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DVP-10PM Application Manual (Programming)

DVP-*10PM*
Application Manual (Programming)

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DVP-10PM Application Manual

Contents

1 Program Framework of a DVP-PM Series Motion Controller

Delta DVP-PM series motion controllers can put axes in particular positions at high-speeds, create linear interpolations, and circular interpolations. They can execute basic instructions, applied instructions, motion instructions, and G-codes. Different DVP-PM series motion controllers support different program frameworks and functions. The functions that DVP-PM series motion controllers support are shown in the table below.

Function		DVP-20PM	DVP-10PM
Program	Main program O100	○	○
	Ox motion subroutines	○	×
	P subroutines	○	○
Instruction	General instructions/Applied instructions	○	○
	Motion instructions	○	×
	G-codes	○	×
	M-codes	○	×
Uniaxial motion	JOG motion	○	○
	Returning home	○	○
	Variable motion	○	○
	Single-speed motion	○	○
	Inserting single-speed motion	○	○
	Two-speed motion	○	○
	Inserting two-speed motion	○	○
	Triggering single-speed motion by means of an external signal	○	×
	Manual pulse generator mode	○	○
	Cyclic/Noncyclic electronic cam motion	○	×

In this chapter, the basic program frameworks of DVP-PM series motion controllers are described. Owing to the fact that the functionality of a DVP-PM series motion controller is composed of sequence control and positioning control, a program comprises O100, Ox motion subroutines, and P subroutines. O100, Ox motion subroutines, and P subroutines are described in this chapter. Basic instructions, applied instructions, motion instructions, and G-codes will be introduced in other chapter 4~chapter 6. The specifications for DVP-PM series motion controllers are shown in the table below.

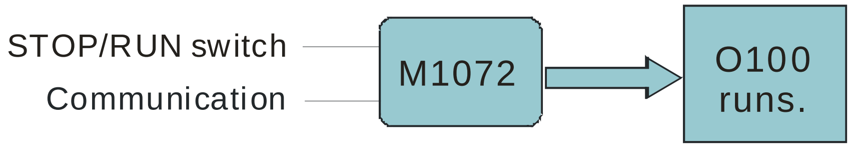
Specifications	DVP-10PM	DVP-20PM
High-speed output	4 axes (1000 kHz)	3 axes (500 kHz)
PWM	Precision: 0.3%@200 kHz	-
High-speed counter	6 input terminals (2 differential input terminals, and 4 input terminals whose collectors are open collectors)	2 input terminals
Program capacity	64K steps	64K steps
Execution speed	LD: 0.14 us MOV: 2 us DMUL: 7.6 us DEMUL: 6.1 us	-

1.1 Structure of O100

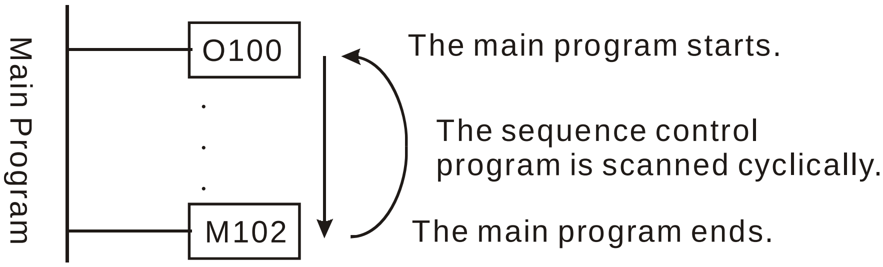
O100 is a sequence control program. It is the main program in a DVP-PM series motion controller. It only supports basic instructions and applied instructions. Users can use these two types of instructions to process I/O data, call P subroutines, and enable Ox motion subroutines (Ox0~Ox99). O100 functions as a main program. Motion subroutines are enabled through O100. There is hierarchical relation between O100 and motion subroutines. The characteristics of O100 are described below.

1. There are two methods of enabling O100.
   - If the STOP/RUN switch of a DVP-PM series motion controller module is turned form the “STOP” position to the “RUN” position when the DVP-PM series motion controller is powered, M1072 will be ON, and O100 will run.

- If a DVP-PM series motion controller is powered, users can use communication to set M1072 to ON, and to run O100.



2. O100 is scanned cyclically. The scan of the main program O100 starts from the starting flag O100. After the ending instruction M102 is scanned, the scan of the main program O100 will go back to the starting flag O100.



3. There are three methods of disabling O100.
   - If the STOP/RUN switch of a DVP-PM series motion controller is turned form the “RUN” position to the “STOP” position when the DVP-PM series motion controller is powered, M1072 will be OFF, and O100 will stop. If O100 stops, Ox motion subroutines and P subroutines will not be executed.
   - If a DVP-PM series motion controller is powered, users can use communication to set M1072 to OFF, and to stop O100. If O100 stops, Ox motion subroutines and P subroutines will not be executed.
   - If an error occurs when O100 is compiled or when O100 runs, O100 will stop automatically. Please refer to appendix A in chapter 9 for more information about error codes.
4. O100 supports basic instructions and applied instructions. Users can write a control program according to their needs. They can set the parameters of motion instructions, and motion subroutine numbers (Ox0~Ox99) in O100.
   - O100 does not support motion instructions and G-codes. Motion instructions and G-codes must be used in the motion subroutines Ox0~Ox99. Please refer to section 1.2 for more information.
   - O100 can call P subroutines. Please refer to section 1.3 for more information.
5. The description of O100 is shown below.

O100	Description
Enabling O100	Starting flag O100 (If O100 is a ladder diagram in PMSoft, the starting flag in O100 will be set automatically, and users do not have to write the starting flag.)
Disabling O100	Ending instruction M102 (If O100 is a ladder diagram in PMSoft, the ending instruction M102 will be set automatically, and users do not have to write the ending instruction M102.)
Executing O100	1. The STOP/RUN switch of a DVP-PM series motion controller is turned form the “STOP” position to the “RUN” position. 2. Users use communication to set M1072 to ON.
Operation characteristic	O100 is scanned cyclically.
Instructions supported	Basic instructions and applied instructions are supported.
Number	There is only one O100 in a program.
Characteristic and function	1. It is a sequence control program. 2. It can enable the motion subroutines Ox0~Ox99, and call P subroutines. 3. If O100 is used with Ox motion subroutines and P subroutines, O100, the Ox motion subroutines, and the P subroutines can be arranged in any order.

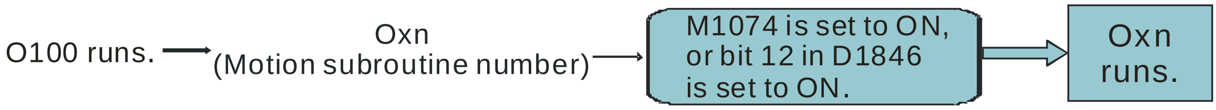
1.1.1 Manual Function of O100

Users can set manual motion modes by means of special registers in O100. (Please refer to section 3.12 for more information.)

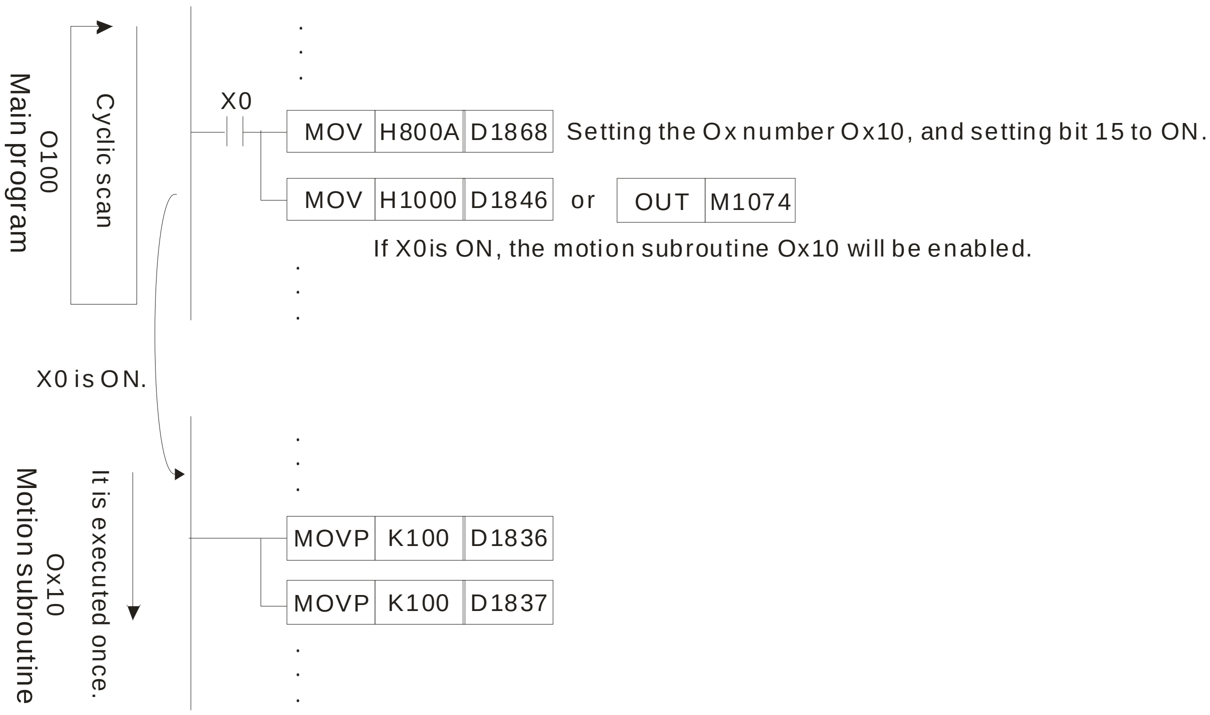
1.2 Structure of Ox Motion Subroutines

The motion subroutines Ox0~Ox99 are motion control programs. They are subroutines which control the motion of the axes of a DVP-PM series motion controller. Ox0~Ox99 support basic instructions, applied instructions, motion instructions, and G-codes. They can call P subroutines. Users can control the paths of the axes of a DVP-PM series motion controller through Ox motion subroutines. The characteristics of Ox motion subroutines are described below.

1. There are two methods of enabling an Ox motion subroutine.
   - When O100 runs, users can set motion subroutine numbers in O100. (The motion subroutine numbers must be in the range of Ox0 to Ox99. The users can set a motion subroutine number in O100 by setting D1868. The value in D1868 must be in the range of H8000 to H8063.) If the users want to enable an Ox motion subroutine, they have to set M1074 to ON or set bit 12 in D1846 to ON.
   - Before an Ox motion subroutine is enabled, users have to make sure that no Ox motion subroutine runs.



2. Whenever an Ox motion subroutine is enabled, it is executed once. After O100 enables an Ox motion subroutine, the execution of the Ox motion subroutine will start from the starting flag in the Ox motion subroutine. After the ending instruction M2 in the Ox motion subroutine is executed, the execution of the Ox motion subroutine will stop.



   If X0 is ON, the motion subroutine Ox10 will be enabled. After the ending instruction M2 in Ox10 is executed, the execution of Ox10 will stop. (Ox10 is executed once. If Ox10 needs to be executed again, X0 has to be set to ON.)

3. There are four methods of disabling an Ox motion subroutine.
   - If the STOP/RUN switch of a DVP-PM series motion controller is turned form the “RUN” position to the “STOP” position when the DVP-PM series motion controller is powered, M1072 will be OFF, O100 will stop, and Ox motion subroutines will not be executed.
   - Users can stop the execution of Ox motion subroutines by means of the external terminal Stop0.
   - If a DVP-PM series motion controller is powered, users can use communication to set the value in D1846 to 0, or to set M1074 to OFF, and to stop the execution of Ox motion subroutines.
   - If an error occurs when an Ox motion subroutine is compiled or when an Ox motion subroutine is

executed, the execution of the Ox motion subroutine will stop automatically. Please refer to appendix A in chapter 9 for more information about error codes.

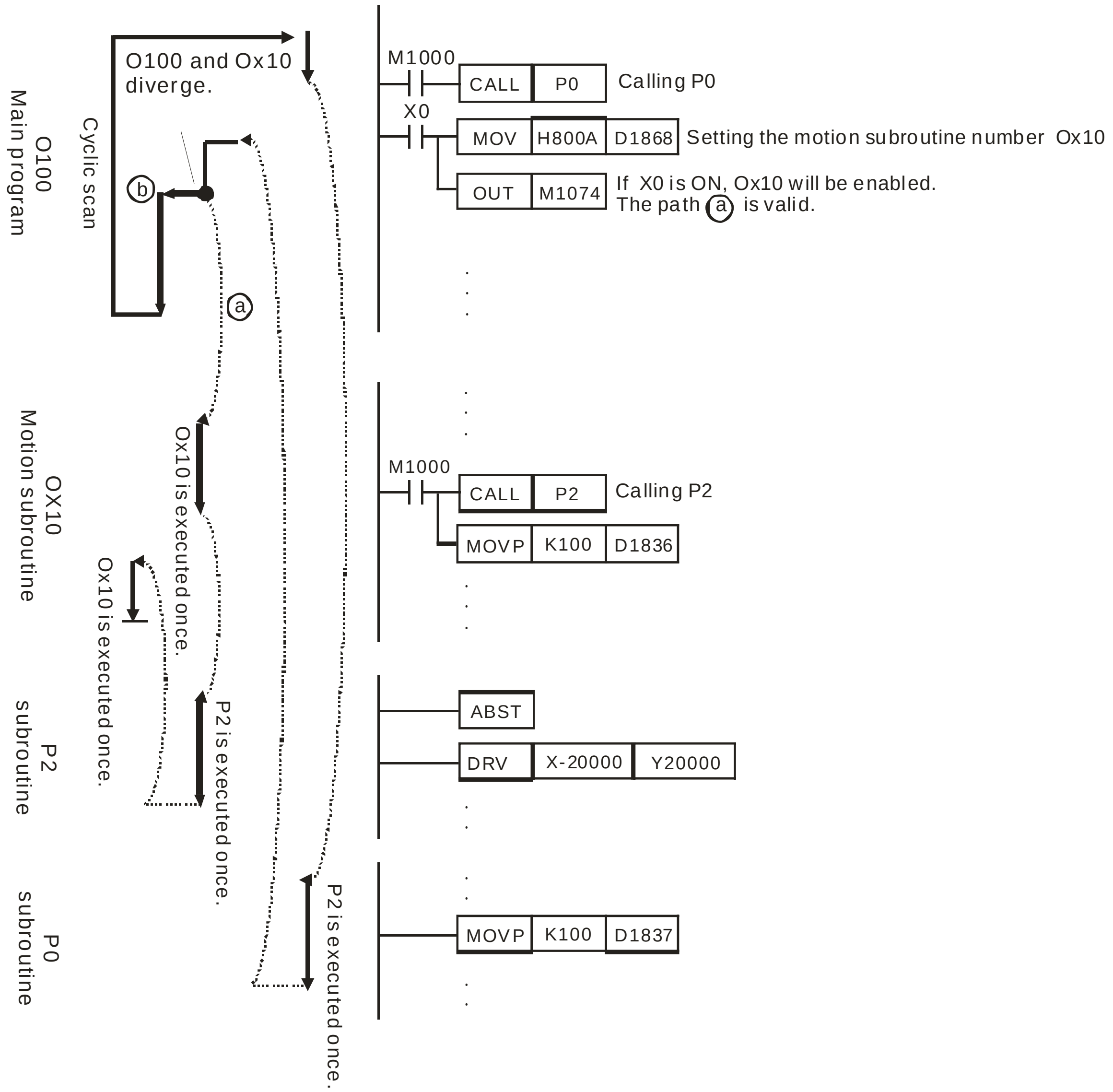
4. An Ox motion subroutine supports basic instructions, applied instructions, motion instructions, and G-codes. Users can write a motion program according to their needs. They can control the motion of the axes of a DVP-PM series motion controller by setting the parameters of the axes.
   - Basic instructions, applied instructions, motion instructions and G-codes must be used in the motion subroutines Ox0~Ox99.
   - Ox motion subroutines can call P subroutines. Please refer to section 1.3 for more information.
5. The description of Ox motion subroutines is shown below.

Ox motion subroutine	Description
Enabling an Ox motion subroutine	There are 100 Ox motion subroutines (Ox0~Ox99). (If an Ox motion subroutine is a ladder diagram in PMSoft, the starting flag in the Ox motion subroutine will be set automatically, and users do not have to write the starting flag.)
Disabling an Ox motion subroutine	Ending instruction M2 (If an Ox motion subroutine is a ladder diagram in PMSoft, the ending instruction M2 will be set automatically, and users do not have to write the ending instruction M2.)
Executing an Ox motion subroutine	1. If users set bit 12 in D1846 or M1074 to ON when O100 runs, an Ox motion subroutine will be enabled. 2. If users use communication to set bit 12 in D1846 or M1074 to ON when O100 runs, an Ox motion subroutine will be enabled. 3. Users can stop the execution of Ox motion subroutines by means of the external terminal Stop0. Note: Before an Ox motion subroutine is enabled, users have to make sure that no Ox motion subroutine runs.
Operation characteristic	Whenever an Ox motion subroutine is enabled, it is executed once. If an Ox motion subroutine needs to be executed again, it has to be enabled again.
Instructions supported	Basic instructions, applied instructions, motion instructions, and G-codes are supported. Note: Users have to avoid using pulse instructions.
Number	There are 100 Ox motion subroutines in a program. If users want to enable a motion subroutine number, they have to set D1868, and set bit 12 in D1846 or M1074 to ON.
Characteristic and function	1. Ox0~Ox99 are motion subroutines. (They can only be enabled by O100.) 2. An Ox motion subroutine can be enabled/disabled by an external terminal, a program, or communication. 3. Ox motion subroutines can call P subroutines. 4. If Ox motion subroutines are used with O100 and P subroutines, the Ox motion subroutines, O100, and the P subroutines can be arranged in any order.

1.3 Structure of P Subroutines

P subroutines are general subroutines. They can be called by O100 and Ox motion subroutines. If P subroutines are called by O100, the P subroutines will support basic instructions and applied instructions. If P subroutines are called by Ox0~Ox99, the P subroutines will support basic instructions, applied instructions, motion instructions, and G-codes. After O100 or an Ox motion subroutine calls a P subroutine, the P subroutine will be executed. After SRET in the P subroutine is executed, the lines under the instruction which calls the P subroutine will be executed.

1. There are two methods of enabling a P subroutine.
   - O100 can call P subroutines.
   - Ox motion subroutines can call P subroutines.
2. Whenever a P subroutine is called, it is executed once. After O100 or an Ox motion subroutine calls a P subroutine, the P subroutine will be executed. After the ending instruction SRET in the P subroutine is executed, the execution of the P subroutine will stop, and the lines under the instruction which calls the P subroutine will be executed.



The subroutine P0 supports basic instructions and applied instructions. The subroutine P2 supports basic instructions, applied instructions, motion instructions, and G-codes.

3. There are three methods of disabling a P subroutine.
   - If the STOP/RUN switch of a DVP-PM series motion controller is turned form the “RUN” position to the “STOP” position when the DVP-PM series motion controller is powered, M1072 will be OFF, O100 will stop, and Ox motion subroutines and P subroutines will not be executed.
   - If a DVP-PM series motion controller is powered, users can use communication to set the value in D1846 to 0, or to set M1074 to OFF, to stop the execution of Ox motion subroutines, and to stop the execution of P subroutines.
   - If an error occurs when a P subroutine is executed, the execution of the P subroutine will stop automatically. Please refer to appendix A in chapter 9 for more information about error codes.
4. If P subroutines are called by O100, the P subroutines will support basic instructions and applied instructions. If P subroutines are called by Ox0~Ox99, the P subroutines will support basic instructions, applied instructions, motion instructions, and G-codes.
5. The description of P subroutines is shown below.

P subroutine	Description
Enabling a P subroutine	There are 256 P subroutines (P0~P255). (If a P subroutine is a ladder diagram in PMSoft, the starting flag in the P subroutine will be set automatically, and users do not have to write the starting flag.)
Disabling a P subroutine	Ending instruction SRET (If a P subroutine is a ladder diagram in PMSoft, the ending instruction SRET will be set automatically, and users do not have to write the ending instruction SRET.)

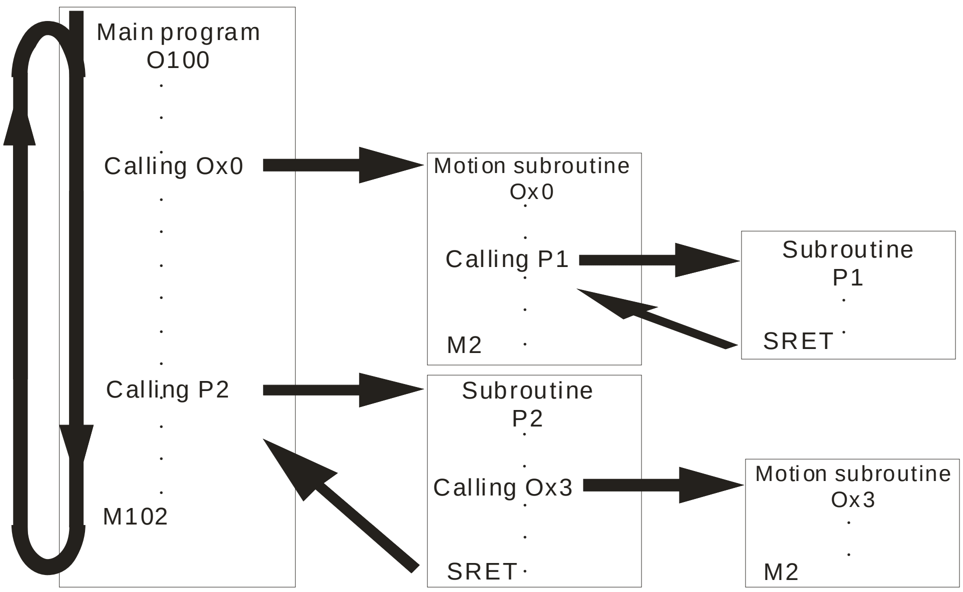
P subroutine	Description
Executing a P subroutine	1. O100 can call P subroutines. 2. Ox motion subroutines can call P subroutines.
Operation characteristic	Whenever a P subroutine is enabled, it is executed once. If a Pn subroutine needs to be executed again, it has to be enabled again.
Instruction supported	1. If P subroutines are called by O100, the P subroutines will support basic instructions and applied instructions. 2. If P subroutines are called by Ox motion subroutines, the P subroutines will support basic instructions, applied instructions, motion instructions, and G-codes. Note: If P subroutines are called by Ox motion subroutines, users have to avoid using pulse instructions.
Number	There are 256 P subroutines in a program.
Characteristic and function	1. P subroutines are general subroutines. 2. P subroutines can be called by O100 and Ox motion subroutines. 3. If P subroutines are used with O100 and Ox motion subroutines, the P subroutines, O100, and the Ox motion subroutines can be arranged in any order.

1.4 Using O100, Ox Motion Subroutines, and P Subroutines

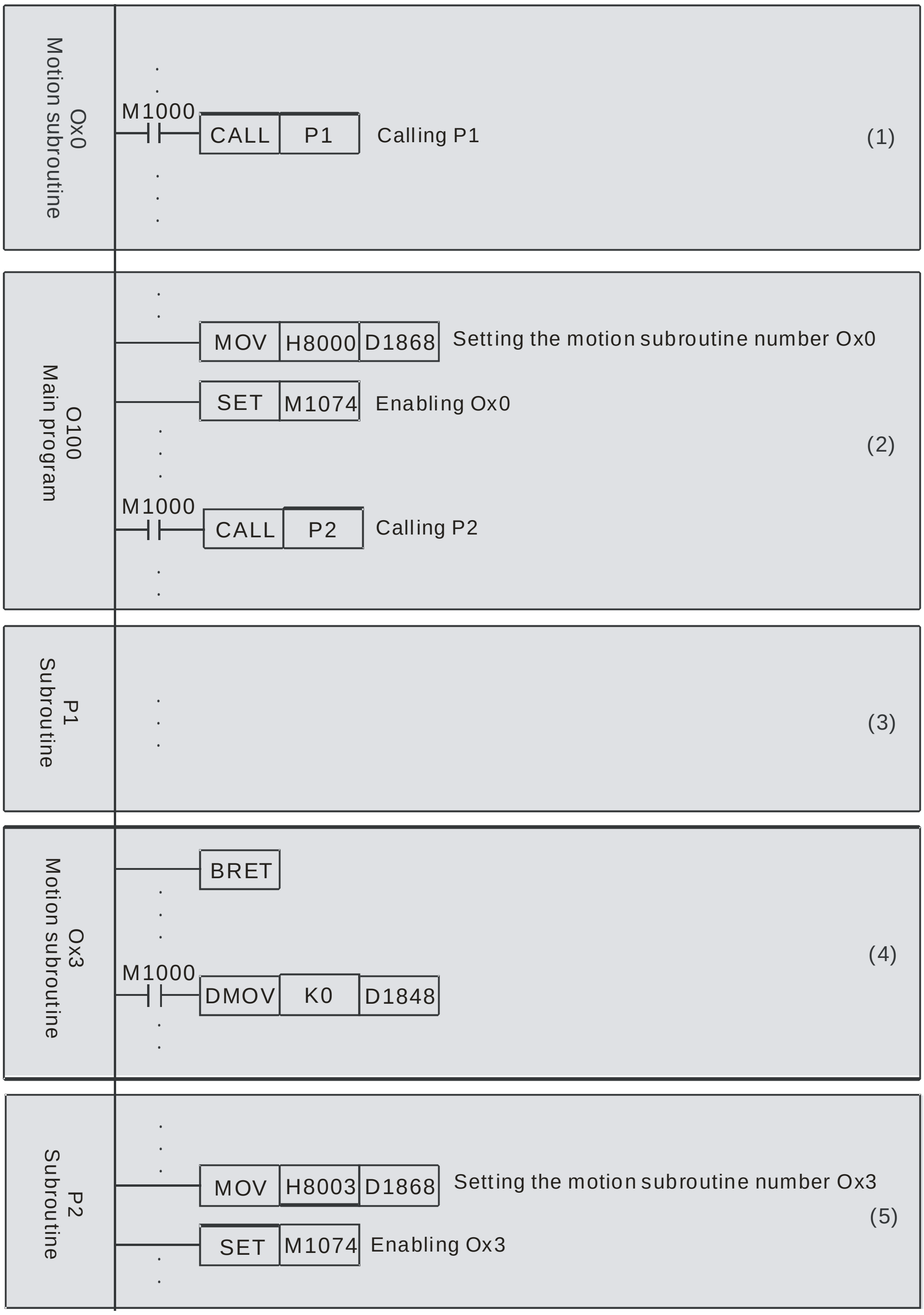
O100, Ox motion subroutines, and P subroutines are introduced in section 1.1~section 1.3. In this section, a program composed of O100, Ox motion subroutines, and P subroutines is described.

1.4.1 Structure of a Program

Suppose a program is composed of O100, Ox0, Ox3, P1, and P2. The five program blocks are shown below.



In order to describe the program, the program is divided into 5 sections (section (1)~section (5)).



The program is described below.

1. Section (1)~section (5) are created in numerical order, but they can be arranged in any order.
2. There is only one O100. O100 can not be called by another program, but it can freely call Ox motion subroutines and P subroutines.
3. Ox motion subroutines can be called by O100 and P subroutines, and it can call P subroutines.
4. P subroutines can be called by O100 and Ox motion subroutines, and it can call Ox motion subroutines.

Note:

1. One Ox motion subroutine is executed at a time. If Ox0 is executed, Ox3 can not be executed. If Ox3 is executed, Ox0 can not be executed.
2. After O100 or a P subroutine enables an Ox motion subroutine, the next line will be executed, and the execution of the Ox motion subroutine will be ignored.

3. Whenever an Ox motion subroutine is enabled, it is executed once. If an Ox motion subroutine needs to be executed again, it has to be enabled again.

The instructions supported by O100, Ox0, Ox3, P1 and P3 are described below. (O: Supported; X: Not supported)

Section	O100	Ox0 and Ox3	P1	P2
Basic instruction	O	O	O	O
Applied instruction	O	O	O	O
Motion instruction	X	O	O	X
G-code	X	O	O	X
Description	-	-	P1 is called by Ox0, and therefore it supports motion instructions and G-codes.	P2 is called by O100, and therefore it does not support motion instructions and G-codes.

Additional remark:

	Main program	Subroutine	Motion subroutine
Order	In any order	In any order	In any order
Execution	It runs normally.	P subroutines can be called by O100 or Ox motion subroutines.	Ox motion subroutines can be called by O100 or P subroutines.
Operation	It is scanned cyclically.	Whenever a subroutine is called, it is executed once.	Whenever a motion subroutine is called, it is executed once.
Number	1 main program	256 subroutines They can be used according to users' needs.	100 motion subroutines They can be used according to users' needs.

2.1 Hardware Specifications

Electrical specifications and wiring are described in this chapter. Please refer to chapter 5~chapter 6 for more information about the writing of a program and the use of instructions. For more information about the peripherals purchased, please refer to the manuals attached to them.

2.1.1 Specifications for Power

Item	10PM
Supply voltage	100~240 V AC (-15%~10%), 50/60 Hz±5%
Fuse	2 A/250 V AC
Power Consumption	60 V A
24 V DC power	500 mA
Power protection	24 V DC output is equipped with a short circuit protection and an overcurrent protection.
Surge voltage withstand level	1500 V AC (Primary-secondary), 1500 V AC (Primary-PE), 500 V AC (Secondary-PE)
Insulation impedance	Above 5 MΩ (The voltage between all input terminals/output terminals and the ground is 500 V DC.)
Noise immunity	ESD: 8 kV air discharge EFT: Power line: 2 kV; digital I/O: 1 kV; analog & communication I/O: 250 V
Ground	The diameter of the ground should not be less than the diameters of the cables connected to the terminals L and N. (If several DVP-10PM series motion controllers are used, please use single-point ground.)
Operation/Storage	Operation:0°C~55°C (Temperature), 5~95% (Humidity), pollution degree 2 Storage: -25°C ~70°C (Temperature), 5~95% (Humidity)
Vibration/Shock resistance	International standards IEC 61131-2, IEC 68-2-6 (TEST Fc)/IEC 61131-2 & IEC 68-2-27 (TEST Ea)
Weight	Approximately 478/688 g

2.1.2 Electrical Specifications for Input Terminals/Output Terminals

Electrical specifications for input terminals:

■ DVP10PM00M: Four-axis mode

Terminal	Description	Response	Maximum input	
			Current	Voltage
X0~X7	1. They are single/A/B-phase input terminals. 2. DOG signals for the X-axis, the Y-axis, the Z-axis, and the A-axis: X0, X2, X4, and X6 3. PG signals for the X-axis, the Y-axis, the Z-axis, and the A-axis: X1, X3, X5, and X7	200 kHz	15 mA	24 V
X10+, X10-, X11+, and X11-	Differential terminals for a manual pulse generator (differential terminals for a counter)	200 kHz	15 mA	5~24 V
X12+, X12-, X13+, and X13-	Differential terminals for a counter	200 kHz	15 mA	5~24 V

■ DVP10PM00M: Six-axis mode

Terminal	Description	Response	Maximum input	
			Current	Voltage
X0~X7	1. They are single/A/B-phase input terminals. 2. DOG signals for the X-axis, the Y-axis, the Z-axis, and the A-axis: X0, X2, X4, and X6 3. PG signals for the X-axis, the Y-axis, the Z-axis, and the A-axis: X1, X3, X5, and X7	200 kHz	15 mA	24 V
X10+, X10-, X11+, and X11-	Differential terminals for a manual pulse generator (differential terminals for a counter)	200 kHz	15 mA	5~24 V

Terminal	Description	Response	Maximum input	
			Current	Voltage
X12+, X12-, X13+, and X13-	1. Differential terminals for a counter 2. DOG signals for the B-axis and the C-axis: (X12+, X12-) and (X13+, X13-) 3. PG signals should ne used with I/O extension modules.	200 kHz	15 mA	5~24 V

Electrical specifications for output terminals:

■ DVP10PM00M: Four-axis mode

Terminal	Description	Response	Maximum current output
Y0~Y3	They are high-speed output terminals whose collectors are open collectors. (PWM) PG signals	200 kHz	40 mA
Y10+, Y10-, Y12+, Y12-, Y14+, Y14-, Y16+, and Y16-	U/D: Counting up P/D: Pulse A/B: A phase	1000 kHz	40 mA
Y11+, Y11-, Y13+, Y13-, Y15+, Y15-, Y17+, Y17-	U/D: Counting down P/D: Direction A/B: B phase	1000 kHz	40 mA

■ DVP10PM00M: Six-axis mode

Terminal	Description	Response	Maximum current output
Y0, C0, Y2, and C2	They are high-speed output terminals whose collectors are open collectors. U/D: Counting up P/D: Pulse A/B: A phase	200 kHz	40 mA
Y1, C1, Y3, and C3	They are high-speed output terminals whose collectors are open collectors. U/D: Counting down P/D: Direction A/B: B phase	200 kHz	40 mA
Y10+, Y10-, Y12+, Y12-, Y14+, Y14-, Y16+, and Y16-	U/D: Counting up P/D: Pulse A/B: A phase	1000 kHz	40 mA
Y11+, Y11-, Y13+, Y13-, Y15+, Y15-, Y17+, and Y17-	U/D: Counting down P/D: Direction A/B: B phase	1000 kHz	40 mA

Digital input terminals:

- DVP-10PM series motion controller

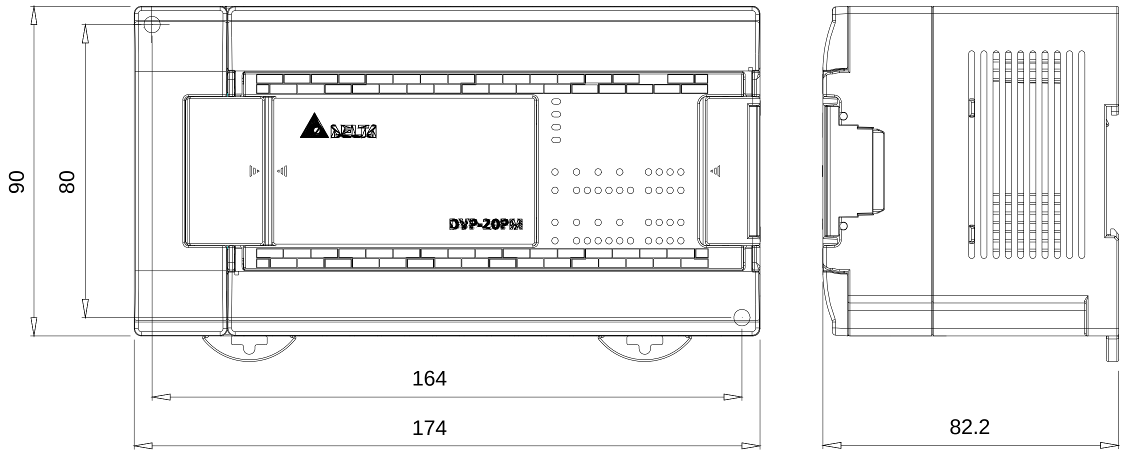
Specifications \ Item		Differential input terminal	24 V DC common terminal	Remark
		High speed of 200 kHz		
Wiring type		Independent wiring	A current flows into the terminal S/S (sinking), or a current flows from the terminal S/S.	#1: Users can filter pulses by setting a digital input terminal to ON after the pulses in 10 ms~60 ms are received. Besides, they can filter high-frequency pulses by setting the terminals for a manual pulse generator to ON when the frequency of pulses received is in the range of 10 kHz to 2600 kHz.
Input indicator		LED indicator (If the LED indicator corresponding to an input terminal is ON, the input terminal is ON. If the LED indicator corresponding to an input terminal is OFF, the input terminal is OFF.)		
Input voltage		5~24 V DC	24 V DC	
Maximum input current		15 mA		
Action level	**Off→On**	20 us		
	On→Off	30 us		
Response time/Noise reduction#1		10 ms/0.5 us		

Digital output terminals:

- DVP-10PM series motion controller

Specifications \ Item		Differential output terminal	Transistor output terminal
Maximum frequency of output signals		1 MHz	200 kHz
Output indicator		LED indicator (If the LED indicator corresponding to an output terminal is ON, the output terminal is ON. If the LED indicator corresponding to an output terminal is OFF, the output terminal is OFF.)	
Output terminal		Y10~Y17	Y0~Y3
Working voltage		5 V DC	5~30 V DC
Maximum output current		40 mA	40 mA
Isolation		Power isolation	Optocoupler
Current specifications	**Resistance**	< 25 mA	0.5A/output terminal (4 A/COM)
	Inductance	--	12 W (24 V DC)
	Bulb	--	2 W (24 V DC)
Response time	**Off→On**	0.2 us	
	On→Off		
Overcurrent protection		N/A	

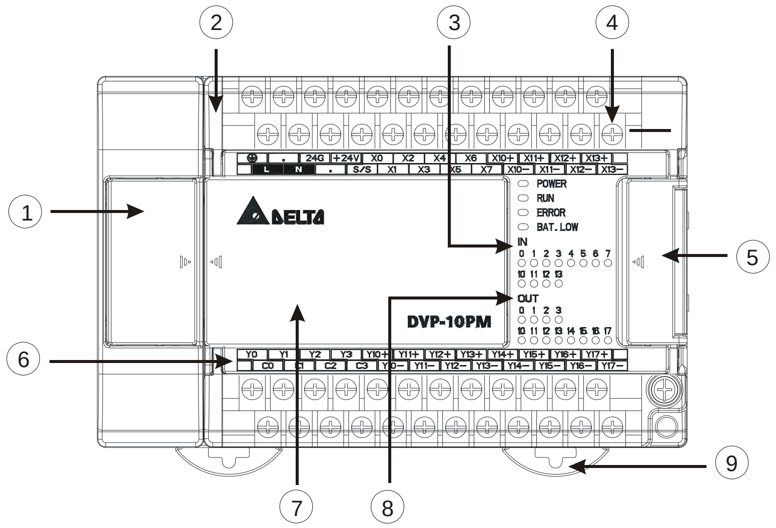
2.1.3 Dimensions

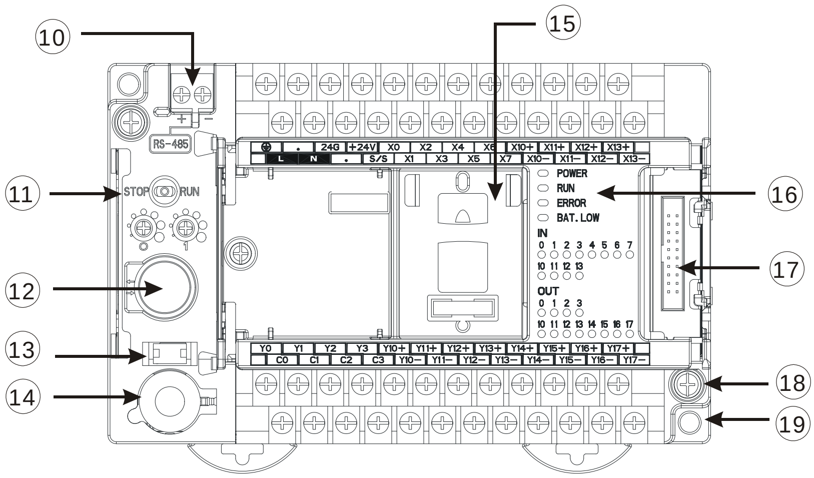


(Unit: mm)

Profile

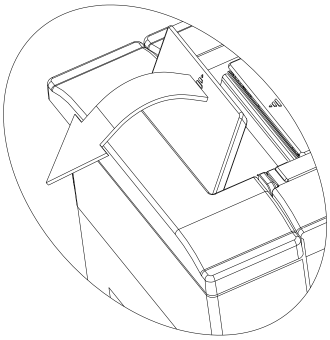
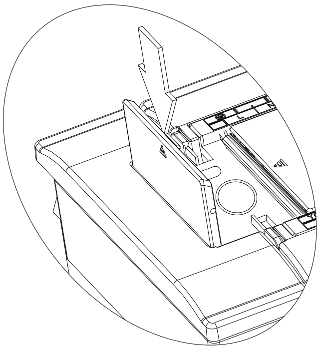
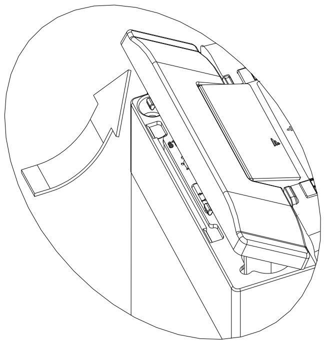
- DVP-10PM series motion controller



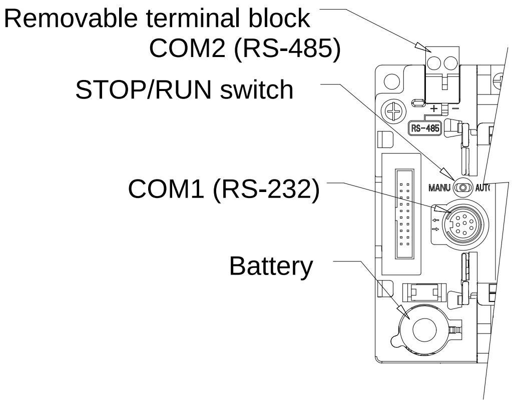


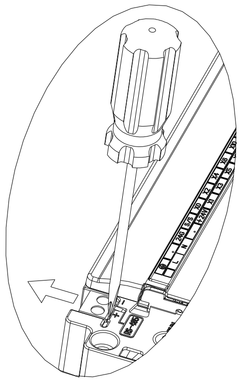
① Communication port cover
② Input/Output terminal cover
③ Input LED indicators
④ Input/Output terminals
⑤ Connector cover
⑥ Input/Output terminal numbers
⑦ Function card/memory card cover
⑧ Output LED indicators
⑨ DIN rail mounting clip
⑩ COM2 (RS-485 port)
⑪ STOP/RUN switch
⑫ COM1 (RS-232 port)
⑬ Battery compartment
⑭ Battery
⑮ Function card slot
⑯ POWER LED indicator, RUN LED indicator, ERROR LED indicator, and BATTERY LED indicator
⑰ Connector
⑱ Set screw
⑲ Mounting hole

Open the COM1 cover.

Please change the battery in a minute. Take out the RS-485 terminals.

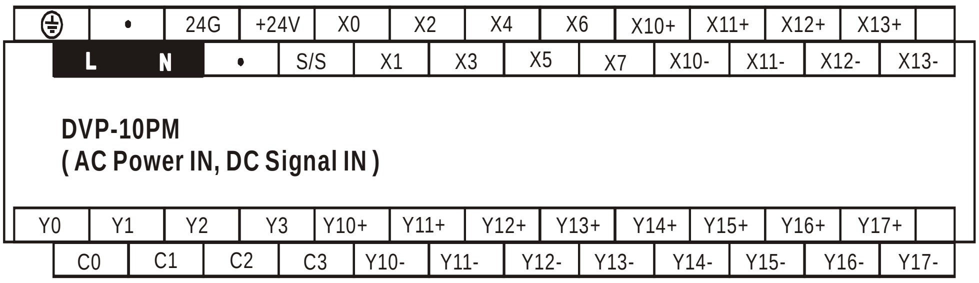




Part	Description
COM2 (RS-485 port)	Master/Slave mode
STOP/RUN switch	Running/Stopping the DVP-10PM series motion controller
COM1 (RS-232 port)	Slave mode (It can be used with COM2 at the same time.)

Arrangement of terminals: Please refer to section 2.1.2 for more information.

- DVP-10PM series motion controller



2.2 Wiring

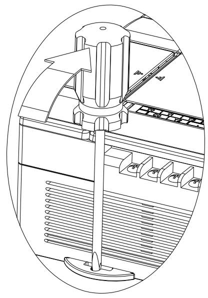
A DVP-10PM series motion controller is an OPEN-TYPE device. It should be installed in a control cabinet free of airborne dust, humidity, electric shock and vibration. To prevent non-maintenance staff from operating a DVP-10PM series motion controller, or to prevent an accident from damaging a DVP-10PM series motion controller, the control cabinet in which a DVP-10PM series motion controller is installed should be equipped with a safeguard. For example, the control cabinet in which a DVP-10PM series motion controller is installed can be unlocked with a special tool or key.

DO NOT connect AC power to any of I/O terminals, otherwise serious damage may occur. Please check all wiring again before a DVP-10PM series motion controller is powered up. Make sure that the ground terminal ⏚ on a DVP-10PM series motion controller is correctly grounded in order to prevent electromagnetic interference.

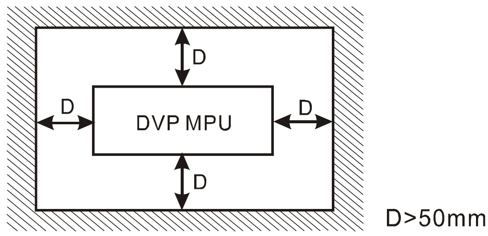
2.2.1 Installation of a DVP-10PM Series Motion Controller in a Control Box

Installing a DIN rail:

The installation is applicable to a 35 millimeter DIN rail. Before users hang a DVP-10PM series motion controller on a DIN rail, they have to insert a slotted screw into the slots on the mounting clips, and pull out the mounting clips. After the users hang the DVP-10PM series motion controller on the DIN rail, they have to push the mounting clips back. If the users want to remove the DVP-10PM series motion controller, they have to insert a slotted screw into the slots on the mounting clips, and pull out the mounting clips. After the mounting clips are pulled out, they will not move back.

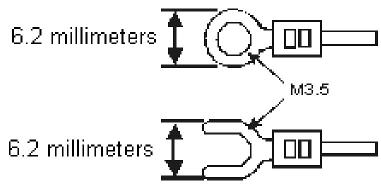


1. Using screws: Please mount a DVP-10PM series motion controller on a DIN rail by means of M4 screws.
2. A DVP-10PM series motion controller has to be installed in a closed control box. In order to ensure that the DVP-10PM series motion controller radiates heat normally, there should be space between the DVP-10PM series motion controller and the control box.



Points for attention:

1. Please use O-type terminals or Y-type terminals. The specifications for terminals are on the right. The torque applied to the terminal screws used should be 9.50 kg-cm (8.25 Ib-in). Please use copper conducting wires. The temperature of the copper conducting wires used should be 60/75°C.
2. Please do not wire NC. Please do not put the cables connected to input terminals and the cables connected to output terminals in the same cable tray.
3. Users have to make sure that there are no tiny metal conductors inside a DVP-10PM series motion controller when they tighten screws and wire terminals. In order to ensure that the DVP-10PM series motion controller radiates heat normally, the users have to remove the sticker on the heat hole.



2.2.2 Wiring Power Input

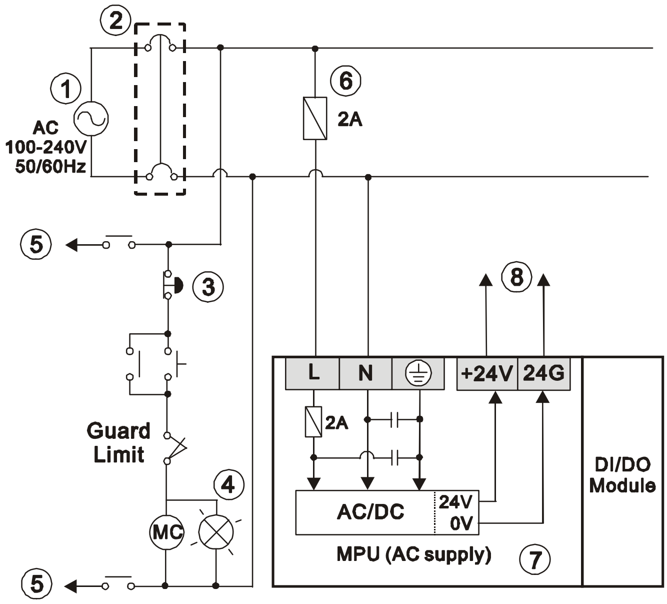
The power input of a DVP-10PM series motion controller is AC input. Users have to pay attention to the following points.

1. The voltage of AC power input is in the range of 100 V AC to 240 V AC. A live wire and a neutral wire are connected to L and N. If 110 V AC power or 220 V AC power is connected to +24V or an input terminal on a DVP-10PM series motion controller, the DVP-10PM series motion controller will be damaged.
2. The AC power input of a DVP-10PM series motion controller, and the AC power input of the I/O module connected to the DVP-10PM series motion controller must be ON or OFF at the same time.
3. The length of the cable connected to the ground terminal on a DVP-10PM series motion controller is at least 1.6 millimeters.
4. If a power cut lasts for less than 10 milliseconds, the DVP-10PM series motion controller used will keep running without being affected. If a power cut lasts for long, or if the voltage of the power input of DVP-10PM series motion controller decreases, the DVP-10PM series motion controller will stop running, and the output terminals will be OFF. When the power input returns to normal, the DVP-10PM series motion controller will resume. (Users have to notice that there are latching auxiliary relays and registers in a DVP-10PM series motion controller when they write a program.)
5. The maximum current which can flows from the power output terminal +24V is 0.5 A. Please do not connect any external power to +24V. The current flows into any input terminal must be in the range of 6 mA to 7 mA. If there are 16 input terminals, 100 mA will be required. As a result, the current that flows

from +24 V to an external load can not be greater than 400 mA.

2.2.3 Safety Wiring

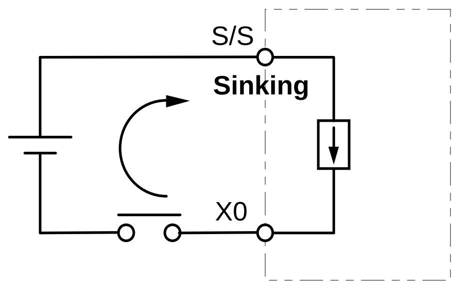
A DVP-10PM series motion controller controls many devices, and the activity of any device affects the activity of other devices. If any device breaks down, the whole automatic control system will go out of control, and dangers will occur. As a result, it is suggested that users should create the protection circuit shown below when they wire power input.



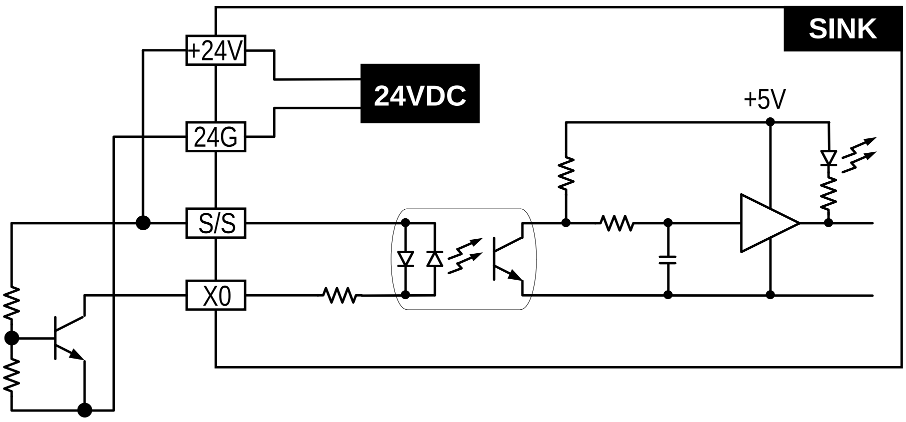
①	Alternating-current power input：100~240 VAC, 50/60 Hz
②	Circuit breaker
③	Emergency stop: The emergency stop button can be used to cut off power when an emergency occurs.
④	Power indicator
⑤	Load through which a alternating current passes
⑥	3 A fuse
⑦	DVP-10PM series motion controller
⑧	Direct-current power output: 24 V DC, 500 mA

2.2.4 Wiring Input/Output Terminals

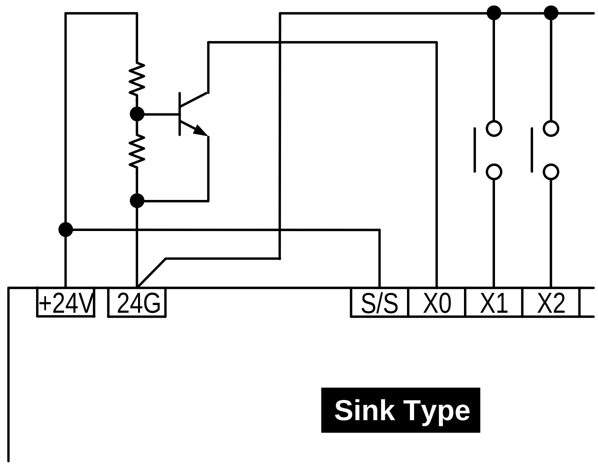
1. The power input of a DVP-10PM series motion controller is DC power input. Sinking and sourcing are current driving capabilities of a circuit. They are defined as follows.

Sinking:
DC power input  Sinking: The current flows into the common terminal S/S.

Equivalent circuit of an input circuit

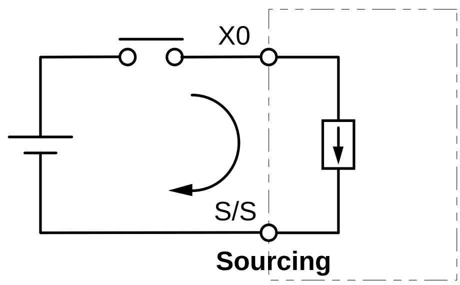


Wiring



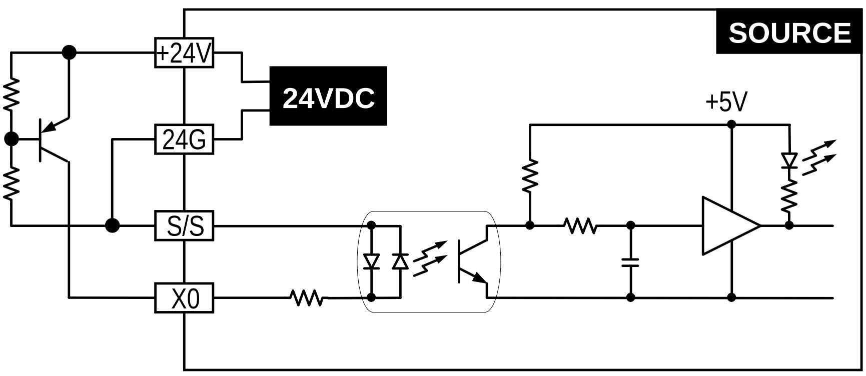
Sourcing:

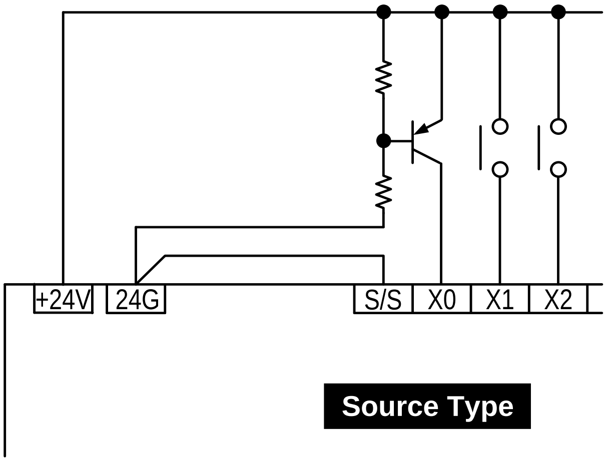
DC power input



Souring: The current flows from the common terminal S/S.

Equivalent circuit of an input circuit

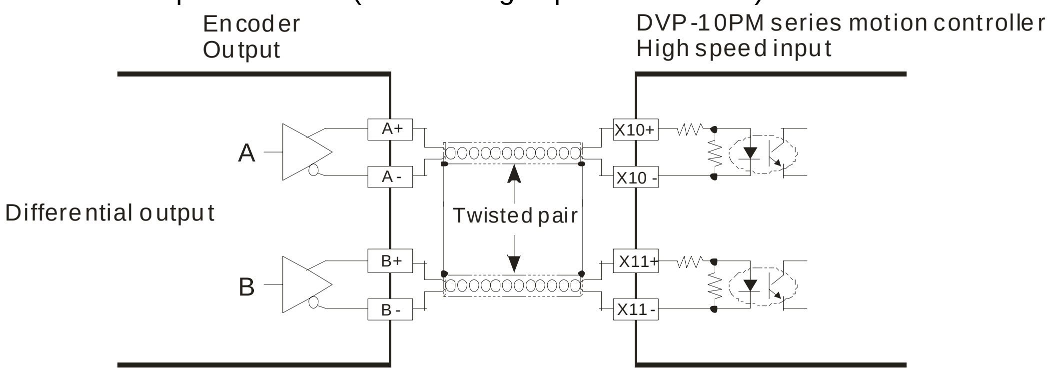


Wiring


2. Wiring differential input terminals

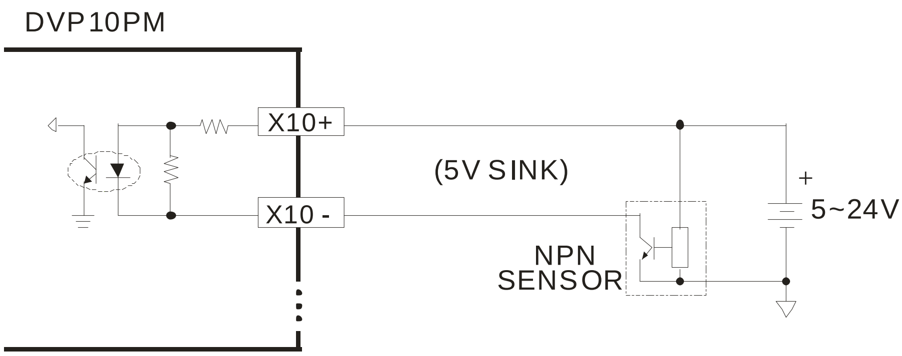
   The direct-current signals ranging in voltage from 5 V to 24 V can pass through the high-speed input terminals X10~X13+ on a DVP-10PM series motion controller. The frequency of input signals can be up to 200 kHz. These high-speed input terminals are connected to a differential (two-wire) line driver.

   Wiring of differential input terminals (used for high speed and noise):

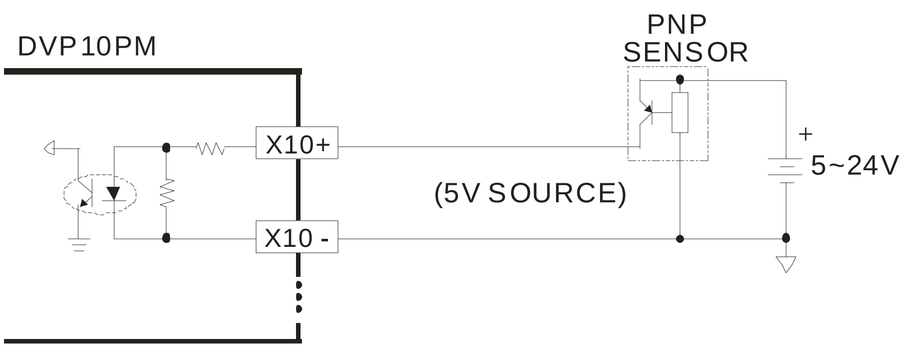


If the frequency of input signals is less than 50 kHz and there is not much noise, these high-speed input terminals can be connected to the direct-current power input whose voltage is in the range of 5 V to 24 V, as shown below.

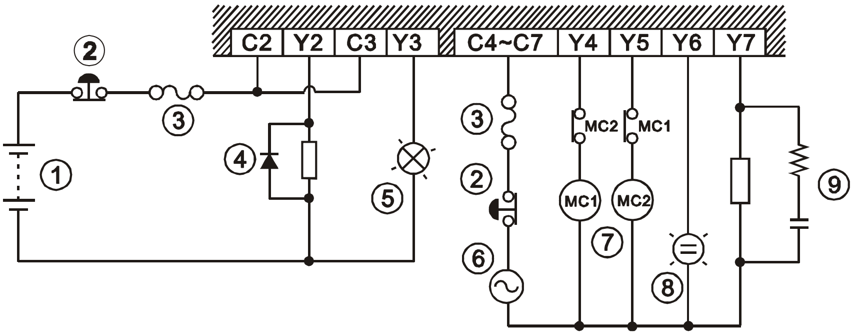
Sinking:



Sourcing:



3. Relay output circuit



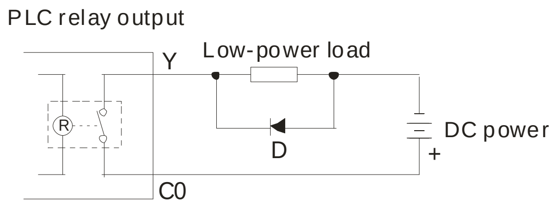
① Direct-current power input

② Emergency stop: An external switch is used.

③ Fuse: To protect the output circuit, a fuse having a breaking capacity in the range of 5 A to 10 A is connected to a common terminal.

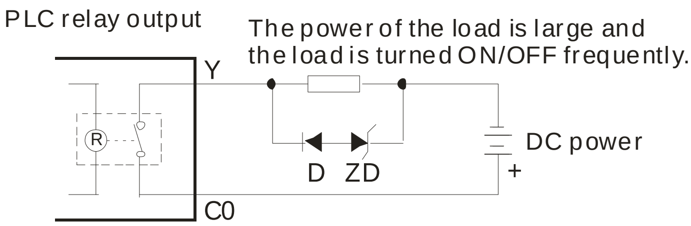
④ A diode is used to absorb the surge voltage which occurs when the load connected is OFF. It can lengthen the lifespan of a terminal.

1. A diode is connected to a load through which a direct current passes. It is used when the power of the load connected is small.



D: 1N4001 diode

2. A diode and a zener diode are connected to a load through which a direct current passes. They are used when the power of the load is large and the load is turned ON/OFF frequently.



D: 1N4001 diode
ZD: 9 V zener diode, 5 W

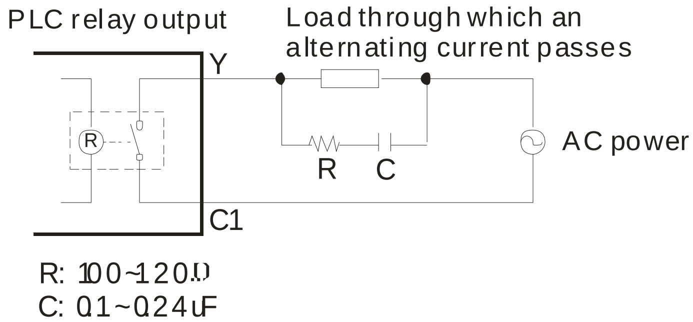
⑤ Incandescent lamp: Resistive load

⑥ Alternating-current power input

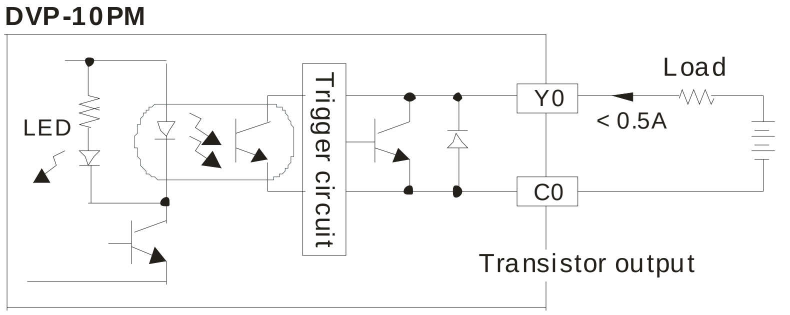
⑦ Mutually exclusive output: Y4 controls the clockwise rotation of a motor, and Y5 controls the counterclockwise rotation of a motor. The interlock circuit which is formed, and the program in the DVP-10PM series motion controller ensure that there will be protective measures if an abnormal condition occurs.

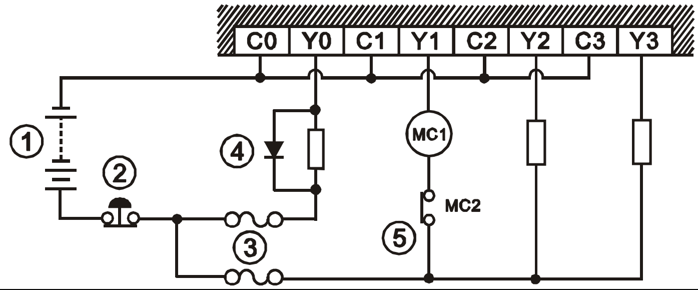
⑧ Indicator: Neon lamp

⑨ Surge absorber: It can be used to reduce the noise of a load through which an alternating current passes.



4. Transistor output circuit

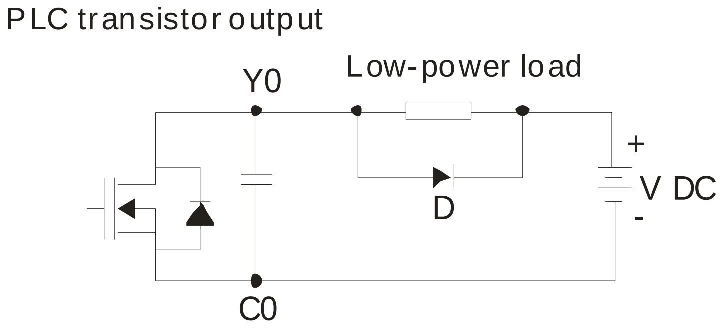




① Direct-current power	② Emergency stop	③ Fuse

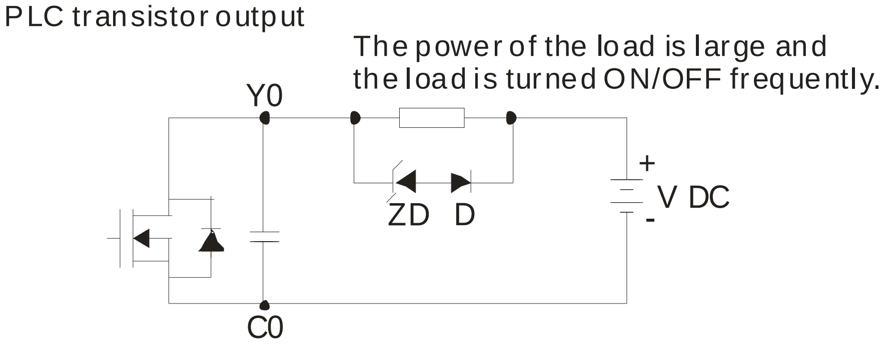
④ Transistor output terminals are open collectors. If Y0/Y1 is a pulse output terminal, the output current passing through an output pull-up resistor must be larger than 0.1 A to ensure that transistor output terminals operate normally.

1. Diode: It is used when the power of the load connected is small.



D: 1N4001 diode

2. Diode and zener diode: They are used when the power of the load connected is large and the load is turned ON/OFF frequently.

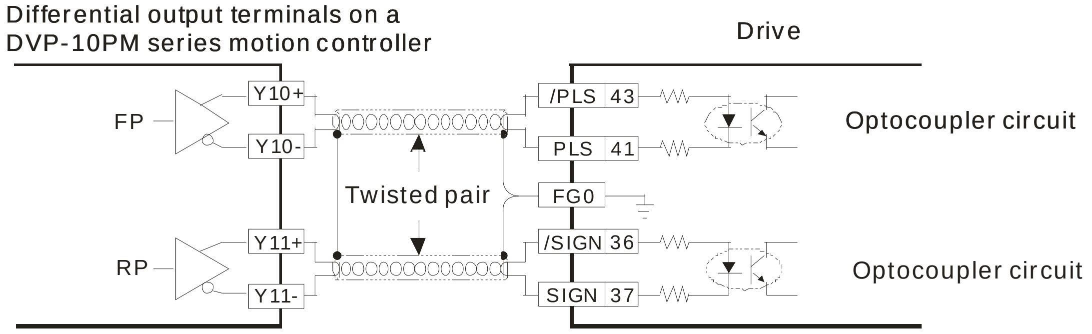


D: 1N4001 diode

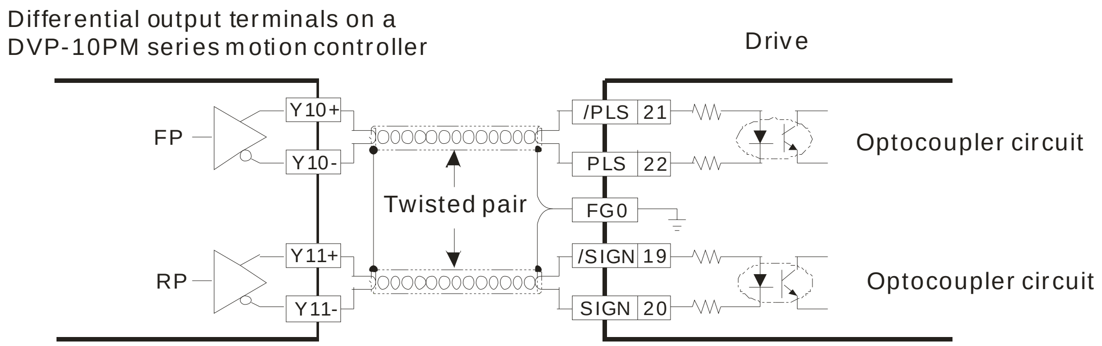
⑤ Mutually exclusive output: Y4 controls the clockwise rotation of a motor, and Y5 controls the counterclockwise rotation of a motor. The interlock circuit which is formed, and the program in the DVP-10PM series motion controller ensure that there will be protective measures if an abnormal condition occurs.

5. Wiring differential output terminals

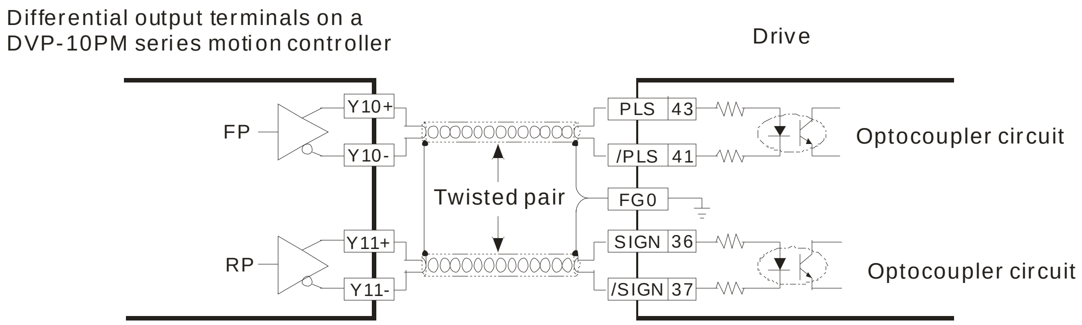
- Wiring differential output terminals on a DVP-10PM series motion controller and an ASDA-A series AC servo drive/ASDA-A+ series AC servo drive/ASDA-A2 series AC servo drive



- Wiring differential output terminals on a DVP-10PM series motion controller and an ASDA-B series AC servo drive

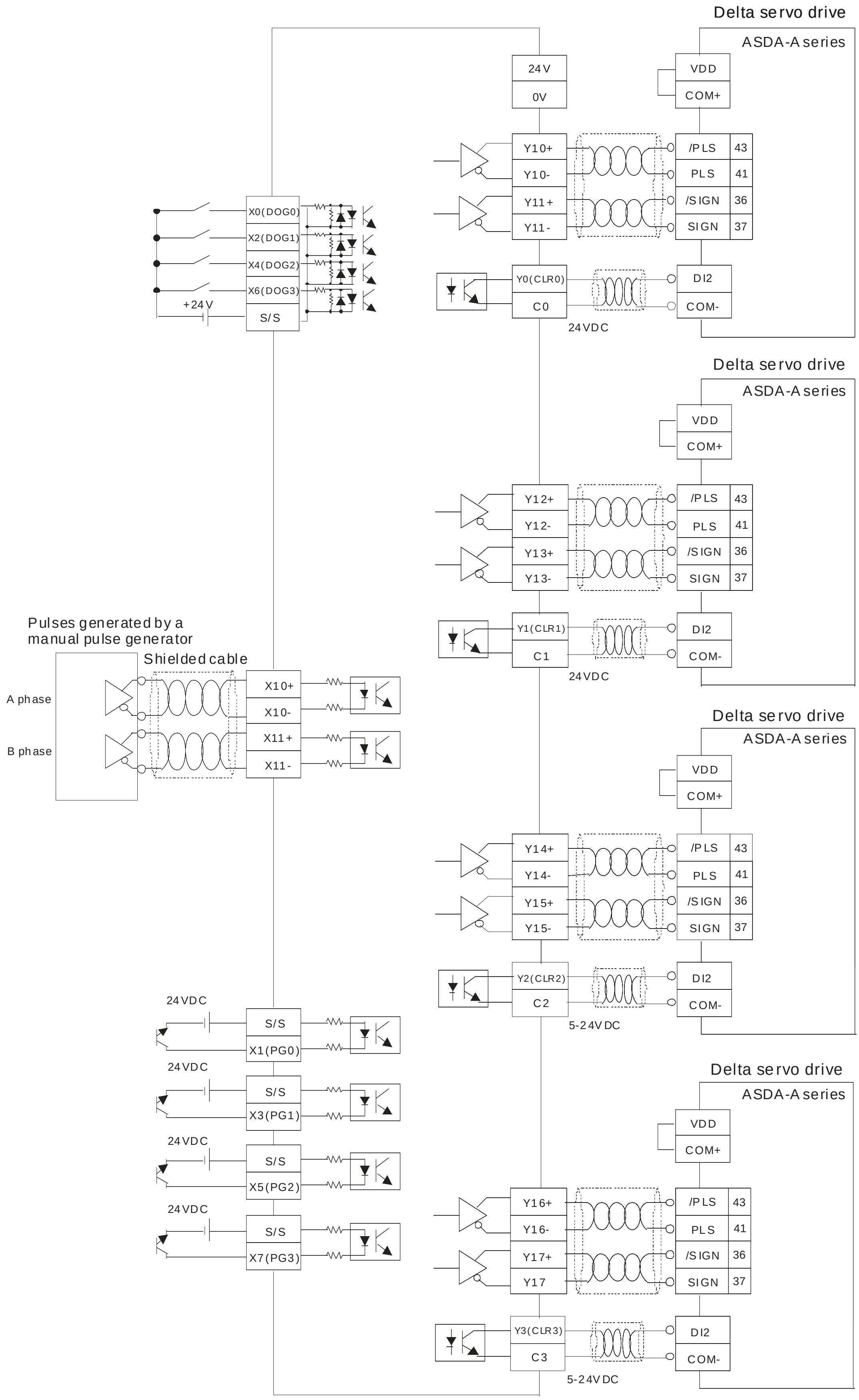


- Wiring differential output terminals on a DVP-10PM series motion controller and an ASDA-AB series AC servo drive

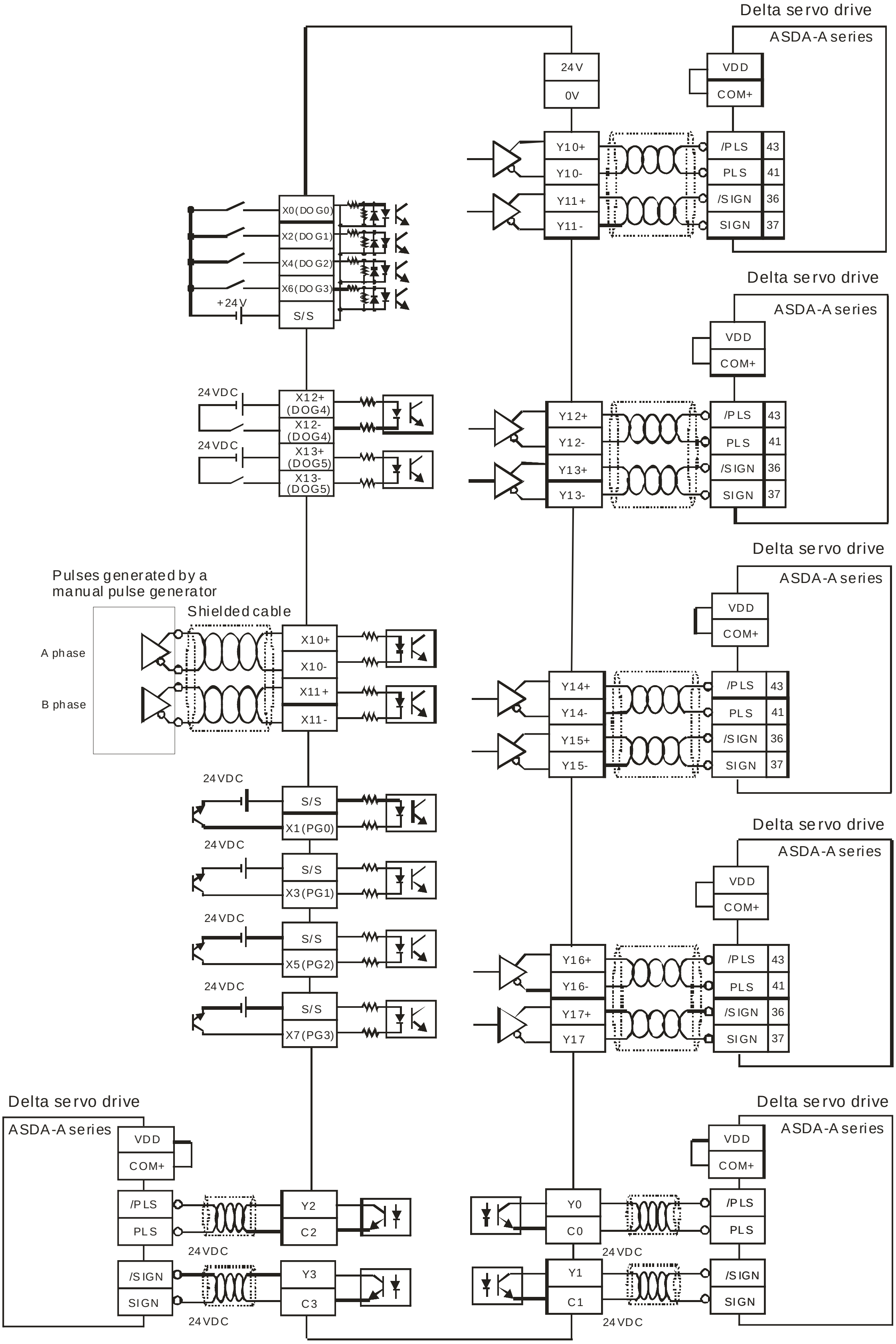


2.2.5 Wiring a DVP-10PM Series Motion Controller and an Inferior Servo Drive

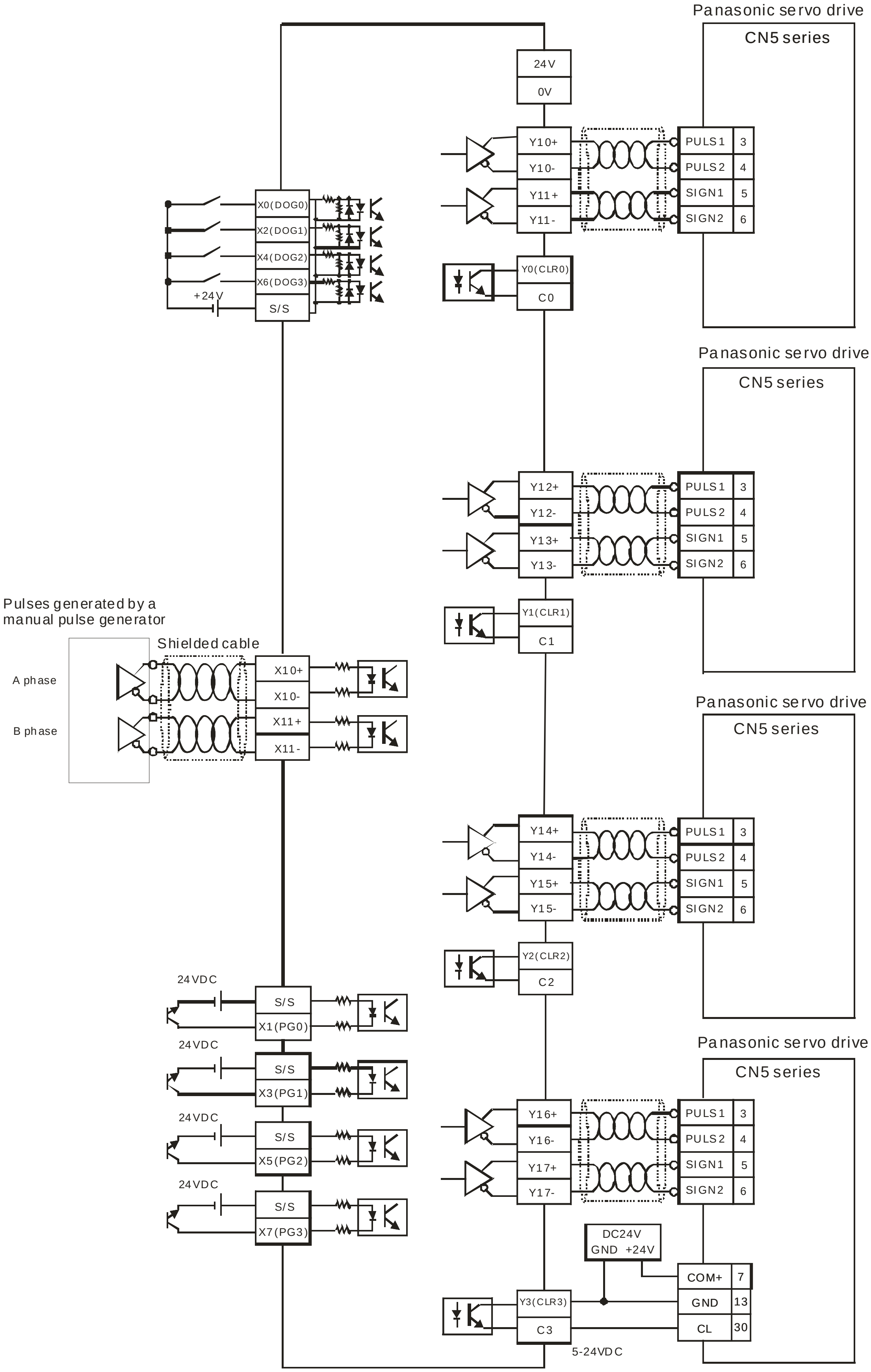
Wiring a DVP-10PM series motion controller and a Delta ASDA-A series AC servo drive: Four-axis wiring



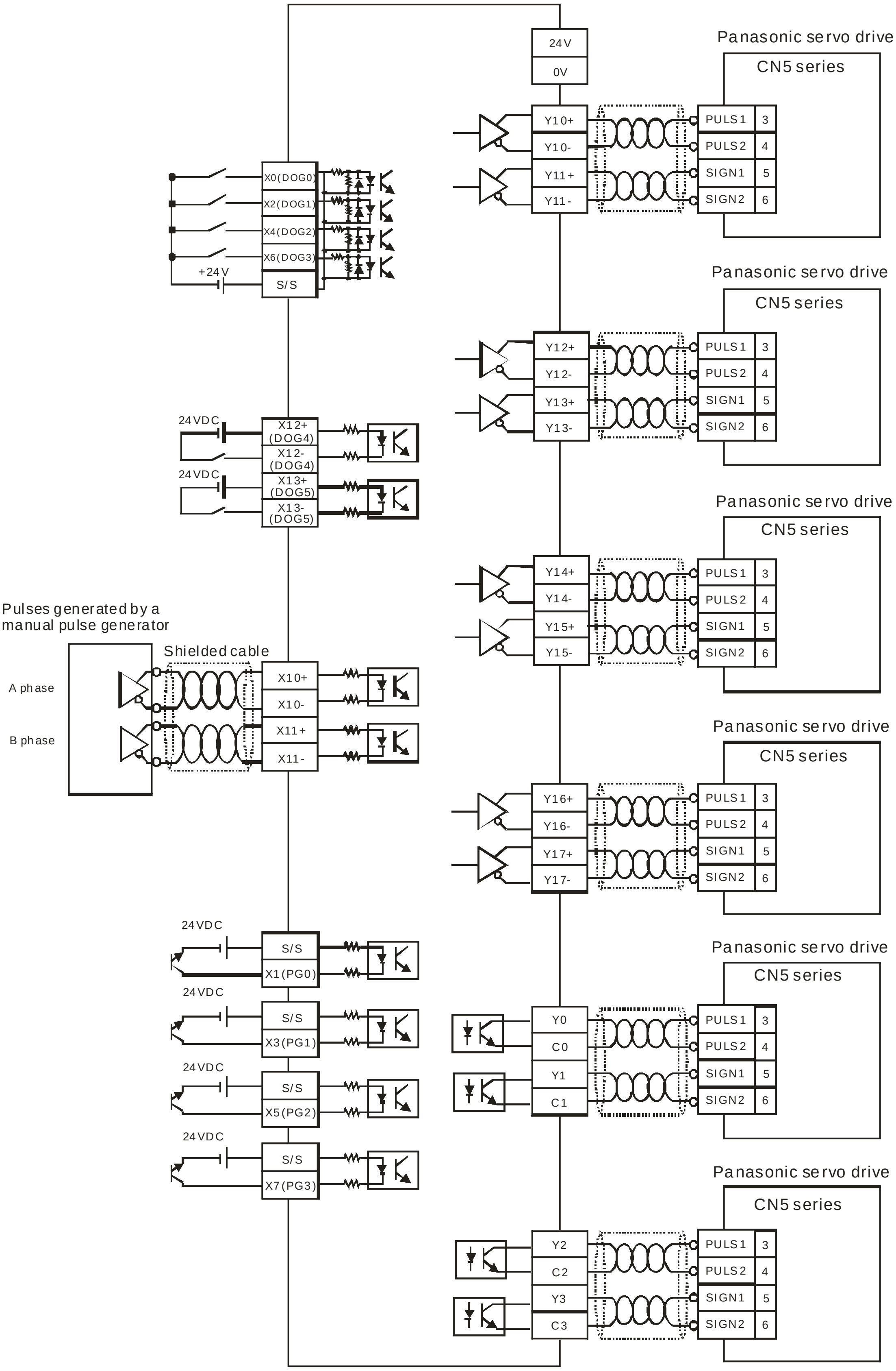
Wiring a DVP-10PM series motion controller and a Delta ASDA-A series AC servo drive: Six-axis wiring



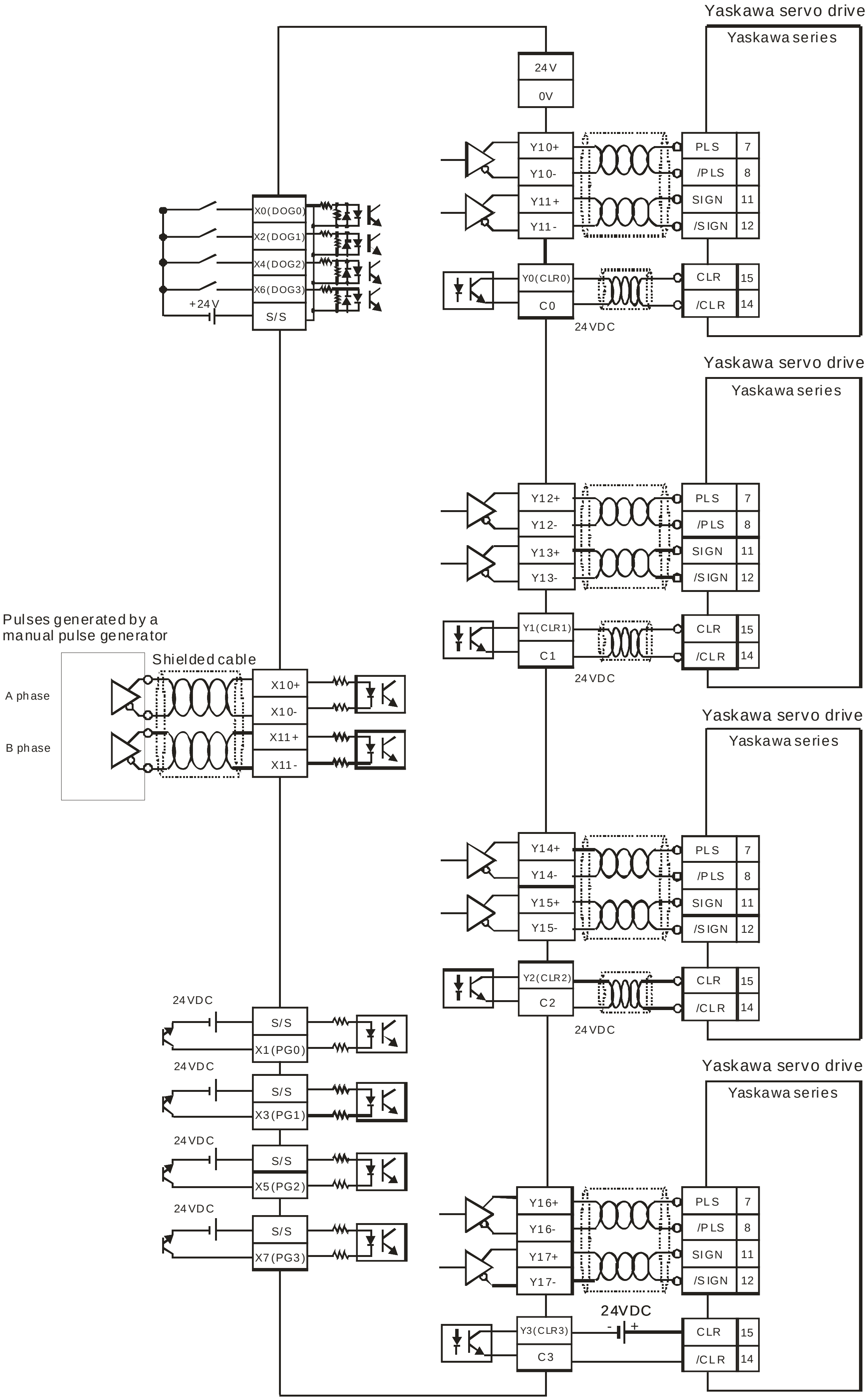
Wiring a DVP-10PM series motion controller and a Panasonic CN5 series servo drive: Four-axis wiring



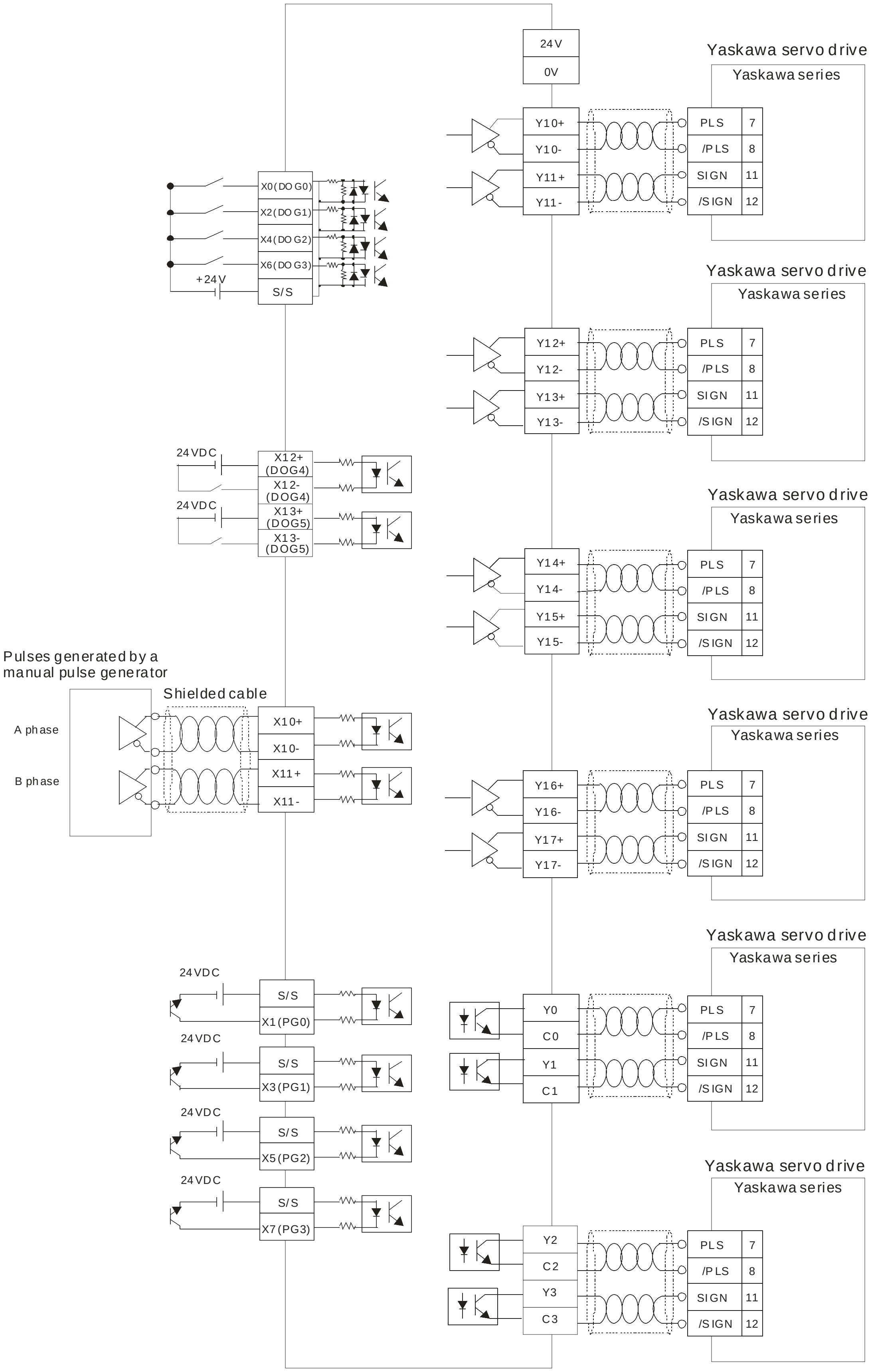
Wiring a DVP-10PM series motion controller and a Panasonic CN5 series servo drive: Six-axis wiring



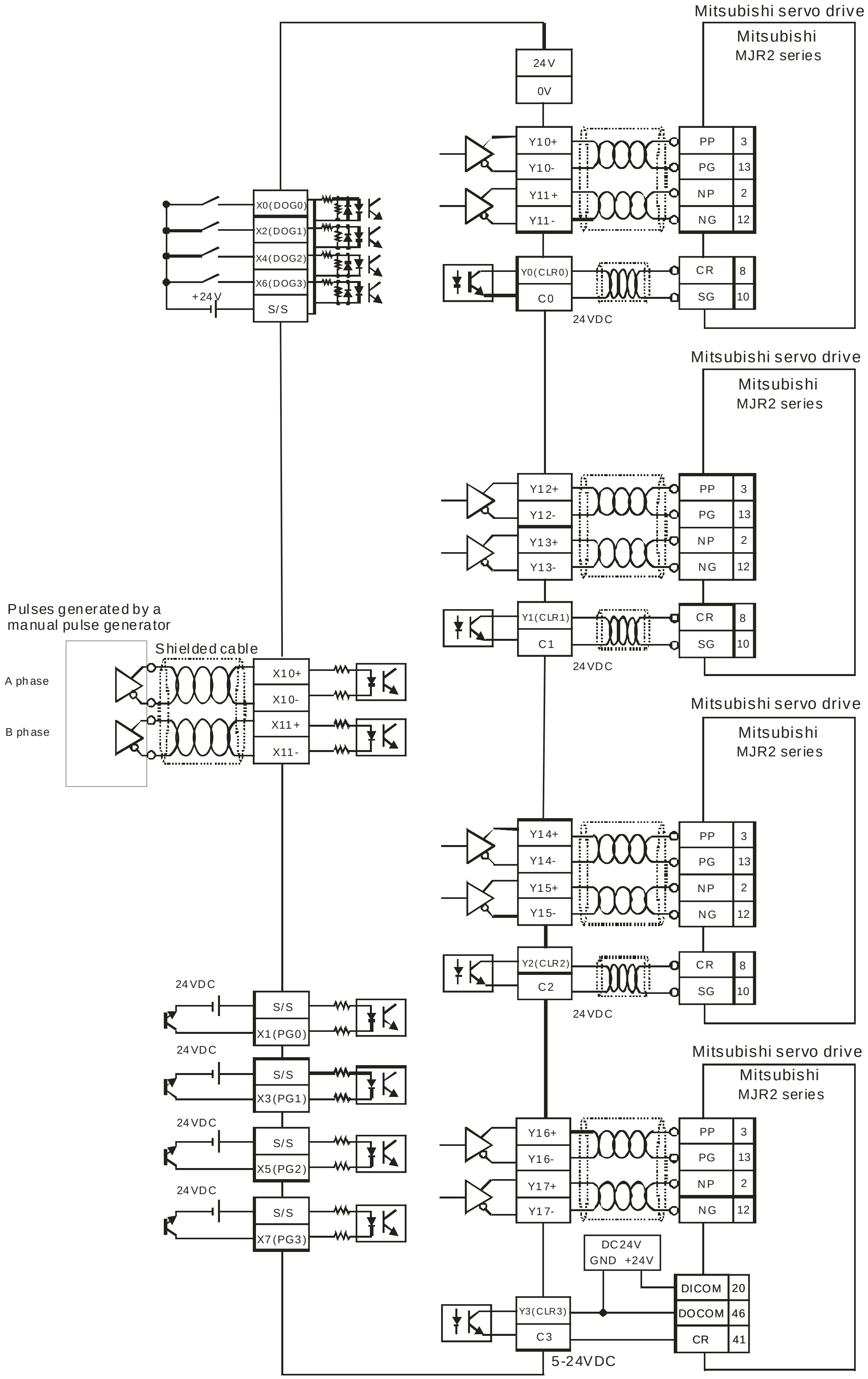
Wiring a DVP-10PM series motion controller and a Yaskawa servo drive: Four-axis wiring



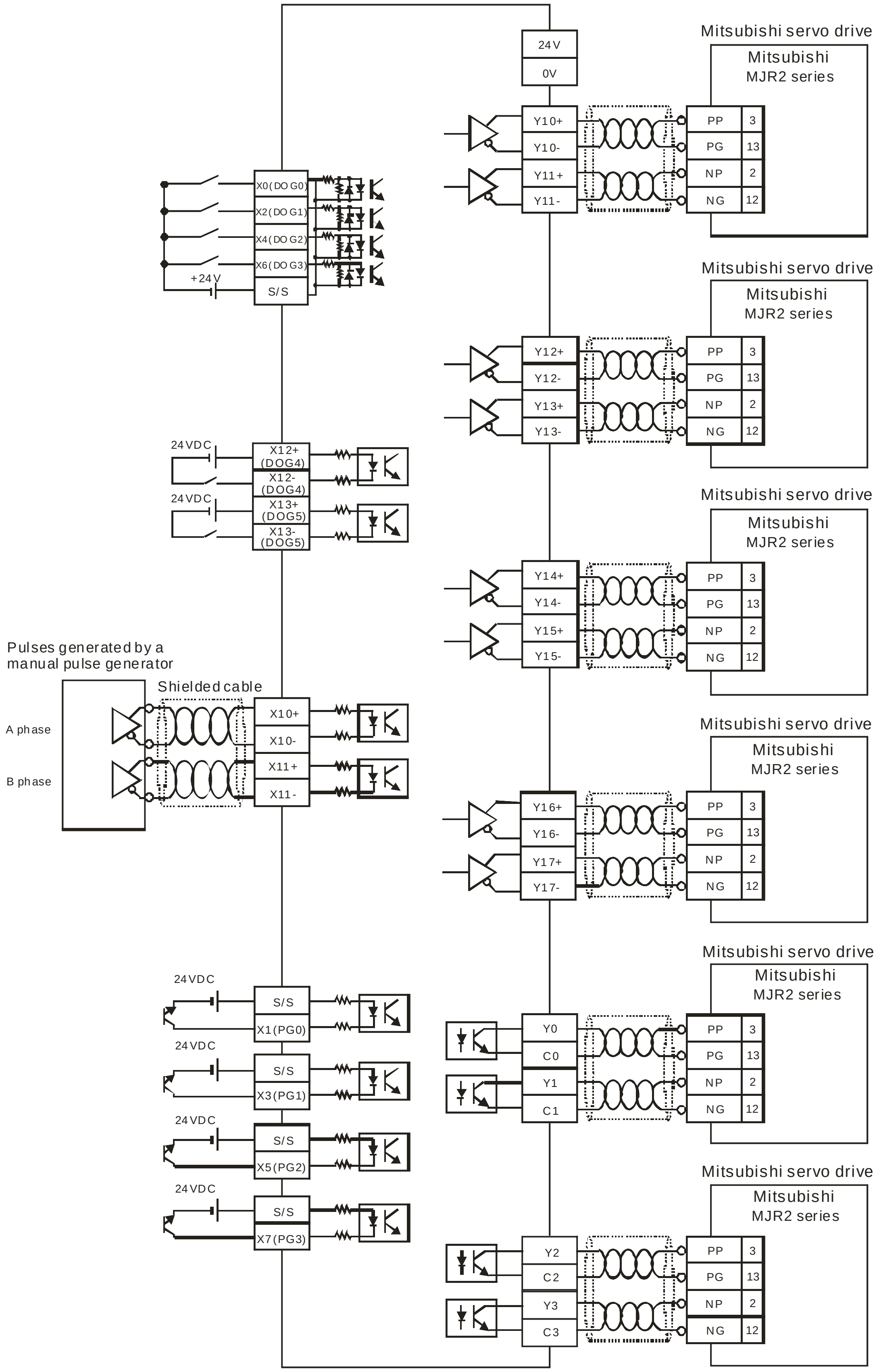
Wiring a DVP-10PM series motion controller and a Yaskawa servo drive: Six-axis wiring



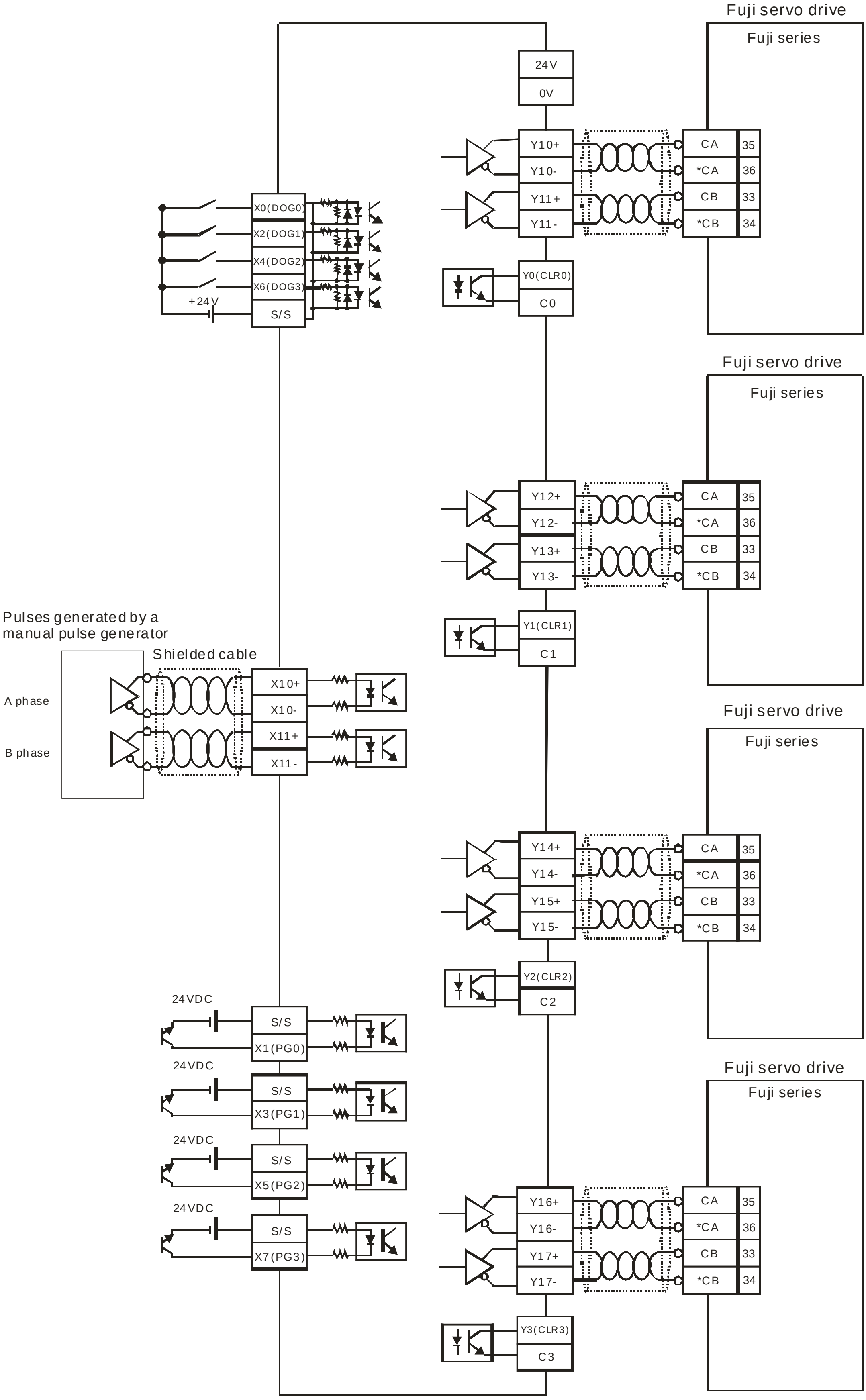
Wiring a DVP-10PM series motion controller and a Mitsubishi MJR2 series servo drive: Four-axis wiring



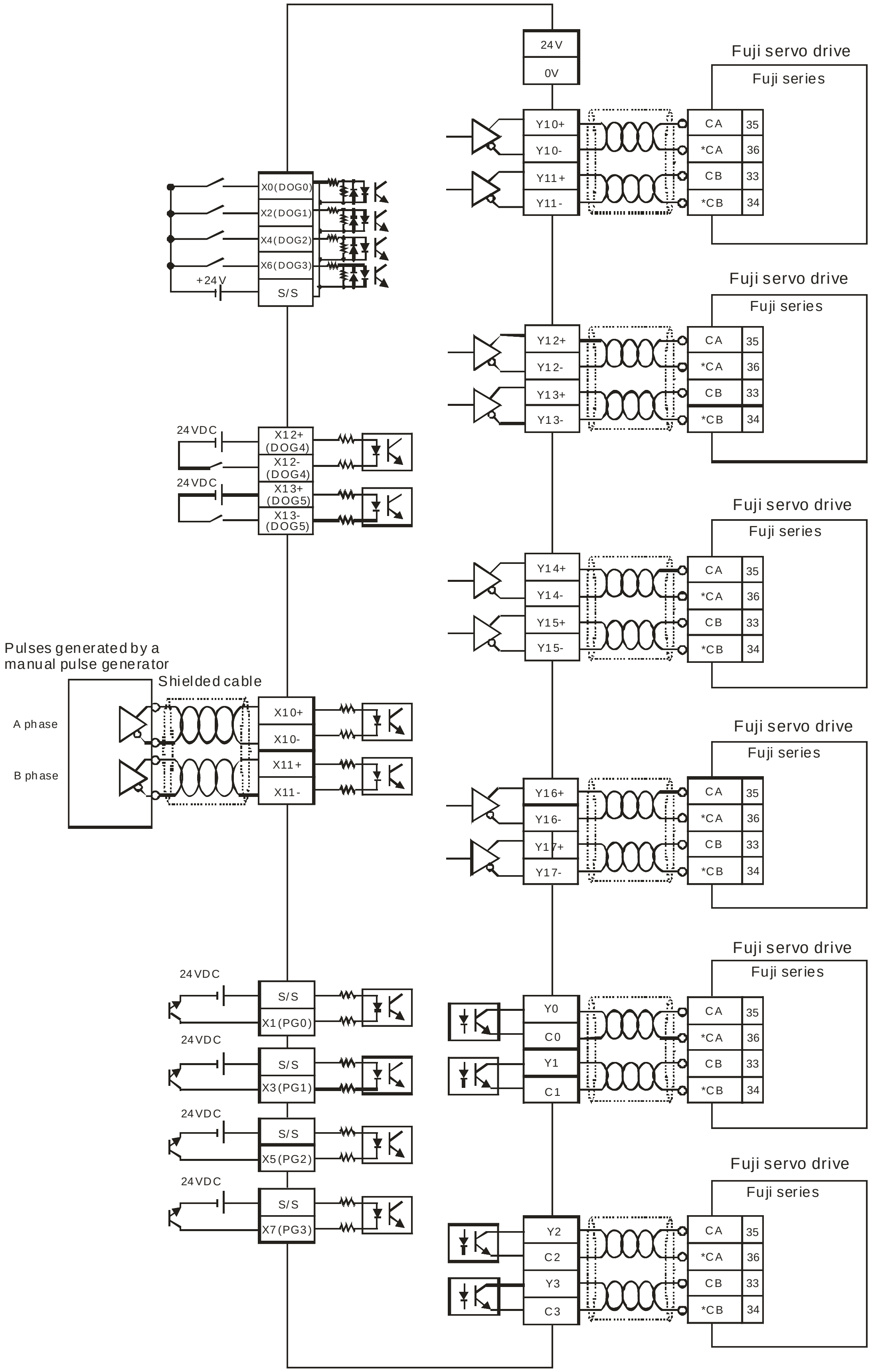
Wiring a DVP-10PM series motion controller and a Mitsubishi MJR2 series servo drive: Six-axis wiring



Wiring a DVP-10PM series motion controller and a Fuji servo drive: Four-axis wiring



Wiring a DVP-10PM series motion controller and a Fuji servo drive: Six-axis wiring



2.3 Communication Ports

A DVP-10PM series motion controller is equipped with COM1 (RS-232 port), COM2 (RS-485 port), and a communication card (COM3 (RS-232 or RS-485 communication)).

COM1: It is an RS-232 port. It can function as a slave station. A program is edited through this port. COM1 can be used in a Modbus ASCII mode or an RTU mode.

COM2: It is an RS-485 port. It can function as a master station or a slave station. It can be used in a Modbus ASCII mode or an RTU mode.

COM3: It is an RS-232/RS-485 port. It can function as a slave station. It can be used in a Modbus ASCII mode.

Communication architecture:

Communication port / Communication parameter	RS-232 port (COM1)	RS-485 port (COM2)	RS-232/RS-485 port (COM3)
Serial transmission rate	110~115,200 bps		110~38,400 bps
Number of data bits	7 bits~8 bits		
Parity bit	Even/Odd parity bit/None		
Number of stop bits	1 data bit~2 data bits		
Register where a communication format is stored	D1036	D1120	D1109
ASCII mode	Slave station	Master station/ Slave station	Slave station
RTU mode	Slave station	Master station/ Slave station	-
Quantity of data read/written (ASCII mode)	100 registers		32 registers
Quantity of data read/written (RTU mode)	100 registers		32 registers

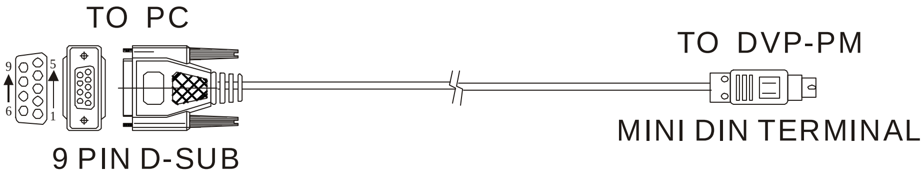
Default communication protocol supported by a communication port

- Modbus ASCII mode
- 7 data bits
- 1 stop bit
- Even parity bit
- Serial transmission rate: 9600 bps

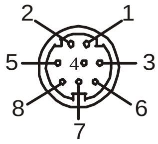
2.3.1 COM1 (RS-232 Port)

1. COM1 is an RS-232 port. Users can upload the program in a DVP-10PM series motion controller through COM1, and download a program to DVP-10PM series motion controller through COM1. The communication protocols that COM1 supports are Modbus ASCII and Modbus RTU, and the transmission rate supported is in the range of 9,600 bps to 57,600 bps.

   The communication cable DVPACAB2A30 is described below.



Communication port on a PC/TP 9-pin D-SUB female connector		↔	COM1 on a DVP-10PM series motion controller 8-pin Mini-DIN connector	
Tx	3	↔	4	Rx
Rx	2	↔	5	Tx
GND	5	↔	8	GND
	7, 8 (connected)		1,2	5V
	1, 4, 6 (connected)			



2. COM1 functions as a slave station. It can be connected to a human-machine interface.

2.3.2 COM2 (RS-485 Port)

1. COM2 is an RS-485 port. It can function as a master station or a slave station. The communication protocols that COM2 supports are Modbus ASCII and Modbus RTU, and the transmission rate supported is in the range of 9,600 bps to 115,200 bps.
2. COM2 can function as a master station or a slave station. If it functions as a master station, it can be connected to a Delta PLC, or an inferior drive such as a Delta servo drive, a Delta AC motor drive, or a temperature controller, and read/write data. If it functions as a slave station, it can be connected to a human-machine interface such as a Delta TP series HMI or DOP series HMI.

2.3.3 COM3 (RS-232/RS-485 Port)

1. If COM1 (RS-232 port) and COM2 (RS-485 port) can not fulfill a communication requirement, users can use the function card DVP-F232S or DVP-F485S to add a communication interface called COM3 (RS-232/RS485 interface). The functions of DVP-F232S/DVP-F485S is the same as those of COM1, but the transmission rate that DVP-F232S/DVP-F485 supports is 9600/19200/38400 bps in an ASCII mode.
2. COM3 functions as a slave station. It can be connected to a human-machine interface.

MEMO

3.1 Device Lists

■ Functional specifications

<table>
<tr><th colspan="2">Item</th><th colspan="3">Specifications</th><th>Remark</th></tr>
<tr><td colspan="2">Operation of axes</td><td colspan="3">Six axes operate synchronously or independently.</td><td></td></tr>
<tr><td colspan="2">Storage</td><td colspan="3">The capacity of a built-in storage is 64K steps.</td><td></td></tr>
<tr><td colspan="2">Unit</td><td>Motor unit</td><td>Compound unit</td><td>Mechanical unit</td><td></td></tr>
<tr><td colspan="2">Master mode</td><td colspan="3">Users can read the data in control registers in an I/O module by means of the instruction FROM and write data into control registers in an I/O module by means of the instruction TO. If the data read or written is 32-bit data, two control registers will be used.</td><td></td></tr>
<tr><td colspan="2">Slave mode</td><td colspan="3">Not supported</td><td></td></tr>
<tr><td colspan="2">Pulse output</td><td colspan="3">There are three types of pulse output modes. These modes adopt differential output.
1. Pulse/Direction
2. Counting up/Counting down
3. A/B-phase output</td><td></td></tr>
<tr><td colspan="2">Maximum speed</td><td colspan="3">Single axis: 1000K pps
Multi-axis interpolation: 1000K pps</td><td></td></tr>
<tr><td rowspan="3">Input signal</td><td>Switch</td><td colspan="3">STOP/RUN switch (Manual/Automatic switch)</td><td></td></tr>
<tr><td>Differential input signal</td><td colspan="3">X10+, X10-, X12+, X12-, X11+, X11-, X13+, and X13-</td><td></td></tr>
<tr><td>Detector</td><td colspan="3">X0~X7
They can be connected to I/O modules. The maximum number of expansion input terminals is 256, including the number of input terminals on a DVP-10PM series motion controller.</td><td></td></tr>
<tr><td rowspan="3">Output signal</td><td>Differential output signal</td><td colspan="3">Y10+, Y10-, Y12+, Y12-, Y14+, Y14-, Y16+, Y16-, Y11+, Y11-, Y13+, Y13-, Y15+, Y15-, Y17+, and Y17-</td><td></td></tr>
<tr><td>General output</td><td colspan="3">Y0~Y3
They can be connected to I/O modules. The maximum number of expansion output terminals is 256, including the number of output terminals on a DVP-10PM series motion controller.</td><td></td></tr>
<tr><td>Serial communication port</td><td colspan="3">The communication ports which can be used for the reading/writing of a program are as follows.
COM1: RS-232 port (It can function as a slave station.)
COM2: RS-485 port (It can function as a master station or a slave station.)
COM3 (Communication card): RS-232/RS-485 port (It can function as a slave station, and it is optionally required.)</td><td></td></tr>
<tr><td>Special I/O module</td><td>Optional purchase</td><td colspan="3">The EH2 series special right-side modules which are supported are AD, DA, PT, TC, XA, and PU. (Eight special right-side modules can be connected at most, and they do not occupy I/O devices.)</td><td></td></tr>
<tr><td>Special function card</td><td>Optional purchase</td><td colspan="3">The function cards which are supported are 02AD, 02DA, and COM3.</td><td></td></tr>
<tr><td colspan="2">Number of basic instructions</td><td colspan="3">27</td><td></td></tr>
<tr><td colspan="2">Number of applied instructions</td><td colspan="3">130</td><td></td></tr>
<tr><td colspan="2">Number of motion instructions</td><td colspan="3">-</td><td></td></tr>
</table>

<table>
<tr><th colspan="4">Item</th><th>Specifications</th><th>Remark</th></tr>
<tr><td colspan="4">M-code</td><td>■ Ox0~Ox99 (motion subroutine/positioning program): M02 (The execution of a program stops. (END))
■ M00~M01, M03~M101, and M103~M65535: The execution of a program pauses. (WAIT) (Users can use them freely.)
■ O100 (main program in a DVP-10PM series motion controller/subtask program): M102 (The execution of a program stops. (END))</td><td></td></tr>
<tr><td colspan="4">G-code</td><td>Not supported</td><td></td></tr>
<tr><td colspan="4">Self-diagnosis</td><td>Errors such as parameter errors, program errors, and external errors are displayed.</td><td></td></tr>
<tr><td rowspan="16">Relay (Bit device)</td><td>X</td><td colspan="2">External input relay</td><td>X0~X377; octal numbers; 256 external input relays (corresponding to external input terminals)</td><td rowspan="2">512 relays in total</td></tr>
<tr><td>Y</td><td colspan="2">External output relay</td><td>Y0~Y377, octal numbers, 256 external output relays (corresponding to external output terminals)</td></tr>
<tr><td rowspan="4">M</td><td rowspan="4">Auxiliary relay</td><td rowspan="2">General</td><td>M0~M499; 500 general auxiliary relays (*2)</td><td rowspan="4">There are 4,096 auxiliary relays in total. They can be set to ON/OFF in a program.</td></tr>
<tr><td>M3000~M4095; 1096 general auxiliary relays (*3)</td></tr>
<tr><td>Latching</td><td>M500~M999; 500 latching auxiliary relays (*3)</td></tr>
<tr><td>Special</td><td>M1000~M2999; 2000 special auxiliary relays (Some special auxiliary relays are latching auxiliary relays.)</td></tr>
<tr><td>T</td><td>Timer</td><td>10 ms</td><td>T0~T255; 256 timers (*2)</td><td>There are 256 timers in total. If the present value of the timer specified by the instruction TMR matches the value set, the contact of the timer will be ON.</td></tr>
<tr><td rowspan="5">C</td><td rowspan="5">Counter</td><td rowspan="2">16-bit up counter</td><td>C0~C99; 100 16-bit up counters (*2)</td><td rowspan="5">There are 250 counters in total. If the present value of the counter specified by the instruction CNT (DCNT) matches the value set, the contact of the counter will be ON.</td></tr>
<tr><td>C100~C199; 100 16-bit up counters (*3)</td></tr>
<tr><td rowspan="2">32-bit up/down counter</td><td>C210~C219; 12 32-bit up/down counters (*2)</td></tr>
<tr><td>C220~C255; 36 32-bit up/down counters (*3)</td></tr>
<tr><td>32-bit high-speed counter</td><td>C200, C204, C208, C212, C216, and C220; 6 32-bit high-speed counters</td></tr>
<tr><td rowspan="2">S</td><td rowspan="2">Stepping relay</td><td>General</td><td>S0~S499; 500 stepping relays (*2)</td><td rowspan="2">There are 1,024 stepping relays in total. They can be set to ON/OFF in a program.</td></tr>
<tr><td>Latching</td><td>S500~S1023; 524 stepping relays (*3)</td></tr>
</table>

Item				Specifications	Remark
Register (Word device)	T	Present value of a timer		T0~T255; 16-bit timers; 256 timers	If the present value of a timer matches the value set, the contact of the timer will be ON.
	C	Present value of a counter		C0~C199; 16-bit counters; 200 counters	If the present value of a counter matches the value set, the contact of the counter will be ON.
				C200~C255; 32-bit counters; 56 counters	
	D	Data register	General	D0~D199; 200 general data registers (*2)	There are 10,000 registers in total. Users can store data in data registers. V/Z registers are index registers.
			Latching	D200~D999; 800 latching data registers (*3)	
				D3000~D9999; 7000 latching data registers (*3)	
			Special	D1000~D2999; 2000 special data registers (Some special data registers are latching data registers.)	
			Index	V0~V7 (16-bit registers); Z0~Z7 (32-bit registers); 16 index registers (*1)	
Pointer	P	Used with CJ, CJN, CALL, or JMP		P0~P255; 256 pointers	It is used with CJ, CJN, CALL, or JMP.
Constant	K	Decimal system		K-32,768~K32,767 (16-bit operation)	
				K-2,147,483,648~K2,147,483,647 (32-bit operation)	
	H	Hexadecimal system		H0000~HFFFF (16-bit operation); H00000000~HFFFFFFFF (32-bit operation)	
	F	Floating-point number		32-bit operation: ±1.1755X10^{-38}~±3.4028X10^{+38} (The IEEE 754 standard is used.)	

*1: They are non-latching devices, and can not be changed.
*2: They are non-latching devices. Users can change them to latching devices by setting parameters.
*3: They are latching devices. Users can change them to non-latching devices by setting parameters.
*4: They are latching devices, and can not be changed.

■ Latching and non-latching memory devices

Auxiliary relay (M)	General auxiliary relays			Special auxiliary relays
	M0~M499	M500~M999	M3000~M4095	M1000~M2999
	Non-latching	Latching	Non-latching	(They are in the general auxiliary relay range.)
	Start: D1200 (K500)*1 End: D1201 (K999) *1			Some special auxiliary relays are latching auxiliary relays. They can not be changed.

Timer (T)	10 ms
	T0~T255
	Non-latching
	Start: D1202 (K-1) *2; End: D1203 (K-1) *2

Counter (C)	16-bit up counters		32-bit up/down counters	
	C0~C99	C100~C199	C200, C204, and C208~C219	C220~C255
	Non-latching	Latching	Non-latching	Latching
	Start: D1204 (K100) End: D1205 (K199)		Start: D1206 (K220) End: D1207 (K255)	

Stepping relay (S)	Initial stepping relays	General stepping relay	Latching stepping relay
	S0~S9	S10~S499	S500~S1023
	Non-latching		Latching
	Start: D1208 (K500); End: D1209 (K1023)		

Data register (D)	General data registers	Latching data registers	Special data registers
	D0~D999	D3000~D9999	D1000~D2999 (They are between the general data register range and the latching data register range.)
	Non-latching	Latching	Some special data registers are latching data registers. They can not be changed.
	Start: D1210 (K200) *3 End: D1211 (K9999) *3		

*1: If the value in D1200 is 0, and the value in D1201 is 4095, the DVP-10PM series motion controller used will automatically skip M1000~M2999, and M0~M999 and M3000~M4095 will be changed to latching devices.

*2: K-1 indicates that the timers are non-latching devices.

*3: If the value in D1210 is 0, and the value in D1211 is 9999, the DVP-10PM series motion controller used will automatically skip D1000~D2999, and D0~M999 and D3000~D9999 will be changed to latching devices.

■ When power is switched ON/OFF, or when the DVP-10PM series motion controller used switches between a manual mode and an automatic mode, the action of general devices are as shown below.

Memory type	Power OFF=>ON	STOP=>RUN	RUN=>STOP	Clearing all non-latching devices (M1031 is ON.)	Clearing all latching devices (M1032 is ON.)	Factory setting
Non-latching	Cleared	Unchanged	Cleared when M1033 is OFF	Cleared	Unchanged	0
			Unchanged when M1033 is ON			
Latching	Unchanged			Unchanged	Cleared	0

3.2 Values, Constants, and Floating-point Numbers

Constant	K	Decimal system	16-bit operation: K-32,768~K32,767 32-bit operation: K-2,147,483,648~K2,147,483,647
	H	Hexadecimal system	16-bit operation: H0~HFFFF 32-bit operation: H0~HFFFFFFFF
Floating-point number	F	32-bit number	32-bit operation: $\pm1.1755X10^{-38}$~$\pm3.4028X10^{+38}$ (The IEEE 754 standard is used.)

A DVP-10PM series motion controller performs operations on five types of values according to various control purposes. The functions of the five types of values are described below.

1. Binary number (BIN)

   The values on which a DVP-10PM series motion controller performs operations, and the values stored in the DVP-10PM series motion controller are binary numbers. Binary numbers are described below.

   Bit: A bit is the basic unit of information in the binary system. Its state is either 1 or 0.

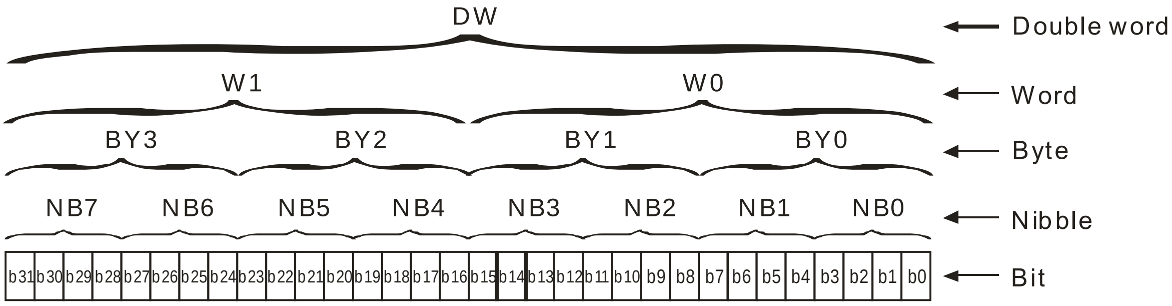
   Nibble: A nibble is composed of four consecutive bits (e.g. b3~b0). Nibbles can be used to represent 0~9 in the decimal system, or 0~F in the hexadecimal system.

   Byte: A byte is composed of two consecutive nibbles (i.e. 8 bits, b7~b0). Bytes can be used to represent 00~FF in the hexadecimal system.

   Word: A word is composed of two consecutive bytes (i.e. 16 bits, b15~b0). Words can be used to represent 0000~FFFF in the hexadecimal system.

   Double word: A double word is composed of two consecutive words (i.e. 32 bits, b31~b0). Double words can be used to represent 00000000~FFFFFFFF in the hexadecimal system.

The relation among bits, nibbles, bytes, words, and double words in the binary system is shown below.



2. Octal number (OCT)

   The external input terminal numbers and the external output terminal numbers on a DVP-10PM series motion controller are octal numbers.

   - External input terminals: X0~X7, X10~X17… (Device numbers)
   - External output terminals: Y0~Y7, Y10~Y17… (Device numbers)

3. Decimal number (DEC)

   - A decimal number can be used as the setting value of a timer, or the setting value of a counter, e.g. TMR T0 K50 (K indicates that the value following it is a constant.).
   - A decimal number can be used as an S/M/T/C/D/V/Z/P device number, e.g. M10 and T30.
   - A decimal number can be used as an operand in an applied instruction, e.g. MOV K123 D0 (K indicates that the value following it is a constant.).

4. Binary-coded decimal number (BCD)

   A decimal value is represented by a nibble or four bits, and therefore sixteen consecutive bits can represent a four-digit decimal value. A binary-coded decimal number is mainly used as the input value of a DIP switch, or the value displayed on a seven-segment display.

5. Hexadecimal Number (HEX)

   - A hexadecimal number can be used as an operand in an applied instruction, e.g. MOV H1A2B D0 (H indicates that the value following it is a constant.).

Constant (K): A decimal number in a DVP-10PM series motion controller is generally preceded by K. For example, K100 represents the decimal number 100.

> Exception:
>
> If K is used with an X/Y/M/S device, a nibble device, a byte device, a word device, or a double word device will be formed.
>
> Example:
>
> K1Y10 represents a device composed of 4 bits, K2Y10 represents a device composed of 8 bits, K3Y10 represents a device composed of 12 bit, and K4Y10 represents a device composed of 16 bits. K1M100 represents a device composed of 4 bits, K2M100 represents a device composed of 8 bits, K3M100 represents a device composed of 12 bit, and K4M100 represents a device composed of 16 bits.

Constant (H): A hexadecimal number in a DVP-10PM series motion controller is generally preceded by H. For example, the hexadecimal number H100 represents the decimal number 256.

Floating-point number (F): A floating-point number in a DVP-10PM series motion controller is generally preceded by F. For example, the floating-point number F3.123 represents 3.123.

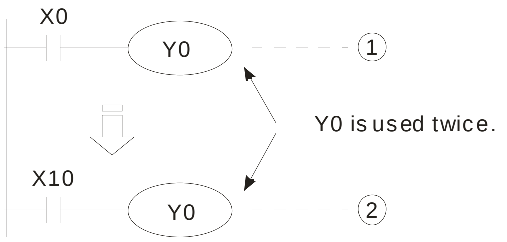
Value table:

Binary number (BIN)		**Octal number (OCT)**	**Decimal number (DEC)**	**Binary-coded decimal number (BCD)**		**Hexadecimal Number (HEX)**
For internal operations in a DVP-10PM series motion controller		X/Y device number	Constant (K) M/S/T/C/D/V/Z/P device number	Input value of a DIP switch, and the value displayed on a seven-segment display		Constant (H)
0 0 0 0	0 0 0 0	0	0	0 0 0 0	0 0 0 0	0
0 0 0 0	0 0 0 1	1	1	0 0 0 0	0 0 0 1	1
0 0 0 0	0 0 1 0	2	2	0 0 0 0	0 0 1 0	2
0 0 0 0	0 0 1 1	3	3	0 0 0 0	0 0 1 1	3
0 0 0 0	0 1 0 0	4	4	0 0 0 0	0 1 0 0	4
0 0 0 0	0 1 0 1	5	5	0 0 0 0	0 1 0 1	5
0 0 0 0	0 1 1 0	6	6	0 0 0 0	0 1 1 0	6
0 0 0 0	0 1 1 1	7	7	0 0 0 0	0 1 1 1	7
0 0 0 0	1 0 0 0	10	8	0 0 0 0	1 0 0 0	8
0 0 0 0	1 0 0 1	11	9	0 0 0 0	1 0 0 1	9
0 0 0 0	1 0 1 0	12	10	0 0 0 1	0 0 0 0	A
0 0 0 0	1 0 1 1	13	11	0 0 0 1	0 0 0 1	B
0 0 0 0	1 1 0 0	14	12	0 0 0 1	0 0 1 0	C
0 0 0 0	1 1 0 1	15	13	0 0 0 1	0 0 1 1	D
0 0 0 0	1 1 1 0	16	14	0 0 0 1	0 1 0 0	E
0 0 0 0	1 1 1 1	17	15	0 0 0 1	0 1 0 1	F
0 0 0 1	0 0 0 0	20	16	0 0 0 1	0 1 1 0	10
0 0 0 1	0 0 0 1	21	17	0 0 0 1	0 1 1 1	11
:		:	:	:		:
0 1 1 0	0 0 1 1	143	99	1 0 0 1	1 0 0 1	63

3.3 External Input Devices and External Output Devices

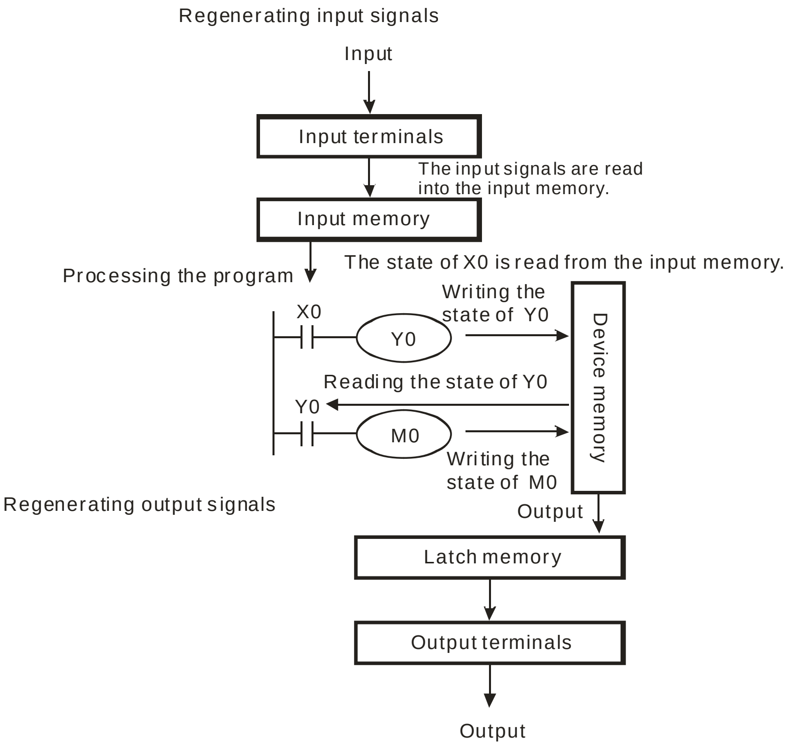
- Input devices: X0~X377
  Input device numbers are octal numbers. A DVP-10PM series motion controller has 256 input devices at most (X0~X7, X10~X17, ……, X370~X377).
- Output devices: Y0~Y377
  Output device numbers are octal numbers. A DVP-10PM series motion controller has 256 output devices at most (YX0~Y7, Y10~Y17, ……, Y370~Y377).
- Functions of input devices:
  After X devices in a DVP-10PM series motion controller are connected to an input device, the input signals sent to the DVP-10PM series motion controller will be read. There is no limitation on the number of times the Form A contact/the Form B contact of an X device can be used in a program. The state of an X device varies with the state of the input device to which the X device is connected.
- Users can turn X devices ON/OFF by means of M1304.
  If M1304 is OFF, X devices can not be turned ON/OFF by means of PMSoft. If M1304 is ON, X devices can be turned ON/OFF by means of PMSoft. However, if users use PMSoft to turn ON/OFF X devices in a DVP-10PM series motion controller when M1304 is ON, the function of updating input signals will be disabled.
- Functions of output devices:
  A Y device sends a signal to drive the load connected to it. There are two types of output devices. They are relays and transistors. There is no limitation on the number of times the Form A contact/the Form B contact of a Y device can be used in a program. However, it is suggested that a Y device should be

used once in a program. If a Y device is used more than once in a program, the state of the Y device depends on the Y device used last time.



The state of Y0 depends on circuit ②, that is, the state of X10 determines the state of Y0.

The procedure for processing the program in a DVP-10PM series motion controller is described below.



- Regenerating an input signal:
  1. Before a DVP-10PM series motion controller executes a program, it reads the states of the input signals sent to it into its input memory.
  2. If the states of the input signals change during the execution of the program, the states of input signals stored in the input memory will not change until the DVP-10PM series motion controller reads the states of the input signals sent to it next time.
  3. The time it takes for an input device in the program to receive the state of an external signal is about 10 milliseconds. (The time it takes for a contact in the program to receive the state of an external signal may be affected by the time it takes for the program to be scanned.)
- Processing a program:

  After the DVP-10PM series motion controller reads the states of the input signals stored in the input memory, the execution of the instructions in the program will start from the beginning of the program. After the program is executed, the states of the Y devices used in the program will be stored in the device memory in the DVP-10PM series motion controller.
- Regenerating an output signal:
  1. After M102 is executed, the states of the Y devices stored in the device memory will be sent to the latch memory in the DVP-10PM series motion controller.
  2. The time it takes for a relay to be turned form ON to OFF or turned from OFF to ON is about 10.
  3. The time it takes for a transistor to be turned form ON to OFF or turned from OFF to ON is about 10~20 milliseconds.

3.4 Auxiliary Relays

Auxiliary relay (M): Auxiliary relay numbers are decimal numbers.

Auxiliary relay (M)	General auxiliary relay	M0~M499 (500 general auxiliary relays) Users can change M0~M499 to latching devices by setting parameters.	4,096 auxiliary relays in total
	Latching auxiliary relay	M500~M999 and M3000~M4095 (1,596 latching auxiliary relays) Users can change M0~M499 to non-latching devices by setting parameters.	
	Special auxiliary relay	M1000~M2999 (2,000 special auxiliary relays) Some of them are latching devices.	

Functions of auxiliary relays:

An M device has an output coil and a Form A contact/Form B contact. There is no limitation on the number of times an M device can be used in a program. Users can combine control loops by means of M devices, but can not drive external loads by means of M devices. There are three types of auxiliary relays.

1. General auxiliary relay: If a power cut occurs when a DVP-10PM series motion controller runs, the general auxiliary relays in the DVP-10PM series motion controller will be reset to OFF. When the supply of electricity is restored, the general auxiliary relays are still OFF.
2. Latching auxiliary relay: If a power cut occurs when a DVP-10PM series motion controller runs, the latching auxiliary relays will remain in their last states. When the supply of electricity is restored, the latching auxiliary relays remain unchanged.
3. Special auxiliary relay: Every auxiliary relay has its own specific function. Please do not use the auxiliary relays which are not defined. Users can refer to section 3.10 for more information about special auxiliary relays and special data registers, and refer to section 3.11 for more information about the functions of special auxiliary relays and functions of special data registers.

3.5 Stepping Relays

Stepping relay (S): Stepping relay numbers are decimal numbers.

Stepping relay (S)	General stepping relay	S0~S499 (490 general stepping relays) Users can change S0~S499 to latching devices by setting parameters.	1,024 stepping relays in total
	Latching stepping relay	S500~S1023 (524 latching stepping relays) Users can change S500~S1023 to non-latching devices by setting parameters.	

Functions of stepping relays:

There are 1024 stepping relays (S0~S1023). An S device has an output coil and a Form A contact/Form B contact. There is no limitation on the number of times an S device can be used in a program. Users can not drive external loads by means of S devices. An S device can be used as a general auxiliary relay.

3.6 Timers

Timer (T): Timer numbers are decimal numbers.

Timer (T)	10 ms General timer	T0~T255 (256 general timers) Users can change T0~T255 to latching devices by setting parameters.

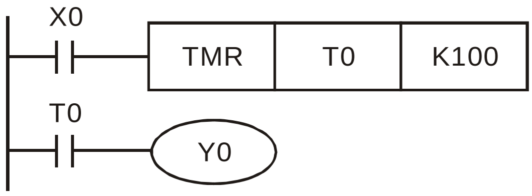
Functions of timers:

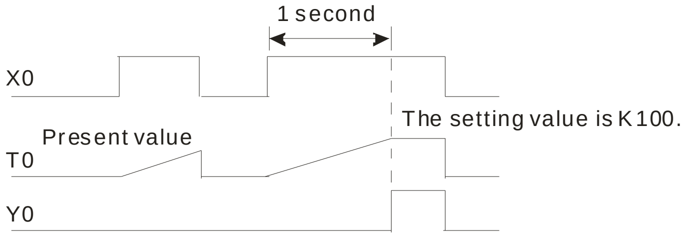
10 milliseconds are a unit of measurement for time. A timer counts upwards for measuring time which elapses. If the present value of a timer is equal to the value set, the output coil of the timer will be ON. The

value set can be a decimal value preceded by K, or the value in a data register.

Actual time measured by a timer= Unit of measurement for time x Setting value

1. If the instruction TMR is executed, a timer will count for measuring time which elapses once. If the value of a timer matches the value set, the output coil of the timer will be ON.





- If X0 is ON, the timer T0 will count upwards from the present time value every 10 milliseconds. If the present timer value matches the setting value K100, the output coil T0 will be ON.
- If X0 is OFF, or there is a power cut, the present value in T0 will become 0, and the output coil T0 will be OFF.

Setting value: Actual time measured by a timer= Unit of measurement for time x Setting value

1. Constant preceded by K: A setting value can be a constant preceded by K.
2. Value in a data register: A setting value can be the value in a data register.

3.7 Counters

Counter (C): Counter numbers are decimal numbers.

C	Counter	16-bit up counter	C0~C199 (200 16-bit up counters)	236 counters in total	If the present value of the counter specified by the instruction CNT (DCNT) matches the value set, the contact of the counter will be ON.
		32-bit up/down counter	C220~C255 (36 32-bit up/down counters) (Accumulation)		
		32-bit high-speed counter	C200, C204, C208, C212, C216, and C220 (6 32-bit high-speed counters)	6 counters in total	Input contact of C200: X0/X1 Input contact of C204: X2/X3 Input contact of C208: X4/X5 Input contact of C212: X6/X7 Input contact of C216: X10+/X10-/X11+/X11- Input contact of C220: X12+/X12-/X13+/X13-

Characteristics of counters:

Item	16-bit counter	32-bit counter	
Type	General counter	General counter	High-speed counter
Direction	Counting up	Counting up/down	
Setting value	0~32,767	-2,147,483,648~+2,147,483,647	
Specification of a setting value	Constant preceded by K, or value stored in a data register	Constant preceded by K, or value stored in two consecutive data registers	
Change of the present value	If the present value matches the setting value, the counter will stop counting.	Even if the present value matches the setting value, the counter will keep counting.	
Output contact	If the present value matches the setting value, the output contact will be ON.	Counting up: If the present value matches the setting value, the output contact will be ON. Counting down: If the present value matches the setting value, the output contact will be reset to OFF.	

Item	16-bit counter	32-bit counter	
Resetting of a contact	If the instruction RST is executed, the present value will becomes zero, and the contact will be reset to OFF.		
Actions of contacts	After the scan of a program is complete, the contacts will act.	After the scan of a program is complete, the contacts will act.	If the present value matches the setting value, the contact will be ON.

Functions of counters:

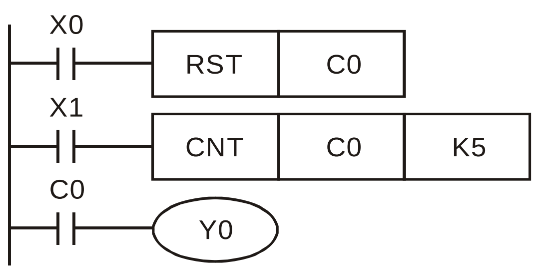
If the input signal of a counter is turned from OFF to ON, and the present value of the counter matches the value set, the output coil of the counter will be ON. A setting value can be a constant preceded by K, or the value stored in a data register.

16-bit counter:

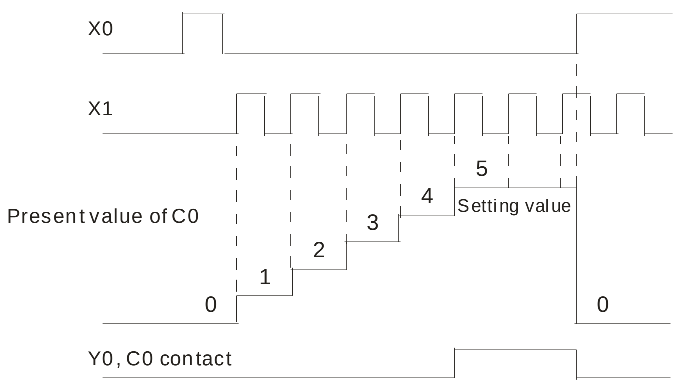
1. The setting value of a 16-bit counter must be in the range of K0 to K32,767. (K0 is equal to K1. If the setting value of a counter is K0 or K1, the output contact of the counter will be ON after the counter counts for the first time.)
2. If a power cut occurs when a general counter in a DVP-20PM series motion controller counts, the present value of the counter will be cleared. If a power cut occurs when a latching counter counts, the present value of the counter and the state of the contact of the counter will be retained, and the latching counter will not continue counting until power is restored.
3. If users move a value greater than the setting value of C0 to C0 by means of the instruction MOV, the contact C0 will be ON, and the present value of the counter will become the setting value next time X1 is turned from OFF to ON.
4. The setting value of a counter can be a constant preceded by K, or the value stored in a data register. (The special data registers D1000~D2999 can not be used.)
5. If the setting value of a counter is a value preceded by K, the setting value can only be a positive value. If the setting value of a counter is the value stored in a data register, the setting value can be a positive value or a negative value. If a counter counts up from the present value 32,767, the next value following 32,767 will be -32,768.

Example:

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



1. If X0 is ON, the instruction RST will be executed, the present value of C0 will become zero, and the output contact will be reset to OFF.
2. If X01 is turned from OFF to ON, the present value of the counter will increase by one.
3. If the present value of C0 matches the setting value K5, the contact C0 will be ON (Present value of C0=Setting value=K5). K5 will be retained even if X1 is turned from OFF to ON again.

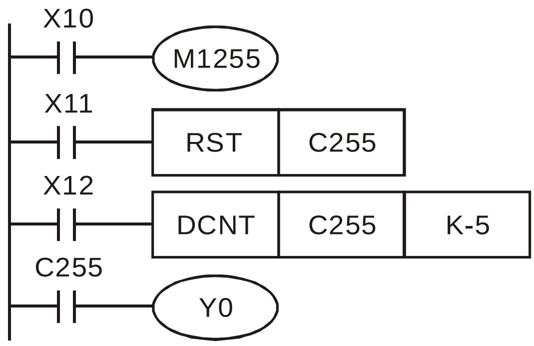


32-bit up/down counter:

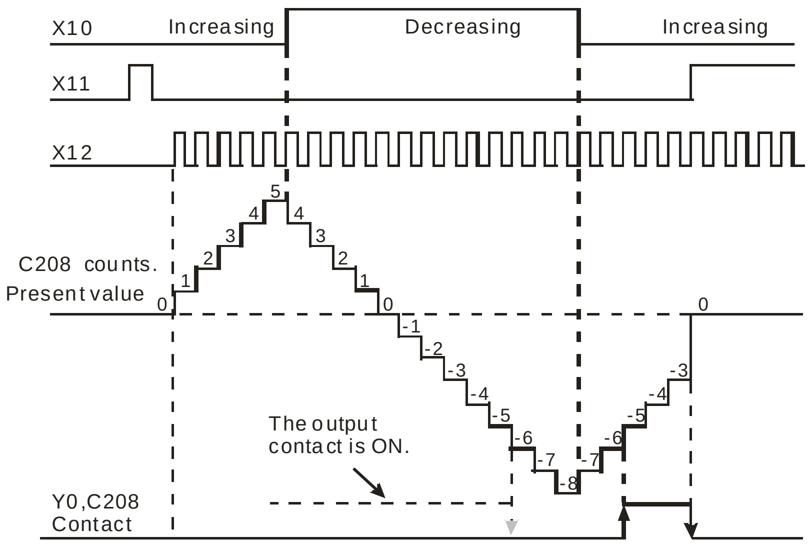
1. The setting value of a 32-bit general up/down counter must be in the range of K-2,147,483,648 to K2,147,483,647. The states of the special auxiliary relays M1208~M1255 determine whether the 32-bit general up/down counters C220~C255 count up or count down. For example, C208 will count up if M1208 is OFF, and C208 will count down if M1208 is ON.
2. The setting value of a 32-bit up/down counter can be a constant preceded by K, or the value stored in two consecutive data registers. (The special data registers D1000~D2999 can not be used.) A setting value can be a positive value, or a negative value.
3. If a power cut occurs when a general counter in a DVP-10PM series motion controller counts, the present value of the counter will be cleared. If a power cut occurs when a latching counter counts, the present value of the counter and the state of the contact of the counter will be retained, and the latching counter will not continue counting until power is restored.
4. If a counter counts up from the present value 2,147,483,647, the next value following 2,147,483,647 will be -2,147,483,648. If a counter counts down from the present value -2,147,483,648, the next value following -2,147,483,648 will be 2,147,483,647.

Example:

```
LD      X10
OUT     M1255
LD      X11
RST     C255
LD      X12
DCNT    C255    K-5
LD      C255
OUT     Y0
```



1. M1255 is driven by X10. The state of M1255 determines whether C255 counts up or counts down.
2. If X11 is turned form OFF to ON, the instruction RST will be executed, the present value of C255 will become 0, and the contact will be OFF.
3. If X12 is turned form OFF to ON, the present value of the counter will increase by one or decrease by one.
4. If the present value of the counter C255 increases from K-6 to K-5, the contact C255 will be turned form OFF to ON. If the present value of the counter C255 decreases from K-5 to K-6, the contact C255 will be turned from ON to OFF.
5. If users move a value greater than the setting value of C255 to C255 by means of the instruction MOV, the contact C255 will be ON, and the present value of the counter will become the setting value next time X11 is turned from OFF to ON.



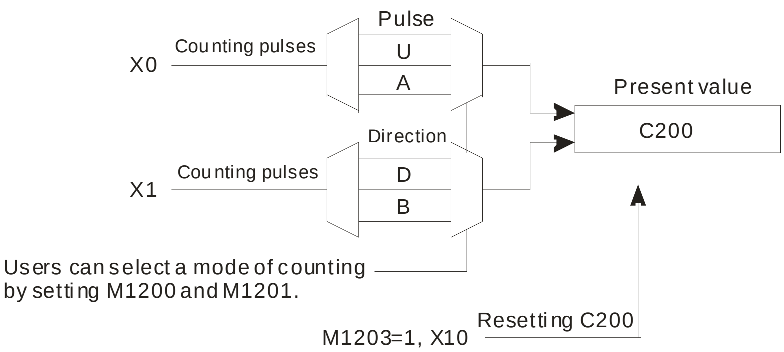
32-bit high-speed counter:

- DVP-10PM series motion controller (C200, C204, C208, C212, C216, and C220)
  1. The setting value of a 32-bit high-speed counter must be in the range of K-2,147,483,648 to K2,147,483,647.
  2. Mode of counting:

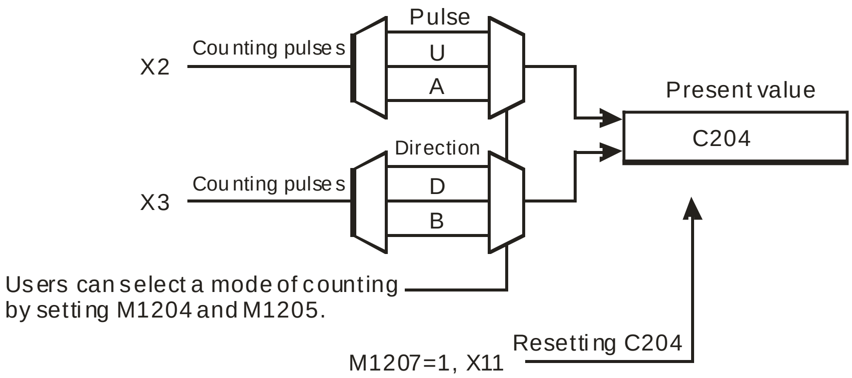
<table>
<tr><th rowspan="2">Counter</th><th colspan="2">Mode of counting</th><th rowspan="2">Resetting a counter</th><th rowspan="2">External reset terminal</th><th rowspan="2">External input terminal</th></tr>
<tr><th>Device</th><th>Setting value</th></tr>
<tr><td>C200</td><td>K1M1200</td><td rowspan="6">■ Mode of counting
0: U/D*
1: P/D*
2: A/B* (One time the frequency of A/B-phase inputs)
3: 4A/B (Four times the frequency of A/B-phase inputs)
■ Mode of measuring time
5: General mode
6: Cyclic mode</td><td>M1203</td><td>X10</td><td>X0, X1, and S/S</td></tr>
<tr><td>C204</td><td>K1M1204</td><td>M1207</td><td>X11</td><td>X2, X3, and S/S</td></tr>
<tr><td>C208</td><td>K1M1208</td><td>M1211</td><td>X12</td><td>X4, X5, and S/S</td></tr>
<tr><td>C212</td><td>K1M1212</td><td>M1215</td><td>X13</td><td>X6, X7, and S/S</td></tr>
<tr><td>C216</td><td>K1M1216</td><td>M1219</td><td>X0</td><td>X10+, X10-, X11+, and X11-</td></tr>
<tr><td>C220</td><td>K1M1220</td><td>M1223</td><td>X1</td><td>X12+, X12-, X13+, and X13-</td></tr>
</table>

Note: U/D: Counting up/Counting down; P/D: Pulse/Direction; A/B: A phase/B phase

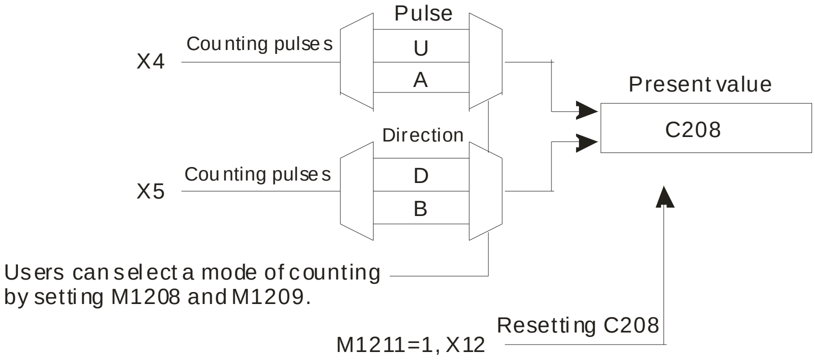
- C200: Users can select a mode of counting by setting M1200 and M1201. Input signals are controlled by X0 and X1. If M1203 is ON, the function of resetting C200 will be enabled. Resetting signals are controlled by X10.



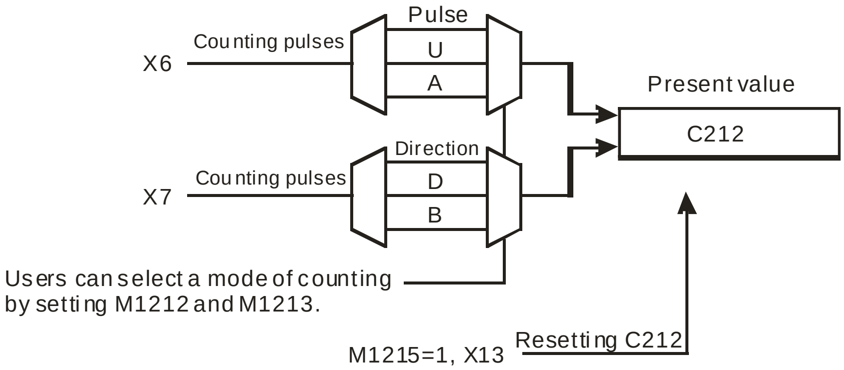
- C204: Users can select a mode of counting by setting M1204 and M1205. Input signals are controlled by X2 and X3. If M1207 is ON, the function of resetting C204 will be enabled. Resetting signals are controlled by X11.



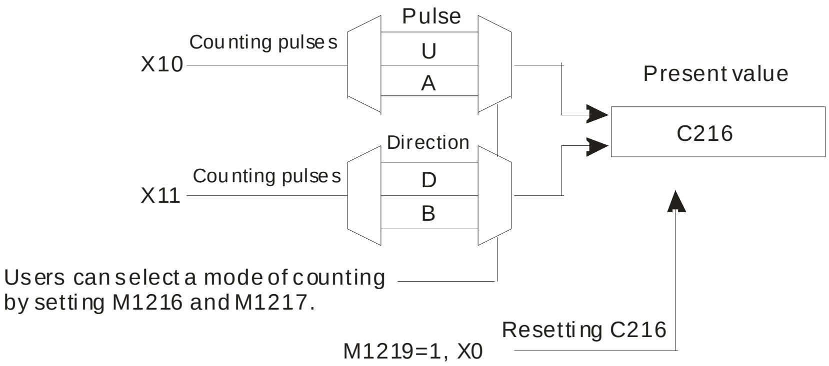
- C208: Users can select a mode of counting by setting M1208 and M1209. Input signals are controlled by X4 and X5. If M1211 is ON, the function of resetting C208 will be enabled. Resetting signals are controlled by X12.



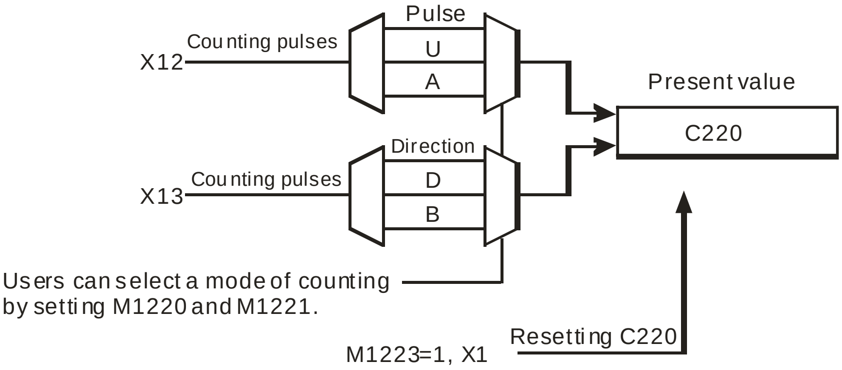
- C212: Users can select a mode of counting by setting M1212 and M1213. Input signals are controlled by X6 and X7. If M1215 is ON, the function of resetting C212 will be enabled. Resetting signals are controlled by X13.



- C216: Users can select a mode of counting by setting M1216 and M1217. Input signals are controlled by X10 and X11. If M1219 is ON, the function of resetting C216 will be enabled. Resetting signals are controlled by X0.



- C220: Users can select a mode of counting by setting M1221 and M1220. Input signals are controlled by X12 and X13. If M1223 is ON, the function of resetting C220 will be enabled. Resetting signals are controlled by X1.



3. The setting value of a 32-bit high-speed counter can be a constant preceded by K, or the value stored in two consecutive data registers. (The special data registers D1000~D2999 can not be used.) A setting value can be a positive value, or a negative value.
4. If a power cut occurs when a general counter in a DVP-10PM series motion controller counts, the present value of the counter will be cleared. If a power cut occurs when a latching counter counts, the present value of the counter and the state of the contact of the counter will be retained, and the latching counter will not continue counting until power is restored.
5. If a counter counts up from the present value 2,147,483,647, the next value following 2,147,483,647 will be -2,147,483,648. If a counter counts down from the present value -2,147,483,648, the next value following -2,147,483,648 will be 2,147,483,647.

3.8 Registers

Registers are classified according to their characters. There are four types of registers.

1. General register: If the STOP/RUN switch on a DVP-10PM series motion controller is turned from the STOP position to the RUN position, or a DVP-10PM series motion controller is disconnected, the values in the general registers will become 0. If M1033 in a DVP-10PM series motion controller is turned ON, the values in the general registers will be retained after the STOP/RUN switch on the DVP-10PM series motion controller is turned from the RUN position to the STOP position, and will become 0 after the module is disconnected.
2. Latching register: If a module is disconnected, the values in the latching registers will be retained.

   If users want to clear the value in a latching register, they can use the instruction RST or ZRST.
3. Special data register: Every special data register has its definition and purposes. System states, error messages, and states monitored are stored in special data registers. Please refer to section 3.10 and section 3.11 for more information about special auxiliary relays and special data registers.
4. Index register (V)/(Z): V devices are 16-bit registers, and Z devices are 32-bit registers. There are 8 V devices (V0~V7), and 8 Z devices (Z0~Z7) in a DVP-10PM series motion controller.

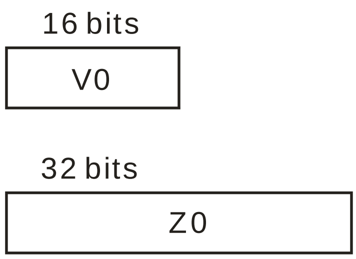
3.8.1 Data Registers

The value in a data register is a 16-bit value. The highest bit in a 16-bit data register represents an algebraic sign. The value stored in a data register must be in the range of -32,768 to +32,767. Two 16-bit data registers can be combined into one 32-bit data register (D+1, D). The highest bit in a 32-bit data register represents an algebraic sign. The value stored in a 32-bit data register must be in the range of -2,147,483,648 to +2,147,483,647.

Data register (D)	**General data register**	D0~D199 (200 general data registers in total) Users can change them to latching devices by setting parameters.	10,000 data registers in total
	Latching data register	D200~D999 and D3000~D9999 (7,800 latching data register in total) Users can change them to non-latching devices by setting parameters.	
	Special data register	D1000~D2999 (2,000 special data registers in total) Some of them are latching devices.	

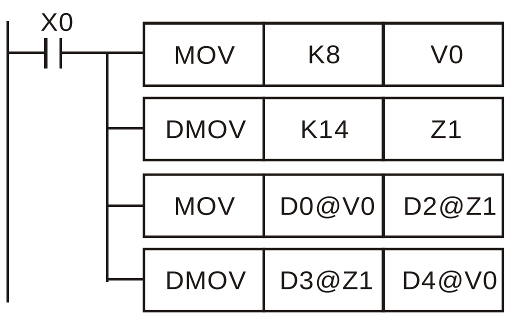
3.8.2 Index Registers

Index register (V)/(Z)	V0~V7	16 index registers in total
	Z0~Z7	



V devices are 16-bit registers. Data can be freely written into a V device, and data can be freely read from a V device. If a V device is used as a general register, it can only be used in a 16-bit instruction.

Z devices are 32-bit registers. If a Z device is used as a general register, it can only be used in a 32-bit instruction.



If X0 is ON, the value in V0 will be 8, and the value in Z1 will be 14, the value in D8 will be moved to D16, and the value in D17 will be moved to D12.

If a V device or a Z device is an index register used to modify an operand, the V device or the Z device can be used in a 16-bit instruction and a 32-bit instruction.

Index registers are like general operands in that they can be used in movement instructions and comparison instructions. They can be used to modify word devices (KnX/KnY/KnM/KnS/T/C/D devices) and bit devices (X/Y/M/S devices).

<u>There are 8 V devices (V0~V7), and 8 Z devices (Z0~Z7) in a DVP-10PM series motion controller.</u>

※Constants and some instructions do not support the use of index registers. Please refer to section 5.4 for more information about using index registers to modify operands.

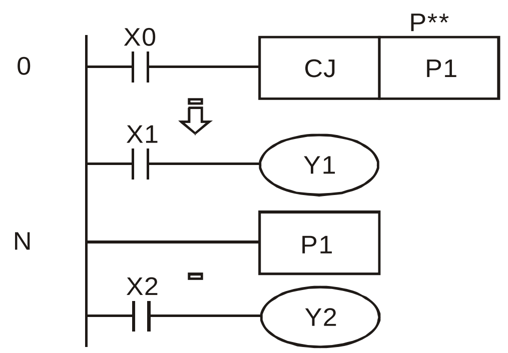
※To prevent error from occurring, if a V device or a Z device is used to modify an operand, the effective address which is formed can not be in the range of D1000 to D2999, and can not be in the range of M1000 to M2999.

3.9 Pointers

Pointer	N	Used with a master control loop	N0~N7 (8 poniters)	Used with a master control loop
	P	Used with CJ, CJN, or JMP	P0~P255 (256 pointers)	Used with CJ, CJN, or JMP

Pointer (P): A pointer is used with API 00 CJ, API 256 CJN, or API 257 JMP. Please refer to chapter 5 for more information about the use of CJ/CJN/JMP.

- Conditional jump (CJ):



- If X0 is ON, the execution of the program will jump from address 0 to address N, and the part of the program between address 0 and address N will not be executed.
- If X0 is OFF, the execution of the program starts from address 0, and the instruction CJ will not be executed.

3.10 Special Auxiliary Relays and Special Data Registers

Special auxiliary relays (special M devices) and special data registers (special D devices) are shown in the tables below. Some device numbers in the tables are marked with *. Users can refer to section 3.11 for more information. If the attribute of a device is “R”, the users can only read data from the device. If the attribute of a device is “R/W”, the users can read data from the device, and write data into the device. In addition, “-” indicates that the state of a special auxiliary relay is unchanged, or the value in a special data register is unchanged. “#” indicates that a special auxiliary relay or a special data register in a DVP-10PM series motion controller is set according to the state of the DVP-10PM series motion controller. The users can read a setting value, and refer to the manual for more information.

Special M device	Function	Off ⇩ On	STOP ⇩ RUN	RUN ⇩ STOP	Attribute	Latching	Default	Page
M1000*	If the motion controller runs, M1000 will be a normally-open contact (Form A contact). When the motion controller runs, M1000 is ON.	Off	On	Off	R	No	Off	3-30
M1001*	If the motion controller runs, M1001 will be a normally-closed contact (Form B contact). When the motion controller runs, M1001 is OFF.	On	Off	On	R	No	On	3-30
M1002*	A positive-going pulse is generated at the time when the motion controller runs. The width of the pulse is equal to the scan cycle.	Off	On	Off	R	No	Off	3-30
M1003*	A negative-going pulse is generated at the time when the motion controller runs. The width of the pulse is equal to the scan cycle.	On	Off	On	R	No	On	3-30
M1008	The watchdog timer is ON.	Off	Off	-	R	No	Off	-
M1009	The low voltage signal has ever occurred.	Off	-	-	R	No	Off	-
M1011	10 millisecond clock pulse (The pulse is ON for 5 milliseconds, and is OFF for 5 milliseconds.)	Off	-	-	R	No	Off	-
M1012	100 millisecond clock pulse (The pulse is ON for 50 milliseconds, and OFF for 50 milliseconds.)	Off	-	-	R	No	Off	-
M1013	1 second clock pulse (The pulse is ON for 0.5 seconds, and OFF for 0.5 seconds.)	Off	-	-	R	No	Off	-
M1014	1 minute clock pulse (The pulse is ON for 30 seconds, and OFF for 30 seconds.)	Off	-	-	R	No	Off	-
M1020	Zero flag (for the instructions SFRD and SFWR)	Off	-	-	R	No	Off	-
M1022	Carry flag (for the instructions SFWR, RCR, and RCL)	Off	-	-	R	No	Off	-

Special M device	Function	Off ⇩ On	STOP ⇩ RUN	RUN ⇩ STOP	Attribute	Latching	Default	Page
M1025	Incorrect request for communication (If a PC or an HMI is connected to a DVP-10PM series motion controller, and the DVP-10PM series motion controller receives illegal request for communication during data transmission, M1025 will be set to ON, and an error code will be stored in D1025.)	Off	Off	-	R	No	Off	-
M1026	Selecting a RAMP mode	Off	-	-	R/W	No	Off	-
M1029	The sending of pulses through CH0 (Y0, Y1) is complete.	Off	-	-	R	No	Off	
M1031	All the non-latching devices are cleared.	Off	-	-	R/W	No	Off	-
M1032	All the latching devices are cleared.	Off	-	-	R/W	No	Off	-
M1033	Data is retained when the DVP-10PM series motion controller does not run.	Off	-	-	R/W	No	Off	-
M1034	All the outputs are disabled.	Off	-	-	R/W	No	Off	-
M1035	Using STOP0/START0 as external I/O terminals.	Off	Off	Off	R/W	No	Off	-
M1039*	The scan time for the program is fixed.	Off	-	-	R/W	No	Off	3-34
M1048	Status of the alarm	Off	-	-	R	No	Off	-
M1049	Monitoring the alarm	Off	-	-	R/W	No	Off	-
M1072	The DVP-10PM series motion controller is made to run. (Communication)	Off	On	Off	R/W	No	Off	-
M1077	The battery voltage is low, or malfunctions, or there is no battery.	Off	-	-	R/W	No	Off	-
M1087	The low voltage signal occurs.	Off	-	-	R/W	No	Off	-
M1120*	The setting of the communication through COM2 (RS-485 port) is retained. After M1120 is set to ON, changing the value in D1120 will be invalid.	Off	Off	-	R/W	No	Off	3-31
M1121	The transmission of the RS-485 data is ready.	Off	On	-	R	No	Off	-
M1122	Request for sending the data	Off	Off	-	R/W	No	Off	-
M1123	The reception of the data is complete.	Off	Off	-	R/W	No	Off	-
M1124	The reception of the data is ready.	Off	Off	-	R	No	Off	-
M1125	The reception of the data is reset.	Off	Off	-	R/W	No	Off	-
M1127	The sending/reception of the data is complete.	Off	Off	-	R/W	No	Off	-
M1128	The data is being sent/received.	Off	Off	-	R	No	Off	-
M1129	Reception timeout	Off	Off	-	R/W	No	Off	-
M1136	The setting of the communication through COM3 (communication card) is retained.	Off	-	-	R	No	Off	3-31
M1138*	The setting of the communication through COM1 (RS-232 port) is retained. After M1138 is set to ON, changing the value in D1036 will be invalid.	Off	-	-	R/W	No	Off	3-31
M1139*	Selecting an ASCII mode or an RTU mode when COM1 (RS-232 port) is in a slave mode. (OFF: ASCII mode; ON: RTU mode)	Off	-	-	R/W	No	Off	3-31
M1140	The data that users receive by means of MODRD/MODWR is incorrect.	Off	Off	-	R	No	Off	-
M1141	The values of parameters of MODRD/MODWR are incorrect.	Off	Off	-	R	No	Off	-
M1143*	Selecting an ASCII mode or an RTU mode when COM2 (RS-485 port) is in a slave mode. (OFF: ASCII mode; ON: RTU mode) Selecting an ASCII mode or an RTU mode when COM2 (RS-485 port) is in a master mode. (M1143 is used with MODRD/MODWR.) (OFF: ASCII mode; ON: RTU mode)	Off	-	-	R/W	No	Off	3-31
M1161	8-bit mode (ON: 8-bit mode; OFF: 16-bit mode)	Off	-	-	R/W	No	Off	-
M1162	Using decimal integers or binary floating-point values when SCLP is executed. ON: Binary floating-point values OFF: Decimal integers	Off	-	-	R/W	No	Off	-
M1168	SMOV: Mode of operation	Off	-	-	R/W	No	Off	-
M1200	C200: Selecting a mode of counting	Off	-	-	R/W	No	Off	-
M1201	C200: Selecting a mode of counting	Off	-	-	R/W	No	Off	-
M1203	Resetting C200	Off	-	-	R/W	No	Off	-

Special M device	Function	Off ⇩ On	STOP ⇩ RUN	RUN ⇩ STOP	Attribute	Latching	Default	Page
M1204	C204: Selecting a mode of counting	Off	-	-	R/W	No	Off	-
M1205	C204: Selecting a mode of counting	Off	-	-	R/W	No	Off	-
M1207	Resetting C204	Off	-	-	R/W	No	Off	-
M1208	C208: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1209	C209: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1210	C210: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1211	C211: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1212	C212: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1213	C213: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1214	C214: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1215	C215: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1216	C216: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1217	C217: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1218	C218: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1219	C219: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1220	C220: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1221	C221: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1222	C222: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1223	C223: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1224	C224: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1225	C225: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1226	C226: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1227	C227: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1228	C228: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1229	C229: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1230	C230: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1231	C231: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1232	C232: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1233	C233: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1234	C234: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1235	C235: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1236	C236: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1237	C237: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1238	C238: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1239	C239: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1240	C240: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1241	C241: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1242	C242: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1243	C243: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1244	C244: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1245	C245: Selecting a mode of counting (On: Counting down)	Off	-	-	R/W	No	Off	-
M1246	C246: Selecting a mode of counting (On: Counting down)	Off	-	-	R	No	Off	-
M1247	C247: Selecting a mode of counting (On: Counting down)	Off	-	-	R	No	Off	-
M1248	C248: Selecting a mode of counting (On: Counting down)	Off	-	-	R	No	Off	-
M1249	C249: Selecting a mode of counting (On: Counting down)	Off	-	-	R	No	Off	-
M1250	C250: Selecting a mode of counting (On: Counting down)	Off	-	-	R	No	Off	-
M1251	C251: Selecting a mode of counting (On: Counting down)	Off	-	-	R	No	Off	-
M1252	C252: Selecting a mode of counting (On: Counting down)	Off	-	-	R	No	Off	-
M1253	C253: Selecting a mode of counting (On: Counting down)	Off	-	-	R	No	Off	-
M1254	C254: Selecting a mode of counting (On: Counting down)	Off	-	-	R	No	Off	-
M1255	C255: Selecting a mode of counting (On: Counting down)	Off	-	-	R	No	Off	-
M1303	Interchanging high bits with low bits when XCH is executed	Off	-	-	R/W	No	Off	-
M1304*	The input terminals can be set to ON or OFF.	Off	-	-	R/W	No	Off	3-37
M1744*	Resetting the M-code in the Ox motion subroutine	Off	Off	-	R/W	No	Off	3-38

Special M device	Function	Off ⇩ On	STOP ⇩ RUN	RUN ⇩ STOP	Attribute	Latching	Default	Page
M1745	Disabling the X-axis from returning home in the Ox motion subroutine	Off	-	-	R/W	No	Off	-
M1760	Using a radian or a degree in the Ox motion subroutine	Off	-	-	R/W	No	Off	-
M1792	The X-axis is ready.	On	On	On	R	No	On	3-38
M1793*	X-axis motion error (M1793 is reset at the time when the X-axis operates.)	Off	-	-	R/W	No	Off	3-39
M1794*	If an M code in an Ox motion subroutine is executed, M1794 will be ON. (M1794 is reset to OFF at the time when the Ox motion subroutine is executed.)	Off	-	Off	R	No	Off	-
M1795	If M0 in an Ox motion subroutine is executed, M1795 will be ON. (M1795 is reset to OFF at the time when the Ox motion subroutine is executed.)	Off	-	-	R	No	Off	-
M1796	If M2 in an Ox motion subroutine is executed, M1796 will be ON. (M1796 is reset to OFF at the time when the Ox motion subroutine is executed.)	Off	On	-	R	No	Off	-
M1808	Zero flag in the Ox motion subroutine	Off	-	-	R	No	Off	-
M1809	Borrow flag in the Ox motion subroutine	Off	-	-	R	No	Off	-
M1810	Carry flag in the Ox motion subroutine	Off	-	-	R	No	Off	-
M1811	An error occurs in a floating-point operation in the Ox motion subroutine.	Off	Off	-	R	No	Off	-
M1825	Disabling the Y-axis from returning home	Off	-	-	R/W	No	Off	-
M1872	The Y-axis is ready.	On	On	On	R	No	On	3-38
M1873*	Y-axis motion error (M1873 is reset at the time when the Y-axis operates.)	Off	-	-	R	No	Off	3-39
M1920	Using a radian or a degree in O100	Off	-	-	R/W	No	Off	-
M1952	O100 is ready.	On	Off	On	R	No	On	-
M1953*	An error occurs in O100.	Off	-	-	R/W	No	Off	3-35
M1957	Status of the STOP/RUN switch (Automatic/Manual switch)	Off	On	-	R	No	Off	-
M1968	Zero flag in O100	Off	-	-	R	No	Off	-
M1969	Borrow flag in O100	Off	-	-	R	No	Off	-
M1970	Carry flag in O100	Off	-	-	R	No	Off	-
M1971	An error occurs in a floating-point operation in O100.	Off	-	-	R	No	Off	-
M1985	Disabling the Z-axis from returning home	Off	-	-	R/W	No	Off	-
M2032	The Z-axis is ready.	On	On	On	R	No	On	3-38
M2033*	Z-axis motion error (M2033 is reset at the time when the Z-axis operates.)	Off	-	-	R/W	No	Off	3-39
M2065	Disabling the A-axis from returning home	Off	-	-	R/W	No	Off	-
M2112	The A-axis is ready.	On	On	On	R	No	On	3-38
M2113*	A-axis motion error (M2113 is reset at the time when the A-axis operates.)	Off	-	-	R/W	No	Off	3-39
M2145	Disabling the B-axis from returning home	Off	-	-	R/W	No	Off	-
M2192	The B-axis is ready.	On	On	On	R	No	On	3-38
M2193*	B-axis motion error (M2193 is reset at the time when the B-axis operates.)	Off	-	-	R/W	No	Off	3-39
M2225	Disabling the C-axis from returning home	Off	-	-	R/W	No	Off	-
M2272	The C-axis is ready.	On	On	On	R	No	On	3-38
M2273*	C-axis motion error (M2273 is reset at the time when the X-axis operates.)	Off	-	-	R/W	No	Off	3-39

Special D device	Function	Off ⇩ On	STOP ⇩ RUN	RUN ⇩ STOP	Attribute	Latching	Default	Page
D1000*	Watchdog timer (Unit: ms)	200	-	-	R/W	No	200	3-30
D1002	Size of the program	65535	-	-	R	No	65535	-
D1003	Checksum of the program	-	-	-	R	Yes	0	-
D1005	Firmware version of the DVP-10PM series motion controller (factory setting)	#	-	-	R	No	#	-
D1008	Step address at which the watchdog timer is ON	0	-	-	R	No	0	-
D1010	Present scan time (Unit: 1 millisecond)	0	-	-	R	No	0	-
D1011	Minimum scan time (Unit: 1 millisecond)	0	-	-	R	No	0	-
D1012	Maximum scan time (Unit: 1 millisecond)	0	-	-	R	No	0	-
D1020	Filtering the inputs X0~X7 (Unit: ms)	10	-	-	R/W	No	10	3-31
D1025	Code for a communication request error	0	0	-	R	No	0	-
D1036*	Communication protocol of COM1	H’86	-	-	R/W	No	H’86	3-31
D1038*	Delay which is allowed when an RS-485 port on the DVP-10PM series motion controller functions as a slave station (Setting range: 0~3000; Unit: 10 ms)	-	-	-	R/W	Yes	0	3-34
D1039*	Fixed scan time (Unit: ms)	0	-	-	R/W	No	0	3-34
D1050 ↓ D1055	Modbus communication data is processed. The DVP-10PM series motion controller automatically converts the ASCII data in D1070~D1085 to hexadecimal values.	0	-	-	R	No	0	-
D1056	Present value of CH0 in the function card 2AD	0	#	-	R	No	0	-
D1057	Present value of CH1 in the function card 2AD	0	#	-	R	No	0	-
D1070 ↓ D1085	Modbus communication data is processed. A DVP-10PM series motion controller has an RS-485 communication instruction. After a receptor receives the command sent by an RS-485 communication instruction, it will reply with a message which will be stored in D1070~D1085. Users can view the message by D1070~D1085.	0	-	-	R	No	0	-
D1089 ↓ D1099	Modbus communication data is processed. A DVP-10PM series motion controller has an RS-485 communication instruction. The command sent by the RS-485 communication instruction is stored in D1089~D1099. Users can check whether the command is correct by viewing the values in D1089~D1099.	0	-	-	R	No	0	-
D1109	Communication protocol of COM3 (communication card)	H’86	-	-	R/W	No	H’86	3-31
D1110	Number by which the sum of several values of CH0 in the function card 2AD is divided	0	#	-	R	No	0	-
D1111	Number by which the sum of several values of CH1 in the function card 2AD is divided	0	#	-	R	No	0	-
D1116	Present value of CH0 in the function card 2DA	0	-	-	R/W	No	0	-
D1117	Present value of CH1 in the function card 2DA	0	-	-	R/W	No	0	-
D1120*	Communication protocol of COM2 (RS-485 port)	H’86	-	-	R/W	No	H’86	3-31
D1121	Communication address of the DVP-10PM series motion controller	-	-	-	R/W	Yes	1	-
D1122	Number characters which remain to be sent	0	0	-	R	No	0	-
D1123	Number of characters which remain to be received	0	0	-	R	No	0	-
D1124	Start-of-text character (STX)	H’3A	-	-	R/W	No	H’3A	-
D1125	First terminator (END High)	H’0D	-	-	R/W	No	H’0D	-
D1126	Second terminator (END Low)	H’0A	-	-	R/W	No	H’0A	-
D1129	Communication timeout (Unit: ms)	0	-	-	R/W	No	0	-
D1130	Error code that a slave station sends by means of Modbus when the RS-485 port on the DVP-10PM series motion controller functions as a master station	0	0	-	R	No	0	-
D1140*	Number of right-side modules (8 right-side modules at most)	0	-	-	R	No	0	3-37
D1142*	Number of X devices in a digital module	0	-	-	R	No	0	3-37
D1143*	Number of Y devices in a digital module	0	-	-	R	No	0	3-37
D1149	ID of a function card (0: No card inserted; 3: COM3; 8: 2AD; 9: 2DA)	0	-	-	R	No	0	-

Special D device	Function	Off ⇩ On	STOP ⇩ RUN	RUN ⇩ STOP	Attribute	Latching	Default	Page
D1200*	Starting latching auxiliary relay address	-	-	-	R/W	Yes	500	3-37
D1201*	Terminal latching auxiliary relay address	-	-	-	R/W	Yes	999	3-37
D1202*	Starting latching timer address	-	-	-	R/W	Yes	-1	3-37
D1203*	Terminal latching timer address	-	-	-	R/W	Yes	-1	3-37
D1204*	Starting latching 16-bit counter address	-	-	-	R/W	Yes	100	3-37
D1205*	Terminal latching 16-bit counter address	-	-	-	R/W	Yes	199	3-37
D1206*	Starting latching 32-bit counter address	-	-	-	R/W	Yes	220	3-37
D1207*	Terminal latching 32-bit counter address	-	-	-	R/W	Yes	255	3-37
D1208*	Starting latching stepping relay address	-	-	-	R/W	Yes	500	3-37
D1209*	Terminal latching stepping relay address	-	-	-	R/W	Yes	1023	3-37
D1210*	Starting latching data register address	-	-	-	R/W	Yes	200	3-37
D1211*	Terminal latching data register address	-	-	-	R/W	Yes	9999	3-37
D1313*	Value of the second in the real-time clock (RTC): 00~59	-	-	-	R/W	Yes	0	-
D1314*	Value of the minute in the real-time clock (RTC): 00~59	-	-	-	R/W	Yes	0	-
D1315*	Value of the hour in the real-time clock (RTC): 00~23	-	-	-	R/W	Yes	0	-
D1316*	Value of the day in the real-time clock (RTC): 1~31	-	-	-	R/W	Yes	1	-
D1317*	Value of the month in the real-time clock (RTC): 01~12	-	-	-	R/W	Yes	1	-
D1318*	Value of the week in the real-time clock (RTC): 1~7	-	-	-	R/W	Yes	2/5	-
D1319*	Value of the year in the real-time clock (RTC): 00~99 (A.D.)	-	-	-	R/W	Yes	8/10	-
D1320*	ID of the first right-side module	0	-	-	R	No	0	3-38
D1321*	ID of the second right-side module	0	-	-	R	No	0	3-38
D1322*	ID of the third right-side module	0	-	-	R	No	0	3-38
D1323*	ID of the fourth right-side module	0	-	-	R	No	0	3-38
D1324*	ID of the fifth right-side module	0	-	-	R	No	0	3-38
D1325*	ID of the sixth right-side module	0	-	-	R	No	0	3-38
D1326*	ID of the seventh right-side module	0	-	-	R	No	0	3-38
D1327*	ID of the eighth right-side module	0	-	-	R	No	0	3-38
D1400	Enabling the interrupt	0	-	-	R/W	No	0	-
D1401	Cycle of the time interrupt (Unit: ms)	0	-	-	R/W	No	0	-
D1500	Data block used by FROM/TO It corresponds to CR#0.	H6260	-	-	R	No	H6260	-
D1501 ↓ D1699	Data block used by FROM/TO They correspond to CR#1~CR#199.	0	-	-	R/W	No	0	-
D1700	Ox motion subroutine which is executed	0	-	-	R	No	0	-
D1702	Step address which is executed in the Ox motion subroutine	0	-	-	R	No	0	-
D1703*	M-code which is executed in the Ox motion subroutine	0	-	-	R	No	0	3-38
D1704	Dwell duration of the Ox motion subroutine which is set	0	-	-	R	No	0	-
D1705	Present dwell duration of the Ox motion subroutine	0	-	-	R	No	0	-
D1706	Number of times the instruction RPT in the Ox motion subroutine is executed	0	-	-	R	No	0	-
D1707	Number of times the instruction RPT in the Ox motion subroutine has been executed	0	-	-	R	No	0	-
D1736	Dwell duration of O100 which is set	0	-	-	R	No	0	-
D1737	Present dwell duration of O100	0	-	-	R	No	0	-
D1738	Number of times the instruction RPT in O100 is executed	0	-	-	R	No	0	-
D1739	Number of times the instruction RPT in O100 has been executed	0	-	-	R	No	0	-
D1799*	Polarities of the input terminals	0	-	-	R/W	No	0	3-39
D1800*	States of the input terminals	0	-	-	R	No	0	3-39
D1802*	O100 error code	0	-	-	R/W	No	0	3-40
D1803*	Step address in O100 at which an error occurs	0	0	-	R/W	No	0	3-40
D1806	Filter coefficient for the input terminals	0	-	-	R/W	No	0	3-40
D1816*	Setting the parameters of the X-axis	-	-	-	R/W	Yes	0	3-40

Special D device	Function	Off ⇩ On	STOP ⇩ RUN	RUN ⇩ STOP	Attribute	Latching	Default	Page
D1818	Number of pulses it takes for the motor of the X-axis to rotate once (Low word)	-	-	-	R/W	Yes	2000	-
D1819	Number of pulses it takes for the motor of the X-axis to rotate once (High word)							
D1820	Distance generated after the motor of the X-axis rotate once (Low word)	-	-	-	R/W	Yes	1000	-
D1821	Distance generated after the motor of the X-axis rotate once (High word)							
D1822	Maximum speed (V_{MAX}) at which the X-axis rotates (Low word)	-	-	-	R/W	Yes	500K	-
D1823	Maximum speed (V_{MAX}) at which the X-axis rotates (High word)							
D1824	Start-up speed (V_{BIAS}) at which the X-axis rotates (Low word)	-	-	-	R/W	Yes	0	-
D1825	Start-up speed (V_{BIAS}) at which the X-axis rotates (High word)							
D1826	JOG speed (V_{JOG}) at which the X-axis rotates (Low word)	-	-	-	R/W	Yes	5000	-
D1827	JOG speed (V_{JOG}) at which the X-axis rotates (High word)							
D1828	Speed (V_{RT}) at which the X-axis returns home (Low word)	-	-	-	R/W	Yes	50K	-
D1829	Speed (V_{RT}) at which the X-axis returns home (High word)							
D1830	Speed (V_{CR}) to which the speed of the X-axis decreases when the axis returns home (Low word)	-	-	-	R/W	Yes	1000	-
D1831	Speed (V_{CR}) to which the speed of the X-axis decreases when the axis returns home (High word)							
D1832*	Number of PG0 pulses for the X-axis	-	-	-	R/W	Yes	0	-
D1833*	Supplementary pulses for the X-axis	-	-	-	R/W	Yes	0	-
D1834*	Home position of the X-axis (Low word)	-	-	-	R/W	Yes	0	-
D1835	Home position of the X-axis (High word)	-	-	-	R/W	Yes	0	-
D1836	Time (T_{ACC}) it takes for the X-axis to accelerate	-	-	-	R/W	Yes	500	-
D1837	Time (T_{DEC}) it takes for the X-axis to decelerate	-	-	-	R/W	Yes	500	-
D1838	Target position of the X-axis (P (I)) (Low word)	0	-	-	R/W	No	0	-
	Pulse width for the X-axis (Low word)	0	-	-	R/W	No	0	-
D1839	Target position of the X-axis (P (I)) (High word)	0	-	-	R/W	No	0	-
	Pulse width for the X-axis (High word)	0	-	-	R/W	No	0	-
D1840	Speed at which the X-axis rotates (V (I)) (Low word)	1000	-	-	R/W	No	1000	-
D1841	Speed at which the X-axis rotates (V (I)) (High word)	1000	-	-	R/W	No	1000	-
D1842	Target position of the X-axis (P (II)) (Low word)	0	-	-	R/W	No	0	-
	Output period for the X-axis (Low word)	0	-	-	R/W	No	0	-
D1843	Target position of the X-axis (P (II)) (High word)	0	-	-	R/W	No	0	-
	Output period for the X-axis (High word)	0	-	-	R/W	No	0	-
D1844	Speed at which the X-axis rotates (V (II)) (Low word)	2000	-	-	R/W	No	2000	-
D1845	Speed at which the X-axis rotates (V (II)) (High word)							
D1846*	Operation command for the X-axis	0	-	0	R/W	No	0	3-42
D1847*	X-axis's mode of operation	0	-	-	R/W	No	0	3-42
D1848	Present command position of the X-axis (Pulse) (Low word)	0	-	-	R/W	No	0	-
	Position of the slave axis (Low word)							
D1849	Present command position of the X-axis (Pulse) (High word)	0	-	-	R/W	No	0	-
	Position of the slave axis (High word)							
D1850	Present command speed of the X-axis (PPS) (Low word)	0	0	0	R/W	No	0	-
D1851	Present command speed of the X-axis (PPS) (High word)							
D1852	Present command position of the X-axis (Unit) (Low word)	0	-	-	R/W	No	0	-
D1853	Present command position of the X-axis (Unit) (High word)							
D1854	Present command speed of the X-axis (Unit) (Low word)	0	0	0	R/W	No	0	-
D1855	Present command speed of the X-axis (Unit) (High word)							
D1856*	State of the X-axis	0	-	-	R	No	0	3-43
D1857*	X-axis error code	0	-	-	R	No	0	3-39
D1858	Electronic gear ratio of the X-axis (Numerator)	-	-	-	R/W	Yes	1	-
D1859	Electronic gear ratio of the X-axis (Denominator)	-	-	-	R/W	Yes	1	-

Special D device	Function	Off ⇩ On	STOP ⇩ RUN	RUN ⇩ STOP	Attribute	Latching	Default	Page
D1860	Frequency of pulses generated by the manual pulse generator for the X-axis (Low word) Frequency of pulses sent by the master axis (Low word)	0	0	-	R/W	No	0	-
D1861	Frequency of pulses generated by the manual pulse generator for the X-axis (High word) Frequency of pulses sent by the master axis (High word)	0	0	-	R/W	No	0	-
D1862	Number of pulses generated by the manual pulse generator for the X-axis (Low word) Position of the master axis	0	-	-	R/W	No	0	-
D1863	Number of pulses generated by the manual pulse generator for the X-axis (High word) Position of the master axis	0	-	-	R/W	No	0	-
D1864*	Response speed of the manual pulse generator for the X-axis	-	-	-	R/W	Yes	5	-
D1865	Mode of stopping Ox0~Ox99 (K1: The execution of Ox0~Ox99 will resume next time Ox0~Ox99 are started. K2: The next instruction will be executed next time Ox0~Ox99 are started. Others: Ox0~Ox99 are executed again.)	-	-	-	R/W	Yes	0	-
D1866	Electrical zero of the X-axis (Low word)	-	-	-	R/W	Yes	0	-
D1867	Electrical zero of the X-axis (High word)	-	-	-	R/W	Yes	0	-
D1868*	Setting an Ox motion subroutine number	0	0	-	R/W	Yes	0	3-34
D1869	Step address in the Ox motion subroutine at which an error occurs	0	-	-	R/W	No	0	-
D1872	Enabling a Y device when the Ox motion subroutine is ready (High byte: K1; Low byte: Starting Y device address)	0	-	-	R/W	No	0	-
D1873	Enabling a Y device when an M-code in the Ox motion subroutine is executed (High byte: K1; Low byte: Starting Y device address)	-	-	-	R/W	Yes	0	-
D1874	Using an X device to reset the M-code	0	-	-	R/W	No	0	-
D1875*	Starting the X-axis manually (ZRN, MPG, JOG-, JOG+)	-	-	-	R/W	Yes	0	-
D1896*	Setting the parameters of the Y-axis	-	-	-	R/W	Yes	0	3-40
D1898	Number of pulses it takes for the motor of the Y-axis to rotate once (Low word)	-	-	-	R/W	Yes	2000	-
D1899	Number of pulses it takes for the motor of the Y-axis to rotate once (High word)							
D1900	Distance generated after the motor of the Y-axis rotate once (Low word)	-	-	-	R/W	Yes	1000	-
D1901	Distance generated after the motor of the Y-axis rotate once (High word)							
D1902	Maximum speed (V_{MAX}) at which the Y-axis rotates (Low word)	-	-	-	R/W	Yes	500K	-
D1903	Maximum speed (V_{MAX}) at which the Y-axis rotates (High word)							
D1904	Start-up speed (V_{BIAS}) at which the Y-axis rotates (Low word)	-	-	-	R/W	Yes	0	-
D1905	Start-up speed (V_{BIAS}) at which the Y-axis rotates (High word)							
D1906	JOG speed (V_{JOG}) at which the Y-axis rotates (Low word)	-	-	-	R/W	Yes	5000	-
D1907	JOG speed (V_{JOG}) at which the Y-axis rotates (High word)							
D1908	Speed (V_{RT}) at which the Y-axis returns home (Low word)	-	-	-	R/W	Yes	50K	-
D1909	Speed (V_{RT}) at which the Y-axis returns home (High word)							
D1910	Speed (V_{CR}) to which the speed of the Y-axis decreases when the axis returns home (Low word)	-	-	-	R/W	Yes	1000	-
D1911	Speed (V_{CR}) to which the speed of the Y-axis decreases when the axis returns home (High word)							
D1912	Number of PG0 pulses for the Y-axis	-	-	-	R/W	Yes	0	-
D1913	Supplementary pulses for the Y-axis	-	-	-	R/W	Yes	0	-
D1914	Home position of the Y-axis (Low word)	-	-	-	R/W	Yes	0	-
D1915	Home position of the Y-axis (High word)							
D1916	Time (T_{ACC}) it takes for the Y-axis to accelerate	-	-	-	R/W	Yes	500	-
D1917	Time (T_{DEC}) it takes for the Y-axis to decelerate	-	-	-	R/W	Yes	500	-

Special D device	Function	Off ↓ On	STOP ↓ RUN	RUN ↓ STOP	Attribute	Latching	Default	Page
D1918	Target position of the Y-axis (P (I)) (Low word)	0	-	-	R/W	No	0	-
	Pulse width for the Y-axis (Low word)	0	-	-	R/W	No	0	-
D1919	Target position of the Y-axis (P (I)) (High word)	0	-	-	R/W	No	0	-
	Pulse width for the Y-axis (High word)	0	-	-	R/W	No	0	-
D1920	Speed at which the Y-axis rotates (V (I)) (Low word)	1000	-	-	R/W	No	1000	-
D1921	Speed at which the Y-axis rotates (V (I)) (High word)							
D1922	Target position of the Y-axis (P (II)) (Low word)	0	-	-	R/W	No	0	-
	Output period for the Y-axis (Low word)	0	-	-	R/W	No	0	-
D1923	Target position of the Y-axis (P (II)) (High word)	0	-	-	R/W	No	0	-
	Output period for the Y-axis (High word)	0	-	-	R/W	No	0	-
D1924	Speed at which the Y-axis rotates (V (II)) (Low word)	2000	-	-	R/W	No	2000	-
D1925	Speed at which the Y-axis rotates (V (II)) (High word)							
D1926*	Y-axis: Operation command	0	-	0	R/W	No	0	3-42
D1927*	Y-axis: Mode of operation	0	-	-	R/W	No	0	3-42
D1928	Present command position of the Y-axis (Pulse) (Low word)	0	-	-	R/W	No	0	-
D1929	Present command position of the Y-axis (Pulse) (High word)							
D1930	Present command speed of the Y-axis (PPS) (Low word)	0	0	0	R/W	No	0	-
D1931	Present command speed of the Y-axis (PPS) (High word)							
D1932	Present command position of the Y-axis (Unit) (Low word)	0	-	-	R/W	No	0	-
D1933	Present command position of the Y-axis (Unit) (High word)							
D1934	Present command speed of the Y-axis (Unit) (Low word)	0	0	0	R/W	No	0	-
D1935	Present command speed of the Y-axis (Unit) (High word)							
D1936*	State of the Y-axis	0	-	-	R	No	0	3-43
D1937*	Y-axis error code	0	-	-	R	No	0	3-39
D1938	Electronic gear ratio of the Y-axis (Numerator)	-	-	-	R/W	Yes	1	-
D1939	Electronic gear ratio of the Y-axis (Denominator)	-	-	-	R/W	Yes	1	-
D1940	Frequency of pulses generated by the manual pulse generator for the Y-axis (Low word)	0	-	0	R/W	No	0	-
D1941	Frequency of pulses generated by the manual pulse generator for the Y-axis (High word)							
D1942	Number of pulses generated by the manual pulse generator for the Y-axis (Low word)	0	-	-	R/W	No	0	-
D1943	Number of pulses generated by the manual pulse generator for the X-axis (High word)							
D1944	Response speed of the manual pulse generator for the Y-axis	-	-	-	R/W	Yes	5	-
D1946	Electrical zero of the Y-axis (Low word)	-	-	-	R/W	Yes	0	-
D1947	Electrical zero of the Y-axis (High word)							
D1955*	Starting the Y-axis manually (ZRN, MPG, JOG-, JOG+)	-	-	-	R/W	Yes	4	-
D1976	Setting the parameters of the Z-axis	-	-	-	R/W	Yes	0	3-40
D1978	Number of pulses it takes for the motor of the Z-axis to rotate once (Low word)	-	-	-	R/W	Yes	2000	-
D1979	Number of pulses it takes for the motor of the Z-axis to rotate once (High word)							
D1980	Distance generated after the motor of the Z-axis rotate once (Low word)	-	-	-	R/W	Yes	1000	-
D1981	Distance generated after the motor of the Z-axis rotate once (High word)							
D1982	Maximum speed (V_{MAX}) at which the Z-axis rotates (Low word)	-	-	-	R/W	Yes	500K	-
D1983	Maximum speed (V_{MAX}) at which the Z-axis rotates (High word)							
D1984	Start-up speed (V_{BIAS}) at which the Z-axis rotates (Low word)	-	-	-	R/W	Yes	0	-
D1985	Start-up speed (V_{BIAS}) at which the Z-axis rotates (High word)							
D1986	JOG speed (V_{JOG}) at which the Z-axis rotates (Low word)	-	-	-	R/W	Yes	5000	-
D1987	JOG speed (V_{JOG}) at which the Z-axis rotates (High word)							

Special D device	Function	Off ⇩ On	STOP ⇩ RUN	RUN ⇩ STOP	Attribute	Latching	Default	Page
D1988	Speed (V_{RT}) at which the Z-axis returns home (Low word)	-	-	-	R/W	Yes	50K	-
D1989	Speed (V_{RT}) at which the Z-axis returns home (High word)							
D1990	Speed (V_{CR}) to which the speed of the Z-axis decreases when the axis returns home (Low word)	-	-	-	R/W	Yes	1000	-
D1991	Speed (V_{CR}) to which the speed of the Z-axis decreases when the axis returns home (High word)							
D1992	Number of PG0 pulses for the Z-axis	-	-	-	R/W	Yes	0	-
D1993	Supplementary pulses for the Z-axis	-	-	-	R/W	Yes	0	-
D1994	Home position of the Z-axis (Low word)	-	-	-	R/W	Yes	0	-
D1995	Home position of the Z-axis (High word)							
D1996	Time (T_{ACC}) it takes for the Z-axis to accelerate	-	-	-	R/W	Yes	500	-
D1997	Time (T_{DEC}) it takes for the Z-axis to decelerate	-	-	-	R/W	Yes	500	-
D1998	Target position of the Z-axis (P (I)) (Low word)	0	-	-	R/W	No	0	-
	Pulse width for the Z-axis (Low word)	0	-	-	R/W	No	0	-
D1999	Target position of the Z-axis (P (I)) (High word)	0	-	-	R/W	No	0	-
	Pulse width for the Z-axis (High word)	0	-	-	R/W	No	0	-
D2000	Speed at which the Z-axis rotates (V (I)) (Low word)	1000	-	-	R/W	No	1000	-
D2001	Speed at which the Z-axis rotates (V (I)) (High word)							
D2002	Target position of the Z-axis (P (II)) (Low word)	0	-	-	R/W	No	0	-
	Output period for the Z-axis (Low word)	0	-	-	R/W	No	0	-
D2003	Target position of the Z-axis (P (II)) (High word)	0	-	-	R/W	No	0	-
	Output period for the Z-axis (High word)	0	-	-	R/W	No	0	-
D2004	Speed at which the Z-axis rotates (V (II)) (Low word)	2000	-	-	R/W	No	2K	-
D2005	Speed at which the Z-axis rotates (V (II)) (High word)							
D2006	Z-axis: Operation command	0	-	0	R/W	No	0	3-42
D2007	Z-axis: Mode of operation	0	-	-	R/W	No	0	3-42
D2008	Present command position of the Z-axis (Pulse) (Low word)	0	-	-	R/W	No	0	-
D2009	Present command position of the Z-axis (Pulse) (High word)							
D2010	Present command speed of the Z-axis (PPS) (Low word)	0	0	0	R/W	No	0	-
D2011	Present command speed of the Z-axis (PPS) (High word)							
D2012	Present command position of the Z-axis (Unit) (Low word)	0	-	-	R/W	No	0	-
D2013	Present command position of the Z-axis (Unit) (High word)							
D2014	Present command speed of the Z-axis (Unit) (Low word)	0	0	0	R/W	No	0	-
D2015	Present command speed of the Z-axis (Unit) (High word)							
D2016	State of the Z-axis	0	-	-	R	No	0	3-43
D2017*	Z-axis error code	0	-	-	R	No	0	3-39
D2018	Electronic gear ratio of the Z-axis (Numerator)	-	-	-	R/W	Yes	1	-
D2019	Electronic gear ratio of the Z-axis (Denominator)	-	-	-	R/W	Yes	1	-
D2020	Frequency of pulses generated by the manual pulse generator for the Z-axis (Low word)	0	-	0	R/W	No	0	-
D2021	Frequency of pulses generated by the manual pulse generator for the Z-axis (High word)							
D2022	Number of pulses generated by the manual pulse generator for the Z-axis (Low word)	0	-	-	R/W	No	0	-
D2023	Number of pulses generated by the manual pulse generator for the Z-axis (High word)							
D2024	Response speed of the manual pulse generator for the Z-axis	-	-	-	R/W	Yes	5	-
D2026	Electrical zero of the Z-axis (Low word)	-	-	-	R/W	Yes	0	-
D2027	Electrical zero of the Z-axis (High word)							
D2029	Step address in the Oz motion subroutine at which an error occurs (reserved, not available presently)	-	-	-	R/W	Yes	0	-
D2056	Setting the parameters of the A-axis	-	-	-	R/W	Yes	0	3-40
D2058	Number of pulses it takes for the motor of the A-axis to rotate once (Low word)	-	-	-	R/W	Yes	2000	-
D2059	Number of pulses it takes for the motor of the A-axis to rotate once (High word)							

Special D device	Function	Off ⇩ On	STOP ⇩ RUN	RUN ⇩ STOP	Attribute	Latching	Default	Page
D2060	Distance generated after the motor of the A-axis rotate once (Low word)	-	-	-	R/W	Yes	1000	-
D2061	Distance generated after the motor of the A-axis rotate once (High word)							
D2062	Maximum speed (V_{MAX}) at which the A-axis rotates (Low word)	-	-	-	R/W	Yes	500K	-
D2063	Maximum speed (V_{MAX}) at which the A-axis rotates (High word)							
D2064	Start-up speed (V_{BIAS}) at which the A-axis rotates (Low word)	-	-	-	R/W	Yes	0	-
D2065	Start-up speed (V_{BIAS}) at which the A-axis rotates (High word)							
D2066	JOG speed (V_{JOG}) at which the A-axis rotates (Low word)	-	-	-	R/W	Yes	5000	-
D2067	JOG speed (V_{JOG}) at which the A-axis rotates (High word)							
D2068	Speed (V_{RT}) at which the A-axis returns home (Low word)	-	-	-	R/W	Yes	50K	-
D2069	Speed (V_{RT}) at which the A-axis returns home (High word)							
D2070	Speed (V_{CR}) to which the speed of the A-axis decreases when the axis returns home (Low word)	-	-	-	R/W	Yes	1000	-
D2071	Speed (V_{CR}) to which the speed of the A-axis decreases when the axis returns home (High word)							
D2072	Number of PG0 pulses for the A-axis	-	-	-	R/W	Yes	0	-
D2073	Supplementary pulses for the A-axis	-	-	-	R/W	Yes	0	-
D2074	Home position of the A-axis (Low word)	-	-	-	R/W	Yes	0	-
D2075	Home position of the A-axis (High word)	-	-	-	R/W	Yes	0	-
D2076	Time (T_{ACC}) it takes for the A-axis to accelerate	-	-	-	R/W	Yes	500	-
D2077	Time (T_{DEC}) it takes for the A-axis to decelerate	-	-	-	R/W	Yes	500	-
D2078	Target position of the A-axis (P (I)) (Low word)	0	-	-	R/W	No	0	-
	Pulse width for the A-axis (Low word)	0	-	-	R/W	No	0	-
D2079	Target position of the A-axis (P (I)) (High word)	0	-	-	R/W	No	0	-
	Pulse width for the A-axis (High word)	0	-	-	R/W	No	0	-
D2080	Speed at which the A-axis rotates (V (I)) (Low word)	1000	-	-	R/W	No	1000	-
D2081	Speed at which the A-axis rotates (V (I)) (High word)							
D2082	Target position of the A-axis (P (II)) (Low word)	0	-	-	R/W	No	0	-
	Output period for the A-axis (Low word)	0	-	-	R/W	No	0	-
D2083	Target position of the A-axis (P (II)) (High word)	0	-	-	R/W	No	0	-
	Output period for the A-axis (High word)	0	-	-	R/W	No	0	-
D2084	Speed at which the A-axis rotates (V (II)) (Low word)	2000	-	-	R/W	No	2K	-
D2085	Speed at which the A-axis rotates (V (II)) (High word)							
D2086	A-axis: Operation command	0	-	0	R/W	No	0	3-42
D2087	A-axis: Mode of operation	0	-	-	R/W	No	0	3-42
D2088	Present command position of the A-axis (Pulse) (Low word)	0	-	-	R/W	No	0	-
D2089	Present command position of the A-axis (Pulse) (High word)							
D2090	Present command speed of the A-axis (PPS) (Low word)	0	0	0	R/W	No	0	-
D2091	Present command speed of the A-axis (PPS) (High word)							
D2092	Present command position of the A-axis (Unit) (Low word)	0	-	-	R/W	No	0	-
D2093	Present command position of the A-axis (Unit) (High word)							
D2094	Present command speed of the A-axis (Unit) (Low word)	0	0	0	R/W	No	0	-
D2095	Present command speed of the A-axis (Unit) (High word)							
D2096	State of the A-axis	0	-	-	R	No	0	3-43
D2097*	A-axis error code	0	-	-	R	No	0	3-39
D2098	Electronic gear ratio of the A-axis (Numerator)	-	-	-	R/W	Yes	1	-
D2099	Electronic gear ratio of the A-axis (Denominator)	-	-	-	R/W	Yes	1	-
D2100	Frequency of pulses generated by the manual pulse generator for the A-axis (Low word)	0	-	0	R/W	No	0	-
D2101	Frequency of pulses generated by the manual pulse generator for the A-axis (High word)	0	-	0	R/W	No	0	-
D2102	Number of pulses generated by the manual pulse generator for the A-axis (Low word)	0	-	-	R/W	No	0	-

Special D device	Function	Off ⇩ On	STOP ⇩ RUN	RUN ⇩ STOP	Attribute	Latching	Default	Page
D2103	Number of pulses generated by the manual pulse generator for the A-axis (High word)	0	-	-	R/W	No	0	-
D2104	Response speed of the manual pulse generator for the A-axis	-	-	-	R/W	Yes	5	-
D2136	Setting the parameters of the B-axis	-	-	-	R/W	Yes	0	3-40
D2138	Number of pulses it takes for the motor of the B-axis to rotate once (Low word)	-	-	-	R/W	Yes	2000	-
D2139	Number of pulses it takes for the motor of the B-axis to rotate once (High word)	-	-	-	R/W	Yes	2000	-
D2140	Distance generated after the motor of the B-axis rotate once (Low word)	-	-	-	R/W	Yes	1000	-
D2141	Distance generated after the motor of the B-axis rotate once (High word)				R/W	Yes	1000	
D2142	Maximum speed (V_{MAX}) at which the B-axis rotates (Low word)	-	-	-	R/W	Yes	500K	-
D2143	Maximum speed (V_{MAX}) at which the B-axis rotates (High word)	-	-	-	R/W	Yes	500K	
D2144	Start-up speed (V_{BIAS}) at which the B-axis rotates (Low word)	-	-	-	R/W	Yes	0	-
D2145	Start-up speed (V_{BIAS}) at which the B-axis rotates (High word)				R/W	Yes	0	
D2146	JOG speed (V_{JOG}) at which the B-axis rotates (Low word)	-	-	-	R/W	Yes	5000	-
D2147	JOG speed (V_{JOG}) at which the B-axis rotates (High word)				R/W	Yes	5000	
D2148	Speed (V_{RT}) at which the B-axis returns home (Low word)	-	-	-	R/W	Yes	50K	-
D2149	Speed (V_{RT}) at which the B-axis returns home (High word)	-	-	-	R/W	Yes	50K	-
D2150	Speed (V_{CR}) to which the speed of the B-axis decreases when the axis returns home (Low word)	-	-	-	R/W	Yes	1000	-
D2151	Speed (V_{CR}) to which the speed of the B-axis decreases when the axis returns home (High word)	-	-	-	R/W	Yes	1000	-
D2152	Number of PG0 pulses for the B-axis	-	-	-	R/W	Yes	0	-
D2153	Supplementary pulses for the B-axis	-	-	-	R/W	Yes	0	-
D2154	Home position of the B-axis (Low word)	-	-	-	R/W	Yes	0	-
D2155	Home position of the B-axis (High word)	-	-	-	R/W	Yes	0	-
D2156	Time (T_{ACC}) it takes for the B-axis to accelerate	-	-	-	R/W	Yes	500	-
D2157	Time (T_{DEC}) it takes for the B-axis to decelerate	-	-	-	R/W	Yes	500	-
D2158	Target position of the B-axis (P (I)) (Low word)	0	-	-	R/W	No	0	-
D2159	Target position of the B-axis (P (I)) (High word)	0	-	-	R/W	No	0	-
D2160	Speed at which the B-axis rotates (V (I)) (Low word)	1000	-	-	R/W	No	1000	-
D2161	Speed at which the B-axis rotates (V (I)) (High word)	1000	-	-	R/W	No	1000	-
D2162	Target position of the B-axis (P (II)) (Low word)	0	-	-	R/W	No	0	-
D2163	Target position of the B-axis (P (II)) (High word)	0	-	-	R/W	No	0	-
D2164	Speed at which the B-axis rotates (V (II)) (Low word)	2000	-	-	R/W	No	2K	-
D2165	Speed at which the B-axis rotates (V (II)) (High word)	2000	-	-	R/W	No	2K	-
D2166	B-axis: Operation command	0	-	0	R/W	No	0	3-42
D2167	B-axis: Mode of operation	0	-	-	R/W	No	0	3-42
D2168	Present command position of the B-axis (Pulse) (Low word)	0	-	-	R/W	No	0	-
D2169	Present command position of the B-axis (Pulse) (High word)	0	-	-	R/W	No	0	-
D2170	Present command speed of the B-axis (PPS) (Low word)	0	0	0	R/W	No	0	-
D2171	Present command speed of the B-axis (PPS) (High word)	0	0	0	R/W	No	0	-
D2172	Present command position of the B-axis (Unit) (Low word)	0	-	-	R/W	No	0	-
D2173	Present command position of the B-axis (Unit) (High word)	0	-	-	R/W	No	0	-
D2174	Present command speed of the B-axis (Unit) (Low word)	0	0	0	R/W	No	0	-
D2175	Present command speed of the B-axis (Unit) (High word)	0	0	0	R/W	No	0	-
D2176	State of the B-axis	0	-	-	R	No	0	3-43
D2177	B-axis error code	0	-	-	R	No	0	3-39
D2178	Electronic gear ratio of the B-axis (Numerator)	-	-	-	R/W	Yes	1	-
D2179	Electronic gear ratio of the B-axis (Denominator)	-	-	-	R/W	Yes	1	-
D2180	Frequency of pulses generated by the manual pulse generator for the B-axis (Low word)	0	-	0	R/W	No	0	-

Special D device	Function	Off ⇩ On	STOP ⇩ RUN	RUN ⇩ STOP	Attribute	Latching	Default	Page
D2181	Frequency of pulses generated by the manual pulse generator for the B-axis (High word)	0	-	0	R/W	No	0	-
D2182	Number of pulses generated by the manual pulse generator for the B-axis (Low word)	0	-	-	R/W	No	0	-
D2183	Number of pulses generated by the manual pulse generator for the B-axis (High word)	0	-	-	R/W	No	0	-
D2184	Response speed of the manual pulse generator for the B-axis	-	-	-	R/W	Yes	5	-
D2216	Setting the parameters of the C-axis	-	-	-	R/W	Yes	0	3-40
D2218	Number of pulses it takes for the motor of the C-axis to rotate once (Low word)	-	-	-	R/W	Yes	2000	-
D2219	Number of pulses it takes for the motor of the C-axis to rotate once (High word)	-	-	-	R/W	Yes	2000	-
D2220	Distance generated after the motor of the C-axis rotate once (Low word)	-	-	-	R/W	Yes	1000	-
D2221	Distance generated after the motor of the C-axis rotate once (High word)	-	-	-	R/W	Yes	1000	-
D2222	Maximum speed (V_{MAX}) at which the C-axis rotates (Low word)	-	-	-	R/W	Yes	500K	-
D2223	Maximum speed (V_{MAX}) at which the C-axis rotates (High word)	-	-	-	R/W	Yes	500K	-
D2224	Start-up speed (V_{BIAS}) at which the C-axis rotates (Low word)	-	-	-	R/W	Yes	0	-
D2225	Start-up speed (V_{BIAS}) at which the C-axis rotates (High word)	-	-	-	R/W	Yes	0	-
D2226	JOG speed (V_{JOG}) at which the C-axis rotates (Low word)	-	-	-	R/W	Yes	5000	-
D2227	JOG speed (V_{JOG}) at which the C-axis rotates (High word)	-	-	-	R/W	Yes	5000	-
D2228	Speed (V_{RT}) at which the C-axis returns home (Low word)	-	-	-	R/W	Yes	50K	-
D2229	Speed (V_{RT}) at which the C-axis returns home (High word)	-	-	-	R/W	Yes	50K	-
D2230	Speed (V_{CR}) to which the speed of the C-axis decreases when the axis returns home (Low word)	-	-	-	R/W	Yes	1000	-
D2231	Speed (V_{CR}) to which the speed of the C-axis decreases when the axis returns home (High word)	-	-	-	R/W	Yes	1000	-
D2232	Number of PG0 pulses for the C-axis	-	-	-	R/W	Yes	0	-
D2233	Supplementary pulses for the C-axis	-	-	-	R/W	Yes	0	-
D2234	Home position of the C-axis (Low word)	-	-	-	R/W	Yes	0	-
D2235	Home position of the C-axis (High word)	-	-	-	R/W	Yes	0	-
D2236	Time (T_{ACC}) it takes for the C-axis to accelerate	-	-	-	R/W	Yes	500	-
D2237	Time (T_{DEC}) it takes for the C-axis to decelerate	-	-	-	R/W	Yes	500	-
D2238	Target position of the C-axis (P (I)) (Low word)	0	-	-	R/W	No	0	-
D2239	Target position of the C-axis (P (I)) (High word)	0	-	-	R/W	No	0	-
D2240	Speed at which the C-axis rotates (V (I)) (Low word)	1000	-	-	R/W	No	1000	-
D2241	Speed at which the C-axis rotates (V (I)) (High word)	1000	-	-	R/W	No	1000	-
D2242	Target position of the C-axis (P (II)) (Low word)	0	-	-	R/W	No	0	-
D2243	Target position of the C-axis (P (II)) (High word)	0	-	-	R/W	No	0	-
D2244	Speed at which the C-axis rotates (V (II)) (Low word)	2000	-	-	R/W	No	2K	-
D2245	Speed at which the C-axis rotates (V (II)) (High word)	2000	-	-	R/W	No	2K	-
D2246	C-axis: Operation command	0	-	0	R/W	No	0	-
D2247	C-axis: Mode of operation	0	-	-	R/W	No	0	3-42
D2248	Present command position of the C-axis (Pulse) (Low word)	0	-	-	R/W	No	0	-
D2249	Present command position of the C-axis (Pulse) (High word)	0	-	-	R/W	No	0	-
D2250	Present command speed of the C-axis (PPS) (Low word)	0	0	0	R/W	No	0	-
D2251	Present command speed of the C-axis (PPS) (High word)	0	0	0	R/W	No	0	-
D2252	Present command position of the C-axis (Unit) (Low word)	0	-	-	R/W	No	0	-
D2253	Present command position of the C-axis (Unit) (High word)	0	-	-	R/W	No	0	-
D2254	Present command speed of the C-axis (Unit) (Low word)	0	0	0	R/W	No	0	-
D2255	Present command speed of the C-axis (Unit) (High word)	0	0	0	R/W	No	0	-
D2256	State of the C-axis	0	-	-	R	No	0	3-43
D2257	C-axis error code	0	-	-	R	No	0	3-39
D2258	Electronic gear ratio of the C-axis (Numerator)	-	-	-	R/W	Yes	1	-

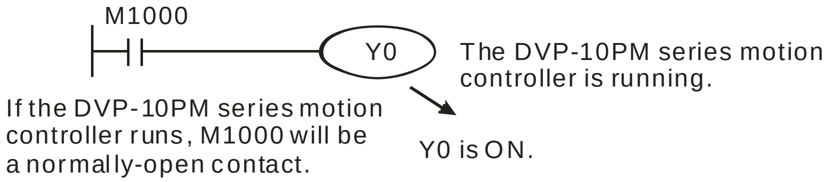
Special D device	Function	Off ⇩ On	STOP ⇩ RUN	RUN ⇩ STOP	Attribute	Latching	Default	Page
D2259	Electronic gear ratio of the C-axis (Denominator)	-	-	-	R/W	Yes	1	-
D2260	Frequency of pulses generated by the manual pulse generator for the C-axis (Low word)	0	-	0	R/W	No	0	-
D2261	Frequency of pulses generated by the manual pulse generator for the C-axis (High word)	0	-	0	R/W	No	0	-
D2262	Number of pulses generated by the manual pulse generator for the C-axis (Low word)	0	-	-	R/W	No	0	-
D2263	Number of pulses generated by the manual pulse generator for the C-axis (High word)	0	-	-	R/W	No	0	-
D2264	Response speed of the manual pulse generator for the C-axis	-	-	-	R/W	Yes	5	-

3.11 Functions of Special Auxiliary Relays and Special Data Registers

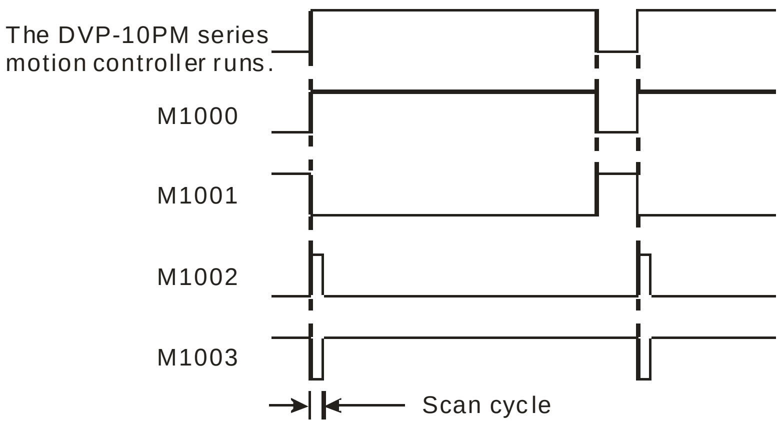
Operation flags

M1000~M1003

1. M1000: If the DVP-10PM series motion controller runs, M1000 will be a normally-open contact (Form A contact). When the DVP-10PM series motion controller runs, M1000 is ON.



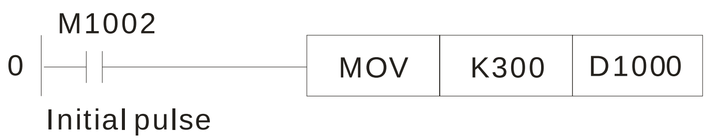
2. M1001: If the DVP-10PM series motion controller runs, M1001 will be a normally-closed contact (Form B contact). When the DVP-10PM series motion controller runs, M1001 is OFF.
3. M1002: A positive-going pulse is generated at the time when the DVP-10PM series motion controller runs. The width of the pulse is equal to the scan cycle. If users want to initialize the DVP-10PM series motion controller, they can use the contact.
4. M1003: A negative-going pulse is generated at the time when the DVP-10PM series motion controller runs. The width of the pulse is equal to the scan cycle.



Watchdog timer

D1000

1. The watchdog timer is used to monitor a scan cycle. If the scan cycle is greater than the watchdog timer value, the ERROR LED indicator on the DVP-10PM series motion controller will be turned ON, and all the output devices will be turned OFF.
2. The watchdog timer is initailly set to 200. If the program is long, or the operation is complex, users can change the watchdog timer value by means of the instruction MOV. In the example below, the watchdog timer value is changed to 300.

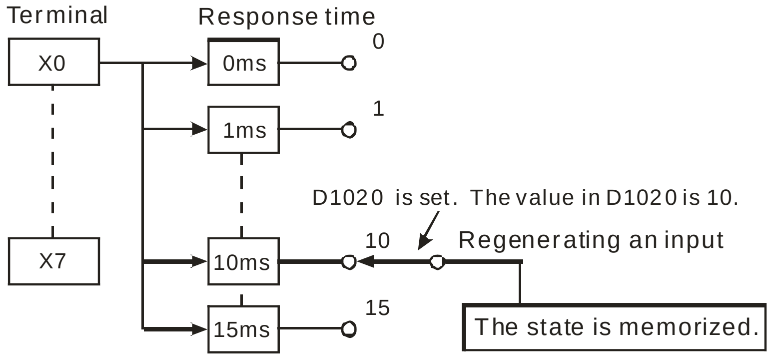


3. The maximum value which can be stored in the watchdog timer is 32,767. However, the larger the watchdog timer value is, the more time it takes to detect any operation error. As a result, if there is no complex operation resulting in a scan cycle longer than 200 milliseconds, it is suggested that the watchdog timer value should be less than 200.
4. If an opration is complex, the scan cycle may be long. Users can check whether the scan cycle is greater than the value stored in D1000 by monitoring D1010~D1012. If the scan cycle is greater than the value stored in D1000, the users can change the value in D1000.

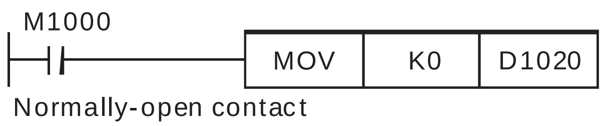
Input filter

D1020

1. Users can set the time it takes for the input terminals X0~X7 to respond by setting D1020. The value in D1020 must be in the range of 0 to 20. (Unit: ms)
2. If the DVP-10PM series motion controller is turned form OFF to ON, the value in S D1020 will automatically become 10.



3. If the program below is executed, the time is takes for the input terminals X0~X7 to respond will be 0 milliseconds. Owing to the fact that the input terminals are connected to resistor-capacitor circuits in series, the shortest time it takes for the input terminals to respond is 50 microseconds.



4. If high-spedd counters and interrupts are used in a program, the value in D1020 does not have any effect.

Communication port

M1120, M1136, M1138, M1139, M1143, D1036, D1109, and D1120

The communication ports with which a DVP-10PM series motion controller is equipped are COM1 (RS-232 port) and COM2 (RS-485 port). They support Modbus ASCII/RTU. The maximum speed available is 115,200 bps. COM3 (RS-232/RS-485 communication card) supports Modbus ASCII. The maximum speed available is 38,400 bps. COM1, COM2, and COM3 can be used simultaneously.

COM1 COM1 can only be used as a slave station. It supports ASCII/RTU, and the adjustment of a communication speed. The maximum speed available is 115,200 bps. It supports the modification of the number of data bits.

COM2 COM2 can be used as a master station or a slave station. It supports ASCII/RTU, and the adjustment of a communication speed. The maximum speed available is 115,200 bps. It supports the modification of the number of data bits.

COM3 COM3 can only be used as a slave station. It supports the ASCII communication format 7, E, 1 (7 data bits, even parity bit, 1 stop bit), and the adjustment of a communication speed. The maximum speed available is 38,400 bps. COM2 and COM3 can not be used as slave stations simultaneously.

◎ Setting a communication format:

COM1
1. D1036 is used to set a communication format. Bit 8~bit 15 in D1036 do not support the setting of a communicaiton format.
2. M1138: The setting of the communication through COM1 is retained.
3. M1139: Selecting an ASCII mode or an RTU mode

COM2
1. D11120 is used to set a communication format.
2. M1120: The setting of the communication through COM2 is retained.
3. M1143: Selecting an ASCII mode or an RTU mode

COM3
1. D1109 is used to set a communication format. Bit 0~bit 3 and Bit 8~bit 15 in D1036 do not support the setting of a communicaiton format.
2. M1136: The setting of the communication through COM3 is retained.

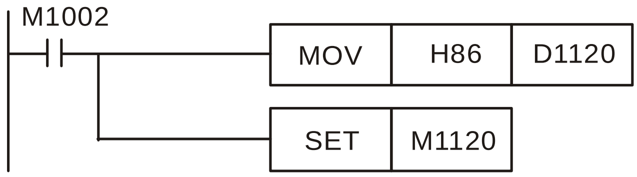
Communication format:

	Contents	0	1
b0	Data length	b0=0: 7	b0=1: 8
b1 b2	Parity bit	b2, b1=00	: None
		b2, b1=01	: Odd
		b2, b1=11	: Even
b3	Stop bit	b3=0: 1 bit	b3=1: 2 bits
b7~b4	b7~b4=0001 (H1)	: 110	bps
	b7~b4=0010 (H2)	: 150	bps
	b7~b4=0011 (H3)	: 300	bps
	b7~b4=0100 (H4)	: 600	bps
	b7~b4=0101 (H5)	: 1,200	bps
	b7~b4=0110 (H6)	: 2,400	bps
	b7~b4=0111 (H7)	: 4,800	bps
	b7~b4=1000 (H8)	: 9,600	bps
	b7~b4=1001 (H9)	: 19,200	bps
	b7~b4=1010 (HA)	: 38,400	bps
	b7~b4=1011 (HB)	: 57,600	bps
	b7~b4=1100 (HC)	: 115,200	bps
b8	Start character	b8=0: None	b8=1: D1124
b9	First terminator	b9=0: None	b9=1: D1125
b10	Second terminator	b10=0: None	b10=1: D1126
b15~b11	Undefined		

Example 1: Modifying the communication format of COM2

If users want to modify the communication format of COM2 on a DVP-10PM series motion controller, they have to add the program shown below to the top of the program in the DVP-10PM series motion controller. After the STOP/RUN switch on the DVP-10PM series motion controller is turned from the STOP position to the RUN position, the state of M1120 will be detected during the first scan cycle. If M1120 is ON, the setting of COM2 will be changed in accordance with the value in D1120.

The communication format of COM2 is changed to the ASCII format 9600, 7, E 1 (9,600bps, 7 data bits, even parity bit, 1 stop bit).



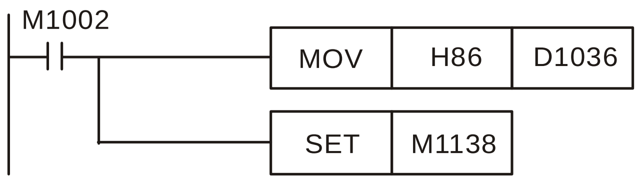
Notes:

1. If COM2 on a DVP-10PM series motion controller is used as a slave station, no communication instruction can exist in the program in the DVP-10PM series motion controller.
2. If the STOP/RUN switch on a DVP-10PM series motion controller is turned from the RUN position to the STOP position after the communication format of COM2 is modified, the new communication format of COM2 will not be changed.
3. If users disconnect a DVP-10PM series motion controller and then power it up after they modify the communication format of COM2, the new communication format of COM2 will be restored to its factory setting.

Example 2: Modifying the communication format of COM1

If users want to modify the communication format of COM1 on a DVP-10PM series motion controller, they have to add the program shown below to the top of the program in the DVP-10PM series motion controller. After the STOP/RUN switch on the DVP-10PM series motion controller is turned from the STOP position to the RUN position, the state of M1138 will be detected during the first scan cycle. If M1138 is ON, the setting of COM1 will be changed in accordance with the value in D1036.

The communication format of COM1 is changed to the ASCII format 9600, 7, E 1 (9,600bps, 7 data bits, even parity bit, 1 stop bit).



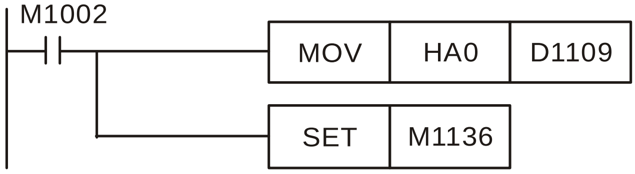
Notes:

1. If the STOP/RUN switch on a DVP-10PM series motion controller is turned from the RUN position to the STOP position after the communication format of COM1 is modified, the new communication format of COM1 will not be changed.
2. If users disconnect a DVP-10PM series motion controller and then power it up after they modify the communication format of COM1, the new communication format of COM1 will be restored to its factory setting.

Example 3: Modifying the communication format of COM3

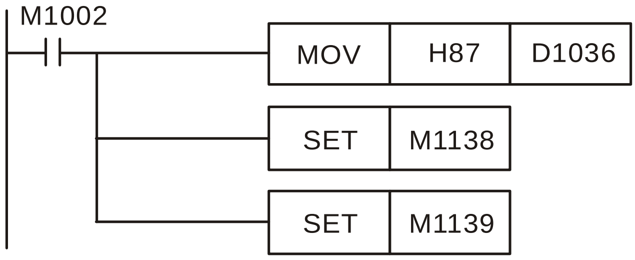
The communication format of COM3 is 7, E 1 (7 data bits, even parity bit, 1 stop bit). If users want to change the communication speed of COM3 on a DVP-10PM series motion controller to 38,400 bps, they have to add the program shown below to the top of the program in the DVP-10PM series motion controller. After the STOP/RUN switch on the DVP-10PM series motion controller is turned from the STOP position to the RUN position, the state of M1136 will be detected during the first scan cycle. If M1136 is ON, the setting of COM3 will be changed in accordance with the value in D1109.

The communication speed of COM3 is changed to 38,400 bps.

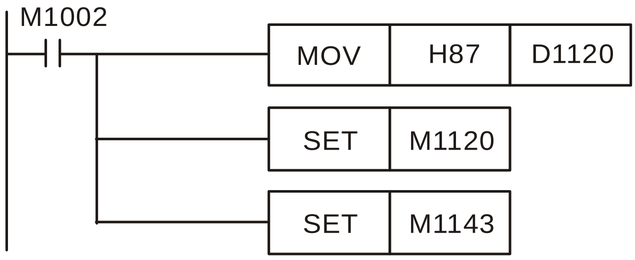


Example 4: Using COM1/COM2 in an RTU mode

COM1: (9,600, 8, E, 1, RTU)



COM2: (9,600, 8, E, 1, RTU)



Communication timeout

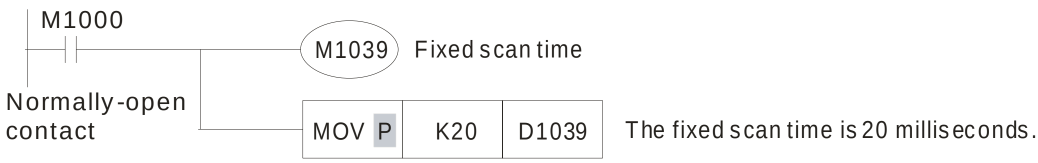
D1038

If an RS-485 port on a DVP-10PM series motion controller functions as a slave station, users can set a communication timeout. The value in D1038 is in the range of 0 to 3,000 (0 to 30 seconds). The unit used is 10 milliseconds. If the value in D1038 is not in the range of 0 to 3,000, the value in D1038 will become 0. The value in D1038 must be less than the value in D1000.

Fixed scan time

M1039 and D1039

1. If M1039 is ON, the time it takes for the program to be scanned will depend on the value in D1039. If the execution of a program is complete, the program will not be scanned again until the fixed scan time set elapses. If the value in D1039 is less than the time it takes for a program to be scanned, the time it takes for a program to be scanned, will be given priority.



2. The values stored in D1010~D1012 include the value stored in D1039.

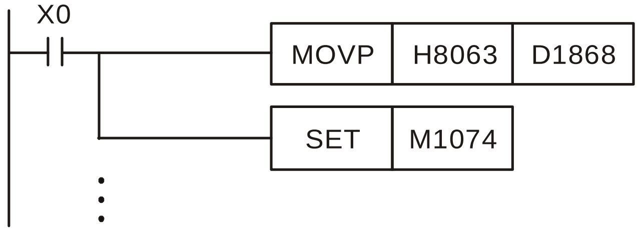
Setting an OX motion subroutine number

M1074 and D1868

Users can specify an Ox motion subroutine by setting D1868. The steps of setting D1868 are as follows.

1. The users have to set bit 14 in D1868 to 1, set bit 15 in D1868 to 1, or set bit 14 and bit 15 in D1868 to 1. Besides, the users have to write K99 (H63) into bit 0~bit 13 in D1868, that is, the Ox motion subroutine number specified is Ox99. To sum up, the users have to write H8063 into D1868.
2. After M1074 is set to ON, the Ox motion subroutine specified by D1868 will be executed.

The program is shown below.



In the main program O100, X0 starts the motion subroutine Ox99.

High-speed counting

M1200 and C200
M1204 and C204
M1208 and C208
M1212 and C212
M1216 and C216
M1220 and C220

There are six high-speed counters.

Number	Counter number	Mode of counting		External resetting terminal	External input terminal
		Device	Setting value		
1	C200	K1M1200	0: U/D* 1: P/D* 2: A/B* (One time the frequency of A/B-phase inputs) 3: 4A/B (Four times the frequency of A/B-phase inputs)	X10/M1203	X0, X1, and S/S
2	C204	K1M1204		X11/M1207	X2, X3, and S/S
3	C208	K1M1208		X12/M1211	X4, X5, and S/S
4	C212	K1M1212		X13/M1215	X6, X7, and S/S
5	C216	K1M1216		X0/M1219	X10+, X10-, X11+, and X11-
6	C220	K1M1220		X1/M1223	X12+, X12-, X13+, and X13-

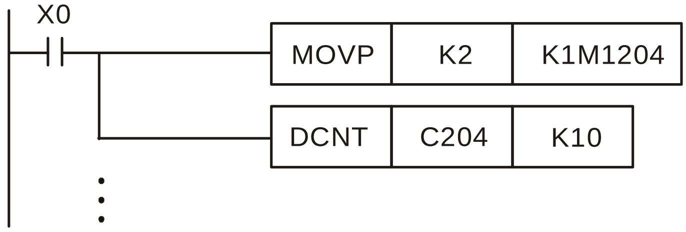
*1. U/D: Counting up/Counting down; P/D: Pulse/Direction; A/B: A phase/B phase

*2. The input terminals of the first counter~the fourth counter are transistors whose collectors are open collectors. The input terminals of the fifth counter~the sixth counter are differential input terminals.

The steps of setting the second counter are as follows.

1. Write K2 into K1M1204.
2. Enable C204.

   The program for step 1 and step 2 is shown below.

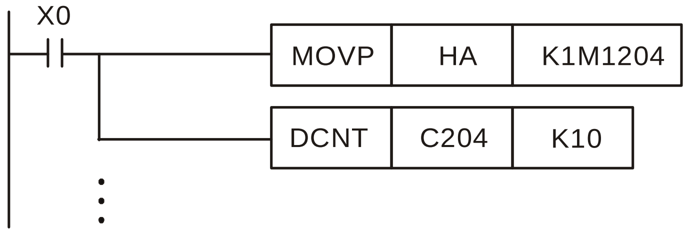


3. If users want to clear the present counter value by means of an external signal, they have to write HA into K1M1024.

M1027	M1026	M1025	M1204
1	0	1	0

4. C204 is enabled. If X11 is ON, the present value of C204 will become zero.

   The program for step 3 and step 4 is shown below.



High-speed timing

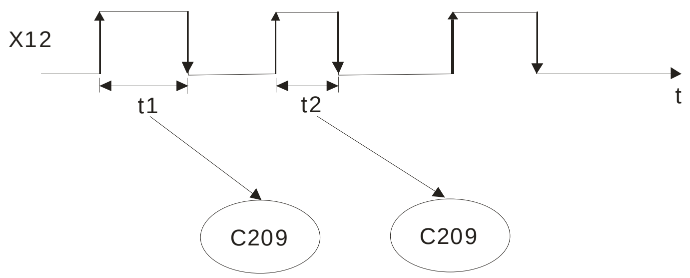
M1200 and C201
M1204 and C205
M1208 and C209
M1212 and C213
M1216 and C217
M1220 and C221

There are six high-speed timers.

<table>
<tr><th rowspan="2">Number</th><th rowspan="2">Counter</th><th colspan="2">Mode of measuring time</th><th rowspan="2">External signal</th><th rowspan="2">Storage device</th></tr>
<tr><th>Device</th><th>Setting value</th></tr>
<tr><td>1</td><td>C200</td><td>K1M1200</td><td rowspan="6"><table><tr><td>Bit3</td><td>Bit2</td><td>Bit1</td><td>Bit0</td></tr><tr><td>x</td><td>Enabling a timer</td><td>x</td><td>Selecting a mode</td></tr></table>Bit2: Enabling a timer
Bit0: (1) 0: General mode (The interval between the rising edge of a pulse and the falling edge of the pulse is measured.)
(2) 1: Cyclic mode (The interval between the rising edge of a pulse and the rising edge of the next pulse is measured.)</td><td>X10</td><td>C201</td></tr>
<tr><td>2</td><td>C204</td><td>K1M1204</td><td>X11</td><td>C205</td></tr>
<tr><td>3</td><td>C208</td><td>K1M1208</td><td>X12</td><td>C209</td></tr>
<tr><td>4</td><td>C212</td><td>K1M1212</td><td>X13</td><td>C213</td></tr>
<tr><td>5</td><td>C216</td><td>K1M1216</td><td>X0</td><td>C217</td></tr>
<tr><td>6</td><td>C220</td><td>K1M1220</td><td>X1</td><td>C221</td></tr>
</table>

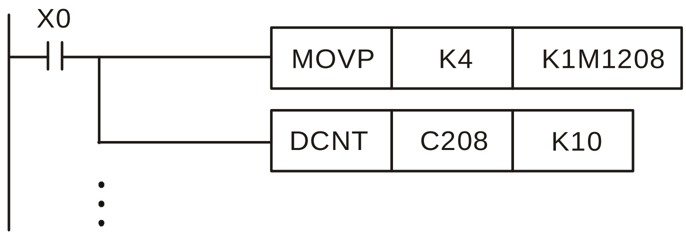
Example 1: Using the third timer in a general mode

1. Users have to select the general mode, and enable the timer, that is, they have to write K4 into K1M1208.
2. C208 is enabled. The interval between the rising edge of a pulse received through X12 and the falling edge of the pulse is measured. The interval is written into C209. (Unit: 0.01 microseconds)



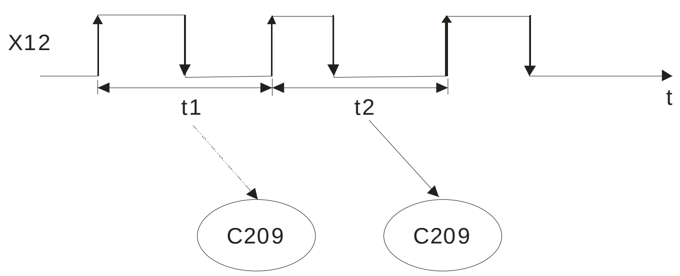
General mode
Unit: 0.01 μs

The program is shown below.



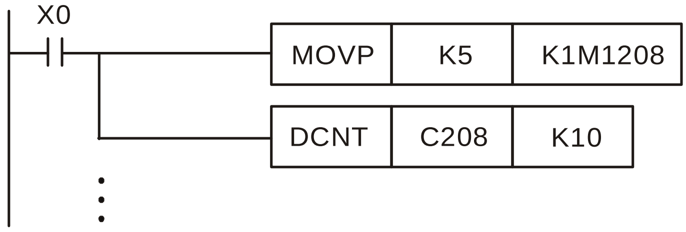
Example 2: Using the third timer in a cyclic mode

1. Users have to write K5 into K1M1208.
2. C208 is enabled. The interval between the rising edge of a pulse received through X12 and the rising edge of the next pulse is measured. The interval is written into C209. (Unit: 0.01 microseconds)



Cyclic mode
Unit: 0.01 μs

The program is shown below.



The cyclic mode is used to measure a frequency.

Detecting expansion

D1140, D1142, and D1143

1. D1140: Number of right-side modules (AD, DA, XA, PT, TC, RT, HC, PU) (8 right-side modules at most)
2. D1142: Number of X devices in a digital module
3. D1143: Number of Y devices in a digital module

Latching device range

D1200~D1211

1. Users can set latching device ranges. The devices in the range of a starting latching device address and a terminal latching device address are latching devices.
2. Please refer to section 3.1 for more information.

Turning the X devices ON/OFF

M1304

If M1304 in a DVP-10PM series motion controller is ON, the X devices in the DVP-10PM series motion controller can be turned ON/OFF by means of PMSoft.

Real-time clock

D1313~D1319

1. Special data registers which are related to the real-time clock in a DVP-10PM series motion controller

Device	Name	Function
D1313	Second	0~59
D1314	Minute	0~59
D1315	Hour	0~23
D1316	Day	1~31
D1317	Month	1~12
D1318	Week	1~7
D1319	Year	0~99 (A.D.)

2. If the value of the second in the real-time clock in a DVP-10PM series motion controller is incorrect, it will become 0. If the value of the minute in the real-time clock in a DVP-10PM series motion controller is incorrect, it will become 0. If the value of the hour in the real-time clock in a DVP-10PM series motion controller is incorrect, it will become 0. If the value of the day in the real-time clock in a DVP-10PM series motion controller is incorrect, it will become 1. If the value of the month in the real-time clock in a DVP-10PM series motion controller is incorrect, it will become 1. If the value of the week in the real-time clock in a DVP-10PM series motion controller is incorrect, it will become 1. If the value of the year in the real-time clock in a DVP-10PM series motion controller is incorrect, it will become 0.
3. The real-time clock in a DVP-10PM series motion controller is a latching device. If it is disconnected and then powered up, it will continue measuring time. It is suggested that users should calibrate the real-time clock in a DVP-10PM series motion controller after it is powered up.

Right-side special I/O module ID

D1320~D1327

1. If a DVP-10PM series motion controller is connected to special I/O modules, the IDs of the special I/O modules will be stored in D1320~D1327.
2. ID's of the special I/O modules which can be connected to a DVP-10PM series motion controller:

I/O module	ID (Hexadecimal value)	I/O module	ID (Hexadecimal value)
DVP04AD-H2	H'6400	DVP01PU-H2	H'6110
DVP04DA-H2	H'6401	DVP04PT-H2	H'6402
DVP04TC-H2	H'6403	DVP06XA-H2	H'6604
DVP-PM	H'6260	DVP01HC-H2	H'6120

Interrupt register

D1400 and D1401

1. D1400 is an interrupt register. If users set a bit in D1400 to ON, an interrupt will be enabled.

Bit#	Interrupt	Interrupt number
0	Time interrupt	I0
1	External terminal START0/X0	I1
2	External terminal STOP0/X1	I2
3	External terminal START1/X2	I3
4	External terminal STOP1/X3	I4
5	External terminal X4	I5
6	External terminal X5	I6
7	External terminal X6	I7
8	External terminal X7	I8

2. If an interrupt enabled is a time interrupt, users can write the cycle of the interrupt into D1401.
3. There are two types of interrupts.
   - External interrupt: If an interrupt is triggered by the rising edge/falling edge of a pulse received through an external terminal, the execution of the present program will stop, and the interrupt will be executed. After an interrupt is executed, the program which is executed before the interrupt is triggered will be executed.
   - Time interrupt: The execution of the present program stops at regular intervals. Whenever the execution of the present program stops, an interrupt is executed.

Clearing the M-code which is executed

M1744, M1794, and D1703

- ◆ If users want to clear the M-code in D1703, they have to set M1744 to ON. If M1744 is set to ON, the value in D1703 will be cleared, and M1794 will be reset.
- ◆ If an M code in an Ox motion subroutine is executed, M1794 will be ON. The M-code which is executed is stored in D1703.

Ready flag

M1792, M1872, M2032, M2112, M2192, and M2272

1. Every motion axis uses a ready flag. The X-axis uses M1792, the Y-axis uses M1872, the Z-axis uses M2032, the A-axis uses M2112, the B-axis uses M2192, and the C-axis uses M2272. Users can use the ready flags to judge whether the axes operate.
2. Description of the ready flag for the X-axis: Before the X-axis operates, M1792 is ON. When the X-axis operates, M1792 is OFF. After the first axis finishes operating, M1792 is ON.

Clearing the motion error

M1793 and D1857
M1873 and D1937
M2033 and D2017
M2113 and D2097
M2193 and D2177
M2273 and D2257

1. If errors occur in the X-axis, the Y-axis, the Z-axis, the A-axis, the B-axis, and the C-axis, M1793, M1873, M2033, M2113, M2193, and M2273 will be ON, and the error messages which appear will be stored in D1857, D1937, D2017, D2097, D2177, and D2257.
2. If users want to eliminate the error occuring in an axis, they have to clear the error code in the special data register corresponding to the axis, and reset the special auxiliary relay corresponding to the axis.

Setting the polarities of the input terminals

D1799

If users want to turn an input terminal into a Form A contact, they have to set the bit corresponding to the input terminal to OFF. If the users want to turn an input terminal into a Form B contact, they have to set the bit corresponding to the input terminal to ON.

Bit#	Polarity	Bit#	Polarity
0	X0 (DOG0)	8	X10 (MPGA)
1	X1 (PG0)	9	X11 (MPGB)
2	X2 (DOG1)	10	X12 (DOG4)
3	X3 (PG1)	11	X13 (DOG5)
4	X4 (DOG2)	12	-
5	X5 (PG2)	13	-
6	X6 (DOG3)	14	-
7	X7 (PG3)	15	-

Reading the states of the input terminals

D1800

If a bit in D1800 is ON, the input terminal corresponding to the bit receives a signal. If a bit in D1800 is OFF, the input terminal corresponding to the bit does not receive a signal.

Bit#	State	Bit#	State
0	X0 (DOG0)	8	X10 (MPGA)
1	X1 (PG0)	9	X11 (MPGB)
2	X2 (DOG1)	10	X12 (DOG4)
3	X3 (PG1)	11	X13 (DOG5)
4	X4 (DOG2)	12	-
5	X5 (PG2)	13	-
6	X6 (DOG3)	14	-
7	X7 (PG3)	15	-

Setting a filter coefficient for the input terminals

D1806

1. Users can set a filter coefficient for the input terminals X0~X7 by setting the low byte in SR806.
2. Users can set a filter coefficient for the input terminals X10+, X10-, X11+, and X11- by setting the low byte in SR806.
3. Filter coefficeint $=\dfrac{85000}{2^{N+4}}$ (kHz); N=1~19

N	kHz	N	kHz
1	2656.25	11	2.593994
2	1328.125	12	1.296997
3	664.0625	13	0.648499
4	332.0313	14	0.324249
5	166.0156	15	0.162125
6	83.00781	16	0.081062
7	41.50391	17	0.040531
8	20.75195	18	0.020266
9	10.37598	19	0.010133
10	5.187988		

4. If the value in D1806 is 0, no signals will be filtered.
5. If the value in D1806 is H000A, the filter coefficient for X0~X7 and MPG0/1 $=\dfrac{85000}{2^{10+4}}=5.187988$ (KHz), and the signals whose frequencies are higher than 5.187988 kHz will be removed.

O100 error

M1953, D1802, and D1803

1. If an error occurs in O100, M1953 will be ON, the error code corresponding to the error will be stored in D1802, and the step address at which the error occurs will be stored in D1803.
2. Please refer to appendix A in chapter 9 for more information about error codes.

Setting the parameters of the axis

D1816, D1896, D1976, D2056, D2136, and D2216

D1816 is for the X-axis, D1896 is for the Y-axis, D1976 is for the Z-axis, D2056 is for the A-axis, D2136 is for the B-axis, and D2216 is for the C-axis.

Bit#	Parameter of the axis	Bit#	Parameter of the axis
0	Unit*1	8	Direction in which the axis returns home *4
1		9	Mode of returning home*4
2	Ratio*4	10	Mode of triggering the return to home*4
3		11	Direction in which the motor rotates*4
4	Output type*3	12	Relative/Absolute coordinates*4
5		13	Mode of triggering the calculation of the target position*4
6*	PWM mode*4	14	Curve*4
7		15	

*: Only DVP-10PM series motion controllers support this function.

*1:

b1	b0	Unit
0	0	Motor unit
0	1	Mechanical unit
1	0	Compound unit
1	1	

	Motor unit	Compound unit	Mechanical unit
Position	pulse	μm	
	pulse	mdeg	
	pulse	10^{-4} inches	
Speed	pulse/second		centimeter/minute
	pulse/second		10 degrees/minute
	pulse/second		inch/minute

*2:

b3	b2	Ratio
0	0	10^0
0	1	10^1
1	0	10^2
1	1	10^3

*3:

b5	b4	Description
0	0	Positive-going pulse+Negative-going pulse
0	1	Pulse+Direction
1	0	A/B-phase pulse (two phases and two inputs)
1	1	

*4:

Bit#	Description
6	Bit 6=1: Enabling a PWM mode (1) If positive JOG motion is started, Y0~Y3 will execute PWM. (2) If single-speed motion is started, Y0~Y3 will send single-phase pulses. (3) Pulse width: D1838, D1918, D1998, and D2078 (4) Output period: D1842, D1922, D2002, and D2082
8	Bit 8=0: The value indicating the present command position of the axis decreases progressively. Bit 8=1: The value indicating the present command position of the axis increases progressively.
9	Bit 9=0: Normal mode ; bit 9=1: Overwrite mode
10	Bit 10=0: The return to home is triggered by a transition in DOG's signal from high to low. Bit 10=1: The return to home is triggered by a transition in DOG's signal from low to high.
11	Bit 11=0: When the motor rotates clockwise, the value indicating the present command position of the axis increases. Bit 11=1: When the motor rotates clockwise, the value indicating the present command position of the axis decreases.
12	Bit 12=0: Absolute coordinates Bit 12=1: Relative coordinates
13	Bit 13=0: The calculation of the target position of the axis is triggered by a transition in DOG's signal from low to high. Bit 13=1: The calculation of the target position of the axis is triggered by a transition in DOG's signal from high to low. (The setting of bit 13 is applicable to the insertion of single-speed motion, and the insertion of two-speed motion.)
14	Bit 14=0: Trapezoid curve Bit 14=1: S curve

Operation command

D1846, D1926, D2006, D2086, D2166, and D2246

D1846 is for the X-axis, D1926 is for the Y-axis, D2006 is for the Z-axis, D2086 is for the A-axis, D2166 is for the B-axis, and D2246 is for the C-axis.

Bit#	Operation command	Bit#	Operation command
0	The motion of the axis specified is stopped by software.	8	A mode of single-speed motion is activated.
1	The motion of the axis specified is started by software.	9	A mode of inserting single-speed motion is activated.
2	The axis specified operates in a JOG+ mode.	10	A mode of two-speed motion is activated.
3	The axis specified operates in a JOG- mode.	11	A mode of inserting two-speed motion is activated.
4	A mode of variable motion is activated.	12	0: The execution of the Ox motion subroutine set stops. 1: The execution of the Ox motion subroutine set starts.
5	A manual pulse generator is operated.	13	-
6	A mode of triggering the return to home is activated.	14	-
7	-	15	-

Mode of operation

D1847, D1927, D2007, D2087, D2167, and D2247

D1847 is for the X-axis, D1927 is for the Y-axis, D2007 is for the Z-axis, D2087 is for the A-axis, D2167 is for the B-axis, and D2247 is for the C-axis.

Bit#	Mode of operation	Bit#	Mode of operation
0	-	8	-
1	-	9	-
2	Mode of sending a CLR signal	10	-
3	Setting the CLR output to ON/OFF	11	-
4	Setting the polarity of the CLR output	12	
5	-	13	-
6	Limitation on the present position of the slave axis controlled by the manual pulse generator used	14	-
7	Mode of stopping the motor used when the motor used comes into contact with a positive limit switch/negative limit switch	15	Restoring the DVP-10PM series motion controller to the factory settings

Bit#	Description
2	Bit 2=0: After the axis specified returns home, the CLR output will send a 130 millisecond signal to the servo drive used, and the present position of the servo drive which is stored in a register in the servo drive will be cleared. Bit 2=1: The CLR output functions as a general output. Its state is controlled by bit 3.
3	Bit 3=0: The CLR output is OFF. Bit 3=1: The CLR output is ON.
4	Bit 4=0: The CLR output is a Form A contact. Bit 4=1: The CLR output is a Form B contact.
6	Bit 6=0: There is no limitation on the present position of the slave axis controlled by the manual pulse generator used Bit 6=1: The present position of the slave axis controlled by the manual pulse generator used has to be in the range of the P (I) set to the P (II) set. If the present position of the slave axis controlled by the manual pulse generator used is not in the range of the P (I) set to the P (II) set, the slave axis will decelerate and stop.
7	Bit 7=0: If the motor used comes into contact with a positive limit switch/negative limit switch when it rotates, it will decelerate and stop. Bit 7=1: If the motor used comes into contact with a positive limit switch/negative limit switch when it rotates, it will stop immediately.

State of the axis

D1856, D1936, D2016, D2096, D2176, and D2256

D1856 is for the X-axis, D1936 is for the Y-axis, D2016 is for the Z-axis, D2096 is for the A-axis, D2176 is for the B-axis, and D2156 is for the C-axis.

Bit#	State of the axis
0	Positive-going pulses are being output.
1	Negative-going pulses are being output.
2	The axis specified is operating.
3	An error occurs.
4	The axis specified pauses.
5	The manual pulse generator used generates positive-going pulses.
6	The manual pulse generator used generates negative-going pulses.
7	-

3.12 Special Data Registers for Motion Axes

The special data registers for the X-axis, the Y-axis, the Z-axis, the A-axis, the B-axis, and the C-axis in a DVP-10PM series motion controller are described below. Please refer to this section for more information about the setting of the special data registers.

Special D device number								Special data register	Setting range	Default value
X-axis		Y-axis		Z-axis		A-axis				
HW*1	LW*1	HW	LW	HW	LW	HW	LW			
-	D1816	-	D1896	-	D1976	-	D2056	Setting the parameters of the axis specified	Bit 0~bit 15	H0
D1819	D1818	D1899	D1898	D1979	D1978	D2059	D2058	Number of pulses it takes for the motor of the axis specified to rotate once (A)	1~+2,147,483,647 pulses/revolution	K2,000
D1821	D1820	D1901	D1900	D1981	D1980	D2061	D2060	Distance generated after the motor of the axis specified rotate once (B)	1~+2,147,483,647 *2	K1,000
D1823	D1822	D1903	D1902	D1983	D1982	D2063	D2062	Maximum speed (V_{MAX}) at which the axis specified rotates	0~+2,147,483,647 *3	K500,000
D1825	D1824	D1905	D1904	D1985	D1984	D2065	D2064	Start-up speed (V_{BIAS}) at which the axis specified rotates	0~+2,147,483,647 *3	K0
D1827	D1826	D1907	D1906	D1987	D1986	D2067	D2066	JOG speed (V_{JOG}) at which the axis specified rotates	0~+2,147,483,647 *3	K5,000
D1829	D1828	D1909	D1908	D1989	D1988	D2069	D2068	Speed (V_{RT}) at which the axis specified returns home	0~+2,147,483,647 *3	K50,000
D1831	D1830	D1911	D1910	D1991	D1990	D2071	D2070	Speed (V_{CR}) to which the speed of the axis specified decreases when the axis returns home	0~+2,147,483,647 *3	K1,000
-	D1832	-	D1912	-	D1992	-	D2072	Number of PG0 signals for the axis specified	0~+32,767 PLS	K0
-	D1833	-	D1913	-	D1993	-	D2073	Number of supplementary pulses for the axis specified	-32,768~+32,767 PLS	K0
D1835	D1834	D1915	D1914	D1995	D1994	D2075	D2074	Home position of the axis specified	0~±999,999 *1	K0
-	D1836	-	D1916	-	D1996	-	D2076	Time (T_{ACC}) it takes for the axis specified to accelerate	10~+32,767 ms	K100
-	D1837	-	D1917	-	D1997	-	D2077	Time (T_{DEC}) it takes for the axis specified to decelerate	10~+32,767 ms	K100
D1839	D1838	D1919	D1918	D1999	D1998	D2079	D2078	Target position of the axis specified (P (I))	-2,147,483,648~ +2,147,483,647 *1	K0
D1841	D1840	D1921	D1920	D2001	D2000	D2081	D2080	Speed at which the axis specified rotates (V (I))	0~+2,147,483,647 *1	K1000
D1843	D1842	D1923	D1922	D2003	D2002	D2083	D2082	Target position of the axis specified (P (II))	-2,147,483,648~ +2,147,483,647 *1	K0
D1845	D1844	D1925	D1924	D2005	D2004	D2085	D2084	Speed at which the axis specified rotates (V (II))	0~+2,147,483,647 *2	K2,000
-	D1846	-	D1926	-	D2006	-	D2086	Operation command	Bit 0~bit 15	H0
-	D1847	-	D1927	-	D2007	-	D2087	Mode of operation	Bit 0~bit 15	H0
D1849	D1848	D1929	D1928	D2009	D2008	D2089	D2088	Present command position of the axis specified (Pulse)	-2,147,483,648~ +2,147,483,647 *1	K0
D1851	D1850	D1931	D1930	D2011	D2010	D2091	D2090	Present command speed of the axis specified (PPS)	0~+2,147,483,647 PPS	K0
D1853	D1852	D1933	D1932	D2013	D2012	D2093	D2092	Present command position of the axis specified (unit *3)	-2,147,483,648~ +2,147,483,647 *1	K0
D1855	D1854	D1935	D1934	D2015	D2014	D2095	D2094	Present command speed of the axis specified (unit *3)	0~+2,147,483,647 PPS	K0
-	D1856	-	D1936	-	D2016	-	D2096	State of the axis specified	Bit 0~bit 15	H0
-	D1857	-	D1937	-	D2017	-	D2097	Axis error code	Please refer to appendix A for more information.	H0

Special D device number								Special data register	Setting range	Default value
X-axis		Y-axis		Z-axis		A-axis				
HW*1	LW*1	HW	LW	HW	LW	HW	LW			
-	D1858	-	D1938	-	D2018	-	D2098	Electronic gear of the axis specified (Numerator)	1~+32,767	K1
-	D1859	-	D1939	-	D2019	-	D2099	Electronic gear of the axis specified (Denominator)	1~+32,767	K1
D1861	D1860	D1941	D1940	D2021	D2020	D2101	D2100	Frequency of pulses generated by the manual pulse generator for the axis specified	Frequency of pulses generated by the manual pulse generator for the axis specified	K0
D1863	D1862	D1943	D1942	D2023	D2022	D2103	D2102	Number of pulses generated by the manual pulse generator for the axis specified	Number of pulses generated by the manual pulse generator for the axis specified	K0
-	D1864	-	D1944	-	D2024	-	D2104	Response speed of the manual pulse generator for the axis specified	Response speed of the manual pulse generator for the axis specified	K5
D1867	D1866	D1947	D1946	D2027	D2026	-	-	Electrical zero of the axis specified	Users have to set a value according to their needs.	K0
D1868	-	-	-	-	-	-	-	Setting an Ox motion subroutine number	Users have to set a value according to their needs.	K0
D1869	-	-	-	-	-	-	-	Step address in the Ox motion subroutine executed at which an error occurs	Users have to set a value according to their needs.	K0
D1872	-	-	-	-	-	-	-	Enabling a Y device when an Ox motion subroutine is ready (High byte)	Users have to set a value according to their needs.	K0
D1873	-	-	-	-	-	-	-	Enabling a Y device when an M-code in an Ox motion subroutine is executed (High byte)	Users have to set a value according to their needs.	K0
D1874	-	-	-	-	-	-	-	Using an X device to reset the M-code	Users have to set a value according to their needs.	K0
D1875	-	D1955	-	-	-	-	-	Starting the X-axis manually (ZRN, MPG, JOG-, JOG+)	Users have to set a value according to their needs.	K0

Special D device number				Special data register	Setting range	Default value
B-axis		C-axis				
HW	LW	HW	LW			
-	D2136	-	D2216	Setting the parameters of the axis specified	Bit 0~bit 15	H0
D2139	D2138	D2219	D2218	Number of pulses it takes for the motor of the axis specified to rotate once (A)	1~+2,147,483,647 pulses/revolution	K2,000
D2141	D2140	D2221	D2220	Distance generated after the motor of the axis specified rotate once (B)	1~+2,147,483,647 *2	K1,000
D2143	D2142	D2223	D2222	Maximum speed (V_{MAX}) at which the axis specified rotates	0~+2,147,483,647 *3	K500,000
D2145	D2144	D2225	D2224	Start-up speed (V_{BIAS}) at which the axis specified rotates	0~+2,147,483,647 *3	K0
D2147	D2146	D2227	D2226	JOG speed (V_{JOG}) at which the axis specified rotates	0~+2,147,483,647 *3	K5,000

Special D device number				Special data register	Setting range	Default value
B-axis		C-axis				
HW	LW	HW	LW			
D2149	D2148	D2229	D2228	Speed (V_{RT}) at which the axis specified returns home	0~+2,147,483,647 *3	K50,000
D2151	D2150	D2231	D2230	Speed (V_{CR}) to which the speed of the axis specified decreases when the axis returns home	0~+2,147,483,647 *3	K1,000
-	D2152	-	D2232	Number of PG0 signals for the axis specified	0~+32,767 PLS	K0
-	D2153	-	D2233	Number of supplementary pulses for the axis specified	-32,768~+32,767 PLS	K0
D2155	D2154	D2235	D2234	Home position of the axis specified	0~±999,999 *1	K0
-	D2156	-	D2236	Time (T_{ACC}) it takes for the axis specified to accelerate	10~+32,767 ms	K100
-	D2157	-	D2237	Time (T_{DEC}) it takes for the axis specified to decelerate	10~+32,767 ms	K100
D2159	D2158	D2239	D2238	Target position of the axis specified (P (I))	-2,147,483,648~ +2,147,483,647 *1	K0
D2161	D2160	D2241	D2240	Speed at which the axis specified rotates (V (I))	0~+2,147,483,647 *1	K1000
D2163	D2162	D2243	D2242	Target position of the axis specified (P (II))	-2,147,483,648~ +2,147,483,647 *1	K0
D2165	D2164	D2245	D2244	Speed at which the axis specified rotates (V (II))	0~+2,147,483,647 *2	K2,000
-	D2166	-	D2246	Operation command	Bit 0~bit 15	H0
-	D2167	-	D2247	Mode of operation	Bit 0~bit 15	H0
D2169	D2168	D2249	D2248	Present command position of the axis specified (Pulse)	-2,147,483,648~ +2,147,483,647 *1	K0
D2171	D2170	D2251	D2250	Present command speed of the axis specified (PPS)	0~+2,147,483,647 PPS	K0
D2173	D2172	D2253	D2252	Present command position of the axis specified (unit *3)	-2,147,483,648~ +2,147,483,647 *1	K0
D2175	D2174	D2255	D2254	Present command speed of the axis specified (unit *3)	0~+2,147,483,647 PPS	K0
-	D2176	-	D2256	State of the axis specified	Bit 0~bit 15	H0
-	D2177	-	D2257	Axis error code	Please refer to appendix A for more information.	H0
-	D2178	-	D2258	Electronic gear of the axis specified (Numerator)	1~+32,767	K1
-	D2179	-	D2259	Electronic gear of the axis specified (Denominator)	1~+32,767	K1
D2181	D2180	D2261	D2260	Frequency of pulses generated by the manual pulse generator for the axis specified	Frequency of pulses generated by the manual pulse generator for the axis specified	K0
D2183	D2182	D2263	D2262	Number of pulses generated by the manual pulse generator for the axis specified	Number of pulses generated by the manual pulse generator for the axis specified	K0
-	D2184	-	D2264	Response speed of the manual pulse generator for the axis specified	Response speed of the manual pulse generator for the axis specified	K5

*1: HW: High word; LW: Low word

*2: Unit: µm/rev, mdeg/rev, and 10^{-4} inches/rev

*3: The unit used varies with the setting of bit 0 and bit 1 in D1816/D1896/D1976.

3.12.1 Descriptions of the Special Data Registers Related to Motion

X-axis		Y-axis		Z-axis		
HW	LW	HW	LW	HW	LW	Setting the parameters of the axis specified
	D1816		D1896		D1976	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
	D2056		D2136		D2216	

[Description]

Bit 0~bit 15 in D1816 (D1896, D1976, D2056, D2136, D2216) are described below.

1. Bit 0 and bit 1 in D1816 (D1896, D1976, D2056, D2136, D2216): Unit

b1	b0	Unit	Description
0	0	Motor unit	A pulse is a unit.
0	1	Mechanical unit	A micrometer, 10-4 inches, or a degree is a unit.
1	0	Compound unit	Position: A micrometer, 10-4 inches, or a degree is a unit. (Mechanical unit) Speed: A pulse is a unit. (Motor unit)
1	1		

	Motor unit	Compound unit	Mechanical unit
Position	pulse	µm	
	pulse	mdeg	
	pulse	10^{-4} inches	
Speed	pulse/second		centimeter/minute
	pulse/second		10 degrees/minute
	pulse/second		inch/minute

- Position: Home position of the axis specified, target position of the axis specified (P (I)), target position of the axis specified (P (II)), and present command position of the axis specified
- Speed: Maximum speed (V_{MAX}) at which the axis specified rotates, start-up speed (V_{BIAS}) at which the axis specified rotates, JOG speed (V_{JOG}) at which the axis specified rotates, speed (V_{RT}) at which the axis specified returns home, speed (V_{CR}) to which the speed of the axis specified decreases when the axis returns home, speed at which the axis specified rotates (V (I)), and speed at which the axis specified rotates (V (II))
- Example 1:

  Bit [1:0]=00⇨Motor unit

  Position: Pulse

  Speed: Pulse/second (PPS)

  Target position of the axis specified (P (I)): 10,000 pulses

  Speed at which the axis specified rotates: 10K PPS

  After the DVP-10PM series motion controller sends 10,000 pulses, the axis specified can move to the target position specified. (The frequency of pulses is 10K PPS.) The distance for which the axis specified can move after a pulse is sent is calculated according to the physical quantity used.

- Example 2:
  Bit [1:0]=01⇨Mechanical unit
  Position: µm
  Speed: Centimeter/minute
  N=0
  D1818 (D1898, D1978, D2058, D2138, D2218)=1,000 (pulses/revolution)
  D1820 (D1900, D1980, D2060, D2140, D2220)=100 (micrometers/revolution)
  P (I)=10,000 (micrometers)
  V (I)=6 (centimeters/minute)
  The number of pulses sent by the DVP-10PM series motion controller and the frequency of pulses are calculated below.

$$\text{Distance} = \underbrace{\frac{\text{Distance}}{\text{Revolution}}}_{B} \times \underbrace{\frac{\text{Revolution}}{\text{Number of pulses}}}_{1/A} \times \text{Number of pulses}$$

  Number of pulses it takes for the axis specified to move to the target position specified $= \frac{\text{P (I)}\,\mu\text{m}}{B/A} = \text{P (I)} \times \frac{A}{B} = 100{,}000\ \text{(pulses)}$

  Speed at which the axis specified rotates (V (I)): 6 (centimeters/minute)=60,000/60 (micrometers/second)

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}} = \underbrace{\frac{\text{Distance}}{\text{Revolution}}}_{B} \times \underbrace{\frac{\text{Revolution}}{\text{Number of pulses}}}_{1/A} \times \underbrace{\frac{\text{Number of pulses}}{\text{Time}}}_{\text{PPS,pulse/sec}}$$

  The frequency of pulses calculated by the DVP-10PM series motion controller

$$= V(I) \times \frac{10^4}{60} \times \frac{A}{B} = \frac{60{,}000}{60} \times \frac{1{,}000}{100} = 10{,}000 \quad \text{(PPS)}$$

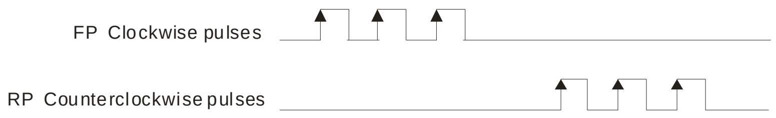
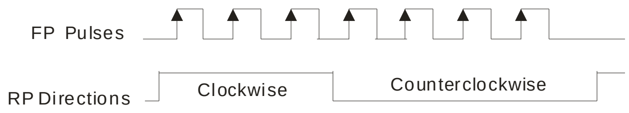
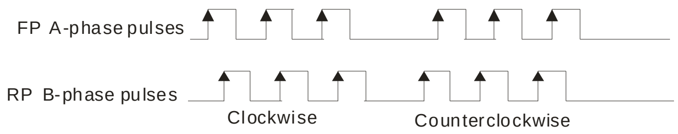
- Example 3
  Bit [1:0]=10 or 11⇨Compound unit
  Position: Micrometer
  Speed: Pulse/second (PPS)
  N=0
  D1818 (D1898, D1978, D2058, D2138, D2218)=2,000 (pulses/revolution)
  D1820 (D1900, D1980, D2060, D2140, D2220)=100 (micrometers/revolution)
  P (I)=10,000 (micrometers)
  V (I)=10K (PPS)
  The number of pulses sent by the DVP-10PM series motion controller is calculated below.
  Number of pulses it takes for the axis specified to move to the target position specified

$$= \frac{\text{P (I)}\,\mu\text{m}}{B/A} = \text{P (I)} \times \frac{A}{B} = 200{,}000\ \text{(pulses)}$$

2. Bit 2 and bit 3 in D1816 (D1896, D1976, D2056, D2136, D2216): Ratio
   Position: The home position of the axis specified, the target position of the axis specified (P (I)), the target position of the axis specified (P (II)), and the present command position of the axis specified must be multiplied by a ratio.

b3	b2	Ratio
0	0	Position×10^0
0	1	Position×10^1
1	0	Position×10^2
1	1	Position×10^3

3. Bit 4 and bit 5 in D1816 (D1896, D1976, D2056, D2136, D2216): Output type

b5	b4	Output type (positive logic)	Description
0	0		Counting up/down
0	1		Pulses+Directions
1	0		A/B-phase pulses
1	1		

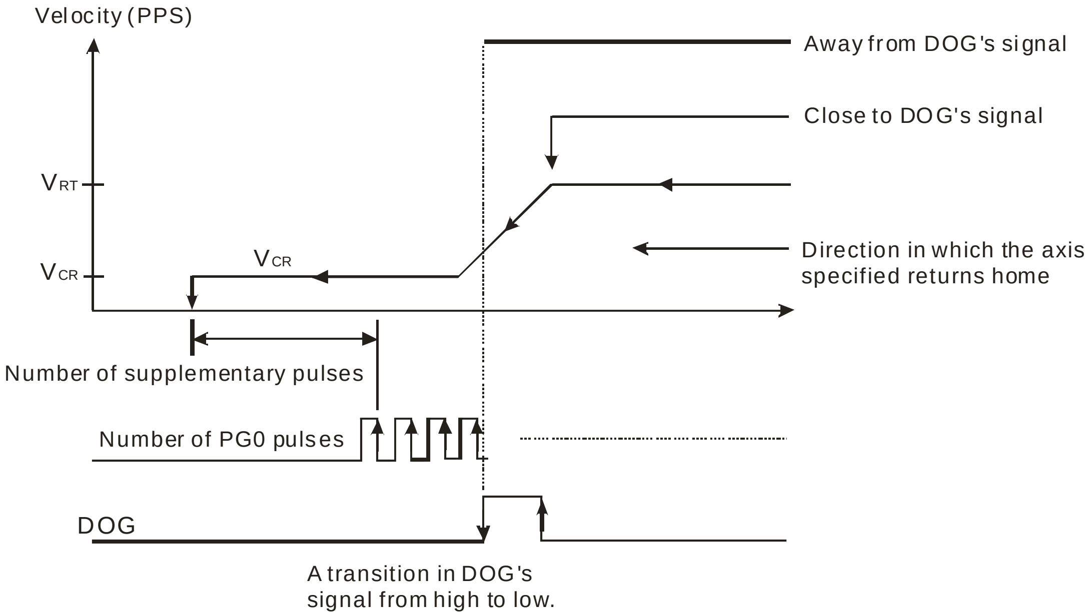
4. Bit 6 in D1816 (D1896, D1976, D2056, D2136, D2216): Setting a PWM mode
   Bit 6=1: If positive JOG motion is started, Y0~Y3 will execute PWM.
5. Bit 8 in D1816 (D1896, D1976, D2056, D2136, D2216): Direction in which the axis specified returns home
   Bit 8=0: The value indicating the present command position of an axis specified decreases, and the axis returns home in the negative direction.
   Bit 8=1: The value indicating the present command position of an axis specified increases, and the axis returns home in the positive direction.
6. Bit 9 in D1816 (D1896, D1976, D2056, D2136, D2216): Mode of returning home
   Bit 9=0: Normal mode
   After DOG's signal is generated, the motor used will rotate for a specific number of PG0 pulses, then rotate for a specific number of supplementary pulses, and finally stop.
   Bit 9=1: Overwrite mode
   After DOG's signal is generated, the motor used will rotate for a number of PG0 pulses or rotate for a number of supplementary pulses, and then stop.

7. Bit 10 in D1816 (D1896, D1976, D2056, D2136, D2216): Mode of triggering the return to home
   Bit 10=0: The return to home is triggered by a transition in DOG's signal from high to low.
   Bit 10=1: The return to home is triggered by a transition in DOG's signal from low to high.
   - Bit [9:10] in D1816 (D1896, D1976, D2056, D2136, D2216) is 00.⇨The mode of returning home is a normal mode, and the return to home is triggered by a transition in DOG's signal from high to low.

     Steps: The motor used rotates at the speed V_{RT}. When DOG's signal is generated, the speed of the motor begins to decrease to the speed V_{CR}. After DOG's signal goes from high to low, the motor will rotate for a specific number of PG0 pulses, and then rotate for a specific number of supplementary pulses, and finally stop.

     If the number of PG0 pulses or the number of supplementary pulses is not large, the speed of the motor used will decrease to the speed V_{CR} after DOG's signal is generated. After DOG's signal goes from high to low, the motor will rotate for a specific number of PG0 pulses, and then rotate for a specific number of supplementary pulses, and finally stop whether the its speed is V_{CR}.

     If the number of PG0 pulses is 0, and the number of supplementary pulses is 0, the motor used will stop after DOG's signal is generated and there is a transition in DOG's signal from high to low.

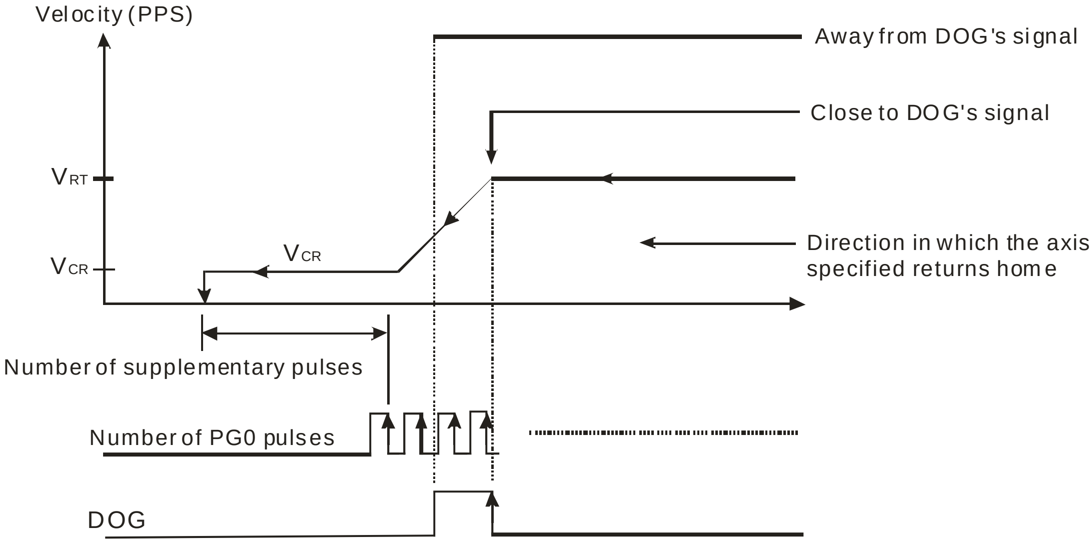


- Bit [9:10] in D1816 (D1896, D1976, D2056, D2136, D2216) is 01.⇨The mode of returning home is a normal mode, and the return to home is not triggered by a transition in DOG's signal from high to low.

  Steps: The motor used rotates at the speed V_{RT}. When DOG's signal is generated, the speed of the motor begins to decrease to the speed V_{CR}. After the motor rotates for a specific number of PG0 pulses, and rotate for a specific number of supplementary pulses, it will stop.

  If the number of PG0 pulses or the number of supplementary pulses is not large, the speed of the motor used will decrease to the speed V_{CR} after DOG's signal is generated. After the motor rotates for a specific number of PG0 pulses, and rotates for a specific number of supplementary pulses, it will stop whether its speed is V_{CR}.

  If the number of PG0 pulses is 0, and the number of supplementary pulses is 0, the motor used will stop after DOG's signal is generated.

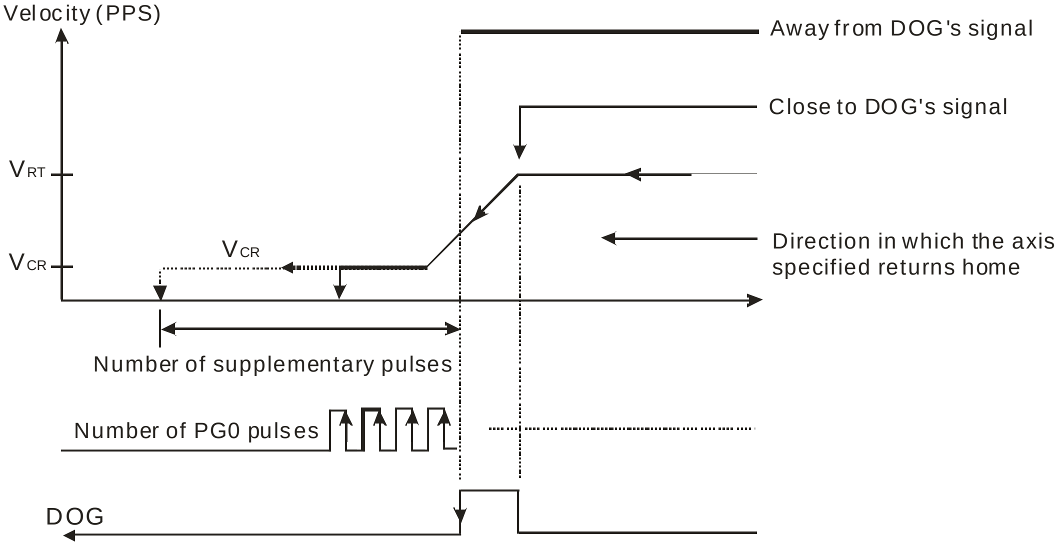


- Bit [9:10] in D1816 (D1896, D1976, D2056, D2136, D2216) is 10.⇨ The mode of returning home is an overwrite mode, and the return to home is triggered by a transition in DOG's signal from high to low.

  Steps: The motor used rotates at the speed V_{RT}. When DOG's signal is generated, the speed of the motor begins to decrease to the speed V_{CR}. After DOG's signal goes from high to low, the motor will rotate for a specific number of PG0 pulses, or rotate for a specific number of supplementary pulses, and then stop.

  If the number of PG0 pulses or the number of supplementary pulses is not large, the speed of the motor used will decrease to the speed V_{CR} after DOG's signal is generated. After DOG's signal goes from high to low, the motor will rotate for a specific number of PG0 pulses, or rotate for a specific number of supplementary pulses, and then stop whether the its speed is V_{CR}.

  If the number of PG0 pulses is 0, and the number of supplementary pulses is 0, the motor used will stop after DOG's signal is generated and there is a transition in DOG's signal from high to low.

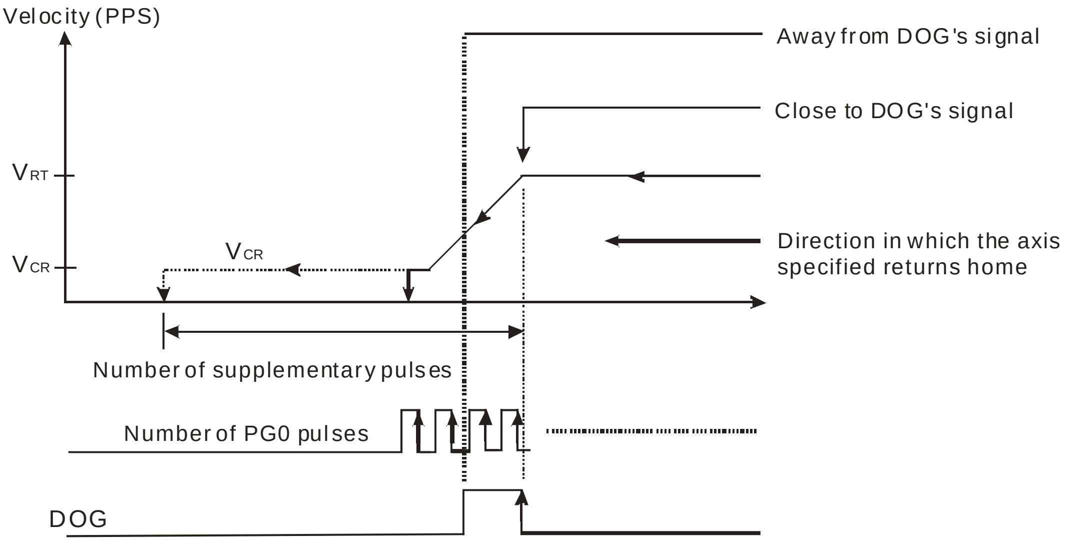


- Bit [9:10] in D1816 (D1896, D1976, D2056, D2136, D2216) is 11.⇨ The mode of returning home is an overwrite mode, and the return to home is not triggered by a transition in DOG's signal from high to low.

  Steps: The motor used rotates at the speed V_{RT}. When DOG's signal is generated, the speed of the motor begins to decrease to the speed V_{CR}. After the motor rotates for a specific number of PG0 pulses, or rotate for a specific number of supplementary pulses, it will stop.

  If the number of PG0 pulses or the number of supplementary pulses is not large, the speed of the motor used will decrease to the speed V_{CR} after DOG's signal is generated. After the motor rotates for a specific number of PG0 pulses, or rotates for a specific number of supplementary pulses, it will stop whether its speed is V_{CR}.

  If the number of PG0 pulses is 0, and the number of supplementary pulses is 0, the motor used will stop after DOG's signal is generated.



8. Bit 11 in D1816 (D1896, D1976, D2056, D2136, D2216): Direction in which the motor used rotates
   - Bit 11=0: When the motor rotates clockwise, the value indicating the present command position of the axis specified increases.
   - Bit 11=1: When the motor rotates clockwise, the value indicating the present command position of the axis specified decreases.
9. Bit 12 in D1816 (D1896, D1976, D2056, D2136, D2216): Relative/Absolute coordinates
   - Bit 12=0: Absolute coordinates
   - Bit 12=1: Relative coordinates
10. Bit 13 in D1816 (D1896, D1976, D2056, D2136, D2216): Mode of triggering the calculation of the target position
    - Bit 13=0: The calculation of the target position of the axis specified is triggered by a transition in DOG's signal from low to high.
    - Bit 13=1: The calculation of the target position of the axis specified is triggered by a transition in DOG's signal from high to low. (The setting of bit 13 is applicable to the insertion of single-speed motion, and the insertion of two-speed motion.)
11. Bit 14 in D1816 (D1896, D1976, D2056, D2136, D2216): Curve
    - Bit 14=0: Trapezoid curve
    - Bit 14=1: S curve

X-axis		Y-axis		Z-axis		Number of pulses it takes for the motor of the axis specified to rotate once (A)
HW	LW	HW	LW	HW	LW	
D1819	D1818	D1899	D1898	D1979	D1978	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
D2059	D2058	D2139	D2138	D2219	D2218	

[Description]

1. Owing to the fact that users can set an electronic gear ratio for a servo drive, the number of pulses it takes for a servo motor to rotate once is not necessarily equal to the number of pulses which will be generated after a decoder rotates once. The relation between the number of pulses it takes for a servo drive to rotate once and an electronic gear ratio is described below.

   Number of pulses it takes for a motor to rotate once (A) x Electronic gear ratio (CMX/CDV)=Number of pulses which will be generated after a decoder rotates once
2. The unit used is determined by bit 0 and bit 1 in D1816 (D1896, D1976, D2056, D2136, D2216). If the unit selected is a mechanical unit or a compound unit, users need to set D1818 (D1898, D1978, D2058, D2138, D2218) and D1819 (D1899, D1979, D2059, D2139, D2219). If the unit selected is a motor unit, users do not need to set D1818 (D1898, D1978, D2058, D2138, D2218) and D1819 (D1899, D1979, D2059, D2139, D2219).

X-axis		Y-axis		Z-axis		Distance generated after the motor of the axis specified rotate once (B)
HW	LW	HW	LW	HW	LW	
D1821	D1820	D1901	D1900	D1981	D1980	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
D2061	D2060	D2141	D2140	D2221	D2220	

[Description]

1. Three units are available. They are µm/revolution, mdeg/revolution, and 10^{-4} inches/revolution. The unit used is determined by bit 0 and bit 1 in D1816 (D1896, D1976, D2056, D2136, D2216). The value in (D1821, D1820) ((D1901, D1900), (D1981, D1980), (D2061, D2060), (D2141, D2140), (D2221, D2220)) is in the range of 1 to 2,147,483,647.
2. The unit used is determined by bit 0 and bit 1 in D1816 (D1896, D1976, D2056, D2136, D2216). If the unit selected is a mechanical unit or a compound unit, users need to set D1820 (D1900, D1980, D2060, D2140, D2220) and D1821 (D1901, D1981, D2061, D2141, D2221). If the unit selected is a motor unit, users do not need to set D1820 (D1900, D1980, D2060, D2140, D2220) and D4821 (D1901, D1981, D2061, D2141, D2221).

X-axis		Y-axis		Z-axis		Maximum speed (V_{MAX}) at which the axis specified rotates
HW	LW	HW	LW	HW	LW	
D1823	D1822	D1903	D1902	D1983	D1982	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
D2063	D2062	D2143	D2142	D2223	D2222	

[Description]

1. Users can set the maximum speed of motion. The value in (D1823, D1822) ((D1903, D1902), (D1983, D1982), (D2063, D2062), (D2143, D2142), (D2223, D2222)) is in the range of 0 to 2,147,483,647. (The unit used is determined by bit 0 and bit 1 in D1816 (D1896, D1976, D2056, D2136, D2216).)
2. The frequency of pulses generated by motion is in the range of 10 PPS to 500K PPS. If the value in (D1823, D1822) ((D1903, D1902), (D1983, D1982), (D2063, D2062), (D2143, D2142), (D2223, D2222)) is greater than 500K, the frequency of pulses generated will be 500K PPS. If the value in (D1823, D1822) ((D1903, D1902), (D1983, D1982), (D2063, D2062), (D2143, D2142), (D2223, D2222)) is less than 10, the frequency of pulses generated will be 10 PPS.

X-axis		Y-axis		Z-axis		
HW	LW	HW	LW	HW	LW	
D1825	D1824	D1905	D1904	D1985	D1984	Start-up speed (V_{BIAS}) at which the axis specified rotates
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
D2065	D2064	D2145	D2144	D2225	D2224	

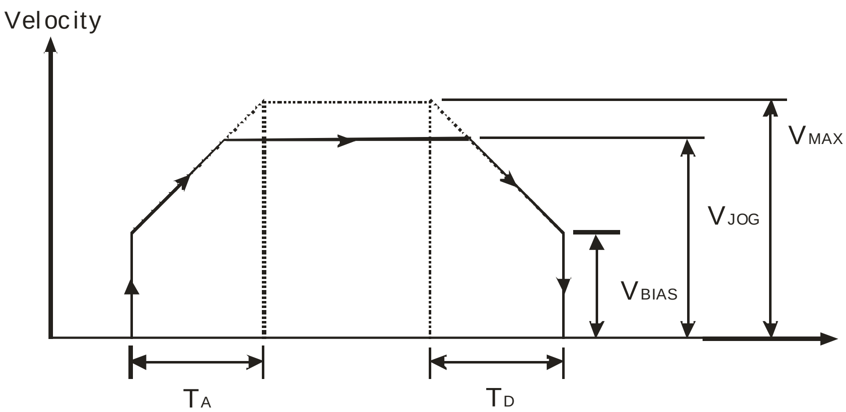
[Description]

1. Users can set the start-up speed of motion. The value in (D1825, D1824) ((D1905, D1904), (D1985, D1984), (D2065, D2064), (D2145, D2144), (D2225, D2224)) is in the range of 0 to 2,147,483,647. (The unit used is determined by bit 0 and bit 1 in D1816 (D1896, D1976, D2056, D2136, D2216).)
2. The frequency of pulses generated by motion is in the range of 0 PPS to 500K PPS. If the value in (D1825, D1824) ((D1905, D1904), (D1985, D1984), (D2065, D2064), (D2145, D2144), (D2225, D2224)) is greater than 500K, the frequency of pulses generated will be 500K PPS. If the value in (D1825, D1824) ((D1905, D1904), (D1985, D1984), (D2065, D2064), (D2145, D2144), (D2225, D2224)) is less than 0, the frequency of pulses generated will be 0 PPS.
3. If a stepper motor system is used, the start-up speed that users set must be greater than the motor resonance frequency generated.

X-axis		Y-axis		Z-axis		
HW	LW	HW	LW	HW	LW	
D1827	D1826	D1907	D1906	D1987	D1986	JOG speed (V_{JOG}) at which the axis specified rotates
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
D2067	D2066	D2147	D2146	D2227	D2226	

[Description]

1. Users can set the JOG speed (V_{JOG}) at which the axis specified rotates. The value in (D1827, D1826) ((D1907, D1906), (D1987, D1986), (D2067, D2066), (D2147, D2146), (D2227, D2226)) is in the range of 0 to 2,147,483,647. (The unit used is determined by bit 0 and bit 1 in D1816 (D1896, D1976, D2056, D2136, D2216).
2. The frequency of pulses generated by motion is in the range of 10 PPS to 500K PPS. If the value in (D1827, D1826) ((D1907, D1906), (D1987, D1986), (D2067, D2066), (D2147, D2146), (D2227, D2226)) is greater than 500K, the frequency of pulses generated will be 500K PPS. If the value in (D1827, D1826) ((D1907, D1906), (D1987, D1986), (D2067, D2066), (D2147, D2146), (D2227, D2226)) is less than 10, the frequency of pulses generated will be 10 PPS.
3. $V_{MAX}>V_{JOG}>V_{BIAS}$
   If the V_{JOG} set is greater than the V_{MAX} set, the actual V_{JOG} will be equal to the V_{MAX}.
   If the V_{JOG} set is less than the V_{BIAS} set, the actual V_{JOG} will be equal to the V_{BIAS}, and an error will occur.
4. When an axis operates, users can not modify the JOG speed of the axis.



X-axis		Y-axis		Z-axis		
HW	LW	HW	LW	HW	LW	Speed (V_{RT}) at which the axis specified returns home
D1829	D1828	D1909	D1908	D1989	D1988	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
D2069	D2068	D2149	D2148	D2229	D2228	

[Description]

1. Users can set the speed at which the axis specified returns home. The value in (D1829, D1828) ((D1909, D1908), (D1989, D1988), (D2069, D2068), (D2149, D2148), (D2229, D2228)) is in the range of 1 to 2,147,483,647. (The unit used is determined by bit 0 and bit 1 in D1816 (D1896, D1976, D2056, D2136, D2216).)
2. The frequency of pulses generated by motion is in the range of 10 PPS to 500K PPS. If the value in (D1829, D1828) ((D1909, D1908), (D1989, D1988), (D2069, D2068), (D2149, D2148), (D2229, D2228)) is greater than 500K, the frequency of pulses generated will be 500K PPS. If the value in (D1829, D1828) ((D1909, D1908), (D1989, D1988), (D2069, D2068), (D2149, D2148), (D2229, D2228)) is less than 10, the frequency of pulses generated will be 10 PPS.
3. $V_{MAX}>V_{RT}>V_{BIAS}$
4. When an axis returns home, the speed at which the axis returns home can not be changed.

X-axis		Y-axis		Z-axis		
HW	LW	HW	LW	HW	LW	Speed (V_{CR}) to which the speed of the axis specified decreases when the axis returns home
D1831	D1830	D1911	D1910	D1991	D1990	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
D2071	D2070	D2151	D2150	D2231	D2230	

[Description]

1. The value in (D1831, D1830) ((D1911, D1910), (D1991, D1990), (D2071, D2070), (D2151, D2150), (D2231, D2230)) is in the range of 1 to 2,147,483,647. (The unit used is determined by bit 0 and bit 1 in D1816 (D1896, D1976, D2056, D2136, D2216).
2. The frequency of pulses generated by motion is in the range of 10 PPS to 500K PPS. If the value in (D1831, D1830) ((D1911, D1910), (D1991, D1990), (D2071, D2070), (D2151, D2150), (D2231, D2230)) is greater than 500K, the frequency of pulses generated will be 500K PPS. If the value in (D1831, D1830) ((D1911, D1910), (D1991, D1990), (D2071, D2070), (D2151, D2150), (D2231, D2230)) is less than 10, the frequency of pulses generated will be 10 PPS.
3. When motion of returning home is executed, the speed of the motor used is the V_{RT} set. When there is a transition in DOG's signal from low to high or from high to low, the speed of the motor used decreases to the V_{CR} set.
4. In order for the axis specified to returns home precisely, it is suggested that the V_{CR} set should be a low speed.
5. When the motion of returning home is executed, the V_{CR} set can not be changed.

X-axis		Y-axis		Z-axis		
HW	LW	HW	LW	HW	LW	Number of PG0 pulses for the axis specified
	D1832		D1912		D1992	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
	D2072		D2152		D2232	

[Description]

1. The value in D1832 (D1912, D1992, D2072, D2152, D2232) is in the range of -32,768 to 32,767. If the value in D1832 (D1912, D1992, D2072, D2152, D2232) is a positive value, the axis specified will move in the direction in which it returns home. If the value in D1832 (D1912, D1992, D2072, D2152, D2232) is a negative value, the axis specified will move in the direction which is opposite to the direction in which it returns home.

2. Please refer to the descriptions of bit 9 and bit10 in D1816 (D1896, D1976, D2056, D2136, D2216) for more information about decelerating and stopping the motor used.

X-axis		Y-axis		Z-axis		Supplementary pulses for the axis specified
HW	LW	HW	LW	HW	LW	
	D1833		D1913		D1993	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
	D2073		D2153		D2233	

[Description]

1. The value in D1833 (D1913, DD1993, D2073, D2153, D2233) is in the range of -32,768 to 32,767. If the value in D1833 (D1913, DD1993, D2073, D2153, D2233) is a positive value, the axis specified will move in the direction in which it returns home. If the value in D1833 (D1913, DD1993, D2073, D2153, D2233) is a negative value, the axis specified will move in the direction which is opposite to the direction in which it returns home.
2. Please refer to the descriptions of bit 9 and bit10 in D1816 (D1896, D1976, D2056, D2136, D2216) for more information about decelerating and stopping the motor used.

X-axis		Y-axis		Z-axis		Home position of the axis specified
HW	LW	HW	LW	HW	LW	
D1835	D1834	D1915	D1914	D1995	D1994	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
D2075	D2074	D2155	D2154	D2235	D2234	

[Description]

1. The value in (D1835, D1834) ((D1915, D1914), (D1995, D1994), (D2075, D2074), (D2155, D2154), (D2235, D2234)) is in the range of 0 to ±999,999. (The unit used is determined by bit 0 and bit 1 in D1816 (D1896, D1976, D2056, D2136, D2216).
2. After the axis specified returns home, the value in (D1835, D1834) ((D1915, D1914), (D1995, D1994), (D2075, D2074), (D2155, D2154), (D2235, D2234)) will be written into (D1849, D1848) ((D1929, D1928), (D2009, D2008), (D2089, D2088), (D2169, D2168), (D2249, D2248)).

X-axis		Y-axis		Z-axis		Time (T_{ACC}) it takes for the axis specified to accelerate
HW	LW	HW	LW	HW	LW	
	D1836		D1916		D1996	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
	D2076		D2156		D2236	

[Description]

1. Users can set the times it takes for the speed of the axis specified to increase from its start-up speed to its maximum speed. The value in D1836 (D1916, D1996, D2076, D2156, D2236) is in the range of 0 to 32,767. A millisecond is a unit.
2. If the value in D1836 (D1916, D1996, D2076, D2156, D2236) is less than 10, it will be counted as 10. If the value in D1836 (D1916, D1996, D2076, D2156, D2236) is greater than 32,767, it will be counted as 32,767.
3. If users want to have a complete S curve, the maximum speed which is set must be the same as the speed at which the axis specified operates.

X-axis		Y-axis		Z-axis		Time (T_{DEC}) it takes for the axis specified to decelerate
HW	LW	HW	LW	HW	LW	
	D1837		D1917		D1997	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
	D2077		D2157		D2237	

[Description]

1. Users can set the times it takes for the speed of the axis specified to decrease from its maximum speed to its start-up speed. The value in D1837 (D1917, D1997, D2077, D2157, D2237) is in the range of 0 to 32,767. A millisecond is a unit.
2. If the value in D1837 (D1917, D1997, D2077, D2157, D2237) is less than 10, it will be counted as 10. If the value in D1837 (D1917, D1997, D2077, D2157, D2237) is greater than 32,767, it will be counted as 32,767.
3. If users want to have a complete S curve, the maximum speed which is set must be the same as the speed at which the axis specified operates.

X-axis		Y-axis		Z-axis		Target position of the axis specified (P (I))
HW	LW	HW	LW	HW	LW	
D1839	D1838	D1919	D1918	D1999	D1998	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
D2079	D2078	D2159	D2158	D2239	D2238	

[Description]

1. The value in (D1839, D1838) ((D1919, D1918), (D1999, D1998), (D2079, D2078), (D2159, D2158), (D2239, D2238)) is in the range of -2,147,483,648 to +2,147,483,647. (The unit used is determined by bit 0 and bit 1 in D1816 (D1896, D1976, D2056, D2136, D2216).)
2. Target position (P (I))
   - Absolute coordinates: Bit 12 in D1816 (D1896, D1976, D2056, D2136, D2216) is 0.
     The target position of the axis specified indicates a distance from 0. If the target position of an axis is greater than its present command position, the motor used will rotate clockwise. If the target position of an axis is less than its present command position, the motor used will rotate counterclockwise.
   - Relative coordinates: Bit 12 in D1816 (D1896, D1976, D2056, D2136, D2216) is 1.
     The target position of an axis indicates a distance from its present command position. If the target position specified is a positive value, the motor used will rotate clockwise. If the target position specified is a negative value, the motor used will rotate counterclockwise.
3. The ratio used is determined by bit 2 and bit 3 in D1816 (D1896, D1976, D2056, D2136, D2216).

X-axis		Y-axis		Z-axis		Speed at which the axis specified rotates (V (I))
HW	LW	HW	LW	HW	LW	
D1841	D1840	D1921	D1920	D2001	D2000	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
D2081	D2080	D2161	D2160	D2241	D2240	

[Description]

1. The value in (D1841, D1840) ((D1921, D1920), (D2001, D2000), (D2081, D2080), (D2161, D2160), (D2241, D2240)) is in the range of -2,147,483,647 to +2,147,483,647. (The unit used is determined by bit 0 and bit 1 in D1816 (D1896, D1976, D2056, D2136, D2216).)
2. The frequency of pulses generated by motion is in the range of 10 PPS to 500K PPS. If the value in (D1841, D1840) ((D1921, D1920), (D2001, D2000), (D2081, D2080), (D2161, D2160), (D2241, D2240)) is greater than 500K, the frequency of pulses generated will be 500K PPS. If the value in (D1841, D1840) ((D1921, D1920), (D2001, D2000), (D2081, D2080), (D2161, D2160), (D2241, D2240)) is less than 10, the frequency of pulses generated will be 10 PPS.

3. V_{MAX} > V (I) > V_{BIAS}
4. When bit 4 in D1846 (D1926, D2006, D2086, D2166, D2246) is ON, the speed at which the axis specified rotates (V (I)) can be changed. If the Speed at which the axis specified rotates is a positive value, the motor used will rotate clockwise. If the Speed at which the axis specified rotates is a negative value, the motor used will rotate counterclockwise.

X-axis		Y-axis		Z-axis		Target position of the axis specified (P (II))
HW	LW	HW	LW	HW	LW	
D1843	D1842	D1923	D1922	D2003	D2002	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
D2083	D2082	D2163	D2162	D2243	D2242	

[Description]

1. The value in (D1843, D1842) ((D1923, D1922), (D2003, D2002), (D2083, D2082), (D2163, D2162), (D2243, D2242)) is in the range of -2,147,483,648 to +2,147,483,647. (The unit used is determined by bit 0 and bit 1 in D1816 (D1896, D1976, D2056, D2136, D2216).)
2. Target position (P (II))
   - Absolute coordinates: Bit 12 in (D1816 (D1896, D1976, D2056, D2136, D2216) is 0.
     The target position of the axis specified indicates a distance from 0. If the target position of an axis is greater than its present command position, the motor used will rotate clockwise. If the target position of an axis is less than its present command position, the motor used will rotate counterclockwise.
   - Relative coordinates: Bit 12 in (D1816 (D1896, D1976, D2056, D2136, D2216) is 1.
     The target position of an axis indicates a distance from its present command position. If the target position specified is a positive value, the motor used will rotate clockwise. If the target position specified is a negative value, the motor used will rotate counterclockwise.
3. The ratio used is determined by bit 2 and bit 3 in D1816 (D1896, D1976, D2056, D2136, D2216).

X-axis		Y-axis		Z-axis		Speed at which the axis specified rotates(V (II))
HW	LW	HW	LW	HW	LW	
D1845	D1844	D1925	D1924	D2005	D2004	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
D2085	D2084	D2165	D2164	D2245	D2244	

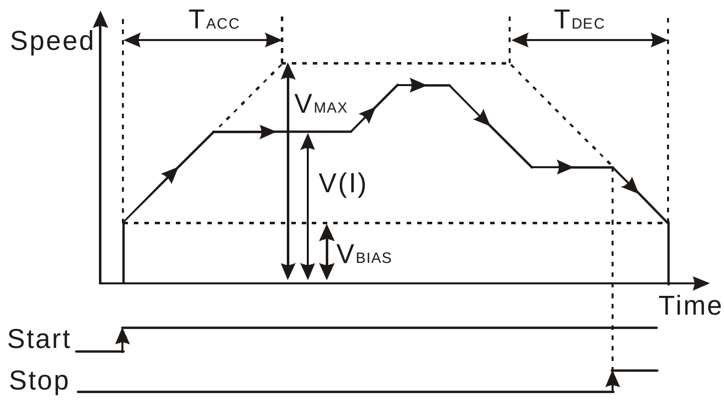
[Description]

1. The value in (D1845, D1844) ((D1925, D1924), (D2005, D2004), (D2085, D2084), (D2165, D2164), (D2245, D2244)) is in the range of 0 to 2,147,483,647. (The unit used is determined by bit 0 and bit 1 in D1816 (D1896, D1976, D2056, D2136, D2216).)
2. The frequency of pulses generated by motion is in the range of 10 PPS to 500K PPS. If the value in (D1845, D1844) ((D1925, D1924), (D2005, D2004), (D2085, D2084), (D2165, D2164), (D2245, D2244)) is greater than 500K, the frequency of pulses generated will be 500K PPS. If the value in (D1845, D1844) ((D1925, D1924), (D2005, D2004), (D2085, D2084), (D2165, D2164), (D2245, D2244)) is less than 10, the frequency of pulses generated will be 10 PPS.
3. V_{MAX} > V (II) > V_{BIAS}

X-axis		Y-axis		Z-axis		Operation command
HW	LW	HW	LW	HW	LW	
	D1846		D1926		D2006	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
	D2086		D2166		D2246	

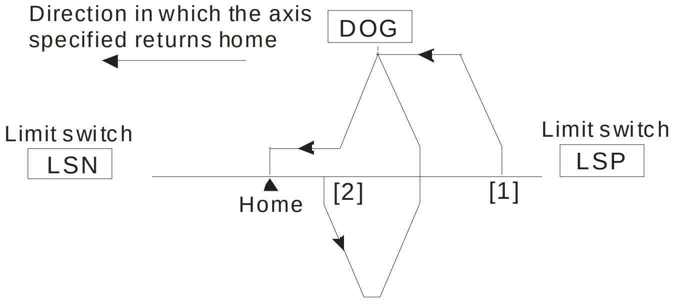
[Description]

1. Bit 0 in D1846 (D1926, D2006, D2086, D2166, D2246): The motion of the axis specified is stopped by software.
   - The motion of the axis specified is stopped by software when bit 0 in D1846 (D1926, D2006, D2086, D2166, D2246) is turned from OFF to ON.
2. Bit 1 in D1846 (D1926, D2006, D2086, D2166, D2246): The motion of the axis specified is started by software.
   - The motion of the axis specified is started by software when bit 1 in D1846 (D1926, D2006, D2086, D2166, D2246) is turned from OFF to ON.
3. Bit 2 in D1846 (D1926, D2006, D2086, D2166, D2246): The axis specified operates in a JOG+ mode.
   - When bit 2 in D1846 (D1926, D2006, D2086, D2166, D2246), clockwise pulses are generated at the JOG speed set.
   - If bit 6 in D1816 (D1896, D1976, D2056, D2136, D2216) is ON, and bit 2 in D1846 (D1926, D2006, D2086, D2166, D2246) is ON, PWM will be executed.
4. Bit 3 in D1846 (D1926, D2006, D2086, D2166, D2246): The axis specified operates in a JOG- mode.
   - When bit 3 in D1846 (D1926, D2006, D2086, D2166, D2246) is ON, counterclockwise pulses are generated at the JOG speed set.
5. Bit 4 in D1846 (D1926, D2006, D2086, D2166, D2246): A mode of variable motion is activated.
   - After bit 4 in D1846 (D1926, D2006, D2086, D2166, D2246) is set to 1, the DVP-10PM series motion controller will execute variable motion, and it will send pulses by a pulse generator.
   - After a mode of variable motion is activated, the V_{BIAS} of the axis specified will increase to its V (I). When the axis operates, users can change its V (I) at will. The DVP-10PM series motion controller accelerates or decelerates according to the V (I) set.
   - Users can stop variable motion by setting bit 0 in D1846 (D1926, D2006, D2086, D2166, D2246) to 1, or by setting bit 4 in D1846 (D1926, D2006, D2086, D2166, D2246) to 0.
   - Diagram



6. Bit 5 in D1846 (D1926, D2006, D2086, D2166, D2246): A manual pulse generator is operated.
   - If bit 5 in D1846 (D1926, D2006, D2086, D2166, D2246) is set to ON, a manual pulse generator mode will be activated. Please refer to the descriptions of D1858~D1864 (D1938~D1944, D2018~D2024, D2098~D2104, D2178~D2184, D2258~D2264) for more information.
7. Bit 6 in D1846 (D1926, D2006, D2086, D2166, D2246): A mode of triggering the return to home is activated.
   - When bit 6 in D1846 (D1926, D2006, D2086, D2166, D2246) is turned from OFF to ON, a mode of triggering the return to home is activated. The mode of triggering the return to home varies with the

present command position of the axis specified. There are two situations.

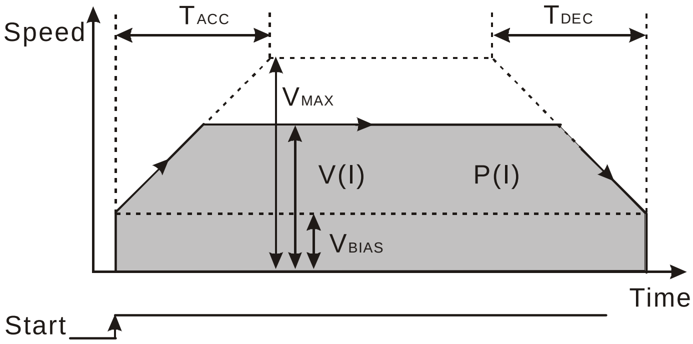


Position (1): Position [1] is at the right side of the home and DOG, and DOG is OFF.

Position (2): Position [2] is at the right side of the home, and DOG is ON.

*: Position (2) does not support the B-axis and the C-axis.

8. Bit 8 in D1846 (D1926, D2006, D2086, D2166, D2246): A mode of single-speed motion is activated.
   - After bit 8 in D1846 (D1926, D2006, D2086, D2166, D2246) is set to 1, a mode of single-speed motion will be activated. The target position of the single-speed motion and the speed of the single-speed motion depend on the P (I) and the V (I) which are set by users, and the DVP-10PM series motion controller sends pulses by a pulse generator.
   - If relative single-speed motion is activated, the sign bit of the P (I) set by users will determine the direction of the relative single-speed motion.
   - Absolute single-speed motion: If the target position of the axis specified is greater than its present command position, the motor used will rotate clockwise. If the target position of the axis specified is less than its present command position, the motor used will rotate counterclockwise.
   - After single-speed motion is activated, the speed of the absolute single-speed motion will increase from the V_{BIAS} set to the V (I) set. The speed of the absolute single-speed motion will not decrease from the V (I) set to the V_{BIAS} set until the number of pulses output is near the P (I) set.
   - V_{BIAS}: D1824 (D1904, D1984, D2054, D2134, D2214); V (I): D1840 (D1920, D2000, D2080, D2160, D2240); V_{MAX}: D1822 (D1902, D1982, D2062, D2142, D2222); P (I): D1838 (D1918, D1998, D2078, D2158, D2238); T_{ACC}: D1836 (D1916, D1996, D2076, D2156, D2236); T_{DEC}: D1837 (D1917, D1997, D2077, D2157, D2237)

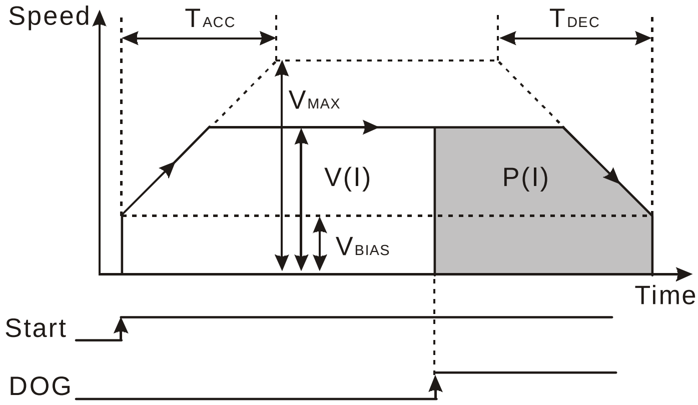


   - If bit 6 in D1816 (D1896, D1976, D2056, D2136, D2216) is ON, and bit 8 in D1846 (D1926, D2006, D2086, D2166, D2246) is ON, Y0~Y3 will execute PWM.

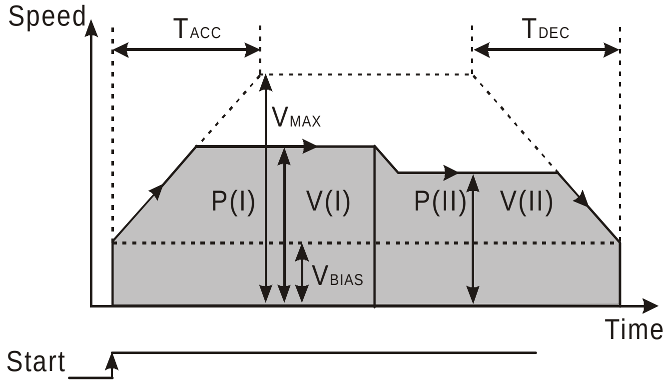
9. Bit 9 in D1846 (D1926, D2006, D2086, D2166, D2246): A mode of inserting single-speed motion is activated.
   - After bit 9 in D1846 (D1926, D2006, D2086, D2166, D2246) is set to 1, a mode of inserting single-speed motion will be activated, and the DVP-10PM series motion controller will send pulses by a pulse generator. After DOG's signal goes from low to high or from high to low, the axis specified will move to the target position indicated by the P (I) set.
   - If relative single-speed motion is activated, the sign bit of the P (I) set by users will determine the direction of the relative single-speed motion.
   - Absolute single-speed motion: If the target position of the axis specified is greater than its present command position, the motor used will rotate clockwise. If the target position of the axis specified is

less than its present command position, the motor used will rotate counterclockwise.

- The speed of motion will increase from the V_{BIAS} set to the V (I) set. After DOG's signal goes from low to high or from high to low, the DVP-10PM series motion controller used will continue sending pulses. The speed of the motion will not decrease from the V (I) set to the V_{BIAS} set until the number of pulses output is near the P (I) set.
- V_{BIAS}: D1824 (D1904, D1984, D2054, D2134, D2214); V (I): D1840 (D1920, D2000, D2080, D2160, D2240); V_{MAX}: D1822 (D1902, D1982, D2062, D2142, D2222); P (I): D1838 (D1918, D1998, D2078, D2158, D2238); T_{ACC}: D1836 (D1916, D1996, D2076, D2156, D2236); T_{DEC}: D1837 (D1917, D1997, D2077, D2157, D2237)



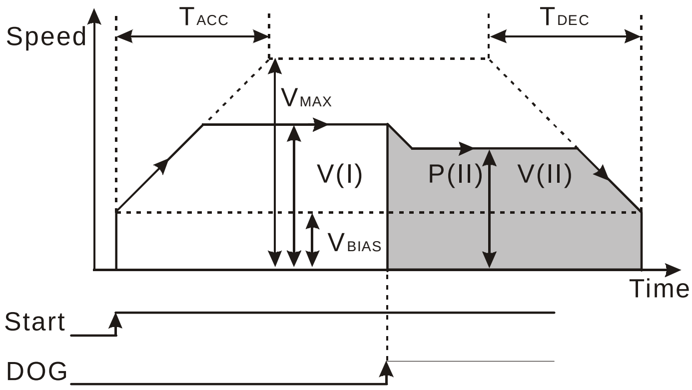
10. Bit 10 in D1846 (D1926, D2006, D2086, D2166, D2246): A mode of two-speed motion is activated.
    - After bit 10 in D1846 (D1926, D2006, D2086, D2166, D2246) is set to 1, a mode of two-speed motion will be activated. The axis specified moves at the V (I) set. After it moves to the P (I) set, it will move to the P (II) set at the V (II) set.
    - Relative coordinates: The sign bit of the P (I) set by users determines the direction of motion. If the P (I) specified is a positive value, the motor used will rotate clockwise. If the P (I) specified is a negative value, the motor used will rotate counterclockwise.
    - Absolute coordinates: If the target position (P (I)) of an axis is greater than its present command position, the motor used will rotate clockwise. If the target position (P (I)) of an axis is less than its present command position, the motor used will rotate counterclockwise.
    - After motion is started, the speed of the motion will increase from the V_{BIAS} set to the V (I) set. The speed of the motion will not increase/decrease from the V (I) set to the V (II) set until the number of pulses output is near the P (I) set. The speed of the motion will not decrease from the V (II) to the V_{BIAS} set until the present command position of the axis specified is near the P (II) set.
11. V_{BIAS}: D1824 (D1904, D1984, D2054, D2134, D2214); V (I): D1840 (D1920, D2000, D2080, D2160, D2240); V (II): D1844 (D1924, D2004, D2084, D2164, D2244); V_{MAX}: D1822 (D1902, D1982, D2062, D2142, D2222); P (I): D1838 (D1918, D1998, D2078, D2158, D2238); P (II): D1842 (D1922, D2002, D2082, D2162, D2242); T_{ACC}: D1836 (D1916, D1996, D2076, D2156, D2236); T_{DEC}: D1837 (D1917, D1997, D2077, D2157, D2237)



12. Bit 11 in D1846 (D1926, D2006, D2086, D2166, D2246): A mode of inserting two-speed motion is

activated.

- After bit 11 in D1846 (D1926, D2006, D2086, D2166, D2246) is set to 1, a mode of inserting two-speed motion will be activated. The axis specified moves at the V (I) set. After DOG's signal goes from low to high or from high to low, the axis will move to the target position indicated by the P (II) set at the V (II) set.
- Relative coordinates: The sign bit of the P (I) set by users determines the direction of motion.
- Absolute coordinates: If the target position (P (I)) of an axis is greater than its present command position, the motor used will rotate clockwise. If the target position (P (I)) of an axis is less than its present command position, the motor used will rotate counterclockwise.
- After motion is started, the speed of the motion will increase from the V_{BIAS} set to the V (I) set. After DOG's signal goes from low to high or from high to low, the speed of the motion will increase/decrease from the V (I) set to the V (II) set.
- V_{BIAS}: D1824 (D1904, D1984, D2054, D2134, D2214); V (I): D1840 (D1920, D2000, D2080, D2160, D2240); V (II): D1844 (D1924, D2004, D2084, D2164, D2244); V_{MAX}: D1822 (D1902, D1982, D2062, D2142, D2222); P (I): D1838 (D1918, D1998, D2078, D2158, D2238); P (II): D1842 (D1922, D2002, D2082, D2162, D2242); T_{ACC}: D1836 (D1916, D1996, D2076, D2156, D2236); T_{DEC}: D1837 (D1917, D1997, D2077, D2157, D2237)



13. Bit 12 inD1846 (D1926, D2006, D2086, D2166, D2246): The execution of the Ox motion subroutine set starts.
    - Bit 12=1: The execution of the Ox motion subroutine set starts.
    - Bit 12=0: The execution of the Ox motion subroutine set stops.

X-axis		Y-axis		Z-axis		Mode of operation
HW	LW	HW	LW	HW	LW	
	D1847		D1927		D2007	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
	D2087		D2167		D2247	

[Description]

1. Bit 2 in D1847 (D1927, D2007, D2087, D2167, D2247): Mode of sending a CLR signal
    - Bit 2=0: After the axis specified returns home, the CLR output will send a 130 millisecond signal to the servo drive used, and the present position of the servo drive which is stored in a register in the servo drive will be cleared.
    - Bit 2=1: The CLR output functions as a general output. Its state is determined by bit 3 in D1847 (D1927, D2007, D2087, D2167, D2247).
2. Bit 3 in D1847 (D1927, D2007, D2087, D2167, D2247): Setting the CLR output to ON/OFF
    - Bit 3=0: The CLR output is OFF.
    - Bit 3=1: The CLR output is ON.
3. Bit 4 in D1847 (D1927, D2007, D2087, D2167, D2247): Setting the polarity of the CLR output
    - Bit 4=0: The CLR output is a Form A contact.
    - Bit 4=1: The CLR output is a Form B contact.

4. Bit 6 in D1847 (D1927, D2007, D2087, D2167, D2247): Limitation on the present position of the slave axis controlled by the manual pulse generator used
   - Bit 6=0: There is no limitation on the present position of the slave axis controlled by the manual pulse generator used.
   - Bit 6=1: The present position of the slave axis controlled by the manual pulse generator used has to be in the range of the P (I) set to the P (II) set. If the present position of the slave axis controlled by the manual pulse generator used is not in the range of the P (I) set to the P (II) set, the slave axis will decelerate and stop.
5. Bit 7 in D1847 (D1927, D2007, D2087, D2167, D2247): Mode of stopping the motor used when the motor used comes into contact with a positive limit switch/negative limit switch
   - Bit 7=0: If the motor used comes into contact with a positive limit switch/negative limit switch when it rotates, it will decelerate and stop.
   - Bit 7=1: If the motor used comes into contact with a positive limit switch/negative limit switch when it rotates, it will stop immediately.
6. Bit 15 in D1847 (D1927, D2007, D2087, D2167, D2247): Restoring the DVP-10PM series motion controller to the factory settings
   - Bit 15=1: The values of parameters are restored to factory settings.

X-axis		Y-axis		Z-axis		Present command position of the axis specified (Pulse)
HW	LW	HW	LW	HW	LW	
D1849	D1848	D1929	D1928	D2009	D2008	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
D2089	D2088	D2169	D2168	D2249	D2248	

[Description]

1. The value in (D1849, D1848) ((D1929, D1928), (D2009, D2008), (D2089, D2088), (D2169, D2168), (D2249, D2248)) is in the range of -2,147,483,648 to +2,147,483,647.
2. The present command position of the axis specified is indicated by the number of pulses. The unit used is determined by bit 0 and bit 1 in D1816 (D1896, D1976, D2056, D2136, D2216). After the axis specified returns home, the value in (D1835, D1834) ((D1915, D1914), (D1995, D1994), (D2075, D2074, (D2155, D2154), (D2235, D2234)) will be written into (D1849, D1848) ((D1929, D1928), (D2009, D2008), (D2089, D2088), (D2169, D2168), (D2249, D2248)).

X-axis		Y-axis		Z-axis		Present command speed of the axis specified (PPS)
HW	LW	HW	LW	HW	LW	
D1851	D1850	D1931	D1930	D2011	D2010	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
D2091	D2090	D2171	D2170	D2251	D2250	

[Description]

1. The value in (D1851, D1850) ((D1931, D1930), (D2011, D2010), (D2091, D2090), (D2171, D2170), (D2251, D2250)) is in the range of 0 to 2,147,483,647.
2. The present command speed of the axis specified is indicated by the number of pulses.

X-axis		Y-axis		Z-axis		Present command position of the axis specified (Unit)
HW	LW	HW	LW	HW	LW	
D1853	D1852	D1933	D1932	D2013	D2012	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
D2093	D2092	D2173	D2172	D2253	D2252	

[Description]

1. The value in (D1853, D1852) ((D1933, D1932), (D2013, D2012), (D2093, D2092), (D2173, D2172),

(D2253, D2252)) is in the range of -2,147,483,648 to +2,147,483,647.

2. The unit used is determined by bit 0 and bit 1 in D1816 (D1896, D1976, D2056, D2136, D2216). After the axis specified returns home, the value in (D1835, D1834) ((D1915, D1914), (D1995, D1994), (D2075, D2074, (D2155, D2154), (D2235, D2234)) will be written into (D1853, D1852) ((D1933, D1932), (D2013, D2012), (D2093, D2092), (D2173, D2172), (D2253, D2252)).

X-axis		Y-axis		Z-axis		
HW	LW	HW	LW	HW	LW	Present command speed of the axis specified (Unit)
D1855	D1854	D1935	D1934	D2015	D2014	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
D2095	D2094	D2175	D2174	D2255	D2254	

[Description]

1. The value in (D1855, D1854) ((D1935, D1934), (D2015, D2014), (D2095, D2094), (D2175, D2174), (D2255, D2254)) is in the range of 0 to 2,147,483,647.
2. The unit used is determined by bit 0 and bit 1 in D1816 (D1896, D1976, D2056, D2136, D2216).

X-axis		Y-axis		Z-axis		
HW	LW	HW	LW	HW	LW	State of the axis specified
	D1856		D1936		D2016	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
	D2096		D2176		D2256	

[Description]

Bit#	D1856 (D1936, D2016…)
0	Positive-going pulses are being output.
1	Negative-going pulses are being output.
2	The axis specified is operating.
3	An error occurs.
4	The axis specified pauses.
5	The manual pulse generator used generates positive-going pulses.
6	The manual pulse generator used generates negative-going pulses.
7	Undefined

X-axis		Y-axis		Z-axis		
HW	LW	HW	LW	HW	LW	Axis error code
	D1857		D1937		D2017	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
	D2097		D2177		D2257	

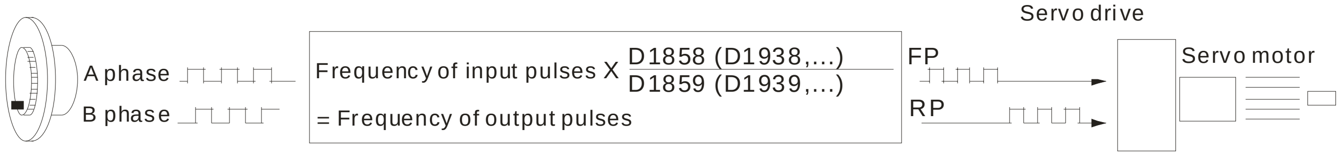
[Description]

Please refer to chapter 11 for more information.

X-axis		Y-axis		Z-axis		Electronic gear ratio
HW	LW	HW	LW	HW	LW	
	D1858		D1938		D2018	Electronic gear ratio (Numerator)
	D1859		D1939		D2019	Electronic gear ratio (Denominator)
A-axis		**B-axis**		**C-axis**		Electronic gear ratio
HW	**LW**	**HW**	**LW**	**HW**	**LW**	
	D2098		D2178		D2258	Electronic gear ratio (Numerator)
	D2099		D2179		D2259	Electronic gear ratio (Denominator)

[Description]

1. If bit 5 in D1846 (D1926, D2006, D2086, D2166, D2246) is set to ON, a manual pulse generator mode will be activated.
2. A manual pulse generator generates A/B-phase pulses that are sent to the input terminals X10± and X11±. The relation between the position of the axis specified and the input pulses generated by the manual pulses used is shown below.



   If a positive limit switch or a negative limit switch is enabled when a manual pulse generator is operated, the generation of pulses will stop. If a positive limit switch is enabled, positive-going pulses will be inhibited, and negative-going will be allowed. If a negative limit switch is enabled, negative-going pulses will be inhibited, and positive-going switch will be allowed.
3. The speed output is determined by the frequency of input pulses generated by a manual pulse generator and an electronic gear ratio.

X-axis		Y-axis		Z-axis		Frequency of pulses generated by the manual pulse generator for the axis specified
HW	LW	HW	LW	HW	LW	
D1861	D1860	D1941	D1940	D2021	D2020	
A-axis		**B-axis**		**C-axis**		
HW	**LW**	**HW**	**LW**	**HW**	**LW**	
D2101	D2100	D2181	D2180	D2261	D2260	

[Description]

1. The value in (D1861, D1860) ((D1941, D1940), (D2021, D2020), (D2101, D2100), (D2181, D2180), (D2261, D2260)) indicates the frequency of pulses generated by the manual pulse generator for the axis specified. It does not vary with the values in D1858 (D1938, D2018, D2098, D2178, D2258) and D1859 (D1939, D2019, 2099, D2179, D2259).

X-axis		Y-axis		Z-axis		Number of pulses generated by the manual pulse generator for the axis specified
HW	LW	HW	LW	HW	LW	
D1863	D1862	D1943	D1942	D2023	D2022	
A-axis		**B-axis**		**C-axis**		
HW	**LW**	**HW**	**LW**	**HW**	**LW**	
D2103	D2102	D2183	D2182	D2263	D2262	

[Description]

1. The value in (D1863, D1862) ((D1943, D1942), (D2023, D2022), (D2103, D2102), (D2183, D2182), (D2263, D2262)) indicates the number of pulses generated by the manual pulse generator for the axis specified. If the pulses generated by the manual pulse generator for the axis specified are clockwise pulses, the value in (D1863, D1862) ((D1943, D1942), (D2023, D2022), (D2103, D2102), (D2183, D2182), (D2263, D2262)) will increase. If the pulses generated by the manual pulse generator for the axis specified are counterclockwise pulses, the value in (D1863, D1862) ((D1943, D1942), (D2023, D2022), (D2103, D2102), (D2183, D2182), (D2263, D2262)) will decrease.

2. The value in (D1863, D1862) ((D1943, D1942), (D2023, D2022), (D2103, D2102), (D2183, D2182), (D2263, D2262)) does not vary with the values in D1858 (D1938, D2018, D2098, D2178, D2258) and D1859 (D1939, D2019, 2099, D2179, D2259).

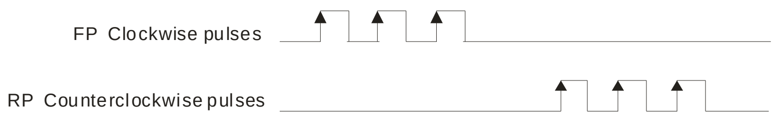
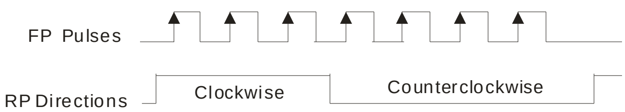
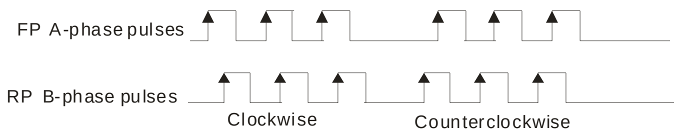
X-axis		Y-axis		Z-axis		
HW	LW	HW	LW	HW	LW	Response speed of the manual pulse generator for the axis specified
	D1864		D1944		D2024	
A-axis		B-axis		C-axis		
HW	LW	HW	LW	HW	LW	
	D2104		D2184		D2264	

[Description]

1. If the response speed set is high, the pulses output happen almost at the same time as the pulses input by the manual pulse generator used.
2. If the response speed set is low, the pulses output follows the pulses input by the manual pulse generator used.

Setting value	Response speed
≧5	4 ms (Initial value)
4	32 ms
3	108 ms
2	256 ms
1 or 0	500 ms

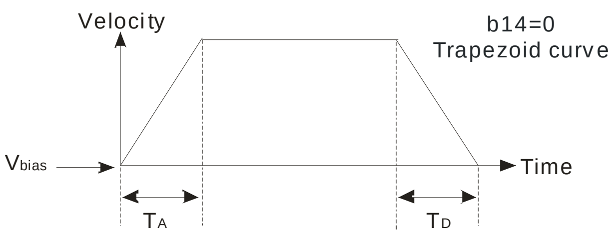
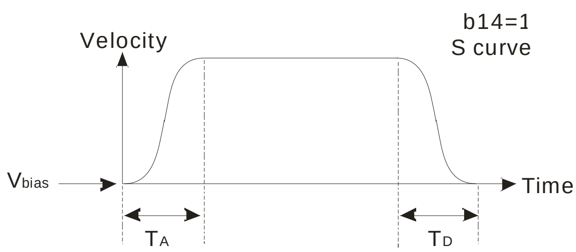
3. Bit 8 and bit 9 in D1864 (D1944, D2024, D2104, D2184, D2264): Setting the input pulses generated by the manual pulse generator specified

b9	b8	Input type (positive logic)	Description
0	0		Counting up/down
0	1		Pulses+Directions
1	0		A/B-phase pulses
1	1		Four times the frequency of A/B-phase pulses

3.12.2 Introduction of Modes of Motion

1. There are eight modes of motions.
   1. Returning home
   2. JOG motion
   3. Single-speed motion
   4. Inserting single-speed motion
   5. Two-speed motion
   6. Inserting two-speed motion
   7. Variable motion
   8. Manual pulse generator mode
2. If more than one mode of motion is activated, they will be executed in particular order.
   1. Stopping the motion of the axis specified by software
   2. Returning home
   3. Positive JOG motion
   4. Negative JOG motion
   5. Manual pulse generator mode
   6. Variable motion
   7. Single-speed motion
   8. Inserting single-speed motion
   9. Two-speed motion
   10. Inserting two-speed motion

   If a mode of motion is activated when another mode of motion is executed, the DVP-10PM series motion controller will continue executing the original mode.
3. There are two types of acceleration curves.

1. Trapezoid curve	2. S curve
	

3.12.3 Special Data Registers for Motion Axes

Special data registers for motion axes								Parameter	Mode of operation							
X-axis		Y-axis		Z-axis		A-axis			JOG motion	Returning home	Single-speed motion	Inserting single-speed motion	Two-speed motion	Inserting two-speed motion	Variable motion	Manual pulse generator mode
HW	LW	HW	LW	HW	LW	HW	LW									
D1819	D1818	D1899	D1898	D1979	D1978	D2059	D2058	Number of pulses it takes for the motor of the axis specified to rotate once (A)	If the unit used is a motor unit, the special data registers do not need to be set. If the unit used is a mechanical unit or a compound unit, the special data registers need to be set.							
D1821	D1820	D1901	D1900	D1981	D1980	D2061	D2060	Distance generated after the motor of the axis specified rotate once (B)								
-	D1816	-	D1896	-	D1976	-	D2056	Setting the parameters of the axis specified	◎	◎	◎	◎	◎	◎	◎	◎
D1823	D1822	D1903	D1902	D1983	D1982	D2063	D2062	Maximum speed (V_{MAX}) at which the axis specified rotates	◎	◎	◎	◎	◎	◎	◎	◎
D1825	D1824	D1905	D1904	D1985	D1984	D2065	D2064	Start-up speed (V_{BIAS}) at which the axis specified rotates	◎	◎	◎	◎	◎	◎	◎	◎
D1827	D1826	D1907	D1906	D1987	D1986	D2067	D2066	JOG speed (V_{JOG}) at which the axis specified rotates	◎	-	-	-	-	-	-	-
D1829	D1828	D1909	D1908	D1989	D1988	D2069	D2068	Speed (V_{RT}) at which the axis specified returns home								
D1831	D1830	D1911	D1910	D1991	D1990	D2071	D2070	Speed (V_{CR}) to which the speed of the axis specified decreases when the axis returns home	-	◎	-	-	-	-	-	-
-	D1832	-	D1912	-	D1992	-	D2072	Number of PG0 pulses for the axis specified								
-	D1833	-	D1913	-	D1993	-	D2073	Supplementary pulses for the axis specified								
D1835	D1834	D1915	D1914	D1995	D1994	D2075	D2074	Home position of the axis specified								
-	D1836	-	D1916	-	D1996	-	D2076	Time (T_{ACC}) it takes for the axis specified to accelerate	◎	◎	◎	◎	◎	◎	◎	-
-	D1837	-	D1917	-	D1997	-	D2077	Time (T_{DEC}) it takes for the axis specified to decelerate	◎	◎	◎	◎	◎	◎	◎	-
D1839	D1838	D1919	D1918	D1999	D1998	D2079	D2078	Target position of the axis specified (P (I))	-	-	◎	◎	◎	◎	-	◎
D1841	D1840	D1921	D1920	D2001	D2000	D2081	D2080	Speed at which the axis specified rotates (V (I))	-	-	◎	◎	◎	◎	◎	-
D1843	D1842	D1923	D1922	D2003	D2002	D2083	D2082	Target position of the axis specified (P (II))	-	-	-	-	◎	◎	-	◎
D1845	D1844	D1925	D1924	D2005	D2004	D2085	D2084	Speed at which the axis specified rotates (V (II))	-	-	-	-	◎	◎	-	-
-	D1846	-	D1926	-	D2006	-	D2086	Operation command	◎	◎	◎	◎	◎	◎	◎	◎

Special data registers for motion axes								Parameter	Mode of operation							
X-axis		Y-axis		Z-axis		A-axis			JOG motion	Returning home	Single-speed motion	Inserting single-speed motion	Two-speed motion	Inserting two-speed motion	Variable motion	Manual pulse generator mode
HW	LW	HW	LW	HW	LW	HW	LW									
-	D1847	-	D1927	-	D2007	-	D2087	Mode of operation	◎	◎	◎	◎	◎	◎	◎	◎
D1849	D1848	D1929	D1928	D2009	D2008	D2089	D2088	Present command position of the axis specified (Pulse)	◎	◎	◎	◎	◎	◎	◎	◎
D1851	D1850	D1931	D1930	D2011	D2010	D2091	D2090	Present command speed of the axis specified (PPS)	◎	◎	◎	◎	◎	◎	◎	◎
D1853	D1852	D1933	D1932	D2013	D2012	D2093	D2092	Present command position of the axis specified (Unit)	◎	◎	◎	◎	◎	◎	◎	◎
D1855	D1854	D1935	D1934	D2015	D2014	D2095	D2094	Present command speed of the axis specified (Unit)	◎	◎	◎	◎	◎	◎	◎	◎
-	D1858	-	D1938	-	D2018	-	D2098	Electronic gear ratio of the axis specified (Numerator)	-	-	-	-	-	-	-	◎
-	D1859	-	D1939	-	D2019	-	D2099	Electronic gear ratio of the axis specified (Denominator)	-	-	-	-	-	-	-	◎
D1861	D1860	D1941	D1940	D2021	D2020	D2101	D2100	Frequency of pulses generated by the manual pulse generator for the axis specified	-	-	-	-	-	-	-	◎
D1863	D1862	D1943	D1942	D2023	D2022	D2103	D2102	Number of pulses generated by the manual pulse generator for the axis specified	-	-	-	-	-	-	-	◎
-	D1864	-	D1944	-	D2024	-	D2104	Response speed of the manual pulse generator for the axis specified	-	-	-	-	-	-	-	◎
D1865	-	-	-	-	-	-	-	Mode of stopping Ox0~Ox99	-	-	-	-	-	-	-	-
D1867	D1866	D1947	D1946	D2027	D2026	-	-	Electrical zero of the axis specified	-	-	-	-	-	-	-	-
D1868	-	-	-	-	-	-	-	Setting an Ox motion subroutine number	-	-	-	-	-	-	-	-
D1869	-	-	-	-	-	-	-	Step address in the Ox motion subroutine at which an error occurs	-	-	-	-	-	-	-	-
D1872	-	-	-	-	-	-	-	Enabling a Y device when the Ox motion subroutine is ready	◎	◎	◎	◎	◎	◎	◎	◎
D1873	-	-	-	-	-	-	-	Enabling a Y device when an M-code in the Ox motion subroutine is executed	-	-	-	-	-	-	-	-
D1874	-	-	-	-	-	-	-	Using an X device to reset the M-code	-	-	-	-	-	-	-	-

Special data registers for motion axes								Parameter	Mode of operation							
X-axis		Y-axis		Z-axis		A-axis			JOG motion	Returning home	Single-speed motion	Inserting single-speed motion	Two-speed motion	Inserting two-speed motion	Variable motion	Manual pulse generator mode
HW	LW	HW	LW	HW	LW	HW	LW									
D1875	-	D1955	-	-	-	-	-	Starting the axis specified manually (ZRN, MPG, JOG-, JOG+)	◎	-	-	-	-	-	-	◎

Special data registers for motion axes				Parameter	Mode of operation							
B-axis		C-axis			JOG motion	Returning home	Single-speed motion	Inserting single-speed motion	Two-speed motion	Inserting two-speed motion	Variable motion	Manual pulse generator mode
HW	LW	HW	LW									
D2139	D2138	D2219	D2218	Number of pulses it takes for the motor of the axis specified to rotate once	If the unit used is a motor unit, the special data registers do not need to be set. If the unit used is a mechanical unit or a compound unit, the special data registers need to be set.							
D2141	D2140	D2221	D2220	Distance generated after the motor of the axis specified rotate once								
-	D2136	-	D2216	Setting the parameters of the axis specified	◎	◎	◎	◎	◎	◎	◎	◎
D2143	D2142	D2223	D2222	Maximum speed (V_{MAX}) at which the axis specified rotates	◎	◎	◎	◎	◎	◎	◎	◎
D2145	D2144	D2225	D2224	Start-up speed (V_{BIAS}) at which the axis specified rotates	◎	◎	◎	◎	◎	◎	◎	◎
D2147	D2146	D2227	D2226	JOG speed (V_{JOG}) at which the axis specified rotates	◎	-	-	-	-	-	-	-

Special data registers for motion axes				Parameter	Mode of operation							
B-axis		C-axis			JOG motion	Returning home	Single-speed motion	Inserting single-speed motion	Two-speed motion	Inserting two-speed motion	Variable motion	Manual pulse generator mode
HW	LW	HW	LW									
D2149	D2148	D2229	D2228	Speed (V_{RT}) at which the axis specified returns home	-	◎	-	-	-	-	-	-
D2151	D2150	D2231	D2230	Speed (V_{CR}) to which the speed of the axis specified decreases when the axis returns home								
-	D2152	-	D2232	Number of PG0 pulses for the axis specified								
-	D2153	-	D2233	Supplementary pulses for the axis specified								
D2155	D2154	D2235	D2234	Home position of the axis specified								
-	D2156	-	D2236	Time (T_{ACC}) it takes for the axis specified to accelerate	◎	◎	◎	◎	◎	◎	◎	-
-	D2157	-	D2237	Time (T_{DEC}) it takes for the axis specified to decelerate	◎	◎	◎	◎	◎	◎	◎	-
D2159	D2158	D2239	D2238	Target position of the axis specified (P (I))	-	-	◎	◎	◎	◎	-	◎
D2161	D2160	D2242	D2240	Speed at which the axis specified rotates (V (I))	-	-	◎	◎	◎	◎	◎	-
D2163	D2162	D2243	D2242	Target position of the axis specified (P (II))	-	-	-	-	◎	◎	-	◎
D2165	D2164	D2245	D2244	Speed at which the axis specified rotates (V (II))	-	-	-	-	◎	◎	-	-
-	D2166	-	D2246	Operation command	◎	◎	◎	◎	◎	◎	◎	◎
-	D2167	-	D2247	Mode of operation	◎	◎	◎	◎	◎	◎	◎	◎
D2169	D2168	D2249	D2248	Present command position of the axis specified (Pulse)	◎	◎	◎	◎	◎	◎	◎	◎
D2171	D2170	D2251	D2250	Present command speed of the axis specified (PPS)	◎	◎	◎	◎	◎	◎	◎	◎
D2173	D2172	D2253	D2252	Present command position of the axis specified (Unit)	◎	◎	◎	◎	◎	◎	◎	◎
D2175	D2174	D2255	D2254	Present command speed of the axis specified (Unit)	◎	◎	◎	◎	◎	◎	◎	◎
-	D2178	-	D2258	Electronic gear ratio of the axis specified (Numerator)	-	-	-	-	-	-	-	◎
-	D2179	-	D2259	Electronic gear ratio of the axis specified (Denominator)	-	-	-	-	-	-	-	◎

Special data registers for motion axes				Parameter	Mode of operation							
B-axis		C-axis			JOG motion	Returning home	Single-speed motion	Inserting single-speed motion	Two-speed motion	Inserting two-speed motion	Variable motion	Manual pulse generator mode
HW	LW	HW	LW									
D2181	D2180	D2261	D2260	Frequency of pulses generated by the manual pulse generator for the axis specified	-	-	-	-	-	-	-	◎
D2183	D2182	D2263	D2262	Number of pulses generated by the manual pulse generator for the axis specified	-	-	-	-	-	-	-	◎
-	D2184	-	D2264	Response speed of the manual pulse generator for the axis specified	-	-	-	-	-	-	-	◎

◎ indicates that the special data registers are applicable to the motion.

MEMO

4.1 Table of Basic Instructions

📖 General instructions

Instruction code	Function	Operand	Execution speed (μs)	Step	Page number
LD	Loading a Form A contact	X, Y, M, S, T, C	0.14	3	4-3
LDI	Loading a Form B contact	X, Y, M, S, T, C	0.14	3	4-3
AND	Connecting a Form A contact in series	X, Y, M, S, T, C	0.14	3	4-4
ANI	Connecting a Form B contact in series	X, Y, M, S, T, C	0.14	3	4-4
OR	Connecting a Form A contact in parallel	X, Y, M, S, T, C	0.14	3	4-5
ORI	Connecting a Form B contact in parallel	X, Y, M, S, T, C	0.14	3	4-5
ANB	Connecting circuit blocks in series	None	-	3	4-6
ORB	Connecting circuit blocks in parallel	None	-	3	4-7

📖 Output instructions

Instruction code	Function	Operand	Execution speed (μs)	Step	Page number
OUT	Driving a coil	Y, M, S	-	3	4-7
SET	Keeping a device ON	Y, M, S	-	3	4-8
RST	Resetting a contact or a register	Y, M, S, T, C, D, V, Z	-	3	4-8

📖 Timer and counters

API	Instruction code	Function	Operand	Execution speed (μs)	Step	Page number
96	TMR	16-bit timer	T-K or T-D	6	5	4-9
97	CNT	16-bit counter	C-K or C-D (16 bits)	2.8	5	4-9
97	DCNT	32-bit counter	C-K or C-D (32 bits)	2.8	6	4-10

📖 Rising-edge/Falling-edge detection instructions

API	Instruction code	Function	Operand	Execution speed (μs)	Step	Page number
90	LDP	Starting rising-edge detection	X, Y, M, S, T, C	0.4	3	4-10
91	LDF	Starting falling-edge detection	X, Y, M, S, T, C	0.5	3	4-11
92	ANDP	Connecting rising-edge detection in series	X, Y, M, S, T, C	0.4	3	4-11
93	ANDF	Connecting falling-edge detection in series	X, Y, M, S, T, C	0.4	3	4-12
94	ORP	Connecting rising-edge detection in parallel	X, Y, M, S, T, C	0.5	3	4-12
95	ORF	Connecting falling-edge detection in parallel	X, Y, M, S, T, C	0.4	3	4-13

Rising-edge/Falling-edge output instruction

API	Instruction code	Function	Operand	Execution speed (us)	Step	Page number
89	PLS	Rising-edge output	Y, M	0.2	3	4-14
99	PLF	Falling-edge output	Y, M	0.3	3	4-14

Other instructions

Instruction code	Function	Operand	Execution speed (us)	Step	Page number
P	Pointer	P0~P255	-	1	4-15

4.2 Descriptions of the Basic Instructions

Instruction code	Function	Applicable model
LD	Loading a Form A contact	10PM
		✓

Operand	X0~X377	Y0~Y377	M0~M4,095	S0~S1,023	T0~T255	C0~C255	D0~D9,999
	✓	✓	✓	✓	✓	✓	-

Explanation

◆ The instruction LD applies to the Form A contact which starts from a busbar or the Form A contact which is the start of a circuit. It reserves the present contents, and stores the state which is gotten in the accumulation register.

Example

Ladder diagram:

Instruction code:		Description:
LD	**X0**	Loading the Form A contact X0
AND	X1	Connecting the Form A contact X1 in series
OUT	Y1	Driving the coil Y1

Instruction code	Function	Applicable model
LDI	Loading a Form B contact	10PM
		✓

Operand	X0~X377	Y0~Y377	M0~M4,095	S0~S1,023	T0~T255	C0~C255	D0~D9,999
	✓	✓	✓	✓	✓	✓	-

Explanation

◆ The instruction LDI applies to the Form B contact which starts from a busbar or the Form B contact which is the start of a circuit. It reserves the present contents, and stores the state which is gotten in an accumulation register.

Example

Ladder diagram:

Instruction code:		Description:
LDI	**X0**	Loading the Form B contact X0
AND	X1	Connecting the Form A contact X1 in series
OUT	Y1	Driving the coil Y1

Instruction code	Function	Applicable model
		10PM
AND	Connecting a Form A contact in series	✓

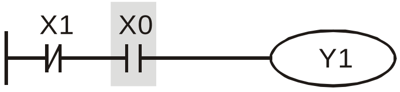
Operand	X0~X377	Y0~Y377	M0~M4,095	S0~S1,023	T0~T255	C0~C255	D0~D9,999
	✓	✓	✓	✓	✓	✓	-

Explanation

◆ The instruction AND is used to connect a Form A contact in series. It reads the state of a contact which is connected in series, and performs the AND operation on the previous logical operation result. The final result is stored in an accumulation register.

Example

Ladder diagram:



Instruction code:		Description:
LDI	X1	**Loading the Form B contact X1**
AND	**X0**	Connecting the Form A contact X0
OUT	Y1	Driving the coil Y1

Instruction code	Function	Applicable model
		10PM
ANI	Connecting a Form B contact in series	✓

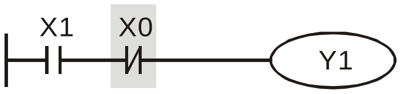
Operand	X0~X377	Y0~Y377	M0~M4,095	S0~S1,023	T0~T255	C0~C255	D0~D9,999
	✓	✓	✓	✓	✓	✓	-

Explanation

◆ The instruction ANI is used to connect a Form B contact in series. It reads the state of a contact which is connected in series, and performs the AND operation on the previous logical operation result. The final result is stored in an accumulation register.

Example

Ladder diagram:



Instruction code:		Description:
LD	X1	Loading the Form A contact X1
ANI	**X0**	Connecting the Form B contact X0 in series
OUT	Y1	Driving the coil Y1

Instruction code	Function	Applicable model
OR	Connecting a Form A contact in parallel	10PM
		✓

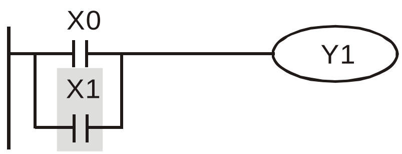
Operand	X0~X377	Y0~Y377	M0~M4,095	S0~S1,023	T0~T255	C0~C255	D0~D9,999
	✓	✓	✓	✓	✓	✓	-

Explanation

- The instruction OR is used to connect a Form A contact in parallel. It reads the state of a contact which is connected in parallel, and performs the OR operation on the previous logical operation result. The final result is stored in an accumulation register.

Example

Ladder diagram:



Instruction code:		Description:
LD	X0	Loading the Form A contact X0
OR	**X1**	Connecting the Form A contact X1 in parallel
OUT	Y1	Driving the coil Y1

Instruction code	Function	Applicable model
ORI	Connecting a Form B contact in parallel	10PM
		✓

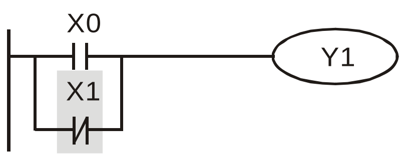
Operand	X0~X377	Y0~Y377	M0~M4,095	S0~S1,023	T0~T255	C0~C255	D0~D9,999
	✓	✓	✓	✓	✓	✓	-

Explanation

- The instruction ORI is used to connect a Form B contact in parallel. It reads the state of a contact which is connected in parallel, and performs the OR operation on the previous logical operation result. The final result is stored in an accumulation register.

Example

Ladder diagram:



Instruction code:		Description:
LD	X0	Loading the Form A contact X0
ORI	**X1**	Connecting the Form B contact X1 in parallel
OUT	Y1	Driving the coil Y1

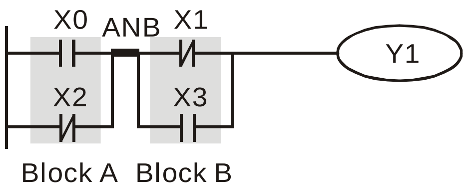
Instruction code	Function	Applicable model
		10PM
ANB	Connecting circuit blocks in series	✓
Operand	None	

Explanation

◆ The instruction ANB is used to perform the AND operation on the logical operation result reserved previously and the contents of the present accumulation register.

Example

Ladder diagram:



Instruction code:		Description:
LD	X0	Loading the Form A contact X0
ORI	X2	Connecting the Form B contact X2 in parallel
LDI	X1	Loading the Form B contact X1
OR	X3	Connecting the Form A contact X3 in parallel
ANB		Connecting the circuit blocks in series
OUT	Y1	Driving the coil Y1

Instruction code	Function	Applicable model
		10PM
ORB	Connecting circuit blocks in parallel	✓

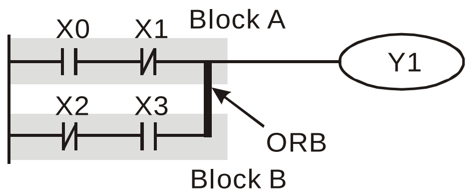
Operand	None

Explanation

- The instruction ORB is used to perform the OR operation on the logical operation result reserved previously and the contents of the present accumulation register.

Example

Ladder diagram:



Instruction code:		Description:
LD	X0	Loading the Form A contact X0
ANI	X1	Connecting the Form B contact X1 in series
LDI	X2	Loading the Form B contact X2
AND	X3	Connecting the Form A contact X3 in series
ORB		Connecting the circuit blocks in parallel
OUT	Y1	Driving the coil Y1

Instruction code	Function	Applicable model
		10PM
OUT	Driving a coil	✓

Operand	X0~X377	Y0~Y377	M0~M4,095	S0~S1,023	T0~T255	C0~C255	D0~D9,999
	-	✓	✓	✓	-	-	-

Explanation

- The logical operation result prior to the application of the instruction OUT is sent to the device specified.
- Action of a coil

Operation result	**OUT**		
	Coil	**Contact**	
		Form A contact (Normally-open contact)	**Form B contact (Normally-closed contact)**
False	Off	OFF	ON
True	On	ON	OFF

Example

Ladder diagram:

Instruction code:		Description:
LDI	X0	Loading the Form B contact X0
AND	X1	Connecting the Form A contact X1 in series
OUT	**Y1**	Driving the coil Y1

Instruction code	Function	Applicable model
		10PM
SET	Keeping a device ON	✓

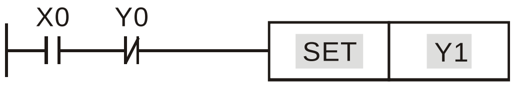
Operand	X0~X377	Y0~Y377	M0~M4,095	S0~S1,023	T0~T255	C0~C255	D0~D9,999
	-	✓	✓	✓	-	-	-

Explanation

- When the instruction SET is driven, the device specified is set to ON. Whether the instruction SET is still driven or not, the device specified remains ON. Users can set the device specified to OFF by means of the instruction RST.

Example

Ladder diagram:



Instruction code:		Description:
LD	X0	Loading the Form A contact X0
ANI	Y0	Connecting the Form B contact Y0
SET	**Y1**	Y01 remains ON.

Instruction code	Function	Applicable model
		10PM
RST	Resetting a contact or a register	✓

Operand	X0~X377	Y0~Y377	M0~M4,095	S0~S1,023	T0~T255	C0~C255	D0~D9,999
	-	✓	✓	✓	✓	✓	✓

Explanation

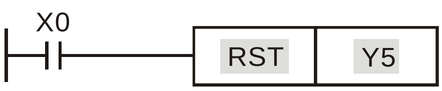
- When the instruction RST is driven, the device specified acts in the way described below.

Device	State
S, Y, M	The coil and the contact are set to OFF.
T, C	The present timer value or the present counter value becomes 0. The coil and the contact are set to OFF.
D, V, Z	The value becomes 0.

- If the instruction RST is not executed, the state of the device specified will remain unchanged.

Example

Ladder diagram:



Instruction code:		Description:
LD	X0	Loading the Form A contact X0
RST	**Y5**	Resetting Y5

Instruction code	Function	Applicable model
		10PM
TMR	16-bit timer	✓

Operand	T-K	T0~T255, K0~K32,767
	T-D	T0~T255, D0~D9,999

Explanation

◆ When the instruction TMR is executed, the coil specified is ON, and the timer specified begins to count. If the timer value matches the setting value (timer value≧setting value), the contact specified will act in the way described below.

NO (Normally-open) contact	OFF
NC (Normally-closed) contact	ON

Example

Ladder diagram:

Instruction code:		Description:
LD	X0	Loading the Form A contact X0
TMR	**T5 K1000**	The setting value in the timer T5 is K1000.

Additional remark

◆ Please refer to the specifications for the model used for more information about the timer range which can be used.

Instruction code	Function	Applicable model
		10PM
CNT	16-bit counter	✓

Operand	C-K	C0~C199, K0~K32,767
	C-D	C0~C199, D0~D9,999

Explanation

◆ When the counter coil specified by the instruction CNT is turned from OFF to ON, the counter value increases by 1. If the counter value matches the setting value (counter value=setting value), the contact specified will act in the way described below.

NO (Normally-open) contact	OFF
NC (Normally-closed) contact	ON

◆ If there are pulses sent to the counter specified by the instruction CNT after the counter value matches the setting value, the state of the contact specified and the counter value will remain unchanged. Users can reset a counter by means of the instruction RST.

Example

Ladder diagram:

Instruction code:		Description:
LD	X0	Loading the Form A contact X0
CNT	**C20 K100**	The setting value in the counter C20 is K100.

Instruction code	Function	Applicable model
		10PM
DCNT	32-bit counter	✓

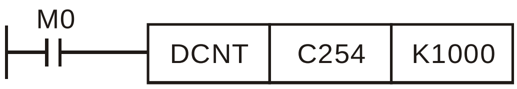
Operand		
Operand	C-K	C200, C204, C208~C255, K-2,147,483,648~K2,147,483,647
	C-D	C200, C204, C208~C255, D0~D9,999

Explanation

- DCNT is an instruction which is used to enable the 32-bit counters C200~C255.
- C221~C2255 are general up/down counters. When the counter coil specified by the instruction DCNT is turned from OFF to ON, the counter value increases or decreases by one according to the setting of M1200~M1234.

Example

Ladder diagram:



Instruction code:		Description:
LD	M0	Loading the Form A contact M0
DCNT	**C254 K1000**	The setting value in the counter C254 is K1000.

Instruction code	Function	Applicable model
		10PM
LDP	Starting rising-edge detection	✓

Operand	X0~X377	Y0~Y377	M0~M4,095	S0~S1,023	T0~T255	C0~C255	D0~D9,999
	✓	✓	✓	✓	✓	✓	-

Explanation

- The usage of LDP is similar to that of LD, but the action of LDP is different from that of LD. LDP reserves the present contents, and stores the state of the rising edge-triggered contact specified to an accumulation register.

Example

Ladder diagram:

Instruction code:		Description:
LDP	**X0**	Starting the detection of the state of the rising edge-triggered contact X0
AND	X1	Connecting the Form A contact X1 in series
OUT	Y1	Driving the coil Y1

Additional remark

- Please refer to the specifications for the model used for more information about the operand ranges which can be used.
- If the state of a rising edge-triggered contact in a DVP-10PM series motion controller is ON before the DVP-10PM series motion controller is powered, it is TRUE after the DVP-10PM series motion controller is powered.

Instruction code	Function	Applicable model
		10PM
LDF	Starting falling-edge detection	✓

Operand	X0~X377	Y0~Y377	M0~M4,095	S0~S1,023	T0~T255	C0~C255	D0~D9,999
	✓	✓	✓	✓	✓	✓	-

Explanation

- The usage of LDF is similar to that of LD, but the action of LDP is different from that of LD. LDF reserves the present contents, and stores the state of the falling edge-triggered contact specified to an accumulation register.

Example

Ladder diagram:

Instruction code:		Description:
LDF	**X0**	Starting the detection of the state of the falling edge-triggered contact X0
AND	X1	Connecting the Form A contact X1 in series
OUT	Y1	Driving the coil Y1

Instruction code	Function	Applicable model
		10PM
ANDP	Connecting rising-edge detection in series	✓

Operand	X0~X377	Y0~Y377	M0~M4,095	S0~S1,023	T0~T255	C0~C255	D0~D9,999
	✓	✓	✓	✓	✓	✓	-

Explanation

- The instruction ANDP is used to connect a rising edge-triggered contact in series.

Example

Ladder diagram:

Instruction code:		Description:
LD	X0	Loading the Form A contact X0
ANDP	**X1**	Connecting the rising edge-triggered contact X1 in series
OUT	Y1	Driving the coil Y1

Instruction code	Function	Applicable model
		10PM
ANDF	Connecting falling-edge detection in series	✓

Operand	X0~X377	Y0~Y377	M0~M4,095	S0~S1,023	T0~T255	C0~C255	D0~D9,999
	✓	✓	✓	✓	✓	✓	-

Explanation

◆ The instruction ANDF is used to connect a falling edge-triggered contact in series.

Example

Ladder diagram:

Instruction code:		Description:
LD	X0	Loading the Form A contact X0
ANDF	**X1**	Connecting the falling edge-triggered contact X1 in series
OUT	Y1	Driving the coil Y1

Instruction code	Function	Applicable model
		10PM
ORP	Connecting rising-edge detection in parallel	✓

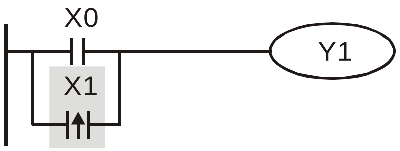
Operand	X0~X377	Y0~Y377	M0~M4,095	S0~S1,023	T0~T255	C0~C255	D0~D9,999
	✓	✓	✓	✓	✓	✓	-

Explanation

◆ The instruction ORP is used to connect a rising edge-triggered contact in parallel.

Example

Ladder diagram:



Instruction code:		Description:
LD	X0	Loading the Form A contact X0
ORP	**X1**	Connecting the rising edge-triggered contact X1 in parallel
OUT	Y1	Driving the coil Y1

Instruction code	Function	Applicable model
ORF	Connecting falling-edge detection in parallel	10PM
		✓

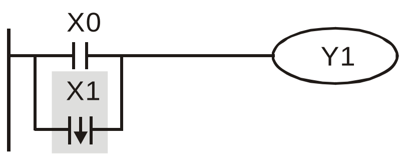
Operand	X0~X377	Y0~Y377	M0~M4,095	S0~S1,023	T0~T255	C0~C255	D0~D9,999
	✓	✓	✓	✓	✓	✓	-

Explanation

- The instruction ORF is used to connect a falling edge-triggered contact in parallel.

Example

Ladder diagram:



Instruction code:		Description:
LD	X0	Loading the Form A contact X0
ORF	**X1**	Connecting the falling edge-triggered contact X1
OUT	Y1	Driving the coil Y1

Instruction code	Function	Applicable model
		10PM
PLS	Rising-edge output	✓

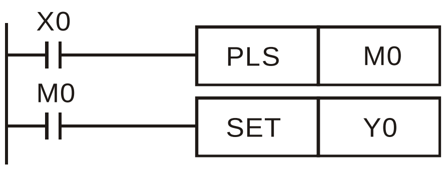
Operand	X0~X377	Y0~Y377	M0~M4,095	S0~S1,023	T0~T255	C0~C255	D0~D9,999
	-	✓	✓	-	-	-	-

Explanation

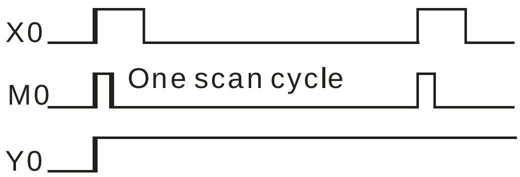
- PLS is a rising-edge output instruction. When X0 is turned from OFF to ON, the instruction PLS is executed. M0 sends a pulse for a scan cycle.

Example

Ladder diagram:



Timing diagram:



Instruction code:		Description:
LD	X0	Loading the Form A contact X0
PLS	**M0**	M0 is rising edge-triggered.
LD	M0	Loading the Form A contact M0
SET	Y0	Y0 remains ON.

Instruction code	Function	Applicable model
		10PM
PLF	Falling-edge output	✓

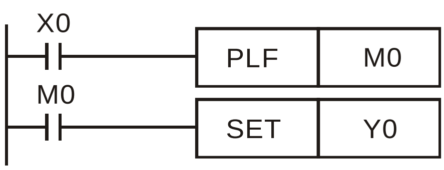
Operand	X0~X377	Y0~Y377	M0~M4,095	S0~S1,023	T0~T255	C0~C255	D0~D9,999
	-	✓	✓	-	-	-	-

Explanation

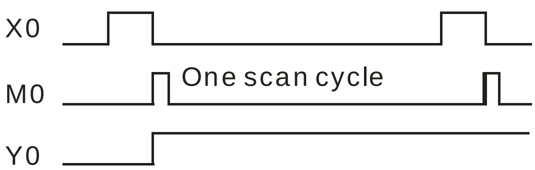
- PLF is a falling-edge output instruction. When X0 is turned from ON to OFF, the instruction PLF is executed. MO sends a pulse for a scan cycle.

Example

Ladder diagram:



Timing diagram:



Instruction code:		Description:
LD	X0	Loading the Form A contact X0
PLF	**M0**	M0 is falling edge-triggered.
LD	M0	Loading the Form A contact M0
SET	Y0	Y0 remains ON.

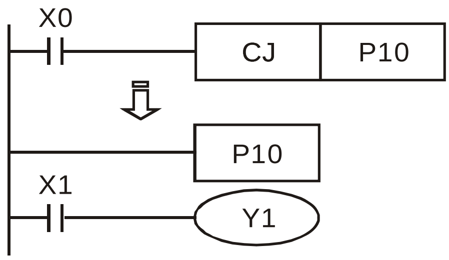
Instruction code	Function	Applicable model
		10PM
P	Pointer	✓
Operand	P0~P255	

Explanation

A pointer can be used by API 00 CJ, API 01 CALL, API 256 CJN, and API 257 JMP. The pointers used do not have to start from P0. A pointer number can not be used repeatedly, otherwise an unexpected error will occur.

Example

Ladder diagram:



Instruction code:		Description:
LD	X0	Loading the Form A contact X0
CJ	P10	The jump instruction CJ specifies P10.
:		
P10		Pointer P10
LD	X1	Loading the Form A contact X1
OUT	Y1	Driving the coil Y1

MEMO

5.1 Table of Applied Instructions

Type	API	Instruction code		Pulse instruction	Function	Step		Page No.
		16-bit	32-bit			16-bit	32-bit	
Loop control	00	CJ	–	✓	Conditional jump	3	–	5-13
	01	CALL	–	✓	Calling a subroutine	3	–	5-16
	02	SRET	–	–	Indicating that a subroutine ends	1	–	5-17
	07	WDT	–	✓	Watchdog timer	1	–	5-19
	08	RPT	–	–	Start of a nested loop (only one loop)	3	–	5-20
	09	RPE	–	–	End of a nested loop	1	–	5-21
Transfer and comparison	10	CMP	DCMP	✓	Comparing values	7	9	5-22
	11	ZCP	DZCP	✓	Zonal comparison	9	12	5-23
	12	MOV	DMOV	✓	Transferring a value	5	6	5-24
	13	SMOV	-	✓	Transferring digits	11	–	5-25
	14	CML	DCML	✓	Inverting bits	5	9	5-28
	15	BMOV	-	✓	Transferring values	7	–	5-29
	16	FMOV	DFMOV	✓	Transferring a value to several devices	7	13	5-31
	17	XCH	DXCH	✓	Interchanging values	5	9	5-32
	18	BCD	DBCD	✓	Converting a binary value into a binary-coded decimal value	5	5	5-33
	19	BIN	DBIN	✓	Converting a binary-coded decimal value into a binary value	5	5	5-34
Arithmetic	20	ADD	DADD	✓	Binary addition	7	9	5-35
	21	SUB	DSUB	✓	Binary subtraction	7	9	5-37
	22	MUL	DMUL	✓	Binary multiplication	7	9	5-38
	23	DIV	DDIV	✓	Binary division	7	9	5-39
	24	INC	DINC	✓	Adding one to a binary value	3	3	5-40
	25	DEC	DDEC	✓	Subtracting one from a binary value	3	3	5-41
	26	WAND	DWAND	✓	Logical AND operation	7	9	5-42
	27	WOR	DWOR	✓	Logical OR operation	7	9	5-43
	28	WXOR	DWXOR	✓	Logical exclusive OR operation	7	9	5-44
	29	NEG	DNEG	✓	Taking the two's complement of a value	3	3	5-45
Rotation and move	30	ROR	DROR	✓	Rotating bits rightwards	5	9	5-47
	31	ROL	DROL	✓	Rotating bits leftwards	5	9	5-48
	32	RCR	DRCR	✓	Rotating bits rightwards with a carry flag	5	9	5-49
	33	RCL	DRCL	✓	Rotating bits leftwards with a carry flag	5	9	5-50
	34	SFTR	–	✓	Moving the states of bit devices rightwards	9	-	5-51
	35	SFTL	–	✓	Moving the states of bit devices leftwards	9	-	5-52
	36	WSFR	–	✓	Moving the values in word devices rightwards	9	-	5-53
	37	WSFL	–	✓	Moving the values in word devices leftwards	9	-	5-55
	38	SFWR	–	✓	Moving a value and writing it into a word device	7	-	5-56
	39	SFRD	–	✓	Moving a value and reading it from a word device	7	-	5-57
Data processing	40	ZRST	–	✓	Resetting a zone	5	–	5-58
	41	DECO	-	✓	Decoder	7	-	5-59
	42	ENCO	-	✓	Encoder	7	-	5-61
	43	SUM	DSUM	✓	Number of bits which are ON	5	9	5-63
	44	BON	DBON	✓	Checking the state of a bit	7	13	5-64
	45	MEAN	DMEAN	✓	Mean	7	13	5-65
	46	ANS	-	-	Driving an annunciator	7	-	5-66
	47	ANR	-	✓	Resetting an annunicator	1	-	5-67
	48	SQR	DSQR	✓	Square root of a binary value	5	9	5-69

Type	API	Instruction code		Pulse instruction	Function	Step		Page No.
		16-bit	32-bit			16-bit	32-bit	
Data processing	49	–	DFLT	✓	Converting a binary integer into a binary floating-point value	–	6	5-70
High-speed processing	50	REF	-	✓	Refreshing the states of I/O devices	5	-	5-72
Convenience	61	SER	DSER	✓	Searching data	9	17	5-73
	66	ALT	-	✓	Alternating between ON and OFF	3	-	5-75
	67	RAMP	DRAMP	-	Ramp	9	17	5-76
	69	SORT	DSORT	-	Sorting data	11	21	5-78
I/O	78	FROM	DFROM	✓	Reading data from a control register in a special module	9	12	5-80
	79	TO	DTO	✓	Writing data into a control register in a special module	9	13	5-81
	87	ABS	DABS	✓	Absolute value	3	5	5-84
Basic instructions	89	PLS	–	–	Rising-edge output	3	–	4-14
	90	LDP	–	–	Starting rising-edge detection	3	–	4-10
	91	LDF	–	–	Starting falling-edge detection	3	–	4-11
	92	ANDP	–	–	Connecting rising-edge detection in series	3	–	4-11
	93	ANDF	–	–	Connecting falling-edge detection in series	3	–	4-12
	94	ORP	–	–	Connecting rising-edge detection in parallel	3	–	4-12
	95	ORF	–	–	Connecting falling-edge detection in parallel	3	–	4-13
	96	TMR	–	–	16-bit timer	5	–	4-9
	97	CNT	DCNT	–	16-bit counter	5	6	4-9
	99	PLF	–	–	Falling-edge output	3	–	4-14
Communication	100	MODRD	–	–	Reading Modbus data	7	–	5-85
	101	MODWR	–	–	Writing Modbus data	7	–	5-89
Floating-point value	110	–	DECMP	✓	Comparing binary floating-point values	7	9	5-94
	111	–	DEZCP	✓	Binary floating-point zonal comparison	9	12	5-95
	112	–	DMOVR	✓	Transferring a floating-point value		9	5-96
	116	–	DRAD	✓	Converting a degree to a radian	–	6	5-97
	117	–	DDEG	✓	Converting a radian to a degree	–	6	5-98
	120	–	DEADD	✓	Binary floating-point addition	7	9	5-99
	121	–	DESUB	✓	Binary floating-point subtraction	7	9	5-100
	122	–	DEMUL	✓	Binary floating-point multiplication	7	9	5-101
	123	–	DEDIV	✓	Binary floating-point division	7	9	5-102
	124	–	DEXP	✓	Exponent of a binary floating-point value	–	6	5-103
	125	–	DLN	✓	Natural logarithm of a binary floating-point value	–	6	5-104
	126	–	DLOG	✓	Logarithm of a binary floating-point value	–	9	5-105
	127	–	DESQR	✓	Square root of a binary floating-point value	5	6	5-106
	128	–	DPOW	✓	Power of a floating-point value	–	9	5-107
	129	–	DINT	✓	Converting a binary floating-point value into a binary integer	–	6	5-108
	130	–	DSIN	✓	Sine of a binary floating-point value	5	6	5-109

Type	API	Instruction code		Pulse instruction	Function	Step		Page No.
		16-bit	32-bit			16-bit	32-bit	
Data processing	49	–	DFLT	✓	Converting a binary integer into a binary floating-point value	–	6	5-70
High-speed processing	50	REF	-	✓	Refreshing the states of I/O devices	5	-	5-72
Convenience	61	SER	DSER	✓	Searching data	9	17	5-73
	66	ALT	-	✓	Alternating between ON and OFF	3	-	5-75
	67	RAMP	DRAMP	-	Ramp	9	17	5-76
	69	SORT	DSORT	-	Sorting data	11	21	5-78
I/O	78	FROM	DFROM	✓	Reading data from a control register in a special module	9	12	5-80
	79	TO	DTO	✓	Writing data into a control register in a special module	9	13	5-81
Basic instructions	87	ABS	DABS	✓	Absolute value	3	5	5-84
	89	PLS	–	–	Rising-edge output	3	–	4-14
	90	LDP	–	–	Starting rising-edge detection	3	–	4-10
	91	LDF	–	–	Starting falling-edge detection	3	–	4-11
	92	ANDP	–	–	Connecting rising-edge detection in series	3	–	4-11
	93	ANDF	–	–	Connecting falling-edge detection in series	3	–	4-12
	94	ORP	–	–	Connecting rising-edge detection in parallel	3	–	4-12
	95	ORF	–	–	Connecting falling-edge detection in parallel	3	–	4-13
	96	TMR	–	–	16-bit timer	5	–	4-9
	97	CNT	DCNT	–	16-bit counter	5	6	4-9
	99	PLF	–	–	Falling-edge output	3	–	4-14
Communication	100	MODRD	–	–	Reading Modbus data	7	–	5-85
	101	MODWR	–	–	Writing Modbus data	7	–	5-89
Floating-point value	110	–	DECMP	✓	Comparing binary floating-point values	7	9	5-94
	111	–	DEZCP	✓	Binary floating-point zonal comparison	9	12	5-95
	112	–	DMOVR	✓	Transferring a floating-point value		9	5-96
	116	–	DRAD	✓	Converting a degree to a radian	–	6	5-97
	117	–	DDEG	✓	Converting a radian to a degree	–	6	5-98
	120	–	DEADD	✓	Binary floating-point addition	7	9	5-99
	121	–	DESUB	✓	Binary floating-point subtraction	7	9	5-100
	122	–	DEMUL	✓	Binary floating-point multiplication	7	9	5-101
	123	–	DEDIV	✓	Binary floating-point division	7	9	5-102
	124	–	DEXP	✓	Exponent of a binary floating-point value	–	6	5-103
	125	–	DLN	✓	Natural logarithm of a binary floating-point value	–	6	5-104
	126	–	DLOG	✓	Logarithm of a binary floating-point value	–	9	5-105
	127	–	DESQR	✓	Square root of a binary floating-point value	5	6	5-106
	128	–	DPOW	✓	Power of a floating-point value	–	9	5-107
	129	–	DINT	✓	Converting a binary floating-point value into a binary integer	–	6	5-108
	130	–	DSIN	✓	Sine of a binary floating-point value	5	6	5-109

Type	API	Instruction code		Pulse instruction	Function	Step		Page No.
		16-bit	32-bit			16-bit	32-bit	
Floating-point value	**131**	–	DCOS	✓	Cosine of a binary floating-point value	5	6	5-111
	132	–	DTAN	✓	Tangent of a binary floating-point value	5	6	5-113
	133	–	DASIN	✓	Arcsine of a binary floating-point value	–	6	5-115
	134	–	DACOS	✓	Arccosine of a binary floating-point value	–	6	5-116
	135	–	DATAN	✓	Arctangent of a binary floating-point value	–	6	5-117
	136	–	DSINH	✓	Hyperbolic sine of a binary floating-point value	–	6	5-118
	137	–	DCOSH	✓	Hyperbolic cosine of a binary floating-point value	–	6	5-119
	138	–	DTANH	✓	Hyperbolic tangent of a binary floating-point value	–	6	5-120
	172	-	DADDR	✓	Floating-point addition	-	13	5-121
	173	-	DSUBR	✓	Floating-point subtraction	-	13	5-122
	174	-	DMULR	✓	Floating-point multiplication	-	13	5-123
	175	-	DDIVR	✓	Floating-point division	-	13	5-124
Logical operation	**215**	LD&	DLD&	–	S1&S2	5	7	5-125
	216	LD|	DLD|	–	S1|S2	5	7	5-125
	217	LD^	DLD^	–	S1^S2	5	7	5-125
	218	AND&	DAND&	–	S1&S2	5	7	5-126
	219	AND|	DAND|	–	S1|S2	5	7	5-126
	220	AND^	DAND^	–	S1^S2	5	7	5-126
	221	OR&	DOR&	–	S1&S2	5	7	5-127
	222	OR|	DOR|	–	S1|S2	5	7	5-127
	223	OR^	DOR^	–	S1^S2	5	7	5-127
Comparison instructions	**224**	LD=	DLD=	–	S1 = S2	5	7	5-128
	225	LD>	DLD>	–	S1 > S2	5	7	5-128
	226	LD<	DLD<	–	S1 < S2	5	7	5-128
	228	LD<>	DLD<>	–	S1≠S2	5	7	5-128
	229	LD<=	DLD<=	–	S1≦ S2	5	7	5-128
	230	LD>=	DLD>=	–	S1≧ S2	5	7	5-128
	232	AND=	DAND=	–	S1 = S2	5	7	5-129
	233	AND>	DAND>	–	S1 > S2	5	7	5-129
	234	AND<	DAND<	–	S1 < S2	5	7	5-129
	236	AND<>	DAND<>	–	S1≠S2	5	7	5-129
	237	AND<=	DAND<=	–	S1≦ S2	5	7	5-129
	238	AND>=	DAND>=	–	S1≧ S2	5	7	5-129
	240	OR=	DOR=	–	S1 = S2	5	7	5-130
	241	OR>	DOR>	–	S1 > S2	5	7	5-130
	242	OR<	DOR<	–	S1 < S2	5	7	5-130
	244	OR<>	DOR<>	–	S1≠S2	5	7	5-130
	245	OR<=	DOR<=	–	S1≦ S2	5	7	5-130
	246	OR>=	DOR>=	–	S1≧ S2	5	7	5-130

Type	API	Instruction code		Pulse instruction	Function	Step		Page No.
		16-bit	32-bit			16-bit	32-bit	
Other instructions	**147**	SWAP	DSWAP	✓	Interchanging the high byte in a device with the low byte in the device	3	5	5-131
	154	RAND	DRAND	✓	Random value	7	13	5-132
	202	SCAL	-	✓	Scale	9	-	5-133
	203	SCLP	DSCLP	✓	Parameter scale	7	13	5-135
	256	CJN	–	✓	Negated conditional jump	3	–	5-139
	257	JMP	–	–	Unconditional jump	3	–	5-140
	258	BRET	–	–	Returning to a busbar	1	–	5-141
	259	MMOV	–	✓	Converting a 16-bit value into a 32-bit value	6	–	5-142
	260	RMOV	–	✓	Converting a 32-bit value into a 16-bit value	6	–	5-143

5.2 Structure of an Applied Instruction

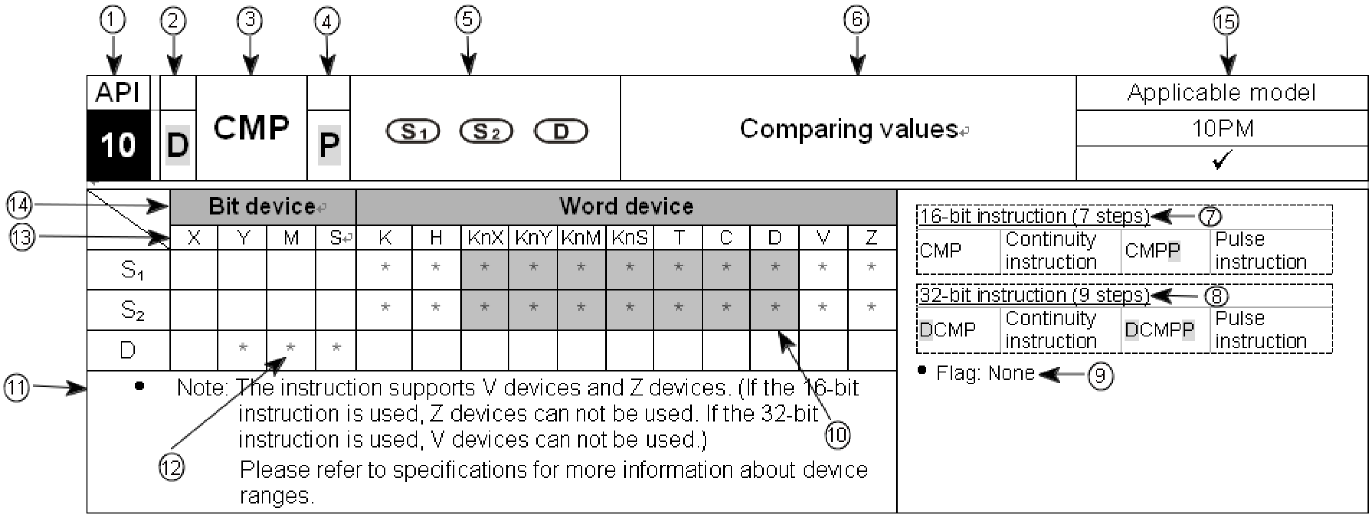
◆ An applied instruction is composed of an instruction name and operands.

Instruction name: An instruction name represents a function.

Operand: An operand is the object of an operation.

An instruction name occupie one step. The number of steps an operand occupies can be two or three, depending on the instruction used is a 16-bit instruciton or a 32-bit instruction.

◆ Descriptions of the applied instructions



① API number

② The upper cell indicates a 16-bit instruction. If the upper cell is a dotted cell, there will be no 16-bit instruction.
The lower cell indicates a 32-bit instruction. If the lower cell is a dotted cell, there is no 32-bit instruction. If there is a 32-bit instruction, **D** is displayed in the lower cell, e.g. API 10 DCMP.

③ Applied instruction name

④ If ☺ is displayed in the upper cell, a pulse instruction is generally used.
The lower cell indicates a pulse instruction. If there is a pulse instruction, **P** is displayed in the lower cell, e.g. API 12 MOVP.

⑤ Operands

⑥ Function

⑦ Number of steps occupied by a 16-bit instruction, continuity instruction name, and pulse instruction name

⑧ Number of steps occupied by a 32-bit instruction, continuity instruction name, and pulse instruction name

⑨ Flags related to an applied instruction

⑩ The devices marked with ‘ * ’ displayed in grayscale can be modified by V devices and Z devices.

⑪ Points for attention

⑫ The devices marked with ‘ * ’ can be used.

⑬ Device name

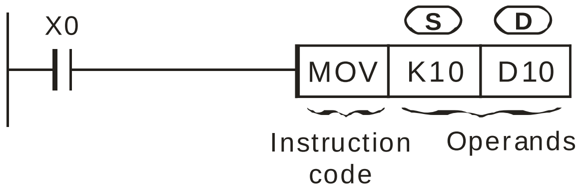
⑭ Device type

⑮ Applicable model

- Typing an applied instruction

Some applied instructions are composed of instruction names, e.g. BRET and SRET, but most applied instructions are composed of instruction names and operands.

The applied instructions that a DVP-10PM series motion controller can use are assigned the instruction numbers API 00~API 260. Besides, every applied instruction is assigned a mnemonic. For example, the mnemonic of API 12 is MOV. If users want to type an instruction by means of PMSoft, they can type the mnemonic assigned to the instruction. If users want to type an instruction by means of the handheld programming panel DVPHPP03, they can type the API number assigned to the instruction. Every applied instruction specifies operands. Take the instruction MOV for instance.



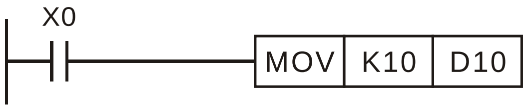
The instruction is used to move the value in the operand **S** to the operand **D**.

S	Source operand If there is more one source operand, the source operands will be represented by $\mathbf{S_1}$, $\mathbf{S_2}$, and etc.
D	Destination operand If there is more than one destination operand, the destination operands will be represented by $\mathbf{D_1}$, $\mathbf{D_2}$, and etc.
If operands are constants, they will be represented by **m**, $\mathbf{m_1}$, $\mathbf{m_2}$, **n**, $\mathbf{n_1}$, $\mathbf{n_2}$, and etc.	

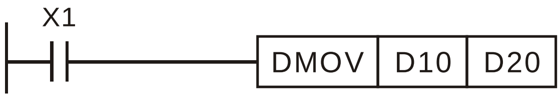
- Length of an operand (16-bit instruction or 32-bit instruction)

The values in operands can be grouped into 16-bit values and 32-bit values. In order to process values of difference lengths, some applied instructions are grouped into 16-bit instructions and 32-bit instructions. After “D” is added to the front of a 16-bit instruction, the instruction becomes a 32-bit instruction.

The instruction MOV is a 16-bit instruction. When X0 is ON, K10 is moved to D10.



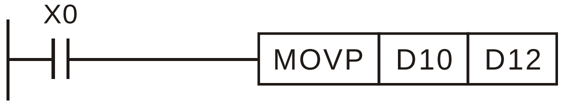
The instruction DMOV is a 32-bit instruction. When X1 is ON, the value in (D11, D10) is moved to (D21, D20).



- Continuity instruction/Pulse instruction

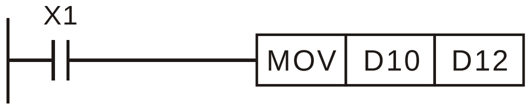
  The applied instructions can be grouped into continuity instructions and pulse instructions in terms of the ways the applied instructions are executed. If an instruction in a program is not executed, the execution of the program will take less time. As a result, if there are pulse instructions in a program, the scan cycle will be shorter. If “P” is added to the back of an instruction, the instruction becomes a pulse instruction. Some instructions are mostly used as pulse instructions.

Pulse instruction



When X0 is turned from OFF to ON, the instruction MOVP is executed once. MOVP will not be executed again during the scan cycle, and therefore it is a pulse instruction.

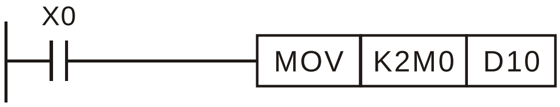
Continuity instruction



Whenever X1 is ON, the instruction MOV is executed once. MOV is a continuity instruction.

When the contacts X0 and X1 are OFF, the instructions are not executed, and the values in the destation operands are not changed.

- Operand
  1. A word device can consist of bit devices. Applied instructions can use KnX, KnY, KnM, and KnS. Values can be stored in KnX, KnY, KnM, and KnS.
  2. Data registers, timers, counters, and index registers can be used as general operands.
  3. A data register is a 16-bit register. If users want to use a 32-bit data register, they have to specify two consecutive data registers.
  4. If a 32-bit instruction uses D0 as an operand, the 32-bit data register composed of D1 and D0 will be used. D1 occupies the high 16 bits, and D0 occupy the low 16 bits. Timers and the 16-bit counters C0~C199 can be used in the same way.
  5. If the 32-bit counters C200~C255 are used as data registers, they can be operands used by 32-bit instructions.
- Operand type
  1. X devices, Y devices, M devices, and S devices can only be turned ON or OFF. They are bit devices.
  2. 16-bit (or 32-bit) T devices, C device, D devices, V devices, and Z devices are word devices.
  3. If Kn is added to the front of an X/Y/M/S device, a word device will be formed. For example, K2M0 represents a device composed of the eight bit devices M0~M7.



When X0 is ON, the values of M0~M7 are moved to bit 0~bit 7 in D10, and bit 8~bit 15 are set to 0.

- Values in word devices composed of bit devices

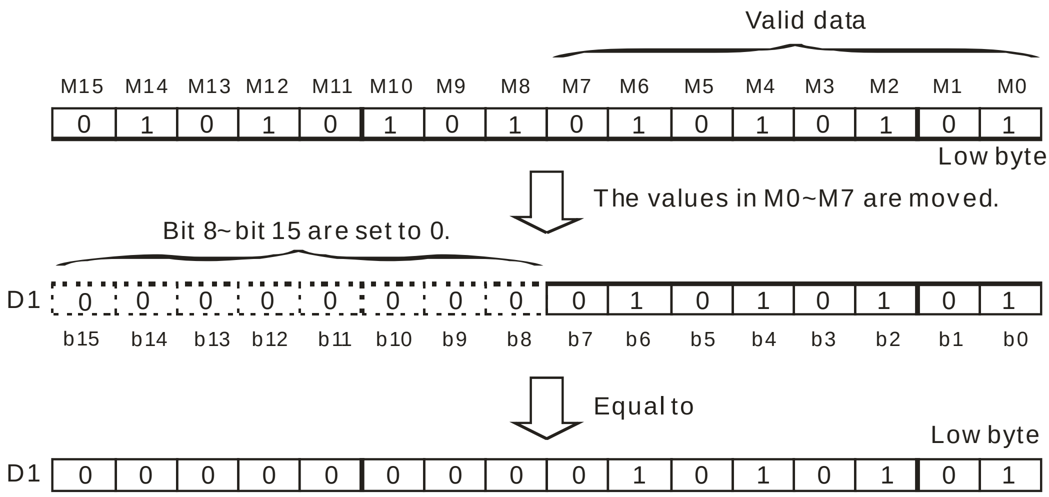
16-bit instruction	
A 16-bit value is in the range of K-32,768 to K32,767.	
Value in a word device composed of bit devices	
K1 (4 bits)	0~15
K2 (8 bits)	0~255
K3 (12 bits)	0~4,095
K4 (16 bits)	-32,768~+32,767

32-bit instruction	
A 32-bit value is in the range of K-2,147,483,648 to K2,147,483,647.	
Value in a word device composed of bit devices	
K1 (4 bits)	0~15
K2 (8 bits)	0~255
K3 (12 bits)	0~4,095
K4 (16 bits)	0~65,535
K5 (20 bits)	0~1,048,575
K6 (24 bits)	0~167,772,165
K7 (28 bits)	0~268,435,455
K8 (32 bits)	-2,147,483,648~+2,147,483,647

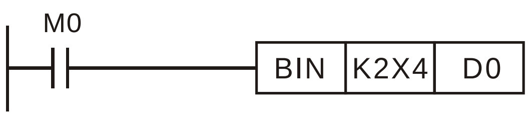
- General flags
  Example: M1968 is a zero flag, M1969 is a borrow flag, and M1970 is a carry flag
  Every flag in a DVP-10PM series motion controller corresponds to an operation result.
  The state of a flag varies with an operation result. For example, if the instruction ADD/SUB/MUL/DIV is used in the main program O100~M102, the operation result gotten will affect the states of M1968~M1970. However, if the instruciton is not executed, the states of the flags will remain unchanged. The states of flags are related to instructions. Please refer to the explanations of instructions for more information.

5.3 Processing Values

- X devices, Y devices, M devices, and S devices can only be turned ON or OFF. They are bit devices. Values can be stored in T device, C devices, D devices, V devices, and Z devices. They are word devices. If Kn is added to the front of an X/Y/M/S device, a word device will be formed.
- If Kn is added to the front of an X/Y/M/S device, a word device will be formed. For example, K2M0 represents a device composed of the eight bit devices M0~M7.



- The value in K1M0 is moved to a 16-bit register, and bit 4~bit 15 in the register are set to 0. The value in K2M0 is moved to a 16-bit register, and bit 8~bit 15 in the register are set to 0. The value in K3M0 is moved to a 16-bit register, and bit 12~bit 15 in the register are set to 0. The value in K1M0 is moved to a 32-bit register, and bit 4~bit 31 in the register are set to 0. The value in K2M0 is moved to a 32-bit register, and bit 8~bit 31 in the register are set to 0. The value in K3M0 is moved to a 32-bit register, and bit 12~bit 31 in the register are set to 0. The value in K4M0 is moved to a 32-bit register, and bit 16~bit 31 in the register are set to 0. The value in K5M0 is moved to a 32-bit regiser, and bit 20~bit 31 in the register are set to 0. The vlaue in K6M0 is moved to a 32-bit register, and bit 24~bit 31 in the register are set to 0. The value in K7M0 is moved to a 32-bit register, and bit 28~bit 31 in the register are set to 0.
- If Kn is in the range of K1~K3 (or K4~K7), the bits which are not assigned values in the 16-bit register (the 32-bit register) to which a value is moved will be set to 0. As a result, operations will be performed on positive values if Kn is in the range of K1~K3 (or K4~K7).



☞ The binary-coded decimal value in X4~X11 is converted into a binary value, and the binary value is stored in D0.

- Users can specify bit device numbers freely. It is suggested X device numbers/Y devuce numbers should end with 0, and that M device numbers/S device numbers should start from a number which is a multiple of 8.

- Consecutive devices

  Take data registers for instances. D0, D1, D2, D3, and D4 are consecutive data registers.

  The consecutive word devices composed of bit devices are shown below.

K1X0	K1X4	K1X10	K1X14……
K2Y0	K2Y10	K2Y20	Y2X30……
K3M0	K3M12	K3M24	K3M36…….
K4S0	K4S16	K4S32	K4S48…….

The consecutive word devices composed of bit devices are shown above. To avoid confusion, please do not skip any word device composed of bit devices. Beisdes, if a 32-bit operation is performed on K4Y0, the high 16 bits in the 32-bit register to which the value in K4Y0 is moved will be set to 0. If a 32-bit value is required, please use K8Y0.

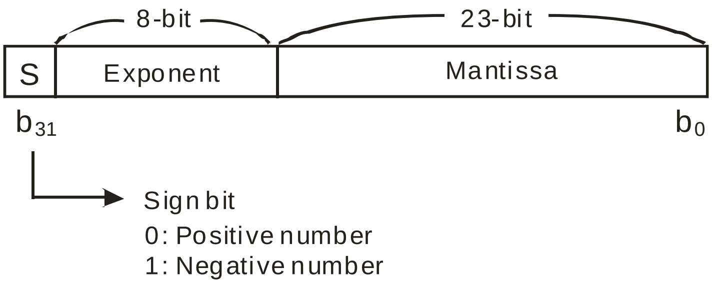
After an operation is performed, the binary integer gotten will be given priority. For example, 40÷3=13, and the remainder 1 is dropped. The integer part of the square root of an integer is retained, and the fractional part of the square root is dropped. However, if a decimal instruiction is used, a decimal will be gotten.

The applied intructions listed below are decimal instructions.

API 110 (D ECMP)	API 111 (D EZCP)	API 116 (D RAD)	API 117 (D DEG)
API 120 (D EADD)	API 121 (D ESUB)	API 122 (D EMUL)	API 123 (D EDIV)
API 124 (D EXP)	API 125 (D LN)	API 126 (D LOG)	API 127 (D ESQR)
API 128 (D POW)	API 129 (D INT)	API 130 (D SIN)	API 131 (D COS)
API 132 (D TAN)	API 133 (D ASIN)	API 134 (D ACOS)	API 135 (D ATAN)
API 136 (D SINH)	API 137 (D COSH)	API 138 (D TANH)	

Representations of binary floating-point values

The floating-point values in a DVP-10PM series motion controller are 32-bit floating-point values, and the representations of the floating-point values conform to the IEEE 754 standard.



Representation of a floating-point value:

$$(-1)^S \times 2^{E-B} \times 1.M ; B = 127$$

A 32-bit floating-point value is in the range of ±2^{-126} to ±2^{+128}, that is, a 32-bit floating-point value is in the range of ±1.1755×10^{-38} to ±3.4028×10^{+38}.

Example 1: 23 is represented by a 32-bit floating-point value.

Step 1: Converting 23 into a binary value: 23.0=10111

Step 2: Normalizing the binary value: 10111=1.0111×24 (0111 is a mantissa, and 4 is an exponent)

Step 3: Getting the exponent which is stored

∵ E-B=4 →E-127=4 ∴ E=131=10000011_2

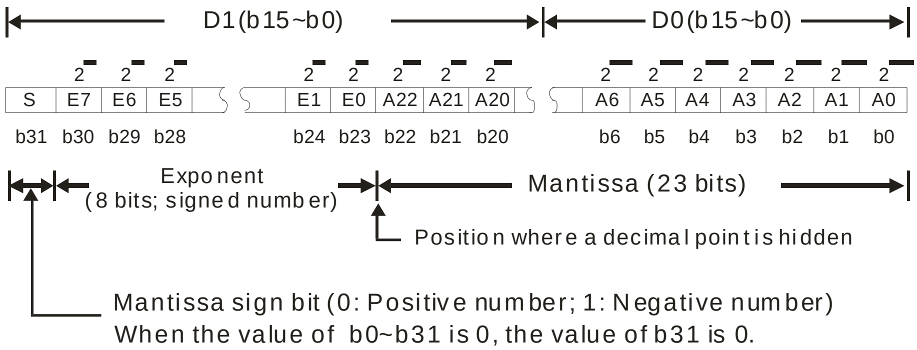
Step 4: Combining the sign bit, the exponent, and the mantissa to form a floating-point value.

0 100**0001**1 011**1000**0000**0000**0000**0000**$_2$=41B80000$_{16}$

Example 2: -23.0 is represented by a 32-bit floating-point value.

-23.0 is converted in the same way as 23.0. Users only need to change the sign bit to 1.

A DVP-10PM series motion controller uses two consecutive registers to form a 32-bit floating-point values. Take (D1, D0) in which a bianry floating-point value is stored for instance.



Decimal floating-point value

- Since binary floating-point values are not widely accepted by people, they can be converted into decimal floating-point values. However, the decimals on which operations are performed in a DVP-10PM series motion controller are still binary floating-point values.
- A decimal floating-point value is stored in two consecutive registers. The constant part is stored in the register whose device number is smaller, and the exponent part is stored in the register whose device number is bigger.

  Take (D1, D0) for instance.

  $$\text{Decimal floating-point number} = [\text{Constant D0}] * 10^{[\text{Exponent D1}]}$$

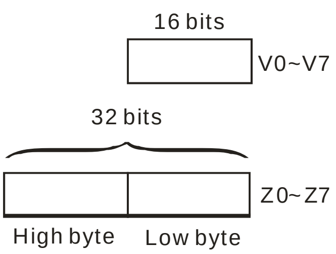
  Base: D0=±1,000~±9,999

  Exponent: D1=-41~+35

  Besides, the base 100 does not exist in D0 because 100 is represented by $1{,}000\times10^{-1}$. A decimal floating-point value is in the range of $\pm1{,}175\times10^{-41}$ to $\pm3{,}402\times10^{+35}$.
- If the instruction ADD/SUB/MUL/DIV is used in the main program O100~M102, the operation result gotten will affect the states of M1968~M1970. If a floating-point operation instruction is used, the result gotten will also affect the state of the zero flag M1968, the state of the borrow flag M1969, and the state of the carry flag M1970.
  - Zero flag: If the operation result gotten is 0, M1968 will be ON.
  - Carry flag: If the absolute value of the operaiton result gotten is greater than the maximum value allowed, M1969 will be ON.
  - Borrow flag: If the absolute value of the operation result gotten is less than the minimum value allowed, M1970 will be ON.

5.4 Using Index Registers to Modify Operands

V devices are 16-bit index registers, and Z devices are 32-bit index registers. There are 6 V devices (V0~V5), 8 Z devices (Z0~Z7) in a DVP-10PM series motion controller.



V devices are 16-bit registers. Data can be freely written into a V device, and data can be freely read from a V device. If a 32-bit value is required, please use a Z device.

Index registers can be used to modify P/I/X/Y/M/S/KnX/KnY/KnM/KnS/T/C/D devices, but they can not be used to modify index registers, constants, and Kn. For example, K4@Z0 is invalid, K4M0@Z0 is valid, and K0@Z0M0 is invalid. The devices marked with ‘ * ’ displayed in grayscale in the table in the explanation of an applied instruction can be modified by V devices and Z devices..

5.5 Instruction Index

- Arranging applied instructions in alphabetical order

Type	API	Instruction code		Pulse instruction	Function	Step		Page No.
		16-bit	32-bit			16-bit	32-bit	
A	**87**	ABS	DABS	✓	Absolute value	3	5	5-84
	20	ADD	DADD	✓	Binary addition	7	9	5-35
	66	ALT	–	✓	Alternating between ON and OFF	3	–	5-75
	218	AND&	DAND&	–	S1&S2	5	7	5-126
	220	AND^	DAND^	–	S1^S2	5	7	5-126
	219	AND|	DAND|	–	S1|S2	5	7	5-126
	234	AND<	DAND<	–	S1 < S2	5	7	5-129
	93	ANDF	–	–	Connecting falling-edge detection in series	3	–	4-10
	92	ANDP	–	–	Connecting rising-edge detection in series	3	–	4-10
	47	ANR	–	✓	Resetting an annunciator	1	–	5-67
	46	ANS	–	–	Driving an annunciator	7	–	5-66
	237	AND<=	DAND<=	–	S1≦ S2	5	7	5-129
	236	AND<>	DAND<>	–	S1≠S2	5	7	5-129
	232	AND=	DAND=	–	S1 = S2	5	7	5-129
	233	AND>	DAND>	–	S1 > S2	5	7	5-129
	238	AND>=	DAND>=	–	S1≧ S2	5	7	5-129
	134	–	DACOS	✓	Arccosine of a binary floating-point value	–	6	5-116
	133	–	DASIN	✓	Arcsine of a binary floating-point value	–	6	5-115
	135	–	DATAN	✓	Arctangent of a binary floating-point value	–	6	5-117
B	**18**	BCD	DBCD	✓	Converting a binary value into a binary-coded decimal value	5	5	5-33
	19	BIN	DBIN	✓	Converting a binary-coded decimal value into a binary value	5	5	5-34
	15	BMOV	–	✓	Transferring values	7	–	5-29
	44	BON	DBON	✓	Checking the state of a bit	7	13	5-64
	258	BRET	–	–	Returning to a busbar	1	–	5-141
C	**01**	CALL	–	✓	Calling a subroutine	3	–	5-16
	131	–	DCOS	✓	Cosine of a binary floating-point value	5	6	5-111
	137	–	DCOSH	✓	Hyperbolic cosine of a binary floating-point value	–	6	5-119
	00	CJ	–	✓	Conditional jump	3	–	5-13
	256	CJN	–	✓	Negated conditional jump	3	–	5-139
	14	CML	DCML	✓	Inverting bits	5	9	5-28
	10	CMP	DCMP	✓	Comparing values	7	9	5-22
	97	CNT	DCNT	–	16-bit counter	5	6	4-9
D	**25**	DEC	DDEC	✓	Subtracting one from a binary value	3	3	5-41
	41	DECO	–	✓	Decoder	7	–	5-59
	117	–	DDEG	✓	Converting a radian to a degree	–	6	5-98
	23	DIV	DDIV	✓	Binary division	7	9	5-39
E	**42**	ENCO	–	✓	Encoder	7	–	5-61
	172	–	DADDR	✓	Floating-point addition	–	13	5-121
	175	–	DDIVR	✓	Floating-point division	–	13	5-124
	120	–	DEADD	✓	Binary floating-point addition	7	9	5-99

Type	API	Instruction code		Pulse instruction	Function	Step		Page No.
		16-bit	32-bit			16-bit	32-bit	
E	**110**	–	DECMP	✓	Comparing binary floating-point values	7	9	5-94
	123	–	DEDIV	✓	Binary floating-point division	7	9	5-102
	122	–	DEMUL	✓	Binary floating-point multiplication	7	9	5-101
	127	–	DESQR	✓	Square root of a binary floating-point value	5	6	5-106
	121	–	DESUB	✓	Binary floating-point subtraction	7	9	5-100
	124	–	DEXP	✓	Exponent of a binary floating-point value	–	6	5-103
	111	–	DEZCP	✓	Binary floating-point zonal comparison	9	12	5-95
	112	–	DMOVP	✓	Transferring a floating-point value	–	9	5-96
	174	–	DMULR	✓	Floating-point multiplication	–	13	5-123
	173	–	DSUBR	✓	Floating-point subtraction	–	13	5-122
F	**49**	–	DFLT	✓	Converting a binary integer into a binary floating-point value	–	6	5-70
	16	FMOV	DFMOV	✓	Transferring a value to several devices	7	13	5-31
	78	FROM	DFROM	✓	Reading data from a control register in a special module	9	12	5-80
I	**24**	INC	DINC	✓	Adding one to a binary value	3	3	5-40
	129	–	DINT	✓	Converting a binary floating-point value into a binary integer	–	6	5-108
J	**257**	JMP	–	–	Unconditional jump	3	–	5-140
L	**215**	LD&	DLD&	–	S1&S2	5	7	5-125
	217	LD^	DLD^	–	S1^S2	5	7	5-125
	216	LD|	DLD|	–	S1|S2	5	7	5-125
	226	LD<	DLD<	–	S1 < S2	5	7	5-128
	229	LD<=	DLD<=	–	S1≦ S2	5	7	5-128
	228	LD<>	DLD<>	–	S1≠S2	5	7	5-128
	224	LD=	DLD=	–	S1 = S2	5	7	5-128
	225	LD>	DLD>	–	S1 > S2	5	7	5-128
	230	LD>=	DLD>=	–	S1≧ S2	5	7	5-128
	125	–	DLN	✓	Natural logarithm of a binary floating-point value	–	6	5-104
	126	–	DLOG	✓	Logarithm of a binary floating-point value	–	9	5-105
	90	LDP	–	–	Starting rising-edge detection	3	–	4-9
	91	LDF	–	–	Starting falling-edge detection	3	–	4-10
M	**45**	MEAN	DMEAN	✓	Mean	7	13	5-65
	259	MMOV	–	✓	Converting a 16-bit value into a 32-bit value	6	–	5-142
	100	MODRD	–	–	Reading Modbus data	7	–	5-85
	101	MODWR	–	–	Writing Modbus data	7	–	5-89
	12	MOV	DMOV	✓	Transferring a value	5	6	5-24
	22	MUL	DMUL	✓	Binary multiplication	7	9	5-38
N	**29**	NEG	DNEG	✓	Taking the two's complement of a value	3	3	5-45
O	**221**	OR&	DOR&	–	S1&S2	5	7	5-127
	223	OR^	DOR^	–	S1^S2	5	7	5-127
	222	OR|	DOR|	–	S1|S2	5	7	5-127
	242	OR<	DOR<	–	S1 < S2	5	7	5-130
	245	OR<=	DOR<=	–	S1≦ S2	5	7	5-130
	244	OR<>	DOR<>	–	S1≠S2	5	7	5-130
	240	OR=	DOR=	–	S1 = S2	5	7	5-130
	241	OR>	DOR>	–	S1 > S2	5	7	5-130

Type	API	Instruction code		Pulse instruction	Function	Step		Page No.
		16-bit	32-bit			16-bit	32-bit	
O	246	OR>=	DOR>=	–	S1≧ S2	5	7	5-130
	95	ORF	–	–	Connecting falling-edge detection in parallel	3	–	4-11
	94	ORP	–	–	Connecting rising-edge detection in parallel	3	–	4-11
P	99	PLF	–	–	Falling-edge output	3	–	4-12
	89	PLS	–	–	Rising-edge output	3	–	4-12
	128	–	DPOW	✓	Power of a floating-point value	–	9	5-107
R	116	–	DRAD	✓	Converting a degree to a radian	–	6	5-97
	67	RAMP	DRAMP	–	Ramp	9	17	5-76
	154	RAND	DRAND	✓	Random value	7	13	5-132
	33	RCL	DRCL	✓	Rotating bits leftwards with a carry flag	5	9	5-50
	32	RCR	DRCR	✓	Rotating bits rightward with a carry flag	5	9	5-49
	50	REF	–	✓	Refreshing the states of I/O devices	5	-	5-72
	260	RMOV	–	✓	Converting a 32-bit value into a 16-bit value	6	–	5-143
	31	ROL	DROL	✓	Rotating bits leftwards	5	9	5-48
	30	ROR	DROR	✓	Rotating bits rightwards	5	9	5-47
	09	RPE	–	–	End of a nested loop	1	–	5-21
	08	RPT	–	–	Start of a nested loop (only one loop)	3	–	5-20
S	202	SCAL	–	✓	Scale	9	-	5-133
	203	SCLP	DSCLP	✓	Parameter scale	7	13	5-135
	61	SER	DSER	✓	Searching data	9	17	5-73
	39	SFRD	–	✓	Moving a value and reading it from a word device	7	–	5-57
	35	SFTL	–	✓	Moving the states of bit devices leftwards	9	–	5-52
	34	SFTR	–	✓	Moving the states of bit devices rightwards	9	–	5-51
	38	SFWR	–	✓	Moving a value and writing it into a word device	7	–	5-56
	13	SMOV	-	✓	Transferring digits	11	–	5-25
	69	SORT	DSORT	–	Sorting data	11	21	5-78
	130	–	DSIN	✓	Sine of a binary floating-point value	5	6	5-109
	136	–	DSINH	✓	Hyperbolic sine of a binary floating-point value	–	6	5-118
	48	SQR	DSQR	✓	Square root of a binary value	5	9	5-69
	02	SRET	–	–	Indicating that a subroutine ends	1	–	5-17
	21	SUB	DSUB	✓	Binary subtraction	7	9	5-37
	43	SUM	DSUM	✓	Number of bits which are ON	5	9	5-63
	147	SWAP	DSWAP	✓	Interchanging the high byte in a device with the low byte in the device	3	5	5-131
T	132	–	DTAN	✓	Tangent of a binary floating-point value	5	6	5-113
	138	–	DTANH	✓	Hyperbolic tangent of a binary floating-point value	–	6	5-120
	96	TMR	–	–	16-bit timer	5	–	4-8
	79	TO	DTO	✓	Writing data into a control register in a special module	9	13	5-81
W	26	WAND	DWAND	✓	Logical AND operation	7	9	5-42
	07	WDT	–	✓	Watchdog timer	1	–	5-19
	27	WOR	DWOR	✓	Logical OR operation	7	9	5-43
	37	WSFL	–	✓	Moving the values in word devices leftwards	9	–	5-55
	36	WSFR	–	✓	Moving the values in word devices rightwards	9	–	5-53
	28	WXOR	DWXOR	✓	Logical exclusive OR operation	7	9	5-44
X	17	XCH	DXCH	✓	Interchanging values	5	9	5-32
Z	11	ZCP	DZCP	✓	Zonal comparison	9	12	5-23
	40	ZRST	–	✓	Resetting a zone	5	–	5-58

5.6 Descriptions of the Applied Instructions

API						Applicable model
00		CJ	P	S	Conditional jump	10PM
						✓

	Bit device				Word device											16-bit instruction (3 steps)
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z	CJ Continuity instruction; CJP Pulse instruction

- Note: S can be a pointer.
  S can be a pointer in the range of P0 to P255.
  A pointer can not be modified by a V device or a Z device.

32-bit instruction: - - - -

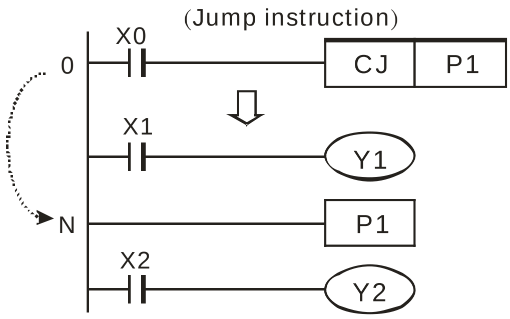
- Flag: None

Explanation

- **S**: Pointer which points to a jump destination
- If some part of the main program O100 does not need to be executed, users can use CJ or CJP to shorten the scan time. Besides, if a dual output is used, users can use CJ or CJP.
- If the program specified by a pointer is prior to the instruction CJ, a watchdog timer error will occur, and the main program will not be executed. Please use the instruction carefully.
- The instruction CJ can specify the same pointer repeatedly. The pointer specified by CJ can not be the same as the pointer specified by CALL, otherwise an error will occur.
- When the instruction CJ/CJP in a program is executed, the actions of the devices in the program are as follows.
  1. The states of the Y devices, the states of the M devices, and the states of the S devices in the program remain the same as those before the execution of the jump.
  2. The 10 millisecond timers in the program stop counting.
  3. The general counters in the program stop counting, and the general applied instructions in the program are not executed.
  4. If the instructions which are used to reset the timers in the program are driven before the jump is executed, the timers will still be reset during the execution of the jump.

Example 1

- When X0 is ON, the execution of the program jumps from address 0 to address N (P1).
- When X0 is OFF, the execution of the program starts from address 0, and the instruction CJ is not executed.



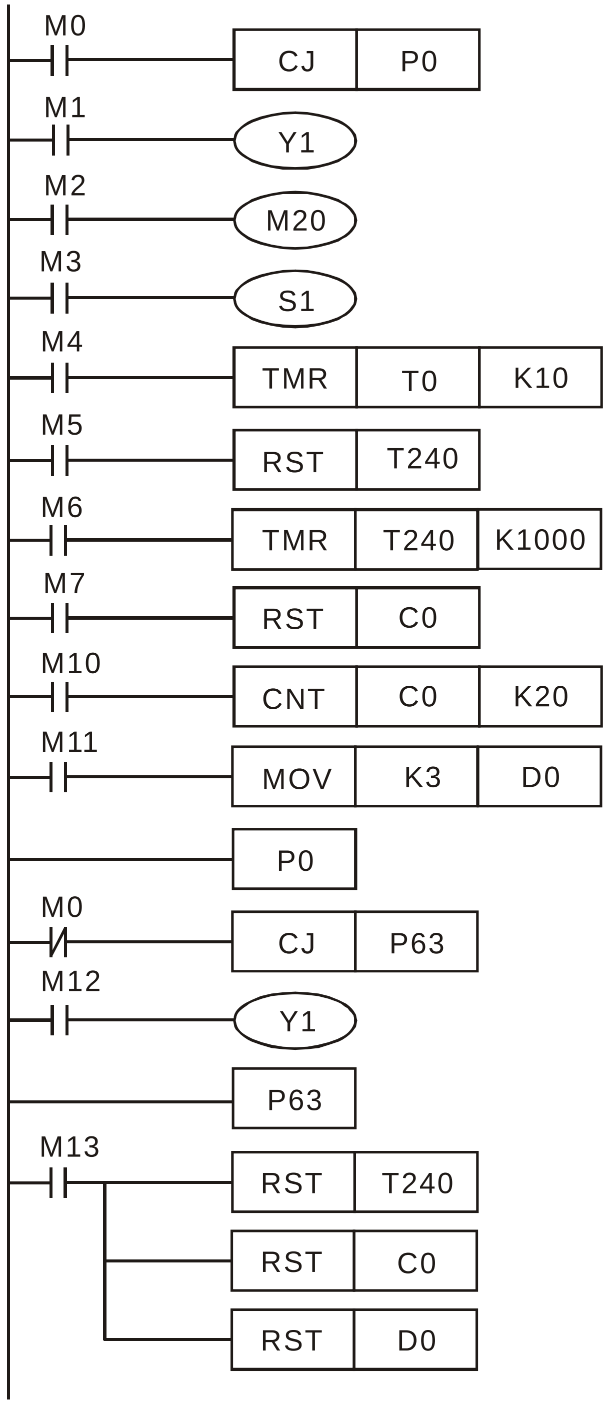
Example 2

◆ States of devices

Device	States of contacts before the execution of CJ	States of contacts during the execution of CJ	States of output coils during the execution of CJ
Y devices, M devices, S devices	M1, M2, and M3 are OFF.	M1, M2, and M3 are turned from OFF to ON.	Y1[*1], M20, and S1 are OFF.
	M1, M2, and M3 are ON.	M1, M2, and M3 are turned from ON to OFF.	Y1[*1], M20, and S1 are ON.
10 millisecond timers	M4 is OFF.	M4 is turned from OFF to ON.	The timer T0 does not count.
	M4 is ON.	M4 is turned from ON to OFF.	The timer T0 stops counting immediately. When M0 is turned from ON to OFF, the timer T0 is reset to 0.
	M6 is OFF.	M6 is turned from OFF to ON.	The timer T240 does not count.
	M6 is ON.	M6 is turned from ON to OFF.	The timer T240 stops counting immediately. When M0 is turned from ON to OFF, the timer T240 is reset to 0.
C0~C234	M7 and M10 are OFF.	M10 is ON/OFF.	The counter C0 does not count.
	M7 is OFF. M10 is ON/OFF.	M10 is ON/OFF.	C0 stops counting. After M0 is turned OFF, C0 will resume counting.
Applied instructions	M11 OFF	M11 is turned from OFF to ON.	The applied instructions are not executed.
	M11 ON	M11 is turned from ON to OFF.	The applied instructions which are skipped are not executed, but API 53~API 59 and API 157~API 159 are still executed,

*1: Y1 is a dual output. When M0 is OFF, Y1 is controlled by M1. When M0 is ON, Y1 is controlled by M12.

- Y1 is a dual output. When M0 is OFF, Y1 is controlled by M1. When M0 is ON, Y1 is controlled by M12.



API						Applicable model
01		CALL	P	(S)	Calling a subroutine	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z

- Note: S can be a pointer.
  S can be a pointer in the range of P0 to P255.
  A pointer can not be modified by a V device or a Z device.

16-bit instruction (3 steps)

CALL Continuity instruction CALLP Pulse instruction

32-bit instruction

\- - - -

- Flag: None

Explanation

- **S**: Pointer which points to a subroutine
- The subroutine to which a pointer points should be written after M102, M2 and the instruction SRET.
- The pointer used by the instruction CALL can not be the same as the pointers used by the instructions CJ, CJN, and JMP.
- If only the instruction CALL is used, the same subroutine can be called repeatedly.

API	SRET	Indicating that a subroutine ends	Applicable model
02			10PM
			✓

Bit device				Word device										
X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z

- Note: There is no operand.
  The instruction does not need to be driven by a contact.

16-bit instruction (1 step)

SRET	Continuity instruction	-	-

32-bit instruction

-	-	-	-

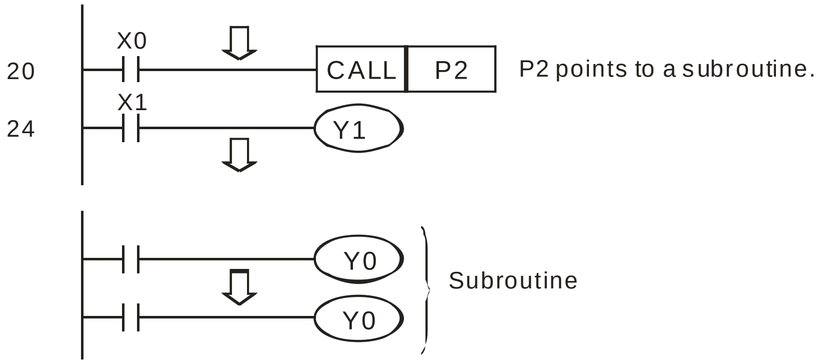
- Flag: None

Explanation

◆ The instruction SRET indicates that a soubroutine ends. After the execution of a subroutine in a program is complete, the instruction following CALL which calls the subroutine in the main program O100 will be executed.

Example 1

◆ When X0 is ON, the instruction CALL is executed, and the execution of the program jumps to the subroutine to which P2 points. When the instruction SRET is executed, the execution of the program returns to address 24.



Example 2

◆ When X20 is turned from OFF to ON, the instruction CALL P10 is executed, and the execution of the program jumps to the subroutine to which P10 points.

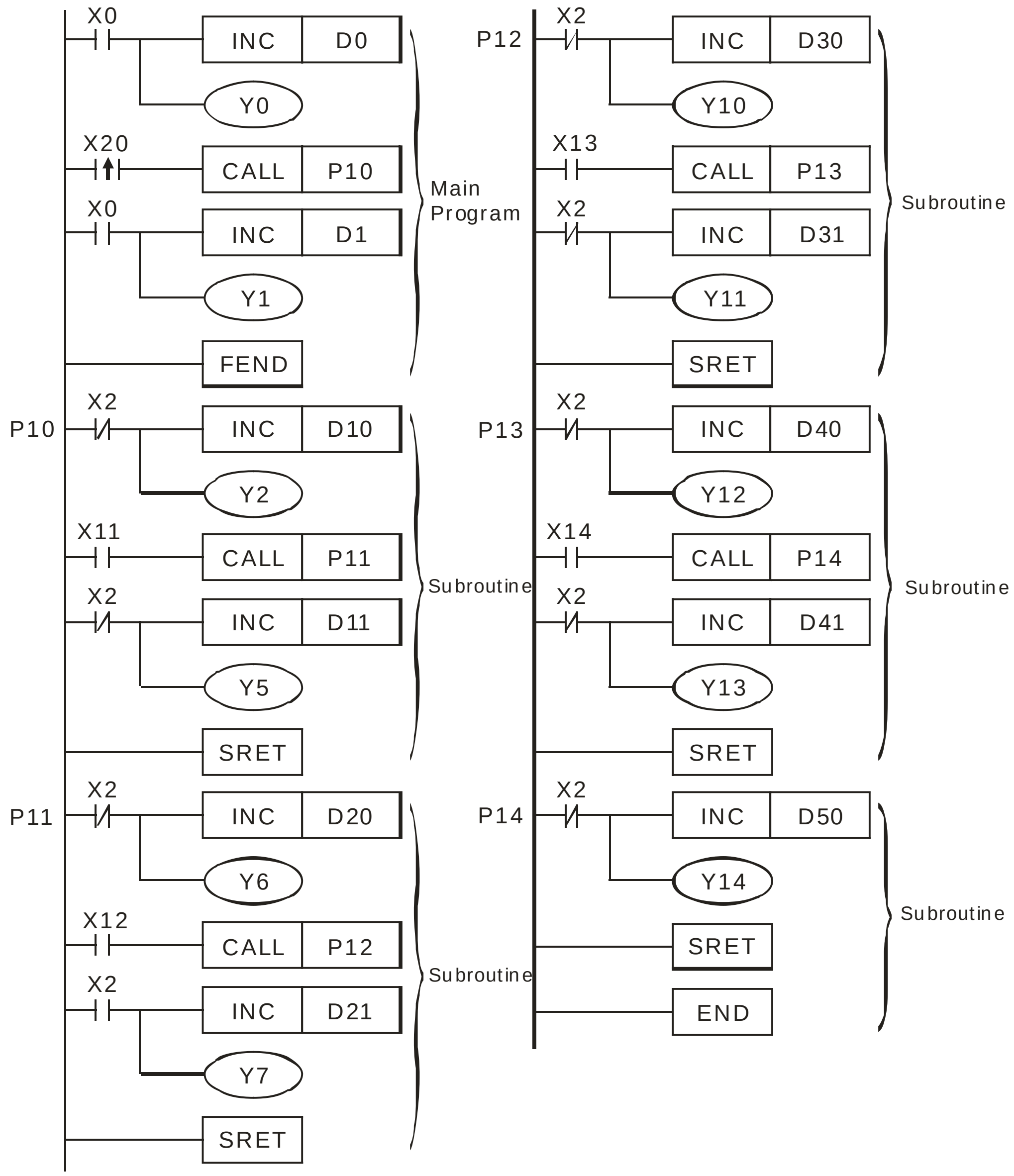
◆ When X11 is ON, the instruction CALL P11 is executed, and the execution of the program jumps to the subroutine to which P11 points.

◆ When X12 is ON, the instruction CALL P12 is executed, and the execution of the program jumps to the subroutine to which P12 points.

◆ When X13 is ON, the instruction CALL P13 is executed, and the execution of the program jumps to the subroutine to which P13 points.

◆ When X14 is ON, the instruction CALL P14 is executed, and the execution of the program jumps to the subroutine to which P14 points. When the instruction SRET is executed, the execution of the program returns to the previous subroutine.

◆ When the instruction SRET in the subroutine to which P10 points is executed, the execution of the program returns to the main program.


X0
INC D0
Y0
X20
CALL P10
X0
INC D1
Y1
FEND
Main Program
P10
X2
INC D10
Y2
X11
CALL P11
X2
INC D11
Y5
SRET
Subroutine
P11
X2
INC D20
Y6
X12
CALL P12
X2
INC D21
Y7
SRET
Subroutine
P12
X2
INC D30
Y10
X13
CALL P13
X2
INC D31
Y11
SRET
Subroutine
P13
X2
INC D40
Y12
X14
CALL P14
X2
INC D41
Y13
SRET
Subroutine
P14
X2
INC D50
Y14
SRET
END
Subroutine

API		WDT			Watchdog timer	Applicable model
07						10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z

- Note: There is no operand.
  The instruction does not need to be driven by a contact.

16-bit instruction (1 step)

WDT	Continuity instruction	WDTP	Pulse instruction

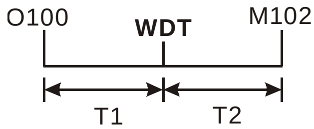
32-bit instruction

-	-	-	-

- Flag: None

Explanation

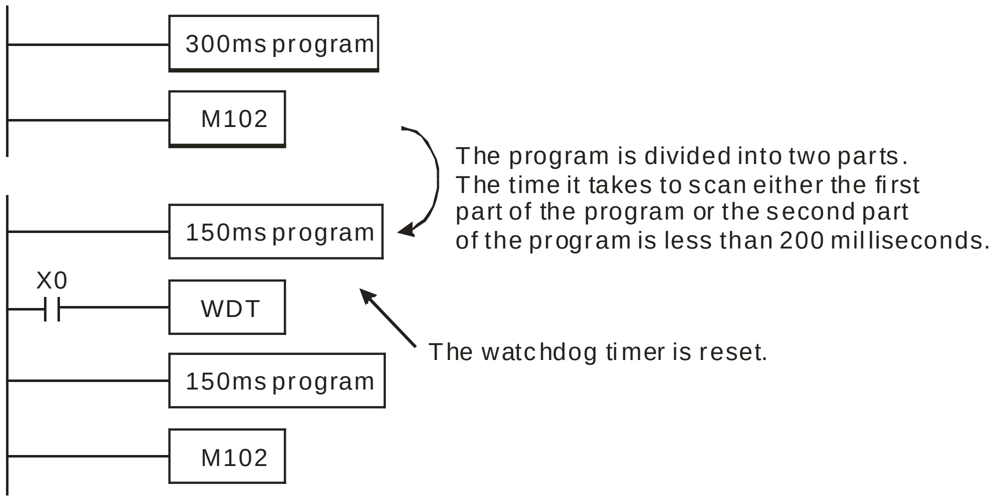
- The instruction WDT is used to reset the watchdog timer in a DVP-10PM series motion controller. If the scan time in a DVP-10PM series motion controller exceeds 200 milliseconds, the ERROR LED indicator of the motion controller will be ON, and users will have to disconnect the motion control module. After the users connect the motion controller again, the motion controller will judge its state according to the setting of the “STOP/RUN switch” switch. If there is no “STOP/RUN switch” switch, the motion controller will stop running automatically.
- The points when a watchdog timer acts are as follows.
  - The system is abnormal.
  - The execution of a program takes much time, and therefore the scan time is greater than the setting value in D1000. There are two ways users can use to improve the situation.
    1. Using the instruction WDT



    2. Changing the value in D1000 (The default setting is 200 milliseconds.)

Example

- Suppose the scan time is 300 milliseconds. After the program is divided into two parts, and the instruction WDT is inserted between these two parts, the time it takes to scan either the first part of the program or the second part of the program will be less than 200 milliseconds.



Additional remark

- The instruction WDT is executed when a condition is met. Users can make the instruction WDT executed only in one scan cycle by writing a program. They can use the pulse instruction WDTP.
- The default setting of a watchdog timer is 200 milliseconds. Users can set a watchdog timer by means of D1000.

API						Applicable model
08		RPT		(S)	Start of a nested loop	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*	*	*	*	*	*	*	*	*	*	

- Note: The instruction does not need to be driven by a contact.
  The instruction supports V devices.
  Please refer to specifications for more information about device ranges.

16-bit instruction (3 steps)

RPT	Continuity instruction	-	-

32-bit instruction

-	-	-	-

- Flag: None

Explanation

- **S**: Number of times a loop is executed
- There is only one RPT-RPE loop in a program. If there is more than one RPT-RPE loop in a program, an error will occur.

API					Applicable model
09		RPE		End of a nested loop	10PM
					✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z

- Note: There is no operand.
  The instruction does not need to be driven by a contact.

16-bit instruction (1 step)

RPE	Continuity instruction	-	-

32-bit instruction

-	-	-	-

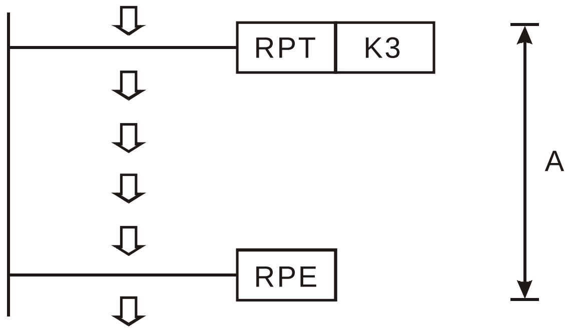
- Flag: None

Explanation

- RPT in a program specifies that the RPT-RPE loop in the program must be executed N times.
- N is in the range of K1 to K32,767. If N≦K1, N will be regarded as K1.
- Users can skip the execution of the RPT-RPE loop in a program by means of the instruction CJ.
- An error will occur if
  1. the instruction RPE is before the instruction RPT.
  2. there is RPT, but there is no RPE.
  3. the number of times RPT is used is not the same as the number of times RPE is used.
- There is only one RPT-RPE loop in a program. If there is more than one RPT-RPE loop in a program, an error will occur.

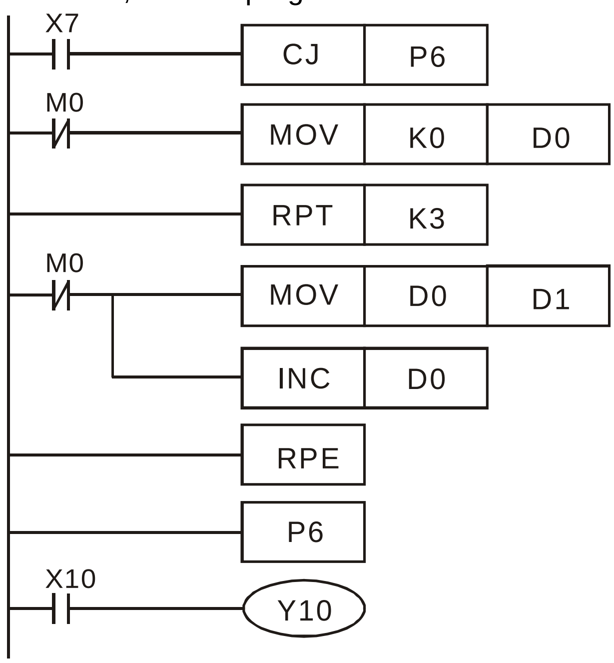
Example 1

- Part A can be executed three times by means of a RPT-RPE loop.



Example 2

- When X0.7 is OFF, the program between RPT and RPE is executed. When X0.7 is ON, the instruction CJ is executed, the subroutine to which P6 points is executed, and the program between RPT and RPE is skipped.



API						Applicable model
10	D	CMP	P	S1 S2 D	Comparing values	10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*	*	*	*	*	*	*	*	*	*	*
S_2					*	*	*	*	*	*	*	*	*	*	*
D		*	*	*											

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.

16-bit instruction (7 steps)

CMP Continuity instruction CMPP Pulse instruction

32-bit instruction (9 steps)

DCMP Continuity instruction DCMPP Pulse instruction

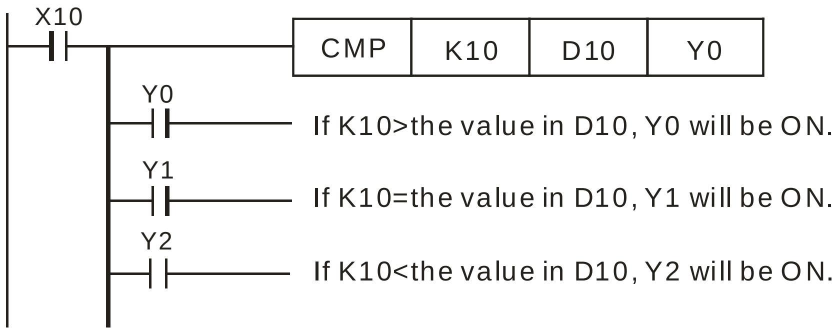
- Flag: None

Explanation

- **S_1**: Comparison value 1; **S_2**: Comparison value 2; **D**: Comparison result
- The instruction is used to compare the value in **S_1** with that in **S_2**. The comparison result is stored in **D**.
- The operand **D** occupies three consecutive devices.
- If the operand **D** is Y0, Y0, Y1, and Y2 will be occupied automatically.

Example

- When X10 is ON, the instruction CMP is executed, and Y0, Y1, or Y2 is ON. When X10 is OFF, the execution of the instruction CMP stops, and the states of Y0, Y1, and Y2 remain unchanged.
- If users want to get the result that K10≧ the value in D10, they have to connect Y0 and Y1 in series. If users want to get the result that K10≦ the value in D10, they have to connect Y1 and Y2 in series. If users want to get the result that K10≠the value in D10, they have to connect Y0, Y1, and Y2 in series.



API						Applicable model
11	D	ZCP	P	S1 S2 S D	Zonal comparison	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*	*	*	*	*	*	*	*	*	*	*
S_2					*	*	*	*	*	*	*	*	*	*	*
S					*	*	*	*	*	*	*	*	*	*	*
D		*	*	*											

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.

16-bit instruction (9 steps)

ZCP Continuity instruction ZCPP Pulse instruction

32-bit instruction (12 steps)

DZCP Continuity instruction DZCPP Pulse instruction

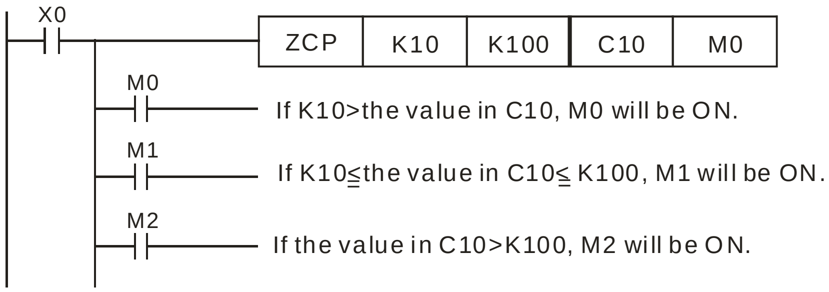
- Flag: None

Explanation

- S_1: Minimum value; S_2: Maximum value; **S**: Comparison value; **D**: Comparison result
- The instruction is used to compare the value in **S** with that in S_1, and compare the value in **S** with that in S_2. The comparison result is stored in **D**.
- The value in S_2 must be greater than that in S_1.
- The operand **D** occupies three consecutive devices.
- If the operand **D** is M0, M0, M1, and M2 will be occupied automatically.

Example

- When X0 is ON, the instruction ZCP is executed, and M0, M1, or M2 is ON. When X0 is OFF, the execution of the instruction ZCP stops, and the states of M0, M1, and M2 remain unchanged.



API						
12	D	MOV	P	S D	Transferring a value	Applicable model: 10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*	*	*	*	*	*	*	*	*	*	*
D								*	*	*	*	*	*	*	*

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.

16-bit instruction (5 steps)
MOV Continuity instruction MOVP Pulse instruction

32-bit instruction (6 steps)
DMOV Continuity instruction DMOVP Pulse instruction

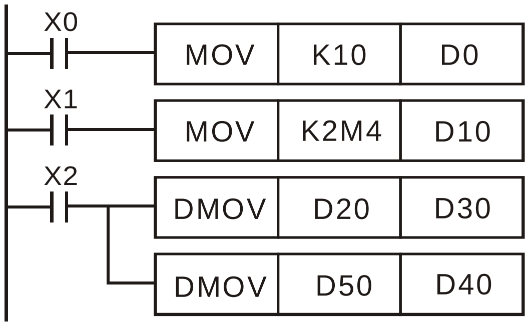
- Flag: None

Explanation

- **S**: Source; **D**: Destination
- When the instruction is executed, the value in **S** is transferred to **D**. When the instruction is not executed, the value in **D** is unchanged.
- If an operation result gotten is a 32-bit value, users can only move the operation result by means of the instruction DMOV.

Example

- If users want to move a 16-bit value, they have to use the instruction MOV.
  1. When X0 is OFF, the value in D0 is unchanged. When X0 is ON, the value K10 is transferred to the data register D0.
  2. When X1 is OFF, the value in D10 is unchanged. When X1 is ON, the value in K2M4 is transferred to the data register D10.
- If users want to move a 32-bit value, they have to use the instruction DMOV.
  When X2 is OFF, the values in (D31, D30) and (D41, D40) are unchanged. When X2 is ON, the value in (D21, D20) is transferred to (D31, D30), and the value in (D51, D50) is transferred to (D41, D40).



API		SMOV		S m1 m2 D n	Transferring digits	Applicable model
13			P			10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S							*	*	*	*	*	*	*	*	*
m1					*	*									
m2					*	*									
D								*	*	*	*	*	*	*	*
n					*	*									

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)

  Please refer to specifications for more information about device ranges.

  If KnX/KnY/KnM/KnS is used, it is suggested that X/devices/Y devices/M device numbers/S device numbers should start from a number which is a multiple of 16 in the octal numeral system or in the decimal numeral system, e.g. K1X0 (octal numeral system), K4SY20 (octal numeral system), K1M0 (decimal numeral system), and K4S16 (decimal numeral system).

16-bit instruction (11 steps)

SMOV	Continuity instruction	SMOVP	Pulse instruction

32-bit instruction

–	–	–	–

- Flag: M1168

Explanation

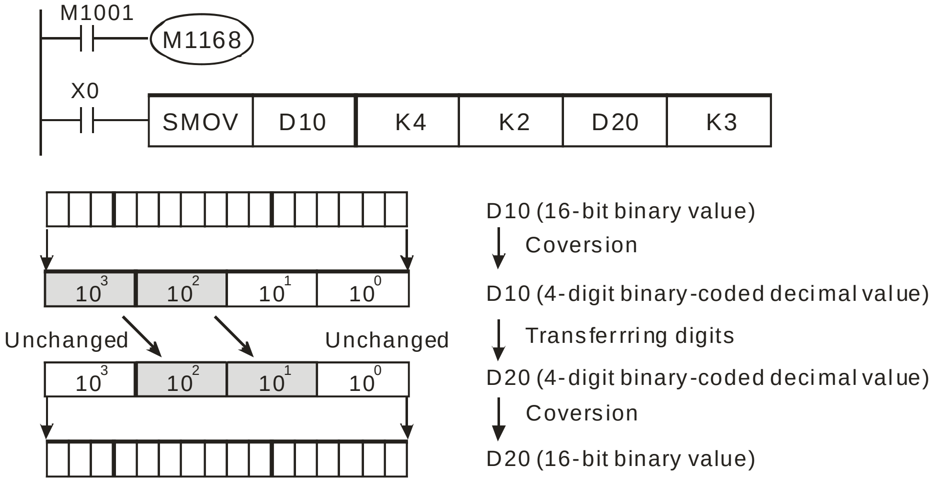
- **S**: Data source; $\mathbf{m_1}$: Start digit which will be transferred from the source device; $\mathbf{m_2}$: Number of digits which will be transferred; **D**: Data destination; **n**: Start digit where the source data is stored in the destination device
- The value used by the instruction is a binary-coded decimal value (M1168 is OFF).

  The value used by SMOV is a binary-coded decimal value. When the instruction is executed, the $\mathbf{m_2}$ digits of the four-digit binary-code decimal value in **S** which start from the $\mathbf{m_1}^{th}$ digit of the four-digit binary-code decimal value in **S** are transferred to the $\mathbf{m_2}$ digits of the four-digit binary-code decimal value in **D** which starts from the $\mathbf{n}^{th}$ digit of the four-digit binary-code decimal value in **D**.
- The value used by the instruction is a binary value (M1168 is ON).

  When the instruction is executed, the $\mathbf{m_2}$ digits of the four-digit decimal value in **S** which start from the $\mathbf{m_1}^{th}$ digit of the four-digit decimal value in **S** are transferred to the $\mathbf{m_2}$ digits of the four-digit decimal value in **D** which starts from the $\mathbf{n}^{th}$ digit of the four-digit decimal value in **D**.
- $\mathbf{m_1}$ is in the range of 1 to 4.
- $\mathbf{m_2}$ is in the range of 1 to $\mathbf{m_1}$.(It can not be greater than $\mathbf{m_1}$.)
- **n** is in the range of $\mathbf{m_2}$ to 4. (It can not be less than $\mathbf{m_2}$.)

Example 1

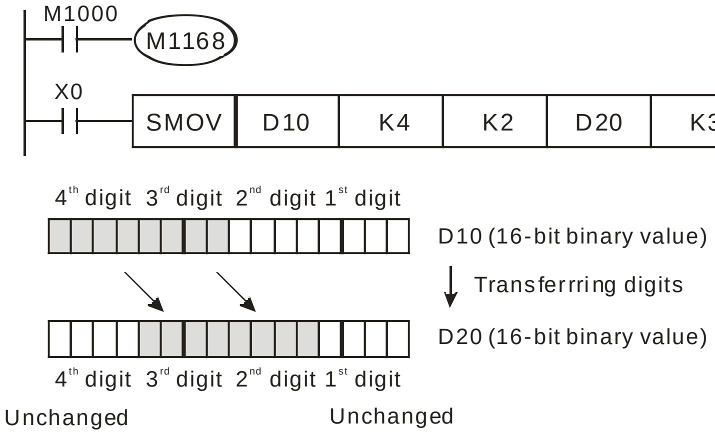
- When M1168 is OFF, the value used by SMOV is a binary-coded decimal value. When X0 is ON, the two digits of the decimal value in D10 which start from the fourth digit of the decimal value (the digit in the thousands place of the decimal value) in D10 are transferred to the two digits of the decimal value in D20 which start from the third digit of the decimal value (the digit in the hundreds place of the decimal value) in D20. After the instruction is executed, the digits in the thousands place of the decimal value (10^3) and the ones place of the decimal value (10^0) in D20 will be unchanged.
- If the binary-coded decimal value used is not in the range of 0 to 9,999, an operation error will occur, the instruction will not executed, M1067 will be ON, and the error code in D1067 will be 0E18 (hexadecimal value).



- Suppose the value in D10 is K1234, and the value in D20 is K5678. After the instruction is executed, the value in D10 will be unchanged, and the value in D20 is K5128.

Example 2

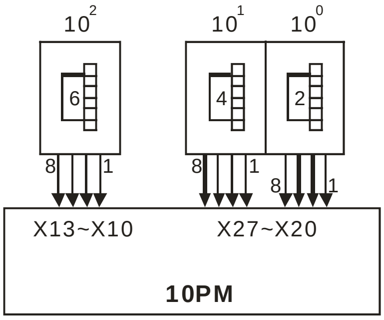
- When M1168 is ON, the value used by SMOV is a is binary value. When the instruction SMOV is executed, the binary values in D10 and D20 are not converted into the binary-coded decimal values, and evey digit which is transferred is composed of four bits.

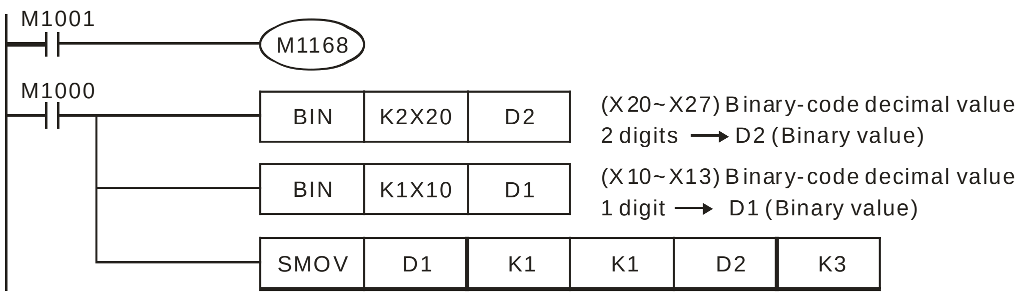


- Suppose the value in D10 is H1234, and the value in D20 is H5678. After the instruction is executed, the value in D10 will be unchanged, and the value in D20 is H5128.

Example 3

- The two digits of the value of the DIP switch on the right are transferred to the the two digits of the value in D2 which start from the second digit of the value in D2, and the one digit of the value of the DIP switch on the left is transferred to the the first digit of the value in D1. The instruction SMOV can be used to transfer the first digit of the value in D1 to the third digit of the value in D2. In other words, the two DIP switches can be combined into one DIP switch by means of the instruction SMOV.





API						
14	D	CML	P	S D	Inverting bits	Applicable model 10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*	*	*	*	*	*	*	*	*	*	*
D								*	*	*	*	*	*	*	*

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)

  Please refer to specifications for more information about device ranges.

  If KnX/KnY/KnM/KnS is used, it is suggested that X/devices/Y devices/M device numbers/S device numbers should start from a number which is a multiple of 16 in the octal numeral system or in the decimal numeral system, e.g. K1X0 (octal numeral system), K4SY20 (octal numeral system), K1M0 (decimal numeral system), and K4S16 (decimal numeral system).

16-bit instruction (5 steps)

CML Continuity instruction CMLP Pulse instruction

32-bit instruction (6 steps)

DCML Continuity instruction DCMLP Pulse instruction

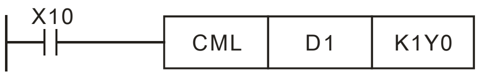
- Flag: None

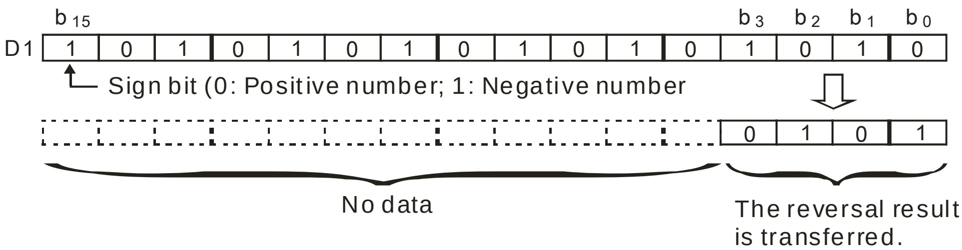
Explanation

- **S**: Source; **D**: Destination
- The instruction is used to invert the bits in **S** (0→1 and 1→0), and transfer the inversion result to **D**.

Example 1

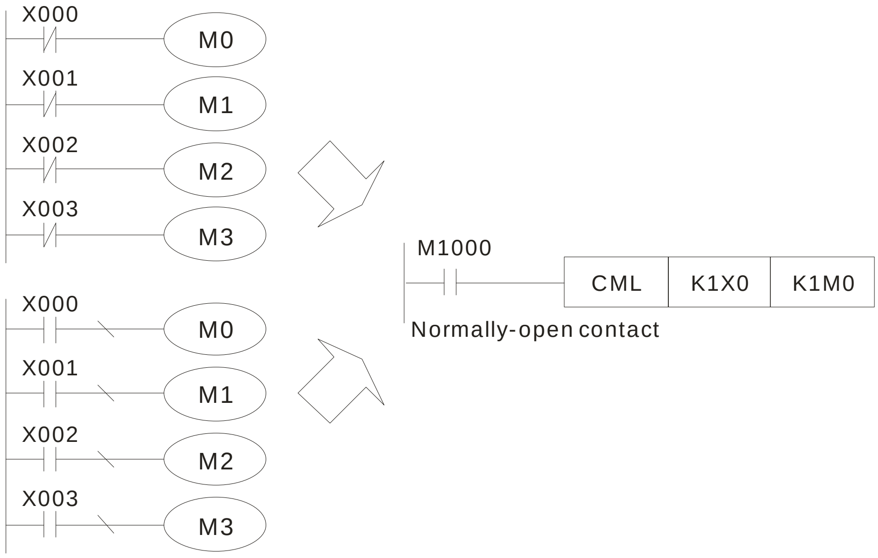
- When X10 is ON, bit 0~bit 3 in D1 are inverted, and the inversion result is transferred to Y0~Y3.





Example 2

- The circuits below can be represented by means of the instruction CML.



API					
15	BMOV	P	(S) (D) (n)	Transferring values	Applicable model: 10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S							*	*	*	*	*	*	*		
D								*	*	*	*	*	*		
n					*	*					*	*	*		

16-bit instruction (7 steps)
BMOV Continuity instruction BMOVP Pulse instruction

32-bit instruction
- - - -

- Flag: None

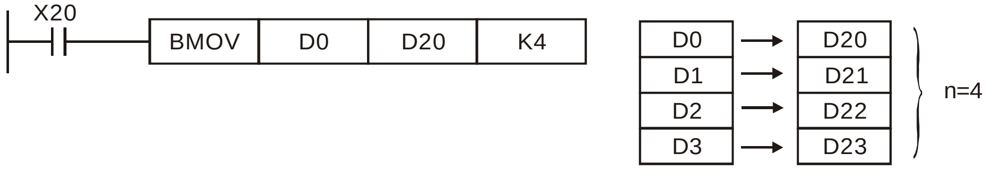
- Note: Please refer to specifications for more information about device ranges.
  If KnX/KnY/KnM/KnS is used, it is suggested that X/devices/Y devices/M device numbers/S device numbers should start from a number which is a multiple of 16 in the octal numeral system or in the decimal numeral system, e.g. K1X0 (octal numeral system), K4SY20 (octal numeral system), K1M0 (decimal numeral system), and K4S16 (decimal numeral system).

Explanation

- **S**: Source; **D**: Destination; **n**: Length
- The instruction is used to transfer the values in registers to new registers. The values in the **n** registers starting from **S** are transferred to the **n** registers starting from **D**. If **n** is not in the range available, only the values in registers available will be transferred.
- **n** is in the range of 1 to 512.

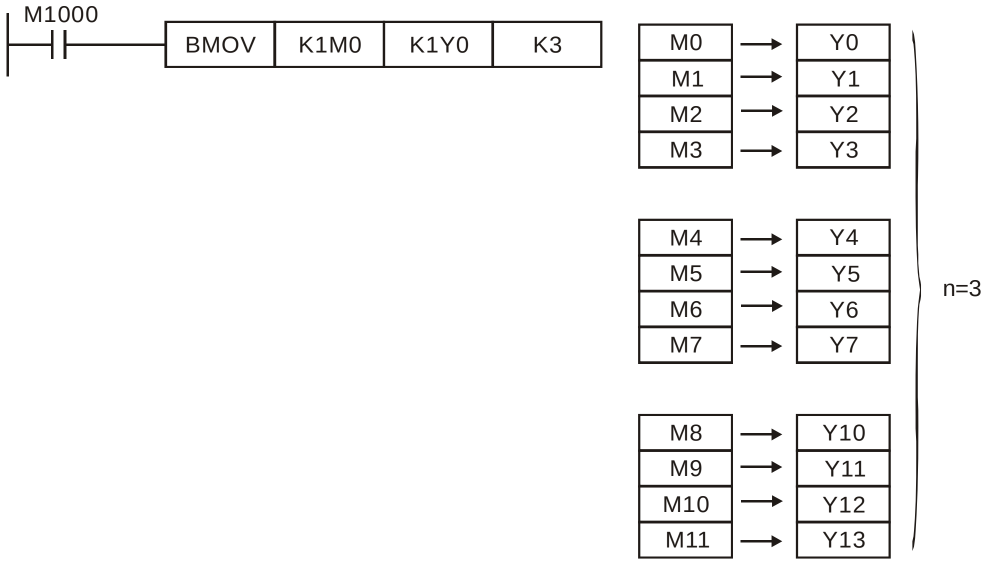
Example 1

- When X2.0 is ON, the values in D0~D3 are transferred to D20~D23.



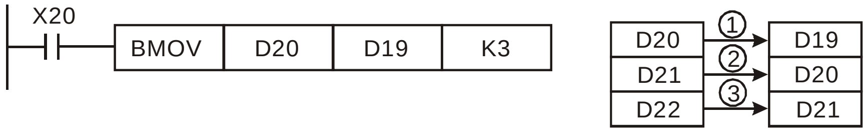
Example 2

- If users specify KnM and KnY, n in KnM must be the same as n in KnY.

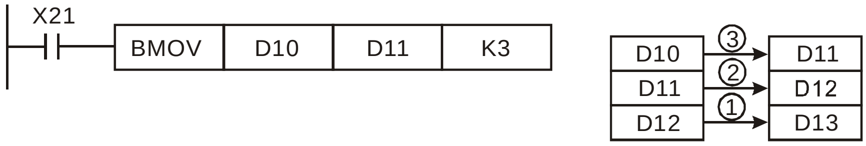


Example 3

- In order to prevent the error which results from the overlap between source devices and destination devices, the values in the source devices are transferred in the following way.
  1. The device number of **S** is greater than the device number of **D**. The values in D20~D22 are transferred in the order ①→②→③.



  2. The device number of **S** is less than the device number of **D**. The values in D10~D12 are transferred in the order ③→②→①. The values in D11~D13 are the same as the value in D10.



API 16	FMOV P	S D n	Transferring a value to several devices	Applicable model 10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S							*	*	*	*	*	*	*	*	
D								*	*	*	*	*	*		
n					*	*									

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)

  Please refer to specifications for more information about device ranges.

  If KnX/KnY/KnM/KnS is used, it is suggested that X/devices/Y devices/M device numbers/S device numbers should start from a number which is a multiple of 16 in the octal numeral system or in the decimal numeral system, e.g. K1X0 (octal numeral system), K4SY20 (octal numeral system), K1M0 (decimal numeral system), and K4S16 (decimal numeral system).

16-bit instruction (7 steps)

FMOV Continuity instruction   FMOVP Pulse instruction

32-bit instruction

DFMOV Continuity instruction   DFMOVP Pulse instruction

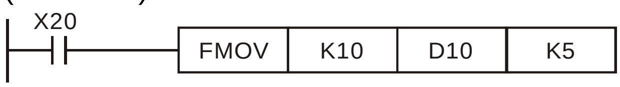
- Flag: None

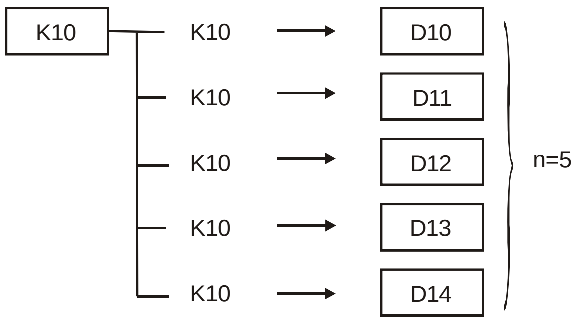
Explanation

- **S**: Source; **D**: Destination; **n**: Length
- The value in **S** is transferred to the n registers starting from **D**. If **n** is not in the range available, a value will only be transferred to registers available.
- **n** is in the range of 1 to 512.

Example

- When X20 is ON, K10 is transferred to the 5 registers starting from D10 (D10~D14).





API	D	XCH	P	D1 D2	Interchanging values	Applicable model 10PM
17	D	XCH	P	D_1 D_2	Interchanging values	✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
D_1								*	*	*	*	*	*	*	*
D_2								*	*	*	*	*	*	*	*

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.
  If KnX/KnY/KnM/KnS is used, it is suggested that X/devices/Y devices/M device numbers/S device numbers should start from a number which is a multiple of 16 in the octal numeral system or in the decimal numeral system, e.g. K1X0 (octal numeral system), K4SY20 (octal numeral system), K1M0 (decimal numeral system), and K4S16 (decimal numeral system).

16-bit instruction (5 steps)
XCH Continuity instruction XCHP Pulse instruction

32-bit instruction (9 steps)
DXCH Continuity instruction DFXCHP Pulse instruction

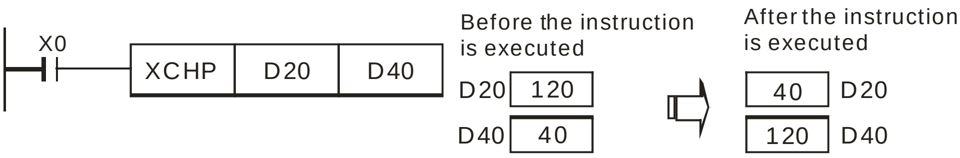
- Flag: None

Explanation

- **D_1**: Value which is interchanged; **D_2**: Value which is interchanged
- The instruction is used to interchange the value in **D_1** with the value in **D_2**.
- It is suggested that users should use the pulse instruction XCHP.

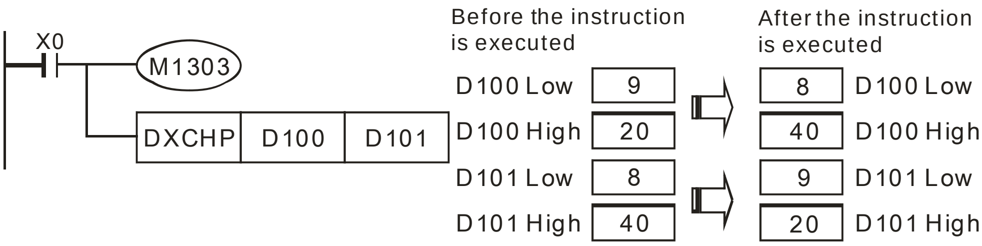
Example

- When X0 is turned from OFF to ON, the value in D20 is interchanged with the value in D40.



Additional remark

- 16-bit instruction: If **D_1** is the same as **D_2**, and M1303 is ON, the high 8 bits are interchanged with the low 8 bits.
- 32-bit instruction: If **D_1** is the same as **D_2**, and M1303 is ON, the high 16 bits are interchanged with the low 16 bits.
- When X0 is ON, and M1303 is ON, the high 8 bits in D100 are interchanged with the high 8 bits in D101, and the low 8 bits in D100 are interchanged with the low 8 bits in D101.



API		BCD			Converting a binary value into a binary-coded decimal value	Applicable model
18	D		P	(S) (D)		10PM: ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S							*	*	*	*	*	*	*	*	*
D								*	*	*	*	*	*	*	*

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.

16-bit instruction (5 steps)

BCD	Continuity instruction	BCDP	Pulse instruction

32-bit instruction (6 steps)

DBCD	Continuity instruction	DBCDP	Pulse instruction

- Flags

Ox	O100	
M1793	M1953	Operation error flag

Explanation

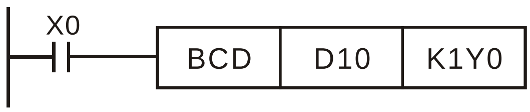
◆ The binary value in **S** is converted into a binary-coded decimal value, and the conversion result is transferred to **D**.

◆ If a binary value is converted to a binary-coded decimal value which is not in the range of 0 to 9,999, the instruction BCD will not be executed. If a binary value is converted to a binary-coded decimal value which is not in the range of 0 to 99,999,999, the instruction DBCD will not be executed.

◆ BCD can be used to convert the binary value in a positioning unit to a binary-coded decimal value, and transfer the conversion result to an external device, e.g. a seven-segment display.

Example

◆ When X0 is ON, the binary value in D10 is converted into a binary-coded decimal value, and the digit in the ones place of the conversion result is stored in K1Y0 (Y0~Y3).



If D10=001E (hexadecimal value)=0030 (decimal value), Y0~Y3=0000 (binary value).

API	W	BIN		S D	Converting a binary-coded decimal value into a binary value	Applicable model
19	D		P			10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S							*	*	*	*	*	*	*	*	*
D								*	*	*	*	*	*	*	*

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.

16-bit instruction (5 steps)

BIN	Continuity instruction	BINP	Pulse instruction

32-bit instruction (6 steps)

DBIN	Continuity instruction	DBINP	Pulse instruction

- Flags

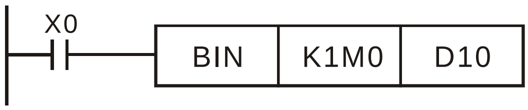
Ox	O100	
M1793	M1953	Operation error flag

Explanation

- **S**: Source; **D**: Conversion result
- The binary-coded decimal value in **S** is converted into a binary value, and the conversion result is transferred to **D**.
- The 16-bit binary-coded decimal value in **S** should be in the range of 0 to 9,999, and the 32-bit binary-coded decimal value in **S** should be in the range of 0 to 99,999,999.
- Decimal constants and hexadecimal constants are converted into binary values automatically. Users do not need to use the instruction.

Example

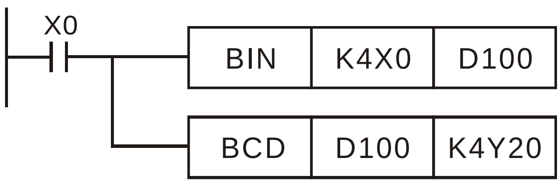
- When X0 is ON, the binary-coded decimal value in K1M0 is converted into a binary value, and the conversion result is stored in D10.



Additional remark

- Applications of the instructions BCD and BIN:

1. If a DVP-10PM series motion controller wants to read a binary-coded decimal value created by a DIP switch, users have to use the instruction BIN to convert the value into a binary value, and store the conversion result in the DVP-10PM series motion controller.
2. If users want to display a value stored in a DVP-10PM series motion controller on a seven-segment display on which binary-coded decimal values can be displayed, they have to use the instruction BCD to convert the value into a binary-coded decimal value, and transfer the conversion result to the seven-segment display.
3. When X0 is ON, the binary-coded decimal value in K4M0 is converted into a binary value, and the conversion result is stored in D100. Subsequently, the binary value in D100 is converted into a binary-coded decimal value, and the conversion result is stored in K4Y20.



API						Applicable model
20	D	ADD	P	S1 S2 D	Binary addition	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*	*	*	*	*	*	*	*	*	*	*
S_2					*	*	*	*	*	*	*	*	*	*	*
D								*	*	*	*	*	*	*	*

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.

16-bit instruction (7 steps)

ADD	Continuity instruction	ADDP	Pulse instruction

32-bit instruction (9 steps)

DADD	Continuity instruction	DADDP	Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1809	M1969	Borrow flag
M1810	M1970	Carry flag

- Please refer to the additional remark below.

Explanation

- **S_1**: Augend; **S_2**: Addend; **D**: Sum
- The binary value in **S_2** is added to the binary value in **S_1**, and the sum is stored in **D**.
- The highest bit in **S_1** and the highest bit in **S_2** are sign bits. If the sign bit in a register is 0, the value in the register is a positive value. If the sign bit in a register is 1, the value in the register is a negative value.
- The flags related to 16-bit binary addition and 32-bit binary addition are listed below.

  16-bit binary addition:

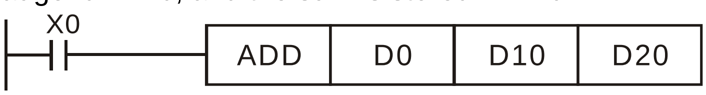
  1. If the operation result gotten is 0, a zero flag will be ON.
  2. If the operation result gotten is less than –32,768, a borrow flag will be ON.
  3. If the operation result gotten is greater than 32,767, a carry flag will be ON.

  32-bit binary addition:

  1. If the operation result gotten is 0, a zero flag will be ON.
  2. If the operation result gotten is less than –2,147,483,648, a borrow flag will be ON.
  3. If the operation result gotten is greater than 2,147,483,647, a carry flag will be ON.

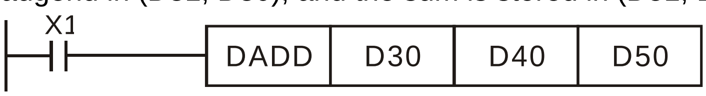
Example 1

- 16-bit binary addition: When X0 is ON, the addend in D10 is added to the augend in D0, and the sum is stored in D20.



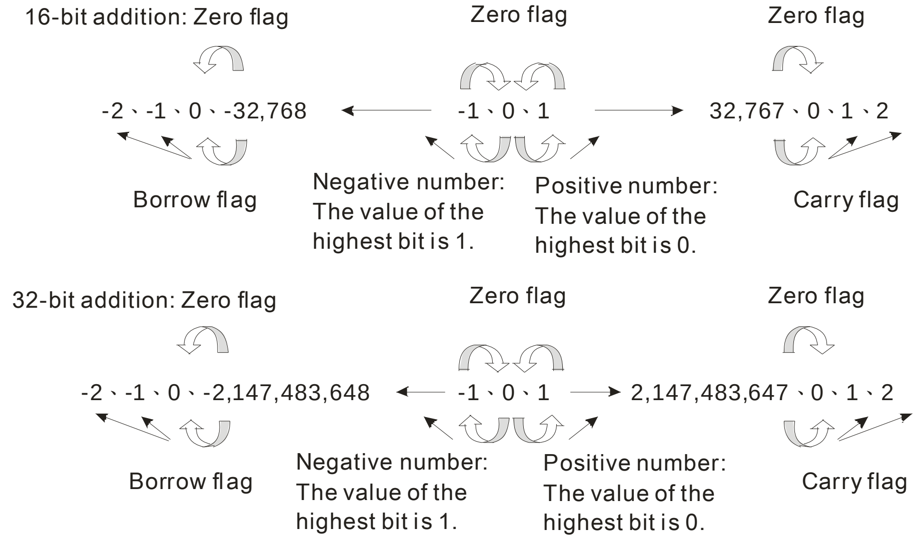
Example 2

- 32-bit binary addition: When X1 is ON, the value in (D41, D40) is added to the augend in (D31, D30), and the sum is stored in (D51, D50).



Additional remark

- The relations between flags and values are shown below.



API						
21	D	SUB	P	S1 S2 D	Binary subtraction	Applicable model 10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*	*	*	*	*	*	*	*	*	*	*
S_2					*	*	*	*	*	*	*	*	*	*	*
D								*	*	*	*	*	*	*	*

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.

16-bit instruction (7 steps)

SUB	Continuity instruction	SUBP	Pulse instruction

32-bit instruction (9 steps)

DSUB	Continuity instruction	DSUBP	Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1809	M1969	Borrow flag
M1810	M1970	Carry flag

- Please refer to the additional remark below.

Explanation

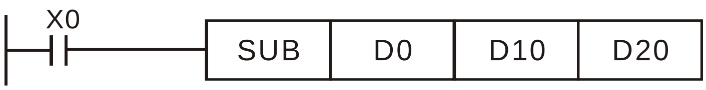
- **S_1**: Minuend; **S_2**: Subtrahend; **D**: Difference
- The binary value in **S_2** is subtracted from the binary value in **S_1**, and the difference is stored in **D**.
- The highest bit in **S_1** and the highest bit in **S_2** are sign bits. If the sign bit in a register is 0, the value in the register is a positive value. If the sign bit in a register is 1, the value in the register is a negative value.
- The flags related to 16-bit binary subtraction and 32-bit binary subtraction are listed below.

  16-bit binary subtraction:
  1. If the operation result gotten is 0, a zero flag will be ON.
  2. If the operation result gotten is less than –32,768, a borrow flag will be ON.
  3. If the operation result gotten is greater than 32,767, a carry flag will be ON.

  32-bit binary subtraction:
  1. If the operation result gotten is 0, a zero flag will be ON.
  2. If the operation result gotten is less than –2,147,483,648, a borrow flag will be ON.
  3. If the operation result gotten is greater than 2,147,483,647, a carry flag will be ON.
- Please refer to the additional remark on the instruction ADD for more information about the relations between flags and values.

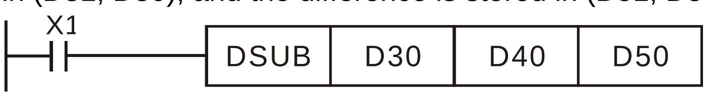
Example 1

- 16-bit binary subtraction: When X0 is ON, the subtrahend in D10 is subtracted from the minuend in D0, and the difference is stored in D20.



Example 2

- When X1 is ON, the subtrahend in (D41, D40) is subtracted from the minuend in (D31, D30), and the difference is stored in (D51, D50).



API						
22	D	MUL	P	S1 S2 D	Binary multiplication	Applicable model: 10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*	*	*	*	*	*	*	*	*	*	*
S_2					*	*	*	*	*	*	*	*	*	*	*
D											*	*	*		

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.

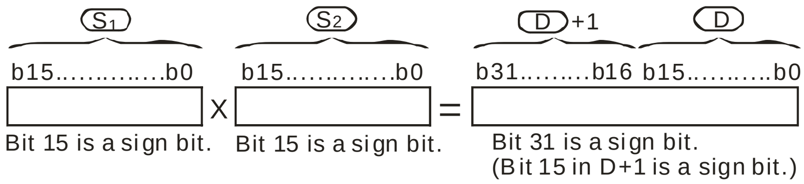
16-bit instruction (7 steps)
MUL Continuity instruction MULP Pulse instruction

32-bit instruction (9 steps)
DMUL Continuity instruction DMULP Pulse instruction

- Flag: None

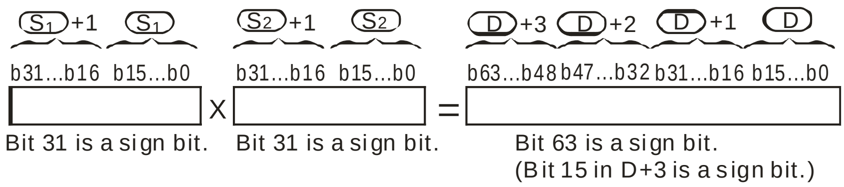
Explanation

- **S_1**: Multiplicand; **S_2**: Multiplier; **D**: Product
- The signed binary value in **S_1** is multiplied by the singed binary value in **S_2**, and the product is stored in **D**. Users have to notice the sign bits in **S_1**, **S_2**, and **D** when 16-bit binary multiplication or 32-bit binary multiplication is done.
- 16-bit binary multiplication



Sign bit=0 (Positive sign); Sign bit=1 (Negative sign)

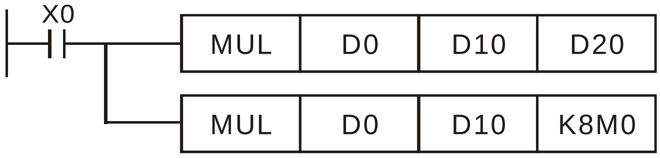
- 32-bit binary multiplication



Sign bit=0 (Positive sign); Sign bit=1 (Negative sign)

Example

- The 16-bit value in D0 is multiplied by the 16-bit value in D10, and the 32-bit product is stored in (D21, D20). The bits in D21 is the high 16 bits in (D21, D20), whereas the bits in D20 is the low 16 bits in (D21, D20). Whether the product is a positive value or a negative value depends on the leftmost bit in (D21, D20).



API						
23	D	DIV	P	S1 S2 D	Binary division	Applicable model: 10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*	*	*	*	*	*	*	*	*	*	*
S_2					*	*	*	*	*	*	*	*	*	*	*
D											*	*	*		

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.

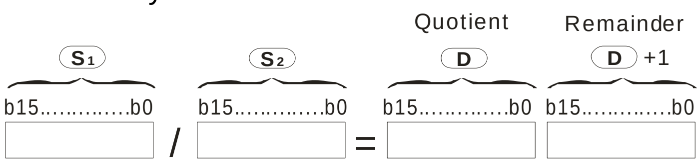
16-bit instruction (7 steps)
DIV Continuity instruction; DIVP Pulse instruction

32-bit instruction (9 steps)
DDIV Continuity instruction; DDIVP Pulse instruction

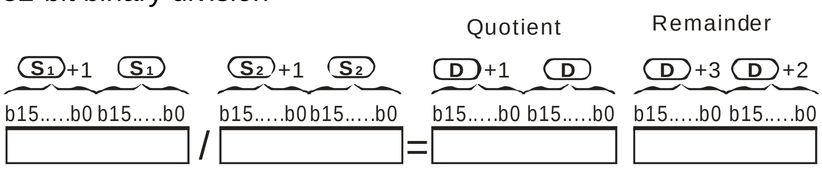
- Flag: None

Explanation

- **S_1**: Dividend; **S_2**: Divisor; **D**: Quotient and remainder
- The singed binary value in **S_1** is divided by the signed binary value in **S_2**. The quotient and the remainder are stored in **D**. Users have to notice the sign bits in **S_1**, **S_2**, and **D** when 16-bit binary division or 32-bit binary division is done.
- If the divisor in **S_2** is 0, the instruciton will not be executed.
- 16-bit binary division

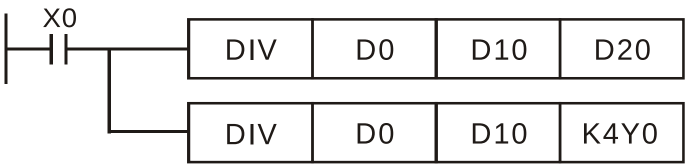


- 32-bit binary division



Example

- When X0 is ON, the dividend in D0 is divided by the divisor in D10, the quotient is stored in D20, and the remainder is stored in D21. Whether the quotient and the remainder are positive values or negative values depends on the leftmost bit in D20 and the leftmost bit in D21.



API						
24	D	INC	P	(D)	Adding one to a binary value	Applicable model: 10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
D								*	*	*	*	*	*	*	*

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.

16-bit instruction (3 steps)
INC Continuity instruction INCP Pulse instruction

32-bit instruction (3 steps)
DINC Continuity instruction DINCP Pulse instruction

- Flag: None

Explanation

◆ **D**: Destination device

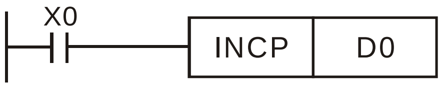
◆ If the instruction used is not a pulse instruction, the value in **D** used by the instruction increases by one whenever the instruction is executed.

◆ Generally, the pulse instructions INCP and DINCP are used.

◆ If a 16-bit operation is performed, 32,767 plus 1 equals -32,768. If a 32-bit operation is performed, 2,147,483,647 plus 1 equals -2,147,483,648.

Example

◆ When X0 is turned from OFF to ON, the value in D0 increases by one.



API						
25	D	DEC	P	D	Subtracting one from a binary value	Applicable model: 10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
D								*	*	*	*	*	*	*	*

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.

16-bit instruction (3 steps)
DEC Continuity instruction DECP Pulse instruction

32-bit instruction (3 steps)
DDEC Continuity instruction DDECP Pulse instruction

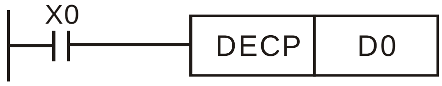
- Flag: None

Explanation

- **D**: Destination device
- If the instruction used is not a pulse instruction, the value in **D** used by the instruction decreases by one whenever the instruction is executed.
- Generally, the pulse instructions DECP and DDECP are used.
- If a 16-bit operation is performed, -32,768 minus 1 leaves 32,767. If a 32-bit operation is performed, -2,147,483,648 minus 1 leaves 2,147,483,647.

Example

- When X0 is turned from OFF to ON, the value in D0 decreases by one.



API						Applicable model
26	D	WAND	P	S1 S2 D	Logical AND operation	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S1					*	*	*	*	*	*	*	*	*	*	*
S2					*	*	*	*	*	*	*	*	*	*	*
D								*	*	*	*	*	*	*	*

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.

16-bit instruction (7 steps)

WAND	Continuity instruction	WANDP	Pulse instruction

32-bit instruction (9 steps)

DWAND	Continuity instruction	DWANDP	Pulse instruction

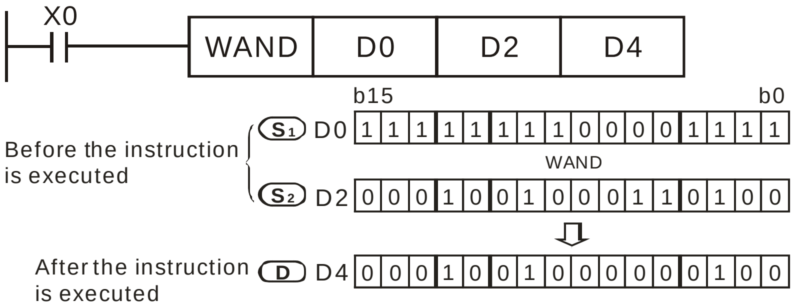
- Flag: None

Explanation

- **S1**: Source device 1; **S2**: Source device 2; **D**: Operation result
- A logical AND operator takes the binary representations in **S1** and **S2**, and performs the logical AND operation on each pair of corresponding bits. The operation result is stored in **D**.
- The result in each position is 1 if the first bit is 1 and the second bit is 1. Otherwise, the result is 0.

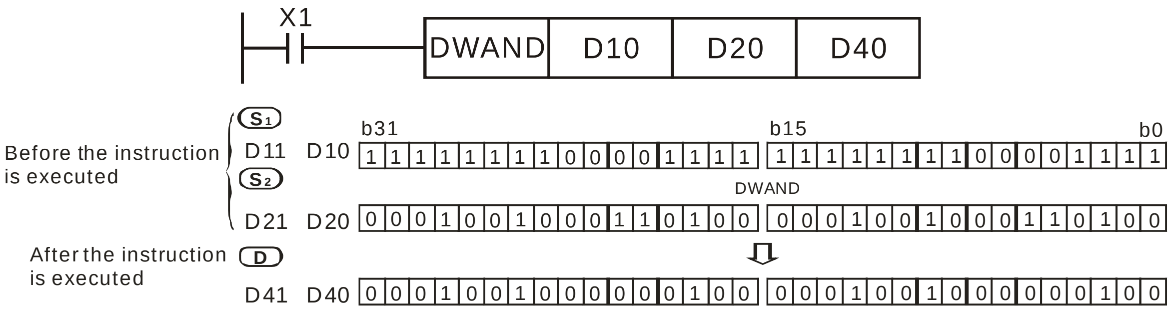
Example 1

- When X0 is ON, a logical AND operator takes the values in the 16-bit device D0 and the 16-bit device D2, and performs the logical AND operation on each pair of corresponding bits, and the operation result is stored in D4.



Example 2

- When X1 is ON, a logical AND operator takes the values in the 32-bit device (D11, D10) and the 32-bit device (D21, D20), and performs the logical AND operation on each pair of corresponding bits, and the operation result is stored in (D41, D40).



API						Applicable model
27	D	WOR	P	S1 S2 D	Logical OR operation	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S1					*	*	*	*	*	*	*	*	*	*	*
S2					*	*	*	*	*	*	*	*	*	*	*
D								*	*	*	*	*	*	*	*

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.

16-bit instruction (7 steps)

WOR	Continuity instruction	WORP	Pulse instruction

32-bit instruction (9 steps)

DWOR	Continuity instruction	DWORP	Pulse instruction

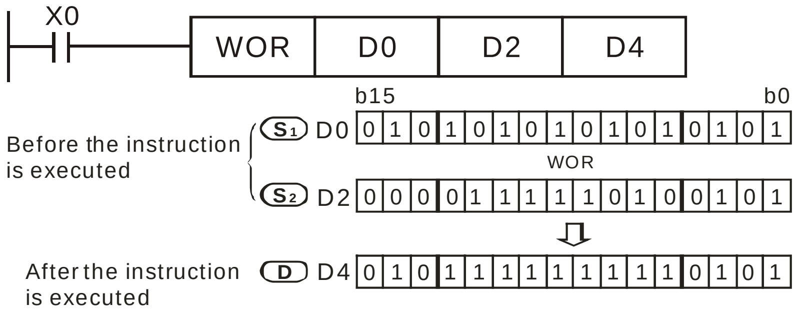
- Flag: None

Explanation

- **S_1**: Source device 1; **S_2**: Source device 2; **D**: Operation result
- A logical OR operator takes the binary representations in **S_1** and **S_2**, and performs the logical inclusive OR operation on each pair of corresponding bits. The operation result is stored in **D**.
- The result in each position is 1 if the first bit is 1, the second bit is 1, or both bits are 1. Otherwise, the result is 0.

Example 1

- When X0 is ON, a logical OR operator takes the values in the 16-bit device D0 and the 16-bit device D2, and performs the logical inclusive OR operation on each pair of corresponding bits, and the operation result is stored in D4.



Example 2

- When X1 is ON, a logical OR operator takes the values in the 32-bit device (D11, D10) and the 32-bit device (D21, D20), and performs the logical inclusive OR operation on each pair of corresponding bits, and the operation result is stored in (D41, D40).

API		Mnemonic		Operands	Function	Applicable model
28	D	WXOR	P	S1 S2 D	Logical exclusive OR operation	10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S1					*	*	*	*	*	*	*	*	*	*	*
S2					*	*	*	*	*	*	*	*	*	*	*
D								*	*	*	*	*	*	*	*

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.

16-bit instruction (7 steps)

WXOR: Continuity instruction; WXORP: Pulse instruction

32-bit instruction (9 steps)

DWXOR: Continuity instruction; DWXORP: Pulse instruction

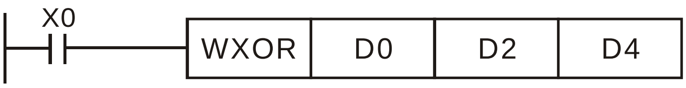
- Flag: None

Explanation

- **S₁**: Source device 1; **S₂**: Source device 2; **D**: Operation result
- A logical XOR operator takes the binary representations in **S₁** and **S₂**, and performs the logical exclusive OR operation on each pair of corresponding bits. The operation result is stored in **D**.
- The result in each position is 1 if the two bits are different, and 0 if they are the same.

Example 1

- When X0 is ON, a logical XOR operator takes the values in the 16-bit device D0 and the 16-bit device D2, and performs the exclusive OR operation on each pair of corresponding bits, and the operation result is stored in D4.



Before the instruction is executed (WXOR):

		b15															b0
S1	D0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
S2	D2	0	0	0	0	1	1	1	1	1	0	1	0	0	1	0	1

After the instruction is executed:

		b15															b0
D	D4	0	1	0	1	1	0	1	0	1	1	1	1	0	0	0	0

Example 2

- When X1 is ON, a logical XOR operator takes the values in the 32-bit device (D11, D10) and the 32-bit device (D21, D20), and performs the logical exclusive OR operation on each pair of corresponding bits, and the operation result is stored in (D41, D40).

Before the instruction is executed (DWXOR):

		b31																b15															b0
S1	D11 D10	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	1
S2	D21 D20	0	0	0	1	0	0	1	0	0	0	1	1	0	1	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	1	0	0

After the instruction is executed:

		b31																b15															b0
D	D41 D40	1	1	1	0	1	1	0	1	0	0	1	1	1	0	1	1	1	1	1	0	1	1	0	1	0	0	1	1	1	0	1	1

API	W	NEG			Applicable model
29	D		P	(D) Taking the two's complement of a value	10PM
					✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
D								*	*	*	*	*	*	*	*

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.

16-bit instruction (7 steps)

NEG Continuity instruction NEGP Pulse instruction

32-bit instruction (9 steps)

DNEG Continuity instruction DNEGP Pulse instruction

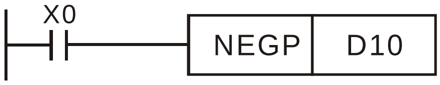
- Flag: None

Explanation

- **D**: Device in which the two's complement of the value in the device is stored
- The instructions can be used to convert a negative binary value into an absolute value.
- Generally, the pulse instructions NEGP and DNEGP are used.

Example 1

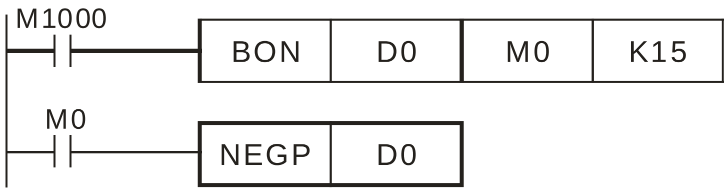
- When X0 is turned from OFF to ON, all the bits in D0 are inverted (0 becomes 1, and 1 becomes 0), 1 is added to the result, and the final value is stored in the original register D10.



Example 2

- Getting the aboluste value of a negative value

1. When bit 15 in D0 is 1, M0 is ON. (The value in D0 is a negative value.)
2. When M0 is ON, the instruction NEG is used to take the two's complement of the negative value in D0.

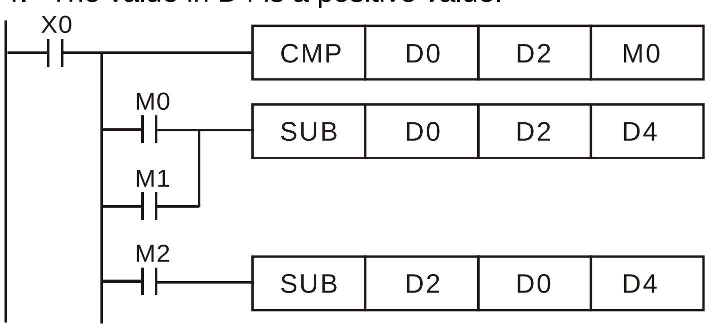


Example 3

- Getting the absolute value of the difference between two values

Suppose X0 is ON.

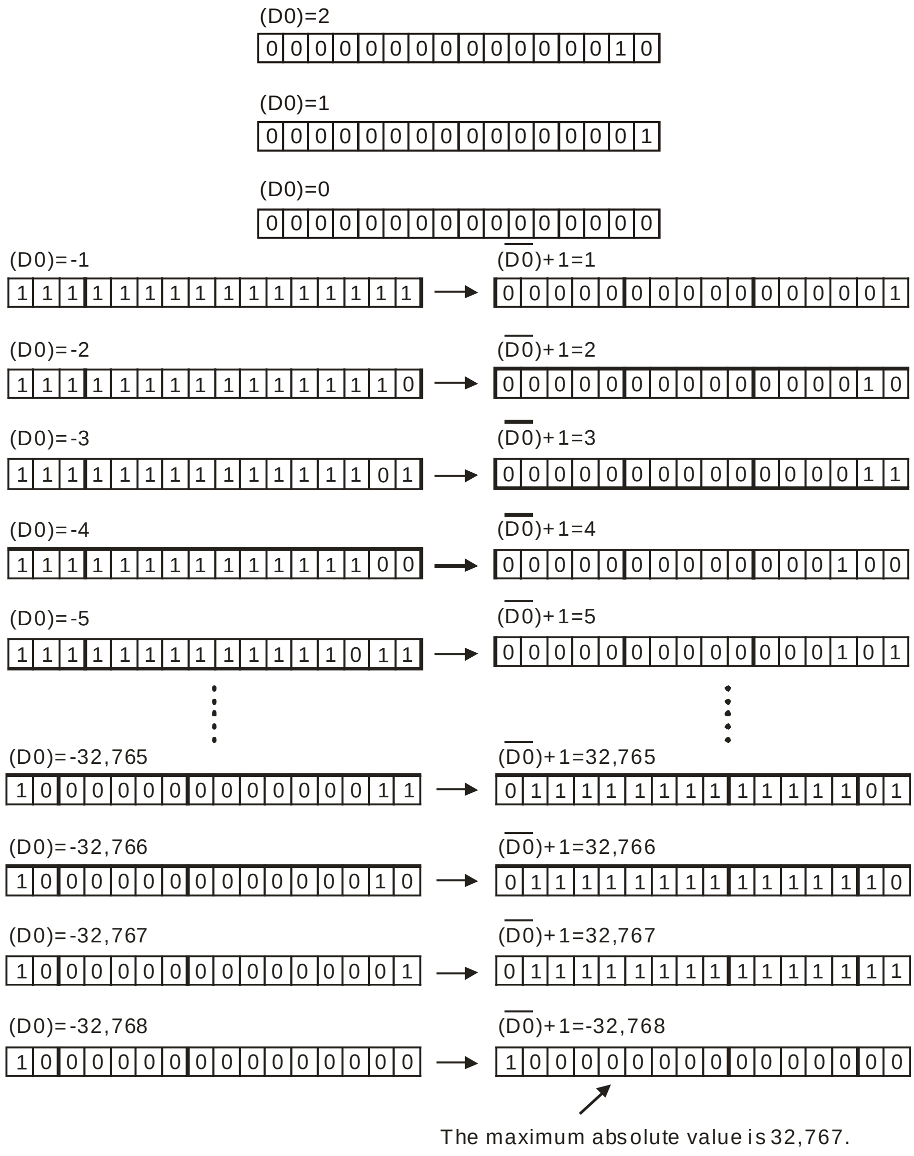
1. When the value in D0 is greater than that in D2, M0 is ON.
2. When the value in D0 is equal to that in D2, M1 is ON.
3. When the value in D0 is less than that in D2, M2 is ON.
4. The value in D4 is a positive value.



Additional remark

◆ The representation of a negative value and its absolute value are described below.

1. Whether the value in a register is a positive value or a negative value depends on the leftmost bit in the register. If the leftmost bit in a register is 0, the value in the register is a positive value. If the leftmost bit in a register is 1, the value in the register is a negative value.
2. The negative value in a register can be converted into its absolute value by means of the instruction NEG.



API						Applicable model
30	D	ROR	P	D n	Rotating bits rightwards	10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
D								*	*	*	*	*	*	*	*
n					*	*									

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.
  If KnX/KnY/KnM/KnS is used, it is suggested that X/devices/Y devices/M device numbers/S device numbers should start from a number which is a multiple of 16 in the octal numeral system or in the decimal numeral system, e.g. K1X0 (octal numeral system), K4SY20 (octal numeral system), K1M0 (decimal numeral system), and K4S16 (decimal numeral system).

16-bit instruction (5 steps)

ROR Continuity instruction RORP Pulse instruction

32-bit instruction (9 steps)

DROR Continuity instruction DRORP Pulse instruction

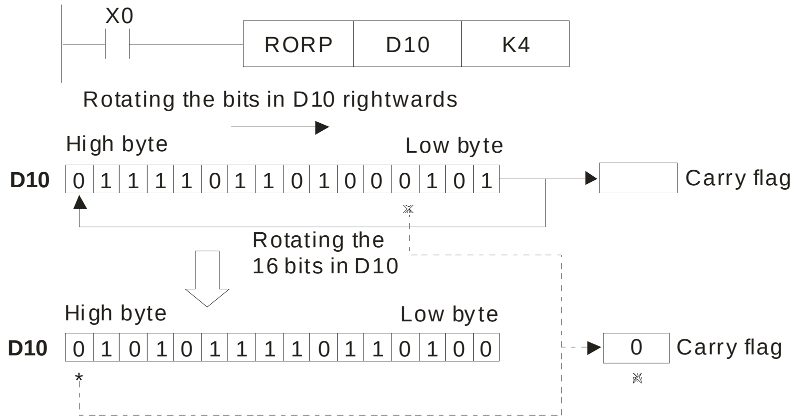
- Flags
  Ox M1810 O100 M1970 Carry flag
- Please refer to the additional remark below.

Explanation

- **D**: Device which is rotated; **n**: Number of bits forming a group
- The bits in **D** are divided into groups (**n** bits as a group), and these groups are rotated rightwards.
- The **n**th bit from the right is transmitted to a carry flag.
- Generally, the pulse instructions RORP and DRORP are used.
- If the operand **D** is KnY/KnM/KnS, Kn in KnY/KnM/KnS must be K4 (16 bits) or K8 (32 bits).
- 16-bit instruction: 1≤**n**≤16; 32-bit instruction: 1≤**n**≤32

Example

- When X0 is turned from OFF to ON, the bits in D10 are divided into groups (four bits as a group), and these groups are rotated rightwards. (The bit marked with ※ is transmitted to a carry flag.)



API		ROL			Rotating bits leftwards	Applicable model
31	D		P	(D) (n)		10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
D								*	*	*	*	*	*	*	*
n					*	*									

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.
  If KnX/KnY/KnM/KnS is used, it is suggested that X/devices/Y devices/M device numbers/S device numbers should start from a number which is a multiple of 16 in the octal numeral system or in the decimal numeral system, e.g. K1X0 (octal numeral system), K4SY20 (octal numeral system), K1M0 (decimal numeral system), and K4S16 (decimal numeral system).

16-bit instruction (5 steps)

ROL Continuity instruction ROLP Pulse instruction

32-bit instruction (9 steps)

DROL Continuity instruction DROLP Pulse instruction

- Flags

Ox	O100	
M1810	M1970	Carry flag

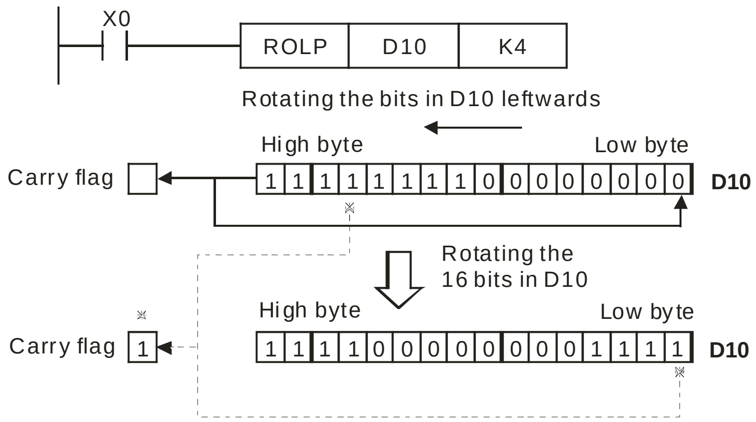
- Please refer to the additional remark below.

Explanation

- **D**: Device which is rotated; **n**: Number of bits forming a group
- The bits in **D** are divided into groups (**n** bits as a group), and these groups are rotated leftwards.
- The **n**th bit from the left is transmitted to a carry flag.
- Generally, the pulse instructions ROLP and DROLP are used.
- If the operand **D** is KY/KnM/KnS, Kn in KY/KnM/KnS must be K4 (16 bits) or K8 (32 bits).
- 16-bit instruction: 1≤**n**≤16; 32-bit instruction: 1≤**n**≤32

Example

- When X0 is turned from OFF to ON, the bits in D10 are divided into groups (four bits as a group), and these groups are rotated leftwards. (The bit marked with ※ is transmitted to a carry flag.)



API						Applicable model
32	D	RCR	P	D n	Rotating bits rightwards with a carry flag	10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
D								*	*	*	*	*	*	*	*
n					*	*									

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)

  Please refer to specifications for more information about device ranges.

  If KnX/KnY/KnM/KnS is used, it is suggested that X/devices/Y devices/M device numbers/S device numbers should start from a number which is a multiple of 16 in the octal numeral system or in the decimal numeral system, e.g. K1X0 (octal numeral system), K4SY20 (octal numeral system), K1M0 (decimal numeral system), and K4S16 (decimal numeral system).

16-bit instruction (5 steps)

RCR	Continuity instruction	RCRP	Pulse instruction

32-bit instruction (9 steps)

DRCR	Continuity instruction	DRCRP	Pulse instruction

- Flags

  Ox M1810   O100 M1970   Carry flag

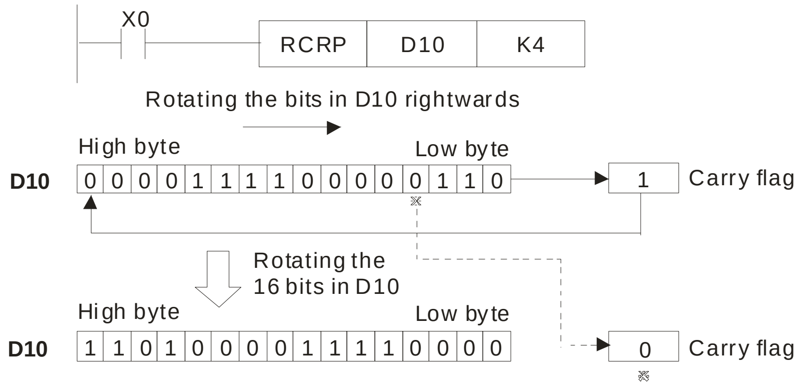
- Please refer to the additional remark below.

Explanation

- **D**: Device which is rotated; **n**: Number of bits forming a group
- The bits in **D** are divided into groups (**n** bits as a group), and these groups are rotated rightwards with a carry flag.
- The $\mathbf{n}^{th}$ bit from the right is transmitted to a carry flag.
- Generally, the pulse instructions RCRP and DRCRP are used.
- If the operand **D** is KnY/KnM/KnS, Kn in KnY/KnM/KnS must be K4 (16 bits) or K8 (32 bits).
- 16-bit instruction: 1≤**n**≤16; 32-bit instruction: 1≤**n**≤32

Example

- When X0 is turned from OFF to ON, the bits in D10 are divided into groups (four bits as a group), and these groups are rotated rightwards with a carry flag. (The bit marked with ※ is transmitted to the carry flag.)



API						Applicable model
33	D	RCL	P	D n	Rotating bits leftwards with a carry flag	10PM ✓

	Bit device X	Y	M	S	Word device K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
D								*	*	*	*	*	*	*	*
n					*	*									

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)

  Please refer to specifications for more information about device ranges.

  If KnX/KnY/KnM/KnS is used, it is suggested that X/devices/Y devices/M device numbers/S device numbers should start from a number which is a multiple of 16 in the octal numeral system or in the decimal numeral system, e.g. K1X0 (octal numeral system), K4SY20 (octal numeral system), K1M0 (decimal numeral system), and K4S16 (decimal numeral system).

16-bit instruction (5 steps)

RCL	Continuity instruction	RCLP	Pulse instruction

32-bit instruction (9 steps)

DRCL	Continuity instruction	DRCLP	Pulse instruction

- Flags

Ox	O100	
M1810	M1970	Carry flag

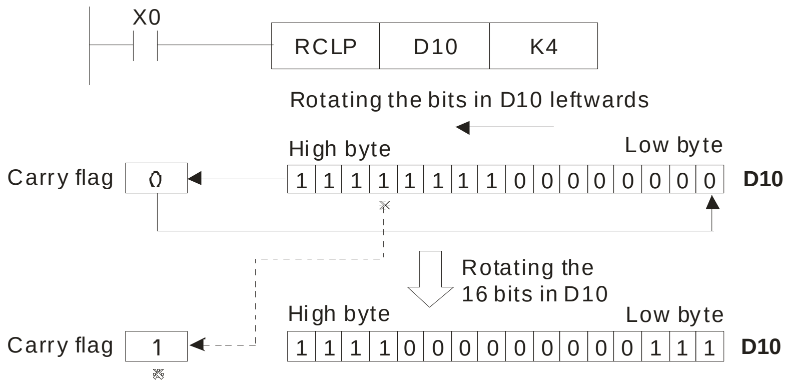
- Please refer to the additional remark below.

Explanation

- **D**: Device which is rotated; **n**: Number of bits forming a group
- The bits in **D** are divided into groups (**n** bits as a group), and these groups are rotated leftwards with a carry flag.
- The **n**th bit from the left is transmitted to a carry flag.
- Generally, the pulse instructions RCLP and DRCLP are used.
- If the operand **D** is KnY/KnM/KnS, Kn in KnY/KnM/KnS must be K4 (16 bits) or K8 (32 bits).
- 16-bit instruction: 1≤**n**≤16; 32-bit instruction: 1≤**n**≤32

Example

- When X0 is turned from OFF to ON, the bits in D10 are divided into groups (four bits as a group), and these groups are rotated leftwards with a carry flag. (The bit marked with ※ is transmitted to the carry flag.)



API		SFTR	P	S D n1 n2	Moving the states of bit devices rightwards	Applicable model 10PM
34						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S	*	*	*	*											
D		*	*	*											
n1					*	*									
n2					*	*									

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.

16-bit instruction (9 steps)

SFTR Continuity instruction SFTRP Pulse instruction

32-bit instruction

\- - - -

- Flag: None

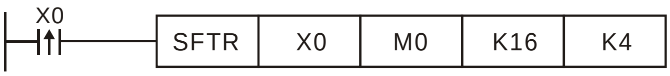
Explanation

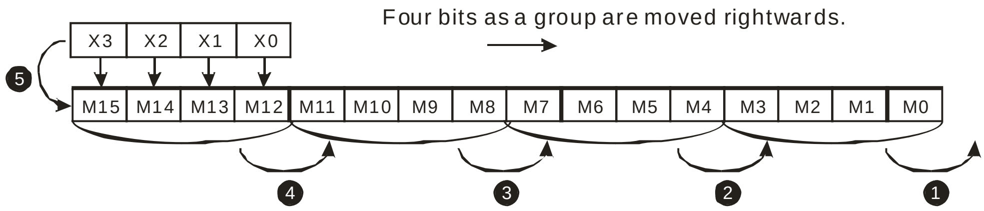
- **S**: Initial device which is moved; **D**: Initial device which is moved; $\mathbf{n_1}$: Number of bits which are moved; $\mathbf{n_2}$: Number of bits forming a group
- The states of the $\mathbf{n_1}$ bit devices starting from **D** are divided into groups ($\mathbf{n_2}$ bits as a group), and these groups are moved rightwards. The states of the $\mathbf{n_2}$ bit devices starting from **S** are moved to the vacant devices in the devices starting from **D**.
- Generally, the pulse instruction SFTRP is used.
- $1 \leq \mathbf{n_2} \leq \mathbf{n_1} \leq 1024$

Example

- When X0 is turned from OFF to ON, the states of the sixteen bit devices starting from M0 are divided into groups (four bits as a group), and these groups are moved rightwards.
- The states of the bit devices are moved rightwards in the order ❶~❺ during a scan cycle.

❶ M3~M0 → The states of M3~M0 are carried.
❷ M7~M4 → M3~M0
❸ M11~M8 → M7~M4
❹ M15~M12 → M11~M8
❺ X3~X0 → M15~M12





API		Mnemonic		Operands	Function	Applicable model
35		SFTL	P	(S) (D) (n1) (n2)	Moving the states of bit devices leftwards	10PM: ✓

	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
	Bit device				Word device										
S	*	*	*	*											
D		*	*	*											
n1					*	*									
n2					*	*									

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.

16-bit instruction (9 steps)
SFTL Continuity instruction SFTLP Pulse instruction

32-bit instruction
\- - - -

- Flag: None

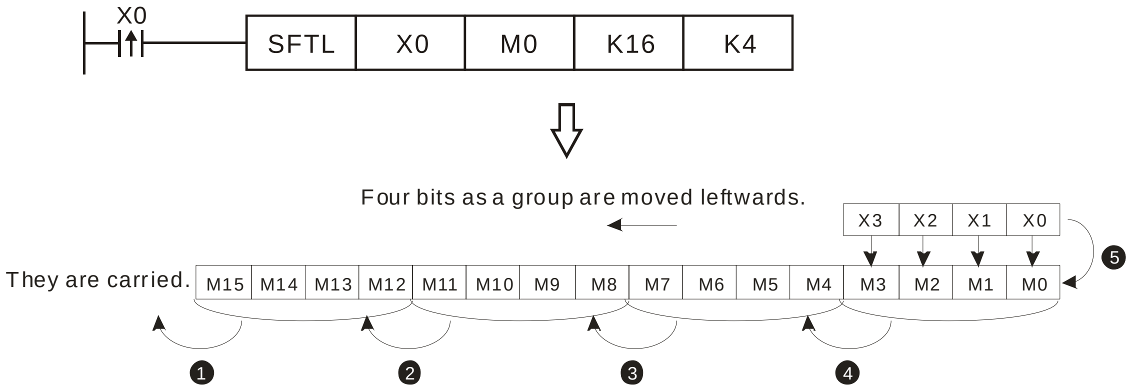
Explanation

- **S**: Initial bit device which is moved; **D**: Initial bit device which is moved; $\mathbf{n_1}$: Number of bits which are moved; $\mathbf{n_2}$: Number of bits forming a group
- The states of the $\mathbf{n_1}$ bit devices starting from **D** are divided into groups ($\mathbf{n_2}$ bits as a group), and these groups are moved leftwards. The states of the $\mathbf{n_2}$ bit devices starting from **S** are moved to the vacant devices in the devices starting from **D**.
- Generally, the pulse instruction SFTRP is used.
- $1 \le \mathbf{n_2} \le \mathbf{n_1} \le 1024$

Example

- When X0 is turned from OFF to ON, the states of the sixteen bit devices starting from M0 are divided into groups (four bits as a group), and these groups are moved leftwards.
- The states of the bit devices are moved leftwards in the order ❶~❺ during a scan cycle.

❶ M15~M12 → The states of M3~M0 are carried.
❷ M11~M8 → M15~M12
❸ M7~M4 → M11~M8
❹ M3~M0 → M7~M4
❺ X3~X0 → M3~M0



API						Applicable model
36		WSFR	P	S D n1 n2	Moving the values in word devices rightwards	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S							*	*	*	*	*	*	*		
D								*	*	*	*	*	*		
n1					*	*									
n2					*	*									

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)

  Please refer to specifications for more information about device ranges.

  If KnX/KnY/KnM/KnS is used, it is suggested that X/devices/Y devices/M device numbers/S device numbers should start from a number which is a multiple of 16 in the octal numeral system or in the decimal numeral system, e.g. K1X0 (octal numeral system), K4SY20 (octal numeral system), K1M0 (decimal numeral system), and K4S16 (decimal numeral system).

16-bit instruction (9 steps)

WSFR Continuity instruction | WSFRP Pulse instruction

32-bit instruction

- | - | - | -

- Flag: None

Explanation

- **S**: Initial word device which is moved; **D**: Initial word device which is moved; $\mathbf{n_1}$: Number of values which are moved; $\mathbf{n_2}$: Number of values forming a group
- The values in the $\mathbf{n_1}$ word devices starting from **D** are divided into groups ($\mathbf{n_2}$ values as a group), and these groups are moved rightwards. The values in the $\mathbf{n_2}$ word devices starting from **S** are moved to the vacant word devices in the word devices starting from **D**.
- Generally, the pulse instruction WSFRP is used.
- If the operand **S** is KnX/KnY/KnM/KnS, the operand **D** can be a counter, timer, or a data register. If the operand **D** is KnY/KnM/KnS, the operand **S** can be a counter, timer, or a data register.
- If the operand **S** is KnX/KnY/KnM/KnS, and the operand **D** is KnY/KnM/KnS, Kn in KnX/KnY/KnM/KnS which is S and Kn in KnY/KnM/KnS must be the same.
- $1 \le \mathbf{n_2} \le \mathbf{n_1} \le 512$

Example 1

- When X0 is turned from OFF to ON, the values in the sixteen word devices starting from D20 are divided into groups (four values as a group), and these groups are moved rightwards.
- The values in the word devices are moved rightwards in the order ❶~❺ during a scan cycle.

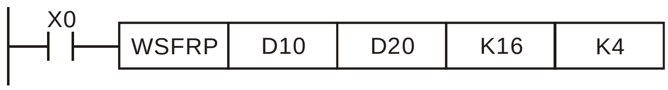
  ❶ D23~D20 → The values in D23~D20 are carried.

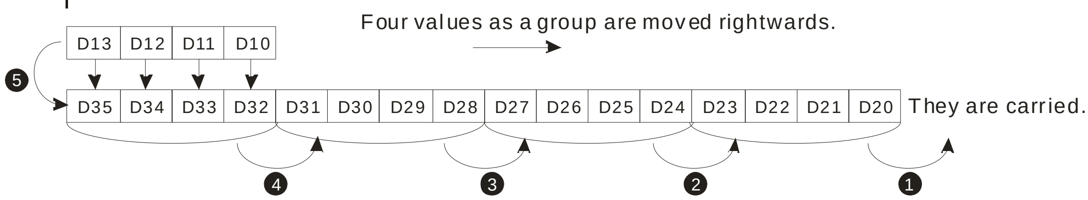
  ❷ D27~D24 → D23~D20

  ❸ D31~D28 → D27~D24

  ❹ D35~D32 → D31~D28

  ❺ D13~D10 → D35~D32

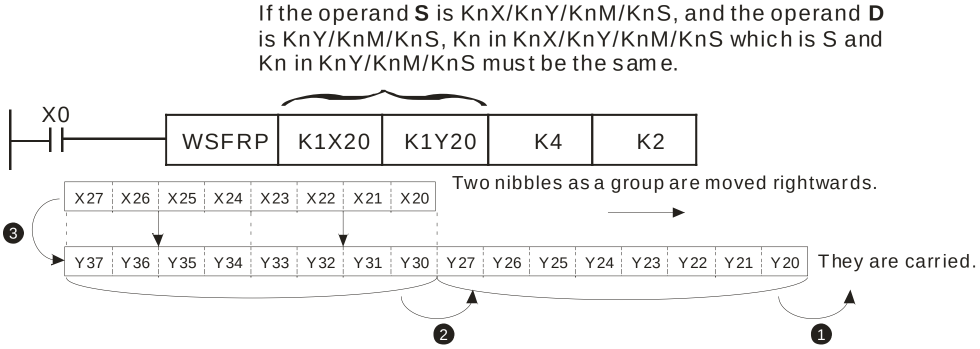




Example 2

- When X0 is turned from OFF to ON, the values in the sixteen bit devices starting from Y20 are divided into groups (eight values as a group), and these groups are moved rightwards.
- The values in the word devices are moved rightwards in the order ❶~❺ during a scan cycle.

❶ Y27~Y20 → The values in Y27~Y20 are carried.
❷ Y37~Y30 → Y27~Y20
❸ X27~X20 → Y37~Y30



API						Applicable model
37		**WSFL**	**P**	S D n1 n2	Moving the values in word devices leftwards	10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S							*	*	*	*	*	*	*		
D								*	*	*	*	*	*		
n1					*	*									
n2					*	*									

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)

  Please refer to specifications for more information about device ranges.

  If KnX/KnY/KnM/KnS is used, it is suggested that X/devices/Y devices/M device numbers/S device numbers should start from a number which is a multiple of 16 in the octal numeral system or in the decimal numeral system, e.g. K1X0 (octal numeral system), K4SY20 (octal numeral system), K1M0 (decimal numeral system), and K4S16 (decimal numeral system).

16-bit instruction (9 steps)

WSFL — Continuity instruction; WSFLP — Pulse instruction

32-bit instruction

\- \- \- \-

- Flag: None

Explanation

- **S**: Initial word device which is moved; **D**: Initial word device which is moved; $\mathbf{n_1}$: Number of values which are moved; $\mathbf{n_2}$: Number of values forming a group
- The values in the $\mathbf{n_1}$ word devices starting from **D** are divided into groups ($\mathbf{n_2}$ values as a group), and these groups are moved leftwards. The values in the $\mathbf{n_2}$ word devices starting from **S** are moved to the vacant word devices in the word devices starting from **D**.
- Generally, the pulse instruction WSFLP is used.
- If the operand **S** is KnX/KnY/KnM/KnS, the operand **D** can be a counter, timer, or a data register. If the operand **D** is KnY/KnM/KnS, the operand **S** can be a counter, timer, or a data register.
- If the operand S is KnX/KnY/KnM/KnS, and the operand D is KnY/KnM/KnS, Kn in KnX/KnY/KnM/KnS which is S and Kn in KnY/KnM/KnS must be the same.
- $1 \leq \mathbf{n_2} \leq \mathbf{n_1} \leq 512$

Example

- When X0 is turned from OFF to ON, the values in the sixteen word devices starting from D20 are divided into groups (four values as a group), and these groups are moved leftwards.
- The values in the word devices are moved leftwards in the order ❶~❺ during a scan cycle.

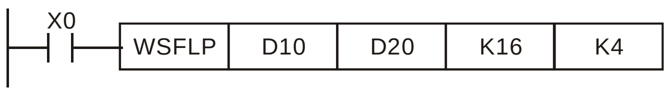
  ❶ D35~D32 → The values in D35~D32 are carried.

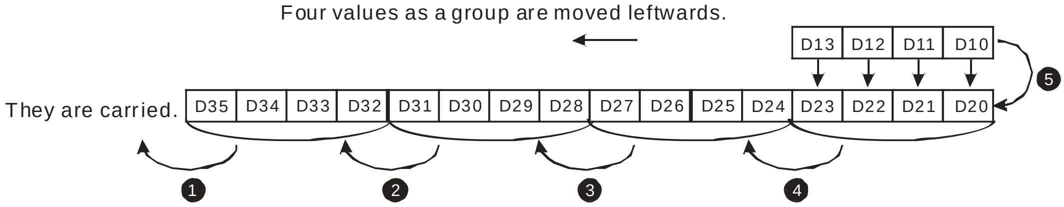
  ❷ D31~D28 → D35~D32

  ❸ D27~D24 → D31~D28

  ❹ D23~D20 → D27~D24

  ❺ D13~D10 → D23~D20





API		Mnemonic		Operands	Function	Applicable model
38		SFWR	P	S D n	Moving a value and writing it into a word device	10PM ✓

	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
	Bit device				**Word device**										
S					*	*	*	*	*	*	*	*	*	*	*
D								*	*	*	*	*	*		
n					*	*									

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.
  If KnX/KnY/KnM/KnS is used, it is suggested that X/devices/Y devices/M device numbers/S device numbers should start from a number which is a multiple of 16 in the octal numeral system or in the decimal numeral system, e.g. K1X0 (octal numeral system), K4SY20 (octal numeral system), K1M0 (decimal numeral system), and K4S16 (decimal numeral system).

16-bit instruction (9 steps)

SFWR Continuity instruction SFWRP Pulse instruction

32-bit instruction

- - - -

- Flags

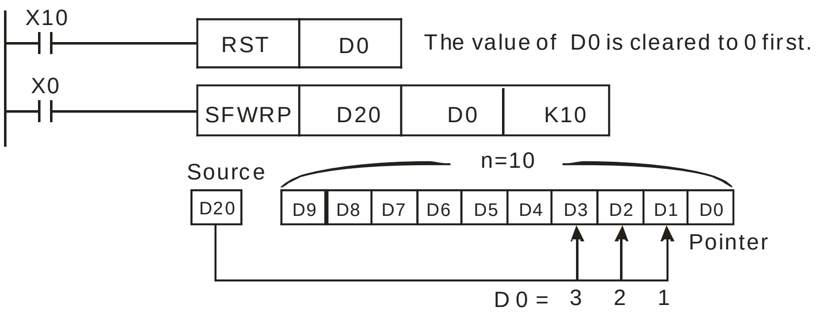
Ox	O100	
M1808	M1968	Zero flag

Explanation

- **S**: Device which is moved; **D**: Initial device; **n**: Number of devices
- The values in the **n** word devices starting from **D** are defined as first in, first out values, and **D** is taken as a pointer. When the instruction is executed, the value of the pointer **D** increases by one, and the value in **S** is written into the device to which the pointer **D** points. When the value of the pointer is greater than or equal to **n**-1, the instruction does not process the writing of the value, and a carry flag is ON.
- When the value of the pointer **D** is greater than **n**-1, the instruction does not process the writing of a value, and the carry flag M1022 is ON.
- Generally, the pulse instruction SFWRP is used.
- 2≤**n**≤512

Example

- The value of the pointer D0 is cleared to 0 first. When X0 is turned from OFF to ON, the value in D20 is written into D1, and the value of D0 becomes 1. When X0 is turned from OFF to ON again, the value in D20 is written to D2, and the value in D0 becomes 2.
- The value in D20 is moved and written into D1 in the way described below.
  ❶ The value in D20 is written into D1.
  ❷ The value of D0 becomes 1.



Additional remark

- The instruction SFWR can be used with the instruction SFRD to write a value and read values.

API						
39		SFRD	P	(S) (D) (n)	Moving a value and reading it from a word device	Applicable model: 10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*	*		*	*	*	*	*	*		
D								*	*	*	*	*	*	*	*
n					*	*									

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)

  Please refer to specifications for more information about device ranges.

  If KnX/KnY/KnM/KnS is used, it is suggested that X/devices/Y devices/M device numbers/S device numbers should start from a number which is a multiple of 16 in the octal numeral system or in the decimal numeral system, e.g. K1X0 (octal numeral system), K4SY20 (octal numeral system), K1M0 (decimal numeral system), and K4S16 (decimal numeral system).

16-bit instruction (9 steps)

SFRD Continuity instruction SFRDP Pulse instruction

32-bit instruction

\- - - -

- Flags

Ox	O100	
M1808	M1968	Zero flag

Explanation

- **S**: Initial device; **D**: Device into which a value is written; **n**: Number of devices
- The values in the **n** word devices starting from **S** are defined as first in, first out values, and **S** is taken as a pointer. When the instruction is executed, the value in **S** decreases by one, the value in **S**+**1** is written into **D**, the values in **S**+**n**-1~**S**+2 are moved rightwards, and the value in **S**+**n**-1 is unchanged. When the value in **S** is equal to 0, the instruction does not process the reading of the values, and a zero flag is ON.
- When the value in **S** is equal to 0, the instruction does not process the reading of the values, and the zero flag M1020 is ON.
- Generally, the pulse instruction SFRDP is used.
- 2≤**n**≤512

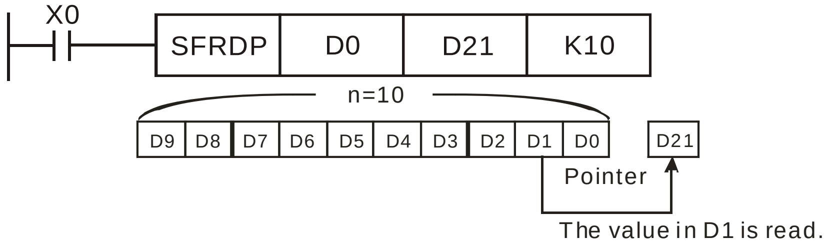
Example

- When X0 is turned from OFF to ON, the value in D1 is written into D21, the values in D9~D2 are moved rightwards, the value in D9 is unchanged, and the value in D0 decreases by one.
- The value in D1 is moved and written into D21 in the way described below.

  ❶ The value in D1 is written into D21.

  ❷ The values in D9~D2 are moved rightwards.

  ❸ The value in D0 decreases by one.



API		ZRST	☺ P	D1 D2	Resetting a zone	Applicable model 10PM
40						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
D_1		*	*	*							*	*	*		
D_2		*	*	*							*	*	*		

- Note: Device number of $D_1 \leq$ Device number of D_2

  The device type that D_1 specifies and the device type that D_2 specifies must be the same.

  All devices can not be modified by V devices and Z devices.

  Please refer to specifications for more information about device ranges.

16-bit instruction (5 steps)

ZRST	Continuity instruction	ZRSTP	Pulse instruction

32-bit instruction

-	-	-	-

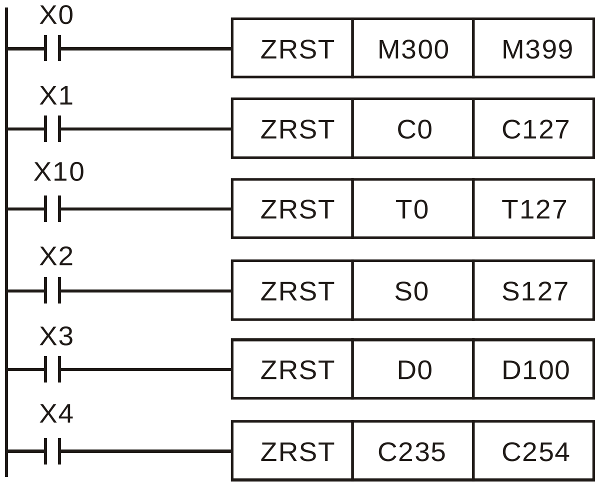
- Flag: None

Explanation

- **D_1**: Initial device which is reset; **D_2**: Final device which is reset
- The instruction ZRST can be used to reset 16-bit counter and 32-bit counters.
- If the device number of **D_1** is greater than the device number of **D_2**, only **D_2** will be reset.

Example

- When X0 is ON, the auxiliary relays M300~M399 are reset to OFF.
- When X1 is ON, the 16-bit counters C0~C127 are reset. (The values of C0~C127 are cleared to 0, and the contacts and the coils are reset to OFF.)
- When X10 is ON, the timers T0~T127 are reset. (The values of T0~T127 are cleared to 0. and the contacts and the coils are reset to OFF.)
- When X2 is ON, the stepping relays S0~S127 are reset to OFF.
- When X3 is ON, the data registers D0~D100 are reset to 0.
- When X4 is ON, the 32-bit counters C235~C254 are reset. (The values of C235~C254 are cleared to 0, and the contacts and the coils are reset to OFF.)



Additional remark

- The instruction RST can be used to reset a single device, e.g. a Y device, an M device, an S device, a T device, a C device, or a D device.

API		DECO	P	(S) (D) (n)	Decoder	Applicable model
41						10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S	*	*	*	*	*	*					*	*	*	*	*
D		*	*	*							*	*	*	*	*
n					*	*									

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.

16-bit instruction (7 steps)

DECO Continuity instruction DECOP Pulse instruction

32-bit instruction

\- - - -

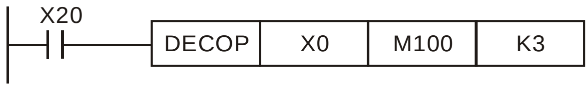
- Flag: None

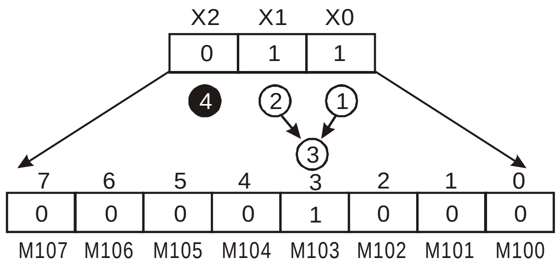
Explanation

- **S**: Source device; **D**: Device in which a decoding result is stored **n**: Number of bits which are decoded
- The low **n** bits in **S** are decoded as the low 2^n bits in **D**.
- Generally, the pulse instruction DECOP is used.
- **D** is in the range of 1 to 8.

Example 1

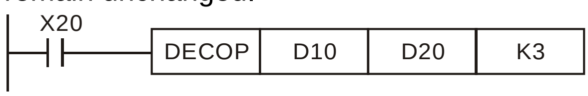
- When **D** is a bit device, **n** is in the range of 1 to 8. If **n** is 0, or greater than 8, an error will occur.
- If **n** is 8, the maximum number of bits which can be decoded is 2^8=256.
- When X20 is turned from OFF to ON, the instruction DECOP decodes X0~X2 as M100~M107.
- If the value in **S** is 3, M103 will be ON.
- After the instruciton is executed, X20 will be OFF, and the states of M100~M107 will remain unchanged.

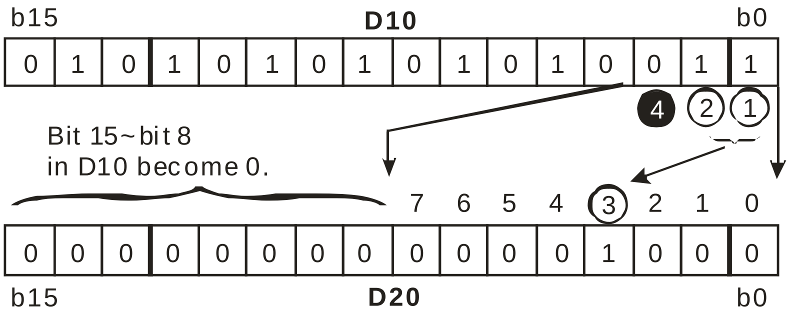




Example 2

- When **D** is a word device, **n** is in the range of 1 to 8. If **n** is 0, or greater than 8, an error will occur.
- If **n** is 8, the maximum number of bits which can be decoded is 2^8=256.
- When X20 is turned from OFF to ON, the instruction DECOP decodes b2~b0 in D10 as b7~b0 in D20, and b15~b8 in D20 become 0.
- The low 3 bits in D10 are decoded as the low 8 bits in D20. The high 8 bits in D20 are 0.
- After the instruciton is executed, X20 will be OFF, and the value in D20 will remain unchanged.




b15
D10
b0
0 1 0 1 0 1 0 1 0 1 0 1 0 0 1 1
4 2 1
Bit 15~bit 8
in D10 become 0.
7 6 5 4 3 2 1 0
0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0
b15
D20
b0

API						Applicable model
42		ENCO	P	(S) (D) (n)	Encoder	10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S	*	*	*	*							*	*	*	*	*
D											*	*	*	*	*
n					*	*									

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.

16-bit instruction (7 steps)
ENCO Continuity instruction ENCOP Pulse instruction

32-bit instruction
- - - -

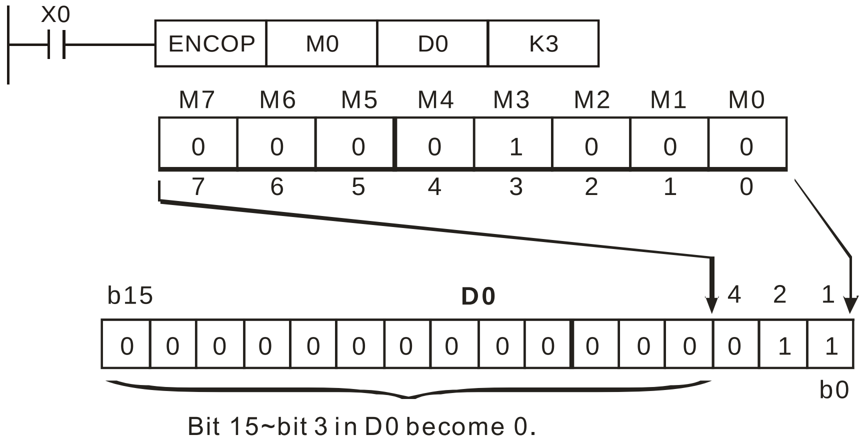
- Flag: None

Explanation

- **S**: Source device **D**: Device in which an encoding result is stored **n**: Number of bits which are encoded
- The low 2^n bits in **S** are encoded as the low **n** bits in **D**.
- If there are many bits which are 1 in **S**, the first bit which is 1 from the left will be processed.
- Generally, the pulse instruction ENCOP is executed.
- If **S** is a bit device, **n** is in the range of 1 to 8. If **S** is a word device, **n** is in the range of 1 to 4.

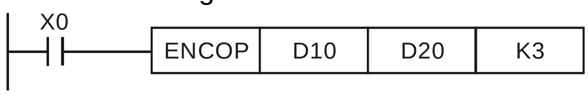
Example 1

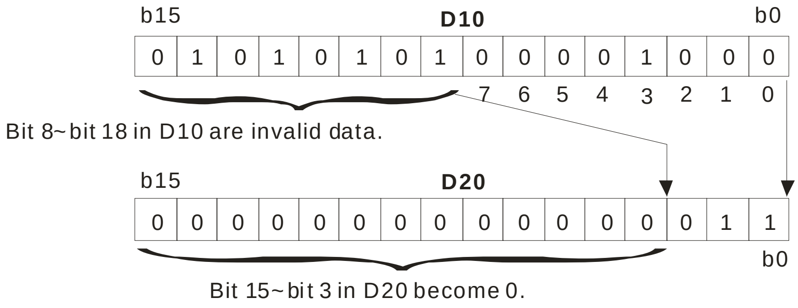
- When **S** is a bit device, **n** is in the range of 1 to 8. If **n** is 0, or greater than 8, an error will occur.
- If **n** is 8, the maximum number of bits which can be decoded is 2^8=256.
- When X0 is turned from OFF to ON, the instruction ENCOP encodes the 8 bits in M0~M7 as the low 3 bits in D0, and b15~b3 in D0 become 0.
- After the instruction ENCOP is executed, X0 will be OFF, and the data in **D** will remain unchanged.



Example 2

- When **S** is a word device, **n** is in the range of 1 to 4. If **n** is 0, or larger than 4, an error will occur.
- If **n** is 4, the maximum number of bits which can be decoded is 2^4=16.
- When X0 is turned from OFF to ON, the instruction ENCOP encodes the 8 bits in D10 as the low 3 bits in D20, and b15~b3 in D20 become 0. (Bit 8~bit 15 in D10 are invalid data.)
- After the instruction ENCOP is executed, X0 will be OFF, and the data in **D** will remain unchanged.




b15
D10
b0
0 1 0 1 0 1 0 1 0 0 0 0 1 0 0 0
7 6 5 4 3 2 1 0
Bit 8~bit 18 in D10 are invalid data.
b15
D20
0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1
b0
Bit 15~bit 3 in D20 become 0.

API						Applicable model
43	D	SUM	P	(S) (D)	Number of bits which are ON	10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S							*	*	*	*	*	*	*	*	*
D											*	*	*	*	*

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)
  Please refer to specifications for more information about device ranges.
  If KnX/KnY/KnM/KnS is used, it is suggested that X device numbers/Y device numbers/M device numbers/S device numbers should start from a number which is a multiple of 16 (including 0), e.g. K1X0, K4Y20 and K4M16.

16-bit instruction (5 steps)

SUM	Continuity instruction	SUMP	Pulse instruction

32-bit instruction (9 steps)

DSUM	Continuity instruction	DSUMP	Pulse instruction

- Flags

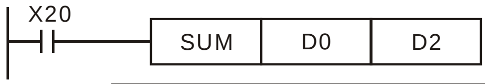
Ox	O100	
M1808	M1968	Zero flag

Explanation

- **S**: Source device; **D**: Destination device
- The number of bits which are 1 in **S** is stored in **D**.
- If the bits in **S** are 0, a zero flag will be ON.
- If the 32-bit instruction is used, **D** will occupy two registers.

Example

- When X20 is ON, the number of bits which are 1 in D0 is stored in D2.



D0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0
D2	3															

API					Applicable model
44	D	BON	P	S D n	Checking the state of a bit	10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*	*	*	*	*	*	*	*	*	*	*
D		*	*	*											
n					*	*					*	*	*	*	*

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)

  Please refer to specifications for more information about device ranges.

  If KnX/KnY/KnM/KnS is used, it is suggested that X/devices/Y devices/M device numbers/S device numbers should start from a number which is a multiple of 16 in the octal numeral system or in the decimal numeral system, e.g. K1X0 (octal numeral system), K4SY20 (octal numeral system), K1M0 (decimal numeral system), and K4S16 (decimal numeral system).

16-bit instruction (7 steps)

BON	Continuity instruction	BONP	Pulse instruction

32-bit instruction (13 steps)

DBON	Continuity instruction	DBONP	Pulse instruction

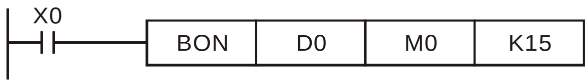
- Flag: None

Explanation

- **S**: Source device; **D**: Device in which a check result is stored; **n**: Bit whose state is judged
- The state of the **n**th bit in **S** is checked, and the result is stored in **D**.
- 16-bit instruction: **n**=0~15; 32-bit instruction: **n**=0~31

Example

- If the 15th bit in D0 is 1 when X0 is ON, M0 will be ON. If the 15th bit in D0 is 0 when X0 is ON, M0 will be OFF.
- When X0 is turned OFF, the state of M0 remains unchanged.



b15 ... b0

b15															b0	
0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	M0=Off

D0

b15															b0	
1	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	M0=On

D0

API						Applicable model
45	D	MEAN	P	(S) (D) (n)	Mean	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*	*	*	*	*	*	*	*	*		
D								*	*	*	*	*	*	*	*
n					*	*	*	*	*	*	*	*	*	*	*

16-bit instruction (7 steps)

MEAN	Continuity instruction	MEANP	Pulse instruction

32-bit instruction (13 steps)

DMEAN	Continuity instruction	DMEANP	Pulse instruction

- Flag: None

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)

  Please refer to specifications for more information about device ranges.

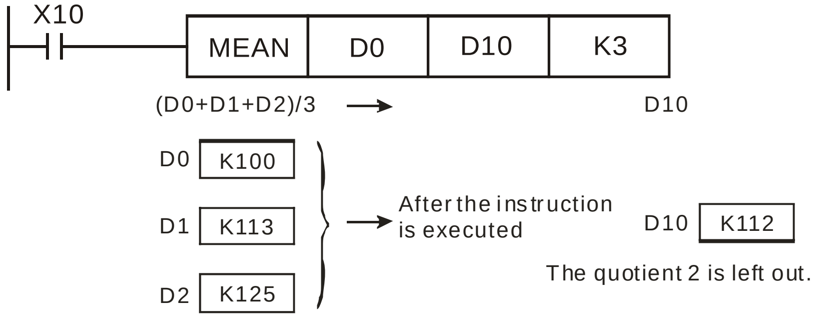
  If KnX/KnY/KnM/KnS is used, it is suggested that X/devices/Y devices/M device numbers/S device numbers should start from a number which is a multiple of 16 in the octal numeral system or in the decimal numeral system, e.g. K1X0 (octal numeral system), K4SY20 (octal numeral system), K1M0 (decimal numeral system), and K4S16 (decimal numeral system).

Explanation

- **S**: Initial device; **D**: Device in which a mean is stored; **n**: Number of devices
- After the values in the **n** devices starting from **S** are added up, the mean of the sum is stored in **D**.
- If a remainder appears in a calculation, it will be left out.
- If **S** is not in a valid range, only the devices in the valid range will be processed.
- If **n** is not in the range of 1 to 64, an operation error will occur.
- **n**=1~64

Example

- When X10 is ON, the values in the three registers starting from D0 are added up. After the values are added up, the sum will be divided by 3. The quotient is stored in D10, and the remainder is left out.



API						Applicable model
46		ANS	P	S m D	Driving an annunciator	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S											*				
m					*										
D				*											

- Note: All devices can not be modified by V devices and Z devices.
  Please refer to specifications for more information about device ranges.

16-bit instruction (7 steps)

ANS Continuity instruction ANS P Pulse instruction

32-bit instruction

\- - - -

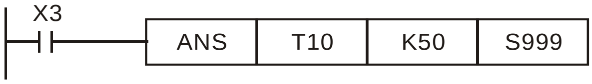
- Flag: None

Explanation

- **S**: Timer; **m**: Time; **D**: Annunciator
- The instruction ANS is used to drive an annunciator.
- **S**: T0~T183
  m: K1~K32,767 (Unit: 100 ms)
  D: S912~S1023
  See the explanation of ANR for more information.

Example

- If X3 is ON for more than 5 seconds, the annunciator S999 will be ON. Even if X3 is turned OFF, S999 will still be ON. (However, T10 will be reset to OFF, and the value of T10 will be 0.)



API						Applicable model
47		ANR	P		Resetting an annunciator	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z

- Note: There is no operand.
  The instruction does not need to be driven by a contact.

16-bit instruction (1 step)

ANR	Continuity instruction	ANRP	Pulse instruction

32-bit instruction

-	-	-	-

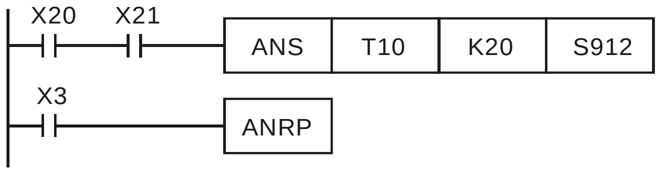
- Flag: None

Explanation

- The instruction ANR is used to reset an annunciator.
- If more than one annunciator is ON simultaneously, the annunciator whose number is smallest will be reset.
- Generally, the pulse instruction ANRP is used.

Example

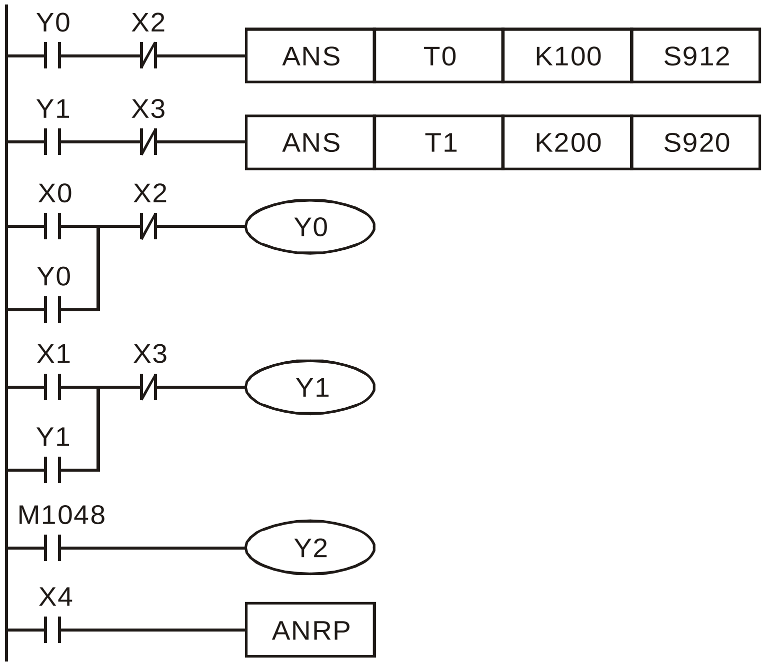
- If X20 and X21 are ON for more than 2 seconds, the annunciator S912 will be ON. If X20 and D21 are turned OFF, S912 will still be ON, T10 will be reset to OFF, and the value of T10 will be 0.
- If X20 and X21 are not ON for 2 seconds, the value of T10 will become 0.
- When X0.3 is turned from OFF to ON, the annunciator whose number is smallest in the annunciators which are driven is reset.
- When X0.3 is turned from OFF to ON again, the next annunciator whose number is smallest in the annunciators which are driven is reset.



Additional remark

- Application of annunciators

X0=Forward switch X1=Backward switch
X2=Front position switch X3=Back position switch
X4=Resetting button
Y0=Forward Y1=Backward
Y2=Indicator
S912=Forward annunciator S920=Backward annunciator



1. If Y0 is ON for more than 10 seconds, and X2 is OFF, S912 will be ON.
2. If Y1 is ON for more than 20 seconds, and X3 is OFF, S920 will be ON.
3. If X1 and Y1 are ON, Y1 will not be OFF until X3 is ON.
4. If an annuciator is driven, Y2 will be ON.
5. When X4 is turned from OFF to ON, the annunciator whose number is smallest in the annunciators which are driven is reset. When X4 is turned from OFF to ON again, the next annunciator whose number is smallest in the annunciators which are driven is reset.

API	D	SQR	P	(S) (D)	Square root of a binary value	Applicable model
48	D	SQR	P	(S) (D)	Square root of a binary value	10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S											*				
m					*										
D				*											

- Note: All devices can not be modified by V devices and Z devices. Please refer to specifications for more information about device ranges.

16-bit instruction (7 steps)

SQR	Continuity instruction	SQR P	Pulse instruction

32-bit instruction

DSQR	Continuity instruction	DSQRP	Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1809	M1969	Borrow flag
M1810	M1970	Carry flag

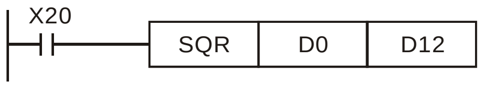
- Please refer to the explanation below.

Explanation

- **S**: Source device; **D**: Device in which a result is stored
- The square root of the value in **S** is calculated, and the result is stored in **D**.
- The value in **S** can only be a positive value. If the value in **S** is a negative value, an error will occur, and the instruction will not be executed.
- The value stored in **D** is an integer. The fractional part of a square root calculated is dropped. If the fractional part of a square root calculated is dropped, a borrow flag will be ON.
- If the value in **D** is 0, a zero flag will be ON.

Example

- When X20 is ON, the square root of the value in D0 is calculated, and the result is stored in D12.



$\sqrt{D0} \rightarrow D12$

API						Applicable model
49	D	FLT	P	S D	Converting a binary integer into a binary floating-point value	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*	*							*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  Only the 32-bit instructions DFLT and DFLTP are valid.

16-bit instruction

-	-	-	-

32-bit instruction (6 steps)

DFLT	Continuity instruction	DFLTP	Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1809	M1969	Borrow flag
M1810	M1970	Carry flag

- Please refer to the explanation below.

Explanation

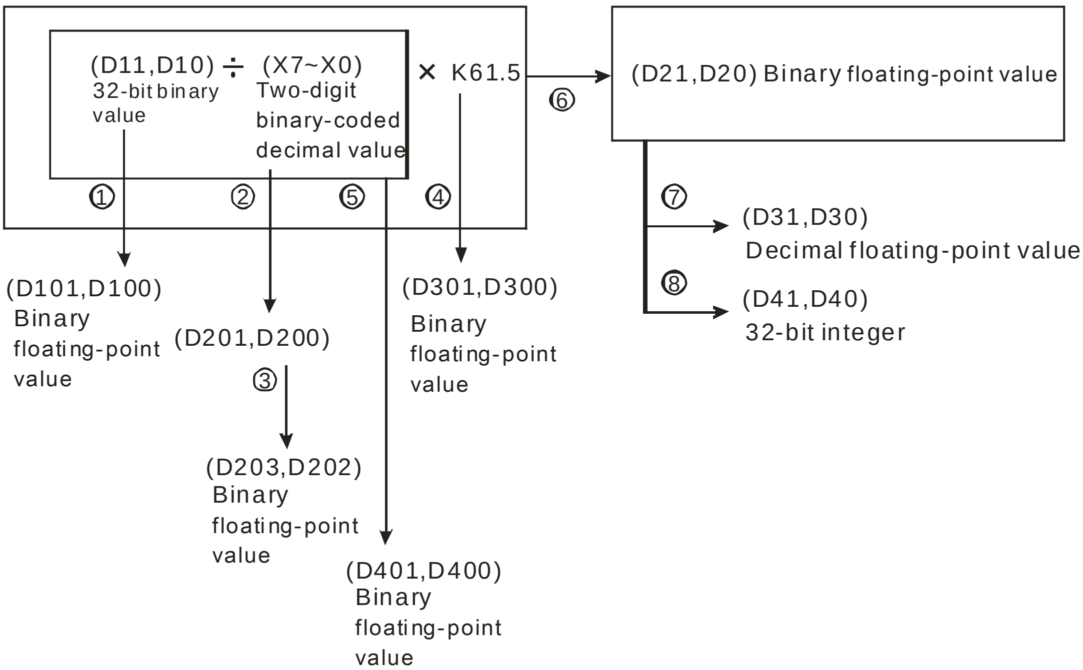
- **S**: Source device; **D**: Conversion result
- The instruction is used to convert a binary integer into a binary floating-point value.
  1. If the absolute value of the converesion result is greater than the maximum floating-point value avaliable, a carry flag will be ON.
  2. If absolute value of the conversion result is less than the mimum floating-point vlaue available, a borrow flag will be ON.
  3. If the conversion result is 0, a zero flag will be ON.

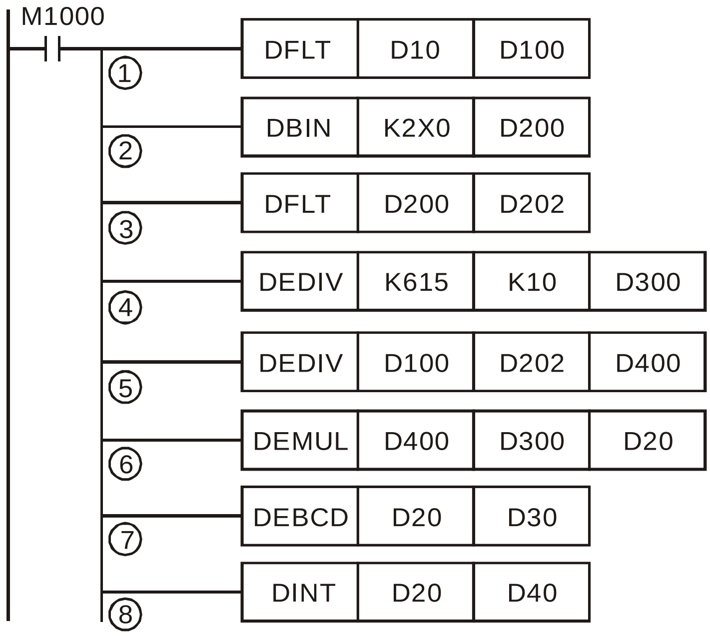
Example 1

- When X11 is ON, the binary integer in (D1, D0) is converted into a binary floating-point value, and the conversion result is stored in (D21, D20).
- Suppose the value in the 32-bit register (D1, D0) is K100,000. When X11 is ON, K100,000 is converted into the 32-bit floating-point value H4735000, and H4735000 is stored in the 32-bit register (D21, D20).

Example 2

- Users can use applied instructions to perform the following calculation.





1. The binary integer in (D11, D10) is converted into a binary floating-point value, and the conversion result is stored in (D101, D100).
2. The binary-coded decimal value in X7~X0 is converted into a binary value, and the conversion result is stored in (D201, D200).
3. The binary integer in (D201, D200) is converted into a binary floating-point value, and the conversion result is stored in (D203, D202).
4. The constant K615 is divided by the constant K10, and the quotient which is a binary floating-point value is stored in (D301, D300).
5. The binary floating-point value in (D101, D100) is divided by the binary floating-point value in (D203, D202), and the quotient which is a binary floating-point value is stored in (D401, D400).
6. The binary floating-point value in (D401, D400) is multiplied by the binary floating-point value in (D301, D300), and the product which is a binary floating-point value is stored in (D21, D20).
7. The binary floating-point value in (D21, D20) is converted into a decimal floating-point value, and the conversion result is stored in (D31, D30).
8. The binary floating-point value in (D21, D20) is converted into a binary integer, and the conversion result is stored in (D41, D40).

API 50	REF	P	D n	Refreshing the states of I/O devices	Applicable model 10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
D	*	*													
n					*	*									

- Note: All devices can not be modified by V devices and Z devices.
  Please refer to specifications for more information about device ranges.

16-bit instruction (7 steps)

REF	Continuity instruction	REF P	Pulse instruction

32-bit instruction

-	-	-	-

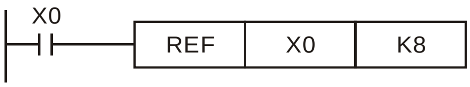
- Flag: None

Explanation

- **D**: Initial I/O device whose state is refreshed; **n**: Number of I/O devices whose states are refreshed
- The states of I/O devices are not refreshed until the instruction END is executed. When the scan of a program starts, the states of external inputs are read, and stored in the input memory. After the instruction END is executed, the contents of the output memory will be sent to output terminals. Therefore, users can use this instruction when they need the latest I/O data in an operation process.
- **D** must be an I/O device whose number ends with 0, e.g. X0, X10, Y0 or Y10. The instruction can not be used to refresh the I/O devices in a digital extension module.
- **D** must be an I/O device in a PLC.
  1. If **D** is X0 and **n** is less than or equal to 8, the states of X0~X0 will be refreshed. If **n** is greater than 8, the states of the input devices and the states of the output devices in the motion controller used will be refreshed.
  2. If **D** is Y0, and **n** is equal to 8, the states of Y0~Y7 will be refreshed. If **n** is greater than 8, the states of the input devices and the states of the output devices in the motion controller used will be refreshed.
  3. If **D** is X10 or Y10, and **n** is any number, the states of all the input devices except X0~X7, and the states of all the output devices except Y0~Y3 in the motion controller used will be refreshed.
- **n** is in the range of 4 to the number of I/O devices in the motion control module used, and is a multiple of 4.

Example 1

- When X0 is ON, the DVP-10PM series motion controller reads the states of X0~X7 immediately. The input signals are refreshed without any delay.



Example 2

- When X0 is ON, the states of Y0~Y3 are sent to output terminals. The output signals are refreshed immediately without the need to wait for the execution of the instruction END.

Example 3

- When X0 is ON, the states of the input terminals starting from X10, or the states of the output terminals starting from Y10 are refreshed.

Or

API	D	SER	P	S1 S2 D n	Searching data	Applicable model
61	D	SER	P	S1 S2 D n	Searching data	10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S1							*	*	*	*	*	*	*		
S2					*	*	*	*	*	*	*	*	*	*	*
D								*	*	*	*	*	*		
N					*	*							*		

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)

  Please refer to specifications for more information about device ranges.

  If KnX/KnY/KnM/KnS is used, it is suggested that X/devices/Y devices/M device numbers/S device numbers should start from a number which is a multiple of 16 in the octal numeral system or in the decimal numeral system, e.g. K1X0 (octal numeral system), K4SY20 (octal numeral system), K1M0 (decimal numeral system), and K4S16 (decimal numeral system).

16-bit instruction (9 steps)

SER	Continuity instruction	SERP	Pulse instruction

32-bit instruction (17 steps)

DSER	Continuity instruction	DSERP	Pulse instruction

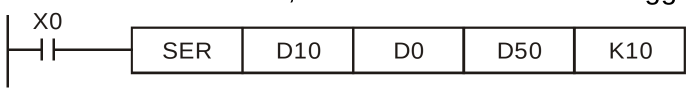
- Flag: None

Explanation

- **S**$_1$: Initial device involved in a comparison; **S**$_2$: Value which is compared; **D**: Initial device in which a comparison result is stored (5 consecutive devices are occupied.); **n**: Number of values
- **S**$_1$ is the initial register involved in a comparison, and **n** is the number of values which are compared. The values in the **n** registers starting from **S**$_1$ are compared with the value in **S**$_2$, and the comparison results are stored in the five registers starting from **D**.
- If the 32-bit instruction is used, **S**$_1$, **S**$_2$, **D**, and **n** will be 32-bit registers.
- 16-bit instruction: **n**=1~256; **n**=1~128 (32-bit instruction)

Example

- When X0 is ON, the values in D10~D19 are compared with the value in D0, and the comparison results are stored in D50~D54. If none of the values in D10~D19 are equal to the value in D0, the values in D50~D52 will be 0.
- A comparison is based on algebra (-10 < 2).
- The number of the minimum value is stored in D53, and the number of the maximum value is stored in D54. If there is more than one minimum value/maximum value, the number which is the biggest will be stored.



S_1	Value	Value which is compared	Number	Result
D10	88		0	
D11	100		1	Equal
D12	110	**S_2** D0=K100	2	
D13	150		3	
D14	100		4	Equal
D15	300		5	
D16	100		6	Equal
D17	5		7	Minimum
D18	100		8	Equal
D19	500		9	Maximum

n (D10 to D19)

D	Value	Description
D50	4	Number of values which are equal to the value in D0
D51	1	Number of the first value which is equal to the value in D0
D52	8	Number of the last value which is equal to the value in D0
D53	7	Number of the minimum value
D54	9	Number of the maximum value

API						Applicable model
66		**ALT**	**P**	(D)	Alternating between ON and OFF	10PM
						✓

	Bit device				Word device											16-bit instruction (9 steps)			
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z	ALT	Continuity instruction	ALTP	Pulse instruction
D		*	*	*												32-bit instruction (17 steps)			
																-	-	-	-

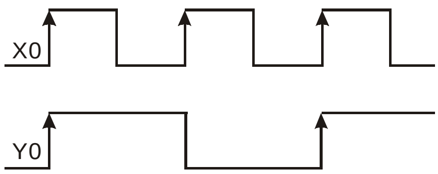
- Note: All devices can not be modified by V devices and Z devices. Please refer to specifications for more information about device ranges.
- Flag: None

Explanation

- **D**: Destination device
- When the instruction ALT is executed, the state of **D** alternates between ON and OFF.
- Generally, the pulse instruction ALTP is used.

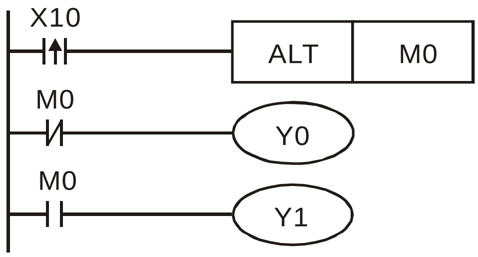
Example 1

- When X0 is turned from OFF to ON for the first time, Y0 is ON. When X0 is turned from OFF to ON for the second time, Y0 is OFF.



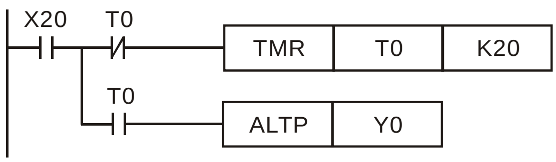
Example 2

- In the beginning, M0 is OFF, and therefore Y0 is ON, and Y1 is OFF. When X10 is turned from OFF to ON for the first time, M0 is ON. Therefore, Y1 is ON, and Y0 is OFF. When X10 is switched from OFF to ON for the second time, M0 is OFF. Therefore, Y0 is ON, and Y1 is OFF.



Example 3

- When X20 is ON, T0 generates a pulse every two seconds. The output Y0 alternates between ON and OFF according to the pulses generated by T0.



API						Applicable model
67	D	RAMP		S1 S2 D n	Ramp	10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S1													*		
S2													*		
D													*		
N													*		

- Note: All devices can not be modified by V devices and Z devices.
  Please refer to specifications for more information about device ranges.

16-bit instruction (9 steps)
RAMP Continuity instruction -

32-bit instruction (17 steps)
D RAMP Continuity instruction -

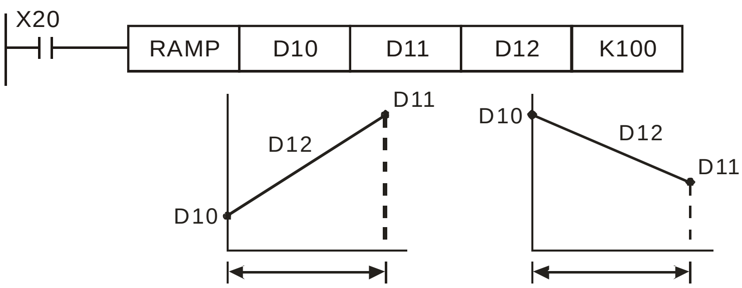
- Flags: M1026 (Please refer to the additional remark below.)
  M1029

Explanation

- **S₁**: Start a ramp; **S₂**: End of a ramp; **D**: Duration of a ramp (2 consecutive devices are occupied.); **n**: Number of scan cycles (**n**=1~32,767)
- The instruction is used to get a slope. Whether a slope is linear or not has an absolute relationship with scan time. When users use the instruction, they have to specify scan time in advance.
- When the contact driving the instruction RAMP is turned from OFF to ON, the value in **D** will increase from the value in **S₁** to the value **S₂**, and the number of scan cycles is stored in **D**+1.
- If the operand **n** is a D device, the value in **n** can not be changed until the execution of the instruction stops.
- If the instruction is used with an output of analog signals, the action of cushioning a start/stop can be executed.

Example

- The start of a ramp is written into D10, and the end of the ramp is written into D11. When X20 is turned ON, the value in D12 increases from the value in D10 to the value in D11, and the number of scan cycles is stored in D13.
- After M1039 in a program is turned ON, the scan time for the program will be fixed. Users can write scan time into the special data register D1039 by means of the instruction MOV. If the scan time set is 30 milliseconds, and **n** is K100, the time it takes for the value in D12 to increase from the value in D10 to the value in D11 will be 3 seconds (30 milliseconds×100).
- If X20 is turned OFF, the execution of the instruction will stop. If X20 is turned ON again, the value in D12 will become 0, and increase again.
- If M1026 is OFF, and M1029 is ON, the value in D12 will becomes the value in D10.

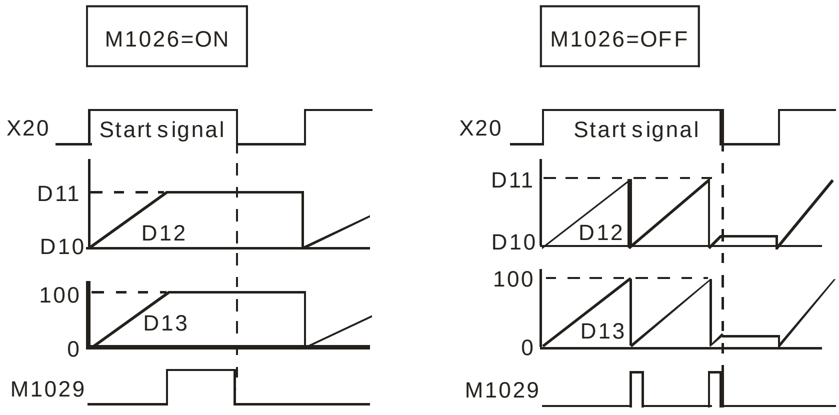


The number of scan cycles is n. D10<D11 The number of scan cycles is n. D10>D11

The number of scan cycle is stored in D13.

Additional remark

- If M1026 is turned ON/OFF, the value in D12 will change in the way described below.



API						Applicable model
69	D	SORT		S m1 m2 D n	Sorting data	10PM
						✓

	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
	Bit device				Word device										
S													*		
m1					*	*									
m2					*	*									
D													*		
N					*	*							*		

- Note: All devices can not be modified by V devices and Z devices. Please refer to specifications for more information about device ranges.

16-bit instruction (9 steps)
SORT Continuity instruction -

32-bit instruction (17 steps)
DSORT Continuity instruction -

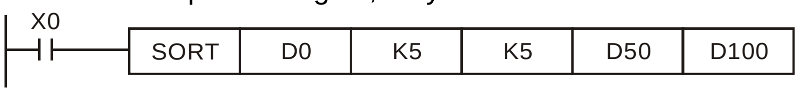
- Flag: None

Explanation

- **S**: Initial device in which original data is stored; $\mathbf{m_1}$: Number of rows of data ($\mathbf{m_1}$ =1~32); $\mathbf{m_2}$: Number of columns of data ($\mathbf{m_2}$ =1~6); **D**: Initial device in which a sorting result is stored; **n**: Reference value (**n**=1~**m2**) (Data is sorted in algebraic order.)
- The data which is sorted is stored in the $\mathbf{m_1 \times m_2}$ registers starting from the register specified by **D**. If **S** and **D** specify the same register, the sorting result gotten will be the same as the original data in the register specified by **S**.
- It is better that the rightmost number of the device number of the register specified by **S** is 0.
- After the instruction is scanned $\mathbf{m_1}$ times, the sorting of data will be complete. After the sorting of data is complete, M1029 will be ON.
- The instruction can be used several times in a program, but one instruction is executed at a time.

Example

- When X0 is turned ON, the data specified is sorted in ascending order. When the sorting of the data specified is complete, M1029 is ON. When the instruction is executed, the data specified can not be changed. If users want to sort the data specified again, they can turn X0 from OFF to ON again.



1. The data which will be sorted is shown below.

m_2 columns of data; m_1 rows of data

Row \ Column	1 Student number	2 Chinese	3 English	4 Math	5 Physics
1	(D0) 1	(D5) 90	(D10) 75	(D15) 66	(D20) 79
2	(D1) 2	(D6) 55	(D11) 65	(D16) 54	(D21) 63
3	(D2) 3	(D7) 80	(D12) 98	(D17) 89	(D22) 90
4	(D3) 4	(D8) 70	(D13) 60	(D18) 99	(D23) 50
5	(D4) 5	(D9) 95	(D14) 79	(D19) 75	(D24) 69

2. If the value in D100 is K3, users can get the sorting result shown below.

m_2 columns of data; m_1 rows of data

Row \ Column	1 Student number	2 Chinese	3 English	4 Math	5 Physics
1	(D50) 4	(D55) 70	(D60) 60	(D65) 99	(D70) 50
2	(D51) 2	(D56) 55	(D61) 65	(D66) 54	(D71) 63
3	(D52) 1	(D57) 90	(D62) 75	(D67) 66	(D72) 79
4	(D53) 5	(D58) 95	(D63) 79	(D68) 75	(D73) 69
5	(D54) 3	(D59) 80	(D64) 98	(D69) 89	(D74) 90

3. If the value in D100 is K5, users can get the sorting result shown below.

m_2 columns of data; m_1 rows of data

Row \ Column	1 Student number	2 Chinese	3 English	4 Math	5 Physics
1	(D50) 4	(D55) 70	(D60) 60	(D65) 99	(D70) 50
2	(D51) 2	(D56) 55	(D61) 65	(D66) 54	(D71) 63
3	(D52) 5	(D57) 95	(D62) 79	(D67) 75	(D72) 69
4	(D53) 1	(D58) 90	(D63) 75	(D68) 66	(D73) 79
5	(D54) 3	(D59) 80	(D64) 98	(D69) 89	(D74) 90

API	Mnemonic	Operands	Function	Applicable model
78	D FROM P	m1 m2 D n	Reading data from a control register in a special module	10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
m_1					*	*					*	*	*	*	*
m_2					*	*					*	*	*	*	*
D											*	*	*	*	*
n					*	*					*	*	*	*	*

- Note: m_1 is in the range of 0 to 255 (16-bit instruction/32-bit instruction).
  m_2 is in the range of 0 to 499 (16-bit instruction/32-bit instruction).
  n is in the range of 1 to (500-m_2) (16-bit instruction).
  n is in the range of 1~(500-m_2)/2 (32-bit instruction).
  The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)

16-bit instruction (9 steps)

FROM Continuity instruction FROMP Pulse instruction

32-bit instruction (17 steps)

DFROM Continuity instruction DFROMP Pulse instruction

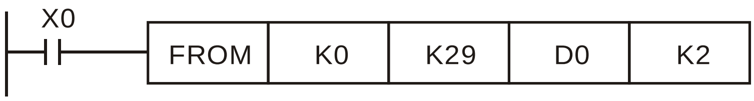
- Please refer to the additional remark below.

Explanation

- **m_1**: Special module number (**m_1** is in the range of 0 to 255.); **m_2**: Control register number (**m_2** is in the range of 0 to 499.); **D**: Device in which the data read will be stored; **n**: Quantity of data which will be read (16-bit instruction: 1~(500-**m_2**); 32-bit instruction: 1~(500-**m_2**)/2
- A DVP-10PM series motion controller can read the data in a control register in a special module by means of the instruction.
- Please refer to the additional remark on the instruction TO for more information about the numbering of special modules.

Example

- The value in CR#29 in special module 0 is read, and then stored in D0 in the motion controller used. The value in CR#30 in special module 0 is read, and then stored in D1 in the motion controller used. The two values are read at the same time.
- When X0 is ON, the instruciton is executed. When X0 is turned OFF, the instruction is not executed, and the values which are read remain unchanged.



API						Applicable model
79	D	TO	P	m1 m2 S n	Writing data into a control register in a special module	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
m_1					*	*					*	*	*	*	*
m_2					*	*					*	*	*	*	*
S					*	*					*	*	*	*	*
n					*	*					*	*	*	*	*

- Note: m_1 is in the range of 0 to 255 (16-bit instruction/32-bit instruction).
  m_2 is in the range of 0 to 499 (16-bit instruction/32-bit instruction).
  n is in the range of 1 to (500-m_2) (16-bit instruction).
  n is in the range of 1~(500-m_2)/2 (32-bit instruction).
  The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)

16-bit instruction (9 steps)

TO	Continuity instruction	TOP	Pulse instruction

32-bit instruction (17 steps)

DTO	Continuity instruction	DTOP	Pulse instruction

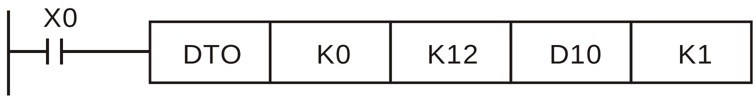
- Please refer to the additional remark below.

Explanation

- **m_1**: Special module number (**m_1** is in the range of 0 to 255.); **m_2**: Control register number (**m_2** is in the range of 0 to 499.); **D**: Data which will be written into a control register; **n**: Quantity of data which will be written (16-bit instruction: 1~(500-**m_2**); 32-bit instruction: 1~(500-**m_2**)/2
- A DVP-10PM series motion controller can write data into a control register in a special module by means of the instruction.

Example

- The 32-bit instruction DTO is used. The value in (D11, D10) is written into (CR#13, CR#12) in special module 0. One value is written at a time.
- When X0 is ON, the instruction is executed. When X0 is turned OFF, the instruction is not executed, and the value which is written remains unchanged.



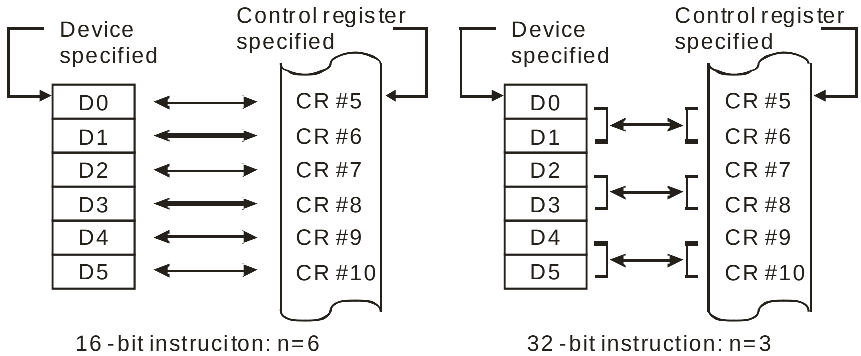
Additional remark

- Regulation of operands

1. **m_1**: **m_1** is a special module number. It is the number of a special module connected to the DVP-10PM series motion controller used.
   The number of the first special module which is connected to the DVP-10PM series motion cotroller used is 0. Eight special modules at most can be connected to the DVP-10PM series motion controller used, and they do not occupy I/O devices.
2. **m_2**: **m_2** is a control register number. the 16-bit memories in a special modules are called control registers. Control register numbers are decimal numbers. The operation of a special module and setting values are stored in the control registers in the special module.
3. If the instruction FROM/TO is used, one control register is taken as a unit for the reading/writing of data. If the instruction DFROM/DTO is used, two control registers are taken as a unit for the reading/writing of data.

High 16 bits	Low 16 bits	
CR #10	CR #9	◄— Control register number specified

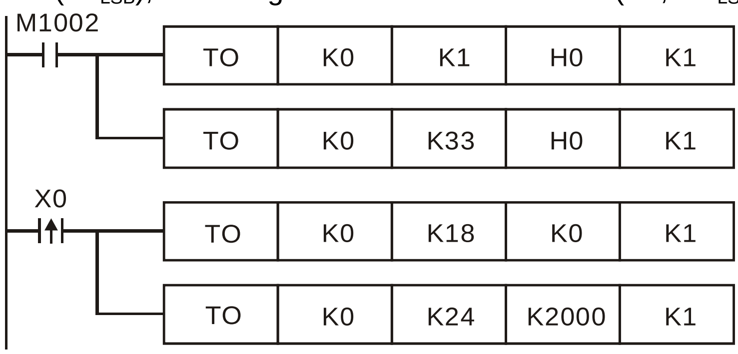
4. **n** which is 2 in a 16-bit instruction has the same meaning as **n** which is 1 in a 32-bit instruction.



- The application of the instruciton FROM/TO is described below.

Example 1

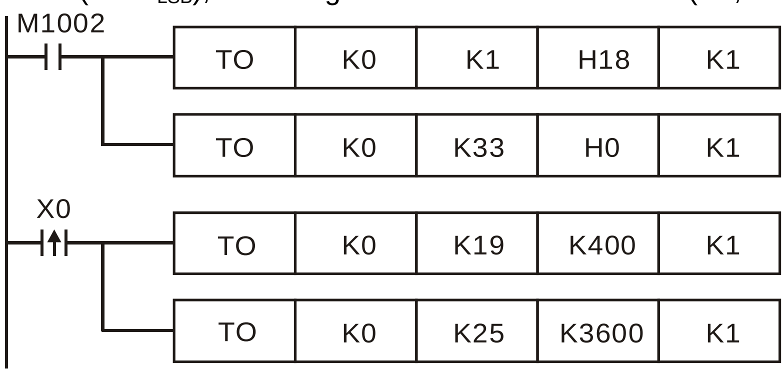
- The characteristic curve of DVP04AD-H2 is adjusted. The offset for channel 1 is 0 V (K0$_{LSB}$), and the gain for channel 1 is 2.5 V (K2,000$_{LSB}$).



1. H0 is written into CR#1 in the analog input module whose number is 0, and channel 1 is set to mode 0 (voltage input: -10 V~+10 V).
2. H0 is written into CR#33. Channel 1~channel 4 can be tuned.
3. When X0 is turned from OFF to ON, the offset K0$_{LSB}$ is writtedn into CR#18, and the gain K2,000$_{LSB}$ is written into CR#24.

Example 2

- The characteristic curve of DVP04AD-H2 is adjusted. The offset for channel 2 is 2 mA (K400$_{LSB}$), and the gain for channel 2 is 18 mA (K3,600$_{LSB}$).



1. H18 is written into CR#1 in the analog input module whose number is 0, and channel 2 is set to mode 3 (current input: -20 mA~+20 mA).
2. H0 is written into CR#33. Channel 1~channel 4 can be tuned.
3. When X0 is turned from OFF to ON, the offset K400$_{LSB}$ is writtedn into CR#19, and the gain K3,600$_{LSB}$ is written into CR#25.

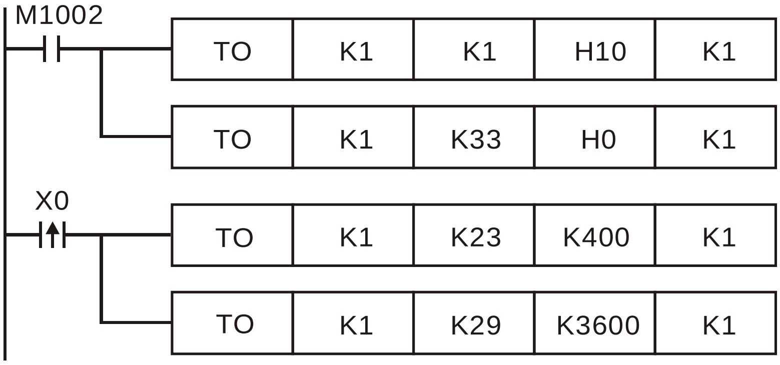
Example 3

◆ The characteristic curve of DVP02DA-H2 is adjusted. The offset for channel 2 is 0 mA (K0$_{LSB}$), and the gain for channel 2 is 10 mA (K1,000$_{LSB}$).

1. H18 is written into CR#1 in the analog output module whose number is 1, and channel 2 is set to mode 3 (current output: 0 mA~+20 mA).
2. H0 is written into CR#33. Channel 1~channel 2 can be tuned.
3. When X0 is turned from OFF to ON, the offset K0$_{LSB}$ is writtedn into CR#22, and the gain K1,000$_{LSB}$ is written into CR#28.

Example 4

◆ The characteristic curve of DVP02DA-H2 is adjusted. The offset for channel 2 is 2 mA (K400$_{LSB}$), and the gain for channel 2 is 18 mA (K3,600$_{LSB}$).



1. H10 is written into CR#1 in the analog output module whose number is 1, and channel 2 is set to mode 2 (current output: +4 mA~+20 mA).
2. H0 is written into CR#33. Channel 1~channel 2 can be tuned.
3. When X0 is turned from OFF to ON, the offset K400$_{LSB}$ is writtedn into CR#23, and the gain K K3,600$_{LSB}$ is written into CR#29.

API						Applicable model
87	D	ABS	P	(D)	Absolute value	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
D								*	*	*	*	*	*	*	*

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)

  Please refer to specifications for more information about device ranges.

  If KnX/KnY/KnM/KnS is used, it is suggested that X/devices/Y devices/M device numbers/S device numbers should start from a number which is a multiple of 16 in the octal numeral system or in the decimal numeral system, e.g. K1X0 (octal numeral system), K4SY20 (octal numeral system), K1M0 (decimal numeral system), and K4S16 (decimal numeral system).

16-bit instruction (9 steps)

ABS	Continuity instruction	ABSP	Pulse instruction

32-bit instruction (17 steps)

DABS	Continuity instruction	DABSP	Pulse instruction

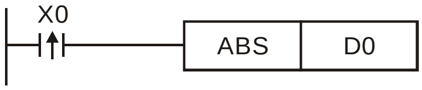
- Flag: None

Explanation

- **D**: Device whose absolute value will be gotten
- When the instruction ABS is executed, the absolute value of the value in **D** is gotten.
- Generally, the pulse instructions ABSP and DABSP are used.

Example

- When X0 is turned from OFF to ON, the absolute value of the value in D0 is gotten.



API	MODRD	S1 S2 n	Reading Modbus data	Applicable model
100				10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*	*							*		
S_2					*	*							*		
n					*	*							*		

- Note: S_1 is in the range of K0 to K254.
  n is in the range of K1 to K6.
  Please refer to specifications for more information about device ranges.

16-bit instruction (7 steps)

MODRD Continuity instruction - -

32-bit instruction

- - - -

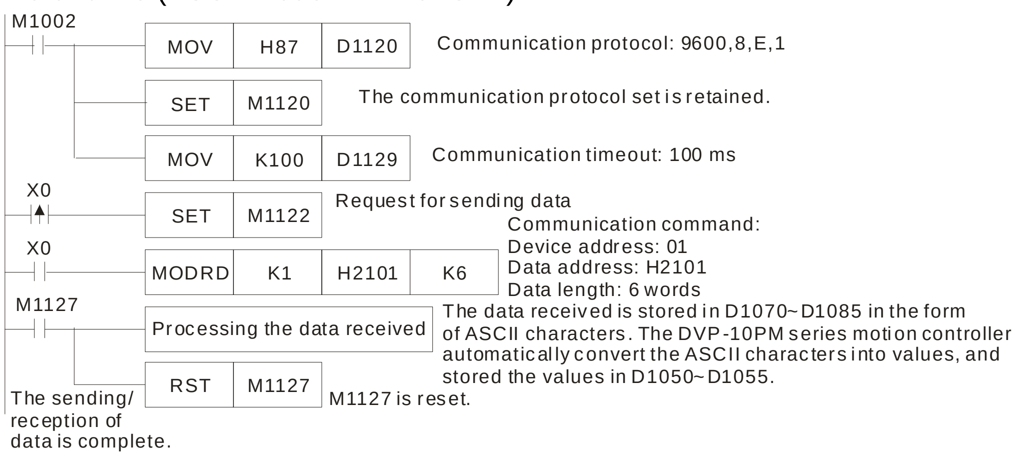
- Flags
  M1120~M1129 and M1140~M1143
  Please refer to the additional remark below.

Explanation

- **S_1**: Device address; **S_2**: Data address; **n**: Data length
- The instruction MODRD is used to drive peripheral equipment in a Modbus ACII/RUT mode. The RS-485 ports on Delta VFD series AC motor drives (except VFD-A series AC motor drives) conform to a Modbus communication format. Users can read data from a Delta AC motor drive by means of the instruction MODRD.
- **S_2** is a data address. If the data address specified is illegal, the device which is connected will respond with an error message, an error code will be stored in D1130 in the DVP-10PM series motion controller used, and M1141 will be ON.
- The data which is sent by a peripheral is stored in D1070~D1085. After a DVP-10PM series motion controller receives the data sent by a peripheral, it will automatically check whether the data received is correct. If an error occurs, M1140 will be ON.
- If an ASCII mode is used, the data sent by a peripheral will be ASCII characters, and the DVP-10PM series motion controller used will convert the data received into values, and store the values in D1050~D1055. If an RTU mode is used, D1050~D1055 will be invalid.
- If a DVP-10PM series motion controller sends correct data to a peripheral after M1140 or M1141 is turned ON, and the data with which the peripheral responds is correct, M1140 or M1141 will be reset.

Example 1

- A DVP-10PM series motion controller is connected to a VFD-B series AC motor drive (ASCII mode: M1143=OFF)



DVP-10PM series motion controller ⇨ VFD-B series AC motor drive: The DVP-10PM series motion controller sends "**01 03 2101 0006 D4**".

VFD-B series AC motor drive ⇨ DVP-10PM series motion controller: The DVP-10PM series motion controller receives "**01 03 0C 0100 1766 0000 0000 0136 0000 3B**".

Data transmission registers in the DVP-10PM series motion controller (message sent by the DVP-10PM series motion controller):

Register	Data		Description	
D1089 low	‘0’	30 H	ADR 1	ADR (1,0): Address of the VFD-B series AC motor drive
D1089 high	‘1’	31 H	ADR 0	
D1090 low	‘0’	30 H	CMD 1	CMD (1,0): Command code
D1090 high	‘3’	33 H	CMD 0	
D1091 low	‘2’	32 H	Starting data address	
D1091 high	‘1’	31 H		
D1092 low	‘0’	30 H		
D1092 high	‘1’	31 H		
D1093 low	‘0’	30 H	Quantity of data (count by the word)	
D1093 high	‘0’	30 H		
D1094 low	‘0’	30 H		
D1094 high	‘6’	36 H		
D1095 low	‘D’	44 H	LRC CHK 1	LRC CHK (0,1): Checksum
D1095 high	‘4’	34 H	LRC CHK 0	

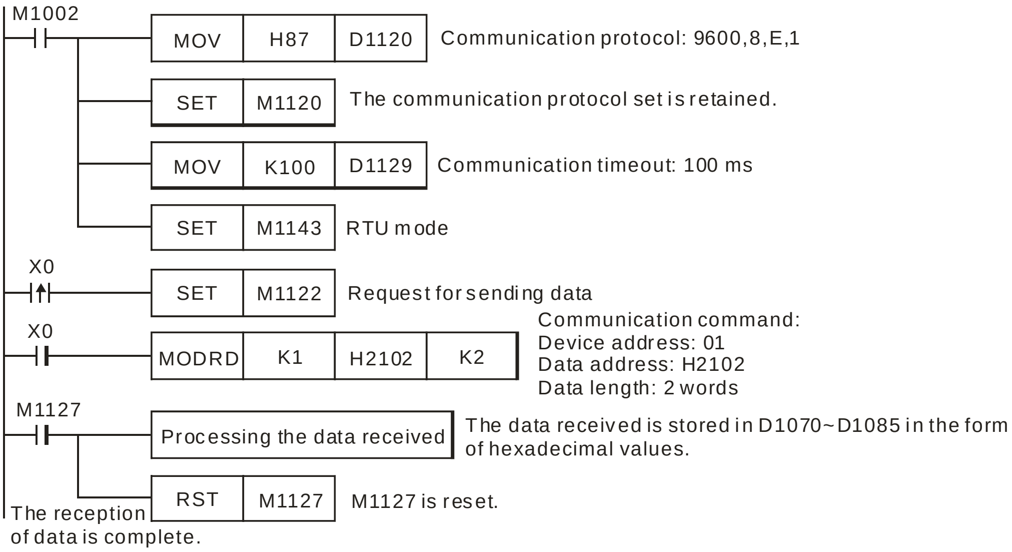
Data reception reigsters in the DVP-10PM series motion controller (message with which the VFD-B series AC motor drive responds):

Register	Data		Description	
D1070 low	‘0’	30 H	ADR 1	
D1070 high	‘1’	31 H	ADR 0	
D1071 low	‘0’	30 H	CMD 1	
D1071 high	‘3’	33 H	CMD 0	
D1072 low	‘0’	30 H	Quantity of data (count by the byte)	
D1072 high	‘C’	43 H		
D1073 low	‘0’	30 H	Contents of the address 2101 H	The DVP-10PM series motion controller automatically converts the ASCII characters into values, and store the values in D1050. (D1050=0100 H)
D1073 high	‘1’	31 H		
D1074 low	‘0’	30 H		
D1074 high	‘0’	30 H		
D1075 low	‘1’	31 H	Contents of the address 2102 H	The DVP-10PM series motion controller automatically converts the ASCII characters into values, and store the values in D1051. (D1051=1766 H)
D1075 high	‘7’	37 H		
D1076 low	‘6’	36 H		
D1076 high	‘6’	36 H		
D1077 low	‘0’	30 H	Contents of the address 2103 H	The DVP-10PM series motion controller automatically converts the ASCII characters into values, and store the values in D1052. (D1052=0000 H)
D1077 high	‘0’	30 H		
D1078 low	‘0’	30 H		
D1078 high	‘0’	30 H		
D1079 low	‘0’	30 H	Contents of the address 2104 H	The DVP-10PM series motion controller automatically converts the ASCII characters into values, and store the values in D1053. (D1053=0000 H)
D1079 high	‘0’	30 H		
D1080 low	‘0’	30 H		
D1080 high	‘0’	30 H		

Register	Data		Description	
D1081 low	'0'	30 H	Contents of the address 2105 H	The DVP-10PM series motion controller automatically converts the ASCII characters into values, and store the values in D1054. (D1054=0136 H)
D1081 high	'1'	31 H		
D1082 low	'3'	33 H		
D1082 high	'6'	36 H		
D1083 low	'0'	30 H	Contents of the address 2106 H	The DVP-10PM series motion controller automatically converts the ASCII characters into values, and store the values in D1055. (D1055=0000 H)
D1083 high	'0'	30 H		
D1084 low	'0'	30 H		
D1084 high	'0'	30 H		
D1085 low	'3'	33 H	LRC CHK 1	
D1085 high	'B'	42 H	LRC CHK 0	

Example 2

◆ A DVP-10PM series motion controller is connected to a VFD-B series AC motor drive (RTU mode: M1143=ON)



DVP-10PM series motion controller ⇨ VFD-B series AC motor drive: The DVP-10PM series motion controller sends "**01 03 2102 0002 6F F7**".

VFD-B series AC motor drive ⇨ DVP-10PM series motion controller: The DVP-10PM series motion controller receives "**01 03 04 1770 0000 FE 5C**".

Data transmission registers in the DVP-10PM series motion controller (message sent by the DVP-10PM series motion controller):

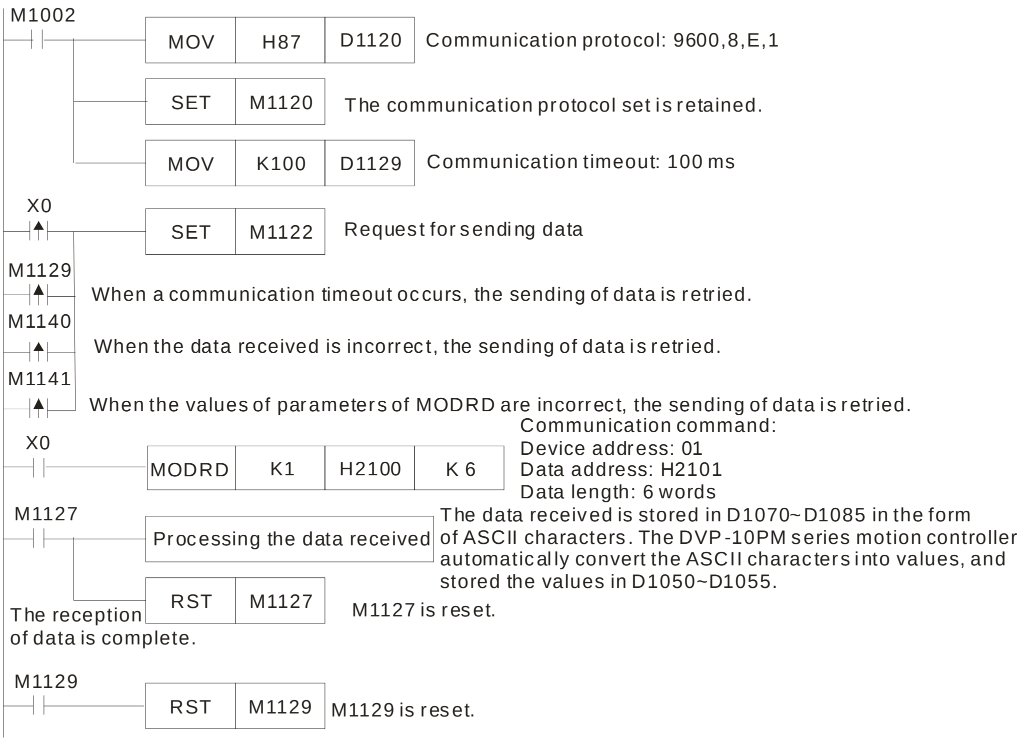
Register	Data	Description
D1089 low	01 H	Address
D1090 low	03 H	Function
D1091 low	21 H	Starting data address
D1092 low	02 H	
D1093 low	00 H	Quantity of Data (count by the word)
D1094 low	02 H	
D1095 low	6F H	CRC CHK Low
D1096 low	F7 H	CRC CHK High

Data reception registers in the DVP-10PM series motion controller (message with which the VFD-B series AC motor drive responds):

Register	Data	Description
D1070 low	01 H	Address
D1071 low	03 H	Function
D1072 low	04 H	Quantity of Data (count by the byte)
D1073 low	17 H	Contents of the address 2102 H
D1074 low	70 H	
D1075 low	00 H	Contents of the address 2103 H
D1076 low	00 H	
D1077 low	FE H	CRC CHK Low
D1078 low	5C H	CRC CHK High

Example 3

- If a communication timeout occurs, the data received is incorrect, or the values of parameters of the instruction MODRD are incorrect when a DVP-10PM series motion controller is connected to a VFD-B series AC motor drive (ASCII mode: M1143=OFF), the sending of data will be retried.
- When X0 is ON, the DVP-10PM series motion controller used reads the data in the data address H2100 in the VFD-B series AC motor drive whose device address is 01, and store the data in D1070~D1085 in the form of ASCII characters. The DVP-10PM series motion controller will automatically convert the ASCII characters in D1070~D1085 into values, and store the values in D1050~D1055.
- If a communication timeout occurs, M1129 will be ON. If M1129 is ON, M1122 will be set to ON.
- If the data received is incorrect, M1140 will be ON. If M1140 is ON, M1122 will be set to ON.
- If the values of parameters of the instruction MODWR is incorrect, M1141 will be ON. If M1141 is ON, M1122 will be set to ON.



Additional remark

- LDP/ANDP/ORP and LDF/ANDF/ORF can not precede the instruction MODRD (function code: H03), otherwise the data stored in data reception registers will be incorrect.
- The instruction can be used several times in a program, but one instruction is executed at a time.

API	MODWR	S1 S2 n	Writing Modbus data	Applicable model
101				10PM
				✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*	*							*		
S_2					*	*							*		
n					*	*							*		

- Note: S_1 is in the range of K0 to K254.
  Please refer to specifications for more information about device ranges.

16-bit instruction (7 steps)

MODWR	Continuity instruction	-	-

32-bit instruction

-	-	-	-

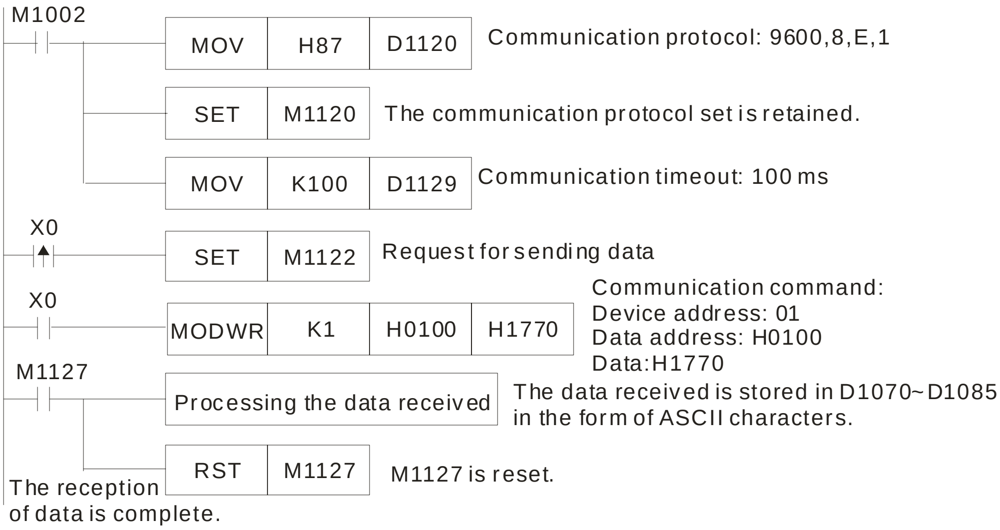
- Flags
  M1120~M1129 and M1140~M1143
  Please refer to the additional remark below.

Explanation

- **S_1**: Device address; **S_2**: Data address; **n**: Data which is written
- The instruction MODWR is used to drive peripheral equipment in a Modbus ACII/RUT mode. The RS-485 ports on Delta VFD series AC motor drives (except VFD-A series AC motor drives) conform to a Modbus communication format. Users can write data into a Delta AC motor drive by means of the instruction MODWR.
- **S_2** is a data address. If the data address specified is illegal, the device which is connected will respond with an error message, an error code will be stored in D1130 in the DVP-10PM series motion controller used, and M1141 will be ON. For example, the data address 8000H in a VFD-B series AC motor drive is illegal, and therefore M1141 is ON, and the value in D1130 is 2. Please refer to VFD-B User Manual for more information about error codes.
- The data which is sent by a peripheral is stored in D1070~D1076. After a DVP-10PM series motion controller receives the data sent by a peripheral, it will automatically check whether the data received is correct. If an error occurs, M1140 will be ON.
- If a DVP-10PM series motion controller sends correct data to a peripheral after M1140 or M1141 is turned ON, and the data with which the peripheral responds is correct, M1140 or M1141 will be reset.

Example 1

- A DVP-10PM series motion controller is connected to a VFD-B series AC motor drive (ASCII mode: M1143=OFF)



DVP-10PM series motion controller ⇨ VFD-B series AC motor drive: The DVP-10PM series motion controller sends “**01 06 0100 1770 71**”.

VFD-B series AC motor drive ⇨ DVP-10PM series motion controller: The DVP-10PM series motion controller receives “**01 06 0100 1770 71**”.

Data transmission registers in the DVP-10PM series motion controller (message sent by the DVP-10PM series motion controller):

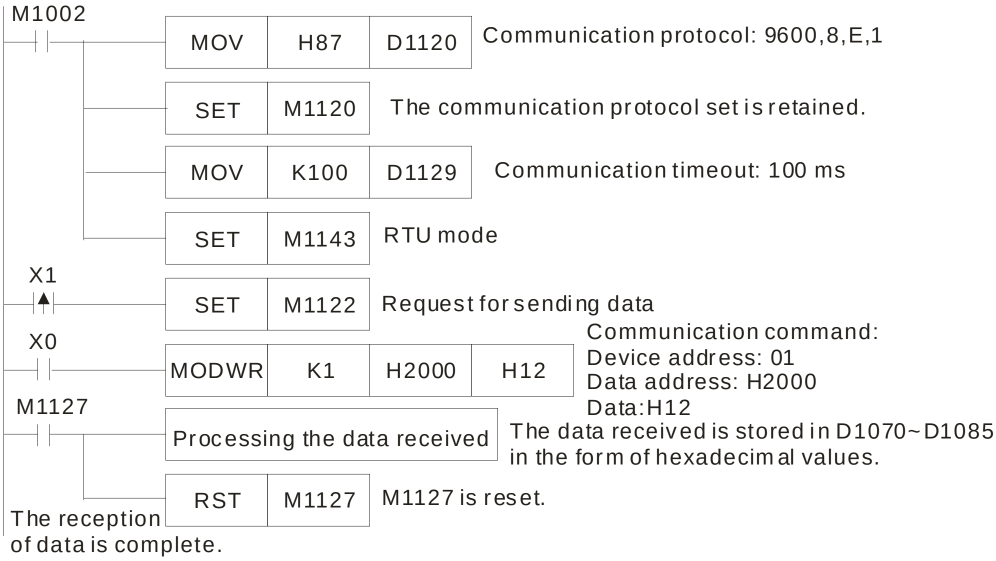
Register	Data		Description	
D1089 low	‘0’	30 H	ADR 1	ADR (1,0): Address of the VFD-B series AC motor drive
D1089 high	‘1’	31 H	ADR 0	
D1090 low	‘0’	30 H	CMD 1	CMD (1,0): Command code
D1090 high	‘6’	36 H	CMD 0	
D1091 low	‘0’	30 H	Data address	
D1091 high	‘1’	31 H		
D1092 low	‘0’	30 H		
D1092 high	‘0’	30 H		
D1093 low	‘1’	31 H	Data	
D1093 high	‘7’	37 H		
D1094 low	‘7’	37 H		
D1094 high	‘0’	30 H		
D1095 low	‘7’	37 H	LRC CHK 1	LRC CHK (0,1): Checksum
D1095 high	‘1’	31 H	LRC CHK 0	

Data reception reigsters in the DVP-10PM series motion controller (message with which the VFD-B series AC motor drive responds):

Register	Data		Description
D1070 low	‘0’	30 H	ADR 1
D1070 high	‘1’	31 H	ADR 0
D1071 low	‘0’	30 H	CMD 1
D1071 high	‘6’	36 H	CMD 0
D1072 low	‘0’	30 H	Data address
D1072 high	‘1’	31 H	
D1073 low	‘0’	30 H	
D1073 high	‘0’	30 H	
D1074 low	‘1’	31 H	Data
D1074 high	‘7’	37 H	
D1075 low	‘7’	37 H	
D1075 high	‘0’	30 H	
D1076 low	‘7’	37 H	LRC CHK 1
D1076 high	‘1’	31 H	LRC CHK 0

Example 2

◆ A DVP-10PM series motion controller is connected to a VFD-B series AC motor drive (RTU mode: M1143=ON)



DVP-10PM series motion controller ⇨ VFD-B series AC motor drive: The DVP-10PM series motion controller sends “**01 06 2000 0012 02 07**”.

VFD-B series AC motor drive ⇨ DVP-10PM series motion controller: The DVP-10PM series motion controller receives “**01 06 2000 0012 02 07**”.

Data transmission registers in the DVP-10PM series motion controller (message sent by the DVP-10PM series motion controller):

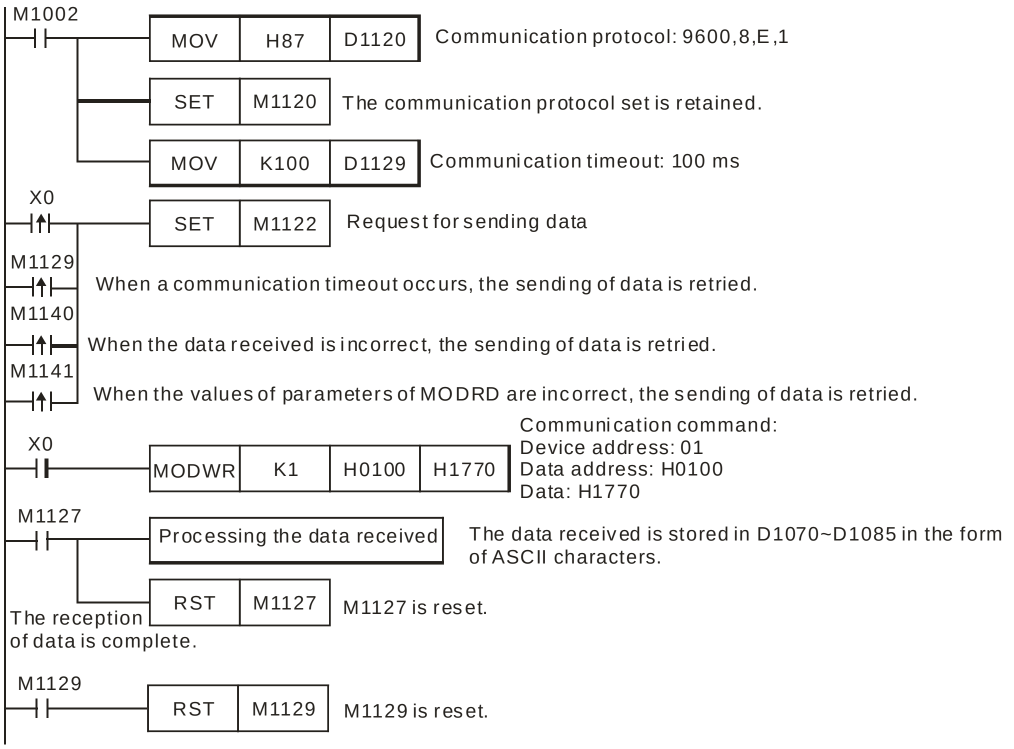
Register	Data	Description
D1089 low	01 H	Address
D1090 low	06 H	Function
D1091 low	20 H	Data address
D1092 low	00 H	
D1093 low	00 H	Data
D1094 low	12 H	
D1095 low	02 H	CRC CHK Low
D1096 low	07 H	CRC CHK High

Data reception reigsters in the DVP-10PM series motion controller (message with which the VFD-B series AC motor drive responds):

Register	Data	Description
D1070 low	01 H	Address
D1071 low	06 H	Function
D1072 low	20 H	Data address
D1073 low	00 H	
D1074 low	00 H	Data content
D1075 low	12 H	
D1076 low	02 H	CRC CHK Low
D1077 low	07 H	CRC CHK High

Example 3

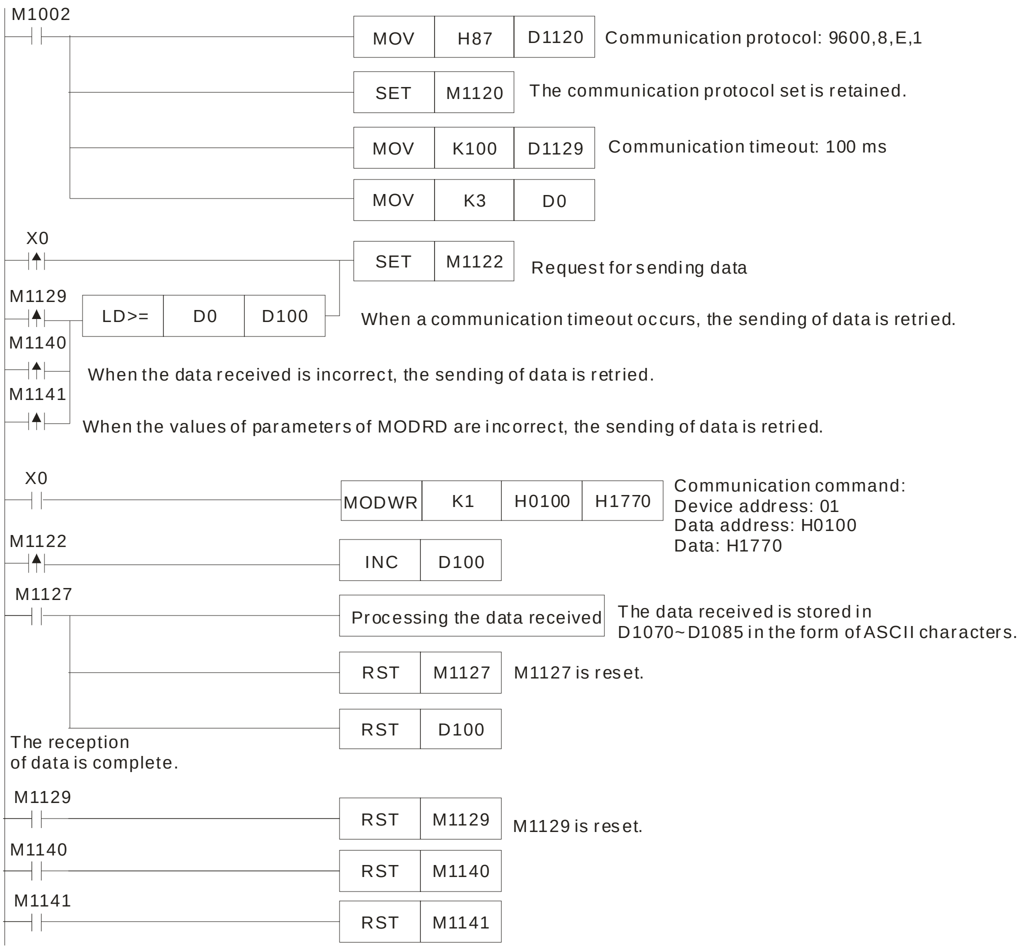
- If a communication timeout occurs, the data received is incorrect, or the values of parameters of the instruction MODRD are incorrect when a DVP-10PM series motion controller is connected to a VFD-B series AC motor drive (ASCII mode: M1143=OFF), the sending of data will be retried.
- When X0 is ON, the DVP-10PM series motion controller used write H1770 (K6000) into the data address H0100 in the VFD-B series AC motor drive whose device address is 01.
- If a communication timeout occurs, M1129 will be ON. If M1129 is ON, M1122 will be set to ON.
- If the data received is incorrect, M1140 will be ON. If M1140 is ON, M1122 will be set to ON.
- If the values of parameters of the instruction MODWR is incorrect, M1141 will be ON. If M1141 is ON, M1122 will be set to ON.



Example 4

- If a communication timeout occurs, the data received is incorrect, or the values of parameters of the instruction MODRD are incorrect when a DVP-10PM series motion controller is connected to a VFD-B series AC motor drive (ASCII mode: M1143=OFF), the sending of data will be retried. The number of times the sending of data is retired is stored in D0. The default value in D0 is 3. If communication is retried successfully, users can control the communication by means of triggering a condition.
- When X0 is ON, the DVP-10PM series motion controller used write H1770 (K6000) into the data address H0100 in the VFD-B series AC motor drive whose device address is 01.

- If a communication timeout occurs, M1129 will be ON. If M1129 is ON, M1122 will be set to ON. The number of times the sending of data is retired is stored in D0. The default value in D0 is 3.
- If the data received is incorrect, M1140 will be ON. If M1140 is ON, M1122 will be set to ON. The number of times the sending of data is retired is stored in D0. The default value in D0 is 3.
- If the values of parameters of the instruction MODWR is incorrect, M1141 will be ON. If M1141 is ON, M1122 will be set to ON. The number of times the sending of data is retired is stored in D0. The default value in D0 is 3.



Additional remark

- If LDP/ANDP/ORP or LDF/ANDF/ORF precedes the instruction MODRD (function code: H06 or H10), M1122 must be set to ON before MODRD is executed.
- The instruction can be used several times in a program, but one instruction is executed at a time.

API						Applicable model
110	D	ECMP	P	S1 S2 D	Comparing binary floating-point values	10PM ✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S1					*								*		
S2					*								*		
D		*	*	*											

- Note: Please refer to specifications for more information about device ranges.
  Only the 32-bit instructions DECMP and DECMPP are valid.
  The operand D occupies three consecutive devices.
  F represents a floating-point value. There is a decimal point in a floating-point value.

16-bit instruction
- - - -

32-bit instruction (9 steps)
DECMP Continuity instruction DECMPP Pulse instruction

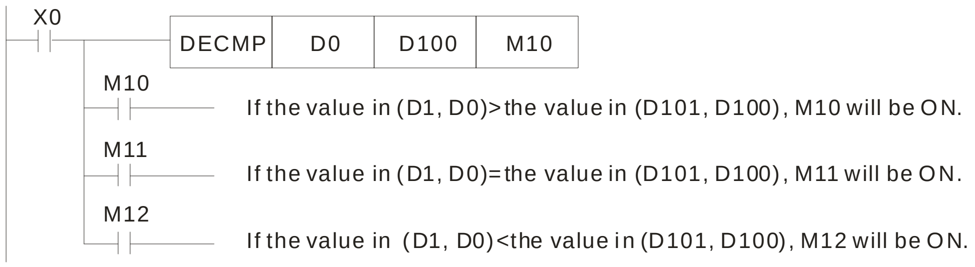
- Flag: None

Explanation

- S_1: Binary floating-point value 1; S_2: Binary floating-point value 2; **D**: Comparison result (D occupies three consecutive devices.)
- The instruction is used to compare the binary floating-point value in S_1 with that in S_2. The comparison result (> , = , or <)is stored in **D**.
- If S_1 is a floating-point value, the instruction will be used to compare the S_1 with the binary floating-point value in S_2. If S_2 is a floating-point value, the instruction will be used to compare the binary floating-point value in S_1 with S_2.

Example

- If the operand **D** is M10, M10, M11, and M12 will be occupied automatically.
- When X0 is ON, the instruction DECMP is executed, and M10, M11, or M12 is ON. When X0 is OFF, the execution of the instruction DECMP stops, and the states of M10, M11, and M12 remain unchanged.
- If users want to get the result that the value in (D1, D0)≧ the value in (D101, D100), they have to connect M10 and M11 in series. If users want to get the result that the value in (D1, D0)≦ the value in (D101, D100), they have to connect M11 and M12 in series. If users want to get the result that the value in (D1, D0)≠the value in (D101, D100), they have to connect M10, M11, and M12 in series.
- If users want to reset M10, M11, or M12, they can use the instruction RST or ZRST.



Additional remark

- Please refer to section 5.3 for more information about performing operations on floating-point values.

API	D	EZCP	P	S1 S2 S D	Binary floating-point zonal comparison	Applicable model 10PM ✓
111						

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*								*		
S_2					*								*		
S					*								*		
D		*	*	*											

- Note: The operand D occupies three consecutive devices.
  The value in S_1 is less than the value in S_2.
  Please refer to specifications for more information about device ranges.
  F represents a floating-point value. There is a decimal point in a floating-point value.
  Only the 32-bit instructions DEZCP and DEZCPP are valid.

16-bit instruction
\- - - -

32-bit instruction (12 steps)
DEZCP Continuity instruction DEZCPP Pulse instruction

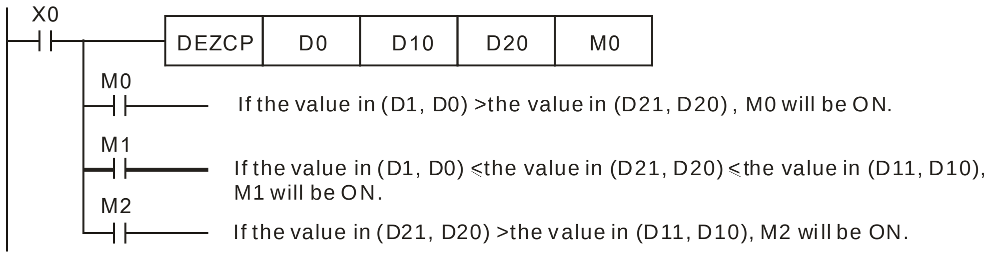
- Flag: None

Explanation

- **S_1**: Minimum binary floating-point value; **S_2**: Maximum binary floating-point value; **S**: Binary floating-point value; **D**: Comparison result (D occupies three consecutive devices.)
- The instruction is used to compare the binary floating-point value in **S** with that in **S_1**, and compare the binary floating-point value in **S** with that in **S_2**. The comparison result is stored in **D**.
- If **S_1** is a floating-point value, the instruction will be used to compare **S_1** with the binary floating-point value in **S_2**. If **S_2** is a floating-point value, the instruction will be used to compare the binary floating-point value in **S_1** with **S_2**.
- If the binary floating-point value in **S_1** is greater than that in **S_2**, the binary floating-point value in **S_1** will be taken as the maximum/minimum value during the execution of the instruction EZCP.
- If the operand **D** is M0, M0, M1, and M2 will be occupied automatically.

Example

- When X0 is ON, the instruction DEZCP is executed, and M0, M1, or M2 is ON. When X0 is OFF, the execution of the instruction DEZCP stops, and the states of M0, M1, and M2 remain unchanged.
- If users want to reset M0, M1, or M2, they can use the instruction RST or ZRST.



Additional remark

- Please refer to section 5.3 for more information about performing operations on floating-point values.

API						Applicable model
112	D	MOVR	P	S D	Transferring a floating-point value	10PM
						✓

	Bit device				Word device											
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S															
D								*	*	*	*	*	*		

- Note: All devices can not be modified by V devices and Z devices.

  Please refer to specifications for more information about device ranges.

  If KnX/KnY/KnM/KnS is used, it is suggested that X/devices/Y devices/M device numbers/S device numbers should start from a number which is a multiple of 16 in the octal numeral system or in the decimal numeral system, e.g. K1X0 (octal numeral system), K4SY20 (octal numeral system), K1M0 (decimal numeral system), and K4S16 (decimal numeral system).

16-bit instruction (7 steps)

-	-	-	-

32-bit instruction

DMOVR	Continuity instruction	DMOVR P	Pulse instruction

- Flag: None

Explanation

- **S**: Source; **D**: Destination
- The operand **S** can be a floating-point value.
- When the instruction is executed, the value in **S** is transferred to **D**. When the instruction is not executed, the value in **D** is unchanged.

Example

- When X0 is OFF, the value in (D11, D10) is unchanged. When X0 is ON, the value F1.2 is transferred to the data register (D11, D10).

API						
116	D	RAD	P	(S) (D)	Converting a degree to a radian	Applicable model: 10PM ✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*								*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  F represents a floating-point value. There is a decimal point in a floating-point value.
  Only the 32-bit instructions DRAD and DRADP are valid.

16-bit instruction
- - - -

32 bit instruction (6 steps)
DRAD Continuity instruction DRADP Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1809	M1969	Borrow flag
M1810	M1970	Carry flag

- Please refer to the additional remark below.

Explanation

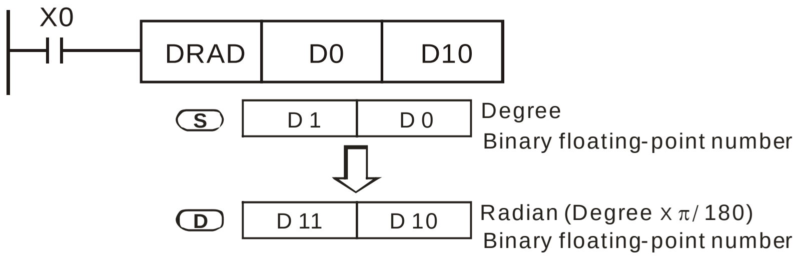
- **S**: Source (degree); **D**: Conversion result (radian)
- The equation below is used to convert a degree into a radian.

  Radian = Degree×(π /180)

- If the absolute value of a conversion result is greater than the maximum floating-point value available, a carry flag will be ON.
- If the absolute value of a conversion reuslt is less than the minimum floating-point value available, a borrow flag will be ON.
- If a converseion result is 0, a zero flag will be ON.

Example

- When X0 is ON, the degree in (D1, D0) is converted into a radian, and the conversion result is stored in (D11, D10). The radian in (D11, D10) is a binary floating-point value.



Additional remark

- Please refer to section 5.3 for more information about performing operations on floating-point values.

API						Applicable model
117	D	DEG	P	S D	Converting a radian to a degree	10PM
						✓

	Bit device				Word device											
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*								*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  F represents a floating-point value. There is a decimal point in a floating-point value.
  Only the 32-bit instructions DDEG and DDEGP are valid.

16-bit instruction
- - - -

32-bit instruction (6 steps)
DDEG Continuity instruction DDEGP Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1809	M1969	Borrow flag
M1810	M1970	Carry flag

- Please refer to the additional remark below.

Explanation

◆ **S**: Source (radian); **D**: Conversion result (degree)

◆ The equation below is used to convert a radian into a degree.

Degree = Radian×(180/π)

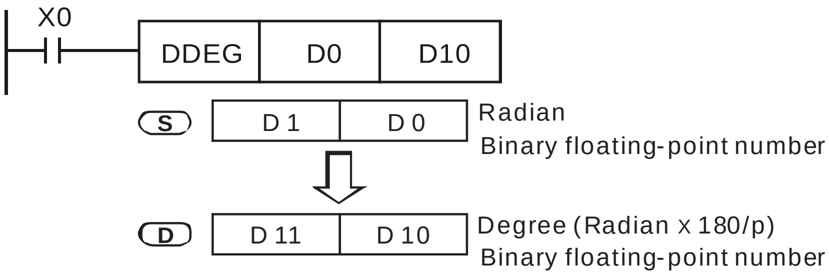
◆ If the absolute value of a conversion result is greater than the maximum floating-point value available, a carry flag will be ON.

◆ If the absolute value of a conversion reuslt is less than the minimum floating-point value available, a borrow flag will be ON.

◆ If a converseion result is 0, a zero flag will be ON.

Example

◆ When X0 is ON, the radian in (D1, D0) is converted into a degree, and the conversion result is stored in (D11, D10). The degree in (D11, D10) is a binary floating-point value.



Additional remark

◆ Please refer to section 5.3 for more information about performing operations on floating-point values.

API					Applicable model
120	D	EADD	P	S1 S2 D	Binary floating-point addition	10PM ✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*								*		
S_2					*								*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  F represents a floating-point value. There is a decimal point in a floating-point value.
  Only the 32-bit instructions DEADD and DEADDP are valid.

16-bit instruction
- - - -

32-bit instruction (9 steps)
DEADD Continuity instruction DEADDP Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1809	M1969	Borrow flag
M1810	M1970	Carry flag

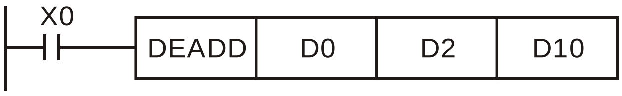
- Please refer to the additional remark below.

Explanation

- **S_1**: Augend; **S_2**: Addend; **D**: Sum
- The binary floating-point value in **S_2** is added to the binary floating-point value in **S_1**, and the sum is stored in **D**.
- If **S_1** is a floating-point value, the instruction will be used to add the binary floating-point value in **S_2** to **S_1**. If **S_2** is a floating-point value, the instruction will be used to add **S_2** to the binary floating-point value in **S_1**.
- **S_1** and **S_2** can be the same register. If the instruction DEADD is used under the circumstances, the value in the register is added to itself whenever the conditional contact is ON in a scan cycle. Generally, the pulse instruction DEADDP is used.
- If the absolute value of an oepration result is greater than the maximum floating-point value available, a carry flag will be ON.
- If the absolute value of an oepration reuslt is less than the minimum floating-point value available, a borrow flag will be ON.
- If an operation result is 0, a zero flag will be ON.

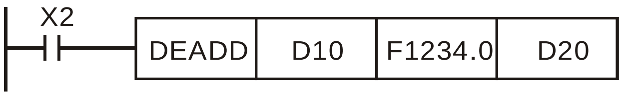
Example 1

- When X0 is ON, the binary floating-point value in (D3, D2) is added to the binary floating-point value in (D1, D0), and the sum is stored in (D11, D10).



Example 2

- When X0 is ON, F1234.0 is added to the binary floating-point value in (D11, D10), and the sum is stored in (D21, D20).



Additional remark

- Please refer to section 5.3 for more information about performing operations on floating-point values.

API						Applicable model
121	D	ESUB	P	S1 S2 D	Binary floating-point subtraction	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*								*		
S_2					*								*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  F represents a floating-point value. There is a decimal point in a floating-point value.
  Only the 32-bit instructions DEADD and DEADDP are valid.

16-bit instruction

-	-	-	-

32-bit instruction (9 steps)

DESUB	Continuity instruction	DESUBP	Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1809	M1969	Borrow flag
M1810	M1970	Carry flag

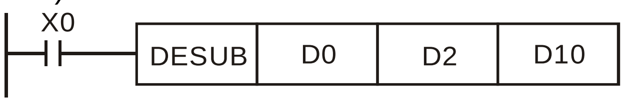
- Please refer to the additional remark below.

Explanation

- **S_1**: Minuend; **S_2**: Subtrahend; **D**: Difference
- The binary floating-point value in **S_2** is subtracted from the binary floating-point value in **S_1**, and the difference is stored in **D**.
- If **S_1** is a floating-point value, the instruction will be used to subtract the binary floating-point value in **S_2** from **S_1**. If **S_2** is a floating-point value, the instruction will be used to subtract **S_2** from the binary floating-point value in **S_1**.
- **S_1** and **S_2** can be the same register. If the instruction DESUB is used under the circumstances, the value in the register is subtracted from itself whenever the conditional contact is ON in a scan cycle. Generally, the pulse instruction DESUBP is used.
- If the absolute value of an oepration result is greater than the maximum floating-point value available, a carry flag will be ON.
- If the absolute value of an oepration reuslt is less than the minimum floating-point value available, a borrow flag will be ON.
- If an operation result is 0, a zero flag will be ON.

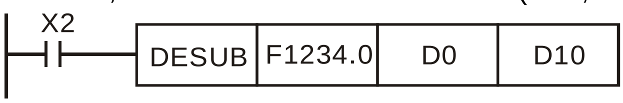
Example 1

- When X0 is ON, the binary floating-point value in (D3, D2) is subtracted from the binary floating-point value in (D1, D0), and the difference is stored in (D11, D10).



Example 2

- When X2 is ON, the binary floating-point value in (D1, D0) is subtracted from F1234.0, and the difference is stored in (D11, D10).



Additional remark

- Please refer to section 5.3 for more information about performing operations on floating-point values.

API 122	D	EMUL	P	S1 S2 D	Binary floating-point multiplication	Applicable model 10PM: ✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*								*		
S_2					*								*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  F represents a floating-point value. There is a decimal point in a floating-point value.
  Onlyt the 32-bit instructions DEMUL and DEMULP are valid.

16-bit instruction

- - - -

32-bit instruction (9 steps)

DEMUL Continuity instruction DEMULP Pulse instruction

- Flags

Ox	O100	
M1810	M1970	Carry flag

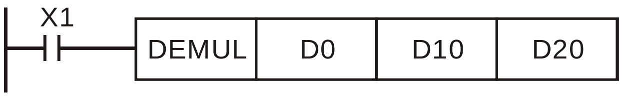
- Please refer to the additional remark below.

Explanation

- **S_1**: Multiplicand; **S_2**: Multiplier; **D**: Product
- The binary floating-point value in **S_1** is multiplied by the binary floating-point value in **S_2**, and the product is stored in **D**.
- If **S_1** is a floating-point value, the instruction will be used to multiply **S_1** by the binary floating-point value in **S_2**. If **S_2** is a floating-point value, the instruction will be used to multiply the binary floating-point value in **S_1** by **S_2**.
- **S_1** and **S_2** can be the same register. If the instruction DEMUL is used under the circumstances, the value in the register is multiplied by itself whenever the conditional contact is ON in a scan cycle. Generally, the pulse instruction DEMULP is used.
- If the absolute value of an oepration result is greater than the maximum floating-point value available, a carry flag will be ON.
- If the absolute value of an oepration reuslt is less than the minimum floating-point value available, a borrow flag will be ON.
- If an operation result is 0, a zero flag will be ON.

Example 1

- When X1 is ON, the binary floating-point value in (D1, D0) is multiplied by the binary floating-point value in (D11, D10), and the product is stored in (D21, D20).



Example 2

- When X2 is ON, F1234.0 is multiplied by the binary floating-point value in (D1, D0), and the product is stored in (D11, D10).

Additional remark

- Please refer to section 5.3 for more information about performing operations on floating-point values.

API	D	EDIV	P	S1 S2 D	Binary floating-point division	Applicable model
123	D	EDIV	P	S_1 S_2 D	Binary floating-point division	10PM ✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*								*		
S_2					*								*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  F represents a floating-point value. There is a decimal point in a floating-point value.
  Only the 32-bit instructions DEDIV and DEDIVP are valid.

16-bit instruction
- - - -

32-bit instruction (9 steps)
DEDIV Continuity instruction DEDIVP Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1809	M1969	Borrow flag
M1810	M1970	Carry flag
M1793	M1953	Operation error flag

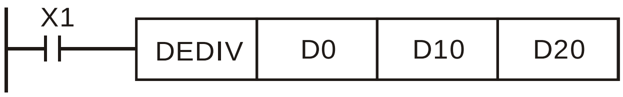
- Please refer to the additional remark below.

Explanation

- **S_1**: Dividend; **S_2**: Divisor; **D**: Quotient and remainder
- The binary floating-point value in **S_1** is divided by the binary floating-point value in **S_2**, and the quotient is stored in **D**.
- If **S_1** is a floating-point value, the instruction will be used to divide **S_1** by the binary floating-point value in **S_2**. If **S_2** is a floating-point value, the instruction will be used to divide the binary floating-point value in **S_1** by **S_2**.
- If the value in **S_2** is 0, an operation error will occur, the instruciton will not be executed, an operation error flag will be ON, and the error code H0E19 will appear.
- If the absolute value of an oepration result is greater than the maximum floating-point value available, a carry flag will be ON.
- If the absolute value of an oepration reuslt is less than the minimum floating-point value available, a borrow flag will be ON.
- If an operation result is 0, a zero flag will be ON.

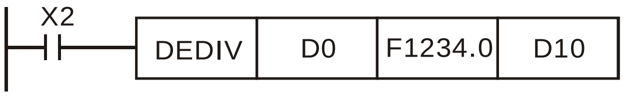
Example 1

- When X1 is ON, the binary floating-point value in (D1, D0) is divided by the binary floating-point value in (D11, D10), and the quotient is stored in (D21, D20).



Example 2

- When X2 is ON, the binary floating-point value in (D1, D0) is divided by F1234.0, and the quotient is stored in (D11, D10).



Additional remark

- Please refer to section 5.3 for more information about performing operations on floating-point values.

API						Applicable model
124	D	EXP	P	S D	Exponent of a binary floating-point value	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*								*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  F represents a floating-point value. There is a decimal point in a floating-point value.
  Only the 32-bit instructions DEXP and DEXPP are valid.

16-bit instruction

-	-	-	-

32-bit instruction (6 steps)

DEXP	Continuity instruction	DEXPP	Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1809	M1969	Borrow flag
M1810	M1970	Carry flag

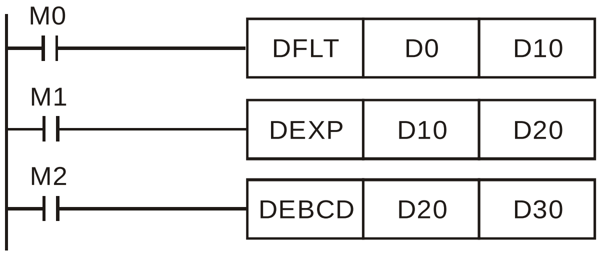
- Please refer to the additional remark below.

Explanation

- **S**: Source device; **D**: Device in which an operation result is stored
- EXP[D+1, D]=[**S**+1, **S**]. e is a base (e=2.71828), and **S** is an exponent.
- The value in **S** can be a positive value or a negative value. **D** must be a 32-bit register, and the value in **S** must be a floating-point value.
- The value in **D** is e^{S}. (e is 2.71828, and **S** represents a source value.)
- If the absolute value of an oepration result is greater than the maximum floating-point value available, a carry flag will be ON.
- If the absolute value of an oepration reuslt is less than the minimum floating-point value available, a borrow flag will be ON.
- If an operation result is 0, a zero flag will be ON.

Example

- When M0 is ON, the value in (D1, D0) is converted into a binary floating-point value, and the conversion result is stored in (D11, D10).
- When M1 is ON, the exponentiation with the value in (D11, D10) as an exponent is performed. The result is a binary floating-point number, and is stored in (D21, D20).
- When M2 is ON, the binary floating-point value in (D21, D20) is converted into a decimal floating-point value, and the conversion result is stored in (D31, D30). (The value in D31 is the value in D30 to the power of 10.)



Additional remark

- Please refer to section 5.3 for more information about performing operations on floating-point values.

API						Applicable model
125	D	LN	P	S D	Natural logarithm of a binary floating-point value	10PM ✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*								*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  F represents a floating-point value. There is a decimal point in a floating-point value.
  Only the 32-bit instructions DLN and DLNP are valid.

16-bit instruction

-	-	-	-

32-bit instruction (6 steps)

DLN	Continuity instruction	DLNP	Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1809	M1969	Borrow flag
M1810	M1970	Carry flag
M1793	M1953	Operation error flag

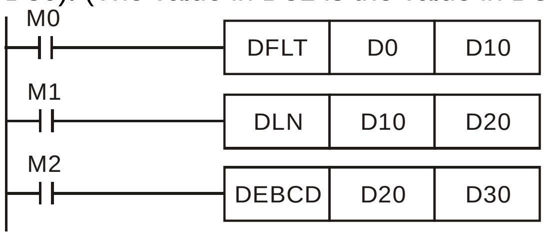
- Please refer to the additional remark below.

Explanation

- **S**: Source device; **D**: Device in which an operation result is stored
- The natural logarithm of the value in **S** is calculated.
  Ln[**S**+1, **S**]=[**D**+1, **D**]
- The value in **S** can only be a positive value. **D** must be a 32-bit register, and the value in **S** must be a floating-point value.
- f the value in **S** is not a positive value, an operation error will occur, the instruciton will not be executed, an operation error flag will be ON, and the error code H0E19 will appear.
- e^{D}=**S**.→The value in **D**=ln**S** (**S**: Source device)
- If the absolute value of an oepration result is greater than the maximum floating-point value available, a carry flag will be ON.
- If the absolute value of an oepration reuslt is less than the minimum floating-point value available, a borrow flag will be ON.
- If an operation result is 0, a zero flag will be ON.

Example

- When M0 is ON, the value in (D1, D0) is converted into a binary floating-point value, and the conversion result is stored in (D11, D10).
- When M1 is ON, the natural logarithm of the floating-point value in (D11, D10) is calculated, and the operation result is stored in (D21, D20).
- When M2 is ON, the binary floating-point value in (D21, D20) is converted into a decimal floating-point value, and the conversion result is stored in (D31, D30). (The value in D31 is the value in D30 to the power of 10.)



Additional remark

- Please refer to section 5.3 for more information about performing operations on floating-point values.

API						Applicable model
126	D	LOG	P	(S1) (S2) (D)	Logarithm of a binary floating-point value	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*								*		
S_2					*								*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  F represents a floating-point value. There is a decimal point in a floating-point value.
  Only the 32-bit instructions DLOG and DLOGP are valid.

16-bit instruction

-	-	-	-

32-bit instruction (9 steps)

DLOG	Continuity instruction	DLOGP	Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1809	M1969	Borrow flag
M1810	M1970	Carry flag

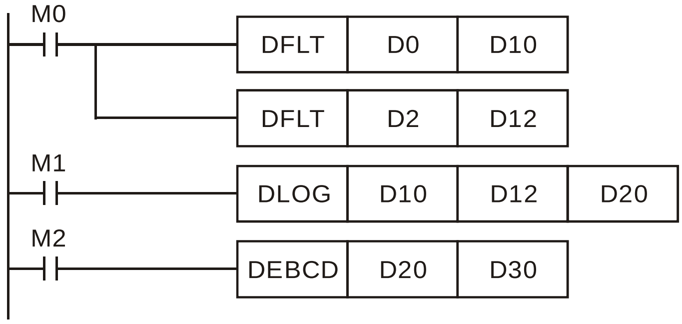
- Please refer to the additional remark below.

Explanation

- S_1: Device in which the base is stored; S_2: Source device; **D**: Device in which an operation result is stored
- The logarithm of the value in S_2 with respect to the value in S_1 is calculated, and the operation result is stored in **D**.
- The values in S_1 and S_2 can only be positive values. **D** must be a 32-bit register, and the values in S_1 and S_2 must be floating-point values.
- $S_1^D = S_2 \rightarrow D = \mathrm{Log}_{S_1} S_2$
- If the absolute value of an oepration result is greater than the maximum floating-point value available, a carry flag will be ON.
- If the absolute value of an oepration reuslt is less than the minimum floating-point value available, a borrow flag will be ON.
- If an operation result is 0, a zero flag will be ON.

Example

- When M0 is ON, the values in (D1, D0) and (D3, D2) are converted into binary floating-point values, and the conversion results are stored in (D11, D10) and (D13, D12) respectively.
- When M1 is ON, the logarithm of the binary floating-point value in (D13, D12) with respect to the binary floating-point value in (D11, D10) is calculated, and the operation result is stored in (D21, D20).
- When M2 is ON, the binary floating-point value in (D21, D20) is converted into a decimal floating-point value, and the conversion result is stored in (D31, D30). (The value in D31 is the value in D30 to the power of 10.)



Additional remark

- Please refer to section 5.3 for more information about performing operations on floating-point values.

API						Applicable model
127	D	ESQR	P	(S) (D)	Square root of a binary floating-point value	10PM ✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*								*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  S is greater than or equal to 0.
  F represents a floating-point value. There is a decimal point in a floating-point value.
  Only the 32-bit instructions DESQR and DESQRP are valid.

16-bit instruction

-	-	-	-

32-bit instruction (6 steps)

DESQR	Continuity instruction	DESQRP	Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1793	M1953	Operation error flag

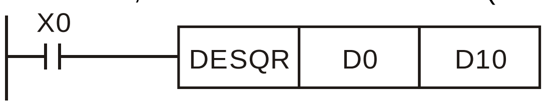
- Please refer to the additional remark below.

Explanation

- **S**: Source device; **D**: Device in which a result is stored
- The square root of the binary floating-point value in **S** is calculated, and the result is stored in **D**.
- If **S** is a floating-point value, the instruction will be used to calculate the floating-point value.
- If an operation result is 0, a zero flag will be ON.
- If the value in **S** is not a positive value, an operation error will occur, the instruciton will not be executed, an operation error flag will be ON, and the error code H0E19 will appear.

Example 1

- When X0 is ON, the square root of the binary floating-point value in (D1, D0) is calculated, and the result is stored in (D11, D10).



$\sqrt{(D1, D0)}$ → (D11, D10)

Binary floating-point number → Binary floating-point number

Example 2

- When X2 is ON, the square root of F1234.0 is calculated, and the result is stored in (D11, D10).

Additional remark

- Please refer to section 5.3 for more information about performing operations on floating-point values.

API						Applicable model
128	D	POW	P	S1 S2 D	Power of a floating-point value	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*								*		
S_2					*								*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  Only the 32-bit instructions DPOW and DPOWP are valid.
  F represents a floating-point value. There is a decimal point in a floating-point value.

16-bit instruction

\- - - -

32-bit instruction (9 steps)

DPOW Continuity instruction DPOWP Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1809	M1969	Borrow flag
M1810	M1970	Carry flag
M1793	M1953	Operation error flag

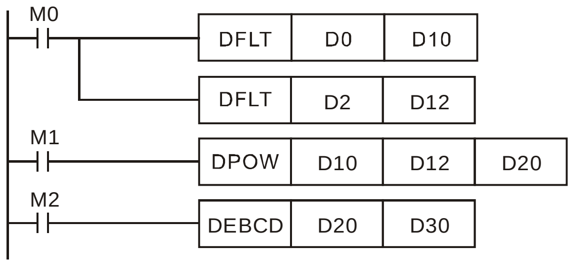
- Please refer to the additional remark below.

Explanation

- **S_1**: Device in which a base is stored; **S_2**: Device in which a power is stored; **D**: Device in which the operation result is stored
- The binary floating-point value in **S_1** is raised to the power of the value in **S_2**, and the operation result is stored in **D**.
  D=POW[**S_1**+1, **S_1**]$^{[S2+1,\ S2]}$
- The value in **S_1** can only be a positive value, whereas the value in **S_2** can be a positive value or a negative value. **D** must be a 32-bit register, and the values in **S_1** and **S_2** must be floating-point values.
- If the values in **S_1** and **S_2** are invalid, an operation error will occur, the instruciton will not be executed, an operation error flag will be ON, and the error code H0E19 will appear.
- If the absolute value of an operation result is greater than the maximum floating-point value available, a carry flag will be ON.
- If the absolute value of an operation reuslt is less than the minimum floating-point value available, a borrow flag will be ON.
- If an operation result is 0, a zero flag will be ON.

Example

- When M0 is ON, the values in (D1, D0) and (D3, D2) are converted into binary floating-point values, and the conversion results are stored in (D11, D10) and (D13, D12) respectively.
- When M1 is ON, the binary floating-point value in (D11, D10) is raised to the power of the binary floating-point value in (D13, D12), and the operation result is stored in (D21, D20).
- When M2 is ON, the binary floating-point value in (D21, D20) is converted into a decimal floating-point value, and the conversion result is stored in (D31, D30). (The value in D31 is the value in D30 to the power of 10.)



Additional remark

- Please refer to section 5.3 for more information about performing operations on floating-point values.

API						Applicable model
129	D	INT	P	(S) (D)	Converting a binary floating-point value into a binary integer	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S													*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  Only the 32-bit instructions DINT and DINTP are valid.

16-bit instruction

-	-	-	-

32-bit instruction (5 steps)

DINT	Continuity instruction	DINTP	Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1809	M1969	Borrow flag
M1810	M1970	Carry flag

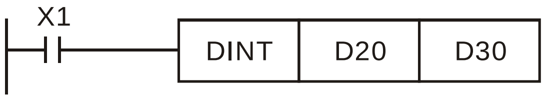
- Please refer to the explanation below.

Explanation

- **S**: Source device; **D**: Conversion result
- The binary floating-point value in **S** is converted into a binary value. The integer part of the binary value is stored in **D**, and the fractional part of the binary value is dropped.
- The instruction is the opposite of API 49 DFLT.
- If a conversion result is 0, a zero flag will be ON.
  If the fractional part of a conversion result is dropped, a borrow flag will be ON.
  If a converesion result is not in the range of -2,147,483,648 to 2,147,483,647, a carry flag will be ON.

Example

- When X1 is ON, the binary floating-point value in (D21, D20) is converted into a binary value. The integer part of the binary value is stored in (D31, D30), and the fractional part of the binary value is dropped.



API						Applicable model
130	D	SIN	P	S D	Sine of a binary floating-point value	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*								*		
D													*		

- Note: $0^o \leqq$ Degree $\leqq 360^0$

  Please refer to specifications for more information about device ranges.

  F represents a floating-point value. There is a decimal point in a floating-point value.

  Only the 32-bit instructions DSIN and DSINP are valid.

16-bit instruction

\- - - -

32-bit instruction (6 steps)

DSIN Continuity instruction DSINP Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1760	M1920	Radian/Degree flag

- Please refer to the additional remark below.

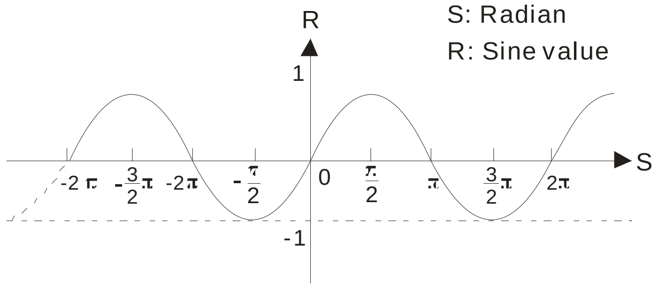
Explanation

- **S**: Source value; **D**: Sine value
- Whether the source value in **S** is a radian or a degree depends on the state of a radian/degree flag.
- If a radian/degree flag is OFF, the source value in **S** is a radian.

  Radian=Degree×π /180.
- If a radian/degree flag is ON, the source value in **S** is a degree.

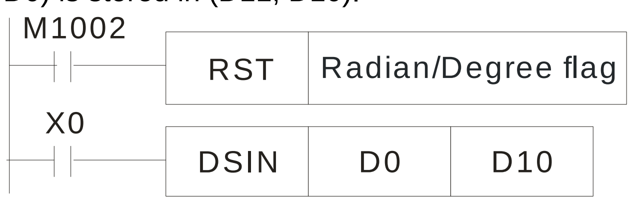
  ($0^o \leqq$ Degree $\leqq 360^0$)
- If an operation result is 0, a zero flag will be ON.
- The sine of the source value in **S** is stored in **D**.

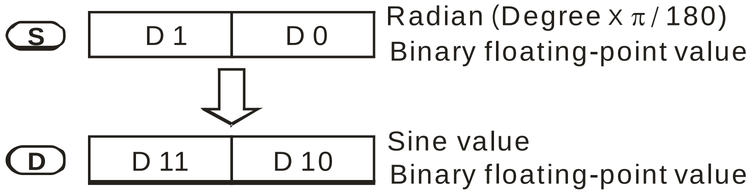
The relation between radians and sine values is shown below.



Example 1

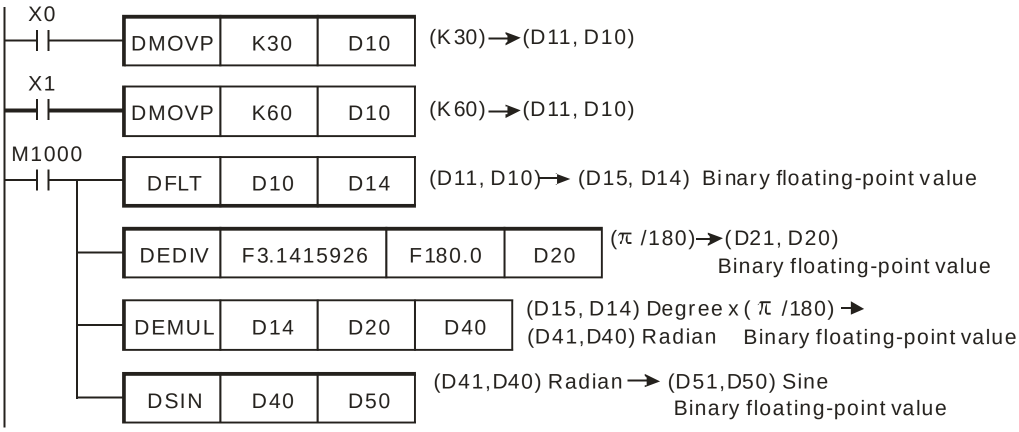
- A radian/degree flag is reset to OFF. The binary floating-point value in (D1, D0) is a radian. When X0 is ON, the sine of the binary floating-point value in (D1, D0) is stored in (D11, D10).





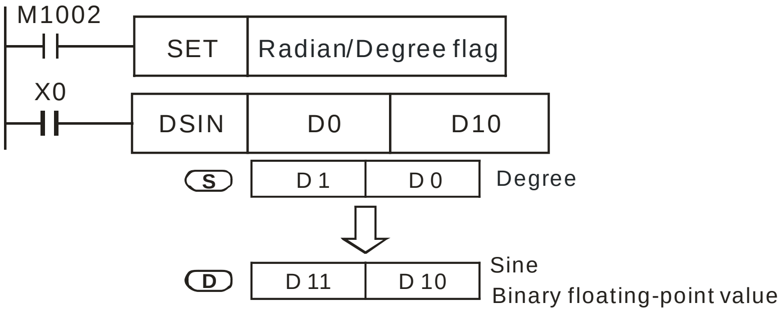
Example 2

◆ A radian/degree flag is OFF. A degree is set by means of X0 or X1. After the degree is converted into a radian, the sine of the radian will be calculated.



Example 3

◆ A radian/degree flag is set to ON. The value in (D1, D0) is a degree in the range of 0° to 360°. When X0 is ON, the sine of the value in (D1, D0) is stored in (D11, D10). The value in (D11, D10) is a binary floating-point value.



Additional remark

◆ Please refer to section 5.3 for more information about performing operations on floating-point values.

API						Applicable model
131	D	COS	P	S D	Cosine of a binary floating-point number	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*								*		
D													*		

- Note: $0^{o} \leqq$ Degree $\leqq 360^{0}$

  Please refer to specifications for more information about device ranges.

  F represents a floating-point value. There is a decimal point in a floating-point value.

  Only the 32-bit instructions DCOS and DCOSP are valid.

16-bit instruction

-	-	-	-

32-bit instruction (6 steps)

DCOS	Continuity instruction	DCOSP	Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1760	M1920	Radian/Degree flag

- Please refer to the additional remark below.

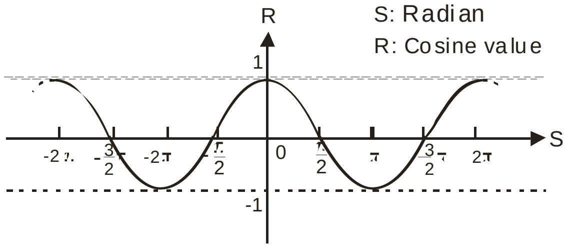
Explanation

- **S**: Source value; **D**: Cosine value
- Whether the source value in **S** is a radian or a degree depends on the state of a radian/degree flag.
- If a radian/degree flag is OFF, the source value in **S** is a radian.

  Radian=Degree×π /180.
- If a radian/degree flag is ON, the source value in **S** is a degree.

  ($0^{o} \leqq$ Degree $\leqq 360^{0}$)
- If an operation result is 0, a zero flag will be ON.
- The cosine of the source value in **S** is stored in **D**.

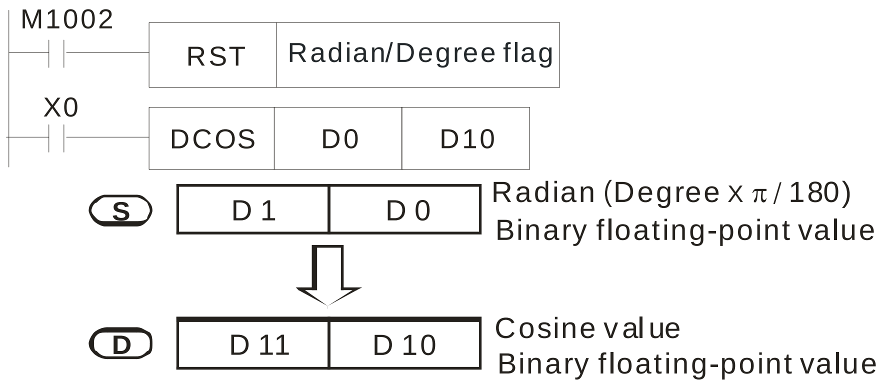
  The relation between radians and cosine values is shown below.



- Radian/Degree flag: If a radian/degree flag is OFF, the source value in **S** is a radian. If a radian/degree flag is ON, the source value in **S** is a degree in the range of 0° to 360°.

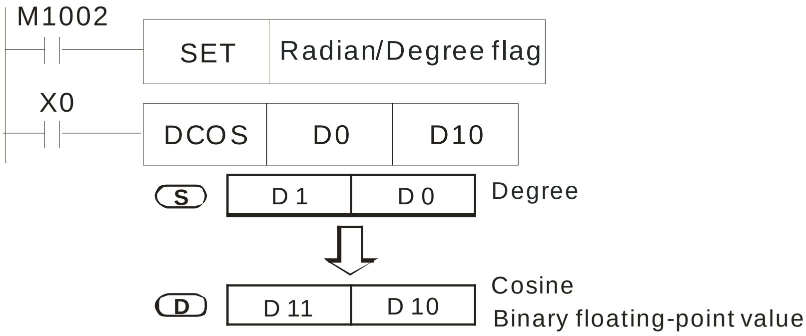
Example 1

- A radian/degree flag is reset to OFF. The binary floating-point value in (D1, D0) is a radian. When X0 is ON, the cosine of the binary floating-point value in (D1, D0) is stored in (D11, D10).



Example 2

- A radian/degree flag is set to ON. The value in (D1, D0) is a degree in the range of 0° to 360°. When X0.0 is ON, the cosine of the value in (D1, D0) is stored in (D11, D10). The value in (D11, D10) is a binary floating-point value.



Additional remark

- Please refer to section 5.3 for more information about performing operations on floating-point values.

API		TAN				Applicable model
132	D	TAN	P	S D	Tangent of a binary floating-point value	10PM: ✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*								*		
D													*		

- Note: $0^o \leqq$ Degree $\leqq 360^0$

  Please refer to specifications for more information about device ranges.

  F represents a floating-point value. There is a decimal point in a floating-point value.

  Only the 32-bit instructions DTAN and DTANP are valid.

16-bit instruction
- - - -

32-bit instruction (6 steps)
DTAN Continuity instruction DTANP Pulse instruction

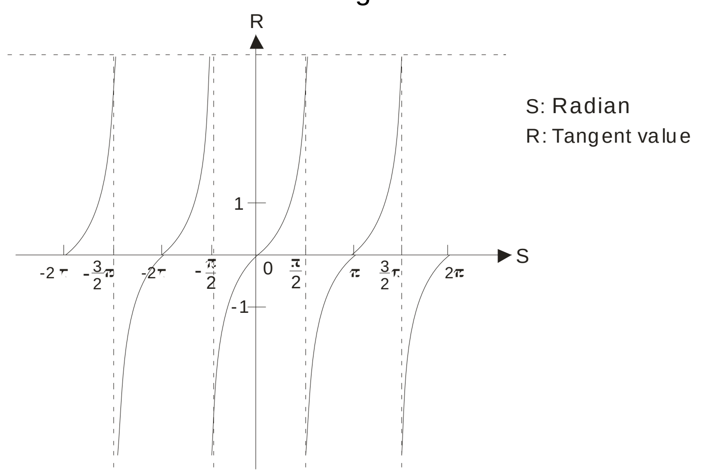
- Flags

Ox	O100	
M1808	M1968	Zero flag
M1760	M1920	Radian/Degree flag

- Please refer to the additional remark below.

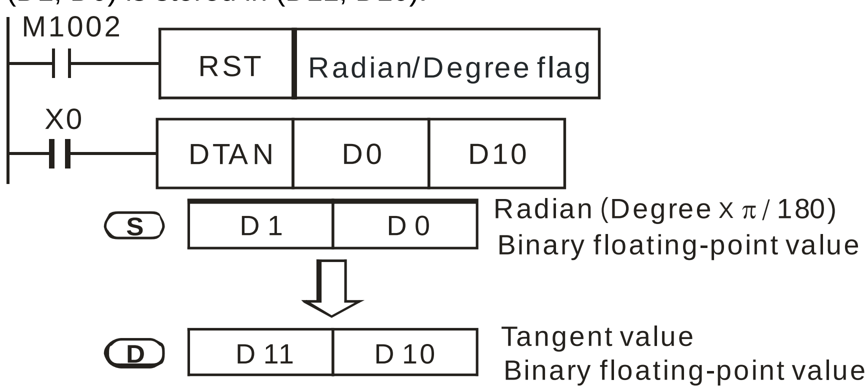
Explanation

- **S**: Source value; **D**: Tangent value
- Whether the source value in **S** is a radian or a degree depends on the state of a radian/degree flag.
- If a radian/degree flag is OFF, the source value in **S** is a radian.
  Radian=Degree×π /180.
- If a radian/degree flag is ON, the source value in **S** is a degree.
  ($0^o \leqq$ Degree $\leqq 360^0$)
- If an operation result is 0, a zero flag will be ON.
- The tangent of the source value in **S** is stored in **D**.
  The relation between radians and tangent values is shown below.



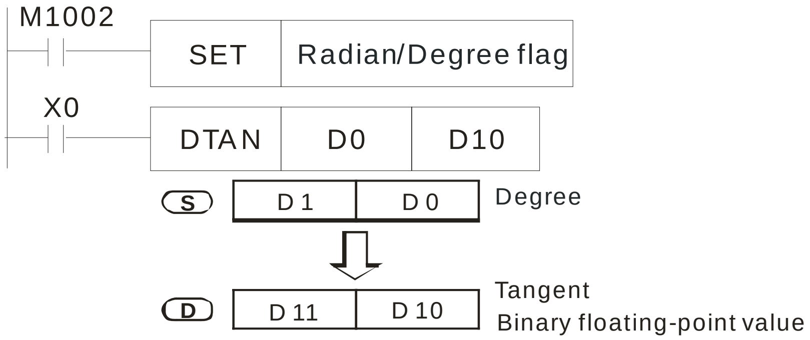
Example 1

- A radian/degree flag is reset to OFF. The binary floating-point value in (D1, D0) is a radian. When X0 is ON, the tangent of the binary floating-point value in (D1, D0) is stored in (D11, D10).



Example 2

- A radian/degree flag is set to ON. The value in (D1, D0) is a degree in the range of 0° to 360°. When X0 is ON, the tangent of the value in (D1, D0) is stored in (D11, D10). The value in (D11, D10) is a binary floating-point value.



Additional remark

- Please refer to section 5.3 for more information about performing operations on floating-point values.

API						Applicable model
133	D	ASIN	P	S D	Arcsine of a binary floating-point value	10PM ✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*								*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  Only the 32-bit instructions DASIN and DASINP are valid.
  F represents a floating-point value. There is a decimal point in a floating-point value.

16-bit instruction: - - - -

32-bit instruction (6 steps): DASIN Continuity instruction; DASINP Pulse instruction

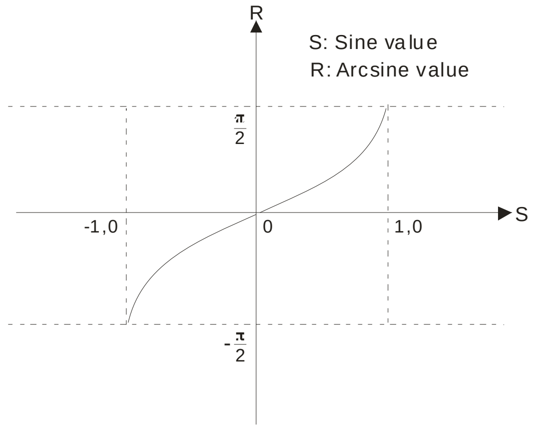
- Flags

Ox	O100	
M1808	M1968	Zero flag
M1793	M1953	Operation error flag

- Please refer to the additional remark below.

Explanation

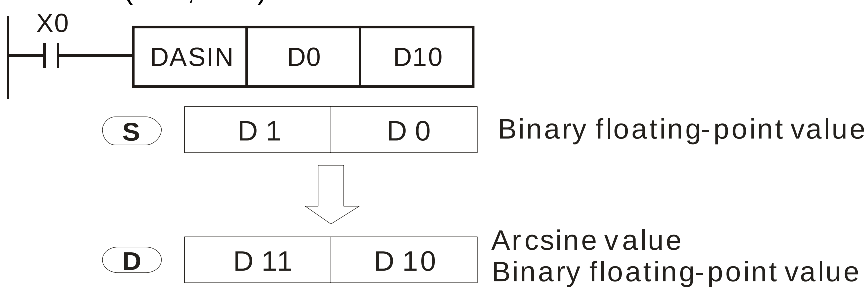
- **S**: Source value (binary floating-point value); **D**: Arcsine value
- Arcsine value=$\sin^{-1}$
  The relation between sine values and arcsine values is shown below.



- The decimal floating-point value into which the sine value in **S** is converted can only be in the range of -1.0 to +1.0. If it is not in the range, the instruction will not be executed, an operation error flag will be ON, and the error code H0E19 will appear.
- If a conversion result is 0, a zero flag will be ON.

Example

- When X0 is ON, the arcsine of the binary floating-point value in (D1, D0) is stored in (D11, D10).



Additional remark

- Please refer to section 5.3 for more information about performing operations on floating-point values.

API						Applicable model
134	D	ACOS	P	S D	Arccosine of a binary floating-point value	10PM ✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*								*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  Only the 32-bit instructions DACOS and DACOSP are valid.
  F represents a floating-point value. There is a decimal point in a floating-point value.

16-bit instruction

-	-	-	-

32-bit instruction (6 steps)

DACOS	Continuity instruction	DACOSP	Pulse instruction

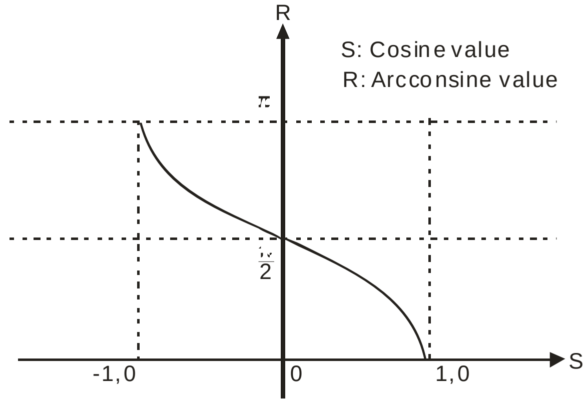
- Flags

Ox	O100	
M1808	M1968	Zero flag
M1793	M1953	Operation error flag

- Please refer to the additional remark below.

Explanation

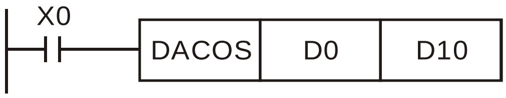
- **S**: Source value (binary floating-point value); **D**: Arccosine value
- Arccosine value=cos^{-1}
  The relation between cosine values and arccosine values is shown below.

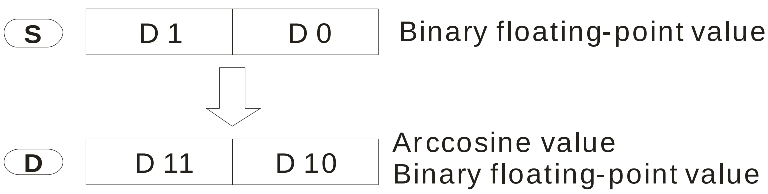


- The decimal floating-point value into which the cosine value in **S** is converted can only be in the range of -1.0 to +1.0. If it is not in the range, the instruction will not be executed, an operation error flag will be ON, and the error code H0E19 will appear.
- If a conversion result is 0, a zero flag will be ON.

Example

- When X0 is ON, the arccosine of the binary floating-point value in (D1, D0) is stored in (D11, D10).





Additional remark

- Please refer to section 5.3 for more information about performing operations on floating-point values.

API						Applicable model
135	D	ATAN	P	S D	Arctangent of a binary floating-point value	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*								*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  Only the 32-bit instrucitons DATAN and DATANP are valid.
  F represents a floating-point value. There is a decimal point in a floating-point value.

16-bit instruction

-	-	-	-

32-bit instruction (6 steps)

DATAN	Continuity instruction	DATANP	Pulse instruction

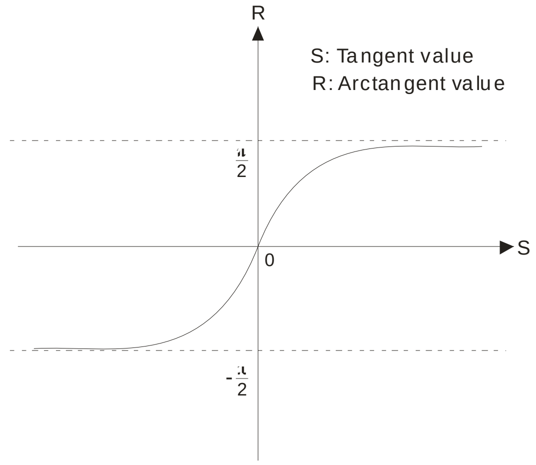
- Flags

Ox	O100	
M1808	M1968	Zero flag

- Please refer to the additional remark below.

Explanation

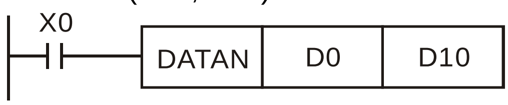
- **S**: Source value (binary floating-point value); **D**: Arctangent value
- Arctangent value=tan^{-1}
  The relation between tangent values and arctangent values is shown below.

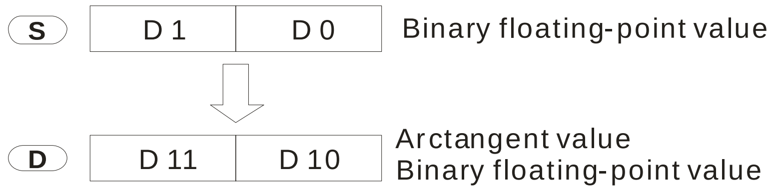


- If a conversion result is 0, a zero flag will be ON.

Example

- When X0 is ON, the arctangent of the binary floating-point value in (D1, D0) is stored in (D11, D10).





Additional remark

- Please refer to section 5.3 for more information about performing operations on floating-point values.

API						Applicable model
136	D	SINH	P	S D	Hyperbolic sine of a binary floating-point value	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*								*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  Only the 32-bit instructions DSINH and DSINHP are valid.
  F represents a floating-point value. There is a decimal point in a floating-point value.

16-bit instruction

-	-	-	-

32-bit instruction (6 steps)

DSINH	Continuity instruction	DSINHP	Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1809	M1969	Borrow flag
M1810	M1970	Carry flag

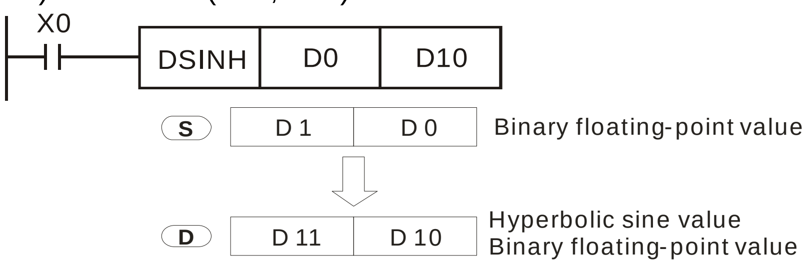
- Please refer to the additional remark below.

Explanation

- **S**: Source value (binary floating-point value); **D**: Hyperbolic sine value
- Hyperbolic sine value=$(e^{S}-e^{-S})/2$

Example

- When X0 is ON, the hyperbolic sine of the binary floating-point number in (D1, D0) is stored in (D11, D10).



- If the absolute value of a conversion result is greater than the maximum floating-point value available, a carry flag will be ON.
- If the absolute value of a conversion result is less than the minimum floating-point value available, a borrow flag will be ON.
- If a conversion result is 0, a zero flag will be ON.

Additional remark

- Please refer to section 5.3 for more information about performing operations on floating-point values.

API						Applicable model
137	D	COSH	P	S D	Hyperbolic cosine of a binary floating-point value	10PM ✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*								*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  Onlyt the 32-bit instructions DCOSH and DCOSHP are valid.
  F represents a floating-point value. There is a decimal point in a floating-point value.

16-bit instruction
- - - -

32-bit instruction (6 steps)
DCOSH Continuity instruction DCOSHP Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1809	M1969	Borrow flag
M1810	M1970	Carry flag

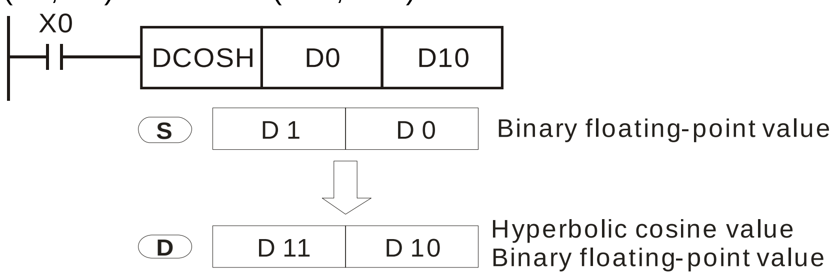
- Please refer to the additional remark below.

Explanation

- **S**: Source value (binary floating-point value); **D**: Hyperbolic cosine value
- Hyperbolic cosine value=$(e^{s}+e^{-s})/2$

Example

- When X0 is ON, the hyperbolic cosine of the binary floating-point number in (D1, D0) is stored in (D11, D10).



- If the absolute value of a conversion result is greater than the maximum floating-point value available, a carry flag will be ON.
- If the absolute value of a conversion result is less than the minimum floating-point value available, a borrow flag will be ON.
- If a conversion result is 0, a zero flag will be ON.

Additional remark

- Please refer to section 5.3 for more information about performing operations on floating-point values.

API						Applicable model
138	D	TANH	P	S D	Hyperbolic tangent of a binary floating-point value	10PM ✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*								*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  Only the 32-bit instructions DTANH and DTANHP are valid.
  F represents a floating-point value. There is a decimal point in a floating-point value.

16-bit instruction
- - - -

32-bit instruction (6 steps)
DTANH Continuity instruction DTANHP Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1809	M1969	Borrow flag
M1810	M1970	Carry flag

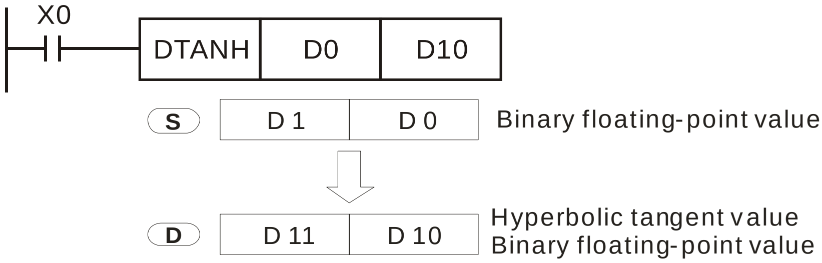
- Please refer to the additional remark below.

Explanation

- **S**: Source value (binary floating-point value); **D**: Hyperbolic tangent value
- Hyperbolic tangent value=$(e^{s}-e^{-s})/(e^{s}+e^{-s})$

Example

- When X0 is ON, the hyperbolic tangent of the binary floating-point number in (D1, D0) is stored in (D11, D10).



- If the absolute value of a conversion result is greater than the maximum floating-point value available, a carry flag will be ON.
- If the absolute value of a conversion result is less than the minimum floating-point value available, a borrow flag will be ON.
- If a conversion result is 0, a zero flag will be ON.

Additional remark

- Please refer to section 5.3 for more information about performing operations on floating-point values.

API						Applicable model
172	D	ADDR	P	S1 S2 D	Floating-point addition	10PM ✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S1													*		
S2													*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  Only the 32-bit instructions DADDR and DADDRP are valid.

16-bit instruction
- - - -

32-bit instruction (13 steps)
DADDR Continuity instruction DADDRP Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1809	M1969	Borrow flag
M1810	M1970	Carry flag

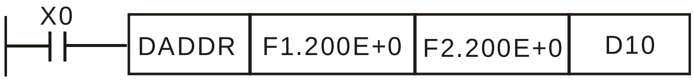
- Please refer to the additional remark below.

Explanation

- S_1: Augend; S_2: Addend; **D**: Sum
- S_1 and S_2 can be floating-point values.
- S_1 and S_2 can be floating-point values (e.g. F1.2), or data registers in which floating-point values are stored.
- If S_1 and S_2 are data registers in which floating-point values are stored, the function of API 172 DAADR is the same as the function of API 120 DEADD.
- The floating-point value in S_2 is added to the floating-point value in S_1, and the sum is stored in **D**.
- S_1 and S_2 can be the same register. If the instruction DAADR is used under the circumstances, the value in the register is added to itself whenever the conditional contact is ON in a scan cycle. Generally, the pulse instruction DADDRP is used.
- If the absolute value of an oepration result is greater than the maximum floating-point value available, a carry flag will be ON. If the absolute value of an oepration reuslt is less than the minimum floating-point value available, a borrow flag will be ON. If an operation result is 0, a zero flag will be ON.

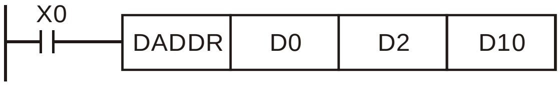
Example 1

- When X0 is ON, the floating-point value F2.200E+0 is added to the floating-point value F1.200E+0, and the sum F3.400E+0 is stored in (D11, D10). (The floating-point value F1.2 is represented by the scientific notation F1.200E+0 in a ladder diagram. The number of decimal places which are displayed can be set by means of the **View** menu in WPLSoft.)



Example 2

- When X0 is ON, the floating-point value in (D3, D2) is added to the floating-point value in (D1, D0), and the sum is stored in (D11, D10).



API		SUBR				Applicable model
173	D	SUBR	P	S1 S2 D	Floating-point subtraction	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S1													*		
S2													*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  Only the 32-bit instructions DSUBR and DSUBRP are valid.

16-bit instruction

-	-	-	-

32-bit instruction (13 steps)

DSUBR	Continuity instruction	DSUBRP	Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1809	M1969	Borrow flag
M1810	M1970	Carry flag

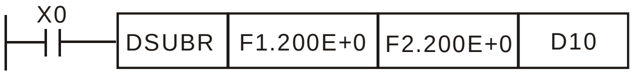
- Please refer to the additional remark below.

Explanation

- **S₁**: Minuend; **S₂**: Subtrahend; **D**: Subtrahend
- **S₁** and **S₂** can be floating-point values
- **S₁** and **S₂** can be floating-point values (e.g. F1.2), or data registers in which floating-point values are stored.
- If **S₁** and **S₂** are data registers in which floating-point values are stored, the function of API 172 DSUBR is the same as the function of API 121 DESUB.
- The floating-point value in **S₂** is subtracted from the floating-point value in **S₁**, and the difference is stored in **D**.
- **S₁** and **S₂** can be the same register. If the instruction DSUBR is used under the circumstances, the value in the register is subtracted from itself whenever the conditional contact is ON in a scan cycle. Generally, the pulse instruction DSUBRP is used.
- If the absolute value of an oepration result is greater than the maximum floating-point value available, a carry flag will be ON. If the absolute value of an oepration reuslt is less than the minimum floating-point value available, a borrow flag will be ON. If an operation result is 0, a zero flag will be ON.

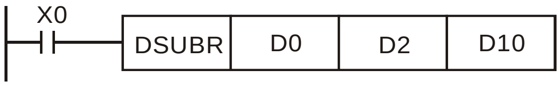
Example 1

- When X0 is ON, the floating-point value F2.200E+0 is subtracted from the floating-point value F1.200E+0, and the difference F-1.000E+0 is stored in (D11, D10). (The floating-point value F1.2 is represented by the scientific notation F1.200E+0 in a ladder diagram. The number of decimal places which are displayed can be set by means of the **View** menu in WPLSoft.)



Example 2

- When X0 is ON, the floating-point value in (D3, D2) is subtracted from the floating-point value in (D1, D0), and the difference is stored in (D11, D10).



API	D	MULR	P	S1 S2 D	Floating-point multiplication	Applicable model
174						10PM
						✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S1													*		
S2													*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  Only the 32-bit instructions DSUBR and DSUBRP are valid.

16-bit instruction
- - - -

32-bit instruction (13 steps)
DMULR Continuity instruction DMULRP Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1809	M1969	Borrow flag
M1810	M1970	Carry flag

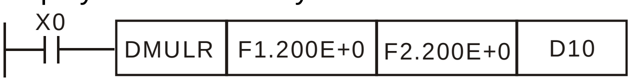
- Please refer to the additional remark below.

Explanation

- **S1**: Multiplicand; **S2**: Multiplier; **D**: Product
- **S1** and **S2** can be floating-point values.
- **S1** and **S2** can be floating-point values (e.g. F1.2), or data registers in which floating-point values are stored.
- If **S1** and **S2** are data registers in which floating-point values are stored, the function of API 172 DMULR is the same as the function of API 122 DEMUL.。
- The floating-point value in **S1** is multiplied by the floating-point value in **S2**, and the product is stored in **D**.
- **S1** and **S2** can be the same register. If the instruction DSUBR is used under the circumstances, the value in the register is multiplied by itself whenever the conditional contact is ON in a scan cycle. Generally, the pulse instruction DMULRP is used.
- If the absolute value of an oepration result is greater than the maximum floating-point value available, a carry flag will be ON. If the absolute value of an oepration reuslt is less than the minimum floating-point value available, a borrow flag will be ON. If an operation result is 0, a zero flag will be ON.

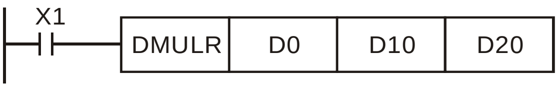
Example 1

- When X0 is ON, the floating-point value F1.200E+0 is multiplied by the floating-point value F2.200E+0, and the product F2.640E+0 is stored in (D11, D10). (The floating-point value F1.2 is represented by the scientific notation F1.200E+0 in a ladder diagram. The number of decimal places which are displayed can be set by means of the **View** menu in WPLSoft.)



Example 2

- When X1 is ON, the floating-point value in (D1, D0) is multiplied by the floating-point value in (D11, D10), and the product is stored in (D21, D20).



API						Applicable model
175	D	DIVR	P	S1 S2 D	Floating-point division	10PM ✓

	Bit device				Word device										
	X	Y	M	S	F	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S1													*		
S2													*		
D													*		

- Note: Please refer to specifications for more information about device ranges.
  Only the 32-bit instructions DSUBR and DSUBRP are valid.

16-bit instruction

\- - - -

32-bit instruction (13 steps)

DDIVR Continuity instruction DDIVP Pulse instruction

- Flags

Ox	O100	
M1808	M1968	Zero flag
M1809	M1969	Borrow flag
M1810	M1970	Carry flag

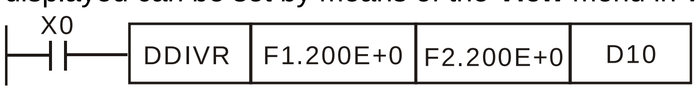
- Please refer to the additional remark below.

Explanation

- $\mathbf{S_1}$: Dividend; $\mathbf{S_2}$: Divisor; **D**: Quotient
- $\mathbf{S_1}$ and $\mathbf{S_2}$ can be floating-point values.
- $\mathbf{S_1}$ and $\mathbf{S_2}$ can be floating-point values (e.g. F1.2), or data registers in which floating-point values are stored.
- If $\mathbf{S_1}$ and $\mathbf{S_2}$ are data registers in which floating-point values are stored, the function of API 172 DDIVR is the same as the function of API 123 DEDIV.
- The floating-point value in $\mathbf{S_1}$ is divided by the floating-point value in $\mathbf{S_2}$, and the product is stored in **D**.
- $\mathbf{S_1}$ and $\mathbf{S_2}$ can be the same register. If the instruction DSUBR is used under the circumstances, the value in the register is divided by itself whenever the conditional contact is ON in a scan cycle. Generally, the pulse instruction DDIVRP is used.
- If the absolute value of an oepration result is greater than the maximum floating-point value available, a carry flag will be ON. If the absolute value of an oepration reuslt is less than the minimum floating-point value available, a borrow flag will be ON. If an operation result is 0, a zero flag will be ON.

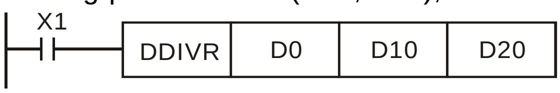
Example 1

- When X0 is ON, the floating-point value F1.200E is divided by the floating-point value F2.200E+0, and the quotient F0.545E+0 is stored in (D11, D10). (The floating-point value F1.2 is represented by the scientific notation F1.200E+0 in a ladder diagram. The number of decimal places which are displayed can be set by means of the **View** menu in WPLSoft.)



Example 2

- When X1 is ON, the floating-point value in (D1, D0) is divided by the floating-point value in (D11, D10), and the quotient is stored in (D21, D20).



API						Applicable model
215~217	D	LD #		S1 S2	Logical operation	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*	*	*	*	*	*	*	*	*	*	*
S_2					*	*	*	*	*	*	*	*	*	*	*

- Note: # represents &, |, or ^.

  Please refer to specifications for more information about device ranges.

16-bit instruction (5 steps)

LD # Continuity instruction - -

32-bit instruction (7 steps)

DLD # Continuity instruction - -

- Flag: None

Explanation

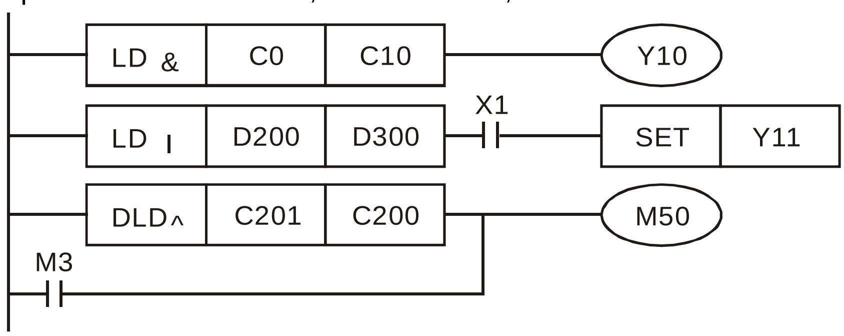
- S_1: Source device 1; S_2: Source device 2
- The instruction is used to compare the value in S_1 with that in S_2. If the comparison result is not 0, the condition of the instruction is met. If the comparison result is 0, the condition of the instruction is not met.
- The instruction LD# can be connected to a busbar directly.

API No.	16-bit instruction	32-bit instruction	ON	OFF
215	LD&	**D**LD&	S_1 & S_2 ≠ 0	S_1 & S_2 = 0
216	LD|	**D**LD|	S_1 | S_2 ≠ 0	S_1 | S_2 = 0
217	LD^	**D**LD^	S_1 ^ S_2 ≠ 0	S_1 ^ S_2 = 0

- &: Logical AND operation
- |: Logical OR operation
- ^: Logical exclusive OR operation
- If a 32-bit counter is used, the 32-bit insturciton DLD# must be used. If a 32-bit counter and the 16-bit instruction LD# are used, a program error will occur, and the ERROR LED indicator on the DVP-10PM series motion controller used will blink. (C200~C255 are 32-bit counters.)

Example

- A logical AND operator takes the values in C0 and C10, and performs the logical AND operation on each pair of corresponding bits. If the operation result is not 0, Y10 will be ON.
- A logical OR operator takes the values in D200 and D300, and performs the logical OR operation on each pair of corresponding bits. If the operation result is not 0 and X1 is ON, Y11 will be set to ON.
- A logical operator XOR takes the values in C201 and C200, and performs the logical exclusive OR operation on each pair of corresponding bits. If the operation result is not 0, or if M3 is ON, M50 will be ON.



API						Applicable model
218~220	D	AND #		S1 S2	Logical operation	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*	*	*	*	*	*	*	*	*	*	*
S_2					*	*	*	*	*	*	*	*	*	*	*

- Note: # represents &, |, or ^.

  Please refer to specifications for more information about device ranges.

16-bit instruction (5 steps)

AND #	Continuity instruction	-	-

32-bit instruction (7 steps)

DAND #	Continuity instruction	-	-

- Flag: None

Explanation

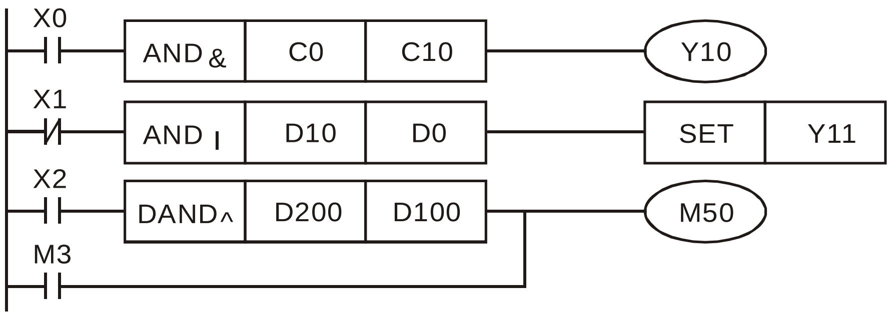
- **S_1**: Source device 1; **S_2**: Source device 2
- The instruction is used to compare the value in **S_1** with that in **S_2**. If the comparison result is not 0, the condition of the instruction is met. If the comparison result is 0, the condition of the instruction is not met.
- The instruction AND# is connected to a contact in series.

API No.	16-bit instruction	32-bit instruction	ON	OFF
218	AND&	**D**AND&	S_1 & S_2 $\neq 0$	S_1 & S_2 $=0$
219	AND|	**D**AND|	S_1 | S_2 $\neq 0$	S_1 | S_2 $=0$
220	AND^	**D**AND^	S_1 ^ S_2 $\neq 0$	S_1 ^ S_2 $=0$

- &: Logical AND operation
- |: Logical OR operation
- ^: Logical exclusive OR operation
- If a 32-bit counter is used, the 32-bit instruction DAND# must be used. If a 32-bit counter and the 16-bit instruction AND# are used, a program error will occur, and the ERROR LED indicator on the DVP-10PM series motion controller used will blink. (C200~C255 are 32-bit counters.)

Example

- When X0 is ON, a logical AND operator takes the values in C0 and C10, and performs the logical AND operation on each pair of corresponding bits. If the operation result is not 0, Y10 will be set to ON.
- When X1 is OFF, a logical OR operator takes the values in D10 and D0, and performs the logical OR operation on each pair of corresponding bits. If the operation result is not 0, Y1 will be set to ON.
- When X2 is ON, a logical XOR operator takes the values in (D201, D200) and (D101, D100), and performs the logical exclusive OR operation on each pair of corresponding bits. If the operation result is not 0, or if M3 is ON, M50 will be ON.



API			Applicable model
221~223 D OR #	S1 S2	Logical operation	10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*	*	*	*	*	*	*	*	*	*	*
S_2					*	*	*	*	*	*	*	*	*	*	*

- Note: # represents &, |, or ^.
  Please refer to specifications for more information about device ranges.

16-bit instruction (5 steps)
OR # Continuity instruction - -

32-bit instruction (7 steps)
DOR # Continuity instruction - -

- Flag: None

Explanation

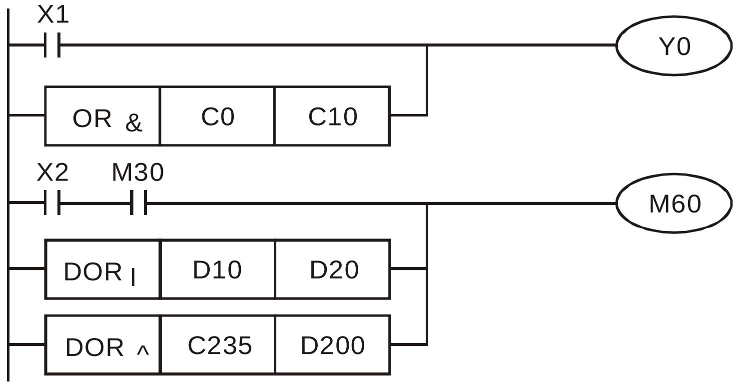
- $\mathbf{S_1}$: Source device 1; $\mathbf{S_2}$: Source device 2
- The instruction is used to compare the value in $\mathbf{S_1}$ with that in $\mathbf{S_2}$. If the comparison result is not 0, the condition of the instruction is met. If the comparison result is 0, the condition of the instruction is not met.
- The instruction OR# is connected to a contact in parallel.

API No.	16-bit instruction	32-bit instruction	ON	OFF
221	OR&	DOR&	S_1 & S_2 $\neq 0$	S_1 & S_2 $= 0$
222	OR|	DOR|	S_1 | S_2 $\neq 0$	S_1 | S_2 $= 0$
223	OR^	DOR^	S_1 ^ S_2 $\neq 0$	S_1 ^ S_2 $= 0$

- &: Logical AND operation
- |: Logical OR operation
- ^: Logical exclusive OR operation
- If a 32-bit counter is used, the 32-bit instruction DOR# must be used. If a 32-bit counter and the 16-bit instruction OR# are used, a program error will occur, and the ERROR LED indicator on the DVP-10PM series motion controller used will blink. (C200~C255 are 32-bit counters.)

Example

- When X1 is ON, Y0 is ON. Besides, when a logical AND operator performs the logical AND operation on each pair of corresponding bits in C0 and C10, and the operation result is not 0, Y0 is ON.
- When X2 and M30 are ON, M60 is ON. When a logical OR operator performs the logical OR operation on each pair of corresponding bits in the 32-bit register (D11, D10) and the 32-bit register (D21, D20), and the operation result is not 0, M60 is ON. Besides, when the logical XOR operator performs the logical exclusive OR operation on each pair of corresponding bits in the 32-bit counter C235 and the 32-bit register (D201, D200), and the operation result is not 0, M60 is ON.



API						Applicable model
224~230	D	LD※		S1 S2	Comparing values	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*	*	*	*	*	*	*	*	*	*	*
S_2					*	*	*	*	*	*	*	*	*	*	*

- Note: ※ represents =, >, <, <>, ≦ , or ≧

  Please refer to specifications for more information about device ranges.

16-bit instruction (5 steps)

LD※ Continuity instruction - -

32-bit instruction (7 steps)

DLD※ Continuity instruction - -

- Flag: None

Explanation

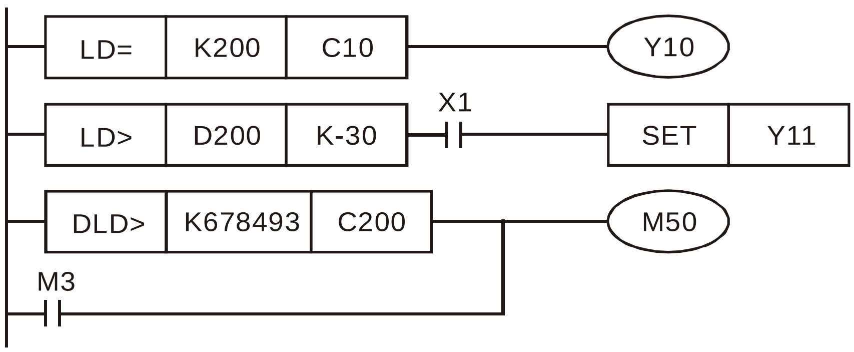
- **S_1**: Source device 1; **S_2**: Source device 2
- The instruction is used to compare the value in **S_1** with that in **S_2**. Take the instruction LD= for instance. If the comparison result is that the value in **S_1** is equal to that in **S_2**, the condition of the instruction is met. If the comparison result is that the value in **S_1** is not equal to that in **S_2**, the condition of the instruction is not met.
- The instruction LD※ can be connected to a busbar directly.

API No.	16-bit instruction	32-bit instruction	ON	OFF
224	LD =	**D**LD =	**$S_1 = S_2$**	**$S_1 \neq S_2$**
225	LD >	**D**LD >	**$S_1 > S_2$**	**$S_1 \leqq S_2$**
226	LD <	**D**LD <	**$S_1 < S_2$**	**$S_1 \geqq S_2$**
228	LD < >	**D**LD < >	**$S_1 \neq S_2$**	**$S_1 = S_2$**
229	LD < =	**D**LD < =	**$S_1 \leqq S_2$**	**$S_1 > S_2$**
230	LD > =	**D**LD > =	**$S_1 \geqq S_2$**	**$S_1 < S_2$**

- If a 32-bit counter is used, the 32-bit insturciton DLD※ must be used. If a 32-bit counter and the 16-bit instruction LD※ are used, ,a program error will occur, and the ERROR LED indicator on the DVP-10PM series motion controller used will blink. (C200~C255 are 32-bit counters.)

Example

- When the value in C10 is equal to K200, Y10 is ON.
- When the value in D200 is greater than K-30, and X1 is ON, Y11 is set to ON.
- When the value in C200 is less than K678,493, or when M3 is ON, M50 is ON.



API				Applicable model
232~238	D AND※	S1 S2	Comparing values	10PM
				✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*	*	*	*	*	*	*	*	*	*	*
S_2					*	*	*	*	*	*	*	*	*	*	*

- Note: ※ represents =, >, <, <>, ≦ , or ≧

  Please refer to specifications for more information about device ranges.

16-bit instruction (5 steps)

AND※	Continuity instruction	-	-

32-bit instruction (7 steps)

DAND※	Continuity instruction	-	-

- Flag: None

Explanation

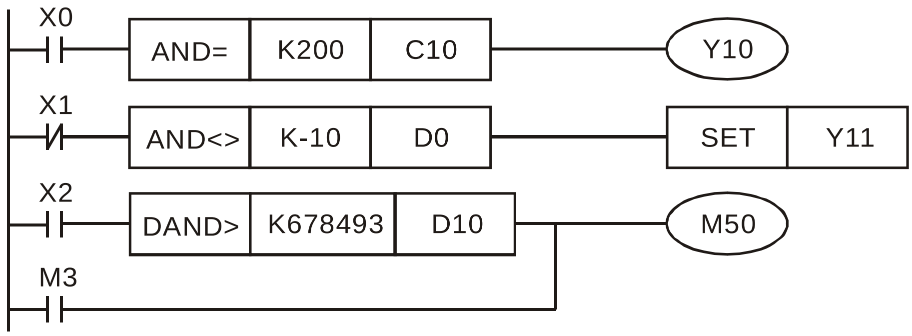
- **S_1**: Source device 1; **S_2**: Source device 2
- The instructions are used to compare the value in **S_1** with that in **S_2**. Take the instruction AND= for instance. If the comparison result is that the value in **S_1** is equal to that in **S_2**, the condition of the instruction is met. If the comparison result is that the value in **S_1** is not equal to that in **S_2**, the condition of the instruction is not met.
- The instruction AND※ is connected to a contact in series.

API No.	16-bit instruction	32-bit instruction	ON	OFF
232	AND =	**D**AND =	**$S_1 = S_2$**	**$S_1 \neq S_2$**
233	AND >	**D**AND >	**$S_1 > S_2$**	**$S_1 \leqq S_2$**
234	AND <	**D**AND <	**$S_1 < S_2$**	**$S_1 \geqq S_2$**
236	AND < >	**D**AND < >	**$S_1 \neq S_2$**	**$S_1 = S_2$**
237	AND < =	**D**AND < =	**$S_1 \leqq S_2$**	**$S_1 > S_2$**
238	AND > =	**D**AND > =	**$S_1 \geqq S_2$**	**$S_1 < S_2$**

- If a 32-bit counter is used, the 32-bit insturciton DAND※ must be used. If a 32-bit counter and the 16-bit instruction AND※ are used, ,a program error will occur, and the ERROR LED indicator on the DVP-10PM series motion controller used will blink. (C200~C255 are 32-bit counters.)

Example

- When X0 is ON and the present value in C10 is equal to K200, Y10 is ON.
- When X1 is OFF and the value in D0 is not equal to K-10, Y11 is set to ON.
- When X2 is ON and the value in (D11, D10) is less than 678,493, or when M3 is ON, M50 is ON.



API						Applicable model
240~246	D	OR※		S1 S2	Comparing values	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*	*	*	*	*	*	*	*	*	*	*
S_2					*	*	*	*	*	*	*	*	*	*	*

- Note: ※ represents =, >, <, <>, ≦ , or ≧

  Please refer to specifications for more information about device ranges.

16-bit instruction (5 steps)			
OR※	Continuity instruction	-	-

32-bit instruction (7 steps)			
DOR※	Continuity instruction	-	-

- Flag: None

Explanation

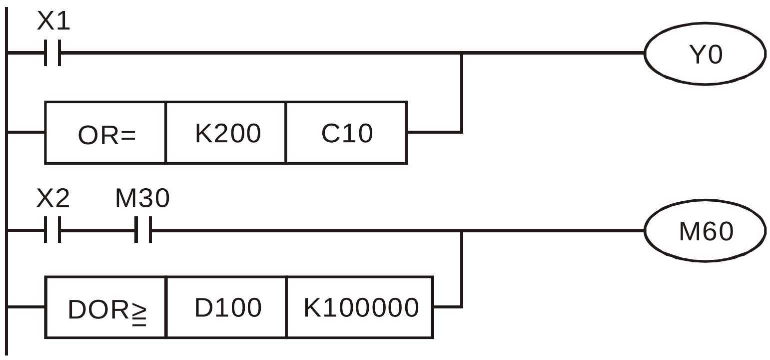
- S_1: Source device 1; S_2: Source device 2
- The instructions are used to compare the value in S_1 with that in S_2. Take the instruction OR= for instance. If the comparison result is that the value in S_1 is equal to that in S_2, the condition of the instruction is met. If the comparison result is that the value in S_1 is not equal to that in S_2, the condition of the instruction is not met.
- The instruction OR※ is connected to a contact in parallel.

API No.	16-bit instruction	32-bit instruction	ON	OFF
240	OR =	DOR =	$S_1 = S_2$	$S_1 \neq S_2$
241	OR >	DOR >	$S_1 > S_2$	$S_1 \leqq S_2$
242	OR <	DOR <	$S_1 < S_2$	$S_1 \geqq S_2$
244	OR < >	DOR < >	$S_1 \neq S_2$	$S_1 = S_2$
245	OR < =	DOR < =	$S_1 \leqq S_2$	$S_1 > S_2$
246	OR > =	DOR > =	$S_1 \geqq S_2$	$S_1 < S_2$

- If a 32-bit counter is used, the 32-bit insturciton DOR※ must be used. If a 32-bit counter and the 16-bit instruction OR※ are used, ,a program error will occur, and the ERROR LED indicator on the DVP-10PM series motion controller used will blink. (C200~C255 are 32-bit counters.)

Example

- When X1 is ON, or when the present value in C10 is equal to K200, Y0 is ON.
- When X2 and M30 are ON, or when the value in (D101, D100) is greater than or equal to K100,000, M60 is ON.



API						
147	D	SWAP	P	(S)	Interchanging the high byte in a device with the low byte in the device	Applicable model 10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S							*	*	*	*	*	*	*	*	*

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)

  Please refer to specifications for more information about device ranges.

  If KnX/KnY/KnM/KnS is used, it is suggested that X/devices/Y devices/M device numbers/S device numbers should start from a number which is a multiple of 16 in the octal numeral system or in the decimal numeral system, e.g. K1X0 (octal numeral system), K4SY20 (octal numeral system), K1M0 (decimal numeral system), and K4S16 (decimal numeral system).

16-bit instruction (5 steps)

SWAP Continuity instruction SWAPP Pulse instruction

32-bit instruction (7 steps)

DSWAP Continuity instruction DSWAPP Pulse instruction

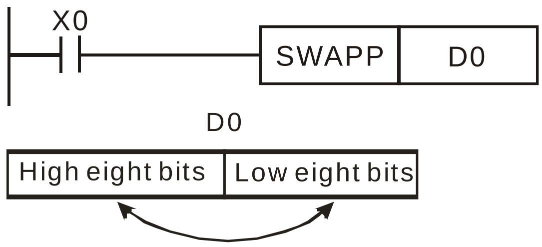
- Flag: None

Explanation

- **S**: Source device
- When the 16-bit instruction is executed, the high eight bits in **S** are interchanged with the low eight bits in **S**.
- When the 32-bit instruction is executed, the high eight bits in **S** are interchanged with the low eight bits in **S**, and the high eight bits in **S**+1 are interchanged with the low eight bits in **S**+1.
- Generally, the pulse instructions SWAPP and DSWAPP are used.

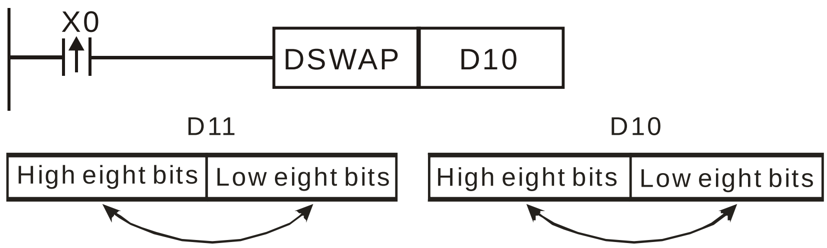
Example 1

- When X0 is ON, the high byte in D0 is interchanged with the low byte in D0.



Example 2

- When X0 is ON, the high eight bits in D11 are interchanged with the low eight bits in D11, and the high eight bits in D10 are interchanged with the low eight bits in D10.



API						
154	D	RAND	P	S1 S2 D	Random value	Applicable model: 10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*	*	*	*	*	*	*	*	*	*	*
S_2					*	*	*	*	*	*	*	*	*	*	*
D								*	*	*	*	*	*	*	*

- Note: The instruction supports V devices and Z devices. (If the 16-bit instruction is used, Z devices can not be used. If the 32-bit instruction is used, V devices can not be used.)

  Please refer to specifications for more information about device ranges.

  If KnX/KnY/KnM/KnS is used, it is suggested that X/devices/Y devices/M device numbers/S device numbers should start from a number which is a multiple of 16 in the octal numeral system or in the decimal numeral system, e.g. K1X0 (octal numeral system), K4SY20 (octal numeral system), K1M0 (decimal numeral system), and K4S16 (decimal numeral system).

16-bit instruction (5 steps)

RAND	Continuity instruction	RANDP	Pulse instruction

32-bit instruction (7 steps)

DRAND	Continuity instruction	DRANDP	Pulse instruction

- Flag: None

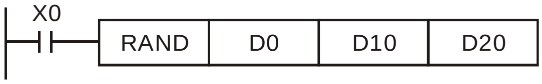
Explanation

- **S_1**: Minimum random value; **S_2**: Maximum random value; **D**: Result
- 16-bit instruction: The value in **S_1** and the value in **S_2** are in the range of K0 to K32,767.

  32-bit instruction: The value in **S_1** and the value in **S_2** are in the range of K0 to K2,147,483,647.
- The value in **S_1** must be less than the value in **S_2**. If the value in **S_1** is greater than the value in **S_2**, an operation error will occur.

Example

- When X0 is ON, the instruction RAND is used to generate a random value in the range of the value in D0 to the value in D10, and the random value is stored in D20.



API		SCAL	P	S1 S2 S3 D	Scale	Applicable model
202						10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*	*							*		
S_2					*	*							*		
S_3					*	*							*		
D													*		

- Note: Please refer to specifications for more information about device ranges.

16-bit instruction (9 steps)

SCAL	Continuity instruction	SCALP	Pulse instruction

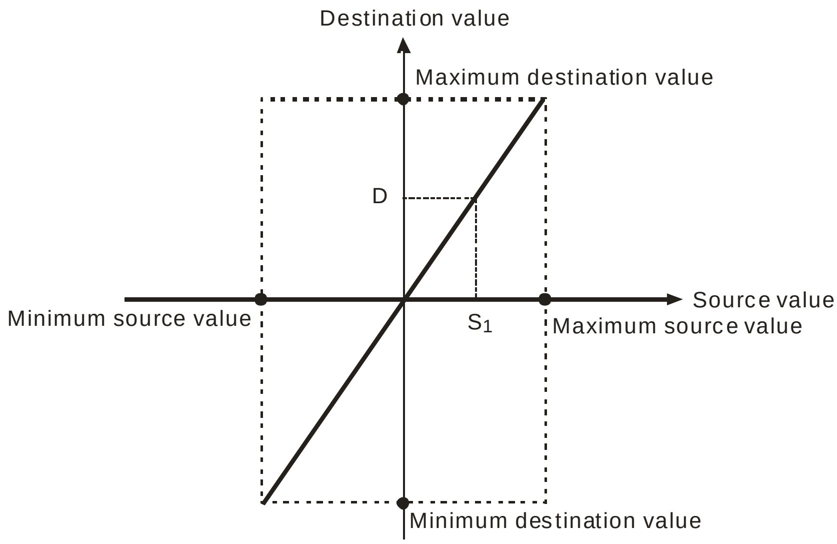
32-bit instruction (7 steps)

-	-	-	-

- Flag: None

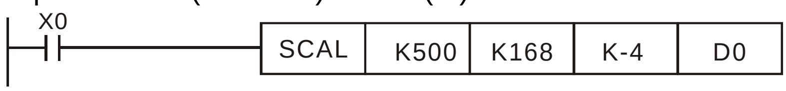
Explanation

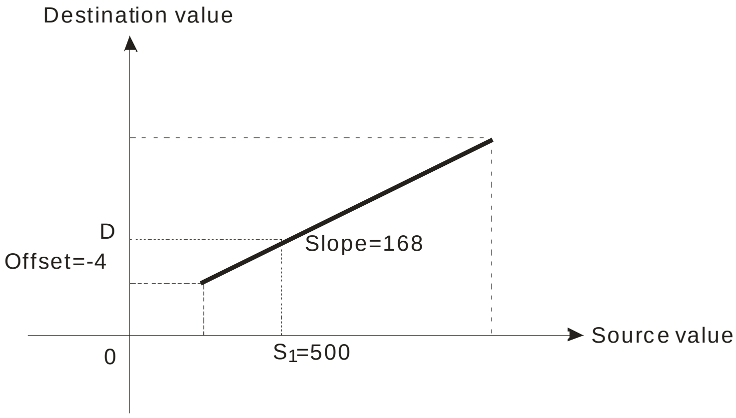
- **S_1**: Source device; **S_2**: Slope (Unit: 0.001); **S_3**: Offset; **D**: Destination device
- The values in **S_1**, **S_2**, and **S_3** must be in the range of -32767 to 32767.
- Equation: **D**=(**S_1**×**S_2**)÷1000+**S_3**
- To obtain the value in **S_2**, users have to use the slope equation below, round the result to the nearest integer, and get a 16-bit integer. To obtain the value in **S_3**, the users have to use the offset equation below, round the result to the nearest integer, and get a 16-bit integer.
- Slope equation: **S_2**=[(Maximum destination value–Minimum destination value)÷(Maximum source value–Minimum source value)]×1,000
- Offset equation: **S_3**= Minimum destination value–Minimum source value×**S_2**÷1,000
- Output curve



Example 1

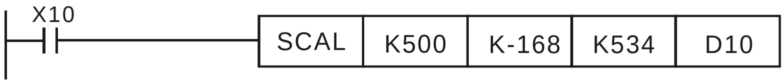
- Suppose the values in **S_1**, **S_2**, and **S_3** are 500, 168, and -4 respectively. When X0 is ON, the instruction SCAL is executed, and a scale is stored in D0.
- Equation: D0=(500×168)÷1000+(-4)=80

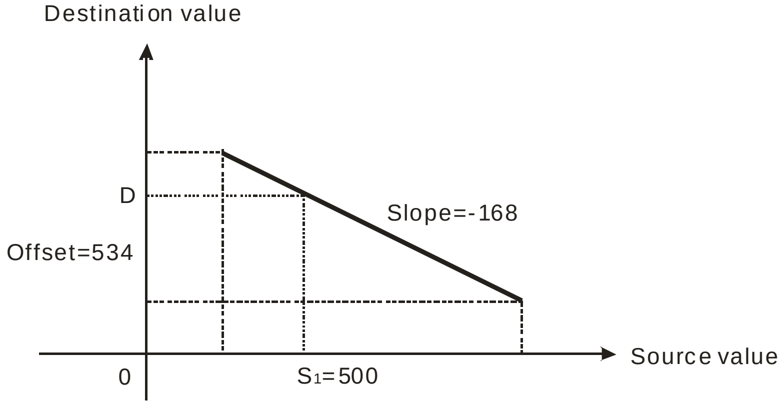




Example 2

- Suppose the values in **S_1**, **S_2**, and **S_3** are 500, -168, and 534 respectively. When X10 is ON, the instruction SCAL is executed, and a scale value is stored in D10.
- Equation: D10=(500×-168)÷1000+534=450





Additional remark

- Only when a slope and an offset are known can the instruction SCAL be used. If a slope and an offset are unknown, it is suggested that users should use the instruction SCLP.
- The value in **S_2** must be in the range of –32,768 to 32,767 (The actual value in **S_2** must be in the range of –32,768 to 32,767.) If the value in **S_2** is not in the range, please use the instruction SCLP instead.
- If users use the slop equation above, the maximum source value must be greater than the minimum source value, and the maximum destination value do not have to be greater than the minimum destination value.
- If the value in **D** is greater than 32,767, the value stored in **D** will be 32,767. If the value in **D** is less than -32,768, the value stored in **D** will be -32,768.

API						Applicable model
203	D	SCLP	P	S1 S2 D	Parameter scale	10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S_1					*	*							*		
S_2					*	*							*		
S_3					*	*							*		
D													*		

- Note: Please refer to specifications for more information about device ranges.

16-bit instruction (7 steps)
SCLP Continuity instruction SCLPP Pulse instruction

32-bit instruction (13 steps)
DSCLP Continuity instruction DSCLPP Pulse instruction

- Flag: M1162

Explanation

- **S_1**: Source device; **S_2**: Parameter (Unit: 0.001); **D**: Destination device
- 16-bit instruction: The setting of **S_2** is described below.

Device number	Parameter	Setting range
S_2	Maximum source value	-32768~32767
S_2+1	Minimum source value	-32768~32767
S_2+2	Maximum destination value	-32768~32767
S_2+3	Minimum destination value	-32768~32767

- If the 16-bit instruction is used, **S_2** will occupy four consecutive devices.
- 32-bit instruction: The setting of **S_2** is decribed below.

Device number	Parameter	Setting range	
		Integer	Floating-point value
S_2, **S_2**+1	Maximum source value	-2,147,483,648~ 2,147,483,647	32-bit floating-point values available
S_2+2, **S_2**+3	Minimum source value		
S_2+4, **S_2**+5	Maximum destination value		
S_2+6, **S_2**+7	Minimum destination value		

- If the 32-bit instruction is used, **S_2** will occupy eight consecutive devices.
- Equation: **D**=[(**S_1**–Minimum source value)×(Maximum destination value–Minimum destination value)]÷(Maximum source value–Minimum source value)+Minimum destination value
- Relation between the source value in **S_1** and the destination value in **D**:

  y=kx+b

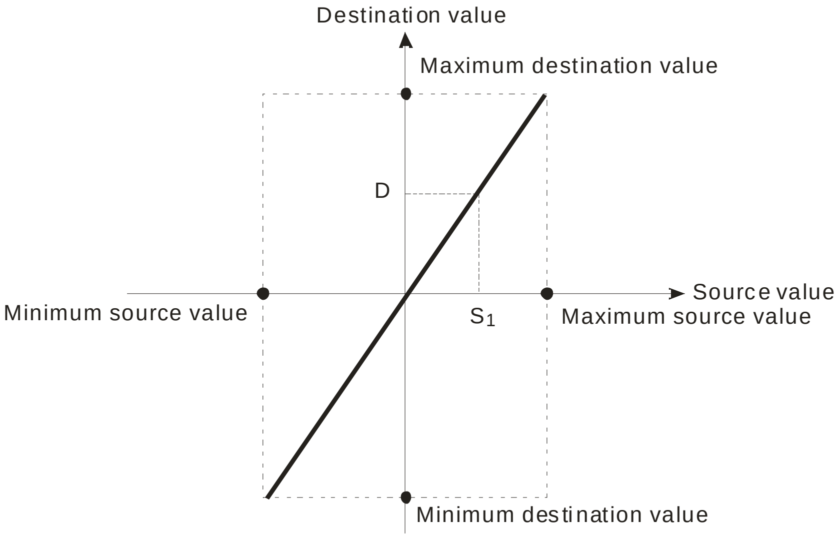
  y=Destination value (**D**)

  k=Slope=(Maximum destination value–Minimum destination value)÷(Maximum source value–Minimum source value)

  x=Source value (**S_1**)

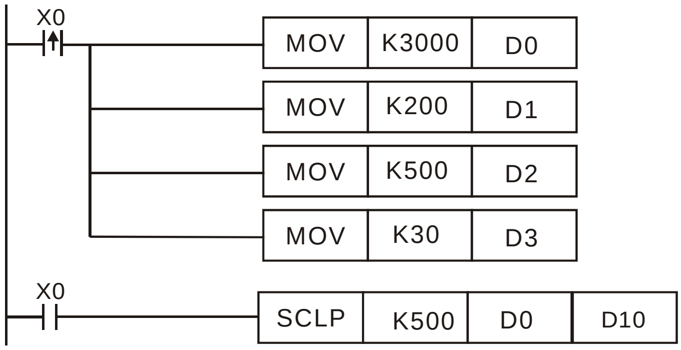
  b=Offset =Minimum destination value–Minimum source value×Slope
- After the parameters above are substituted for y, k, x, and b in the equation y=kx+b, the equation below will be obtained.

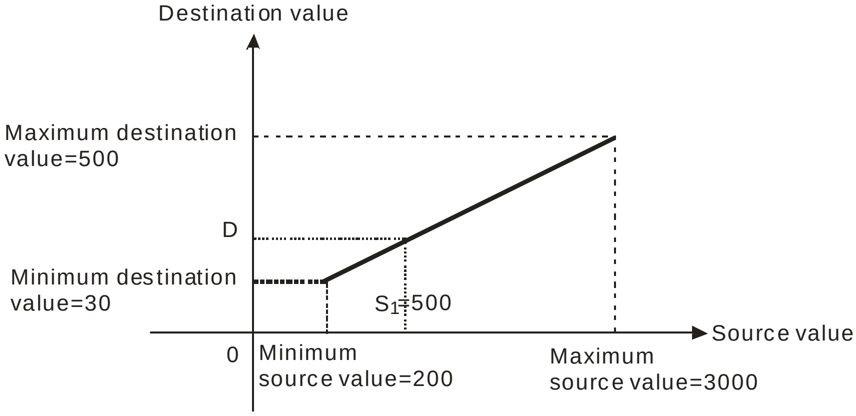
  y=kx+b=**D**=k**S_1**+b=Slope×**S_1** + Offset = Slope×**S_1** + Minimum destination value–Minimum source value×Slope=Slope×(**S_1**–Minimum source value) + Minimum destination value =(**S_1**–Minimum source value)×(Maximum destination value–Minimum destination value)÷(Maximum source value–Minimum source value) + Minimum destination value
- If the value in **S_1** is greater than the maximum source value, the value in **S_1** will be equal to the maximum source value. If the value in **S_1** is less than the minimum source value, the value in **S_1** will be equal to the minimum source value. After input values and parameters are set, an output curve will be gotten.



Example 1

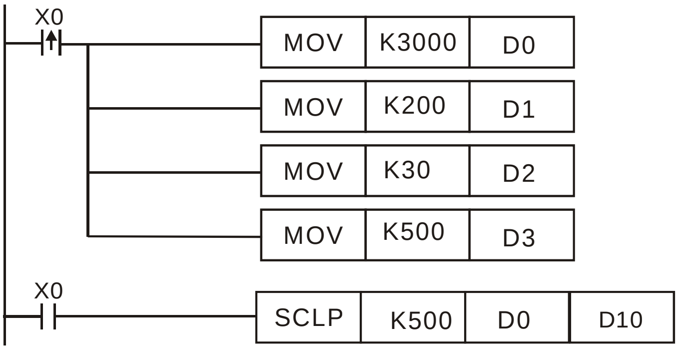
- Suppose the value in $\mathbf{S_1}$ is 500, the maximum source value in D0 is 3,000, the minimum source value in D1 is 200, the maximum destination value in D2 is 500, and the minimum destination value in D3 is 30. When X0 is ON, the instruction SCLP is executed, and a scale is stored in D10.
- Equation: D10=[(500–200)×(500–30)]÷(3,000–200)+30=80.35
  80.35 is rounded to the nearest integer, and becomes 80. 80 is stored in D10.

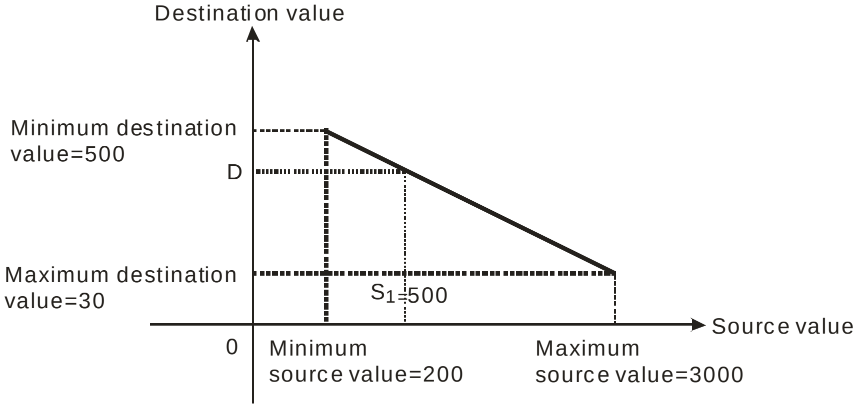




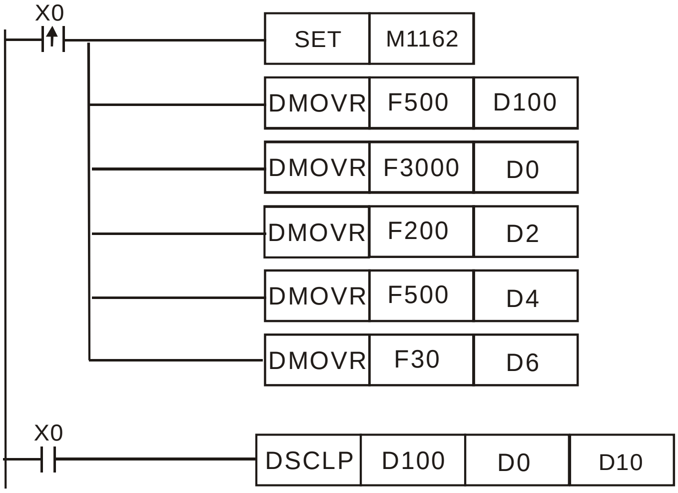
Example 2

- Suppose the value in $\mathbf{S_1}$ is 500, the maximum source value in D0 is 3,000, the minimum source value in D1 is 200, the maximum destination value in D2 is 30, and the minimum destination value in D3 is 500. When X0 is ON, the instruction SCLP is executed, and a scale is stored in D10.
- Eequation: D10=[(500–200)×(30–500)]÷(3,000–200)+500=449.64
  449.64 is rounded to the nearest integer, and becomes 450. 450 is stored in D10.





- Suppose S_1 is D100, the value in D100 is F500, the maximum source value in D0 is F3000, the minimum source value in D2 is F200, the maximum destination value in D4 is F500, and the minimum destination value in D6 is F30. When X0 is ON, M1162 is set to ON, the instruction DSCLP is executed, and a scale is stored in D10.
- Equation: D10=[(F500–F200)×(F500–F30)]÷(F3000–F200)+F30=F80.35
  F80.35 is rounded to the nearest integer, and becomes F80. F80 is stored in D10.



Additional remark

- 16-bit instruction: The value in S_1 is in the range of the minimum source value and the maximum source value, i.e. the value in S_1 is in the range of -32,768 to 32,767. If the value in S_1 exceeds the minimum source value/the maximum source value, the minimum source value/the maximum source value will be used.
- 32-bit instruction: The integer in S_1 is in the range of the minimum source value and the maximum source value, i.e. the integer in S_1 is in the range of -2,147,483,648 to 2,147,483,647. If the integer in S_1 exceeds the minimum source value/the maximum source value, the minimum source value/the maximum source value will be used.
- 32-bit instruction: The floating-point value in S_1 is in the range of the minimum source value and the maximum source value, i.e. the floating-point value in S_1

is a 32-bit floating-point value available. If the floating-point value in **S_1** exceeds the minimum source value/the maximum source value, the minimum source value/the maximum source value will be used.

- If users use the instruction, the maximum source value must be greater than the minimum source value, and the maximum destination value does not have to be greater than the minimum destination value.

API 256	CJN	P	S	Negated conditional jump	Applicable model: 10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z

- Note: The operand S can be a pointer.
  S is in the rage of P0~P255.
  A pointer can not be modified by a V device or a Z device.

16-bit instruction (3 steps)

CJN	Continuity instruction	CJNP	Pulse instruction

32-bit instruction

-	-	-	-

- Flag: None

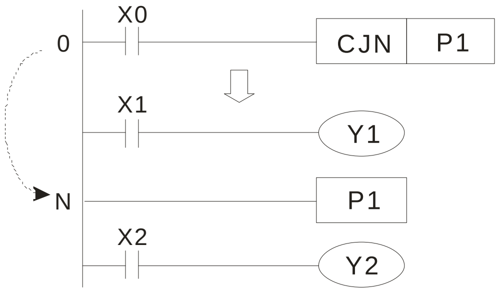
Explanation

- **S**: Pointer
- If the conditional contact connected to CJN is ON, the next address will be executed. If the conditional contact connected to CJN is not ON, the address to which **S** points will be executed.
- If some part of the main program O100 does not need to be executed, users can use CJN or CJNP to shorten the scan time. Besides, if a dual output is used, users can use CJ or CJP.
- If the program specified by a pointer is prior to the instruction CJN, a watchdog timer error will occur, and the main program O100 will not be executed. Please use the instruction carefully.
- The instruction CJN can specify the same pointer repeatedly. The pointer specified by CJN can not be the same as the pointer specified by CALL, otherwise an error will occur.
- When the instruction CJN/CJNP in a program is executed, the actions of the devices in the program are as follows.
  1. The states of the Y devices, the states of the M devices, and the states of the S devices in the program remain the same as those before the execution of the jump.
  2. The 10 millisecond timers in the program stop counting.
  3. The general counters in the program stop counting, and the general applied instructions in the program are not executed.
  4. If the instructions which are used to reset the timers in the program are driven before the jump is executed, the timers will still be reset during the execution of the jump.

Example

- When X0 is OFF, the execution of the program jumps from address 0 to address N (P1), and the addresses between address 0 and address N are skipped.
- When X0is ON, the execution of the program starts from address 0, and the instruction CJN is not executed.

(Negated conditional jump)



API					
257	**JMP**	S	Unconditional jump	Applicable model	10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z

- Note: The operand S can be a pointer.
  S is in the rage of P0~P255.
  The instruction does not need to be driven by a contact.
  A pointer can not be modified by a V device or a Z device.

16-bit instruction (3 steps)

JMP	Continuity instruction	-	-

32-bit instruction

-	-	-	-

- Flag: None

Explanation

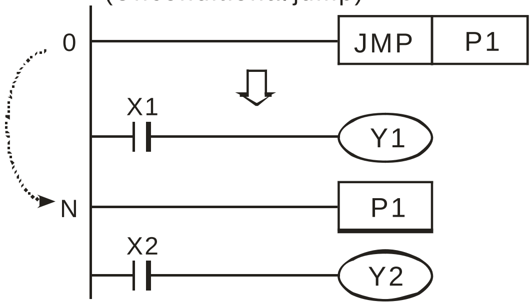
◆ The function of JMP is similar to the function of CJ. CJ must be driven by a contact whereas JMP does not have to be driven by a contact.

◆ The pulse instruction JMPP is not supported.

Example

◆ After address 0 is scanned, address N will be executed whether there is a conditional contact before the instruction JMP (and whether the conditional contact is ON or OFF), and the addresses between address 0 and address N (P1) will be skipped.

(Unconditional jump)



API		BRET			Returning to a busbar	Applicable model
258						10PM
						✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z

- Note: There is no operand.
  The instruction does not need to be driven by a contact.

16-bit instruction (1 step)

BRET	Continuity instruction	-	-

32-bit instruction

-	-	-	-

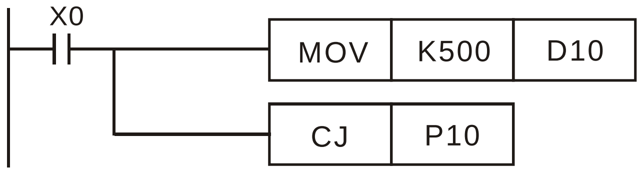
- Flag: None

Explanation

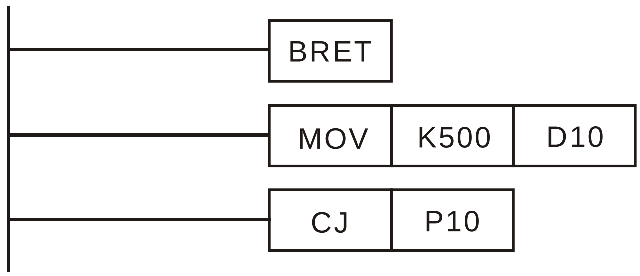
- ◆ The instruction BRET does not have to be driven by a contact.
- ◆ After the instruction BRET is executed, the instructions which should be driven by a conditional contact will seem to be connected to a busbar, and will be executed.

Example

- ◆ In the general program shown below, the instructions are executed only when X0 is ON.



- ◆ After the instruction BRET is added, the instructions which should be driven by a contact will seem to be connected to a busbar, and will be executed.



API		MMOV				Converting a 16-bit value into a 32-bit value	Applicable model
259			P	S	D		10PM
							✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*	*	*	*	*	*	*	*	*	*	*
D								*	*	*	*	*	*	*	*

- Note: Please refer to specifications for more information about device ranges.

16-bit instruction (5 steps)

MMOV	Continuity instruction	MMOVP	Pulse instruction

32-bit instruction

-	-	-	-

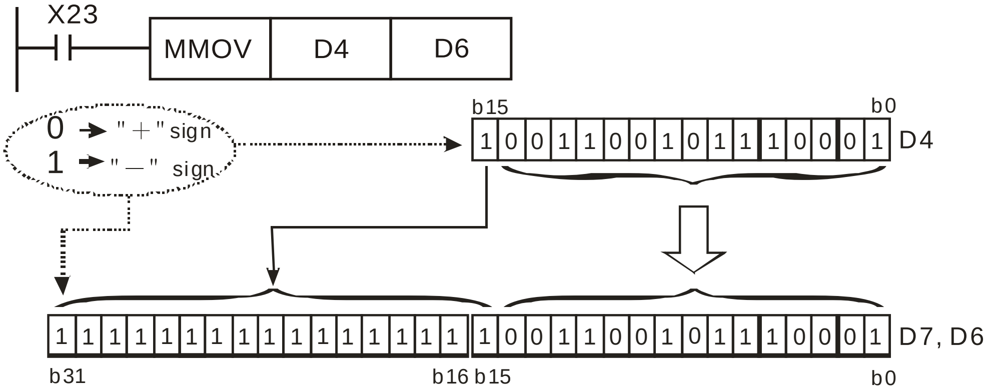
- Flag: None

Explanation

- **S**: Source device (16-bit device); **D**: Destination device (32-bit device)
- The value in the 16-bit device **S** is transferred to the 32-bit device **D**. The sign bit in **S** is duplicated, and stored in **D**.

Example

- When X23 is ON, the value in D4 is transferred to D6 and D7.



Bit 15 is D4 is transferred to bit 15~ bit 31 in (D7, D6). The value in (D7, D6) becomes a negative value. (The value in D4 is also a negative value.)

API		Mnemonic		Operands	Function	Applicable model
260		RMOV	P	(S) (D)	Converting a 32-bit value into a 16-bit value	10PM ✓

	Bit device				Word device										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	V	Z
S					*	*	*	*	*	*	*	*	*	*	*
D								*	*	*	*	*	*	*	*

- Note: Please refer to specifications for more information about device ranges.

16-bit instruction (5 steps)

RMOV	Continuity instruction	RMOVP	Pulse instruction

32-bit instruction

-	-	-	-

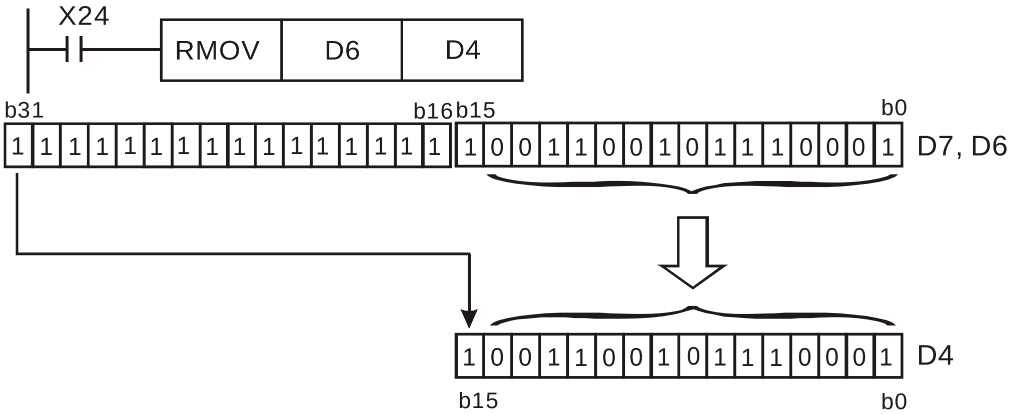
- Flag: None

Explanation

- **S**: Source device (32-bit device); **D**: Destination device (16-bit device)
- Data in the 32-bit device **S** is transferred to the 16-bit device **D**. The sign bit in **S** is retained.

Example

- When X24 is ON, data in D6 and D7 is transferred to D4.



When X24 is ON, bit 31 in D7 is transferred to bit 15 in D4, bit 0~bit 14 in D6 are transferred, and bit 15~bit 30 in D6 and D7 are not transferred.

5.7 Motion Control Function Block Table

Type	Name	Description	Page No.
Uniaxial motion control function blocks	Absolute single-speed motion	Starting absolute single-speed motion	5-152
	Relative single-speed motion	Starting relative single-speed motion	5-156
	Absolute two-speed motion	Starting absolute two-speed motion	5-160
	Relative two-speed motion	Starting relative two-speed motion	5-163
	Inserting single-speed motion	Inserting single-speed motion	5-166
	Inserting two-speed motion	Inserting two-speed motion	5-170
	JOG motion	Starting JOG motion	5-173
	Manual pulse generator mode	Enabling a manual pulse generator mode	5-176
	Electronic gear motion	Starting electronic gear motion	5-179
	Returning home	Starting motion of returning home	5-181
	Stopping uniaxial motion	Stopping the motion of the axis specified	5-183
	Parameter setting 1	Setting motion parameters	5-186
	Parameter setting 2	Setting motion parameters	5-187
	Reading the present position/speed of an axis	Reading the present position/speed of an axis	5-189
	State of an axis	Reading and clearing the present erroneous state of an axis	5-191
	Setting the present position of an axis	Setting the present position of an axis	5-193
	Setting the polarities of input terminals	Setting the polarities of input terminals	5-194
Multiaxial motion control function blocks	Multiaxial absolute linear interpolation	Starting multiaxial absolute linear interpolation	5-196
	Multiaxial relative linear interpolation	Starting multiaxial relative linear interpolation	5-197
	Stopping multiaxial linear interpolation	Stopping multiaxial linear interpolation	5-200
Other motion control function blocks	High-speed counter	Starting a high-speed counter	5-203
	High-speed timer	Starting a high-speed timer	5-206
	Setting high-speed comparison	Starting high-speed comparison	5-209
	Resetting high-speed comparison	Resetting high-speed comparison	5-211
	Setting high-speed capture	Starting high-speed capture	5-215
	High-speed masking	Starting high-speed masking	5-218
	Setting an interrupt	Setting the trigger for an interrupt subroutine	5-220

5.8 Introduction of the Pins in a Motion Control Function Block

5.8.1 Definitions of Input Pins/Output Pins

Common input pins and output pins in motion control function blocks are listed below. The pins listed below do not appear in a single motion control function block. For example, a motion control function block only has one input pin, that is, it has either the Execute input pin or the Enable input pin.

Input pin			
Name	**Description**	**Format**	**Setting value**
Execute	Starting the motion control function block	BOOL	True/False
Enable	Starting the motion control function block	BOOL	True/False

Output pin			
Name	**Description**	**Format**	**Setting value**
Done	The execution of the function block is complete.	BOOL	There is a transition in the Done output pin's signal from low to high when the execution of motion control function block is complete.
Valid	An output value is valid.	BOOL	There is a transition in the Valid output pin's signal from low to high when there is a transition in the Enable input pin's signal from low to high.
Busy	The motion control function block is being executed.	BOOL	There is a transition in the Busy output pin's signal from low to high when there is a transition in the Execute input pin's signal from low to high.
Aborted	The execution of the motion control function block is interrupted by a command.	BOOL	There is a transition in the Aborted output pin's signal from low to high when the execution of the motion control function block is interrupted by a command.
Error	An error occurs in a function block.	BOOL	There is a transition in the Error output pin's signal from low to high when an error occurs in the motion control function block.

A motion control function block has either the Execute input pin or the Enable input pin. The Execute input pin/The Enable input pin in a motion control function block is used to start the motion control function block. A motion control function block generally has the Busy output pin and the Done output pin. The Busy output pin and the Done output pin in a function block indicate the state of the motion control function block. If the execution of motion control function block is to be interrupted by another motion control function block, the Aborted output pin will be added to the motion control function block. Besides, the Error output pin in a motion control function block is used to indicate that an error occurs in the motion control function block when the motion control function block is executed.

A motion control function block has not only the Execute input pin/the Enable input pin, but also value/state input pins. The characteristics of the value/state input pins are described below.

- Use of input values
  - If the input pin that a motion control function block has is the Execute input pin, values are used when there is a transition in the Execute input pin's signal from low to high. If a new value is created, it becomes valid when the Execute input pin is triggered again.
  - If the input pin that a motion control function block has is the Enable input pin, values are used when there is a transition in the Enable input pin's signal from low to high. Compared with the Execute input pin, the Enable input pin is used more often when a value used is updated repeatedly.
- An input value exceeds a range.

  After a motion control function block is started, the input values which are not in ranges allowed will be limited, or result in an error occurring in the motion control function block. If an error occurring in a motion control function block results in an error occurring in an axis, the motion control function block is applied incorrectly. Users should prevent incorrect values from being generated in an applied program.

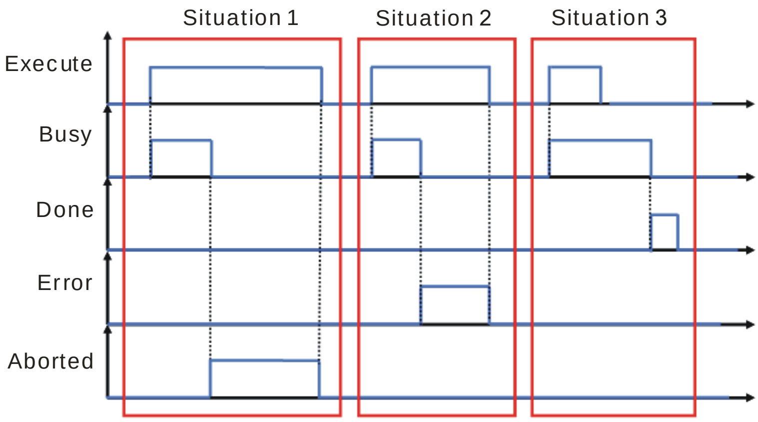
- Output pins are mutually exclusive.
  - If the input pin that a motion control function block has is the Execute input pin, only the Busy output pin, the Done output pin, the Aborted output pin, or the Error output pin can be set to True. If the Execute input pin is set to True, the Busy output pin, the Done output pin, the Aborted output pin, or the Error output pin must be set to True.
  - If the input pin that a motion control function block has is the Enable input pin, the Valid output pin and the Error output pin are mutually exclusive, and only the Valid output pin or the Error output pin can be set to True.
- Time when output data/states are valid
  - If the input pin that a motion control function block has is the Execute input pin, the Done output pin, the Error output pin, the Aborted output pin, and data output are reset when there is a transition in the Execute input pin’s signal from high to low, but the execution of the function block does not stop when there is a transition in the Execute input pin’s signal from high to low. Even if the Execute input pin in a motion control function block is reset before the execution of the motion control function block is complete, output states will still be generated and retained for one cycle. If a motion control function block is started again before the execution of the motion control function block is complete, the motion control function block will not give feedback to the Done output pin and the Aborted output pin, and an error will occur.
  - If the input pin that a motion control function block has is the Enable input pin, the Valid output pin, the Busy output pin, and the Error output pin are reset when there is a transition in the Enable input pin’s signal from high to low.
- Characteristic of the Done output pin

  The Done output pin in a motion control function block will be set to True after the motion control function block is executed successfully.
- Characteristic of the Busy output pin
  - If the input pin that a motion control function block has is the Execute input pin, the motion control function block uses the Busy output pin to indicate that the execution of the motion control function block is not complete, and new output states (values) are expected to be generated. The Busy output pin is set to True when there is a transition in the Execute input pin’s signal from low to high. When the Done output pin, the Aborted output pin, and the Error output pin are set to True, the Busy output pin are reset.
  - If the input pin that a motion control function block has is the Enable input pin, the motion control function block uses the Busy output pin to indicate that the execution of the motion control function block is not complete, and new output states (values) are expected to be generated. The Busy output pin in a motion control function block is set to True when there is a transition in the Enable input pin’s signal from low to high, and is set to True when the motion control function block is executed. When the Busy output pin is set to True, output states (values) still change.
- Characteristic of the Aborted output pin

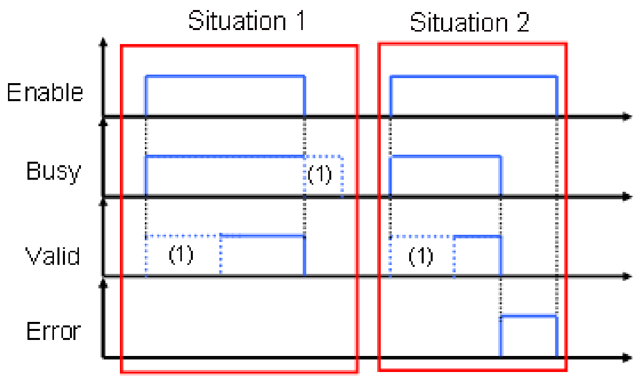
  The Aborted output pin in a motion control function block is set to True when the execution of the motion control function block is interrupted by a command.
- Relation between the Enable input pin and the Valid output pin

  If the input pin that a motion control function block has is the Enable input pin, the motion control function block uses the Busy output pin to indicate whether output data/states are valid. The Valid output pin is set to True only when the Enable input pin is set to true or output data/state are valid. If an error occurs in a motion control function block, output data/states will not be valid, and the Valid output pin will be set to False. The Valid output pin in a motion control function block will not be reset until the error occurring in the motion control function block is eliminated, and output data/states become valid.

5.8.2 Timing Diagram for Input/Output Pins



Situation 1: The execution of the motion control function block is interrupted.
Situation 2: An error occurs in the motion control function block.
Situation 3: The execution of the motion control function block is complete normally.



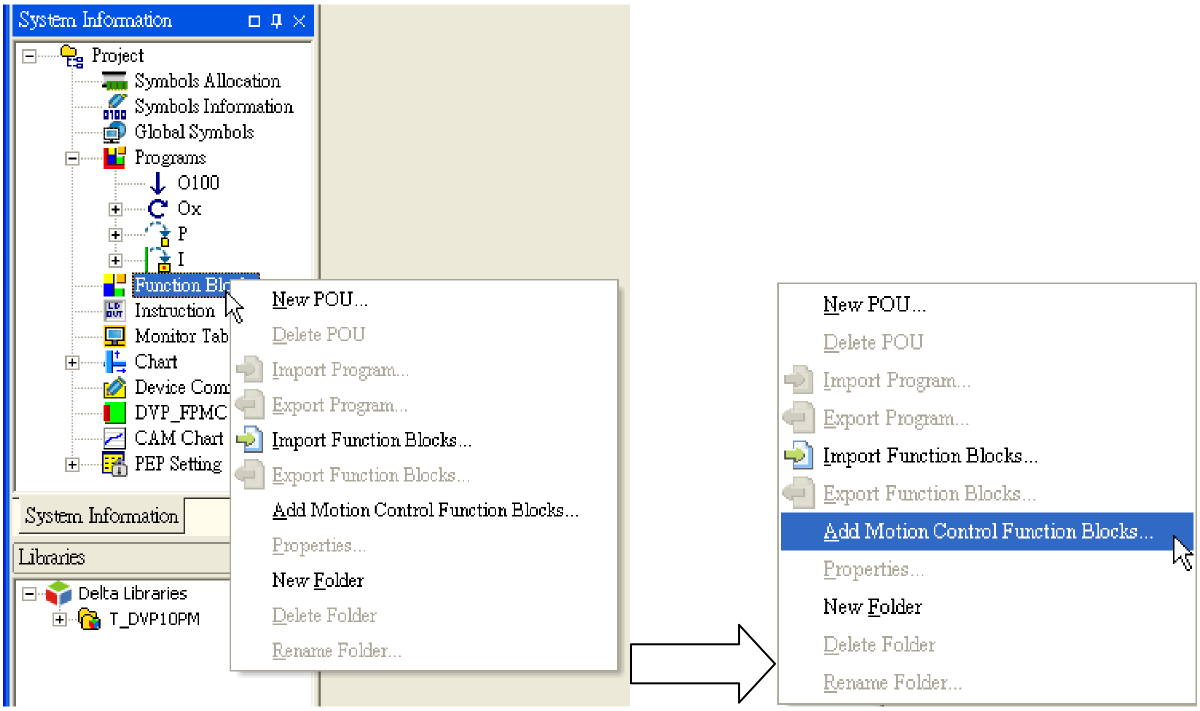
(1) It may take some time.

Situation 1: The motion control function block is executed normally.
Situation 2: An error occurs in the motion control function block.

5.8.3 Introducing the Use of PMSoft

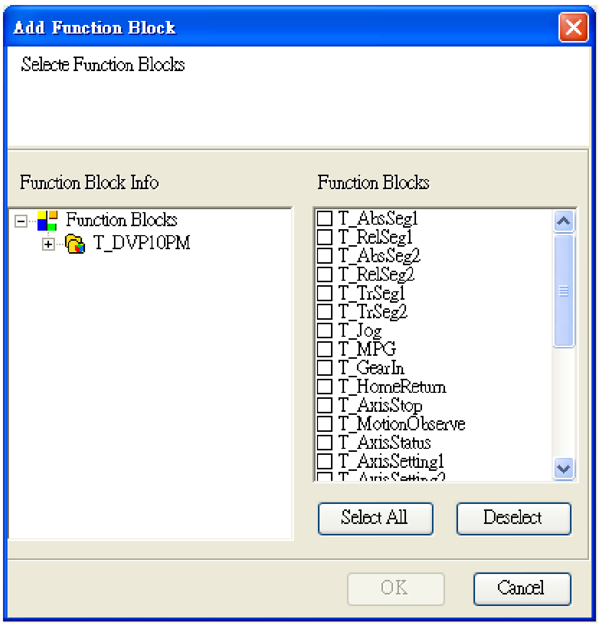
The use of the motion control function blocks in PMSoft is introduced below.

(1) Right-click **Function Blocks** in the system information area in PMSoft.



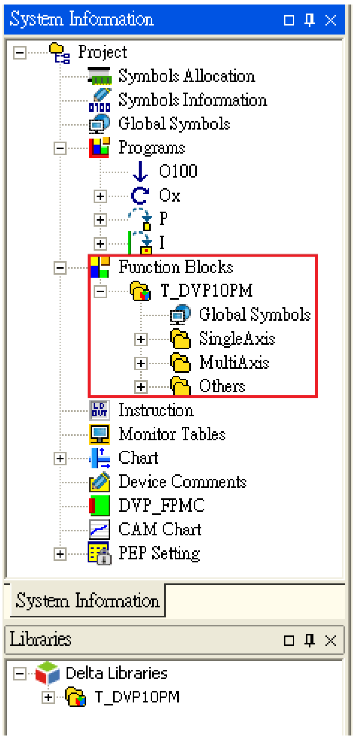
Click **Add Motion Control Function Blocks...** on the context menu.

(2) The **Add Function Block** window appears.



Users can select motion control function blocks in the **Add Function Block** window. If the users click **Select All**, all the motion control function blocks in the **Add Function Block** window will be selected. After users select motion control function blocks, they have to click **OK**.

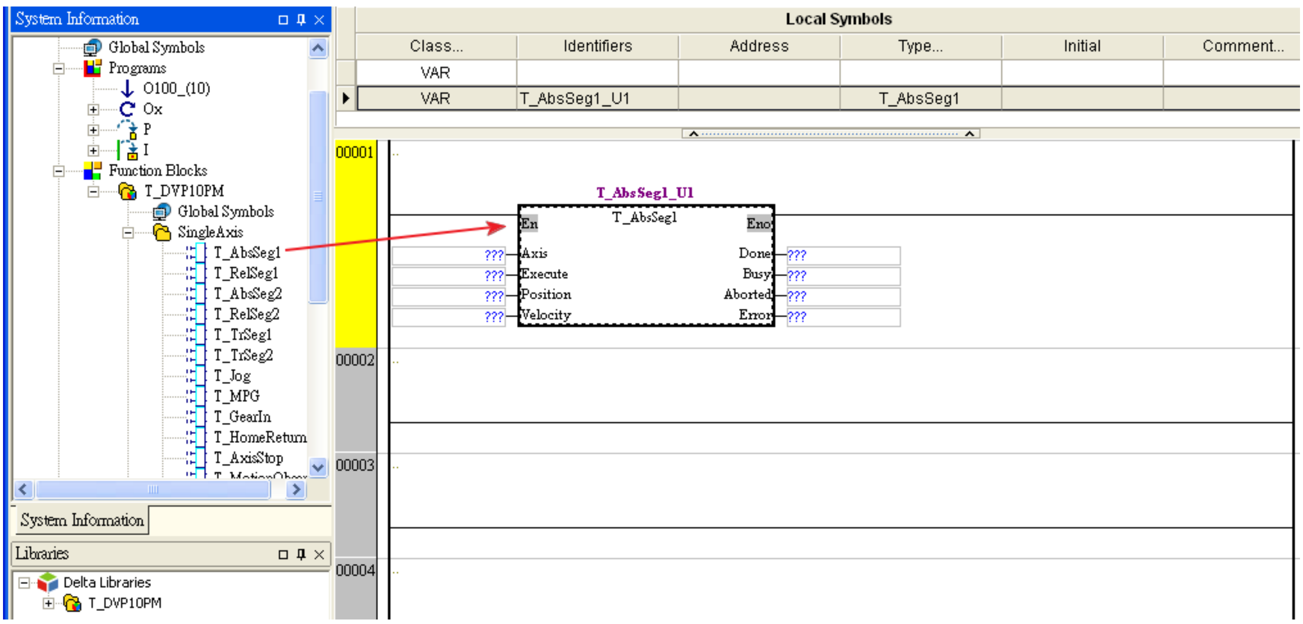
(3) After the users click **OK**, the motion control function blocks selected in the **Add Function Block** window will be automatically added to **Function Blocks** in the system information area.



- The folders added to **Function Blocks** are shown below.

- Definitions of the folders
  - SingleAxis: Uniaxial motion (Uniaxial point-to-point motion and electronic gear synchronization)
  - MultiAxis: Multi-axis motion (multi-axis linear interpolation)
  - Others: Other functions (measuring time, high-speed comparison, high-speed capture, and setting interrupts)

(4) After the users drag motion control function blocks in folder, they can use them.



5.9 Delta-defined Parameter Table

Delta-defined parameters are for input pins in Delta motion control function blocks. Users can directly use Delta-defined parameters to operate motion control function blocks without having to know the descriptions of the input pins in the motion control function blocks. Delta-defined parameters are described below.

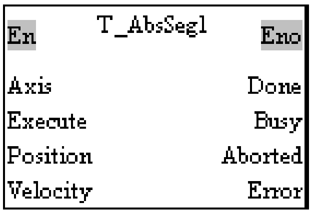
Name	Type	Value	Motion control function block	Description
TRUE	BOOL	True	All motion control function blocks	Input pin
FALSE	BOOL	False		Input pin
mcRising	BOOL	True	T_TrSeg2, T_TrSeg1, T_HomeReturn	Transition in DOG's signal from low to high
mcFalling	BOOL	False		Transition in DOG's signal from high to low
mcPositive	BOOL	True	T_HomeReturn	Returning home in the positive direction
mcNegative	BOOL	False		Returning home in the negative direction
mcSCurve	BOOL	True	T_AxisSetting2	Speed curve: S curve
mcTrapezoid	BOOL	False		Speed curve: Trapezoid curve
mcNC	BOOL	True	T_InputPolatiry	Normally-closed contact
mcNO	BOOL	False		Normally-open contact
mcUp_Up	BOOL	True	T_HTmr	A high-speed timer becomes active when its signal goes from low to high.
mcUp_Down	BOOL	False		A high-speed timer becomes active when its signal goes from high to low.
mcCmpSet	BOOL	True	T_Compare	An output is set when the condition of a comparison is met.
mcCmpRst	BOOL	False		An output is reset when the condition of a comparison is met.
mcMotor	WORD	0	T_AxisSetting2	Motor unit
mcMachine	WORD	1		Mechanical unit,
mcComp	WORD	2		Compound unit
mcUD	WORD	0	T_AxisSetting2, T_HCnt	Counting up/down
mcPD	WORD	1		Pulses+Directions
mcAB	WORD	2		A/B-phase pulses
mc4AB	WORD	3		Four times the frequency of A/B-phase pulses
IntTimer	WORD	0	T_Interrupt	An interrupt signal is triggered by a time interval.
IntX00	WORD	1		The source of an interrupt signal is X0.
IntX01	WORD	2		The source of an interrupt signal is X1.
IntX02	WORD	3		The source of an interrupt signal is X2.
IntX03	WORD	4		The source of an interrupt signal is X3.
IntX04	WORD	5		The source of an interrupt signal is X4.
IntX05	WORD	6		The source of an interrupt signal is X5.
IntX06	WORD	7		The source of an interrupt signal is X6.
IntX07	WORD	8		The source of an interrupt signal is X7.
IntStart0	WORD	1		The source of an interrupt signal is Start0.
IntStop0	WORD	2		The source of an interrupt signal is Stop0.
IntStart1	WORD	3		The source of an interrupt signal is Start1.
IntStop1	WORD	4		The source of an interrupt signal is Stop1.
mcCmpAxis1	WORD	0	T_Compare	The source of a comparison is the present position of the first axis.
mcCmpAxis2	WORD	1		The source of a comparison is the present position of the second axis.
mcCmpAxis3	WORD	2		The source of a comparison is the present position of the third axis.

Name	Type	Value	Motion control function block	Description
mcCmpAxis4	WORD	3	T_Compare	The source of a comparison is the present position of the fourth axis.
mcCmpC200	WORD	4		The source of a comparison is the value of C200.
mcCmpC204	WORD	5		The source of a comparison is the value of C204.
mcCmpC208	WORD	6		The source of a comparison is the value of C208.
mcCmpC212	WORD	7		The source of a comparison is the value of C212.
mcCmpCLR0	WORD	0		The device used for a comparison is CLR0.
mcCmpCLR1	WORD	1		The device used for a comparison is CLR1.
mcCmpY0	WORD	0		The device used for a comparison is Y0.
mcCmpY1	WORD	1		The device used for a comparison is Y1.
mcCmpY2	WORD	2		The device used for a comparison is Y2.
mcCmpY3	WORD	3		The device used for a comparison is Y3.
mcCmpRstC200	WORD	4		The device used for a comparison is C200.
mcCmpRstC204	WORD	5		The device used for a comparison is C204.
mcCmpRstC208	WORD	6		The device used for a comparison is C208.
mcCmpRstC212	WORD	7		The device used for a comparison is C212.
mcCapAxis1	WORD	0	T_Capture	The source of capture is the present position of the first axis.
mcCapAxis2	WORD	1		The source of capture is the present position of the second axis.
mcCapAxis3	WORD	2		The source of capture is the present position of the third axis.
mcCapAxis4	WORD	3		The source of capture is the present position of the fourth axis.
mcCapC200	WORD	4		The source of capture is the value of C200.
mcCapC204	WORD	5		The source of capture is the value of C204.
mcCapC208	WORD	9		The source of capture is the value of C208.
mcCapC212	WORD	7		The source of capture is the value of C212.
mcCapPG0	WORD	0		The source of a capture signal is PG0.
mcCapMPGB0	WORD	1		The source of a capture signal is MPGB0.
mcCapMPGA0	WORD	2		The source of a capture signal is MPGA0.
McCapLSN0	WORD	3		The source of a capture signal is LSN0.
McCapLSP0	WORD	4		The source of a capture signal is LSP0.
McCapDOG0	WORD	5		The source of a capture signal is DOG0.
mcCapStop0	WORD	6		The source of a capture signal is Stop0.
mcCapStart0	WORD	7		The source of a capture signal is Start0.
mcCapPG1	WORD	8		The source of a capture signal is PG1.
mcCapMPGB1	WORD	9		The source of a capture signal is MPGB1.
mcCapMPGA1	WORD	10		The source of a capture signal is MPGA1.
mcCapLSN1	WORD	11		The source of a capture signal is LSN1.
mcCapLSP1	WORD	12		The source of a capture signal is LSP1.
McCapDOG1	WORD	13		The source of a capture signal is DOG1.
mcCapStop1	WORD	14		The source of a capture signal is Stop1.
mcCapStart1	WORD	15		The source of a capture signal is Start1.
mcX0	WORD	0		The source of a capture signal is X0.
mcX1	WORD	1		The source of a capture signal is X1.
mcX2	WORD	2		The source of a capture signal is X2.
mcX3	WORD	3		The source of a capture signal is X3.
mcX4	WORD	4		The source of a capture signal is X4.

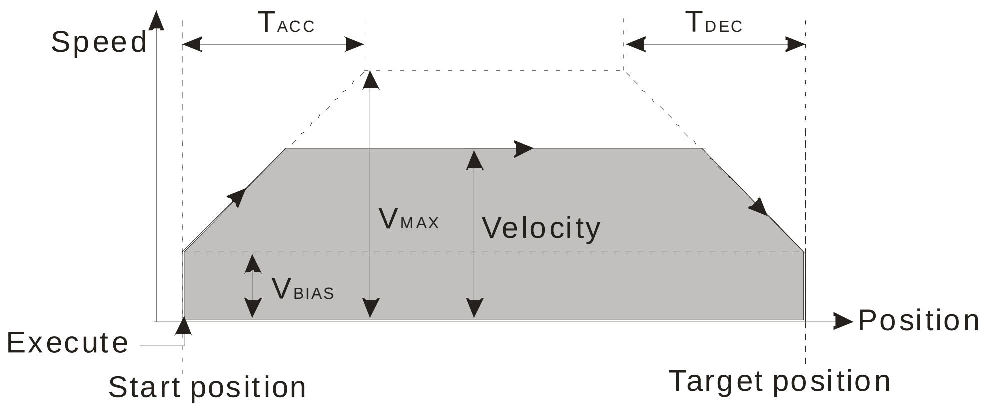
Name	Type	Value	Motion control function block	Description
mcX5	WORD	5	T_Capture	The source of a capture signal is X5.
mcX6	WORD	6		The source of a capture signal is X6.
mcX7	WORD	7		The source of a capture signal is X7.
mcX10	WORD	8		The source of a capture signal is X10.
mcX11	WORD	9		The source of a capture signal is X11.
mcX12	WORD	10		The source of a capture signal is X12.
mcX13	WORD	11		The source of a capture signal is X13.

5.10 Uniaxial Motion Control Function Blocks

5.10.1 Absolute Single-speed Motion



1. Motion control function block
   The motion control function block T_AbsSeg1 is used to start absolute single-speed motion. After absolute single-speed motion is started, the speed of the absolute single-speed motion will increase from the V_{BIAS} set to the velocity set. The speed of the absolute single-speed motion will not decrease from the velocity set to the V_{BIAS} set until the present command position of the axis specified is near the target position set. Users can set the Vbias input pin, the Vmax input pin, the Tacc input pin, and the Tdec input pin in the motion control function block T_AxisSetting1. The number of pulses is a unit for the Position input pin, and the number of pulses per second is a unit for the Velocity input pin. The users can change the unit used by means of the motion control function block T_AxisSetting2.



2. Input pins/Output pins

Input pin				
Name	Function	Data type	Setting value	Time when a value is valid
Axis	Motion axis number	WORD	DVP10PM00M: K1~K6	The value of the Axis input pin is valid when there is a transition in the Execute input pin’s signal from low to high.

Input pin				
Name	Function	Data type	Setting value	Time when a value is valid
Execute	Motion is started when there is a transition in the Execute input pin's signal from low to high.	BOOL	True/False	-
Position	Absolute position	DWORD	K-2,147,483,648~ K2,147,483,647	The value of the Position input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Velocity	Target speed	DWORD	K1~ K2,147,483,647	When the motion control function block is executed, the value of the Velocity input pin is updated repeatedly.

Output pin				
Name	Function	Data type	Time when there is a transition in an output pin's signal from low to high	Time when there is a transition in an output pin's signal from high to low
Done	The execution of the motion control function block is complete.	BOOL	• There is a transition in the Done output pin's signal when motion is complete.	• There is a transition in the Done output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. • If the Execute input pin is set to False when motion is complete, the Done output pin will be set to False in the next cycle.
Busy	The motion control function block is being executed.	BOOL	• There is a transition in the Busy output pin's signal from low to high when there is a transition in the Execute input pin's signal from low to high.	• There is a transition in the Busy output pin's signal from high to low when there is a transition in the Done output pin's signal from low to high. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Aborted output pin's signal from low to high.
Aborted	The execution of the motion control function block is interrupted by a command.	BOOL	• The execution of the motion control function block is interrupted by a command.	• There is a transition in the Aborted output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. • If the Execute input pin is set to False when the execution of the motion control function block is interrupted, the Aborted output pin will be set to False in the next cycle.

Output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Error	An error occurs in the motion control function block.	BOOL	● Input values are incorrect. ● The axis specified is in motion before the motion control function block is executed.	● There is a transition in the Error output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.

The number of pulses is a unit for the Position input pin, and the number of pulses per second is a unit for the Velocity input pin. Users can change the unit used by means of the motion control function block T_AxisSetting2.

3. Troubleshooting

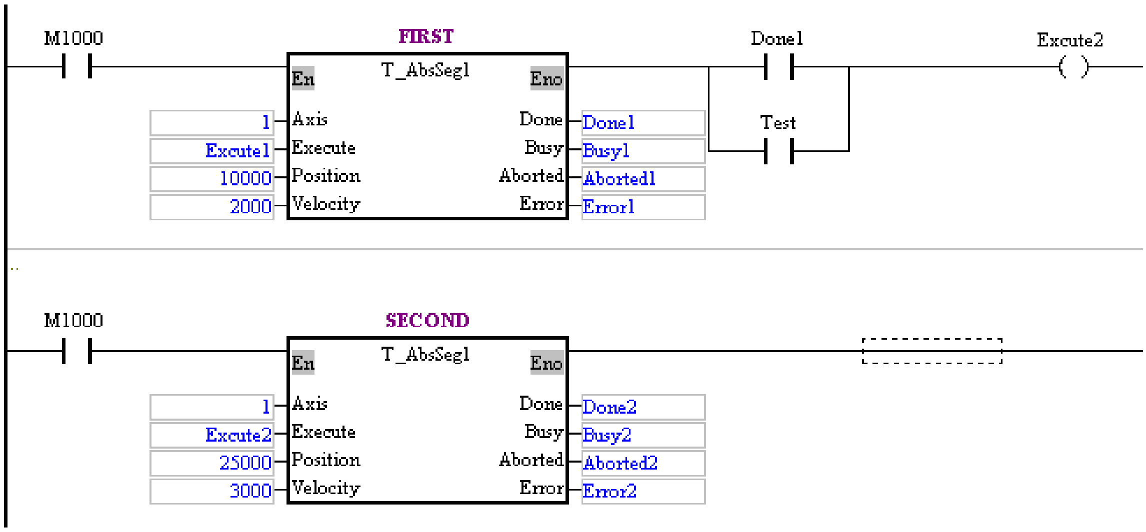
Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.
The motion control function block conflicts with other motion control function blocks.	Make sure that other uniaxial motion control function blocks are not started or the execution of other uniaxial motion control function blocks is complete before the motion control function block is started.

4. Example

Purposes:

- After the first single-speed motion is complete, the second single-speed motion will be executed.
- The second single-speed motion is executed before the execution of the first single-speed motion is complete.

The motion control function block named FIRST is set so that the first axis moves at a speed of 2,000 pulses per second, and moves for 10,000 pulses. The motion control function block named SECOND is set so that the first axis moves at a speed of 3,000 pulses per second, and moves for 15,000 pulses.



- After the first single-speed motion is complete, the second single-speed motion will be executed.

  Steps:

  (a) Set Execute1 to True.

  (b) Wait for a transition in Done2's signal from low to high or a transition in Error2's signal from low to high.

- The second single-speed motion is executed before the execution of the first single-speed motion is complete.

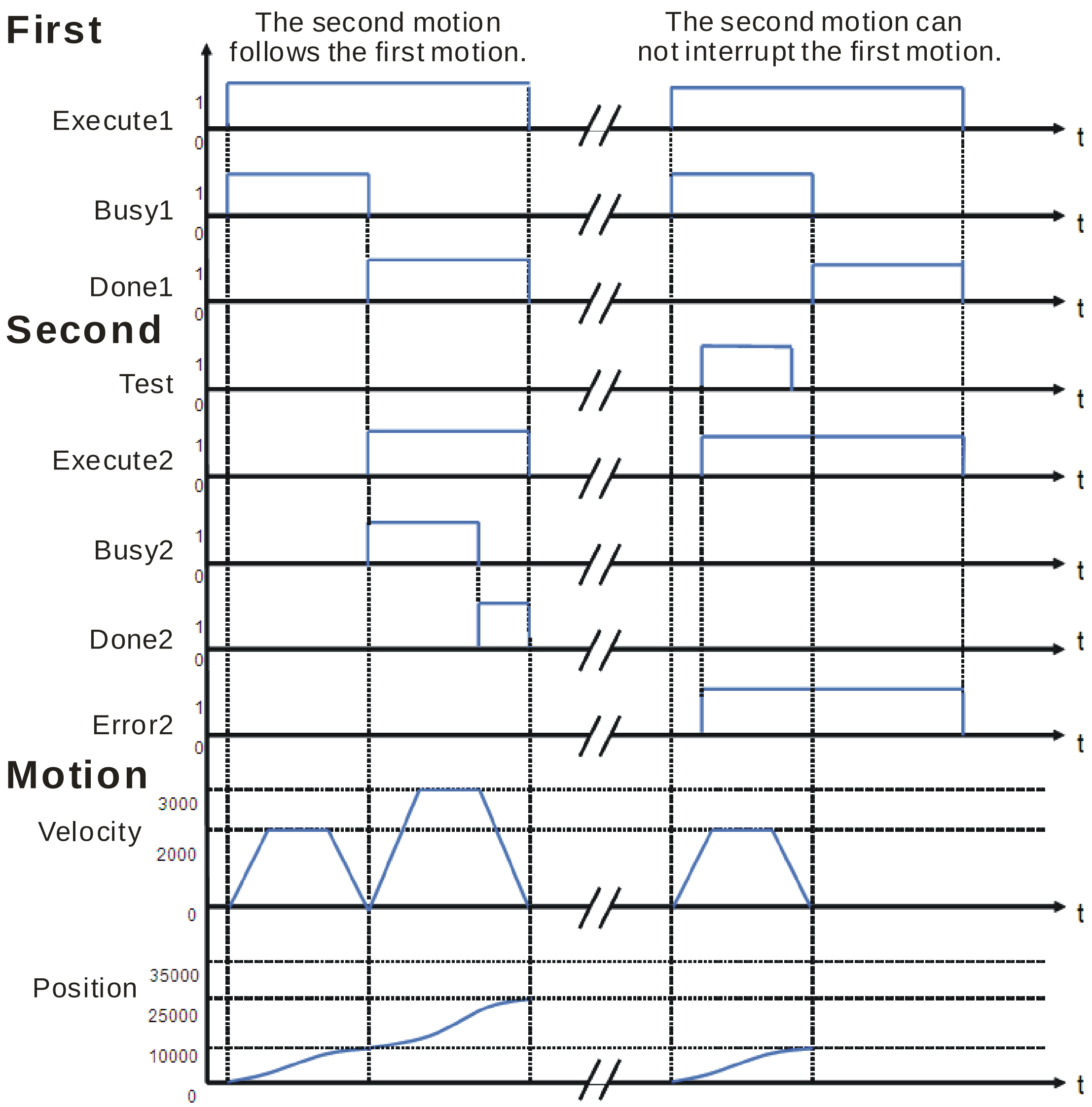
  Steps:

  (a) Set Execute1 to True.

  (b) Set Test to ON when Busy1 is set to True.

  (c) Wait for a transition in Done2's signal from low to high or a transition in Error2's signal from low to high.

Timing diagram:



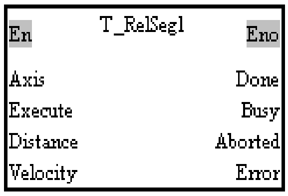
- After the first single-speed motion is complete, the second single-speed motion will be executed. After the execution of the motion control function block named FIRST is complete, the motion control function block named SECOND will be executed. The first axis moves for 25,000 pulses.
- The second single-speed motion is executed before the execution of the first single-speed motion is complete.

  When Error2 is set to True, the first axis moves for 10,000 pulses. The motion control function block named SECOND is invalid.

5. Module which is supported

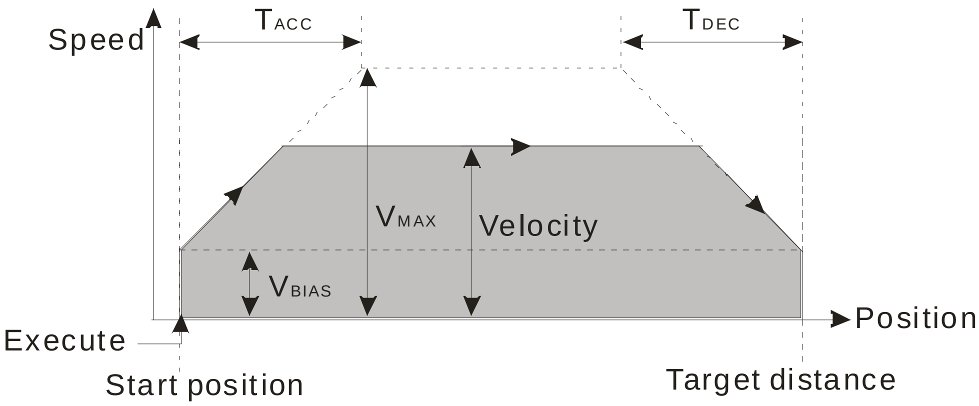
   The motion control function block T_AbsSeg1 supports DVP10PM00M.

5.10.2 Relative Single-speed Motion



1. Motion control function block

   The motion control function block T_RelSeg1 is used to start relative single-speed motion. After relative single-speed motion is started, the speed of the relative single-speed motion will increase from the V_{BIAS} set to the velocity set. The speed of the relative single-speed motion will not decrease from the velocity set to the V_{BIAS} set until the distance for which the relative single-speed motion moves is the distance set. Users can set the Vbias input pin, the Vmax input pin, the Tacc input pin, and the Tdec input pin in the motion control function block T_AxisSetting1. The number of pulses is a unit for the Distance input pin, and the number of pulses per second is a unit for the Velocity input pin. Users can change the unit used by means of the motion control function block T_AxisSetting2.



2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Axis	Motion axis number	WORD	K1~K6	The value of the Axis input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Execute	Motion is started when there is a transition in the Execute input pin's signal from low to high.	BOOL	True/False	-
Distance	Relative distance	DWORD	K-2,147,483,648~ K2,147,483,647	The value of the Distance input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Velocity	Target speed	DWORD	K1~K2,147,483,647	When the motion control function block is executed, the value of the Velocity input pin is updated repeatedly.

Output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Done	The execution of the motion control function block is complete.	BOOL	• There is a transition in the Done output pin's signal when motion is complete.	• There is a transition in the Done output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. • If the Execute input pin is set to False when motion is complete, the Done output pin will be set to False in the next cycle.
Busy	The motion control function block is being executed.	BOOL	• There is a transition in the Busy output pin's signal from low to high when there is a transition in the Execute input pin's signal from low to high.	• There is a transition in the Busy output pin's signal from high to low when there is a transition in the Done output pin's signal from low to high. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Aborted output pin's signal from low to high.
Aborted	The execution of the motion control function block is interrupted by a command.	BOOL	• The execution of the motion control function block is interrupted by a command.	• There is a transition in the Aborted output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. • If the Execute input pin is set to False when the execution of the motion control function block is interrupted, the Aborted output pin will be set to False in the next cycle.
Error	An error occurs in the motion control function block.	BOOL	• Input values are incorrect. • The axis specified is in motion before the motion control function block is executed.	• There is a transition in the Error output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.

The number of pulses is a unit for the Distance input pin, and the number of pulses per second is a unit for the Velocity input pin. Users can change the unit used by means of the motion control function block T_AxisSetting2.

3. Troubleshooting

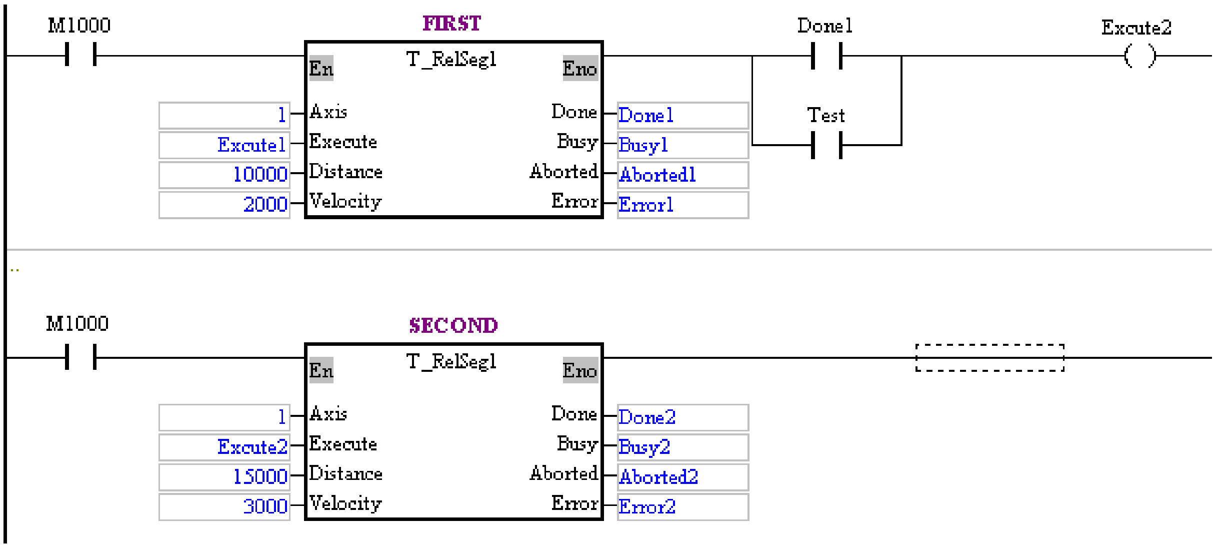
Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.
The motion control function block conflicts with other motion control function blocks.	Make sure that other uniaxial motion control function blocks are not started or the execution of other uniaxial motion control function blocks is complete before the motion control function block is started.

4. Example

Purposes:

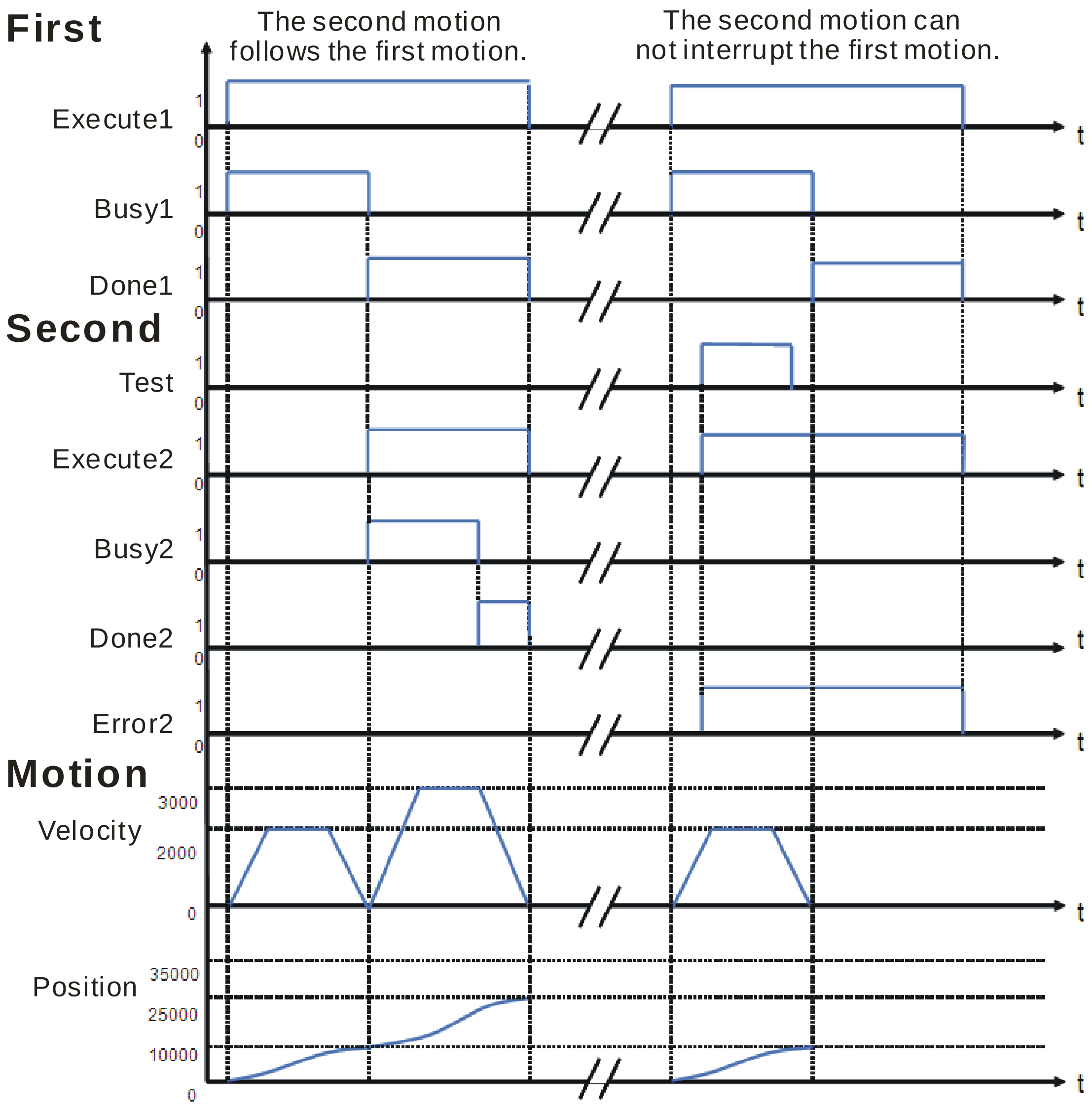
- After the first single-speed motion is complete, the second single-speed motion will be executed.
- The second single-speed motion is executed before the execution of the first single-speed motion is complete.

The motion control function block named FIRST is set so that the first axis moves at a speed of 2,000 pulses per second, and moves for 10,000 pulses. The motion control function block named SECOND is set so that the first axis moves at a speed of 3,000 pulses per second, and moves for 15,000 pulses.



- After the first single-speed motion is complete, the second single-speed motion will be executed.
  Steps:
  (a) Set Execute1 to True.
  (b) Wait for a transition in Done2's signal from low to high or a transition in Error2's signal from low to high.
- The second single-speed motion is executed before the execution of the first single-speed motion is complete.
  Steps:
  (a) Set Execute1 to True.
  (b) Set Test to ON when Busy1 is set to true.
  (c) Wait for a transition in Done2's signal from low to high or a transition in Error2's signal from low to high.

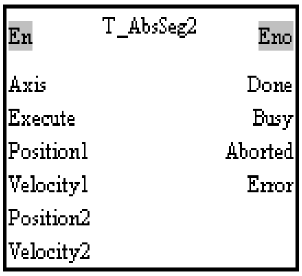
Timing diagram:



- After the first single-speed motion is complete, the second single-speed motion will be executed. When the motion control function block named FIRST is executed, the first axis moves for 10,000 pulses. After the execution of the motion control function block named FIRST is complete, the motion control function block named SECOND will be executed. When the motion control function block named SECOND is executed, the first axis moves for 15,000 pulses.
- The second single-speed motion is executed before the execution of the first single-speed motion is complete.
  When Error2 is set to True, the first axis moves for 10,000 pulses. The motion control function block named SECOND is invalid.

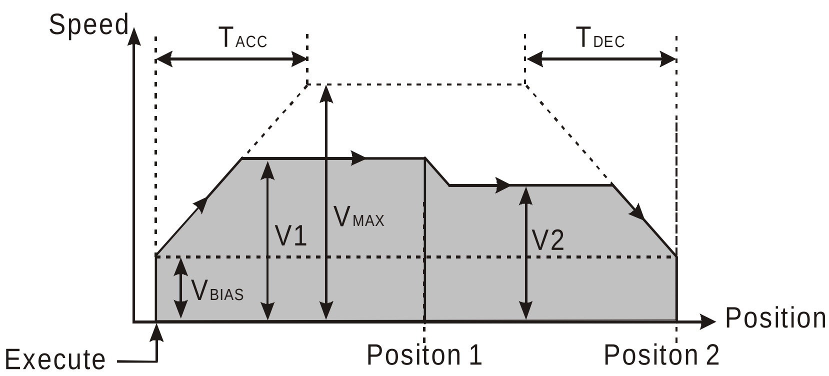
5. Module which is supported
   The motion control function block T_RelSeg1 supports DVP10PM00M.

5.10.3 Absolute Two-speed Motion



1. Motion control function block

   The motion control function block T_AbsSeg2 is used to start absolute two-speed motion. After absolute two-speed motion is started, the speed of the absolute two-speed motion will increase from the V_{BIAS} set to the V (I) set. The speed of the absolute two-speed motion will not increase/decrease from the V (I) set to the V (II) set until the present command position of the axis specified is near the P (I) set. The speed of the absolute two-speed motion will not decrease from the V (II) set to the V_{BIAS} set until the present command position of the axis specified is near the P (II) set. The P (I) set must be between the present command position of the axis specified and the P (II) set. Users can set the Vbias input pin, the Vmax input pin, the Tacc input pin, and the Tdec input pin in the motion control function block T_AxisSetting1. The number of pulses is a unit for the Position1 input pin/the Position2 input pin, and the number of pulses per second is a unit for the Velocity1 input pin/the Velocity2 input pin. The users can change the unit used by means of the motion control function block T_AxisSetting2.



2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Axis	Motion axis number	WORD	K1~K6	The value of the Axis input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Execute	Motion is started when there is a transition in the Execute input pin's signal from low to high.	BOOL	True/False	-
Position1	Absolute position of the first motion	DWORD	K-2,147,483,648~ K2,147,483,647	The value of the Position1 input pin is valid when there is a transition in the Execute input pin's signal from low to high.

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Velocity1	Target speed of the first motion	DWORD	K1~K2,147,483,647	The value of the Velocity1 input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Position2	Absolute position of the second motion	DWORD	K-2,147,483,648~ K2,147,483,647 (If the value of the Position1 input pin is greater than 0, the value of the Position2 input pin must be greater than or equal to the value of the Position1 input pin. If the value of the Position1 input pin is less than or equal to 0, the value of the Position2 input pin must be less than or equal to the value of the Position1 input pin.)	The value of the Position2 input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Velocity2	Target speed of the second motion	DWORD	K1~K2,147,483,647	The value of the Velocity2 input pin is valid when there is a transition in the Execute input pin's signal from low to high.

Output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Done	The execution of the motion control function block is complete.	BOOL	• There is a transition in the Done output pin's signal when motion is complete.	• There is a transition in the Done output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. • If the Execute input pin is set to False when motion is complete, the Done output pin will be set to False in the next cycle.
Busy	The motion control function block is being executed.	BOOL	• There is a transition in the Busy output pin's signal from low to high when there is a transition in the Execute input pin's signal from low to high.	• There is a transition in the Busy output pin's signal from high to low when there is a transition in the Done output pin's signal from low to high. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Aborted output pin's signal from low to high.

Output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Aborted	The execution of the motion control function block is interrupted by a command.	BOOL	● The execution of the motion control function block is interrupted by a command.	● There is a transition in the Aborted output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. ● If the Execute input pin is set to False when the execution of the motion control function block is interrupted, the Aborted output pin will be set to False in the next cycle.
Error	An error occurs in the motion control function block.	BOOL	● Input values are incorrect. ● The axis specified is in motion before the motion control function block is executed.	● There is a transition in the Error output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.

The number of pulses is a unit for the Position1 input pin/the Position2 input pin, and the number of pulses per second is a unit for the Velocity1 input pin/the Velocity2 input pin. Users can change the unit used by means of the motion control function block T_AxisSetting2.

3. Troubleshooting

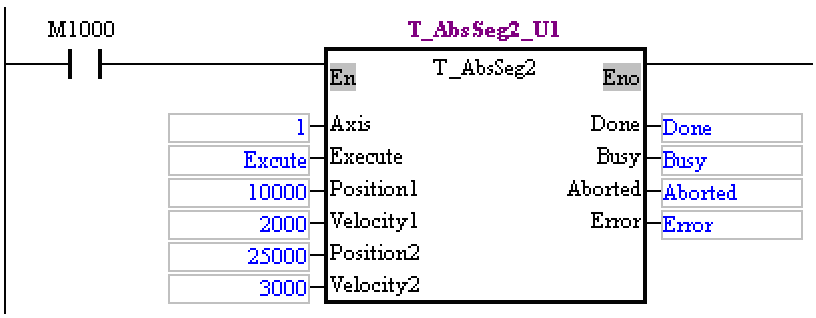
Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.
The motion control function block conflicts with other motion control function blocks.	Make sure that other uniaxial motion control function blocks are not started or the execution of other uniaxial motion control function blocks is complete before the motion control function block is started.

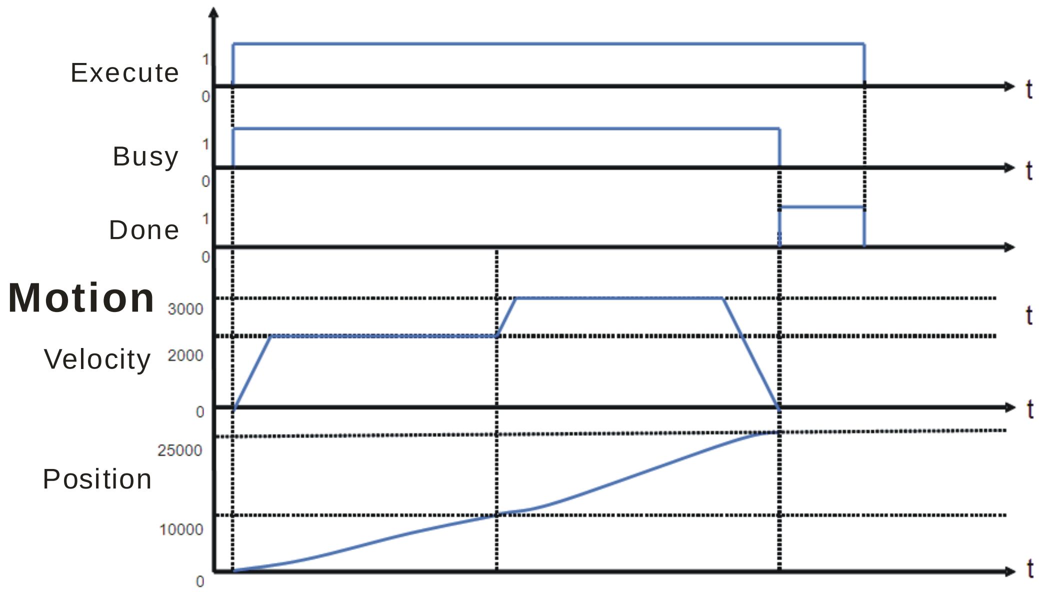
4. Example

Purposes:

- The motion control function block T_AbsSeg2 is used to start absolute two-speed motion of an axis.

The first motion is set so that the first axis moves at a speed of 2,000 pulses per second, and moves for 10,000 pulses. The second motion is set so that the first axis moves at a speed of 3,000 pulses per second, and moves for 15,000 pulses.



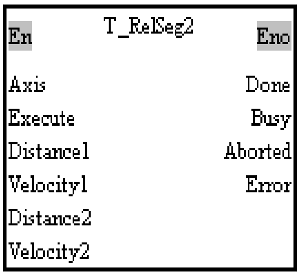


After the motion control function block is started, the first axis moves for 10,000 pulses at a speed of 2,000 pulses per second, and moves for 15,000 pulses at a speed of 3,000 pulses per second.

5. Module which is supported

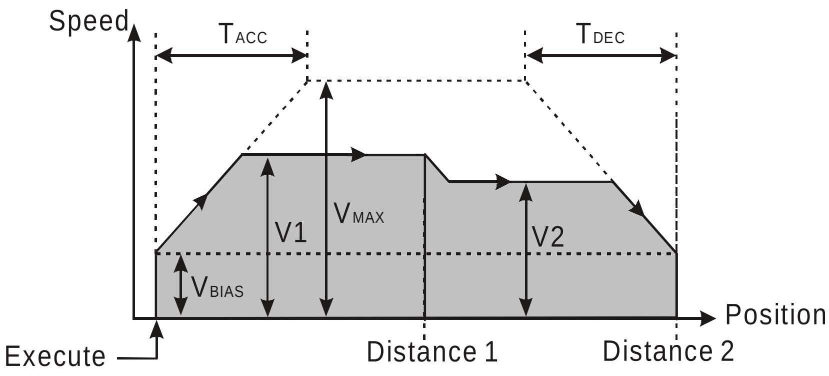
   The motion control function block T_AbsSeg2 supports DVP10PM00M.

5.10.4 Relative Two-speed Motion



1. Motion control function block

   The motion control function block T_RelSeg2 is used to start relative two-speed motion. After relative two-speed motion is started, the speed of the relative two-speed motion will increase from the V_{BIAS} set to the V (I) set. The speed of the relative two-speed motion will not increase/decrease from the V (I) set to the V (II) set until the number of pulses output is near the value of the Distance1 input pin. The speed of the relative two-speed motion will not decrease from the V (II) set to the V_{BIAS} set until the number of pulses output is near the value of the Distance2 input pin. Users can set the Vbias input pin, the Vmax input pin, the Tacc input pin, and the Tdec input pin in the motion control function block T_AxisSetting1. The number of pulses is a unit for the Distance1 input pin/the Distance2 input pin, and the number of pulses per second is a unit for the Velocity1 input pin/the Velocity2 input pin. Users can change the unit used by means of the motion control function block T_AxisSetting2.



2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Axis	Motion axis number	WORD	K1~K6	The value of the Axis input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Execute	Motion is started when there is a transition in the Execute input pin's signal from low to high.	BOOL	True/False	-
Distance1	Relative distance for which the first motion moves	DWORD	K-2,147,483,648~ K2,147,483,647	The value of the Distance1 input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Velocity1	Target speed of the first motion	DWORD	K1~K2,147,483,647	The value of the Velocity1 input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Distance2	Relative distance for which the second motion moves	DWORD	K-2,147,483,648~ K2,147,483,647 (If the value of the Distance1 input pin is a positive value, the value of the Distance2 input pin must be a positive value. If the value of the Distance1 input pin is a negative value, the value of the Distance2 input pin must be a negative value.)	The value of the Distance2 input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Velocity2	Target speed of the second motion	DWORD	K1~K2,147,483,647	The value of the Velocity2 input pin is valid when there is a transition in the Execute input pin's signal from low to high.

Output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Done	The execution of the motion control function block is complete.	BOOL	• There is a transition in the Done output pin's signal when motion is complete.	• There is a transition in the Done output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. • If the Execute input pin is set to False when motion is complete, the Done output pin will be set to False in the next cycle.
Busy	The motion control function block is being executed.	BOOL	• There is a transition in the Busy output pin's signal from low to high when there is a transition in the Execute input pin's signal from low to high.	• There is a transition in the Busy output pin's signal from high to low when there is a transition in the Done output pin's signal from low to high. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Aborted output pin's signal from low to high.
Aborted	The execution of the motion control function block is interrupted by a command.	BOOL	• The execution of the motion control function block is interrupted by a command.	• There is a transition in the Aborted output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. • If the Execute input pin is set to False when the execution of the motion control function block is interrupted, the Aborted output pin will be set to False in the next cycle.
Error	An error occurs in the motion control function block.	BOOL	• Input values are incorrect. • The axis specified is in motion before the motion control function block is executed.	• There is a transition in the Error output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.

The number of pulses is a unit for the Distance1 input pin/the Distance2 input pin, and the number of pulses per second is a unit for the Velocity1 input pin/the Velocity2 input pin. Users can change the unit used by means of the motion control function block T_AxisSetting2.

3. Troubleshooting

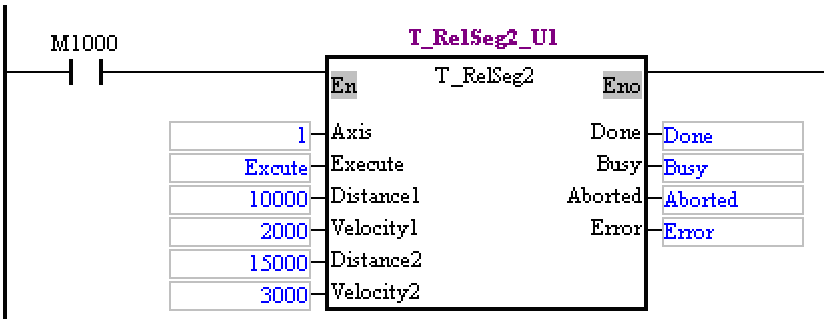
Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.
The motion control function block conflicts with other motion control function blocks.	Make sure that other uniaxial motion control function blocks are not started or the execution of other uniaxial motion control function blocks is complete before the motion control function block is started.

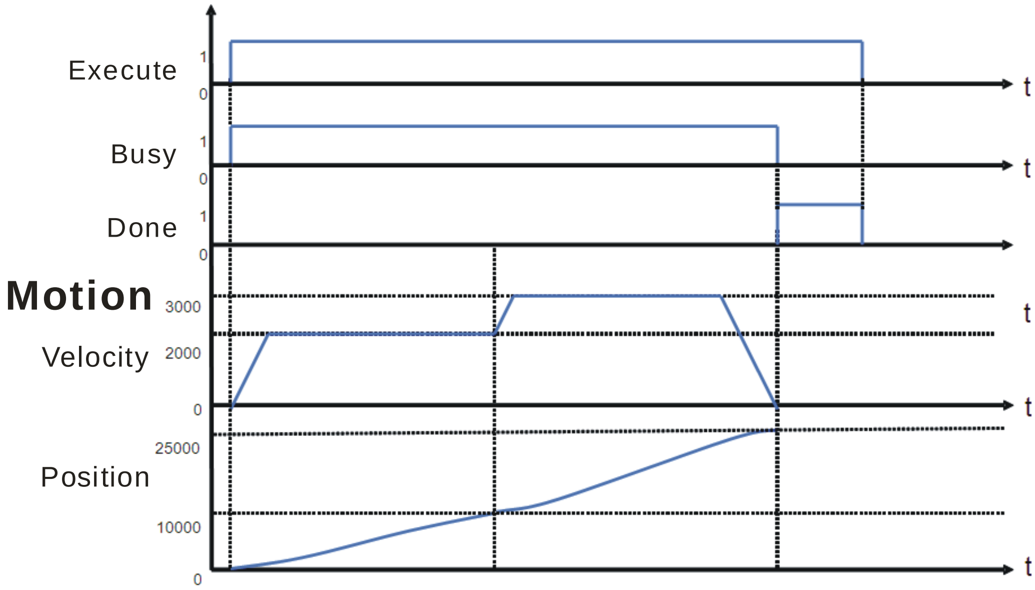
4. Example

Purpose:

- The motion control function block T_AbsSeg2 is used to start relative two-speed motion of an axis.

The first motion is set so that the first axis moves at a speed of 2,000 pulses per second, and moves for 10,000 pulses. The second motion is set so that the first axis moves at a speed of 3,000 pulses per second, and moves for 15,000 pulses.



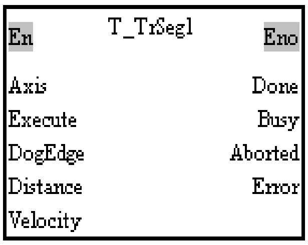


After the motion control function block is started, the first axis moves for 10,000 pulses at a speed of 2,000 pulses per second, and moves for 15,000 pulses at a speed of 3,000 pulses per second.

5. Module which is supported

The motion control function block T_RelSeg2 supports DVP10PM00M.

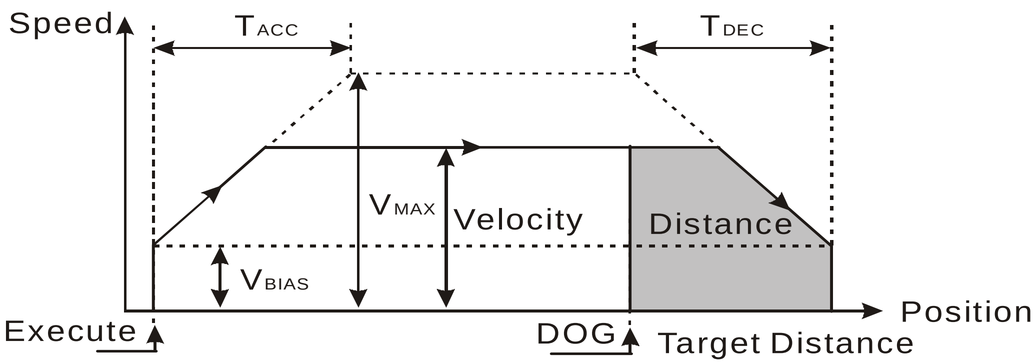
5.10.5 Inserting Single-speed Motion



1. Motion control function block

The motion control function block T_TrSeg1 is used to insert single-speed motion. The speed of motion increases from the V_{BIAS} set to the velocity set. After DOG's signal goes from low to high or from high to low, the DVP-10PM series motion controller used will continue sending pulses. The speed of the motion will not decrease from the velocity set to the V_{BIAS} set until the number of pulses output is near the value of the Distance input pin. Users can set the Vbias input pin, the Vmax input pin, the Tacc input pin, and the Tdec input pin in the motion control function block T_AxisSetting1. The number of pulses is a unit for the Distance input pin, and the number of pulses per second is a unit for the

Velocity input pin. The users can change the unit used by means of the motion control function block T_AxisSetting2. If the value of the DogEdge input pin is mcRising, motion will be triggered by a transition in DOG's signal from low to high. If the value of the DogEdge input pin is mcFalling, motion will be triggered by a transition in DOG's signal from high to low.



2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Axis	Motion axis number	WORD	K1~K6	The value of the Axis input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Execute	Motion is started when there is a transition in the Execute input pin's signal from low to high.	BOOL	True/False	-
DogEdge	Transition in DOG's signal from low to high or from high to low	BOOL	mcRising (True)/ mcFalling (False)	The value of the DogEdge input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Distance	Distance for which motion moves after a transition in DOG's signal from low to high or from high to low	DWORD	K-2,147,483,648~ K2,147,483,647	The value of the Distance input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Velocity	Target speed	DWORD	K1~K2,147,483,647	The value of the Velocity input pin is valid when there is a transition in the Execute input pin's signal from low to high.

Output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Done	The execution of the motion control function block is complete.	BOOL	• There is a transition in the Done output pin's signal when motion is complete.	• There is a transition in the Done output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. • If the Execute input pin is set to False when motion is complete, the Done output pin will be set to False in the next cycle.
Busy	The motion control function block is being executed.	BOOL	• There is a transition in the Busy output pin's signal from low to high when there is a transition in the Execute input pin's signal from low to high.	• There is a transition in the Busy output pin's signal from high to low when there is a transition in the Done output pin's signal from low to high. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Aborted output pin's signal from low to high.
Aborted	The execution of the motion control function block is interrupted by a command.	BOOL	• The execution of the motion control function block is interrupted by a command.	• There is a transition in the Aborted output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. • If the Execute input pin is set to False when the execution of the motion control function block is interrupted, the Aborted output pin will be set to False in the next cycle.
Error	An error occurs in the motion control function block.	BOOL	• Input values are incorrect. • The axis specified is in motion before the motion control function block is executed.	• There is a transition in the Error output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.

The number of pulses is a unit for the Distance input pin, and the number of pulses per second is a unit for the Velocity input pin. Users can change the unit used by means of the motion control function block T_AxisSetting2. If the value of the DogEdge input pin is mcRising, motion will be triggered by a transition in DOG's signal from low to high. If the value of the DogEdge input pin is mcFalling, motion will be triggered by a transition in DOG's signal from high to low.

3. Troubleshooting

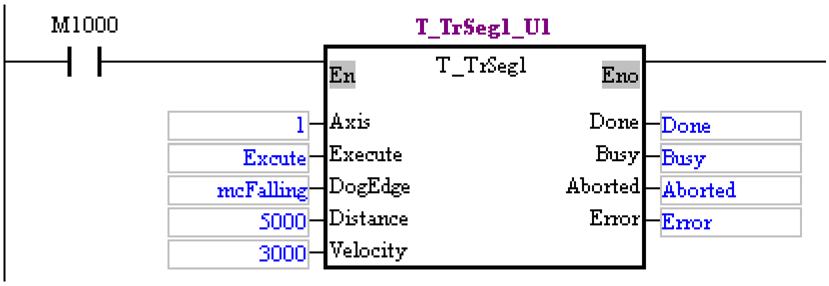
Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.
The motion control function block conflicts with other motion control function blocks.	Make sure that other uniaxial motion control function blocks are not started or the execution of other uniaxial motion control function blocks is complete before the motion control function block is started.

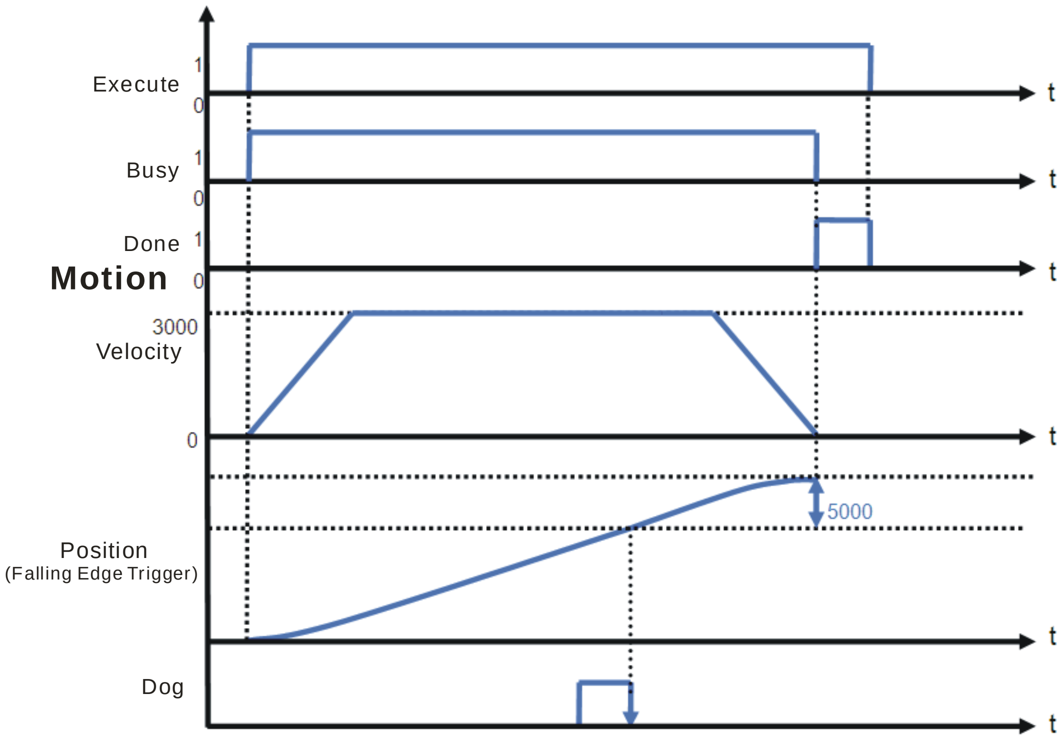
4. Examples

Example 1:

- The motion control function block T_TrSeg1 is used to insert single-speed motion which is triggered by a transition in DOG's signal from high to low.

The motion control function block named T_TrSeg1_U1 is set so that the first axis moves at a speed of 3,000 pulses per second, and will move for 5,000 pulses after a transition in DOG's signal from high to low. After the first axis moves for 5,000 pulses, Done will be set to True.

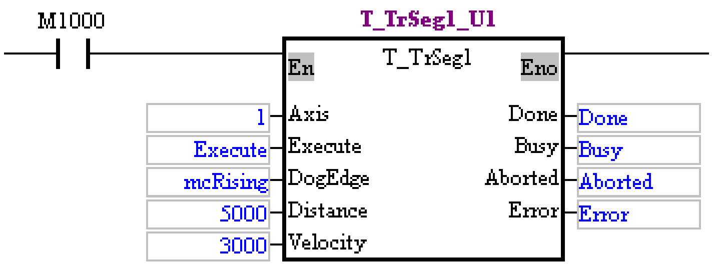


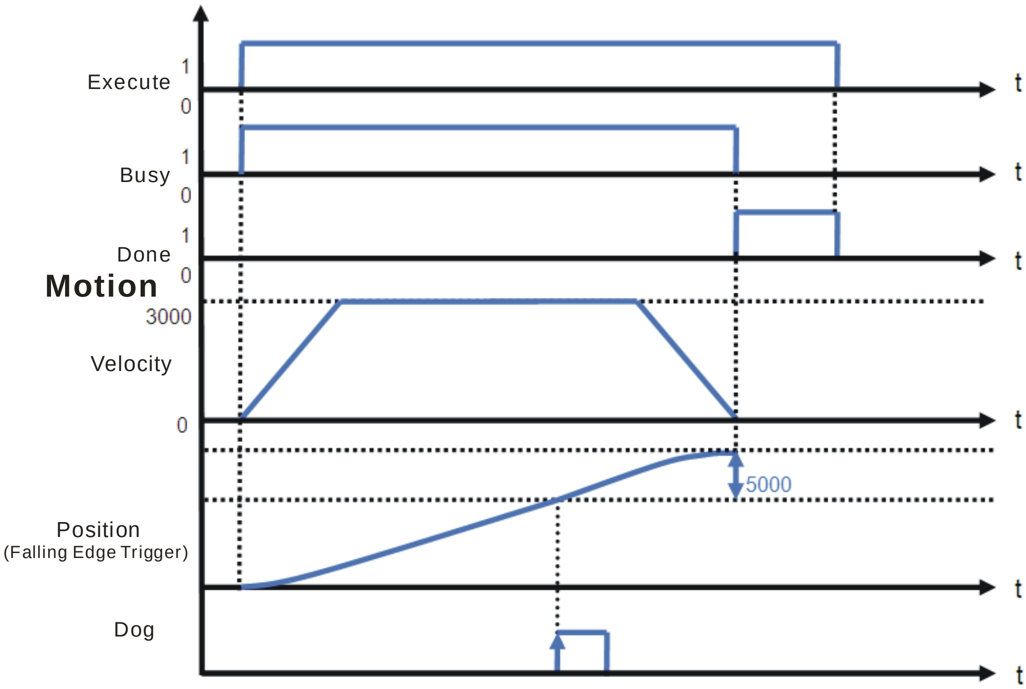


Example2:

- The motion control function block T_TrSeg1 is used to insert single-speed motion which is triggered by a transition in DOG's signal from low to high.

The motion control function block named T_TrSeg1_U1 is set so that the first axis moves at a speed of 3,000 pulses per second, and will move for 5,000 pulses after a transition in DOG's signal from low to high. After the first axis moves for 5,000 pulses, Done will be set to True.

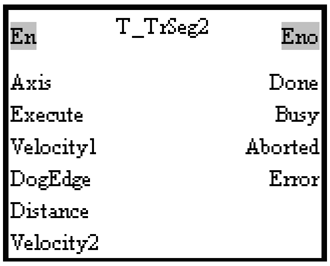




5. Module which is supported

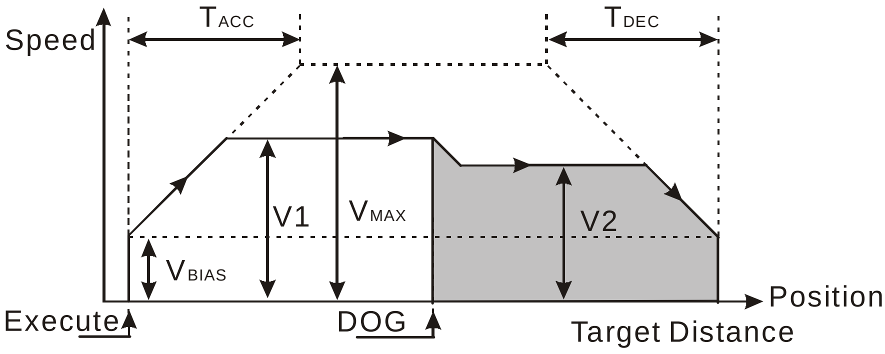
   The motion control function block T_TrSeg1 supports DVP10PM00M.

5.10.6 Inserting Two-speed Motion



1. Motion control function block

   The motion control function block T_TrSeg2 is used to insert two-speed motion. The speed of motion increases from the V_{BIAS} set to the V (I) set. After DOG's signal goes from low to high or from high to low, the speed of the motion will increase/decrease from the V (I) set to the V (II) set. The motion will not stop until the number of pulses output is near the value of the Distance input pin. Users can set the Vbias input pin, the Vmax input pin, the Tacc input pin, and the Tdec input pin in the motion control function block T_AxisSetting1. The number of pulses is a unit for the Distance input pin, and the number of pulses per second is a unit for the Velocity1 input pin/the Velocity2 input pin. The users can change the unit used by means of the motion control function block T_AxisSetting2. If the value of the DogEdge input pin is mcRising, motion will be triggered by a transition in DOG's signal from low to high. If the value of the DogEdge input pin is mcFalling, motion will be triggered by a transition in DOG's signal from high to low.



2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Axis	Motion axis number	WORD	K1~K6	The value of the Axis input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Execute	Motion is started when there is a transition in the Execute input pin's signal from low to high.	BOOL	True/False	-
DogEdge	Transition in DOG's signal from low to high or from high to low	BOOL	mcRising (True)/ mcFalling (False)	The value of the DogEdge input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Velocity1	Target speed before a transition in DOG's signal from low to high or from high to low	DWORD	K1~K2,147,483,647	The value of the Velocity1 input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Distance	Distance for which motion moves after a transition in DOG's signal from low to high or from high to low	DWORD	K-2,147,483,648~ K2,147,483,647	The value of the Distance input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Velocity2	Target speed after a transition in DOG's signal from low to high or from high to low	DWORD	K1~K2,147,483,647	The value of the Velocity2 input pin is valid when there is a transition in the Execute input pin's signal from low to high.

Output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Done	The execution of the motion control function block is complete.	BOOL	● There is a transition in the Done output pin's signal when motion is complete.	● There is a transition in the Done output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. ● If the Execute input pin is set to False when motion is complete, the Done output pin will be set to False in the next cycle.
Busy	The motion control function block is being executed.	BOOL	● There is a transition in the Busy output pin's signal from low to high when there is a transition in the Execute input pin's signal from low to high.	● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Done output pin's signal from low to high. ● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. ● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Aborted output pin's signal from low to high.
Aborted	The execution of the motion control function block is interrupted by a command.	BOOL	● The execution of the motion control function block is interrupted by a command.	● There is a transition in the Aborted output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. ● If the Execute input pin is set to False when the execution of the motion control function block is interrupted, the Aborted output pin will be set to False in the next cycle.
Error	An error occurs in the motion control function block.	BOOL	● Input values are incorrect. ● The axis specified is in motion before the motion control function block is executed.	● There is a transition in the Error output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.

The number of pulses is a unit for the Distance input pin, and the number of pulses per second is a unit for the Velocity1 input pin/the Velocity2 input pin. Users can change the unit used by means of the motion control function block T_AxisSetting2. If the value of the DogEdge input pin is mcRising, motion will be triggered by a transition in DOG's signal from low to high. If the value of the DogEdge input pin is mcFalling, motion will be triggered by a transition in DOG's signal from high to low.

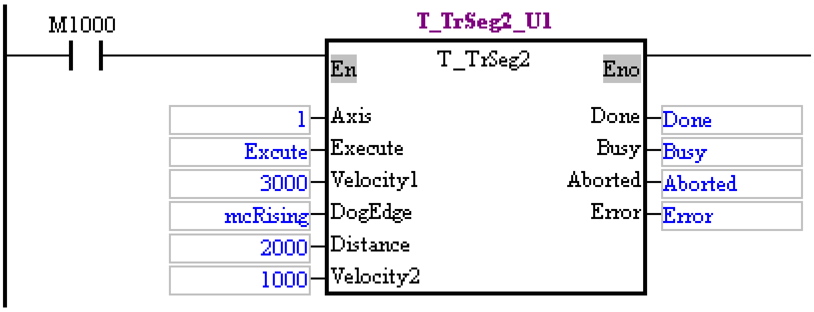
3. Troubleshooting

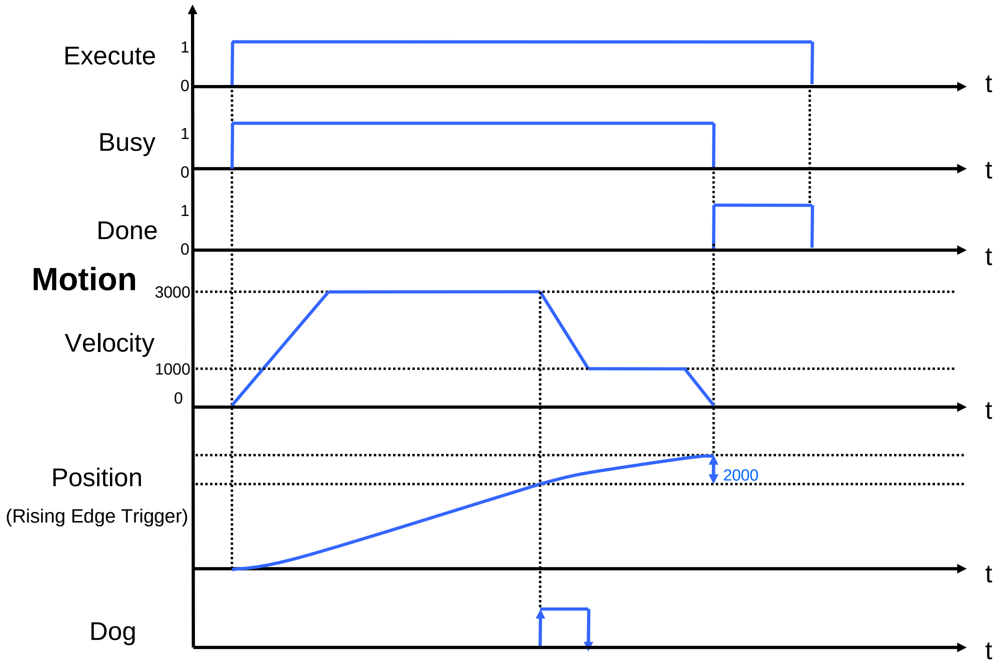
Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.
The motion control function block conflicts with other motion control function blocks.	Make sure that other uniaxial motion control function blocks are not started or the execution of other uniaxial motion control function blocks is complete before the motion control function block is started.

4. Example

The motion control function block T_TrSeg2 is used to insert two-speed motion which is triggered by a transition in DOG's signal from low to high.

The motion control function block named T_TrSeg2_U1 is set so that the first axis moves at a speed of 3,000 pulses per second, and will move for 2,000 pulses at a speed of 1,000 pulses per second after a transition in DOG's signal from low to high.



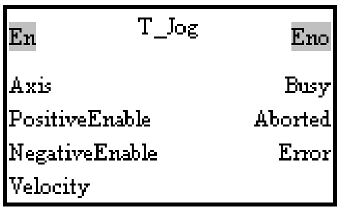


After the first axis moves for 2,000 pulses, Done will be set to True.

5. Module which is supported

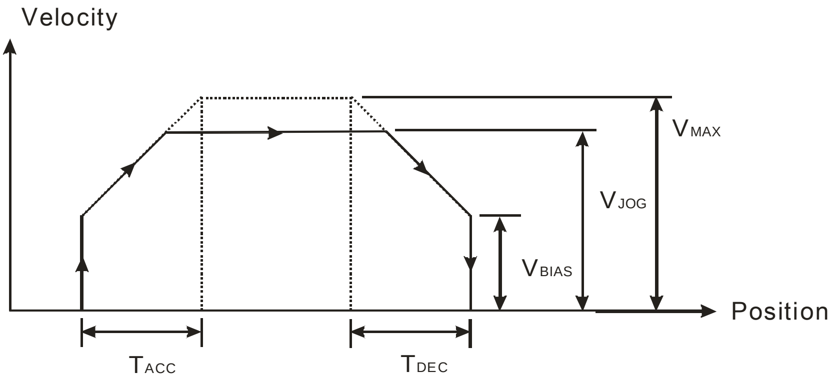
The motion control function block T_TrSeg2 supports DVP10PM00M.

5.10.7 JOG Motion



1. Motion control function block

The motion control function block T_Jog is used to start JOG motion. The value of the Axis input pin indicates an axis number, and the value of the Velocity input pin indicates the speed of JOG motion. If the PositiveEnable input pin is set to True, positive JOG motion will be started. If the NegativeEnable input pin is set to True, negative JOG motion will be started. The number of pulses per second is a unit for the Velocity input pin. Users can change the unit used by means of the motion control function block T_AxisSetting2.



2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Axis	Motion axis number	WORD	K1~K6	The value of the Axis input pin is valid when there is a transition in the Execute input pin's signal from low to high.
PositiveEnable	Enabling positive JOG motion	BOOL	True/False	● If the PositiveEnable input pin and the NegativeEnable input pin are set to True simultaneously, positive JOG motion will be enabled, and the NegativeEnable input pin will be reset to False. ● If the PositiveEnable input pin is set to True after the NegativeEnable input pin is set to True, the NegativeEnable input pin will be reset to False, the negative JOG motion will stop, and the positive JOG motion will be enabled.
NegativeEnable	Enabling negative JOG motion	BOOL	True/False	● If the PositiveEnable input pin and the NegativeEnable input pin are set to True simultaneously, positive JOG motion will be enabled, and the NegativeEnable input pin will be reset to False. ● If the NegativeEnable input pin is set to True after the PositiveEnable input pin is set to True, the PositiveEnable input pin will be reset to False, the positive JOG motion will stop, and the negative JOG motion will be enabled.
Velocity	Target speed	DWORD	K1~K2,147,483,647	When the motion control function block is executed, the value of the Velocity input pin is updated repeatedly.

Output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Busy	The motion control function block is being executed.	BOOL	• There is a transition in the Busy output pin's signal from low to high when there is a transition in the PositiveEnable input pin's signal from low to high or when there is a transition in the NegativeEnable input pin's signal from low to high.	• There is a transition in the Busy output pin's signal from high to low when motion stops. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Aborted output pin's signal from low to high.
Aborted	The execution of the motion control function block is interrupted by a command.	BOOL	• The execution of the motion control function block is interrupted by a command.	• There is a transition in the Aborted output pin's signal from high to low when there is a transition in the PositiveEnable input pin's signal from high to low or when there is a transition in the NegativeEnable input pin's signal from high to low. • If the PositiveEnable input pin and the NegativeEnable are set to False when the execution of the motion control function block is interrupted, the Aborted output pin will be set to False in the next cycle.
Error	An error occurs in the motion control function block.	BOOL	• Input values are incorrect. • The axis specified is in motion before the motion control function block is executed.	• There is a transition in the Error output pin's signal from high to low when there is a transition in the PositiveEnable input pin's signal from high to low or when there is a transition in the NegativeEnable input pin's signal from high to low.

The number of pulses per second is a unit for the Velocity input pin. Users can change the unit used by means of the motion control function block T_AxisSetting2.

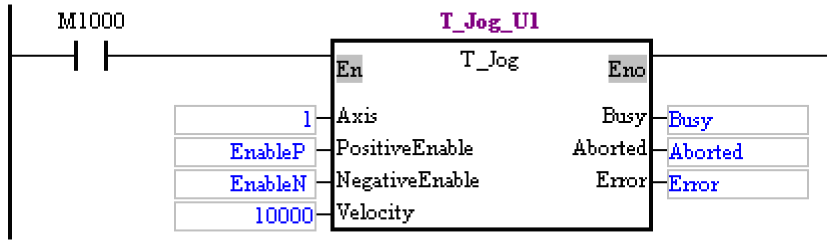
3. Troubleshooting

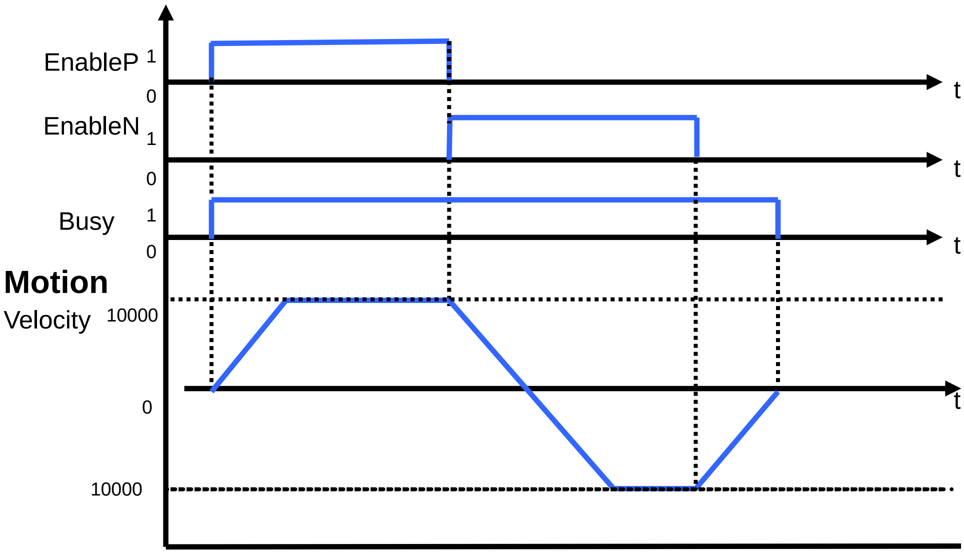
Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.
The motion control function block conflicts with other motion control function blocks.	Make sure that other uniaxial motion control function blocks are not started or the execution of other uniaxial motion control function blocks is complete before the motion control function block is started.

4. Example

The motion control function block T_Jog is used to start JOG motion. Positive JOG motion is enabled by EnableP, and negative JOG motion is enabled by EnableN.

The first axis moves at a speed of 10,000 pulses per second. If EnableP is set to 1, the first axis will move in the positive direction. If EnableN is set to 1, the first axis will move in the negative direction.



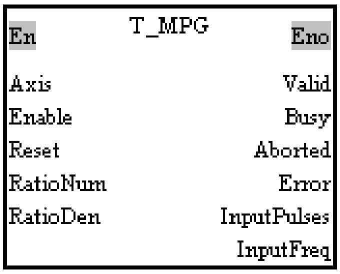


When EnableP is set to 1, the first axis moves at a speed of 10,000 pulses per second in the positive direction. When EnableN is set to 1, the first axis moves at a speed of 10,000 pulses per second in the negative direction. When EnableP and EnableN are not set to 1, the first axis stops moving.

5. Module which is supported

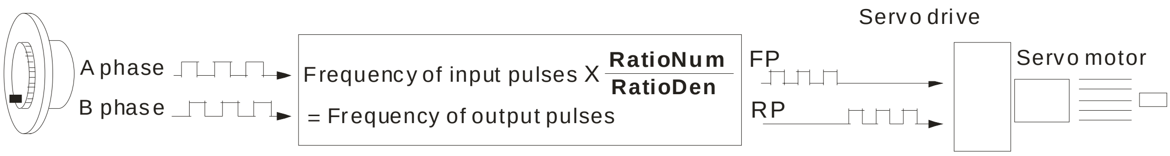
The motion control function block T_Jog supports DVP10PM00M.

5.10.8 Manual Pulse Generator Mode

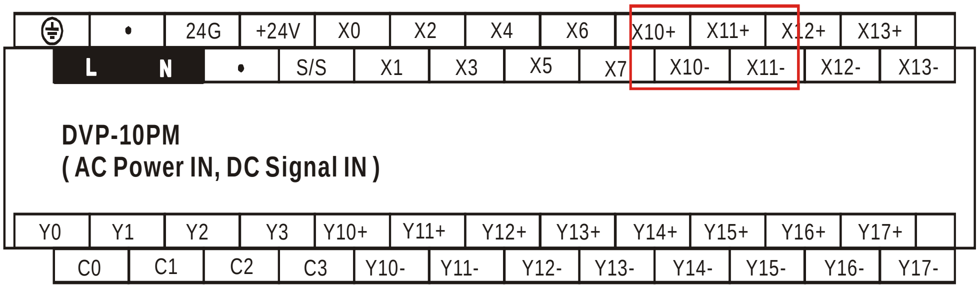


1. Motion control function block

The motion control function block T_MPG is used to enable a manual pulse generator mode. The value of the Axis input pin indicates an axis number. The motion of the axis specified follows the operation of a manual pulse generator. The relation between the position of the axis specified and the input pulses generated by the manual pulse generator used is determined by the RatioNum input pin and the RatioDen input pin. The speed at which the manual pulse generator used responds depends on the value of the Tacc input pin and the value of the Tdec input pin. Users can set the Tacc input pin and the Tdec input pin in the motion control function block T_AxisSetting1.



The input terminals which can be connected to a manual pulse generator are shown below.



The terminals in the red frame are for the first axis~the sixth axis.

2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Axis	Motion axis number	WORD	K1~K6	The value of the Axis input pin is valid when there is a transition in the Enable input pin's signal from low to high.
Enable	Manual pulse generator mode	BOOL	True/False	-
Reset	Resetting the manual pulse generator used	BOOL	True/False	The value of the Reset input pin is valid when there is a transition in the Enable input pin's signal from low to high.
RatioNum	Numerator of an electronic gear ratio	DWORD	K0~K32,767	When the motion control function block is executed, the value of the RatioNum input pin is updated repeatedly.
RatioDen	Denominator of an electronic gear ratio	DWORD	K1~K32,767	When the motion control function block is executed, the value of the RatioDen input pin is updated repeatedly.

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Valid	The execution of the motion control function block is complete.	BOOL	• There is a transition in the Valid output pin's signal from low to high when there is a transition in the Enable input pin's signal from low to high.	• There is a transition in the Valid output pin's signal from high to low when motion stops. • There is a transition in the Valid output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. • There is a transition in the Valid output pin's signal from high to low when there is a transition in the Aborted output pin's signal from low to high.
Busy	The motion control function block is being executed.	BOOL	• The execution of the motion control function block is interrupted by a command.	• There is a transition in the Busy output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low. • If the Enable input pin is set to False when the execution of the motion control function block is interrupted, the Aborted output pin will be set to False in the next cycle.

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Aborted	The execution of the motion control function block is interrupted by a command.	BOOL	● The execution of the motion control function block is interrupted by a command.	● There is a transition in the Aborted output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.
Error	An error occurs in the motion control function block.	BOOL	● Input values are incorrect. ● The axis specified is in motion before the motion control function block is executed.	● There is a transition in the Error output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.

Value output pin				
Name	**Function**	**Data type**	**Output range**	**Update**
InputPulses	Number of pulses generated by the manual pulse generator used	DWORD	K-2,147,483,648~ K2,147,483,647	When the motion control function block is executed, the value of the InputPulses output pin is updated repeatedly.
InputFreq	Frequency of pulses generated by the manual pulses generator used	DWORD	K0~K2,147,483,647	When the motion control function block is executed, the value of the InputFreq output pin is updated repeatedly.

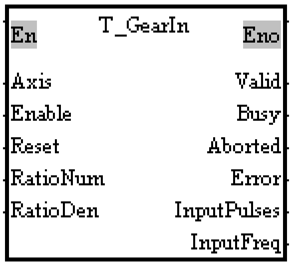
3. Troubleshooting

Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.
The motion control function block conflicts with other motion control function blocks.	Make sure that other uniaxial motion control function blocks are not started or the execution of other uniaxial motion control function blocks is complete before the motion control function block is started.

4. Module which is supported

The motion control function block T_MPG supports DVP10PM00M.

5.10.9 Electronic Gear Motion



1. Motion control function block

   The value of the RatioNum input pin is the numerator of an electronic gear ratio. The value of the RatioDen input pin is the denominator of an electronic gear ration. The Reset input pin is used to clear the number of input pulses. The speed at which the electronic gear used responds does not depend on the value of the Tacc input pin and the value of the Tdec input pin. The electronic gear used operates in accordance with the source of input. The input terminals for electronic gear motion are the same as the input terminals which can be connected to a manual pulse generator.

2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Axis	Slave axis number	WORD	K1~K6	The value of the Axis input pin is valid when there is a transition in the Enable input pin's signal from low to high.
Enable	Enabling electronic gear motion	BOOL	True/False	-
Reset	Resetting the InputPulses output pin	BOOL	True/False	The value of the Reset input pin is valid when there is a transition in the Enable input pin's signal from low to high.
RatioNum	Numerator of an electronic gear ratio	DWORD	K-32,767~K32,767	When the motion control function block is executed, the value of the RatioNum input pin is updated repeatedly.
RatioDen	Denominator of an electronic gear ratio	DWORD	K1~K32,767	When the motion control function block is executed, the value of the RatioDen input pin is updated repeatedly.

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Valid	An output value is valid.	BOOL	• There is a transition in the Valid output pin's signal from low to high when there is a transition in the Enable input pin's signal from low to high.	• There is a transition in the Valid output pin's signal from high to low when motion stops. • There is a transition in the Valid output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. • There is a transition in the Valid output pin's signal from high to low when there is a transition in the Aborted output pin's signal from low to high.

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Busy	The motion control function block is being executed.	BOOL	● The execution of the motion control function block is interrupted by a command.	● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low. ● If the Enable input pin is set to False when the execution of the motion control function block is interrupted, the Aborted output pin will be set to False in the next cycle.
Aborted	The execution of the motion control function block is interrupted by a command.	BOOL	● The execution of the motion control function block is interrupted by a command.	● There is a transition in the Aborted output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.
Error	An error occurs in the motion control function block.	BOOL	● Input values are incorrect. ● The axis specified is in motion before the motion control function block is executed.	● There is a transition in the Error output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.

Value output pin				
Name	**Function**	**Data type**	**Output range**	**Update**
InputPulses	Number of input pulses	DWORD	K-2,147,483,648~ K2,147,483,647	When the motion control function block is executed, the value of the InputPulses output pin is updated repeatedly.
InputFreq	Frequency of input pulses	DWORD	K0~K2,147,483,647	When the motion control function block is executed, the value of the InputFreq output pin is updated repeatedly.

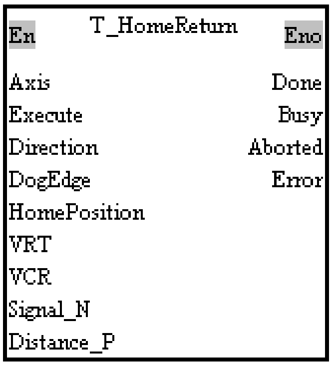
3. Troubleshooting

Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.
The motion control function block conflicts with other motion control function blocks.	Make sure that other uniaxial motion control function blocks are not started or the execution of other uniaxial motion control function blocks is complete before the motion control function block is started.

4. Module which is supported

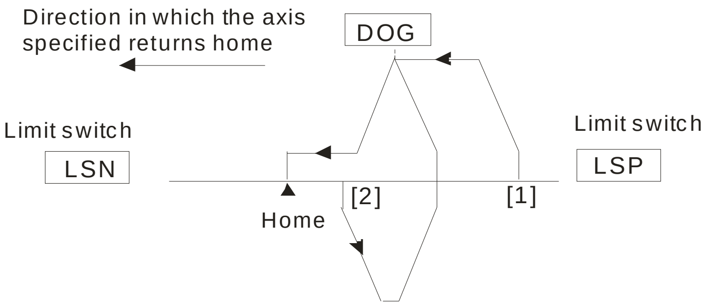
The motion control function block T_GearIn supports DVP10PM00M.

5.10.10 Returning Home



1. Motion control function block

   The motion control function block T-HomeReturn is used to start motion of returning home. The value of the Axis input pin indicates an axis number, and the value of the Direction input pin indicates whether the axis specified returns home in the positive direction or in the negative direction. The value of the VRT input pin indicates the speed at which the axis specified returns home. The value of the DogEdge input pin indicates whether motion is triggered by a transition in DOG's signal from low to high or from high to low. The value of the VCR input pin indicates the speed to which the speed of the axis specified decreases. The value of the Signal_N input pin is the number of zero pulses. The value of the Distance_P is the number of supplementary pulses needed. After motion of returning home is complete, the value of the HomePosition input pin will be taken as the present position of the axis specified. Motion of returning home is shown below.



   Position (1): Position [1] is at the right side of the home and DOG, and DOG is OFF.
   Position (2)*: Position [2] is at the right side of the home, and DOG is ON.
   *: Position (2) does not support the fifth axis and the sixth axis.

2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Axis	Motion axis number	WORD	K1~K6	The value of the Axis input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Execute	Motion is started when there is a transition in the Execute input pin's signal from low to high.	BOOL	True/False	-

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Direction	Direction in which the axis specified returns home	BOOL	mcNegative (False)/ mcPositive (True)	The value of the Direction input pin is valid when there is a transition in the Execute input pin's signal from low to high.
DogEdge	Transition in DOG's signal from low to high or from high to low	BOOL	mcFalling (False)/ mcRising (True)	The value of the DogEdge input pin is valid when there is a transition in the Execute input pin's signal from low to high.
HomePosition	Home position	DWORD	K-2,147,483,648~ K2,147,483,647	The value of the HomePosition input pin is valid when there is a transition in the Execute input pin's signal from low to high.
VRT	Speed at which the axis specified returns home	DWORD	K1~K1000000	The value of the VRT input pin is valid when there is a transition in the Execute input pin's signal from low to high.
VCR	Speed to which the speed of the axis specified decreases	DWORD	K1~VRT	The value of the VCR input pin is valid when there is a transition in the Execute input pin's signal form low to high.
Signal_N	Number of zero pulses	WORD	K0~K32,767	The value of the Signal_N input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Distance_P	Number of supplementary pulses	WORD	K-32768~K32,767	The value of the Distance_P input pin is valid when there is a transition in the Execute input pin's signal from low to high.

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Done	The execution of the motion control function block is complete.	BOOL	● There is a transition in the Done output pin's signal from low to high when motion of returning home is complete.	● There is a transition in the Done output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. ● If the Execute input pin is set to False when the execution of the motion control function block is complete, the Done output pin will be set to False in the next cycle.

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Busy	The motion control function block is being executed.	BOOL	• There is a transition in the Busy output pin's signal from low to high when there is a transition in the Execute input pin's signal from low to high.	• There is a transition in the Busy output pin's signal from high to low when there is a transition in the Done output pin's signal from low to high. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. • There is a transition in the Busy output pin's signal from high to low when there is a transition in the Aborted output pin's signal from low to high.
Aborted	The execution of the motion control function block is interrupted by a command.	BOOL	• The execution of the motion control function block is interrupted by a command.	• There is a transition in the Aborted output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. • If the Execute input pin is set to False when the execution of the motion control function block is interrupted, the Aborted output pin will be set to False in the next cycle.
Error	An error occurs in the motion control function block.	BOOL	• Input values are incorrect. • The axis specified is in motion before the motion control function block is executed.	• There is a transition in the Error output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.

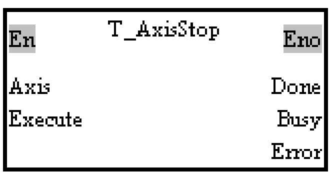
3. Troubleshooting

Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.
The motion control function block conflicts with other motion control function blocks.	Make sure that other uniaxial motion control function blocks are not started or the execution of other uniaxial motion control function blocks is complete before the motion control function block is started.

4. Module which is supported

   The motion control function block T-HomeReturn supports DVP10PM00M.

5.10.11 Stopping Uniaxial Motion



1. Motion control function block

   The motion control function block T_AxisStop is used to stop the motion of the axis specified. The value of the Axis input pin indicates an axis number.

2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Axis	Motion axis number	WORD	K1~K6	The value of the Axis input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Execute	Motion is started when there is a transition in the Execute input pin's signal from low to high.	BOOL	True/False	-

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Done	The execution of the motion control function block is complete.	BOOL	● There is a transition in the Done output pin's signal from low to high when motion of returning home is complete.	● There is a transition in the Done output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. ● If the Execute input pin is set to False when the execution of the motion control function block is complete, the Done output pin will be set to False in the next cycle.
Busy	The motion control function block is being executed.	BOOL	● There is a transition in the Busy output pin's signal from low to high when there is a transition in the Execute input pin's signal from low to high.	● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Done output pin's signal from low to high. ● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. ● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Aborted output pin's signal from low to high.
Error	An error occurs in the motion control function block.	BOOL	● Input values are incorrect. ● The motion of the axis specified is not uniaxial motion, gear motion, or cam motion.	● There is a transition in the Error output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.

3. Troubleshooting

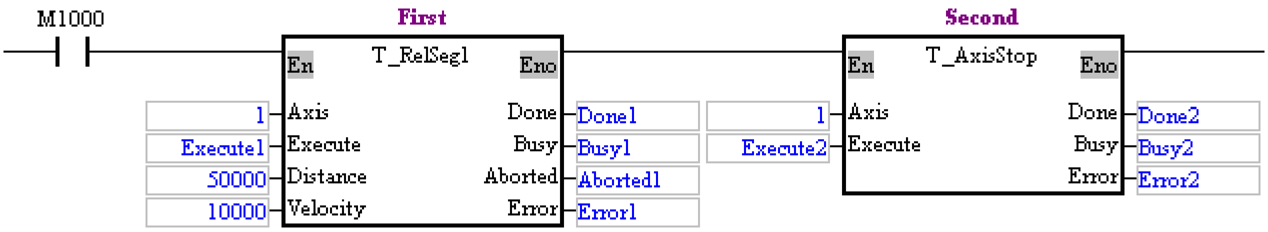
Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.

Error	Troubleshooting
The motion control function block conflicts with other motion control function blocks.	Make sure that other uniaxial motion control function blocks are not started or the execution of other uniaxial motion control function blocks is complete before the motion control function block is started.

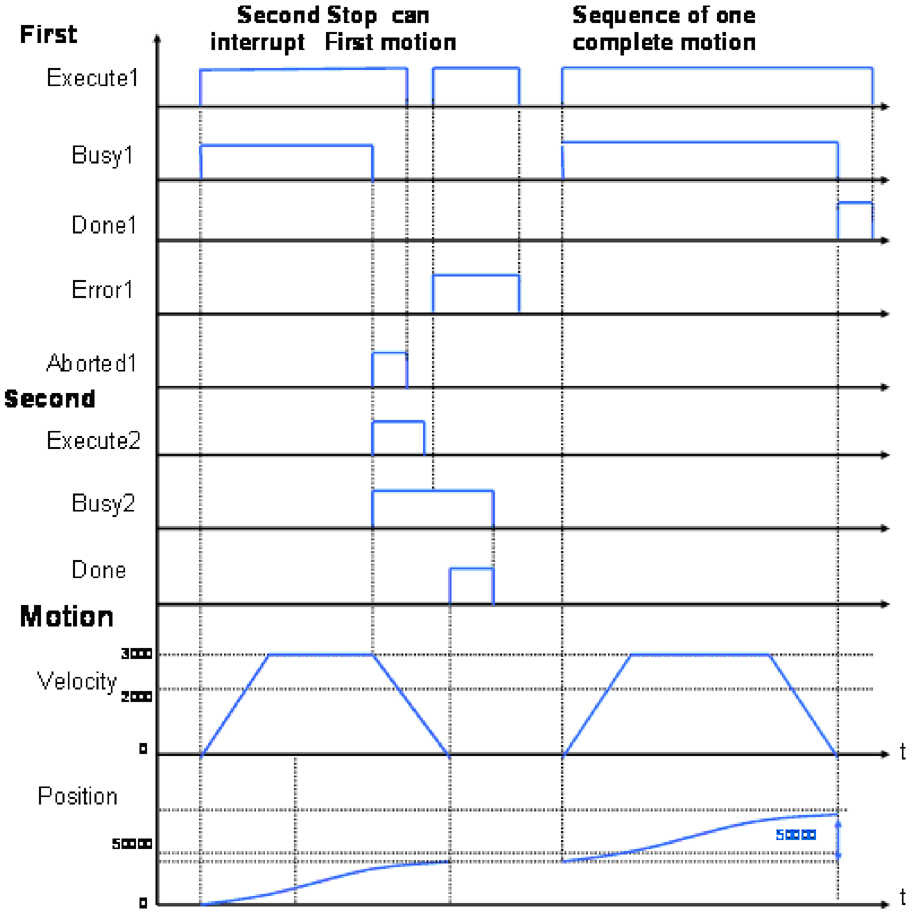
4. Example

The single-speed motion of an axis is started, and then the motion control function block T_AxisStop is used to stop the motion.

The motion control function block named First is used to start single-speed motion. It is set so that the first axis moves for 50,000 pulses at a speed of 10,000 per second. The motion control function block named Second is used to stop the motion of the first axis.



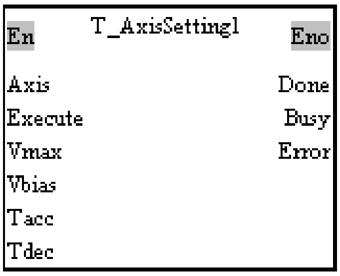
The motion control function block named First is started. Before Done 1 is set to True, Execute2 is used to start the motion control function block named Second.



After the motion control function block named First is started, the first axis will move at a speed of 10,000 pulses per second. After the motion control function block named Second is started, Aborted1 will be set to True, Busy1 will be set to False, and the first axis will stop moving. When the motion control function block named Second is used to stop the motion of the first axis, no motion can be started. If any motion is started, an error will occur.

5. Module which is supported
   The motion control function block T_AxisStop supports DVP10PM00M.

5.10.12 Parameter Setting I



1. Motion control function block
   The motion control function block T_AxisSetting1 is used to set motion parameters. The value of the Axis input pin indicates an axis number. Users can set the maximum speed of the axis specified, the start-up speed of the axis specified, the time it takes for the start-up speed of the axis specified to increase to its maximum speed, and the time it takes for the maximum speed of the axis specified to decrease to its start-up speed. The setting of the Unit input pin in the motion control function block T_AxisSetting2 determines the unit for the Vmax input pin and the unit for the Vbias input pin.
2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Axis	Motion axis number	WORD	K1~K6	The value of the Axis input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Execute	Motion is started when there is a transition in the Execute input pin's signal from low to high.	BOOL	True/False	-
Vmax	Maximum speed	DWORD	K1~K2,147,483,647	The value of the Vmax input pin is valid when there is a transition in the Execute input pin's signal from low tot high.
Vbias	Start-up speed	DWORD	K0~K2,147,483,647	The value of the Vbias input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Tacc	Acceleration time (Unit: ms)	WORD	K0~K32,767	The value of the Tacc input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Tdec	Deceleration time (Unit: ms)	WORD	K0~K32,767	The value of the Tdec input pin is valid when there is a transition in the Execute input pin's signal from low to high.

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Done	The execution of the motion control function block is complete.	BOOL	● There is a transition in the Done output pin's signal from low to high when motion of returning home is complete.	● There is a transition in the Done output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. ● If the Execute input pin is set to False when the execution of the motion control function block is complete, the Done output pin will be set to False in the next cycle. 。
Busy	The motion control function block is being executed.	BOOL	● There is a transition in the Busy output pin's signal from low to high when there is a transition in the Execute input pin's signal from low to high.	● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Done output pin's signal from low to high. ● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. ● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Aborted output pin's signal from low to high.
Error	An error occurs in the motion control function block.	BOOL	● Input values are incorrect.	● There is a transition in the Error output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.

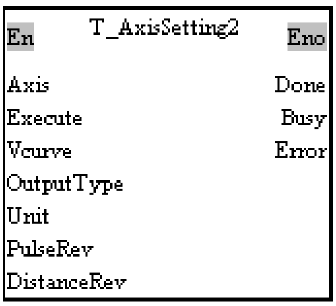
3. Troubleshooting

Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.

4. Module which is supported

   The motion control function block T_AxisSetting1 supports DVP10PM00M.

5.10.13 Parameter Setting II



1. Motion control function block

   The motion control function block T_AxisSetting2 is used to set motion parameters. The value of the Axis input pin indicates an axis number. Users can set the velocity curve of the axis specified, an output type, and a unit. The setting of a unit requires the number of pulses it takes for a motor to rotate once and the distance for which the axis specified moves when the motor rotates once.

There are three types of units. They are motor units, compound units, and mechanical units. The setting of a unit requires the number of pulses it takes for a motor to rotate once (the value of the PulseRev input pin) and the distance for which the axis specified moves when the motor rotates once (the value of the DistanceRev input pin). The units for positions and speeds are as shown below.

	Motor unit	Compound unit	Mechanical unit
Position	pulse	µm	µm
	pulse	mdeg	mdeg
	pulse	10^{-4} inches	10^{-4} inches
Speed	pulse/second	centimeter/minute	pulse/second
	pulse/second	10 degrees/minute	pulse/second
	pulse/second	inch/minute	pulse/second

2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Axis	Motion axis number	WORD	K1~K6	The value of the Axis input pin is valid when there is a transition in the Execute input pin’s signal from low to high.
Execute	Motion is started when there is a transition in the Execute input pin’s signal from low to high.	BOOL	True/False	-
Vcure	Velocity curve	BOOL	mcTrapezoid: False mcSCurve: True	The value of the Vcurve input pin is valid when there is a transition in the Execute input pin’s signal from low to high.
OutputType	Output type	WORD	mcUD: 0 mcPD: 1 mcAB: 2 mc4AB: 3	The value of the OutputType input pin is valid when there is a transition in the Execute input pin’s signal from low to high.
Unit	Unit	WORD	mcMotor: 0 mcMachine: 1 mcComp: 2	The value of the Unit input pin is valid when there is a transition in the Execute input pin’s signal from low to high.
PulseRev	Number of pulses it takes for a motor to rotate once	WORD	K1~K2,147,483,647	The value of the PulseRev input pin is valid when there is a transition in the Execute input pin’s signal from low to high.
DistanceRev	Distance for which the axis specified moves when the motor used rotates once	WORD	K1~K2,147,483,647	The value of the DistanceRev input pin is valid when there is a transition in the Execute input pin’s signal from low to high.

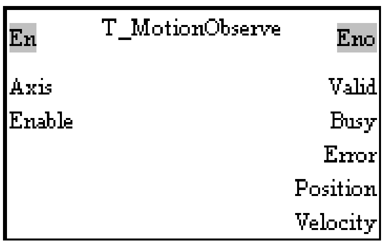
State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Done	The execution of the motion control function block is complete.	BOOL	● There is a transition in the Done output pin's signal from low to high when motion of returning home is complete.	● There is a transition in the Done output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low. ● If the Execute input pin is set to False when the execution of the motion control function block is complete, the Done output pin will be set to False in the next cycle.
Busy	The motion control function block is being executed.	BOOL	● There is a transition in the Busy output pin's signal from low to high when there is a transition in the Execute input pin's signal from low to high.	● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Done output pin's signal from low to high. ● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. ● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Aborted output pin's signal from low to high.
Error	An error occurs in the motion control function block.	BOOL	● Input values are incorrect.	● There is a transition in the Error output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.

3. Troubleshooting

Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.

4. Module which is supported
   The motion control function block T_AxisSetting2 supports DVP10PM00M.

5.10.14 Reading the Present Position / Speed of an Axis



1. Motion control function block
   The motion control function block T_MotionObserve is used to read the present position/speed of an axis. The value of the Axis input pin indicates an axis number. After the motion control function block is started, users can read the present position of the axis specified through the Position output pin, and the speed of the axis specified through the Velocity output pin.

2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Axis	Motion axis number	WORD	K1~K6	The value of the Axis input pin is valid when there is a transition in the Enable input pin's signal from low to high.
Enable	Manual pulse generator mode	BOOL	True/False	-

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Valid	The execution of the motion control function block is complete.	BOOL	● There is a transition in the Valid output pin's signal from low to high when there is a transition in the Enable input pin's signal from low to high.	● There is a transition in the Valid output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low. ● There is a transition in the Valid output pin's signal from high to low when there is a transition in the Error input pin's signal from low to high.
Busy	The motion control function block is being executed.	BOOL	● There is a transition in the Busy output pin's signal from low to high when there is a transition in the Enable input pin's signal from low to high.	● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low. ● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high.
Error	An error occurs in the motion control function block.	BOOL	● Input values are incorrect.	● There is a transition in the Error output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.

Value output pin				
Name	**Function**	**Data type**	**Output range**	**Update**
Position	Present position (Pulse unit)	DWORD	K-2,147,483,648~ K2,147,483,647	When the motion control function block is executed, the value of the Position output pin is updated repeatedly.
Velocity	Present speed (Pulse unit)	DWORD	K0~K2,147,483,647	When the motion control function block is executed, the value of the Velocity output pin is updated repeatedly.

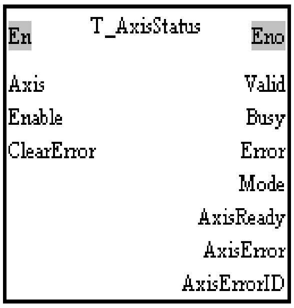
3. Troubleshooting

Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.

4. Module which is supported

The motion control function block T_MotionObserve supports DVP10PM00M.

5.10.15 State of an Axis



1. Motion control function block

   The motion control function block is T_AxisStatus is used to read and clear the present erroneous state of an axis. The value of the Axis input pin indicates an axis number. Users can clear the present erroneous state of the axis specified by means of the ClearError input pin. The value of the AxisErrorID output pin indicates the present erroneous state of the axis specified.
2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Axis	Motion axis number	WORD	K1~K6	The value of the Axis input pin is valid when there is a transition in the Enable input pin's signal from low to high.
Enable	Reading the present erroneous state of the axis specified.	BOOL	True/False	-
ClearError	The erroneous state of the axis specified is cleared when there is a transition in the ClearError input pin's signal from low to high.	BOOL	True/False	The value of the ClearError input pin is valid when the motion control function block is executed.

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Valid	An output value is valid.	BOOL	● There is a transition in the Valid output pin's signal from low to high when there is a transition in the Enable input pin's signal from low to high.	● There is a transition in the Valid output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low. ● There is a transition in the Valid output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high.

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Busy	The motion control function block is being executed.	BOOL	● There is a transition in the Busy output pin's signal from low to high when there is a transition in the Enable input pin's signal from low to high.	● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low. ● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high.
Error	An error occurs in the motion control function block.	BOOL	● Input values are incorrect.	● There is a transition in the Error output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.

Value output pin				
Name	**Function**	**Data type**	**Output range**	**Update**
Mode	Mode of motion	WORD	H0~H32x (*1)	When the motion control function block is executed, the value of the Mode output pin is updated repeatedly.
AxisReady	Ready flag for the axis specified	BOOL	True/False	When the motion control function block is executed, the value of the AxisReady output pin is updated repeatedly.
AxisError	Axis error flag	BOOL	True/False	When the motion control function block is executed, the value of the AxisError output pin is updated repeatedly.
AxisErrorID	Error code	WORD	H0002~HC4FF	When the motion control function block is executed, the value of the AxisErrorID output pin is updated repeatedly.

*1: Value of the Mode output pin

Value	Definition
H0	Idle
H100	Uniaxial motion is being stopped.
H101	Absolute single-speed motion
H102	Relative single-speed motion
H103	Absolute two-speed motion
H104	Relative two-speed motion
H105	Inserting single-speed motion
H106	Inserting two-speed motion
H107	JOG motion
H108	Manual pulse generator mode
H109	Motion of returning home
H10A	Electronic gear motion
H300	Multiaxial interpolation is being stopped.
H31x	Multiaxial absolute linear interpolation
H32x	Multiaxial relative linear interpolation

Please refer to appendix A in chapter 9 for more information about error codes.

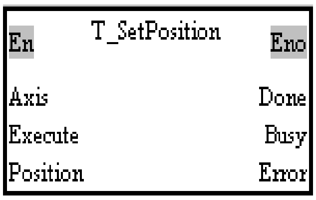
3. Troubleshooting

Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.

4. Module which is supported

The motion control function block is T_AxisStatus supports DVP10PM00M.

5.10.16 Setting the Present Position of an Axis



1. Motion control function block

The motion control function block T_SetPosition is used to set the present position of an axis. The value of the Axis input pin indicates an axis number. Users can set the present position of the axis specified by means of the Position input pin. Note: To prevent errors from occurring, please avoid using the motion control function block to set the present position of the master axis involved in cam motion or gear motion.

2. Input pins/Output pins

Input pin				
Name	Function	Data type	Setting value	Time when a value is valid
Axis	Motion axis number	WORD	K1~K6	The value of the Axis input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Execute	Motion is started when there is a transition in the Execute input pin's signal from low to high.	BOOL	True/False	-
Position	Present position of the axis specified	DWORD	K-2,147,483,648~ K2,147,483,647	The value of the Position input pin is valid when there is a transition in the Execute input pin's signal from low to high.

State output pin				
Name	Function	Data type	Time when there is a transition in an output pin's signal from low to high	Time when there is a transition in an output pin's signal from high to low
Done	The execution of the motion control function block is complete.	BOOL	• The writing of a position is complete.	• There is a transition in the Done output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Busy	The motion control function block is being executed.	BOOL	● There is a transition in the Busy output pin's signal from low to high when there is a transition in the Execute input pin's signal from low to high.	● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Done output pin's signal from low to high. ● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high.
Error	An error occurs in the motion control function block.	BOOL	● Input values are incorrect.	● There is a transition in the Error output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.

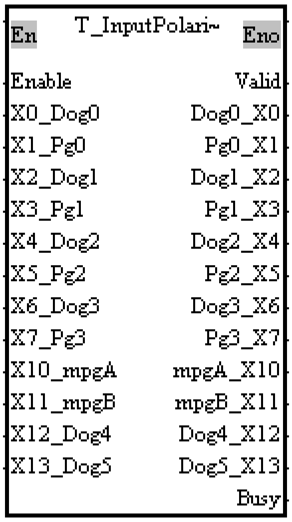
3. Troubleshooting

Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.

4. Module which is supported

The motion control function block T_SetPosition supports DVP10PM00M.

5.10.17 Setting the Polarities of Input Terminals



1. Motion control function block

The motion control function block T_InputPolarity is used to set the polarities of the input terminals on the DVP-10PM series motion controller used. Users can set the polarities of the input terminals on the DVP-10PM series motion controller used by means of input pins.

2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Enable	Manual pulse generator mode	BOOL	True/False	-

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
X0_Dog0	Polarity	BOOL	mcNO: False mcNC: True	When the motion control function block is executed, the values of the input pins are updated repeatedly.
X1_Pg0	Polarity	BOOL		
X2_Dog1	Polarity	BOOL		
X3_Pg1	Polarity	BOOL		
X4_Dog2	Polarity	BOOL		
X5_Pg2	Polarity	BOOL		
X6_Dog3	Polarity	BOOL		
X7_Pg3	Polarity	BOOL		
X10_mpgA	Polarity	BOOL		
X11_mpgB	Polarity	BOOL		
X12_Dog4	Polarity	BOOL		
X13_Dog5	Polarity	BOOL		

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Valid	The execution of the motion control function block is complete.	BOOL	● There is a transition in the Valid output pin's signal from low to high when there is a transition in the Enable input pin's signal from low to high.	● There is a transition in the Valid output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.
Busy	The motion control function block is being executed.	BOOL	● There is a transition in the Busy output pin's signal from low to high when there is a transition in the Enable input pin's signal from low to high.	● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.
Dog0_X0	Polarity	BOOL	● When input pins are set to True, and the input terminals are OFF, there are transitions in these output pins' signals from low to high. ● When input pins are set to False, and the input terminals are ON, there are transitions in these output pins' signals from low to high.	● When input pins are set to True, and the input terminals are ON, there are transitions in these output pins' signals from high to low. ● When input pins are set to False, and the input terminals are OFF, there are transitions in these output pins' signals from high to low. ● There are transitions in these output pins' signals from high to low when there is a transition in the Enable input pin's signal from high to low.
Pg0_ X1	Polarity	BOOL		
Dog1_X2	Polarity	BOOL		
Pg1_X3	Polarity	BOOL		
Dog2_X4	Polarity	BOOL		
Pg2_X5	Polarity	BOOL		
Dog3_X6	Polarity	BOOL		
Pg3_X7	Polarity	BOOL		
mpgA_X10	Polarity	BOOL		
mpgB_X11	Polarity	BOOL		
Dog4_X12	Polarity	BOOL		
Dog5_X13	Polarity	BOOL		

3. Troubleshooting

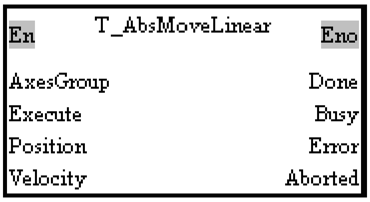
Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.

4. Module which is supported

   The motion control function block T_InputPolarity supports DVP10PM00M.

5.11 Multiaxial Motion Control Function Blocks

5.11.1 Multiaxial Absolute Linear Interpolation



1. Motion control function block

   The motion control function block T_AbsMoveLinear is used to start multiaxial absolute linear interpolation. Users can set the axes which execute interpolation by means of the AxesGroup input pin, set the target positions of the axes specified by means of the Position input pin, and set the speed of the axes specified by means of the Velocity input pin.

2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
AxesGroup	Axes which execute interpolation	WORD[6]	[_,_,_,_,_,_] 0: Not setting axes n: Adding the n[th] axis (n is in the range of 1 to 6.) (The first cell must be set.)	The value of the AxesGroup input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Execute	Motion is started when there is a transition in the Execute input pin's signal from low to high.	BOOL	True/False	-
Position	Target positions	DWORD[6]	[_,_,_,_,_,_] K-2,147,483,648~ K2,147,483,647	The value of the Position input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Velocity	Speed of interpolation	DWORD	K1~K2,147,483,647	The value of the Velocity input pin is valid when there is a transition in the Execute input pin's signal from low to high.

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Done	The execution of the motion control function block is complete.	BOOL	● There is a transition in the Done output pin's signal from low to high when the execution of the motion control function block is complete.	● There is a transition in the Done output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.
Busy	The motion control function block is being executed.	BOOL	● There is a transition in the Busy output pin's signal from low to high when there is a transition in the Execute input pin's signal from low to high.	● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. ● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Done output pin's signal from low to high.
Error	An error occurs in the motion control function block.	BOOL	● Input values are incorrect.	● There is a transition in the Error output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.
Aborted	The execution of the motion control function block is interrupted by a command.	BOOL	● The execution of the motion control function block is interrupted by a command.	● There is a transition in the Aborted output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.

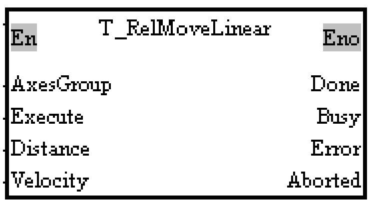
3. Troubleshooting

Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.
The motion control function block conflicts with other motion control function blocks.	Make sure that other uniaxial motion control function blocks are not started or the execution of other uniaxial motion control function blocks is complete before the motion control function block is started.

4. Module which is supported

   The motion control function block T_AbsMoveLinear supports DVP10PM00M.

5.11.2 Multiaxial Relative Linear Interpolation



1. Motion control function block

   The motion control function block T_RelMoveLinear is used to start multiaxial relative linear interpolation. Users can set the axes which execute interpolation by means of the AxesGroup input pin, set the distances for which the axes specified move by means of the Distance input pin, and set the speed of the axes specified by means of the Velocity input pin.

2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
AxesGroup	Axes which execute interpolation	WORD[6]	[_,_,_,_,_,_] 0: Not setting axes n: Adding the n^{th} axis (n is in the range of 1 to 6.) (The first cell must be set.)	The value of the AxesGroup input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Execute	Motion is started when there is a transition in the Execute input pin's signal from low to high.	BOOL	True/False	-
Distance	Distances for which the axes specified move	DWORD[6]	[_,_,_,_,_,_] K-2,147,483,648~ K2,147,483,647	The value of the Distance input pin is valid when there is a transition in the Execute input pin's signal from low to high.
Velocity	Speed of interpolation	DWORD	K1~K2,147,483,647	The value of the Velocity input pin is valid when there is a transition in the Execute input pin's signal from low to high.

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Done	The execution of the motion control function block is complete.	BOOL	● There is a transition in the Done output pin's signal from low to high when the execution of the motion control function block is complete.	● There is a transition in the Done output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.
Busy	The motion control function block is being executed.	BOOL	● There is a transition in the Busy output pin's signal from low to high when there is a transition in the Execute input pin's signal from low to high.	● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. ● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Done output pin's signal from low to high.
Error	An error occurs in the motion control function block.	BOOL	● Input values are incorrect.	● There is a transition in the Error output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Aborted	The execution of the motion control function block is interrupted by a command.	BOOL	● The execution of the motion control function block is interrupted by a command.	● There is a transition in the Aborted output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.

3. Troubleshooting

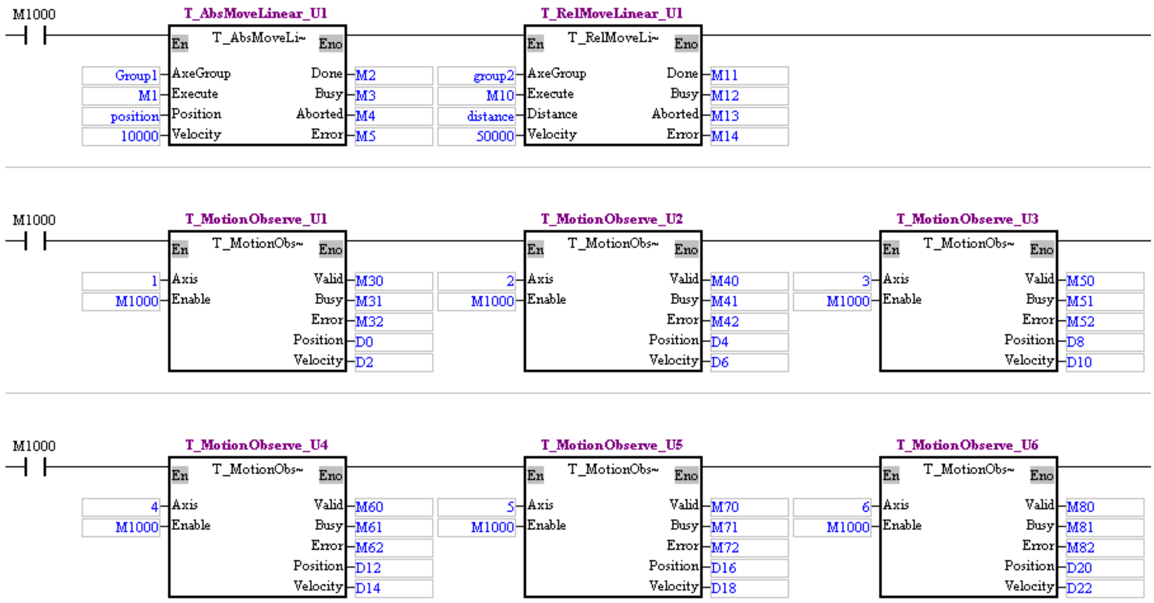
Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.
The motion control function block conflicts with other motion control function blocks.	Make sure that other uniaxial motion control function blocks are not started or the execution of other uniaxial motion control function blocks is complete before the motion control function block is started.

4. Example

Purpose:

- The motion control function block T_AbsMoveLinear and the motion control function block T_RelMoveLinear are used to start the absolute linear interpolation executed by the axes specified and the relative linear interpolation executed by the axes specified.

Local Symbols					
Class...	Identifiers	Address	Type...	Initial	Comment...
VAR	Group1		WORD[6]	[0(6)]	
VAR	Group2		WORD[6]	[0(6)]	
VAR	Position		DWORD[6]	[0(6)]	
VAR	Distance		DWORD[6]	[0(6)]	

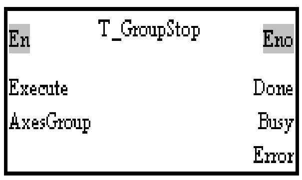


- Create the two identifiers Group1 and Group2 in the local symbol table in O100. Group1 is an array composed of 6 words. Group2 is an array composed of 6 words.
- Create the two identifiers Position and Distance in the local symbol table in O100. Position is an array composed of 6 double words. Distance is an array composed of 6 double words.
- When the program is executed, the array indicated by Group1 is set to [1, 2, 3, 0, 0, 0]. The first axis, the second axis, and the third axis are used to execute linear interpolation.
- When the program is executed, the array indicated by Group2 is set to [4, 5, 6, 0, 0, 0]. The fourth axis, the fifth axis, and the sixth axis are used to execute linear interpolation.
- When the program is executed, the array indicated by Position is set to [15000, 30000, -15000, 0, 0, 0]. [15000, 30000, -15000, 0, 0, 0] indicates the target positions of the absolute linear interpolation executed by the first axis, the second axis, and the third axis.
- When the program is executed, the array indicated by Distance is set to [1000, 10000, -10000, 0, 0, 0]. [1000, 10000, -10000, 0, 0, 0] indicates the distances for which the fourth axis, the fifith axis, and the sixth axis move when the fourth axis, the fifith axis, and the sixth axis execute relative linear interpolation.
- After M1 is set to ON, the multiaxial absolute linear interpolation set will be started.
- After M10 is set to ON, the multiaxial absolute linear interpolation set will be started.
- Users can use the motion control function block T_MotionObserve to check whether the positions of the axes which execute the linear interpolation set are correct.

5. Module which is supported

   The motion control function block T_RelMoveLinear supports DVP10PM00M.

5.11.3 Stopping Multiaxial Linear Interpolation



1. Motion control function block

   The motion control function block T_GroupStop is used to stop multiaxial linear interpolation. Users can set the axes which execute interpolation by means of the AxesGroup input pin.

2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Execute	Linear interpolation is stopped when there is a transition in the Execute input pin's signal from low to high.	BOOL	True/False	-
AxesGroup	Axes which execute interpolation	WORD[6]	[_,_,_,_,_] 0: Not setting axes n: Adding the n^{th} axis (n is in the range of 1 to 6.) (The first cell must be set.)	The value of the AxesGroup input pin is valid when there is a transition in the Execute input pin's signal from low to high.

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Done	The execution of the motion control function block is complete.	BOOL	● There is a transition in the Done output pin's signal from low to high when the execution of the motion control function block is complete.	● There is a transition in the Done output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.
Busy	The motion control function block is being executed.	BOOL	● There is a transition in the Busy output pin's signal from low to high when there is a transition in the Execute input pin's signal from low to high.	● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. ● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Done output pin's signal from low to high.
Error	An error occurs in the motion control function block.	BOOL	● Input values are incorrect.	● There is a transition in the Error output pin's signal from high to low when there is a transition in the Execute input pin's signal from high to low.

3. Troubleshooting

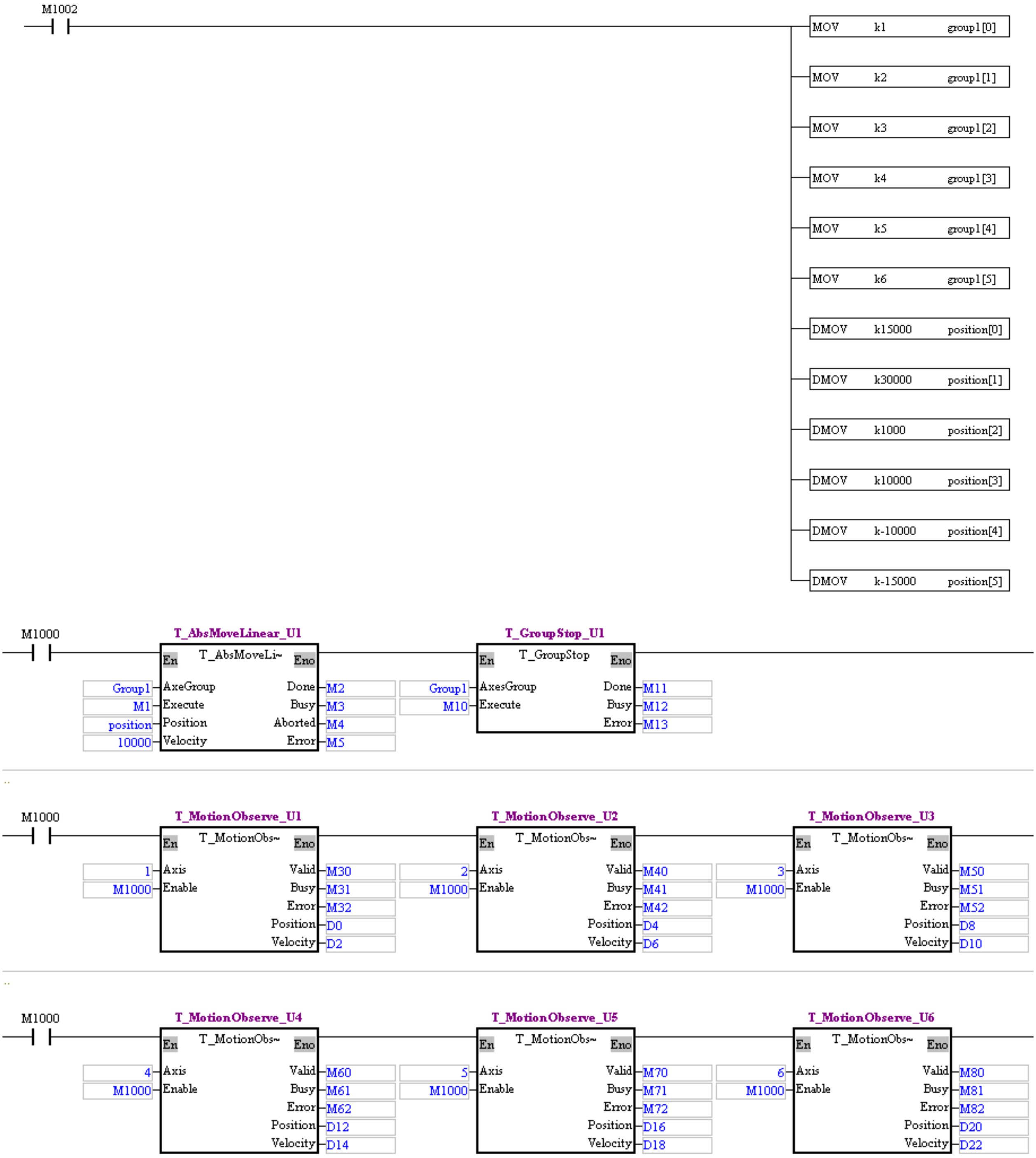
Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.

4. Example

Purpose:

- The motion control function block T_AbsMoveLinear and the motion control function block T_RelMoveLinear are used to start the absolute linear interpolation executed by the axes specified and the relative linear interpolation executed by the axes specified.

Local Symbols					
Class...	Identifiers	Address	Type...	Initial	Comment...
VAR	Group1		WORD[6]	[0(6)]	
VAR	Position		DWORD[6]	[0(6)]	



- Create the identifier Group1 in the local symbol table in O100. Group1 is an array composed of 6 words.
- Create the identifier Position in the local symbol table in O100. Position is an array composed of 6 double words.
- When the program is executed, the array indicated by Group1 is set to [1, 2, 3, 4, 5, 6]. The first axis, the second axis, the third axis, the fourth axis, the fifth axis, and the sixth axis are used to execute linear interpolation.

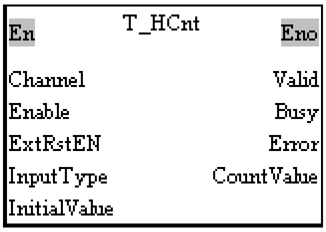
- When the program is executed, the array indicated by Position is set to [15000, 30000, 1000, 10000, -10000, -15000]. [15000, 30000, 1000, 10000, -10000, -15000] indicates the target positions of the absolute linear interpolation executed by the first axis, the second axis, the third axis, the fourth axis, the fifth axis, and the sixth axis.
- After M1 is set to ON, the multiaxial absolute linear interpolation set will be started.
- Set M10 to ON when M1 is ON. When the multiaxial absolute linear interpolation set is stopped, the Aborted output pin the the motion control function block T_AbsMoveLinear is True, and the Done output pin in the motion control function block T_GroupStop is True.

5. Module which is supported

   The motion control function block T_GroupStop supports DVP10PM00M.

5.12 Other Motion Control Function Blocks

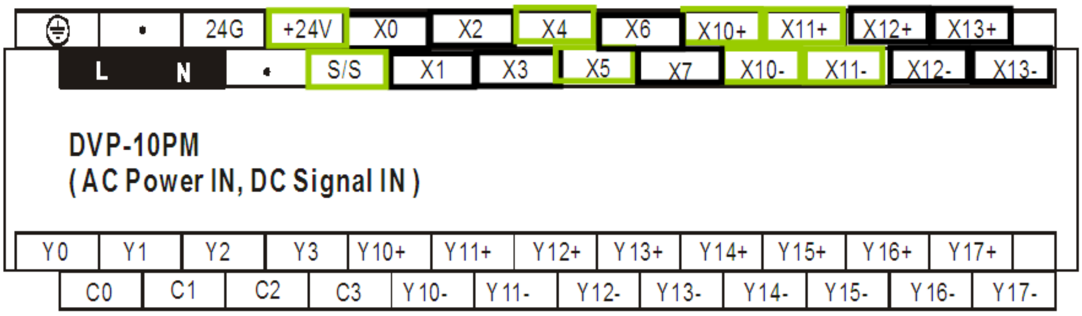
5.12.1 High-speed Counter



1. Motion control function block

   The motion control function block T_HCnt is used to start a high-speed counter. The value of the Channel input pin indicates a counter number, and the value of the InputType input pin indicates an input pulse type. The ExtRstEN input pin is used to set an external reset switch. The value of the InitialValue input pin is the initial value in the counter specified, and the value of the CountValue output pin is the value in the counter specified.

   The input terminals for the high-speed counters in a DVP-10PM series motion controller are shown below.



   X0 and X1 are for high-speed counter 0; X2 and X3 are for high-speed counter 1; X4 and X5 are for high-speed counter 2; X6 and X7 are for high-speed counter 3; X10+, X10-, X11+, and X11- are for high-speed counter 4; X12+, X12-, X13+, and X13- are for high-speed counter 5.

2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Channel	Counter number	WORD	0~5 (*1)	The value of the Channel input pin is valid when there is a transition in the Enable input pin's signal from low to high.

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Enable	The motion control function block is enabled when there is a transition in the Enable input pin's signal from low to high.	BOOL	True/False	-
InputType	Input pulse type	WORD	mcUD: 0 mcPD: 1 mcAB: 2 mc4AB: 3	When the motion control function block is executed, the value of the InputType input pin is updated repeatedly.
ExtRstEN	External reset switch	BOOL	True/False (*2)	The value of the ExtRstEN input pin is valid when there is a transition in the Enable input pin's signal from low to high.
InitialValue	Initial value in the counter specified	DWORD	K0~2,147,483,647	The value of the InitialValue input pin is valid when there is a transition in the Enable input pin's signal from low to high.

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Valid	An output value is valid.	BOOL	● There is a transition in the Valid output pin's signal from low to high when there is a transition in the Enable input pin's signal from low to high.	● There is a transition in the Valid output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.
Busy	The motion control function block is being executed.	BOOL	● There is a transition in the Busy output pin's signal from low to high when there is a transition in the Enable input pin's signal from low to high.	● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. ● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.
Error	An error occurs in the motion control function block.	BOOL	● Input values are incorrect. ● The source specified has been occupied.	● There is a transition in the Error output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.

Value output pin				
Name	**Function**	**Data type**	**Output range**	**Time when a value is valid**
CountValue	Value in the counter specified	DWORD	K0~2,147,483,647	When the Valid output pin is set to True, the value of the CountValue output pin is updated repeatedly.

*1: Value of the Channel input pin

Value	Definition
0	C200
1	C204
2	C208
3	C212
4	C216
5	C220

*2: External terminals for resetting the high-speed counters in a DVP-10PM series motion controller

Counter number	Reset terminal
0	X10
1	X11
2	X12
3	X13
4	X0
5	X1

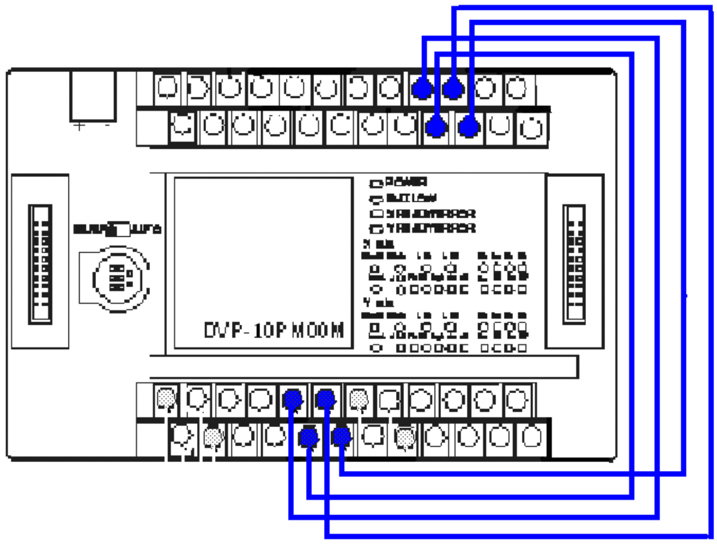
3. Troubleshooting

Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.
The counter specified has been used.	Use another counter, or stop the counter which has been used.

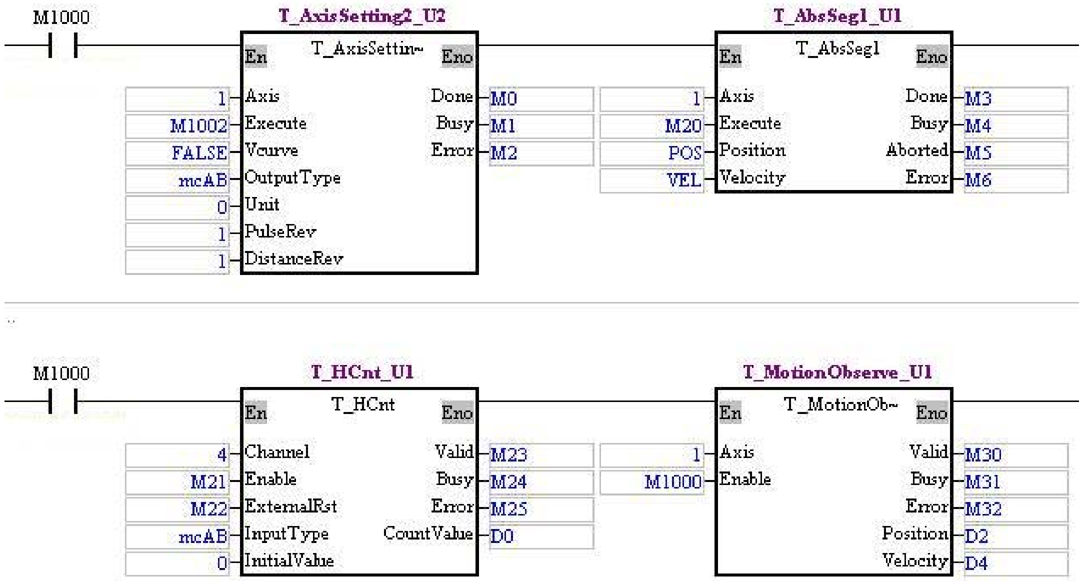
4. Example

Purpose:

- The first axis sends pulses to high-speed counter 4. Users can check whether the number of pulses output is the same as the number of pulses input. The external wiring required is shown below.



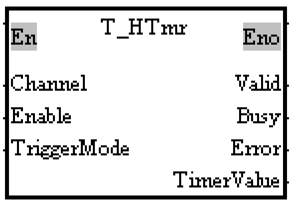
Y10+ is connected to X10+.
Y10- is connected to X10.-
Y11+ is connected to X11+.
Y11- is connected to X11-.



- The pulses output by the first axis are A/B-phase pulses.
- After M21 is set to ON, high-speed counter 4 will be started.
- The value of POS is 30,000, and the value of VEL is 10,000.
- After M20 is set to ON, the absolute single-speed motion set will be started.
- Compare the value in D0 (the value in high-speed counter 4) with the value in D2 when M3 is ON.

5. Module which is supported
   The motion control function block T_HCnt supports DVP10PM00M.

5.12.2 High-speed Timer



1. Motion control function block
   The motion control function block T_HTmr is used to start a high-speed timer. The value of the Channel input pin indicates a timer number, the value of the TriggerMode indicates a mode of triggering the measurement of time, and the value of the TimerValue output pin the value in the timer specified. 0.01 μs is a unit. The high-speed timer numbers available are the same as the high-speed counter numbers available.
2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Channel	Timer number	WORD	0~5 (*1)	The value of the Channel input pin is valid when there is a transition in the Enable input pin's signal from low to high.

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Enable	The motion control function block is enabled when there is a transition in the Enable input pin's signal from low to high.	BOOL	True/False	-
TriggerMode	Mode of triggering the measurement of timer	BOOL	mcUp_Down: False mcUp_Up: True	When the motion control function block is executed, the value of the TriggerMode input pin is updated repeatedly.

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Valid	An output value is valid.	BOOL	● There is a transition in the Valid output pin's signal from low to high when there is a transition in the Enable input pin's signal from low to high.	● There is a transition in the Valid output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.
Busy	The motion control function block is being executed.	BOOL	● There is a transition in the Busy output pin's signal from low to high when there is a transition in the Enable input pin's signal from low to high.	● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. ● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.
Error	An error occurs in the motion control function block.	BOOL	● Input values are incorrect. ● The source specified has been occupied.	● There is a transition in the Error output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.

Value output pin				
Name	**Function**	**Data type**	**Output range**	**Time when a value is valid**
TimeValue	Value in the timer specified	DWORD	K0~2,147,483,647	When the motion control function block is executed, the value of the TimerValue output pin is updated repeatedly. If there is no trigger, the value in the timer specified will remain unchanged.

*1: Value of the Channel input pin

Value	Definition	Terminal
0	C200	X10
1	C204	X11
2	C208	X12
3	C212	X13
4	C216	X0
5	C220	X1

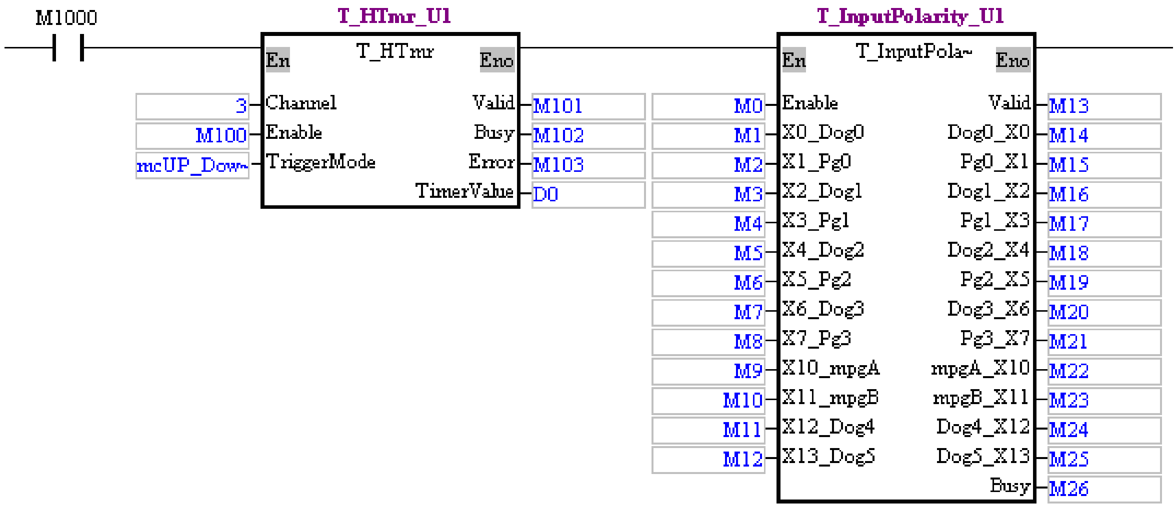
3. Troubleshooting

Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.
The timer specified has been used.	Use another timer, or stop the timer which has been used.

4. Example

Purpose:

- Users can use the motion control function block T_InputPolarity to simulate the state of the terminal for a high-speed timer.

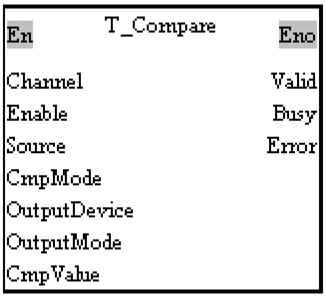


- After M0 is set to ON, the motion control function block T_InputPolarity will be started.
- After M100 is set to ON, high-speed timer 3 will be started.
- Set M12 to ON.
- Set M12 to OFF.
- The value of the TimerValue input pin indicates the time it takes for M12 to be turned from ON to OFF. If the value of the TimerValue input pin is multiplied by 0.01, the product gotten will be the number of microseconds.

5. Module which is supported

The motion control function block T_HTmr supports DVP10PM00M.

5.12.3 Setting High-speed Comparison



1. Motion control function block

   The motion control function block T_Compare is used to start high-speed comparison. The value of the Channel input pin indicates a comparator number, the value of the Source input pin indicates a source, the value of the CmpMode input pin indicates a comparison condition, and the value of the OutputDevice indicates an output device.

2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Channel	Comparator number	WORD	0~7	The value of the Channel input pin is valid when there is a transition in the Enable input pin's signal from low to high.
Enable	The motion control function block is enabled when there is a transition in the Enable input pin's signal from low to high.	BOOL	True/False	-
Source	Source	WORD	mcCmpAxis1: 0 mcCmpAxis2: 1 mcCmpAxis3: 2 mcCmpAxis4: 3 mcCmpC200: 4 mcCmpC204: 5 mcCmpC208: 6 mcCmpC212: 7	The value of the Source input pin is valid when there is a transition in the Enable input pin's signal from low to high.
CmpMode	Comparison condition	WORD	1: = 2: ≧ 3: ≦	The value of the CmpMode input pin is valid when there is a transition in the Enable input pin's signal from low to high.
OutputDevice	Output device	WORD	mcCmpY0: 0 mcCmpY1: 1 mcCmpY2: 2 mcCmpY3: 3 mcCmpRstC200: 4 mcCmpRstC204: 5 mcCmpRstC208: 6 mcCmpRstC212: 7	The value of the OutputDevice input pin is valid when there is a transition in the Enable input pin's signal from low to high.
OutputMode	Output mode	BOOL	mcCmpSet: True mcCmpRst: False	The value of the OutputMode input pin is valid when there is a transition in the Enable input pin's signal from low to high.

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
CmpValue	Value with which a source is compared	DWORD	K-2,147,483,647~ K2,147,483,647	The value of the CmpValue input pin is valid when there is a transition in the Enable input pin's signal from low to high.

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Valid	An output value is valid.	BOOL	● There is a transition in the Valid output pin's signal from low to high when there is a transition in the Enable input pin's signal from low to high.	● There is a transition in the Valid output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.
Busy	The motion control function block is being executed.	BOOL	● There is a transition in the Busy output pin's signal from low to high when there is a transition in the Enable input pin's signal from low to high.	● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. ● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.
Error	An error occurs in the motion control function block.	BOOL	● Input values are incorrect. ● The source specified has been occupied.	● There is a transition in the Error output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.

Please note that the number of high-speed comparators plus the number of high-speed capturers is 8 at most.

◆ Source
- mcCmpAxis1: Present position of the first axis
- mcCmpAxis2: Present position of the second axis
- mcCmpAxis3: Present position of the third axis
- mcCmpAxis4: Present position of the fourth axis
- mcCmpC200: Present value in C200
- mcCmpC204: Present value in C204
- mcCmpC204: Present value in C208
- mcCmpC204: Present value in C212

◆ Output device
- mcCmpY0: Y0
- mcCmpY1: Y1
- mcCmpY2: Y2
- mcCmpY3: Y3
- mcCmpRstC200: Resetting C200
- mcCmpRstC204: Resetting C204
- mcCmpRstC208: Resetting C208

- mcCmpRstC212: Resetting C212

◆ Output mode

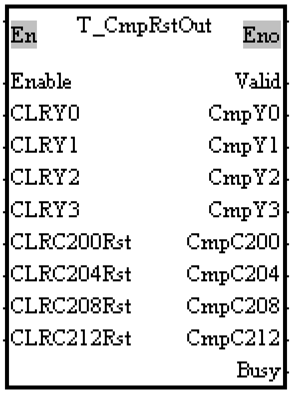
- The device specified is Y0, Y1, Y2, or Y3.
  McCmpSet: Enabling the output device specified
  McCmpRst: Diabling the output device specified
- The device specified is C200, C204, C208, or C212.
  McCmpSet: The value in the counter specified is cleared.
  McCmpRst: The counter specified counts.

3. Troubleshooting

Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.
The comparator specified has been used.	Use another comparator.

4. Module which is supported
   The motion control function block T_Compare supports DVP10PM00M.

5.12.4 Resetting High-speed Comparison



1. Motion control function block
   The motion control function block T_CmpRstOut is used to reset high-speed comparison. CLRY0, CLRY1, CLRY2, CLRY3, CLRC200Rst, CLRC204Rst, CLRC208Rst, and CLRC212Rst determine the output devices which will be reset. The values of the output pins indicate whether the output devices Y0, Y1, Y2, Y3, C200, C204, C208, and C212 are enabled or disabled.
2. Input pins/Output pins

Input pin				
Name	Function	Data type	Setting value	Time when a value is valid
Enable	The motion control function block is enabled when there is a transition in the Enable input pin’s signal from low to high.	BOOL	True/False	-

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
CLRY0 CLRY1 CLRY2 CLRY3 CLRC200Rst CLRC204Rst CLRC208Rst CLRC212Rst	Resetting the output devices Y0, Y1, Y2, Y3, C200, C204, C208, and C212	BOOL	True/False	When the motion control function block is executed, the values of these input pins are updated repeatedly.

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Valid	An output value is valid.	BOOL	● There is a transition in the Valid output pin's signal from low to high when there is a transition in the Enable input pin's signal from low to high.	● There is a transition in the Valid output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.
Busy	The motion control function block is being executed.	BOOL	● There is a transition in the Busy output pin's signal from low to high when there is a transition in the Enable input pin's signal from low to high.	● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. ● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.
Error	An error occurs in the motion control function block.	BOOL	● Input values are incorrect. ● The source specified has been occupied.	● There is a transition in the Error output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.

Value output pin				
Name	**Function**	**Data type**	**Output range**	**Time when a value is valid**
CmpY0 CmpY1 CmpY2 CmpY3 CmpC200 CmpC204 CmpC208 CmpC212	States of the output devices Y0, Y1, Y2, Y3, C200, C204, C208, and C212	BOOL	True/False	● When the Valid output pin is set to True, the values of these output pins are updated repeatedly.

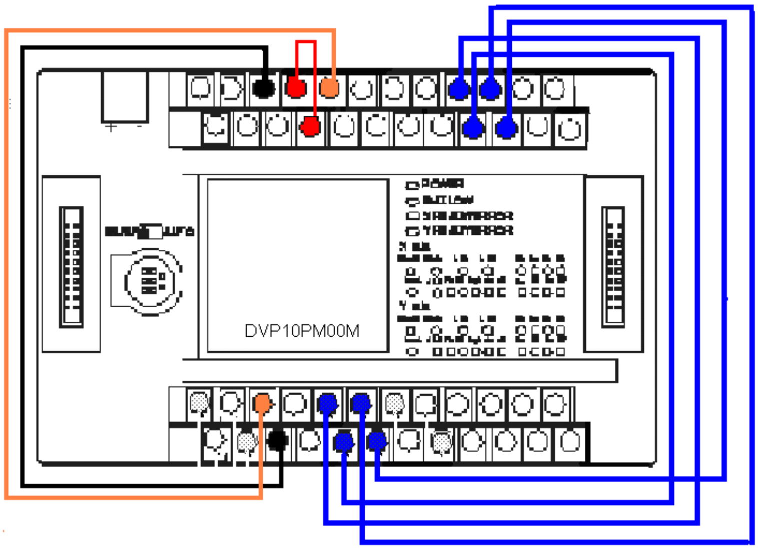
3. Troubleshooting

Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.

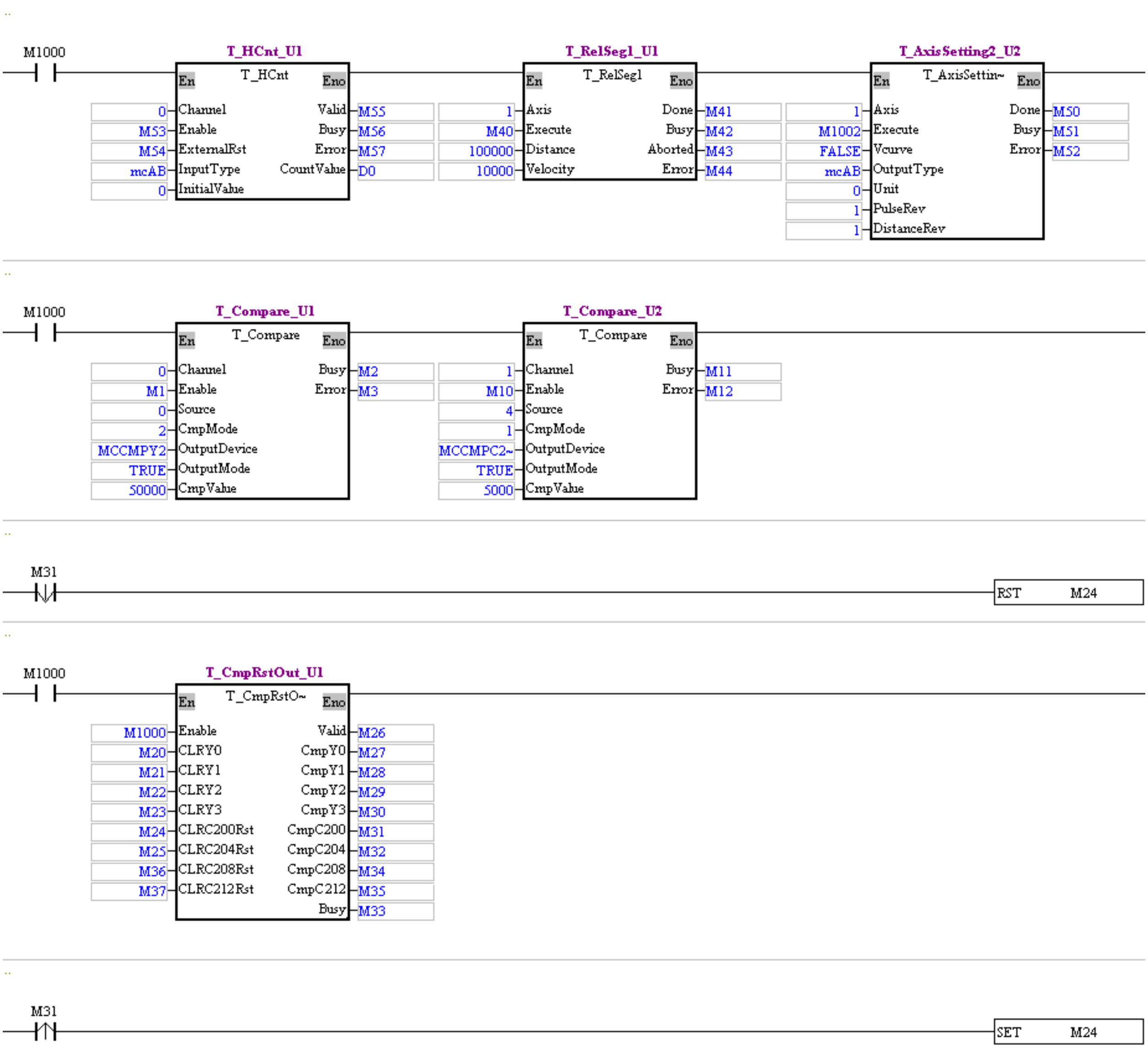
4. Example

Purpose:

- Two high-speed comparators are set. When the conditions set are met, users can check whether the output devices specified are set/reset. The external wiring required is shown below.



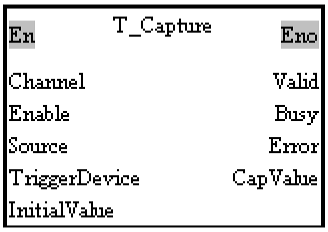
Y10± are connected to X10±.
Y11± are connected to X11±.
C2 is connected to 24G.
Y2 is connected to X0.
S/S is connected to +24V.



- If the program is executed, the pulses output by the first axis will be A/B-phase pulses, the motion control function block T_CmpRstOut will be started, and the states of output devices will be read.
- After M53 is set to ON, a high-speed counter will be started.
- After M1 is set to ON, high-speed comparator 0 will be started.
  Setting high-speed comparator 0: If the number of pulses output by the first axis is greater than or equal to 50,000, Y2 will be set to ON.
- After M10 is set to ON, high-speed comparator 1 will be started.
  Setting high-speed comparator 1: If the value in C200 is equal to 5,000, the value in C200 will be cleared to 0.
- After M40 is set to ON, the first axis will move for 100,000 pulses.
- If the value in C200 is equal to 5,000, and M31 is ON, the comparison condition set for high-speed comparator 1 is met, and the value in C200 is cleared to 0. The value in C200 will be cleared to 0 next time the value in C200 becomes 5,000. If M31 is not reset, high-speed comparator 1 will not act next time the comparison condition set for high-speed comparator 1 is met.
- If the number of pulses output by the first axis is 100,000, the comparison condition set for high-speed comparator 0 is met, and Y2 is set to ON. When Y2 is set to ON, the users can check whether X0 is ON.
- If X0 is ON, the comparison condition set for high-speed comparator 0 is met. The users can turn X0 OFF by means of M22.

5. Module which is supported
   The motion control function block T_CmpRstOut supports DVP10PM00M.

5.12.5 Setting High-speed Capture



1. Motion control function block
   The motion control function block T_Capture is used to start high-speed capture. The value of the Channel input pin indicates a capturer number. The value of the Source input pin indicates a source, the value of the TriggerDevice input pin indicates the device which triggers the capture of a value, the value of the InitialValue input pin is an initial value, and the value of the CapValue output pin is the value captured.
2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Channel	Capturer number	WORD	0~7	The value of the Channel input pin is valid when there is a transition in the Enable input pin's signal from low to high.
Enable	The motion control function block is enabled when there is a transition in the Enable input pin's signal from low to high.	BOOL	True/False	-
Source	Source	WORD	mcCapAxis1: 0 mcCapAxis2: 1 mcCapAxis3: 2 mcCapAxis4: 3 mcCapC200: 4 mcCapC204: 5 mcCapC208: 6 mcCapC212: 7	The value of the Source input pin is valid when there is a transition in the Enable input pin's signal from low to high.
TriggerDevice	Device which triggers the capture of a value	WORD	mcX0 (0): X0 mcX1 (1): X1 mcX2 (2): X2 mcX3 (3): X3 mcX4 (4): X4 mcX5 (5): X5 mcX6 (6): X6 mcX7 (7): X7 mcX10 (8): X10 mcX11 (9): X11 mcX12 (10): X12 mcX13 (11): X13	The value of the TriggerDevice input pin is valid when there is a transition in the Enable input pin's signal from low to high.

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
InitialValue	Initial value	DWORD	K-2,147,483,648~ K2,147,483,647	The value of the InitialValue input pin is valid when there is a transition in the Enable input pin's signal from low to high.

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Valid	An output value is valid.	BOOL	● There is a transition in the Valid output pin's signal from low to high when there is a transition in the Enable input pin's signal from low to high.	● There is a transition in the Valid output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.
Busy	The motion control function block is being executed.	BOOL	● There is a transition in the Busy output pin's signal from low to high when there is a transition in the Enable input pin's signal from low to high.	● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. ● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.
Error	An error occurs in the motion control function block.	BOOL	● Input values are incorrect. ● The source specified has been occupied.	● There is a transition in the Error output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.

Value output pin				
Name	**Function**	**Data type**	**Output range**	**Time when a value is valid**
CapValue	Value which is captured	DWORD	K-2,147,483,648~ K2,147,483,647	When the motion control function block is executed, the value of the CapValue output pin is updated repeatedly. If there is no trigger, the value captured will remain unchanged.

3. Troubleshooting

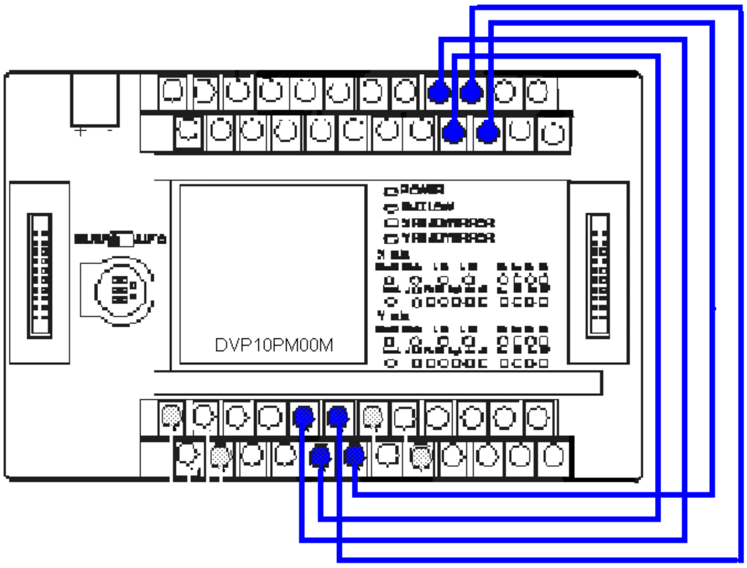
Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.
The capturer specified has been used.	Use another capturer.

4. Example

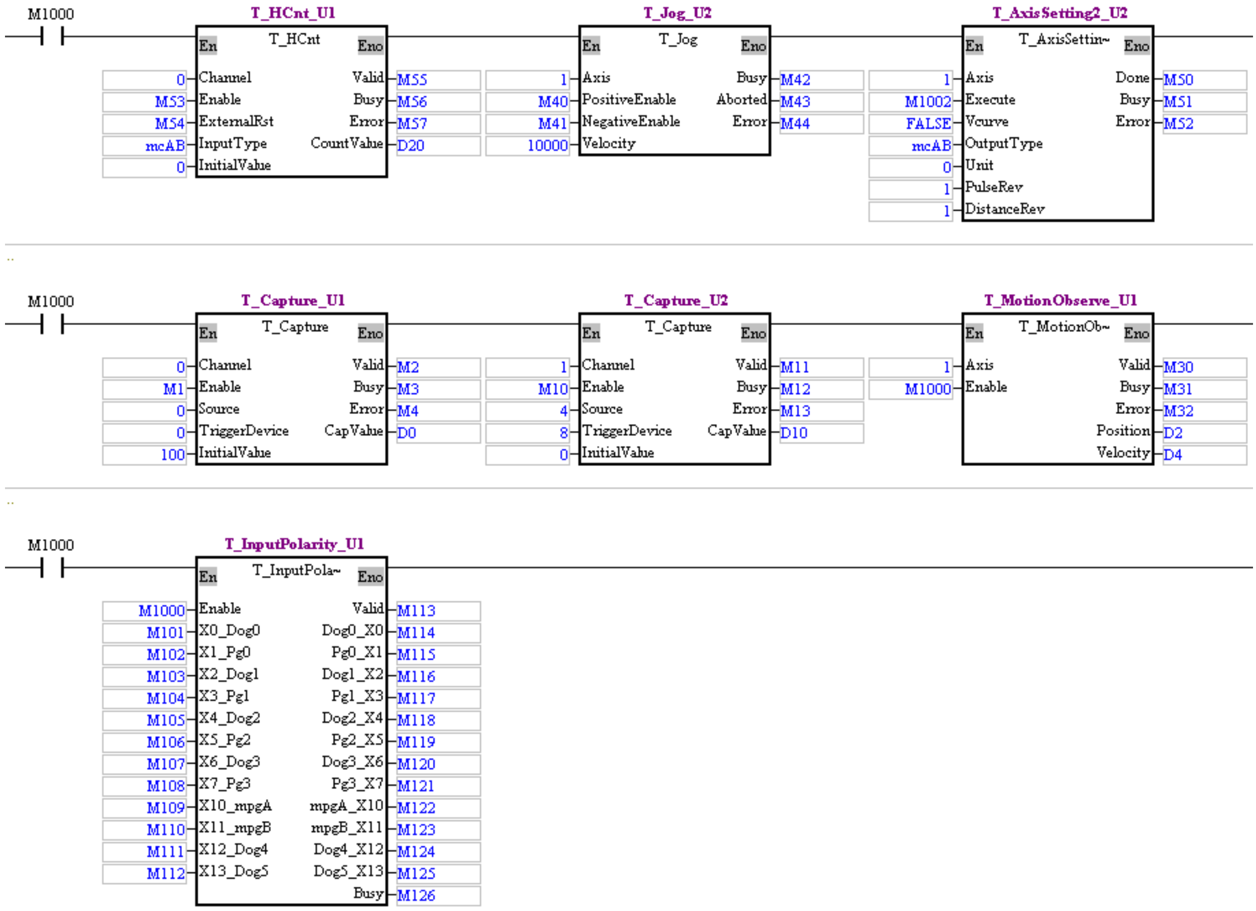
Purpose:

- Two high-speed capturers are used. If external terminals are turned ON, the present position of the first axis and the present value in C200 will be captured. The motion control function block

T_InputPolarity is used to set the polarity of the external terminal which triggers the capture of the present position of the first axis, and the polarity of the external terminal which triggers the capture of the present value in C200. The external wiring required is shown below.



Y10± are connected to X10±.
Y11± are connected to X11±.



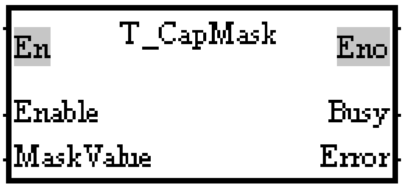
- The pulses output by the first axis are A/B-phase pulses. After the motion control function block T_MotionObserve is enabled, the present position of the first axis and the present speed of the first axis will be read.
- After M53 is set to ON, a high-speed counter will be started.
- After M1 is set to ON, high-speed capturer 0 will be started.

  Setting high-speed capturer 0: If X0 is turned ON, the present position of the first axis will be captured.

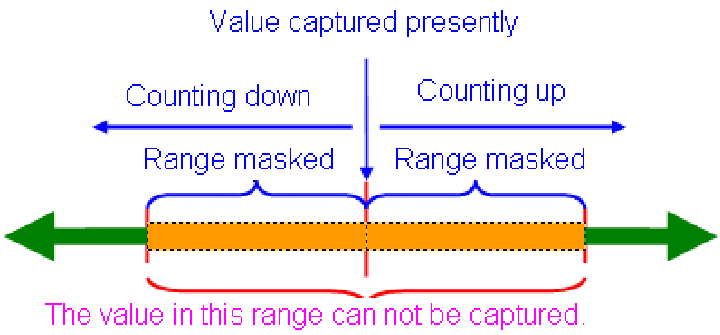
- After M10 is set to ON, high-speed capturer 1 will be started.
  Setting high-speed capturer 1: If X10 is turned ON, the present value in C200 will be captured.
- After M40 is set to ON, the positive JOG motion of the first axis will be started.
- If M101 is turned ON, X0 will become a normally-closed contact, there will be a transition in X0's signal from low to high, and the value in D0 will change.
- If M109 is turned ON, X10 will become a normally-closed contact, there will be a transition in X10's signal from low to high, and the value in D10 will change.

5. Module which is supported
   The motion control function block T_Capture supports DVP10PM00M.

5.12.6 High-speed Masking



1. Motion control function block



The motion control function block T_CapMask is used to start high-speed masking. The MaskValue input pin determines the range which will be masked. After high-speed masking is started, if the relative difference between the value captured this time and the value captured last time is in the range which can be masked, the signal which triggers the capture of the value this time will be disregarded.

2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
Enable	The motion control function block is enabled when there is a transition in the Enable input pin's signal from low to high.	BOOL	True/False	-
MaskValue	Range which is masked	DWORD	K0~2,147,483,647	When the motion control function block is executed, the value of the MaskValue input pin is updated repeatedly.

State output pin				
Name	Function	Data type	Time when there is a transition in an output pin's signal from low to high	Time when there is a transition in an output pin's signal from high to low
Busy	The motion control function block is being executed.	BOOL	● There is a transition in the Busy output pin's signal from low to high when there is a transition in the Enable input pin's signal from low to high.	● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. ● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.
Error	An error occurs in the motion control function block.	BOOL	● Input values are incorrect. ● The source specified has been occupied.	● There is a transition in the Error output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.

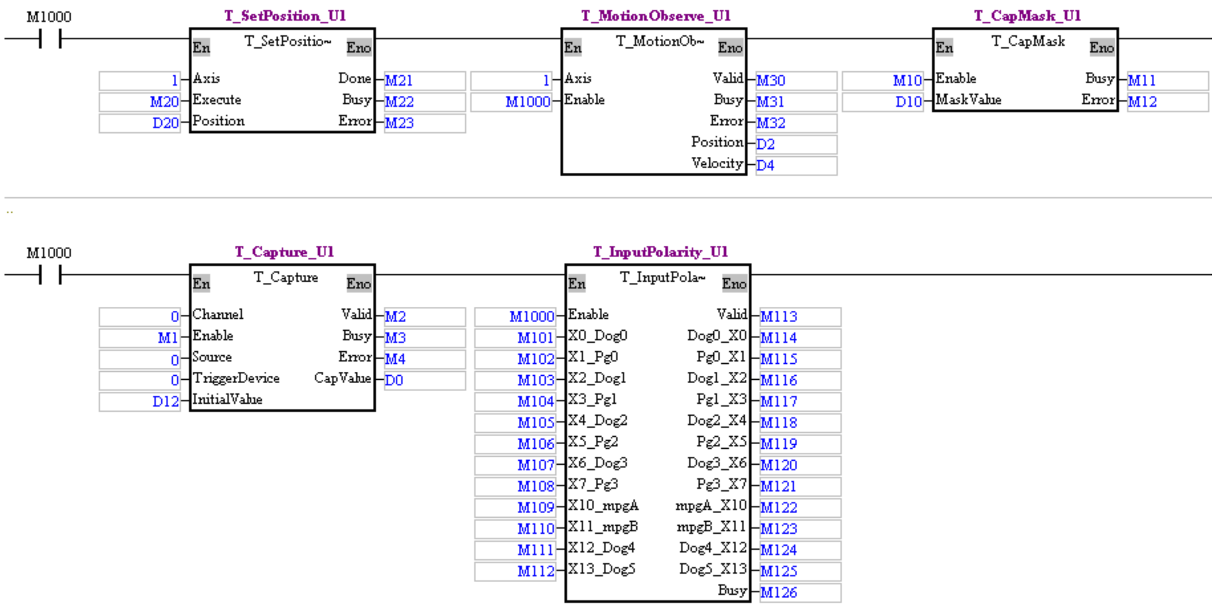
3. Troubleshooting

Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.

4. Example

● Purpose

A high-speed capturer and the motion control function block T_CapMask are used. If the present position of the first axis is in the range (the value of the CapValue output pin±the value of the MaskValue input pin) which is masked, it will not be captured after an external device is set to ON.



- After the program is executed, the present position of the first axis and the present speed of the first axis will be read.
- After the value in D20 is set to 0, and M20 is turned ON, the first axis will output 0 pulses.
- Set the value in D12 to 100. After M1 is turned ON, high-speed capturer 0 will be started.
  Setting high-speed capturer 0: If X0 is turned ON, the present position of the first axis will be captured.
- Set the value in D10 to 500. After M10 is turned ON, the high-speed masking specified will be started.
- After M101 is set to ON, there will be a transition in X0's signal from low to high, and the value of

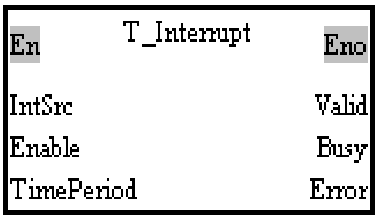
the CapValue output pin will still be 100.

- After the value in D20 is set to 500, and M20 is turned ON. The first axis will output 500 pulses.
- After M101 is set to ON, there will be a transition in X0's signal from low to high, and the value of the CapValue output pin will still be 100.
- After the value in D20 is set to 600, and M20 is turned ON. The first axis will output 600 pulses.
- After M101 is set to ON, there will be a transition in X0's signal from low to high, and the value of the CapValue output pin will become 600.

5. Module which is supported

   The motion control function block T_CapMask supports DVP10PM00M.

5.12.7 Setting an Interrupt



1. Motion control function block

   The motion control function block T_Interrupt is used to set the trigger for an interrupt subroutine. The value of the IntSCR input pin indicates the trigger for an interrupt subroutine. If the interrupt set is a time interrupt, the value of the TimePeriod input pin indicates the cycle of the interrupt.

2. Input pins/Output pins

Input pin				
Name	**Function**	**Data type**	**Setting value**	**Time when a value is valid**
IntSrc	Setting an interrupt	WORD	IntTimer: 0 IntX00: 1 IntX01: 2 IntX02: 3 IntX03: 4 IntX04: 5 IntX05: 6 IntX06: 7 IntX07: 8	The value of the IntSrc input pin is valid when there is a transition in the Enable input pin's signal from low to high.
Enable	The motion control function block is enabled when there is a transition in the Enable input pin's signal from low to high.	BOOL	True/False	-
TimePeriod	Cycle of a time interrupt (Unit: ms) (Not applicable to terminal interrupts)	WORD	K1~K65,535	When the motion control function block is executed, the value of the TimePeriod input pin is updated repeatedly.

State output pin				
Name	**Function**	**Data type**	**Time when there is a transition in an output pin's signal from low to high**	**Time when there is a transition in an output pin's signal from high to low**
Valid	An Interrupt is enabled.	BOOL	● There is a transition in the Valid output pin's signal from low to high when an interrupt is enabled.	● There is a transition in the Valid output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.
Busy	The motion control function block is being executed.	BOOL	● There is a transition in the Busy output pin's signal from low to high when there is a transition in the Enable input pin's signal from low to high.	● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Error output pin's signal from low to high. ● There is a transition in the Busy output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.
Error	An error occurs in the motion control function block.	BOOL	● Input values are incorrect. ● The source specified has been occupied.	● There is a transition in the Error output pin's signal from high to low when there is a transition in the Enable input pin's signal from high to low.

3. Troubleshooting

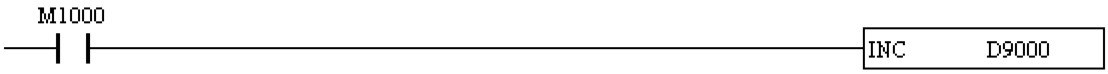
Error	Troubleshooting
The values of input pins in the motion control function block are incorrect.	Check whether the values of the input pins are in the ranges allowed.

4. Example

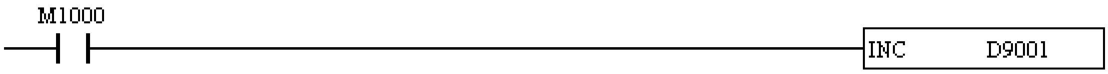
Purpose:

● A time interrupt and an external interrupt are used. Users can use the motion control function block T_InputPolarity to simulate the state of an external terminal.

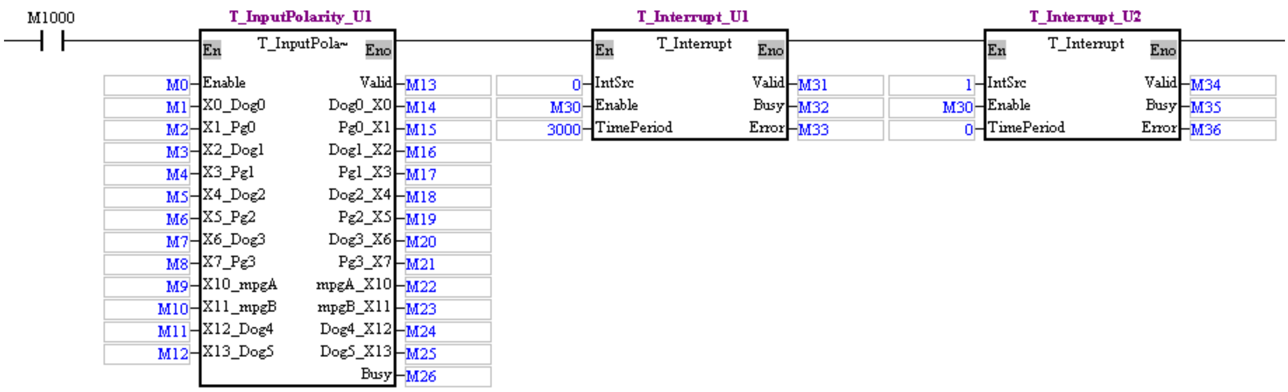
I0:



I1:



O100:



● After M0 is set to ON, the motion control function block T_InputPolarity will be started.

- After M30 is set to ON, the time interrupt I0 and the external interrupt I1 will be started.
- After the time interrupt I0 is started, it will be executed every three seconds, and the value in D9000 will increase by one every three seconds.
- After the external interrupt I1 is started, the users can simulate the state of X0 by setting M1. If M1 is turned from OFF to ON, the value in D9001 will increase by one.

5. Module which is supported

   The motion control function block T_Interrupt supports DVP10PM00M.

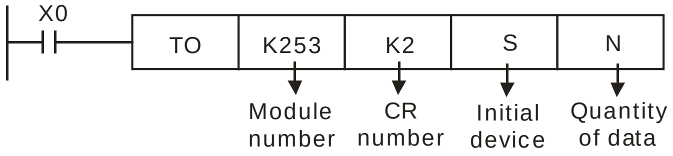
6.1 Introduction of Multiaxial Interpolation

DVP-10PM series motion controllers support multiaxial interpolation. Users can execute linear interpolation by means of the instruction TO.

6.2 Description of TO

A DVP-10PM series motion controller can start and stop linear interpolation by means of the instruction TO. The use of TO to set linear interpolation is described below.

- CR#2: Starting interpolation



- Data

Device	Setting
S, **S**$_{+1}$	Axes specified
S$_{+2}$, **S**$_{+3}$	Speed of interpolation
S$_{+4}$, **S**$_{+5}$	Poistion of the X-axis
S$_{+6}$, **S**$_{+7}$	Poistion of the Y-axis
S$_{+8}$, **S**$_{+9}$	Poistion of the Z-axis
S$_{+10}$, **S**$_{+11}$	Poistion of the A-axis
S$_{+12}$, **S**$_{+13}$	Poistion of the B-axis
S$_{+14}$, **S**$_{+15}$	Poistion of the C-axis

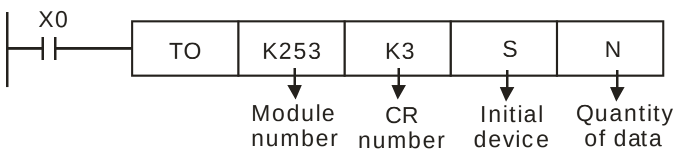
- The device (**S**, **S**$_{+1}$) is described below.

Bit	31:12	11:10	9:8	7:6	5:4	3:2	1:0
Axis number	Not used	C-axis	B-axis	A-axis	Z-axis	Y-axis	X-axis

- Evey axis is controlled by two bits in (**S**, **S**$_{+1}$).

Value	Definition
0	Not participating in interpolation
1	Participating in interpolation
2	Not used
3	Not used

- CR#3: Stopping interpolation



- Data

Device	Setting
S, **S**$_{+1}$	Axes specified

- The device (**S**, **S**$_{+1}$) is described below.

Bit	31:12	11:10	9:8	7:6	5:4	3:2	1:0
Axis number	Not used	C-axis	B-axis	A-axis	Z-axis	Y-axis	X-axis

- Evey axis is controlled by two bits in (**S**, **S**$_{+1}$).

Value	Definition
0	Not participating in interpolation
1	Stopping linear interpolation

Value	Definition
2	Not used
3	Not used

- Users can set the parameters of the axes participating in linear interpolation by means of D1816, D1896, D1976, D2056, D2136, and D2216..

Bit#	Parameter of the axis	Bit#	Parameter of the axis
0	Unit (Note 1)	8	Direction in which the axis returns home (Note 3)
1		9	Mode of returning home (Note 3)
2	Ratio (Note 2)	10	Mode of triggering the return to home (Note 3)
3		11	Direction in which the motor rotates (Note 3)
4	Output type(Note 2)	12	Relative/Absolute coordinates (Note 3)
5		13	Mode of triggering the calculation of the target position (Note 3)
6*	PWM mode (Note 3)	14	Curve (Note 3)
7		15	

Note 1:

b1	b0	Unit
0	0	Motor unit
0	1	Mechanical unit
1	0	Compound unit
1	1	

	Motor unit	Compound unit	Mechanical unit
Position	pulse	um	
	pulse	mdeg	
	pulse	10^{-4} inches	
Speed	pulse/second		centimeter/minute
	pulse/second		10 degrees/minute
	pulse/second		inch/minute

Note 2:

b3	b2	Ratio
0	0	100
0	1	101
1	0	102
1	1	103

b5	b4	Description
0	0	Positive-going pulse+Negative-going pulse
0	1	Pulse+Direction
1	0	A/B-phase pulse (two phases and two inputs)
1	1	

Note 3:

Bit#	Description
6	Bit 6=1: Enabling a PWM mode (1) If positive JOG motion is started, Y0~Y3 will execute PWM. (2) If single-speed motion is started, Y0~Y3 will send single-phase pulses. (3) Pulse width: D1838, D1918, D1998, and D2078 (4) Output period: D1842, D1922, D2002, and D2082
8	Bit 8=0: The value indicating the present command position of the axis decreases progressively. Bit 8=1: The value indicating the present command position of the axis increases progressively.
9	Bit 9=0: Normal mode ; bit 9=1: Overwrite mode
10	Bit 10=0: The return to home is triggered by a transition in DOG's signal from high to low. Bit 10=1: The return to home is triggered by a transition in DOG's signal from low to high.
11	Bit 11=0: When the motor rotates clockwise, the value indicating the present command position of the axis increases. Bit 11=1: When the motor rotates clockwise, the value indicating the present command position of the axis decreases.
12	Bit 12=0: Absolute coordinates Bit 12=1: Relative coordinates

Bit#	Description
13	Bit 13=0: The calculation of the target position of the axis is triggered by a transition in DOG's signal from low to high. Bit 13=1: The calculation of the target position of the axis is triggered by a transition in DOG's signal from high to low. (The setting of bit 13 is applicable to the insertion of single-speed motion, and the insertion of two-speed motion.)
14	Bit 14=0: Trapezoid curve Bit 14=1: S curve

Users can use M1792, M1872, M2032, M2112, M2192, and M2272 to judge whether the axes complete the execution of linear interpolation..

MEMO

7.1 Introduction of DVP-FPMC: CANopen Communication Card

DVP-FPMC is a CANopen communication card for a DVP-10PM series motion controller to conduct data exchange. The functions of DVP-FPMC are as follows.

- It conforms to the CANopen standard protocol DS301 v4.02.
- It supports an NMT protocol.
- It supports an SDO protocol.
- It supports the CANopen standard protocol DS402 v2.0. Four motion axes at most are supported.
- Motion axes support a profile position mode.

7.2 Specifications

- CANopen connector

Item	Specifications
Transmission method	CAN
Electrical isolation	500 V DC
Type	Removable connector (5.08 mm)
Transmission cable	2 communication cables, 1 shielded cable, and 1 ground

- Ethernet connector

Item	Specifications
Transmission method	Ethernet
Electrical isolation	500 V DC
Type	Removable connector (5.08 mm)
Transmission cable	2 communication cables, 1 shielded cable, and 1 ground

- Communication

Item	Specifications
Protocol type	PDO, SDO, SYNC (synchronous object), EMCY (emergency object), NMT, Heartbeat
Serial transmission speed	500 kbps, 1 Mbps (bits per second)
Product code	254
Equipment type	0 (Non-profile)
Company ID	477 (Delta Electronics, Inc.)

- Electrical specifications

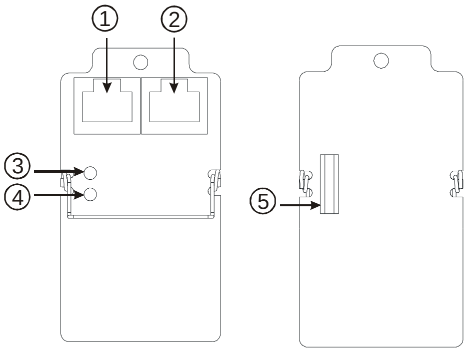
Item	Specifications
Supply voltage	24 V DC (-15~20%) (A DVP-10PM series motion controller supplies power through its internal bus.)
Electric energy consumption	1.7 W
Insulation voltage	500 V
Weight	Approximately 66 g

- Environmental specifications

Item	Specifications
Noise immunity	ESD (IEC 61131-2, IEC 61000-4-2): 8 kV air discharge, 4 kV contact discharge EFT (IEC 61131-2, IEC 61000-4-4): Power line: 2 kV; Digital I/O: 1 kV; Analog & Communication I/O: 1 kV Damped-Oscillatory Wave: Power line: 1 kV; Digital I/O: 1 kV RS (IEC 61131-2, IEC 61000-4-3): 80 MHz~1000 MHz, 1.4 GHz~2.0GHz, 10V/m
Operation/Storage	Operation: 0ºC ~ 55ºC (Temperature), 50~95% (Humidity) , pollution degree 2 Storage: -25ºC~70ºC (Temperature), 5~95% (Humidity)
Vibration/Shock resistance	International standards IEC 61131-2, IEC 68-2-6 (TEST Fc)/IEC 61131-2 & IEC 68-2-27 (TEST Ea)
Standard	IEC 61131-2

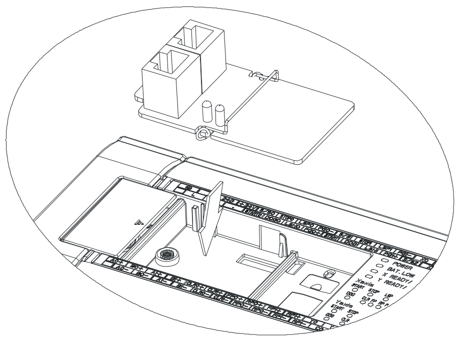
7.3 Product Profile and Installation

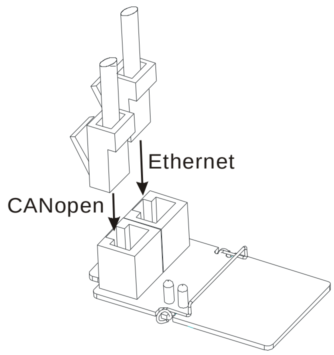
Product profile:



①	CANopen connector
②	Ethernet connector
③	CANopen indicator
④	Ethernet indicator
⑤	Communication connector

Installing DVP-FPMC on a DVP-10PM series motion controller, and connecting it to a communication cable:





7.4 Parameters for Control Registers

- Normal mode: Common parameters

CR number	Function	Attribute	Data type	Length
#001	Firmware version of DVP-FPMC	R	Word	1
#052	CANopen synchronous packet sending setting	R/W	Word	1
#053	CANopen node ID setting	R/W	Word	1
#054	CANopen transmission speed setting	R/W	Word	1
#055	CANopen SDO/NMT timeout	R/W	Word	1
#056	DVP-FPMC error status	R/W	Word	1
#059	Network IP address and port setting for DVP-FPMC	R/W	Word	3
#062	Ethernet connection command and status	R/W	Word	1
#063	IP address and port setting for an Ethernet master	R/W	Word	3
#064	Length of data to be transmitted through Ethernet	R/W	Word	1
#065	Data to be transmitted through Ethernet	R/W	Word	512
#066	Length of data to be received through Ethernet	R	Word	1
#067	Data to be received through Ethernet	R	Word	512
#070	Node ID of an SDO server	R/W	Word	1
#071	SDO access command and status	R/W	Word	1
#072	SDO OD index	R/W	Word	1
#073	SDO OD transmission/reception register 1	R/W	Word	512
#074	SDO OD transmission/reception register 2	R/W	Word	512
#075	SDO OD transmission/reception register 3	R/W	Word	512
#076	SDO OD transmission/reception register 4	R/W	Word	512
#080	NMT command	R/W	Word	1

- A2 mode: Four-axis parameters

CR number	Function	Attribute	Data type	Length
#010	CANopen bus scan	R/W	Word	1
#020	CANopen bus communication status	R	Word	1
#040	Error status of a server	R	Word	1
#050	CANopen bus control command	R/W	Word	1
#090	Data written into a DVP-FPMC QBuffer	R/W	Word	32
#091	Address of the data written into a DVP-FPMC QBuffer	R/W	Word	32
#092	Data read from a DVP-FPMC QBuffer	R/W	Word	32
#093	Address of the data read from a DVP-FPMC QBuffer	R/W	Word	32
#**n**00	Node ID	R	Word	1
#**n**01 #**n**02	Manufacturer ID	R	Word	1
#**n**03 #**n**04	Product ID	R	Word	1
#**n**05 #**n**06	Firmware version	R	Word	1
#**n**07 #**n**08	Product type	R	Word	1
#**n**09	CANopen node communication status	R	Word	1
#**n**10	Emergency error code	R	Word	1
#**n**11 #**n**12	Manufacturer's error code	R	Word	1
#**n**20	Servo drive status	R	Word	1
#**n**21	Present motion mode of a servo drive	R	Word	1
#**n**22 #**n**23	Servo drive position	R	Word	1
#**n**40	Node control command	R/W	Word	1
#**n**50	SDO access command and status	R/W	Word	1
#**n**51	SDO OD (object dictionary) index	R/W	Word	1
#**n**52	SDO transmission/reception register 1	R/W	Word	512
#**n**53	SDO transmission/reception register 2	R/W	Word	512
#**n**54	SDO transmission/reception register 3	R/W	Word	512
#**n**55	SDO transmission/reception register 4	R/W	Word	512
#**n**60	Servo drive control	R/W	Word	1
#**n**61	Motion mode selection	R/W	Word	1
#**n**70 #**n**71	Target position of a profile position mode	R/W	Word	1
#**n**72 #**n**73	Target speed of a profile position mode	R/W	Word	1
#**n**74 #**n**75	Acceleration time of a profile position mode (ms)	R/W	Word	1
#**n**76 #**n**77	Deceleration time of a profile position mode (ms)	R/W	Word	1
#**n**78	Profile position settings	R/W	Word	1
#**n**80	Homing method	R/W	Word	1
#**n**81 #**n**82	Home offset	R/W	Word	1
#**n**83 #**n**84	Homing speed	R/W	Word	1

CR number	Function	Attribute	Data type	Length
#**n**85	Speed at which motion homes after a transition in a DOG signal	R/W	Word	1
#**n**86				
#**n**87	Homing acceleration time	R/W	Word	1
#**n**88				
#**n**89	Enabling a homing mode	R/W	Word	1
#**n**90	Target position of an interpolation mode	R/W	Word	1
#**n**91				
#**n**92	Enabling an interpolation mode	R/W	Word	1

- CANopen common mode

CR number	Function	Attribute	Data type	Length
#500	CANopen mode switch	R/W	Word	1
#504	Enabling a heartbeat protocol	R/W	Word	1
#505	Execution status of a heartbeat protocol	R	Word	1
#506	Heartbeat statuses	R	Word	1

- Object dictionary parameters

CR number	Function	Attribute	Data type	Length
#H'1006	Synchronization cycle setting	R/W	DWord	1
#H'1017	DVP-FPMC heartbeat cycle setting	R/W	Word	1
#H'1400~#H'143F	Parameter settings for a RPDO	R/W	Word	3
#H'1600~#H'163F	Parameter settings for RPDO data mapping	R/W	DWord	4
#H'1800~#H'183F	Parameter settings for a TPDO	R/W	Word	3
#H'1A00~#H'1A3F	Parameter settings for TPDO data mapping	R/W	Dword	4
#H'2000~#H'207F	PDO data registers	R/W	Word	4

7.5 Descriptions of Control Registers

- Normal mode: Common parameters

CR#001: Firmware version of DVP-FPMC

[Description]

The firmware version of DVP-FPMC is displayed in a hex value, e.g. H'8161 indicates that the data of issuing the firmware of DVP-FPMC is "Afternoon, August 16".

CR#052: CANopen synchronous packet sending setting

[Description]

The control register has two functions.

- The low byte of CR052 sets up a CANopen synchronous function. If the value of the low byte is 1, DVP-FPMC will send out a synchronous packet. If the value is 0, the function will be disabled.
- The high byte of CR052 sets up a synchronous cycle. Setting value×5=Value in D1040. If the value of the high byte is greater than 0, the synchronization between the DVP-10PM series motion controller used and DVP-FPMC will be enabled.

Bit	Bit [15:8]	Bit [7:0]
Value	Synchronous cycle	Enabling the sending of a synchronous packet

CR#053: CANopen node ID setting

[Description]

The control register is used to set a CANopen node ID. A CANopen node ID is in the range of 5 to 127.

Default value: 127

CR#054: CANopen transmission speed setting

[Description]

The control register is used to set a CANopen transmission speed. The setting status is indicated by bit 15. If bit 15 is 1, the setting is in progress. If bit 15 is 0, the setting is completed. For example, if the CANopen transmission speed required is 1000 kb/s, users can write K1000 into CR#054.

Bit	Bit [15]	Bit [14:0]
Setting value	Setting status 0: Completed 1: In progress	1000: CANopen speed=1000 kb/s 500: CANopen speed=500 kb/s

CR#055: CANopen SDO/NMT timeout

[Description]

The control register is used to set a CANopen SDO/NMT timeout.

Unit: Millisecond

Default value: 1000

CR#056: DVP-FPMC error status

[Description]

The control register is used to display the error status of DVP-FPMC. Please refer to the table below for more information.

Error status	**Value**	**Resolution**
CANopen connection error	C1	Check the CANopen nodes of the present slaves.
Ethernet connection error	E1	Check the connection between the communication module and Ethernet.

CR#059: Network IP address and port setting for DVP-FPMC

[Description]

The control register is used to set an IP address and a port number for DVP-FPMC.

Data length: 3 words

Default IP address: 192.168.0.100

Port number: 1024

Please refer to the example below. (IP address: 192.168.0.100; Port number: 1024)

Word 0		**Word 1**		**Word 2**
H-byte	L-byte	H-byte	L-byte	1024
192	168	0	100	

CR#062: Ethernet connection command and status

[Description]

The control register is used to set an Ethernet connection command, and obtain a connection status.

- H’0: Disconnected
- H’30: Connected
- H’10: Sending a connection command
- H’20: Sending a disconnection command

CR#063: IP address and port setting for an Ethernet master

[Description]

The control register is used to set an IP address and a port number for an Ethernet master.

Data length: 3 words

Please refer to the table below for more information.

Word 0		Word 1		Word 2
H-byte	L-byte	H-byte	L-byte	1024
192	168	0	100	

CR#064~CR#67: Length of data to be transmitted/received through Ethernet/Data to be transmitted/received through Ethernet

[Description]

The control register is used to set the data to be accessed through Ethernet. The maximum capacity is 1024 bytes.

- Sending data: After users write a data length data into CR#064, and data into CR#65, DVP-FPMC will automatically clear values in the two control registers to 0.
- Receiving data: Users read the contents of CR#066 first, and then read the data in CR#067.

CR#070: Node ID of an SDO server

[Description]

The control register is used to set the node ID of an SDO server. A node ID is in the range of 1 to 127.

CR#071: SDO access command and status

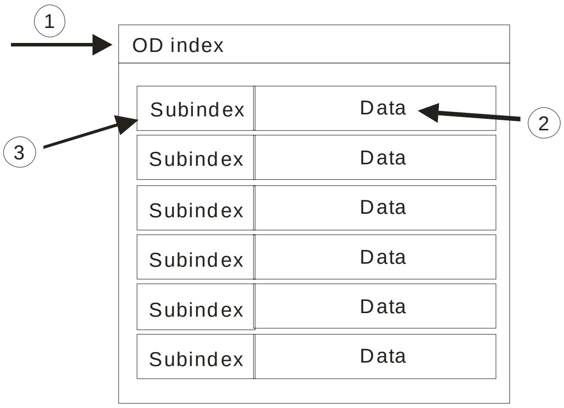
[Description]

The control register is used to set an SDO access command, and obtain a status. Please refer to the table below for more information.

Bit	Bit [15:8]	Bit [7:4]	Bit [3]	Bit [2:0]
Setting value	Subindex of a target OD index	Data length (Unit: Byte) Range: 1~8 If users want to write data, they have to specify a data length.	Error flag	Command: 0: Completed 1: Writing (including a check) 2: Reading (including a check) 3: Writing (not including a check) 4: Reading (not including a check)

Example: SDO data transmission

1. Specify the OD index of an SDO server (CR#070) in CR#072.
2. Set the data to be transmitted in CR#073~CR#076.
3. Refer to the table above. Specify a subindex in bit 15~bit 8 in CR#071, and an SDO access command.



CR#072: SDO OD index

[Description]

The control register is used to specify a target OD index.

Range: H’0000~H’FFFF.

CR#073~CR#76: SDO OD transmission/reception register 1~SDO OD transmission/reception register 4

[Description]

The data to be accessed through an SDO protocol is stored in the four control registers. The maximum capacity is 1024 bytes. If an error occurs during SDO data transmission, an error code will be stored in CR#073 and CR#074. If CR#073~CR#076 are used at a time, CR#073 functions as the LSB and CR#076 functions as the MSB.

CR#080: NMT command

[Description]

If DVP-FPMC is a master, an NMT command can be used to change a network status. Please refer to the table below for more information.

Bit	Bit [15:8]	Bit [7:0]
Setting value	Network management command 1: Enabling node communication 2: Disabling node communication 128: Switch an operation mode 129: Resetting node communication	Node ID of a slave

- Parameters for an A2 mode

  An A2 mode is one of the applications of DVP-FPMC specifically for Delta ASDA-A2 series servo drives. In an A2 mode, CANopen node ID 1~CANopen ID 4 are for ASDA-A2 series servo drives, and CR#100~CR#499 correspond to servo parameters. CR#100~CR#199 are control registers for node ID 1, CR#200~CR#299 are control registers for node ID 2, CR#300~CR#399 are control registers for node ID 3, CR#400~CR#499 are control registers for node ID 4. n in a control register number represents the digit in the hundreds place of the control register number. It is in the range of 1 to 4. Control registers for ASDA-A2 application are applicable only in an A2 mode.

CR#010: CANopen bus scan

[Description]

The control register is used to scan CANopen node ID 1~CANopen node ID 4. Bit 0~bit 3 in CR#010 correspond to node 1~node 4. If a bit is 1, its corresponding node will be scanned, and the contents of the control register will be cleared automatically. Please refer to the table below for more information.

Bit	Bit [15:4]	Bit [3]	Bit [2]	Bit [1]	Bit [0]
Node number	Reserved	Node 4	Node 3	Node 2	Node 1

CR#020: CANopen bus communication status

[Description]

Two consecutive bits in the control register are used to display a node communication status.

00: Disconnected

01: Connected

11: Ready

Please refer to the table below for more information.

Bit	Bit [15:8]	Bit [7:6]	Bit [5:4]	Bit [3:2]	Bit [1:0]
Node number	Reserved	Node 4	Node 3	Node 2	Node 1

CR#040: Error status of a server

[Description]

The control register is used to display the error status of a servo drive. Bit 0~bit 3 in CR#010 correspond to node 1~node 4. If an error occurs, its corresponding bit will be 1. If an error reset command is executed, the contents of the register will be cleared automatically. Please refer to the table below for more information.

Bit	Bit [15:4]	Bit [3]	Bit [2]	Bit [1]	Bit [0]
Node number	Reserved	Node 4	Node 3	Node 2	Node 1

CR#050: CANopen bus control command

[Description]

The control register is used to send bus control commands to the nodes connected successfully in a CANopen network. If the value in the control register is 1, the servos which have been connected are ON. If the value in the control registers is 128, the servos which have been connected are OFF. If the value in the control register is 129, the errors which appear are cleared. After the setting of the control register is completed, the contents of the register will be cleared automatically. Please refer to the table below for more information.

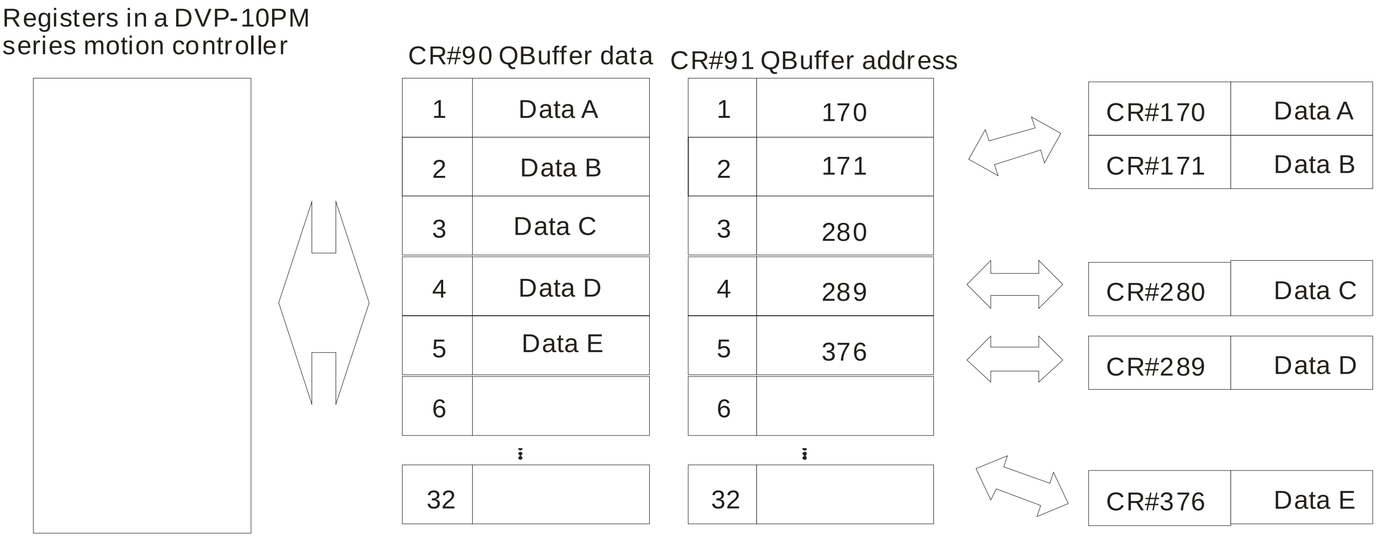
Bit	Bit [15:8]	Bit [7:0]
Value	Reserved	1: All servos are ON. 128: All servos are OFF. 129: All errors are cleared.

CR#090~CR#093: Data written into/read from a DVP-FPMC QBuffer/Address of the data written into/read from a DVP-FPMC QBuffer

[Description]

A QBuffer is designed for accessing several inconsecutive control registers by means of executing TO/FROM once. PLC scan time can be reduced by decreasing the number of times TO/FROM is executed. QBuffer access operation is described below.

For example, after the inconsecutive control register numbers CR#170, CR#171, CR#280, CR#289, and CR#376 are written into the QBuffer address CR#91, DVP-FPMC will connect the data in CR#170, CR#171, CR#280, CR#289, and CR#376 with CR#90 automatically. Users only need to access CR#90, and the data in CR#170, CR#171, CR#280, CR#289, and CR#376 can be modified.



CR#n00: Node ID

[Description]

The control register is used to display the node ID of a servo drive in a CANopen network.

Node ID=1: CR#100=1

Node ID=2: CR#200=2

Node ID=3: CR#300=3

Node ID=4: CR#400=4

CR#n01~CR#n02: Manufacturer ID

[Description]

The control registers are used to display the manufacturer ID of an ASDA-A2 series servo drive.

Data type: Double word

CR#n03~CR#n04: Product ID

[Description]

The control registers are used to display the product ID of an ASDA-A2 series servo drive.

Data type: Double word

CR#n05~CR#n06: Firmware version

[Description]

The control registers are used to display the firmware version of an ASDA-A2 series servo drive.

Data type: Double word

CR#n07~CR#n08: Product type

[Description]

The control registers are used to display the product type of an ASDA-A2 servo drive.

Data type: Double word

CR#n09: CANopen node communication status

[Description]

The control register is used to display a node communication status in a CANopen network. Please refer to the table below for more information.

Status	Value
Disconnected	H'1
Connected	H'2
Operation mode	H'5
Error	H'6
Reset	H'7

CR#n10: Emergency error code

[Description]

The control register is used to display an error code defined by a CANopen protocol when an error occurs in a certain node.

CR#n11~CR#n12: Manufacturer's error code

[Description]

The control registers are used to display an error code defined by a manufacturer when an error occurs in an ASDA-A2 series servo drive. Please refer to Delta ASDA-A2 User Manual for more information about error codes.

CR#n20: Servo drive status

[Description]

The value in the control register indicates the present status of an ASDA-A2 series servo drive. Please refer to the table below for more information.

	Status word															
	X	OM	OM	OM	X	TR	RM	X	WR	X	QS	X	FT	SO	X	RS
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

- RS: The servo drive is ready. After the initialization of the servo drive is completed, the bit will be 1.
- SO: The servo drive is ON. The bit will be 1 if the servo drive is ON.
- FT: It is an error flag. If an error occurs in the servo drive, the bit will be 1.
- QS: If the bit is 1, the servo drive can be stopped urgently.
- WR: It is a warning flag. If the servo drive sends a warning message, the bit will be 1.
- RM: If the bit is 1, remote monitoring can be executed.
- TR: If the execution of a motion command is completed, the bit will be 1.
- OM [14:12]: The bits indicate the statuses of motion modes. Please see the table below for more information.

	Profile position mode	Homing mode	Interpolation mode
OM [12]	A target position has been set successfully.	A homing mode is being executed.	An interpolation mode is being executed.
OM [13]	Following error	Homing error	X

	Profile position mode	Homing mode	Interpolation mode
OM [14]	X	X	Enabling synchronization

CR#n21: Present motion mode of a servo drive

[Description]

The control register is used to display the present motion mode of a servo drive.

Value	Motion mode
0x01	Profile position mode
0x06	Homing mode
0x07	Interpolation mode

CR#n22~CR#n23: Servo drive position

[Description]

The control registers are used to display the present position of a servo drive.

Data type: Double word

CR#n40: Node control command

[Description]

The control register is used to send a node control command to the node connected. If the value in the control register is 1, the servo which has been connected is ON. If the value in the control registers is 128, the servo which has been connected is OFF. If the value in the control register is 129, the error which appears is cleared. Please refer to the table below for more information.

Bit	Bit [15:8]	Bit [7:0]
Value	Reserved	1: The servo which has been connected is ON. 128: The servo drive which has been connected is OFF. 129: The error which appears is cleared.

CR#n50: SDO access command and status

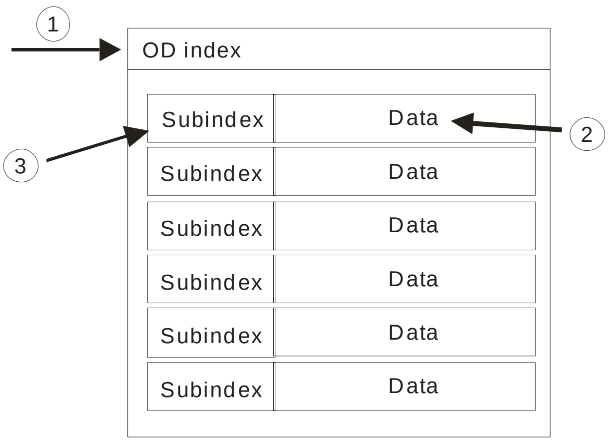
[Description]

The control register is used to set an SDO access command, and obtain a status. Please refer to the table below for more information.

Bit	Bit [15:8]	Bit [7:4]	Bit [3]	Bit [2:0]
Setting value	Subindex of a target OD index	Data length (Unit: Byte) Range: 1~8 If users want to write data, they have to specify a data length.	Error flag	Command: 0: Completed 1: Writing (including a check) 2: Reading (including a check) 3: Writing (not including a check) 4: Reading (not including a check)

Example: SDO data transmission

1. Specify the OD index of an SDO server in CR#n51.
2. Set the data to be transmitted in CR#n52~CR#n55.
3. Refer to the table above. Specify a subindex in bit 15~bit 8 in CR#n50, and an SDO access command.



CR#n51: SDO OD (object dictionary) index

[Description]

The control register is used to specify the OD index of a node.

Range: H'0000~H'FFFF.

CR#n52~CR#n55: SDO transmission/reception register 1~SDO transmission/reception register 4

[Description]

The data to be accessed through an SDO protocol is stored in the four control registers. The maximum capacity is 1024 bytes. If an error occurs during SDO data transmission, an error code will be stored in CR#n52 and CR#n53. If CR#n52~CR#n55 are used at a time, CR#n52 functions as the LSB and CR#n55 functions as the MSB.

CR#n60: Servo drive control

[Description]

The control register is used to send a control command to an ASDA-A2 series servo drive. Please refer to the table below for more information.

	Control word															
	X	X	X	X	X	X	X	X	FR	OM	OM	OM	EO	X	X	X
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

- EO: The servo drive is enabled. The servo drive will be ON if the bit is 1.
- FR: The error occurs in the servo is cleared. The servo drive will clear the error which appears if the bit is 1.
- OM: It is used to control the function of motion modes. Please refer to the table below for more information.

	Profile position mode	Homing mode	Interpolation mode
OM [4]	Setting a new target position	Enabling a homing mode	X
OM [5]	A target position is allowed to be changed during motion.	X	X
OM [6]	Absolute/Relative positioning	X	X

Note: “X” indicates “Reserved”.

CR#n61: Motion mode selection

[Description]

The control register is used to set the motion mode of a servo drive. Please refer to the table below for more information.

Setting value	Motion mode
0x01	Profile position mode
0x06	Homing mode
0x07	Interpolation mode

CR#n70~CR#n71: Target position of a profile position mode

[Description]

The control registers are used to set the target position of a profile position mode.

Data type: Double word

CR#n72~CR#n73: Target speed of a profile position mode

[Description]

The control registers are used to set the target speed of a profile position mode.

Data type: Double word

CR#n74~CR#n75: Acceleration time of a profile position mode

[Description]

The control registers are used to set the acceleration time of a profile position mode.

Data type: Double word

CR#n76~CR#n77: Deceleration time of a profile position mode

[Description]

The control registers are used to set the deceleration time of a profile position mode.

Data type: Double word

CR#n78: Profile position settings

[Description]

The control register is used to set a profile position mode. A profile position mode can be absolute positioning or relative positioning.

- 0: Positioning is completed.
- 1: A profile position mode is absolute positioning. The value in the control register will be cleared to 0 after positioning is completed.
- 2: A profile position mode is relative positioning. The value in the control register will be cleared to 0 after positioning is completed.
- 3: A profile position mode is absolute positioning. The value in the control register will be retained after positioning is completed.

CR#n80: Homing method

[Description]

The control register is used to set a homing method.

Range: 1~35

For more information, please refer to chapter 13 in CiA DSP402 V2.0.

CR#n81~CR#n82: Home offset

[Description]

The control registers are used to set a home offset.

Range: -2,147,483,648~2,147,483,647

Data type: Double word

CR#n83~CR#n84: Homing speed

[Description]

The control registers are used to set a homing speed.

Range: 0~2,147,483,647

Data type: Double word

CR#n85~CR#n86: Speed at which motion homes after a transition in a DOG signal

[Description]

The control registers are used to set the speed at which motion homes after a transition in a DOG signal.

Range: 0~2,147,483,647

Data type: Double word

CR#n87~CR#n88: Homing acceleration time

[Description]

The control registers are used to set homing acceleration time.

Range: 0~2,147,483,647

Data type: Double word

CR#n89: Enabling a homing mode

[Description]

A homing mode will be executed if the value in the control register is 1. After homing is completed, the value in the control register will be cleared to 0 automatically.

CR#n90~CR#n91: Target position of an interpolation mode

[Description]

The control registers are used to set the target position of an interpolation mode.

Range: -2,147,483,648 ~2,147,483,647

Data type: Double word

CR#n92: Enabling an interpolation mode

[Description]

An interpolation mode will be executed if the value in the control register is 1. An interpolation mode will be disabled if the value in the control register is 0.

- CANopen common mode

CR#500: CANopen mode switch

[Description]

The control register is used to switch the CANopen mode of DVP-FPMC. If the value in the control register is 1, the CANopen mode of DVP-FPMC is an A2 mode. If the value in the control register is 2, the CANopen mode of DVP-FPMC is a normal mode.

Default value: 1

Control registers for an A2 mode will be unavailable if the CANopen mode of DVP-FPMC is a normal mode. Control registers for a normal mode will be unavailable if the CANopen mode of DVP-FPMC is an A2 mode.

CR#504: Enabling a heartbeat protocol

[Description]

If a heartbeat protocol is enabled in a common mode, the heartbeat mechanisms of node ID 1~nod ID 16 (slaves) will be enabled by a master. If the value in the control register is 0, a heartbeat protocol is disabled. If the value in the control register is 1, a heartbeat protocol is enabled.

CR#505: Execution statuses of a heartbeat protocol

[Description]

The control register is used to display the execution statuses of the heartbeat protocol executed by node ID 1~node ID 16. If the value in the control register is 0, the execution of a heartbeat protocol is completed. If the value in the control register is 1, a heartbeat protocol is being executed.

CR#506: Heartbeat statuses

[Description]

The control register is used to display the heartbeat statuses of node ID1~node ID 16. Node ID 1~node ID 16 correspond to bit 0~bit 15. If the heartbeat mechanism of a slave is enabled successfully, the bit corresponding to the salve is 1. If the heartbeat mechanism of a slave is not enabled, the bit corresponding to the salve is 0. In addition, if a slave is disconnected from a master, the bit corresponding to the slave is 0.

	Heartbeat statuses of slaves															
Node IDs	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

- Object dictionary parameters

CR#H’1006: Synchronization cycle setting

[Description]

The control register is used to set a time interval (unit) for the sending of CANopen synchronization packets in a normal mode.

Unit: μs

Data type: Double word

Default value: 5000

A synchronization cycle is measured by the millisecond now. The time less than one millisecond is ignored. It is suggested that the minimum synchronization cycle for 1 PDO~3 PDOs in a CANopen network should be 3 milliseconds, and the minimum synchronization cycle for 4 PDOs~8PDOs should be 4 milliseconds. That is to say, one millisecond will be added to a minimum synchronization cycle if four PDOs are added.

CR#H’1017: DVP-FPMC heartbeat cycle setting

[Description]

The control register is used to set a heartbeat cycle.

Unit: Millisecond

Default value: 0

If the value in the control register is 0, the heartbeat mechanism of DVP-FPMC is not enabled.

CR#H’1400~CR#H’143F: Parameter settings for a RPDO

[Description]

The control registers are used to set the parameters for RPDO in a normal mode. The capacity of the control registers is 3 words. Please refer to the table below for more information.

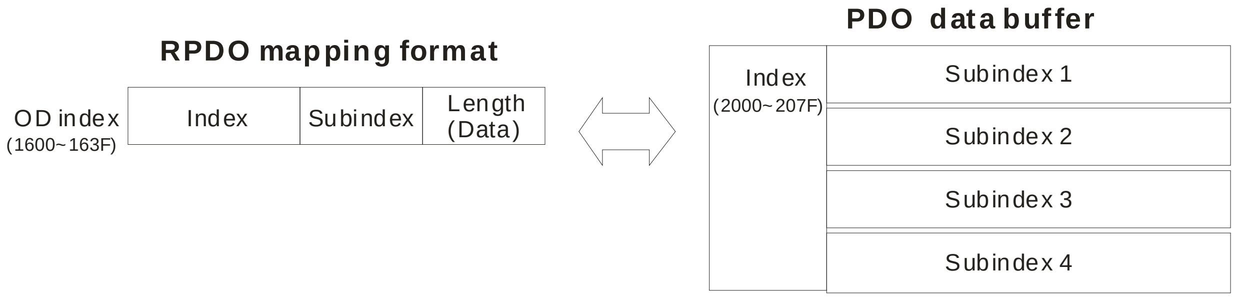
Transmission method	PDO ID	
Word 2	Word 1 (High)	Word 0 (Low)

- PDO ID: A CANopen POD ID occupies two words.
  Default values:
  CR#H’1400=H180+FPMC DVP-FPMC node ID (CR#053)
  CR# H’1401=H280+FPMC DVP-FPMC node ID (CR#053)
  CR#H’1403=H380+FPMC DVP-FPMC node ID (CR#053)
  CR#H’1404=H480+FPMC DVP-FPMC node ID (CR#053)
- Transmission method: If the value set is in the range of 1 to 240, the sending of a PDO is synchronized with the sending of a CANopen packet, and is executed every synchronization cycle. If the value set is in the range of 241 to 255, no PDO is sent.
  Default value: 241

CR#H’1600~CR#H’163F: Parameter settings for RPDO data mapping

[Description]

The control registers are used to set parameters for RPDO data mapping in a normal mode. A RPDO parameter is composed of a double word. The first word is used to set an OD Index. The high byte of the second word is used to set a subindex, and the low byte is used to set a data type. A bit is a unit for setting a data type. Please refer to the figure below for more information.



CR#H’1800~CR#H’183F: Parameter settings for a TPDO

[Description]

The control registers are used to set the parameters for TPDO in a normal mode. The capacity of the control registers is 3 words. Please refer to the table below for more information.

Transmission method	PDO ID	
Word 2	Word 1 (High)	Word 0 (Low)

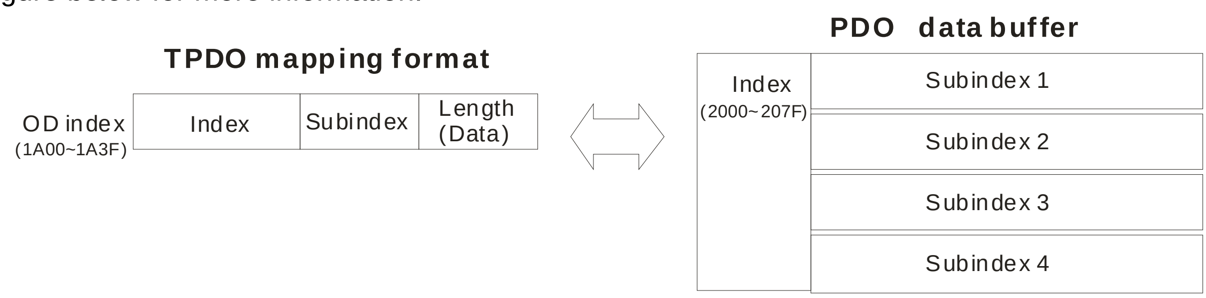
- PDO ID: A CANopen POD ID occupies two words.
  Default values:
  CR#H’1800=H200+ DVP-FPMC node ID (CR#053)
  CR# H’1801=H300+ DVP-FPMC node ID (CR#053)
  CR#H’1803=H400+ DVP-FPMC node ID (CR#053)
  CR#H’1804=H500+ DVP-FPMC node ID (CR#053)
- Transmission method: If the value set is in the range of 1 to 240, the sending of a PDO is synchronized with the sending of a CANopen packet, and is executed every synchronization cycle. If the value set is in the range of 241 to 255, no PDO is sent.
  Default value: 241

Transmission method	PDO ID	
Word 2	Word 1 (High)	Word 0 (Low)

CR#H’1A00~CR#H’1A3F: Parameter settings for TPDO data mapping

[Description]

The control registers are used to set parameters for TPDO data mapping in a normal mode. A TPDO parameter is composed of a double word. The first word is used to set an OD Index. The high byte of the second word is used to a subindex, and the low byte is used to set a data type (unit: bit). Please refer to the figure below for more information.



CR#H'2000~CR#H'207F: PDO data registers

[Description]

Data registers storing the data for PDO access. DVP-FPMC takes CR#H'2000~CR#H'207F in an OD as data registers. Every index has 4 subindices in which data can be stored. The size of a subindex is one word. If the size of the data to be accessed is bigger than one word, users have to use several subindex areas for data transmission.

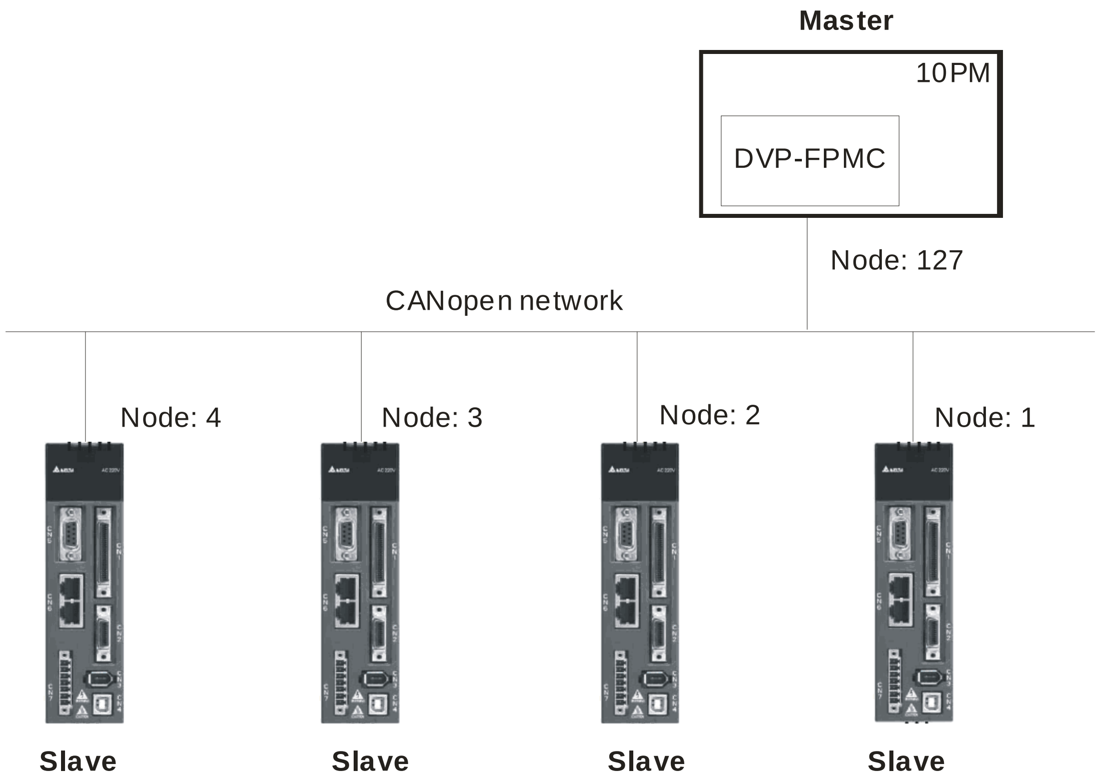
- Object dictionary for DVP-FPMC

Index (Hexadecimal value)	Object name	Number of subindices	Name	Data type	Attribute	Mapping target
1000	VAR	1	Product type	UNSIGNED32	RO	N
1006	VAR	1	Synchronization cycle	UNSIGNED32	RW	N
1018	ARRAY	5	Product information	UNSIGNED32	RO	N
1200	ARRAY	3	SDO parameter of a master	UNSIGNED32	RO	N
1280	ARRAY	4	SDO parameter of a slave	UNSIGNED32	RO	N
:	:	:	:	:	:	:
128F	ARRAY	4	SDO parameter of a slave	UNSIGNED32	RO	N
1400	ARRAY	6	RPDO parameter	UNSIGNED32	RW	N
:	:	:	:	:	:	:
143F	ARRAY	6	RPDO parameter	UNSIGNED32	RW	N
1600	ARRAY	9	RPDO mapping parameter	UNSIGNED32	RW	N
:	:	:	:	:	:	:
163F	ARRAY	9	RPDO mapping parameter	UNSIGNED32	RW	N
1800	ARRAY	6	TPDO parameter	UNSIGNED32	RW	N
:	:	:	:	:	:	:
183F	ARRAY	6	TPDO parameter	UNSIGNED32	RW	N
1A00	ARRAY	9	TPDO mapping parameter	UNSIGNED32	RW	N
:	:	:	:	:	:	:
1A3F	ARRAY	9	TPDO mapping parameter	UNSIGNED32	RW	N
2000	ARRAY	5	PDO data register	UNSIGNED32	RW	Y
:	:	:	:	:	:	:
207F	ARRAY	5	PDO data register	UNSIGNED32	RW	Y
6000	ARRAY	5	Mode switch	UNSIGNED8	R	Y
6100	ARRAY	17	Servo drive control	UNSIGNED16	R	Y
6120	ARRAY	17	Parameter of a profile position mode	UNSIGNED32	R	Y
6200	ARRAY	5	Present motion mode of a servo drive	UNSIGNED8	RW	Y
6300	ARRAY	5	Servo drive status	UNSIGNED16	RW	Y
6320	ARRAY	5	Servo drive position	UNSIGNED32	RW	Y

7.6 Setting a DVP-FPMC Mode

■ A2 mode

In an A2 mode, DVP-FPMC communicates with four Delta ASDA-A2 series servo drives through a CANopen network. During the communication, DVP-FPMC functions as a master, and the servo drives functions as slaves. The communication structure required is show below. The default node ID of DVP-FPMC is 127. The objects which are connected are node ID 1~ node ID 4. After users assign node ID 1~node ID4 to the servo drives, the servo drives can exchange data with DVP-FPMC.



In the A2 mode, there are six PDOs for the setting of servo parameters. The users can monitor the statuses of the servo drives directly by accessing control registers in a CANopen network. They do not need to set PDO parameters. Four PDOs are assigned to DVP-FPMC, and two PDOs are assigned to the servo drives. Please refer to the table below for more information.

PDO	Master (transmission)	Slave (transmission)
1	Target position of a profile position mode (CR#n70~CR#n71) Target speed of a profile position mode (CR#n72~CR#n73)	
2	Acceleration time of a profile position mode (CR#n74~CR#n75) Deceleration time of a profile position mode (CR#n76~CR#n77)	
3	Servo drive control (CR#n60)	
4	Target position of an interpolation mode (CR#n90~CR#n91)	
5		Servo drive status (CR#n20) Present motion mode of a servo drive (CR#n21)
6		Servo drive position (CR#n22~CR#n23)

Setting communication in an A2 mode:

- Setting the ASDA-A2 series servo drives

  Before creating a CANopen connection, the users have to set the servo drives to CANopen mode.

  1. Set P1-01 to H'0B. (The servo drive is set to CANopen mode.)
  2. Set P3-00. The value of P3-00 indicates a node number. It is in the range of H'01 to H'04.
  3. Set P3-01 to H'0403. The value of P3-01 indicates a baud rate. (If the high byte of the value of P3-01 is 2, the baud rate used is 500 kbps. If the high byte of the value of P3-01 is 4, the baud rate used is 1 Mbps.) The baud rates which are supported by DVP-FPMC now are 1 Mbps and 500 kbps. (Default: 1 Mbps)

- Setting DVP-FPMC

  After the setting of the CNopen parameters in the servo drives connected is completed, the users can create a CANopen network by means of DVP-FPMC.

  1. Write 1 into CR#500. DVP-FPMC is set to A2 mode.
  2. Write a node ID into CR#053. The default node ID of DVP-FPMC is 127.
  3. Write H'FFFF into CR#010. All servo drives which are connected are scanned.
  4. Read the value in CR#010 by means of the instruction FROM, and check whether the value in CR#010 is cleared to 0.
  5. Write 1 into CR#050. All servo drives which has been connected are set to ON.

■ Normal mode

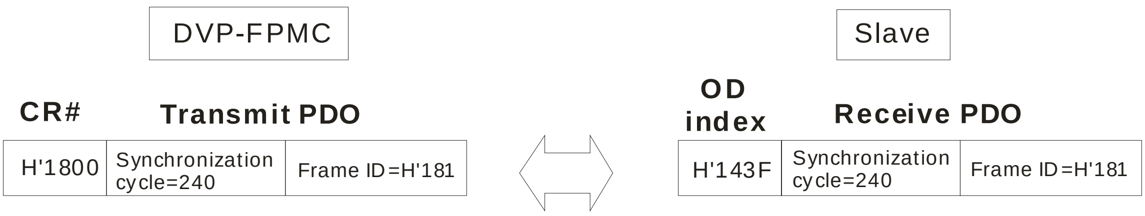
In a normal mode, users have to set the PDO parameters in DVP-FPMC and the slaves which are connected. They have to use FROM/TO to set control registers in DVP-FPMC, and use an SDO protocol to set the PDO parameters in the servo drives connected. The steps of setting the PDO parameters in DVP-FPMC are as follows.

1. Setting PDO transmission parameters

   The setting of PDO parameters includes the setting of a frame ID and the setting of a synchronization cycle. A frame ID is in the range of H'181 to H'578. Please note that the frame ID and the synchronization cycle in the PDO for a master must be the same as the frame ID and the synchronization cycle in the PDO for the slave connected. There are two kinds of PDOs: transmit and receive PDOs (TPDO and RPDO).

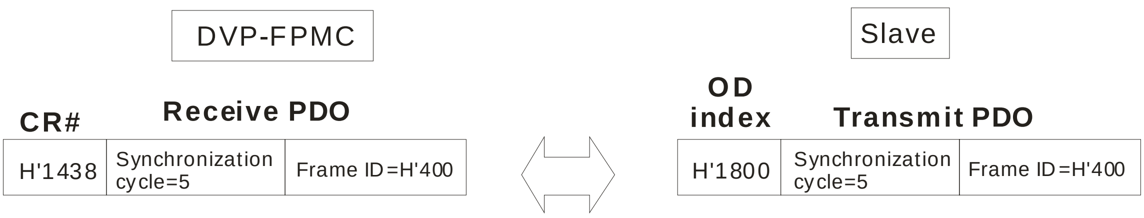
   - Setting a TPDO

     CR#H'1800~CR#H'183F in DVP-DPMC function as TPDOs. They communicate with a slave's RPDOs. For example, the OD index H'1800 (TPDO) in a master communicates with the OD index H'143F (RPDO) in a slave. The synchronization cycle set is 240, and the frame ID set is H'181.



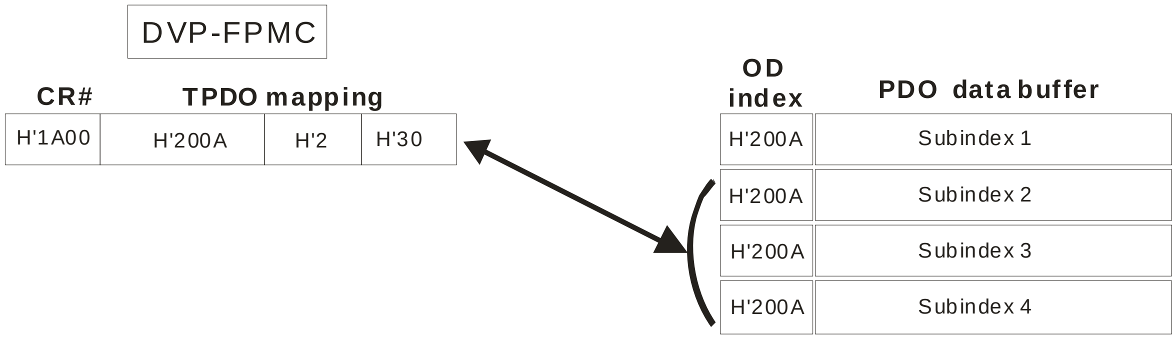
   - Setting a RPDO

     CR#H'1400~CR#H'143F in DVP-DPMC function as RPDOs. They communicate with a slave's TPDOs. For example, the OD index H'1438 (RPDO) in a master communicates with the OD index H'1800 (TPDO) in a slave. The synchronization cycle set is 5, and the frame ID set is H'400.



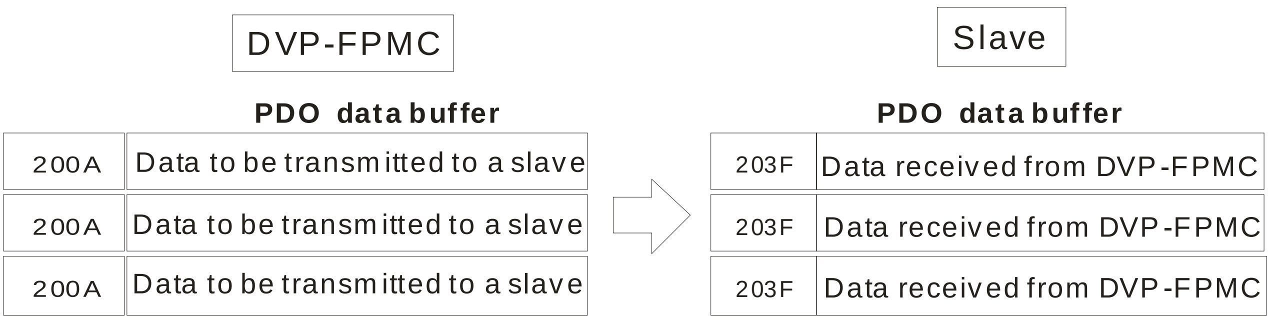
2. Setting PDO mapping parameters

   The setting of PDO mapping parameters includes the setting of a mapping target and the setting of a data length in a PDO data buffer. The maximum data length which can be set is 64 bits, that is to say, four subindices in a PDO data buffer can be occupied at a time. For example, the mapping target set is the second subindex in CR#H'200A, and the data length set is 48 bits. Subindex 2~subindex 4 in the PDO data buffer used are occupied.



3. Setting PDO data

   Write the data to be transmitted by a PDO into the OD indices set. For example, subindex 2~subindex 4 in CR#H'200A in DVP-FPMC is TPDO data, and subindex 1~subindex 3 in CR#H'203F in the slave connected is RPDO data. After communication is enabled, data will be transmitted/received every synchronization cycle.



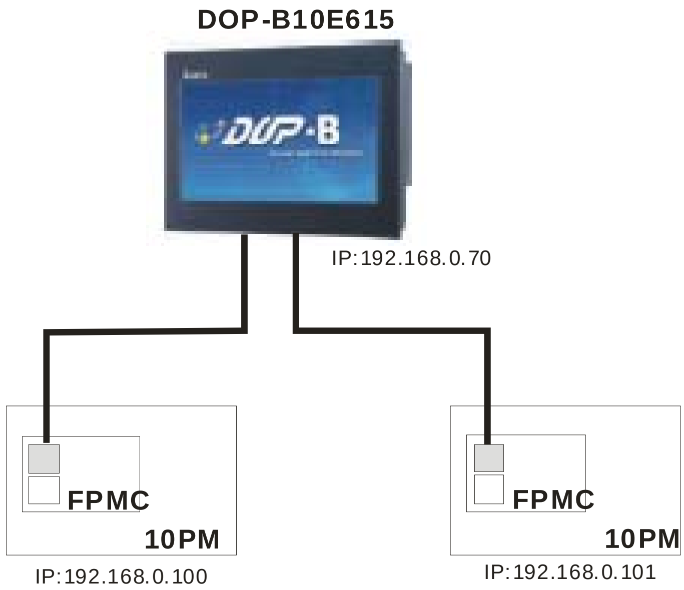
7.7 Ethernet Mode of DVP-FPMC

DVP-FPMC supports Ethernet connection. It can be connected to an Ethernet device or a PC. If DVP-FPMC is connected to a PC, PMSoft can be used to upload/download a program and monitor devices. Users only need to connect the communication port on DVP-FPMC to a communication port on equipment. Please refer to section 9.3 for more information about installing hardware. If DVP-FPMC is connected to a PC, the Ethernet LED indicator will be ON. Please check the setting of hardware or the setting of the PC connected if the Ethernet LED indicator is not ON.

7.7.1 Communication between DVP-FPMC and an HMI

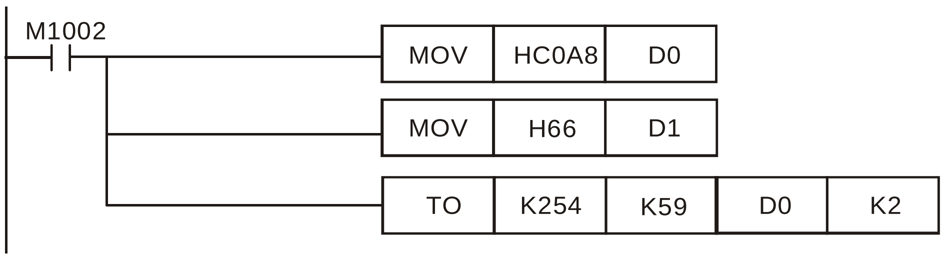
- Configuration

  In this example, two DVP-10PM series motion controllers equipped with DVP-FPMC exchange data with the HMI DOP-B10E615 through Ethernet. The hardware configuration required is shown below. The program in the HMI controls Y0~Y7 on the two DVP-10PM series motion controllers.



- Setting DVP-FPMC

  In this example, DVP-FPMC functions as a slave. The IP address of DVP-FPMC needs to be set. The IP address of the equipment to be connected and Ethernet connections do not need to be set. Users need to write the IP address of DVP-FPMC into CR#59. Please refer to 7.5 for more information about setting CR#59. Take the IP address 192.168.0.100 for instance. The program in DVP-PM is shown below.

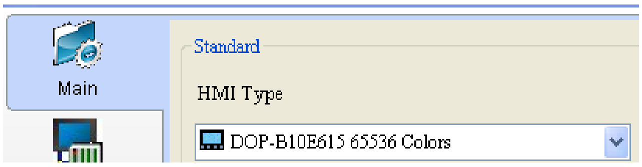


■ Setting an HMI

An HMI is used as a master. It is connected to two slaves. The IP address of the HMI and Ethernet connections need to be set. The steps of creating the connection between the HMI and DVP-FPMC are as follows.

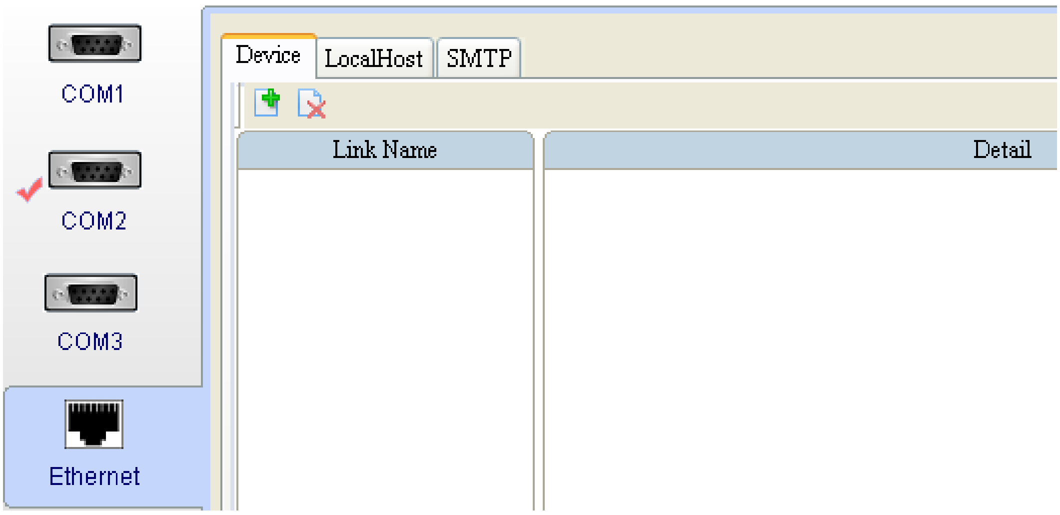
1. Click **Configuration…** on the **Options** menu.

2. Click the **Main** tab, and then select **DOP-B10E615 65536 Colors** in the **HMI Type** drop-down list box.

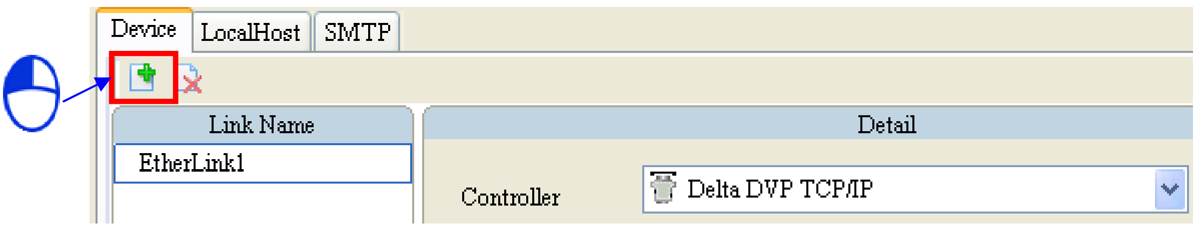


3. Click **Communication Setting** on the **Options** menu.

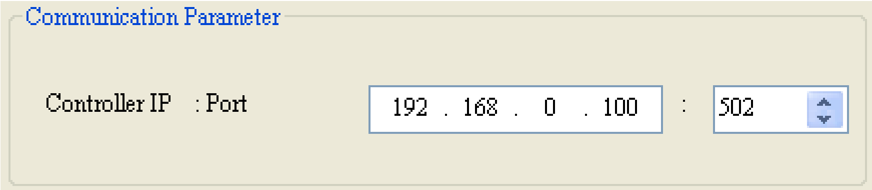
4. Click the **Ethernet** tab.



5. After users click the add icon, they have to type a link name in the **Link Name** box, and select **Delta DVP TCP/IP** in the **Controller** drop-down list box.

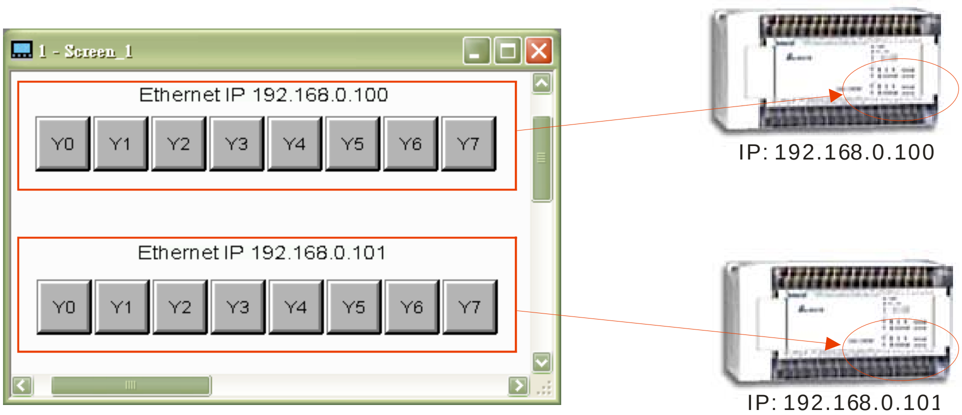


6. The users have to set the IP address of DVP- FPMC in the **Communication Parameter** section.



7. After the users select the link name created in step 5 in the **Input** window for an element, they can operate the memory defined by the element by means of Ethernet.

The HMI needs to control Y0~Y7 on two DVP-10PM series motion controllers which function as slaves. The interface required is shown below. The buttons Y0~Y7 correspond to Y0~Y7 on EtherLink1 and EtherLink2, that is to say, they correspond to Y0~Y7 on the two slaves connected. After the setting described above is completed, the HMI can connect to the two slaves by means of Ethernet.

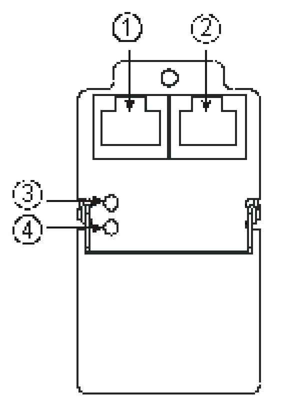


7.7.2 Communication between DVP-FPMC and PMSoft

Before users create communication between DVP-FPMC and PMSoft, they have to use COMMG to create an Ethernet driver. An Ethernet driver can be used to upload the program in a DVP-10PM series motion controller, download a program into a DVP-10PM series motion controller, and monitor a DVP-10PM series motion controller.

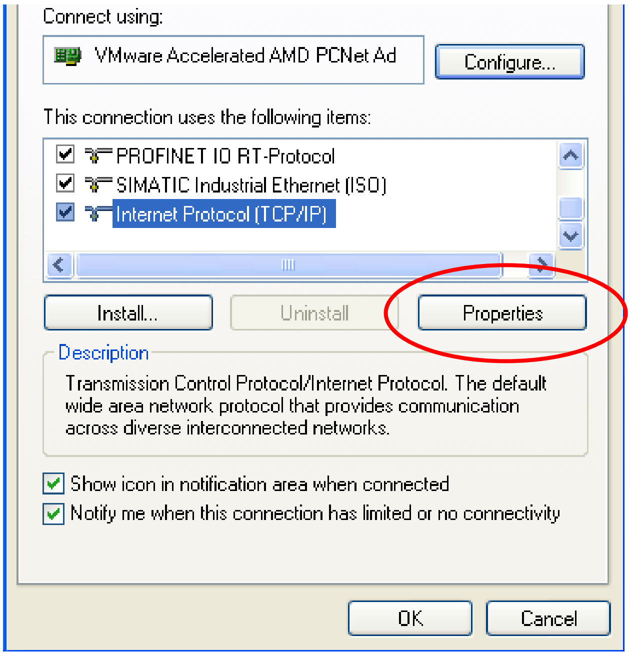
- Wiring hardware

  Users can connect the network port on DVP-FPMC to a network port on a PC by means of a network cable. If DVP-FPMC is connected to a PC, the Ethernet LED indicator on DVP-FPMC will be ON. Please check the setting of hardware and or the setting of the PC is the Ethernet LED indicator is not ON.

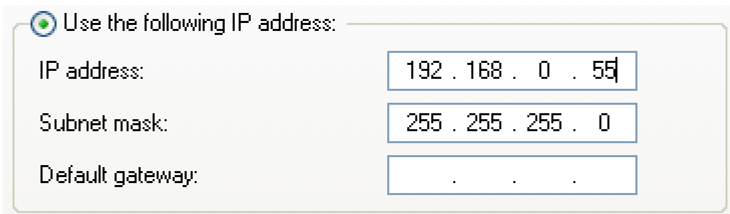
①	CANopen port	
②	Ethernet port	
③	CANopen LED indicator	
④	Ethernet LED indicator	

■ Setting a PC

1. Click **Internet Protocol (TCP/IP)** in the **Local Area Connection Properties** window, and then click **Properties**.

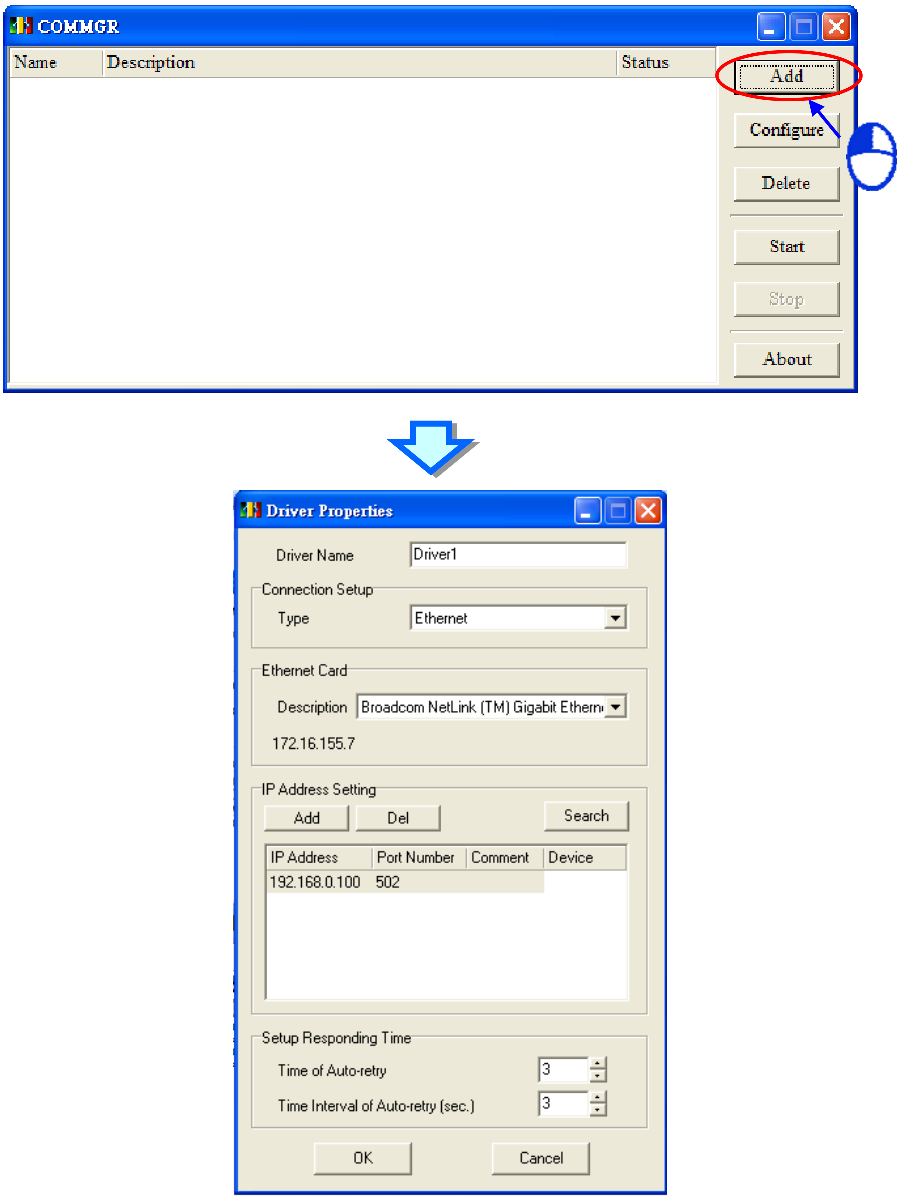


2. Select the **Use the following IP address** option button in the **Internet Protocol (TCP/IP) Properties** window. Type 192.168.0.55 in the **IP address** box. The last number is in the range of 1 to 255, bit it can not be 100. Type 255.255.255.0 in the **Subnet mask** box, and click **OK**.



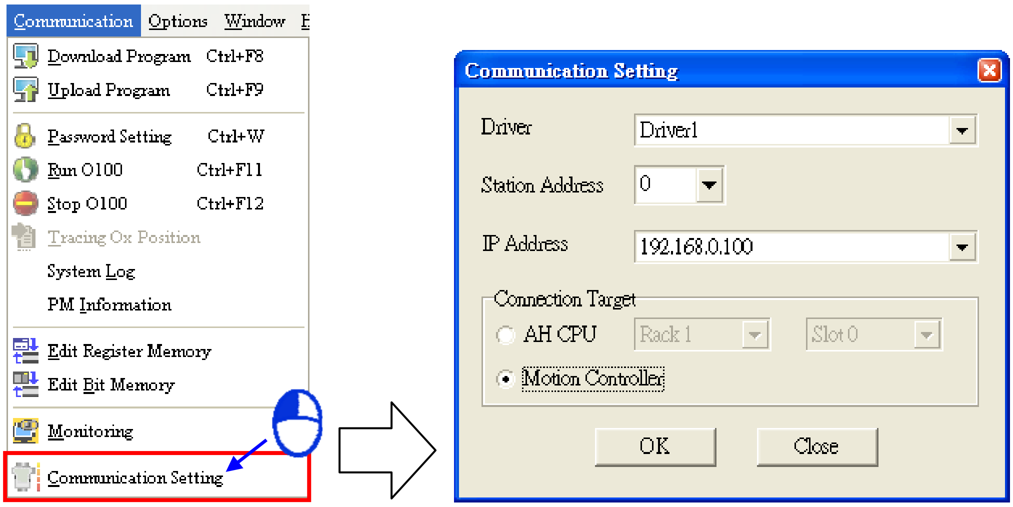
■ Setting PMSoft

1. Click **Add** in the **COMMGR** window, and then create an Ethernet driver in the **Driver Properties** window.



The IP Address set is 192.168.0.100, and the port number set is 502.

2. Start PMSoft, and click **Communication Setting** on the **Communication** menu. In the **Communication Setting** window, select the driver created in the first step in the **Driver** drop-down list box, and select the IP address 192.168.1.100. After **OK** is clicked, users can upload/download a program and monitor devices by means of Ethernet.



3. Downloading a program: If users want to download a program, they can click  on the toolbar, or click **Download Program** on the **Communication** menu. The procedure for downloading a program through Ethernet is the same as the procedure for downloading a program through a general communication port.

4. Uploading a program: If users want to upload a program, they can click  on the toolbar, or click **Upload Program** on the **Communication** menu. The procedure for uploading a program through Ethernet is the same as the procedure for uploading a program through a general communication port.

5. Monitoring a DVP-10PM series motion controller: If users want to monitor a DVP-10PM series motion controller, they can click  on the toolbar, or click **Monitoring** on the **Communication** menu. The procedure for monitoring a DVP-10PM series motion controller through Ethernet is the same as the procedure for monitoring a DVP-10PM series motion controller through a general communication port.

7.8 LED Indicators and Troubleshooting

■ CANopen LED indicator

LED indicator	Description	Resolution
The green light is OFF.	A CANopen cable is not connected.	Check whether cables are connected correctly.
The green light is ON.	A CANopen cable is connected normally.	No action is required.

■ Ethernet LED indicator

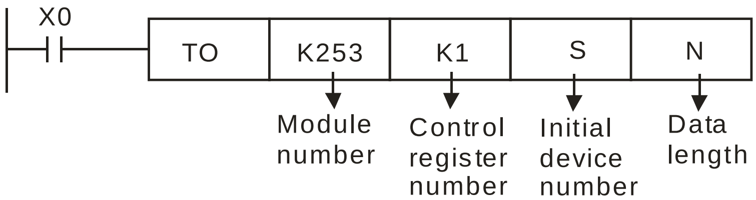
LED indicator	Description	Resolution
The green light is OFF.	DVP-FPMC is not connected to a network.	Check whether a network cable is connected correctly.
The green light is ON.	DVP-FPMC is connected to a network normally.	No action is required.
The green light blinks.	There is data exchange.	

MEMO

8.1 High-speed Comparison and High-speed Capture

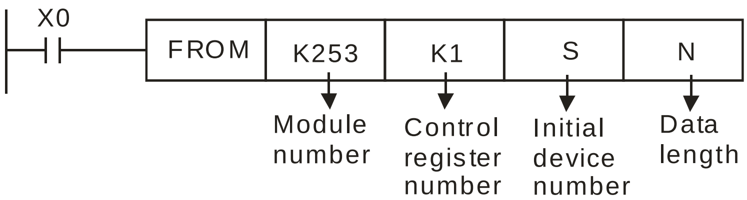
A DVP-10PM series motion controller sets and reads values by means of the instructions FROM and TO. The use of FROM/TO to set high-speed comparison and high-speed capture, and to read values is described below.

- Control



Device	Control	Resetting output devices	Setting a range which is masked
S	Initial group number n (n=0~7)	0	0
S_{+1}	0	1	2
(S_{+3}, S_{+2})	Control register whose group number is n		
(S_{+5}, S_{+4})	Data registers whose group numbers are n		
(S_{+7}, S_{+6})	Control register whose group number is n+1		
(S_{+9}, S_{+8})	Data registers whose group numbers are n+1		
:	:		
(S_{+31}, S_{+30})	Control register whose group number is n+7		
(S_{+33}, S_{+32})	Data registers whose group numbers are n+7		
N	Data length=2+m*4 m=number of groups (8 groups at most can be used.)		

- Reading



Device	Reading the values in counters	Reading the states of output devices/Enabling capture
S	Initial group number n (n=0~7)	0
S_{+1}	0	1
(S_{+3}, S_{+2})	Control register whose group number is n	States of output devices
(S_{+5}, S_{+4})	Data registers whose group numbers are n	Enabling capture (8 bits)
(S_{+7}, S_{+6})	Control register whose group number is n+1	
(S_{+9}, S_{+8})	Data registers whose group numbers are n+1	
:	:	
(S_{+31}, S_{+30})	Control register whose group number is n+7	
(S_{+33}, S_{+32})	Data registers whose group numbers are n+7	
N	Data length=2+m*4 m=number of groups (8 groups at most can be used.)	

- Control/Reading

(1) The format of a control register in a high-speed comparison mode is described below.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Item					Comparison result				Output action		Condition		Comparison source			

Item	Bit	Setting value	DVP-10PM series motion controller
Comparison source	[3-0]	0	Present position of the X-axis
		1	Present position of the Y-axis
		2	Present position of the Z-axis
		3	Present position of the A-axis
		4	Value in C200
		5	Value in C204
		6	Value in C208
		7	Value in C212
Comparison condition	[5-4]	1	Equal to (=)
		2	Greater than or equal to (≧)
		3	Less than or equal to (≦)
Output action	[7-6]	0	Set
		1	Reset
		2, 3	No output
Comparison result	[11-8]	0	Y0
		1	Y1
		2	Y2
		3	Y3
		4	Clearing the value in C200
		5	Clearing the value in C204
		6	Clearing the value in C208
		7	Clearing the value in C212

(2) The format of a control register in a high-speed capture mode is described below.

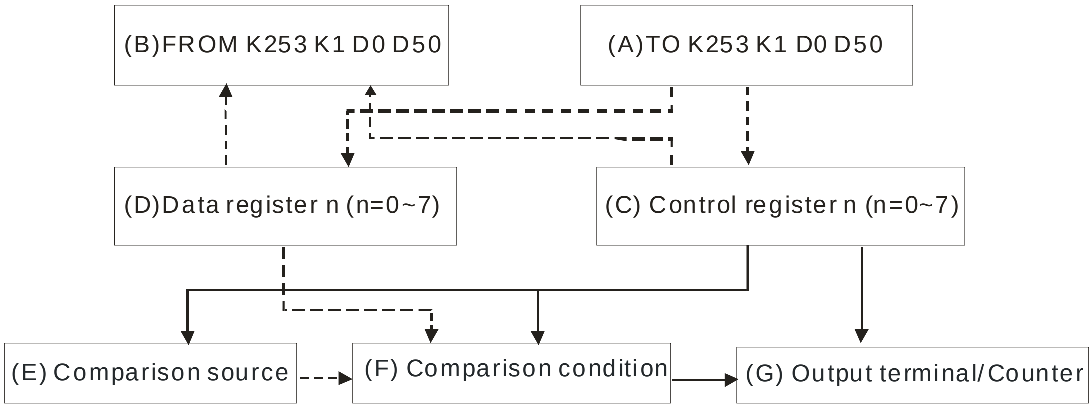
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Item	Trigger				—						Setting		Capture source			

Item	Bit	Setting value	DVP-10PM series motion controller
Capture source	[3-0]	0	Present position of the X-axis
		1	Present position of the Y-axis
		2	Present position of the Z-axis
		3	Present position of the A-axis
		4	Value in C200
		5	Value in C204
		6	Value in C208
		7	Value in C212
Setting	[5-4]	0	Capture mode
External trigger	[15-12]	0	X0
		1	X1
		2	X2
		3	X3
		4	X4
		5	X5
		6	X6
		7	X7
		8	X10
		9	X11
		10	X12
		11	X13
		12	-

Item	Bit	Setting value	DVP-10PM series motion controller
External trigger	[15-12]	13	-
		14	-
		15	-

8.2 High-speed Comparison

A high-speed comparison is shown below. Users use FROM/TO to read/write values so that they can compare data.



※ The dotted lines are data procedures, and the solid lines are control procedures.

Block (A): The instruction TO is used to write data into control registers (block C) and data registers (block D).

Block (B): The instruction FROM is used to read data from control registers (block C) and data registers (block D).

Block (C): User set a comparison source (block E), a comparison condition (block F), and an output terminal (block G) in a control register in accordance with the value it receives by means of TO.

Block (D): The value that users write into data registers by means of the instruction TO is compared with a comparison source (block E).

Block (E): The present positions of four axes, the values in C200, C204, C208, and C212 are comparison sources.

Block (F): There are three comparison conditions, they are equal to, greater than or equal to, and less than or equal to. If block D and block E meet the comparison condition set, the output terminal selected will be set to ON, the counter selected will be reset, the output terminal selected will be reset to OFF, or the counter selected will not be reset.

Block (G): If a comparison condition is met, Y0, Y1, Y2, Y3, C200, C204, C208, or C212 will be set or reset.

Procedure for a high-speed comparison: The instruction TO is used to write data into control registers and data registers (block A).→The comparison source set (block E) is compared with the value in data registers (block D). The comparison result meets the condition set (block F).→Y0, Y1, Y2, Y3, C200, C204, C208, or C212 will be set or reset (block G).

■ Example

【Description】

The high-speed counter C204 is used. If the value in C204 is greater than 100, Y1 will be set to ON. If the value in C204 is greater than 300, Y1 will be reset to OFF. Two comparators are used in a program. One comparator is used to set Y1 to ON, and the other is used to reset Y1 to OFF. When Y1 is set to ON, no LED indicator on DVP10PM00M will indicate that Y1 is ON, but users can know whether Y1 is ON by means of its external wiring. As a result, the terminal C1 is connected to the terminal 24G, Y1 is connected to X7, S/S2 is connected to +24V. A manual pulse generator is used, and is connected to X2 and X3.

【Steps】

1. After O100 is started, the initial setting of two high-speed comparisons will be carried out.
   (1) D0=0→Initial group number n=0
   (2) D1=0
   (3) D20=10→Writing 10 values by means of the instruction TO (two groups of high-speed comparison values)
   (4) D60=10→Reading 10 values by means of the instruction FROM (two high-speed comparison values)
2. Two groups of high-speed comparison values are set when M1 is ON.
   (1) First group: The value in (D3, D2) is H125.→ The comparison source set is C204. (The value of bit 3~bit 0 is 5.) The comparison condition set is greater than or equal to. (The value of bit 5~bit 4 is 2.) The output action selected is set. (The value of bit7~bit 6 is 0.) The terminal selected is Y1 (The value of bit11~bit 8 is 1.)
   (2) First group: The value in (D5, D4) is K100. If the value in C204 is greater or equal to K100, Y1 will be set to ON.
   (3) Second group: The value in (D7, D6) is H165.→ The comparison source set is C204. (The value of bit 3~bit 0 is 5.) The comparison condition set is greater than or equal to. (The value of bit 5~bit 4 is 2.) The output action selected is reset. (The value of bit7~bit 6 is 1.) The terminal selected is Y1. (The value of bit11~bit 8 is 1.)
   (4) Second group: The value in (D9, D8) is K300. If the value in C204 is greater or equal to K300, Y1 will be reset to OFF.
3. The two high-speed comparisons are started when M2 is ON.
4. The setting of the two high-speed comparisons is read when M3 is ON.

MonitorTable

Device No.	Radix	Value	Comment
C204	d32u	0	
D44	d32u	100	
D48	d32u	300	
D40	d16u	0	
D41	d16u	0	
D42	h32	00000125	
D44	d32u	100	
D46	h32	00000165	
D48	d32s	300	

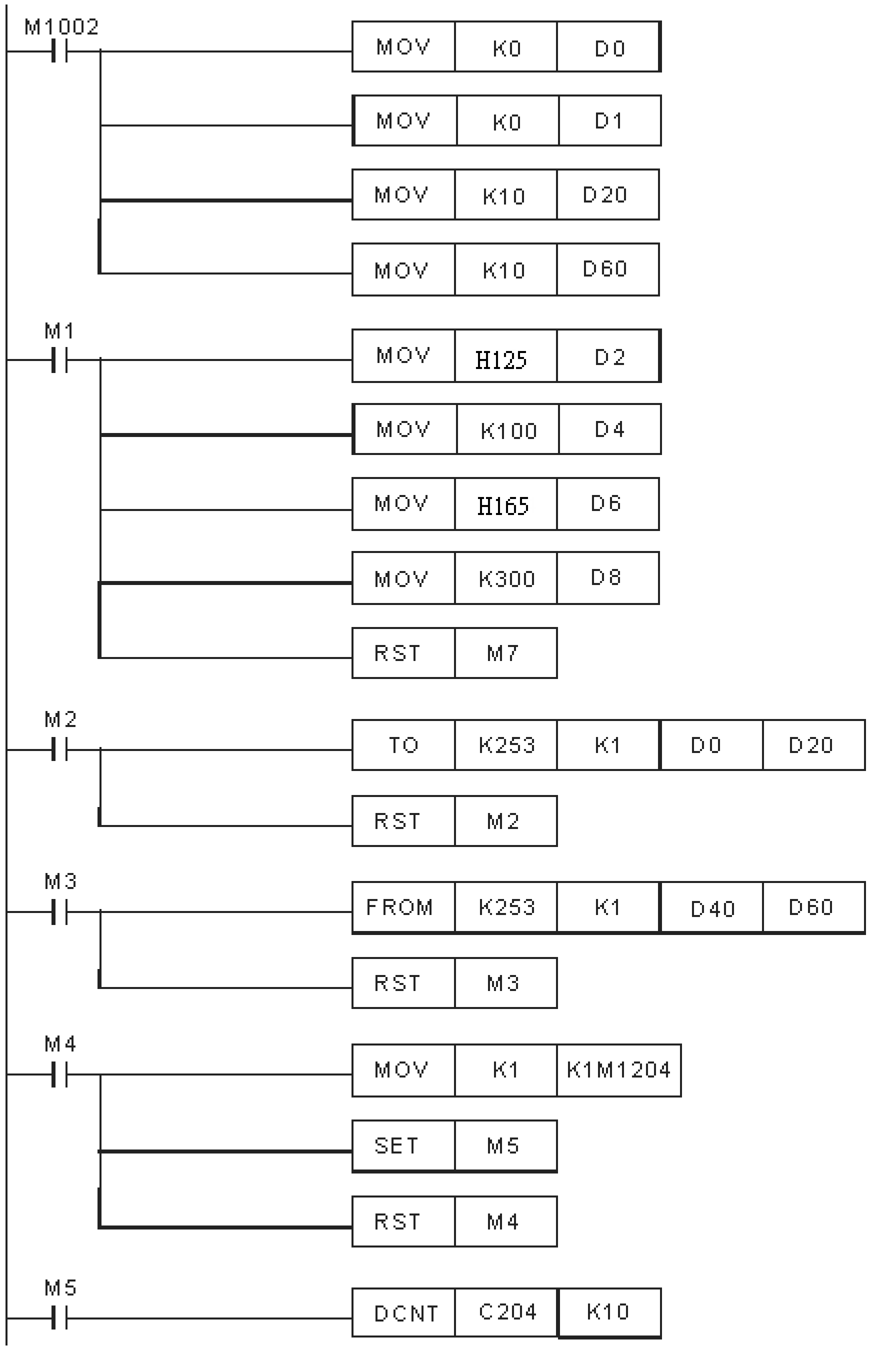
5. When M4 is ON, K1 is moved to M1204~M1207. C204 is started when M5 is set to ON. (Mode of counting: Pulse/Direction)
6. Use the manual pulse generator, and check whether C204 counts.

MonitorTable

Device No.	Radix	Value	Comment
C204	d32u	95	
D44	d32u	100	
D48	d32u	300	

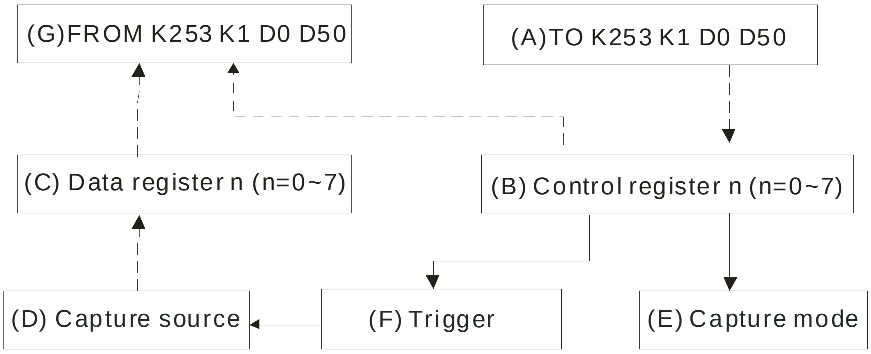
7. Use the manual pulse generator. Check whether X7 on the DVP-10PM series motion controller used is ON when the value in C204 is greater than 100. If X7 is ON, Y1 is set to ON.
8. Use the manual pulse generator. Check whether X7 on the DVP-10PM series motion controller used is OFF when the value in C204 is greater than 300. If X7 is OFF, Y1 is reset to OFF.

【Program in PMSoft】



8.3 High-speed Capture

A deviation often occurs when the present position of an axis or the value in C200/C204/C208/C212 is read. To prevent a deviation from occurring, users read a value immediately by setting an input terminal to ON. Capture is described below.



Block (A): The instruction TO is used to write data into control registers (block B).

Block (B): Users set a capture source (block D), set bit 5~bit 4 to 0 (block E), and set a trigger (block F) in a control register.

Block (C): The capture of a value (block D) is triggered by an input terminal, and the value captured is stored in data registers.

Block (D): The present positions of four axes, the values in C200, C204, C208, and C212 are capture sources.

Block (E): Capture mode

Block (F): External trigger

Block (G): The instruction FROM is used to read data from control registers (block C) and data registers (block B). The values stored in the data registers are values captured.

Procedure for a high-speed capture: The instruction TO is used to write data into control registers (block A).→ An input terminal is set to ON (block F).→ The present position of the X-axis/Y-axis/Z-axis/A-axis, or the value in C200/C204/C208/C212 is captured (block D). The value captured is stored in data registers (block C).→Users read the value captured by means of the instruction FROM.

- Example

【Description】

Start the high-speed counter C204. The value in C204 is captured when X5 is set to ON. A manual pulse generator is used, and is connected to X2 and X3.

【Steps】

1. When M1002 in O100 is ON, the initial setting of high-speed capture is carried out.
   (1) D0=0→Initial group number n=0
   (2) D1=0
   (3) D20=6→Writing 6 values by means of the instruction TO (Only one value is captured.)
   (4) D60=10→Reading 6 values by means of the instruction FROM (Only one value is captured.)
2. When M1 is ON, the high-speed capture is set.
   (1) The value in (D3, D2) is H5005.→The capture source set is C204. (The value of bit 3~bit 0 is 5). The mode selected is a capture mode. (The value of bit 5~bit 4 is 0.) The trigger selected is X5. (The value of bit 15~bit 12 is 5.)
   (2) The value in (D5, D4) is K100. Users can set (D5, D4) by themselves.
3. The high-speed capture is started when M2 is ON.

4. The setting of the high-speed capture is read when M3 is ON.

MonitorTable

Device No.	Radix	Value	Comment
C204	d32u	0	
D44	d32u	100	
D48	d32u	300	
D40	d16u	0	
D41	d16u	0	
D42	h32	00005005	
D44	d32u	100	

5. When M4 is ON, K1 is moved to M1204~M1207. C204 is started when M5 is set to ON. (Mode of counting: Pulse/Direction)
6. Use a manual pulse generator, and check whether C204 counts.

MonitorTable

Device No.	Radix	Value	Comment
C204	d32u	244	
D44	d32u	100	
D40	d16u	0	
D41	d16u	0	
D42	h32	00005005	
D44	d32u	100	

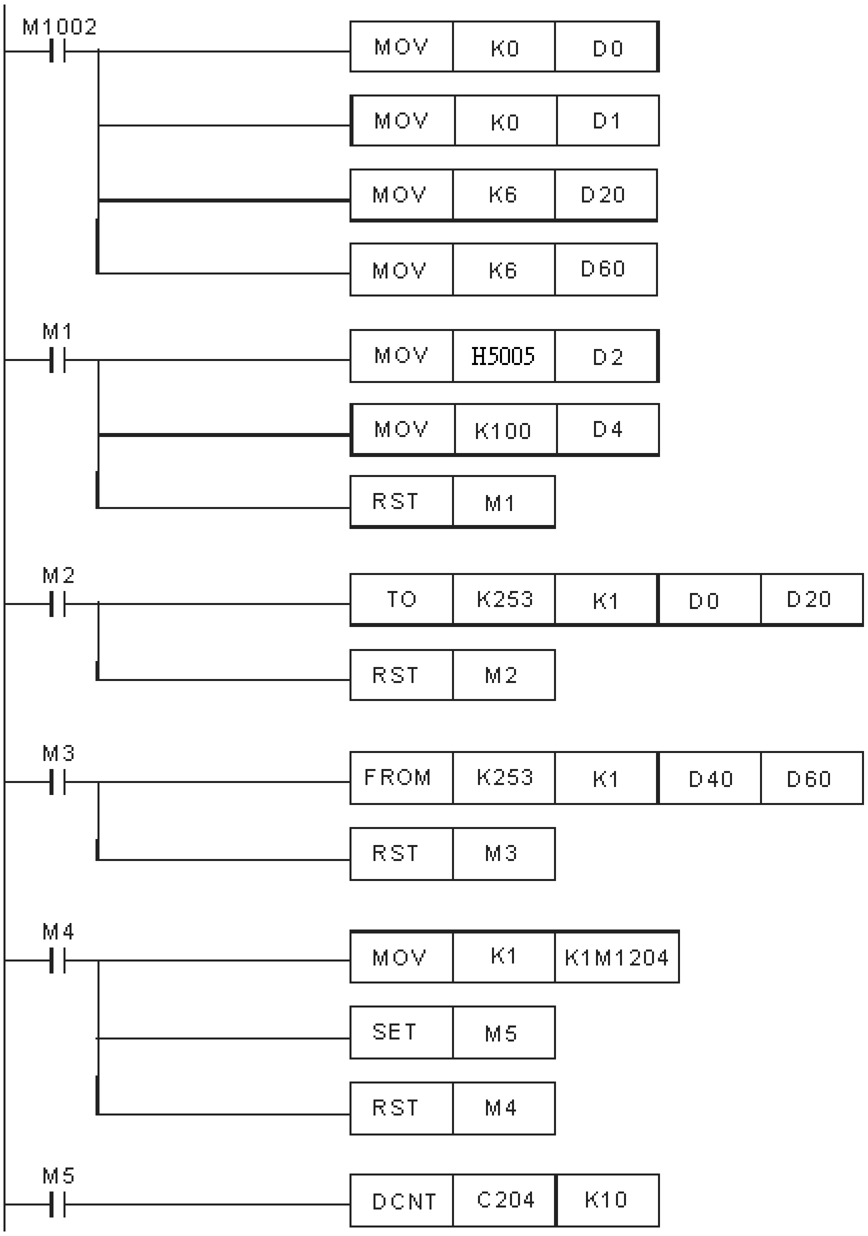
7. Use the manual pulse generator, and set X5 to ON.
8. The value captured is read when M3 is ON. When X5 is ON, the value in C204 is captured. The value captured is 677.

MonitorTable

Device No.	Radix	Value	Comment
C204	d32u	726	
D44	d32u	677	
D40	d16u	0	
D41	d16u	0	
D42	h32	00005005	
D44	d32u	677	

When X5 is ON, the value in C204 is captured.

【Program in PMSoft】



9.1 Appendix A: Error Code Table

After a program is written into a DVP-10PM series motion controller, the ERROR LED indicator will blink and an error flag will be ON if an error occurs in O100 or an Ox motion subroutine. The reason for the error occurring in O100 or an Ox motion subroutine may be that the use of operands (devices) is incorrect, syntax is incorrect, or the setting of motion parameters is incorrect. Users can know the reasons for the errors occurring in a DVP-10PM series motion controller by means of the error codes (hexadecimal codes) stored in error registers.

◆ Error message table

Program block	O100						
Error type	Program error	Motion error					
		X-axis	Y-axis	Z-axis	A-axis	B-axis	C-axis
Error flag	M1953	M1793	M1873	M2033	M2113	M2193	M2273
Error register	D1802	D1857	D1937	D2017	D2097	D2177	D2257
Step number	D1803	D1869					
Program block	Ox						
Error type	Program error	Motion error					
		X-axis	Y-axis	Z-axis	A-axis	B-axis	C-axis
Error flag	M1793	M1793	M1873	M2033	M2113	M2193	M2273
Error register	D1857	D1857	D1937	D2017	D2097	D2177	D2257
Step number	D1869	D1869					

◆ Program error codes and motion error codes (hexadecimal codes)

Error code	Description	Error code	Description
0002	The subroutine used has no data.	0031	The positive-going pulses generated by motion are inhibited.
0003	CJ, CJN, and JMP have no matching pointers.	0032	The negative-going pulses generated by motion are inhibited.
0004	There is a subroutine pointer in the main program.	0033	The motor used comes into contact with the left/right limit switch set.
0005	Lack of a subroutine	0040	A device exceeds the device range available.
0006	A pointer is used repeatedly in the same program.	0041	A communication timeout occurs when MODRD/MODWR is executed.
0007	A subroutine pointer is used repeatedly.	0044	An error occurs when a device is modified by a 16-bit index register/32-bit index register.
0008	The pointer used in JMP is used repeatedly in different subroutines.	0045	The conversion into a floating-point number is incorrect.
0009	The pointer used in JMP is the same as the pointer used in CALL.	0E18	The conversion into a binary-coded decimal number is incorrect.
000A	A pointer is the same as a subroutine pointer.	0E19	Incorrect division operation (The divisor is 0.)
0011	Target position (I) is incorrect.	C401	General program error
0012	Target position (II) is incorrect.	C402	LD/LDI has been used more than nine times.
0021	Velocity (I) is incorrect.	C404	There is more than one nested program structure supported by RPT/RPE.
0022	Velocity (II) is incorrect.	C405	SRET is used between RPT and RPE.
0023	The velocity (V_{RT}) of returning home is incorrect.	C4EE	There is no M102 in the main program, or there is no M2 in a motion subroutine.
0024	The velocity (V_{CR}) to which the velocity of the axis specified decreases when the axis returns home is incorrect.	C4FF	A wrong instruction is used, or a device used exceeds the range available.
0025	The JOG speed set is incorrect.		

MEMO