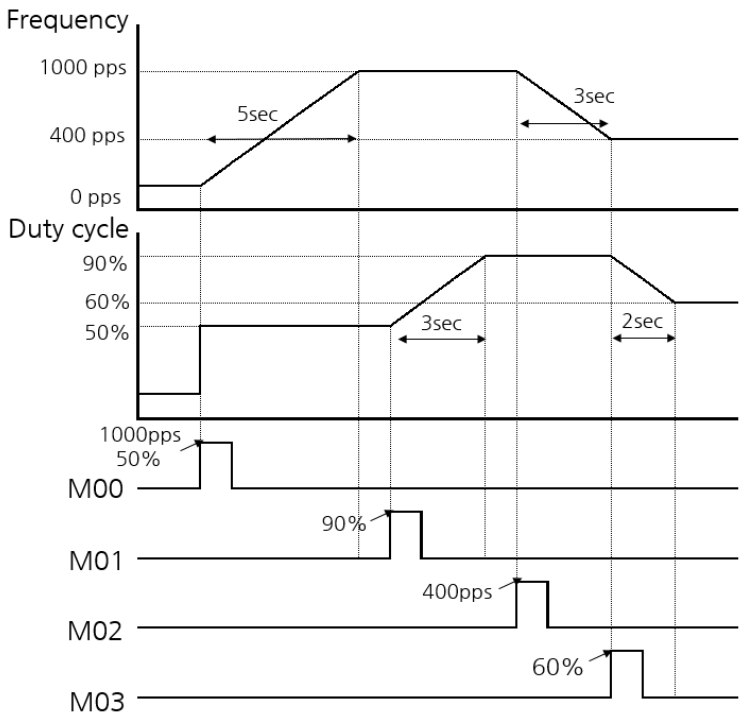
⚠ Change ramp control time before the value to control as user intended.

⚠ In case of power reset or CPU STOP reset the value again by using TO command as all set value of buffer memory will be set back to initial value(0)

5.1 Example for basic operation

Example 1: PWM Basic Operation

This item is an example that changes the frequency and the duty cycle in channel 2 (Y03).

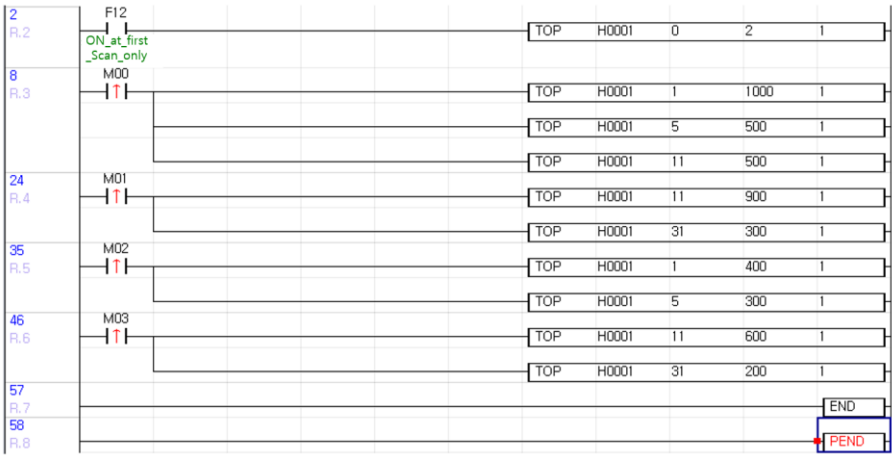


When M00 turns on, the system operates below:

a) Set duty cycle 50.0% so that gradually increase the frequency 0pps to 1000pps for 5 seconds.

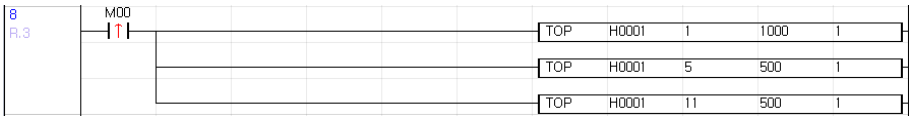
b) Gradually increase the duty cycle 50.0% to 90.0% for 3 seconds.
c) Gradually decrease the frequency 1000pps to 400pps for 3 seconds.
d) Gradually decrease the duty cycle 90.0% to 60.0% for 2 seconds.

Entire scan program is as below.



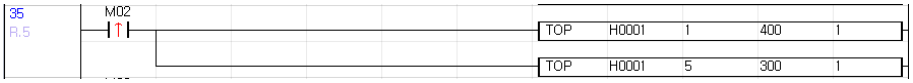
(1) Use TOP command to enter value 2 on buffer memory No. 0 to be enable channel PWM output.

(2) Receive the M00 value and trigger the function. Enter 1000 on buffer memory No. 1, 500 on No. 5 and 500 on No. 11 by using TOP command so can be changed 0pps to 1000pps for 5 seconds with duty cycle 50.0%.



(3) Receive the M01 value. Enter 900 on buffer memory No.11 and 300 on No.31 by using TOP command. The duty cycle changes 50.0% to 90.0% for 3 seconds.

(4) Receive the M02 value. Enter 400 on buffer memory No.1 and 300 on No.5 by using TOP command. The frequency changes 1000pps to 400pps for 3 seconds.



(5) Receive the M03 value. Enter 600 on buffer memory No.11 and 200 on No. 31 by using TOP command. The duty cycle changes 90.0% to 60.0% for 2 seconds.

5.2 Examples for utilization

Followings are examples about how to utilize PWM output module. Example 1 is about motor control using frequency ramp control function. Example 2 is about PID temperature control using frequency ramp control function and duty cycle.

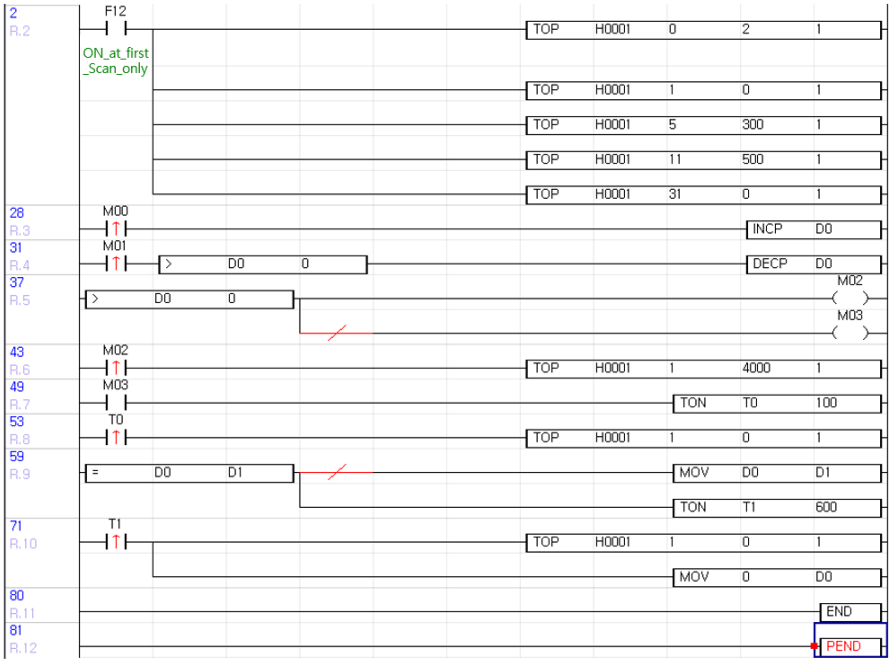
Example 1: Softstart Using Ramp Control

This is an example to control an escalator using stepping motor control. Basic requirement of the system is as below.

<Requirements>

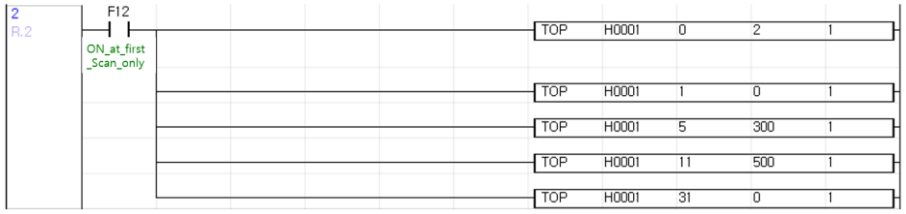
- Should be able to identify the number of passengers on board by counting who have been in-and-out through escalator sensor.
- Run the stepping motor when the number of passenger becomes 1 from 0.
- When the motor starts to run/activated, gradually increase the speed for 3 seconds then move to the maximum speed(4000pps) later.
- When the number of passenger on escalator becomes 0, wait 10 seconds then stop running.
- When the number of passenger on escalator does not change for 1 minute, then stop running.
- To stop the stepping motor, gradually decrease the speed for 3 seconds, then stop completely(0pps) later.

Entire scan program is as below.



(1) Initialize module parameter as below.

- Enable CH2 PWM (Buffer memory No. 0)
- Initial frequency 0pps (Buffer memory No. 1), frequency ramp control time 3 seconds(Buffer memory No. 5).
- Duty cycle 50.0% (Buffer memory No. 11), No duty cycle ramp control time(Buffer memory No. 31).



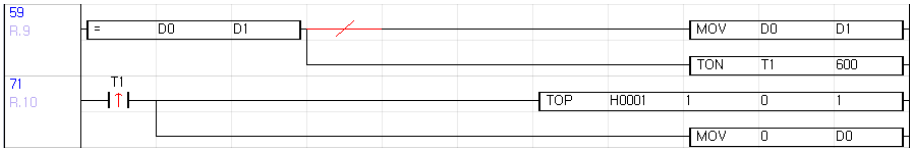
(2) M00 checks passenger who go into the escalator, and M01 checks passenger who comes out from the escalator. In case of passenger entering, increase the number of passenger(D0). In case of passenger exiting, decrease the number of passenger(D0) but only if the number is higher than 0.

(3) Check whether the number of passenger is 0 or higher than 0.-

(4) In case the number of passenger is higher than 0, configure frequency to 4000pps. (As frequency ramp control time is set to 3 seconds, frequency will gradually increase from 0pps to 4000pps for 3 seconds.)

(5) Check whether the passenger is on board and if there are none, configure the frequency to 0 after 10seconds. (As frequency ramp control time is set to 3 seconds, frequency will gradually decrease from 4000pps to 0pps in 3 seconds.)

(6) Check whether the number of passenger changes and if it does change, initialize the timer. But if it does not change for 1 minute, then set the frequency to 0pps and initialize the number of passenger.



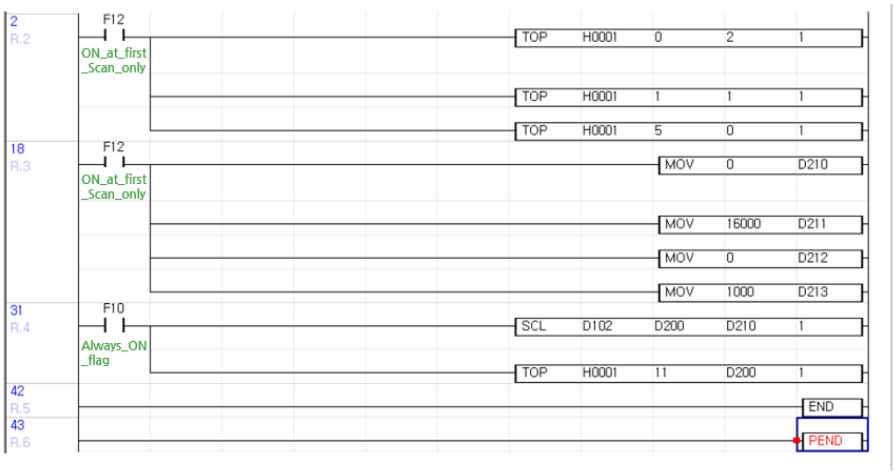
Example 2: PWM PID Control

This is an example about PID temperature control of the heater which turns on 24V and turns off on 0V. Basic requirement of the system is as below.

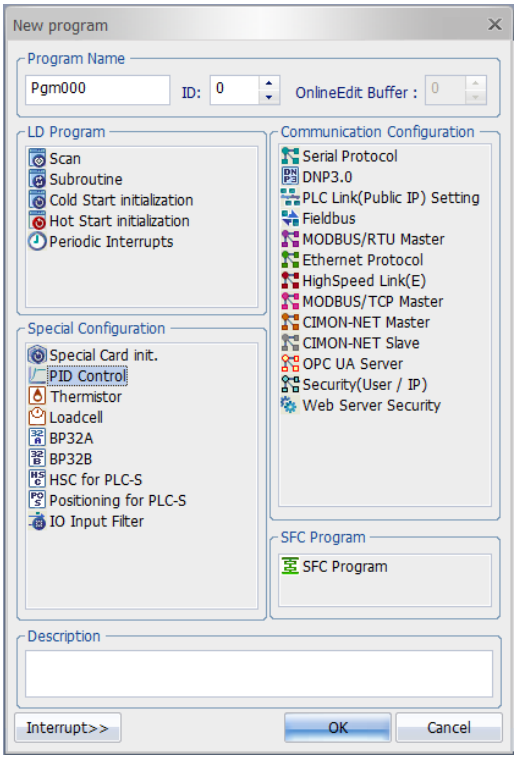
<Requirements>

- Temperature value of the system should be controlled by PID control.
- MV value should be applied to control every second.
- Should be controlled by ON-OFF of the heater.
- MV value with range from 0 to 16000 should be applied as range from 0.0% to 100.0%(Duty cycle control).

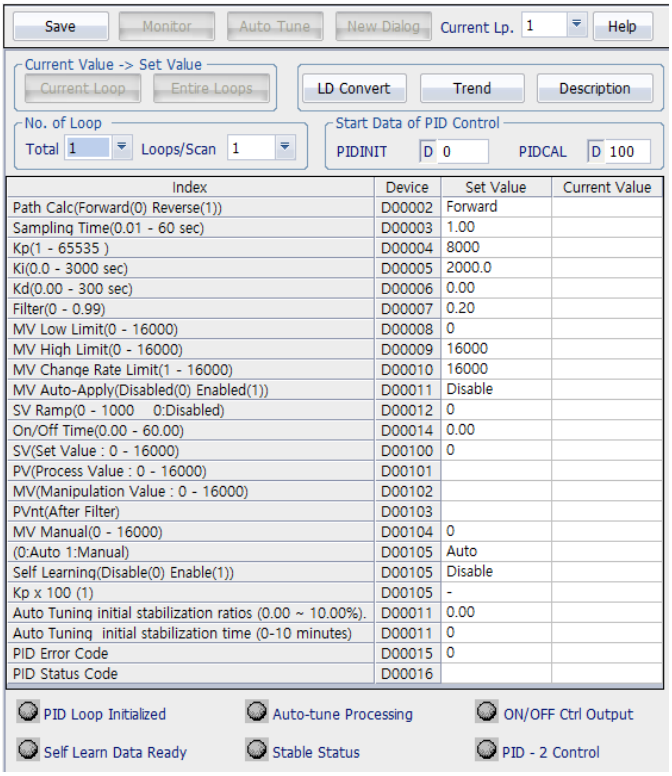
Entire scan program is as below.



(1) Create a new PID program.



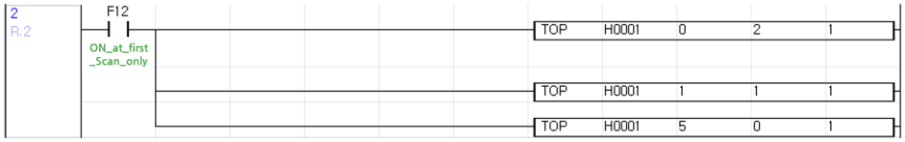
(2) Set proper Kp, Ki, Kd value and set sampling cycle to 1 second.



Index	Device	Set Value	Current Value
Path Calc(Forward(0) Reverse(1))	D00002	Forward	
Sampling Time(0.01 - 60 sec)	D00003	1.00	
Kp(1 - 65535)	D00004	8000	
Ki(0.0 - 3000 sec)	D00005	2000.0	
Kd(0.00 - 300 sec)	D00006	0.00	
Filter(0 - 0.99)	D00007	0.20	
MV Low Limit(0 - 16000)	D00008	0	
MV High Limit(0 - 16000)	D00009	16000	
MV Change Rate Limit(1 - 16000)	D00010	16000	
MV Auto-Apply(Disabled(0) Enabled(1))	D00011	Disable	
SV Ramp(0 - 1000 0:Disabled)	D00012	0	
On/Off Time(0.00 - 60.00)	D00014	0.00	
SV(Set Value : 0 - 16000)	D00100	0	
PV(Process Value : 0 - 16000)	D00101		
MV(Manipulation Value : 0 - 16000)	D00102		
PVnt(After Filter)	D00103		
MV Manual(0 - 16000)	D00104	0	
(0:Auto 1:Manual)	D00105	Auto	
Self Learning(Disable(0) Enable(1))	D00105	Disable	
Kp x 100 (1)	D00105	-	
Auto Tuning initial stabilization ratios (0.00 ~ 10.00%).	D00011	0.00	
Auto Tuning initial stabilization time (0-10 minutes)	D00011	0	
PID Error Code	D00015	0	
PID Status Code	D00016		

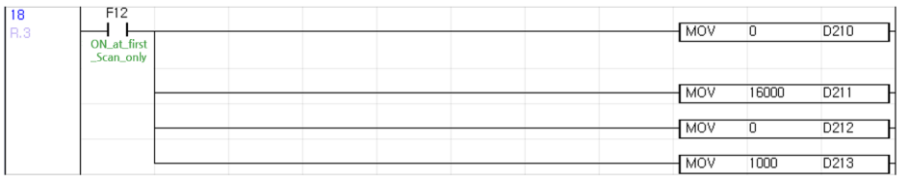
(3) Enable PWM output of CH2 to write value 2 to buffer memory No. 0 by using TOP command.

(4) Set frequency and frequency ramp control time. Set 1(1pps) to buffer memory No. 1 and 0(frequency ramp control time) to buffer memory No. 5 by using TOP command.



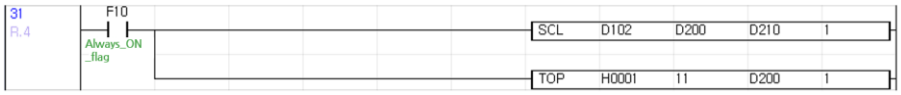
(5) Configure the MV value from a range of 0 to 16000 to a range of 0 to 1000. Set range value of before to D210 and D211 by using MOV command. (0~16000)

(6) Set the configured value to D212 and D213 by using MOV command. (0~1000)



(7) Scale transform the MV value(D102) by using SCL command and save the value to D200.

(8) Set the duty cycle by using configured D200 value. Set D200 value to buffer memory No. 11 by using TOP command.



6 Maintenance work and repair

You are recommended to do daily checkup and surveillance test for maintaining PLC in top form. The I/O module's life can be shortened by surroundings, so regular maintenance is required. The followings must be checked for inspection.

6.1 Maintenance work

✓ Daily checkup

For items that should be daily-checked.

(1) LED status of module

LED of module	Item to check
Output module	Lighting when output On, lights out when output Off (Problems on besides states)

(2) Link status of cable

Check tightness of screws which are grounded terminal of I/O module.

✓ Maintenance

For items that should be checked 1~2 times in every six months or a year. Also you are required to checkup when you move, change, convert the facilities, or shift wirings.

(1) General standard items

Item	Item to check
Operating temperature	-10 ~ 55℃ (14 ~ 131℉)
Operating humidity	5 ~ 95% RH
Ambient conditions	Avoid corrosive gases and dusts

(2) Power supply voltage checkup

Check if the standard has conformity by measuring DC input voltage(DC 10~26V).

(3) Installation status of module

Check if the module is solidly mounted or particle-free.

6.2 Repair

✓ Replacing a module

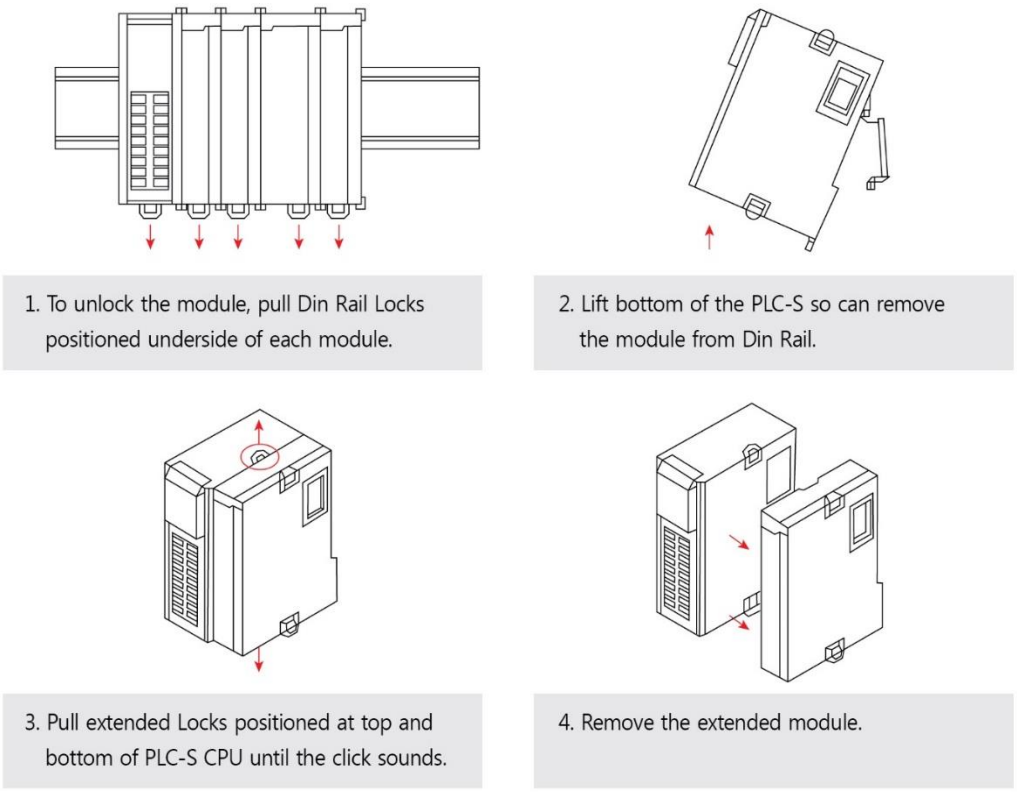
When a module requires replacement in case of failure or damaged, follow the procedure below.

a) Turn the PLC drive power supply off.

b) Isolate defected connector from PLC-S.

c) Remove Din rail fixing hook and remove the PLC.

d) Release PLC-S fixing hook and remove/replace the module.



[Figure 8] Ejecting order in case of module replacement

6.3 Trouble shooting

This section describes errors that may happen during run-time and actions to be taken.

See the following items before making a judgement of PLC problems.

(1) Check if the power is on. (Does PLC drive input voltage approved normally?)

(2) Check that each module is mounted (Such as power supply, CPU, I/O, special modules) or wired (Such as I/O signal, cable) properly.

Remind that response speed would be slower while capacity of scan program is bigger.

See the following table for recommended actions when troubleshooting signal failures.

✓ Recommended action for signal failures

Error	Remedy
General output is disabled	- Check if the PLC module wired or mounted correctly. - Check that the buffer memory (PWM enable) channel per BIT is OFF. The Y interface does not operate as general output in ON status.
PWM output is disabled	- Check if the PLC module wired or mounted correctly. - Check that the buffer memory (PWM Enable, frequency, Duty cycle) is set properly. The PWM output operates when corresponding BIT per channel of PWM buffer is in ON status. - Check if the frequency and the duty cycle are set properly. The PWM output does not operate when the frequency or the duty cycle is 0.

Appendix 1 Using FROM·FROMP/TO·TOP Commands

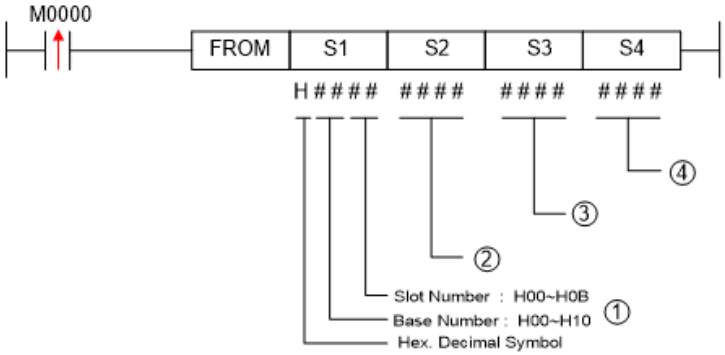
The CIMON PLC has composition of various special modules such as AD, DA, High Speed Counter, etc. All of these have a shared memory in their hardware for data exchange with CPU module. The CPU module can send various operation commands, and receive data through shared memory. On the same way, a scan program can read from and write to shared memories of special module by using dedicated commands to this purpose, FROM·FROMP and TO·TOP.

In the CIMON PLC system, shared memory is called "Buffer memory". To use FROM·FROMP/TO·TOP commands appropriately, a programmer must know the memory map of the target special module. Every special module which have a shared memory is documented the map of the memory in their manuals.

1. FROM/FROMP command

FROM/FROMP command reads Word data from shared memory of special module, and stores them to the internal device of CPU. The data contain such as the converted value of AD module, the temperature value of RTD or TC module, etc.

The typical usage of the command can be represented by following LD.



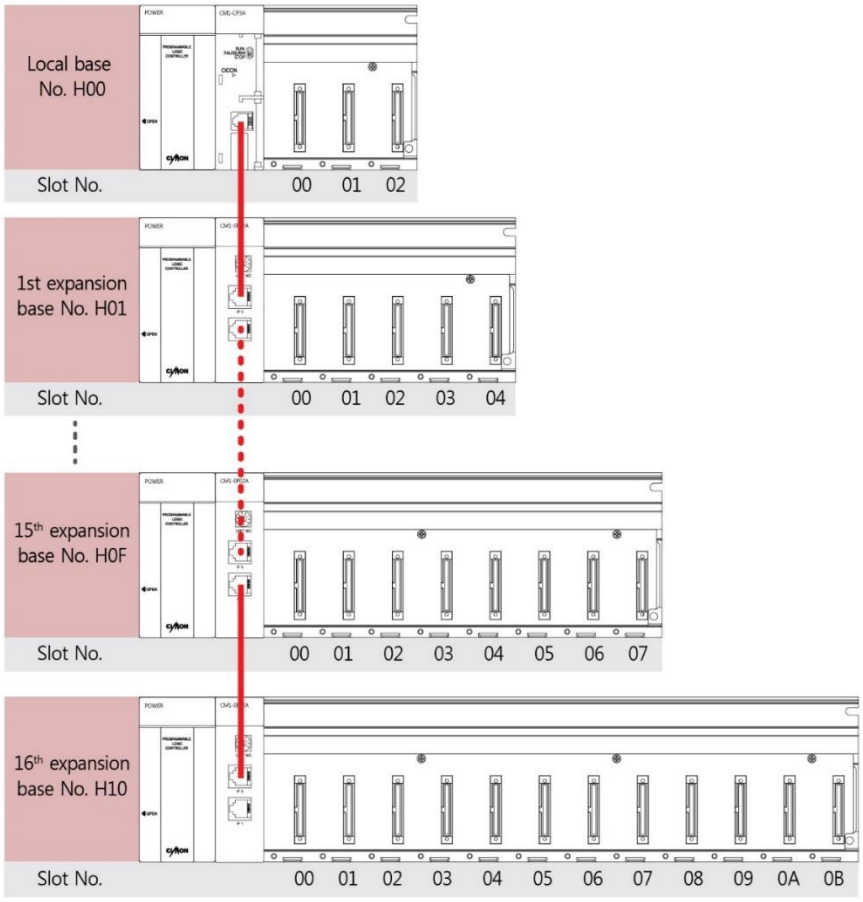
[Figure 9] How to use FROM / FROMP command

Form	Content	Remarks
S1	Base and Slot number where the special module is installed	H00 01: Base No.0, Slot No.1 *As PLS-S Series have no expansion function, H00 is upper base..
S2	Start address of buffer memory	Check the buffer memory address of the module as buffers memory start address of each module varies.
S3	Start address of the device where read data are stored	Save the value from buffer memory of module from device area of CPU.
S4	Number of words to read	Save a number of data to S4-designated area in order as the number of data(word) to read.

[Table 8] Notation and form of FROM / FROMP command

(1) S1 (base and slot number)

CIMON PLC can be expanded up to 16 bases. Following is a sample drawing of 16 bases expansion.



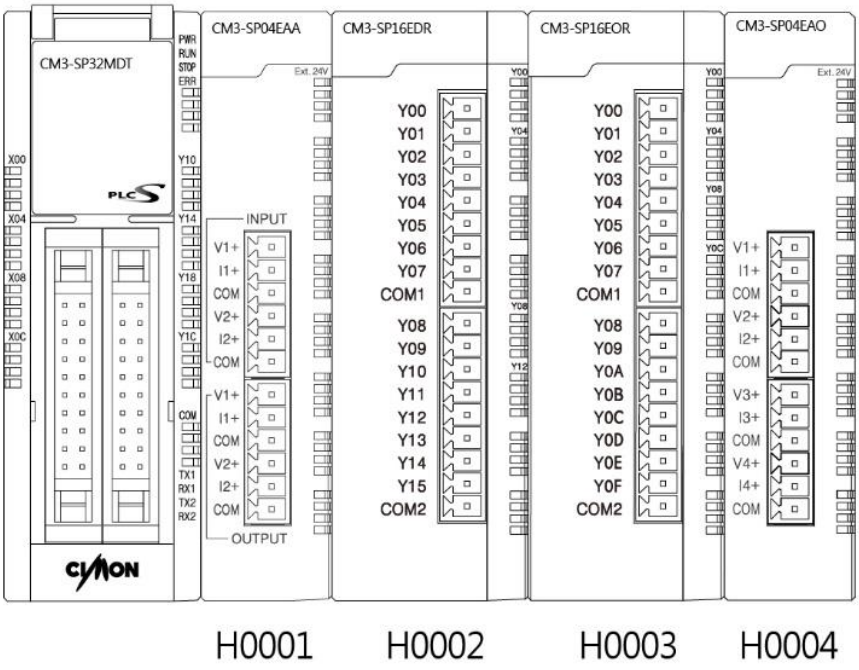
[Figure 10] Example of PLC-CM1 Series module extension

The first operand of FROM / FROMP command should be base and slot number. The upper Byte is assigned as base number and the lower Byte is assigned as slot number, so can be easily understood with hexa-decimal notation. Keep in mind that base and slot numbers are '0' based, and both the number of local base and the first slot are zero.

Base No.	Slot	S1
Local base	Slot no. 5	H0005 or 5
1st expansion	Slot no. 3	H0103
10th expansion	Slot no. 7	H0A07
14th expansion	Slot no. 12	H0D0C
16th expansion	Slot no. 10	H100A

[Table 9] Example of setting slot number of extension function

Besides of the CIMON PLC-CM1 series, PLC-S series' slot numbers are numbered from one and upward.



[Figure 11] Example of PLC-S Series module extension

In the PLC-S series, H00 is used for upper Byte as there is no base expansion.

(2) S2 (Start address of buffer memory)

Designate the start address of buffer memory to read. Refer to the manual or quick-reference guide of objective module.

(3) S3 (Start address of device)

Designate the start address of device where read values will be stored. Y/M/L/K/D/Z areas are available.

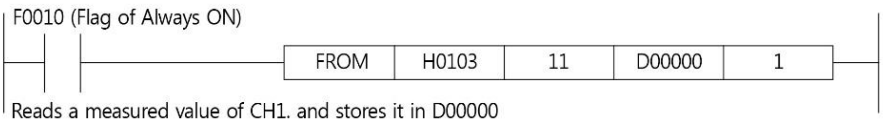
(4) Number of words to read and store

Designate the number of Words to read and store.

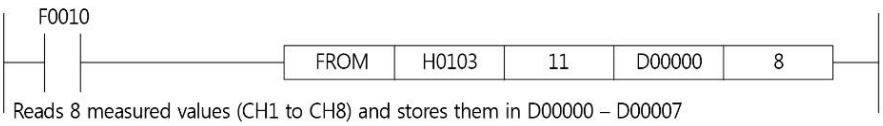
Example 1: How To Use FROM/FROMP Command

Following is an example program which reads one word and eight words. It assumes the special module is CM1-ADxxxx and installed in fourth slot of the first expanded base.

Address		Descriptions
Hex	Dec	
0H	0	Channel Enable/Disable
1H	1	CH1 Avr.Const (time/count)
2H	2	CH2 Avr.Const (time/count)
3H	3	CH3 Avr.Const (time/count)
4H	4	CH4 Avr.Const (time/count)
5H	5	CH5 Avr.Const (time/count)
6H	6	CH6 Avr.Const (time/count)
7H	7	CH7 Avr.Const (time/count)
8H	8	CH8 Avr.Const (time/count)
9H	9	Avr. Mode Select
AH	10	A/D Conv. Completed Flags
BH	11	CH1 Measured Value
CH	12	CH2 Measured Value
DH	13	CH3 Measured Value
EH	14	CH4 Measured Value
FH	15	CH5 Measured Value
10H	16	CH6 Measured Value
11H	17	CH7 Measured Value
12H	18	CH8 Measured Value
13H	19	Error Code
14H	20	Ranges of Value (CH.1 ~ CH.4)



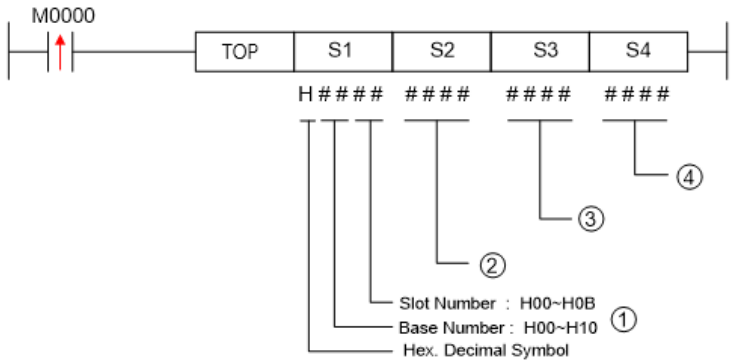
Reads a measured value of CH1. and stores it in D00000



Reads 8 measured values (CH1 to CH8) and stores them in D00000 – D00007

2. TO/TOP command

'TO/TOP' command writes word data to shared memory of special module such as DA modules. The typical usage of the command can be represented by following LD.



[Figure 12] How to TO/TOP command

Form	Content	Note
S1	Base and Slot number where the special module is installed. Upper: Base no. / Lower: Slot no.	H00 01: 1st Slot of Base no. 0 *PLC-S Series do not have extended base. So Upper Base no. is H00.
S2	Start address of the point where Buffer memory will write	Each modules have different start address of Buffer memory. Please check the address of Buffer memories you use.
S3	Constant value or start address of device where to write	Device area or constant value where to write at Buffer memory of module.
S4	Length of words to write	Write value starting at the designated area of S4 by turns, as many as data (word) which will be written by Buffer memory address.

[Table 10] Notation of TO/TOP command in use and meaning of its form

(1) S1 (base and slot number)

Refer to 'FROM / FROMP' command.

(2) S2 (Start address of user program memory)

Designate the start address of user program memory where to write. Refer to the manual or quick-reference guide of objective module.

(3) S3 (Constant value or start address of device)

Designate the start address of word device storing value to write. X/Y/M/L/K/F/D/Z devices are available. This operand can be designated with constant value to write. In this case, only one value can be written to user program memory at once.

(4) Number of words to write

Designate the number of words to write.

Example 2: How To Use TO/TOP Command

Following is an example program which writes one word and eight words. It assumes the special module is CM1-DAxxxx and installed in fourth slot of the first expanded base.

Address		Descriptions
Hex	Dec	
0H	0	Channel Enable/Disable
1H	1	CH1 Output Value
2H	2	CH2 Output Value
3H	3	CH3 Output Value
4H	4	CH4 Output Value
5H	5	CH5 Output Value
6H	6	CH6 Output Value
7H	7	CH7 Output Value
8H	8	CH8 Output Value
9H	9	Error Code
	⋮	
17H	23	Outout enable flags
	⋮	

F0012 (ON during the first scan)

TOP	H0103	23	D000FF	1

Enable outputs of all channels (CH1 – Ch8, DA module needs this step for safety)

F0010 (Always ON flag)

TOP	H0103	1	D00000	1

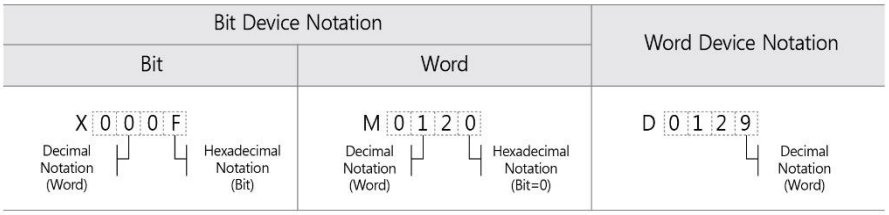
F0010

TOP	H0103	1	D00000	8

Write 8 output values to CH1 – CH8 by single instruction.
Output values are stored in D00000 ~ D00007.

Appendix 2 Method of Address Allocation

1. Address Allocation



[Figure 13] Notation of each Bit/Word device

(1) Bit Data Designation

Composition	[Device Symbol] + [Card no.] + [Bit no.]
Device Symbol	X, Y, M, K, L, F
Card no.	Notated in 3 digits of decimal number
Bit no.	Notated in 1 digit of hexadecimal number
Example	X000E, Y0012, M034F, K0120, L023C, F0093

(2) Word Data Designation

Composition	[Device Symbol] + [Card no.]
Device Symbol	D, Z, T, C
Card no.	Notated in 4 digits of decimal number
Example	D1234, Z0001, T0011, C1023

(3) Timer, Counter Output Designation

Composition	[Device Symbol] + [Bit no.]
Device Symbol	T, C
Card no.	Notated in 4 digits of decimal number
Example	T0003, C0567

(4) Step Controller Pin Designation

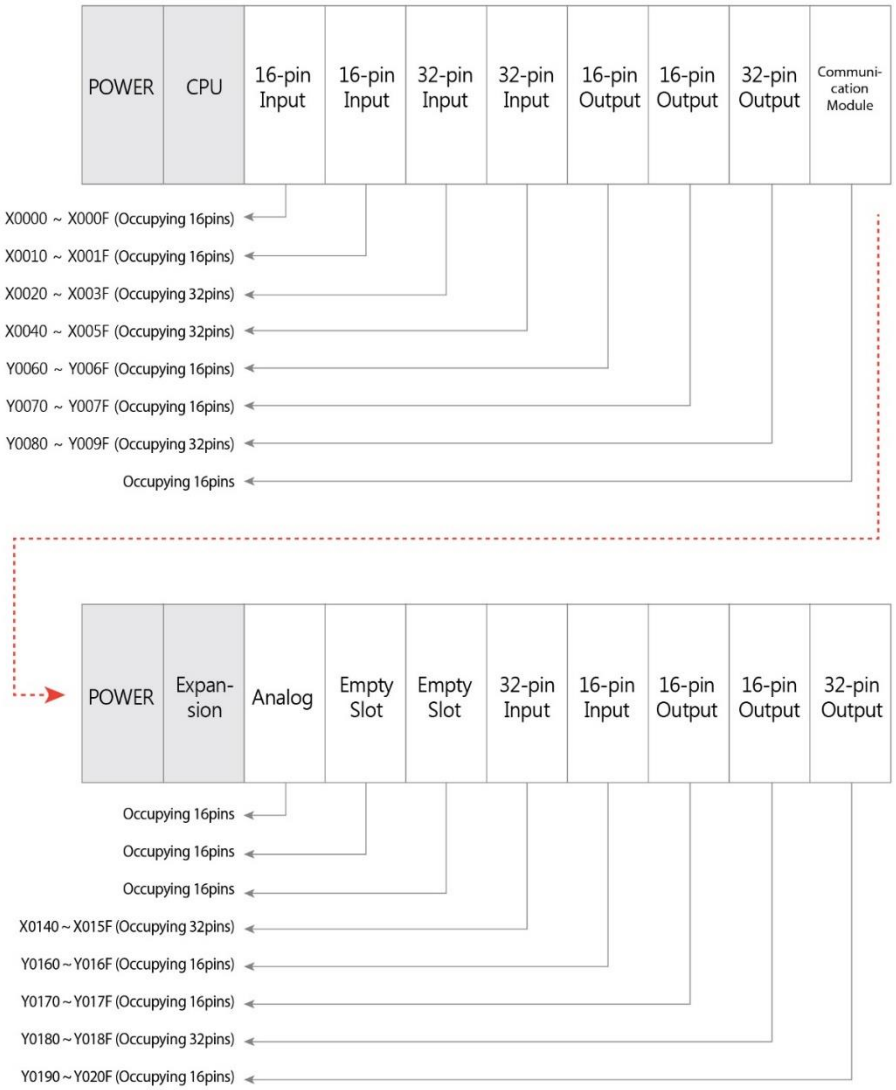
Composition	[Device Symbol] + [Card no.] + [.] +[Bit no]
Device Symbol	S
Card no.	Notated in 2 digits of decimal number
Step no.	Notated in 2 digits of decimal number
Example	S00.00, S12.78

(5) Designating Bit Device to Word (Card) Unit

Composition	[Device Symbol] + [Card no.] + [0]
Device Symbol	X, Y, M, K, L, F
Card no.	Notated in 3 digits of decimal number
Example	X0110, Y0330, M0440, K0000, L0040, F0130

2. I/O Address Allocation

I/O Address Allocation is to assign each modules a number to output the data from the input module. I/O Address is allocated in order of expanded base access from the local base. Address number is allocated from left side except the power of each bases and CPU. Address number starts from No.0 Analog, Communication, Special modules and empty slots occupy 16pins (1Word).

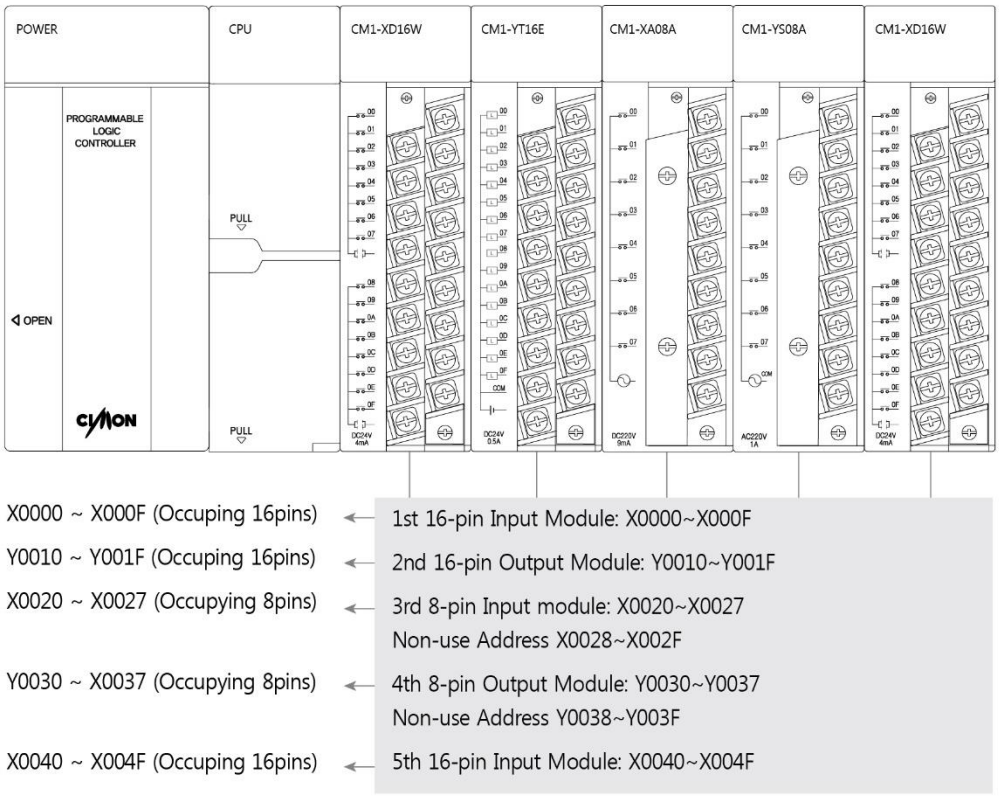


[Figure 14] I/O Address Allocation of CM1-Series(Upper) and PLC-S Series(Lower)

In case of PLC-S Series, I/O Address Allocation is different from CM1-Series. Refer to the <Example of PLC-S Series Module Composition>.

(1) 8-pin I/O Module

- Composition: POWER + CPU + Input 16-pin Module + Output 16-pin Module + 8-pin Input Module + 8-pin Output Module +16-pin Input Module

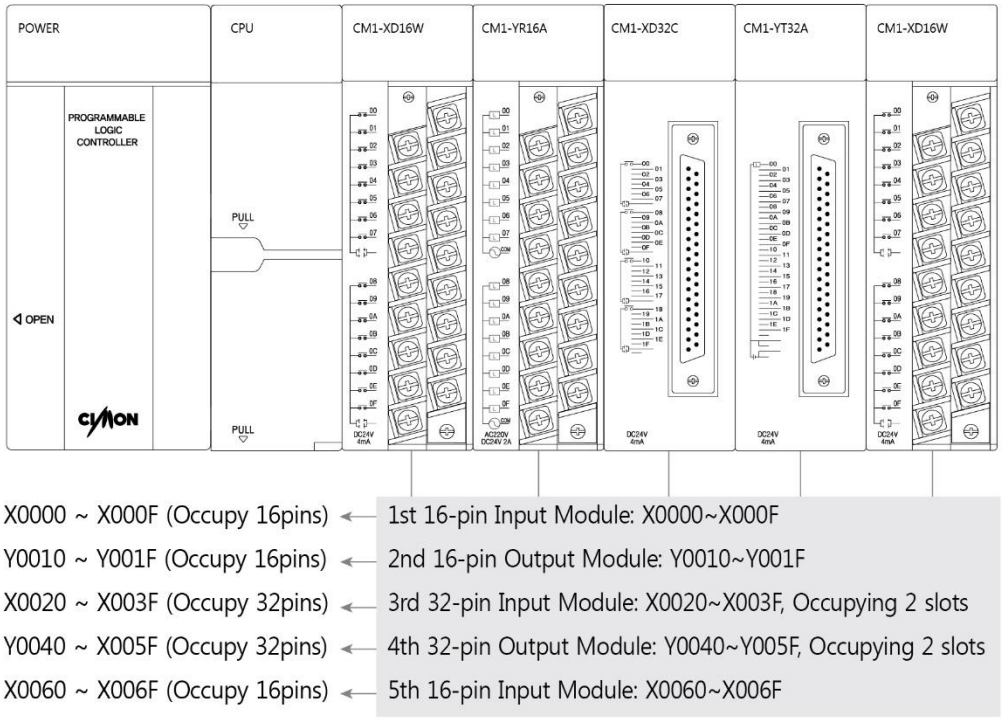


[Figure 15] Example of CM1-Series Module Composition (8-pin I/O Module)

(2) 32-pin I/O Module

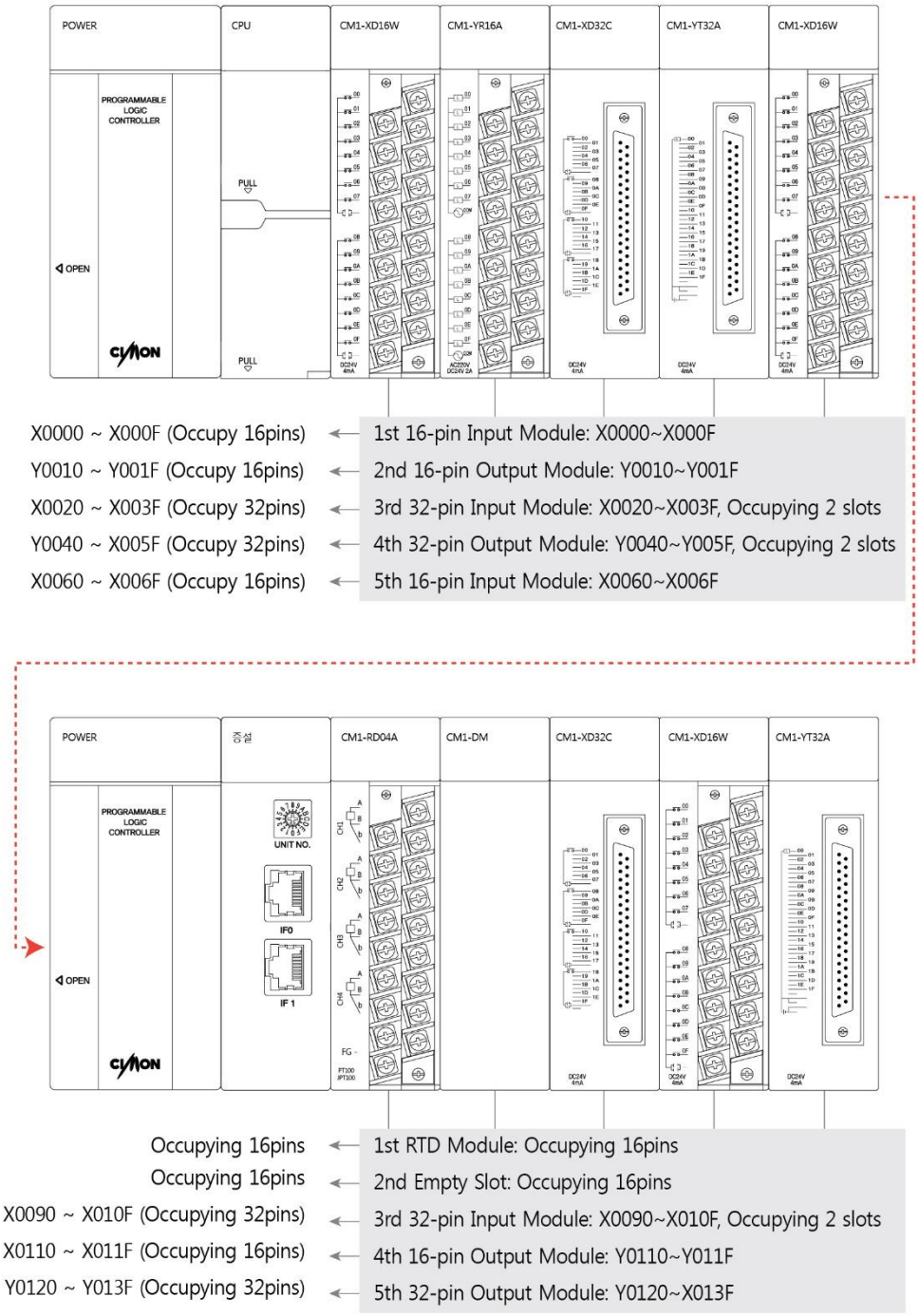
16-pin Module takes 1 slot and 32-pin Module takes 2 slots.

- Composition: POWER + CPU +16-pin Input Module + 16-pin Output Module + 32-pin Input Module + 32-pin Output Module + 16-pin Input Module



[Figure 16] Example of CM1-Series Module Composition (32-pin I/O Module)

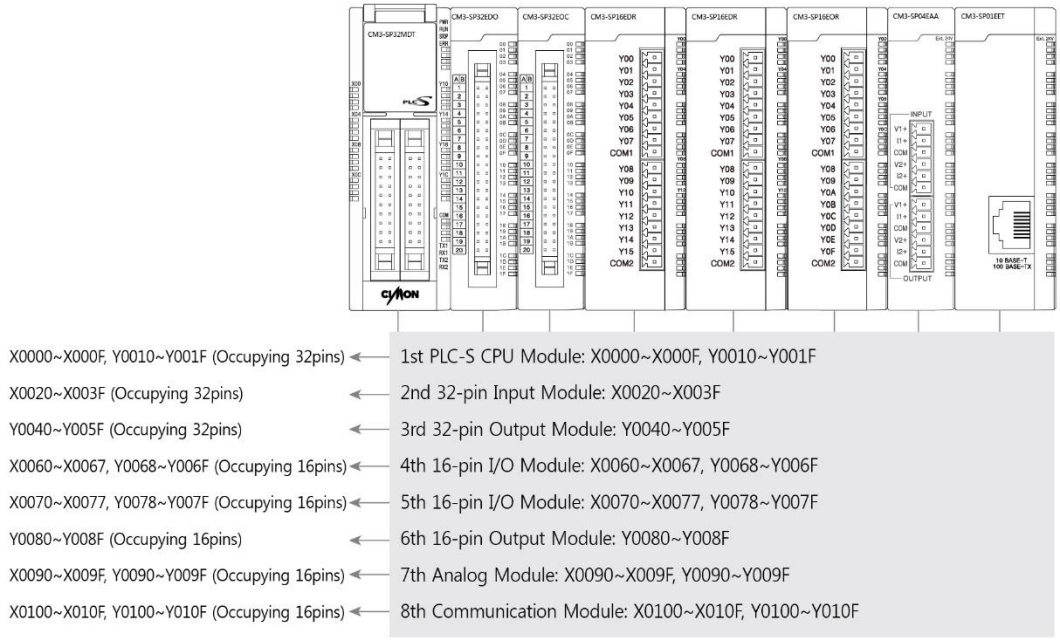
Address of Expanded Base is connected after the Address of Local Base.



[Figure 17] Case of Additional CM1-Series Connection

In case of PLC-S CPU, it has an I/O function unlike the CM1-Series I/O address allocation. Address number is assigned in order from CPU. PLC-S CPU is separated into CM3-SP32MDTx and CM3-SP16MDRx. CM3-SP32MDTx CPU occupies 32-pin of I/O area and CM3-SP16MDRx uses 8-pin of both input and output but occupies 32-pin of I/O area.

- Composition: CPU 32pin + 32-pin Input Module +32-pin Output Module + 16-pin I/O Module +16-pin I/O Module + Output 16pin + Analog Module 16pin + Communication Module 16pin



[Figure 18] Example of PLC-S Series Module composition

3. X/Y I/O area allocation

(1) X area (Bit / Output device)

This is an Input pin which receives a signal from Input Card. This is a read-only device which user cannot input the value randomly. X area is Bit Type. It means that the size of detailed table signifies the number of Bit. In case it is used as Word Type, it is same as the Word Command of Bit Device.

- I/O Allocation: Device Allocation of X/Y area of PLC Modules (I/O Card / Special Card), except CPU.

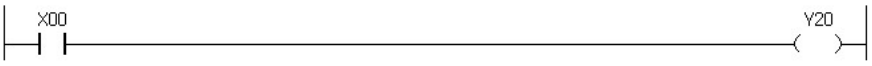
1. PLC Card occupies 16-pin (1Word) basically.

2. I/O Card under 16-pin: occupies 16-pin (1Word).

3. 32-pin I/O Card: occupies 32-pin (2Word).

4. Special Card except I/O Card occupies 16-pin (1Word).

Ex)



It outputs "Y20" when "X00" is ON.

(2) Y area (Bit / Output Device)

This is an output pin which shows the result of calculation by Output Card. Y area is Bit Type. It means that the size of detailed table signifies the number of Bit. In case it is used as Word Type, it is same as the Word Command of Bit Device.

- I/O Allocation: Device Allocation of X/Y area of PLC Modules (I/O Card / Special Card), except CPU.

1. PLC Card occupies 16-pin (1Word) basically.

2. I/O Card under 16-pin: occupies 16-pin (1Word).

3. 32-pin I/O Card: occupies 32-pin (2Word).

4. Special Card except I/O Card occupies 16-pin (1Word).

Ex)

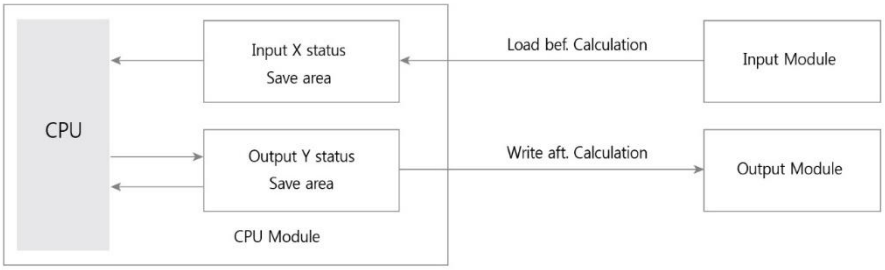
It outputs "Y20" when "X00" is on.

4. Features

I/O X, Y respond to external devices. X is to receive the signal of input device such as Push button switch, Limit switch and etc. Y is to convey the calculation results from Output Device such as Solenoid Valve, Motor, Lamp and etc.

Input section X conserves the input status inside of PLC which enables to use the A, B pin. Output section Y only uses the A-pin output.

[Figure 19] Example of I/O configuration.



[Figure 20] I/O Area Implementation Method

As above Figure 20, X, Y area have one-to-one responding area on the one pin of each I/O Module. While PLC is scanning, it calculates with the memory(X, Y) inside of the CPU, regardless of status of I/O Module. After the calculation, it outputs the content of inner memory Y which responds to the output. Later, it saves the pin-status to the inner memory X which corresponds to Input, for the next calculation.

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[Figure Reference List]

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Revision

Date	Version	Description
22/09/2017	V1.0	First Edition

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Date 22/09/2017 V 1.0

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