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DVP-PM Application Manual Programming

DELTA ELECTRONICS, INC.

# DVP-PM
# Application Manual

## Programming


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# *DVP-PM APPLICATION MANUAL*

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## Chapter 4: Basic Instructions



## Chapter 5: Categories and Use of Basic Application Instructions



## Chapter 6: Motion Instructions and G-Code Instructions

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# Chapter 8: Application Examples



# Chapter 9: Appendix

Delta's DVP-PM series MPU is a high-speed positioning and multi-functional programmable logic controller with 2-axis linear/arc interpolation, featuring functions as basic instructions, application instruction, motion instructions and G-code instructions, making the editing and compiling of program more diverse.

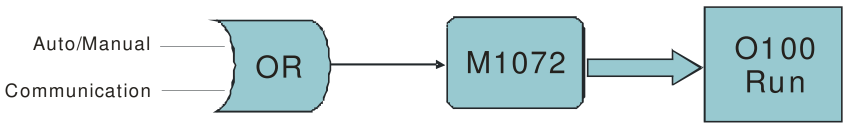
This chapter will introduce the program structure of DVP-PM series MPU. DVP-PM combines the sequential control and 2-axis interpolation positioning control; therefore, the program is in three types: O100 main program, OX motion subroutine and Pn subroutine, which will be illustrated in this chapter.

The basic instructions, application instructions and G-Code instructions will be given in Chapter 4 ~ 6.

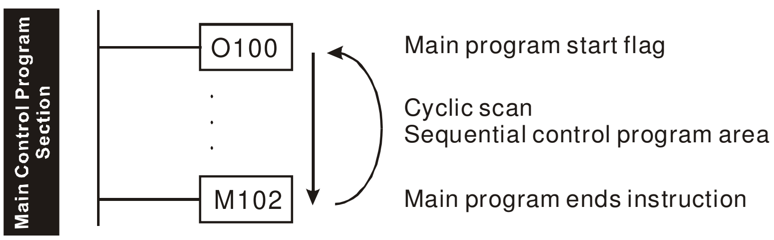
## 1.1 O100 Main Program

O100 main program is the PLC sequential control program, which is the main program of sequential control for DVP-PM series MPU. The O100 main program section only supports basic instructions and application instructions. Besides processing I/O signals and calling Pn subroutine, basic instructions and application instructions also control 100 OX motion subroutines which enable OX0 ~ OX99. Therefore, O100 main program establishes the main control program, and the main control program sets up and activates motion subroutines. This is the control structure of the operation of DVP-PM. See below the operation procedure and features of O100 main program.

1. There are two ways to activate O100 main program
   - When DVP-PM is powered, and the AUTO/MANU switch goes from MANU to AUTO, M1072 will be On automatically, and O100 main program will be in RUN status.
   - When DVP-PM is powered, you can set M1072 to be On or O100 main program to be in RUN status by communication.




2. The program is scanned in cycles. When O100 main program is enabled, the scan will starts at the start flag of O100. When the scan reaches M102 (main program ends instruction), it will return to the start flag of O100 and resume the scan, as shown in the figure below: The instruction can be compiled in any forms when Auto/Manual is in the main control program section, i.e. the "sequential control program area"




3. There are three ways to stop the operation of O100 main program:
   - When DVP-PM is powered, and the AUTO/MANU switch goes from AUTO to MANU, M1072 will be Off automatically, and O100 main program will be in STOP status. The operation of OX and Pn subroutines will stop at this moment.
   - When DVP-PM is powered, you can set M1072 to be Off or O100 main program to be in STOP

status by communication. The operation of OX and Pn subroutines will stop immediately.

- When errors occur during the design, compiling or operation of the program, O100 main program will stop automatically. See 3.13 for the table of the error codes and their causes.

4. O100 main program supports basic instructions and application instructions; therefore, you can design the program according to your actual needs. Besides, you can further activate OX0 ~ OX99 motion subroutines by setting up the parameters in motion instructions and the activation No. in the motion program.
   - O100 main program does not support motion instructions and G-Code instructions; therefore, please design motion instructions and G-Code instructions in OX0 ~ OX99 motion subroutines. See 1.2 for more details.
   - O100 main program is able to call Pn subroutine. See 1.3 for more details.
5. The above explanations are sorted in the table below:

| O100 main program | Explanation |
|---|---|
| Start of the program | Start flag of O100 main program (*In ladder diagram editing mode, it will be set up automatically. Therefore you do not have to compile this row.) |
| End of the program | End of M102 main program (*In ladder diagram editing mode, it will be set up automatically. Therefore you do not have to compile this row.) |
| Execution of the program | 1. DVP-PM MANU → AUTO<br>2. M1072 Off → On by communication |
| How to operate | Scan and operation in cycles |
| Instruction supported | Basic instructions and application instructions |
| Quantity | Only one O100 program is allowed in the program |
| Features & functions | 1. A PLC sequential control program<br>2. Able to activate OX0 ~ OX99 motion subroutines and call Pn subroutine<br>3. The three sequences can be piled freely when used with OX0 ~ OX99 motion subroutines and Pn subroutines. |

6. Manual Motion in O100 Main Program
   In O100 main program, you can use special registers for designing your own manual motion modes (see 3.12 for how to set it up).

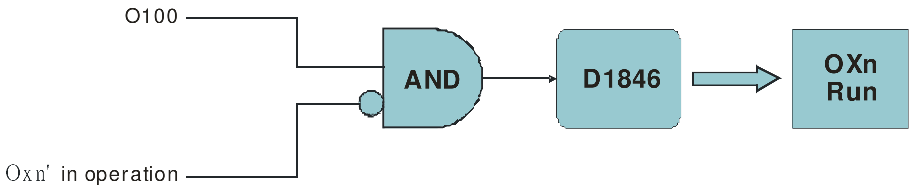
## 1.2 Structure of OX Motion Subroutine

OX0 ~ OX99 motion subroutines are motion control programs for controlling the motions on X and Y axes in DVP-PM. The OX0 ~ OX99 motion subroutine sections support basic instruction, application instructions, motion instructions and G-Code instructions, and they are able to call Pn subroutines. OX0 ~ OX99 are for the user to design and compile the moving path of X and Y axes. See below the operation procedure and features of OX motion subroutines.

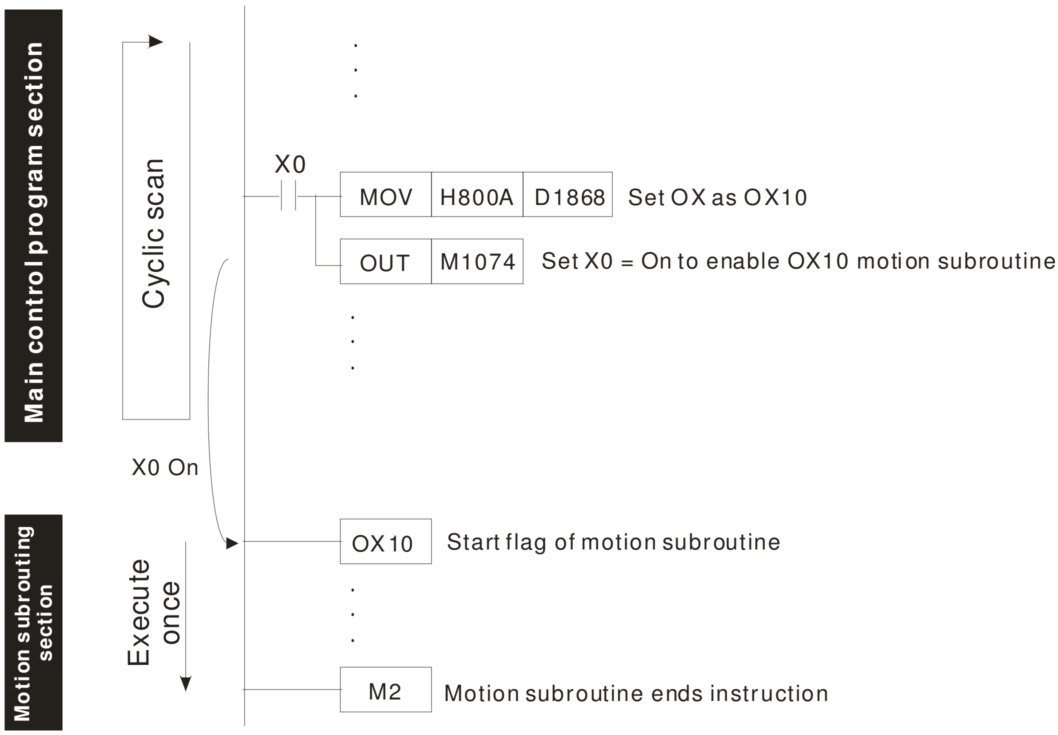
1. How to activate OX0 ~ OX99 motion subroutines:
   - When O100 main program is in RUN status, you can set up the execution No. of OX in O100 main

program (D1868: K0 ~ K99) and set b12 of X-Y axis operation instruction (D1846) to be On to enable OX motion subroutine.

- When you enable OX motion subroutine, please make sure there are no other motion subroutines in operation.




2. The scan starts whenever the program is enabled. When O100 main program activates OX motion subroutine, the scan will start from the start flag of OX motion subroutine and end at M2 (motion subroutine ends instruction), i.e. the end of the motion subroutine, as shown in the figure below:




When X0 = On, OX10 motion subroutine will be enabled and stop when the execution reaches M2 (motion subroutine ends instruction). The execution will only execute once. If you need a re-execution, re-activate X0 to re-enable OX10 motion subroutine.

3. There are four ways to stop OX motion subroutine:
   - When DVP-PM is powered, and the AUTO/MANU switch goes from AUTO to MANU, M1072 will be Off automatically, and O100 main program will be in STOP status. The operation of OX motion subroutines will stop at this moment.
   - You can also stop OX by controlling the input signals of the external control terminal (STOP0).
   - When DVP-PM is powered, you can also stop OX by setting D1846 to be 0 through communication.
   - When errors occur during the design, compiling or operation of the motion subroutine, OX will stop automatically. See 3.13 for the table of the error codes and their causes.

4. OX motion subroutines support basic instructions, application instructions, motion subroutines and G-Code subroutines. Therefore, you can design your own motion program by using these instructions and setting up X-Y axis parameters for your desired X-Y motion control.

   - The instructions mentioned above shall be designed in OX0 ~ OX99 motion subroutines.
   - OX motion subroutine supports calling Pn subroutine. See 1.3 for more details.

5. The above explanations are sorted in the table below:

| OX motion subroutine | Explanation |
|---|---|
| Start of the program | OX motion subroutine (OX0 ~ OX99, 100 motion subroutines) |
| End of the program | M2 motion subroutine ends |
| Execution of the program | 1. When O100 main program is in RUN statues, set D1846_b12 as 1 to enable OX motion subroutine.<br>2. When O100 main program is in RUN status, set D1846_b12 by communication to also enable OX motion subroutine.<br>3. Stop OX motion subroutine by the input signals at external control terminal (STOP0).<br>🗋 **Note:** When you need to enable OX motion subroutine, make sure there are no other motion subroutines in operation. |
| How to operate | Execute once whenever the subroutine is enabled. Re-enable it for the re-execution. |
| Instruction supported | Basic instructions, application instructions, motion instructions, and G-Code instructions.<br>🗋 **Note:** Avoid pulse-type instruction when using basic instructions and application instructions. |
| Quantity | The program can only contain 100 OX motion subroutines. If you need to active other OX motion subroutines, you can set up D1868 and enable the subroutine (SET M1074). |
| Features & functions | 1. A motion subroutine which can only be enabled by designing O100 main program.<br>2. Offers the third axis (Z) control. See 6.4 G00 and G01 instructions for more details.<br>3. Can be enabled/ disabled by controlling the external terminals, program design and communication.<br>4. Able to call Pn subroutine.<br>5. The three sequences can be piled freely when used with O100 main program and Pn subroutines. |

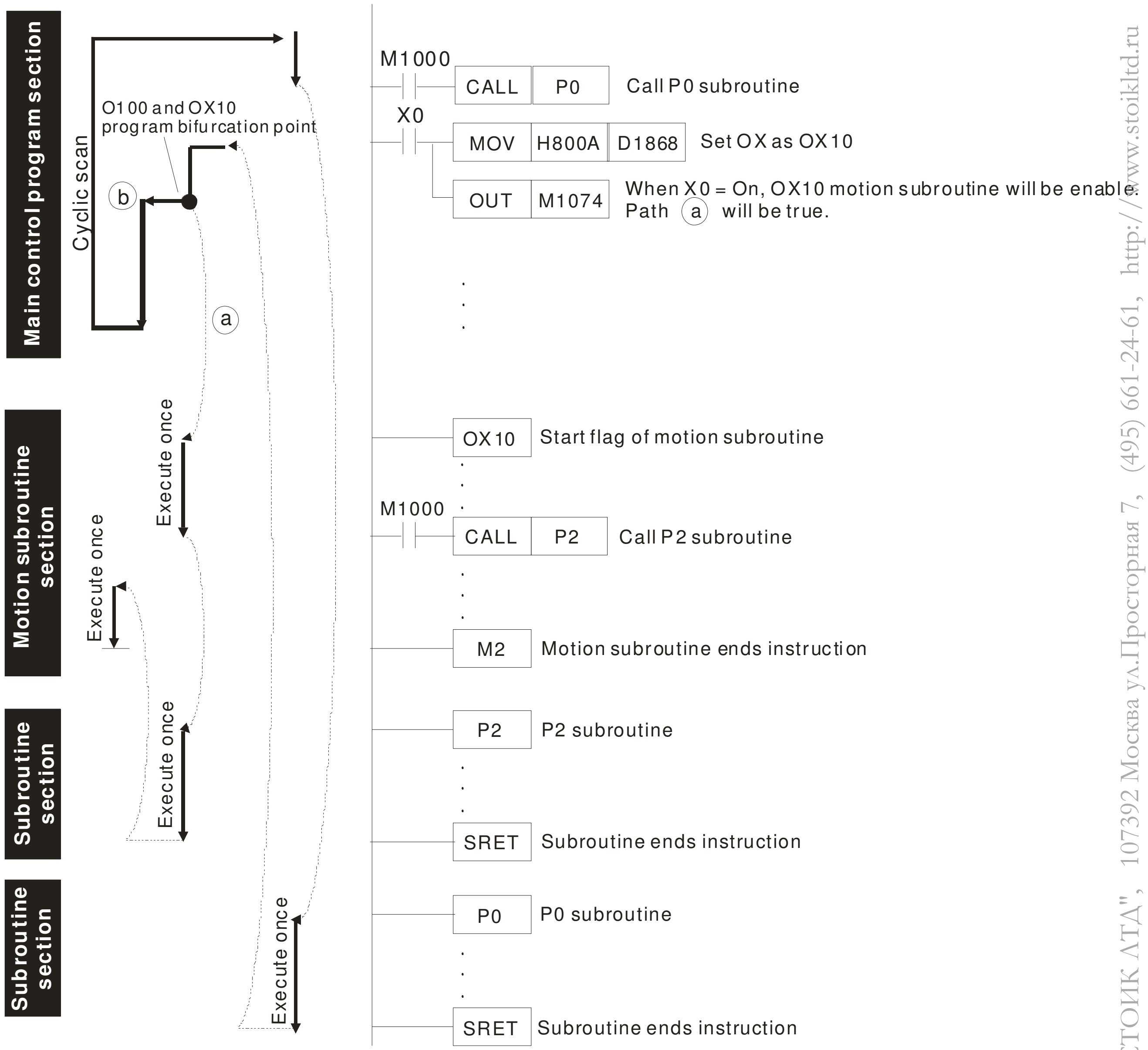
## 1.3 Structure of Pn Subroutine

Pn subroutine is a general-purpose subroutine for calling subroutines by O100 main program and OX motion subroutines. When Pn subroutine is called in O100 main program, the Pn subroutine area will support basic instructions and application instructions. When Pn subroutines is called in OX0 ~ OX99 motion subroutines, the Pn subroutine area will support basic instructions, application instructions, motion instructions and G-Code instructions. The Pn subroutine is called in O100 or OX, O100 or OX will jump to Pn subroutine when Pn subroutine is being executed and return to the next row after Pn subroutine to resume the execution when SRET is executed.

1. How to enable Pn subroutine:

   - Call Pn subroutine in O100 main program.
   - Call Pn subroutine in OX motion subroutine.

2. How does the scan work: The scan executes once whenever Pn subroutine is called once. After Pn subroutine is called in O100, Pn subroutine will be executed, and the subroutine will end when the execution reaches SRET (subroutine ends instruction). The program will return to the next row after Pn and resume the scan. The same operation also applied to OX motion subroutine calling Pn subroutine.




In P0 subroutine section, you can compile basic instructions and application instructions freely, and in P2 subroutine section, you can compile basic instructions, application instructions, motion instructions and G-Code instructions freely.

3. There are three ways to stop Pn subroutine:

- When DVP-PM is powered, and the AUTO/MANU switch goes from AUTO to MANU, M1072 will be Off automatically, and O100 main program will be in STOP status. The operation of OX motion subroutines and Pn subroutine will stop at this moment.
- When DVP-PM is powered, you can also stop OX by setting D1846 to be 0 through communication.

- When errors occur during the operation of Pn subroutine, Pn will stop automatically. See 3.13 for the table of the error codes and their causes.

4. When Pn subroutine is called in O100 main program, the Pn subroutine will only support basic instructions and application instructions. When Pn subroutines is called in OX0 ~ OX99 motion subroutines, the Pn subroutine will support basic instructions, application instructions, motion instructions and G-Code instructions.

5. The above explanations are sorted in the table below:

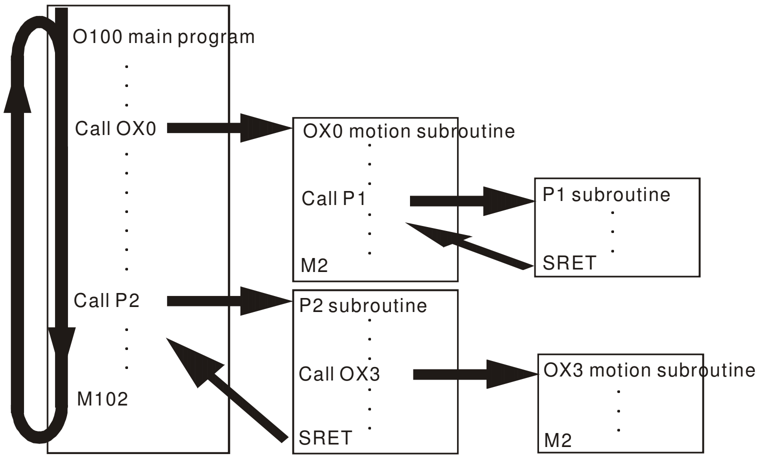
| Pn subroutine | Explanation |
|---|---|
| Start of the program | Start flag of Pn subroutine (P0 ~ P255) |
| End of the program | End of SRET subroutine |
| Execution of the program | 1. Call Pn subroutine in O100 main program.<br>2. Call Pn subroutine in OX motion subroutine. |
| How to operate | Execute once whenever the subroutine is enabled. Re-enable it for the re-execution. |
| Instructions supported | 1. When called in O100: supports basic instructions and application instructions<br>2. When called in OX: supports basic instructions, application instructions, motion instructions and G-Code instructions.<br>**Note:** When you need to call Pn in OX and use basic instructions and application instructions, please avoid pulse-type instructions. |
| Quantity | The program can only contain 256 Pn subroutines. |
| Features & functions | 1. A general-purpose subroutine<br>2. For O100 main program and OX motion subroutine to call a subroutine.<br>3. The three sequences can be piled freely when used with O100 main program and OX motion subroutine. |

## 1.4 Structure of O100, OX and Pn Program Design

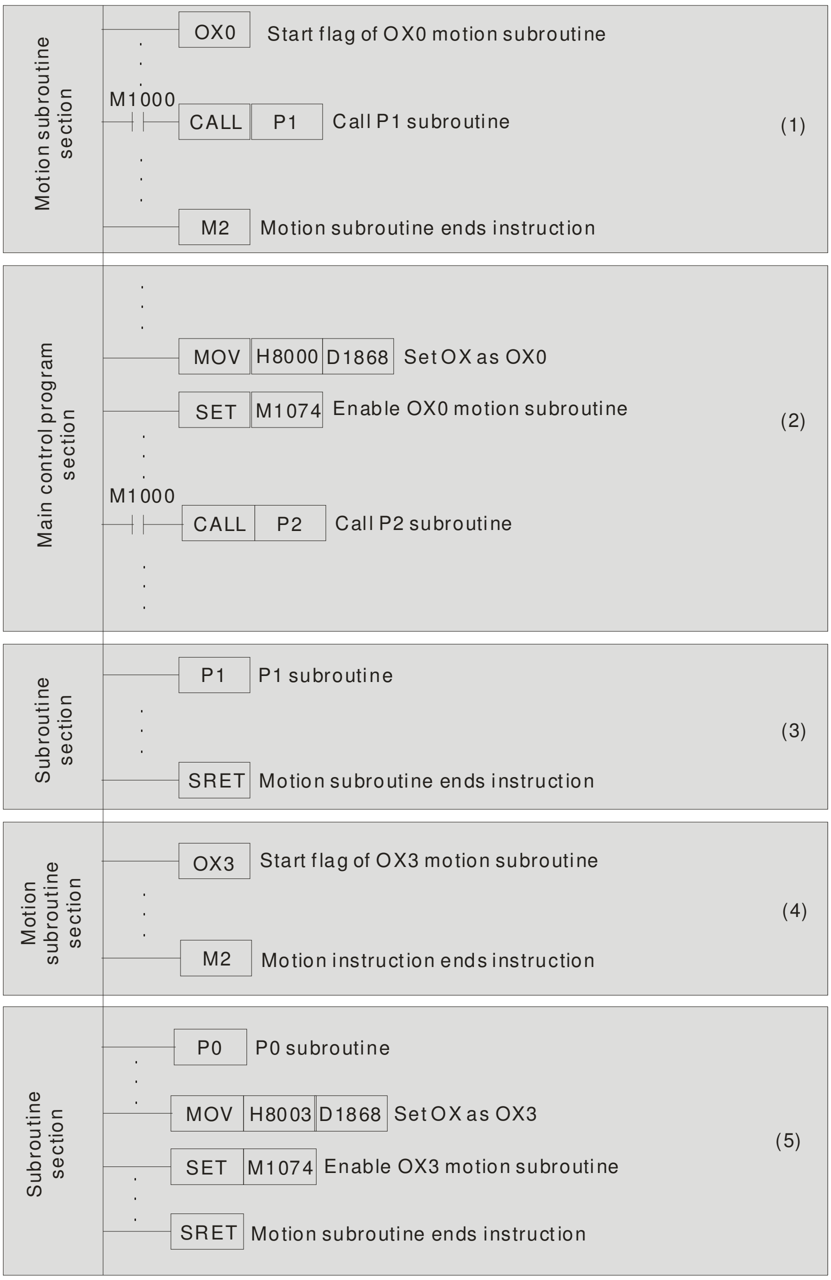
O100 main program, OX motion subroutine and Pn subroutine are introduced in 1.1 ~ 1.3. In this section, we will further illustrate how to mix the structures of the three and how to design it.

### 1.4.1 The Program Structure

Assume we would like to design a O100 main program, OX0 motion subroutine, P1 subroutine and P2 subroutine (5 program sections), please follow the design procedure as the follow:




To explain the example in an easier way, the program design will be given in section (1) ~ (5), as shown below:



Explanations on the program design:

1. The compiling sequence is from (1) to (5), but there is not a rule for the sequence of how and where you place them.
2. There can only be one O100 main program (2), and it cannot be called by other programs. O100 can call OX motion subroutines and Pn subroutines.
3. OX motion subroutine can be called by O100 main program and Pn subroutine, and it can also call a Pn subroutine.
4. Pn subroutine can be called by O100 main program and OX motion subroutine, and it can also call a OX motion subroutine.

🗋 **Note:**

1. More then two OX motion subroutines cannot be executed at the same time. Therefore, when OX0 motion subroutine is executed, OX3 will not be able to work, and vice versa.
2. Once O100 main program or Pn subroutine enables an OX motion subroutine, it will continue to execute the next row of the program without paying attention to the OX motion subroutine.
3. The enabled OX motion subroutine will only execute once. If you want it to execute again, you have to re-enable it.

Instructions supported in each program section: (O: supported; X: not supported)

| Section | O100 main program | OX motion subroutine (OX0, OX3) | P1 subroutine | P2 subroutine |
|---|---|---|---|---|
| Basic instruction | O | O | O | O |
| Application instruction | O | O | O | O |
| Motion instruction | X | O | O | X |
| G-Code instruction | X | O | O | X |
| Explanation | Instructions supported are fixed | Instructions supported are fixed | Called by OX motion subroutine; therefore, motion instructions and G-Code instructions are supported. | Called by O100 main program; therefore, motion instructions and G-Code instructions are not supported. |

Remarks:

| | Main program | Subroutine | Motion subroutine |
|---|---|---|---|
| Start of the program | - | Pn (n = 0 ~ 255) | OXn (n = 0 ~ 99) |
| End of the program | - | SRET | M2 |
| Placing sequence | No limitation | No limitation | No limitation |
| Execution of the program | RUN normally | Called by main program or motion subroutine | Called by main program or subroutine |
| How to operate | In cycles | Execute once whenever being called once | Execute once whenever being called once |
| Quantity | 1 | 256, depending on the user’s demand. | 100, depending on the user’s demand. |

## 2.1 Hardware Specifications

This chapter only provides information on electrical specification and wiring. For detailed information on program design and instructions, please refer to Chapter 5 ~ 6. For how to purchase its peripheral devices, please refer to the instruction sheet enclosed with the product.

### 2.1.1 Power Specifications

| Item | Description |
|---|---|
| Power supply voltage | 100 ~ 240V AC（-15% ~ 10%）, 50/60Hz ± 5% |
| Fuse capacity | 2A/250V AC |
| Power consumption | 60VA |
| DC24V current supply | 500mA |
| Power protection | DC24V; output short-circuited |
| Withstand voltage | 1,500V AC (Primary-secondary); 1,500V AC (Primary-PE); 500V AC (Secondary-PE) |
| Insulation impedance | > 5MΩ (all I/O point-to-ground: 500V DC) |
| Noise immunity | ESD: 8KV Air Discharge; EFT: Power Line: 2KV, Digital I/O: 1KV, Analog & Communication I/O: 250V |
| Earth | The diameter of grounding wire shall not be less that of L, N terminal of the power. When many PLCs are in use at the same time, please make sure every PLC is properly grounded. |
| Operation/storage | Operation: 0℃ ~ 55℃ (temperature), 50 ~ 95% (humidity), pollution degree 2<br>Storage: -25℃ ~ 70℃ (temperature), 5 ~ 95% (humidity) |
| Vibration/shock immunity | International standards: IEC61131-2, IEC 68-2-6 (TEST Fc)/IEC61131-2 & IEC 68-2-27 (TEST Ea) |
| Weigh (approx. g.) | 478/688 |

### 2.1.2 I/O Point Specifications

**Input point specifications:**

| Terminal | Description | Response characteristics | Max. input current |
|---|---|---|---|
| START0, START1 | Enabling input | 10ms | 6mA |
| STOP0, STOP1 | Disabling input | 10ms | 6mA |
| LSP0/LSN0, LSP1/LSN1 | Right limit input/left limit input | 10ms | 6mA |
| A0+, A0-, A1+, A1- | MPG A-phase pulse input +, - (differential signal input) | 200KHz | 15mA |
| B0+, B0-, B1+, B1- | MPG B-phase pulse input +, - (differential signal input) | 200KHz | 15mA |
| PG0+, PG0-, PG1+, PG1- | Zero point signal input +, - (differential signal input) | 1ms | 15mA |
| DOG0, DOG1 | There are two variations according to different operation modes:<br>1. DOG signal when zero return<br>2. Inserting enabling signal at 1-segment speed or 2-segment speed | 1ms | 10mA |

**Output point specifications:**

| Terminal | Description | Response characteristics | Max. input current |
|---|---|---|---|
| CLR0+, CLR0-, CLR1+, CLR1- | Clearing signals (by the error counter in servo drive) | 10ms | 20mA |
| FP0+, FP0-, FP1+, FP1- | Forward/reverse running mode: Forward pulse output<br>Pulse direction: Towards pulse output end<br>A, B phase: A-phase output | 500KHz | 40mA |
| RP0+, RP0-, RP1+, RP1- | Forward/reverse running mode: Reverse pulse output<br>Pulse direction: Towards output end<br>A, B phase: B-phase output | 500KHz | 40mA |

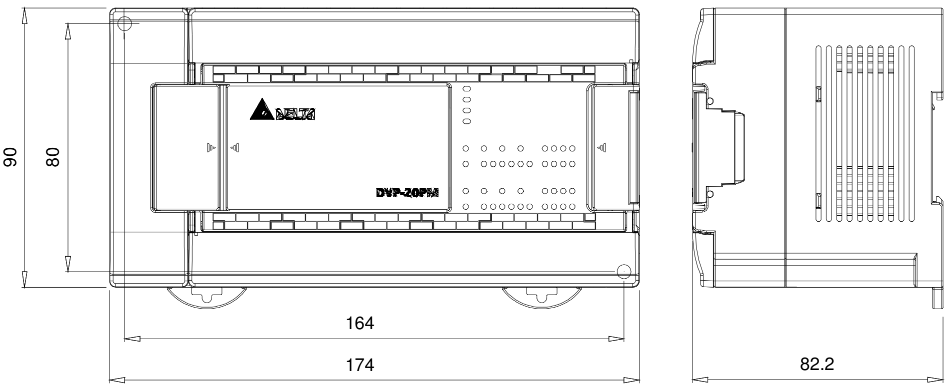
**Digital input points:**

| Item / Spec | | 24V DC single common port input | | Note |
|---|---|---|---|---|
| | | Low speed | High speed (200KHz) | |
| Input wiring type | | Change wiring from S/S to SINK or SOURCE | | Input point X0 ~ X7 can conduct 10 ~ 60ms digital filter adjustment. |
| Input indicator | | LED display; light on = ON, light off = OFF | | |
| Input voltage | | - | | |
| Action level | Off→On | 20us | | |
| | On→Off | 30us | | |
| Response time/noise immunity | | 10ms | 0.5us | |

**Digital output point:**

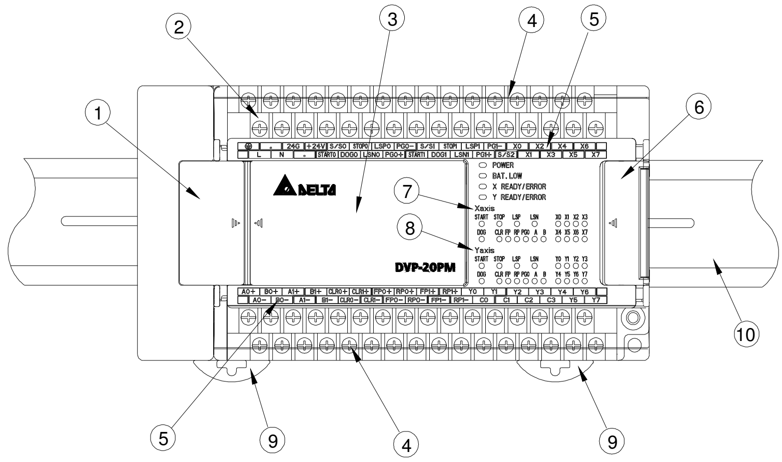
| Item / Spec | | Single common port transistor output | | Single common port relay output |
|---|---|---|---|---|
| | | Low speed | High speed | |
| Maximum frequency | | 10KHz | 200KHz | For load ON/OFF control |
| Output indicator | | LED display; light on = ON, light off = OFF | | |
| Minimum load | | - | | 2mA/DC power supply |
| Working voltage | | 5 ~ 30V DC | | < 250V AC, 30V DC |
| Isolation | | Photocoupler isolation | | Electromagnetic isolation |
| Current specification | | 0.3A/1 point@ 40℃ | 30mA | 2A/1 point (5A/COM)<br>75VA (conductive), 90W (resistive) |
| Max. output delay time | Off→On | 20us | 0.2us | 10ms |
| | On→Off | 30us | | |
| Over-current protection | | N/A | | |

### 2.1.3 Dimension

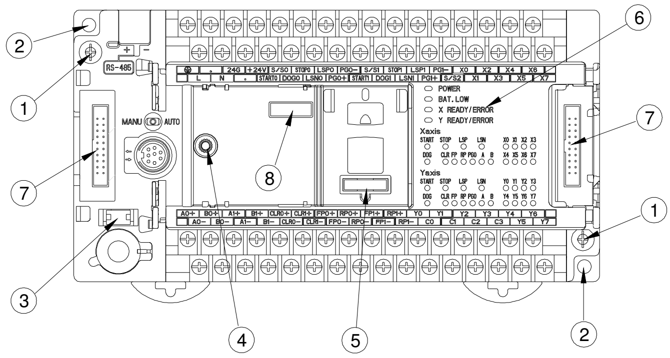



(Unit: mm)

**Product Profile & Outline:**

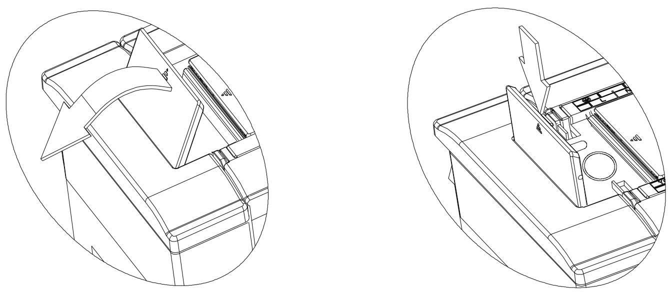


| | |
|---|---|
| ① | Communication port cover |
| ② | I/O terminal cover |
| ③ | Function card/memory card cover |
| ④ | I/O terminals |
| ⑤ | I/O terminal No. |
| ⑥ | Extension module connection port cover |
| ⑦ | Input indicator |
| ⑧ | Output indicator |
| ⑨ | DIN rail clip |
| ⑩ | DIN rail (35mm) |

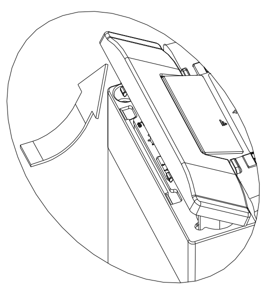


| | |
|---|---|
| ① | Mounting screw |
| ② | Direct mounting hole |
| ③ | Battery socket |
| ④ | Function card mounting hole |
| ⑤ | Memory card port |
| ⑥ | POWER/BAT.LOW/ERROR indicator |
| ⑦ | Extension module connection port |
| ⑧ | Function card port |

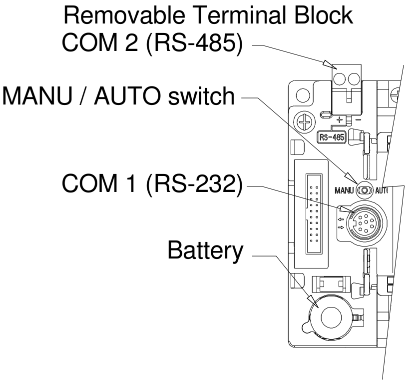
Open COM1 cover



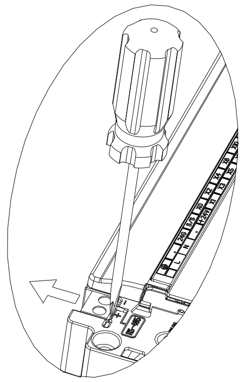
Open COM2 cover



The battery shall be changed within 1 minute.

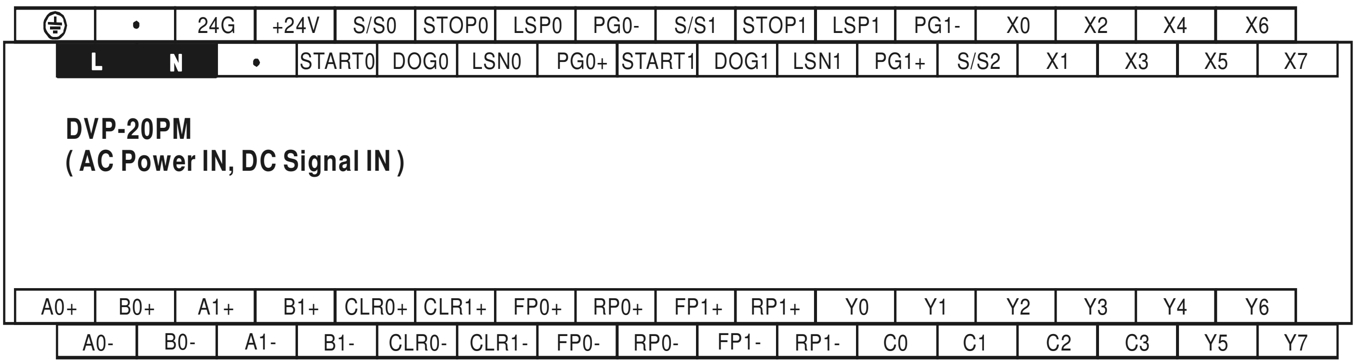



Remove RS-485 terminal



| Part | Description |
|---|---|
| COM2 (RS-485) | For both master and slave modes |
| MANU/AUTO switch | RUN/STOP control |
| COM1 (RS-232) | Slave mode (can be used with COM2 at the same time) |

**Wiring Terminals:** See 2.1.1 for detailed specifications.




## 2.2 Installation & Wiring

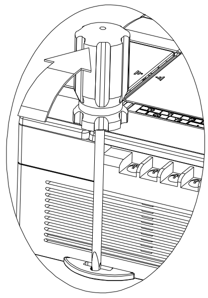
DVP-PM is and OPEN-TYPE device and therefore should be installed in an enclosure free of airborne dust, humidity, electric shock and vibration. The enclosure should prevent non-maintenance staff from operating the device (e.g. key or specific tools are required for opening the enclosure) in case danger and damage on the device may occur.

DO NOT connect input AC power supply to any of the I/O terminals; otherwise serious damage may occur. Check all the wiring again before switching on the power. Make sure the ground terminal ⏚ is correctly grounded in order to prevent electromagnetic interferences.

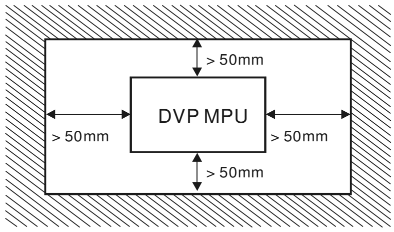
### 2.2.1 Wiring

**How to install DIN rail:**

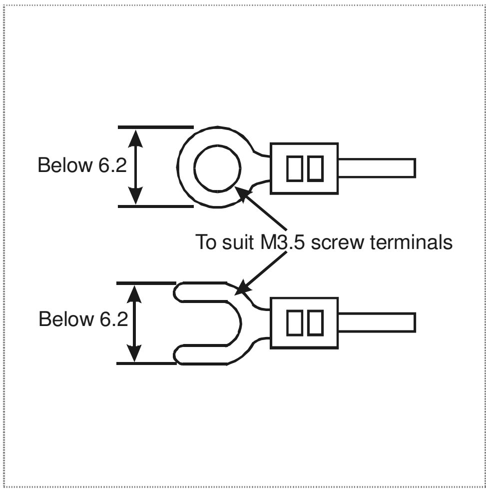
DVP-PM can be secured to a cabinet by using the DIN rail of 35mm in height and 7.5mm in depth. When mounting PLC to DIN rail, be sure to use the end bracket to stop any side-to-side movement of PLC and reduce the chance of wires being loosen. A small retaining clip is at the bottom of PLC. To secure DVP-PM to DIN rail, place the clip onto the rail and gently push it up. To remove it, pull the retaining clip down and gently remove DVP-PM from the DIN rail, shown in the figure.



1. **How to screw:** Please use M4 screws which fit the dimension of the product.
2. Please install DVP-PM in an enclosure with sufficient space around it to allow heat dissipation, as shown in the figure.




**Wiring notes:**



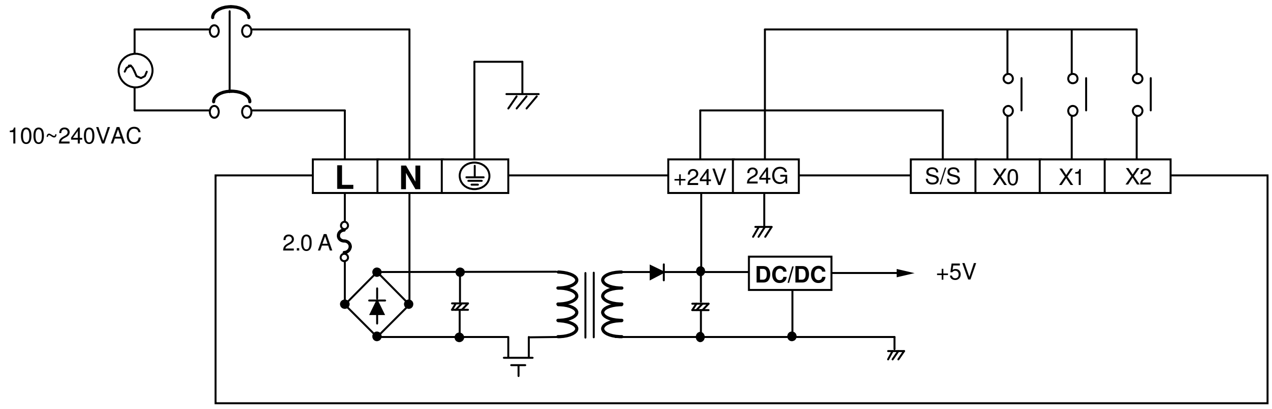

1. Use O-type or Y-type terminal. See the figure in the right for its specification. PLC terminal screws should be tightened to 5 ~ 8 kg-cm (4.3 ~ 6.9 in-lbs).
2. DO NOT wire empty terminal • . DO NOT place the input signal cable and output power cable in the same wiring circuit.
3. DO NOT drop tiny metallic conductor into the PLC while screwing and wiring. Tear off the sticker on the heat dissipation hole for preventing alien substances from dropping in, to ensure normal heat dissipation of the PLC.
4. Use 60/75ºC copper conductor only.

### 2.2.2 Power Input Wiring

The power input of DVP-PM series is AC. When operating it, please make sure that:

1. The input voltage should be current and its range should be 100 ~ 240V AC. The power should be connected to L and N terminals. Wiring AC110V or AC220V to +24V terminal or input terminal will result in serious damage on the PLC.
2. The AC power input for PLC MPU and I/O extension modules should be On or Off at the same time.
3. Use wires of 1.6mm (or longer) for the grounding of PLC MPU.
4. The power shutdown of less than 10ms will not affect the operation of DVP-PM. However, power shutdown time that is too long or the drop of power voltage will stop the operation of DVP-PM and all outputs will go “Off". When the power supply turns normal again, DVP-PM will automatically return to its operation. Please be aware of the latched auxiliary relays and registers inside DVP-PM when programming.

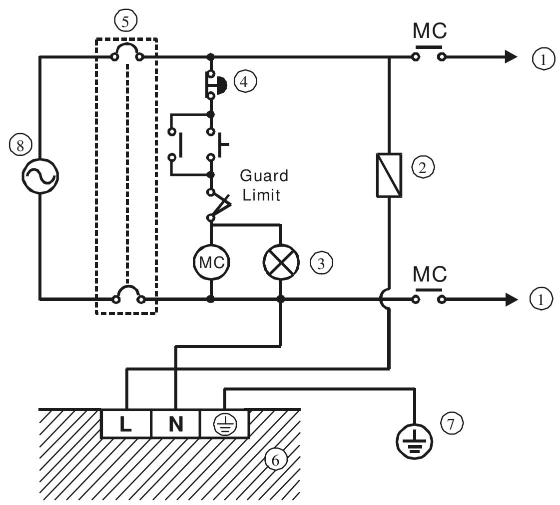
**AC power input:**




0.5A is the maximum power supply for +24V power supply output terminal. DO NOT connect other external power supplies to this terminal. Every input terminal requires 6 ~ 7mA to be driven; e.g. the 16-point input will require approximately 100mA. Therefore, +24V cannot give output to external load that is more than 400mA.

## 2.2.3 Safety Wiring

Since DVP-PM controls many devices, actions of any device may affect actions of other devices and the breakdown of any one device may cause the breakdown of the entire auto-control system and danger. Therefore, we suggest you wire a protection circuit at the power input terminal, as shown in the figure below.

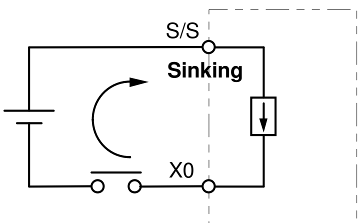



| | |
|---|---|
| ① | AC power supply load |
| ② | Power circuit protection fuse (3A) |
| ③ | Power indicator |
| ④ | Emergency stop<br>This button can cut off the system power supply when accidental emergency takes place. |
| ⑤ | System circuit isolation device<br>The device is made of electromagnetic contactor and relay as the switch to prevent the instability of system when the power is intermittently supplied. |
| ⑥ | DVP-PLC (main processing unit) |
| ⑦ | Earth |
| ⑧ | Power supply: AC: 100 ~ 240V AC, 50/60Hz |

## 2.2.4 I/O Point Wiring

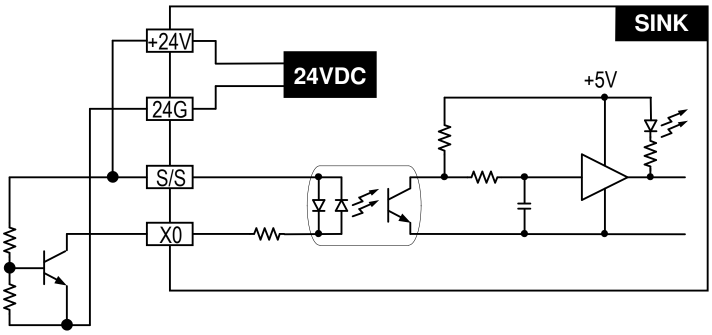
There are two types of DC input, SINK and SOURCE.

(DC Signal IN)

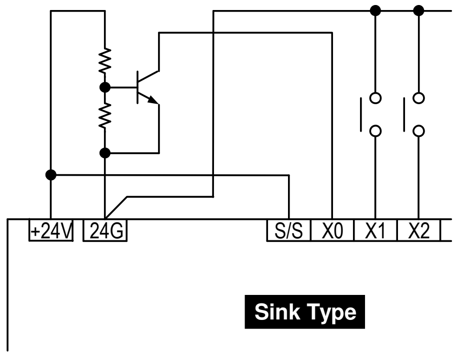



**SINK** mode: Common port for current input S/S

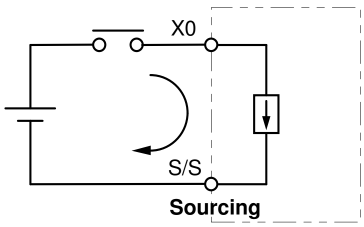
**Input point loop equivalent circuit:**




**Wiring loop:**

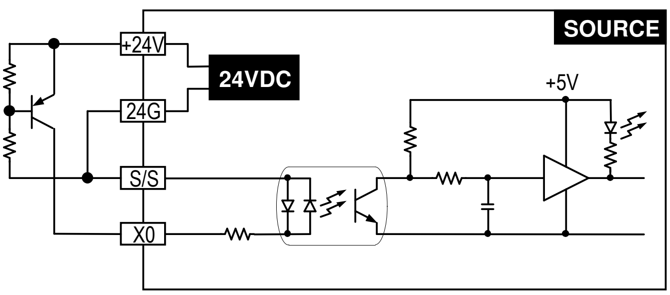



(DC Signal IN)

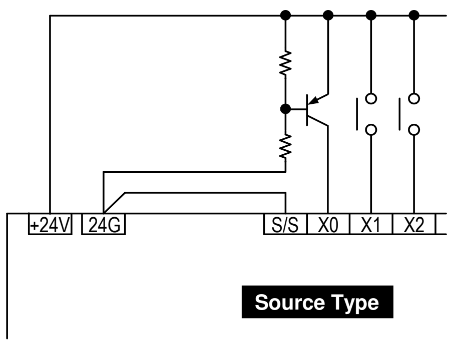



**Source** mode: Common port for current output S/S

**Input point loop equivalent circuit:**



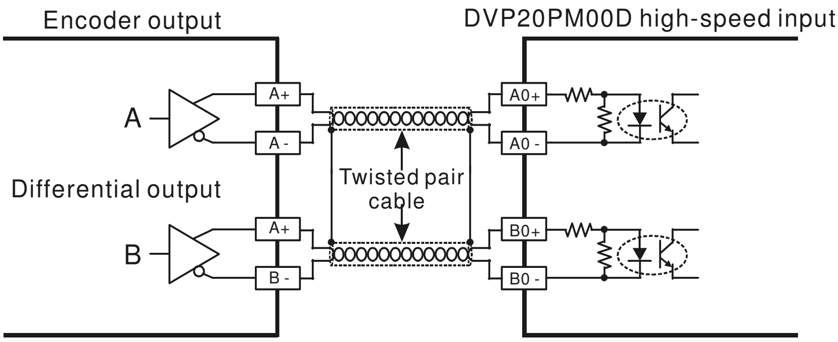

**Wiring loop:**



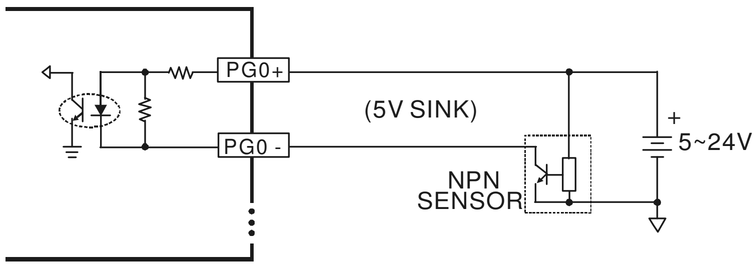
**Wiring of differential input:**

A0 ~ A1 and B0 ~ B1 of DVP-PM are all high-speed input circuit, and others are DC24V input. The working frequency of high-speed input circuit can reach up to 200KHz and is mainly for connecting to differential (double-wire) LINE DRIVER output circuit.

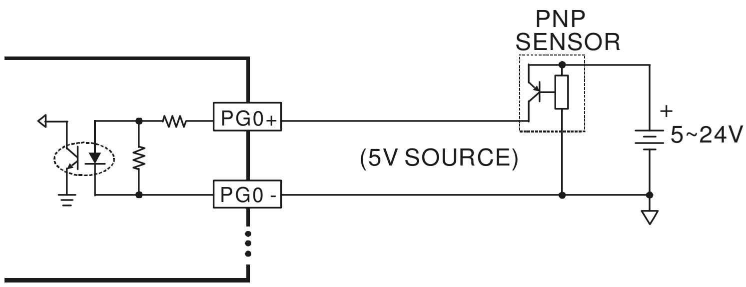
■ **Wiring in a high-speed, high-noise environment**



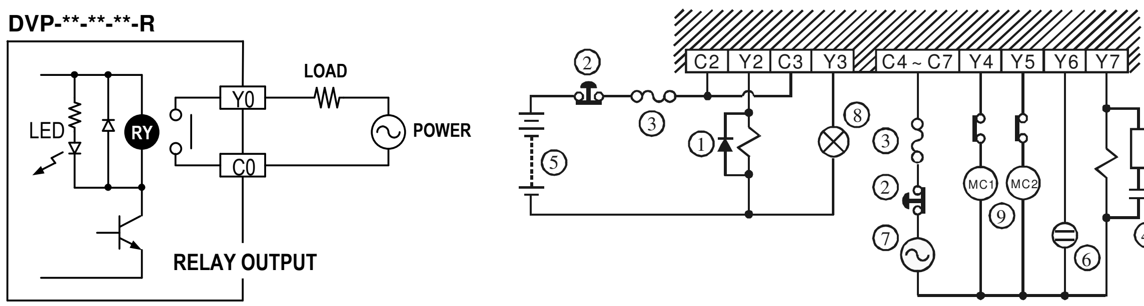

■ **Wiring of DVP20PM00D DC5V SINK**




■ **Wiring of DVP20PM00D DC5V SOURCE**




■ **Relay (R) contact circuit wiring**



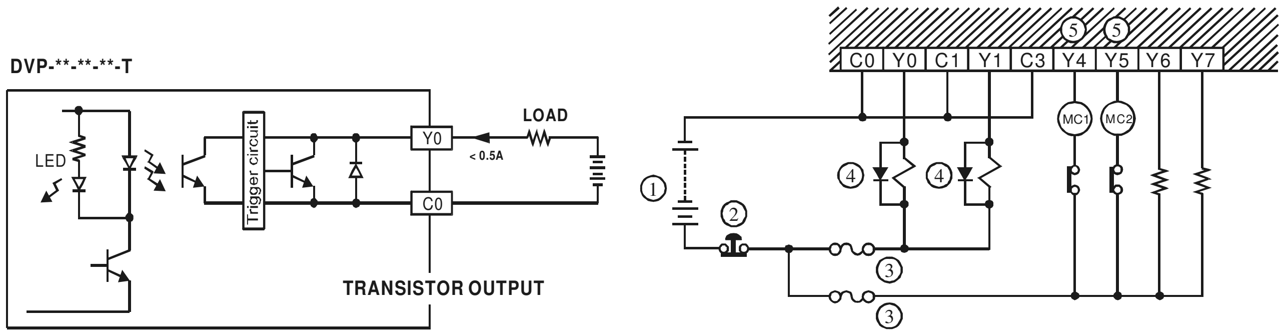

① Flywheel diode: To extend the lift span of contact ② Emergency stop: Uses external switch

③ Fuse: Uses 5 ~ 10A fuse at the shared terminal of output contacts to protect the output circuit

| | | | |
|---|---|---|---|
| ④ | Varistor: To reduce the interference on AC load | ⑤ | DC power supply |
| ⑥ | Neon indicator | ⑦ | AC power supply |
| ⑧ | Incandescent light (resistive load | | |
| ⑨ | Manually exclusive output: Uses external circuit and forms an interlock, together with PLC internal program, to ensure safe protection in case of any unexpected errors. | | |

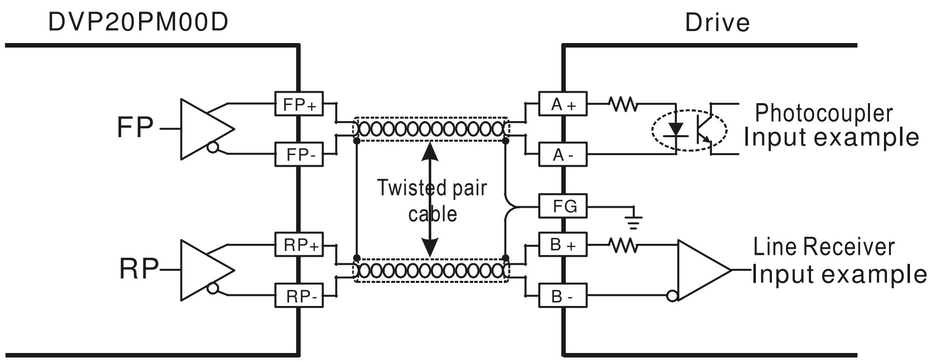


■ **Transistor (T) contact circuit wiring**



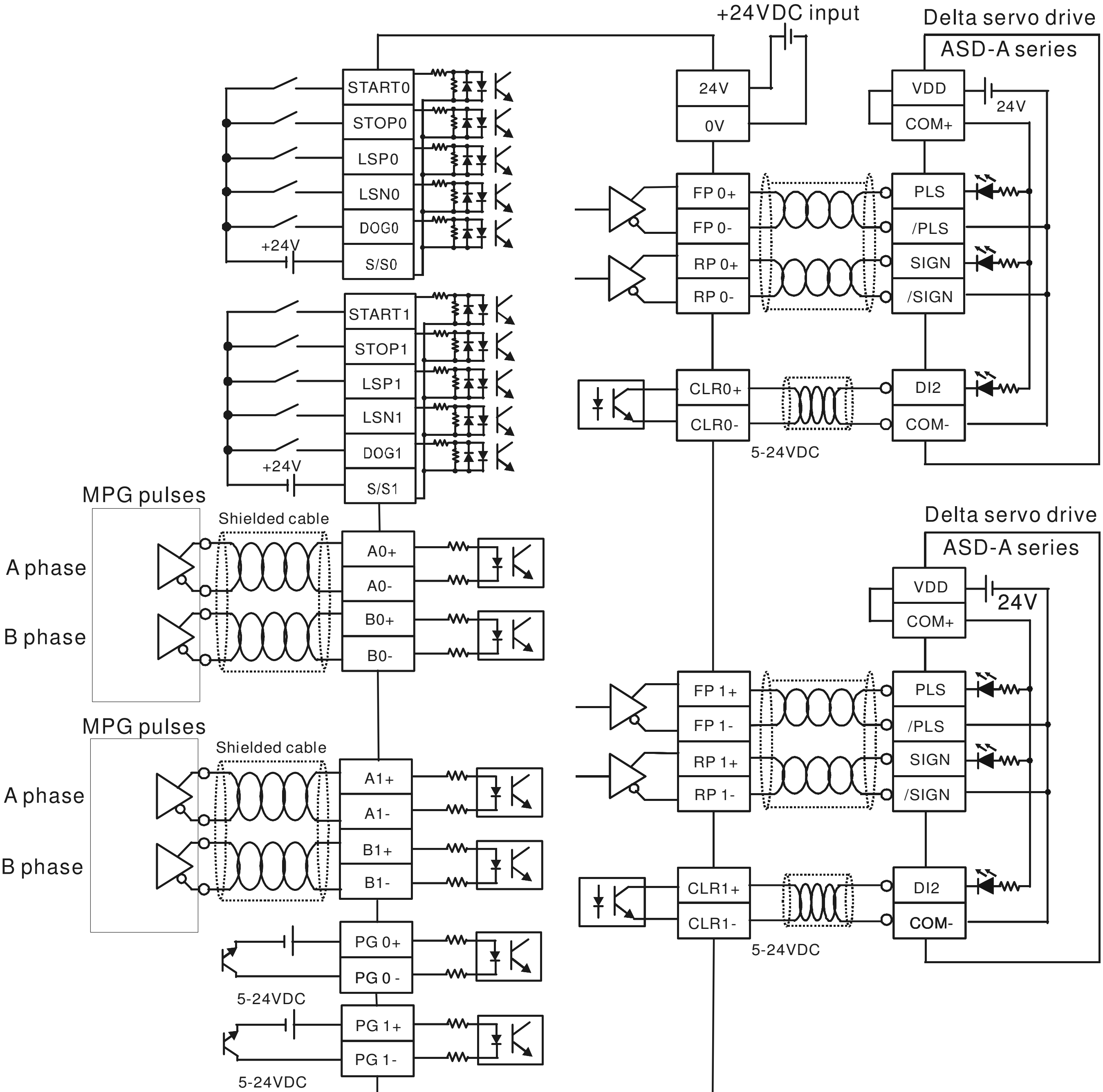

| | | | |
|---|---|---|---|
| ① | DC power supply | ② | Emergency stop |
| ③ | Circuit protection fuse | ④ | Flywheel diode + inductive load |
| ⑤ | Manually exclusive output: Uses external circuit and forms an interlock, together with PLC internal program, to ensure safe protection in case of any unexpected errors. | | |

■ **Wiring of differential output**

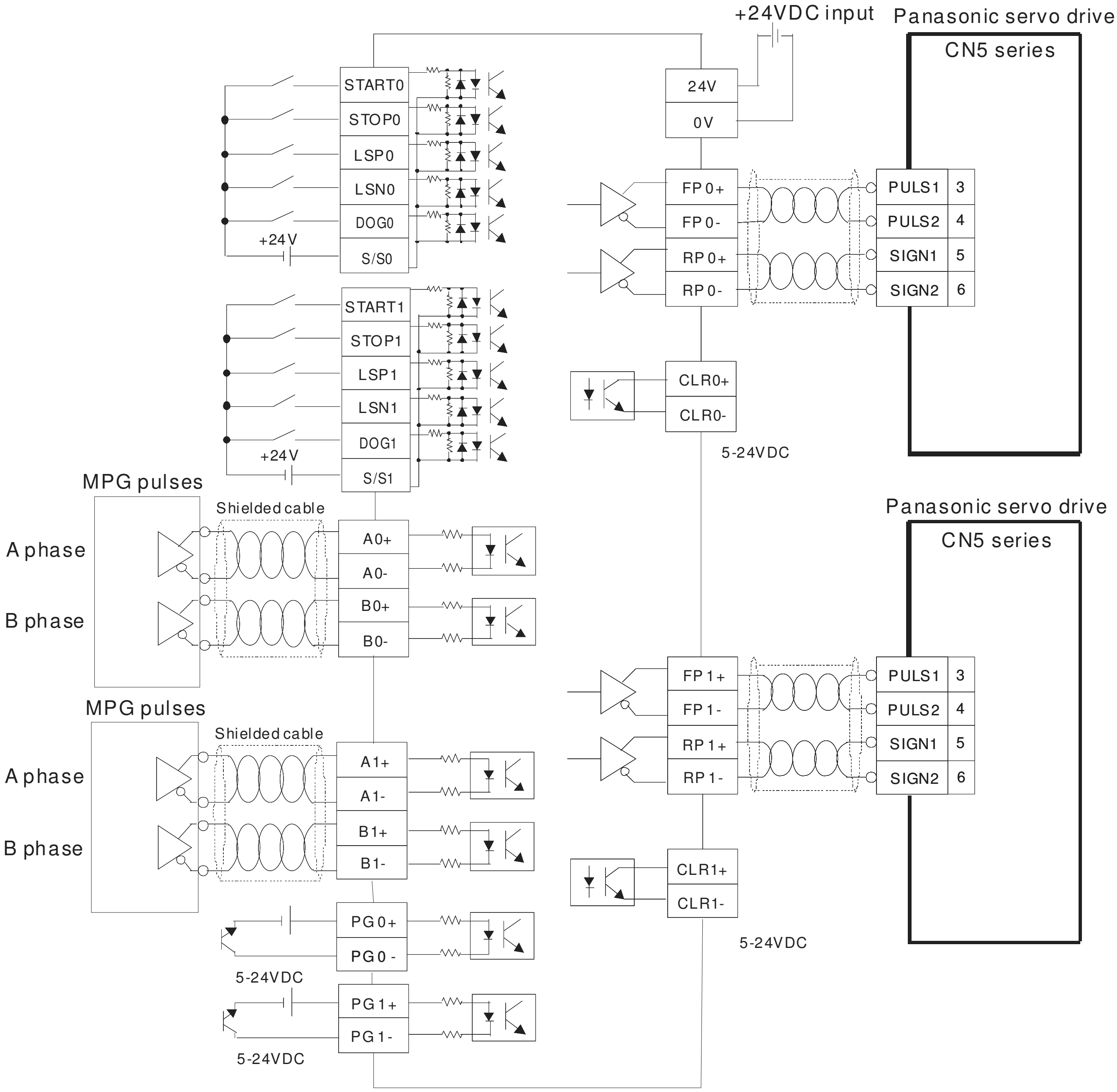


## 2.2.5 Wiring with Drives

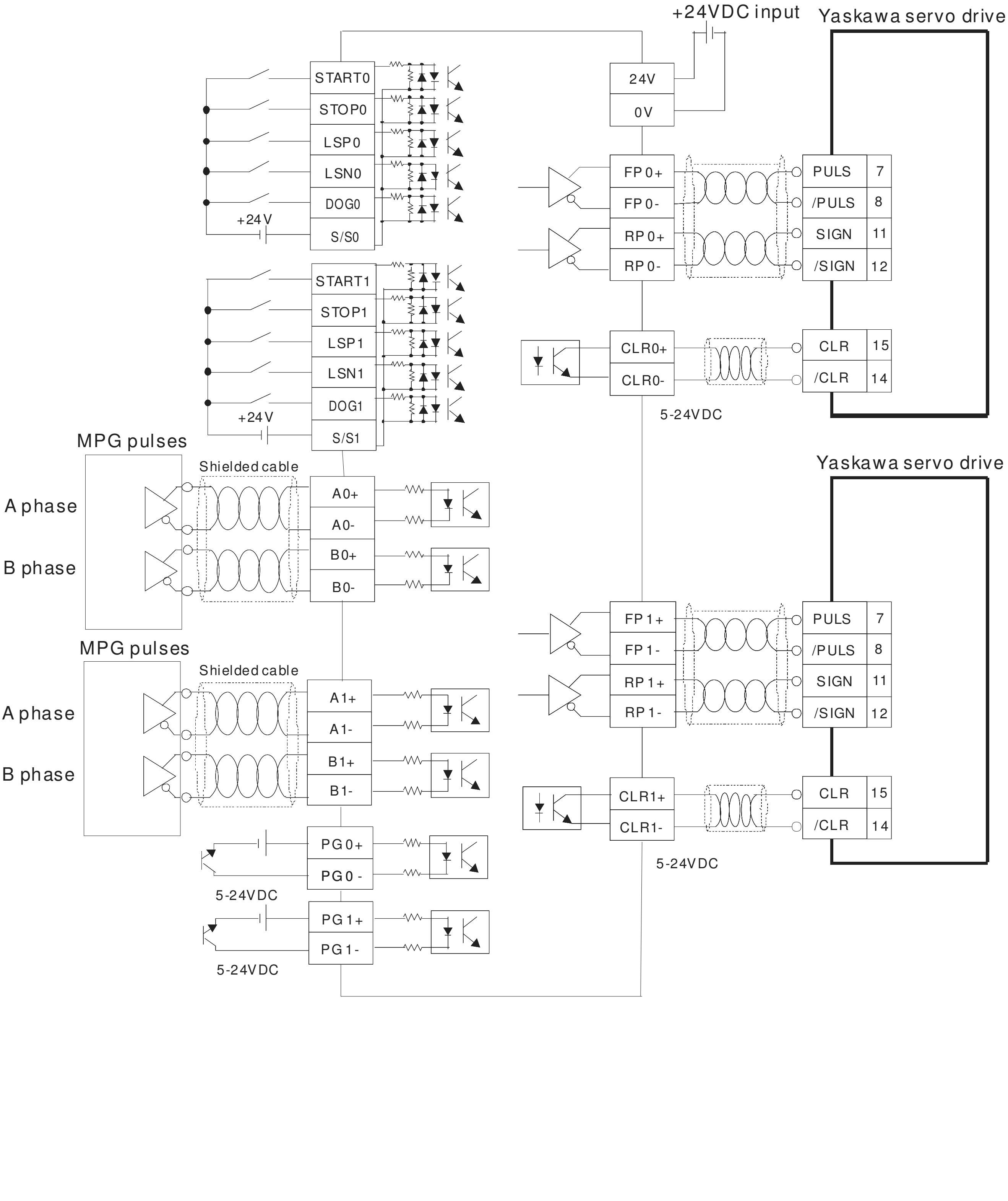
**DVP-PM and Delta ASD-A series servo drive:**



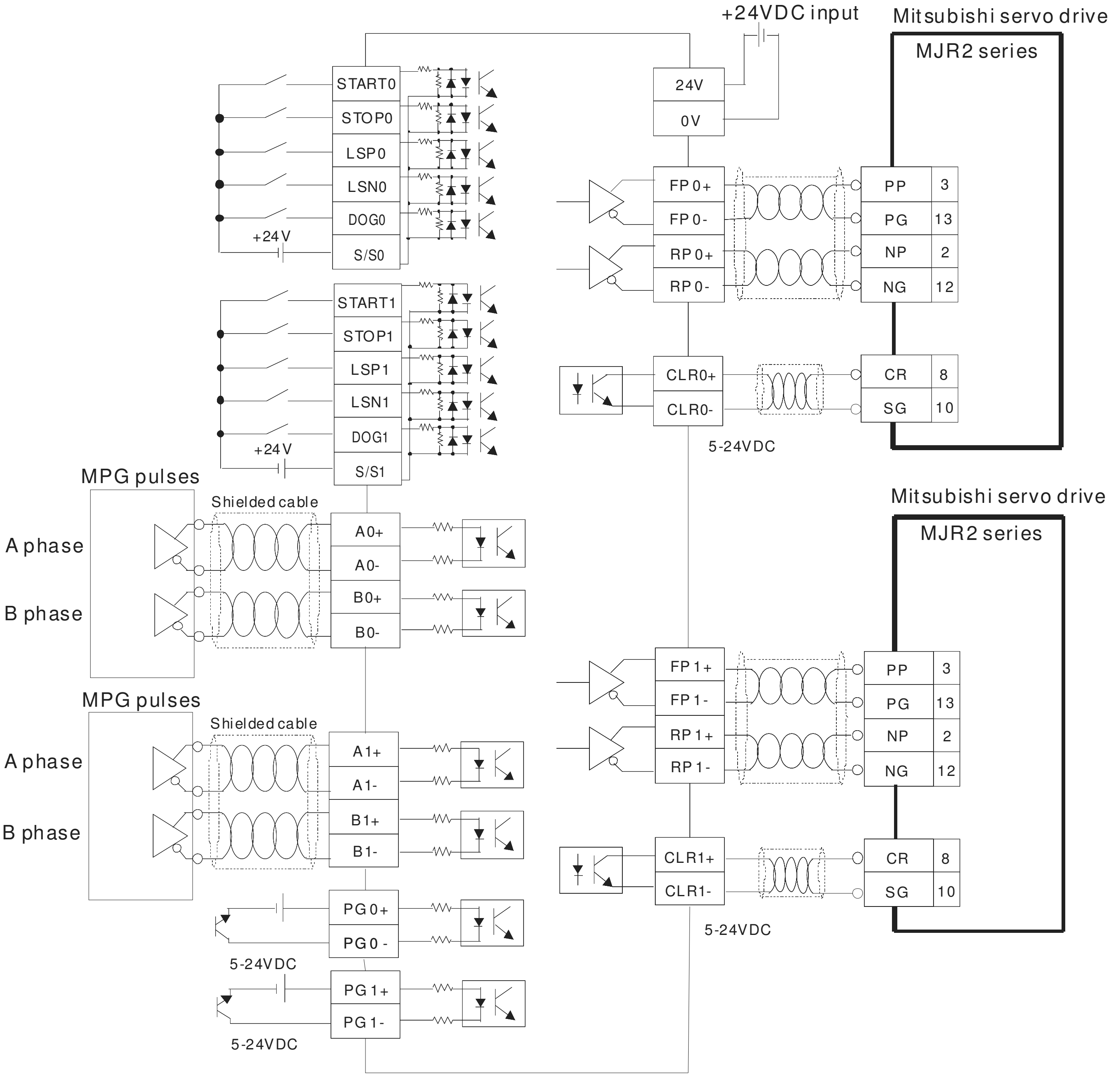
**DVP-PM and Panasonic CN5 series servo drive:**



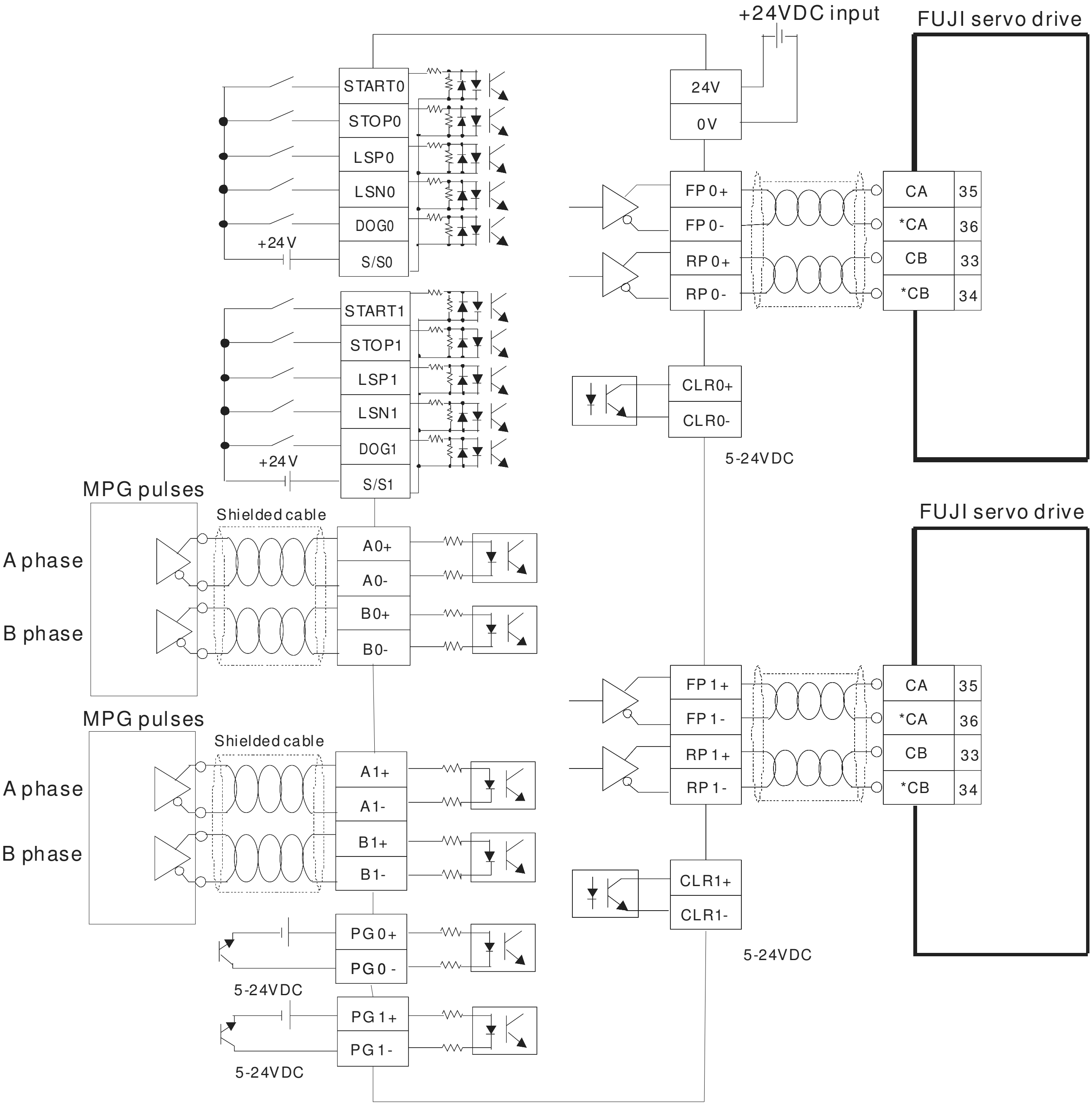
**DVP-PM and Yaskawa servo drive:**



**DVP-PM and Mitsubishi MJR2 series servo drive:**



**DVP-PM and FUJI servo drive:**



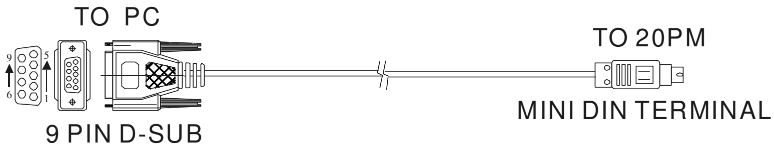
## 2.3 Communication Ports

DVP-PM has two communication ports, COM1 (RS-232 communication) and COM2 (RS-485 communication).

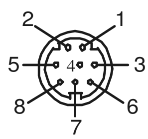
### 2.3.1 COM1 (RS-232)

1. The interface of COM1 is RS-232, for uploading and downloading of the program. It supports Modbus communication format with baud rate 9,600 ~ 115, 200bps.

■ **The communication cable:**




| PC/TP COM Port 9 PIN D-SUB female | | ↔ | PM COM1 Port 8 PIN MINI DIN | |
|---|---|---|---|---|
| Tx | 3 | ↔ | 4 | Rx |
| Rx | 2 | ↔ | 5 | Tx |
| GND | 5 | ↔ | 8 | GND |
| | 7, 8 (connected) | | 1,2 | 5V |
| | 1, 4, 6 (connected) | | | |




See the catalog of Delta PLCs for detailed model names or download the most updated information on the accessories on Delta's website.

2. COM1 is for Slave mode. Therefore, it can be connected to a human machine interface for monitoring purposes.

### 2.3.2 COM2 (RS-485)

1. The interface of COM2 is RS-485, for the communication among many masters and slaves. It supports Modbus communication format with baud rate 9,600 ~ 115,200bps.
2. COM2 is for Master or Slave mode. When for Master mode, it can be connected to a Delta PLC or a drive in the next level (e.g. Delta servo drive, temperature controller, AC motor drive, and so on) for reading/writing data. When for Slave mode, it can be connected to a human machine interface (e.g. Delta's TP and DOP series HMI) for monitoring purposes.

**MEMO**

## 3.1 Devices in DVP-PM

**Function Specifications:**

<table>
<tr><th colspan="2">Item</th><th colspan="3">Specification</th><th>Note</th></tr>
<tr><td colspan="2">Number of control axes</td><td colspan="3">2-axis synchronous linear/arc interpolation and independent 2-axis control</td><td>1</td></tr>
<tr><td colspan="2">Program storage</td><td colspan="3">Built-in 64K step storage device</td><td></td></tr>
<tr><td colspan="2">Units</td><td>Motor system</td><td>Combined system</td><td>Machine system</td><td></td></tr>
<tr><td colspan="2">How does MPU read/write extension module</td><td colspan="3">Uses FROM/TO instruction to read/write the contents of CR in the extension module. If the content is 32-bit, it needs 2 CRs for the content.</td><td></td></tr>
<tr><td colspan="2">Series connection with MPU</td><td colspan="3">When used as an extension module, the built-in CR0 ~ CR199 (corresponding to its own D1500 ~ D1699) are for the MPU to read/write.</td><td></td></tr>
<tr><td colspan="2">Pulse output method</td><td colspan="3">3 modes: Pulse/Dir, FP(CW) / RP(CCW), A/B by differential output</td><td></td></tr>
<tr><td colspan="2">Maximum speed</td><td colspan="2">For single axis: 500K PPS</td><td>For interpolation axis: 500K PPS</td><td></td></tr>
<tr><td rowspan="3">Input signal</td><td>Operation switch</td><td colspan="3">AUTO/MANU (auto/manual selection), START, STOP</td><td></td></tr>
<tr><td>Detector</td><td colspan="3">DOG (near point), LSP (forward running limit), LSN (reverser running limit), PG0 (zero point)</td><td></td></tr>
<tr><td>General input point</td><td colspan="3">X0 ~ X7, I/O modules extendable; maximum 256 points extendable</td><td></td></tr>
<tr><td rowspan="3">Output signal</td><td>Servo output</td><td colspan="3">FP (forward pulse), RP (reverse pulse), CLR (clear signal)</td><td></td></tr>
<tr><td>General output point</td><td colspan="3">Y0 ~ Y7, I/O modules extendable; maximum 256 points extendable</td><td></td></tr>
<tr><td>Series communication port</td><td colspan="3">Program write-in/read-out communication port:<br>COM1: RS-232/COM2: RS-485 (can be master or slave)</td><td></td></tr>
<tr><td rowspan="2">Special extension module</td><td rowspan="2">Optional</td><td colspan="3">Program stored by HPP03</td><td></td></tr>
<tr><td colspan="3">The right-side extension module and DVP-EH2 series share all modules, AD, DA, PT, TC, XA, PU (maximum 8 modules extendable).<br>The left side can connect to new high-speed extension modules (maximum 8).</td><td>Maximum 8 modules extendable and will not occupy any I/O points.</td></tr>
<tr><td colspan="2">Basic instruction</td><td colspan="3">27</td><td></td></tr>
<tr><td colspan="2">Application instruction</td><td colspan="3">56</td><td></td></tr>
<tr><td colspan="2">Motion instruction</td><td colspan="3">22</td><td></td></tr>
<tr><td colspan="2">M -Code</td><td colspan="3">OX0 ~ 99 (Positioning Program):<br>M02: program stops (END)<br>M00 ~ M01, M03 ~ M99: program pauses (WAIT), for free use<br>O100 (Sub-task Program):<br>M102: program stops (END)</td><td></td></tr>
<tr><td colspan="2">G-Code</td><td colspan="3">G0 (fast move), G1 (linear interpolation), G2 (clockwise arc interpolation), G3 (counter-clockwise arc interpolation), G4 (pause), G90 (absolute coordinate), G91 (relative coordinate)</td><td></td></tr>
<tr><td colspan="2">Self-diagnosis</td><td colspan="3">Displaying parameter error, program error, external error, and so on.</td><td></td></tr>
</table>

| | | | | | | |
|---|---|---|---|---|---|---|
| Relay (bit) | X | External input relay | | X0 ~ X377, octal encoding, 256 points | Total 512 points | Corresponds to external input points |
| | Y | External output relay | | Y0 ~ Y377, octal encoding, 256 points | | Corresponds to external output points |
| | M | Auxiliary relay | General purpose | M0 ~ M499, 500 points (*2) | Total 4,096 points | The contact can be On/Off in the program. |
| | | | | M3000 ~ M4095, 2,096 points (*3) | | |
| | | | Latched | M500 ~ M999, 500 points (*3) | | |
| | | | Special purpose | M1000 ~ M2999, 2,000 points (part for latched) | | |
| | T | Timer | 10ms | T0 ~ T255, 256 points (*2) | Total 256 points | TMR instruction. If the timing reaches its target, the T contact of the same No. will be On. |
| | C | Counter | 16-bit counting up | C0 ~ C99, 100 points (*2) | Total 256 points | The counter indicated by CNT (DCNT) instruction. If the counting reaches its target, the C contact of the same No. will be On. |
| | | | | C100 ~ C199, 100 points (*3) | | |
| | | | 32-bit counting up/down | C200 ~ C219, 20 points (*2) | | |
| | | | | C220 ~ C255, 36 points (*3) | | |
| | S | Internal relay | General purpose | S0 ~ S499, 500 points (*2) | Total 1,024 points | The contact can be On/Off in the program. |
| | | | Latched | S500 ~ S1023, 524 points (*3) | | |
| Register (word data) | T | Present value in timer | | T0 ~ T255, 256 points | | When the timing reaches its target, the contact of the timer will be On. |
| | C | Present value in counter | | C0 ~ C199, 16-bit counter, 200 points | | When the counting reaches its target, the contact of the counter will be On. |
| | | | | C200 ~ C255, 32-bit counter, 56 points | | |
| | D | Data register | General purpose | D0 ~ D199, 200 points (*2) | Total 10,000 points | Memory area for data storage. V/Z can be used for indirect designation. |
| | | | Latched | D200 ~ D999, 800 points (*3) | | |
| | | | | D3000 ~ D9999, 7,000 points (*3) | | |
| | | | Special purpose | D1000 ~ D2999, 2,000 points (part for latched) | | |
| | | | Indirect designation | V0 ~ V7 (16-bit), Z0 ~ Z7, 16 points (32-bit) (*1) | | |
| Index | P | For CJ, CJN, CALL, JMP instructions | | P0 ~ P255, 256 points | | Position index of CJ, CJN, CALL and JMP |
| Constant | K | Decimal | | K-32,768 ~ K32,767 (16-bit operation) | | |
| | | | | K-2,147,483,648 ~ K2,147,483,647 (32-bit operation) | | |
| | H | Hex | | H0000 ~ HFFFF (16-bit operation); H00000000 ~ HFFFFFFFF (32-bit operation) | | |
| | F | Floating point | | Displaying floating points by the length of 32 bits with IEEE754 standard. $\pm 1.1755X10^{-38}$ ~ $\pm 3.4028X10^{+38}$ | | |

*1: Non-latched area cannot be modified.

*2: Non-latched area, can be modified into latched area by changing the parameter settings

*3: Latched area, can be modified into non-latched area by changing the parameter settings
*4: Latched area, cannot be modified

**Settings of latched and non-latched memory devices:**

<table>
<tr><td rowspan="4">M<br>(Auxiliary relay)</td><td colspan="3">General purpose</td><td colspan="2">Special auxiliary relay</td></tr>
<tr><td>M0 ~ M499</td><td>M500 ~ M999</td><td>M2000 ~ M4095</td><td colspan="2">M1000 ~ M1999</td></tr>
<tr><td>Default: non-latched</td><td>Default: latched</td><td>Default: non-latched</td><td colspan="2">Also in “general purpose” area</td></tr>
<tr><td colspan="3">Start: D1200 (K500)*1<br>End: D1201 (K999) *1</td><td colspan="2">Some are latched and cannot be modified.</td></tr>
<tr><td rowspan="4">T<br>(Timer)</td><td colspan="5">10ms</td></tr>
<tr><td colspan="5">T0 ~ T255</td></tr>
<tr><td colspan="5">Default: non-latched</td></tr>
<tr><td colspan="5">Start: D1202 (K-1) *2<br>End: D1203 (K-1) *2</td></tr>
<tr><td rowspan="4">C<br>(Counter)</td><td colspan="3">16-bit counting up</td><td colspan="2">32-bit counting up/down</td></tr>
<tr><td>C0 ~ C99</td><td colspan="2">C100 ~ C199</td><td>C200 ~ C219</td><td>C220 ~ C255</td></tr>
<tr><td>Default: non-latched</td><td colspan="2">Default: latched</td><td>Default: non-latched</td><td>Default: latched</td></tr>
<tr><td colspan="3">Start: D1204 (K100)<br>End: D1205 (K199)</td><td colspan="2">Start: D1206 (K220)<br>End: D1207 (K255)</td></tr>
<tr><td rowspan="4">S<br>(Step relay)</td><td>Initial</td><td colspan="2">General purpose</td><td colspan="2">Latched</td></tr>
<tr><td>S0 ~ S9</td><td colspan="2">S10 ~ S499</td><td colspan="2">S500 ~ S1023</td></tr>
<tr><td colspan="3">Default: non-latched</td><td colspan="2">Default: latched</td></tr>
<tr><td colspan="5">Start: D1208 (K500), End: D1209 (K1023)</td></tr>
<tr><td rowspan="4">D<br>(Register)</td><td>General purpose</td><td colspan="2">Latched</td><td colspan="2">Special register</td></tr>
<tr><td>D0 ~ D199</td><td colspan="2">D200 ~ D9999</td><td colspan="2">D1000 ~ D1999<br>Also in "general purpose” and “latched” area</td></tr>
<tr><td>Default: non-latched</td><td colspan="2">Default: latched</td><td colspan="2" rowspan="2">Some are latched and cannot be modified.</td></tr>
<tr><td colspan="3">Start: D1210 (K200) *3<br>End: D1211 (K9999) *3</td></tr>
</table>

*1: If you set D1200 = 0 and D1201 = 4095, DVP-PM will automatically ignore M1000 ~ M2999 and set M0 ~ M999 and M3000 ~ M4095 as latched area.

*2: K-1 refers to default = non-latched.

*3: If you set D1210 = 0 and D1211 = 9999, DVP-PM will automatically ignore D1000 ~ D2999 and set D0 ~ D999 and D3000 ~ D9999 as latched areas.

**Status of general devices when power On/Off or MPU switches between MANU/AUTO (excluding internal devices)**

<table>
<tr><td>Memory type</td><td>Power OFF->ON</td><td>MANU->AUTO</td><td>AUTO->MANU</td><td>Clear all non-latched areas (M1031)</td><td>Clear all latched area (M1032)</td><td>Default</td></tr>
<tr><td rowspan="2">Non-latched</td><td rowspan="2">Cleared</td><td rowspan="2">Unchanged</td><td>Cleared when M1033 = Off</td><td rowspan="2">Cleared</td><td rowspan="2">Unchanged</td><td rowspan="2">0</td></tr>
<tr><td>Remain unchanged when M1033 = On</td></tr>
<tr><td>Latched</td><td colspan="3">Unchanged</td><td>Unchanged</td><td>Cleared</td><td>0</td></tr>
</table>

## 3.2 Values, Constants [K] / [H], Floating Points [F]

| | | | |
|---|---|---|---|
| Constant | K | Decimal form | K-32,768 ~ K32,767 (16-bit operation)<br>K-2,147,483,648 ~ K2,147,483,647 (32-bit operation) |
| | H | Hexadecimal form | H0 ~ HFFFF (16-bit operation)<br>H0 ~ HFFFFFFFF (32-bit operation) |
| Floating point | F | 32 bits | ±1.1755X10-38 ~ ±3.4028X10+38<br>(The floating point is presented in 32 bits, with IEEE754 standard.) |

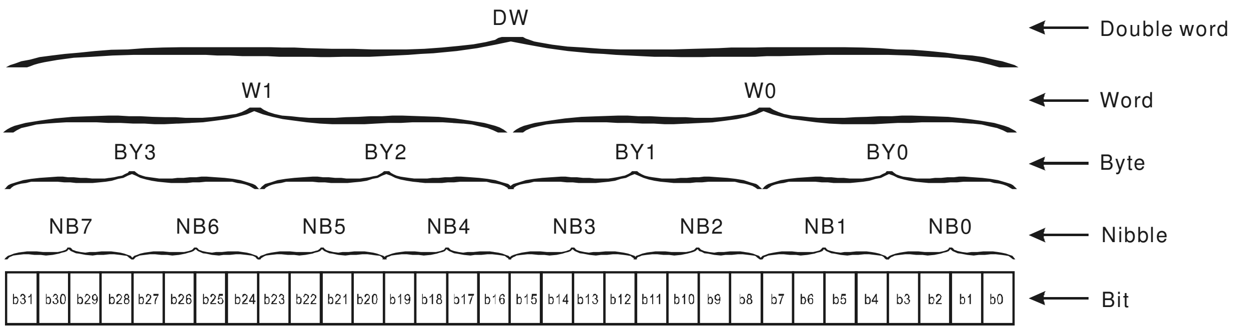
For different control purposes, there are 5 types of values inside DVP-PM for executing the operations. See the explanations bellows for the functions and works of every type of value.

1. Binary value (BIN)

   All the operations and storages of values in DVP-PM are conducted in BIN. See below for the terms for BIN values.

| | |
|---|---|
| **Bit:** | The basic unit for a BIN value, either 1 or 0. |
| **Nibble:** | Composed of 4 continuous bits (e.g. b3 ~ b0). Presented as the decimal value 0 ~ 9 of a digit or 0 ~ F in hex. |
| **Byte:** | Composed of 2 continuous nibbles (i.e. 8 bits, b7 ~ b0). Presented as 00 ~ FF in hex. |
| **Word:** | Composed of 2 continuous bytes (i.e. 16 bits, b15 ~ b0), Presented as 4-digit 0000 ~ FFFF in hex. |
| **Double word:** | Composed of 2 continuous words (i.e. 32 bits, b31 ~ b0). Presented as 8-digit 00000000 ~ FFFFFFFF in hex. |

   Bit, nibble, byte, word and double word in a binary system:




2. Octal value (OCT)

   The No. of external input and output terminals in DVP-PM in numbered in octal system.

   For example:

   External input: X0 ~ X7, X10 ~ X17... (device No.)

   External output: Y0 ~ Y7, Y10 ~ Y17 (device No.)

3. Decimal value (DEC)

   The timings of using decimal values in DVP-PM are as follows:

   ■ As the set value for timer T and counter C, e.g. TMR T0 K50 (constant K)

   ■ As the No. of device S, M, T, C, D, V, Z, P, e.g. M10, T30 (device No.)

   ■ As an operand in the application instruction, e.g. MOV K123 D0 (constant K)

4. Binary code decimal (BCD)

A decimal datum is presented by a nibble or 4 bits. Therefore, a continuous 16 bits can be presented as a 4-digit decimal value. BCD is mainly used on reading the input value from the DIP switch or the data output to a 7-segment display.

5. Hexadecimal value (HEX)

   Occasion of using hexadecimal values:

   ■ Operands in application instructions, e.g. MOV H1A2B D0 (constant H)

**Constant K:**

“K” is normally placed before a decimal value in DVP-PM. For example, K100 refers to a decimal value, 100.

> Exception:
>
> K and bit devices X, Y, M and S can combine into data in bit, byte, word or double word, e.g. K2Y10, K4M100. Here K1 refers to a 4-bit data and K2 ~ K4 refer to 8-bit, 12-bit and 16-bit data.

**Constant H:**

"H” is normally placed before a hexadecimal value in DVP-PM. For example, H100 refers to a hexadecimal value,100.

**Floating point F:**

“F” is normally placed before a floating point value in DVP-PM. For example, F3.123 refers to a floating point value, 3.123.

Reference table:

| Binary (BIN) | | Octal (OCT) | Decimal (DEC) | Binary Code Decimal (BCD) | | Hexadecimal (HEX) |
|---|---|---|---|---|---|---|
| For DVP-PM internal operation | | No. of device X, Y | Constant K, No. of device M, S, T, C, D, V, Z, P | For DIP switch and 7-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 |

| Binary (BIN) | | Octal (OCT) | Decimal (DEC) | Binary Code Decimal (BCD) | | Hexadecimal (HEX) |
|---|---|---|---|---|---|---|
| For DVP-PM internal operation | | No. of device X, Y | Constant K, No. of device M, S, T, C, D, V, Z, P | For DIP switch and 7-segment display | | Constant H |
| 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 Numbering and Functions of External Input/Output Contacts [X] / [Y]

- **Input relay X0 ~ X377**

  The numbering of input relay (or input terminal) is in octal form. DVP-PM is designed for up to 256 points, and the range is: X0 ~ X7, X10 ~ X17, ...X370 ~ X377.

- **Output relay Y0 ~ Y377**

  The numbering of output relay (or output terminal) is in octal form. DVP-PM is designed for up to 256 points, and the range is: Y0 ~ Y7, Y10 ~ Y17, …Y370 ~ Y377.

- **Functions of input contact X**

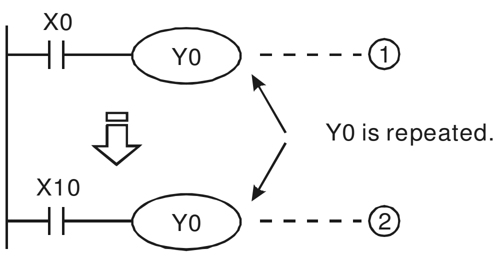
  The input contact X is connected to the input device and reads the input signals into DVP-PM. There is no limitation on the times of using contact A or B of input contact X in the program. On/Off of the input contact X only changes with On/Off of the input device. You cannot use the peripheral devices (HPP03 or PMSoft) to force On/Off of input contact X.

- **Force On/Off of M1304**

  When M1304 = On, the peripheral HPP03 or PMSoft will be allowed to forced On/Off of input contact X on DVP-PM. However, the function of updating the input signals by external scan will be disabled.

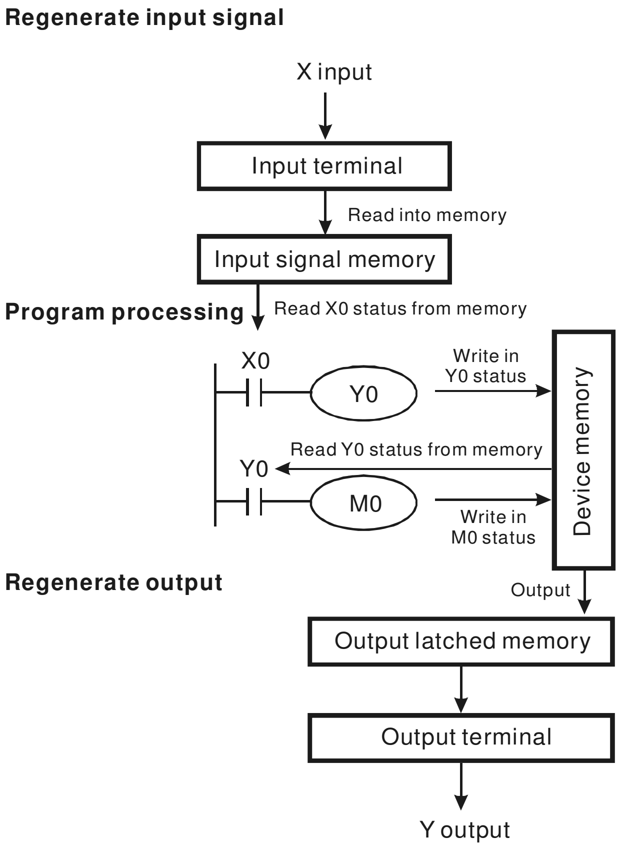
- **Functions of output contact Y**

  Output contact Y sends out On/Off signals to drive the load connected to output contact Y. There are two types of output contacts, relay and transistor. There is no limitation on the times of using contact A or B of output contact Y in the program, but the No. of output coil Y can only be used once in the program; otherwise according to the scan principle of the program, the output status will be determined by the circuit of the last output Y in the program.




The output of Y0 will be determined by circuit ②, i.e. On/Off of X10 will determine the output status of Y0.

**The handling process of DVP-PM program:**




■ **Regenerate input signal**

1. Before the execution of the program, DVP-PM reads the On/Off status of the external input signals into the input signal memory at a time.
2. The On/Off status of the input signal during the execution of the program will not change the signal status in the input signal memory. The new On/Off status will be read in the next scan.
3. There will be approximately a 10ms delay from the On →Off or Off→On changes to the status being recognized by the contact in the program. The delay time may be affected by the scan time in the program.

■ **Program processing**

After DVP-PM reads the On/Off status of every input signal in the input signal memory, it will start to execute every instruction in the program in order starting from address 0. The execution result (On/Off of every output coil) will be stored in order into the device memory.

■ **Regenerate output**

1. When the program executes to M102 instruction, it will send the On/Off status of Y in the device memory to the output latched memory. The output latched memory is the coil of the output relay.
2. There will be a 10ms delay from On→Off or Off→On of the relay coil to the On/Off status of the contact.
3. There will be a 10 ~ 20us delay from On→Off or Off→On of the transistor module to the On/Off status of the contact.



## 3.4 Numbering and Functions of Auxiliary Relays [M]

■ **No. of auxiliary relays (in decimal):**

| | | | |
|---|---|---|---|
| Auxiliary relay M | General purpose | M0 ~ M499, 500 points, can be modified into latched area by setting up parameters. | Total 4,096 points |
| | Latched | M500 ~ M999, M3000 ~ M4095, 1,596 points, can be modified into non-latched area by setting up parameters. | |
| | Special purpose | M1000 ~ M2999, 2,000 points, some are latched. | |

■ **Functions of auxiliary relays:**

Both auxiliary relay M and output relay Y have output coils and contact A, B, and there is no limitation on the times of using the contact. You can use auxiliary relay M to assemble a control loop, but it cannot directly drive the external load. There are three types of auxiliary relays.

1. **General purpose auxiliary relay:** If the relay encounters power cut during the operation of DVP-PM, its status will be reset to Off and stay Off when the power is On again.
2. **Latched auxiliary relay:** If the relay encounters power cut during the operation of DVP-PM, its status will be retained and stay at the status before the power cut when the power is On again.
3. **Special purpose auxiliary relay:** Every relay of this kind has its specific function. DO NOT use undefined special purpose auxiliary relay. See 3.10 for special purpose relay and special registers and 3.11 for their functions.

## 3.5 Numbering and Functions of Step Relays [S]

■ **No. of step relay (in decimal):**

| | | | |
|---|---|---|---|
| Step relay S | General purpose | S0 ~ S499, 490 points, can be modified into latched area by setting up parameters. | Total 1,024 points |
| | Latched | S500 ~ S1023, 524 points, can be modified into non-latched area by setting up parameters. | |

■ **Functions of step relays:**

The device No. of S is S0 ~ S1023 (total 1,024 points) and both step relay S and output relay Y have output coils and contact A, B, and there is no limitation on the times of using the contact. S cannot directly drive the external load and can be used as a normal auxiliary relay.

## 3.6 Numbering and Functions of Timers [T]

■ **No. of timers (in decimal):**

| | | | |
|---|---|---|---|
| Timer T | 10ms general purpose | T0 ~ T255, 256 points, can be modified into latched area by setting up parameters. | |

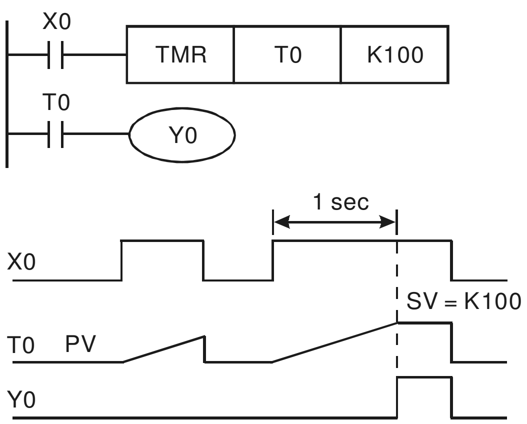
■ **Functions of timers:**

The unit of the timer is 10ms, and the counting method is counting up. When the present value in the timer equals the set value, the output coil will be On, The set value should be a K value in decimal, and the data register D can also be a set value.

The actual set time in the timer = timing unit × set value

**General purpose timer:**

The timer executes once when the program reaches TMR instruction. When TMR instruction is executed, the output coil will be On when the timing reaches its target.




- When X0 = On, The PV in timer T0 will count up by 10ms. When the PV = SV K100, the output coil T0 will be On.
- When X0 = Off or the power is Off, the PV in timer T0 will be cleared as 0, and the output coil will be Off.

**How to designate SV:** The actual set time in the timer = timing unit × set value

1. Designating constant K: SV is a constant K
2. Indirectly designating D: SV is a data register D

## 3.7 Numbering and Functions of Counters [C]

■ **No. of counters (in decimal):**

| | | | | |
|---|---|---|---|---|
| Counter C | 16-bit counting up | C0 ~ C199, 200 points | Total 256 points | When the timing of timer designated by CNT (DCNT) instruction reaches its target, contact C of the same No. will be On. |
| | 32-bit counting up/down | C200 ~ C255, 56 points (accumulative) | | |

■ **Features of counter:**

| | 16-bit counter | 32-bit counter |
|---|---|---|
| Type | General purpose | General purpose |
| Counting direction | Counting up | Counting up, counting down |
| Set value | 0 ~ 32,767 | -2,147,483,648 ~ +2,147,483,647 |
| SV designation | Constant K or data register D | Constant K or data register D (designating 2 values) |
| Present value | Counting will stop after SV is reached. | Counting will continue after SV is reached. |
| Output contact | On and being retained when the counting reaches SV. | On and keeps being On when the counting up reaches SV.<br>Reset to Off when the counting down reaches SV. |
| Reset | PV will return to 0 when RST instruction is executed, and the contact will be reset to Off. | |
| Contact action | The contact acts when the scan is completed. | The contact acts when the scan is completed. |

■ **Functions of counters:**

When the pulse input signals of the counter goes from Off to On, and the present value in the counter equals the set value, the output coil will be On. The set value should be a K value in decimal, and the data register D can also be a set value.

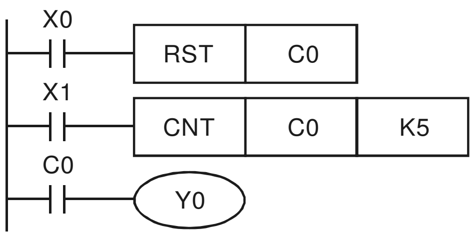
**16-bit counters C0 ~ C199:**

1. The setup range of 16-bit counter: K0 ~ K32,767. K0 is the same as K1. The output contact will be On immediately when the first counting starts.

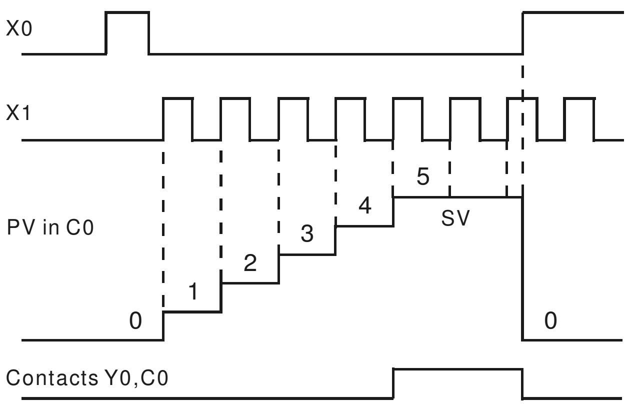
2. PV in the general purpose counter will be cleared when the power of DVP-PM is switched off. If the counter is a latched type, PV and the contact status before the power is off will be retained, and the counting will resume after the power is On again.
3. If you use MOV instructions, PMSoft or HPP03 to send a value bigger than SV to the present value register of C0, next time when X1 goes from Off to On, the contact of counter C0 will be On and its PV will equal SV.
4. SV in the counter can be constant K (set up directly) or the values in register D (set up indirectly, excluding special data register D1000~D1999).
5. If you set up a constant K as SV, it should be a positive value. Data register D as SV can be positive or negative. When PV reaches up to 32,767. The next PV will turn to -32,768.

**Example:**

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




1. When X0 = On, RST instruction will be executed, PV in C0 will be “0”, and the output contact will be reset to Off.
2. When X1 goes from Off to On, PV in the counter will count up (plus 1).
3. When the counting of C0 reaches SV = K5, the contact of C0 will be On, and PV of C0 = SV = K5. The X1 trigger signal comes afterwards will not be accepted by C0, and PV of C0 will stay at K5.



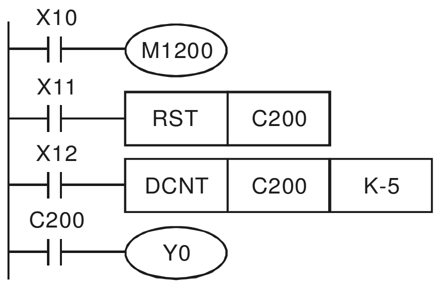

**32-bit general purpose addition/subtraction counters C200 ~ C255:**

1. The setup range of 32-bit counter: K-2,147,483,648 ~ K2,147,483,647. Addition or subtraction of the counter is designated by On/Off status of special auxiliary relay M1200 ~ M1255. For example, when M1200 = Off, C200 will be an addition counter; when M1200 = On, C200 will be a subtraction counter.
2. SV can be constant K or data register D (excluding special data register D1000 ~ D1999). Data register D as SV can be a positive or negative value, and an SV will occupy 2 consecutive data registers.
3. PV in the general purpose counter will be cleared when the power of DVP-PM is switched off. If the counter is a latched type, PV and the contact status before the power is off will be retained, and the counting will resume after the power is On again.

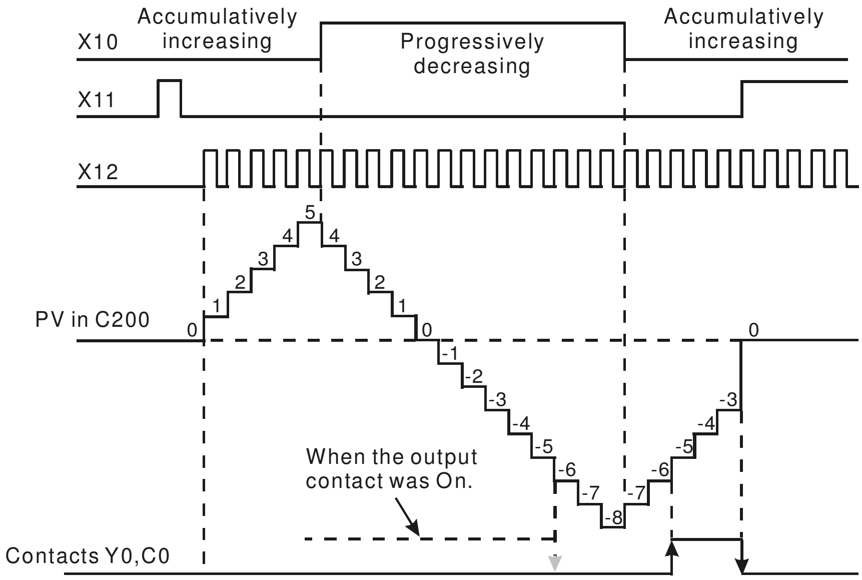
4. When PV reaches up to 2,147,483,647, the next PV will turn to -2,147,483,648. When PV reaches down to -2,147,483,648, the next PV will turn to 2,147,483,647.

**Example:**

| | | |
|---|---|---|
| LD | X10 | |
| OUT | M1200 | |
| LD | X11 | |
| RST | C200 | |
| LD | X12 | |
| DCNT | C200 | K-5 |
| LD | C200 | |
| OUT | Y0 | |




1. X10 drives M1200 to determine whether C200 is an addition or subtraction counter.
2. When X11 goes from Off to On, RST instruction will be executed, PV in C200 will be cleared to "0", and the contact will be Off.
3. When X12 goes from Off to On, PV in the counter will count up (plus 1) or down (minus 1).
4. When PV in C200 changes from K-6 to K-5, the contact of C200 will go from Off to On. When PV in C200 changes from K-5 to K-6, the contact of C200 will go from On to Off.
5. If you use MOV instruction, PMSoft or HPP03 to send a value bigger than SV to the present value register of C0, next time when X1 goes from Off to On, the contact of counter C0 will be On, and its PV will equal SV.




## 3.8 Numbering and Functions of Registers [D]

### 3.8.1 Data Register [D]

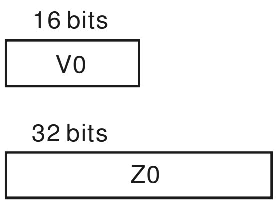
A data register is for storing a 16-bit datum of values between -32,768 ~ +32,767. The highest bit is "+" or "-" sign. Two 16-bit registers can be combined into a 32-bit register (D + 1; D of smaller No. is for lower 16 bits). The highest bit is "+" or "-" sign, and it can store a 32-bit datum of values between -2,147,483,648 ~ +2,147,483,647.

| | | | |
|---|---|---|---|
| Data register D | General purpose | D0 ~ D199, 200 points, can be modified into latched area by setting up parameters. | Total 10,000 points |
| | Latched | D200 ~ D999, D3000 ~ D9999, 7,800 points, can be modified into non-latched area by setting up parameters. | |
| | Special purpose | D1000 ~ D2999, 2,000 points, some are latched | |
| | Index register V, Z | V0 ~ V7, Z0 ~ Z7, 16 points | |
| File register | | K0 ~ K9,999, MPU 10,000 points, fixed as latched | 10,000 points |

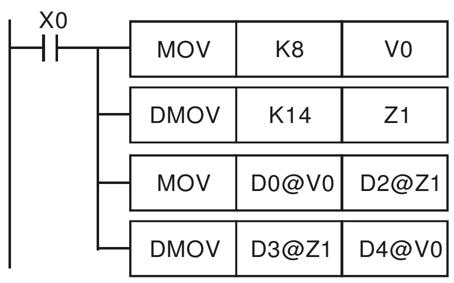
There are five types of registers:

1. **General purpose register:** When DVP-PM goes from AUTO to MANU or the power is switched off, the data in the register will be cleared to "0". When M1033 = On and DVP-PM goes from AUTO to MANU, the data will not be cleared but will still be cleared to "0" when the power is Off.
2. **Latched register:** When the power of DVP-PM is switched off, the data in the register will not be cleared but will retain at the value before the power if off. You can use RST or ZRST instruction to clear the data in the latched register.
3. **Special purpose register:** Every register of this kind has its special definition and purpose, mainly for storing the system status, error messages and monitored status. See 3.10 and 3.11 for more details.
4. **Index register V, Z:** V is a 16-bit register, and Z is a 32-bit register. V0 ~ V7, Z0 ~ Z7, total 16 points.

## 3.8.2 Index Registers [V], [Z]




Register V is a 16-bit data register and can be written and read. V as a general register can only be used in 16-bit instructions.
Z is a 32-bit data register. Z as a general register can only be used in 32-bit instructions.




When X0 = On, V0=8, Z1 = 14.
If you need to use V and Z to modify the operand, you can mix-use16-bit and 32-bit instructions (see left).

The index register is the same as normal operands, can be used for moving or comparison on word devices (KnX, KnY, KnM, KnS, T, C, D) and bit devices (X, Y, M, S). It supports constant (K, H) index register.

V0 ~ V7, Z0 ~ Z7, total 16 point

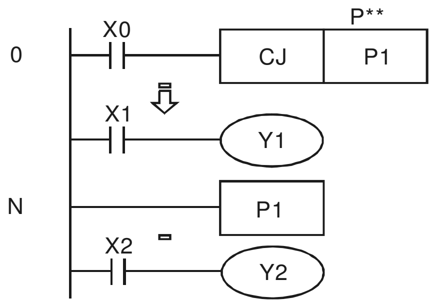
- Some instructions do not support index registers. For how to use index register V, Z to modify the operands, see Chapter 4.4.4 for more details.
- When you use the instruction mode in PMSoft to generate constant (K, H) index register function, please use symbol @. For example, "MOVK10@V0D0V1"
- When you use index register V, Z to modify the operands, the modification range CANNOT exceed the area of special purpose registers D1000 ~ D1999 and special auxiliary relays M1000 ~ M1999 in case errors may occur.

## 3.9 Pointer [N], Pointer [$P_n$]

| Pointer | | | | |
|---|---|---|---|---|
| Pointer | N | For master control loop | N0 ~ N7, 8 points | Control point of master control loop |
| | P | For CJ, CJN, JMP instructions | P0 ~ P255, 256 points | Position pointer of CJ, CJN, JMP |

Pointer P: Used with API 00 CJ, API 256 CJN, and API 257 JMP. See Chapter 5 for explanations on CJ, CJN and JMP instructions for more details.

**CJ conditional jump:**




- When X0 = On, the program will jump from address 0 to N (designated label P1) and keep on the execution. The addresses in the middle will be ignored.
- When X0 = Off, the program will execute from address 0 and keep on executing. At this time, CJ instruction will not be executed.

## 3.10 Special Auxiliary Relays [M], Special Data Register [D]

The types and functions of special auxiliary relays (special M) and special data register (special D) are listed in the tables below. Special M and special D marked with "*" will be further illustrated in 3.11. Columns marked with "R" refers to "read only", "R/W" refers to "read and write", "-" refers to the status remains unchanged, and "#" refers to the system will set it up according to the status of DVP-PM.

| Special M | Function | Off ⇩ On | MANU ⇩ AUTO | AUTO ⇩ MANU | Attribute | Latched | Default | Page number |
|---|---|---|---|---|---|---|---|---|
| M1000* | Monitoring normally open contact (A): Normally On when in AUTO. | Off | On | Off | R | NO | Off | 3-22 |
| M1001* | Monitoring normally closed contact (B): Normally Off when in AUTO. | On | Off | On | R | NO | On | 3-22 |
| M1002* | Enabling positive pulses (On when AUTO). Initial pulses of contact A. Pulse width = scan period. | Off | On | Off | R | NO | Off | 3-22 |
| M1003* | Enabling negative pulses (Off when AUTO). Initial pulses of contact A. Pulse width = scan period. | On | Off | On | R | NO | On | 3-22 |
| M1008 | Scanning watchdog timer (WDT) On | Off | Off | - | R | NO | Off | - |
| M1009 | LV signal has been occurred. | Off | - | - | R | NO | Off | |
| M1011 | 10ms clock pulse, 5ms On/5ms Off | Off | - | - | R | NO | Off | - |
| M1012 | 100ms clock pulse, 50ms On/50ms Off | Off | - | - | R | NO | Off | - |
| M1013 | 1s clock pulse, 0.5s On/0.5s Off | Off | - | - | R | NO | Off | - |
| M1014 | 1min clock pulse, 30s On/30s Off | Off | - | - | R | NO | Off | - |
| M1025 | There is incorrect request for communication service. (When HPP03, PC or HMI is connected with DVP-PM, and DVP-PM receives illegal request for communication service during the data transmission, M1025 will be set, and the error code will be stored in D1025.) | Off | Off | - | R | NO | Off | - |
| M1031 | Clear all non-latched areas | Off | - | - | R/W | NO | Off | - |
| M1032 | Clear all latched areas | Off | - | - | R/W | NO | Off | - |
| M1033 | Memory latched when not in operation | Off | - | - | R/W | NO | Off | - |

| Special M | Function | Off ⇩ On | MANU ⇩ AUTO | AUTO ⇩ MANU | Attribute | Latched | Default | Page number |
|---|---|---|---|---|---|---|---|---|
| M1034 | Disabling all Y outputs | Off | - | - | R/W | NO | Off | - |
| M1039* | Fixing scan time | Off | - | - | R/W | NO | Off | 3-26 |
| M1072 | Executing AUTO instruction (communication) | Off | On | Off | R/W | NO | Off | - |
| M1074* | Enabling OX motion subroutine | Off | - | - | R/W | NO | Off | |
| M1077 | Battery in low voltage, malfunction or no battery | Off | - | - | R/W | NO | Off | - |
| M1087 | Enabling LV signal | Off | - | - | R/W | NO | Off | - |
| M1120* | Retaining the communication setting of COM2 (RS-485). Modifying D1120 will be invalid when M1120 is set. | Off | Off | - | R/W | NO | Off | 3-23 |
| M1121 | Waiting for the sending of RS-485 communication data | Off | On | - | R | NO | Off | - |
| M1122 | Sending request | Off | Off | - | R/W | NO | Off | - |
| M1123 | Receiving is completed | Off | Off | - | R/W | NO | Off | - |
| M1124 | Waiting for receiving | Off | Off | - | R | NO | Off | - |
| M1125 | Communication reset | Off | Off | - | R/W | NO | Off | - |
| M1127 | Sending/receiving data of communication instruction is completed. | Off | Off | - | R/W | NO | Off | - |
| M1128 | Sending…/receiving… indication | Off | Off | - | R | NO | Off | - |
| M1129 | Receiving time-out | Off | Off | - | R/W | NO | Off | - |
| M1138* | Retaining the communication setting of COM1 (RS-232). Modifying D1036 will be invalid when M1138 is set. | Off | - | - | R/W | NO | Off | 3-23 |
| M1139* | Selecting ASCII or RTU mode of COM1 (RS-232) when in Slave mode<br>Off: ASCII; On: RTU | Off | - | - | R/W | NO | Off | 3-23 |
| M1140 | MODRD/MODWR data receiving error | Off | Off | - | R | NO | Off | - |
| M1141 | MODRD/MODWR parameter error | Off | Off | - | R | NO | Off | - |
| M1143* | Selecting ASCII or RTU mode of COM2 (RS-485) when in Slave mode<br>Off: ASCII; On: RTU<br>Selecting ASCII or RTU mode of COM2 (RS-485) when in Master mode (used together with MODRD/MODWR instructions<br>Off: ASCII; On: RTU | Off | - | - | R/W | NO | Off | 3-23 |
| M1161 | 8-bit mode<br>On: 8-bit mode; Off: 16-bit mode | Off | - | - | R/W | NO | Off | - |
| M1200 | Counting mode of C200 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1201 | Counting mode of C201 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1202 | Counting mode of C202 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1203 | Counting mode of C203 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1204 | Counting mode of C204 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1205 | Counting mode of C205 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1206 | Counting mode of C206 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1207 | Counting mode of C207 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1208 | Counting mode of C208 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1209 | Counting mode of C209 (On: counting down) | Off | - | - | R/W | NO | Off | - |

| Special M | Function | Off ⇩ On | MANU ⇩ AUTO | AUTO ⇩ MANU | Attribute | Latched | Default | Page number |
|---|---|---|---|---|---|---|---|---|
| M1210 | Counting mode of C210 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1211 | Counting mode of C211 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1212 | Counting mode of C212 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1213 | Counting mode of C213(On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1214 | Counting mode of C214 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1215 | Counting mode of C215 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1216 | Counting mode of C216 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1217 | Counting mode of C217 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1218 | Counting mode of C218 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1219 | Counting mode of C219 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1220 | Counting mode of C220 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1221 | Counting mode of C221 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1222 | Counting mode of C222 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1223 | Counting mode of C223 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1224 | Counting mode of C224 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1225 | Counting mode of C225 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1226 | Counting mode of C226 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1227 | Counting mode of C227 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1228 | Counting mode of C228 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1229 | Counting mode of C229 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1230 | Counting mode of C230 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1231 | Counting mode of C231 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1232 | Counting mode of C232 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1233 | Counting mode of C233 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1234 | Counting mode of C234 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1235 | Counting mode of C235 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1236 | Counting mode of C236 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1237 | Counting mode of C237 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1238 | Counting mode of C238 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1239 | Counting mode of C239 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1240 | Counting mode of C240 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1241 | Counting mode of C241 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1242 | Counting mode of C242 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1243 | Counting mode of C243 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1244 | Counting mode of C244 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1245 | Counting mode of C245 (On: counting down) | Off | - | - | R/W | NO | Off | - |
| M1246 | Counting mode of C246 (On: counting down) | Off | - | - | R | NO | Off | - |

| Special M | Function | Off ⇩ On | MANU ⇩ AUTO | AUTO ⇩ MANU | Attribute | Latched | Default | Page number |
|---|---|---|---|---|---|---|---|---|
| M1247 | Counting mode of C247 (On: counting down) | Off | - | - | R | NO | Off | - |
| M1248 | Counting mode of C248 (On: counting down) | Off | - | - | R | NO | Off | - |
| M1249 | Counting mode of C249 (On: counting down) | Off | - | - | R | NO | Off | - |
| M1250 | Counting mode of C250 (On: counting down) | Off | - | - | R | NO | Off | - |
| M1251 | Counting mode of C251 (On: counting down) | Off | - | - | R | NO | Off | - |
| M1252 | Counting mode of C252 (On: counting down) | Off | - | - | R | NO | Off | - |
| M1253 | Counting mode of C253 (On: counting down) | Off | - | - | R | NO | Off | - |
| M1254 | Counting mode of C254 (On: counting down) | Off | - | - | R | NO | Off | - |
| M1255 | Counting mode of C255 (On: counting down) | Off | - | - | R | NO | Off | - |
| M1304* | Enabling force On/Off of input point X | Off | - | - | R/W | NO | Off | 3-27 |
| M1744* | OX M code Off | Off | Off | - | R/W | NO | Off | 3-27 |
| M1745 | Disabling zero return of X axis in OX | Off | - | - | R/W | NO | Off | - |
| M1760 | Using radian/degree of OX | Off | - | - | R/W | NO | Off | - |
| M 1792 | Ready flag for OX and X axis | On | On | On | R | NO | On | - |
| M1793* | Clearing motion on X axis; error flag of X axis (automatically cleared when X axis is enabled) | Off | - | - | R/W | NO | Off | 3-28 |
| M1794* | OX M code On (automatically cleared when OX is enabled) | Off | - | Off | R | NO | Off | 3-27 |
| M1795 | OX M0 code On (automatically cleared when OX is enabled) | Off | - | - | R | NO | Off | - |
| M1796 | OX M2 code On (automatically cleared when OX is enabled) | Off | On | - | R | NO | Off | - |
| M1808 | OX zero flag | Off | - | - | R | NO | Off | - |
| M1809 | OX borrow flag | Off | - | - | R | NO | Off | - |
| M1810 | OX carry flag | Off | - | - | R | NO | Off | - |
| M1825 | Disabling zero return of Y axis | Off | - | - | R/W | NO | Off | - |
| M1872 | Y axis ready flag | On | On | On | R | NO | On | |
| M1873* | Clearing motion on Y axis; error flag of Y axis (automatically cleared when Y axis is enabled) | Off | - | - | R | NO | Off | 3-28 |
| M1920 | Using radian/degree of O100 | Off | - | - | R/W | NO | Off | - |
| M1952 | O100 ready flag | On | Off | On | R | NO | On | - |
| M1953* | O100 error flag/clear | Off | Off | - | R/W | NO | Off | 3-29 |
| M1957 | Switching to AUTO mode | Off | On | - | R | NO | Off | - |
| M1958 | Low battery | Off | - | - | R | NO | Off | |
| M1968 | O100 zero flag | Off | - | - | R | NO | Off | - |
| M1969 | O100 borrow flag | Off | - | - | R | NO | Off | - |
| M1970 | O100 carry flag | Off | - | - | R | NO | Off | - |
| M1971 | O100 floating point operation error flag | Off | - | - | R | NO | Off | - |

| Special D | Function | Off ⇩ On | MANU ⇩ AUTO | AUTO ⇩ MANU | Attribute | Latched | Default | Page number |
|---|---|---|---|---|---|---|---|---|
| D1000* | Scanning watchdog timer (WDT) (unit: ms) | 200 | - | - | R/W | NO | 200 | 3-23 |
| D1001 | Displaying the program version of DVP-PM (in default version) | # | - | - | R | NO | # | - |
| D1002 | Program capacity | 65,535 | - | - | R | NO | 65,535 | - |
| D1003 | Sum of program memory | - | - | - | R | YES | 0 | - |
| D1008 | STSC address when WDT is On | 0 | - | - | R | NO | 0 | - |
| D1010 | Current scan time (unit: 1ms) | 0 | - | - | R | NO | 0 | - |
| D1011 | Minimum scan time (unit: 1ms) | 0 | - | - | R | NO | 0 | - |
| D1012 | Maximum scan time (unit: 1ms) | 0 | - | - | R | NO | 0 | - |
| D1020 | X0 ~ X7 input filter (unit: ms) | 10 | - | - | R/W | NO | 10 | - |
| D1025 | Code for communication request error | 0 | 0 | - | R | NO | 0 | - |
| D1036* | COM1 communication protocol | H'86 | - | - | R/W | NO | H'86 | 3-23 |
| D1038* | Delay time of data response when DVP-PM as slave in RS-485 communication. Range: 0 ~ 3,000 (unit: 10ms) | - | - | - | R/W | YES | 0 | 3-26 |
| D1039* | Fixing scan time (ms) | 0 | - | - | R/W | NO | 0 | 3-26 |
| D1050 ↓ D1055 | Process of data for Modbus communication instruction. DVP-PM automatically converts the ASCII data in D1070 ~ D1085 into hex data. | 0 | - | - | R | NO | 0 | - |
| D1070 ↓ D1085 | Process of data for Modbus communication instruction. When the RS-485 communication instruction built-in in DVP-PM sent out is received, the response message will be stored in D1070 ~ D1085. You can view the response messages by checking these registers. | 0 | - | - | R | NO | 0 | - |
| D1089 ↓ D1099 | Process of data for Modbus communication instruction. When the RS-485 communication instruction built-in in DVP-PM is executed, the words of the instruction will be stored in D1089 ~ D1099. You can check whether the instruction is correct by the contents in these registers. | 0 | - | - | R | NO | 0 | - |
| D1120* | COM2 (RS-485) communication protocol | H'86 | - | - | R/W | NO | H'86 | 3-23 |
| D1121 | DVP-PM communication address (latched) | - | - | - | R/W | YES | 1 | - |
| D1122 | Remaining number of words of sent data | 0 | 0 | - | R | NO | 0 | - |
| D1123 | Remaining number of words of received data | 0 | 0 | - | R | NO | 0 | - |
| D1129 | Abnormal communication time-out (ms) | 0 | - | - | R/W | NO | 0 | - |
| D1130 | Error code returning from Modbus | 0 | 0 | - | R | NO | 0 | - |
| D1140* | Number of right-side special extension modules (max. 8) | 0 | - | - | R | NO | 0 | 3-27 |
| D1142* | Number of points X in digital extension unit | 0 | - | - | R | NO | 0 | 3-27 |
| D1143* | Number of points Y in digital extension unit | 0 | - | - | R | NO | 0 | 3-27 |
| D1200* | Start latched address for auxiliary relays M | - | - | - | R/W | YES | 500 | 3-27 |
| D1201* | End latched address for auxiliary relays M | - | - | - | R/W | YES | 999 | 3-27 |
| D1202* | Start latched address for timer T | - | - | - | R/W | YES | -1 | 3-27 |
| D1203* | End latched address for timer T | - | - | - | R/W | YES | -1 | 3-27 |
| D1204* | Start latched address for 16-bit counter C | - | - | - | R/W | YES | 100 | 3-27 |

| Special D | Function | Off ⇩ On | MANU ⇩ AUTO | AUTO ⇩ MANU | Attribute | Latched | Default | Page number |
|---|---|---|---|---|---|---|---|---|
| D1205* | End latched address for 16-bit counter C | - | - | - | R/W | YES | 199 | 3-27 |
| D1206* | Start latched address for 32-bit counter C | - | - | - | R/W | YES | 220 | 3-27 |
| D1207* | End latched address for 32-bit counter C | - | - | - | R/W | YES | 255 | 3-27 |
| D1208* | Start latched address for step relay S | - | - | - | R/W | YES | 500 | 3-27 |
| D1209* | End latched address for step relay S | - | - | - | R/W | YES | 1,023 | 3-27 |
| D1210* | Start latched address for data register D | - | - | - | R/W | YES | 200 | 3-27 |
| D1211* | End latched address for data register D | - | - | - | R/W | YES | 9,999 | 3-27 |
| D1320* | ID of the 1st right-side extension module | 0 | - | - | R | NO | 0 | 3-27 |
| D1321* | ID of the 2nd right-side extension module | 0 | - | - | R | NO | 0 | 3-27 |
| D1322* | ID of the 3rd right-side extension module | 0 | - | - | R | NO | 0 | 3-27 |
| D1323* | ID of the 4th right-side extension module | 0 | - | - | R | NO | 0 | 3-27 |
| D1324* | ID of the 5th right-side extension module | 0 | - | - | R | NO | 0 | 3-27 |
| D1325* | ID of the 6th right-side extension module | 0 | - | - | R | NO | 0 | 3-27 |
| D1326* | ID of the 7th right-side extension module | 0 | - | - | R | NO | 0 | 3-27 |
| D1327* | ID of the 8th right-side extension module | 0 | - | - | R | NO | 0 | 3-27 |
| D1328 | Low word of the third axis control of G-Code, G00 and G01 | 0 | - | - | R/W | NO | NO | 6-30 |
| D1329 | High word of the third axis control of G-Code, G00 and G01 | 0 | - | - | R/W | NO | NO | 6-30 |
| D1330* | Low word of condition of G-Code, G00<br>Low word of interpolation speed of G-Code, G01 | 0 | - | - | R/W | NO | NO | 6-30<br>6-34 |
| D1331* | High word of condition of G-Code, G00.<br>High word of interpolation speed of G-Code, G01 | 0 | - | - | R/W | NO | NO | 6-30<br>6-34 |
| D1500 | FROM/TO data area, corresponding to CR#0 | H'6260 | - | - | R | NO | H'6260 | - |
| D1501 ↓ D1699 | FROM/TO data area, corresponding to CR#1 ~ CR#199 | 0 | - | - | R/W | NO | 0 | - |
| D1700 | No. of OX for execution | 0 | - | - | R | NO | 0 | - |
| D1702 | Step No. of OX execution | 0 | - | - | R | NO | 0 | - |
| D1703* | OX executing M-Code | 0 | - | - | R | NO | 0 | 3-27 |
| D1704 | Set waiting time of OX | 0 | - | - | R | NO | 0 | - |
| D1705 | Present waiting time of OX | 0 | - | - | R | NO | 0 | - |
| D1706 | Set value of OX RPT instruction | 0 | - | - | R | NO | 0 | - |
| D1707 | Present value of OX RPT instruction | 0 | - | - | R | NO | 0 | - |
| D1708<br>D1709 | Low word of compensation value of X-axis moving distance<br>High word of compensation value of X-axis moving distance | 0 | - | - | R | NO | 0 | - |
| D1710<br>D1711 | Low word of compensation value of X-axis center<br>High word of compensation value of X-axis center | 0 | - | - | R | NO | 0 | - |
| D1712 | Low word of compensation radius of X-axis arc | 0 | - | - | R | NO | 0 | - |

| Special D | Function | Off ⇩ On | MANU ⇩ AUTO | AUTO ⇩ MANU | Attribute | Latched | Default | Page number |
|---|---|---|---|---|---|---|---|---|
| D1713 | High word of compensation radius of X-axis arc | | | | | | | |
| D1724 | Low word of compensation value of Y-axis moving distance | 0 | - | - | R | NO | 0 | - |
| D1725 | High word of compensation value of Y-axis moving distance | | | | | | | |
| D1726 | Low word of compensation value of Y-axis center | 0 | - | - | R | NO | 0 | |
| D1727 | High word of compensation value of Y-axis center | | | | | | | |
| D1728 | Low word of compensation radius of Y-axis arc | 0 | - | - | R | NO | 0 | |
| D1729 | High word of compensation radius of Y-axis arc | | | | | | | |
| D1736 | Set waiting time (TIM) of O100 | 0 | - | - | R | NO | 0 | - |
| D1737 | Present waiting time (TIM) of O100 | 0 | - | - | R | NO | 0 | - |
| D1738 | Set value of O100 RPT instruction | 0 | - | - | R | NO | 0 | - |
| D1739 | Present value of O100 RPT instruction | 0 | - | - | R | NO | 0 | - |
| D1799* | Polarity of input terminal | 0 | - | - | R/W | NO | 0 | 3-28 |
| D1800* | Status of input terminal | 0 | - | - | R | NO | 0 | 3-28 |
| D1802* | Incorrect No. of O100 | 0 | - | - | R/W | NO | 0 | 3-29 |
| D1803* | Incorrect STEP position of O100 | 0 | 0 | - | R/W | NO | 0 | 3-29 |
| D1816* | Parameter setting of X axis | - | - | - | R/W | YES | 0 | 3-29 |
| D1817 | Backlash compensation of X axis | - | - | - | R/W | YES | 0 | - |
| D1818 | Number of pulses required per revolution of motor at X axis (low word) | - | - | - | R/W | YES | 2,000 | - |
| D1819 | Number of pulses required per revolution of motor at X axis (high word) | | | | | | | |
| D1820 | Distance created by 1 revolution of motor at X axis (low word) | - | - | - | R/W | YES | 1,000 | - |
| D1821 | Distance created by 1 revolution of motor at X axis (high word) | | | | | | | |
| D1822 | Maximum speed of X axis: $V_{MAX}$ (low word) | - | - | - | R/W | YES | 500K | - |
| D1823 | Maximum speed of X axis: $V_{MAX}$ (high word) | | | | | | | |
| D1824 | Bias speed of X axis: $V_{BIAS}$ (low word) | - | - | - | R/W | YES | 0 | - |
| D1825 | Bias speed of X axis: $V_{BIAS}$ (high word) | | | | | | | |
| D1826 | JOG speed of X axis: $V_{JOG}$ (low word) | - | - | - | R/W | YES | 5,000 | - |
| D1827 | JOG speed of X axis: $V_{JOG}$ (high word) | | | | | | | |
| D1828 | Zero return speed of X axis: $V_{RT}$ (low word) | - | - | - | R/W | YES | 50K | - |
| D1829 | Zero return speed of X axis: $V_{RT}$ (high word) | | | | | | | |
| D1830 | Zero return deceleration speed of X axis: $V_{CR}$ (low word) | - | - | - | R/W | YES | 1,000 | - |
| D1831 | Zero return deceleration speed of X axis: $V_{CR}$ (high word) | | | | | | | |
| D1832 | Number of zero point signals at X axis: N | - | - | - | R/W | YES | 0 | - |
| D1833 | Supplemented distance at X axis: P | - | - | - | R/W | YES | 0 | - |
| D1834 | Definition of zero point at X axis:HP (low word) | - | - | - | R/W | YES | 0 | - |
| D1835 | Definition of zero point at X axis: HP (high word) | | | | | | | |

| Special D | Function | Off ⇩ On | MANU ⇩ AUTO | AUTO ⇩ MANU | Attribute | Latched | Default | Page number |
|---|---|---|---|---|---|---|---|---|
| D1836 | Acceleration time of X axis: $T_{ACC}$ | - | - | - | R/W | YES | 500 | - |
| D1837 | Deceleration time of X axis: $T_{DEC}$ | - | - | - | R/W | YES | 500 | - |
| D1838 | Target position (I) of X axis: P(I) (low word) | 0 | - | - | R/W | NO | 0 | - |
| D1839 | Target position (I) of X axis: P(I) (high word) | | | | | | | |
| D1840 | Operation speed (I) of X axis: V(I) (low word) | 1,000 | - | - | R/W | NO | 1,000 | - |
| D1841 | Operation speed (I) of X axis: V(I) (high word | | | | | | | |
| D1842 | Target position (II) of X axis: P(II) (low word) | 0 | - | - | R/W | NO | 0 | - |
| D1843 | Target position (II) of X axis: P(II) (high word) | | | | | | | |
| D1844 | Operation speed (II) of X axis: V(II) (low word) | 2,000 | - | - | R/W | NO | 2,000 | - |
| D1845 | Operation speed(II) of X axis: V(II) (high word) | | | | | | | |
| D1846* | Operation instruction for X axis | 0 | - | - | R/W | NO | 0 | 3-30 |
| D1847* | Work mode of X axis | 0 | - | - | R/W | NO | 0 | 3-30 |
| D1848 | Current position of X axis: CP (PLS) (low word) | 0 | - | - | R/W | NO | 0 | - |
| D1849 | Current position of X axis: CP (PLS) (high word) | | | | | | | |
| D1850 | Current speed of X axis: PPS (low word) | 0 | 0 | 0 | R/W | NO | 0 | - |
| D1851 | Current speed of X axis: PPS (high word) | | | | | | | |
| D1852 | Current position of X axis: CP (unit) (low word) | 0 | - | - | R/W | NO | 0 | - |
| D1853 | Current position of X axis: CP (unit) (high word) | | | | | | | |
| D1854 | Current speed of X axis: CS (unit) (low word) | 0 | 0 | 0 | R/W | NO | 0 | - |
| D1855 | Current speed of X axis:CS (unit) (high word) | | | | | | | |
| D1856* | Execution status of X axis | 0 | - | - | R | NO | 0 | 3-31 |
| D1857* | Incorrect No. of OX, X axis | 0 | - | - | R | NO | 0 | 3-28 |
| D1858 | Electronic gearing of X axis (numerator) | - | - | - | R/W | YES | 1 | - |
| D1859 | Electronic gearing of X axis (denominator) | - | - | - | R/W | YES | 1 | - |
| D1860 | MPG input frequency at X axis (low word) | 0 | 0 | - | R/W | NO | 0 | - |
| D1861 | MPG input frequency at X axis (high word) | | | | | | | |
| D1862 | Accumulated number of MPG input pulses at X axis (low word) | 0 | - | - | R/W | NO | 0 | - |
| D1863 | Accumulated number of MPG input pulses at X axis (high word) | | | | | | | |
| D1864 | Responding speed of MPG input at X axis | - | - | - | R/W | YES | 5 | - |
| D1865 | Stop mode for OX0 ~ 99. (K1 → completing unfinished distance after next activation, K2 → executing the next instruction after next activation, Others → restart) | - | - | - | R/W | YES | 0 | - |
| D1866 | Electrical zero point address on X axis (low word) | - | - | - | R/W | YES | 0 | - |
| D1867 | Electrical zero point address on X axis (high word) | | | | | | | |
| D1868* | Setting up the No. of OX | - | - | - | R/W | YES | 0 | 3-26 |
| D1869 | Incorrect STEP position of OX | 0 | - | - | R/W | NO | 0 | - |
| D1872 | Enabling Y output when OX is ready | 0 | - | - | R/W | NO | 0 | - |

| Special D | Function | Off ⇩ On | MANU ⇩ AUTO | AUTO ⇩ MANU | Attribute | Latched | Default | Page number |
|---|---|---|---|---|---|---|---|---|
| | High byte: K1; low byte: designating start No. of Y output | | | | | | | |
| D1873 | Enabling Y output when OX executes M-code<br>High byte: K1; low byte: designating start No. of Y output | - | - | - | R/W | YES | 0 | - |
| D1874 | OX M-Code Off, start No. of input point X | 0 | - | - | R/W | NO | 0 | - |
| D1875 | Enabling external MANU of X axis (ZRN, MPG, JOG-, JOG+) | - | - | - | R/W | YES | 0 | 3-31 |
| D1896* | Parameter setting of Y axis | - | - | - | R/W | YES | 0 | 3-29 |
| D1897 | Backlash compensation of Y axis | - | - | - | R/W | YES | 0 | - |
| D1898 | Number of pulses required per revolution of motor at Y axis (low word) | - | - | - | R/W | YES | 2,000 | - |
| D1899 | Number of pulses required per revolution of motor at Y axis (high word) | | | | | | | |
| D1900 | Distance created for 1 revolution of motor at Y axis (low word) | - | - | - | R/W | YES | 1,000 | - |
| D1901 | Distance created for 1 revolution of motor at Y axis (high word) | | | | | | | |
| D1902 | Maximum speed of Y axis: $V_{MAX}$ (low word) | - | - | - | R/W | YES | 500K | - |
| D1903 | Maximum speed of Y axis:$V_{MAX}$ (high word) | | | | | | | |
| D1904 | Bias speed of Y axis: $V_{BIAS}$ (low word) | - | - | - | R/W | YES | 0 | - |
| D1905 | Bias speed of Y axis:$V_{BIAS}$ (high word) | | | | | | | |
| D1906 | JOG speed of Y axis: $V_{JOG}$ (low word) | - | - | - | R/W | YES | 5,000 | - |
| D1907 | JOG speed of Y axis:$V_{JOG}$ (high word) | | | | | | | |
| D1908 | Zero return speed of Y axis:$V_{RT}$ (low word) | - | - | - | R/W | YES | 50K | - |
| D1909 | Zero return speed of Y axis: $V_{RT}$ (high word) | | | | | | | |
| D1910 | Zero return deceleration of Y axis (low word) | - | - | - | R/W | YES | 1,000 | - |
| D1911 | Zero return deceleration of Y axis (high word) | | | | | | | |
| D1912 | Number of zero point signals at Y axis: N | - | - | - | R/W | YES | 0 | - |
| D1913 | Supplemented distance at Y axis: P | - | - | - | R/W | YES | 0 | - |
| D1914 | Definition of zero point at Y axis: HP (low word) | - | - | - | R/W | YES | 0 | - |
| D1915 | Definition of zero point at Y axis: HP (high word) | | | | | | | |
| D1916 | Acceleration time of Y axis: $T_{ACC}$ | - | - | - | R/W | YES | 500 | - |
| D1917 | Deceleration time of Y axis: $T_{DEC}$ | - | - | - | R/W | YES | 500 | - |
| D1918 | Target position (I) of Y axis: P(I) (low word) | 0 | - | - | R/W | NO | 0 | - |
| D1919 | Target position (I) of Y axis: P(I) (high word) | | | | | | | |
| D1920 | Operation speed (I) of Y axis: V(I) (low word) | 1,000 | - | - | R/W | NO | 1,000 | - |
| D1921 | Operation speed (I) of Y axis: V(I) (high word) | | | | | | | |
| D1922 | Target position (II) of Y axis: P(II) (low word) | 0 | - | - | R/W | NO | 0 | - |
| D1923 | Target position (II) of Y axis: P(II) (high word) | | | | | | | |
| D1924 | Operation speed (II) of Y axis: V(II) (low word) | 2,000 | - | - | R/W | NO | 2,000 | - |
| D1925 | Operation speed (II) of Y axis: V(II) (high word) | | | | | | | |

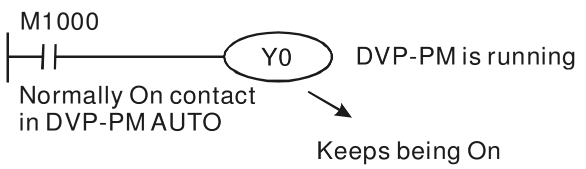
| Special D | Function | Off ⇩ On | MANU ⇩ AUTO | AUTO ⇩ MANU | Attribute | Latched | Default | Page number |
|---|---|---|---|---|---|---|---|---|
| D1926* | Operation instruction of Y axis | 0 | - | - | R/W | NO | 0 | 3-30 |
| D1927* | Work mode of Y axis | 0 | - | - | R/W | NO | 0 | 3-30 |
| D1928 | Current position of Y axis: CP (PLS) (low word) | 0 | - | - | R/W | NO | 0 | - |
| D1929 | Current position of Y axis: CP (PLS) (high word) | | | | | | | |
| D1930 | Current speed of Y axis: PPS (low word) | 0 | 0 | 0 | R/W | NO | 0 | - |
| D1931 | Current speed of Y axis: PPS (high word) | | | | | | | |
| D1932 | Current position of Y axis: CP (unit) (low word) | 0 | - | - | R/W | NO | 0 | - |
| D1933 | Current position of Y axis: CP (unit) (high word) | | | | | | | |
| D1934 | Current speed of Y axis: CS (unit) (low word) | 0 | 0 | 0 | R/W | NO | 0 | - |
| D1935 | Current speed of Y axis: CS (unit) (high word) | | | | | | | |
| D1936* | Execution status of Y axis | 0 | - | - | R | NO | 0 | 3-31 |
| D1937* | Incorrect No. of Y axis | 0 | - | - | R | NO | 0 | 3-28 |
| D1938 | Electronic gearing of Y axis (numerator) | - | - | - | R/W | YES | 1 | - |
| D1939 | Electronic gearing of Y axis (denominator) | - | - | - | R/W | YES | 1 | - |
| D1940 | MPG input frequency at Y axis (low word) | 0 | - | 0 | R/W | NO | 0 | - |
| D1941 | MPG input frequency at Y axis (high word) | | | | | | | |
| D1942 | Accumulated number of MPG input pulses at Y axis (low word) | 0 | - | - | R/W | NO | 0 | - |
| D1943 | Accumulated number of MPG input pulses at Y axis (high word) | | | | | | | |
| D1944 | Responding speed of MPG input at Y axis | - | - | - | R/W | YES | 5 | - |
| D1946 | Electrical zero point address on Y axis (low word) | - | - | - | R/W | YES | 0 | - |
| D1947 | Electrical zero point address on Y axis (high word) | | | | | | | |
| D1955* | Enabling external MANU of Y axis (ZRN, MPG, JOG-, JOG+) | - | - | - | R/W | YES | 4 | 3-31 |

## 3.11 Functions of Special Auxiliary Relays and Special Registers

**Function Group:** DVP-PM Operation Flag

**Number:** M1000 ~ M1003

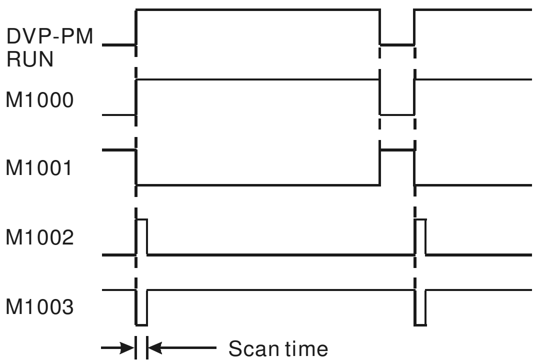
1. **M1000:** M1000 (A contact) is constantly "On" during the operation and monitoring. When DVP-PM is in AUTO status, M1000 will remain "On".




2. **M1001:** M1001 (B contact) is constantly "Off" during the operation and monitoring, When DVP-PM is in AUTO status, M1001 will remain "Off".
3. **M1002:** M1002 is "On" during the first scan when DVP-PM starts to be AUTO and remains "Off" afterward. The

pulse width = 1 scan time. Use this contact for all kinds of initial setting.

4. **M1003:** M1003 is “Off” during the first scan when DVP-PM starts to be AUTO and remains “On” afterward. M1003 enables negative direction (“Off” immediately when AUTO) pulses.

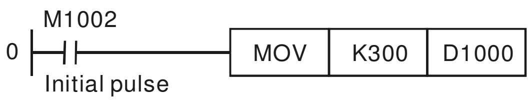



**Function Group:** Monitor Timer

**Number:** D1000

**Contents:**

1. The monitor timer is used for monitoring DVP-PM scan time. When the scan time exceeds the set time in the monitor timer, the red ERROR LED indicator will keep beaconing, and all outputs will be “Off”.
2. The initial set value of the time in the monitor timer is 200ms. If the program is too long, or the operation is too complicated, MOV instruction can be used for changing the set value. See the example below for SV = 300ms.




3. The maximum set value in the monitor timer is 32,767ms. Please be noted that if the SV is too big, the timing of detecting operational errors will be delayed. Therefore, it is suggested that you remain the scan time of shorter than 200ms.
4. Complicated instruction operations or too many extension modules being connected to DVP-PM will result in the scan time being too long. Check D1010 ~ D1012 to see if the scan time exceeds the SV in D1000. If so, modify the SV in D1000.

**Function Group:** Communication Port Function

**Number:** M1120, M1138, M1139, M1143, D1036, D1120

**Content:**

COM ports (COM1: RS-232, COM2: RS232/RS-485/RS-422) in DVP-PM support Modbus ASCII/RTU communication format with speed of up to 115,200bps. COM1 and COM2 can be used at the same time.

COM1: For slave stations only. COM1 supports ASCII/RTU communication format, adjustable baud rate with speed of up to 115,200bps, and modification on data length (data bits, parity bits, stop bits).

COM2: For master or slave stations. COM2 supports ASCII/RTU communication format, adjustable baud rage with speed of up to 115,200bps, and modification on data length (data bits, parity bits, stop bits).

■ Communication format settings:

COM1: 1. Communication format is set in D1036.
2. Communication setting is M1138 remains.
3. ASCII/RTU mode is set in M1139.

COM2: 1. Communication format is set in D1120.
2. Communication setting in M1120 remains.
3. ASCII/RTU mode is set in M1143.

D1136: b8 ~ b15 do not support the communication protocol of COM1 (RS-232) Slave

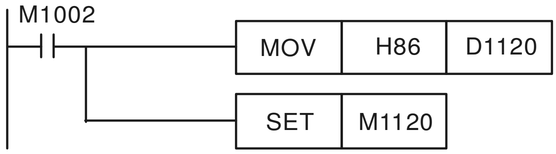
D1120: Communication protocol of COM2 (RS-232/RS-485/RS-422) Master or Slave

■ Communication protocols and how to set:

| | Content | 0 | 1 |
|---|---|---|---|
| b0 | Data length | b0=0：7 | b0=1：8 |
| b1<br>b2 | Parity bit | b2, b1=00 ：None<br>b2, b1=01 ：Odd<br>b2, b1=11 ：Even | |
| b3 | Stop bits | b3=0：1 bit | b3=1：2 bit |
| | Content | | |
| b4<br>b5<br>b6<br>b7 | 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 | Select start bit | b8=0: None | b8=1：D1124 |
| b9 | Select the $1^{st}$ end bit | b9=0: None | b9=1：D1125 |
| b10 | Select the $2^{nd}$ end bit | b10=0: None | b10=1：D1126 |
| b15 ~ b11 | Not defined | | |

<u>Example 1: Modifying communication format of COM2</u>

1. Add the program code below on top of the program to modify the communication format of COM2. When DVP-PM switches from MANU to AUTO, the program will detect whether M1120 is On in the first scan time. If M1120 is On, the program will modify the relevant settings of COM2 according to the value set in D1120.
2. Modify the communication format of COM2 into ASCII mode, 9,600bps, 7 data bits, even parity, 1 stop bit (9,600, 7, E, 1)

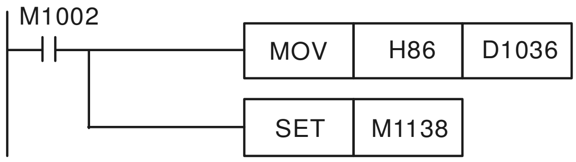



Notes:

1. If COM2 is to be used as a Slave terminal, make sure there is no communication instruction existing in the program.
2. After the communication format is modified, the format will stay intact when DVP-PM switches from AUTO to MANU.
3. If you shut down the power of DVP-PM and re-power it again, the modified communication format will return to default setting.

Example 2: Modifying the communication format of COM1

1. Add the program code below on top of the program to modify the communication format of COM1. When DVP-PM switches from MANU to AUTO, the program will detect whether M1138 is On in the first scan time. If M1138 is On, the program will modify the relevant settings of COM1 according to the value set in D1036.
2. Modify the communication format of COM1 into ASCII mode, 9,600bps, 7 data bits, even parity, 1 stop bit (9,600, 7, E, 1)

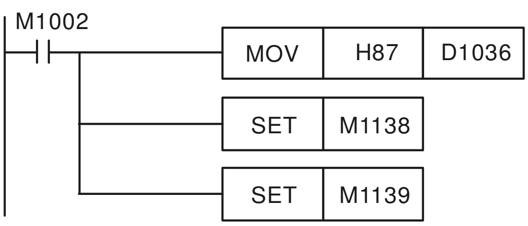



Note:

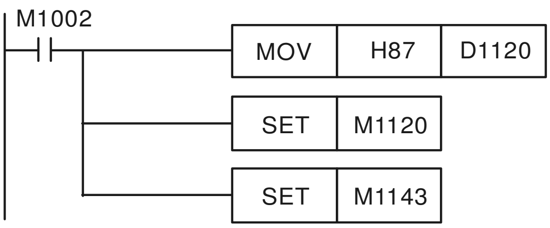
1. After the communication format is modified, the format will stay intact when DVP-PM switches from AUTO to MANU.
2. If you shut down the power of DVP-PM and re-power it again, the modified communication format will return to default setting.

Setting up RTU mode of COM1 and COM2

COM1:




COM2:



**Function Group:** Communication Response Delay

**Number:** D1038

**Contents:**

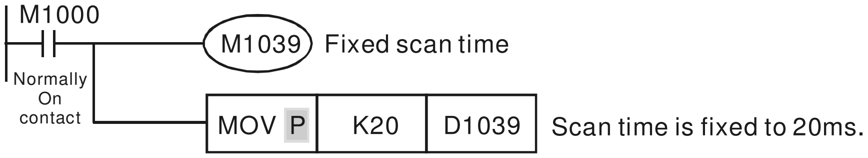
When DVP-PM is used as a slave, in RS-485 interface, you can set up communication response delay time ranging from 0 to 1,000 (0 ~ 1 second). If the time falls without the range, D1038 = 0 (time unit: 0.1ms). The set value of time must be less than that in D1000.

**Function Group:** Fixed Scan Time

**Number:** M1039, D1039

**Contents:**

1. When M1039 = On, the scan time of the program is determined by the content in D1039. When the execution of the program is completed, the next scan will take place when the fixed scan time is reached. If the content in D1039 is less than the actual scan time of the program, the scan time will follow the actual scan time of the program.




2. The scan time displayed in D1010 ~ D1012 also include the fixed scan time.

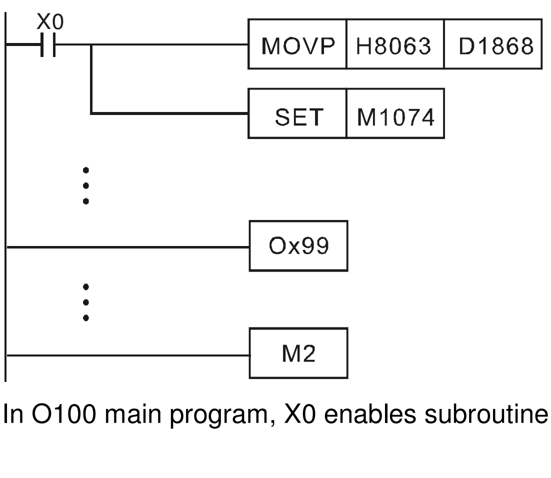
**Function Group:** Setting up the No. of OX Program

**Number:** M1074, D1868

**Contents:**

D1868 designates the No. of OX program to be executed. How to set:

1. Set b14 of D1068 to be “1” or b15 = “1", or b14 = b15 = 1 (only one of the three needs to be true). Write b0 ~ b13 of D1868 into K99 (= H’63), i.e. set OX as OX99. Later, write H’8063 into D1868.
2. Set up M1074 to enable the OX program designated by D1868.
3. Program example:




In O100 main program, X0 enables subroutine OX99 and executes the program in OX99.

**Function Group:** Detecting Extension

**Number:** D1140, D1142, D1143

**Contents:**

1. D1140: Number of special right-side extension modules (AD, DA, XA, PT, TC, RT, HC, PU); Max. 8.
2. D1142: Number of X input points on the digital extension unit.
3. D1143: Number of Y output points on the digital extension unit.

**Function Group:** Setting Up Latched Area

**Number:** D1200 ~ D1211

**Contents:**

1. The latched area is from the start address to end address in DVP-PM latched setting.
2. See the tables in 3.1 for more details.

**Function Group:** Force Om/Off of Input Point X

**Number:** M1304

**Contents:**

When M1304 = On, the peripheral devices (e.g. PMSoft, HPP03) can force On/Off of X0 ~ X17, but the hardware LED will not respond to ot.

**Function Group:** Right-Side Special Extension Module ID

**Number:** D1320 ~ D1327

**Contents:**

1. The ID of special extension module, if any, connected to DVP-PM are stored in D1320 ~ D1327 in sequence.
2. Special extension module ID for DVP-PM:

| Module Name | Module ID (hex) | Module Name | Module ID (hex) |
|---|---|---|---|
| DVP04AD-H2 | H'6400 | DVP01PU-H2 | H'6110 |
| DVP04DA-H2 | H'6401 | DVP04PT-H2 | H'6402 |
| DVP04TC-H2 | H'6403 | DVP06XA-H2 | H'6604 |
| DVPPM | H'6260 | DVP01HC-H2 | H'6120 |

**Function Group:** Clearing M-Code In Execution

**Number:** M1744, M1794, D1703

**Contents:**

1. Make M1744 = 1 to clear the M-Code instruction. When M1744 is executed, D1703 will be cleared and M1794 will be reset.

2. M1794 is the flag indicating M-Code of OX has been executed. D1703 is the register for M-Code of OX.

**Function Group:** Clearing Erroneous Motion

**Number:** M1793, D1857, M1873, D1937

**Contents:**

1. When errors occur on X or Y axis, the error flags are M1793 for X and M1873 for Y, and the error messages will be stored in D1857 for X and D1937 for Y.
2. To eliminate the error, please clear the error message registers and reset the error flags.

**Function Group:** Setting up Polarity of Input Terminal

**Number:** D1799

**Contents:**

Set bit# to be On to make the polarity of the input terminal as contact A. Set bit# to be Off to make the polarity of the input terminal as contact B.

| bit# | Polarity of input terminal on X axis | bit# | Polarity of input terminal on Y axis |
|---|---|---|---|
| 0 | PG0 | 8 | PG0 |
| 1 | MPGB | 9 | MPGB |
| 2 | MPGA | 10 | MPGA |
| 3 | LSN | 11 | LSN |
| 4 | LSP | 12 | LSP |
| 5 | DOG | 13 | DOG |
| 6 | STOP | 14 | STOP |
| 7 | START | 15 | START |

**Function Group:** Reading the Status of Input Terminal

**Number:** D1800

**Contents:**

bit# = On indicates there is signal input. bit# = Off indicates there is no signal input.

| bit# | Input terminal status on X axis | bit# | Input terminal status on Y axis |
|---|---|---|---|
| 0 | PG0 | 8 | PG0 |
| 1 | MPGB | 9 | MPGB |
| 2 | MPGA | 10 | MPGA |
| 3 | LSN | 11 | LSN |
| 4 | LSP | 12 | LSP |
| 5 | DOG | 13 | DOG |
| 6 | STOP | 14 | STOP |
| 7 | START | 15 | START |

**Function Group:** Error Check on O100

**Number:** M1953, D1802, D1803

**Contents:**

1. When errors occur in O100 program, the error flag in O100, M1953, will be set On, and the error message will be D1802. The STEP where the error occurs will be stored in D1803.
2. See the table of error messages in Appendix C of Chapter 9.

**Function Group:** Parameter Settings on X-Y Axis

**Number:** D1816, D1896

**Contents:**

D1816 is the parameter setting for X axis, and D1896 for Y axis. See the tables below:

| bit# | X-Y axis parameter setting | bit# | X-Y axis parameter setting |
|---|---|---|---|
| 0 | Unit (*1) | 8 | Zero return direction (*4) |
| 1 | | 9 | Zero return mode (*4) |
| 2 | Multiplication of position data (*2) | 10 | Detecting DOG falling edge in zero return (*4) |
| 3 | | 11 | Pulse rotation direction (*4) |
| 4 | Pulse type (*3) | 12 | Relative/absolute coordinate (*4) |
| 5 | | 13 | DOG trigger mode (*4) |
| 6 | | 14 | Curve selection (*4) |
| 7 | | 15 | |

Note *1:

| b1 | b0 | Unit |
|---|---|---|
| 0 | 0 | Motor |
| 0 | 1 | Machine |
| 1 | 0 | Combined |
| 1 | 1 | |

| | Motor unit | Combined unit | Machine unit |
|---|---|---|---|
| Position | pulse | um | |
| | pulse | m deg | |
| | pulse | $10^{-4}$inch | |
| Speed | pulse/sec | | cm/min |
| | pulse/sec | | 10deg/min |
| | pulse/sec | | inch/min |

Note *2:

| b3 | b2 | Multiplication of position data |
|---|---|---|
| 0 | 0 | $10^0$ |
| 0 | 1 | $10^1$ |
| 1 | 0 | $10^2$ |
| 1 | 1 | $10^3$ |

Note *3:

| b5 | b4 | Description |
|---|---|---|
| 0 | 0 | Forward pulse + reverse pulse |
| 0 | 1 | Pulse + direction |
| 1 | 0 | A/B phase pulse (2-phase 2) |
| 1 | 1 | |

Note *4:

| bit# | Explanation |
|---|---|
| 8 | b[8]=0: Decreasing current position (CP) towards zero<br>b[8]=1: Increasing current position (CP) towards zero |
| 9 | b[9]=0: normal mode<br>b[9]=1: overwrite mode |
| 10 | b[10]=0: Detecting DOG falling edge in zero return<br>b[10]=1: Detecting DOG rising edge in zero return |

| bit# | Explanation |
|---|---|
| 11 | b[11]=0: Increasing current position (CP) when in forward running<br>b[11]=1: Decreasing current position (CP) when in forward running |
| 12 | b[12]=0: Absolute coordinate positioning<br>b[12]=1: Relative coordinate positioning |
| 13 | b[13]=0: Triggering DOG rising edge<br>b[13]=1: Triggering DOG falling edge<br>(Valid in single-speed positioning interruption mode and 2-speed positioning interruption mode) |
| 14 | b[14]=0: Adopting trapezoid acceleration curve<br>b[14]=1: Adopting S acceleration curve |

**Function Group:** Parameter Settings for X-Y Axis Operation

**Number:** D1846, D1926

**Contents:**

D1846 is for operation setting of X axis, and D1926 for Y axis.

| bit# | X-Y operation setting | bit# | X-Y operation setting |
|---|---|---|---|
| 0 | Software STOP | 8 | Enabling single-speed positioning |
| 1 | Software START | 9 | Enabling single-speed positioning interruption |
| 2 | JOG+ operation | 10 | Enabling 2-speed positioning |
| 3 | JOG- operation | 11 | Enabling 2-speed positioning interruption |
| 4 | Enabling variable speed operation | 12 | 0: Stop OX; 1: Start OX |
| 5 | MPG input operation | 13 | |
| 6 | Enabling zero return mode | 14 | |
| 7 | | 15 | |

**Function Group:** Work Mode of X-Y Axis

**Number:** D1847, D1927

**Contents:**

D1847 is for the work mode setting of X axis, and D1927 for Y axis.

| bit# | Work mode of X-Y | bit# | Work mode of X-Y |
|---|---|---|---|
| 0 | | 8 | MASK selection |
| 1 | | 9 | |
| 2 | CLR signal output mode | 10 | |
| 3 | CLR output On/Off control | 11 | |
| 4 | CLR polarity setting | 12 | |
| 5 | STOP mode setting | 13 | |
| 6 | Range for MPG | 14 | |
| 7 | LSP/LSN stop mode | 15 | Returning to default setting |

| bit# | Explanation |
|---|---|
| 2 | When b[2] = 0, CLR will output 130ms signal to the servo when the zero return is completed as the clear signal for the error counter in the servo.<br>When b[2] = 1, CLR will be a general output point, and its status will be controlled by On/Off of b[3]. |
| 3 | When b[3] = 0, output point CLR will be Off.<br>When b[3] = 1, output point CLR will be On. |
| 5 | b[5] = 0: During the running of motor, when encountering STOP signal input , the motor will decelerate to stop. When the next motion instruction comes in, the motor will ignore the unfinished distance and immediately execute the distance in the next step.<br>b[5] = 1: During the running of motor, when encountering STOP signal input, the motor will decelerate to stop. When the next motion instruction comes in, the motor will complete the unfinished distance before executing the next positioning step. |
| 6 | b[6] = 0: No limitation on MPG pulse input<br>b[6] = 1: The range for MPG pulse output is limited with P(I) and P(II). When the range is exceeded, the pulse deceleration will stop. |
| 7 | b[7] = 0: During the running of motor, the motor decelerates to stop when encountering LSP/LSN signal input<br>b[7] = 1: During the running of motor, the motor stops immediately when encountering LSP/LSN signal input. |
| 8, 9, 10 | MASK settings (single-speed positioning, 2-speed positioning, single-speed positioning interruption, 2-speed positioning interruption)<br>b[10~8] = K0 (000): or other values: No MASK function<br>b[10~8] = K1 (001): Triggering MASK by the rising edge of input terminal ΦA±<br>b[10~8] = K2 (010): Triggering MASK by the falling edge of input terminal ΦA±<br>b[10~8] = K3 (011): Triggering MASK by the rising edge of input terminal ΦB±<br>b[10~8] = K4 (100): Triggering MASK by the falling edge of input terminal ΦB± |

**Function Group:** Execution Status of X-Y Axis

**Number:** D1856, D1936

**Contents:**

D1856 is for the execution status of X axis, and D1936 for Y.

| bit# | Execution status of X-Y | bit# | Execution status of X-Y |
|---|---|---|---|
| 0 | Forward pulse output in progress | 8 | |
| 1 | Reverse pulse output in progress | 9 | |
| 2 | Operation in progress | 10 | |
| 3 | Error occurs | 11 | |
| 4 | Operation pauses | 12 | |
| 5 | Forward MPG input | 13 | |
| 6 | Reverse MPG input | 14 | |
| 7 | | 15 | |

**Function Group:** External Start for X-Y Axis

**Number:** D1875, D1955

**Contents:**

1. The high byte of D1875 and D1955 = H’01 indicates enabling external input. H’00 indicates disabling external input.
2. The low byte of D1875 and D1955 = H’00 indicates designating 4 consecutive external input X, X0 ~ X3, for enabling JOG+, JOG-, MPG and ZRN.

3. Example: D1875 and D1955 = H'0110 refers to X10 ~ X13 are able to enable JOG+, JOG-, MPG and ZRN.

## 3.12 Special Registers for Manual Motion Mode

Below are the types and functions of special registers (special D) for motion modes. See the next section for more details on the functions. You will know more about the system information by comparing the set value read with the instructions in this manual.

| Special D | | | | Content | Range | Default setting |
|---|---|---|---|---|---|---|
| X axis | | Y axis | | | | |
| HW | LW | HW | LW | | | |
| | D1816 | | D1896 | Parameter setting | b0 ~ b15 | H0 |
| | D1817 | | D1897 | Backlash compensation | 1 ~ +32,767 PLS | K0 |
| D1819 | D1818 | D1899 | D1898 | Number of pulses required per revolution of the motor (A) | 1 ~ +2,147,483,647 PLS/REV | K2,000 |
| D1821 | D1820 | D1901 | D1900 | Distance created for 1 motor revolution (B) | 1 ~ +2,147,483,647 ***1** | K1,000 |
| D1823 | D1822 | D1903 | D1902 | Maximum speed | 0 ~ +2,147,483,647 ***2** | K500,000 |
| D1825 | D1824 | D1905 | D1904 | Bias speed | 0 ~ +2,147,483,647 ***2** | K0 |
| D1827 | D1826 | D1907 | D1906 | JOG speed $V_{JOG}$ | 0 ~ +2,147,483,647 ***2** | K5,000 |
| D1829 | D1828 | D1909 | D1908 | Zero return speed $V_{RT}$ | 0 ~ +2,147,483,647 ***2** | K50,000 |
| D1831 | D1830 | D1911 | D1910 | Zero return deceleration speed $V_{CR}$ | 0 ~ +2,147,483,647 ***2** | K1,000 |
| | D1832 | | D1912 | Number of PG0 signals N | 0 ~ +32,767 PLS | K0 |
| | D1833 | | D1913 | Number of pulse signals P | -32,768～+32,767 PLS | K0 |
| D1835 | D1834 | D1915 | D1914 | Definition of zero point HP | 0 ~ ±999,999 ***1** | K0 |
| | D1836 | | D1916 | Acceleration time $T_{ACC}$ | 10 ~ +32,767 ms | K100 |
| | D1837 | | D1917 | Deceleration time $T_{DEC}$ | 10 ~ +32,767 ms | K100 |
| D1839 | D1838 | D1919 | D1918 | Target position (I) P(I) | -2,147,483,648 ~ +2,147,483,647 ***1** | K0 |
| D1841 | D1840 | D1921 | D1920 | Operation speed (I) V(I) | -2,147,483,648 ~ +2,147,483,647 ***1** | K1,000 |
| D1843 | D1842 | D1923 | D1922 | Target position (II) P(II) | -2,147,483,648 ~ +2,147,483,647 ***1** | K0 |
| D1845 | D1844 | D1925 | D1924 | Operation speed (II) V(II) | 0 ~ +2,147,483,647 ***1** | K2,000 |
| | D1846 | | D1926 | Operation instruction | b0 ~ b15 | H0 |
| | D1847 | | D1927 | Work mode | b0 ~ b15 | H0 |
| D1849 | D1848 | D1929 | D1928 | Current position CP (PLS) | -2,147,483,648 ~ +2,147,483,647 ***1** | K0 |
| D1851 | D1850 | D1931 | D1930 | Current speed CS (PPS) | 0 ~ +2,147,483,647 PPS | K0 |
| D1853 | D1852 | D1933 | D1932 | Current position CP (unit ***2** ) | -2,147,483,648 ~ +2,147,483,647 ***1** | K0 |
| D1855 | D1854 | D1935 | D1934 | Current speed CS (unit ***2**) | 0 ~ +2,147,483,647 PPS | K0 |
| | D1856 | | D1936 | Execution status | b0 ~ b15 | H0 |
| | D1857 | | D1937 | Error code | See the error code table | H0 |
| | D1858 | | D1938 | Electronic gear (numerator) | 1 ~ +32,767 | K1 |
| | D1859 | | D1939 | Electronic gear (denominator) | 1 ~ +32,767 | K1 |
| D1861 | D1860 | D1941 | D1940 | MPG input frequency | Pulse frequency by MPG input | K0 |
| D1863 | D1862 | D1943 | D1942 | Accumulated number of MPG input pulses | Number of input pulses from MPG | K0 |
| | D1864 | | D1944 | Response speed of MPG input | Response speed of MPG input | K5 |

*1: Units available: um/rev, m deg/rev and $10^{-4}$ inch/rev.

*2: The unit setting follows the settings of b0 and b1 of D1816 and D1896 (for parameter setting)

### 3.12.1 Functions of Special Registers for Manual Motion Mode

| X axis | | Y axis | | Parameter Setting |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| | D1816 | | D1896 | |

See the tables below for the meanings of b0 ~ b15.

■ **b0 and b1 of D1816 (D1896): setting of the unit**

| b1 | b0 | Unit | Explanation |
|---|---|---|---|
| 0 | 0 | Motor | Unit: pulse |
| 0 | 1 | Machine | Unit: length, angle |
| 1 | 0 | Combined | Unit for position: length, angle (machine)<br>Unit for speed: pulse (motor) |
| 1 | 1 | | |

| | Motor unit | Combined unit | Machine unit |
|---|---|---|---|
| Position | pulse | um | |
| | pulse | m deg | |
| | pulse | 10-4inch | |
| Speed | pulse/sec | | cm/min |
| | pulse/sec | | 10deg/min |
| | pulse/sec | | inch/min |

- Position data: zero point position (HP), target position (I) (P(I)), target position (II) (P(II), current position (CP).
- Speed data: maximum speed ($V_{MAX}$), bias speed ($V_{BIAS}$), JOG speed ($V_{JOG}$), zero return speed ($V_{RT}$), zero return deceleration speed ($V_{CR}$), operation speed (I) (V(I)), operation speed (II) (V(II)).
- Example 1:

  Motor unit b[1:0] = 00 ⇨ unit for position data: pulse; unit for speed data: pulse/sec (PPS)

  Setting: target position P(I): 10,000 (pulse); operation speed V(I): 10K (PPS)

  Explanation: The positioning controller only needs to send out 10,000 pulses (frequency at 10KPPS) to move to the target position. The distance created by every pulse is calculated by the user according to the parameter settings.
- Example 2:

  Machine unit b[1:0] = 01 ⇨ unit for position data: um; unit for speed data: cm/min

  Assume DD1818 (DD1898) =1,000 (Pulse/REV), DD1820 (DD1900) = 100 (um/REV), target position P(I) = 10,000 (um), and operation speed V(I) = 1,000 (cm/min), what are the number of pulses and the frequency from the pulse instruction of the positioning controller?

  Solve:

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

  Number of pulses required for running to P(I) calculated by the positioning controller

$$=\frac{P(I)um}{B/A}=P(I)\times\frac{A}{B}=100{,}000\ \text{Pulse}$$

Operation speed V(I): 6 (cm/min) = 60,000/60 (um/sec)

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

Calculate the pulse frequency (PPS) by the positioning controller

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

- Example 3:

Combined unit b[1:0] = 10, 11 ⇨ unit for position data: um; unit for speed data: pulse/sec (PPS)

Assume DD1818 (DD1898) = 2,000 (Pulse/REV), DD1820 (DD1900) =100 (um/REV), target position P(I): 10,000 (um), and operation speed V(I): 10K (PPS), what is the number of pulses from the pulse instruction of the positioning controller?

Solve:

Calculate the number of pulses required for running to P(I) by the positioning controller

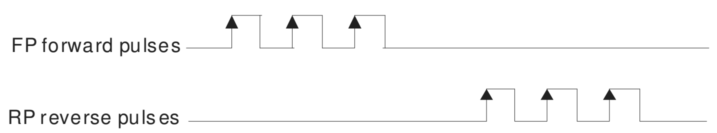
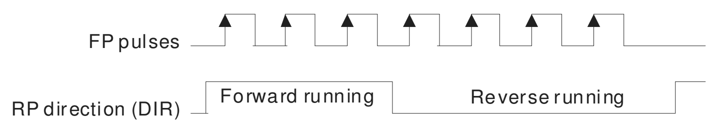
$$=\frac{P(I)um}{B/A}=P(I)\times\frac{A}{B}=200{,}000\ \text{PULSE}$$

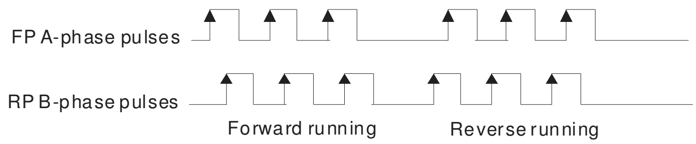
■ **b2 and b3 of D1816 (D1896): setting of multiplication of position data**

The position data, i.e. zero point position (HP), target position (I) (P(I)), target position (II) (P(II)), current position (CP), have to be multiplied by the multiplication values listed in the table below.

| b3 | b2 | Multiplication |
|---|---|---|
| 0 | 0 | Position data × $10^0$ |
| 0 | 1 | Position data × $10^1$ |
| 1 | 0 | Position data × $10^2$ |
| 1 | 1 | Position data × $10^3$ |

■ **b4 and b5 of D1816 (D1896): pulse output type**

| b5 | b4 | Pulse output type (positive logic) | Explanation |
|---|---|---|---|
| 0 | 0 |  | Dual pulses |
| 0 | 1 |  | Single pulse |

| b5 | b4 | Pulse output type (positive logic) | Explanation |
|---|---|---|---|
| 1 | 0 |   | A/B phase pulse |
| 1 | 1 | | |

■ **b8 of D1816 (D1896): zero return direction**

b[8] = 0: decreasing current position (CP) value towards zero

b[8] = 1: increasing current position (CP) value towards zero

■ **b9 of D1816 (D1896): zero return mode**

b[9] = 0: normal mode. After the DOG signal is generated, N PG0 signals and P pulse signals, the motor will stop immediately.

b[9]=1: overwrite mode. After the DOG signal is generated, N PG0 signals and P pulse signals, the motor will stop immediately when either N or P is reached.

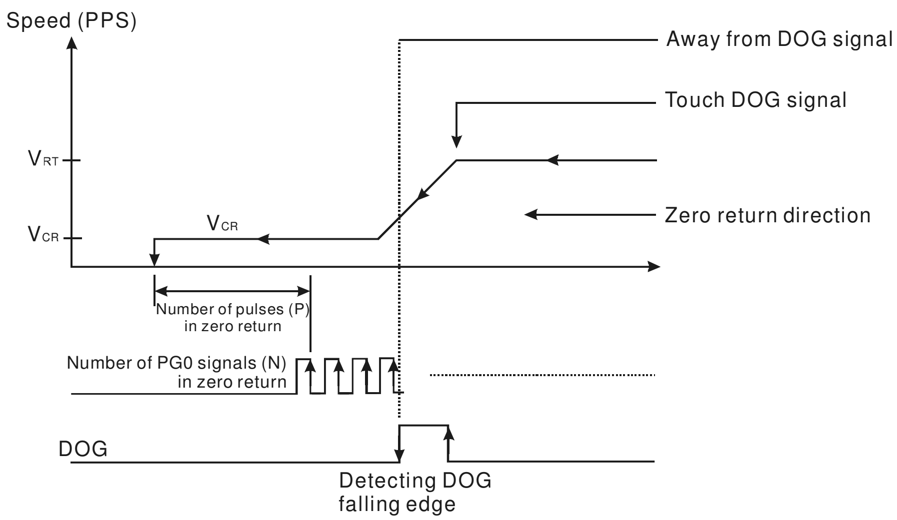
■ **b10 of D1816 (D1896): detecting DOG falling edge in zero return**

b[10] = 0: detecting DOG falling edge (On)

b[10] = 1: detecting DOG rising edge (Off)

• b [9:10] = 00: normal mode; detecting DOG falling edge in zero return (On)

1. Zero return: The motors operates at zero return speed $V_{RT}$, and when it encounters DOG signal, it will decelerate to zero return deceleration speed $V_{CR}$. After passing N PG0 signals and P pulse signals for zero return, the motor will stop.
2. If the set N or P is too small, when the motor encounters DOG signal, it will decelerate to zero return deceleration speed $V_{CR}$ and detect the DOG falling edge. When the designated N is reached, and after passing P, the motor will stop immediately (whether it has reached $V_{CR}$).
3. Assume N is set as “0” and P as “0”, the motor will stop immediately after it touches DOG signal and detects DOG falling edge.

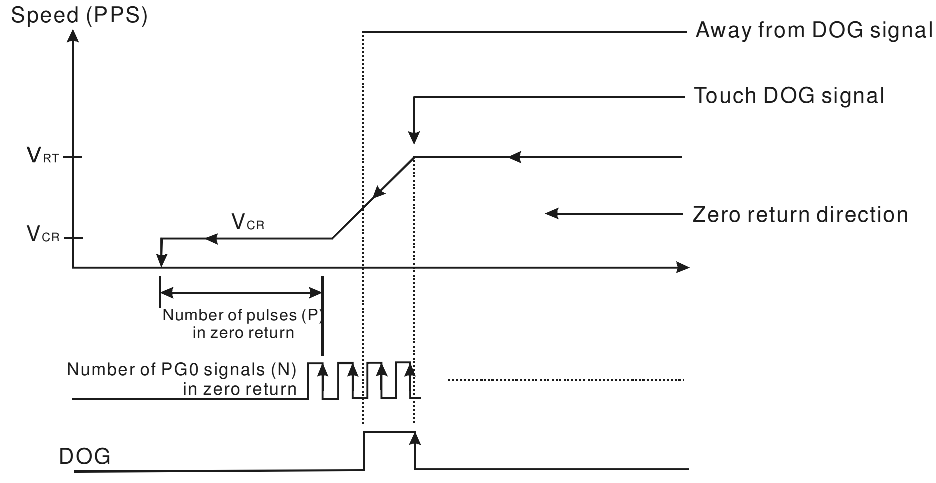



• b[9:10] = 10: normal mode; detecting DOG falling edge in zero return is Off

1. Zero return: The motors operates at zero return speed $V_{RT}$, and when it encounters DOG signal, it will decelerate to zero return deceleration speed $V_{CR}$. After passing N PG0 signals and P pulse signals for zero

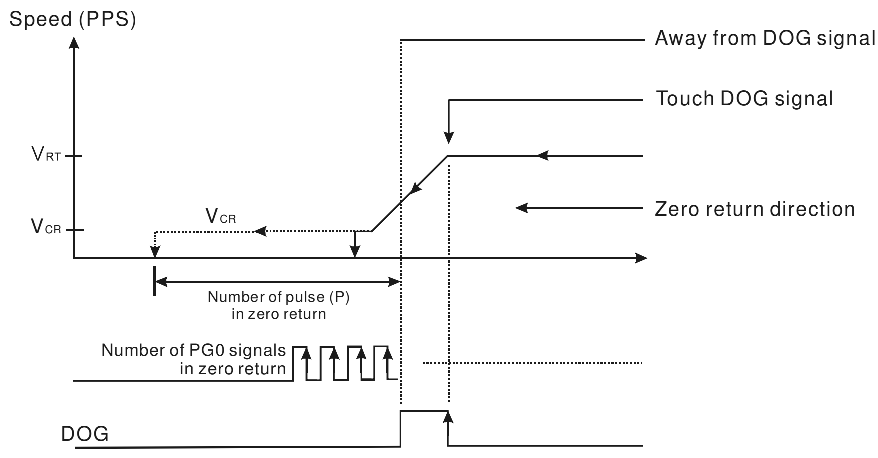
return, the motor will stop.

2. If the set N or P is too small, when the motor encounters DOG signal, it will decelerate to zero return deceleration speed $V_{CR}$. When the designated N is reached, and after passing P, the motor will stop immediately (whether it has reached $V_{CR}$).
3. Assume N is set as “0” and P as “0”, the motor will stop immediately after it touches DOG signal.




- b[9:10] = 01: overwrite mode; detecting DOG falling edge in zero return is On

1. Zero return: The motors operates at zero return speed $V_{RT}$, and when it encounters DOG signal, it will decelerate to zero return deceleration speed $V_{CR}$. After the motor detects the DOG falling edge and passes N PG0 signals or P pulse signals for zero return, it will stop.
2. If the set N or P is too small, when the motor encounters DOG signal, it will decelerate to zero return deceleration speed $V_{CR}$. When the designated N or P is reached, the motor will stop immediately (whether it has reached $V_{CR}$).
3. Assume N is set as “0” and P as “0”, the motor will stop immediately after it touches DOG signal.

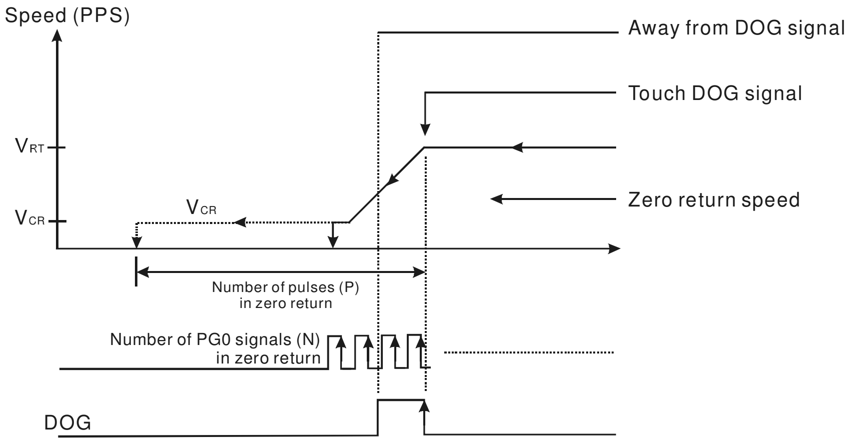



- b[9:10] = 11: overwrite mode; detecting DOG falling edge in zero return is Off

1. Zero return: The motors operates at zero return speed $V_{RT}$, and when it encounters DOG signal, it will decelerate to zero return deceleration speed $V_{CR}$. After the motor passes N PG0 signals or P pulse signals for zero return, it will stop.
2. If the set N or P is too small, when the motor encounters DOG signal, it will decelerate to zero return

deceleration speed $V_{CR}$. When the designated N or P is reached, the motor will stop immediately (whether it has reached $V_{CR}$).

3. Assume N is set as “0” and P as “0”, the motor will stop immediately after it touches DOG signal.




■ **b11 of D1816 (D1896): rotation direction**

b[11] = 0: CP value increases when in forward running

b[11] = 1: CP value decreases when in forward running

■ **b12 of D1816 (D1896): absolute/relative coordinate setting**

b[12] = 0: absolute coordinate positioning

b[12] = 1: relative coordinate positioning

■ **b13 of D1816 (D1896): triggering DOG**

b[13] = 0: triggering DOG rising edge

b[13] = 1: triggering DOG falling edge (valid in single-speed positioning interruption mode and 2-speed positioning interruption mode)

■ **b14 of D1816 (D1896): acceleration/deceleration curve selection**

b[14] = 0: trapezoid curve

b[14] = 1: S curve

| X axis | | Y axis | | Backlash Compensation |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| | D1817 | | D1897 | |

Backlash compensation is used for compensating the mechanical error, e.g. the errors in lead screw transmission, and enhancing the accuracy of positioning.

| X axis | | Y axis | | Number of Pulses Required Per Revolution of Motor (A) |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| D1819 | D1818 | D1899 | D1898 | |

1. Due to that you can set up the electronic gearing ratio in the servo drive, the number of pulses required for 1 motor revolution does not need to equal the number required for 1 motor revolution in the servo drive.

**(A) × electronic gear (CMX/CDV) = pulses generated from 1 revolution of encoder**

2. The unit varies according to the settings of b0 and b1 in D1816 (D1896). Parameter A is valid when the unit is set

to be machine unit or combined unit. Parameter A cannot be set to be motor unit.

| X axis | | Y axis | | Distance Created From 1 Motor Revolution (B) |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| D1821 | D1820 | D1901 | D1900 | |

1. There are three units available for the distance created from 1 motor revolution, and they can be set in b0 and b1 of D1816 (D1896). Range of B: 1 ~ +2,147,483,647 (um/Rev, mdeg/Rev, $10^{-4}$ inch/Rev)
2. The unit varies according to the settings of b0 and b1 in D1816 (D1896). Parameter B is valid when the unit is set to be machine unit or combined unit. Parameter B cannot be set to be motor unit.

| X axis | | Y axis | | Maximum Speed ($V_{MAX}$) |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| D1823 | D1822 | D1903 | D1902 | |

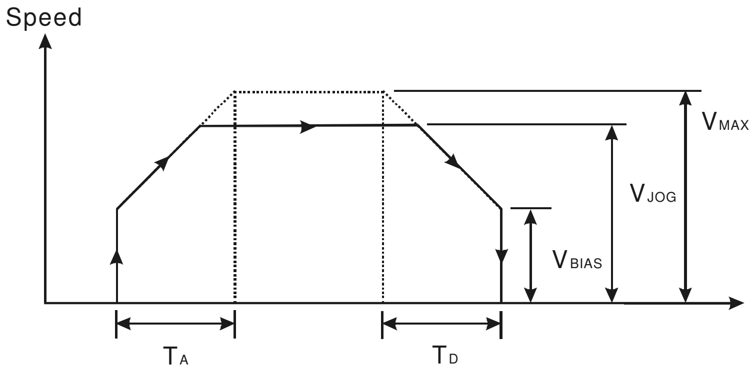
1. Maximum speed for all kinds of operation modes. Range: 0 ~ +2,147,483,647; the unit is set by b0 and b1 of D1816 (D1896).
2. Corresponding to pulse instruction 10 ~ 500KPPS. If the speed is bigger than 500K, the output will be in 500K; if the speed is smaller than 10, the output will be in 10.

| X axis | | Y axis | | Bias Speed ($V_{BIAS}$) |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| D1825 | D1824 | D1905 | D1904 | |

1. Start speed for pulse output. Range: 0 ~ +2,147,483,647; the unit is set by b0 and b1 of D1816 (D1896).
2. Corresponding to pulse instruction 10 ~ 500KPPS. If the speed is bigger than 500K, the output will be in 500K; if the speed is smaller than 10, the output will be in 10.
3. If you are using a step drive system, please be aware of the resonance frequency in the step motor. Set the bias speed above the resonance frequency for safe startup.

| X axis | | Y axis | | JOG Speed ($V_{JOG}$) |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| D1827 | D1826 | D1907 | D1906 | |

1. Range: 0 ~ +2,147,483,647; the unit is set by b0 and b1 of D1816 (D1896).
2. Corresponding to pulse instruction 10 ~ 500KPPS. If the speed is bigger than 500K, the output will be in 500K; if the speed is smaller than 10, the output will be in 10.
3. Setup range limitation: $V_{MAX} > V_{JOG} > V_{BIAS}$. If $V_{JOG} > V_{MAX}$, $V_{JOG}$ output = $V_{MAX}$. If $V_{JOG} < V_{BIAS}$, $V_{JOG} = V_{BIAS}$.
4. $V_{JOG}$ cannot be modified during the execution.




| X axis | | Y axis | | Zero Return Speed $V_{RT}$ |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| D1829 | D1828 | D1909 | D1908 | |

1. The speed for returning to mechanical zero point. Range: 0 ~ +2,147,483,647; the unit is set by b0 and b1 of D1816 (D1896).
2. Corresponding to pulse instruction 10 ~ 500KPPS. If the speed is bigger than 500K, the output will be in 500K; if the speed is smaller than 10, the output will be in 10.
3. Setup range limitation: $V_{MAX} > V_{RT} > V_{BIAS}$
4. $V_{RT}$ cannot be modified during the execution.

| X axis | | Y axis | | Zero Return Deceleration Speed $V_{CR}$ |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| D1831 | D1830 | D1911 | D1910 | |

1. Range: 0 ~ +2,147,483,647; the unit is set by b0 and b1 of D1816 (D1896).
2. Corresponding to pulse instruction 10 ~ 500KPPS. If the speed is bigger than 500K, the output will be in 500K; if the speed is smaller than 10, the output will be in 10.
3. When zero return is executed, the motor will operate at zero return speed $V_{RT}$. When DOG signal is touched, the motor will decelerate to zero return deceleration speed $V_{CR}$.
4. To position precisely at the zero point, we suggest you set up $V_{CR}$ in low speed.
5. $V_{CR}$ cannot be modified during the execution.

| X axis | | Y axis | | Number of Zero Signals (PG0) in Zero Return (N) |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| | D1832 | | D1912 | |

1. Range: -32,768 ~ 32,767 (PULSE). Positive values are for the number of pulses P in forward direction. Negative values are for the number of pulses P in reverse direction.
2. See explanation on b9 of D1816 (D1896) (zero return mode) for signals of motor deceleration and stop.

| X axis | | Y axis | | Number of Pulse Signals in Zero Return (P) |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| | D1833 | | D1913 | |

1. Range: -32,768 ~ 32,767 (PULSE). Positive values are for the number of pulses P in forward direction. Negative values are for the number of pulses P in reverse direction.
2. See explanation on b9 of D1816 (D1896) (zero retuen mode) for signals of motor deceleration and stop.

| X axis | | Y axis | | Definition of Zero Point (HP) |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| D1835 | D1834 | D1915 | D1914 | |

1. Range: 0 ~ ±999,999; the unit is set by b0 and b1 of D1816 (D1896).
2. After the zero return is completed, current position (CP) will be updated into zero point (HP).

| X axis | | Y axis | | Acceleration Time $T_{ACC}$ |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| | D1836 | | D1916 | |

1. $T_{ACC}$ is the time required from bias speed $V_{BIAS}$ (DD1824 (DD1904)) to maximum speed $V_{MAX}$ (DD1822 (DD1902)).
2. When the setting <10ms, it will be regarded as 10ms. When the setting is > 32,767ms, it will be regarded as 32,767 ms.
3. If you need a complete S acceleration curve, please set the operation speed as maximum speed $V_{MAX}$.

| X axis | | Y axis | | Deceleration Time $T_{DEC}$ |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| | D1837 | | D1917 | |

1. $T_{DEC}$ is the time required from maximum speed $V_{MAX}$ (DD1822 (DD1902)) to bias speed $V_{BIAS}$ (DD1824 (DD1904)).
2. When the setting <10ms, it will be regarded as 10ms. When the setting is > 32,767ms, it will be regarded as 32,767 ms.
3. If you need a complete S acceleration curve, please set the operation speed as maximum speed $V_{MAX}$.

| X axis | | Y axis | | Target Position (I) (P(I)) |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| D1839 | D1838 | D1919 | D1918 | |

1. Range: -2,147,483,648 ~ +2,147,483,647; the unit is set by b0 and b1 of D1816 (D1896).
2. Attribute of target position P(I):
   - ♦ Absolute coordinate: b12 of D1816 (D1896) = 0
     Starting from "0", when the target position P(I) > current position (DD1848 (DD1928)), the motor will conduct forward running. When the target position P(I) < current position, the motor will conduct reverse running.
   - ♦ Relative coordinate: b12 of D1816 (D1896) = 1
     Calculating the distance created by the motor starting from the current position (DD1848 (DD1928)). When

the relative coordinate is a positive value, the motor will conduct forward running. When the relative coordinate is a negative value, the motor will conduct reverse running.

3. The data multiplication of the target position P(I) varies according to the settings of b2 and b3 in D1816 (D1896).

| X axis | | Y axis | | Operation Speed (I) (V(I)) |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| D1841 | D1840 | D1921 | D1920 | |

1. Range: -2,147,483,648 ~ +2,147,483,647; the unit is set by b0 and b1 of D1816 (D1896).
2. Corresponding to pulse instruction 10 ~ 500KPPS. If the speed is bigger than 500K, the output will be in 500K; if the speed is smaller than 10, the output will be in 10.
3. Setup range limitation: $V_{MAX} > V(I) > V_{BIAS}$.
4. When operating in variable speed (b4 of D1846 (D1926) = 1), the operation speed V(I) can be modified during the operation. When the sign of V(I) is "+", the motor will conduct forward running; when the sign of V(I) is "-", the motor will conduct reverse running.

| X axis | | Y axis | | Target Position (II) (P(II)) |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| D1843 | D1842 | D1923 | D1922 | |

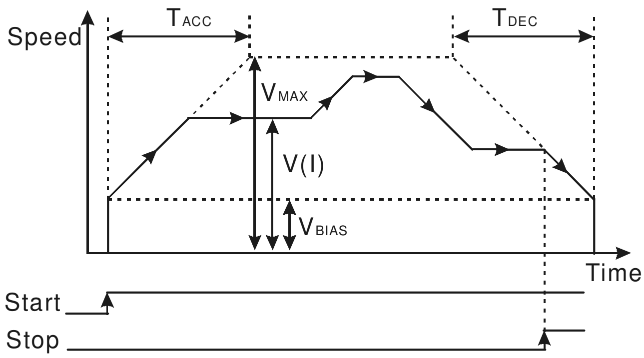
1. Range: -2,147,483,648 ~ +2,147,483,647; the unit is set by b0 and b1 of D1816 (D1896).
2. Attribute of target position P(II):
   - ♦ Absolute coordinate: b12 of D1816 (D1896) = 0
     Starting from "0", when the target position P(II) > current position (DD1848 (DD1928)), the motor will conduct forward running. When the target position P(II) < current position, the motor will conduct reverse running.
   - ♦ Relative coordinate: b12 of D1816 (D1896) = 1
     Calculating the distance created by the motor starting from the current position (DD1848 (DD1928)). When the relative coordinate is a positive value, the motor will conduct forward running. When the relative coordinate is a negative value, the motor will conduct reverse running.
3. The data multiplication of the target position P(II) varies according to the settings of b2 and b3 in D1816 (D1896).

| X axis | | Y axis | | Operation Speed (II) (V(II)) |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| D1845 | D1844 | D1925 | D1924 | |

1. Range: -2,147,483,648 ~ +2,147,483,647; the unit is set by b0 and b1 of D1816 (D1896).
2. Corresponding to pulse instruction 10 ~ 500KPPS. If the speed is bigger than 500K, the output will be in 500K; if the speed is smaller than 10, the output will be in 10.
3. Setup range limitation: $V_{MAX} > V(II) > V_{BIAS}$.

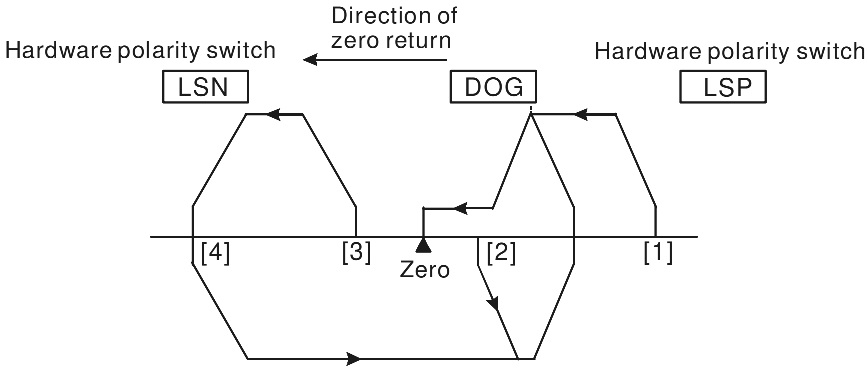
| X axis | | Y axis | | Operation Instruction |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| | D1846 | | D1926 | |

1. b0 of D1846 (D1926): software STOP
   - ♦ Action timing: 0→1.
   - ♦ The function is the same as external input force STOP. The positioning controller will decelerate and stop positioning.
2. b1 of D1846 (D1926): software START
   - ♦ b[1] = 0→1: The operation starts and operates according to the settings of D1846 (D1926)
3. b2 of D1846 (D1926): enabling JOG+
   - ♦ b[2] = 1: JOG+ sends out forward pulses (CW)
4. b3 of D1846 (D1926): enabling JOG-
   - ♦ b[3] = 1: JOG- sends out reverse pulses (CCW)
5. b4 of D1846 (D1926): variable speed operation
   - ♦ When b[4] is triggered and START On, the positioning controller will start to operate at variable speed V(I), and DVP-PM will start to send out pulses.
   - ♦ The action: The operation speed will be stable from VBIAS accelerating to the expected V(I). During the pulse output, you can modify V(I), and the pulse output from DVP-PM will accelerate or decelerate according to the modification. At this point, the external STOP input contact cannot stop the pulse output from DVP-PM. To stop the pulse output, you have to control the software STOP flag (b0 of D1846 (D1926) = 1) by the operation instruction.
   - ♦ Action diagram:




6. b5 of D1846 (D1926): manual pulse generator (MPG) input
   - ♦ b[5] = 1: enabling MPG input. See D1858 ~ D1864 (D1938 ~ D1944) for more details.
7. b6 of D1846 (D1926): enabling zero return mode
   - ♦ b[6] = 0→1: starting zero return. The motions of zero return vary depending on different current positions (CP)

     Zero return route:



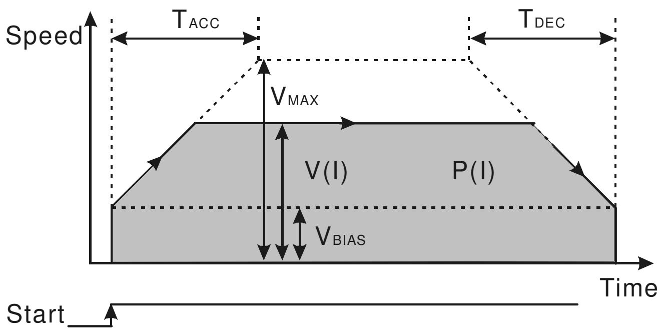

CP 1: Starting from position [1], to the right of zero and DOG; DOG = Off.

CP 2: Starting from position [2], to the right of zero; DOG = On.

CP 3: Starting from position [3], to the left of zero and DOG; DOG = Off, LSN =Off.

CP 4: Starting from position [4], to the left of zero and DOG; DOG = Off, LSN = On.

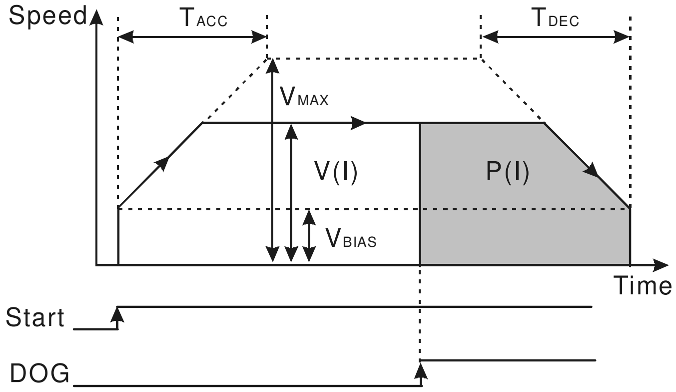
8. b8 of D1846 (D1926): enabling single-speed positioning
   - ♦ When b[8] is triggered, receives the instruction for single-speed positioning and START On, the first positioning program will start to execute. The number of steps and speed are determined by P(I) and V(I).
   - ♦ Operation direction: The relative coordinate positioning is determined by the sign bit of the register for P(I). The absolute coordinate positioning is determined by P(I) (set in D1838 (D1918)). Forward running when the absolute coordinate is bigger than the current position; reverse running when the absolute coordinate is smaller than the current position.
   - ♦ The operation speed will be stable from $V_{BIAS}$ accelerating to the expected V(I). When it is approaching the P(I) value set in the register, the positioning will start to decelerate to $V_{BIAS}$ and stop. There are P(I) pulses generated during the positioning.
   - ♦ The registers involved: DD1824 (DD1904) ($V_{BIAS}$), DD1840 (DD1920) (V(I)), DD1822 (DD1902) ($V_{MAX}$), DD1838 (DD1918) (P(I)), D1836 (D1916) ($T_{ACC}$) and D1837 (D1917) ($T_{DEC}$).



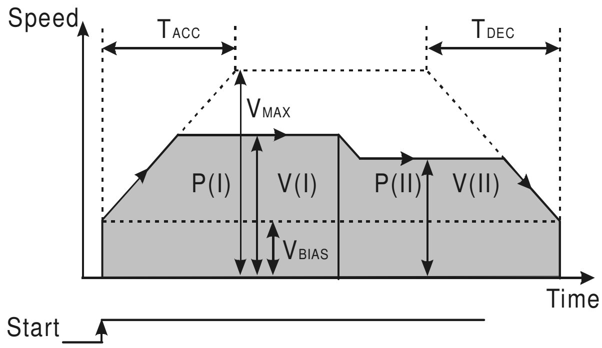

9. b9 of D1846 (D1926): inserting single-speed positioning interruption
   - ♦ When b[1] is trigger, receives the instruction for single-speed positioning and START On, the output pulses will start. When the external DOG signal is executed, the P(I) value will be reloaded in.
   - ♦ Operation direction: The relative coordinate positioning is determined by the sign bit of the register for P(I). The absolute coordinate positioning is determined by P(I) (set in D1838 (D1918)). Forward running when the absolute coordinate is bigger than the current position; reverse running when the absolute coordinate is smaller than the current position.
   - ♦ The operation speed will be stable from $V_{BIAS}$ accelerating to the expected V(I). When encountering DOG

signals during the pulse output, the pulse output unit will send out the number of steps in P(I). When it is approaching the P(I) value set in the register, the positioning will start to decelerate to $V_{BIAS}$ and stop.

- ♦ The registers involved: DD1824 (DD1904) ($V_{BIAS}$), DD1840 (DD1920) (V(I)), DD1822 (DD1902) ($V_{MAX}$), DD1838 (DD1918) (P(I)), D1836 (D1916) ($T_{ACC}$) and D1837 (D1917) ($T_{DEC}$).



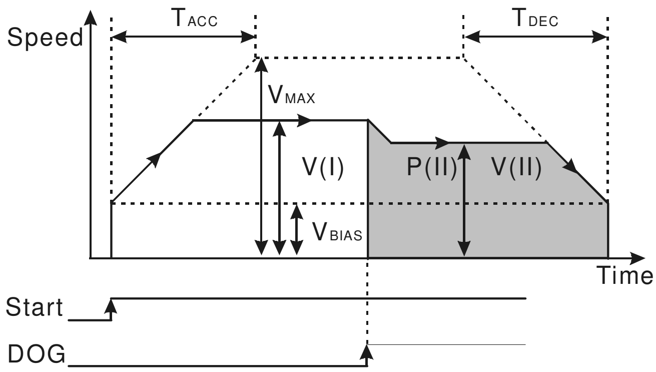

10. b10 of D1846 (D1926): enabling 2-speed positioning
    - ♦ When b[10] is triggered and START On, the second positioning program will start to execute. The second positioning program will start immediately after the first positioning program reaches P(I).
    - ♦ Operation direction: The relative coordinate positioning is determined by the sign bit of the register for P(I). The absolute coordinate positioning is determined by P(I) (set in D1838 (D1918)). Forward running when the absolute coordinate is bigger than the current position; reverse running when the absolute coordinate is smaller than the current position.
    - ♦ The operation speed will be stable from $V_{BIAS}$ accelerating to the expected V(I). After the pulse output unit sends out the number of pulses equivalent to P(I), it will accelerate/decelerate again from V(I) to V(II) and operate at V(II) stably until P(II) is reached. The pulse output will then decelerate to $V_{BIAS}$ and stop. Total P(I) + P(II) pulses are sent during the operation.
    - ♦ The registers involved: DD1824 (DD1904) ($V_{BIAS}$), DD1840 (DD1920) (V(I)), DD1822 (DD1902) ($V_{MAX}$), DD1838 (DD1918) (P(I)), DD1842 (DD1922) (P(II), D1836 (D1916) ($T_{ACC}$) and D1837 (D1917) ($T_{DEC}$).




    - ♦ The output accelerates to V(I) and operates at V(I) stably until it reaches P(I). It will then accelerate or decelerate to V(II) stably until it reaches P(II) and stops.
11. b11 of D1846 (D1926): inserting 2-speed positioning interruption
    - ♦ When b[11] is triggered and START On, the second positioning program will start immediately after an external DOG signal is enabled during the first positioning program. The pulse output unit will start to send

out pulses.

- ♦ Operation direction: The relative coordinate positioning is determined by the sign bit of the register for P(I). The absolute coordinate positioning is determined by P(I) (set in D1838 (D1918)). Forward running when the absolute coordinate is bigger than the current position; reverse running when the absolute coordinate is smaller than the current position.
- ♦ The operation speed will be stable from $V_{BIAS}$ accelerating to the expected V(I). When encountering DOG signals during the pulse output, the pulse output will accelerate/decelerate again from V(I) to V(II) and operate at V(II) stably. In the second positioning program, the external STOP input will force the pulse output unit to immediately stop the pulse output.
- ♦ The registers involved: DD1824 (DD1904) ($V_{BIAS}$), DD1840 (DD1920) (V(I)), DD1822 (DD1902) ($V_{MAX}$), DD1838 (DD1918) (P(I)), DD1842 (DD1922) (P(II), D1836 (D1916) ($T_{ACC}$) and D1837 (D1917) ($T_{DEC}$).




- ♦ The output accelerates to V(I) and operates at V(I) stably until it reaches P(I). After the external DOG signal is enabled, the output will then accelerate or decelerate to V(II) and operate at V(II) stably until it reaches P(II) and stops.

12. b12 of D1846 (D1926): enabling OX
    - ♦ b[12] = 1: start OX program; b[12] = 0: stop OX program

| X axis | | Y axis | | Work Mode |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| | D1847 | | D1927 | |

1. b2 of D1847 (D1927): CLR signal output mode
    - ♦ b[2] = 0: When zero return is completed, CLR will output 130ms to servo as the clear signal for the error counter in the servo.
    - ♦ b[2] = 1: CLR output point as general output point, controlled by On/Off of b[3].
2. b3 of D1847 (D1927): CLR output On/Off
    - ♦ b[3] = 0: CLR is Off.
    - ♦ b[3] = 1: CLR is On.
3. b4 of D1847 (D1927): CLR polarity
    - ♦ b[4] = 0: CLR is contact a.
    - ♦ b[4] = 1: CLR is contact b.
4. b5 of D1847 (D1927): STOP mode
    - ♦ b[5] = 0: During the running of motor, when encountering STOP signal input, the motor will decelerate to

stop. When the next motion instruction comes in, the motor will ignore the unfinished distance and immediately execute the distance in the next step.

- b[5] = 1: During the running of motor, when encountering STOP signal, the motor will decelerate to stop. When the next motion instruction comes in, the motor will complete the unfinished distance before executing the next positioning step.

5. b6 of D1847 (D1927): manual pulse generator (MPG) range
   - b[6] = 0: No limitation on MPG pulse output
   - b[6] = 1: The range of MPG pulse output is limited within P(I) and P(II). When the range is exceeded, the pulse will decelerate and stop.
6. b7 of D1847 (D1927): LSP/LSN stop mode
   - b[7] = 0: During the running of motor, the motor will decelerate to stop when encountering LSP/LSN signal input.
   - b[7] = 1: During the running of motor, the motor will stop immediately when encountering LSP/LSN signal input.
7. b8 ~ b10 of D1847 (D1927): MASK settings
   - MASK settings include single-speed positioning, 2-speed positioning, single-speed positioning interruption and 2-speed positioning interruption.
   - b[10~8] = K0 (000) or other values: No MASK function
   - b[10~8] = K1 (001): Triggering MASK by the rising edge of input terminal ΦA±.
   - b[10~8] = K2 (010): Triggering MASK by the falling edge of input terminal ΦA±.
   - b[10~8] = K3 (011): Triggering MASK by the rising edge of input terminal ΦB±.
   - b[10~8] = K4 (100): Triggering MASK by the falling edge of input terminal ΦB±.
8. b15 of D1847 (D1927): returning to default setting
   - b[15] = 1: All parameters return to default settings.

| X axis | | Y axis | | Current Position (CP) (PLS) |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| D1849 | D1848 | D1929 | D1928 | |

1. Range: -2,147,483,648 ~ +2,147,483,647
2. The current position is displayed in pulse value (PLS) and set by b0 and b1 of D1816 (D1896). When the zero return is completed, the definition of zero point (HP) (DD1834 (DD1914)) will be filled into current position CP (PLS).

| X axis | | Y axis | | Current Speed (CS) (PPS) |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| D1851 | D1850 | D1931 | D1930 | |

1. Range: 0 ~ +2,147,483,647
2. Displayed in PPS.

| X axis | | Y axis | | Current Position (CP) (Unit) |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| D1853 | D1852 | D1933 | D1932 | |

1. Range: -2,147,483,648 ~ +2,147,483,647
2. The unit of the current position varies according to be settings of b0 and b1 in D1816 (D1896). When the zero return is completed, the definition of zero point (HP) (DD1834 (DD1914)) will be filled into current position (DD1852 (DD1932)).

| X axis | | Y axis | | Current Speed (CS) (Unit) |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| D1855 | D1854 | D1935 | D1934 | |

1. Range: 0 ~ +2,147,483,647
2. The unit of the current speed varies according to be settings of b0 and b1 in D1816 (D1896).

| X axis | | Y axis | | Execution Status |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| | D1856 | | D1936 | |

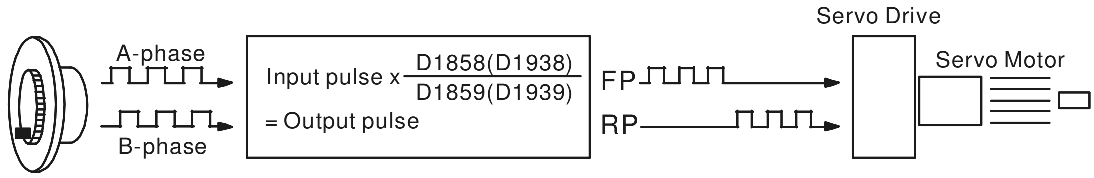
| bit# | D1856 (D1936) | bit# | D1856 (D1936) |
|---|---|---|---|
| 0 | Forward pulses output in progress | 8 | Reverse MPG input |
| 1 | Reverse pulses output in progress | 9 | Not defined |
| 2 | Operation in progress | 10 | Not defined |
| 3 | Error occurs | 11 | Not defined |
| 4 | Operation pauses | 12 | Not defined |
| 5 | Error occurs | 13 | Not defined |
| 6 | Operation pauses | 14 | Not defined |
| 7 | Forward MPG input | 15 | Not defined |

| X axis | | Y axis | | Error Code |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| | D1857 | | D1937 | |

See Appendix C in Chapter 9 for details.

| X axis | | Y axis | | Special Registers |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| | D1858 | | D1938 | Electronic gear (numerator) |
| | D1859 | | D1939 | Electronic gear (denominator) |

1. Set On b5 of D1846 (D1926) to enable the work mode of MPG input.
2. Generate A/B phase pulse input by MPG to ΦA and ΦB. See the figure below for the relation between FP/RP input and output pulses.




3. During the operation, if LSP or LSN is enabled, the output will stop immediately. If LSP is enabled, the forward pulse will be forbidden, and reverse pulse will be allowed. If LSN is enabled, the reverse pulse will be forbidden, and forward pulse will be allowed.
4. The pulse input generated by MPG is proportional to the electronic gearing (D1858 (D1938), D1859 (D1939)).

| X axis | | Y axis | | MPG Input Frequency |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| D1861 | D1860 | D1941 | D1940 | |

The frequency of MPG input is not affected by the MPG electronic gearing ratio.

| X axis | | Y axis | | Accumulated Number of MPG Input Pulses |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| D1863 | D1862 | D1943 | D1942 | |

1. Accumulating the number of pulse from MPG input. Forward pulses are accumulated by “plus”, and reverse pulses are accumulated by “minus”.
2. The accumulated value will not be affected by the electronic gearing ratio (D1858 (D1938), D1859 (D1939)).

| X axis | | Y axis | | Response Speed of MPG Input |
|---|---|---|---|---|
| HW | LW | HW | LW | |
| | D1864 | | D1944 | |

1. The faster the response speed, the more synchronous the pulse output and MPG input.
2. The slower the response speed, the more possible the pulse output lags behind MPG input.

| Set value | Response speed |
|---|---|
| ≧5 | 4ms (default) |
| 4 | 32ms |
| 3 | 108ms |
| 2 | 256ms |
| 1 or 0 | 500ms |

### 3.12.2 Manual Modes

1. There are 8 motion modes in DVP-PM as a position module
   1. Mechanical zero return
   2. JOG mode
   3. Single-speed positioning
   4. Single-speed positioning interruption
   5. 2-speed positioning
   6. 2-speed positioning interruption
   7. Variable speed mode
   8. MPG input

2. When many work modes are enabled at the same time, they will be processed in the following order.
   1. STOP
   2. Mechanical zero return
   3. JOG+ mode
   4. JOG- mode
   5. MPG input
   6. Variable speed mode
   7. Single-speed positioning
   8. Single-speed positioning interruption
   9. 2-speed positioning
   10. 2-speed positioning interruption

   When one of the work modes is being executed, and another work mode is enabled, DVP-PM will remain in the original work mode.
3. There are two types of pulse acceleration curves.
   1. Trapezoid curve
   2. S curve

### 3.12.3 Application Position & Speed Control Registers for Manual Modes

| Registers for the Motion | | | | Parameter Name | Operation Mode | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| X axis | | Y axis | | | JOG | Zero return | Single-speed positioning | Single-speed positioning interruption | 2-speed positioning | 2-speed positioning interruption | Variable speed | MPG input |
| HW | LW | HW | LW | | | | | | | | | |
| D1819 | D1818 | D1899 | D1898 | Number of pulses required per revolution of motor (A) | No need to be set up if the unit (b0, b1 of D1816 (D1896)) is motor unit. Needs to be set up if the unit is machine unit or combined unit. | | | | | | | |
| D1821 | D1820 | D1901 | D1900 | Distance created by 1 revolution of motor (B) | | | | | | | | |
| | D1816 | | D1896 | Parameter setting | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ |
| D1823 | D1822 | D1903 | D1902 | Maximum speed ($V_{MAX}$) | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ |
| D1825 | D1824 | D1905 | D1904 | Bias speed ($V_{BIAS}$) | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ |
| D1827 | D1826 | D1907 | D1906 | JOG speed ($V_{JOG}$) | ◎ | - | - | - | - | - | - | - |
| D1829 | D1828 | D1909 | D1908 | Zero return speed ($V_{RT}$) | - | ◎ | - | - | - | - | - | - |
| D1831 | D1830 | D1911 | D1910 | Zero return deceleration speed ($V_{CR}$) | | | | | | | | |
| | D1832 | | D1912 | Number of PG0 signals in zero return (N) | | | | | | | | |
| | D1833 | | D1913 | Number of pulse signals in zero return (P) | | | | | | | | |
| D1835 | D1834 | D1915 | D1914 | Definition of zero point (HP) | | | | | | | | |
| | D1836 | | D1916 | Acceleration time ($T_{ACC}$) | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | - |
| | D1837 | | D1917 | Deceleration time ($T_{DEC}$) | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | - |
| D1839 | D1838 | D1919 | D1918 | Target position(I) (P(I)) | - | - | ◎ | ◎ | ◎ | ◎ | - | ◎ |
| D1841 | D1840 | D1921 | D1920 | Operation speed (I) (V(I)) | - | - | ◎ | ◎ | ◎ | ◎ | ◎ | - |
| D1843 | D1842 | D1923 | D1922 | Target position (II) (P(II)) | - | - | - | - | ◎ | ◎ | - | ◎ |
| D1845 | D1844 | D1925 | D1924 | Operation speed (II) (V(II)) | - | - | - | - | ◎ | ◎ | - | - |
| | D1846 | | D1926 | Operation instruction | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ |
| | D1847 | | D1927 | Work mode | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ |
| D1849 | D1848 | D1929 | D1928 | Current position (CP) (PLS) | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ |

| Registers for the Motion | | | | Parameter Name | Operation Mode | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| X axis | | Y axis | | | JOG | Zero return | Single-speed positioning | Single-speed positioning interruption | 2-speed positioning | 2-speed positioning interruption | Variable speed | MPG input |
| HW | LW | HW | LW | | | | | | | | | |
| D1851 | D1850 | D1931 | D1930 | Current speed (CS) (PPS) | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ |
| D1853 | D1852 | D1833 | D1932 | Current position (CP) (unit) | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ |
| D1855 | D1854 | D1935 | D1934 | Current speed (CS) (unit) | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ |
| | D1858 | | D1938 | Numerator of electronic gear | - | - | - | - | - | - | - | ◎ |
| | D1859 | | D1939 | Denominator of electronic gear | - | - | - | - | - | - | - | ◎ |
| D1861 | D1860 | D1941 | D1940 | Frequency of MPG input | - | - | - | - | - | - | - | ◎ |
| D1863 | D1862 | D1943 | D1942 | Accumulated number of MPG input pulses | - | - | - | - | - | - | - | ◎ |
| | D1864 | | D1944 | MPG response speed | - | - | - | - | - | - | - | ◎ |

◎ refers to the control register for the operation mode.

MEMO

## 4.1 Basic Instructions

### 🕮 General Instructions

| Instruction code | Function | Operands | Execution speed (us) | Step | Page number |
|---|---|---|---|---|---|
| LD | Loading in A contact | X, Y, M, S, T, C | 3.3 | 3 | 4-2 |
| LDI | Loading in B contact | X, Y, M, S, T, C | 3.3 | 3 | 4-2 |
| AND | Series connection- A contact | X, Y, M, S, T, C | 3.3 | 3 | 4-3 |
| ANI | Series connection- B contact | X, Y, M, S, T, C | 3.3 | 3 | 4-3 |
| OR | Parallel connection- A contact | X, Y, M, S, T, C | 3.3 | 3 | 4-4 |
| ORI | Parallel connection- B contact | X, Y, M, S, T, C | 3.3 | 3 | 4-4 |
| ANB | Series connection- loop blocks | N/A | 2.3 | 3 | 4-5 |
| ORB | Parallel connection- loop blocks | N/A | 2.3 | 3 | 4-5 |

### 🕮 Output Instructions

| Instruction code | Function | Operands | Execution speed (us) | Step | Page number |
|---|---|---|---|---|---|
| OUT | Output coil | Y, M, S | 7.3 | 3 | 4-6 |
| SET | Latched (On) | Y, M, S | 5.6 | 3 | 4-6 |
| RST | Clear the contact or register | Y, M, S, T, C, D, V, Z | 6.9 | 3 | 4-7 |

### 🕮 Timers, Counters

| API | Instruction code | Function | Operands | Execution speed (us) | Step | Page number |
|---|---|---|---|---|---|---|
| 96 | TMR | 16-bit timer | T-K or T-D | 19 | 5 | 4-7 |
| 97 | CNT | 16-bit counter | C-K or C-D (16 bits) | 16 | 5 | 4-8 |
| 97 | DCNT | 32-bit counter | C-K or C-D (32 bits) | 16.5 | 6 | 4-8 |

### 🕮 Instructions for Detecting Contacts of Rising-/Falling-Edge

| API | Instruction code | Function | Operands | Execution speed (us) | Step | Page number |
|---|---|---|---|---|---|---|
| 90 | LDP | Rising-edge detection operation | X, Y, M, S, T, C | 12.3 | 3 | 4-9 |
| 91 | LDF | Falling-edge detection operation | X, Y, M, S, T, C | 12.3 | 3 | 4-9 |
| 92 | ANDP | Rising-edge series connection | X, Y, M, S, T, C | 12.3 | 3 | 4-10 |
| 93 | ANDF | Falling-edge series connection | X, Y, M, S, T, C | 12.3 | 3 | 4-10 |
| 94 | ORP | Rising-edge parallel connection | X, Y, M, S, T, C | 12.6 | 3 | 4-10 |
| 95 | ORF | Falling-edge parallel connection | X, Y, M, S, T, C | 12.6 | 3 | 4-11 |

### 🕮 Rising-/Falling-Edge Output Instruction

| API | Instruction code | Function | Operands | Execution speed (us) | Step | Page number |
|---|---|---|---|---|---|---|
| 89 | PLS | Rising-edge output | Y, M | 20.7 | 3 | 4-11 |
| 99 | PLF | Falling-edge output | Y, M | 20.9 | 3 | 4-12 |

📖 Other Instructions

| API | Instruction code | Function | Operands | Execution speed (us) | Step | Page number |
|---|---|---|---|---|---|---|
| - | NOP | No operation | N/A | 1.9 | 3 | 4-12 |
| - | P | Pointer | P0 ~ P255 | - | 1 | 4-13 |
| - | O | Subroutine pointer | O100, OX0 ~ OX99 | - | 1 | 4-13 |
| - | M | M-Code instruction | M0 ~ M65535<br>M102: O100 main program ends<br>M2: OX0 ~ OX99 motion subroutine ends | - | 1 | 4-14 |

## 4.2 Explanations on Basic Instructions

| Mnemonic | Function |
|---|---|
| **LD** | Loading in A Contact |

| Operand | X0~X377 | Y0~Y377 | M0~M4095 | S0~S1023 | T0~T255 | C0~C255 | D0~D9999 |
|---|---|---|---|---|---|---|---|
| | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - |

**Explanations:**

LD instruction is used on the A contact that has its start from the left bus or the A contact that is the start of a contact circuit. The functions are to save the present contents and store the acquired contact status into the accumulative register.

**Program Example:**

Ladder diagram:


| Instruction code: | | Operation: |
|---|---|---|
| **LD** | **X0** | Loading in contact A of X0 |
| AND | X1 | Connecting to contact A of X1 in series |
| OUT | Y1 | Driving Y1 coil |

| Mnemonic | Function |
|---|---|
| **LDI** | Loading in B Contact |

| Operand | X0~X377 | Y0~Y377 | M0~M4095 | S0~S1023 | T0~T255 | C0~C255 | D0~D9999 |
|---|---|---|---|---|---|---|---|
| | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - |

**Explanations:**

LDI instruction is used on the B contact that has its start from the left bus or the B contact that is the start of a contact circuit. The functions are to save the present contents and store the acquired contact status into the accumulative register.

**Program Example:**

Ladder diagram:


| Instruction code: | | Operation: |
|---|---|---|
| **LD** | **X0** | Loading in contact B of X0 |
| AND | X1 | Connecting to contact A of X1 in series |
| OUT | Y1 | Driving Y1 coil |

| Mnemonic | Function |
|---|---|
| **AND** | Series Connection – A Contact |

| Operand | X0~X377 | Y0~Y377 | M0~M4095 | S0~S1023 | T0~T255 | C0~C255 | D0~D9999 |
|---|---|---|---|---|---|---|---|
| | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - |

**Explanations:**

AND instruction is used in the series connection of A contact. The functions are to read out the status of present series connection contacts and perform the “AND” operation with the logical operation result obtained. The final result will be stored in the accumulative register.

**Program Example:**

Ladder diagram:


| Instruction code: | | Operation: |
|---|---|---|
| LD | X1 | Loading in contact B of X1 |
| **AND** | **X0** | Connecting to contact A of X0 in series |
| OUT | Y1 | Driving Y1 coil |

| Mnemonic | Function |
|---|---|
| **ANI** | Series Connection – B Contact |

| Operand | X0~X377 | Y0~Y377 | M0~M4095 | S0~S1023 | T0~T255 | C0~C255 | D0~D9999 |
|---|---|---|---|---|---|---|---|
| | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - |

**Explanations:**

ANI instruction is used in the series connection of B contact. The functions are to read out the status of present designated series connection contacts and perform the "AND” operation with the logical operation result obtained. The final result will be stored in the accumulative register.

**Program Example:**

Ladder diagram:


| Instruction code: | | Operation: |
|---|---|---|
| LD | X1 | Loading in contact A of X1 |
| **ANI** | **X0** | Connecting to contact B of X0 in series |
| OUT | Y1 | Driving Y1 coil |

| Mnemonic | Function |
|---|---|
| **OR** | Parallel Connection – A Contact |

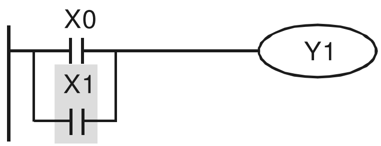
| Operand | X0~X377 | Y0~Y377 | M0~M4095 | S0~S1023 | T0~T255 | C0~C255 | D0~D9999 |
|---|---|---|---|---|---|---|---|
| | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - |

**Explanations:**

OR instruction is used in the parallel connection of A contact. The functions are to read out the status of present designated parallel connection contacts and perform the "OR" operation with the logical operation result obtained. The final result will be stored in the accumulative register.

**Program Example:**

Ladder diagram:




| Instruction code: | | Operation: |
|---|---|---|
| LD | X0 | Loading in contact A of X0 |
| **OR** | **X1** | Connecting to contact A of X1 in parallel |
| OUT | Y1 | Driving Y1 coil |

| Mnemonic | Function |
|---|---|
| **ORI** | Parallel Connection – B Contact |

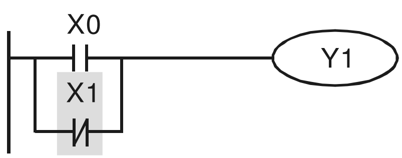
| Operand | X0~X377 | Y0~Y377 | M0~M4095 | S0~S1023 | T0~T255 | C0~C255 | D0~D9999 |
|---|---|---|---|---|---|---|---|
| | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - |

**Explanations:**

ORI instruction is used in the parallel connection of B contact. The functions are to read out the status of present designated parallel connection contacts and perform the "OR" operation with the logical operation result obtained. The final result will be stored in the accumulative register.

**Program Example:**

Ladder diagram:




| Instruction code: | | Operation: |
|---|---|---|
| LD | X0 | Loading in contact A of X0 |
| **ORI** | **X1** | Connecting to contact B of X1 in parallel |
| OUT | Y1 | Driving Y1 coil |

| Mnemonic | Function |
|---|---|
| **ANB** | Series Connection – Loop Blocks |

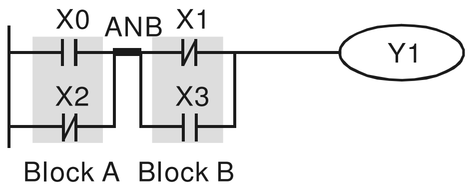
| | |
|---|---|
| Operand | N/A |

**Explanations:**

Perform the "AND" operation of the preserved logic results and content in the accumulative register.

**Program Example:**

Ladder diagram:




| Instruction code: | | Operation: |
|---|---|---|
| LD | X0 | Loading in contact A of X0 |
| ORI | X2 | Connecting to contact B of X2 in parallel |
| LDI | X1 | Loading in contact B of X1 |
| OR | X3 | Connecting to contact A of X3 in parallel |
| **ANB** | | Connecting circuit block in series |
| OUT | Y1 | Driving Y1 coil |

| Mnemonic | Function |
|---|---|
| **ORB** | Parallel Connection – Loop Blocks |

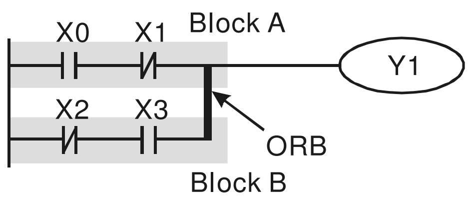
| | |
|---|---|
| Operand | N/A |

**Explanations:**

To perform the "OR" operation of the preserved logic result and content in the accumulative register.

**Program Example:**

Ladder diagram:




| Instruction code: | | Operation: |
|---|---|---|
| LD | X0 | Loading in contact A of X0 |
| ANI | X1 | Connecting to contact B of X2 in series |
| LDI | X2 | Loading in contact B of X2 |
| AND | X3 | Connecting to contact A of X3 in series |
| **ORB** | | Connecting circuit block in parallel |
| OUT | Y1 | Driving Y1 coil |

| Mnemonic | Function |
|---|---|
| **OUT** | Output Coil |

| Operand | X0~X377 | Y0~Y377 | M0~M4095 | S0~S1023 | T0~T255 | C0~C255 | D0~D9999 |
|---|---|---|---|---|---|---|---|
| | — | ✓ | ✓ | ✓ | - | - | - |

**Explanations:**

1. To output the logical operation result before OUT instruction into a designated device.
2. Actions of coil contact:

| Operational result | OUT instruction | | |
|---|---|---|---|
| | Coil | Contact | |
| | | A contact (normally open) | B contact (normally closed) |
| FALSE | OFF | OFF | ON |
| TRUE | ON | ON | OFF |

**Program Example:**

Ladder diagram:


| Instruction code: | | Operation: |
|---|---|---|
| LDI | X0 | Loading in contact B of X0 |
| AND | X1 | Connecting to contact A of X1 in series |
| **OUT** | **Y1** | Driving Y1 coil |

| Mnemonic | Function |
|---|---|
| **SET** | Latched (On) |

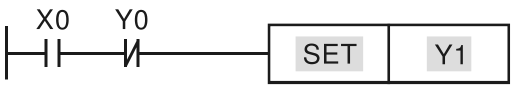
| Operand | X0~X377 | Y0~Y377 | M0~M4095 | S0~S1023 | T0~T255 | C0~C255 | D0~D9999 |
|---|---|---|---|---|---|---|---|
| | - | ✓ | ✓ | ✓ | - | - | - |

**Explanations:**

When SET instruction is driven, its designated device will be “On” and keep being On both when SET instruction is still being driven or not driven. Use RST instruction to set “Off” the device.

**Program Example:**

Ladder diagram:




| Instruction code: | | Operation: |
|---|---|---|
| LD | X0 | Loading in contact A of X0 |
| ANI | Y0 | Connecting to contact B of Y0 in series |
| **SET** | **Y1** | Y1 latched (On) |

| Mnemonic | Function |
|---|---|
| **RST** | Clear the Contact or Register |

| Operand | X0~X377 | Y0~Y377 | M0~M4095 | S0~S1023 | T0~T255 | C0~C255 | D0~D9999 | V, Z |
|---|---|---|---|---|---|---|---|---|
| | - | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

**Explanations:**

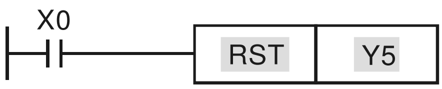
1. When RST instruction is driven, the actions of the designated devices are:

| Device | Status |
|---|---|
| S, Y, M | Coil and contact will be set to “Off”. |
| T, C | Present value in the timer or counter will be set to “0”, and the coil and contact will be set to be “Off”. |
| D, V, Z | The content will be set to “0”. |

2. If RST instruction is not being executed, the status of the designated device will stay intact.

Program Example:

Ladder diagram:




| Instruction code: | | Operation: |
|---|---|---|
| LD | X0 | Loading in contact A of X0 |
| **RST** | **Y5** | Resetting contact Y5 |

| Mnemonic | Function |
|---|---|
| **TMR** | 16-bit Timer |

| Operand | | |
|---|---|---|
| | T-K | T0 ~ T255, K0 ~ K32,767 |
| | T-D | T0 ~ T255, D0 ~ D9999 |

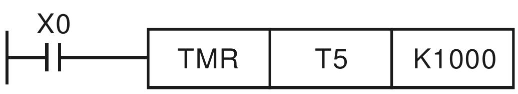
**Explanations:**

When TMR instruction is executed, the designated coil of the timer will be On, and the timer will start to time. When the set value in the timer is reached (present ≥ set value), The contact will be:

| | |
|---|---|
| NO (normally open) contact | Open collector |
| NC (normally closed) contact | Close collector |

**Program Example:**

Ladder diagram:




| Instruction code: | | Operation: |
|---|---|---|
| LD | X0 | Loading in contact A of X0 |
| **TMR** | **T5 K1,000** | Set value in timer T5 as K1,000 |

**Remarks:**

See the specification of DVP-PM for the range of operand T.

| Mnemonic | Function |
|---|---|
| **CNT** | 16-bit Counter |

| Operand | | |
|---|---|---|
| Operand | C-K | C0 ~ C199, K0 ~ K32,767 |
| | C-D | C0 ~ C199, D0 ~ D9999 |

**Explanations:**

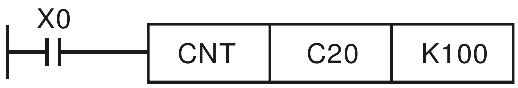
1. When CNT instruction goes from Off to On, the designated counter coil will be driven, and the present value in the counter will plus 1. When the counting reaches the set value (present value = set value), the contact will be:

| | |
|---|---|
| NO (normally open) contact | Open collector |
| NC (normally closed) contact | Close collector |

2. If there are other counting pulse inputs after the counting reaches its target, the contact and present value will stay intact. Use RST instruction to restart or reset the counting.

**Program Example:**

Ladder diagram:




| Instruction code: | | Operation: |
|---|---|---|
| LD | X0 | Loading in contact A of X0 |
| **CNT** | **C20 K100** | Set value in counter C20 as K100 |

| Mnemonic | Function |
|---|---|
| **DCNT** | 32-bit Counter |

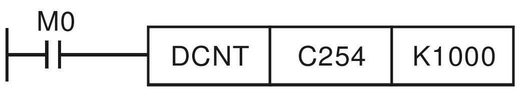
| Operand | | |
|---|---|---|
| Operand | C-K | C200 ~ C255, K-2,147,483,648 ~ K2,147,483,647 |
| | C-D | C200 ~ C255, D0 ~ D9999 |

**Explanations:**

1. DCNT is the instruction for enabling the 32-bit counters C200 ~ C255.
2. For general-purpose addition/subtraction counter C200 ~ C255, when DCNT instruction goes from Off to On, the present value in the counter will plus 1 (counting up) or minus 1 (counting down) according to the modes set in M1200 ~ M1234.

**Program Example:**

Ladder diagram:




| Instruction code: | | Operation: |
|---|---|---|
| LD | M0 | Loading in contact A of M0 |
| **DCNT** | **C254 K1,000** | Set value in counter C254 as K1,000 |

| Mnemonic | Function |
|---|---|
| **LDP** | Rising-Edge Detection Operation |

| Operand | X0~X377 | Y0~Y377 | M0~M4095 | S0~S1023 | T0~T255 | C0~C255 | D0~D9999 |
|---|---|---|---|---|---|---|---|
| | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - |

**Explanations:**

The method of using LDP instruction is the same as using LD, but the actions of the two instructions differ. LDP saves the current content and store the detected status of the rising edge into the accumulative register.

**Program Example:**

Ladder diagram:


| Instruction code: | | Operation: |
|---|---|---|
| **LDP** | **X0** | Starting X0 rising-edge detection |
| AND | X1 | Connecting to contact A of X1 in series |
| OUT | Y1 | Driving Y1 coil |

**Remarks:**

1. See the specification of DVP-PM for the range of operands.
2. If the status of a designated rising edge is On before DVP-PM is powered, the contact of the rising edge will be TRUE after DVP-PM is powered.

| Mnemonic | Function |
|---|---|
| **LDF** | Falling-Edge Detection Operation |

| Operand | X0~X377 | Y0~Y377 | M0~M4095 | S0~S1023 | T0~T255 | C0~C255 | D0~D9999 |
|---|---|---|---|---|---|---|---|
| | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - |

**Explanations:**

The method of using LDF instruction is the same as using LD, but the actions of the two instructions differ. LDF saves the current content and store the detected status of the falling edge to the accumulative register.

**Program Example:**

Ladder diagram:


| Instruction code: | | Operation: |
|---|---|---|
| **LDP** | **X0** | Starting X0 falling-edge detection |
| AND | X1 | Connecting to contact A of X1 in series |
| OUT | Y1 | Driving Y1 coil |

| Mnemonic | Function |
|---|---|
| **ANDP** | Rising-Edge Series Connection |

| Operand | X0~X377 | Y0~Y377 | M0~M4095 | S0~S1023 | T0~T255 | C0~C255 | D0~D9999 |
|---|---|---|---|---|---|---|---|
| | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - |

**Explanations:**

ANDP instruction is used in the series connection of the contacts' rising-edge detection.

**Program Example:**

Ladder diagram:


| Instruction code: | | Operation: |
|---|---|---|
| LD | X0 | Loading in A contact of X0 |
| **ANDP** | **X1** | X1 rising-edge detection in series connection |
| OUT | Y1 | Driving Y1 coil |

| Mnemonic | Function |
|---|---|
| **ANDF** | Falling-Edge Series Connection |

| Operand | X0~X377 | Y0~Y377 | M0~M4095 | S0~S1023 | T0~T255 | C0~C255 | D0~D9999 |
|---|---|---|---|---|---|---|---|
| | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - |

**Explanations:**

ANDF instruction is used in the series connection of the contacts' falling-edge detection.

**Program Example:**

Ladder diagram:


| Instruction code: | | Operation: |
|---|---|---|
| LD | X0 | Loading in A contact of X0 |
| **ANDF** | **X1** | X1 falling-edge detection in series connection |
| OUT | Y1 | Driving Y1 coil |

| Mnemonic | Function |
|---|---|
| **ORP** | Rising-Edge Parallel Connection |

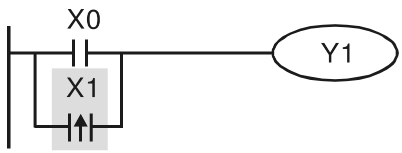
| Operand | X0~X377 | Y0~Y377 | M0~M4095 | S0~S1023 | T0~T255 | C0~C255 | D0~D9999 |
|---|---|---|---|---|---|---|---|
| | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - |

**Explanations:**

ORP instruction is used in the parallel connection of the contacts' rising-edge detection.

**Program Example:**

Ladder diagram:




| Instruction code: | | Operation: |
|---|---|---|
| LD | X0 | Loading in A contact of X0 |
| **ORP** | **X1** | X1 rising-edge detection in parallel connection |
| OUT | Y1 | Driving Y1 coil |

| Mnemonic | Function |
|---|---|
| **ORF** | Falling-Edge Parallel Connection |

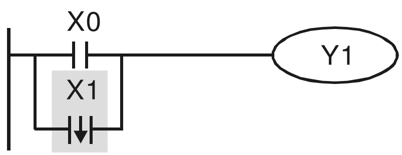
| Operand | X0~X377 | Y0~Y377 | M0~M4095 | S0~S1023 | T0~T255 | C0~C255 | D0~D9999 |
|---|---|---|---|---|---|---|---|
| | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - |

**Explanations:**

ORF instruction is used in the parallel connection of the contacts' falling-edge detection.

**Program Example:**

Ladder diagram:




| Instruction code: | | Operation: |
|---|---|---|
| LD | X0 | Loading in A contact of X0 |
| **ORF** | **X1** | X1 falling-edge detection in parallel connection |
| OUT | Y1 | Driving Y1 coil |

| Mnemonic | Function |
|---|---|
| **PLS** | Rising-Edge Output |

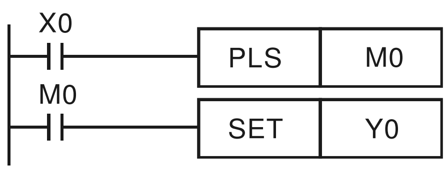
| Operand | X0~X377 | Y0~Y377 | M0~M4095 | S0~S1023 | T0~T255 | C0~C255 | D0~D9999 |
|---|---|---|---|---|---|---|---|
| | - | ✓ | ✓ | - | - | - | - |

**Explanations:**

When X0 goes from Off to On (rising-edge trigger), PLS instruction will be executed, and M0 will send out pulses for once in 1 scan time.

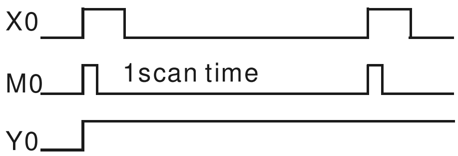
**Program Example:**

Ladder diagram:




| Instruction code: | | Operation: |
|---|---|---|
| LD | X0 | Loading in A contact of X0 |
| **PLS** | **M0** | M0 rising-edge output |
| LD | M0 | Loading in A contact of M0 |
| SET | Y0 | Y0 latched (On) |

Timing diagram:




| Mnemonic | Function |
|---|---|
| **PLF** | Falling-Edge Output |

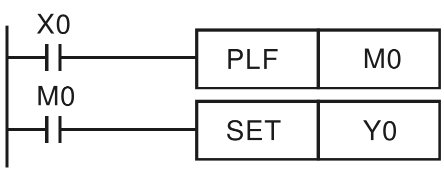
| Operand | X0~X377 | Y0~Y377 | M0~M4095 | S0~S1023 | T0~T255 | C0~C255 | D0~D9999 |
|---|---|---|---|---|---|---|---|
| | - | ✓ | ✓ | - | - | - | - |

**Explanations:**

When X0 goes from On to Off (falling-edge trigger), PLF instruction will be executed, and M0 will send out pulses for once in 1 scan time.

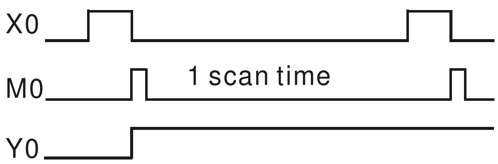
**Program Example:**

Ladder diagram:




| Instruction code: | | Operation: |
|---|---|---|
| LD | X0 | Loading in A contact of X0 |
| **PLF** | **M0** | M0 falling-edge output |
| LD | M0 | Loading in A contact of M0 |
| SET | Y0 | Y0 latched (On) |

Timing diagram:



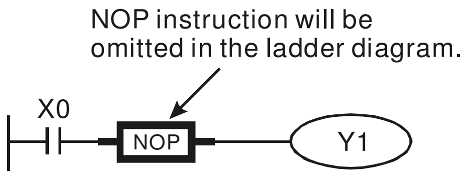

| Mnemonic | Function |
|---|---|
| **NOP** | No Operation |
| Operand | N/A |

**Explanations:**

NOP instruction does not conduct any operations in the program; therefore, after the execution of NOP, the existing logical operational result will be kept. If you want to delete a certain instruction without altering the length of the program, you can use NOP instruction.

**Program Example:**

Ladder diagram:




| Instruction code: | | Operation: |
|---|---|---|
| LD | X0 | Loading in B contact of X0 |
| **NOP** | | No operation |
| OUT | Y1 | Driving Y1 coil |

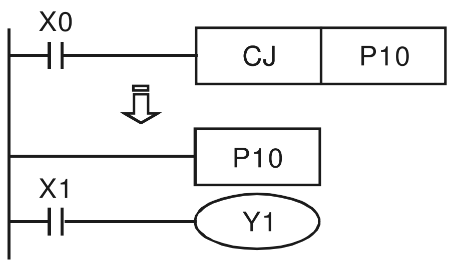
| Mnemonic | Function |
|---|---|
| **P** | Pointer |
| Operand | P0 ~ P255 |

**Explanations:**

Pointer P is used in API 00 CJ, API 01 CALL, API 256 CJN and API 257 JMP instructions. The use of P does not need to start from No. 0, and the No. of P cannot be repeated; otherwise, unexpected errors may occur

**Program Example:**

Ladder diagram:




| Instruction code: | | Operation: |
|---|---|---|
| LD | X0 | Loading in contact A of X0 |
| CJ | P10 | From instruction CJ to P10 |
| : | | |
| **P10** | | Pointer P10 |
| LD | X1 | Loading in A contact of X1 |
| OUT | Y1 | Driving Y1 coil |

| Mnemonic | Function |
|---|---|
| **O** | Subroutine Pointer |
| Operand | Sequential control program pointer: O100<br>Motion control program pointer: OX0 ~ OX99 |

**Explanations:**

1. O100 is the start pointer of general main control programs. You need the main control program to activate OX0 ~ OX99 motion subroutines. Execute M102 instruction to end O100 main control program.
2. OX0 ~ OX99 are the pointers for 100 motion control subroutines and can be compiled by the programming engineer for different motion routes. Register D1868 (CR72) stores the No. of subroutine, in which b14 or b15 has to be “1”, and finally b12 of D1846 (CR50) will activate the program. See the example below.

   Example: To activate OX99 motion subroutine, follow the two steps below:

   (1) Set up the No. to be activated: D1868 = H’4063 (or H’8063, H’C063)

   (2) Enable OX99: D1846 = H’1000

3. M2 is the instruction to end OX0 ~ OX99 motion subroutines.

**Program Example:**

In the program example below, N0000 ~ N0100 are O100 main control program; N0102 ~ N0304 are OX50 motion subroutines.

| No. of row | Program |
|---|---|
| **N000** | **O100** |
| **N001** | **LD M1000** |
| **:** | **:** |
| **:** | **:** |
| **N0099** | **OUT Y30** |
| **N0100** | **M102** |
| N0101 | NOP |
| **N0102** | **OX50** |
| **N0103** | **DRVZ** |
| **N0104** | **ABS** |
| **:** | **:** |
| **:** | **:** |
| **N0304** | **M2** |

| Mnemonic | Function |
|---|---|
| **M** | M-Code Instruction |

| Operand | M0 ~ M65535 |
|---|---|

**Explanations:**

1. M-Code instruction is used in motion instruction. When M-Code is executed, first store the No. of M-Code into D1703. When M-Code is enabled, M1794 will be "On" automatically. If M1744 is set "On", M1794 will become "Off", indicating that the execution of M-Code is completed.
2. Execute M-Code to control Y output. Set the high byte of D1873 as "1" to enable the output. The low byte is the start No. of Y output. When M1794 is "On" (i.e. starting to execute M-Code), the Y output No. corresponding to the setting in D1873 will be "On". When M1794 is "Off", the Y will be "Off". See Program Example 1.
3. M-Code generally is used in the sections of OX00 ~ OX00 subroutines.
4. There are two modes for M-Code instruction: "after" mode and "with" mode. The difference between the two modes is the timing of enabling M-Code instruction. See Program Example 2.
5. When the execution of M-Code is completed, M1794 will turn from On to Off in two ways:
   (1) Set M1794 to be "0" directly to reset the action.
   (2) Set M1744 to be "On" directly.

**Program Example 1:**

1. How to design the procedure when you want to display the current No. of M-Code being executed in device Y when M6 is executed:
   (1) First set the parameter in D1873 as follow:

MOV H0□□□ D1873
- N: Start No. of Y output (the last two □)
- 0: Disable / 1: Enable (the first □)

(2) Execute M-Code (M6), and DVP-PM will automatically write H'6 (binary 1010) into D1703 and The value in D1703 into K2YN. N is the start No. of Y output.

MOV H6 D1703

MOV D1703 $K2Y_N$

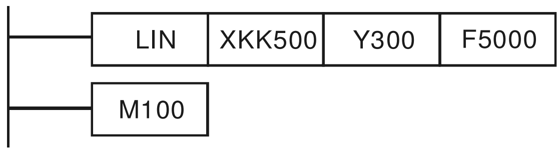
When the M-Codes of the two programs above are enabled, the program will run automatically. Therefore, you do not need to compile the program

(3) When N in D1873 is set as the settings in the table below, see also the table below for the output status of $K2Y_N$.

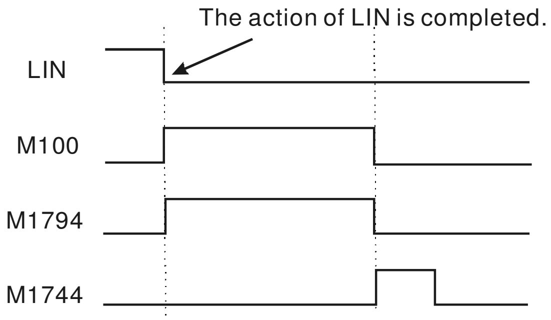
| D1873 | Y7 | Y6 | Y5 | Y4 | Y3 | Y2 | Y1 | Y0 |
|---|---|---|---|---|---|---|---|---|
| H00□□ | No Y output | | | | | | | |
| H0100 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| H0101 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | - |
| H0102 | 0 | 0 | 1 | 0 | 1 | 0 | - | - |
| H0103 | 0 | 1 | 0 | 1 | 0 | - | - | - |
| ⋮ | ⋮ | | | | | | | |

**Program Example 2:**

1. "after" mode: Only M-Code instruction in a single row of the program.

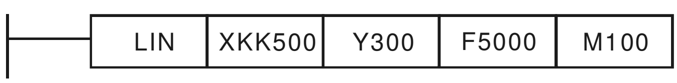



The timing diagram:

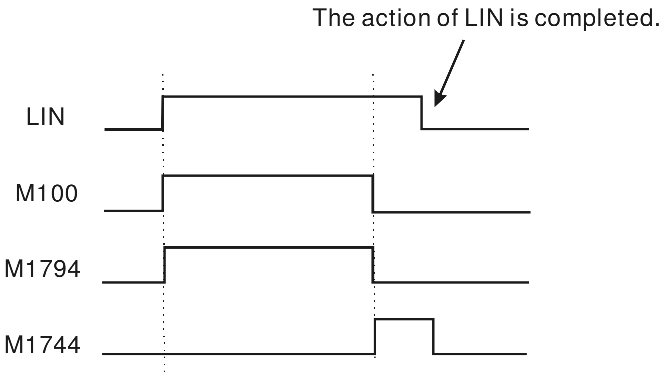



When LIN instruction is completed, M-Code (M100) will be enabled automatically. M1794 will be On automatically as well. To stop M100, set On M1744. If you need to re-enable M-Code, all you have to do is reset and re-enable M-Code in the program.

2. "with" mode: Place M-Code instruction at the end of the motion instruction.



The timing diagram:




When LIN instruction is triggered, M-Code (M100) will be enabled automatically. M1794 will be On automatically as well. Set On M1744 to stop M100. If you need to re-enable M-Code, you have to wait until the action of LIN instruction is completed and reset the parameter, and next trigger M-Code by the program design.

**Program Example 3:**

N0100 and N0301 are special instruction for M-Code. N0105 = M-Code “with” mode; N0250 = M-Code “after” mode.

| No. of row | Program |
|---|---|
| N000 | O100 |
| N001 | LD M1000 |
| : | : |
| : | : |
| N0099 | OUT Y30 |
| N0100 | M102 |
| N0101 | NOP |
| N0102 | OX50 |
| N0103 | DRVZ |
| N0104 | ABS |
| **N0105** | **DRV XD10 FXD12 M20** |
| **:** | **:** |
| **N0250** | **M08** |
| **:** | **:** |
| N0304 | M2 |

**Remarks:**

There are two special designated methods of using M-Code: 1) M102 for ending O100 main program; 2) M2 for ending OX0 ~ OX99 motion subroutines. Therefore, please avoid using M02 and M102 when using M-Codes.

## MEMO

## 5.1 List of Instructions

| Category | API | Mnemonic | | P instruction | Function | STEPS | | Page |
|---|---|---|---|---|---|---|---|---|
| | | 16-bit | 32-bit | | | 16-bit | 32-bit | |
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| | **01** | CALL | - | ✓ | Call Subroutine | 3 | - | 5-15 |
| | **02** | SRET | - | - | Subroutine Return | 1 | - | 5-15 |
| | **08** | RPT | - | - | Repetition Start (only 1 layer) | 3 | - | 5-17 |
| | **09** | RPE | - | - | Repetition End | 1 | - | 5-17 |
| Transmission Comparison | **10** | CMP | DCMP | ✓ | Compare | 7 | 9 | 5-19 |
| | **11** | ZCP | DZCP | ✓ | Zone Compare | 9 | 12 | 5-20 |
| | **12** | MOV | DMOV | ✓ | Move | 5 | 6 | 5-21 |
| | **18** | BCD | DBCD | ✓ | Binary Coded Decimal | 5 | 5 | 5-22 |
| | **19** | BIN | DBIN | ✓ | Binary | 5 | 5 | 5-23 |
| Four Arithmetic Operation | **20** | ADD | DADD | ✓ | Addition | 7 | 9 | 5-24 |
| | **21** | SUB | DSUB | ✓ | Subtraction | 7 | 9 | 5-26 |
| | **22** | MUL | DMUL | ✓ | Multiplication | 7 | 9 | 5-28 |
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| | **24** | INC | DINC | ✓ | Increment | 3 | 3 | 5-30 |
| | **25** | DEC | DDEC | ✓ | Decrement | 3 | 3 | 5-31 |
| | **26** | WAND | DWAND | ✓ | Logical Word AND | 7 | 9 | 5-32 |
| | **27** | WOR | DWOR | ✓ | Logical Word OR | 7 | 9 | 5-33 |
| | **28** | WXOR | DWXOR | ✓ | Logical Exclusive OR | 7 | 9 | 5-34 |
| | **29** | NEG | DNEG | ✓ | 2's Complement (Negative) | 3 | 3 | 5-35 |
| Data | **40** | ZRST | - | ✓ | Zone Reset | 5 | - | 5-37 |
| | **49** | - | DFLT | ✓ | Floating Point | - | 6 | 5-38 |
| I/O | **78** | FROM | DFROM | ✓ | Read CR Data in Special Modules | 9 | 12 | 5-40 |
| | **79** | TO | DTO | ✓ | Write CR Data into Special Modules | 9 | 13 | 5-41 |
| Basic Instructions | **89** | PLS | - | - | Rising-Edge Output | 3 | - | 4-11 |
| | **90** | LDP | - | - | Rising-Edge Detection Operation | 3 | - | 4-9 |
| | **91** | LDF | - | - | Falling-Edge Detection Operation | 3 | - | 4-9 |
| | **92** | ANDP | - | - | Rising-Edge Series Connection | 3 | - | 4-10 |
| | **93** | ANDF | - | - | Falling-Edge Series Connection | 3 | - | 4-10 |
| | **94** | ORP | - | - | Rising-Edge Parallel Connection | 3 | - | 4-10 |
| | **95** | ORF | - | - | Falling-Edge Parallel Connection | 3 | - | 4-11 |
| | **96** | TMR | - | - | 16-bit Timer | 5 | - | 4-7 |
| | **97** | CNT | DCNT | - | 16-bit/32-bit Counter | 5 | 6 | 4-8 |
| | **99** | PLF | - | - | Falling-Edge Output | 3 | - | 4-12 |
| Communi-cations | **100** | MODRD | - | - | Read Modbus Data | 7 | - | 5-44 |
| | **101** | MODWR | - | - | Write Modbus Data | 7 | - | 5-48 |
| Floating Point Operation | **110** | - | DECMP | ✓ | Floating Point Compare | 7 | 9 | 5-53 |
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| Category | API | Mnemonic | | P instruction | Function | STEPS | | Page |
|---|---|---|---|---|---|---|---|---|
| | | 16-bit | 32-bit | | | 16-bit | 32-bit | |
| | **124** | - | DEXP | ✓ | Exponent of Binary Floating Point | - | 6 | 5-61 |
| | **125** | - | DLN | ✓ | Natural Logarithm of Binary Floating Point | - | 6 | 5-62 |
| | **126** | - | DLOG | ✓ | Logarithm of Binary Floating Point | - | 9 | 5-63 |
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| | **128** | - | DPOW | ✓ | Floating Point Power Operation | - | 9 | 5-65 |
| | **129** | - | DINT | ✓ | Float to Integer | - | 6 | 5-67 |
| | **130** | - | DSIN | ✓ | Sine | 5 | 6 | 5-68 |
| | **131** | - | DCOS | ✓ | Cosine | 5 | 6 | 5-70 |
| | **132** | - | DTAN | ✓ | Tangent | 5 | 6 | 5-72 |
| | **133** | - | DASIN | ✓ | Arc Sine | - | 6 | 5-74 |
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| | **138** | - | DTANH | ✓ | Hyperbolic Tangent | - | 6 | 5-79 |
| Contact Type Logic Operation | **215** | LD& | DLD& | - | S1 & S2 | 5 | 7 | 5-80 |
| | **216** | LD\| | DLD\| | - | S1 \| S2 | 5 | 7 | 5-80 |
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| | **218** | AND& | DAND& | - | S1 & S2 | 5 | 7 | 5-81 |
| | **219** | AND\| | DAND\| | - | S1 \| S2 | 5 | 7 | 5-81 |
| | **220** | AND^ | DAND^ | - | S1 ^ S2 | 5 | 7 | 5-81 |
| | **221** | OR& | DOR& | - | S1 & S2 | 5 | 7 | 5-82 |
| | **222** | OR\| | DOR\| | - | S1 \| S2 | 5 | 7 | 5-82 |
| | **223** | OR^ | DOR^ | - | S1 ^ S2 | 5 | 7 | 5-82 |
| Contact Type Comparison Instruction | **224** | LD= | DLD= | - | S1 = S2 | 5 | 7 | 5-83 |
| | **225** | LD> | DLD> | - | S1 > S2 | 5 | 7 | 5-83 |
| | **226** | LD< | DLD< | - | S1 < S2 | 5 | 7 | 5-83 |
| | **228** | LD<> | DLD<> | - | S1 ≠ S2 | 5 | 7 | 5-83 |
| | **229** | LD<= | DLD<= | - | S1 ≦ S2 | 5 | 7 | 5-83 |
| | **230** | LD>= | DLD>= | - | S1 ≧ S2 | 5 | 7 | 5-83 |
| | **232** | AND= | DAND= | - | S1 = S2 | 5 | 7 | 5-84 |
| | **233** | AND> | DAND> | - | S1 > S2 | 5 | 7 | 5-84 |
| | **234** | AND< | DAND< | - | S1 < S2 | 5 | 7 | 5-84 |
| | **236** | AND<> | DAND<> | - | S1 ≠ S2 | 5 | 7 | 5-84 |
| | **237** | AND<= | DAND<= | - | S1 ≦ S2 | 5 | 7 | 5-84 |
| | **238** | AND>= | DAND>= | - | S1 ≧ S2 | 5 | 7 | 5-84 |
| | **240** | OR= | DOR= | - | S1 = S2 | 5 | 7 | 5-85 |
| | **241** | OR> | DOR> | - | S1 > S2 | 5 | 7 | 5-85 |
| | **242** | OR< | DOR< | - | S1 < S2 | 5 | 7 | 5-85 |
| | **244** | OR<> | DOR<> | - | S1 ≠ S2 | 5 | 7 | 5-85 |
| | **245** | OR<= | DOR<= | - | S1 ≦ S2 | 5 | 7 | 5-85 |
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## 5.2 Composition of Application Instruction

◆ An application instruction has two parts: the instruction and operands

Instruction: The function of the instruction

Operands: The device for processing the operation of the instruction

An application instruction usually occupies 1 step, and 1 operand occupies 2 or 3 steps depending on the instruction is a 16-bit or 32-bit one.

◆ Format of an application instruction

| API ① | Mnemonic ② ③ ④ | | | Operands ⑤ | Function ⑥ |
|---|---|---|---|---|---|
| 41 | D | CMP | P | $S_1$ $S_2$ D | Compare |

| Type ⑪ / OP ⑩ | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $S_1$ | | | | | * | * | * | * | * | * | * | * | * | * | * | CMP, CMPP: 7 steps ⑦<br>DCMP, DCMPP: 9 steps |
| $S_2$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| D | | * | * | * | | | | | | | | | | | | |

(Bit Devices: X, Y, M, S ⑨; Word Devices: K ~ Z ⑧)

① API No.

② Indication of if there is a 16-bit or 32-bit instruction. If there is a 32-bit instruction, the column will be marked with “D".

③ Mnemonic of the application instruction

④ Indication of if there is a pulse execution type instruction. If there is a pulse instruction, the column will be marked with “P”.

⑤ Operands

⑥ Function of the application instruction

⑦ Steps occupied by the 16-bit/32-bit instruction

⑧ Column marked with * and in grey refers to V, Z index register modification is applicable.

⑨ Column marked with * is the device applicable for the operand.

⑩ Device name

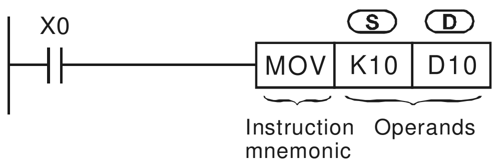
⑪ Device type

◆ Input of application instruction:

Some application instructions are only composed of the instruction such as BRET and SRET. However, most application instructions are composed of the instruction part and many operands.

The application instructions represented as API 00 ~ API 260 for DVP-PM and every application instruction has its own mnemonic, e.g. the mnemonic of API 12 is MOV. Therefore, when using the ladder diagram editing software (PMSoft) to input API 12 into the program, you simply need to enter “MOV”; when using the hand-held programming panel (HPP03) to input API 12 into the program, enter the API No. “12”.

The different application instructions designate different operands. Take MOV instruction for example:



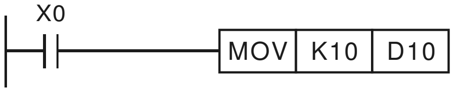

MOV instruction is to move the operand designated in **S** to the operand designated in **D**.

| | |
|---|---|
| **S** | Source operand: If there are more than 1 source operands, they will be represented as $\mathbf{S_1}$, $\mathbf{S_2}$ and so on. |
| **D** | Destination operand: If there are more than 1 destination operands, they will be represented as $\mathbf{D_1}$, $\mathbf{D_2}$ and so on. |
| If the operand can only be constant K/H or a register, it will be represented as **m**, $\mathbf{m_1}$, $\mathbf{m_2}$, **n**, $\mathbf{n_1}$, $\mathbf{n_2}$… | |

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

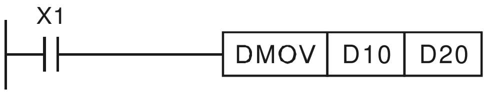
  The length of an operand can be 16-bit or 32-bit depending on the contents in the operand. The 32-bit instruction is indicated by adding a “D” before the 16-bit instruction.

16 bits MOV instruction




When X0 = On, K10 will be sent to D10.

32 bits DMOV instruction

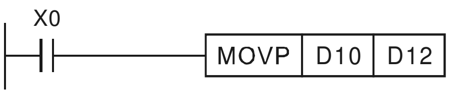



When X1 = On, the content in (D11, D10) will be sent to (D21, D20).

- Continuous-execution instruction and pulse-execution instruction

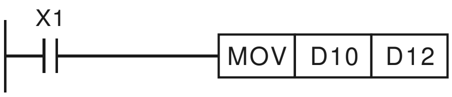
  Continuous-execution and pulse-execution are two types of execution for an application instruction. The pulse-execution instructions are used more because it can decrease the period of program scan. And, if the continuous-execution instruction is not working, the required execution time will be shorter. Thus, some instructions are mostly used as pulse execution type, e.g. INC, DEC, and the kind of displacement instruction. Instructions marked with a “P” following the mnemonic are pulse execution instruction.

Pulse-execution instruction




When X0 goes from Off to On, MOVP instruction will be executed once, and the instruction will not be executed again in the scan period.

Continuous-execution instruction

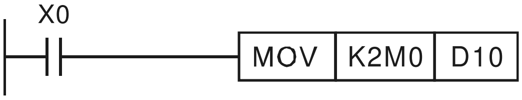



In every scan period when X1 = On, MOV instruction will be executed once.

In the two figures, when X0, X1 = Off, the instruction will not be executed, and the content in operand **D** will remain unchanged.

- Designation of operands
  1. Bit devices X, Y, M and S can be combined into word device to store values and data for operations in the form of KnX, KnY, KnM and KnS in an application instruction.
  2. Data register D, time T, counter C and index register V, Z are designated by general operands.
  3. A data register is usually in 16-bit, i.e. of the length of 1 register D. A designated 32-bit data register refers to 2 consecutive register Ds.
  4. If an operand of a 32-bit instruction designates D0, the 32-bit data register composed of (D1, D0) will be occupied. D1 is the higher 16-bit; D0 is the lower 16-bit. The same rule also apply to timer T and 16-bit counters C0 ~ C199.
  5. When the 32-bit counters C200 ~ C255 are used as data registers, they can only be designated by the operands of 32-bit instructions.
- Format of operand
  1. X, Y, M and S can only On/Off a single point and are defined as bit devices.

2. 16-bit (or 32-bit) devices T, C, D and V, Z are defined as word devices.
3. You can place Kn (n = 1 refers to 4 bits. For 16-bit instruction, n = K1 ~ K4; for 32-bit instructions, n = K1 ~ K8) before bit devices X, Y, M and S to make it a word device for performing word-device operations. For example, K2M0 referes to 8 bits, M0 ~ M7.




When X0 = On, the contents in M0 ~ M7 will be moved to b0 ~ b7 in D19, and b8 ~ b15 will be set as “0”.

◆ Data processing of word devices combined from bit devices

| 16-bit instruction | |
|---|---|
| Designated value: K-32,768 ~ K32,767 | |
| Values for designated K1 ~ K4 | |
| 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 | |
|---|---|
| Designated value: K-2,147,483,648 ~ K2,147,483,647 | |
| Values for designated K1 ~ K8 | |
| 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 |

◆ Flags

The flags listed below are for indicating the operational result of the application instruction.

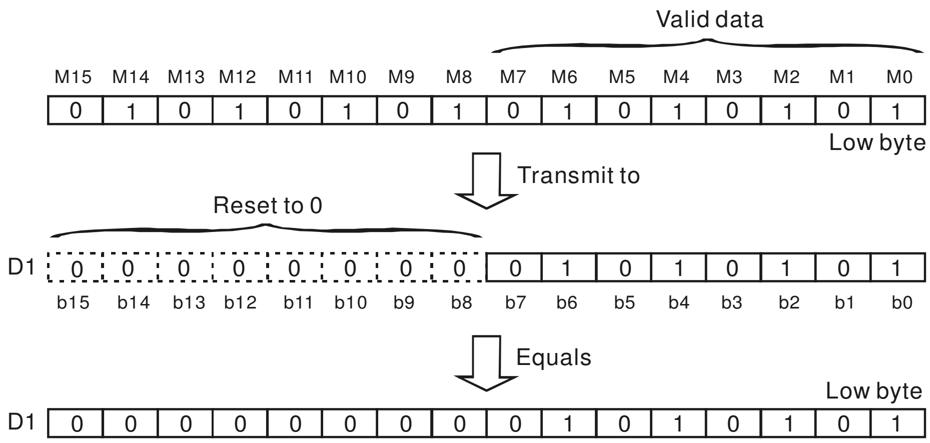
M1968: zero flag M1969: borrow flag M1970: carry flag

All flags will turn On or Off according to the operational result of an instruction. For example, the execution result of operation instruction ADD/SUB/MUL/DIV in the sections of O100 ~ M102 main control programs will affect the status of M1968 ~ M1970. When the instruction is not executed, the On/Off status of the flag will be held. The status of the four flags relates to many instructions. See explanations on the relevant instructions for more details.

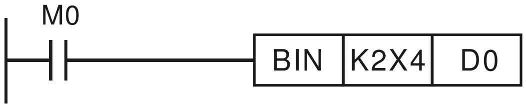
## 5.3 Handling of Numeric Values

◆ Devices only with On/Off status are called “bit devices”, e.g. X, Y, M and S. Devices used exclusively for storing numeric values are called “word devices”, e.g. T, C, D, V and Z. Bit device plus a specific bit device (place a digit before the bit device in Kn) can be used in the operand of an application instruction in the form of numeric value.

◆ n = K1 ~ K4 for a 16-bit value; n = K1 ~ K8 for a 32-bit value. For example, K2M0 refers to an 8-bit value composed of M0 ~ M7.




- K1M0, K2M0 and K3M0 are transmitted to 16-bit registers, and the vacant high bits will be filled in “0”. The same rule can be applied when K1M0, K2M0, K3M0, K4M0, K5M0, K6M0 and K7M0 are transmitted to 32-bit registers, and the vacant high bits will be filled in “0”.
- In the 16-bit (or 32-bit) operation, if the contents of the operand are designated as bit devices K1 ~ K3 (or K4 ~ K7), the vacant high bits will be regarded as “0”. Therefore, the operation is a positive-value one.




☞ The BCD value composed of X4 ~ X13 will be converted to BIN value and sent to D0.

- You can choose any No. for bit devices, but please make the 1s place of X and Y "0”, e.g. X0, X10, X20, …Y0, Y10…, and the 1s place of M and S “8’s multiple” (“0” is still the best choice), e.g. M0, M10, M20….
- Designating continuous device No.

Take data register D for example, continuous D refers to D0, D1, D2, D3, D4...

For bit devices with specifically designated digit, continuous No. refers to:

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

Please follow the No. in the table and do not skip No. in case confusion may occur. In addition, if you use K4Y0 in the 32-bit operation, the higher 16 bits will be regarded as “0”. For 32-bit data, please use K8Y0.

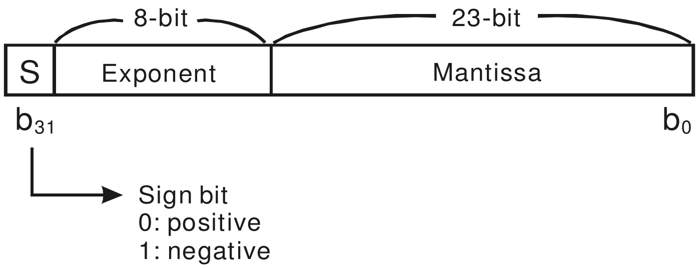
The operations in DVP-PM are conducted in BIN integers. When the integer performs division, e.g. 40 ÷ 3 = 13, the remainder is 1. When the integer performs square root operations, the decimal point will be left out. Use decimal point operation instructions to obtain the decimal point.

Application instructions relevant to decimal point:

| | | | |
|---|---|---|---|
| API 110（DECMP） | API 111（DEZCP） | API 116（DRAD） | API 117（DDEG） |
| API 120（DEADD） | API 121（DESUB） | API 122（DEMUL） | API 123（DEDIV） |
| API 124（DEXP） | API 125（DLN） | API 126（DLOG） | API 127（DESQR） |
| API 128（DPOW） | API 130（DSIN） | API 131（DCOS） | API 132（DTAN） |
| API 133（DASIN） | API 134（DACOS） | API 135（DATAN） | API 136（DSINH） |
| API 137（DCOSH） | API 138（DTANH） | | |

**Binary Floating Point**

DVP-PM presents floating points in 32 bits and adopts the IEEE754 standard:




$1^{S} \times 2^{EB} \times 1.M$ , in which B = 127

Therefore, the range for the 32-bit floating point is $\pm 2^{-126} \sim \pm 2^{+128}$, i.e. $\pm 1.1755\times 10^{-38} \sim \pm 3.4028\times 10^{+38}$.

Example 1: Representing "23" in 32-bit floating point

Step 1: Convert "23" into a binary value: 23.0 = 10111

Step 2: Normalize the binary value: 10111 = $1.0111 \times 2^{4}$, in which 0111 is mantissa, and 4 is exponent.

Step 3: Obtain the exponent

$\because E - B = 4 \rightarrow E - 127 = 4 \quad \therefore E = 131 = 10000011_2$

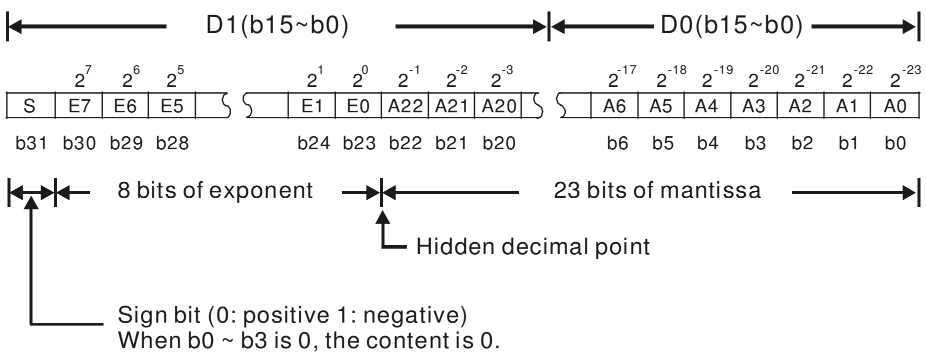
Step 4: Combine the sign bit, exponent and mantissa into a floating point

0 1000**0001**1 011**1000**0000**0000**0000**0000**$_2$ = $41B80000_{16}$

Example 2: Representing "-23.0" into 32-bit floating point

The steps required are the same as those in Example 1. The only difference is user have to alter the sign bit into "1".

DVP-PM uses registers of 2 continuous No. to combine into a 32-bit floating point. For example, we use registers (D1, D0) for storing a binary floating point as below:




**Decimal Floating Point**

- Since the binary floating point is not very user-friendly, we can convert it into a decimal floating point for use. Please be noted that the decimal point operation in DVP-PM is still in binary floating point.
- The decimal floating point is represented by 2 continuous registers. The register of smaller No. is for the constant while the register of bigger No. for the exponent.

Example: Storing a decimal floating point in register (D1, D0)

Decimal floating point = [constant D0] x $10^{[\text{exponent D1}]}$

Constant D0 = ±1,000 ~ ±9,999

Exponent D1 = -41 ~ +35

The constant 100 does not exist in D0 due to 100 is represented as $1{,}000\times10^{-1}$. The range of decimal floating point is $\pm1{,}175\times10^{-41}$ ~ $\pm3{,}402\times10^{+35}$.

- ◆ The decimal floating point can be used in the following instructions:

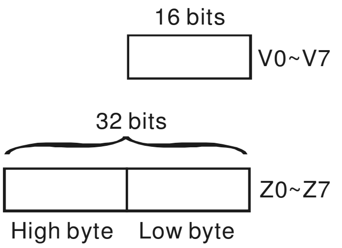
  DEBCD: Converting binary floating point into decimal floating point

  DEBIN: Converting decimal floating point into binary floating point

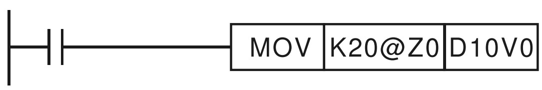
- ◆ In O100 ~ M102 main control programs, when using ADD/SUB/MUL/DIV instructions, the execution result will affect the status of M1968 ~ M1970. See below for zero flag (M1968), borrow flag (M1970), carry flag (M1969) and their corresponding status to floating point operation instructions:
  - Zero flag: M1968 = On if the operational result is “0”.
  - Borrow flag: M1970 = On if the operational result exceeds the minimum unit.
  - Carry flag: M1969 = On if the absolute value of the operational result exceeds the range of use.

## 5.4 V, Z Index Register Modification

The index registers are 16-bit registers. V is 16-bit register, and Z is 32-bit register. In DVP-PM, there are V0~ V7 and Z0 ~ Z7, totaling 16 points.




V is 16-bit data register, can be read and written. If you need a 32-bit register, you have to designate Z.




Z0=8  V0=14

20+8=28  10+14=24

Transmission  K28 → D24

See the diagram on the left hand side. V, Z index register modification refers to the content in the operand changes with the contents in V and Z.

For example, Z0 = 8 and K20@Z0 represents constant K28 (20 + 8). When the condition is true, constant K28 will be transmitted to register D24.

Devices modifiable in DVP-PM: P, I, X, Y, M, S, K, H, KnX, KnY, KnM, KnS, T, C, D.

V and Z can modify the devices listed above but cannot modify themselves and Kn. K4M0Z0 is valid and K0Z0M0is invalid. Grey columns in the table of operand at the beginning page of each application instruction indicate the operands modifiable by V and Z.

If you need to modify device P, I, X, Y, M, S, KnX, KnY, KnM, KnS, T, C and D by V and Z, you have to designate V or Z.

When you use the instruction mode in PMSoft to modify constant K and H, you have to use @, for example, “MOV K10@Z0 D0V0”.

## 5.5 Instruction Index

**Sorted by alphabetic order:**

| Category | API | Mnemonic | | P Instruction | Function | STEPS | | Page |
|---|---|---|---|---|---|---|---|---|
| | | 16-bit | 32-bit | | | 16-bit | 32-bit | |
| A | **20** | ADD | DADD | ✓ | Addition | 7 | 9 | 5-24 |
| | **92** | ANDP | - | - | Rising-Edge Series Connection | 3 | - | 4-10 |
| | **93** | ANDF | - | - | Falling-Edge Series Connection | 3 | - | 4-10 |
| | **133** | - | DASIN | ✓ | Arc Sine | - | 6 | 5-74 |
| | **134** | - | DACOS | ✓ | Arc Cosine | - | 6 | 5-75 |
| | **135** | - | DATAN | ✓ | Arc Tangent | - | 6 | 5-76 |
| | **218** | AND& | DAND& | - | S1 & S2 | 5 | 7 | 5-81 |
| | **219** | AND\| | DAND\| | - | S1 \| S2 | 5 | 7 | 5-81 |
| | **220** | AND^ | DAND^ | - | S1 ^ S2 | 5 | 7 | 5-81 |
| | **232** | AND= | DAND= | - | S1 = S2 | 5 | 7 | 5-84 |
| | **233** | AND> | DAND> | - | S1 > S2 | 5 | 7 | 5-84 |
| | **234** | AND< | DAND< | - | S1 < S2 | 5 | 7 | 5-84 |
| | **236** | AND<> | DAND<> | - | S1 ≠ S2 | 5 | 7 | 5-84 |
| | **237** | AND<= | DAND<= | - | S1 ≦ S2 | 5 | 7 | 5-84 |
| | **238** | AND>= | DAND>= | - | S1 ≧ S2 | 5 | 7 | 5-84 |
| B | **18** | BCD | DBCD | ✓ | Binary Coded Decimal | 5 | 5 | 5-22 |
| | **19** | BIN | DBIN | ✓ | Binary | 5 | 5 | 5-23 |
| | **258** | BRET | - | - | Return to Bus Line | 1 | - | 5-88 |
| C | **00** | CJ | - | ✓ | Conditional Jump | 3 | - | 5-12 |
| | **01** | CALL | - | ✓ | Call Subroutine | 3 | - | 5-15 |
| | **10** | CMP | DCMP | ✓ | Compare | 7 | 9 | 5-19 |
| | **97** | CNT | DCNT | - | 16-bit/32-bit Counter | 5 | 6 | 4-8 |
| | **131** | - | DCOS | ✓ | Cosine | 5 | 6 | 5-70 |
| | **137** | - | DCOSH | ✓ | Hyperbolic Cosine | - | 6 | 5-78 |
| | **256** | CJN | - | ✓ | Negated Conditional Jump | 3 | - | 5-86 |
| D | **23** | DIV | DDIV | ✓ | Division | 7 | 9 | 5-29 |
| | **25** | DEC | DDEC | ✓ | Decrement | 3 | 3 | 5-31 |
| | **117** | - | DDEG | ✓ | Radian → Angle | - | 6 | 5-56 |
| E | **110** | - | DECMP | ✓ | Floating Point Compare | 7 | 9 | 5-53 |
| | **111** | - | DEZCP | ✓ | Floating Point Zone Compare | 9 | 12 | 5-54 |
| | **120** | - | DEADD | ✓ | Floating Point Addition | 7 | 9 | 5-57 |
| | **121** | - | DESUB | ✓ | Floating Point Subtraction | 7 | 9 | 5-58 |
| | **122** | - | DEMUL | ✓ | Floating Point Multiplication | 7 | 9 | 5-59 |
| | **123** | - | DEDIV | ✓ | Floating Point Division | 7 | 9 | 5-60 |
| | **124** | - | DEXP | ✓ | Exponent of Binary Floating Point | - | 6 | 5-61 |
| | **127** | - | DESQR | ✓ | Floating Point Square Root | 5 | 6 | 5-64 |
| F | **49** | - | DFLT | ✓ | Floating Point | - | 6 | 5-38 |
| | **78** | FROM | DFROM | ✓ | Read CR Data in Special Modules | 9 | 12 | 5-40 |
| I | **24** | INC | DINC | ✓ | Increment | 3 | 3 | 5-30 |
| | **129** | - | DINT | ✓ | Float to Integer | - | 6 | 5-67 |
| J | **257** | JMP | - | - | Unconditional Jump | 3 | - | 5-87 |

| Category | API | Mnemonic | | P Instruction | Function | STEPS | | Page |
|---|---|---|---|---|---|---|---|---|
| | | 16-bit | 32-bit | | | 16-bit | 32-bit | |
| L | 90 | LDP | - | - | Rising-Edge Detection Operation | 3 | - | 4-9 |
| | 91 | LDF | - | - | Falling-Edge Detection Operation | 3 | - | 4-91 |
| | 125 | - | DLN | ✓ | Natural Logarithm of Binary Floating Point | - | 6 | 5-62 |
| | 126 | - | DLOG | ✓ | Logarithm of Binary Floating Point | - | 9 | 5-63 |
| | 215 | LD& | DLD& | - | S1 & S2 | 5 | 7 | 5-80 |
| | 216 | LD\| | DLD\| | - | S1 \| S2 | 5 | 7 | 5-80 |
| | 217 | LD^ | DLD^ | - | S1 ^ S2 | 5 | 7 | 5-80 |
| | 224 | LD= | DLD= | - | S1 = S2 | 5 | 7 | 5-83 |
| | 225 | LD> | DLD> | - | S1 > S2 | 5 | 7 | 5-83 |
| | 226 | LD< | DLD< | - | S1 < S2 | 5 | 7 | 5-83 |
| | 228 | LD<> | DLD<> | - | S1 ≠ S2 | 5 | 7 | 5-83 |
| | 229 | LD<= | DLD<= | - | S1 ≦ S2 | 5 | 7 | 5-83 |
| | 230 | LD>= | DLD>= | - | S1 ≧ S2 | 5 | 7 | 5-83 |
| M | 12 | MOV | DMOV | ✓ | Move | 5 | 6 | 5-21 |
| | 22 | MUL | DMUL | ✓ | Multiplication | 7 | 9 | 5-28 |
| | 100 | MODRD | - | - | Read Modbus Data | 7 | - | 5-44 |
| | 101 | MODWR | - | - | Write Modbus Data | 7 | - | 5-48 |
| | 259 | MMOV | - | ✓ | Magnifying Transfer with Sign Extension | 6 | - | 5-89 |
| N | 29 | NEG | DNEG | ✓ | 2's Complement (Negative) | 3 | 3 | 5-35 |
| O | 94 | ORP | - | - | Rising-Edge Parallel Connection | 3 | - | 4-10 |
| | 95 | ORF | - | - | Falling-Edge Parallel Connection | 3 | - | 4-11 |
| | 221 | OR& | DOR& | - | S1 & S2 | 5 | 7 | 5-82 |
| | 222 | OR\| | DOR\| | - | S1 \| S2 | 5 | 7 | 5-82 |
| | 223 | OR^ | DOR^ | - | S1 ^ S2 | 5 | 7 | 5-82 |
| | 240 | OR= | DOR= | - | S1 = S2 | 5 | 7 | 5-85 |
| | 241 | OR> | DOR> | - | S1 > S2 | 5 | 7 | 5-85 |
| | 242 | OR< | DOR< | - | S1 < S2 | 5 | 7 | 5-85 |
| | 244 | OR<> | DOR<> | - | S1 ≠ S2 | 5 | 7 | 5-85 |
| | 245 | OR<= | DOR<= | - | S1 ≦ S2 | 5 | 7 | 5-85 |
| | 246 | OR>= | DOR>= | - | S1 ≧ S2 | 5 | 7 | 5-85 |
| P | 89 | PLS | - | - | Rising-Edge Output | 3 | - | 4-11 |
| | 99 | PLF | - | - | Falling-Edge Output | 3 | - | 4-12 |
| | 128 | - | DPOW | ✓ | Floating Point Power Operation | - | 9 | 5-65 |
| R | 08 | RPT | - | - | Repetition Start (only 1 layer) | 3 | - | 5-17 |
| | 09 | RPE | - | - | Repetition End | 1 | - | 5-17 |
| | 116 | - | DRAD | ✓ | Angle → Radian | - | 6 | 5-55 |
| | 260 | RMOV | - | ✓ | Reducing Transfer with Sign Holding | 6 | - | 5-90 |
| S | 02 | SRET | - | - | Subroutine Return | 1 | - | 5-15 |
| | 21 | SUB | DSUB | ✓ | Subtraction | 7 | 9 | 5-26 |
| | 130 | - | DSIN | ✓ | Sine | 5 | 6 | 5-68 |
| | 136 | - | DSINH | ✓ | Hyperbolic Sine | - | 6 | 5-77 |
| T | 79 | TO | DTO | ✓ | Write CR Data into Special Modules | 9 | 13 | 5-41 |
| | 96 | TMR | - | - | 16-bit Timer | 5 | - | 4-7 |
| | 132 | - | DTAN | ✓ | Tangent | 5 | 6 | 5-72 |
| | 138 | - | DTANH | ✓ | Hyperbolic Tangent | - | 6 | 5-79 |
| W | 26 | WAND | DWAND | ✓ | Logical Word AND | 7 | 9 | 5-32 |
| | 27 | WOR | DWOR | ✓ | Logical Word OR | 7 | 9 | 5-33 |

| Category | API | Mnemonic | | P Instruction | Function | STEPS | | Page |
|---|---|---|---|---|---|---|---|---|
| | | 16-bit | 32-bit | | | 16-bit | 32-bit | |
| | **28** | WXOR | DWXOR | ✓ | Logical Exclusive OR | 7 | 9 | 5-34 |
| Z | **11** | ZCP | DZCP | ✓ | Zone Compare | 9 | 12 | 5-20 |
| | **40** | ZRST | - | ✓ | Zone Reset | 5 | - | 5-37 |

## 5.6 Application Instructions

| API | | Mnemonic | | Operands | Function |
|---|---|---|---|---|---|
| 00 | | CJ | P | (S) | Conditional Jump |

| OP | Range | Program Steps |
|---|---|---|
| (S) | P0 ~ P255 | CJ, CJP: 3 steps |

**Operands:**

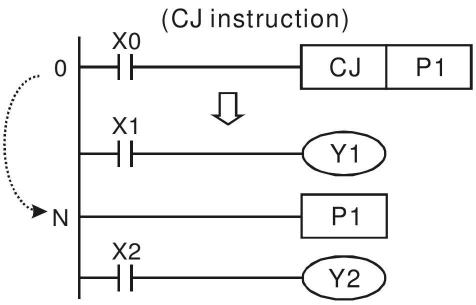
**S**: The destination pointer of conditional jump

**Explanations:**

1. Operand **S** can designate P0 ~ P255.
2. P cannot be modified by index register V, Z.
3. When you do not want to execute a particular part of O100 main program in order to shorten the scan time and execute dual outputs, CJ instruction or CJP instruction can be adopted.
4. When the program designated by pointer P is prior to CJ instruction, WDT time-out will occur, and O100 main program will stop running. Please use it carefully.
5. CJ instruction can designate the same pointer P repeatedly. However, CJ and CALL cannot designate the same pointer P; otherwise errors may occur.
6. Actions of all devices while conditional jump is being executed.
   a) Y, M and S remain their previous status before the conditional jump takes place.
   b) The 10ms timer which is executing stops.
   c) General-purpose counter will stop counting, and general application instruction will not be executed.
   d) If the “reset instruction” of the timer is executed before the conditional jump, the device will be in the reset status while conditional jumping is being executed.

**Program Example 1:**

1. When X0 = On, the program will automatically jump from address 0 to N (the designated label P1) and keep its execution. The addresses between 0 and N will not be executed.
2. When X0 = Off, as an ordinary program, the program will keep on executing from address 0. CJ instruction will not be executed at this time.




**Program Example 2:**

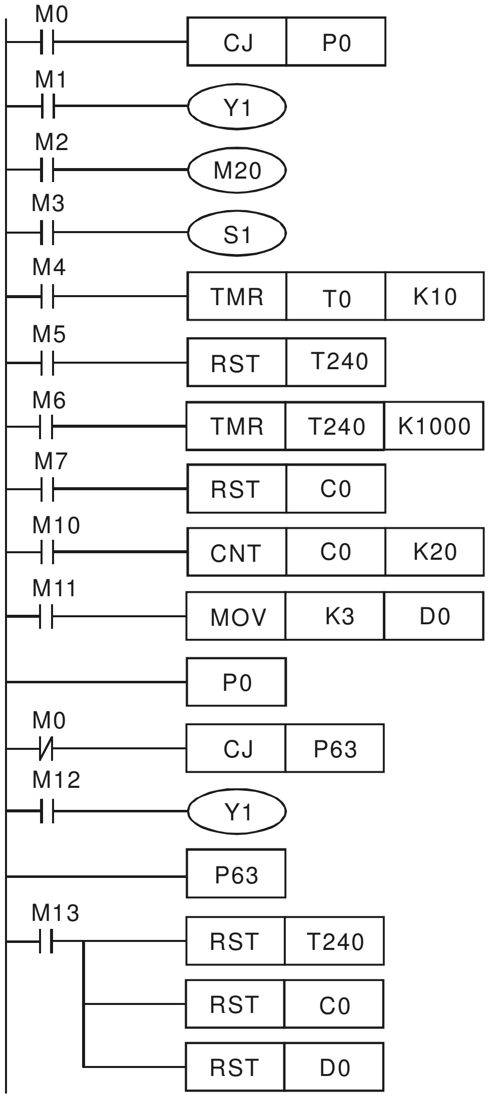
1. The status of each device:

| Device | Contact status before CJ is executed | Contact status when CJ is being executed | Output coil status when CJ is being executed |
|---|---|---|---|
| Y, M, S | M1, M2, M3 Off | M1, M2, M3 Off → On | Y1[*1], M20, S1 Off |
| | M1, M2, M3 On | M1, M2, M3 On → Off | Y1[*1], M20, S1 On |
| 10ms Timer[*2] | M4 Off | M4 Off → On | Timer T0 is not enabled. |
| | M4 On | M4 On → Off | Time T0 immediately stops and is latched. M0 On → Off. T0 is reset as 0. |
| | M6 Off | M6 Off → On | Timer T240 is not enabled. |
| | M6 On | M6 On → Off | Time T240 immediately stops and is latched. M0 On → Off. T240 is reset as 0. |
| C0 ~ C234 | M7, M10 Off | M10 On/Off trigger | Counter C0 does not count. |
| | M7 Off, M10 On/Off trigger | M10 On/Off trigger | Counter C0 stops counting and stays latched. After M0 goes Off, C0 will resume its counting. |
| Application instruction | M11 Off | M11 Off → On | Application instructions are not executed. |
| | M11 On | M11 On → Off | The skipped application instructions are not executed, but API 53 ~ 59, API 157 ~ 159 keep being executed. |

*1: Y1 is a dual output. When M0 is Off, M1 will control Y1. When M0 is On, M12 will control Y1.

*2: When the timers used by a subroutine are driven and encounter the execution of CJ instruction, the timing will resume. After the timing target is reached, the output contact of the timer will be On.

2. Y1 is a dual output. When M0 = Off, Y1 is controlled by M1. When M0 = On, Y1 is controlled by M12.


M0
CJ
P0
M1
Y1
M2
M20
M3
S1
M4
TMR
T0
K10
M5
RST
T240
M6
TMR
T240
K1000
M7
RST
C0
M10
CNT
C0
K20
M11
MOV
K3
D0
P0
M0
CJ
P63
M12
Y1
P63
M13
RST
T240
RST
C0
RST
D0

| API | Mnemonic | | Operands | Function |
|---|---|---|---|---|
| 01 | CALL | P | S | Call Subroutine |

| OP | Range | Program Steps |
|---|---|---|
| S | P0 ~ P255 | CALL, CALLP: 3 steps |

**Operands:**

**S**: The pointer of call subroutine

**Explanations:**

1. Operand **S** can designate P0 ~ P255.
2. P cannot be modified by index register V, Z.
3. Please compile the subroutine designated by the pointer after M102, M2 and SRET instructions.
4. The number of pointer P, when used by CALL, cannot be the same as the number designated by CJ, CJN and JMP instructions.
5. If only CALL instruction is in use, it can call subroutines of the same pointer number with no limits on the times.
6. You cannot use CALL to call other subroutines in a subroutine.

| API | Mnemonic | Function |
|---|---|---|
| 02 | SRET | Subroutine Return |

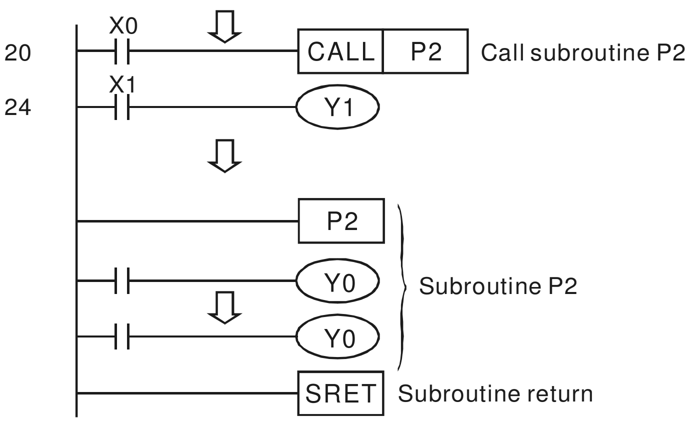
| OP | Descriptions | Program Steps |
|---|---|---|
| N/A | Automatically returns to the step immediately following the CALL instruction which activated the subroutine | SRET: 1 steps |

**Explanations:**

1. No operand. No contact to drive the instruction is required.
2. The subroutine will return to O100 main program from SRET adter the termination of subroutine and exxecute the instruction next to CALL instruction.

**Program Example 1:**

When X0 = On, CALL instruction will be executed, and the program will jump to the subroutine designated by P2. When SRET instruction is executed, the program will return to address 24 and continue its execution.

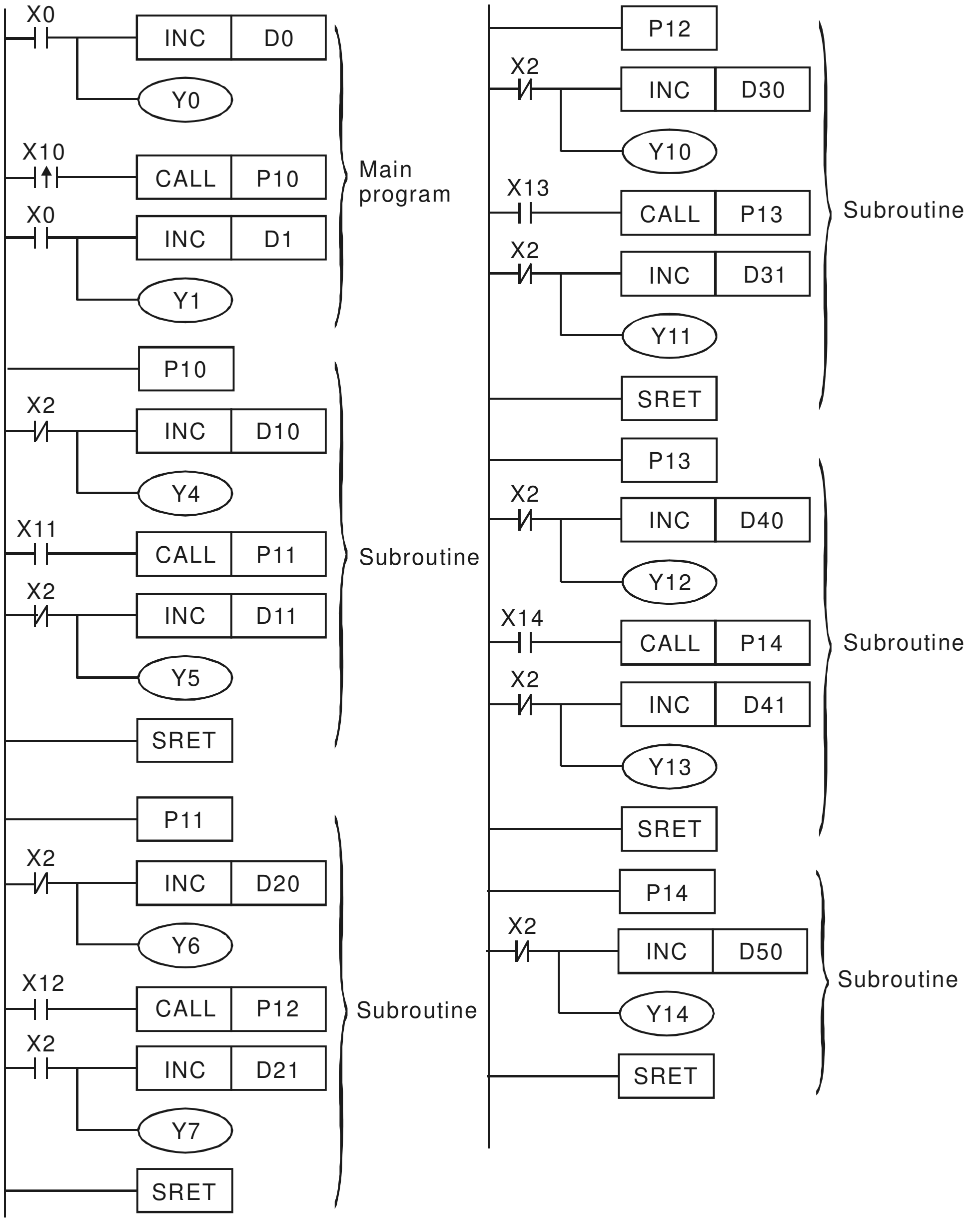



**Program Example 2:**

1. When X10 goes from Off to On, its rising-edge trigger will execute CALL P10 instruction, and the program will

jump to the subroutine designated by P10.

2. When X11 is On, CALL P11 will be executed, and the program will jump to the subroutine designated by P11.
3. When X12 is On, CALL P12 will be executed, and the program will jump to the subroutine designated by P12.
4. When X13 is On, CALL P13 will be executed, and the program will jump to the subroutine designated by P13.
5. When X14 is On, CALL P14 will be executed, and the program will jump to the subroutine designated by P14. When SRET is executed, the program will return to the previous P※ subroutine and continue its execution.
6. After SRET instruction is executed in P10 subroutine, the execution will return to the main program.



| API | Mnemonic | Operands | Function |
|---|---|---|---|
| 08 | RPT | (S) | Repetition Start |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | RPT: 3 steps |
| S | | | | | * | * | * | * | * | * | * | * | * | * | | |

**Operands:**

**S**: The number of repeated nested loops

**Explanations:**

1. No contact to drive the instruction is required.
2. RPT instruction supports V device.
3. See the specification of DVP-PM for its range of use.
4. The nested RPT ~ RPE loop can only be 1 layer. Errors will occur when the number of layers is more than 1.

| API | Mnemonic | Function |
|---|---|---|
| 09 | RPE | Repetition End |

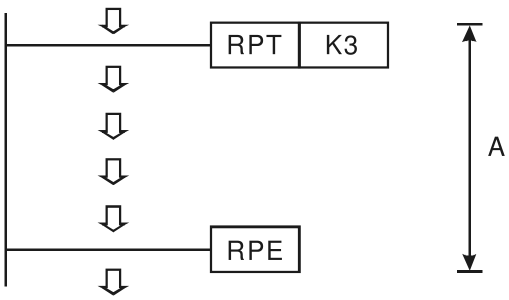
| OP | Descriptions | Program Steps |
|---|---|---|
| N/A | | RPE: 1 steps |

**Explanations:**

1. No operand. No contact to drive the instruction is required.
2. RPT instruction designates RPT ~ RPE loops to execute back and forth for N times before they escape for the next execution.
3. N = K1 ~ K32,767. N is regarded as K1 when N ≦ K1.
4. When RPT ~ RPE loop are not executed, you can use CJ instruction to escape the loop.
5. Errors will occur when
   - RPE instruction is placed before RPT instruction.
   - RPT instruction exists, but RPE instruction does not exist.
   - The numbers of instructions between RPT ~ RPE differ.
6. The nested RPT ~ RPE loop can only be 1 layer. Errors will occur when the number of layers is more than 1.

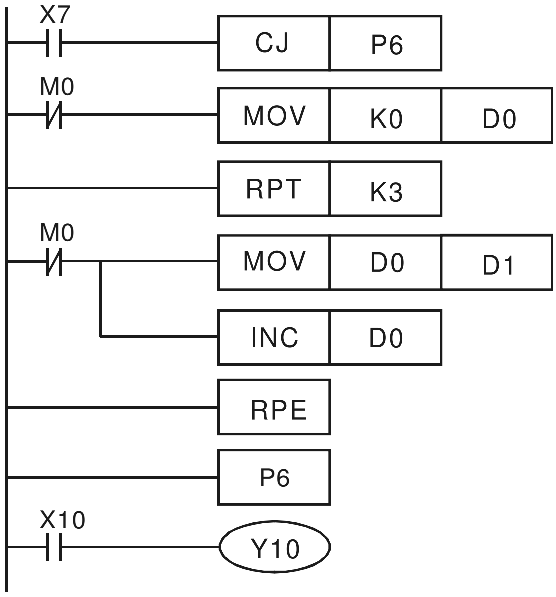
**Program Example 1:**

If you would like program section A to execute for 3 time, you can use RPT ~ RPE written as follow:



**Program Example 2:**

When X7 = Off, PLC will execute the program between RPT ~ RPE. When X7 = On, CJ instruction will jump to P6 and skip the program between RPT ~ RPE.



| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 10 | D | CMP | P | (S1) (S2) (D) | Compare |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | CMP, CMPP: 7 steps<br>DCMP, DCMPP: 9 steps |
| $S_1$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| $S_2$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| D | | * | * | * | | | | | | | | | | | | |

**Operands:**

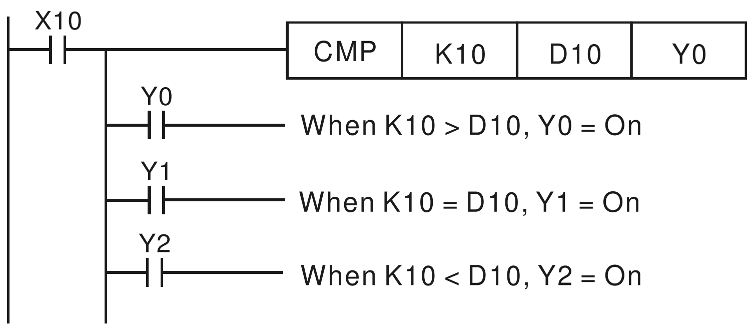
$\mathbf{S_1}$: Comparison value 1 $\mathbf{S_2}$: Comparison value 2 **D**: Comparison result

**Explanations:**

1. CMP instruction supports V and Z. When CMP is used as 16-bit instruction, Z device cannot be adopted; when CMP is used as 32-bit instruction, V device cannot be adopted.
2. See the specification of DVP-PM for its range of use.
3. The contents in $\mathbf{S_1}$ and $\mathbf{S_2}$ are compared, and the result will be stored in **D**.
4. **D** will occupy 3 consecutive points.

**Program Example:**

1. Designate device Y0, and operand **D** will automatically occupy Y0, Y1 and Y2.
2. When X10 = On, CMP instruction will be executed, and one of Y0, Y1 and Y2 will be On. When X10 = Off, CMP instruction will not be executed, and Y0, Y1 and Y2 will remain in their status before X10 = Off.
3. If you need to obtain a comparison result with ≧, ≦ and ≠, make a series/parallel connection between Y0 and Y2.



| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 11 | D | ZCP | P | (S1) (S2) (S) (D) | Zone Compare |

| OP \ Type | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | ZCP, ZCPP: 9 steps<br>DZCP, DZCPP: 12 steps |
| $S_1$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| $S_2$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| S | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| D | | * | * | * | | | | | | | | | | | | |

**Operands:**

**$S_1$**: Lower bound of zone comparison **$S_2$**: Upper bound of zone comparison **S**: Comparison value

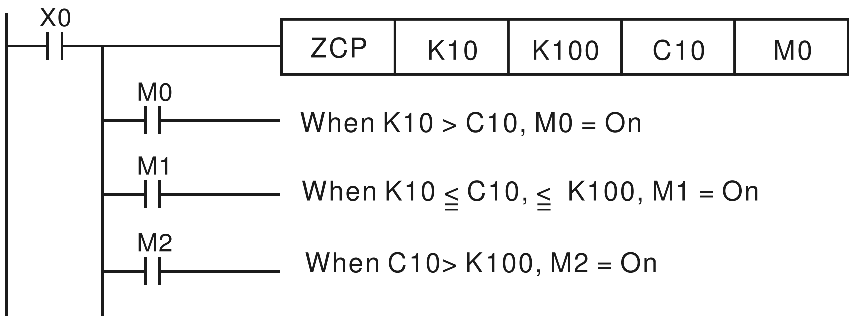
**D**: Comparison result

**Explanations:**

1. ZCP instruction supports V and Z. When ZCP is used as 16-bit instruction, Z device cannot be adopted; when ZCP is used as 32-bit instruction, V device cannot be adopted.
2. See the specification of DVP-PM for its range of use.
3. **S** is compared with **$S_1$**, **$S_2$**, and the result is stored in **D**.
4. The content in S1 should be smaller than the content in S2.
5. Operand **D** occupies 3 consecutive devices.

**Program Example:**

1. Designate device M0, and M0, M1 and M2 will be occupied automatically.
2. When X0 = On, ZCP instruction will be executed, and one of M0, M1 and M2 will be On. When X0 = Off, ZCP instruction will not be executed, and M0, M1 and M2 will remain their status before X0 = Off.



| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 12 | D | MOV | P | (S) (D) | Move |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | MOV, MOVP: 5 steps |
| S | | | | | * | * | * | * | * | * | * | * | * | * | * | DMOV, DMOVP: 6 steps |
| D | | | | | | | | * | * | * | * | * | * | * | * | |

**Operands:**

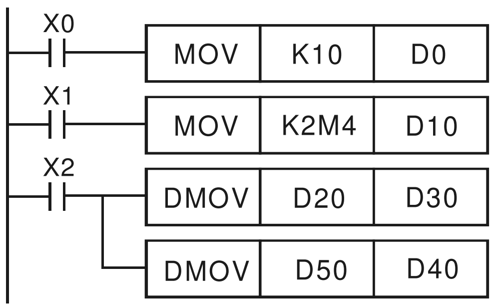
**S**: Source of data **D**: Destination of data

**Explanations:**

1. MOV instruction supports V and Z. When MOV is used as 16-bit instruction, Z device cannot be adopted; when MOV is used as 32-bit instruction, V device cannot be adopted.
2. See the specification of DVP-PM for its range of use.
3. When MOV instruction is executed, the content in **S** will be moved directly to **D**. When MOV is not executed, the content in **D** will remain unchanged.
4. If the operational result refers to a 32-bit output (e.g. application instruction MUL and so on), you will have to use DMOV instruction to move the data.

**Program Example:**

1. MOV instruction has to be adopted in the moving of 16-bit data.
   a) When X0 = Off, the content in D10 will remain unchanged. If X0 = On, the value K10 will be moved to data register D10.
   b) When X1 = Off, the content in D10 will remain unchanged. If X1 = On, the present value in K2M4 will be moved to data register D10.
2. DMOV instruction has to be adopted in the moving of 32-bit data.
   When X2 = Off, the content in (D31, D30) and (D41, D40) will remain unchanged. If X2 = On, the present value in (D21, D20) will be sent to data register (D31, D30). Meanwhile, the present value in (D51, D50) will be moved to data register (D41, D40).



| API | Mnemonic | | | Operands | | Function |
|---|---|---|---|---|---|---|
| 18 | D | BCD | P | (S) | (D) | Binary Coded Decimal |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | BCD, BCDP: 5 steps<br>DBCD, DBCDP: 6 steps |
| S | | | | | | | * | * | * | * | * | * | * | * | * | |
| D | | | | | | | | * | * | * | * | * | * | * | * | |

**Operands:**

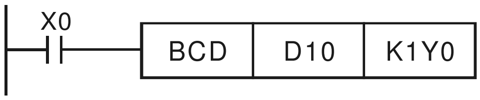
**S**: Source of data **D**: Result of conversion

**Explanations:**

1. BCD instruction supports V and Z. When BCD is used as 16-bit instruction, Z device cannot be adopted; when BCD is used as 32-bit instruction, V device cannot be adopted.
2. See the specification of DVP-PM for its range of use.
3. Flags: M1811, M1891, M1971 (operational error)
4. The content in **S** (BIN value) is converted into BCD value and stored in **D**.
5. If the conversion result exceeds the range of 0 ~ 9,999, BCD will not be executed. If the conversion result exceeds the range of 0 ~ 99,999,999, DBCD will not be executed.
6. BCD instruction converts the BIN data in the positioning unit into BCD data (7-segment display and so on) to be output to the external device.

**Program Example:**

When X0 = On, the binary value in D10 will be converted into BCD value, and the 1s digit of the conversion result will be stored in K1Y0 (Y0 ~ Y3, the 4 bit devices).




If D10 = 001E (hex) = 0030 (decimal), the execution result will be: Y0 ~ Y3 = 0000 (BIN).

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 19 | D | BIN | P | (S) (D) | Binary |

| OP \ Type | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | BIN, BINP: 5 steps<br>DBIN, DBINP: 6 steps |
| S | | | | | | | * | * | * | * | * | * | * | * | * | |
| D | | | | | | | | * | * | * | * | * | * | * | * | |

**Operands:**

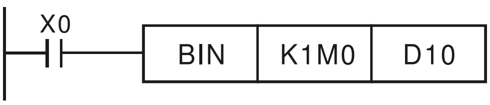
**S**: Source of data **D**: Result of conversion

**Explanations:**

1. BIN instruction supports V and Z. When BIN is used as 16-bit instruction, Z device cannot be adopted; when BIN is used as 32-bit instruction, V device cannot be adopted.
2. See the specifications of DVP-PM for its range of use.
3. Flags: M1811, M1891, M1971 (operational error)
4. The content in **S** (BCD value) is converted into BIN value and stored in **D**.
5. Valid range of **S**: BCD (0 ~ 9,999), DBCD (0 ~ 99,999,999)
6. Constant K and H will automatically be converted into BIN format. Thus, they do not need to adopt this instruction.

**Program Example:**

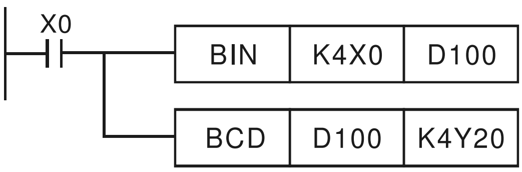
When X0 = On, the BCD value in K1M0 will be converted into BIN value and stored in D10.




**Remarks:**

Explanations on BCD and BIN instructions:

1. When DVP-PM needs to read an external DIP switch in BCD format, BIN instruction has to be first adopted to convert the read data into BIN value and store the data in DVP-PM.
2. When DVP-PM needs to display its stored data by a 7-segment display in BCD format, BCD instruction has to be first adopted to convert the data into BCD value and send the data to the 7-segment display.
3. When X0 = On, the BCD value in K4X0 will be converted into BIN value and sent to D100. The BIN value in D100 will then be converted into BCD value and sent to K4Y20.



| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 20 | D | ADD | P | S1 S2 D | Addition |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | ADD, ADDP: 7 steps<br>DADD, DADDP: 9 steps |
| $S_1$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| $S_2$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| D | | | | | | | | * | * | * | * | * | * | * | * | |

**Operands:**

**$S_1$**: Summand **$S_2$**: Addend **D**: Sum

**Explanations:**

1. ADD instruction supports V and Z. When ADD is used as 16-bit instruction, Z device cannot be adopted; when ADD is used as 32-bit instruction, V device cannot be adopted.
2. See the specifications of DVP-PM for its range of use.
3. Flags:

| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Borrow flag | M1809 | M1889 | M1969 |
| Carry flag | M1810 | M1890 | M1970 |

See below for more information.

4. ADD instruction adds up **$S_1$** and **$S_2$** in BIN format and stores the result in **D**.
5. The highest bit is sign bit 0 (+) and 1 (-), which is for algebraic addition, e.g. 3 + (-9) = -6.
6. Flag changes in binary addition

   In 16-bit BIN addition,

   a) If the operational result = 0, the zero flag will be On.
   b) If the operational result < -32,768, the borrow flag will be On.
   c) If the operational result > 32,767, the carry flag will be On.

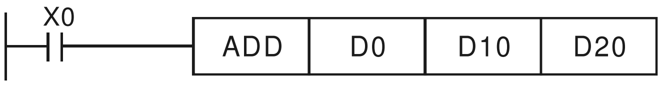
   In 32-bit BIN addition,

   a) If the operational result = 0, the zero flag will be On.
   b) If the operational result < -2,147,483,648, the borrow flag will be On.
   c) If the operational result > 2,147,483,647, the carry flag will be On.

**Program Example 1:**

In 16-bit BIN addition:

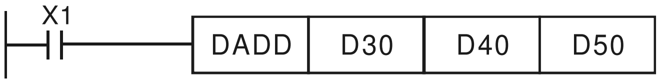
When X0 = On, the content in D0 will plus the content in D10, and the sum will be stored in D20.




**Program Example 2:**

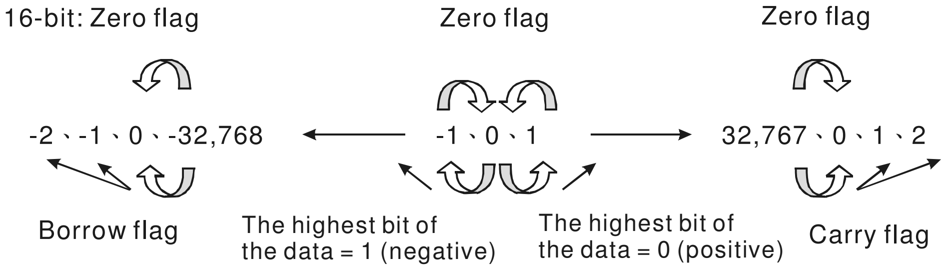
In 32-bit BIN addition:

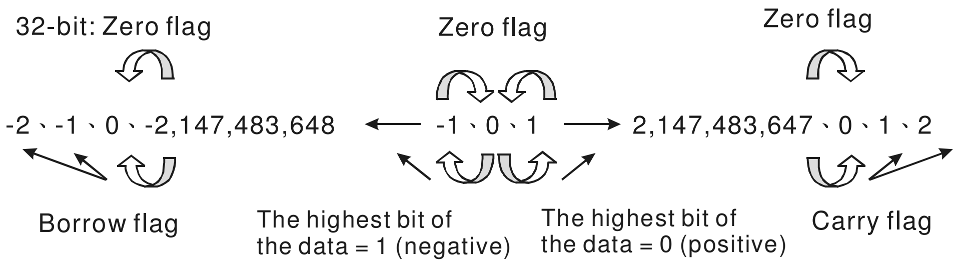
When X1 = On, the content in (D31, D30) will plus the content in (D41, D40), and the sum will be stored in (D51, D50). D30, D40 and D50 are low 16-bit data; D31, D41 and D51 are high 16-bit data.




**Remarks:**

Flags and the positive/negative sign of the values:



| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 21 | D | SUB | P | (S1) (S2) (D) | Subtraction |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | SUB, SUBP: 7 steps<br>DSUB, DSUBP: 9 steps |
| $S_1$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| $S_2$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| D | | | | | | | | * | * | * | * | * | * | * | * | |

**Operands:**

**$S_1$**: Minuend  **$S_2$**: Subtrahend  **D**: Remainder

**Explanations:**

1. SUB instruction supports V and Z. When SUB is used as 16-bit instruction, Z device cannot be adopted; when SUB is used as 32-bit instruction, V device cannot be adopted.
2. See the specifications of DVP-PM for its range of use.
3. Flags:

| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Borrow flag | M1809 | M1889 | M1969 |
| Carry flag | M1810 | M1890 | M1970 |

   See below for more information.
4. SUB instruction subtracts **$S_1$** and **$S_2$** in BIN format and stores the result in **D**.
5. The highest bit is sign bit 0 (+) and 1 (-), which is for algebraic subtraction.
6. Flag changes in binary subtraction

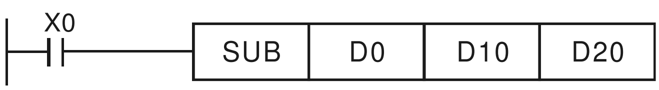
   In 16-bit DIN subtraction,
   a) If the operational result = 0, the zero flag will be On.
   b) If the operational result < -32,768, the borrow flag will be On.
   c) If the operational result > 32,767, the carry flag will be On.

   In 32-bit BIN subtraction,
   a) If the operational result = 0, the zero flag will be On.
   b) If the operational result < -2,147,483,648, the borrow flag will be On.
   c) If the operational result > 2,147,483,647, the carry flag will be On.
7. For flag operation of SUB instruction and the positive/negative sign of the values, see the explanations in ADD instruction on the pervious page.

**Program Example 1:**

In 16-bit BIN subtraction:

When X0 = On, the content in D0 will minus the content in D10, and the remainder will be stored in D20.

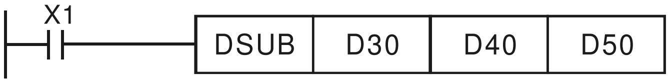



**Program Example 2:**

In 32-bit BIN subtraction:

When X1 = On, the content in (D31, D30) will minus the content in (D41, D40), and the remainder will be stored in

(D51, D50). D30, D40 and D50 are low 16-bit data; D31, D41 and D51 are high 16-bit data.



| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 22 | D | MUL | P | S1 S2 D | Multiplication |

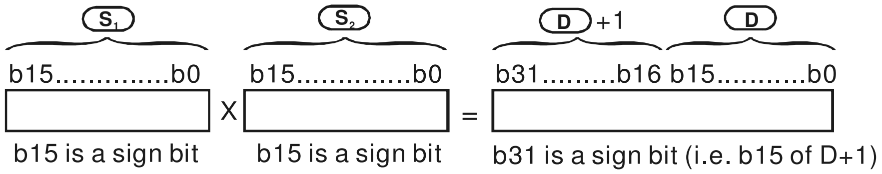
| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | MUL, MULP: 7 steps<br>DMUL, DMULP: 9 steps |
| $S_1$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| $S_2$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| D | | | | | | | | | | | * | * | * | | | |

**Operands:**

$S_1$: Multiplicand    $S_2$: Multiplicator    **D**: Product

**Explanations:**

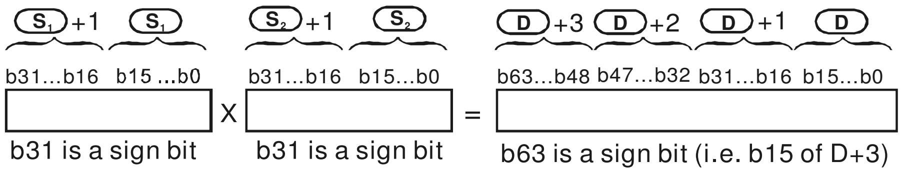
1. MUL instruction supports V and Z. When SUB is used as 16-bit instruction, Z device cannot be adopted; when MUL is used as 32-bit instruction, V device cannot be adopted.
2. See the specifications of DVP-PM for its range of use.
3. MUL instruction multiplies $S_1$ by $S_2$ in BIN format and stores the result in **D**. Be careful with the positive/negative sign of $S_1$, $S_2$ and **D** when doing 16-bit and 32-bit operations.
4. In 16-bit BIN multiplication:




   Sign bit = 0 refers to a positive value.

   Sign bit = 1 refers to a negative value.

5. In 32-bit BIN multiplication:

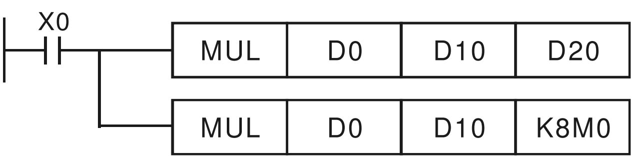



   Sign bit = 0 refers to a positive value.

   Sign bit = 1 refers to a negative value.

**Program Example:**

The 16-bit D0 is multiplied by the 16-bit D10 and brings forth a 32-bit product. The higher 16 bits are stored in D21, and the lower 16 bits are stored in D20. On/Off of the most left bit indicates the positive/negative status of the result.



| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 23 | D | DIV | P | S1 S2 D | Division |

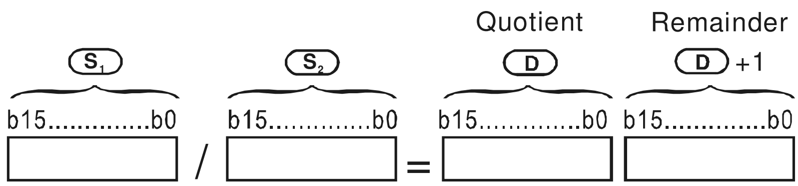
| OP \ Type | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DIV, DIVP: 7 steps<br>DDIV, DDIVP: 9 steps |
| $S_1$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| $S_2$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| D | | | | | | | | | | | * | * | * | | | |

**Operands:**

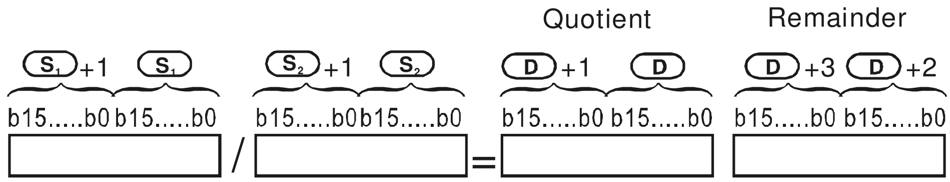
**$S_1$**: Dividend **$S_2$**: Divisor **D**: Quotient and remainder

**Explanations:**

1. DIV instruction supports V and Z. When DIV is used as 16-bit instruction, Z device cannot be adopted; when DIV is used as 32-bit instruction, V device cannot be adopted.
2. See the specifications of DVP-PM for its range of use.
3. DIV instruction divides **$S_1$** and **$S_2$** in BIN format and stores the result in **D**. Be careful with the positive/negative signs of **$S_1$**, **$S_2$** and **D** when doing 16-bit and 32-bit operations.
4. DIV will not be executed when the divisor is 0.
5. In 16-bit BIN division:

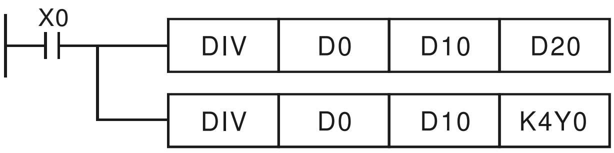



6. In 32-bit BIN division:




**Program Example:**

When X0 = On, D0 will be divided by D10, and the quotient will be stored in D20 and remainder in D21. On/Off of the highest bit indicates the positive/negative status of the result.



| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 24 | D | INC | P | D | Increment |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | INC, INCP: 3 steps |
| D | | | | | | | | * | * | * | * | * | * | * | * | DINC, DINCP: 3 steps |

**Operands:**

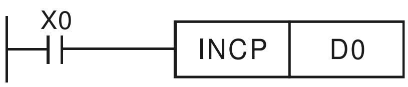
**D**: Destination device

**Explanations:**

1. INC instruction supports V and Z. When INC is used as 16-bit instruction, Z device cannot be adopted; when INC is used as 32-bit instruction, V device cannot be adopted.
2. See the specifications of DVP-PM for its range of use.
3. If the instruction is not a pulse execution one, the content in the designated device D will plus “1” in every scan period whenever the instruction is executed.
4. API 24 adopts the pulse execution instruction (INCP, DINCP).
5. In the 16-bit operation, 32,767 pluses “1” into -32,768. In the 32-bit operation, 2,147,483,647 pluses “1” into -2,147,483,648.

**Program Example:**

When X0 goes from Off to On, the content in D0 will plus “1” automatically.



| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 25 | D | DEC | P | D | Decrement |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DEC, DECP: 3 steps |
| D | | | | | | | | * | * | * | * | * | * | * | * | DDEC, DDECP: 3 steps |

**Operands:**

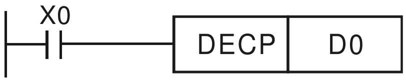
**D**: Destination device

**Explanations:**

1. DEC instruction supports V and Z. When DEC is used as 16-bit instruction, Z device cannot be adopted; when DEC is used as 32-bit instruction, V device cannot be adopted.
2. See the specifications of DVP-PM for its range of use.
3. If the instruction is not a pulse execution one, the content in the designated device D will minus “1” in every scan period whenever the instruction is executed.
4. API 25 adopts the pulse execution instruction (DECP, DDECP).
5. In the 16-bit operation, -32,768 mimuses “1” into 32,767. In the 32-bit operation, -2,147,483,648 minuses “1” into 2,147,483,647.

**Program Example:**

When X0 goes from Off to On, the content in D0 will minus “1” automatically.



| API | | Mnemonic | | Operands | Function |
|---|---|---|---|---|---|
| 26 | D | WAND | P | S1 S2 D | Logical Word AND |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | WAND, WANDP: 7 steps<br>DWAND, DWANDP: 9 steps |
| $S_1$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| $S_2$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| D | | | | | | | | * | * | * | * | * | * | * | * | |

**Operands:**

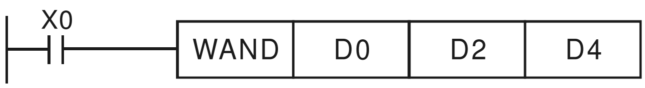
**$S_1$**: Source data device 1 **$S_2$**: Source data device 2 **D**: Operational result

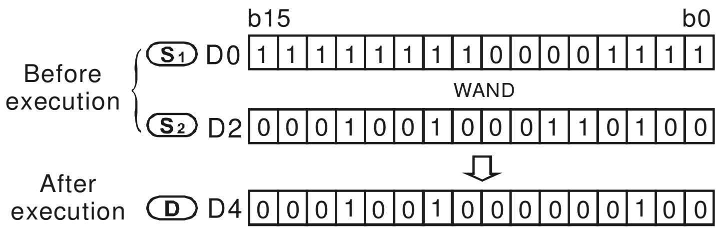
**Explanations:**

1. WAND instruction supports V and Z. When WAND is used as 16-bit instruction, Z device cannot be adopted; when WAND is used as 32-bit instruction, V device cannot be adopted.
2. See the specifications of DVP-PM for its range of use.
3. WAND instruction conducts logical AND operation of **$S_1$** and **$S_2$** and stores the result in **D**.
4. Operation rule: The operational result will be "0" if any of the bits in **$S_1$** or **$S_2$** is "0".

**Program Example 1:**

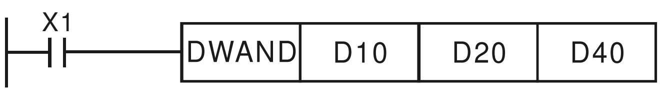
When X0 = On, the 16-bit D0 and D2 will perform WAND logical AND operation, and the result will be stored in D4.

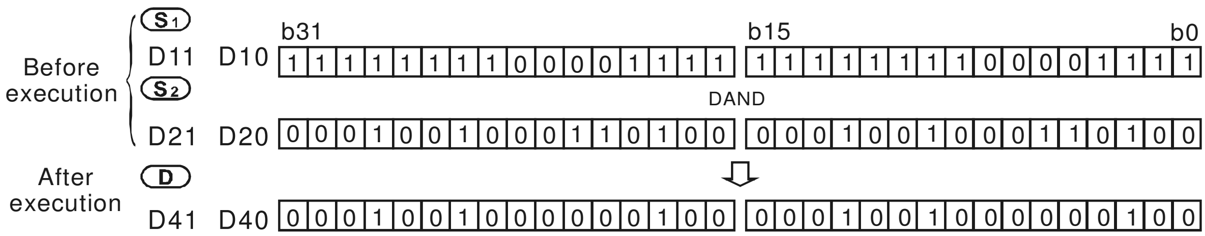



**Program Example 2:**

When X1 = On, the 32-bit (D11, D10) and (D21, D20) will perform DWAND logical AND operation, and the result will be stored in (D41, D40).



| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 27 | D | WOR | P | (S1) (S2) (D) | Logical Word OR |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | WOR, WORP: 7 steps<br>DWOR, DWORP: 9 steps |
| $S_1$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| $S_2$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| D | | | | | | | | * | * | * | * | * | * | * | * | |

**Operands:**

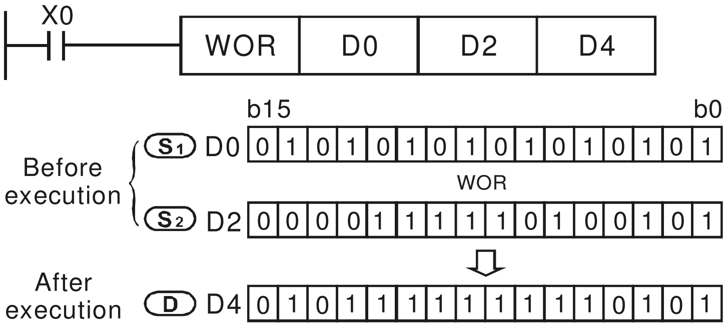
**$S_1$**: Source data device 1 **$S_2$**: Source data device 2 **D**: Operational result

**Explanations:**

1. WOR instruction supports V and Z. When WOR is used as 16-bit instruction, Z device cannot be adopted; when WOR is used as 32-bit instruction, V device cannot be adopted.
2. See the specifications of DVP-PM for its range of use.
3. WOR instruction conducts logical OR operation of $S_1$ and $S_2$ and stores the result in **D**.
4. Operation rule: The operational result will be "1" if any of the bits in $S_1$ or $S_2$ is "1".

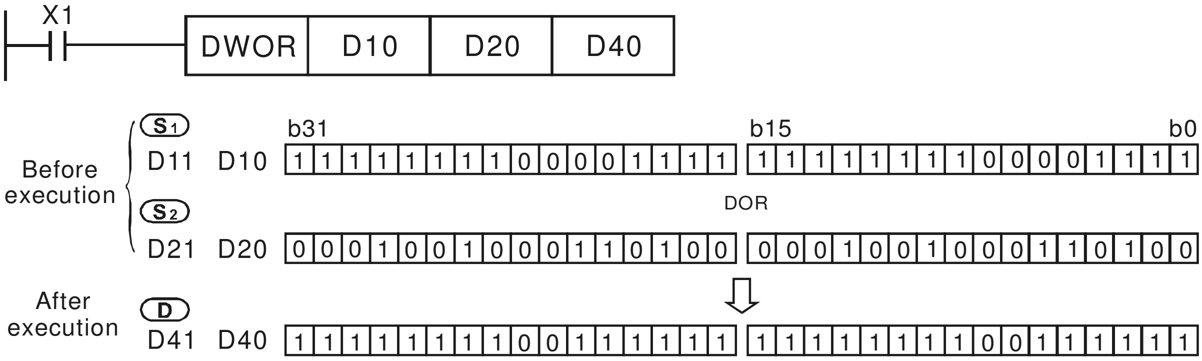
**Program Example 1:**

When X0 = On, the 16-bit D0 and D2 will perform WOR logical OR operation, and the result will be stored in D4.




**Program Example 2:**

When X1 = On, the 32-bit (D11, D10) and (D21, D20) will perform DWOR logical OR operation, and the result will be stored in (D41, D40).



| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 28 | D | WXOR | P | S1 S2 D | Logical Exclusive OR |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | |
| $S_1$ | | | | | * | * | * | * | * | * | * | * | * | * | * | WXOR, WXORP: 7 steps<br>DWXOR, DWXORP: 9 steps |
| $S_2$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| D | | | | | | | | * | * | * | * | * | * | * | * | |

**Operands:**

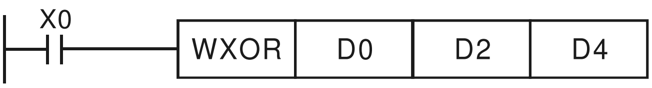
**$S_1$**: Source data device 1 **$S_2$**: Source data device 2 **D**: Operational result

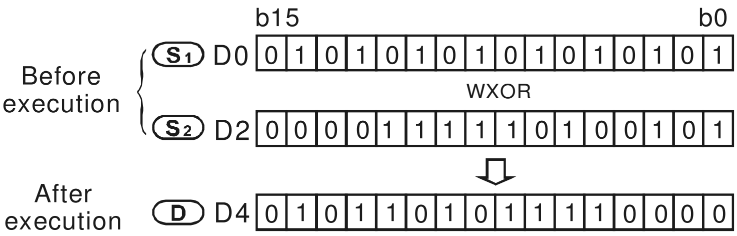
**Explanations:**

1. WXOR instruction supports V and Z. When WXOR is used as 16-bit instruction, Z device cannot be adopted; when WXOR is used as 32-bit instruction, V device cannot be adopted.
2. See the specifications of DVP-PM for its range of use.
3. WXOR instruction conducts logical XOR operation of **$S_1$** and **$S_2$** and stores the result in **D**.
4. Operation rule: If the bits in **$S_1$** and **$S_2$** are the same, the corresponding bit of the operational result in D will be "0". If the bits in **$S_1$** and **$S_2$** are different, the corresponding bit of the operational result in D will be "1".

**Program Example 1:**

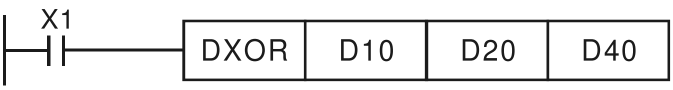
When X0 = On, the 16-bit D0 and D2 will perform WXOR logical XOR operation, and the result will be stored in D4.

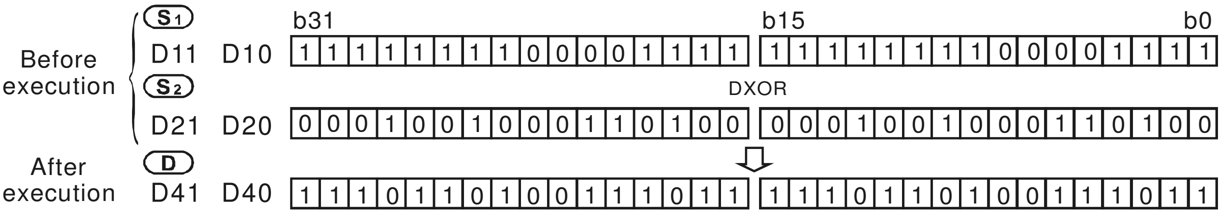



**Program Example 2:**

When X1 = On, the 32-bit (D11, D10) and (D21, D20) will perform DWXOR logical XOR operation, and the result will be stored in (D41, D40).



| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 29 | D | NEG | P | D | 2’s Complement (Negative) |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | NEG, NEGP: 7 steps |
| D | | | | | | | | * | * | * | * | * | * | * | * | DNEG, DNEGP: 9 steps |

**Operands:**

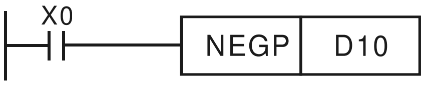
**D**: Device to store 2’s complement

**Explanations:**

1. NEG instruction supports V and Z. When NEG is used as 16-bit instruction, Z device cannot be adopted; when NEG is used as 32-bit instruction, V device cannot be adopted.
2. See the specifications of DVP-PM for its range of use.
3. NEG instruction converts a negative BIN value into an absolute value.
4. API 29 adopts the pulse execution instruction (NEGP, DNEGP).

**Program Example 1:**

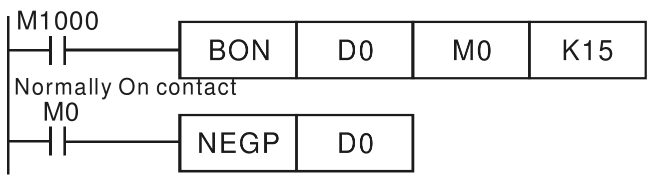
When X0 goes from Off to On, the phase of every bit of the content in D10 will be reversed (i.e. 0→1, 1→0) and plus “1”. The result will then be stored in D10.




**Program Example 2:**

Obtaining the absolute value of a negative value:

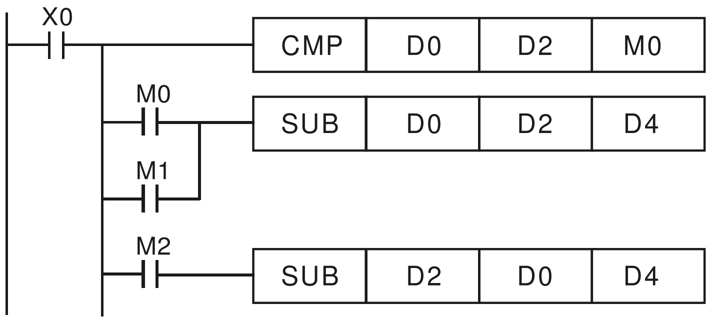
1. When the 15th bit of D0 is “1”, M0 will be On. (D0 is a negative value.)
2. When M0 = On, use NEG instruction to obtain 2’s complement of D0 and further its absolute value.




**Program Example 3:**

Obtaining the absolute value of the remainder in the subtraction. When X0 = On,

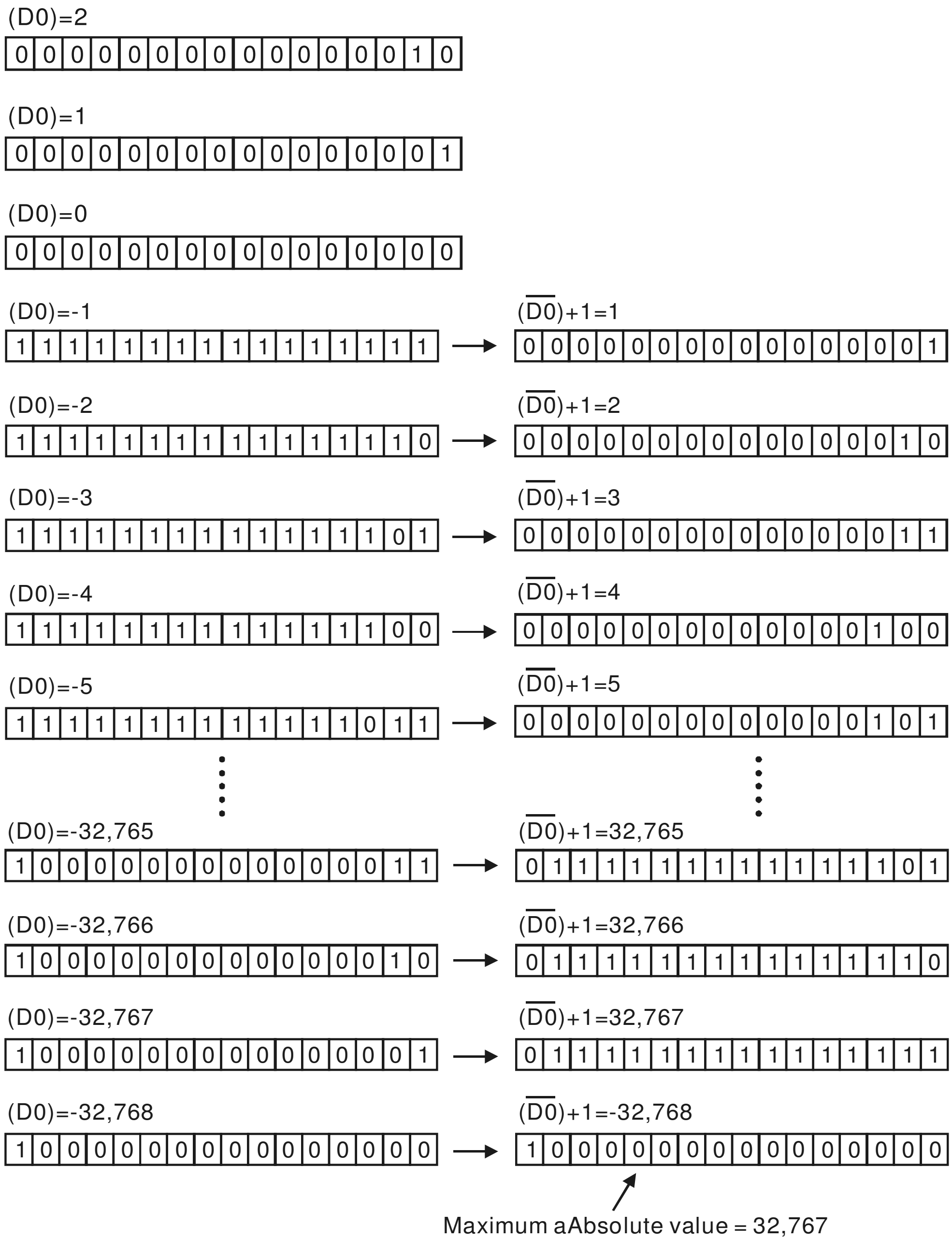
1. If D0 > D2, M0 = On.
2. If D0 = D2, M1 = On.
3. If D0 < D2, M2 = On.
4. D4 is then able to remain positive.




**Remarks:**

Negative value and its absolute value:

1. The sign of a value is indicated by the highest (most left) bit in the register. “0” indicates that the value is a positive on, and “1” indicates that the value is a negative one.
2. NEG instruction is able to convert a negative value into its absolute value.



| API | Mnemonic | | Operands | Function |
|---|---|---|---|---|
| 40 | ZRST | P | D1 D2 | Zero Reset |

| Type / OP | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bit Devices | | | | Word Devices | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | ZRST, ZRSTP: 5 steps |
| $D_1$ | | * | * | * | | | | | | | * | * | * | | | |
| $D_2$ | | * | * | * | | | | | | | * | * | * | | | |

**Operands:**

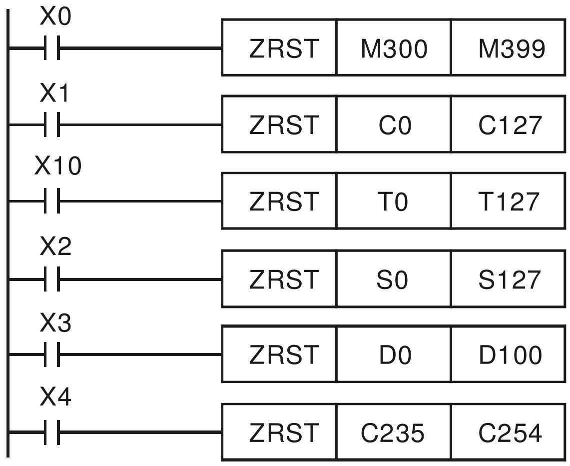
**$D_1$**: Start device of the range to be reset **$D_2$**: End device of the range to be reset

**Explanations:**

1. The No. of operand **$D_1$** ≦ the No. of operand **$D_2$**.
2. **$D_1$** and **$D_2$** have to designate devices of the same type.
3. All the devices do not support V and Z index modification.
4. See the specifications of DVP-PM for its range of use.
5. 16-bit counter and 32-bit counter can use ZRST instruction together.
6. When **$D_1$** > **$D_2$**, only operands designated by **$D_2$** will be reset.

**Program Example:**

1. When X0 = On, auxiliary relay M300 ~ M399 will be reset to Off.
2. When X1 = On, 16-bit counters C0 ~ C127 will all be reset (being written in 0; contact and coil reset to Off).
3. When X10 = On, timers T0 ~ T127 will all be reset (being written in 0; contact and coil reset to Off).
4. When X2 = On, steps S0 ~ S127 will be reset to Off.
5. When X3 = On, data registers D0 ~ D100 will be reset to 0.
6. When X4 = On, 32-bit counters C235 ~ C254 will all be reset (being written in 0; contact and coil being reset to Off).




**Remarks:**

Bit devices Y, M, S and word devices T, C, D can use RST instruction individually.

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 49 | D | FLT | P | (S) (D) | Floating Point |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DFLT, DFLTP: 6 steps |
| S | | | | | * | * | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

**S**: Source device for conversion **D**: Device for storing the conversion result

**Explanations:**

1. See the specifications of DVP-PM for its range of use.
2. Only 32-bit instructions DFLT and DFLTP are applicable.
3. Flags:

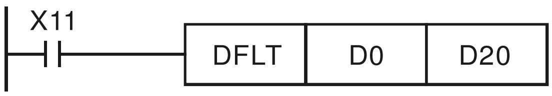
| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Borrow flag | M1809 | M1889 | M1969 |
| Carry flag | M1810 | M1890 | M1970 |

See below for more information.

4. FLT instruction converts BIN integer into binary floating point value.
   a) If the absolute value of the converstion result > max. floating point value, the carry flag will be On.
   b) If the absolute value of the conversion result < min. floating point value, the borrow flag will be On.
   c) If the conversion result is “0”, the zero flag will be On.

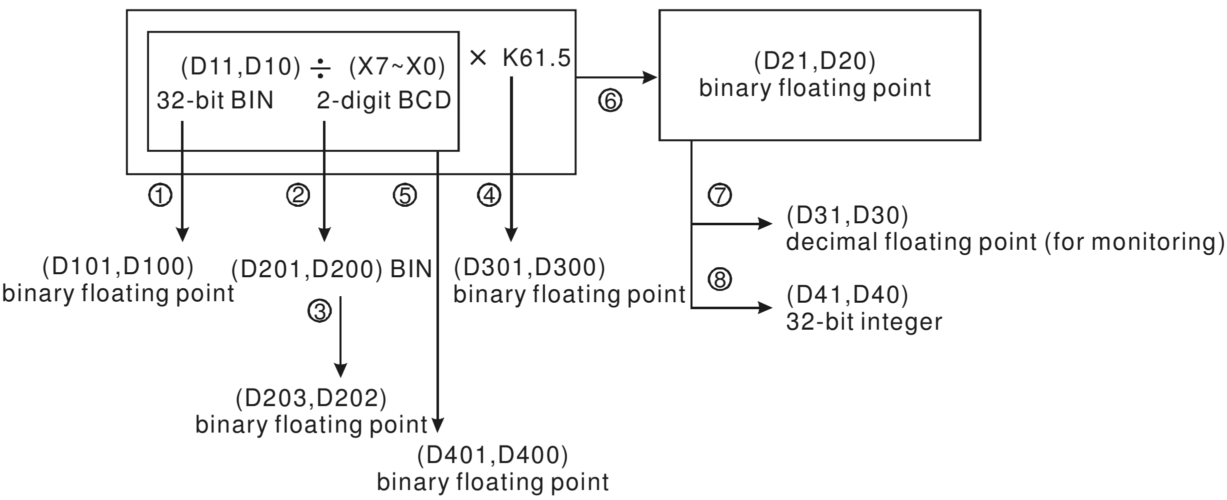
**Program Example 1:**

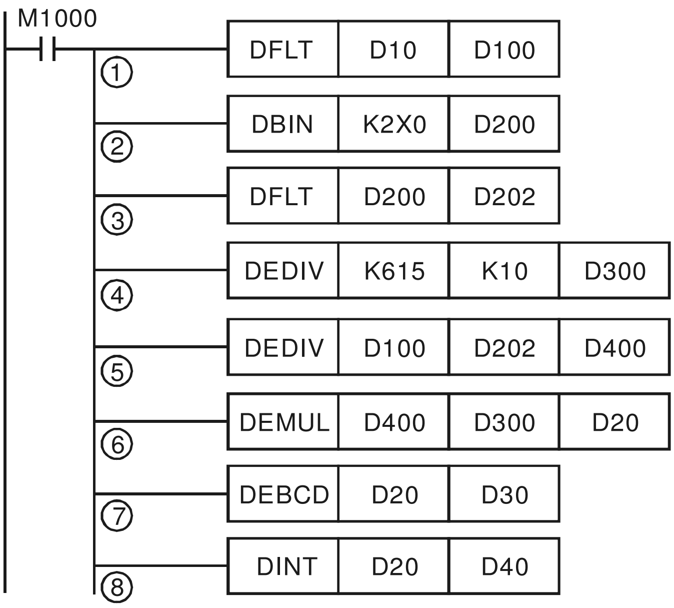
1. When X11 = On, D1 and D0 (BIN integers) are converted into D21 and D20 (binary floating point values).
2. If 32-bit register D0 (D1) = K100,000, X11 will be On. The 32-bit value of the converted floating point will be H’4735000 and stored in the 32-bit register D20 (D21).




**Program Example 2:**

Using FLT instruction to complete the following operation:






① D11 and D10 (BIN integers) are converted into D101 and D100 (binary floating point values).

② X7 ~ X0 (BCD values) are converted into D201 and D200 (BIN values).

③ D201 and D200 (BIN integers) are converted into D203 and D202 (binary floating point values).

④ The result of K615 ÷ K10 is stored in D301 and D300 (binary floating point values).

⑤ The result of binary decimal division (D101, D100) ÷ (D203, D202) is stored in D401 and D400 (binary floating point values).

⑥ The result of binary decimal multiplication (D401, D400) × (D301, D300) is stored in D21 and D20 (binary floating point values).

⑦ D21 and D20 (binary floating point values) are converted into D31 and D30 (decimal floating point values).

⑧ D21 and D20 (binary floating point values) are converted into D41 and D40 (BIN integers).

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 78 | D | FROM | P | (m1) (m2) (D) (n) | Read CR Data in Special Modules |

| OP \ Type | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | FROM, FROMP: 9 steps<br>DFROM, DFROMP: 17 steps |
| $m_1$ | | | | | * | * | | | | | * | * | * | * | * | |
| $m_2$ | | | | | * | * | | | | | * | * | * | * | * | |
| D | | | | | | | | | | | * | * | * | * | * | |
| n | | | | | * | * | | | | | * | * | * | * | * | |

**Operands:**

**$m_1$**: No. of special module **$m_2$**: CR# in special module to be read **D**: Device for storing read data **n**: Number of data to be read at a time

**Explanations:**

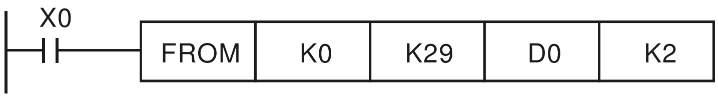
1. Range of **$m_1$** (16-bit and 32-bit): 0 ~ 255
2. Range of **$m_2$** (16-bit and 32-bit): 0 ~ 499
3. Range of **n**:

   16-bit: 1 ~ (500 – m2)

   32-bit: 1 ~ (500 – m2)/2
4. FROM instruction supports V and Z. When FROM is used as 16-bit instruction, Z device cannot be adopted; when FROM is used as 32-bit instruction, V device cannot be adopted.
5. FROM instruction is used for reading the data in the CR in special modules.
6. See Remarks of API 79 TO for the numbering of special modules.

**Program Example:**

1. Read CR#29 of special module No. 0 into D0 and CR#30 into D1. Only 2 groups of data are read at a time (n = 2).
2. When X0 = On, the instruction will be executed. When X0 = Off, the instruction will not be executed, and the data read will not be changed.



| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 79 | D | TO | P | m1 m2 S n | Write CR Data into Special Modules |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | TO, TOP: 9 steps<br>DTO, DTOP: 17 steps |
| $m_1$ | | | | | * | * | | | | | * | * | * | * | * | |
| $m_2$ | | | | | * | * | | | | | * | * | * | * | * | |
| S | | | | | * | * | | | | | * | * | * | * | * | |
| n | | | | | * | * | | | | | * | * | * | * | * | |

**Operands:**

**$m_1$**: No. of special module **$m_2$**: CR# in special module to be written **S**: Data to be written in CR

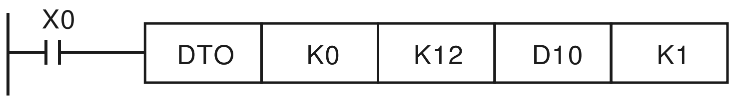
**n**: Number of data to be written at a time

**Explanations:**

1. Range of **$m_1$** (16-bit and 32-bit): 0 ~ 255
2. Range of **$m_2$** (16-bit and 32-bit): 0 ~ 499
3. Range of **n**:
   16-bit: 1 ~ (500 – m2)
   32-bit: 1 ~ (500 – m2)/2
4. TO instruction supports V and Z. When TO is used as 16-bit instruction, Z device cannot be adopted; when TO is used as 32-bit instruction, V device cannot be adopted.
5. TO instruction is used for writing the data into the CR in special modules.

**Program Example:**

1. Use 32-bit instruction DTO to write the contents in D11 and D10 into CR#13 and CR#12 of special module No. 0. Only 1 group of data is written in at a time ( n = 1).
2. When X0 = On, the instruction will be executed. When X0 = Off, the instruction will not be executed, and the data written will not be changed.

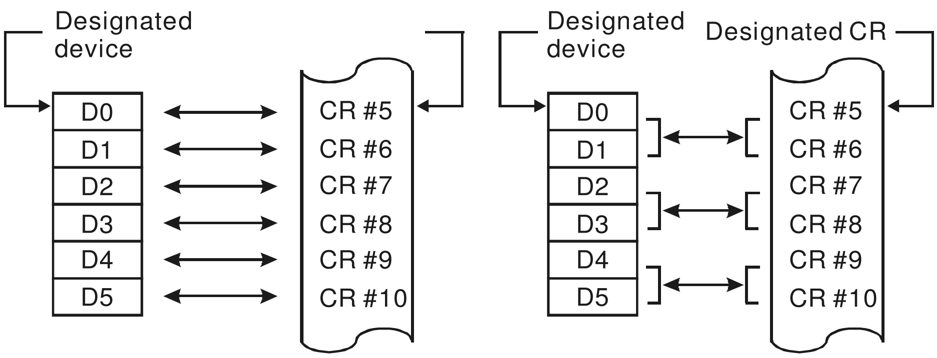



**Remarks:**

Operand rules:

1. **$m_1$**: The No. of special modules connected to DVP-PM. No. 0 is the module closest to DVP-PM. Maximum 8 modules are allowed to connect to DVP-PM, and they will not occupy any I/O points.
2. m2: CR#. CR (control register) is the 16-bit memories built in the special module, numbered in decimal as #0 ~ #n. All operational status and settings of the special modules are contained in the CR.
3. FROM/TO instruction is for reading/writing 1 CR at a time. DFROM/DTO instruction is for reading/writing 2 CRs at a time.

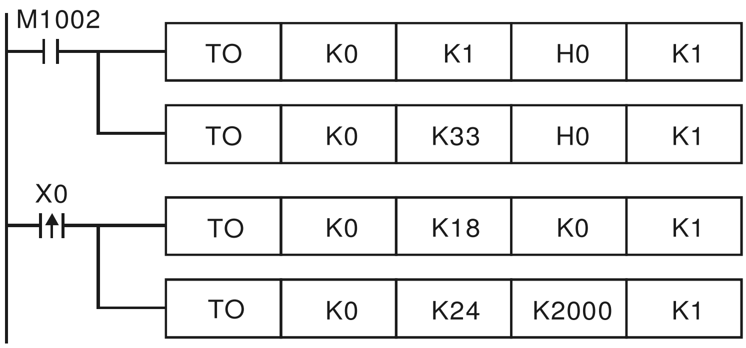

4. Number of groups “n” to be transmitter: n = 2 in 16-bit instructions and n = 1 in 32-bit instruction mean the same.




16-bit instruction when n = 6 32-bit instruction when n = 3

**FROM/TO Application Example 1:**

Adjust the A/D conversion curve of DVP04AD-H2. Set the OFFSET value of CH1 as 0V ( = $K0_{LSB}$) and GAIN value as 2.5V ( = $K2,000_{LSB}$).




1. Write H’0 into CR#1 of analog input module No. 0, and set CH1 as mode 0 (voltage input: -10V ~ +10V).
2. Write H’0 into CR#33 and allow OFFSET/GAIN tuning in CH1 ~ CH4.
3. When X0 goes from Off to On, write the OFFSET value $K0_{LSB}$ into CR#18 and GAIN value $K2,000_{LSB}$ into CR#24.

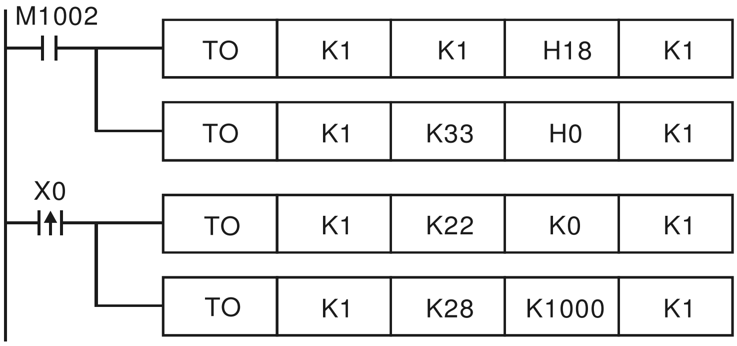
**FROM/TO Application Example 2:**

Adjust the A/D conversion curve of DVP04AD-H2. Set the OFFSET value of CH2 as 2mA ( = $K400_{LSB}$) and GAIN value as 18mA ( = $K3,600_{LSB}$).


1. Write H’18 into CR#1 of analog input module No. 0, and set CH2 as mode 3 (current input: -20mA ~ +20mA).
2. Write H’0 into CR#33 and allow OFFSET/GAIN tuning in CH1 ~ CH4.
3. When X0 goes from Off to On, write the OFFSET value $K400_{LSB}$ into CR#19 and the GAIN value $K3,600_{LSB}$ into CR#25.

**FROM/TO Application Example 3:**

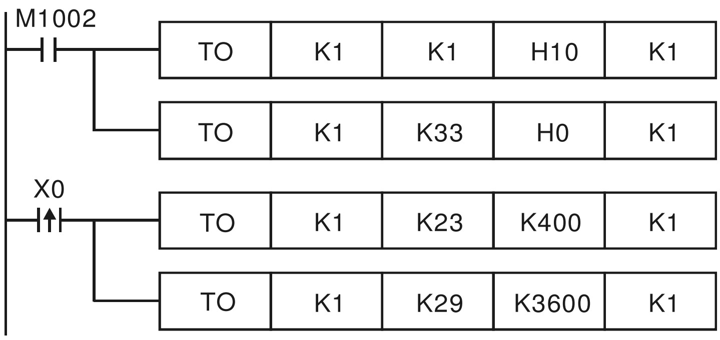
Adjust the D/A conversion curve of DVP02DA-H2. Set the OFFSET value of CH2 as 0mA ( = $K0_{LSB}$) and GAIN value as 10mA（= $K1{,}000_{LSB}$).




1. Write H'18 into CR#1 of analog output module No. 1 and set CH2 as mode 3 (current output: 0mA ~ +20mA).
2. Write H'0 into CR#33 and allowe OFFSET/GAIN tuning in CH1 and CH2.
3. When X0 goes from Off to On, write the OFFSET value $K0_{LSB}$ into CR#22 and the GAIN value $K1{,}000_{LSB}$ into CR#28.

**FROM/TO Application Example 4:**

Adjust the D/A conversion curve of DVP02DA-H2. Set the OFFSET value of CH2 as 2mA ( = $K400_{LSB}$) and GAIN value as 18mA ( = $K3{,}600_{LSB}$)




1. Write H'10 to CR#1 of analog output module No. 1 and set CH2 as mode 2 (current output: +4mA ~ +20mA).
2. Write H'0 to CR#33 and allow OFFSET/GAIN tuning in CH1 and CH2.
3. When X0 goes from Off to On, write the OFFSET value $K400_{LSB}$ into CR#23 and GAIN value $K3{,}600_{LSB}$ into CR#29.

| API | Mnemonic | Operands | Function |
|---|---|---|---|
| 100 | MODRD | S1 S2 n | Read Modbus Data |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | MODRD: 7 steps |
| $S_1$ | | | | | * | * | | | | | | | * | | | |
| $S_2$ | | | | | * | * | | | | | | | * | | | |
| n | | | | | * | * | | | | | | | * | | | |

**Operands:**

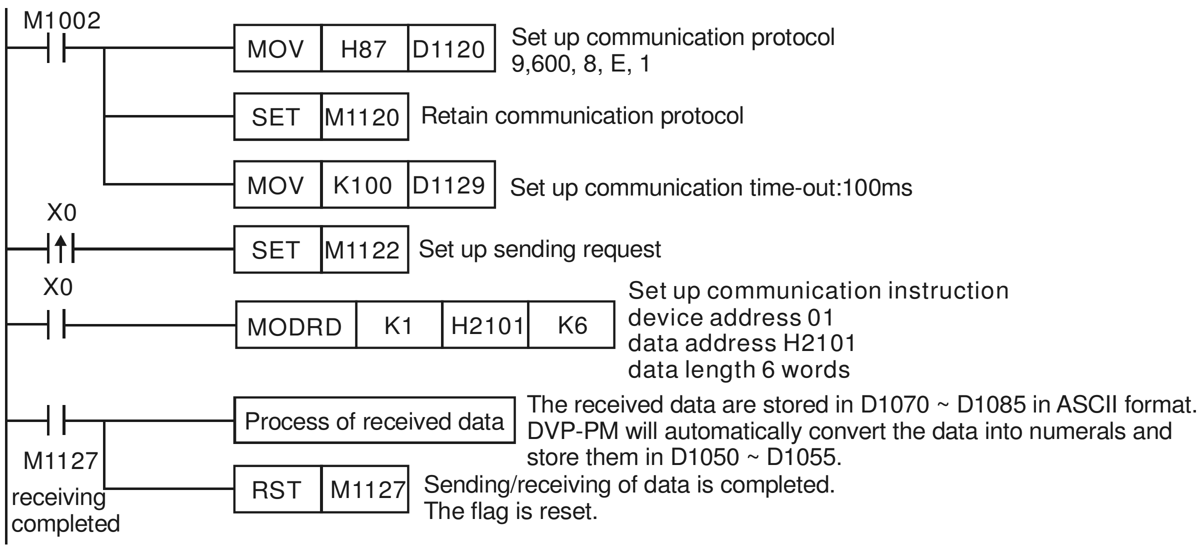
**$S_1$**: Address of communication device  **$S_2$**: Address of data to be read  **n**: Length of read data

**Explanations:**

1. Range of **$S_1$**: K0 ~ K254
2. Range of **n**: K1 ≦ n ≦ K6
3. See the specifications of DVP-PM for its range of use.
4. Flags: M1120 ~ M1129, M1140 ~ M1143. See Remarks for more information.
5. MODRD is a drive instruction exclusively for peripheral communication equipment in Modbus ASCII mode/RTI mode. The built-in RS-485 communication ports in Delta VFD series AC motor drives (except for VFD-A series) are all compatible with Modbus communication format. MODRD can be used for controlling communication (data reading) of Delta AC motor drives.
6. If **$S_2$** is illegal to the designated communication device, the device will respond with an error, and DVP-PM will record the error code in D1130. M1141 will be On as well.
7. The feedback (returned) data from the peripheral equipment will be stored in D1070 ~ D1085. After receiving the feedback data is completed, DVP-PM will auto-check if all data are correct. If there is an error, M1140 will be On.
8. In ASCII mode, due to that the feedback data are all in ASCII, DVP-PM will convert the feedback data into numerals and store them in D1050 ~ D1055. D1050 ~ D1055 will be invalid in RTU mode.
9. After M1140 or M1140 turns On, the program will send a corrent datum to the peripheral equipment. If the feedback datum is correct, M1140 and N1141 will be reset.

**Program Example 1:**

Communication between DVP-PM and VFD-S series AC motor drive (ASCII mode, M1143 = Off)



DVP-PM ⇨ VFD-S, DVP-PM sends: “**01 03 2101 0006 D4**”

VFD-S ⇨ DVP-PM, DVP-PM receives: “**01 03 0C 0100 1766 0000 0000 0136 0000 3B**”

Registers for sent data (sending messages)

| Register | DATA | | Explanation | |
|---|---|---|---|---|
| D1089 low | ‘0’ | 30 H | ADR 1 | Address of AC motor drive: ADR (1,0) |
| D1089 high | ‘1’ | 31 H | ADR 0 | |
| D1090 low | ‘0’ | 30 H | CMD 1 | Instruction code: CMD (1,0) |
| 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 | Number of Data (counted by words) | |
| D1093 high | ‘0’ | 30 H | | |
| D1094 low | ‘0’ | 30 H | | |
| D1094 high | ‘6’ | 36 H | | |
| D1095 low | ‘D’ | 44 H | LRC CHK 1 | Chekcsum: LRC CHK (0,1) |
| D1095 high | ‘4’ | 34 H | LRC CHK 0 | |

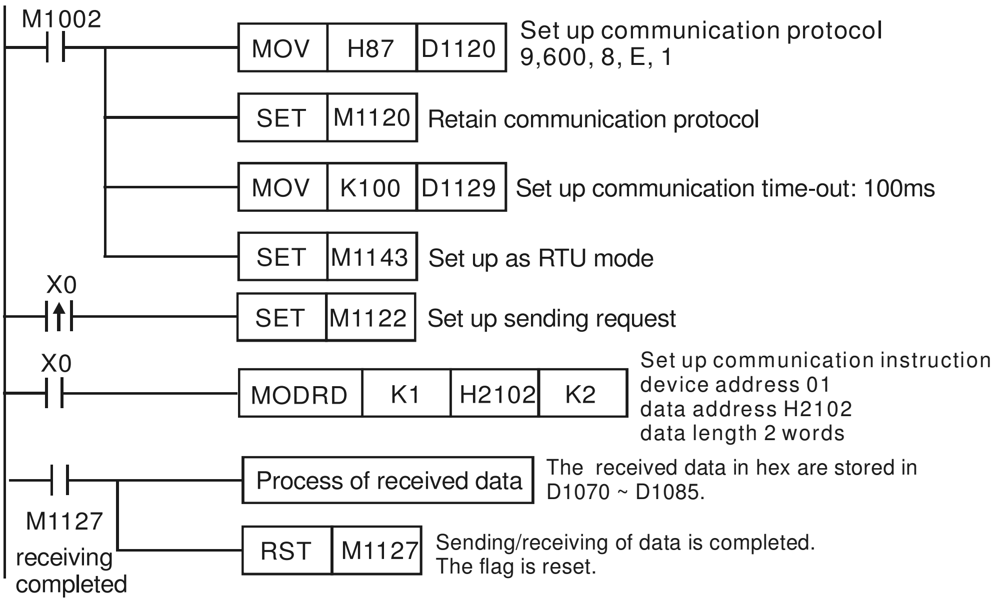
Registers for received data (responding messages)

| Register | DATA | | Explanation | |
|---|---|---|---|---|
| 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 | Number of Data (counted by byte) | |
| D1072 high | ‘C’ | 43 H | | |
| D1073 low | ‘0’ | 30 H | Content in address 2101 H | DVP-PM automatically converts ASCII codes to numerals and stores the numeral in D1050 = 0100 H |
| D1073 high | ‘1’ | 31 H | | |
| D1074 low | ‘0’ | 30 H | | |
| D1074 high | ‘0’ | 30 H | | |
| D1075 low | ‘1’ | 31 H | Content in address 2102 H | DVP-PM automatically converts ASCII codes to numerals and stores the numeral in D1051 = 1766 H |
| D1075 high | ‘7’ | 37 H | | |
| D1076 low | ‘6’ | 36 H | | |
| D1076 high | ‘6’ | 36 H | | |
| D1077 low | ‘0’ | 30 H | Content in address 2103 H | DVP-PM automatically converts ASCII codes to numerals and stores the numeral in D1052 = 0000 H |
| D1077 high | ‘0’ | 30 H | | |
| D1078 low | ‘0’ | 30 H | | |
| D1078 high | ‘0’ | 30 H | | |
| D1079 low | ‘0’ | 30 H | Content in address 2104 H | DVP-PM automatically converts ASCII codes to numerals and stores the numeral in D1053 = 0000 H |
| D1079 high | ‘0’ | 30 H | | |
| D1080 low | ‘0’ | 30 H | | |
| D1080 high | ‘0’ | 30 H | | |
| D1081 low | ‘0’ | 30 H | Content in address 2105 H | DVP-PM automatically converts ASCII codes to numerals and stores the numeral in D1054 = 0136 H |
| D1081 high | ‘1’ | 31 H | | |
| D1082 low | ‘3’ | 33 H | | |
| D1082 high | ‘6’ | 36 H | | |
| D1083 low | ‘0’ | 30 H | Content in address 2106 H | DVP-PM automatically converts ASCII codes to |
| D1083 high | ‘0’ | 30 H | | |

| Register | DATA | | Explanation | |
|---|---|---|---|---|
| D1084 low | ‘0’ | 30 H | | numerals and stores the numeral in D1055 = 0000 H |
| D1084 high | ‘0’ | 30 H | | |
| D1085 low | ‘3’ | 33 H | LRC CHK 1 | |
| D1085 high | ‘B’ | 42 H | LRC CHK 0 | |

**Program Example 2:**

Communication between DVP-PM and VFD-S series AC motor drive (RTU mode, M1143 = On)




DVP-PM ⇨ VFD-S, DVP-PM sends: “**01 03 2102 0002 6F F7**”

VFD-S ⇨ DVP-PM, DVP-PM receives: “**01 03 04 1770 0000 FE 5C**”

Registers for sent data (sending messages)

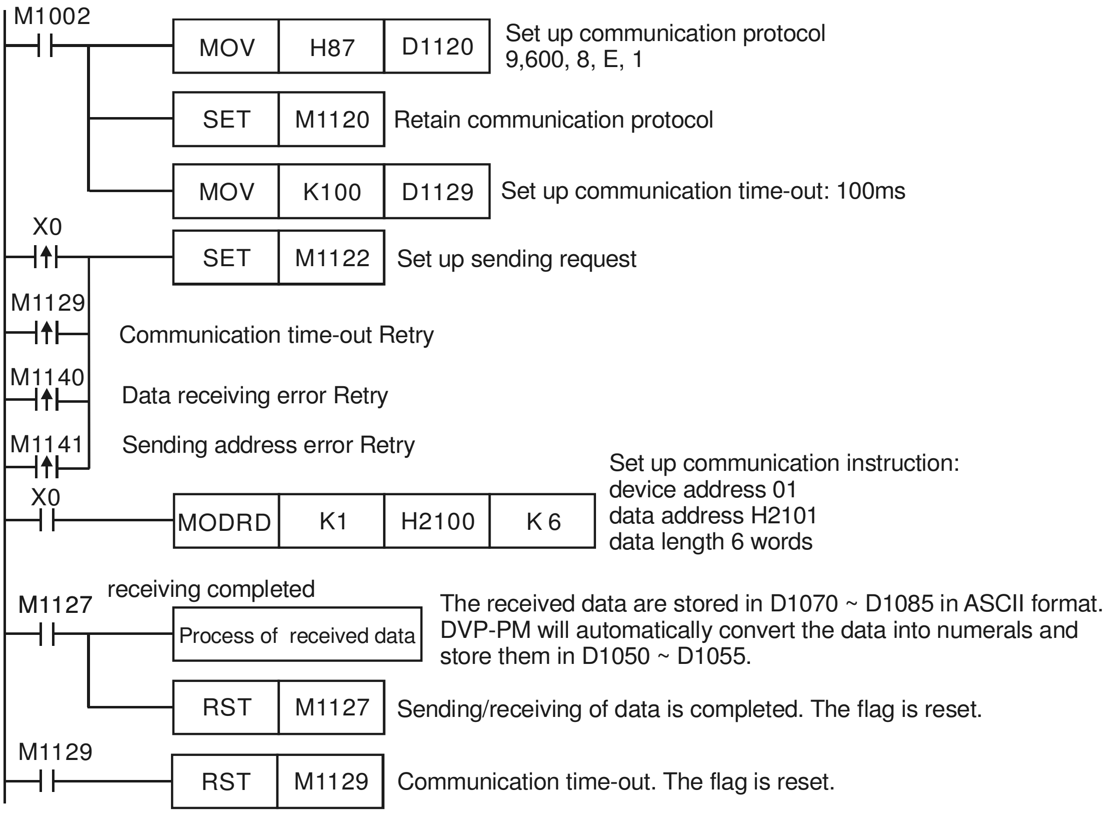
| Register | DATA | Explanation |
|---|---|---|
| D1089 low | 01 H | Address |
| D1090 low | 03 H | Function |
| D1091 low | 21 H | Starting Data Address |
| D1092 low | 02 H | |
| D1093 low | 00 H | Number of Data (counted by words) |
| D1094 low | 02 H | |
| D1095 low | 6F H | CRC CHK Low |
| D1096 low | F7 H | CRC CHK High |

Registers for received data (responding messages)

| Register | DATA | Explanation |
|---|---|---|
| D1070 low | 01 H | Address |
| D1071 low | 03 H | Function |
| D1072 low | 04 H | Number of Data (counted by byte) |
| D1073 low | 17 H | Content in address 2102 H |
| D1074 low | 70 H | |
| D1075 low | 00 H | Content in address 2103 H |
| D1076 low | 00 H | |
| D1077 low | FE H | CRC CHK Low |
| D1078 low | 5C H | CRC CHK High |

**Program Example 3:**

1. In the communication between DVP-PM and VFD-S series AC motor drive (ASCII mode, M1143 = Off), retry when communication time-out, data receiving error and sending address error occur.
2. When X0 = On, DVP-PM will read the data in VFD-S data address H'2100 of device 01 and store the data in ASCII format in D1070 ~ D1085. DVP-PM will automatically convert the data into numerals and store them in D1050 ~ D1055.
3. M1129 will be On when communication time-out occurs. The program will trigger M1129 and send request to M1122 for reading the data again.
4. M1140 will be On when data receiving error occurs. The program will trigger M1140 and send request to M1122 for reading the data again.
5. M1140 will be On when sending address error occurs. The program will trigger M1140 and send request to M1122 for reading the data again.




**Remarks:**

1. The activation condition placed before the three instructions, API 100 MODRD (Function Code H'03) cannot use rising-edge contacts (LDP, ANDP, ORP) and falling-edge contacts (LDF, ANDF, ORF); otherwise, the data stored in the receiving registers will be incorrect.
2. There is no limitation on the times of using this instruction in the program, but only one instruction is allowed to be executed at a time.

| API | Mnemonic | Operands | Function |
|---|---|---|---|
| 101 | MODWR | S1 S2 n | Write Modbus Data |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | MODWR: 7 steps |
| $S_1$ | | | | | * | * | | | | | | | * | | | |
| $S_2$ | | | | | * | * | | | | | | | * | | | |
| n | | | | | * | * | | | | | | | * | | | |

**Operands:**

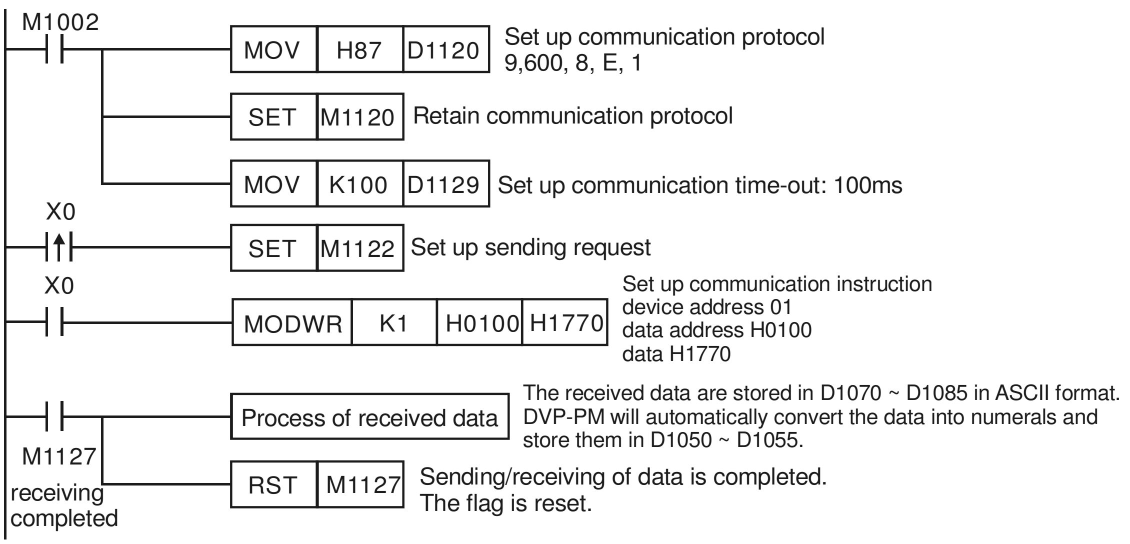
**$S_1$**: Address of communication device **$S_2$**: Address of data to be read **n**: Data to be written

**Explanations:**

1. Range of **$S_1$**: K0 ~ K254.
2. See the specifications of DVP-PM for its range of use.
3. Flags: M1120 ~ M1129, M1140 ~ M1143. See Remarks for more information.
4. MODWR is a drive instruction exclusively for peripheral communication equipment in Modbus ASCII mode/RTU mode. The built-in RS-485 communication ports in Delta VFD series AC motor drives (except for VFD-A series) are all compatible with Modbus communication format. MODWR can be used for controlling communication (data writing) of Delta AC motor drives.
5. If S2 is illegal to the designated communication device, the device will respond with an error, and DVP-PM will record the error code in D1130. M1141 will be On as well. For example, if 8000H is illegal to VFD-S, M1140 will be On and D1130 = 2. For error codes, please refer to the user manual of VFD-S.
6. The feedback (returned) data from the peripheral equipment will be stored in D1070 ~ D1076. After receiving the feedback data is completed, DVP-PM will auto-check if all data are correct. If there is an error, M1140 will be On.
7. After M1140 or M1140 turns On, the program will send a correct datum to the peripheral equipment. If the feedback datum is correct, M1140 and M1141 will be reset.

**Program Example 1:**

Communication between DVP-PM and VFD-S series AC motor drive (ASCII mode, M1143 = Off)




DVP-PM ⇨ VFD-S, DVP-PM sends: “**01 06 0100 1770 71**”

VFD-S ⇨ DVP-PM, DVP-PM receives: “**01 06 0100 1770 71**”

Registers for sent data (sending messages)

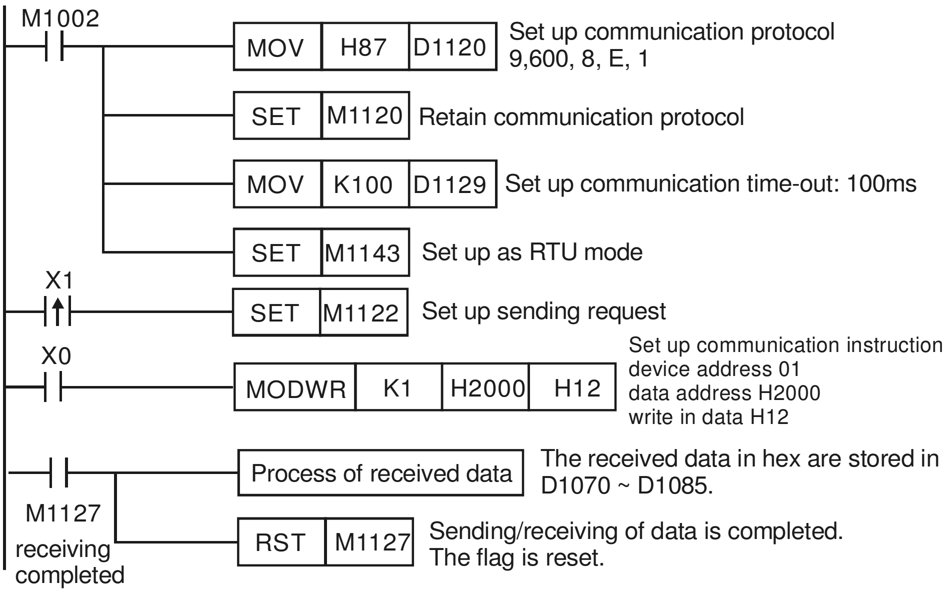
| Register | DATA | | Explanation | |
|---|---|---|---|---|
| D1089 low | ‘0’ | 30 H | ADR 1 | Address of AC motor drive: ADR (1,0) |
| D1089 high | ‘1’ | 31 H | ADR 0 | |
| D1090 low | ‘0’ | 30 H | CMD 1 | Instruction code: CMD (1,0) |
| D1090 high | ‘6’ | 36 H | CMD 0 | |
| D1091 low | ‘0’ | 30 H | Data Address | |
| D1091 high | ‘1’ | 31 H | | |
| D1092 low | ‘0’ | 30 H | | |
| D1092 high | ‘0’ | 30 H | | |
| D1093 low | ‘1’ | 31 H | Data contents | |
| D1093 high | ‘7’ | 37 H | | |
| D1094 low | ‘7’ | 37 H | | |
| D1094 high | ‘0’ | 30 H | | |
| D1095 low | ‘7’ | 37 H | LRC CHK 1 | Error checksum: LRC CHK (0,1) |
| D1095 high | ‘1’ | 31 H | LRC CHK 0 | |

Registers for received data (responding messages)

| Register | DATA | | Explanation |
|---|---|---|---|
| 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 content |
| 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 |

**Program Example 2:**

Communication between DVP-PM and VFD-S series AC motor drive (RTU mode, M1143 = On)




DVP-PM ⇨ VFD-S, DVP-PM sends: "**01 06 2000 0012 02 07**"

VFD-S ⇨ DVP-PM, DVP-PM receives: "**01 06 2000 0012 02 07**"

Registers for sent data (sending messages)

| Register | DATA | Explanation |
|---|---|---|
| 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 content |
| D1094 low | 12 H | |
| D1095 low | 02 H | CRC CHK Low |
| D1096 low | 07 H | CRC CHK High |

Registers for received data (responding messages)

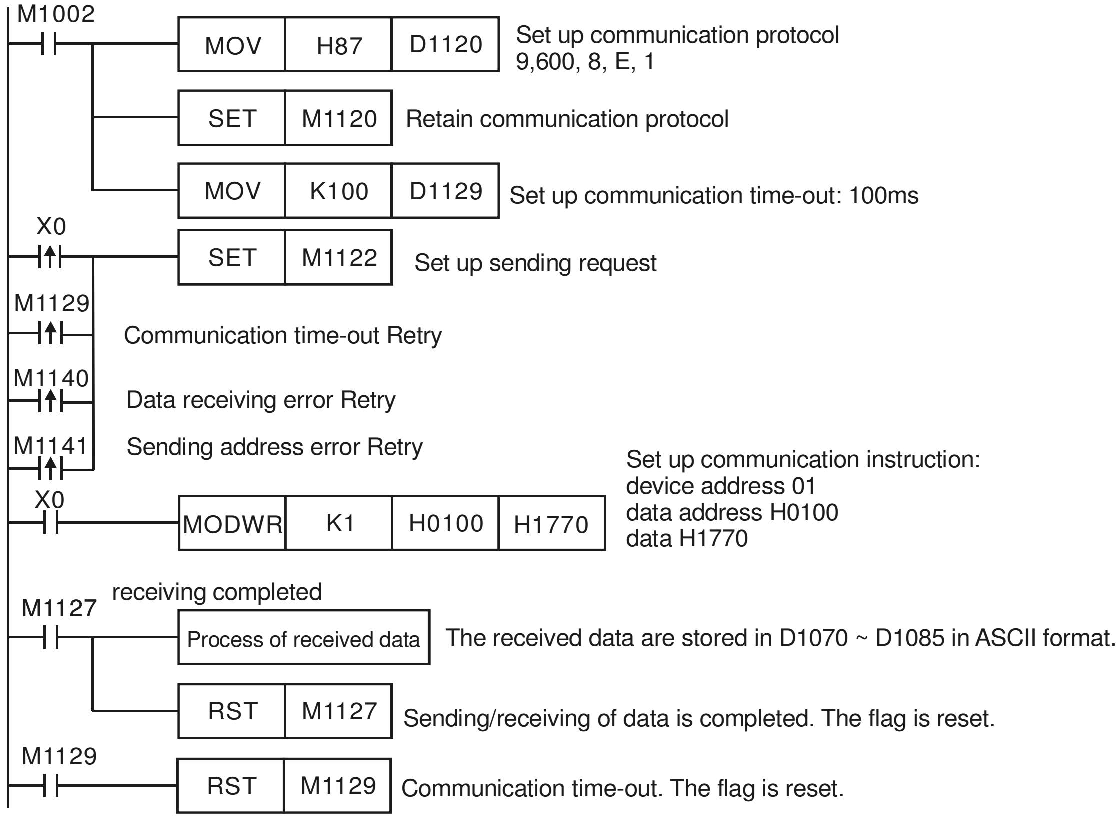
| Register | DATA | Explanation |
|---|---|---|
| D1070 low | 01 H | Address |
| D1071 low | 06 H | Function |
| D1072 low | 20 H | Data Address |
| D1073 low | 00 H | |
| D1074 low | 00 H | Data content |
| D1075 low | 12 H | |
| D1076 low | 02 H | CRC CHK Low |
| D1077 low | 07 H | CRC CHK High |

**Program Example 3:**

1. In the communication between DVP-PM and VFD-S series AC motor drive (ASCII mode, M1143 = Off), retry when communication time-out, data receiving error and sending address error occur.
2. When X0 = On, DVP-PM will write H1770 (K6,000) into VFD-S data address H0100 of device 01.
3. M1129 will be On when communication time-out occurs. The program will trigger M1129 and send request to M1122 for writing the data again.
4. M1140 will be On when data receiving error occurs. The program will trigger M1140 and send request to M1122

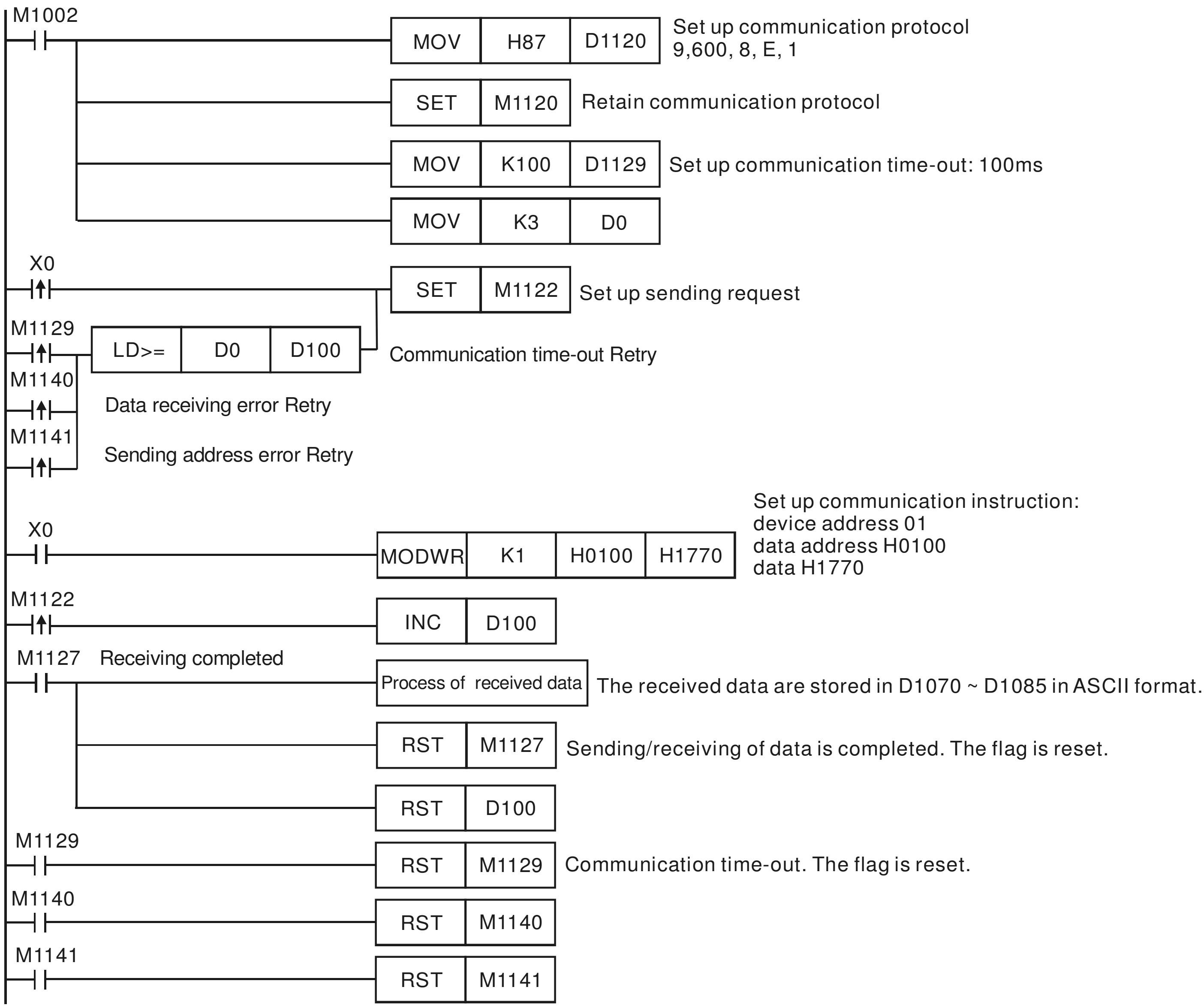
for writing the data again.

5. M1141 will be On when sending address error occurs. The program will trigger M1141 and send request to M1122 for writing the data again.




**Program Example 4:**

1. In the communication between DVP-PM and VFD-S series AC motor drive (ASCII mode, M1143 = Off), retry when communication time-out, data receiving error and sending address error occur. The times of retry = D0 (default = 3). When communication Retry is successful, you can return to controlling by triggering condition.
2. When X0 = On, DVP-PM will write H1770 (K6,000) into VFD-S data address H0100 of device 01.
3. M1129 will be On when communication time-out occurs. The program will trigger M1129 and send request to M1122 for writing the data again. The times of retry = D0 (default = 3).
4. M1140 will be On when data receiving error occurs. The program will trigger M1140 and send request to M1122 for writing the data again. The times of retry = D0 (default = 3).
5. M1141 will be On when sending address error occurs. The program will trigger M1141 and send request to M1122 for writing the data again. The times of retry = D0 (default = 3).




**Remarks:**

1. The activation condition placed before API 101 MODWR (Function Code H'06, H'10) cannot use rising-edge contacts (LDP, ANDP, ORP) and falling-edge contacts (LDF, ANDF, ORF) and have to enable sending request M1122 first.
2. There is no limitation on the times of using this instruction in the program, but only one instruction is allowed to be executed at a time.

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 110 | D | ECMP | P | S1 S2 D | Floating Point Compare |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | F | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DECMP, DECMPP: 9 steps |
| $S_1$ | | | | | * | | | | | | | | * | | | |
| $S_2$ | | | | | * | | | | | | | | * | | | |
| D | | * | * | * | | | | | | | | | | | | |

**Operands:**

$\mathbf{S_1}$: Binary floating point comparison value 1 $\mathbf{S_2}$: Binary floating point comparison value 2

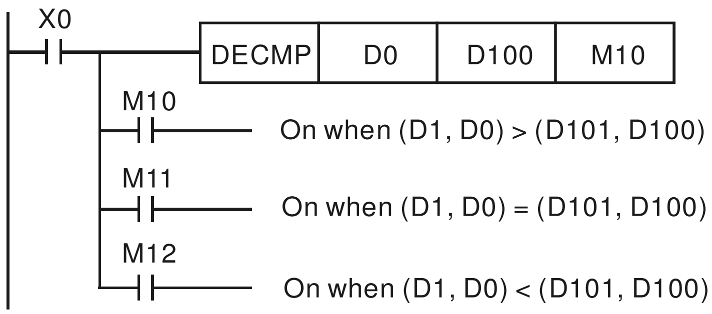
**D**: Comparison result

**Explanations:**

1. See the specifications of DVP-PM for its range of use.
2. Only 32-bit instructions DECMP and DECMPP are applicable.
3. **D** occupies 3 consecutive devices.
4. F refers to floating point input. Be sure to add a decimal point when using it.
5. The binary floating point values $\mathbf{S_1}$ and $\mathbf{S_2}$ are compared with each other. The comparison result (>, =, <) is stored in **D**.
6. If $\mathbf{S_1}$ or $\mathbf{S_2}$ is a designated floating point F, the instruction will compare in binary floating point.

**Program Example:**

1. Designate device M10, and M10 ~ M12 will be occupied automatically.
2. When X0 = On, DECMP instruction will be executed, and one of M10 ~ M12 will be On. When X0 = Off, DECMP will not be executed, and M10 ~ M12 will remain in their status before X0 = Off.
3. To obtain results in ≧, ≦, ≠, series/parallel connect M10 ~ M12.
4. Use RST or ZRST instruction to clear the result.




**Remarks:**

For floating point operations, see “5.3 Handling of Numeric Values”.

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 111 | D | EZCP | P | S1 S2 S D | Floating Point Zone Compare |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | F | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DEZCP, DEZCPP: 12 steps |
| $S_1$ | | | | | * | | | | | | | | * | | | |
| $S_2$ | | | | | * | | | | | | | | * | | | |
| S | | | | | * | | | | | | | | * | | | |
| D | | * | * | * | | | | | | | | | | | | |

**Operands:**

**$S_1$**: Lower bound of binary floating point **$S_2$**: Upper bound of binary floating point

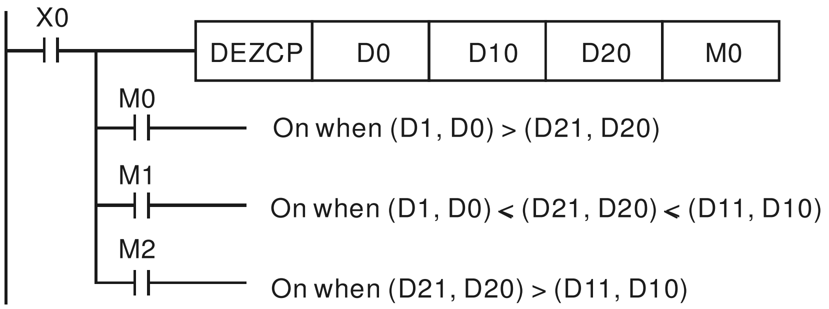
**S**: Binary floating point comparison result **D**: Comparison result

**Explanations:**

1. **D** occupies 3 consecutive devices.
2. **$S_1$** ≦ **$S_2$**.
3. See the specifications of DVP-PM for its range of use.
4. F refers to floating point input. Be sure to add a decimal point when using it.
5. Only 32-bit instructions DEZCP and DEZCPP are applicable.
6. The binary floating point values **$S_1$** and **$S_2$** are compared with each other. The comparison result (>, =, <) is stored in **D**.
7. If **$S_1$** or **$S_2$** is a designated floating point F, the instruction will compare in binary floating point.
8. When **$S_1$** > **$S_2$**, **$S_1$** will be used as upper/lower bound for the comparison.

**Program Example:**

1. Designate device M0, and M0 ~ M2 will be occupied automatically.
2. When X0 = On, DEZCP instruction will be executed, and one of M0 ~ M2 will be On. When X0 = Off, DEZCP will not be executed, and M0 ~ M2 will remain in their status before X0 = Off.
3. Use RST or ZRST instruction to clear the result.




**Remarks:**

For floating point operations, see “5.3 Handling of Numeric Values”.

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 116 | D | RAD | P | S D | Angle → Radian |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | F | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DRAD, DRADP: 6 steps |
| S | | | | | * | | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

**S**: Source (angle) **D**: Result (radian)

**Explanations:**

1. See the specifications of DVP-PM for its range of use.
2. F refers to floating point input. Be sure to add a decimal point when using it.
3. Only 32-bit instructions DRAD and DRADP are applicable.
4. Flags:

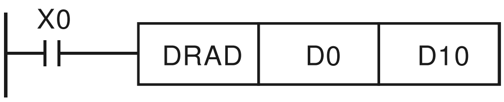
| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Borrow flag | M1809 | M1889 | M1969 |
| Carry flag | M1810 | M1890 | M1970 |

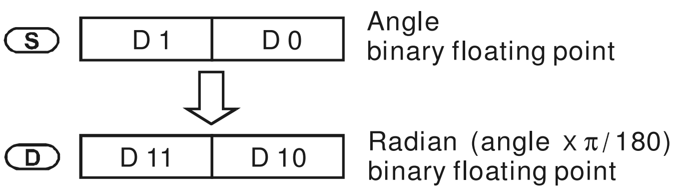
   See below for more information.

5. Radian = angle × ( $\pi$ /180)
6. If the absolute value of the result > maximum floating point available, the carry flag will be On.
7. If the absolute value of the result < minimum floating point available, the borrow flag will be On.
8. If the result = 0, the zero flag will be On.

**Program Example:**

When X0 = On, designate the angle of the binary floating point (D1, D0). Convert the angle into radian and store the result in binary floating point in (D11, D10).




**Remarks:**

For floating point operations, see “5.3 Handling of Numeric Values”.

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 117 | D | DEG | P | S D | Radian → Angle |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | F | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DDEG, DDEGP: 6 steps |
| S | | | | | * | | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

**S**: Source (radian)  **D**: Result (angle)

**Explanations:**

1. See the specifications of DVP-PM for its range of use.
2. F refers to floating point input. Be sure to add a decimal point when using it.
3. Only 32-bit instructions DDEG and DDEGP are applicable.
4. Flags:

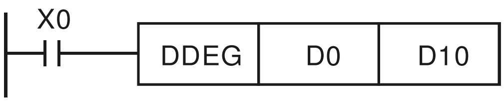
| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Borrow flag | M1809 | M1889 | M1969 |
| Carry flag | M1810 | M1890 | M1970 |

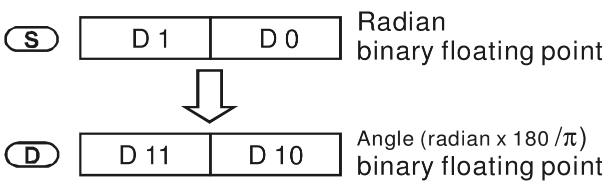
   See below for more information.

5. Angle = radian × (180 / $\pi$ )
6. If the absolute value of the result > maximum floating point available, the carry flag will be On.
7. If the absolute value of the result < minimum floating point available, the borrow flag will be On.
8. If the result = 0, the zero flag will be On.

**Program Example:**

When X0 = On, designate the radian of the binary floating point (D1, D0). Convert the radian into angle and store the result in binary floating point in (D11, D10).




**Remarks:**

For floating point operations, see “5.3 Handling of Numeric Values”.

| API | | Mnemonic | | Operands | Function |
|---|---|---|---|---|---|
| 120 | D | EADD | P | S1 S2 D | Floating Point Addition |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | F | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DEADD, DEADDP: 9 steps |
| $S_1$ | | | | | * | | | | | | | | * | | | |
| $S_2$ | | | | | * | | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

**$S_1$**: Summand **$S_2$**: Addend **D**: Sum

**Explanations:**

1. See the specifications of DVP-PM for its range of use.
2. F refers to floating point input. Be sure to add a decimal point when using it.
3. Only 32-bit instructions DEADD and DEADDP are applicable.
4. Flags:

| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Borrow flag | M1809 | M1889 | M1969 |
| Carry flag | M1810 | M1890 | M1970 |

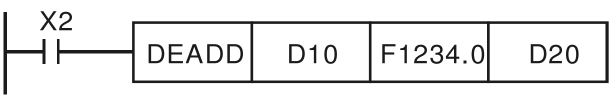
   See below for more information.
5. **$S_1$** + **$S_2$** = **D**. The floating point value in the register designated by **$S_1$** and **$S_2$** are added up, and the sum is stored in the register designated by **D**. The addition in conducted in binary floating point system.
6. If **$S_1$** or **$S_2$** is a designated floating point F, the instruction will conduct the addition in binary floating point.
7. **$S_1$** and **$S_2$** can designate the same register. In this case, if the "continuous execution" instruction is in use, during the period when the contact is On, the register will be added once in every scan by pulse execution instruction DEADDP.
8. If the absolute value of the result > maximum floating point available, the carry flag will be On.
9. If the absolute value of the result < minimum floating point available, the borrow flag will be On.
10. If the result = 0, the zero flag will be On.

**Program Example 1:**

When X0 = On, binary floating point (D1, D0) + binary floating point (D3, D2), and the result will be stored (D11, D10).


**Program Example 2:**

When X2 = On, binary floating point (D11, D10) + F1234.0 (automatically converted into binary floating point), and the result will be stored in (D21, D20).




**Remarks:**

For floating point operations, see "5.3 Handling of Numeric Values".

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 121 | D | ESUB | P | (S1) (S2) (D) | Floating Point Subtraction |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | F | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DESUB, DESUBP: 9 steps |
| $S_1$ | | | | | * | | | | | | | | * | | | |
| $S_2$ | | | | | * | | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

**$S_1$**: Minuend  **$S_2$**: Subtrahend  **D**: Remainder

**Explanations:**

1. See the specifications of DVP-PM for its range of use.
2. F refers to floating point input. Be sure to add a decimal point when using it.
3. Only 32-bit instructions DEADD and DEADDP are applicable.
4. Flags:

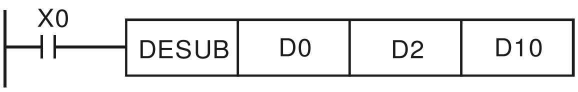
| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Borrow flag | M1809 | M1889 | M1969 |
| Carry flag | M1810 | M1890 | M1970 |

   See below for more information.

5. **$S_1$ – $S_2$ = D**. The floating point value in the register designated by **$S_2$** is subtracted from the floating point value in the register designated by **$S_1$**, and the result will be stored in the register designated by **D**. The subtraction is conducted in binary floating point system.
6. If **$S_1$** or **$S_2$** is a designated floating point F, the instruction will conduct the subtraction in binary floating point.
7. **$S_1$** and **$S_2$** can designate the same register. In this case, if the "continuous execution" instruction is in use, during the period when the contact is On, the register will be subtracted once in every scan by pulse execution instruction DESUBP.
8. If the absolute value of the result > maximum floating point available, the carry flag will be On.
9. If the absolute value of the result < minimum floating point available, the borrow flag will be On.
10. If the result = 0, the zero flag will be On.

**Program Example 1:**

When X0 = On, binary floating point (D1, D0) – binary floating point (D3, D2), and the result will be stored in (D11, D10).




**Program Example 2:**

When X2 = On, F1234.0 (automatically converted into binary floating point) – binary floating point (D1, D0), and the result will be stored in (D11, D10).


**Remarks:**

For floating point operations, see "5.3 Handling of Numeric Values".

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 122 | D | EMUL | P | (S1) (S2) (D) | Floating Point Multiplication |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | F | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DEMUL, DEMULP: 9 steps |
| $S_1$ | | | | | * | | | | | | | | * | | | |
| $S_2$ | | | | | * | | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

$S_1$: Multiplicand $S_2$: Multiplicator **D**: Product

**Explanations:**

1. See the specifications of DVP-PM for its range of use.
2. F refers to floating point input. Be sure to add a decimal point when using it.
3. Only 32-bit instructions DEMUL and DEMULP are applicable.
4. Flags:

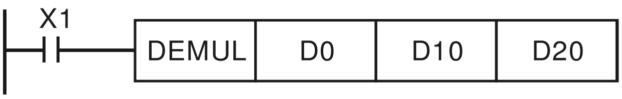
| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Borrow flag | M1809 | M1889 | M1969 |
| Carry flag | M1810 | M1890 | M1970 |

See below for more information.

5. $S_1 \times S_2 = D$. The floating point value in the register designated by $S_1$ is multiplied with the floating point value in the register designated by $S_2$, and the result will be stored in the register designated by **D**. The multiplication is conducted in binary floating point system.
6. If $S_1$ or $S_2$ is a designated floating point F, the instruction will conduct the multiplication in binary floating point.
7. $S_1$ and $S_2$ can designate the same register. In this case, if the “continuous execution” instruction is in use, during the period when the contact is On, the register will be multiplied once in every scan by pulse execution instruction DEMULP.
8. If the absolute value of the result > maximum floating point available, the carry flag will be On.
9. If the absolute value of the result < minimum floating point available, the borrow flag will be On.
10. If the result = 0, the zero flag will be On.

**Program Example 1:**

When X1 = On, binary floating point (D1, D0) × binary floating point (D11, D10), and the result will be stored in (D21, D20).




**Program Example 2:**

When X2 = On, F1234.0 (automatically converted into binary floating point) × binary floating point (D1, D0), and the result will be stored in (D11, D10).


**Remarks:**

For floating point operations, see “5.3 Handling of Numeric Values”.

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 123 | D | EDIV | P | (S1) (S2) (D) | Floating Point Division |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | F | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DEDIV, DEDIVP: 9 steps |
| $S_1$ | | | | | * | | | | | | | | * | | | |
| $S_2$ | | | | | * | | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

**$S_1$**: Dividend **$S_2$**: Divisor **D**: Quotient and remainder

**Explanations:**

1. See the specifications of DVP-PM for its range of use.
2. F refers to floating point input. Be sure to add a decimal point when using it.
3. Only 32-bit instructions DEDIV and DEDIVP are applicable.
4. Flags:

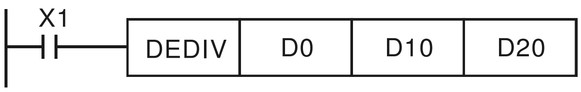
| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Borrow flag | M1809 | M1889 | M1969 |
| Carry flag | M1810 | M1890 | M1970 |
| Operational error flag | M1793 | M1873 | M1953 |

   See below for more information.

5. **$S_1$ ÷ $S_2$ = D**. The floating point value in the register designated by **$S_1$** is divided by the floating point value in the register designated by **$S_2$**, and the result will be stored in the register designated by **D**. The division is conducted in binary floating point system.
6. If **$S_1$** or **$S_2$** is a designated floating point F, the instruction will conduct the division in binary floating point.
7. If **$S_2$** = 0, operational error will occur, and the instruction will not be executed. The operational error flag will be On, and the error code H'0E19 will be recorded.
8. If the absolute value of the result > maximum floating point available, the carry flag will be On.
9. If the absolute value of the result < minimum floating point available, the borrow flag will be On.
10. If the result = 0, the zero flag will be On.

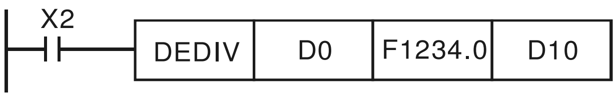
**Program Example 1:**

When X1 = On, binary floating point (D1, D0) ÷ binary floating point (D11, D10), and the quotient will be stored in (D21, D20).




**Program Example 2:**

When X2 = On, binary floating point (D1, D0) ÷ F1234.0 (automatically converted into binary floating point), and the result will be stored in (D11, D10).




**Remarks:**

For floating point operations, see "5.3 Handling of Numeric Values".

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 124 | D | EXP | P | (S) (D) | Exponent of Binary Floating Point |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | F | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DEXP, DEXPP: 6 steps |
| S | | | | | * | | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

S: Device for operation source D: Device for operational result

**Explanations:**

1. See the specifications of DVP-PM for its range of use.
2. F refers to floating point input. Be sure to add a decimal point when using it.
3. Only 32-bit instructions DEXP and DEXPP are applicable.
4. Flags:

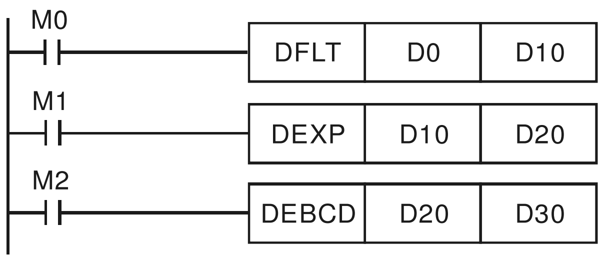
| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Borrow flag | M1809 | M1889 | M1969 |
| Carry flag | M1810 | M1890 | M1970 |

See below for more information.

5. e = 2.71828 as the base and **S** as exponent for EXP operation: $EXP^{[\mathbf{D}+1,\ \mathbf{D}]} = [\mathbf{S} + 1, \mathbf{S}]$
6. Both positive and negative values are valid for **S**. When designating D registers, the data should be 32-bit, and the operation should be performed in floating point system. Therefore, **S** should be converted into a floating point value.
7. The content in **D** = $e^{\mathbf{S}}$; e = 2.71828, **S** = designated source data.
8. If the absolute value of the result > maximum floating point available, the carry flag will be On.
9. If the absolute value of the result < minimum floating point available, the borrow flag will be On.
10. If the result = 0, the zero flag will be On.

**Program Example:**

1. When M0 = On, convert (D1, D0) into binary floating point and store it in register (D11, D10).
2. When M1 = On, use (D11, D10) as the exponent for EXP operation and store the binary floating point result in register (D21, D20).
3. When M2 = On, convert the binary floating point (D21, D20) into decimal floating point (D30 × $10^{[D31]}$) and store it in register (D31, D30)




**Remarks:**

For floating point operations, see "5.3 Handling of Numeric Values".

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 125 | D | LN | P | (S) (D) | Natural Logarithm of Binary Floating Point |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | F | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DLN, DLNP: 6 steps |
| S | | | | | * | | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

**S**: Device for operational source  **D**: Device for operational result

**Explanations:**

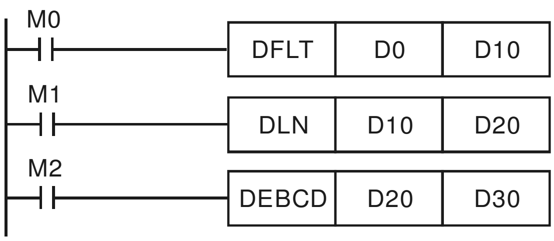
1. See the specifications of DVP-PM for its range of use.
2. F refers to floating point input. Be sure to add a decimal point when using it.
3. Only 32-bit instructions DLN and DLNP are applicable.
4. Flags:

| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Borrow flag | M1809 | M1889 | M1969 |
| Carry flag | M1810 | M1890 | M1970 |
| Operational error flag | M1793 | M1873 | M1953 |

   See below for more information.
5. LN instruction performs natural logarithm “In” operation by **S**: LN [ **S** +1, **S**] = [ **D** + 1, **D**]
6. Only positive values are valid for **S**. When designating D registers, the data should be 32-bit, and the operation should be performed in floating point system. Therefore, **S** should be converted into a floating point value.
7. If **S** is not a positive value, operational error will occur, and the instruction will not be executed. The operational error flag will be On, and the error code H’0E19 will be recorded.
8. $e^{D}$ = **S** → The content in **D** = ln**S**; **S** = designated source data.
9. If the absolute value of the result > maximum floating point available, the carry flag will be On.
10. If the absolute value of the result < minimum floating point available, the borrow flag will be On.
11. If the result = 0, the zero flag will be On.

**Program Example:**

1. When M0 = On, convert (D1, D0) into binary floating point and store it in (D11, D10).
2. When M1 = On, use register (D11, D10) as the real number for In operation and store the binary floating point result in register (D21, D20).
3. When M2 = On, convert the binary floating point (D21, D20) into decimal floating point (D30 × $10^{[D31]}$) and store it in register (D31, D30).




**Remarks:**

For floating point operations, see “5.3 Handling of Numeric Values”.

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 126 | D | LOG | P | S1 S2 D | Logarithm of Binary Floating Point |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | F | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DLOG, DLOGP: 9 steps |
| $S_1$ | | | | | * | | | | | | | | * | | | |
| $S_2$ | | | | | * | | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

**$S_1$**: Device for base **$S_2$**: Device for operation source **D**: Device for operational result

**Explanations:**

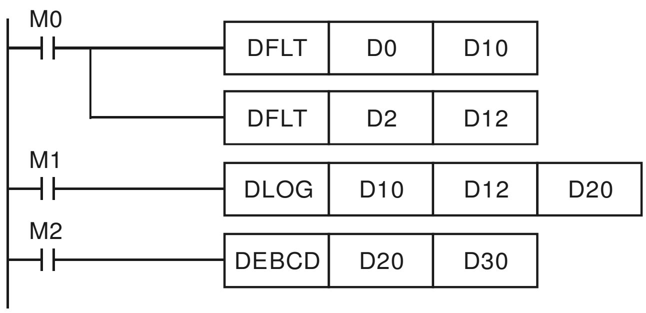
1. See the specifications of DVP-PM for its range of use.
2. F refers to floating point input. Be sure to add a decimal point when using it.
3. Only 32-bit instructions DLOG and DLOGP are applicable.
4. Flags:

| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Borrow flag | M1809 | M1889 | M1969 |
| Carry flag | M1810 | M1890 | M1970 |

   See below for more information.
5. LOG instruction performs “log” operation of the content in **$S_1$** and **$S_2$** and stores the result in D.
6. Only positives are valid for the content in **$S_1$** and **$S_2$**. When designating D registers, the data should be 32-bit, and the operation should be performed in floating point system. Therefore, **$S_1$** and **$S_2$** should be converted into floating point values.
7. $\mathbf{S_1}^{D} = \mathbf{S_2}$, $\mathbf{D}$ = ? → $\mathbf{D} = \mathrm{Log}_{\mathbf{S1}}{}^{\mathbf{S2}}$
8. If the absolute value of the result > maximum floating point available, the carry flag will be On.
9. If the absolute value of the result < minimum floating point available, the borrow flag will be On.
10. If the result = 0, the zero flag will be On.

**Program Example:**

1. When M0 = On, convert (D1, D0) and (D3, D2) into binary floating points and store them in the 32-bit registers (D11, D10) and (D13, D12).
2. When M1 = On, perform log operation on the binary floating points in the 32-bit registers (D11, D10) and (D13, D12) and store the result in the 32-bit register (D21, D20).
3. When M2 = On, convert the binary floating point (D21, D20) into decimal floating point (D30 × $10^{[D31]}$) and store it in register (D31, D30).




**Remarks:**

For floating point operations, see “5.3 Handling of Numeric Values”.

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 127 | D | ESQR | P | (S) (D) | Floating Point Square Root |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | F | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DESQR, DESQRP: 6 steps |
| S | | | | | * | | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

**S**: Source device  **D**: Operational result

**Explanations:**

1. See the specifications of DVP-PM for its range of use.
2. **S** ≧ 0.
3. F refers to floating point input. Be sure to add a decimal point when using it.
4. Only 32-bit instructions DESQR and DESQRP are applicable.
5. Flags:

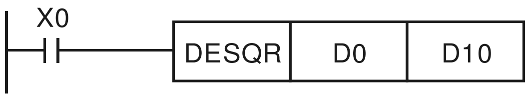
| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Operational error flag | M1793 | M1873 | M1953 |

   See below for more information.

6. ESQR instruction performs a square root operation on the content in the register designated by **S** and stores the result in the register designated by **D**. The square root operation is performed in floating point system.
7. If **S** is a designated floating point F, the instruction will convert it into a binary floating point value before the operation.
8. If the result of the operation = 0, the zero flag will be On.
9. **S** can only be a positive value. Performing any square root operation on a negative value will result in "operational error", and ESQR will not he executed. The operational error flag will be On, and the error code H'0E19 will be recorded.

**Program Example 1:**

When X0 = On, calculate the square root of the binary floating point (D1, D0) and store the result in register (D11, D10).




$\sqrt{(D1, D0)} \rightarrow (D11, D10)$

Binary floating point  Binary floating point

**Program Example 2:**

When X2 = On, calculate the square root of F1234.0 (automatically converted into binary floating point) and store the result in register (D11, D10)


**Remarks:**

For floating point operations, see "5.3 Handling of Numeric Values".

| API | | Mnemonic | | Operands | Function |
|---|---|---|---|---|---|
| 128 | D | POW | P | S1 S2 D | Floating Point Power Operation |

| Type OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DPOW, DPOWP: 9 steps |
| $S_1$ | | | | | * | | | | | | | | * | | | |
| $S_2$ | | | | | * | | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

**$S_1$**: Device for base **$S_2$**: Device for exponent **D**: Device for operational result

**Explanations:**

1. See the specifications of DVP-PM for its range of use.
2. F refers to floating point input. Be sure to add a decimal point when using it.
3. Only 32-bit instructions DPOW and DPOWP are applicable.
4. Flags:

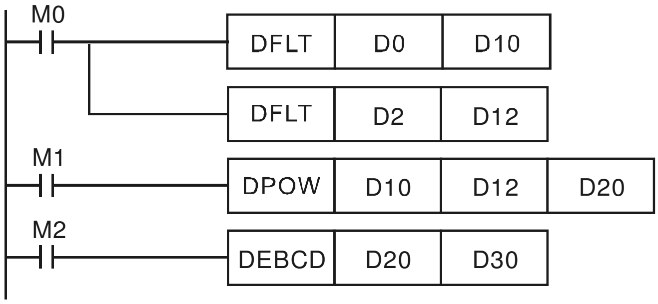
| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Borrow flag | M1809 | M1889 | M1969 |
| Carry flag | M1810 | M1890 | M1970 |
| Operational error flag | M1793 | M1873 | M1953 |

See below for more information.

5. POW instruction performs power multiplication of binary floating point S1 and S2 and stores the result in **D**.
   **D** = POW [ $\mathbf{S_1}$ + 1, $\mathbf{S_1}$ ] ^ [ $\mathbf{S_2}$ + 1, $\mathbf{S_2}$ ]
6. Only positives are valid for the content in S1. Both positives and negatives are valid for the content in S2. When designating D registers, the data should be 32-bit, and the operation should be performed in floating point system. Therefore, S1 and S2 should be converted into floating point values.
7. If S1 and S2 are invalid, operational error will occur, and the instruction will not be executed. The operational error flag will be On, and the error code H'0E19 will be recorded.
8. If the absolute value of the result > maximum floating point available, the carry flag will be On.
9. If the absolute value of the result < minimum floating point available, the borrow flag will be On.
10. If the result = 0, the zero flag will be On.

**Program Example:**

1. When M0 = On, convert (D1, D0) and (D3, D2) into binary floating points and store them in the 32-bit registers (D11, D10) and (D13, D12).
2. When M1 = On, perform POW operation on the binary floating points in 32-bit registers (D11, D10) and (D13, D12) and store the result in the 32-bit registers (D21, D20).
3. When M2 = On, convert the binary floating point (D21, D20) into decimal floating point ($D30 \times 10^{[D31]}$) and store it in register (D31, D30).




**Remarks:**

For floating point operations, see “5.3 Handling of Numeric Values”.

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 129 | D | INT | P | (S) (D) | Float to Integer |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DINT, DINTP: 5 steps |
| S | | | | | | | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

**S**: Source device **D**: Converted result

**Explanations:**

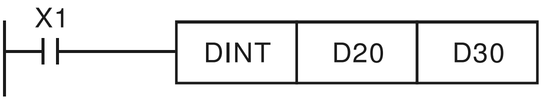
1. See the specifications of DVP-PM for its range of use.
2. Only 32-bit instructions DINT and DINTP are applicable.
3. Flags:

| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Borrow flag | M1809 | M1889 | M1969 |
| Carry flag | M1810 | M1890 | M1970 |

   See below for more information.
4. The binary floating point value in the register designated by **S** is converted to BIN integer and stored in the register designated by **D**. The decimal of BIN integer is left out.
5. INT is the inverse operation of API 49 DFLT instruction.
6. If the conversion result = 0, the zero flag will be On
   If there is any decimal left out, the borrow flag will be On.
   If the result exceeds the range (-2,147,483,648~2,147,483,647), the carry flag will be On.

**Program Example:**

When X1 = On, the binary floating point (D21, D20) will be converted into BIN integer, and the result will be stored in (D31, D30). The decimal of the BIN integer will be left out.



| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 130 | D | SIN | P | (S) (D) | Sine |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | F | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DSIN, DSINP: 6 steps |
| S | | | | | * | | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

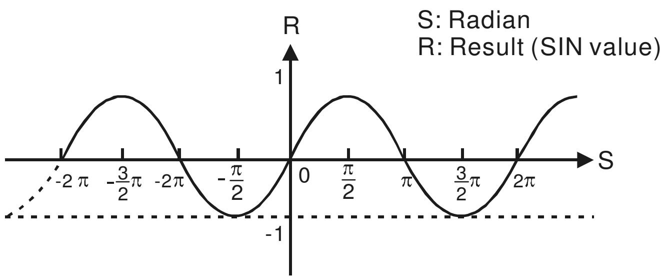
**S**: Source value **D**: SIN result

**Explanations:**

1. See the specifications of DVP-PM for its range of use.
2. F refers to floating point input. Be sure to add a decimal point when using it.
3. Only 32-bit instructions DSIN and DSINP are applicable.
4. 0° ≦ angle ＜360°
5. Flags:

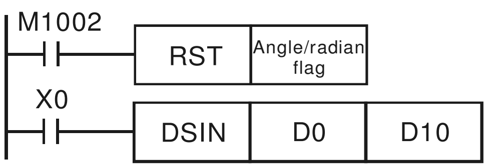
| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Angle/radian flag | M1760 | M1840 | M1920 |

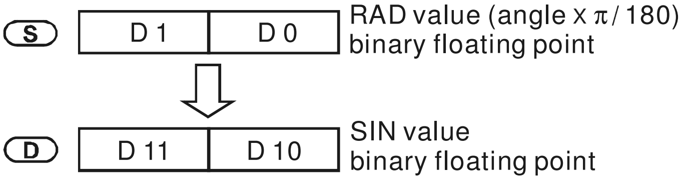
   See below for more information.
6. **S** can be an angle or radian, decided by the angle/radian flag.
7. When the angle/radian flag is Off, the program will be in radian mode, and the RAD value = angle × π/180.
8. When the angle/radian flag is On, the program will be in angle mode, and the range of angle should be 0° ≦ angle ＜360°.
9. If the result = 0, the zero flag will be On.
10. The SIN value obtained by **S** is calculated and stored in the register designated by **D**. The figure below offers the relation between radian and the result.




**Program Example 1:**

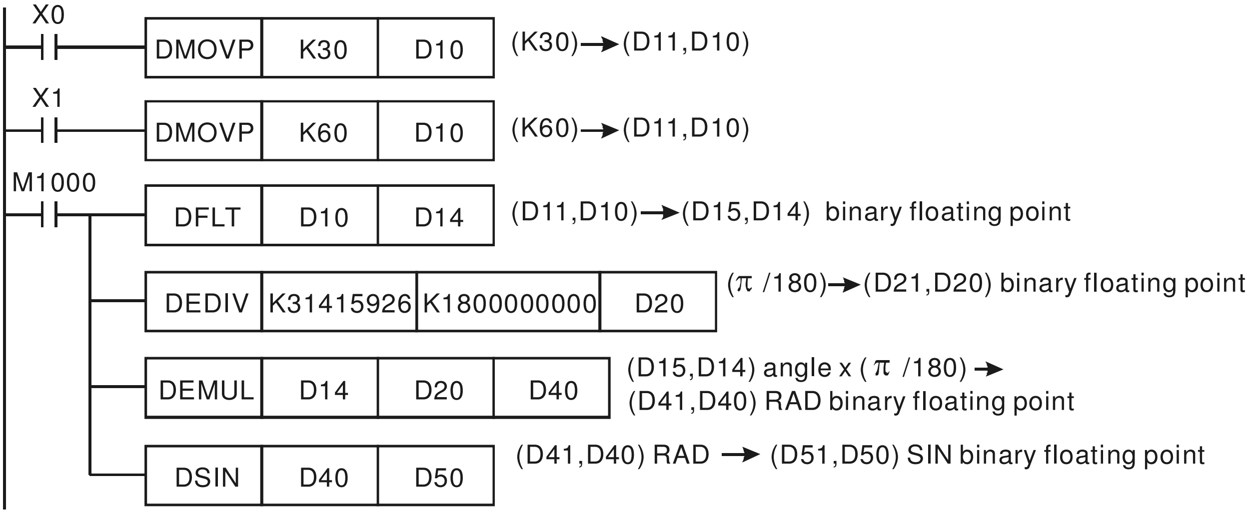
When the angle/radian flag = Off, the program will be in radian mode. When X0 = On, use the RAD value of binary floating point (D1, D0) and obtain its SIN value. The binary floating point result will be stored in (D11, D10).





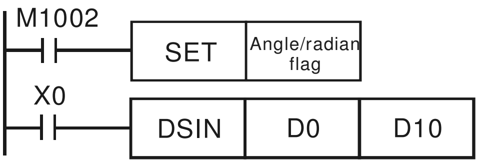

**Program Example 2:**

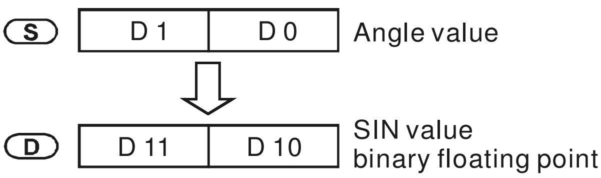
When the angle/radian flag = Off, the program is in radian mode. Input terminals X0 and X1 will select the angle. The angles will be converted into RAD value for calculating the SIN value.




**Program Example 3:**

When the angle/radian flag = On, the program will be in angle mode. When X0 = On, use the angle of (D1, D0) to obtain SIN value and store the binary floating point result in (D11, D10). 0° ≦ angle ＜360°




**Remarks:**

For floating point operations, see “5.3 Handling of Numeric Values”.

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 131 | D | COS | P | (S) (D) | Cosine |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | F | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DCOS, DCOSP: 6 steps |
| S | | | | | * | | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

**S**: Source value  **D**: COS result

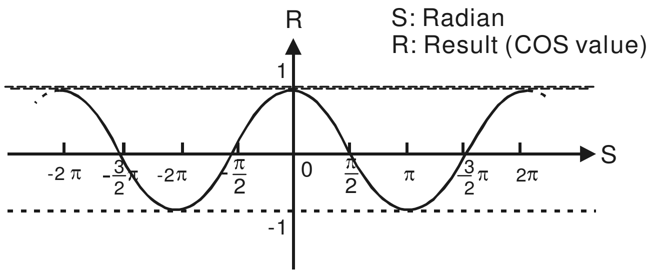
**Explanations:**

1. See the specifications of DVP-PM for its range of use.
2. F refers to floating point input. Be sure to add a decimal point when using it.
3. Only 32-bit instructions DCOS and DCOSP are applicable.
4. 0° ≦ angle ＜360°
5. Flags:

| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Angle/radian flag | M1760 | M1840 | M1920 |

   See below for more information.

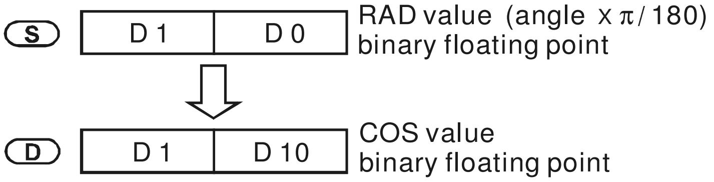
6. **S** can be angle or radian, decided by the angle/radian flag.
7. When the angle/radian flag is Off, the program will be in radian mode, and the RAD value = angle × π/180.
8. When the angle/radian flag is On, the program will be in angle mode, and the range of angle should be 0° ≦ angle ＜360°.
9. If the result = 0, the zero flag will be On.
10. The COS value obtained by **S** is calculated and stored in the register designated by **D**. The figure below offers the relation between radian and the result.




11. Switch between radian and angle by the angle/radian flag: When the flag = Off, S will be a RAD value; when the flag = On, S will be an angle value (0°~ 360°).

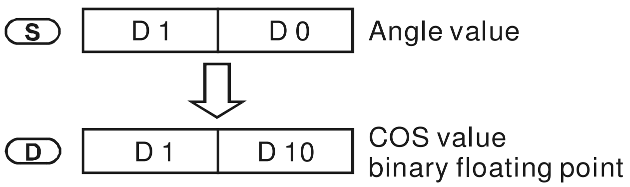
**Program Example 1:**

When the angle/radian flag = Off, the program will be in radian mode. When X0 = On, use the RAD value of binary floating point (D1, D0) and obtain its COS value. The binary floating point result will be stored in (D11, D10).




**Program Example 2:**

When the angle/radian flag = On, the program will be in angle mode. When X0 = On, use the angle of (D1, D0) to obtain COS value and store the binary floating point result in (D11, D10). 0° ≦ angle ＜360°


**Remarks:**

For floating point operations, see “5.3 Handling of Numeric Values”.

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 132 | D | TAN | P | (S) (D) | Tangent |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | F | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DTAN, DTANP: 6 steps |
| S | | | | | * | | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

**S**: Source value **D**: TAN result

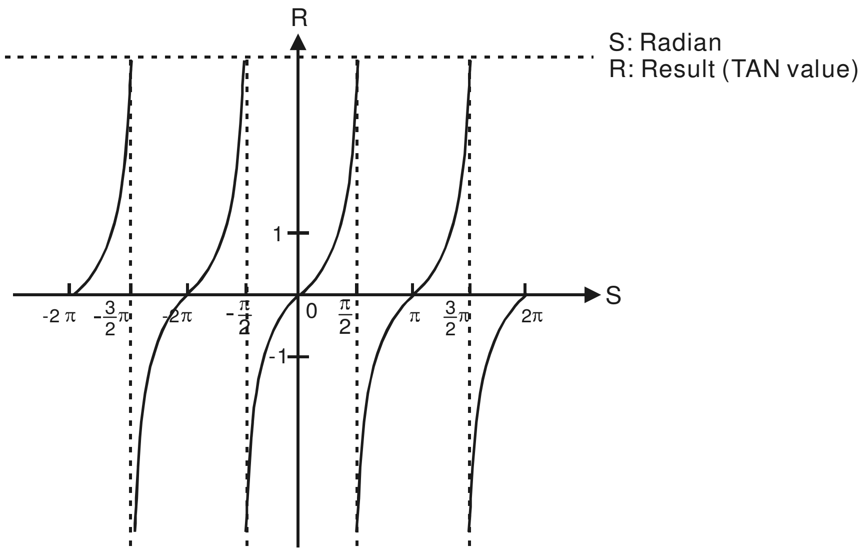
**Explanations:**

1. See the specifications of DVP-PM for its range of use.
2. F refers to floating point input. Be sure to add a decimal point when using it.
3. Only 32-bit instructions DTAN and DTANP are applicable.
4. 0° ≦ angle ＜360°
5. Flags:

| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Angle/radian flag | M1760 | M1840 | M1920 |

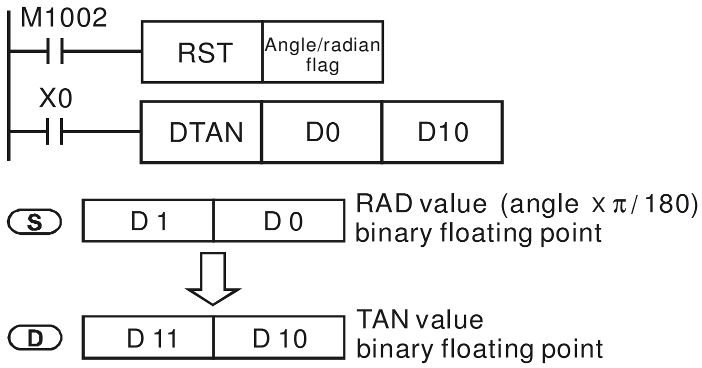
See below for more information.

6. **S** can be angle or radian, decided by the angle/radian flag.
7. When the angle/radian flag is Off, the program will be in radian mode, and the RAD value = angle × $\pi$/180.
8. When the angle/radian flag is On, the program will be in angle mode, and the range of angle should be 0° ≦ angle ＜360°.
9. If the result = 0, the zero flag will be On.
10. The TAN value obtained by **S** is calculated and stored in the register designated by **D**. The figure below offers the relation between radian and the result.



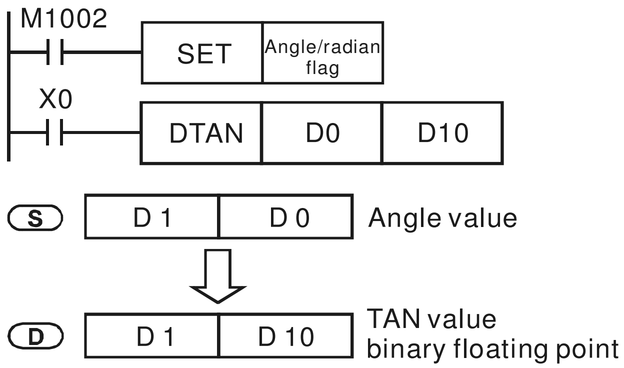

**Program Example 1:**

When the angle/radian flag = Off, the program will be in radian mode. When X0 = On, use the RAD value of binary floating point (D1, D0) and obtain its TAN value. The binary floating point result will be stored in (D11, D10).




**Program Example 2:**

When the angle/radian flag = On, the program will be in angle mode. When X0 = On, use the angle of (D1, D0) to obtain TAN value and store the binary floating point result in (D11, D10). $0° \leqq$ angle $< 360°$




**Remarks:**

For floating point operations, see “5.3 Handling of Numeric Values”.

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 133 | D | ASIN | P | (S) (D) | Arc Sine |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | F | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DASIN, DASINP: 6 steps |
| S | | | | | * | | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

**S**: Source value (binary floating point)  **D**: ASIN result

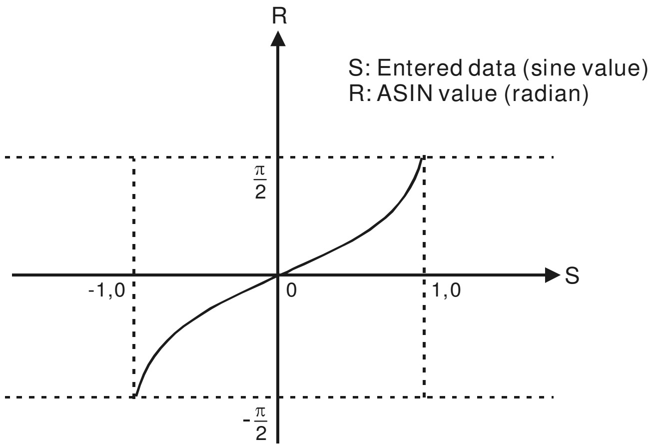
**Explanations:**

1. See the specifications of DVP-PM for its range of use.
2. F refers to floating point input. Be sure to add a decimal point when using it.
3. Only 32-bit instructions DASIN and DASINP are applicable.
4. Flags:

| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Operational error flag | M1793 | M1873 | M1953 |

   See below for more information.

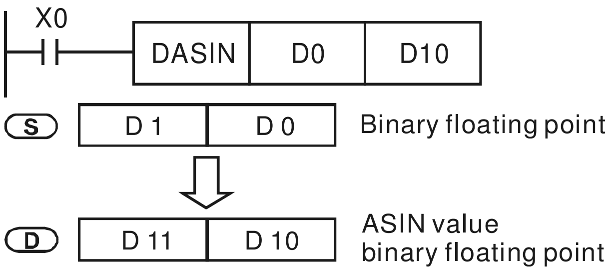
5. ASIN value = $\sin^{-1}$. The figure below offers the relation between the entered sin value and the result.




6. The decimal floating point of the SIN value designated by **S** should be in the range -1.0 ~ +1.0. If the value falls without the range, the operational error flag will be On, and the error code H'0E19 will be recorded.
7. If the result = 0, the zero flag will be On.

**Program Example:**

When X0 = On, obtain the ASIN value of binary floating point (D1, D0) and store the binary floating point result in (D11, D10).




**Remarks:**

For floating point operations, see "5.3 Handling of Numeric Values".

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 134 | D | ACOS | P | (S) (D) | Arc Cosine |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | F | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DACOS, DACOSP: 6 steps |
| S | | | | | * | | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

**S**: Source value (binary floating point) **D**: ACOS result

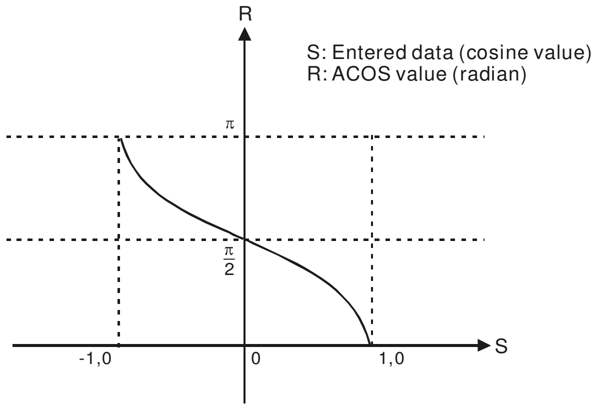
**Explanations:**

1. See the specifications of DVP-PM for its range of use.
2. F refers to floating point input. Be sure to add a decimal point when using it.
3. Only 32-bit instructions DACOS and DACOSP are applicable.
4. Flags:

| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Operational error flag | M1793 | M1873 | M1953 |

See below for more information.

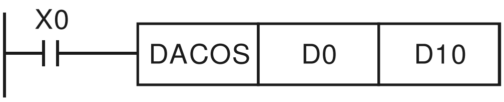
5. ACOS value = $\cos^{-1}$. The figure below offers the relation between the entered cos value and the result.

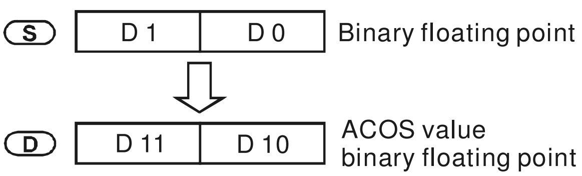



6. The decimal floating point of the COS value designated by **S** should be in the range -1.0 ~ +1.0. If the value falls without the range, the operational error flag will be On, and the error code H'0E19 will be recorded.
7. If the result = 0, the zero flag will be On.

**Program Example:**

When X0 = On, obtain the ACOS value of binary floating point (D1, D0) and store the binary floating point result in (D11, D10).




**Remarks:**

For floating point operations, see "5.3 Handling of Numeric Values".

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 135 | D | ATAN | P | (S) (D) | Arc Tangent |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | F | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DATAN, DATANP: 6 steps |
| S | | | | | * | | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

**S**: Source value (binary floating point) **D**: ATAN result

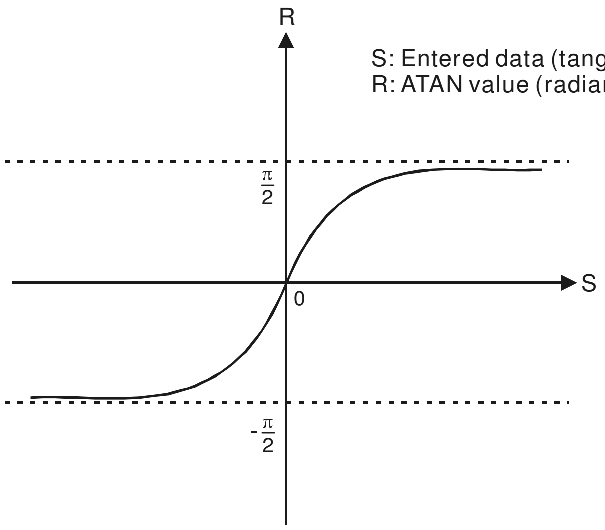
**Explanations:**

1. See the specifications of DVP-PM for its range of use.
2. F refers to floating point input. Be sure to add a decimal point when using it.
3. Only 32-bit instructions DATAN and DATANP are applicable.
4. Flags:

| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |

See below for more information.

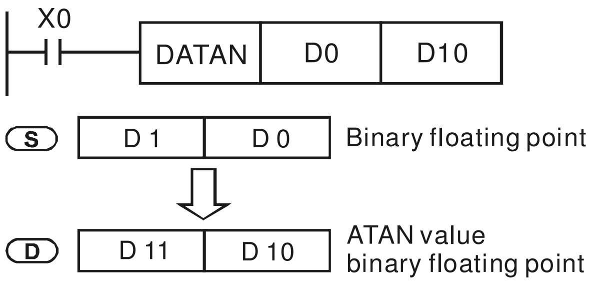
5. ATAN value = $\tan^{-1}$. The figure below offers the relation between the entered tan value and the result




6. If the result = 0, the zero flag will be On.

**Program Example:**

When X0 = On, obtain the ATAN value of binary floating point (D1, D0) and store the binary floating point result in (D11, D10).




**Remarks:**

For floating point operations, see "5.3 Handling of Numeric Values".

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 136 | D | SINH | P | (S) (D) | Hyperbolic Sine |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | F | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DSINH, DSINHP: 6 steps |
| S | | | | | * | | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

**S**: Source value (binary floating point)     **D**: SINH result

**Explanations:**

1. See the specifications of DVP-PM for its range of use.
2. F refers to floating point input. Be sure to add a decimal point when using it.
3. Only 32-bit instructions DSINH and DSINHP are applicable.
4. Flags:

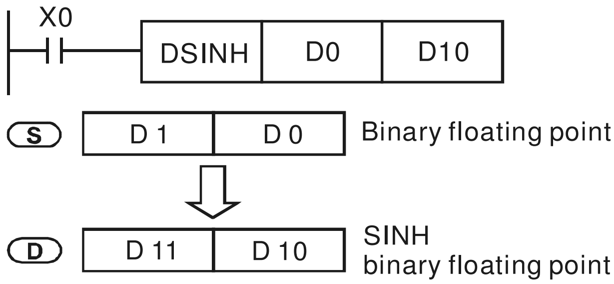
| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Borrow flag | M1809 | M1889 | M1969 |
| Carry flag | M1810 | M1890 | M1970 |

   See below for more information.

5. SINH value = $(e^{s} - e^{-s}) / 2$

**Program Example:**

1. When X0 = On, obtain the SINH value of binary floating point (D1, D0) and store the binary floating point result in (D11, D10).




2. If the absolute value of the result > maximum floating point available, the carry flag will be On.
3. If the absolute value of the result < minimum floating point available, the borrow flag will be On.
4. If the result = 0, the zero flag will be On.

**Remarks:**

For floating point operations, see “5.3 Handling of Numeric Values”.

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 137 | D | COSH | P | S D | Hyperbolic Cosine |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | F | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DCOSH, DCOSHP: 6 steps |
| S | | | | | * | | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

**S**: Source value (binary floating point) **D**: COSH result

**Explanations:**

1. See the specifications of DVP-PM for its range of use.
2. F refers to floating point input. Be sure to add a decimal point when using it.
3. Only 32-bit instructions DCOSH and DCOSHP are applicable.
4. Flags:

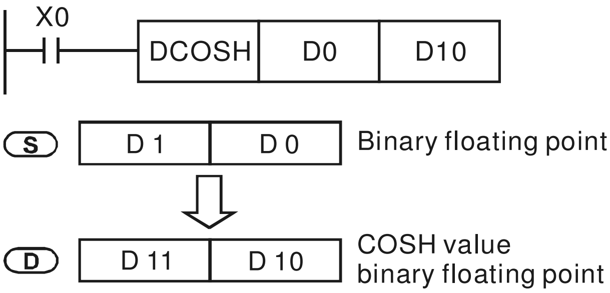
| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Borrow flag | M1809 | M1889 | M1969 |
| Carry flag | M1810 | M1890 | M1970 |

See below for more information.

5. COSH value = $(e^{s} + e^{-s}) / 2$

**Program Example:**

1. When X0 = On, obtain the COSH value of binary floating point (D1, D0) and store the binary floating point result in (D11, D10).




2. If the absolute value of the result > maximum floating point available, the carry flag will be On.
3. If the absolute value of the result < minimum floating point available, the borrow flag will be On.
4. If the result = 0, the zero flag will be On.

**Remarks:**

For floating point operations, see “5.3 Handling of Numeric Values”.

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 138 | D | TANH | P | (S) (D) | Hyperbolic Tangent |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | F | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | DTANH, DTANHP: 6 steps |
| S | | | | | * | | | | | | | | * | | | |
| D | | | | | | | | | | | | | * | | | |

**Operands:**

**S**: Source value (binary floating point)     **D**: TANH result

**Explanations:**

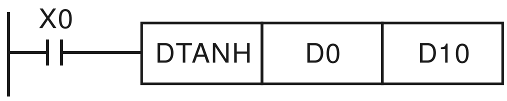
1. See the specifications of DVP-PM for its range of use.
2. F refers to floating point input. Be sure to add a decimal point when using it.
3. Only 32-bit instructions DTANH and DTANHP are applicable.
4. Flags:

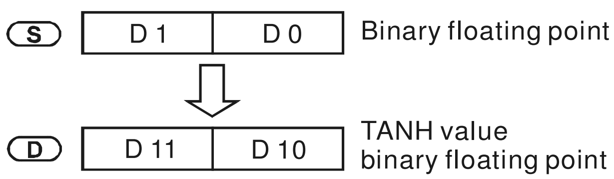
| | OX | OY | O100 |
|---|---|---|---|
| Zero flag | M1808 | M1888 | M1968 |
| Borrow flag | M1809 | M1889 | M1969 |
| Carry flag | M1810 | M1890 | M1970 |

   See below for more information.
5. TANH value = $(e^{s} – e^{-s}) / (e^{s} + e^{-s})$

**Program Example:**

1. When X0 = On, obtain the TANH value of binary floating point (D1, D0) and store the binary floating point result in (D11, D10).




2. If the absolute value of the result > maximum floating point available, the carry flag will be On.
3. If the absolute value of the result < minimum floating point available, the borrow flag will be On
4. If the result = 0, the zero flag will be On.

**Remarks:**

For floating point operations, see “5.3 Handling of Numeric Values”.

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 215~217 | D | LD# | | S1 S2 | Contact Logical Operation LD# |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | LD#: 5 steps<br>DLD#: 7 steps |
| $S_1$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| $S_2$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |

**Operands:**

**$S_1$**: Data source device 1 **$S_2$**: Data source device 2

**Explanations:**

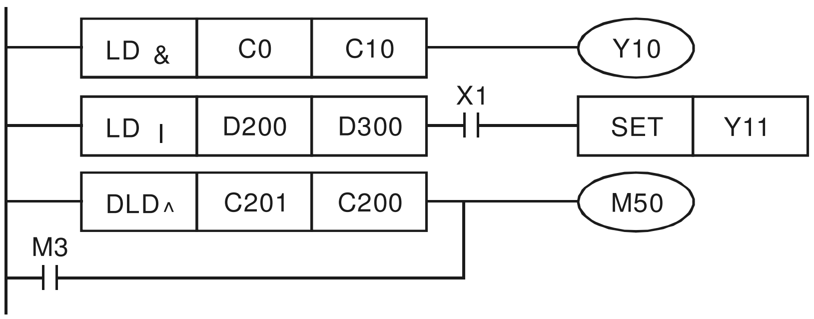
1. See the specifications of DVP-PM for its range of use.
2. #: &, |, ^
3. LD# instruction compares the content in **$S_1$** and **$S_2$**. If the result is not “0”, the instruction will be On. If the result is “0”, instruction will be Off.
4. LD# can be connected directly with bus.

| API No. | 16-bit instruction | 32-bit instruction | “On” condition | “Off” condition |
|---|---|---|---|---|
| 215 | LD& | **D**LD& | **$S_1$** & **$S_2$** $\neq 0$ | **$S_1$** & **$S_2$** $= 0$ |
| 216 | LD\| | **D**LD\| | **$S_1$** \| **$S_2$** $\neq 0$ | **$S_1$** \| **$S_2$** $= 0$ |
| 217 | LD^ | **D**LD^ | **$S_1$** ^ **$S_2$** $\neq 0$ | **$S_1$** ^ **$S_2$** $= 0$ |

5. &: Logical ‘AND’ operation
6. |: Logical ‘OR’ operatioin
7. ^: Logical ‘XOR’ operation
8. When 32-bit counters (C200 ~ C255) are used in this instruction for operation, please adopt 32-bit instruction (DLD#). If 16-bit instruction (LD#) is adopted, “program error” will occur, and the ERROR LED indicator on the panel of DVP-PM will flash.

**Program Example:**

1. When the result of logical AND operation of C0 and C10 ≠ 0, Y10 will be On.
2. When the result of logical OR operation of D200 and D300 ≠ 0 and X1 = On, Y11 will be On and held.
3. When the result of logical XOR operation of C201 and C200 ≠ 0 or M2 = On, M50 will be On.



| API | | Mnemonic | Operands | Function |
|---|---|---|---|---|
| 218~220 | D | AND# | (S1) (S2) | Contact Logical Operation AND# |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | |
| $S_1$ | | | | | * | * | * | * | * | * | * | * | * | * | * | AND#: 5 steps<br>DAND#: 7 steps |
| $S_2$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |

**Operands:**

**$S_1$**: Data source device 1 **$S_2$**: Data source device 2

**Explanations:**

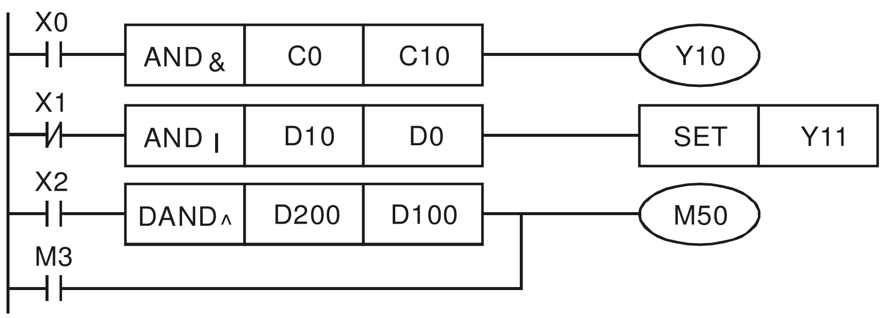
1. See the specifications of DVP-PM for its range of use.
2. #: &, |, ^
3. AND# instruction compares the content in **$S_1$** and **$S_2$**. If the result is not “0”, the instruction will be On. If the result is “0”, instruction will be Off.
4. AND# is series connected to contacts:

| API No. | 16-bit instruction | 32-bit instruction | “On" condition | “Off” condition |
|---|---|---|---|---|
| 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^ | **$S_1$** ^ **$S_2$** $\neq 0$ | **$S_1$** ^ **$S_2$** $= 0$ |

5. &: Logical ‘AND’ operation
6. |: Logical ‘OR’ operatioin
7. ^: Logical ‘XOR’ operation
8. When 32-bit counters (C200 ~ C255) are used in this instruction for operation, please adopt 32-bit instruction (DAND#). If 16-bit instruction (AND#) is adopted, “program error” will occur, and the ERROR LED indicator on the panel of DVP-PM will flash.

**Program Example:**

1. When the result of logical AND operation of C0 and C10 ≠ 0, Y10 will be On.
2. When the result of logical OR operation of D10 and D0 ≠ 0 and X1 = Off, Y11 will be On and held.
3. When X2 = On and the result of logical XOR operation of 32-bit register D200 (D201) and 32-bit register D100 (D101) ≠ 0 or M3 = On, M50 will be On.



| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 221~223 | D | OR# | | (S1) (S2) | Contact Logical operation OR# |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | OR#: 5 steps<br>DOR#: 7 steps |
| $S_1$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| $S_2$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |

**Operands:**

**$S_1$**: Data source device 1 **$S_2$**: Data source device 2

**Explanations:**

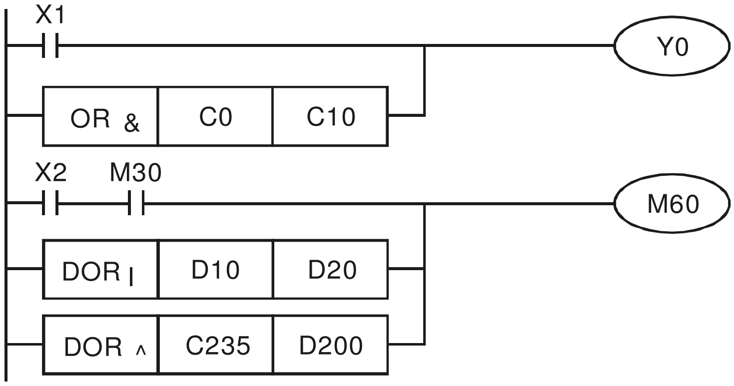
1. See the specifications of DVP-PM for its range of use.
2. #: &, |, ^
3. OR# instruction compares the content in **$S_1$** and **$S_2$**. If the result is not “0”, the instruction will be On. If the result is “0”, instruction will be Off.
4. OR# is parallel connected to contacts:

| API No. | 16-bit instruction | 32-bit instruction | “On” condition | “Off” condition |
|---|---|---|---|---|
| 221 | OR& | **D**OR& | **$S_1$** & **$S_2$** $\neq 0$ | **$S_1$** & **$S_2$** $= 0$ |
| 222 | OR\| | **D**OR\| | **$S_1$** \| **$S_2$** $\neq 0$ | **$S_1$** \| **$S_2$** $= 0$ |
| 223 | OR^ | **D**OR^ | **$S_1$** ^ **$S_2$** $\neq 0$ | **$S_1$** ^ **$S_2$** $= 0$ |

5. &: Logical ‘AND’ operation
6. |: Logical ‘OR’ operatioin
7. ^: Logical ‘XOR’ operation
8. When 32-bit counters (C200 ~ C255) are used in this instruction for operation, please adopt 32-bit instruction (DOR#). If 16-bit instruction (OR#) is adopted, “program error” will occur, and the ERROR LED indicator on the panel of DVP-PM will flash.

**Program Example:**

1. When X1 = On, or the result of logical AND operation of C0 and C10 ≠ 0, Y0 will be On
2. M60 will be On when X2 = On, M30 = On, or the result of logical OR operation of 32-bit register D10 (D11) and 32-bit register D20 (D21) ≠ 0, or the result of logical XOR operation of 32-bit register D200 (D201) and 32-bit counter C235 ≠ 0.



| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 224~ 230 | D | LD※ | | S1 S2 | Load Compare |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | LD※: 5 steps |
| $S_1$ | | | | | * | * | * | * | * | * | * | * | * | * | * | DLD※: 7 steps |
| $S_2$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |

**Operands:**

$S_1$: Data source device 1　　$S_2$: Data source device 2

**Explanations:**

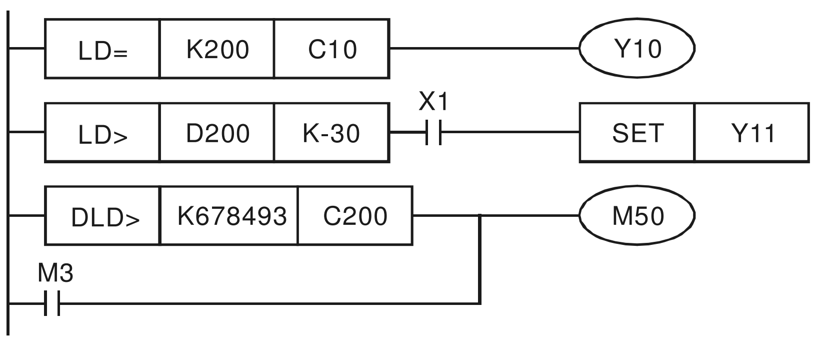
1. See the specifications of DVP-PM for its range of use.
2. ※: =, >, <, <>, ≦, ≧
3. LD※ instruction compares the content in $S_1$ and $S_2$. Take API 224 (LD=) for example, if the result is "=", the instruction will be On. If the result is "≠", the instruction will be Off.
4. LD※ can be connected directly with bus.

| API No. | 16-bit instruction | 32-bit instruction | "On" condition | "Off" condition |
|---|---|---|---|---|
| 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>= | $S_1 \geqq S_2$ | $S_1 < S_2$ |

5. When 32-bit counters (C200 ~ C255) are used in this instruction for comparison, please adopt 32-bit instruction (DLD※). If 16-bit instruction (LD※) is adopted, "program error" will occur, and the ERROR LED indicator on the panel of DVP-PM will flash.

**Program Example:**

1. When the content in C10 = K200, Y10 will be On.
2. When the content in D200 > K-30 and X1 = )n, Y11 will be On and held.
3. When the content in C200 < K678, 493 or M3 = On, M50 will be On.



| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 232~ 238 | D | AND※ | | $S_1$ $S_2$ | AND Compare |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | AND※: 5 steps<br>DAND※: 7 steps |
| $S_1$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| $S_2$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |

**Operands:**

**$S_1$**: Data source device 1  **$S_2$**: Data source device 2

**Explanations:**

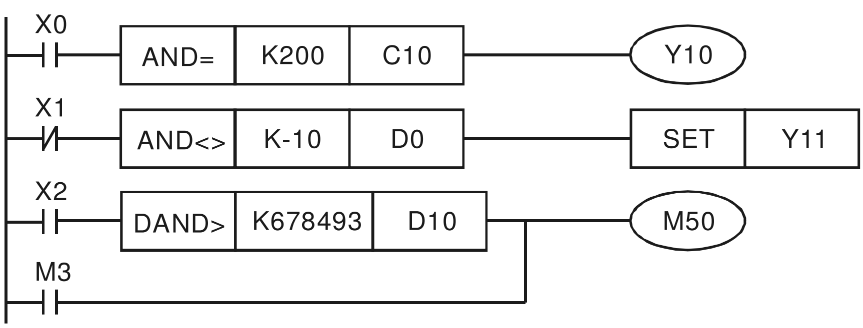
1. See the specifications of DVP-PM for its range of use.
2. ※: =, >, <, <>, ≦, ≧
3. AND※ instruction compares the content in **$S_1$** and **$S_2$**. Take API 232 (AND=) for example, if the result is "=", the instruction will be On. If the result is "≠", the instruction will be Off.
4. AND※ is series connected to contacts:

| API No. | 16-bit instruction | 32-bit instruction | "On" condition | "Off" condition |
|---|---|---|---|---|
| 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>= | **$S_1 \geqq S_2$** | **$S_1 < S_2$** |

5. When 32-bit counters (C200 ~ C255) are used in this instruction for comparison, please adopt 32-bit instruction (DAND※). If 16-bit instruction (AND※) is adopted, "program error" will occur, and the ERROR LED indicator on the panel of DVP-PM will flash.

**Progran Example:**

1. When X0 = On and the present value in C10 = K200, Y10 will be On.
2. When X1 = Off and the content in register D10 ≠ K-10, Y11 will be On and held.
3. When X2 = On and the content in the 32-bit register D0 (D11) < 678, 493 or M3 = On, M50 will be On.



| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 240~ 246 | D | OR※ | | (S1) (S2) | OR Compare |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | OR※: 5 steps<br>DOR※: 7 steps |
| $S_1$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| $S_2$ | | | | | * | * | * | * | * | * | * | * | * | * | * | |

**Operands:**

**$S_1$**: Data source device 1 **$S_2$**: Data source device 2

**Explanations:**

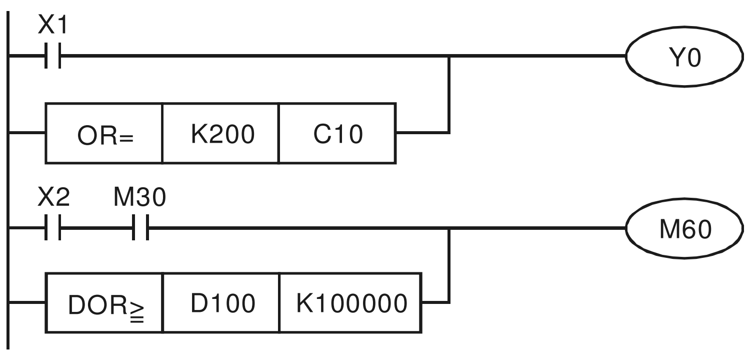
1. See the specifications of DVP-PM for its range of use.
2. ※: =, >, <, <>, ≦, ≧
3. OR※ instruction compares the content in **$S_1$** and **$S_2$**. Take API 240 (OR=) for example, if the result is "=", the instruction will be On. If the result is "≠", the instruction will be Off.
4. OR※ is parallel connected to contacts:

| API No. | 16-bit instruction | 32-bit instruction | "On" condition | "Off" condition |
|---|---|---|---|---|
| 240 | OR= | **D**OR= | $S_1 = S_2$ | $S_1 \neq S_2$ |
| 241 | OR> | **D**OR> | $S_1 > S_2$ | $S_1 \leqq S_2$ |
| 242 | OR< | **D**OR< | $S_1 < S_2$ | $S_1 \geqq S_2$ |
| 244 | OR<> | **D**OR<> | $S_1 \neq S_2$ | $S_1 = S_2$ |
| 245 | OR<= | **D**OR<= | $S_1 \leqq S_2$ | $S_1 > S_2$ |
| 246 | OR>= | **D**OR>= | $S_1 \geqq S_2$ | $S_1 < S_2$ |

5. When 32-bit counters (C200 ~ C255) are used in this instruction for comparison, please adopt 32-bit instruction (DOR※). If 16-bit instruction (OR※) is adopted, "program error" will occur, and the ERROR LED indicator on the panel of DVP-PM will flash.

**Program Example:**

1. When X1 = On and the present value in C10 = K200, Y0 will be On.
2. M60 will be On when X2 = On, M30 = On and the content in 32-bit register D100 (D101) ≧ K100,000.



| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 256 | | CJN | P | S | Negated Conditional Jump |

| OP | Range | Program Steps |
|---|---|---|
| S | P0 ~ P255 | CJN, CJNP: 3 steps |

**Operands:**

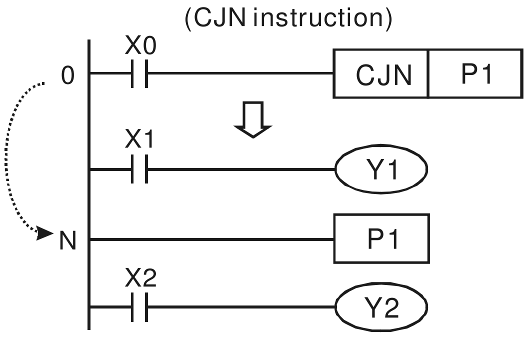
**S**: The destination pointer of conditional jump

**Explanations:**

1. Operand **S** can designate P.
2. Device P does not support V and Z index register modification.
3. When the contact before CJN is “On”, the execution will continue in the next row of the program. When the contact before CJN is “Off”, the execution will jump to where the designated P is.
4. When you do not want to execute a particular part of O100 main program in order to shorten the scan time and execute dual outputs, CJN instruction or CJNP instruction can be adopted.
5. When the program designated by pointer P is prior to CJN instruction, WDT time-out will occur, and O100 main program will stop running. Please use it carefully.
6. CJN instruction can designate the same pointer P repeatedly. However, CJN and CALL cannot designate the same pointer P; otherwise errors may occur
7. Actions of all devices while the negated conditional jump is being executed.
   a) Y, M and S remain their previous status before the jumping takes place.
   b) The 10ms timer which is executing stops.
   c) General-purpose counter will stop counting, and general application instruction will not be executed.
   d) If the “reset instruction” of the timer is executed before the jumping, the device will be in the reset status while the jumping is being executed.

**Program Example 1:**

1. When X0 = On, the program will automatically jump from address 0 to N (the designated label P1) and keep its execution. The addresses between 0 and N will not be executed.
2. When X0 = On, as an ordinary program, the program will keep on executing from address 0. CJN instruction will not be executed at this time.



| API | Mnemonic | Operands | Function |
|---|---|---|---|
| 257 | JMP | S | Unconditional Jump |

| OP | Range | Program Steps |
|---|---|---|
| S | P0 ~ P255 | JMP: 3 steps |

**Operands:**

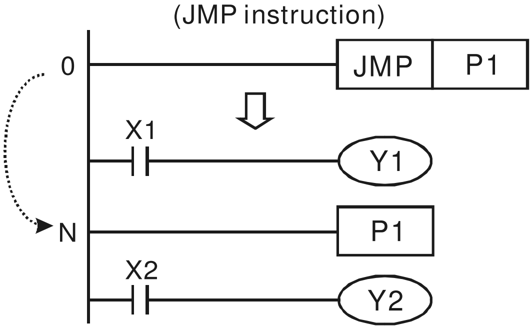
**S**: The destination pointer of conditional jump

**Explanations:**

1. Operand **S** can designate P.
2. No contact to drive the instruction is required.
3. Device P does not support V and Z index register modification.
4. JMP instruction is similar to CJ instruction. The difference is that a contact before CJ instruction to drive it is required, but JMP instruction does not need such contact to drive it.
5. JMP does not support pulse execution JMPP instruction.

**Program Example:**

When the scan of program reaches address 0, either there is a contact (regardless of the contact status) or no contact before JMP, the program will automatically jump from address 0 to N (the designated label P1) and continue its execution. The addresses between 0 and N will not be executed.



| API | Mnemonic | Function |
|---|---|---|
| 258 | BRET | Return to Bus Line |

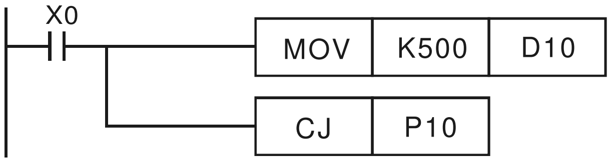
| OP | Descriptions | Program Steps |
|---|---|---|
| N/A | N/A | BRET: 1 steps |

**Explanations:**

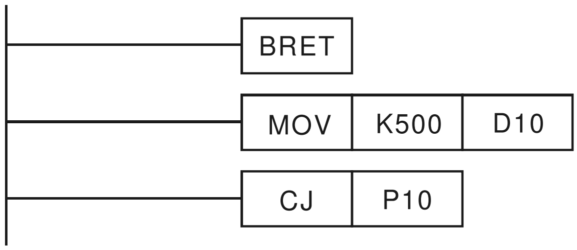
1. No operand. No contact to drive the instruction is required.
2. When BRET instruction is executed, the instructions which need a contact to be driven will be equivalent to being connected to a bus. Therefore, you can execute these instructions directly.

**Program Example:**

1. In general programs, the instructions behind the contact will be executed only when X0 = On.




2. When BRET instruction is added into the program, the instructions which need a contact to be driven will be equivalent to being connected to a bus and can be executed directly.



| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 259 | | MMOV | P | (S) (D) | Magnifying Transfer with Sign Extension |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | MMOV, MMOVP: 5 steps |
| S | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| D | | | | | | | | * | * | * | * | * | * | * | * | |

**Operands:**

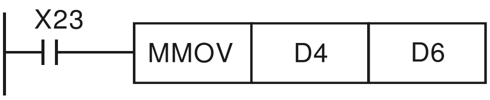
**S**: Data source (16-bit) **D**: Data destination (32-bit)

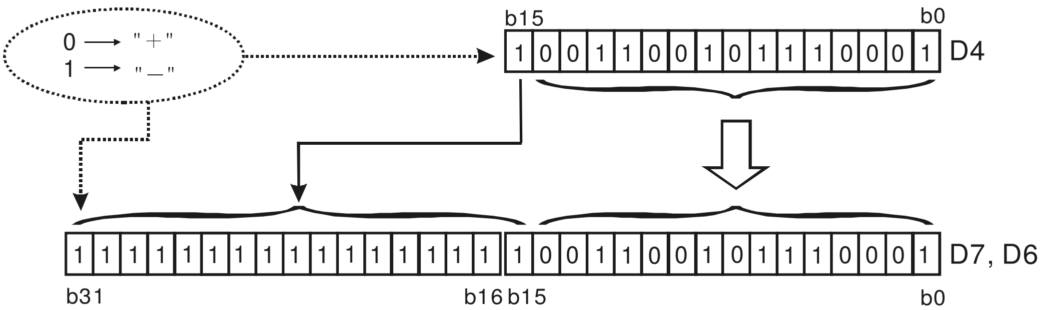
**Explanations:**

1. See the specifications of DVP-PM for its range of use.
2. MMOV instruction sends the data (including the sign bit) in **S** into **D**.

**Program Example:**

When X23 = On, the data in D4 will be sent to D6 and D7.




b15 of D4 is sent to b15 ~ b31 of (D7, D6) as a negative value (same as it is in D4).

| API | Mnemonic | | | Operands | Function |
|---|---|---|---|---|---|
| 260 | | RMOV | P | (S) (D) | Reducing Transfer with Sign Holding |

| Type / OP | Bit Devices | | | | Word Devices | | | | | | | | | | | Program Steps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | M | S | K | H | KnX | KnY | KnM | KnS | T | C | D | V | Z | RMOV, RMOVP: 5 steps |
| S | | | | | * | * | * | * | * | * | * | * | * | * | * | |
| D | | | | | | | | * | * | * | * | * | * | * | * | |

**Operands:**

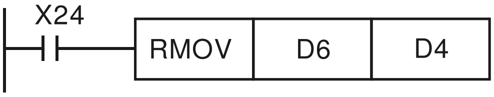
**S**: Data source (16-bit)  **D**: Data destination (32-bit)

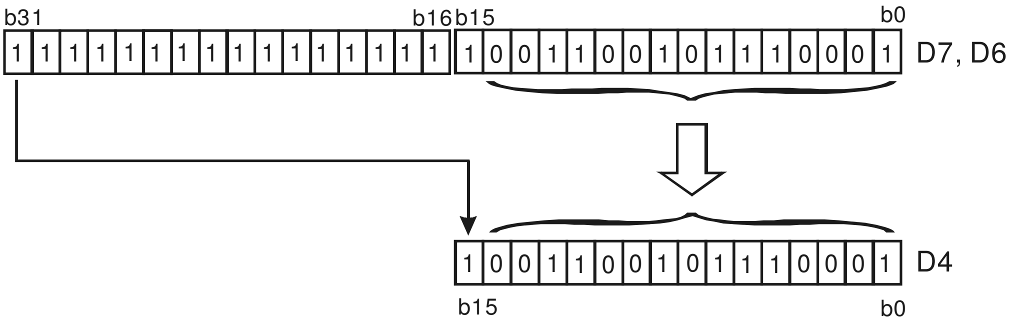
**Explanations:**

1. See the specifications of DVP-PM for its range of use.
2. RMOV instruction sends the data (without the sign bit) in **S** into **D**

**Program Example:**

When X24 = On, the data in D6 and D7 will be sent to D4.




When X24 = On, b31 (the most significant bit) of D7 (**S**) will be sent to b15 (the most significant bit) of D4 (**D**). Other less significant bits will then start to be sent in sequence. b15 ~ b30 of D7 will be ignored (not be sent).

## MEMO

## 6.1 List of Motion Instructions and G-Code Instructions

| Category | MON | Mnemonic | Function | Response Time | Page |
|---|---|---|---|---|---|
| Motion Instruction | 00 | DRV | High-Speed Positioning | 20 ~ 25ms | 6-5 |
| | 01 | LIN | 2-Axis Synchronous Linear Interpolation (considering remaining distance) | 20 ~ 22ms | 6-7 |
| | 02 | CW | Clockwise Arc Movement (set the position of center) | 20 ~ 24ms | 6-9 |
| | 03 | CCW | Counterclockwise Arc Movement (set the position of center) | 20 ~ 24ms | 6-9 |
| | 04 | CW | Clockwise Arc Movement (set the radius) | 20 ~ 24ms | 6-11 |
| | 05 | CCW | Counterclockwise Arc Movement (set the radius) | 20 ~ 24ms | 6-11 |
| | 06 | TIM | Pause Time | - | 6-13 |
| | 07 | DRVZ | Return to Mechanical Zero Point (zero return) | 20 ~ 25ms | 6-14 |
| | 08 | SETR | Set up Electrical Zero Point | - | 6-17 |
| | 09 | DRVR | Return to Electrical Zero Point | 20 ~ 25ms | 6-18 |
| | 10 | INTR | 2-Axis Synchronous Single-Speed Interpolation (ignoring remaining distance) | 20 ~ 25ms | 6-19 |
| | 11 | SINTR | Inserting Single-Speed Operation | 20 ~ 25ms | 6-20 |
| | 12 | DINTR | Inserting 2-Speed Operation | 20 ~ 25ms | 6-22 |
| | 13 | MOVC | Set up Linear Movement Compensation | - | 6-24 |
| | 14 | CNTC | Arc Center Compensation | - | 6-25 |
| | 15 | RADC | Arc Radius Compensation | - | 6-26 |
| | 16 | CANC | Cancel Compensation | - | 6-27 |
| | 17 | ABST | Set up Absolute Coordinate | - | 6-28 |
| | 18 | INCT | Set up Relative Coordinate | - | 6-28 |
| | 19 | SETT | Set up Current Position | - | 6-29 |

| Category | G-Code | Mnemonic | Function | Page |
|---|---|---|---|---|
| G-Code Instruction | 0 | DRV | High-Speed Positioning | 6-30 |
| | 1 | LIN | 2-Axis Synchronous Linear Interpolation (considering remaining distance) | 6-34 |
| | 2 | CW | Clockwise Arc Movement (set the position of center) | 6-37 |
| | 3 | CCW | Counterclockwise Arc Movement (set the position of center) | 6-37 |
| | 2 | CW | Clockwise Arc Movement (set the radius) | 6-38 |
| | 3 | CCW | Counterclockwise Arc Movement (set the radius) | 6-38 |
| | 4 | TIM | Pause Time | 6-39 |
| | 90 | ABS | Set up Absolute Coordinate | 6-39 |
| | 91 | INC | Set up Relative Coordinate | 6-39 |

## 6.2 Composition of Motion Instructions and G-Code Instructions

### 6.2.1 Motion Instructions

◆ A motion instruction has two parts: the mnemonic and operand

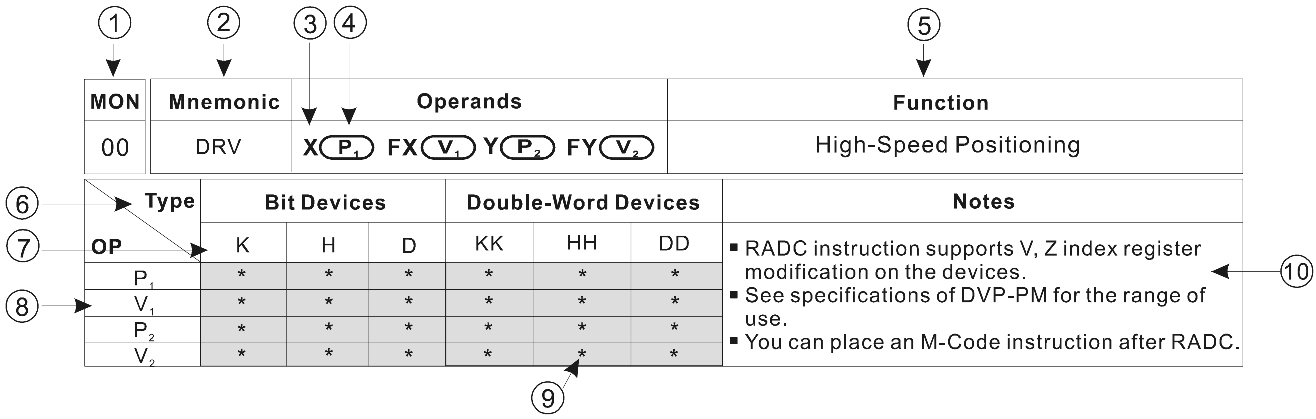
| Mnemonic | | Function of the instruction |
|---|---|---|
| Operand | Function | For which axis |
| | Parameter | Parameter value |

- "Function" part in the operand must not be ignored.
- "Parameter" part in the operand can be represented as follows:
  1. Enter numeral + 32-bit register (DD). The operand parameters are all in 32 bits.
     For example: DRV X**1000** FX**1000** Y**1000** FY**DD1000**
  2. Enter K, H, D + numeral. The operand parameters are all in 16 bits.
     For example: DRV X**K1000** FX**H1000** Y**K1000** FY**D1000**
  3. Enter numeral. The operand parameters can be 16 bits or 32 bits.
     For example: DRV X**1000** FX**H1000** Y**K1000** FY**1000**

◆ Program steps occupied by motion instruction

- Mnemonic: 1 step.
- Operand parameter with only numeral: 3 steps per operand
- Operand parameter with K, H, D, DD + numeral: 2 steps per operand
- Operand parameter with KK, HH + numeral: 3 steps per operand

◆ Format of a motion instruction:




① MON (motion) No.
② Mnemonic
③ Operand function: for which axis
④ Operand parameter: parameter value
⑤ Function of the MON instruction
⑥ Device type
⑦ Device name
⑧ Parameter column marked with * is the device applicable for the operand.
⑨ Parameter column marked with * and in grey refers to V, Z index register modification is applicable.
⑩ Notes for the instruction

◆ Input of motion instruction

Some motion instructions are only composed of the instruction part (mnemonic), e.g. DRVZ, SETR, ABS and so on. However, most motion instructions are composed of the instruction part and many operands. No contact is required to be placed before a motion instruction.

## 6.2.2 G-Code Instructions

◆ A G-Code instruction has two parts: the mnemonic and operand

| Mnemonic | | Function of the instruction |
|---|---|---|
| Operand | Function | For which axis |
| | Parameter | Parameter value |

- "Function" part in the operand must not be ignored
- Enter integer or decimal in numeral. The operand parameters are all in 32 bits.
  For example: G0 X**100** Y**100** or G0 X**100.0** Y**100.0**
- Operand with decimal is 1,000 times larger than it being without decimal point.
  For example: G0 X**100.0** Y**100.0 =** G0 X**100000** Y**100000** ◦

◆ Program steps occupied by G-Code instruction

- Mnemonic: 1 step
- Operand parameter with numeral: 3 steps per operand

◆ Format of a G-Code instruction:

| G-Code | Mnemonic ① | Operands ② ③ | Function ④ |
|---|---|---|---|
| | G0 | X(P₁) Y(P₂) Z(P₃) | High-Speed Positioning |

① G-Code instruction No.

② Operand function: for which axis

③ Operand parameter: parameter value

④ Function of the G-Code instruction

◆ Input of G-Code instruction

Some G-Code instructions are only composed of the instruction part (mnemonic), e.g. G90, G91. However, most G-Code instructions are composed of the instruction part and many operands. No contact is required to be placed before a G-Code instruction.

◆ How to use G-Code

(a) Many instructions can be placed in the same row in the program

For example: G91G01 X100.0 Y300.0 F500.0 M8 G04 X4.5;

(b) When the same group of instructions is placed in the same row in the program, the last instruction has the priority.

For example: G2 G0 G03 G01 X100.0 Y300.0 F500.0; => G1 X100.0 Y300.0 F500.0;

(c) Fast moving instruction (G00) does not need to use parameter $V_{MAX}$

For example: G0 X100.2 Y500.0;

In which the speed is the maximum moving speed ($V_{MAX}$) set in the parameter in DVP-PM.

(d) Fast moving instruction (G0) and linear interpolation instruction (G1) have continuity.

```
N0000  G0  X500.0  Y125.0;
N0001  X-400.0  Y-500.0;                  => G0  X-400.0  Y-500.0;
N0002  G1  X100.0  Y25.0  F200.0;
N0003  X-200.0  Y50.0;                    => G1  X-200.0  Y50.0  F200.0;
```

(e) Speed parameter F of G1 G2 G3 has continuity.

```
N0000  G1  X500.0  Y125.0  F200.0;
N0001  G3  X-40.0  Y-50.0  R100.0;        => G3  X-40.0  Y-50.0  R100.  F200.0;
N0002  G2  X100.0  Y25.0  I400.5  F200.0;
N0003  G1  X-200.0  Y50.0;                => G1  X-200.0  Y50.0  F200.0;
```

(f) G90 (absolute coordinate) and G91 (relative coordinate) have the top priority.

```
G90  G1  X100.0  Y300.0  F500.0;          => G90  G1  X100.0  Y300.0  F500.0;
G1G90  X100.0  Y300.0  F500.0;            => G90  G1  X100.0  Y300.0  F500.0;
```

(g) Program code with or without spaces can all be identified.

```
G1G91X500.0  Y125.0F200.0;                => G1  G91  X500.0  Y125.0  F200.0;
```

(h) Coordinates and speeds will all be converted into 32 bits.

```
G1  X-125.5  F200.0;                      => G1  X-125500  F200000;
```

(i) Coordinates and speeds with decimal (.) will be multiplied by 1,000.

```
G1  X100  Y-125.5  F200.0;                => G1  X100  Y-125500  F200000;
```

(j) The unit of pause instruction: 10ms

```
G4  X4.5    (pause for 4.5 seconds)       => TIM  450;
G4  X5      (pause for 5 seconds)         => TIM  500;
G4  P4500   (pause for 4.5 seconds)       => TIM  450;
G4  P2509   (pause for 2.5 seconds)       => TIM  250;
```

(k) G-Codes DVP-PM does not support will be ignored.

```
G21G54G1  X-125.5  F200.0;                => G1  X-125500  F200000;
G43G87G96  X250.5  F200.0;                => G1  X250500  F200000;
```

## 6.3 Motion Instructions

| MON | Mnemonic | Operands | Function |
|---|---|---|---|
| 00 | DRV | X$(P_1)$ FX$(V_1)$ Y$(P_2)$ FY$(V_2)$ | High-Speed Positioning |

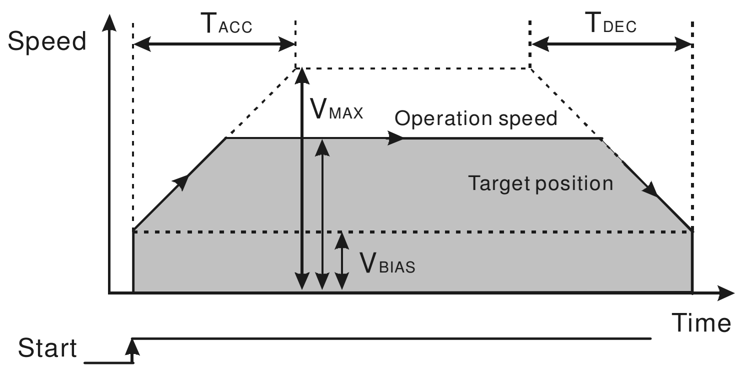
| Type / OP | Bit Devices | | | Double-Word Devices | | | Notes |
|---|---|---|---|---|---|---|---|
| | K | H | D | KK | HH | DD | |
| $P_1$ | * | * | * | * | * | * | ■ DRV instruction supports V, Z index register modification on the devices.<br>■ See specifications of DVP-PM for the range of use.<br>■ You can place an M-Code instruction after DRV. |
| $V_1$ | * | * | * | * | * | * | |
| $P_2$ | * | * | * | * | * | * | |
| $V_2$ | * | * | * | * | * | * | |

**Operands:**

**$P_1$**: Target position on X axis **$V_1$**: Moving speed on X axis **$P_2$**: Target position on Y axis
**$V_2$**: Moving speed on Y axis

**Explanations:**

1. Maximum **$V_1$**, **$V_2$** = $V_{MAX}$
2. Range of parameters: (16-bit) K = -32, 768 ~ 32,767; H = 0 ~ FFFF; D = 0 ~ 9,999; (32-bit) KK = -2,147,483,648 ~ 2,147,483,647; HH = 0 ~ FFFFFFFF; DD = 0 ~ 9,998.
3. Acceleration/deceleration time and bias speed can be set up in special D.
4. Acceleration/deceleration time increases or decreases in proportional to the setting of $V_{MAX}$.
5. The operation:




6. The 16-bit parameter devices and 32-bit parameter devices can be used together.
7. If you set up the moving speed on axis, you have to set up the target position on the axis. However, if you set up the target position, it is not necessary to set up the moving speed. There are 8 parameter combinations for DRV instruction.

| NO. | Instruction | Parameter combination |
|---|---|---|
| 1 | DRV | X$(P_1)$ |
| 2 | | X$(P_1)$ FX$(V_1)$ |
| 3 | | Y$(P_2)$ |
| 4 | | Y$(P_2)$ FY$(V_2)$ |
| 5 | | X$(P_1)$ Y$(P_2)$ |
| 6 | | X$(P_1)$ Y$(P_2)$ FY$(V_2)$ |
| 7 | | X$(P_1)$ FX$(V_1)$ Y$(P_2)$ |
| 8 | | X$(P_1)$ FX$(V_1)$ Y$(P_2)$ FY$(V_2)$ |

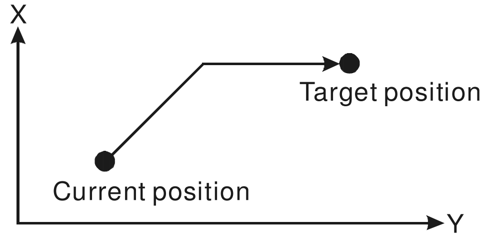
8. If you set up the target position on the axis without setting up the moving speed, the operation will run at $V_{MAX}$.

**Program Example:**

1. DRV XK12345 YH7567 FYKK40000

   In this example, the two axes will fast move to target position (K12,345, H7567) in linear movement. The target position can be an absolute coordinate or relative coordinate, which is determined by the instruction closest to DRV. The moving speed on X axis is not set (i.e. output by $V_{MAX}$), and Y axis outputs at 40K per second.

2. Moving path




3. Combination of operand:

   DRV XKK-345289 FXD100 YDD10Z5 FYDD102

   DRV XDD20 FXHH2345 YK456@V4 FYDD0

   These instructions are legal. Device D is indirect set value.

**Remarks:**

Relevant special registers

| | |
|---|---|
| D1822, D1823 | Maximum speed of X axis. D1822 for low word; D1823 for high word. |
| D1824, D1825 | Bias speed of X axis. D1824 for low word; D1825 for high word. |
| D1836 | Acceleration time of X axis |
| D1837 | Deceleration time of X axis |
| D1902, D1903 | Maximum speed of Y axis. D1902 for low word; D1903 for high word. |
| D1904, D1905 | Bias speed of Y axis. D1904 for low word; D1905 for high word. |
| D1916 | Acceleration time of Y axis |
| D1917 | Deceleration time of Y axis |

| MON | Mnemonic | Operands | Function |
|---|---|---|---|
| 01 | LIN | X (P1) Y (P2) F (V) | 2-Axis Synchronous Linear Interpolation (considering remaining distance) |

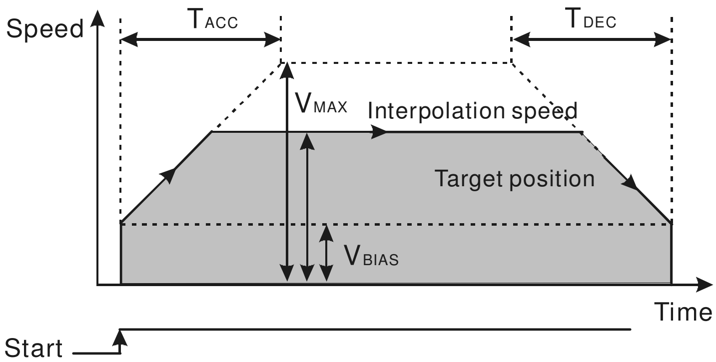
| Type / OP | Bit Devices | | | Double-Word Devices | | | Notes |
|---|---|---|---|---|---|---|---|
| | K | H | D | KK | HH | DD | ▪ LIN instruction supports V, Z index register modification on the devices. ▪ See specifications of DVP-PM for the range of use. |
| $P_1$ | * | * | * | * | * | * | |
| $P_2$ | * | * | * | * | * | * | |
| F | * | * | * | * | * | * | |

**Operands:**

**$P_1$**: Target position on X axis **$P_2$**: Target position on Y axis **V**: Speed for 2-axis linear interpolation

**Explanations:**

1. Maximum **V** = $V_{MAX}$.
2. Range of parameters: (16-bit) K = -32,768 ~ 32,767; H = 0 ~ FFFF; D = 0 ~ 9,999; (32-bit) KK = -2,147,483,648 ~ 2,147,483,647; HH = 0 ~ FFFFFFFF; DD = 0 ~ 9,998.
3. Acceleration/deceleration time and bias speed can be set up in special D.
4. Acceleration/deceleration time increases or decreases in proportional to the setting of $V_{MAX}$.
5. Individual output on X, Y axis:




6. The interpolation speed is monitored by special registers: D1850 ~ D1851 for X axis; D1930 ~ D1931 for Y axis.
7. D1865 is for setting up stop mode with the consideration on the remaining distance (see Remarks for more information).
8. The 16-bit parameter devices and 32-bit parameter devices can be used together.
9. Target position is necessary, and moving speed is not necessary. There are 6 parameter combinations for LIN instruction.

| NO. | Instruction | Parameter combination |
|---|---|---|
| 1 | LIN | X (P1) |
| 2 | | X (P1) F (V) |
| 3 | | Y (P2) |
| 4 | | Y (P2) F (V) |
| 5 | | X (P1) Y (P2) |
| 6 | | X (P1) Y (P2) F (V) |

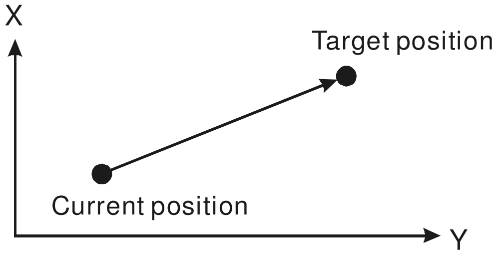
10. If you set up the target position on the axis without setting up the moving speed, the operation will run at $V_{MAX}$.

**Program Example:**

1. LIN XK12345 YH7567 FKK40000

   In this example, the two axes fast move to (K12,345, H7567) in linear movement. The target position can be an absolute coordinate or relative coordinate, which is determined by the instruction closest to LIN. The linear movement operates at speed 40KHz.

2. Moving path:




3. Combination of operand:

   LIN XKK-345289 YDD10Z5 FD100

   LIN XDD20 Y456@V4

   These instructions are legal. Device D is indirect set value.

**Remarks:**

Relevant special registers

| | |
|---|---|
| D1822, D1823 | Maximum speed of X axis. D1822 for low word; D1823 for high word. |
| D1824, D1825 | Bias speed of X axis. D1824 for low word; D1825 for high word. |
| D1836 | Acceleration time of X axis |
| D1837 | Deceleration time of X axis |
| D1865 | Stop mode for OX0 ~ 99<br>(K1: completing unfinished distance after next activation => considering remaining distance<br>K2: executing the next instruction after next activation<br>Others: restart) |
| D1902, D1903 | Maximum speed of Y axis. D1902 for low word; D1903 for high word. |
| D1904, D1905 | Bias speed of Y axis. D1904 for low word; D1905 for high word. |
| D1916 | Acceleration time of Y axis |
| D1917 | Deceleration time of Y axis |

| MON | Mnemonic | Operands | Function |
|---|---|---|---|
| 02<br>03 | CW / CCW | X(P1) Y(P2)<br>I(P3) J(P4) F(V) | Clockwise/Counterclockwise Arc Movement (set the position of center) |

| OP \ Type | Bit Devices | | | Double-Word Devices | | | Notes |
|---|---|---|---|---|---|---|---|
| | K | H | D | KK | HH | DD | |
| $P_1$ | * | * | * | * | * | * | ■ CW/CCW instruction supports V, Z index register modification on the devices.<br>■ You can place an M-Code instruction after CW/CCW. |
| $P_2$ | * | * | * | * | * | * | |
| $P_3$ | * | * | * | * | * | * | |
| $P_4$ | * | * | * | * | * | * | |
| V | * | * | * | * | * | * | |

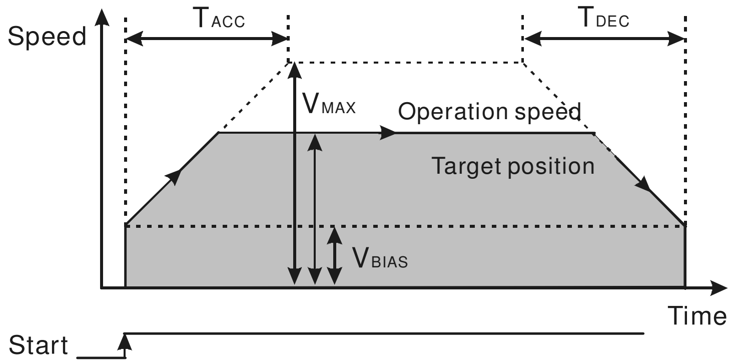
**Operands:**

**$P_1$**: Target position of arc on X axis **$P_2$**: Target position of arc on Y axis **$P_3$**: Center of arc on X axis

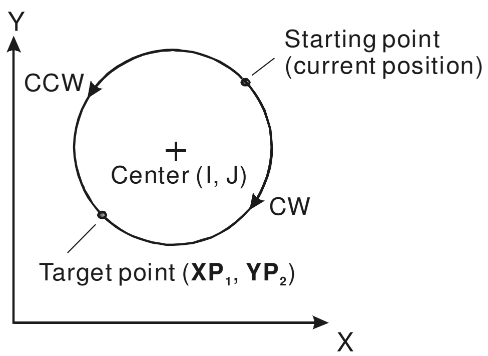
**$P_4$**: Center of arc on Y axis **V**: Arc interpolation speed

**Explanations:**

1. $V_{MAX}$ = 500KHz.
2. Range of parameters: (16-bit) K = -32,768 ~ 32,767; H = 0 ~ FFFF; D = 0 ~ 9,999; (32-bit) KK = -2,147,483,648 ~ 2,147,483,647; HH = 0 ~ FFFFFFFF; DD = 0 ~ 9,998.
3. Acceleration/deceleration time and bias speed can be set up in special D.
4. Acceleration/deceleration time increases or decreases in proportional to the setting of $V_{MAX}$.
5. Individual output on X, Y axis:




6. 2-axis synchronous interpolation:




7. If the target position is not in the trajectory of the center and starting point, DVP-PM will automatically set up the termination of the arc at the contact point of the arc and tangent line according to the target position set up by the user.
8. The 16-bit parameter devices and 32-bit parameter devices can be used together.

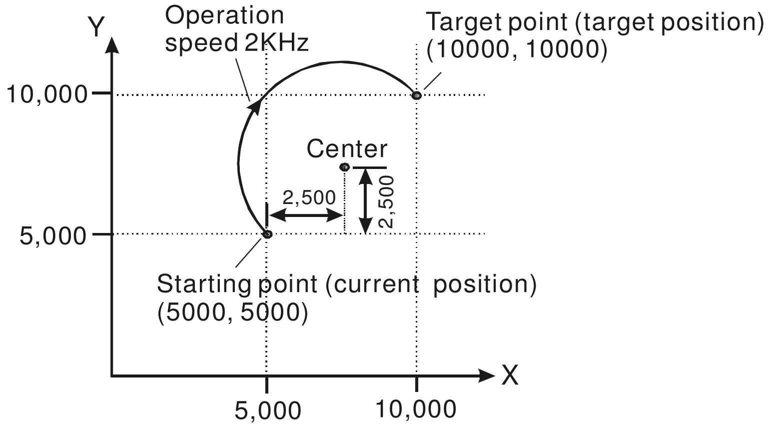
9. Target position is necessary, and moving speed is not necessary. There are 18 parameter combinations for CW/CCW instruction.

| NO. | Instruction | Parameter combination |
|---|---|---|
| 1 | CW/CCW | X $P_1$ I $P_3$ |
| 2 | | X $P_1$ I $P_3$ F V |
| 3 | | X $P_1$ J $P_4$ |
| 4 | | X $P_1$ J $P_4$ F V |
| 5 | | X $P_1$ I $P_3$ J $P_4$ |
| 6 | | X $P_1$ I $P_3$ J $P_4$ F V |
| 7 | | Y $P_2$ I $P_3$ |
| 8 | | Y $P_2$ I $P_3$ F V |
| 9 | | Y $P_2$ J $P_4$ |
| 10 | | Y $P_2$ J $P_4$ F V |
| 11 | | Y $P_2$ I $P_3$ J $P_4$ |
| 12 | | Y $P_2$ I $P_3$ J $P_4$ F V |
| 13 | | X $P_1$ Y $P_2$ I $P_3$ |
| 14 | | X $P_1$ Y $P_2$ I $P_3$ F V |
| 15 | | X $P_1$ Y $P_2$ J $P_4$ |
| 16 | | X $P_1$ Y $P_2$ J $P_4$ F V |
| 17 | | X $P_1$ Y $P_2$ I $P_3$ J $P_4$ |
| 18 | | X $P_1$ Y $P_2$ I $P_3$ J $P_4$ F V |

10. If you set up the target position on the axis without setting up the moving speed, the operation will run at $V_{MAX}$.
11. The arc movement can reach 360°.

**Program Example:**

1. Set the program in absolute coordinate, using CW clockwise arc instruction, target position of arc as (10000, 10000), the center at (2500, 2500) relative to the starting point of the arc, and output speed as 2,000Hz.




The program should be written as:

ABS

CW XK10000 YK10000 IK2500 JK2500 FK2000

2. Combination of parameters: The instructions below can also adopt indirect set value and are legal.

CW XK123 YDD10V7 I450000 JD10 FKK50000

CCW XHAABB YDD100 IK4500 JK3500 FK4000@V5

| MON | Mnemonic | Operands | Function |
|---|---|---|---|
| 04<br>05 | CW / CCW | X $P_1$ Y $P_2$ R L F V | Clockwise/Counterclockwise Arc Movement (set the radius) |

| Type / OP | Bit Devices | | | Double-Word Devices | | | Notes |
|---|---|---|---|---|---|---|---|
| | K | H | D | KK | HH | DD | ■ CW/CCW instruction supports V, Z index register modification on the devices.<br>■ You can place an M-Code instruction after DRV. |
| $P_1$ | * | * | * | * | * | * | |
| $P_2$ | * | * | * | * | * | * | |
| L | * | * | * | * | * | * | |
| V | * | * | * | * | * | * | |

**Operands:**

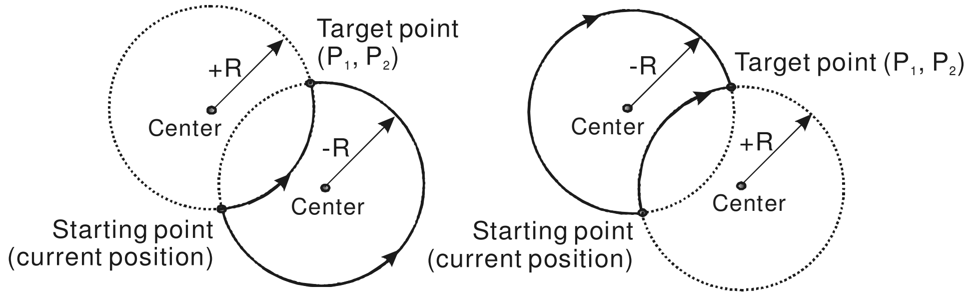
**$P_1$**: Target position of arc on X axis  **$P_2$**: Target position of arc on Y axis

**L**: Radius of arc (R = ”+“ when radian < 180°; R = “-” when radian > 180°)

**V**: Speed for arc to move to target position

**Explanations:**

1. Maximum **V** = $V_{MAX}$.
2. Range of parameters: (16-bit) K = -32,768 ~ 32,767; H = 0 ~ FFFF; D = 0 ~ 9,999; (32-bit) KK = -2,147,483,648 ~ 2,147,483,647; HH = 0 ~ FFFFFFFF; DD = 0 ~ 9,998.
3. Acceleration/deceleration time and bias speed can be set up in special D.
4. Acceleration/deceleration time increases or decreases in proportional to the setting of $V_{MAX}$.
5. 2-axis synchronous interpolation:




**CCW Counterclockwise Operation**  **CW Clockwise Operation**

6. The 16-bit parameter devices and 32-bit parameter devices can be used together.
7. Target position is necessary, and moving speed is not necessary. There are 6 parameter combinations for CW/CCW instruction.

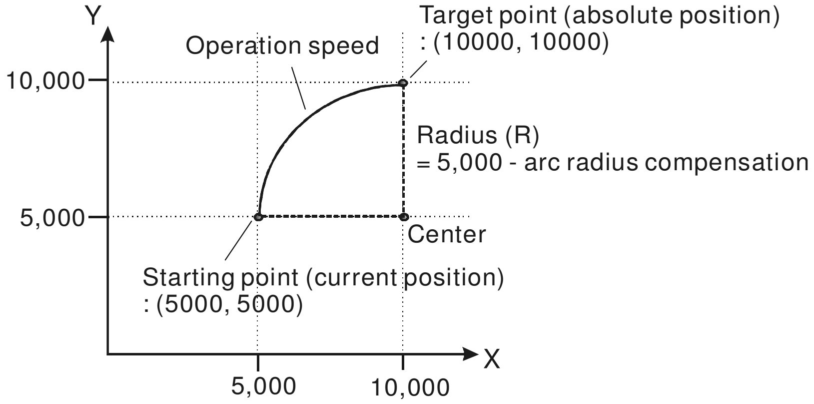
| NO. | Instruction | Parameter combination |
|---|---|---|
| 1 | CW/CCW | X $P_1$ R L |
| 2 | | X $P_1$ R L F V |
| 3 | | Y $P_2$ R L |
| 4 | | Y $P_2$ R L F V |
| 5 | | X $P_1$ Y $P_2$ R L |
| 6 | | X $P_1$ Y $P_2$ R L F V |

8. If you set up the target position on the axis without setting up the moving speed, the operation will run at $V_{MAX}$

**Program Example:**

1. Set the program in absolute coordinate, using CW clockwise arc instruction, target position of arc as (10000,

10000), radius = 500, radian < 180° (+), and speed at 1,000 pulses per second.




The program should be written as:

ABS

CW XK10000 YK10000 RK5000 FK1000

2. For how to set up arc radius compensation, please refer to MON 15 RADC.
3. The arc movement cannot reach 360°.
4. Combination of parameters: The instructions below can also adopt indirect set value and are legal.

   CW XK123 YDD10 RKK450000 FKK50000

   CCW XHAABB R350000 F400000@V5

| MON | Mnemonic | Operands | Function |
|---|---|---|---|
| 06 | TIM | T | Pause Time |

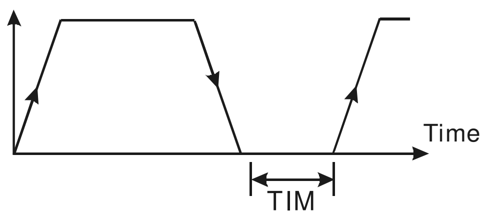
| Type / OP | Bit Devices | | | Double-Word Devices | | | Notes |
|---|---|---|---|---|---|---|---|
| | K | H | D | KK | HH | DD | ▪ TIM instruction supports V, Z index register modification on the devices.<br>▪ See the specifications of DVP-PM for the range of use.<br>▪ You can place an M-Code instruction after DRV. |
| T | * | * | * | * | * | * | |

**Operands:**

**T**: Pause time (unit: 10ms => K100 refers to pausing for 1 second)

**Explanations:**

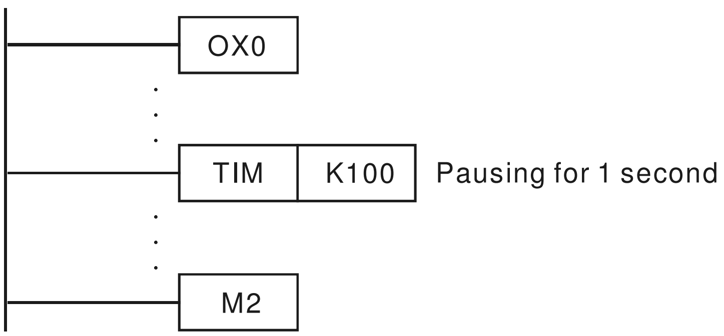
1. TIM instruction is used for setting up the pause time between instruction and instruction.




2. Range of parameters: (16-bit) K = -32,768 ~ 32,767; H = 0 ~ FFFF; D = 0 ~ 9,999; (32-bit) KK = -2,147,483,648 ~ 2,147,483,647; HH = 0 ~ FFFFFFFF; DD = 0 ~ 9,998.

**Program Example:**

The program should be written as follow:



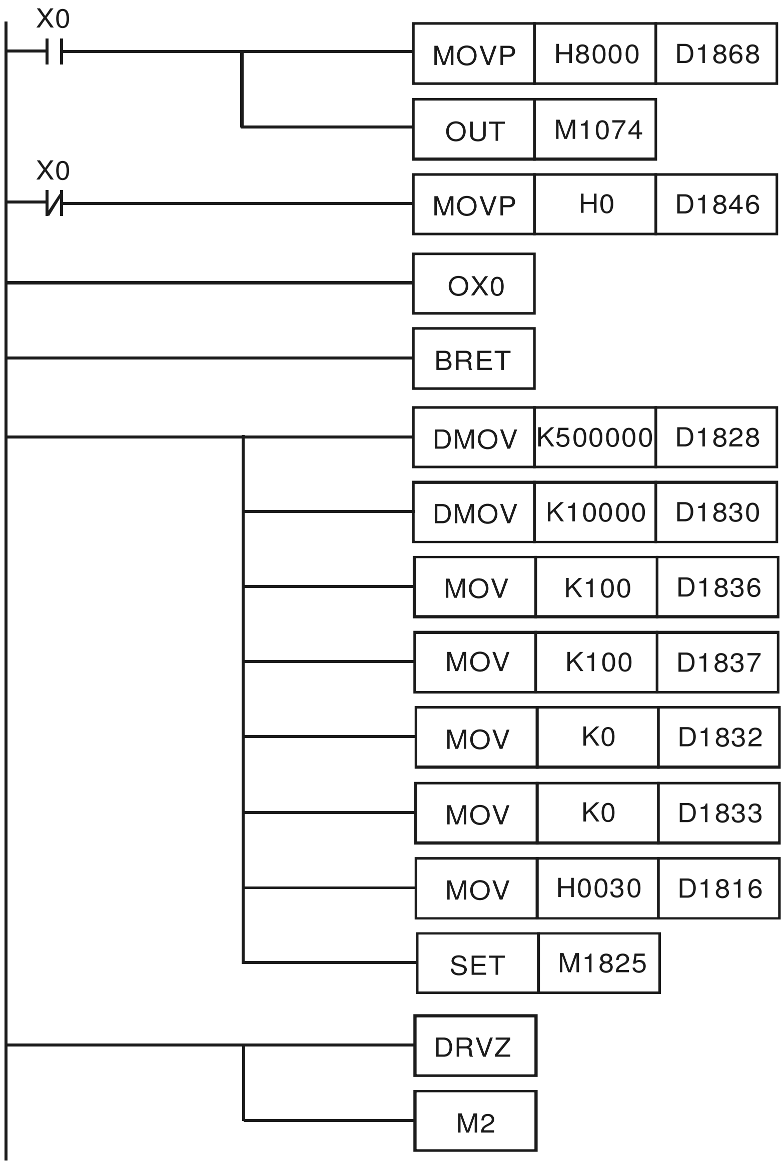
| MON | Mnemonic | Operands | Function |
|---|---|---|---|
| 07 | DRVZ | N/A | Return to Mechanical Zero Point (Zero Return) |

**Explanations:**

1. You can place an M-Code instruction after DRVZ.
2. Before enabling DRVZ, you have to first set up its parameters as follow:
   a) Zero return speed ($V_{RT}$): The speed for returning to mechanical zero point. $V_{RT}$ cannot be modified during the execution. Range: 0 ~ 500KHz. Limitation: $V_{MAX} > V_{RT} > V_{BIAS}$
   b) Zero return deceleration speed ($V_{CR}$): The speed generated when the zero point signal is triggered during the operation. In order to accurately position at the zero point, it is suggested that you set $V_{CR}$ at low speed. Range: 0 ~ 500KHz. Limitation: $V_{CR} < V_{RT}$. $V_{CR}$ cannot be modified during the execution.
   c) Acceleration time: The time spent on accelerating to $V_{RT}$.
   d) Deceleration time: The time spent on decelerating from $V_{RT}$ to $V_{CR}$ and from $V_{CR}$ to zero speed.
   e) Number of zero point signals (PG0) in zero return (N): Reference signal for the motor to decelerate and stop. When a DOG signal is detected, the program will start to count the number of PG0 pulses for the reference to stop. Range: 0 ~ +32,767 PLS.
   f) Number of pulse signals in zero return (P): Reference signal for the motor to decelerate and stop. Positive set values are for forward-running pulses, and negative set values are for reverse-running pulses. Range: -32,768 ~ 32,767.
   g) Disabling zero return on X, Y axis.
3. Parameters below should be set up in special registers. D1816 for X axis; D1896 for Y axis.
   a) Zero return direction
      b[8] = 0: Decreasing towards current position (CP)
      b[8] = 1: Increasing towards current position (CP)
   b) Zero return mode
      b[9] = 0: Normal mode
      b[9] = 1: Overwrite mode
   c) Detecting DOG falling edge in zero return
      b[10] = 0: On
      b[11] = 1: Off
   d) There are four zero return modes in total. See 3.12 for how they work.

**Program Example:**

When X0 = On, DRVZ instruction in OX00 will be executed, and the zero return on Y axis will be disabled. X axis accelerates for 100ms to $V_{RT}$ (500KHz), searching for the mechanical zero point. When DOG signal is triggered, X axis will decelerate for 100ms to 10KHz. When the falling edge of DOG signal is triggered, the zero return mode will be in normal mode, starting to count the number of PG0 signals (N) and number of pulse signals in zero return (P) until the counting and the positioning is completed.




**Remarks:**

1. Relevant flags:

| | |
|---|---|
| M1745 | Disabling zero return of X axis in OX |
| M1825 | Disabling zero return of Y axis in OX |
| M1074 | Enabling OX motion subroutine |

2. Relevant special registers:

| | |
|---|---|
| D1816 | Parameter setting of X axis |
| D1846 | Operation instruction for X axis |
| D1868 | Setting up the No. of OX |
| D1828 | Zero return speed of X axis: $V_{RT}$ (low word) |
| D1829 | Zero return speed of X axis: $V_{RT}$ (high word) |
| D1830 | Zero return deceleration speed of X axis: $V_{CR}$ (low word) |
| D1831 | Zero return deceleration speed of X axis: $V_{CR}$ (high word) |
| D1832 | Number of zero point signals at X axis: N |
| D1833 | Supplemented distance at X axis: P |
| D1836 | Acceleration time of X axis: $T_{ACC}$ |
| D1837 | Deceleration time of X axis: $T_{DEC}$ |

| | |
|---|---|
| D1896 | Parameter setting of Y axis |
| D1908 | Zero return speed of Y axis: $V_{RT}$ (low word) |
| D1909 | Zero return speed of Y axis: $V_{RT}$ (high word) |
| D1910 | Zero return deceleration of Y axis (low word) |
| D1911 | Zero return deceleration of Y axis (high word) |
| D1912 | Number of zero point signals at Y axis: N |
| D1913 | Supplemented distance at Y axis: P |
| D1916 | Acceleration time of Y axis: $T_{ACC}$ |
| D1917 | Deceleration time of Y axis: $T_{DEC}$ |

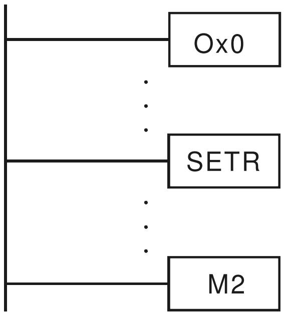
| MON | Mnemonic | Operands | Function |
|---|---|---|---|
| 08 | SERT | N/A | Set up Electrical Zero Point |

**Explanations:**

1. You can place an M-Code instruction after SERT.
2. When SETR is executed, you can set the current position of X, Y axis as the electrical zero point. That is, you can move the content in the current position register into the register for electrical zero point.

**Program Example:**

The program should be written as:




**Remarks:**

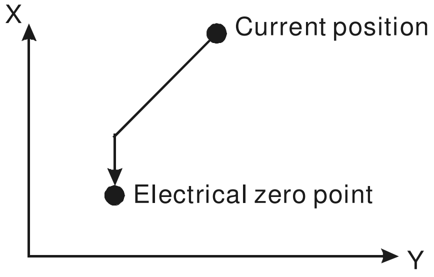
Relevant special registers

| | |
|---|---|
| D1848 | Current position of X axis: CP (low word) |
| D1849 | Current position of X axis: CP (high word) |
| D1866 | Electrical zero point address on X axis (low word) |
| D1867 | Electrical zero point address on X axis (high word) |
| D1928 | Current position of Y axis: CP (low word) |
| D1929 | Current position of Y axis: CP (high word) |
| D1946 | Electrical zero point address on Y axis (low word) |
| D1947 | Electrical zero point address on Y axis (high word) |

| MON | Mnemonic | Operands | Function |
|---|---|---|---|
| 09 | DRVR | N/A | Return to Electrical Zero Point |

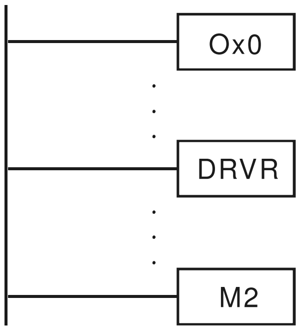
**Explanations:**

1. You can place an M-Code instruction after DRVR.
2. When DRVR instruction is executed, X and Y axes will return to electrical zero point at $V_{MAX}$ (0 ~ 500KHz).
3. Moving path:




**Program Example:**

The program should be written as:




**Remarks:**

Relevant special registers

| | |
|---|---|
| D1822 | Maximum speed of X axis: $V_{MAX}$ (low word) |
| D1823 | Maximum speed of X axis: $V_{MAX}$ (high word) |
| D1848 | Current position of X axis: CP (low word) |
| D1849 | Current position of X axis: CP (high word) |
| D1866 | Electrical zero point address on X axis (low word) |
| D1867 | Electrical zero point address on X axis (high word) |
| D1902 | Maximum speed of Y axis: $V_{MAX}$ (low word) |
| D1903 | Maximum speed of Y axis: $V_{MAX}$ (high word) |
| D1928 | Current position of Y axis: CP (low word) |
| D1929 | Current position of Y axis: CP (high word) |
| D1946 | Electrical zero point address on Y axis (low word) |
| D1947 | Electrical zero point address on Y axis (high word) |

| MON | Mnemonic | Operands | Function |
|---|---|---|---|
| 10 | INTR | X $P_1$ Y $P_2$ F V | 2-Axis Synchronous Single-Speed Interpolation (ignoring remaining distance) |

| Type / OP | Bit Devices | | | Double-Word Devices | | | Notes |
|---|---|---|---|---|---|---|---|
| | K | H | D | KK | HH | DD | |
| $P_1$ | * | * | * | * | * | * | ■ INTR instruction supports V, Z index register modification on the devices.<br>■ See specifications of DVP-PM for the range of use.<br>■ You can place an M-Code instruction after INTR. |
| $P_2$ | * | * | * | * | * | * | |
| F | * | * | * | * | * | * | |

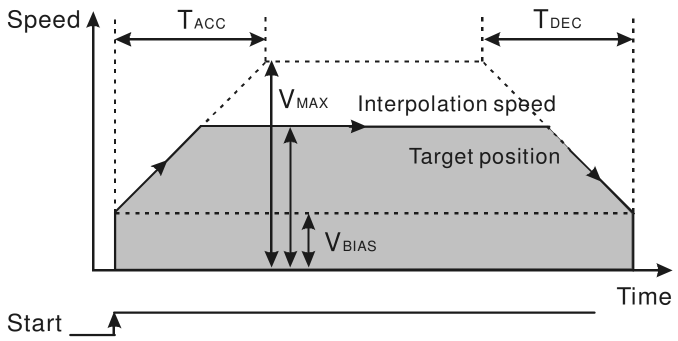
**Operands:**

**$P_1$**: Target position of arc on X axis  **$P_2$**: Target position of arc on Y axis

**V**: Speed for 2-axis linear interpolation

**Explanations:**

1. Maximum **V** = $V_{MAX}$.
2. Range of parameters: (16-bit) K = -32,768 ~ 32,767; H = 0 ~ FFFF; D = 0 ~ 9,999; (32-bit) KK = -2,147,483,648 ~ 2,147,483,647; HH = 0 ~ FFFFFFFF; DD = 0 ~ 9,998.
3. Acceleration/deceleration time and bias speed can be set up in special D.
4. Acceleration/deceleration time increases or decreases in proportional to the setting of $V_{MAX}$.
5. Individual output on X, Y axis:




6. The interpolation speed is monitored by special registers: D1850 ~ D1851 for X axis; D1930 ~ D1931 for Y axis.
7. The functions of LIN and INTR are the same, except that LIN can set up stop mode.
8. Target position is necessary, and moving speed is not necessary. There are 6 parameter combinations for INTR instruction.

| NO. | Instruction | Parameter combination |
|---|---|---|
| 1 | INTR | X $P_1$ |
| 2 | | X $P_1$ F V |
| 3 | | Y $P_2$ |
| 4 | | Y $P_2$ F V |
| 5 | | X $P_1$ Y $P_2$ |
| 6 | | X $P_1$ Y $P_2$ F V |

**Remarks:**

See Remarks of LIN instruction for relevant special registers.

| MON | Mnemonic | Operands | Function |
|---|---|---|---|
| 11 | SINTR | X(P1) F(V)<br>Y(P2) F(V) | Inserting Single-Speed Operation |

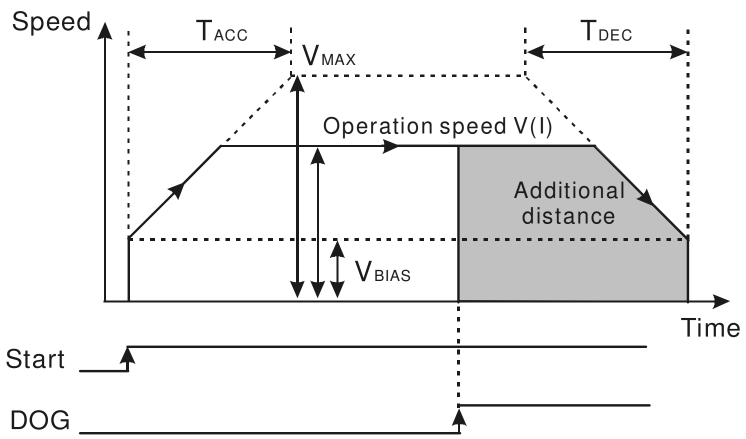
| Type / OP | Bit Devices | | | Double-Word Devices | | | Notes |
|---|---|---|---|---|---|---|---|
| | K | H | D | KK | HH | DD | |
| $P_1$ | * | * | * | * | * | * | ▪ SINTR instruction supports V, Z index register modification on the devices.<br>▪ See specifications of DVP-PM for the range of use.<br>▪ You can place an M-Code instruction after SINTR. |
| $P_2$ | * | * | * | * | * | * | |
| F | * | * | * | * | * | * | |

**Operands:**

**$P_1$**: Additional distance on X axis **$P_2$**: Additional distance on Y axis **V**: Operation speed

**Explanations:**

1. Maximum **V** = $V_{MAX}$.
2. The first operand in SINTR can be inserting single-speed positioning on X axis or Y axis.
3. Range of parameters: (16-bit) K = -32,768 ~ 32,767; H = 0 ~ FFFF; D = 0 ~ 9,999; (32-bit) KK = -2,147,483,648 ~ 2,147,483,647; HH = 0 ~ FFFFFFFF; DD = 0 ~ 9,998.
4. Acceleration/deceleration time and bias speed can be set up in special D.
5. Acceleration/deceleration time increases or decreases in proportional to the setting of $V_{MAX}$.
6. The 16-bit parameter devices and 32-bit parameter devices can be used together.
7. The operation:




8. When SINTR instruction is enabled, the operation speed will start from $V_{BIAS}$ and accelerate to V(I) and then operate stably. When the execution encounters triggered DOG signals, it will follow the additional distance set in the program and continue the operation.
9. The target position and moving speed have to be set up. There are 2 parameter combinations for SINTR instruction.

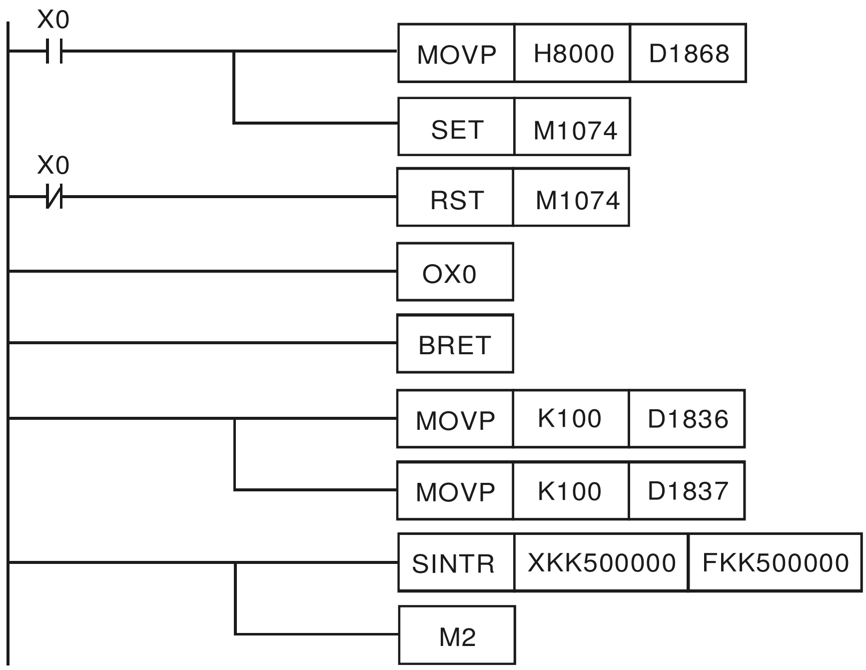
| NO. | Instruction | Parameter combination |
|---|---|---|
| 1 | SINTR | X(P1) F(V) |
| 2 | | Y(P2) F(V) |

**Program Example:**

1. When X0 = On, SINTR instruction in program OX00 will be executed. X axis accelerates to single-speed

operation at 500KHz in 100ms. When the DOG signal is triggered, the additional 500,000 pulses output set in the program and the positioning will be completed.

2. Program OX00 and SINTR instruction will be disabled.




**Remarks:**

1. Even you adopt absolute coordinate system in the program, once SINTR is executed, the displacement will be regarded as additional distance.
2. Relevant special registers:

| | |
|---|---|
| D1848 | Current position of X axis: CP (low word) |
| D1849 | Current position of X axis: CP (high word) |
| D1836 | Acceleration time of X axis: $T_{ACC}$ |
| D1837 | Deceleration time of X axis: $T_{DEC}$ |

| MON | Mnemonic | Operands | Function |
|---|---|---|---|
| 12 | DINTR | X(P1) F(V1) F(V2)<br>Y(P2) F(V1) F(V2) | Inserting 2-Speed Operation |

| Type / OP | Bit Devices | | | Double-Word Devices | | | Notes |
|---|---|---|---|---|---|---|---|
| | K | H | D | KK | HH | DD | ▪ DINTR instruction supports V, Z index register modification on the devices.<br>▪ See specifications of DVP-PM for the range of use.<br>▪ You can place an M-Code instruction after DINTR. |
| $P_1$ | * | * | * | * | * | * | |
| $P_2$ | * | * | * | * | * | * | |
| $V_1$ | * | * | * | * | * | * | |
| $V_2$ | * | * | * | * | * | * | |

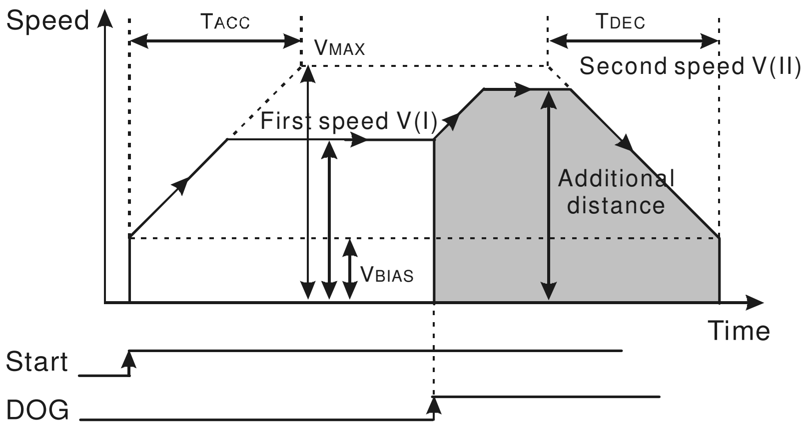
**Operands:**

**$P_1$**: Additional distance on X axis  **$P_2$**: Additional distance on Y axis  **$V_1$**: The first speed

**$V_2$**: The second speed

**Explanations:**

1. Maximum **$V_1$**, **$V_2$** = $V_{MAX}$.
2. The first operand in DINTR can be inserting 2-speed positioning on X axis or Y axis.
3. Range of parameters: (16-bit) K = -32,768 ~ 32,767; H = 0 ~ FFFF; D = 0 ~ 9,999; (32-bit) KK = -2,147,483,648 ~ 2,147,483,647; HH = 0 ~ FFFFFFFF; DD = 0 ~ 9,998.
4. Acceleration/deceleration time and bias speed can be set up in special D.
5. Acceleration/deceleration time increases or decreases in proportional to the setting of $V_{MAX}$.
6. The 16-bit parameter devices and 32-bit parameter devices can be used together.
7. The operation:

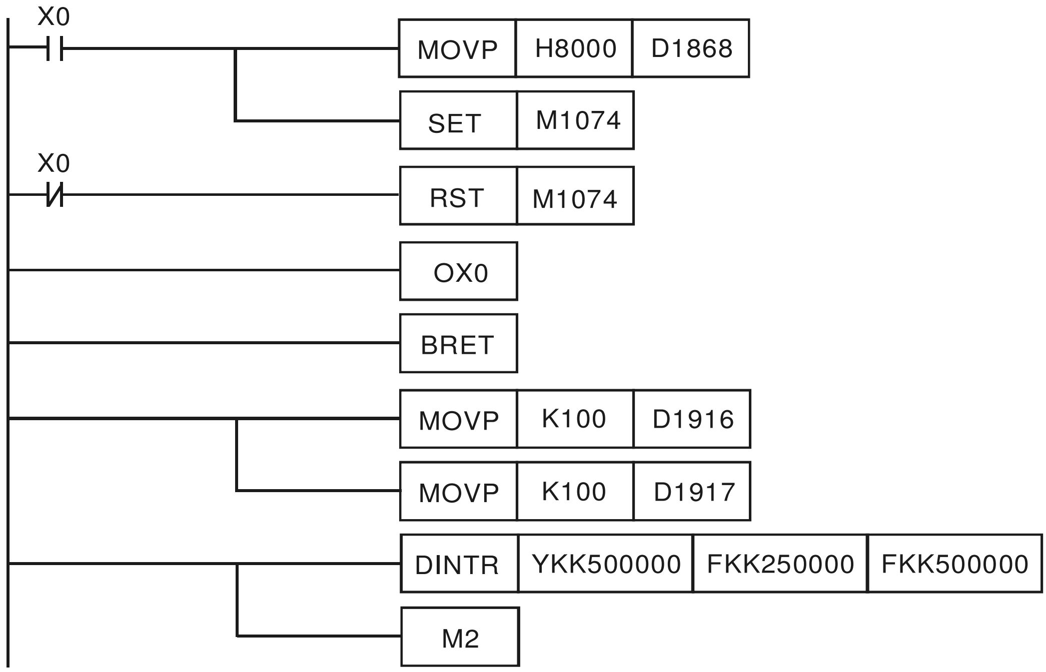



8. When DINTR instruction is enabled, the operation speed will start from $V_{BIAS}$ and accelerate to V(I) and then operate stably. When the execution encounters triggered DOG signals, it will further accelerate to V(II) and follow the additional distance set in the program and continue the operation.
9. The target position and moving speed have to be set up. There are 2 parameter combinations for SINTR instruction.

| NO. | Instruction | Parameter combination |
|---|---|---|
| 1 | DINTR | X(P1) F(V1) F(V2) |
| 2 | | Y(P2) F(V1) F(V2) |

**Program Example:**

1. When X0 = On, DINTR instruction in program OX00 will be executed. X axis accelerates to the first speed 250KHz in 100ms and operate at the speed stably. When the DOG signal is triggered, it will further accelerate to the second speed 500KHz, and the additional 500,000 pulses output set in the program and the positioning will be completed.
2. When X0 = Off, program OX00 and DINTR instruction will be disabled.




**Remarks:**

Relevant special registers

| | |
|---|---|
| D1848 | Current position of X axis: CP (low word) |
| D1849 | Current position of X axis: CP (high word) |
| D1836 | Acceleration time of X axis: $T_{ACC}$ |
| D1837 | Deceleration time of X axis: $T_{DEC}$ |

| MON | Mnemonic | Operands | Function |
|---|---|---|---|
| 13 | MOVC | X(L1) Y(L2) | Set up Linear Movement Compensation |

| Type / OP | Bit Devices | | | Double-Word Devices | | | Notes |
|---|---|---|---|---|---|---|---|
| | K | H | D | KK | HH | DD | ▪ MOVC instruction supports V, Z index register modification on the devices.<br>▪ See specifications of DVP-PM for the range of use.<br>▪ You can place an M-Code instruction after MOVC. |
| $L_1$ | * | * | * | * | * | * | |
| $L_2$ | * | * | * | * | * | * | |

**Operands:**

**$L_1$**: Compensation on X axis **$L_2$**: Compensation on Y axis

**Explanations:**

1. You can set up only the compensation on X axis, e.g. MOVC XDD0.
2. When MOVC instruction is executed, the set compensation will be written automatically into special registers: D1708 ~ D1709 for X axis; D1724 ~ D1725 for Y axis.
3. The linear movement compensation can be adopted in DRV, LIN and TNTR instructions.
4. Write the compensation value into the compensation register and execute linear movement instructions, and the compensation will be executed.
5. Range of parameters: (16-bit) K = -32,768 ~ 32,767; H = 0 ~ FFFF; D = 0 ~ 9,999; (32-bit) KK = -2,147,483,648 ~ 2,147,483,647; HH = 0 ~ FFFFFFFF; DD = 0 ~ 9,998.
6. The 16-bit parameter devices and 32-bit parameter devices can be used together.

| NO. | Instruction | Parameter combination |
|---|---|---|
| 1 | MOVC | X(L1) |
| 2 | | X(L1) Y(L2) |

**Remarks:**

Relevant special registers

| | |
|---|---|
| D1708 | Compensation value of X-axis moving distance (low word) |
| D1709 | Compensation value of X-axis moving distance (high word) |
| D1724 | Compensation value of Y-axis moving distance (low word) |
| D1725 | Compensation value of Y-axis moving distance (high word) |

| MON | Mnemonic | Operands | Function |
|---|---|---|---|
| 14 | CNTC | I (L1) J (L2) | Arc Center Compensation |

| Type / OP | Bit Devices | | | Double-Word Devices | | | Notes |
|---|---|---|---|---|---|---|---|
| | K | H | D | KK | HH | DD | ■ CNTC instruction supports V, Z index register modification on the devices.<br>■ See specifications of DVP-PM for the range of use.<br>■ You can place an M-Code instruction after CNTC. |
| $L_1$ | * | * | * | * | * | * | |
| $L_2$ | * | * | * | * | * | * | |

**Operands:**

**$L_1$**: Compensation of center on X axis **$L_2$**: Compensation of center on Y axis

**Explanations:**

1. When CNTC instruction is executed, the set compensation will be written automatically into special registers: D1710 ~ D1711 for X axis; D1726 ~ D1727 for Y axis.
2. The arc center compensation can be adopted in CW and CCW instructions.
3. Write the compensation value into the compensation register and execute arc instructions, and the compensation will be executed.
4. Range of parameters: (16-bit) K = -32,768 ~ 32,767; H = 0 ~ FFFF; D = 0 ~ 9,999; (32-bit) KK = -2,147,483,648 ~ 2,147,483,647; HH = 0 ~ FFFFFFFF; DD = 0 ~ 9,998.
5. The 16-bit parameter devices and 32-bit parameter devices can be used together.

**Remarks:**

Relevant special registers

| | |
|---|---|
| D1710 | Compensation value of X-axis center (low word) |
| D1711 | Compensation value of X-axis center (high word) |
| D1726 | Compensation value of Y-axis center (low word) |
| D1727 | Compensation value of Y-axis center (high word) |

| MON | Mnemonic | Operands | Function |
|---|---|---|---|
| 15 | RADC | R(L) | Arc Radius Compensation |

| Type / OP | Bit Devices | | | Double-Word Devices | | | Notes |
|---|---|---|---|---|---|---|---|
| | K | H | D | KK | HH | DD | ■ RADC instruction supports V, Z index register modification on the devices.<br>■ See specifications of DVP-PM for the range of use.<br>■ You can place an M-Code instruction after RADC. |
| L | * | * | * | * | * | * | |

**Operands:**

**L**: Compensation of arc radius on X-Y axis

**Explanations:**

1. When RADC instruction is executed, the set compensation will be written automatically into special registers D1712 ~ D1713.
2. The arc radius compensation can be adopted in CW and CCW instructions.
3. Write the compensation value into the compensation register and execute arc instructions, and the compensation will be executed.
4. Range of parameters: (16-bit) K = -32,768 ~ 32,767; H = 0 ~ FFFF; D = 0 ~ 9,999; (32-bit) KK = -2,147,483,648 ~ 2,147,483,647; HH = 0 ~ FFFFFFFF; DD = 0 ~ 9,998.
5. The 16-bit parameter devices and 32-bit parameter devices can be used together.

**Remarks:**

Relevant special registers

| | |
|---|---|
| D1712 | Compensation radius of X-axis arc (low word) |
| D1713 | Compensation radius of X-axis arc (high word) |

| MON | Mnemonic | Operands | Function |
|---|---|---|---|
| 16 | CANC | N/A | Cancel Compensation |

**Explanations:**

1. You can place an M-Code instruction after CANC.
2. When CANC instruction is executed, all motion compensations will be cancelled, i.e. special registers D1708 ~ D1709, D1724 ~ D1725, D1710 ~ D1711, D1726 ~ D1727, and D1712 ~ D1713 will all be cleared automatically.

**Remarks:**

| | |
|---|---|
| D1708 | Compensation value of X-axis moving distance (low word) |
| D1709 | Compensation value of X-axis moving distance (high word) |
| D1724 | Compensation value of Y-axis moving distance (low word) |
| D1725 | Compensation value of Y-axis moving distance (high word) |
| D1710 | Compensation value of X-axis center (low word) |
| D1711 | Compensation value of X-axis center (high word) |
| D1726 | Compensation value of Y-axis center (low word) |
| D1727 | Compensation value of Y-axis center (high word) |
| D1712 | Compensation radius of X-axis arc (low word) |
| D1713 | Compensation radius of X-axis arc (high word) |

| MON | Mnemonic | Operands | Function |
|---|---|---|---|
| 17 | ABST | N/A | Set up Absolute Coordinate |

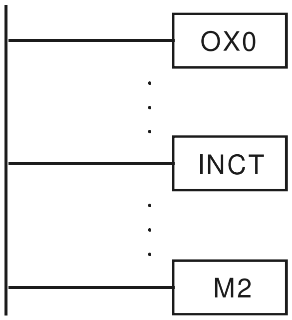
| MON | Mnemonic | Operands | Function |
|---|---|---|---|
| 18 | INCT | N/A | Set up Relative Coordinate |

**Explanations:**

1. Executing ABST instruction: Starting from 0, when the target position > current position, the motor will run forwardly. When the target position < current position, the motor will run reversely.
2. Executing INCT instruction. Calculating the distance created by the motor from the current position. When the relative coordinate is positive, the motor will run forwardly. When the relative coordinate is negative, the motor will run reversely.
3. The arc center coordinate (I, J), radius (R) and the displacement coordinates set by SINT and DINT instructions are all regarded as additional values.

**Program Example:**

When DVP-PM switches from MANU to AUTO, if ABST or INCT is not designated in the program, the default setting for the program will be in ABST (relative coordinate) system. After INCT instruction is executed, the motion instructions starting from the next row (e.g. DRV, LIN, CW, CCW) will be operated in relative coordinate system. The program should be written as:



| MON | Mnemonic | Operands | Function |
|---|---|---|---|
| 19 | SETT | X(P1) Y(P2) | Set up Current Position |

| Type / OP | Bit Devices | | | Double-Word Devices | | | Notes |
|---|---|---|---|---|---|---|---|
| | K | H | D | KK | HH | DD | ■ SETT instruction supports V, Z index register modification on the devices.<br>■ See specifications of DVP-PM for the range of use.<br>■ You can place an M-Code instruction after SETT. |
| $P_1$ | * | * | * | * | * | * | |
| $P_2$ | * | * | * | * | * | * | |

**Operands:**

$P_1$: Current position on X axis $P_2$: Current position on Y axis

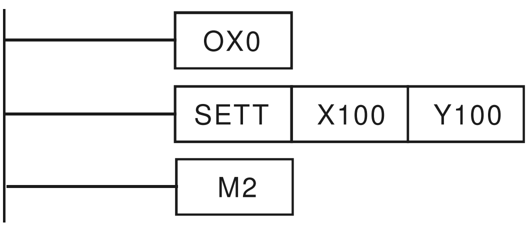
**Explanations:**

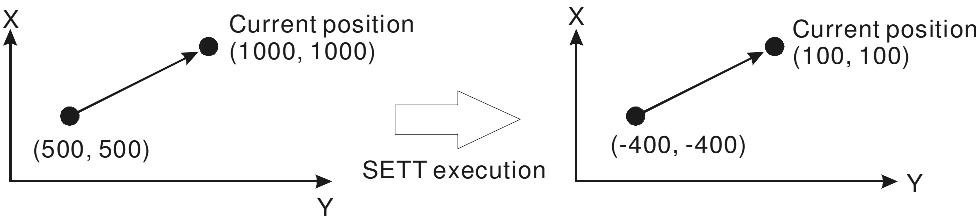
1. You can set up only the current position on X axis, e.g. SETT XDD0.
2. When SETT instruction is executed, the set current position will be written automatically into the special register: D1848 ~ D1849 for X axis; D1928 ~ D1929 for Y axis.
3. Range of parameters: (16-bit) K = -32,768 ~ 32,767; H = 0 ~ FFFF; D = 0 ~ 9,999; (32-bit) KK = -2,147,483,648 ~ 2,147,483,647; HH = 0 ~ FFFFFFFF; DD = 0 ~ 9,998.
4. The 16-bit parameter devices and 32-bit parameter devices can be used together.
5. When SETT instruction is executed, the value in the current position register will be modified into the value designated by the instruction. Therefore, the mechanical zero point and electrical zero point will be changed.
6. There are 2 parameter combinations for SETT instruction.

| NO. | Instruction | Parameter combination |
|---|---|---|
| 1 | SETT | X(P1) |
| 2 | | X(P1) Y(P2) |

**Program Example:**

The program should be written as:




**Remarks:**

Relevant special registers

| | |
|---|---|
| D1848 | Current position of X axis: CP (low word) |
| D1849 | Current position of X axis: CP (high word) |
| D1928 | Current position of Y axis: CP (low word) |
| D1929 | Current position of Y axis: CP (high word) |

## 6.4 G-Code Instructions

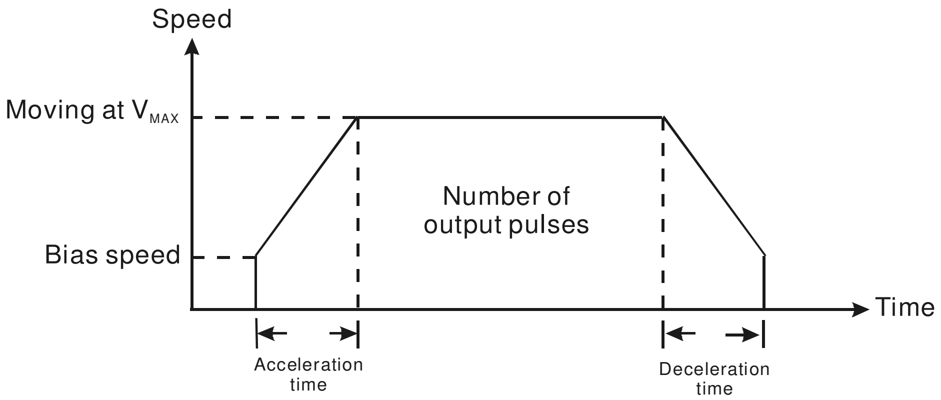
| G-Code | Mnemonic | Operands | Function |
|---|---|---|---|
| | G0 | X (P1) Y (P2) Z (P3) | High-Speed Positioning (I) |

**Operands:**

**$P_1$**: Target position on X axis **$P_2$**: Target position on Y axis **$P_3$**: Target position on Z axis (built-in 3rd axis)

**Explanations:**

1. Range of parameters: -2,147,483,648 ~ 2,147,483,647 (without decimal point); -2,147,483.648 ~ 2,147,483.647 (with decimal point)
2. For relevant special registers, see Remarks of MON 00 DRV.
3. When G0 instruction is executed, the moving speed will be fixed at maximum speed $V_{MAX}$.
4. The settings of position have continuity. See Remarks.
5. Acceleration/deceleration time and bias speed can be set up in special D.
6. Acceleration/deceleration time and bias speed increase or decrease in proportional to the setting of $V_{MAX}$.
7. The operation:




8. DVP-PM does not support 3-axis synchronous control; therefore, you have to design a 2-axis high-speed interpolation in X-Y axis and Z axis for independent high-speed movement. For the safety of the mechanical operation, when G0 instruction is executed, Z-axis high-speed movement will be executed first before the X-Y-axis high-speed interpolation. That is to say, when DVP-PM is executing G0 instruction with X-Z, Y-Z, X-Y-Z combinations, the program will automatically be divided as:
   G0 Z **$P_3$** (A)
   G0 X **$P_1$** Y**$P_2$** (B)
   See Remarks for more explanations on row (A) and (B)

**Remarks:**

1. The settings of position have continuity, for example:
   G0 X500.0 Y500.0
   X1000.0 Y1000.0
   After the row with G0 instruction is executed, the program will execute the next row. The second row of the program will reach the target position automatically by G0.
2. The program example when G0 adopts Z-axis target position (built-in 3rd axis control):

G0 X1000 Y1000 **Z100**

After the compilation:

G0 **Z100**; ... (A)

G0 X1000 Y1000; ... (B)

(A) is the first executed, and at this time Z axis fast moves to position K100. Next (B) is executed and moves to target position (1000, 1000) at the maximum speed.

| G-Code | Mnemonic | Operands | Function |
|---|---|---|---|
| | G0 | Z (P3) | High-Speed Positioning (3rd axis control) |

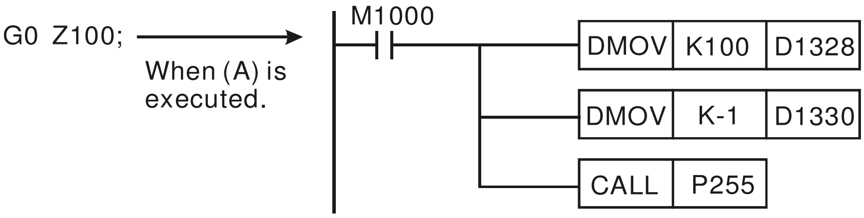
**Remarks:**

The program example when G0 adopts Z-axis target position (built-in 3rd axis control):

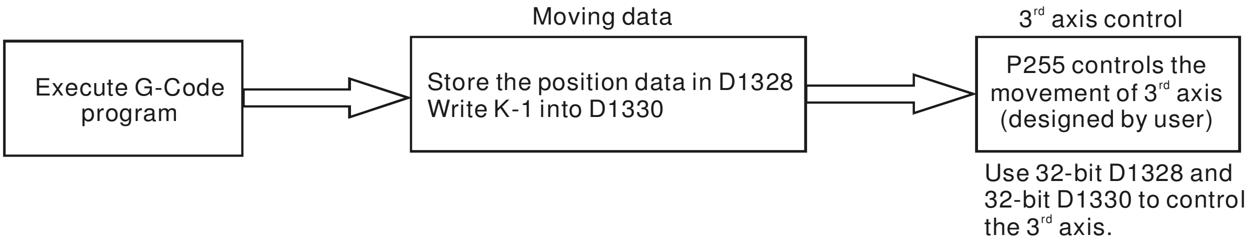
G0 **Z100**; ... (A)

(A) is first executed. At this time, DVP-PM writes target position K100 on Z axis into the 32-bit D1328. The moving speed for G0 has already existed in the program. Therefore, write K-1 into the 32-bit D1330 (for the program to determine whether it is G0 or G1). After that, call and execute P255 subroutine.

Operation of step (A):




P255 is a subroutine for controlling the 3rd axis (e.g. pen lifting, clipping and release, and so on) compiled from the data in 32-bit D1328 and 32-bit D1330.




When you use Z-axis control, please do not use D1328 ~ D1331 and P255 repeatedly.

| G-Code | Mnemonic | Operands | Function |
|---|---|---|---|
| | G0 | X(P1) Y(P2) | High-Speed Positioning (II) |

**Explanations:**

See Remarks of MON 00 DRV for relevant special registers.

| G-Code | Mnemonic | Operands | Function |
|---|---|---|---|
| | G1 | X (P1) Y (P2) Z (P3) F (V) | 2-Axis Synchronous Linear Interpolation (considering remaining distance) |

**Operands:**

**$P_1$**: Target position on X axis **$P_2$**: Target position on Y axis

**$P_3$**: Target position on Z axis (built-in 3rd axis control) **V**: Speed for 2-axis linear interpolation

**Explanations:**

1. Range of **$P_1$**, **$P_2$**: -2,147,483,648 ~ 2,147,483,647 (without decimal point); -2,147,483.648 ~ 2,147,483.647 (with decimal point)
2. Range of **V**: 0 ~ 500,000 (without decimal point); 0 ~ 500.0 (with decimal point)
3. The speed has continuity. See Remarks.
4. For how to position, see MON 01 LIN.
5. DVP-PM does not support 3-axis synchronous control; therefore, you have to design a 2-axis high-speed interpolation in X-Y axis and Z axis for independent high-speed movement. For the safety of the mechanical operation, when G1 instruction is executed, Z-axis movement will be executed first before the X-Y-axis interpolation. That is to say, when DVP-PM is executing G1 instruction with X-Z, Y-Z, X-Y-Z combinations, the program will automatically be divided as:

   G1 Z **$P_3$** F**V** (A)

   G1 X **$P_1$** Y**$P_2$** F**V** (B)

   See Remarks for more explanations on row (A) and (B)

**Remarks:**

1. The settings of speed have continuity, for example:

   G1 X100 Y100 F200;

   X200 Y200;

   After the row with G1 instruction is executed, the program will execute the next row. The second row of the program will reach the target position automatically by speed F200 set in the first row.
2. The program example when G1 adopts Z-axis target position (built-in 3rd axis control):

   G1 X1000 Y1000 **Z100** F200;

   After the compilation:

   G1 **Z100** F200; ... (A)

   G1 X1000 Y1000 F200; ... (B)

   (A) is first executed, and at this time Z axis fast moves to target position K100 at speed K200. Next (B) is executed and moves to target position (1000, 1000) at speed K200.

| G-Code | Mnemonic | Operands | Function |
|---|---|---|---|
| | G1 | Z (P3) F (V) | The 3rd Axis Control |

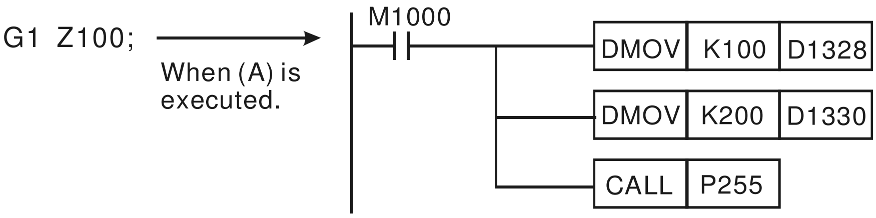
**Remarks:**

The program example when G1 adopts Z-axis target position (built-in 3rd axis control):

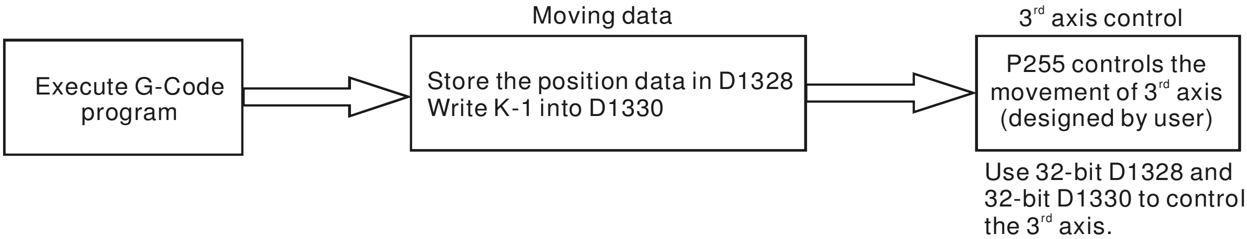
G0 **Z100** **F200**; ... (A)

(A) is first executed. At this time, DVP-PM writes target position K100 on Z axis into the 32-bit D1328 and 2-axis linear interpolation speed K200 into the 32-bit D1330. After that, call and execute P255 subroutine.

Operation of step (A):




P255 is a subroutine for controlling the 3rd axis (e.g. pen lifting, clipping and release, and so on) compiled from the data in 32-bit D1328 and 32-bit D1330.




Using Z-axis control, please do not use D1328 ~ D1331 and P255 repeatedly.

| G-Code | Mnemonic | Operands | Function |
|---|---|---|---|
| | G1 | **X** (P1) **Y** (P2) | 2-Axis Synchronous Linear Interpolation (considering remaining distance) |

**Explanations:**

See Remarks of MON 01 LIN for how to position.

| G-Code | Mnemonic | Operands | Function |
|---|---|---|---|
| | G2<br>G3 | X(P1) Y(P2) I(P3)<br>J(P4) F(V) | Clockwise/Counterclockwise Arc Movement<br>(set the position of center) |

**Operands:**

**$P_1$**: Target position of arc on X axis **$P_2$**: Target position of arc on Y axis **$P_3$**: Center of arc on X axis

**$P_4$**: Center of arc on Y axis **V**: Speed for arc interpolation

**Explanations:**

1. Range of **$P_1$**, **$P_2$**, **$P_3$**, **$P_4$**: -2,147,483,648 ~ 2,147,483,647 (without decimal point); -2,147,483.648 ~ 2,147,483.647 (with decimal point)
2. Range of **V**: 0 ~ 500,000 (without decimal point); 0 ~ 500.0 (with decimal point)
3. The speed has continuity. See Remarks.
4. For how to position, see MON 02 CW and MON 03 CCW.

**Remarks:**

1. The settings of speed have continuity, for example:
   G2 X0.0 Y100.0 I0.0 J50.0 F100.0;
   X0.0 Y0.0 I0.0 J50.0;
2. After the row with G2 instruction is executed, the program will execute the next row. The second row of the program will reach the target position automatically by speed F100 set in the first row.

| G-Code | Mnemonic | Operands | Function |
|---|---|---|---|
| | G2<br>G3 | X (P1) Y (P2)<br>R (L) F (V) | Clockwise/Counterclockwise Arc Movement<br>(set the radius) |

**Operands:**

**$P_1$**: Target position of arc on X axis **$P_2$**: Target position of arc on Y axis

**L**: Radius of arc (R = ”-“ when radian < 180°; R = “+” when radian > 180°)

**V**: Speed for arc to move to target position

**Explanations:**

1. Range of **$P_1$**, **$P_2$**, **R**: -2,147,483,648 ~ 2,147,483,647 (without decimal point); -2,147,483.648 ~ 2,147,483.647 (with decimal point)
2. Range of **V**: 0 ~ 500,000 (without decimal point); 0 ~ 500.0 (with decimal point)
3. For how to position, see MON 04 CW and MON 05 CCW.

| G-Code | Mnemonic | Operands | Function |
|---|---|---|---|
| | G4 | X(T) P(T) | Pause Time |

**Operands:**

**XT**: Pause time (unit: 1 sec). G4X1 refers to pausing for 1 second; G4 X2.5 refers to pausing for 2.5 seconds.

**PT**: Pause time (unit: 1 ms). G4 P100 refers to pausing for 0.1 second; G4 P4500 refers to pausing for 4.5 seconds.

**Explanations:**

1. 10ms is the base for **PT**. If **PT** < 10ms, **PT** will be regarded as 0ms. That is to say, if **PT** = 23ms, it will be regarded as 20ms.
2. See MON 06 TIM for the operation of G4.

| G-Code | Mnemonic | Operands | Function |
|---|---|---|---|
| | G90 | N/A | Set up Absolute Coordinate |

See MON 17 ABS for the operation of G90

| G-Code | Mnemonic | Operands | Function |
|---|---|---|---|
| | G91 | N/A | Set up Relative Coordinate |

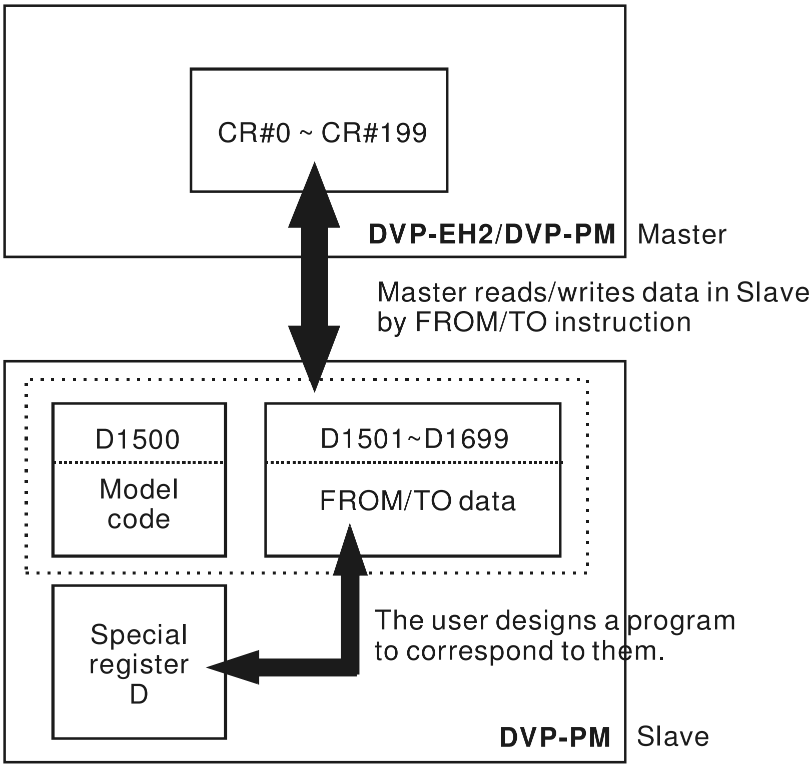
See MON 18 INC for the operation of G90

## 7.1 How to Connect DVP-EH2, DVP-PM (as Master) and DVP-PM (as Slave)

There is a special register area in DVP-PM which corresponds to the control registers in the Master. The users can thereby control the data exchange and motion between the Slave and Master depending on their actual demands.

### 7.1.1 The Structure

- DVP-EH2 and DVP-PM Master use FROM/TO instruction to drive DVP-PM Slave for executing all kinds of motions.
- DVP-EH2 and DVP-PM Master use FROM/TO instruction to read/write the control registers (CR#0 ~ CR#199, corresponding to special registers D1500 ~ D1699 in the Slave) in DVP-PM Slave.




### 7.1.2 Example of Master-Slave Connection

- How to set up
  1. Decide which the data in DVP-PM Slave to be controlled by the Master are. Use MOV instruction to move the data into the special registers in DVP-PM.
  2. Decide which control registers in the Master will control the Slave.
- Example 1

  Requirements:

  - DVP-EH2 Master gives FROM/TO instruction, corresponding to D1500 ~ D1699 in DVP-PM Slave, to control X and Y axes for executing all kinds of manual motion modes (see 3.12.3).

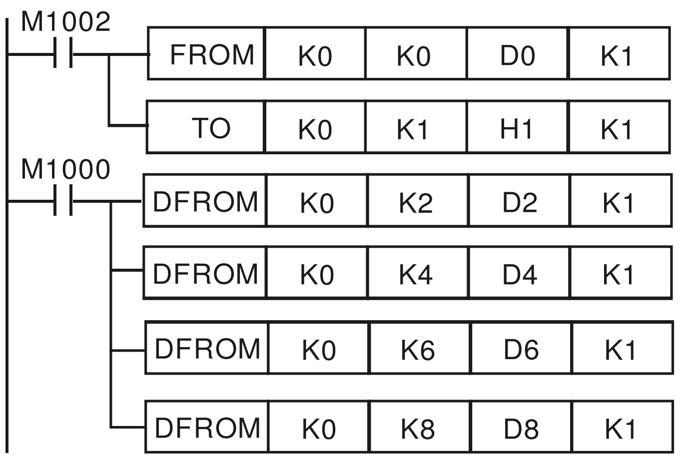
**Table for CR in the Master and corresponding special registers in the Slave:**

| Master | Slave | | Content |
|---|---|---|---|
| | Planned internally | Planned by user | |
| CR#0 | D1500 | Set up by the system | Model code of DVP-PM Slave |
| CR#1 | D1501 | D1846 | Operation instruction for X axis |
| CR#2 ~ 3 | D1502 ~ D1503 | D1848 ~ D1849 | Current position of X axis CP (PLS) |
| CR#4 ~ 5 | D1504 ~ D1505 | D1850 ~ D1851 | Current speed of X axis (PPS) |
| CR#6 ~ 7 | D1506 ~ D1507 | D1860 ~ D1861 | MPG input frequency of X axis |
| CR#8 ~ 9 | D1508 ~ D1509 | D1862 ~ D1863 | Accumulated number of MPG input pulses of X axis |

1. If you need to use other modes in DVP-PM Slave, please refer to Chapter 3 and correspond the registers for the functions required with the “Planned by the user” column and add the functions in the example program to execute all kinds of control modes offered by DVP-PM.
2. D1500 ~ D1699 are the special registers planned internally in the Slave, among which D1500 is the read-only register for storing the model code (H’6260) of DVP-PM. Therefore, D1501 ~ D1699 are the registers which can be used freely.

**Program in DVP-EH2 Master**

Ladder diagram:




Operation:

When DVP-EH2 Master is in RUN, read CR#0 of the Slave, corresponding to D1500 in Slave.

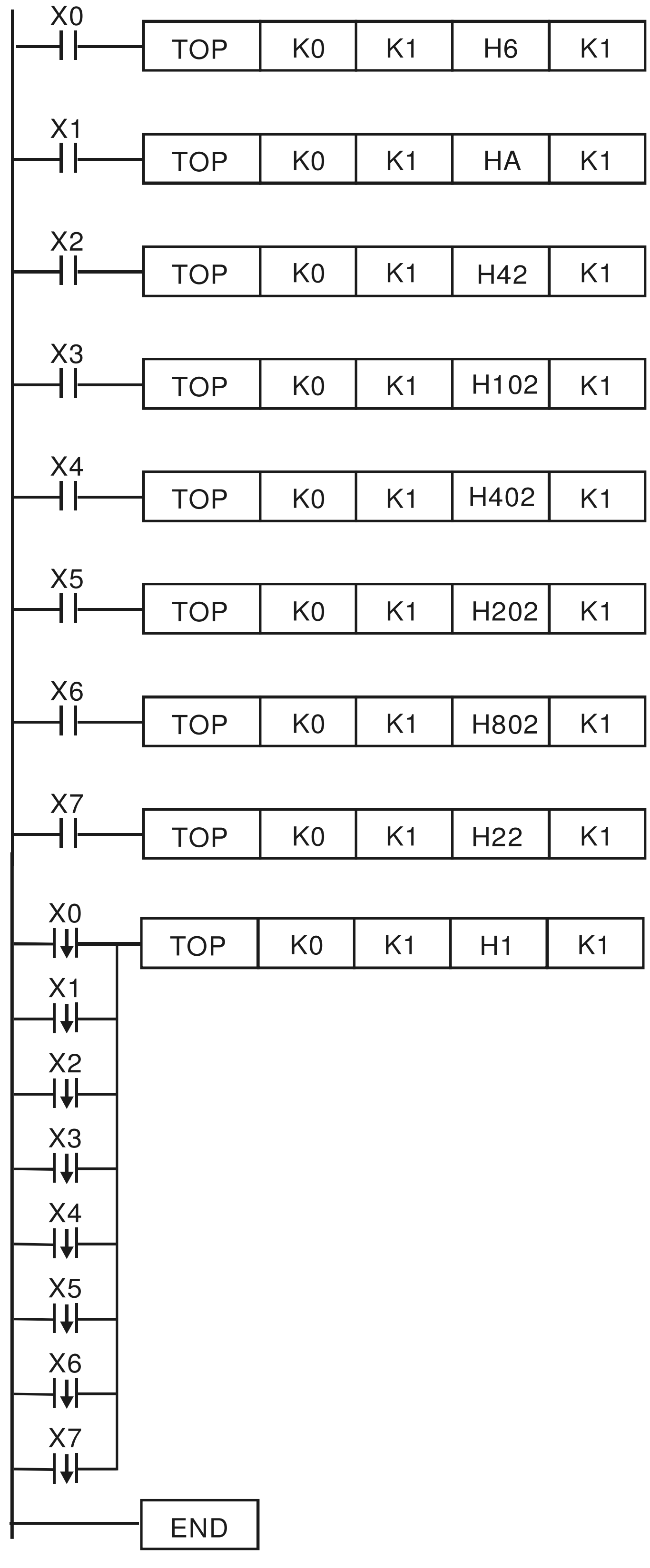
Write CR#1 of Slave, corresponding to D1501 in Slave, to enable STOP mode for X axis in Slave.

Read CR#2 of Slave, corresponding to D1502 ~ D1503 in Slave.

Read CR#2 of Slave, corresponding to D1504 ~ D1505 in Slave.

Read CR#2 of Slave, corresponding to D1506 ~ D1507.

Read CR#2 of Slave, corresponding to D1508 ~ D1509.




When X0 = On, write CR#1 of Slave, corresponding to D1501 in Slave, to enable JOG+ mode of X axis in Slave.

When X1 = On, write CR#1 of Slave, corresponding to D1501 in Slave, to enable JOG- mode of X axis in Slave.

When X2 = On, write CR#1 of Slave, corresponding to D1501 in Slave, to enable zero return mode of X axis in Slave.

When X3 = On, write CR#1 of Slave, corresponding to D1501 in Slave, to enable single-speed mode of X axis in Slave.

When X4 = On, write CR#1 of Slave, corresponding to D1501 in Slave, to enable 2-speed mode of X axis in Slave.

When X5 = On, write CR#1 of Slave, corresponding to D1501 in Slave, to enable inserting single-speed mode of X axis in Slave.

When X6 = On, write CR#1 of Slave, corresponding to D1501 in Slave, to enable inserting 2-speed mode of X axis in Slave.

When X7 = On, write CR#1 of Slave, corresponding to D1501 in Slave, to enable MPG mode of X axis in Slave.

When X0 ~ X7 = Off, write CR#1 of Slave, corresponding to D1501 in Slave, to enable STOP mode of X axis in Slave.

**Program in DVP-PM Slave**

| Ladder diagram: | | | | Operation: |
|---|---|---|---|---|
| M1002 | DMOV | K0 | D1848 | Enable O100 in Slave, and clear the current position of X axis as “0”. |
| | DMOV | K0 | D1862 | Clear the number of accumulated MPG pulses of X axis as “0”. |
| | DMOV | K10000 | D1838 | Set up the target position (I) of X axis P(I) |
| | DMOV | K10000 | D1840 | Set up the operation speed (I) of X axis V(I) |
| | DMOV | K20000 | D1842 | Set up the target position (II) of X axis P(II) |
| | DMOV | K20000 | D1844 | Set up the operation speed (II) of X axis V(II) |
| M1000 | MOV | D1501 | D1846 | Move D1501, corresponding to CR#0, to X axis for parameter setting. |
| | DMOV | D1848 | D1502 | Move the current position of X axis D1848 ~ D1849 to D1502 ~ D1503, corresponding to CR#2 ~ CR#3. |
| | DMOV | D1850 | D1504 | Move the current speed of X axis D1850 ~ D1851 to D1504 ~ D1505, corresponding to CR#4 ~ CR#5. |
| | DMOV | D1860 | D1506 | Move MPG input frequency of X axis D1860 ~ D1861 to D1502 ~ D1503, corresponding to CR#6 ~ CR#7. |
| | DMOV | D1862 | D1508 | Move the number of MPG pulses of X axis D1862 ~ D1863 to D1508 ~ D1509, corresponding to CR#8 ~ CR#9. |

◆ Example 2

Requirements:

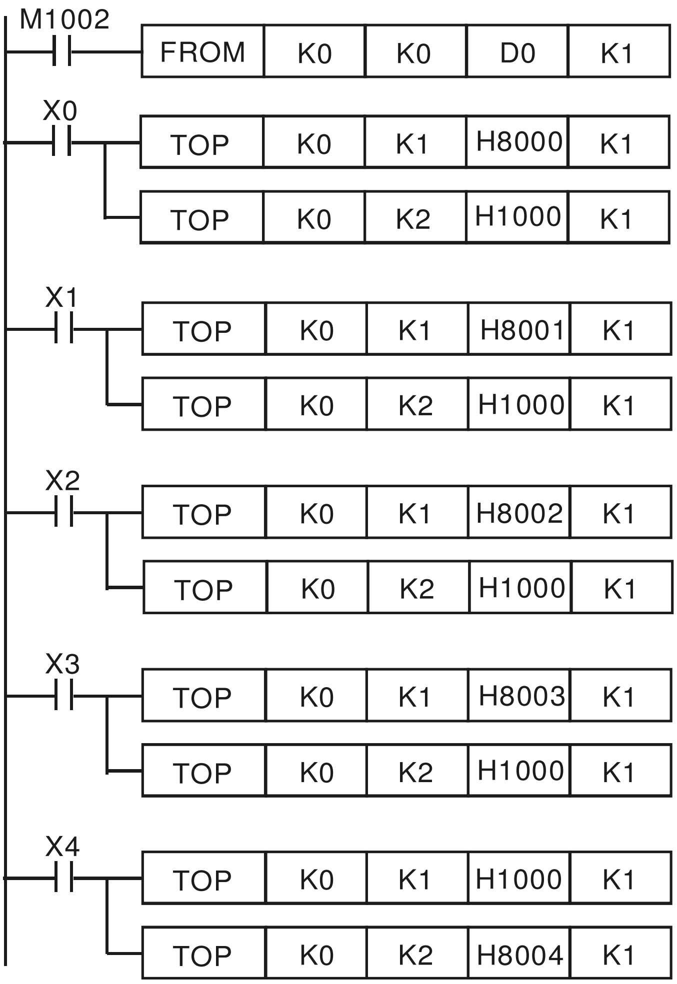
- DVP-EH2 Master gives FROM/TO instruction, corresponding to D1500 ~ D1699 in DVP-PM Slave, to control OX motion program and execute all kinds of motion modes (see Chapter 6 for how to use motion instructions).

**Table for CR in the Master and corresponding special registers in the Slave:**

| Master | Slave | | Content |
|---|---|---|---|
| | Planned internally | Planned by user | |
| CR#0 | D1500 | - | Model code of DVP-PM Slave |
| CR#1 | D1501 | D1868 | No. of OX program |
| CR#2 | D1502 | D1846 | Operation instruction for X axis (OX) |

**Program of DVP-EH2 Master**

Ladder diagram:




Operation:

When DVP-EH2 Master is in RUN, read CR#0 of Slave, corresponding to D1500 in Slave.

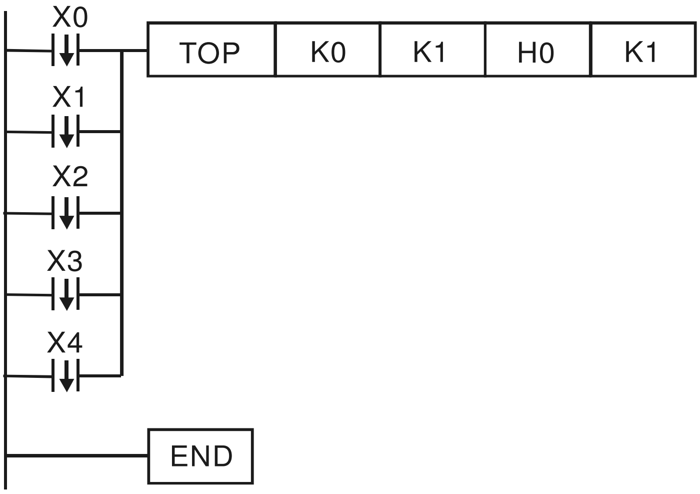
Write CR#1 of Slave, corresponding to D1501 in Slave, to enable OX00 and execute DRV instruction in Slave.
Write CR#2 of Slave, corresponding to D1502 in Slave, to enable OX subroutine in Slave.

Write CR#1 of Slave, corresponding to D1501 in Slave, to enable OX01 and execute LIN instruction in Slave.
Write CR#2 of Slave, corresponding to D1502 in Slave, to enable OX subroutine in Slave.

Write CR#1 of Slave, corresponding to D1501 in Slave, to enable OX02 and execute CW instruction in Slave.
Write CR#2 of Slave, corresponding to D1502 in Slave, to enable OX subroutine in Slave.

Write CR#1 of Slave, corresponding to D1501 in Slave, to enable OX03 and execute CCW instruction in Slave.
Write CR#2 of Slave, corresponding to D1502 in Slave, to enable OX subroutine in Slave.

Write CR#1 of Slave, corresponding to D1501 in Slave, to enable OX03 and execute DRVZ instruction in Slave.
Write CR#2 of Slave, corresponding to D1502 in Slave, to enable OX subroutine in Slave.

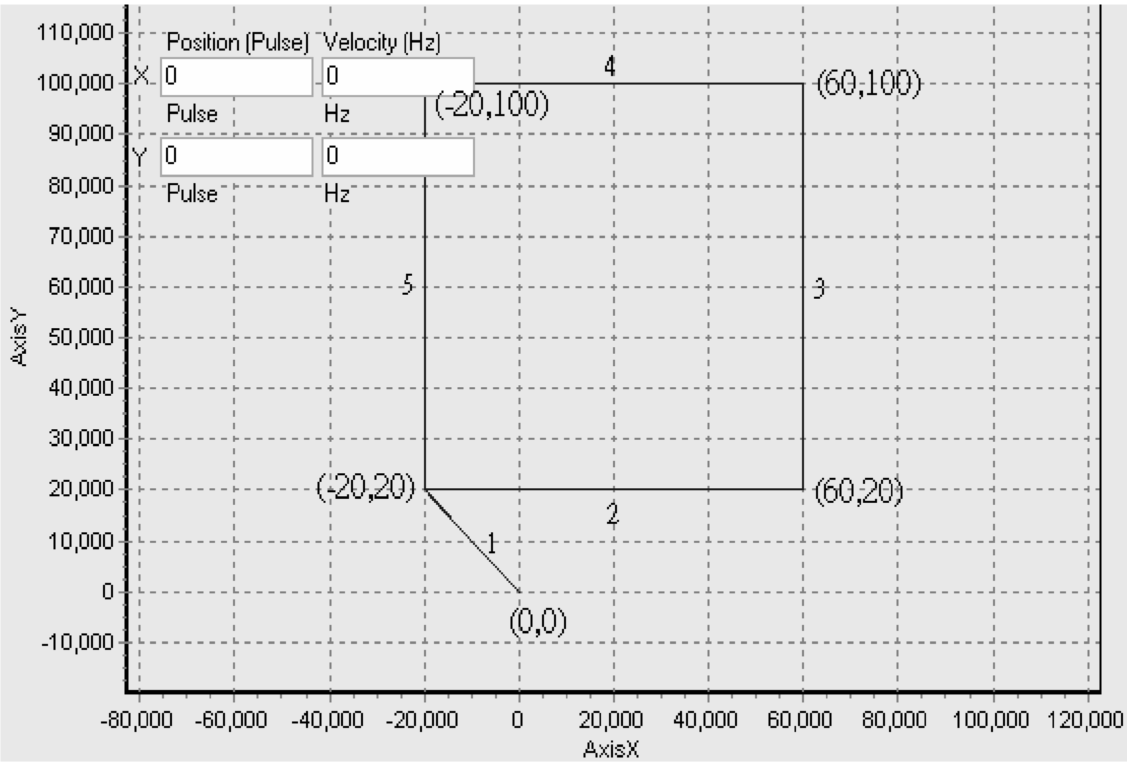



When X0 ~ X4 = Off, write CR#1 of Slave, corresponding to D1501 in Slave, to disable OX subroutine in Slave.

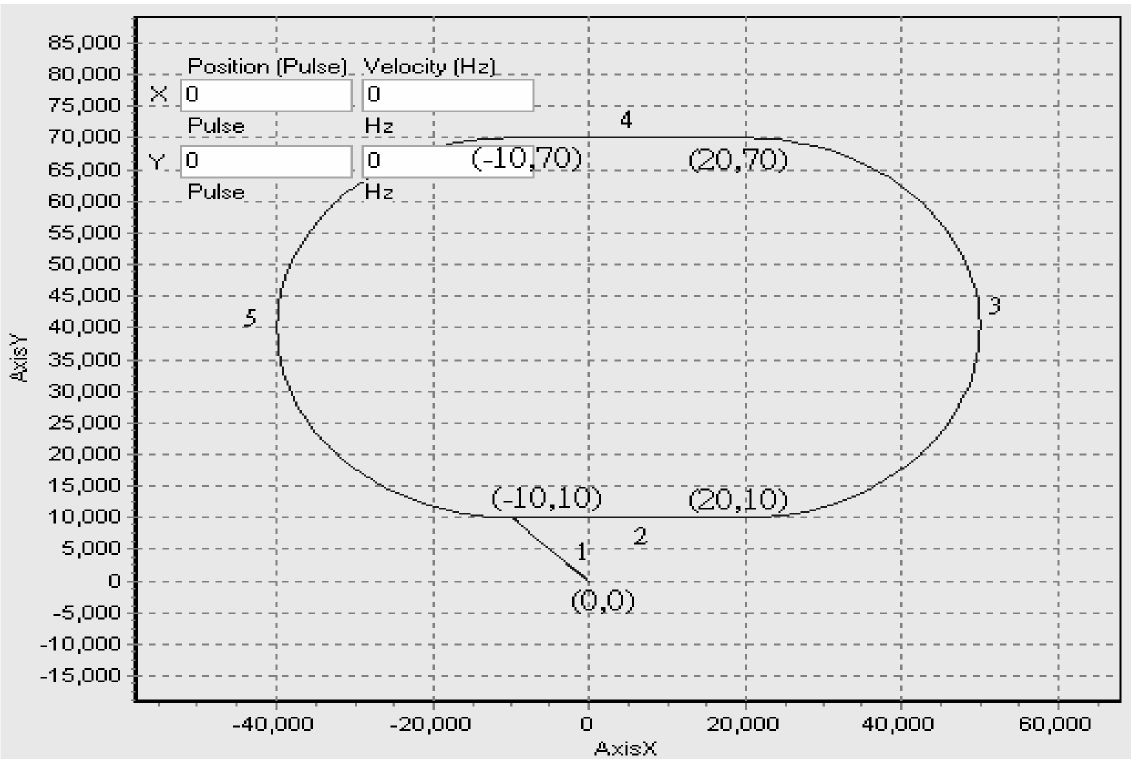
**Program in DVP-PM Slave**

| Instruction mode: | Operation: |
|---|---|
| O100 | |
| LD M1002 | Place the initialized value in O100 main program. |
| DMOV K0 D1848 | Enable O100 in Slave and clear the record of the |
| DMOV K0 D1928 | current position of X, Y axis as “0”. |
| M102 | |
| OX00 | |
| DRV X200000 FX100000 Y200000 FY100000 | Place motion instruction DRV in OX00 subroutine. |
| M2 | |
| OX01 | |
| LIN X100000 Y100000 F200000 | Place motion instruction LIN in OX01 subroutine. |
| M2 | |
| OX02 | |
| CW X0 Y100000 I0 J50000 F200000 | Place motion instruction CW in OX02 subroutine. |
| M2 | |
| OX03 | |
| CCW X0 Y100000 I0 J50000 F200000 | Place motion instruction CCW in OX03 subroutine. |
| M2 | |
| OX04 | |
| BRET | |
| DMOV K200000 D1828 | |
| DMOV K100000 D1830 | Place motion instruction DRVZ in OX04 subroutine, |
| DMOV K200000 D1908 | and set up relevant parameters for DRVZ. |
| DMOV K100000 D1910 | |
| DRVZ | |
| M2 | |

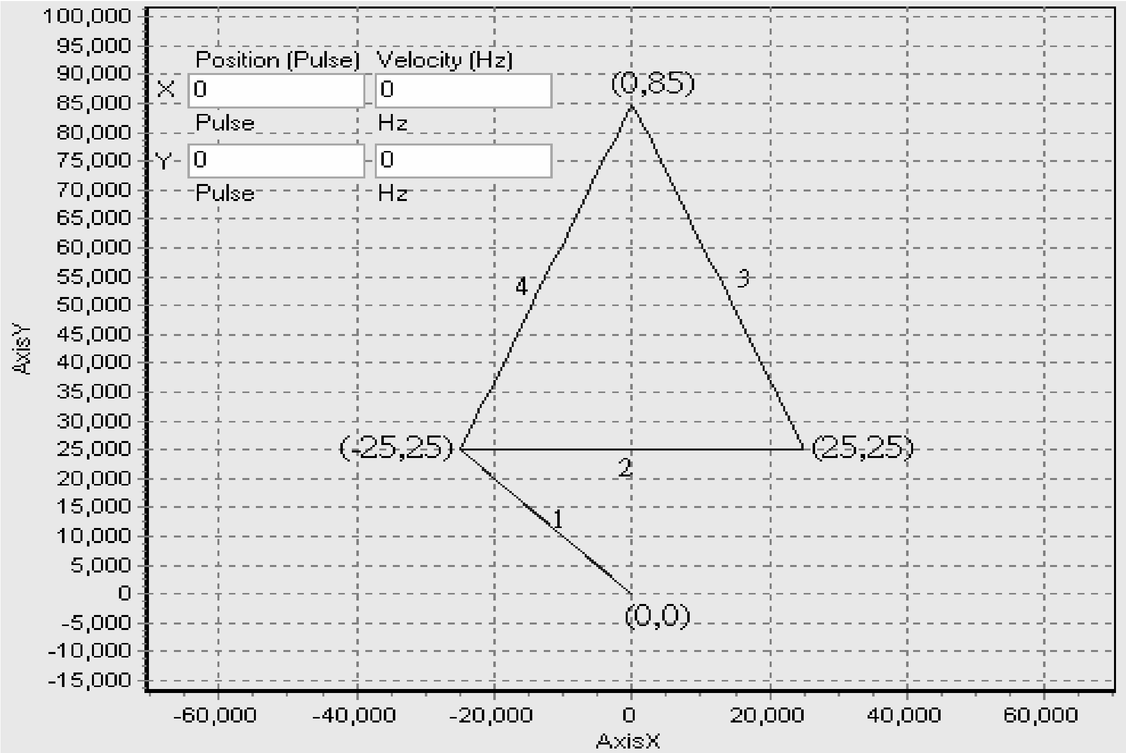
## 8.1 Draw the Trajectories Below by Using Motion Instructions and G-Codes



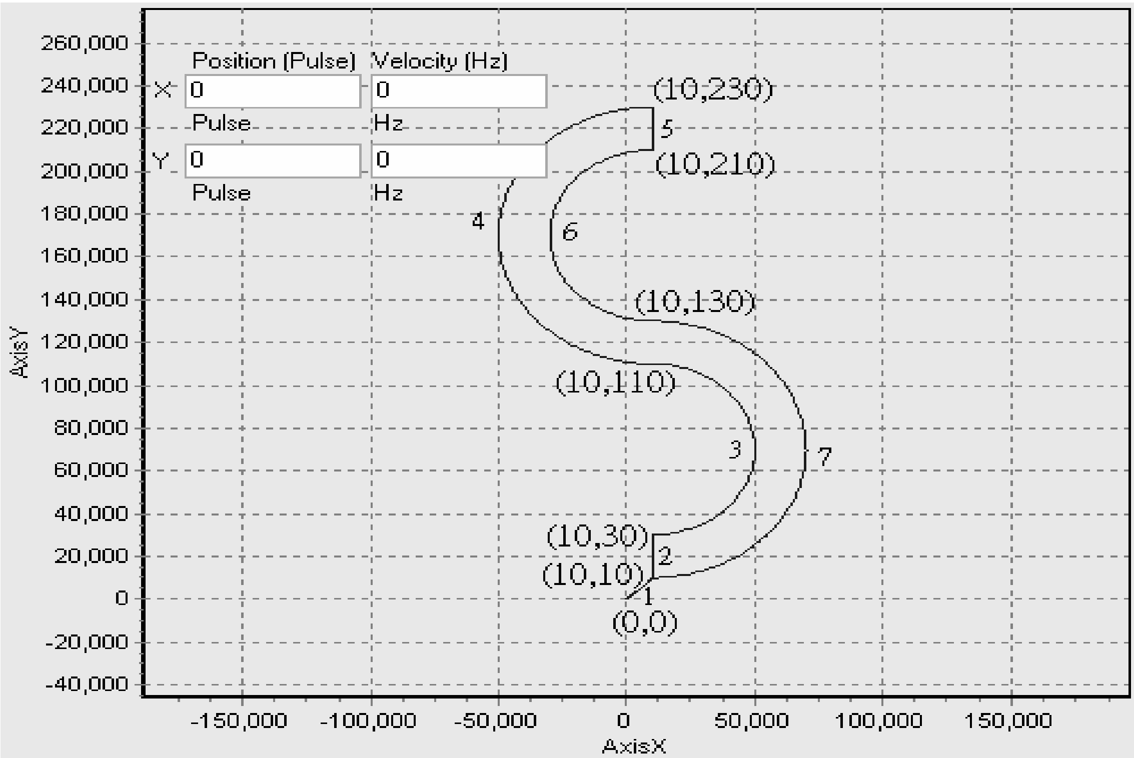

Trajectory 1




Trajectory 2




Trajectory 3




Trajectory 4

### 8.1.1 Design Procedure

1. Trajectory 1: Set up the absolute coordinates of the four points (-20, 20), (60, 20), (60, 100) and (-20, 100). Depart from (0, 0).
2. Trajectory 2: Set up the absolute coordinates of the four points (-10, 10), (20, 10), (20, 70) and (-10, 70). Depart from (0, 0).
3. Trajectory 3: Set up the absolute coordinates of the three points (-25, 25), (25, 25) and (0, 85). Depart from (0, 0).
4. Trajectory 4: Set up the absolute coordinates of the seven points (10, 10), (10, 30), (10, 110), (10, 230), (10, 210), (10, 130) and (10, 10). Depart from (0, 0).
5. How to write the program codes of a motion instruction:

   /*instruction mode: Place the initialized value in O100 main program. Clear the current position of X, Y axis as"0" and enable OX0 subroutine*/

| | | | | |
|---|---|---|---|---|
| O100 | | | | /*O100 main program*/ |
| LD | M1002 | | | |
| DMOV | K0 | D1848 | | /*Set the current position of X axis as 0*/ |
| DMOV | K0 | D1928 | | /*Set the current position of Y axis as 0*/ |
| RST | M1074 | | | /*Disable OX motion subroutine*/ |
| MOV | H8000 | D1868 | | /*Write the No. (0) of OX to be enabled*/ |
| SET | M1074 | | | /*Enable OX motion subroutine*/ |
| M102 | | | | |
| /*OX0 subroutine: Call pointer P0 in subroutine*/ | | | | |
| OX0 | | | | /*OX motion subroutine*/ |
| BRET | | | | /*Trigger condition*/ |
| CALL | P0 | | | /*Call P0 subroutine*/ |
| M2 | | | | |

/*Program codes below are how to write the motion instruction for trajectory 1*/

| | | | | |
|---|---|---|---|---|
| P0 | | | | /*P0 subroutine*/ |
| ABST | | | | /*Obtain absolute coordinate*/ |
| DRV | X-20000 | Y20000 | | /*Fast move to designated position*/ |
| LIN | X60000 | Y20000 | F20000 | /*Move to designated position by linear interpolation. Can also be written as LIN X60000 F20000 */ |
| LIN | X60000 | Y100000 | F20000 | /*Move to designated position by linear interpolation. Can also be written as LIN Y100000 */ |
| LIN | X-20000 | Y100000 | F20000 | /*Move to designated position by linear interpolation. Can also be written as LIN X-20000 */ |
| LIN | X-20000 | Y20000 | F20000 | /*Move to designated position by linear interpolation. Can also be written as LIN Y20000 */ |
| SRET | | | | |

/*Program codes below are how to write G-Code for trajectory 1: Place the motion program to be operated in the pointer.*/

| | | | | | |
|---|---|---|---|---|---|
| P0 | | | | | /*P0 subroutine*/ |
| G90 | | | | | /*Obtain absolute coordinate*/ |
| G0 | X-20.0 | Y20.0 | | | /*Fast move to designated position*/ |
| G1 | X60.0 | Y20.0 | F20.0 | | /*Move to designated position by linear interpolation. Can also be written as G1 X60.0 F20.0 */ |
| G1 | X60.0 | Y100.0 | F20.0 | | /*Move to designated position by linear interpolation. Can also be written as G1 Y100.0 */ |
| G1 | X-20.0 | Y100.0 | F20.0 | | /*Move to designated position by linear interpolation. Can also be written as G1 X-20.0 */ |
| G1 | X-20.0 | Y20.0 | F20.0 | | /*Move to designated position by linear interpolation. Can also be written as G1 Y20.0 */ |
| SRET | | | | | |

/*Program codes below are how to write the motion instruction for trajectory 2*/

| | | | | | |
|---|---|---|---|---|---|
| P0 | | | | | /*P0 subroutine*/ |
| ABST | | | | | /*Obtain absolute coordinate*/ |
| DRV | X-10000 | Y10000 | | | /*Fast move to designated position*/ |
| LIN | X20000 | Y10000 | F40000 | | /*Move to designated position by linear interpolation. Can also be written as LIN X20000 F40000 */ |
| CCW | X20000 | Y70000 | R30000 | F20000 | /*Move to designated position by arc interpolation. Can also be written as CCW Y70000 R30000 F20000 */ |
| LIN | X-10000 | Y70000 | F20000 | | /*Move to designated position by linear interpolation. Can also be written as LIN X-10000 */ |
| CCW | X-10000 | Y10000 | J-30000 | F20000 | /*Move to designated position by arc interpolation. Can also be written as CCW Y10000 J-30000 */ |
| SRET | | | | | |

/*Program codes below are how to write G-Code for trajectory 2*/

| | | | | | |
|---|---|---|---|---|---|
| P0 | | | | | /*P0 subroutine*/ |
| G90 | | | | | /*Obtain absolute coordinate*/ |
| G0 | X-10.0 | Y10.0 | | | /*Fast move to designated position*/ |
| G1 | X20.0 | Y10.0 | F40.0 | | /*Move to designated position by linear interpolation. Can also be written as G1 X20.0 F40.0 */ |
| G3 | X20.0 | Y70.0 | R30.0 | F20.0 | /*Move to designated position by arc interpolation. Can also be written as G3 Y70.0 R30.0 F20.0 */ |
| G1 | X-10.0 | Y70.0 | F20.0 | | /*Move to designated position by linear interpolation. Can also be written as G1 X-10.0 */ |
| G3 | X-10.0 | Y10.0 | J-30.0 | F20.0 | /*Move to designated position by arc interpolation. Can also be written as G3 Y10.0 J-30.0 */ |
| SRET | | | | | |

/*Program codes below are how to write the motion instruction for trajectory 3*/

| | | | | | |
|---|---|---|---|---|---|
| P0 | | | | | /*P0 subroutine*/ |
| INCT | | | | | /*Obtain relative position*/ |
| DRV | X-25000 | Y25000 | | | /*Fast move to designated position*/ |
| LIN | X50000 | Y0 | F20000 | | /*Move to designated position by linear interpolation. Can also be written as LIN X50000 Y0 F20000 */ |
| LIN | X-25000 | Y60000 | F20000 | | /*Move to designated position by linear interpolation. Can also be written as LIN X-25000 Y60000 */ |
| LIN | X-25000 | Y-60000 | F20000 | | /*Move to designated position by linear interpolation. Can also be written as LIN Y-60000 */ |
| DRV | X25000 | Y-25000 | | | /*Fast move to designated position*/ |
| SRET | | | | | |

/*Program codes below are how to write G-Code for trajectory 3*/

| | | | | | |
|---|---|---|---|---|---|
| P0 | | | | | /*P0 subroutine*/ |
| G91 | | | | | /*Obtain relative coordinate*/ |
| G0 | X-25.0 | Y25.0 | | | /*Fast move to designated position*/ |
| G1 | X50.0 | Y0 | F20.0 | | /*Move to designated position by linear interpolation. Can also be written as G1 X50.0 Y0 F20.0 */ |
| G1 | X-25.0 | Y60.0 | F20.0 | | /*Move to designated position by linear interpolation. Can also be written as G1 X-25.0 Y60.0 */ |
| G1 | X-25.0 | Y-60.0 | F20.0 | | /*Move to designated position by linear interpolation. Can also be written as G1 Y-60.0 */ |
| G0 | X25.0 | Y-25.0 | | | /*Fast move to designated position*/ |
| SRET | | | | | |

/*Program codes below are how to write the motion instruction for trajectory 4*/

| | | | | | |
|---|---|---|---|---|---|
| P0 | | | | | /*P0 subroutine*/ |
| ABST | | | | | /*Obtain absolute coordinate*/ |
| DRV | X10000 | Y10000 | | | /*Fast move to designated position*/ |
| LIN | X10000 | Y30000 | F20000 | | /*Move to designated position by linear interpolation. Can also be written as LIN Y30000 F20000 */ |
| CCW | X10000 | Y110000 | J40000 | F20000 | /*Move to designated position by arc interpolation. Can also be written as CCW Y110000 J40000 */ |
| CW | X10000 | Y230000 | R60000 | F15000 | /*Move to designated position by arc interpolation. Can also be written as CW Y230000 R60000 F15000 */ |
| LIN | X10000 | Y210000 | F15000 | | /*Move to designated position by linear interpolation. Can also be written as LIN Y210000 */ |
| CCW | X10000 | Y130000 | J-40000 | F15000 | /*Move to designated position by arc interpolation. Can also be written as CCW Y130000 J-40000 */ |
| CW | X10000 | Y10000 | R60000 | F20000 | /*Move to designated position by arc interpolation. Can also be written as CW Y10000 F20000 */ |

SRET

/*Program codes below are how to write G-Code for trajectory 4*/

| | | | | | |
|---|---|---|---|---|---|
| P0 | | | | | /*P0 subroutine*/ |
| G90 | | | | | /*Obtain absolute coordinate*/ |
| G0 | X10.0 | Y10.0 | | | /*Fast move to designated position*/ |
| G1 | X10.0 | Y30.0 | F20.0 | | /*Move to designated position by linear interpolation. Can also be written as G1 Y30.0 F20.0 */ |
| G3 | X10.0 | Y110.0 | J40.0 | F20.0 | /*Move to designated position by arc interpolation. Can also be written as G3 Y110.0 J40.0 */ |
| G2 | X10.0 | Y230.0 | R60.0 | F15.0 | /*Move to designated position by arc interpolation. Can also be written as G2 Y230.0 R60.0 F15.0 */ |
| G1 | X10.0 | Y210.0 | F15.0 | | /*Move to designated position by linear interpolation. Can also be written as G1 Y210.0 */ |
| G3 | X10.0 | Y130.0 | J-40.0 | F15.0 | /*Move to designated position by arc interpolation. Can also be written as G3 Y130.0 J-40.0 */ |
| G2 | X10.0 | Y10.0 | R60.0 | F20.0 | /*Move to designated position by arc interpolation. Can also be written as G2 Y10.0 F20.0 */ |

SRET

6. When M1072 in DVP-PM is On, the motion mode will start to be executed.

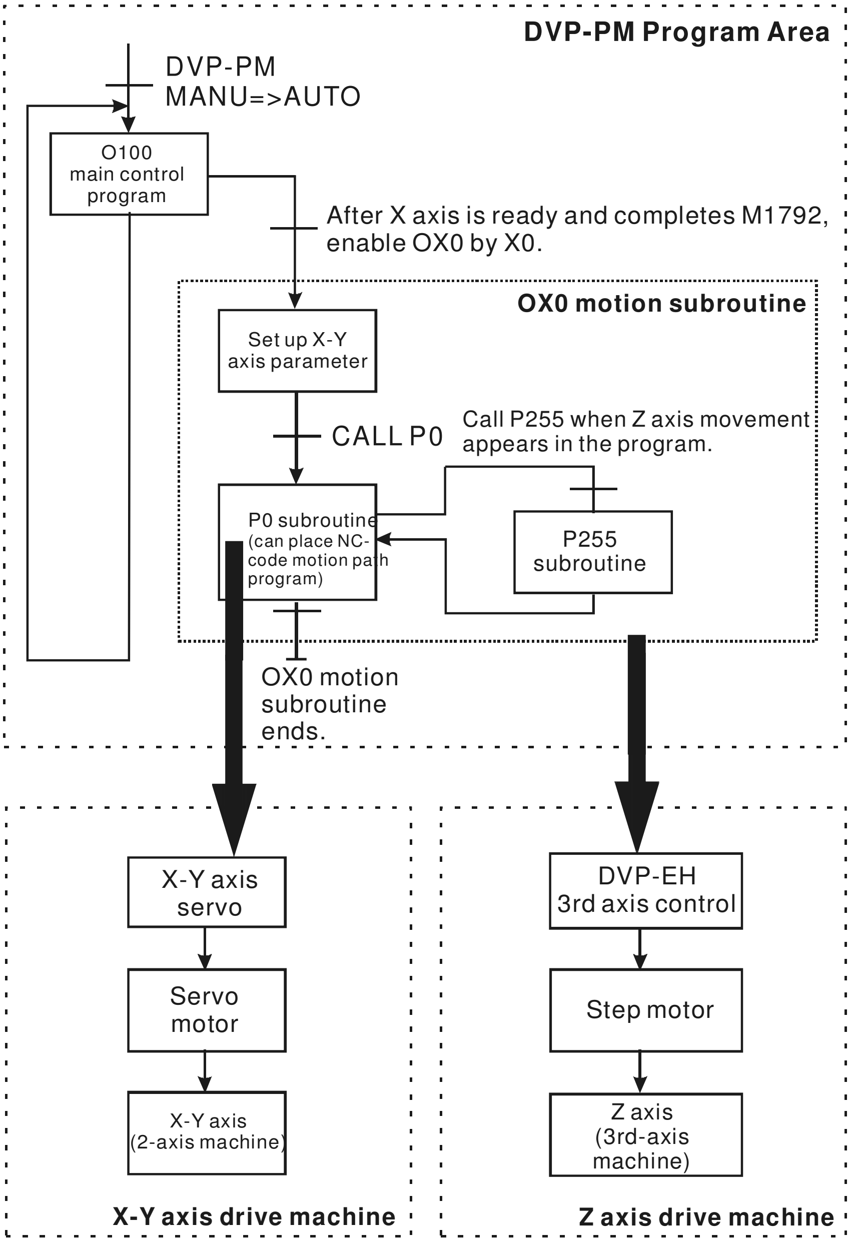
## 8.2 Applying “motionSample” in PMSoft

Follow the example below to draw English letters, any graph or text. If you wish to apply this function to any 2-axis control equipment, you can modify the example program below for you to realize more diverse control programs. Path: Open PMSoft => File => Open Examples... => select “motionSample_26Letter” file to open the example program.

### 8.2.1 Design Plan

Suppose we have decided to draw English letters and graphs by DVP-PM, we have to convert the letter and graph into G-Code (i.e. NC code) before designing the main control program of DVP-PM. Due to that DVP-PM only offers 2-axis (X, Y) interpolation, we have to add a Z axis for the “pen-lifting” controlled by the third axis. In this example, we will use DVP-EH series MPU (can be replaced by other controllers) to complete the third axis control.

The design plan:



### 8.2.2 Design Example Program

First, we design the main program of DVP-PM. To make to clearer, we will divide the program into four blocks.

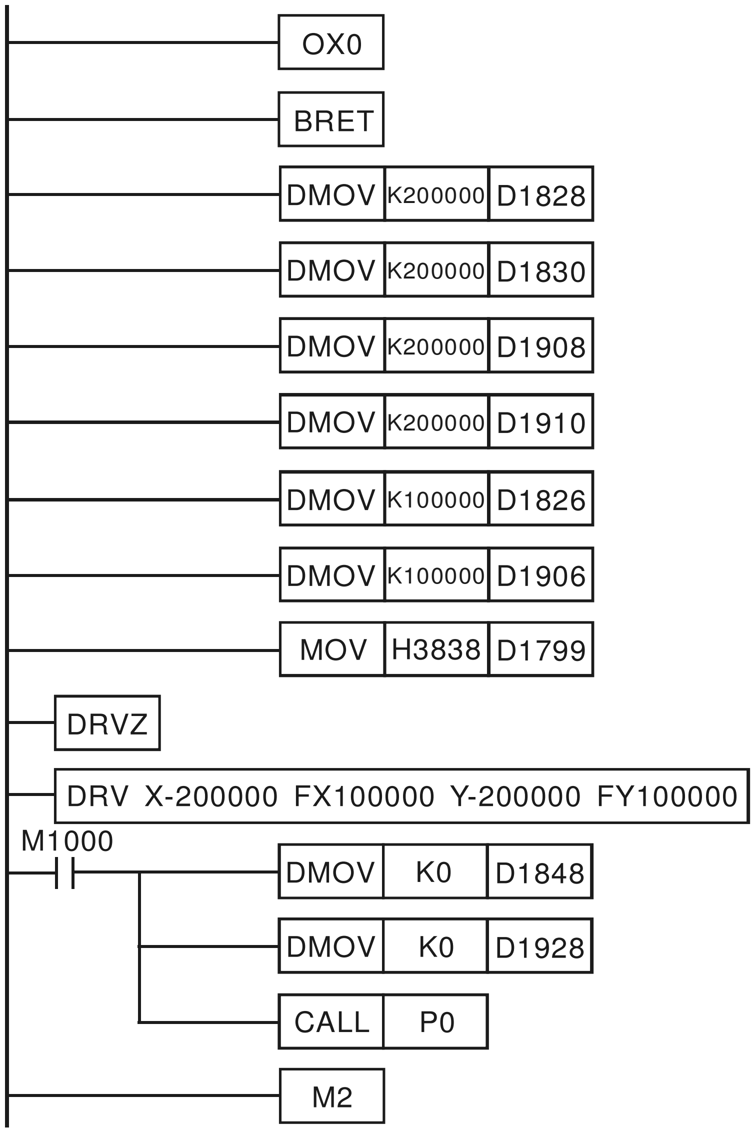
1. OX0 ~ M2: For setting up function parameters of X, Y axes

When DVP-PM is in AUTO status and OX is ready (M1792 = On), X0 will be On to enable OX0 subroutine. After OX0 is enabled, we have to set up parameters required for zero return, JOG speed and input terminal polarity on X, Y axes.

Next, enable zero return and move X, Y axes to (-200000, -200000) by 100KHz. Clear the current position as 0 and call P0 subroutine. OX0 subroutine will end when the execution of P0 subroutine is completed.

If you need to use other control modes, please refer to explanations on special register D in Chapter 2.

Ladder diagram:




Operation:

Start of OX0 motion subroutine

Zero return speed ($V_{RT}$) of X axis = 200KHz

Zero return deceleration speed ($V_{CR}$) of X axis = 200KHz

Zero return speed ($V_{RT}$) of Y axis = 200KHz

Zero return deceleration speed ($V_{CR}$) of Y axis = 200KHz

JOG speed of X axis = 100KHz

JOG speed of Y axis =100KHz

Set up input terminal polarity of X, Y axes

Enable zero return on X, Y axes

X, Y axes move to (-200000,-200000) by 100KHz.

Clear the current position of X axis as 0

Clear the current position of Y axis as 0

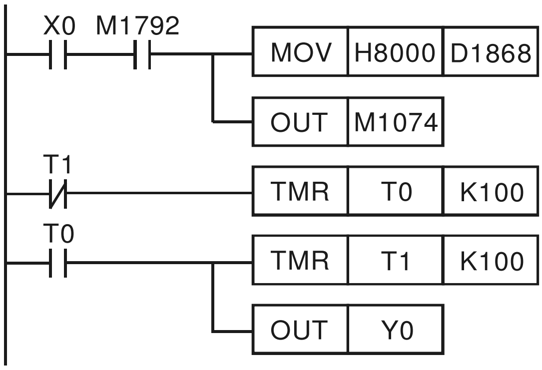
Y calls P0 subroutine

End of OX0 motion subroutine

2. O100 ~ M102: Main program control

O100 main program controls whether to enable OX0 subroutine. When X0 (condition contact for enabling OX0) and M1792 (flag deciding whether OX is ready) in the program are On, OX0 subroutine will be enabled. You can further place other operations in the main program.

Ladder diagram:




Operations:

When OX is ready (M1792 = On), prepare to enable OX0 motion subroutine.

Enable OX0 motion subroutine

It can execute other operations

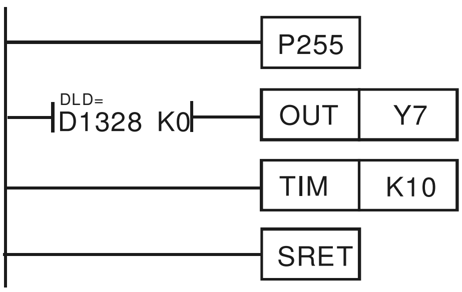
It can execute other operations

It can execute other operations

3. P255 ~ SRET: Generation of the 3rd axis (Z) control signals

When we use G0 and G1 (G-Code) in given in Chapter 6 for the target position on Z axis, the generated value in D1328 will decide the On/Off status of Y7, which will further give signals for DVP-EH series MPU to lift or release the pen (i.e. up/down movement of Z axis). When Z operand appears in the G-Code (NC-Code) instruction in P0 subroutine, P255 subroutine will be enabled automatically. For more details, please refer to G0 and G1 instructions in Chapter 6.

Ladder diagram:




Operations:

Start of P255 subroutine

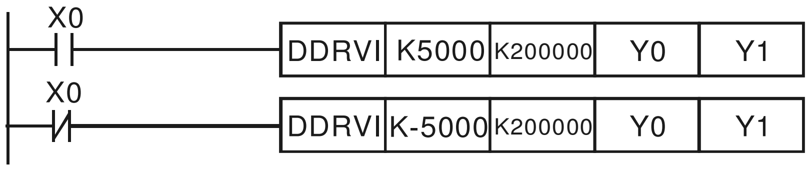
Y7 (control signals for pen lifting) is decided by the target position (D1328) on Z axis.

Pausing for 0.1 second

End of P255 subroutine

Due to that there is the control signal (Y7) to drive Z axis in P255 subroutine in DVP-PM, offering On/Off of Y7 to the external input point X0 in DVP-EH, when X0 = On, the output pulses will control the step motor and move the Z axis to position 1 (i.e. lifting the pen). When X0 = Off, the output pulses will control the step motor and move the Z axis to position 2 (i.e. releasing the pen).

The program of DVP-EH:

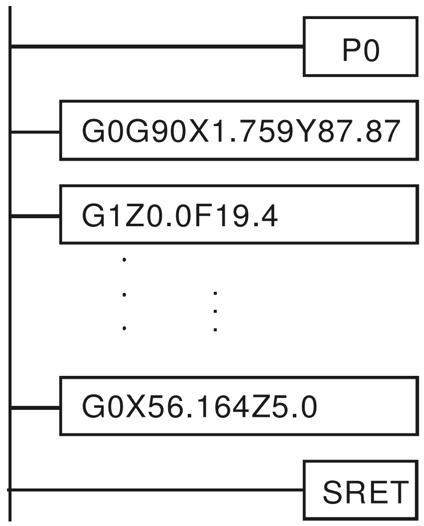



Connect the input devices Y0 and Y1 in DVP-EH to the pulse input terminals on the step motor.

4. P0 ~ SRET: 2-axis (X, Y) interpolation control

After we convert the letter or graph into G-Code (NC-Code), we will not place the G-Code into OX0 subroutine but into P0 subroutine in order to simplify the program. We will then be able to draw the letter or graph following the three program blocks above.

Ladder diagram:




Operations:

Start of P0 subroutine

Where we place G-Code (NC-Code)

End of P0 subroutine

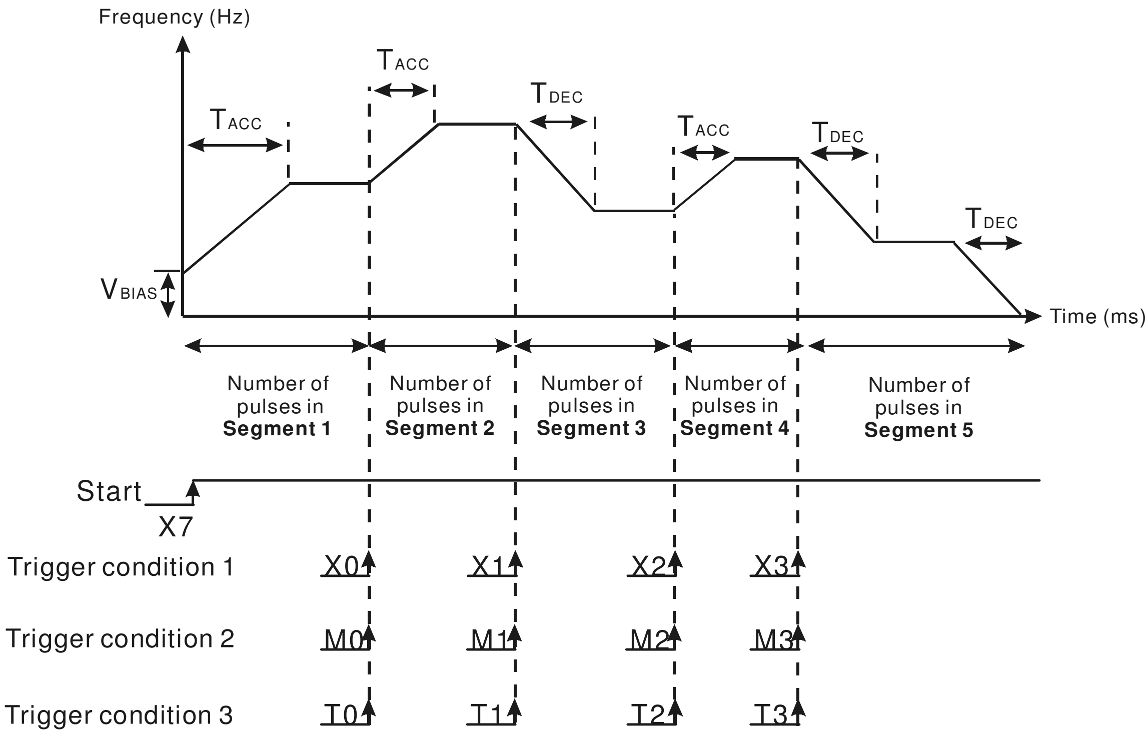
When the program blocks 1 ~ 4 are completed, we will be able to draw English letters, graphs or any text by DVP-PM.

## 8.3 Planning Variable Speed Operation

This section introduces how to trigger many segments of speed (variable speed) in a fixed route by using single-speed output mode.

### 8.3.1 Design Plan

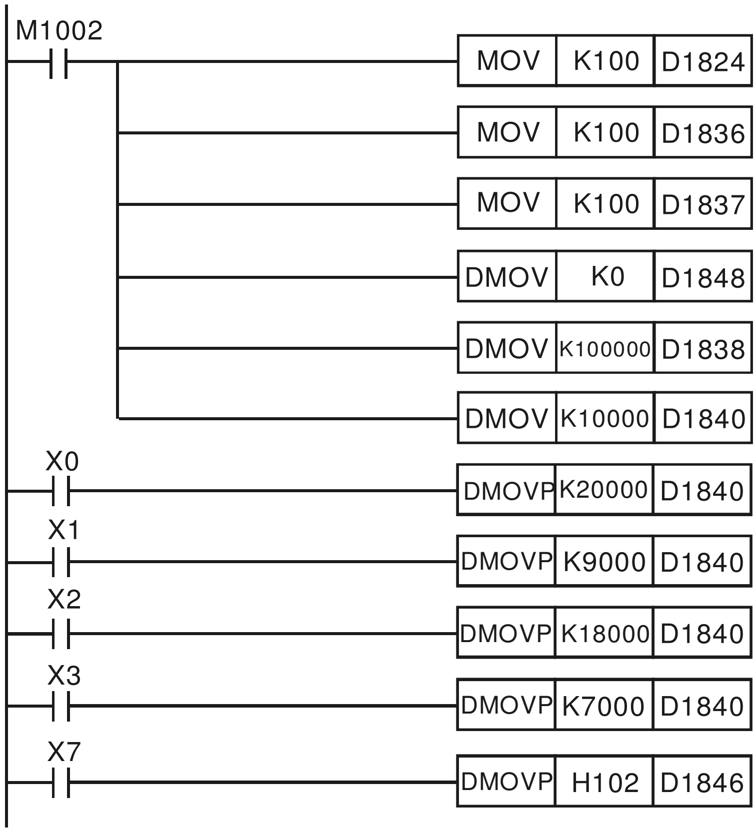
1. Trigger condition 1: Controlled by external input signal. X0 ~ X3 are for switching to the 2nd ~ 5th speed.
2. Trigger condition 2: Determined by current position. M0 ~ M3 are for switching to the 2nd ~ 5th speed.
3. Trigger condition 3: Controlled by time. T0 ~ T3 are for switching to the 2nd ~ 5th speed.




32-bit D1838 (total number of output pulses) = number of pulses in Segment 1 + Segment 2 + … + Segment 5

## 8.3.2 Design Example Program

Ladder diagram of trigger condition 1:




Operations:

Set up bias speed of X axis ($V_{BIAS}$)

Set up acceleration time of X axis ($T_{ACC}$)

Set up deceleration time of X axis ($T_{DEC}$)

Clear the current position of X axis as 0

Set up the moving distances of all segments for X axis

Set up the operation speed for the 1$^{st}$ segment on X axis

X0 = On, modify the operation speed into 20,000Hz

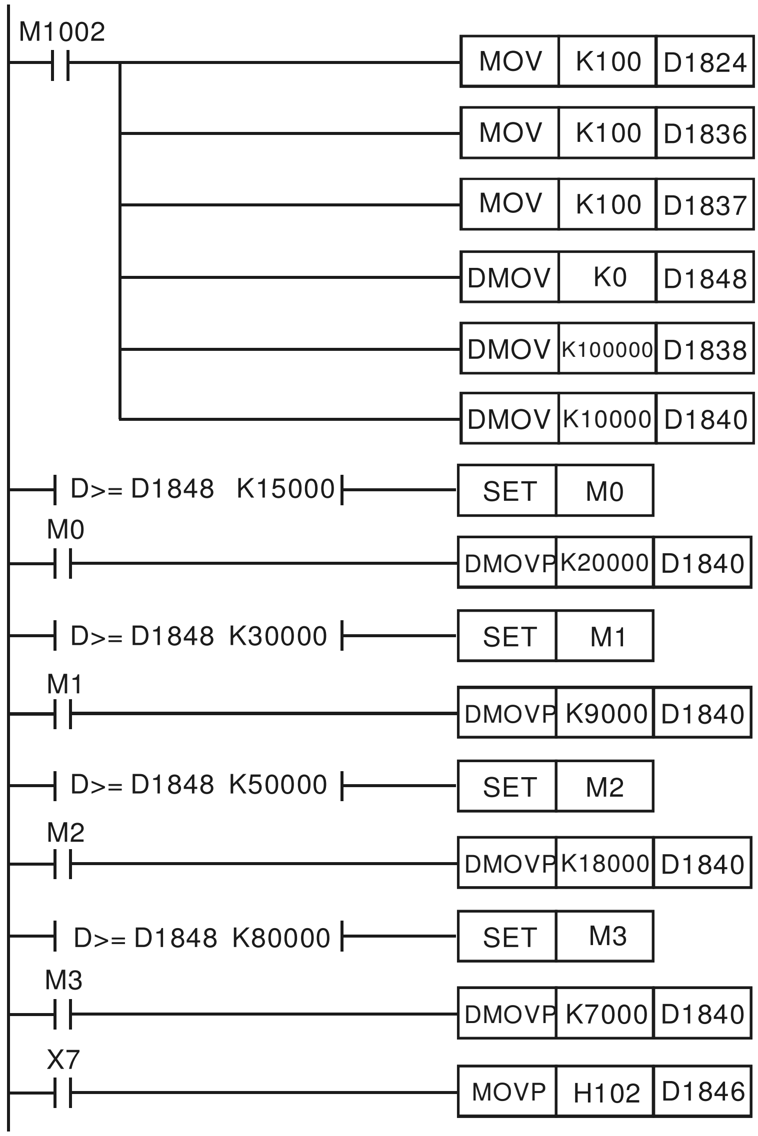
X1 = On, modify the operation speed into 9,000Hz

X2 = On, modify the operation speed into 18,000Hz

X3 = On, modify the operation speed into 7,000Hz

X7 = On, software enables motion instruction (single-speed) of X axis. The output executes until the end of the entire route.

Ladder diagram for trigger condition 2:




Operations:

Set up the bias speed of X axis ($V_{BIAS}$)

Set up the acceleration time of X axis ($T_{ACC}$)

Set up the deceleration time of X axis ($T_{DEC}$)

Clear the current position of X axis as 0

Set up the moving distances of all segments for X axis

Set up the operation speed for the 1st segment on X axis

Compare the current position
M0 = On, modify the operation speed into 20,000Hz

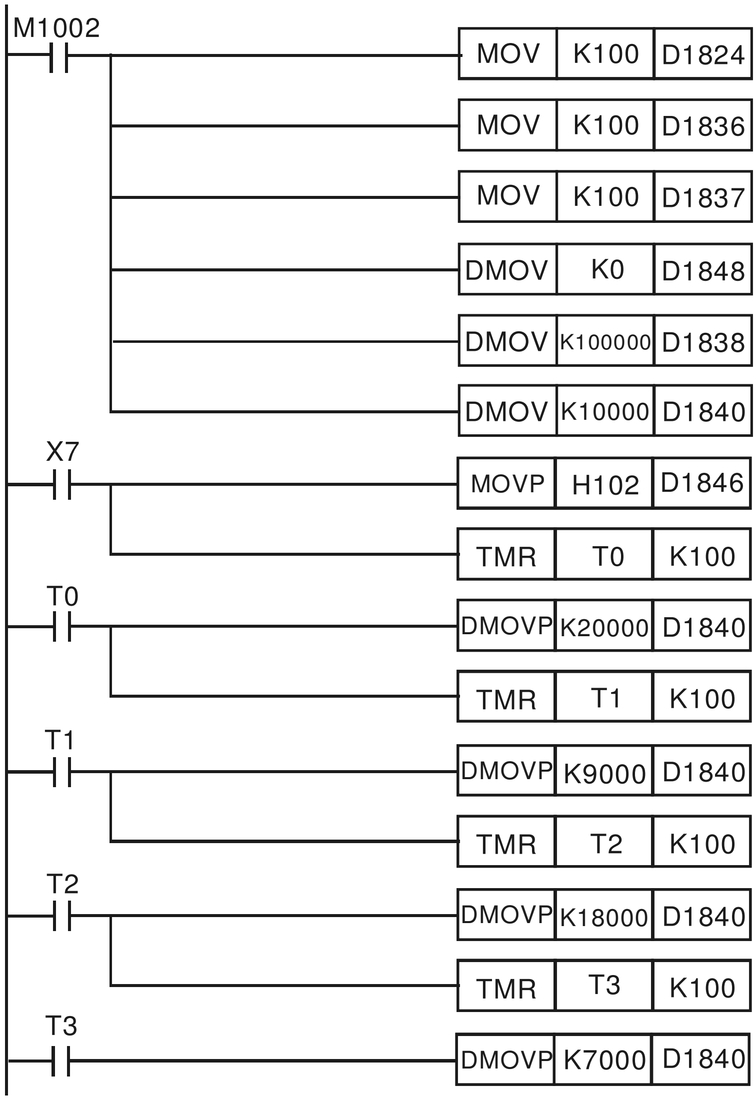
Compare the current position
M1 = On, modify the operation speed into 9,000Hz

Compare the current position
M2 = On, modify the operation speed into 18,000Hz

Compare the current position
M3 = On, modify the operation speed into 7,000Hz. The output executes until the end of the entire route.

X7 = On, software enables motion instruction (single-speed) of X axis.

Ladder diagram for trigger condition 3:




Operations:

Set up the bias speed of X axis ($V_{BIAS}$)

Set up the acceleration time of X axis ($T_{ACC}$)

Set up the deceleration time of X axis ($T_{DEC}$)

Clear the current position of X axis as 0

Set up the moving distances of all segments for X axis

Set up the operation speed for the 1st segment on X axis

X7 = On, the software enables the motion instruction (single-speed) of X axis and starts to count, preparing for switching to the 2nd segment.

T0 = On, modify the operation speed into 20,000Hz and start to count, preparing for switching to the 3rd segment.

T1 = On, modify the operation speed into 9,000Hz and start to count, preparing for switching to the 4th segment.

T2 = On, modify the operation speed into 18,000Hz and start to count, preparing for switching to the 5th segment.

T2 = On, modify the operation speed into 7,000Hz. The output executes until the end of the entire route.

## 8.4 How to Connect DVP-PM (as Master) and DVP01PU-H2 (as Slave) for 3rd Axis Control

The operation:

1. Enable O100 and execute OX0.
2. Wen the execution encounters G01 Z-25000 F10000 in OX0 subroutine, the program will call P255.
3. When in P255 and D1328 < 0, execute DVP01PU-H2 with target position K1,000 and operation speed K10,000.
4. Return to OX0 after the execution of P255 is completed. Wait for 10 seconds.
5. When the execution encounters G01 Z10000 F20000 in OX0 subroutine, the program will call P255.
6. When in P255 and D1328 > 0, execute DVP01PU-H2 with target position K2,000 and operation speed K20,000.
7. Return to OX0 after the execution of P255 is completed.

How to write the program codes:

/*instruction mode: Place the initialized value in O100 main program. Clear the current position of X, Y axis as"0" and enable OX0 subroutine*/

| | | | | | |
|---|---|---|---|---|---|
| O100 | | | | | /*O100 main program*/ |
| LD | M1002 | | | | |
| MOV | H8000 | D1868 | | | /*Write the No. (0) of OX to be enabled*/ |
| SET | M1074 | | | | /*Enable OX motion subroutine*/ |
| M102 | | | | | |
| /*OX0 subroutine*/ | | | | | |
| G1 | Z-25000 | F10000 | | | /*G1 3rd axis control*/ |
| TIM | K1000 | | | | /*Pause for 10 seconds*/ |
| G1 | Z10000 | F20000 | | | /*G1 3rd axis control*/ |
| M2 | | | | | |
| /*P255 subroutine*/ | | | | | |
| BRET | | | | | |
| TO | K0 | K31 | H2 | K1 | /*Close DVP01PU software*/ |
| DLD>= | K0 | D1328 | | | /*D1328 comparison*/ |
| DTO | K0 | K23 | K1000 | K1 | /*Set up target position for DVP01PU*/ |
| DTO | K0 | K25 | D1330 | K1 | /*Set up operation speed for DVP01PU*/ |
| TO | K0 | K32 | H1 | K1 | /*Set up single speed for DVP01PU*/ |
| TO | K0 | K31 | H100 | K1 | /*Enable DVP01PU software*/ |
| DLD< | K0 | D1328 | | | /*D1328 comparison*/ |
| DTO | K0 | K23 | K2000 | K1 | /*Set up target position for DVP01PU*/ |
| DTO | K0 | K25 | D1330 | K1 | /*Set up operation speed for DVP01PU*/ |
| TO | K0 | K32 | H1 | K1 | /*Set up single speed for DVP01PU*/ |
| TO | K0 | K31 | H100 | K1 | /*Enable DVP01PU software*/ |

## 9.1 Appendix A: Special Registers for Manual Motion Mode

| Special D | | | | Content | Range | Default setting | Page |
|---|---|---|---|---|---|---|---|
| X axis | | Y axis | | | | | |
| HW | LW | HW | LW | | | | |
| | D1816 | | D1896 | Parameter setting | b0 ~ b15 | H0 | 3-33 |
| | D1817 | | D1897 | Backlash compensation | 1 ~ +32,767 PLS | K0 | 3-37 |
| D1819 | D1818 | D1899 | D1898 | Number of pulses required per revolution of the motor (A) | 1 ~ +2,147,483,647 PLS/REV | K2,000 | 3-37 |
| D1821 | D1820 | D1901 | D1900 | Distance created for 1 motor revolution (B) | 1 ~ +2,147,483,647 ***1** | K1,000 | 3-38 |
| D1823 | D1822 | D1903 | D1902 | Maximum speed | 0 ~ +2,147,483,647 ***2** | K500,000 | 3-38 |
| D1825 | D1824 | D1905 | D1904 | Bias speed | 0 ~ +2,147,483,647 ***2** | K0 | 3-38 |
| D1827 | D1826 | D1907 | D1906 | JOG speed $V_{JOG}$ | 0 ~ +2,147,483,647 ***2** | K5,000 | 3-38 |
| D1829 | D1828 | D1909 | D1908 | Zero return speed $V_{RT}$ | 0 ~ +2,147,483,647 ***2** | K50,000 | 3-39 |
| D1831 | D1830 | D1911 | D1910 | Zero return deceleration speed $V_{CR}$ | 0 ~ +2,147,483,647 ***2** | K1,000 | 3-39 |
| | D1832 | | D1912 | Number of PG0 signals N | 0 ~ +32,767 PLS | K0 | 3-39 |
| | D1833 | | D1913 | Number of pulse signals P | -32,768 ~ +32,767 PLS | K0 | 3-40 |
| D1835 | D1834 | D1915 | D1914 | Definition of zero point HP | 0 ~ ±999,999 ***1** | K0 | 3-40 |
| | D1836 | | D1916 | Acceleration time $T_{ACC}$ | 10 ~ +32,767 ms | K100 | 3-40 |
| | D1837 | | D1917 | Deceleration time $T_{DEC}$ | 10 ~ +32,767 ms | K100 | 3-40 |
| D1839 | D1838 | D1919 | D1918 | Target position (I) P(I) | -2,147,483,648 ~ +2,147,483,647 ***1** | K0 | 3-40 |
| D1841 | D1840 | D1921 | D1920 | Operation speed (I) V(I) | -2,147,483,648 ~ +2,147,483,647 ***1** | K1000 | 3-41 |
| D1843 | D1842 | D1923 | D1922 | Target position (II) P(II) | -2,147,483,648 ~ +2,147,483,647 ***1** | K0 | 3-41 |
| D1845 | D1844 | D1925 | D1924 | Operation speed (II)V(II) | 0 ~ +2,147,483,647 ***1** | K2,000 | 3-41 |
| | D1846 | | D1926 | Operation instruction | b0 ~ b15 | H0 | 3-42 |
| | D1847 | | D1927 | Work mode | b0~b15 | H0 | 3-45 |
| D1849 | D1848 | D1929 | D1928 | Current position CP (PLS) | -2,147,483,648 ~ +2,147,483,647 ***1** | K0 | 3-46 |
| D1851 | D1850 | D1931 | D1930 | Current speed CS (PPS) | 0 ~ +2,147,483,647 PPS | K0 | 3-46 |
| D1853 | D1852 | D1933 | D1932 | Current position CP (unit ***2** ) | -2,147,483,648 ~ +2,147,483,647 ***1** | K0 | 3-47 |
| D1855 | D1854 | D1935 | D1934 | Current speed CS (unit ***2**) | 0 ~ +2,147,483,647 PPS | K0 | 3-47 |
| | D1856 | | D1936 | Execution status | b0 ~ b15 | H0 | 3-47 |
| | D1857 | | D1937 | Error code | See the error code table | H0 | 3-47 |
| | D1858 | | D1938 | Electronic gear (numerator) | 1 ~ +32,767 | K1 | 3-47 |
| | D1859 | | D1939 | Electronic gear (denominator) | 1 ~ +32,767 | K1 | 3-47 |
| D1861 | D1860 | D1941 | D1940 | MPG input frequency | Pulse frequency by MPG input | K0 | 3-48 |
| D1863 | D1862 | D1943 | D1942 | Accumulated number of MPG input pulses | Number of input pulses from MPG | K0 | 3-48 |
| | D1864 | | D1944 | Response speed of MPG input | Response speed of MPG input | K5 | 3-48 |

| Registers for the Motion | | | | Parameter Name | Operation Mode | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| X axis | | Y axis | | | JOG | Zero return | Single-speed positioning | Single-speed positioning interruption | 2-speed positioning | 2-speed positioning interruption | Variable speed | MPG input |
| HW | LW | HW | LW | | | | | | | | | |
| D1819 | D1818 | D1899 | D1898 | Number of pulses required per revolution of motor (A) | No need to be set up if the unit (b0, b1 of D1816 (D1896)) is motor unit.<br>Needs to be set up if the unit is machine unit or combined unit. | | | | | | | |
| D1821 | D1820 | D1901 | D1900 | Distance created by 1 revolution of motor (B) | | | | | | | | |
| | D1816 | | D1896 | Parameter setting | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ |
| D1823 | D1822 | D1903 | D1902 | Maximum speed ($V_{MAX}$) | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ |
| D1825 | D1824 | D1905 | D1904 | Bias speed ($V_{BIAS}$) | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ |
| D1827 | D1826 | D1907 | D1906 | JOG speed ($V_{JOG}$) | ◎ | - | - | - | - | - | - | - |
| D1829 | D1828 | D1909 | D1908 | Zero return speed ($V_{RT}$) | - | ◎ | - | - | - | - | - | - |
| D1831 | D1830 | D1911 | D1910 | Zero return deceleration speed ($V_{CR}$) | | | | | | | | |
| | D1832 | | D1912 | Number of PG0 signals in zero return (N) | | | | | | | | |
| | D1833 | | D1913 | Number of pulse signals in zero return (P) | | | | | | | | |
| D1835 | D1834 | D1915 | D1914 | Definition of zero point (HP) | | | | | | | | |
| | D1836 | | D1916 | Acceleration time ($T_{ACC}$) | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | - |
| | D1837 | | D1917 | Deceleration time ($T_{DEC}$) | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | - |
| D1839 | D1838 | D1919 | D1918 | Target position(I) (P(I)) | - | - | ◎ | ◎ | ◎ | ◎ | - | ◎ |
| D1841 | D1840 | D1921 | D1920 | Operation speed (I) (V(I)) | - | - | ◎ | ◎ | ◎ | ◎ | ◎ | - |
| D1843 | D1842 | D1923 | D1922 | Target position (II) (P(II)) | - | - | - | - | ◎ | ◎ | - | ◎ |
| D1845 | D1844 | D1925 | D1924 | Operation speed (II) (V(II)) | - | - | - | - | ◎ | ◎ | - | - |
| | D1846 | | D1926 | Operation instruction | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ |
| | D1847 | | D1927 | Work mode | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ |
| D1849 | D1848 | D1929 | D1928 | Current position (CP) (PLS) | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ |
| D1851 | D1850 | D1931 | D1930 | Current speed (CS) (PPS) | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ |
| D1853 | D1852 | D1833 | D1932 | Current position (CP) (unit) | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ |
| D1855 | D1854 | D1935 | D1934 | Current speed (CS) (unit) | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ | ◎ |
| | D1858 | | D1938 | Numerator of electronic gear | - | - | - | - | - | - | - | ◎ |
| | D1859 | | D1939 | Denominator of electronic gear | - | - | - | - | - | - | - | ◎ |
| D1861 | D1860 | D1941 | D1940 | Frequency of MPG input | - | - | - | - | - | - | - | ◎ |
| D1863 | D1862 | D1943 | D1942 | Accumulated number of MPG input pulses | - | - | - | - | - | - | - | ◎ |
| | D1864 | | D1944 | MPG response speed | - | - | - | - | - | - | - | ◎ |

◎ refers to the control register for the operation mode.

See 3.12.1 for how to set up the special registers in manual motion mode.

## 9.2 Appendix B: Motion Instructions & G-Code Instructions

| Category | MON | Mnemonic | Function | Page |
|---|---|---|---|---|
| Motion Instructions | 00 | DRV | High-Speed Positioning | 6-5 |
| | 01 | LIN | 2-Axis Synchronous Linear Interpolation (considering remaining distance) | 6-7 |
| | 02 | CW | Clockwise Arc Movement (set the position of center) | 6-9 |
| | 03 | CCW | Counterclockwise Arc Movement (set the position of center) | 6-9 |
| | 04 | CW | Clockwise Arc Movement (set the radius) | 6-11 |
| | 05 | CCW | Counterclockwise Arc Movement (set the radius) | 6-11 |
| | 06 | TIM | Pause Time | 6-13 |
| | 07 | DRVZ | Return to Mechanical Zero Point (zero return) | 6-14 |
| | 08 | SETR | Set up Electrical Zero Point | 6-17 |
| | 09 | DRVR | Return to Electrical Zero Point | 6-18 |
| | 10 | INTR | 2-Axis Synchronous Single-Speed Interpolation (ignoring remaining distance) | 6-19 |
| | 11 | SINTR | Inserting Single-Speed Operation | 6-20 |
| | 12 | DINTR | Inserting 2-Speed Operation | 6-22 |
| | 13 | MOVC | Set up Linear Movement Compensation | 6-24 |
| | 14 | CNTC | Arc Center Compensation | 6-25 |
| | 15 | RADC | Arc Radius Compensation | 6-26 |
| | 16 | CANC | Cancel Compensation | 6-27 |
| | 17 | ABST | Set up Absolute Coordinate | 6-28 |
| | 18 | INCT | Set up Relative Coordinate | 6-28 |
| | 19 | SETT | Set up Current Position | 6-29 |
| Category | G-Code | Mnemonic | Function | Page |
| G-Code Instructions | 0 | DRV | High-Speed Positioning | 6-30 |
| | 1 | LIN | 2-Axis Synchronous Linear Interpolation (considering remaining distance) | 6-34 |
| | 2 | CW | Clockwise Arc Movement (set the position of center) | 6-37 |
| | 3 | CCW | Counterclockwise Arc Movement (set the position of center) | 6-37 |
| | 2 | CW | Clockwise Arc Movement (set the radius) | 6-38 |
| | 3 | CCW | Counterclockwise Arc Movement (set the radius) | 6-38 |
| | 4 | TIM | Pause Time | 6-39 |
| | 90 | ABS | Set up Absolute Coordinate | 6-39 |
| | 91 | INC | Set up Relative Coordinate | 6-39 |

See 6.3 and 6.4 for details of motion instructions and G-Code instructions.

## 9.3 Appendix C: Error Codes

After you write the program into DVP-PM, the illegal use of operands (devices) or incorrect syntax in different program blocks, O100, OX, will result in flashing of ERROR indicator and error flag being On. See the tables below for the error codes (in hex) stored in the error code register if the motion parameters set are incorrect.

■ Devices for storing error codes and number of steps in different program blocks:

| Program block | O100 | | | OX | | |
|---|---|---|---|---|---|---|
| Error type | Program error | Motion error | | Program error | Motion error | |
| | | X axis | Y axis | | X axis | Y axis |
| Error flag | M1953 | M1793 | M1873 | M1793 | M1793 | M1873 |
| Error register | D1802 | D1857 | D1937 | D1857 | D1857 | D1937 |
| Number of steps | D1803 | D1869 | | D1869 | D1869 | |

■ Error codes (in hex)

| Code | Cause of error | Code | Cause of error |
|---|---|---|---|
| 0002 | No content in the subroutine in use | 0031 | Forward pulses are forbidden. |
| 0003 | No corresponding Pn in CJ, CJN and JMP | 0032 | Reverse pulses are forbidden. |
| 0004 | Subroutine flag exists in the main program | 0033 | Left/right limit is reached. |
| 0005 | No subroutine | 0040 | The device used is in incorrect range. |
| 0006 | The pointer in the same program is repeated. | 0041 | MODRD, MODWR communication time-out |
| 0007 | The subroutine pointer is repeated. | 0044 | Incorrect V/Z index register modification |
| 0008 | Pointers of jump instruction in different subroutines are repeated. | 0045 | Incorrect floating point conversion |
| 0009 | The jump instruction and call subroutine instruction use the same flags. | 0E18 | Incorrect BCD conversion |
| 000A | The pointer is the same as the pointer in the subroutine. | 0E19 | Incorrect division (divisor = 0) |
| 0011 | Incorrect target position (I) | C401 | General circuit error |
| 0012 | Incorrect target position (II) | C402 | LD/LDI instruction is used continuously for more than 9 times. |
| 0021 | Incorrect operation speed (I) | C404 | RPT ~ RPE is more than 1 layers |
| 0022 | Incorrect operation speed (II) | C405 | SRET is used between RPT and RPE |
| 0023 | Incorrect zero return deceleration speed ( $V_{RT}$) | C4EE | There is no end instruction (M102, M2) in the program. |
| 0024 | Incorrect zero return deceleration speed ($V_{CR}$) | C4FF | No such instruction/ operand, or the range is incorrect. |
| 0025 | Incorrect JOG speed | | |