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Industrial Automation Headquarters

Delta Electronics, Inc.
Taoyuan Technology Center
No.18, Xinglong Rd., Taoyuan City,
Taoyuan County 33068, Taiwan
TEL: 886-3-362-6301 / FAX: 886-3-371-6301

Asia

Delta Electronics (Jiangsu) Ltd.
Wujiang Plant 3
1688 Jiangxing East Road,
Wujiang Economic Development Zone
Wujiang City, Jiang Su Province,
People's Republic of China (Post code: 215200)
TEL: 86-512-6340-3008 / FAX: 86-769-6340-7290

Delta Greentech (China) Co., Ltd.
238 Min-Xia Road, Pudong District,
ShangHai, P.R.C.
Post code : 201209
TEL: 86-21-58635678 / FAX: 86-21-58630003

Delta Electronics (Japan), Inc.
Tokyo Office
2-1-14 Minato-ku Shibadaimon,
Tokyo 105-0012, Japan
TEL: 81-3-5733-1111 / FAX: 81-3-5733-1211

Delta Electronics (Korea), Inc.
1511, Byucksan Digital Valley 6-cha, Gasan-dong,
Geumcheon-gu, Seoul, Korea, 153-704
TEL: 82-2-515-5303 / FAX: 82-2-515-5302

Delta Electronics Int'l (S) Pte Ltd
4 Kaki Bukit Ave 1, #05-05, Singapore 417939
TEL: 65-6747-5155 / FAX: 65-6744-9228

Delta Electronics (India) Pvt. Ltd.
Plot No 43 Sector 35, HSIIDC
Gurgaon, PIN 122001, Haryana, India
TEL : 91-124-4874900 / FAX : 91-124-4874945

Americas

Delta Products Corporation (USA)
Raleigh Office
P.O. Box 12173,5101 Davis Drive,
Research Triangle Park, NC 27709, U.S.A.
TEL: 1-919-767-3800 / FAX: 1-919-767-8080

Delta Greentech (Brasil) S.A
Sao Paulo Office
Rua Itapeva, 26 - 3° andar Edificio Itapeva One-Bela Vista
01332-000-São Paulo-SP-Brazil
TEL: +55 11 3568-3855 / FAX: +55 11 3568-3865

Europe

Deltronics (The Netherlands) B.V.
Eindhoven Office
De Witbogt 15, 5652 AG Eindhoven, The Netherlands
TEL: 31-40-2592850 / FAX: 31-40-2592851

Delta Human Machine Interface & Controller HMC Series User Manual

Delta Human Machine Interface & Controller HMC Series User Manual

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Chapter 1 Introduction

1.1 Brief Introduction of HMC Controller

Today's industry develops toward automation and follows a more precise, higher speed and higher cost performance trend. Thus, Delta offers a distributed motion control framework, which separates the logic controller and motion computing controller. Without the centralized computing load, it uses lots of lower-level processor (the price is cheaper in overall) instead of the high-level processor.

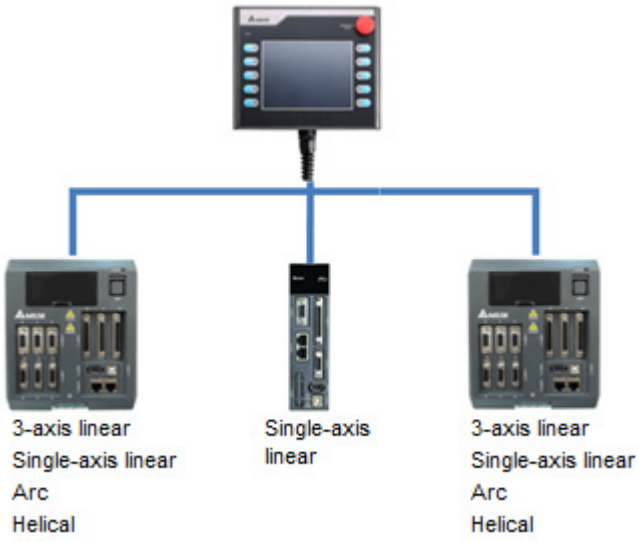
In Delta's distributed framework, HMC is mainly in charge of logic control and human machine operation. ASDA servo drive is responsible for motion control. Through the high speed communication, DMCNet, HMC and ASDA servo drive perfectly combine together. With this concept, the distributed framework accomplishes multi-axis precise motion control and reduces the cost of equipment at the same time.

Delta's HMC (Human Machine Interface & Control) integrates HMI and the function of logic computing (controller), which brings the high efficiency integration of HMI and logic control. It even plays an important role in today's industrial system and distributed control framework and provides users a great benefit including more powerful functions and less development time.

1.2 Concept of Distributed Motion Control

HMC processes the program logic control in Delta's distributed motion control framework, including calculating and issuing parameters of motion commands. HMC commands ASDA servo drive to conduct the interpolation during the process so as to acquire a more precise motion interpolation path. During the process, HMC only needs to exchange the data from ASDA servo drive, such as current position, current speed and flag status including servo alarm, command completed.

Unlike the traditional PLC, the controller has to frequently calculate the motion path and sends to the servo drive, the interpolation calculation in this framework is conducted by ASDA servo drive. Therefore, it will acquire a more accurate path and more smooth motion curve. However, since the multi-axis interpolation (e.g. multi-axis linear interpolation, arc interpolation or helical interpolation) is directly conducted and calculated by servo drive, the interpolation can only be done by one or each servo drive individually. Aiming at this multi-axis linear interpolation motion, HMC allocates the speed to different servo drive to conquer this barrier. Further explanation about this motion control will be detailed later. Following is the figure of distributed motion control framework.



1.3 Overview of HMC models

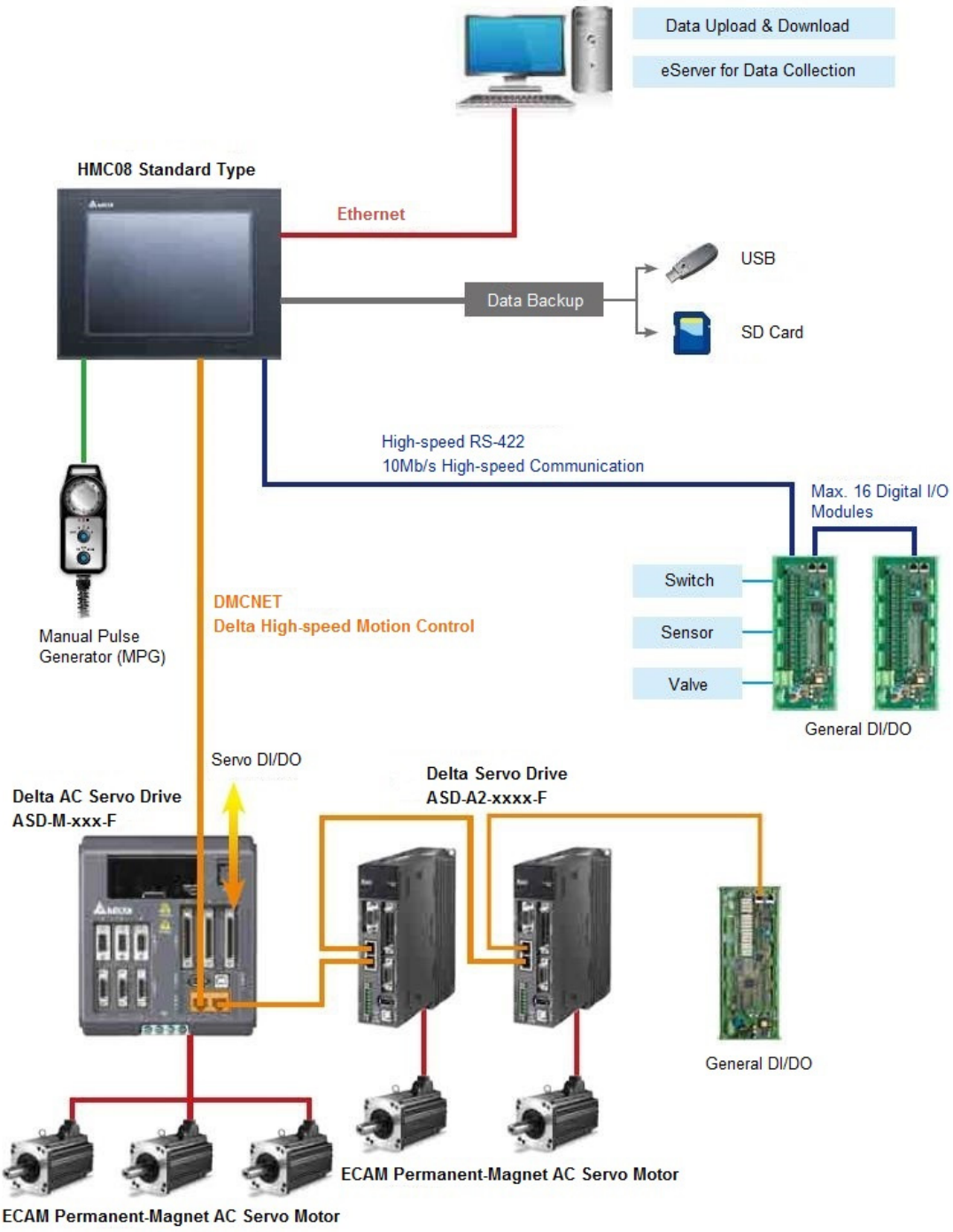
Delta offers three types of HMC models: HMC08 standard type, HMC07 handheld type, and HMC07 light type. Each model has slightly different specification, and these differences are listed in the table below. Please refer to the installation manuals (Quick Start) for more details on the product's hardware specifications.

Model		HMC08 Standard Type	HMC07 Handheld Type	HMC07 Light Type
LCD Module	Display Type	8" TFT LCD	7" TFT LCD	7" TFT LCD (Widescreen)
	Resolution (pixels)	800 x 600 pixels		800 x 480
Axes of Control		Max.12 Axes	Max.12 Axes	Max.12 Axes
I/O Module		High-speed RS-422 IO module / DMCNet Remote IO module	High-speed RS-422 IO module / DMCNet Remote IO module	DMCNet Remote IO module
Sound Effect Output		Stereo output	N/A	N/A
Serial Com Port	COM1	RS-232	RS-232／RS-422／RS-485	RS-485
	COM2	RS-232／RS-422／RS-485	N/A	N/A
	COM3	RS-232／RS-422／RS-485	N/A	N/A
Ethernet		1 Port		N/A
Function Key		N/A	10	15

Model	HMC08 Standard Type	HMC07 Handheld Type	HMC07 Light Type
Emergency Stop Switch	N/A	A contact (NO): 1 B contact (NC): 1 Rated voltage: 30 V_{DC}	B contact (NC): 2 Rated voltage: 24 V_{DC}
Limit Switch	N/A	A contact: 1 Rated voltage: 30 V_{DC}	Only for internal register, no output signal
MPG	N/A(Note 1)	N/A	Resolution: 50 (P/R) Only for internal register, no output signal
Weight	Approx. 1314g	Approx. 1500g	750g (wire excluded)
Note: 1) HMC08 Standard Type can connect external MPG via expansion slot.			

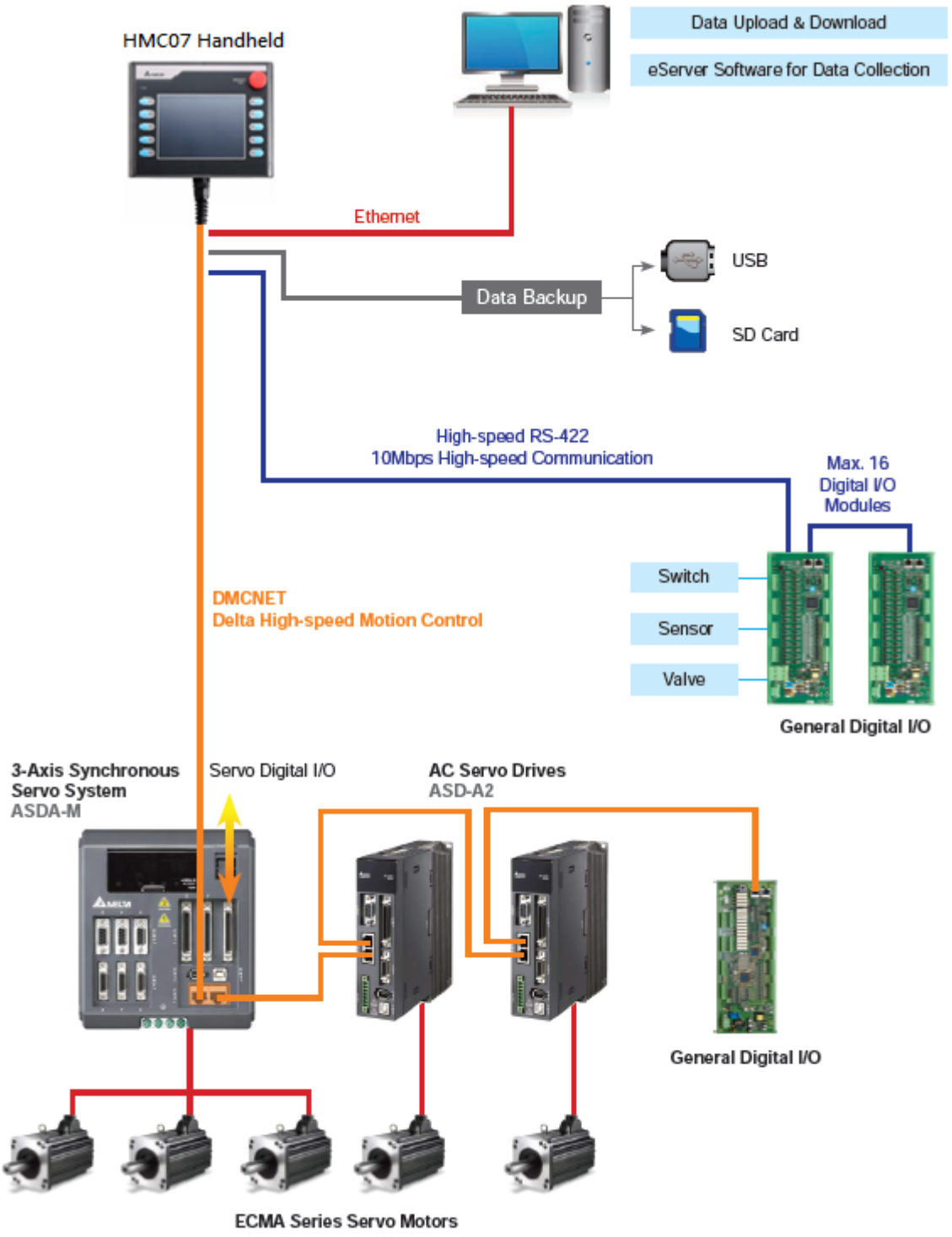
- **HMC08 Standard Type**

Using HMC08 Standard Type, users can connect ASDA series servo drives via DMCNet, and seclect the I/O module in accordance with the communication needs (High-speed RS-422 I/O module or DMCNet remote I/O module). In addition, users can use DOP eServe on PC to access the production records through Ethernet. HMC08 also can be connected to external MPG via expansion slot. Please refer to the figure below for the actual application:


Data Upload & Download
eServer for Data Collection
HMC08 Standard Type
Ethernet
USB
Data Backup
SD Card
High-speed RS-422
10Mb/s High-speed Communication
Max. 16 Digital I/O Modules
Switch
Sensor
Valve
General DI/DO
DMCNET
Delta High-speed Motion Control
Manual Pulse Generator (MPG)
Servo DI/DO
Delta AC Servo Drive
ASD-M-xxx-F
Delta Servo Drive
ASD-A2-xxxx-F
General DI/DO
ECAM Permanent-Magnet AC Servo Motor
ECAM Permanent-Magnet AC Servo Motor

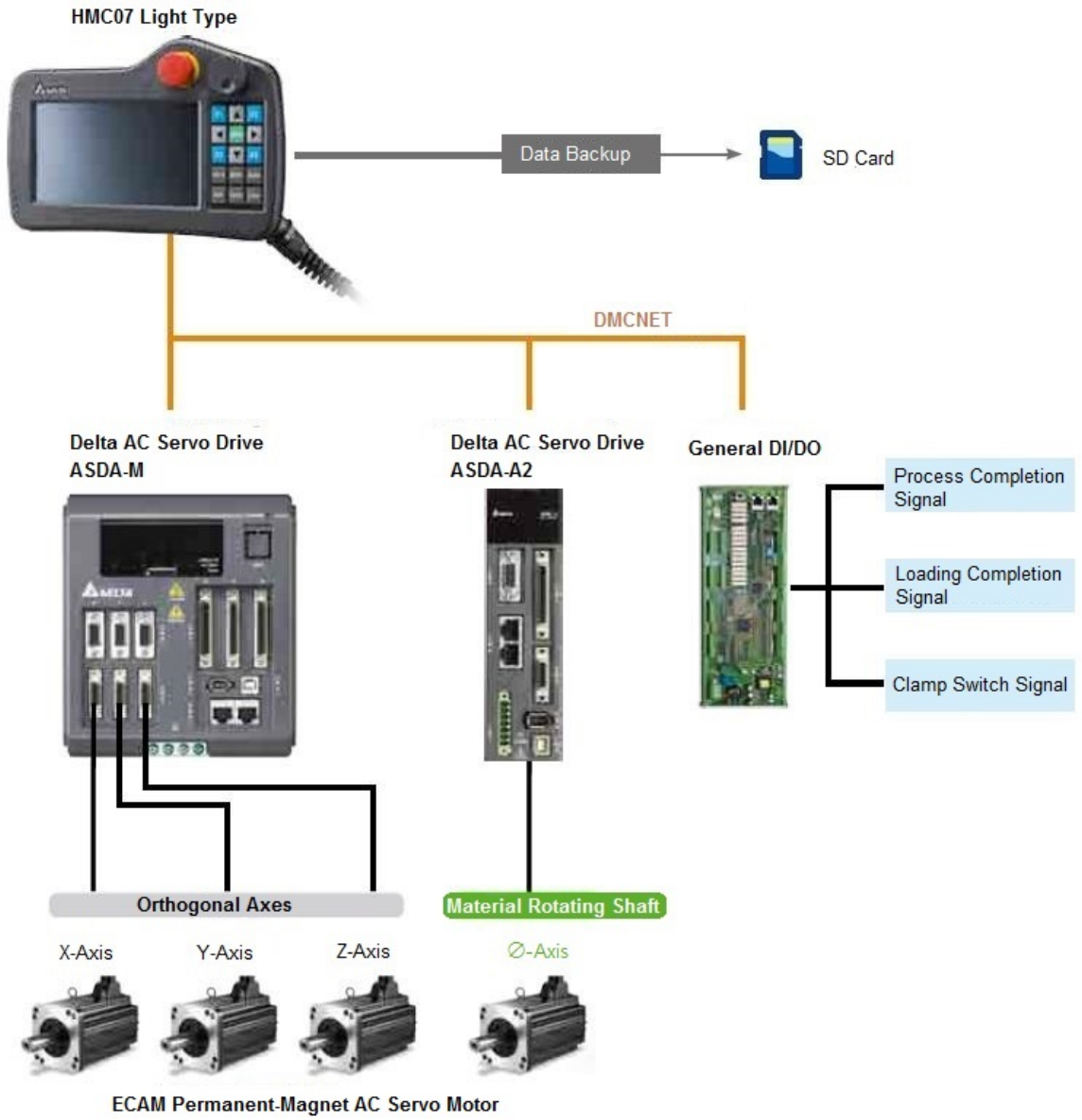
➢ HMC07 Handheld Type

Using HMC07 Handheld Type, users can connect ASDA series servo drives via DMCNet, and seclect the I/O module in accordance with the communication needs (High-speed RS-422 I/O module or DMCNet remote I/O module). In addition, users can use DOP eServe on PC to access the production records through Ethernet. In addition, HMC07 Handheld Type offers physical emergency stop switch and limit switch, and provides 10 function keys. Please refer to the figure below for the actual application:



➢ HMC07 Light Type

Using HMC07 Light Type, users can connect ASDA series servo drives via DMCNet, and select DMCNet remote I/O module. HMC07 Light Type offers physical emergency stop switch, limit switch and MPG operation. It also provides 15 function keys. Please refer to the figure below for the actual application:



Chapter 2 Introduction of Controller

2.1 Controllers Framework

The processing theorem of ladder used by HMC controller is time-division multiplexing which is different from the traditional PLC ladder diagram.

The traditional PLC only has one processor and can only execute one single ladder program. The theorem of PLC is that PLC reads the status of input device first at the beginning of every cycle and executes the command step by step sequentially. Then, it sends the computing result to the output device at the end of each cycle. Go round and begin again, starting from the cycle of [Read input status] ➔ [Computing] ➔ [Change output status]. However, a single ladder program will encounter difficulties, like a more complicated control and computing in development and maintenance.

HMC controller adopts TDM (Time Division Multiplexing) framework, which can execute from a single Cyclic Task to four Cyclic Tasks simultaneously at most. It provides users a great flexibility on program development. When HMC executes four Cyclic Tasks at the same time, it can be regarded as four small individual PLC for programming, which is a great benefit to the complicated program development. Each Cyclic Task of HMC has its own scanning time. Through the software setting, users can determine the time proportion of each Cyclic Task being executed by processor and to adjust the scanning time of each task. It can allocate more time to the vital one so as to shorten its scanning cycle.

HMC controller also adopts the concept of calling subroutine. It programs the function as subroutine, which will be called when needed for simplifying program development. HMC controller also provides Motion Program for the demand of motion control. This is for offering users different control method.

HMC controller's program includes Initial Task, Cyclic Task, Timer Task, Sub Program and Motion Program. Detailed description of each type will be shown in later part.

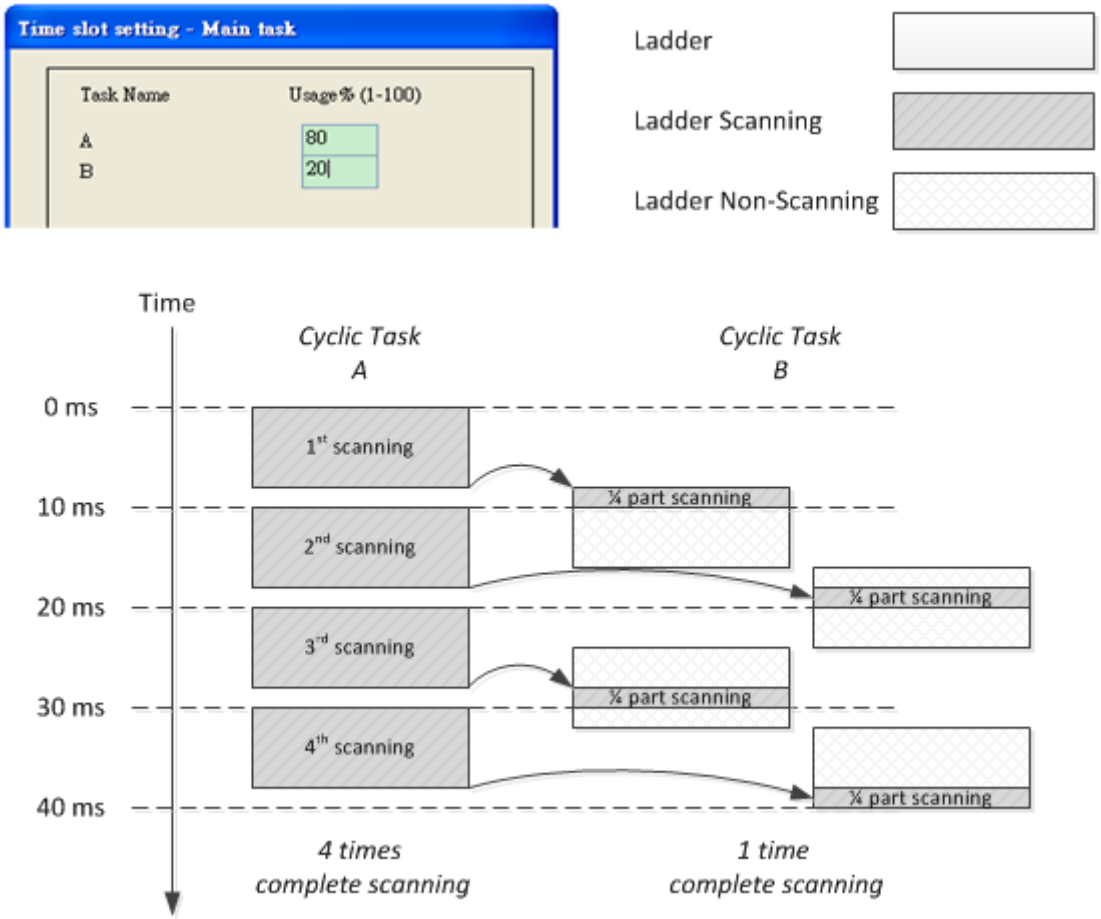
2.2 Ladder Program

2.2.1 Initial Task

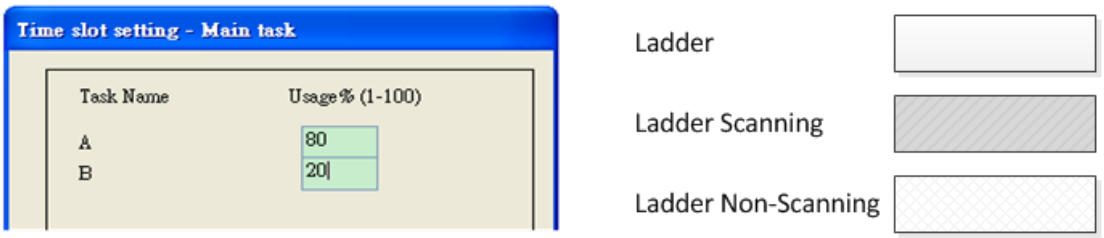
A whole project can only exist one initial task. After activating HMC, it will be firstly executed once only. The initial setting of the system can be programmed in initial task. Since DMCNet communication has not been fully established when initial task is being executed, if applying reading/writing servo parameters, such as WSVP and RSVP command, and the W address that corresponded to servo parameters will be invalid.

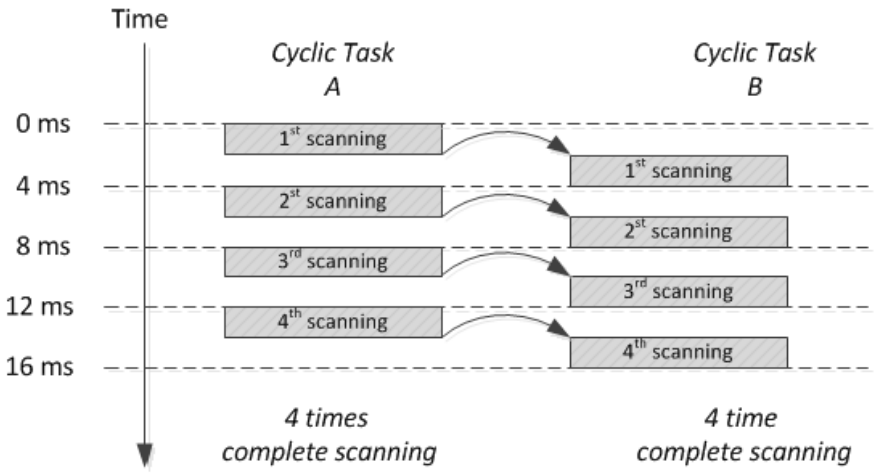
2.2.2 Cyclic Task

A project will exist at least one cyclic task (Four is at most). HMC simultaneously executes these cyclic tasks by TDM. Through the setting of each task's usage, HMC can determine the computing time of cyclic task executed by processor. See the following diagram as the example. If two cyclic tasks, A and B are in a project, both have the same ladder program and require 8 ms of each scan, the usage is set as 80% and 20%, respectively. Assume the total scanning time of each cycle is 10 ms, the processor allocates 8 ms to execute cyclic task A and 2 ms to B, the pattern of executing cyclic tasks is as the following diagram. In the cycle, cyclic task A will be allocated 8 ms for execution, which could accomplish a complete scan. However, cyclic task B is only allocated 2 ms, which only can execute one fourth ladder program in each cycle. Thus, cyclic task B can execute an entire program after four scanning cycles while cyclic task A has already executed the program for four times. Therefore, aiming at different cyclic task, users can setup different usage, such as allocate more usage to a more important or timely needed cyclic task. So that it can reduce its scanning time.



In next example, the arrangement of usage rate will bring different influence to the scanning time of cyclic task. See the following figure below. There are two cyclic tasks, A and B, in a project, both have the same ladder program and require 2 ms to complete the process. We also arrange 80% of usage rate to A and 20% to B. Assuming that the scanning time per cycle is 10 ms, 8 ms will be allocated to A while 2 ms will be B. Please refer to the following figure for executing two cyclic tasks. In the first cycle, cyclic task A has 8 ms to scan. Since cyclic task A only takes 2 ms to complete the scanning, cyclic task B will start scanning right away. Cyclic task B is allocated to 2 ms and complete its mission in the first cycle. In this case, the scanning time of cyclic task A is identical to cyclic task B.



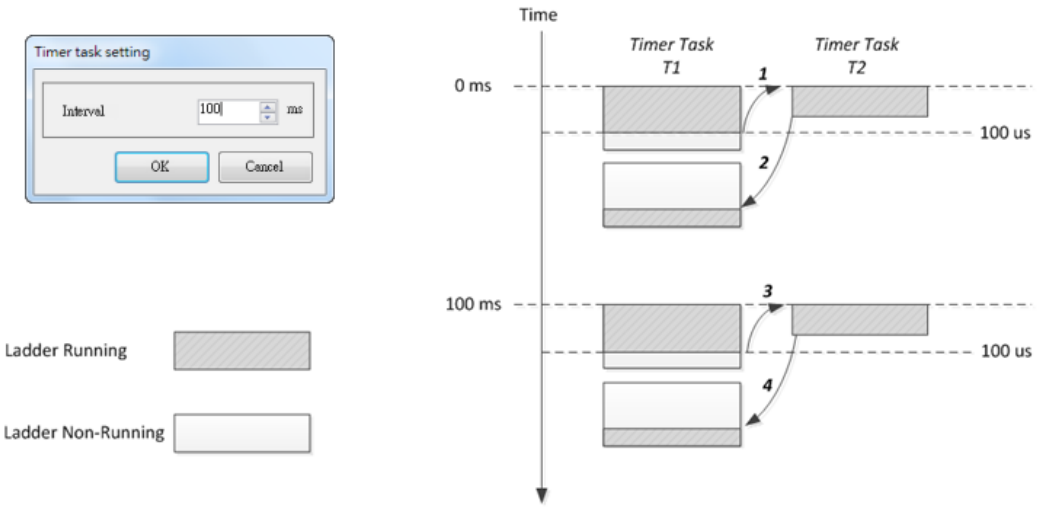


The ladder program of general controller updates the external input signal, On/Off status into the memory zone of input signal device. Save the computing result into the memory zone of each device during program execution. When END command is executed, send the On/Off status of memory zone to output device so as to change the external output. Since HMC controller can execute more than one cyclic task at the same time, it will read the external input signal at the beginning of every cyclic task. When any cyclic task executes END command, the On/Off status of computing result will be outputted to the external output device.

2.2.3 Timer Task

In a whole project, executing 8 timer task is at most. Each timer task can setup its [Time Interval](Unit: ms). It has the highest priority of execution for ensuring the task can be executed in time. Since HMC can execute more than one timer tasks, a single task cannot be executed too long. Otherwise it is unable to execute other tasks timely. Setup [Switching time](Default: 50 us) in the system, so that timer tasks can be switched for execution simultaneously.

See the following diagram as the example. If a project has two timer tasks, T1 and T2, set [Switching time] to 100 us and both set [Time Interval] to 100 ms. Since T1 is a bigger ladder program, the complete scanning time of T1 is longer than 100 us; While T2 is the smaller task, it takes less than 100 us for a scanning. As the following diagram, T1 is executed every 100 ms, but it could not complete scanning within 100 us. When the scanning runs for 100 us, it will stop the execution of T1 and the processor will switch to T2. The scanning time of T2 will not exceed 100 us, after the scanning is completed, the controller will switch back to T1 until the execution of T1 is completed.

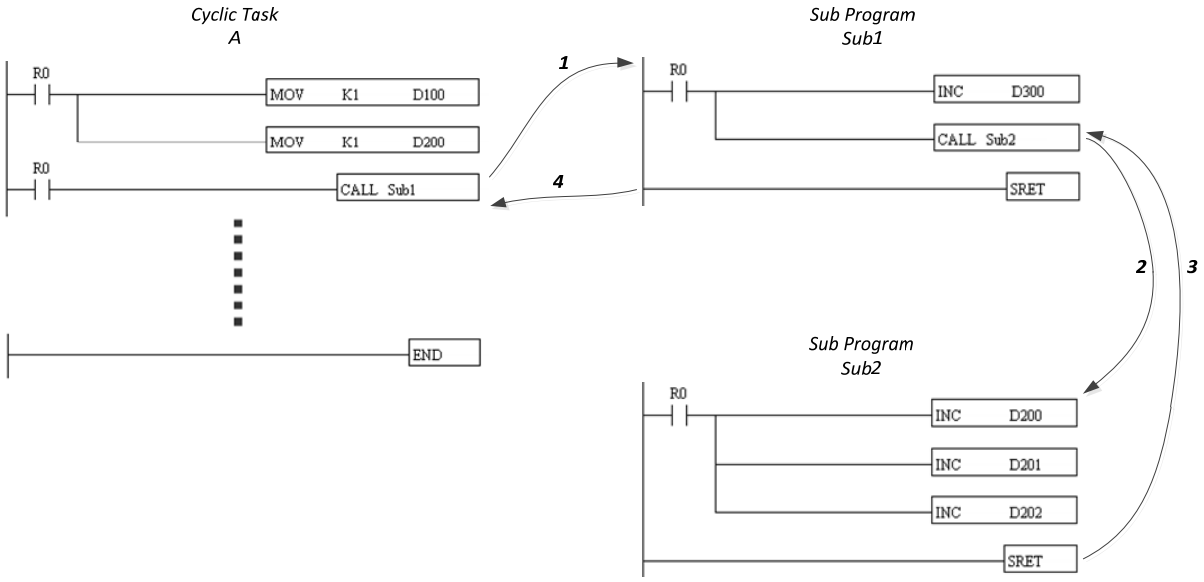


Please bear in mind when using this task. Timer task has the highest priority of execution in all types of tasks. If timer tasks are executed too frequently, it will influence the scanning of cyclic task. Even the cyclic task might be unable to operate.

2.2.4 Sub Program

256 sub programs can be used in a project at most. Different function can be classified to different sub programs. And all types of tasks can repeatedly call the sub programs in order to accomplish program modularization which is good for maintenance as well as enhance the readability.
Command, [CALL] plus the sub program name can trigger the sub program. Then, the processor will execute the called sub program. When executing the command, [SRET], it means to end the sub program and return to the position where the sub program is called and continue the execution.

See the following diagram as the example. Call sub program, Sub1 by the command of [CALL Sub1] in cyclic task A. And Sub1 will be executed. Then, call Sub2 by the command of [CALL Sub2]. It will switch to execute Sub2. When [SRET] command is executed in Sub2, Sub2 is completed. It will return to the position where [CALL Sub2] is called in Sub1 and continue its execution. Similarly, if it encounters [SRET] command when executing Sub1, it means Sub1 is completed and will return to cyclic task A, continue the execution of [CALL Sub1] command until it goes to END command which means the scanning of cyclic task is finished.



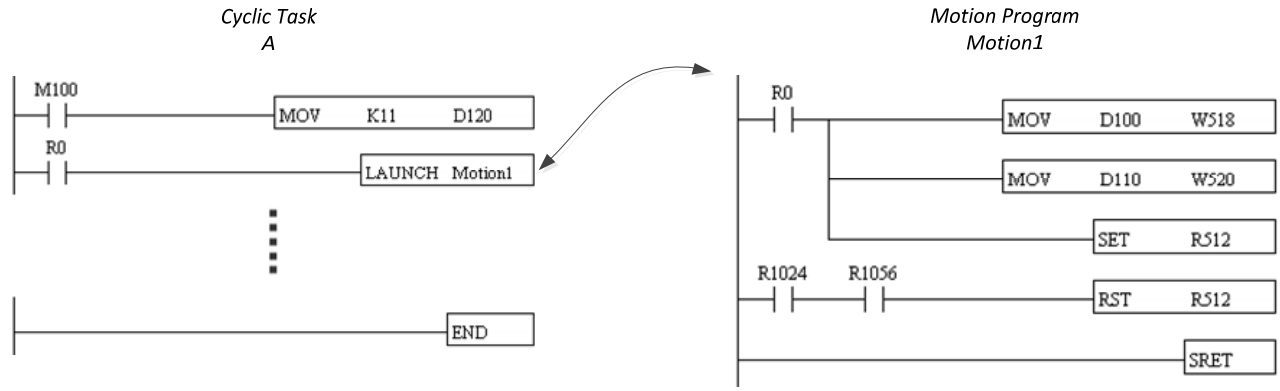
Since sub program is allowed to call sub program, 8 layers of called sub program is at most. If exceeding the limit, status of [Grammar error](R18) will be On and the display of [Code of Grammar error](W18) will show 6.

2.2.5 Motion Program

256 motion programs can be used in a project at most. Its feature is similar to sub program, but the original program will continue to operate after using motion programs. The called motion program will be activated and executed with the original one. Motion program is mainly used in motion control. This is for maintaining the original execution of main control when the cyclic task triggers the motion command and will not influence the original procedure.

The [LAUNCH] command plus the name of motion program can activate the motion program. When [SRET] command is executed during operation, it means the motion program is completed. One motion program can be executed for one time. If more than one motion program is called, they will be executed one by one in order. Please note that once the motion program is launched, it will only execute one scanning.

See the following diagram as the example. Call Motion1 by [LAUNCH Motion1] when executing cyclic task A, cyclic task A will not be interrupted when triggering [LAUNCH Motion1] command. It will be executed continuously. If no motion program is executed at the moment, Motion1 will be executed until [SRET] command appears, which means the motion program is completed.



Please pay attention that, motion program cannot call another motion program. 256 motion programs which are waiting to be executed by HMC are at most. If exceeding the limit, status of [Grammar error](R18) will be On and the display of [Code of grammar error](W18) will show 12.

2.3 Devices

Range and number of devices available in HMC controller

Type	Device	Item		Range		Contents
Relay (Bit)	X	Input relay		0 ~ 511	Total 512 points	
	Y	Output relay		0 ~ 511	Total 512 points	
	DX	DMCNet input relay		1.0 ~ 12.63	Total 768 points	
	DY	DMCNet output relay		1.0 ~ 12.63	Total 768 points	
	M	Auxiliary relay	General	0 ~ 511 1024 ~	Total 8192 points	
			Latched	512 ~ 1023 (*1 Use W10 and W11 to adjust the range.)		
	T	Timer	100ms	0 ~ 199	Total 256 points	
			10ms	200~255		
	C	Counter	16-bit	0 ~ 199	Total 256 points	
			32-bit	200 ~ 255		
	R	Special relay		0 ~ 1535	Total 1536 points	
Register (Word)	T	Timer's current value	16-bit	0 ~ 255	Total 256 points	0 ~ 65535
	C	Counter's current value	16-bit	0 ~ 199	Total 256 points	0 ~ 65535
			32-bit	200 ~ 255		-2147,483,648~2147,483,647
	D	Data register	16-bit General	0 ~ 2999 4000 ~ 65535	Total 65536 points	-32,768 ~ 32,767

Type	Device	Item			Range		Contents
				Latched	3000~3999 (*2 Use W12 and W13 to adjust the range.)		
	V	Indirect reference register	16-bit		0 ~ 127	Total 128 points	-32,768~32,767
	Z	Indirect reference register	32-bit		0 ~ 127	Total 128 points	-2147,483,648~2147,483,647
	W	Special register	16-bit		0 ~ 4095	Total 4096 points	
	DAI	DMCNet analog input			1.0 ~ 12.3	Total 48 points	
	DAO	DMCNet analog output			1.0 ~ 12.3	Total 48 points	
Indicator	N	Loop indicator			0 ~ 7	Total 8 points	
	P	Jump indicator			0 ~ 255	Total 256 points	
Constant	K	Decimal constant					
Floating point number	F	Floating point number					

Note 1: W10 can determine the start position while W11 can determine its size.

Note 2: W12 can determine the start position while W13 can determine its size.

2.3.1 Input Relay (X) / Output Relay (Y)

The input/output relay is assigned number by decimal. Input relay X and Output relay Y corresponds to the input point and output point of Remote I/O module respectively. Please refer to the table below:

Device	Remote I/O				
	Station 1	Station 2	Station 3	~	Station 16
Input X	X0 ~ X31	X32 ~ X63	X64 ~ X95	~	X480~X511
Output Y	Y0 ~ Y31	Y32 ~ Y63	Y64 ~ Y95	~	Y480~Y511

Note 1: A Remote I/O module has 32 input points and 32 output points.

Note 2: Remote I/O module can connect up to 16 stations at most.

Note 3: The station number of Remote I/O module is determined by module number and its physical station number. For example, if HMC is connected for 3 Remote I/O modules, the least physical station number is station 1, the second one is station 2 and the maximum one is station 3.

- Input relay (X)
  Connect to the input device and read the input signal. Each A or B contact of input relay can be used without time limit in the program. On/Off of input relay X only can be switched by the On/Off of external input device.

- Output relay (Y)
  Send On/Off signal and connect to contact Y. Each A or B contact of input relay can be used without time limit in the program.

2.3.2 DMCNet Input Relay (DX) / Output Relay (DY)

DMCNet input/output relay is assigned number by decimal. DMCNet input relay DX and DMCNet output relay DY corresponds to input point and output point of DMCNet RM (MN\NT\PT) module or HMC-RIO3232RT5 module respectively. Please refer to the table below:

Device	DMC-RMxx(MN\NT\PT), HMC-RIO3232RT5			
	Station 1	Station 2	~	Station 12
Input DX	DX1.0 ~ DX1.63	DX2.0 ~ DX2.63	~	DX12.0 ~ DX12.63
Output DY	DY1.0 ~ DY1.63	DY2.0 ~ DY2.63	~	DY12.0 ~ DY12.63

- DMCNet input relay (DX)
  Connect to the input device of DMCNet RM (MN\NT\PT) module and access the input signal. Each A or B contact of input relay can be used without time limit. On/Off of input relay D only can be switched by the On/Off of external input device.

- DMCNet output relay (DY)
  Send On/Off signal to set the contact DY of DMC-RM module. Each A or B contact of input relay can be used without time limit in the program.

2.3.3 Auxiliary Relay

Auxiliary relay M has output winding, contact A, B which acts as output relay Y, has no use limit in the program. Users can use auxiliary relay M but cannot drive the external devices. According to the characteristics, there are two types.

Auxiliary relay M	General	M0~M511 M1024~M4095	Total 8192 points
	Latched	M512~M1023, 512 points is for latched zone as default. Adjust the range by W10 and W11	

- Auxiliary relay for general use
  When HMC power off, the status will be set to Off even when the power is On again.

- Auxiliary relay for latched
  When HMC power off, the status will be remained even when the power is On again.

2.3.4 Timer (T)

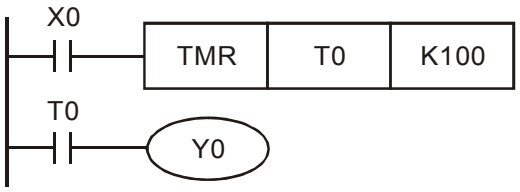
Timer is coded by decimal number. Range: T0 ~T255

Timer T	100ms for general use	T0~T199, 200 points	Total 256 points
	10ms for general use	T200~T255, 56 points	

Timer uses 10ms or 100ms as the timing unit and counts upward. When [Time's current value = Setting value], the output winding is On. Its setting value is a decimal constant (K), which can use a data register D as its setting value.

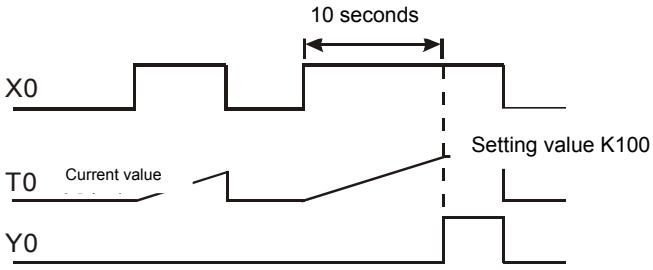
Timer's actual setting time = time unit * setting value

The timer times once after each TMR command execution. When the current value of the timer equals its setting value, its winding coil turns On.



When X0 = On, the current value of the timer T0 counts up in units of 100ms. In case the current value of T0 equals the setting value K100 (10 seconds), the winding coil T0 turns On.

When X0 = Off or power outage, the current value of timer T0 resets to 0 and its winding coil sets to Off.



2.3.5 Counter (C)

Counter is coded by decimal numbers. Range: C0 ~C255

Counter C	16-bit count up, general purpose	C0~C199, 200 points	Total 256 points
	32-bit count up/down, general purpose	C200~C255,56 points, can be changed to count down with settings R32~ R87	

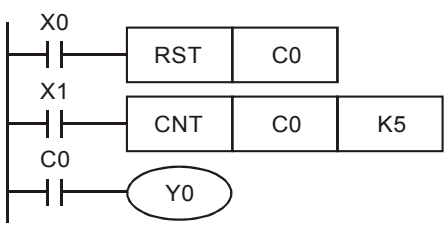
Counter's features:

Item	16-bit	32-bit
Type	General purpose	General purpose
Direction	Count up	Count up and down
Setting value	0 ~ 65,535	-2,147,483,648 ~ 2,147,483,647
Type of setting value	Constant K or data register D	Constant K or data register D (assign both)
Change of the current value	Stop counting when setting value reached	Keep counting when setting value reached
Output contacts	Contact sets and retains On when setting value reached	Contact sets and retains On when setting value reached during counting up. Contact resets to Off when setting value reached during counting down.
Reset	The RST command reset current value to 0 and contact to Off	

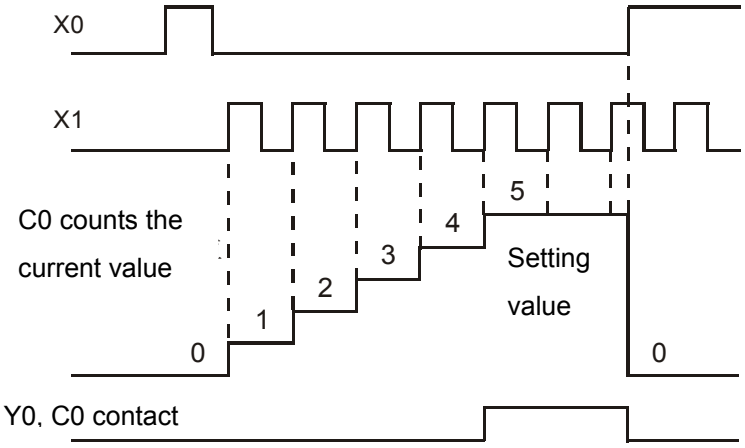
When the counter's signal changes from Off to On, the counter will increase by 1. When the current value of the counter matches the setup one, the winding coil of the counter will turn on. The setting value is either a decimal constant K or a data register D. K0 and K1 functions in the same way and the output contact set On at the first counting.

16-bit counter C0~C199:
Setting range of 16-bit counter: K0~K65,535
Counter's setting value can be done by constant K directly or by register D indirectly.
Example:

```
LD    X0
RST   C0
LD    X1
CNT   C0   K5
LD    C0
OUT   Y0
```



When X0 = On, RST command is executed to reset C0 to 0 and output contact to Off.
When X1 changes from Off ➔ On, the counter counts up by 1.
When counter C0 matches with the setting value of K5, the C0 contact turns On. The current value of C0 = setting value = K5. Later, C0 does not accept the trigger signal from X1. Its value remains equal to K5.



32-bit, general purpose arithmetic operation counter C200~C255:
Range of 32-bit, general purpose counter's setting value: K-2,147,483,648 ~ K2,147,483,647

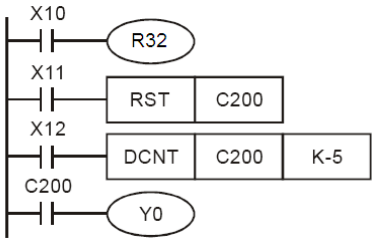
32-bit, general purpose arithmetic operation counters counting up or down can be switched by special relay R32~R87. For example, R32 = Off indicates C200 is for addition and R32 = On for subtraction.

The setting value can be constant K or data register D. The value can be positive or negative. If data register D is used, two consecutive data registers are required for one setup value.

Counter's current value changes from 2,147,483,647 to -2,147,483,648 when counting upward and -2,147,483,648 to 2,147,483,647 when counting downward.

Example:

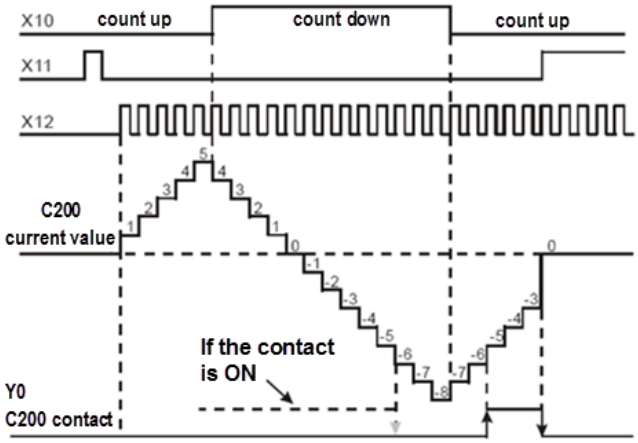
```
LD      X10
OUT     R32
LD      X11
RST     C200
LD      X12
DCNT    C200   K-5
LD      C200
OUT     Y0
```



X10 driven R32 determines C200 is either addition (count up) or subtraction (count down).

When X11 changes from Off to On, RST command is executed to reset C200 to 0 and output contact to Off.

When X12 changes from Off to On, the counter value increased by 1 or decreased by 1. When the value of counter C200 changes from K-6 to K-5 (count up), the C200 contact turns On. When the value of counter C200 changes from K-5 to K-6 (count down), the C200 contact turns On.



2.3.6 Data Register (D)

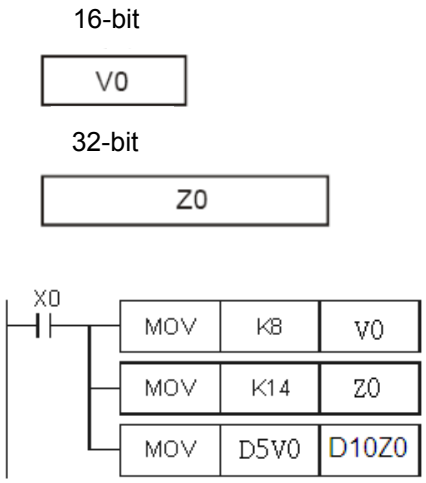
The data register is used for keeping 16-bit numeric data in range of -32,768 ~ +32,767. The left most bit is a sign bit. Two 16-bit registers can be combined into one 32-bit register (D+1,D where the smaller ID represents the lower bits, 16-bit), with the left most bit serving as the sign bit. It can store numeric data in range of -2,147,483,648 ~ +2,147,483,647.

Data register D	General	D0~D2999 D4000~D65535	Total 65536 points
	Latched	D3000~D3999, 1000 points is for latched zone. Adjust the range by W12 and W13.	

- General register
  When power Off, its value will be reset to 0.
- Latched register
  The value will remain when power Off.

2.3.7 Indirect Reference Register (V) / (Z)

Indirect reference register V is the 16-bit register and Z is the 32-bit one. The range is V0 ~ V127 and Z0 ~ Z127, 128 points for each register.



V is the 16-bit data register, which is the same as the general ones. It can be written in or read without limit. If it is used as the general register, it only can be used in the 16-bit command.
Z is the 32-bit data register. If it is used as the general register, it only can be used in the 32-bit command.

When X0 = On,
V0 = 8, Z0 = 14,
D5V0 = D(5+8) = D13,
D10Z0 = D(10+14) = D24,
and contents in D13 will be moved to D24.

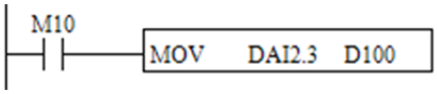
2.3.8 DMCNet Analog Input (DAI) / DMCNet Analog Output (DAO)

DMCNet analog input and output are using decimal numeration. DMCNet analog input (DAI) corresponds to ASD-DMC-RM04AD module, and DMCNet analog output (DAO) corresponds to ASD-DMC-RM04DA module. Each module provides 4 channels, and the corresponding addresses are listed in the table below:

Device	ASD-DMC-RM04AD, ASD-DMC-RM04DA			
	Station 1	Station 2	~	Station 12
DMCNet Analog Input (DAI)	DAI1.0 ~ DA1.3	DAI2.0 ~ DAI2.3	~	DAI12.0 ~ DAI12.3
DMCNet Analog Output (DAO)	DAO1.0 ~ DY1.3	DAO2.0 ~ DAO2.3	~	DAO12.0 ~ DAO12.3

- DMCNet Analog Input (DAI)

  When connected via DMCNet, analog input signals can be read through ASD-DMC-RM04AD module according to the input range of each channel. The acquired analog signals will be converted to digital signals. The range of the digital conversion is 0 ~ 65535.



When X10 = On, contents of AI CH03 in station 2 will be sent to the register D100.

- DMCNet Analog Output (DAO)

  When connected via DMCNet, analog output signals can be read through ASD-DMC-RM04DA module according to the output range of each channel. The acquired analog signals will be converted to digital signals. The range of the digital conversion is 0 ~ 65535.

When X10 = On, contents in register D100 will be sent to AO CH02 in station 2.

Note 1: The channel input/output range can be set via Ladder Editor: [Project] > [DAI/DAO setting].

2.3.9 Indicator (N) / Indicator (P)

Indicator	N	For main control loop	N0~N7, 8 points	Main control loop′ s control point
	P	For CJ command	P0~P255, 256 points	Position indicator by using CJ

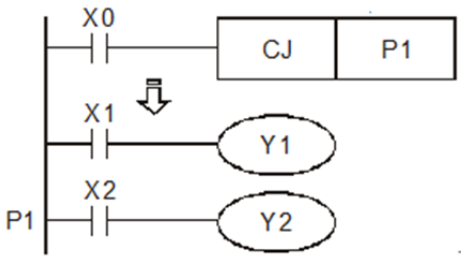
- Indicator N

  Work together with MC/MCR command. MC is the main control initial command. When MC command is active, commands between MC and MCR run in a normal manner.

- Indicator P

  Work together with application command CJ.

  Example:



When X0 = On, the program jumps from address 0 to N (the assigned label P1), keeps executing and ignores statements in between. When X0 = Off, the program executes from address 0 downward and ignores command CJ.

2.3.10 Special Relay (R) / Special Register (W)

Detailed descriptions are in the chapter of special devices.

Classification	Range
Special relay in PLC system	R0 ~ R511
Special register in PLC system	W0 ~ W511
Special relay in motion mode	R512 ~ R1535
Special register in motion mode	W512 ~ W4095

2.3.11 Constant (K) / Floating Points (F)

Use 2 value types to execute computing. The following details the function of each one. The internal numerical computation adopts binary system, which is shown below:

Bit	Bit is the fundamental unit of a binary numeric value. It features only two states: 0 and 1.
Nibble	Composed of four consecutive bits (e.g. bit0 ~ bit3) to express decimal numbers 0 ~ 15 or once place, hexadecimal numbers 0 ~ F.
Byte	Composed of two consecutive nibbles (e.g. 8 bits, bit0 ~ bit7) to express two places, hexadecimal numbers 00 ~ FF.
Word	Composed of two consecutive bytes (e.g. 16-bit, bit0~bit15) to express four places, hexadecimal numbers 0000~FFFF.
Double Word	Composed of two consecutive words (e.g. 32-bit, bit0~bit31) to express eight places, hexadecimal number 00000000~FFFFFFFF.

- Constant K

  Decimal numbers are usually prefixed with the letter K, such as K100, represents a decimal constant of value 100. Exceptions: Constant K can be combined with bit devices X, Y, M to express data in nibble, byte, word or double word format. Take K2Y10 and K4M100 as the example. Here K1 represents a 4 bits combination; K2~K4 represents a combination of 8, 12 and 16 bits respectively.

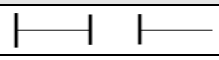
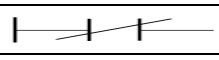
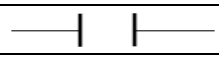
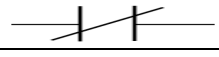
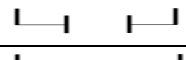
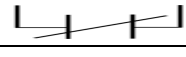
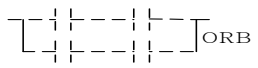
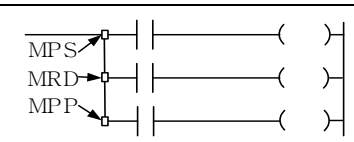
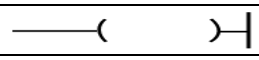
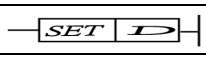
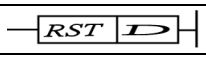
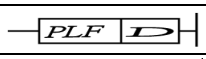
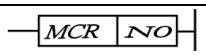
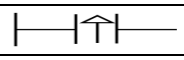
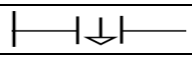
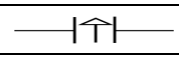
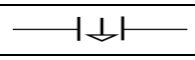
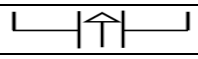
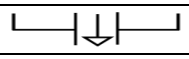
- Constant F

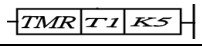
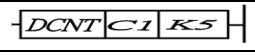
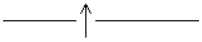
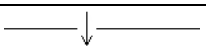
  Operand in application command, e.g.【FADD F12.3 F0 D0】. (F represents a floating point constant.)

2.4 Command List

Followings are the commands provided by HMC controller.

Basic Command

Type	Code	Symbol
Contact command	LD	
	LDI	
	AND	
	ANI	
	OR	
	ORI	
Combine command	ANB	
	ORB	
	MPS	
	MRD	
	MPP	
Output command	OUT	
	SET	
	RST	
	PLS	
	PLF	
Main control command	MC	
	MCR	
Rising and falling edge detection	LDP	
	LDF	
	ANDP	
	ANDF	
	ORP	
	ORF	

Type	Code	Symbol
Timing	TMR	
Counting	CNT	
	DCNT	
Program end	END	
Timing program end	IRET	
Subroutine end	SRET	
Invert phase	INV	
Rising edge	NP	
Falling edge	PN	
No operation	NOP	

Application Command

Type	API	Command code		Function	STEPS	Page
		16-bit	32-bit			
Data compare	001	LD※	DLD※	Contact type compare	5	
	002	AND※	DAND※	Contact type compare	5	
	003	OR※	DOR※	Contact type compare	5	
Data transfer and compare	004	MOV	DMOV	Data move	5	
	005	BMOV	-	All sending	11	
	006	CML	DCML	Invert sending	5	
	007	BCD	DNCD	BIN→BCD convert	5	
	008	BIN	DBIN	BCD→BIN convert	5	
	009	-	FCMP	Floating point compare	7	
	050	FMOV	DFMOV	Assign all	11	
I/O	010	REF	-	I/O update	2	
Rotate and shift	011	ROR	DROR	Right rotate	3	
	012	ROL	DROL	Left rotate	3	
Loop control	013	CJ	-	Conditional jump	2	
	014	CALL	-	Call subroutines	2	
	015	LAUNCH	-	Activate motion program	2	
	016	FOR	-	Nest loops start	3	
	017	NEXT	-	Nest loops end	1	
Arithmetic computing command	018	ADD	DADD	BIN addition	7	
	019	SUB	DSUB	BIN subtraction	7	
	020	MUL	DMUL	BIN multiplication	7	
	021	DIV	DDIV	BIN division	7	
	022	INC	DINC	BIN add one	3	
	023	DEC	DDEC	BIN minus one	3	
Logic computing command	024	WAND	DWAND	AND operation	7	
	025	WOR	DWOR	OR operation	7	
	026	WXOR	DWXOR	XOR operation	7	
	027	NEG	DNEG	Two’s complement	3	
Floating points computing and convert	028	-	FADD	Floating point number addition	7	
	029	-	FSUB	Floating point number subtraction	7	
	030	-	FMUL	Floating point number multiplication	7	

	031	-	FDIV	Floating point number division	7	
	032	-	FINT	Floating point → Integer	5	
	033	-	FDOT	Integer → Floating point	5	
	034		FRAD	Degree → Radian	5	
	035		FDEG	Radian → Degree	5	
	036		FSIN	Floating point SIN operation	5	
	037		FCOS	Floating point COS operation	5	
	038		FTAN	Floating point TAN operation	5	
	039		FASIN	Floating point ASIN operation	5	
	040		FACOS	Floating point ACOS operation	5	
	041		FATAN	Floating point ATAN operation	5	
	042		FSQR	Floating point square root operation	5	
Data processing command	043	ZRST	-	Zone reset	4	
	044	DECO	-	Decoder	11	
	045	ENCO	-	Encoder	11	
	046	BON	DBON	Bit ON detect	5	
	047	ALT	-	ON/OFF alternation	2	
Others	048	RSVP	-	Read parameters from servo drive	13	
	049	WSVP	-	Write parameters to servo drive	13	
	051	CKFZ		Forbidden zone check	5	

Chapter 3 Special Devices

3.1 List of Special Devices

There are two types of special devices, special relay(R) and special register(W). For controller system and servo motion control, it can be classified as PLC system and motion mode. System's motion control and monitoring function can be realized by special devices of HMC. Please note that the command of block move (e.g. BMOV command) cannot be executed by special devices.

Type	Range
PLC special relay	R0 ~ R511
Special relay in motion mode	R512 ~ R1535
PLC special register	W0 ~ W511
Special register in motion mode	W512 ~ W4095

3.2 PLC Special Relay

This special relay can be used to acquire the system's current status, including the calculating result, error monitoring, the connection of peripheral devices, key trigger and etc.

Type	No.	Function	Description	Attribute	Latched
Operation flag	R0	Normally close contact	B contact	R	No
	R1	Normally open contact	A contact	R	No
	R4	Error flag	On means abnormal; Off means normal	R/W	Yes
	R7	Motion control reset	On means reset, and will be clear automatically	R/W	No
	R8	Zero flag	On means the calculation is 0.	R	No
	R9	Borrow flag	On: the computing result is to borrow.	R	No
	R10	Carry flag	On: the computing result is to carry	R	No
	R13	Speed up data exchange	On means activate; Off means deactivate	R/W	No
	R14	Motion control ready	On means ready; Off means not ready	R	No
	R15	Motion control activate	On means activate; Off means deactivate	R/W	No
Flag of error types	R16	Remote IO error	On means it is unable to establish connection; Off means the connection is established.	R	No
	R17	DMCNet communication error	On means it is unable to establish connection; Off means the connection is established.	R	No
	R18	Grammar error	On means grammar error occurs during the operation, which needs to be cleared by users.	R/W	No

Type	No.	Function	Description	Attribute	Latched
	R19	Motion control error	On means motion control is abnormal; Off means normal.	R	No
	R20	Command error	On means command error occurs during the operation, which should be cleared by users.	R/W	No
	R22	Servo parameters synchronous error	On means vital servo parameters error occur and should be cleared by users.	R/W	No
Setting of 32-bit counting mode	R32	Setting of C200 counting mode	On = count down, Off = count up	R/W	Yes
	R33	Setting of C201 counting mode	On = count down, Off = count up	R/W	Yes
	~	~	~	~	~
	R86	Setting of C254 counting mode	On = count down, Off = count up	R/W	Yes
	R87	Setting of C255 counting mode	On = count down, Off = count up	R/W	Yes
Remote IO module connection status	R96	Connection status of station 0	On = online, Off = offline	R	No
	R97	Connection status of station 1	On = online, Off = offline	R	No
	~	~	~	~	~
	R126	Connection status of station 30	On = online, Off = offline	R	No
	R127	Connection status of station 31	On = online, Off = offline	R	No
PLC special flag	R139	EMS button status	On = press, Off = release	R	No
	R140	Limit switch status	On = press, Off = release	R	No

Type	No.	Function	Description	Attribute	Latched
	R144	Handwheel control switch	On = activate, Off = deactivate	R/W	No
Logging flag	R498	Disable logging	On = disable logging Off = enable logging (default)	R/W	No
	R499	Enable file output	On = enable file output Off = disable file output	R/W	No
	R500	Save the record in latch area	On = enable latch function Off = disable latch function	R/W	No
Others	R511	Pause PLC operation	On = Pause PLC operation Off = Resume PLC operation	R/W	No

- Normally close contact (R0)
  - Definition: The flag is constantly On during operation. It is called normally close contact (B contact / NC).

- Normally open contact (R1)
  - Definition: The flag is constantly Off during operation. It is called normally open contact (A contact / NC).

- Error flag (R4)
  - Definition: One of the error flags is activated, this flag will be On. It should be cleared by users after the alarm is relieved.
  - Related device: [Remote I/O error] (R16), [DMCNet communication error] (R17), [Grammar error](R18), [Motion control error](R19) or [Command error](R20) is activated so that this flag is ON.

- Motion control reset (R7)
  - Definition: Set this flag On to reset system motion control. After it is done, the flag will be Off automatically.

- Zero flag (R8)
  - Definition: After executing operational command, if the result is 0, this flag will be On.

- Borrow flag (R9)
  - Definition: After executing 16-bit operational command, if the result is less than -32,768 or the result of 32-bit operation is less than -2,147,483,648, then this flag is ON.

- Carry flag (R10)
  - Definition: After executing 16-bit operational command, if the result is more than 32,767 or the result of 32-bit operation is more than 2,147,483,647, then this flag is ON.

- Speed up data exchange (R13)
  - Definition: On means the speed up function is done, and the system will arrange more time to deal with the communication between PLC and HMI. Therefore, the display of servo status on HMI will be timelier and the data exchange between PLC and HMI will be more quickly. While turning off this flag, this function will be disabled.

- Motion control ready (R14)
  - Definition: Check if the node connection of DMCNet network is completed. On means the connection is done.

- Motion control activate (R15)
  - Definition: Check if the node underlying connection of DMCNet network is completed. On means the connection is completed. Set it to Off can reset the network.

- REMOTE IO error (R16)
  - Definition: Check if the connection of Remote IO connected to HMC is normal. On means the connection is in error.
  - Related device: The alarm code is shown in [Error Code of Remote IO](W16) when this flag is activated. This flag is off automatically when the connection is back to normal.

- DMCNet communication error (R17)
  - Definition: Check if the connection of DMCNet is normal. On means the connection is in error. This flag is off automatically when the connection is back to normal.
  - Related device: The alarm code is shown in [Error Code of DMCNet](W17) when this flag is activated.

- Grammar error (R18)
  - Definition: This flag is On when grammar error occurs during the command execution. Then, program scan is unable to carry on, jumps from the error occurred command and starts scan from the beginning. Users need to set this flag to off after the alarm is cleared.
  - Related device: The alarm code is shown in [Grammar error code](W18) when this flag is activated.

- Motion control error (R19)
  - Definition: On means the system's motion control is in error. [Motion Control Alarm Code] needs to be activated to clear the error.

- Command error (R20)
  - Definition: This flag is On when command error occurs during the operation. Program scan is unable to carry on. It will jump from the wrong command and start to scan from the beginning. Users need to set this flag to off after the alarm is cleared.
  - Related device: The alarm code is shown in [Command error code](W20) when this flag is activated.

- Servo parameters synchronous error (R22)
  - Definition: When DMCNet is connected, HMC will synchronous with servo parameters. When HMC changes values of main parameters, the synchronization will be done as well. However, when synchronization fails, this flag is activated and needs to be cleared manually. Meanwhile, [Servo parameters synchronous error code](W22) will be reset to 0.
  - Related device: The alarm code is shown in [Servo parameters synchronous error code] (W22) when this flag is activated.

- Setting of C200~C255 counting mode flag (R32~R87)
  - Definition: When flag is Off, the counter counts up while On means the counter counts down.

- REMOTE I/O connection status flag (R96~R127)
  - Definition: When flag is On, it means the connection is normal while Off means it is disconnected. R96 is the 1st station's connection status and R97 represents the second one and so on.

- EMS button status (R139)
  - Definition: When flag is On, it means the EMS button is pressed. Off means it is released.

- Limit switch status (R140)
  - Definition: When flag is On, it means the limit switch is in enabled status. Off means the switch is disabled.

- Handwheel control swtich (R144)
  - Definition: When flag is On, it means the current motion speed will be controlled by the handwheel. The flag can be activated anytime, before issuing the motion command or when the motion command is being processed. Off means to deactivate the handwheel control function and resume the original motion.
  - Related device: When this function is enabled, the motion speed will determine by [handwheel speed] (W80).

- Disable logging (R498)
  - Definition: When flag is On, it means the logging function is disabled. Off means logging function is enabled. When the function is activated, the system will continuously record the latest 50 servo commands and 50 servo statuses.
    User can acquire system's status through the function of [Review HMC command history].

- Enable file output (R499)
  - Definition: When flag is On, it means the system will output the record as HMI file (.des) every ten seconds. The record number is up to 20. When the flag is Off, it means this function is disabled.
    Through the setting from [System setting]➔[File management]➔[Copy files], Users can output these records to external device, such as USB or SD card. Then, open these files (.des) to know more about system's status from [Review HMC command history].

- Save the record in latch area (R500)
  - Definition: When flag is On, it means the current 50 servo commands and 50 current servo statuses will be saved in latch area. The system will be resumed after re-power on. Off means this function is disabled.
  - Users can acquire these records through [Device data table]. After exporting files (.dep), [Review HMC command history] can be used as the reference when looking up system's status.

- Pause PLC operation (R511)
  - Definition: When this flag is On, the system will pause PLC operation in order to accelerate the accessing process between HMI internal memory and PLC devices. When system completes the accessing process, users need to set this flag to Off to resume PLC's operation.

3.3 PLC Special Register

This special register can acquire system's status and the related settings, including the information of version and controller's system, alarm code, peripheral devices and etc.

Type	No.	Function	Description	Attribute	Latched
Information of controller system	W0	Module number	DW	R	No
	W2	DSP Firmware number	DW	R	No
	W4	Program format version	DW	R	No
	W7	Program size	Unit: Step	R	No
	W8	Address of execution error	DW, Unit: Step	R/W	No
	W10	The starting address of latched device M	Default value: 512. The setting value should be 16's multiple.	R/W	Yes
	W11	The size of latched device M	Default value: 512. The setting value should be 16's multiple.	R/W	Yes
	W12	The starting address of latched device D	Default value: 3000	R/W	Yes
	W13	The size of latched device D	Default value: 1000	R/W	Yes
	W14	Servo parameters synchronous error mode	Default value: 0	R/W	No

Type	No.	Function	Description	Attribute	Latched
Alarm code	W16	Remote I/O alarm code		R	No
	W17	DMCNet alarm code		R	No
	W18	Grammar error code		R	No
	W19	Motion control alarm code		R	No
	W20	Command error code		R	No
Remote IO module version number	W32	Module version number of station 0		R	No
	~	~	~	~	No
	W63	Module version number of station 31		R	No
Information of FPGA controller	W66	FPGA firmware version		R	No
	W67	FPGA PCB version		R	No
Others	W68	Time stamp	DW, Unit: 0.1 ms	R	No
	W72	Retry times of command issuing	Default value: 0	R/W	Yes
	W73	Retry times of servo parameter issuing	Default value: 0	R/W	Yes
	W74	Handwheel factor		R/W	Yes
	W75	DMCNet Mask	Command mask setting of each station in DMCNet. The default value is FFFF. It should be set to FCFF when using special ASDA-M 4-axis synchronizedservo drive.	R/W	Yes

Type	No.	Function	Description	Attribute	Latched
	W76	Handwheel counting	DW, pulse counter of outer type of handwheel	R/W	No
	W80	Handwheel speed	DW	R	No
	W82	Sampling rate of handwheel speed	Default: 10; Unit: 1 ms; Range: 10 ~ 65535	R/W	No
	W83	Smoothing constant of handwheel speed	Default: 10; Range: 1 ~ 100	R/W	No

- Module number (W0)
  - Definition: Controller's module number, which is in DW format.

- DSP firmware number (W2)
  - Definition: Controller's DSP firmware number, which is in DW format.

- CWP format version (W4)
  - Definition: Controller's program format version, which is in DW format.

- Program size (W7)
  - Definition: Step number in controller's program

- Address of execution error (W8)
  - Definition: When command execution error occurs, the step address of program error will be reported.
  - Related device: It occurs with [Grammar error](R18) or [Command error](R20).

- The starting address of latched device M (W10)
  - Definition: The setting of starting address of latched device M. Its setting value should be 16's multiple.

- The size of latched device M (W11)
  - Definition: The setting of the size of latched device M. Its setting value should be 16's multiple.

- The starting address of latched device D (W12)
  - Definition: The setting of starting address of latched device D.

- The size of latched device D (W13)
  - Definition: The setting of the size of latched device D.

- Servo parameters synchronous error mode (W14)
  - Definition: When servo parameters synchronous error occurs, [Servo parameters synchronous error](R22) will be On. And its address index will be shown in [Servo parameters synchronous error code](W22). Once this error occurs, the action dealing with this error status is according to its setting mode. Refer to the code below:

Code	Definition
00	No corrective action will be done. The system will only notify the users by flag [Servo parameters synchronous error](R22).
01	Before confirming the error (Flag of [Servo parameters synchronous error](R22) has to be manually cleared.), it is not allowed to proceed any operation, including jog and handwheel operation.
02	DMCNet communication will be reconnected until servo parameters are successfully synchronized with HMC. Then, [Co-Ld] will be shown on servo panel. Please note that when wrong HMC parameters' range leads to synchronous failure, users cannot change the parameters by screen element or OnLine Monitoring. It has to switch the mode back to 0 or 1 first so as to correct the value.

- REMOTE I/O error code (W16)
  - Definition: Communication error code of Remote I/O
    The error code:
    01: No Remote I/O device is detected
    03: Detect the disconnection of Remote I/O device
  - Related device: Activate with [Remote IO error](R16)

- DMCNet error code (W17)
  - Definition: Communication error code in DMCNet underlying network.
    The error code:
    01: unable to initialize DMCNet hardware
    02: unable to activate DMCNet hardware
    03: unable to initialize DMCNet connection
    04: underlying communication error on DMCNet
    05: error occurs when building connection among the devices via DMCNet.

07: During communication, disconnection occurs among the devices connected via DMCNet.

- Related device: Activate with [DMCNet communication error](R17).
  When the DMCNet error code is 7, please refer to the **Disconnection Flag** of each axis (R1184 ~R1195).

- Grammar error code (W18)
  - Definition: Grammar error code during operation.
  - The error code:

Code	Definition
05	FOR ~NEXT loop depth exceeds 5
06	CALL sub program depth exceeds 8
07	Floating point format is in error
10	The used device exceeds the range
11	RSVP, WSVP command execution error
12	The launched motion programs in queue that wait to be executed exceed 255

  - Related device: Activate with [Grammar error](R18)

- Motion control error code (W19)
  - Definition: Error occurs while processing motion control
    The error code:

Code	Definition
03	Serious motion control error occurs in the system, such as servo motor crash (AL. 30) or motor overspeed (AL. 918). When saving the record in latch area is enabled, this error will occur as well.
04	Error occurs when sending data to the servo
05	Error occurs when receiving data from the servo
09	Error occurs when processing motion command

  - Related device: Activate with [Motion control error](R19)

- Command error code (W20)
  - Definition: Command error code during operation.
    The error code:

Code	Definition
01	The conversion of BCD command exceeds 0~9,999 or the conversion of DBCD command exceeds 0~99,999,999.

Code	Definition
02	The devisor of DIV, DDI, FDIV command is 0
03	No bit is 1 in ENCO command source
04	The value exceeds 0~9 in BIN/DBIN command source
10	The source of FASIN command exceeds -1.0 ~ 1.0
11	The source of FACOS command exceeds -1.0 ~ 1.0

- Related device: Activate with [Command error](R20)

- Servo parameters synchronous error code (W22)
  - Definition: error code will be shown when servo parameters synchronization failed. See the following table for error code:

Code	Definition
1XXXX	When DMCNet communication is built at initial stage, HMC is failed to read parameters from the servo drive. XXXX represents the parameter index number that HMC is failed to access. For example, if the parameter that HMC is failed to read is W670, then the code will be 0670.
2XXXX	HMC is failed to write the parameter into the servo drive. Parameter write-in failure might result from the value exceeding the range. XXXX represents the parameter index number that HMC is failed to write in. For example, if the parameter that HMC is failed to write is W670, then the code will showbe 0670.

  - Related device: Activate with [Servo parameter synchronization error](R22). When this error flag is cleared, [Servo parameter synchronization error code] will be set to 0 as well.

- REMOTE IO module version (W32~W63)
  - Definition: Remote IO module version of each station

- FPGA firmware version (W66)
  - Definition: FPGA firmware version of HMC

- FPGA PCB version (W67)
  - Definition: FPGA PCB version number of HMC

- Time stamp (W68)
  - Definition: Time stamp of the system. Unit: 0.1ms; in DW format

- Retry times of command issuing (W72)
  - Definition: It is the setting of communication times when HMC issues command to servo. If the default value is 0, the system will issued each command twice to servo. Users could increase the time in order to enhance the communication quality. If the setting value is 3, then the command will be issued five times to servo.

- Retry times of servo parameter issuing (W73)
  - Definition: It is the setting of communication times when HMC writes the special relay with Remote attribute into servo. If the default value is 0, the system will writes into servo twice. User can increase the time in order to make sure the accuracy of writing parameters. If the setting value is 3, then the parameter will be written into servo for 5 times.

- Handwheel factor (W74)
  - Definition: The scaling setting of pulse received by handwheel and transferred to servo drive. Through this, handwheel pulse can be magnified in order to meet the requirement.

    For example, 100 pulses can be sent by operating the handwheel for a cycle. If the motor needs 1,280,000 pulses for running a cycle in ASDA-M, the scaling setting should be 12,800 (1,280,000 / 100 = 12,800). Then, if handwheel operates a cycle, the motor will run a cycle.
  - Related device: Flag is enabled means the axis is controlled by handwheel. It might be axis 1 (R608), axis 2 (R609), …, or axis 12(R619). It only can enable one axis each time. If more than one axis is enabled, the alarm occurs. Its scaling setting will influence the accumulated counting of [Handwheel counting](W76).

- DMCNet MASK (W75)
  - Definition: It is the mask setting when controller communicates with DMCNet's each station. With the general servo drive, the value should set to FFFF. However, the special framework should have different setting value, such as ASDA-M which supports 4-axis synchronized servo drive. The value should be set to FCFF to enable the operation.

- Handwheel counting (W76)
  - Definition: It is the accumulated counting value which magnified the pulse number received by handwheel and then transferred to the servo drive.
  - Related device: When the handwheel magnified the received pulse number through [Handwheel factor](W74), [Handwheel factor](W76) will accumulate the magnification value.

- Handwheel speed (W80)
  - Definition: When the handwheel control function is activated, servo motion speed will be controlled by handwheel speed.
  - Related device: After receiving the pulse from handwheel, HMC will magnify the pulse counting via [Handwheel factor] (W74). Then, start sampling according to [Sampling rate of handwheel speed] (W82). Referring to [Smoothing constant of handwheel speed] (W82) and acquire the result of [Handwheel speed] (W80).

- Sampling rate of handwheel speed (W82)
  - Definition: The setting value will determine the pulse counting sampling cycle. The smaller setting value it has, the more sensitive by the handwheel rotating, but sometimes it will occur the zero speed phenomenon
  - Related device: After receiving the pulse from handwheel, HMC will magnify the pulse counting via [Handwheel factor] (W74). Then, start sampling according to [Sampling rate of handwheel speed] (W82). Referring to [Smoothing constant of handwheel speed] (W82) and acquire the result of [Handwheel speed] (W80).

- Smoothing constant of handwheel speed (W83)
  - Definition: The setting value determines the smoothing level when it is controlled by handwheel. Bigger setting value brings smoother motion.
  - Related device: After receiving the pulse from handwheel, HMC will magnify the pulse counting via [Handwheel factor] (W74). Then, start sampling according to [Sampling rate of handwheel speed] (W82). Referring to [Smoothing constant of handwheel speed] (W82) and acquire the result of [Handwheel speed] (W80).

3.4 Special Relay in Motion Mode

HMC controls servo for 12 axes at most in DMCNet. The corresponding axis of each axis is as the following:

Function	Corresponding address							
	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	~	Axis 12
Control by Servo axis								
Command start	R512	R513	R514	R515	R516	R517		R523
Quick stop	R528	R529	R530	R531	R532	R533		R539
Forward Jog	R544	R545	R546	R547	R548	R549		R555
Reverse Jog	R560	R561	R562	R563	R564	R565		R571
Servo On	R576	R577	R578	R579	R580	R581		R587
Fault Reset	R592	R593	R594	R595	R596	R597		R603
Handwheel activate	R608	R609	R610	R611	R612	R613		R619
Command load	R624	R625	R626	R627	R628	R629		R635
Command cancel	R640	R641	R642	R643	R644	R645		R651
Feed rate execution	R656	R657	R658	R659	R660	R661		R667
Pause	R672	R673	R674	R675	R676	R677		R683
Servo axis								
Command error	R1024	R1025	R1026	R1027	R1028	R1029		R1035
Command ready	R1040	R1041	R1042	R1043	R1044	R1045		R1051
Command complete	R1056	R1057	R1058	R1059	R1060	R1061		R1067
Servo ON	R1072	R1073	R1074	R1075	R1076	R1077		R1083
Servo quick stop release	R1088	R1089	R1090	R1091	R1092	R1093		R1099
Servo Fault	R1104	R1105	R1106	R1107	R1108	R1109		R1115
Servo Warning	R1120	R1121	R1122	R1123	R1124	R1125		R1131
Servo ready	R1136	R1137	R1138	R1139	R1140	R1141		R1147

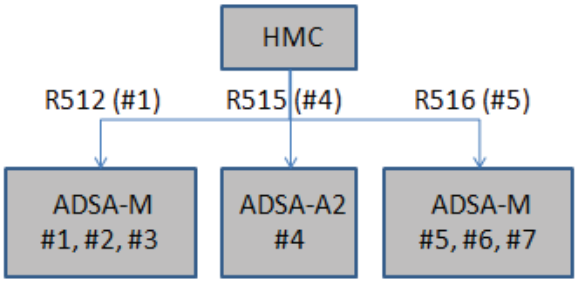
Disconnection flag	R1184	R1185	R1186	R1187	R1188	R1189	~	R1195

3.4.1 Relay Control in Motion Mode

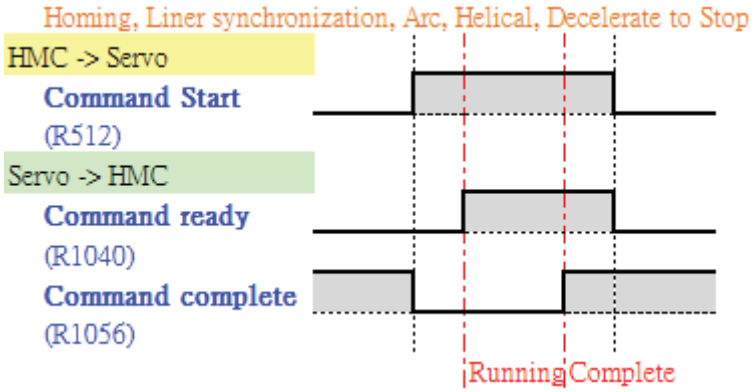
The list below is about the relay control in motion mode. These could accomplish the function to activate motion or clear the flag error. Take axis 1 as the example:

Function	No.	Description	Attribute	Latched
Command start	R512	On is starting motion command execution	R/W	No
Quick stop	R528	On means servo quick stops while Off means to release quick stop	R/W	No
Forward Jog	R544	On is for activating JOG in forward direction. Off is to release	R/W	No
Reverse Jog	R560	On is for activating JOG in reverse direction. Off is to release.	R/W	No
Servo On	R576	On means Servo On while Off means Servo Off	R/W	No
Fault Reset	R592	On means to clear the servo error	R/W	No
Handwheel activate	R608	On is to enable handwheel while Off means to disable it.	R/W	No
Command preload	R624	On is to load in the continuous motion command and starts to execute.	R/W	No
Command cancel	R640	On is for cancelling the continuous motion command.	R/W	No
Feed Rate execution	R656	On means to change the speed during operation. It turns Off after the command is completed automatically.	R/W	No
Pause	R672	On means pause; Off means resume	R/W	No

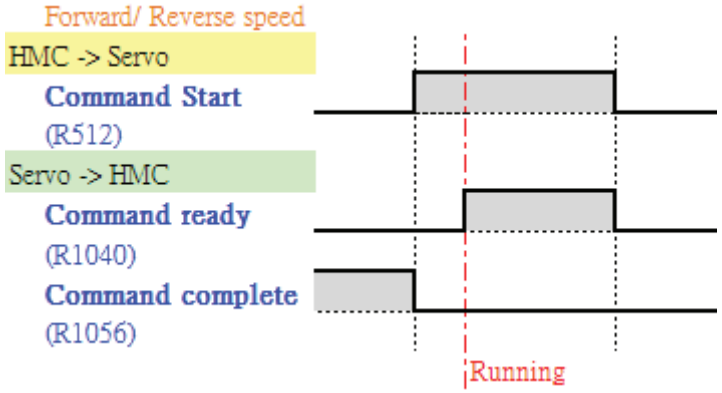
- Command start (R512)
  - Definition: When the flag is On. HMC starts to write the related parameters into servo and starts to execute the motion command. When HMC controls more than one servo drives, it only needs to issue the command to the very first one. For instance, if HMC controls a 5-axis servo drive, axis 1, 2, 3, 4 and 5, when the drive is executing 5-axis linear synchronized motion, issue the command to axis 1 and trigger the command will do. Trigger [Command start](R512) of axis 1 to On and sets up [Command selection] (Set W513 to 31. If Bit0 is On in W513, it means axis 1 should be activated, Bit1 On represents axis 2 and so on and so forth) to determine the related motion axis.
    If desire to execute 3-axis linear synchronized motion of axis 2, 3, and 4. Issue the command to axis 2 will do. Trigger [Command start](R513) of axis 2 to On and set up [Command selection] can be done. (Set W769 to 7. Bit0 On means axis 2 should be activated, Bit1 On represents axis 3 and, Bit3 On represent s the fourth axis).
    Apart from linear motion of multi-axis, if desire to execute the arc or helical motion, issuing the command to the first axis of ASDA-M will do.
    In the following framework, HMC can only enable [Command start](R512) of axis 1 to execute arc or helical motion of axis 1, 2, and 3. Activate [Command start](R516) of axis 5 to execute arc or helical motion of axis 5, 6, and 7.



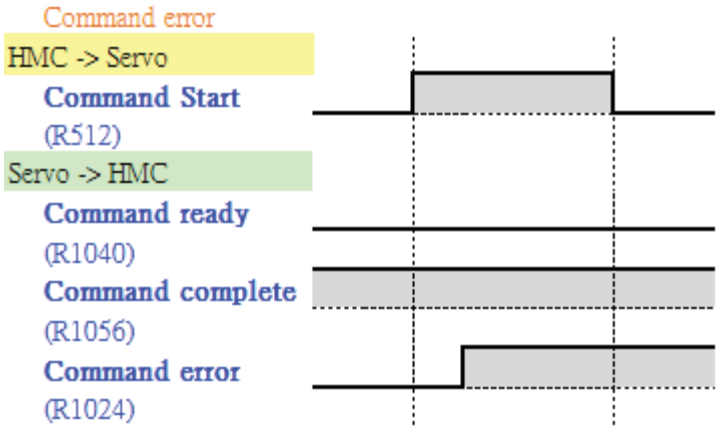
  - Related device: Flag of [Command complete] will have different status in different motion type. It is suggested to use handshaking method for program procedure control and to accomplish command issuing.
    Take axis 1 as the example, in homing, linear and jog motion, before activate the command, users should write in the motion command and its correct corresponding parameters. When the setting of [Command code](W512), [Command selection](W513), [Speed setting](W518), [Target position](W520) is correctly completed, activate [Command start](R512). If the command has been written into the servo, the status of [Command ready](R1040) is On. Then, execute the motion command. When [Command complete](R1056) turns On, it means the motion command is completed.



In speed command, when issuing [Command start], [Command ready] is On, which means the command is issued to the servo drive and executed. However, it will not turn On [Command complete] when the servo drive executes the speed command. There is no need to wait flag, [Command complete]. It is suggested to use handshaking method for program procedure control and to accomplish command issuing.



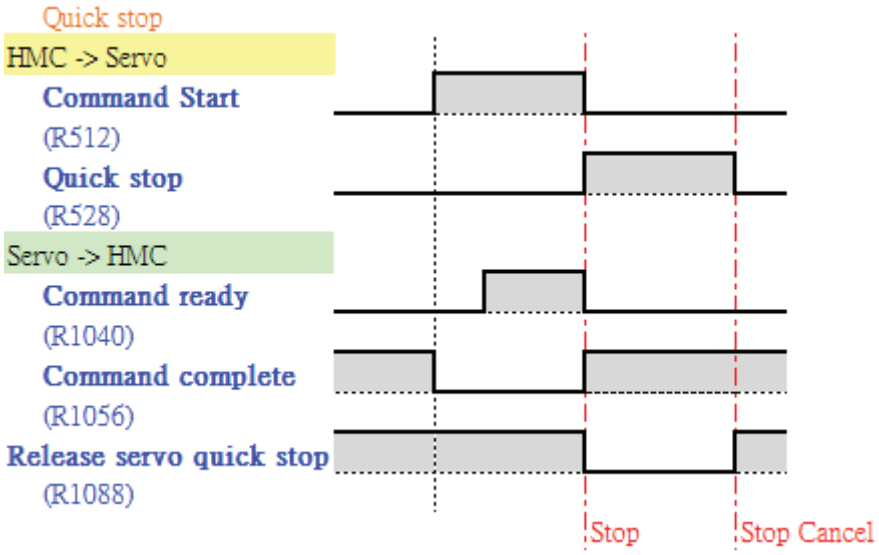
When issuing the command is in error or servo status error, which is unable to accept the command, [Command start](R512) will be failed to trigger motion and [Command error] turns On.



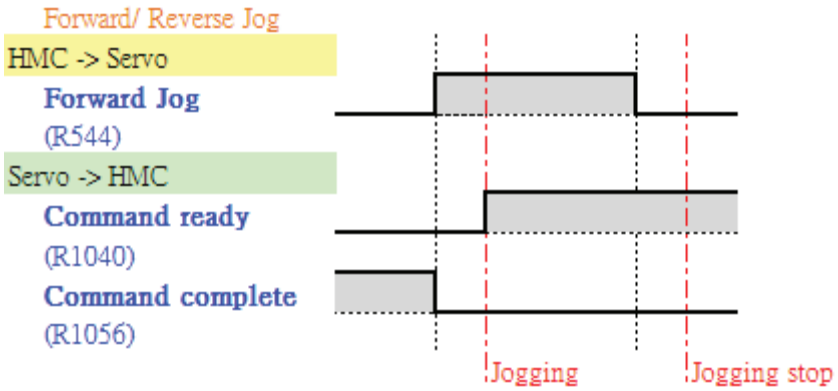
- Error: The following situations might result in [Command error] after activating [Command start]. The corresponding error code will display in [Error code] (W576 ...) of each axis.

Code	Definition
01	The speed is set to 0 or becomes 0 after transferring by E-gear ratio.
02	Axis of issuing command is in emergency stop status
03	Axis of issuing command is in Servo Off status
04	Command is executing and is unable to receive the new one.
05	Trigger the wrong command selection
06	Command parameter error
07	Command code error
08	Exceed the largest amount of continuous command when issuing continuous command
09	Issue continuous command time out
10	Command code cannot be used in continuous motion
11	Wrong [Speed command] setting
12	Pause time of multi-axis synchronous control is too long
13	Pause time of multi-axis synchronous control is 0
14	Motion mode switch error
15	Fail to update servo parameters
16	Servo parameter synchronization error
17	Incorrect distance given in the continuous commands

- Quick stop (R528)
  - Definition: Flag [Quick stop] turns On. If the axis is in operation, it will stop the motion and then, stop urgently.
  - Related device: Take axis 1 as the example, when [Quick stop](R528) is activated, if the servo is in operation, it will execute emergency stop according to [Quick Stop deceleration time](W670). Then, status of [Servo quick stop release](R1088) is Off, which means the axis is in the status of Quick stop. When [Quick stop](R528) is Off, status of [Servo quick stop release](R1088) will be On, which means the axis is not in quick stop status.

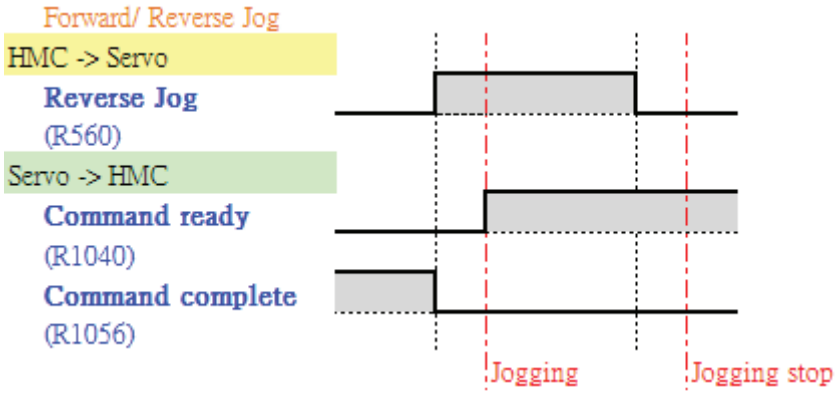


- Forward Jog (R544)
  - Definition: Flag [Forward Jog] is On. This axis is executing Jog in forward direction and will stop when the flag turns Off.
  - Related device: Take axis 1 as the example, when [Forward Jog] (R544) turns On, it will accelerate to the speed of [Jog speed](W678) according to the curve of [Jog acceleration time](W680). Then, it will remain at constant speed in forward direction according to [Jog speed](W678). When [Forward Jog](R544) is Off, the axis will decelerate to stop according to the curve of [Jog deceleration time](W681). In addition, set up [Jog torque limit](W682) can accomplish the torque protection function of Jog.



  - Error: The following situation might result in no action after enabling the flag.
    A. Servo is not in Servo On status.
    B. Jog speed (W678) exceeds the setting of maximum speed limit (W660).
    C. Servo is in Quick Stop status.
    D. Handwheel function is activated.
    E. Jog speed (W678) is set to 0.

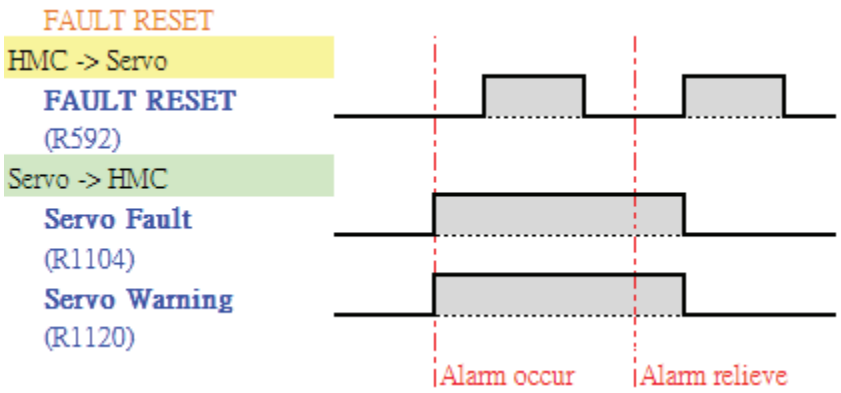
- Reverse Jog (R560)
  - Definition: Flag [Reverse Jog] is On. This axis is executing Jog in reverse direction and will stop when the flag turns Off.
  - Related device: Take axis 1 as the example, when [Reverse Jog] (R560) turns On, it will accelerate to the speed of [Jog speed](W678) according to the curve of [Jog acceleration time](W680). Then, it will remain at constant speed in reverse direction according to [Jog speed](W678). When [Reverse Jog](R560) is Off, the axis will decelerate to stop according to the curve of [Jog deceleration time](W681). In addition, set up [Jog torque limit](W682) can accomplish the torque protection function of Jog.



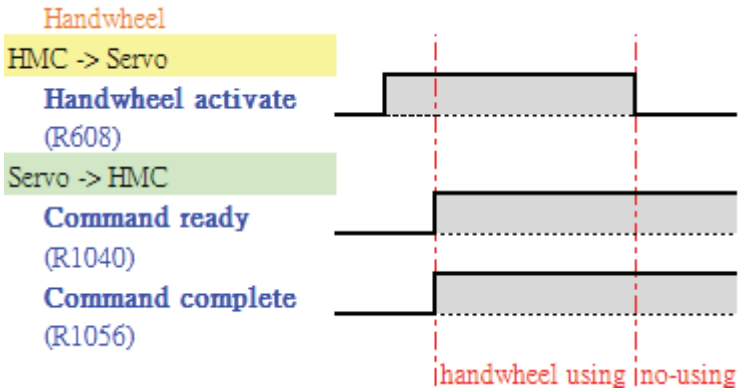
  - Error: The following situation might result in no action of servo after enabling the flag.
    A. Servo is not in Servo On status.
    B. Jog speed (W678) exceeds the setting of maximum speed limit (W660).
    C. Servo is in Quick Stop status.
    D. Handwheel function is activated.
    E. Jog speed (W678) is set to 0.

- SERVO ON (R576)
  - Definition: Set flag [Servo On] to On. This axis is Servo On. If the flag is set to Off, then it is Servo Off.
  - Related device: Take axis 1 as the example, when flag [Servo On](R576) is On, this axis will be Servo On. Status in [Servo On](R1072) will be On. If flag [Servo On](R576) is Off, then the axis will be Servo Off and display Off status in [Servo On](R1072).
  - Error: The following situation might result in no action of servo after enabling the flag.
    A. DMCNet connection error. Check if it is DMCNet communication error (R17) or motion control error (R19).

- FAULT RESET (R592)
  - Definition: When servo axis is in error, this flag is On and enables the servo to clear the error. Users have to self turn the flag Off.



- Handwheel activate (R608)
  - Definition: Turn On the flag to activate the handwheel. Only one axis of handwheel can be activated at a time. Activate multi-axis of handwheel will cause command error.
  - Related device: After enabling handwheel function, the controller will multiply the pulse number which sent by handwheel according to [Handwheel factor](W74), then issue operation command to the servo. Its target position will be limited between [Reverse software limit of handweel] (W690) and [Forward software limit of handweel] (W692).



  - Error: The following situation might result in no action of servo after enabling the flag.
    A. Servo is not in Servo On status.
    B. Handwheel function from other axis had been activated.

- Command load (R624)
  - Definition: [Command load] is the flag for loading in continuous motion commands and execution. It turns On the flag [Command load], and HMC starts to write related parameters into servo (preload command). When the write-in is completed,

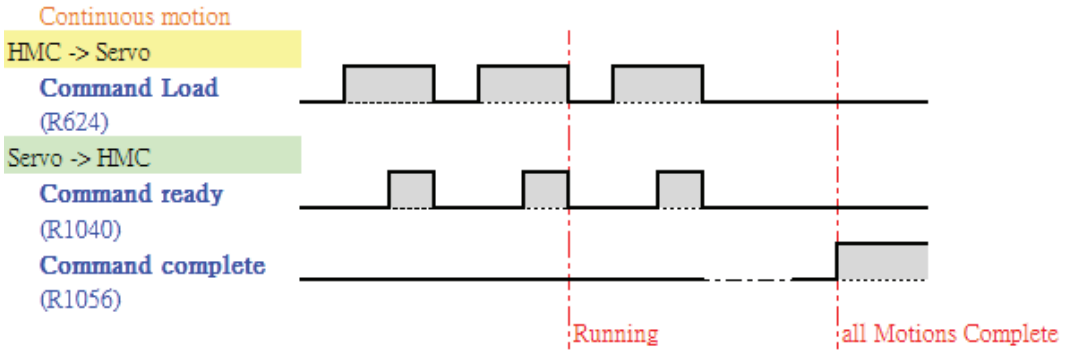
HMC starts to execute continuous motion commands. Before the current command has been completed (At least two are executing), other motion command still can be loaded in. These commands will be wrote into the servo continuously and then executed in order so as to accomplish the so-called continuous motion commands.

Multi-axis linear or arc motion can be issued to continuous commands, only by writing into different command code and parameters will do. Also, through the setting of [Overlap], function of PR overlap can be enabled. When two PR are executed overlap, the motion can be completed quickly and smoothly.

The way of issuing each section of continuous motion command is the same as the single one. The difference is that single command should trigger [Command start](R512) and wait until [Command complete](R1056) is done so it can execute the next command. As for continuous command, triggering [Command load](R624) can issue and execute the command. After enabling [Command load], wait till [Command ready](R1040) is On, which means the command had been successfully loaded into the servo. And then, users can issue the next command. When all issued commands are completed, [Command complete](R1056) turns On.

Please note that for continuous command, when the last one is executed, the new command cannot be loaded in.

- Related device: Take axis 1 as the example, when issuing continuous commands, please write in commands and parameters first, such as [Command code](W512), [Command selection](W513), [Speed setting](W518), [Target position](W520) and [Parameter start address](W525). Then, trigger [Command load](R624) in order to write parameters into the servo. When the status of [Command ready](R1040) is On, it means the command has been successfully written into the servo. When the second command is loaded in, the system will start to execute the motion. Before the last command has been executed, users can load in new command continuously. These load-in commands will be executed in order. [Command complete](R1056) turns On when all load-in commands are completed. The relevant Handshaking procedure is as the following:



HMC can preload 8 motion commands at most. Through [PR surplus](W594), users could acquire the remained number of commands which has been preloaded into the servo. When the number reached the limit ([PR surplus](W594) equals 8), users will not be able to issue new [Command load]. Flag of [Command ready] will not be On, which means the new motion command will be unable to write into the servo. Some current PR have to be completed, which means [PR surplus](W594) should less than 8 so that the system could trigger new [Command load] and write into the servo.

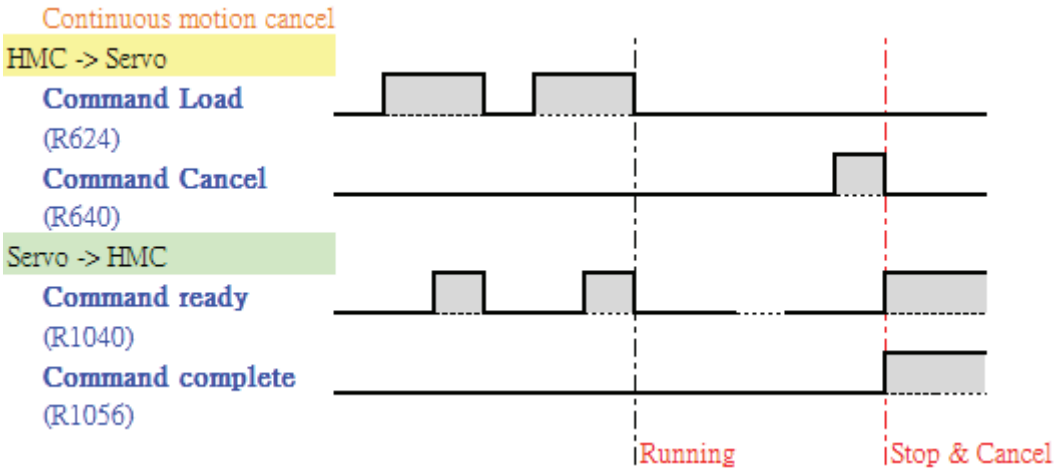
When the continuous command is being executed, if that is the last one (W594 = 1), then it could not receive new preload command. Users should wait until the current command is completed or stopped. If preload the wrong command, the preload command is failed and will not be wrote into the servo.

- Error: When command is given incorrectly, Error code will be displayed along with its definition. Please refer to the table below for more details:

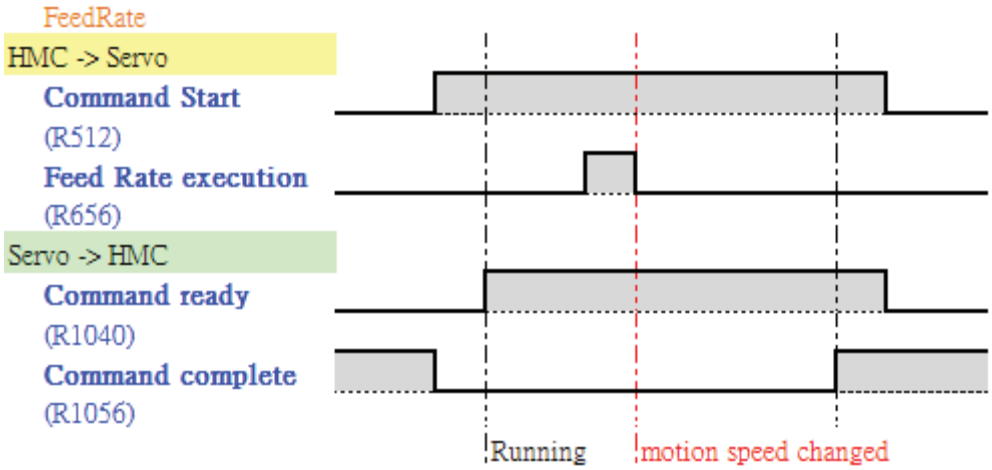
Code	Definition
01	The speed is set to 0 or becomes 0 after transferring by E-gear ratio.
02	Axis of issuing command is in emergency stop status
03	Axis of issuing command is in Servo Off status
04	Command is executing and is unable to receive the new one.
05	Trigger the wrong command selection
06	Command parameter error
07	Command code error
08	Exceed the largest amount of continuous command when issuing continuous command
09	Issue continuous command time out
10	Command code cannot be used in continuous motion
11	Wrong [Speed command]setting
12	Pause time of multi-axis synchronous control is too long
13	Pause time of multi-axis synchronous control is 0
14	Motion mode switch error
15	Fail to update servo parameters
16	Servo parameter synchronization error

Code	Definition
17	Incorrect distance given in the continuous commands

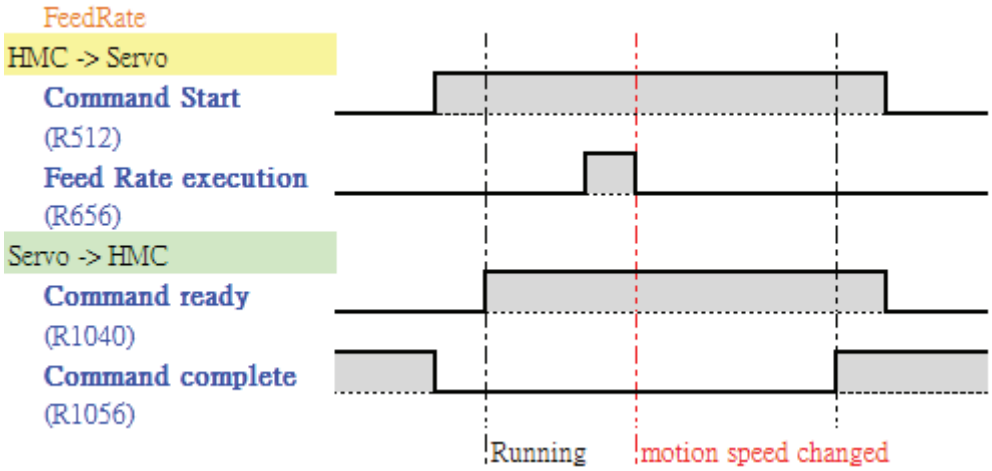
- Command cancel (R640)
  - Definition: When executing continuous commands, after triggering [Command cancel](R640), all preloaded continuous commands will be canceled and stop executing.
  - Related device: Take axis 1 as the example, when executing continuous commands, if [Command cancel]is On, command executing will stop and end the continuous commands. Then, [Command ready](R1040) and [Command complete](R1056) will be On. The relevant handshaking procedure is as the following:



- FEED RATE execution (R656)
  - Definition: During command execution, after triggering [Feed Rate execution], the setting of [Feed Rate speed], [Feed Rate acceleration time] and [Feed Rate deceleration time] will be changed. When the related commands of Feed Rate are executed, this flag will return to Off automatically.
    In continuous motions, change the Feed Rate will only change the current motion. Before the current command is completed, it will execute the command according to the original setting speed. That is to say, change the feed rate is only effective to the current motion command.
  - Related device: Take axis 1 as the example, if [Feed Rate execution](R656) is On, the motion speed will be changed to [Feed Rate speed](W684), the acceleration time will be changed to [Feed Rate acceleration time](W686) and the deceleration time will be [Feed Rate deceleration time](W687). After the change is completed, flag [Feed Rate execution](R656) is Off automatically. Meanwhile, this will not influence the time sequence of command issuing.



- Pause (R672)
  - Definition: Set [Pause] to On during operation, the current action will stop. Set it to Off when the operation stops so that it will resume the original operation.



3.4.2 Status Relay in Motion Mode

Status relay in motion mode indicates servo's current alarm and function. The following is described in axis 1.

Function	No.	Description	Attribute	Latched
Command error	R1024	On means it is in error when issuing command. Users should self clear the error.	R/W	No
Command ready	R1040	On means the command has been issued to the servo.	R	No
Command complete	R1056	On means the servo has completed the command.	R	No
Servo ON	R1072	On means it is in Servo On status.	R	No
Servo quick stop release	R1088	On means servo quick stop has been released. Off means the servo is in quick stop status.	R	No
Servo Fault	R1104	On means servo error occurs	R	No
Servo Warning	R1120	On means servo alarm warning occurs	R	No
Servo ready	R1136	On means the connection between DMCNet and servo drive is established.	R	No

- Command error (R1024)
  - Definition: When issuing command to the servo, if parameter or servo status is in error and results in invalid command, this flag is On. As long as the flag is On, users have to set it back to Off. This flag only shows the command error that had ever occurred, if the error is not cleared, it will not influence the next command.
  - Related device: Take axis 1 as the example, when issuing [Command start](R512) or [Command load](R624), if command error occurs, [Command error](R1024) is On. And [Error code](W576) will show the reason of error occurs. The error code is as the followings:

Code	Definition
01	The speed is set to 0 or becomes 0 after transferring by E-gear ratio.
02	Axis of issuing command is in emergency stop status

Code	Definition
03	Axis of issuing command is in Servo Off status
04	Command is executing and is unable to receive the new one.
05	Trigger the wrong command selection
06	Command parameter error
07	Command code error
08	Exceed the largest amount of continuous command when issuing continuous command
09	Issue continuous command time out
10	Command code cannot be used in continuous motion
11	Wrong [Speed command]setting
12	Pause time of multi-axis synchronous control is too long
13	Pause time of multi-axis synchronous control is 0
14	Motion mode switch error
15	Fail to update servo parameters
16	Servo parameter synchronization error
17	Incorrect distance given in the continuous commands

- Command ready (R1040)
  - Definition: When issuing command to the servo, controller will write parameters into the corresponding servo drive through DMCNet. After that, flag of [Command ready] is On.

    If command error occurs, it means the command issuing is failed. Then, flag of [Command ready] will not On. [Command ready]is the vital one to issue the command.
  - Related device: Take axis 1 as the example, when [Command start](R512) is On, [Command ready](R1040)] is Off automatically. When [Command start](R512) is Off, [Command ready](R1040) is Off, too. Please refer to [Command start] in [Control relay in motion mode] for detailed time sequence description.

- Command complete (R1056)
  - Definition: After issuing the command to servo drive, [Command complete] will be Off first. When the command is completed, [Command complete] will be On.

Related device: Take axis 1 as the example, when [Command start](R512) is set to On, [Command complete](R1056) of axis 1 is Off automatically. Please refer to [Command start] in [Control relay in motion mode] for detailed time sequence description.

- Servo ON (R1072)
  - Definition: It represents the servo drive's status. When this flag is On, it means the axis is in Servo On status. When this flag is Off, it means the axis is Servo Off.
  - Related device: Take axis 1 as the example, when [Servo On](R576) is On, it means Servo On is activated. When the status of servo axis 1 becomes Servo On, [Servo ON](R1072) will be On.

- Servo quick stop release (R1088)
  - Definition: See if servo axis is in quick stop status. If this flag is On, it means Quick Stop status has been released and can receive motion command. However, if this flag is Off, it means this axis is still in Quick Stop status and cannot receive motion command.
  - Related device: Take axis 1 as the example, if [Quick stop](R528) is On, it means HMC issues quick stop command to the servo. When servo is in quick stop status, flag of [Servo quick stop release](R1088) is Off.
    Set [Quick stop](R528) to Off, means HMC issues quick stop released command to the servo. If it is released successfully, flag of [Servo quick stop release](R1088) is On.
    In addition, if [DI Function Planning] of ASDA Servo parameter is set to Emergency stop (EMGS), DI signal will control the servo to be in quick stop status and HMC will lose its control.

- Servo fault (R1104)
  - Definition: This flag will be On if an alarm occurs in servo axis. After being cleared, this flag is Off.
  - Related device: Take axis 1 as the example, [Servo alarm code](W585) can show the alarm content of servo axis. [Fault Reset](R592) (Set to On) can be used to clear the alarm and reset the servo.

- Servo warning (R1120)
  - Definition: When a warning occurs, this flag is On. When the warning is cleared, then this flag is Off.

- Related device: Take axis 1 as the example, [Servo alarm code](W585) can show the content of servo warning and [Fault Reset](R592) (Set to On) can be used to clear the alarm and reset the servo.

- Servo ready (R1136)
  - Definition: When DMCNet connection between HMC and the servo is completed, the corresponding servo axis will set this flag to On, which means successful connection.
  -
- Disconnection flag (R1184)
  - Definition: When the DMCNet connection has been built between HMC and servo drive, the disconnection flag status indicates the connection status. On indicates connection is in normal status, and Off means abnormal disconnection.
  - Users can rebuild DMCNet connection through the function of Motion control activate (R15).

3.5 Special Register in Motion Mode

Latched, readable (R) and writable (W) are included in the attribute of [Special register in motion mode]. When the attribute of [Latched] and [Remote] are both in special register, its parameters' setting value will be written into the servo drive when DMCNet connection between HMC and servo drive is successfully built.

Take [Electronic gear ratio (Numerator/Denominator)]as the example, when HMC successfully connects to servo drive, the setting value of [Electronic gear ratio (Numerator)](W640) and [Electronic gear ratio (Denominator)](W642) will be wrote into P1-44 (GR1) and P1-45 (GR2) of the servo drive. Thus, through the parameter setting, HMC could keep the consistency of the system's parameters.

HMC can control 12 axes of servo axis at most. Its function and corresponding address of DMCNet each axis are as the followings:

Function	Corresponding address							
	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	~	Axis 12
Command								
Command code	W512	W768	W1024	W1280	W1536	W1792		W3328
Command selection	W513	W769	W1025	W1281	W1537	W1793		W3329
Command mode	W514	W770	W1026	W1282	W1538	W1794		W3330
Delay time	W515	W771	W1027	W1283	W1539	W1795		W3331
Acceleration time	W516	W772	W1028	W1284	W1540	W1796		W3332
Deceleration time	W517	W773	W1029	W1285	W1541	W1797		W3333
Speed setting (DW)	W518	W774	W1030	W1286	W1542	W1798		W3334
Target position (DW)	W520	W776	W1032	W1288	W1544	W1800		W3336
Speed proportion	W522	W778	W1034	W1290	W1546	W1802		W3338
Parameter start address	W524	W780	W1036	W1292	W1548	W1804		W3340
Overlap	W525	W781	W1037	W1293	W1549	W1805		W3341
Speed option	W526	W782	W1038	W1294	W1550	W1806		W3342
Range of position completed	W528	W784	W1040	W1296	W1552	W1808	~	W3344

Status								
Error code	W576	W832	W1088	W1344	W1600	W1856		W3392
Current position (DW)	W578	W834	W1090	W1346	W1602	W1858		W3394
Average torque (DW)	W580	W836	W1092	W1348	W1604	W1860		W3396
Current speed (DW)	W582	W838	W1094	W1350	W1606	W1862		W3398
Servo alarm code	W585	W841	W1097	W1353	W1609	W1865		W3401
Monitoring item 1(DW)	W586	W842	W1098	W1354	W1610	W1866		W3402
Monitoring item 2 (DW)	W588	W844	W1100	W1356	W1612	W1868		W3404
Monitoring item 3 (DW)	W590	W846	W1102	W1358	W1614	W1870		W3406
Monitoring item 4 (DW)	W592	W848	W1104	W1360	W1616	W1872		W3408
Motion surplus	W594	W850	W1106	W1362	W1618	W1874		W3410
DMCNet communication A error rate	W596	W852	W1108	W1364	W1620	W1876		W3412
DMCNet communication B error rate	W598	W854	W1110	W1366	W1622	W1878		W3414
Rapid monitoring item	W600	W856	W1112	W1368	W1624	W1880		W3416
Current speed	W602	W858	W114	W1370	W166	W1882		W3418
Motion parameter								
Electronic gear ratio (Numerator) (DW)	W640	W896	W1152	W1408	W1664	W1920		W3456
Electronic gear ratio (Denominator) (DW)	W642	W898	W1154	W1410	W1666	W1922		W3458
Unit display	W644	W900	W1156	W1412	W1668	W1924		W3460
Acc. / Dec. curve	W645	W901	W1157	W1413	W1669	W1925		W3461
Acceleration time	W646	W902	W1158	W1414	W1670	W1926		W3462
Deceleration time	W647	W903	W1159	W1415	W1671	W1927		W3463
Homing speed 1(DW)	W648	W904	W1160	W1416	W1672	W1928		W3464

Homing speed 2(DW)	W650	W906	W1162	W1418	W1674	W1930		W3466
Homing mode	W652	W908	W1164	W1420	W1676	W1932		W3468
Homing acc. /dec. time	W653	W909	W1165	W1421	W1677	W1933		W3469
Homing offset value (DW)	W654	W910	W1166	W1422	W1678	W1934		W3470
Forward software limit (DW)	W656	W912	W1168	W1424	W1680	W1936		W3472
Reverse software limit (DW)	W658	W914	W1170	W1426	W1682	W1938		W3474
Maximum speed limit (DW)	W660	W916	W1172	W1428	W1684	W1940		W3476
Monitoring item index 1	W666	W922	W1178	W1434	W1690	W1946		W3482
Monitoring item index 2	W667	W923	W1179	W1435	W1691	W1947		W3483
Monitoring item index 3	W668	W924	W1180	W1436	W1692	W1948		W3484
Monitoring item index 4	W669	W925	W1181	W1437	W1693	W1949		W3485
Quick Stop deceleration time	W670	W926	W1182	W1438	W1694	W1950		W3486
Deceleration time of stop command	W671	W927	W1183	W1439	W1695	W1951		W3487
Deceleration time for communication error	W672	W928	W1184	W1440	W1696	W1952		W3488
Motor overload deceleration time	W673	W929	W1185	W1441	W1697	W1953		W3489
Deceleration time of reverse software limit	W674	W930	W1186	W1442	W1698	W1954		W3490
Deceleration time of forward software limit	W675	W931	W1187	W1443	W1699	W1955		W3491
Deceleration time of reverse hardware limit	W676	W932	W1188	W1444	W1700	W1956		W3492
Deceleration time of forward hardware limit	W677	W933	W1189	W1445	W1701	W1957		W3493

Jog speed (DW)	W678	W934	W1190	W1446	W1702	W1958		W3494
Jog acceleration time	W680	W936	W1192	W1448	W1704	W1960		W3496
Jog deceleration time	W681	W937	W1193	W1449	W1705	W1961		W3497
Jog torque limit	W682	W938	W1194	W1450	W1706	W1962		W3498
Feed Rate speed (DW)	W684	W940	W1196	W1452	W1708	W1964		W3500
Feed Rate acceleration time	W686	W942	W1198	W1454	W1710	W1966		W3502
Feed Rate deceleration time	W687	W943	W1199	W1455	W1711	W1967		W3503
Rapid monitoring item index	W688	W944	W1200	W1456	W1712	W1968		W3504
Maximum speed limit	W689	W945	W1201	W1457	W1713	W1969		W3505
Reverse software limit of handwheel (DW)	W690	W946	W1202	W1458	W1714	W1970		W3506
Forward software limit of handwheel (DW)	W692	W948	W1204	W1460	W1716	W1972		W3508
Servo parameter								
Auto low-frequency vibration suppression setting	W704	W960	W1216	W1472	W1728	W1984		W3520
Inertia ratio to servo drive	W705	W961	W1217	W1473	W1729	W1985		W3521
Proportional gain of position control	W706	W962	W1218	W1474	W1730	W1986		W3522
Feed forward gain of position control	W707	W963	W1219	W1475	W1731	W1987		W3523
Speed control gain	W708	W964	W1220	W1476	W1732	W1988		W3524
Speed integral compensation	W709	W965	W1221	W1477	W1733	W1989		W3525
Low-pass filter of resonance suppression	W710	W966	W1222	W1478	W1734	W1990		W3526

Anti-interference gain	W711	W967	W1223	W1479	W1735	W1991		W3527
Speed detection filter and jitter suppression	W712	W968	W1224	W1480	W1736	W1992		W3528
Excessive deviation of position control (DW)	W724	W980	W1236	W1492	W1748	W2004		W3540
E-Cam curve scaling	W726	W982	W1238	W1494	W1750	W2006		W3542
E-Cam: Master gear ratio setting P	W728	W984	W1240	W1496	W1752	W2008		W3544
E-Cam: Activate E-Cam control	W730	W986	W1242	W1498	W1754	W2010		W3546
E-Cam: Information of disengaging time	W732	W988	W1244	W1500	W1756	W2012		W3548

3.5.1 Command Register

Command register in motion mode has the function of issuing the motion command. Take axis 1 as the example for description:

Function	No.	Description	Attribute	Latched	Default value
Command code	W512	Motion command type	R/W	No	0
Command selection	W513	The additional information that command code needs	R/W	No	0
Command mode	W514	Mode of position command	R/W	No	0
Delay time	W515	Delay time when positioning complete. Unit: ms	R/W	No	0
Acceleration time	W516	Acceleration time of servo axis	R/W	No	0
Deceleration time	W517	Deceleration time of servo axis	R/W	No	0
Speed setting (DW)	W518	Unit: PUU/s	R/W	No	0
Target position (DW)	W520	Unit: PUU	R/W	No	0

Speed proportion	W522	Percentage of actual motion speed	R/W	No	0
Parameter start address	W524	The start address of accessing parameters in D device in continuous PR path	R/W	No	0
Overlap	W525	PR overlap	R/W	No	0
Speed option	W526	Additional information that linear motion needs	R/W	No	0
Range of position completed	W528	Unit is PUU.	R/W	No	0

- Command code (W512)
  - Definition: According to different demands, different command code will be issued to the servo drive. Followings are the codes that are supported.
    0: No action
    1: Linear synchronization
    4: Forward speed
    5: Reverse speed
    6: Decelerate to stop
    8: Homing
    10: Arc: Radius & angle mode
    11: Arc: Midpoint & end point mode
    12: Arc: Center & end point mode
    13: Arc: Radius & end point mode
    14: Arc: Center & angle mode
    24: 4-axis linear synchronization (Special type of servo drive)
    30: Helical
    31: Helical W
  - Related device: When HMC issues command to the servo drive, the command needs to be written into [Command code] of trigger axis. For example, for the 3 axes of ASDA-M, if users desire to execute 3-axis motion, the command needs to be written into [Command code](W512), [Command selection](W513), [Speed setting](W518) and [target position](W520) of axis 1. Then, trigger flag of [Command start](R512) of axis 1 to enable the servo. Please refer to Chapter 5 for further information.

- Command selection (W513)
  - Definition: Different [Command code] has different corresponding setting method of [Command selection], which needs to be written into the trigger axis.
    In linear and speed motion, [Command selection] is for enabling the axis, which starts from low bit to high bit in sequence. It will trigger the very first one. For example, when triggering [Command start] (R512) of axis 1, if bit0 of [Command selection](W513) is On, it means axis 1 needs to be activated. If bit1 is On, it means axis 2 needs to be activated and so on. However, when triggering [Command start] (R514) of axis 3, if bit0 of [Command selection] (W1025) is On, it means axis 3 needs to be activated. And if bit1 is On, it means axis 4 needs to be activated.
    [Command selection] is the axis selection for arc motion. If the 3-axis of ASDA-M is axis1, axis 2 and axis 3 in sequence, then 0 means the arc motion is executed in axis 1 and 2. 1 means it is executed in axis 2 and 3 and 2 means the motion is executed in axis 1 and 3.
    In helical motion, [Command selection] is the axis selection for helical moving. If the 3-axis of ASDA-M is axis 1, axis 2 and axis 3 in sequence, then 0 means arc moving is executed in axis 1 and 2 and axis 3 is for helical height moving. 1 means arc moving is executed in axis 2 and 3 and axis 1 is for helical height moving. 2 means axis 1 and 3 is for arc moving and axis 2 is for helical height moving.
    Related device: If the motion axis includes axis 1, it needs to trigger [Command start](R512). And parameters it uses will be [Command code] (W512), [Command selection](W513) and the related ones such as speed, position and etc. Please refer to Chapter 5 for further information.

- Command mode (W514)
  - Definition: The command mode used by linear motion supports the followings:
    0: Absolute position command. The destination of position command is directly specified as DATA.
    1: Relative position command. The destination of position command is the current feedback position plus the specified incremental DATA.
    2: Incremental position command. The destination of position command is the previous command destination plus the specified incremental DATA.

- DELAY time (W515)
  - Definition: The setting of Delay time after the single motion reaches the position.

- Acceleration time (W516)
  - Definition: The setting of acceleration time in single motion. If there is no setting, please refer to the system's [Acceleration time](W646).

- Deceleration time (W517)
  - Definition: The setting of deceleration time in single motion. If there is no setting, please refer to the system's [Deceleration time](W647).

- Speed setting (W518)
  - Definition: In multi-axial synchronized motion, since the multi-axis has to be activated and ended simultaneously, the actual speed should be adjusted by the speed setting and moving distance of each axis. The default setting is based on the speed of the longest traveling distance. The speed of the axes with shorter travel distance will be adjusted by the based speed in order to synchronize multi-axis.
  - Fault: Take axis 1 as the example, if the speed is set to 0, error will occur and [Command error](R1024) will be On. If the speed setting exceeds the setting value of [Max. speed limit] (W660), the system will operate at the speed of [Max. speed limit]. In multi-axis synchronized motion, if one of the axes exceeds the speed of [Max. speed limit], that axis will operate at [Max. speed limit]. Thus, the speed of multi-axis synchronized motion will be limited by [Max. speed limit] of each axis and reduce its speed.

- Target position (W520)
  - Definition: Setting of command arrival position
  - Related device: The target position will be influenced by [Command mode](W514). The target position will be different because of the absolute, relative or incremental mode.

- Speed proportion (W522)
  - Definition: The actual speed is the result of [Speed setting] multiplies the percentage of [Speed proportion]. If [Speed setting] is 10000 and speed proportion is set to 20, then, the actual speed will be 10000 x 20% = 2000. Also, each axis influences the speed of all synchronized axis by the speed of triggering axis.

    The setting value is between 1 and 100. When exceeding the range, the setting of speed proportion will be regarded as 100, which operates at the speed of [Speed setting].

- Parameter start address (W524)
  - Definition: When issuing arc and helical commands, the related parameters should be written into the continuous D register. [Parameter start address] is the start address of setting PR. Take axis 1 as the example, if [Parameter start address](W524) is set to 1000, then, when issuing commands, the system will start to capture data from D1000 and send it to servo.

    Take axis 1 in Arc: Radius & angle mode (Command code is 10) as the example, if [Parameter start address](W524) is set to 1000, when issuing arc motion command, the system will issue parameters, which start from D1000 to the servo drive. Since the parameter needs 6 continuous bits, the 6 continuous bits should be reserved. For example, if W524 is set to 1000, when planning the program, D1000 ~ D1005 should be reserved. Assume that [Parameter start address] is set to n, when executing arc motion, the definition of D register data is as the followings:

Definition	Parameter address
Radius (DW)	Dn
Start angle (DW; Unit: 0.5°)	Dn+2
Motion angle (DW; Unit: 0.5°)	Dn+4

    Take axis 1 in Arc: Midpoint & endpoint mode (Command code is 11) as the example, if [Parameter start address](W524) is set to 1000, when issuing motion command, the system will issue parameters, which start from D1000 to the servo drive. Since the parameter needs 8 continuous bits, the 8 continuous bits should be reserved. For example, if W524 is set to 1000, when planning the program, D1000 ~ D1007 should be reserved. Assume that [Parameter start address] is set to n, when executing arc motion, the definition of D register data is as the followings:

Definition	Parameter address
Midpoint coordinate 1 (DW)	Dn
Midpoint coordinate 2 (DW)	Dn+2
Endpoint coordinate 1 (DW)	Dn+4
Endpoint coordinate 2 (DW)	Dn+6

    Take axis 1 in Arc: Center & endpoint mode (Command code is 12) as the example, if [Parameter start address](W524) is set to 1000, when issuing motion command, the system will issue parameters, which start from D1000 to the servo drive. Since the parameter needs 10 continuous bits, the 10 continuous bits should be reserved. For example, if W524 is set to 1000, when planning the program, D1000 ~ D1009 should be reserved. Assume that [Parameter start

address] is set to n, when executing arc motion, the definition of D register data is as the followings:

Definition	Parameter address
Circle center coordinate 1 (DW)	Dn
Circle center coordinate 2 (DW)	Dn+2
Endpoint coordinate 1 (DW)	Dn+4
Endpoint coordinate 2 (DW)	Dn+6
Forward & reverse (DW, 0 forward, 1reverse)	Dn+8

Take axis 1 in Arc: Endpoint & radius mode (Command code is 13) as the example, if [Parameter start address](W524) is set to 1000, when issuing motion command, the system will issue parameters, which start from D1000 to the servo drive. Since the parameter needs 8 continuous bits, the 8 continuous bits should be reserved. For example, if W524 is set to 1000, when planning the program, D1000 ~ D1007 should be reserved. Assume that [Parameter start address] is set to n, when executing arc motion, the definition of D register data is as the followings:

Definition	Parameter address
Endpoint coordinate 1 (DW)	Dn
Endpoint coordinate 2 (DW)	Dn+2
Radius (DW)	Dn+4
Forward & reverse (DW, 0 forward, 1reverse)	Dn+6

Take axis 1 in Arc: Center & angle mode (Command code is 14) as the example, if [Parameter start address](W524) is set to 1000, when issuing motion command, the system will issue parameters, which start from D1000 to the servo drive. Since the parameter needs 6 continuous bits, the 6 continuous bits should be reserved. For example, if W524 is set to 1000, when planning the program, D1000 ~ D1005 should be reserved. Assume that [Parameter start address] is set to n, when executing arc motion, the definition of D register data is as the followings:

Definition	Parameter address
Circle center coordinate 1 (DW)	Dn
Circle center coordinate 2 (DW)	Dn+2
Motion angle (DW; Unit: 0.5°)	Dn+4

Take axis 1 in helical command (Command code is 30) as the example, if [Parameter start address](W524) is set to 1000, when issuing helical command, the system will issue parameters, which start from D1000 to the servo drive. Since the parameter needs 8 continuous bits, the 8 continuous bits should be reserved. For example, if W524 is set to 1000, when planning the program, D1000 ~ D1007 should be reserved. Assume that [Parameter start address] is set to n, when executing arc motion, the definition of D register data is as the followings:

Definition	Parameter address
Radius (DW)	Dn
Start angle (DW; Unit: 0.5°)	Dn+2
Motion angle (DW; Unit: 0.5°)	Dn+4
Height (DW)	Dn+6

Take axis 1 in helical W command (Command code is 31) as the example, if [Parameter start address](W524) is set to 1000, when issuing helical W command, the system will issue parameters, which start from D1000 to the servo drive. Since the parameter needs 10 continuous bits, the 10 continuous bits should be reserved. For example, if W524 is set to 1000, when planning the program, D1000 ~ D1009 should be reserved. Assume that [Parameter start address] is set to n, when executing arc motion, the definition of D register data is as the followings:

Definition	Parameter address
Circle center coordinate 1 (DW)	Dn
Circle center coordinate 2 (DW)	Dn+2
Height of one cycle (DW)	Dn+4
Total pitch number (DW)	Dn+6
Offset angle (DW; Unit: 0.5°)	Dn+8

- Related device: Take axis 1 in arc motion as the example, set up arc command in [Command code](W512) and setup axis selection in [Command selection](W513). Then trigger the flag of [Command start](R512) to start the execution. HMC will access arc motion data from D register of [Parameter start address](W524) and then issue parameters to the servo drive.

- OVERLAP (W525)
  - Definition: When executing the continuous motion, [Overlap] is for setting the overlap extent between the current motion and the next one. This setting could help to accomplish the interpolation between two paths.
    There are two ways for overlap:

1. Overlap for acceleration / deceleration time

   It is the overlap percentage of the current PR deceleration time and the next PR acceleration time. Parameter P1-78, [The setting of PR overlap](P1-78) should set to 0, the range of [Overlap] setting value and its definition are as the followings:

Grade	7	6	5	4	3	2	1	0
Percentage	45%	40%	35%	30%	25%	20%	10%	0%
Grade	F	E	D	C	B	A	9	8
Percentage	100%	90%	80%	75%	70%	65%	55%	50%

2. Overlap for PR distance

   It is the percentage of the current and next PR distance. Parameter P1-78, [The setting of PR overlap](P1-78) should set to 1, the range of [Overlap] setting value and its definition are as the followings:

Index 0~F	Description
0	1%
1	2%
2	4%
3	6%
4	8%
5	10%
6	12%
7	14%
8	16%
9	18%
A	20%
B	Refer to P1-79, The setting of the percentage of overlap PR path
C	Refer to P1-80, The setting of the distance of overlap PR path
D	Reserved
E	Reserved
F	Reserved

   The setting range of parameter P1-79 is 1 ~ 30. The setting unit of parameter P1-80 is PUU and the range is 100 ~ 2147483647.

- Related device: When executing continuous motion, take axis 1 as the example, when using [Command load](R624) to load and trigger command, it will issue the command, [Overlap] to the servo drive so as to setup the interpolation between two PR paths.

- Speed option (W526)
  - Definition: Through the setting of [speed option], the speed type of linear motion can be changed. Refer to the followings for its setting.
    1. 0: The longest traveling distance
    2. 1 ~ 12: Speed of specified axis. The setting value means the multi-axis linear motion should be adjusted according to the speed of specified axis. For example, in three-axis linear motion (including axis 1, 2 and 3), if the setting value is 2, speed of axis 1 and 3 should be adjusted according to the speed setting of axis 2 (W774) so as to accomplish 3-axis linear synchronization.
    3. 255: Vector speed; when regarding [Speed setting] of trigger axis as the vector speed of multi-axis linear motion, in 3-axis linear motion (axis 1, 2 and 3), if the setting value is 255, it means the speed (W518) of trigger axis is regarded as the vector speed during operation.
  - Related device: When executing multi-axis linear motion command, including axis 1, users should set [Command code](W512) of axis 1 to 1 (linear) and [Command selection](W513) as the related selection of motion axis, such as [Speed setting](W518, W774, W1030, ...) and [Target position](W520, W776, W1032, ...). Refer to [Speed option](W526) so as to determine the speed mode. Then, trigger [Command start](R512) of axis 1 will do.

- Range of position completed (W528)
  - Definition: During the motion process, When the distance between motor's current position and target position is shorter than the range of position completed (W528), [Command complete] (R1056) will be On. Its unit is PUU.
  - Note1: this function is similar to servo parameter P1-54.

3.5.2 Status Register

It shows the current servo alarm status and servo function. Take axis 1 as the example:

Function	No.	Description	Attribute	Latched	Default value
Error code	W576	Error code when failed to issue the command.	R	No	0
Current position (DW)	W578	Current servo drive's position; Unit is PUU.	R	No	0
Average torque (DW)	W580	Current servo drive's average torque; Unit is %.	R	No	0

Function	No.	Description	Attribute	Latched	Default value
Current speed (DW)	W582	Current servo drive's speed; Unit is PUU/s.	R	No	0
Servo alarm code	W585	Servo alarm code, in BCD format	R	No	0
Monitoring item 1 (DW)	W586	The specified servo information of monitoring item 1	R	No	0
Monitoring item 2 (DW)	W588	The specified servo information of monitoring item 2	R	No	0
Monitoring item 3 (DW)	W590	The specified servo information of monitoring item 3	R	No	0
Monitoring item 4 (DW)	W592	The specified servo information of monitoring item 4	R	No	0
PR surplus	W594	The current written PR number in the servo drive.	R	No	0
DMCNet communication error A (DW)	W596	Communication error rate in channel A of DMCNet communication	R	No	0
DMCNet communication error B (DW)	W598	Communication error rate in channel B of DMCNet communication	R	No	0
Rapid monitoring item (DW)	W600	The specified servo information of rapid monitoring item	R	No	0
Current speed	W602	Current servo drive's speed; Unit is RPM	R	No	0

- Error code (W576)
  - Definition: When command issuing is failed, the error occurs with [Command error], and it will display the current error code, which shown below:

Code	Definition
01	Parameter of motion speed is 0: 1. Speed is set to 0. 2. The speed becomes 0 after transferring by E-gear ratio.
02	Servo drive is in QuickStop status: Axis of issuing command is in QuickStop status.
03	Servo drive is off: Axis of issuing command is in Servo Off status
04	Command is being executed: Command is being executed and is unable to receive the new one.
05	Continuous motion command error: 1. In continuous motion path, each motion has to be executed by same axes. If the new motion command requires different axes, this error will occur. 2. Axes required by motion command do not exist (hasn't been connected).
06	Helical or arc motion command error: 1. Issuing wrong parameters of motion position, e.g. If issuing three target positions for constituting an arc while three are in the same line, this error occurs. 2. Select wrong parameters of plane selection 3. Axes required by motion command do not exist (hasn't been connected).
07	Command code error: Use undefined command code
08	Exceed the largest amount of continuous command when issuing continuous command: Users are allowed to issue more than one motion commands continuously. However, the number of continuous command exceeds the limit, 8, the system will not be able to trigger new motion commands and this error will occur.
09	Issue continuous command time out: When the last continuous motion command is being executed, which means the continuous motion command will be completed soon, if new continuous command is issued, this error will occur.

Code	Definition
10	Command code cannot be used in continuous motion: Continuous motion command only accepts linear, arc and helical motions. Issuing other motion commands will result in this error.
11	Wrong speed setting for the specifying axis: When multiple axes are executing synchronous linear motion, if the moving distance of specifying axis is 0, this error will occur.
12	Pause time of multi-axis synchronous control is too long: In multi-axis synchronous motion control, the pause time of not-moving axis is calculated according to the motion time. If the pause time exceeds the allowable range, this error will occur. Users can speed up the motion to solve this problem.
13	Pause time of multi-axis synchronous control is 0: In multi-axis synchronous motion control, the pause time of not-moving axis is calculated according to the motion time. If the pause time is set to 0, this error will occur.
14	Motion mode switch error: [Command start] or [Command load] is triggered when the system is still in JOG or handwheel mode.
15	Fail to update servo parameters: When the system is in JOG or handwheel mode (means not allow to enter servo parameters), if users change servo parameters W, this error will occur.
16	Servo parameter synchronization error: When servo parameters synchronization error occurs and [Servo parameters synchronous error](W14) is set to 1 or 2, safety protection mechanism will be activated. Thus, before correcting the error, no command can be issued at the moment.
17	Incorrect distance given in the continuous commands: When the commands are given for continuous path, the total motion path of 8 continuous commands is 0.

- Current position (W578)
  - Definition: The current position; Unit is PUU

- Average torque (W580)
  - Definition: The current average torque; Unit is %.

- Current speed (W582)
  - Definition: The current speed; Unit is PUU/s.

- Servo alarm code (W585)
  - Definition: The code shows when servo error occurs, and the code is in BCD format.
    Please refer to servo drive's user manual for code definition.

- Monitoring item 1/2/3/4 (W586/W588/W590/W592)
  - Definition: The status monitoring register which corresponds to the servo drive.
  - Related device: [Monitoring item index] determines the content of [Monitoring item]. Take axis 1 as the example, [Monitoring item 1](W586) will change its content according to [Monitoring item index 1](W666).
    When changing the setting of [Monitoring item index], HMC will change the setting value and then send it to servo drive. Thus, the corresponding [Monitoring item] will display the correct parameter content after 1ms.

- PR surplus (W594)
  - Definition: It represents the command number that has been written into the servo drive and waits for execution. HMC can preload 8 commands into the servo drive at most. Range is from 0 to 8. 0 means no command is executing. In continuous command, when [PR surplus] is 8, it means the system has already been preloaded 8 commands and cannot trigger [Command load](R624) at the moment. That is to say, flag of [Command ready](R1040) will not be On until the current command is completed . When the number of [PR surplus] is less than 8, the new command can be loaded into the servo drive and flag of [Command ready](R1040) will be On.

- DMCNet communication error A/B (W596/W598)
  - Definition: The cumulative number of lost packages on communication channel A/B of DMCNet.

- Rapid monitoring item (W600)
  - Definition: The rapid monitoring register which corresponds to the servo drive.
  - Related device: [Rapid monitoring item index](W688) determines the content of [Rapid monitoring item](W600).
    When changing the setting of [Rapid monitoring item index], HMC will change the setting value and then send it to servo drive. Thus, the corresponding [Rapid monitoring item] will display the content of correct parameter after 1ms.

- Current speed (W602)
  - Definition: The current speed; Unit is rpm.

3.5.3 Parameter Register in Motion Mode

Parameters that are related to motion control. Take axis 1 as the example for the following description.

Function	No.	Description	Attribute	Latched	Default setting
Electronic gear ratio (Numerator) (DW)	W640	Electronic gear ratio (Numerator)	Remote	Yes	1
Electronic gear ratio (Denominator) (DW)	W642	Electronic gear ratio (Denominator)	Remote	Yes	1
Unit display	W644	Unit setting; 0 = PUU	R/W	Yes	0
Acceleration / Deceleration curve	W645	S-curve acceleration / deceleration constant	Remote	Yes	0
Acceleration time	W646	Acceleration time	R/W	Yes	200
Deceleration time	W647	Deceleration time	R/W	Yes	200
Homing speed 1 (DW)	W648	First homing speed	R/W	Yes	2133333
Homing speed 2 (DW)	W650	Second homing speed	R/W	Yes	426666
Homing mode	W652	Homing mode selection	R/W	Yes	1
Homing acc. /dec. time	W653	Acceleration / deceleration time of homing	R/W	Yes	200
Homing offset value (DW)	W654	Offset of homing and positioning point	R/W	Yes	0
Forward software limit (DW)	W656	Position of forward software limit	Remote	Yes	0x7FFFFFFF
Reverse software limit (DW)	W658	Position of reverse software limit	Remote	Yes	0x80000000
Maximum speed limit (DW)	W660	The maximum operation speed; Unit: PUU/s	Remote	Yes	64000000

Function	No.	Description	Attribute	Latched	Default setting
Monitoring item index1	W666	The content of monitoring item index 1	R/W	Yes	1
Monitoring item index 2	W667	The content of monitoring item index 2	R/W	Yes	13
Monitoring item index 3	W668	The content of monitoring item index 3	R/W	Yes	39
Monitoring item index 4	W669	The content of monitoring item index 4	R/W	Yes	40
Quick Stop deceleration time	W670	Deceleration time when Quick Stop	R/W	Yes	200
Deceleration time of stop command	W671	Deceleration time of stop command	Remote	Yes	30
Deceleration time for communication error	W672	Deceleration time for communication error	Remote	Yes	30
Deceleration time of motor overload	W673	Deceleration time when motor overload	Remote	Yes	30
Deceleration time of reverse software limit	W674	Deceleration time when in reverse software limit	Remote	Yes	30
Deceleration time of forward software limit	W675	Deceleration time when in forward software limit	Remote	Yes	30
Deceleration time of reverse hardware limit	W676	Deceleration time when in reverse hardware limit	Remote	Yes	30
Deceleration time of forward hardware limit	W677	Deceleration time when in forward hardware limit	Remote	Yes	30
Jog speed (DW)	W678	Jog speed	Remote	Yes	426666
Jog acceleration time	W680	Acceleration curve during jog operation	R/W	Yes	200
Jog deceleration time	W681	Deceleration curve during jog operation	R/W	Yes	200

Function	No.	Description	Attribute	Latched	Default setting
Jog torque limit	W682	Torque limit setting during jog operation; Unit: 0.1%	R/W	No	0
Feed Rate speed (DW)	W684	Setting of Feed Rate speed	R/W	No	0
Feed Rate acceleration time	W686	Setting of Feed Rate acceleration time	R/W	Yes	200
Feed Rate deceleration time	W687	Setting of Feed Rate deceleration time	R/W	Yes	200
Rapid monitoring item index	W688	The content of rapid monitoring item	R	No	0
Maximum speed limit	W689	The maximum operation speed; Unit: rpm	R	No	0
Reverse software limit of handwheel (DW)	W690	Position of reverse software limit when handwheel function is activated.	R/W	Yes	0x8000000
Forward software limit of handwheel (DW)	W692	Position of forward software limit when handwheel function is activated.	R/W	Yes	0x7FFFFFFF

- Electronic gear ratio (Numerator) (W640)
  - Definition: The setting of servo drive's electronic gear ratio (numerator) should be done when Servo Off.
    Through the setting of [Electronic gear ratio (Numerator)] and [Electronic gear ratio (Denominator)], pulse command (Pulse) is transferred to position command (PUU):

    Command pulse input: f1 ***Position command: f2***

    Electronic gear ratio (N): N ***Electronic gear ratio (D): M***

    f2 = f1 x (N/M)
  - Related Device: According to [Electronic gear ratio (Denominator)], it transfers the user unit of servo axis (PUU). Range: 1/50 ~ 25600.

- Electronic gear ratio (Denominator) (W642)
  - Definition: The setting of servo drive's electronic gear ratio (Denominator) should be done when Servo Off.
    Through the setting of [Electronic gear ratio (Numerator)] and [Electronic gear ratio (Denominator)], pulse command (Pulse) is transferred to position command (PUU):

    Command pulse input: f1 ***Position command: f2***

    Electronic gear ratio (N): N ***Electronic gear ratio (D): M***

    f2 = f1 x (N/M)
  - Related Device: According to [Electronic gear ratio (Denominator)], it transfers the user unit of servo axis (PUU).

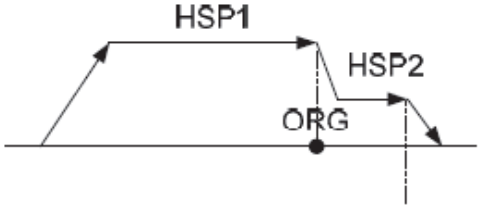
- Unit display (W644)
  - Definition: It is the unit setting of HMC and servo drive. It only supports 0 as the default value, which is PUU.

- Acceleration / Deceleration curve (W645)
  - Definition: It is the setting of S-curve acceleration / deceleration smooth constant during operation, which corresponds to the setting of parameter P1-36 (Acceleration / Deceleration constant of S-curve)

- Acceleration time (W646)
  - Definition: It is the setting of system's acceleration time during operation.

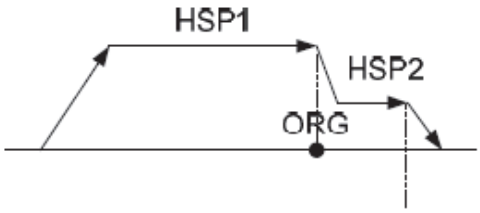
- Deceleration time (W647)
  - Definition: It is the setting of system's deceleration time during operation.
  -

- Homing speed 1 (W648)
  - Definition: It is the setting of first homing speed. When executing homing, the starting speed corresponds to parameter P5-05 (HSP1). The range of setting value is 0.1 ~ 2000.0 (rpm)



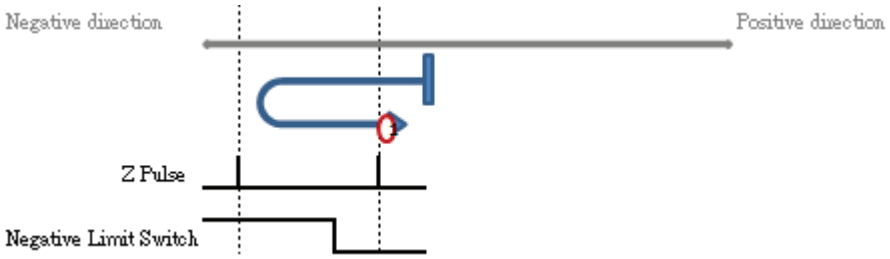
  - Related Device: When executing homing, it starts by [Homing speed 1] first. When ORG signal is ON, it will switch to the speed of [Homing speed 2]. Then, stop homing until Z pulse is found.

- Homing speed 2 (W650)
  - Definition: It is the setting of second homing speed. When executing homing, the starting speed corresponds to parameter P5-06 (HSP2). The range of setting value is 1 ~ 500.0 (rpm).

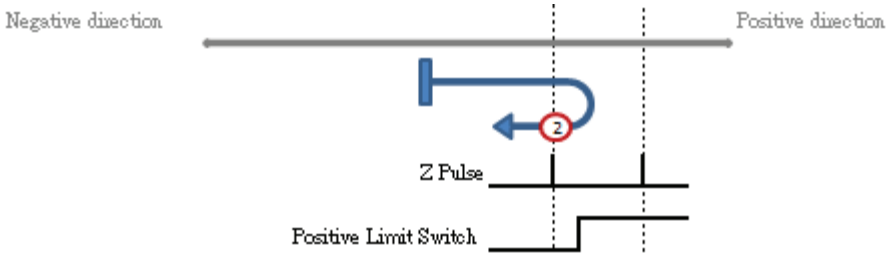


  - Related Device: When executing homing, it starts by [Homing speed 1] first. When ORG signal is ON, it will switch to the speed of [Homing speed 2]. Then, stop homing until Z pulse is found.

- Homing mode (W652)
  - Definition: The homing mode setting during operation. Followings are the codes of supported homing mode.
    1. Homing in reverse direction. It becomes forward direction when encounter negative limit switch and regard the first Z pulse as homing point.



    2. Homing in forward direction. It becomes reverse direction when encounter positive limit switch and regard the first Z pulse as homing point.

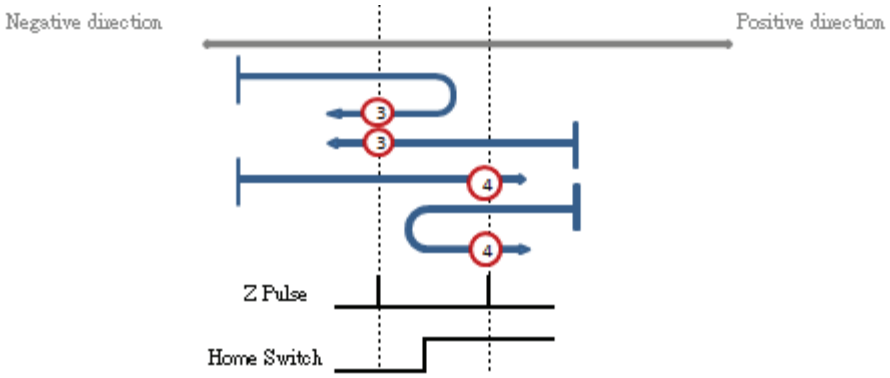


    3. Determine to operate in forward or reverse direction according to Home Switch status

       If homing is executed on Home Switch, then it will operate in reverse direction until it leaves Home Switch and regard the first Z pulse as homing point.

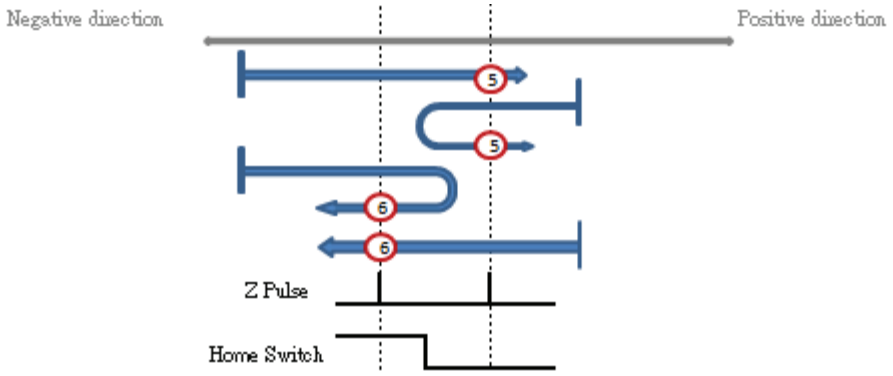
If homing is not executed on Home Switch, it will operate in forward direction to search Home Switch. Then, it will operate in reverse direction until it leaves Home Switch and regard the first Z pulse as homing point.

4. Determine to operate in forward or reverse direction according to Home Switch status
   If homing is executed on Home Switch, it will operate in reverse direction until it leaves Home Switch. Then, it will operate in forward direction and regard the first Z pulse as homing point.
   If homing is not executed on Home Switch, it will operate in forward direction to search Home Switch. Then, regard the first Z pulse as homing point.



5. Determine to operate in forward or reverse direction according to Home Switch status
   If homing is executed on Home Switch, it will operate in forward direction until it leaves Home Switch. Then, regard the first Z pulse as homing point.
   If homing is not executed on Home Switch, it will operate in reverse direction and search Home Switch. Then, after leaving Home Switch, regard the first Z pulse as homing point.

6. Determine to operate in forward or reverse direction according to Home Switch status
   If homing is executed on Home Switch, it will operate in forward direction until it leaves Home Switch. Then, it will operate in reverse direction and regard the first Z pulse as homing point.
   If homing is not executed on Home Switch, it will operate in reverse direction to search Home Switch. Then, regard the first Z pulse as homing point.



7. Determine to operate in forward or reverse direction according to Home Switch status

   If homing is not executed on Home Switch, it will operate in forward direction until it encounters Home Switch. Then, it will operate in reverse direction until it leaves Home Switch and regard the first Z pulse as homing point. If it does not encounter Home Switch but positive limit switch, it will operate in reverse direction and leaves positive limit switch. Then, keep operating until it encounters Home Switch and regards the first Z pulse as homing point after leaving Home Switch.

   If homing is executed on Home Switch, it will operate in reverse direction until it leaves Home Switch and regards the first Z pulse as homing point.

   Simply to say, it is for searching the falling edge signal of Home Switch.

8. Determine to operate in forward or reverse direction according to Home Switch status

   If homing is not executed on Home Switch, it will operate in forward direction until it encounters the first Z pulse and regards it as homing point. If it does not encounter Home Switch in forward direction but positive limit switch. Leave the positive limit switch in reverse direction and then it will encounter Home Switch. Then, keep operating in reverse direction until it leaves Home Switch and operates in forward direction and regards the first Z pulse as homing point.

   If homing is executed on Home Switch, it will operate in reverse direction until it leaves Home Switch. Then, it will operate in forward direction and regards the first Z pulse as homing point.

   Simply to say, it is for searching the rising edge signal of Home Switch.

9. Determine to operate in forward or reverse direction according to Home Switch status

   If homing is not executed on Home Switch, it will operate in forward direction and encounters Home Switch. Keep operating in forward

direction until it leaves Home Switch. Then, operate in reverse direction until it regards the first Z pulse as homing point.

If homing is executed on Home Switch, it will operate in forward direction until it leaves Home Switch. Then, operate in reverse direction, encounter Home Switch and regard the first Z pulse as homing point.

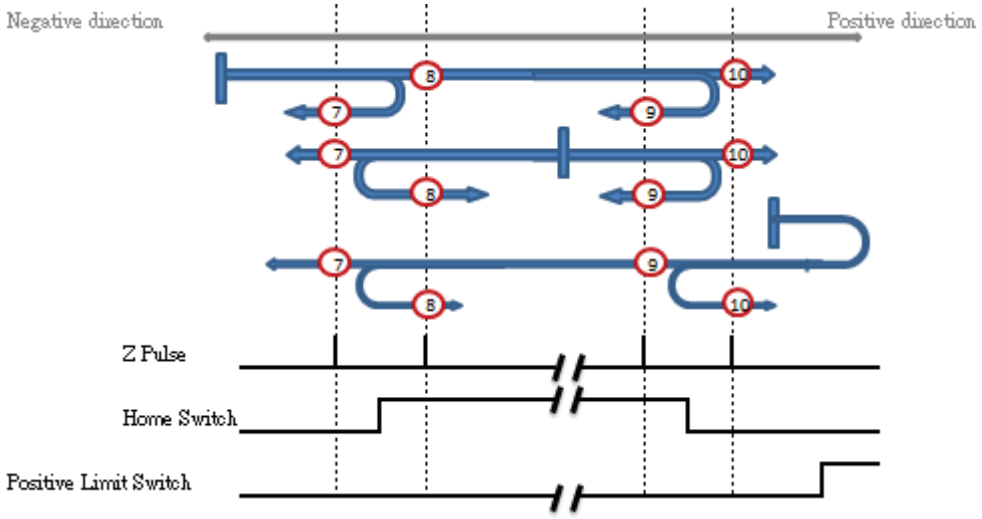
Simply to say, it is for searching the rising edge signal of Home Switch.

10. Determine to operate in forward or reverse direction according to Home Switch status

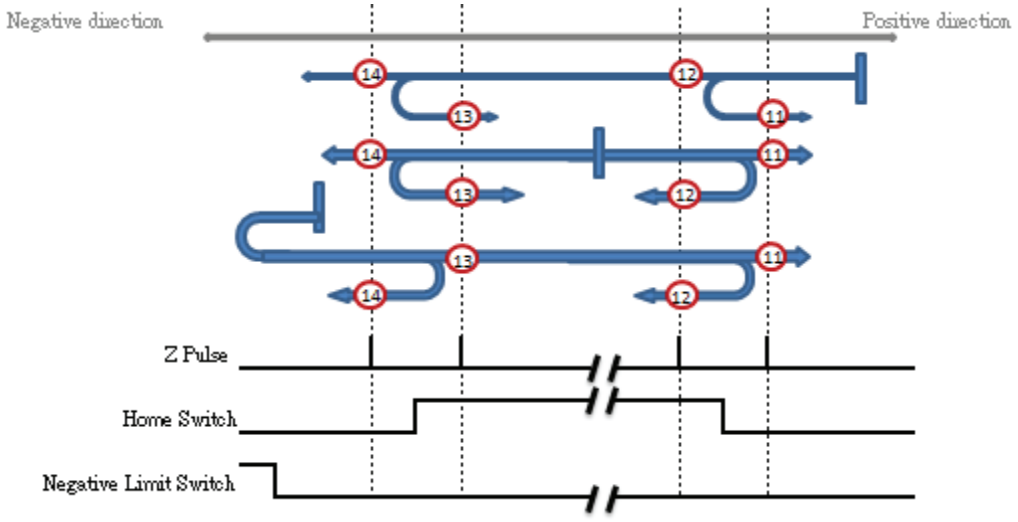
If homing is not executed on Home Switch, it will operate in forward direction until it encounters Home Switch. Keep operating and regard the first Z pulse as homing point when leaving Home Switch. If it does not encounter Home Switch in forward direction but positive limit switch, it will operate in reverse direction to leave positive limit switch. Keep operating until it encounters Home Switch. Then, regard the first Z pulse as homing point after leaving Home Switch.

If homing is executed on Home Switch, it will operate in positive direction to leave Home Switch. Then, regard the first Z pulse as homing point.

Simply to say, it is for searching the falling edge signal of Home Switch.



11.~ 14.: Homing method corresponds to 7~10. The difference is the initial operating direction.



17. ~ 30.: Homing method is similar to 1~14, but it no longer needs to search Z pulse.

33. Operate in reverse direction and regard the first Z pulse as homing point.

34. Operate in forward direction and regard the first Z pulse as homing point.

35. Regard the current position as homing point.

- Related Device: When executing homing, [Command code] should be set to 8 and write [Command selection] into axis selection. Then trigger [Command start] according to [Homing mode], [Homing speed 1], [Homing speed 2], [Acceleration / deceleration time of homing] and [Offset value of homing] for homing.

- Acceleration / deceleration time of homing (W653)
  - Definition: It is the acceleration / deceleration time setting of homing. Its unit is ms.

- Offset value of homing (W654)
  - Definition: After homing, set the distance between home position and zero position as the offset value. If the setting value is 1000, the home position will be -1000.

- Forward software limit (W656)
  - Definition: Setup the position of forward software limit
  - Related Device: During Jog or homing, the operation will not stop when encountering software limit. However, [Servo Warning] will be On. If encounter software limit while executing other commands, the operation will stop and [Servo Warning] will be On and [Servo quick stop release] will be Off.
    If desire to enable the operation again, set [Fault Reset] to On to reset the servo alarm status, then the command can be executed.

- Reverse software limit (W658)
  - Definition: Setup the position of reverse software limit
  - Related Device: During Jog or homing, the operation will not stop when encountering software limit. However, [Servo Warning] will be On. If encounter software limit while executing other commands, the operation will stop and [Servo Warning] will be On and [Servo quick stop release] will be Off.
  - Set [Fault Reset] to On to reset the servo alarm status, then the command can be executed.

- Maximum speed limit (W660)
  - Definition: During jog operation, if the speed exceeds this setting value, the servo drive cannot execute jog. When executing other motion commands, if the speed exceeds the setting value, it will operate at the speed of [Maximum speed limit].
    After changing electronic gear ratio and the value exceeds the max. limit of the servo drive, the value will be changed to the setting value of [Maximum speed limit]. If HMC goes with ASDA servo drive which has the resolution of 1280000 pulses, the maximum speed is 5000rpm. Through [Electronic gear ratio (Numerator)] and [Electronic gear ratio (Denominator)], pulse command (Pulse) will be transferred to position command (PUU). Following is the calculation with max. speed limit.

    Command pulse input: f1 ***Position command: f2***

    Electronic gear ratio (N): N ***Electronic gear ratio (D): M***

    f2 = f1 x (N/M)

    => f1 = f2 x (M/N)

    => 1 Pulse = (M/N) PUU

    => 1280000 Pulse = 1280000 x (M/N) PUU

    => 1 r = 1280000 x (M/N) PUU

    => 1 rps = 1280000 x (M/N) PUU/s

=> 1 rpm = 1280000 / 60 x (M/N) puu/s

Servo's maximum speed, 5000rmp

=> 5000 rmp = 5000 x 1280000 /60 x (M/N) puu/s

- Monitoring item index 1/2/3/4 (W666/W667/W668/W669)
  - Definition: Setup the display of [Monitoring item 1/2/3/4]. The setting content is the same as parameter function of [Servo drive status display]. Parameters' definition is as the following:
    00: Motor feedback pulse number
    01: Pulse number of command input
    02: Command pulse and feedback pulse error
    03: Motor feedback pulse number
    04: Pulse number of command input
    05: Error pulse number
    06: Pulse command frequency
    07: Motor speed
    08: Speed input command
    09: Speed input command
    10: Torque input command
    11: Torque input command
    12: Average torque
    13: Peak torque
    14: Main circuit voltage
    15: Inertia ratio
    16: IGBT temperature
    17: Resonance frequency
    18: The absolute pulse number of Z phase
    39: DI status
    40: DO status
  - Related Device: [Monitoring item index] determines the display content of [Monitoring item]. Take axis 1 as the example, [Monitoring item 1](W586) will change the display content according to the setting of [Monitoring item index 1](W666).

- Quick Stop deceleration time (W670)
  - Definition: Deceleration time setting of servo's Quick Stop
  - Related Device: Take axis 1 as the example, activate [Quick stop](R528) during operation, the system will stop by [Servo quick stop release](W670). Flag of [Release servo Quick Stop](R1088) will be Off, which means the servo is in stop status.

- Deceleration time of stop command (W671)
  - Definition: Deceleration time setting when servo is executing deceleration stop command.
  - Related Device: Take axis 1 as the example, if desire to execute deceleration stop command, [Command code](W512) should be set to 6 and trigger [Command start](R512). When the servo speed is 0, [Command complete](R1056) will be On, which means the command is completed.

- Deceleration time for communication error (W672)
  - Definition: When DMCNet communication is in error, the servo will decelerate to stop by command of [Deceleration time for communication error] and the servo is Off.

- Deceleration time of motor overload (W673)
  - Definition: When the motor is overload, the servo will decelerate to stop by command of [Deceleration time of motor overload].

- Deceleration time of reverse software limit (W674)
  - Definition: It is the deceleration time setting when servo encounters reverse software limit during operation.

- Deceleration time of forward software limit (W675)
  - Definition: It is the deceleration time setting when servo encounters forward software limit during operation.

- Deceleration time of reverse hardware limit (W676)
  - Definition: It is the deceleration time setting when servo encounters reverse hardware limit during operation.

- Deceleration time of forward hardware limit (W677)
  - Definition: It is the deceleration time setting when servo encounters forward hardware limit during operation.

- Jog speed (W678)
  - Definition: It is the speed setting during jog operation
  - Related Device: If the setting value of [Jog speed] is greater than the value of [Maximum speed limit], it will be unable to execute jog.

- Jog acceleration time (W680)
  - Definition: It is the curve setting of acceleration time during jog operation.

- Jog deceleration time (W681)
  - Definition: It is the curve setting of deceleration time during jog operation.

- Jog torque limit (W682)
  - Definition: It is the maximum torque limit setting during jog operation. The unit is 0.1%. If the value is set to 500, it means the maximum torque cannot exceed 50% during jog operation.

- FEED RATE speed (W684)
  - Definition: Change the setting value of current speed.
  - Related Device: When [Feed Rate execution] is On, the current speed will be changed to the value of [Feed Rate speed]. Then, [Feed Rate execution] will be Off.

- FEED RATE acceleration time (W686)
  - Definition: Change the acceleration time of current operation.
  - Related Device: When [Feed Rate execution] is On, the current acceleration time will be changed to the value of [Feed Rate acceleration time]. Then, [Feed Rate execution] will be Off.

- FEED RATE deceleration time (W687)
  - Definition: Change the deceleration time of current operation.
  - Related Device: When [Feed Rate execution] is On, the current deceleration time will be changed to the value of [Feed Rate deceleration time]. Then, [Feed Rate execution] is Off.

- Rapid monitoring item index (W688)
  - Definition: Setup the display of [Rapid monitoring item]. The setting content is the same as parameter function of [Servo drive status display]. Parameters' definition is as the following:
    00: Motor feedback pulse number
    01: Pulse number of command input

02: Command pulse and feedback pulse error
03: Motor feedback pulse number
04: Pulse number of command input
05: Error pulse number
06: Pulse command frequency
07: Motor speed
08: Speed input command
09: Speed input command
10: Torque input command
11: Torque input command
12: Average torque
13: Peak torque
14: Main circuit voltage
15: Inertia ratio
16: IGBT temperature
17: Resonance frequency
18: The absolute pulse number of Z phase
39: DI status
40: DO status

- Related device: [Rapid monitoring item index](W688) determines the display content of [Rapid monitoring item](W600).

- Maximum speed limit (W689)
  - Definition: Maximum moving speed in rpm, and this value will be changed with [Maximum speed limit](W660). During Jog operation, if the speed exceeds this setting value, the servo drive cannot execute Jog. When executing other motion commands, if the speed exceeds the setting value, it will operate at the speed of [Maximum speed limit].

- Reverse software limit of handwheel (W690)
  - Definition: Position of reverse software limit when handwheel function is activated.
  - Related device: When the flag of [Handwheel activate] (R608) is on, the reverse limit is activated.

- Forward software limit of handwheel (W692)
  - Definition: Position of forward software limit when handwheel function is activated.
  - Related device: When the flag of [Handwheel activate] (R608) is on, the forward limit is activated.

3.5.4 Register of Servo Parameter

It issues parameters which are related to servo control. Take axis 1 as the following description:

Function	No.	Attribute	Latched	Default value
Auto setting of low-frequency vibration suppression	W704	Remote	No	0
Inertia ratio and load weight ratio to servo motor	W705	Remote	No	10
Proportional gain of position control	W706	Remote	No	35
Feed forward gain of position control	W707	Remote	No	50
Speed control gain	W708	Remote	No	500
Speed integral compensation	W709	Remote	No	100
Resonance suppression of low-pass filter	W710	Remote	No	20
Anti-interference gain	W711	Remote	No	0
Speed detection filter and jitter suppression	W712	Remote	No	0
Excessive deviation of position control deviation (DW)	W724	Remote	Yes	3840000
E-Cam curve scaling	W726	Remote	No	1000000
E-Cam: Master gear ratio setting P	W728	Remote	No	3600
E-Cam: Activate E-Cam control	W730	Remote	No	0
E-Cam: Information of disengaging time	W732	Remote	No	0

- Auto setting of low-frequency vibration suppression (W704)
  - Definition: It corresponds to the setting of P1-29, Auto setting of low-frequency vibration suppression. If it is set to 0, the function is disabled. If it is set to 1, the value will set back to 0 after vibration suppression.

- Inertia ratio and load weight ratio to servo motor (W705)
  - Definition: It corresponds to the setting of P1-37, Inertia ratio and load weight ratio to servo motor.

    Rotary motor: (J_load／J_motor)

    J_motor: rotor inertia of the servo motor,
    J_load: Total equivalent of inertia of external mechanical load.

- Proportional gain of position control (W706)
  - Definition: It corresponds to the setting of P2-00, Proportional gain of position control. When the value of position loop gain is increased, the position response can be enhanced and the position error can be reduced. If the value is set too big, it may easily cause vibration and noise.

- Feed forward gain of position control (W707)
  - Definition: It corresponds to the setting of P2-02, Feed forward gain of position control. If the position command is changed smoothly, increasing the gain value can reduce the position error. If the position command is not changed smoothly, decreasing the gain value can tackle the problem of mechanical vibration.

- Speed control gain (W708)
  - Definition: It corresponds to the setting of P2-04, Speed control gain. Increase the value of speed loop gain can enhance the speed response. However, if the value is set too big, it would easily cause resonance and noise.

- Speed integral compensation (W709)
  - Definition: It corresponds to the setting of P2-06, Speed integral compensation. Increasing the value of speed integral compensation can enhance speed response and diminish the deviation of speed control. However, if the value is set too big, it would easily cause resonance and noise.

- Resonance suppression of low-pass filter (W710)
  - Definition: It corresponds to the setting of P2-25 Resonance suppression of low-pass filter. Set the low-pass filter of resonance suppression. When the value is set to 0, the function of low-pass filter is disabled.

- Anti-interference gain (W711)
  - Definition: It corresponds to the setting of P2-26, Anti-interference gain. Increasing the value of this parameter can increase the damping of speed loop.

- Speed detection filter and jitter suppression (W712)
  - Definition: It corresponds to the setting of P2-49, Speed detection filter and jitter suppression, which is for setting speed detection filter.

- Excessive deviation of position control (W724)
  - Definition: It corresponds to the setting of P2-35, Condition of excessive position control deviation. The setting of excessive position control deviation warning in servo drive error display.

- E-Cam curve scaling (W726)
  - Definition: It corresponds to the setting of P5-19, E-Cam curve scaling. This parameter is used to magnify or minify the E-Cam table.

- E-Cam: Master gear ratio setting P (W728)
  - Definition: It corresponds to the setting of P5-84, E-Cam: Master gear ratio setting P. When receiving pulse number P of the master, E-Cam will rotate M circle, which is the M cycle of the E-Cam table.

- E-Cam: Activate E-Cam control (W730)
  - Definition: It corresponds to the setting of P5-88, E-Cam: Activate E-Cam control, which controls E-Cam activate, Command source and Engaging.

- E-Cam: Information of disengaging time (W732)
  - Definition: It corresponds to the setting of P5-89, E-Cam: Information of disengaging time. Control E-Cam disengaging time.

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Chapter 4 Command Introduction

4.1 Basic Command

- LD

Command	Function	Step Number
LD	Load A contact	1 Step

Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	bit	Word
	O	O	O	O	O	O	-	-	-	-	-	-	-	-	-	O	-

Command description

The LD command applies to the starting A contact of a left bus bar or a starting A contact in loop block. It saves the current value and stores the acquired contact status in a cumulative register.

Example

Ladder diagram:

Command code：		Description：
LD	X0	Load X0's A contact
AND	X1	Serial connect X1'sA contact
OUT	Y1	Drives coil Y1

- LDI

Command	Function	Step Number
LDI	Load B contact	1 Step

Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	O	O	O	O	O	O	-	-	-	-	-	-	-	-	-	O	-

Command description

The LDI command applies to the starting B contact of a left bus bar or a starting B contact in loop block. It saves the current value and stores the acquired contact status in a cumulative register.

Example

Ladder diagram:

Command code:		Description:
LDI	X0	Load X0's B contact
AND	X1	Serial connect X1's A contact
OUT	Y1	Drives coil Y1

- AND

Command	Function	Step Number
AND	Serial connect A contact	1 Step

Operand	Bit device						Word device								External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	O	O	O	O	O	O	-	-	-	-	-	-	-	-	-	O	-

Command description

The AND command serial connects A contacts. It reads the current status of the given serial contacts and executes the AND operation on the acquired data together with the outcomes from previous logic operations and saves the outcome in a cumulative register.

Example

Ladder diagram:

Command code:		Description:
LDI	X1	Load X0's B contact
AND	X0	Serial connect X0's A contact
OUT	Y1	Drives coil Y1

- ANI

Command	Function	Step Number
ANI	Serial connect B contact	1 Step

Operand	Bit device						Word device								External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	O	O	O	O	O	O	-	-	-	-	-	-	-	-	-	O	-

Command description

The ANI command serial connects B contacts. It reads the current status of the given serial contacts and executes the AND operation on the acquired data together with the outcomes from previous logic operations and saves the outcome in a cumulative register.

Example

Ladder diagram:

Command code:		Description:
LD	X1	Load X1's A contact
ANI	X0	Serial connect X0's B contact
OUT	Y1	Drives coil Y1

- OR

Command	Function	Step Number
OR	Parallel connect A contact	1 Step

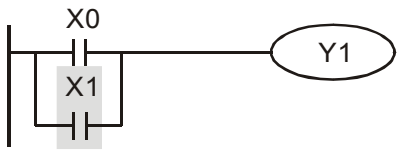
Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	O	O	O	O	O	O	-	-	-	-	-	-	-	-	-	O	-

Command description

The OR command parallel connects A contacts. It reads the current status of the given serial contacts and executes the OR operation on the acquired data together with the outcomes from previous logic operations and saves the outcome in a cumulative register.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load X0's A contact
OR	X1	Parallel connect X1's A contact
OUT	Y1	Drives coil Y1

- ORI

Command	Function	Step Number
ORI	Parallel connect B contact	1 Step

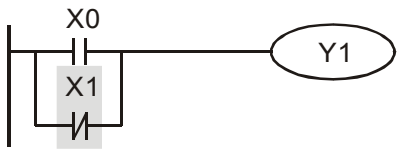
Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	O	O	O	O	O	O	-	-	-	-	-	-	-	-	-	O	-

Command description

The ORI command parallel connects B contacts. It reads the current status of the given serial contacts and executes OR operation on the acquired data together with the outcomes from previous logic operations and saves the outcome in a cumulative register.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load X0's A contact
ORI	X1	Parallel connect X1's B contact
OUT	Y1	

- ANB

Command	Function	Step Number
ANB	Serial connect loop block	1 Step

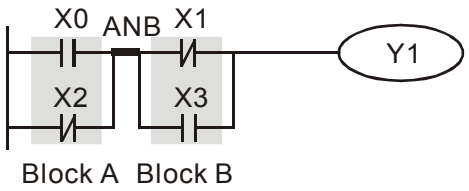
Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	-																

Command description

The ANB command executes the AND operation on previously saved logic outcome and current value in a cumulative register.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load X0's A contact
ORI	X2	Parallel connect X2's B contact
LDI	X1	Load X1's B contact
OR	X3	Parallel connect X3's A contact
ANB		Parallel connect X3's A contact
OUT	Y1	Drives coil Y1

- ORB

Command	Function	Step Number
ORB	Parallel connect loop block	1 Step

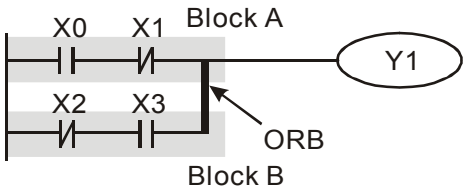
Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	-																

Command description

The ORB command executes the OR operation on previously saved logic outcomes and the current value in a cumulative register.

Example

Ladder Diagram:



Command code:		Description:
LD	X0	Load X0's A contact
ANI	X1	Parallel connect X1's B contact
LDI	X2	Load X2's B contact
AND	X3	Serial connect X3's A contact
ORB		Parallel connect loop block
OUT	Y1	Drives coil Y1

- MPS

Command	Function	Step Number
MPS	Saves it in stack	1 Step

Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	-																

Command description

Saves the current value contained in the cumulative register in a stack. (Stack index increase by 1)

- MDR

Command	Function	Step Number
MDR	Read stack (Stack index remain intact)	1 Step

Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Charcter
	-																

Command description

Saves the current value contained in the cumulative register in a stack. (Stack index increase by 1)

- MPP

Command	Function	Step Number
MPP	Read stack	1 Step

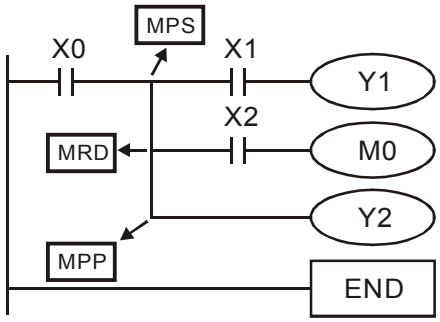
Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	-																

Command description

Retrieves the last saved logic computing outcome and saves it in a cumulative register. (Stack index decrease by 1)

Example

Ladder diagram:



Command code:		Description
LD	X0	Load X0's A contact
MPS		Saves it in stack
AND	X1	Serial connect X's A contact
OUT	Y1	Drives coil Y1
MRD		Read stack (Stack index remain intact)
AND	X2	Serial connect X2's A contact
OUT	M0	Drives coil Y2
MPP		Read stack
OUT	Y2	Drives coil Y2
END		Program ends

- OUT

Command	Function	Step Number
OUT	Drives coil	1 Step

Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	-	O	O	O	O	O	-	-	-	-	-	-	-	-	-	O	-

Command description

Outputs the logic computing outcome before the OUT command to the given components.

Coil contact action:

Computing outcome	OUT command		
	Coil	Contact	
		A contact (frequently open)	B contact (frequently close)
FALSE	Off	Turns off	Turns on
TRUE	On	Turns on	Turns off

Example

Ladder diagram:

Command code:		Description
LDI	X0	Load X0's B contact
AND	X1	Serial connect X1's A contact
OUT	Y1	Drives coil Y1

- SET

Command	Function	Step Number
SET	Fix actions (ON)	1 Step

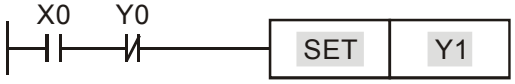
Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	-	O	O	O	O	O	-	-	-	-	-	-	-	-	-	O	-

Command description

The SET command sets components assigned by it to ON and remains ON until being SET OFF by RST command.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load X0's A contact
ANI	Y0	Serial connect Y0's B contact
SET	Y1	Fix Y1's action (ON)

- RST

Command	Function	Step Number
RST	Clear contacts or registers	1 Step

Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	-	O	O	O	O	O	-	-	-	-	-	-	-	-	-	O	-

Command description

See the table below for actions of components driven by RST command:

Components	Status
S, Y, M	Both coils and contacts are set Off.
T, C	Current timing and counting data are reset to 0 while coils and contacts are set Off.
D, E, F	Content values are reset to 0.

Status of the components assigned by RST command remains intact if it was not executed.

Example

Ladder diagram:

Command code:		Description:
LD	X0	Load X0's A contact
RST	Y5	Clear contact Y5

- PLS

Command	Function	Step Number
PLS	Upper differential output	1 Step

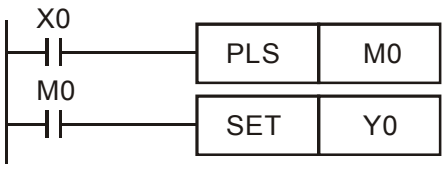
Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	-	O	O	O	O	O	-	-	-	-	-	-	-	-	-	O	-

Command description

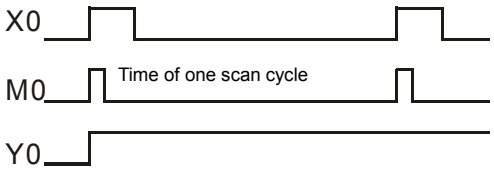
Upper differential output command. When conditional contact turns On (positive edge triggering), the PLS command executes, S sends one pulse with a length of one cycle time.

Example

Ladder diagram:



Timing diagram:



Command code:		Description:
LD	X0	Load X0's A contact
PLS	M0	M0 upper differential output
LD	M0	Load M0's A contact
SET	Y0	Y0 action retaining (ON)

- PLF

Command	Function	Step Number
PLF	Lower differential output	1 Step

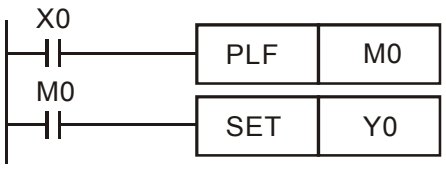
Operand	Bit device						Word device								External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	-	O	O	O	O	O	-	-	-	-	-	-	-	-	-	O	-

Command description

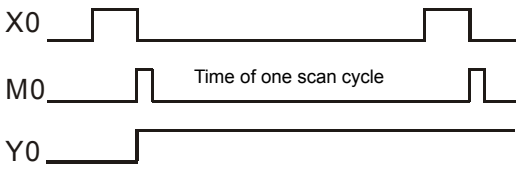
Lower differential output command. When conditional contact turns Off negative edge triggering), the PLF command executes, S sents one pulse with a length of one cycle time..

Example

Ladder diagram:



Timing diagram:



Command code		Description
LD	X0	Load X0's A contact
PLF	M0	M0 lower differential output
LD	M0	Load M0's A contact
SET	Y0	Y0 action retaining (ON)

- MC/MCR

Command	Function	Step Number
MC/MCR	Connection/disconnection of common serial contacts	1 Step

Operand	N0 ~N7

Command description

The MC command serves as the beginning of primary control. After it is executed, commands placed between MC and MCR commands run as usual. When the MC command is OFF, execution of commands placed between MC and MCR commands is described in table below:

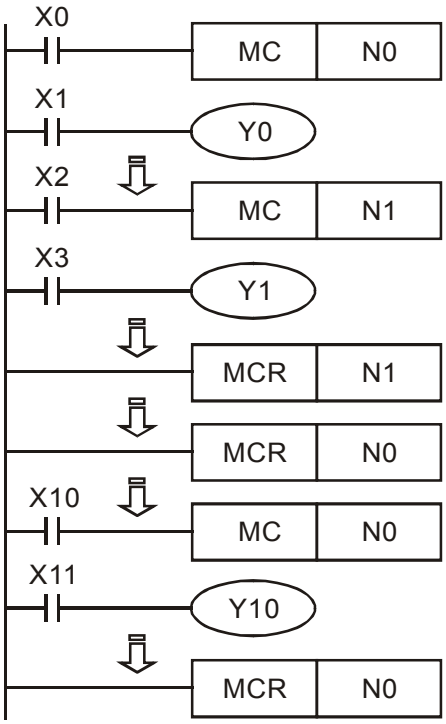
Types of commands	Description
Common timers	Reset timing value, coil OFF, contacts remain inactive
Accumulative timer	Coil OFF, counting values and contacts remain as the current status.
Counter	Coil OFF, counting values and contacts remain as the current status.
Coils driven by OUT command	All turned Off
Components driven by SET and RST commands	Remain the current status
Application commands	Action remains intact. The FOR-NEXT nest loop keeps running for N times. Commands in the FOR-NEXT loop run in the same manner as that of commands between MC and MCR.

The MCR command is the primary control end command and is placed after cyclic task. No contact command is allowed before the MCR one.

The MC-MCR primary control commands support nest structure up to 8 layers from N0 to N7. See example program shown below for details:

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load X0's A contact
MC	N0	N0 common serial contacts' connection in existence
LD	X1	Load X1's A contact
OUT	Y0	Drives coil Y0
:		
LD	X2	Load X2's A contact
MC	N1	Connection of N1 common serial contacts
LD	X3	Load X3's A contact
OUT	Y1	Drives coil Y1
:		
MCR	N1	Disconnection of N1 common serial contacts
:		
MCR	N0	Disconnection of N0 common serial contacts
:		
LD	X10	Load X10's A contact
MC	N0	Connection of N0 common serial contacts
LD	X11	Load X11's A contact
OUT	Y10	Drives coil Y10
:		
MCR	N0	Disconnection of N0 common serial contacts

- LDP

Command	Function	Step Number
LDP	Start of positive edge detection	1 Step

Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	O	O	O	O	O	O	-	-	-	-	-	-	-	-	-	O	-

Command description

The LDP command is used as the LD command but with a different function. It saves the current contents and saves the acquired contact's rising edge detection status in a cumulative register.

Example

Ladder diagram:

Command code:		Description:
LDP	X0	X0: the positive edge detection operation starts
AND	X1	Serial connect X1's A contact
OUT	Y1	Drives coil Y1

- LDF

Command	Function	Step Number
LDF	Start of negative edge detection	1 Step

Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	O	O	O	O	O	O	-	-	-	-	-	-	-	-	-	O	-

Command description

The LDF command is used as the LD command but with a different function. It saves the current contents and saves the acquired contact's falling edge detection status in a cumulative register.

Example

Ladder diagram:

Command code:		Description:
LDF	X0	X0: the negative edge detection operation starts
AND	X1	Serial connect X1's A contact
OUT	Y1	Drives coil Y1

- ANDP

Command	Function	Step Number
ANDP	Positive edge detection serial connection	1 Step

Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	O	O	O	O	O	O	-	-	-	-	-	-	-	-	-	O	-

Command description

The ANDP command serial connects the contact's rising edge detection.

Example

Ladder diagram:

Command code:		Description:
LD	X0	Load X0's A contact
ANDP	X1	X1 positive edge detection serial connection
OUT	Y1	Drives coil Y1

- ANDF

Command	Function	Step Number
ANDF	Negative edge detection serial connection	1 Step

Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	O	O	O	O	O	O	-	-	-	-	-	-	-	-	-	O	-

Command description

The ANDF command serial connects the contact's falling edge detection.

Example

Ladder diagram:

Command code:		Description:
LD	X0	Load X0's A contact
ANDF	X1	X1: Negative edge detection serial connection
OUT	Y1	Drives coil Y1

- ORP

Command	Function	Step Number
ORP	Positive edge detection parallel connection	1 Step

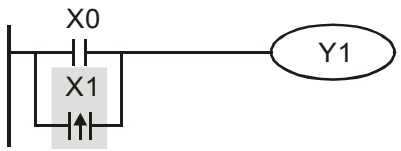
Operand	Bit device						Word device								External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	O	O	O	O	O	O	-	-	-	-	-	-	-	-	-	O	-

Command description

The ORP command parallel connects the contact's rising edge detection.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load X0‘s A contact
ORP	X1	X1: Positive edge detection parallel connection
OUT	Y1	Drives coil Y1

- ORF

Command	Function	Step Number
ORF	Negative edge detection parallel connection	1 Step

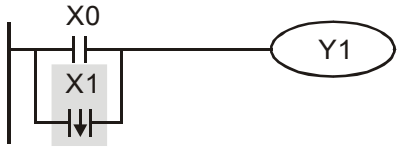
Operand	Bit device						Word device								External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	O	O	O	O	O	O	-	-	-	-	-	-	-	-	-	O	-

Command description

The ORF command parallel connects the contact's falling edge detection.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load X0’s A contact
ORF	X1	X1: Negative edge detection parallel connection
OUT	Y1	Drives coil Y1

- TMR

Command	Function	Step Number
TMR	16-bit timer	2 Step

Operand	T-K	T0~T255, K0~K32,767
	T-D	T0~T255, D0~D65,535

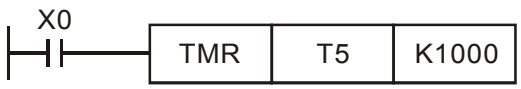
Command description

After a TMR command is executed, the timer assigned by it turns On and starts timing. The timer's contacts function as shown in table below when setup time is reached (timing value >= setup value):

NO(Normally Open) contact	Open
NC(Normally Close) contact	Close

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load X0's A contact
TMR	T5 K1000	Timer T5 is set to K1000

- CNT

Command	Function	Step Number
CNT	16-bit counter	2 Step

Operand	C-K	C0~C199, K0~K32,767
	C-D	C0~C199, D0~D65,535

Command description

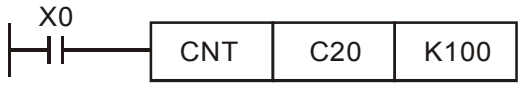
When the CNT command changes from Off to On, the coil of the counter assigned by it switches from Off to On, leading to its counting value increasing by 1. The counter's contacts function as shown in table below when setup counts is reached (counting value >= setup value):

NO(Normally Open) contact	Open
NC(Normally Close) contact	Close

After the count settings is reached, the counter's contacts and counting values remain intact even when more counting pulse inputs are received. An RST command is required to restart counting or clear the value.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load X0's A contact
CNT	C20 K100	Counter C20 is setK100

- DCNT

Command	Function	Step Number
DCNT	32-bit counter	3 Step

Operand	C-K	C200~C255, K-2,147,483,648~K2,147,483,647
	C-D	C200~C255, D0~D65,535

Command description

The DCNT is a 32-bit counter for counters C200 ~ C255 initiation.
General arithmetic counter C200~C255: When the DCNT command changes from Off to On, the counter's current value increases or decreases by 1 in setup mode to that of special R32~R87. When the DCNT command is OFF, its counters stop counting and the existing values remain. An RST C2XX command is required to clear the counting values and its contacts.

Example

Ladder diagram:

Command code:		Description:
LD	M0	Load M0's A contact
DCNT	C254 K1000	Counter C254 is set to K1000

- END

Command	Function	Step Number
END	Cyclic task ends	1 Step

Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	-																

Command description

The cyclic task has to be saved in END command. PLC scans from address 0 to END command. Then, return to address 0 to scan again.
After compiling, END command will be added into the software automatically.

- IRET

Command	Function	Step Number
IRET	Timer task ends	1 Step

Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	-																

Command description

The timer task has to be saved in IRET command. In timer task, PLC scans from address 0 to IRET command. Then, the timer task ends..
After compiling, IRET command will be added into the software automatically.

- SRET

Command	Function	Step Number
SRET	Sub program / Motion program end	1 Step

Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	-																

Command description

The sub program / motion program have to be saved in SRET command. In sub program / motion program, PLC will scan from address 0 to SRET command. After that, the scan of the sub program / motion program is complete.
After compiling, SRET command will be added into the software automatically.

- INV

Command	Function	Step Number
INV	Invert the computing outcome.	1 Step

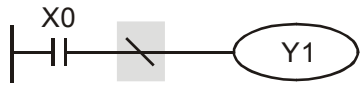
Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	-																

Command description

Invert the logic outcome before the INV command and saves it in a cumulative register.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load X0's A contact
INV		Computing outcome invert
OUT	Y1	Drives coil Y1

- NP

Command	Function	Step Number
NP	Rising edge	1 Step

Operand	Bit device						Word device								External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	-																

Command description

Acquire the rising edge status from the logical computing result which is before NP command, then store it in accumulative register.

Example

Ladder diagram:

Command code:		Description:
LD	X0	Load X0's A contact
LD	M1	Load M1's A contact
NP		Computing result is rising edge
OUT	Y1	Drives coil Y1

- PN

Command	Function	Step Number
PN	Falling edge	1 Step

Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	-																

Command description

Acquire the falling edge status from the logical computing result which is before PN command, then store it in the accumulative register.

Example

Ladder diagram:

Command code:		Description:
LD	X0	Load X0's A contact
LD	M1	Load M1's A contact
PN		Computing result is falling edge
OUT	Y1	Drives coil Y1

- NOP

Command	Funciton	Step Number
NOP	No action	1 Step

Operand	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
	-																

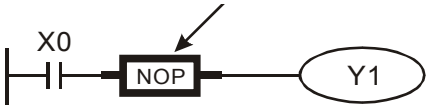
Command description

The NOP command does not compute at all. After its execution, the logic computing outcome remains. If users desire to delete a statement in a program and keep the program size intact, then it can be replaced with a NOP command.

Example

Ladder diagram:

The NOP command is omitted from the ladder diagram.



Command code:		Description:
LD	X0	Load X0's B contact
NOP		No action
OUT	Y1	Drives coil Y1

4.2 Application Command

- LD※

API					
001	D	LD※		(S1) (S2)	Contact type compare LD※

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S1							O	O	O	O	O	O	O	O	O		O
S2							O	O	O	O	O	O	O	O	O		O

Notes on the use of operands: ※ : = 、 > 、 < 、 <> 、 ≦ 、 ≧

16-bit command (5 STEP)
LD※

32-bit command (5 STEP)
DLD※

Flag signal: None

Command description

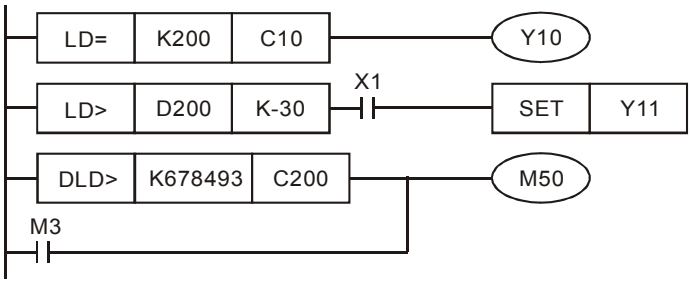
S1: Data source device 1. S2: Data source device 2.
This command compares values stored in S1 and S2. When the comparing result is enabled, the command turns on otherwise it does not turn on.
The LD※ command may connect to a bus bar directily.

16-bit command	32-bit command	Turn-on condition	Not turn-on condition
LD =	DLD =	S1 = S2	S1 ≠ S2
LD >	DLD >	S1 > S2	S1 ≦ S2
LD <	DLD <	S1 < S2	S1 ≧ S2
LD < >	DLD < >	S1 ≠ S2	S1 = S2
LD < =	DLD < =	S1 ≦ S2	S1 > S2
LD > =	DLD > =	S1 ≧ S2	S1 < S2

It has to use the 32-bit command (DLD※) to compare the 32-bit counter (C200~C255).

Example

When the data contained in C10 equals to that in K200, then Y10 = On.
When the data contained in D200 is greater than that in K-30 and X1 = On, then Y11 = On and remains so.
When the data contained in C200 is less than K678, 493 or M3 = On, then M50 = On.



- AND※

API					
002	D	AND※		(S1) (S2)	Contact type compare AND※

	Bit device						Word device								External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S1							O	O	O	O	O	O	O	O	O		O
S2							O	O	O	O	O	O	O	O	O		O

Notes on the use of operands: ※ : = 、> 、< 、<> 、≦ 、≧

16-bit command (5 STEP)
AND※

32-bit command (5 STEP)
DAND
※

Flag signal: None

Command description

S1: Data source device 1. S2: Data source device 2.
This command compares values stored in S1 and S2. When the comparing result is enabled, the command turns on otherwise it does not turn on.
The AND※ is a compare command series connects to a contact.

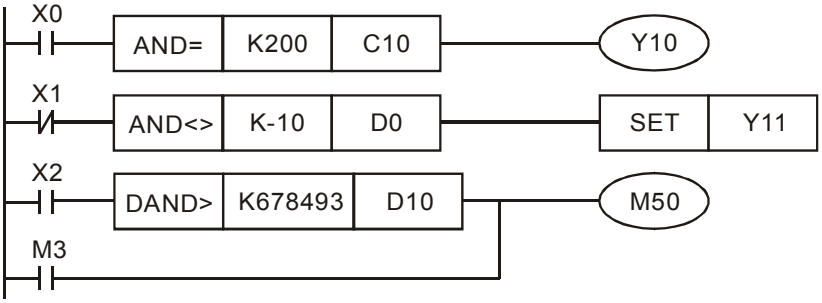
16-bit command	32-bit command	Turn-on condition	Not turn-on condition
AND =	DAND =	S1 = S2	S1 ≠ S2
AND >	DAND >	S1 > S2	S1 ≦ S2
AND <	DAND <	S1 < S2	S1 ≧ S2
AND < >	DAND < >	S1 ≠ S2	S1 = S2
AND < =	DAND < =	S1 ≦ S2	S1 > S2

AND > =	DAND > =	S1 ≧ S2	S1 < S2

It has to use the 32-bit command (DAND※) to compare 32-bit counter (C200~C255).

Example

When X0 = On and the data contained in C10 equals to that in K200, then Y10 = On.
When X1 = Off and the data contained in register D0 is not equal to that in K-10, then Y11 = On and remains so.
When X2 = On and data contained in 32-bit register D0 (D11) are less than 678,493 or M3 = On, then M50 = On.



- OR※

API					
003	D	OR※		(S1) (S2)	Contact type compare OR※

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S1							O	O	O	O	O	O	O	O	O		O
S2							O	O	O	O	O	O	O	O	O		O

Notes on the use of operands: ※ : = 、 > 、 < 、 <> 、 ≦ 、 ≧

16-bit command (5 STEP)
OR※

32-bit command (5 STEP)
DOR※

Flag signal: None

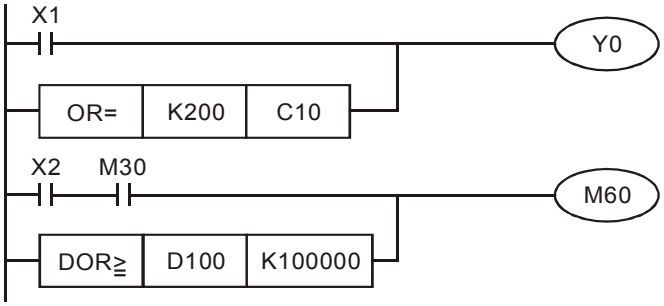
Command description

S1: Data source device 1. S2: Data source device 2.
This command compares values stored in S1 and S2. When the comparing result is enabled, the command turns on otherwise it does not turn on.
The OR※ is a compare command parallel connects to a contact.

16-bit command	32-bit command	Turn-on condition	Not turn-on condition
OR =	DOR =	S1 = S2	S1 ≠ S2
OR >	DOR >	S1 > S2	S1 ≦ S2
OR <	DOR <	S1 < S2	S1 ≧ S2
OR < >	DOR < >	S1 ≠ S2	S1 = S2
OR < =	DOR < =	S1 ≦ S2	S1 > S2
OR > =	DOR > =	S1 ≧ S2	S1 < S2

Example

It has to use 32-bit command (DOR※) to compare the 32-bit counter (C200~C255).
When X1 = On or the data contained in C10 equals to that in K200, then Y0 = On.
When X2 and M30 is On, or the data contained in 32-bit register D100 (D101) is greater or equals to K100, 000, then M60 = On.



- MOV

API					
004	D	MOV		(S) (D)	Move data

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S							O	O	O	O	O	O	O	O	O		O
D								O	O	O	O	O	O	O	O		O

Notes on the use of operands: S operand can use external device, such as KnDX, KnDY, DAI and DAO. D operand can use KnDY and DAO external device.

16-bit command (5 STEP) MOV

32-bit command (5 STEP) DMOV※

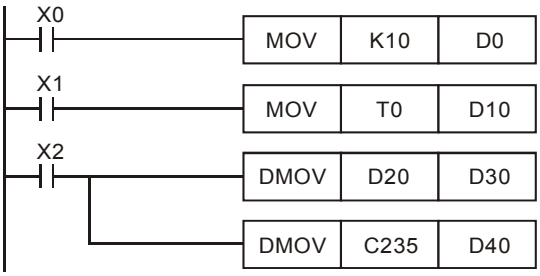
Flag signal: None

Command description

S: Source of data. D: Destination of data to be moved to.
This command moves data contained in S to D. Contents contained in D remain intact.
For 32-bit outoput from computing outcomes (e.g. application command MUL) and current values of the 32-bit device's high speed counter, it moves them with the DMOV command.

Example

Move 16-bit data with the MOV command.
When X0 = Off, contents of D10 remain intact. If X0 = On, it moves data contained in K10 to register D.
When X1 = Off, contents of D10 remain intact. If X1 = On, it moves the current value of T0 to register D10.
Move 32-bit data with DMOV command.
When X2 = Off, contents of (D31, D30) and (D41, D40) remain intact. If X2=On, it moves the current values of (D21, D20) to register (D31, D30) and that of C235 to register (D41, D40).



- BMOV

API 005		BMOV		S D n	All transmission

	Bit device						Word device								External device		
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S										O	O	O			O		O
D										O	O	O					O
n												O			O		

Notes on the use of operands: S operand can use external device, such as DAI and DAO.
D operand can use DAO as the external device.
N operand can use K device.

16-bit command (11 STEP) BMOV

32-bit command

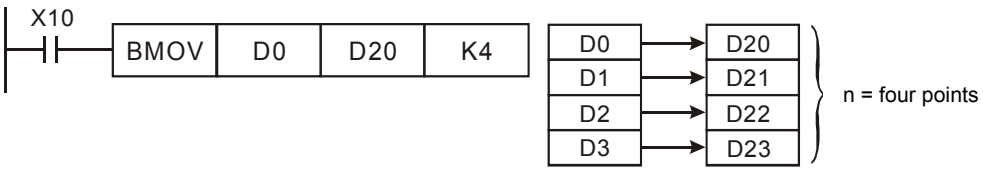
Flag signal: None

Command description

S: Start of source device. D: Start of target device. n: Length of transmission block. Content of the n^{th} register starting from the S specified device is converted to the one specified by D. If the number specified by n exceeds the range, the command will not be executed.

Example

When X10 = On, content of register D0 ~ D3, will be transmitted to the four registers, D20 ~ D23.



- CML

API					
006	D	CML		(S) (D)	Invert transmission

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S							O	O	O	O	O	O	O	O	O		O
D								O	O	O	O	O	O	O	O		O

Notes on the use of operands: S operand can use external device, such as KnDX, KnDY, DAI and DAO.
D operand can use KnDY and DAO as the external device.

16-bit command (5 STEP)
CML

32-bit command (5 STEP)
DCML

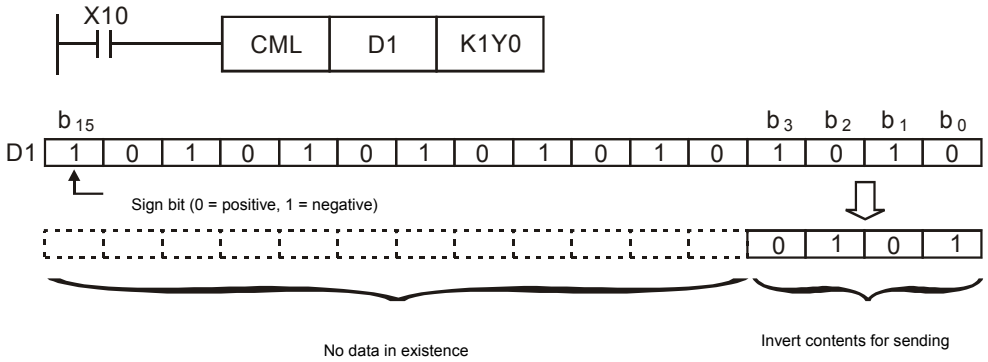
Flag signal: None

Command description

S: Source of data to be transmitted. D: Target device of transmission. Invert (0→1, 1→0) data contained in S and send to D. Automatically invert constant K to BIN value.

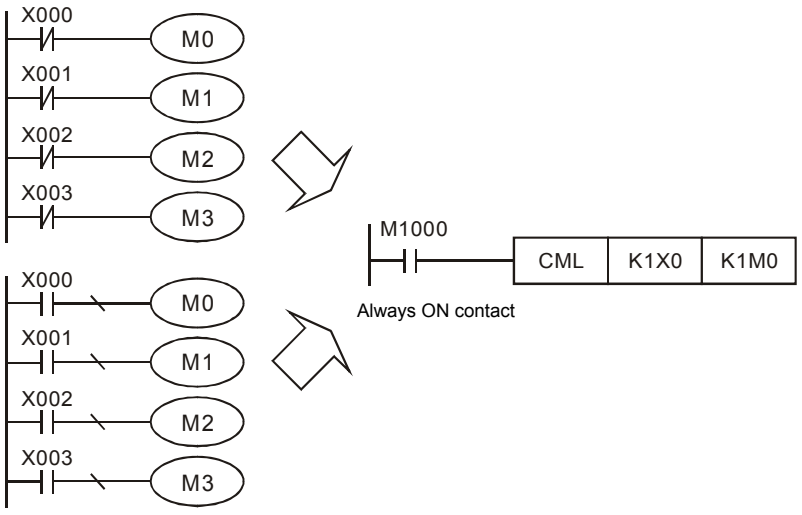
Example 1

When X10 = On, invert D1's b0~b3 contents and send to Y0~Y3.



Example 2

The circuit shown to the left in the figure below can be presented with a CML command as presented in the circuit to the right.



- BCD

API					
007	D	BCD		(S) (D)	BIN→BCD conversion

	Bit device						Word device								External device		
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S												O	O	O			O
D												O	O	O			O

Notes on the use of operands: S operand can use external device, such as DAI and DAO. D operand can use DAO as the external device.

16-bit command (5 STEP)
BCD

32-bit command (5 STEP)
DBCD

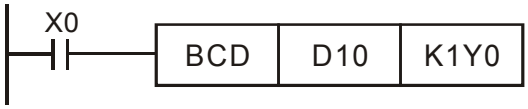
Flag signal: R20

Command description

S: Source of data. D: Outcome of conversion.
Do BCD conversion for BIN data contained in S and save in D.
When the BCD conversion output exceeds 0~9,999, and R20=On, the command error code is 01.
When the DBCD conversion output exceeds 0~99,999,999 and R20 = On, the command error code W20 is 01.
The INC and DEC commands used by PLC's arithmetic operations are executed with values in BIN format. To see values displayed in decimal format, users need to convert values in BIN format to BCD one with the BCD conversion.

Example

When X0 = On, values in D10 are converted from BIN to BCD format and the digit in ones of the outcome is stored in bit elements K1Y0 (Y0~Y3).



If D10 = 001E (Hex) = 0030 (decimal), then the outcome of execution is Y0~Y3 = 0000 (BIN).

- BIN

API					
008	D	BIN		(S) (D)	BCD→BIN conversion

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S												O	O	O			O
D												O	O	O			O

Notes on the use of operands: S operand can use external device, such as DAI and DAO. D operand can use DAO as the external device.

16-bit command (5 STEP)
BIN

32-bit command (5 STEP)
DBIN

Flag signal: R20

Command description

S: Source of data. D: Outcome of conversion.
Do BIN conversion for source data in S (BCD: 0~9,999) and save in D.
Valid range of source data in S is BCD (0~9,999) and DBCD (0~99,999,999).
When the data contained in S is not BCD value (Any of the digit in Hex format is not within the range between 0 and 9.), computing error will occur. Then, R20 is On and the command error code, W20 is 04.
Constant K is converted to BIN automatically, thus, no need to use this command.

Example

When X0 = On, BCD format value in K1M0 is converted to a BIN format one and save in D10.

- FCMP

API					
009		FCMP		(S1) (S2) (D)	Floating point number compare

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	word
S1												O	O	O	O		
S2												O	O	O	O		
D		O	O														

Notes on the use of operands: S1 operand could use F device and so does S2.

16-bit command

32-bit command (7 STEP)
FCMP

Flag signal: None

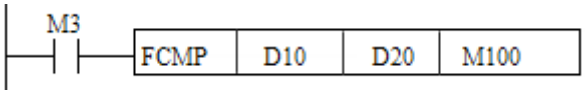
Command description

S1: comparison value 1. S2: comparison value 2. D: comparison result.
Compare the comparison value 1 and 2 and place the outcome (> , = , <) in D.
When the comparison outcome > is established, the first bit of D is On; When the comparison outcome = is established, the second bit of D is On; When the

comparison outcome < is established, the third bit of D is On.

Example

When M3 = On, compare the content of register D10 and D20 in floating point number format.
When the value of D10 is greater than D20, M100 = On.
When the value of D10 equlas to D20, M101 = On.
When the value of D10 is less than D20, M102 = On.



- FMOV

API					
050		FMOV		(S) (D) (n)	Assign all

	Bit device						Word device								External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	word
S										O	O	O			O		O
D										O	O	O					O
n												O			O		O

Notes on the use of operands: S operand can use K device and external device, such as DAI and DAO.
D operand can use DAO as the external device; N operand can use K device.

16-bit command (11 STEP)
FMOV

32-bit command (11 STEP)
DFMOV

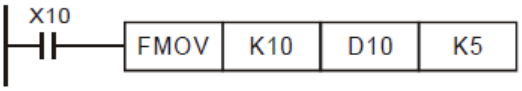
Flag signal: None

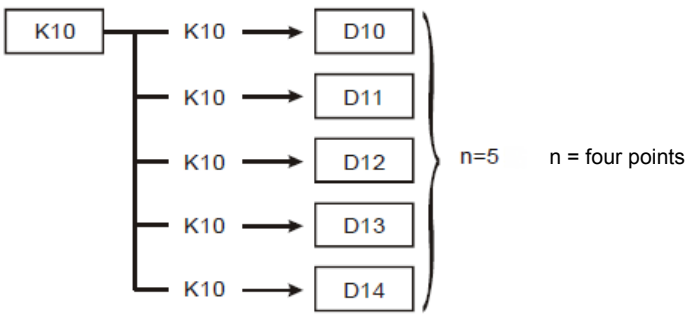
Command description

S: Data source. D: Start of target device. n: Length of assigned block.
The value of S is assigned to each device in a data block starting from the D specified and the block length is n. If the number specified by n exceeds the range, the command will not be executed.

Example

When X10 = On, content of register D0 ~ D3, will be transmitted to the four registers, D20 ~ D23.





- REF

API					
010		REF		D n	I/O refresh

	Bit device						Word device									External device		
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word	16-bit command (2 STEP)
D	O	O														O		REF
n																		
Notes on the use of operands: D operand can use external device, DX and DY, which shuld select the multiple of 16 as the device number.																		32-bit command
Range of n operand: 16~512, which is the multiple of 16.																		Flag signal: None

Command description

D: The starting device for I/O refresh. n: Number of devices to be I/O refreshed. The I/O terminals are refreshed only after all their statuses are scanned. The status of the input device is read from the status of the external input point and saved in the input point's memory after the program scanning is started. Contents contained in the output terminal's memory are sent to output devices only after the END command is executed. Use this command to get the latest I/O data during computing.

Example

When X0 = On, it reads the status of the input points X0~X17 and updates the input signals immediately (without any input delay).

- ROR

API					
011	D	ROR		D n	Rotate right

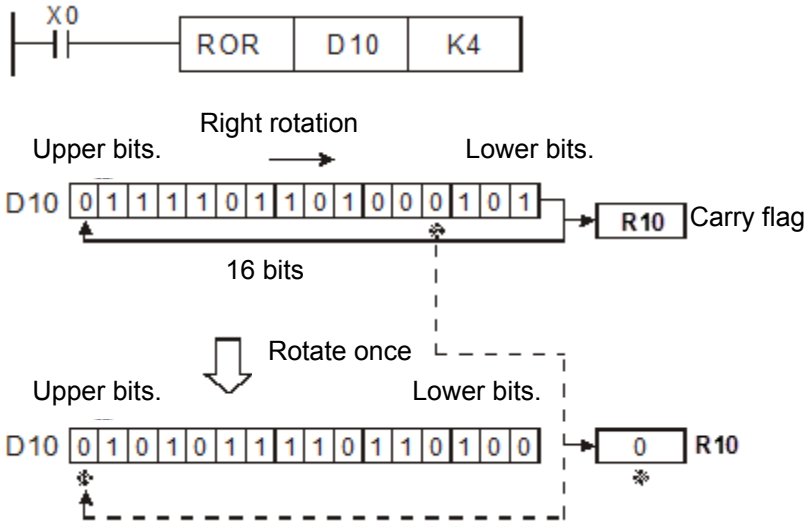
	Bit device						Word device									External device		
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word	16-bit command(3 STEP)
D								O	O	O	O	O	O	O		O		ROR
n																		
Notes on the use of operands: D operand can use external device, KnDY and DAO.																		32-bit command (3 STEP) DROR
Range of n operand: n = K1~K16 (16-bit), n = K1~K32 (32-bit)																		Flag signal: R10

Command description

D: Device to be rotated. n: Number of bits to be rotated in one operation. Right rotate n bits of digit contained in device specified by D for one time.

Example

When X0 changes from Off→On, the 16 bits of number kept in D10 right rotates in unit of 4 bits as shown in figure below. ※marked bit value is sent to carry flag R10.



- ROL

API					
012	D	ROL		D n	Rotate left

	Bit device						Word device								External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
D								O	O	O	O	O	O	O		O	
n																	

Notes on the use of operands: D operand can use external device, KnDY and DAO.

Range of n operand: n = K1~K16 (16-bit), n = K1~K32 (32-bit)

16-bit command (3 STEP)
ROL

32-bit command (3 STEP)
DROL

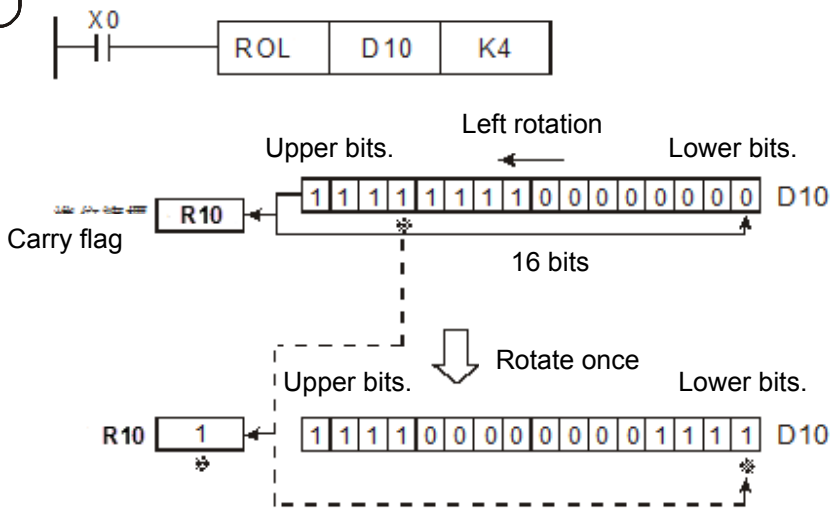
Flag signal: R10

Command description

D: Device to be rotated. n: Number of bits to be rotated in one operation.
Left rotate n bits of digit contained in device specified by D for one time.

Example

When X0 changes from Off→On, the 16 bits of number kept in D10 left rotates in unit of 4 bits as shown in figure below. ※marked bit value is sent to carry flag R10.



- CJ

API					
013		CJ		S	Conditional jump

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word

Notes on the use of operands:
The S operand can assign index P0~P255.

16-bit command (2 STEP)
CJ

32-bit command

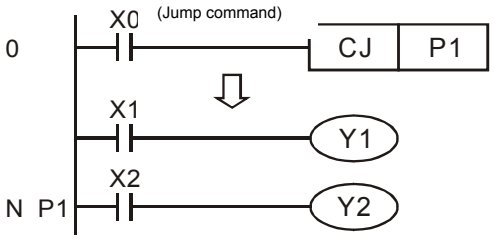
Flag signal: None

Command description

S: Command indicator of a conditional jump.
Use the CJ command to skip a section of statements in an MLC program to reduce scan time.
Multiple CJ commands can point to one subject P. DO NOT point CJ and CALL commands to the same subject P as this may lead to a program error.
Device actions when executing jump command:
Status of device Y, M, and S remains intact before jump command execution.
The 10ms and 100ms timer stops timing.
Timer T192~T199 for sub program keeps on timing and the output contact functions normally.
Counter stops counting.
If the clear command of timer is executed before jumping, the device is in clear status when executing jumping, thus, the command will not be executed.

Example

When X0 = On, the program jumps from address 0 to N (the assigned label P1) for execution and ignore all statements in between.
When X0 = Off, the program executes from address 0 downward in sequence as common ones and ignores the CJ command.



- CALL

API		CALL		S	Call sub programs
014					

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word

Notes on the use of operands: S operand is the name of sub program

16-bit command (2 STEP)
CALL

32-bit command

Flag signal: R18

Command description

S: Command indicator of calling sub program, which should be already existed.
Call command call a sub program as many times as desired.
The CALL command can nest eight calling layers inclduing the original one.
Subroutine called in the nineth layer does not run and will cause grammar error.
Then, R18 = On and the grammar error code W18 is 06.

- LAUNCH

API					
015		LAUNCH		(S)	Activate motion program

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word

Notes on the use of operands: S operand is the name of motion program.

16-bit command (2 STEP)
LAUNC
H

32-bit command

Flag signal: R18

Command description

S: The called motion program has to be existed.
LAUNCH command can be used to call any motion program without limit number of times.
LAUNCH command cannot be used in motion program.
LAUNCH command can be used to call motion program without limit number of times in cyclic task or sub program. The number of motion program that is wating to be executed can up to 256. If it exceeds 256, the command which is called after that will not be executed and cause grammar error. Then, R18 = On and W18 is 12.

- FOR

API					
016		FOR		(S)	Nest loops start

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S												O	O	O			O

Notes on the use of operands: S operand can use external device, DAO.

16-bit command (3 STEP)
FOR

32-bit command

Flag signal: R18

Command description

S: Number of times the loop is to be executed.

- NEXT

API					
017		NEXT		-	Nest loops end

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word

Notes on the use of operands:
No operand is required. Connection point driven command does not follow.

16-bit command (1 STEP)
NEXT

32-bit command

Flag signal: R18

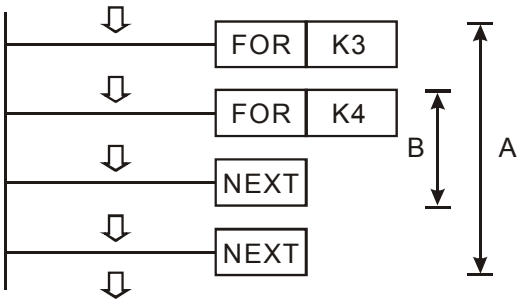
Command description

The FOR command specifies the number of times a FOR~NEXT loop is to be executed. After the loop is ended, the program continues running from the statement next to the NEXT command.
The valid range of repetition times is indicated by N=K1~K32,767. Any value of N less than K1 will be rounded to K1, when the range is N ≦ K1.
Users can use a CJ command to exit the FOR~NEXT loop.
Possible errors are:
1. The NEXT command precedes the FOR one.
2. The FOR command lacks an accompanying NEXT one.
3. END, SRET or IRET command follows by a NEXT one.
4. FOR and NEXT command are not in pair.

The FOR~NEXT loops can nest for up to 5 layers. If the nesting number exceeds the limit, grammar error might occur. Then, R18 = On and the grammar error code W18 is 05.

Example

Program A continues running the subroutine next to the last NEXT command after being repeated 3 times. During each execution of program A, program B is executed for 4 times. That is, program B runs for 12 times in total.



- ADD

API					
018	D	ADD		(S1) (S2) (D)	BIN addition

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S1							O	O	O	O	O	O	O	O	O		O
S2							O	O	O	O	O	O	O	O	O		O
D								O	O	O	O	O	O	O	O		O

Notes on the use of operands: S operand can use external device, KnDX, KnDY, DAI and DAO and K device.
S2 operand can use external device, KnDX, KnDY, DAI and DAO and K device.
D operand can use external device, KnDY and DAO

16-bit command (7 STEP)
ADD

32-bit command (7 STEP)
DADD

Flag signal:R8, R9, R10

Command description

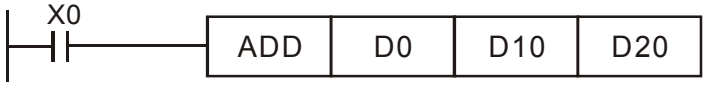
S1: Summand. S2: Addend. D: Sum.
Add values contained in data sources S1 and S2 in BIN format and save the sum in D.
The very first bit of each data represnts it's positive (0) or negative (1). This enables algebraic addition operations like 3+(-9)=-6.
Flag of addition:

16-bit BIN addition:
1. When the addition outcome is 0, the zero flag R8 is On.
2. When the addition outcome is less than –32,768, the borrow flag R9 is On.
3. When the addition outcome is greater than 32,767 the carry flag R10 is On.

32-bit BIN addition:
1. When the addition outcome is 0, the zero flag R8 is On.
2. When the addition outcome is less than –2,147,483,648, the borrow flag R9 is On.
3. When the addition outcome is greater than 2,147,483,647 the carry flag R10 is On.

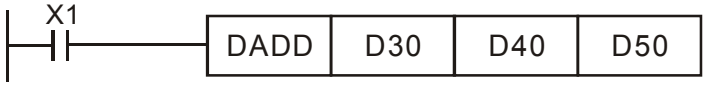
Example 1

16-bit BIN addition: In case X0=On, the sum of summand D0 and addend D10 is kept in D20.



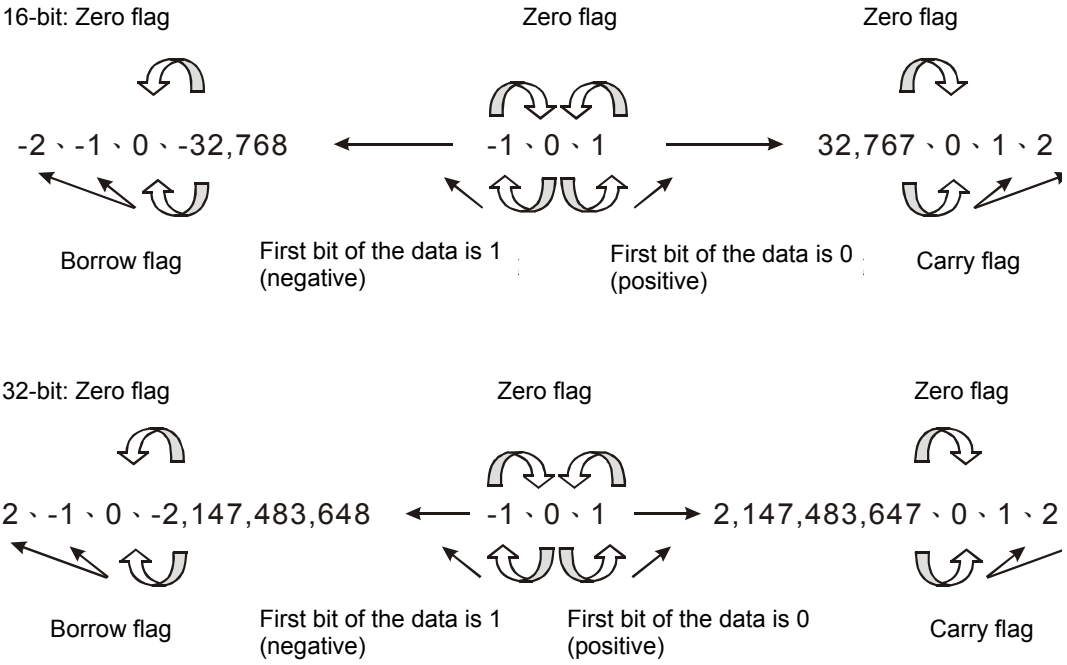
Example 2

32-bit BIN addition: when X1=On, the sum of summand (D31, D30) and addend (D41, D40) is kept in (D51, D50) where D30, D40, and D50 are the lower 16-bit data while D31, D41, and D51 are the upper one.



Supplementary description

Relations between flag changes and the positive/negative property of a number:



- SUB

API					
019	D	SUB		(S1) (S2) (D)	BIN subtraction

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S1							O	O	O	O	O	O	O	O	O		O
S2							O	O	O	O	O	O	O	O	O		O
D								O	O	O	O	O	O	O	O		O

Notes on the use of operands: S operand can use external device, KnDX, KnDY, DAI and DAO and K device.
S2 operand can use external device, KnDX, KnDY, DAI and DAO and K device.
D operand can use external device, KnDY and DAO.

16-bit command (7 STEP)
SUB

32-bit command (7 STEP)
DSUB

Flag signal:R8, R9, R10

Command description

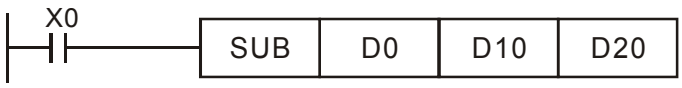
S1: Minuend. S2: Subrahend. D: Difference.
Subtract values contained in data sources S1 and S2 in BIN format and save the sum in D.
The very first bit of each data represnts it's positive (0) or negative (1). This enables algebraic subtraction operation like 3+(-9)=-6.
Flag of subtraction:

16-bit BIN subtraction:
1. When the addition outcome is 0, the zero flag R8 is On.
2. When the addition outcome is less than –32,768, the borrow flag R9 is On.
3. When the addition outcome is greater than 32,767 the carry flag R10 is On.

32-bit BIN subtraction:
1. When the addition outcome is 0, the zero flag R8 is On.
2. When the addition outcome is less than –2,147,483,648, the borrow flag R9 is On.
3. When the addition outcome is greater than 2,147,483,647 the carry flag R10 is On.

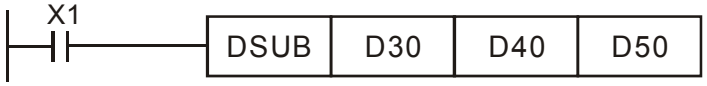
Example 1

16-bit BIN subtraction: When X0=On, the remnant of D0 less D10 is kept in D20.



Example 2

32-bit BIN subtraction: When X1=On, the remnant of (D31, D30) less (D41, D40) is kept in (D51, D50) where D30, D40, and D50 are the lower 16-bit data while D31, D41, and D51 are the upper one.



- MUL

API					
020	D	MUL		(S1) (S2) (D)	BIN multiplication

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S1							O	O	O	O	O	O	O	O	O		O
S2							O	O	O	O	O	O	O	O	O		O
D								O	O	O	O	O	O	O	O		O

Notes on the use of operands: S operand can use external device, KnDX, KnDY, DAI and DAO and K device.
S2 operand can use external device, KnDX, KnDY, DAI and DAO and K device.
D operand can use external device, KnDY and DAO.
16-bit command D operand takes consecutive 2 points.
32-bit command D operand takes consecutive 4 points.

16-bit command (7 STEP)
MUL

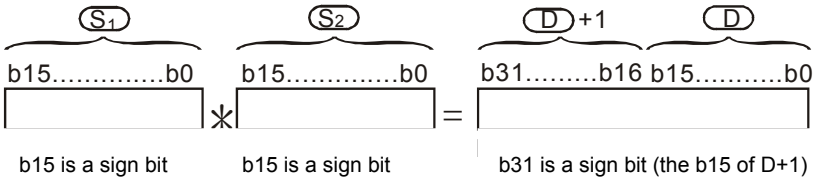
32-bit command (7 STEP)
DMUL

Flag signal: None

Command description

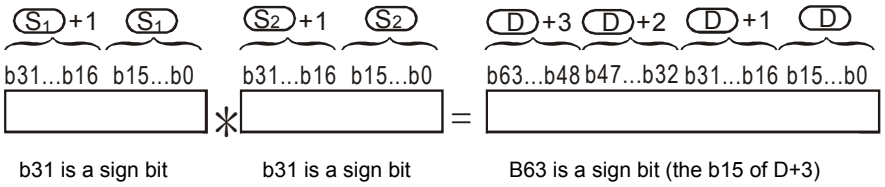
S1: Multiplicand. S2: Multiplier. D: Product.
Multiply values contained in data source S1 and S2 in binary integer multiplication and save its product in D. Please pay special attention to the sign bit of data contained in S1, S2 and D during 16-bit and 32-bit operation.

16-bit BIN multiplication operation:



Sign bit = 0 indicates positive number; sign it = 1 indicates negative number.

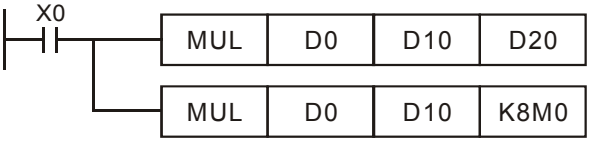
32-bit BIN multiplication operation:



Sign bit = 0 indicates positive number; sign it = 1 indicates negative number.

Example

The product of 16-bit D0 and 16-bit D10 is a 32-bit value with the upper 16-bit kept in D21 and lower 16-bit in D20. The number's positive or negative property is determined by Off/On status of its first bit.



- DIV

API					
021	D	DIV		S1 S2 D	BIN division

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S1							O	O	O	O	O	O	O	O	O		O
S2							O	O	O	O	O	O	O	O	O		O
D								O	O	O	O	O	O	O	O		O

Notes on the use of operands: S operand can use external device, KnDX, KnDY, DAI and DAO and K device.
S2 operand can use external device, KnDX, KnDY, DAI and DAO and K device.
D operand can use external device, KnDY and DAO.
16-bit command D operand takes consecutive 2 points.
32-bit command D operand takes consecutive 4 points.

16-bit command (7 STEP)
DIV

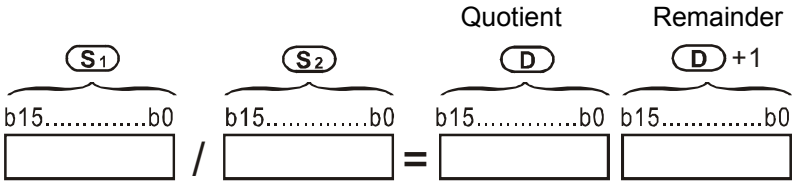
32-bit command (7 STEP)
DDIV

Flag signal: R20

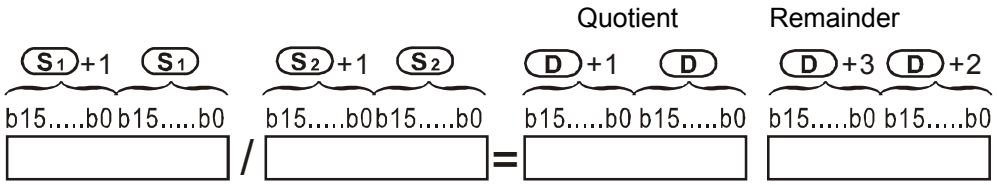
Command description

S1: Dividend. S2: Divisor. D: Quotient and remainder.
Values contained in S1 divided by that of S2 in binary integer division and saves its quotient and remainder in D. Please pay special attention to the sign bit of data contained in S1, S2 and D during 16-bit and 32-bit operation.
This command is ignored in case the divisor is 0. When R20 = On, the error code of W20 is 02.

16-bit BIN division operation:

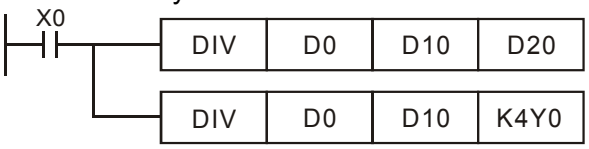


32-bit BIN division operation:



Example

When X0 = On, the quotient and remainder of D0 divided by divisor D10 is kept in D20 and D21 respectively. Both numbers' positive or negative property is determined by Off/On status of their first bit respectively.



- INC

API				
022	D	INC	D	BIN add one

	Bit device						Word device								External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
D								O	O	O	O	O	O	O	O		O

Notes on the use of operands: D operand can use external device, KnDY and DAO.

16-bit command (3 STEP)
INC

32-bit command (3 STEP)
DINC

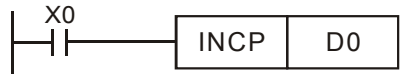
Flag signal: None

Command description

D: The target device.
This command increases the value contained in specified device D by 1 every time it is scanned by the program.
For 16-bit operation the sum of 32,767 and 1 is -32,768 and the sum of 2,147,483,647 and 1 is -2,147,483,648 for 32-bit operation.

Example

When X0 = Off→On, value of D0 increase by 1 automatically.



- DEC

API					
023	D	DEC		(D)	BIN less one

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
D								O	O	O	O	O	O	O	O		O

Notes on the use of operands: D operand can use external device, KnDY and DAO.

16-bit command (3 STEP)
DEC

32-bit command (3 STEP)
DDEC

Flag signal: None

Command description

D: The target device.
This command decreases value contained in specified device D by 1 every time it is scanned by the program.
For 16-bit operation the remnant of -32,768 less 1 is 32,767 and the remnant of -2,147,483,648 less 1 is 2,147,483,647.

Example

When X0 = Off→On, value of D0 decrease by 1 automatically.

- WAND

API					
024	D	WAND		(S1) (S2) (D)	AND operation

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S1							O	O	O	O	O	O	O	O	O		O
S2							O	O	O	O	O	O	O	O	O		O
D								O	O	O	O	O	O	O	O		O

Notes on the use of operands: S operand can use external device, KnDX, KnDY, DAI and DAO and K device.
S2 operand can use external device, KnDX, KnDY, DAI and DAO and K device.
D operand can use external device, KnDY and DAO.

16-bit command (7 STEP)
WAND

32-bit command (7 STEP)
DWAN
D

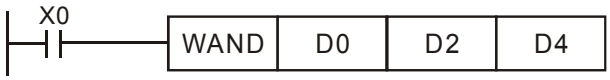
Flag signal: None

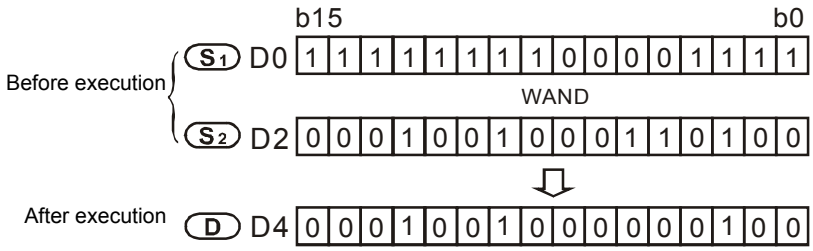
Command description

S1: Source data device 1. S2: Source data device 2. D: Operation outcome.
Do logic AND operation on data sources S1 and S2 and save its outcome in D.
The logic AND operation turns an outcome of 0 when either of its two values is 0.

Example

When X0 = On, do WAND (logic AND) operation on 16-bit D0 and D2 and save the outcome in D4.





- WOR

API					
025	D	WOR		S1 S2 D	OR operation

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S1							O	O	O	O	O	O	O	O	O		O
S2							O	O	O	O	O	O	O	O	O		O
D								O	O	O	O	O	O	O	O		O

Notes on the use of operands: S operand can use external device, KnDX, KnDY, DAI and DAO and K device.
S2 operand can use external device, KnDX, KnDY, DAI and DAO and K device.
D operand can use external device, KnDY and DAO.

16-bit command (7 STEP)
WOR

32-bit command (7 STEP)
DWOR

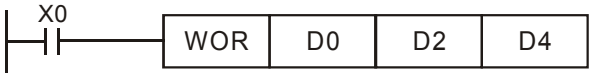
Flag signal: None

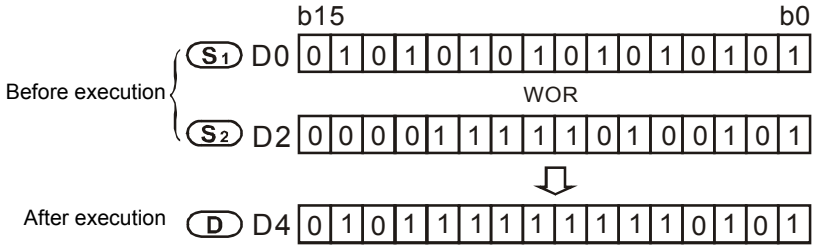
Command description

S1: Source data device 1. S2: Source data device 2. D Operation outcome.
Do logic OR operation on data sources S1 and S2 and save its outcome in D.
The logic OR operation turns an outcome of 1 when either of its two values is 1.

Example

When X0 = On, do WOR (logic OR) operation on 16-bit D0 and D2 and save the outcome in D4.





- WXOR

API					
026	D	WXOR		S1 S2 D	XOR operation

	Bit device						Word device								External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S1							O	O	O	O	O	O	O	O	O		O
S2							O	O	O	O	O	O	O	O	O		O
D								O	O	O	O	O	O	O	O		O

Notes on the use of operands: S operand can use external device, KnDX, KnDY, DAI and DAO and K device.
S2 operand can use external device, KnDX, KnDY, DAI and DAO and K device.
D operand can use external device, KnDY and DAO.

16-bit command (7 STEP)
WXOR

32-bit command (7 STEP)
DWXR

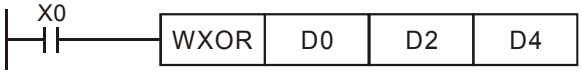
Flag signal: None

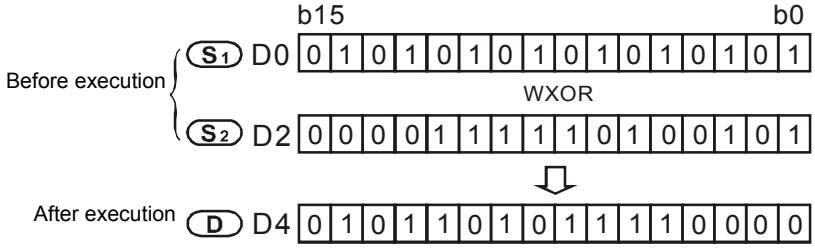
Command description

S1: Source data device 1. S2: Source data device 2. D: Operation outcome.
Do logic XOR operation on data sources S1 and S2 and save its outcome in D.
The logic XOR operation turns an outcome of 0 when both of its two values are the same and 1 when its two values differ from each other.

Example

When X0 = On, do WXOR (logic XOR) operation on 16-bit D0 and D2 and save the outcome in D4.





- NEG

API					
027	D	NEG		(D)	Two's complement

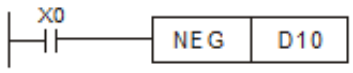
	Bit device						Word device								External device		16-bit command (3 STEP)
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word	NEG
D								O	O	O	O	O	O	O	O		O	
Notes on the use of operands: D operand can use external device, KnDY and DAO.																		32-bit command (3 STEP) DNEG
																		Flag signal: None

Command description

D: The device where two's complement is required. This command converts negative BIN value into the absolute one.

Example

When X0 = On, invert (0→1, 1→0) every bit of digit contained in D10 and increase it by 1 to save in register D10.



Supplementary description

Presentation of negative number and absolute value
Digit in a register is either positive or negative according to value of its leftest bit: "0" indicate a positive number and "1" negative.
Users may convert a negative number into its absolute value with NEG command.

- FADD

API					
028		FADD		(S1) (S2) (D)	Binary floating point number addition

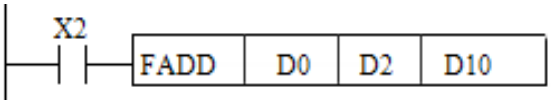
	Bit device						Word device								External device		16-bit command
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word	
S1												O	O	O	O		O	
S2												O	O	O	O		O	
D												O	O	O	O		O	32-bit command (7 STEP) FADD
Notes on the use of operands: S1 operand could use F device S2 operand could use F device																		Flag signal: R8, R9, R10

Command description

S1: Summand. S2: Addend. D: Sum.
Add the value contained in the register assigned by S1 and S2 save the sum in the register assigned by D with all operations executed in binary floating point number format.
When the absolute value of the sum is greater than the maximum value of floating point, the carry flag R10 turns On.
When the absolute value of the sum is less than the minimum value of floating point, the carry flag R9 turns On.
When the sum equals 0, the zero flag R8 turns On.

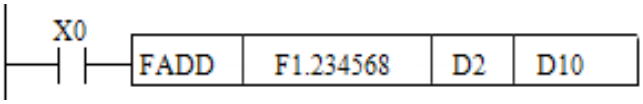
Example 1

When X2 = On, place the sum of a binary floating point number (D1, D0) + binary floating point number (D3, D2) in (D11, D10).



Example 2

When X0 = On, place the sum of a binary floating point number (D3, D2) + F1.234568 (after automatically converted into a binary floating point format) in (D11, D10)



- FSUB

API		FSUB		S1 S2 D	Binary floating point number subtraction
029					

	Bit device						Word device								External device		
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S1												O	O	O	O		O
S2												O	O	O	O		O
D												O	O	O	O		O

Notes on the use of operands: S1 operand could use F device
S2 operand could use F device

16-bit command

32-bit command (7 STEP)
FSUB

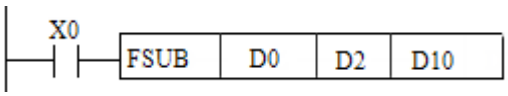
Flag signal: R8, R9, R10

Command description

S1: Minuend. S2: Subtrahend. D: Remnant.
Subtract value contained in the register S1 by value contained in register S2 by value contained in register D with all operations executed in binary floating point number format.
When the absolute value of the remnant is greater than the maximum value of floating point, the carry flag R10 turns On.
When the absolute value of the remnant is less than the minimum value of floating point, the carry flag R9 turns On.
When the remnant equals 0, the zero flag R8 turns On.

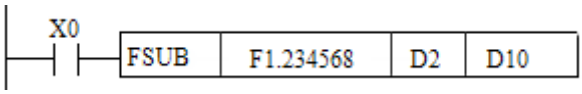
Example 1

When X0 = On, place the remnant of the binary floating point number (D1, D0) - binary floating point number (D3, D2) in (D11, D10).



Example 2

When X0 = On, places remnant of F1.234568 - binary floating point number (D3, D2) in (D11, D10).



- FMUL

API		FMUL		(S1) (S2) (D)	Binary floating point number multiplication
030					

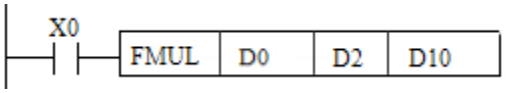
	Bit device						Word device								External device		
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word	16-bit command
S1												O	O	O	O		O	
S2												O	O	O	O		O	
D												O	O	O	O		O	32-bit command (7 STEP) FMUL
Notes on the use of operands: S1 operand could use F device S2 operand could use F device																		Flag signal: R8, R9, R10

Command description

S1: Multiplicand. S2: Multiplier. D: Product.
Multiply the value contained in the register assigned by S1 and S2 save the product in the register assigned by D with all operations executed in binary floating point number format.
When the absolute value of the product is greater than the maximum value of floating point, the carry flag R10 turns On.
When the absolute value of the product is less than the minimum value of floating point, the carry flag R9 turns On.
When the product equals 0, the zero flag R8 turns On.

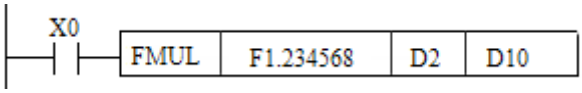
Example 1

When X0 = On, places the product of the binary floating point number (D1, D0) multiply binary floating point number (D3, D2) in the register assigned by (D11, D10).



Example 2

When X0 = On, places the product of the constant F1.234568 × binary floating point number (D3, D2) in (D11, D10).



- FDIV

API					
031		FDIV		(S1) (S2) (D)	Binary floating point number division

	Bit device						Word device								External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S1												O	O	O	O		O
S2												O	O	O	O		O
D												O	O	O	O		O

Notes on the use of operands: S1 operand could use F device

S2 operand could use F device

16-bit command

32-bit command (7 STEP)

FDIV

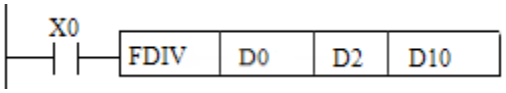
Flag signal: R8, R9, R10, R20

Command description

S1: Dividend. S2: Divisor. D: Quotient and remainder.
Divide value contained in the register S1 by value contained in the register S2 and save the quotient in the register defined by D with all operations executed in binary floating point number format.
If the value in S2 is 0, then the command is ignored with error message "computing error". Then, R20 = On, and the error code is 02.
When the absolute value of the quotient is greater than the maximum value of floating point, the carry flag R10 turns On.
When the absolute value of the quotient is less than the minimum value of floating point, the carry flag R9 turns On.
When the quotient equals 0, the zero flag R8 turns On.

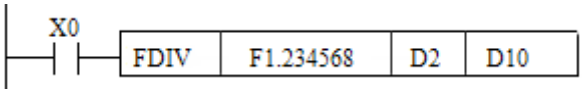
Example 1

When X0 = On, place the remainder of the binary floating point number (D1, D0) divided by binary floating point number (D3, D2) in the register assigned by (D11, D10).



Example 2

When X0 = On, place the outcome of the binary floating point number (D3, D2) ÷ K1,234568 in (D11, D10).



- FINT

API					
032		FINT		(S) (D)	Binary floating point number → Integer

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S												O	O	O	O		
D												O	O	O	O		

Notes on the use of operands: S1 operand takes consecutive 2 points and can use F device.

D operand takes consecutive 2 points.

16-bit command

32-bit command (5STEP)

FINT

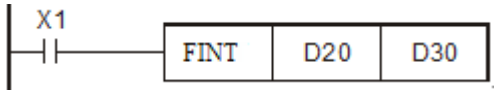
Flag signal: R8

Command description

S: The source device to be converted. D: The conversion outcome.
The value contained in the register assigned by S is converted from binary floating point number to BIN integer and saves in the register assigned by D with the integral floating point number being discarded.
For conversion outcome in zero, the zero flag R8 = On.

Example

When X1 = On, convert binary floating point number (D21, D20) to BIN integer, save the outcome in (D31, D30), and discards the BIN integral floating point number.



- FDOT

API					
033		FDOT		(S) (D)	Integer → Binary floating point number

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S												O	O	O	O		
D												O	O	O	O		

Notes on the use of operands: S1 operand takes consecutive 2 points and can use F device.

D operand takes consecutive 2 points.

16-bit command

32-bit command (5STEP)

FDOT

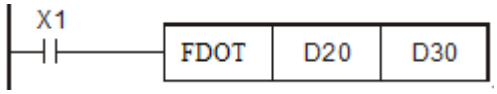
Flag signal: R8

Command description

S: The source device to be converted. D: The conversion outcome.
The register content specified by S is converted to floating point number from BIN integer and saved in the register specified by D.
For conversion outcome in zero, the zero flag R8 = On.

Example

When X1 = On, convert BIN integer (D21, D20) to binary floating point number and save the outcome in (D31, D30),



- FRAD

API					
034		FRAD		(S) (D)	Degree → Radian

	Bit device						Word device								External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S												O	O	O	O		
D												O	O	O	O		

Notes on the use of operands: S1 operand takes consecutive 2 points and can use F device.

D operand takes consecutive 2 points.

16-bit command

32-bit command (5 STEP)

FRAD

Flag signal: R8

Command description

S: Source data (degree). D: Conversion outcome (radian).
Converts the value in the unit of degrees to radians.

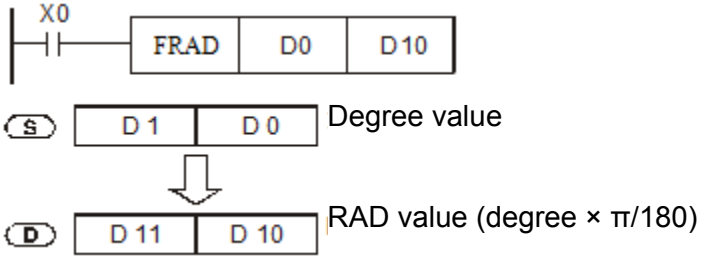
radian = degree × (π/180)

The register content specified by S is converted to the radian in floating point number format from the degree in floating point number format and saved in the register specified by D.

If the outcome equals 0, the zero flag R8 turns On.

Example

When X0 = On, convert binary floating point degree value contained in (D1, D0) to radian value in binary floating point format and save in (D11, D10).



- FDEG

API 035		FDEG		(S) (D)	Radian → Degree

	Bit device						Word device								External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S												O	O	O	O		
D												O	O	O	O		

Notes on the use of operands: S1 operand takes consecutive 2 points and can use F device.

16-bit command (5 STEP)
BIN

32-bit command (5STEP)
DBIN

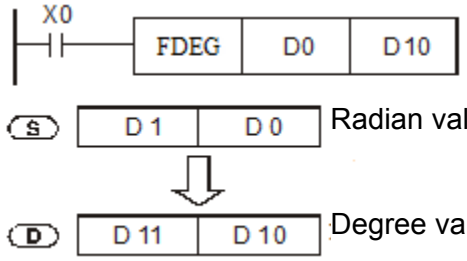
Flag signal: R20

Command description

S: Source data (radian). D: Conversion outcome (degree).
Converts the value in units of radians to degrees.
degree = radian × (180/π)
The register content specified by S is converted to the degree in floating point number format from the radian in floating point number format and saved in the register specified by D. If the outcome equals 0, the zero flag R8 turns On.

Example

When X0 = On, it converts the binary floating point radian value contained in (D1, D0) to a degree value in binary floating point format and saves it in (D11, D10).



- FSIN

API 036		FSIN		(S) (D)	SIN operation in floating point number format

	Bit device						Word device								External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S												O	O	O	O		
D												O	O	O	O		

Notes on the use of operands: S1 operand takes consecutive 2 points and can use F device.
D operand takes consecutive 2 points

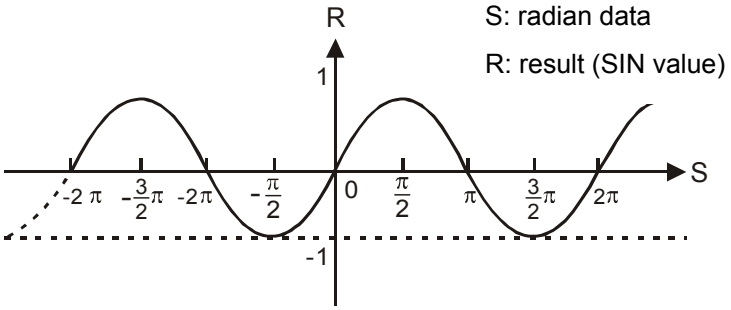
16-bit command

32-bit command (5 STEP)
FSIN

Flag signal: R8

Command description

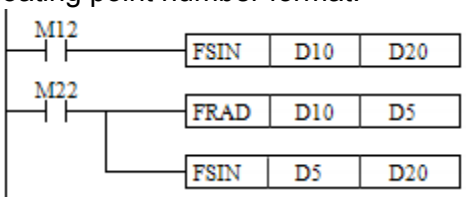
S: Specified source value (floating point number). D: Result acquired from SIN value (floating point number).
Acquire SIN value from the radian specified by S and save in the register specified by D.
The following shows the relation of radian and result:



If the conversion result is 0, then R8 is On.

Example

When M12 = On, acquire SIN value from the radian of (D11, D10) and save in (D21, D20), which is in floating point number format.
When M22 = On, convert the angle of (D11, D10) to RAD value and save in (D6, D5). Then, acquire SIN value of (D6, D5) and save in (D21, D20), which is in floating point number format.



- FCOS

API		FCOS		S D	COS operation in floating point number format
037					

	Bit device						Word device								External device		
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S												O	O	O	O		
D												O	O	O	O		

Notes on the use of operands: S1 operand takes consecutive 2 points and can use F device.
D operand takes consecutive 2 points

16-bit command

32-bit command (5 STEP)
FCOS

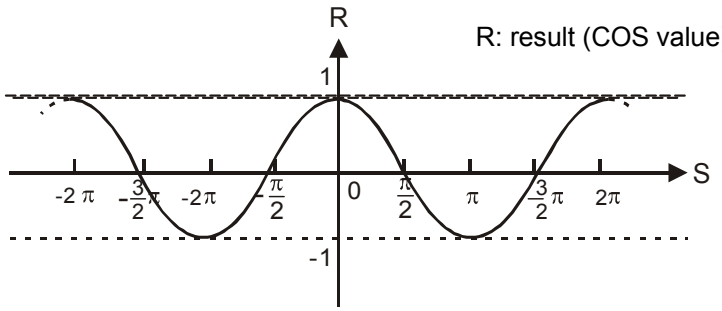
Flag signal: None

Command description

S: Specified source value (floating point number). D: Acquire COS value (floating point number).
Acquire COS value from the radian specified by S and save in the register specified by D.
The following shows the relation of radian and result:

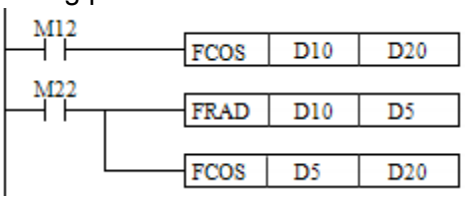
S: radian data

R: result (COS value)



Example

When M12 = On, acquire COS value from RAD value of (D11, D10) and save in (D21, D20), which is in floating point number format.
When M22 = On, convert the angle of (D11, D10) to RAD value and save in (D6, D5). Then, acquire COS value of (D6, D5) and save in (D21, D20), which is in floating point number format.



- FTAN

API 038		FTAN		(S) (D)	TAN operation in floating point number format

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S												O	O	O	O		
D												O	O	O	O		

Notes on the use of operands: S1 operand takes consecutive 2 points and can use F device.

D operand takes consecutive 2 points

16-bit command

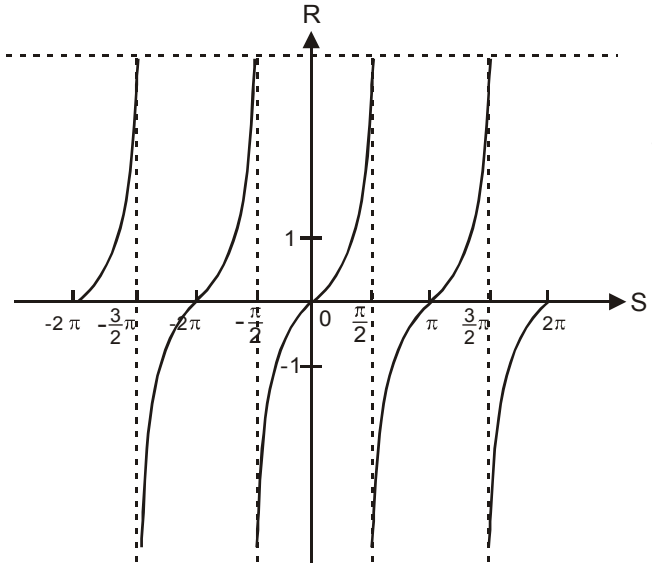
32-bit command (5 STEP)

FTAN

Flag signal: R8

Command description

S: Specified source value (floating point number). D: Acquire TAN value (floating point number).
Acquire TAN value from the radian specified by S and save in the register specified by D.
Following shows the relation of radian and result:



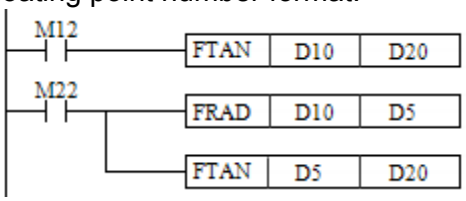
S: radian data

R: result (TAN value)

If the conversion result is 0, then R8 = On.

Example

When M12 = On, acquire TAN value from RAD value of (D11, D10) and save in (D21, D20), which is in floating point number format.
When M22 = On, convert the degree of (D11, D10) to RAD value and save in (D6, D5). Then, acquire TAN value of (D6, D5) and save in (D21, D20), which is in floating point number format.



- FASIN

API					
039		FASIN		(S) (D)	ASIN operation in floating point number format

	Bit device						Word device								External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S												O	O	O	O		
D												O	O	O	O		

Notes on the use of operands: S1 operand takes consecutive 2 points and can use F device.

D operand takes consecutive 2 points

16-bit command

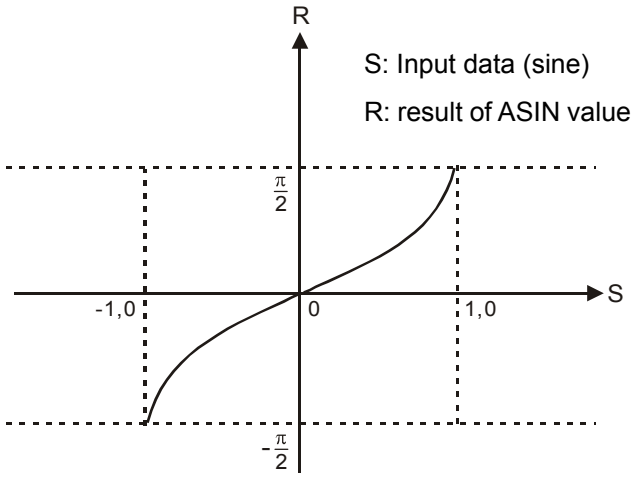
32-bit command (5 STEP)

FASIN

Flag signal: R8, R20

Command description

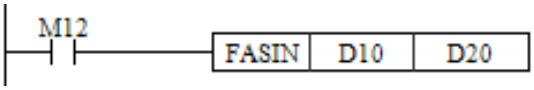
S: Source of specified sine value (floating point number). D: Acquire radian result of ASIN value (floating point number).
ASIN value = sin-1
Following shows the relation of input data and result:



The sine value specified by S operand can only between –1.0 and +1.0. If the value is not within the range, then R20 = On and W20 is 10.
If the conversion result is 0, then R8 = On.

Example

When M12 = On, acquire ASIN value from value of (D11, D10) and save in (D21, D20), which is in floating point number format.



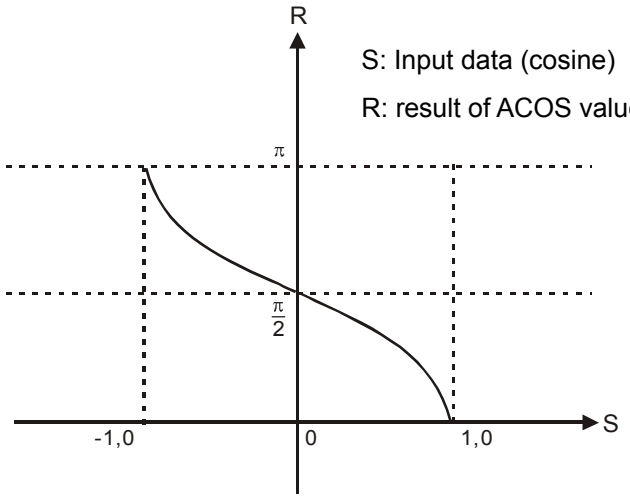
- FACOS

API 040		FACOS		S D	ACOS operation in floating point number format

	Bit device						Word device								External device		
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word	16-bit command
S												O	O	O	O			
D												O	O	O	O			
Notes on the use of operands: S1 operand takes consecutive 2 points and can use F device. D operand takes consecutive 2 points																		32-bit command (5 STEP) FACOS Flag signal: R8, R20

Command description

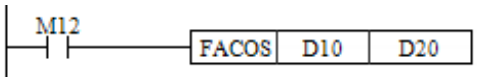
S: Source of specified cosine value (floating point number). D: Acquire radian result of ACOS value (floating point number).
ACOS value = cos-1
Following shows the relationg of input data and result:



The cosine value specified by S operand can only between –1.0 and +1.0. If the value is not within the value, then R20 = On and W20 is 11.
If the conversion result is 0, then R8 = On.

Example

When M12 = On, acquire ACOS value from (D11, D10) and save in (D21, D20), which is in floating point number format.



- FATAN

API		FATAN		(S) (D)	ATAN operation in floating point number format
041					

	Bit device						Word device								External device		
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S												O	O	O	O		
D												O	O	O	O		

Notes on the use of operands: S1 operand takes consecutive 2 points and can use F device.
D operand takes consecutive 2 points

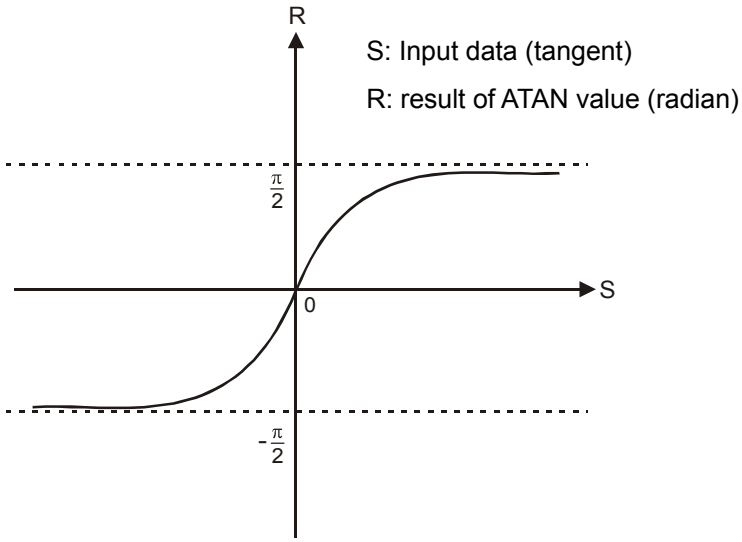
16-bit command

32-bit command (5 STEP)
FATAN

Flag signal: R8

Command description

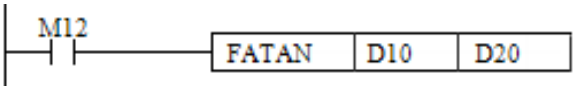
S: Specified tangent source (floating point number). D: Acquire radian result of ATAN value (floating point number).
ATAN value = tan-1
Following shows the relation of input data and result:



If the conversion result is 0, then R8 = On.

Example

When M12 = On, acquire ATAN value from (D11, D10) and save in (D21, D20), which is in floating point number format.



- FSQR

API 042		FSQR		S D	Square root operations in floating point number format

	Bit device						Word device								External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S												O	O	O	O		
D												O	O	O	O		

Notes on the use of operands: S1 operand takes consecutive 2 points and can use F device.

D operand takes consecutive 2 points

16-bit command

32-bit command (5 STEP) FSQR

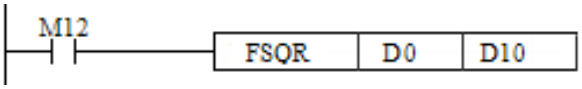
Flag signal: R8

Command description

S: The source device is took square root (floating point number). D: Result of square root (floating point number).
The register content specified by S is took square root. The result is saved in the register specified by D and is in floating point number format.
If the source of S operands is constant K or H, the command will convert the constant into the floating point number for operation.
Only positive number is effective in source operand, the negative one will be regarded as operation error. In this situation, R20 = On and W20 is 12.
If the result of square root is 0, R8 = On.

Example

When X0 = On, take the square root of floating point number, (D1, D0) and save the result in register specified by (D11, D10).



- ZRST

API		ZRST		D1 D2	Zone reset
043					

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
D1		O	O	O	O					O	O	O	O	O			
D2		O	O	O	O					O	O	O	O	O			

Notes on the use of operands: The D1 operand ID ≦ D2 operand ID

Both D1 and D2 operands must be assigned to devices of the same type.

16-bit command (4 STEP)

ZRST

32-bit command

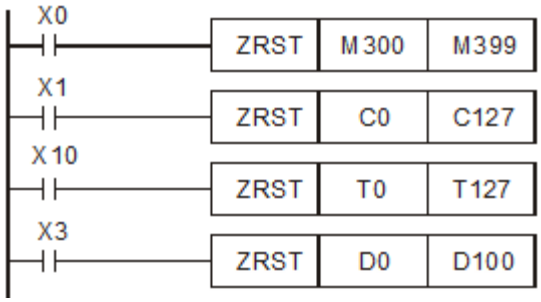
Flag signal: None

Command description

D1: Zone reset starting device. D2: Zone reset ending device.
The 16-bit and 32-bit counters can use the ZRST command together.
When D1 opernad ID ＞ D2 operand ID, only the device assigned by D2 is reset.

Example

When X0 is On, auxiliary relays M300 ~ M399 are reset to Off.
When X1 is On, 16-bit counters C0 ~ C127 are all reset. (Overwrite with value 0 and reset contacts and coils to Off.)
When X10 is On, timer T0 ~ T127 are all reset. (Overwrite with value 0 and reset contacts and coils to Off.)
When X3 is On, data register D0 ~ D100 are all reset to 0.



- DECO

API 044		DECO		S D n	Decoder

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S	O	O	O							O	O	O	O	O		O	O
D		O	O							O	O	O	O	O		O	O
n																	

Notes on the use of operands: S operand can use external device, DX, DY, DAI, DAO and K device.
D can use external device, DY and DAO.
n can use K device.

16-bit command (5 STEP)
DECO

32-bit command

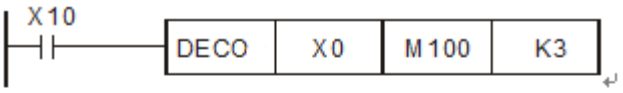
Flag signal: None

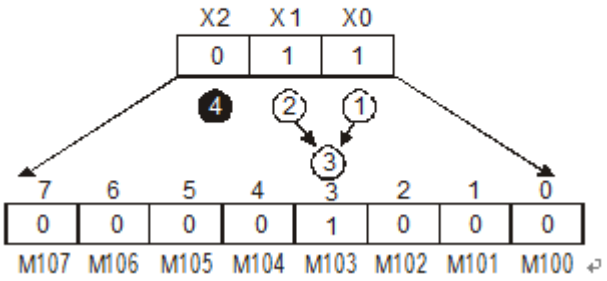
Command description

S: Source device for decoding. D: Target device where decoded value is kept.
n: Decoding bit length.
Decode the lower bits of the "n" bits in source device S and save its outcome of “2 n” bit length in D.

Example

When D is a bit device, n = 1~8. If n = 0 or n > 8, the error occurs.
When n = 8, the DECO command can decode up to 256 (2^8) points. (Please ensure that the range of storage devices after decoding is not duplicated.)
When X10 = On, the DECO command decodes values stored in X0~X2 to M100~M107.
When data source is 1+2 = 3, then the 3rd bit (M103) from M100 is set to 1.
When the DECO command turns X10 to Off, those have been decoded continue the operation.





- ENCO

API		ENCO		S D n	Encoder
045					

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S	O	O	O							O	O	O	O	O		O	O
D										O	O	O	O	O			O
n																	

Notes on the use of operands: S operand can use external device, DX, DY, DAI, DAO and K device.
D can use external device, DAO.
n can use K device.

16-bit command (11 STEP)
ENCO

32-bit command

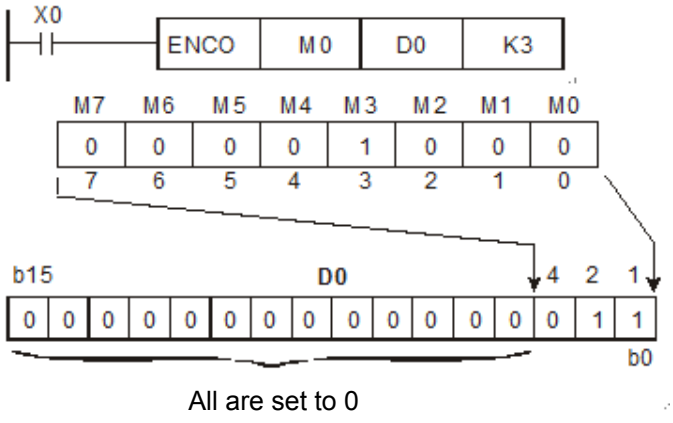
Flag signal: R20

Command description

S: Source device for encoding. D: Target device where encoded value is kept.
n: Encoding bit length.
Encode the lower bits of the "n" bits in source device S and save their outcome of "2^n" bit length in D .
If more than one bit in data source is 1, the first 1 bit (the higherest one) will be processed.
If none of the bit in data source is 1, then R20 = On and W20 is 03.

Example

When S is a bit device and n = 1~8, if n = 0 or n > 8, the error occurs.
When n = 8, the ENCO command can encode up to 256 (2^8) points.
When X0 = On, the ENCO command encodes 8 (2^3) bits of data (M0~ M7) and saves in the lower bits (b2~b0) of D0. Bits not used in D0 (b15~b3) are all set to 0.
When ENCO command turns X0 to Off after its execution, data in D remains intact.



All are set to 0

- BON

API					
046	D	BON		(S) (D) (n)	Bit ON detect

	Bit device						Word device								External device		
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S										O	O	O			O		O
D										O	O	O					O
n												O			O		

Notes on the use of operands: S operand can use external device, DAI and DAO.
D can use external device, DAO.
n can use K device.

16-bit command (5 STEP)
BON

32-bit command (5 STEP)
DBON

Flag signal: None

Command description

S(S): Source device. D: Target device for judgment outcome. n: Position of bit to be judged (beginning with 0).

Example

When X0 = On and the value of the 15th bit in D0 is “1”, then M0 = On. M0 = Off, the value is "0" instead.
If X0 turns to Off, M0 remains intact.

- ALT

API 047		ALT		(D)	ON/OFF alternate

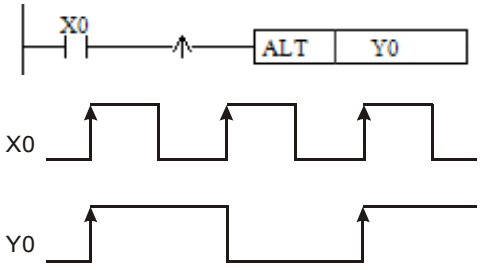
	Bit device						Word device									External device		
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word	16-bit command (2 STEP) ALT
D		O	O			O										O		32-bit command
Notes on the use of operands: D can use external device, DY																		Flag signal: None

Command description

D: Target device..
When ALT command is executing, D alternate On and Off.

Example

Y0 turns On when X0 changes from Off to On for the first time, then Y0 turns Off when X0 changes from Off to On for the second time.



- RSVP

API 048		RSVP		(S1) (S2) (D)	Read parameters of the servo drive

	Bit device						Word device									External device		
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word	16-bit command (13 STEP) RSVP
S1												O	O	O				32-bit command
S2												O	O	O				
D												O	O	O				
Notes on the use of operands: S1 operand can use K device; S2 operand can use K device; S3 operand takes consecutive.																		Flag signal: R18

Command description

S1: Access servo axis ID of parameters. S2: Access parameter ID. D: Accessing result.
Access the servo parameter from S1. If reading P3-21, then value of S2 is 0321 (decimal). The accessing content is saved in the register specified by D.
S2 format and servo dirve parameters.

S2	AB CD
Parameters	**P**AB - CD

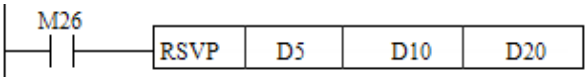
Example of S2:

S2	0321
Parameters	**P**03 - 21

If the connection breaks down or read the incorrect parameters, it results in failure of reading parameters. Then, R18 = On and W18 is 11.

Example

When M26 = On, access parameters (D10) from servo axis specified by the decimal system (D5) and save the result in (D21, D20).



- WSVP

API 049		WSVP		(S1) (S2) (D)	Write parameters of the servo drive

	Bit device						Word device									External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S1												O	O	O			
S2												O	O	O			
D												O	O	O			

Notes on the use of operands: S1 operand can use K device;
S2 operand can use K device;
S3 operand takes consecutive and can use K device

16-bit command (13 STEP)
WSVP

32-bit command

Flag signal: R18

Command description

S1: Write in servo axis ID of parameters.. S2: Write-in parameter ID. D: Source of write-in data.
S1 is the write-in servo axis ID. Assume that P3-21 is the write-in servo parameter, the setting value of S2 is 0321(decimal). Write the register content specified by D into the servo parameter.
S2 format and servo dirve parameters.

S2	AB CD
Parameters	**P**AB - CD

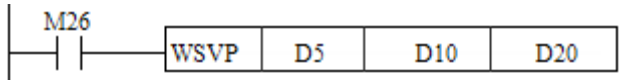
Example of S2:

S2	0321
Parameters	**P**03 - 21

If the connection breaks down or read the incorrect parameters, it results in failure of writing parameters. Then, R18 = On and W18 is 11.

Example

When M26 = On, write the content of (D21, D20) into parameters (D10) specified by the decimal system (D5).



- CKFZ

API		CKFZ		(S) (D)	Forbidden zone check
051					

	Bit device						Word device								External device	
	X	Y	M	T	C	R	KnX	KnY	KnM	T	C	D	V	Z	W	Bit	Word
S												O					
D		O	O													O	

Notes on the use of operands: S1 operand can use K device;
S2 operand can use K device;
S3 operand takes consecutive and can use K device

16-bit command (13 STEP)
CKFZ

32-bit command

Flag signal: None

Command description

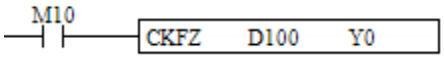
S: Start device stored forbidden zone and the line coordinate data. D: Result of intersection check.
The content of coordinate data is defined as below:

S	Definition
Dn	Start X coordinate of forbidden zone
D(n+2)	Start Y coordinate of forbidden zone
D(n+4)	Start Z coordinate of forbidden zone
D(n+6)	End X coordinate of forbidden zone
D(n+8)	End Y coordinate of forbidden zone
D(n+10)	End Z coordinate of forbidden zone
D(n+12)	Start X coordinate of line
D(n+14)	Start Y coordinate of line
D(n+16)	Start Z coordinate of line
D(n+18)	End X coordinate of line
D(n+20)	End Y coordinate of line
D(n+22)	End Z coordinate of line

If the intersection doesn't occur between forbidden zone and line, the result device will turn On.

Example

When M10 = On, check the intersection of coordinate data (D100 ~ D123). While it exists, the result (Y0) will be turned On. If it doesn't exist, the result will be Off.



Chapter 5 Example of Motion Command

5.1 Preparation

- Confirm the setting and servo drive version
  - Setup P3-00 for servo drive station number
    In DMCNet, it must have station 1.
  - Setup P1-01 in control mode of servo drive
    Set P1-01 to x00b means DMCNet communication
  - Setup P3-01 for servo drive communication
    Set P3-01 to 0203 for general servo drive
    Set P3-01 to 5203 for 4-axis synchronous servo drive
  - Setup P3-10 for servo CANOpen protocol
    Set P3-10 to 11 for use the complete CANOpen DS402 protocol and the motor will servo off while disconnected.

- Clear the alarm of servo drive
  - Servo drive's alarm reset, set [Fault Reset](R592, R593, R594,…) to On
  - Make sure [Servo Fault](R1104, R1105, R1106,…) is set to Off
  - Make sure [Servo Warning](R1120, R1121, R1122,…) is set to Off

- Servo activate
  - The servo axis that executes motion has to be activated. Set [Servo On](R576, R577, R578,…) to On.
  - Make sure the servo drive is On. Set [Servo On](R1072, R1073, R1074,…) to On.

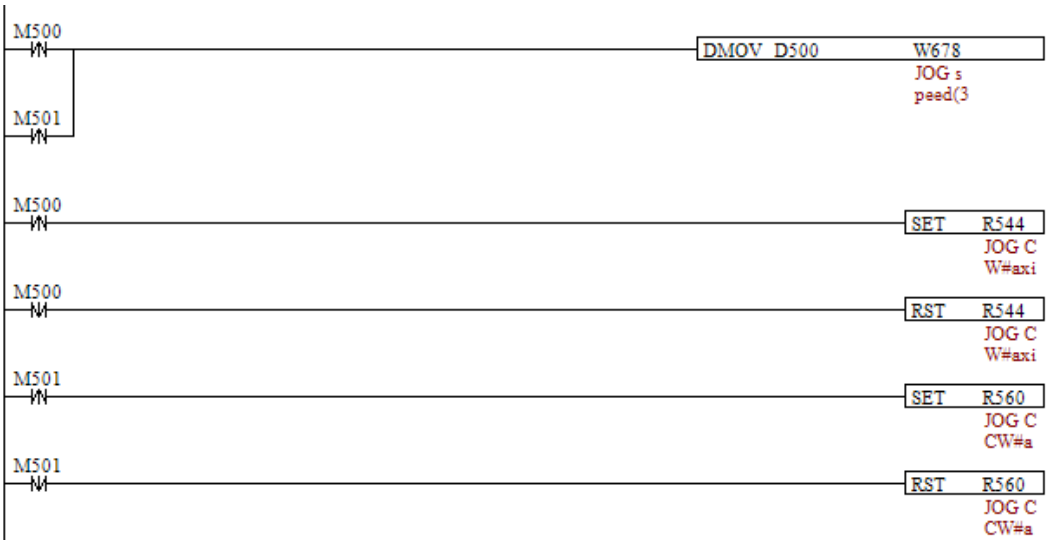
- Release Quick Stop
  - [Quick stop](R528, R529, R530,…) of the servo axis that executes motion has to be Off.
  - Make sure the quick stop status of the servo drive is released. Set [Servo quick stop release](R1088, R1089, R1090, …) to On.
  - If the quick stop status cannot be released, please check the DI setting of the servo drive.

- Others
  - When it is not in Handwheel status, make sure [Handwheel activate](R608, R609, R610, …) is set to Off.

5.2 JOG

- Example description
  - Use M500 as the forward jog control bit of the 1st axis and M501 as the reverse jog control bit of the 1st axis.

- Example program
  - Cyclic Task



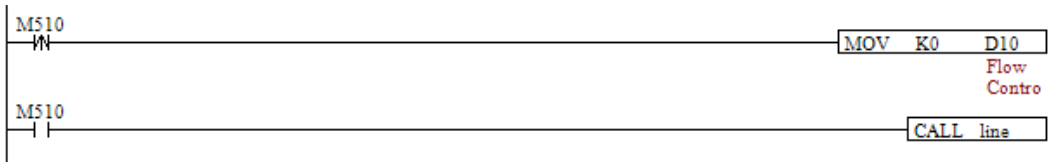
a. When the status of M500 or M501 turns On, write the setting value of D500 into [Jog Speed]W678 (Jog speed of the 1st axis)
b. When M500 turns On, set [Forward Jog] R544 to On, the 1st axis will execute jog in forward direction.
c. When M500 turns Off, set [Forward Jog] R544 to Off, the 1st axis will stop jog in forward direction.
d. When M501 turns On, set [Reverse Jog] R560 to On, the 1st axis will execute jog in reverse direction.
e. When M501 turns Off, set [Reverse Jog] R560 to Off, the 1st axis will stop jog in reverse direction.

- Note
  - The jog speed cannot exceed the maximum speed limit, or the servo drive will has no action after being triggered.
  - If forward jog and reverse jog is activated in the same axis, the priority will be given to the first activated one.
  - Setup [Jog torque limit](W682, ...) to enable the torque limit protection function when Jog is activated.

5.3 Single Axis Linear Motion

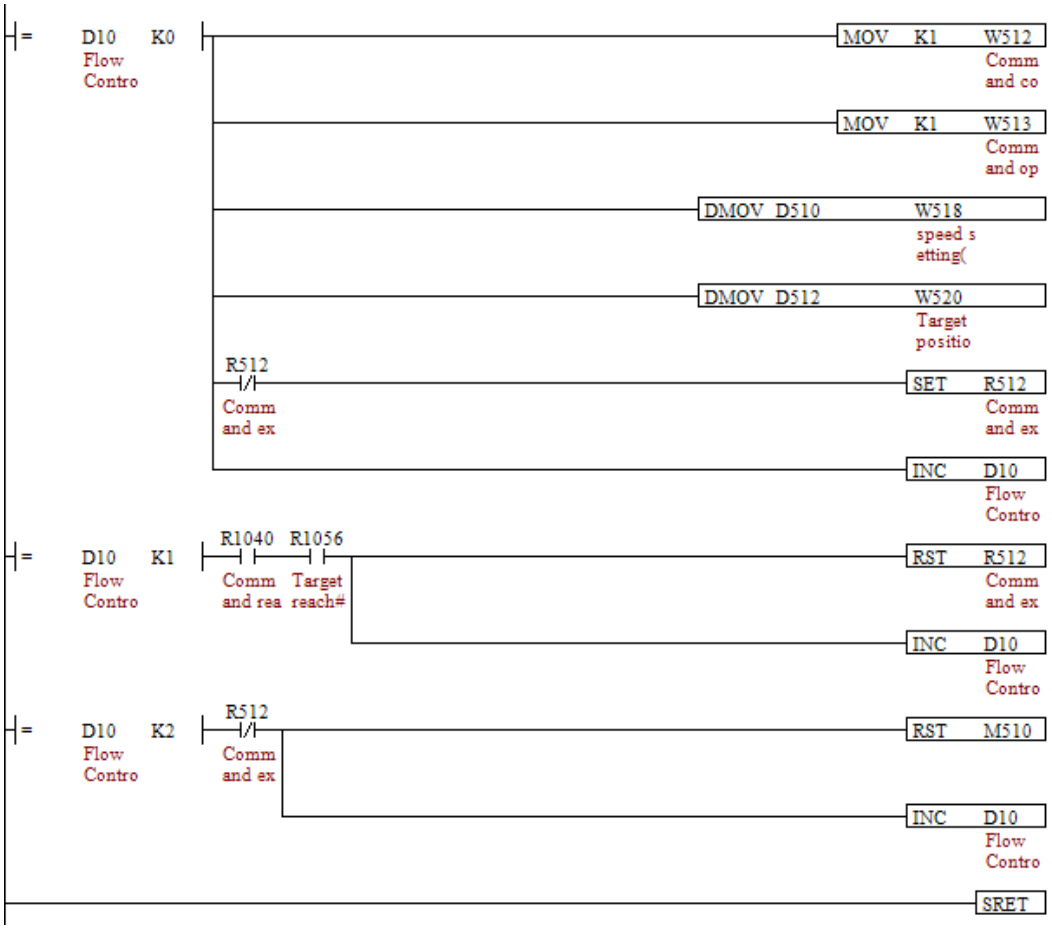
- Example description
  - Use M510 as the enabling condition for triggering and executing linear motion of single axis. After M510 is activated, related parameters will be executed and starts to issue the motion command.

- Example program
  - Cyclic Task



a. When the status of M510 turns On, it is in initial control status (D10=0).
b. When M510 is On, it enters the sub program, line, to execute linear motion of single axis. After the motion is completed, M510 is Off.

  - Sub program: Line

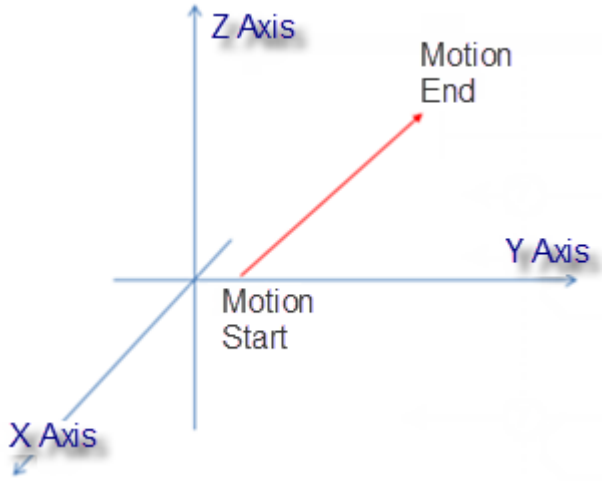


a. When D10 = 0, it starts to write parameters. Set [Command code](W512) to 1, it means linear motion; Set [Command selection](W513) to 1, it means to execute the single axis motion selection of the 1st axis. Write D510 into [Speed setting](W518) of the 1st axis and write D512 into [Target position](W520) of the 1st axis. Trigger [Command start](R512) to On and then D10 = 1.
b. When D10 = 1 and [Command ready](R1040) is On, it means the motion is executing. When [Command complete](R1056) is On, it means the motion is completed. Then, set [Command start](R512) to Off and D10 = 2.
c. When D10 = 2, it means the motion is completed. Make sure [Command start](R512) is set to Off. Then clear the executed flag, M510 to Off. The control procedure is completed.

- Note
  - If the speed is greater than [Max. speed limit], it will operate at the limited max. speed.

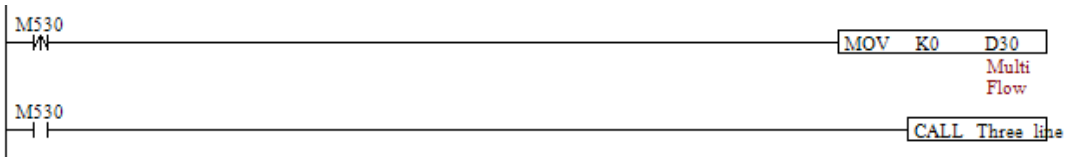
5.4 3-axis Synchronous Linear Motion

- Example description
  - Use M530 as the enabling condition for triggering and executing 3-axis synchronous motion. After M530 is activated, the related parameters are executed and start to issue the command. Linear motion path of the 3-axis is shown in the diagram below.



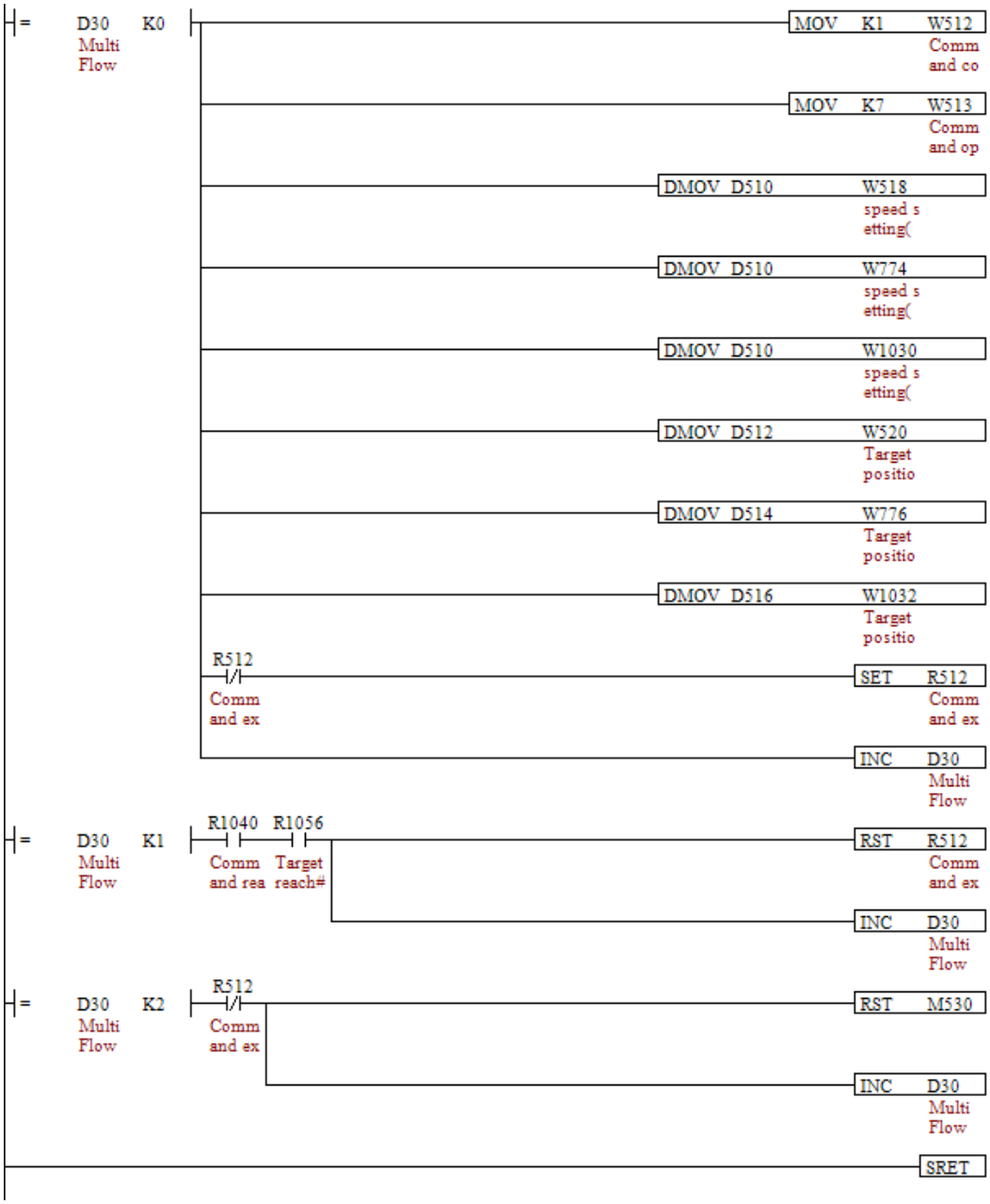
- Example program
  - HMC screen

  - Cyclic Task



a. When M530 turns On, it is in initial control status (D30=0).
b. When M530 is On, it enters sub program, three_line, to execute 3-axis synchronous motion. After the motion is completed, M530 is Off automatically.

・ Sub program: Three_line



a. When D30 = 0, it starts to write the command. Set [Command code] (W512) to 1 which means linear motion is executed. When [Command selection](W513) is set to 7, it represents the 3-axis motion of axis 1, 2, and 3. Write D510 into [Speed setting](W518, W744, W1030) of each axis. Write D512 into [Target position](W520) of axis 1; Write D514 into [Target position](W776) of axis 2 and write D516 into [Target position](W1032) of axis 3. Then, trigger [Command start](R512) to On and D30 = 1.
b. When D30 = 1, [Command ready](R1040) is On, which means the 3-axis synchronous motion is being executed. When [Command completed](R1056) is On, it means the motion is completed. Then, set [Command start](R512) to

Off and D30 = 2.

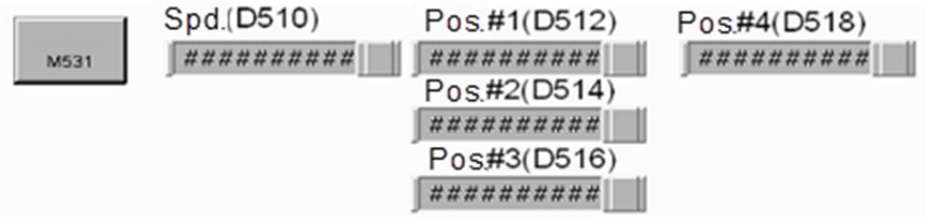
c. When D30 = 2, the motion is completed. Make sure [Command start](R512) is Off and set flag, M530 to Off. The control procedure is completed.

- Note
  - If the speed is greater than [Max. speed limit], it will operate at the limited max. speed.
  - At non-vector speed or in multi-axis linear motion with the specified speed, the servo drive will operate base on the speed which with the longest traveling distance and adjust the speed of other axes so as to accomplish synchronous linear motion.

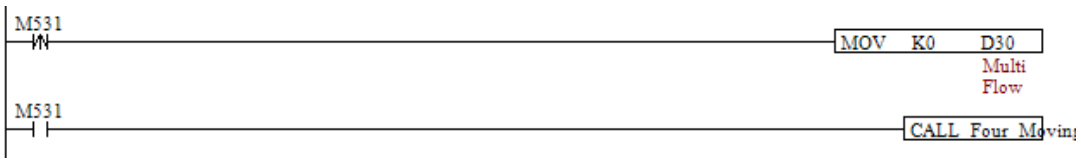
5.5 4-axis Synchronous Linear Motion (Special Type)

- Example description
  - Use M531as the enabling condition for triggering and executing 4-axis synchronous linear motion. After M531 is activated, the related parameters will be executed and issue the command.

- Example program
  - HMC screen



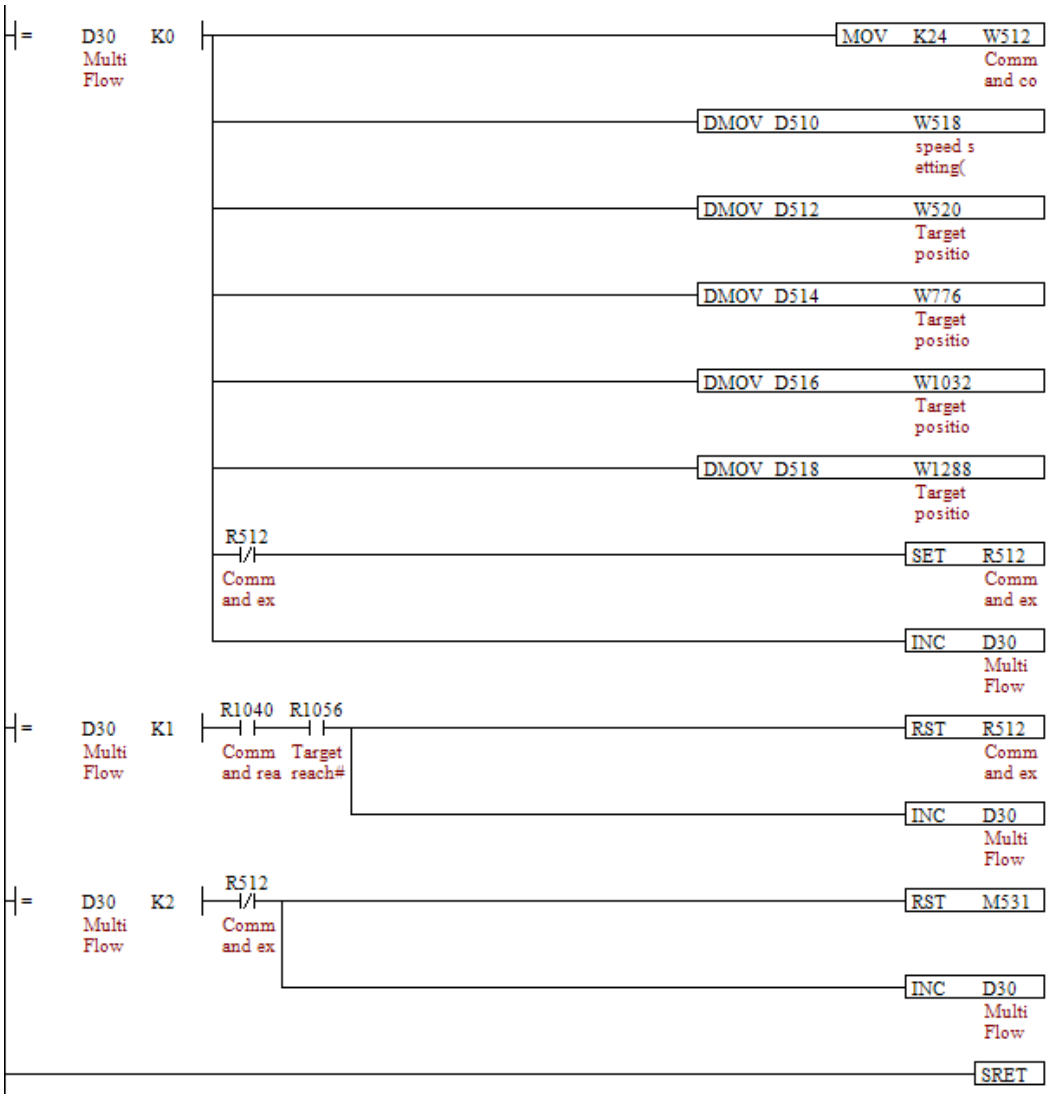
  - Cyclic task



a. When M531 turns On, it is in initial control status (D30=0).

b. When M531 is On, it enters sub program, Four_Moving, to execute 4-axis synchronous motion. After that, M531 is Off automatically.

- Sub program: Four_Moving



a. When D30 = 0, it starts to write parameters. Set [Command code](W512) to 24 means to execute 4-axis synchronous linear motion. Write D510 into [Speed setting](W518) of axis 1, D512 into [Target position](W520) of axis 1, D514 into [Target position](W776) of axis 2, D516 into [Target position](W1032) of axis 3 and D518 into [Target position](W1288) of axis 4. Then, trigger [Command start](R512) to On and D30 = 1.

b. When D30 = 1, if [Command ready](R1040) is On, it means the 4-axis synchronous linear motion is being executed. When [Command ready](R1056) is On, it means the motion is completed. Set [Command start](R512) to Off and D30 = 2.

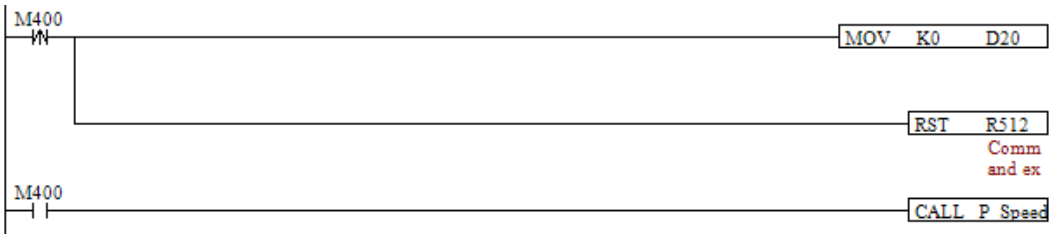
c. When D30 = 2, it means the motion is completed. Make sure [Command start](R512) is Off. Set flag, M531 to Off and the control procedure is completed.

- Note
  - The 4-axis synchronous linear interpolation is for the special function of ASDA-M servo drive. When issuing the command to the servo drive, the 4-axis synchronous servo drive will execute the interpolation. Please refer to appendix C for the using framework and setting.
  - If the speed is greater than [Max. speed limit], it will operate at the limited max. speed.
  - It only needs to issue the speed command to axis 1.

5.6 Forward Speed

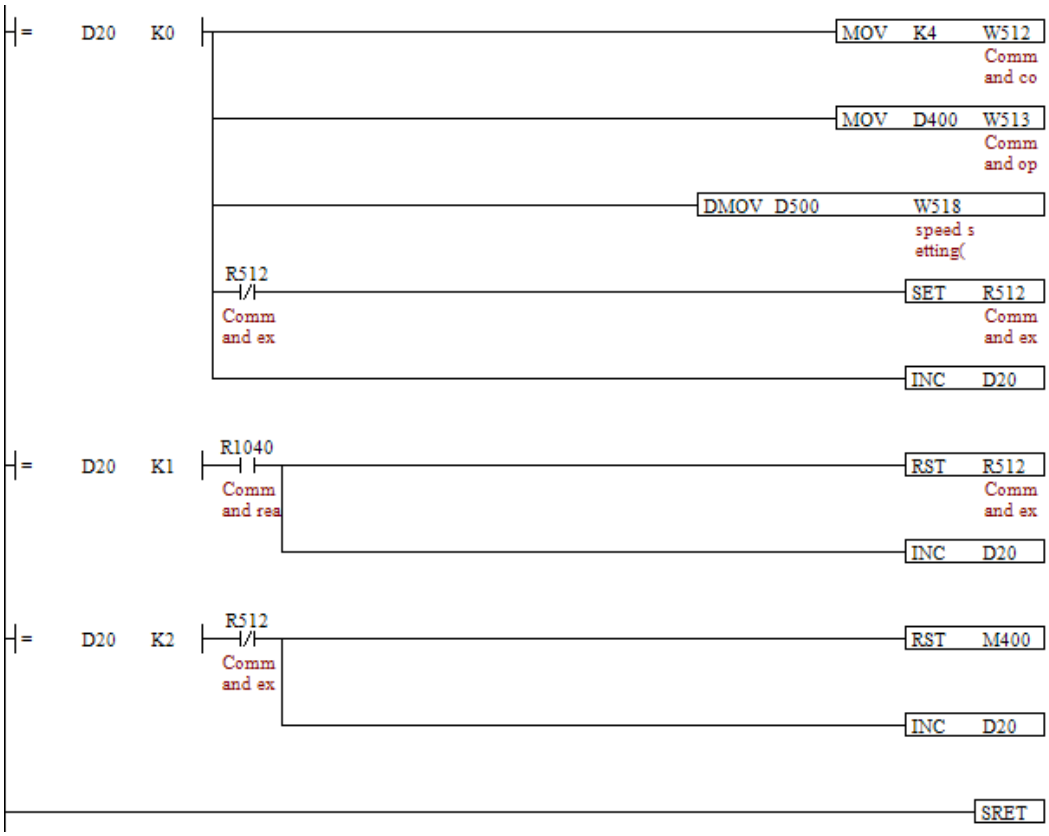
- Example description
  - Use M400 as the enabling condition for triggering and executing forward speed motion. After M400 is executed, the related parameters will be executed and issue the command.

- Example program
  - Cyclic task



a. When M400 turns On, it is in initial control status (D20=0) and resets [Command start](R512) at the same time.
b. When M400 is On, it enters sub program, P_Speed, to execute multi-axis forward speed motion. After the motion is completed, M400 is Off automatically.

- Sub program: P_SPEED



a. When D20 = 0, it starts to write parameters. Set [Command code](W512) to 4 means the operation at forward direction is executed. Write D400 into [Command selection](W513) to activate forward speed axis (Bit 0 is On means axis 1 is activated; while Bit 1 is On means axis 2 is activated.). Write D500 into [Speed setting](W518). Then, trigger [Command start](R512) to On and D20 = 1.

b. When D20 = 1 and [Command ready](R1040) is On, it means the operation at forward direction is executed. Since the status of [Command complete] will not be changed when executing speed command, flag of [Command start](R512) can be Off directly and D20 = 2.

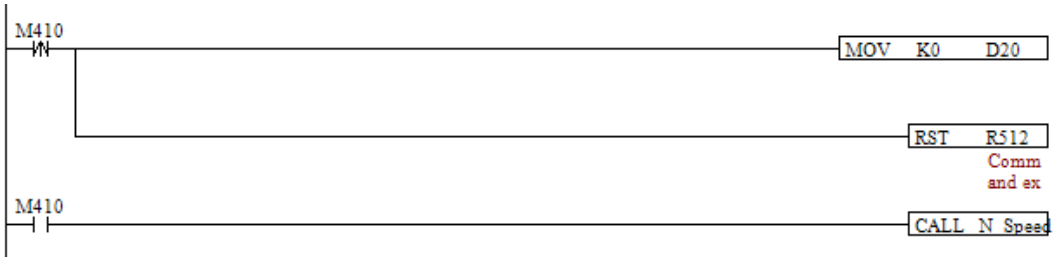
c. When D20 = 2, make sure [Command start](R512) is Off. After that, set M400 to Off and the control procedure is completed.

- Note
  - If the operation speed is greater than [Max. speed limit], it will operate with the limited max. speed.
  - Forward speed operation should be stopped by deceleration stop command or flag of [Quick stop].
  - When speed command at forward or reverse direction is executed, issuing the motion command again will cause command error.

5.7 Reverse Speed

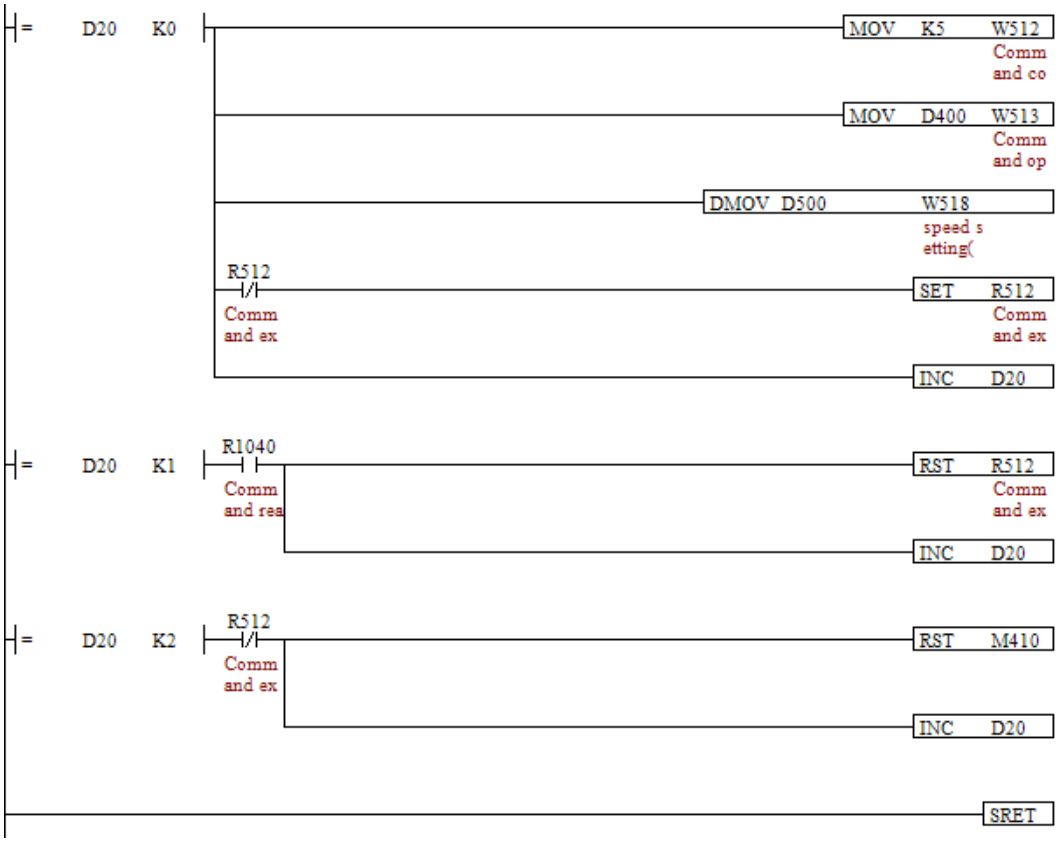
- Example description
  - Use M410 as the enabling condition for triggering and executing operation at reverse speed. After M410 is activated, the related parameters will be executed and issue the command.

- Example program
  - Cyclic task



a. When M410 turns On, it is in initial control status (D20=0) and resets [Command start](R512) at the same time.
b. When M410 is On, it enters sub program, N_Speed, to execute multi-axis reverse operation. Then, M410 will be Off automatically.

  - Sub program: N_SPEED



a. When D20 = 0, it starts to write parameters. When [Command code](W512) is set to 5, it means the operation is at reverse direction. Write D400 into

[Command selection](W513) to select reverse speed axis (When Bit 0 is On, it means axis 1 is activated; Bit 1is On means axis 2 is activated.). Write D500 into [Speed setting](W518). Then, trigger [Command start](R512) to On and D20 = 1.

b. When D20 = 1 and [Command ready](R1040) is On, it means reverse operation is executed. Since the status of [Command complete] will not be changed when executing speed command, flag of [Command start](R512) can be Off and D20 = 2.

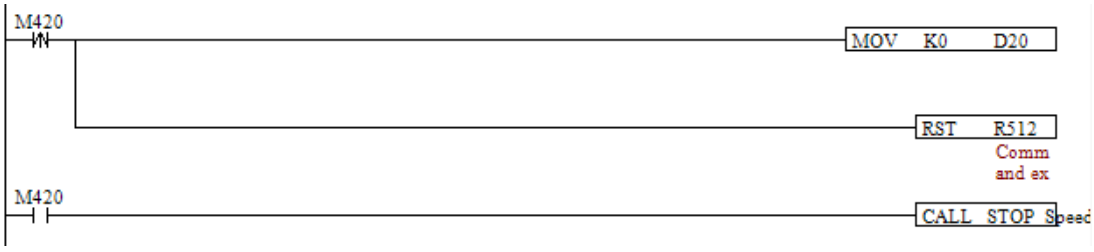
c. When D20 = 2, make sure [Command start](R512) is Off. Then set flag, M410 to Off and the control procedure is completed.

- Note
  - If the operation speed is greater than [Max. speed limit], it will operate at the limited max. speed.
  - Reverse speed operation should be stopped by deceleration stop command or flag of [Quick stop].
  - When speed command at forward or reverse direction is executed, issuing the motion command again will cause command error.

5.8 Decelerate to Stop

- Example description
  - Use M420 as the enabling condition for triggering and executing deceleration to stop command. After M420 is activated, the related parameters are executed and issue the command.

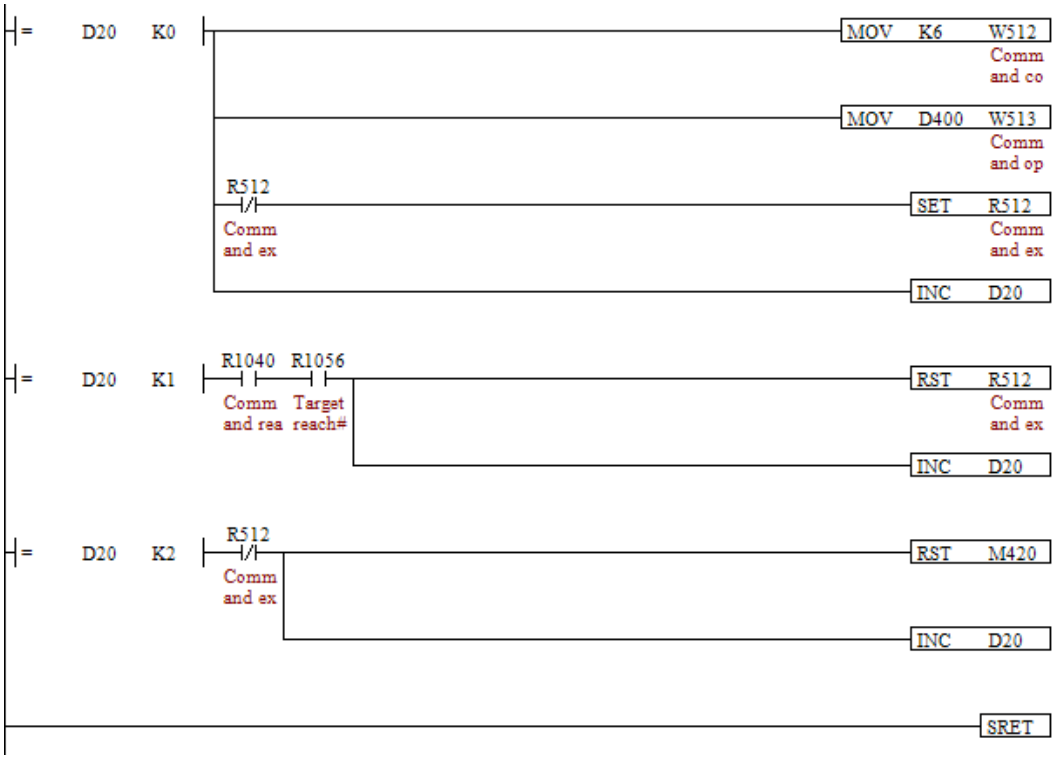
- Example program
  - Cyclic task



a. When M420 turns On, it is in initial control status (D20=0) and resets [Command start](R512) at the same time.

b. When M420 is On, it enters sub program, STOP_Speed, to execute deceleration to stop command. After that, M420 is Off automatically.

- Sub program: STOP_SPEED



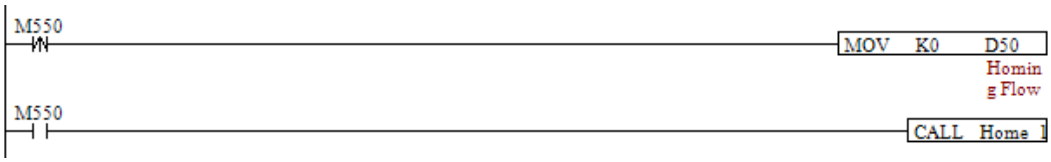
a. When D20 = 0, it starts to write parameters. When [Command code](W512) is set to 6, it means the deceleration to stop operation is executed. Write the value of D400 into [Command selection](W513) to select stop axis (When Bit 0 is On, it means axis 1 is activated. Bit 1 is On means axis 2 is activated.). Then, trigger [Command start](R512) to On and D20 = 1.
b. When D20 = 1 and [Command ready](R1040) is On, it means deceleration to stop command is enabled. When [Command complete](R1056) is On, the command is stopped. Set [Command start](R512) to Off and D20 = 2.
c. When D20 = 2, make sure [Command start](R512) is Off. Then, set flag M420 to Off and the control procedure is completed.

- Note
  - Deceleration to stop command uses [Deceleration time of stop command](W670,…) as the time basis.

5.9 Homing

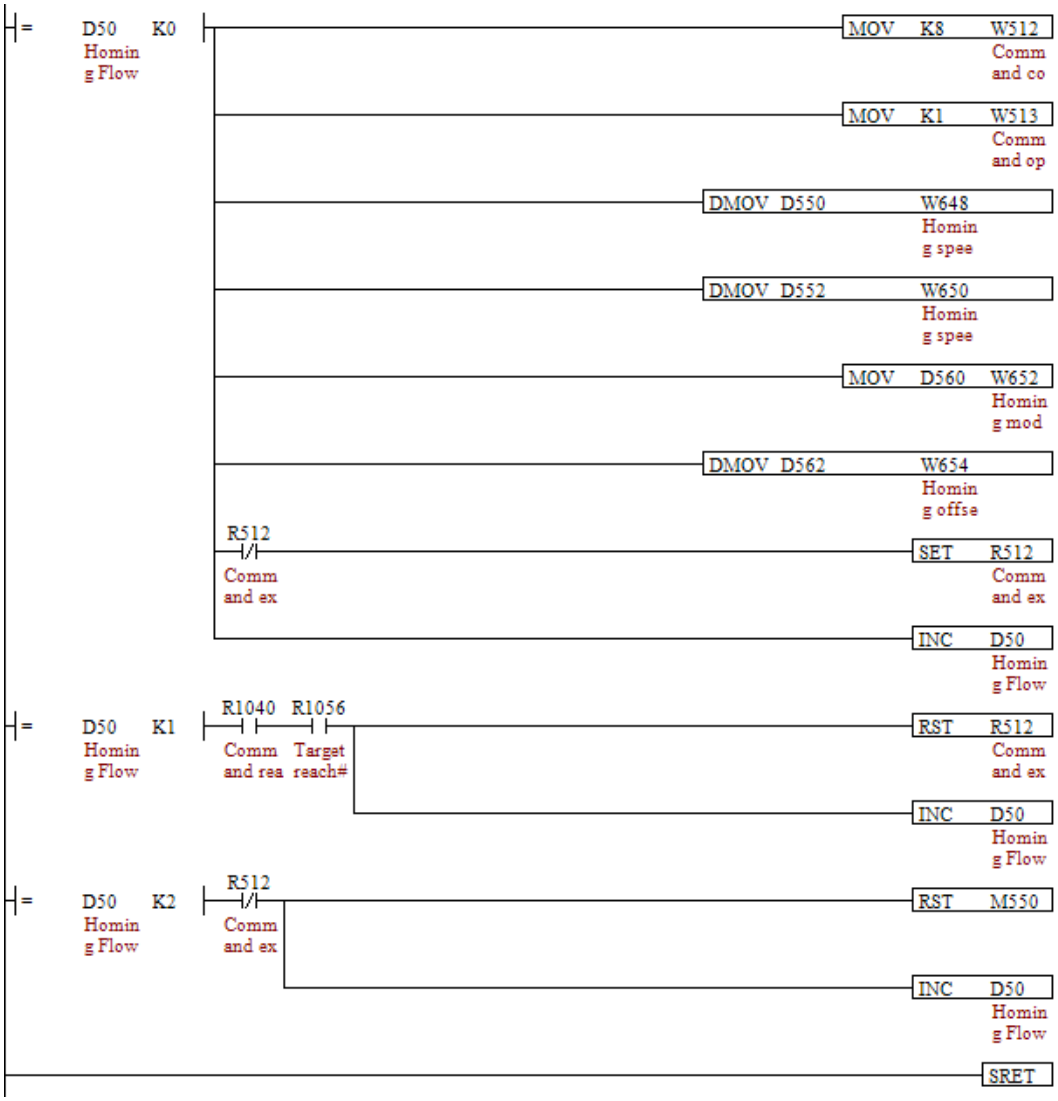
- Example description
  - Use M550 as the enabling condition for triggering and executing homing. After M550 is activated, the related parameters are executed and issue the command.

- Example program
  - Cyclic task



a. When M550 turns On, it is in initial control status (D50=0).
b. When M550 is On, it enters sub program, Home_1, to execute homing of single axis. After that, M550 is Off automatically.

  - Sub program: Home_1

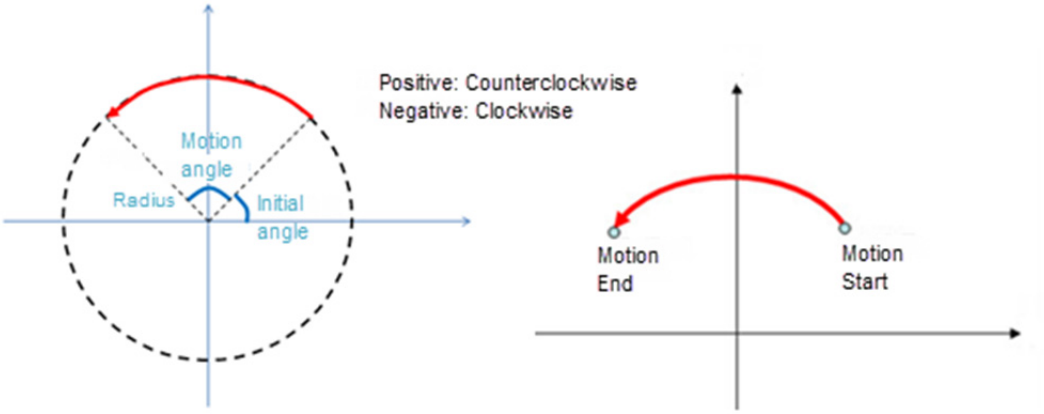


a. When D50 = 0, it starts to write parameters. Set [Command code](W512) to 8, homing is executed. When [Command selection](W513) is set to 1, it means axis 1 is executed. Write the setting value of D550 into [First speed of homing](W648), D552 into [Second speed of homing](W650), D560 into [Homing mode](W652) and D562 into [Offset amount of homing](W654). Then, trigger [Command start](R512) to On and D50 = 1.
b. When D50 = 1 and [Command ready](R1040) is On, it means the command has been executed. When [Command complete](R1056) is On, the operation is completed. Then, set [Command start](R512) to Off and D50 = 2.
c. When D50 = 2, the operation is completed. Make sure [Command start](R512) is Off and set flag, M550 to Off. The control procedure is completed.

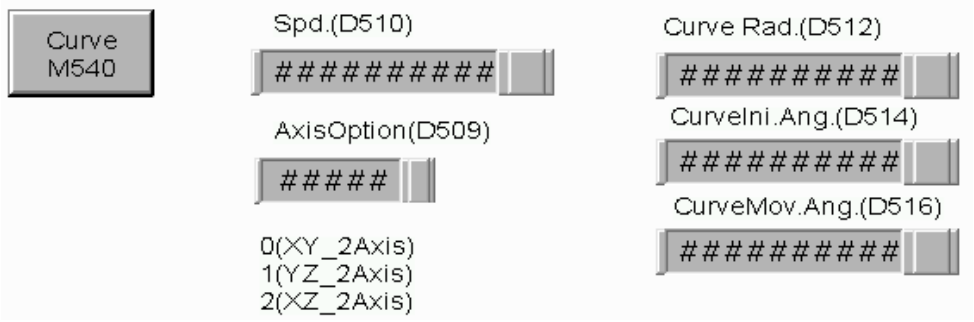
- Note
  - If the operation speed is greater than [Max. speed limit], it will operate at the limited max. speed.
  - Through the setting of [Command selection], it can activate multi-axis, that is corresponded to bit, to conduct homing.

5.10 Arc: Radius & Angle

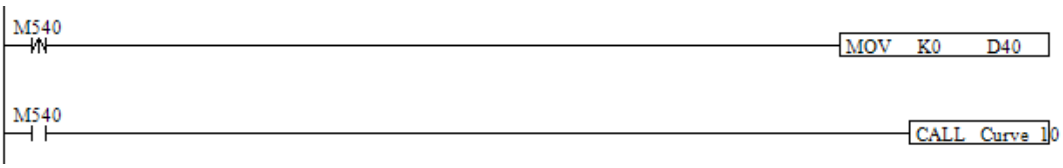
- Example description
  - Use M540 as the enabling condition for triggering and executing arc motion. After M540 is executed, the related parameters are activated and issue the commands.
  - Arc motion needs to issue three parameters, [Radius], [Initial angle] and [Motion angle]. If the start address of data parameter is D1000, then D1000 represents [Radius](PUU), D1002 represents [Initial angle] and D1004 represents [Motion angle]. Please pay attention that the unit of angle is 0.5 degrees. That is to say, if the setting value is 180, it means it is in 90 degrees. According to the setting, the motion path shows as below:



- Example program
  - HMC screen

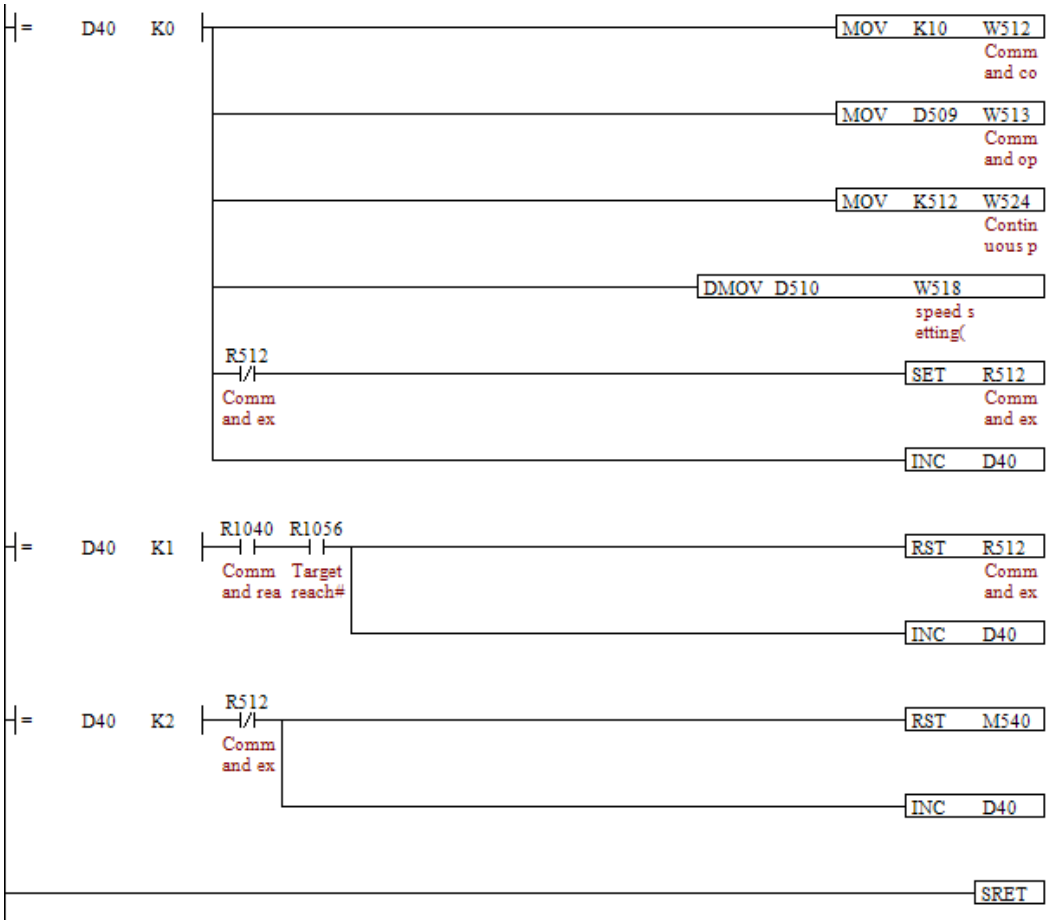


  - Cyclic task



a. When M540 turns On, it is in initial control status (D40=0).
b. When M540 is On, it enters sub program, Curve_10, to execute arc motion. After that, M540 is Off.

- Sub program: Curve_10



a. When D40 = 0, it starts to write parameters. Set [Command code](W512) to 10 means to execute arc motion. Write D509 into [Command selection](W513), it means to execute axis selection. 0 represents the arc interpolation of X and Y axis; while 1 represents the arc interpolation of Y and Z axis and 2 represents the arc interpolation of X and Z axis. Set [Parameter start address](W524) to 512, which means to access parameters starting from D512. Write D510 into [Speed setting](W518) of axis 1. Then, trigger [Command start] (R512) to On. Parameters and arc data, including [Radius] D512, [Start angle] D514 and [Motion angle] D516, will be written into the servo drive and D40 = 1.
b. When D40 = 1, if [Command ready](R1040) is On, it means the arc motion is executing. When [Command complete](R1056) is On, it means the command is completed. Then, set [Command start](R512) to Off and D40 = 2.
c. When D40 = 2, command is completed. Make sure [Command start](R512) is Off. After that, set flag, M540 to Off and the control procedure is completed.

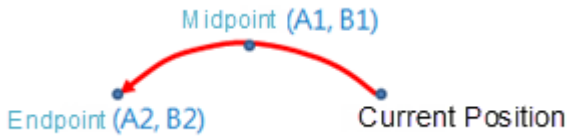
- Note
  - Arc motion issues the command to three axes for one time. Thus, the command only can be issued to ASDA-M for executing arc interpolation of 3-axis.
  - For 3-axis servo drive, when two axes are executing arc motion, the other one will

be unable to execute other commands.

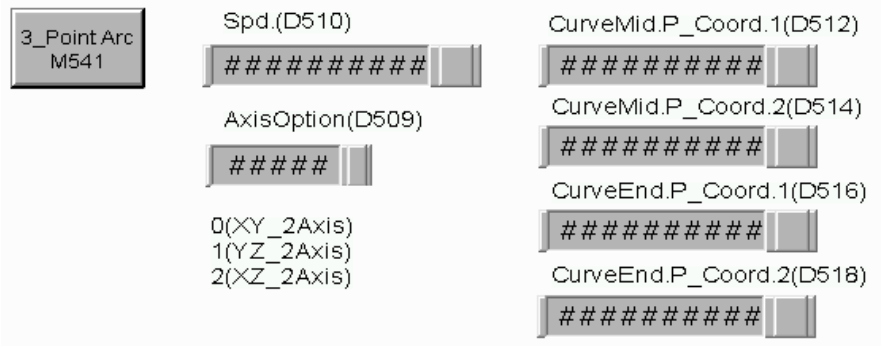
- Set the angle to the positive value, which represents counterclockwise direction. On the contrary, if the value is set to negative, it represents clockwise direction.

5.11 Arc: Midpoint & End Point

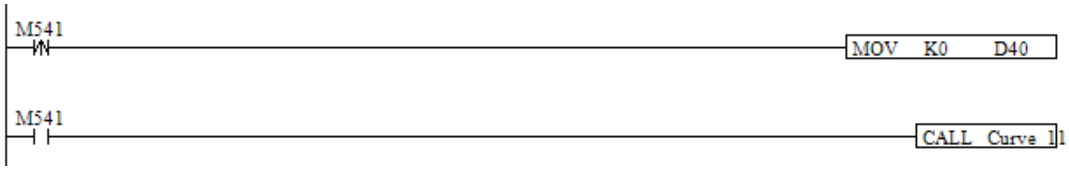
- Example description
  - Use M541 as the enabling condition for triggering and executing arc motion. After activating M541, the related parameters are activated and issue the commands.
  - Arc: Midpoint & End point should issue four parameters, including [Midpoint coordinate 1](A1), [Midpoint coordinate 2](B1), [End point coordinate 1](A2) and [End point coordinate 2](B2). If the data start address is D1000, then D1000 represents [Midpoint coordinate 1](PUU), D1002 represents [Midpoint coordinate 2](PUU), D1004 represents [End point coordinate 1](PUU) and D1006 represents [End point coordinate 2](PUU). According to the setting, the motion path shows as below:



- Example program
  - HMC screen

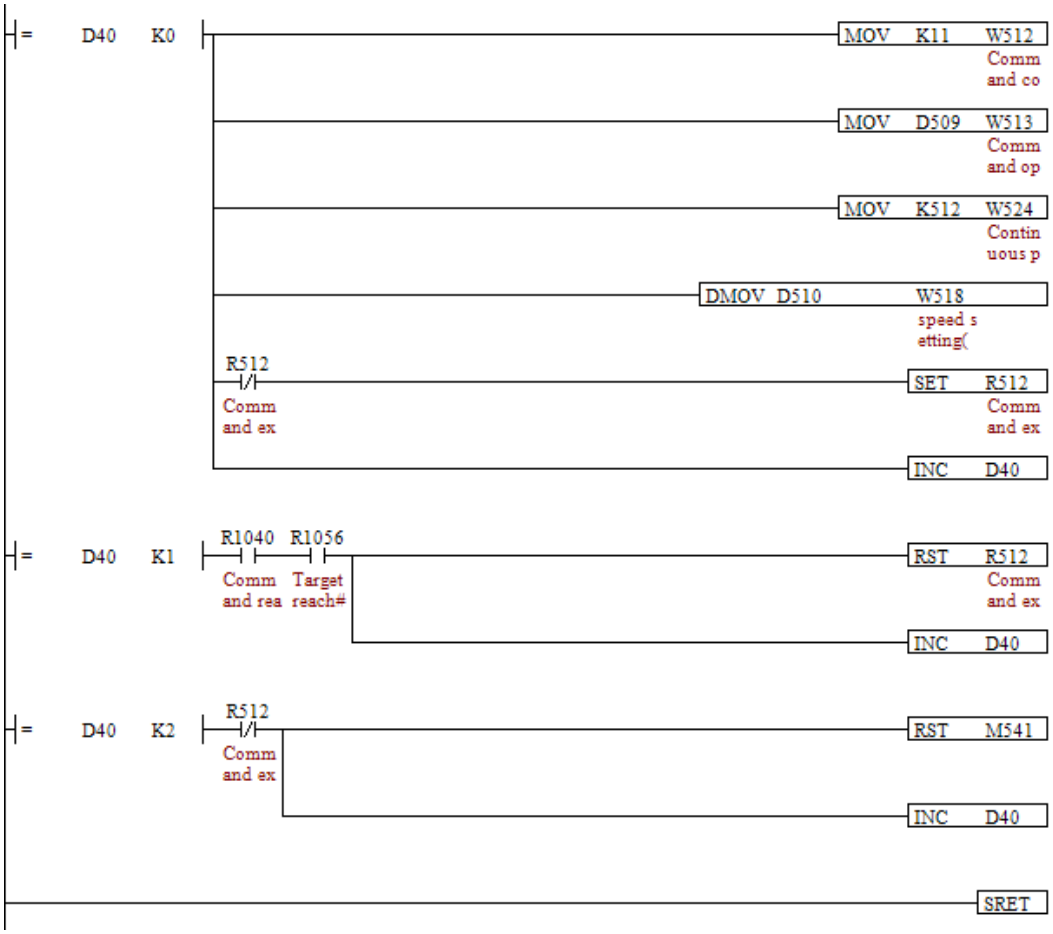


  - Cyclic task



a. When M541turns On, it is in initial control status (D40=0).
b. When M541 is On, it enters sub program, Curve_11, to execute arc through three points. After that, M541 is Off.

- Sub program: Curve_11



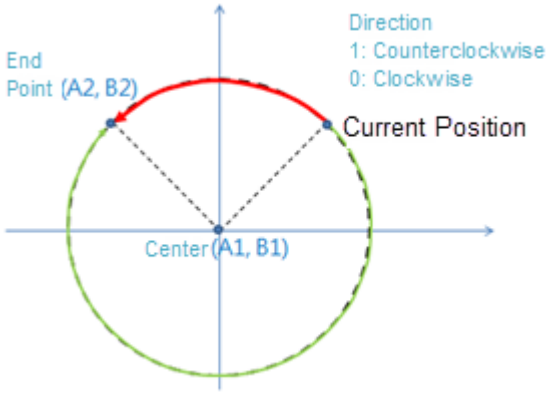
a. When D40 = 0, it starts to issue parameters. Set [Command code](W512) to 11, which means to execute arc: midpoint & end point motion. Write D509 into [Command selection](W513) means to execute axis selection. Among them, 0 represents the arc interpolation of X and Y axis, 1 represents the arc interpolation of Y and Z axis and 2 is the one for X and Z axis. Set [Parameter start address](W524) to 512 means it starts to read parameters starting from D512. Write D510 into [Speed setting](W518). Then, trigger [Command start](R512) to On. After that, write parameters, including [Midpoint coordinate 1](D512), [Midpoint coordinate 2](D514), [End point coordinate1](D516) and [End point coordinate 2](D518) into the servo drive and D40 = 1.
b. When D40 = 1 and [Command ready](R1040) is On, it means the arc motion is executing. When [Command complete](R1056) is On, it means the motion is completed. Set [Command start](R512) to Off and D40 = 2.
c. When D40 = 2, the command is completed. Make sure [Command start](R512) is Off. Then, set flag, M541, to Off and the control procedure is over.

- Note
  - Arc motion issues the command to three axes for one time. Thus, the command only can be issued to ASDA-M for executing arc interpolation of 3-axis.

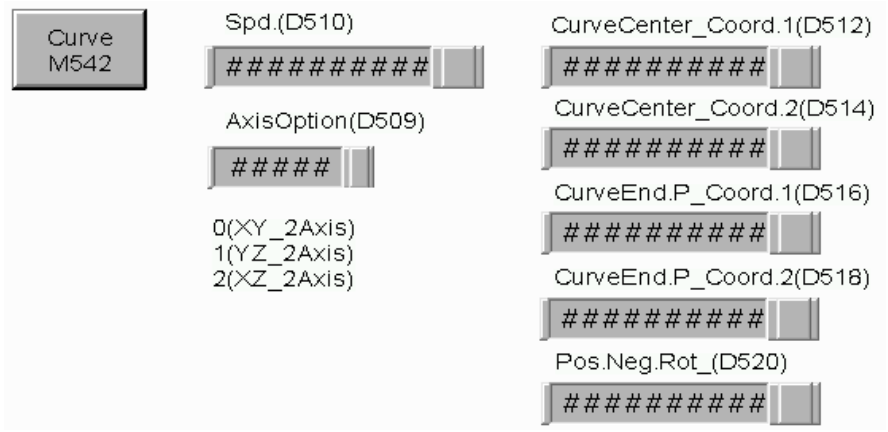
- For 3-axis servo drive, when two axes are executing arc motion, the other one will be unable to execute other commands.

5.12 Arc: Center & End Point

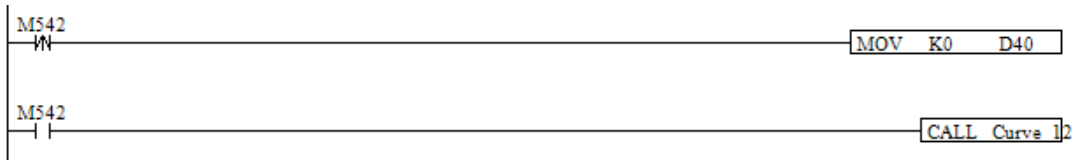
- Example description
  - Use M542 as the enabling condition for triggering and executing arc motion. After activating M542, the related parameters are executed and issue the commands.
  - Arc: center & end point motion should issue parameters, including [Center coordinate 1](A1), [Center coordinate 2](B1), [End point coordinate 1](A2), [End point coordinate 2](B2) and [Reverse and forward direction]. If data start address is D1000, D1000 represents [Center coordinate 1](PUU), D1002 represents [Center coordinate 2](PUU), D1004 represents [End point coordinate 1](PUU), D1006 represents [End point coordinate 2](PUU) and D1008 represents [Reverse and forward direction]. According to the setting, the motion path shows as below:



- Example diagram
  - HMC

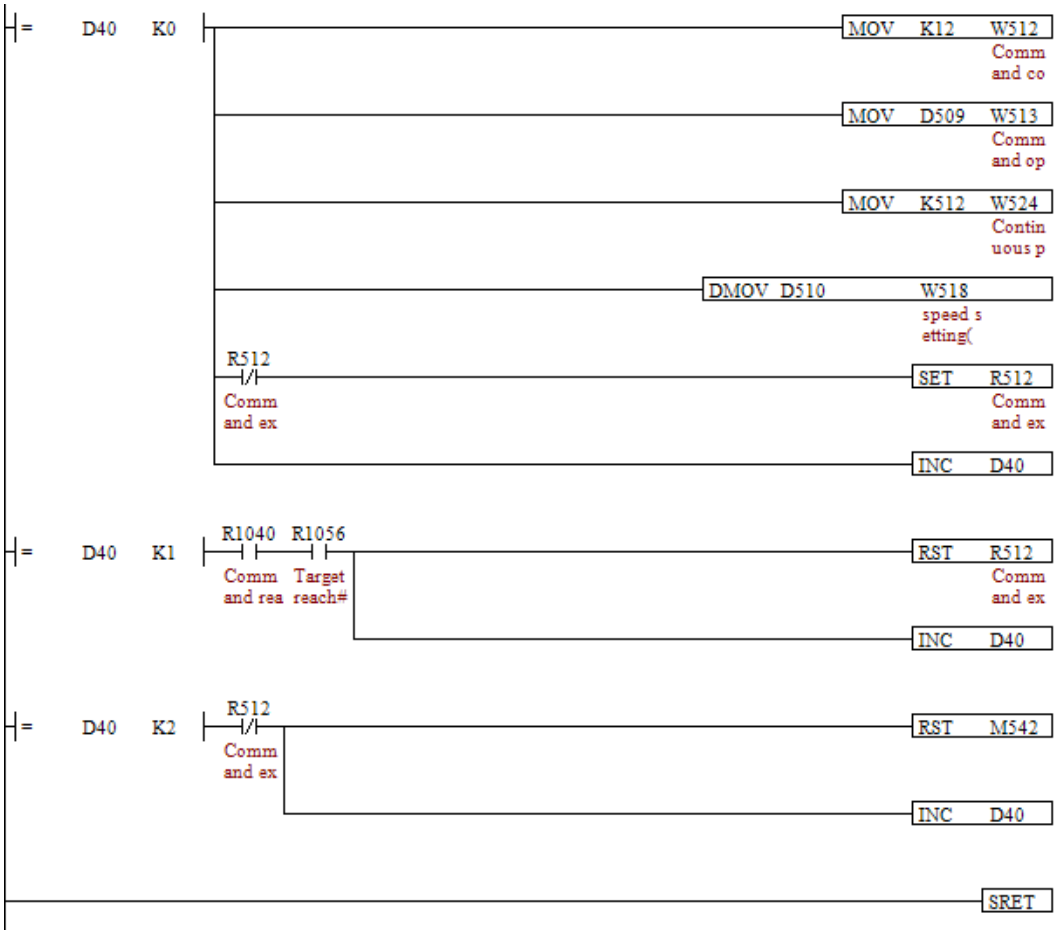


- Cyclic task



a. When M542 turns On, it is in initial control status (D40=0).
b. When M542 is On, it enters sub program, Curve_12, to execute arc motion. When the command is completed, M 542 is Off.

- Sub program: Curve_12



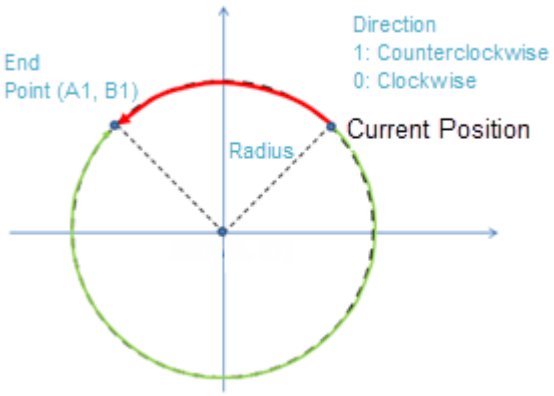
a. When D40 = 0, it starts to issue parameters. Set [Command code](W512) to 12, means to execute arc: center & end point motion. Write D509 into [Command selection](W513), means to execute axis selection. Among them, 0 represents the arc interpolation of X and Y axis. 1 represents the arc interpolation of Y and Z and 2 represents the one of X and Z axis. Set [Parameter start address](W524) to 512, means to access parameters starting from D512. Write D510 into [Speed setting](W518). Then, trigger [Command start](R512) to On. After that, write parameters, including [Center coordinate 1](D512), [Center coordinate 2](D514), [End point coordinate 1](D516), [End point coordinate 2](D518) and [Reverse and forward direction](D520) into the servo drive and D40 = 1.

b. When D40 = 1 and [Command ready](R1040) is On, it means the arc motion is executing. When [Command complete](R1056) is On, it means the command is completed. Then, set [Command start](R512) to Off and D40 = 2.
c. When D40 = 2, the command is completed. Make sure [Command start](R512) is Off. Then, set flag, M542 to Off and the control procedure is completed.

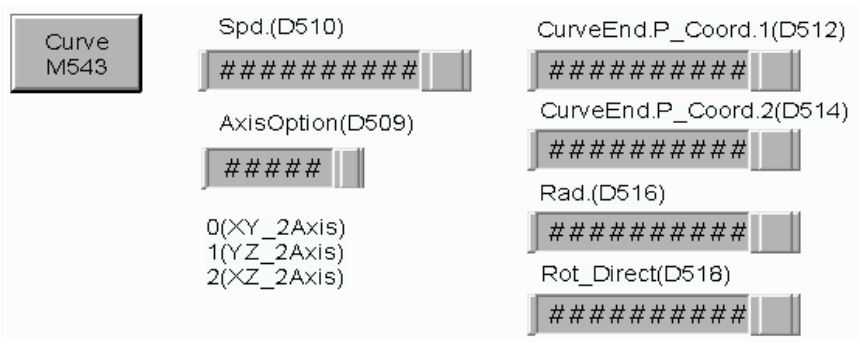
- Note
  - Arc motion issues the command to three axes for one time. Thus, the command only can be issued to ASDA-M for executing arc interpolation of 3-axis.
  - For 3-axis servo drive, when two axes are executing arc motion, the other one will be unable to execute other commands.
  - If the value is set to 1, it represents counterclockwise direction. On the contrary, if the value is set to 0, it represents clockwise direction.

5.13 Arc: End Point & Radius

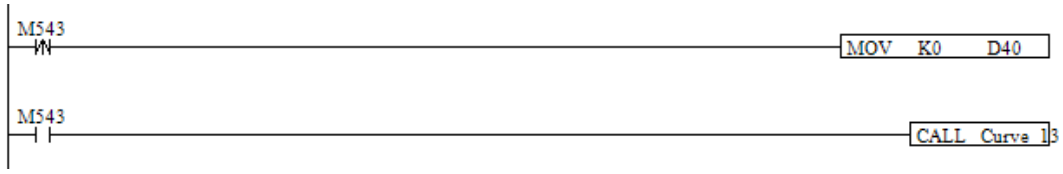
- Example description
  - Use M543 as the enabling condition for triggering and executing arc motion. After activating M543, the related parameters are executed and issue the commands.
  - Arc: end point & radius motion should issue parameters, including [End point coordinate 1](A1), [End point coordinate 2](B1), [Radius] and [Reverse and forward direction]. If data start address is D1000, D1000 represents [End point coordinate 1](PUU), D1002 represents [End point coordinate 2](PUU), D1004 represents [Radius] (PUU) and D1006 represents [Reverse and forward direction]. According to the setting, the motion path shows as below:



- Example program
  - HMC screen

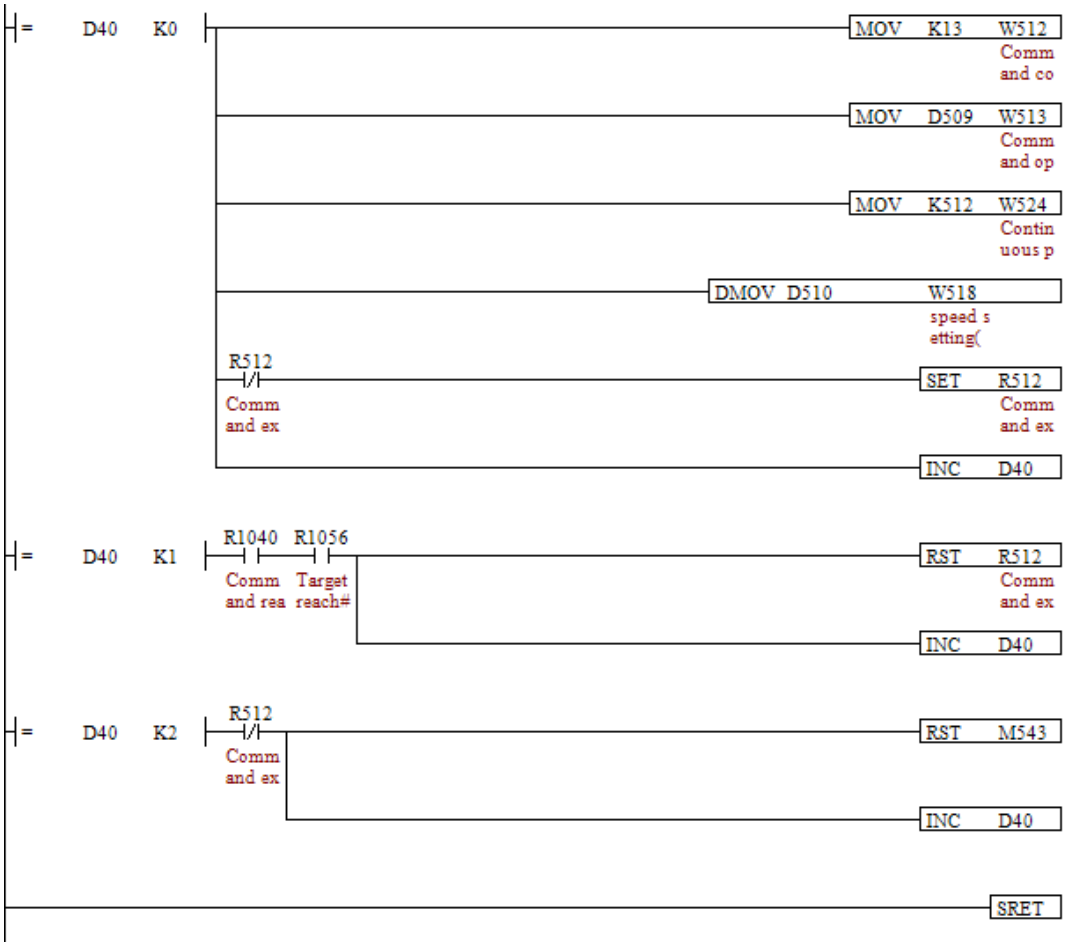


  - Cyclic task



a. When M543 turns On, it is in initial control status (D40 = 0).
b. When M543 is On, it enters sub program, Curve_13, to execute arc motion. When the command is completed, M543 is Off.

  - Sub program: Curve_13

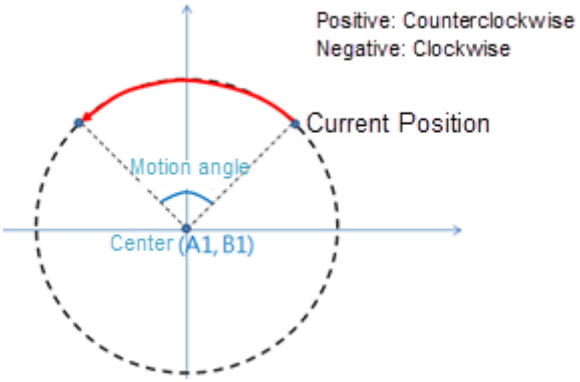


a. When D40 = 0, it starts to issue parameters. Set [Command code](W512) to 13, means to execute arc: end point & radius motion. Write D509 into [Command selection](W513), means to execute axis selection. Among them, 0 represents the arc interpolation of X and Y axis, 1 represent the arc interpolation of Y and Z axis and 2 represents the one of X and Z axis. Set [Parameter start address](W524) to 512, means to read parameters starting from D512. Write D510 into [Speed setting](W518). Then, trigger [Command start](R512) to On and write parameters, including [End point coordinate 1](D512), [End point coordinate 2](D514), [Radius](D516) and [Reverse and forward direction](D518) into the servo drive and D40 = 1.
b. When D40 = 1 and [Command ready](R1040) is On, it means the arc motion is executing. When [Command complete](R1056) is On, it means the command is completed. Set [Command start](R512) to Off and D40 = 2.
c. When D40 = 2, the command is completed. Make sure [Command start](R512) is Off. Then set flag, M543 to Off and the control procedure is over.

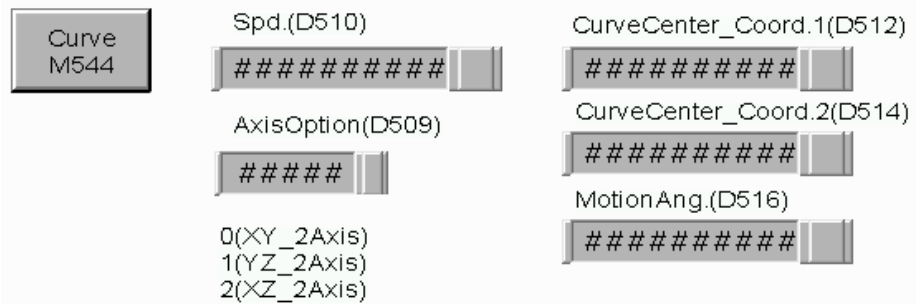
- Note
  - Arc motion issues the command to three axes for one time. Thus, the command only can be issued to ASDA-M for executing arc interpolation of 3-axis.
  - For 3-axis servo drive, when two axes are executing arc motion, the other one will be unable to execute other commands.
  - If the value is set to 1, it represents counterclockwise direction. On the contrary, if the value is set to 0, it represents clockwise direction.

5.14 Arc: Center & Angle

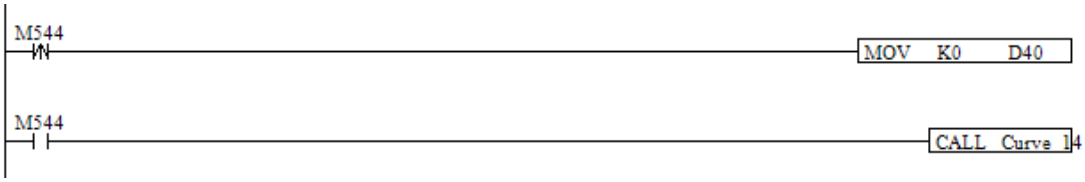
- Example description
  - Use M544 as the enabling condition for triggering and executing arc motion. After activating M544, the related parameters are executed and issue the commands.
  - Arc: center & angle motion should issue parameters, including [Center coordinate 1](A1), [Center coordinate2](B1) and [Angle]. If data start address is D1000, D1000 represents [Center coordinate 1](PUU), D1002 represents [Center coordinate2](PUU) and D1004 represents [Angle] setting. Please pay attention that the angle unit is 0.5 degrees, that is to say, if the value is 180, it means 90 degrees. According to the setting, the motion path shows as below:



- Example program
  - HMC screen

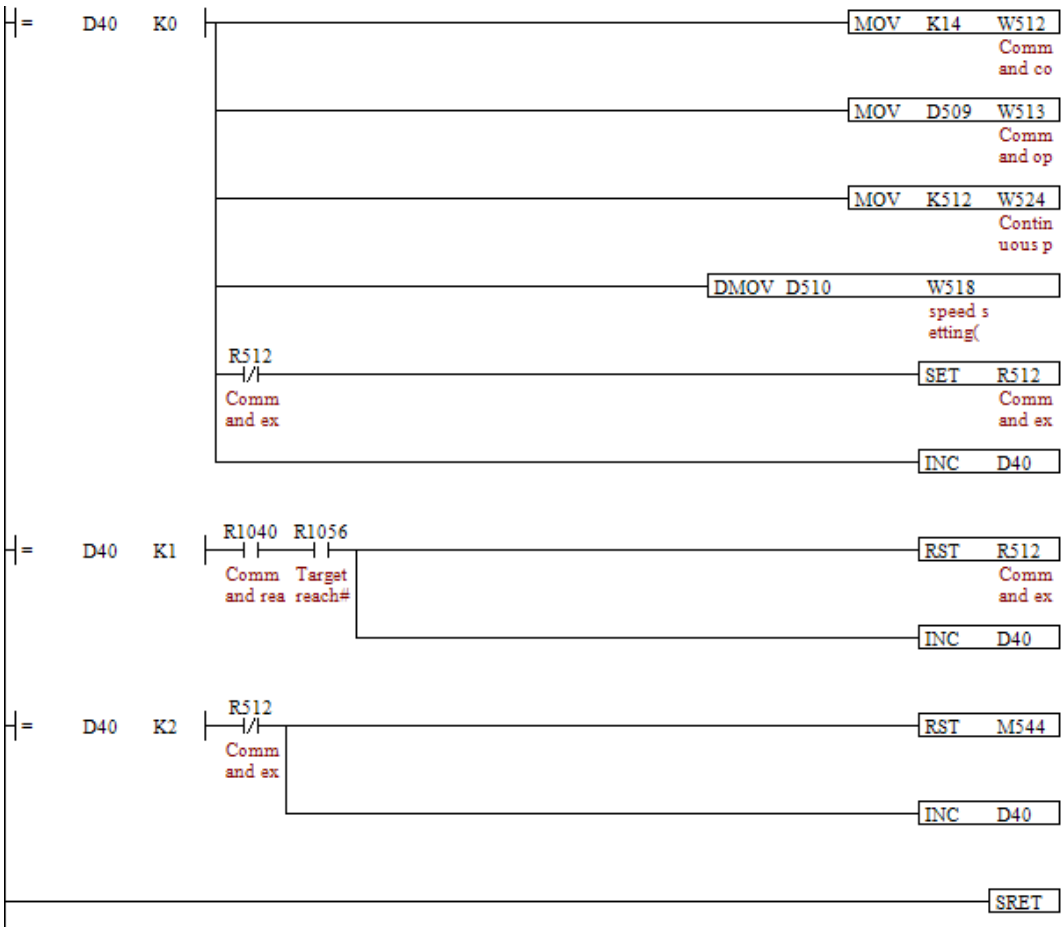


  - Cyclic task



a. When M544 turns On, it is in initial control status (D40 = 0).
b. When M544 is On, it enters sub program, Curve_14, to execute arc motion. When the command is completed, M544 is Off.

- Sub program: Curve_14



a. When D40 = 0, it starts to issue parameters. Set [Command code](W512) to 14, means to execute arc: center & angle motion. Write D509 into [Command selection](W513), means to execute axis selection. Among them, 0 represents the arc interpolation of X and Y axis, 1 represents arc interpolation of Y and Z axis and 2 represents X and Z axis. Set [Parameter start address](W524) to 512, means to read parameters starting from D512. Write D510 into [Speed setting](W518). Then, trigger [Command start](R512) to On and write parameters, including [Center coordinate 1](D512), [Center coordinate 2](D514) and [Angle](D516) into the servo drive and D40 = 1.
b. When D40 = 1 and [Command ready](R1040) is On, it means the arc motion is executing. When [Command complete](R1056) is On, it means the command is completed. Then, set [Command start](R512) to Off and D40 = 2.
c. When D40 = 2, the command is completed. Make sure [Command start](R512) is Off. Then, set flag, M544 to Off and the control procedure is over.

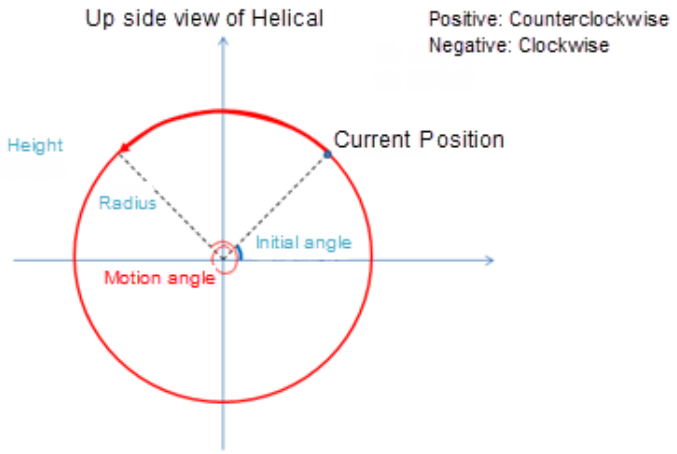
- Note
  - Arc motion issues the command to three axes for one time. Thus, the command only can be issued to ASDA-M for executing arc interpolation of 3-axis.
  - For 3-axis servo drive, when two axes are executing arc motion, the other one will

be unable to execute other commands.

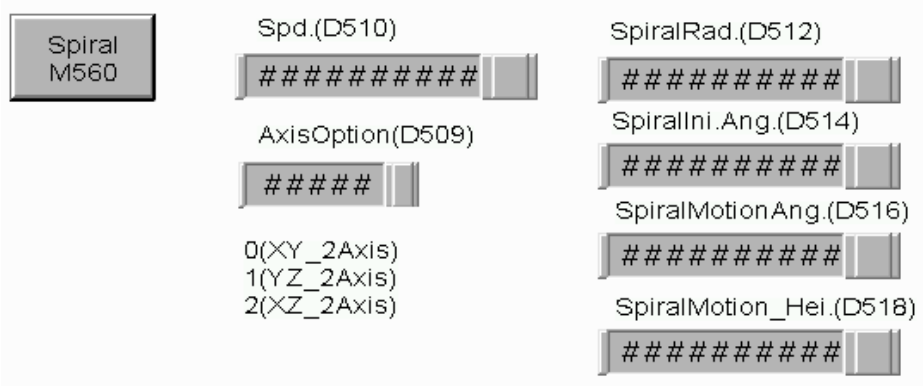
- Set the angle to the positive value, which represents counterclockwise direction. On the contrary, if the value is set to negative, it represents clockwise direction.

5.15 Helical

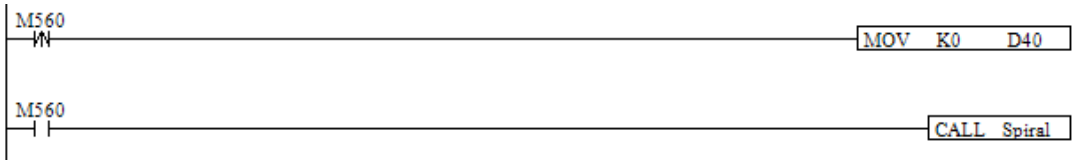
- Example description
  - Use M560 as enabling condition for triggering and executing helical motion. After activating M560, the related parameters are executed and start to issue commands.
  - Helical motion is the combination of arc motion and the height interpolation of another axis. Four parameters are needed, including [Radius], [Initial angle], [Motion angle] and [Height]. If the data start address is D1000, then D1000 represents [Radius](PUU), D1002 represents [initial angle], D1004 represents [Angle] and D1006 represents [Height](PUU). Please pay attention that the angle unit is 0.5 degrees. That is to say, 180 = 90 degrees. According to the setting, the motion path shows as below:



- Example program
  - HMC screen

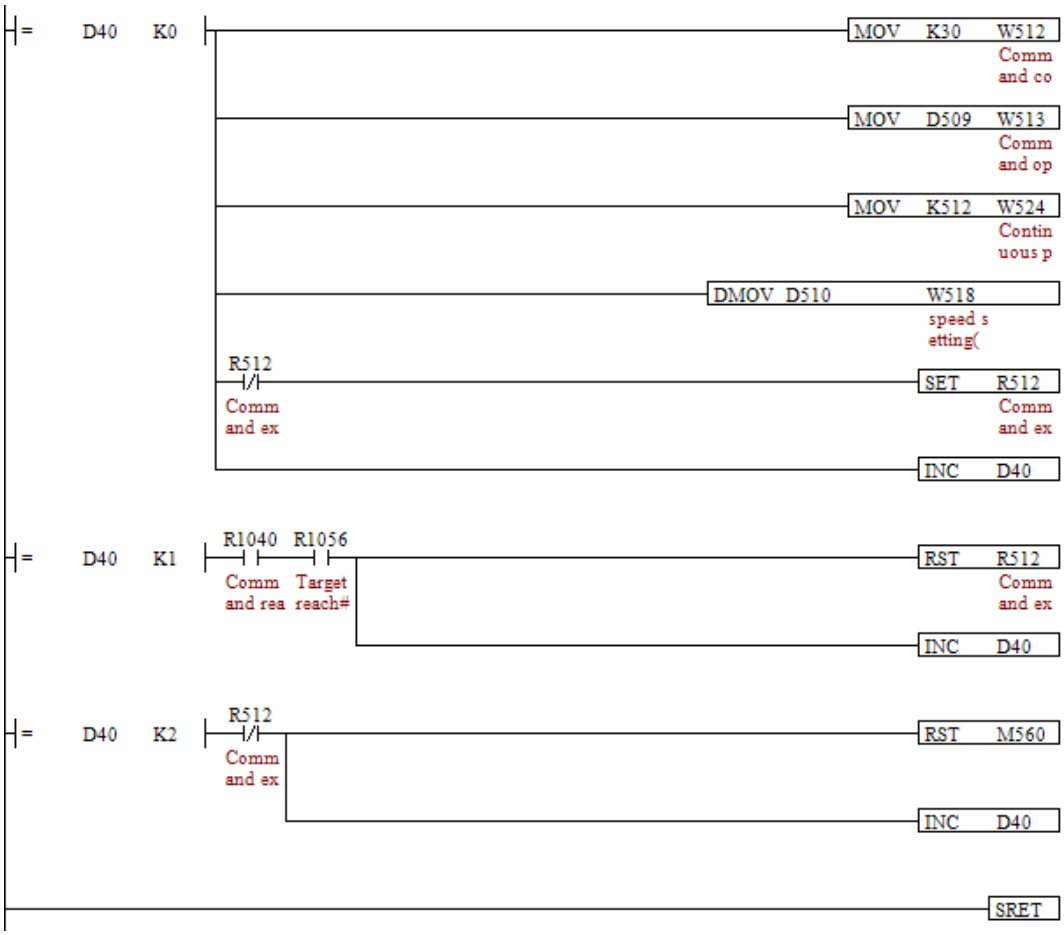


- Cyclic task



a. When M560 turns On, it is in initial control status (D40 = 0).
b. When M560 is On, it enters sub program, Spiral to execute helical motion. After that, M560 is Off.

- Sub program: Spiral



a. When D40 = 0, it starts to issue parameters. Set [Command code](W512) to 30, means to execute helical motion. Write D509 into [Command selection](W513), means to execute axis selection. Among them, 0 represents the arc interpolation of X and Y axis, 1 represents the arc interpolation of Y and Z axis and 2 represents the one of X and Z axis. Set [Parameter start address](W524) to 512, means it access the parameters starting from D512. Write D510 into [Speed setting](W518). Then trigger [Command start](R512) to On. Write parameters, including [radius](D512), [Initial angle](D514), [Motion

angle](D516) and [Height](D518) into the servo drive and D40 = 1.

b. When D40 = 1 and [Command ready](R1040) is On, it means helical motion is executing. When [Command complete](R1056) is On, it means the command is completed. Set [Command start](R512) to Off and D40 = 2.

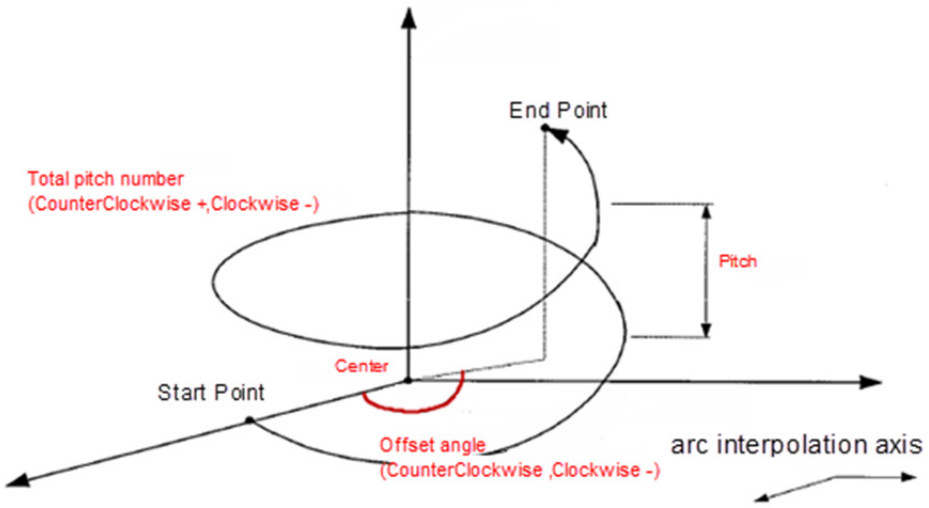
c. When D40 = 2, the command is completed. Make sure [Command start](R512) is Off. Then, set flag, M560 to Off and the control procedure is over.

- Note

  - Helical motion issues the command to three axes for one time. Thus, the command only can be issued to ASDA-M for executing arc interpolation of 3-axis.
  - Set the angle in helical parameter to the positive value, which represents counterclockwise direction. On the contrary, if the value is set to negative, it represents clockwise direction.

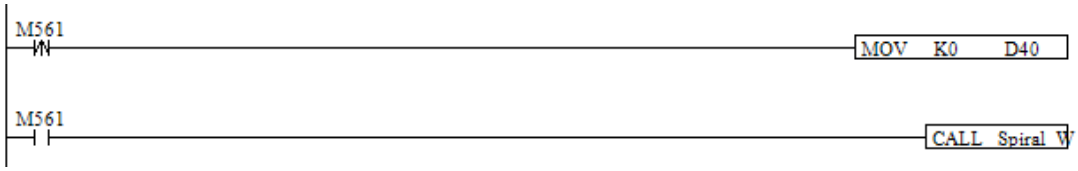
5.16 Helical W

- Example description
  - Use M561 as the enabling condition for triggering and executing helical W motion. After M561 is activated, the related parameters are executed and issue the commands.
  - Refer to the current position, helical W motion completes the settings of center coordinates, helical radius, pitch, total pitch number and final offset angle. Thus, helical W needs to issue five parameters, including [Center coordinate 1], [Center coordinate 2, [Pitch], [Total pitch number] and [Offset angle]. If the data start address is D1000, then D1000 represents [Center coordinate 1], D1002 represents [Center coordinate 2], D1004 represents [Pitch], D1006 represents [Total pitch number] and D1008 represents [Offset angle]. Pay special attention that the angle unit is 0.5 degrees, which means 180 = 90 degrees. According to the setting, the motion path shows as below:



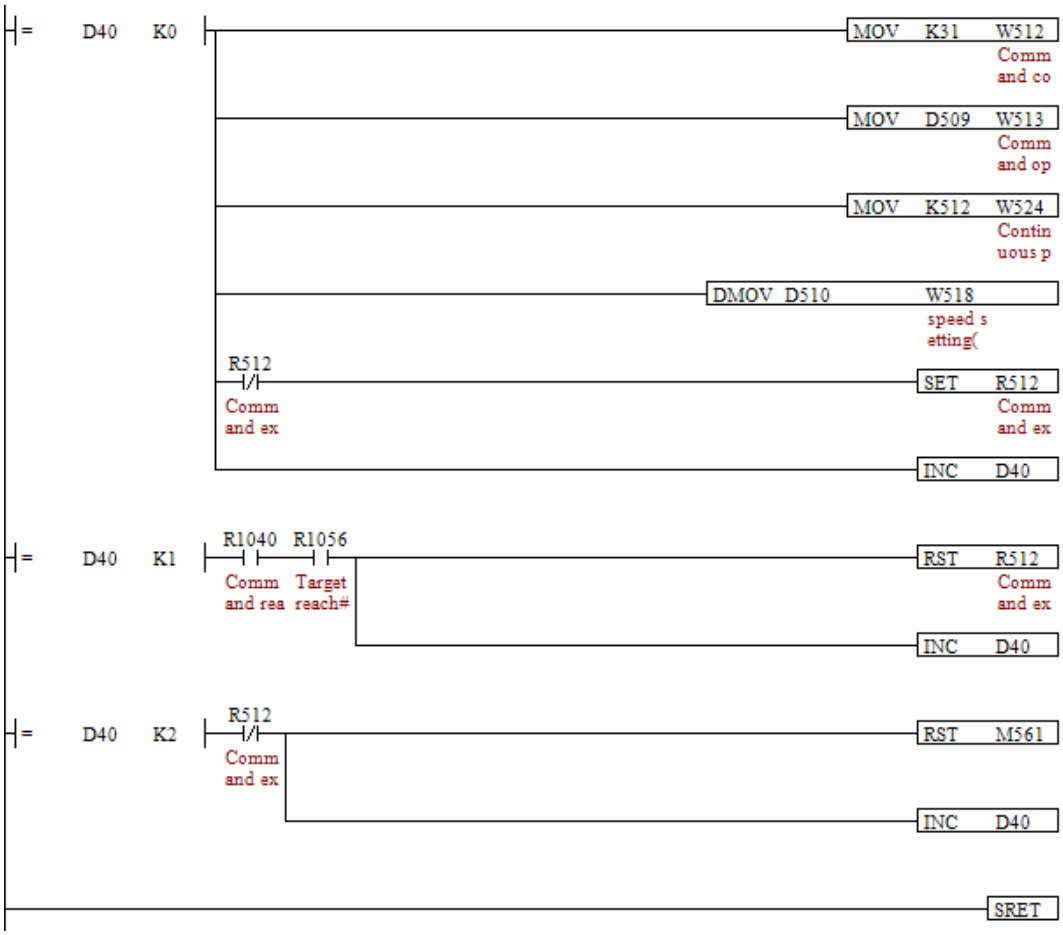
- Example program
  - HMC screen

- Cyclic task



a. When M561 turns On, it is in initial control status (D40 = 0).
b. When M561 is On, it enters sub program, Spiral_W to execute helical W. Then, set M561 to Off.

- Sub program: Screw_W



a. When D40 = 0, it starts to issue parameters. Set [Command code](W512) to 31, means to execute helical W motion. Write D509 into [Command selection](W513), means to execute axis selection. Among them, 0 represents the arc interpolation of X and Y axis, 1 represents the arc interpolation of Y and Z axis and 2 represents the one of X and Z axis. Set [Parameter start address] (W524) to 512, means it reads parameters starting from D512. Write D510 into [Speed setting](W518). Then, trigger [Command start](R512) to On and write parameters, including [Center coordinate 1](D512), [Center coordinate 2]

(D514), [Pitch](D516), [Total pitch number](D518) and [Offset angle](D520) into the servo drive. D40 = 1.

b. When D40 = 1 and [Command ready](R1040) is On, it means helical W motion is executing. When [Command complete](R1056) is On, it means the command is completed. Set [Command start](R512) to Off and D40 = 2.

c. When D40 = 2, the command is completed. Make sure [Command start](R512) is Off. Then, set flag, M561 to Off and the control procedure is completed.

- Note

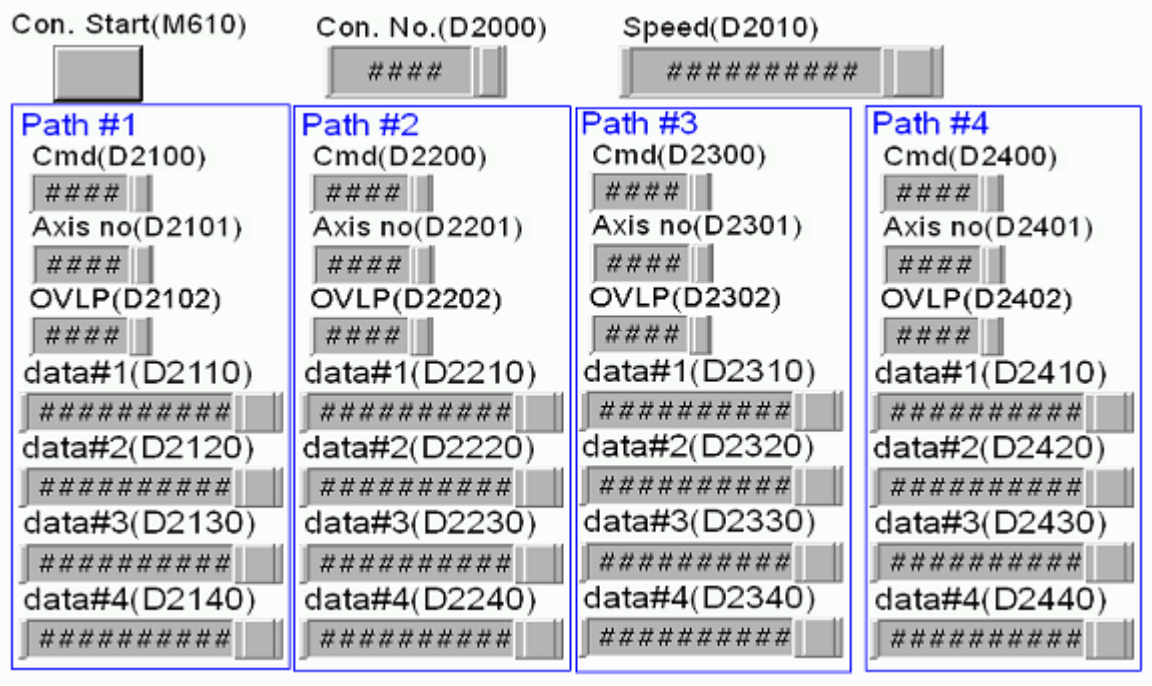
  · Helical W motion issues the command to three axes for one time. Thus, the command only can be issued to ASDA-M for executing arc interpolation of 3-axis.

  · If the value of pitch and offset angle is set to positive, it represents counterclockwise direction; on the contrary, if the value is set to negative, it represents clockwise direction.

5.17 Continuous PR Path

- Example description
  · Use M610 as the enabling condition for triggering and executing continuous motion.
  · After activating M610, setup the number of [Co. PR No.](4 paths are showed at most in the example). Download the data from Path#1 to Path#4 in the screen to the servo. If set [Co. PR No.] to 3, only three continuous motion, Path#1 ~ Path#3 are loaded in and executed.

- Example program
  · HMC screen
  Four PR data can be entered to the screen at most. When activating continuous motion, load in the setup number to the servo drive according to [Co. PR No.]. Following is the setup screen of HMC.

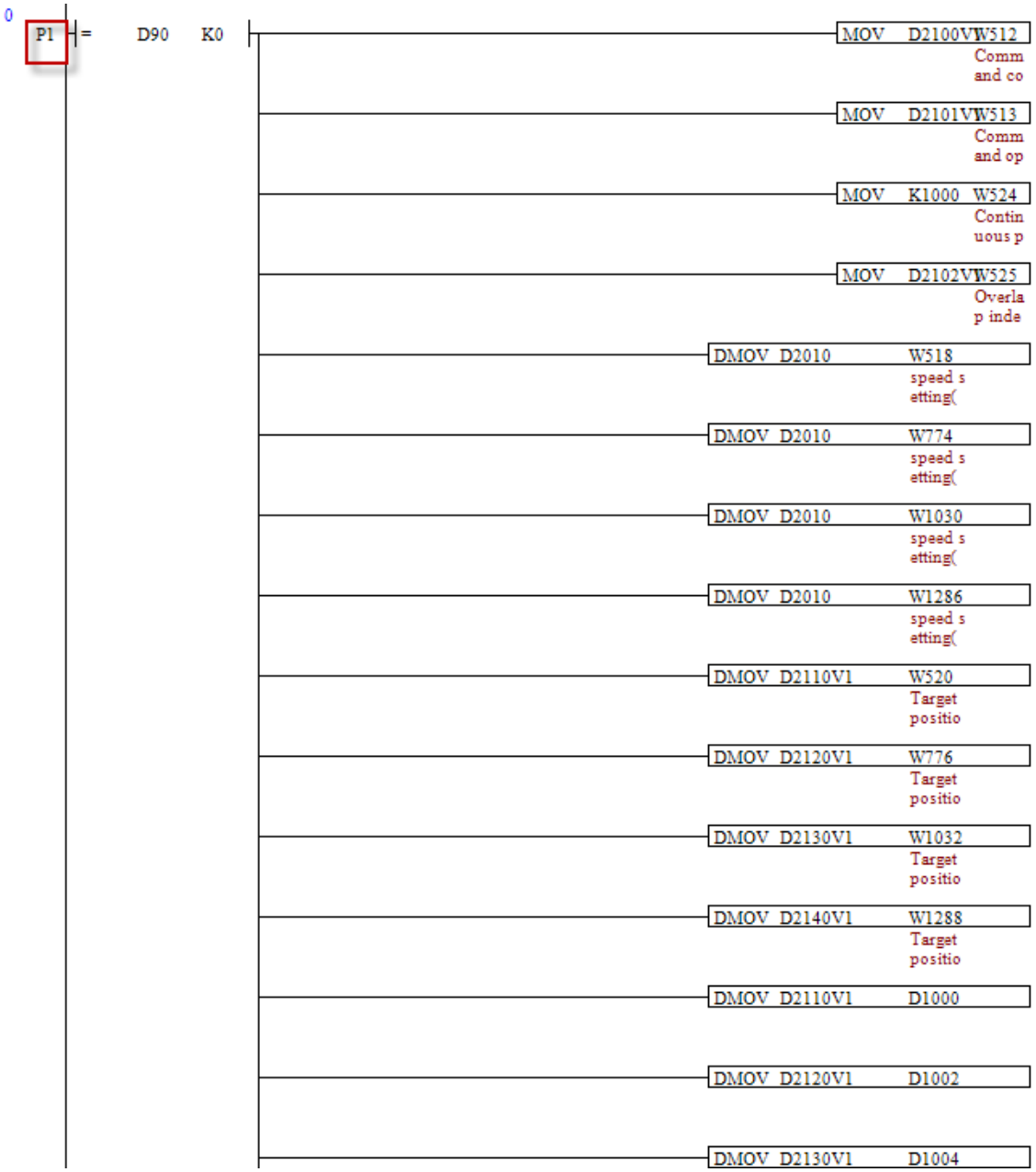


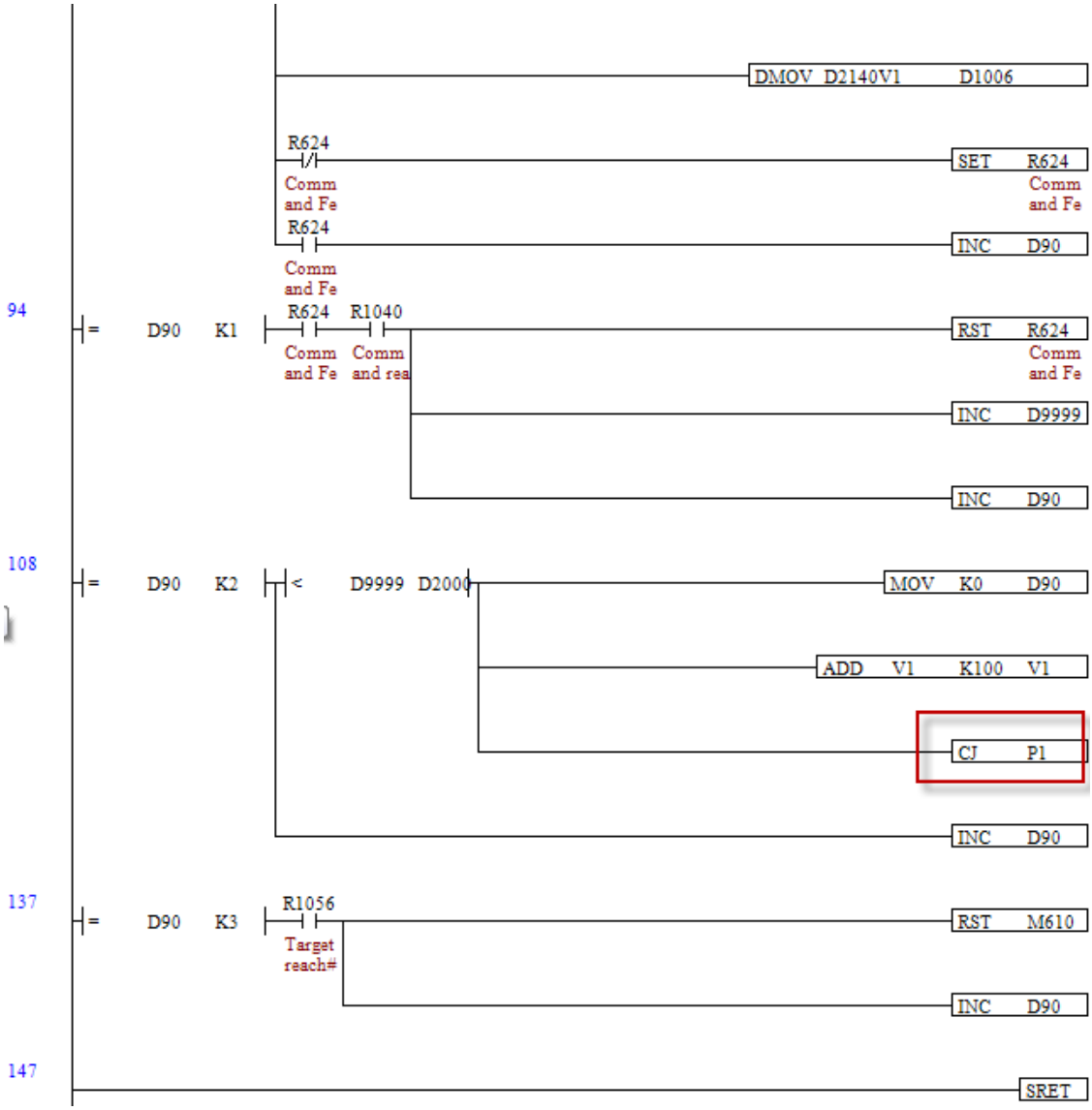
- Cyclic task

a. When M610 status turns On, it is in initial control status D90, V1 (parameter offset) and D9999 (continuous PR number that has been issued successfully).

b. When M610 is On, call sub program, Continue, to issue and execute continuous PR command. After that, M610 is Off.

- Sub program: Continue





a. When D90 = 0, it starts to issue commands. Write D2100 into [Command code](W512) and D2101 into [Command selection](W513). Set [Parameter start address](W524) to 1000 and write D2102 to [Overlap](W525), D2010 to [Speed setting](W518, …) of each axis and write D2110, D2120, D2130 and D2140 into [Target position](W520, …) of each axis. If the command is not linear motion, but arc or helical motion, parameters shall be accessed via referral data zone. Thus, write D2110, D2120, D2130 and D2140 into the referral data zone starting from D1000. Then, trigger [Command load](R624) to On and D90 = 1.

b. When D90 = 1, trigger [Command load](R624) until [Command ready](R1040) is On, which means this motion is successfully loaded into the servo drive and add 1 to the value of [Command number that has been issued](D9999). Then, D90 = 2.

c. When D90 = 2, check if the command number is the same as it set first (D2000

is the setting of command number). If not, load in the next command to the servo drive. First, increase the command offset value V1 (When the value is added 100, it should refer to Path#2; 200 is for Path#3 and so on and so forth.). Return to D90 = 0 and issue the command (CJ P1); If the issued command number is enough, no need to load other commands and D90 = 3.

d. When D90 = 0 again for N times, it means to issue motion parameters. Write D(2100+100x(*N*-1)) into [Command code](W512), D(2101+100x(*N*-1)) into [Command selection](W513), D(2102+100x(*N*-1)) into [Overlap](W525), D2010+100x(*N*-1)) into [Speed setting](W518, …) of each axis and the starting address of D(2110+100x(*N*-1)) into [Target position](W520, …) of each axis. Also, write the starting address of D(2110+100x(***N***-1)) into the continuous address of PR data zone starting from D1000. After that, trigger [Command load](R624) to On, D90 = 1 and repeat step b.

e. When D90 = 3, wait until all continuous motion command is completed, which means [Command complete](R1056) is On. Then, D90 = 4 and M610 is Off.

- Note

  - The continuous path can issue unlimited number of motion parameters to the servo drive. The number of motion that is waited to be executed in servo drive is 8 at most. Trigger the next motion command by [Command load] right after a command is completed will do.
  - In continuous motion, the command will not be executed until two PR commands (at least) are issued.
  - In continuous motion, when executing the last command, no more new command can be accepted.
  - When using [Command load] to issue the command, users could know if the command issuing is succeed via [Command ready] and acquire the information of unfinished command number of the current servo drive through [Motion surplus].

5.18 Handwheel

- Example description
  - Connect the handwheel device to HMC08 and switch the factors (1, 10 and 100 times) and control axis (axis 1, 2, and 3) via I/O device. Use handwheel to send signal to X0 means to activate axis 1; send signal to X1 means to activate axis 2 and send signal to X2 means to activate axis 3. Send signal to X3 means to switch the factor to 1, X4 means to switch the factor to 10 and X5 means to switch the factor to 100.

- Example program
  - Cyclic task

a. When X0 is On, X1 is Off and X2 is Off, R608 is On, R609 is Off and R610 is Off. Set [Handwheel activate] of axis 1 to On. Then, the handwheel function of axis 1 is enabled.
b. When X1 is On, X0 is Off and X2 is Off, R608 is Off, R609 is On and R610 is Off. Set [Handwheel activate] of axis 2 to On. Then, the handwheel function of axis 2 is enabled.
c. When X2 is On, X0 is Off and X1 is Off, R608 is Off, R609 is Off and R610 is On. Set [Handwheel activate] of axis 3 to On. Then, the handwheel function of axis 3 is enabled.
d. When X3 is On, set [Handwheel factor](W74) to 1, the speed of handwheel operation is double.
e. When X4 is On, set [Handwheel factor](W74) to 10, the handwheel will operate 10 times more.
f. When X5 is On, set [Handwheel factor](W74) to 100, the handwheel will operate 100 times more.

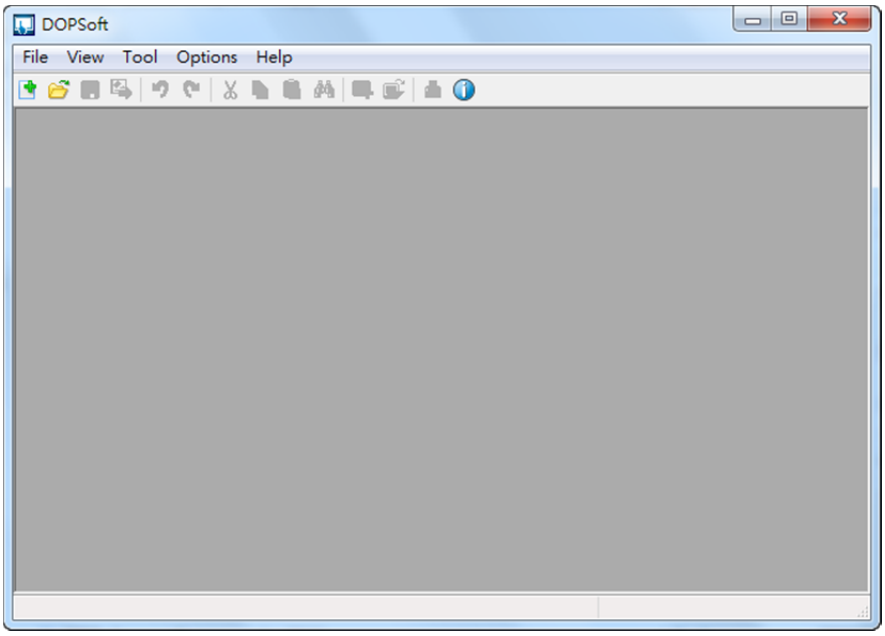
- Note
  - Only one axis can active handwheel function within the same time.

Chapter 6 Ladder Editor

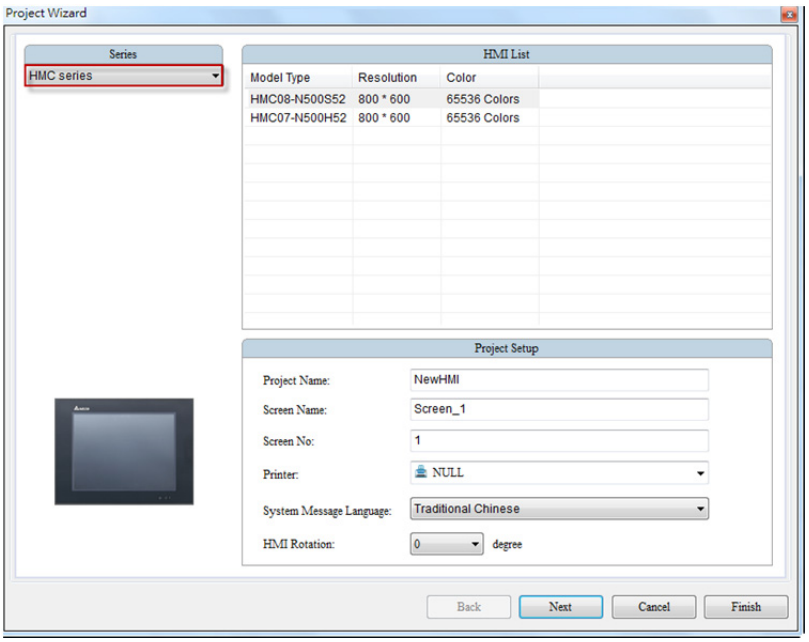
This chapter details the instructions of Ladder Editor which is integrated into DOPSoft. Please refer to DOPSoft User Manual for the installation of DOPSoft, and the function of HMI editing.

6.1 Ladder Editor Software

1. Open Ladder Editor Software

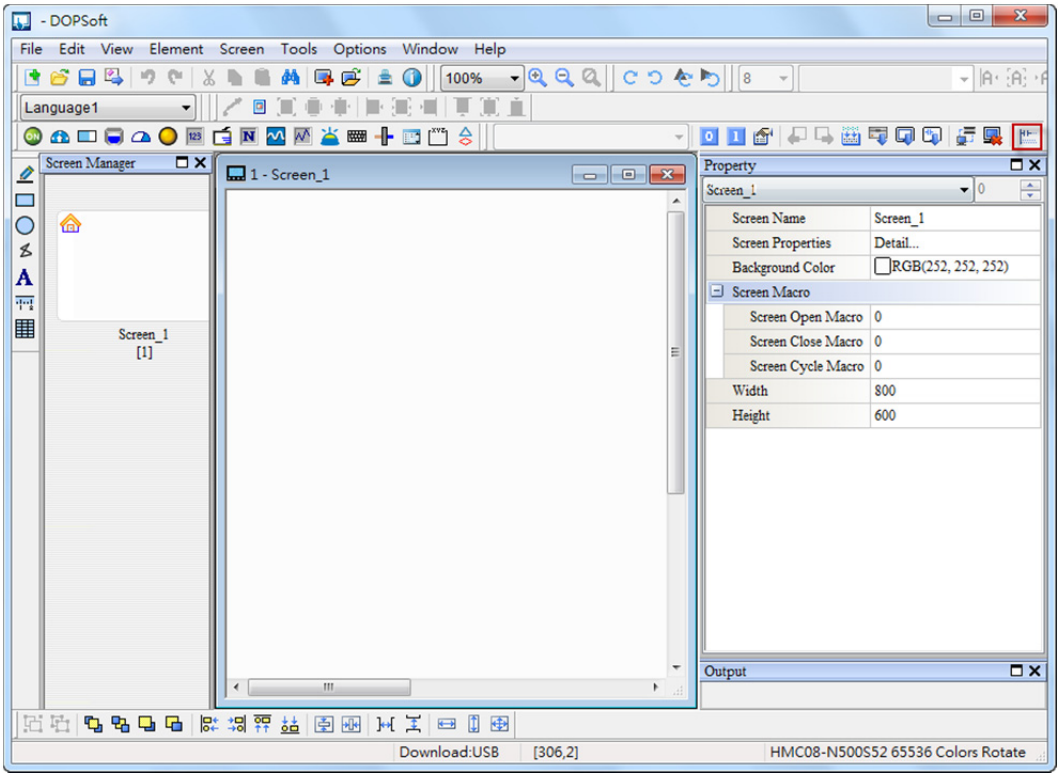


2. Select HMC model:

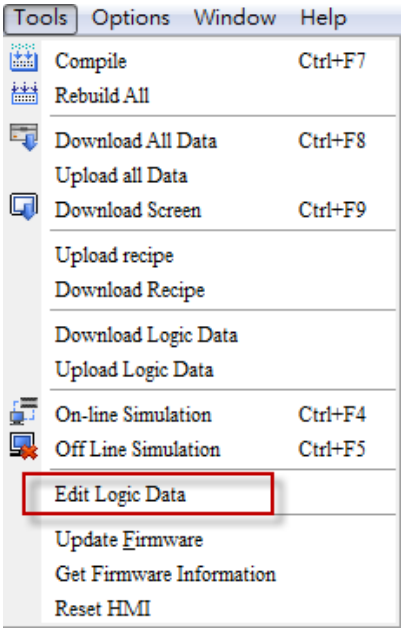


3. Open Ladder Editor

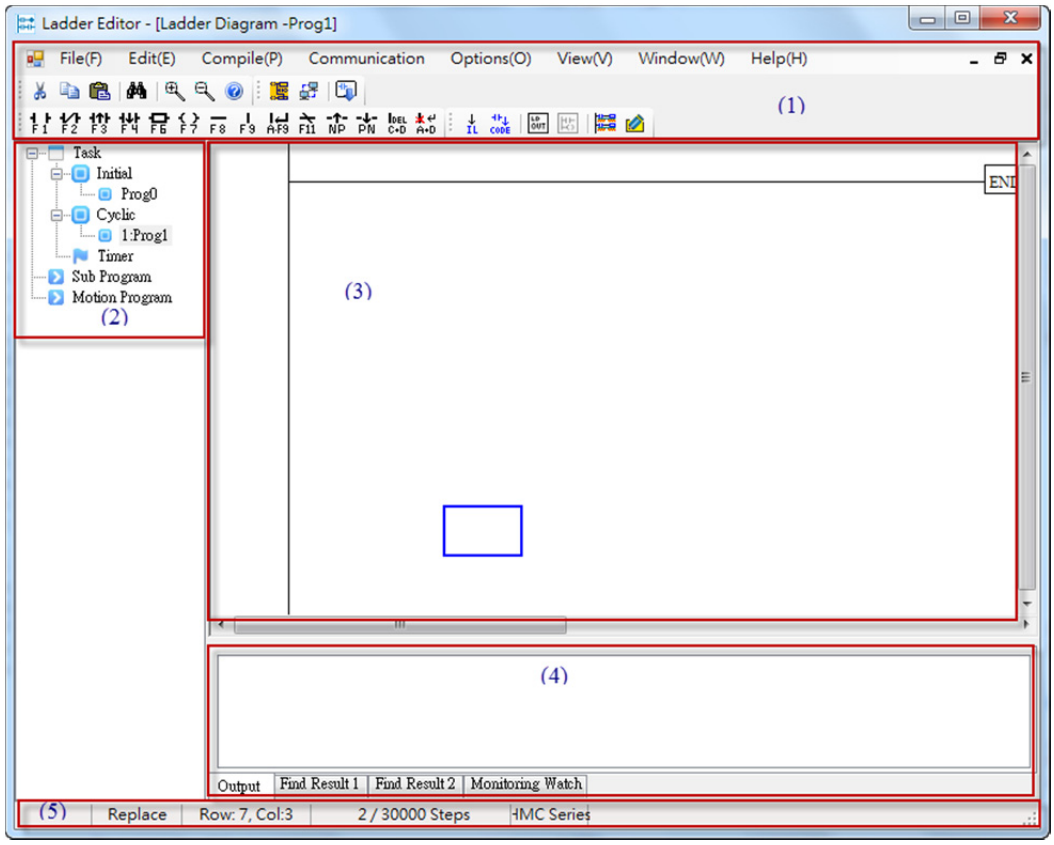
Click the icon of Edit Logic Data in the tool bar to enable Ladder Editor.



Or users can select Edit Logic Data from Tools to enable Ladder Editor.



4. Ladder Editor is ready

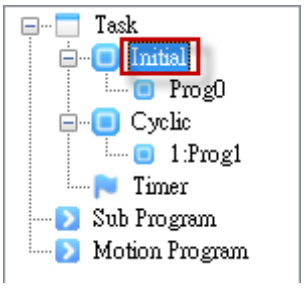


Mark	Item	Description
(1)	Tool Bar	Function of file, edit, compile, communication setting and etc.
(2)	Program Tree Diagram	It is the framework of Ladder that used by the current project.
(3)	Program Editing Zone	It shows the current editing program content.
(4)	Application Zone	It includes output window, find result and monitor device window.
(5)	Editing Status	It shows the current editing status and can be switched to **Replace** or **Insert** Mode.

6.2 New Ladder Program and Its Setting

6.2.1 Initial Task

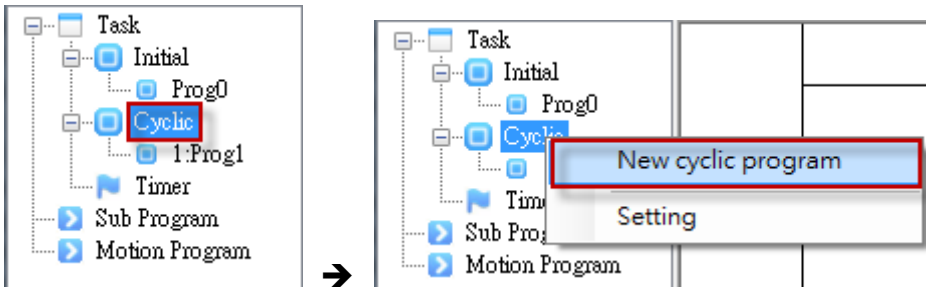
It can only exist one initial task. Users are unable to change its name. The initial setting can be written into this task.



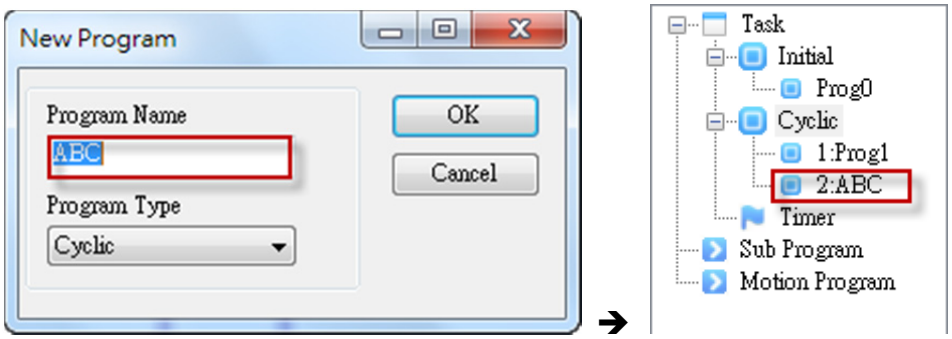
6.2.2 Cyclic Task

1. New Cyclic Task

   Right click **Cyclic**. Then, select **New cyclic program**. A **New Program** window will pop up.

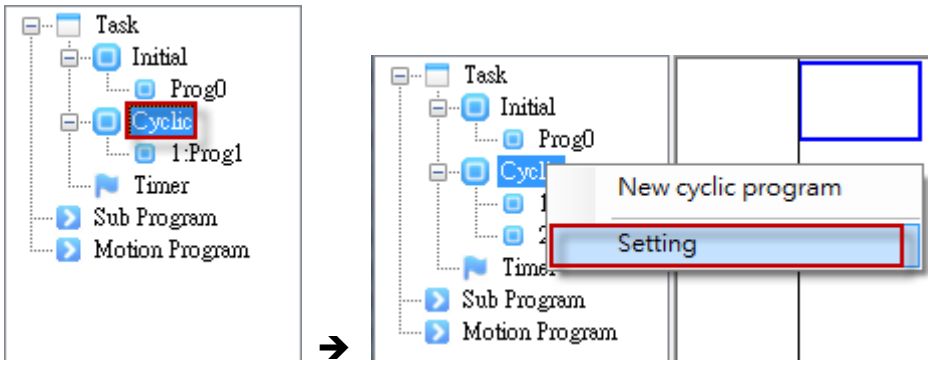


   Enter the program name, which is up to 16 characters. Then press **OK**.

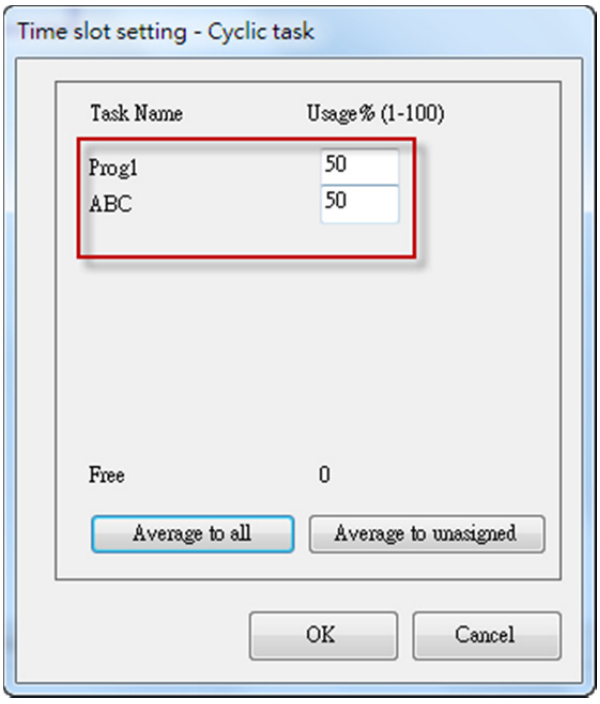


2. Setup Cyclic Task

Right click **Cyclic**. Then, select **Setting**. The **Time slot setting** window will pop up.

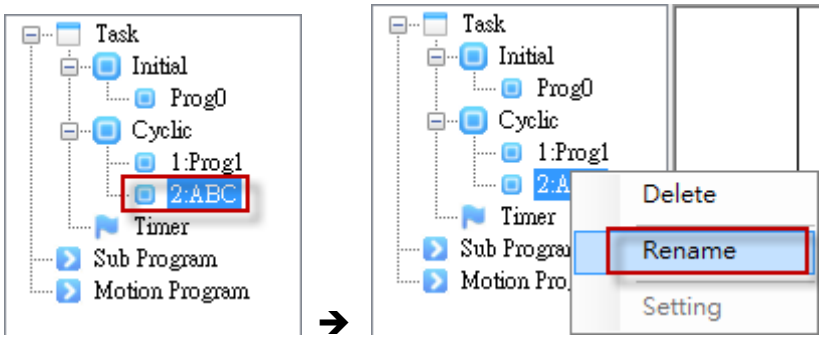


According to the actual Task which shown in the window, enter the usage (%) of each task. The usage sum of all tasks has to be 100. Otherwise, a warning message of **Total usage of time slot must equal to 100** might pop up. Users could also use **Average to all** and **Average to unassigned** to do quick setting.

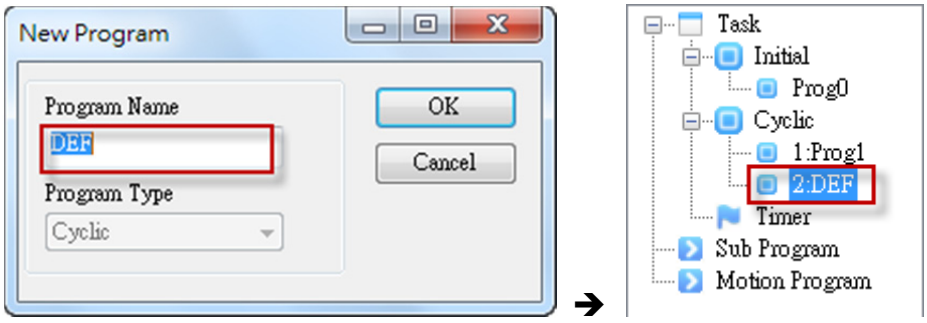


3. Rename the program

Right click the program name and select **Rename**. A **New Program** window will pop up.



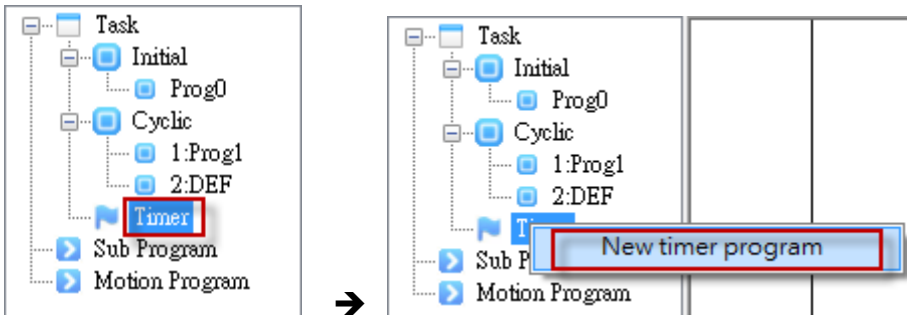
Change the program name and click OK.



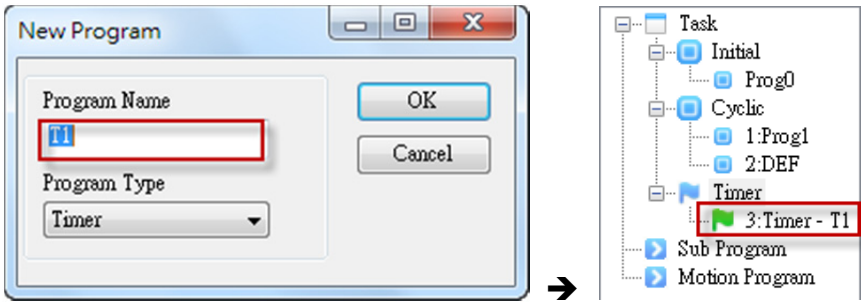
6.2.3 Timer Task

1. New Timer Task

Right click **Timer** and select **New timer program**. A **New program** window will pop up.

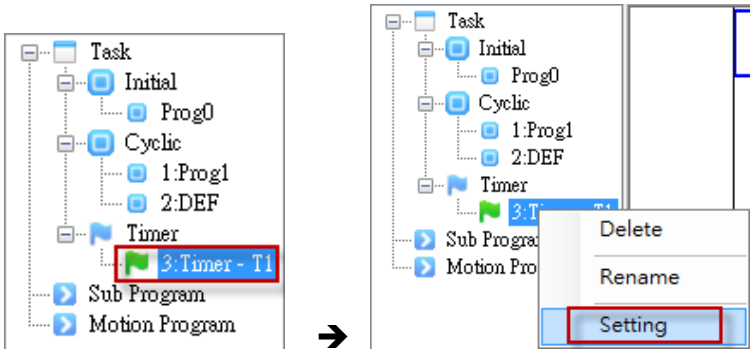


Enter the program name, which is up to 16 characters. Then, press OK.

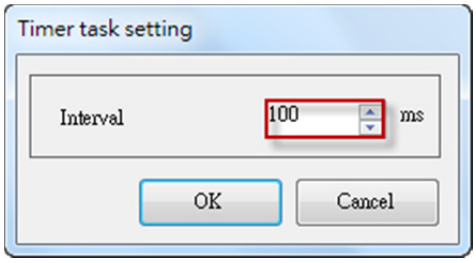


2. Setup Timer Task

Each Timer Task has to be set individually. Right click the program name and select **Setting**. **Timer task setting** window will pop up.

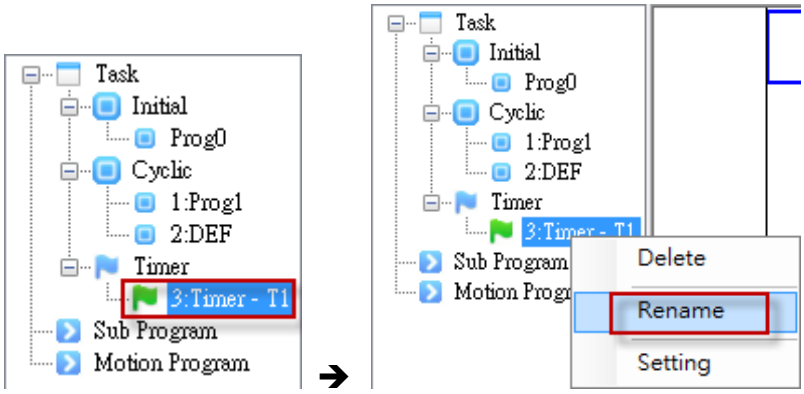


Enter the time interval of the Timer Task. Its setting unit is ms and range is between 1 ms and 30000 ms.

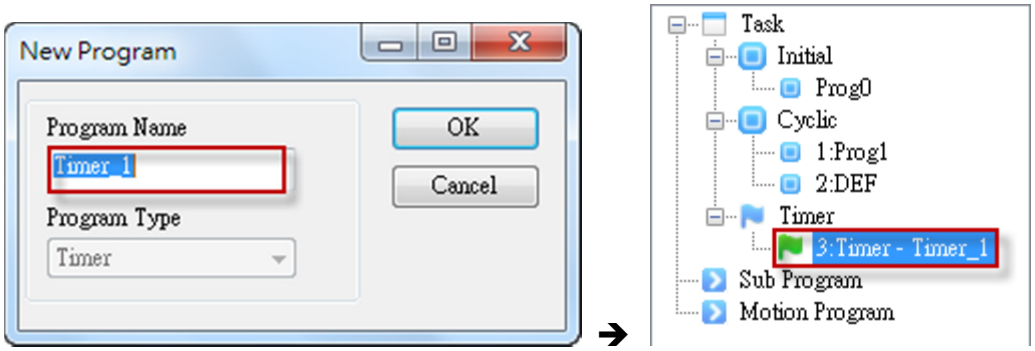


3. Rename the program

Right click the program name and select **Rename**. A **New program** window will pop up.



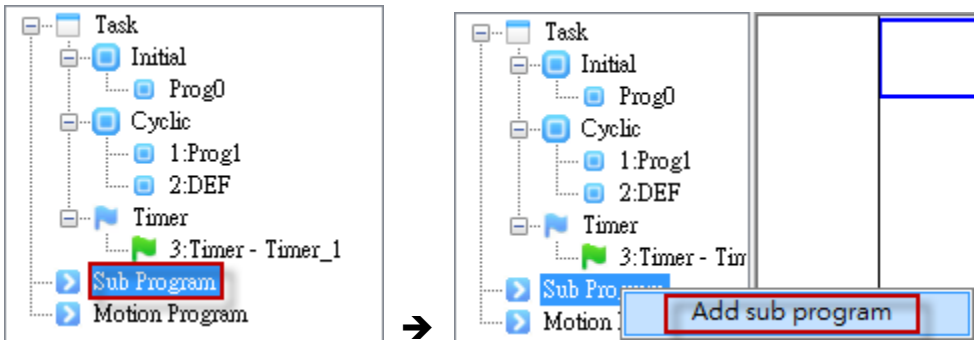
Enter the program new and press **OK**.



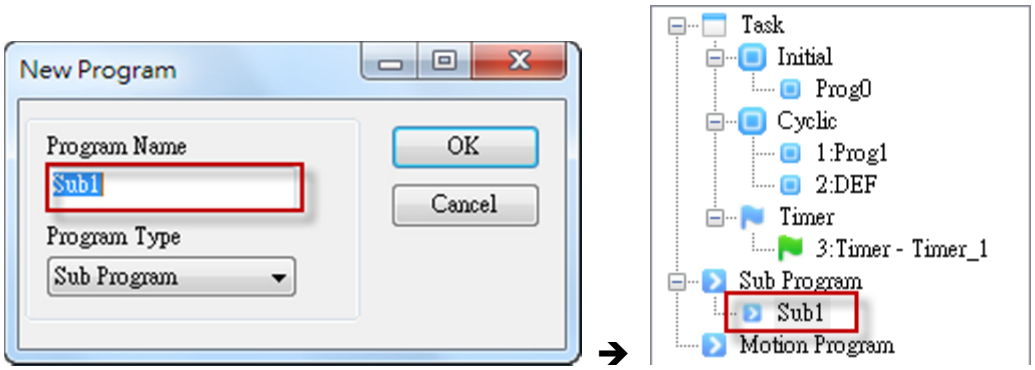
6.2.4 Sub Program

1. New Sub Program

Right click the **Sub Program** and select **New Sub Program**. A **New program** window will pop up.

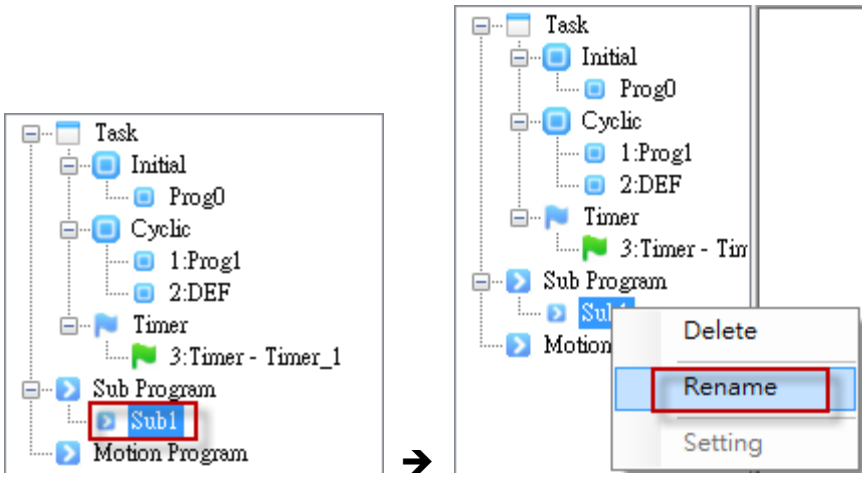


Enter the program name, which is up to 16 characters. Then, press OK.

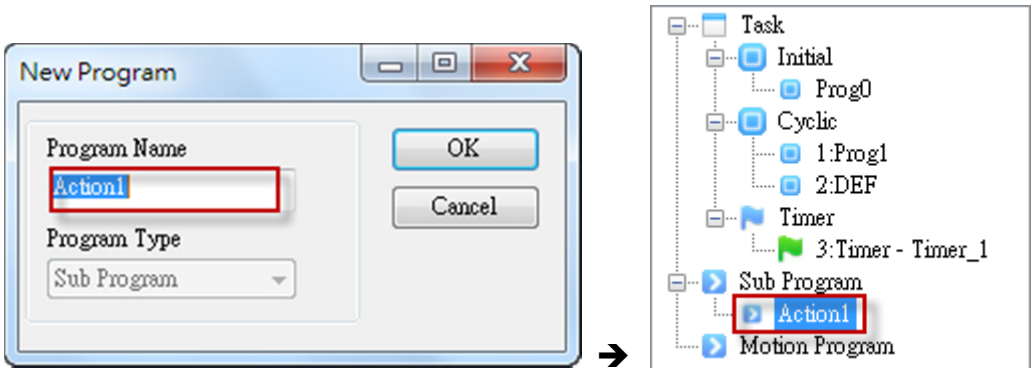


2. Rename the program

Right click the program name and select **Rename**. A **New program** window will pop up.



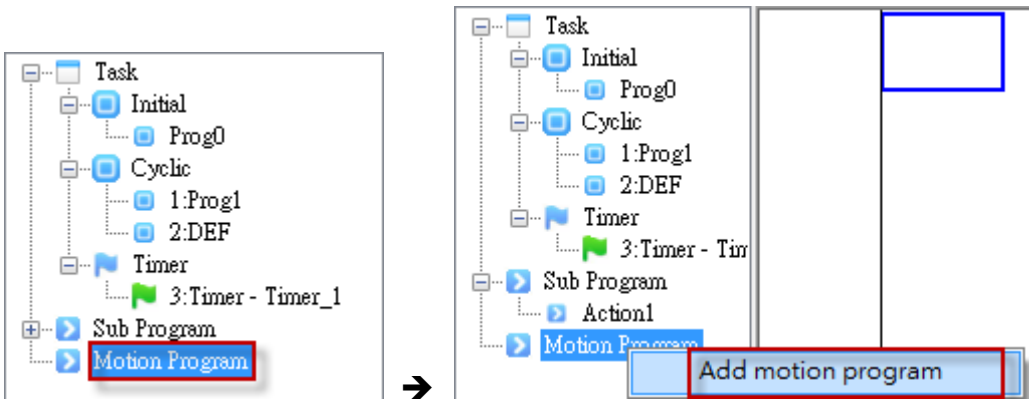
Enter the new program name and press OK. Meanwhile, if the Ladder program has called the command about this sub program, it will be renamed automatically.



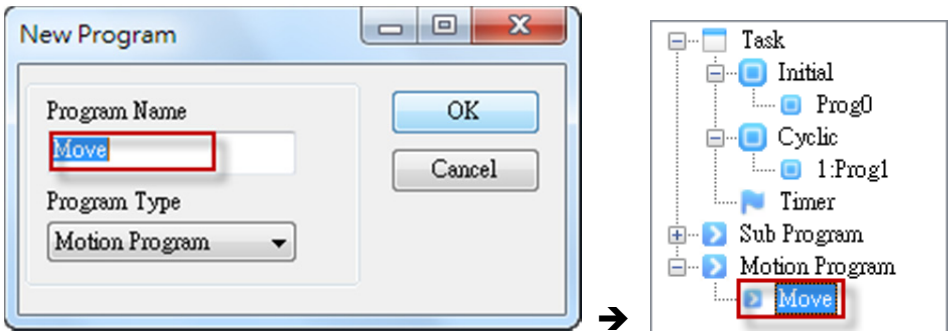
6.2.5 Motion Program

1. New Motion Program

Right click the **Motion Program** and select **New Motion Program**. A **New program** window will pop up.

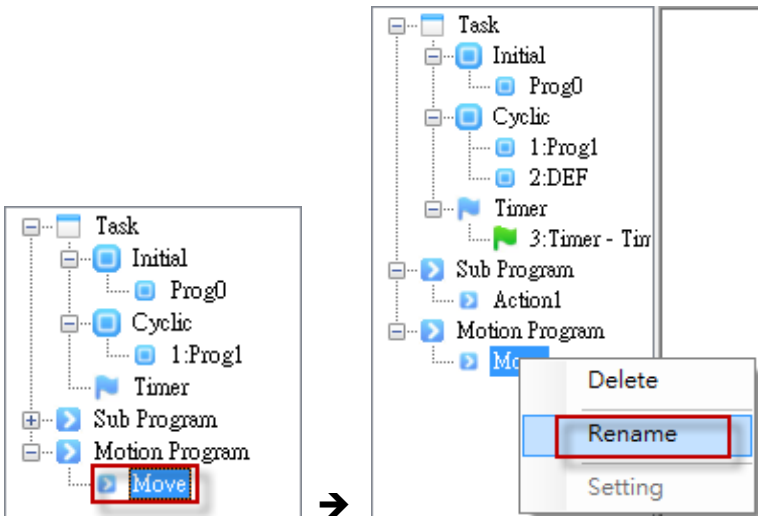


Enter the program name, which is up to 16 characters. Then, press **OK**.

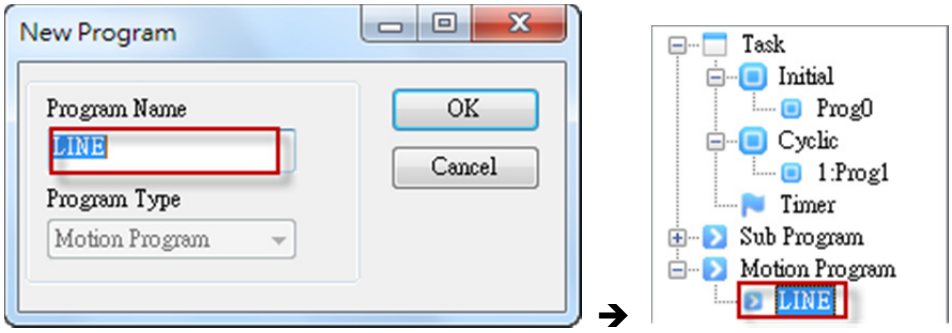


2. Rename the program

Right click the program name and select **Rename**. A **New program** window will pop up.

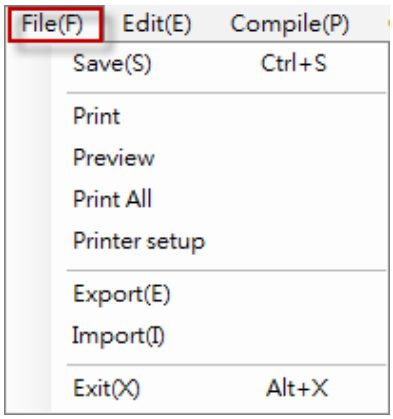


Enter the new program name and press OK. Meanwhile, if the Ladder program has launched the command about this motion program, it will be renamed automatically.



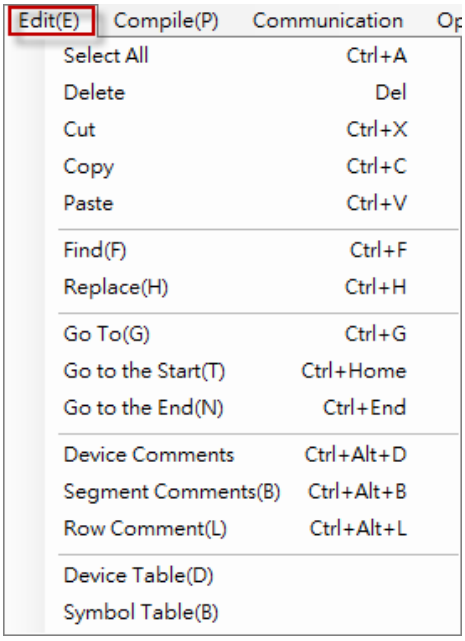
6.3 Other Functions

File Function



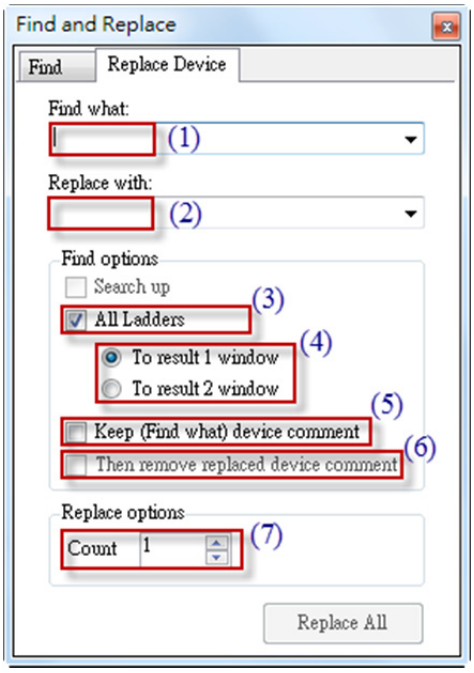
Item	Description
Save (S)	Save the current Ladder program
Print	Print the current editing content of Ladder program
Preview	Preview the current editing content of Ladder program
Print ALL	Print all the content of unlocked Ladder program.
Printer setup	Setup the printing format, including paper size, border, direction and etc.
Export (E)	Export Ladder program (.cwp)
Import (I)	Import Ladder program (.cwp)
Exit (X)	Close Ladder Editor

Edit Function



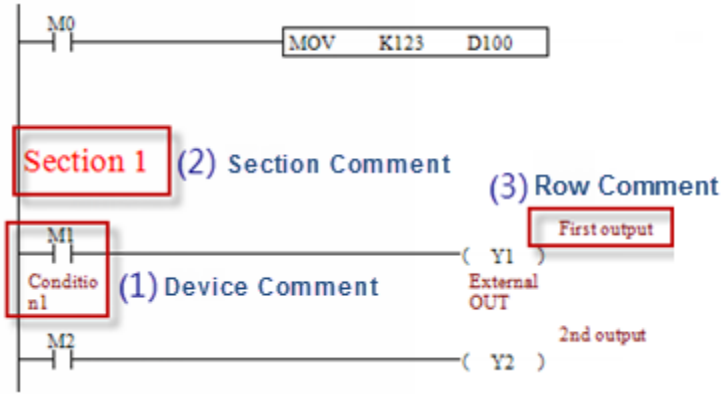
Item	Description
Select All	Select all content of current Ladder program
Delete	Delete the selected content
Cut	Cut the selected content
Copy	Copy the selected content
Paste	Paste the selected content
Find (F)	Find the target from current or all program
Replace (H)	Find the target and specify the replaced device from current or all program
Go To (G)	Go to the specified STEP
Go to the Start (T)	Go to STEP 0 in editing program
Go to the End (N)	Go to END command in editing program
Device Comments	Edit Device Comments
Segment Comments	Edit Segment Comments
Row Comments	Edit Row Comments
Device Table (D)	Open the window of Device Table
Symbol Table (D)	Open the window of Symbol Table

- Find and Replace

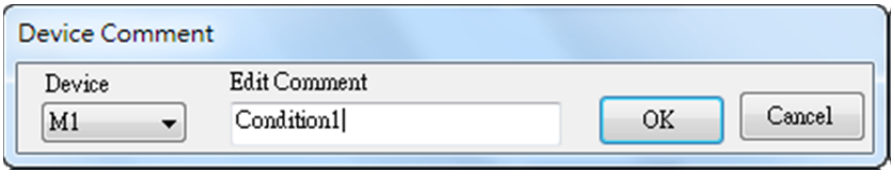


Item	Description
(1)	Find the device
(2)	Replace the device
(3)	Find from the **current program** or **all program**
(4)	Select the output result to **result 1 window** or **result 2 window**
(5)	Replace **find device comment** with **replaced device comment**
(6)	Replace **find device comment** with **replaced device comment** and remove **find device comment**
(7)	The replaced device number

- Device Comments / Segment Comments / Row Comments

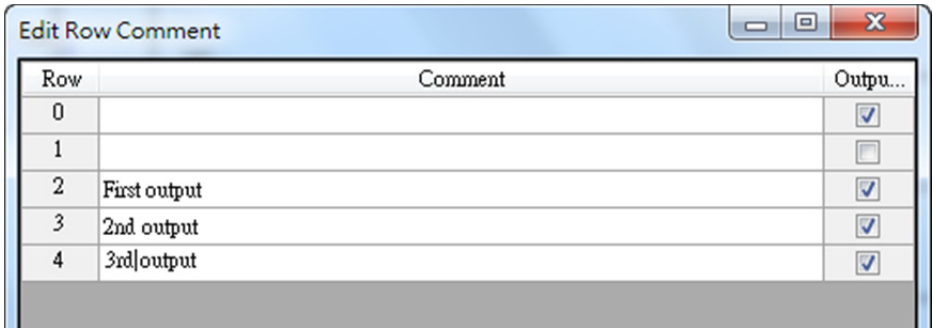


· Select the Device first and click **Edit Device Comments** to open the editing window.



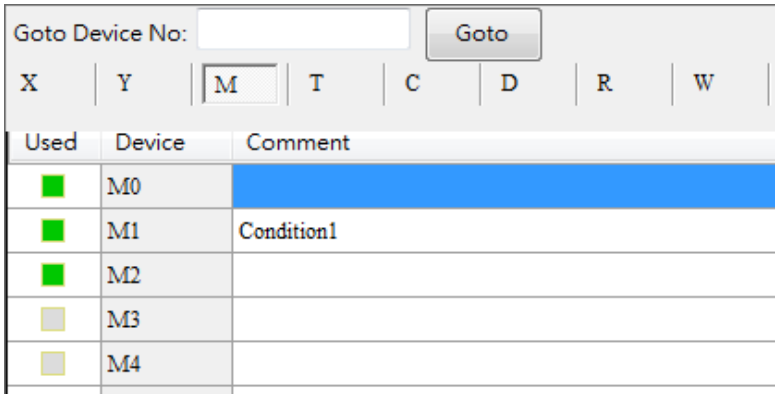
· Select the blank row and click **Edit Segment Comments** to open the editing window.

- Click **Edit Row Comments** to open the Edit Row Comment window.

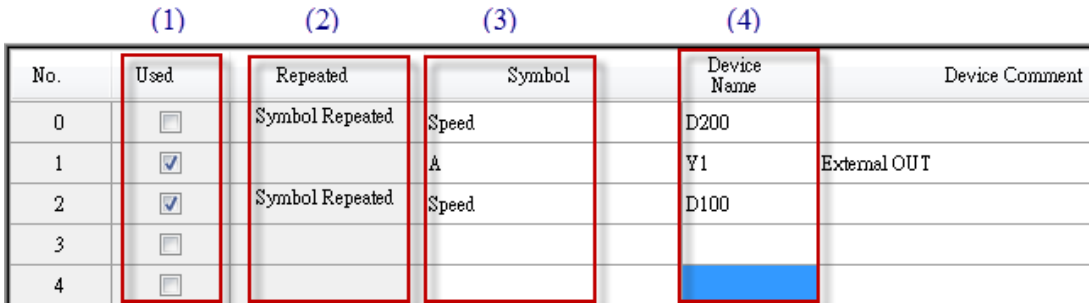


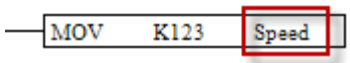
- Device Table

  It shows the comment of all devices. Users can directly edit the table according to the selected device.

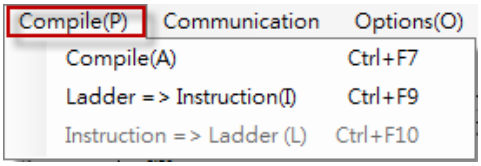


- Symbol Table



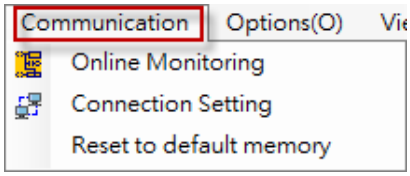
Item	Description
(1)	If the device is checked, it means it is being used in the program.
(2)	Symbol Repeated➔ Different devices use the same symbol. Device Repeated➔ One device use more than two symbols.
(3)	Symbol is used by the device. It will replace the device in the program. 
(4)	Select the device which uses symbol.

Compile Function



Item	Description
Compile all	Compile all program
Ladder → Instruction	Convert ladder diagram to instruction
Instruction → Ladder	Convert instruction to ladder diagram

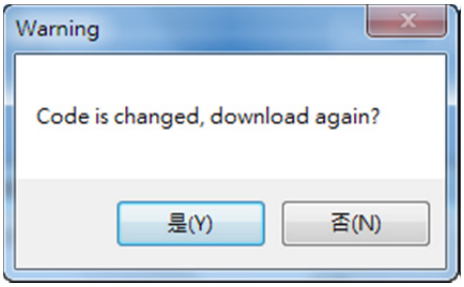
Communication Setting Function



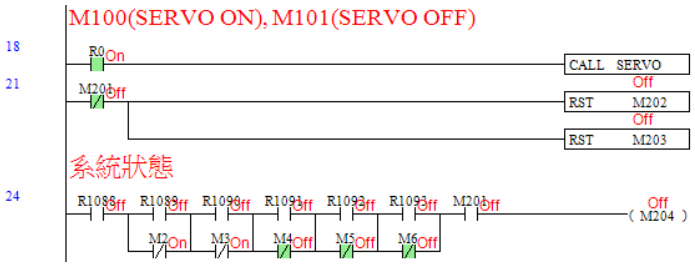
Item	Description
Online Monitoring	Monitor the execution of HMC ladder program through Ethernet
Connection Setting	Connection setting of HMC's Ethernet
Reset to default memory	Reset the value to the default one

- Online Monitoring

  Connect to HMC according to the connection setting. Before executing online monitoring, HMC program has to be compiled first and check if the HMC internal program is the same as editing ladder. Warning message will pop up if it is different.

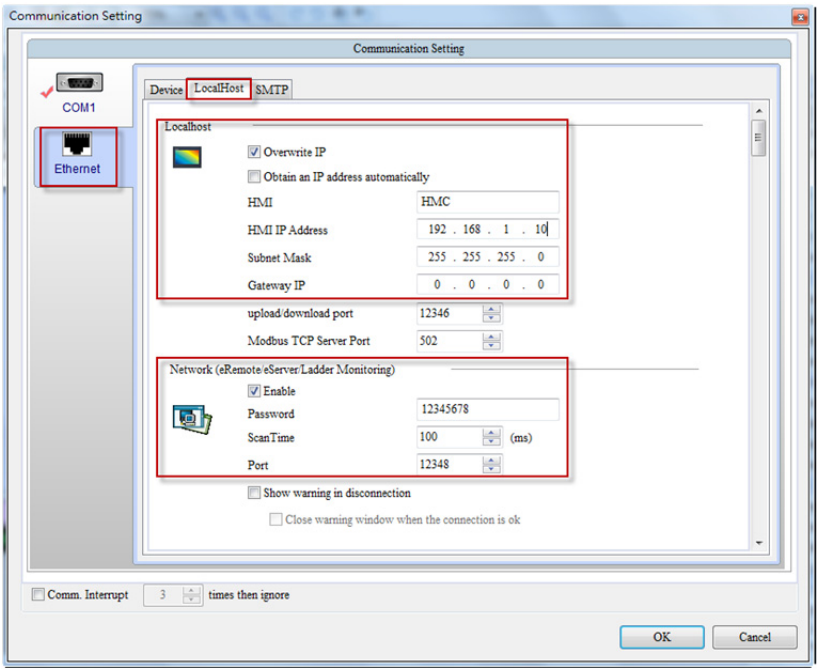


When the connection is successfully built, users can monitor the execution of current ladder.

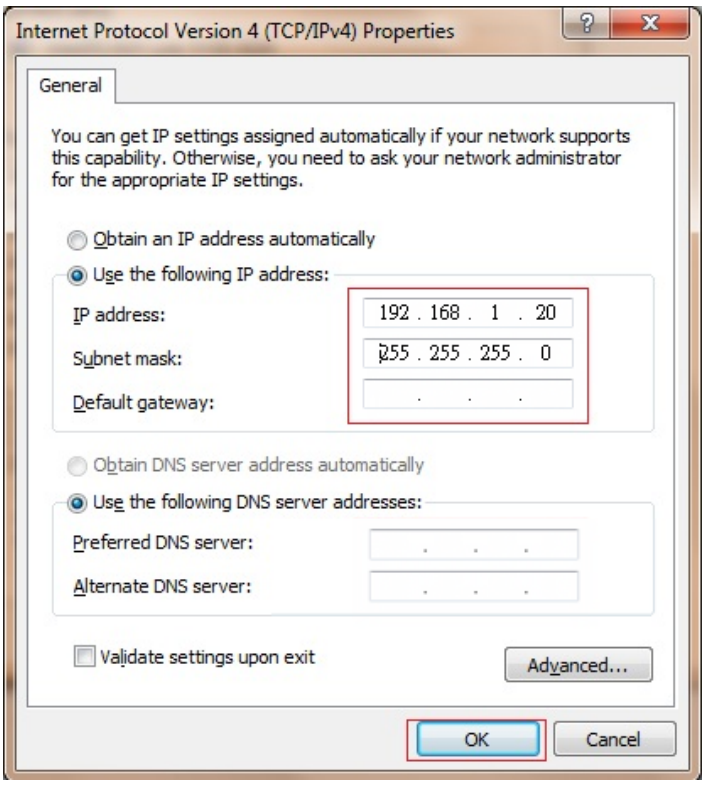


- Connection Setting

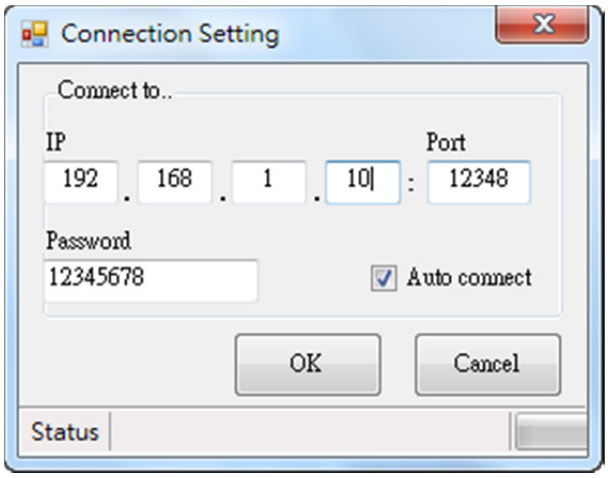
  Click **Option** → **Communication Setting** to open the window from DOPSoft. Then, setup IP address as the followings and check **Enable Network Application** to download the screen to HMC.



IP setting of PC should be set in the same domain as HMC

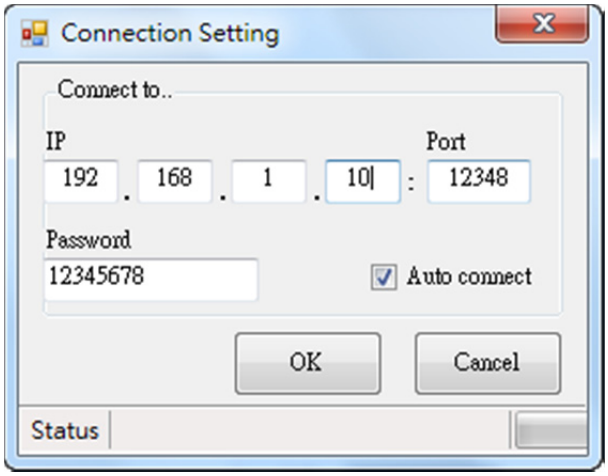


Setup HMC IP and use Port and password

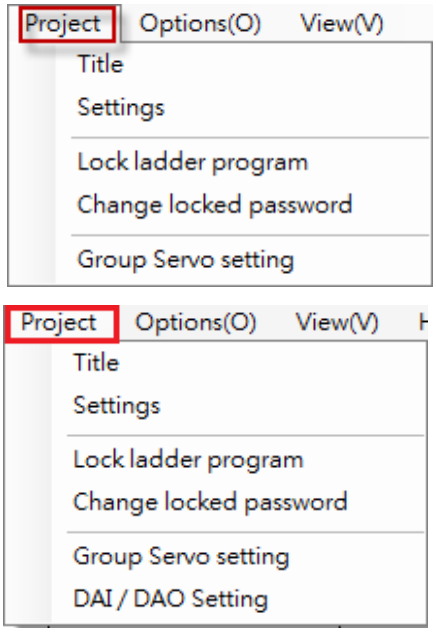


- Reset Value of Device Memory

  Reset the device back to the default value through Ethernet



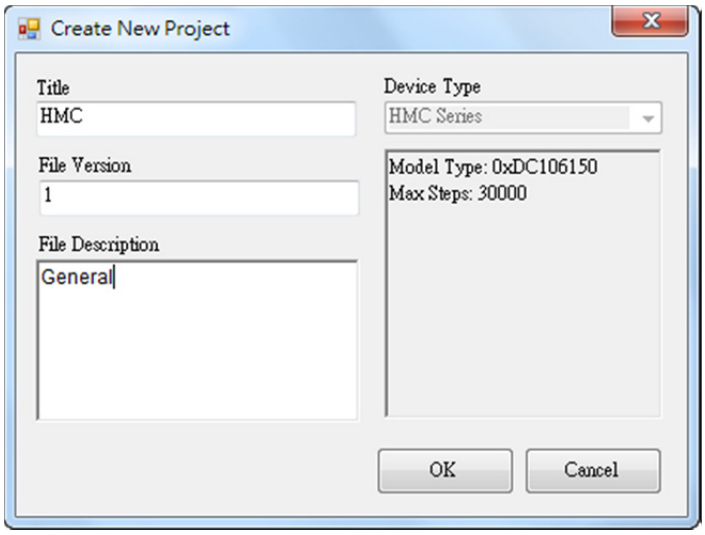
Project Function



Item	Description
Title	Setup the project version
Setting	Setup parameters of the project
Lock the Ladder	After verifying the password, lock the specified ladder. The locked program cannot be opened or changed.
Change the Password	Change the password
Group servo setting	Servo architecture in use setting
DAI/DAO parameter	Set the parameters of DMCNet analog input (DAI) and DMCNet analog output (DAO)

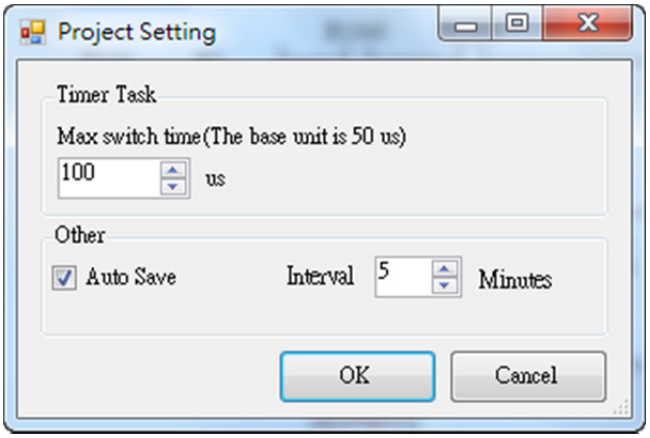
- Title

  Enter the project tile, file version and file description



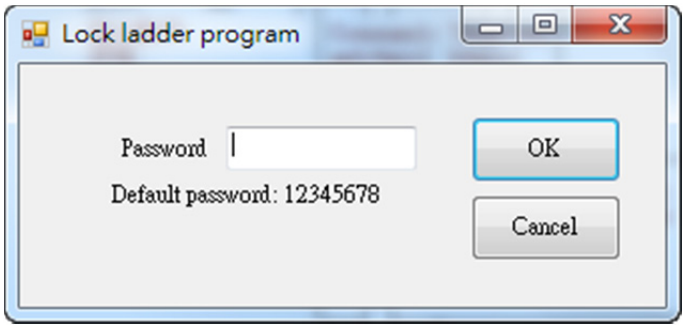
- Setting

  Setup the maximum switch time (Unit is us) in timer task and automatically save the cycle of ladder program.

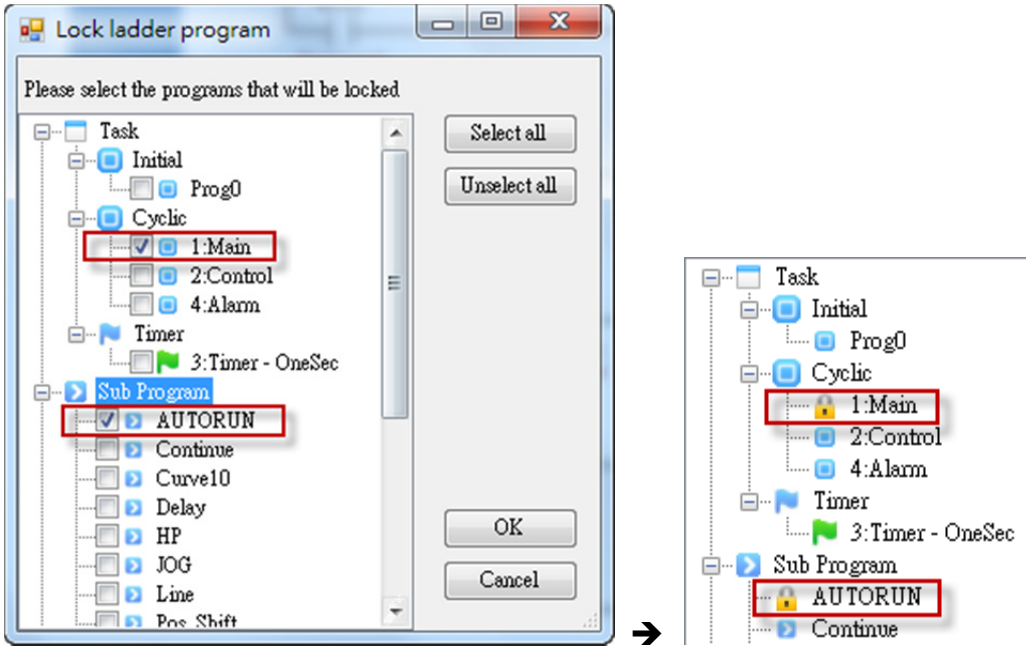


- Lock Ladder program

  Password authentication first

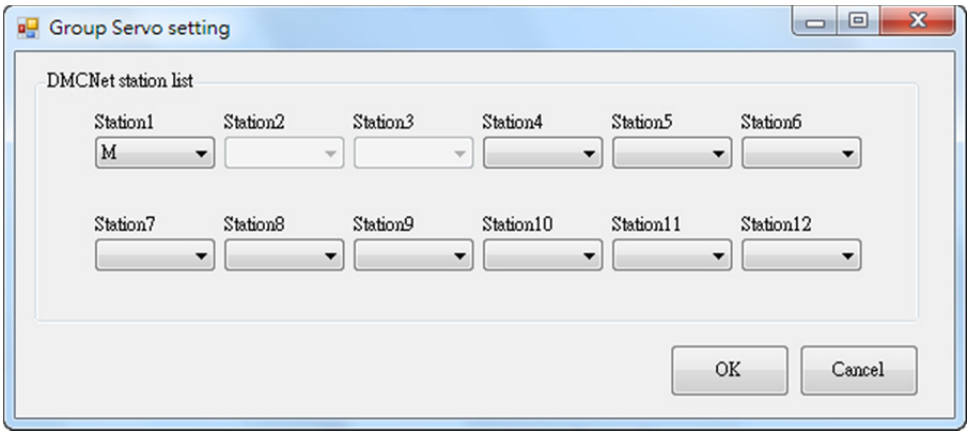


Select the ladder program that lock and check. And that program will be unable to open or edit.



- Group servo setting

  The setting of servo architecture in use implements the multiple-axis motion between different servo drives.

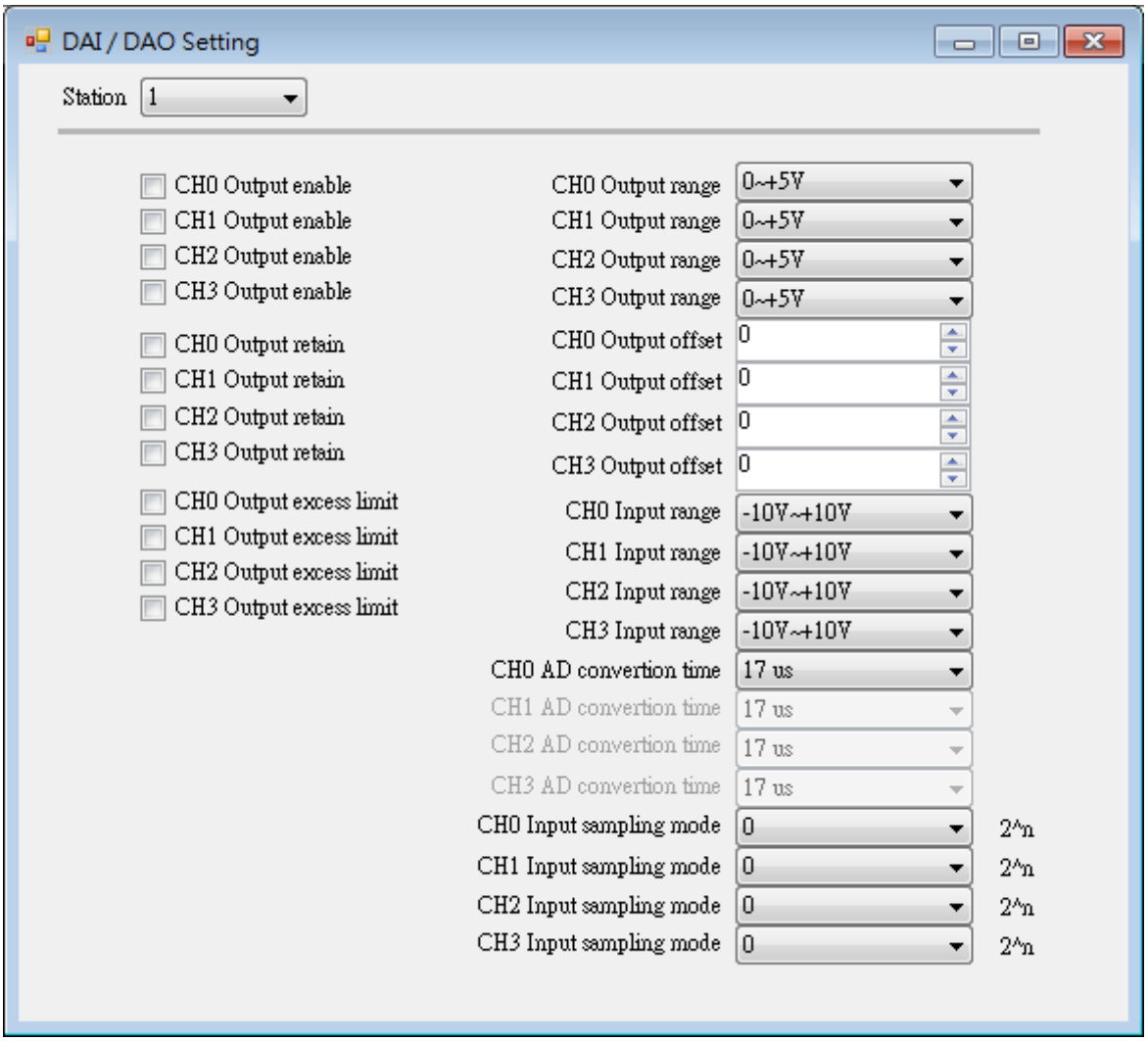


- DAI/DAO parameter setting

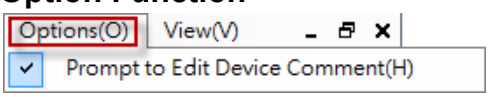
The DAI/DAO setting window can be used to set DMCNet analog input (DAI) and DMCNet analog output (DAO) modules. Users can set the parameters according to different DMCNet station ID.

The analog input module enables the user to set the voltage input range and the input sampling mode (average number of the input values) for CH0~CH3.

The analog output module enables the user to configure the following settings for CH0 ~ CH3: output enable, output retain when disconnected, output excess limit (voltage), the voltage output range, output offset and AD conversion time.

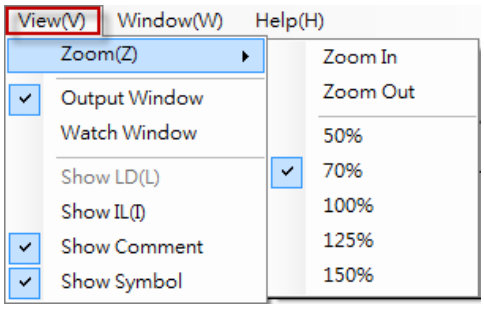


Option Function



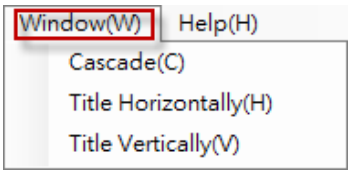
Item	Description
Prompt to Edit Device Comment	After entering the command, automatically check if the device comment does exist. If not, it will automatically activate the window for entering the device comment.

View Function



Item	Description
Zoom	The window can be zoomed in or zoomed out to 50%, 70%, 100%, 125% and 150%.
Output Window	It shows the output window.
Watch Window	It shows the watch window.
Show LD	It shows the ladder program.
Show IL	It shows the instruction.
Show Comment	Show the device comments and row comments or not?
Show Symbol	Show the symbol or device or not?

Window Function



Item	Description
Cascade	More than one ladder diagrams are in cascade display
Title Horizontally	More than one ladder diagrams are in title horizontally.
Title Vertically	More than one ladder diagrams are in title vertically.

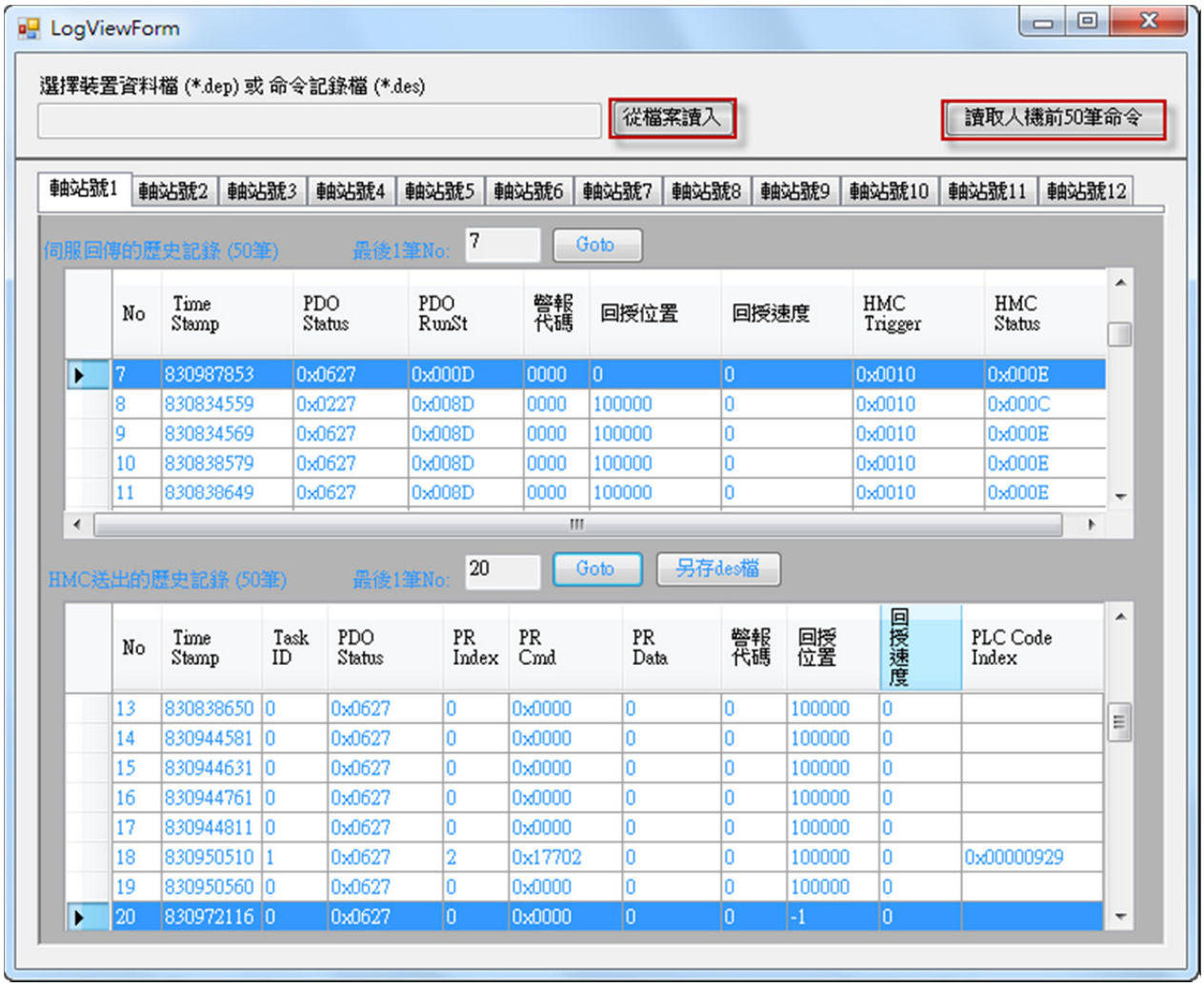
Review HMC Command History

Item	Description
Review HMC command history	Acquire HMC's record: 1. The latest 50 motion commands issued by servo drive. 2. The latest 50 motion statuses

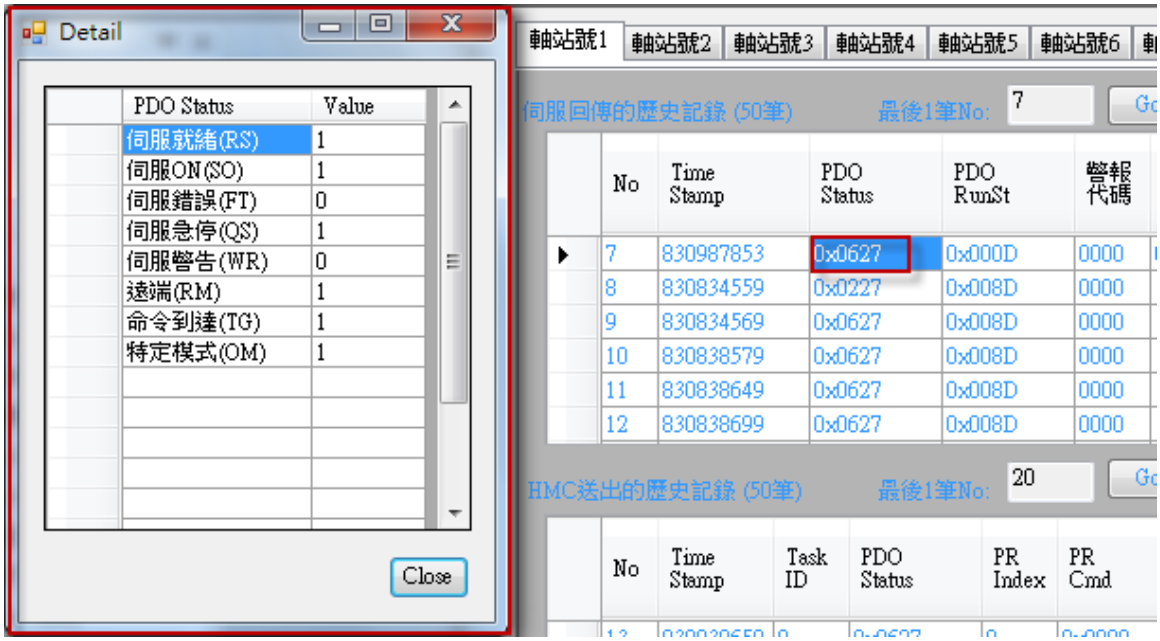
- LogViewForm

  Left click the button of [Review HMC Command History] to open the window of [LogViewForm].

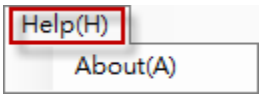
  Click [Read from file] to import the record (.dep or .des) so as to read the detailed information. Users also can acquire HMC's file through [Access the HMI's latest 50 commands] when the communication is built.



The record includes the information of 12 axes. User can select the axis from [Axis number] and double click the column for further information.



Help Function



Item	Description
About (A)	Version of Ladder Editor

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Chapter 7 Appendix

7.1 Extension Pin (including the installation of handwheel)

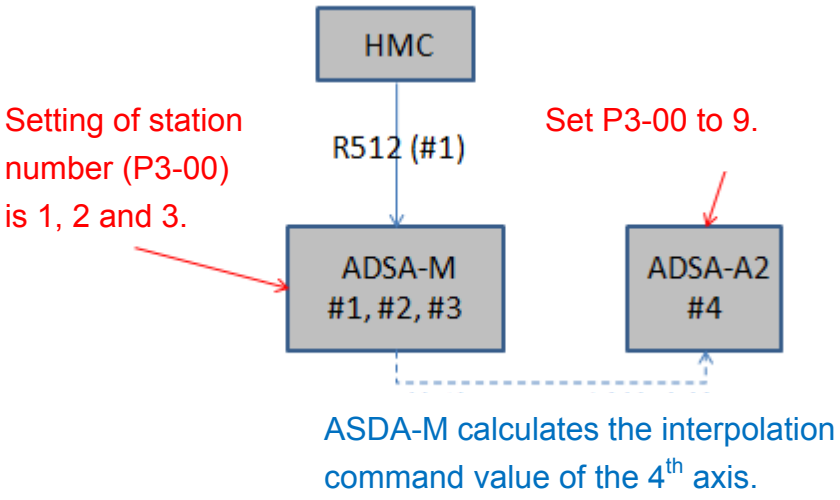
Pin Definition (See diagram on the right)	Description
1	24V A (FOR PHASE A, B)
2	PHASE A (Handwheel PHASE A)
3	PHASE B (Handwheel PHASE B)
4	GND A (For PHASE A, B)
5	GND B (For INTERRUPT 0 ~ 3
6	INTERRUPT 0
7	INTERRUPT 1
8	INTERRUPT 2
9	INTERRUPT 3
10	24V B (FOR INTERRUPT 0~3)
Note: Handwheel only needs to connect to 1~4 pins.	

7.2 Definition of Bus Pin

Lines	Name	Description	12 pin	16 pin	32 pin
White & Orange	URG_C	Emergency switch B contact	*	*	*
White & Orange	URG_C	Emergency switch B contact	*	*	*
White & Green	URG_O	Emergency switch A contact	*	*	*
White & Green	URG_O	Emergency switch A contact	*	*	*
Red	Power	Power supply 24V+	*	*	*
Black	PGND	Power ground	*	*	*
White	EGND	Ground	*	*	*
Yellow	422_TX+	RS422: TX+, RS232: TX, RS485: T+/R+			*
White & Yellow	422_TX-	RS422: TX-, RS485: T-/R-			*
Black & White	CGND	Signal ground	*	*	*
Black & White	CGND	Signal ground			*
Black & White	CGND	Signal ground			*
White & Blue	LIM_O	Limit switch A contact			*
White & Blue	LIM_O	Limit switch A contact			*
Purple	422_RX+	RS422: R+, RS232:RX			*
White & Purple	422_RX-	RS422: R-			*
Black & Orange	INT1	Interrupt 1 (Reserved)			*
Black & Green	INT0	Interrupt 0 (Reserved)			*
Red & Black	I_GND	Interrupt ground			*
White & Red	I_PW	Interrupt power supply 24V+			*
RJ45 Blue	DMC	DMCNET wiring	*	*	*
RJ45 Black	ETH	EtherNet wiring			*
RJ45 Green	RIO	Remote IO wiring		*	*

7.3 Setting and Framework of ASDA-M 4-axis Synchronous Servo Drive

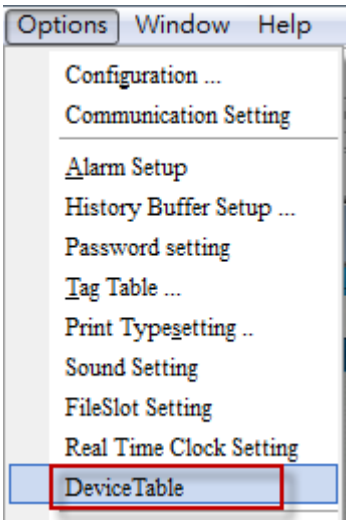
Framework of special 4-axis synchronous control:



7.4 Function of Capturing Device Table

Capture [Device Table] function from DOPSoft enables users to capture HMC partial devices' current status ($M, D, W, M, R) and the records of HMC command history (!SYS). Users can copy status and records and do remote debug.

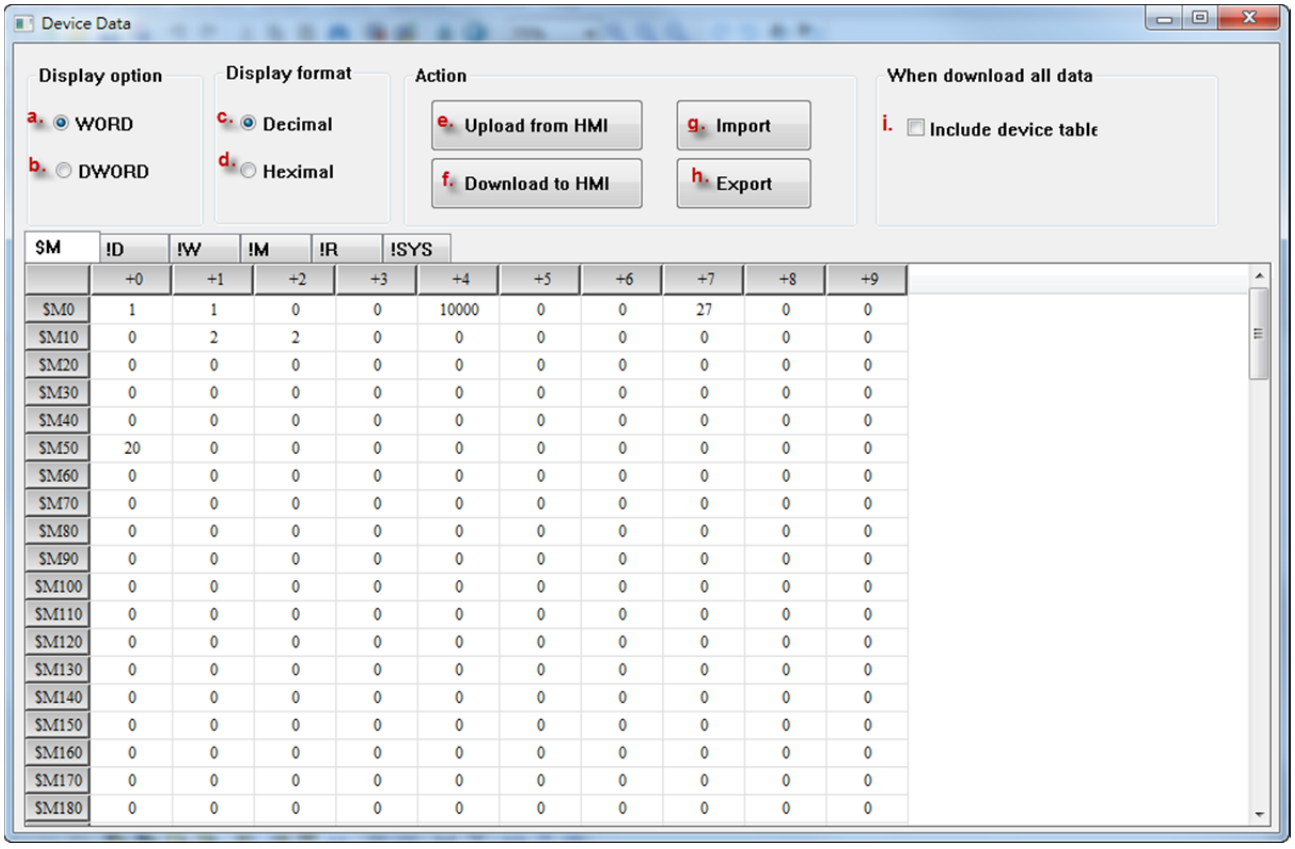
Select [Option] ➔ [DeviceTable] to open the window of Device Data in DOPSoft.



Functions in Device Data include:

a. Display in [WORD]:
   Each data is made up of Word.
b. Display in [DWORD]:
   Each data is made up of DWord
c. Display in [Decimal]:
   The display format of each data is Signed Decimal.

d. Display in [Hexadecimal]:
   The display format of each data is Hexadecimal.
e. [Upload from HMI]:
   When the communication between PC and HMC is successfully built, users can capture HMC's data to PC via USB or EtherNet.
f. [Download to HMI]:
   Write the device data into HMC.
g. [Import]:
   View the external data via [Import] function.
h. [Export]:
   Save the device data table as .dep file. Users can open the file via [View HMC command history] and view the system's status (!SYS).
i. Download all data including Device Table:
   When [Including device table] is checked, the device data table including in project file will be downloaded to HMC.



	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9
$M0	1	1	0	0	10000	0	0	27	0	0
$M10	0	2	2	0	0	0	0	0	0	0
$M20	0	0	0	0	0	0	0	0	0	0
$M30	0	0	0	0	0	0	0	0	0	0
$M40	0	0	0	0	0	0	0	0	0	0
$M50	20	0	0	0	0	0	0	0	0	0
$M60	0	0	0	0	0	0	0	0	0	0
$M70	0	0	0	0	0	0	0	0	0	0
$M80	0	0	0	0	0	0	0	0	0	0
$M90	0	0	0	0	0	0	0	0	0	0
$M100	0	0	0	0	0	0	0	0	0	0
$M110	0	0	0	0	0	0	0	0	0	0
$M120	0	0	0	0	0	0	0	0	0	0
$M130	0	0	0	0	0	0	0	0	0	0
$M140	0	0	0	0	0	0	0	0	0	0
$M150	0	0	0	0	0	0	0	0	0	0
$M160	0	0	0	0	0	0	0	0	0	0
$M170	0	0	0	0	0	0	0	0	0	0
$M180	0	0	0	0	0	0	0	0	0	0

HMC command history (!SYS) will automatically update to the latest status in following three situations:

a. AL.918 occurs:

   This alarm occurs when servo drive is over speed. When the drive speed exceeds the range of [P1-55, Maximum Speed Limit], the drive will automatically servo off and DO.BRKR will be on. Once AL.918 occurs, HMC will record the current command history in data retained device !SYS for reference.

b. AL.030 occurs:

   This is for protecting servo drive from crash. When the condition of protection function is fulfilled, the drive will automatically servo off and DO.BRKR will be on. Once AL.030 occurs, HMC will record the current command history in data retained device !SYS for reference.

c. Set the flag of [Save the record in latch area](R500) to ON:

   When this flag is on, HMC will record the current command history in data retained device !SYS.

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Chapter 8 Application Notes

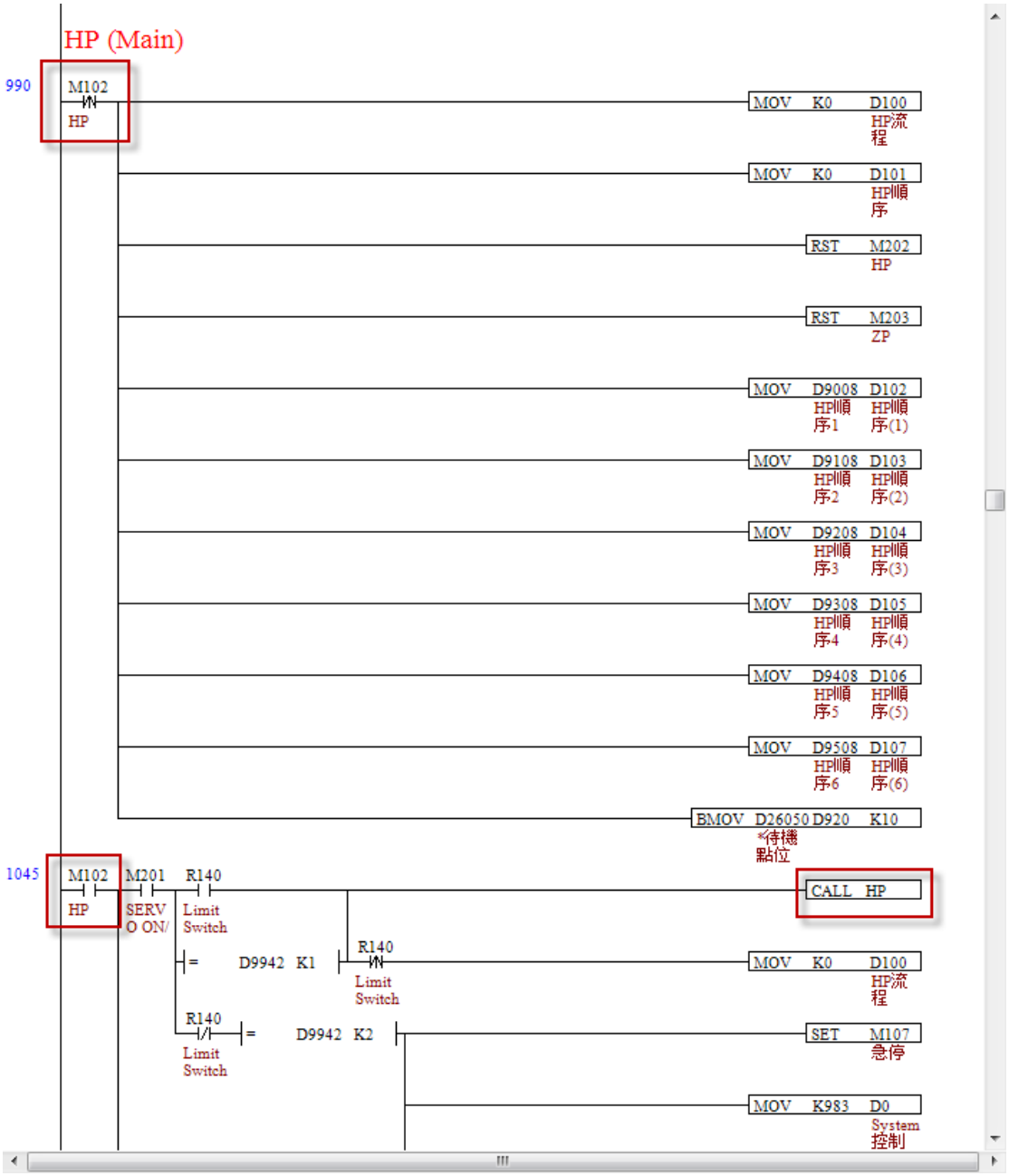
8.1 Use Rising-Edge of Flag to Initialize the Procedure

a. Wrong programming:

1. M102 is set as the triggering button on HMI. When it is on, it means the system should start homing.

2. The rising-edge of M102 initializes homing.

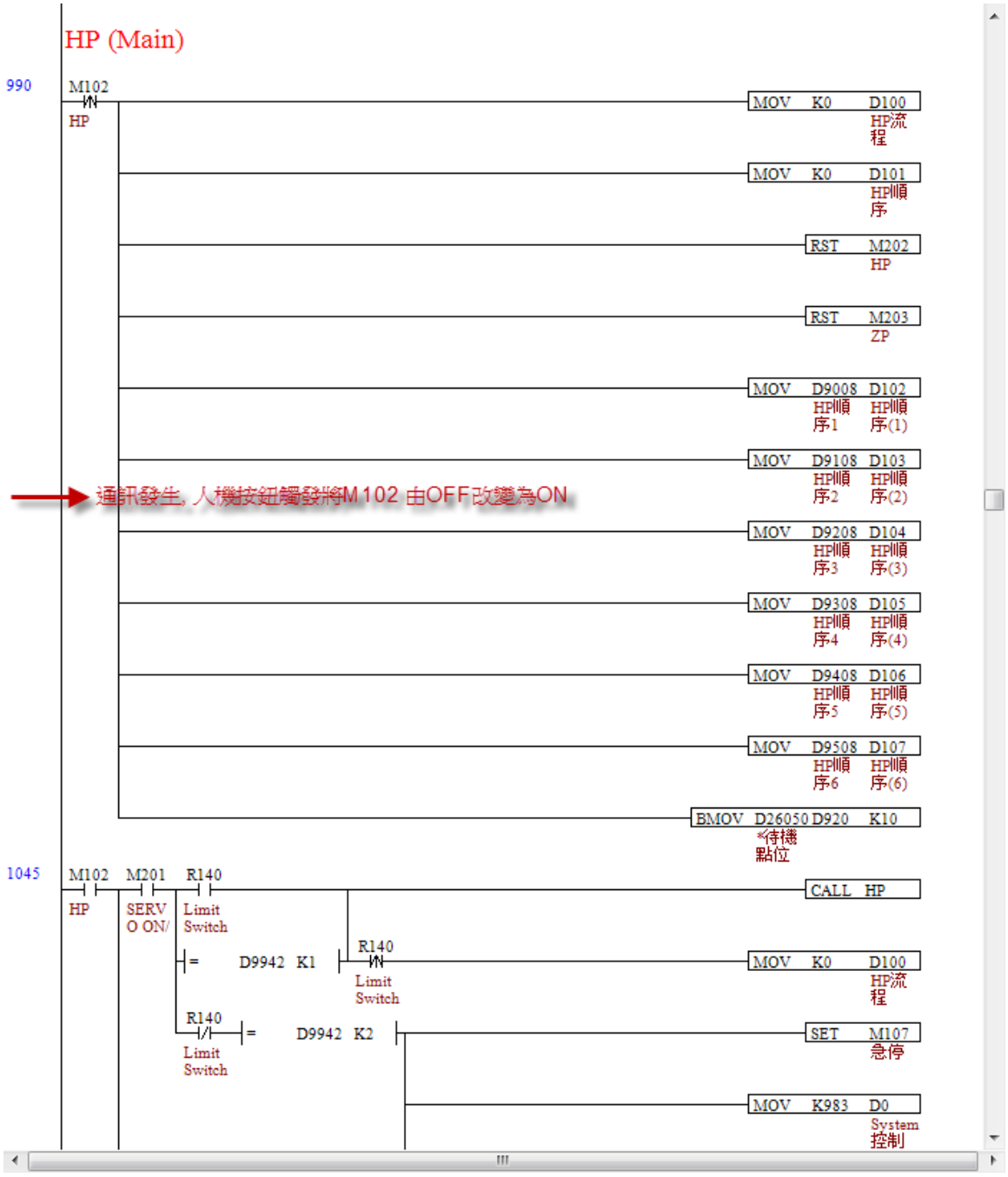
3. M102 is on and go into sub-program, [HP], to do homing (When homing is complete, M102 is set to off.



b. Causes:

HMI side is always communicating with the controller. If the timing that HMI side triggers M102 to on as the figure that shows below, homing will start before initialing. See followings for the time sequence:

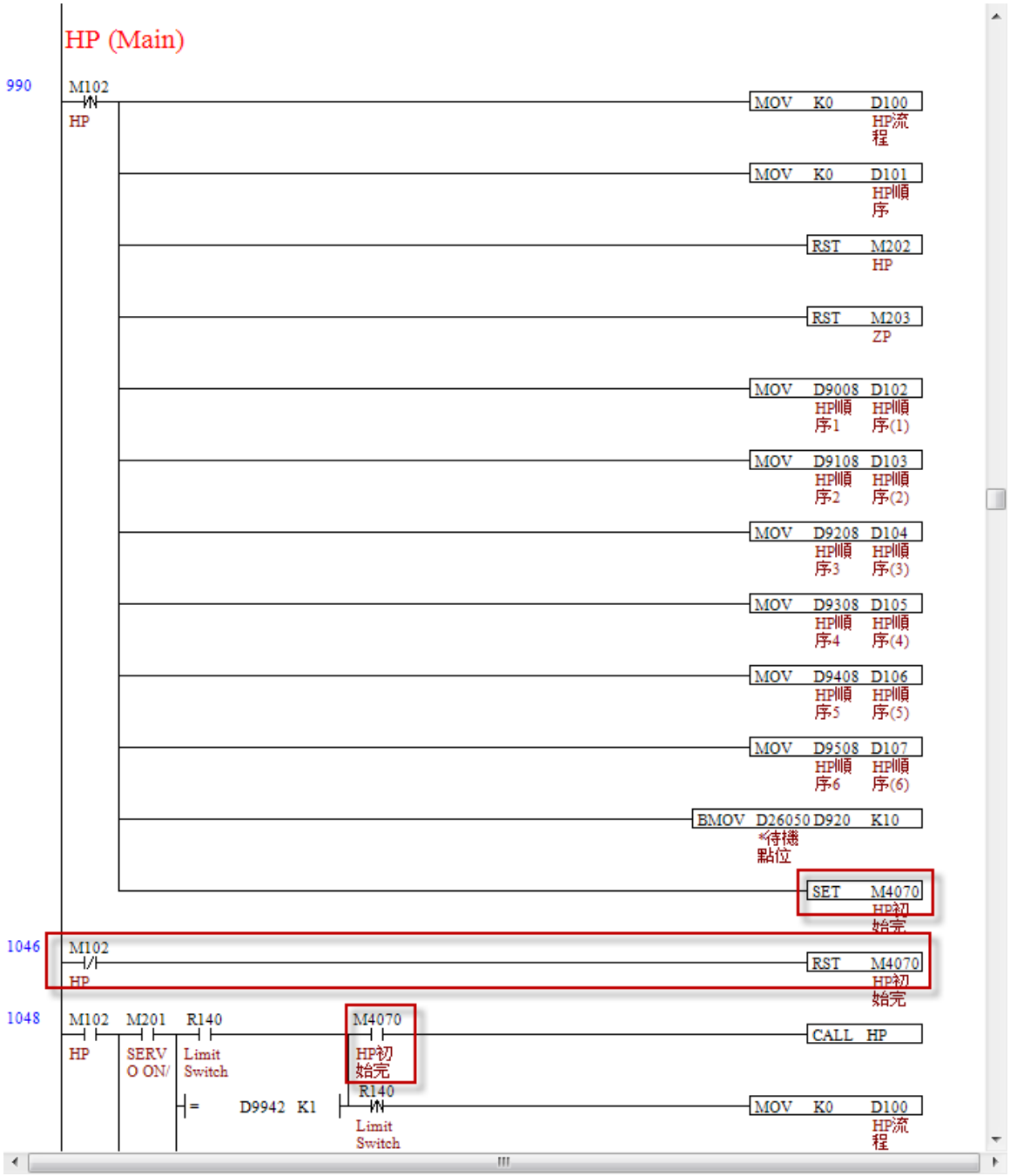
1. Rising-edge of M102 is not detected. Thus, it does not initialize homing (M102 is still off).
2. M102 is set to on (see the following diagram for its triggering timing)
3. M102 is on. Go to [HP] and start homing. However, it might cause error since it has not been initialized.
4. In next scanning, rising-edge of M102 is detected, but the system has done homing before doing initialization. Sequence error.



c. Suggestions:

For instance, set M4070 to on after the initialization is complete so as to ensure the user initializes homing before executing.

1. The rising-edge of M102 initializes homing.
2. M102 is on. The initialized setting should be complete (M4070 is on) before going to the sub-program, [HP] to do homing.
3. When homing is complete or homing will not be executed (M102 is off), the flag should be off (RST M4070.)



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