FATEK

M Series

Programmable Controller

M-Series PLC Software Function and Application User Manual

NEXT Level SOLUTION

Since the content of the manual will be revised as the version changes, this version may not be the final version.
To download the latest version of the manual, please go to the technical support area of www.fatek.com

FATEK AUTOMATION CORP.

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Manual for the FATEK M-Series PLC Software

Function and Application Preface

This Manual provides important information related to the use of the FATEK M-Series PLC CPU Module. Before using the product, be sure to read this Manual carefully in order to get familiar with and understand its content. Should you have any questions or comments, please contact the FATEK distributor for detailed warranty services and responsibility limit.

Warranty Service
The warranty period provided by FATEK for its product shall last for one year (or other period as otherwise agreed) starting from the date when the product is sold and it will be offered under the pre-conditions that there are no defects in product use.

Please contact FATEK or the local distributor in the event failure occurs on any of the FATEK products for reasons not caused by man-made factors during the aforesaid warranty period. However, the failure due to any of the following reasons shall not be covered by the warranty services:

1. The malfunction is due to the user's failure in following the conditions, environment, operations, installation and correct wiring method specified in this Manual.

2. The malfunction is due to the user's failure in following the operating method originally designed.

3. The malfunction is not due to the reasons of the product.

4. The malfunction is not caused by the modification and the maintenance executed by FATEK.

5. The malfunction is caused by other types of *force majeure* factors such as natural disasters or man-made negligence.

In the meantime, the aforesaid warranty services shall be limited to the FATEK product only and the losses resulting from the product failure will not be covered in the warranty scope.

Limit of responsibilities
Unless it has been confirmed that the product is properly used, stored, installed and serviced and that it has not been contaminated, abused, misused or improperly modified or repaired as being analyzed by FATEK; otherwise, FATEK shall not be liable for any product-related particular damage, consequential damage or derivative damage or even revenue loss or commercial loss that resulted from whatever means.

Precautions on using the product

Compliance with the application-related conditions

The user shall evaluate the suitability of FATEK product and shall install the product in the well-designed equipment or system.

The user needs to check if the system, machinery or device currently used is compatible with the FATEK product. If the user fails to confirm the compatibility or the suitability, then FATEK shall not be liable for the suitability of the product.

When required by the customer, FATEK shall provide correlated third party certification to define the value rating and the application restrictions that will be applicable for the product. However, the aforesaid certification message shall not be considered as sufficient to determine the suitability of the FATEK product, the final product, the machine, the system and other applications or relevant combinations. Described below are certain applications that should be cautiously treated by the user. In spite of this, the content described below shall neither be considered as having included all of the intended product purposes nor suggesting that all of the following purposes shall be entirely suitable for the product. For example, outdoors use, use in an area subjected to potential chemical contamination or electrical interference or used under conditions or functions not mentioned in this Manual or used with the system, machine and equipment that may create risks to life or properties.

Before working with the product, the user will be required to check if the entire system is marked with a hazard sign and shall select the design that can ensure the safety such as the backup design, etc. Otherwise, the user shall not be allowed to use the product in the application that will present personnel and the property safety concerns. In no event shall FATEK be liable for the specifications, statutory regulations or restrictions that will be used by the customer in the product combination or the product operations.

When using the product, FATEK shall not be liable for the programs edited by the user or the resulting consequences.

Disclaimers

Dimensions and weight
The dimensions and the weight specified in the manual are nominal values only. Even if provided with the tolerance, they cannot be used in the manufacturing purposes.

Performance data
The data specified in this Manual mean that the performance data obtained under FATEK's test conditions are provided for the user to confirm its compliance only. Therefore, the user is also required to consider the actual application conditions. Therefore, actual performance shall be defined according to the content of the guarantee and the limit of responsibilities established by FATEK.

Errors and negligence
The content of this Manual is provided through careful checking process and is considered as correct. However, FATEK shall not be liable for the errors or the negligence that may be found in the text, printing content and proofreading.

Change of specifications
The product specifications and accessories may be subject to change along with the technical improvement or other reasons. In the event that the published specifications or performance need to be changed or where significant structural change is required, FATEK will change the model number of the product accordingly. If certain specifications of the product have changed, then FATEK will not give the notice under the following situation: when it is required to use a special model number or create particular specifications in order to support the customer's application according to the instructions given by the customer. To confirm actual specifications of the product to be purchased, please contact the local FATEK distributor.

Precautions for Safety

Signs and meaning of safety precautions

The following signs will be used in this Manual in order to provide precautions that will be required for using the M-Series PLC safely. These precautions are extremely important for using the product safely. Please read the safety precautions carefully in order to get familiar with and understand the content and the meaning of the aforesaid instructions.

⚠ Warning	Means a potentially dangerous situation that will result in death or serious injury if not avoided. In the meantime, it may also lead to serious property losses.

⚠ Caution	Means a potentially dangerous situation that may result in minor or medium level injury or property losses if not avoided.

🚫	Means operations that must not be executed.
❗	Means operations that must be executed.
⚠	Means general precautions.
🔥	Means the precautions relating to hot surfaces.
⚡	Means the precautions related to the wiring, grounding and electrocution of the electrical system.

Warning	
Do not attempt to dismantle any module or touch the internal side of the module when it is under energized status or it may lead to electrocution injury.	⃠
Do not attempt to touch any terminal or terminal board when the module is under energized status, or it may lead to electrocution injury.	⚡
To ensure the system safety in order to avoid abnormal actions that may be caused by man-made external factors or false actions resulting from the faulty PLC, it is required to install the following safety measures in the external circuit (not within the PLC procedure); otherwise, it may lead to serious accident. The externally controlled circuit must be provided with emergency stop switch, interlocking circuit, limit switch and similar safety measures. The PLC will stop outputting the signals when encountering major failure alarm during the operations. However, the errors in the I/O controller and the I/O register as well as other undetectable errors will still trigger unexpected actions. To deal with the aforesaid errors, you are required to install external safety measures to protect the system safety. If the output relay is jammed, burnt or if the output transistor is damaged, then the PLC may still maintain its output at the ON or OFF status. To solve the aforesaid issues, it is required to install external safety measures to protect the system safety. By installing the corresponding safety measures in the system and the equipment, it allows you to maintain the safety of the entire system in spite of the fact that communication errors or false actions have occurred during the operating process.	❗
The user must take corresponding failure preventive measures in order to ensure safety when the signal line is damaged or when the power is instantly disconnected or when the signal is wrong, missing or abnormal as may be caused by other reasons. If failing to taking the appropriate measures, it may lead to improper operations that may result in serious accidents.	❗

Precautions	
Do not touch the power module when the PLC is under energized status or when the power source is disconnected. At this time, the power module might still present extremely high temperature that can cause a scorching injury.	⚠
When connecting with the terminal board of the power module, the cable should be secured with the appropriately sized Ferrule. If the cable is loose, it may lead to burning or the failure of the power module.	ⓘ
The online editing shall be allowed only after confirming that the extended PLC cycle duration will not result in any adverse impact or the system may not be able to read the input signal.	⚠
After confirming that the I/O terminal is safe, you may transmit the required parameters to other terminals such as PLC setting, I/O table and I/O register data, etc. Otherwise, it may lead to unexpected actions if transmitting or modifying the aforesaid data before that.	⚠

Precautions for Use

When using the M-Series PLC, please observe the precautions provided below.

Using the power

- Please use the voltage specified in the Manual. Incorrect voltage will lead to false action or burning damage to the equipment.

- If the number of the module being connected exceeds the current rating of the power module, you may not be able to start the CPU module or other modules.

- Please use the designated power source and then supply the power according to the specified voltage and frequency rating. Special attention should also be given to the location subjected to unsteady power supply, as incorrect power supply may result in false action.

- Before starting any of the following operations, be sure to disconnect the PLC power; or it may lead to false action or electrocution injury.

  (1) When installing or dismantling power module, I/O module, CPU module or any other type of module.

  (2) When connecting cables or executing the system wiring.

  (3) When connecting or disconnecting the connector.

- When using the power module, be sure to observe following precautions.

  (1) The voltage applied at the equipment output point or the connected load shall not be higher than the rated specifications established for the power module.

  (2) If it is required to put aside the power module for over 3 months, it shall be stored in a cool and dry location in order to maintain its function at normal status.

  (3) If the power module is improperly installed, it will result in the accumulation of heat as to cause the aging or the damage of the component within. Therefore, it shall be properly connected and you are also required to use the standard installation method.

Installation

- Do not install the PLC at the location near a high frequency noise interfering source.

- Confirm that the terminal board, the connector, the memory card, the peripheral communication wires and other buckle-mounted devices are latched in position. Improper latching will result in false action.

- After connecting to the adjacent module, the buckle at the top or the bottom must be securely locked (*i.e.,* properly latched). If failing to lock the buckle tightly, the module may not be able to achieve the intended function.

Wiring

- Please follow the instructions provided in the Manual in order to execute the wiring operations correctly.
- Before connecting the power, please check the setting status of all wires and switches. Incorrect wiring may result in burning damage to the equipment.
- After checking the installation position, you may start installing the terminal board and the connector.
- During the wiring process, the label should be tagged on the module. If you tear off the label, foreign mattes may get into the module as to cause a false action.
- To ensure normal heat dissipating function, please tear off the label after completing the wiring operations. If retaining the label, it may lead to false action.
- Please use an EU-standard terminal to execute the wiring operations. Do not connect the terminal with bare stranded wires. The aging or the breaking of wires may result in burning damage to the equipment.
- The voltage applied to the input module shall not be higher than the input voltage rating or it may result in burning damage to the equipment.
- The voltage or the load applied to the output module shall not be higher than the maximum switch capacity. The over-voltage or the overload may result in burning damage of the equipment.
- Do not drag or bend the cable excessively. Such action may cause the breaking of the cable.
- Do not place any objects on the cable or other type of wires or it may cause the breaking of the cable.
- Please set the grounding wire correctly for the power module and communication port to avoid communication error and equipment malfunction caused by noise interference.
- It is recommended to use M series dedicated AC power modules to supply power to MPLC related modules.
- It is recommended to use twisted-pair shielded cables for communication cables and ground them properly.

Operating

- Before supplying power to the MPLC to start the operations, ensure that the setting of the data register is correct without any mistakes.
- Before executing any of the following tasks, confirm that it will not bring about any adverse impact on the system; otherwise, it may result in unexpected action.
  (1) When changing the operating mode of the PLC (RUN Mode/STOP Mode).
  (2) When executing compulsory enable/ compulsory disable for any of the data retained in the register.
  (3) When changing the present value of any bit or setting that has been logged in the register.
- Do not attempt to dismantle, repair or modify any module; or it may result in false action, fire or electrocution.

- It is required to protect the PLC from falling or from excessive vibration or impact.
- If the I/O is located at the "ON" position, when switching the "RUN Mode" to the "STOP Mode," the system will set the PLC output at the "OFF" position and then all output actions will be disabled. Please ensure that the external load will not generate hazardous factors during the aforesaid process.
- If the CPU module stops running due to catastrophic error, please set all of the output points on the output module at the "OFF" position. The output status will be retained after being set as the holding-type memory configuration parameters.
- If the status monitoring pages or the parameters are improperly set, it may result in unexpected action. Even though the status monitoring pages or the parameters are correct, it is also required to confirm that the controlled system will not be subject to adverse impact before starting.
- When applying maximum level of voltage or when the power supplied to the operating switch is interrupted suddenly during the Insulation Strength Test, it may result in the damage of the CPU module. In this case, please use the variable resistor to increase or reduce the voltage level gradually.
- Before conducting the Withstand Voltage Test or the Insulation Resistance Test, please separate the wire grounding terminal of the power module from the functional grounding terminal. Otherwise, it may result in burning damage to the equipment.

Precautions for the application environment

● Please follow the instructions described in this Manual for carrying out the installation activities correctly.

● Do not operate the control system in any of the following locations:

(1) The location exposed to direct sunlight.

(2) The location with temperature or humidity exceeding the specified range.

(3) The location vulnerable to dewing effect due to abrupt temperature changes.

(4) The location exposed to corrosive or combustible gases.

(5) The location exposed to dust (especially iron chips) or smoke.

(6) The location exposed to water, oil or chemicals.

(7) The location vulnerable to impact or vibration.

● When installing the system in any of the following locations, appropriate and effective preventive measures should be taken:

(1) The location exposed to electrostatic or other type of noise.

(2) The location exposed to strong electromagnetic field.

(3) The location that may be exposed to radioactive pollution.

(4) The location near the power supply source.

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System Specifications

The Host of Basic/ Advanced Motion Control Module

Item		ME1C1-1616 ◇	ME2C3-1616 ◇	ME2C4-1616 ◇	ME2C5-1616 ◇	ME3C6-1616 ◇
Programming Language		LD/ ST/ (FUN/FB)D/ STP/ MotionFlow				
Instruction Programming Speed	LD Instruction	0.8nS / Instruction Sequence				
	MOV Instruction	7.5nS / MOV				
Max. I/O Point	DIO	1024	1024	1024	2048	2048
	AIO	128	128	128	256	256
Max. Modules	Basic+ High-Speed Modules	64 (with Branching and Expansion Modules)				
	High-Speed Modules	6 (must be installed between CPU Modules and Basic Modules)				
Programming Memory	PLC	40 KB	60 KB	60 KB	60 KB	80 KB
	Motion	370 KB	742 KB	1.1 MB	1.5 MB	3 MB
Function of Memory Card Specifications Micro-SD Card	Projects and OS Update	Support high-speed loading and OS updates of projects with memory cards				
	Collection, Backup, Loading of Data	●	●	●	●	●
Built-in Digital I/O		Input 16 Points, Output 16 Points				
Built-in Analog Input		2ch 12 bit				
Communication Interface	ETHER NET — Interface	1 Port 10/100 Base-T				
	ETHER NET — Modbus / User-Defined	Master/Slave	Master/Slave	Master/Slave	Master/Slave	Master/Slave
	EtherCAT	1 Port				
	RS-485	2 Ports, Master/Slave, Communication Speed: 4.8K ~ 921.6Kbps				
	USB	1 Port, USB2.0 - Type C (Device terminal)				
IOT Expansion		MQTT, FATEK iMonitor/ iAccess (Optional)				

Motion and Position Control		Total Axes of Motion Control	6 axes	8 axes	12 axes	16 axes	20 axes
	Pulse	Axis	4 axes	4 axes	4 axes	4 axes	4 axes
		Output Frequency	200KHz	200KHz	200KHz	200KHz	200KHz
		Output Pulse Wave Module	6 Types (U, Ux2, A/B, A/Bx2, A/Bx3, A/Bx4)				
		Position Control *	●	●	●	●	●
	EtherCAT	Axis	2 axes	4 axes	8 axes	12 axes	16 axes
		Circular Interpolation/ Position Control	●	●	●	●	●
		Helical Interpolation/ Electric CAM (Chasing/ Flying Shears)	●	●	●	●	●
High-Speed Counter 200KHz			8 channels, 4 channels are for EtherCAT motion control only				
High-Speed Timer 0.1mS			1 (16 bit), 4 (32 bit)				
HSPWM		Point	16 points				
		Output Frequency	72Hz~18.432KHz (Resolution: 0.1%) / 720Hz~184.3KHz (Resolution: 1%)				
Interrupt Control		External Input Interrupt	16 (rising/ falling edge of 8-point input)				
		Internal Timing Interrupt	0.1 ms: 4 groups / 1 ms: 4 groups / 10 ms: 4 groups				
		Counter Interrupt	8 groups				
Captured Input		Point	Max. 16 points				
		Width of Captured Pulse Wave	>10μs (High-Speed Input)				
Digital Filter			X0~X15 (Frequency is changeable: 14KHz~1.8MHz, Lasting Time is changeable: 0~1.5ms/0~15ms (Unit: 0.1ms))				
Input Contacts (DI)		X	512	512	512	1024	1024

Output Relay (DO)	Y	512	512	512	1024	1024
Latching Relay	TR	16				
Internal Relay	M	29600				
Stepping Relay	S	3104				
Timer Status Contacts	T	1024				
Counter Status Contacts	C	16 bit: 1024, 32 bit: 256				
Timer	TMR	1024				
	CTR 16	1024				
	CTR 32	256				
Data Register	R	34768				
	D	12000				
	ROR	4096				
	F	65536				
I/O Register	AI+AO	128	128	128	256	256
Special Register of System	SR	7944 (all)				
Pointer Register	XR	12(V, Z, P0~P9 (10))				
RTC		Year, Month, Day, Hour, Min., Sec., Day				
Data Retention	Programming and Elements	Non-Volatile Memory (no need to charge)				
	RTC	Battery Memory				

Item		MS1C1-1616◇	MS1C2-1616 ◇	MS2C3-1616 ◇	MS2C4-1616 ◇	MS2C5-1616 ◇	MS3C6-1616◇
Programming Language		LD / ST / FBD / STP / MotionFlow					
Instruction Programming Speed	LD Instruction	0.8nS / LD					
	MOV Instruction	7.5nS / MOV					

Max. I/O Point	DIO	512	512	512	1024	2048	2048
	AIO	128	128	128	128	256	256
Max. Modules	Basic+ High-Speed Modules	64 (with Branching and Expansion Modules)					
	High-Speed Modules	6 (must be installed between CPU Modules and Basic Modules)					
Programming Memory	PLC	40 KB	40KB	60KB	60 KB	60 KB	80 KB
	Motion	370 KB	556 KB	802KB	1.1 MB	1.5 MB	3 MB
Function of Memory Card Specifications Micro-SD Card	Projects and OS Update	Support high-speed loading and OS updates of projects with memory cards					
	Collection, Backup, Loading of Data	-	●	●	●	●
Built-in Digital I/O		Input 16 Points, Output 16 Points					
Built-in Analog Input		2ch 12 bit					
Communication Interface / ETHERNET	Interface	1 Port 10/100 Base-T					
	Modbus / User-Defined	Master/Slave	Slave	Master/ Slave	Modbus / User-Defined	Master/Slave	Master/ Slave
	EtherCAT	1 Port					
	RS-485	2 Ports, Master/Slave, Communication Speed: 4.8K ~ 921.6Kbps					
	USB	1 Port, USB2.0 - Type C (Device terminal)					
Internet of Things (IoT) expansion		MQTT · FATEK iMonitor / iAccess (optional equipment)					
Motion and Position Control	Total Axes of Motion Control	6 axes	7 axes	12 axes	12 axes	16 axes	20 axes
	Pulse / Axis	4 axes	4 axes	8 axes	4 axes	4 axes	4 axes
	Output Frequency	200KHz	200KHz	100KHz	200KHz	200KHz	200KHz
	Output Pulse Wave Module	6 Types (U, Ux2, A/B, A/Bx2, A/Bx3, A/Bx4)					
	Position Control *	●	●	●	●	●	●

		Axis	2 axes	3 axes	4 axes	8 axes	12 axes	16 axes
EtherCAT		Circular Interpolation/ Position Control	●	●	●	●	●	●
		Helical Interpolation/ Electric CAM (Chasing/ Flying Shears)	-	-	-	-	-	-
High-Speed Counter 200KHz			6 Channels	7 Channels	8 channels, 4 channels are for EtherCAT motion control only			
High-Speed Timer 0.1mS			1 (16 bit), 4 (32 bit)					
HSPWM		Point	16 points					
		Output Frequency	72Hz~18.432KHz (Resolution: 0.1%) / 720Hz~184.3KHz (Resolution: 1%)					
Interrupt Control		External Input Interrupt	16 (rising/ falling edge of 8-point input)					
		Internal Timing Interrupt	0.1 ms: 4 groups / 1 ms: 4 groups / 10 ms: 4 groups					
		Counter Interrupt	8 groups					
Captured Input		Point	Max. 16 points					
		Width of Captured Pulse Wave	>10μs (High-Speed Input)					
Digital Filter			X0~X15 (Frequency is changeable: 14KHz~1.8MHz, Lasting Time is changeable: 0~1.5ms/0~15ms (Unit: 0.1ms))					
Input Contacts (DI)	X		256	256	256	512	1024	1024
Output Relay (DO)	Y		256	256	256	512	1024	1024
Latching Relay	TR		16					
Internal Relay	M		29600					
Stepping Relay	S		3104					
Timer Status Contacts	T		1024					

Counter Status Contacts	C	16 bit : 1024, 32 bit : 256					
Timer	TMR	1024					
	CTR 16	1024					
	CTR 32	256					
Data Register	R	34768					
	D	12000					
	ROR	4096					
	F	65536					
I/O Register	AI+AO	128	128	128	128	256	256
Special Register of System	SR	7944(all)					
Pointer Register	XR	12(V 、 Z 、 P0~P9(10))					
RTC		Year, Month, Day, Hour, Min., Sec., Day					
Data Retention	Programming and Elements	Non-Volatile Memory (no need to charge)					
	RTC	Battery Memory					

Basic Host

Item		MA1N1-1616◇	MA1N2-1616◇	MA1N3-1616◇	MA1I4-1616◇	MA1M3-1616◇	MA2M3-1616◇	MA3M3-1616◇
Programming Language		LD / ST / FBD / STP / MotionFlow						
Instruction Programming Speed	LD Instruction	0.8nS / LD						
	MOV Instruction	7.5nS / MOV						
Max. I/O Point	DIO	512	512	512	512	512	1024	2048
	AIO	128	128	128	128	128	128	256
Max. Modules	Basic+ High-Speed Modules	64 (with Branching and Expansion Modules)						
	High-Speed Modules	6 (must be installed between CPU Modules and Basic Modules)						
Programming Memory	PLC	40 KB	40 KB	40 KB	40 KB	40 KB	60 KB	80 KB
	Motion	-	-	-	-	-	-	-

Supports Micro-SD Card			Data Collection, Backup, Recovery						
Built-in Digital I/O			Input 16 Points, Output 16 Points						
Built-in Analog Input			-	-	-	-	-	-	-
Communication Interface	ETHERNET	Interface	1 Port 10/100 Base-T						
		Modbus / User-Defined	Slave	Slave	Slave	Slave	Master/ Slave	Master/ Slave	Master/ Slave
	EtherCAT		–	-	-	-	-	-	-
	RS-485		2 Ports, Master/Slave, Communication Speed: 4.8K ~ 921.6Kbps						
	USB		1 Port, USB2.0 - Type C (Device terminal)						
IOT Expansion			MQTT, FATEK iMonitor/ iAccess						
Motion and Position Control	Total Axes of Motion Control		2 axes	3 axes	4 axes	8 axes	4 axes	4 axes	4 axes
	Pulse	Axis	2 axes	3 axes	4 axes	8 axes	4 axes	4 axes	4 axes
		Output Frequency	200KHz	200KHz	200KHz	100KHz	200KHz	200KHz	200KHz
		Output Pulse Wave Module	6 Types (U, Ux2, A/B, A/Bx2, A/Bx3, A/Bx4)						
		Position Control *	●	●	●	●	●	●	●
	EtherCAT	Axis	-	-	-	-	-	-	-
		Circular Interpolation / Position Control	-	-	-	-	-	-	-
		Helical Interpolation / Electric CAM (Chasing/ Flying Shears)	-	-	-	-	-	-	-
High-Speed Counter 200KHz			2 channels	3 channels	4 channels	4 channels	4 channels	4 channels	4 channels
High-Speed Timer 0.1mS			1 (16 bit), 4 (32 bit)						
HSPWM	Point		16 points						
	Output Frequency		72Hz~18.432KHz (Resolution: 0.1%) / 720Hz~184.3KHz (Resolution: 1%)						
Interrupt Control	External Input Interrupt		16 (rising/ falling edge of 8-point input)						

	Internal Timing Interrupt	0.1 ms: 4 groups / 1 ms: 4 groups / 10 ms: 4 groups						
	Counter Interrupt	8 groups						
Captured Input	Point	Max. 16 points						
	Width of Captured Pulse Wave	>10μs (High-Speed Input)						
Digital Filter		X0~X15 (Frequency is changeable: 14KHz~1.8MHz, Lasting Time is changeable: 0~1.5ms/0~15ms (Unit: 0.1ms))						
Input Contacts (DI)	X	256	256	256	256	256	512	1024
Output Relay (DO)	Y	256	256	256	256	256	512	1024
Latching Relay	TR	16						
Internal Relay	M	29600						
Stepping Relay	S	3104						
Timer Status Contacts	T	1024						
Counter Status Contacts	C	16 bit: 1024, 32 bit: 256						
Timer	TMR	1024						
	CTR 16	1024						
	CTR 32	256						
Data Register	R	34768						
	D	12000						
	ROR	4096						
	F	65536						
I/O Register	AI+AO	128	128	128	128	128	128	256
Special Register of System	SR	7944 (all)						
Pointer Register	XR	12(V、Z、P0~P9(10))						
RTC		Year, Month, Day, Hour, Min., Sec., Day						
Data Retention	Programming and Elements	Non-Volatile Memory (no need to charge)						
	RTC	Battery Memory						

◇:T=Transistor SINK (NPN) Output ◇:J — Transistor SOURCE (PNP) Output

*CPU Bulit-in supports MQTT and iMonitor function, iAccess needs Module to expand its support; while iMonitor and iAccess need keys to activate the service.

*HSC in 2 channels from MS1C1-161, 3 channels from MS1C2-1616, and 4 channels from other items are for motion control function in EtherCAT.

*Position Control: Includes point-to-point, interrupt fixed length/ angle; circular interpolation: including the functions of linear/ circular interpolation and position control; electronic CAM: including the functions of chasing/ flying shears, helical interpolation, circular interpolation and position control.

2

Host Features Overview

FATEK has been focusing on software and hardware of control system on industrial automation industry for more than 30 years, and its products include PLC (Programmable Logic Controller), HMI (Human Machine Interface), Servo (Servo Drives), and SCADA (Supervisory Control and Data Acquisition) in order to provide the best automatic solution for a variety of devices.

M-Series PLC is the whole new PLC products developed by FATEK, who accumulates much experiences in the industry of industrial automation. Its ultimate performance, high-efficiency control center integration, strong expandability and high-speed response, humanized product design, independent motion control chip, remote monitoring and maintenance integration make M-Series PLC a perfect choice for customers to introduce automation equipment, product line control, and even provide the whole plant with best solutions.

Supremely High-Speed

The brand-new High-Performance Processor and High-Performance Computing reach the maximum of instruction processing speed at 0.8ns, pushing the performance of control to the realm of nanoseconds beyond imagination

Incredibly Accurate Performance in Motion Control

Equipped with a dedicated motion control chip to handle motion control related tasks independently, no matter how complex or huge motion control instructions are executed, it can also be completed in real time and accurately without affecting the scanning cycle.
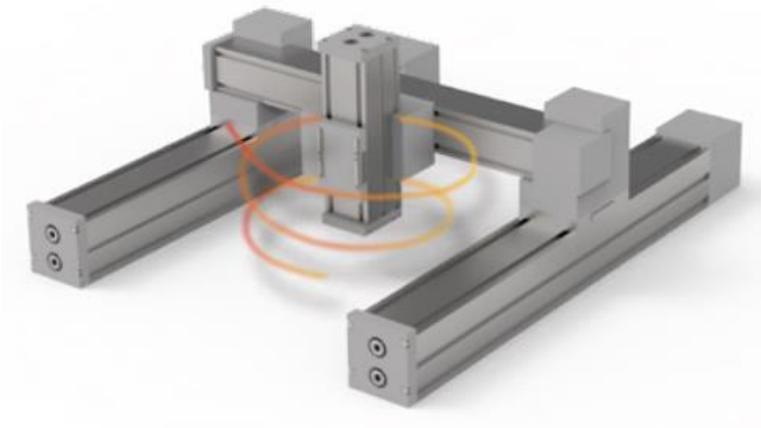
Extremely Low Latency Response with Instant Interrupt

The processing speed of interruption response reaches the maximum of 7.7uS, without any impacts on access time during scanning cycle to ensure reaching precise and immediate control requirements under any circumstances.
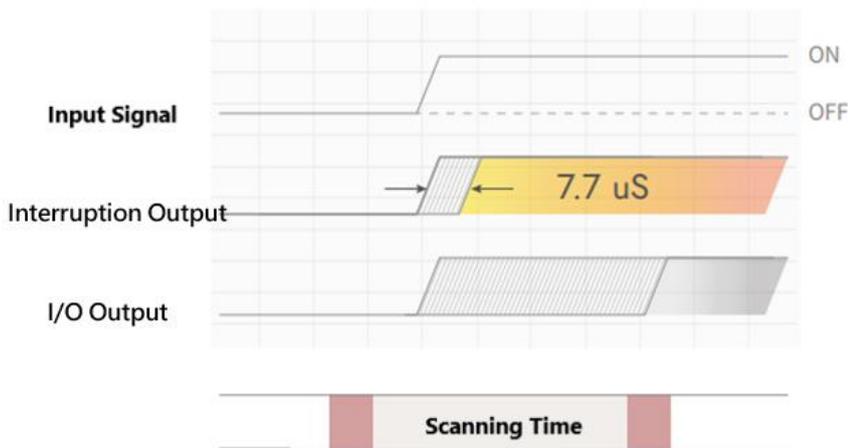
Larger Capacity for Programming

The built-in memory capacity is up to 3MB, making large points I/O and multi-axis motion control unlimited so that product lines and even the whole plant reach the goal of monitoring and highly complicated motion controlling.
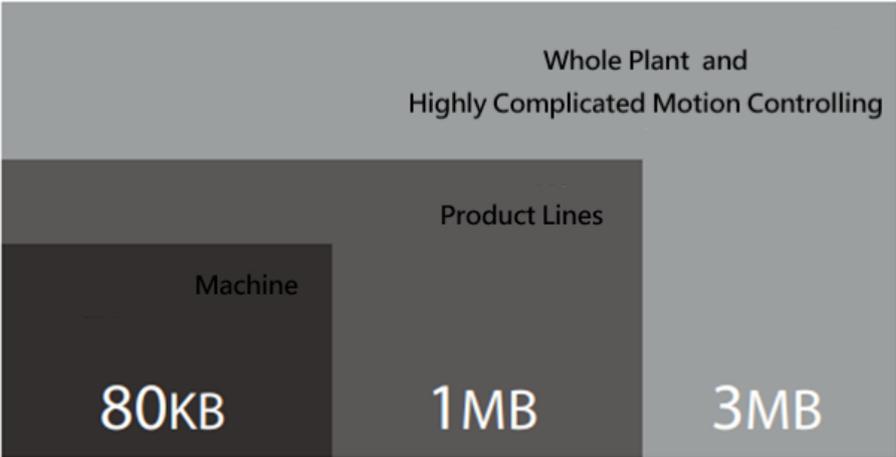
Ethernet Communication Interface with Dual-Industrial Grade

Ethernet supports Modbus TCP, MQTT, and Custom Protocol, so it is able to exchange information or data with surrounding devices, system, and platforms. EtherCAT interface connects with other EtherCAT servo, and the built-in motion control function is available for advanced execution without expansion.
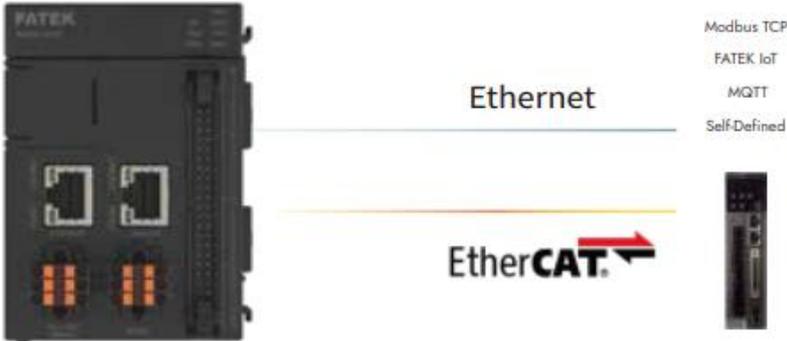
IoT Control Center

The Control Center supports FATEK IoT solutions without an IoT gateway, and easily implement applications such as remote monitoring, project maintenance, and alarm notifications. It also supports the MQTT protocol and can be grafted with third-party cloud platforms.

High-Speed Pulse and Position Control

The built-in is equipped with the maximum of 8 axes and 200KHz of High-Speed Pulse Output. It is able to execute the max. of 8-axis relative and definite position control, and supports advanced functions such as interrupting fixed length and fixed angle so that application requirements of machine: edging, edge banding, and suppling will be available.
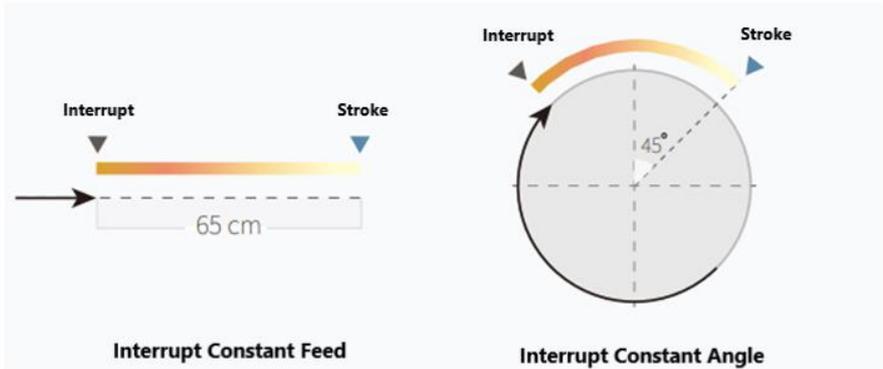
Integrates Digital I/O with High-Density

There are 16 sets of built-in digital input and output points,repectively, with up to 200KHz high-speed counter and high-speed pulse function. It supports interrupt processing and captured input when the real-time control is extremely required, and also ensures that the instructions and signal acquisition are not affected by the scan cycle.
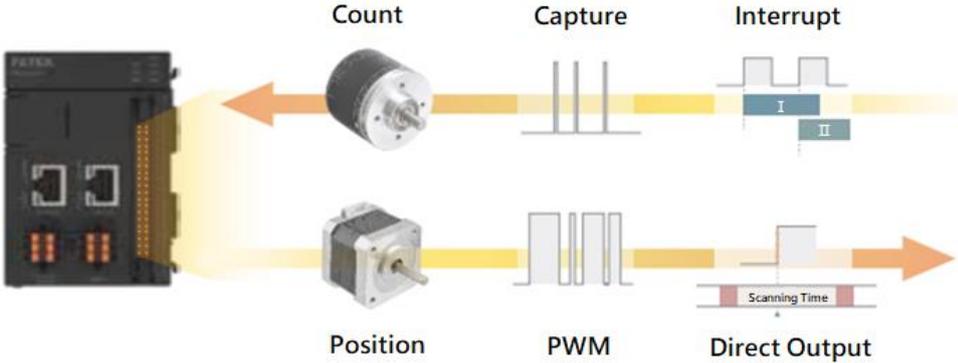
2-Channel RS-485 Communication Port

The built-in 2-Channel RS-485 Communication Port supports Modbus Master/ Slave.

2-Channel Analog Input Interface

Built-in 12-bits of 2-Channel Analog Input Interface

Powerful Control Scale and Expandability

The control scale can reach 2048 points of DIO and 256 points of AIO, and the maximum of 64 various expansion modules can be added. The data can be transmitted in real time through the exclusive FHB transmission technology, there is nothing to worry about latency even if more points of information are monitored.
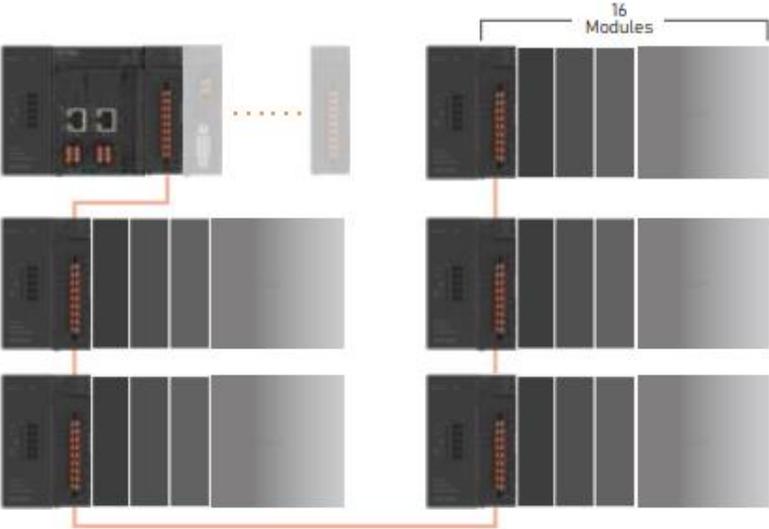
FHB Ultra-fast Data Transmission Technology

Hyperbus solves the problem that the more serial communication modules, the slower the speed. It is 10 times faster than the industrial-grade CANbus that is transmitted in parallel. The patented shock-absorbing joint design of busbar makes data transmission more stable and reliable.
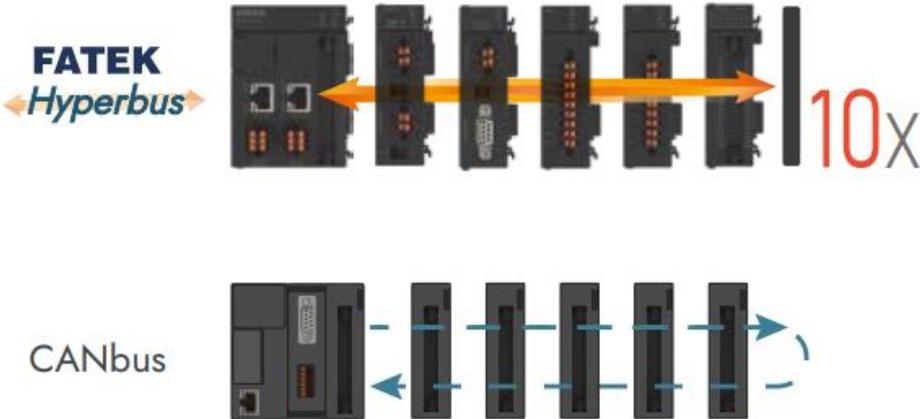
Comprehensive Expansion Modules

The provided I/O, surrounding communication, data monitoring, and IoT* modules are applicable to various general-purpose and special-purpose machines and systems, it can also be used as a control integration center for cross-domain system integration.

Distributed Computing Module

The Module is equipped with independent MCU to execute complex task of real time computing. Communication analysis, auto-tuning and various post-processing can be executed directly on the module, improving system efficiency and greatly reducing CPU load with a distributed architecture.

PID Auto-tuning

Scaling
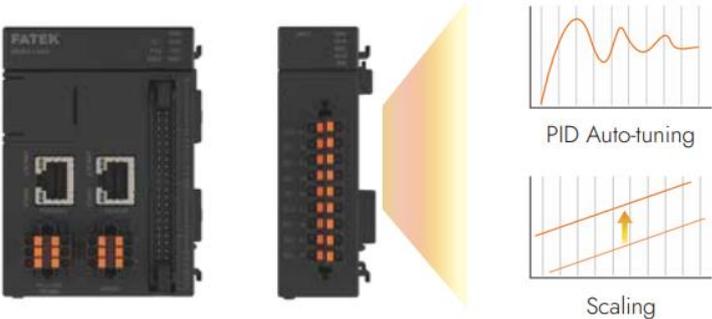
Battery-free Program Memory

The program applies Non-Volatile Memory to conduct programs and data memorization. The storge process does not require charging, so there will not be problems about losing projects and data due to a dead battery.

Expanded Slot of Micro-SD Slot

The collected data can be directly stored in the Micro-SD card, and it can be used to perform project update, system backup and recovery. Data retrieval, project loading and maintenance can also be performed without a computer.

Patented Shock-Absorbing Busbar

The busbar designed with patented shock-absorbing joints can absorb the impact of vibration caused by the machine and the environment, improve durability and avoid data loss caused by poor contact. It is especially suitable for industries such as processing machines and transportation.

Convenient Wiring and Quick Release

The Push-in terminal can be quickly wired without tools, and can ensure that the contacts are tightly bonded to avoid poor contacts.

RUN/STOP Switch

Switches the running state without a computer, which greatly improves the convenience of machine adjustment and debugging.

Type-C Transmission Interface

Adopts USB Type-C as the standard transmission interface, and common transmission lines can be used for project upload/ download and online monitoring/ editing.

Independent Motion Control Chip

Making motion control and project logic program operate independently, even if the complex high-speed and high-precision motion control requirements are implemented, it will not be affected by the program scan cycle or other interrupt tasks to ensure the best control accuracy and stability.

EtherCAT

EtherCAT fieldbus connects with other* EtherCAT servo seamlessly, and provides high-efficiency and reliable control approaches as well as faster transmission speed. It is equipped with standard RJ-45 wires to conduct data transmission, which improves efficiency a lot and reduces maintenance cost at the same time.
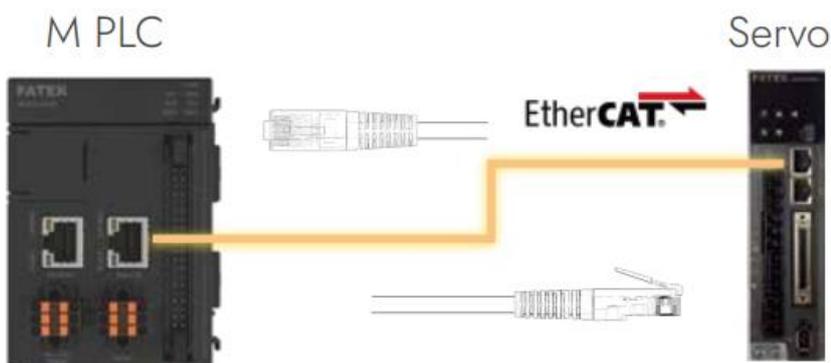
16-axis Synchronous Control

Without the need to expand any motion control modules or connect multiple hosts in series, one can simultaneously control up to 16 axes of servo drives for high-precision, multi-axis, and time-synchronized cooperative control, and each axis can conduct advanced synchronized axis control separately

EtherCAT

16 Axes
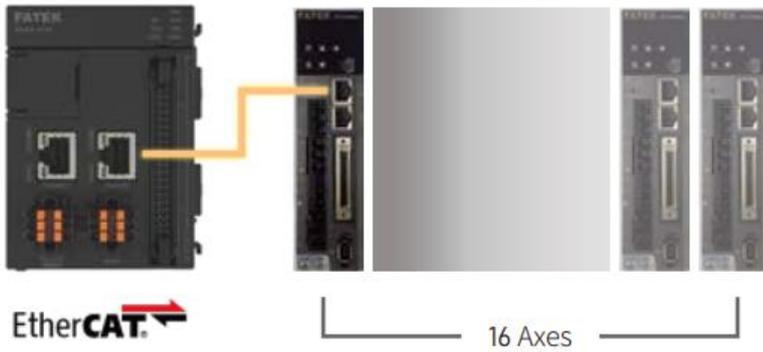
Advanced Interpolation Functions

Built-in multiple interpolation such as straight line, circular, and helical functions support continuous circular function between points, which can connect two motion trajectories with auxiliary circles, making the transition process smoother and reducing mechanism vibration.
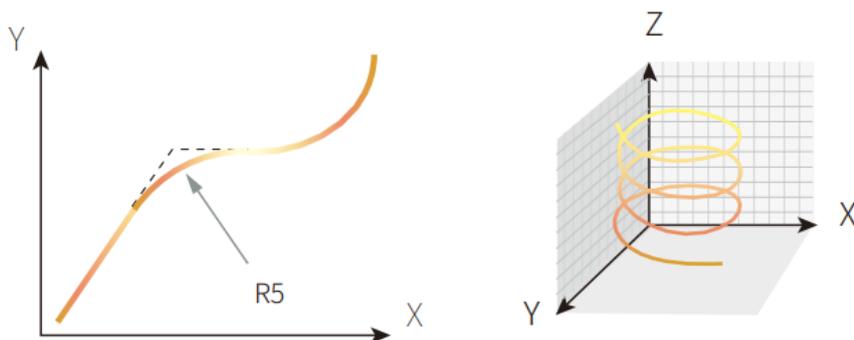
Synchronous Axis Control

There is no need to go through mechanical structures such as variable gears, clutches, and axes. M-Series PLC can be used to set the linkage relationship between multiple axes to achieve synchronous axis control, reducing mechanism and maintenance costs while increasing the flexibility of real-time adjustment of synchronization parameters.
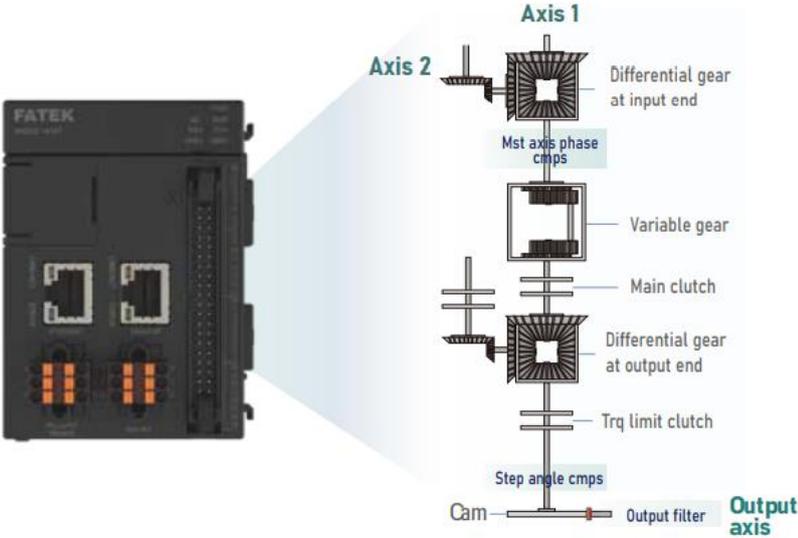
Electric CAM

The Electronic Cam supports the its function on the synchro-control output shaft, which can achieve chasing/ flying shears and other actions without a physical cam mechanism, and can easily comply with complex machine application requirements such as packaging and cutting.
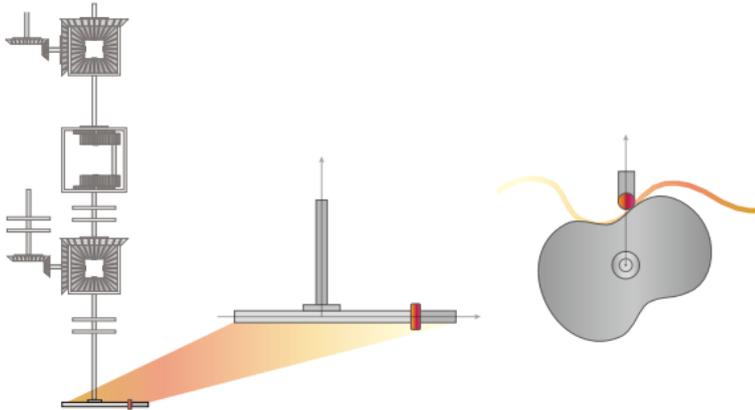
Stable and Smooth Control

Supports S-curve of acceleration and deceleration under different modes of motion control. Without undermining the existing acceleration and deceleration, it can reduce dramatic speed changes so that the operation goes more smoothly.
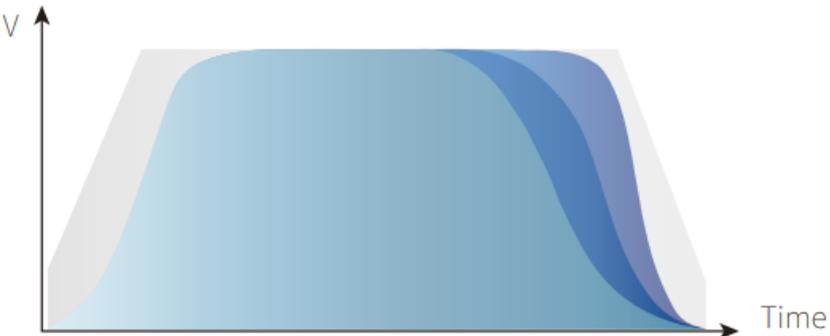
Easy-to-use Motion Control

With highly visualized Motion Flow planning motion control tasks, the control process and requirements can be transferred into a motion control program directly without complicated programming.
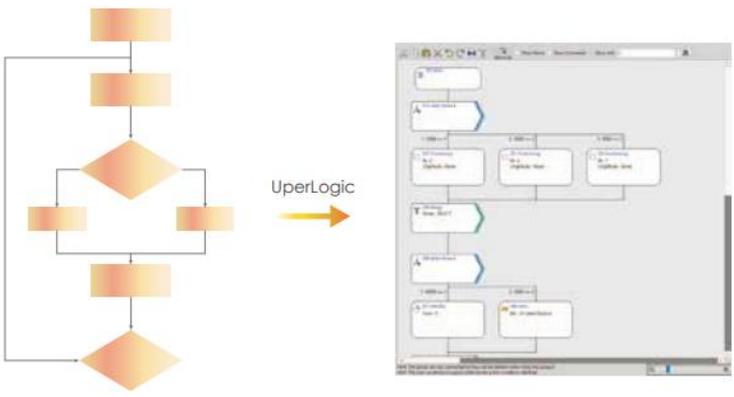
iMonitor Remote Data Monitoring

The data of various devices can be monitored remotely through mobile phones and computers. The alarm task can immediately notify the administrator when the operation is abnormal, and the location of the device can be quickly located through GPS information. Even if many devices are distributed everywhere, the overall situation can still be controlled.
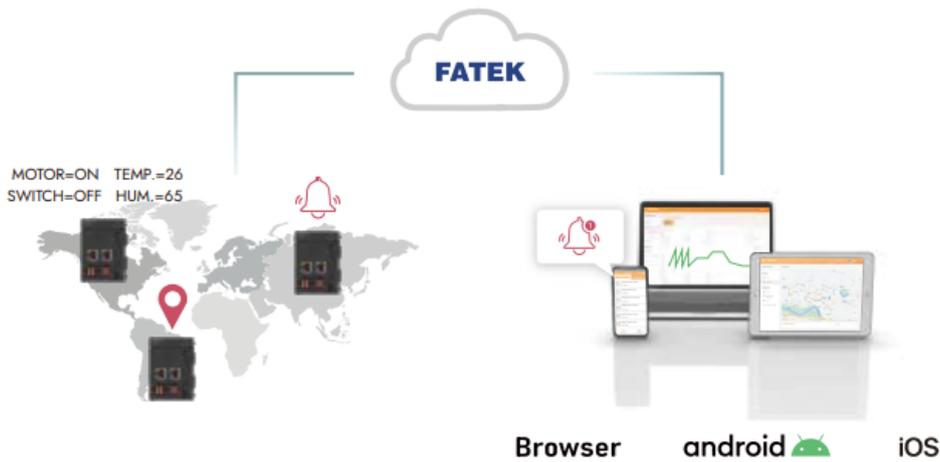
iAccess Maintenance of Remote Projects

There is no need to set an IP address and complex firewalls, the only thing is to connect to the Internet and then one can easily conduct projects, firmware maintenance, update remotely in high-speed mode. Furthermore, one can execute immediate online monitoring and project editing without particular devices.
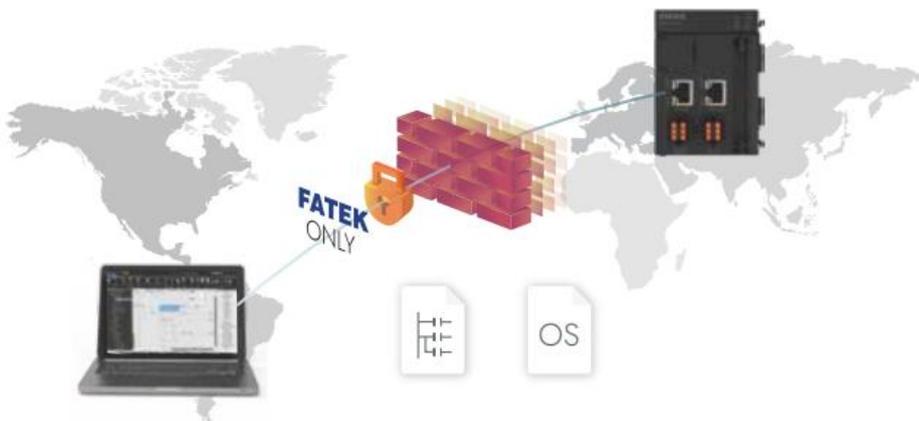
MQTT Connects with Major Cloud Platforms

Built-in common MQTT communication protocol for the IoT and convenient setting interface without any programming make it easy to graft with major mainstream cloud platforms, and expand applications in more aspects and fields without limitation.

FATEK IoT Solution

Featured in user-friendly operating interface and comprehensive backstage management, FATEK IoT Solution can be introduced directly without developing IoT platforms, and supports cross-platform system to easily control data and status of remote devices in anywhere or at any time.

3

Time Setting Functions

M-Series PLC Software Function and Application User Manual

A real time clock (RTC) has been built in the M-Series PLC's MC/MN main unit. No matter whether the PLC is switched on or off, the RTC will always keep accurate time. It provides 7 kinds of time value data-week, year, month, day, hour, minute and second. Users can take advantage of the real time clock to do 24 hours controls throughout the year (for example, businesses or factories can switch lights on and off at set times each day, control gate access, and do pre-cooling and pre-heating before business or operations begin). It can enable your control system to automatically coordinate with people's living schedules, and not only will it raise the level of automatic control, it will improve efficiency.

3-1 Calendar Time of System

3-1-1 RTC Register

Within PLC, there are special purpose registers (RTCR) for storing the time values of the RTC. There are 8 RTCR registers in all, going from R35312 to R35319. R35312 to R35318 are used to store the 7 kinds of time values mentioned above, from weeks to seconds. Because in practical daily application, certain hour and minute time data is often used, we have specially merged the time values of the hour register (R35314) and minute register (R35313) within RTCR, and put them in R35319 high byte and low byte, so they can be accessed by the user. Its comparison table is as follows.

Register	Content
R35312	Second
R35313	Minute
R35314	Hour
R35315	Day
R35316	Month
R35317	Year
R35318	Week
R35319	Hour (High byte) + Minute (Low byte)

Table 3 RTC of System and the Corresponding Register

This figure shows the relationship between RTC and registers R35312~R35318, and the related control switches and status flags (M9179~M9182) when RTC is accessed.
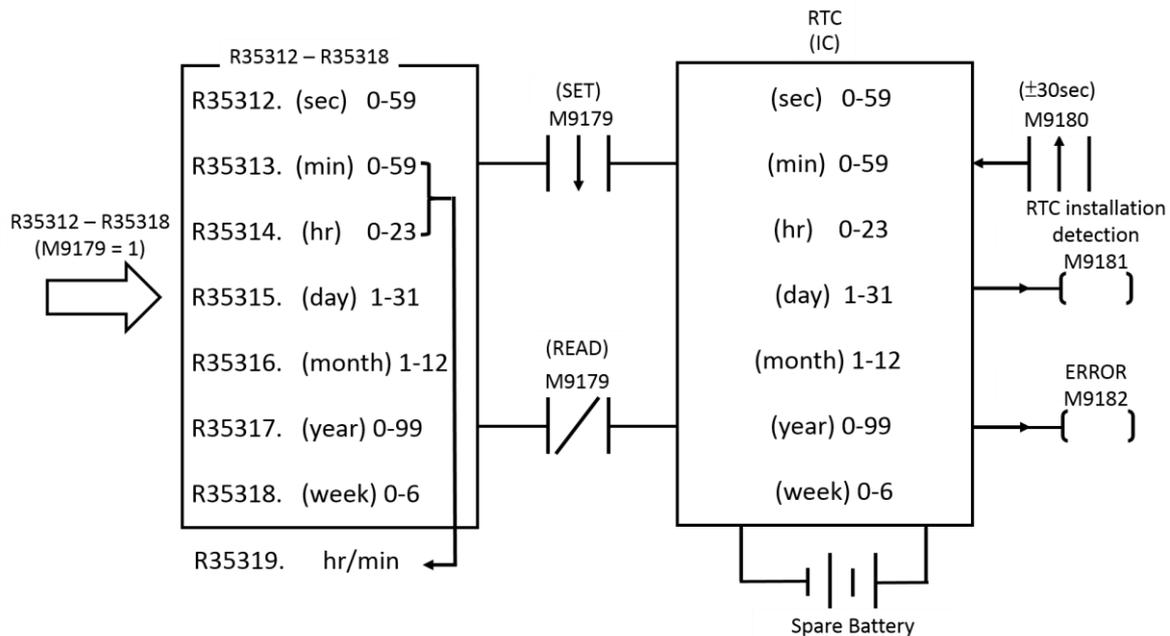

Figure 1 RTC of System and the Corresponding Register

3-1-2 RTC Access Control and Settings

Within PLC, R35312~R35318 registers have been allocated to store the time values of RTC, and this is of great convenience to the user. However, if you want to load the set values of R35312~R35318 into RTC or read out what is in RTC onto R35312~R35318, and tune the time value, etc. then the setting must be done using the special relays (M9179 and M9180) for RTC access. Below is an explanation of the access and adjustment procedures, and the status flag relays.

● RTC setting (R35312 ~ R35318→RTC):

● The setting action is only executed once at the moment that relay M1952 goes from 1→0 (falling edge).

M-Series PLC Software Function and Application User Manual
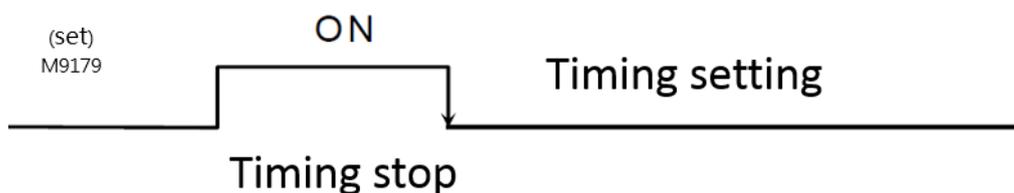
- When M9179 changes from 1 to 0, the set value of R35312~R35318 is written to the corresponding temporary register in RTC. After M9179 returns to 0, the timing action starts, and at the same time, the CPU will reversely retrieve the time value in the RTC and write it to R35312~R35318 for each scan.

- Note: If you want to load the set values into RTC, you must first make M9179 as 1 and then load the set values into R35312~R35318. The loading of the set values into R35312~R35318 can be done via MOVE instruction. However, you must first halt the RTC read out (make M9179 as 1), otherwise the data that you just wrote into R35312~R35318 will immediately be overridden by the time data being read back from RTC in the opposite direction.

- RTC readout (RTC→R35312~R35319):

  Whenever the M9179 relay is 0 (RTC timing active). With every scan, CPU will take the time value data within RTC and move it to R35312~R35319. When it is 1, it will not read out. In this case R35312~R35318 can load in the set values and they won't be overridden.

- ±30 second adjustment:

  At the moment that the status of relay M9180 goes 1, CPU will check the value of the second register (R35312) within RTC. If its value is between 0 and 29 seconds then it will be cleared to 0. If its value is between 30 and 59 seconds then besides being cleared to 0, the minute register (R35313) will be increased by 1 (i.e., one minute will be added).

- This can be used to adjust your RTC time value. That is, when the RTC time is slow, you can clear it when the value of the second register (R35312) is between 30 to 59 seconds (M9180 changes from 0 to 1), at this time, the time can be adjusted faster due to the minute carry; otherwise, when R35312 clears it at 0-29 seconds, the time can be adjusted slower.

- M1981 RTC installation detecting flag:

  When RTC is fitted to the PLC, relay M9181 will be set as 1; otherwise, it will be 0.

- M9182 set value error flag:

  When the time value which is set to RTC's IC is illegal, then the error flag relay M9182 will be set as 1, and the setting action will not be executed.

Note: The host has already set the time, so customer don't need to set it again when using it. However, if you need to reset by yourself, in addition to using your ladder diagram program and follows RTC setting method (the control of M9179) to make settings; on the UperLogic package software, we provide more convenient setting function. As long as you enter the time you want to set, press the set button to complete the setting, and you don't need to deal with the control of M9179, please refer to the instructions of the Ladder Master package software

3-1-3 Setting Calendar (RTC) with UperLogic

By setting on the UperLogic package software, it allows the user to set up the PLC perpetual calendar (RTC) without the need of using special M9179 relay and Ladder control function. Described below are the setting and the operation methods:

1. Open the UperLogic and then connect it to the PLC that will be set.

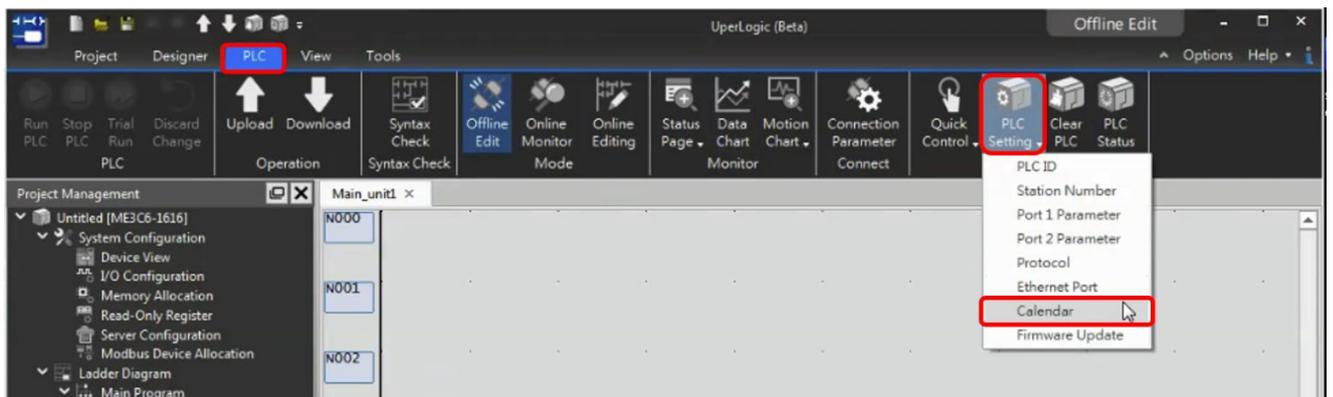2. In the upper left tool bar, click PLC-> PLC set -> RTC.

Figure 2 Selections of RTC Settings

3. After being selected, the following page will be exported.
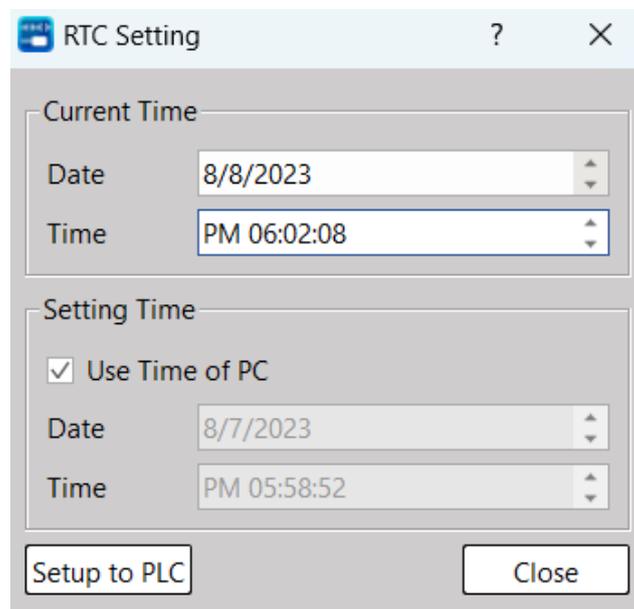
Figure 3 Window of RTC Settings

4. Adjust the time that will be set and then click the "Set to PLC" option.

Instructions and notice for the RTC setting window:

● "Current Time" column: The current time retrieved from PLC under online status.

● "Set Time" column: Tick "Use PC Time" and the PC time will be displayed in the lower-side column. Next, press the "Set to PLC" button and "Current Time" will be changed to current PC time.

● When cancelling the ticking of "Use PC Time", you may change the "Date" and "Time" in the lower-side column as required. Next, press the "Set to PLC" button again and "Current PLC Time" will be changed to the time being set currently.

● When the PLC stops running, you cannot set the RTC and the picture below will appear.
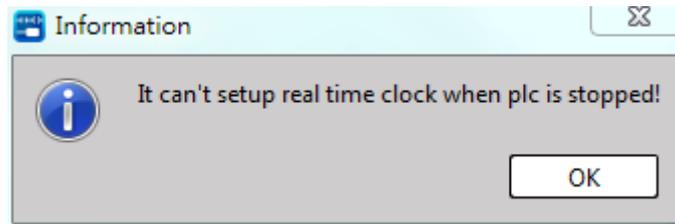
Figure 4 RTC setting is not available when the PLC stops running.

3-2 Network Time Synchronization Settings

The built-in network provides the NTP function, users can enable time synchronization, and easily achieve regular time synchronization on the host through the configured network server and related setting.

Click Project ->Server Configuration ->NTP ->Timezone to synchronize (Disable->Enable) and then set up the cycle time and the time zone that will be synchronized.

Function	Description
Enable Time Synchronization	Enable NTP Function
Synchronizing Cycle (Minute)	Set NTP Time Synchronization (1~1440 minutes)
Time Zone	Set NTP Time Zone Synchronization
NTP Server Address	Set NTP Server Synchronization

If the PLC network maintains normal communication after downloading the Project to PLC, it will run the first round of time synchronization and then execute the synchronization according to the designed synchronizing cycle. If the PLC network is unsteady after being started, the synchronization will be executed during next synchronizing cycle.
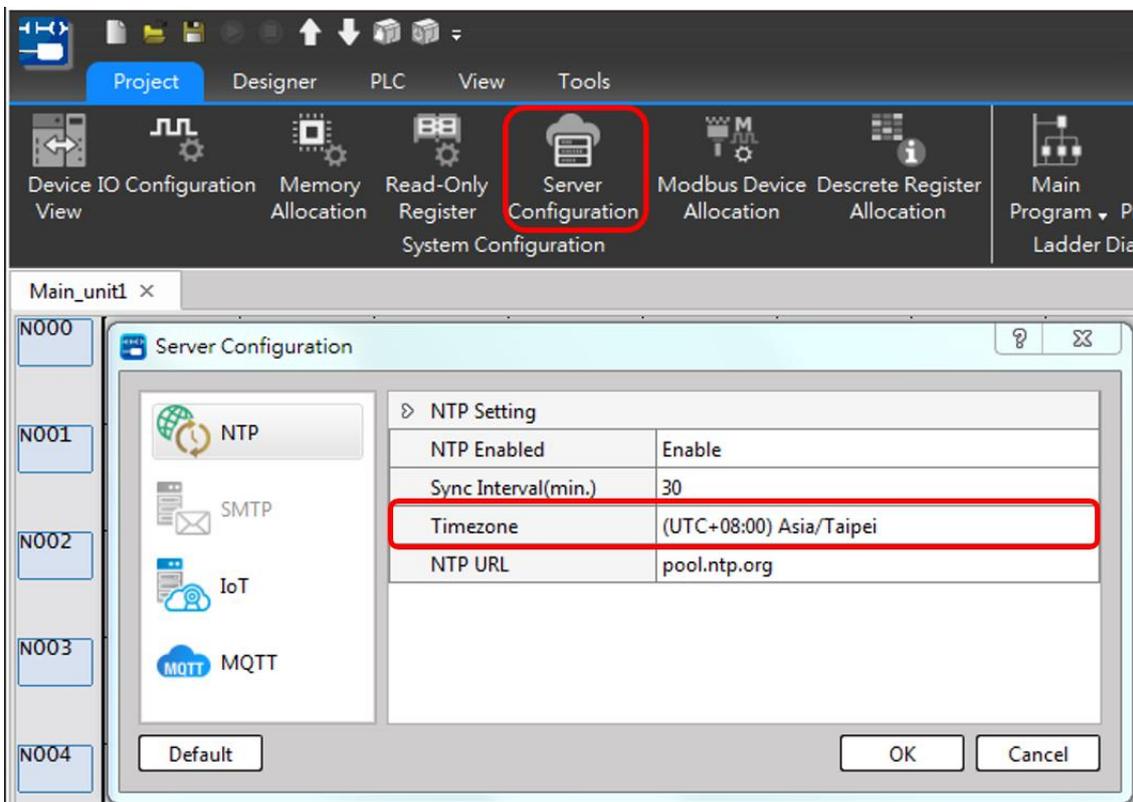
Figure 5 Setting of time synchronization on server

3-3 Timing Base

The timing base includes:

- Cyclic Pulse Function for use with the cycle-triggered special relay.

- A Timer for dealing with the time event through polling or interruption method.

3-3-1 Type of timing base

Cyclic pulse

The cycle of special relay that will change cyclically is fixed such as M9127 0.01s cyclic pulse, etc. It can be switched between ON and OFF according to 0.01s of fixed cycle. It allows the designer to apply in the change of fixed time, as per the figure below:
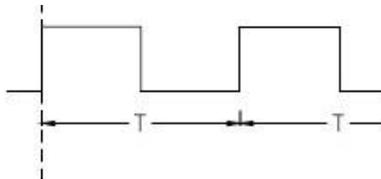

Figure 6 Schematic Diagram of Cyclic Pulse (0.01s)

Its time cycle comprises the following for patterns, i.e., 0.01s cycle, 0.1s cycle, 1s cycle and 60s cycle. For the corresponding relays, please refer to 3.3.2 of this Manual.

Time-setting Timer

During the setting cycle, such time base will interrupt the program being run by the PLC in order to run the program process designed by the user in the interrupted sub-program. When running the program to RTI (Return from Interruption), it will return to the interrupted time-point in order to continue the operation. Its time unit comprises the following for patterns, i.e., 0.1ms, 1ms and 10ms. For the corresponding relays and the available number, please refer to 3.3.2 of this Manual.

Supportive Timer types are as following:

- 0.1ms time-setting HSTA cycling counting

- 0.1ms time-setting HST

- 1ms time-setting timer STM

- 10ms time-setting timer LTM, etc.

3-3-2 Example of using Timing Base

Example of cyclic pulse

Taking 0.01s cyclic pulse relay for example, its Ladder program is shown as below:

```
M9127                                                                        Y0
──┤ ├───────────────────────────────────────────────────────────────────── ( )──
```

Figure 7 The program example of cyclic pulse

Description of example:

In the program example, "Y0" will keep changing according to 0.01s cycle because M9127 Relay will keep outputting 0->1 and 1->0 change to Y0 by using 0.01s as the cycle.

Example of Time-setting Timer

With HST 0 Relay using 0.1ms time base for example, its Ladder program is shown as below:

```
MO                                                                        M9174
──┤ ├───────────────────────────────────────────────────────────────────── ( )──

                                                          ┌─08D.MOV─┐
                                                   EN──── S :      2000
                                                          D :    R35451
                                                          └─────────┘
```

Figure 8 The main program of cyclic pulse

```
┌65┐
│LBL      HST0I │

                                                      ┌15┐
                                               EN──── (+1)      R0 ──OVF─
                                                      └──┘
┌69┐
│    RTI  │
```

Figure 9 The interrupt sub-program example of cyclic pulse

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Description of example:

After finishing the program running, the system will move "2000" to "R35451 0.1ms" for setting the timing at "HST 0" cycle. When "M0 ON", M9174 will be "ON" and it means HST 0 is active and it will change HST 0 cycle to 2000*0.1ms=0.2s and it means that the program currently run by the PLC will be interrupted every 0.2s. Next, the PLC will enter Sub-program HST01 for running "R0+1" action. After that, the PLC will run the program process that has not been finished during the previous step.

Regarding the detailed description and the introduction of interruption, please refer to Chapter 5: Interruption Function

3-3-3 List of timing base special relay

Register No.	Register Name
M9127	0.01s Cyclic pulse
M9128	0.1s Cyclic pulse
M9129	1s Cyclic pulse
M9130	60s Cyclic pulse
M9166	1ms Timer STM 0 Control
M9167	1ms Timer STM 1 Control
M9168	1ms Timer STM 2 Control
M9169	1ms Timer STM 3 Control
M9170	10ms Timer LTM 0 Control
M9171	10ms Timer LTM 1 Control
M9172	10ms Timer LTM 2 Control
M9173	10ms Timer LTM 3 Control
M9174	0.1ms Timer HST 0 Control
M9175	0.1ms Timer HST 1 Control
M9176	0.1ms Timer HST 2 Control
M9177	0.1ms Timer HST 3 Control
M9178	0.1ms Timer HSTA loop count control

Table 4 Comparison table of timing base special relay

3-3-4 List of special register

Register No.	Register Name	Description of Register
R35435	1ms timer STM 0 cyclic setting	
R35436	1ms timer STM 0 current time	
R35437	1ms timer STM 1 cyclic setting	
R35438	1ms timer STM 1 current time	
R35439	1ms timer STM 2 cyclic setting	
R35440	1ms timer STM 2 current time	
R35441	1ms timer STM 3 cyclic setting	
R35442	1ms timer STM 3 current time	
R35443	10ms timer LTM 0 cyclic setting	
R35444	10ms timer LTM 0 current time	
R35445	10ms timer LTM 1 cyclic setting	
R35446	10ms timer LTM 1 current time	
R35447	10ms timer LTM 2 cyclic setting	
R35448	10ms timer LTM 2 current time	
R35449	10ms timer LTM 3 cyclic setting	
R35450	10ms timer LTM 3 current time	
R35451	0.1ms timer HST 0 cyclic setting LOW WORD	
R35452	0.1ms timer HST 0 cyclic setting HIGH WORD	
R35453	0.1ms timer HST 0 current time LOW WORD	

R35454	0.1ms timer HST 0 current time HIGH WORD	
R35455	0.1ms timer HST 1 cyclic setting LOW WORD	
R35456	0.1ms timer HST 1 cyclic setting HIGH WORD	
R35457	0.1ms timer HST 1 current time LOW WORD	
R35458	0.1ms timer HST 1 current time HIGH WORD	
R35459	0.1ms timer HST 2 cyclic setting LOW WORD	
R35460	0.1ms timer HST 2 cyclic setting HIGH WORD	
R35461	0.1ms timer HST 2 current time LOW WORD	
R35462	0.1ms timer HST 2 current time HIGH WORD	
R35463	0.1ms timer HST 3 cyclic setting LOW WORD	
R35464	0.1ms timer HST 3 cyclic setting HIGH WORD	
R35465	0.1ms timer HST 3 current time LOW WORD	
R35466	0.1ms timer HST 3 current time HIGH WORD	
R35467	0.1ms HSTA loop current count LOW WORD	
R35468	0.1ms HSTA loop current count HIGH WORD	

Table 5 Comparison table of timing base special relay

4

Retentive Memory Allocation

4-1 Setting Retentive Memory

In addition to providing the project data and the system information, the PLC also allows the user to execute retentive preservation of important data register and digital output points being written, which means the retentive configuration will be set up successfully with the plan of related memory. In the meantime, the host provides the preservation setting of analog output register (OR), and it is also able to draft the scope of the memory that will be preserved.

4-1-1 Retentive Plan of Memory

Run function bar "Project" → "Memory setup"; or in project window, click→ "System configuration" → "Memory setup" twice and the memory setup window appears:
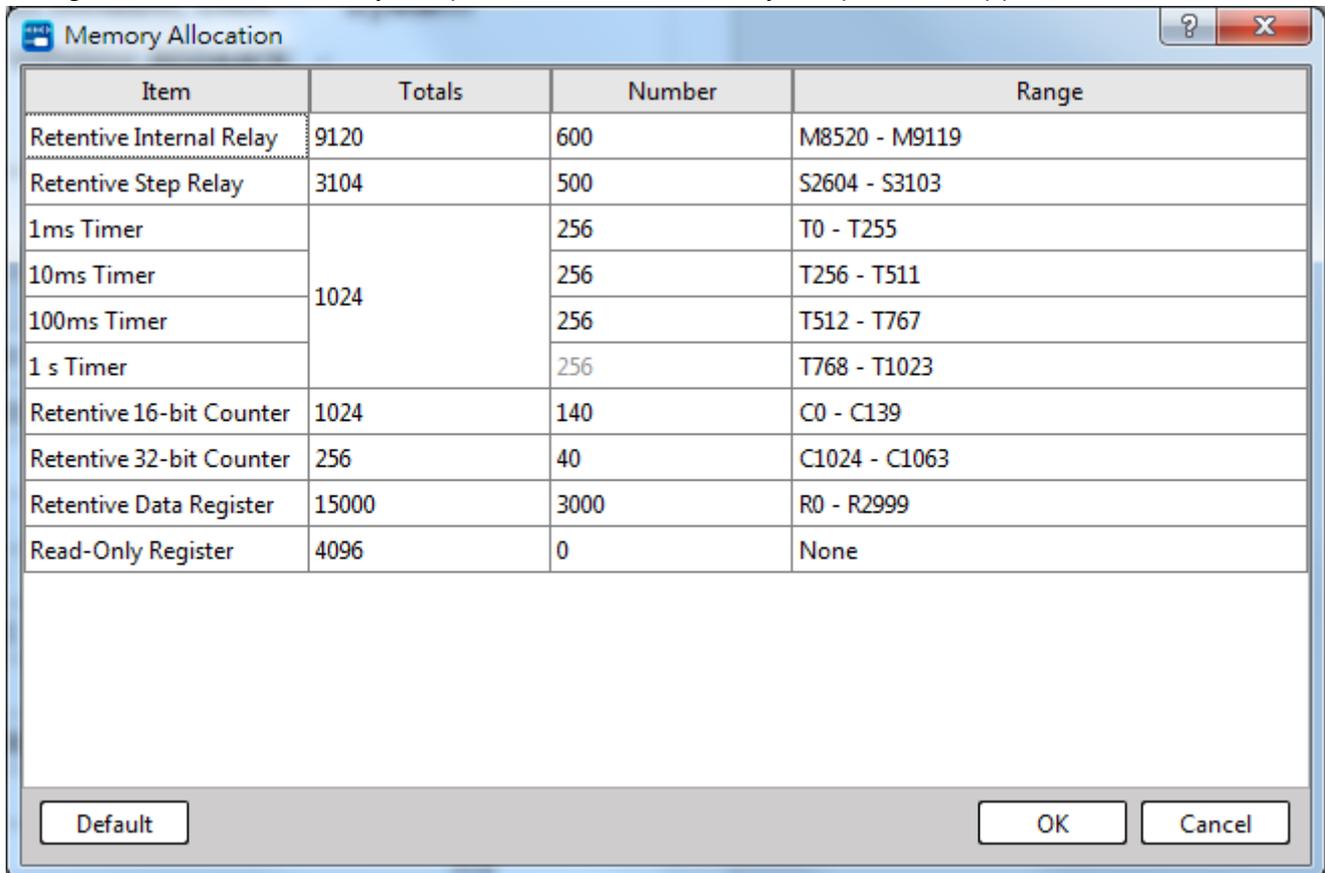
Item	Totals	Number	Range
Retentive Internal Relay	9120	600	M8520 - M9119
Retentive Step Relay	3104	500	S2604 - S3103
1ms Timer		256	T0 - T255
10ms Timer	1024	256	T256 - T511
100ms Timer		256	T512 - T767
1 s Timer		256	T768 - T1023
Retentive 16-bit Counter	1024	140	C0 - C139
Retentive 32-bit Counter	256	40	C1024 - C1063
Retentive Data Register	15000	3000	R0 - R2999
Read-Only Register	4096	0	None

Figure 10 Configuration window of memory

When delivering from the plant (by setting the PLC in initialized status), the "M SERIES PLC" has been properly arranged for setting the system configuration such as Retentive, Non-retentive coil or the distribution of the register or the scope of read-only register. Here, it is called the Default Configuration. In most applications, it is not required to change the default configuration. To cope with special or complicated applications, it also provides the UperLogic function in addition to the default configuration in order that the user may create his own setting or change the configuration. With "Preset" value, the

user may return to the initial system setting status by pressing such button. After pressing "OK", the current contact and register related information will be displayed to complete the memory configuration setting.
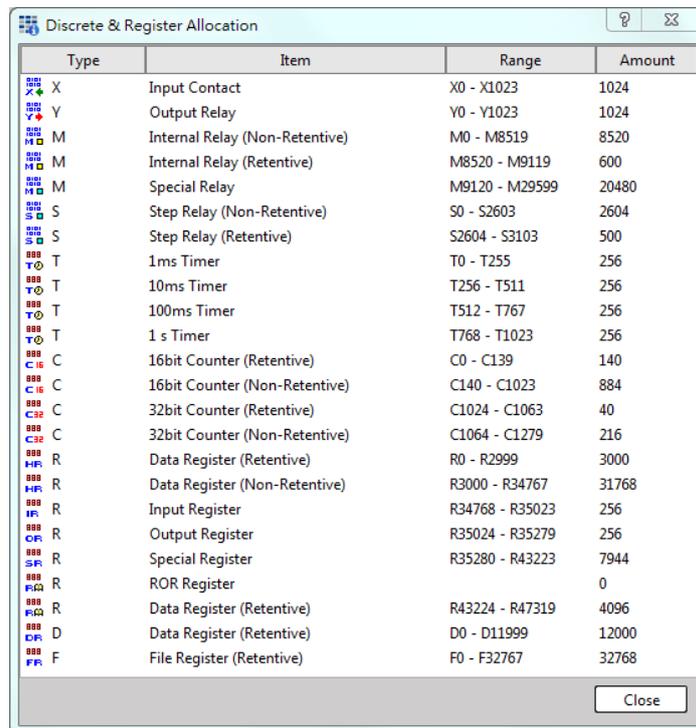
Type	Item	Range	Amount
X	Input Contact	X0 - X1023	1024
Y	Output Relay	Y0 - Y1023	1024
M	Internal Relay (Non-Retentive)	M0 - M8519	8520
M	Internal Relay (Retentive)	M8520 - M9119	600
M	Special Relay	M9120 - M29599	20480
S	Step Relay (Non-Retentive)	S0 - S2603	2604
S	Step Relay (Retentive)	S2604 - S3103	500
T	1ms Timer	T0 - T255	256
T	10ms Timer	T256 - T511	256
T	100ms Timer	T512 - T767	256
T	1 s Timer	T768 - T1023	256
C	16bit Counter (Retentive)	C0 - C139	140
C	16bit Counter (Non-Retentive)	C140 - C1023	884
C	32bit Counter (Retentive)	C1024 - C1063	40
C	32bit Counter (Non-Retentive)	C1064 - C1279	216
R	Data Register (Retentive)	R0 - R2999	3000
R	Data Register (Non-Retentive)	R3000 - R34767	31768
R	Input Register	R34768 - R35023	256
R	Output Register	R35024 - R35279	256
R	Special Register	R35280 - R43223	7944
R	ROR Register		0
R	Data Register (Retentive)	R43224 - R47319	4096
D	Data Register (Retentive)	D0 - D11999	12000
F	File Register (Retentive)	F0 - F32767	32768

Figure 11 Discrete and Register Allocation

When restarting after shutdown or when setting the PLC from STOP→RUN, the Non-retentive replay or register will be cleared as "0"; however, the Retentive will maintain the original status (before shutdown or when STOP).

4-1-2 Setting the retentive output register

The amount of general output register (R35024~R35279) will not be retained after shutdown or under the operation STOP->RUN. Please click "Apply retentive output register" below Figure 10 to unlock the function of retention.

4-1-3 Output shutdown retention

The general digital output contacts will not be retained after shutdown or under the operation STOP->RUN**. The function can be unlocked in project window, click→ "System configuration" → "I/O configuration" and choose output setting to operate the function:**

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| I/O Configuration | | ? | × |

High Speed Counter | Interrupt | Output Setup | Input Setup

∨ Input		▷ Retentive Output Coil	
X0 Undefined		Select All	☐
X1 Undefined			
X2 Undefined		Y0	☐
X3 Undefined		Y1	☐
X4 Undefined			
X5 Undefined		Y2	☐
X6 Undefined		Y3	☐
X7 Undefined			
X8 Undefined		Y4	▣
X9 Undefined		Y5	☐
X10 Undefined			
X11 Undefined		Y6	☐
X12 Undefined		Y7	☐
X13 Undefined			
X14 Undefined		Y8	☐
X15 Undefined		Y9	☐
∨ Output		Y10	☐
Y0 Undefined		Y11	☐
Y1 Undefined			
Y2 Undefined		Y12	☐
Y3 Undefined		Y13	☐
Y4 Undefined		Y14	☐

I/O Check   OK   Cancel

Figure 12 The setting of output shutdown retention

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5

Interrupt Function

5-1 The Principle and the Structure of Interrupt Function

There are many jobs that M-Series PLC needs to carry out. For example, there are at least 20k words user's program need to be solved, 1024 points of I/O status need to be captured or updated, many communication ports need to be serviced, and etc. However, jobs can only be executed one at a time as there is merely one CPU available. Therefore, PLC service one job after another in sequence until all the jobs are executed once. Then, it will return to the first job to repeat the same cycle. The time interval of each execution is called the "scan time" of PLC. The CPU execution speed is extremely fast in comparison with human response. As far as human feeling is concerned, PLC almost completes all jobs at the same time when PLC can normally complete the foregoing huge workload within tens of milliseconds(ms). Hence, it can meet the requirements of the most practical control cases.

In most application cases, the control method described above is very much sufficient. But for some applications that require a high-speed response (such as positioning control), a delay in scan time will certainly mean an increase in error. Under the circumstances, only applying the "Interrupt" function can achieve the precision requirement.

The so-called "Interrupt" means the interrupt request to the CPU during normal scan cycle when an immediate response is required. After receiving such request, the CPU will promptly stop all scanning work to prioritize to perform and complete the corresponding service work before return (the so-called "Return from Interrupt" or RTI) to where interrupt occurred and resume the interrupted scanning work. The service work needed to carry out while interrupt occurred is called Interrupt Service Routine, which is a subroutine consisted by a series of ladder codes. It is placed in the subroutine area and begin with the LBL instruction with reserved label name (please refer to Section 5.3). Since it is placed in the subroutine area, it will not be executed in a normal PLC scanning cycle (PLC only constantly scans the main program area but not the subroutine area).

In normal case, the CPU can promptly execute the corresponding interrupt routine within hundreds of micro-seconds when an interrupt occurred. When there are more than one interrupt occurred at the same time (i.e., M-Series PLC has 36 interrupts source), only the interrupt with highest priority can be executed. All the other interrupt routines need to wait until it became the highest priority among the pending interrupts. Consequently, a response delay of hundreds of microseconds, or even few milliseconds, may be caused. Hence, in a multiple interrupt inputs structure, an interrupt priority is given to each interrupt in accordance with its importance. In case another interrupt request is made when the PLC is carrying out the interrupt service routine for an interrupt request that has a higher priority than the new interrupt request, the CPU will wait until the execution of the subroutine is completed before accepting the new interrupt request. However, if the priority of the new interrupt request is higher than the one being executed, the CPU will stop the running of the current interrupt service routine immediately to execute the interrupt service routine with a higher priority. After completing the execution, the CPU will return to the previously interrupted service routine with a lower priority to continue the incomplete work. This kind of interrupt in an interrupt execution is called the "Nested Interrupt".

5-1 Structure and Application of Interrupt Service Routine

Although both "Interrupt" and "Call" are having subroutines, but the calling methods (to jump to subroutine for execution) are different. When the CALL command [FUN67] is executed by "Call" in the main program, the CPU will execute the subroutine with the label name designated by the CALL command. The CPU will return to the main program after the RTS (Return from Subroutine) command is executed.

The calling of "Interrupt" is triggered by, instead of using software commands, the hardware interrupt signal to the CPU. The CPU will identify the source of the interrupt and jump automatically to the "Interrupt Service Routine" with the label name of the interrupt in the subroutine for execution. It will return to the main program after the RTI (Return from Interrupt) command is executed. Therefore, there is no ladder code relevant to interrupt in the main program area.

As mentioned before, interrupt service routine must be placed in the sub program area. The structure is shown as the diagram on the right where a "head", a "tail" and the main body of the service routine are included. The "head" is the "interrupt label name" of the interrupt (to be discussed in the next section). The "tail" is the RTI command [FUN69], to tell the CPU that the interrupt subroutine is ended and it should jump to the place where were interrupted, please refers to FUN69 (RTI) instruction. In between the "head" and the "tail" is the main body of the interrupt service routine used to tell the CPU what control actions should be executed when interrupt occurs.

The power line for subroutine is indicated by double lines to differentiate from the power line for the main program (single line) for easy reading.
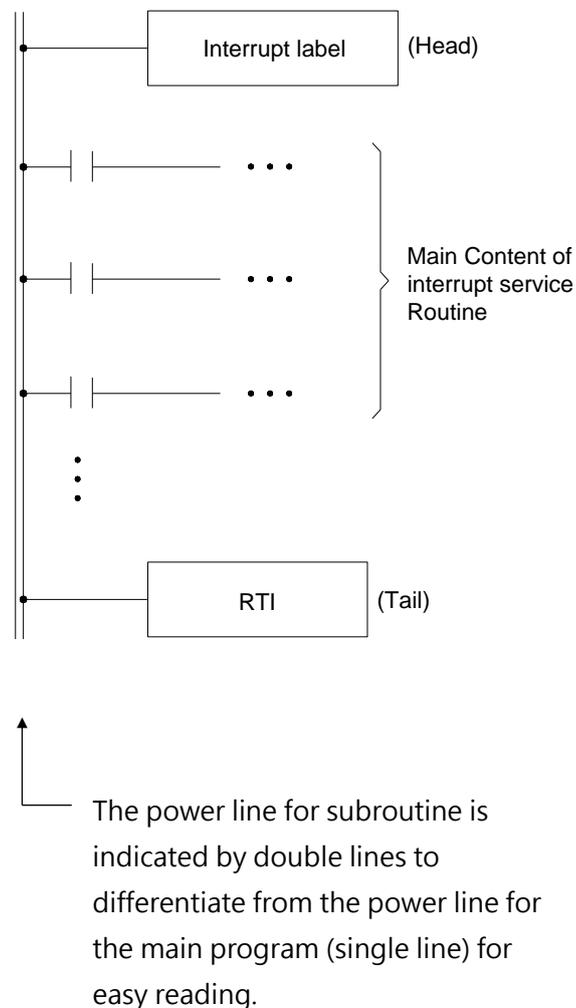
Figure 12 Interrupt Service Routine

5-2 Interrupt Source, Label and Priority

As described in the last section, every "Interrupt Service Routine" should have a unique "Interrupt Label". There are "Interrupt Labels" for interrupts, namely "Interrupt Reserve Words "in UperLogic, can be used in the sub program area of M-Series PLC. These labels are dedicated to the interrupt routines hence cannot use for normal subroutine or jump target.

The "Interrupt Label" (Interrupt Reserve Words) are all suffix with an "I" letter. For examples, the interrupt label for high-speed counter HSC0 should be "HSC0I" and the interrupt label for X0+ should be "X0+I". The "Interrupt Labels" and their priorities for M-Series PLC interrupt sources are shown as below.

The following table is the interrupt sources and their label names, the principle of use is to use STM0I~STM3I, X0+I~X7 first。

The smaller the priority value, the higher the priority of the interrupt source or tag.

No.	Suspension source	Priority	Suspension marking	Conditions	Remark
1	Hardware timing base	3	STM0I	Interval: 1ms–9ms	Time unit: 1ms
2		3	STM1I	Interval: 1ms–9ms	
3		3	STM2I	Interval: 1ms–9ms	
4		3	STM3I	Interval: 1ms–9ms	
5		3	LTM0I	Interval: 10ms–60000ms	Time unit: 10ms
6		3	LTM1I	Interval: 10ms–60000ms	
7		3	LTM2I	Interval:10ms–60000ms	
8		3	LTM3I	Interval:10ms–60000ms	
9	HSC	2	HSC0I	Interval: HSC0 to (CV=PV)	
10		2	HSC1I	Interval: HSC1 to (CV=PV)	
11		2	HSC2I	Interval: HSC2 to (CV=PV)	
12		2	HSC3I	Interval: HSC3 to (CV=PV)	
13		2	HSC4I	Interval: HSC4 to (CV=PV)	

14		2	HSC5I	Interval: HSC5 to (CV=PV)	Basic Host
15		2	HSC6I	Interval: HSC6 to (CV=PV)	Support
16		2	HSC7I	Interval: HSC7 to (CV=PV)	
17	HST	1	HST0I	Interval: HST0 to (CV=PV)	Time unit: 100us
18		1	HST1I	Interval: HST1 to (CV=PV)	
19		1	HST2I	Interval: HST2 to (CV=PV)	
20		1	HST3I	Interval: HST3 to (CV=PV)	
21	Built-in digital input	2	X0+I (INT0+)	X0 Positive edge triggered	
22		2	X0–I (INT0-)	X0 Negative edge triggered	
23		2	X1+I (INT1+)	X1 Positive edge triggered	
24		2	X1–I (INT1-)	X1Negative edge triggered	
25		2	X2+I (INT2+)	X2 Positive edge triggered	
26		2	X2–I (INT2-)	X2 Negative edge triggered	
27		2	X3+I (INT3+)	X3 Positive edge triggered	
28		2	X3–I (INT3-)	X3 Negative edge triggered	
29		2	X4+I (INT4+)	X4 Positive edge triggered	
30		2	X4–I (INT4-)	X4 Negative edge triggered	
31		2	X5+I (INT5+)	X5 Positive edge triggered	
32		2	X5–I (INT5-)	X5 Negative edge triggered	
33		2	X6+I (INT6+)	X6 Positive edge triggered	

34		2	X6–I (INT6-)	X6 Negative edge triggered	
35		2	X7+I (INT7+)	X7 Positive edge triggered	
36		2	X7–I (INT7-)	X7 Negative edge triggered	

5-4 How to use Interrupt Function?

Whether internal timing suspension, external input suspension or HSC/HST interruption, a similar operating method will be used. Because a dedicated section is provided for describing the operation method of HSC/HST, this section shall provide the example in order to explain internal timing suspension and external input suspension.

```
                    ┌─────────────┐
                    │    Start    │
                    └──────┬──────┘
                           │
                           ▼
    ┌──────────────────────────────┐
    │ Set up the Interrupt value in │   -------------------For special register,
    │ Main Program Field: For        │   please refer to Appendix A,
    │ example, set the STMO cycle    │
    │ as R35435.                     │
    └──────────────┬────────────────┘
                   │
                   ▼
    ┌──────────────────────────────┐
    │ In Main Program Field,         │   -------------------For special register,
    │ trigger the Interrupt of special │ please refer to Appendix A,
    │ relay; for example, set STM0   │
    │ as M9166.                      │
    └──────────────┬────────────────┘
                   │
                   ▼
    ┌──────────────────────────────┐
    │ In sub-program field, write    │   ----------------please refer to
    │ the service Interrupt program. │   Section 5.6-
    └──────────────┬────────────────┘
                   │
                   ▼
             ┌───────────┐
             │    End    │
             └───────────┘
```
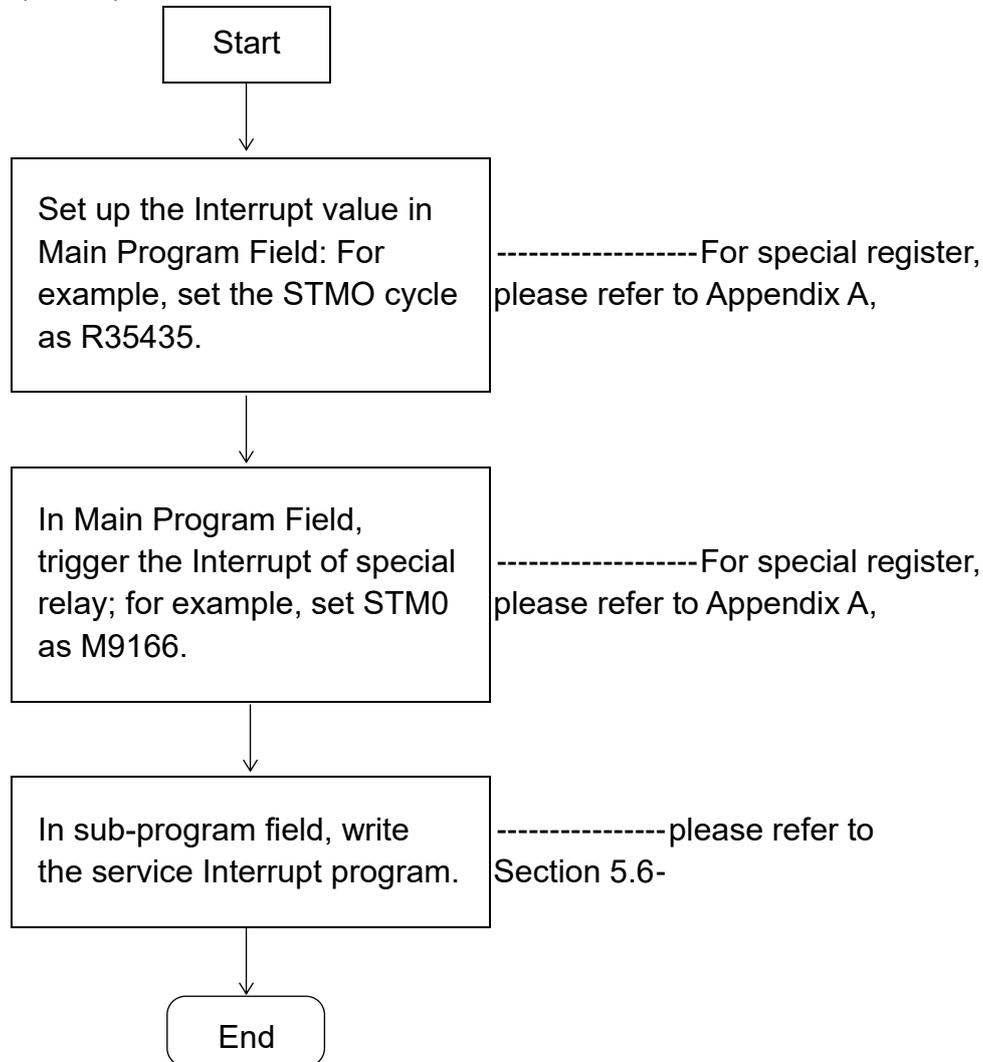
Figure 13 The configuration of time-setting interrupt

```
        ┌─────────────┐
        │    Start    │
        └─────────────┘
               │
               ▼
   ┌──────────────────────┐
   │ Set up the suspended │ ------------------- Please refer to Section 5.5
   │ configuration        │
   └──────────────────────┘
               │
               ▼
   ┌──────────────────────┐
   │ In sub-program field, │
   │ write the service     │ ---------------- Please refer to Section 5.6
   │ suspension program    │
   └──────────────────────┘
               │
               ▼
         ╭─────────────╮
         │     End     │
         ╰─────────────╯
```
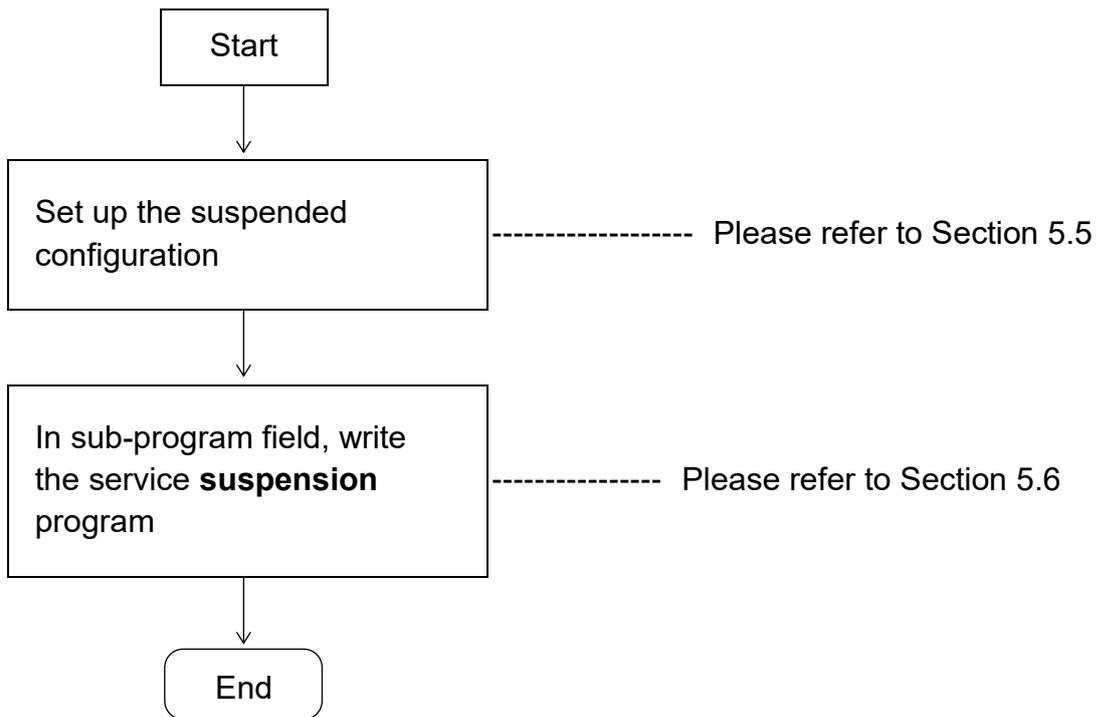
Figure 14 The configuration of external interrupt

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5-5 Configuring the Interrupt Function

In fact, the interrupt configuration means the application regarding whether certain interrupt functions should be used or not.

The interrupt configuration comprises the I/O relevant configuration and the I/O irrelevant configuration. When using the I/O relevant HSC/HST and external interrupt, activate the corresponding I/O interrupt in the I/O configuration of the UperLogic System. After being configured, the system will trigger the Enable to suspend such device.

As for the "internal timing interrupt" irrelevant to I/O, the system will regard it that such interrupt function is being planned when the interrupt-running sub-program is enabled by the "Timing interrupt" wording that will be displayed in the sub-program field. In this case, set the interrupt cycle with Special Register and then enable the interrupt function by triggering the corresponding Special Relay. The value required for setting up the interrupt of Special Register cannot be written after Special Relay is triggered. Therefore, it should be changed before triggering the relay.

5-5-1 Example of Interrupt Configuration

In project window, click "I/O Configuration Setup"： Project Name

System configuration

I/O configuration → Select "interrupt setup"

After displaying the "Interrupt setup" picture, you may click the external input that will be suspended in the window.
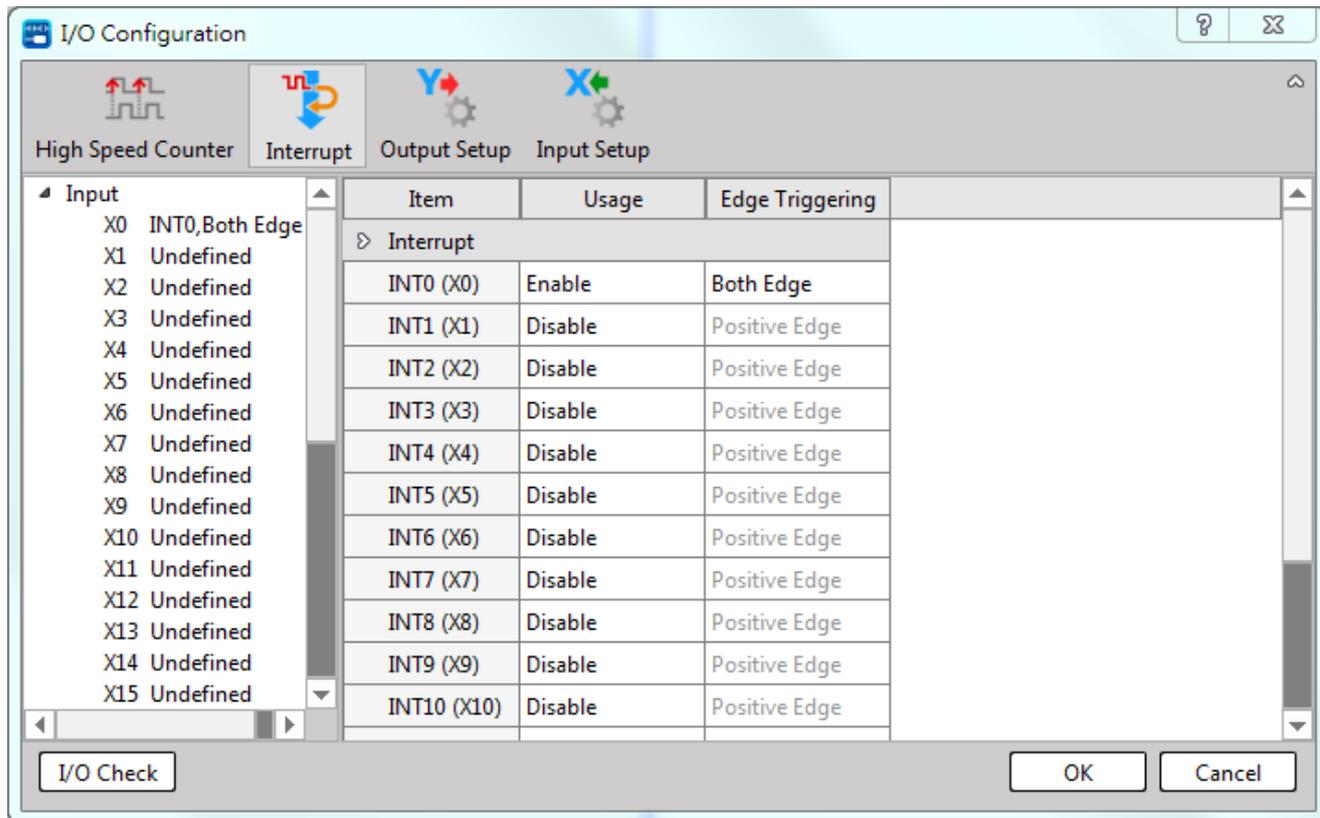
Figure 15 Interrupt Configuration

5-6 Type of Interrupt Function

5-6-1 Hardware timing base

The hardware time base comprises 1ms STM, 10ms LTM, 0.1ms graduation of High-speed Timer HST and a 32-bit cycle timer. In addition to the cycle timer, other hardware timing bases support interrupts, and can be turned on or off by calling the EN (FUN145) and DIS (FUN146) commands (after setting its special relay, the default is on). Interrupts are used by triggering their corresponding special relays. According to the period value of the register corresponding to the timing base, the interrupt program is executed periodically; the current timing register is also provided as a program or monitoring. See Section 8.2 for details.

Time-setting Timer STM

Totaling 4 of 16-bit timer, time unit: 1ms.

Time-setting Timer LTM

Totaling 4 of 16-bit timer, time unit: 10ms.

High-speed Timer HST

Totaling 4 of 32-bit high-speed timer, time unit: 0.1ms.

Cycle Timer HSTA

Totaling 1 of 32-bit cycle timer, time unit: 0.1ms.

5-6-2 High-speed Counter HSC

M-Series PLC supports the Hardware High-Speed Counter (briefed as HHSC) configured by hardware circuit. Such HHSC can read the high-speed signal that cannot be achieved by conventional counters. In this regard, M-Series PLC comprises 8 units of HHSCs (in SoC chip) and they are serving as 32-bit high-speed counters (HSC0–HSC7). For details, please refer to Section 8.1.

5-6-3 External Interrupt

The external interrupt is mainly used in the application that needs to be executed or reflected within a very short period of time when receiving the external signal from the PLC. When compared to general input, the external interrupt may vary according to the program scanning time. The system can execute the content of externally imported interrupt within a very short period of time in order to achieve the control action such as stopping the motor immediately when the motor reaches the intended position.

- The external interrupt is sharing 8 units of high-speed input points ranging from X0 to X7 with HSC. Therefore, the input point code being used by HSC cannot be configured in external interrupt.

● Once completing the interrupt configuration, it cannot be changed during the PLC RUN process. In spite of this, M-Series PLC provides EN command (FUN145) and DIS command (FUN146) to allow or prohibit the external interrupt and the HSC interrupt so as to control the change flexibly during the PLC RUN process. Please refer to the description of the aforesaid two commands.

5-7 Example of Interrupt Program

Regarding the content of interrupt, following suggestions are provided as a reference for users:

● The content of the suspended program should be short and concise in order to improve the PLC efficiency.

● If time is not an important factor for the time interrupt program, you may write the Timer in Main Program and then trigger the type of the required sub-program.

● The Jump and Label commands can be used in the suspended program for jumping alternately in the suspended program. However, you cannot jump from Main Program or Sub-program to the suspended Label or jump from the suspended content to the Main Program or Sub-program Label. Indicated below is the concept diagram:
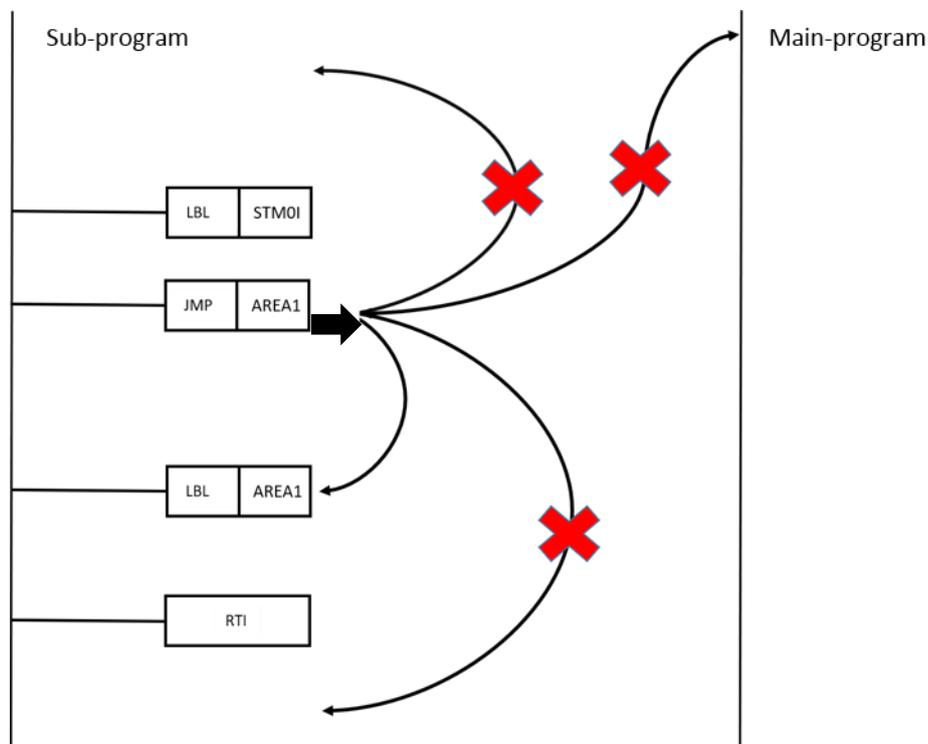
Figure 16 Using JUMP in an interrupt program

Example 1

Example of position precision control for desired contact by suspending "X0+" with external hardware:

X0: Detects the position of sensor

X1: Emergency stop

Y0: Controlling motor

【External interrupt configuration】

【INT : X0+】	During the configuration, input X0 and then issue the interrupt signal when 0→1

【Main Program】
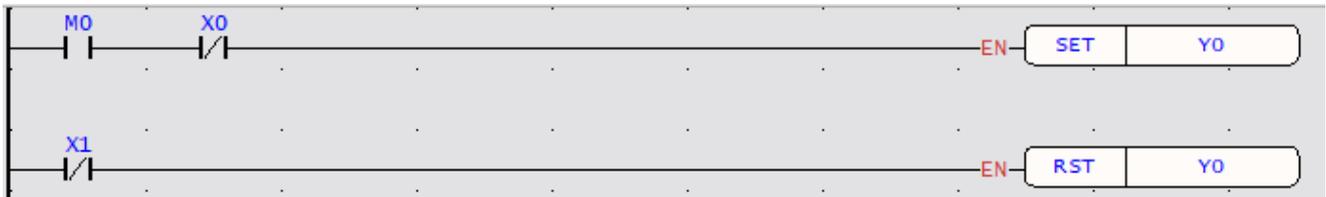
M0 (Enable). When 0→1, the Controlling Motor is ON.

【Sub-program】
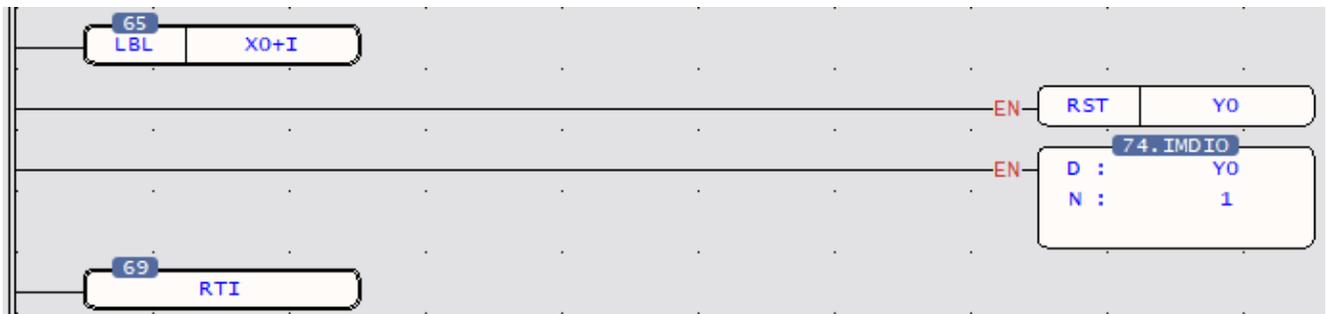
When Sensor X0 detects that the command reaches the detected position. i.e., when X0 becomes 0→1 and the hardware will execute such Interrupt Sub-program automatically.

When the Controlling Motor changes from Y0 to 0, the system will stop the motor immediately.

In the interrupt sub-program, you need to issue the Input/Output command immediately in order to achieve the real-time high-speed precision control effect.

Example 2   1ms internal timing interrupt

【Main Program】

When M0=1, set the interrupt cycle of STM0 as 1ms. After R35435=1 and M1=1, the STM0 will execute timing interrupt once every 1ms.

【Sub-program】
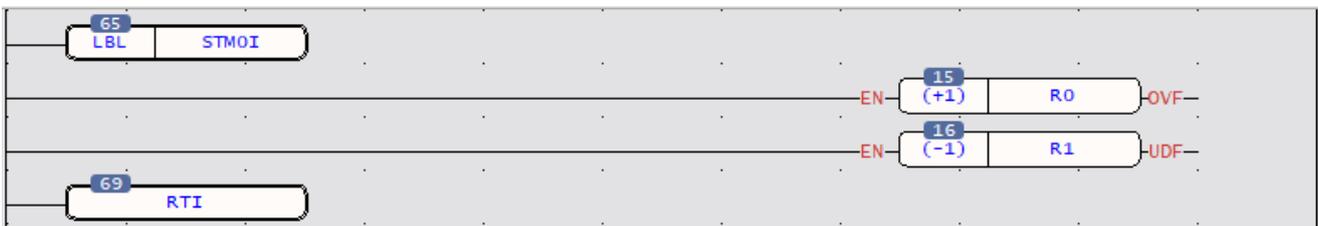
After enabling 1ms timing suspension, the system will run such suspension sub-program every 1ms automatically.

R0 serves as the up-cycle timer of 1ms time base.

R1 serves as the down-cycle timer of 1ms time base.

6

Program Scanning Time

6-1 Setting the Scanning Time

The program scanning time means the duration required for the PLC to complete the scanning of program change per time, and the PLC will execute the scanning from left to right and from top to bottom cyclically according to the procedure. Such working type is executed by scanning the status of each input point sequentially according to the system procedure. During the entire process, the status will be computed according to the procedure set by the user and then the system will issue the corresponding control signal sequentially to each output point. During the scanning process, apart from the aforesaid items, the PLC needs to carry out the self-diagnosis in order to communicate with external devices for processing the events that have been detected. Normally, the PLC is executing the scanning from top to bottom item by item and the event that interrupts the cyclic scanning will be regarded as the suspension in order to suspend the corresponding suspension procedure. After that, the system will continue the scanning from the suspended point. The scanning time is closely related to the length of the user's procedure, the type of suspension and the speed of command executed by the PLC. If the user sets up a longer procedure, the command execution time will take a pretty large percentage of the scanning time. Therefore, the scanning time will be extended according to the length of the procedure, the type of the command, the suspension processing and the communication, etc. To know about the information relating to PLC scanning time, max. scanning time and min. scanning time, the user may refer to the corresponding relay setting table specified in "6.2: Scanning Time Monitoring".

In the meantime, the user may also set up a fixed scanning time for the PLC to run the user's procedure according to such scanning time in order to coordinate with the required special applications. Through the monitoring window, the user may input the fixed scanning time required for R35373 special relay. Following that, the PLC will run the user procedure according to the fixed scanning time and the unit required for the input time will be expressed as "ms". If the actual execution time was longer than configuration time, the operation will be based on the real time

Status Page				
Name	Status	Data	Comment	Name
R35370	DEC	0	[R35370]	
R35371	DEC	0	[R35371]	
R35372	DEC	0	[R35372]	
R35373	DEC	0	[R35373]	

Figure 17 Configuration of fixed scanning time

Through FUN08 MOV function, the user may also input the desired R35373 value to the relay.

Example:
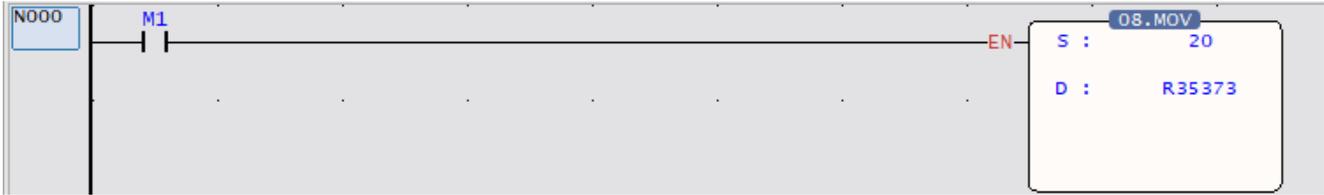
Figure 18 Example program of changing fixed scanning time

After turning on Contact-A of M1, the system will export "20" to R35373 (time unit is expressed as "ms"). Therefore, the scanning will become 20ms.

6-2 Monitoring the Scanning Time

To check the duration of scanning time, the max. or the min. scanning time (such time will change along with the size of user's program), you may input R35370, R35371, R35372 and R35373 in the monitoring window and then start the inquiry.

Corresponding relay	Function description
R35370	Current scanning time
R35371	Max. scanning time
R35372	Min. scanning time
R35373	Fixed scanning time

Table 7 Monitoring the scanning time of corresponding relay

Name	Status	Data	Comment	Name	Status
R35370	DEC	1	[R35370]		
R35371	DEC	1	[R35371]		
R35372	DEC	0	[R35372]		
R35373	DEC	0	[R35373]		

Figure 19 Inquiry of Current scanning time, Max. scanning time, Min. scanning time

7

Memory Card Function

M-Series PLC supports FATEK Memory Card, and the supportive specifications depends on the chosen host machine. The memory card and description are shown below:

Item	MFM06
System	FAT32
Function	Host/Expansion Module Updating System Backup and Restoration (Register/Program/System Data) Access of Memory Card Register Protection of Copy Collection of Data

Host/Expansion Module Updating

Multiple expansion modules and host firmware can be updated to easily complete system upgrades.

System Backup and Restoration (Register/Program/System Data)

Users can quickly copy the program during mass production through the memory card. After the designer completes the first machine tool, subsequent machines can use this function to quickly complete a large number of copy shipments.

Access of Memory Card Register

During the execution of the Ladder program, the user backs up the register data through the special command WR-MP (161), or writes the backup data to a specific register address through the special command RD-MP (162).

Protection of Copy

One-to-one binding between the memory card and the host provides a protection method for the user to misuse the memory card. If you want to unbind, you need to execute the unbind action on the original host.

Collection of Data

The host computer collects data from registers and contacts according to relevant settings, and supports CSV format for users to conduct follow-up inspection and analysis.

7-1 Writing Backup Information

The execution time of backing up information is when the host is powered on, and the restriction is that it must be in shutdown mode. Therefore, if the memory card written into the system backup is to be backed up on a host computer, it must be inserted into the slot before power-on, and the DIP switch must be switched to shutdown mode before power-on. Subsequent hosts will perform restoration operations according to the backup content of the memory card.
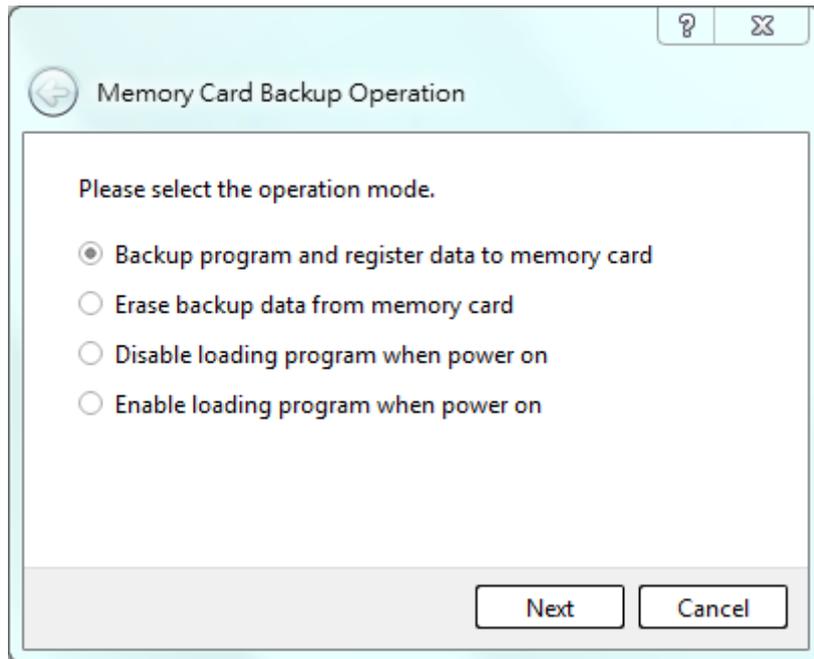
Figure 21 Writing Backup Information

7-1-1 Writing Backup Information through Software

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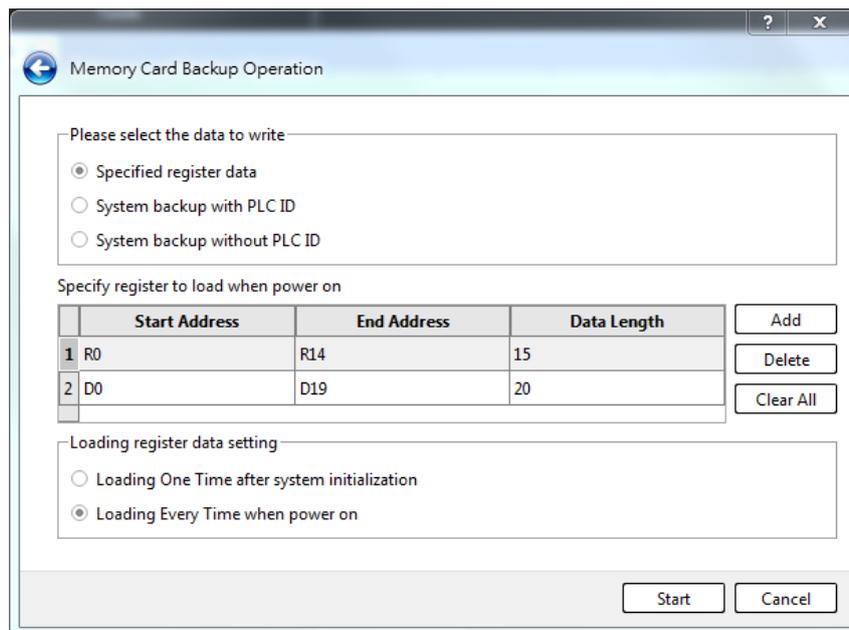
Figure 22 Replicating Program and Register to Memory Card

● Data_Data Register to be replicated

With such option, you may replicate the program and register content to the memory card. After selecting "Add", the system will display the data register picture showing the register that has been appointed for replicating to the memory card. On such planning page, you may define the scope of register that will be read back from the memory card when turning on the PLC. If not required, you may back up the data register on the memory card and then press "Start" to start the replicating process.

※ The PLC allows you to replicate max. 4 lots of data registers to the memory card. You may execute the addition or deduction by clicking "Add" or "Delete".

※ Upon each start, the memory card will display the data register being replicated on the memory card such as the machine adjustment value or the constant application value. As a result, you may use the initial value of the data register corresponding to the RAM of the CPU module as the value being written to the memory card in order that correct operating data will be saved permanently and that the maintenance will be executed more easily.

※ To copy the content of all registers to the memory card, simply click "System backup" without the need of executing the addition item by item.

● Replicated Data_System Backup (including PLC ID)

If it is required to include the PLC ID in the selected system backup copy, the PLC ID and the program will be loaded by the Memory Card upon each start. Depending on the options to be replicated, the Memory Card will upload all of the register data and the contact status that will be replicated per time (selecting "Upload for each start") or once (selecting "Upload once when initialized"). In other words, the Memory Card created by such mode can be used to replicate massive amounts of data and upload the

required ID (i.e. Program ID and PLC ID) to serve as the operation protecting control program in the PLC host without the need of setting the ID through the program editing tool. When using Program ID and PLC ID as the operation protecting control program, do not install the Memory Card created by such mode on the PLC host; otherwise, the protection purpose will never be achieved.

● Replicated Data_System Backup (excluding PLC ID):

If it is not required to include the PLC ID in the selected system backup copy, the Memory Card created by such mode will not include the replicated PLC ID. In this case, the Memory Card will upload the program upon each start. Depending on the options to be replicated, the Memory Card will upload all of the data, the register and the contact status that should be replicated per time (selecting "Upload for each start") or once (selecting "Upload once when initialized"). When installing the Memory Card being set with Program ID for operation protecting on another PLC, the PLC ID of such PLC must be the same as the Program ID used by Memory Card so that such PLC will operate normally.

For the system that needs the Program ID and PLC ID to achieve the operation protection, such method can be used for replicating the ID to the Memory Card in order to realize mass production and long-term maintenance purposes.

7-1-2 Manual Backup Production

In order to meet the application requirements of different customers, the replication of the Memory Card can also be completed by setting the content value of the special register. The UperLogic users can skip this part because the setting is completed when the UperLogic performs the Memory Card operation option.

Related Register of Replicating Memory Card:
● R35480: Test-run modification mode or replicate the Memory Card command and status:

Register	Setting	Description of Function
R35480	5530H (Test-run Modification Mode)	If the Memory Card has been programmed with a Ladder program, the Ladder program stored in the RAM of the CPU module will not be overwritten by the Ladder program of the Memory Card every time it is turned on; that is, the Ladder program of the RAM of the CPU module will remain at the last modification state (when the PLC is running or being modified, it actually executes the Ladder program in the RAM of the CPU module). After the machine is in operation, if you need to

		modify the program, you can use this function; after all the modification and testing are completed, replicate the Ladder program and data register to the Memory Card. In case you want to give up during the program modification process and want to restore the original state, you only need to clear R35480 to 0 and restart the computer.
	Other Value	If the Memory Card has been programmed with a Ladder program, the Ladder program on the Memory Card will overwrite the Ladder program stored in the RAM of the CPU module each time the machine is turned on, and the PLC will automatically enter the RUN mode. If a Memory Card is installed in the CPU module, after each test is completed, it is best to replicate the Ladder program and data register to the Memory Card for long-term storage and convenient maintenance.

Table 10 Function of memory card-related register_R35480

● R35479 : Reading selection of the data register written in the Memory Card; when programming the Ladder program to the Memory Card, if there is also a plan to burn the data register (part or all) at the same time, each time the computer is turned on, The content of the data register that has been replicated to the Memory Card will be initialized to the value at the time of burning; this application will replicate the tuning parameters (stored in the data register) to the Memory Card after the test is completed. Mass production or maintenance would be of great help. However, there are many applications that only need to initialize the data register programmed into the Memory Card at the first boot, and the data register must maintain the value before shutdown when booting up later. The user can control the value of the data register R4046 to achieve the above two applications, the description is as follows:

Register	Setting	Description of Function
R35479	5530H	The data registers replicated to the Memory Card will not be initialized at startup, that is, the data registers will retain the value before shutdown.
	Other Value	Every time the computer is turned on, the contents of the data registers programmed into the Memory Card will be initialized to the values at the time of replicating.

Table 11 Function of memory card-related register_R35479

※ If you only need to initialize the data registers programmed into the Memory Card at the first boot, you only need to write the value of R35479 into 5530H in the Ladder program.

● In RUN/STOP mode, the PLC can issue the command to clear the Memory Card or replicate the Ladder + Register command:

Register	Setting	Description of Function
R35480	5550H	Issue the Clear Memory Card Command
	5551H	Clearing
	5552H	Clear Comparison
	5553H	Clear Completed
	5554H	Clear Failed
	5560H	Issue the Command to Replicate Ladder + Register
	5562H	Replicating Ladder Program
	5563H	Replicating Register
	5566H	Comparing the Replicated Ladder Program
	5567H	Comparing the Replicated Register
	556AH	Ladder + Register Replication Completed
	556BH	Ladder Program Replication Error
	556CH	Register Replication Error

Table 12 Function of memory card-related register_R35480_2

7-1-3 Clearing Memory Card Data

Such option allows the user to remove the program or the data saved on the Memory Card. Press "Start" and the system will start the removal action. After that, the corresponding window will pop up informing the user if the clearing action is successfully done.

7-1-4 Entering Test-run Modification Mode

Such option allows the user to select whether to enter the Test-run Modification Mode (i.e. whether allowing the program and the data on the Memory Card to override that saved on the host). Press "Start" and you may enter the Test-run Modification Mode (without overriding the data on the host).

※ When installing the Memory Card, if you do not know whether the project has been replicated to the Memory Card or whether the replicated project is the required target, you should set the PLC to Test-Run Modification Mode and then install the Memory Card for the sake of safety. In this way, you may prevent the program in the PLC from being overridden.

7-1-5 Entering Normal Mode option

Press "Start" to complete the normal mode setting.

※ If the project and the data register have been replicated to the Memory Card R35480 and if the value is not equivalent to 5530H, then the project on the Memory Card will override that in the RAM upon each start. If the R35479 value of the data register being replicated to the Memory Card is not equivalent to 5530H, then the system will select the register that will be read by the Memory Card according to the selection made during the user's replication and then initialize the data register corresponding to the RAM in the CPU Module to the value being replicated to the Memory Card. In the meantime, the PLC will enter RUN Mode automatically.

7-2 Writing Firmware Information

In addition to using the software UperLogic to update the firmware of the host and expansion modules, the Memory Card also supports firmware updates. Product upgrades or accidental repairs are made according to different scenarios.

The Memory Card can be programmed for the following functions:

Host firmware update

It is used to update the current host firmware of the same or above version. After power on, wait until the Run light is on, and insert the Memory Card to update.

Host Firmware Rescue

To prevent unexpected situations, it can be used to rescue and update the current host, insert the Memory Card in shutdown mode before powering on and power on to update.

Expansion Module Firmware Update

It is used to update the firmware of one or more expansion modules of the same or higher version. The same module models will be updated synchronously. After powering on and waiting for the Run light to light up, insert a memory card to update.

Expansion Module Firmware Rescue

To prevent unexpected situations, it can be used to rescue and update an expansion module that enters the rescue mode. After powering on and waiting for the Run light to light up, insert the Memory Card to update.

Select the type of settings to be made, and select the firmware file of the corresponding device. After selection, the firmware file information selected by the user will be displayed below. When creating the firmware updating or the Rescue Card, the CPU can be used together with the Expansion Module; however, the firmware rescue car and the firmware updating are incompatible with each other.
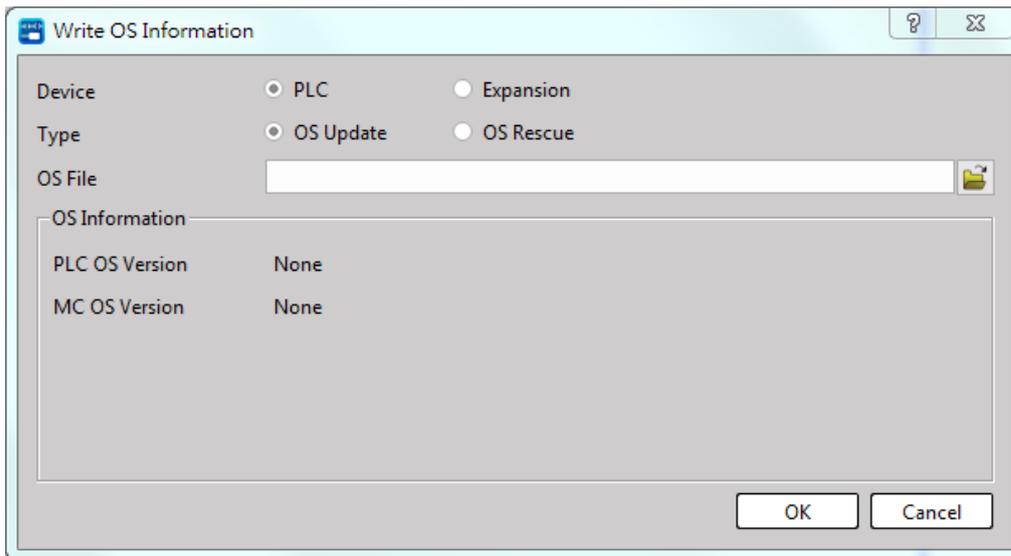
Figure 23 Firmware update or rescue

Setup type	Insertion timing	Description
Updating Card	To be inserted when "Ready" indicator is lit after pressing "RUN".	Update the Expansion Module (updating the multiple units coded with the same model number) and then update the host OS.
Rescue Card	To be inserted before turning on the power.	Rescue the host and then rescue the Expansion Module (for one only).

Table 9 Description of firmware update/rescue card

For details on how to update the firmware through the Memory Card, please refer to Section 14-2.

※If the firmware version of the expansion module is changed using the Memory Card, it needs to be disconnected from the software, and then reconnected to UperLogic before the display will be updated.

7-3 Switching Copy Protection

The copy protection function provides a protection mechanism that allows users to prevent the memory card from being misused in an unintended host device. The memory card with copy protection turned on will be bound to the current host, and the bound memory card will not be able to be used on other host devices. If you want to cancel the copy protection, you need to cancel the protection on the bound host.

Enable or disable the card and the host serial number binding function:
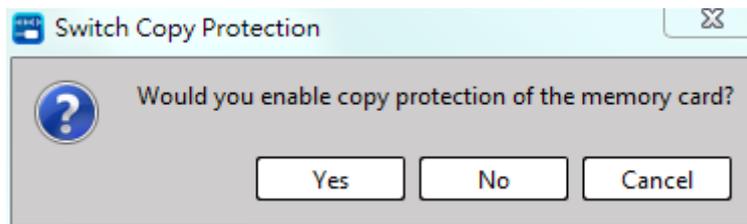
Figure 24 Enable or disable host binding

After selecting, it will bind the serial number of the card and the current host. After pressing "No", the system will unlock the binding function.

7-4 Memory Card Information

After clicking, you may check the message of the card currently selected:

Item	Status
Total Capacity	7572.0 MB
Available Capacity	7572.0 MB
Backup Model	>$]-0000
Memory Card Model	MFM00
Copy Protection	Disabled
System Backup	None
PLC Rescue OS	
ME3C6-1616	0.1.196(PLC) - 1.4.22(MC) - 1(HW)
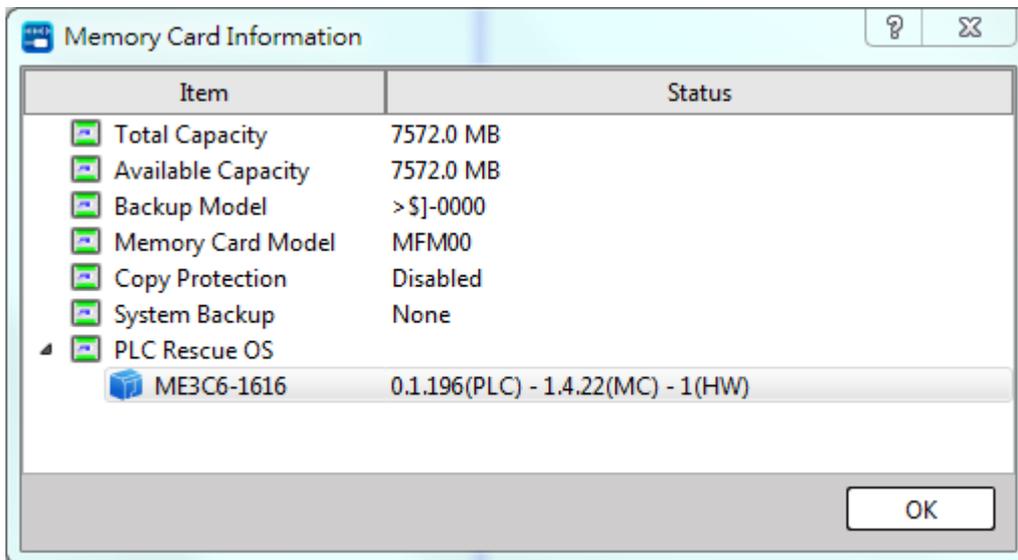
Capacity

Total capacity of the memory card.

Available Capacity

The available capacity of the memory card will be calculated after the execution of the first command, and will be ended calculating when the host is in operation.

Backup Model

Information about the version of the host used to create the memory card content.

Copy Protection

Enable or disable copy protection.

System Backup

Host-related information of system backup.

Update/Rescue Firmware Version

Display the updated firmware object and version information contained in the memory card content.

7-5 Reading the Data Register Being Replicated to Memory Card

●Based on the setting of R35479, the data register replicated to the Memory Card (such as the adjusted value or the fixed application value) shall be read by the Memory Card according to the value of R35479 upon each start. After that, the data register being saved in the RAM of the CPU Module shall be initialized to the value of the Memory Card at that time in order that correct operating data will be maintained.

● R35469–R35478 are used to read the data register being replicated to the Memory Card. Before replicating the Ladder program and the Register to the Memory Card, it is required to set the value of R35469–R35478 and then replicate these values to the Memory Card. When starting the machine each time, the system will execute the following actions according to R35469–RS35478 being replicated to the Memory Card.

Register	Setting	Description of Function
R35469	A66AH	When starting the machine each time, you may read the data register being replicated to the Memory Card according to the instructions provided in the table below (such function shall be available for the shutdown holding-type register).
	Other value	The aforesaid function shall not be available when R35479 value equals to 5530H. If it is not required to run such function upon each start, you should set R35469 as "0".
R35470	1–4	The lot count of the data register (4 lots at most) retrieved from the Memory Card.
R35471	Length 0	Reading the data length of Lot #1 registers from Memory Card: The data length scope of R0–R3839 registers being read shall be 1–3840. The data length scope of R5000–R8071 registers being read shall be 1–3072. The data length scope of D0–D4095 registers being read shall be 1–4096. The data length scope of R4000–R4165 special registers being read shall be 1–166. If the data length is 7FF7H, it means such data will be used as the system backup (including PLC ID and station number). It will be ignored by the system if the data length is incorrect (data length or "data length + initial address" is not covered in the aforesaid scope).

		* If the data length is correct, then the registers being replicated to the MEMORY_PACK shall start from R35472, with R35471 representing the length, in order to read back the corresponding registers being saved in the CPU.
R35472	Start 0	Reading the initial address of Lot #1 registers from Memory Card: The scope of initial address to be read for R0–R3839 registers shall be 0–3839. The scope of initial address to be read for R5000–R8071 registers shall be 5000–8071. The scope of initial address to be read for D0–D4095 registers shall be 10000–14095. (i.e. it is required to add 10000 for the initial address of Dxxxx registers that should be read). The scope of initial address to be read for R4000–D4165 registers shall be 4000–4165, and R35472 shall be used together with R35471.
R35473	Length 1	Reading the data length of Lot #2 registers from Memory Card: The scope of data length shall be the same as R35471. Incorrect data length will be ignored by the system. * If the data length is correct, then the registers being replicated to the Memory Card shall start from R35474, with R35473 representing the length, in order to read back the corresponding registers being saved in the CPU.
R35474	Start 1	Reading the initial address of Lot #2 registers from Memory Card: The scope of initial address shall be the same as R35472. R35474 shall be used together with R35473.
R35475	Length 2	Reading the data length of Lot #3 registers from Memory Card: The scope of data length shall be the same as R35471. Incorrect data length will be ignored by the system. * If the data length is correct, then the registers being replicated to the Memory Card shall start from R35476, with R35475 representing the length, in order to read back the corresponding registers being saved in the CPU.
R35476	Start 2	Reading the initial address of Lot #3 registers from Memory Card: The scope of initial address shall be the same as R35472. R35472 shall be used together with R35475.

R35477	Length 3	Reading the data length of Lot #4 registers from Memory Card: The scope of data length shall be the same as R35471. Incorrect data length will be ignored by the system. * If the data length is correct, then the registers being replicated to the Memory Card shall start from R35478, with R35477 representing the length, in order to read back the corresponding registers being saved in the CPU.
R35478	Start 3	Reading the initial address of Lot #4 registers from Memory Card: The scope of initial address shall be the same as R35472. R35478 shall be used together with R35477.

Table 13 Memory Card Replication Related Register Function

7-6 Reading and Writing Memory Card through Function Instruction

To meet the applications required by different Clients, apart from using the software and the register to read and write the Memory Card, it also allows the user to read and write the commands (FUN161, FUN162) with Memory Card on the Ladder in order to read or write the data in the Memory Card flexibly. Provided below is the description and the application example of FUN161 and FUN162 commands.

8

High-Speed Counter and Timer

8-1 High-Speed Counter

The counting frequency of an ordinary PLC's software counter can only reach tens of Hz (depending on the scan time). If the frequency of input signal is higher than that, it is necessary to utilize high-speed counter (HSC). M-Series PLC provides 8 HSCs in the highest specification, and all of them can be set as 32-bit or 16-bit high-speed counter depending on different modules.

8-1-1 Counting Modes

As shown in the table below, HSC provides 6 kinds of counting modes to choose from:

※For general and advanced motion control hosts, HSC4~7 currently only support ABx4.

Counting Mode			HHSC (HSC0 ~ HSC3)	Counting Waveform	
				Up Counting（+1）	Down Counting（−1）
Up-down pulse	MD0	U	○		
	MD1	U×2	○		
Pulse-direction	MD2	P/R	○		
AB phase	MD3	A/B	○		
	MD4	A/B×2	○		
	MD5	A/B×4	○		

Table 14 Counting modes of the high-speed counter

The up/down arrow（↑,↓）on the positive/negative edge in the waveform represents where counting (+1 or −1) occurs.

8-1-2 System Architecture

The diagrams below are the system architecture for HSC where has multi-purpose input and counting functions. Some of the functions are built-in (such as CV register number, PV register number, interrupt label and relay number for software MASK, CLEAR and direction selection) that user need not to assign for configuration. However, some functions, with a "*" marked in the diagrams below, must use the UperLogic to configure the HSC (such as HSC application selection, counting mode, application of each function input, inverse polarity and appointment of corresponding input point number Xn) etc. For detailed structure and operation of the 6 kinds of counting modes that assigned in configuration, please refer to section 10.2.1~10.2.3 for explanation.

Note: CV (Current Value); PV (Preset Value).
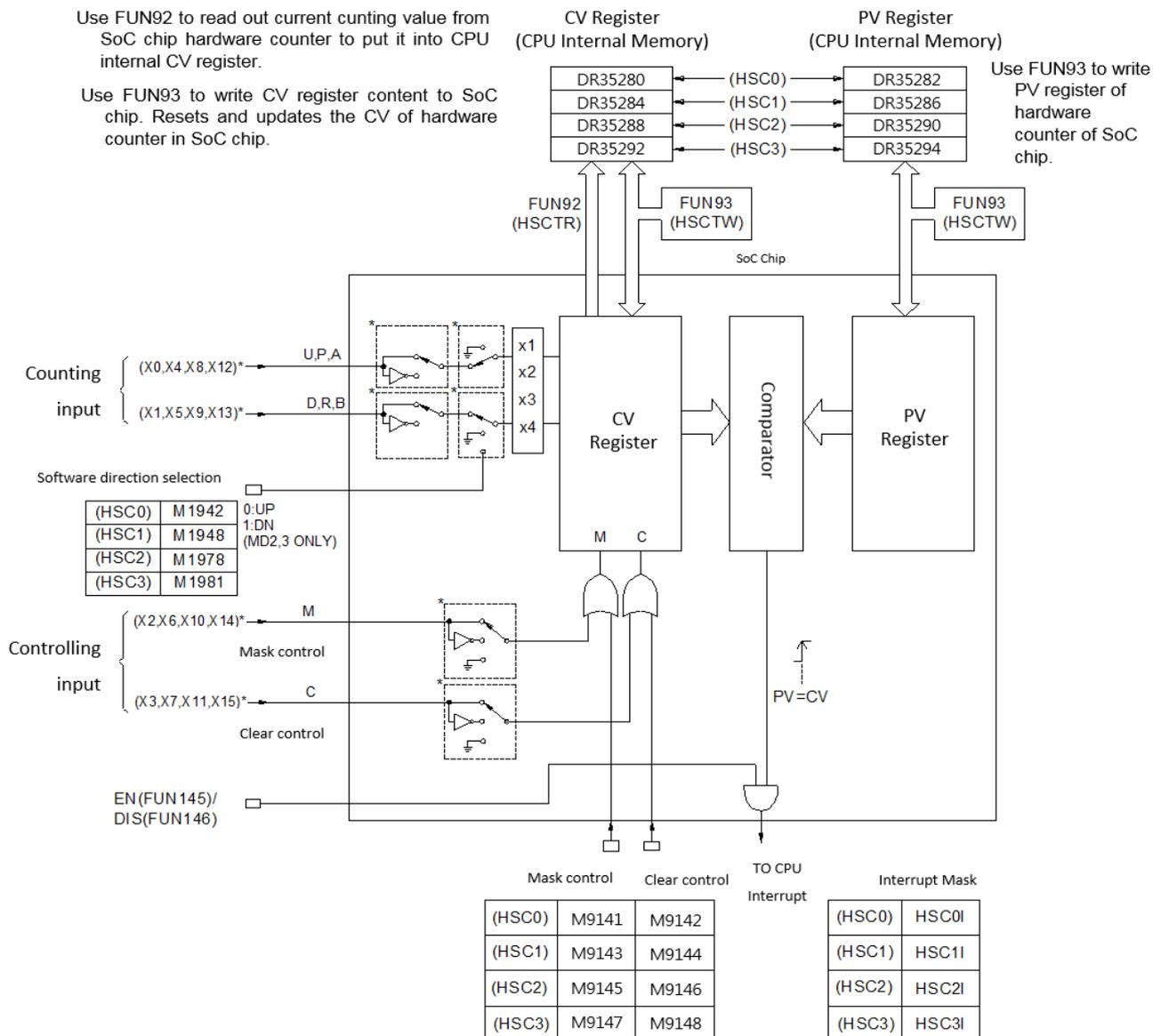
Figure 26 System architecture of hardware high-speed counter (HSC0-HSC3)

- All control signals of HHSC are default as Active High (i.e., Status =1 for active and 0 for non-active). In order to cooperate with the sensor's polarity, the HSC counting inputs (U, D, P, R, A and B) and control inputs (M and C) can be selected for polarity inverse.

- By default, when the MASK control signal, M is 1, the HSC counting pulse will be masked without any counting being performed and all HSC internal status (such as CV and PV) will remain unchanged. The HSC will function normally only when M returns to "0". Some sensors have Enable outputs which function is on the contrary to MASK. Counters will not count when Enable = 0 and can only start functioning when Enable = 1. Then, function of inverse polarity input of MASK can be selected to cooperate with the sensors having Enable output.

- When the CLEAR control signal, C is 1, the HSC internal CV register will be cleared to 0 and no counting will be performed. The HSC will start counting from 0 when C returns to 0. Ladder program can also directly clear the CV register (DR35280, DR35284, DR35288, and DR35292), so as to clear the current counting value to 0.

- The 8 sets of M-Series PLC HHSC are located in the SoC chips where the CV or the PV registers the user can't access directly. What the user can access are the CV registers (DR35280 ~ DR35292) located in the CPU internal memory. Ideally, the contents of CV and PV registers in the chips should be updated simultaneously with the CV and PV registers in the CPU internal memory. However, to keep the correspondence between the two must be loaded or read by the CPU when they, in fact, belong to two different hardware circuits. It is necessary to use FUN93 to load the CV and the PV registers inside the CPU to the respective CV and PV registers (to allow HHSC to start counting from this initial value. Then, FUN92 can be used to read back the counting value of the HHSC CV register in the chips to the CV register in the CPU (i.e., the CV register in the CPU has the bi-direction function). Since read can only be carried out when FUN92 is executed (so-called "sampling" reading), it might result in difference between the HHSC CV value in the chips and the CV value in the CPU, the deviation will getting greater especially when the counting frequency is high.

- When the counting frequency is not high or the demand for positioning precision is not so much, using FUN92 in the main program to read the current counting value and then incorporate comparator instruction is adequate for a simple counting positioning control.

- When the demand for positioning precision is higher, or in the multi-zone count setting control, it may use the FUN92 to read the current counting value while in the time base interrupt routine and incorporate compare instruction to perform more precise counting positioning control.

- As the demand for positioning precision is extremely high, it must use the preset interrupt function of hardware counter. The preset value can load by FUN93 into the PV register of HHSC in the chipset. When CV value of HHSC reaches this preset value, the hardware comparator in the HHSC will send

interrupt to CPU at the very moment CV=PV, and jump to interrupt subroutine to do real time control or procession.

● None of the special relay controls, such as software MASK, CLEAR and direction control, is real time. This means that although MASK, CLEAR or direction change has been set during routine scanning, the signal will only be transmitted to HSC when I/O updating is under way after the completion of routine scanning. Hence, it is not suitable for the real time control in HSC operation (which should be mainly used for initial setting before HSC operation). Should real time control be required, please use hardware to control input or apply the FUN145(EN), FUN146(DIS), FUN92(HSCTR), and FUN93(HSCTW) etc. instructions for control.

● Every HSC is equipped with the functions, Enable (FUN145) and Disable (FUN146), when HSC is Enable, HSC can count and can generate an interrupt signal when the count is up, when HSC is disabled, the counting still works but the interrupt function being disabled. In I/O configuration, after selecting count mode (P, AB, etc.) for HSC, HSC is set to be on by default, and the program can use the Enable (FUN145) and Disable (FUN146) functions to turn it on or off at any time according to the control needs.

※The counting interruption of HSC4~HSC7 is supported by the basic host, and the specifications of the high-speed counters will vary depending on the model. For details, please refer to Chapter 1 System Specifications

● Pulse-direction relative up/down counting high-speed counter
(MD2)
Pulse-direction relative up/down counting high-speed counters have only one counting pulse input P (Pulse), and the up/down counting must be determined by the other direction input R (Direction) when the counting pulse positive edge arrives. The value is to be +1 (R=0) or -1 (R=1). MD2 only counts at the positive edge of the PS pulse (+1 or -1). When the control function is not used, its state (such as M9143 and M9144 in this example) must be kept at 0. In addition to the built-in software masking and software clearing, hardware masking and hardware clearing control can also be used. The soft/hardware masking is OR first, and then connected to the masking control M pin of the HSC. Soft/hardware clearing is the same way, the following is the function diagram of constructing HSC1 into MD2 HSC.
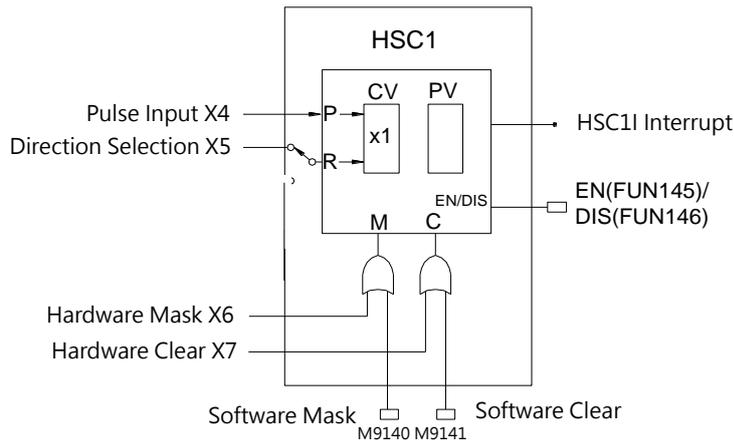
Figure 27   MD2（P/R）

● When HSC is working in MD2 mode, it can choose external input (such as X5 in this example) for direction selection.

The figure below is the waveform diagram of the counting and control relationship of the HSC in MD2 mode in this example when the set value PV is 6.
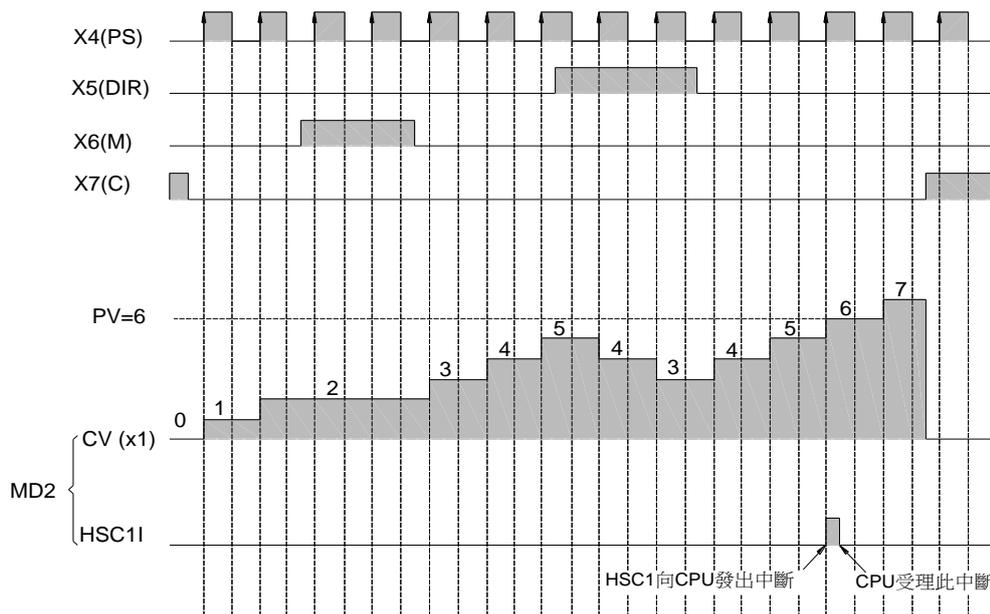
Figure 28 HSC in MD2 mode

8-1-3 AB Phase Input Mode of High-Speed Counter (MD3, MD4, MD5)

The AB phase high-speed counter is equipped with phase A and phase B pulse input with counting value +1 or −1, depending on the phase relationship between the two. i.e., the related counting of the two phases. If phase A is ahead of phase B, the CV value should be +1, else, the CV value should be −1. The

counting of the three modes, MD3 (A/B), MD4 (A/Bx2), MD5 (A/Bx4), of AB phase HSC are similar. Their differences are:

①MD3（A/B）   : The rising edge of A is +1 when A is ahead of B and the falling edge
                         of A is –1 when A is behind B.

②MD4（A/B×2）   : The rising and falling edges of A are +1 when A is ahead of B, and
                         –1 when A is behind B (twice the counts of MD3).

③MD5（A/B×4）   : The rising and falling edges of A and B are +1 when A is ahead of B
                         and the rising and falling edges of A and B are –1 when A is behind B (four times
                         the counts of MD3).

Mode MD3~MD5 HSC has built-in software MASK and software CLEAR. When control function is not in use, it must keep the status (such as M9145 and M9146 in this example) to be 0. Apart from the built-in software MASK and CLEAR, the controls of hardware MASK and CLEAR can also be configured. The MASK control is first performed by the OR operation of the hardware and software control, then the result is send to the HSC MASK control M, and so does CLEAR. The function schematic diagrams of HSC2 for the four MD3~MD5 HSC modes are shown as below.

MD3 (A/B)

MD4 (A/Bx2)

MD5 (A/Bx4)

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The diagram below is the waveform diagram for the relationship between counting and control of the four HSC modes in this example when the PV value is set as at -4.

Figure 31 Three modes of HSC
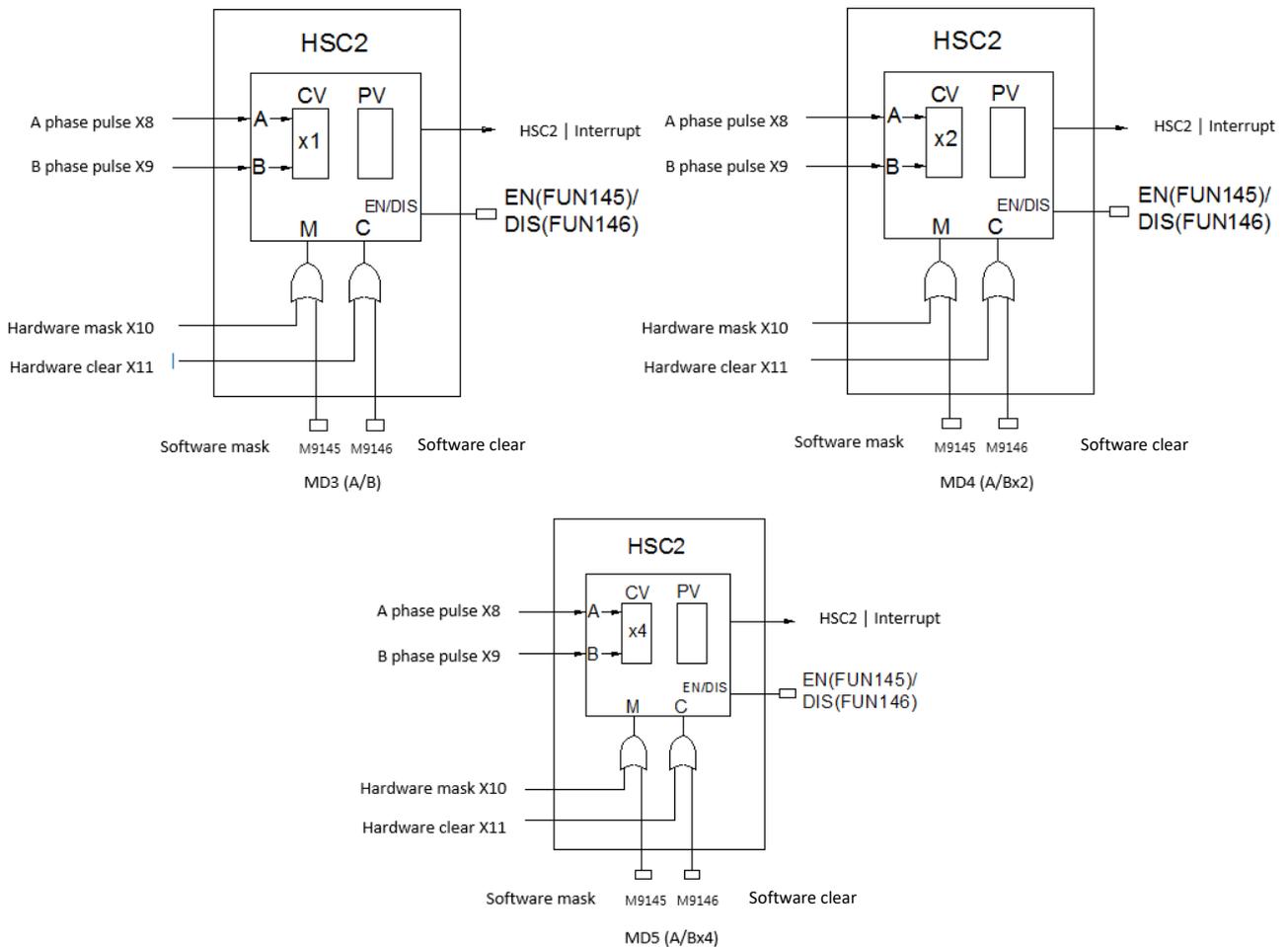
8-1-4 Procedure for Counting

16BIT HSC

- Supports up/down counting interrupt.

- CV and PV values can be set arbitrarily within the numerical range.

```
┌─────────────┐
│    Start    │
└─────────────┘
       │
       ▼
┌──────────────────────────┐
│ ● Configure HSC counting │          1. Please refer to Section 8.1 for respective HSC counting
│   mode and respective    │ -------      modes and principles.
│   input                  │          2. Please refer to Section 8.1.7 for setting examples.
│   (by UperLogic)         │
└──────────────────────────┘
       │
       ▼
┌──────────────────────────┐
│ ● Complete hardware      │
│   wiring according to    │
│   the previous input     │
│   assignment             │
└──────────────────────────┘
       │
       ▼
┌──────────────────────────┐
│ ● Set HSC initial CV     │          1. It is necessary to apply FUN93 to load it into the HHSC CV
│   value and interrupt    │ -------      and PV in the SoC chip.
│   PV value in the main   │          2. Please refer to Section 8.1.7.2 for program examples.
│   program                │
└──────────────────────────┘
       │
       ▼
┌──────────────────────────┐
│ ● Write necessary        │          1. Please refer to Section 5.1 for subroutine structure.
│   handling procedures    │ -------   2. Please refer to Section 8.1.7.2 "Actual Examples" for
│   to be taken during     │             program examples.
│   interrupt and          │
│   condition for next     │
│   interrupt in sub       │
│   program area           │
└──────────────────────────┘
       │
       ▼
┌──────────────────────────┐
│ ● Start the operation    │ ---------  Please refer to Section 8.1.7.2 for program examples and
└──────────────────────────┘            description.
       │
       ▼
┌─────────────┐
│     End     │
└─────────────┘
```

Table 15 Steps of 16-bit high-speed counter

32BIT HSC

- Supports up/down counting interrupt.

- CV and PV values can be set arbitrarily within the numerical range.

- When the PV value is set to be the same as the CV value, it will be invalid

- After the interruption occurs, the PV value needs to be set again before the next counting

   interruption can be performed

```
Start
  │
  ▼
● Configure HSC counting mode
  and respective input
  (by UperLogic)
  │
  ▼
● Complete hardware wiring
  according to the previous input
  assignment
  │
  ▼
● Set HSC initial CV value and
  interrupt PV value in the main
  program
  │
  ▼
● Write necessary handling
  procedures to be taken during
  interrupt and condition for next
  interrupt in sub program area
  │
  ▼
● Start the operation
  │
  ▼
End
```

3. Please refer to Section 8.1 for respective HSC counting modes and principles.
4. Please refer to Section 8.1.7 for setting examples.

1. It is necessary to apply FUN93 to load it into the HHSC CV and PV in the SoC chip.
2. Please refer to Section 8.1.7.2 for program examples.

3. Please refer to Section 5.1 for subroutine structure.
4. Please refer to Section 8.1.7.2 "Actual Examples" for program examples.

1. Please refer to Section 8.1.7.2 for program examples and description.

Table 15 Steps of 32-bit high-speed counter

8-1-5 Counter Configuration

Construction of HSC with UperLogic

In project window, click "I/O Configuration Setup" :

Project Name

System configuration

I/O configuration → Select "High Speed Counter"

● After displaying the "High Speed Counter" picture, you may click the external input that will be suspended in the window.
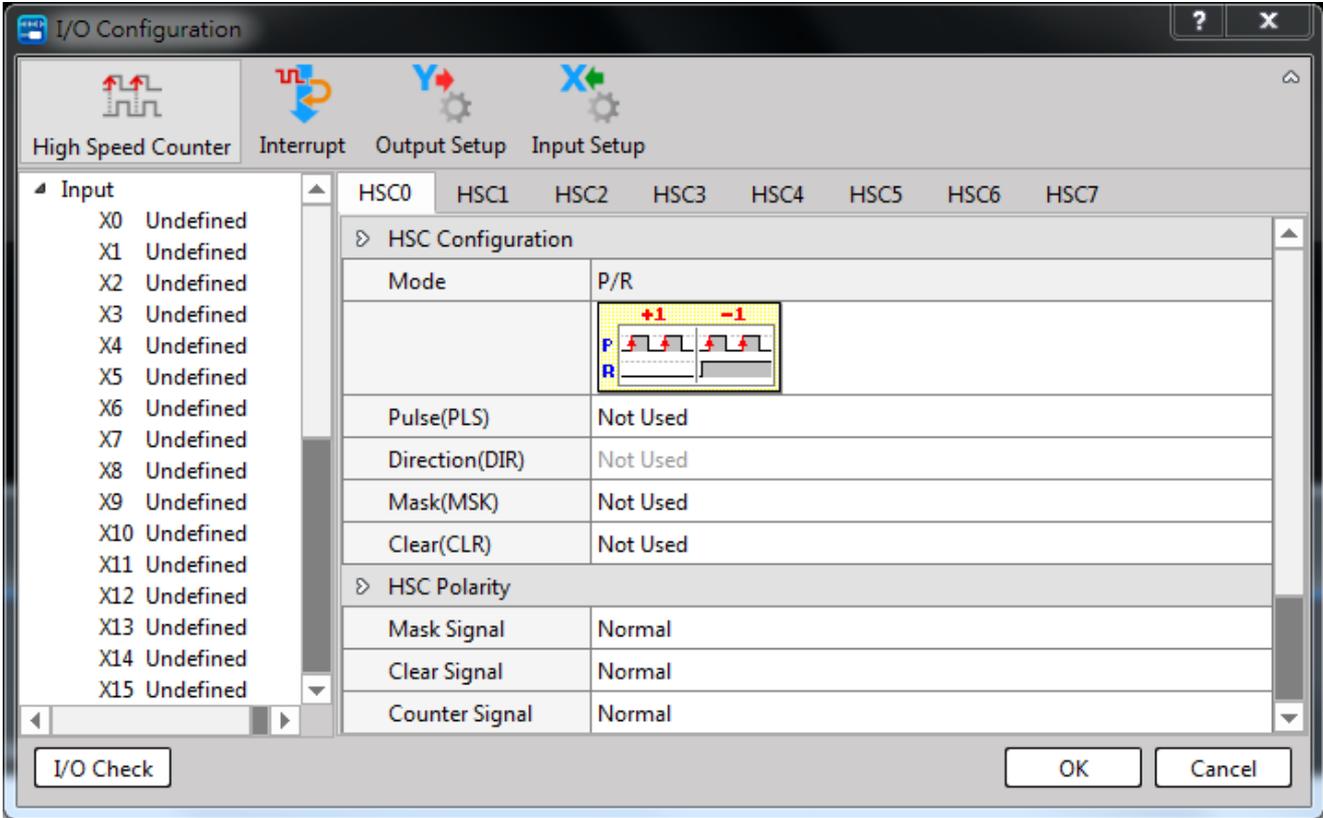
Figure 32 I/O Configuration _ High-Speed Counter

[Counter setting]:

Usage Mode: Selectable hardware counter or hardware timer.

Count Mode: The count mode can be selected, such as U, P/R, A/B, etc.

UP: Select the input of the count up signal. If the count mode is P/R, this field is PS;

　　If the count mode is A/B, this field is A

DN: Select the input of the count-down signal. If the count mode is P/R, this field is DIR;

　　If the count mode is A/B, this field is B

MSK: Select the input mask signal.

CLR: Select the input clear signal.

[HSC polarity setting]:

Mask: Determines whether the mask signal is positive or negative.

Clear: Determines whether the clear signal is positive or negative.

Count: Determines whether the count signal is positive or negative.

[HSC Content length setting]:

The mode that can be selected is to store the count value in double word group (32-Bit counter) or single word group (16-Bit counter). Customers can apply it according to their own needs.

The following table summarizes the relevant numbers of input point numbers, software mask, clear, direction selection, etc. that are set or selectable by HSC. (HSC4~HSC7 only support AB*4 and do not support input control function.)

Type No. HSC	HSC							
	HSC0	HSC1	HSC2	HSC3	HSC4	HSC5	HSC6	HSC7
CV Register	DR35280	DR35284	DR35288	DR35292	DR35296	DR35300	DR35304	DR35308
PV Register	DR35282	DR35286	DR35290	DR35294	DR35298	DR35302	DR35306	DR35310
Count — UP or A (HSC4~HSC7 only A*4)	X0	X2	X4	X6	X8	X10	X12	X14
Count — R or B (HSC4~HSC7 only B*4)	X1	X3	X5	X7	X9	X11	X13	X15
Input — M	X2、X4、X6				NC			
Input — C	X3、X5、X7							
Software mask	M9141	M9143	M9145	M9147	M9149	M9151	M9153	M9155
Software clear	M9142	M9144	M9146	M9148	M9150	M9152	M9154	M9156
Interrupt label	HSC0I	HSC1I	HSC2I	HSC3I	HSC4I	HSC5I	HSC6I	HSC7I

Table 16 Summary of HSC related numbers

When working in bidirectional mode (HHSC is MD3~MD5), the input points must be paired with consecutive numbers, and the even number is the A-phase input (Example X4), and the odd number is the B-phase input (Example X5).

The X0~X15 input points in the above table can only be assigned once (that is, only used as one function) and cannot be used repeatedly.

Examples of Application of High-Speed Counter

Example 1 · This example uses high-speed counter for equal-length cutting control.

Mechanism
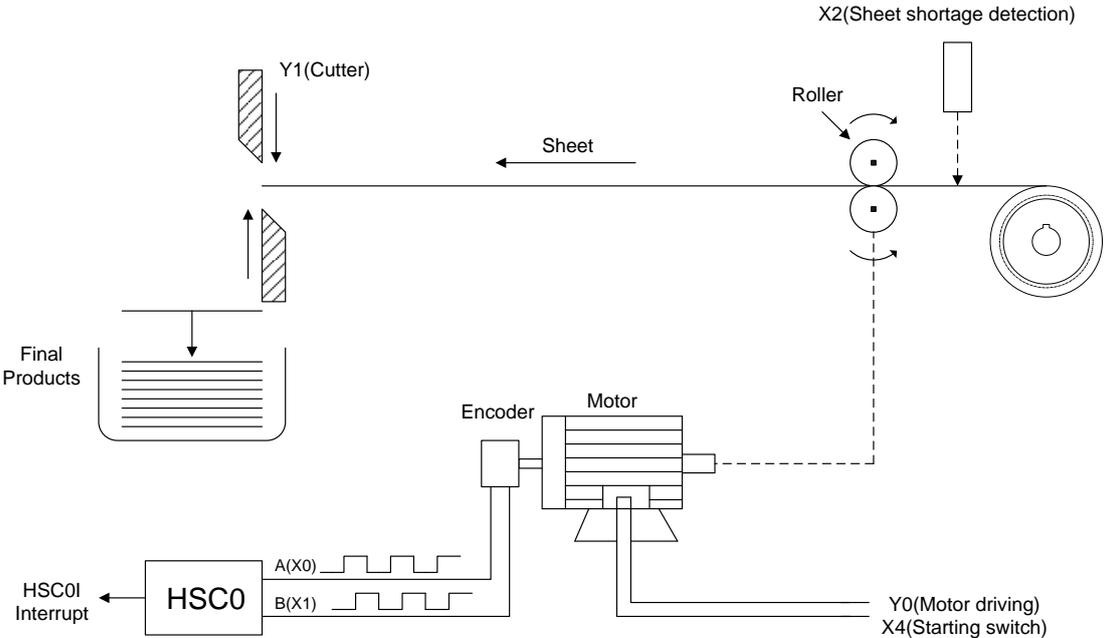
Figure 33 Schematic diagram of equal-length cutter control using high-speed counter

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HSC configuration（Set HSC0 to MD5 to increase the cutter resolution by a factor of 4）
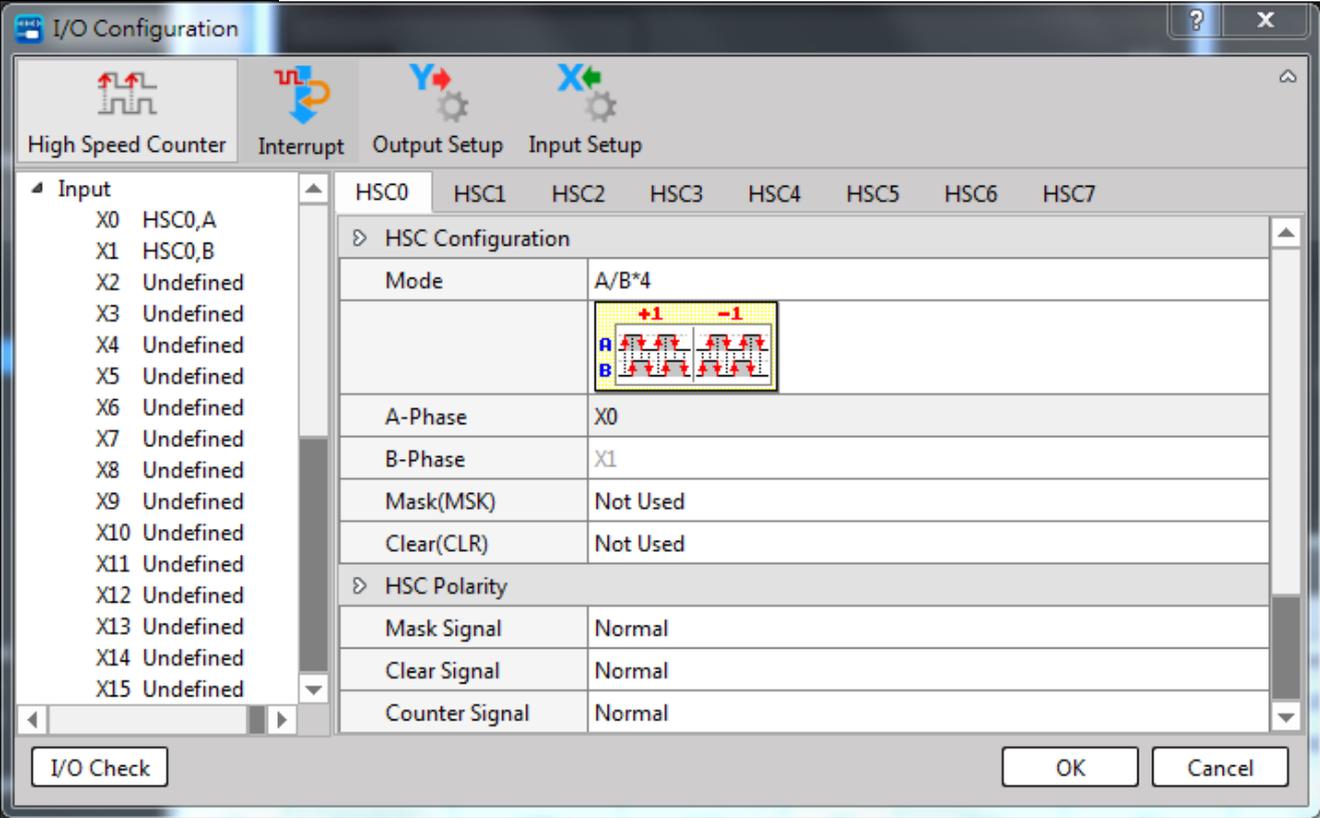
Figure 34 Configuration window of high-speed counter

Control program

【Main Program】
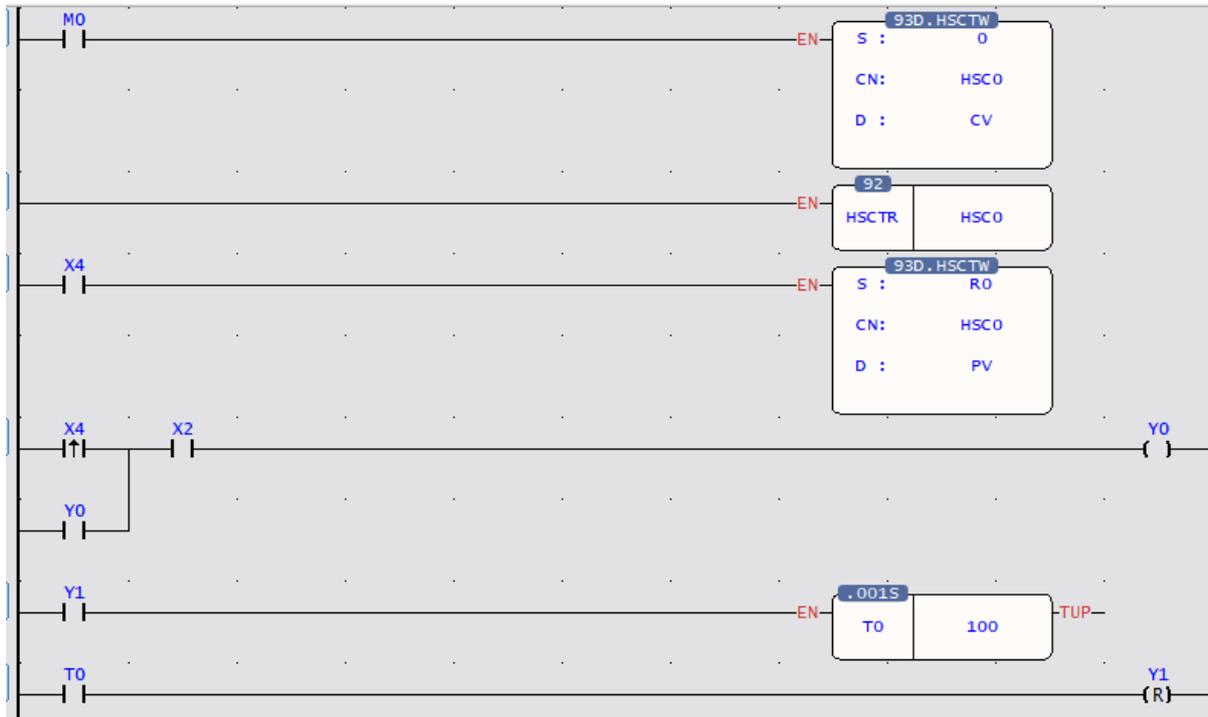
• Use FUN93 to write the contents of the current value register DR35280 into the CV register of HSC0 in the SoC chip.

CN =0 indicates HSC0

D=0 indicates CV

• Use FUN 92 to read the counting value of the HSC0 CV register in the SoC chip (store into DR35280)

• Store the counting of cutting length DR0 into DR35282 and use FUN93 to store the value into the PV register of HSC0 in the SoC chip

CN =0 indicates HSC0

D=1 indicates PV

• Start the motor

• Turn the cutter Y1 ON for 0.1 second

【Subroutine】
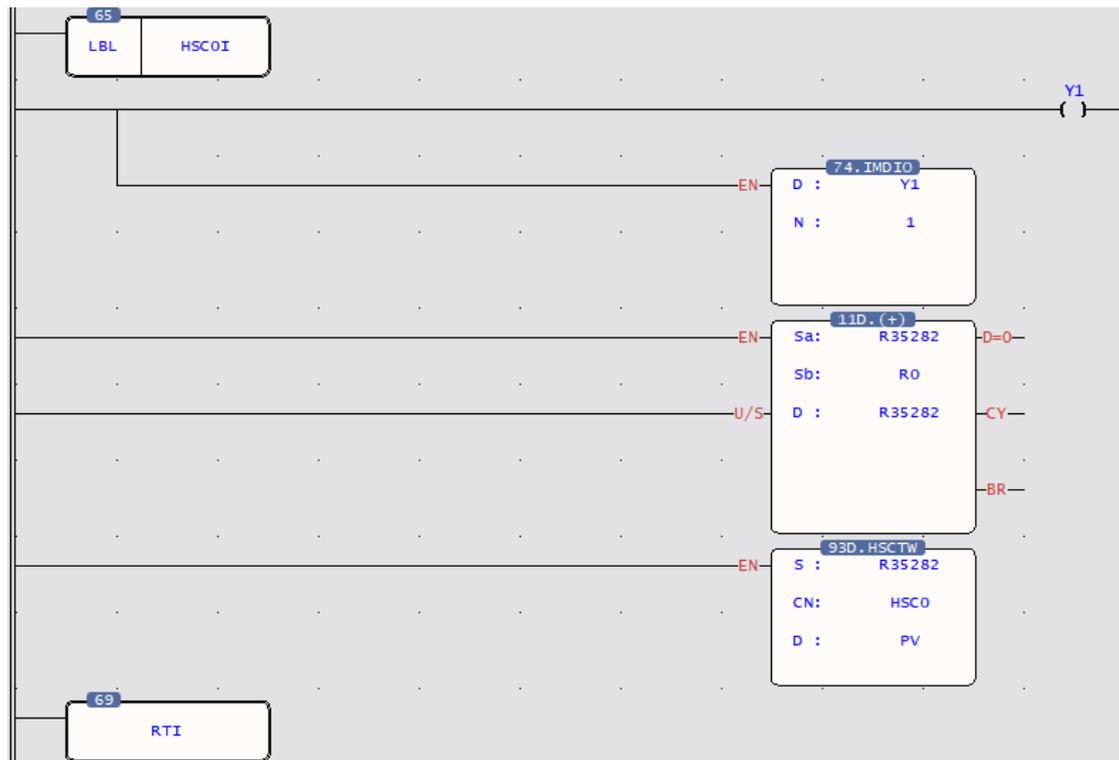
• When HSC0 CV=PV in the SoC chip, the hardware will automatically execute the interrupt subroutine labeled HSC0I.

• When counting is up, turn Y1 ON (to cut materials)

• Output Y1 immediately to reduce the error caused by scan time

• Calculate new cutting position and load HSC0 PV

【Description】

The main program will initialize the HSC0 CV (CV=0) in advance and move the cropping length (DR0) to the HSC0 PV before starts Y0 to turn on the motor for material conveying.

When CV reaches PV, the length of R0 is added to the PV before being reloaded into HSC0 PV.

When all materials are rolled out, the material shortage detector X2 will be ON and stop the motor.

Example 2．Example of high-speed counting up action processed by Interrupt

【Main program】
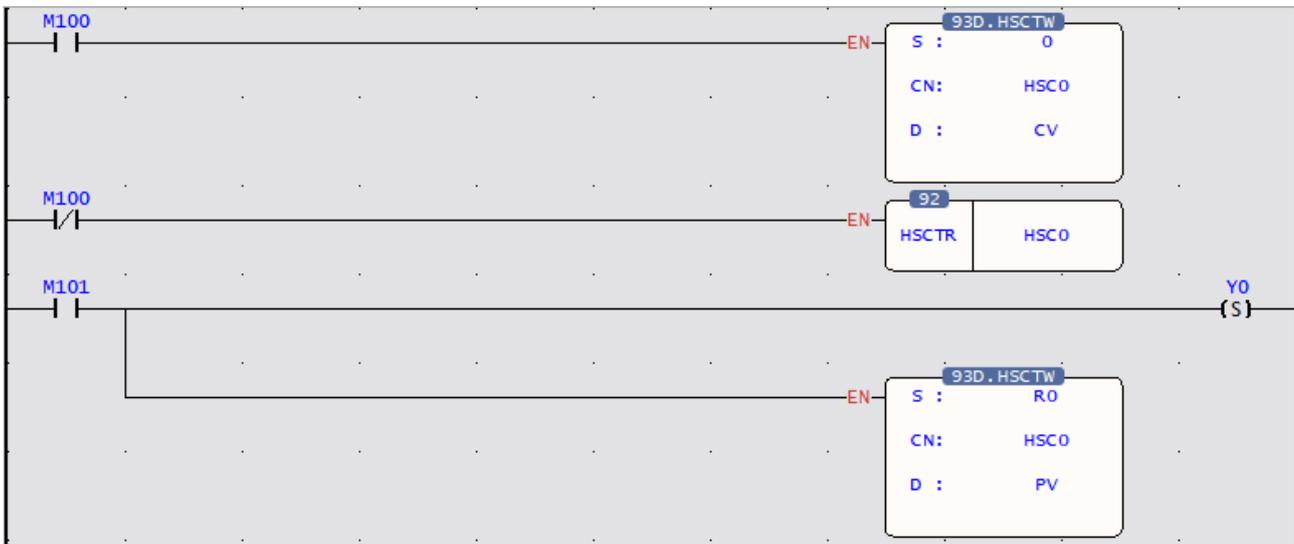
• Employ FUN93 to write the content of current value register DR35280 into the CV of HSC0 in SoC chip

(reset)

CN=0, represents HSC0

D=0, represents CV

• Employ FUN92 to read out the current counting value of HSC0

in SoC chip, and store it into the CV register (DR35280)

CN=0, represents HSC0

• As M101 change from 0→1, start Y0 ON (begin to operate)

• Employ FUN93 to write the content of preset register into HSC0 PV in SoC chip, which serves as setting

value of counting up interrupt

CN=0, represents HSC0

D=1, represents PV

【Subroutine】

• Hardware high speed counter #0 interrupt label

• When time up, it sets Y0 OFF (stop)

• Let Y0 out immediately, so as to stop promptly

(Otherwise, Y0 will have a scan time output delay)

8-2 High-Speed Timer

The finest time base for most of the ordinary PLC is 1mS or 10mS. Though some PLC may have HST with a time base of 1mS. When deviations in the PLC scan time is taken into consideration (e.g. if the scan time is 10mS when the time base is 1mS, the total deviation still exceeds 10mS), the figure of 1mS becomes meaningless. Therefore, these PLCs can't be applied in high precision timing. The M-series host provides 3 kinds of time bases, a total of 13 timing timers, including 4 STM timers, 4 LTM timers, and 4 HST with the fastest time base of 0.1mS. The time up is sent out by interrupt to provide a precision 100 times better than ordinary PLC timer application and can be used for many applications demanding precision timing. Also built in a 0.1ms 32-bit HSTA cycle timer. For detailed usage of HST, please refer to the example in section 8.2.1 of this Manual.

8-2-1 STM Time-setting Timer

M-series host provides a 16-bit 1ms STM time-setting timer, which can be used to set the corresponding period register and trigger the corresponding special relay. Relevant relay and register information are as follows:

Item	Relay
1 ms time-setting timer STM 0 control	M9166
1 ms time-setting timer STM 1 control	M9167
1 ms time-setting timer STM 2 control	M9168
1 ms time-setting timer STM 3 control	M9169
Item	Register
1 ms time-setting timer STM 0 cyclic setting	R35435
1 ms time-setting timer STM 0 recent timing	R35436
1 ms time-setting timer STM 1 cyclic setting	R35437
1 ms time-setting timer STM 1 recent timing	R35438
1 ms time-setting timer STM 2 cyclic setting	R35439
1 ms time-setting timer STM 2 recent timing	R35440
1 ms time-setting timer STM 3 cyclic setting	R35441
1 ms time-setting timer STM 3 recent timing	R35442

8-2-2 LTM Time-setting Timer

M-series host provides a 16-bit 10ms LTM time-setting timer, which can be used to set the corresponding period register and trigger the corresponding special relay. Relevant relay and register information are as follows:

Item	Relay
10 ms time-setting timer LTM 0 control	M9170
10 ms time-setting timer LTM 1 control	M9171
10 ms time-setting timer LTM 2 control	M9172
10 ms time-setting timer LTM 3 control	M9173
Item	Register
10 ms time-setting timer LTM 0 cyclic setting	R35443
10 ms time-setting timer LTM 0 recent timing	R35444
10 ms time-setting timer LTM 1 cyclic setting	R35445
10 ms time-setting timer LTM 1 recent timing	R35446
10 ms time-setting timer LTM 2 cyclic setting	R35447
10 ms time-setting timer LTM 2 recent timing	R35448
10 ms time-setting timer LTM 3 cyclic setting	R35449
10 ms time-setting timer LTM 3 recent timing	R35450

8-2-3 HST High-Speed Timer

M-series host provides four (HST0-HST3) 32-bit high-speed time-setting timer, which can be used to set the corresponding period register and trigger the corresponding special relay. Relevant relay and register information are as follows:

Item	Relay
0.1 ms time-setting HST 0 control	M9174
0.1 ms time-setting HST 1 control	M9175
0.1 ms time-setting HST 2 control	M9176
0.1 ms time-setting HST 3 control	M9177
項目	Register
0.1 ms time-setting HST 0 cyclic setting LW	R35451
0.1 ms time-setting HST 0 cyclic setting HW	R35452
0.1 ms time-setting HST 0 recent timing LW	R35453
0.1 ms time-setting HST 0 recent timing HW	R35454

0.1 ms time-setting HST 1 cyclic setting LW	R35455
0.1 ms time-setting HST 1 cyclic setting HW	R35456
0.1 ms time-setting HST 1 recent timing LW	R35457
0.1 ms time-setting HST 1 recent timing HW	R35458
0.1 ms time-setting HST 2 cyclic setting LW	R35459
0.1 ms time-setting HST 2 cyclic setting HW	R35460
0.1 ms time-setting HST 2 recent timing LW	R35461
0.1 ms time-setting HST 2 recent timing HW	R35462
0.1 ms time-setting HST 3 cyclic setting LW	R35463
0.1 ms time-setting HST 3 cyclic setting HW	R35464
0.1 ms time-setting HST 3 recent timing LW	R35465
0.1 ms time-setting HST 3 recent timing HW	R35466

8-2-4 Example of HST High-Speed Timer

Configuration of HST (with UperLogic)

Start

↓

HST value being set in Main Program field.

Set R35451 per the HST 0 cycle

----------------- For special register, please refer to Software User Manual Instruction Chapter 2.

↓

In Main Program field, trigger the special register suspension.

For example: M9174 of HST 0

----------------- For special register, please refer to Software User Manual Instruction Chapter 2

↓

In Sub-program field, write the suspension of Service Program HST0I.

----------------- Please refer to Section 5.6.

↓

End

Taking the 0.1 ms time-setting HST 0 relay as an example, the ladder diagram program is as follows:
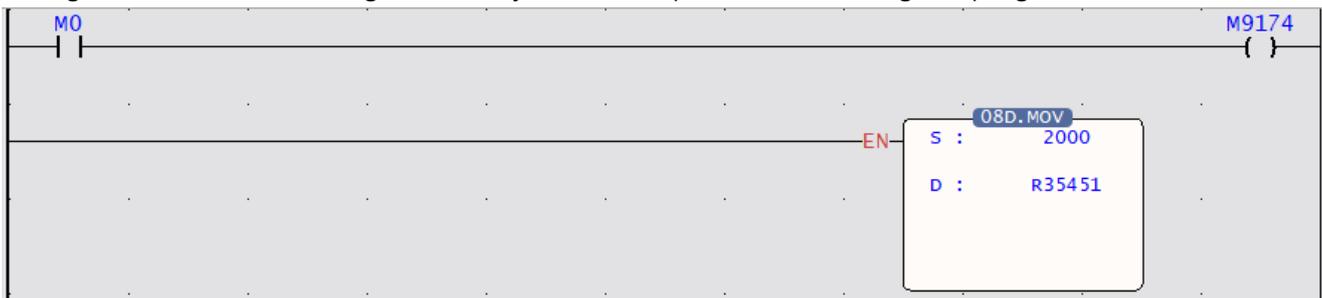
Figure 36 Main program of cyclic pulse

Figure 37 Interrupt subroutine of cyclic pulse

Example 1 · Application of High-Speed Delay Timer

This example uses HST0 as a cyclic timer, cooperating with HSC1, to connect the rotary motor of the automatic woodworking drilling machine to its rotation number, and an interrupt will be issued every fixed time period, and the number of motor rotations counted during this period will be read. The number of revolutions when there is no load (idling without drilling), and the speed change when the drill is pressed down (drilling), and the condition of the drill can be known; because the resistance of the motor is small when the drill is normal (sharp), The rotation speed is moderate, but when the drill bit becomes dull, the resistance is larger and the rotation speed becomes slower, and when the drill bit is broken, there is no resistance, the rotation speed will be the same as the idling speed, which is the fastest, because the difference between fast, medium and slow speeds is usually not large. If a general timer is used for sampling and detection, since the error is as high as tens of mS, the error value alone exceeds the difference between fast, medium and slow speed, and it is impossible to judge the speed change. At a relatively low cost, it can detect whether the drill bit is normal, dull or broken, and can warn or stop the replacement of the drill bit. [Fixed time, variable number of pulses]

Mechanism
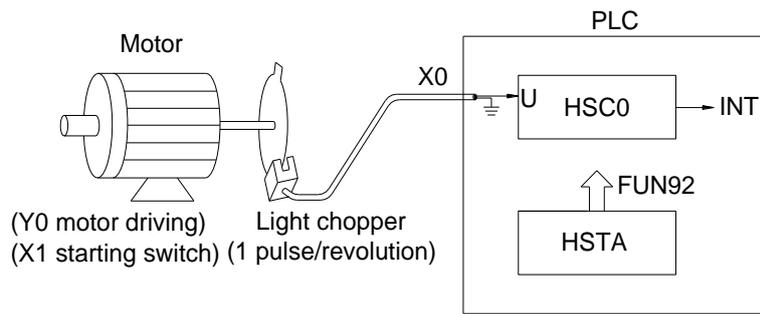
Figure 38 Schematic diagram of motor paired with high-speed counter and timer

【Main Program】
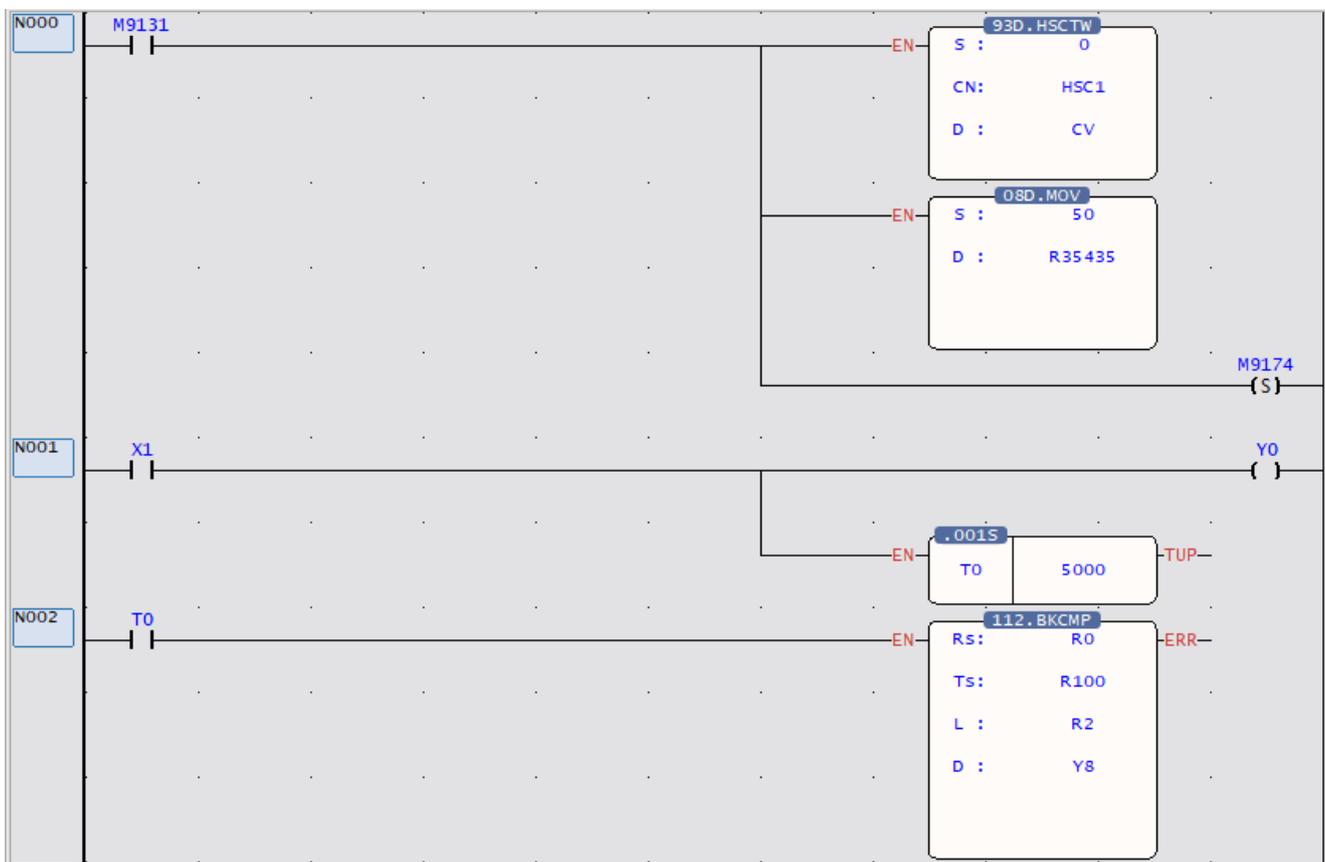
- CN=1 of FUN93 means HSC1; D=0 represents CV
- PV value of HST0 is set to 50, that is, every 5mS
  (50x0.1mS) interrupt once
- Start the motor for 5 seconds before using FUN112 to compare the speed of the drill bit
- R0: Obtain the pulse number of HST1 every 5mS

【Subroutine】
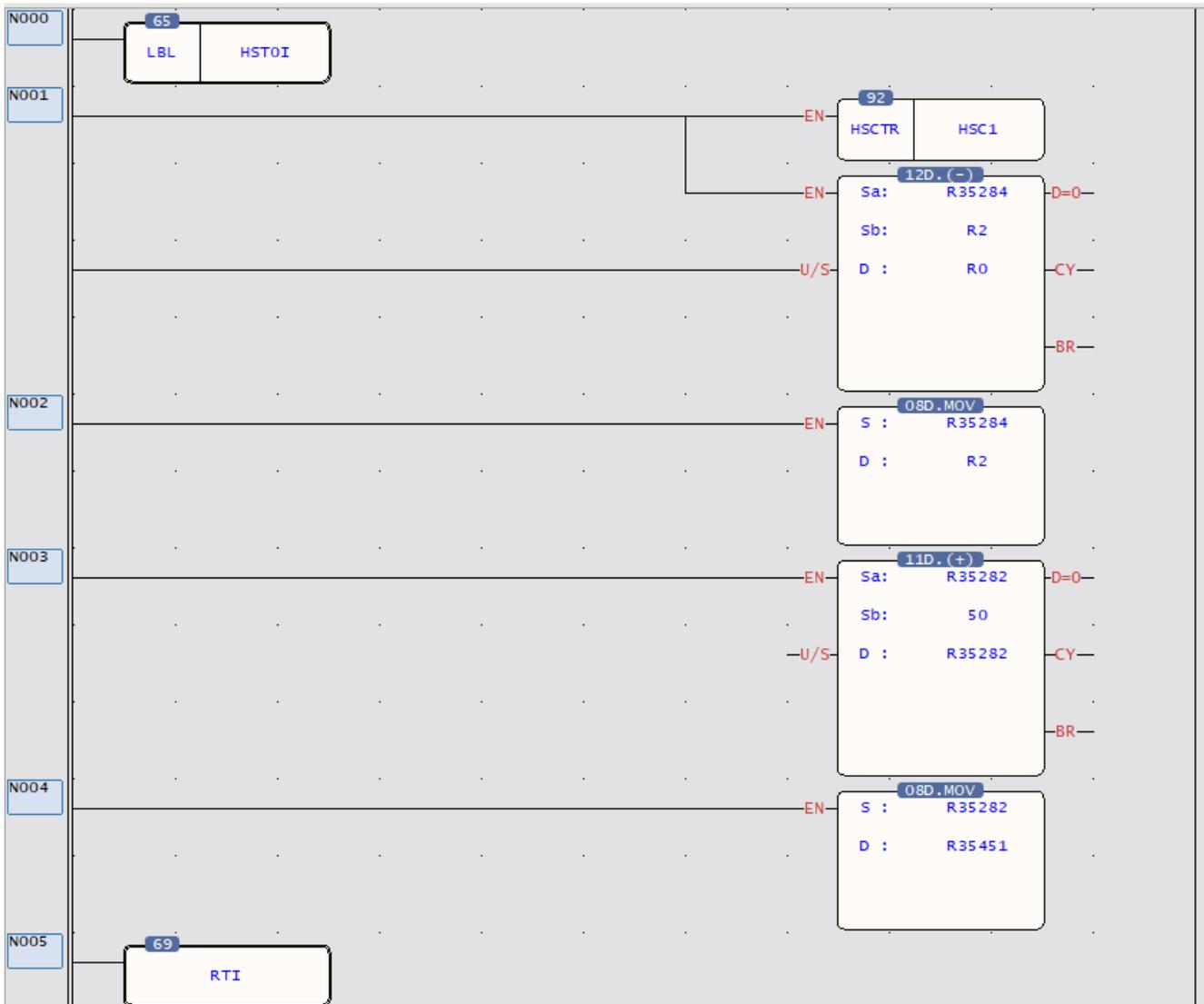
- Every 5mS, the hardware will automatically run this interrupt subroutine.
- Read the HSC1 CV and store to DR35284
- Calculate the increase value of HSC1 CV within 5mS and store it in DR0 (in practice, R1=0)
- Calculate the new PV value of HST0

【Explanation】Assuming that the speed of the drill bit is 18000RPM under normal conditions, and 1 revolution will cause the photo interrupter to generate 8 pulses, then the frequency of the U pin of HSC1=18000/60 8=2400Hz, that is, there will be 12 pulses within 5mS . Therefore, HST0 can be used to interrupt every 5mS, and the CV value of HSC1 can be read to know the speed status.

X4

HSC1 CV: 11, 12, 13 ··· 23, 24, 25 ··· 35, 36, 37 ··· 46, 47, 48

HSC0 CV: ······ 50 ············ 100 ·············· 150 ············· 200

HST0 PV: 50, 100, 150, 200

HST0I

ΔT Time base 0.1mS | DT = 5mS (50 x 0.1mS) | DT = 5mS (50 x 0.1mS) | DT = 5mS (50 x 0.1mS)

HSC1 CV increment | ΔCV=12 (24 - 12) | ΔCV=12 (36 - 24) | ΔCV=12 (47 - 36)

Upper	Lower			
R101	R100	←——→	R0 (ΔCV)	——→ Y8
R103	R102	←——→		——→ Y9
R105	R104	←——→		——→ Y10

※Set different upper and lower limits to detect the speed condition
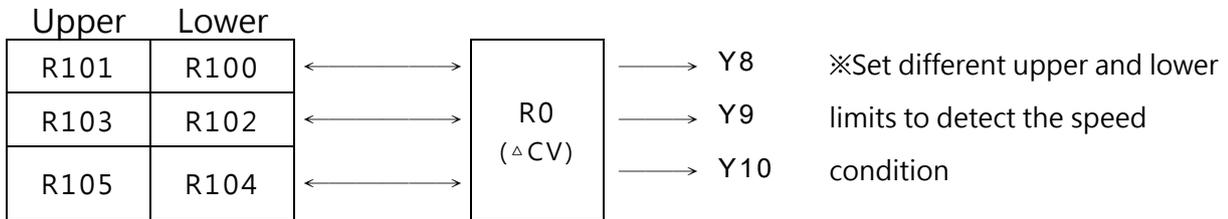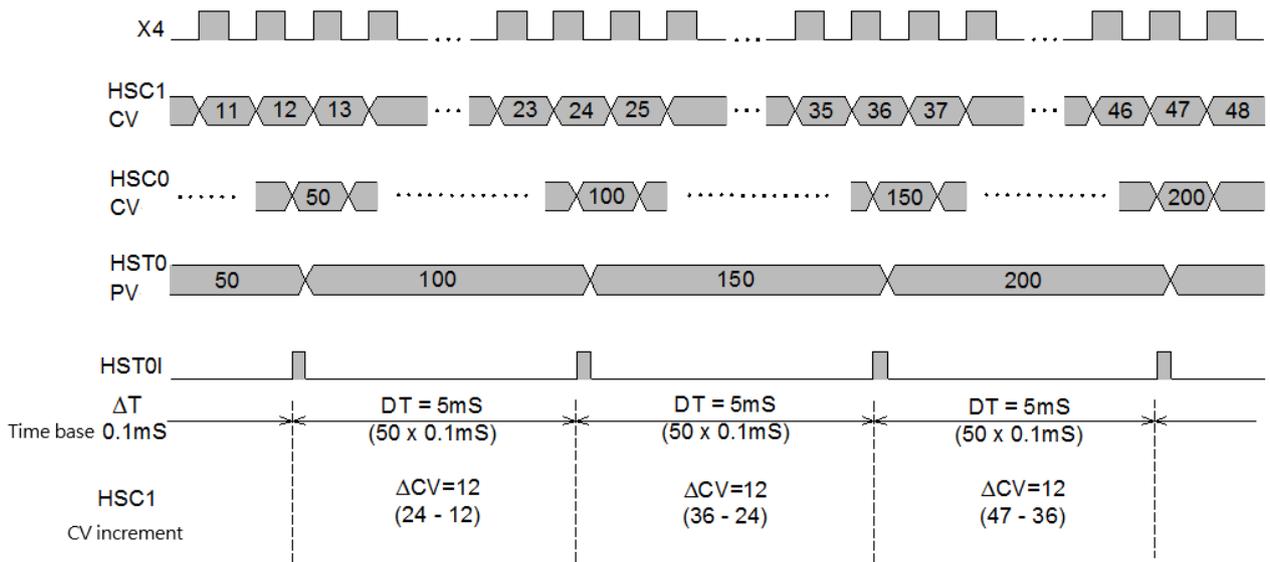
Example 2 · HST3 serves as time-setting interrupt timer program

【Main program】

- When power on or M301 is ON, disable HST3 sent a time-setting interrupt.

- When M300 changes from 0 to 1, start using HST3I interrupt.

- Set up the period of timely interrupt time. S=5 represents that it performs the interrupt service subroutine with the label name of HST3I every 0.5mS.

- Use FUN8 to write the set value into the PV of HST3, as the timer to interrupt the set value.

Enable the HST3 time-setting interrupt

【Subroutine】

- Interrupt service subroutine with the label name of HST3I.
- Read the current value of hardware high speed counter HSC0 once every 0.5mS.
- Determine which section of the electronic cam the current count value falls on, and turn the corresponding output point ON.
- Immediately output Y8 to Y15
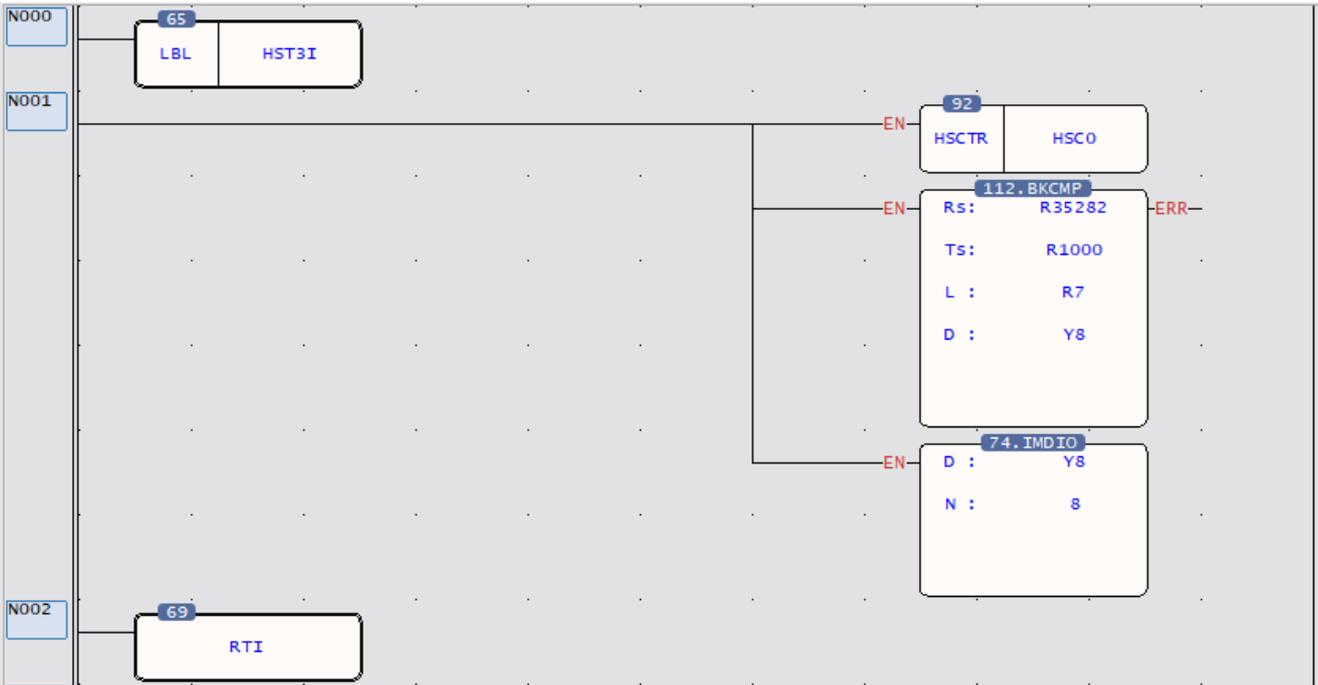
8-2-5 HSTA High-Speed Cyclic Timer

HSTA is a 32-bit hardware timer built in the SoC chip, is a 32-bit cyclic timer, It can be enabled by special relay M9178, and the current timing time can be obtained in the special register DR35467, and the numerical scale is 0.1ms. Information about related relay and register is as follows:

Item	Relay
0.1 ms time-setting HSTA cyclic counting control	M9178
Item	Register
0.1 ms HSTA cyclic recent counting LW	R35467
0.1 ms HSTA cyclic recent counting HW	R35468

The user is not required to configure HSTA because it is a built-in unit. To use, simply set Special Relay M9178 as "1" and you may read HSTA value to the HSTA-related Special Relay (DR35467).

A. HSTA 32-bit cyclic timer

The so-called "Cyclic Timer" is a timer that add 1 to its current value for every fixed interval and will persistently carry out up counting cyclic timing. Its CV value will cycle around as 0, 1, 2, ... 2147483647, 2147483648, 2147483649, ... 4294967295, 0, 1, 2, ... (as the time base is 0.1mS, CV value x 0.1mS will be its accumulative time). In fact, the cyclic timer is an up counting cyclic timing clock having a time base of 0.1mS that can operate endlessly and be used to read any two events at the time when they occurred and to calculate the time interval between the occurrence of the said two events. After triggering the HSTA control relay (M9178 0.1ms timing HSTA cycle count control), read out the cycle timer register value when the two events occur, and do the calculation, that is, the time difference can be obtained. The typical application of the cyclic timer is for more precision of turning speed (RPM) detection under the circumstances when the change in turning speed (RPM) is huge or when it is extremely low. Please refer to Example of Section 8.2.3 for description.

After triggering the HSTA control relay (M9178 0.1 ms timing HSTA cycle count control), it can be read out and stored in the temporary register to be stored (take DR35467 as an example), so that the user can knowtrack time elapsed value.
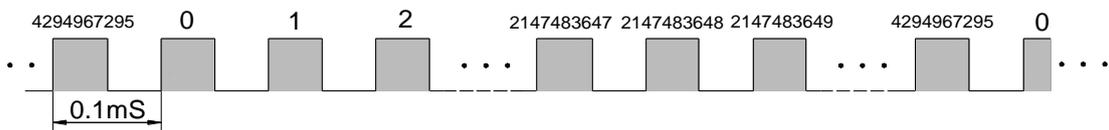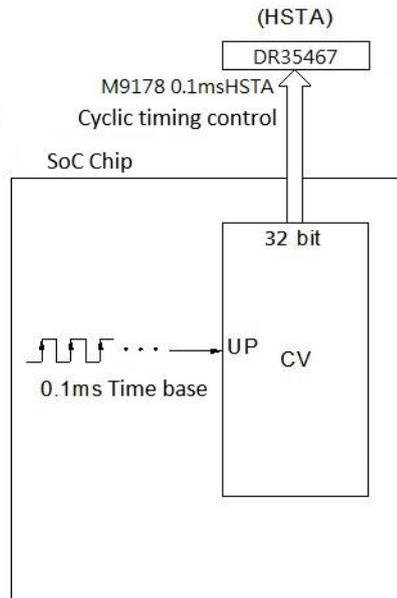
8-2-6 Examples of Application of High-Speed Timer HSTA

Example 1 · HSTA serves as 32-bit cyclic timer

When M1=1, M9178 HSTA cycle timer control is triggered, and the value in the special register DR35467 is moved into R0.

Example 2 · Application example for cyclic timer

This example uses HSTA as a cyclic timer, cooperating with HSC0, to read the time interval for accumulation of 10 pulses and sending an interrupt out each time as 10 pulses are accumulated and, reciprocally, find out the required RPM (the number of pulses is fixed when the time varies).

Note: This example is suitable for high-speed RPM applications (300-6000RPM), not suitable for low-speed RPM (at low speed, the RPM value is updated too slowly).

Mechanism
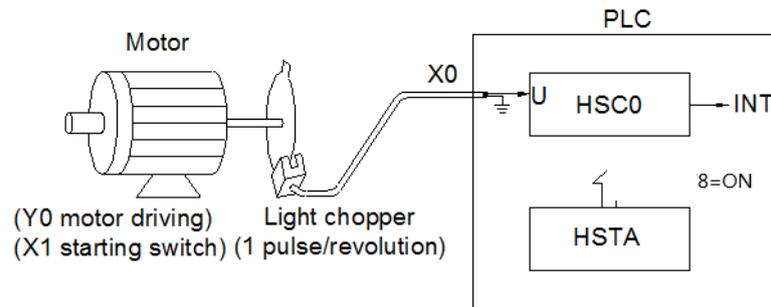
Figure 42 Schematic diagram of cyclic timer application

HSC and HST configuration

① As HSTA is built in, no configuration is required. Just need to trigger M9178 to use.

② To cooperate with the photo interrupter, set the HSC0 as an up-counting counter having single input (MD0, but use only U input).

【Main Program】
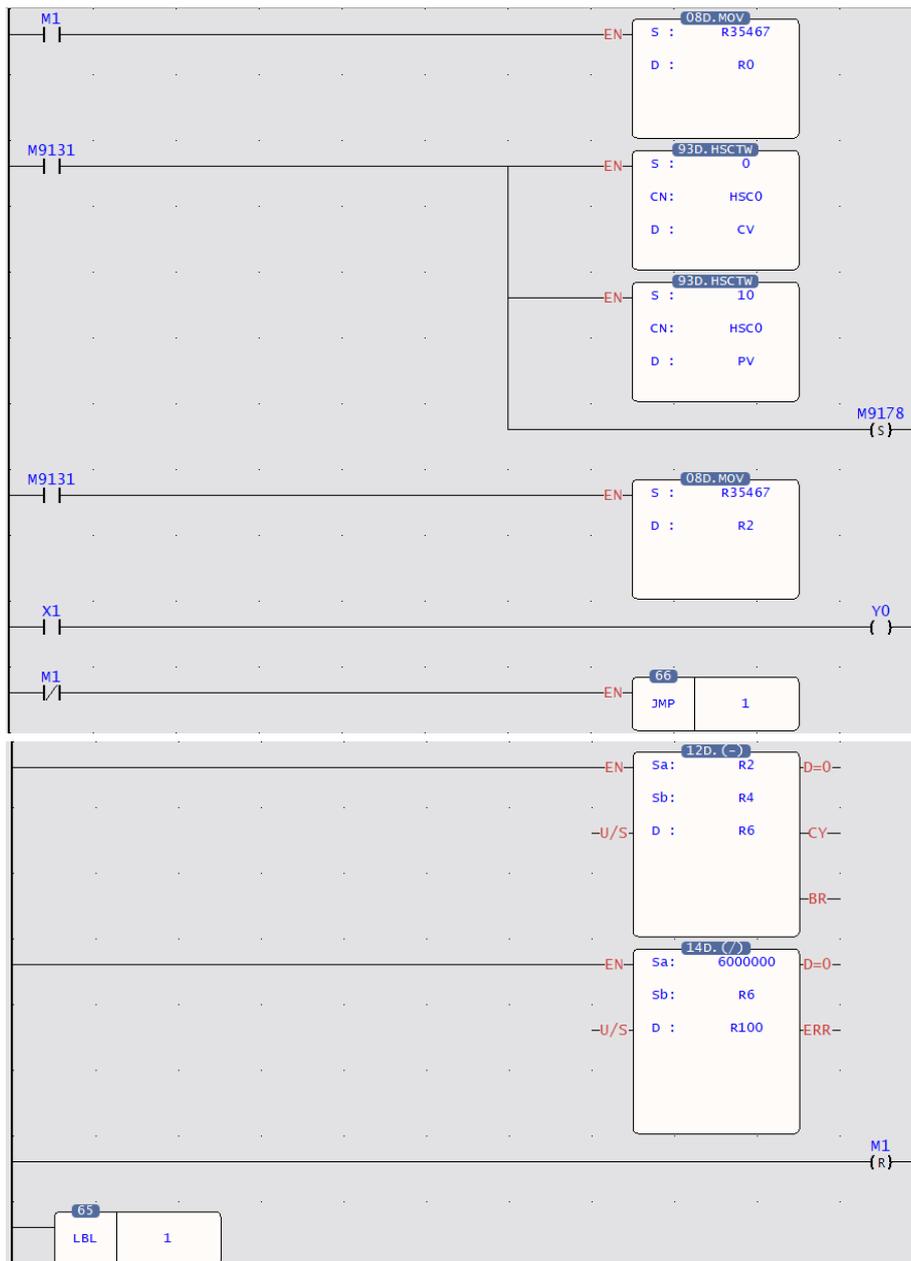
1. Employ FUN93 to write current value 0 into the CV of HSC0 in SoC chip (reset)

2. FUN93 CN=0, represents HSC0 ; D=0, represents CV

3. Write 10 into the preset register in SoC chip, which acts as interrupt value for counting up;

4. FUN93 CN=0 indicates HSC0 and D=1 indicates PV

5. Enable HSTA control

6. The initial value of HSTA CV register is stored to DR2, find interval for each HSC0 interrupt

$\triangle$T（DR6×0.1mS）

$\text{Rotating speed} = \dfrac{N}{\Delta T} \times 60\,\text{RPM}$

$N=10,\ \Delta T = \Delta CV \times 0.1mS = \dfrac{（currentCV\text{-}previousCV）}{10000S}$

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Therefore, $\text{rotating speed} = \dfrac{6000000}{\Delta CV}\text{RPM}$

R100=RPM

7. Clear the calculation flag of RPM (reset M1)

【Subroutine】
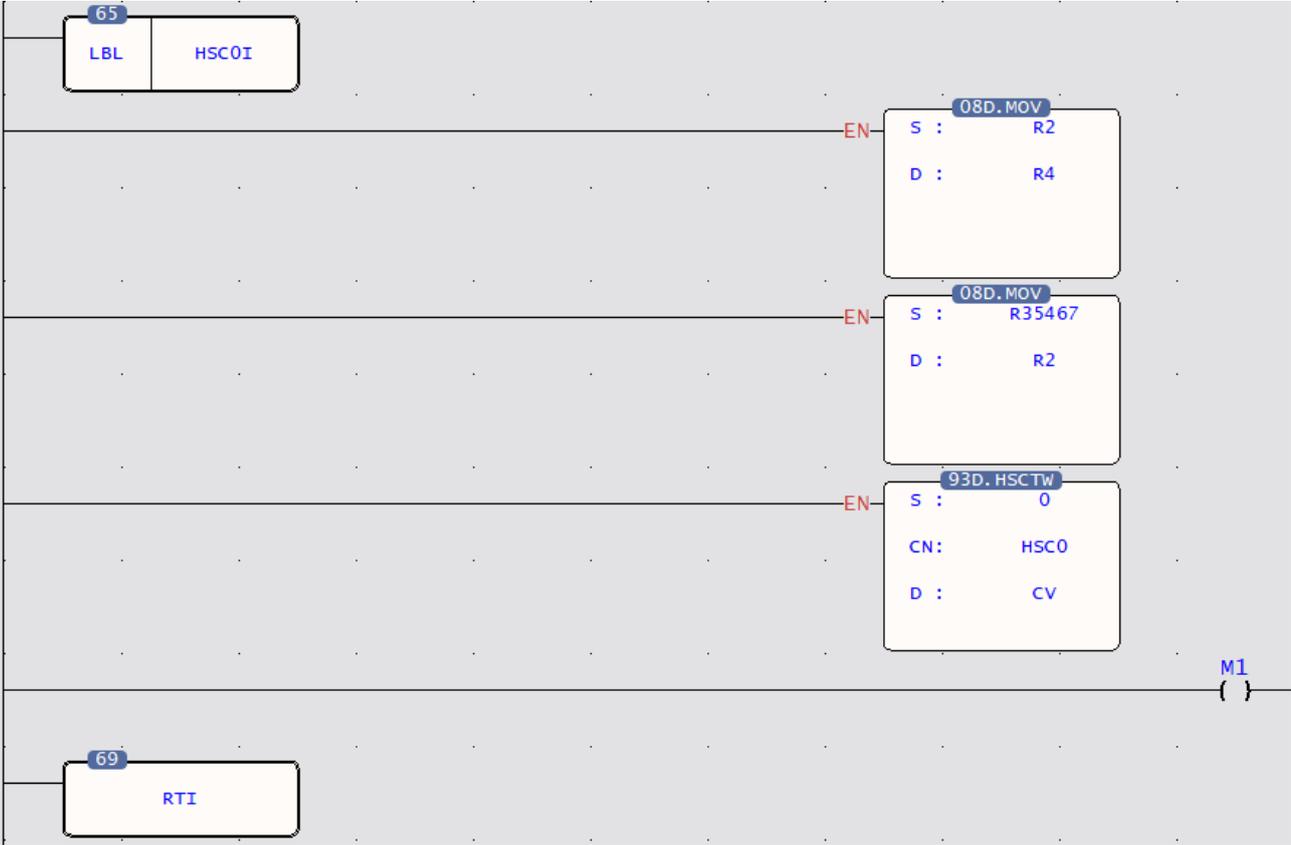
- Each time when HSC0 accumulates 10 pulses, the hardware will automatically run this interrupt subroutine
- Read the HSTA CV
- Reset the current value to 0
- M1=ON, RPM calculating flag
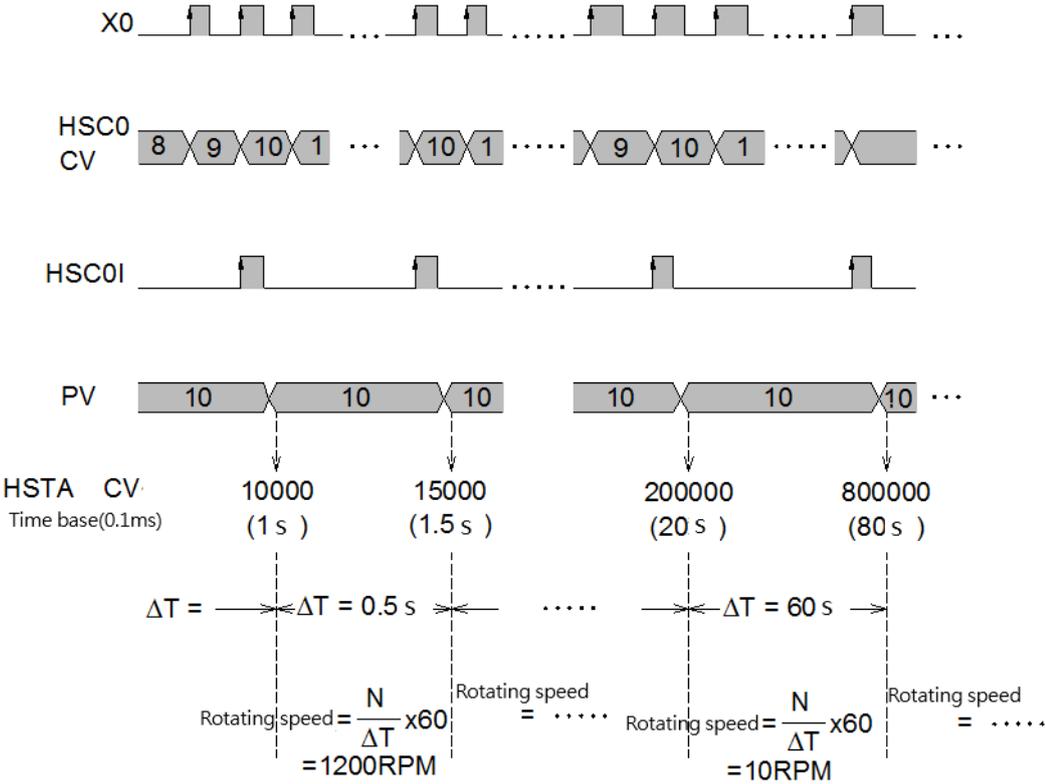
Figure 43 Comparison chart of the obtained motor RPM

8-3 Captured Input

For many high-speed applications, in addition to using the interrupt input to prevent signal omission, the input point included in the host can also be set as a capture input to capture its fleeting signal. The setup using capture input is fairly simple:

In project window, click "I/O Configuration Setup"： | Project name |

| System configuration |

| I/O configuration | → Select "Input Setup"

After the capture input setting screen appears, simply click the input points you want to capture.
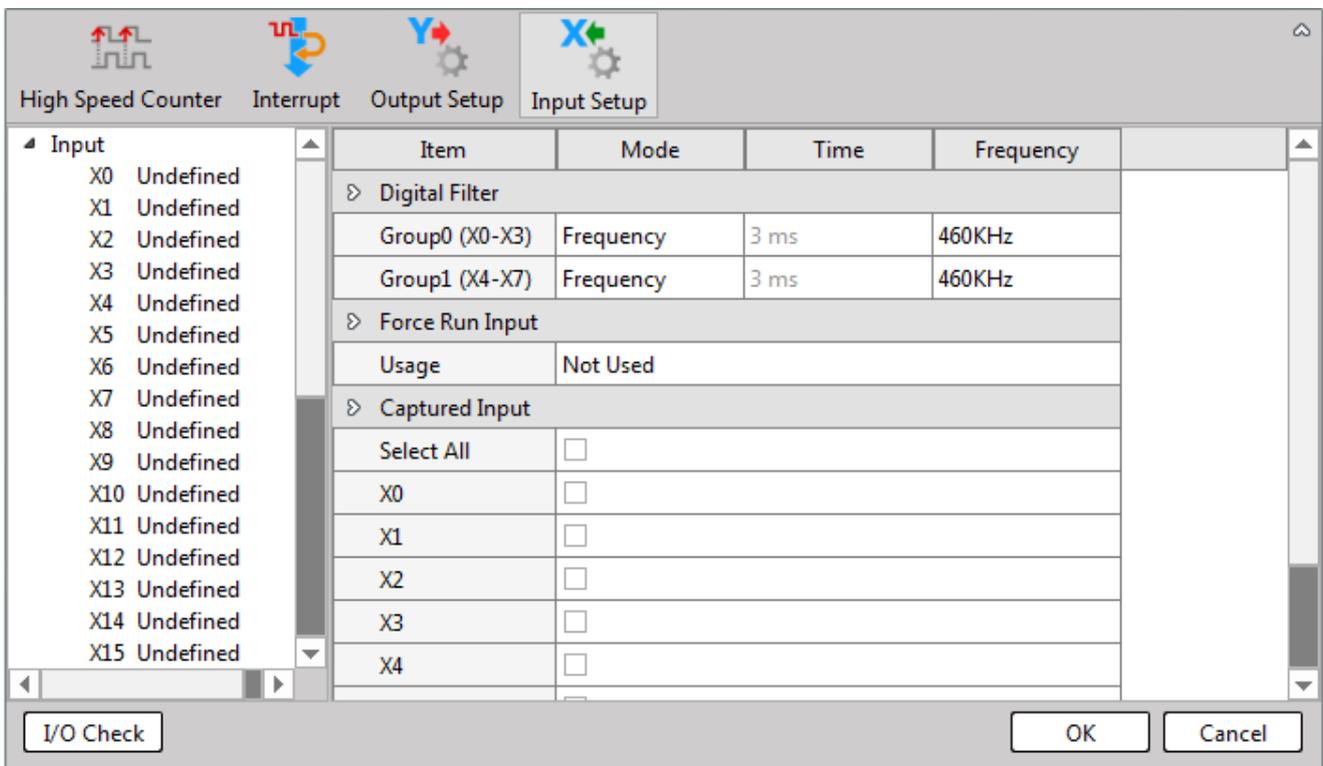
Example 1

If the capture input is to be used for counting, the input period must be at least twice as long as the scan period, so that there will be no omission. For example, if the frequency of an input signal is 50Hz, the scan time must be at least less than 10mS for the input count to be correct. If you need to set the PLC scan time, you can refer to the Chapter 6 of this Manual.
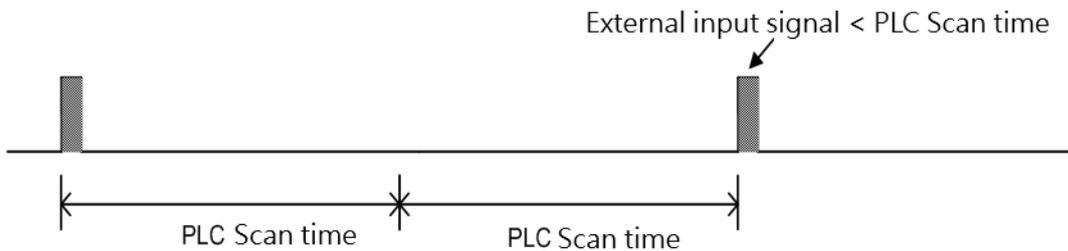
Figure 45 Schematic diagram of minimum signal frequency of captured input

Example description

The following example can set the capture input to capture the external input signal shorter than the PLC scan time (Scan Time). In addition, it must be noted that the setting of the capture input is only for the number of points contained in the host, and the number of points can be expanded. no effect
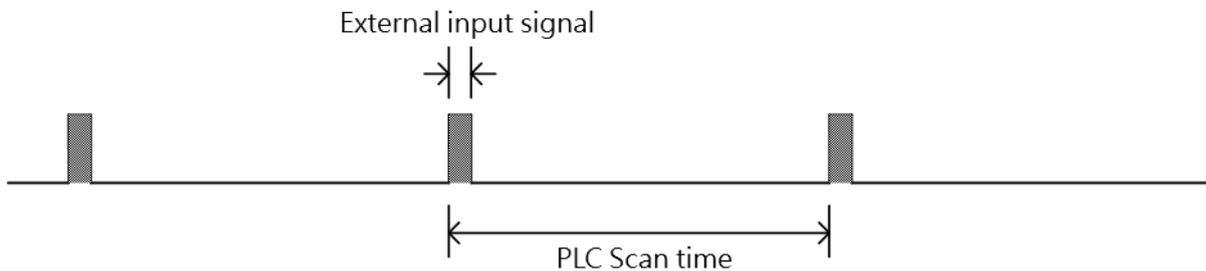
Figure 46 Schematic diagram of capturing signals that can be set to capture inputs that are shorter than the PLC scan time

8-3-1 Input Digital Filter

The input points included in the M-Series host can not only be set to capture input, but also can be divided into two groups {(X0~X3), (X4~X7)} for input filter condition setting.

The digital filter setting can be divided into setting filter conditions for time or frequency. The first 2 groups of input signals (X0~X15) can be used to set the filter frequency or filter time; when the frequency is used as the setting, 8 options such as 28KHz~1.8MHz can be set; when the time is set, it can be set (3~15) ×1mS. Set the input filter time to eliminate the noise lower than the set time; set the input filter frequency to eliminate the noise higher than the set frequency.

Example description 1

When the filter time is set to 2mS, when the signal ON or OFF time is less than 2mS, the ON or OFF signal cannot be detected.
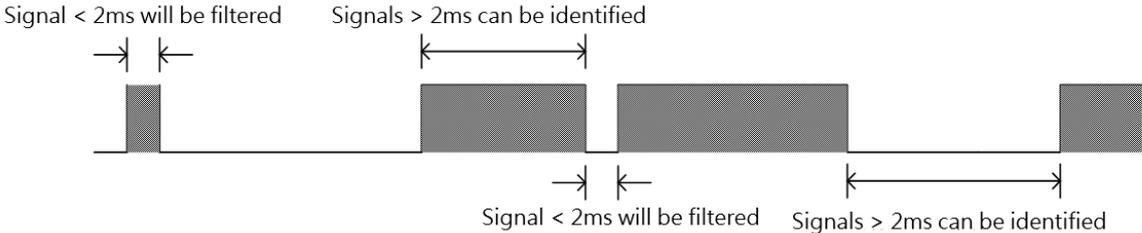
Figure 47 Schematic diagram of input points of digital filter time parameters

Example description 2

When the filter frequency is set to 28KHz, when the input frequency is greater than 28KHz, the input signal cannot be detected.
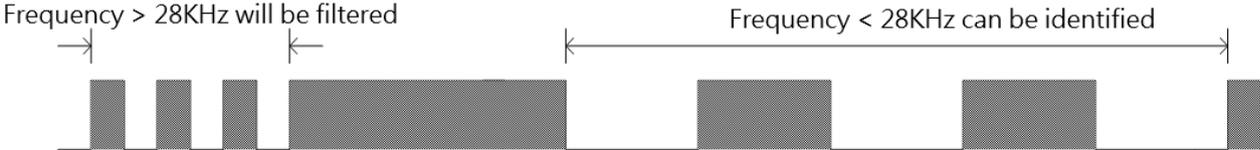
Figure 47 Schematic diagram of input points of digital filter frequency parameters

9

Pulse Output and NC Positioning Control

9-1 The Methods of NC Positioning Control

People use ordinary motor to exercise positioning control in early stage; since the speed and precision demand was not so high then, it was enough to fulfill the demand. As the increasing of mechanical operation speed for the efficiency purpose, finished product quality standard, and precision demands are getting higher, the stopping position control of motor is no more what the ordinary motor is capable to do. The best solution for this problem is to adopt NC positioning controller which incorporate with stepping or servo motor to do the position control. In the past, the extremely high cost limited the prevailing of its usage; however, the technology advance and cost decreasing, which made the pricing affordable, had helped to increase the prevailing of usage gradually. To cope with this trend, M-Series PLC integrated into its internal SoC chip the special NC positioning controller that is available on the market, therefore makes it free from the bothersome data transaction and linking procedure between PLC and special NC positioning controller. Furthermore, it greatly lowered the entire gadget cost hence provides the user the solution for a good bargain, high quality, simple, and convenient integrated NC positioning control with PLC.

Controlling stepping or servo drives with high-speed pulses is often used. The M-series host includes multi-axis high-speed pulse output and high-speed hardware counters, and can provide easy-to-use and designed positioning program editing.

The methods for controlling interface of PLC and stepping or servo driver are as follows:

- Semi closed loop control

The PLC is responsible for sending high speed pulse command to servo driver. The motion detector installed on servo motor will forward directly to server driver, closed loop reaches only to server driver and servo motor. The superior point is that the control is simple and the precision is satisfactory (which is suitable for most of the applications). The defect is that it can't fully reflect the actual shift amount after the transmission element; furthermore, the element being consumed, become aging, or has defect will not be able to be compensated nor checked to verify.

- Closed loop control

The PLC is responsible for sending high speed pulse command to servo driver. In addition to that the shift detection signal installed on servo motor which will be forwarded directly to servo driver, the attached shifting detector installed after the transmission element can fully reflect the actual shift amount and forward it to the high-speed counter that PLC contains. So as to make the control becomes more delicate, and help to avoid the defect of above mentioned semi closed loop.

9-2 Absolute Coordinate and Relative Coordinate

The designation of moving distance can be assigned by absolute location (absolute coordinate positioning), or assigned by relative distance (relative coordinate positioning). And the DRV instruction is used to drive motor.

While marking the moving distance with absolute coordinate,

If it is located at 100mm at the present, for moving to 300 mm, the positioning instruction is:

DRV   ABS,   ,300, Ut

If it is located at 300mm at the present, for moving to 0 mm, the positioning instruction is:

DRV   ABS,   ,0, Ut

While marking the moving distance with relative coordinate,

if it is located at 100mm at the present, for moving to 300 mm, the positioning instruction is ：

DRV   ADR,+,200, Ut

if it is located at 300mm at the present, for moving to 0mm, the positioning instruction is:

DRV   ADR,-,300, Ut

● Absolute coordinate labeling

Program coding for location of 300mm moving to 0mm:

DRV   ABS,   ,   0,Ut

-100   0   100   200   300

Program coding for location of 100mm moving to 300mm:

DRV   ABS,   ,300,Ut

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● Relative coordinate labeling

Program coding for location of 300mm moving to 0mm:

DRV ADR,－,300,Ut

-100   0   100   200   300

Program coding for location of 100mm moving to 300mm:

DRV ADR,+,200,Ut

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9-3 Procedures of Using Positioning Control

Start

Configure the high-speed pulse output (HSPSO) function under UperLogic configuration function. Switch the Y0 ~ Y7 output of M Series-PLC to HSPSO circuit in the SoC, and determine the working mode of output pulse (U/D, PLS/DIR, A/B), and complete the hardware wiring layout between PLC and positioning driver.

Each axis of motor is controlled by one FUN140 (it can also by more than one, but only one can be active at any time); then employs the FUN140 extended positioning instruction (SPD, DRV, etc.) to coding for the needed positioning control program that will be saved into register block assigned by FUN140 SR operand.   Once the FUN 140 input control started, it can exercise the positioning controls.

Please refer to FUN140 and its extended positioning instruction for the function and usage explanation.

If it needs to do close loop control, it can employ the M-Series PLC hardware high speed counter to count the feedback pulse (e.g. Encoder etc.) after transmission element to achieve.

End

9-3-1 Configuration of Positioning Axis

In project window, click "I/O Configuration Setup": Project name

System configuration

I/O configuration → Select "Output Setup"

When Output Setup picture is displayed, you may decide the output item.
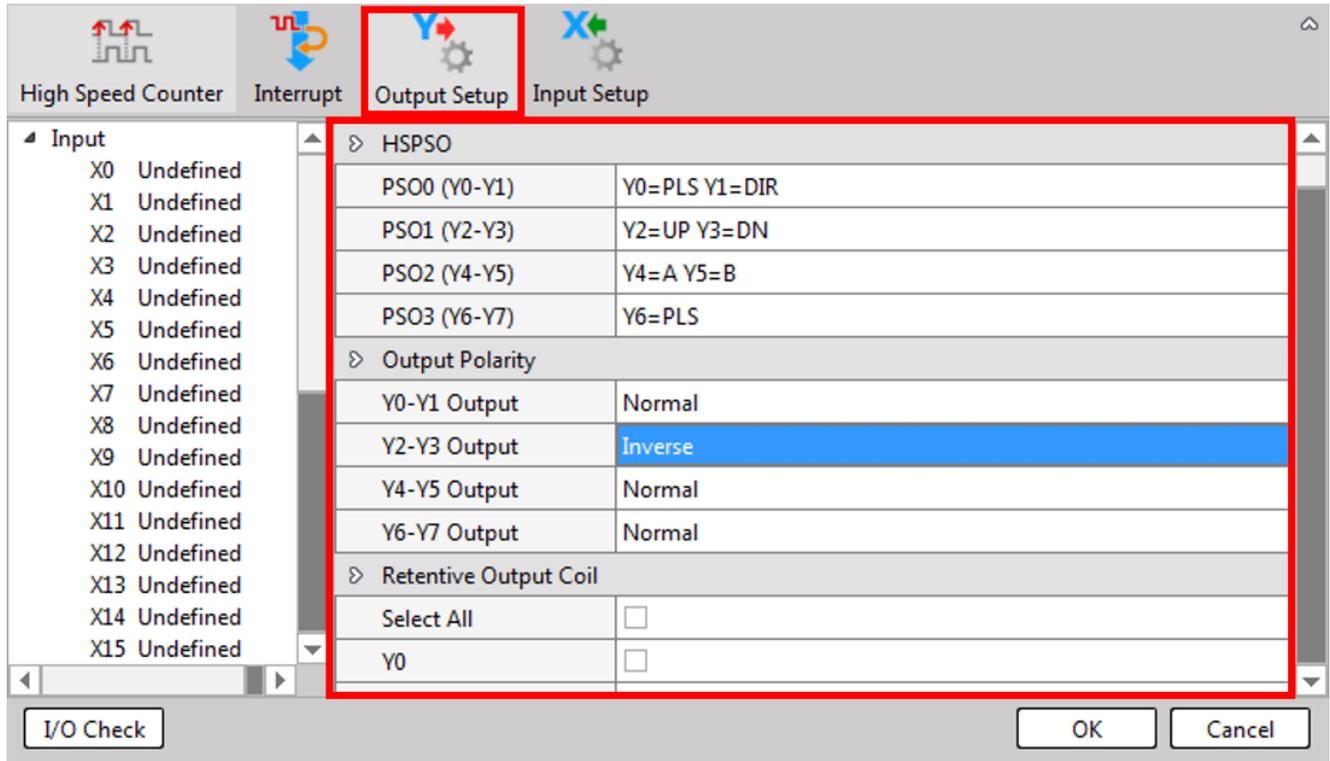
Figure 49 Plan High-Speed Pulse Output (HSPSO)

9-3-2 Output of Positioning Axis

The output pulse frequency of M-Series PLC can reach 200KHz (the upper limit varies with different models). High speed pulse output circuit share to use the Y0 ~ Y15 (the upper numbers varies with different models) exterior output of PLC. While it is not yet using the HSPSO function (haven't configured the PSO function under configuration function), the Y0 ~ Y15 exterior output of M-Series PLC is corresponding to the Y status of internal output relay. When the HSPSO has been configured, the external output point will be switched to the HSPSO output circuit, not used as the original output relay.

The following is the detailed signals, output modes and supportive frequency list for respective axis output with the largest specification:

Axis No.	Exterior output	Output modes			
		U/D output	P/R output	A/B output	Single PLS output
PSO0	Y0, Y1	Y0=U, Y1=D	Y0=P, Y1=R	Y0=A, Y1=B	Y0=P
PSO1	Y2, Y3	Y2=U, Y3=D	Y2=P, Y3=R	Y2=A, Y3=B	Y2=P
PSO2	Y4, Y5	Y4=U, Y5=D	Y4=P, Y5=R	Y4=A, Y5=B	Y4=P
PSO3	Y6, Y7	Y6=U, Y7=D	Y6=P, Y7=R	Y6=A, Y7=B	Y6=P

Table 18 The detailed signals, output modes and supportive frequency list for respective axis output

9-3 Positioning Control Function

The built-in M-series host can control positioning motion of up to 8 axes (the upper limit varies with different models), and provides point-to-point positioning speed control. The NC positioning control instructions used are based on the previous generation of PLC FBs/B1 series, on which compatibility is provided and other application-type instructions are added, such as interrupt fixed length (ICF) and interrupt fixed angle (ICA), etc. If you want to use the M-series host to drive the servo or stepping motor through the pulse, as long as the circuit structure and frequency can be matched, it can work normally.

9-4-1 Stepping Motor Interface
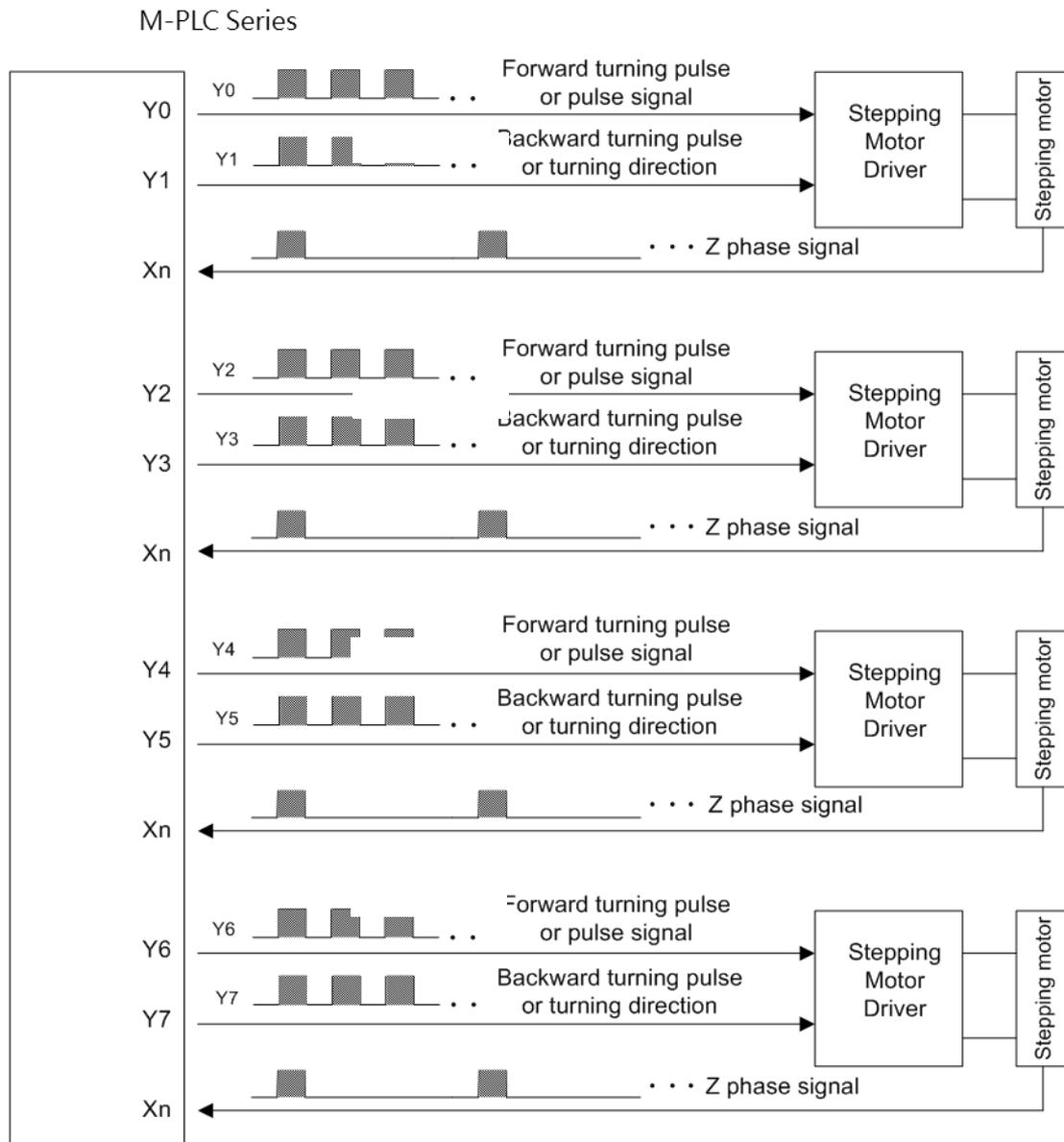
Figure 50 Schematic diagram of signal transmission between stepping motor and PLC

Stepping motor is designed to receive input pulse to attain to the control of desired angle or distance, therefore the turning angle and the input pulse count has a positive correlation ship, and the turning speed also depends on the input pulse frequency.

N: Revolving speed of motor (RPM)

N (RPM) = 60×f/n   f: Pulse frequency (PLS/Sec)

n: Pulse counts for motor to turn for a revolution (PLS/ Rev)

n = 360 / θs   θs   : Angle (Deg)

Phase	Basic pulse angle	FULL		HALF	
		Pulse angle	Pulse counts for turning one revolution	Pulse angle	Pulse counts for turning one revolution
5 phases	0.36°	0.36°	1000	0.18°	2000
	0.72°	0.72°	500	0.36°	1000
4 phases	0.90°	0.90°	400	0.45°	800
2 phases	1.80°	1.80°	200	0.90°	400

Table 19 Comparison table of motor phases, pulse angles and pulse counts for turning one revolution

9-4-2 Interface of Servo Motor
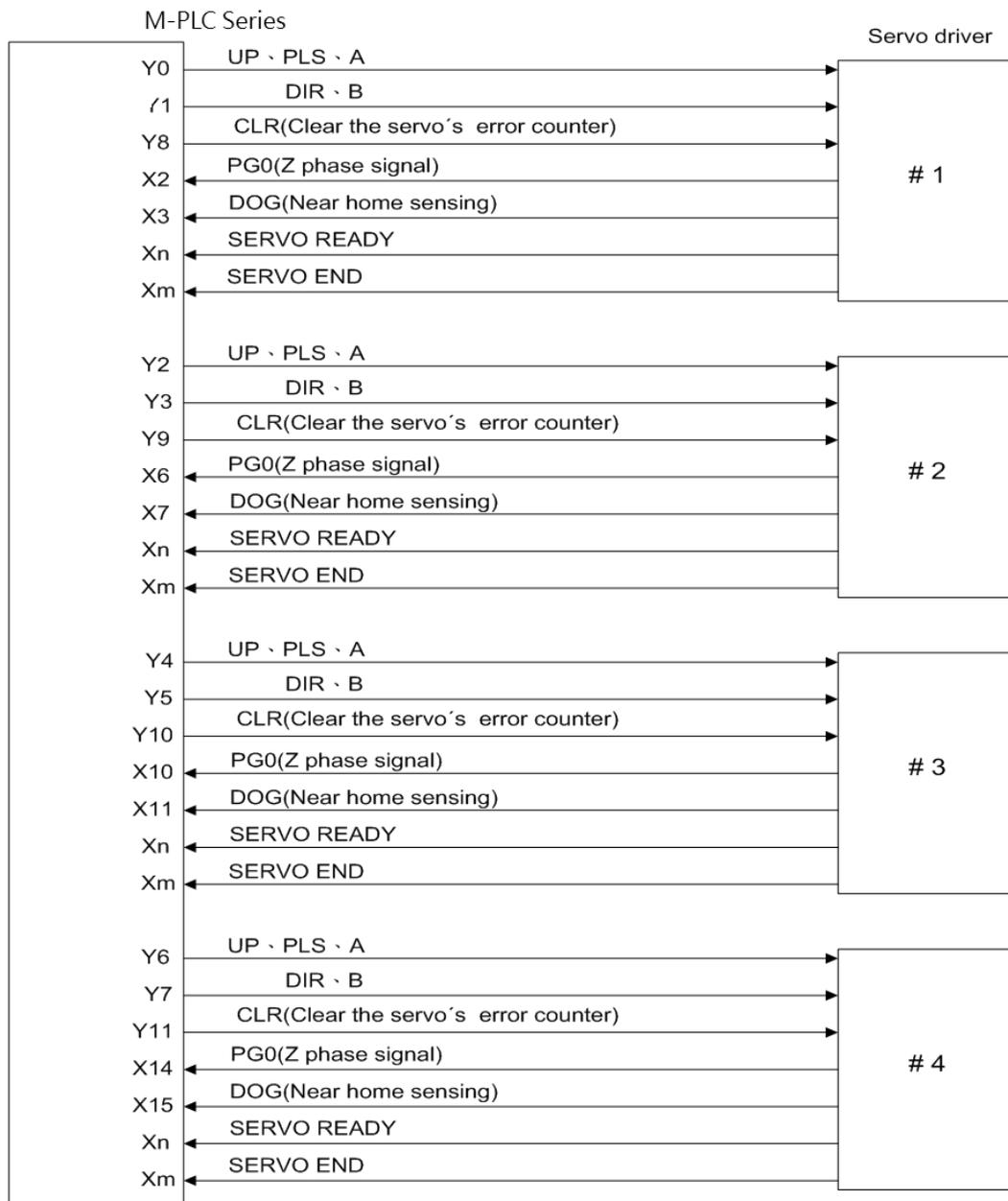
Figure 51 Schematic diagram of signal transmission between Servo motor and PLC

※ Except that the Y0 ~ Y7 of above diagram are for dedicated purpose, Y8 ~ Y11 and respective inputs can be adjusted for using according to demand.

※ The leftover travel, right over travel limit switches for safety detection also need to be connected to PLC to assure proper operation.

9-4-3 Working Diagram Illustration for Servo Motor
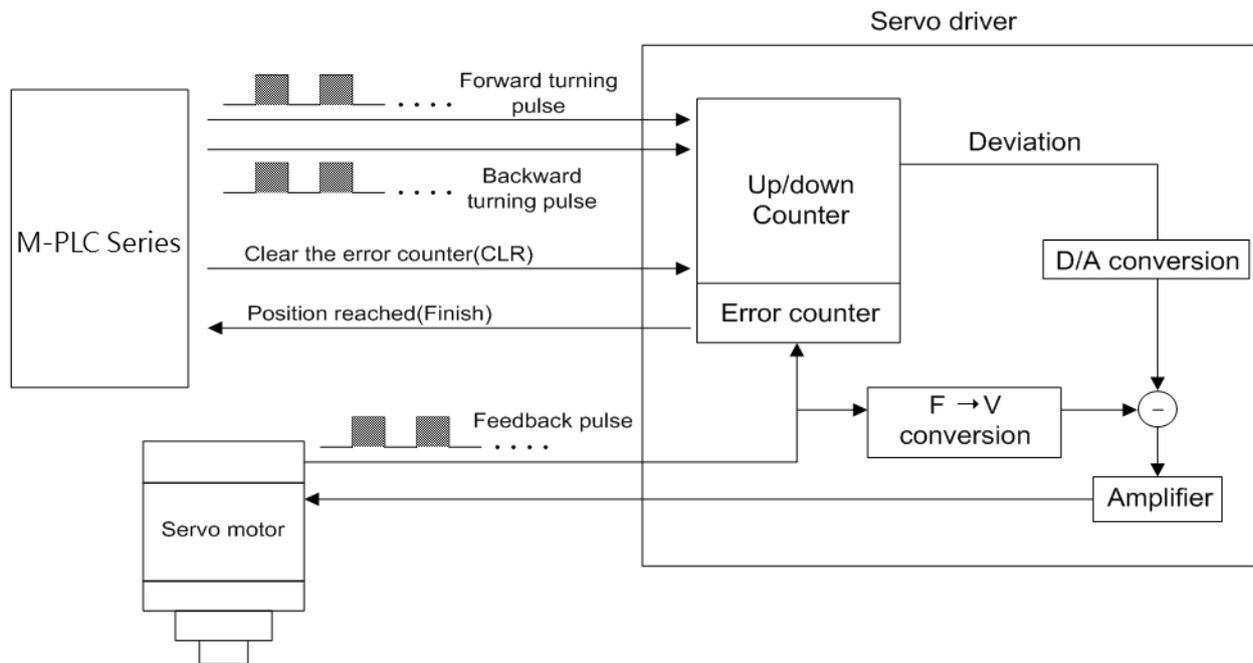
Figure 52 Working diagram illustration for Servo Motor

- The Encoder of servo motor feedback the shifting detection signal to servo driver. The driver gets the pulse frequency, and pulse count of input signal (pulse instruction), as well as the frequency and pulse count of feedback signal processed with internal error counter and frequency to voltage conversion circuit, and acquired the pulse and turning speed deviations.   Using these operations to control the servo motor, so as to obtain a high speed, precise speed and positional closed-loop processing system.

- The revolving speed of servo motor depends on the pulse frequency of input signal; the turning stroke of motor is determined by pulse count.

- Generally speaking, the final control error deviation of servo motor is ±1 pulse.

9-5 NC Positioning Control Instruction

Interrupt Constant Angle (ICA)

FUN137 is based on the initial angle at 0 degree, it is positioned in fixed angle when exterior interrupt is detected.

Interrupt Constant Feed (ICF)

FUN138 outputs specific amount of movement when exterior interrupt is detected.

High-Speed Pulse Width Modulation (HSPWM)

FUN139 outputs PWM waveform with specified pulse width and frequency, but the output waveform is limited by the internal formula, which is reserved because it is compatible with the previous PLC FBs/B1 series. FUN144 can provide more direct control.

High-Speed Pulse Output (HSPSO)

FUN140 executes NC control through positioning table, which includes the following 9 extension positioning instructions:

1. SPD	4. DRVZ	7. EXT	Used for positioning program coding and stored to SR operand area of FUN140
2. DRV	5. WAIT	8. GOTO	
3. DRVC	6. ACT	9. MEND	

*FUN140 does not support U Mode, if users need it, FUN139 and FUN144 are supported.

Parameter Setting for Positioning Program（MPARA）

FUN141 sets parameters such as moving unit, acceleration and deceleration, and return to origin, which will take effect on the specified positioning axis.

Enforcing Pulse Output Stop（PSOFF）

FUN142 stops pulse output of the specified axis.

Converting the Current Pulse Value to Displaying Value（PSCNV）

FUN143 converts units of movement.

High-Speed Pulse Width Modulation 2 (HSPWM2)

FUN139 inputs specific pulse width and PWM waveform of frequency.

Manual Pulse Generator for Positioning (MPG)

FUN148 carries out manual pulse action for a positioning axis

9-5-1 Interrupt Constant Angle (ICA)

FUN137 ICA	Interrupt Constant Angle	FUN137 ICA

Symbol	

Ladder symbol

```
              137.ICA
Execution  EN    Ps :        ACT
Control
Direction  DIR   Io :        ERR
                 Fo:         DN
                 Ag:
```

Ps：The set number of Pulse Output (0～7)

0：Y0 & Y1

1：Y2 & Y3

2：Y4 & Y5

3：Y6 & Y7

4：Y8 & Y9

5：Y10 & Y11

6：Y12 & Y13

7：Y14 & Y15

Ls：External input point X index number (0~15)

Fo：Target Working Speed

(1~100000 or 1~200000)

Ag：Fixed angle during interrupt (0~36000)

Range / Operand	X	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K
	Xn	WX0 | WX1008	WY0 | WY1008	WM0 | WM19578	WS0 | WS3088	T0 | T1023	C0 | C1279	R0 | R34767	R34768 | R34895	R35024 | R35151	R35280 | R43223	R43224 | R47319	D0 | D11999	
Pw														0～7
Ls	○													
Fo							○				○	○		1 ～ 100000 or 1~ 200000
Ag							○				○	○		0 ～ 36000

FUN137 ICA	Interrupt Constant Angle	FUN137 ICA
Instruction		

1. The positioning axis can be controlled up to PSO7, but the actual maximum axis number that can be controlled varies with the host machine model.

2. The target working speed and the maximum frequency vary according to the host model, 100K and 200K.

3. In general and advanced motion control hosts, external input points 8~15 of X will be reserved for the motion function and not supported by this command.

4. The external input point does not need additional special configuration in the interrupt setting in the I/O configuration. The relevant settings will be automatically made when the command is executed.

9-5-2 FUN 138 Interrupt Constant Feed (ICF)

FUN138 ICF	Interrupt Constant Feed	FUN138 ICF

Symbol	

<table>
<tr><td rowspan="2">

Ladder symbol↵

Execution↵ Control↵ —EN←

Direction↵—DIR←

138.ICF↵

Ps :　　　　　↵ —ACT←

Io :　　　　　↵ —ERR←

Fo:　　　　　↵ —DN←

Fd:　　　　　↵

</td>
<td>

Ps：The set number of Pulse Output (0～7)

0：Y0 & Y1

1：Y2 & Y3

2：Y4 & Y5

3：Y6 & Y7

4：Y8 & Y9

5：Y10 & Y11

6：Y12 & Y13

7：Y14 & Y15

Ls：External input point X index number (0~15)

Fo：Target Working Speed

　　(1~100000 or 1~200000)

Fd：Amount of pulse wave movement after interrupt capture

</td></tr>
</table>

Range \ Operand	X	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K
	Xn	WX0 | WX1008	WY0 | WY1008	WM0 | WM19578	WS0 | WS3088	T0 | T1023	C0 | C1279	R0 | R34767	R34768 | R34895	R35024 | R35151	R35280 | R43223	R43224 | R47319	D0 | D11999	
Pw														0 ~ 7
Ls	○													
Fo							○					○	○	1 ~ 100000 or 1~ 200000
Fd							○					○	○	○

FUN138 ICF	Interrupt Constant Feed	FUN138 ICF
Description		

1. The positioning axis can be controlled up to PSO7, but the actual maximum axis number that can be controlled varies with the host machine model.

2. The target working speed and the maximum frequency vary according to the host model, 100K and 200K.

3. In general and advanced motion control hosts, external input points 8~15 of X will be reserved for the motion function and not supported by this command.

4. The external input point does not need additional special configuration in the interrupt setting in the I/O configuration. The relevant settings will be automatically made when the command is executed.

9-5-3 FUN139 High-Speed Pulse Width Modulation (HSPWM)

FUN139 HSPWM	High-Speed Pulse Width Modulation	FUN139 HSPWM
Symbol		

<table>
<tr>
<td>

Ladder symbol↵

</td>
<td>

Pw: Output of High-Speed Pulse Width Modulation (0=Y0, 1=Y2, 2=Y4, 3=Y6, 4=Y8, 5=Y10, 6=Y12, 7=Y14)

Op: Output polarity;

0=Output non-reversed phase

1=Output reversed phase

Rs: Resolution;

0=1/100 (1%)

1=1/1000 (0.1%)

Pn: Setting of output frequency parameter (0~255)

OR: PWM Output Width Setting Register

0~100 or 0~1000

WR: Instruction operation work register, other programs cannot be reused.

</td>
</tr>
</table>

Operand \ Range	Y	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K
	Yn	WX0 | WX1008	WY0 | WY1008	WM0 | WM19578	WS0 | WS3088	T0 | T1023	C0 | C1279	R0 | R34767	R34768 | R34895	R35024 | R35151	R35280 | R43223	R43224 | R47319	D0 | D11999	
Pw	○													0 ~ 3
Op	○													0 ~ 1
Rs	○													0 ~ 1
Pn		○	○	○	○	○	○	○	○	○	○	○	○	0 ~ 255
OR								○				○	○	0 ~ 1000
WR			○	○	○	○	○	○		○	○	○	○	

FUN139 HSPWM	High-Speed Pulse Width Modulation	FUN139 HSPWM
Description		

- The PWM output of point 0 (Y0) and point 1 (Y2) must have the same resolution, both 1/100 or 1/1000; and the output frequency parameter setting must also be the same, only the output width (PULSE WIDTH) can be not the same; Similarly, the 2nd point (Y4) and the 3rd point (Y6) PWM output are also as specified above.

- When the execution control "EN"=1, the output point specified by this command will output at the frequency determined by the following formula with the specified pulse width.

1. $f_{pwm} = \dfrac{184320}{(P_n + 1)}$, when Rs (Resolution) is set 1/100

2. $f_{pwm} = \dfrac{18432}{(P_n + 1)}$, when Rs (Resolution) is set 1/1000

| Example 1 | If Pn (Parameter of output frequency) =50, Rs (Resolution)=0 |

$$f_{pwm} = \frac{184320}{(50+1)} = 3614.117......\fallingdotseq 3.6KHz$$

$$T(Cycle)= \frac{1}{f_{pwm}} \fallingdotseq 277uS$$

Resolution= 1/100,

If OR (Output Width) =1 then To$\fallingdotseq$2.7uS; OR (Output Width) =50 then To$\fallingdotseq$140uS。

Diagrams are shown below:

(1) Pn (Parameter of output frequency) =50, Rs=0 (Resolution =1/100), OR (Output Width) =1

Output Waveform:

To$\fallingdotseq$ 2.7usec

Tp$\fallingdotseq$ 277usec
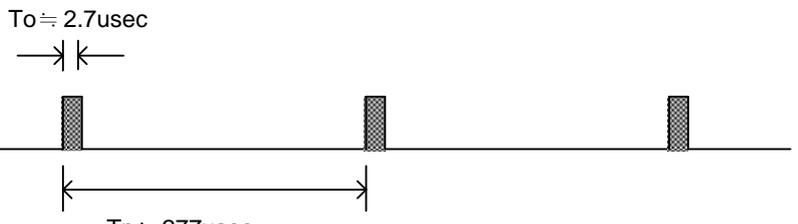
(2) Pn (Parameter of output frequency) =50, Rs=0 (Resolution =1/100), OR (Output Width) =50

Output Waveform:

To$\fallingdotseq$ 140usec

Tp$\fallingdotseq$ 277usec

FUN139 HSPWM	High-Speed Pulse Width Modulation	FUN139 HSPWM
Example 2	If Pn (Parameter of output frequency) is set 200, Rs (Resolution)=1	

$$f_{pwm} = \frac{18432}{(200+1)} \fallingdotseq 91.7Hz; \ T(Cycle) = \frac{1}{f_{pwm}} \fallingdotseq 10.9mS$$

Rs (Resolution) =1/1000,

If OR(Output Width) =10 then To≒109uS; OR(Output Width)=800 then To≒8.72mS.

Diagrams are shown below:

(1) Pn (Parameter of output frequency) =200, Rs=1(Resolution=1/1000), OR (Output Width) =10

   Output Waveform:

To≒109usec

Tp≒10.90msec
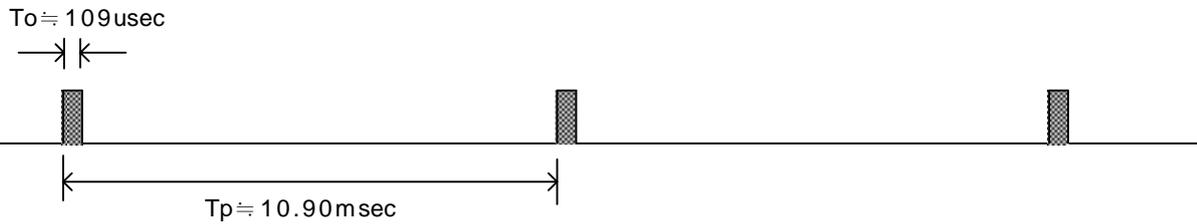
(2) Pn (Parameter of output frequency) =200, Rs=1(Resolution=1/1000), OR (Output Width) =800

   Output Waveform:

To≒8.72msec

9-5-4 FUN140 High Speed Pulse Output（HSPSO）

FUN140	High Speed Pulse Output	FUN140
HSPSO	（Including the extended positioning instruction）	HSPSO

Symbol	

<table>
<tr><td rowspan="2">

<u>Ladder symbol</u>

┌ 140.HSPSO ┐

Execution — EN ─ Ps :
control

Pause — INC ─ SR :

Abort — ABT ─ WR :

── ACT — Acting

── ERR — Error

── DN — Done

</td>
<td>

Ps : The set number of Pulse Output (0 ~ 7)

0: Y0 & Y1

1: Y2 & Y3

2: Y4 & Y5

3: Y6 & Y7

4 : Y8 & Y9

5 : Y10 & Y11

6 : Y12 & Y13

7 : Y14 & Y15

SR: Starting register for positioning program

WR: Starting register for instruction operation controls

7 registers, which the other program cannot repeat in using.

</td></tr>
</table>

Range / Operand	HR R0 | R34767	DR D0 | D11999	ROR R43224 | R47319	K
Ps				0-3
SR	○	○	○	
WR	○	○	○	

Description	

1. The positioning axis can be controlled up to PSO7, but the actual maximum axis number that can be controlled varies with the host machine model.

2. The NC positioning program of FUN140 (HSPSO) instruction is a program written and edited with text programming. We named every position point as a step (which includes output frequency, traveling distance, and transfer conditions). For one FUN140, it can be arranged with 250 steps of positioning points at the most, with every step of positioning point controlled by 9 registers.

3. The best benefit to store the positioning program into the registers is that in the case of association with MMI (Man Machine Interface) to operate settings, it may save and reload the positioning program via MMI when replacing the molds.

4. When execution control "EN" =1, if the other FUN140 instructions to control Ps0 ~ 3 are not active (corresponding status of Ps0=M9183, Ps1=M9184, Ps2=M9185, and Ps3=M9186 will be ON), it will start to execute from the next step of positioning point (when goes to the last step, it will be restarted from the first step to perform); if Ps0 ~ 3 is controlled by other FUN140 instruction (corresponding status of Ps0=M9183, Ps1=M9184, Ps2=M9185, and Ps3=M9186 would be OFF), this instruction will acquire the pulse output right of positioning control once the controlling FUN140 has released the control right.

5. When execution control input "EN" =0, it stops the pulse output immediately.

6. When output pause "PAU" =1 and execution control "EN" was 1 beforehand, it will pause the pulse output.
    When output pause "PAU" =0 and execution control is still 1, it will continue the unfinished pulse output.

7. When output abort "ABT" =1, it stops pulse output immediately. (When the execution control input "EN" becomes 1 next time, it will restart from the first step of positioning point to execute.)

8. While the pulse is in output transmitting, the output indication "ACT" is ON.

9. When there is execution error, the output indication "ERR" will be ON.
    (The error code is stored in the error code register.)

10. When each step of positioning point is complete, the output indication "DN" will be ON.

FUN140	High Speed Pulse Output	FUN140
HSPSO	(Including the extended positioning instruction)	HSPSO

*** The working mode of Pulse Output must be set (without setting, Y0 ~ Y7 will be treated as general output) to be one of U/D, P/R, or A/B modes, thus the Pulse Output may have a regular output.

U/D Mode: Y0 (Y2．Y4．Y6．Y8．Y10．Y12．Y14), it sends out upward counting pulse.

            Y1 (Y3．Y5．Y7．Y9．Y11．Y13．Y15), it sends out downward counting pulse.

P/R Mode: Y0 (Y2．Y4．Y6．Y8．Y10．Y12．Y14), it sends the pulse out.

            Y1 (Y3．Y5．Y7．Y9．Y11．Y13．Y15), it sends out the directional signal;

            ON=upward counting, OFF= downward counting.

A/B Mode: Y0 (Y2．Y4．Y6．Y8．Y10．Y12．Y14), it sends out the phase A pulse.

            Y1 (Y3．Y5．Y7．Y9．Y11．Y13．Y15), it sends out the phase B pulse.

The output polarity for Pulse Output can select to be Normal ON or Normal OFF.

【The interfaces for positioning control】

M9183	ON: Ps1 Ready
	OFF: Ps1 is in action
M9184	ON: Ps1 Ready
	OFF: Ps1 is in action
M9185	ON: Ps2 Ready
	OFF: Ps2 is in action
M9186	ON: Ps3 Ready
	OFF: Ps3 is in action
M9187	ON: Ps0 has finished the last step
M9188	ON: Ps1 has finished the last step
M9189	ON: Ps2 has finished the last step
M9190	ON: Ps3 has finished the last step
M9191	ON: Ps4 Ready
	OFF: Ps4 is in action
M9192	ON: Ps5 Ready
	OFF: Ps5 is in action

FUN140 HSPSO	High Speed Pulse Output (Including the extended positioning instruction)	FUN140 HSPSO

	ON: Ps6 Ready
M9193	OFF: Ps6 is in action
M9194	ON: Ps7 Ready
	OFF: Ps7 is in action
M9195	ON: Ps4 has finished the last step
M9196	ON: Ps5 has finished the last step
M9197	ON: Ps6 has finished the last step
M9198	ON: Ps7 has finished the last step

Ps No.	Current output frequency	Current pulse position	The remaining pulse counts to be transmitted	Error code
Ps0	DR35328	DR35336	DR35344	R35320
Ps1	DR35330	DR35338	DR35346	R35321
Ps2	DR35332	DR35340	DR35348	R35322
Ps3	DR35334	DR35342	DR35350	R35323
Ps4	DR35655	DR35663	DR35671	R35647
Ps5	DR35657	DR35665	DR35673	R35648
Ps6	DR35659	DR35667	DR35675	R35649
Ps7	DR35661	DR35669	DR35677	R35650

FUN140	High Speed Pulse Output	FUN140
HSPSO	(Including the extended positioning instruction)	HSPSO

R35324：The step number (positioning point) which has been completed of Ps0.

R35325：The step number (positioning point) which has been completed of Ps1.

R35326：The step number (positioning point) which has been completed of Ps2.

R35327：The step number (positioning point) which has been completed of Ps3.

R35651：The step number (positioning point) which has been completed of Ps4.

R35652：The step number (positioning point) which has been completed of Ps5.

R35653：The step number (positioning point) which has been completed of Ps6.

R35654：The step number (positioning point) which has been completed of Ps7.

● Format of positioning program：

SR: Starting register of registers block which reserved to store positioning program, explained as follows:

SR	A55AH	; The effective positioning program; its starting register must be A55AH
SR+1	Total steps	; 1 ~ 250
SR+2		
SR+3		
SR+4		
SR+5		
SR+6		The first positioning point (step) of positioning program (Every step controlled by 9 registers).
SR+7		
SR+8		
SR+9		
SR+10		
	. . .	
		The Nth step of positioning program
SR+N×9+2		

FUN140	High Speed Pulse Output	FUN140
HSPSO	(Including the extended positioning instruction)	HSPSO

Explanation for working register of instruction operation：

WR is the starting register.

WR+0	Being executed or stopped step
WR+1	Working flag
WR+2	Controlled by system
WR+3	Controlled by system
WR+4	Controlled by system
WR+5	Controlled by system
WR+6	Controlled by system

WR+0 : If this instruction is in execution, the content of this register represents the step (1～N) being

performed. If this instruction is not in execution, the content of this register represents the step

where it stopped at present. When execution control "EN" =1, it will perform the next step, i.e.

the current step plus 1 (if the current step is at the last step, it will restart to perform from the

first step). Before starting the execution control "EN" =1, the user can renew the content of

WR+0 to determine starting from which step to perform (when the content of WR+0 =0, and

execution control "EN" =1, it represents that the execution starts from the first step).

WR+1 : B0～B7, total steps

B8 = ON, output paused

B9 = ON, waiting for transfer condition

B10 = ON, endless output (the stroke operand of DRV command is set to be 0)

B12 = ON, pulse output transmitting (the status of output indicator "ACT")

B13 = ON, instruction execution error (the status of output indicator "ERR")

B14 = ON, finished being executed step (the status of output indicator "DN")

FUN140	High Speed Pulse Output	FUN140
HSPSO	(Including the extended positioning instruction)	HSPSO

Error indication   Error code

R35320 (Ps0)   0   : Error free

R35321 (Ps1)   1   : Parameter 0 error

R35322 (Ps2)   2   : Parameter 1 error

R35323 (Ps3)   3   : Parameter 2 error

                    4   : Parameter 3 error

                    5   : Parameter 4 error

                    6   : Parameter 5 error

                    7   : Parameter 6 error

                    8   : Parameter 7 error

                    9   : Parameter 8 error

                   10   : Parameter 9 error

                   13   : Parameter 12 error

                   14   : Parameter 13 error

                   15   : Parameter 14 error

                   30   : Error of variable address for speed setting

                   31   : Error of setting value for speed setting

                   32   : Error of variable address for stroke setting

                   33   : Error of setting value for stroke setting

                   34   : Illegal positioning program

                   35   : Length error of total step

                   36   : Over the maximum step

                   37   : Limited frequency error

                   38   : Initiate/stop frequency error

                   39   : Over range of compensation value for

                   40   : Over range of moving stroke

                   41   : ABS positioning is not allowed within DRVC

                   42   : DRVC instruction not allow ABS addressing

                   43   : Driver command code error

                   50   : Illegal operation mode of DRVZ

                   51   : Illegal DOG input number

                   52   : Illegal PG0 input number

                   53   : Illegal CLR output number

                   60   : Illegal linear interpolation command

The possible error codes for FUN141 execution

Note: The content of the error indication register will keep the latest error code. If you need to confirm that there is no more error, you can clear the error indication register to 0. As long as the content remains 0, it means there is no error occur.

The possible error codes for FUN140, FUN147

The possible error codes

9-29

FUN140	High Speed Pulse Output	FUN140
HSPSO	(Including the extended positioning instruction)	HSPSO

Editing Servo Program Table with UperLogic

Click the "Servo Program Table" Item which in project windows:
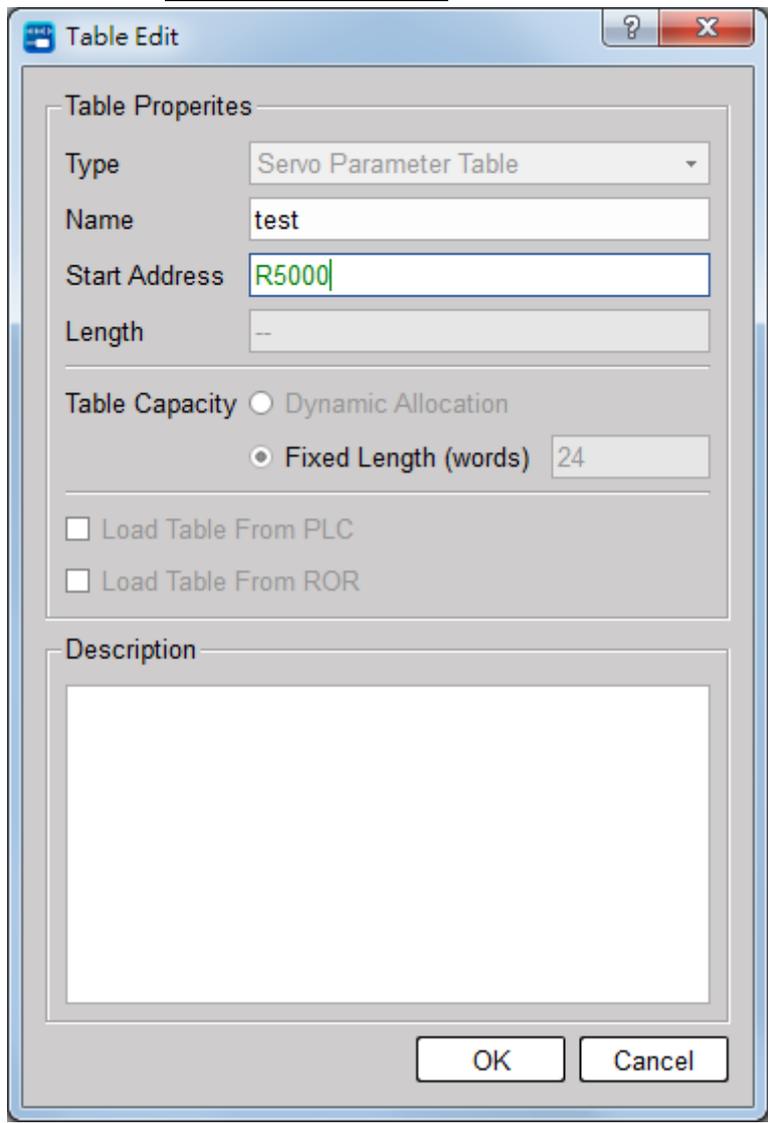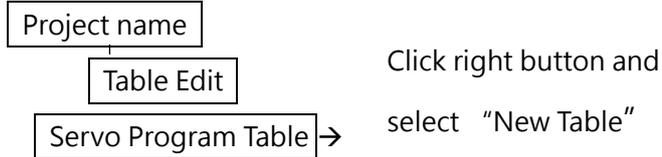
Project name

Table Edit

Servo Program Table →

Click right button and

select "New Table"

M-Series PLC Software Function and Application User Manual

FUN140	High Speed Pulse Output	FUN140
HSPSO	(Including the extended positioning instruction)	HSPSO

- Table Type: It will be fixed to "Servo Program Table".
- Table Name: For modify or debug, you can give a convenient name.
- Table Starting address: Enter the address which Starting register of Servo Program Table.

※ For detail of servo command table, please refer to Chapter 7 (Table Input and Editing) of the UperLogic Interface Manual, or click command and press Z (shortcut key) to create it.

FUN140	High Speed Pulse Output	FUN140
HSPSO	(Including the extended positioning instruction)	HSPSO

- For easy programming and trouble-shooting, the UperLogic provides the text editing environment to edit the motion program.

- Extended positioning instructions are listed as follows:

Instruction	Operand	Explanation
SPD	XXXXXX or Rxxxxx or Dxxxxx	• Moving speed in frequency or velocity (FUN141 Parameter_0=0 represents velocity; Parameter_0=1 or 2 for frequency; the system default is frequency). The operand can be input directly with constant or variable (Rxxxx, Dxxxx); when the operand is variable, it needs 2 registers, e.g. D10 represents D10 (Low Word) and D11 (High Word), which is the setting of frequency or velocity. • When selecting to use the velocity setting, the system will automatically convert the velocity setting to corresponding output frequency. • Output frequency range: 1≦output frequency≦921600 Hz. *** When the output frequency is 0, this instruction will wait until the setting value isn't 0 to execute the positioning pulse output.

FUN140	High Speed Pulse Output	FUN140
HSPSO	(Including the extended positioning instruction)	HSPSO

<table>
<tr><td rowspan="2">DRV</td><td>
ADR · + · XXXXXXXX · Ut
ADR · + · XXXXXXXX · Ps
ADR · − · XXXXXXXX · Ut
ADR · − · XXXXXXXX · Ps
ADR ·　· 　XXXXXXXX · Ut
ADR ·　· −XXXXXXXX · Ut
ADR ·　· 　XXXXXXXX · Ps
ADR ·　· −XXXXXXXX · Ps
ADR · + · Rxxxx · Ut
ADR · + · Rxxxx · Ps
ADR · − · Rxxxx · Ut
ADR · − · Rxxxx · Ps
ADR ·　· Rxxxx · Ut
ADR ·　· Rxxxx · Ps
ADR · + · Dxxxx · Ut
ADR · + · Dxxxx · Ps
ADR · − · Dxxxx · Ut
ADR · − · Dxxxx · Ps
ADR ·　· Dxxxx · Ut
ADR ·　· Dxxxx · Ps
ABS ·　· 　XXXXXXXX · Ut
ABS ·　· −XXXXXXXX · Ut
ABS ·　· 　XXXXXXXX · Ps
ABS ·　· −XXXXXXXX · Ps
ABS ·　· Rxxxx · Ut
ABS ·　· Rxxxx · Ps
ABS ·　· Dxxxx · Ut
ABS ·　· Dxxxx · Ps
</td><td>

● Moving stroke setting in Ps or mm, Deg, Inch. (When FUN141 Parameter_0=1, the setting stroke in Ut is Ps; Parameter_0=0 or 2, the setting stroke in Ut is mm, Deg, Inch; the system default for Ut is Ps).

● When 4_th operand of DRV is Ut (not Ps), according to parameter setting of 1, 2, 3 of FUN141, the system will convert the corresponding pulse count to output.

● There are 4 operands to construct DRV instruction as follows:

1st operand: coordinate selection.
　ADR or ABS: ADR, relative distance movement
　ABS, absolute position movement

2_nd operand: revolving direction selection (Valid for ADR only).
　'+' , forward or clockwise
　'-' , backward or counterclockwise
　' ' ,direction is determined by the setting value (positive value: forward; negative value: backward)

3_rd operand: moving stroke setting

XXXXXXXX: or XXXXXXXX or Rxxxx or Dxxxx — It can directly input with constant or variable (Rxxxx, Dxxxx); it needs 2 registers when adopting the variable. e.g., R0 represents R0 (Low Word) and R1 (High Word) as the setting of moving stroke.

*** When the setting of moving stroke is 0 and 1_st operand is ADR, it represents to revolve endless.

Stroke setting range −99999999 ≤ stroke setting ≤ 99999999

4_th operand: resolution of stroke setting
　Ut or Ps:for Ut, the resolution is one unit; (it is determined by parameter 0, 3 of FUN141); for Ps, the enforced resolution is one pulse.

</td></tr>
</table>

FUN140	High Speed Pulse Output	FUN140
HSPSO	(Including the extended positioning instruction)	HSPSO

Instruc	Operand	Explanation

DRVC	ADR · + · XXXXXXXX · Ut
	 or or or or
	ABS · - · Rxxxx · Ps
	                    or
	                 Dxxxx
		The usage of DRVC and the operand explanation is the same as DRV's instruction.
		*** DRVC is used to do successive speed changing control (8 speeds at the most).
		*** Of the successive speed changing control, only the first DRVC instruction can use the absolute value coordinate for positioning.
		*** The revolution direction of DRVC can only be decided by '+' or '-'.
		*** The revolution direction only determined by the first DRVC of successive DRVC instructions; i.e. the successive speed changing control can only be the same direction.
		For example: successive 3 speed changing control

		001 SPD 10000 * Pulse frequency = 10KHz.
		    DRVC ADR · + · 20000 · Ut * Forward 20000 units.
		    GOTO NEXT
		002 SPD 50000 * Pulse frequency =50 KHz
		    DRVC ADR · + · 60000 · Ut * Forward 60000 units.
		    GOTO NEXT
		003 SPD 3000 * Pulse frequency = 3KHz.
		    DRV ADR · + · 5000 · Ut * Forward 5000 units.
		    WAIT X0 * Wait until X0 ON to restart
		    GOTO 1 from the first step to execute.

		Note: The number of DRVC instructions must be the number of successive speeds deducted by 1, i.e. the successive speed changing control must be ended with the DRV instruction.

Instruction	Operand	Explanation
		The mentioned example above is for successive 3 speeds changing control, which used 2 DRVC instructions and the third must use DRV instruction. Diagram illustration for the above mentioned example:
DRVZ	MD1	DRVZ is a convenient return-to-origin command, MD1. Users can choose the most appropriate return-to-origin mode according to different machine mechanisms. ***For details of MD1 of DRVZ, please refer to Section 9.6 (Machine origin return).

Note: Comparison explanation between the relative coordinate positioning (ADR) and the absolute coordinate positioning (ABS)

M-Series PLC Software Function and Application User Manual

FUN140 HSPSO	High Speed Pulse Output (Including the extended positioning instruction)	FUN140 HSPSO

Instruction	Operand	Explanation
WAIT	TIME · XXXXX or Rxxxxx or Dxxxxx or X0～X1023 or Y0～Y1023 or M0～ 　　M29599 or S0～S3103	● When pulse output is complete, performing the wait instruction for going to the next step. There are 5 kind of operands that explained as follows: 　Time: The waiting time (the unit is 0.01 second), it can be directly input with constant or variable (Rxxxx or Dxxxx); when it is time up, performs the step that assigned by GOTO. ● X0～X1023：Waiting until the input status is ON, it performs the step that assigned by GOTO. ● Y0～Y1023：Waiting until the output status is ON, it performs the step that assigned by GOTO. ● M0～M29599：Waiting until the internal relay is ON, it performs the step that assigned by GOTO. ● S0～S3103：Waiting until the step relay is ON, it performs the step that assigned by GOTO.
ACT	TIME · XXXXX or Rxxxxx or Dxxxxx	● After the time to output pulses described by operand of ACT, it performs immediately the step that assigned by GOTO, i.e. after the pulse output for a certain time, it performs the next step immediately. The action time (the unit is 0.01 second) can be directly input with constant or variable (Rxxxx or Dxxxx); when the action time is up, it performs the step assigned by GOTO.

FUN140 HSPSO	High Speed Pulse Output (Including the extended positioning instruction)	FUN140 HSPSO

Instruction	Operand	Explanation
EXT	X0~X1023 Y0~Y1023 M0~M29599 S0~S999	• External trigger instruction; when it is in pulse output (the number of pulses sending is not complete yet), if the status of external trigger is ON, it will perform the step assigned by GOTO immediately. If the status of external trigger is still OFF when the pulse output has been complete, it is the same as WAIT instruction; waiting the trigger signal ON, then perform the step assigned by GOTO.
GOTO	NEXT 1~N Rxxxxx Dxxxxx	When matching the transfer condition of WAIT, ACT, EXT instruction, by using GOTO instruction to describe the step to be executed. NEXT: It represents to perform the next step. 1~N: To perform the described number of steps. Rxxxx: The step to be performed is stored in register Rxxxxx. Dxxxx: The step to be performed is stored in register Dxxxxx.
MEND		The end of the positioning program.

FUN140 HSPSO	High Speed Pulse Output (Including the extended positioning instruction)	FUN140 HSPSO

●   The coding for positioning programming:

First, it must complete the FUN140 instruction before the editing of positioning program, and assigned

in FUN140 instruction the starting register of registers block to store positioning program.   While

editing the positioning program, it will store the newly edited positioning program to the assigned

registers block; for every one positioning point (called as one step) edited, it is controlled by 9 registers.

If there are N positioning points, it will be controlled by N × 9 + 2 registers in total.

*** Note: The registers storing the positioning program cannot be repeated in using!

Format and example for the positioning program 1:

```
001 SPD   5000              ; Pulse frequency = 5KHz.
    DRV   ADR,+,10000,Ut    ; Moving forward 10000 units.
    WAIT  Time,100          ; Wait for 1 second.
    GOTO  NEXT              ; Perform the next step.
002 SPD   R1000             ; Pulse frequency is stored in DR1000 (R1001 and R1000).
    DRV   ADR,+,D100,Ut     ; Moving forward, the stroke is stored in DD100 (D101 and D100).
    WAIT  Time,R500         ; The waiting time is stored in R500.
    GOTO  NEXT              ; To perform the next step.
003 SPD   R1002             ; Pulse frequency is stored in DR1002 (R1003 and R1002).
    DRV   ADR,−,D102,Ut     ; Moving backward, the stroke is stored in DD102 (D103 and
                              D102).
    EXT   X0                ; When external trigger X0 (slow down point) ON, it performs the
                              next
       GOTO         NEXT                 ; step immediately.
004 SPD   2000              ; Pulse frequency = 2KHz.
    DRV   ADR,−,R4072,Ps    ; Keep outputting the remain (stored in DR4072).
    WAIT  X1                : Wait until X1 ON,
    GOTO  1                 : Perform the first step.
```

FUN140 HSPSO	High Speed Pulse Output (Including the extended positioning instruction)	FUN140 HSPSO

Program example: Jog forward ward

As the jog forward button has been pressed for less than 0.5 second (changeable), it sends out only one (changeable) pulse;

As the jog forward button has been pressed for more than 0.5 second (changeable), it continuously sends pulses out (the frequency is 10KHz, changeable), until the release of the jog forward button to stop the pulse transmitting; or it may be designed to send N pulses out at the most.
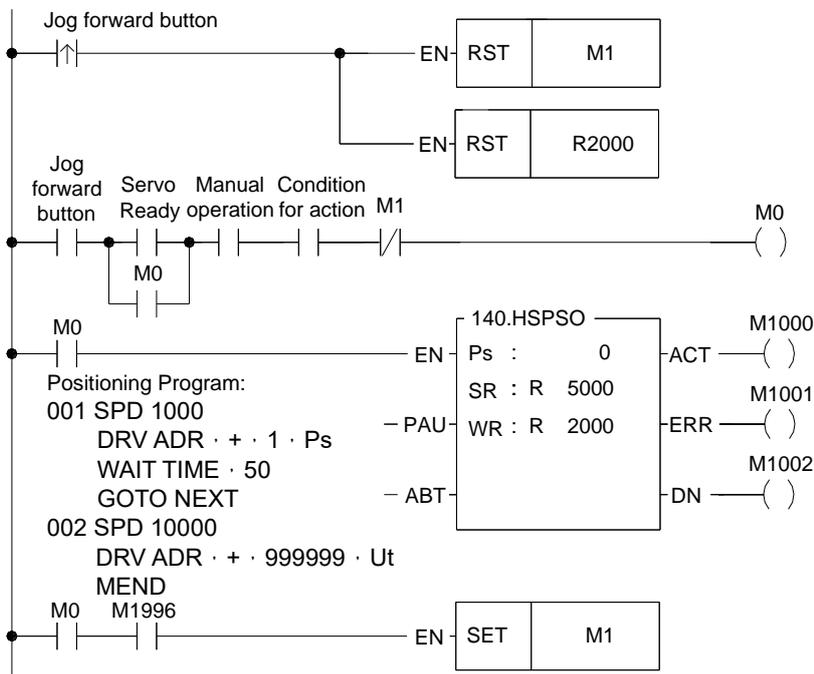
- Clear finish signal.
- Perform from the first step every time.
- When the last step been complete, set finish signal.

FUN140 HSPSO	High Speed Pulse Output (Including the extended positioning instruction)	FUN140 HSPSO

Program example: Jog Backward

As the jog backward button has been pressed for less than 0.5 second (changeable) it sends out only one (changeable) pulse;

As the jog backward button has been pressed for more than 0.5 second (changeable), it continuously sends pulses out (the frequency is 10KHz, changeable), until the release of the jog backward button to stop the pulse transmitting; or it may be designed to send N pulses out at the most.
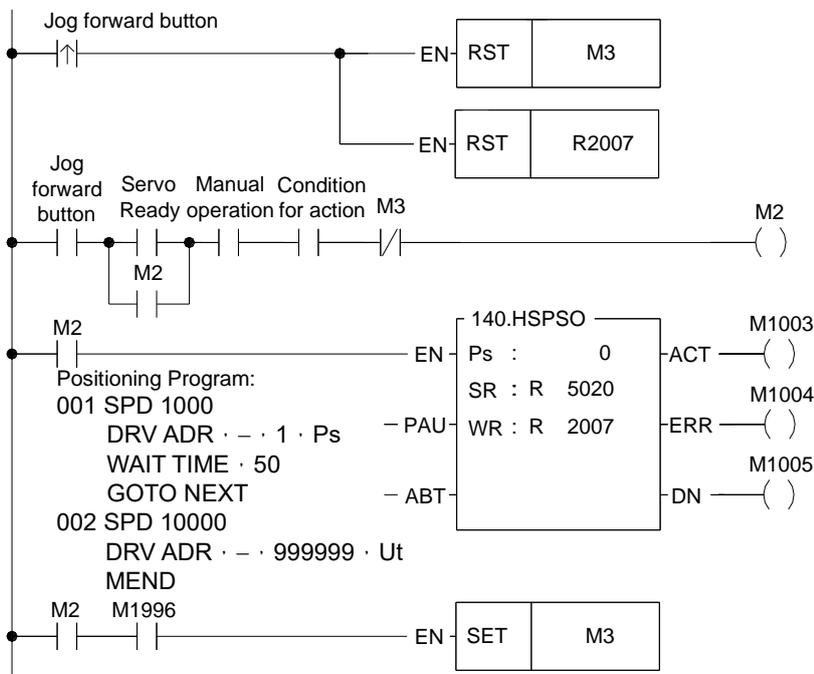
- Clear finish signal.
- Perform from the first step every time.
- When the last step been complete, set finish signal.

9-5-5 FUN141 Parameter Setting for Positioning Program（MPARA）

FUN141 MPARA	Instruction of Parameter Setting for Positioning Program	FUN141 MPARA

Symbol	

	Ladder symbol	

Ladder symbol

141.MPARA

Execution control — EN

Ps :

SR :

— ERR —

Ps: The set number of Pulse Output (0 ~ 7).

SR: Starting register for parameter table, it has totally 18 parameters which controlled by 24 registers.

Range / Operand	HR	DR	ROR	L
	R0 | R34767	D0 | D11999	R43224 | R47319	2 | 256
D				0-3
SR	○	○	○	

Description	

FUN141 MPARA	Instruction of Parameter Setting for Positioning Program	FUN141 MPARA

1. The positioning axis can be controlled up to PSO7, but the actual maximum axis number that can be controlled varies with the host machine model.

2. This instruction is not necessary if the system default for parameter value is matching what users need. However, if it needs to open the parameter value to do dynamic modification, this instruction is required.

3. This instruction incorporates with FUN140 for positioning control purpose, each axis can have one FUN140 instruction only.

4. Whether the execution control input "EN" = 0 or 1, anyway, this instruction will be performed.

5. When there is error in parameter value, the output indication "ERR" will be ON, and the error code is appeared in the error code register.

    SR =Starting register of parameter table, suppose it is R2000.

FUN141 MPARA	Instruction of Parameter Setting for Positioning Program		FUN141 MPARA

R2000	0 ~ 2		Parameter 0	System default =1
R2001	1 ~ 65535 Ps/Rev		Parameter 1	System default =2000
DR2002	1 ~ 999999　　μM/Rev 1 ~ 999999 mDeg/Rev 1 ~ 99999930.1 mInch/Rev		Parameter 2	System default =2000
R2004	0 ~ 3		Parameter 3	System default =2
DR2005	1 ~ 921600 Ps/Sec 1 ~ 153000		Parameter 4	System default =460000
DR2007	0 ~ 921600 Ps/Sec 1 ~ 153000		Parameter 5	System default =141
R2009	1 ~ 65535 Ps/Sec		Parameter 6	System default =1000
R2010	0 ~ 32767		Parameter 7	System default =0
R2011	0 ~ 30000		Parameter 8	System default =5000
R2012	0 ~ 1	0 ~ 1	Parameter 9	System default =0100H
R2013	-32768 ~ 32767		Parameter 10	System default =0
R2014	-32768 ~ 32767		Parameter 11	System default =0
R2015	0 ~ 30000		Parameter 12	System default =0
R2016	0 ~ 30000		Parameter 13	System default =500
DR2017	0 ~ 1999999		Parameter 14	System default =0
DR2019	00H~FFH	00H~FFH	Parameter 15	System default =FFFFFFFFH
	00H~FFH	00H~FFH		
DR2021	-999999 ~ 999999		Parameter 16	System default =0
R2023	0 ~ 255		Parameter 17	System default =1

FUN141 MPARA	Instruction of Parameter Setting for Positioning Program	FUN141 MPARA

Editing Servo Parameter Table with UperLogic

Click the "Servo Parameter Table" Item which in project windows:

```
Project name
    └── Table Edit
            └── Servo Parameter Table  → Click right button and select "New Table"
```
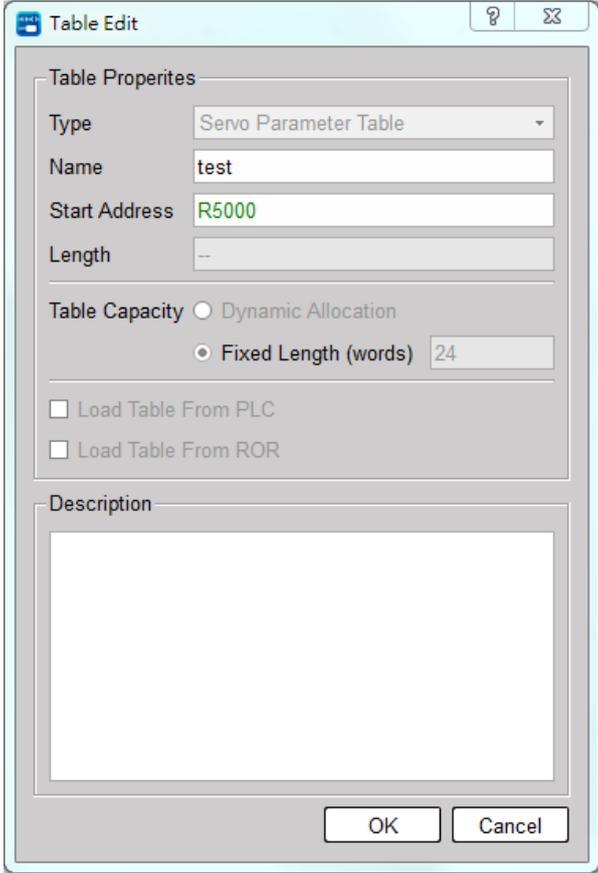

- Table Type: It will be fixed to "Servo Parameter Table".
- Table Name: For modify or debug, you can give a convenient name.
- Table Starting address: Enter the address which Starting register of Servo Parameter Table.

FUN141 MPARA	Instruction of Parameter Setting for Positioning Program	FUN141 MPARA
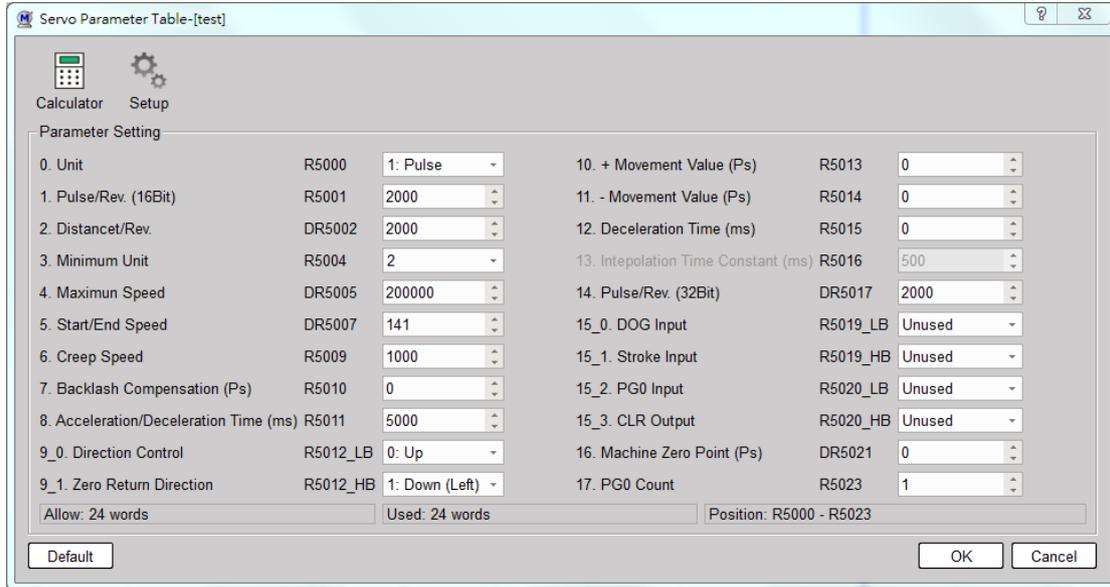
Explanation for the parameter

- Parameter 0: The setting of unit, its default is 1.
    - When the setting value is 0, the moving stroke and speed setting in the positioning program will all be assigned with the unit of mm, Deg, Inch, so called machine unit.
    - When the setting value is 1, the moving stroke and speed setting in the positioning program will all be assigned with the unit of Pulse, so called motor unit.
    - When the setting value is 2, the moving stroke setting in the positioning program will all be assigned with the unit of mm, Deg, Inch, and the speed setting will all be assigned with the unit of Pulse/Sec, which is called as compound unit.

Parameter 0, unit	"0" machine unit	"1" motor unit	"2" compound unit
Parameter 1, 2	Must be set	No need to set	Must be set
Parameter 3, 7, 10, 11	mm · Deg · Inch	Ps	mm · Deg · Inch
Parameter 4,5,6,15,16	Cm/Min · Deg/Min ·	Ps/Sec	Ps/Sec

FUN141 MPARA	Instruction of Parameter Setting for Positioning Program	FUN141 MPARA

- Parameter 1: Pulse count/1-revolution, its default is 2000, i.e. 2000 Ps/Rev.

    The pulse counts needed to turn the motor for one revolution

    A= 1 ~ 65535 (for value greater than 32767, it is set with unsigned decimal) Ps/Rev.

    When Parameter 14 = 0, Parameter 1 is the setting for Pulse /Rev

    When Parameter 14 ≠ 0, Parameter 14 is the setting for Pulse/Rev

- Parameter 2: Movement/1 revolution, its default is 2000, i.e. 2000 Ps/Rev.

    The movement while motor turning for one revolution.

    B=1 ~ 999999 µM/Rev

    1 ~ 999999 mDeg/Rev

    1 ~ 999999 0.1 mInch/Rev

- Parameter 3: The resolution of moving stroke setting, its default is 2.

Parameter 0 / Parameter 3	Set value=0, machine unit; Set value=2, compound			Set value=1 motor unit (Ps)
	mm	Deg	Inch	
Set value =0	x1	x1	x0.1	x1000
Set value =1	x0.1	x0.1	x0.01	x100
Set value =2	x0.01	x0.01	x0.001	x10
Set value =3	x0.001	x0.001	x0.0001	x1

FUN141 MPARA	Instruction of Parameter Setting for Positioning Program	FUN141 MPARA

● Parameter 4: The limited speed setting, its default is 460000, i.e. 460000 Ps/Sec.

　• Motor and compound unit: 1 ~ 921600 Ps/Sec.

　• Machine unit: 1 ~ 153000 (cm/Min, -10 Deg/Min, Inch/Min).

　　However, the limited frequency can't be greater than 921600 Ps/Sec.

　　$f\_max = (V\_max - 1000 \times A) / (6 \times B) \leq 921600$ Ps/Sec

　　$f\_min \geq 1$ Ps/Sec

　　Note: A = Parameter 1, B = Parameter 2.

● Parameter 5: Initiate/Stop speed, the default = 141.

　• Motor and compound unit: 1 ~ 921600 Ps/Sec.

　• Machine unit: 1 ~ 15300 (cm/Min, x 10 Deg/Min, Inch/Min).

　　However, the limited frequency can't be greater than 921600 Ps/Sec.

● Parameter 6: Creep speed for machine zero return; the default is 1000.

　　Motor and compound unit: 1 ~ 65535 Ps/Sec

　　Machine unit: 1 ~ 15300 (cm/Min, ×10 Deg/Min, Inch/Min).

● Parameter 7: Backlash compensation, the default = 0.

　　Setting range: 0 ~ 32767 Ps.

　　While backward traveling, the traveling distance will be added with this value automatically.

● Parameter 8: Acceleration/Deceleration time setting, the default = 5000, and the unit is mS.

　Setting range: 0 ~ 30000 mS.

　The setting value represents the time required to accelerate from idle state up to limited speed state or decelerate from the limited speed state down to the idle state.

　When Parameter 12 = 0, Parameter 8 is the deceleration time

　There will have the auto deceleration function for short stroke movement.

FUN141 MPARA	Instruction of Parameter Setting for Positioning Program	FUN141 MPARA

●   Parameter 9: Rotation and zero return direction; the default is 0100H (Not used in linear interpolation mode)

$$b15 \qquad b8 \; b7 \qquad b0$$

SR+12	Para 9-1	Para 9-0

●   Parameter 9-0: Rotation direction setting; the default is 0

   ●   Setting value =0, the present value increases while in forward pulse output; the present value decreases while in backward pulse output.

   ●   Setting value =1, the present value decreases while in forward pulse output; the present value increases while in backward pulse output.

●   Parameter 9-1: Zero return direction setting; the default is 1

   ●   Setting value =0, direction in which the present value increases.

   ●   Setting value =1, direction in which the present value decreases.

●   Parameter 10: Forward movement compensation, the default = 0.

   ●   Setting range: -32768 ~ 32767 Ps.

   ●   When it is in backward pulse output, it will automatically add with this value as the moving distance.

●   Parameter 11: Backward movement compensation, the default =0.

   ●   Setting range: -32768 ~ 32767 Ps.

   ●   When it is in backward pulse output, it will automatically add with this value as the moving distance.

● Parameter 12: Deceleration time setting, the default =0, and the unit is mS.

　● Setting range: 0 ~ 30000 mS.

　● When Parameter 12 = 0, Parameter 8 is the deceleration time

　● When Parameter 12 ≠ 0, Parameter 12 is the deceleration time

● Parameter 13: Interpolation time constant; the default is 500.

　● Setting range: 0 ~ 30000 mS.

　● Set the time required to achieve the speed specified by the program. (The initiate speed is always regarded as "0.)

● Parameter 14: Pulse count/1-revolution, the default = 0.

　● Setting range: 0 ~ 19999999.

　● When Parameter 14 = 0, Parameter 1 is the setting for Pulse /Rev

　● When Parameter 14 ≠ 0, Parameter 14 is the setting for Pulse/Rev

● Parameter 15: I/O control interface for DRVZ; the default is FFFFFFFFH

	b15　　　b8 b7　　　　　b0	
SR+19	Para 15-1	Para 15-0
SR+20	Para 15-3	Para 15-2

　● Parameter 15-0: Setting of DOG input (SR+19), it must be the input of the main unit)

　　b6~b0: Reference number of DOG input (0~15, it means X0~X15)

　　b7=0: Contact A or Normal Open

　　　=1: Contact B or Normal Close

　　b7 ~ b0=FFH, without DOG input

　● Parameter 15-1: Travel limit input contact setting (SR+19)

　　b14 ~ b8: Travel limit input contact number (0 ~ 125, namely X0 ~ X125)

　　b15 = 0: Travel limit input is a normally open contact (A or NO contact)

　　　=1: Travel limit input is a normally closed contact (B or NC contact)

　　b15 ~ b8=FFH : No stroke limit input

FUN141 MPARA	Instruction of Parameter Setting for Positioning Program	FUN141 MPARA

● Parameter 15-2: Setting of PG0 signal input (SR+20), it must be the input of the main unit.

  b6~b0: Reference number of PG0 input (0~15, it means X0~X15)

  b7= 0: Start counting at front end of sensing DOG input

  b7= 1; Start counting at rear end of sensing DOG input

  b7~b0 = FFH, without PG0 input

● Parameter 15-3: Setting of CLR signal output (SR+20), it must be the output of the main unit.

  b15~b8: Reference number of CLR output (0~23, it means Y0~Y23)

  b15~b8 =FFH, without CLR output

● Parameter 16: Machine zero-point address; the default is 0. Setting range: -999999 ~ 999999 Ps

● Parameter 17: Number of zero-point signals (Sensing of PG0 input); the default is 1. Setting range: 0~255 count.
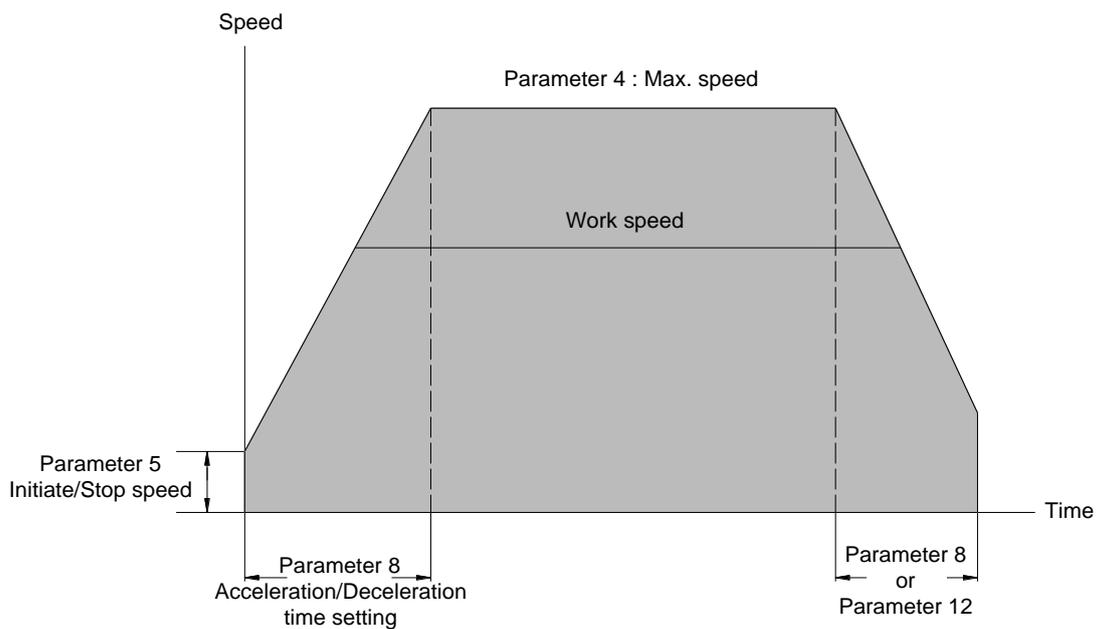
9-5-6 FUN142Enforcing to Stop Pulse Output (PSOFF)

FUN142 P PSOFF	Enforcing to Stop Pulse Output	FUN142 P PSOFF
Symbol		

	Ladder symbol	N: 0 ~ 3, enforces the assigned set number of Pulse Output to stop its output.
Execution control — EN ┤	┌ 142P. ─┐ PSOFF PsN	

Description	

1. The positioning axis can be controlled up to PSO7, but the actual maximum axis number that can be controlled varies with the host machine model.
2. When stop control "EN" =1, or changes from 0→1 (P instruction), this instruction will enforce the assigned set number of Pulse Output to stop its output.
3. When applying in the process of return home, as the home has returned, it can immediately stop the pulse output by using this instruction, so as to make it stop at the same position every time when performing Mechanical Homing.

Example	

M0 ┤├── EN ┤ ┌ 142P. ─┐ PSOFF 0	When M0 changes from 0→1, it enforces the Ps0 to stop the pulse output.

9-5-7 FUN143 Converting the Current Pulse Value to the Displaying Value（PSCNV）

FUN143 P	Converting the Current Pulse Value to the Displaying Value	FUN143 P
PSCNV	(mm, Deg, Inch, PS)	PSCNV

Symbol	

<table>
<tr>
<td>
Execution control — EN
</td>
<td>
<u>Ladder symbol</u>
143P.PSCNV
Ps :
D :
</td>
<td>
Ps: 0 ~ 3; converting the assigned pulse position to mm (Deg, Inch, PS) which has the same unit as the set point, so as to make the current position displayed.

D: Registers that store the current position after conversion. It uses 2 registers, e.g. D10 represents D10 (Low Word) and D11 (High Word) two registers.
</td>
</tr>
</table>

Range Ope-rand	HR	DR	ROR	K
	R0 | R34767	D0 | D11999	R43224 | R47319	2 | 256
Ps				0-3
D	○	○	○*	

Description	

1. The positioning axis can be controlled up to PSO7, but the actual maximum axis number that can be controlled varies with the host machine model.

2. When execution control "EN" =1 or changes from 0→1 (P instruction), this instruction will convert the assigned current pulse position (Ps) to be the mm (or Deg, Inch, or Ps) that has the same unit as the set value, so as to make current position displaying.

3. After the FUN140 and FUN147 instructions have been performed, it will then be able to get the correct conversion value by executing this instruction

FUN143 P	Converting the Current Pulse Value to the Displaying Value	FUN143 P
PSCNV	(mm, Deg, Inch, PS)	PSCNV

Example	

<table>
<tr>
<td>
M0
─┤ ├─── EN

┌─143P.PSCNV─┐
│ Ps :   0 │
│ D : D10 │
└───────────┘
</td>
<td>
When M0=1, it converts the current pulse position of Ps0 (DR4088) to the mm (or Deg or Inch or Ps) that has the same unit as the set value, and store it into the DD10 to make the current position displaying.
</td>
</tr>
</table>

FUN143 P	Converting the Current Pulse Value to the Displaying Value	FUN143 P
PSCNV	(mm, Deg, Inch, PS)	PSCNV

9-5-8 FUN144 High-Speed Pulse Width Modulation 2 (HSPWM2)

FUN144 HSPWM2	High-Speed Pulse Width Modulation 2 (HSPWM2)	FUN144 HSPWM2

Symbol	

<div>

Ladder symbol

```
              XXX D.PWM
Execution ─EN
Control          PW :
                 Op :
                 Hz:
                 OR:
```
ACT
ERR

</div>

PW : Output of pulse width modulation (0=Y0, 1=Y2, 2=Y4, 3=Y6, 4=Y8, 5=Y10, 6=Y12, 7=Y14)

Op : Output polarity (0=positive phase, 1=negative phase)

Hz : Output frequency (1~100000000 or 1~200000000, unit: 0.001Hz)

OR : Width of output pulse (0~100, unit: %)

Range Operand	Y	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K
	Yn	WX0 | WX1008	WY0 | WY1008	WM0 | WM19578	WS0 | WS3088	T0 | T1023	C0 | C1279	R0 | R34767	R34768 | R34895	R35024 | R35151	R35280 | R43223	R43224 | R47319	D0 | D11999	
Pw								○				○	○	
Op														0~1
Hz								○				○	○	
OR								○				○	○	0~100

FUN144 HSPWM2	High-Speed Pulse Width Modulation 2 (HSPWM2)	FUN144 HSPWM2
Description		

1. Compared with FUN139, FUN144 provides more direct and convenient high-speed PWM output control without calculating parameters through built-in formulas.

2. The maximum output frequency may be 100K or 200K depending on the model. If the maximum output frequency exceeds the maximum output frequency, it will not be executed.

9-5-9 FUN148 Manual Pulse Generator for Positioning (MPG)

FUN148 MPG	Manual Pulse Generator for Positioning	FUN148 MPG
Symbol		

EN —— 148. MPG —— ACT

Sc :

Ps :

Fo:

Mr:

WR:

Sc：Source of high-speed counter; 0~7

Ps：Axis of pulse output; 0~3

Fo：Setting of output speed (2 registers)

Mr：Setting of multipliers (2 registers)

Mr+0：Multiplicand (Fa)

Mr+1：Dividend (Fb)

WR：Starting address of working registers, it needs 4 registers

* This instruction can be supported in PLC OS firmware V4.60 or late

Range Ope-rand	HR R0 | R34767	DR D0 | D11999	ROR R43224 | R47319	K 16-BIT
Sc	◯	◯	◯	0-7
Ps	◯	◯	◯	0-3
Fo	◯	◯	◯	
Mr	◯	◯	◯	
WR	◯	◯*	◯	

FUN148	Manual Pulse Generator for Positioning	FUN148
MPG		MPG

- The positioning axis can be controlled up to PSO7, but the actual maximum axis number that can be controlled varies with the host machine model.

- Let this instruction be executed in 10mS fixed time interrupt service routine (LTM0), by using the 0.1mS high speed timer to generate 50mS fixed time interrupt service to have accurate repeat time to sample the pulse input from manual pulse generator. If it comes the input pulses, it will calculate the number of pulses needing to output according to the setting of multiplier (Mr+0 and Mr+1), and then outputs the pulse stream in the speed of setting (Fo) during this time interval.

  The setting of output speed (Fo) must be fast enough, and the acceleration / deceleration rate (Parameter 4 and parameter 8 of FUN141 instruction) must be sharp to guarantee it can complete the sending of pulse stream during the time interval if it is under high multiplier (100 or 200 times) situation.

- When execution ˋENˊ =1, this instruction will sample the pulse input from manual pulse generator by reading the current value of assigned high speed counter every time interval; it doesn't have any output if it doesn't have any

- Input pulse; but if it senses the input pulses, it will calculate the number of pulses needing to output according to the setting of multiplier (Mr+0 and Mr+1), and then outputs the pulse stream in the speed of setting (Fo) during this time interval.

  Number of output pulses = (Number of input pulses × Fa) / Fb

- If the specified output axis is used by other positioning instructions (FUN140/FUN147), even if there is sampling of manual pulse input, there will be no output.

- The output indicator ACT=1 if it outputs the pulses; otherwise, ACT=0.

- This instruction will occupy 4 working registers (WR), other programs cannot be reused.

9-57

FUN148 MPG	Manual Pulse Generator for Positioning	FUN148 MPG
Example 1		

FUN148 MPG	Manual Pulse Generator for Positioning	FUN148 MPG

Status Page

Name	Status	Data	Comment	Name	Status	Data	Comment	Name	Status	Data	Comment	Name	Status	Data	Comment
DR4080	DEC	0	[R4080]	DR4082	DEC	0	[R4082]	D800	DEC	0	[D800]	D810	DEC	0	[D810]
DR4088	DEC	0	[R4088]	DR4090	DEC	0	[R4090]	D801	DEC	0	[D801]	D811	DEC	0	[D811]
								DD802	DEC	0	[D802]	DD812	DEC	0	[D812]
DR2005	DEC	0	[R2005]	DR2105	DEC	0	[R2105]	DR4096	DEC	0	[R4096]				
R2011	DEC	0	[R2011]	R2111	DEC	0	[R2111]					M100	ENABLE	OFF	[M100]
DD600	DEC	0	[D600]	DD602	DEC	0	[D602]	D700	DEC	0	[D700]	D701	DEC	0	[D701]
M500	ENABLE	OFF	[M500]	M501	ENABLE	OFF	[M501]	X34	ENABLE	OFF	[X34]				
X32	ENABLE	OFF	[X32]	X33	ENABLE	OFF	[X33]	X35	ENABLE	OFF	[X35]	X36	ENABLE	OFF	[X36]

X32 ：Select axis 0 (Ps0)

X33 ：Select axis 1 (Ps1)

X34 ：Multiplier = 1

X35 ：Multiplier = 10

X36 ：Multiplier = 100

M100：Enable / disable MPG activity

DR2005：Maximum speed of axis 0(Parameter 4 of FUN141); 200K Hz

R2011 ：Acc/Dec time of axis 0(Parameter 8 of FUN141); 30mS

DD600：Output speed of axis 0 for MPG; 200K Hz

DR2105： Maximum speed of axis 1 (Parameter 4 of FUN141); 200K Hz

R2111 ： Acc/Dec time of axis 1 (Parameter 8 of FUN141); 30mS

DD602： Output speed of axis 1 for MPG; 200K Hz

Description： Let the MPG instruction (FUN148) be executed in 50mS fixed time interrupt service routine (50MSI) to handle the MPG positioning of Ps0 and Ps1. When X32=1 and M100=1, it will handle the MPG positioning of Ps0; it will sample the pulse input from reading the current value of HSC0 every 50mS time interval; it doesn't have any output if it doesn't have any input pulse; but if it senses the input pulses, it will calculate the number of pulses needing to output according to the setting of multiplier (D700 and D701), and then outputs the pulse stream in the speed of setting (DD600) during this time interval.

Number of output pulses = (Number of input pulses from HSC0 × D700) / D701

9-6 Mechanical Homing

The machine set which undertakes relative model Encoder as shifting detector usually need the reset action for the reference of positioning coordinate; we called this action as Homing (seeking for zero reference).

Method 1 :
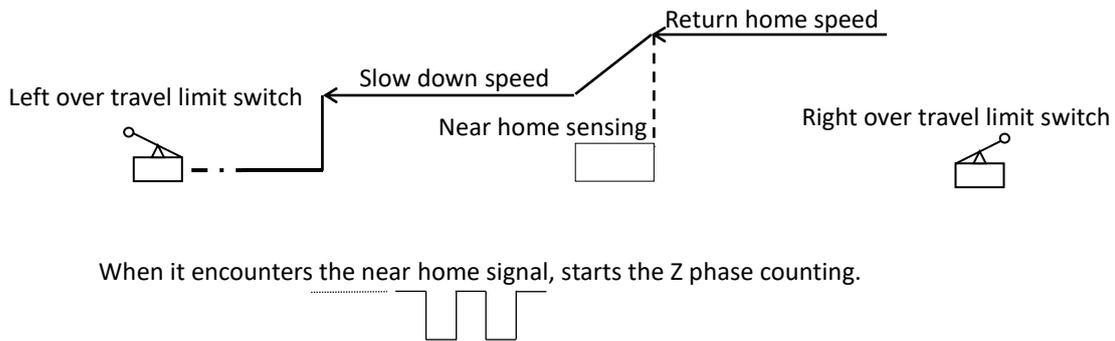
When it encounters the near home signal, starts the Z phase counting.

Z phase counting is up, the pulse output stops, then send out the CLR signal to clear the error counter of servo driver.

Z phase counting is up, the pulse output stops, then send out the CLR signal to clear the error counter of servo driver.

e.g.:

X3: Near home sensing input is configured as interrupt input; in the case of Homing, it starts HSC4 to begin counting in X3+ interrupt service subroutine.

X2: Z phase counting input, it is configured as UP input of HSC4; the X2+ is prohibited to interrupt in regular time, when executing Homing and X3 near home interrupt occurred, it starts HSC4 to begin Z phase counting. When HSC4 counting is up, it stops the pulse output, prohibit the X2+ interrupt, set home position to signal, and sends out the CLR signal to clear the error counter of servo driver. Please consult program example.

Method 2: According to application demand, it may slow down when encountering the near home sensor, while over the sensor a little far away, stop the pulse output, and then traveling slowly with backward direction; the very moment when it getting out of near home sensor (the sensing signal changes from 1→0), it is treated as machine home.   This program is simpler!
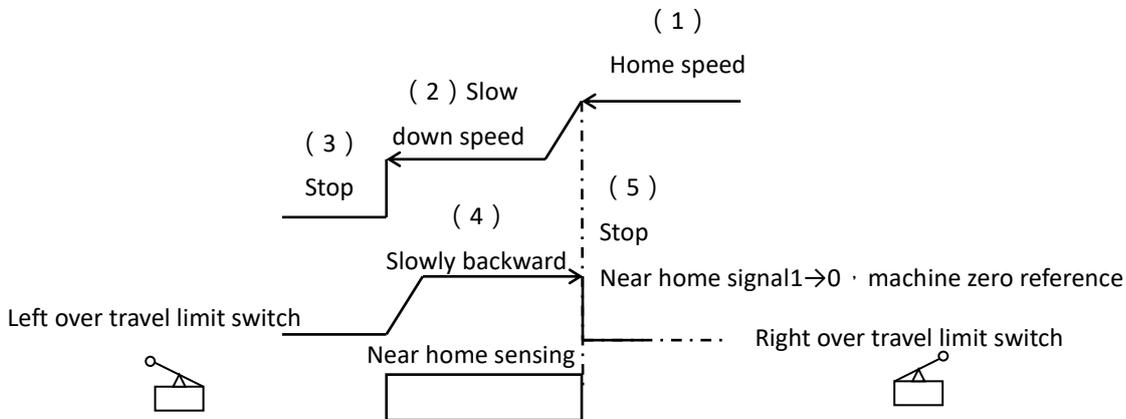
X3: Near home sensing input; it is configured as falling edge interrupt input.

· Once encountering the near home sensor, it will enable X3 falling edge interrupt, and slow down to stop within the near home sensing range.

· Slowly backward traveling until the near home sensing signal changes from 1→0.

· When the near home sensing signal changes from 1→0, it performs the X3- interrupt service subroutine immediately.

· The X3-I interrupt service subroutine: Stops the pulse output immediately, prohibits the X3-I interrupt, sets home position to signal, and sends out CLR signal to clear the error counter of servo driver. (Please consult the example program.)

Since FATEK is taking into account the customer's utility and convenience, we add machine zero return command (DRVZ) in high-speed pulse output instruction (FUN140).

When using DRVZ command for Homing, it should conjoin the FUN141 motion parameter's setting of machine zero related, it can be listed as below:

	DRVZ MD1
Parameter 6 (Creep speed)	Must be
Parameter 9-1 (Return direction)	Must be
Parameter 15-0 (DOG input)	Must be
Parameter 15-1 (Limit input)	Optional
Parameter 15-2 (PG0 input)	No need
Parameter 15-3 (CLR output)	Optional
Parameter 16 (Zero-point address)	Must be
Parameter 17 (No. of PG0 signal)	No need

Table 20 Table of parameter setting related to machine zero command

The FUN 140 instruction can't be executed for machine zero return while encountering the following situations with the error indications:

	Error Code	Explanation
R35320(PS0)	42	DRVZ can't follow DRVC
R35321(PS1)	50	Illegal operation mode of DRVZ
R35322(PS2)		
R35323(PS3)	51	Illegal DOG input
R35647(PS4)	52	Illegal PG0 input
R35648(PS5)	53	Illegal CLR output
R35649(PS6)		
R35650(PS7)		

Table 21 Comparison table of error codes

The method of using DRVZ is same as the method of two modes (DRV and DRVC) of FUN140. To see the details please choose MD0~MD2 of Movement Action mode of the servo program table in the project window (See below).
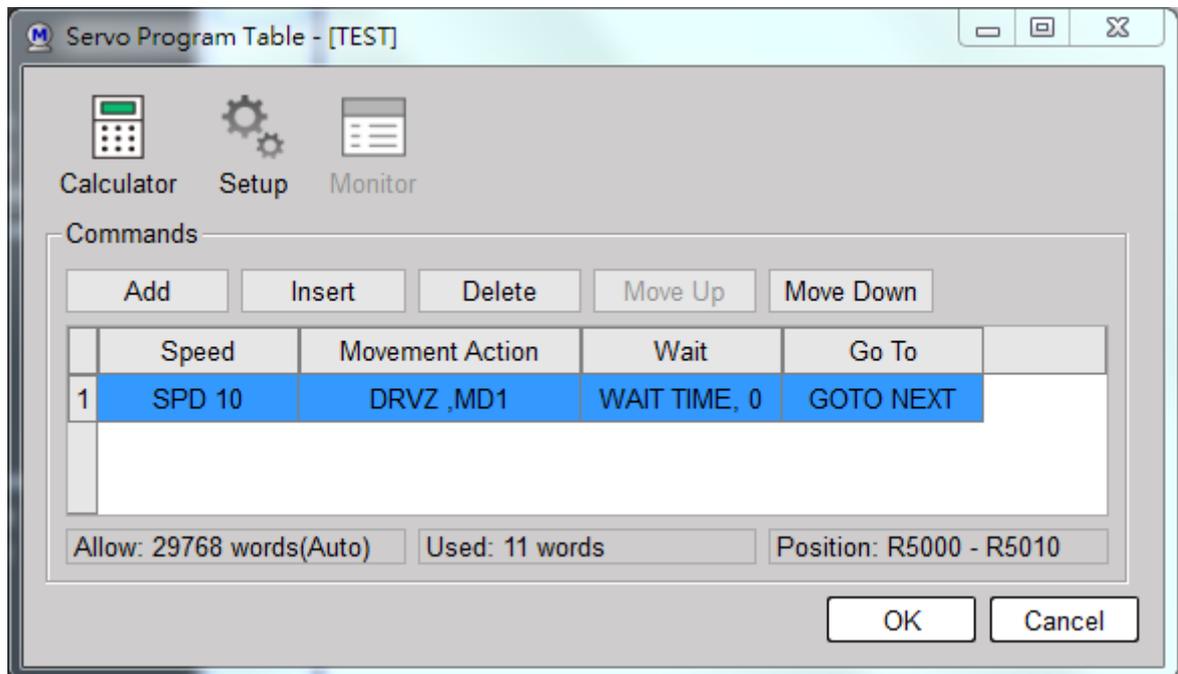
Figure 54 Methods of setting DRVZ

In order to achieve high accuracy and reproducibility, DRVZ uses interrupt to process external signals (such as near-point DOG input), so the bounce signal generated by mechanical switches or field noise must be added. Filter out to avoid malfunction. Generally speaking, it is recommended to use

photoelectric or inductive proximity switches for proximity DOG sensors to avoid bouncing signals similar to mechanical contact switches (Limit switch).

The schematic diagram and action description of the mode are shown below. The following examples all assume that the position of the machine is on the right side of the proximity sensor switch when homing is to be performed (the zero-return direction is to the left):

Mode 1
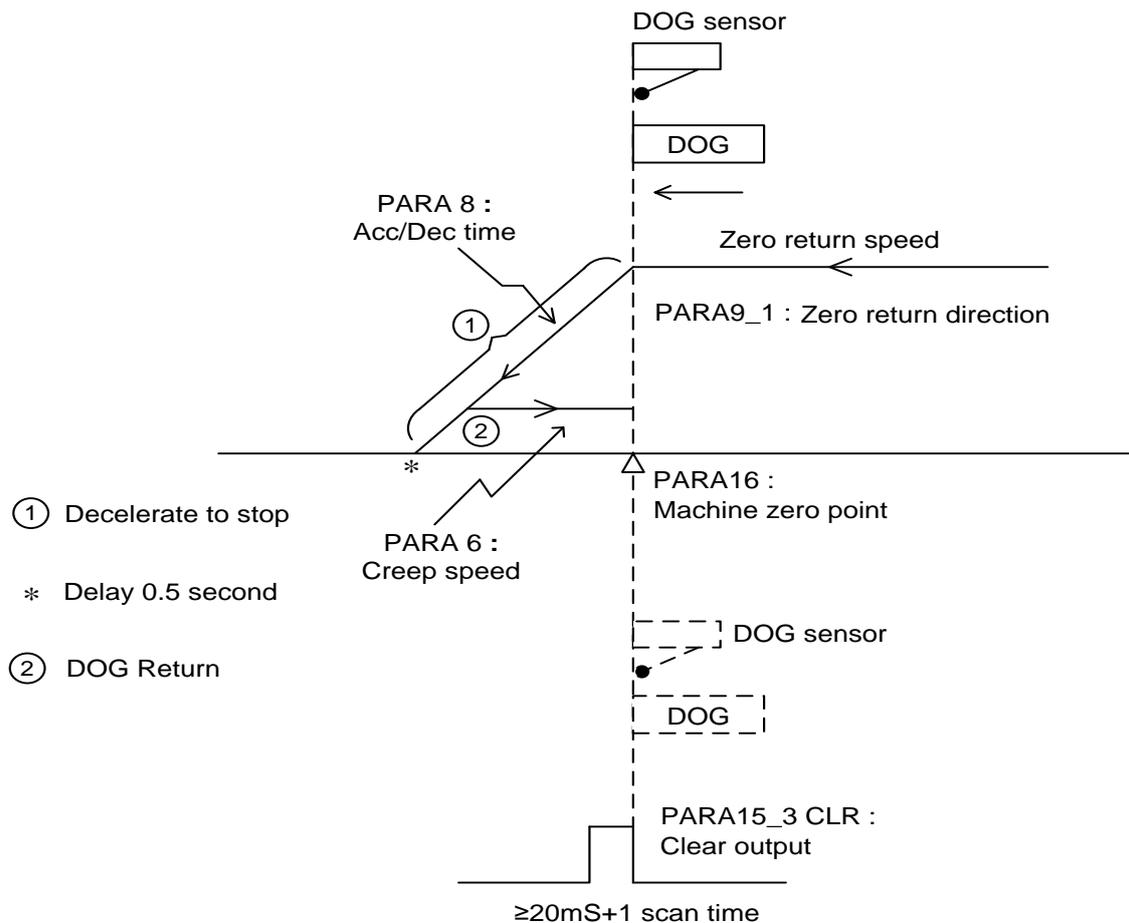
Figure 56 Schematic diagram and action description of mode 1

【Description】
1. Zero return starts behind the DOG sensor (Parameter 15_0)
   a. Moving forward to zero direction in Zero Return Speed
   b. Auto slow down to stop movement while sensing the dog sensor (Edge detection and interrupt processing)
   c. Delay 0.5 second, then moving backward until leaving the dog sensor (Edge detection and interrupt processing), it is the zero-home position
   d. If it doesn't configure the CLR output (Parameter 15_3) for servo driver, the zero-return process has been finished at step c

e. If it has been configured the CLR output (Parameter 15_3) for servo driver, the zero-return process will be finished after the CLR output with more than 20mS duration

2. Zero return starts at or in front of the DOG sensor (Parameter 15_0) + Stroke limit sensor (Parameter 15_1)

a. Moving forward to zero direction in zero return speed, there will stop moving while sensing the limit sensor

b. Moving backward in zero return speed and after leaving the dog sensor, it will drive the zero return procedures same as mentioned above 1.

※ Working at this mode, it should be noticed to adjust the correct position of DOG sensor to incorporate with PG0 signal to avoid one count PG0 error for zero return processing.

Zero return starts at or in front of the DOG sensor

Steps
1. When homing operation has started, it moves toward the homing direction (Parameter 9_1) in zero return speed until strokes the switch of limit input point (Parameter 15_1).
2. When it strokes the limit input point (Parameter 15_1), it immediately moving backward to the homing direction until leave the DOG sensor (sensor signal from 1 → 0).
3. Upon completion of the Step 2, you can determine that the starting point has returned back to the right of DOG sensor, and then it will complete the homing operation as we set the homing mode (MD0~MD2) earlier.

10

Serial Communication

With the two built-in RS-485 communication ports and the serial expansion module of the M-series host, users can connect and integrate with smart peripherals that have the same serial hardware communication interface through communication.

The FUN151 (CLINK) communication connection convenience command can specify the working mode of the communication port. There are 5 working modes, including Mode 0, 1, 2, 4, and 5.

The following table shows the description of the command mode.

Type \ Item		Transmission Rate	Data Length	Transmission Code	Error Detection Method	Command Processing Speed
FUN151 (CLINK)	FATEK M1 Communication Protocols (MD0) User-Defined Communication Protocols (MD1、2、4、5)	4.8Kbps | 921.6Kbps	7bit/8bit Adjustable	Binary Code	Based on Protocols	Scanning Time

FUN150（Modbus） communication connection command can specify the communication port to communicate with the Modbus Communication Protocols.

The following table is the description of the command mode:

Type \ Item	Transmission Rate	Data Length	Transmission Code	Error Detection Method	Command Processing Speed
FUN150 (MODBUS)	Modbus RTU/ASCII	4.8Kbps | 921.6Kbps	7bit/8bit Adjustable	Binary Code	Checksum	Scanning Time

10-1 Function of Serial Communication Port

M-Series host comprises two RS485 software interfaces, Port 1 and Port 2. If it is not enough, you can install another communication module (CM) to expand the communication port interface to fourteen at most. (PORT1~PORT2+(PORTA+PORTB) *6). Communication module (CM) has two interfaces of RS232 or RS485 to choose from. UperLogic software have communication drivers that conform to the "FATEK M1 Communication Protocols". If the hardware interface and communication parameters are consistent, Communication port can be connected by connecting to the communication port of the "standard interface". If there is no communication driver that conforms to this protocol, in addition to writing commands conforming to the " FATEK M1 Communication Protocols" format to communicate with the PLC, you can also use the most commonly used Modbus RTU/ASCII Protocols in the industry to communicate with the PLC. Port 1 and Port 2 are also defaulted as FATEK standard communication interface in the factory setting or system initialization of PLC. In order to meet the wide application and demand of communication connection, Port 1 and Port 2 not only provide FATEK standard communication interface. It also provides support for powerful communication convenience commands, allowing users to write the required application communication programs through the Ladder program, which can easily achieve the purpose of system integration and decentralized monitoring. For details, please refer to the descriptions in the following chapters.

In M SERIES PLC, its software comprises two types of software interfaces. Listed below are the types of software interfaces that can be set through the respective port：

Type Option / Software interface	Communication port		Remark
	Port1	Port2	
Standard interface	○	○	The Port will be controlled by CPU with FATEK standard communication driving program of Modbus communication drive program.
Ladder process-controlled interface	○	○	The Port will be controlled by the user (Ladder program command)

- Standard interface：

Port1–Port2 can be set as this type of interface. In such interface, the Port is controlled by the standard communication drive program (using FATEK's M SERIES PLC communication protocol or Modbus RTU/ASCII communication protocol) installed in the M SERIES PLC and it is termed as the "standard interface". To communicate with the "standard interface", the online operation will be allowed after

meeting FATEK's M-SERIES PLC communication protocol or Modbus RTU/ASCII communication protocol.

- Ladder process-controlled interface:

P Such type of interface can be selected by Port1–Port2. When operating on such type of interface, such Port will be controlled by Ladder commands (e.g., FUN94, FUN150 and FUN151). Through the Ladder program, the user will be allowed to control such Port.

Provided below is the description of function and application when these two communication ports of M SERIES PLC are operating under the aforesaid two types of interfaces.

10-1-1 Communication Port1 ~ Port2 : RS485 Interface

Functional specification

- RS485 interface functional specification complies with the EIA RS485 standard

Basic usage

There are 2 types of software interface are selectable as follows:

① Standard interface:

Connectable to peripherals with RS485 interface, such as computer, WinProladder, HMI, SCADA, etc.

② Ladder diagram Program controlled interface:

User can control Port1~Port2 through the ladder diagram instructions; FUN151 (CLINK) command takes control of Port1~Port2 to establish connection with FATEK CPU Link or peripherals with RS485 interfaces; FUN150 (MBUS) command can turn Port1~Port2 into a master of Modbus RTU/ASCII communication protocol for connecting Slaves with this communication protocol.

Extended usage

- Under Standard interface, act as the Slave for multi-drop FATEK RS485.
- Under Ladder diagram program-controlled interface types, Port1~Port2 has the following functions:

① Use MD0 mode of FUN151 (CLINK) instruction to act as the master for FATEK CPU Link network.

② Use MD1 mode of FUN151 (CLINK) instruction to actively connect to intelligent peripherals equipped with this communication interface, such as other brands' PLC, servo driver, temperature controller, inverter, message display, etc.

③ Use FUN150 (MBUS) instruction to act as the Master for Modbus RTU/ASCII communication protocol to connect to peripherals with this communication protocol.

10-1-2 Description of Communication Functions

For the computer equipment to be able to communicate, hardware interface and organization software interface (i.e., communication protocol) communication parameters must be consistent between the

sender and receiver. The same is true for PLC. After meeting the above three basic elements, PLC can communicate with PLC or other peripherals. These three aspects are described here.

Matching between hardware interface and mechanism

In order to meet the different needs of various peripheral devices, M-Series PLC can expand S232, RS485 communication interfaces are available. When using, please confirm whether the interface is consistent? If different communication interfaces are connected together, it may cause permanent damage to the hardware. Please also confirm whether the connected signal is correct? For example: TxD must be connected to RxD, RTS will be connected to CTS, RS232, RS485 are explained as follows：

Port 1 ~ Port 2 & Port A、Port B

If you purchase a communication module (CM), you can expand one to twelve communication port interfaces, and the maximum number of communication port interfaces can be expanded to 14. (Port1 ~ Port2+6* (Port A + Port B)).

Port1 ~ Port2 are defaulted to the "FATEK communication interface" in the factory setting or when the PLC system is initialized. For Port A & Port B, users need to select the mode by themselves, and they must go to the device view to configure the settings. In order to meet the wide application of communication connections According to the requirements, Port1 ~ Port2 not only provide FATEK standard communication interface, but also provide convenient communication commands with powerful functions, so that users can write the required application communication programs through Ladder commands, which can easily achieve system integration and decentralization. Purpose of monitoring. Communication port interface of the communication module (CM) has two options: RS232+RS485 or RS485+RS485

● RS232 Communication interface

Each communication module (CM) provides one or two sets of RS232 communication interface (9 Pin D-sub female connector). For application, users can purchase a standard 9 Pin RS232 cable from a computer store, or use the following Make 9 Pin RS232 cable by yourself.

Port Connector \ Signal		TXD	RXD	RTS	CTS	SG	DTR	DSR
9Pin D-sub	MALE	3	2	7	8	5	4	6
	FEMALE (HCM25 Module)	2	3	8	7	5	6	4

M-Series PLC is not used.

9P D-sub female ＞ 9P D-sub male RS232 communication cable :

M-Series PLC Software Function and Application User Manual
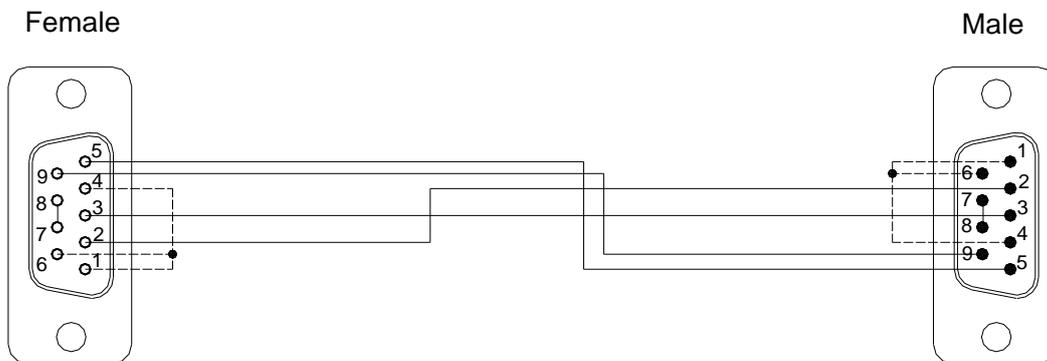
If you make RS232 cables by yourself and the definition of each pin is not clear, use a multimeter for measurement to determine TXD and RXD.

9 Pin connector: The pin 5 is SG;

Measure the pin 2 (red probe) and the pin 5 (black probe) with a multimeter. If it is approximately -9V, it means that the pin 2 is the transmission pin; If it is approximately 0V, it means that the pin 2 is the receiving pin.

Measure the pin 3 (red probe) and the pin 5 (black probe) by a multimeter. If it is approximately -9V, it means that the pin 3 is the transmission pin; If it is approximately 0V, it means that the pin 3 is the receiving pin.

- RS485 Communication interface

Each communication board (or module) provides one or two standard RS485 4-pin European plug-able terminal block. The pin assignment of connector(s) is show below.

Built-in RS485   CM module RS485

Selection and Setting of Communication Protocols

Setting Steps:

● Select Communication Configuration:

Click "Communication Configuration " of "System Configuration" in "Project Management" on the left side of the software interface, as shown in the figure below, and then click "Serial Port Settings".

At this time, you can select the Modbus or FATEK communication protocol in the "Communication Configuration " in the "Advanced Settings" below, as shown in the figure below.

After the setting is completed, download it to the PLC.
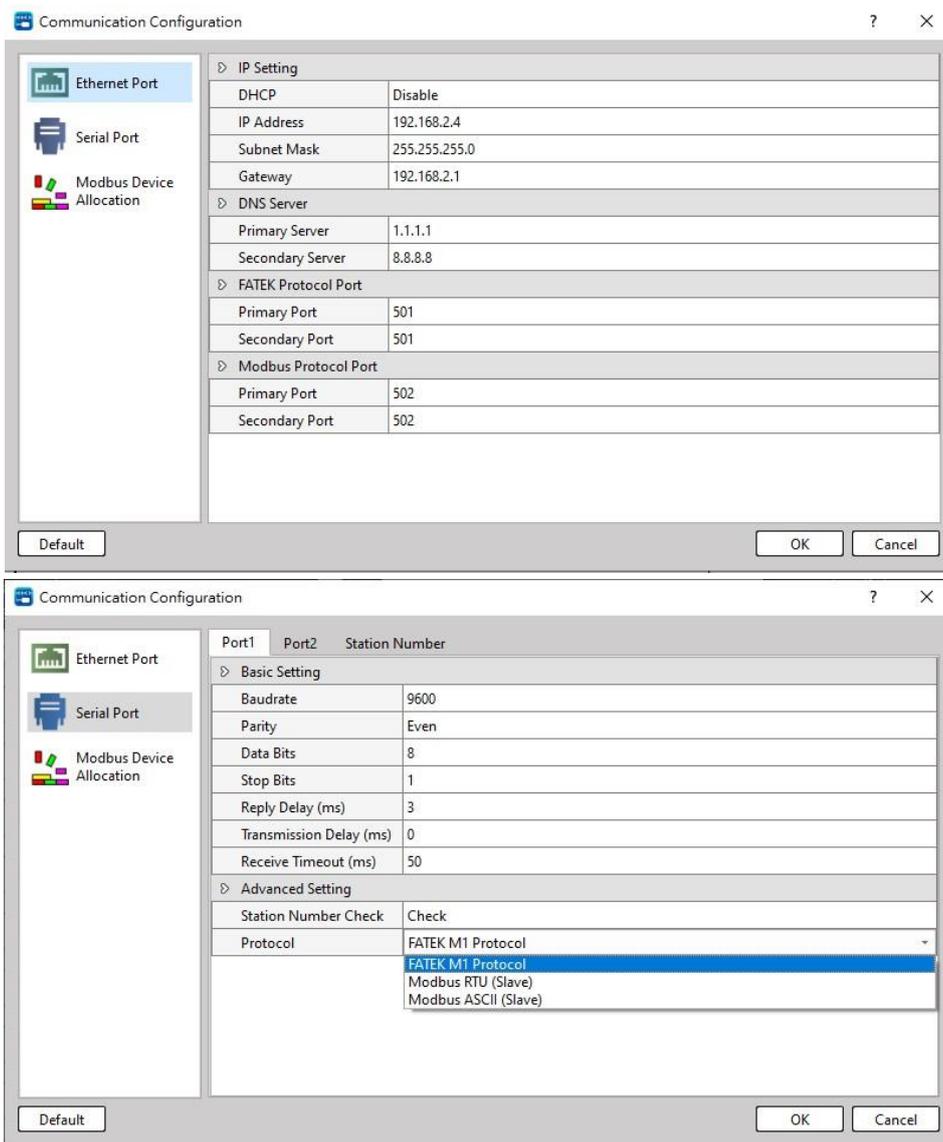
- Set protocol via special register:

R35355：High byte = 56H, the planned communication port is Modbus RTU / Modbus ASCII communication protocol interface.

= other values, don't have the function above.

(FATAK communication protocol as default)

Low byte = Port1~2, FATEK / Modbus RTU / Modbus ASCII, the specified format of the communication protocol is as follows:

High byte   Low byte

56H	b7	b6	b5	b4	b3	b2	b1	b0

Bits	Value	Description
b1b0	0 or 1	Port1 works FATEK communication protocol
	2(b1:1, b0:0)	Port1 works Modbus RTU communication protocol
	3(b1:1, b0:1)	Port1 works Modbus ASCII communication protocol
b3b2	0 or 1	Port2 works FATEK communication protocol
	2(b3:1, b2:0)	Port2 works Modbus RTU communication protocol
	3(b3:1, b2:1)	Port2 works Modbus ASCII communication protocol

※ It is allowed to designate multiple ports as the Modbus RTU communication protocol interface, as long as the corresponding bit is set to 1.
Setting example:

R35355=5602H, specify Port1 as Modbus RTU communication protocol interface
R35355=5608H, specify Port2 as Modbus RTU communication protocol interface
R35355=560AH, designate Port1 and Port2 as Modbus RTU communication protocol interface

※ If the communication port of the PLC is to be used as a Modbus RTU / Modbus ASCII slave station, it can be used by planning a Modbus RTU / Modbus ASCII communication protocol interface according to the above method, and the Modbus address configuration must meet the application requirements.
※ Please refer to Chapter 10-4-2 for the conversion principles of Modbus and FATEK data addresses.

Port 1 ~ Port 2 work as the master station of Modbus RTU/ASCII communication protocol

※ If PLC communication port is a Master station of Modbus RTU/Modbus ASCII, please follow FUN150 (M-BUS) instruction (refer to below diagram). Please refer to Chapter 10-4 for further details of FUN150 (M-BUS) instruction.

2

Settings for Communication Parameters

The factory default or system initial values of the communication parameters of Port 1~Port 2 are as follows:

Baud Rate	9600 bps
Data length	8 Bits
Parity Check	Even
Stop Bit	1 Bit
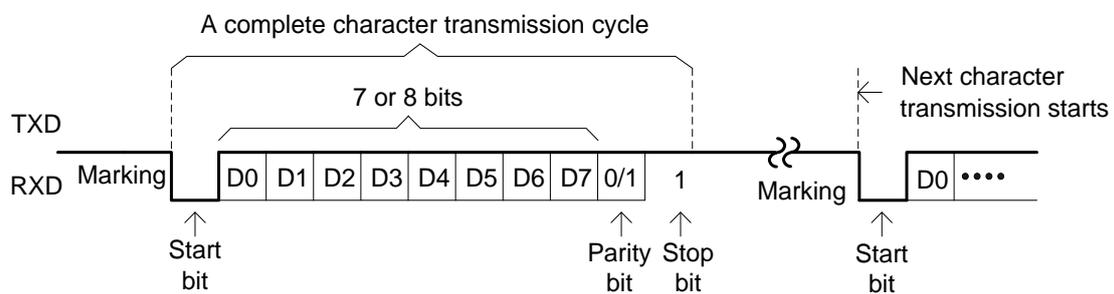
Default communication parameters

Port	Register Setup	Default Value	Default Baud Rate	Other Default Parameters
Port 1	R35352	5661H	9600 bps	8-bit Data、Even、1-bit Stop
Port 2	R35353	5661H	9600 bps	8-bit Data、Even、1-bit Stop

※ When a port is set to Modbus RTU communication protocol, data bit is always 8-bit.

※ Port 1~Port 2 also provide Baud Rate settings for user-defined (1125 bps~1152000 bps).

Setup of Port 1~Port 2 communication parameters

Port1, Port2's communication parameters can be found by Project->Communication Configuration->Serial Port.
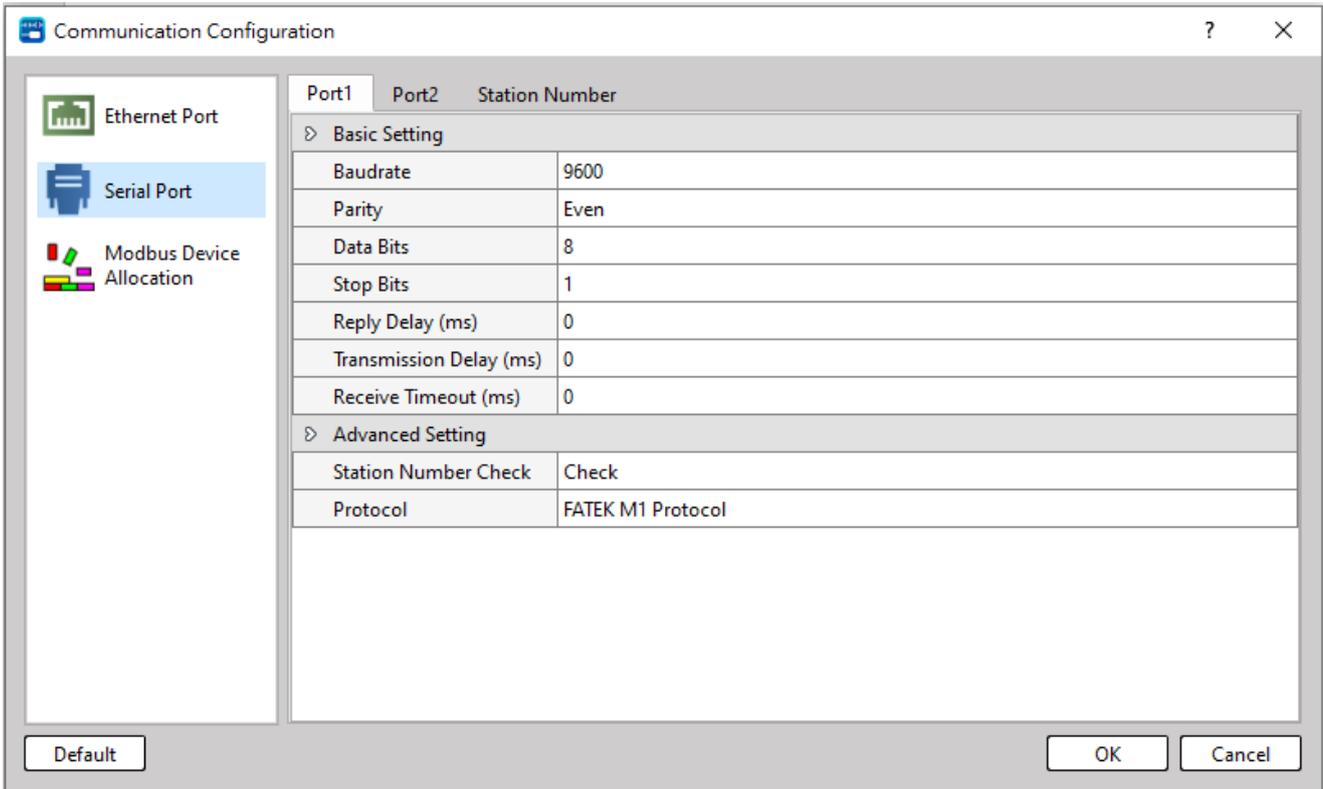
Without station number checking for HMI or SCADA connecting

While PLC communicating with UperLogic, it recognizes the FATEK M1 communication protocol.

While PLC communicating with Man Machine Interface (MMI) or Supervising software (SCADA), it recognizes the FATEK's external communication protocol.

Low byte of R35354 = 1, Port 1 without station number checking while FATEK's external communication protocol.

High byte of R35354 = 1, Port 2 without station number checking while FATEK's external communication protocol.

Transmission delay time setting

While the communication port being used as the master of FATEK CPU LINK (FUN151) or Modbus RTU (FUN150) multidrop's network, it allows the user to set the transmission delay time to slow down the expiration of message frame.

High byte of R35357: Port 1 transmission delay time setting (Unit in 10mS)

High byte of R35358: Port 2 transmission delay time setting (Unit in 10mS)

Receive time-out span setting

When the communication port of the PLC uses FUN150 (M-BUS) or FUN151 (CLINK) as the master of the Modbus or Fatek communication network. After sending a command, it must complete the transmission of all response messages within the set time. When the time is up, if the receiving party does not respond or the response is not completed, it is determined that the communication transaction command has failed.

Low byte of R35357: Port 1 receive time-out span setting (Unit in 10mS).

Low byte of R35358: Port 2 receive time-out span setting (Unit in 10mS).

New message detection time interval setting

While the communication port being used as the master or slave of Modbus RTU communication protocol, the system will give the default time interval to identify each packet of receiving message.

Without station number checking for FATEK's internal communication protocol

While PLC communicating with UperLogic, it recognizes the FATEK's internal communication protocol, the quick way to communicate with the PLC is to key in 255 as the station number for UperLogic to connect with the unsure station number of target.

Related internal relay

Communication Port	Port ready Indication relay	Indication relay to complete the last command
Port1	M9135	M9136
Port2	M9138	M9139

10-1-3 Description and Application of Software Interface Types

As described in Section 10.1, the built-in communication port has 2 types of software interfaces, Port1~Port2 are both "Standard Interface" and "Ladder Diagram Program Controlled Interface", and the interface type is based on PLC's CPU of user's program setting (when user used communication-controlled instruction FUN150 and FUN151, it will automatically set to "Ladder Diagram Program Controlled Interface").

Standard Interface

The port with the standard interface is controlled by PLC CPU, and the communication transaction of the ports is controlled by FATEK "Standard Communication Driver" or "Modbus Communication Driver". All accesses to the port must be executed in the format of "FATEK-PLC Protocol" or "Modbus Communication Driver". UperLogic software package, and many HMI and SCADA have communication drivers conforming to "FATEK-PLC Protocol", so linkage is built immediate when the "standard interface" port is connected and the hardware interface and communication parameters are consistent. When no such conforming communication driver is available, additional commands that conform to the format of "FATEK-PLC Protocol" or "Modbus Communication Driver" must be written for PLC communication.

Ladder Program Control Interface

This type of interface can be set up for Port1~Port2. The ladder program that are used to control the ports are FUN150 (M-BUS) and FUN151 (CLINK).

FUN150 (M-BUS) controls Port 1~Port 2 and uses them as masters on the Modbus network. The ports can connect to Modbus peripherals (slaves) easily. Refer to the "Convenient instruction for Modbus RTU Master" below for more information.

FUN151 (CLINK) controls Port 1~Port 2 and uses them for resource sharing among PLCs or connection to intelligent peripherals. FUN151 provides three operation modes. Refer to the "FATEK Binary Master/Slave Protocols" below for more information.

10-2 FATEK M1 Communication Protocols

FUN151 (CLINK) Usage Step
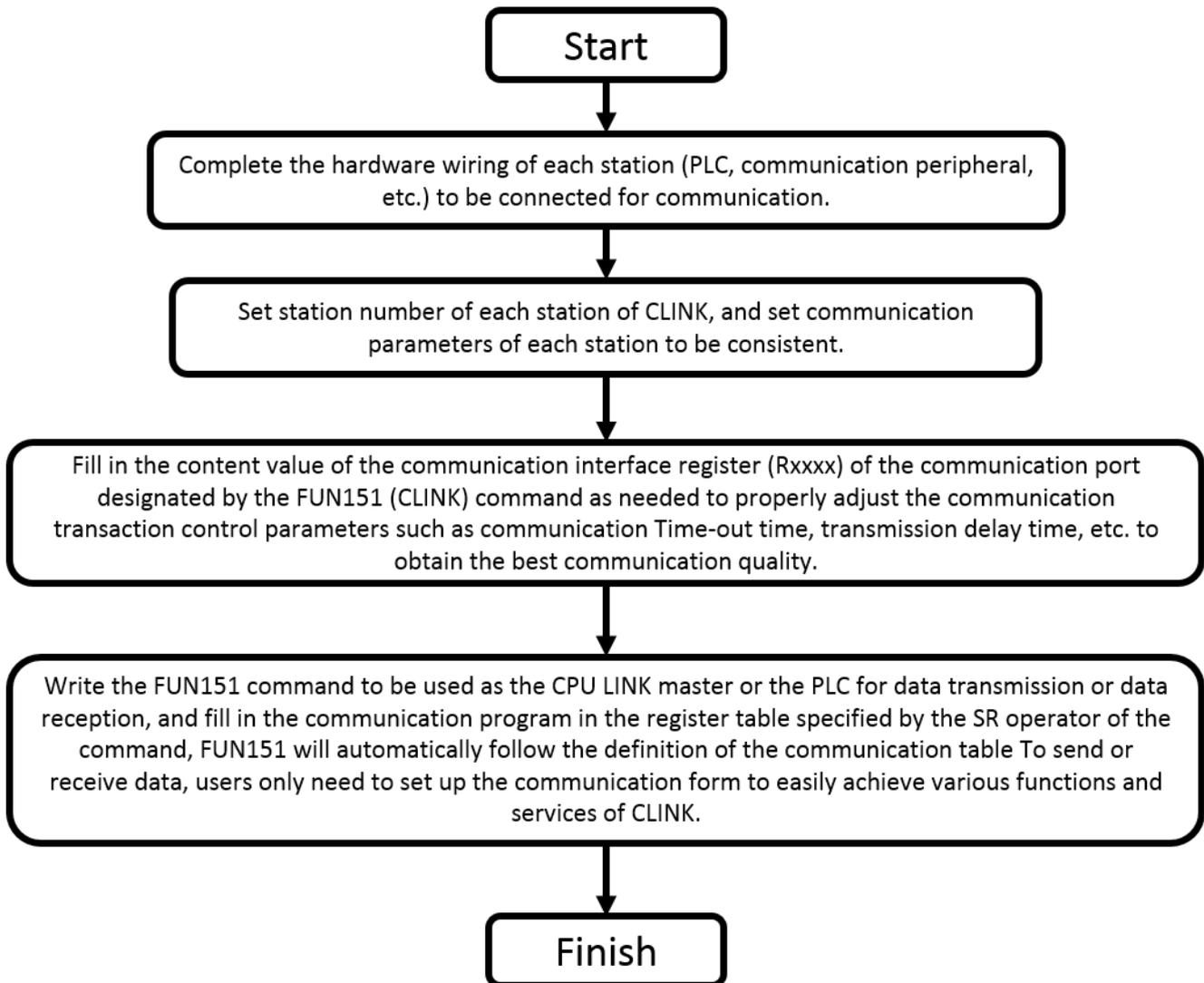
- Station number can be any one from 1 to 254, but cannot be repeated
- Please refer to the section Communication parameter setting instructions.

10-2-1 Description and examples of instruction

This chapter will explain the usage of the MD0 working modes of the FUN151 (CLINK) command with practical application examples.

FUN151（CLINK）: MD0 Communication Connection Facilitation Command

FUN151 CLINK	FUN151 (CLINK): MD0 Communication Connection Facilitation Command (which makes PLC act as the master station in FATEK communication protocol through PORT 1~2)	FUN151 CLINK
Symbol		

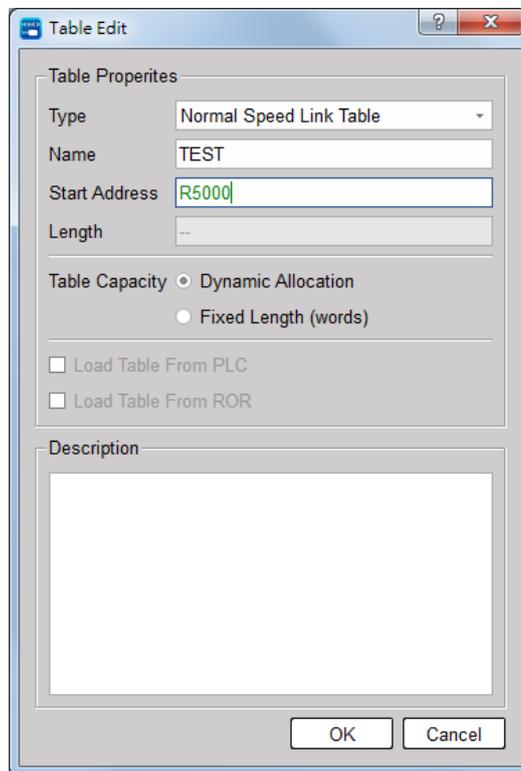| Ladder symbol	Pt : Assign the port, 1 ~ 2
151P.CLINK	MD: 0, master station of CPU LINK (Using FATEK communication protocol).
Execution control — EN Pt : ___ ── ACT — MD : ___ SR : ___ ── ERR — WR : ___ Pause — PAU Abort — ABT ── DN —	SR: Starting register of communication table WR: Starting register for instruction operation. It controls 8 registers; the other programs can not repeat in using.

Range / Operand	HR R0 | R34767	ROR R43224 | R47319	DR D0 | D11999	K
Pt				1-2
MD				0
SR	○	○	○	
WR	○	○	○	

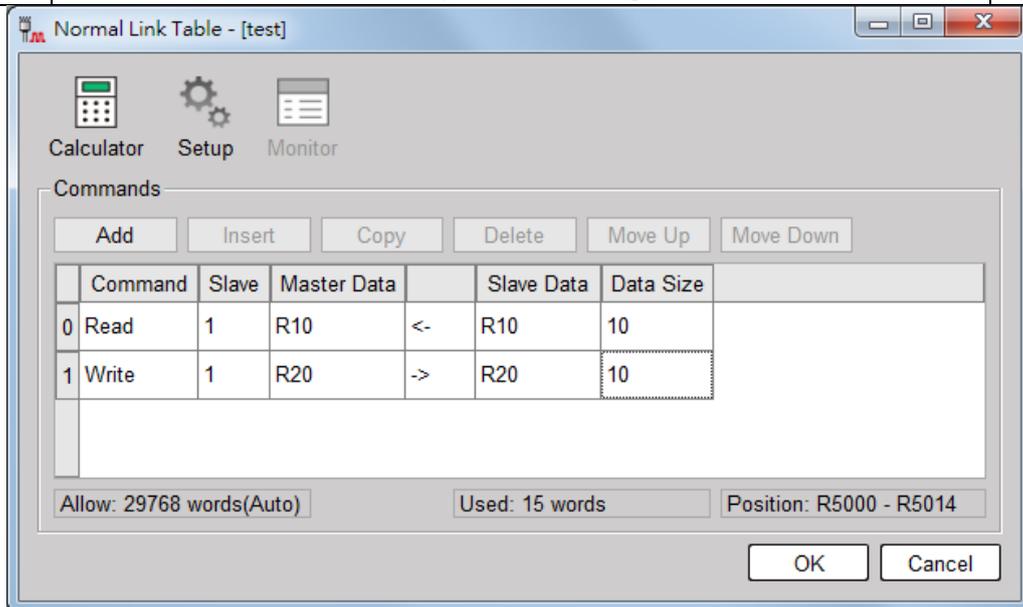| FUN151 CLINK	FUN151 (CLINK)：MD0 Communication Connection Facilitation Command (which makes PLC act as the master station in FATEK communication protocol through PORT 1~2)	FUN151 CLINK
Description		

1.   FUN151 (CLINK): MD 0 mode provides data sharing between FATEK PLC and PLC

2.   The master PLC may connect with 254 slave stations through the RS485 interface.

3.   Only the master PLC needs to use FUN151 instruction, the slave doesn't need.

4.   It employs the program coding method or table filling method to plan for the data flow controls; i.e. from which one of the slave station to get which type of data and save them to the master PLC, or from the master PLC to write which type of data to the assigned slave station. It needs only 7 registries to make definition; every 7 registers define one packet of data transaction.

5.   When execution control 〝EN〞 changes from 0→1 and both inputs "PAU" and "ABT" are 0, and if Port 1/2 hasn't been controlled by other communication instructions [i.e. M9135 (Port1) / M9138 (Port2) = 1], this instruction will control the Port 1/2 immediately and set the M9135/M9138 to be 0 (which means it is being occupied), then going on a packet of data transaction immediately. If Port 1/2 has been controlled (M9135/M9138= 0), then this instruction will enter into the standby status until the controlling communication instruction completes its transaction or pause/abort its operation to release the control right (M9135/M9138 =1), and then this instruction will become enactive, set M9135/M9138 to be 0, and going on the data transaction immediately.

6.   While in transaction processing, if operation control "PAU" becomes 1, this instruction will release the control right (M9135/M9138 = 1) after this transaction. Next time, when this instruction takes over the transmission right again, it will restart from the next packet of data transaction.

7.   While in transaction processing, if operation control "ABT" becomes 1, this instruction will abort this transaction immediately and release the control right (M9135/M9138 = 1). Next time, when this instruction takes over the transmission right again, it will restart from the first packet of data transaction.

8.   While it is in the data transaction, the output indication "ACT" will be ON.

9.   When a data transaction is completed, if there is an error, the output indication "DN" and "ERR" will be ON at the same time.

10.   If there is no error occurred when it finishes a packet of data transaction, the output indication "DN" will be ON.

11.   If "EN" is ON, the communication will continue.

FUN151 CLINK	FUN151（CLINK）：MD0 Communication Connection Facilitation Command (which makes PLC act as the master station in FATEK communication protocol through PORT 1~2)	FUN151 CLINK

| Description | |

Port Interface Signal

List of relays and registers used by communication ports:

Communication Port Interface Signal	Port 1	Port 2
1. Port occupation indication	M9135	M9138
2. Port command complete indication	M9136	M9139
3. Port communication parameter register	R35352	R35353
4. Transmit Delay and Receive Anomaly Detection Register	R35357	R35358

1.   Port occupation indication: the signal is generated by CPU, ON signal means the Port can accept new orders to send data. OFF means the Port is being occupied and cannot accept new commands to transmit data.

2.   Port command completion indication: This signal is generated by the CPU. When the last transaction of the communication program is completed, it is ON for one scan time (continuous transmission). When the last transaction of the communication program is completed, ON (discontinuous transmission).

3.   Port communication parameter setting register: (10-1-2 Description of Communication Functions).

4.   Transmission delay and reception abnormality detection register:

Low Byte: Define the error detection time-out time of CLINK command, the unit is 0.01 second. The CLINK command uses the Time-out time to judge whether the communication object is online correctly; when the master station sends a read or write command to the slave station, if the slave station does not respond within this time, it means that the communication Time-out is abnormal. When multiple devices are connected, adjust this value appropriately (more than one scan time of the slave station with the longest scan time), so that if more than one slave station is not powered on (time-out will occur), there will be a connection PLC communication does not significantly affect scan time.

High Byte: Define the transmission delay time between one transaction and one transaction of CLINK instruction, the unit is 0.01 second. If there is only one-to-one connection, this value can be set to 0 to shorten communication transaction time and improve communication efficiency. When multiple devices are connected, if the master station needs to delay the sending of communication commands to improve the communication quality, this value can be set.

FUN151 CLINK	FUN151 (CLINK)：MD0 Communication Connection Facilitation Command (which makes PLC act as the master station in FATEK communication protocol through PORT 1~2)	FUN151 CLINK
Example	Use Port 2 to execute communication command program	
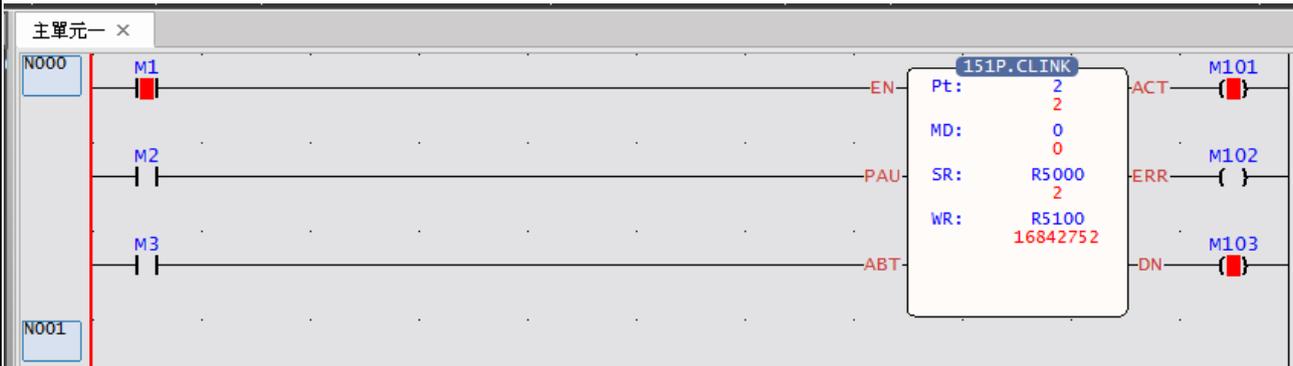
When M1 = ON, the master station will continue to read the slave station data through Port 2, or write data to the slave station

Editing Communication Table with UperLogic

Click the "Link Table" Item which in project windows： Project name

Table Edit
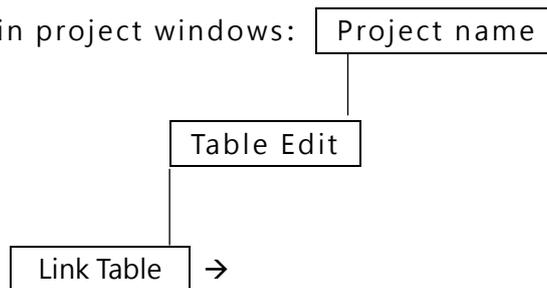
Link Table →

Click right button and select "New Link Table".

FUN151 CLINK	FUN151 (CLINK): MD0 Communication Connection Facilitation Command (which makes PLC act as the master station in FATEK communication protocol through PORT 1~2)	FUN151 CLINK

Figure 57 Table of communication command

FUN151 CLINK	FUN151 (CLINK)：MD0 Communication Connection Facilitation Command (which makes PLC act as the master station in FATEK communication protocol through PORT 1~2)	FUN151 CLINK

Figure 58 Table of Normal Link

- Table Type: MD0 must be selected "Normal Link Table".

- Table Name: For modification or debug, you can give a convenient name.

- Table Starting Address: Enter the address which is the starting register of communication table to store the data exchange list.

※ To make it easy to edit, read, and maintain the communication program, we have extended following related instructions under FUN150 and FUN151. The use method is taking focus on FUN150 or FUN151, and press the hotkey "Z". When "Table Edit" windows appear, then you can edit the communication table.

FUN151 CLINK	FUN151 (CLINK)：MD0 Communication Connection Facilitation Command (which makes PLC act as the master station in FATEK communication protocol through PORT 1~2)	FUN151 CLINK

Figure 59 Table of Normal Link_Communicatoin Command Setting

● Command: read is the master read data back from the slave, write is write data from the master to the slave.

● Slave Station: The station number of the slave station to be transmitted.

● Master data: read is the location where the data is read from the slave station and stored, and write is where the data is written from the master station to the slave station.

● Slave data: read is the position that the slave station wants to send back to the master station, and write is the position of writing data from the master station to the slave station.

● Data Length: The length to be sent, the range is 1 ~ 64.

FUN151 CLINK	FUN151 (CLINK)：MD0 Communication Connection Facilitation Command (which makes PLC act as the master station in FATEK communication protocol through PORT 1~2)	FUN151 CLINK

Explanation for MD0 Operand SR

SR：Starting register for communication program of CLINK instruction。

SR+0	Total transactions	● Low Byte is valid; one transaction takes 7 registers to describe, which means 7 registers define a packet of data transaction.
SR+1	Slave station No. which is about to transact with	● Low Byte is valid, 0 to 254 (if it is 0: it means that the master PLC sends a broadcast to all slave PLCs, and the slave PLC does not respond).
SR+2	Command code	● Low Byte is valid; =1, means reading data from slave PLC; =2, means writing data to slave PLC.
SR+3	Data length of this transaction	● Low Byte is valid; the range is 1 ~ 64.
SR+4	Data type of Master PLC	● Low Byte is valid, and its range is 0 to 13; it defines the data type of master PLC (see next page).
SR+5	Starting reference of Master PLC	● Word is valid; it defines the starting address of data (master).
SR+6	Data type of slave PLC	● Low Byte is valid, and its range is 0 to 13; it defines the datatype of slave PLC (see next page).
SR+7	Starting reference of Slave PLC	● Word is valid; it defines the starting address of data (slave).

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FUN151 CLINK	FUN151 (CLINK)： MD0 Communication Connection Facilitation Command (which makes PLC act as the master station in FATEK communication protocol through PORT 1~2)	FUN151 CLINK

SR+8	Slave station No. which is about to transact with	
SR+9	Command Code	
SR+10	Data length of this transaction	
SR+11	Data type of Master PLC	Description of the 2nd packet of transaction.
SR+12	Starting reference of Master PLC	
SR+13	Data type of slave PLC	
SR+14	Starting reference of Slave PLC	

FUN151 CLINK	FUN151 (CLINK)：MD0 Communication Connection Facilitation Command (which makes PLC act as the master station in FATEK communication protocol through PORT 1~2)	FUN151 CLINK

Master/Slave data type, code and reference number

Data code	Data type	Reference number
0	X (discrete input)	0 ~ 1023
1	Y (discrete output)	0 ~ 1023
2	M (internal relay M)	0 ~ 9119
3	S (step relay S)	0 ~ 3103
4	T (timer contact)	0 ~ 1023
5	C (counter contact)	0 ~ 1023
6	WX (word of discrete input ,16 bits)	0 ~ 1008, it must be the multiple of 16.
7	WY (word of discrete output ,16 bits)	0 ~ 1008, it must be the multiple of 16.
8	WM (word of internal relay,16 bits)	0 ~ 9104, it must be the multiple of 16.
9	WS (word of step relay,16 bits)	0 ~ 3088, it must be the multiple of 16.
10	TR (timer register)	0 ~ 1023
11	CR (counter register)	0 ~ 1023
12	R (data register)	0 ~ 34767
13	D (data register)	0 ~ 11999

Note: The data type for master and slave must be consistent. i.e., if the master station is any value between 0 to 5, the slave station must also be any value between 0 to 5; if the master station is any value between 6 to 13, the slave station must also be any value between 6 to 13.

FUN151 CLINK	FUN151 (CLINK): MD0 Communication Connection Facilitation Command (which makes PLC act as the master station in FATEK communication protocol through PORT 1~2)	FUN151 CLINK

FUN151: Explanation for the Operand WR of MD0

	High Byte	Low Byte
WR+0	Result code	Transaction No.
WR+1	Station No.	Command code
WR+2	For internal operation	
WR+3	For internal operation	
WR+4	For internal operation	
WR+5	For internal operation	
WR+6	For internal operation	
WR+7	For internal operation	

- Transaction No.: the operating transaction (starting from 0)
- Result code indicates the transaction result; 0= normal, other value = abnormal.
- Command = 0H, reading system status from slave PLC.
  = 1H, writing system status from slave PLC.
- Station No.: the slave station number which is in transaction.

Result code: 0, this transaction is successful.

2, data length error (data length is 0 or greater than 64 in one transaction).

3, command code error (command code is greater than 2).

4, data type error (data type is greater than 13, please refer to data type code).

5, reference number error (please refer to reference number).

6, inconsistence in data type (e.g., master station is 0 ~ 5 while slave is 6 ~ 13).

A, no response from slave station (Time-out error).

B, communication error (received error data).

FUN151 CLINK	FUN151 (CLINK)∶ MD0 Communication Connection Facilitation Command (which makes PLC act as the master station in FATEK communication protocol through PORT 1~2)	FUN151 CLINK

● For easier programming and troubleshooting, the WinProladder provides the table editing environment to edit the communication table of FUN151 instruction; Key in the complete FUN151 instruction first and then move the cursor to the position of it, depressing the "Z" key, now comes the table editing environment. The user can create the new communication table or display the existed table under this friendly user interface operation.

Communication Table for Normal Link (MD0)

Command	Slave	Master Data	Slave Data	Length
Read (=1) Write (=2)	Describing the station number of slave PLC which is about to transact with.	Describing the data type & reference number of this packet of transaction for the master PLC.	Describing the data type & reference number of this packet of transaction for the slave PLC.	Data length of this transaction. 1 ~ 64
	Station number=0, The master PLC broadcasts the data to all slave PLCs and slave PLCs will not reply.	X0 ~ X1023 Y0 ~ Y1023 M0 ~ M9119 S0 ~ S3103 T0 ~ T1023 C0 ~ C1023 WX0 ~ WX1008	X0 ~ X1023 Y0 ~ Y1023 M0 ~ M9119 S0 ~ S3103 T0 ~ T1023 C0 ~ C1023 WX0 ~ WX1008	
	Station number=N, it means the station number of the slave PLC which is about to transact with the master PLC N=1~ 254	WY0 ~ WY1008 WM0~WM9104 WS0 ~ WS3088 TR0 ~ TR1023 CR0 ~ CR1023 R0 ~ R34767 D0 ~ D11999	WY0 ~ WY1008 WM0 ~ WM9104 WS0 ~ WS3088 TR0 ~ TR1023 CR0 ~ CR1023 R0 ~ R34767 D0 ~ D11999	

10-3　User-Defined Communication Protocols

The functions of MD1 and MD4 are both connected to intelligent peripheral devices with RS-485 communication interface, so that PLC can be used as data transmission (automatic transmission) through Port 1 and 2. The difference is that the transmission data of MD1 will only occupy one Low Byte in a Word, while the transmission data of MD4 will occupy the High Byte and Low Byte in a Word.

The functions of MD2 and MD5 are ready to receive at any time. The message sent by the intelligent peripheral equipment of the RS485 communication interface makes the PLC receive data through Port 1 and 2 (passive reception). The difference is that the received data of MD2 will only occupy one Low Byte in a Word, and the received data of MD5 will occupy the High Byte and Low Byte in a Word.

10-3-1 Instruction description and examples

This chapter will explain the usage of the working modes (MD1, MD4, MD2, MD5) of FUN151 (CLINK) command with examples of actual applications.

FUN151（CLINK）：MD1、MD4 Communication Connection Convenience Command

FUN151 CLINK	FUN151（CLINK）：MD1、MD4 Communication Connection Convenience Command （ Use PLC as a data transmission unit via Port 1 and 2 ）	FUN151 CLINK
Symbol		

Pt：Assign communication port, 1～2.
MD：1 & 4；Connect with intelligent peripheral devices with RS-485 communication interface.
SR：Communication transmission table start register.
(Look at the example description).
WR：Instruction operation start register (see example description), a total of 8 registers are occupied, and other programs cannot be reused.

Range / Operand	HR	ROR	DR	K
	R0 | R34767	R43224 | R47319	D0 | D11999	
Pt				1 ～ 2
MD				1、4
SR	○	○	○	
WR	○	○*	○	

MD1 and MD4 are used to connect with intelligent peripheral devices with RS-485 communication interface, so that PLC can be used as data transmission (automatic transmission) through Port 1 and 2. The difference is that the transmission data of MD1 will only occupy one Low Byte in a Word, and the transmission data of MD4 will occupy the High Byte and Low Byte in a Word, please refer to the description of the follow-up SR for details.

FUN151 CLINK	FUN151（CLINK）: MD1、MD4 Communication Connection Convenience Command （ Use PLC as a data transmission unit via Port 1 and 2 ）	FUN151 CLINK
Function Description		

1. FUN151 (CLINK): MD1 and MD4 modes are mainly provided for FATEK PLC to actively connect with intelligent peripheral devices with RS-485 communication interface.

2. One master PLC can connect with multiple peripheral devices with the same protocol via RS-485 interface.

3. The communication format is written by the UperLogic program and must be consistent with the communication peripheral to be connected in order to successfully connect.

4. When the execution control "EN" changes from 0 to 1 and both the suspend operation "PAU" and the abort operation "ABT" are 0, if the specified communication port is not occupied by other communication commands [M9135(Port1), M9138(Port2)) =1], then this command will control the communication port immediately, and set M9135 and M9138 to 0 (indicating occupation), and then immediately carry out data transmission transactions. If the specified communication port is already occupied (M9135, M9138 = 0), this command enters the waiting state until the occupied communication command is sent or the operation is suspended/abandoned, and after the control is released (M9135, M9138 = 1), This instruction immediately leaves the waiting state, sets M9135 and M9138 to 0, and immediately carries out the transmission transaction

5. When the transmission transaction is in progress, if the suspension operation "PAU" becomes 1, this instruction will suspend the operation and release the control right after the transaction data transmission is completed at that time (M9135, M9138 =1).

6. During the transfer transaction, if abandon operation then "ABT" becomes 1, this instruction will immediately stop the transfer and release the control right (M9135, M9138 =1).

7. When the data transaction is being transmitted, the output indication "ACT" is ON.

8. When a data transaction has been transmitted (completed or transmitted and then received), if an error occurs, the output indication "DN" and "ERR" will be ON at the same time.

9. When a data transaction has been transmitted (completed or transmitted and then received), if no error occurs, the output indication "DN" will be ON.

FUN151 CLINK	FUN151（CLINK）：MD1、MD4 Communication Connection Convenience Command （ Use PLC as a data transmission unit via Port 1 and 2 ）	FUN151 CLINK
Function Description		

Port Interface Signal

List of relays and registers used by communication ports:

Communication Port / Interface Signal	Port 1	Port 2
1. Port Occupation Indication	M9135	M9138
2. Port Command Completion Indication	M9136	M9139
3. Port Communication Parameter Setting Register	R35352	R35353
4. Transmit Delay and Receive Anomaly Detection Register	R35357	R35358

1. Port Occupation Indication: This signal is generated by the CPU.

   ON represents the Port accepts new commands to transmit data.

   OFF means that the Port is being occupied and cannot accept new commands to transmit data.

2. Port Command Completion Indication: This signal is generated by the CPU.

   ON, complete a data transaction.

3. Port Communication Parameter Setting Register : (Refer to 10-1-2 Description of Communication Functions)

4. Transmit Delay and Receive Anomaly Detection Register:

   Low Byte: Define the abnormal detection Time-out time when the CLINK command specifies the use of Port, and the unit is 0.01 second. The CLINK command uses the Time-out time to judge whether the communication object is online or not; when the CLINK is MD1 and is set to the "transmit and then receive" mode, if the PLC sends a communication transaction to the peripheral, but the communication object cannot respond within this time, then a Time-out error occurs. When CLINK is MD1 and set to "transmit only" mode, this value is meaningless.

   High Byte: For MD1, it is recommended to set it to 0.

FUN151 CLINK	FUN151（CLINK）: MD1、MD4 Communication Connection Convenience Command （ Use PLC as a data transmission unit via Port 1 and 2 ）	FUN151 CLINK
Example	Using Port 2 to actively connect with smart peripherals using non-standard communication protocols	

Example description: Actively and continuously send 02H ('STX'), 4FH (' O'), 4BH ('K'), 03H ('ETX') through PLC Port 2 to intelligent peripheral devices with RS485 communication interface.

Example N000:
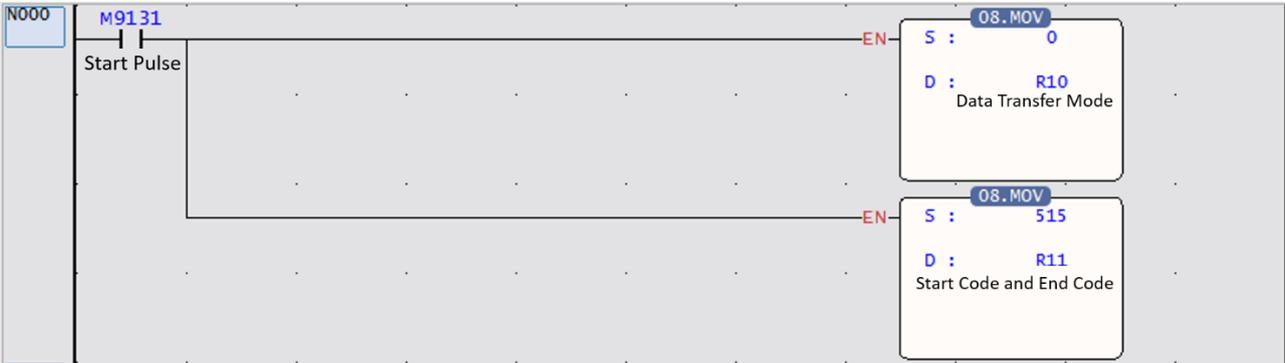
Program Description:
1. Data Transfer Mode: Set only outgoing messages, no response message mode from the other party (R10=0).
2. Set the start code (02H) and end code (03H).
    （ The start code is High Byte and the end code is Low Byte ）

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FUN151 CLINK	FUN151（CLINK）: MD1、MD4 Communication Connection Convenience Command （ Use PLC as a data transmission unit via Port 1 and 2 ）	FUN151 CLINK

Program Example N001:

Program Description:

    Package transmission data:

3.   Set the transmission data length（R12=N）

    Fill in the data to be sent:

4.   Fill in the data 1（R13= 02H ' STX '）

5.   Fill in the data 2（R14= 4FH ' O '）

6.   Fill in the data 3（R15= 4BH ' K '）

7.   Fill in the data 4（R16= 03H ' ETX '）

FUN151 CLINK	FUN151（CLINK）: MD1、MD4 Communication Connection Convenience Command （ Use PLC as a data transmission unit via Port 1 and 2 ）	FUN151 CLINK

Program Example N002:

Program Description:

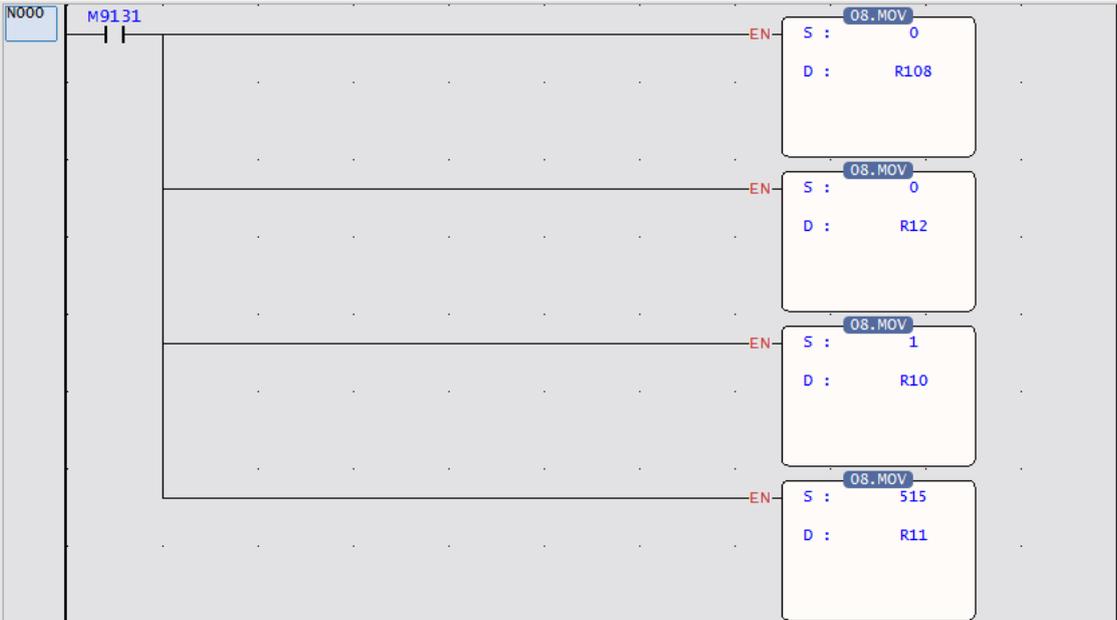8.　When M1=ON, PLC will send data through Port2 in MD1 mode.

FUN151 CLINK	FUN151（CLINK）: MD1、MD4 Communication Connection Convenience Command （ Use PLC as a data transmission unit via Port 1 and 2 ）	FUN151 CLINK

FUN 151: Explanation of MD1 operand SR

SR: The initial register for the data transfer form.

SR+0	Transfer only / transfer then receive	● **Low Byte** is valid, = **00H,** only send message, the other side has no response message. = **01H**, send a message, and then wait for the response message from the other side. (Do receive if no communication error) = **81H,** send messages, then wait for the response message from the other side. (Receive with or without communication
SR+1	Receive start / end code	● **High Byte**: Describe the **start code** of the response message when receiving. **Low Byte**: Describe the **end code** of the response message when receiving.
SR+2	Transfer data length	● The length of the data to be transmitted; the maximum is 1024.
SR+3	**MD1**: Data **1** **MD4**: Data **2** and **1**	● **MD1**: Low Byte is valid; **MD4**: High Byte and Low Byte are valid.
SR+4	**MD1**: Data**2** **MD4**: Data **4** and **3**	● **MD1**: Low Byte is valid; **MD4**: High Byte and Low Byte are valid.
SR+5	**MD1**: Data **3** **MD4**: Data **6** and **5**	● **MD1**: Low Byte is valid; **MD4**: High Byte and Low Byte are valid.
	⋮	
	MD1: Data **N** **MD4**: Data **N** and **N-1**	

FUN151 CLINK	FUN151（CLINK）: MD1、MD4 Communication Connection Convenience Command （ Use PLC as a data transmission unit via Port 1 and 2 ）	FUN151 CLINK

Note:

1.   When the transmission-only mode is selected, the start/end codes of reception are meaningless.

2.   When selecting the mode of sending and then receiving, before starting the transmission, you must first estimate the start code and end code of the response message from the other side and fill it in the receiving start/end code register (for example, SR+1=0203H, 02H represents the start code, 03H represents the end code), so as to ensure correct reception. The communication protocol with start/end code is easy to distinguish each message, and the communication program is simple and efficient.

3.   When the mode of sending and receiving is selected, if the response message has no start code, the high byte of the start/end code register is filled with 0; if the response message has no end code, the start/end code register fill the low byte with 0.

4.   When selecting the mode of sending and then receiving, and when the CPU completes the transmission and receives a response message, it will fill the received data into the receive register and set the receive length (the sum of WR+8 and the length of the subsequent register).

FUN151 CLINK	FUN151（CLINK）: MD1、MD4 Communication Connection Convenience Command （ Use PLC as a data transmission unit via Port 1 and 2 ）	FUN151 CLINK

FUN151: Description of MD1 operand WR

	High Byte	Low Byte
WR+0	Result Code	0
WR+1	Internal operation use	
WR+2	Internal operation use	
WR+3	Internal operation use	
WR+4	Internal operation use	
WR+5	Internal operation use	
WR+6	Internal operation use	
WR+7	Internal operation use	
WR+8	The total number of data received	
WR+9	**MD1**: Receive data **1** **MD4**: Receive data **2** and **1**	
. . . .	**MD1**: Receive data **2** **MD4**: Receive data **4** and **3**	
	MD1: Receive data **3** **MD4**: Receive data **6** and **5**	
	⋮	
	MD1: Receive data N **MD4**: Receive data **N** and N-1	

- The **result code** stores the operation result; =0, normal; other values, abnormal.
- Internal operation use; execute the CLINK command, the register that the CPU needs to use.

- A total of several Byte data received (received data length register; the received start code and end code are included).

MD1: The first Byte data received (start code if there is a start code), High Byte = 0.
MD4: The 1st and 2nd Byte data received.

MD1: For the second Byte data received, High Byte=0.
MD4: The 3rd and 4th Byte data received.

MD1: For the second Byte data received, High Byte=0.
MD4: The received 5th and 6th Byte data.

MD1: For the received Nth Byte data (end code if there is one), High Byte = 0.
MD4: The received N and N-1 Byte data.

FUN151 CLINK	FUN151（CLINK）：MD1、MD4 Communication Connection Convenience Command （ Use PLC as a data transmission unit via Port 1 and 2 ）	FUN151 CLINK

Result Code: 0, The transfer (transaction) was successful.

2, Data length error（The value is 0, or a transaction volume is greater than 1024）.

A, No response from the other side.

B, Communication abnormality (wrong data received).

FUN151（CLINK）: MD2、MD5 Communication Connection Convenience Command
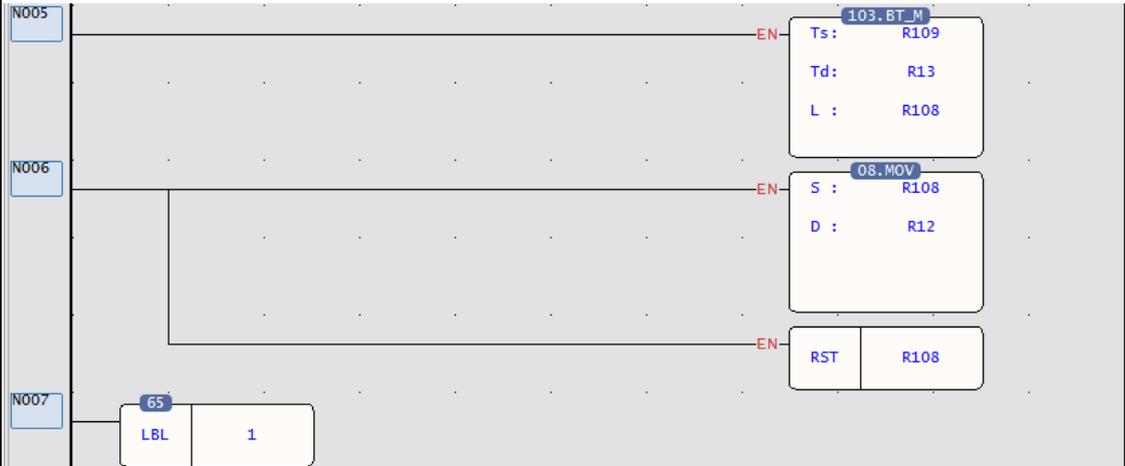
FUN151 CLINK	FUN151（CLINK）: MD2、MD5 Communication Connection Convenience Command （ Use PLC as a data transmission unit via Port 1 and 2 ）	FUN151 CLINK

Symbol	

Ladder symbol
151P.CLINK

Compare control —EN— Pt:　　　ACT — Communication
　　　　　　　MD:
Pause —PAU— SR:　　　ERR — Error
　　　　　　　WR:
Abort —ABT—　　　　　DN — Done

Pt: Assign port, 1 ~ 2.

MD: 2, 5; always be ready to receive messages from intelligent peripheral devices with RS485 communication interface.

SR: The initial register of the communication transmission table (refer to example description).

WR: Instruction operation start register (refer to example description), a total of 8 registers are occupied, and other programs cannot be reused.

Operand \ Range	HR R0 | R34767	ROR R43224 | R47319	DR D0 | D11999	K
Pt				1 ~ 2
MD				2、5
SR	○	○	○	
WR	○	○*	○	

The functions of MD2 and MD5 are ready to receive at any time. The message sent by the intelligent peripheral equipment of the RS485 communication interface makes the PLC receive data through Port 1 and 2 (passive reception). The difference is that the received data of MD2 will only occupy the Low Byte part of a Word, and the received data of MD5 will occupy the High Byte and Low Byte of a Word, please refer to the description of the follow-up SR for details.

FUN151 CLINK	FUN151（CLINK）: MD2、MD5 Communication Connection Convenience Command （ Use PLC as a data transmission unit via Port 1 and 2 ）	FUN151 CLINK
Function Description		

1.   FUN151 (CLINK): MD2 and MD5 modes, providing FATEK PLC to receive messages from peripherals with RS485 communication interface at any time.

2.   The communication format is written by the Ladder program, which must be consistent with the peripheral to be connected in order to successfully connect.

3.   When the execution control "EN" changes from 0 to 1 and both the suspend operation "PAU" and the abort operation "ABT" are 0, if the specified communication port is not occupied by other communication commands [M9135(Port1), M9138(Port2)) = 1], then this command will control the communication port immediately, and set M9135 and M9138 to 0 (means occupied). If the specified communication port is already occupied (M9135, M9138 = 0), this command enters the waiting state until the occupied communication command is transmitted or the operation is suspended/abandoned, and after the control is released (M9135, M9138 = 1), This instruction immediately leaves the waiting state, sets M9135 and M9138 to 0, and enters the receiving state.

4.   When suspending operation "PAU" or abandoning operation "ABT" is 1, immediately abandon receiving (M9135, M9138 =1).

5.   When entering the receiving state, the output indicator "ACT" is ON.

6.   When a transaction is completed (received or received and then transmitted), if an error occurs, the output indication "DN" and "ERR" will be ON for one scan time at the same time.

7.   When a transaction is completed (received or received and then transmitted), if no error occurs, the output indication "DN" will be ON.

Port Interface Signal

List of relays and registers used by communication ports:

Communication port Interface Signal	Port 1	Port 2
1. Port Occupation Indication	M9135	M9138
2. Port Command Completion Indication	M9136	M9139
3. Port Communication Parameter Setting	R35352	R35353
4. Transmit Delay and Receive Anomaly	R35357	R35358

FUN151 CLINK	FUN151（CLINK）: MD2、MD5 Communication Connection Convenience Command （ Use PLC as a data transmission unit via Port 1 and 2 ）	FUN151 CLINK

1. Port Occupation Indication: This signal is generated by the CPU.

   ON represents the Port accepts new commands to transmit data.

   OFF means that the Port is being occupied and cannot accept new commands to transmit data.

2. Port Command Completion Indication: This signal is generated by the CPU.

   ON, complete a data transaction.

3. Port Communication Parameter Setting Register :（Refer to 10-1-2 Description of Communication Functions ）

4. Transmission error detection register:

   Low Byte: Define the abnormal detection Time-out time when the CLINK command specifies the use of Port, and the unit is 0.01 second. When the PLC receives a message and must respond (receive and then transmit mode), but the Ladder program cannot process and send the response message within this period of time, the CPU abandons the response and automatically returns to the receiving state. When FUN151: MD2 is set to receive only (following examples) mode, this value is meaningless.

   High Byte: Not used for MD2.

Note:

1：FUN151: MD2 and MD5 stay in the receiving state as long as they start receiving, unless the input signal of abandon receiving (ABT) is ON, they will leave the receiving state to stop receiving and wait for the next start of receiving control.

2： When the start/end code of reception is changed, it is necessary to control the ABT input signal ON, and then start the reception control "EN↑" from 0→1 to start receiving messages.

FUN151 CLINK	FUN151（CLINK）: MD2、MD5 Communication Connection Convenience Command （Use PLC as a data transmission unit via Port 1 and 2）	FUN151 CLINK
Example	Use Port2 to return the data received by this PLC to the host that sent the data	

Program Example N000:

```
N000    M9131                                              08.MOV
         ┤├──────────────────────────────────EN─ S :        0
                                                       D :      R108

                                                         08.MOV
                                                ──────EN─ S :        0
                                                       D :       R12

                                                         08.MOV
                                                ──────EN─ S :        1
                                                       D :       R10

                                                         08.MOV
                                                ──────EN─ S :      515
                                                       D :       R11
```

Program Description:

1. Clear the received data length to 0.

2. Clear the data transmission length to 0.

3. （If you only receive but not transmit, you don't need this program）

4. Set the receiving method: set the receive and transmit mode.

5. Set the start code (02H) and end code (03H) of the received message (R11=0, if there is no start code and end code, it can also be received normally).

    (The start code is High Byte and the end code is Low Byte)

M-Series PLC Software Function and Application User Manual

FUN151 CLINK	FUN151（CLINK）: MD2、MD5 Communication Connection Convenience Command （ Use PLC as a data transmission unit via Port 1 and 2 ）	FUN151 CLINK
Example	Use Port2 to return the data received by this PLC to the host that sent the data	

Program Example N001 ~ N002:

Program Description:

6.　　When M1=ON, the PLC will receive the data sent by the other through Port2.

7.　　When the transmission is complete, clear the data transmission length to 0.

8.　　（ If you only receive but not transmit, you don't need this program ）

FUN151 CLINK	FUN151（CLINK）: MD2、MD5 Communication Connection Convenience Command （ Use PLC as a data transmission unit via Port 1 and 2 ）	FUN151 CLINK
Example	Use Port2 to return the data received by this PLC to the host that sent the data	

Program Example N003 ~ N004:

Ladder Program Description:

9. When the mode of receiving and sending is selected, use the comparison command to judge whether a new message has been received; if so, then M100=OFF, and process the received data.

10. If the number received is 0, jump to Lable1 to execute the relevant program.

FUN151 CLINK	FUN151（CLINK）: MD2、MD5 Communication Connection Convenience Command （ Use PLC as a data transmission unit via Port 1 and 2 ）	FUN151 CLINK
Example	Use Port2 to return the data received by this PLC to the host that sent the data	

Ladder Program Example N005 ~ N007:

```
N005                                                      103.BT_M
                                              EN—  Ts:      R109
                                                   Td:      R13
                                                   L :      R108

N006                                                      08.MOV
                                              EN—  S :      R108
                                                   D :      R12


                                              EN—  RST      R108

N007        65
            LBL      1
```

Program Description:

11. When a new message has been received, copy all received data to the response register.

   - R108 is the length of received data.

   - After R109 is data received.

   - After R13 are response registers.

12. After processing the received data, fill in the length of the received data as the length of the returned data to start the response transmission.

13. Clear the received data length to 0.

14. （ Ready to receive new data ）

FUN151 CLINK	FUN151（CLINK）: MD2、MD5 Communication Connection Convenience Command （ Use PLC as a data transmission unit via Port 1 and 2 ）	FUN151 CLINK

FUN151: Description of MD2 operand SR

SR: The initial register of the data transmission form.

SR+0	Receive only / receive then transfer	• **Low Byte** is valid. = **00H**, only receive messages (receive only if there is no communication error), and do not respond. = **01H**, receive the message (received only if there is no communication error), and then send out Respond to the message. = **80H**, only receive messages (whether there is a communication error or not), and do not respond. = **81H**, receive messages (receive with or without communication errors), and then send out Respond to the message.
SR+1	Receive start / end code	• **High Byte**: Describe the start code of reception. **Low Byte** : Describe the end code of receiving.
SR+2	Response data length	• The length of the data received and transmitted, the maximum is 1024; when the data length is not equal to zero, start to transmit.
SR+3	**MD2**: Data **1** **MD5**: Data **2** and **1**	• **MD2**: Low Byte is valid; **MD5**: High Byte and Low Byte are valid.
SR+4	**MD2**: Data2 **MD5**: Data **4** and **3**	• **MD2**: Low Byte is valid; **MD5**: High Byte and Low Byte are valid.
	⋮	
	MD2: Data **N** **MD5**: Data **N** and **N-1**	• **MD2**: Low Byte is valid; **MD5**: High Byte and Low Byte are valid.

FUN151 CLINK	FUN151（CLINK）: MD2、MD5 Communication Connection Convenience Command （ Use PLC as a data transmission unit via Port 1 and 2 ）	FUN151 CLINK

Note:

1. When the receive-only mode is selected, after the CPU receives a complete message, it will fill the received data into the receiving register and set the receiving length (the sum of WR+8 and the length of the subsequent register), and immediately start receiving the next message.

2. When the receive-then-transmit mode is selected, after the CPU receives a complete message, it fills the received data into the receiving register and sets the receiving length (the sum of WR+8 and the length of the subsequent register), and then begins to wait for the response. The transmission starts when the data length (SR+2) is not equal to zero (so choose this mode, when the response data has not yet filled the response register, the response data length must be controlled to be zero; wait for the response data to fill the response register, then the response data length can be set).

3. Before starting to receive, the start code and end code of the received message must be filled into the receive start/end code register (for example, SR+1=0A0DH, 0AH represents the start code, 0DH represents the end code), only in this way can we ensure correct reception. The communication protocol with the start/end code can be easily used to distinguish each message, and the communication program is simple and efficient.

4. If the received message has no start code, fill the high byte of the start/end code register with 0. If the received message has no end code, fill the low byte of the start/end code register with 0.

FUN151 CLINK	FUN151 (CLINK) : MD2、MD5 Communication Connection Convenience Command (Use PLC as a data transmission unit via Port 1 and 2)	FUN151 CLINK

FUN151: Description of MD2 operator WR

High Byte   Low Byte

	High Byte	Low Byte
WR+0	Result Code	0
WR+1	Internal operation use	
WR+2	Internal operation use	
WR+3	Internal operation use	
WR+4	Internal operation use	
WR+5	Internal operation use	
WR+6	Internal operation use	
WR+7	Internal operation use	
WR+8	The total number of data received	
WR+9	MD2: Receive data **1** MD5: Receive data **2** and **1**	
.	MD2: Receive data **2** MD5: Receive data **4** and **3**	
.		
.	MD2: Receive data **N** MD5: Receive data **N** and **N-1**	

- The **result code** stores the operation result; =0, normal; other values, abnormal.
- Internal operation use; Execute the CLINK command, the register that the CPU needs to use.

- A total of several Byte data received (received data length register; the received start code and end code are included).
- **MD2**: The first Byte data received (start code if there is a start code), High Byte = 0.
  MD5: The 1st and 2nd Byte data received.
- **MD2**: For the second Byte data received, High Byte=0.
  MD5: The 3rd and 4th Byte data received.

- **MD1**: For the received Nth Byte data (end code if there is one), High Byte = 0.
  MD4: The received **N** and **N-1** Byte data.

FUN151 CLINK	FUN151（CLINK）: MD2、MD5 Communication Connection Convenience Command （ Use PLC as a data transmission unit via Port 1 and 2 ）	FUN151 CLINK

Note: When the CPU receives a complete message, it will fill the received data into the receiving register and set the receiving length, so before the Ladder program starts receiving, the receiving data length register (WR+8) can be cleared to Zero, as long as the received data length register is not zero, it means that a new message has been received; after the Ladder program reads the received data, it clears the received data length register to zero. As long as the received data length register is not zero, it means that a new message has been received, so that the receiving action can be easily processed.

Result Code:

0, the data transaction is successful.

2, The data length is wrong (the value is 0, or the transaction volume is greater than 1024).

A, Unable to respond to messages within the Time-out time (receive and transmit mode).

B, Abnormal communication (wrong data received).

10-4 Modbus RTU/ASCII Communication Protocols

Procedures for Usage
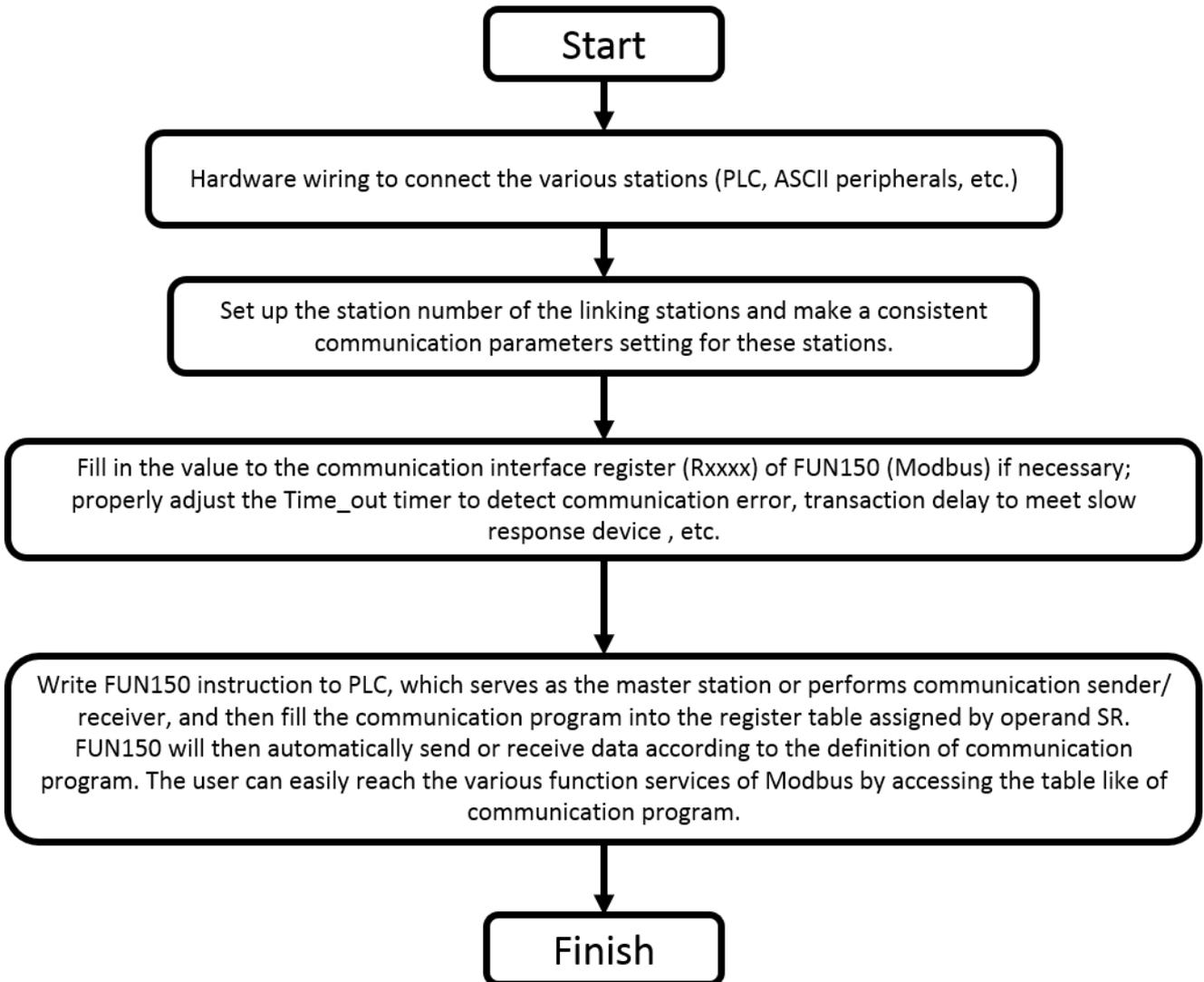
- Station number can be set to any one between 1 to 254 without replication.
- For communication parameters, please refer to the description of "Communication Related Setting".

10-4-1   Instruction description and examples

This section will instruction to explain FUN150 (Modbus) usages, with respective practical application program examples.

Convenient Instruction for Modbus RTU/ASCII Master (makes PLC as the Modbus

RTU/ASCII master through Port 1 ~ 2)

FUN150	Convenient Instruction for Modbus RTU/ASCII Master	FUN150
M-BUS	(makes PLC as the Modbus RTU/ASCII master through Port 1 ~ 2)	M-BUS
Symbol		

Ladder symbol

150.M_BUS

Execution control — EN — Pt :
ASCII/RTU — A/R — SR :
WR :
Abort — ABT —

ACT —
ERR —
DN —

Pt：1 ~ 2, specify the communication port to work as the Modbus RTU master

SR：Starting register of communication program

WR：Starting register for instruction operation. It controls 8 registers; the other programs can not repeat in using.

Range / Operand	HR	ROR	DR	K
	R0 | R34767	R43224 | R47319	D0 | D11999	
Pt				1-2
SR	○	○	○	
WR	○	○*	○	

M-Series PLC Software Function and Application User Manual

FUN150	Convenient Instruction for Modbus RTU/ASCII Master	FUN150
M-BUS	(makes PLC as the Modbus RTU/ASCII master through Port 1 ~ 2)	M-BUS

Description	

1. FUN150 (M-BUS) instruction makes PLC act as Modbus RTU/ASCII master through Port 1 ~ 2, thus it is very easy to communicate with the intelligent peripheral with Modbus RTU/ASCII protocol.

2. Only the master PLC needs to use M-BUS instruction.

3. It employs the program coding method or table filling method to plan for the data flow controls; i.e., from which one of the slave stations to get which type of data and save them to the master PLC, or from the master PLC to write which type of data to the assigned slave station. It needs only seven registries to make definition; every seven registers define one packet of data transaction.

4. When execution control ˋENˊ changes from 0→1 and the input "ABT" is 0, and if Port 1/2 hasn't been controlled by other communication instructions [i.e. M9135 (Port1), M9138 (Port2) = 1], this instruction will control the Port 1/2 immediately and set the M9135、M9138、to be 0 (which means it is being occupied), then going on a packet of data transaction immediately. If Port 1/2 has been controlled (M9135、M9138 = 0), then this instruction will enter into the standby status until the controlling communication instruction completes its transaction or pause/abort its operation to release the control right (M9135、M9138 =1), and then this instruction will become enactive, set M9135、M9138 to be 0, and going on the data transaction immediately.

5. While in transaction processing, if operation control "ABT" becomes 1, this instruction will abort this transaction immediately and release the control right (M9135、M9138 = 1). Next time, when this instruction takes over the transmission right again, it will restart from the first packet of data transaction.

6. While ˋA/Rˊ =0，Modbus RTU protocol ; ˋA/Rˊ =1，Modbus ASCII protocol.

7. While it is in the data transaction, the output indication "ACT" will be ON.

FUN150 M-BUS	Convenient Instruction for Modbus RTU/ASCII Master (makes PLC as the Modbus RTU/ASCII master through Port 1 ~ 2)	FUN150 M-BUS

8. If there is no error occurred when it finishes a packet of data transaction, the output indication "DN" will be ON.

9. If "EN" is ON, it will continue to communicate.

10.

Interface Signals

Dedicated Relays and Registers for corresponding port:

Commmnication Port ⟋ Signals	Port 1	Port 2
1. Port Ready Indicator	M9135	M9138
2. Port Finished Indicator	M9136	M9139
3. Port Communication Parameters	R35352	R35353
4. TX Delay & RX Time-out Span	R35357	R35358

11. Port Ready Indicator：This signal is generated from CPU.

ON, it represents that port is free and ready.

OFF, it represents that port is busy, data transaction is going.

12. Port Communication Parameters: The register is for communication parameters setting of corresponding port. (Please refer to the chapter of communication parameters setting).

FUN150 M-BUS	Convenient Instruction for Modbus RTU/ASCII Master (makes PLC as the Modbus RTU/ASCII master through Port 1 ~ 2)	FUN150 M-BUS

13. TX Delay & RX Time-out Span:

The content of **Low Byte** defines the receive time-out span of M-BUS instruction. The M-BUS instruction employs receive time-out span to judge whether the slave station on line or not. When the master PLC sent out the read/write command to the slave station, the slave station didn't reply within this period means that there is abnormal event in communication called Time-out. When there are multi-drop linking, properly adjust this value (greater than 1 scan time of the slave station with the longest scan time) to shorten the communication response time among the active linking stations if there are many slave stations power off (The time-out cases will happen). The content of **High Byte** defines the transmission delay time between two packets of data transaction for M-BUS instruction. For point-to-point link, this value can be set as 0 to shorten the communication transaction time and promote the communication efficiency. In the case of linking multi-drop and if the scan time of master PLC is far longer than any slave station, this value can also be set to 0 to shorten the communication transaction time and promote the communication efficiency.

14. Setting of RX Time-out Span: Please refer FUN151 MD0 for details.

15. Edge Trigger Execution: Please refer FUN151 MD0 for details.

FUN150 M-BUS	Convenient Instruction for Modbus RTU/ASCII Master (makes PLC as the Modbus RTU/ASCII master through Port 1 ~ 2)	FUN150 M-BUS
Example	Communicate with Modbus devices via Port 2	

Description

16. When execution control 〝EN〞changes from 0→1, and Port 2 is not occupied by other communication instruction (M9138 ON), M-BUS instruction will start the data transaction. according to the settings in the Modbus table, what kind of data should be read from which slave station and stored to the master station (PLC), or what kind of data should be written from the master station (PLC) to the slave station, and the data will be continuously transaction.

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FUN150 M-BUS	Convenient Instruction for Modbus RTU/ASCII Master (makes PLC as the Modbus RTU/ASCII master through Port 1 ~ 2)	FUN150 M-BUS

Editing Communication Table with UperLogic

Click the "Modbus Master" Item which in project windows: Modbus Master Table：

Project name

Table Edit
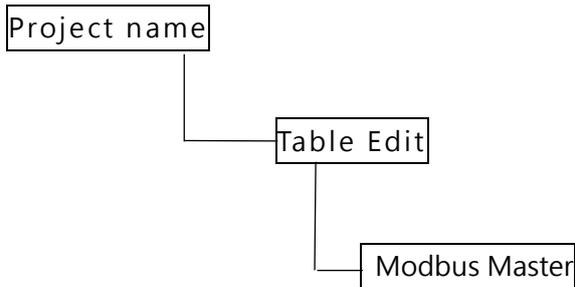
Modbus Master

→Click right button and select "Add Modbus Master Table"
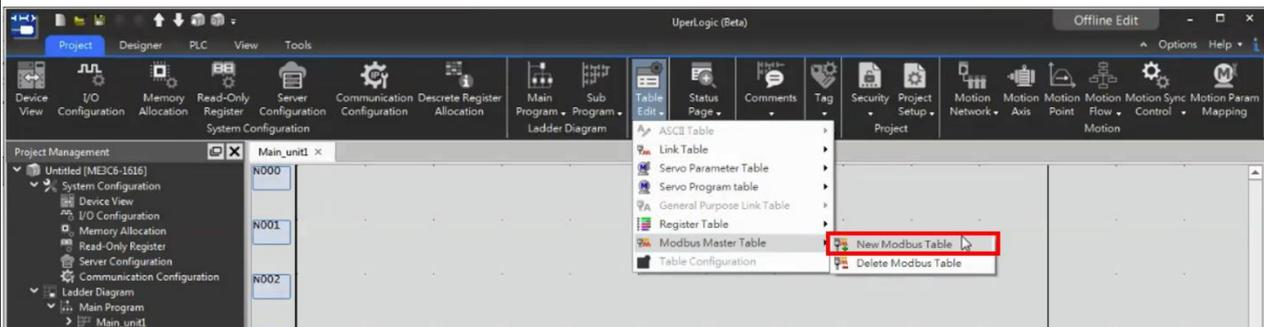
Figure 60 Adding Modbus Master Table

FUN150 M-BUS	Convenient Instruction for Modbus RTU/ASCII Master (makes PLC as the Modbus RTU/ASCII master through Port 1 ~ 2)	FUN150 M-BUS
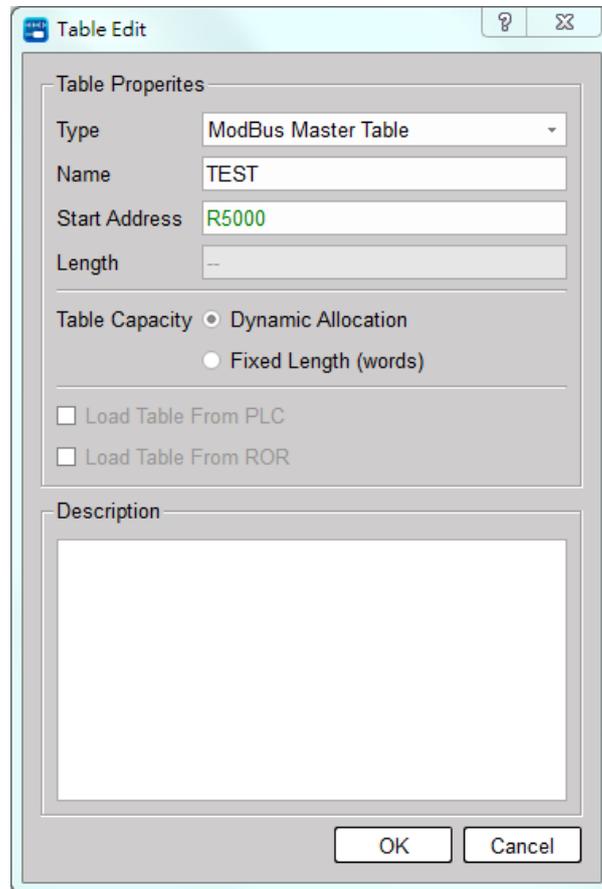
Figure 61 Editing Modbus Master Table

- Table Type: It will be fixed to "Modbus Master Table".
- Table Name: For modify or debug, you can give a convenient name.
- Table Starting Address: Enter the address which Starting register of communication Table

FUN150 M-BUS	Convenient Instruction for Modbus RTU/ASCII Master (makes PLC as the Modbus RTU/ASCII master through Port 1 ~ 2)	FUN150 M-BUS

Modbus Master Table-[TEST]

Calculator | Setup | Monitor

Commands

| Add | Insert | Copy | Delete | Move Up | Move Down |

	Command	Slave	Master Data		Slave Data	Data Size	
0	Read	2	R10	<-	400001	5	
1	Write	2	R20	->	400002	5	

Allow: 29768 words(Auto)   Used: 15 words   Position: R5000 - R5016

OK | Cancel

- Command: Read means that the master station reads the data from the Modbus slave station, and write means that the master station writes data to the Modbus slave station.

- Slave station: The station number of the slave station to be transmitted.

- Master data: read is the location where the data is read from the slave station and stored, and write is where the data is written from the master station to the slave station.

- Slave data: read is the position that the slave station wants to send back to the master station, and write is the position of writing data from the master station to the slave station.

- Length: The length to be sent.

FUN150 M-BUS	Convenient Instruction for Modbus RTU/ASCII Master (makes PLC as the Modbus RTU/ASCII master through Port 1 ~ 2)	FUN150 M-BUS

Description of FUN150 operand SR

SR : Starting register for communication program of M-BUS instruction.

| SR+0	reserve	50h	• Low Byte valid; = 50H, it means valid M-BUS program
SR+1	reserve	Total transactions	• Low Byte : Total number of transactions, one transaction needs 7 registers to describe.
SR+2	Slave station No. Which is about to transact with		• Low Byte is valid, 0 ~ 247 (0 means that master PLC broadcasts the data to all slaves, the slaves do not reply).

SR+3	Command code		• Low Byte is valid;
			  =1, means "Read data from slave station"
			  =2, means "Write multiple data to slave station"

SR+4	Data length of this transaction		• Low Byte is valid; the range is 1 ~ 125 (Reg.) or 1 ~ 255 (Discrete).
SR+5	Data type of Master PLC		• Low Byte is valid, and its range is 1 ~ 3 or 12 ~ 13; it defines the data type of master PLC (see next page).
SR+6	Starting reference of Master PLC		• Word is valid; it defines the starting address of data (master).
SR+7	Data type of slave station		• Low Byte is valid, and its range is 0 or 4; it defines the data type of slave station (see next page).
SR+8	Starting reference of Slave station		• Word is valid; it defines the starting address of data (slave).

FUN150 M-BUS	Convenient Instruction for Modbus RTU/ASCII Master (makes PLC as the Modbus RTU/ASCII master through Port 1 ~ 2)	FUN150 M-BUS

Description of FUN150 operand SR

SR+9	Slave station No. which is about to transact with	
SR+10	Command code	
SR+11	Data length of this transaction	Description of the 2_nd packet of transaction
SR+12	Data type of Master PLC	
SR+13	Starting reference of Master PLC	
SR+14	Data type of slave station	
SR+15	Starting reference of Slave station	
• • •		
SR+2+n ×7	Reserved	• N is the total number of transactions.

FUN150 M-BUS	Convenient Instruction for Modbus RTU/ASCII Master (makes PLC as the Modbus RTU/ASCII master through Port 1～2)	FUN150 M-BUS

● Data code, type and reference number of Master station (FATEK PLC)

Data code	Data type	Reference number
1	Y (Output Relay)	0～1023
2	M (Internal M Relay)	0～29599
3	S (Step Relay)	0～3103
12	R (Data Register)	0～34767
13	D (Data register)	0～11999

● Data code, type and reference number of Slave station (Modbus slave)

Data code	Data type	Reference number
0	Discrete Output	1～65535
4	Holding register	1～65535
1	Discrete Input	1～65535
3	Input Register	1～65535

Note: The master and slave data types must be the same, if the master station is Y/M/S, the slave station must be 0/1; If the master station is R/D, the slave station must be 3/4; and vice versa.

FUN150 M-BUS	Convenient Instruction for Modbus RTU/ASCII Master (makes PLC as the Modbus RTU/ASCII master through Port 1 ~ 2)	FUN150 M-BUS

Description of FUN150 operand WR

	High Byte	Low Byte	
WR+0	Result code	Transaction No.	• Result code indicates the transaction result; 0 means "Normal", other value means "Abnormal" • Transaction No. indicates which one is in processing (begins from 0).
WR+1	Station number	Command code	• Station number: the slave station No. which is in transaction. Command code: Low Byte valid
WR+2	For internal working use		=1 (read)
WR+3	For internal working use		=2 (write) =3 (write once)
WR+4	For internal working use		
WR+5	For internal working use		
WR+6	For internal working use		
WR+7	For internal working use		

Result code:
0, Transaction is successful.
2, Data length error (for length is 0 or over limit).
3, Command code error (Command code is 0 or greater than 3).
4, Data type error.
5, Reference number error.
6, Inconsistence in data type (e.g., master station is Y/M/S while slave is 4).
7, Port error (Not Port 1 ~ 4).
8, Invalid communication table.
A, No response from slave station (Time-out error).
B, Communication error (received error data or exception reply).

FUN150 M-BUS	Convenient Instruction for Modbus RTU/ASCII Master (makes PLC as the Modbus RTU/ASCII master through Port 1 ~ 2)	FUN150 M-BUS

For easier programming and troubleshooting, the WinProladder provides the table editing environment to edit the communication table of FUN150 instruction; Key in the complete FUN150 instruction first and then move the cursor to the position of it, depressing the "Z" key, now comes the table editing environment. The user can create the new communication table or display the existed table under this friendly user interface operation.

M-BUS Communication Table

Command	Slave	Data of Master	Data of Slave	Length
Read (=1) Write (=2) Write single (=3)	The station number of slave which is about to transact with Station No.=0, It means broadcasting, there will not any response from the slave Station No.=N, means the station number of slave which is about to transact with; N=1~247	The data type of Master for this transaction Y0 ~ Y1023 M0 ~ M9119 S0 ~ S3103 R0 ~ R34767 D0 ~ D11999	The data type of Slave for this transaction 000001 ~ 065535(read/write) 400001 ~ 465535(read/write) 100001 ~ 165535(read) 300001 ~ 365535(read)	Quantity of this While Register,1 ~ 125 While Discrete,1 ~ 255

FUN150 M-BUS	Convenient Instruction for Modbus RTU/ASCII Master (makes PLC as the Modbus RTU/ASCII master through Port 1 ~ 2)	FUN150 M-BUS

※UperLogic provides the user friendly table edit for M-BUS Master：

Command	Slave	Data of Master		Data of Slave	Data length
Read	1 ~ 247	Y0 ~ Y1023	← 000001 ~ 065535	1 ~ 255	
		M0 ~ M9119	← 000001 ~ 065535	1 ~ 255	
		S0 ~ S3103	← 000001 ~ 065535	1 ~ 255	
		Y0 ~ Y1023	← 100001 ~ 165535	1 ~ 255	
		M0 ~ M9119	← 100001 ~ 165535	1 ~ 255	
		S0 ~ S3103	← 100001 ~ 165535	1 ~ 255	
		R0 ~ R34767	← 400001 ~ 465535	1 ~ 125	
		D0 ~ D11999	← 400001 ~ 465535	1 ~ 125	
		R0 ~ R34767	← 300001 ~ 365535	1 ~ 125	
		D0 ~ D11999	← 300001 ~ 365535	1 ~ 125	
Write	0 ~ 247	Y0 ~ Y1023	→ 000001 ~ 065535	1 ~ 255	
		M0 ~ M9119	→ 000001 ~ 065535	1 ~ 255	
		S0 ~ S3103	→ 000001 ~ 065535	1 ~ 255	
		R0 ~ R34767	→ 400001 ~ 465535	1 ~ 125	
		D0 ~ D11999	→ 400001 ~ 465535	1 ~ 125	

10-4-2 Address mapping between Modbus and FATEK

Modbus Slave	Address mapping between Modbus and FATEK (PLC works as the slave station of Modbus Communication Protocols through Port 1, Port 2)	Modbus Slave
	• M-Series PLC can use FUN150 to be Modbus protocol Master, besides it also can be Modbus communication Slave by configuration (Port1 ~ Port2, but Port0 fixed to FATEK communication protocol) then it can connect with the intelligent peripheral.	

◆ Set up the connection with the M PLC

◆ Method 1: In the "PLC Setting" of the "PLC" tab of the UperLogic software, select the Port to be modified, such as "Port2 Parameter", as shown in the figure below.
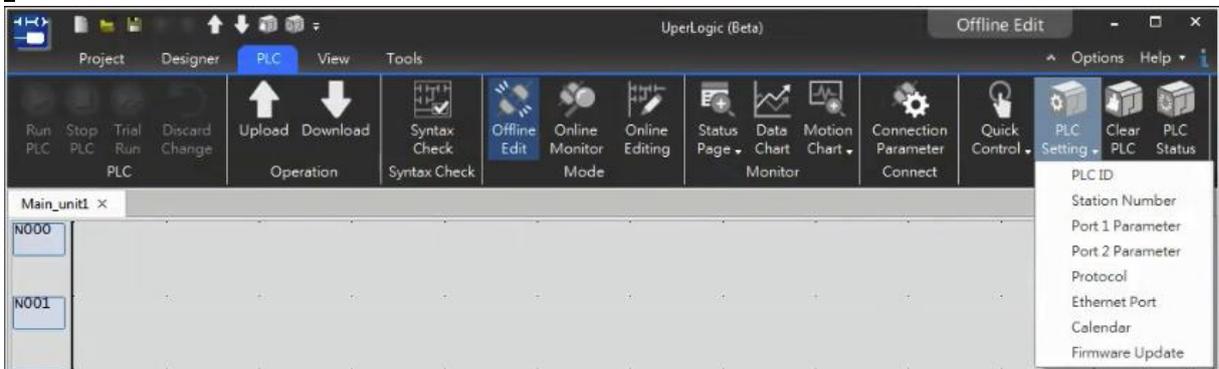
◆ Click "Serial Configuration – Port2"
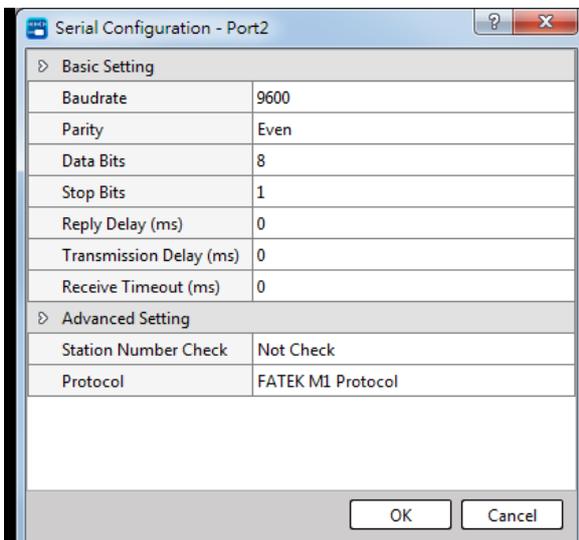
Modbus Slave	Address mapping between Modbus and FATEK (PLC works as the slave station of Modbus Communication Protocols through Port 1, Port 2)	Modbus Slave

◆ Change the "Protocol" to "Modbus RTU (Slave)" or "Modbus ASCII (Slave)" and press OK.
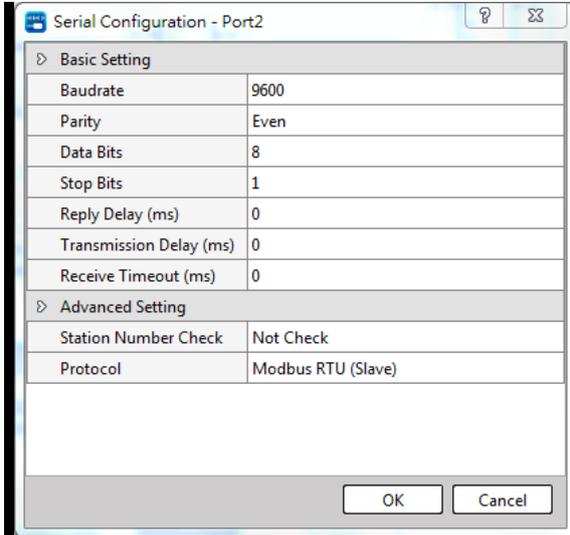
◆ setting is successful.
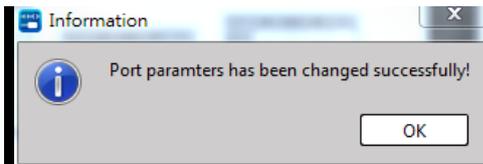
◆ Method 2: In the "PLC Setting" of the "PLC" tab of the UperLogic software, select "Communication Protocol", as shown in the figure below.
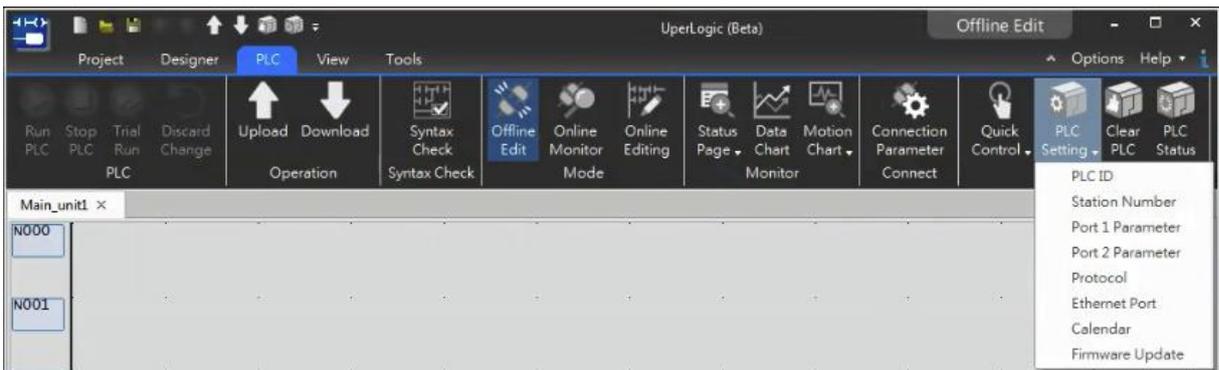
M-Series PLC Software Function and Application User Manual

Modbus Slave	Address mapping between Modbus and FATEK (PLC works as the slave station of Modbus Communication Protocols through Port 1, Port 2)		Modbus Slave

◆ Click "Protocol"

◆ Change the "Protocol" to "Modbus RTU (Slave)" or "Modbus ASCII (Slave)" and press OK.

◆ setting is successful.
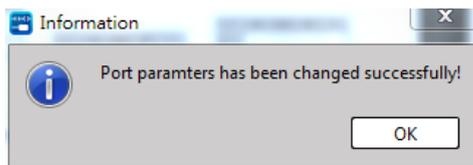
See below for Modbus and FATEK data address mapping rules:

Mapping Rule

Modbus		FATEK
5 Code	0XXXX	Discrete elements of Ynnnn、Xnnnn、Mnnnnn、Snnnn、Tnnnn、Cnnnn
	4XXXX	Data Registers of Rnnnnn、Dnnnn、Tnnnn、Cnnnn
6 Code	00XXXX	Discrete elements of Ynnnn、Xnnnn、Mnnnnn、Snnnn、Tnnnn、Cnnnn
	40XXXX	Data Registers of Rnnnn、Dnnnn、Tnnn、Cnnn

Modbus Slave	Address mapping between Modbus and FATEK (PLC works as the slave station of Modbus Communication Protocols through Port 1, Port 2)	Modbus Slave

- The range of Modbus slave address conversion can be planned by the designer through the software in "Communication Configuration".

◆ In the UperLogic software "Project" tab, click "Communication Configuration"

◆ "Modbus Device Allocation" as shown below.

M-Series PLC Software Function and Application User Manual

Modbus Slave	Address mapping between Modbus and FATEK (PLC works as the slave station of Modbus Communication Protocols through Port 1, Port 2)	Modbus Slave

◆ Designer can adjust the range of PLC and Modbus to be converted, or the starting address, etc.

◆ Table options are explained below.

- Items: Including contact settings, such as I/O contacts (X / Y), internal relays (M), etc., and register settings, such as registers (R / D), etc.

- Address: It refers to the address of the PLC. For example, input 0 in the internal relay [M], it means that M0 corresponds to the address specified by Modbus. As shown in the figure above, M0 corresponds to the address of Modbus 20001.

- Modbus address: refers to the address of the corresponding Modbus.

- Totals: It is the length of the total conversion starting from the starting address.

- Usage: When the starting address and total number are set, the software will display the total converted addresses, so that the designer can know the usage status more clearly.

- Default: After clicking, the setting value will return to the default state.

Modbus Slave	Modbus Communication Protocols		Modbus Slave

- When the PLC communication port works in the Modbus slave communication mode, in addition to adjusting the range to be converted between PLC and Modbus, or the initial address, etc. through the table; you can also adjust the corresponding access method through the PLC register; it is not in the setting range for data access, PLC will respond with a communication error.

Register No.	Value	Description
M9162	= ON	New address mapping for Modbus slave communication protocol (Detailed as below)
	= OFF	Existed address mapping for Modbus slave comm protocol
R35402	0 ~ 1023	• Assign the starting address of Y output relay of FATEK • 0 ~ 1023: Means Y output relay Y0 ~ Y1023
R35403	0 ~ 65535	• Assign the starting address of discrete output of Modbus • 0 ~ 65535: Means discrete output 000001 ~ 065536
R35404	1 ~ 1023	• Assign the range of access both for Modbus contact output and Y output of FATEK. • 1 ~ 1023: Means access range between 1 ~ 1023 point • R35402 and R35403 are used to specify the access range of Modbus contact output corresponding to FATEK's Y output relay. (M9162 must be ON for a pulse)

Modbus Slave	Modbus Communication Protocols	Modbus Slave

Register No.	Value	Description
R35405	0 ~ 1023	• Assign the starting address of X input relay of FATEK. • 0 ~ 1023: Means X input relay X0 ~ X1023
R35406	0 ~ 65535	• Assign the starting address of Modbus contact output (Coil) • 0 ~ 65535: Means contact output number 000001 ~ 065536
R35407	1 ~ 1023	• Assign the range of access both for Modbus contact output and X input of FATEK. • 1 ~ 1023: Means access range between 1 ~ 1023 point • R35405 and R35406 are used to specify the access range of Modbus contact output corresponding to X input relay of FATEK. (M9162 must be ON for a pulse)
R35408	0 ~ 9119	• Assign the starting address of M internal relay of FATEK • 0 ~ 9119: Means M internal relay M0 ~ M9119
R35409	0 ~ 65535	• Assign the starting address of Modbus contact output (Coil) • 0 ~ 65535: Means contact output number 000001 ~ 065536

Modbus Slave	Modbus Communication Protocols	Modbus Slave

Register No.	Value	Description
R35410	1 ~ 9119	• Assign the range of access both for Modbus contact output and M internal relay of FATEK. • 1 ~ 9119: Means access range between 1 ~ 9119 point • R35408 and R35409 are used to specify the access range of Modbus contact output corresponding to M internal relay of FATEK. (M9162 must be ON for a pulse).
R35411	0 ~ 3103	• Assign the starting address of stepper relay of FATEK. • 0 ~ 3103: Means stepper relay S0 ~ S3103
R35412	0 ~ 65535	• Assign the starting address of Modbus contact output (Coil) • 0 ~ 65535: Means contact output number 000001 ~ 065536
R35413	1 ~ 9119	• Assign the range of access both for Modbus contact output and Stepper relay of FATEK. • 1 ~ 3103: Means access range between 1 ~ 3103 point • R35411 and R35412 are used to specify the access range of Modbus contact output corresponding to M internal relay of FATEK. (M9162 must be ON for a pulse).
R35414	0 ~ 1023	• Assign the starting address of Timer relay of FATEK. • 0 ~ 1023: Means Timer relay T0 ~ T1023

Modbus Slave	Modbus Communication Protocols	Modbus Slave

Register No.	Value	Description
R35415	0 ~ 65535	• Assign the starting address of Modbus contact output (Coil) • 0 ~ 65535: Means contact output number 000001 ~ 065536
R35416	1 ~ 1023	• Assign the range of access both for Modbus contact output and T Timer relay of FATEK. • 1 ~ 1023: Means access range between 1 ~ 1023 point • R35414 and R35415 are used to specify the access range of Modbus contact output corresponding to T Timer relay of FATEK. (M9162 must be ON for a pulse).
R35417	0 ~ 1023	• Assign the starting address of C Counter relay of FATEK. • 0 ~ 1023: Means C Counter relay C0 ~ C1023
R35418	0 ~ 65535	• Assign the starting address of Modbus contact output (Coil) • 0 ~ 65535: Means contact output number 000001 ~ 065536
R35419	1 ~ 1023	• Assign the range of access both for Modbus contact output and C Counter relay of FATEK. • 1 ~ 1023: Means access range between 1 ~ 1023 point • R35417 and R35418 are used to specify the access range of Modbus contact output corresponding to C Counter relay of FATEK. (M9162 must be ON for a pulse).

Modbus Slave	Modbus Communication Protocols	Modbus Slave

Register No.	Value	Description
R35420	0 ~ 34767	• Assign the starting address of R registers of FATEK. • 0 ~ 34767: Means R registers R0 ~ R34767
R35421	0 ~ 65535	• Assign the starting address of Modbus registers • 0 ~ 65535: Means Modbus registers number 400001~465536
R35422	1 ~ 34767	• Assign the range of access both for Modbus contact output and R registers of FATEK. • 1 ~ 34767: Means access range between 1 ~ 34767 point • R35420 and R35421 are used to specify the access range of Modbus contact output corresponding to D registers of FATEK. (M9162 must be ON for a pulse).
R35423	0 ~ 11999	• Assign the starting address of D registers of FATEK. • 0 ~ 11999: Means D registers D0 ~ D11999
R35424	0 ~ 65535	• Assign the starting address of Modbus registers • 0 ~ 65535: Means Modbus registers number 400001~465536

Modbus Slave	Modbus Communication Protocols	Modbus Slave

Register No.	Value	Description
R35425	1 ~ 11999	• Assign the range of access both for Modbus contact output and D registers of FATEK. • 1 ~ 11999: Means access range between 1 ~ 11999 point • R35423 and R35424 are used to specify the access range of Modbus contact output corresponding to D registers of FATEK. (M9162 must be ON for a pulse).
R35426	0 ~ 1023	• Assign the starting address of T Timer registers of FATEK. • 0 ~ 1023: Means T Timer registers T0 ~ T1023
R35427	0 ~ 65535	• Assign the starting address of Modbus registers • 0 ~ 65535: Means Modbus registers number 400001~465536
R35428	1 ~ 1023	• Assign the range of access both for Modbus contact output and T Timer registers of FATEK. • 1 ~ 1023: Means access range between 1 ~ 1023 point • R35426 and R35427 are used to specify the access range of Modbus contact output corresponding to T Timer registers of FATEK. (M9162 must be ON for a pulse).

Modbus Slave	Modbus Communication Protocols	Modbus Slave

Register No.	Value	Description
R35429	0 ~ 1023	• Assign the starting address of C Counter relay of FATEK. • 0 ~ 1023: Means C Counter relay C0 ~ C1023
R35430	0 ~ 65535	• Assign the starting address of Modbus registers • 0 ~ 65535: Means Modbus registers number 400001~465536
R35431	1 ~ 1023	• Assign the range of access both for Modbus contact output and C Counter registers of FATEK. • 1 ~ 1023: Means access range between 1 ~ 1023 registers • R35429 and R35430 are used to specify the access range of Modbus registers corresponding to C Counter registers of FATEK. (M9162 must be ON for a pulse).
R35432	0 ~ 1023	• Assign the starting address of C Counter relay (32 bit) of FATEK. • 1024 ~ 1279: Means C Counter relay (32 bit) C1024 ~ C1279
R35433	0 ~ 65535	• Assign the starting address of Modbus registers • 0 ~ 65535: Means Modbus registers number 400001~465536

Modbus Slave	Modbus Communication Protocols		Modbus Slave

Register No.	Value	Description
R35434	1024 ~ 1279	• Assign the range of access both for Modbus contact output and C Counter registers (32 bit) of FATEK. • 1~256: Means access range between 1 ~ 256 registers • R35432 and R35432 are used to specify the access range of Modbus registers correspond to C Counter registers (32-bit) of FATEK. (M9162 must be ON for a pulse).

For example, after the settings of R35402 ~ R35434 are completed, M9162 is turned ON for a pulse, which means that the corresponding access mode is adjusted through the PLC register method.

● R35409=0, R35408=1000, R3971=100：

Mapping 000001 ~ 000100(Modbus) ＞ M1000~M1099(FATEK)

● R35421=0，R35420=2000，R3980=200：

Mapping 400001 ~ 400200(Modbus) ＞ R2000~R2219(FATEK)。

11

Ethernet Function
and Ethernet Communication

M-Series PLC Software Function and Application User Manual

M-Series PLC is designed with an Ethernet communication port. Such port provides a number of Ethernet functions for the user to combine with network-related equipment or applications, such as combining with IoT application.

Functional specifications

Meet the IEEE802.3 standard and provide 10/100 Base T interface.

Basic purpose

Provide the UperLogic for using FATEK on PC in order to realize communication with the Ethernet communication port of M-Series PLC through the Ethernet, including the project online uploading and downloading as well as PLC data online monitoring, etc.

It can also be connected with the Ethernet interface mounted FATEK communication drive program device or with the Modbus drive program related UperLogic, HMI and graphical control devices, etc.

Derivative purpose

In addition to the aforesaid functions, this product also provides the following functions and they will be described in the subsequent paragraphs.

-   NTP (Network Time Protocol) time synchronization. Through the appointed NTP server address, it allows the designed to run the time synchronization through the network.

-   MQTT publishing/subscription functions, allowing more efficient remote monitoring and data swapping through the IoT.

-   Modbus TCP master/slave communication protocol function. Through the Ethernet, the user may communicate with the device provided for supporting the Modbus protocol.

11-1 Setting the Network Interface

Default parameter of network interface

Address	Content
IP Address	192.168.2.4
Sub-net Mask	255.255.255.0
Gateway Preset	192.168.2.1
DNS Primary Address	1.1.1.1
DNSS Secondary Address	8.8.8.8

Setting network interface through software:

1. Open UperLogic software and then set up the connection between PC and PLC. Click "Connection Parameter" in PLC tag.

2.
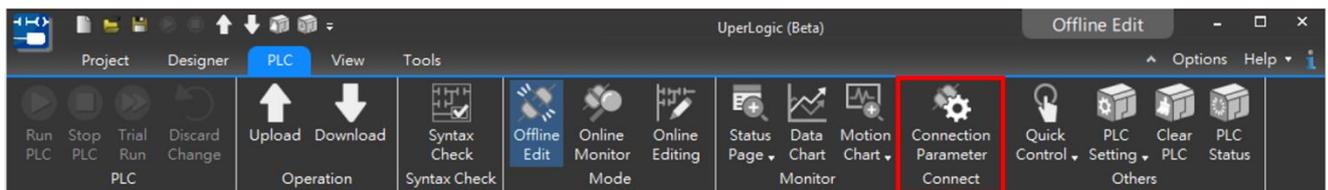
Figure 63 "Connection Parameter" under PLC tag

3. Select the USB type that will be connected.

4. Connection test: Check if the connection is normal while displaying the required information such as the connected model and firmware version, etc.

5.
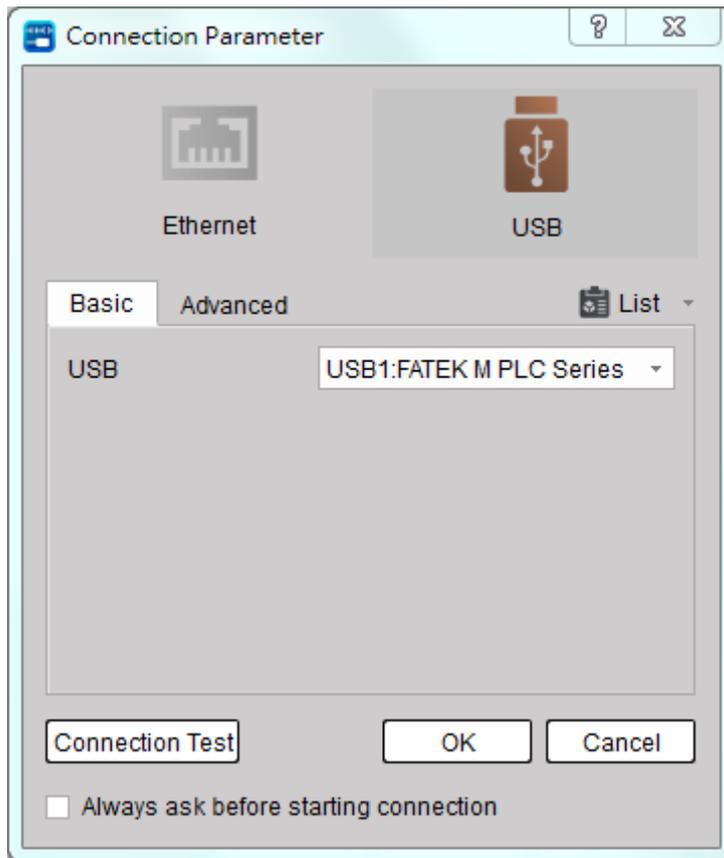
Figure 64 Connection Parameter
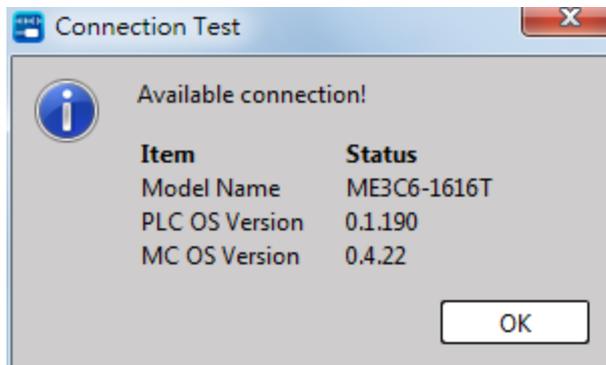
Figure 65 Connection Test

6. Click "Ethernet Configuration" and the Ethernet setup window will appear. At this time, you may start setting the PLC IP address, sub-net mask, gateway preset and DNS service as well as selecting the need of using the DHCP function. You also can set up the primary and secondary ports of FATEK and Modbus TCP communication protocols.

7.
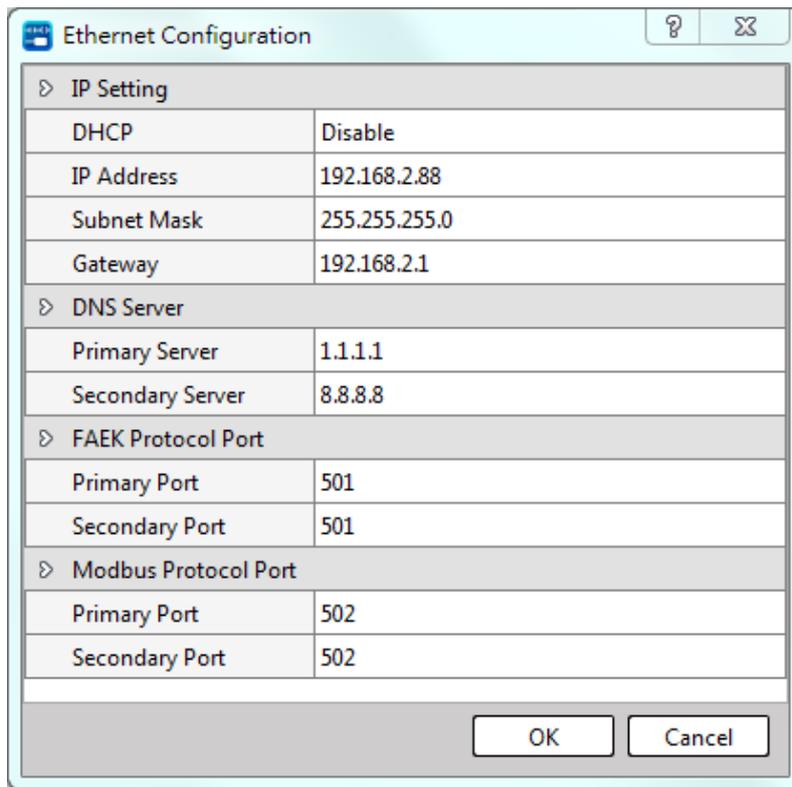
Figure 66 Setting of Ethernet

8.   Click "OK" and then the system will start writing in the PLC.

The network interface setting through the registers:

Special Register No.	Description
R35382	Host IP address OCT1 (Leading)
R35383	Host IP address OCT2
R35384	Host IP address OCT3
R35385	Host IP address OCT4

Special Register No.	Description
R35386	Host Sub-net Mask OCT1 (Leading)
R35387	Host Sub-net Mask OCT2
R35388	Host Sub-net Mask OCT3
R35389	Host Sub-net Mask OCT4
R35390	Host Router OCT1 (Leading)
R35391	Host Router OCT2

R35392	Host Router OCT3
R35393	Host Router OCT4
R35394	Host Primary DNS Server OCT1 (Leading)
R35395	Host Primary DNS Server OCT2
R35396	Host Primary DNS Server OCT3
R35397	Host Primary DNS Server OCT4
R35398	Host Secondary DNS Server OCT1 (Leading)
R35399	Host Secondary DNS Server OCT2
R35400	Host Secondary DNS Server OCT3
R35401	Host Secondary DNS Server OCT4

Special Contact No.	Description
M9164	Network interface restarting
M9165	DHCP enable

Special Register No.	Description
R35481	FATEK M1Communication Protocols Port
R35482	Modbus TCP Communication Protocols Port

When using the register to set up the Ethernet IP address, please execute the following procedure:

To set the IP address of the PLC as "192.168.0.152":

1. If the IP address of the original Ethernet of the host is "192.168.0.150", check the value of special registers R35382–R35385 on the monitoring page, i.e., R35382=192, R35383=168, R35384=0 and R35385=150, as per below.

2.

Name	Status	Data	Comment	Name	Status	Data	Comment	Name	Status	Data	Comment
M9129	ENABLE	OFF	1s cycle pulse	R100	DEC	0	[R100]				
R35382	DEC	0	Host IP address OCT1	R35394	DEC	0	Primary DNS Server OCT1	M9164	ENABLE	OFF	Network interface restarting
R35383	DEC	0	Host IP address OCT2	R35395	DEC	0	Primary DNS Server OCT2	M9165	ENABLE	OFF	DHCP enable
R35384	DEC	0	Host IP address OCT3	R35396	DEC	0	Primary DNS Server OCT3				
R35385	DEC	0	Host IP address OCT4	R35397	DEC	0	Primary DNS Server OCT4				
R35386	DEC	0	Sub-net Mask OCT1	R35398	DEC	0	Secondary DNS Server OCT1				
R35387	DEC	0	Sub-net Mask OCT2	R35399	DEC	0	Secondary DNS Server OCT2				
R35388	DEC	0	Sub-net Mask OCT3	R35400	DEC	0	Secondary DNS Server OCT3				
R35389	DEC	0	Sub-net Mask OCT4	R35401	DEC	0	Secondary DNS Server OCT4				
R35390	DEC	0	Host Router OCT1								
R35391	DEC	0	Host Router OCT2								
R35392	DEC	0	Host Router OCT3								
R35393	DEC	0	Host Router OCT4								

Figure 70 Values of R25382~R35383 special registers on status page

3. Change the values of R35382–R35385 special registers as follows:

R35382=192, R35383=18, R35384=0 and R35385=152, as per the figure below.

Name	Status	Data	Comment	Name	Status	Data	Comment	Name	Status	Data	Comment
M9129	ENABLE	OFF	[M9129]	R100	DEC	0	[R100]				
R35382	DEC	192	[R35382]	R35394	DEC	1	[R35394]	M9164	ENABLE	OFF	[M9164]
R35383	DEC	168	[R35383]	R35395	DEC	1	[R35395]	M9165	ENABLE	ON	[M9165]
R35384	DEC	2	[R35384]	R35396	DEC	1	[R35396]				
R35385	DEC	88	[R35385]	R35397	DEC	1	[R35397]				
R35386	DEC	255	[R35386]	R35398	DEC	8	[R35398]				
R35387	DEC	255	[R35387]	R35399	DEC	8	[R35399]				
R35388	DEC	255	[R35388]	R35400	DEC	8	[R35400]				
R35389	DEC	0	[R35389]	R35401	DEC	8	[R35401]				
R35390	DEC	192	[R35390]								
R35391	DEC	168	[R35391]								
R35392	DEC	2	[R35392]								
R35393	DEC	1	[R35393]								

Figure 71 Modifying values of R25382~R35383 special registers

4. Run M9164 for one pulse and then write the value of special register on Ethernet in the PLC in order to establish the changed IP address. At this time, you have completed the setting of Ethernet IP address for M-PLC with the register.

5. Note: M9164 is designed in resetting type. After being set as "ON", it will be restored automatically.

11-2 FATEK Searching Protocols

When there is more than one host in the same network domain, users need a method to make it easier to maintain on hosts with different purposes. This is the purpose of the FATEK Searching Protocols. You can use the software to search for hosts in the current domain, obtain the main information of each host, and directly connect to the target host.

Execute the function of searching on network through software:

1. Open UperLogic and then click "Connection Parameter" in PLC tag.
2.
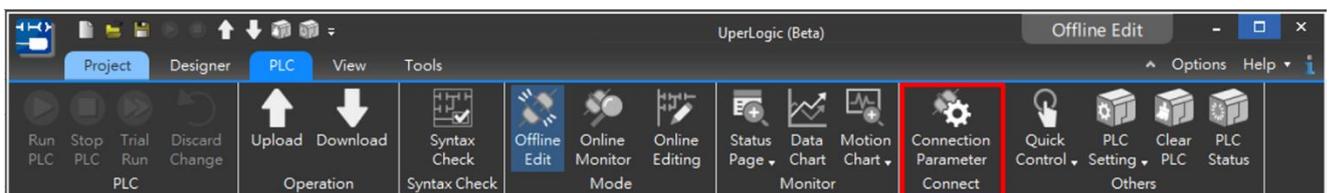
Figure 72 "Connection Parameter" in PLC tag

3. Click "Ethernet" in "Connection Parameter".
4.
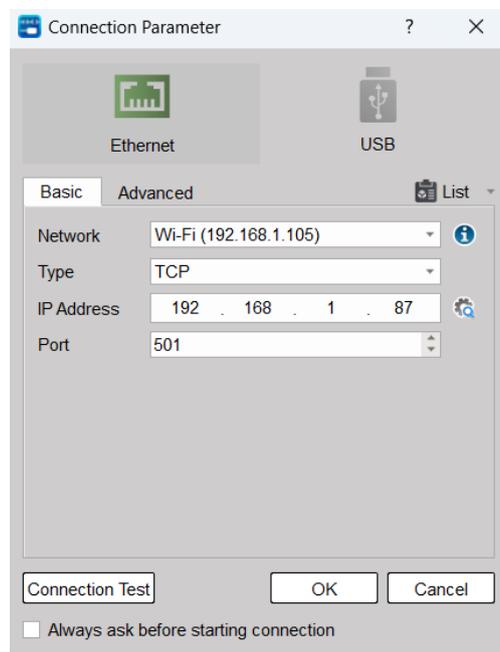
Figure 73 Click "Ethernet"

5. Click "Search".
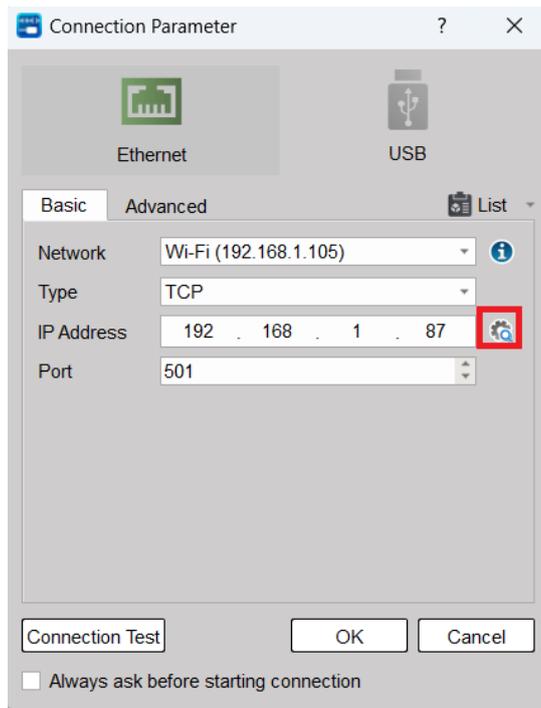
Figure 74 Network searching

6. Click "Scan", and the hosts in the same domain that support the FATEK searching protocol will appear, and their IP (name), MAC address, and mode information will be displayed.
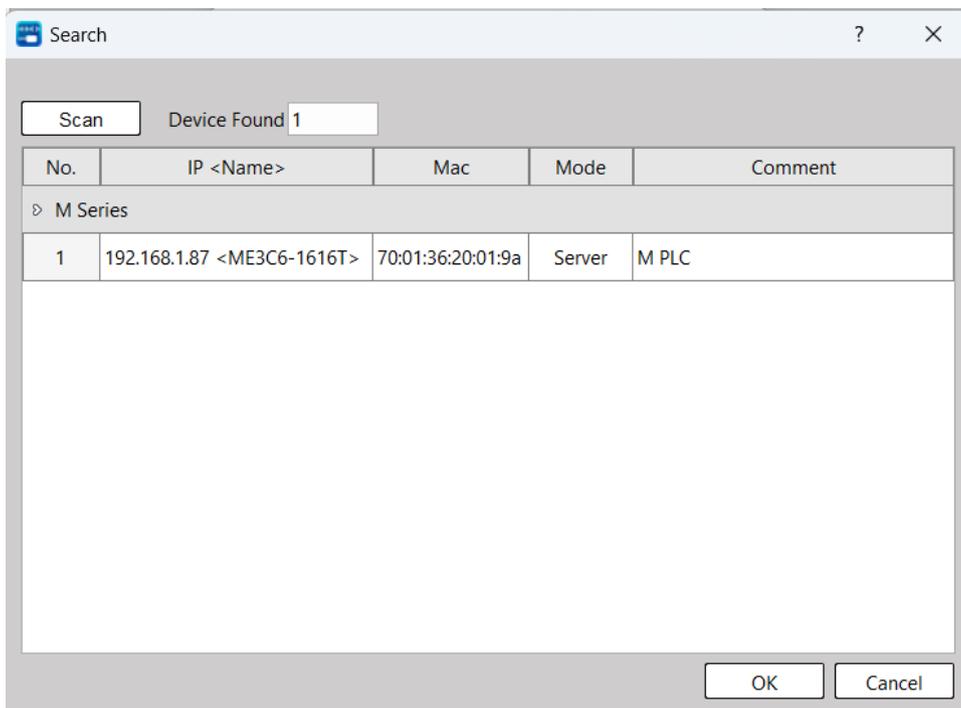
Figure 75 Click "Scan"

7. To connect with the PLC of other unit, click the PLC of that unit and then press "OK" and the connection parameter will be set as the IP address of the respective PLC automatically.

8.
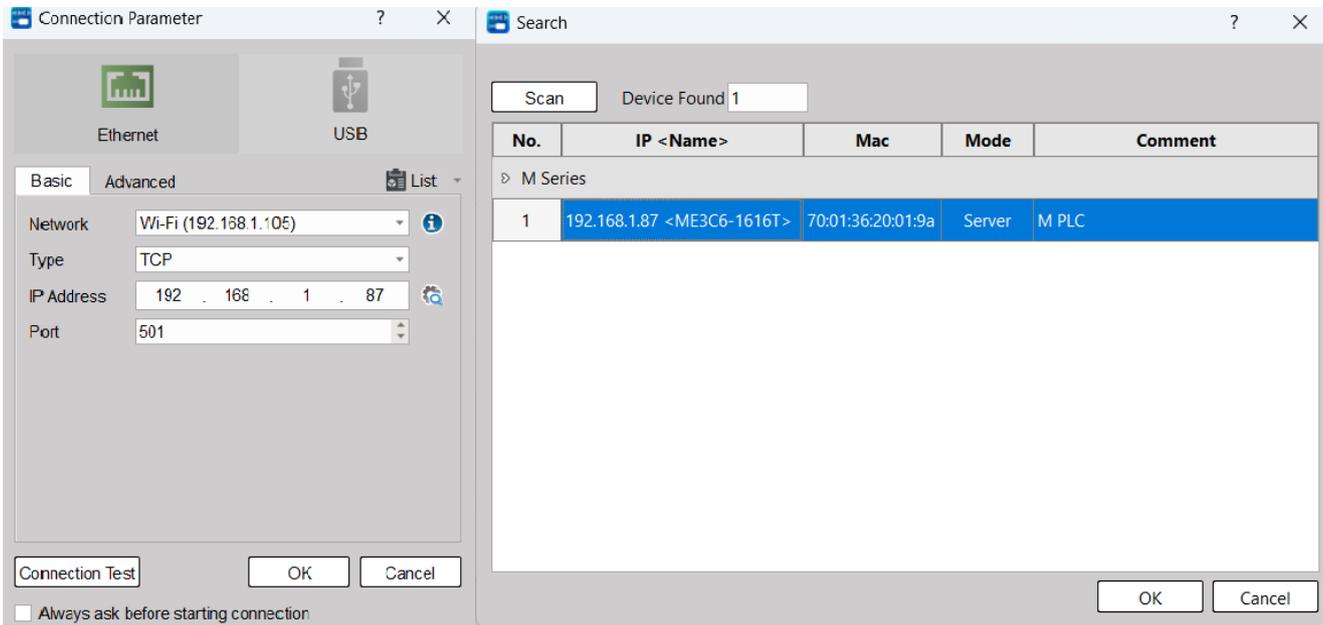
Figure 77 Host connection

11-3 NTP Time Synchronization

The purpose of NTP time synchronization function is to avoid the trouble of manual time calibration regularly for the PLC to execute the time synchronization through the network and the appointed server in order to achieve more efficient time calibration and synchronization for the equipment.

Setting and description of NTP time synchronization function:

1. Open UperLogic and click the "Server Configuration" in "Project" tag or click "Server Configuration" in "Project management".

2.
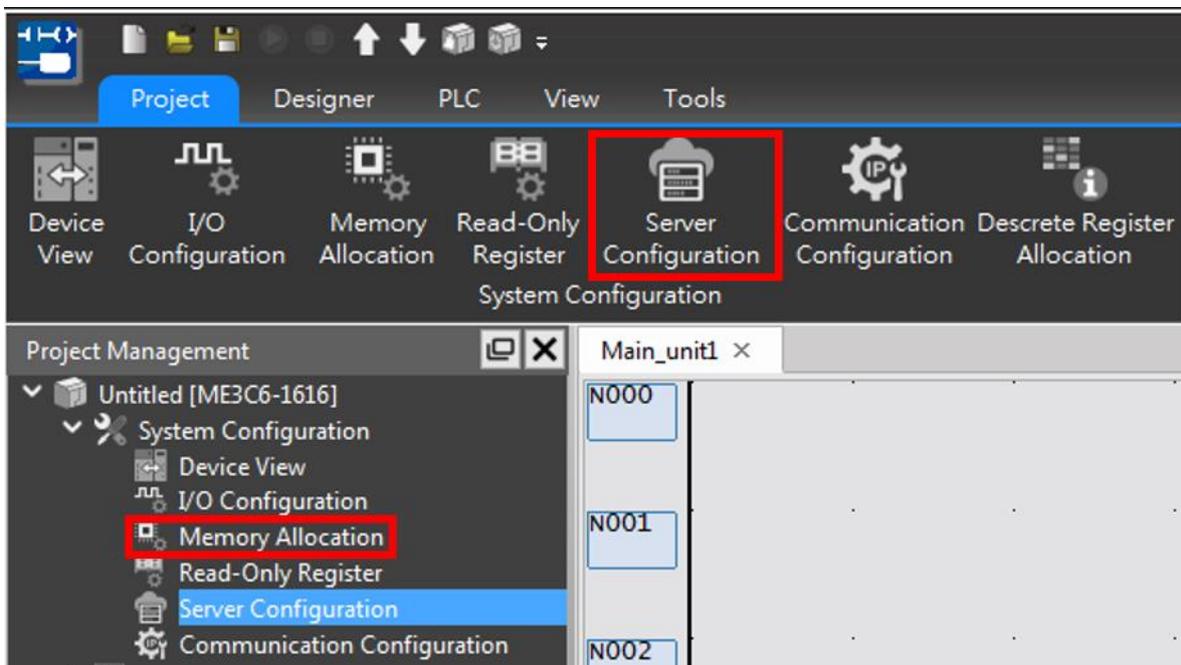
Figure 78 Click "Server Configuration" in "Project".

3.   After that, the system will show the "Server Configuration" dialogue window as per below:
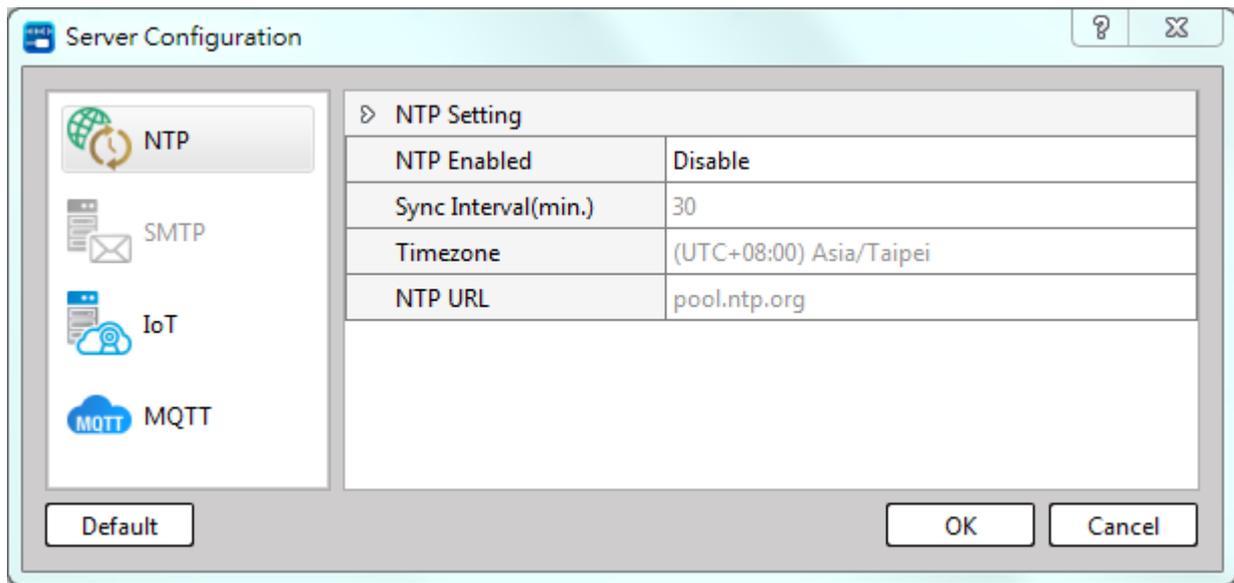
Figure 79 Server setting

4.   Click the left-side "NTP" function option and the right-side is the function setting.

5.   Select the "NTP Enabled" option as "Enable" and then set "Sync Interval", "Timezone" and "NTP URL". Finally, download the project to PLC to complete the setting process.

6.   If the PLC network maintains normal communication after downloading the project to PLC, the system will execute the first round of time synchronization and then follow the programmed synchronization interval. If the PLC network is operating unstably from the very beginning, then it will execute the synchronization during the next round of synchronization interval.

Option	Description
NTP Enabled	Click the NTP time synchronization function to see if it is enabled.
Sync Interval	To set the synchronous time; the unit will be expressed in minutes.
Timezone	Set according to the time zone where the application is located. The example shown is Taipei GMT+08:00 and it means that the time zone in Taipei will be GMT+8 hours.
NTP URL	The website where the network time-setting server (NTP server) is installed.

Table 22 Description table of NTP setting options

11-4 Publishing/ Subscribing MQTT

The MQTT serves a kind of communication protocol designed for the IoT. Being simple and compact, it is suitable for applying in an environment where the hardware resources and the network bandwidth are restricted in order to satisfy the remote monitoring and data swapping demands.

The message transmission mechanism is designed in publishing/subscribing mode. Each individual message should be assigned with a subject name for easier identification such as temperature. The Client end is acting the publisher and subscriber role in which, the Publisher is liable for publishing the subject-affixed message and the Subscriber is playing the role of subscribing the subject. The server end serves as a Broker to receive the message from the Publisher and then transfer to the Subscriber asking for the subject.

The MQTT function triggered by the M-Series hosts can play the aforesaid 3 roles concurrently, i.e., Publisher, Subscriber and Broker. Through MQTT function, M-Series hosts will be allowed to publish the register address of the device (HMI, PLC) to the Broker on the network; in the meantime, it also connects the subject data to be subscribed by the Broker and then read and write such data in the register address. Further, the M SERIES PLC can also use the built-in Broker directly without the need of searching for another Broker tool.

This chapter will describe the MQTT related pages and setting method.
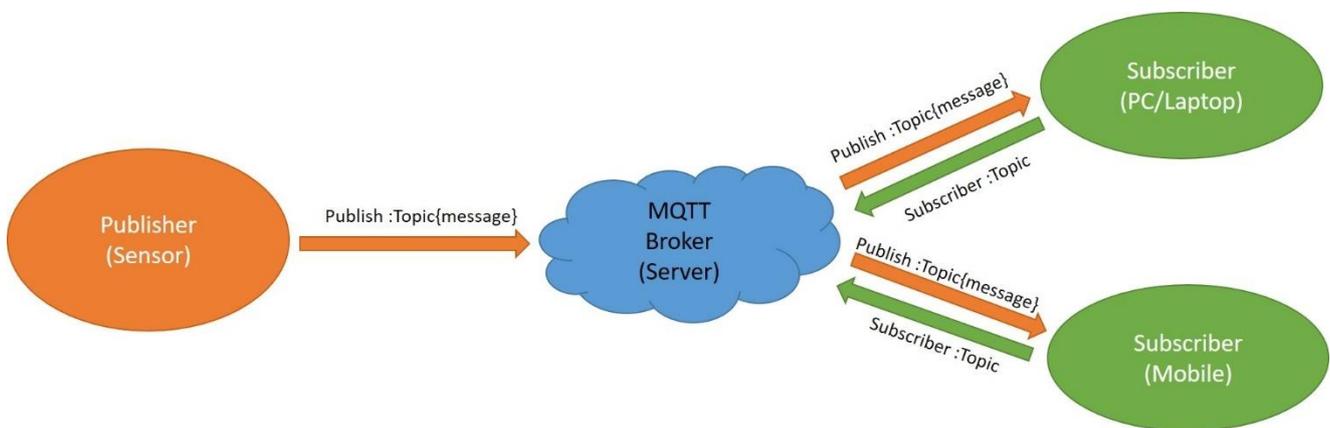
Figure 80 Schematic diagram of MQTT application

11-4-1 Server configuration

To use the MQTT function, click "MQTT" from the "Server Configuration" window in the left-side "Project" and you will be allowed to access the setup page. The "Server" page can be used to set the MQTT Server (Broker), as per the figure below:
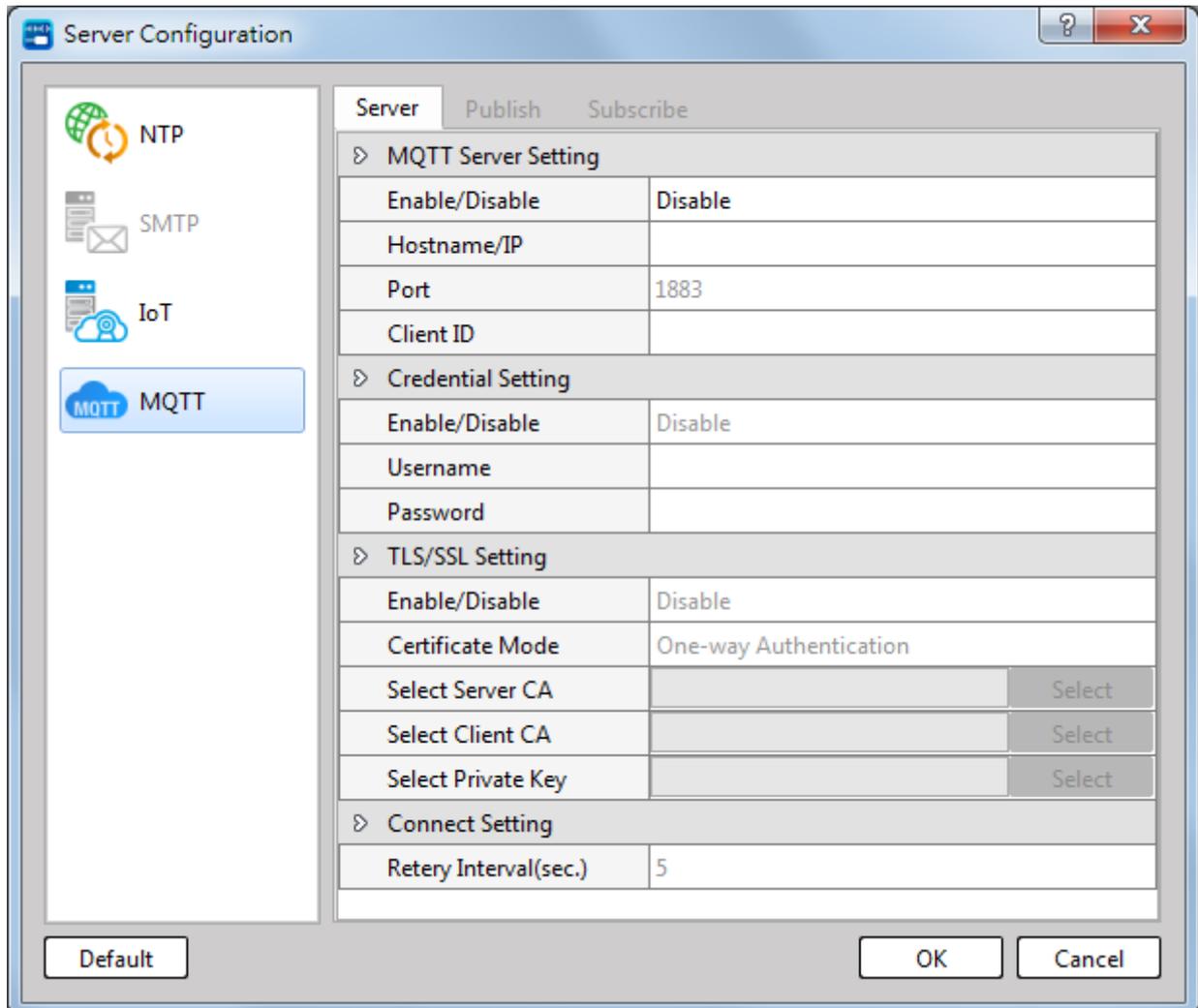
Figure 81 Setting window of MQTT Server

Column	Description
【Set MQTT server】	【Enable/ Disable】 For selecting to see if to enable "MQTT" and it is serving as the main switch of the "MQTT" function. After being enabled, you will be allowed to set the detail column and use the desired "Subject publishing" and "Subject subscribing" pages. 【Host (IP or domain name)】 To set the Broker host address, you may log in the IP or domain name and then it will be preset as "127.0.01". 【Port No.】 To set the Broker connection port. Preset as "1883". 【Client ID】 The ID specially owned by the Client. It can be set privately and you may use special code bearing "%" prefix to combine them into unique ID: %1: HMI name %2: Random code %%: Bit %
【ID verify】	【Enable/Disable】 For selecting to see if MOTT Broker ID should be used. The Broker to be connected has been set with an ID. You may input the following items here: 【User name】 Input the username appointed by the Broker. 【Password】 Input the password appointed by the Broker. After that, it will be protected with the encryption code.
【TLS/SSL】	【Enable/Disable】 For selecting to see if the TLS/SSL function of MQTT should be used 【Certification Mode】 For selecting to see if it belongs to one-way verification or two-way verification function. The Broker to be connected has been set with TLS/SSL encrypted message transmission function. You may import the certification file here.

	【Select server certificate】 When using server certification method, "import" the required certificate. 【Select Client certificate】 Use the Client certification method in order to "import" the required certificate. 【Select private key】 For selecting the private key to be used.

Table 23: Properties for setting MQTT Server page

11-4-2 Topic Publish

To use the MQTT function, click "MQTT" from the "Server Configuration" window in the left-side "Project" and then select "Enable" to show the "Topic Publish". Next, click the upper-left "Add" button to add a new subject. By clicking "Delete" button, you may delete the selected subject. By clicking "Edit" or double clicking the item in the Topic List, you may edit the selected topic. If the Topic List contains the existing items, you may click "Export" and all of the topic data will be exported for creating the specific-format CSC file. By clicking the "Import" button, you may import the specific-format CSC file for updating the topic table. In Topic List, the left-side of each topic is provided an exclusive ID and it will be used as the topic ID.
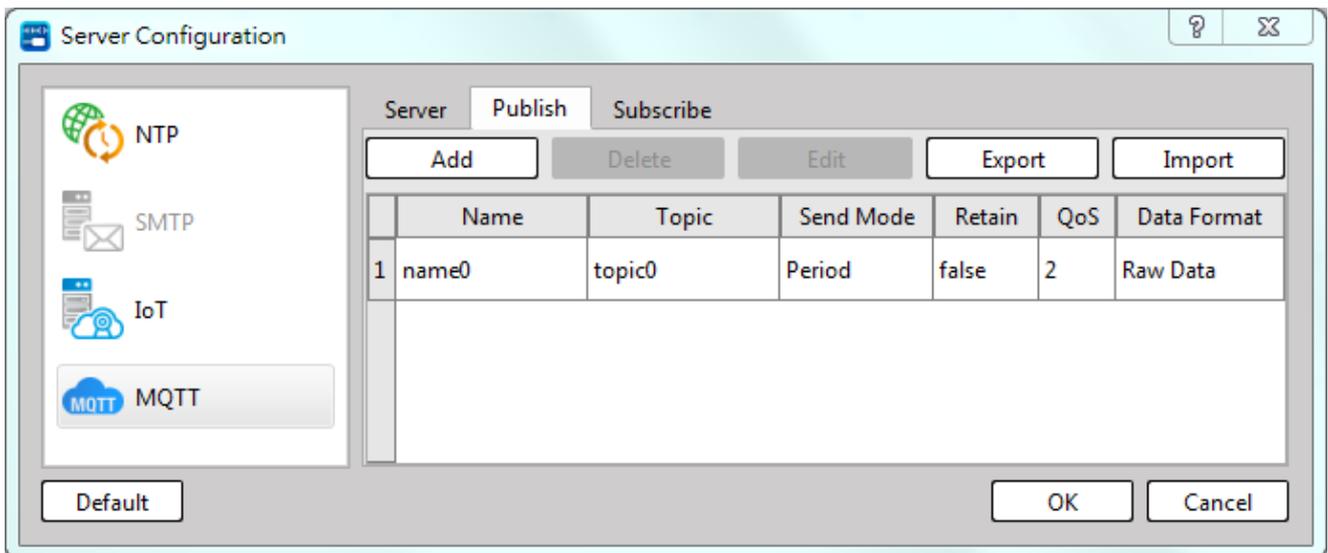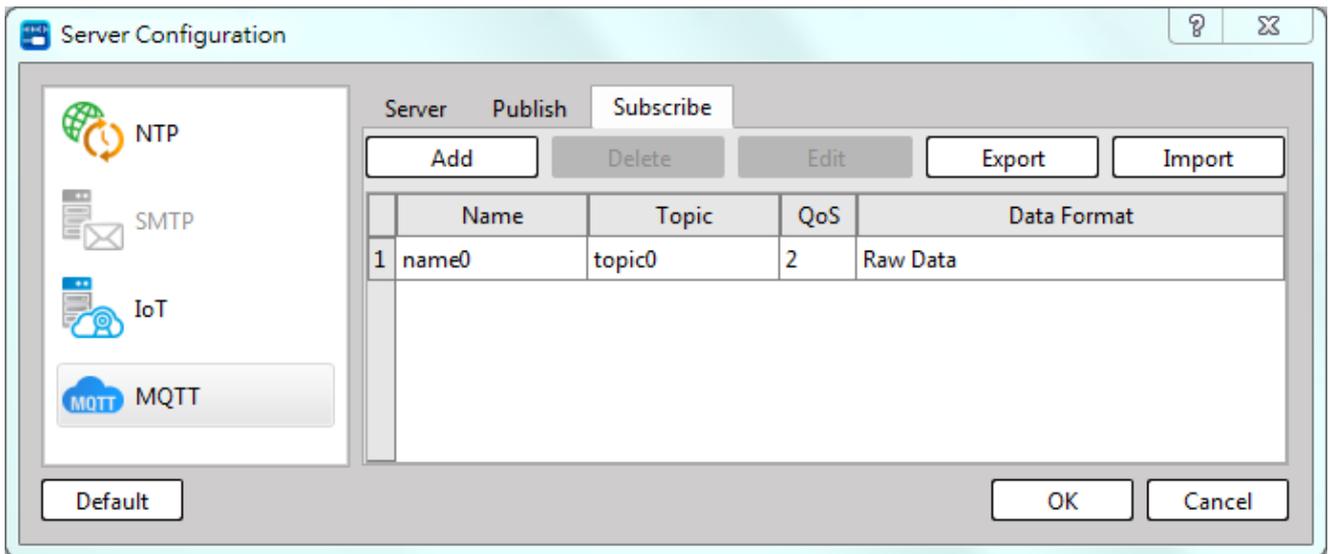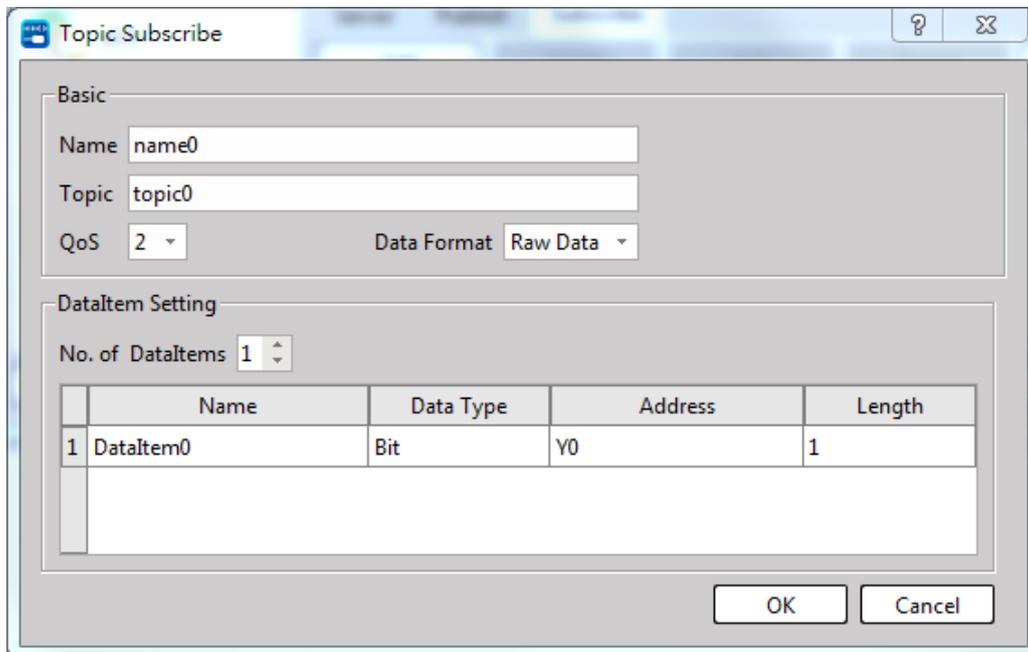
Figure 82 Topic setting of publishing MQTT topics
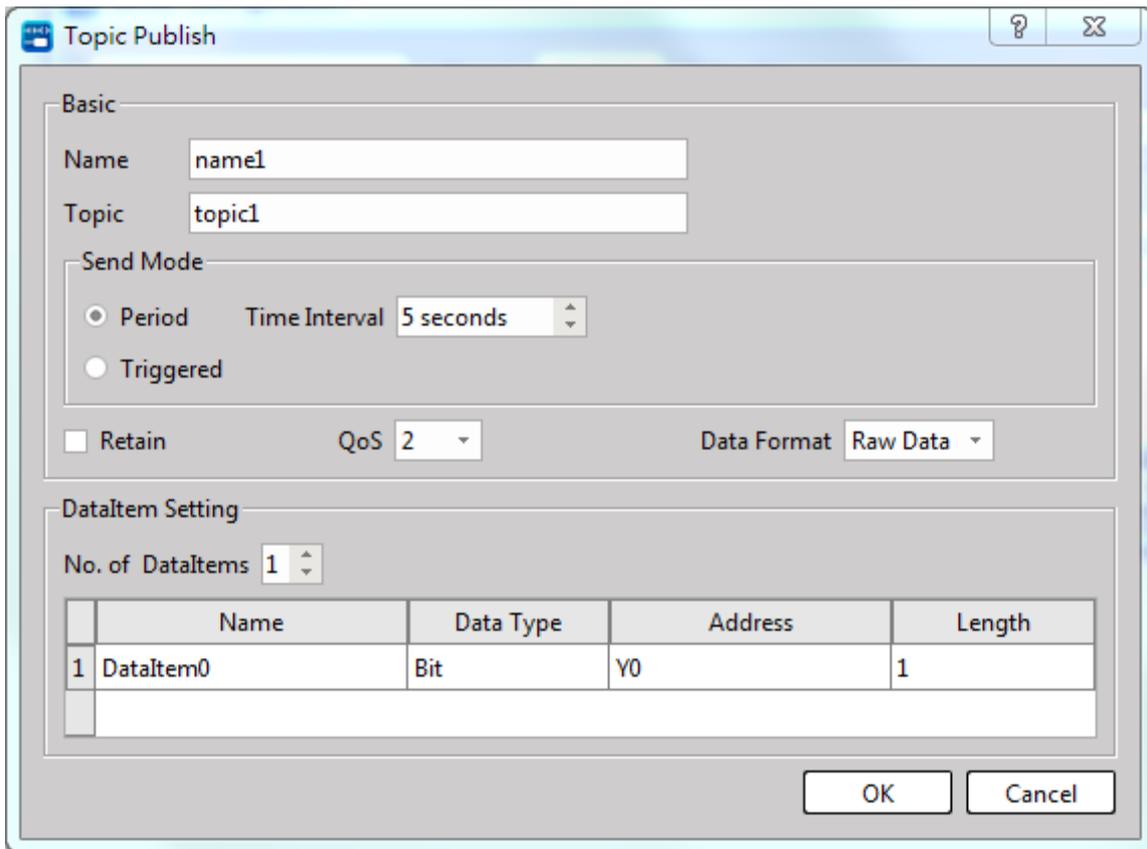
Figure 83 Topic publish of MQTT

Column	Description
【Basic】	【Name】 For setting the topic name and it can be used to describe the name. 【Topic】 The topic when MQTT is transmitting the message. (Notice: "#" and "+" are wildcard characters and they should not be used). 【Transmission Mode】 a. 【Cyclic】 Transmitting the message periodically and it can be used to set the interval second duration. b. 【Value change trigger】 The system will transmit the message when the value of the figure data item has changed. 【Retain message】 For determining if the MQTT message should be retained in the server. If selecting this item, the server will preserve such subject message. If a new subscriber is required or when the interrupted subscriber should be reconnected, then they will receive the latest message being retained. 【QoS】 For setting the Quality of Service of MQTT, and it comprises the following 3 classes:

Class	Description
0	Message transmitted once only. Message serving not guaranteed. Message will not be repeated.
1	Message will be served at least once. Message serving guaranteed. Message may be repeated.
2	Message will be served just once. Message serving guaranteed. Message will not be repeated.

【Data format】

The message content of each individual subject is composed of the address values of the figure data item, as per below:

【Raw Data】

01 2a 03 b8 1e e5 3f 6c 6f 76 65

Note:

	1. The data format and the figure data item to be published and subscribed must be the same in order that the data will be swapped successfully. 2. The publishing function does not support JSON mode.
【Set figure data item】	【Number of figure data item】 Set the number of figure data item required for such topic. Described below is the detailed setting of figure data item. 【Name】 The name of figure data item cannot be left blank and the name of each item must be unique and exclusive. The user shall be allowed to input the item name directly. 【Type of figure data】 It comes with 【bit】, 【16-bit BCD number】, 【16-bit positive integer】, 【32-bit BCD number】, 【32-bit integer】, 【32-bit positive integer】, 【32-bit floating point number】 and 【Ascii (U.S.)】 for option. 【Address】 Based on the type of figure data, the user will be allowed to set the address for each individual figure data item. 【Length】 If the type of figure data is configured in 16-bit, it will occupy one byte and 32-bit will occupy two bytes. In case of Ascii-String, it allows the user to determine the number of bytes that will be occupied by the figure data item. Each individual byte can accommodate 2 bits.

11-4-3 Topic Subscribe

To use the MQTT function, click "MQTT" from the "Server Configuration" window in the left-side "Project" and then select "Enable" to show the "Topic Subscribe". Next, click the upper-left "Add" button to add a new topic. By clicking the "Delete" button, you may delete the selected topic. By clicking "Edit" or double clicking the item in the Topic List, you may edit the selected topic. If the Topic List contains the existed items, you may click "Export" and all of the topic data will be exported for creating the specific-format CSC file. By clicking the "Import" button, you may import the specific-format CSC file for updating the topic table. In Topic List, the left-side of each topic is provided with an exclusive ID and it will be used as the topic ID.

Figure 84 Topic setting of MQTT topic subscribe

Figure 85 Topic Subscribe

Column	Description
【Basic】	【Name】 Setting the topic name for making detailed description. 【Topic】 The topic used when MQTT is transmitting the message. (Notice: "#" and "+" are wildcard characters and they should not be used). 【QoS】 For setting the QoS (Quality of Service) for MQTT, and it comprises the following 3 classes: | Class	Description
0	Message transmitted once only. Message serving not guaranteed. Message will not be repeated.
1	Message will be served at least once. Message serving guaranteed. Message may be repeated.

2	Message will be served just once. Message serving guaranteed. Message will not be repeated. |
	
	【Data Format】
	The message content of each individual subject is composed of the address values of the data item, as per the format below:
	【Raw Data】
	01 2a 03 b8 1e e5 3f 6c 6f 76 65
	【JSON】
	{
	    "d": {
	    "DataItem0": [true, true],
	    "DataItem1": [810, 793, 688],
	    "DataItem2": [1.789, 3.51],
	    "DataItem3": ["love"]
	  },
	  "error": [],
	  "ts": "2019-06-18T10:55:41.491"
	 }
	Note:
	1. The data format and the figure data item to be published and subscribed must be the same in order that the data will be swapped successfully.
	2. When it is in JSON mode, the data format will be JSON ARRAY.

【Set figure data item】	【Number of figure data item】
	Set the number of figure data item required for such subject.
	Described below is the detailed setting of figure data item.
	【Name】
	The name of figure data item cannot be left as blank and the name of each item must be unique and exclusive. The user shall be allowed to input the item name directly.
	【Type of figure data】
	It comes with 【bit】, 【16-bit BCD number】, 【16-bit positive integer】, 【32-bit BCD number】, 【32-bit integer】, 【32-bit positive integer】, 【32-bit floating point number】 and 【Ascii (U.S.)】 for option.
	【Address】
	Based on the type of figure data, the user will be allowed to set the address for each individual figure data item.
	【Length】
	If the type of figure data is configured in 16-bit, it will occupy one byte and 32-bit will occupy two bytes. In case of Ascii-String, it allows the user to determine the number of bytes that will be occupied by the figure data item. Each individual byte can accommodate 2 bits.

Table 25 Setting Properties of Topic Subscription Edit Window

11-4-4 R35679 Status Register

The system provides the MQTT status register R35679 for users to check the MQTT connection status.

R35679 Status Code	Description
0	Connected
1	Version not support
2	Descriptor Mismatch
3	Access Denied
4	Wrong account & password
5	Authentication failed
256	Connection Closed
257	Connection Timeout

11-4-5 Used Tools

This chapter describes the MQTT related tools:

Using external Broker

In 【Host (IP or domain name)】 of 【Server】 setup page, input the IP address or the domain name of the external Broker.

Example: Using the publicly tested Broker on Mosquitto (https://test.mosquitto.org/)

- Host: test.mosquitto.org
- Port: 1883

Install the Broker

It allows the user to install the Broker.

Example: Using Mosquitto (http://mosquitto.org/download/), and it is a public and free resource. For detailed installation and using method, please visit its website.

11-4-6 Client application

To monitor the data transmitted by MQTT, it will be required to use the MQTT client program provided by the third party for connecting to the selected Broker and then you may subscribe the topic published by HMI in order to receive the updated data. Currently, a lot of free MQTT client programs are available on the network for download.

Example: MQTT.fx (https://mqttfx.jensd.de/index.php/download)

11-5   Modbus TCP Communication Protocols

Modbus TCP Slave Station

The scope of Modbus slave station address conversion can be planned by the designer in "Modbus Address Allocation" through software, please refer to Section 10-4-2.

Modbus TCP Master Station

Use the Modbus network communication connection command to communicate, please refer to Section 11-5-1.

11-5-1 Convenient command for Modbus network communication connection

FUN152 NCR	Convenient command for Modbus network (Master station) communication connection	FUN152 NCR

Symbol

```
         ┌──── 152. NCR ────┐
EN ──────┤  SR :            ├──── ACT
         │                  │
         │  MD :            ├──── ERR
         │                  │
         │  WR :            ├──── DN
         └──────────────────┘
```

SR: Starting register address in the table
MD: Modbus TCP proactive communication (=1)
WR: Working Register

Range / Operand	WY	WM	WS	TMR	CTR	HR	OR	SR	ROR	DR	K
	WY0 | WY1008	WM0 | WM29584	WS0 | WS3088	T0 | T1024	C0 | C1280	R0 | R34767	R35024 | R35151	R35280 | R40279	R40280 | R48471	D0 | D11999	
SR				○	○	○	○	○*	○*	○	
MD											1
WR				○	○	○	○	○*	○*	○	

Description

1. The FUN152 (NCR) command is connected to the smart peripheral (slave station) with the Modbus communication protocol through the Ethernet port.
2. This command is mainly based on the specified form, such as using the Modbus Master TCP form, read or write according to the form specified, and actively carry out network communication. The communication form must be set before use; only six registers are required for definition. Every 6 registers define a transfer transaction.
3. When EN is ON for this command, the communication will continue.
4. When the data transaction is being transmitted, the output indication "ACT" is ON.

FUN152 NCR	Convenient command for Modbus network (Master station) communication connection	FUN152 NCR

Description of FUN152 command operand SR

SR	Word Size	Purpose	Description
SR + 0	1	ID letter: 0x544D	For identifying effect table: "M", "T".
SR + 1	1	ID letter: 0x544D	Each lot of communication will be expressed by 6 registers.
SR + 2	2	Remote IP	
SR + 4	1	Remote port	
SR + 5	1	TCP online active	=0: One round of online created for each individual communication. =1: One round of TCP online maintained in the table.
SR + 6	1	Overtime setting	Unit: 10ms
SR + 7	1	Retest number	
SR + 8	1	Enable done signal	=0, Disabled =1, Enabled
SR + 9	1	Communication table done signal	M XXXXX
SR + 10	1	Order Code (1st lot)	=1, Read =2, Write =3, Write once
SR + 11	1	Data Length	Register: Reading length is 125 and writing length is 123. Contacts: 1–255
SR + 12	1	Type of Master PLC data	Please see the data type, code and initial number of FATEK master station.

FUN152 NCR	Convenient command for Modbus network (Master station) communication connection	FUN152 NCR

Description of FUN152 command operand SR

SR	Word Size	Purpose	Description
SR + 13	1	Master PLC data starting number	Please see the data type, code and initial number of FATEK master station.
SR + 14	1	Slave PLC data type	Please refer to Modbus Data Type Table.
SR + 15	1	Slave PLC data starting number	Please refer to Modbus Data Type Table.
SR + 16	1	Order Code (2nd lot)	
...	...	...	

The data type, code and initial number of FATEK master station.

Data Code	Data Type	Scope
1	Y (Output Relay)	0~1023
2	M (Internal Relay)	0~29599
3	S (Stepping Relay)	0~3103
12	R (Data Register)	0~34767
13	D (Data Register)	0~11999

FUN152 NCR	Convenient command for Modbus network (Master station) communication connection	FUN152 NCR

- Slave Station (Modbus) data type, code and starting number

Data Code	Data Type	Scope
0	Output or internal relay	1~65535
4	Data Register	1~65535
1	Contact input	1~65535
3	Input Register	1~65535

Note: The data type of Master and Slave must be the same. In other words, if Master Station is Y/M/S, then the Slave Station must be coded as"0/1".

If the Master Station is R/D, then the Slave Station must be coded as "3/4"; and vice versa.

FUN152 NCR	Convenient command for Modbus network (Master station) communication connection	FUN152 NCR

Description of FUN152 command operand WR

High Byte   Low Byte

WR+0	Current communication index
WR+1	Result Code
WR+2	Function Code
WR+3	Internal TCP online index
WR+4	Connection status
WR+5	Retest number

- Current communication index: The system is executing No. xx transaction (starting from 0).
- Result Code saving operation result: 0=Normal; other value = Abnormal
- Function Code: Please refer to the description provided below.

- Connection status: WR+4=0, communication success
  - =2, waiting for reply
  - =3, communication out of time
  - =4, try to communication
  - =5, communication error

Function Code: Low Byte valid;
                 =0, read slave PLC system status
                 =1, read slave PLC data
                 =2, write data to slave PLC
Result code: 0, communication success.
                 2, data length error (=0 or out of upper limit.)
                 3, command code error (=0, or <3)
                 4, data type error (refer data types code)

| FUN152 NCR	Convenient command for Modbus network (Master station) communication connection	FUN152 NCR

5: Data number is incorrect (see data starting number).

6: Master and slave data type are not the same.

  (e.g., Master Station is Y/M/S and Slave Station is coded as "4").

7: Communication port is incorrect (it should be coded as Port 1, 2, 3 or 4 only).

8: Illegal communication table is used.

A: Slave Station remains inactive (Time-out error)

B: Communication is abnormal.

  (Receiving incorrect data or incorrect message is replied by Slave Station).

C: Connect error

Example	Slave Station 400101– 400105 (IP: 192.168.0.151) to Master Station R100–R104 addresses (IP: 192.168.0.150).
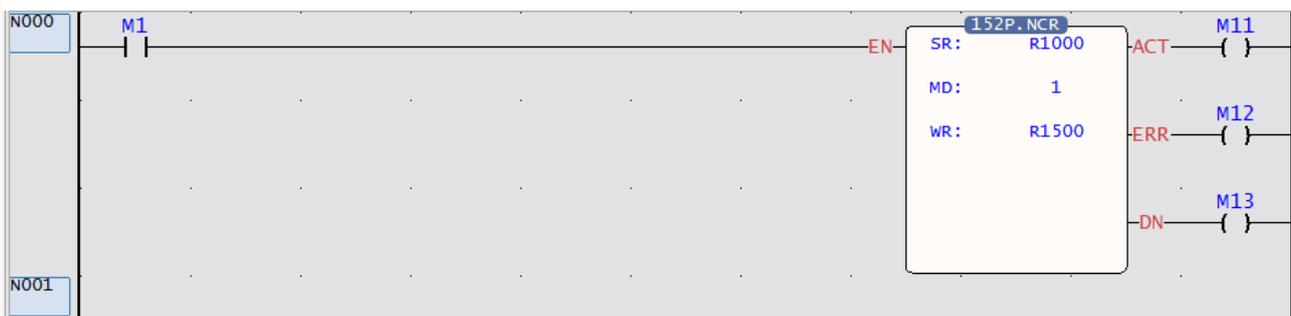
Description of program example

When the input control "EN" changes from 0 to 1, based on the settings in the Modbus TCP table, the remote IP Slave Station reads the register data and stores it in the PLC Master Station, and continuously completes the data transaction.

For detailed setting steps, please see the description provided below

1. First, add the "Modbus Master" table in the original data list.

2. In Modbus Master table, define remote IP and Port as well as the address that will be read and written, including the Master Station and Slave Station data.

3. Edit Fun152 NCR command in Master Station Ladder.

FUN152 NCR	Convenient command for Modbus network (Master station) communication connection	FUN152 NCR
Example		

Edit communication table with UperLogic

In Project window, click followings:

Communication order table: Project name

Data List

Modbus Master Table

Press right key and then click "New Modbus Table". The table type will be "Master TCP table". You may also click "Table Edit" in "Project" tag, roll down for selecting "Modbus Master table" and then select "New Modbus Table". The table can also be configured as "Modbus TCP table" type。
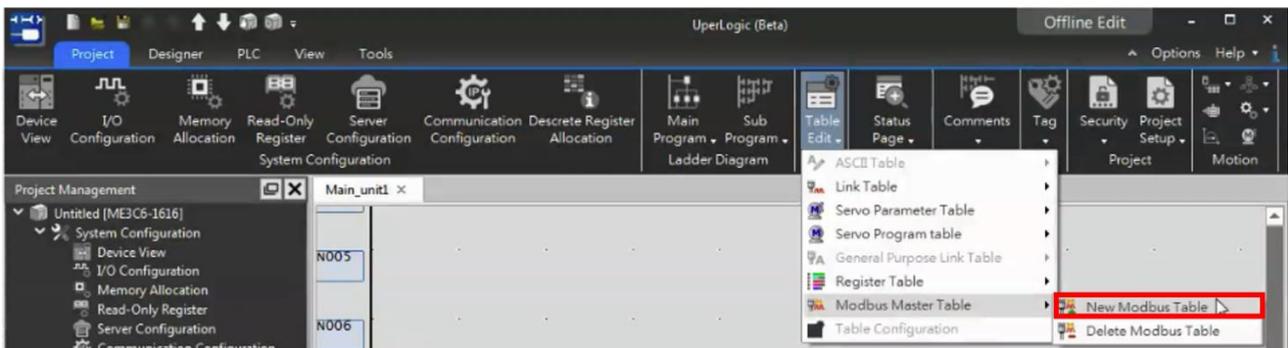
FUN152 NCR	Convenient command for Modbus network (Master station) communication connection	FUN152 NCR
Example		
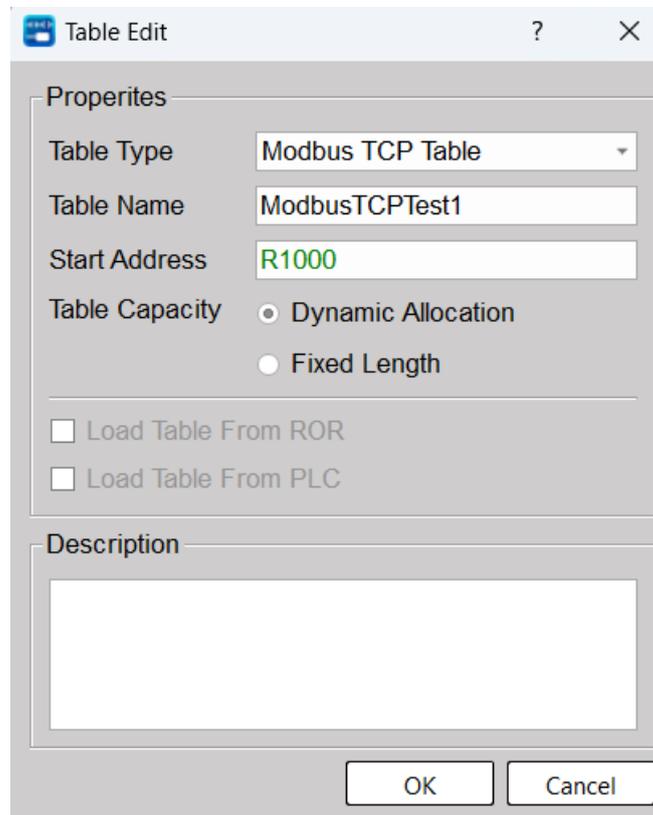
Figure 87 Editing Modbus Master Table

- Table type: Select as "Modbus TCP Table".
- Table name: It can be configured in the online table type for inputting an identifiable name for the convenience of modifying or debugging later on.
- Table starting position: The starting position of the Start Register (SR) required for the communication program (data transmission table) used by the input communication command (FUN152).

FUN152 NCR	Convenient command for Modbus network (Master station) communication connection	FUN152 NCR
Example		
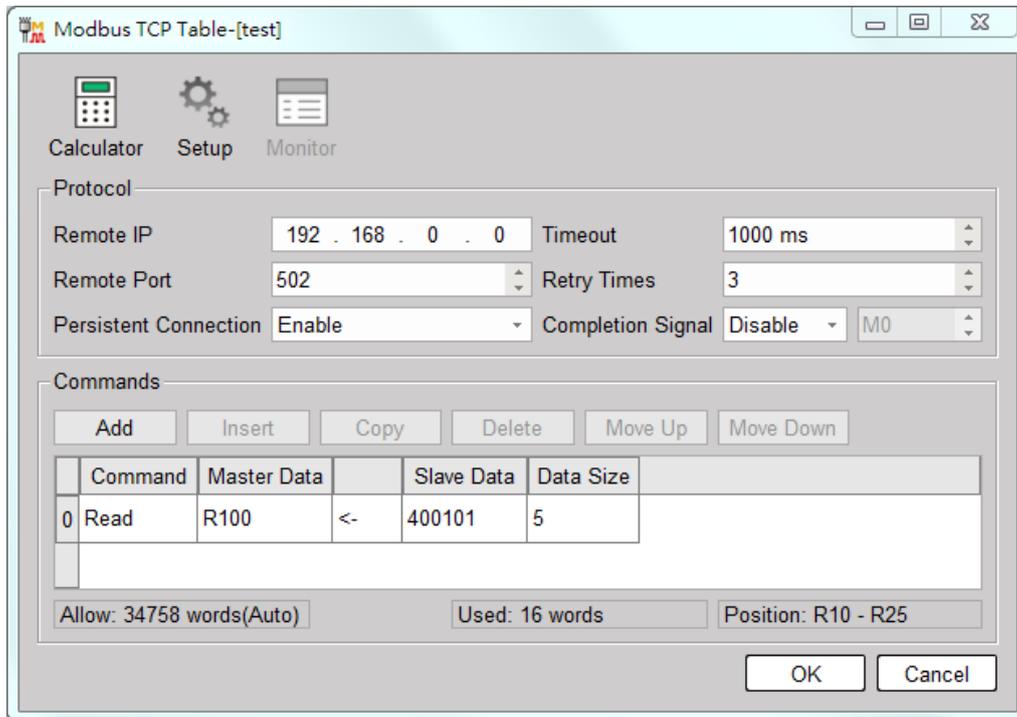
Figure 88 Modbus Master Table

- Remote IP: The IP address of remote device.

- Remote port number: The port number of remote device.

- Order: The order used by the Master Station to read data from Modbus Slave Station or to write the data to Modbus Slave Station.

- Master Station data: For reading, it serves as the position for saving the data being read from Slave Station. As for writing, it is the position in Master Station that will be used to write the data to Slave Station.

- Slave Station Data: For reading, it serves as the position for transmitting the data to the Master Station. As for writing, it is the position for Master Station to write the data to Slave Station.

- Length: The length of data to be transmitted. The reading length is coded as "125" and the writing length is coded as "123".

- Connection maintenance: When starting, it will only initiate a TCP connection establishment request for the remote IP, and subsequent communications will exchange data on this connection; otherwise, it will re-establish a TCP connection for each communication

11-6 iMonitor Remote Monitoring

FATEK IoT provides a new iMonitor remote monitoring HMI and PLC solution, as long as the device can be connected to the Internet, users can easily obtain the data on the device, and can monitor and access multiple device systems at the same time, and receive the system alarm information and data collection function in a real time for remote debugging and troubleshooting. In terms of communication security, there is also a professional security encryption mechanism to help customers check, so as to effectively protect the operation and access equipment data, and avoid the use of malicious people. Above, users do not need to make any network settings.

For detailed usage, please refer to the FATEK IoT cloud service user manual linked below:

https://www.fatek.com/zh-tw/download.php?act=list&cid=16

11-6-1 HWID

Every FATEK product that supports iMonitor has a unique device code called HWID. You can view 【PLC Status】 in the project, as shown in the figure below, and you can also view the current iMonitor connection status in this window. The same information can also be obtained in server-related settings. In order to facilitate the user to register the device correctly in the cloud background, click the function icon behind the HWID to quickly copy the HWID text content.
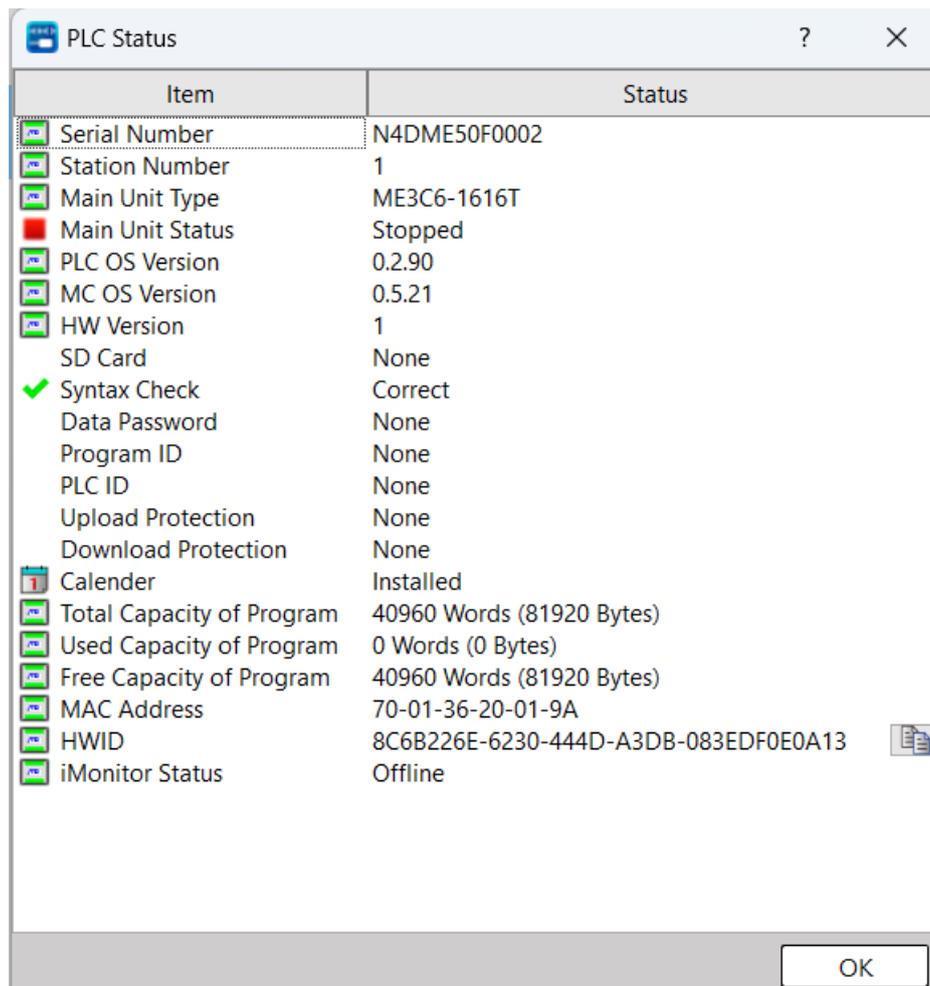
PLC Status	? ✕
Item	**Status**
Serial Number	N4DME50F0002
Station Number	1
Main Unit Type	ME3C6-1616T
Main Unit Status	Stopped
PLC OS Version	0.2.90
MC OS Version	0.5.21
HW Version	1
SD Card	None
Syntax Check	Correct
Data Password	None
Program ID	None
PLC ID	None
Upload Protection	None
Download Protection	None
Calender	Installed
Total Capacity of Program	40960 Words (81920 Bytes)
Used Capacity of Program	0 Words (0 Bytes)
Free Capacity of Program	40960 Words (81920 Bytes)
MAC Address	70-01-36-20-01-9A
HWID	8C6B226E-6230-444D-A3DB-083EDF0E0A13
iMonitor Status	Offline

OK

Figure 81 Status of PLC

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11-6-2 Server Setting

For the iMonitor function, click 【IoT】 in the 【Server Configuration】 window in the 【Project】 on the left to enter its setting page. The 【Server】 tab can be used to view and configure iMonitor, as shown in the figure below:
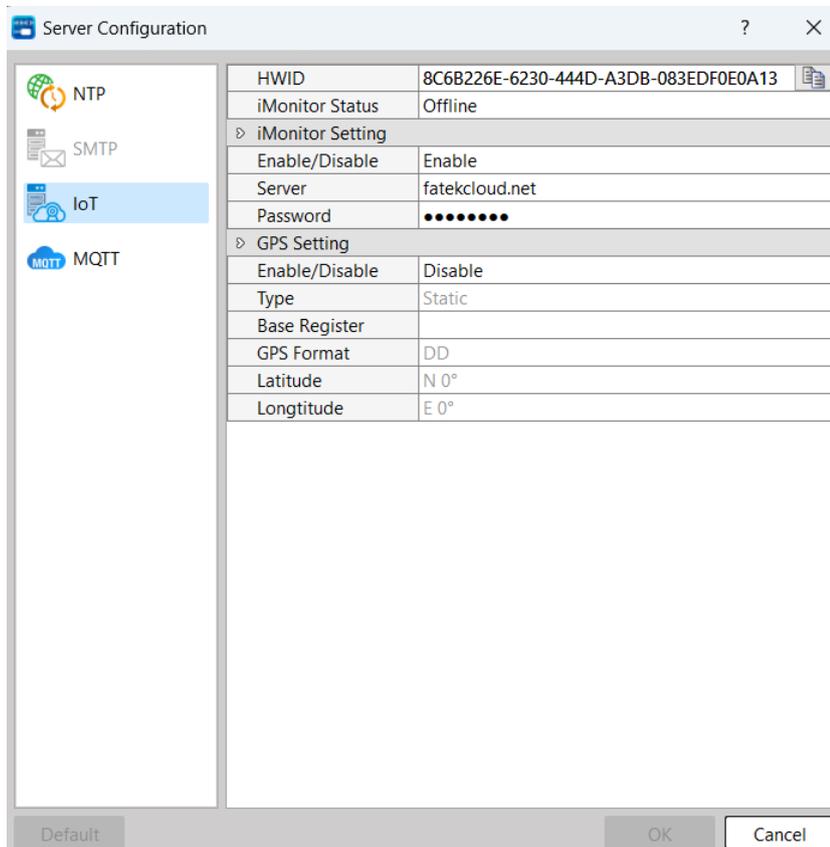
Figure 81 iMonitor setting window

11-6-3 Status Register

In addition to knowing the iMonitor connection information through the software interface, the relevant detailed information can also be obtained in the status register R35483.

R35483 Status Code	Description
0	Offline
1	Online
2	In connection
Other	Error code

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12

Analog Input Function

11-1 Built-in Analog Input Function

12-1-1 Position and specifications of wiring

The general and advanced motion control hosts are configured with two units of analog input (AI) channels for the user to input 0–10V voltage and 0–20mA current. Its resolution is rated at 12-bit and it should be used together with 2x3 EU-spec terminal connector.
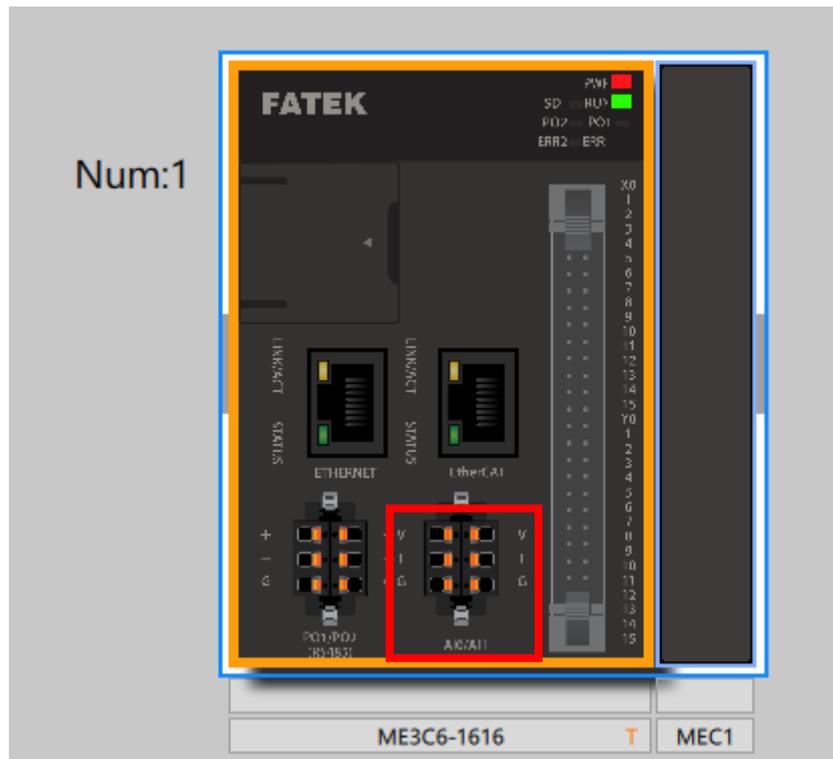
Figure 91 AI0 AND AI1

12-1-2 Channel Value Register

After RUN is executed, the host will take fixed samples and update the values of AI0 and AI1 to R35645 and R35646. No additional settings are required for use.

Table 26 Channel Value Register

Special Register	Channel No.
R35645	CH0 value (0~4095)
R35646	CH1 value (0~4095)

13

PID Temperature Control

13-1 PID Temperature Control Instruction Description and Examples

FUN99 P TPCTL2	PID temperature control instruction 2	FUN99 P TPCTL2
Symbol		

ID: The number of the expansion module used as the input signal

CH: Channel number for input signal

SR: Process control setup start register

PR: Gain setup start register

OR: Output start register

WR: Working start register

Range Ope-rand	HR R0 | R34767	IR R34768 | R34895	OR R35024 | R35151	SR R35280 | R43223	ROR R43224 | R47319	DR D0 | D11999	K |
ID							
CH	◯	◯	◯	◯	◯	◯	0-127
SR	◯				◯	◯	0-63
PR	◯				◯*	◯	
OR	◯				◯*	◯	
WR	◯				◯*	◯	

FUN99 P TPCTL2	PID temperature control instruction 2	FUN99 P TPCTL2

Description	

- PID temperature control (FUN99) uses the temperature module and the temperature planning form to measure the current external temperature value as a Process Variable (PV), and the temperature Set Point (SP) set by the user, and the program-controlled variable through the software PID mathematical formula to obtain the appropriate output control value to control the temperature within the temperature range expected by the user.

- Convert the numerical result after PID operation into time-proportional ON/OFF (PWM) output, and control the heating or cooling circuit connected in series with the SSR through the transistor-type contact output, and you can get quite precise control results. It is also possible to control the conduction angle of the SCR or the proportional valve through the D/A analog output module to control the SCR conduction angle or the proportional valve for precise temperature control.

- EN: Execute temperature control when ON, stop when OFF

- UPD: When ON, the parameters will be updated to the specified channel of the module

- A/M: PID manual mode (PID manual mode), if enabled, the output will be in manual control mode, and the MOUT value will be automatically copied to MV instead of using the PID calculation result as the output.

- H/C: Perform heating or cooling control.

FUN99 P TPCTL2	PID temperature control instruction 2	FUN99 P TPCTL2

PID control

● The PID control system is independently operated by the modules, and the PLC scan cycle will not be increased due to multiple modules performing PID at the same time.

● Each channel will be able to execute the desired PID computation. The temperature control mode must be set as PID control in order to carry out the temperature control more efficiently through the proportional (P), integral action (I) and derivative action (D). It can also execute the P, PI, PD and PID control according to actual demand.

● Proportional (proportional): The amount of output quantity (MV) will configure an output proportion according to the error (E) between the measured value (PV) and the setup value (SV). The bigger the setup of proportional, the lighter the fluctuation.

● Integral time: The output quantity will be increased and decreased according to the error (E) between the measured value (PV) and the setup value (SV) in order to reduce the error that will be finally produced by P action. The smaller the integral time, the stronger the fluctuation and the quicker the rising; on the contrary, it will become lighter and slower. The scape is 0–3600s. If the integral time is set at "0", then the system will not execute the integral control.

● Derivative time (derivative time); The output quantity will be increased or decreased according to the error (E) change rate between the measured value (PV) and the setup value (SV). Even though abrupt change has resulted due to the noise influence, it can be restored to stabilized status through the derivative action. The smaller the derivative time, the lighter the fluctuation and the slower the noise reaction; on the contrary, it will become larger and quicker. Its scope is 0–3600s. If the derivative time becomes "0", the system will not execute the derivative control.

SR Parameter	Word size	Description
TS	1	Time cycle size, the unit is 0.1s (0.1s~30.0s)
SV	2	Set value, the unit is 0.1 degree
DEAD BAND	1	Reach the dead band near the SV, the range is 0.1%~10.0%
DOUT	1	Output points
PERIOD	1	PWM cycle, the unit is 1s
Out mode	1	0, PWM output 1, else

● PID_Deadband: The setting scope is rated at 0–10.0% (input scope). During the PID control, such zone is an offset (E) inactive area. When the temperature process value (PV, temperature control value) enters such deadband, the system will still execute the PID computation until it rides through the set value (SV, setup value). At this time, the system will replace "0" with "E" to resolve in the formula. After riding through such zone, it will restore to normal status to execute the PID computation. Taking the following figure as the example, the system will take "E" in A-zone as "0".
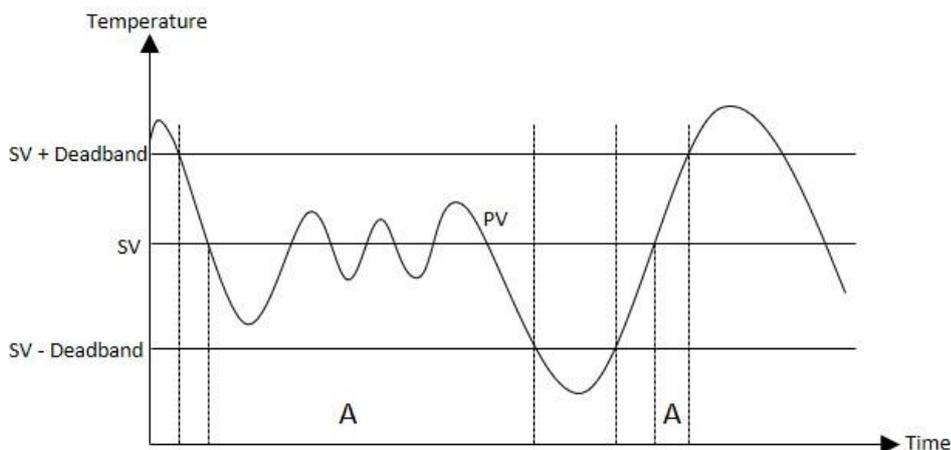
FUN99 P		FUN99 P
TPCTL2	PID temperature control instruction 2	TPCTL2

PR	Word size	Description
Kp	2(floating point)	Proportional, real number
Ti	1	Integral time, 0~3600s
Td	1	Differential time, 0~3600s
Bias	2(floating point)	Output bias, real number
Output upper limit	2(floating point)	Higher output limit
Output lower limit	2(floating point)	Lower output limit
PID Method	1	0: Standard PID 1: Minimum transcending
AT	1	Enable/Disable AT
MAUTO	1	MOUT values change with MV or not

● Kp, Ti, Td：PID parameter, to specify or turn on the automatic generation of AT and adjust it for use.

● Bias：Output bias, users can use it to increase or decrease the output value, but it will still be limited by the setting of the output range.

● High/Low output limit：Limitation of output range, to set the high and low limits of PID output. If the output lower limit is greater than or equal to the output upper limit, an error alarm will be issued.

● PID Method：Choose the appropriate PID algorithm.

● AT：Enable/disable Autotuning to get PID control parameters.

● MAUTO：To copy MV values to MOUT.

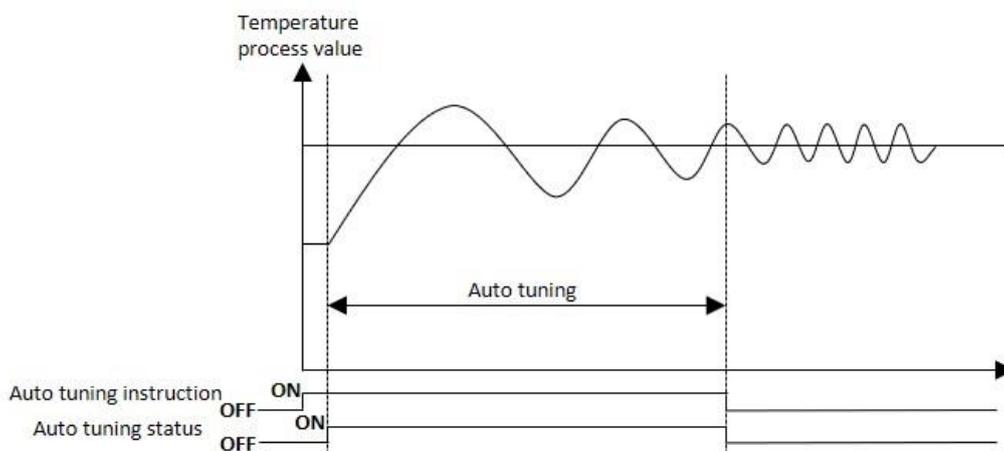| OR	Word size	Description
MV	2(floating point)	Report of output values
MOUT	2(floating point)	Setting of Manual Output Values (MV)

FUN99 P	PID temperature control instruction 2	FUN99 P
TPCTL2		TPCTL2

WR	Word size	Description
PID operating state	1	=0, Idle
		=1, Working
		=2, Error
		=3, AT now
AT working state	1	=0, Idle
		=1, Running
		=2, Error
		=3, Finish
		=4, Time out
PV	2	Programmed return values

Auto tuning

● Based on the environment of the control system, such function will calculate the PID parameters suitable for proportional (P), integral time (I) and differential time (D) automatically and shall become active when it is required to select the PID control mode to execute the temperature control. Before this, it will execute the calculation according to the waveforms being obtained after the ON/OFF control in order to present the optimal PID parameters. After that, the system will write the parameters in the memory of the respective PID automatically where the parameter will be converted to PID control mode to carry out the temperature control.

FUN99 P TPCTL2	PID temperature control instruction 2	FUN99 P TPCTL2

● During the auto tuning period, the system will execute the output according to the output upper limit and the output lower limit. The auto tuning will become active when the output cycle is not set as "0".

● If SV exceeds the temperature scope value, the auto tuning will not be executed.

● If the auto tuning is not completed after being run for 2 hours, then the system will signal the auto tuning overdue error alarm.

● The channel being set as close will not be able to execute the auto tuning function.

● To change the value set for SV, dead band, TC module calibration, output upper limit, output cycle, control mode and channel closing, the system will stop the auto tuning and then signal the error alarm in order to trigger the relay (i.e. ON).

● Execution method: Through temperature control command

● Ending method: Report the ending of Auto tuning.

FUN99 P TPCTL2	PID temperature control instruction 2	FUN99 P TPCTL2
Auto Tuning Example	SSR Example	

Step0 Related settings of M04TC/ M04TCR module

Select ^{o}F/ ^{o}C

In M04TC/M04TCR, choose PID control

FUN99 P		FUN99 P
TPCTL2	PID temperature control instruction 2	TPCTL2

Step1 Setting parameters:

Fill in the required TS, SV, DOUT, PWM period, set the output upper limit to 1, the output lower limit to zero, and AT to 1, as shown in the figure below:

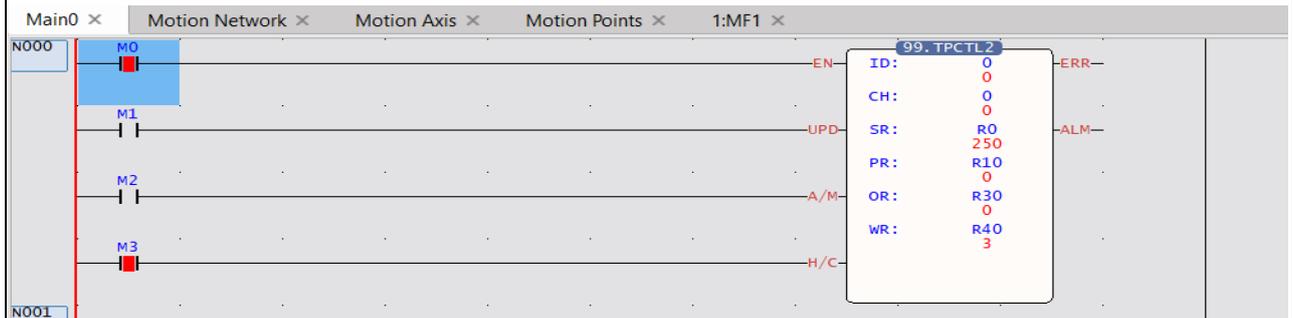| Name	Status	Data	Comment	Name	Status	Data	Comment	Name	Status	Data	Comment
R0	DEC	250	[R0]	DR10	FLOAT	0	[R10]	DR34768	DEC	360	[R34768]
DR1	DEC	550	[R1]	R12	DEC	0	[R12]				
				R13	DEC	0	[R13]				
R3	DEC	0	[R3]	DR14	FLOAT	0	[R14]				
R4	DEC	4	[R4]	DR16	DEC	1	[R16]				
R5	DEC	25	[R5]	DR18	DEC	0	[R18]				
R6	DEC	0	[R6]	R20	DEC	0	[R20]				
R7	DEC	0	[R7]	R21	DEC	1	[R21]				
				R22	DEC	0	[R22]				
R40	DEC	0	[R40]								
R41	DEC	0	[R41]	DR30	FLOAT	0	[R30]				
DR42	DEC	551	[R42]	DR32	DEC	0	[R32]				

Example usage parameters and related definitions	The meaning of the corresponding parameters in the example
R0 = Control cycle (unit is 0.1s)	=25seconds.
DR1 = setting value	=55 $^{\circ}$C /$^{\circ}$F, determined by the setting of Step0 whether it is $^{\circ}$C or $^{\circ}$F.
R4 = point number of the output	=4, the table output is Y4 of the host
R5 = PWM control period	=25, control once every 25 seconds
R6= output mode	=0, PWM mode (1 is other modes, it will output MV out, allowing users to move to the required OR register)
DR16 = output upper limit	=1, 1 times of full scale (ex: K type is 1350-(-200)=1550*1 $^{\circ}$C)
DR18 = output lower limit	=0, 0 times the full scale (same as above, please refer to the thermocouple temperature table for the full scale)

FUN99 P	PID temperature control instruction 2	FUN99 P
TPCTL2		TPCTL2

In Step2 Auto tuning:

During Auto tuning, you need to wait for relevant parameters (Kp, Ki, Kd, Auto tuning status = 3, that is, Tune is completed), and Error will be output if it exceeds 2 hours.

As shown below

Status Page

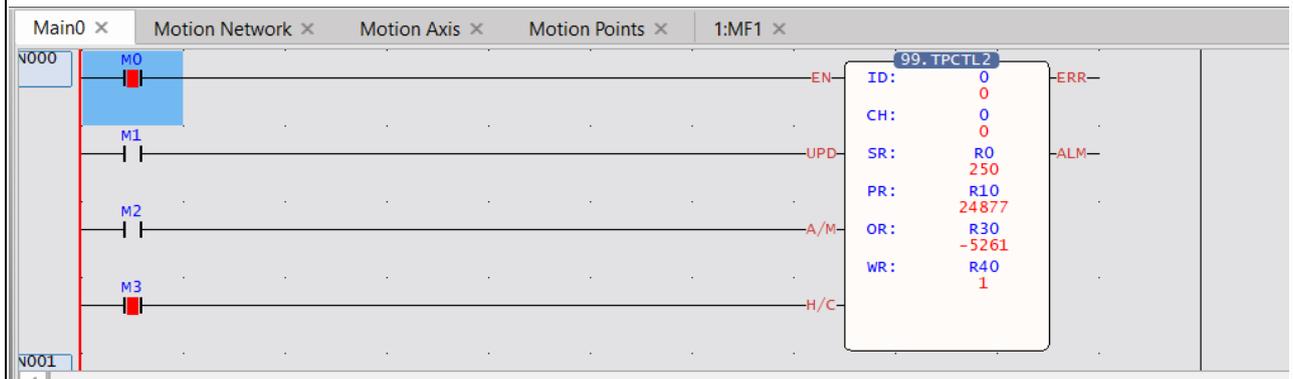| Name	Status	Data	Comment	Name	Status	Data	Comment	Name	Status	Data	Comment
R0	DEC	250	[R0]	DR10	FLOAT	0	[R10]	DR34768	DEC	364	[R34768]
DR1	DEC	550	[R1]	R12	DEC	0	[R12]				
				R13	DEC	0	[R13]				
R3	DEC	0	[R3]	DR14	FLOAT	0	[R14]				
R4	DEC	4	[R4]	DR16	DEC	1	[R16]				
R5	DEC	25	[R5]	DR18	DEC	0	[R18]				
R6	DEC	0	[R6]	R20	DEC	0	[R20]				
R7	DEC	0	[R7]	R21	DEC	1	[R21]				
				R22	DEC	0	[R22]				
R40	DEC	3	[R40]								
R41	DEC	1	[R41]	DR30	FLOAT	1	[R30]				
DR42	DEC	363	[R42]	DR32	DEC	0	[R32]				

Example usage parameters and related definitions	The meaning of the corresponding parameters in the example
M0=Turn on temperature control	=1, trigger command
M3=Output point output is heating or cooling	=1, heating
R40=PID state	=3, in Auto tuning
R41=Auto tuning status	=1, Auto tuning is in progress
DR42 = Programmed return value (PV)	=36.3 °C/°F

M-Series PLC Software Function and Application User Manual

FUN99 P		FUN99 P
TPCTL2	PID temperature control instruction 2	TPCTL2

Step3 Auto tuning completed:

After Auto tuning is completed, the relevant parameters Kp, Ki, and Kd should have corresponding

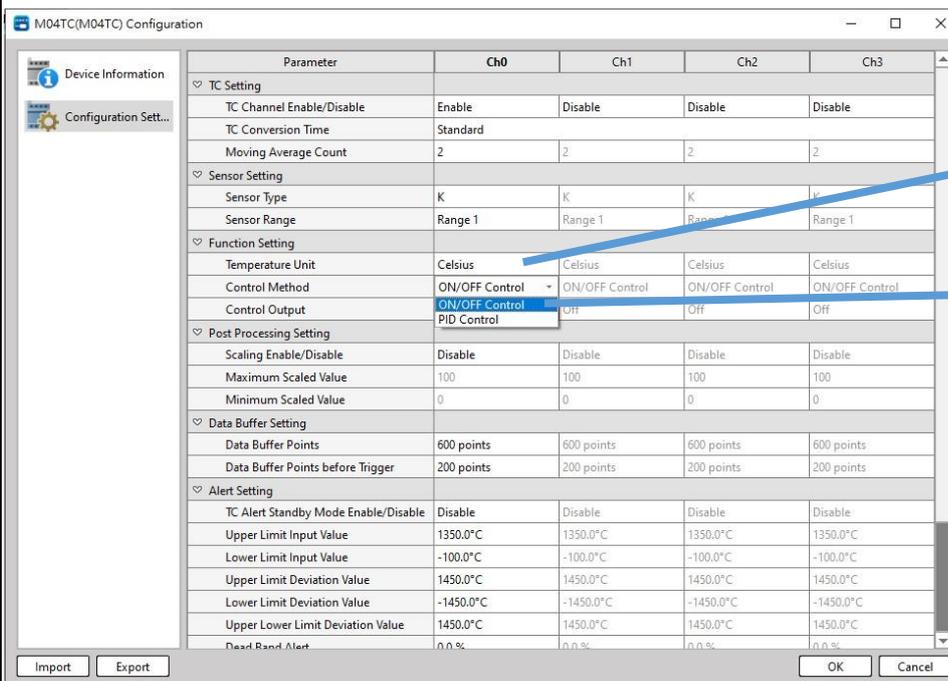parameters and Auto tuning status=3

As shown below

Name	Status	Data	Comment	Name	Status	Data	Comment	Name	Status	Data	Comment
R0	DEC	250	[R0]	DR10	FLOAT	0.015915478	[R10]	DR34768	DEC	548	[R34768]
DR1	DEC	550	[R1]	R12	DEC	23	[R12]				
				R13	DEC	6	[R13]				
R3	DEC	0	[R3]	DR14	FLOAT	0	[R14]				
R4	DEC	4	[R4]	DR16	DEC	1	[R16]				
R5	DEC	25	[R5]	DR18	DEC	0	[R18]				
R6	DEC	0	[R6]	R20	DEC	0	[R20]				
R7	DEC	0	[R7]	R21	DEC	1	[R21]				
				R22	DEC	0	[R22]				
R40	DEC	1	[R40]								
R41	DEC	3	[R41]	DR30	FLOAT	0.45296821	[R30]				
DR42	DEC	551	[R42]	DR32	DEC	0	[R32]				

Example usage parameters and related definitions	The meaning of the corresponding parameters in the example
M0=Turn on temperature control	=1, trigger command
M3=Output point output is heating or cooling	=1, heating
DR10=Kp, proportional item	=0.0159...... (output as floating-point number)
R12=Ki, integration time	=23, the unit is second
R13=Kd, differential time	=6, unit is second
R40=PID state	=1, PID is executing
R41=Auto tuning state	=3, Auto tuning completed

FUN99 P TPCTL2	PID temperature control instruction 2	FUN99 P TPCTL2
On/Off mode Example:		

Step0 Related settings of M04TC/ M04TCR module
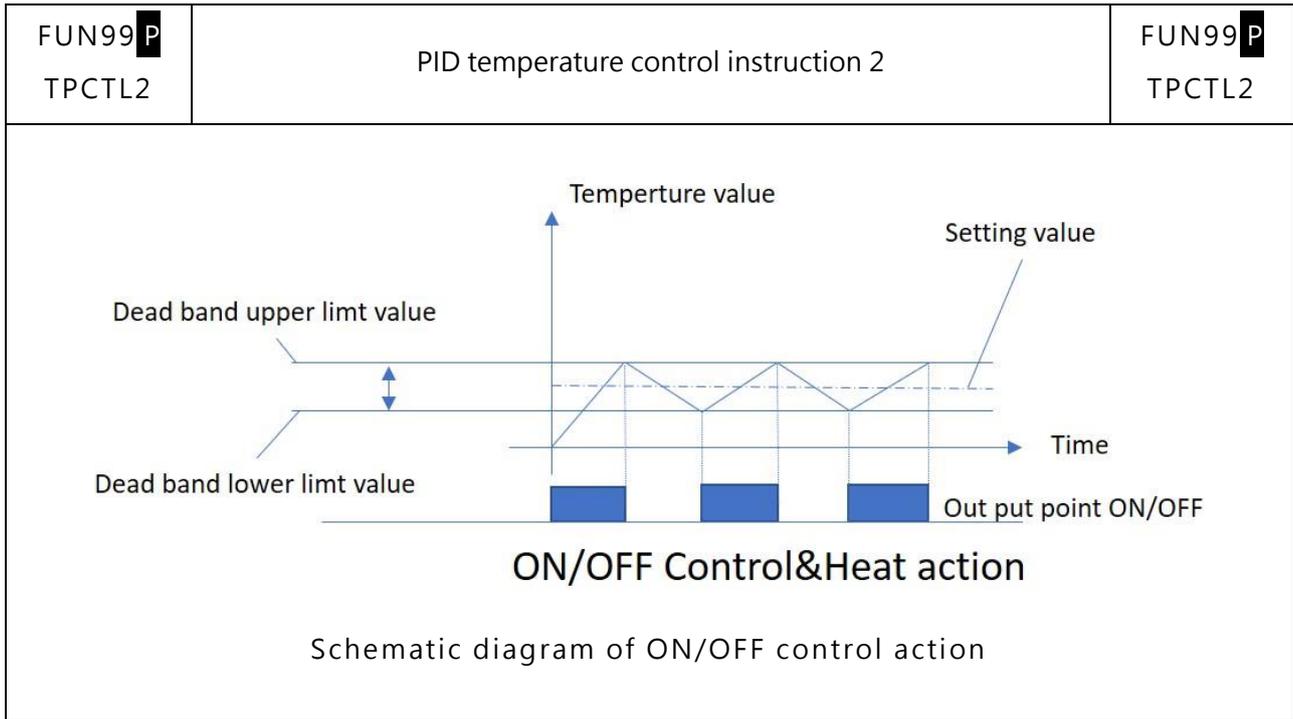

Select °F/ °C

On M04TC/M04TCR, select "ON/OFF Control"

M-Series PLC Software Function and Application User Manual

FUN99 P TPCTL2	PID temperature control instruction 2	FUN99 P TPCTL2
On/Off mode Example:		

Step1 Fill in the required TS, SV, dead band, DOUT, output upper limit, output lower limit, and trigger the command

Example usage parameters and related definitions	The meaning of the corresponding parameters in the example
M0=Turn on temperature control	=1, trigger command
M3=Output point output is heating or cooling	=1, heating
R0 = control period (Unit is 0.1s)	=25 seconds
DR1 = Set value	=55°C/°F, determined by Step0 setting is °C or °F
R3= Dead band	=1, i.e., 0.1% of full scale, taking K type thermocouple as an example, when filling 1 in the temporary register, it means that 0.1% of full scale will be used as the dead band size, i.e., (1350-(-200)) *0.1% is approximately equal to 1.5 °C, the upper limit of the dead zone is 55+1.5, and the lower limit is 55-1.5 (please refer to the thermocouple temperature range table for the full scale)
R4 = Point number of the output	=4, the table output is Y4 of the host
R5 = PWM control period	=25, control once every 25 seconds
DR16 = Output upper limit	=1, 1 times of full scale (ex: K type is 1350-(-200) =1550*1 °C)
DR18 = Output lower limit	=0, it is 0 times of full scale (ex: K type is 1350-(-200) =1550*0 °C)

FUN99 P	PID temperature control instruction 2	FUN99 P
TPCTL2		TPCTL2

Schematic diagram of ON/OFF control action

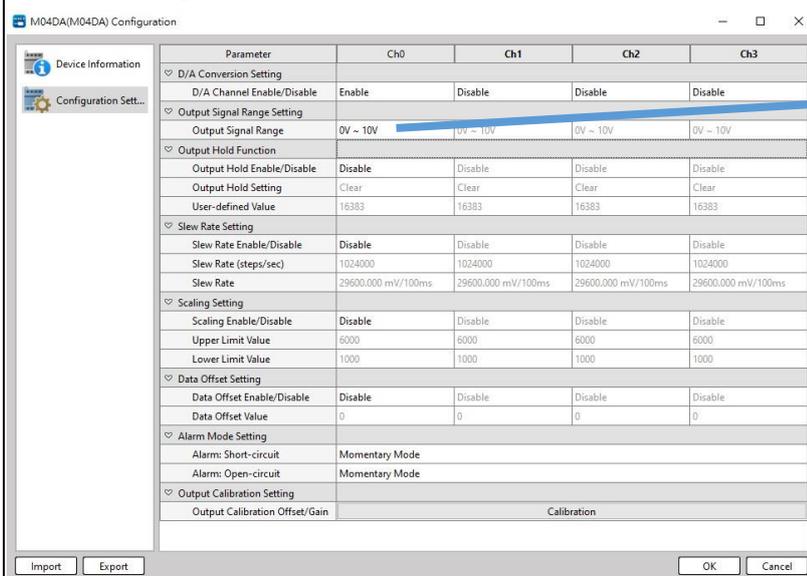| FUN99 P TPCTL2	PID temperature control instruction 2	FUN99 P TPCTL2
Auto tuning Example:	SCR example, this is an example with the M04DA analog output module	

Step0

Related settings of M04TC/ M04TCR module
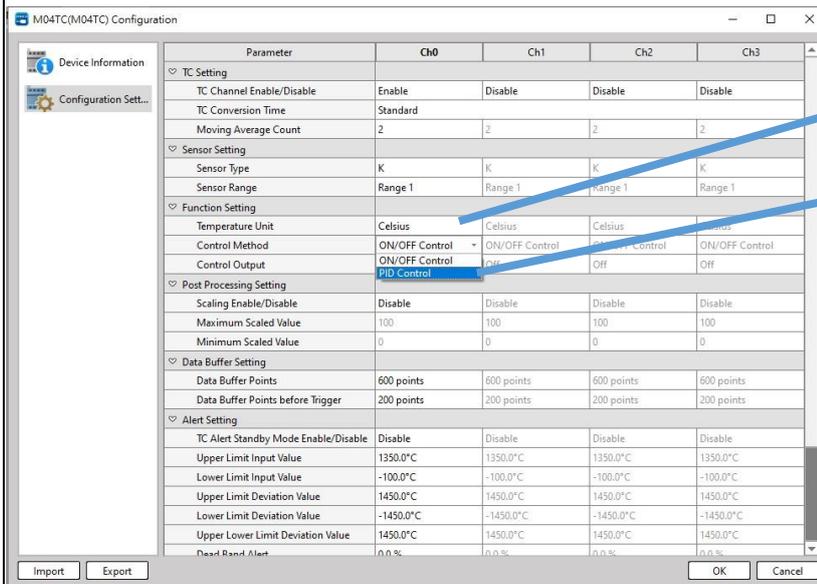
Select °F / °C

In M04TC/M04TCR, choose PID control
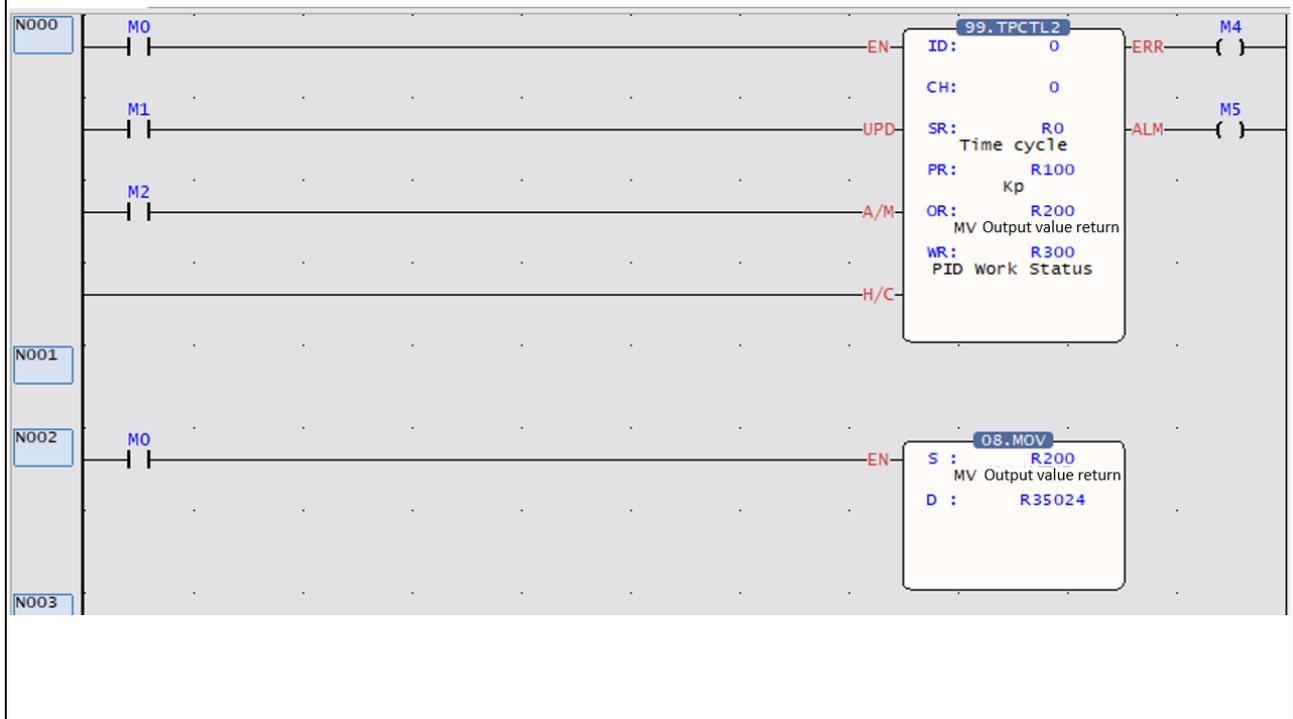
Related settings of M04DA/ M04DAR module

Turn on the AO

Take 0~10V as an example, you can also choose other range

FUN99 P		
TPCTL2	PID temperature control instruction 2	FUN99 P
		TPCTL2

Step1 Setting parameters: Setting parameters and ladder diagram program, the detailed content and explanation of the table are on the next page

Name	Status	Data	Comment	Name	Status	Data	Comment
R0	DEC	100	Time cycle	DR200	DEC	0	MV Output value return
DR1	DEC	500	Set Value	DR202	DEC	0	MOUT MV manual output value setting
R3	DEC	0	DEAD BAND				
R4	DEC	0	Output I/O NO.				
R5	DEC	10	PWM cycle	R300	DEC	0	PID Work Status
R6	DEC	1	Output mode	R301	DEC	3	AT Work Status
				DR302	DEC	494	PV
DR100	DEC	963	Kp	DR500	FLOAT	0	[R500]
R102	DEC	133	Ti	R600	DEC	0	[R600]
R103	DEC	33	Td				
DR104	DEC	0	Bias	R35024	DEC	0	[R35024]
DR106	DEC	16383	MV output upper limit	R34776	DEC	0	[R34776]
DR108	DEC	0	MV output lower limit				
R110	DEC	0	PID Method	R200	HEX	0000H	MV Output value return
R111	DEC	1	ensure AutoTuning is on	R201	HEX	0000H	[R201]
R112	DEC	0	Does MOUT value change with MV				

FUN99 P TPCTL2	PID temperature control instruction 2	FUN99 P TPCTL2

Example usage parameters and related definitions	The meaning of the corresponding parameters in the example
R0 = control period (unit is 0.1 second)	=100(10 seconds)
DR1 = set value (unit 0.1 degree)	=500(50.0^{o}C/^{o}F), determined by the M04TC module setting
R5=PWM output period (unit 1 second)	=10(10 seconds)
R6= output mode	=1, other modes (0 is PWM mode, it will output according to the set output point
DR106=Output upper limit	=16383 (corresponding to the upper limit of the digital value of the M04DA module)
DR108=output lower limit	=0 (corresponding to the lower limit of the digital value of the M04DA module)
R111=AT open	=1 (AT is on)
R300=PID state	=0(idle)
R301=AT state	=1(idle)
R21 = Auto tuning ON	=1, 1 ON; 0 OFF
R40 = PID state	=0, idle
R41 = Auto tuning state	=0, idle
DR302=Programmed value return	=494 (49.4^{o}C/^{o}F)

The command H/C is short-circuited, which means that when there is output, it is heating control; if it is empty, it means cooling control

After filling in the above setting values, you can turn M0 ON, trigger the command and perform Autotuning.
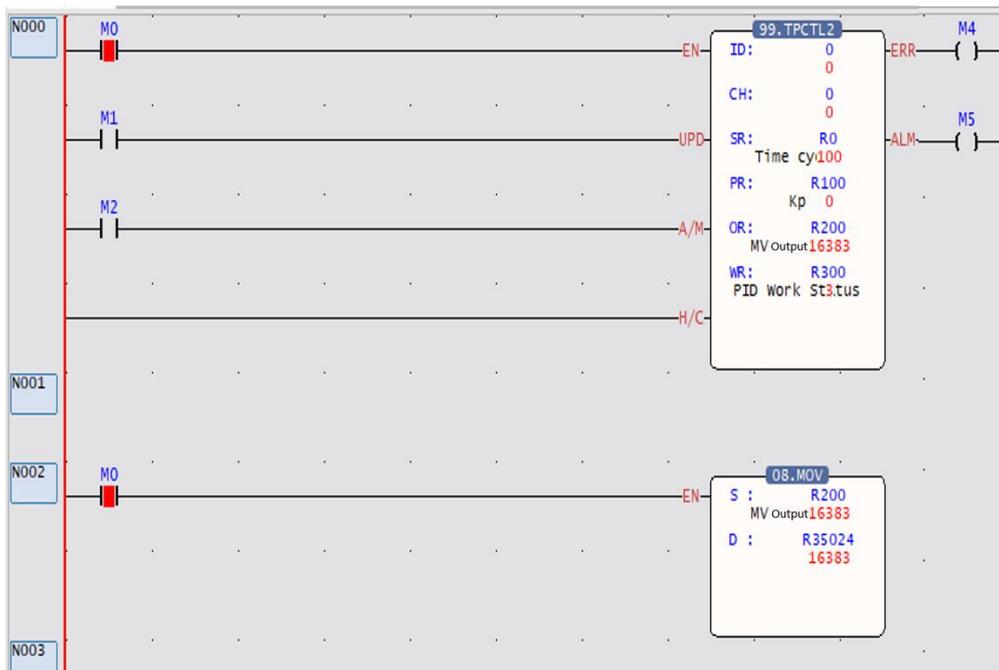
FUN99 P		FUN99 P
TPCTL2	PID temperature control instruction 2	TPCTL2

In Step2 Auto tuning:

During Auto tuning, you only need to wait for relevant parameters (Kp, Ki, Kd appear, Auto tuning status = 3, that is, Tune is completed, you can enter Step 3), and Error will be output if it exceeds 2 hours.

As shown below

Name	Status	Data	Comment	Name	Status	Data	Comment
R0	DEC	100	Time cycle	DR200	DEC	16383	MV Output value return
DR1	DEC	500	Set Value	DR202	DEC	0	MOUT MV manual output value setting
R3	DEC	0	DEAD BAND				
R4	DEC	0	Output I/O NO.				
R5	DEC	10	PWM cycle	R300	DEC	3	PID Work Status
R6	DEC	1	Output mode	R301	DEC	1	AT Work Status
				DR302	DEC	30	PV
DR100	DEC	0	Kp	DR500	FLOAT	0	[R500]
R102	DEC	0	Ti	R600	DEC	0	[R600]
R103	DEC	0	Td				
DR104	DEC	0	Bias	R35024	DEC	0	[R35024]
DR106	DEC	16383	MV output upper limit	R34776	DEC	0	[R34776]
DR108	DEC	0	MV output lower limit				
R110	DEC	0	PID Method				
R111	DEC	1	ensure AutoTuning is on				
R112	DEC	0	Does MOUT value change with MV				

FUN99 P		FUN99 P
TPCTL2	PID temperature control instruction 2	TPCTL2

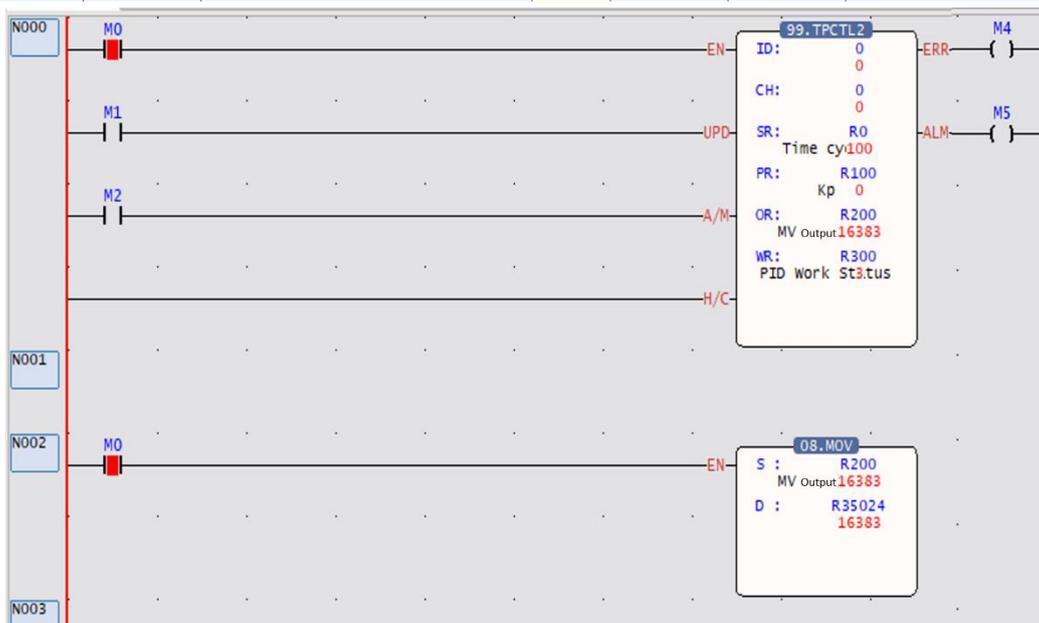| Example usage parameters and related definitions	The meaning of the corresponding parameters in the example
M0=Turn on temperature control	=1, trigger command
H/C= stands for heating/cooling control	=1, for heating control (ex: connected to a heating rod to control heating)
R300=PID state	=3, in Auto tuning
R301=AT state	=1, Auto tuning is running
DR42 = Programmed return value (PV)	=36.3 $^{\circ}$C/$^{\circ}$F
DR200=MV output value, for integer output	=16383, it is the output control value after instruction operation
R35024=OR register, This example is CH0 of M04DA output channel register	=16383 (the value transferred into R200 by instruction FUN8)

FUN99 P TPCTL2	PID temperature control instruction 2	FUN99 P TPCTL2

Step3 Auto tuning completed:

After Auto tuning is completed, the relevant parameters Kp, Ki, and Kd should have corresponding

parameters and Auto tuning status=3

As shown below:

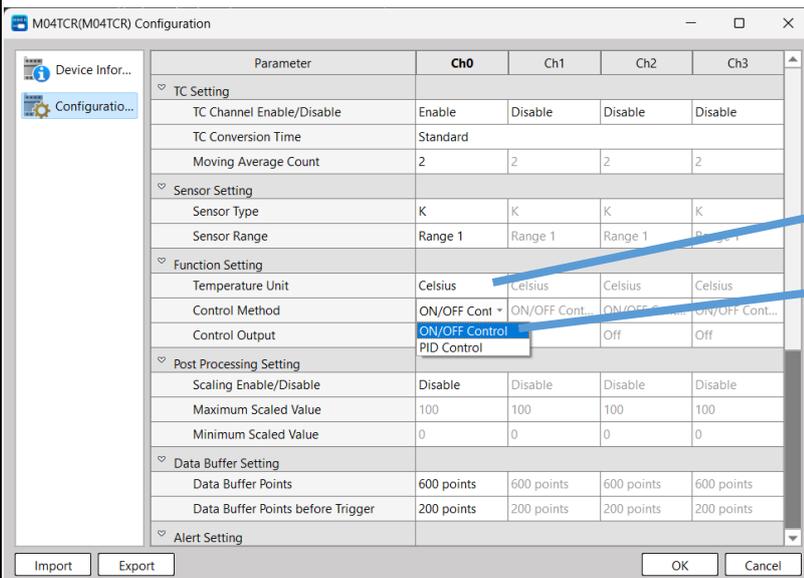| Name	Status	Data	Comment	Name	Status	Data	Comment
R0	DEC	100	Time cycle	DR200	DEC	16383	MV Output value return
DR1	DEC	500	Set Value	DR202	DEC	0	MOUT MV manual output value setting
R3	DEC	0	DEAD BAND				
R4	DEC	0	Output I/O NO.				
R5	DEC	10	PWM cycle	R300	DEC	1	PID Work Status
R6	DEC	1	Output mode	R301	DEC	3	AT Work Status
				DR302	DEC	30	PV
DR100	DEC	963	Kp	DR500	FLOAT	0	[R500]
R102	DEC	50	Ti	R600	DEC	0	[R600]
R103	DEC	1	Td				
DR104	DEC	0	Bias	R35024	DEC	16383	[R35024]
DR106	DEC	16383	MV output upper limit	R34776	DEC	0	[R34776]
DR108	DEC	0	MV output lower limit				
R110	DEC	0	PID Method				
R111	DEC	1	ensure AutoTuning is on				
R112	DEC	0	Does MOUT value change with MV				

FUN99 P TPCTL2	PID temperature control instruction 2	FUN99 P TPCTL2

Example usage parameters and related definitions	The meaning of the corresponding parameters in the example
R300=PID state	=1 (PID is executing)
R301=AT state	=3(AT completed)
R111=AT open	=1 (AT is on)
DR100=Kp, proportional item	=963 (for floating point output)
R102=Ki, integral time	=50, unit is second
R103=Kd, differential time	=1, unit is second
DR200=MV output value (for integer output)	=16383, it is the output control value after instruction operation

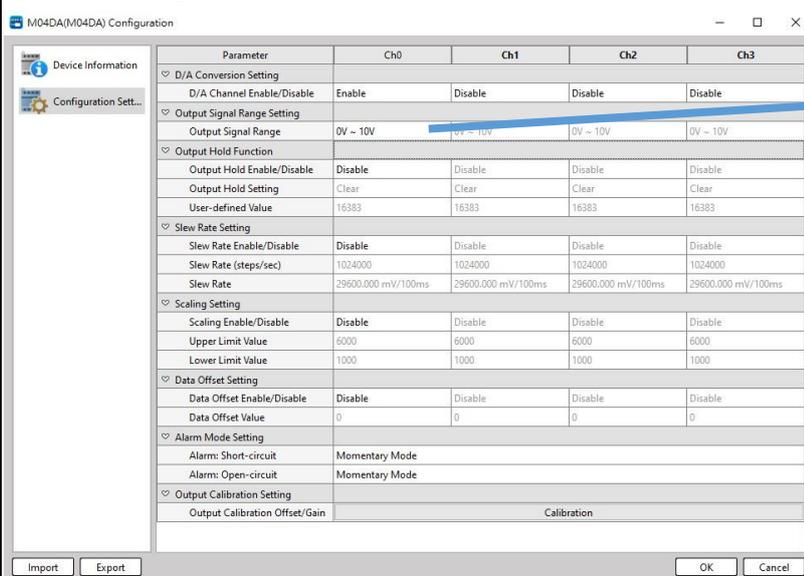| FUN99 P TPCTL2	PID temperature control instruction 2	FUN99 P TPCTL2
On/Off mode Example:		

Step0

Related settings of M04TC/ M04TCR module

Select °F/°C

On M04TC/M04TCR, select "ON/OFF Control"

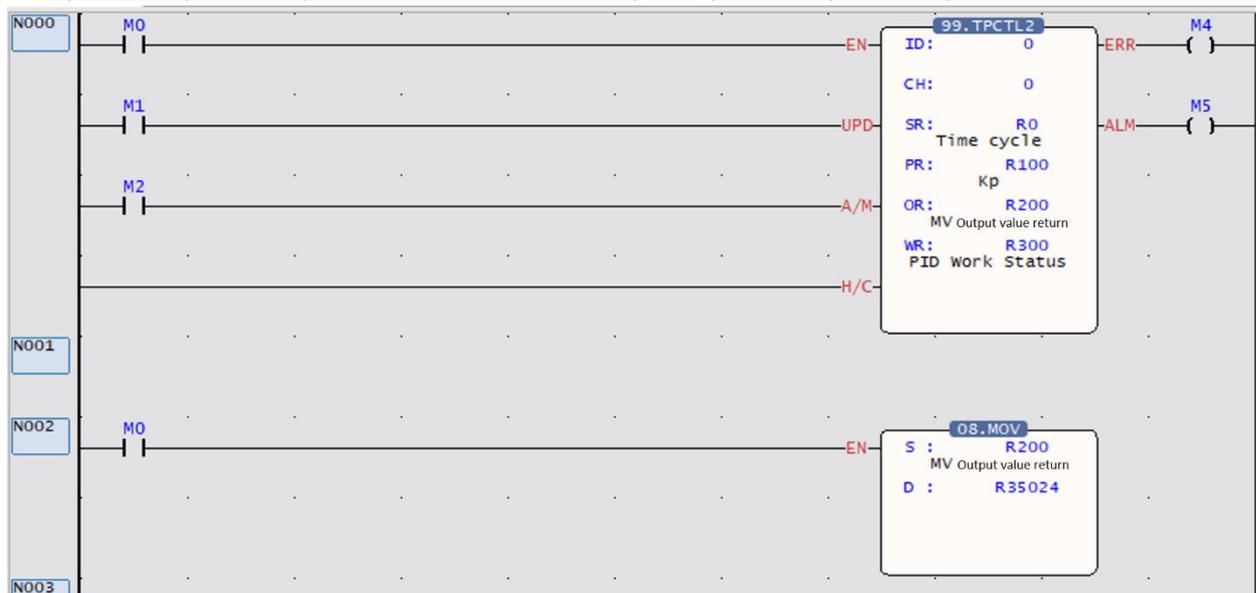Related settings of M04DA/M04DAR module

Turn on the AO

Take 0~10V as an example, you can also choose other range

M-Series PLC Software Function and Application User Manual

FUN99 P		FUN99 P
TPCTL2	PID temperature control instruction 2	TPCTL2

On/Off mode Example:	

Step1 Setting parameters: Setting parameters and ladder diagram program, the detailed content and explanation of the table are on the next page

Name	Status	Data	Comment	Name	Status	Data	Comment
R0	DEC	100	Time cycle	DR200	DEC	0	MV Output value return
DR1	DEC	500	Set Value	DR202	DEC	0	MOUT MV manual output value setting
R3	DEC	0	DEAD BAND				
R4	DEC	0	Output I/O NO.				
R5	DEC	10	PWM cycle	R300	DEC	0	PID Work Status
R6	DEC	1	Output mode	R301	DEC	0	AT Work Status
				DR302	DEC	30	PV
DR100	DEC	0	Kp	DR500	FLOAT	0	[R500]
R102	DEC	0	Ti	R600	DEC	0	[R600]
R103	DEC	0	Td				
DR104	DEC	0	Bias	R35024	DEC	0	[R35024]
DR106	DEC	16383	MV output upper limit	R34776	DEC	0	[R34776]
DR108	DEC	0	MV output lower limit				
R110	DEC	0	PID Method				
R111	DEC	0	ensure AutoTuning is on				
R112	DEC	0	Does MOUT value change with MV				

FUN99 P TPCTL2	PID temperature control instruction 2	FUN99 P TPCTL2

Example usage parameters and related definitions	The meaning of the corresponding parameters in the example
M0=Turn on temperature control	=1, trigger command
H/C = Heating Cooling Control	=1 (short connection), 1 for heating control; 0 for cooling control
R0=control cycle (unit 0.1S)	=100(10 seconds)
DR1=set value (unit 0.1 degree)	=500(50.0^{o}C/^{o}F), determined by the M04TC module setting
R3= dead band	=1, 0.1% of full scale, taking K type thermocouple as an example, when filling 1 in the temporary register, it means that 0.1% of full scale will be used as the dead band size , that is (1350-(-200)) *0.1% is approximately equal to 1.5oC, the upper limit of the dead zone is 55+1.5, and the lower limit is 55-1.5 (please refer to the thermocouple temperature range table for the full scale)
R5 = PWM control period	=10, control once every 10 seconds
R6=Output mode	=1 (Other output, namely MV output scratchpad output)
DR302=Programmed value return	=30 (3.0^{o}C/^{o}F)
DR106 = Output upper limit	=16383 (corresponding to the upper limit of the digital value of the M04DA module)
DR108 = Output lower limit	=0 (the lower limit of the digital value of the M04DA module)
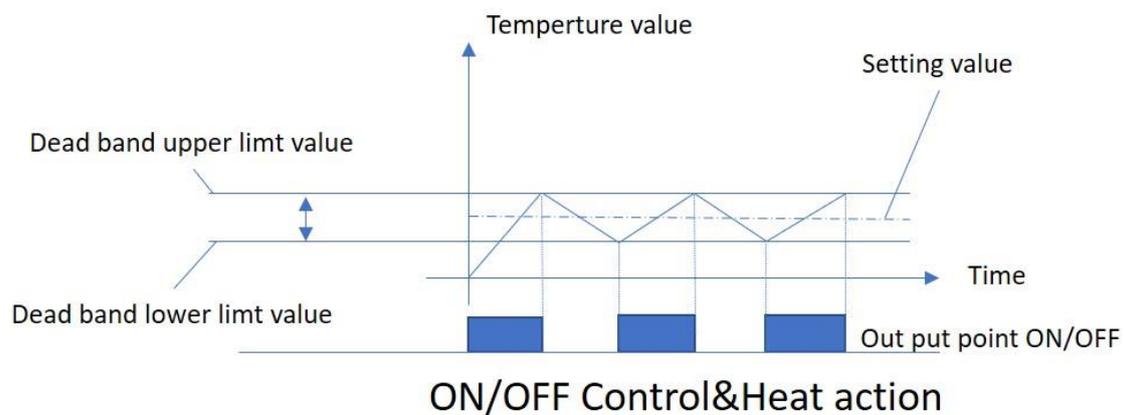
Schematic diagram of ON/OFF control action

13-2 General-Purpose PID Control Instruction Description and Examples

FUN38 PID2	PID 2		FUN38 PID2
Symbol			

<table>
<tr>
<td rowspan="2">
Ladder symbol
38P.PID2
Control — EN   ID   ERR — Communication error
Update — UPD   CH
Manual output/PID output — A/M   SR
forward output/reverse output — D/R   OR
PR
WR
</td>
<td>
ID: The number of the expansion module used as the input signal.

CH: Channel number for input signal.

SR: The starting register number of the program-controlled setting value, occupying 8 registers in total.

OR: PID output register number

PR: The starting register number of the parameter setting value, occupying 7 registers in total

WR: The initial number of the working register used by this command occupies 5 registers in total, and cannot be reused in other places.
</td>
</tr>
</table>

Operand \ Range	HR R0 | R34767	IR R34768 | R34895	SR R35280 | R43223	ROR R43224 | R47319	DR D0 | D11999	K
ID						0 ~ 127
CH	○	○	○	○	○	0 ~ 63
SR	○			○	○	
OR	○			○*	○	
PR	○			○	○	
WR	○			○	○	

Function Description	

FUN38 PID2	PID 2	FUN38 PID2

- The general-purpose PID2 command (FUN38) regards the currently measured external analog input value as a process variable (Process Variable, referred to as PV), and uses the set point (Set Point, referred to as SP) set by the user to process the variable through After the software PID mathematical calculation, the appropriate output control value is obtained through the D/A analog output module or reprocessed through other interfaces to control the controlled program within the user's desired setting range.

- The digitalize PID calculation formula is as follows:

$Mn = [Kp \times En] \sum_{0}^{n}[Kp \times Ti \times Ts \times En] - [Kp \times Td \times (PVn - PVn-1)/Ts] + Bias$

Mn = Control output at "n" time

Kp: Proportional term real number (Range: $\pm(1.8 \times 10^{-38} \sim 3.4 \times 10^{38})$)

Ti: Integral time constant (range: 0~3600, equivalent to 0~3600 Repeats/Seconds)

Td: Derivative time constant (range: 0~3600, equivalent to 0~3600 Seconds)

PVn: Program-controlled variable value at "n" time

PV n-1: The value of the program-controlled variable last time "n"

En: Error at "n" time = set value (SP) - program variable value (PVn) at "n" time

Ts: Interval time between PID operations (Range: 1~300, unit: 0.1s)

Bias: Bias output (Range: $\pm(1.8 \times 10^{-38} \sim 3.4 \times 10^{38})$)

FUN38	PID 2	FUN38
PID2		PID2

- When the control selection "A/M"=0, it means the manual control mode, and the PID operation will not be executed. Directly filling the output register (OR) can control the analog output to control the program-controlled response.

- When the control selection "A/M"=1, it represents the automatic control mode, the value of the output register (OR) is calculated by PID, and the program-controlled load is controlled through the analog output module or other interfaces to implement closed-loop program control.

- When the control selection "A/M"=1 and the operation direction "D/R"=1, the program control is forward PID control; that is, when the error (SP-PVn) is positive, the control output of the PID operation result, the larger the value is; when the error is negative, the control output of the PID calculation result is smaller.

- When the control selection "A / M" = 1 and the operation direction "D/R" = 0, the program control is reverse PID control; that is, when the error (SP-PVn) is positive, the control output of the PID operation result, the smaller the value is; when the error is negative, the control output of the PID operation result is larger.

- When the program control setting value or parameter setting value is wrong, the PID instruction will not be executed, and the error indicator "ERR"=1 is set.

- If you want to update the parameters, turn UPD OFF->ON after updating the content of the relevant register.

FUN38 PID2	PID 2	FUN38 PID2

SR Parameter	Word size	Description
TS	1	Time cycle size, unit: 0.1s(0.1s~30.0s)
SV	2	Set value, unit: 0.1 degree
DEAD BAND	1	Reach the dead band near the SV, the range is 0.1%~10.0%

● PID_Deadband setting range is 0~10.0% (input range). In PID control, this area is a bias (E) inactive area. When the temperature process value (PV) enters the dead band at the beginning, it will still operate PID normally. The operation is performed until the set value (SV) is crossed, then the E will be substituted into the formula with 0, and the normal PID operation will resume after crossing this area. For example, E in area A in the figure is regarded as 0.

FUN38 PID2	PID 2	FUN38 PID2

PR	Word size	Description
Kp	2(floating point)	Proportional item, real number
Ti	1	Integral time, 0~3600s
Td	1	Differential time, 0~3600s
Bias	2(floating point)	Proportional, real number
High output limit	2(floating point)	Integral time, 0~3600s
Low output limit	2(floating point)	Differential time, 0~3600s
PID Method	1	Output bias, real number
BUM	2	Smooth transfer enables (1: enable, 0: disable), it is a function of smooth transfer when manual to automatic control mode.
AT	1	Enable/Disable AT
MAUTO	1	MOUT values change with MV or not

- Kp, Ti, Td：PID parameter, to specify or turn on the automatic generation of AT and adjust it for use.

- Bias：Output bias, users can use it to increase or decrease the output value, but it will still be limited by the setting of the output range.

- High/Low output limit：Limitation of output range, to set the high and low limits of PID output. If the output lower limit is greater than or equal to the output upper limit, an error alarm will be issued.

- PID Method：Choose the appropriate PID algorithm.

- AT：Enable/disable Autotuning to get PID control parameters.

- MAUTO：To copy MV values to MOUT.

FUN38 PID2	PID 2	FUN38 PID2

SR Parameter	Word size	Description
TS	1	Time cycle size, unit: 0.1s(0.1s~30.0s)
SV	2	Set value, unit: 0.1 degree
DEAD BAND	1	Reach the dead band near the SV, the range is 0.1%~10.0%

● PID_Deadband setting range is 0~10.0% (input range). In PID control, this area is a bias (E) inactive area. When the temperature process value (PV) enters the dead band at the beginning, it will still operate PID normally. The operation is performed until the set value (SV) is crossed, then the E will be substituted into the formula with 0, and the normal PID operation will resume after crossing this area. For example, E in area A in the figure is regarded as 0.
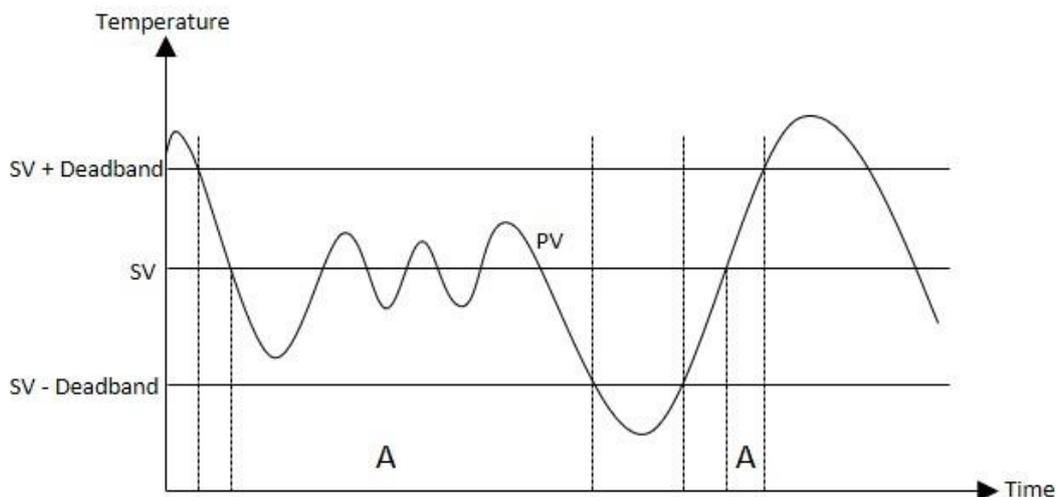
FUN38 PID2	PID 2	FUN38 PID2

WR	Word size	Description
PID Operating State	1	=0, Idle =1, Working =2, Error =3, AT now
AT Working State	1	=0, Idle =1, Running =2, Error =3, Finish =4, Time out
PV	2	Programmed return value

OR	Word size	Description
MV	2(floating point)	Report of output values
MOUT	2(floating point)	Setting of Manual Output Values (MV)

FUN38 PID2	PID 2	FUN38 PID2
Auto tuning Example:	SCR example, this is an example of M04DA analog output and M04AD analog input module	

Step0

Related settings of M04DA/ M04DAR module

Open the conversion channel of the analog input

Take 0~10V as an example, you can also choose other range

Related settings of M04DA/ M04DAR module

Turn on the AO output

Take 0~10V as an example, you can also choose other range

FUN38 PID2	PID 2	FUN38 PID2

Step1 Setting parameters: Setting parameters and ladder diagram program, the detailed content and explanation of the table are on the next page.

Name	Status	Data	Comment	Name	Status	Data	Comment
R1000	DEC	10	Time cycle	DR1200	FLOAT	16383	MV
DR1001	DEC	500	Set value	DR1202	DEC	0	MOUT
DR1003	DEC	0	DEAD BAND				
DR1100	DEC	0	Kp	R1300	DEC	0	PID Work Status
R1102	DEC	0	Ti	R1301	DEC	0	AT Work Status
R1103	DEC	0	Td	DR1302	DEC	10	PV
DR1104	DEC	0	Bias				
DR1106	DEC	16383	MV output upper limit				
DR1108	DEC	0	MV output lower limit				
R1110	DEC	0	PID Method				
R1111	DEC	0	BUM				
R1112	DEC	1	AT enable				
R1113	DEC	0	MAUTO				

```
  M0                                    ┌──────38.PID2──────┐        M11
──┤├───────────────────────────────EN──┤ID:          2     ├─ERR──( )
                                        │             2     │
                                        │CH:          0     │
  M7                                    │             0     │
──┤├───────────────────────────────UPD─┤SR:       R1000    │
                                        │   Time cyc10      │
                                        │OR:       R1200    │
  M9                                    │   MV -1024        │
──┤├───────────────────────────────A/M─┤PR:       R1100    │
                                        │   Kp   0          │
                                        │WR:       R1300    │
  M10                                   │PID work St0.tus   │
──┤├───────────────────────────────D/R─┤                   │
                                        └───────────────────┘

  M0                                    ┌──────201.F->I─────┐        M110
──┤├───────────────────────────────EN──┤S :       R1200    ├─ERR──( )
                                        │   MV 16383        │
                                        │D :       R1600    │
                                        │          0        │
                                        └───────────────────┘

  M0                                    ┌──────08.MOV───────┐
──┤├───────────────────────────────EN──┤S :       R1600    │
                                        │          0        │
                                        │D :       R35024   │
                                        │          0        │
                                        └───────────────────┘
```

FUN38 PID2	PID 2	FUN38 PID2

Example usage parameters and related definitions	The meaning of the corresponding parameters in the example
R1000 = Control Period (unit is 0.1 second)	=10(10 seconds)
DR1001 = Set Value (unit 0.1 degree)	=500, the reading value of the module set by the command, take this example as the reading value of channel 0 with module ID 2
DR1106=Output upper limit	=16383 (corresponding to the upper limit of the digital value of the M04DA module)
DR1108=Output lower limit	=0 (corresponding to the lower limit of the digital value of the M04DA module)
R1112=AT ON	=1 (AT is on)
R1300=PID State	=0(Idle)
R1301=AT State	=0(Idle)
DR1302=Programmed Value Return	=10

The command H/C is short-circuited, which means that when there is output, it is heating control; if it is empty, it means cooling control.

After filling in the above setting values, you can turn M0 ON, trigger the command and perform Autotuning.

FUN38 PID2	PID 2	FUN38 PID2

In Step2 Auto tuning:

During Auto tuning, you only need to wait for relevant parameters (Kp, Ki, Kd appear, Auto tuning status = 3, that is, Tune is completed, you can enter Step 3), and Error will be output if it exceeds 2 hours.

As shown below:

Name	Status	Data	Comment	Name	Status	Data	Comment
R1000	DEC	10	Time cycle	DR1200	FLOAT	16383	MV
DR1001	DEC	500	Set value	DR1202	DEC	0	MOUT
DR1003	DEC	0	DEAD BAND				
DR1100	DEC	0	Kp	R1300	DEC	3	PID Work Status
R1102	DEC	0	Ti	R1301	DEC	1	AT Work Status
R1103	DEC	0	Td	DR1302	DEC	10	PV
DR1104	DEC	0	Bias				
DR1106	DEC	16383	MV output upper limit				
DR1108	DEC	0	MV output lower limit				
R1110	DEC	0	PID Method				
R1111	DEC	0	BUM				
R1112	DEC	1	AT enable				
R1113	DEC	0	MAUTO				

FUN38 PID2	PID 2	FUN38 PID2

Example usage parameters and related definitions	The meaning of the corresponding parameters in the example
M0=Enable PID control =1, trigger command	M0=Enable PID control =1, trigger command
D/R= stands for forward/reverse control	=1, for positive control (ex: AO voltage rise)
R1300=PID state	=3, Auto tuning
R1301=AT state	=1, Auto tuning executing
DR1302 = Programmed return value (PV)	=10
DR200=MV output value, output as floating-point number	=16383, it is the output control value after instruction operation
R35024=OR register, This example is CH0 of M04DA output channel register	=16383 (the value of R1600 converted into an integer by instruction FUN8 into R1600 by instruction FUN201)

FUN38 PID2	PID 2	FUN38 PID2

Step3 Auto tuning completed:

After Auto tuning is completed, the relevant parameters Kp, Ki, and Kd should have corresponding parameters and Auto tuning status=3

As shown below:

Name	Status	Data	Comment	Name	Status	Data	Comment
R1000	DEC	10	Time cycle	DR1200	FLOAT	16383	MV
DR1001	DEC	500	Set value	DR1202	DEC	0	MOUT
DR1003	DEC	0	DEAD BAND				
DR1100	DEC	963	Kp	R1300	DEC	1	PID Work Status
R1102	DEC	50	Ti	R1301	DEC	3	AT Work Status
R1103	DEC	1	Td	DR1302	DEC	10	PV
DR1104	DEC	0	Bias				
DR1106	DEC	16383	MV output upper limit				
DR1108	DEC	0	MV output lower limit				
R1110	DEC	0	PID Method				
R1111	DEC	0	BUM				
R1112	DEC	1	AT enable				
R1113	DEC	0	MAUTO				

FUN38 PID2	PID 2	FUN38 PID2

Example usage parameters and related definitions	The meaning of the corresponding parameters in the example
R300=PID state	=1 (PID is executing)
R301=AT state	=3(AT completed)
R111=AT open	=1 (AT is on)
DR100=Kp, proportional item	=963 (for floating point output)
R102=Ki, integral time	=50, unit is second
R103=Kd, differential time	=1, unit is second
DR200=MV output value (for integer output)	=16383, it is the output control value after instruction operation

14

Updating Host and Module Firmware

14-1 Software Updating Process

14-1-1 Host

Notice

- Applicable to all host modules.

- During the updating process, do not attempt to shut down the power or remove the USB or the network plug.

- Repeat the steps if failure occurs when updating the modules.

- If unexpected update failures cause the host to fail to boot, please refer to Section 14-2-1.

Step 1

Set the Dip Switch of the target host to the "STOP" position. Connect your host computer and computer via USB or network cable, and use the "PLC Status" in the UperLogic software to confirm the current version. The PLC firmware version in the picture: V0.2.90, MC firmware version V0.5.21.
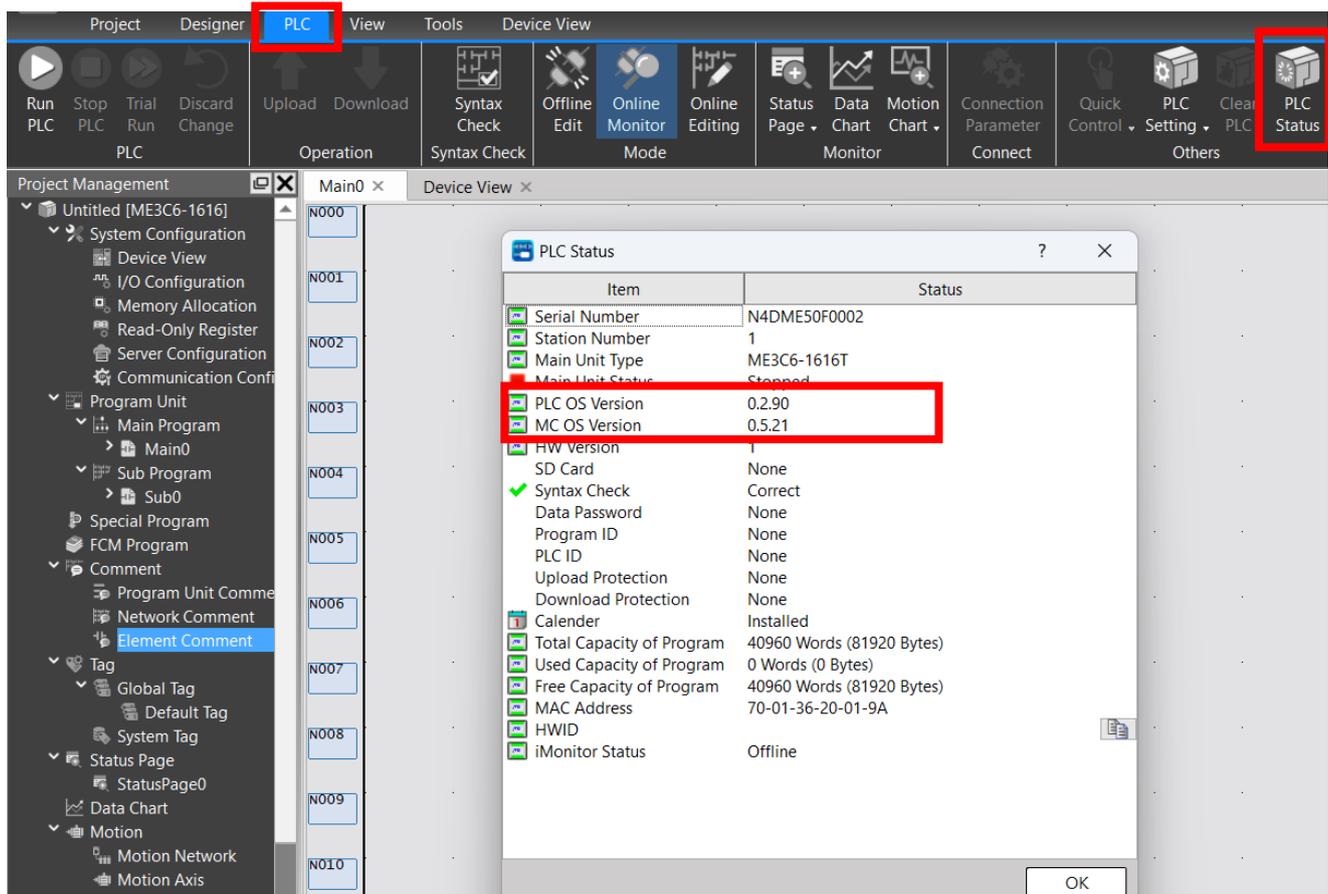
Figure 92 Information of firmware version

Step 2

Select "PLC Setting" and then click the option in the lower side "Firmware Update".
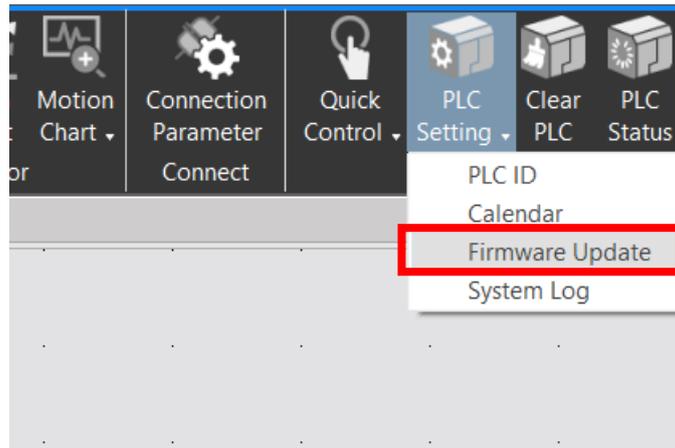
Figure 93 Selection of firmware update

Step 3

In the pop-up window, select the OS file to be updated.

Per the figure, the "m_plc_HW01_enc_v0_3_2_v0_5_22_00000000.os" file is selected.

Figure 94 Review and select PLC firmware file

Step 4

After opening, the system will start the update and the progress bar will be displayed during the update process. After that, a notification will be shown.
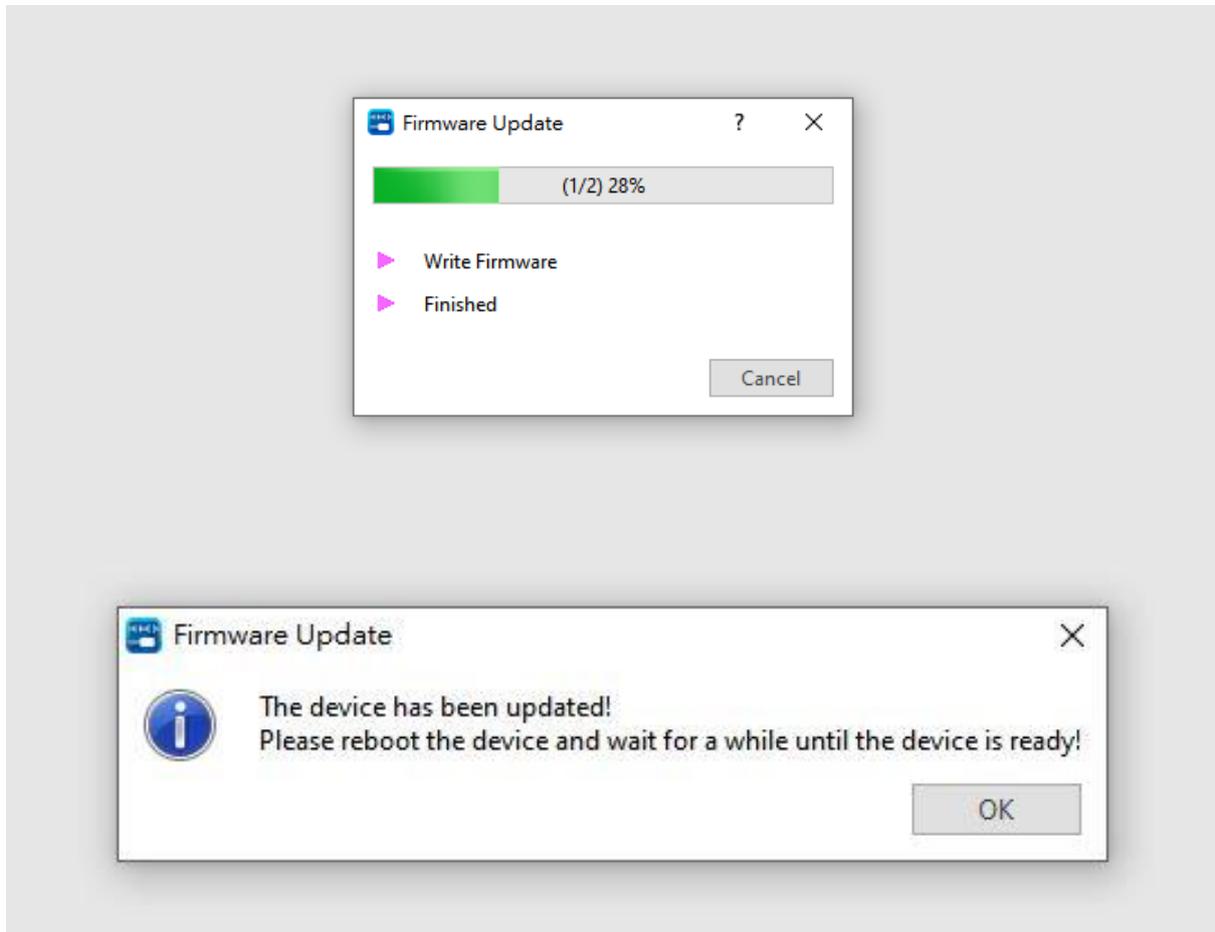
Figure 95 Notification of update progress bar and update success

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Step 5

After being updated, it can be used normally without restarting the power and then click "PLC status" to confirm that the version has been updated.
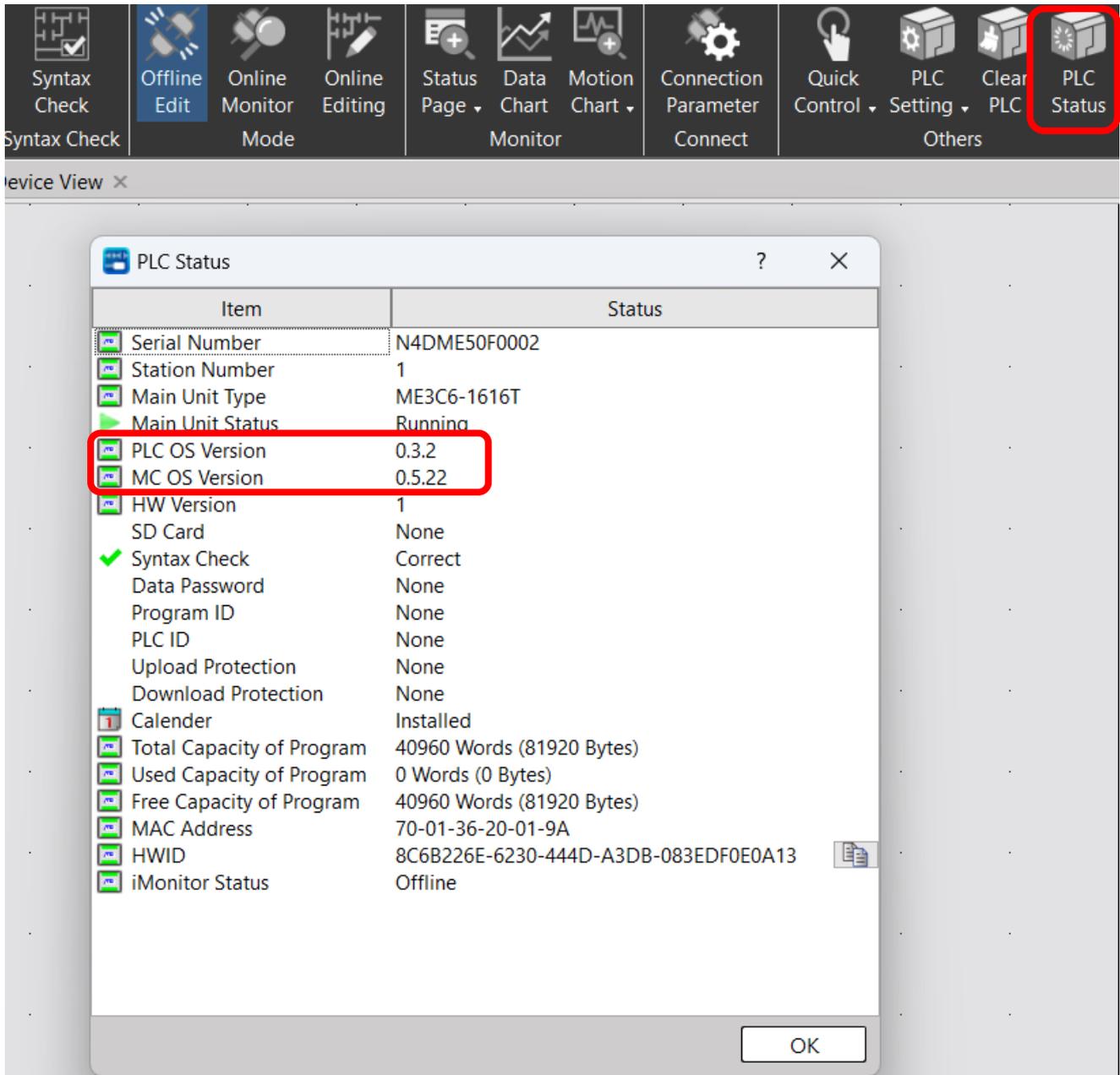
Figure 96 Update success of firmware version

14-1-2 Expansion Module

Notice

- Applicable to all host modules.

- During the updating process, do not attempt to shut down the power or remove the USB or the network plug.

- Repeat the steps if failure occurs when updating the modules.

- If unexpected update failures cause the host to fail to boot, please refer to Section 14-2-2.

Step 1

Set the Dip Switch of the target host to the "STOP" position. Connect your host computer and computer via USB or network cable.

Step 2

Select "Upload"
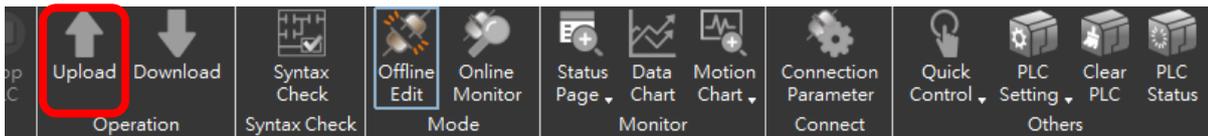
Figure 99 Select "Upload"

Step 3

Select "Expansion Data" and "Motion Program" to upload.
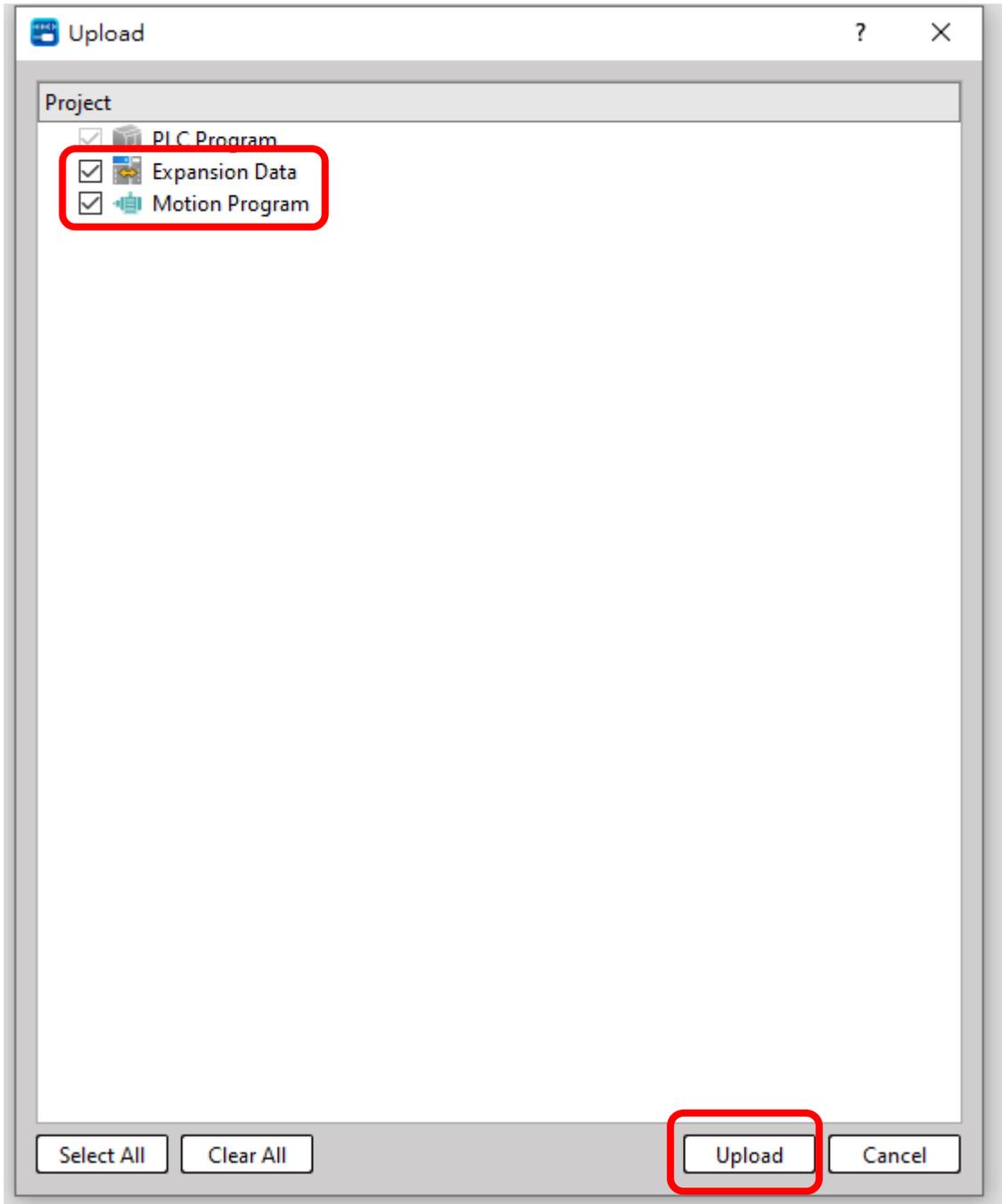
Figure 102 Upload expansion and motion data

Step 4

After selecting "Online Monitor", please confirm the PLC is under shutdown status in order to update the expansion module firmware.
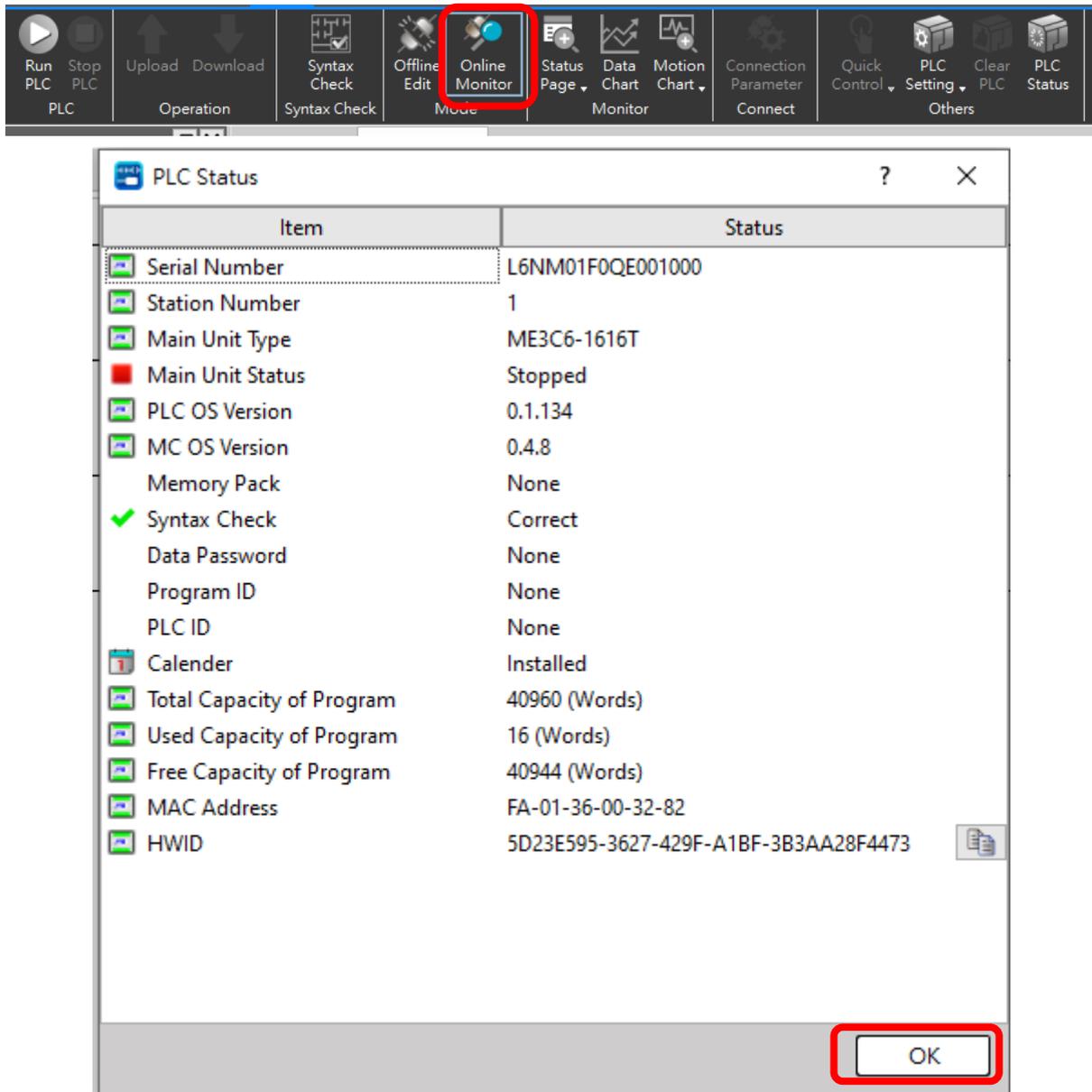
Figure 103 Online monitoring

Step 5

Click "Project" ->Equipment picture.
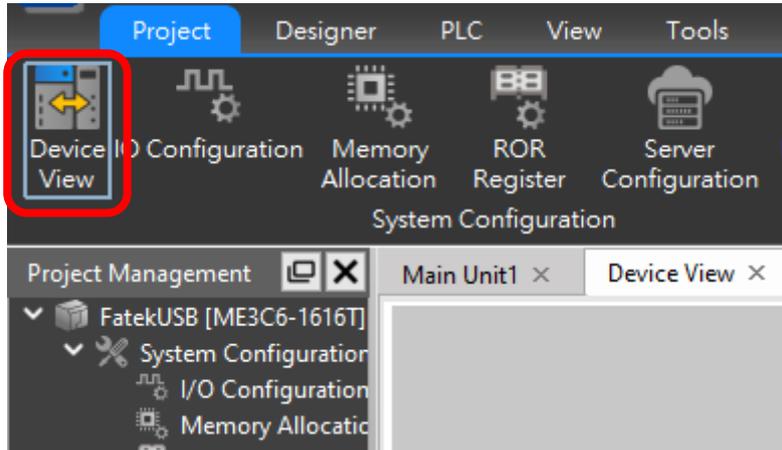
Figure 104 Find the equipment picture in "Project"

Step 6

Select the module to be upgraded. (Here takes M04AD as an example)
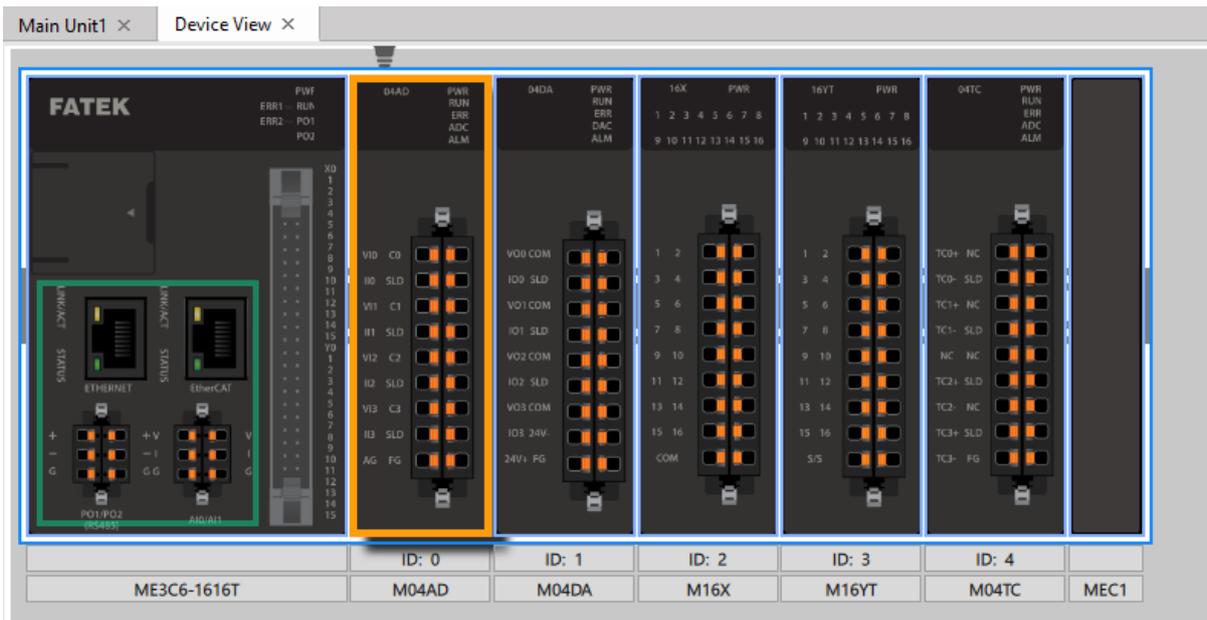
Figure 105 Select the target module

Step 7

In the pop-up window, select the firmware version and then click "Upgrade".
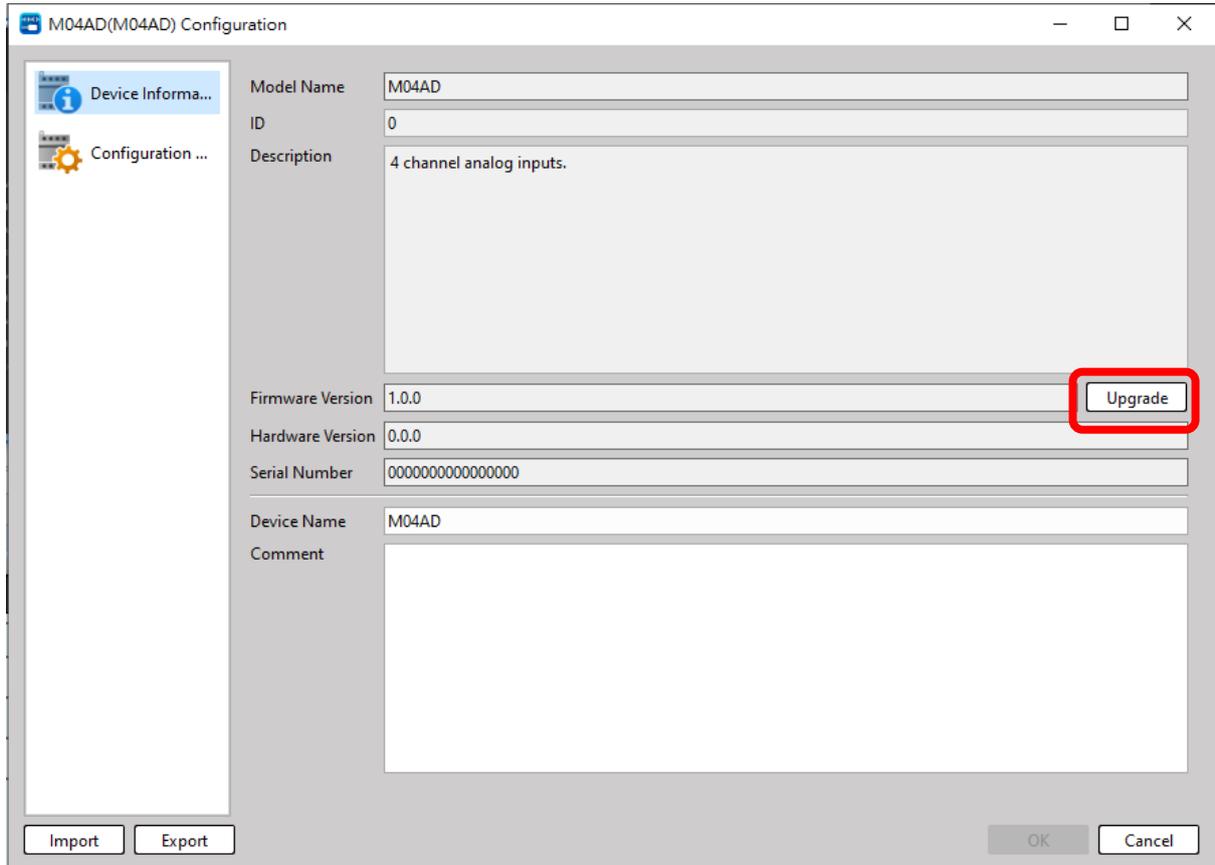
Figure 106 Click the module firmware to be upgraded

Step 8

In the pop-up window, tick the OS module to be updated until all of the modules that will be updated are selected.
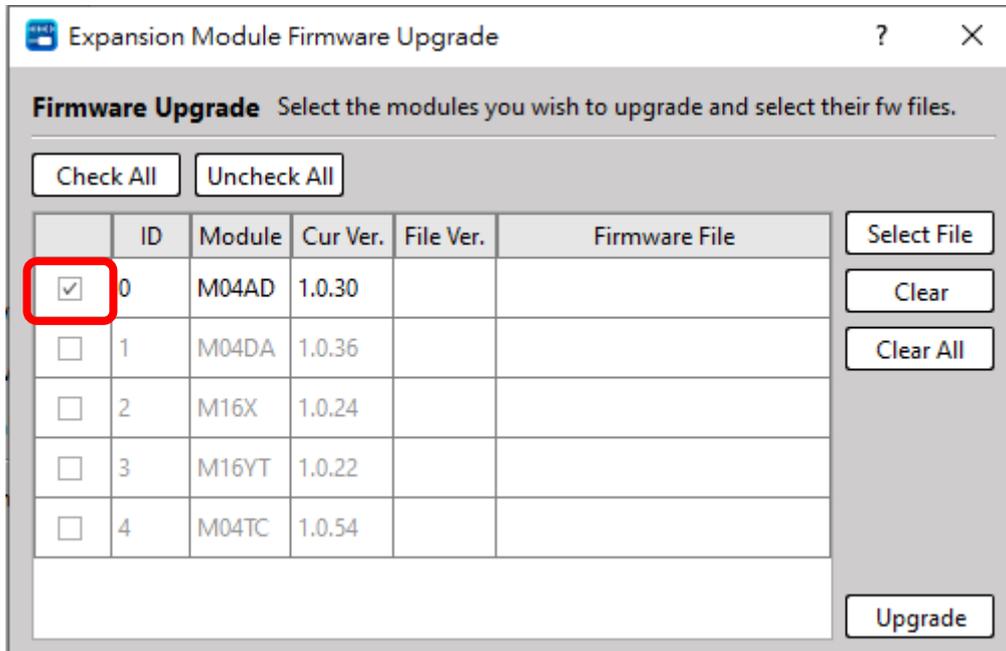
Figure 107 Tick the module to be upgraded

Step 9

Click in the column of all modules to update the OS to select the file
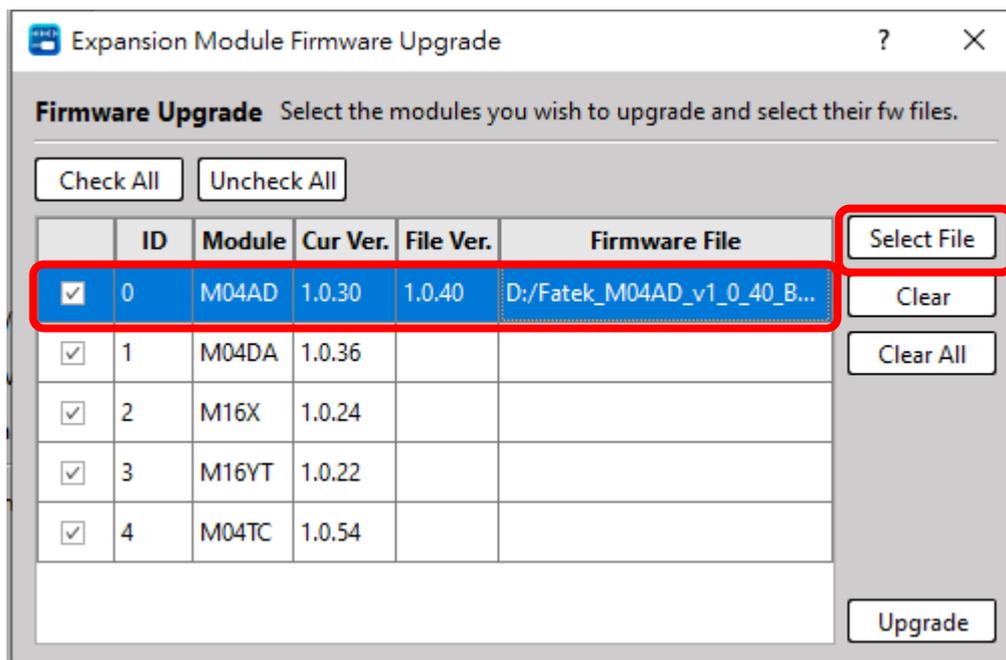
Figure 108 Select firmware file

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Step 10

Click "Upgrade". Do not attempt to shut down the power or remove the USB or the network wire before new window pops up.
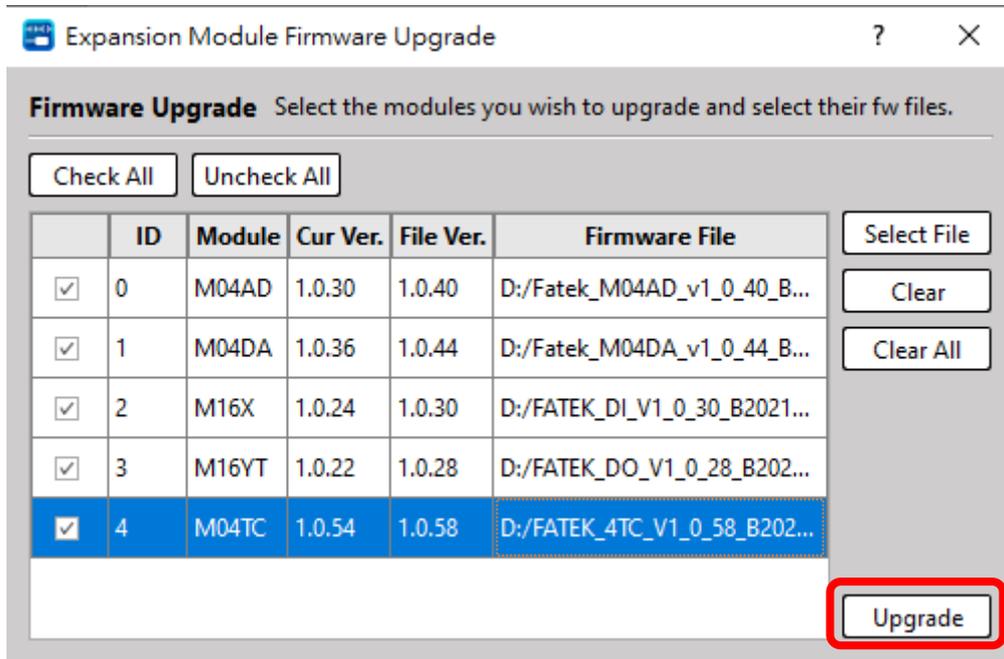
Figure 110 Execution of upgrading

The following window will pop up after completing the up, notifying that the update has been done.
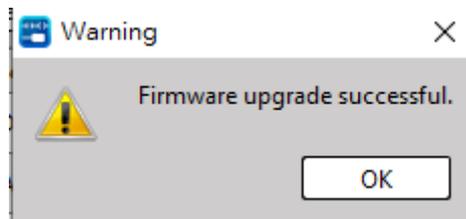
Figure 111 Notifying window after upgrade

M-Series PLC Software Function and Application User Manual

14-2-2 Expansion Module

Notice

- Applicable to all host modules.
- During the updating process, do not attempt to shut down the power .
- Repeat the steps if failure occurs when updating the modules.
- Firmware rescue can only be performed on a single module.

Firmware Update via Memory Card

Step 1 Write the expansion module firmware update file to the memory card.

Step 2 Power on the host normally, and confirm that the host is in shutdown mode.

Step 3 Insert the memory card for firmware update.

Step 4 Check the LED status. When updating, the memory card execution light will flash, and the flashing ends and the normal LED display returns to indicate that the update is complete.

Step 5 Use UperLogic software to connect to the host, and confirm that the firmware version of the expansion module has been successfully updated.

Firmware Rescue via Memory Card

Step 1 Write the expansion module firmware update file to the memory card.

Step 2 Power on the host normally, and confirm that the host is in shutdown mode.

Step 3 Insert the memory card for firmware update.

Step 4 Check the LED status. When updating, the memory card execution light will flash, and the flashing ends and the normal LED display returns to indicate that the update is complete.

Step 5 Use UperLogic software to connect to the host, and confirm that the firmware version of the expansion module has been successfully updated.

15

Expansion Modules

I/O Address of Analog Input/Output Modules

The input point numbers of the analog I/O modules are calculated from the module closest to the PLC host, and the channel values of each module correspond to the I/O registers IR (starting at R34768) and OR (starting at R35024) inside the PLC.), but the total number of IR/OR varies with different models, please refer to the system specifications and model descriptions. In order to facilitate the user's use and save the effort of calculation, the software of UperLogic will automatically detect and calculate it after connecting with the PLC. In addition, the resolution will be different depending on the model of the module, therefore, it may occupy 16-bit or 32-bit of value space.

Module ID

Each module connected to the PLC will get a unique identification code ID, the number starts from 0. This number will be used for the ID item in the related command to control the specified module, and the user can obtain this information from the device view of UperLogic.

Module Types

There are three types of connection between the module and the PLC: left ultra-high speed, right ultra-high speed, and right high-speed bus. Among them, the right ultra-high speed is used for a large amount of data or high-speed data exchange requirements. It can only connect up to six units and must be connected directly. Continuously connected to the right side of the PLC. The current module related information is as follows.

Connection Types	Modules
Right High-Speed	M16X/M16Y/M1616XY
	M04AD/M04ADR
	M04DA/M04DAR
	M0202AH
	M04TC/M04TCR
	M02LC/M02LCR
Right Ultra-High Speed	MHCM25/MHCM55
Left Ultra-High Speed	-

System-Related Register

The system provides two special register information for modules: heartbeat detection and current points. Each bit of the heartbeat register corresponds to a module, and when it is 1, it means that the communication is safe; the system will automatically detect the heartbeat status of all modules, and will alarm when it is abnormal.

Register	Register No.
Expansion module heartbeat detection (0 ~ 15)	R35374
Expansion module heartbeat detection (16 ~ 31)	R35375
Expansion module heartbeat detection (32 ~ 47)	R35376
Expansion module heartbeat detection (48 ~ 63)	R35377
Expansion AI points	R35378
Expansion AO points	R35379
Expansion DI points	R35380
Expansion DO points	R35381

15-1 Communication Module

The M-series host has two built-in RS-485 serial ports. If it is still not enough, you can add a communication module (MHCM) to increase the number of communication ports to 14.

MHCM is FATEK's Communication Module, in which MHCM25/55 modules are equipped with two ports for use; MHCM25 has RS232 and RS485 interfaces, while MHCM55 has two sets of RS485 interfaces. Each port has a master/slave communication function at the same time, and supports Modbus ASCII/RTU and user-defined communication protocols. The currently used protocol needs to be configured through software. If you want to configure it as a Modbus master station, you need to set the communication commands with each slave station; if you want to configure it as a Modbus slave station, you need to set Modbus map to correspond to the relationship between the standard Modbus memory and FATEK PLC memory; if the configuration is a user-defined protocol, it is necessary to set the communication protocol (protocol command) with each device, and each communication protocol type can be set to send , receiving, sending and receiving three types of communication, the packet can be defined by the user, and can be defined as constants, check codes, PLC registers... and other different types. The user-defined protocol enables PLC to freely expand and support more communication devices. The naming method of the communication module is as mentioned above. The 2 of MHCM represents the RS-232 interface, and the 5 represents the RS-485 interface. The specifications and appearance are as follows.

Model No./Item		Specifications
MHCM55		2 units of RS485 communication ports (Port A + Port B) and they are provided with TX and TX indicator lamps.
MHCM25		One unit of RS232 communication port (Port A)+ one unit of RS485 communication port (Port B) and they are provided with TX and RX indicator lamps.
RS232 spec.	Mechanical	DB-9F standard socket
	Electrical	EIA RS232 standard specification
RS485 spec.	Mechanical	4-PIN EU-spec terminal board
	Electrical	The EIA RS485 standard specifications and the built-in terminal resistance shall be selected with the Dip Switch.

● Two RS485 communication ports
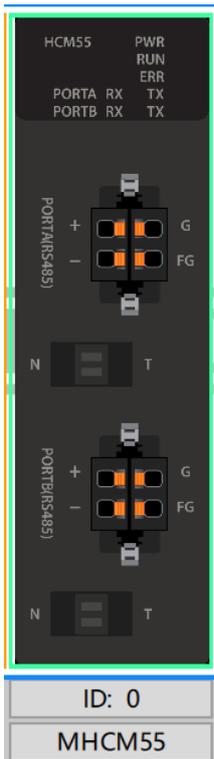
〔MHCM55〕
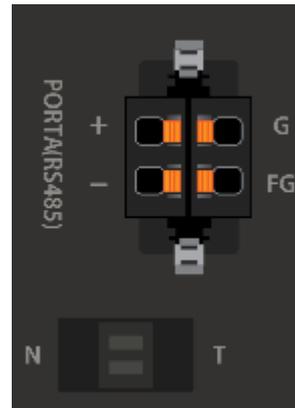
Communication port pin

● RS232 + RS485 communication ports
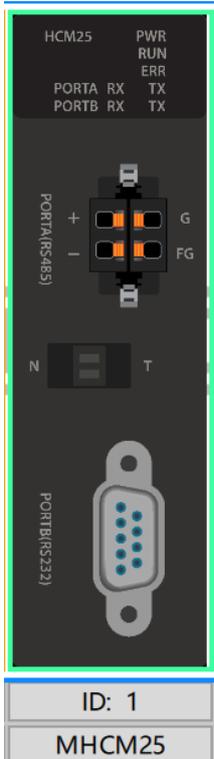
〔MHCM25〕
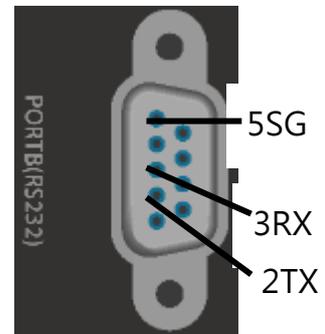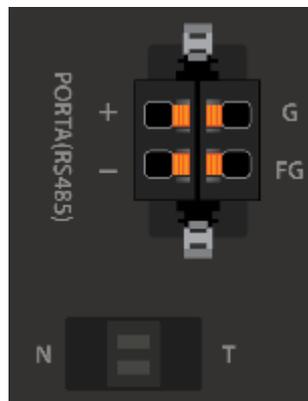
Communication port pin

15-1-1 MHCM55

Performance specifications

Technical specifications / Item	MHCM55
Connection interface	RS-485 1 channel RS-485 1 channel
Connection port	4 pin EU-spec terminal board * 2 Port
Transmission speed	485: Max. 230400bps
Max. cable length	485 (1200m)
Disconnection method	Internal power isolation
Internal current consumption	Below 200 mA
Weight	About 190 g

Table 27 Performance specifications of MHCM55

Setting RS485 terminal resistance
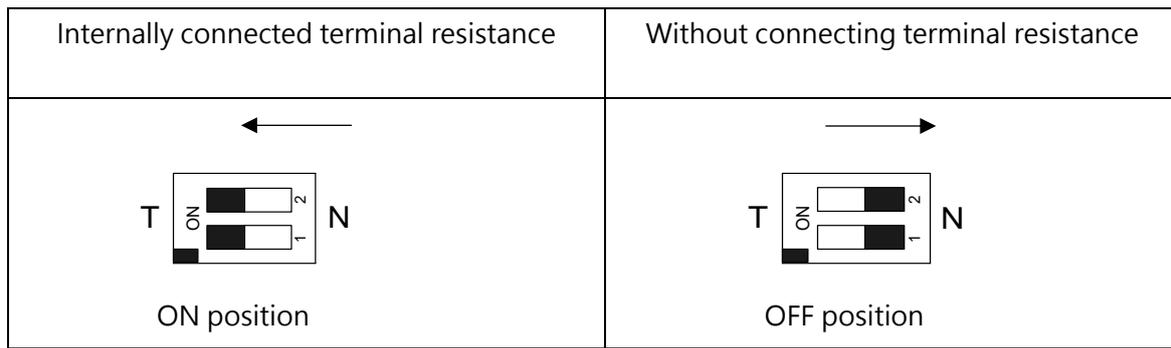
Internally connected terminal resistance	Without connecting terminal resistance
ON position	OFF position

Upon delivery, the communication parameters will be preset as below:

Communication setting	Preset value
Baud rate	9600bps
Data bit number	8 Bits
Parity checking	Even
Stopping bit number	1 Bit

Table 28 Preset value of MHCM55 communication setting

15-1-2 MHCM25

Performance specifications

Item \ Technical Spec.	MHCM25
Connection interface	RS-232C 1 channel RS-485 1 channel
Connection port	4 pin EU-spec terminal board* 2 Ports
Transmission speed	232-max. 115200bps 422/485- max. 230400bps
Max. cable length	RS-232C (15m) 422/485 (1200m)
Isolation method	Internal power isolation
Internal current consumption	Below 200 mA
Weight	About 190 g

Table 29 Performance specifications of MHCM55

Setting RS485 & RS232 terminal resistance
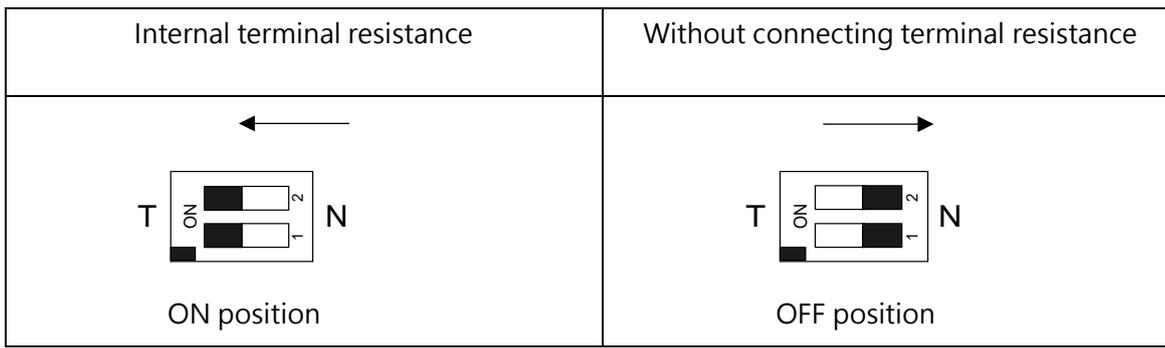
Internal terminal resistance	Without connecting terminal resistance
← T [ON ■ / 2, 1] N ON position	→ T [ON / ■ 2, 1] N OFF position

Upon delivery, the communication parameters will be preset as below:

Communication setting	Preset value
Baud rate	9600bps
Data bit number	8 Bits
Parity checking	Even
Stopping bit number	1 Bit

Table 30 Preset value of MHCM55 communication setting

15-1-3 Communication mode

The MHCM module can configure Modbus or user-defined value communication protocols for different ports, and different communication protocols and communication parameters can be set between ports. In the Modbus protocol, it will be divided into Master Station and Slave Station for option by the user.

15-1-4 State Register

Find the information of the HCM module from the device monitor

Click [Project] → [Device Window] → [Device Monitor] in the execution function bar, and the device monitoring window on the right will appear:
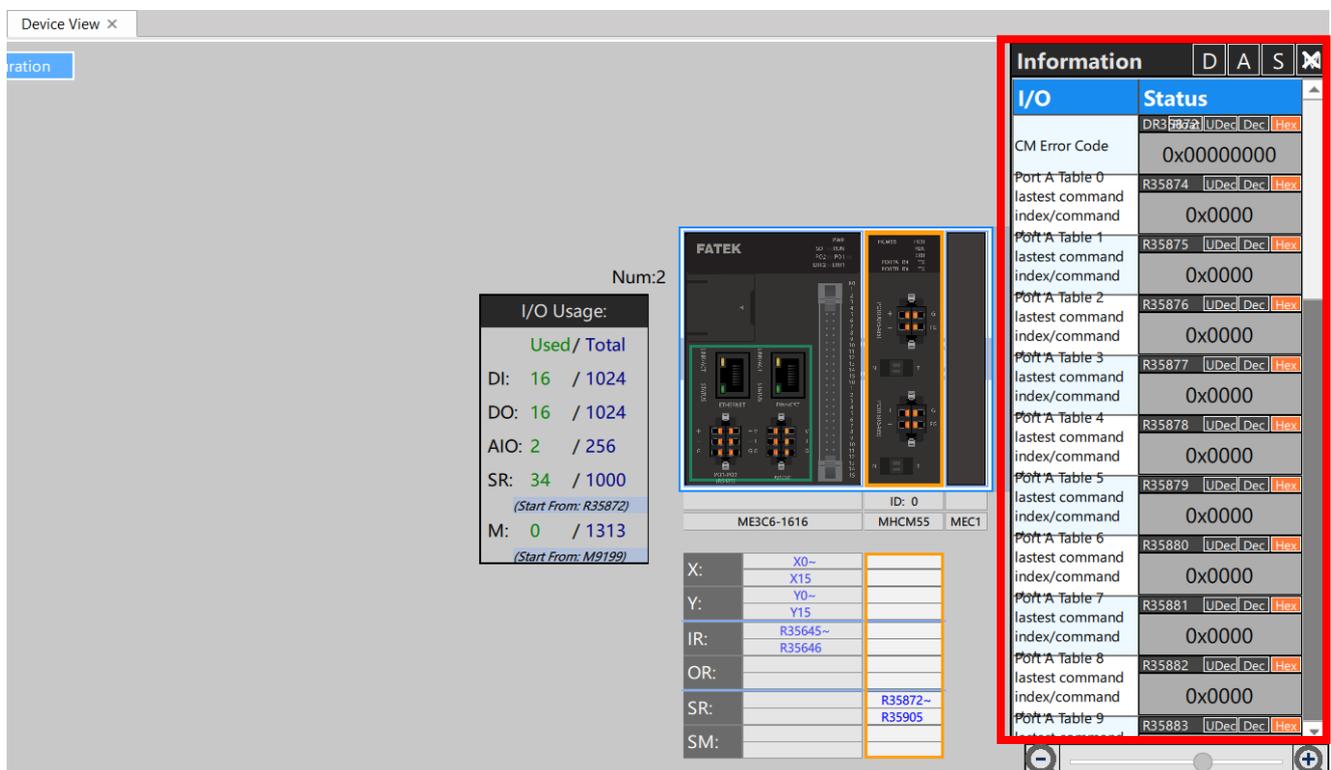
Figure 116 Device monitoring

The state register of automatic configuration shows the communication connection status of each table and each port, and the status code definition is as follows.

Status Code	Description
0	Normal operation
1	Receive overtime
2	Packet error
Other	Reserve

15-1-5 Modbus Communication Protocol (Master Station)

Modbus Master Station Illustrative Table

The Modbus communication protocol supports RTU/ASUII mode. When serving as the Master Station, if should be configured with Modbus table, communication table and order. Based on the order received, the CM module will transmit commands to the Slave Station sequentially and then wait for reply. The Modbus table shall support at most 16 sets of communication tables and teach communication table contains several orders that will be transmitted.

Figure 112 Modbus Master Station Illustrative Table

Status of Modbus Master Station Table

When executing according to Modbus table, the CM module will check the status of Communication Table #0 to Communication Table #16 sequentially and then execute the corresponding action. After executing the communication table, the CM module will start from Communication Table #1 again. The status of communication table can be controlled through PLC commands and such control can be set as "Run once", "Run cycling", "Stop".

Status of table	Action of status
Run once	Execute "Run once" and appoint the target communication table. Based on the priority order, transmit all of the orders contained in the communication table sequentially.
Run cycling	Continue executing the table and transmit all of the orders contained in the communication table sequentially.
Stop	Stop the execution. When restarting, it will start executing the table again.

Table 31 Status of Modbus Master Station Table

Modbus Master Station Time Parameter

When using the CM module as the Master Station, it can set 4 kinds of following time parameters for changing the behavior of Master Station and they are "Send delay time", "Send retest number", "Send retest interval" and "Receive overtime interval".

Time parameter	Unit	Master Station behavior
Send delay time	ms	After executing the order, the Master Station shall wait for the elapsing of "Send delay time" before executing next lot of orders.
Receive overtime interval	ms	If the Master Station does not receive the packet within the "Send overtime interval", then it will be judged as receiving overtime.
Send retest interval	ms	When receiving overtime occurs, the Master Station shall wait for the elapsing of "Send retest interval" before executing the retest.
Send retest number	Frequency	When receiving overtime occurs, the "Send retest number" will be regarded as the number of re-sending the order. If the retest number exceeds the "Send retest number", then the Master Station will execute next lot of orders directly.

Table 32 Modbus Master Station Time Parameter Table

Setting Modbus Master Station Table

The Modbus table supports at most 16 sets of communication tables and each communication table contains several orders that will be transmitted. In each communication table, the total number of orders shall not be over 256 individuals. When configuring the Modbus table, you need to set up communication table #0–#15 sequentially. In the communication table, each order shall define the ON/OFF, read/write, PLC type, and Modbus register type, etc. After being configured, you need to save the Modbus table in the module and the module will execute according to the communication table and the sequence of the orders. For detailed setting of order, please refer to the table below.
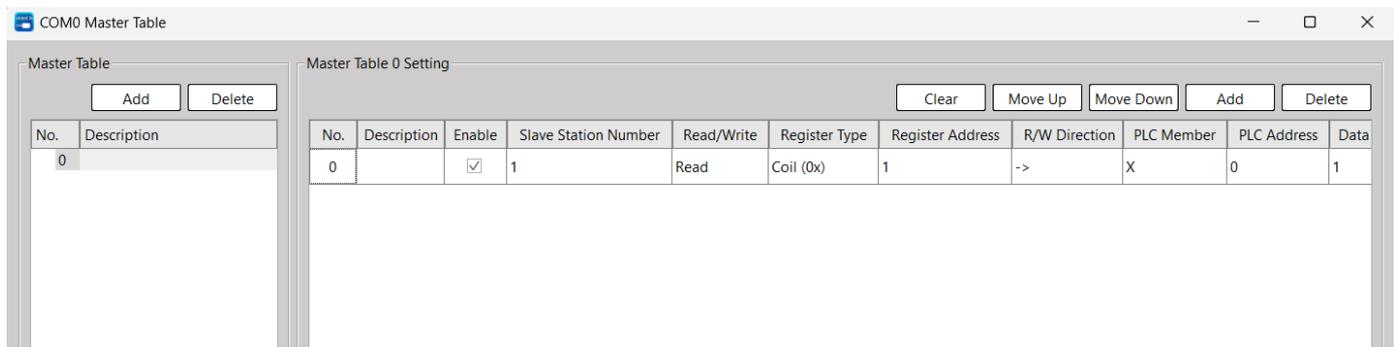
Order parameter	Description
Enable/disable	Enable/disable
Read/write	Order command is the writing or reading of the PLC data.
Slave Station No.	The number of Slave Station for the equipment receiving the order.
Type of Modbus register	The type of Modbus memory in the corresponding Slave Station when swapping the PLC data.
Address of Modbus register	The position of Modbus memory in the corresponding Slave Station.
PLC Master Station register	The type of the register in the corresponding PLC when swapping data with Slave Station.
PLC Master Station address	The position of the register in the corresponding PLC.
Data length	The size of the data that will be written or read.

Table 33 Communication parameters of Modbus Master Station

15-1-6 Modbus Communication Protocol (Slave Station)

Modbus Slave Station Illustrative Table

The Modbus communication protocol supports RTU/ASCII mode. When used as the Slave Station, it should be configured with Modbus address, in which the corresponding relationship between standard Modbus memory and FATEK PLC memory shall be defined. When used as the Slave Station, the CM module will be waiting for the commands continuously. After receiving the command, the CM will execute the data swapping between the PLC and external devices according to the Modbus address.
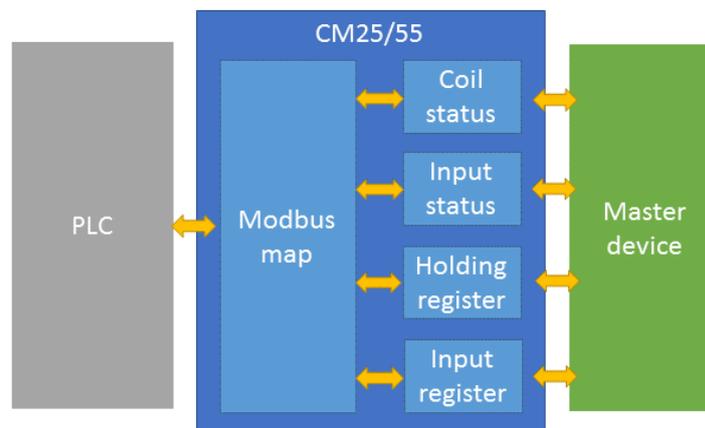
Figure 113 Slave Station Illustrative Table

Modbus Slave Station Time Parameter

When used as the Slave Station, the CM module will be allowed to set the time parameters for changing the behaviors of the Slave Station.

Time Parameter	Unit	Master Station Behavior
Reply delay time	ms	When receiving the command and after executing the command, the CM needs to wait for the "Reply delay time" and then transmit the message to Master Station.

Table 34 Modbus Slave Station Time Parameter

Setting Modbus Slave Station Address

When configuring the Modbus Slave Station address, you need to define the relationship between standard Modbus memory and PLC. There are 4 types of Modbus memory addresses that should be defined and they are Coil Address, Discrete Input Address, Storage Register Address and Input Register Address. In addition, you are also required to set up the type of PLC register, PLC address and data length, etc., in the table. After being configured, save the Modbus address in the module. Based on the received order and the imported Modbus address, the module will start the data swapping with external devices. For detailed Modbus address setting method, please refer to the table below.

Slave Station No.	Modbus addressing parameter	Description
0	Slave Station number	The number of Slave Station set by the CM module.
	Coil status addressing related register address	The coil status related position.
	Coil status addressing related PLC register type	The coil status related PLC register type.
	Coil status addressing related PLC address	The coil status related PLC register position.
	Coil status related data length	The coil status related data size.
1	Discrete input addressing related register address	The discrete input related position.
	Discrete input addressing related PLC register type	The discrete input related PLC register type.
	Discrete input addressing related PLC address	The discrete input related PLC register position.

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	Discrete input related data length	The discrete input related data size.
2	Storage register addressing related register address	The storage register related position.
	Storage register addressing related PLC register type	The storage register related PLC register type.
	Storage register addressing related PLC address	The storage register related PLC register position.
	Storage register data length	The storage register related data size.
3	Input register addressing related register address	The input register related position.
	Input register addressing related PLC register type	The input register related PLC register type.
	Input register addressing related PLC address	The input register related PLC register position.
	Input register related data length	Input register related data size.

Table 35 Address parameters of Modbus Slave Station

15-1-7 User-defined Communication Protocol

User-defined Illustrative Table

When setting as user-defined communication protocol (UD protocol), it should be configured with user defined table (UD table). The communication protocol table, communication setup table, user defined packet and user defined table shall support maximum 16 sets of communication protocol tables, with each communication protocol table containing several communication protocols that should be transmitted. Each communication protocol will be combined with the following 3 different types of communication packets and they are transmitted packet, received packet and transmitted & received packet.

The packet pool can support 32 sets of different packet format. The packet format can be defined by the user for classifying them into constant, check code and PLC register, etc. Through the user defined packet, the PLC will be allowed to communicate with other communication devices.

Based on the communication type, each communication protocol shall be allowed to select the outgoing packet and incoming packet from the packet pool. When executing the communication protocol, the module will transmit specific command to the external device or receive the command from such device according to the outgoing packet or the incoming packet.

Figure 114 User-defined Illustrative Table

User-defined Table Status

When running the user-defined table, the CM module will check the status of communication protocol Table #1 to Table #16 sequentially in order to execute corresponding behavior. After completing the desired table, the CM will start the checking from communication protocol Table #1 again. The status of communication protocol table can be controlled through the PLC command and the control method can be set as "Run once", "Run cycling" or "Stop".

Table status	Status behavior
Run once	Run the "Run once" and appoint the desired communication protocol. Based on the priority sequence, transmit or receive all of the communication protocols listed in the Communication Protocol Table.
Run cycling	Keep running the protocol. Based on the priority sequence, transmit or receive all of the communication protocols listed in the Communication Protocol Table.
Stop	Stop and then keep running the protocol upon starting.

Table 36 User-defined value table status

User-defined Time Parameters

When using the user-defined value as the Master Station, the CM module will be allowed to set up the following 4 types of time parameters to change the Master Station behavior and they are "Send delay time", "Send retest number", "Send retest interval" and "Receiving overtime interval".

Time parameter	Unit	Master Station behavior
Send delay time	ms	After running the communication protocol, the Master Station shall wait for the elapsing of "Send delay time" before running next lot of communication protocols.
Receiving overtime interval	ms	If the Master Station does not receive the packet within the "Send overtime interval", then it will be judged as receiving overtime.
Send retest interval	ms	When receiving overtime occurs, the Master Station shall wait for the elapsing of "Send retest interval" before executing the retest.
Send retest number	Frequency	When receiving overtime occurs, the "Send retest number" will be regarded as the number of re-sending the communication protocol. If the retest number exceeds the "Send retest number", then

		the Master Station will execute next lot of communication protocols directly.

Table 37 User-defined Time Parameters

Setting the User-defined Table

The user-defined table supports at most 16 sets of communication protocol tables and each communication protocol table contains several communication protocols that will be transmitted. In each communication protocol table, the total number of protocols shall not be over 256 individuals.

When configuring the user defined table, you need to set up communication protocol Table #1–#16 according to sequential order. In the communication protocol table, each communication protocol shall be defined with Enable/Disable, Send/Receive/Send & Receive, Tx packet and Rx packet, etc., respectively. After being configured, save the user defined table to the module and the module will run the protocols according to the Communication Protocol Table and the sequence of communication protocols. For detailed setting of communication protocol, please refer to the table below.

Communication protocol parameter	Description
Enable/Disable	Check if the communication protocol is enabled.
Packet Mode	Appoint the send, receive or send & receive mode
Tx packet	If the packet mode is send/send & receive mode, you may access the packet pool for selecting the packet format that will be sent.
Rx packet	If the packet mode is receive/send & receive mode, you may access the packet pool for selecting the packet format that will be received.

Figure 38 Setting the User-defined Table

Setting User-defined Packet Pool

The user-defined packet pool supports at most 32 sets of packets for selecting Tx packet or Rx packet when setting the communication protocol. Being composed of a variety of components, the packet allows the user to execute the setting flexibly as required so that the PLC will be expanded to support more communication devices.
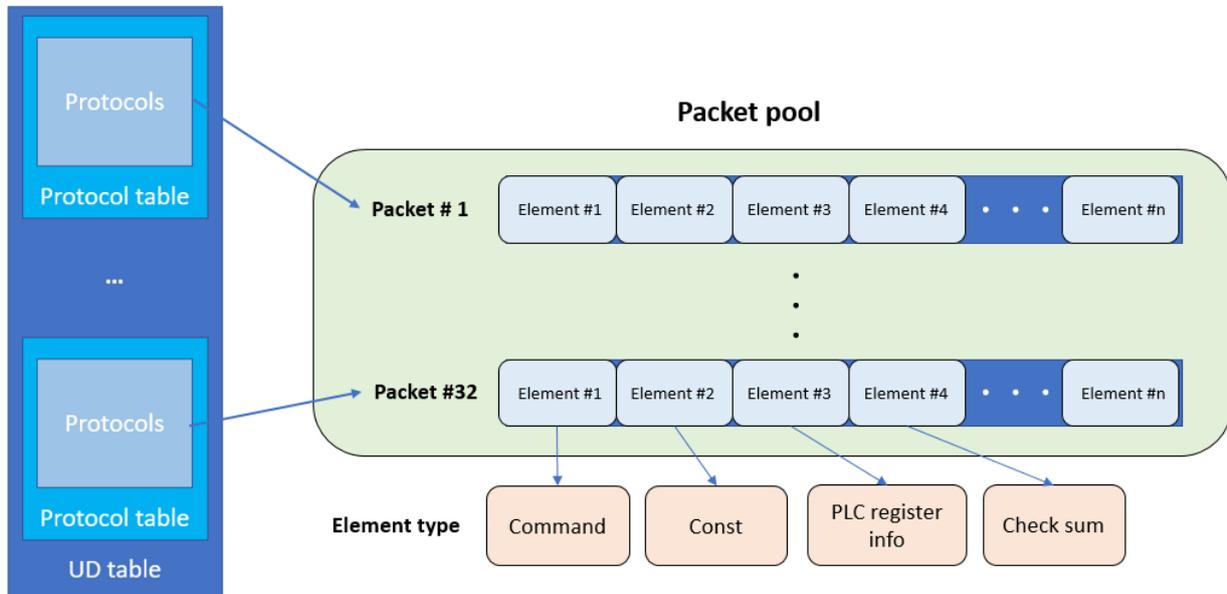
In the packet pool, the total number of components contained in all of the packets shall not be over 512 individuals.

The components can be defined as the following types such as order, constant, check code and PLC register.

Setting User-defined Component Type

Constant:

Set the appointed component as the fixed constant.

Order:

Set the appointed component as the control character.

Control Character	HEX
SOH	0x1
STX	0x2
ETX	0x3
EOT	0x4
ENQ	0x5
ACK	0x6
LF	0xA
CR	0xD
NAK	0x15
SYN	0x16
ETB	0x17
ESC	0x1B

Table 39 Control Character table

PLC register information:

Based on the binding type of Tx packet and Rx packet in the communication protocol, the software will determine whether to read or write in the PLC data in order to execute the data swapping.

If the packet is set as Tx packet, the software will read the PLC data according to the register action mode and then update it to the appointed component. If the packet is set as Rx packet, then the software will write the component data in the PLC register according to the register action mode. For detailed PLC register information setting, please refer to the table below.

PLC register information of the component	Description
PLC register type	The type of PLC register relating to the data swapping.
PLC address	The position of the related PLC register.
Data length	The size of the data that will be written or read.
Register action	Determine the PLC reading method. Byte swap The data required for PLC reading and writing shall be Word or DWord (based on the register type). Byte swap by word: Byte swap by DWord: Put 1 byte to 1 bit (Only available in receiving mode) Use Bit when writing the PLC data (based on the register type)
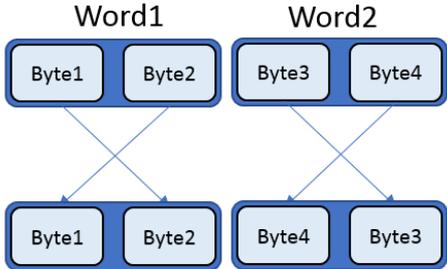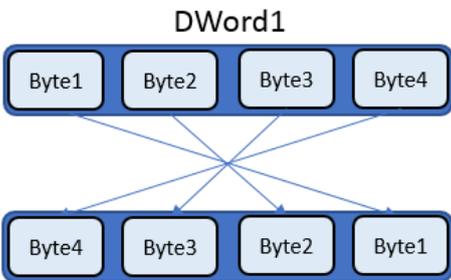
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Put 1 byte to 2 bits

(Only available in receiving mode)

Use Bit when writing the PLC data

(based on the register type)
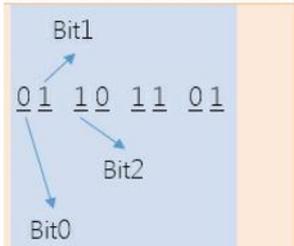
None: (Only available in sending mode)

Post-treatment is not required when reading the PLC data.

Check code:

Set the appointed component as check code and it is required to appoint the type, the start position and the length of the check code. Based on the content of the packet, the CM Module will calculate the check code and then update it to the appointed component.

Component check code	Description
Type of check code	There are 9 types of check codes for option by the user and they are CRC, summation (byte), summation (character set), XOR, AND, OR, LRC, sum complement, and sum negation.
Starting position of check code	The starting position of the check code that will be calculated.
Length of check code	The length of the check code that will be calculated.

Table 41 Parameter table of check codes

15-1-8 Serial communication module control instruction (CMCTL)

```
┌─────────────┐
│    Start    │
└─────────────┘
       │
       ▼
┌──────────────────────────────────────────────┐
│ After connecting the communication module, check │
│ if the project is consistent with the installed module │
│ (uploading or add in the equipment picture directly). │
└──────────────────────────────────────────────┘
       │
       ▼
┌──────────────────────────────────────────────┐
│ When the program is under offline edit status, │
│ double clicking the module -> Set configuration in │
│ the equipment picture. │
└──────────────────────────────────────────────┘
       │
       ▼
┌──────────────────────────────────────────────┐
│ In "Configure", set the mode required by the user │   ........ Refer to Section 10.1.7
│ and then set the packet and the master/slave. │
└──────────────────────────────────────────────┘
       │
       ▼
┌──────────────────────────────────────────────┐
│ In Ladder program, select CMCTL command and then │   ........ Refer to Section 10.1.8
│ set the ID in the command parameter for the CM module │
│ that will be used. │
└──────────────────────────────────────────────┘
       │
       ▼
┌─────────────┐
│     End     │
└─────────────┘
```

CMCTL Instruction

FUN156P CMCTL	CMCTL	FUN156P CMCTL
Symbol		

<table>
<tr><td>

```
              ┌── 156. CMCTL ──┐
EN ───────────┤                ├─────── ERR
              │  ID  :         │
              │                │
PAU ──────────┤  Pt  :         │
              │                │
              │  Ts  :         │
              │                │
              │  MD  :         │
              │                │
              │  WR  :         │
              └────────────────┘
```

</td><td>

ID: Module number used

Pt: Appointed COMA/COMB (A= 0; B=1)

Ts: Communication table mask

Bit 1: Table 1

Bit 2: Table 2

   |

Bit 15: Table 15

Bit 16–Bit 31: Retained. Do not use.

MD: Setting the mode

0: RUN ONCE

1: RUN CYCLING

2: STOP

WR: Storage working status

Bit0–Bit1: Table 0 state

Bit2–Bit3: Table 1 state

   |

Bit30–Bit31: Table 15 state

(= 0: RUN_ONCE

= 1: RUN_CYCLING

= 2: STOP)

</td></tr>
</table>

FUN156P	CMCTL						FUN156P
CMCTL							CMCTL

Range / Operand	HR	OR	SR	ROR	DR	K
	R0 | R34767	R35024 | R35151	R35280 | R43323	R43324 | R47319	D0 | D11999	
ID						0-127
Pt						0-23
Ts	○	○	○	○	○	0-63
MD	○	○	○	○	○	0-63
WR	○			○	○	5word

Description	Such command should be used with CM25 and CM55 communication modules. Before each use, please set the communication module data.

- EN OFF->ON will carry out communication control for the specified port, ON->OFF will stop.
- PAU is not yet supported
- The communication status code of each table will be updated in the assigned status register, and the status code can be confirmed in the device view.

FUN156 : WR Description

Bit0

Bit1

Table0 State

Table0 = 0(00): RUN_ONCE
    = 1(01): RUN_CYCLING
    = 2(10): STOP

Bit2

Bit3

Table1 State

Table1 = 0(00): RUN_ONCE
    = 1(01): RUN_CYCLING
    = 2(10): STOP

Bit4

Bit5

Table2 State

Table2 = 0(00): RUN_ONCE
    = 1(01): RUN_CYCLING

Bit6

Bit7

Table3 State

Table3 = 0(00): RUN_ONCE
    = 1(01): RUN_CYCLING
    = 2(10): STOP

Bit30

Bit31

Table15 State

Table15 = 0(00): RUN_ONCE
    = 1(01): RUN_CYCLING
    = 2(10): STOP

Reserve Bit32 and the above

Example	


```
    M0                                                    ┌─156P.CMCTL─┐
────┤ ├──────────────────────────────────────────EN─│ ID:      0 │─ERR─
                                                      │            │
                                                      │ Pt:      0 │
                                              ─PAU─│ Ts:      3 │
                                                      │            │
                                                      │ MD:      1 │
                                                      │            │
                                                      │ WR:     R0 │
                                                      └────────────┘
```

In the aforesaid figure, when M0 becomes "1", it will open "Port 0" of "No. 0 module" and then start the communication according to Table 1 and Table 2 (with 0001b+0010b=0011b equivalent to 3(10)). Next, select RUN CYCLING mode and then select RO for use as the working register.

13-2　General Analog Input Module

15-2-1 M04AD/M04ADR

The analog input module is configured with the following two kinds of different resolutions and they are AI and AIH type of modules. The resolution of AI is rated at 14 bits, which is the same as 14 effect bit mode designed for M Series-6AD and that of AIH is rated at 18 bits. The difference between them is the conversion speed and resolution. For details, please refer to "Inputting signal scope" section and "Setting conversion time" section.

Operating Steps of Analog Input Module

Start

After installing the expansion module, upload the analog input module and then add it in the hardware indicated in the equipment picture. In the configuration, set up the voltage or the current mode, alarm or filter that will be read.
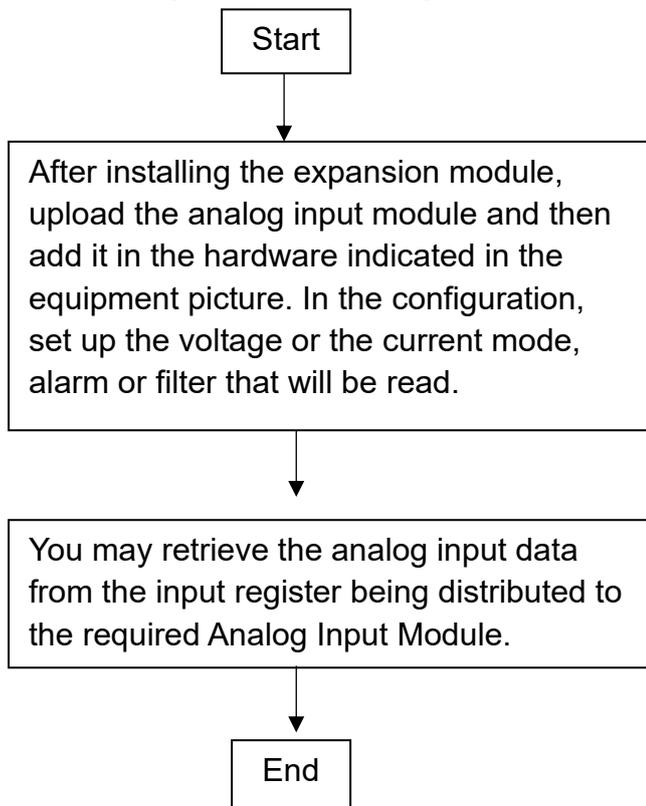
-------- For detailed equipment picture and configuration, please refer to Interface Manual.

You may retrieve the analog input data from the input register being distributed to the required Analog Input Module.

------- In the equipment picture, you may retrieve the input register being distributed to such module.

End

15.2.1.1.1 Description of analog input format planning

In terms of analog reading value processing, FATEK provides three commonly used data representation methods and multiple averaging of reading values that can be set to improve the phenomenon of reading value drift caused by interference or unstable input signals in the field.

UperLogic provides a very simple operation interface to plan the data format, effective bits, and average times of analog input readings and other related settings.

Searching AI module data through device monitoring

In function bar, click "Project" → "Device View" → "Device Monitor" and the picture will show the right-side device monitoring window:
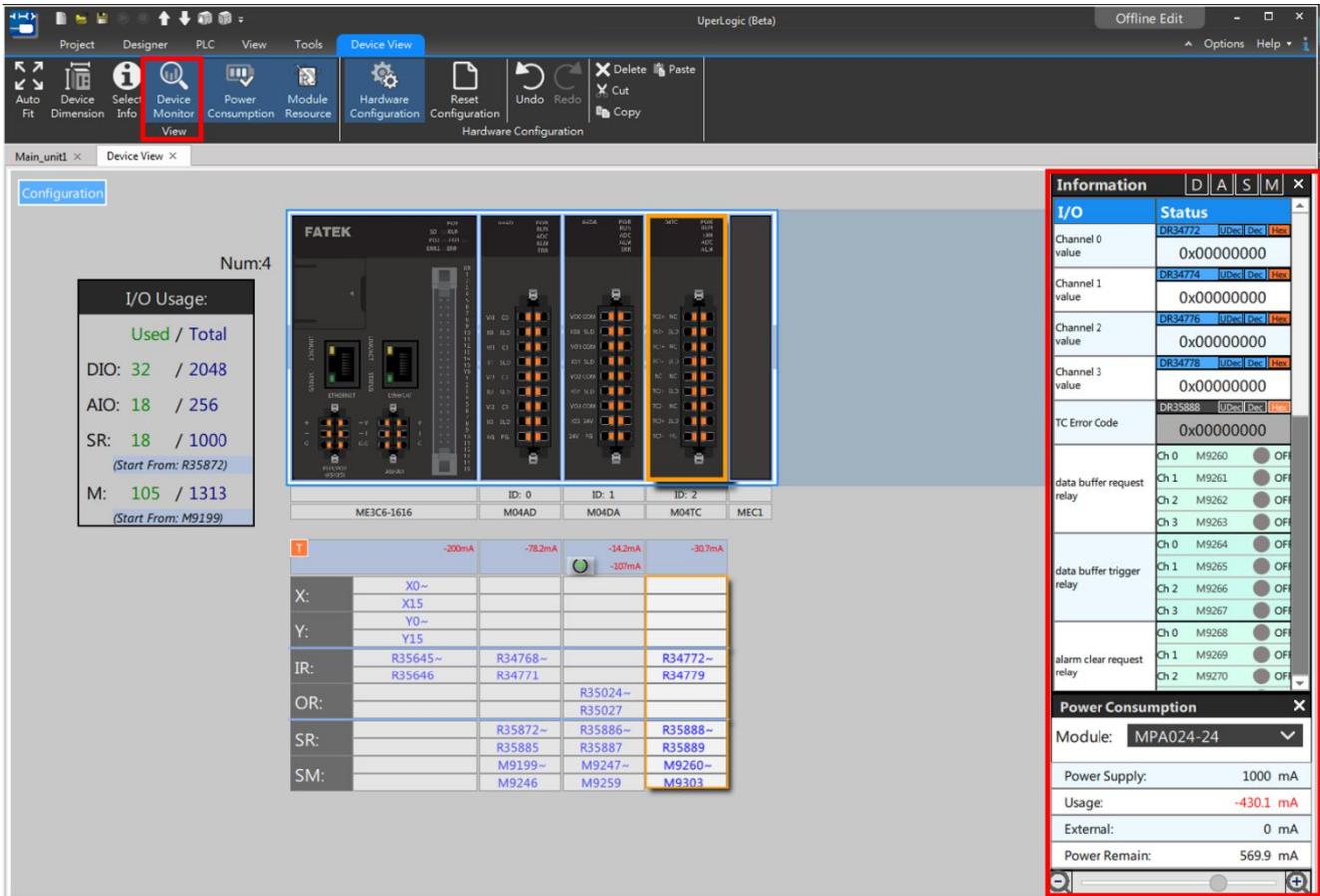
Figure 116 Device Monitor

In the information, you may select the resources to be displayed such as "Digital data", "Logic data", "Status data" and "Relay".

● Logic Data (Analog read value data)

In analog modules (AI, AO, TC), the logic data refer to the values retrieved from the channel.

When clicking the "Logic data" at the upper side "Device monitor", the Module List will display the logic data only. Place the mouse on the desired value and when the data is lit in blue as per the figure below, you may revise the value of such register. Through the "Dec" and "Hex" on right-hand side of the register, you may also revise the value display pattern instantly.

Figure 117 Logic data in device monitor

● Status Data

When clicking the "Status data" at the upper side "Device monitor", the Module List will display the status data only. When the data is lit in gray as per figure below, you cannot revise the value of such register; for the "Dec" and "Hex" on right-hand side of the register, however, you will be allowed to revise the value display pattern instantly.
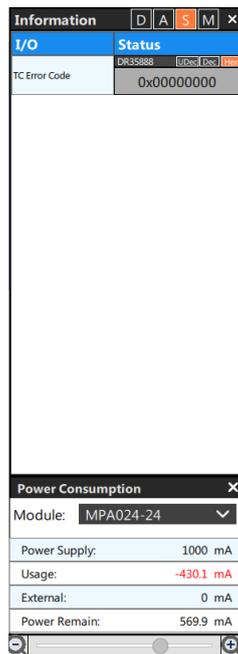
Figure 118 Status data in logic monitor

● Relay

When clicking the "Relay" at upper side of "Device monitor", the Module List will display the status data only. When placing the mouse on the value and if the data is lit in blue as per the figure below, you will be allowed to revise the value of such register. If the register position in lit in gray, then you will not be able to revise the value display pattern.

13-31

Figure 119 Status data in logic monitor

M04AD/M04ADR function

The Analog In (AI) Module is designed with lots of functions for use by the user such as data buffering, value scaling and alarm setting, etc. To use these functions, double click the required module on "Project->Equipment picture" and then click "Configure" and you can find out the position of AI setting functions, as per the figure below. Same as the Ladder editing, these functions can be set only under offline editing status.
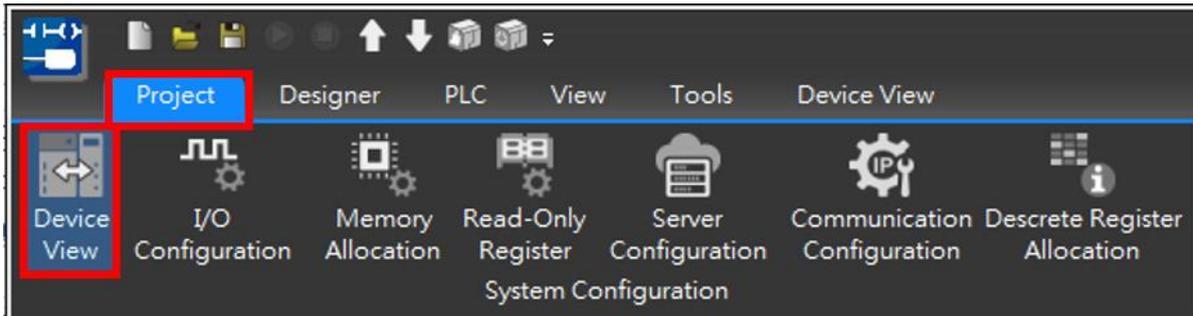
Figure 120 Position of Device View
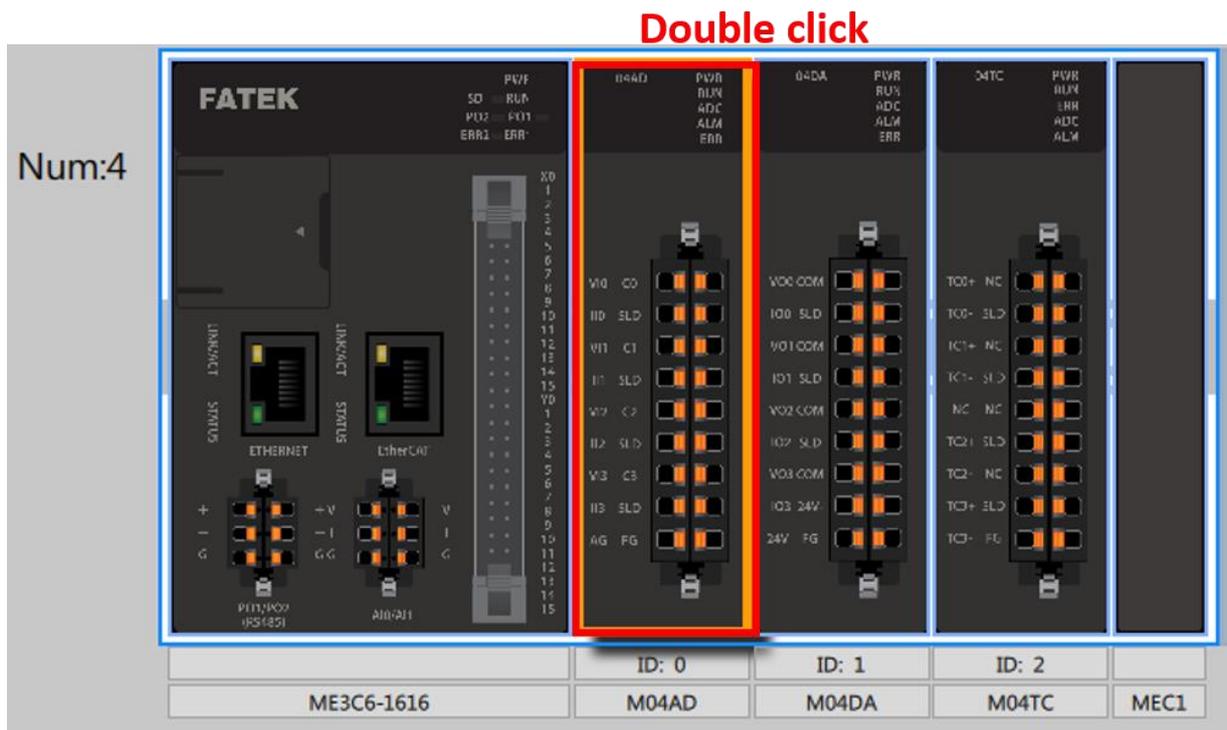
Figure 121 Find and click the module
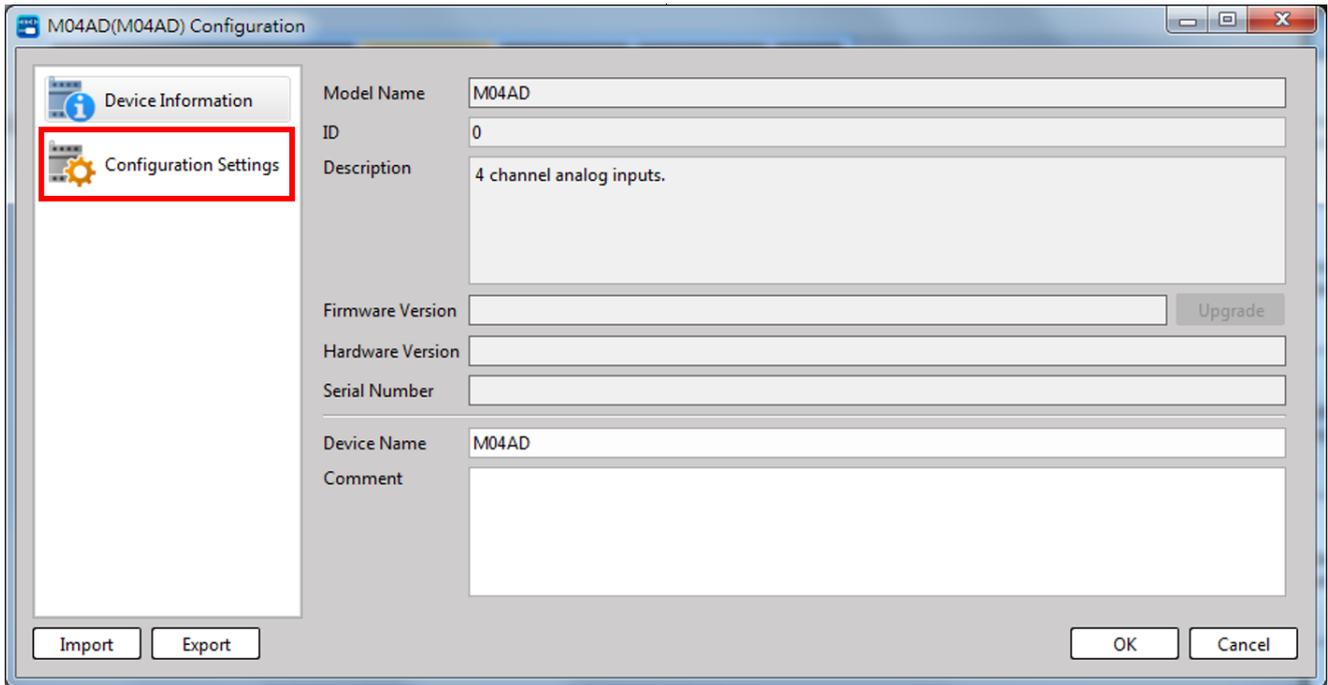
Figure 122 Click "Configuration Settings"
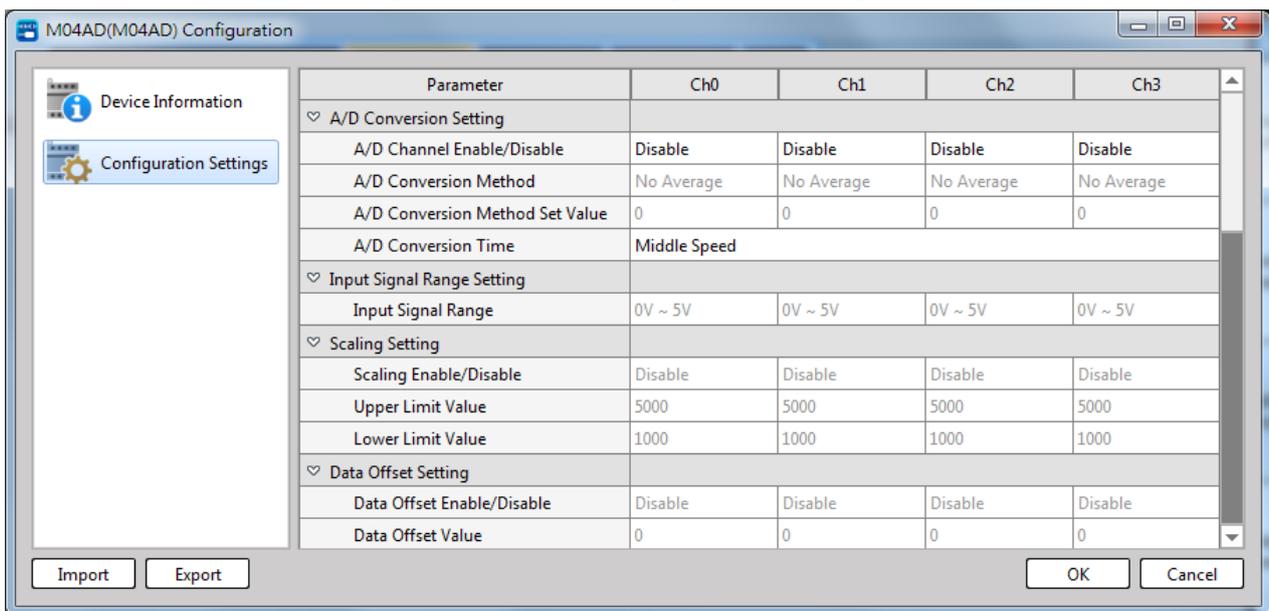
Figure 123 Setting window of M04AD/M04ADR modules

For other modules, same path should be used to access the function setting page; however, the function may vary according to the module selected.

The functions of AI module will be introduced in this section.

Channel opening/closing

This function is designed for setting the opening or closing for the respective A/D conversion channel. When opening the A/D conversion channel, such channel will execute the A/D conversion. When closing the A/D conversion channel, such channel will not execute the A/D conversion. Such function also reduces the conversion cycle time for all of the channels.

Application method and instructions

Conversion cycle time = (A/D configuring time + A/D conversion time) x Number of opened A/D channel

Where:

A/D configuring time = MUX input time + PGA configuring time

A/D conversion time >= A/D data reading time + A/D data processing time

Example:

Number of opened A/D channel = 3

Conversion cycle time = (A/D configuring time + A/D conversion time) x 3

T_{cfg} = A/D configuring time for current-flowing channel

T_{rd} = A/D data reading time for last channel

$T_{process}$ = A/D data processing time for last channel
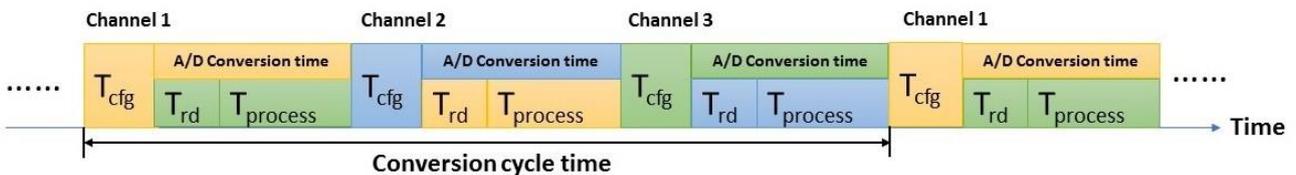
Figure 124: Impact from channel opening and closing to total channel conversion cycle time

Setting and Preset value

If the channel opening/closing is not being set, then it will be preset as closing.

Function	M04AD	M04ADR	Preset setting
Channel opening/closing	Opening	Opening	Closing
	Closing	Closing	

Table 42 Channel Opening/Closing of M04AD/M04ADR

Input Calibration Function

The system will execute the input calibration for each channel. The calibration will be executed according to the offsetting and the gain quantity being saved in the corresponding bay of each individual channel. The calibration value has been preset as the factory default value and saved in the module and it will not be revised. The preset value can be used for restoring to the roll-out status.

Application method and instructions

Execute the offset calibration first and then the gain calibration.

Input 0V or interrupt the channel and then compute the internal offset value. Next, input the max. voltage for each bay (5V, 10V or 20mA) and then compute the internal gain value. Finally, save the offset value together with the gain value in the module.

Final output = (A/D output – offset value) * Gain value

The calibration comprises the following two modes:

User Calibration Mode:

- If the user has special needs or there is a large error in the value due to the large difference between the current ambient temperature and the general room temperature, you can use the user calibration mode to correct the error.

Restoring Factory Calibration Mode:

- When delivered from the factory, all channels will be calibrated. In the meantime, each channel will save the offset value and the gain value of 0–5V, 0–10V and 0–20mA in the module.

User Calibration Steps:

Make the PLC stop running, and in the "Online Monitor Mode", double-click the module to be recalled in the "Device View", and find "Calibration" in the "Configuration Settings", select the channel to be calibrated and find "Offset/Gain Calibration", press "Offset/Gain" to input the specified voltage according to the software prompt (if it is a general analog output module, adjust the meter to the corresponding gear) to complete the offset/gain Correction。

Parameter	Ch0	Ch1	Ch2	Ch3
Upper Lower Limit Value	5000	5000	5000	5000
Lower Upper Limit Value	0	0	0	0
Lower Lower Limit Value	0	0	0	0
♡ Burnout Detection Setting				
Burnout Detection Enable/Disable	Disable	Disable	Disable	Disable
Burnout Detection Output	Down Scale			
♡ Alarm Mode Setting				
Alarm: Overflow	Momentary Mode			
Alarm: Underflow	Momentary Mode			
Alarm: Alert Output(Upper Limit)	Momentary Mode			
Alarm: Alert Output(Upper Limit)	Momentary Mode			
Alarm: Burnout Detection	Momentary Mode			
♡ Max. and Min Hold Setting				
Max. and Min Hold Enable/Disable	Disable	Disable	Disable	Disable
♡ Data Buffer Setting				
Data Buffer Points	600 points	600 points	600 points	600 points
Data Buffer Points before Trigger	50 points	50 points	50 points	50 points
♡ Input Calibration Setting				
Input Calibration Offset/Gain	Calibration			

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Figure 125 M04AD/M04ADR user calibration process

Restore factory settings steps:

Make the PLC stop running, and in the "Online Monitor Mode", double-click the module to be recalled in the "Device View", and find "Calibration" in the "Configuration Settings", and find "Restore Factory Settings" after entering and press "Restore".

M-Series PLC Software Function and Application User Manual
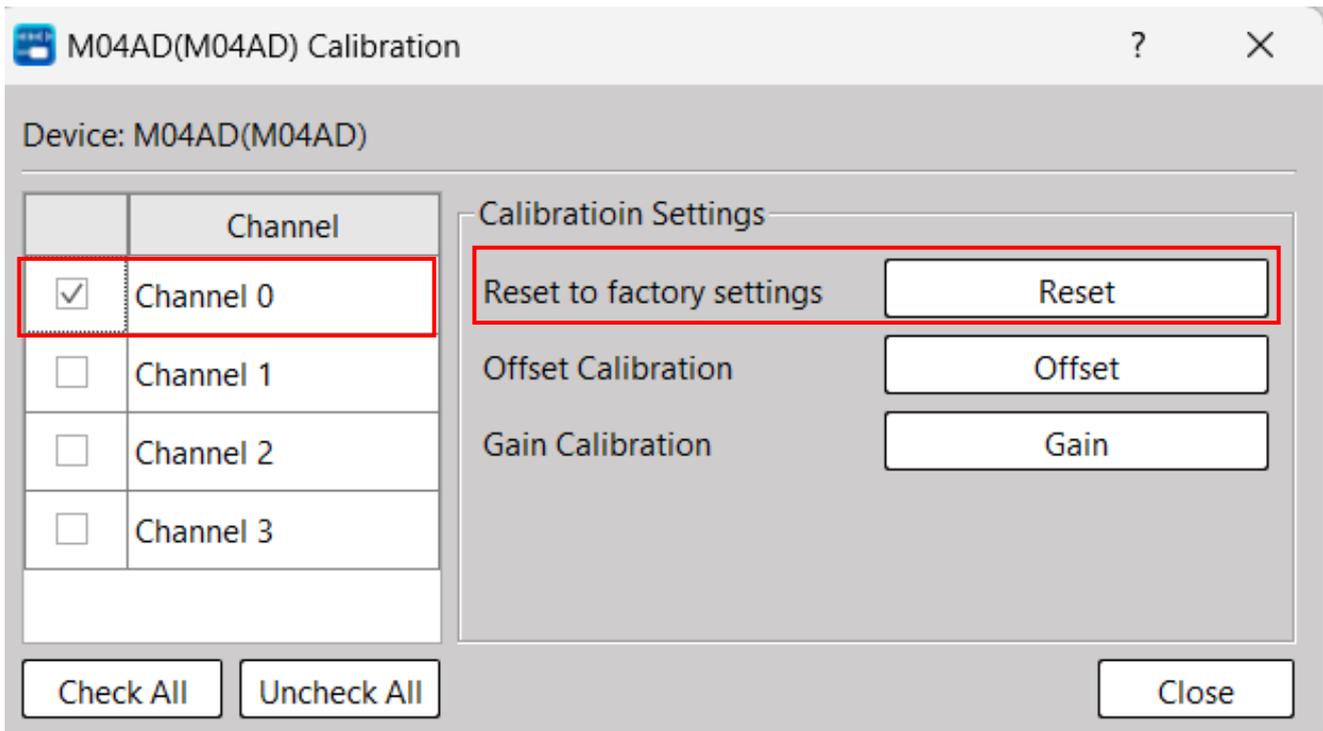
Figure 126 M04AD/M04AD restore factory setting process

Setting and preset value

Each channel is designed with 5V offset, 10V offset and 20mA offset as well as 5V gain, 10V gain and 20mA gain values. The preset value serves as the factory calibration value and will be saved in the module.

Input calibration setting	Preset value
Offset value	Factory calibration value
Gain value	Factory calibration value

Table 43 M04AD/M04ADR calibration preset value

A/D Conversion Mode

When setting the average value of each channel, it will be set as follows: No Average Mode, Frequency Average Mode, Time Average Mode and Move Average Mode.

Application method and instructions

No Average Mode: The mean value processing will not be executed after completing the A/D conversion. The processing time will be equivalent to the conversion cycle time.

Frequency Average Mode: The system will execute the A/D conversion according to the established frequency and then execute the average process for the converted value. The Frequency Average Mode shall be effective when the set value is bigger than "2".

The required processing time will be equivalent to the result acquired by multiplying the average value with the conversion cycle.

Example:

If the module converts 11 pieces of data and sets the average number of times to 5, the returned results are as follows:
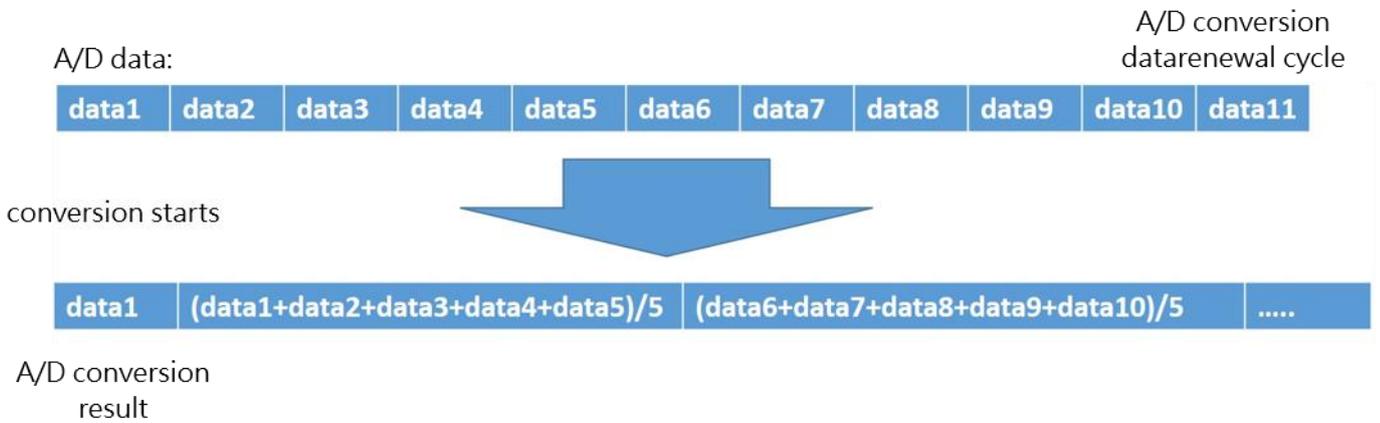
Figure 127 Schematic diagram of M04AD/M04ADR module times average mode processing time

Time Average Mode: The system will execute the A/D conversion according to the set time and will execute the mean value processing for the values being converted within such period of time. The averaging will become processed when the set time is over 2 times of the conversion cycle.
The processing time will be equivalent to the setting time.
Example:
Numbers of channel used: 8ch. The action required for setting the average processing time as 4ms.
Number of A/D conversion data undergoing average processing = 100ms, then the average number of A/D conversion data processed = 100ms ÷ 4ms =25
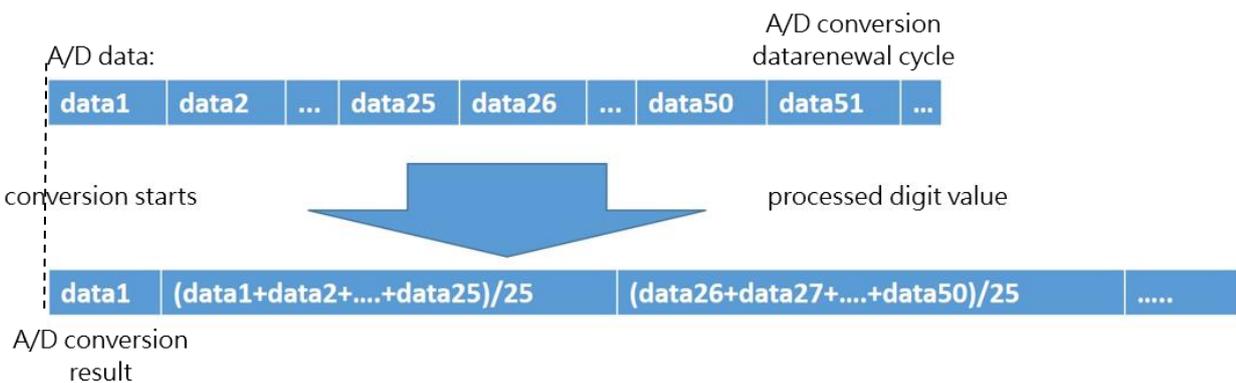
Figure 128 Schematic diagram of M04AD/M04ADR module times average mode processing time

Move Average Mode: Set the average number. During each conversion cycle, the system will execute the mean value processing for the latest A/D conversion data according to established frequency. The system will execute the move averaging when the value is bigger than "2".

The processing time will be equivalent to the conversion cycle.

Example:

Action when average move frequency is set at 5 times.
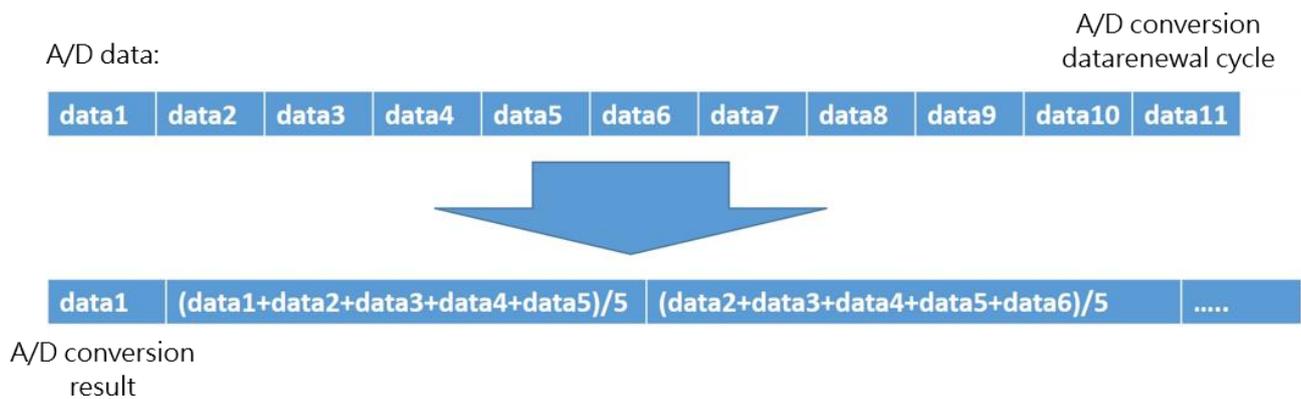
AVG1= D1
AVG2= (D1+D2+D3+D4+D5)/5
AVG3= (D2+D3+D4+D5+D6)/5
AVG4= (D3+D4+D5+D6+D7)/5
AVG5= (D4+D5+D6+D7+D8)/5
AVG6= (D5+D6+D7+D8+D9)/5
AVG7= (D6+D7+D8+D9+D10)/5

Setting and Preset value

If A/D conversion mode is not established for the channel, then the preset mode shall be regarded as No Average Mode. In this case, each averaged unit can accommodate up to 1000 individuals of converted values.

A/D Conversion Mode	AI setting scope	AIH setting scope	Preset value
No Average Mode	None	None	None
Frequency Average Mode	2 to 1000 (times)	2 to 1000 (times)	2
Move Average Mode	2 to 1000 (times)	2 to 1000 (times)	2
Time Average Mode	1 to 1604000 (ms)	1 to 1604000 (ms)	1

Table 44 M04AD/M04ADR setting value ranges for each average mode

Input Signal Scope

Application method and instructions

1–5V: Same as the resolution of 0–5V, which is the scaling result through 0–5V.

4mA–20mA: Same as the resolution of 0–20mA, which is the scaling result through 0–20mA.

Setting and Preset value

If the input signal scope is not being set for the channel, then it will be preset as 0V–10V.

Input signal scope		Digital output scope
Voltage	0V – 10V	0 – 16383
	-10V – 10V	-8192 – 8191
	0V – 5V	0 – 16383
	-5V – 5V	-8192 – 8191
	1V – 5V	0 – 16383
Current	0 mA – 20 mA	0 – 16383
	-20 mA ~ 20 mA	-8192 ~ 8191
	4 mA ~ 20 mA	0 ~ 16383

Table 45 M04AD setting input signal range

Input signal scope		Digital output scope
Voltage	0V – 10V	Voltage
	-10V – 10V	-80000 ~ 80000
	0V – 5V	0 ~ 80000
	-5V – 5V	-80000 ~ 80000
	1V – 5V	0 ~ 80000
Current	0 mA – 20 mA	Current
	-20 mA – 20 mA	-80000 ~ 80000
	4 mA – 20 mA	0 ~ 80000

Table 46 M04AR setting input signal range

Overflow and underflow

Each channel shall be set in either opening or closing status. When opening, you need to check if the channel is under overflow or underflow status. In the meantime, it is also required to determine the alarm relay behavior according to the alarm module selected. Such detection will not be required when the channel is closed.

Application method and instructions

Based on the input signal scope set for each channel, you need to check if the detected digital output is exceeding the overflow limit or is lower than the underflow limit value. When detecting the overflow or underflow status, the system will output the alarm and the corresponding relay will shift from OFF to ON.

Input signal scope		Digital output scope	Overflow Limit Value	Underflow Limit Value
Voltage	0V ~ 10 V	0 ~ 16383	16383	0
	-10V ~ 10V	-8192 ~ 8191	8191	-8192
	0V ~ 5V	0 ~ 16383	16383	0
	-5V ~ 5V	-8192 ~ 8191	8191	-8192
	1V ~ 5V	0 ~ 16383	16383	0
Current	0mA ~ 20mA	0 ~ 16383	16383	0
	-20mA ~ 20mA	-8192 ~ 8191	8191	-8192
	4 ~ 20 mA	0 ~ 16383	16383	0

Table 47 M04AD overflow and underflow range

Input signal scope		Digital output scope	Overflow Limit Value	Underflow Limit Value
Voltage	0V ~ 10 V	0 ~ 80000	96000	-16000
	-10V ~ 10V	-80000 ~ 80000	96000	-96000
	0V ~ 5V	0 ~ 80000	96000	-16000
	-5V ~ 5V	-80000 ~ 80000	96000	-96000
	1V ~ 5V	0 ~ 80000	88000	-8000
Current	0mA ~ 20mA	0 ~ 80000	96000	-16000
	-20mA ~ 20mA	-80000 ~ 80000	96000	-96000
	4 ~ 20 mA	0 ~ 80000	88000	-8000

Table 48 M04AR overflow and underflow range

Example:
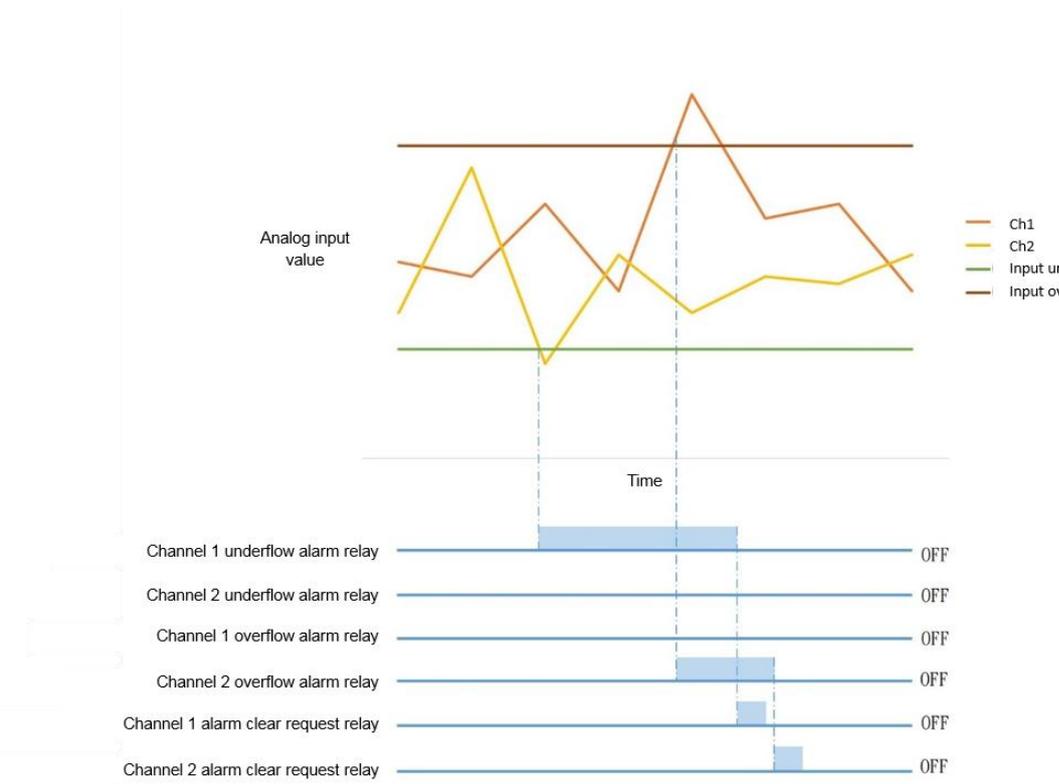
Figure 130 Diagram of Overflow and underflow alarm output

Setting and Preset value

If the channel is not set with downflow and underflow limit, then it will be preset as closing.

Function	M04AD	M04ADR	Preset
Overflow and underflow	Opening Closing	Opening Closing	Closing

Table 49 M04AD/M04ADR overflow and underflow opening/closing settings

Run-time relay control

For detailed relay and alarm mode setting, please refer to alarm section.

Setting Conversion Time

Due to different resolutions, the AI and AIH modules are designed with the respective conversion time "S". Such conversion time can be used for setting the A/D conversion speed as High (high speed), Middle (medium speed) and Low (low speed) as well as 50Hz or 60Hz. The conversion speed shall be set for all channels and cannot be changed for certain channels individually.

Setting and Preset value

If the conversion time is not being set, then it will be preset as "Middle".

Note: Conversion time = (A/D setup time + A/D conversion time)

Conversion time setup	M04AD conversion time	M04ADR conversion time
High	0.3ms/ch	1.5ms/ch
Middle	0.5ms/ch	4ms/ch
Low	1ms/ch	15ms/ch
50Hz	80ms/ch	80ms/ch
60Hz	67ms/ ch	67ms/ ch

Figure 50 M04AD/M04ADR time conversion setting

Alert Output

Each channel shall be set as opening or closing status. When opening, you need to set the alarm output scope and then start the channel detection. Based on the alert mode, you are also required to determine the alert relay behavior, but the detection will not be required when the channel is closed.

Alert triggering conditions and behavior

When detecting that the digital output value exceeds the alert output scope, the system will output the alert and the corresponding relay will shift from OFF to ON status.
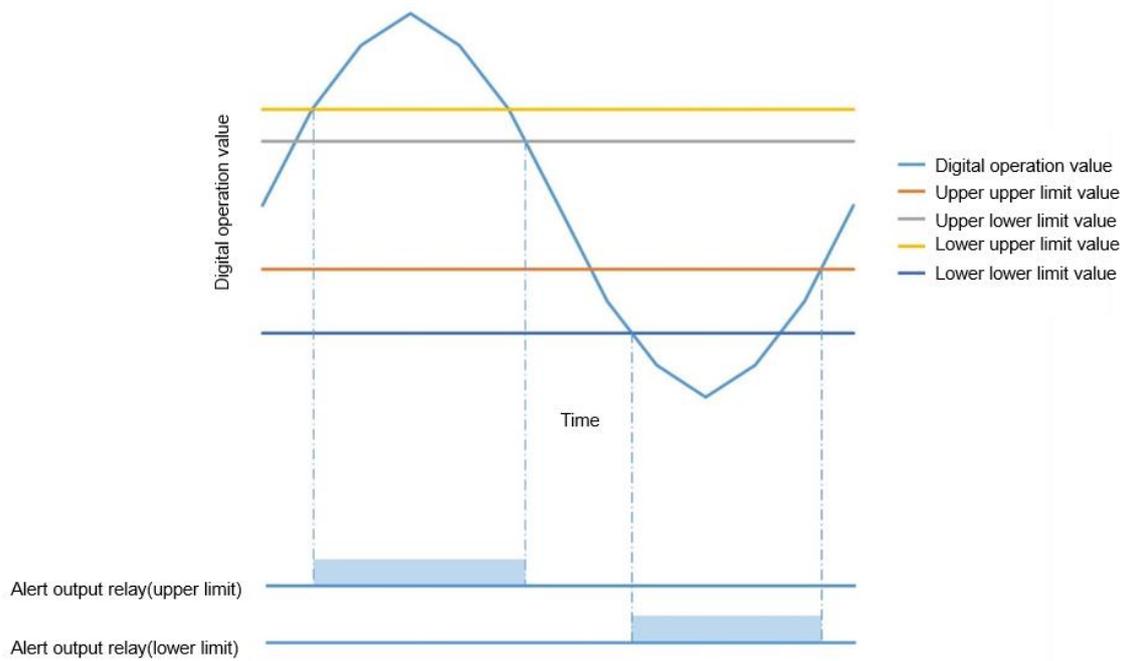
Figure 131 Schematic diagram of alert output

Setting and Preset value

Conditions required for the alert output scope:

Upper limit value of upper limit ≥ Lower limit value of upper limit > Upper limit value of lower limit ≥ Lower limit value of lower limit

If the channel has not been set with the alert output, then it will be preset as closing.

Setting	M04AD	M04ADR	Preset
Alert output	Opening Closing	Opening Closing	Closing
Upper limit value of upper limit	Restricted in digital output scope	-82000~82000	5000
Lower limit value of upper limit		-82000~82000	5000
Upper limit value of lower limit		-82000~82000	0
Lower limit value of lower limit		-82000~82000	0

Table 51 Setting of alert output

Run-time relay control

For detailed alarm relay and alarm mode setting method, please refer to alarm section.

Value Scaling Function

Each channel shall be set as opening or closing status. When opening, you need to set the scaling scope and then start converting the digital output scope to the set scaling scope; but the conversion will not be required when the channel is closed.

Application method and instructions

Select "Device view" and click M04AD/M04ADR module you want to use, and click "Configuration Settings", after enabling the A/D channel you want to enable, find "Scaling Setting" (as shown in the figure below), and enable the desired A/D channel. Fill in the upper limit value and lower limit value for the channel using this function, then press OK and download the setting data of the module.

Parameter	Ch0	Ch1	Ch2	Ch3
▽ A/D Conversion Setting				
A/D Channel Enable/Disable	Enable	Enable	Enable	Enable
A/D Conversion Method	No Average	No Average	No Average	No Average
A/D Conversion Method Set Value	0	0	0	0
A/D Conversion Time	Middle Speed			
▽ Input Signal Range Setting				
Input Signal Range	0V ~ 5V	0V ~ 5V	0V ~ 5V	0V ~ 5V
▽ Scaling Setting				
Scaling Enable/Disable	Enable	Enable	Enable	Enable
Upper Limit Value	5000	5000	5000	5000
Lower Limit Value	1000	1000	1000	1000
▽ Data Offset Setting				
Data Offset Enable/Disable	Disable	Disable	Disable	Disable
Data Offset Value	0	0	0	0
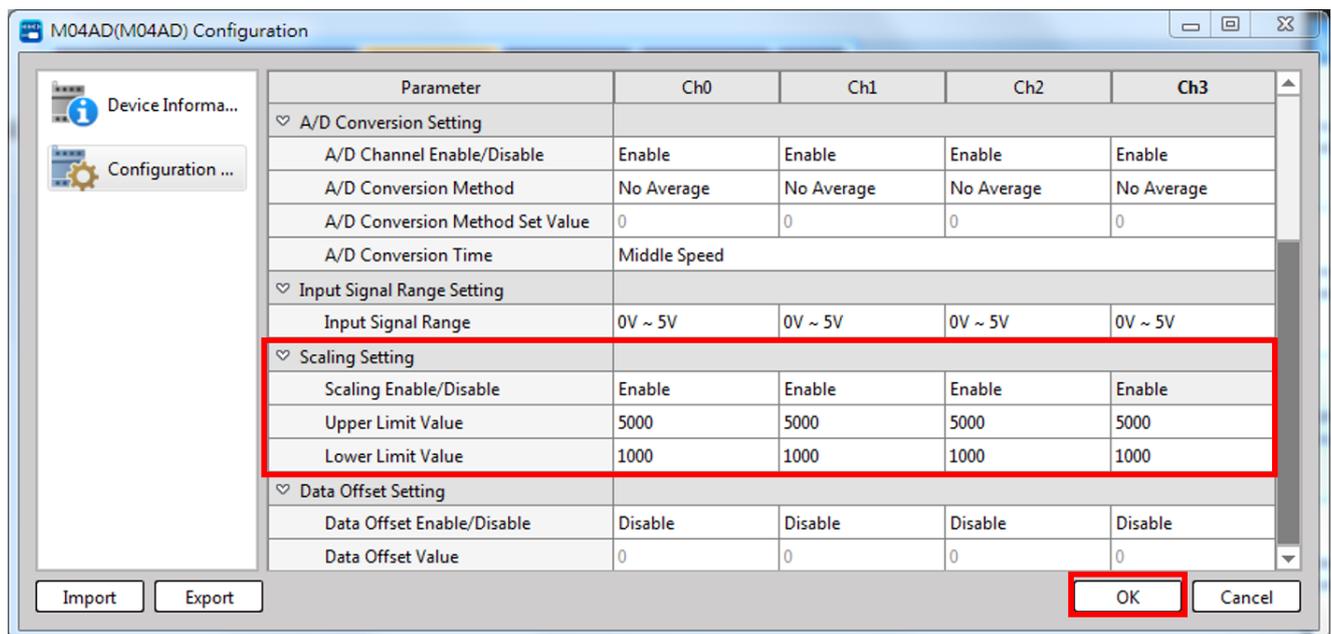
Convert the digital output scope graduation mark to the preset scaling scope.

Example:

When selecting 1V–5V mode for M04AD/M04ADR:

Actual analog input scope ＝ "1V–5V"

Scaling setup scope ＝ "1000–5000"

Digital output scope ＝ "0–16383"
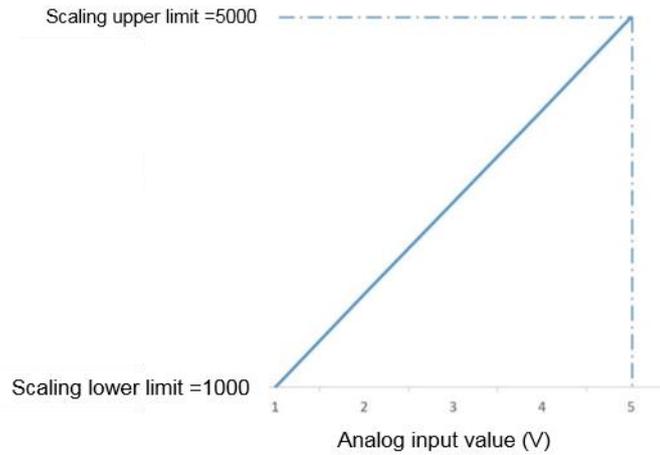
Figure 133 Schematic diagram of M04AD/M04ADR scaling scope

Analog input	Digital output value	Digital computation value (scaling value)
1V	0	1000
2V	4096	2000
3V	8192	3000
4V	12288	4000
5V	16383	5000

Table 52 Comparison table of M04AD/M04ADR digital scaling value and analog input to digital output

Setting and Preset value

The scaling scope setting shall meet following conditions:

Scaling upper limit value > Scaling lower limit value

If the channel is not designed with scaling function, then it will be preset as closing.

Function	AI setting	AIH setting	Preset
Scaling function	Opening Closing	Opening Closing	Closing
Scaling upper limit value	Restricted in digital output scope	-131072–131071	Closing
Scaling lower limit value		-131072–131071	Closing

Table 53 Scaling function setting

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Max. value/Min. value recording function

Each channel shall be set as opening or closing status. When opening, you need to save the maximum value and the minimum value of the channel in the corresponding register, but the value saving will not be required when the channel is closed.

Application method and instructions

Save the maximum value and the minimum value of the respective channel in the corresponding register.
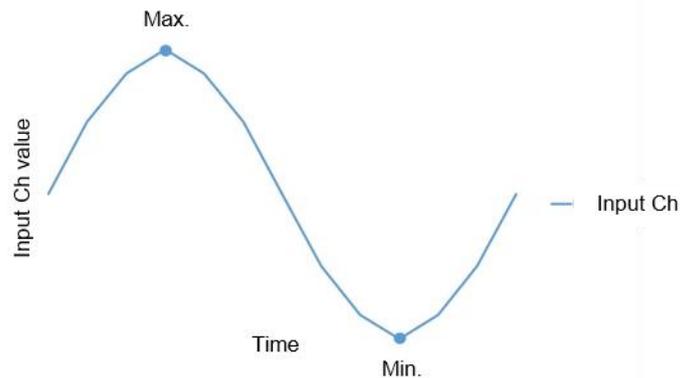
Figure 134 Diagram of Max. value/ Min. value recording function

Setting and Preset value

If the channel is not set with max. value and min. value, then it will be preset as closing.

Function	M04AD	M04ADR	Preset
Maintain max. value and min. value	Opening Closing	Opening Closing	Closing

Table 54 Setting maintenance of max. value and min. value

To update the max. value and the min. value, confirm that the max. value and the min. value function has been opened in the configuration setting. Next, distribute such module to the corresponding SM and then operate according to the procedure indicated below in order to complete the updating.

Run-time relay control

Run-time relay control	Description	Setting
Max. value clearing request relay	Clear max. channel value	Off->On: Rest max. channel value On->Off: Triggering done
Min. value clearing request relay	Clear min. channel value	Off->On: Rest min. channel value On->Off: Triggering done

Table 55 Use the relay to control the max. value and the min. value to maintain the setting

Burn-out Detection Function

You may set the opening or closing for specific bay (1V–5V and 4mA–20mA). When opening, you need to set up the burn-out detection function and start detecting the burn-out condition of the channel. Next, determine the alarm relay behavior according to the alarm mode, but such detection will not be required if the channel is closed.

Application method and instructions

The burn-out detection function can be used to detect 1V–5V or 4mA–20mA bay only.

If the burn-out threshold conditions are established, the system will output the burn-out alarm and the corresponding relay will shift from Off to On.

When detecting the burn-out, the system will determine the digital value to be transmitted whether the control output is high-level or low-level.

Burn-out detection of M04AD:

Analog input		Digital output	M04AD Burn-out Threshold
Voltage	1V ~ 5V	0~16383	Digital value<-32767
current	4 mA ~ 20 mA	0~16383	Digital value <-32767

Table 56 M04AD burn-out detection threshold

When detecting the burn-out, the system will determine the digital value to be transmitted whether the control output is high-level or low-level.

Burn-out detection setting	When detecting burn-out
Low-level	Digital value = 0
High-level	Digital value = 0x7FFF

Table 57 M04AD low-level and high-level settings for burn-out

Burn-out detection of M04ADR:

Analog input		Digital output	M04ADR Burn-out Threshold
Voltage	1V ~ 5V	0~8000	Digital value<-16000
Current	4 mA ~ 20 mA	0~8000	Digital value <-16000

Table 58 M04ADR burn-out detection threshold

When detecting the burn-out, the system will determine the digital value to be transmitted whether the control output is high-level or low-level.

Burn-out detection setting	When detecting burn-out
Low-level	Digital value = 0
High-level	Digital value = 0x1FFFF

Table 57 M04ADR low-level and high-level settings for burn-out

Setting and Preset value

If the channel is not set with burn-out detection function, it will be preset as closing.

If the channel is set with burn-out detection function, it will be preset as low-level.

Function	M04AD	M04ADR	Preset
Burn-out detection	Opening Closing	Opening Closing	Closing
Burn-out detection setting	High-level Low-level	High-level Low-level	Low-level

Table 60 Burn-out setting of M04AD/M04ADR

Run-time relay control

For detailed alert relay and alarm mode setting, please refer to alarm section.

Digital Clipping Setting (only M04ADR supports such function at current stage)

Only M04ADR module can be set to enable the digital clipping function. Each channel shall be set with opening or closing function. When opening, M04ADR will restrict the digital output value in the digital output scope, but M04ADR will not execute the digital clipping if the channel is closed.

Application method and instructions

When enabling the digital clipping function and when the input voltage/current is beyond the input signal scope, the system will restrict the digital output value in the digital output scope. When closing the digital clipping function, the signal may exceed the digital output scope.

Input signal scope	Digital output scope	Digital output limit	Digital computation value	
			Enable digital clipping	Disable digital clipping
0V ~ 10 V	0 ~ 80000	-20000 ~ 100000	0 ~ 80000	-20000 ~ 100000
-10V ~ 10V	-80000 ~ 80000	-100000 ~ 100000	-80000 ~ 80000	-100000 ~ 100000
0V ~ 5V	0 ~ 80000	-20000 ~ 100000	0 ~ 80000	-20000 ~ 100000
-5V ~ 5V	-80000 ~ 80000	-100000 ~ 100000	-80000 ~ 80000	-100000 ~ 100000
1V ~ 5V	0 ~ 80000	-20000 ~ 100000	0 ~ 80000	-20000 ~ 100000
0 mA ~ 20 mA	0 ~ 80000	-20000 ~ 100000	0 ~ 80000	-20000 ~ 100000
-20 mA ~ 20 mA	-80000 ~ 80000	-100000 ~ 100000	-80000 ~ 80000	-100000 ~ 100000
4 mA ~ 20 mA	0 ~ 80000	-20000 ~ 100000	0 ~ 80000	-20000 ~ 100000

Setting and Preset value

If the channel is not designed with digital clipping function, then it will be preset as closing.

*Note: Such function is not available for M04AD Module.

Function	M04ADR	Preset
Digital clipping	Opening	Closing
	Closing	

Table 62 Digital clipping function setting

Deviation Running Function

Through the channel, you may control the starting and stopping of the corresponding relay. When setting the relay from Off to On, you may execute the deviation running and then update the value used for triggering the deviation running to the register. When the relay is shifted from On to Off, the system will cancel the deviation running function.

Application method and instructions

When the relay "Off -> On" is triggered by the deviation running function, you may use the digital value being exported at that time as the reference value and then update it as "0". During the deviation running period with the relay being set at "On" status, the system will deduct the deviation reference value from digital output value.

Digital computation value = Digital output value = Deviation reference value.

Example:
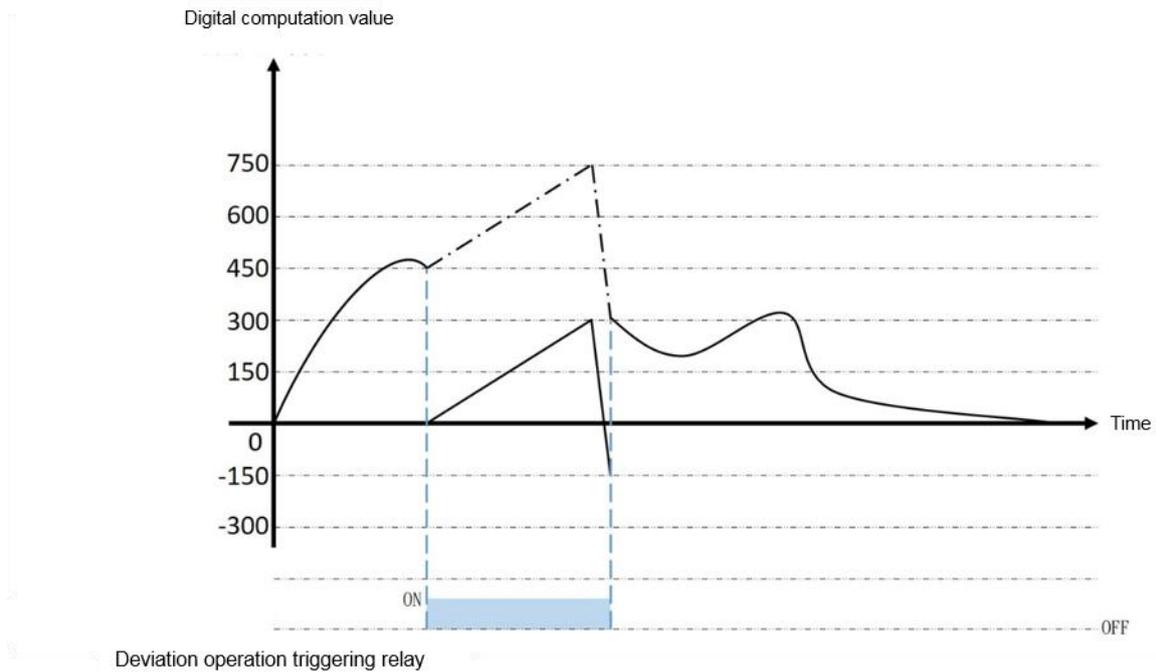
Figure 135 Schematic diagram of deviation operation function

Deviation operation triggering relay: When the relay is under "Off -> On" status, the system will save the digital output value (0) as the deviation reference value and then update the digital computation value as "0". When the relay is under "On->Off" status, it will take the calibrated datum point as the datum point.

Run-time relay control

Run-time relay control	Description	Setting
Deviation operation triggering relay	Trigger the deviation operating	Off->On: Run the deviation operating On->Off: Cancel the function

Table 63 Deviation operation function for relay control

Data Offset Setting Function

Each channel can be set as opening or closing. When opening, you need to set up the data offsetting function in order to correct the data through data translation.

The digital output value should be added with the set offset value for executing the data correction.

Digital computation value = Digital output value + Data offset value

Example:
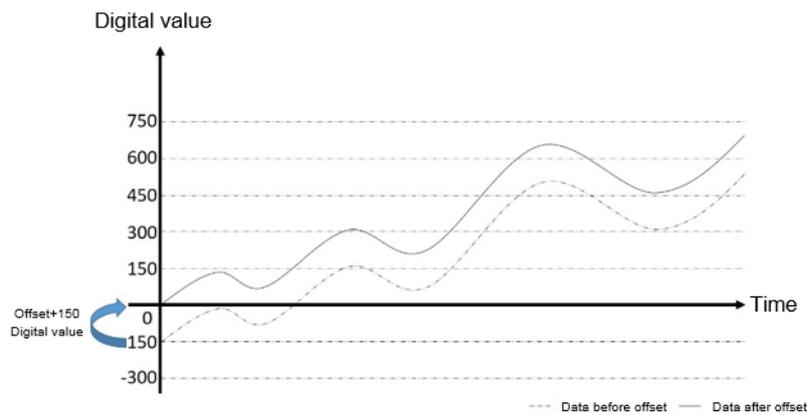

Figure 136 Diagram of data offset

If the channel is not designed with data offsetting function, then it will be preset as closing.

Setup	M04AD	M04ADR	Preset
Set data offset setting	Opening Closing	Opening Closing	Closing
Data offset value	-16383–16383	-82000–82000	0

Table 64 Setting of data offset

Data Buffering Function

Through the relay-controlled data buffering function, you may save the digital computation value in the data buffering field in order to observe the change of the digital computation value.

Application method and instructions

Based on the processing time required for the A/D conversion mode, each buffering point will be allowed to save the digital computation value in the data buffering field.

Each channel will be allowed for saving up to 600 points/ch.

Example:

When the number of data points is set as 50, you may set the number of buffering points as 600.
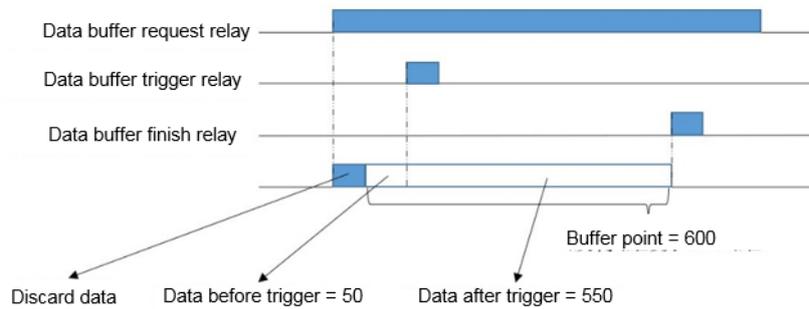
Figure 137 Example diagram of data buffering function

Setting and Preset value

If the channel is not designed with digital amplitude limiting function, then it will be preset as closing.

Setup	M04AD setting scope	M04ADR setting scope	Preset value
Number of buffer points before triggering	0–599	0–599	200
Number of buffer points	1–600	1–600	600

Table 65 Setting of data buffering function

Described below is the data buffering function application method:

Run-time relay control

Data buffer relay	Description	Setting
Data buffer request relay	Request for buffering	Off->On: Start buffer On->Off: Stop buffer
Data buffer trigger relay	Triggering	Off->On: Trigger data buffer request relay
Data buffer complete status relay	Data being buffered	Off->On: Instruct the software to read the buffer by reading the relay when completing the required number of buffer points. On->Off: Instruct the software to read the buffer by reading the relay after reading the required number of buffer points. Data buffer trigger relay: On->Off->On. When triggered again, it will shift to Off and then change to Off->On after reading the required number of buffer points.

Table 66 Steps of applying data buffering function

After completing the data buffering, you may use Fun115 DBUF to read the buffer data from the module to the PLC.

15.2.1.1.2 M04AD/M04ADR Alarm

● Alarm mode

Alarm mode setup	Description of mode
Transient Mode (preset)	When analog input is restored to normal scope, the alarm will be cleared (On->Off) automatically.
Latch Mode	Even if the analog input resumes normal scope, the alarm relay will maintain the status continuously. The clear alarm relay will order the relay to shift from Off to On by clearing the trigger alarm.

Table 67 Setting of alarm mode

● Types of alarm

The alarm relay will perform the action according to the alarm mode.

Alarm relay	Description of function
CH* Underflow Alarm Relay	Off->On: Underflow detected in CH*. Off: Channel is in normal scope.
CH* Overflow Alarm Relay	Off->On: Overflow detected in CH*. Off: Channel is in normal scope.
CH* Alarm Output Relay (upper limit)	Off->On: Alarm output detected in CH* (upper limit). Off: Channel is in normal scope.
CH* Alarm Output Relay (lower limit)	Off->On: Alarm output detected in CH* (lower limit). Off: Channel is in normal scope.
CH* Burn-out Alarm	Off->On: Burn-out detected in CH*. Off: Channel is in normal scope.

Table 68 All types of alarms and actions of M04AD/M04ADR
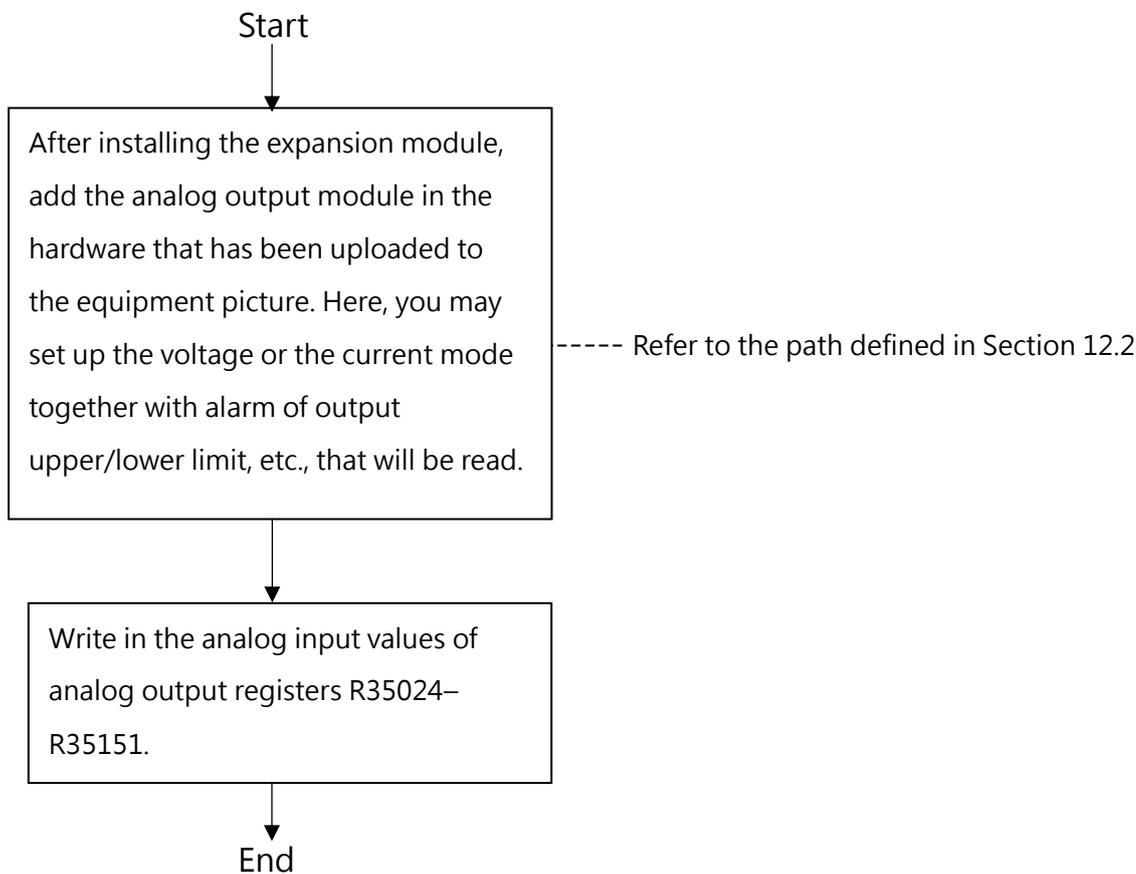
* Means the number of the channel.

If the alarm mode is set as latch mode, you may clear all of the alarms in CH* by setting alarm clear request relay from Off to On.

15-3 General Analog Output Module

15-3-1 M04DA/M04DAR

The analog input module is configured with the following two kinds of different resolutions and they are AIO and AOH type of modules. The resolution of AO is rated at 14 bits, which is the same as 14 effect bit mode designed for M Series-4DA and that of AOH is rated at 16 bits. The difference between them is the graduation mark being defined according to the resolution. For details, please refer to the "Outputting signal scope" section.

Operating Steps of Analog Output Module

Start

After installing the expansion module, add the analog output module in the hardware that has been uploaded to the equipment picture. Here, you may set up the voltage or the current mode together with alarm of output upper/lower limit, etc., that will be read.

----- Refer to the path defined in Section 12.2

Write in the analog input values of analog output registers R35024–R35151.

End

Search M04DA/M04DAR data in Device Monitor

Click "Project" → "Device View" → "Device Monitor", the device monitoring window will be shown as below on the right side:

Figure 116 Device monitor

In the information, you can choose the resources to be displayed, such as "Digital Data", "Logic Data", "Status Data", and "Relay".

● Logic data (temperature data)

Logic data refers to the value obtained or output by the channel. Click "Logic Data" on the top information of "Device Monitor", only logical data will be displayed in the module list. Put the mouse over the value, and when the data is blue as shown in the figure below, the value of the register can be modified; or modify the value display mode through "Dec" and "Hex" on the right of the register.

Figure 117 Logic data in "Device Monitor"

● Status Data

Click "Status Data" on the top of "Device Monitor", and only the status data will be displayed in the module list. When the data is grayed out as shown in the figure below, the value of the register cannot be modified. However, it is still possible to quickly modify the value display mode through "Dec" and "Hex" on the right side of the register.

Figure 118 Status data in "Device Monitor"

Figure 119 Error code in "Device Monitor"

● Relay

Click "Relay" on the top of "Device Monitor", and only the status information will be displayed in the module list. Put the mouse over the value, when the data is blue as shown in the figure below, the value of the register can be modified, otherwise, if the register position is gray, it cannot be modified.

	Ch 0	M9199	OFF
data buffer request relay	Ch 1	M9200	OFF
	Ch 2	M9201	OFF
	Ch 3	M9202	OFF
	Ch 0	M9203	OFF
data buffer trigger relay	Ch 1	M9204	OFF
	Ch 2	M9205	OFF
	Ch 3	M9206	OFF
	Ch 0	M9207	OFF
alarm clear request relay	Ch 1	M9208	OFF
	Ch 2	M9209	OFF
	Ch 3	M9210	OFF

Figure 120 Status data in "Device Monitor"

15.3.1.1 M04AD/M04ADR Function

The AO (Analog Output) Module is designed with lots of functions for use by the user such as slew rate setting, scaling and alarm setting. The use these functions, access "Project->Device View" and double click the desired module and you will find out the position required for setting the M04AD/M04ADR function in "Configuration Settings". For details, please refer to Section 12.2. It is the same as the Ladder editing except that these settings can only be executed under offline editing status.

Channel Opening/Closing

Each channel is designed with D/A conversion channel opening or closing function. When D/A conversion channel is under opening status, the channel will execute D/A conversion. When D/A conversion channel is under closing status, the channel will not execute D/A conversion and it can also reduce the conversion cycle of all channels.

Application method and instructions

Conversion cycle time = (D/A conversion time) x (Number of opened D/A channels)

Example:

Number of opened channels= 3

Conversion cycle time = (D/A conversion time) x 3

Setting and Preset value

If the channel is not designed with channel opening/closing function, it will be preset as closing.

Setup	M04AD setting	M04ADR setting	Preset Value
Channel opening/closing	Opening	Opening	Closing
	Closing	Closing	

Table 69 Setting of channel opening/closing

Output Calibration Function

Each channel will execute the output calibration for the respective bay. Each channel will store the offset value and the gain value of each bay to carry out the required calibration.

The preset value is the factory calibration value and is saved in the module and it cannot be changed. The preset value can be used to restore to the factory status.

● Application method and instructions

Execute the offset calibration and then the gain calibration.

Upon delivery, the factory will calibrate the respective bay of each channel. To make the calibration, the user may calibrate the bay being set for the channel that will be calibrated.

Set the offset until the external measuring DAC outputs "0". Save the offset value and then set the gain until the external measuring DAC outputs the voltage (5V, 10V) or current (20mA) for the respective bay. After being confirmed, the user may save the internal gain value in the module.

DAC input = Data input * gain value/65535 + offset value

The calibration comprises the following two types:

User Calibration Mode

● Based on the set bay, perform the calibration for the target channel.

Factory Restoration Mode

● All channels will be calibrated before leaving the factory, and the parameters will be stored in the module. If the user needs to return the factory calibration value in the future, he can use UperLogic to recall it.

For the calibration steps of M04DA/M04DAR, please refer to chapter 15.2.1.2.2 M04AD/M04ADR Input Calibration Function.

Setting and Preset value

Each channel is designed with offset value and gain value. The present value is the factory calibration value and it is saved in the module.

Input Calibration Setting	M04DA	M04DAR	Preset Value
Offset Value	-16383 ~ 16383	-32000~32000	Factory calibration value
Gain Value	-100000 ~ 100000	-100000~100000	Factory calibration value

Table 70 Setting of Input Calibration function

Output Signal Scope

Due to varied resolutions, the M04DA and M04DAR modules are designed with the respective output signal scope. Such function is used to set up the output analog voltage/current in order that they can be switched within the output signal scope configured for the respective channel.

Setting and Preset value

If the channel is not designed with output signal scope, then it will be preset as 0V–10V.

Output Signal Scope		Digital Input Scope
Voltage	-10 to +10 V	-8192 to 8191
	-5 to +5 V	-8192 to 8191
	0 to +10 V	0 to 16383
	0 to +5 V	0 to 16383
	1 to +5 V	0 to 16383
Current	0 to 20 mA	0 to 16383
	4 to 20 mA	0 to 16383

Table 71 M04DA output signal scope setting

Output Signal Scope		Digital Input Scope
Voltage	-10 to +10 V	-27000 to 27000
	-5 to +5 V	-27000 to 27000
	0 to +10 V	0 to 27000
	0 to +5 V	0 to 27000
	1 to +5 V	0 to 27000
Current	0 to 20 mA	0 to 27000
	4 to 20 mA	0 to 27000

Table 71 M04DAR output signal scope setting

Scaling Function

The opening or closing mode should be designed for the scaling function of each channel. Before opening, you need to set the conversion graduation mark of digital input scope as scaling scope so that the user will be allowed to determine the graduation mark of the digital input. However, the conversion will not be required when it is closed.

Application method and instructions

Select "Device View" and click M04AD/M04ADR module you want to use, and click 'Configuration Settings", after enabling the A/D channel you want to enable, find "Scaling Setting" (as shown in the figure below), and enable the desired A/D channel. Fill in the upper limit value and lower limit value for the channel using this function, then press OK and download the setting data of the module.
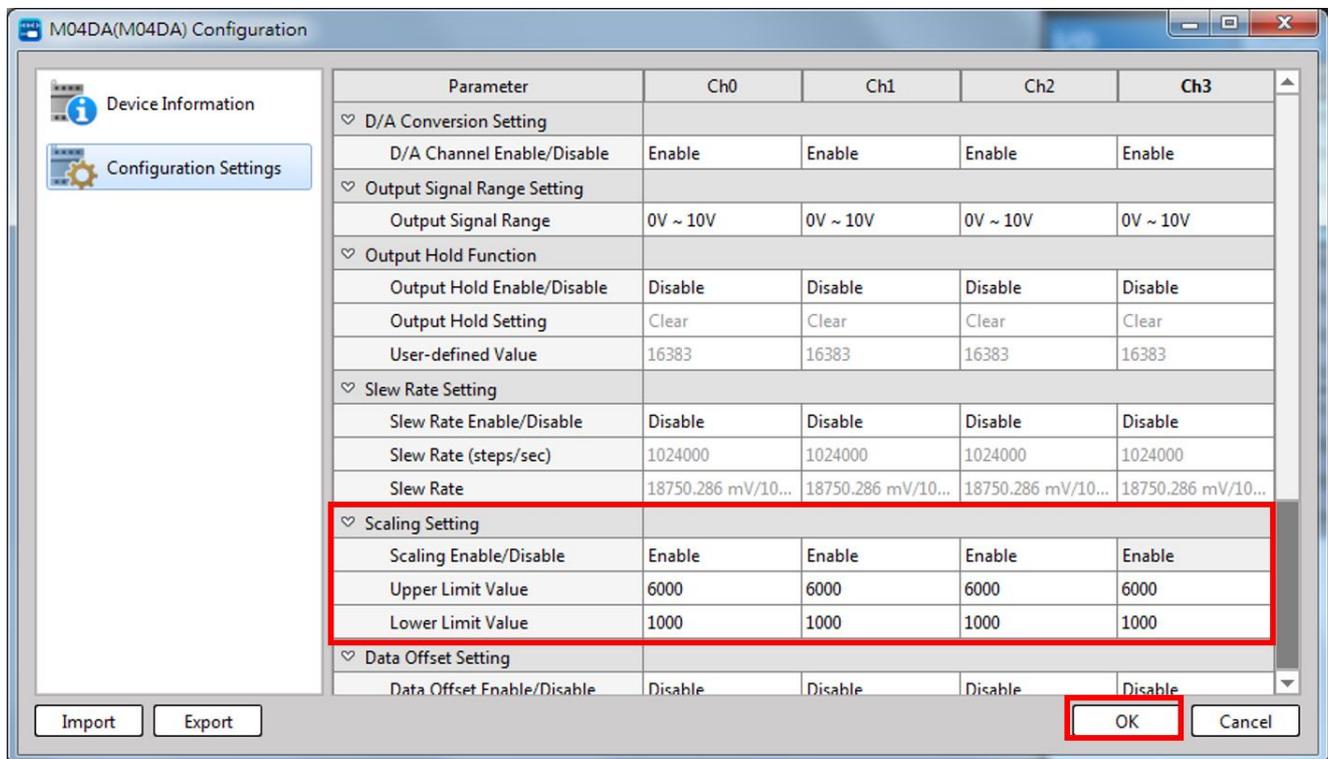

Figure 138 Position of M04AD/M04ADR scaling setting

※If the digital input entered by the user exceeds the scaling scope, it will be limited to the boundary value of the zoom range.

Example:

Analog output scope = "0V–10V"

Digital input scope = "0–27000"

Scaling setting scope = "1000–6000"
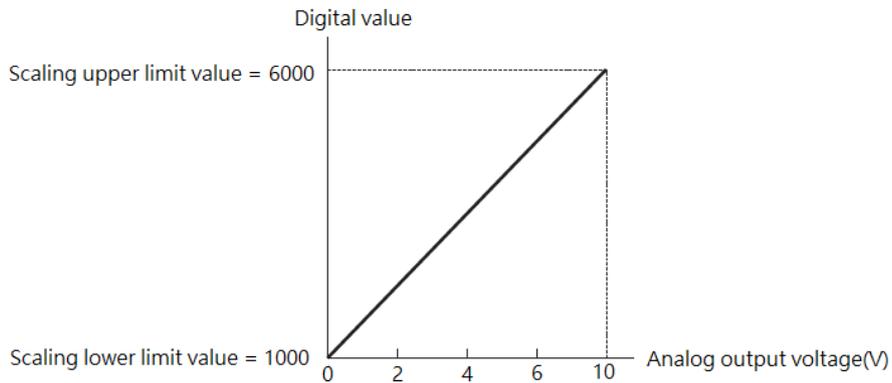
Figure 139 Schematic diagram of M04AD/M04ADR scaling scope

User Input Value	Digital Input Value	Output Voltage (V)
1000	0	0 V
2000	5400	2 V
3000	10800	4 V
4000	16200	6 V
5000	21600	8 V
6000	27000	10 V

Table 73 Comparison table of analog output of digital scaling value and digital input

Setting and Preset value

The scaling scope shall be configured according to the condition provided below:

Scaling upper limit value > Scaling lower limit value

Setup	M04DA Setting	M04DAR Setting	Preset Value
Scaling	Opening Closing	Opening Closing	Closing
Scaling upper limit value	-2147483648 to 2147483647	-2147483648 to 2147483647	Closing
Scaling lower limit value	-2147483648 to 2147483647	-2147483648 to 2147483647	Closing

Table 74 Comparison table of analog output of digital scaling value and digital input

Output Holding Function

If the channel opening/closing is set as opening, then the output holding function of the respective channel can also be set as opening or closing. When opening, you need to set the output holding function. If the PLC stops running or incorrect stopping occurs, the system will control the output according to the output holding setup value; however, the output will not be controlled it the channel is closed.

Application method and instructions

The output holding setup function comprises the following 3 modes:

Clear Mode: Output the offset value if PLC stops running or if incorrect stopping is detected.

Hold Mode: Maintain the output before PLC stopping or incorrect stopping when PLC stops running or when incorrect stopping is detected.

User-Defined Value: The output value set by the user when PLC stops running or when incorrect stopping is detected.

	When channel opens			When channel closes
Output Holding	Clear Mode	Hold Mode	User-defined Value	N/A
CPU status: Run	D/A value	D/A value	D/A value	0 V/mA
CPU status: Stop	Offset value	The value before stopping	User-defined value	0 V/mA
CPU status: Stop error	Offset value	The value before stopping	User-defined value	0 V/mA

Table 75 Analog output status when the output holding function opens

※　When the CPU stops/stops due to an error, if the M04DA/M04DAR uses the clear mode, the channel will output an offset value (the voltage/current output by the offset value will be equivalent to the output voltage/current when a digital value of 0 is input (When the CPU is normal and the same gear and data offset are used)).

Setting and Preset value

If the channel is not designed with output hold function, then it will be preset as closing.

If the channel is not designed with output hold function, then it will be preset as clear.

If the user-defined value is not being specially set, then it will be preset as the maximum bay output value.

Setup	M04DA	M04DAR	Preset
Output hold function	Opening Closing	Opening Closing	Closing
Output hold setup	Clear Hold User-defined value	Clear Hold User-defined value	Clear

Setting Slew Rate Control

Set as opening or closing for the slew rate control of each channel. When setting the slew rate control as opening, you need to set the slew rate in order to avoid abrupt rising of voltage/current output. If the bay output changes violently when closing, then it will execute the output directly.

Setting and Preset value

If the channel is not designed with slew rate control function, then it shall be preset as closing.

Setup	M04DA setting	M04DAR setting	Preset
Slew rate control setting	Opening Closing	Opening Closing	Closing
Slew rate	64 steps/100ms 125 steps/100ms 250 steps/100ms 500 steps/100ms 1000 steps/100ms 2000 steps/100ms 4000 steps/100ms 8000 steps/100ms 16000 steps/100ms 32000 steps/100ms 64000 steps/100ms 128000 steps/100ms 256000 steps/100ms 512000 steps/100ms 1024000 steps/100ms	64 steps/100ms 125 steps/100ms 250 steps/100ms 500 steps/100ms 1000 steps/100ms 2000 steps/100ms 4000 steps/100ms 8000 steps/100ms 16000 steps/100ms 32000 steps/100ms 64000 steps/100ms 128000 steps/100ms 256000 steps/100ms 512000 steps/100ms 1024000 steps/100ms	1024000 steps/100ms

Table 77 Slew rate control setting

Data Offset Function

This function is designed for setting the opening or closing mode for the data offsetting function of each channel. When opening, you need to set up the data offsetting function in order that the data will be shifted for correction. However, the data offsetting will not be required when the channel is closed.

Application method and instructions

The digital input value should be used with the set data offset function to execute the data correction.

If the digital computation value exceeds the digital input scope, then it will be limited to the digital input scope.

Digital computation value = Digital input value + Data offset value

Example: If Analog output scope: 0–10V, then the data offset value will become "+50"

Digital input value	Digital computation value	Analog output voltage (V)
-50	0	0
31950	32000	10V

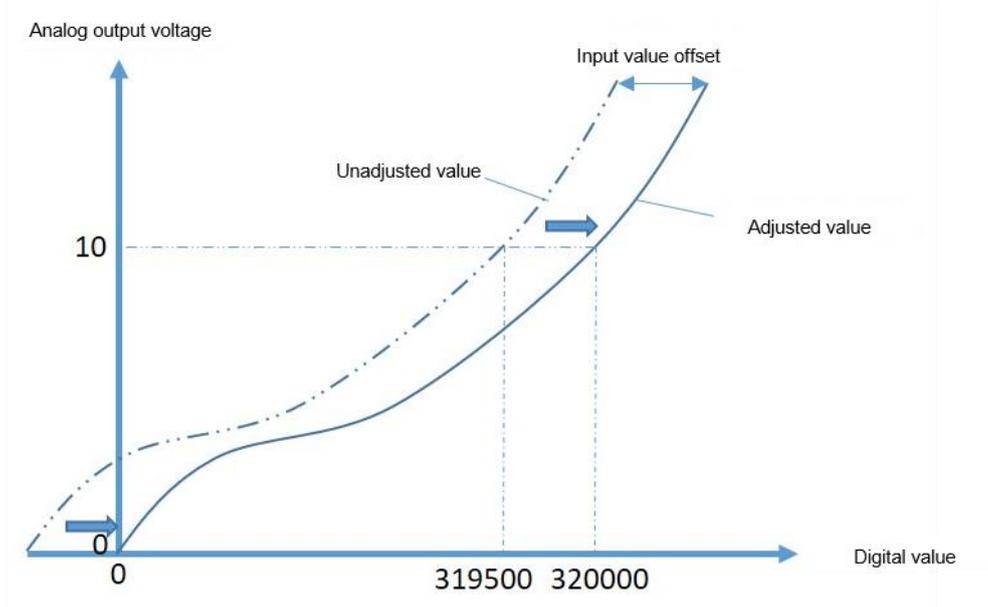Table 78 Example of using data offset function

Figure 140 Schematic diagram of M04DA/M04DAR data offset

Setting and Preset value

If the channel is not designed with data offsetting function, then it will be preset as closing.

Setup	M04DA setting	M04DAR setting	Preset
Data offset function	Opening Closing	Opening Closing	Closing
Data offset value	-16383 – 16383	-64000 – 64000	0

Table 79 Setting of data offset function

Short-circuit Detection

The relay behavior shall depend on the alarm mode and on whether short circuit has occurred to the automatic detection device.

The purpose of short-circuit detection is to detect the voltage bay for determining if any short circuit has occurred.

Application method and instructions

When detection short-circuited, an alarm will be output, so that the corresponding relay will be changed from Off -> On.

Setting and Preset value

When detecting the short circuit in the channel, the system will output the alarm and the corresponding relay will shift from Off to On.

Setup	M04DA	M04DAR	Preset
Short-circuit detection	Opening Closing	Opening Closing	Closing

Table 80 M04DA/M04DAR short-circuit detection setting

Run-time relay control

For detailed setting of alarm relay and alarm mode, please refer to alarm section.

Open-circuit Detection

The relay behavior shall depend on the alarm mode and on whether open circuit has occurred to the automatic detection device.

The purpose of open-circuit detection is to detect the current bay for determining if any open circuit has occurred.

Application method and instructions

When detecting the open circuit in the channel, the system will output the alarm and the corresponding relay will shift from Off to On.

Setting and Preset value

If the channel is not designed with open-circuit detecting function, then it will be preset as closing.

Setup	M04DA	M04DAR	Preset
Open-circuit detection	Opening	Opening	Closing
	Closing	Closing	

Table 81 M04DA/M04DAR open-circuit detection setting

Run-time relay control

For detailed setting of alarm relay and alarm mode, please refer to alarm section.

M04AD/M04ADR Alarm

● Alarm mode

Alarm mode setup	Alarm behavior
Instant Mode (preset)	When analog input resumes normal scope, the system will clear the alarm (On->Off) automatically.
Latch Mode	Even if the analog input resumes normal scope, the alarm relay will maintain the status continuously. The clear alarm relay will order the relay to remove the alarm (Off->On).

Table 82 M04AD/M04ADR alarm mode setting

● All types of alarms

The alarm mode will determine the alarm relay behavior.

Alarm relay	Description of function
CH* Short-circuit Alarm Relay	Off->On: Short-circuit detected in CH* Off: Channel is within normal scope
CH* Open-circuit Alarm Relay	Off->On: Open-circuit detected in CH* Off: Channel is within normal scope
CH* Alarm Clear Request Relay	The Alarm Clear Request Relay will be active when the alarm is under Latch Mode. Off->On: Clear all alarms in CH*.

Table 83 All types of alarms of M04AD/M04ADR

* Represents the number coded for the channel.

15-4 General Analog Input/Output Modules

15-4-1 M0202AH

The M0202AH module uses analog input for the first two channels, and analog output for the last two channels, which is an economical solution with fewer analog input and output points. Its function is actually a mixed application of M04AD and M04DA, so the usage is the same.

Analog Input Part

Please refer to chapter 15-2-1 M04AD/M04ADR in this manual for the analog input usage method and steps and how to find related information.

Analog Output Part

Please refer to chapter 15-3-1 M04DA/M04DAR in this manual for the method and steps of using analog input and how to find relevant information.

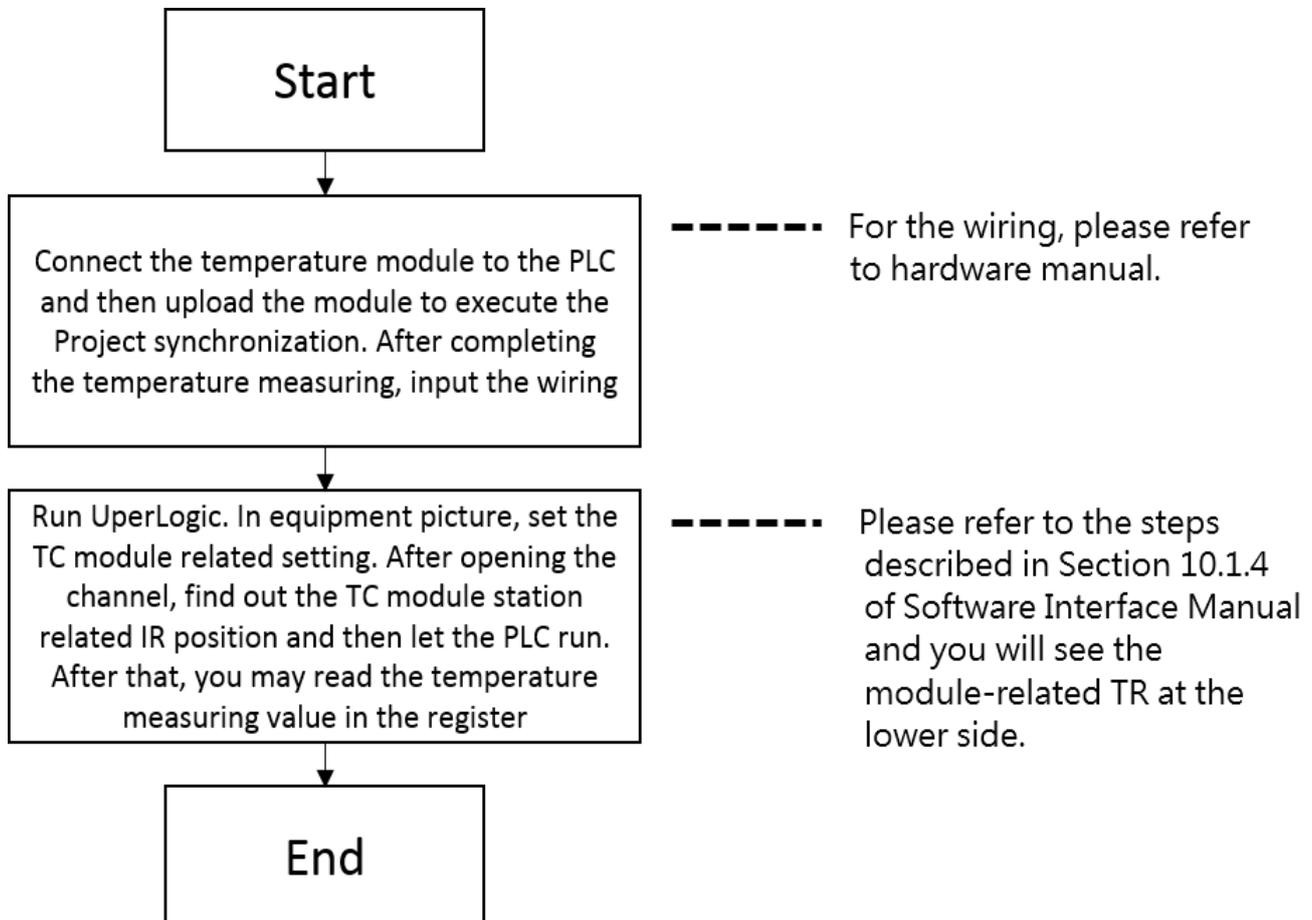# 15-5 Temperature Control Module

To satisfy the massive scale of temperature control application market, the M SERIES PLC provides the most common thermocouple (TC) in which, the temperature modules such as M04TC can be used for measuring the temperature being exported from 4-point type of thermocouple. The thermocouple comes with the following 9 models for option and they are J, K, T, E, N, B, R, S and±100kV. The temperature measuring of the temperature module is designed in time-division multiplexing type. In actual I/O address, each temperature module only occupies 1 unit of digital input (Input Register) and 8 points of digital output (digital output). Each individual PLC host can perform the temperature measuring for up to 32 points. In the meantime, the updating speed of temperature measuring can be set in either general mode (updating time: 0.4 seconds; resolution: 0.1°) or quick mode (updating time: 0.2 seconds; resolution: 1°).
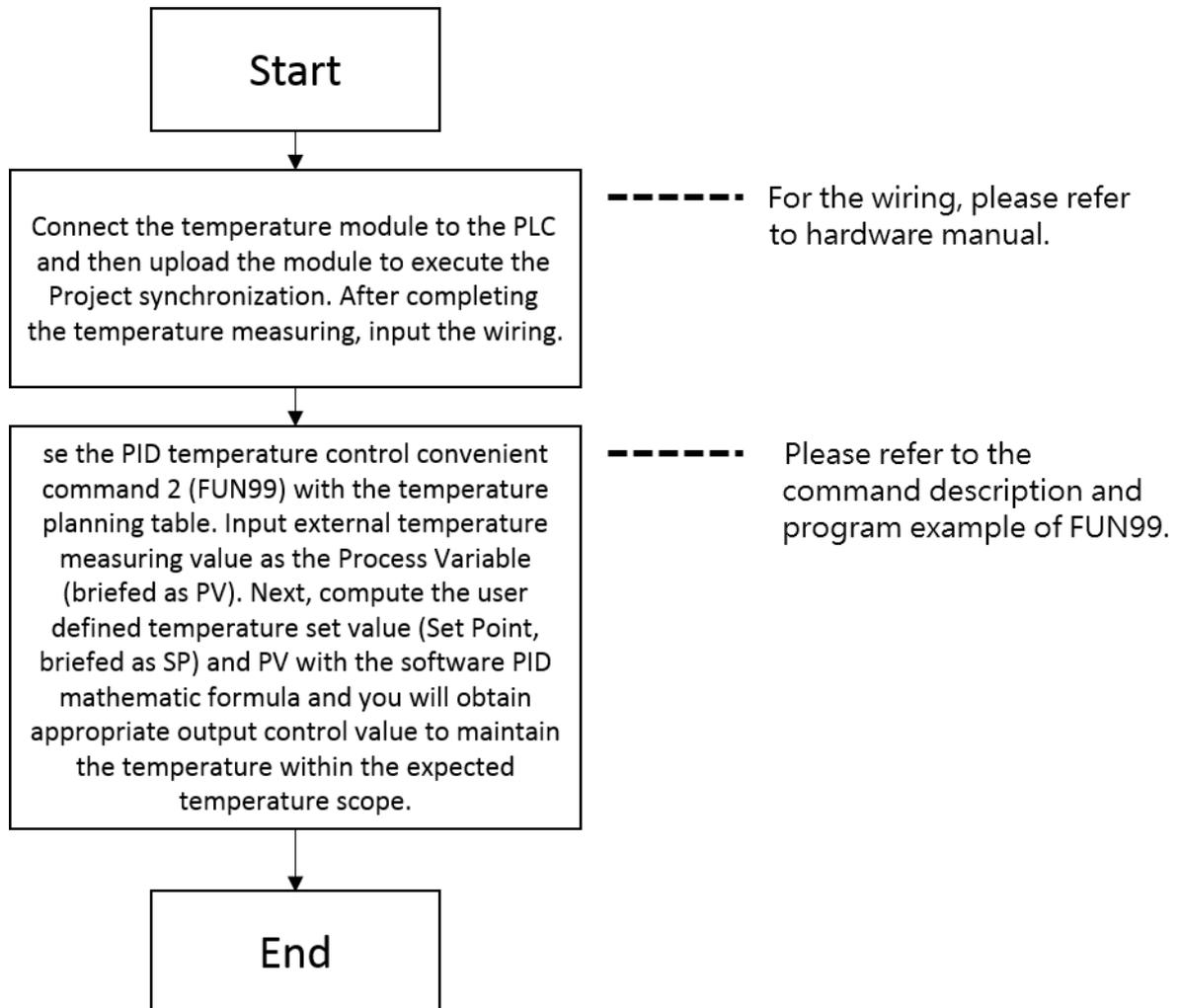
When executing the temperature measuring with the aforesaid temperature modules, the UperLogic provides very convenient table-filling method for planning the desired temperature module and the sensor type. Further, it can also appoint the corresponding register in order that the temperature value will be saved more efficiently. In terms of PID temperature control, it is provided with exclusive convenient command (FUN99) for executing the PID computation control and then output the computation result through appropriate output interface.

15-5-1 M04TC/M04TCR

Temperature mode application steps

Temperature measuring

Start

↓

Connect the temperature module to the PLC and then upload the module to execute the Project synchronization. After completing the temperature measuring, input the wiring

┈┈┈┈┈ For the wiring, please refer to hardware manual.

↓

Run UperLogic. In equipment picture, set the TC module related setting. After opening the channel, find out the TC module station related IR position and then let the PLC run. After that, you may read the temperature measuring value in the register

┈┈┈┈┈ Please refer to the steps described in Section 10.1.4 of Software Interface Manual and you will see the module-related TR at the lower side.

↓

End

Closed circuit temperature PID control

```
            ┌─────────────────────┐
            │       Start         │
            └─────────────────────┘
                       │
                       ▼
   ┌─────────────────────────────────────┐        ■ ─ ─ ─ ■·    For the wiring, please refer
   │ Connect the temperature module to   │                     to hardware manual.
   │ the PLC and then upload the module  │
   │ to execute the Project              │
   │ synchronization. After completing   │
   │ the temperature measuring, input    │
   │ the wiring.                         │
   └─────────────────────────────────────┘
                       │
                       ▼
   ┌─────────────────────────────────────┐        ■ ─ ─ ─ ■·    Please refer to the
   │ se the PID temperature control      │                     command description and
   │ convenient command 2 (FUN99) with   │                     program example of FUN99.
   │ the temperature planning table.     │
   │ Input external temperature          │
   │ measuring value as the Process      │
   │ Variable (briefed as PV). Next,     │
   │ compute the user defined            │
   │ temperature set value (Set Point,   │
   │ briefed as SP) and PV with the      │
   │ software PID mathematic formula and │
   │ you will obtain appropriate output  │
   │ control value to maintain the       │
   │ temperature within the expected     │
   │ temperature scope.                  │
   └─────────────────────────────────────┘
                       │
                       ▼
            ┌─────────────────────┐
            │        End          │
            └─────────────────────┘
```

Searching M04TC/M04TCR data in Device Monitor

Click "Project" → "Device View" → "Device Monitor", the device monitoring window will be shown as below on the right side:

Figure 116 Device monitor

In the information, you can choose the resources to be displayed, such as "Digital Data", "Logic Data", "Status Data", and "Relay".

● Logic data (temperature data)

Logic data refers to the value obtained or output by the channel. Click "Logic Data" on the top information of "Device Monitor", only logical data will be displayed in the module list. Put the mouse over the value, and when the data is blue as shown in the figure below, the value of the register can be modified; or modify the value display mode through "Dec" and "Hex" on the right of the register.

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Figure 117 Logic data in "Device Monitor"

● Status Data

Click "Status Data" on the top of "Device Monitor", and only the status data will be displayed in the module list. When the data is grayed out as shown in the figure below, the value of the register cannot be modified. However, it is still possible to quickly modify the value display mode through "Dec" and "Hex" on the right side of the register.

Figure 118 Status data in "Device Monitor"

Figure 119 Error code in "Device Monitor"

● Relay

Click "Relay" on the top of "Device Monitor", and only the status information will be displayed in the module list. Put the mouse over the value, when the data is blue as shown in the figure below, the value of the register can be modified, otherwise, if the register position is gray, it cannot be modified.

data buffer request relay	Ch 0	M9199	OFF
	Ch 1	M9200	OFF
	Ch 2	M9201	OFF
	Ch 3	M9202	OFF
data buffer trigger relay	Ch 0	M9203	OFF
	Ch 1	M9204	OFF
	Ch 2	M9205	OFF
	Ch 3	M9206	OFF
alarm clear request relay	Ch 0	M9207	OFF
	Ch 1	M9208	OFF
	Ch 2	M9209	OFF
	Ch 3	M9210	OFF

Figure 120 Status data in "Device Monitor"

15.5.1.1 Temperature module related function and setting

After connecting M04TC module with CPU module, click "Device View-> Configuration Settings" to start the setting in the Project window.

Project
└── Device View → Select temperature module
                                    └── Configuration Settings

Parameter	Ch0	Ch1	Ch2	Ch3
♡ TC Setting				
TC Channel Enable/Disable	Disable	Disable	Disable	Disable
TC Conversion Time	Standard			
Moving Average Count	2	2	2	2
♡ Sensor Setting				
Sensor Type	K	K	K	K
Sensor Range	Range 1	Range 1	Range 1	Range 1
♡ Function Setting				
Temperature Unit	Celsius	Celsius	Celsius	Celsius
Control Method	ON/OFF Control	ON/OFF Control	ON/OFF Control	ON/OFF Control
Control Output	Off	Off	Off	Off
♡ Post Processing Setting				
Scaling Enable/Disable	Disable	Disable	Disable	Disable
Maximum Scaled Value	100	100	100	100
Minimum Scaled Value	0	0	0	0

Device Information | Configuration Settings

Import | Export | OK | Cancel

M04TC Channel Opening/Closing

In each channel, the A/D conversion channel is designed with opening or closing function. When A/D conversion channel is opened, the channel will execute the A/D conversion. When A/D conversion channel is closed, the channel will not execute the A/D conversion and will reduce the conversion cycle for all of the channels

Setup: Opening/closing (preset)

M04TC Conversion Time

It comprises standard and fast speed for changing the temperature and the conversion speed of the channel and selecting the temperature updating speed. The faster the conversion speed, the poorer the conversion speed accuracy; otherwise, it is more accurate. Such kind of setting is not available for the closed channel.

Set value: (conversion speed-ms)

Average Move Frequency

The average move frequency can be applied in the temperature control value (PV) of each channel.

Assume noise is presented in the environment, the noise interference encountered by the control value

can be reduced through such function. The setting scope is 2–10.

Setting: (frequency)

Preset value: 2

Sensor Type

The system is equipped with a variety of thermocouple temperature sensors to meet the diversified

applications. It is also designed with voltage bays to work with special type of thermocouple temperature

sensor. You may select the temperature sensor that suits the channel the most. Listed below the

supported sensor type and the related input scope:

Sensor type	Input scope(°C)
B	200~1800
E	-200~1000
J	-100~1200
K	-200~1350
N	-150~1300
R	0~1750
S	0~1750
T	-200~400

Table 84 Supported ranges for various sensors

Temperature Unit

Based on the country, you may select local temperature unit (either in °C or °F). The temperature unit

selected for each channel can be accurate till to the first place following the decimal point.

°C (preset value)

°F

Controlling Method

Set the temperature control method for each channel.

Switch control: Compare with the set SV value to control the output for conversion between ON (max. output value) and OFF (min. output value).

PID control: By combing the proportional (P), integral action (I) and derivative action (D), it allows the system to achieve more efficient temperature control and its fluctuating ratio is also better then that of switch control.

Set value: Select the mode (preset, switch control)

Start running: Temperature control command

Shifting set: Stop temperature control and then set in "Equipment picture -> Configure".

Controlling Output

When M04TC module/CPU is faulty or when CPU is shut down, set the output value required for controlling each channel at Open (max. output value), Close (min. output value) or Hold (hold output value).

Setting:

Open/Close (preset)/Hold

Scaling

By mapping the input scope to the new scope set by the user, you may enlarge or shrink the process control value; for example, applying -100°C–500°C to the newly created 0–10000 scope.

Setting:

Open/Close (preset value)

Max. scaling value (100)

Min. scaling value (0)

Scope: -32000–32000

Note: The system will output the error alarm if the min. value is greater than or equal to the max. value.

Circuit Disconnection Detection

If the output value is the output max. limit value or output min. limit value, you may monitor the temperature measuring value (PV) at each time point. As long as the rising or the dropping does not exceed 2°C, the system will output the circuit disconnection detection alarm. Each channel will be allowed for setting:

Set judgment time: (s)

Scope: 0–7200(s). Such function remains inactive if set as "0".

Burn-out Detection

During the burn-out detection, it is not required to execute any setting and the M04TC module will keep checking to see if any burn-out occurs. If the burn-out phenomenon is detected at the input end, the system will report error warning; in this case, the system will display the bit required for the burn-out detection.

For details of the bit required for burn-out detection, please refer to the method specified in Section 12.1.3.

Setting Data Buffer

Based on the sampling cycle, you may save the temperature control value (PV). The maximum number that can be saved in each channel shall be up to 600 individuals. After setting the desired observation point, you will be allowed to check the change of the number of the observation point before and after the observation. By using with DBUF FUN115 command, you will be allowed to save the massive data captured by the TC module in the PLC.

Setting:

Number of buffer point before triggering (data number before the triggering point: 0–600)

Number of data buffer point (1–600)

Before triggering, the number of buffer point shall be less than or equal to that of the data buffer point.

Running method:

  1. Data Buffer Request Relay starts/stops the saving (upper edge triggering).

  2. Data Buffer Trigger Relay starts data collection (upper edge triggering).

  3. After that, the module will continue the relay reporting through the data buffer function.

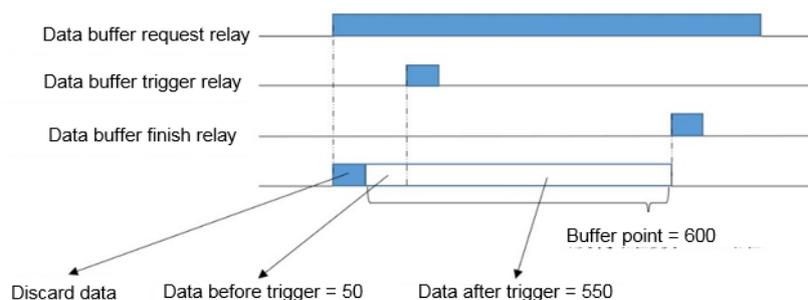 4. The user may load back the data in the PLC through DBUF FUN115 command

Figure 142 Sequence diagram of data buffering process

Assume that the user triggers the Data Buffer Trigger Relay before filling up the data retrieved from the buffer points before the triggering, the system will ignore the remaining data and then start saving the data after the triggering. If the relay is under "On" status when completing the data buffer, the ignored data will not be included in the data that are transmitted back to the PLC by the user. For example, when setting the number of buffer point before the triggering as 200, the system will trigger the Data Buffer Request Relay to start data saving. If the Data Buffer Trigger Relay is triggered when the quantity of the data saved by the buffer is accumulated to 150 points, the system will ignore the remaining 50 points and then start collecting the data after the triggering. As a result, the quantity of the data being loaded back to the PLC will become the value obtained by deducting 50 individuals of data from that of the total buffer points.

Before the triggering, the system will ignore the buffer points being existed during the period after completing the data buffer points and before the relay is activated following the data buffering.

The application method shall be the same as M04AD/M04ADR module. For details, please refer to Section 12.2.14 of "Analog Input/Output Expansion Module".

Alert

When process control value (PV) or deviation value (E) reaches the set alert value, the system will enter alert status.
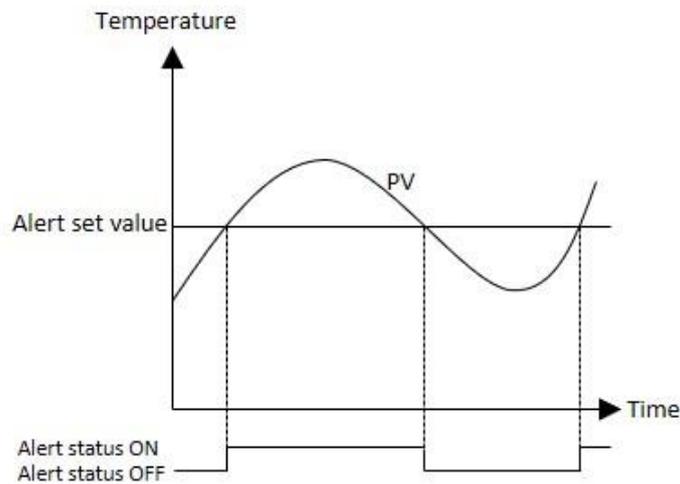
Input alert:

Figure 143 Input upper limit alert.

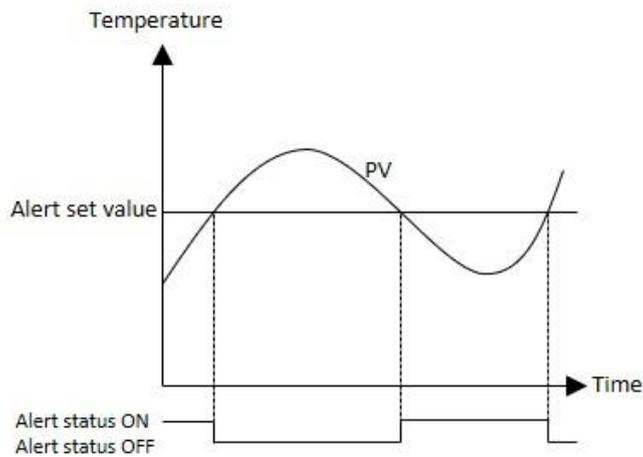When the programmable value (PV) exceeds or equals to the alert set value, an alert will be issued.

Figure 143 Input lower limit alert.

When the programmable value (PV) exceeds or equals to the alert set value, an alert will be issued.

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Deviation Alert (E)

Upper deviation limit alert. The system outputs the alert when deviation (E) is greater than or equal to the alert set value
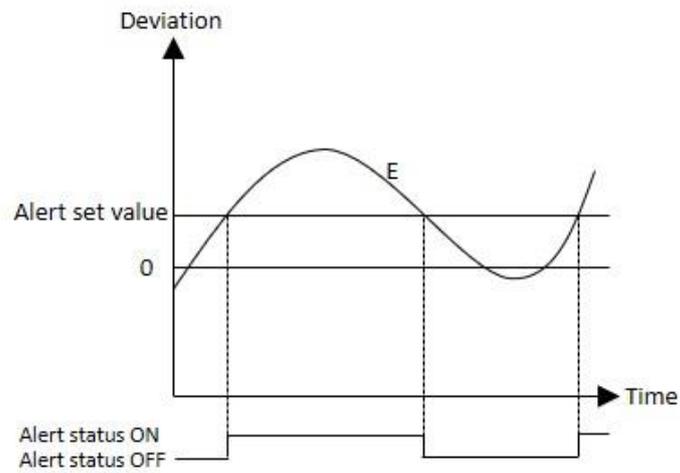

Figure 145 Deviation upper limit alert set value is greater than zero.
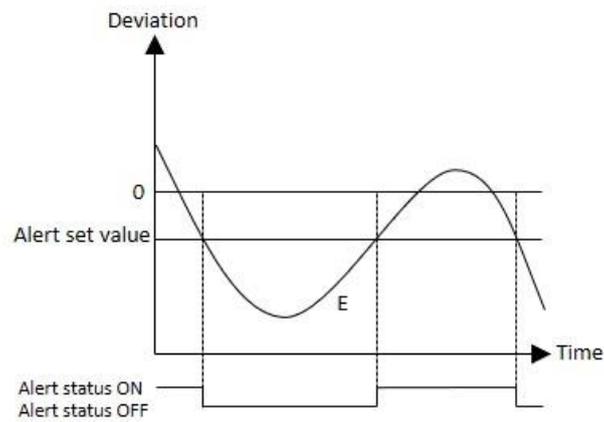

Figure 146 Deviation upper limit alert set value is less than zero.

Lower deviation limit alert. The system outputs the alert when deviation (E) is less than or equal to the alert set value.
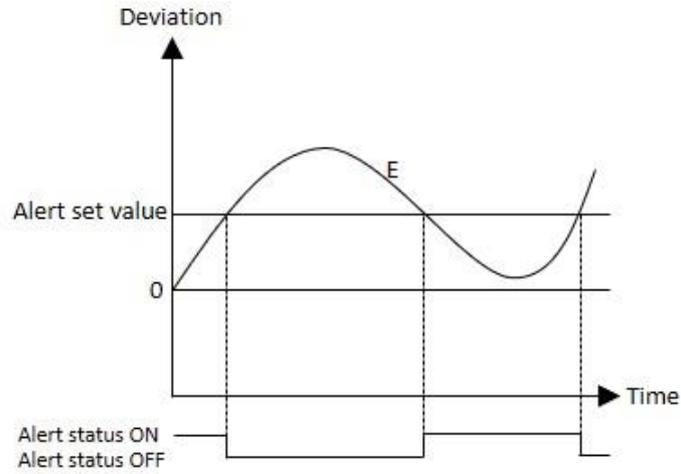

Figure 147 Deviation lower limit alert set value is greater than zero.
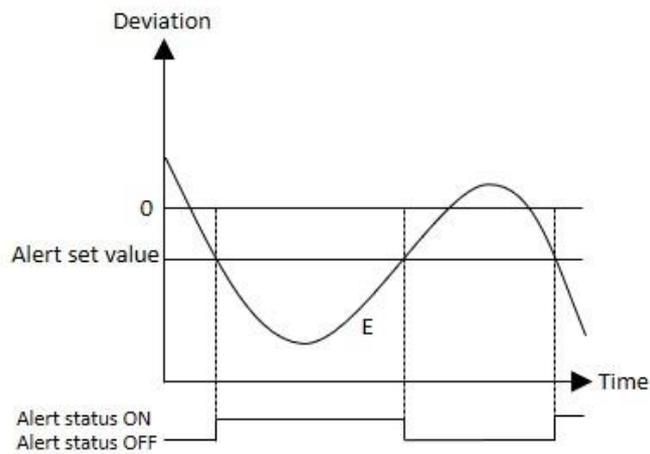

Figure 148 Deviation lower limit alert set value is less than zero.

Upper/lower deviation limit alert: The system will enter alert status when satisfying the following conditions.
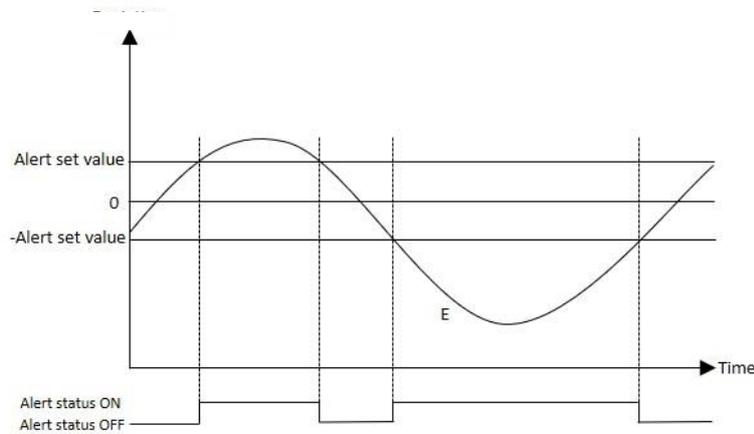
Figure 149 Deviation (E) ≥ Alert set value or Deviation (E) ≤ -Alert set value

The alert standby mode ON or OFF status. It is configured as standby mode. If changing the set value (SV) or the error value before starting the temperature control, the system will enter the warning mode. When running under standby mode, the system will not output the alert (ON) before setting the alert as OFF even if the temperature process control value (PV) or the deviation value (E) has reached the alert status ON scope.

Figure 150 When starting the temperature control, the system will not output the alarm when reaching the first round of alarm OFF scope.

Figure 151 Assuming that the temperature programmed value (PV) is in the safe range, when the set value (SV) changes, the PV may fall within the alert region, so as to avoid alerts in standby mode.
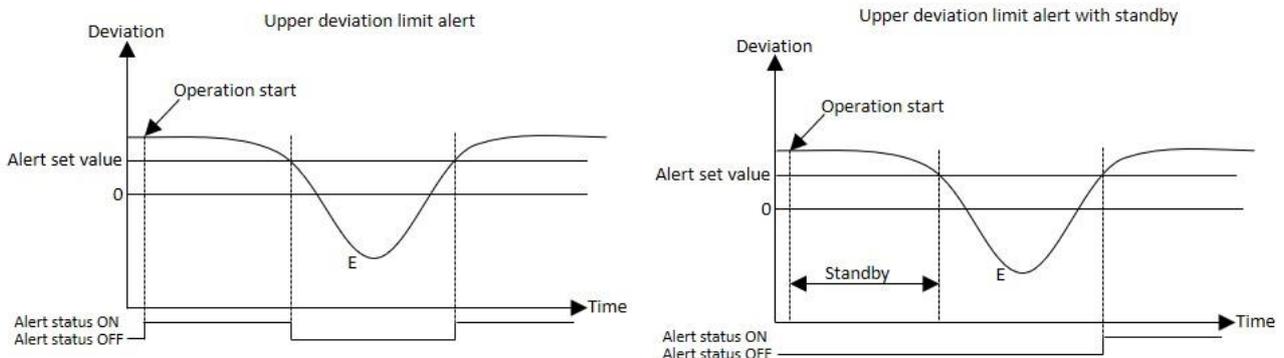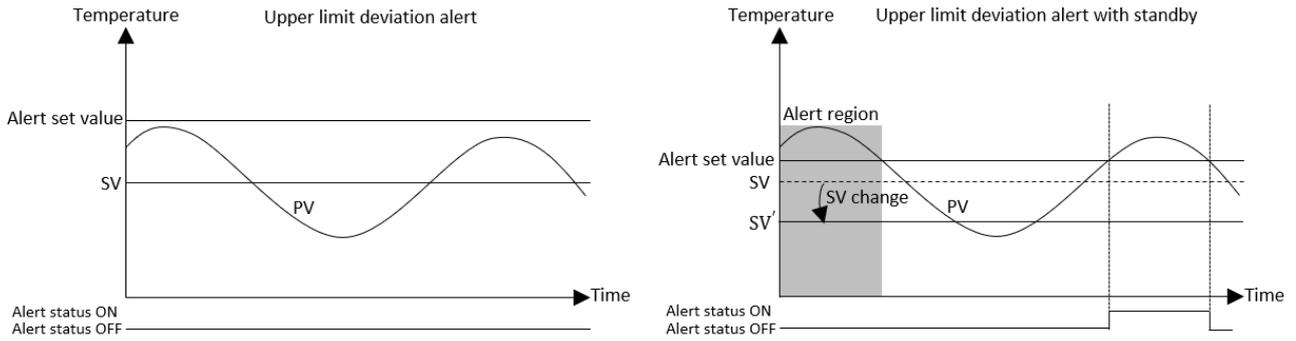
Setting alert mode and alert value

● Type of setting

● Setting alarm value

● The alarm value set by the input alarm will be regarded as the input scope.

● The alarm value set by the deviation alarm will be ranging between "-full scale–full scale".

Note:

1. Full scale: The max. and the min. temperature scope of such type of sensor. Taking "K" for example, the max. value is 1350 and the min. value is -200. Therefore, the full scale will be set as 1550.

● When setting, check if the standby mode should be enabled (ON/OFF).

● It is required to set the dead band alert and the value of each channel. The input scope will be 0– 10.0% of the full scale.
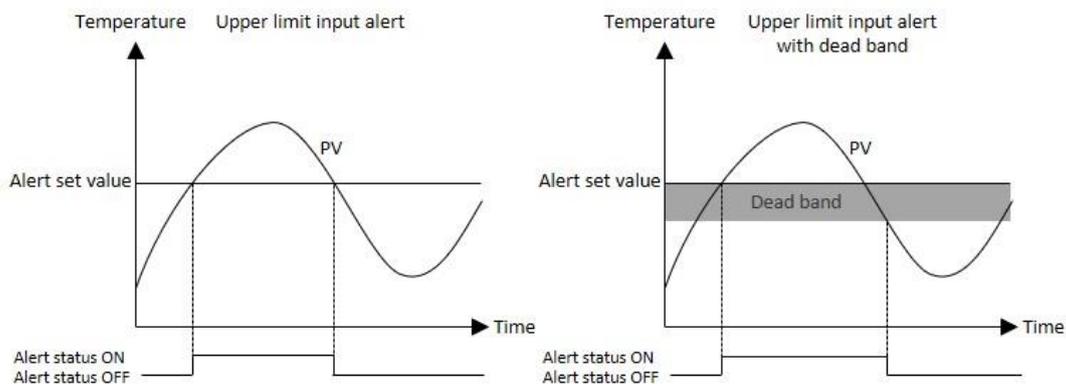
Figure 152 Schematic diagram of dead band alert mode

● Set the alarm delay frequency. If it is judged as the alert status, then the system will accumulate the frequency when entering the alarm status each time. The system will output the alert if the accumulated frequency is bigger than the set value. The scope is ranging between 0–255.

Dead Band

You need to set the response difference that will be exported when the channel temperature control mode is under "ON/OFF" status, and such setting is also applicable for the PID temperature control. For details, please refer to Section 13.2.12 "PID Control".

Set value: (dead band) temperature, ranging between 0–10.0% (input scope).

● Taking "K" for example, the scale of dead band will be as below: (1350 – (-200)) *0.1 = 155°C

Figure 153 ON/OFF control & heat action
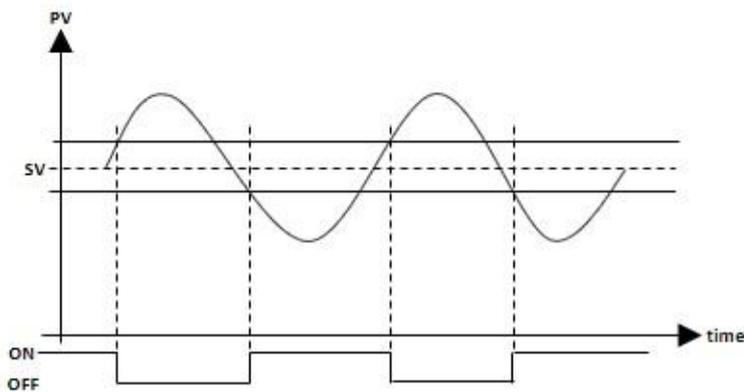
Figure 154 ON/OFF control & cool action

PID Control

Each channel can run the respective PID computation, and the Temperature Control Mode shall be set as the PID control. By using proportional (P), integral action (I) and derivative action (D), the system will be allowed to execute the temperature more efficiently in order to execute the P, PI, PD and PID control according to actual operation need.
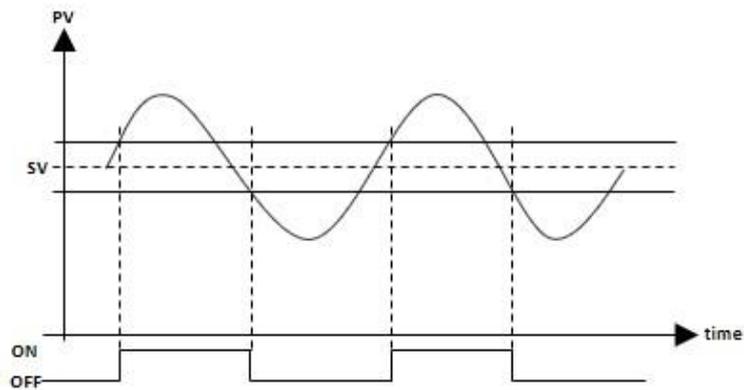
Proportional: Specific output proportion will be created according to the scale of output quantity (MV) along with the error (E) between the measured value (PV) and the set value (SV). The smaller the proportional value, the stronger the fluctuation; otherwise, smaller fluctuation will result.
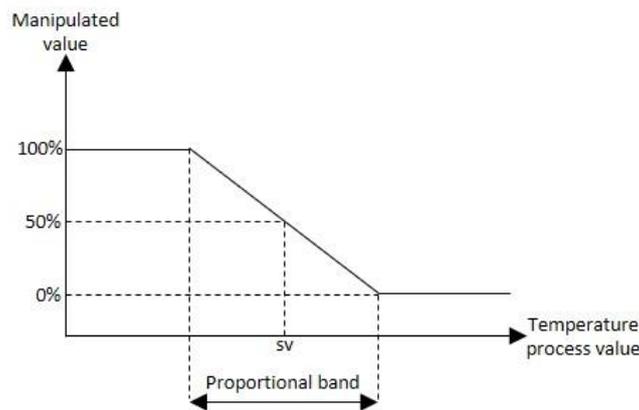
Figure 155 Proportional control layout

Integral Time: The output quantity will be increased and decreased according to the error (E) between the measured value (PV) and the set value (SV) in order to minimize the error that will be created by the P action. The smaller the integral time, the stronger the fluctuation and the quicker the rising; otherwise, it will become smaller and slower. The scope is ranging between 0–3600s. If the integral time is set as "0", then the system will not execute the integral control.
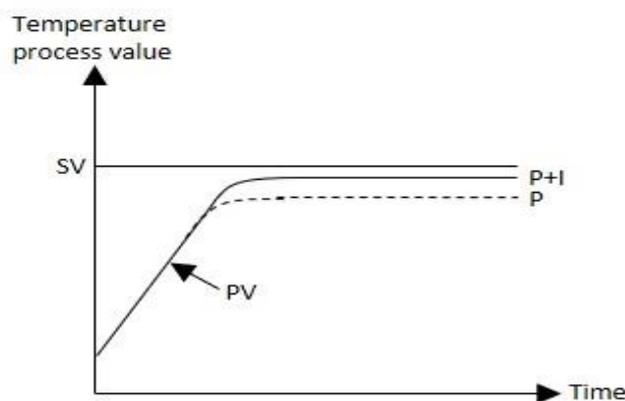
Figure 156 Integral control layout

Derivative Time: The output quantity will be increased and decreased according to the change rate between the measured value (PV) and the set value (SV). Even though abrupt change is created due to the noise, the system will be restored to stabilized status within a short period of time through the derivative action. The smaller the derivative time, the weaker the fluctuation and the slower the response; otherwise, it will become bigger and quicker. The scope is ranging between 0–3600s. If the derivative time is set as "0", then the system will not execute the derivative control.

PID Dead Band: The setting scope is ranging between 0–10.0% (input scope). During the PID control, the system will regard such zone as a deviation (E) inactive area. When the temperature process control value (PV) enters the dead band, the system will keep the PID computation until riding through the set value SV). At this time, "E" will be resolved in the computation formula when expressed as "0" and then the system will resume normal PID computation after riding through the dead band. As shown in the figure below, "E" in Zone-A is expressed as "0".

Figure 157 Derivative control layout

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PID Manual Mode: After being enabled, the output quantity (MV) will be changed to manual control mode instead of using the PID computation result as the output data.

Output scope limit. Such function is used to set the PID output scale. Based on the operating status, it is used to set the upper ou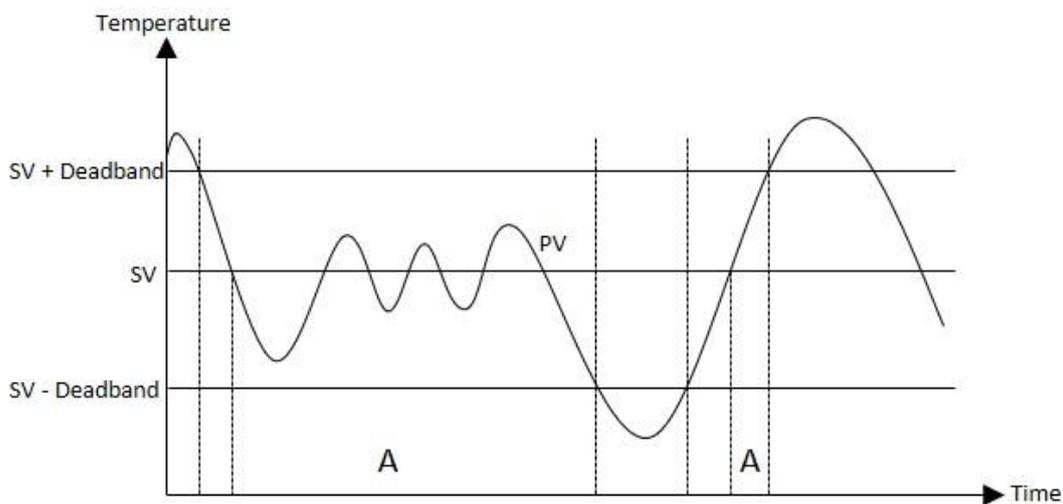tput limit, limited max. output value, lower output limit and limited min. output value. If the lower output limit is greater than or equal to upper output limit, then the system will output error alarm.

Biase: The output biase value. It allows the user to increase or decrease the output value. In spite of this, it will be limited by the created output scope.

Manual Output: Set the manual output quantity and its scope will be ranging between "lower output limit – upper output limit".

Set value:

1. Channel No. (channel number)
2. PID parameters (proportional (P), integral time (I), derivative time (D))
3. PID manual mode: ON/OFF (preset)
4. Biase: Output biase (real)
5. Manual output: Lower output limit – upper output limit
6. Upper output limit: To be bigger than lower output limit.
7. Lower output limit: To be smaller than upper output limit.
8. Dead band setting: 0.0–10.0%

Selecting Heating/Cooling Control

Such function is used to set the heating control or the cooling control when executing the temperature control for the respective channel.

Setting type: Temperature control command

Heat/cool: Forward/Reverse (preset)

When executing the ON/OFF control, the method will vary according to the selected action.

Heat/cool	Description
Heating control	If the measured value is smaller than the set value, the output increase action will be regarded as the set value for the heating process.
Cooling control	If the measured value is bigger than the set value, the output increase action will be regarded as the set value for the cooling process.

Table 85 Heat/cool control behavior relationship

Auto tuning

Based on the control system operating environment, such function can be used to calculate appropriate PID parameters required for the proportional (P), integral time (I) and derivative time (D). You will be allowed to use the aforesaid parameters after executing the temperature control under PID Control Mode. In this case, it provides several waveforms through ON/OFF control for the temporary in order to obtain the optimal PID parameters. After that, the system will log the parameters in the PID-related memory where they will be converted to PID control mode in order to execute the temperature control.
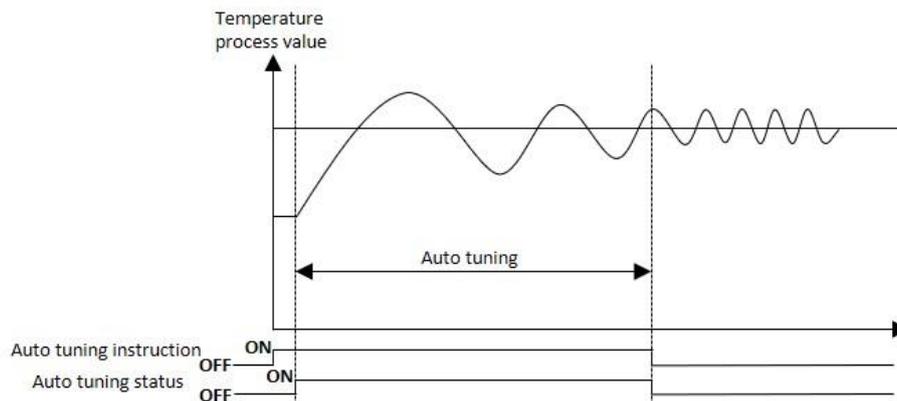
Figure 158 Auto tuning layout

During the auto tuning period, the system will use the upper output limit and the lower output limit as the reference for executing the output. To execute the auto tuning, you need to set the output cycle as the value other than "0".

If the SV setting exceeds the temperature scope value, then the system will not execute the auto tuning function.If the cycle still remains after the auto tuning process, then the system will output auto tuning overdue error alarm.

The auto tuning function cannot be executed for the channel that has been set as closed conversion. If you change the value set for the SV, dead band, sensor calibration, output limit, output cycle, control mode and channel closing, then the system will stop executing the auto tuning function and will trigger the error alarm (ON).

Execution method: Through temperature control commands.

Ending method: Auto tuning finish report (the Auto tuning status set by the TPCTL will be shown as "3").

M04TC Calibration Steps

If the user considers that certain errors may exist in the value during the running process, then the calibration function can be used to calibrate the values of TC module according to the steps provided below:

```
┌─────────────────┐
│      Start      │
└─────────────────┘
         │
         ▼
┌──────────────────────────┐
│ Connect TC module to PLC │
│   and then upload to the │
│        UperLogic.        │
└──────────────────────────┘
         │
         ▼
┌──────────────────────────┐       ─ ─ ─ ─ ─  For detailed online
│ After starting the online│                  monitoring, please refer to
│  monitoring, the system  │                  Interface Manual.
│  will not execute the    │
│        Project.          │
└──────────────────────────┘
         │
         ▼
┌──────────────────────────┐       ─ ─ ─ ─ ─  Please refer to Section
│ In "Project->Equipment   │                  13.3.1 and Section 13.3.2.
│ picture", search for the │
│ "TC module->Configure->  │
│ Input calibration        │
│ setting" that will be    │
│ calibrated and then tick │
│ the channel to be        │
│ calibrated. After that,  │
│ select the setting that  │
│ will be calibrated.      │
└──────────────────────────┘
         │
         ▼
┌─────────────────┐
│       End       │
└─────────────────┘
```
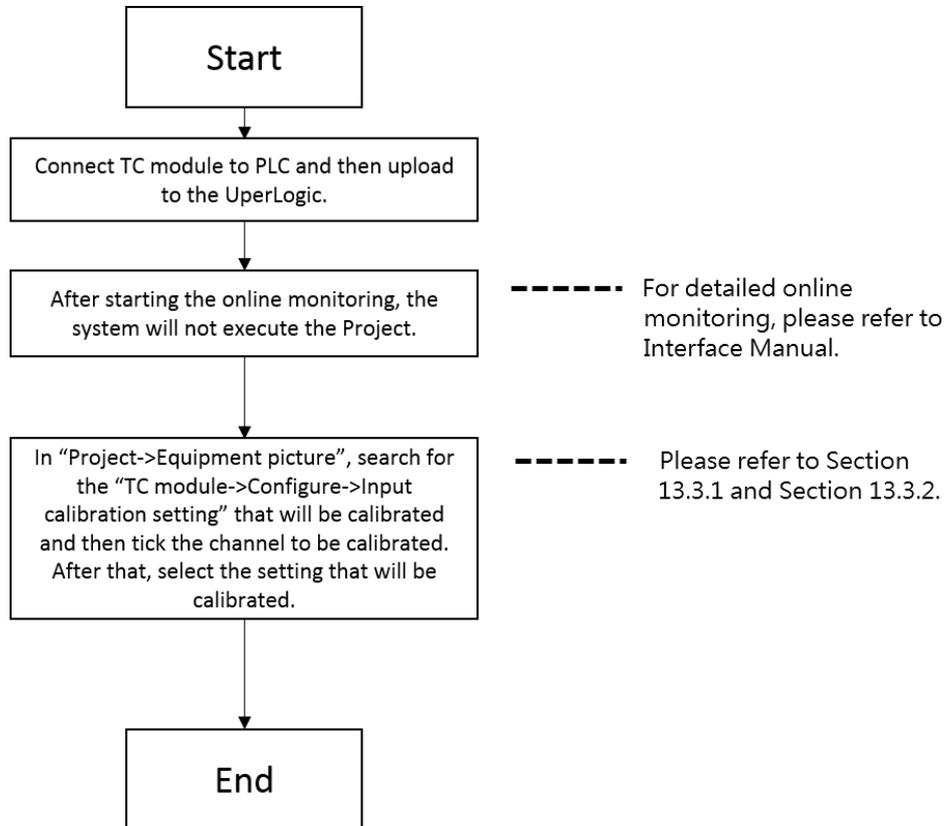
Figure 159 M04TC module user calibration steps

Figure 160 M04TC module calibration window
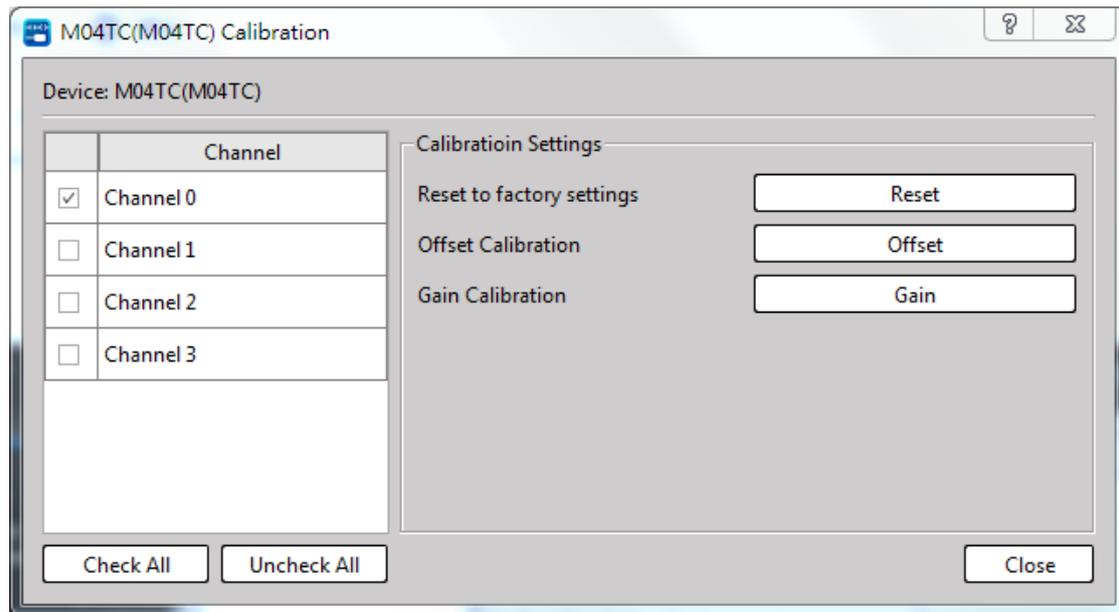
Restore Factory Calibration Value

Upon delivery, the system will calibrate the TC module once and then save the calibrated value in TC module. To restore such value to the factory calibration value, you may find out the "Restore factory setting" in the picture above and then select "Reset" in order to restore the offset value and the gain value to the factory setting.

User Correction

If the correction value set by the factory presents certain errors during the operating process, then these errors can be corrected by the user. To correct, click the offset value/gain value to be corrected and then input corresponding values according to steps described in the wording hint.

Correction of the process control value of the respective channel. If the imported temperature value is different from actual one, you may use the temperature measuring value (PV) obtained through the Offset value and Gain value calibration and then save it in the M04TC module
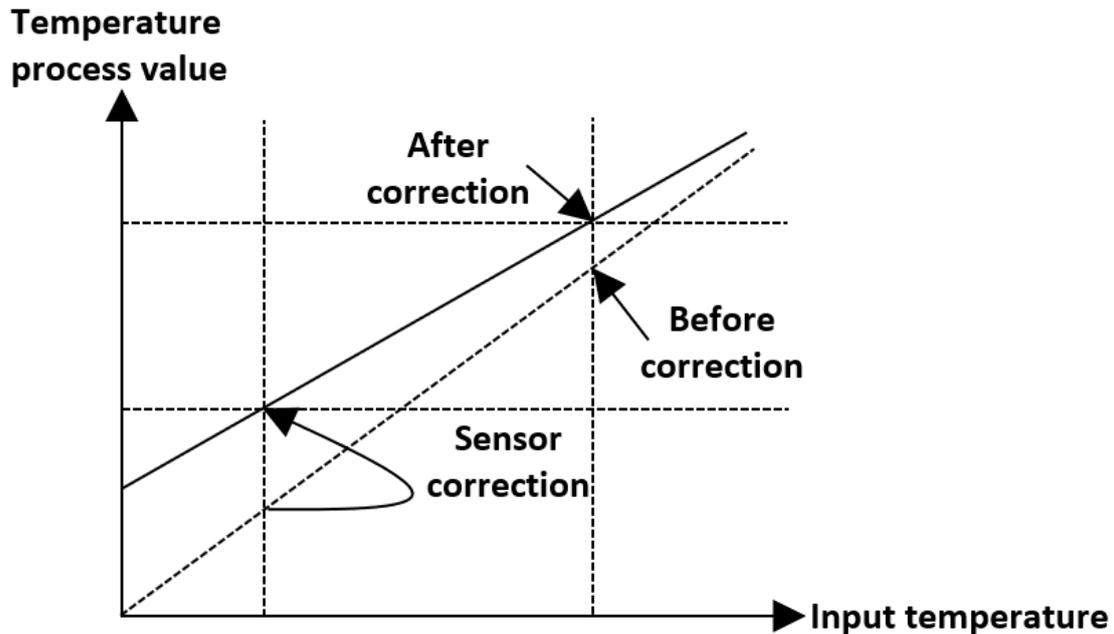

Figure 161 Data figure layout before and after sensor correction

Setting type: When executing the correction, please refer to user calibration and the formula will be as follows: Gain value/1000 + Data offset
Setting:
1. Channel number
2. Gain scope: -32000–32000
3. Offset scope: -32000–32000
4. Save in M04TC module

● Offset calibration

Calibration path is indicated as below:

In "Project->Device View", find the "M04TC module->Configuration Settings->Input calibration setting" that will be calibrated and then tick the channel to be calibrated. Next, select the "Offset" option.

Figure 162 M04TC module offset calibration window

Based on the wording hint, input the value of the corresponding mode to complete the calibration.

● Gain calibration

Calibration path is indicated as below:

In "Project->Device View", find the "M04TC module->Configuration Settings->Input calibration setting" that will be calibrated and then tick the channel to be calibrated. Next, select the "Gain" option.
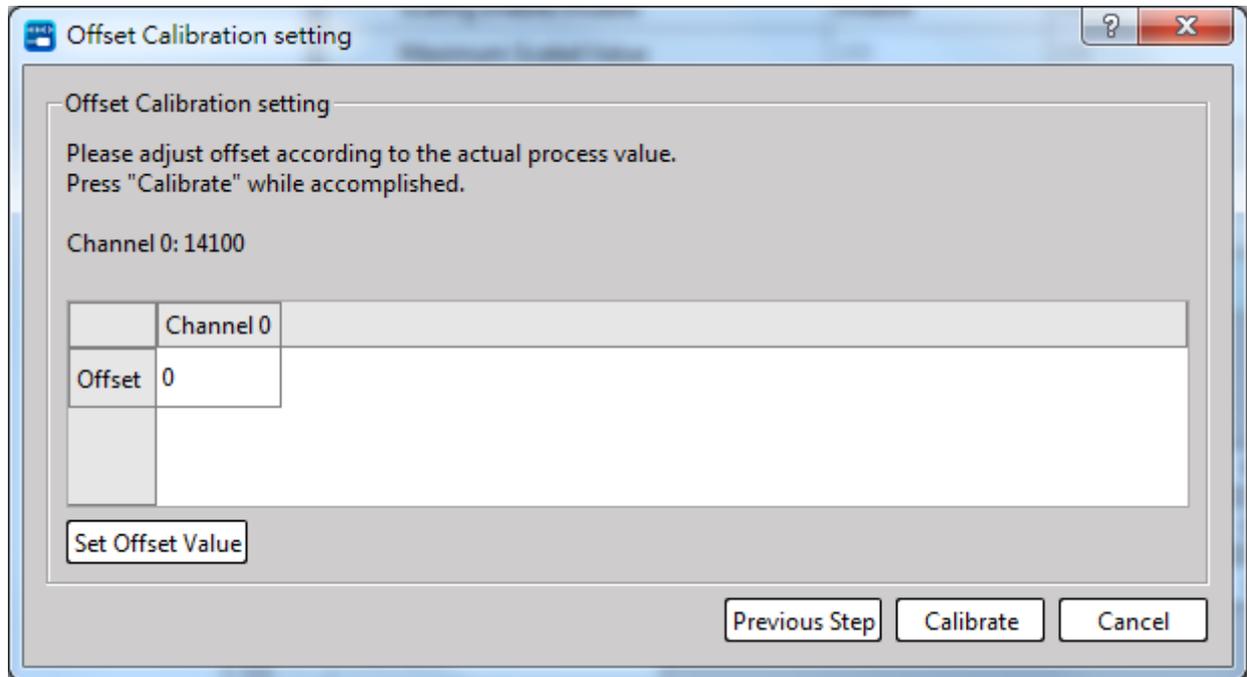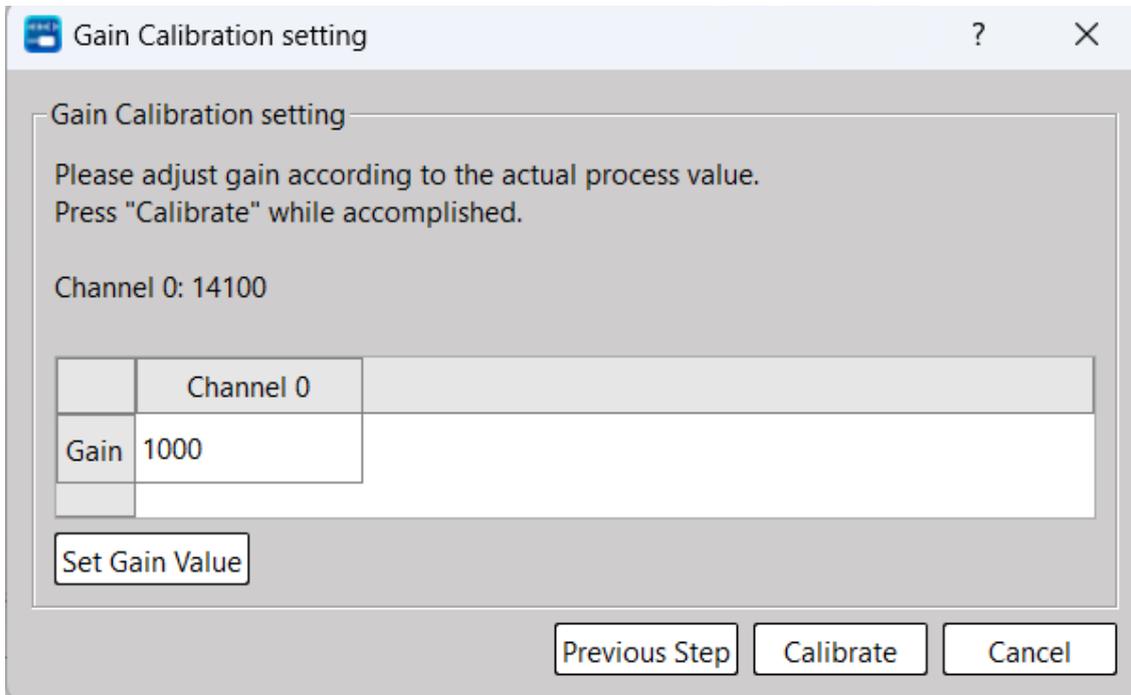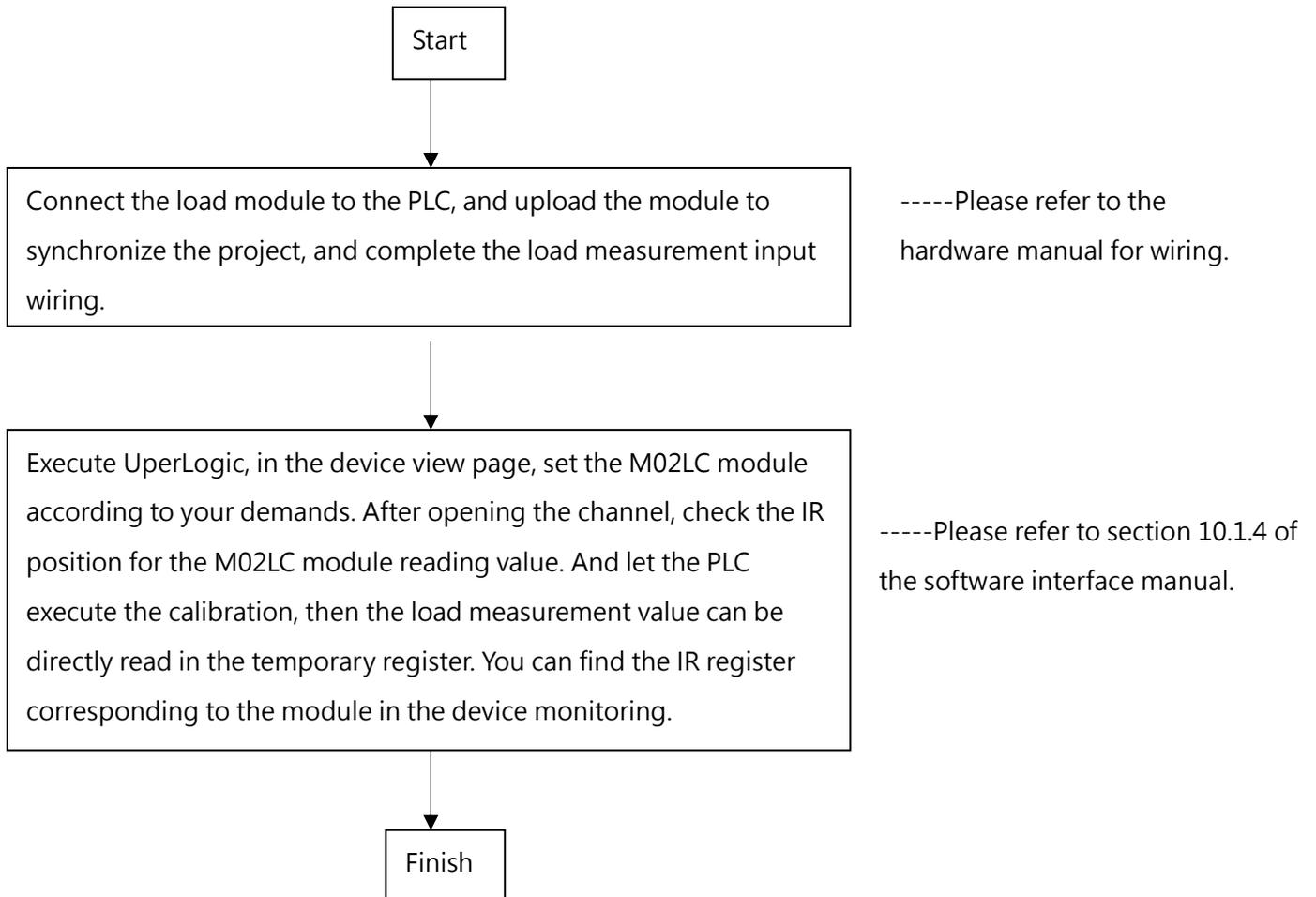

Figure 163 M04TC module gain calibration window

Based on the wording hint, input the value of the corresponding mode to complete the calibration.

15-6 Load Cell Module

15-6-1 M02LC/M02LCR

15.6.1.1 Steps to use Load Cell Module

Load Cell Measurement

```
                    ┌─────────┐
                    │  Start  │
                    └────┬────┘
                         │
                         ▼
┌──────────────────────────────────────────────┐        -----Please refer to the
│ Connect the load module to the PLC, and        │         hardware manual for wiring.
│ upload the module to synchronize the project,  │
│ and complete the load measurement input        │
│ wiring.                                         │
└──────────────────────┬─────────────────────────┘
                       │
                       ▼
┌──────────────────────────────────────────────┐        -----Please refer to section 10.1.4 of
│ Execute UperLogic, in the device view page,    │         the software interface manual.
│ set the M02LC module according to your         │
│ demands. After opening the channel, check the  │
│ IR position for the M02LC module reading       │
│ value. And let the PLC execute the             │
│ calibration, then the load measurement value   │
│ can be directly read in the temporary          │
│ register. You can find the IR register          │
│ corresponding to the module in the device      │
│ monitoring.                                     │
└──────────────────────┬─────────────────────────┘
                       │
                       ▼
                  ┌─────────┐
                  │ Finish  │
                  └─────────┘
```

Module Introduction

Load cell module provides two different resolutions, namely the M02LCR and M02LCRR module. It can be used to measure weak signals generated by load cells.

The hardware resolution capability of this module is 24 bits. The range of weight readings is elastically changed according to the setting of the load cell. The range of digital readings is fixed at 0~10000.

In order to filter out the on-site noise accompanying the signal, this module also provides the functions of sampling signal averaging and automatic zero-point compensation.

The difference between the two modules in the conversion speed and resolution. The resolution of M02LR is 14 bits, and the resolution of M02LCR is 18 bits. For details, please refer to the input "Signal Scope" chapter and "Conversion Time Setting".

The ambient temperature and the connecting distance will affect the accuracy of the load cell. If the environmental parameters changes, it will affect the accuracy of the load cell after calibration. The user must re-calibrate to ensure the correctness of the weight reading.

M02LCR Sampling Time

100 sample/second.

M02LC Sampling Time

4800 sample/second.

Planning Description of Input Format

In terms of analog reading value processing, FATEK provides three commonly used data representation methods, and the reading value can be set to be averaged multiple times, so as to improve the field that is more easily affected. Interference, or reading drift caused by unstable input signal.

UperLogic provides an extremely simple operation interface for planning the data format, effective bits, and average times of the load reading and other related settings.

Monitoring Load Cell Module Value

Click [Project] → [Device View] → [Device Monitor] in the execution function bar, and the device monitoring window on the right will appear:
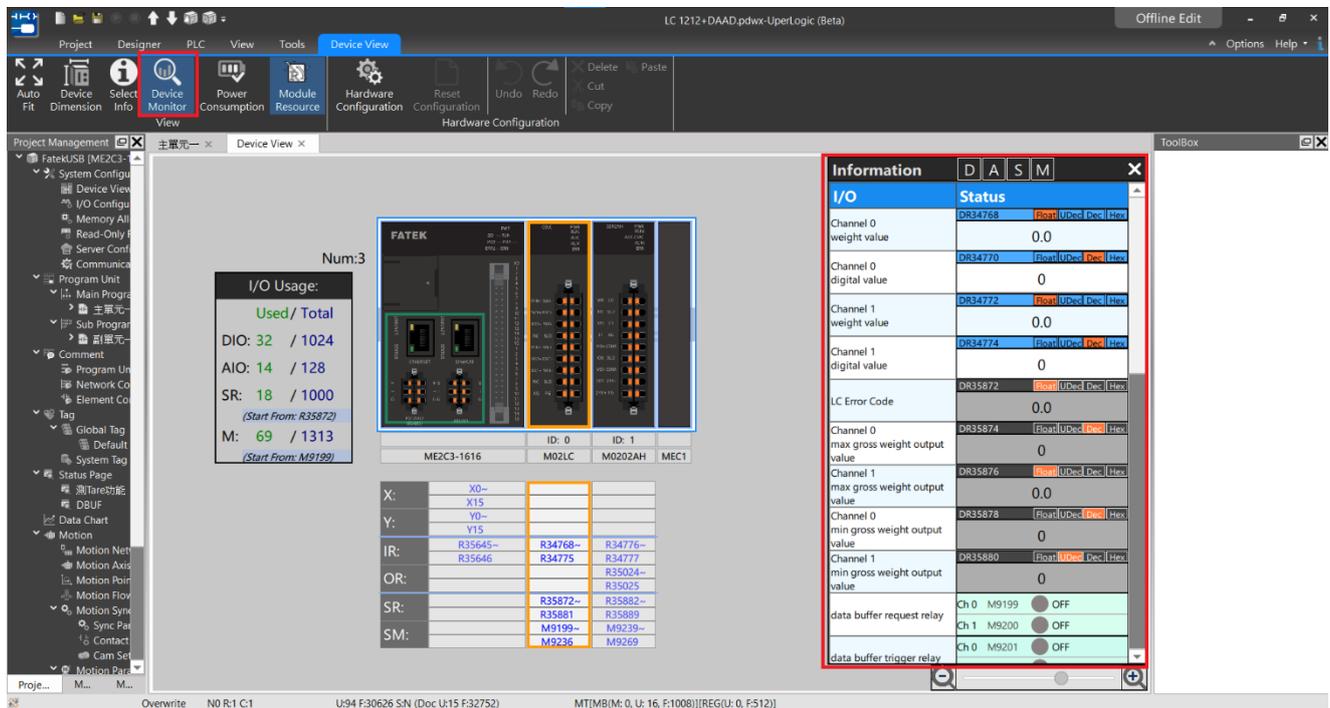

Figure 116 Device Monitoring

In the information, you can choose the resources to be displayed, such as [Digital Data], [Logic Data], [Status Data] and [Relay].

● Logic Data

In the load cell module (M02LCR), logic data refers to the value obtained or output by the channel. Click [Logic Data] on the top information of [Device Monitor], then only the logical data will be displayed in the module list. If you put the mouse over the value, and when the data is blue as shown in the figure below, the value of the register can be modified. You can also quickly modify the value display mode through [Float], [Dec] and [Hex] on the right side of the register.

The default value of the LC module is displayed as a 32-bit floating-point number. If the user needs to convert it to decimal, it can be achieved with the relevant instructions for converting floating-point numbers to integers.

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Figure 117 Logic data for device monitoring

● Status Data

Click [Status Data] on the top of [Device Monitor], and only the status data will be displayed in the module list. When the data is grayed out as shown in the figure below, the value of the register cannot be modified. However, it is still possible to quickly modify the value display mode through [Dec] and [Hex] on the right side of the register.

13-107

Figure 118 Status data of device monitoring

● Relay

Click [Relay] on the top information of [Device Monitoring], and only the status information will be displayed in the module list. Put the mouse over the value, when the data is blue as shown in the figure below, the value of the register can be modified, otherwise, if it is the register position with a gray background, it cannot be modified.

Figure 119 Status data of device monitoring

Load Cell Application Function

The M02LCR module provides a lot of functions for users to use, such as data buffering, value scaling, alarm setting and other functions. These functions can be accessed from "Project- >Device view->click the desired module twice-> Configuration Settings" to find the position of M02LCR function settings, as shown in the figure below, and it is the same as ladder diagram editing, these settings can only be set in the offline editing state.
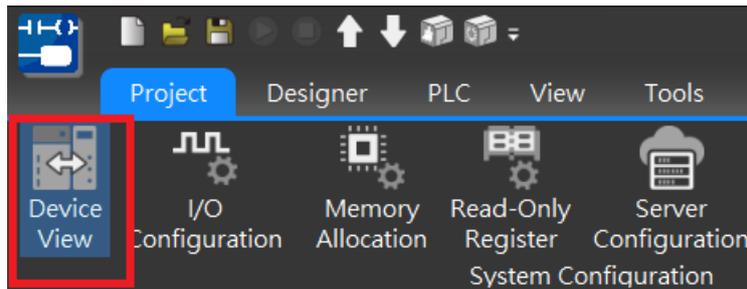
Figure 120 Position of device view
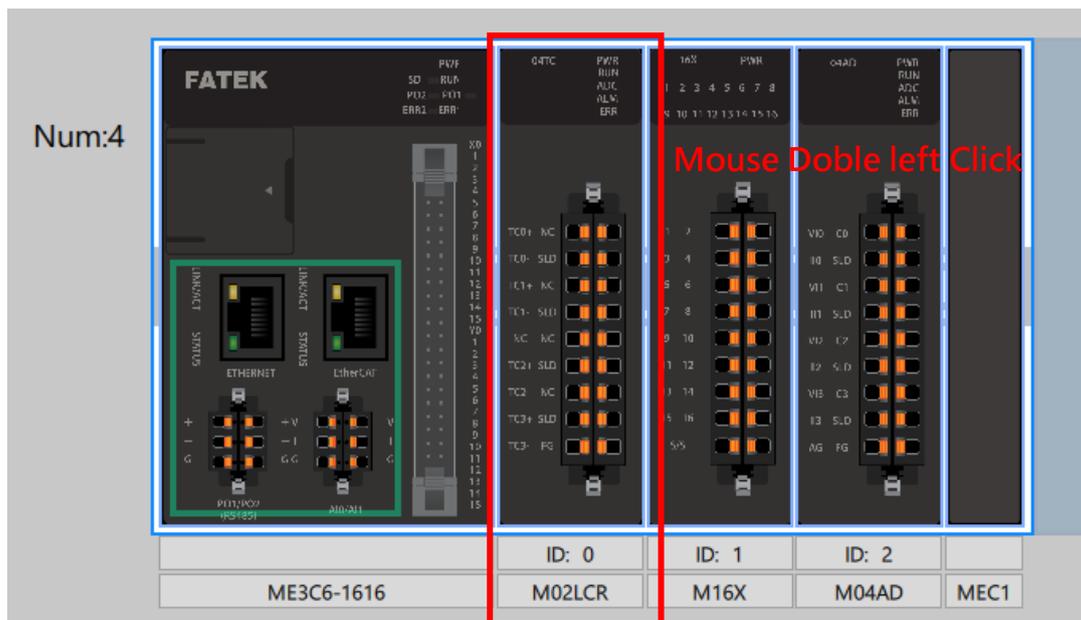
Figure 121 Find and click on the module
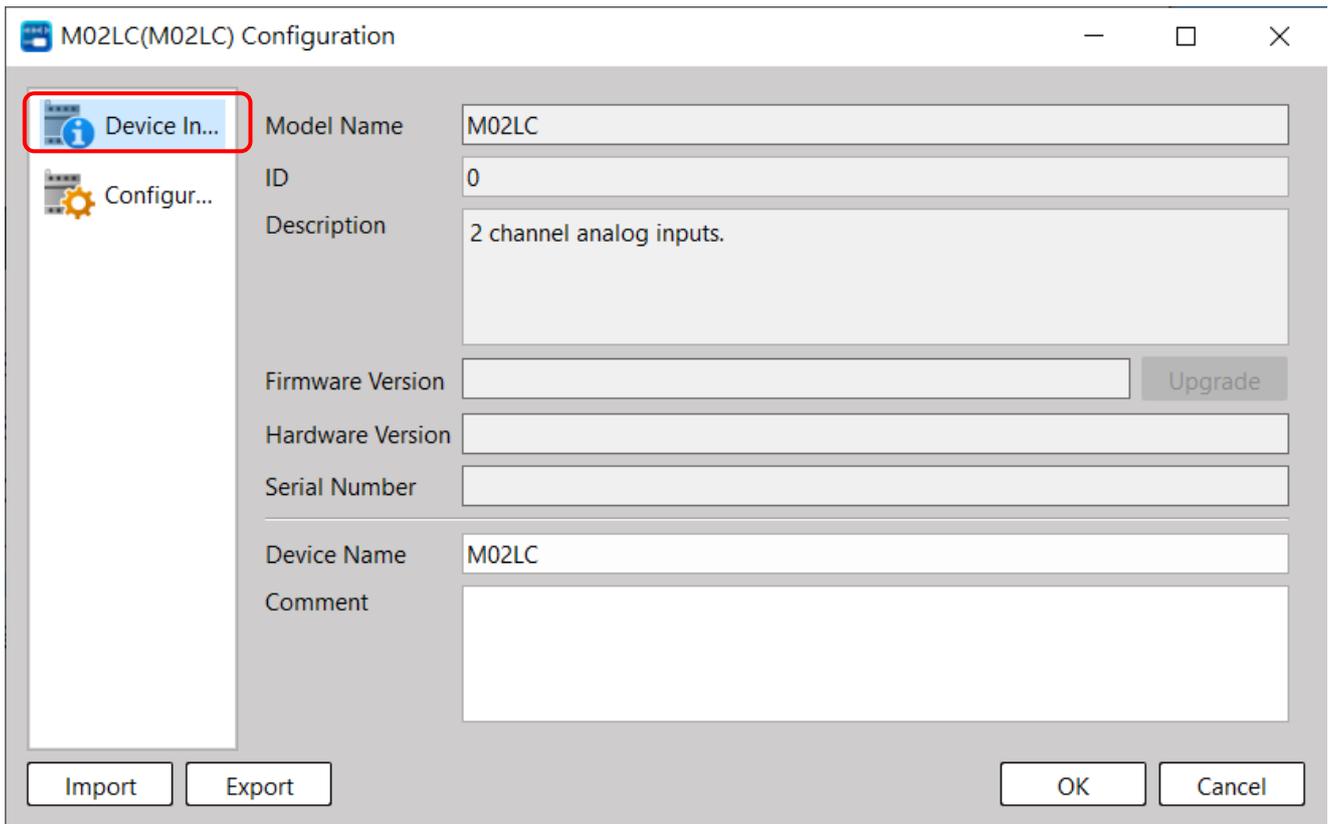
Figure 122 Click Configuration Settings
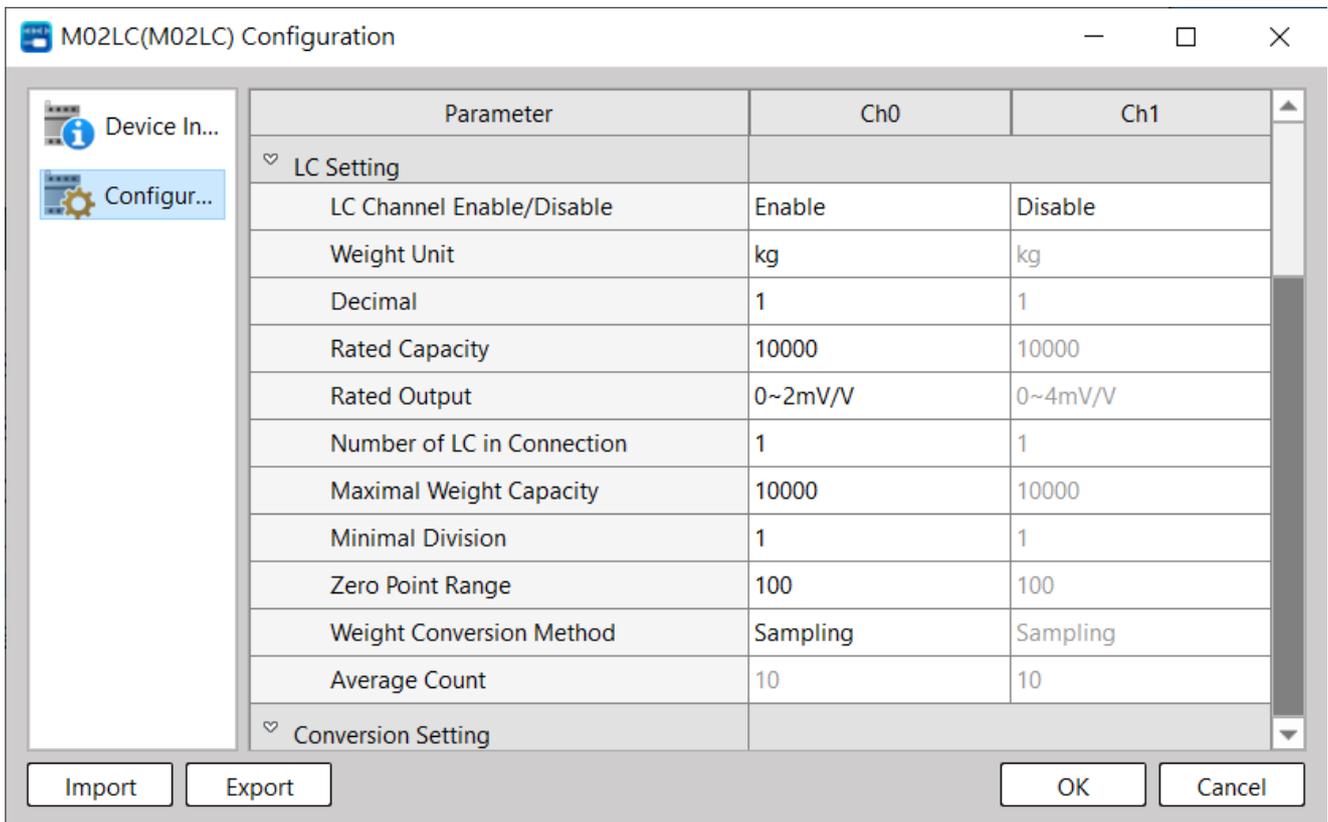
Figure 123 Setting page of M02LCR module

Channel Opening/Closing

Each channel can be set to ON or OFF.

When the channel is turned on, the channel takes a load reading.

When a conversion channel is turned off, the channel is not read and reduces the total channel conversion time.

Conversion time description

M02LCR sampling time: 100 time/second

When the single/dual channel is turned on, the sampling cycle period is 10ms.

M02LC sampling time: 4800 time/second

When single channel is turned on, the sampling period is 0.2ms

When dual channels are turned on, the sampling period is 0.4ms

Settings and Preset value

If the channel is not set to on/off, the default setting is off.

Load Cell Parameter setting

Before using the LC module, it is necessary to set the sensitivity, weight unit, decimal point, etc. according to the usage situation. The parameters must be set as follows:

How to use and instructions

Set the weight unit, number of decimal places, rated capacity, rated output, etc. and then set user calibration to make the measurement range match to the user's needs.

Weight unit selection

Kg (Default)/G/T

Weight decimal point selection

10^0(Default)/ $10^{-1}/10^{-2}/10^{-3}$

Rated capacity setting

For load cells with different capacities, different rated capacities can be set to correspond to the maximum range of the load cell

Rated capacity: the maximum range of a single Load cell

Range: 0~999999

Default: 50000

Rated output setting

For load cells with different sensitivities, the channel can be set, the range is as follows

Rated output range	
Rated output	1mV /V
	2mv/V
	3mv/V
	4mv/V

Table 45 Setting input signal range of M02LCR & M02LC

Maximum weight capacity setting

For the load cells in each channel, the entire load system can be set according to the number of load cells.

Range: 0~maximum rated capacity

※The setting range cannot exceed the rated capacity, and must be less than or equal to the (maximum capacity of the load cell)*(Number of load cell connections)

Number of connections setting

The number of load cells used by the channel at the same time

Range: 1~4

Default: 1

Minimum division setting

Users can set the load reading minimum division value.

Minimum scale: 1/2/5/10/20/50

Zero-point range setting

In the case of no load, the output gross weight of the scale may not be reset to zero due to some reasons .

About this situation, it can be corrected with "zero-point setting"

and "zero-point tracking time" and "zero-point tracking range" , with the parameters setting, LC module could automatically correct the zero-point and reset the gross weight reading to zero .

If the weight value is higher that the setting range, then will not be automatically zero corrected

Settable range: 0.0~10.0% (Maximum weight capacity capacity)

Default: 10.0%

Weight conversion settings

For the average processing of each channel, users could set to three modes: no average mode/time average mode/moving average.

How to use and instructions

Sampling (No Averaging Mode):

When the LC module is reading value, no averaging processing is performed.

The processing time is equal to the conversion cycle time.

Counting average mode:

A/D conversion is performed according to the set number of times, and the conversion value is averaged.

The counting average needs to be set above 4 to be effective.

The required processing time is equal to the set average multiplied by the conversion period.

Example:

For example, if the module converts 11 data and sets the average number of times to 5, the returned results are as follows:

A/D Conversed Data:

data1	data2	data3	data4	data5	data6	data7	data8	data9	data10	data11

Average Result:

data1	(data1+data2+data3+data4+data5)/5	(data6+data7+data8+data9+data10)/5	.....
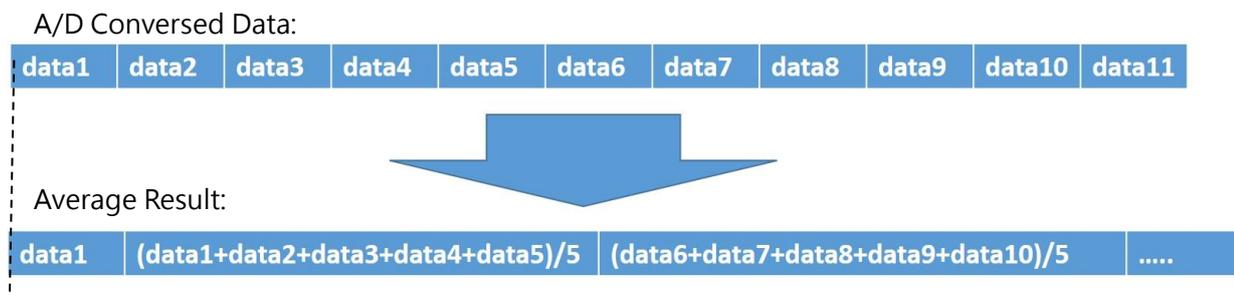
Figure 127　Schematic diagram of M02LCR module times average mode processing time

Moving average mode:

Set the number of averages. During each conversion cycle, the weight reading data will be averaged according to the set times. The moving average needs to be set above 2 to be effective.

The required processing time is equal to the set average multiplied by the conversion period

example:

If the number of moving averages is set to 5 times, the conversion diagram is as follows.

A/D Conversed Data:

data1	data2	data3	data4	data5	data6	data7	data8	data9	data10	data11

Average Result:

data1	(data1+data2+data3+data4+data5)/5	(data2+data3+data4+data5+data6)/5	.....

Figure 129 Schematic diagram of the processing time of the moving average mode of the load cell module

Settings and Defaults

If the channel has no A/D conversion mode set, the default mode is "no averaging mode".

A/D conversion mode	M02LCR Setting range	Defaults
Sampling (No averaging mode)	none	none
Counting average mode	4 to 255 (times)	4
Moving average mode	2 to 255 (times)	2

Table 44 Load cell average mode setting value range

Calibration Function

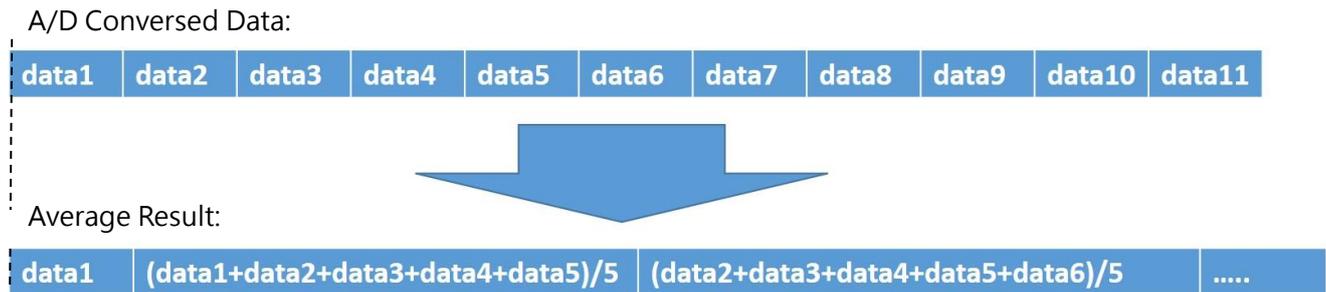After setting the unit, input calibration can be performed on each channel, and each channel stores the corresponding calibration value.

The default is the factory calibration value and is permanently stored in the module and will not be modified. The default value can be used to restore to the factory state.

How to use and instructions

There are two types of calibration:

User Calibration Mode:

- If the user has special needs or there is a large error in the value due to the large difference between the current ambient temperature and the general room temperature, the user correction mode can be used to correct the error.

Restore Factory Settings:

- When the factory leaves the factory, all channels will be calibrated and the parameters will be placed in the module. If the user needs to return the factory calibration value in the future, he can use UperLogic to recall it.

User Calibration Steps:

Let the PLC stop running, and in the "Online Monitor Mode", double-click the module to be recalled in the "Device View", and find "Calibration" in the "Configuration Settings".

After selecting the channel to be calibrated, follow the software prompts to complete the calibration.

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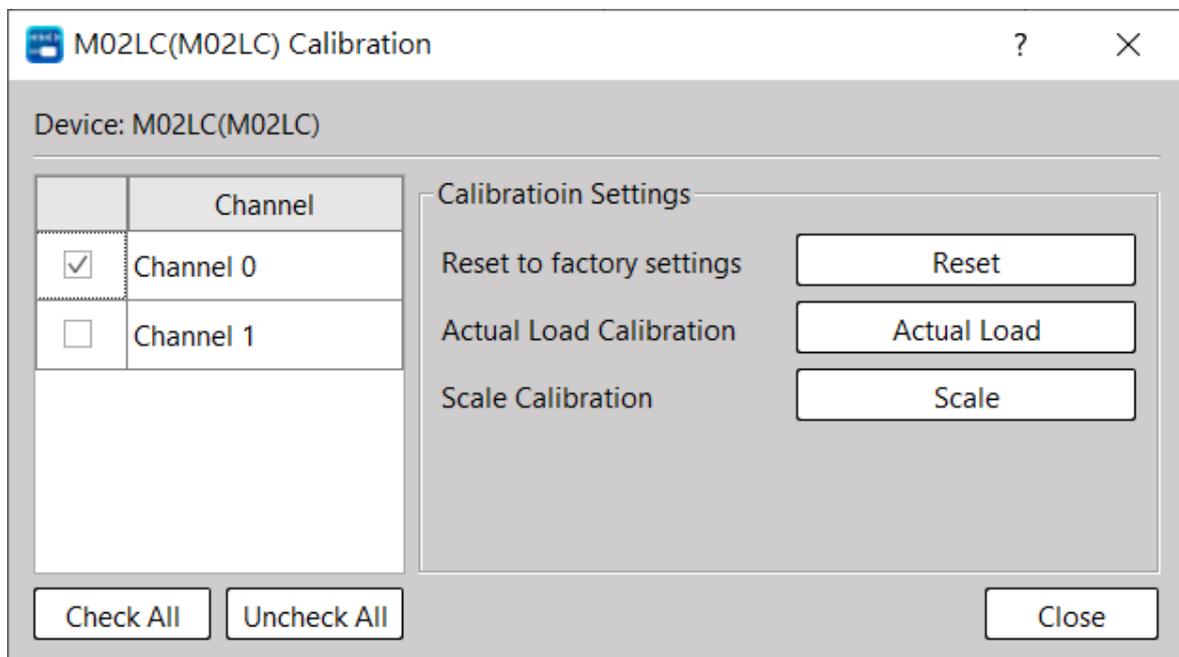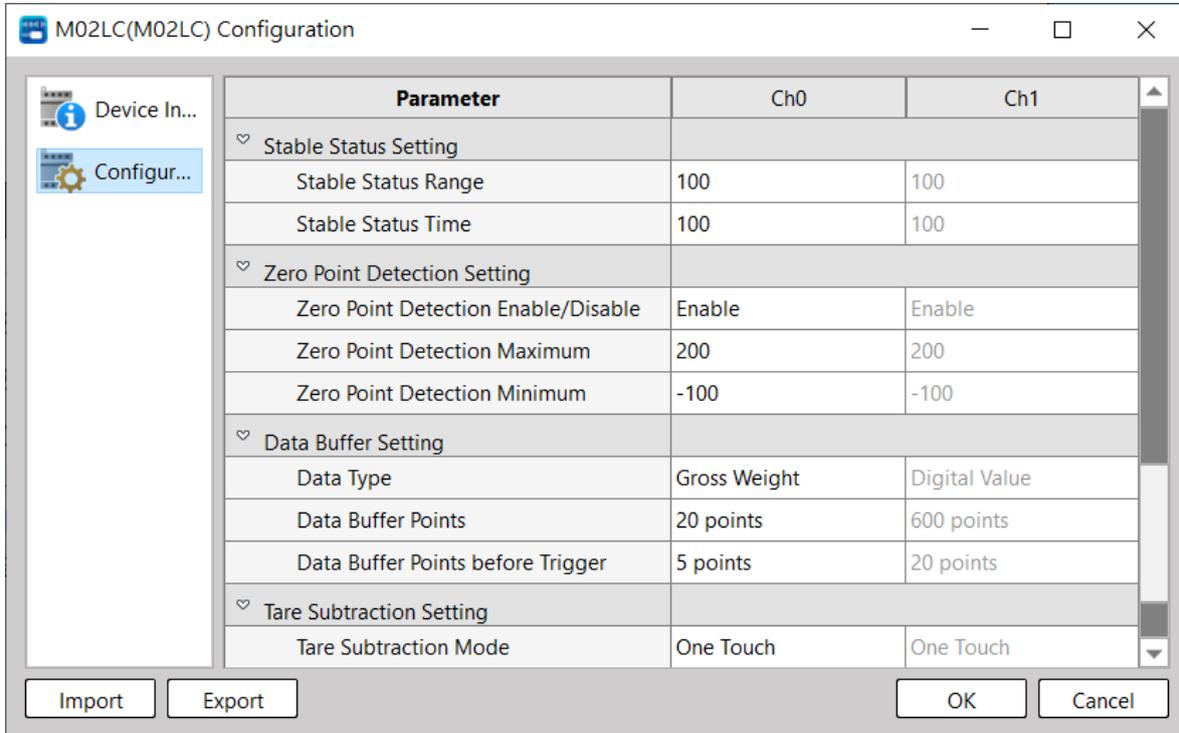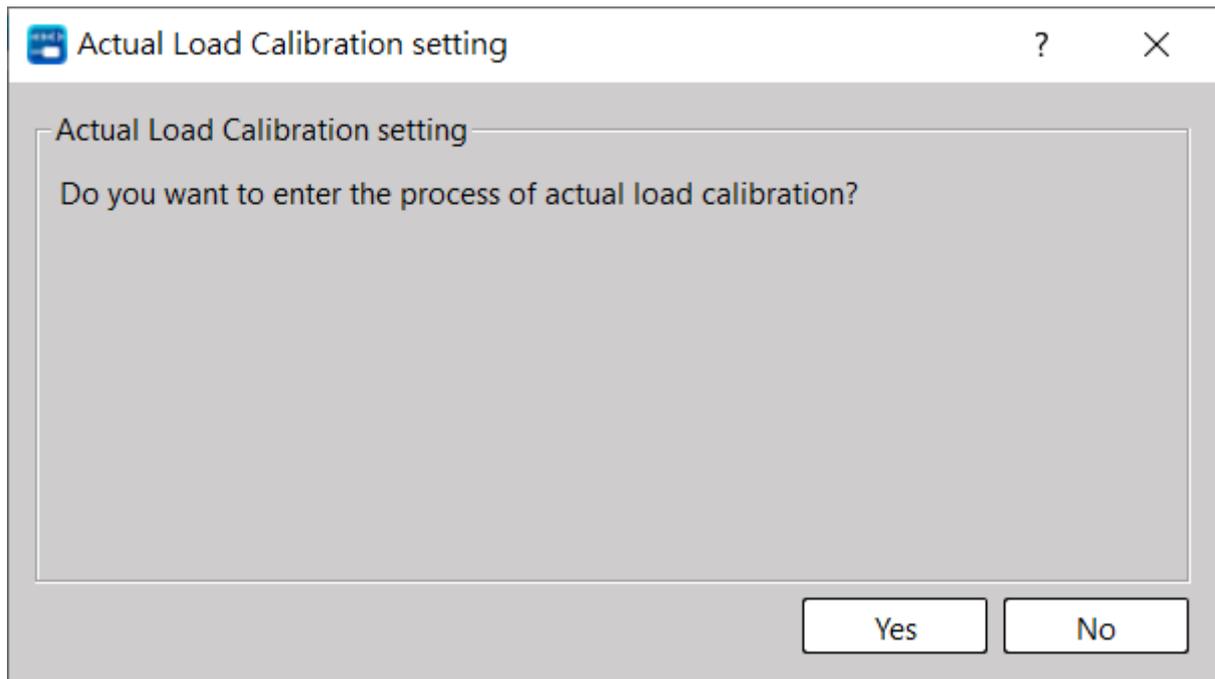
Figure 125 M02LCR user calibration process

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Reset factory settings steps:

Let the PLC stop running, and in the "Online Monitor Mode", click twice on the module to be recalled in the "Device View", and find "Calibration" in the "Configuration Settings", and find "Reset to factory settings" after entering press "Reset".
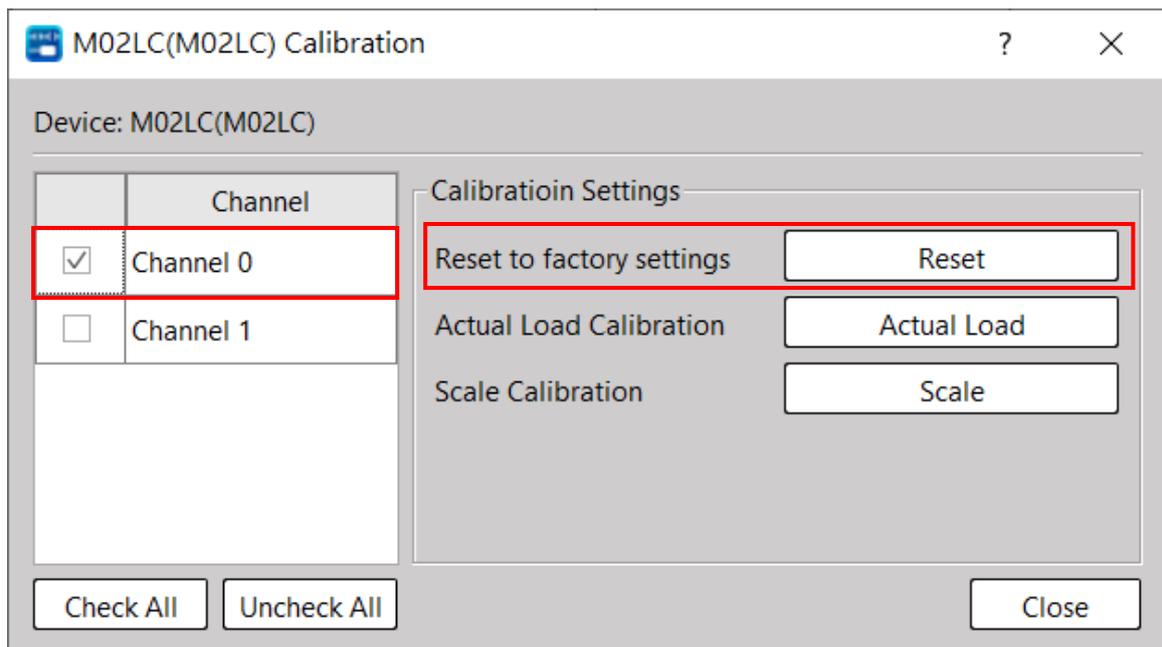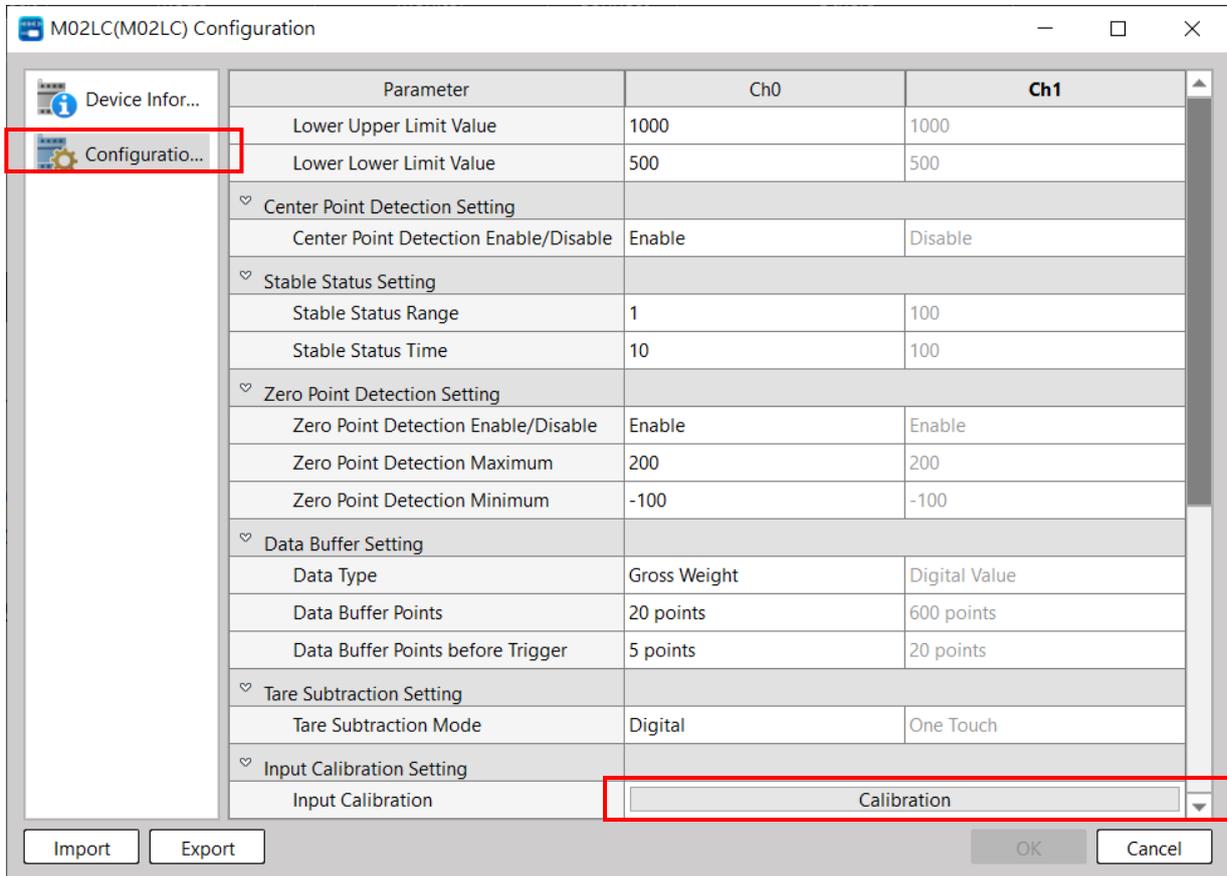
Figure 126 M02LCR reset factory settings process

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Settings and Defaults

Each channel has a default factory calibration value and stored in the module.

Enter Calibration Settings	Defaults
Offset value	Factory calibration value
Gain value	Factory calibration value

Table 43 M02LCR Calibration Preset Value Table

Conversion settings

Users can set the conversion method according to their needs.

Mode 1-Automatic stop:

When set to automatic stop, if the load exceeds the "weight capacity over frequency" alarm set value, the reading will be stopped.

And at this time, the output value is all 0, and the warnings of other functions will not be activated until the user triggers "error clear", then the value will be changed and all detection errors will start.

In this mode, all warnings need to be cleared by the user. Errors and warnings need to be cleared through special registers.

※It can be monitored from the device to confirm the location of " error clear register "

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Mode 2 - Automatic Recovery:

Set to automatic recovery, if the load exceeds the "weight capacity overclocking" alarm set value, it will continue to turn the value.

At this time, the output value and all warnings are fixed.

If the turn value returns to the normal range, the warning will be cleared automatically.

※The system will automatically confirm the status of "input signal error" and "out of zero point range" . Whether the alarm is cleared depends on the current status and is not affected by the aforementioned conversion settings.

Gravity Acceleration settings

This function calibrates the weight error caused by different gravitational acceleration.

Users can correct the corresponding value according to the location.

※ The value of acceleration of gravity when leaving the factory is stored by default.

Weight value = gross weight output value * calibration position value / installation position value

Setting range: 9.7000~9.9999

※When the installation position = calibration position, this calibration is not enabled .

Zero Point tracking settings

When the gross weight is not zero, the zero-point will be adjusted automatically. When the scale is not loaded , the output gross weight may not be reset to zero due to some reasons .

At this time, it can be combined with "Zero Point Tracking Time" and "Zero Point Tracking Range" to automatically correct the zero-point and output the weight as 0 .

After enabling this function,as shown in the timing diagram below, during the time of zero-point tracking, it will check whether the reading value is within the range of zero-point tracking . If it is within the range, the zero-point will be automatically corrected and the weight reading will be set to 0.

If it is outside the range, zero-point calibration will not be performed.

If it exceeds the zero-point range, the zero-point tracking function will not be performed.

Zero-point tracking range: 0~100*(1/ 4 minimum scale)

Zero-point tracking time: 0~100*(100ms)

Default value: range & time are both 0
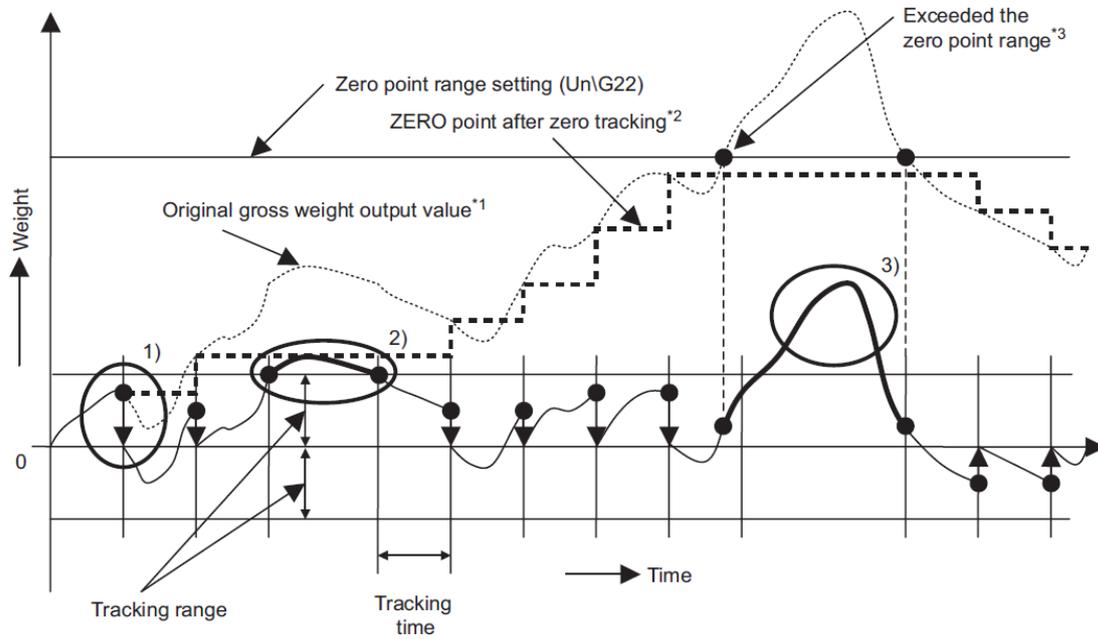
Figure 165 Zero tracking timing diagram

Input signal error settings

This function will detect whether the input signal meets the conditions set by the warning.

When the "input signal error" is activated, the following three error & alarm functions will be detected.

Input signal error:

1.　The user can customize an input **signal error percentage** value. If the weight reading value is greater than the condition , a warning will be issued.

2.　Conditions for triggering signal error: weight reading > maximum weight capacity + maximum weight capacity * **input signal error percentage**

3.　Set value range 0.0~25.0%

Overweight alarm setting:

1. When the load exceeds the set value of " overweight alarm ", a warning signal will be issued.

2. Conditions for triggering overweight alarm: weight reading > maximum weight capacity + (current minimum scale *9)

When the zero-point range is exceeded:

When using a special relay **to set the zero-point**, the system will check the zero-point position, if it exceeds the reasonable zero-point range, the warning relay will be ON

※ Zero-point range = maximum weight capacity * zero-point range [%]

Gross weight setting (warning setting)

Turn on the " warning output " and set the upper and lower limit warnings, and whenever the weight reading exceeds the set range, a warning message will be sent

Conditions for warning

1. When the weight reading value > the upper limit value, a warning will be issued

2. When the weight reading value < lower limit value, a warning will be issued

Conditions for clearing warnings

1. When the weight reading value < the upper and lower limit values, a warning will be issued

2. When the weight reading value > the lower upper limit value, a warning will be issued.

Center point detection setting

It is convenient for users to find the center point.

If this function is turned on, it will automatically find the center point of the weight value.

The range of the center point is plus or minus 1/4 of the smallest scale of the weight reading.

If the weight value is within this range, it will be detected. For the detailed timing diagram, please refer to the following figure:
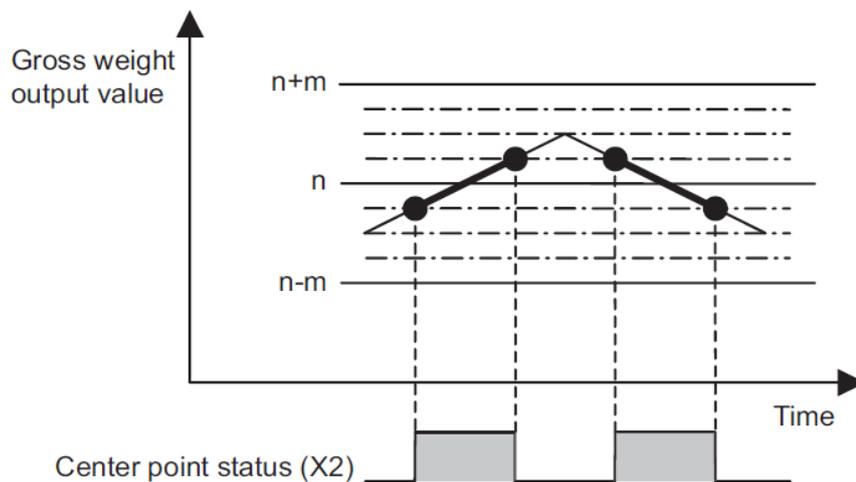
Figure 166 Center point detection timing diagram

Steady state setting

Check whether the weight value is in a stable state. If the change degree is lower than the stable state range within the stable state time, it will enter a stable state.

※ If the steady state time is set to 0, it means that the steady state detection will not be performed.

Available range:

Steady state range: 0~100 (minimum scale)

Steady state time: 0~100 (100ms)

Zero-point detection settings

This function can know whether the load has been removed from the scale.

If the load has been removed, the load cell should be in a stable state at this time. If it is not in a stable state, no detection will be performed.

Data buffer settings

Data buffer function can be controlled through the relay, and the digital operation value can be stored in the data buffer area to observe the change of the digital operation value.

For detailed usage and instructions, please refer to the instruction description section below.

Settings and Defaults

If the channel is not set, the default setting is off.

Setup	M02LCR setting range	M02LCRR setting range	Defaults
Buffer points before trigger	0 - 599	0 - 599	200
Buffer points	1 - 600	1 - 600	600

Table 65 Setting of data buffering function

Tare Deduction Mode

When using the tare weight deduction command, there are two modes for the user to choose

Light touch mode :

take the current gross weight as the tare weight, and deduct the tare

weight Return to zero and start to measure the net weight

※ It must be in a stable state at this time , otherwise it may cause incorrect deduction

Digital mode:

Subtract any number from the gross weight (weight reading value), and this value must be a multiple of the minimum scale.

When tare weight deduction is triggered, the set value will be subtracted from the gross weight.

Cancel the tare deduction and restore the deducted value in the gross weight

Setting value range: 0-50000 (0-maximum rated capacity)

For the instruction application, please refer to the following instructions.

【Instruction Description】

Tare Deduction and Tare Offset Instructions

*The tare weight offset command is only supported by the LCR module, but not by the LC module.

Tare Deduction Instruction

Ladder Diagram Symbol
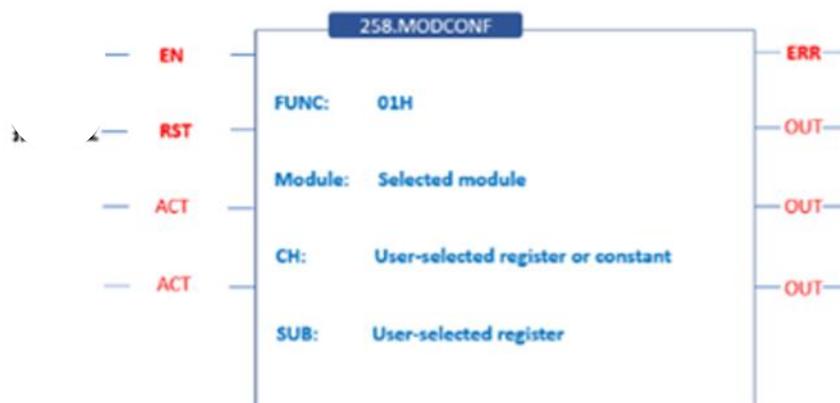
FUN : 01 is the tare weight deduction mode

Module : the expansion module ID number

CH: the channel position to be deducted

SUB: the tare weight value to be subtracted, occupying two temporary registers

※If you want to **customize** the tare weight to be subtracted, you need to change the config setting to "digital mode".

If it is "light touch mode", the current gross weight will be regarded as tare weight, and the current gross weight will be deducted directly.

※ Light touch mode can only be used in a **stable state**

- Removing the fixed tare weight and recalibrating it may benefit from improved accuracy.

- When the tare removal command is enabled, if the command mode is set to "light touch", it is the automatic parameter setting mode.

  The module will automatically calculate the appropriate parameters and send them back to the PLC, and automatically subtract the current weighing value.

- When the command of tare weight removal is enabled, if the command mode is set to "digital", it is the manual parameter setting mode.

At this time, the user can set the tare weight to be deducted by himself. When the command to enable tare weight removal is sent, the command will subtract the corresponding weight according to the parameters set by the user.

The following is an example of input in the ladder diagram

```
        258DP.MODCONF
 —EN—  OP:     TARESUB   —ERR—
       ID:        0
 .
 —RST— CH:        0
       SB:       R0
 .




 .




 .
```
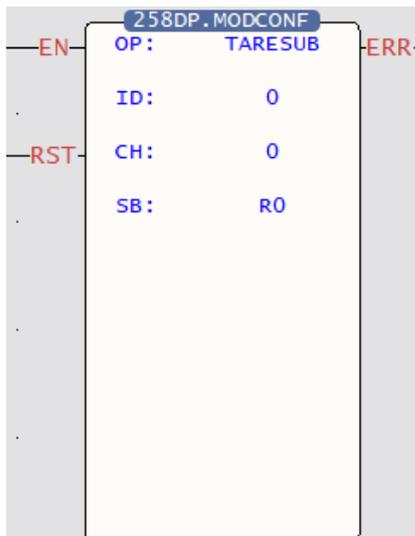
OP: tare weight deduction mode

ID: expansion module ID number

CH: channel position to be deducted

SB: tare weight value to be subtracted, occupying two temporary registers

If you want to subtract the custom tare weight, you need to change the config setting of the LC module - tare weight deduction mode to "digital mode" in the device view, so that the value set by the user will be subtracted only when the command is triggered.

If it is "light touch mode", the current gross weight will be regarded as tare weight, and the current gross weight will be deducted directly.

Tare Offset Instruction

Ladder Diagram Symbol
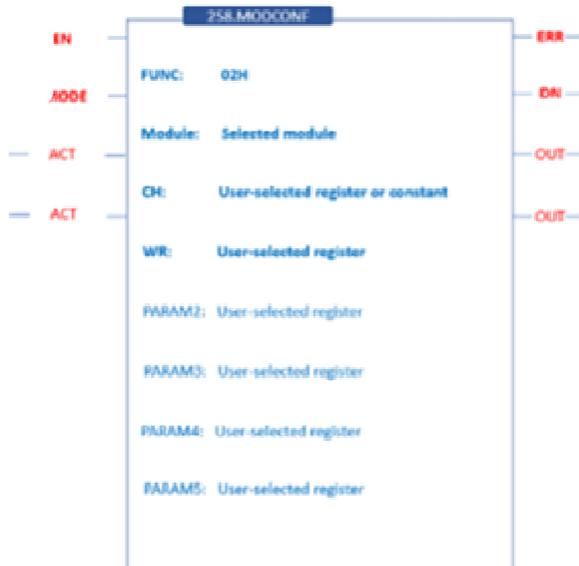
FUN : 02 is tare weight offset mode

Module : expansion module ID number

CH: channel position to be deducted

WR0-3 :

WR+0: I NA GAIN

WR+1: ADC GAIN

WR+2 ~+3 : Digital Value

*The tare weight offset command is only supported by LCR module, not LC

- Remove the fixed tare weight, by setting Instrumentation amplifier gain and ADC gain, it is possible to get the benefit of ADC conversion accuracy improvement .

- Automatically set the parameter mode, set the command mode to 0, send the command to enable t are zero function , and the module will automatically calculate the appropriate Instrumentation amplifier gain, ADC gain and Digital value and send them back to the PLC.

- Users can set the mode by oneself, set the instruction mode to 1, and send the instruction to

enable the t are zero function , and the instruction will be accompanied by the Instrumentation amplifier gain, ADC gain and Digital value set by the user.

➢ The formula for calculating fixed weight (Fixed weight):

$$\text{Fixed tare weight} = \left(\frac{DAC\ digital\ value}{65535} \times 2.5\right) \times \frac{Rated\ capacity \times Number\ of\ LC\ sensors}{INA\ gain \times Excitation\ voltage \times Rated\ output}$$

➢ A DC/INA Gain setting suggestion formula:

$$\frac{Max\ weighting\ capacity}{Rated\ capacity \times Number\ of\ LC\ sensors} \times INA\ gain \times ADC\ gain \leq 500$$

$$= \left(\frac{DAC\ digital\ value}{65535} \times 2.5\right) \times$$

$$\frac{Rated\ capacity \times Number\ of\ LC\ sensors}{INA\ gain \times Excitation\ voltage \times Rated\ output}$$

➢ Setting Type: Instruction

➢ Instrumentation amplifier gain is 444.4, 222.2 and 111.1.

➢ ADC gains are 1, 2, 4, 8, 16, 32 and 64

➢ Digital value setting range is 1-57671 (2.2V)

The following is an example of input in the ladder diagram

```
           ┌─258DP.MODCONF─┐
 ─EN─      │ OP:  TAREZROFFSET├ERR─
           │                 │
           │ ID:        0    │
           │                 │
 ─MD─      │ CH:        0    ├DN─
           │                 │
           │ WR:        D0   │
           │                 │
           └─                ┘
```
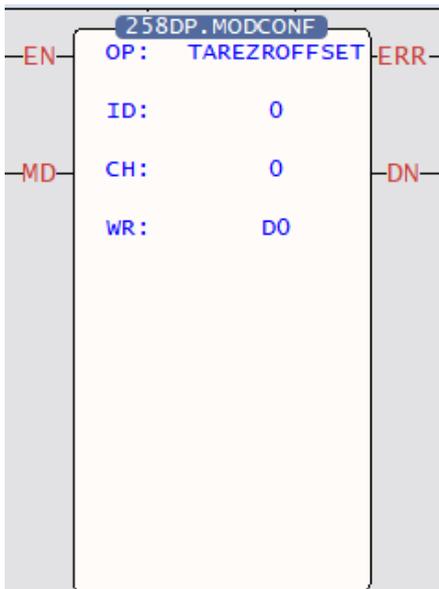
OP : tare weight offset mode

ID: expansion module ID number

CH: channel position to be deducted

WR: offset parameter setting register

WR+0: INA GAIN

WR+1: ADC GAIN

WR+2 - +3 : Digital value

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Data Buffer Instruction

How to use and instructions:

Through the data buffer relay and the data trigger relay, a continuous load cell reading value can be recorded, and the stored reading can be moved to the PLC register through the data buffer command to observe the change of the analog value.

According to the processing time of the load cell reading value conversion mode, the digital operation value of each buffer point is updated to the data buffer area.

Each channel can store up to 600 points.

Example:

When the buffer points are set to 600 and the data points before triggering are set to 50
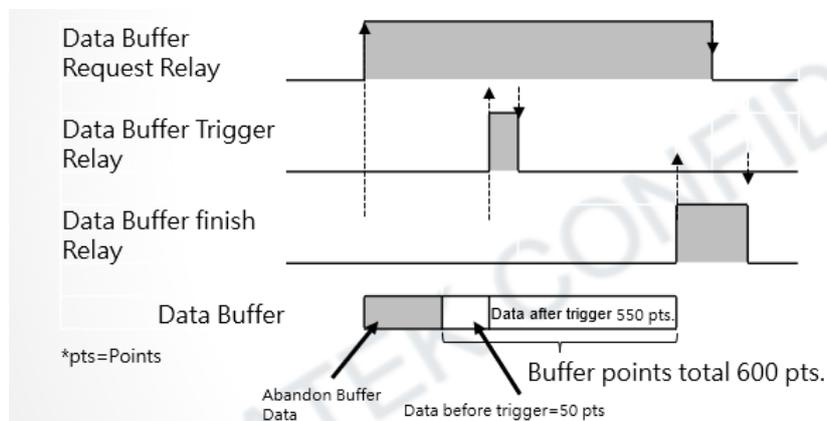
Figure 137 Example diagram of the data buffering function

Settings and Defaults

If the channel is not set, the default setting is off.

Setup	M02LCR setting range	M02LCRR setting range	Defaults
Buffer points before trigger	0-599	0-599	200
Buffer points	1-600	1-600	600

Table 65 Setting of data buffering function

The following table shows how to use the data buffering function

Run-time relay control

Data Buffer Relay	Description	Setup
Data Buffer Request Relay	Buffer Request	Off- >On: Start caching. On- >Off: Disable caching.
Data Buffer Trigger Relay	Trigger	Off->On: Trigger the data buffer relay.
Data Buffer Completion Status Relay	Buffer Completion Data	Off- >On: specified buffer points are completed, the buffer can be read through command 115 (DBUF function). On- >Off: Data buffer request relay: On -> Off, Off when the buffer is turned off. Data buffer trigger relay: On->Off->On, then Off when retriggering, until Off->On after the buffer points are completed.

Table 66 Steps to use the data buffer function

After the data buffer is completed, you can use Fun 115 DBUF to read the buffered data stored in the module to the PLC.

【Description of Device Information】

Channel Weight Value

Engineering weight reading value confirm by user will be affected by the user's calibration and will change the scale of the weight reading value.

Channel Digit Value

Original reading value of voltage signal conversion, and the range is 0~10000.
For example:
1 mv/V load cell with a range of 100 kg.
When the actual load of the load cell is 100 kg, the reading value of this channel should be 10000, which means that the module receives the full-scale voltage of the 1 mv/V load cell.

LC Error Code

Error indicators used during program debugging.
Currently, the function is reserved.

Channel Maximum Total Weight Output Value

After being energized, the maximum & minimum gross weight read by the LC module will be stored and placed in the appropriate register.
The maximum gross weight will be stored in this register.

Channel Minimum Total Weight Output Value

After being energized, the maximum & minimum gross weight read by the LC module will be stored and placed in the appropriate register.
The minimum gross weight will be stored in this register.

Data Buffer Request Relay

When the relay is ON, the data buffer request is started.
For detailed steps, please refer to the data buffer setting chapter.

Data Buffer Trigger Relay

When the relay is ON, start the data buffer trigger.

For detailed steps, please refer to the data buffer setting chapter.

Alarm Clear Request Relay

After alarm happened, the Alarms can be cleared by using this relay.

Error Clear Request Relay

After error occurred, the alarms can be cleared by using this relay.

Zero-point Set Request Relay

Set the current weight reading to zero.

Zero-point Return Request Relay

Restore the current weight reading to the preset zero-point after calibration.

Stable Output

When is in stable state, the relay is ON.

When is not a stable state, the relay is OFF.

Center Point Detection Output

When entering the center point state, the relay is ON.

When leaving the center point state, the relay is OFF.

Zero-point Detection Output

When entering the zero state, the relay is ON.

When leaving the zero state, the relay is OFF.

Zero-point Setting Completed Output

When the zero-point setting completed, the relay will stay in ON state for one scan period.

Zero-point Restoration Completed Output

When the zero-point setting completed, the relay will stay in ON state for one scan period.

Input Signal Error Detection

When the "weight reading value" is greater than "(maximum weight capacity) + (maximum weight capacity * input signal error percentage)", a warning signal will be issued, and the relay will be ON.

Conditions for Triggering Signal Error : weight reading > maximum weight capacity + maximum weight capacity * input signal error percentage.

※This function will only be detected when " input signal error " is enabled in the software settings.

Excess Weight Capacity

When the load exceeds the " weight capacity overclocking " alarm setting value, a warning signal will be issued, then relay will be ON.

Conditions for Triggering an Overweight Alarm: weight reading > maximum weight capacity + current minimum scale *9.

※ This function will only be detected when " input signal error" is enabled in the software setting.

Out of Zero-point range

When using a special relay **to set the zero-point**, the system can check the zero-point position, if it exceeds the reasonable zero-point range, the warning relay will ON.

※This function will only be detected when " input signal error " is enabled in the software settings.

Conversion Excess

When the load input signal voltage exceeds the maximum upper limit, the warning relay will ON .

For example:

The sensitivity of the load cell is 1 mv/v.

If the input signal is greater than 5 mv (the maximum range of the load cell), the warning relay will ON .

※ This function will only be detected when " input signal error " is enabled in the software settings.

Total Weight Upper Limit Alarm

When the total weight exceeds the set upper limit, the warning relay will ON.

Total Weight Lower Limit Alarm

When the total weight is lower than the set lower limit, the warning relay will ON.

Data Buffer Done Relay

When data buffering is completed, the relay will ON.

Error Flag

The warning relay is ON when conversion excess or weight capacity overclocking occurs.

Appendix A Description of LED Indicator

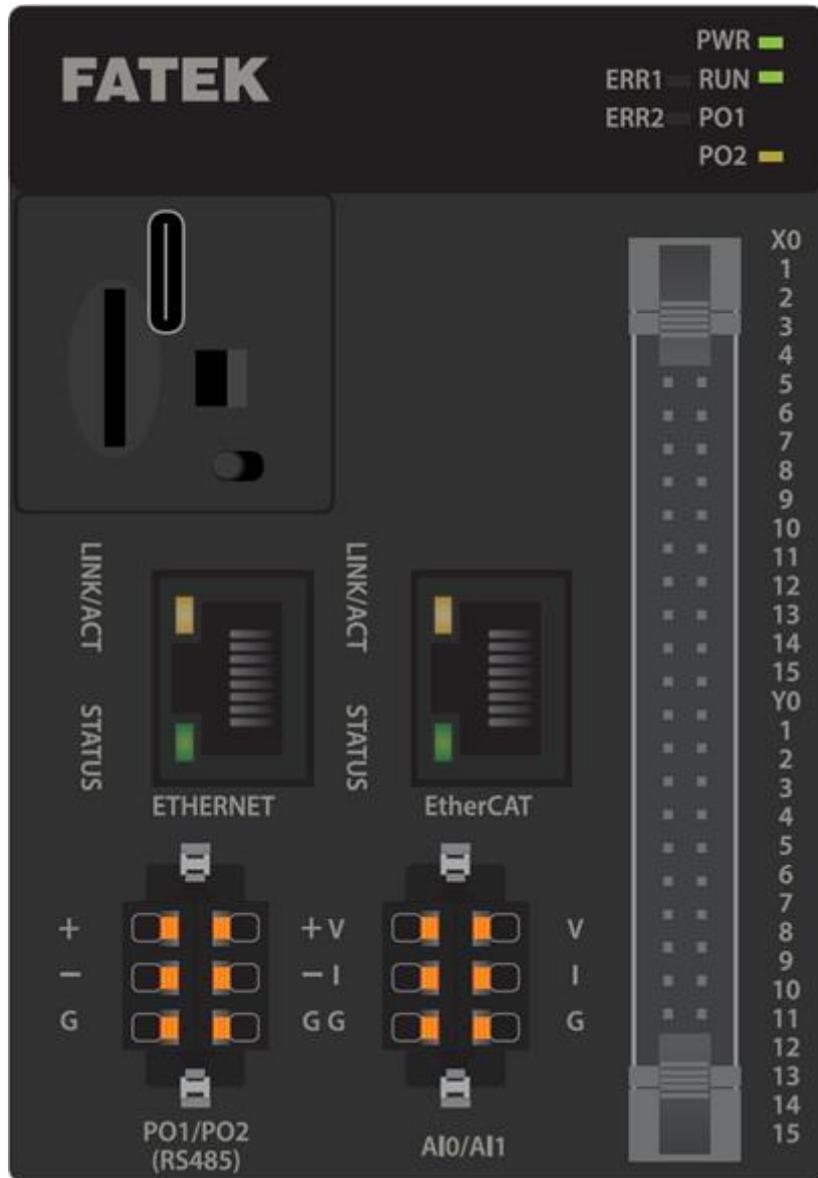## A-1 General/Advanced Motion Control Host

Figure 164 Host_ME3C6-1616T

Motion Control Type: (ME3C6-1616T, ME2C5-1616T, ME2C4-1616T, ME2C3-1616T, ME1C1-1616T, MS3C6-1616T, MS2C5-1616T, MS2C4-1616T, MS1C2-1616T, MS1C1-1616T)

Indicator	Color	Definition
PWR	Red	Constant light for being energized.
RUN	Yellow-green	- Slow flashing when shut down. - Constant dark for shutdown due to error. - Quick flashing when running.
SD	Yellow-green	- Slow flashing when mounting. - Constant light for normal use.
ERR1	Red	Constant light for error detection.
ERR2	Red	Constant light for error detection.
PO1	Orange-yellow	Flashing when Port1 is under communication status.
PO2	Orange-yellow	Flashing when Port2 is under communication status.
I/O X0–X15	Yellow-green	- Lit when ON. - Dark when OFF.
I/O Y0–Y15	Yellow-green	- Lit when ON. - Dark when OFF.
Ethernet LINK/ACT	Yellow	- Lit when the network is connected. - Flashing when under communication status. - Constant dark when the network wire is not connected.
Ethernet STATUS	Green	- Flashing under DHCP mode means retrieving IP. - Constant light means the IP is being set or retrieved through DHCP. - Constant dark means IP setting is invalid.
EtherCAT LINK/ACT	Yellow	- Lit when the network is connected. - Flashing when under communication status. - Constant dark when the network wire is not connected.

| EtherCAT STATUS | Green | - Constant light: shutdown emergency

- Flickering: in operation

- Blinking: connecting

- Single flash: boot completed

- Double flash: operating error

Lighting patterns are defined according to the following diagram:

 |

Table Host_ME3C6-1616T indicator description
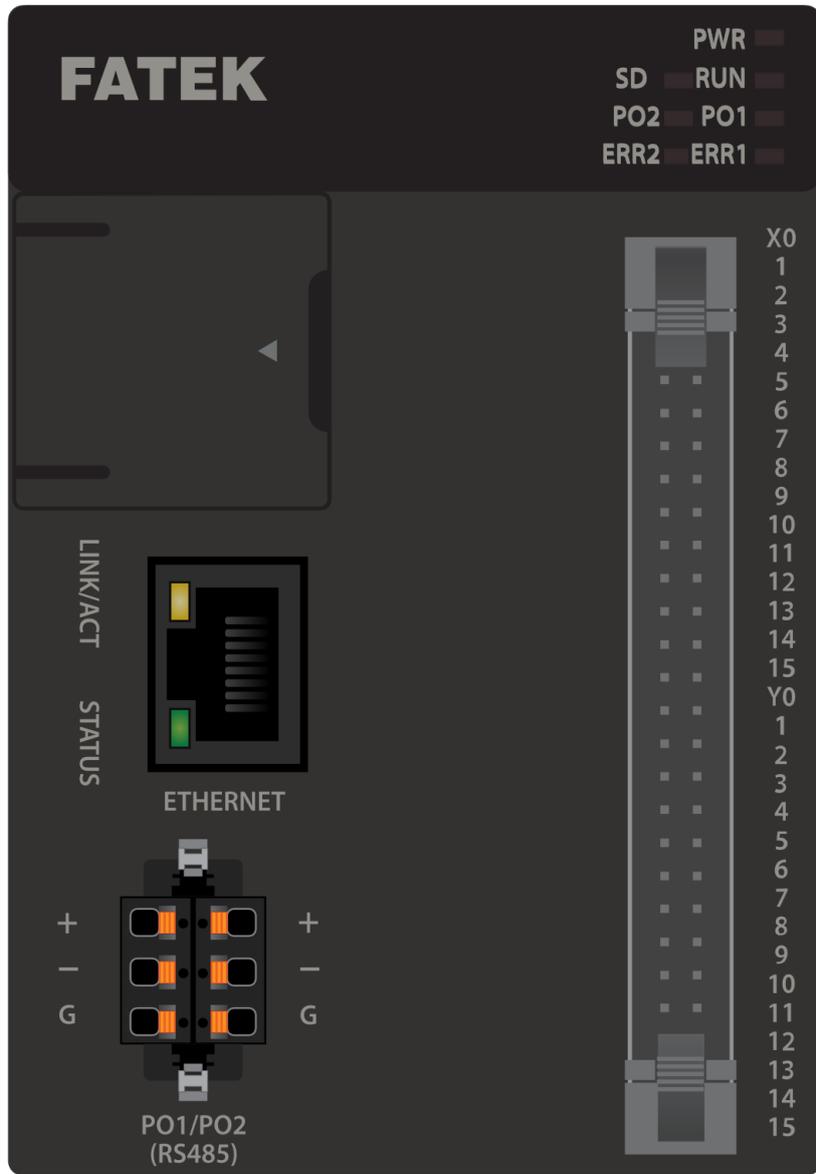
A-2 Basic Host

Figure 164 Host_ MA1I4-1616T

Without Motion Control Type: (MA3M3-1616T, MA2M3-1616T, MA1M3-1616T, MA1I4-1616T, MA1N3-1616T, MA1N2-1616T, MA1N1-1616T)

Indicator	Color	Definition
PWR	Red	Constant light for being energized.
RUN	Yellow-green	- Slow flashing when shut down. - Constant dark for shutdown due to error. - Quick flashing when running.
SD	Yellow-green	- Slow flashing when mounting. - Constant light for normal use.
ERR1	Red	Constant light for error detection.
ERR2	Red	Constant light for error detection.
PO1	Orange-yellow	Flashing when Port1 is under communication status.
PO2	Orange-yellow	Flashing when Port2 is under communication status.
I/O X0–X15	Yellow-green	- Lit when ON. - Dark when OFF.
I/O Y0–Y15	Yellow-green	- Lit when ON. - Dark when OFF.
Ethernet LINK/ACT	Yellow	- Lit when the network is connected. - Flashing when under communication status. - Constant dark when the network wire is not connected.
Ethernet STATUS	Green	- Flashing under DHCP mode means retrieving IP. - Constant light means the IP is being set or retrieved through DHCP. - Constant dark means IP setting is invalid.

Table Host_ MA1I4-1616T indicator description

A-3 M16X
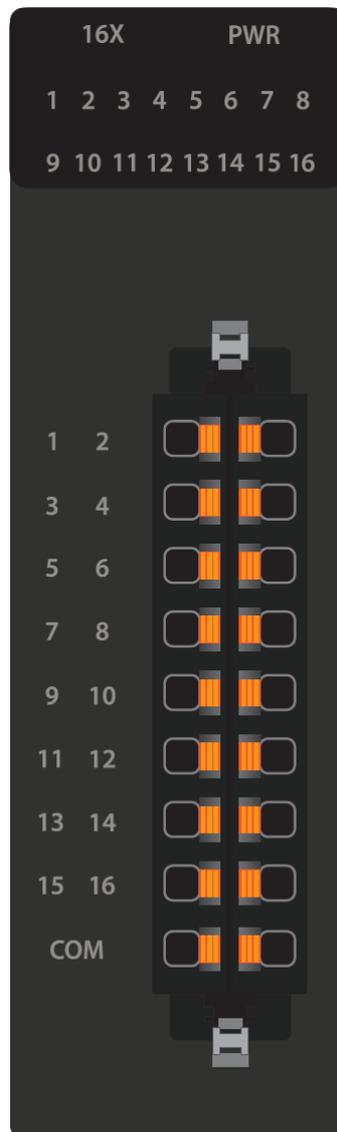
Figure 165 Expansion DI_M16X

Indicator	Color	Definition
PWR	Red	Constant light for being energized.
X1–X16 indicator	Yellow-green	Lit when ON Dark when OFF

Table 87 Expansion DI_M16X indicator description

A-4 M16YT
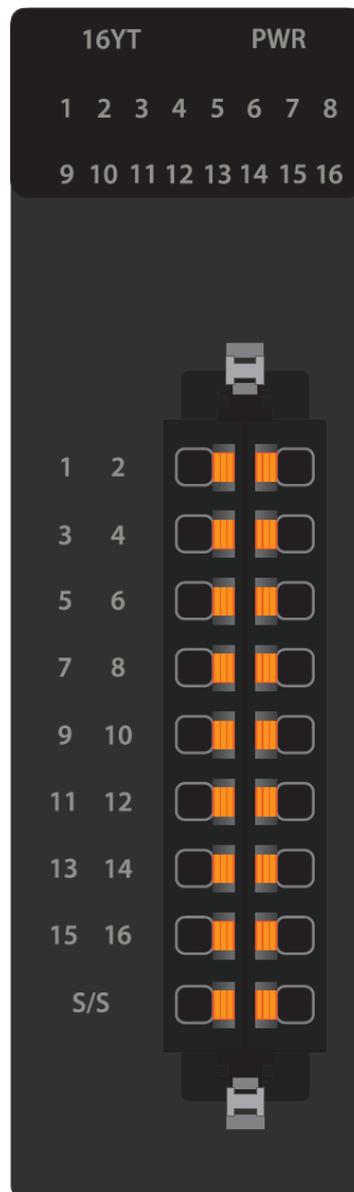
Figure 166 Expansion DO_M16Y

Indicator	Color	Definition
PWR	Red	Constant light for being energized.
Y1–Y16 indicator	Yellow-green	Lit when ON Dark when OFF

Table 88 Expansion DO_M16Y indicator description

A-5 M1616XYT
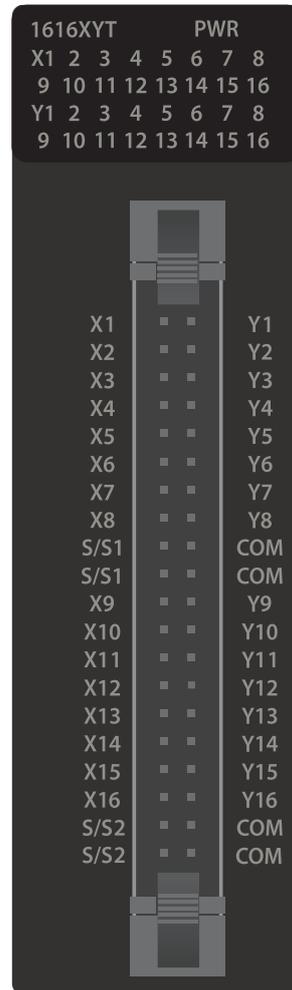
Figure 169 Expansion DIO_1616XYT

Indicator	Color	Definition
PWR	Red	Constant light for being energized.
Y1–Y16 indicator	Yellow-green	Lit when ON Dark when OFF
X1–X16 indicator	Yellow-green	Lit when ON Dark when OFF

Table 88 Expansion DIO_M1616XYT indicator description

A-6 M04AD/M04ADR

Figure 167 Expansion AI_M04AD/M04ADR

Indicator	Color	Definition
PWR	Red	Constant light for being energized.
RUN	Yellow-green	- Slow flashing when shutdown - Quick flashing when running
ERR	Red	Action mode under warning or major error mode
ADC	Yellow-green	Constant light for signal conversion
ALM	Red	Alarm indicator

Table 89 Expansion AI_M04AD/M04ADR indicator description

M-Series PLC Software Function and Application User Manual
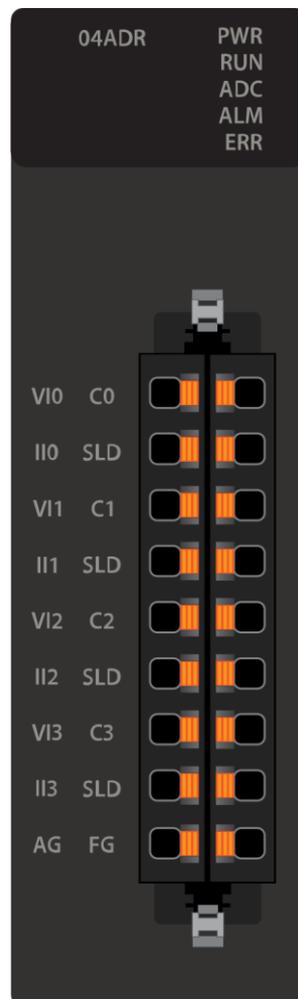
A-7 M04DA/M04DAR

Figure 168 Expansion AO_M04DA/M04ADR

Indicator	Color	Definition
PWR	Red	Constant light for being energized.
RUN	Yellow-green	- Slow flashing when shutdown - Quick flashing when running
ERR	Red	Action mode under warning or major error mode
ADC	Yellow-green	Constant light for signal conversion
ALM	Red	Alarm indicator

Table 90 Expansion AO_M04DA/M04DAR indicator description

A-8 MHCM25

Figure 169 Expansion CM_HCM25

Indicator	Color	Definition
PWR	Red	Constant light for being energized.
RUN	Yellow-green	- Slow flashing when shutdown - Quick flashing when running
ERR	Red	Action mode under warning or major error mode
PORT A TX/RX	Orange-yellow	Lit during serial port transceiving
PORT B TX/RX	Orange-yellow	Lit during serial port transceiving

Table 89 Expansion CM_HCM25 indicator description

A-9 MHCM55
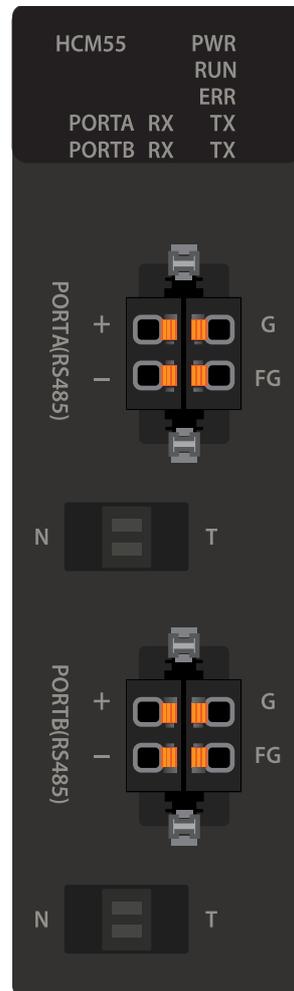
Figure 169 Expansion CM_HCM55

Indicator	Color	Definition
PWR	Red	Constant light for being energized.
RUN	Yellow-green	- Slow flashing when shutdown - Quick flashing when running
ERR	Red	Action mode under warning or major error mode
PORT A TX/RX	Orange-yellow	Lit during serial port transceiving
PORT B TX/RX	Orange-yellow	Lit during serial port transceiving

Table 90 Expansion CM_HCM55 indicator description

A-10 M04TC/M04TCR
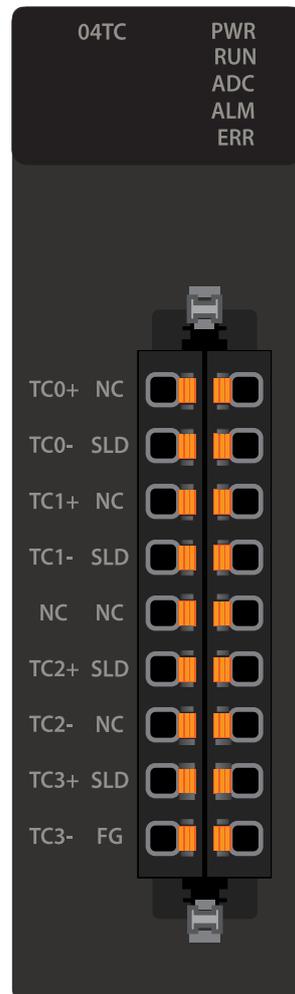
Figure 169 Expansion TC_M04TC/M04TCR

Indicator	Color	Definition
PWR	Red	Constant light for being energized.
RUN	Yellow-green	- Slow flashing when shutdown - Quick flashing when running
ERR	Red	Action mode under warning or major error mode
ADC	Yellow-green	Constant light for signal conversion
ALM	Red	Alarm indicator

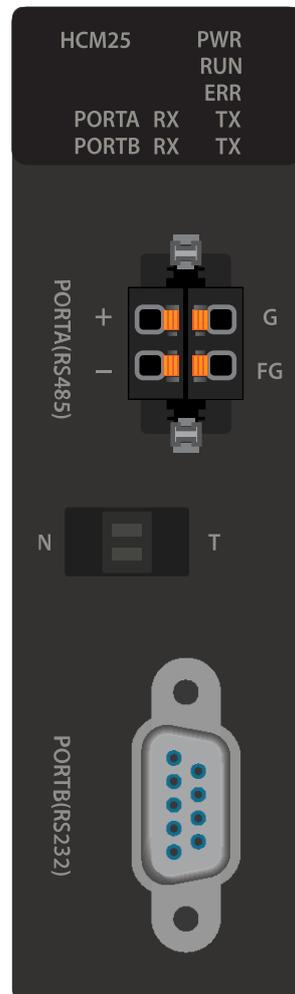Table 91 Expansion TC_M04TC/M04TCR indicator description

A-11 POWER
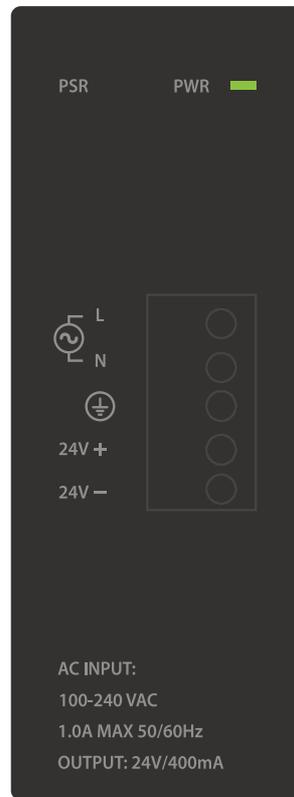
Figure 169 Power Module

Appendix B Host Memory

● This configuration is the factory setting

<table>
<tr><th colspan="3">Category</th><th>Specification</th><th>Notes</th></tr>
<tr><td rowspan="9">B I T</td><td>X</td><td colspan="2">Digital Input (DI)
(Maximum 2048 points)</td><td>X0 ~ X1023 (1024)</td><td>Corresponding to external digital input</td></tr>
<tr><td>Y</td><td colspan="2">Digital Output (DO)
 (Maximum 2048 points)</td><td>Y0 ~ Y1023 (1024)</td><td>Corresponding to external digital input</td></tr>
<tr><td>TR</td><td colspan="2">Temporary relay</td><td>TR0 ~ TR31(32)
(Reserved by the system)</td><td></td></tr>
<tr><td rowspan="2">M</td><td colspan="2">Internal relay</td><td>M0 ~ M9119 (9120)</td><td>M0~M9119 can be planned as retentive or non-retentive relays.</td></tr>
<tr><td colspan="2">Special relay</td><td>M9120 ~ M29599 (20480)</td><td></td></tr>
<tr><td>S</td><td colspan="2">Stepping relay</td><td>S0 ~ S3103 (3104)</td><td>S0 ~ S3103 can be planned as retentive **or** non-retentive relays.</td></tr>
<tr><td>T</td><td colspan="2">Timer relay</td><td>T0 ~ T1023 (1024)</td><td></td></tr>
<tr><td>C</td><td colspan="2">Counter relay</td><td>C0 ~ C1279 (1280)</td><td></td></tr>
<tr><td rowspan="5">W O R D</td><td rowspan="3">TMR</td><td rowspan="3">Timer present value register</td><td>0.01S time base</td><td>T0 ~ T255 (256) *</td><td rowspan="3">T0 ~ T1023 can flexibly plan the number of each time base</td></tr>
<tr><td>0.1S time base</td><td>T256 ~ T511 (256) *</td></tr>
<tr><td>1S time base</td><td>T512 ~ T1023 (512) *</td></tr>
<tr><td>CTR</td><td>Counter present</td><td>16
BIT</td><td>C0 ~ C1023 (1024)</td><td>Can be planned as retentive or non-retentive relays.</td></tr>
</table>

		value register	32 BIT	C024 ~ C1279 (256)	Can be planned as retentive or non-retentive relays.
	HR DR	Data register	Retentive	R0 ~ R14999 (15000) * Note: Can be planned non-retentive relays. D0 ~ D11999 (12000)	
			Non-Retentive	R15000 ~ R34767 (19768)	
	HR ROR		Retentive	R43224 ~ R47319 (4096) * Note: When it is not planned as ROR, it can be used as a general register	
			Read only register (ROR)	R43224 ~ R47319 Can be planned as read only register, factory setting is 0*	Stored in the ROR area, does not occupy the program capacity
			File register	F0 ~ F65535(65536) * Note: Requires access through dedicated instruction	
	IR	Input register (AI)		R34768 ~ R34895 (128)	Corresponds to external analog input
	OR	Output register (AO)		R35024 ~ R35151 (128)	Corresponds to external analog output
	SR	System special register		R35280 ~ R43223 (7944)	
	Special Register	0.1ms timer HST register		R35451~R35466(16)	
		1ms timer HST register		R35435~R35442(8)	
		10ms timer LTM register		R35443~R35450(8)	
		0.1ms timing HSTA loop count		DR35467	

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		High-speed counter register	R35280~R35311(32)				
		RTC register	R35312 (sec)	R35313 (min)	R35314 (h)	R35315 (day)	
			R35316 (month)	R35317 (year)	R35318 (week)	R35319 (h + min)	
FR		File register	F0~F65535(65536)				
XR		Index register	V: R43214 Z: R43216 P0 ~ P9 : R43194, R43196, R43198, R43200, R43202, R43204, R43206, R43208, R43210, R43212				

Table 92 M-Series PLC memory

Appendix C System Error Detection

Item	ERR1/ERR2 LED	SR/MASK
Not enough memory capacity	ON/ON	Reserve
Initialization error	ON/ON	Reserve
System error	ON/ON	Reserve
System stack error	ON/ON	R35361/0x0200
System check code error instruction	ON/ON	R35361/0x0004
Power-on detection for power-off operation	ON/ON	R35360/0x0400
System check code error instruction	ON/ON	R35362/0x3E00
Expansion module detection error	ON/OFF	R35360/0x0001
Expansion module configuration error	ON/OFF	R35360/0x0002
The number of expansion modules does not match the host project	ON/OFF	R35360/0x0004
Expansion module I/O points out of range	ON/OFF	R35360/0x0008
The number of expansion modules out of range	ON/OFF	R35361/0x0100
Motion control unit queue error	ON/OFF	R35360/0x0080
Motion control unit overflow error	ON/OFF	R35360/0x0100
Motion control unit emergency stop	ON/OFF	R35360/0x0200
Watchdog restart detection	ON/OFF	R35361/0x0010
Illegal memory card detection instruction	OFF/ON	R35360/0x0010
Memory card operation error detection	OFF/ON	R35360/0x0020
PLC ID dose not match PROG ID	OFF/ON	R35360/0x0040
The application exceeds the capabilities of this CPU	OFF/ON	R35361/0x0800
System service error instruction	OFF/ON	R35361/0x8000

Amendment Record

Version	Date	Description	Page	Author
V0.0.01	2020/11/02	Version 1		
V0.0.02	2020/12/07	Version 2		
V0.0.03	2021/01/05	Version 3		
V0.0.04	2022/02/22	Version 4	400	