DVP-MC Bus-Type Multi-Axis Motion Controller Operating Manual

http://www.delta.com.tw/industrialautomation

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Content

1. Overview of DVP10MC11T

DVP10MC11T is a type of multi-axis motion controller researched and produced by Delta autonomously on basis of CANopen field bus. It complies with CANopen DS301 basic communication protocol and DSP402 motion control protocol. Also, it supports motion control standard instruction libraries defined by most international organizations. It brings great convenience to user to learn to develop projects quickly.

The multi-function controller consists of standard PLC module and MC motion control module. PLC module is similar to DVP serial PLC in function and usage. User could utilize WPLSoft or ISPSoft programming software to write and edit the ladder diagram, SFC, instruction table and Delta standard PLC logic programs. Moreover, PLC supports the two extension ports in its left and right sides. The one in its left side is a parallel extension port which could be connected with max 7 field bus master modules such as DeviceNet/CANopen master, Ethernet modules and high-speed analog quantity modules. The other one in its right side is to connect DVP-S series of PLC extension modules such as low-speed analog quantity and digital quantity modules.

DVP10MC11T is mainly applied to control the servo drive precisely via CANopen bus so as to accomplish the functions like the speed control, position control and etc. that user expects.

CANopen Builder software is used to edit the motion control program for DVP10MC11T to achieve all kinds of complicate motion control tasks.

Its graphical motion control language provided to user to program on the motion control function is easy and convenient for user to learn and understand.

Besides, CANopen Builder provides the interfaces of G codes editing, preview and electronic cam editing for user to plan a more distinctive motion control demand.

With communication system adopting the highly reliable CAN bus as main line, DVP10MC11T just need provide the simple wiring to user.

Thanks to the high-speed and reliable motion control system, DVP10MC11T can be widely applied in the automation control industry such as packaging, printing, encapsulating, cutting, digital control machine, automatic storage and so on.

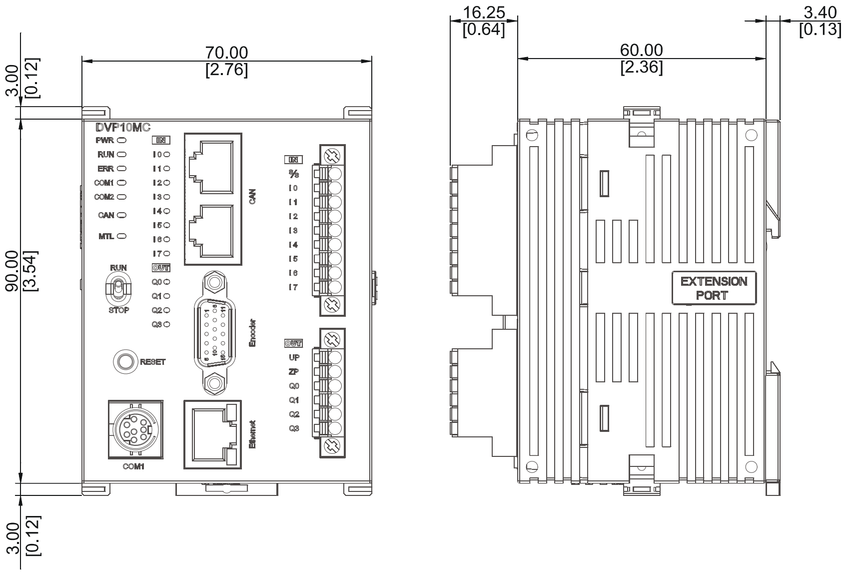
1.1. Function

The PLC module of DVP10MC11T resembles DVP-SX2 MPU. For the detailed function parameter information, please refer to Application Manual of DVP-ES2/EX2/SS2/SA2/SX2 (Programming). We focus on the main functions of DVP10MC11T below:

- Capable of controlling up to 16 real axes via (CANopen) high-speed bus (Axis No. range: 1~16)
- Virtual axes as well as the external encoder virtual master axis can be constructed in DVP10MC11T. (Axis No range: 1~18; the numbers of real and virtual axes must be different.)
- Equipped with the high-speed floating point processor for handling all kinds of complicate motion control tasks.
- Supporting powerful field bus network by serving as DeviceNet master/slave, CANopen master/slave and Profibus-DP slave and also making up of the control system with complicate functions.
- It has many kinds of IO extensions (high-speed AIAO on the left, low-speed AIAO and DIDO on the right, temperature module and etc.)
- Using the software interface which is easy to operate with complete functions.
- Providing the accessory products such as standard bus cables, terminal resistor and terminal block to wire the circuit easily just by plugging. So users do not need to prepare for them additionally by themselves.

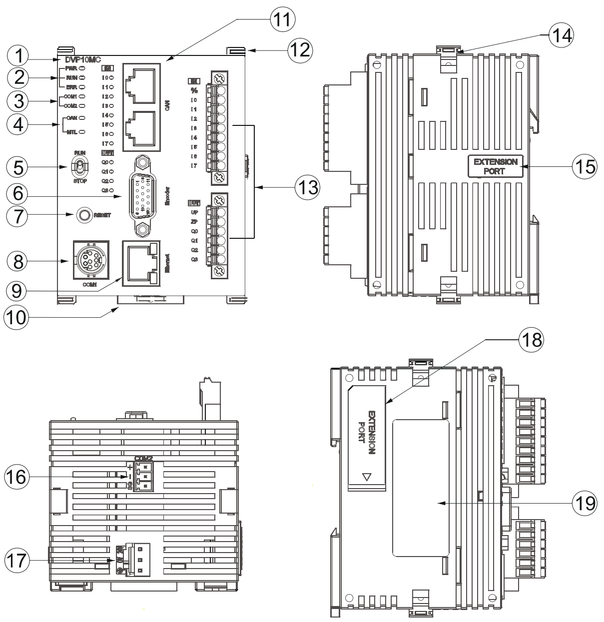
1.2. Profile and Outline

1.2.1. Dimension



Unit: mm [in.]

1.2.2. Components



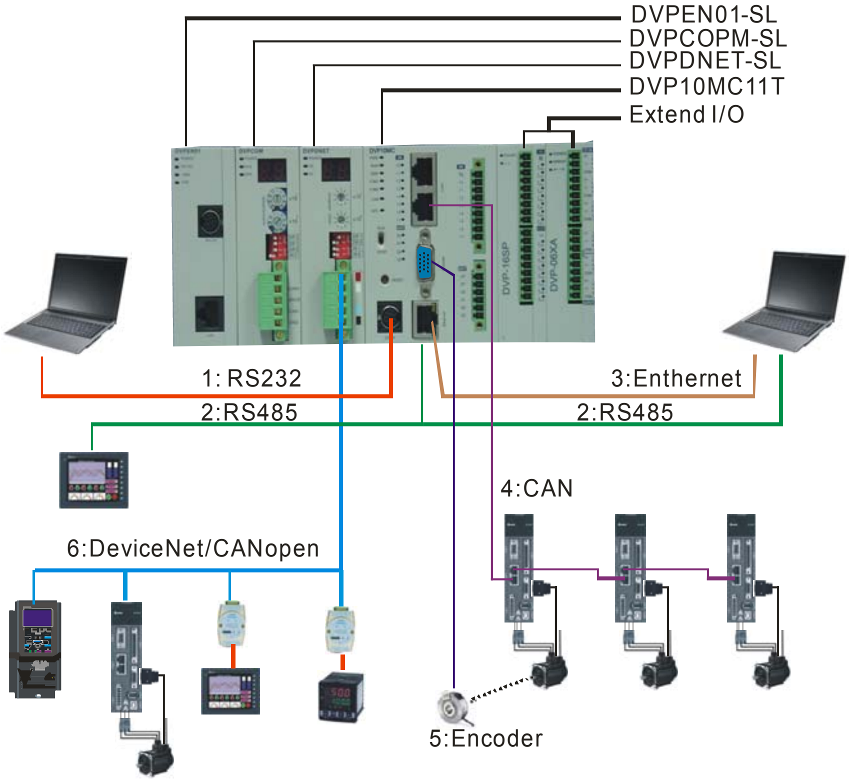
1	Model name
2	POWER /RUN /ERR indicator
3	COM1 /COM2 communication indicator
4	CAN, MTL indicator
5	RUN/STOP switch
6	Encoder interface
7	RESET button
8	COM1 communication port
9	Ethernet communication port
10	DIN rail clip
11	CANopen communication port
12	Clip for fixing extension module
13	Input/Output terminals
14	Clip for fixing extension module
15	Extension port on the right side
16	COM2 communication port
17	24V power interface
18	Extension port on the left side
19	Nameplate

2. Introduction to System Function

DVP10MC11T is a high-performance controller in charge of 1~ 16 real axes and max. 18 virtual axes with the application functions like gear box, cam, rotary cut, flying shear. With a standard PLC module inside it, DVP10MC11T supports the functions of PLC and can be extended with the DeviceNet module, CANopen module, Ethernet module, high-speed analog-quantity module on its left side and all Slim series of modules with analog quantity and digital quantity on its right side. In addition, DVP10MC11T provides the standard RS232, RS485 communication port, CANopen bus interface, Ethernet interface, encoder interface so that user could handily construct a motion control network with powerful functions.

2.1. System Architecture

DVP10MC11T can be applied to the construction of a multi-layer industrial network. In the following figure, the top layer is the network constituted by Ethernet, the middle layer is the network made up of CAN bus supporting DeviceNet and CANopen protocol, the bottom layer is the network consisting of 485 bus supporting Modbus.



The figure above displays the external equipment connected to each port of DVP10MC11T. The following sections will introduce the functions of each communication port.

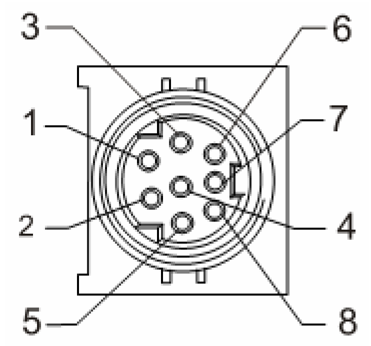
2.1.1. COM Port

■ **COM1（RS-232）**

COM1, RS-232 communication port possessed by PLC module, supports Modbus protocol and could serve as Modbus master (supporting MODRW, RS instructions) or slave to upload and download programs, monitor PLC device, and connect human-machine interface and etc.

COM1 Pin Definition:

Pin	Signal	Description
1, 2	+5V	5V power positive pole
3	GND	Grounding
4	Rx	Receiving data
5	TX	Sending data
6	GND	Grounding
7	NC	Reserved
8	GND	Grounding

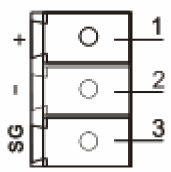


■ **COM2（RS-485）**

COM2, RS-485 communication port supporting Modbus protocol, is the hardware port commonly used by motion control module and PLC. The motion control module or PLC can be accessed through different node ID. Their node ID must be different with each other. If COM2 is used by PLC, 10MC could be regarded as Modbus master or slave. If COM2 is used by motion control module, 10MC could only serve as Modbus slave to download CANopen motion control network configuration, program, G-codes and monitor devices.

COM2 Pin Definition:

Pin	Signal	Description
1	+	Signal+
2	_	Signal-
3	SG	Grounding

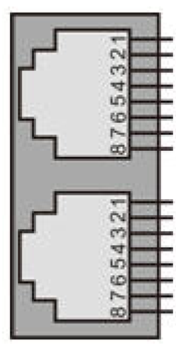


Note: Please refer to appendix A for more details on Modbus.

■ **CANopen Bus Interface**

There are two RJ45 ports for CANopen bus interface and the standard CAN communication cable (TAP-CB03/TAP-CB05/TAP-CB10) is needed for user to create a reliable motion control network conveniently and quickly. CAN bus need be added with two terminal resistors in its two terminals to constitute the network and Delta supplies the standard terminal resistance module (TAP-TR01). There are two terminal resistors enclosed in the package of 10MC product.

Pin	Signal	Explanation
1	CAN_H	Signal+
2	CAN_L	Signal-
3	CAN_GND	Grounding
4	RESE_1	Reserved
5	RESE_2	Reserved
6	CAN_SHLD	Shielded cable
7	CAN_GND	Grounding
8	RESE_3	Reserved



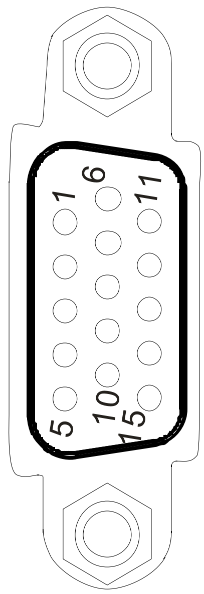
Note: DVP10MC11T provides two RJ45-type CAN port to make a daisy-chain topological structure in the two ends of the bus. One of RJ45 ports is left for connection of terminal resistor.

■ Encoder Interface

The encoder interface is a 15-pin D-SUB connector connected to the external encoder.

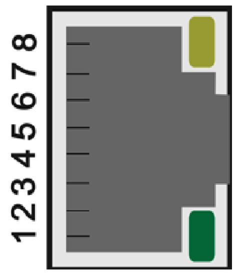
It supports differential signal input with max work frequency 1MHz (250Kx 4 = 1MHz for per input). Meanwhile, this interface integrates two kinds of power output: 24V（500mA）and 5V（500mA) to supply the power to encoder. And thus users do not need to prepare power for encoder additionally.

User could read D6513 (H9971) in motion control module to check the pulse number that encoder receives through sending Modbus instruction and also could create virtual master axis by using DMC-ExternalMaster instruction in motion program. Rotation of slave axis can be controlled by using encoder to receive the pulse number.

Terminal No.	Definition	Explanation	15-Pin SUB-D figure
1	A+	Differential signal of Incremental encoder	
2	A-		
10	B+		
11	B-		
4	Z+		
5	Z-		
7	+24V	+24V encoder power	
8	GND	Grounding for +24V and +5V	
15	+5V	+5V encoder power	
3	Reserved	Reserved	
6	Reserved	Reserved	
9	Reserved	Reserved	
12	Reserved	Reserved	
13	Reserved	Reserved	
14	Reserved	Reserved	

■ Ethernet communication port

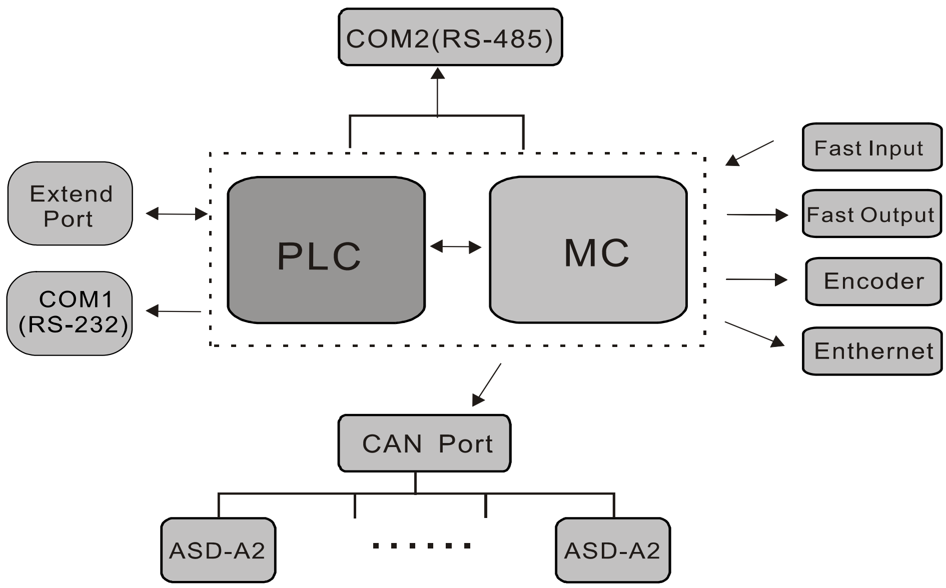
Ethernet communication port supporting Modbus TCP protocol is possessed by motion control module. CANopen Builder in the PC can download CANopen network configuration, motion control program, cam curves and G codes and also can monitor devices via Ethernet communication port. DVP10MC11T only serves as slave and could be accessed by maximum 4 masters in Ethernet network. Ethernet communication port supports auto jumper function. It can be directly connected to computer or switchboard without specially handling wire jumper. The LED indicator in the communication port displays Ethernet current connection status so that user can judge the connection status quickly accordingly.

Terminal No.	Definition	Explanation	RJ -45 figure
1	Tx+	Positve pole for transmitting data	
2	Tx-	Negative pole for transmitting data	
3	Rx+	Positve pole for receiving data	
4	--	N/C	
5	--	N/C	
6	Rx-	Negative pole for receiving data	
7	--	N/C	
8	--	N/C	

Note: Modbus TCP can be referred to in appendix B.

2.1.2. System Construction Structure

DVP10MC11T consists of two function modules: PLC module and MC motion control module. PLC module is similar to Delta DVP-SX2 MPU and motion control module supports motion control function based on CANopen. The two modules utilize the independent processor to process the complicate motion control task and a large quantity of logic operation in parallel to enhance the work efficiency.
Illustration of the internal structure of DVP10MC11T:



PLC Module

The PLC module built in DVP10MC11T is identical to DVP series of PLC products. User could utilize the WPLSoft or ISPSoft software to edit the program, conduct the monitoring and make a connection with the left and right I/O extension and etc. The following is its functions.

- CPU specification: 32- bit CPU with the built-in instruction for 32-bit multiplication and division operation.
- In terms of program capacity, devices and instructions
  - Compatible with SX2/ES2/EX2 MPU series of programs; program space: Max 16K Step
  - Fast-speed execution of instruction (Basic instruction: 0.35us～1us, MOV instruction< 5us)
  - The application instruction library is identical to SX2/ ES2/EX2 series
  - Max 10000 D devices and 2112 latched areas.
- Communication devices
  - COM1（RS232）communication port
  - COM2（RS485）communication port
  - Run/Stop switch can control the program to run or stop
- Extension module
  - Max 7 high-speed extension modules in the left side and 8 extension modules in the right are available
  - The temperature modules like PT/TC supports the function of automatic adjustment of PID temperature
  - Max 240 input points and 240 output points for digital extension module.
- Other functions
  - Providing user with the special identification code, subprogram password protection and the limit of the time for inputting the wrong main password
  - The built-in DELTA Q-Link communication protocol expedites to refresh HMI screen.
  - For more details on the functions of PLC modules, please refer to the operating manuals (Programming) of DVP-ES2/EX2/SS2/SA2/SX2.

MC Motion Control Module

The MC motion control module in DVP10MC11T controls the servo drive to complete the high-speed, precise and high-efficiency control task via CANopen bus. DVP10MC11T makes the complicate CANopen communication packaged and users do not need to know CANopen communication principle except to do the simple setting and edit the motion control program through CANopen Builder software to accomplish the complicate motion control. Therefore, it saves a lot of time for user to learn and shortens the lead time to develop products and speeds up the products to be marketed

The major functions of the motion control module of DVP10MC11T are listed below.

- Supporting motion control instructions
  - Logical instruction
  - Single-axis motion instruction
  - Multi-axis motion instruction
  - Typical application instruction
- High-speed input point and output point
  - Supporting 8 high-speed digital input points (I0~I7) with interruption function
  - Supporting 4 high-speed digital output points (Q0~Q3)

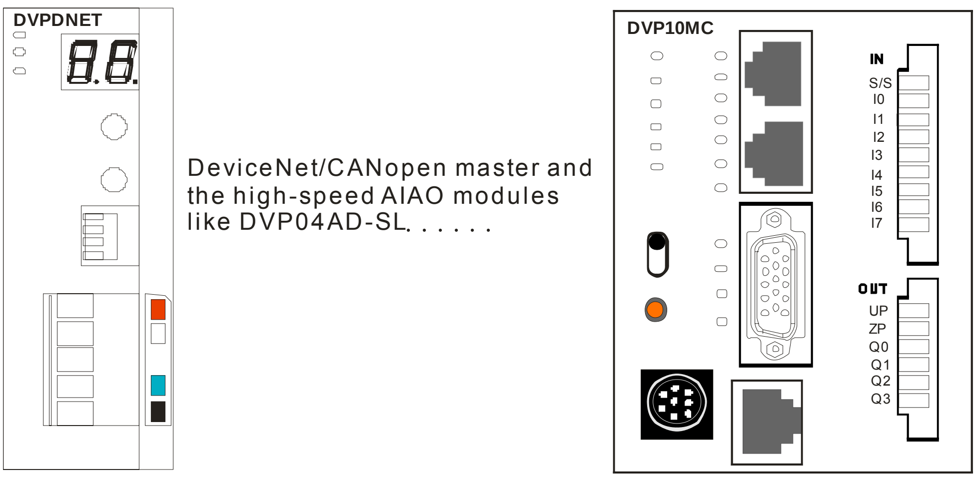
- Supporting G code
  - Supporting standard G code and supporting the dynamic download of G code; G code is executed while being downloaded in order to accomplish the complicate objects processing.
  - Capable to debug the G code in the way of a single step or fixed point through CANopen Builder software
  - CANopen Builder software provides the function of preview of G codes so that user could conveniently judge if the input G codes are correct or not.
- Supporting electronic CAM
  - Supporting to call the specified cam curve through CANopen Builder software so as to edit the cam curve.
  - Supporting the application instruction of typical technology such as rotary cutting, flying shear. Users do not program the cam curve except to input the crucial technological parameters so that the cam curve will be reflected automatically in the inner of the instruction. And thus it will reduce a lot of work load for user to develop the project.
- Supporting E-gear
- Program capacity
  - Providing max 1M bytes for the program space, max 12K Fbs program editable
  - Max 6000 rows of G codes storable.
  - Max 16 electronic cam curves editable and max 2048 key points storable.

2.1.3. System Extension

DVP10MC11T can be connected with extension modules on both its left side and right side.

- **The extension module connected to the left side of DVP10MC11T**

DVP10MC11T can be connected with CANopen, DeviceNet master and high-speed modules with analog quantity like DVP04AD-SL on its left side. Max 7 high-speed modules are allowed to connect to the left side of DVP10MC11T.



- **The extension module connected to the right side of DVP10MC11T**

DVP10MC11T can also be connected with all Slim series of extension modules with the digital quantity of max. 240 input points and 240 output points in its right side. Besides, max 8 special modules with non-digital quantity such as analog-quantity module, temperature module, pulse module and etc. can be connected to the right side of DVP10MC11T.

The number of digital input/ output point is reflected with X and Y and the functions are as follows.

■ The number of input/ output point: (Octal)

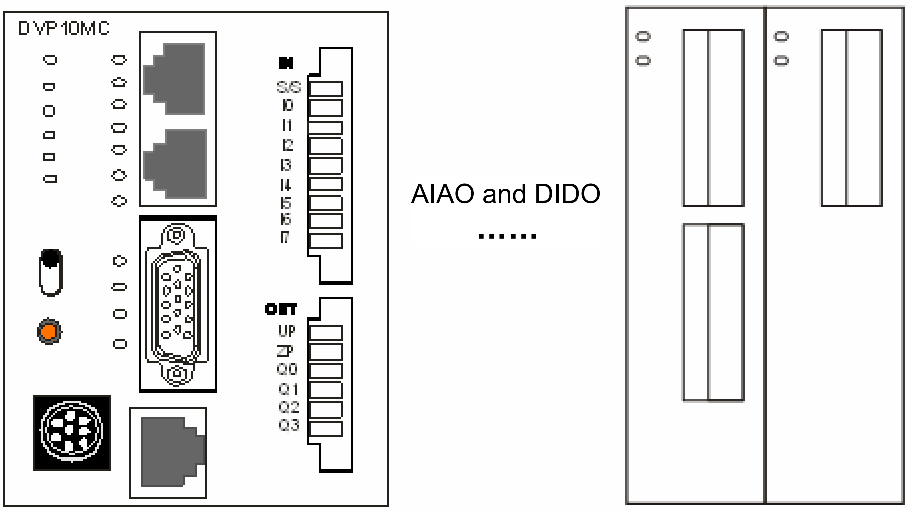
X20 ~ X27......, X70 ~ X77, X100 ~ X107...

Y20 ~ Y27......, Y70 ~ Y77, Y100 ~ Y107...

Note: The number of digital points of the digital-quantity extension module on the right of DVP10MC11T starts from 20. Suppose that the input point for the first digital-quantity extension module starts from X20 and output point starts from Y20. The numbers of input point and output point are added by 8’s multiple; it is counted as 8 points if the number is less than 8.

■ The number of special modules

The extension modules on the right side of DVP10MC11T like analog-quantity module, temperature module and pulse module are called special modules. The number of the first special module on the right side of 10MC is 0; the number of the second one is 1, and so on. PLC module could access the special module according to such serial number through executing FROM/TO instruction.



2.2. The internal devices

2.2.1. The internal devices of PLC module

See appendix E on the internal devices of PLC in DVP10MC11T

2.2.2. The internal devices of MC motion control module

The internal devices of motion control module in DVP10MC11T:

Type	Device	Data type	Device name	Range	Modbus address
High-speed input	I	BOOL	High-speed external input point	I0~I7	0400~0407
High-speed output	Q	BOOL	High-speed external output point	Q0~Q3	0500~0503
Auxiliary relay	M	BOOL	Auxiliary relay	M0~M1535	0800~0DFF
				M1536~M4095	B000~B9FF
General register	D	WORD	Data register	D0~D4095	1000~1FFF
				D4096~5999	9000~976F
				D7000~D24575	9B58~DFFF
Special register	D	WORD	GPIO register	D6000~D6226	9770~9852
	D	WORD		D6250~D6476	986A~994C
	D	WORD	Special data register	D6500~D6518	9964~9976
	D	WORD	Axis parameter register	D24576~D28671	E000~EFFF
	D	WORD	CAM key point register	D28672~D45055	2000~5FFF

Note: Please refer to appendix C for the explanation of the corresponding content of axis parameter register.

■ **Special register**

The special data register of motion control module of DVP10MC11T has its special functions as shown below.

Special D	Function explanation	Attribute	Data type	latched	Remark
D6000 … D6226	The area of data exchange between PLC and MC	PLC: R MC: R/W	UINT	N	This area is for data exchange between PLC and MC, MC writes the data into this area and PLC reads the data in this area.

Special D	Function explanation	Attribute	Data type	latched	Remark
D6250 … D6476	The area of data exchange between PLC and MC	PLC: R/W MC: R	UINT	N	This area is for data exchange between PLC and MC, PLC writes the data into this area and MC reads the data in this area.
D6500	Current scanning time for DVP10MC(unit: us)	R	UINT	N	The time needed for motion control program to scan the last time.
D6501	Max. scanning time for DVP10MC (unit: us)	R	UINT	N	Max. time needed for motion control program to scan once.
D6502	The major revision of DVP10MC firmware	R	UINT	N	It is in hexadecimal. The part to the left of decimal point is high byte and the part to the right of decimal point is low byte. If the read value is 0101H, it means the current major firmware is V1.01 revision.
D6503	The minor revision of DVP10MC firmware	R	UINT	Y	It is in hexadecimal. The part to the left of hexadecimal point is high byte and the part to the right of hexadecimal point is low byte. If the read value is 0101H, it means the current min firmware is V1.01 revision.
D6504	Firmware revision of PLC module	R	UINT	Y	Firmware revision of 10MC PLC module
D6505	The exchanged data length when MC => PLC (unit: word)	R	UINT	Y	The length of the data written to PLC by MC with word as its unit.
D6506	The exchanged data length when PLC => MC (unit: word)	R	UINT	Y	The length of the data written to MC by PLC with word as its unit.
D6507	The check code of exchanged data when MC => PLC	R	UINT	N	The check code of the data which MC writes to PLC.

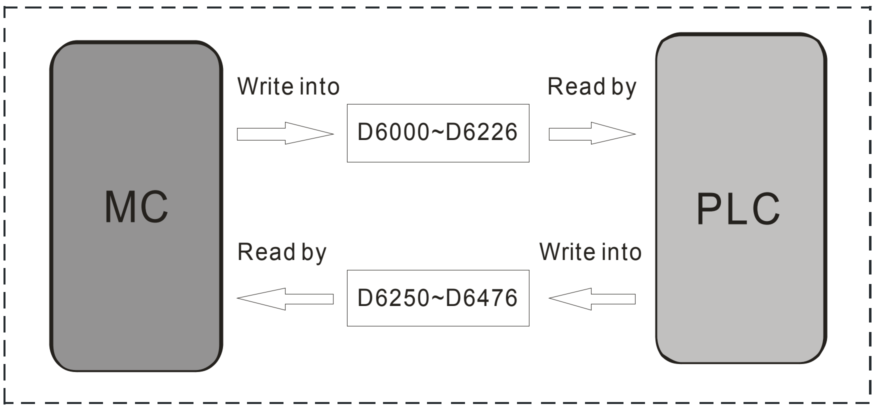
Special D	Function explanation	Attribute	Data type	latched	Remark
D6508	The check code of exchanged data when PLC => MC	R	UINT	N	The check code of the data which PLC writes to MC.
D6509	Setting of RUN/STOP switch	R/W	UINT	N	1. When D6509 value = 0 RUN/STOP switch is disabled. 2. When D6509 value = 1, RUN/STOP switch is enabled.
D6511	Low word of DVP10MC status word	R	UINT	N	Status word of MC module
D6512	High word of DVP10MC status word	R	UINT	N	
D6513	Low word of feedback pulse number of the encoder	R	UDINT	N	Feedback pulse number of the encoder
D6514	High word of feedback pulse number of the encoder				
6515	Motion program RUN/STOP and system reset	R/W	UINT	N	7: Program is being executed. 0: Execution of program stops 16: System reset which is equivalent to that 10MC is powered on again. When the motion control program of 10MC is running, write 0 to D6515 to stop the program being executed. Afterwards, the motion control program can not be executed again unless 7 is written to D6515 after pressing the Reset key.

Special D	Function explanation	Attribute	Data type	latched	Remark
D6516	Communication ID and communication format of DVP10MC11T	R/W	UINT	Y	b3~b0=0000: 7,E,1,ASCII b3~b0=0001: 7,O,1,ASCII b3~b0=0010: 7,N,1,ASCII b3~b0=0100: 8,N,2,RTU b7~b4=0000: 9600bps b7~b4=0001: 19200bps b7~b4=0010: 38400bps b7~b4=0011: 57600bps b7~b4=0100: 115200bps b15~b8 are used to set the modbus node ID, e.g. b15~b8=00000001which indicates that modbus node ID is 1, likewise other modbus node ID are named in the same way. Note: b stands for bit.
D6517	Current scan time for logical program （Unit: us）	R	UINT	N	The time needed for the logical program to carry out scanning currently.
D6518	Max. scan time for logical program （Unit: us）	R	UINT	N	The maximum time needed for the logical program to scan one time.
D6519	Setting of the quantitiy of D device in the latched area	R/W	UINT	Y	The start D device in the latched area is D7000; the quantity is specified by D6519; range: 0~3000.
D6520	Setting of the quantitiy of M device in the latched area	R/W	UINT	Y	The start M device in the latched area is M3000; the quantity is specified by D6520; range: 0~1000
D6527	The pulse number that servo motor feeds back to servo drive	R	DINT	N	When DMC_ CapturePosition is used for position capture in mode 1, the value of D6527 is the pulse number that servo motor feeds back to servo drive.

Special D	Function explanation	Attribute	Data type	latched	Remark
D6529	The pulse number received at the interface of the encoder	R	DINT	N	When DMC_ CapturePosition uses I0 for position capture in mode 10, the value of D6529 is the pulse number received at the interface of the encoder of 10MC.
D6532	Axis alarm detection	R/W	UINT	N	0: Axis alarm is not detected. The instructions related with the alarm axis can still be executed when the axis alarms. 1: When the axis alarms, the alarm axis enters the state of ErrorStop and the motion instructions related with the alarm axis stops being executed.

Note: The areas for exchanging the data between MC and PLC are D6000~D6226, D6250~D6476. D6000~D6226 are where MC writes the data and PLC reads the value of the register; D6250~D6476 are where PLC writes the data and MC reads the value of the register.

The principle figure is displayed below.



■ Status word in DVP10MC

D6511 and D6512 are the status words of MC module and the following is the specific explanation:

Bit Device	The implication when each bit in D6511 is 1	How to deal with
Bit0	DVP10MC11T is in error mode, motion control program is terminated by accident.	Press RESET button to restart DVP10MC11T
Bit1	DVP10MC11T is in mode of configuration and the configuration data is being downloaded.	No need of action but wait the download is finished and then 10MC will automatically restore to run.
Bit2	Node list is empty and slave has not been configured.	Redownload the configuration data to the controller after the network is configured through CANopen Builder software.
Bit3	The configuration that the upper computer downloads is invalid	Check if the configured data is wrong and redownload after revising configuration.
Bit4	Buffer area sending data is full	1. Check if CANopen bus connection is normal 2. Check if the baud rate of CANopen bus master is identical to that of slave. 3. Check if the two ends of CANopen bus have been connected with terminal resistors.
Bit5	Buffer area receiving data is full	1. Check if CANopen bus connection is normal 2. Check if the baud rate of CANopen bus master is identical to that of slave 3. Check if the two ends of CANopen bus have been connected with terminal resistors.
Bit6	Power supply for DVP10MC11T is insufficient.	Check if power supply for DVP10MC11T is normal.
Bit7	Internal storage operation error	Repower on; return to factory for repair if the error still exists
Bit8	GPIO operation error	Repower on; return to factory for repair if the error still exists
Bit9	SRAM operation error	Repower on; return to factory for repair if the error still exists
Bit10	Some slave in CANopen network is offline	Check if CANopen bus connection is normal.
Bit11	The program in MC is running.	--
Bit12	The synchronous cycle set is too small	Enlarge the synchronous cycle.
Bit13～Bit15	Reserved	Reserved

Note: D6512 is reserved for further development in the near future.

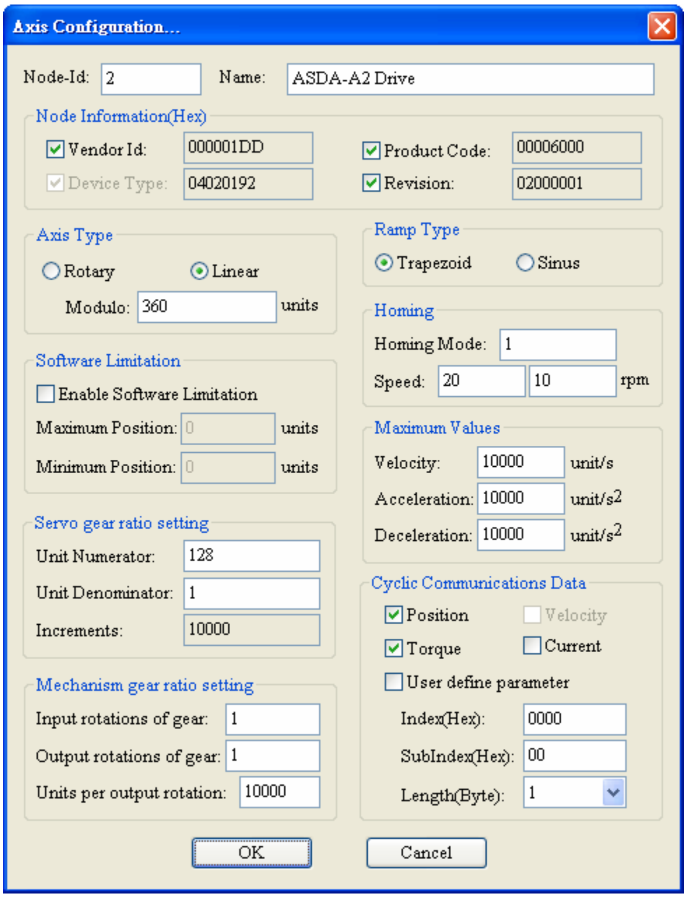
2.3. System Work Principle

2.3.1. Axis Parameter Setting

MC function module in DVP10MC11T is mainly applied to control over drive axis. Therefore, the setting of parameter of every drive axis is very crucial and the following is the main parameters to be set up.

- Node ID: axis number (which is the node address of servo drive in CANopen network);
- Axis Type: Linear, Rotary;
- Ramp Type: To set the feature type in the process in which axis increases and decreases speed
- Software Limitation: To limit the maximum and minimum position of motion controller;
- Servo Gear Ratio Setting: The ratio decides how many units are needed for one circle the axis rotates;
- Homing: It is used to set the mode and speed for homing;
- Maximum Value: To set the max. velocity, acceleration and deceleration of the axis;
- Cyclic communication data: To specify the servo drive parameters to be read by 10MC
- Axis parameters are mainly used for setting the feature of the axis and the setting could be completed in the CANopen Builder software. The newly set axis parameters will be effective only after they are downloaded to DVP10MC11T

■ **Axis Parameter Configuration**



■ **Description of Axis Parameter:**

Serial No	Parameter Name	Function	Data Type	Default Value
1	Node-ID	Axis number; range:1-16	UINT	-

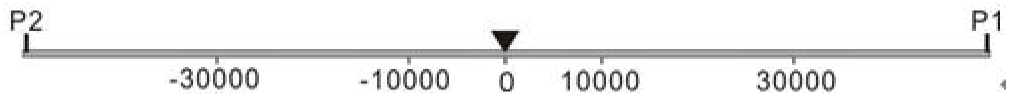
"Node-ID" is the CANopen node address of servo drive.

Serial No	Parameter Name	Function	Data Type	Default Value
2	Name	Axis name	String	-

"Name" is the word commented on servo drive by software, which is only used for naming the servo drive without actual meaning.

Serial No	Parameter Name	Function	Data Type	Default Value
3	Axis type	Axis type: linear axis/ rotary axis	-	Rotary axis

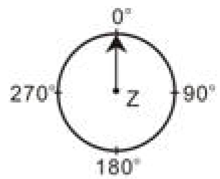
Linear Axis:

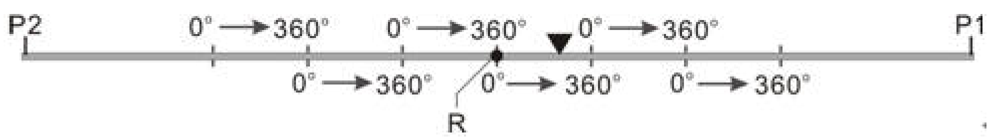


Notes for Linear Axis Model:

P1	Positive Limit
P2	Negative Limit
▼	Servo Position

Rotary Axis :





Rotary Axis Mode（"Modulo": 360）can not see the photo

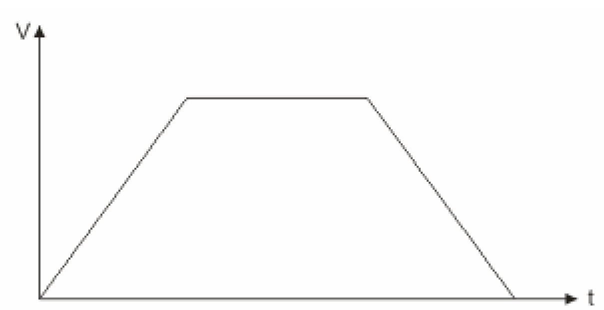
Notes for Rotary Axis Mode:

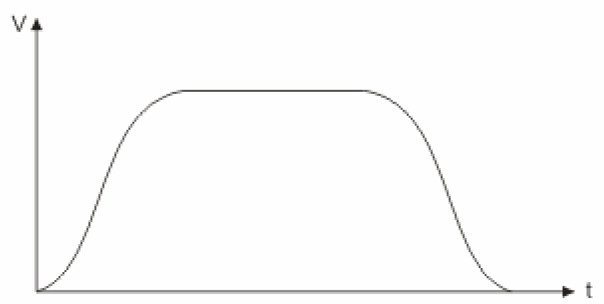
P1	Positive Limit
P2	Negative Limit
▼	Servo Position
R	Home Position
Z	Axis of servo motor

Difference between linear axis and rotary axis

The rotary axis regards modulo as its cycle, which is the difference between linear axis and rotary axis. The position of terminal actuator of linear axis is 500 and the corresponding position of rotary axis is 140 which is the remainder of 500 divided by modulo (360).

Serial No	Parameter Name	Function	Data Type	Default Value
4	Modulo	The cycle used for equally dividing the actual position of the terminal actuator.	REAL	360

<table>
<tr><th>Serial No</th><th>Parameter Name</th><th>Function</th><th>Data Type</th><th>Default Value</th></tr>
<tr><td>5</td><td>Software Limitation</td><td>Enable software limitation;
If it item is not selected, The maximum/ minimum position of axis which software limits is invalid.
If selected, the maximum/ minimum position of axis limited by software is valid.</td><td>BOOL</td><td>0</td></tr>
<tr><td>6</td><td>Maximum Position</td><td>The max. position of axis limited by software</td><td>REAL</td><td>-</td></tr>
<tr><td>7</td><td>Minimum Position</td><td>The mini. position of axis limited by software</td><td>REAL</td><td>-</td></tr>
<tr><td>8</td><td>Acceleration Type</td><td>Trapezoid/Sinus</td><td>-</td><td>Trapezoid</td></tr>
<tr><td colspan="5">Servo motor presents the features in process of acceleration and deceleration while DVP10MC11T is controlling servo drive.
Trapezoid:


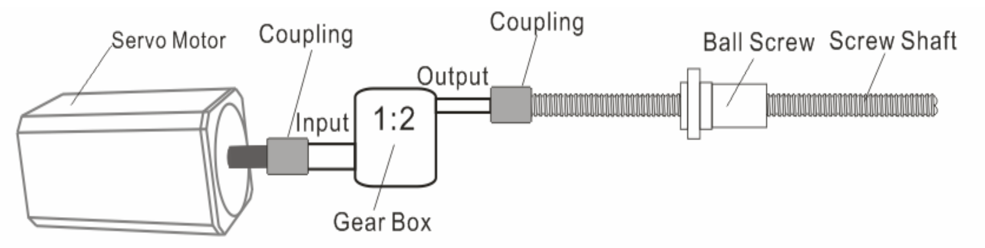
Sinus:

</td></tr>
<tr><td>9</td><td>Unit Numerator</td><td>To set the pulse quantity needed when motor rotates for one circle by adjusting unit numerator and the denominator.</td><td>UINT</td><td>128</td></tr>
<tr><td>10</td><td>Unit Denominator</td><td>To set the pulse quantity needed when motor rotates for one circle by adjusting unit numerator and the denominator.</td><td>UINT</td><td>1</td></tr>
<tr><td>11</td><td>Increment</td><td>How many pulses are needed when servo motor rotates for one circle.</td><td>UINT</td><td>10000</td></tr>
<tr><td colspan="5">Adjusting the Unit Numerator and Unit Denominator parameters is to set the electronic gear proportion of servo drive. Electronic gear proportion is to set how many pulses servo drive receives while servo motor rotates for a circle.
The resolution of A2 servo drive motor is 1280000 pulses/ circle;
Suppose the value of parameter 11 is N, N* (Unit Numerator/ Unit Denominator)=1280000</td></tr>
</table>

Serial No	Parameter Name	Function	Data Type	Default Value
12	Input rotations of gear	This parameter and Output rotations of gear decide the mechanism gear ratio.	UINT	1
13	Output rotations of gear	This parameter and Input rotations of gear decide the mechanism gear ratio.	UINT	1
14	Unit per output rotation	The corresponding position units which the terminal actuator moves while output end of the gear rotates for a circle.	UINT	10000

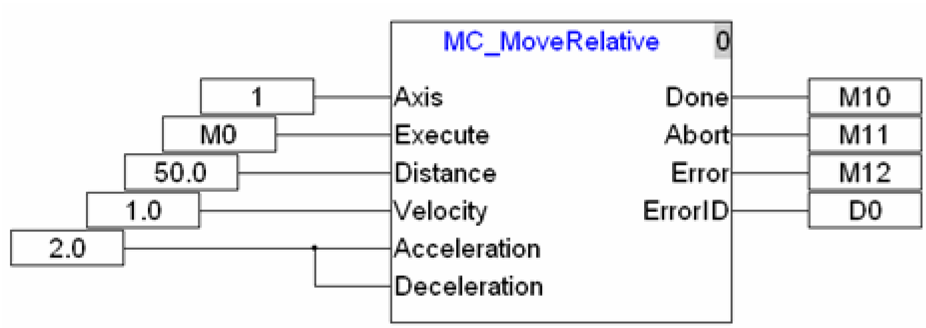
As illustrated below, Input rotation of gear =1, Output rotation of gear =2, it means the input mechanism of gear box rotates for one circle and the output mechanism of gear box rotates for 2 circles. “Unit per output rotation” represents the corresponding position (units) that ball screw moves while the output mechanism of gear box rotates for one circle.

E.g. If output mechanism of gear rotates for one circle and ball screw moves 1mm and "Unit per output rotation" is set to 1, through the relative position motion instruction the ball screw will move 1 unit, i.e. the ball screw will move 1mm;

If Unit per output rotation is set to 1000, the ball screw will move 1 unit through the relative position motion instruction, i.e. 1/1000mm actually. The unit of position in the motion control instruction, G codes and electronic cam is Unit.



As mentioned above, set Unit per output rotation to 1, the ball screw will move 50 mm at the speed of 1mm/s and acceleration of 2mm/ s2.



15	Homing Mode	Servo drive is set to homing mode; range: 1~ 35. See appendix D for more details.	UINT	1
16	The first-phase speed for homing	The speed from returning to zero point to finding the home switch;Unit: rpm, setting range: 1-2000 rpm	UDINT	20
	The second-phase speed for homing	The speed from finding the home switch to reaching the mechanical home;Unit: rpm, setting range: 1-500 rpm	UDINT	10
17	Max. Velocity	The available max. velocity; (Unit: unit)	REAL	10000
18	Max. Acceleration	The available max. acceleration; (Unit: unit)	REAL	10000

Serial No	Parameter Name	Function	Data Type	Default Value
19	Max.Deceleration	The available max. deceleration; (Unit: unit)	REAL	10000
Parameters 17~19 are used in the specific situation. E.g. The velocity, acceleration and deceleration of G0 in instruction CNC; the velocity, acceleration and deceleration at which slave enters the state of meshing with the master axis when Cam in; the velocity, acceleration and deceleration at which slave follows the master to move when Gear in.				
20	Position	The current position of servo drive (Unit: Pulse)	DINT	
21	Velocity	The current speed of servo drive (Unit: 0.1 rpm)	DINT	
22	Torque	The current torque of servo drive (Permille of the rated torque)	INT	
Above three parameters are used for setting DVP10MC11T to adjust PID of servo drive				
23	Current	The present current of servo drive (Permille of the rated current)	INT	
24	User defines parameter	Servo drive parameters customized by users		
"User defines parameter" is the servo drive parameter to be read. Its length is specified according to the data type of the read parameter. The byte parameter length is 1; the word parameter length is 2 and double-word parameter length is 4. The method of calculating sub-index and index of the servo drive parameter is shown below: Index= Servo drive parameter (Hex) + 2000 (Hex), Sub-index=0 For example: The index of servo drive parameter P6-10: 2000+060A (P6-10 hex.)=260A; sub-index: 0.				
Cyclic communication data can be selected by users. The data length selected can not exceed 8 bytes which can be calculated by computer automatically. The data length of position, speed, torque and current are 4 bytes, 4 bytes, 2 bytes and 2 bytes respectively. The current value of cyclic communication data selected by user can be read by the special registers related with axis. See appendix C for more details.				

2.3.2. Motion Program Execution Principle

DVP10MC11T consists of two function modules: PLC module and MC motion control module. To enhance the work efficiency, the two modules handle the logic tasks and motion control task respectively. User could edit the program for the PLC module through ISPSoft and WPLSoft software to achieve logic control function, while, to achieve motion control function, CANopen Builder software is necessary for programming.

The way of execution of motion control program is basically same as that for PLC program through three stages of input capture, program execution, output refresh. But motion control program is executed on basis of the synchronized cycle which is the cycle for updating the control and status data between motion controller and servo drive. In one synchronized cycle, motion controller needs to capture all data related with control program including the status data returning from servo drive, then to execute the motion program and finally output the data of operation result to each register and control data to all servo drives. All these actions have to be completed in one synchronized cycle.

When DVP10MC11T is connected with multi-servo drives, 10MC can achieve synchronization of multi-servo drives through sending out synchronous signals in the method of broadcast. Servo drives receive control data that 10MC sends out. These data are not effective immediately till the synchronous signals reach the servo drives to realize the synchronization of multi-servo drives.

As 2.2.1 figure is shown, 10MC is connected with 4 servo drives and T is the synchronized cycle. In the synchronized cycle, 4 servo drives receive the control data at different time (t1, t2, t3, t4) respectively but the control data do not get effective immediately. The control data will get effective while the servo drives receive the SYNC signals.

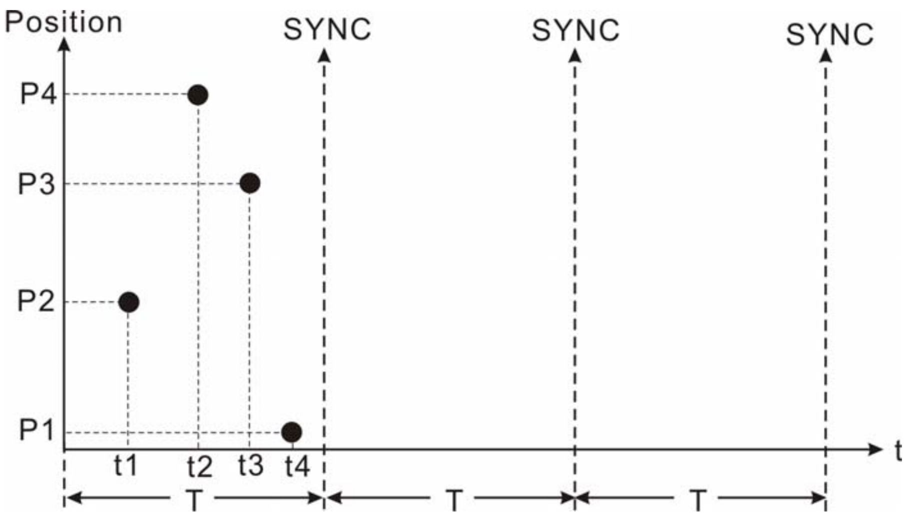


Figure 2.2.1

Figure 2.2.2 is an example of motion program (using MTL language). When motion control module detects M2=on in a synchronized cycle, MC_MoveAbsolute instruction starts to be executed. In this scan cycle, motion control module sends a piece of position control data to servo drive but M20 (Done bit) will not turn on. In the following several cycles, motion control module will constantly send the data to servo drives to control positions till the actual positions that servo drives feedbacks to motion control module approach the target position. At that time, “Done” bit M20=on and execution of MC_MoveAbsolute instruction is finished.

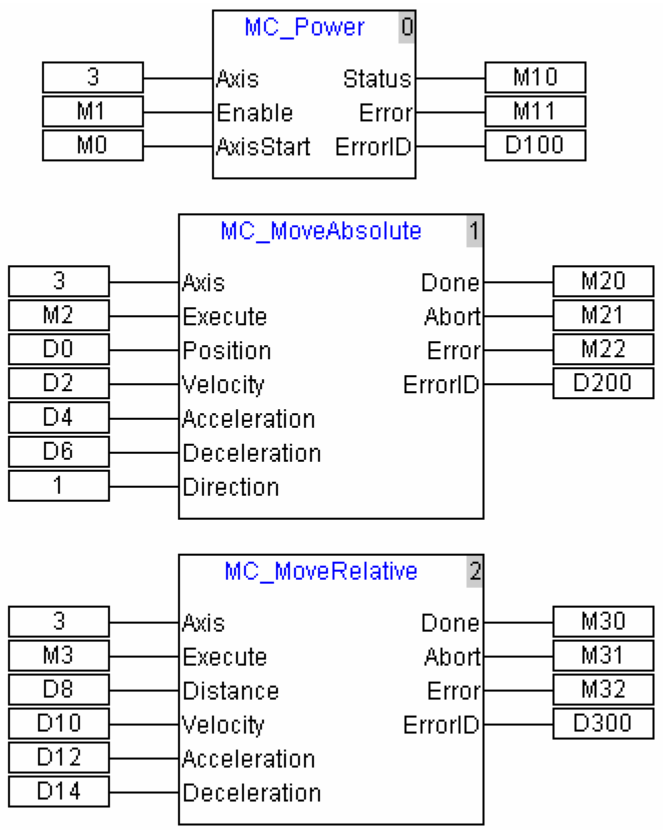


Figure 2.2.2 Motion control task list

In above figure, suppose MC_MoveAbsolute instruction is being executed but has not finished execution yet. At the moment, if M3=on is detected, the execution of MC_MoveAbsolute instruction will be terminated and MC_MoveRelative instruction starts executing. Meanwhile, Abort bit M21=on which indicates an accident occurs in MC_MoveAbsolute and so the instruction stops executing. The interrupted MC_MoveAbsolute will be always in stop status. MC_MoveAbsolute instruction can be executed again unless M2 turns Off → On once again.

2.3.3. CNC Function

DVP10MC11T, a multi-axis motion controller, supports the standard CNC function and can execute G codes dynamically and statically to achieve the simple numerical control of machine tool. Besides, it could also be applied to the occasions where G codes are used to locate and path planning.

CANopen Builder software provides CNC G code editing function; user could edit G codes in the CNC editor or import the G codes switched by other design software into this editor. When G codes are input in the code list, the two-dimension chart of G codes is output in the preview window.

The software interface of CNC editor is shown as figure 2.3.1

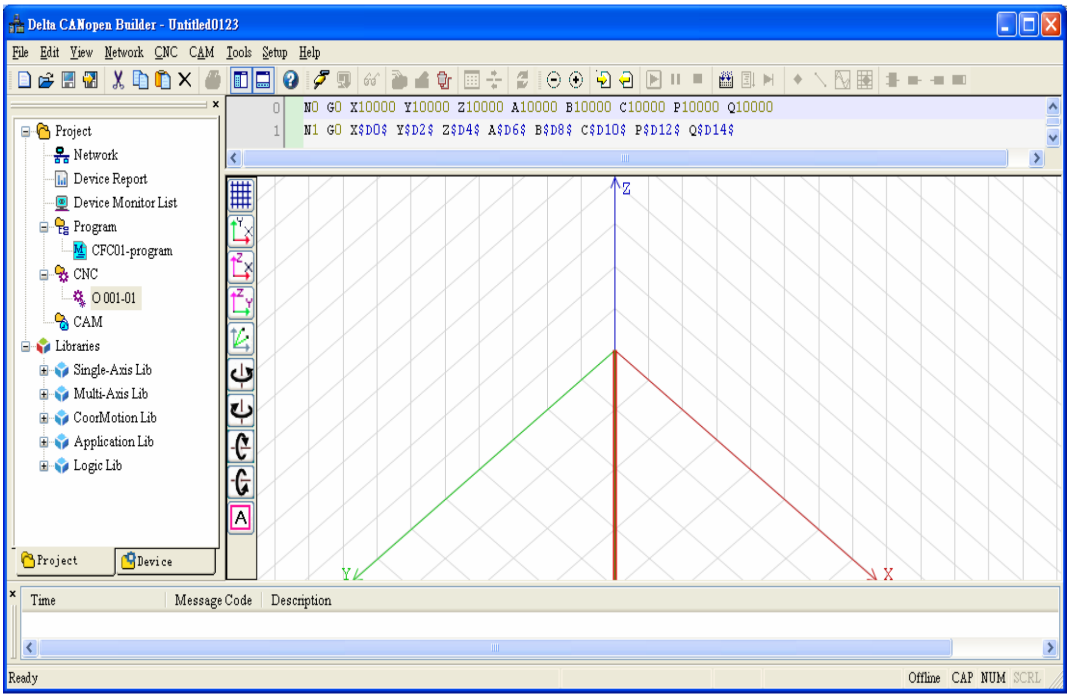


Figure 2.3.1

DVP10MC11T could execute G codes in two ways. One is the way of statically downloading all G codes to controller for run. The other one is dynamic way. When complicate objects are processed, the quantity of G codes needed is quite huge and so the controller could not store all G codes. Then the dynamic way is adopted and the G codes could be executed while being downloaded. DVP10MC11T provides the buffer area which could store 100 rows of G codes to store the G codes the upper computer sends. In way of dynamic download, the G codes the upper computer sends will not be stored and will be dumped after they are executed. If the G codes downloaded need be latched when power off, user should adopt the way of static download.

After G code editing is finished, it should be called for use in the motion control program. NC document is called for use via DMC_NC in motion control program. The usage of DMC_NC can be seen in the relevant instruction introduction. The input parameter NcTableID is to choose the NC document number to be executed. CMC editor could edit 8 NC documents at the same time.

If user wants to execute G codes in dynamic way, the current chosen NC document number should be set to 0. At this moment, the controller will wait the upper computer to send G codes and the G codes will be executed while being sent.

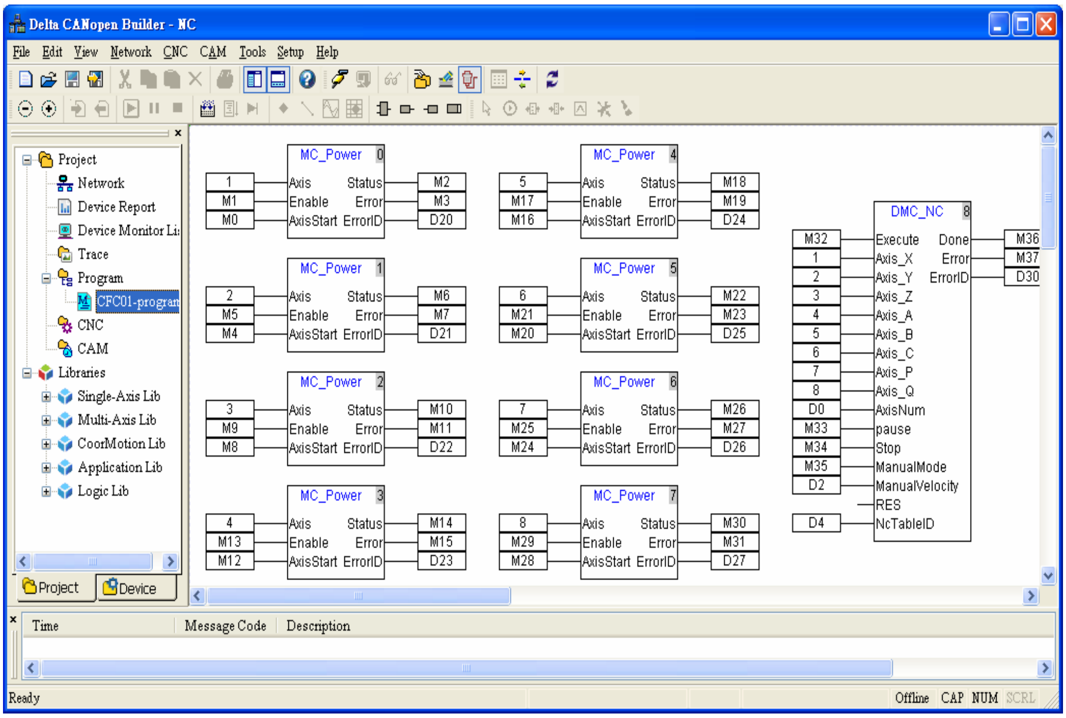


Figure 2.3.2

CNC editor provides the function of debugging of the current G codes so that user only need preset the target position of the G codes to be executed. Also, CNC editor can provide the function of one single -step execution of the current G-code document to ensure the correctness of debugging of G codes.

2.3.3.1. CNC Program Downloading and Debugging

When users use the motion control program to call CNC program, the value: 0 of parameter NcTableID of DMC_NC indicates to download CNC program in dynamic way. CANopen Builder provides the following tools for downloading and debugging

: Start to download dynamically CNC program which will be executed after controller receives the first program.

: Make the current CNC program run and stop at the place selected by cursor, which is convenient for user to debug the current CNC program.

: Single -step execution of CNC program; execute one row every time and when the current row of program is executed, it will be displayed in yellow.

2.3.3.2. The Protocol for Dynamic Download of CNC Program

DVP10MC11T supports the open protocol for download of CNC program. User could autonomously develop the process software in PC end to produce G codes and dynamically download the codes to DVP10MC11T for execution.

2.3.3.3. Message Format

The following is the format of the Modbus packet of CNC program downloaded dynamically.

Request message format:

0	1	2…n-1	n…n+1
Address	Function Code 0x7A]	G-Code string	Parity

Address: The communication node ID of DVP10MC11T, default: 02

Function Code: Function code, 0x7A indicates to download CNC programs dynamically.

G-Code String: A complete row of CNC program character string presented in ASCII code value with the symbol of “Enter” in the end.

For instance, suppose that the address of DVP10MC11T is 02, the G code character string to be download is N00 G00 X10.0 Y10.0.

The request message (Hex) will be 027A4E303020473030205831302E30205931302E300D8E57

Explanation of message:

027A: Node ID and function code

4E303020: N00 [A blank space]

47303020: G00 [A blank space]

5831302E3020: X10.0 [A blank space]

5931302E300D: Y10.0 [A blank space]

8E57: CRC parity

Response message format:

0	1	2	3-4
Address	Function Code [0x7A]	ResposeCode	Parity

Address: The node ID of DVP10MC11T, default :02.

Function Code: Function code, 0x7A indicates to download CNC program dynamically.

Response Code:

00	Illegal function code
01	Success
02	In process of transmission
04	Illegal command
05	Time-out
06	Illegal length of the message received
07	Equipment is busy
08	The buffer area receiving data is full

2.3.4. CAM Function

CAM is a component with curve profile or grooves. It transmits the motion to the follower near its edge and the rack will turn around periodically following the follower. CAM mechanism consists of CAM, follower and rack. The following figure is the profile chart of CAM made up of point A, B, C, and D. AB' is a follower which is connected to rack. δ4 is an inner angle of repose; δ2 is an external angle of repose. The radius of base circle is r0 and S is the diagram of CAM.

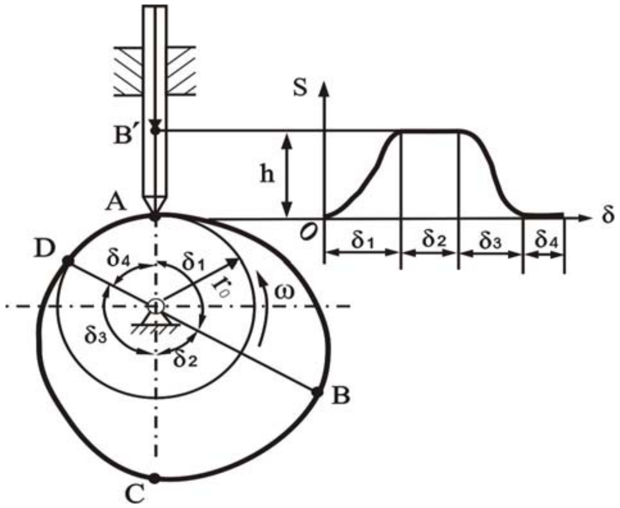


Figure 2.3.3

Electronic CAM is analog CAM of mechanical CAM by means of applying computer technology. Compared with mechanical CAM, Electronic CAM has many advantages of being easy to design and modify; cost saving; higher efficiency and preciseness. Because electronic CAM is analog CAM, these defects of mechanical CAM like being easy to be damaged and not fit for high-speed rotation and transmission can be avoided for electronic CAM.

DVP10MC11T controller supports the function of electronic CAM. User can edit the CAM curve in the CAM editor provided by CANopen Builder as follows.

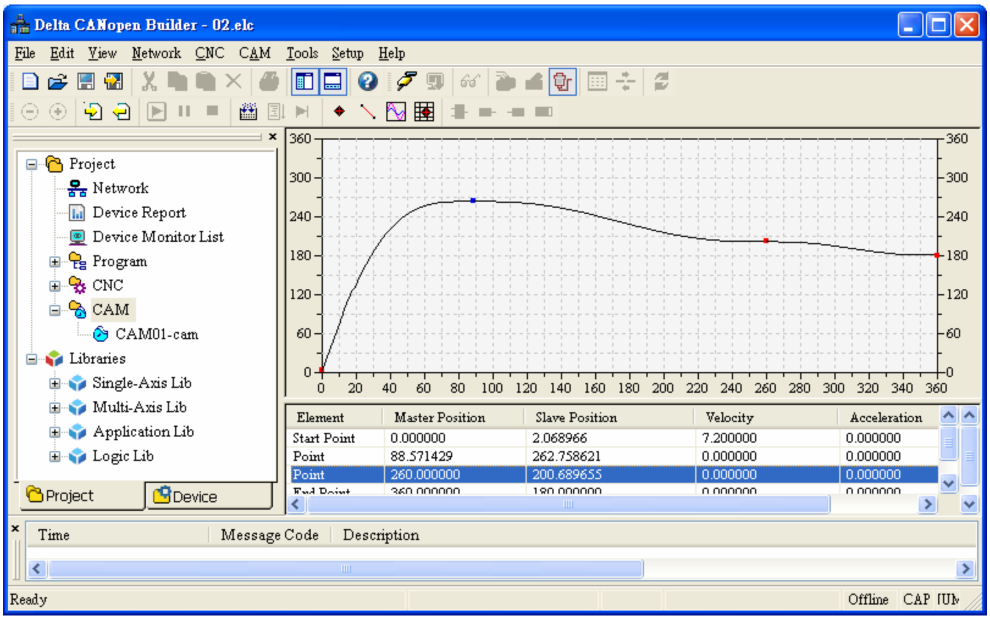


Figure 2.3.4

After CAM curve is finished editing, it should be called for use in the motion control program where MC_CamTableSelect and MC_CamIn are included together as figure 2.3.5 shows.

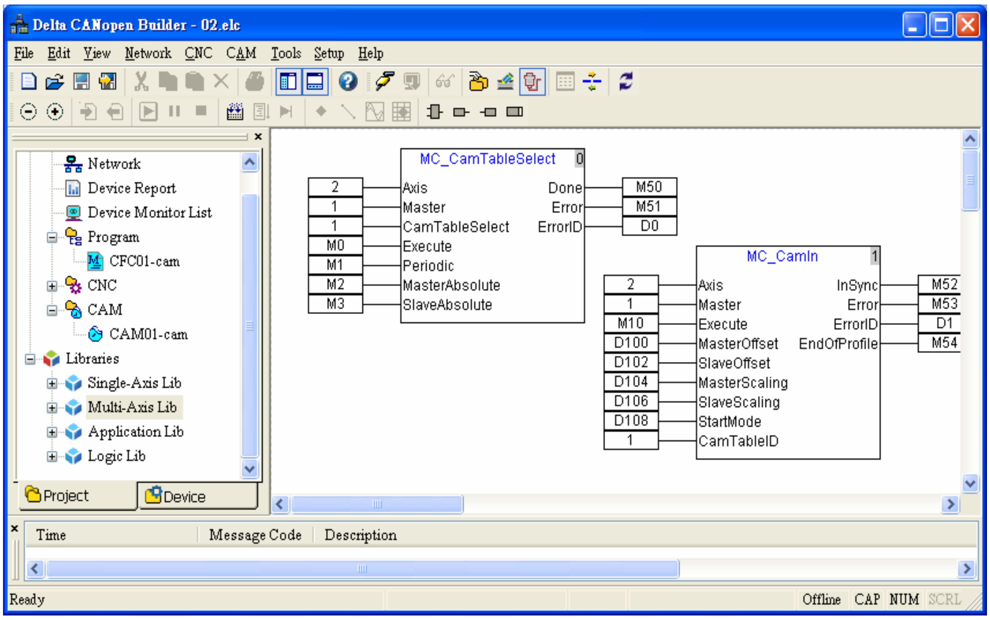


Figure 2.3.5

3. System Installation

This chapter focuses on the instructions of electrical specification and system installation. For the details of peripheral devices, please refer to the user manual enclosed with the product or log on the website: http://www.delta.com.tw.

3.1. Electrical Feature

■ **Electrical** specification

Item	Content
Voltage	24 VDC（-15% ~ +20%）
Current	2.5 A/30 VAC
Electrical isolation	500 VDC（Secondary-PE）
Consumption power	Max 8W
Vibration/shock immunity	Standard:IEC61131-2,IEC 68-2-6 (TEST Fc)/IEC61131-2 & IEC 68-2-27 (TEST Ea)
Interference immunity	Static electricity: 8KV Air Discharge EFT: Power Line: 2KV, Digital I/O: 1KV RS: 26MHz ~ 1GHz, 10V/m
Environment	Work: 0° C ~ 55° C （Temperature）, 50 ~ 95% （Humidity）, Pollution level 2 Storage: -25° C ~ 70° C （Temperature）, 5 ~ 95% （Humidity）
Weight	About 240g

■ Electrical specification for the input point

Item	Content
Input channel number	8 channels
Channel type	High-speed digital input type for the 8 channels
Input terminals	Terminal I0, I1, I2, I3, I4, I5, I6, I7
Common terminal for the input point	Terminal S/S used for connection of the plus or minus pole of supply power
Input type	Sink mode or Source mode
Input delay	2.5μS （ Off ->On ）, 5 μS （On -> Off ）
Input current	24 VDC, 5mA
Max cable length	The Shielded cable: 500m
	The cable without a shield wire: 300m

■ Electrical **specification** for the output point

Item	Content
Input channel number	4 transistors for output (Source)
Channel type	High-speed digital output type for the 4 channels
Output terminals	Terminal: Q0, Q1, Q2, Q3
Power voltage for output point	24 VDC（-15% ~ +20%）#1
Output delay	2μS （ Off -> On）, 3μS （ On -> Off ）
Max switch frequency	1KHZ
Max loading	Resistance: 0.5A/1point （2A/ZP）
	Inductance: 15W（30VDC）
	Bulb: 2.5W（30VDC）
Max cable length	The Shielded cable: 500m
	The cable without a shield wire: 300m

#1: UP and ZP must connecte the auxiliary power 24VDC（-15%~20%.

3.2. System Connection

3.2.1. Power and IO Wiring

■ **Power input**

It is direct current input for DVP10MC11T MPU power and below items should be paid special attention to for use.

1. The input power voltage is in the range from 20.4 VDC to 28.8VDC and the power is connected to the two terminals: 24V and 0 and earth terminal is connected to the ground. Besides, please note that the positive pole and negative pole of the power must not be connected reversely otherwise any damage on DVP10MC11T may be caused.
2. The earth terminal of DVP10MC11T MPU uses the cable above 1.6mm for grounding.
3. If the time for power-off is too long or power voltage is descended, DVP10MC11T will stop working, output will turn off and communication with servo drive will also be terminated. DVP10MC11T cannot make the communication with servo drive any more unless the power restores into normal status.

■ **Safety circuit wiring**

DVP10MC11T controls servo drive and any action of its internal device is possible to influence the action of external mechanical organization. So any malfunction of any device may cause the whole automatic control system to lose control and even result in personal injury and death. Below protection devices are suggested for use in power input circuit.

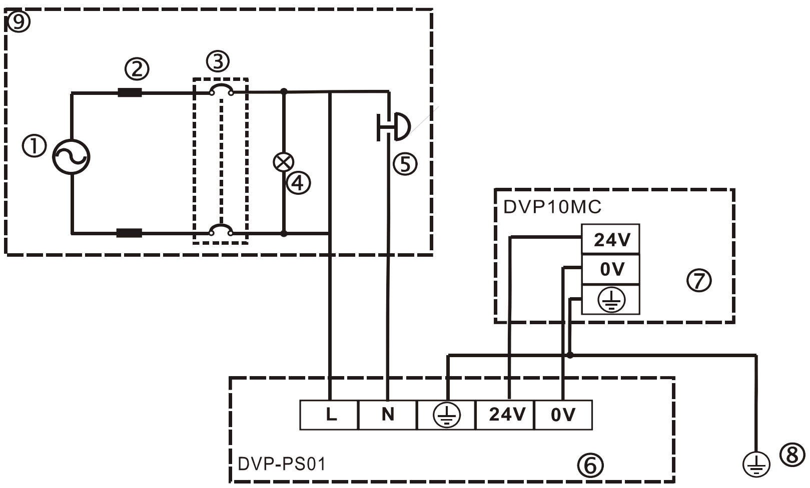


Figure 3.2.1

① AC power supply: 100～240VAC, 50/60Hz;
② Fuse for power loop protection;
③ System circuit isolation device: use the switches of electromagnetic contactor and relay as the isolation devices of system power circuit in case the system is unstable when power supply is interrupted frequently
④ Power indicator
⑤ Emergent stop: To prevent sudden status happening, emergent stop button is set to cut system power once accident occurs;

⑥	Delta power module DVPPS02/24VDC (It is recommended to adopt the power module DVPPS02 for DVP10MC11T);
⑦	DVP10MC11T body;
⑧	Grounding
⑨	Safety circuit

■ Wiring of input and output point

Wiring of input circuit

The input signal of input point is direct-current power input in two ways of wiring: Sink mode and Source mode. The following is the introduction of the two ways.

- **Sink mode**

The feature of Sink mode is that the current flows to the common terminal S/S. See the simplified model as figure 3.2.2.

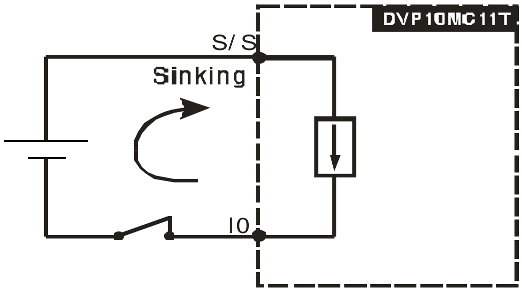


Figure 3.2.2

The relevant circuit for wiring is shown as figure 3.2.3

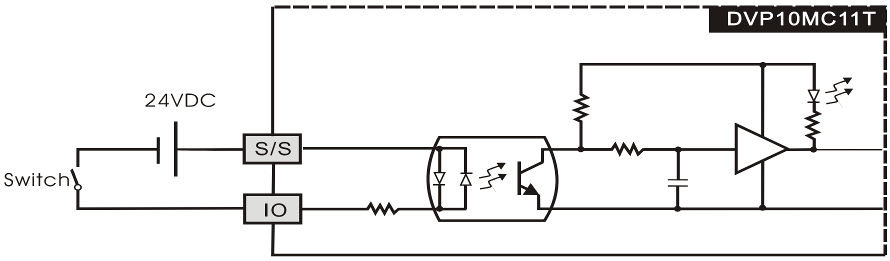


Figure 3.2.3

- **Source mode**

The feature of Source mode is that the current flows out from the common terminal S/S. See the simplified model as figure 3.2.4

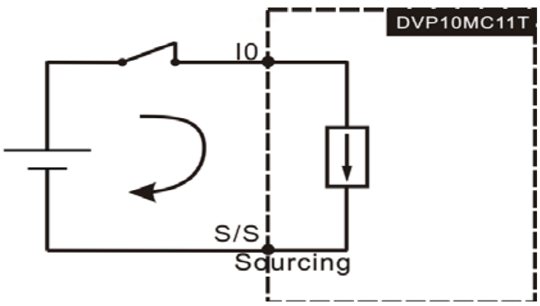


Figure 3.2.4

The relevant circuit for wiring is shown as figure 3.2.5

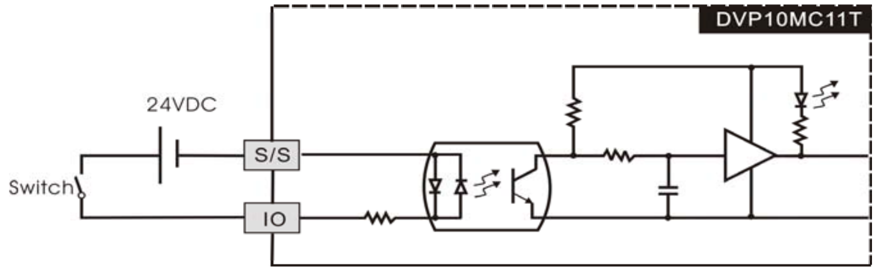


Figure 3.2.5

Wiring of output circuit

The circuit plate for the transistor output in DVP10MC11T includes the diodes with the protection function of counter potential. It is sufficient for application of the inductive load at low power and little higher frequency of On/Off change. In the case of high power or high On/Off change frequency, please additionally connect the suppression circuit according to the following figure to decrease the interference and prevent over-voltage or over-heat from damaging the transistor output circuit.

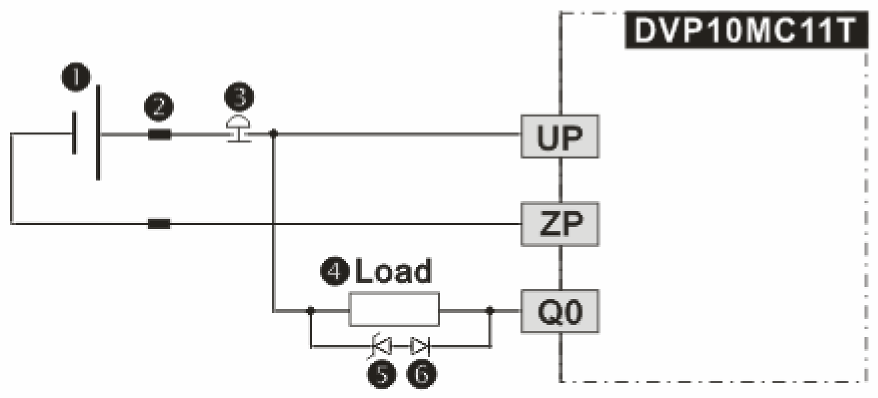


Figure 3.2.6

❶	24V direct current power
❷	Fuse protector for power circuit protection;
❸	Emergent stop button;
❹	Loading for switch, inductance and etc.
❺	9V Zener diode, 5W; When the power for loading is quite high and On/Off status is switched frequently, ❺and ❻ will be used together.
❻	Diode or the equivalent object is used as the diode suppressor. When the power for loading is low, ❺ is in no need for use but ❻.

3.2.2. Connected to ASDA-A2 Series of Servo

There are multiple models for ASDA-A2 series of servo drive. ASDA-A2-●●●●-M supporting CANopen communication can be used to create the CANopen motion control network with DVP10MC11T together. The connection between DVP10MC11T and servo drive can be made with TAP-CB03 or TAP-CB05 cable through CN6 port.

The relevant parameters are set below for connection between DVP10MC11T and servo drive:

Parameter	Explanation	Setting value	Explanation of Setting
P1-01	Setting of servo control mode	0B	Servo drive is set as CANopen mode
P3-00	Setting of node ID	Setting range: 1~16	For DVP10MC11T, the setting of this parameter corresponds to the axis number of servo in the CANopen network
P3-01	Baud rate	0403	The corresponding baud rate of the parameter value must correspond to that of DVP10MC11T.

The wiring figure of DVP10MC11T and ASDA-A2-●●●●-M series of servo drive

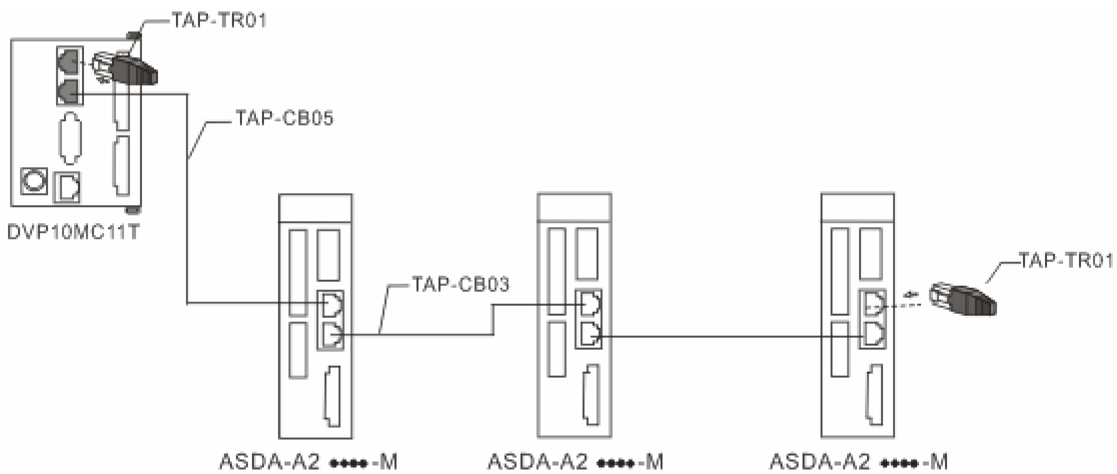


Figure 3.2.7

Note:

1) Please refer to the user manual of servo for the method of wiring between ASDA-A2-●●●●-M series of servo drive, servo motor and encoder.
2) Choose TAP-CB03 or TAP-CB05 or TAP-CB10 communication cable according to on-site status.
3) The two ends of the bus network are connected with terminal resistors TAP-TR01 which could be found in the packing box of 10MC.

3.2.3. Connecting the Extension Module to the Left Side of DVP10MC11T as DeviceNet Master

1. Connecting DVPDNET-SL to DVP10MC11T
   - ➢ Open the extension module clips on the top left and bottom left of DVP10MC11T and install DVPDNET-SL along four mounting holes in the four angles of DVP10MC11T as figure 3.2.8.
   - ➢ Press the clips respectively on the top left and bottom left of DVP10MC11T to fix the module tightly and ensure that their contact is normal.

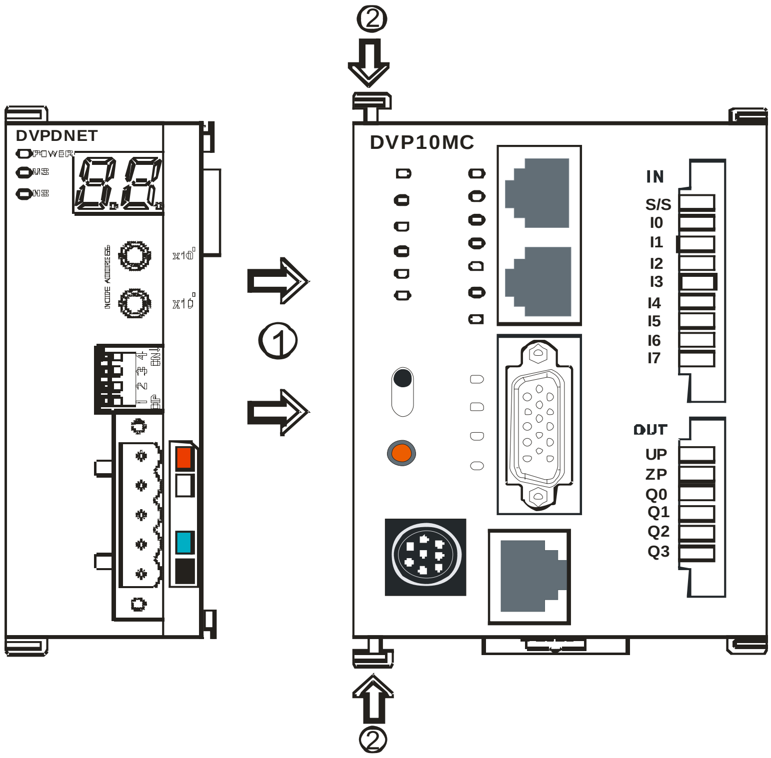


Figure 3.2.8

2. Installing DVP10MC11T and DVPDNET-SL into the DIN rail
   - ➢ Use standard 35mm DIN rail;
   - ➢ Open DIN rail clips of DVP10MC11T and DVPDNET-SL and then insert the two modules in DIN rail.
   - ➢ Press the DIN rail clips into DVP10MC11T and DVPDNET-SL to fix the two modules in DIN rail as figure below.

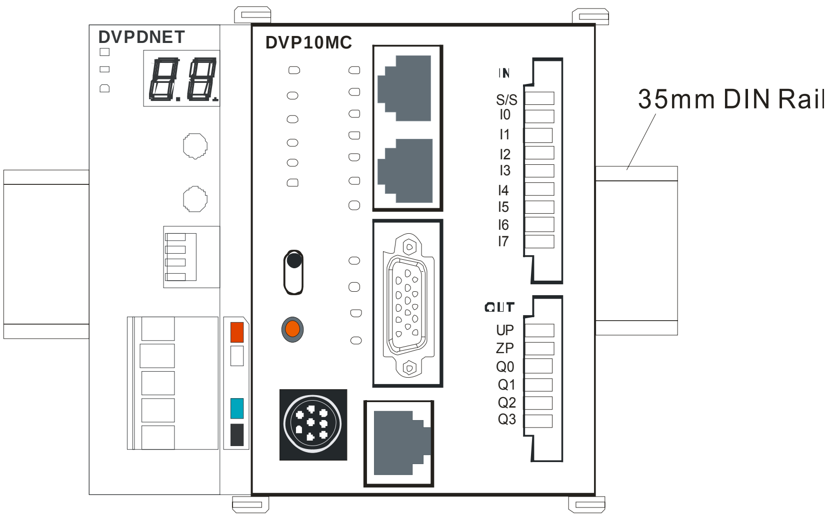


Figure 3.2.9

3.2.4. Connecting the Extension Module (DVP16SP11T) to the Right Side of DVP10MC11T

1. Connecting DVP16SP11T to DVP10MC11T;
   - Open the extension module clips on the top right and bottom right of DVP10MC11T and install DVP16SP11T along four mounting holes in the four angles of DVP10MC11T as figure 3.2.10.
   - Press the clips on the upper right and bottom right of DVP10MC11T to fix the module tightly and ensure that their contact is normal.

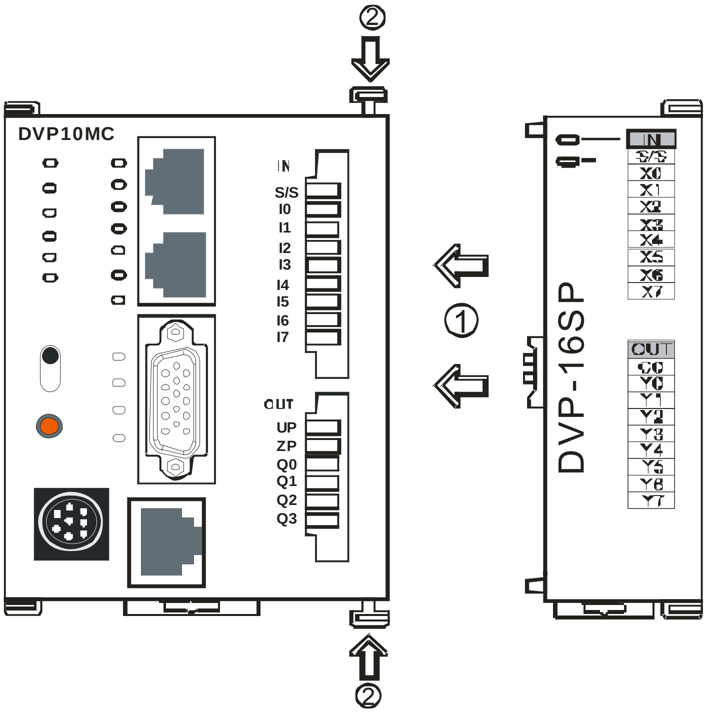


Figure 3.2.10

2. Installing DVP10MC11T and DVP16SP11T in DIN Rail
   - Use standard 35mm DIN rail;
   - Open DIN rail clips of DVP10MC11T and DVP16SP11T and then insert the two modules in DIN rail.
   - Press the DIN rail clips into DVP10MC11T and DVP16SP11T to fix the two modules in DIN rail as figure below.

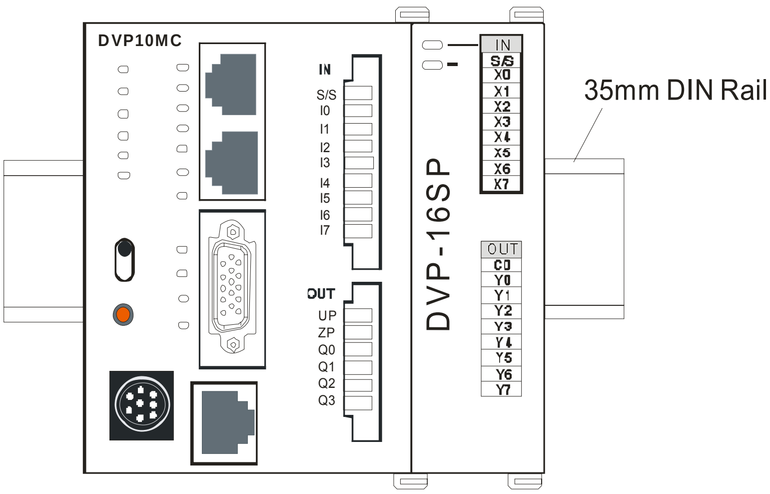


Figure 3.2.11

4. Motion Control Instruction

4.1. Instruction Table

Class	API	Instruction Name	Function	Page
Singel-axis instruction	1	MC_MoveAbsolute	Move absolutely	4-8
	2	MC_MoveRelative	Move relatively	4-14
	3	MC_MoveAdditive	Move additively	4-18
	4	MC_MoveSuperImposed	Superimposed motion	4-22
	5	MC_MoveVelocity	Velocity instruction	4-27
	6	MC_Stop	Stop instruction	4-30
	7	MC_PassiveHome	Homing instruction	4-33
	8	MC_Power	Power control instruction	4-36
	9	MC_Reset	Reset instruction	4-37
	10	MC_ReadStatus	Read axis status	4-39
	11	MC_ReadActualPosition	Read actual position	4-40
	12	MC_ReadAxisError	Read axis error	4-41
	13	MC_ReadParameter	Read parameters	4-42
	14	MC_WriteParameter	Write parameters	4-43
	15	DMC_SetTorque	Set torque	4-44
Multi-axis instruction	64	MC_CamTableSelect	Select cam table	4-46
	65	MC_CamIn	Cam-in instruction	4-47
	66	MC_CamOut	Cam-out instruction	4-66
	67	DMC_CamSet	Set cam	4-69
	68	MC_GearIn	Gear-in instruction	4-73
	69	MC_GearOut	Gear-out instruction	4-75
	70	MC-Phasing	Phase shift	4-77
	71	DMC-CapturePosition	Capture position	4-80
	72	DMC-VirtualAxis	Create virtual axis	4-86
	73	DMC-ExternalMaster	Create external virtual master axis	4-88

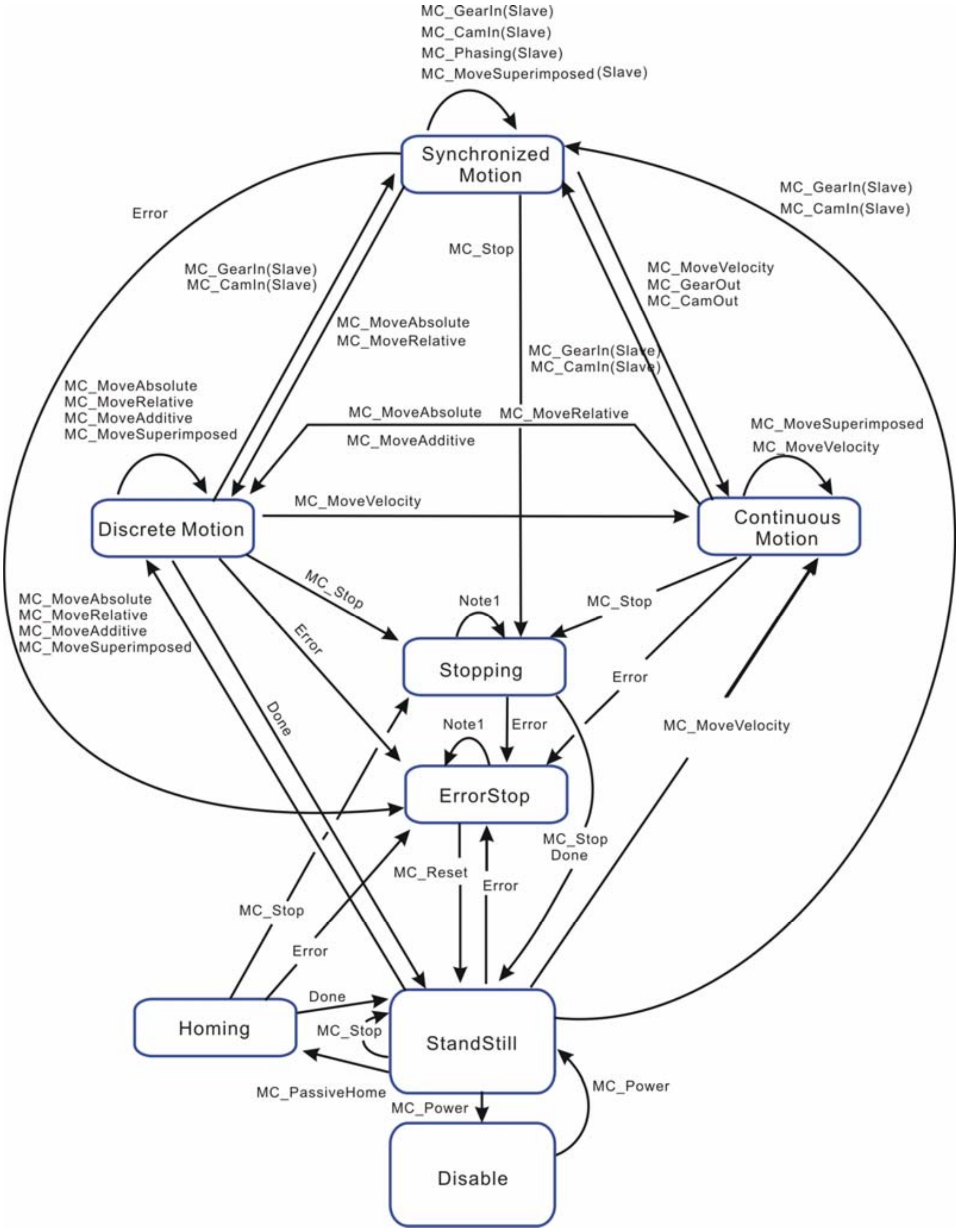
Class	API	Instruction Name	Function	Page
Logical Instruction	128	ADD	Addition of 16-bit integer	4-90
	129	ADD_DI	Addition of 32-bit integer	4-90
	130	ADD_R	Addition of floating number	4-91
	131	SUB	Subtraction of 16-bit integer	4-91
	132	SUB_DI	Subtraction of 32-bit integer	4-92
	133	SUB_R	Subtraction of floating number	4-92
	134	MUL	Multiplication of 16-bit integer	4-93
	135	MUL_DI	Multiplication of 32-bit integer	4-93
	136	MUL_R	Multiplication of floating number	4-94
	137	DIV	Division of 16-bit integer	4-94
	138	DIV_DI	Division of 32-bit integer	4-95
	139	DIV_R	Division of floating number	4-95
	140	AND	Logical AND operation	4-96
	141	OR	Logical OR operation	4-96
	142	XOR	Logical XOR operation	4-97
	143	NOT	Logical NOT operation	4-97
	144	CTU	Up-counter	4-98
	145	CTD	Down-counter	4-100
	146	CTUD	Up/down-counter	4-102
	147	TON_s	On-delay timer（Unit:1s）	4-104
	148	TOF_s	Off-delay timer（Unit: 1s）	4-106
	149	TONR_s	Retentive on-delay timer（Unit:1s）	4-108
	150	TON_ms	On-delay timer（Unit:1ms）	4-110
	151	TOF_ms	Off-delay timer（Unit:1ms）	4-111
	152	TONR_ms	Retentive on-delay timer（Unit: 1ms）	4-112
	153	CMP	Comparison of 16-bit integers	4-113
	154	CMP_DI	Comparison of 32-bit integers	4-114
	155	CMP_R	Comparison of floating numbers	4-115
	156	MOV	Move 16-bit integer	4-116
	157	MOV_DI	Move 32-bit integer	4-117
	158	MOV_R	Move floating number	4-117
	159	MOVF	Move 16-bit integer to multiple registers	4-118

Class	API	Instruction Name	Function	Page
	160	MOVF_DI	Move 32-bit integer to multiple registers	4-119
	161	MOVF_R	Move floating number to multiple registers	4-120
	162	MOVB	Move multiple register data to the target registers	4-121
	163	MOV_BW	Move multiple bit device values to multiple registers	4-122
	164	MOV _WB	Move multiple register values to multiple bit devices	4-123
	165	ZCP	Compare 16-bit integer to the value in one zone	4-124
	166	ZCP_DI	Compare 32-bit integer to the value in one zone	4-125
	167	ZCP_R	Compare floating number to the value in one zone	4-126
	168	SET	Setting instruction	4-127
	169	RESET	Reset instruction	4-127
	170	OUT	Coil driving	4-128
	171	R_Trig	Rising edge triggering	4-128
	172	F_Frig	Falling edge triggering	4-130
	173	ZRSTM	Reset one zone of bit devices	4-131
	174	ZRSTD	Reset one zone of word devices	4-132
	175	SQRT_R	Square root of floating number	4-133
	176	MOD	Remainder from 16-bit integer division	4-133
	177	MOD_DI	Remainder from 32-bit integer division	4-134
	178	MOD_R	Remainder from floating number division	4-134
	179	Real_To_Int	Convert floating number into 16-bit integer	4-135
	180	Real_To_Dint	Convert floating number into 32-bit integer	4-135
	181	Int_To_Real	Convert 16-bit integer into floating number	4-136
	182	Dint_To_Real	Convert 32-bit integer into floating number	4-136
	183	Offset	16-bit integer index register instruction	4-137
	184	Offset_DI	32-bit integer index register instruction	4-139
	185	Offset_R	Floating-point number index register instruction	4-141

Class	API	Instruction Name	Function	Page
Application function instruction	220	APF_RotaryCut_Init	Initialize rotary cut	4-148
	221	APF_ RotaryCut_In	Rotary cut-in	4-150
	222	APF_ RotaryCut_Out	Rotary cut-out	4-151
	223	APF_FlyingShear_Init	Initialize flying shear	4-158
	224	APF_FlyingShear	Flying shear instruction	4-160
Coordinate Motion Instruction	260	DMC_NC	CNC instruction	4-192
	261	DNC_Group	Build coordinate motion instruction group	4-197
	262	DNC_Absolute（G90）	In absolute mode	4-200
		DNC_Relative（G91）	In relative mode	
	263	DNC_MOV(G0)	Rapid positioning instruction	4-201
	264	DNC_LIN(G1)	Linear interpolation instruction	4-202
	265	DNC_CW（IJK）（G2）	Clockwise circular/ helical interpolation （The coordinates of center of a circle are set）	4-204
		DNC_CCW（IJK）（G3）	Anticlockwise circular/ helical interpolation （The coordinates of center of a circle are set）	
	266	DNC_CW（R）（G2）	Clockwise circular/ helical interpolation （Radius is set	4-206
		DNC_CCW（R）（G3）	Anticlockwise circular/ helical interpolation （Radius is set）	
	267	DNC_XY（G17）	XY plane selection	4-208
		DNC_XZ（G18）	XZ plane selection	
		DNC_YZ（G19）	YZ plane selection	

4.2. Axis Status

When DVP10MC11T utilizes the motion control instruction to control every axis, there is one internal-run state for every axis and axis states are switched by following the state machine instruction below. The state machine defines the motion instructions that can be executed in all states and the states after the motion instructions are executed. Using the motion instructions, user could judge if a certain instruction could be used in current state through the state machine. The state machine of DVP10MC11T is shown as below and the arrow points to the axis status.



Axis status can be judged according to the special register for axis status. For explanation of the special register on axis, please refer to appendix C. All states of the axes correspond to the values as below.

State	Value	Remark	State	Value	Remark
Disable	0	No-execution state	Cam_In	7	The state when Cam-in is completed
StandStill	1	Pre-execution state	Gear_In	8	The state when Gear-in is completed
ErrorStop	2	Error state	CNC	9	CNC state
Stopping	3	Stop state	Rotary	A	Rotary cutting state
Homing	4	Homing state	Gearing	B	The state when Gear-in has not been completed
Discrete	5	Discrete state	Caming	C	The state when Cam-in has not been completed
Continuous	6	Continuous state	Fly Shear	D	Flying shear state

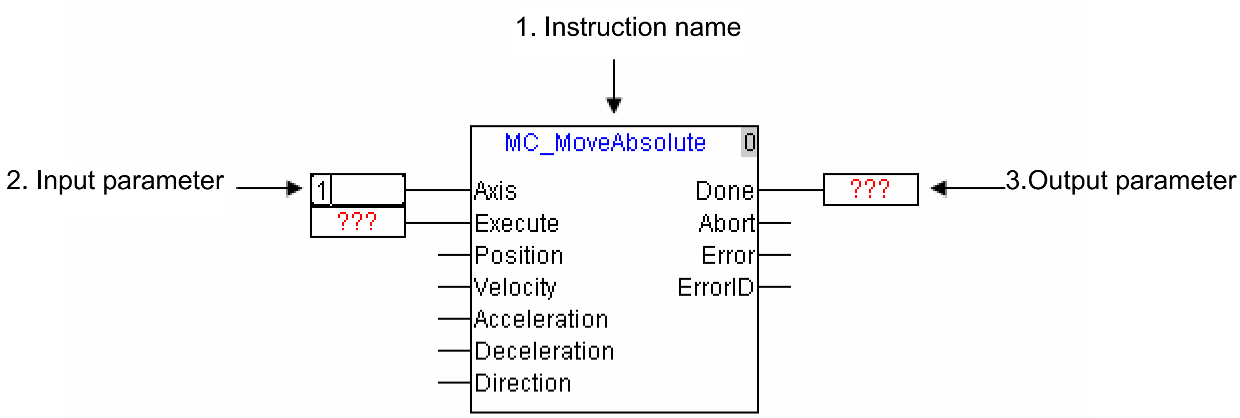
Note: The states of Cam_In, gear_In, Gearing, Caming belong to synchronized state in the state machine figure above.

4.3. Instruction Usage

- An instruction consists of two parts: instruction name and operand.

Instruction name	Indicates the function of execution of the instruction
Operand	Indicates the parameter processed by the instruction

- Instruction format



Note: Different functions for different instructions decide that the parameters are different. The parameters of the left area in one instruction are to be set and the results from execution of instruction are in the right area in the instruction.

■ Data type list

The data types in the motion control program for DVP10MC11T are

Serial No.	Data type	Lower limit	Upper limit	Bit number
1	BOOL	0	1	8
2	BYTE	0	255	8
3	WORD	0	65535	16
4	DWORD	0	4294967295	32
5	SINT	-128	127	8
6	USINT	0	255	8
7	INT	-32768	32767	16
8	UINT	0	65535	16
9	DINT	-2147483648	2147483647	32
10	UDINT	0	4294967295	32
11	REAL(Positive number)	3.4×10^{-38}	3.4×10^{38}	32
	REAL(Negative number)	-3.4×10^{38}	-3.4×10^{-38}	
12	LREAL	-1.79769313486231E308	1.79769313486232E308	64

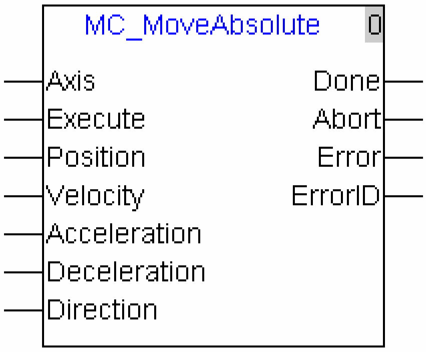
4.4. Single-Axis Instruction Usage

4.4.1. MC_MoveAbsolute

API	MC_MoveAbsolute	Move absolutely	Controller
01			10MC11T

Explanation of the Instruction:

MC_MoveAbsolute is applied to control the terminal actuator to move to the target position relative to the zero point at the given speed, acceleration and deceleration. Once this instruction is aborted in process of motion, the uncompleted distance left will be ignored and the new instruction will be executed subsequently.



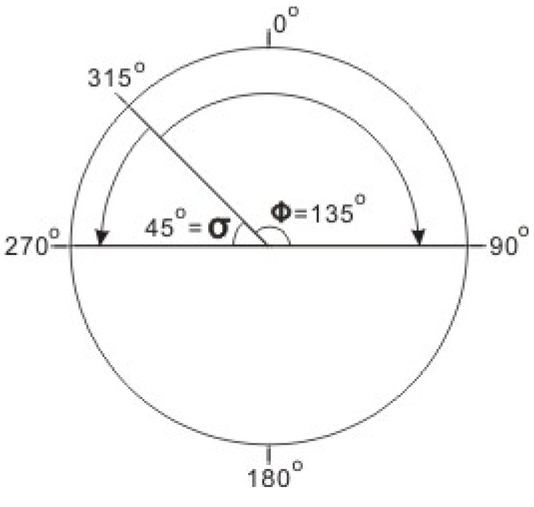
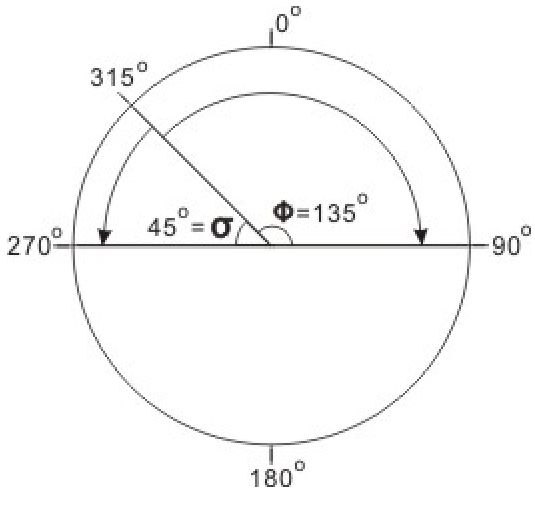
Explanation of input and output parameter of the instruction:

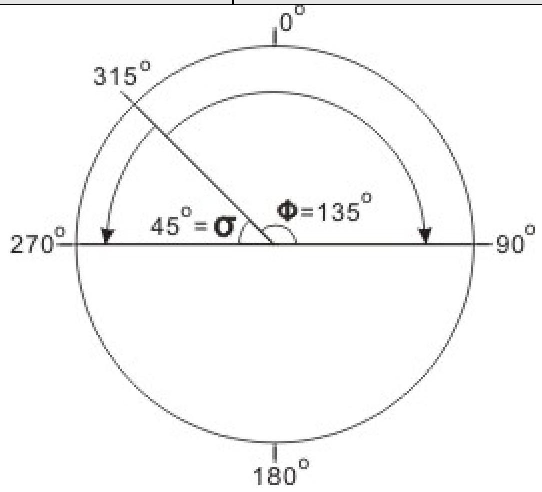
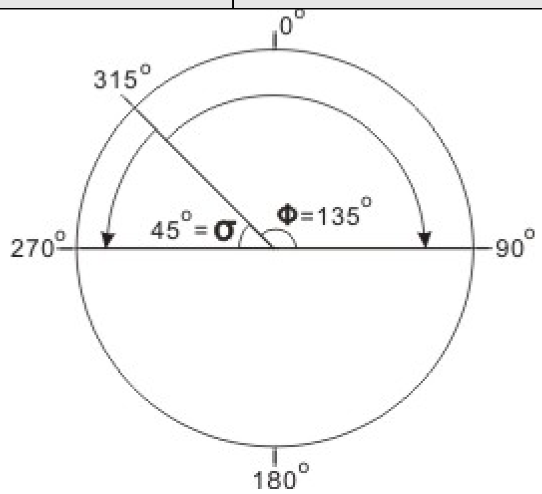
Parameter name	Explanation	Data type	Available device
Axis	The node address of servo drive	UINT	Constant, D
Execute	This instruction is executed when “Execute” turns Off ->On.	BOOL	M,I,Q, Constant
Position	The target position for the terminal actuator with zero point as the reference point. Unit: Unit. (See section 2.3.1 on axis parameter setting) For rotary axis, 0≤ Position< modulo.	REAL	Constant, D
Velocity	Running speed of terminal actuator and this parameter is always positive. (Unit: unit/second).	REAL	Constant, D
Acceleration	Acceleration of terminal actuator and this parameter is always positive.(Unit: unit/second2)	REAL	Constant, D
Deceleration	Deceleration of terminal actuator and this parameter is always positive.(Unit: unit/second2)	REAL	Constant, D
Direction	The direction for servo motor rotation 0: the direction for the shortest distance ; 1: positive direction; -1: negative direction; 2: extends the current direction The parameter will be effective only for rotary axis.	INT	Constant, D
Done	When absolute position execution is finished, "Done" turns on; when “execute” is off, "Done" is reset.	BOOL	M,Q

Parameter name	Explanation	Data type	Available device
Abort	When this instruction execution is aborted, "Abort" turns on; when “Execute” is off, "Abort" is reset.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when “Execute” is off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to selection 5.3.	UINT	D

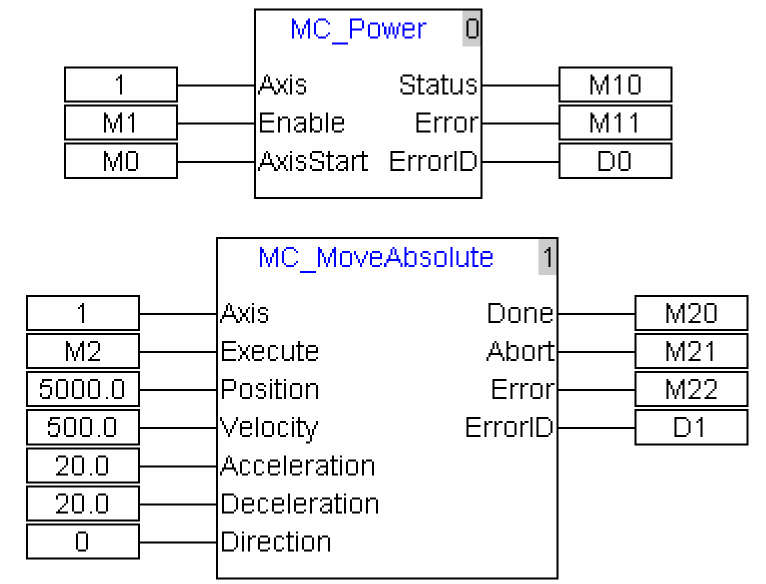
Note:

1. While MC_MoveAbsolute instruction is being executed, “Execute”: rising edge occurs, which does not impact the execution of the instruction.
2. When the velocity, acceleration and deceleration of the instruction are read and written via human-computer interface, their value types must be set as Double Word（Floating）
3. When direction values are different, motion directions of rotary axis are also different as follows. Suppose the output unit of physical actuator is degree, the motion direction of rotary axis is explained as below.

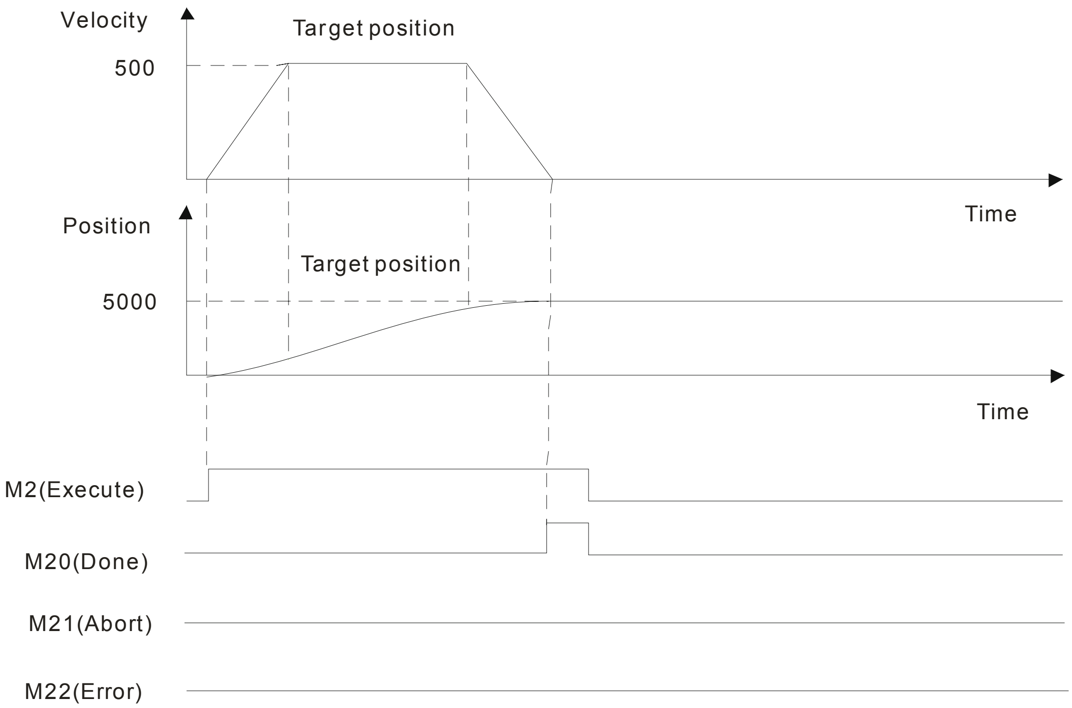
<table>
<tr>
<th>Direction: 1 (Positive direction)
Current position: 315°
Target position: 90°
Movement angle: 135°</th>
<th>Direction: -1 (Negative direction)
Current position: 315°
Target position: 90°
Movement angle: 225°</th>
</tr>
<tr>
<td>
</td>
<td>
</td>
</tr>
</table>

<table>
<tr>
<td>Direction: 0 (Shortest)
Current position: 315°
Target position: 90°
Movement angle: 135°</td>
<td>Direction: 0 (Shortest)
Current position: 315°
Target position: 270°
Movement angle: 45°</td>
</tr>
<tr>
<td colspan="2">
</td>
</tr>
<tr>
<td>Direction: 2 (Extend current direction)
Rotary axis status: in state of negative rotation before function block is executed.
Current position: 315°
Target position: 90°
Movement angle: 225°</td>
<td>Direction: 2(Extend current direction)
Rotary axis status: be motionless, in state of positive rotation before function block is executed.
Current position: 315°
Target position: 90°
Movement angle: 135°</td>
</tr>
<tr>
<td colspan="2">
</td>
</tr>
</table>

Program Example (1)



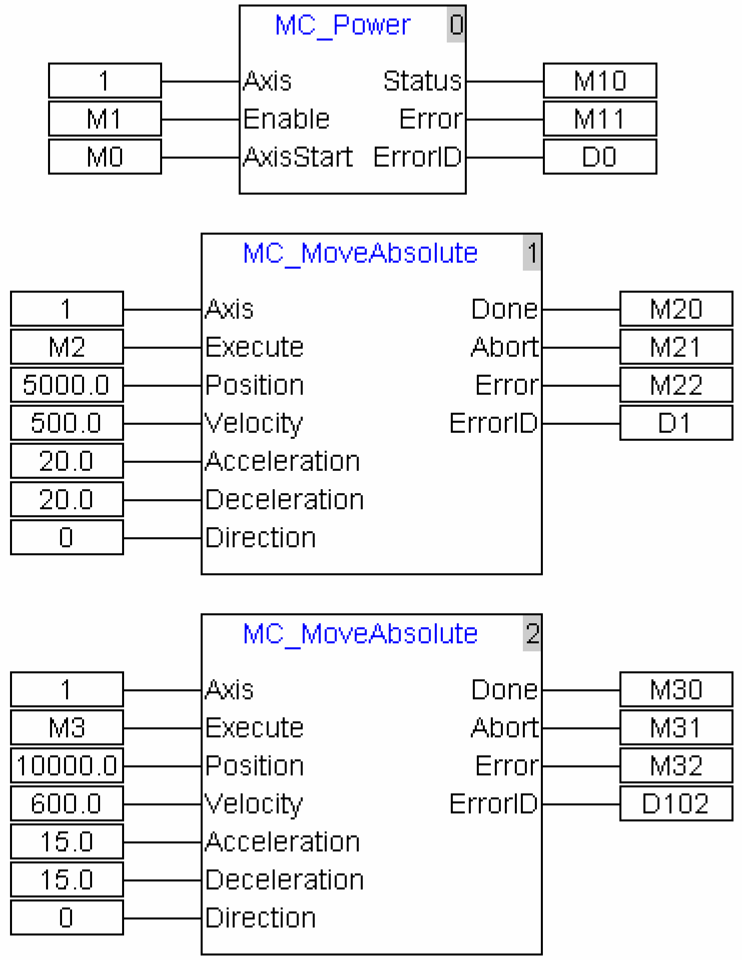
Motion diagram as below:



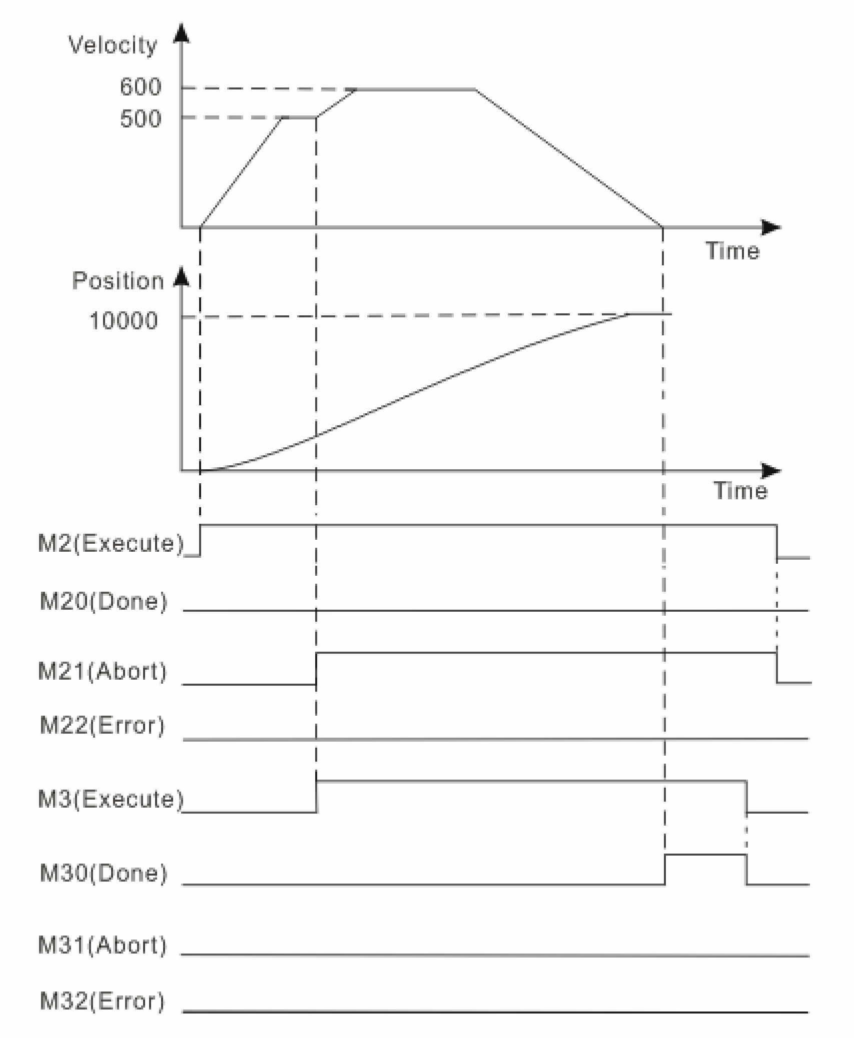
- ◆ When M2 is Off → On, motion controller starts to control servo motor rotation. When servo reaches target position, M20 of "Done" will be Off→On.
- ◆ When M2 is On → Off, M20 of "Done" will be reset.
- ◆ After servo motor reaches target position, as M2 turns Off→On again, servo motor will not move since it has reached the target position.

Program Example (2)

Two MC-MoveAbsolute instructions in the same task list are matched for use as follows.



Motion diagram as below:



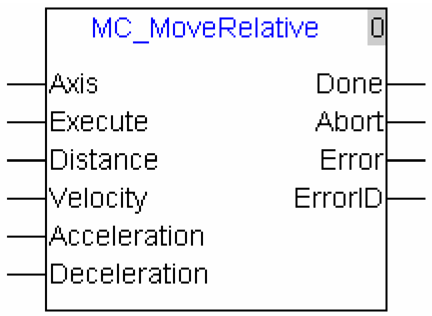
- When M2 is Off→On, motion controller starts to control servo motor rotation. When M3 turns Off→On, the first MC_MoveAbsolute instruction is aborted, and M21 of "Abort" bit turns Off→On. Meanwhile, the second MC_MoveAbsolute instruction is executed and servo action is performed according to the parameter of the second MC_MoveAbsolute instruction. When servo reaches the target position of the second MC_MoveAbsolute instruction, M30 of "Done" bit turns Off→On.
- When M3 turns On →Off , M30 of "Done" bit is reset

4.4.2. MC_MoveRelative

API	MC_MoveRelative	Move relatively	Controller
02			10MC11T

Explanation of the Instruction:

MC_MoveRelative is applied to control the terminal actuator to move for a given distance with the current position as the reference point at a given speed, acceleration, deceleration. Once this instruction is aborted in process of motion, the uncompleted distance left will be ignored and the new instruction will be executed subsequently.



Explanation of input and output parameter of the instruction:

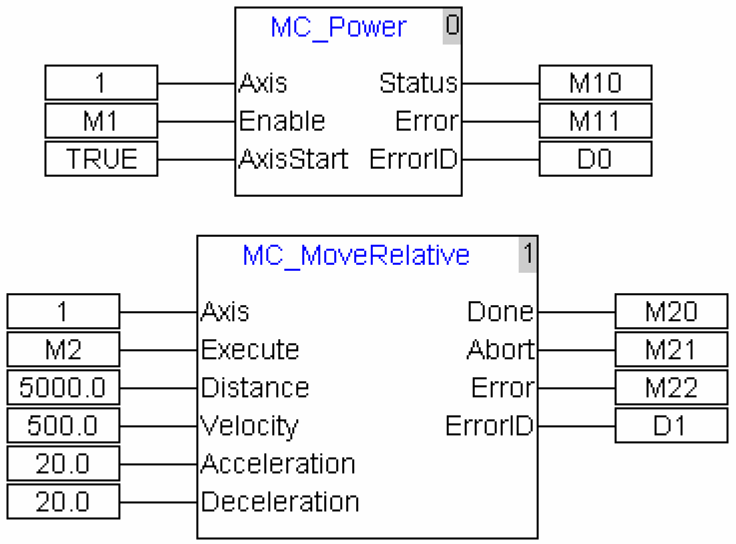
Parameter name	Explanation	Data type	Available device
Axis	The node address of servo drive	UINT	Constant, D
Execute	This instruction is executed when “Execute” turns Off –> On.	BOOL	M,I,Q, Constant
Distance	The target distance for terminal actuator to move with the current position as the reference point. If the setting is negative, servo will rotate reversely. Unit: Unit.	REAL	Constant, D
Velocity	Running speed of terminal actuator and this parameter is always positive.(Unit: unit/second)	REAL	Constant, D
Acceleration	Acceleration of terminal actuator and this parameter is always positive.(Unit: unit/second^2)	REAL	Constant, D
Deceleration	Deceleration of terminal actuator and this parameter is always positive.(Unit: unit/second^2)	REAL	Constant, D
Done	When relative position execution is completed, "Done" turns on; when “Execute” is off, "Done" is reset.	BOOL	M,Q
Abort	When this instruction execution is aborted, "Abort" turns on; when “Execute” is off, "Abort" is reset.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when “Execute” is off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to table 5.3.	UINT	D

Note:

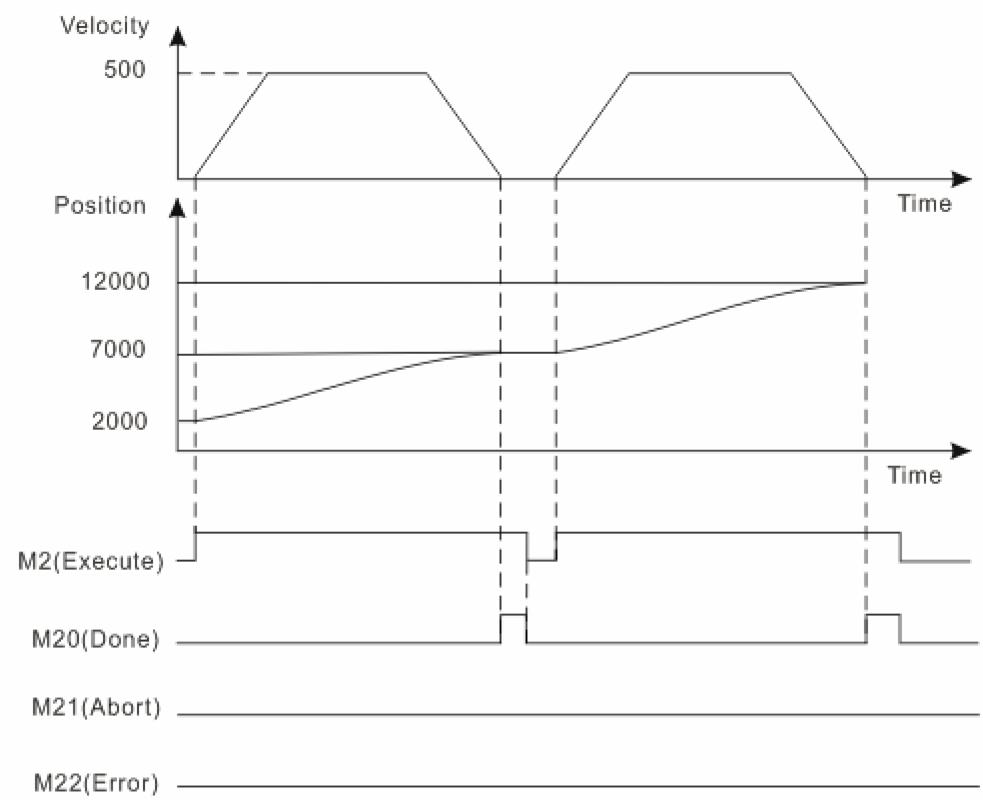
1. When MC_MoveRelative instruction is being executed, “Execute”: rising edge occurs, which does not impact the execution of the instruction.

2. When the velocity, acceleration and deceleration of the instruction are read via human-computer interface, their value types must be set as Double Word （Floating）

Program Example (1)



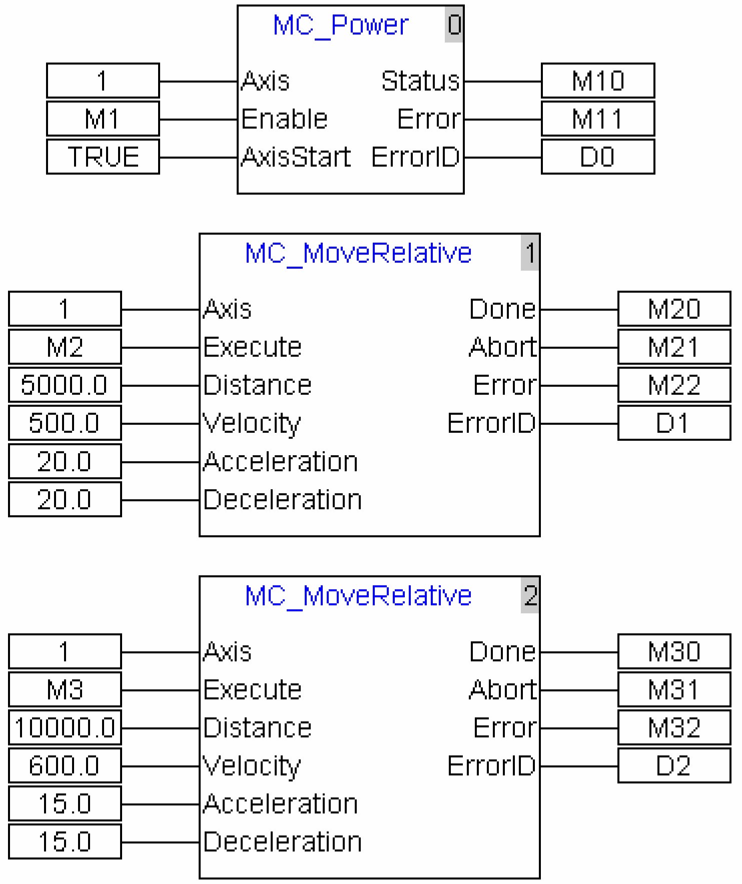
Motion diagram:



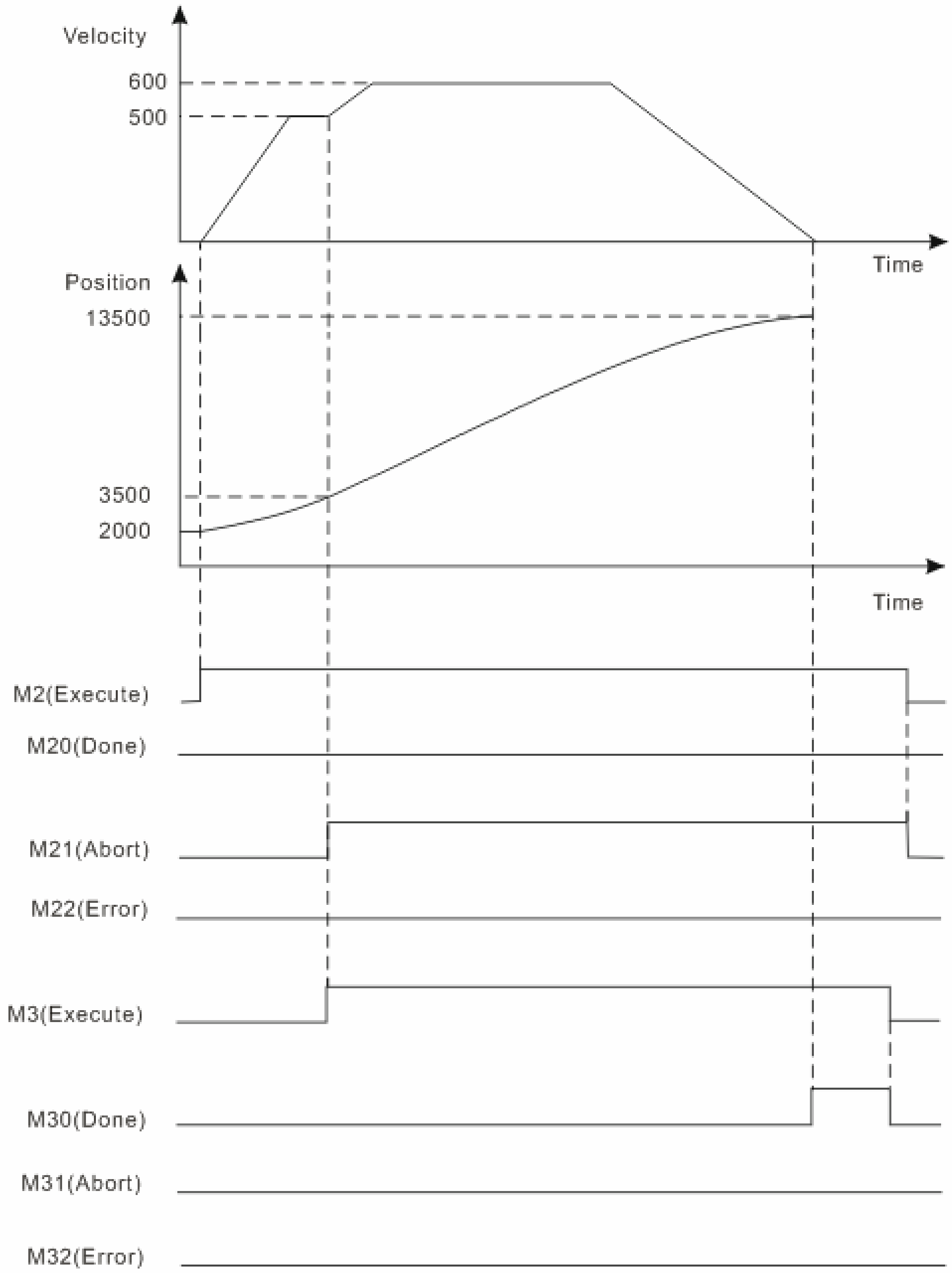
- When M2 turns Off→On, motion controller controls servo motor to rotate with current position as reference point. After servo motor completes the set distance, M20 of "Done" bit turns Off→On.
- When M2 turns On→Off, M20 of "Done" bit is reset.
- Servo motor completes the set distance, M2 turns Off→On again, motion controller sends command once again to control servo motor rotation, after servo motor completes the set distance, M20 of "Done" bit turns Off→On once again

Program Example (2)

Two MC_MoveRelative instructions in the same task list are matched for use as follows.



Motion diagram as below:



- When M2 turns Off→On, motion controller controls servo motor to rotate with initial position as reference point. When M3 turns Off→On, the first relative position instruction is aborted and M21 of "Abort" bit turns Off→On. Meanwile, servo motor starts to execute the second relative position instruction with where the first relative position instruction is aborted as reference point. After servo motor completes the set distance of the second instruction with the abort position as the initial position, M30 of "Abort" bit turns Off→On.
- When M3 turns On→Off, M30 of "Done" bit is reset.

4.4.3. MC_MoveAdditive

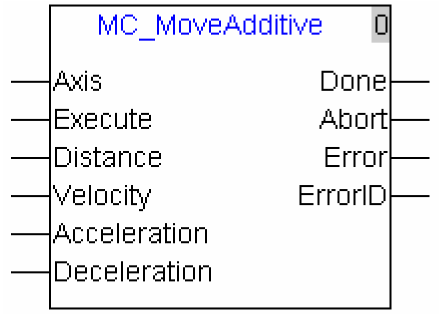
API	MC_MoveAdditive	Move additively	Controller
03			10MC11T

Explanation of the Instruction:

MC_MoveAdditive is applied to control the terminal actuator to move for an additive distance at a given speed and acceleration.

When the former instruction is related with position and it has not completed its given distance, MC_MoveAdditive is executed to control the terminal actuator to move for the distance which includes the uncompleted distance left by the former instruction and the distance given to this instruction. When execution of this instruction is finished, the final position of the terminal actuation is the addition of the given distance for the former and the current instruction.

If the former one is velocity instruction, MC_MoveAdditive will terminate the execution of velocity instruction, move for the given distance at a given speed, acceleration and deceleration and then stop.



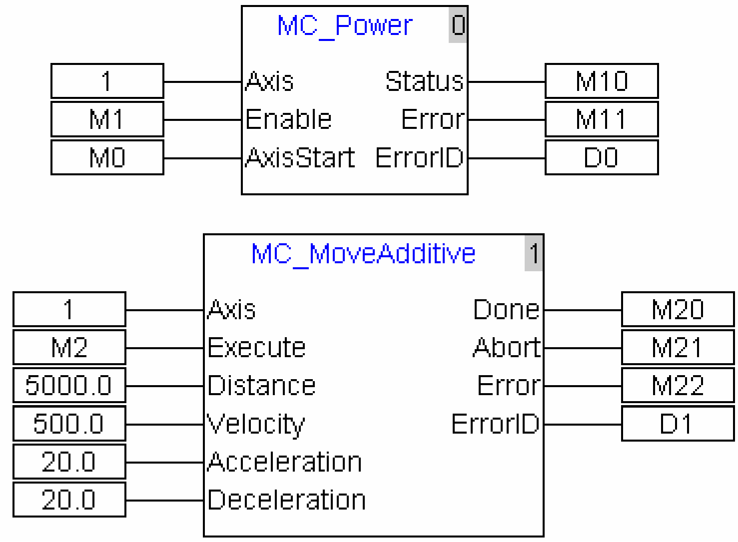
Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Axis	The node address of servo drive.	UINT	Constant, D
Execute	This instruction is executed when “Execute” turns Off –> On.	BOOL	M,I,Q, constant
Distance	The additive distance of terminal actuator with the unit: Unit..	REAL	Constant, D
Velocity	Running speed of terminal actuator and this parameter is always positive.(Unit: unit/second)	REAL	Constant, D
Acceleration	Acceleration of terminal actuator and this parameter is always positive. (Unit: unit/second2).	REAL	Constant, D
Deceleration	Deceleration of terminal actuator and this parameter is always positive. (Unit: unit/second2).	REAL	Constant, D
Done	When additive position execution is completed, "Done" turns on; when “Execute” is off, "Done" is reset.	BOOL	M,Q
Abort	When this instruction execution is aborted, "Abort" turns on; when “Execute” is off, "Abort" is reset.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when “Execute” is off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to table 5.3.	UINT	D

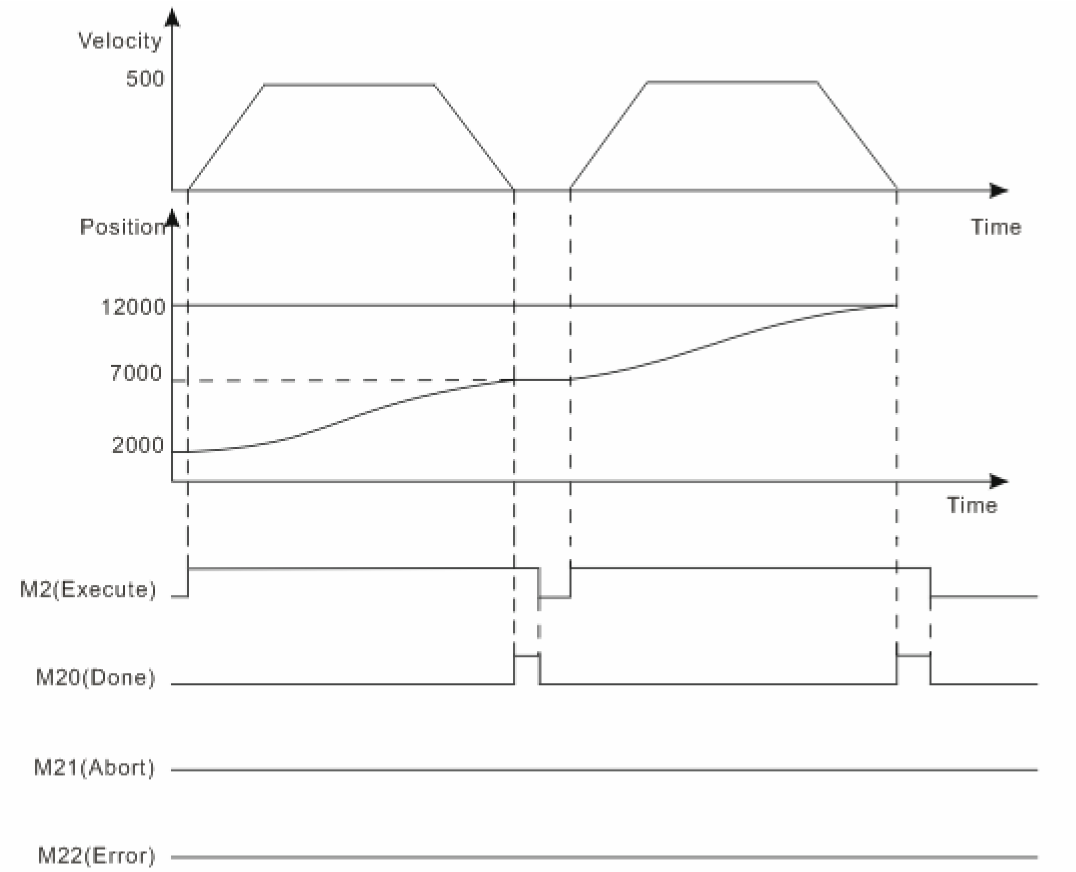
Note:

1. When MC_MoveAdditive instruction is being executed, “Execute”: rising edge occurs, which doe not impact the execution of the instruction.
2. When the velocity, acceleration and deceleration of the instruction are read and written via human-computer interface, their value types must be set as Double Word（Floating).

Program Example (1)



Motion diagram as below:

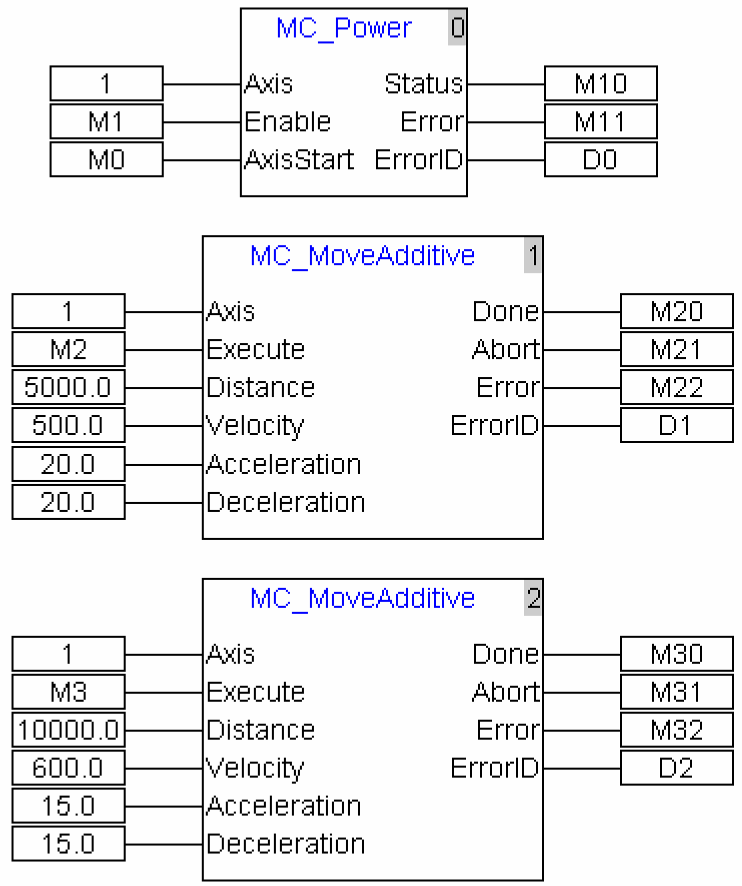


- When M2 turns Off→On, motion controller controls servo motor to rotate with current position as reference point. After servo motor completes the set distance, M20 of "Done" bit turns Off→On.
- When M2 turns On→Off, M20 of "Done" bit is reset.

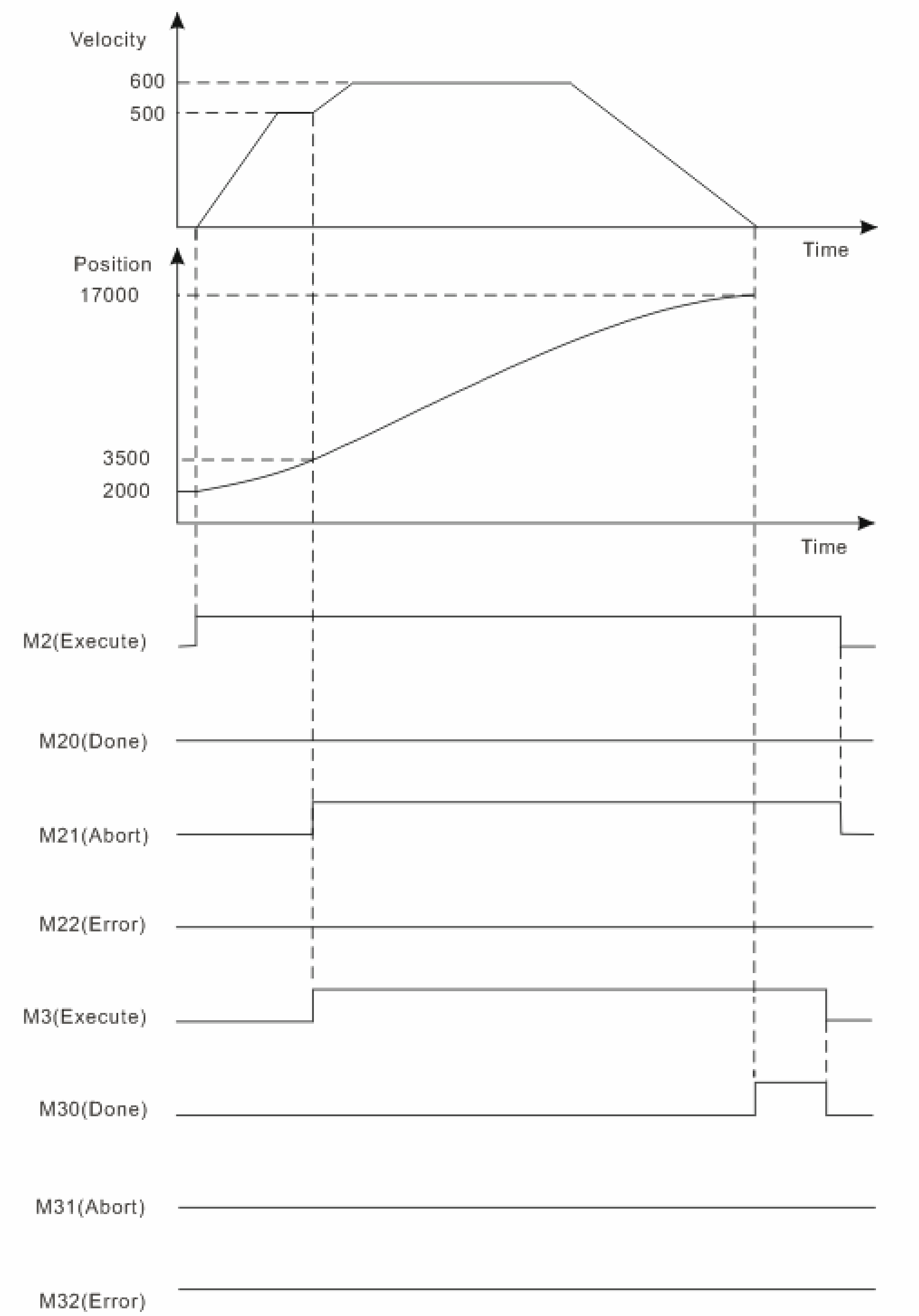
◆ Servo motor completes the set distance, M2 turns Off→On again, motion controller sends command to control servo motor rotation; after servo motor completes the set distance, M20 of "Done" bit turns Off→On once again.

Program Example **(2)**

Two MC_MoveAdditive instructions in the same task list are matched for use as follows.



Motion diagram as below:



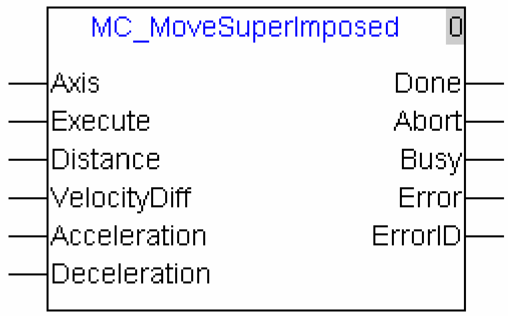
- When M2 turns Off→On, motion controller controls servo motor to rotate with current position as reference point. When M2 turns Off→On, the first MC_MoveAdditive instruction is aborted and M21 of "Abort" bit turns Off→On. Meanwile, servo motor starts to execute the second MC_MoveAdditive instruction to rotate. After servo motor reaches the set distance which is the total set distance of the first and the second instruction, M30 of "Done" bit turns Off→On.
- When M3 turns On→Off, M30 of "Done" bit is reset.

4.4.4. MC_MoveSuperImposed

API	MC_MoveSuperImposed	Superimposed motion	Controller
04			10MC11T

Explanation of the Instruction:

MC_MoveSuperImposed is applied to control the terminal actuator to chase for a given distance at a given speed, acceleration and deceleration in current motion status. When this instruction is executed, the execution of the former instruction will not be terminated, the two instructions will be executed together, the distance, velocity, acceleration and deceleration will enter the real-time superposition. When one of the two instructions reaches the given velocity, the acceleration will become 0. When the execution of one instruction is finished, the speed, acceleration and deceleration will not be superimposed any more and meanwhile, the other instruction is still being executed independently.



Explanation of input and output parameter of the instruction:

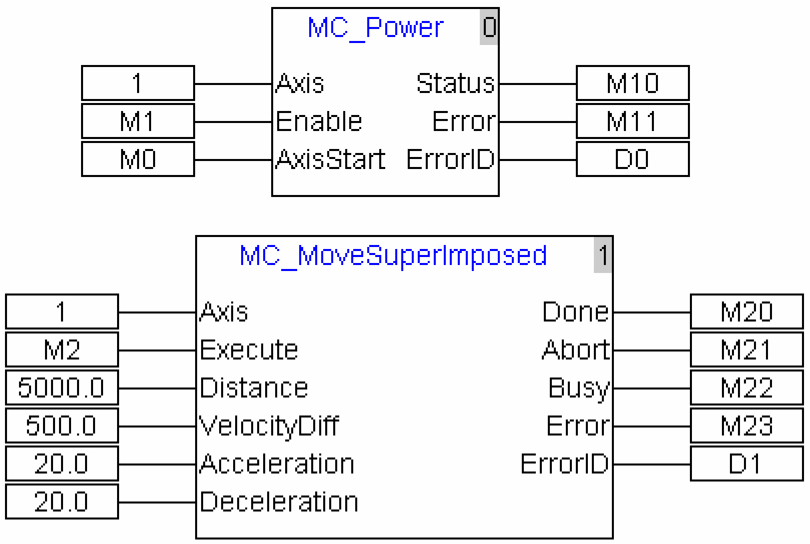
Parameter name	Explanation	Data type	Available device
Axis	The node address of servo drive	UINT	Constant, D
Execute	This instruction is executed when “Execute” turns from Off to On.	BOOL	M,I,Q, Constant
Distance	The additive distance for terminal actuator with the unit: Unit.	REAL	Constant, D
Velocity	The additive speed for terminal actuator and this parameter is always positive.(Unit: unit/second)	REAL	Constant, D
Accelerati on	Additional acceleration of terminal actuator and this parameter is always positive.(Unit: unit/second2)	REAL	Constant, D
Decelerati on	Additive deceleration of terminal actuator and this parameter is always positive.(Unit: unit/second2)	REAL	Constant, D
Done	When the execution of MC_MoveSuperImposed is completed, "Done" turns on; when “Execute” is off, "Done" is reset.	BOOL	M,Q
Abort	When this instruction execution is aborted, "Abort" turns on; when “Execute” is off, "Abort" is reset.	BOOL	M,Q
Busy	When the instruction execution is aborted, "Busy" turns on; when “Done” is on or “Execute” is off, “Busy” is reset.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when “Execute” is off, "Error" is reset.	BOOL	M,Q

Parameter name	Explanation	Data type	Available device
ErrorID	Error code. Please refer to section 5.3.	UINT	D

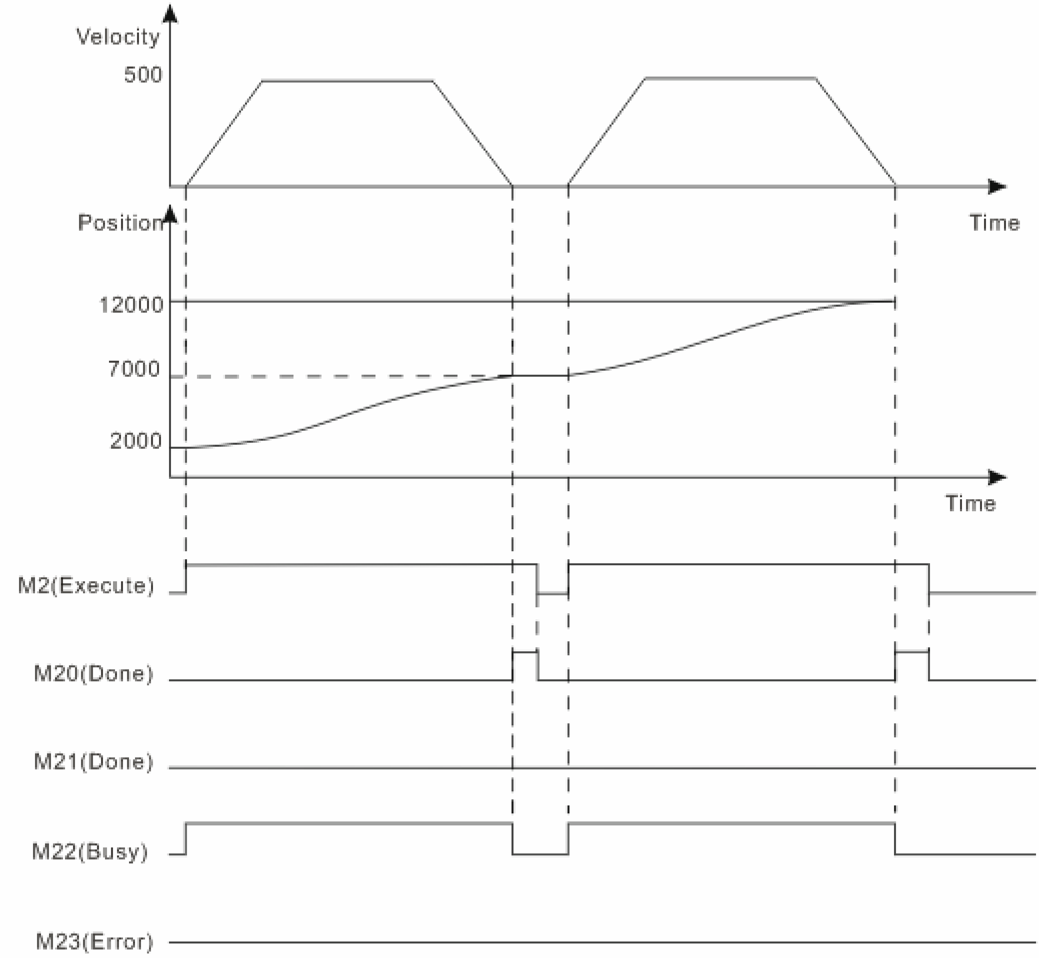
Note:

1. When MC_MoveSuperImposed instruction is being executed, "Execute": rising edge occurs, which does not impact the execution of the instruction.
2. When the velocity, acceleration and deceleration of the instruction are read and written via human-computer interface, their value types must be set as Double Word （Floating).

Program Example (1)



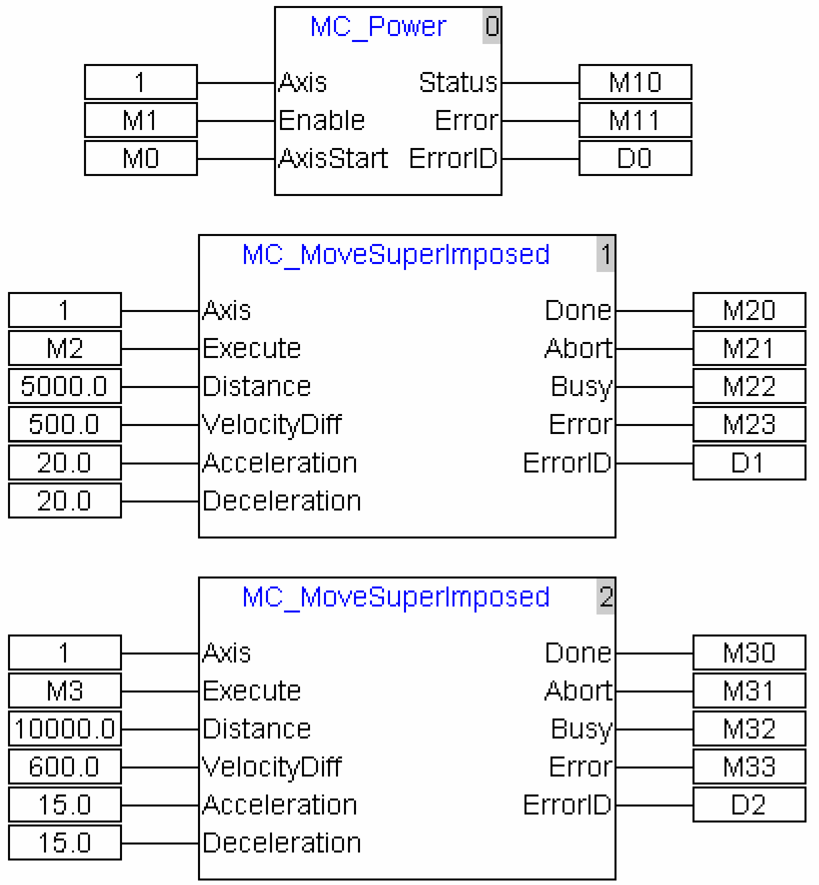
Motion diagram as below:



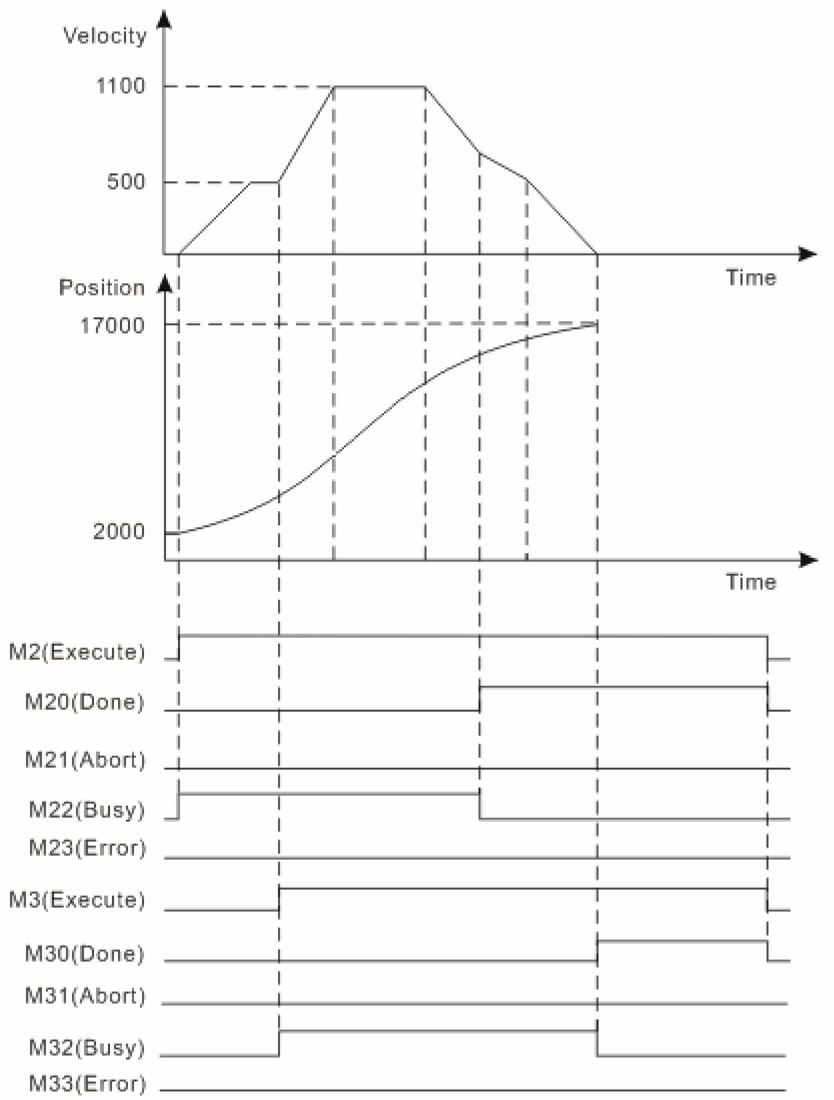
- When M2 turns Off→On, motion controller controls servo motor to rotate with current position as reference point. After servo motor completes the target distance, M20 of "Done" bit turns Off→On.
- When M2 turns On→Off, M20 of "Done" bit is reset.
- Servo motor completes the set distance, M2 turns Off→On again, motion controller sends command to control servo motor rotation, after servo motor completes the set distance, M20 of "Done" bit turns Off→On once again.

Program **Example (2)**

Two MC_MoveSuperImposed instructions in the same task list are matched for use as follows.



Motion diagram as below:



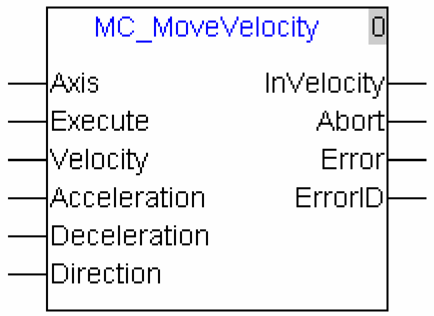
- When M2 turns Off→On, M22 of "Busy" turns Off→On and motion controller controls servo motor to rotate with current position as reference point. When M3 turns Off→On, M32 of "Busy" turns Off→On; the second MC_MoveSuperImposed instruction starts to be executed and the speed and acceleration of servo motor enter the superposition state respectively. When the position of the second MC_MoveSuperImposed instruction is completed, M30 of "Done" bit turns Off→On and M32 of "Busy" turns On→Off. When the position of the first MC_MoveSuperImposed instruction is completed, M20 of "Done" bit turns Off→On and M22 of "Busy" turns On→Off. The final distance is the addition of given distances for the two instructions.
- When M2 turns On→Off, M20 of "Done" bit is reset. When M3 turns On→Off, M30 of "Done" bit is reset.

4.4.5. MC_MoveVelocity

API	MC_ MoveVelocity	Velocity instruction	Controller
05			10MC11T

Explanation of the Instruction:

MC_MoveVelocity is applied to control the terminal actuator to move at the given acceleration and deceleration and finally it moves at the constant speed when reaching the given velocity. The execution of this instruction is completed after the speed of terminal actuator reaches the given speed but terminal actuator will still keep moving at this speed.



Explanation of input and output parameter of the instruction:

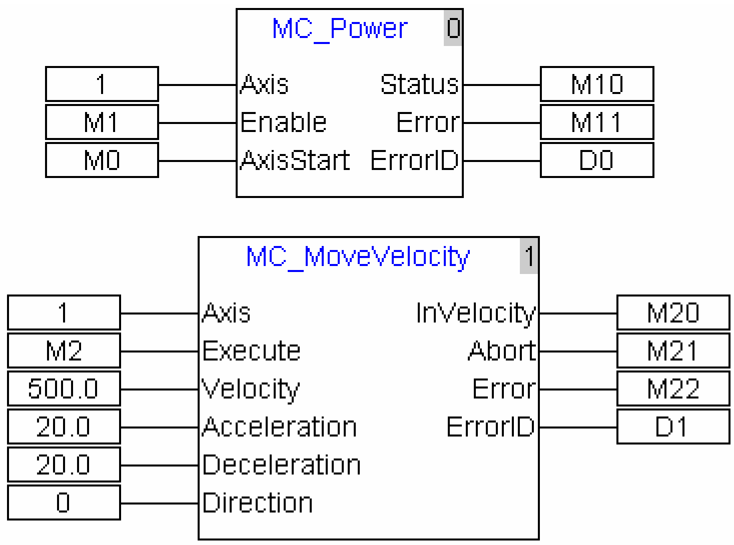
Parameter name	Explanation	Data type	Available device
Axis	The node address of servo drive	UINT	Constant, D
Execute	This instruction is executed when “Execute” turns Off -> On.	BOOL	M,I,Q, Constant
Velocity	The running speed of terminal actuator and it is always positive.(Unit: unit/second)	REAL	Constant, D
Acceleration	Acceleration of terminal actuator and this parameter is always positive.(Unit: unit/second2)	REAL	Constant, D
Deceleration	Deceleration of terminal actuator and this parameter is always positive.(Unit: unit/second2)	REAL	Constant, D
Direction	Direction for servo motor rotation 1: positive direction; -1: negative direction; 2: keeps the current direction (The current rotation direction is positive when the motor stops.)	INT	Constant, D
Invelocity	“Invelocity” bit is on when servo motor reaches the target position; “Invelocity” bit is reset when “Execute” turns On → Off.	BOOL	M,Q
Abort	When the execution of this instruction is interrupted before it reaches the target speed, "Abort" turns on; when “Execute” turns off, “Abort” is reset; when other instruction is executed after the velocity of this instruction reaches the given velocity, “Abort” of this instruction will not turn on.	BOOL	M,Q

Parameter name	Explanation	Data type	Available device
Error	If any error is detected, "Error" turns on; when “Execution” turns from on to off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to selection 5.3.	UINT	D

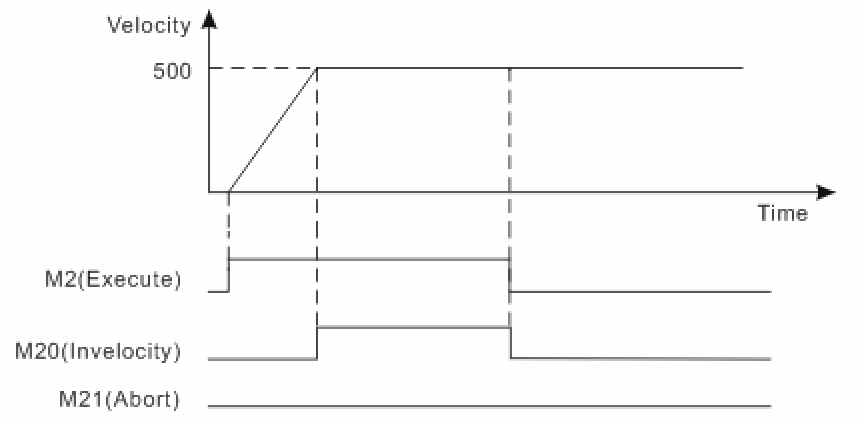
Note:

1. When MC-MoveVelocity instruction is being executed, “Execute”: rising edge occurs, which does not impact the execution of the instruction.
2. When the velocity, acceleration and deceleration of the instruction are read via human-computer interface, their value types must be set as Double Word （Floating).

Program Example (1)



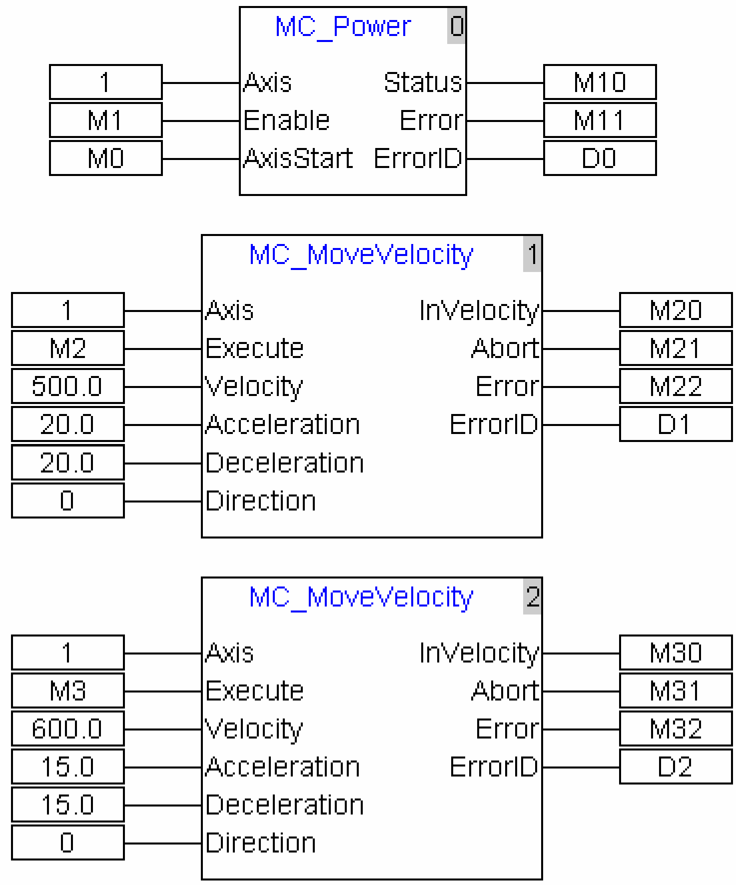
Motion diagram as below:



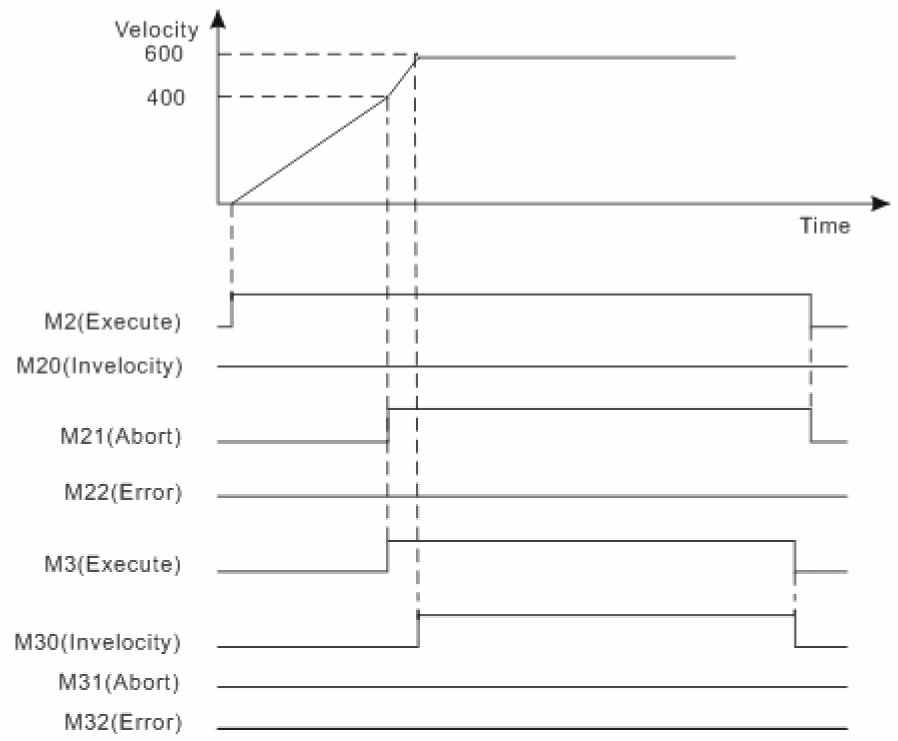
- When M2 turns Off→On, motion controller controls servo motor rotation; when servo motor reaches target velocity, M20 of "Invelocity" turns Off→On.
- M20 of "Invelocity" is reset when M2 turns On→Off.

Program Example (2)

Two MC_MoveVelocity instructions in the same task list are matched for use as follows.



Motion diagram as below:



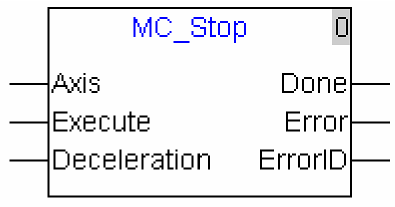
- Motion controller controls servo motor rotation as M2 turns Off→On; M3 turns Off→On when servo motor has not reached target speed; M21 of "Abort" of the first instruction turns Off→On and servo motor accelerates to the speed of the second MC_MoveVelocity instruction to run; M30 of "Invelocity" turns Off→On after servo motor is up to the target speed.
- M30 of "Invelocity" turns On→Off when M3 turns On→Off.

4.4.6. MC_Stop

API	MC_Stop	Stop instruction	Controller
06			10MC11T

Explanation of the Instruction:

MC_Stop is applied to control the terminal actuator to decrease the speed at the given acceleration till it stops moving. During execution of this instruction, any other instruction can not abort it.



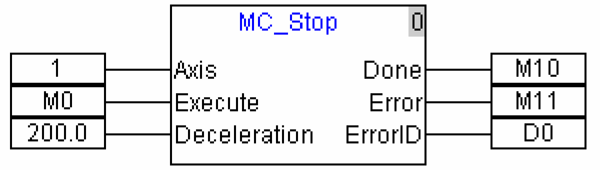
Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Axis	The node address of servo drive	UINT	Constant, D
Execute	This instruction is executed when “Execute” turns Off –> On.	BOOL	M,I,Q, Constant
Deceleration	Deceleration of terminal actuator and this parameter is always positive. (Unit: unit/second2)	REAL	Constant, D
Done	“Done” turns on as speed is decelerated to 0; “Done” bit is reset as “Execute” turns off.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to table 5.3.	UINT	D

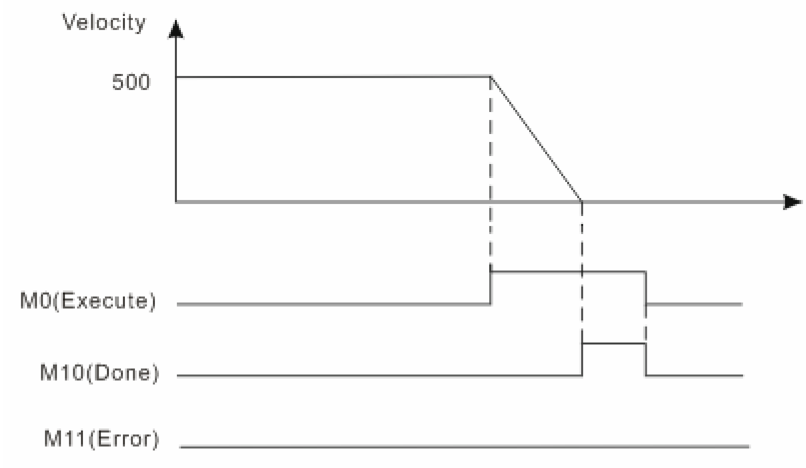
Note:

1. When MC_Stop instruction is being executed, “Execute”: rising edge occurs, which does not impact the execution of the instruction.
2. When the velocity, acceleration and deceleration of the instruction are read via human-computer interface, their value types must be set as Double Words (Floating).

Program Example (1)



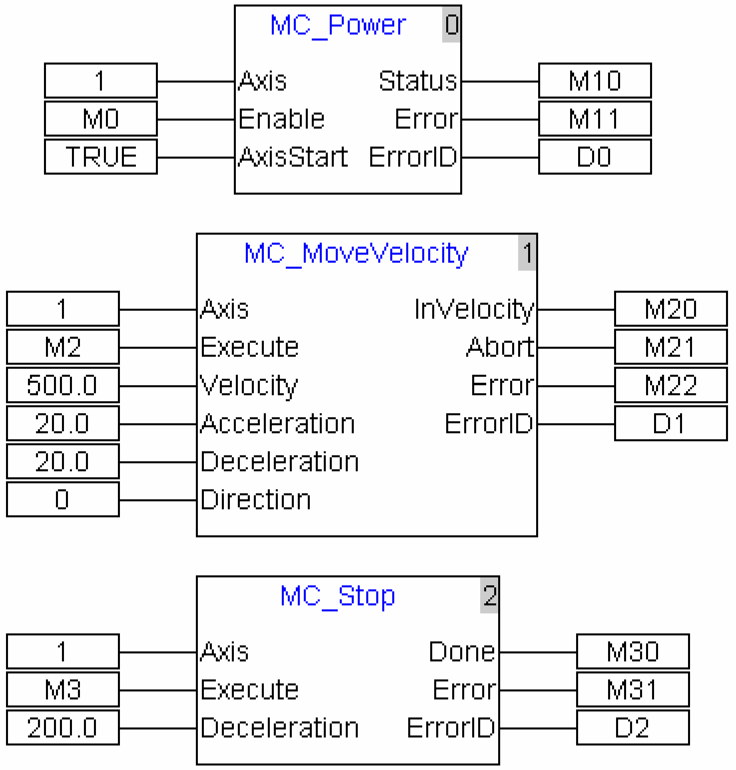
Motion diagram as below:



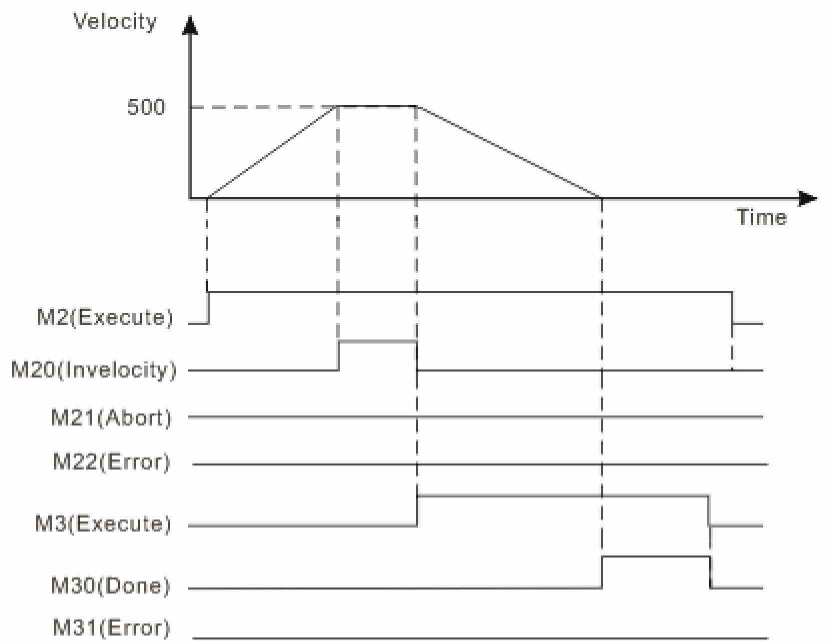
- When M0 turns Off→On, motion controller controls servo motor to decelerate; after servo motor speed reaches 0, M10 of "Done" turns Off→On.
- M10 of "Done" is reset when M0 turns On→Off.

Program Example (2)

MC_MoveVelocity and MC_Stop in the same task list are matched for use as follows.



Motion diagram as below:



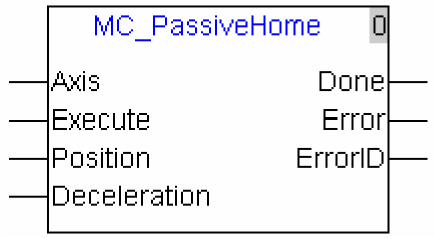
- When M2 turns Off→On, motor starts to rotate. When its rotation speed reaches the specified speed of MC_MoveVelocity instruction, M20 turns Off→On. When M3 turns Off→On, MC_Stop starts being executed. M30 of "Done" turns Off→On as the speed is decreased to 0.
- M30 of "Done" is reset as M3 turns On→Off.

4.4.7. MC_PassiveHome

API	MC_PassiveHome	Homing instruction	Controller
07			10MC11T

Explanation of the Instruction:

MC_PassiveHome is applied to control the servo motor to perform the homing action in mode and at the velocity that axis parameter gives. The homing mode and velocity are set in the interface of axis parameters setting.



Explanation of input and output parameter of the instruction:

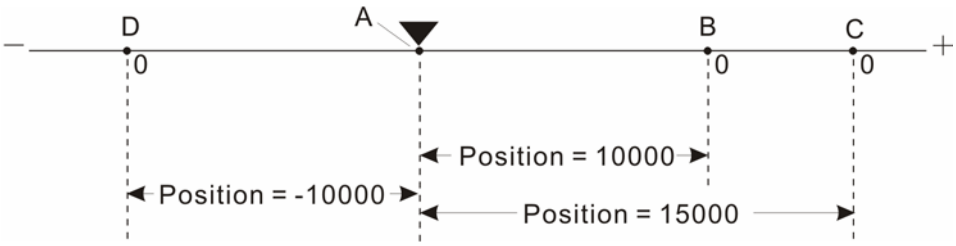
Parameter name	Explanation	Data type	Available device
Axis	The node address of servo drive	UINT	Constant, D
Execute	This instruction is executed when “Execute” turns Off –> On.	BOOL	M,I,Q, Constant
Position	Offset position of servo zero point, unit: Pulse.		
Deceleration	Deceleration of servo drive and this parameter is always positive.(Unit: Pulse/second2)	REAL	Constant, D
Done	“Done” turns on after zero homing is over; “Done” bit is reset as “Execute” turns off.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. See section 5.3.	UINT	D

Note:

1. MC_PassiveHome is a special instruction and the servo could connect the home switch and limit switches according to the homing mode selected.
2. While MC_PassiveHome instruction is being executed, “Execute”: rising edge occurs, which does not impact the execution of the instruction.
3. When the deceleration of the instruction is read via human-computer interface, its value type must be set as Double Word (Floating).
4. Position parameter defines the offset between the mechanical zero point and servo zero point as the figure below:

A	Mechanical zero point, where the photoelectric sensor is.
▼	The position is where the servo is after the execution of this instruction is finished.

For different Position value, the servo will eventually stop at the mechanical point A under the control of this instruction. But the reference zero point of the servo position makes the change as shown below.



As Position=10000, the reference zero point of the servo position is point B and point A position is -10000;

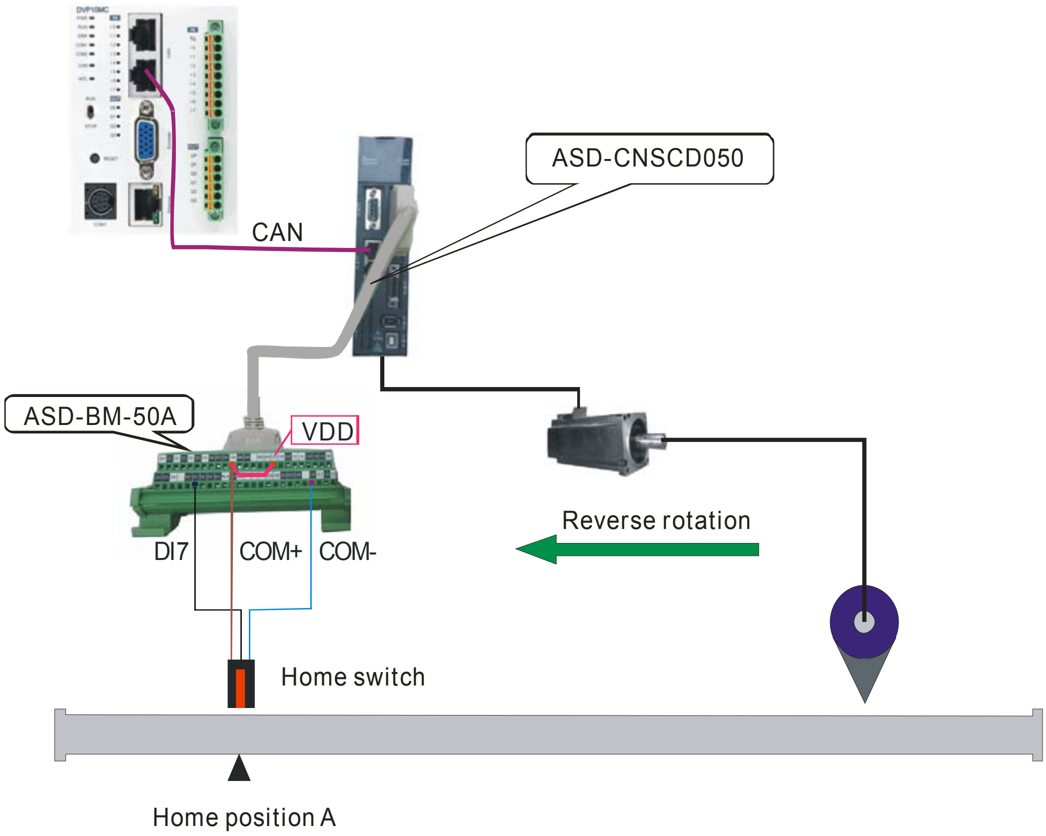
As Position=15000, the reference zero point of the servo position is point C and point A position is -15000;

As Position= -10000, the reference zero point of the servo position is point D and point A position is 10000.

Example

Select an appropriate homing mode via the positions of the mechanism and photoelectric switch. When M1 turns off -> on, the motion controller controls the servo motor to rotate and drive the mechanism to return to the mechanical zero point position A.

1) Hardware wiring



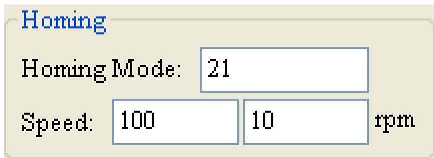
Note:

- During wiring, COM+ and VDD must be shorted.
- The brown terminal (24V+) of photoelectric switch is connected to COM+ its blue terminal (0V) is connected to COM- and its black terminal (Signal cable) is connected to DI7
- The DI7 function is set to the home switch, i.e. P2-16 is set to 124

2) Homing mode selection

It can be seen from the hardware wiring figure that the mechanism regards the home switch positon as the mechanical zero point position A. The home switch is in low bit before finding the home; During the mechanism is looking for the home, the servo rotates reversely at beginning and select homing mode 21 to achieve the homing.

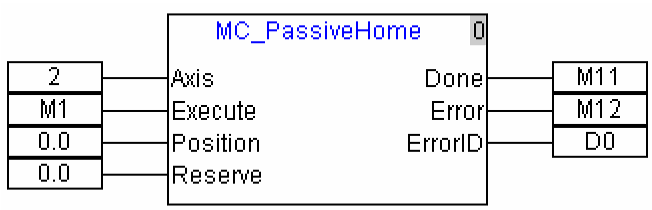
The settings for homing in the correspoinding axis parameters are as follows.



Homing mode	21
The first phase speed (To find the speed of home switch, Unit: r/m)	100
The second phase speed (The speed to reach the mechanical zero point after finding the home switch, Unit:r/m)	10

Note: The set axis parameters are valid after being downloaded.

3) Program control



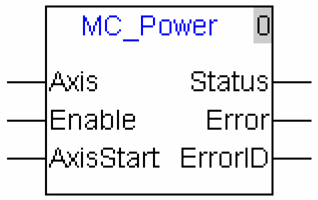
- ◆ When M1 turns off -> on, the motion controller controls the servo motor to rotate and drive the mechanism to return to the mechanical zero point position A.
- ◆ When meeting the home switch, the homing is finished and M11 is on.

4.4.8. MC_Power

API	MC_Power	Power control instruction	Controller
08			10MC11T

Explanation of the Instruction:

MC_Power is applied to enable or disable the corresponding servo axis.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Axis	The node address of servo drive	UINT	Constant, D
Enable	“Enable” turns Off –> On, this instruction is executed	BOOL	M,I,Q, Constant
AxisStart	When “AxisStart” turns on, “Enable” turns Off –> On and servo drive is enabled; When “AxisStart” turns off , “Enable” turns Off –> On and servo drive is disabled	BOOL	M,I,Q, Constant
Status	“Status” turns on after axis is enabled; if “Enable” is off, “Status” is reset.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when “Enable” turns On –> Off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

Note:

1. Axis can not be powered off or powered on as servo motor is running. At this moment, if "Power Off/On" action is performed, "Error" will turn on, but servo drive will not be impacted at all.
2. The motion control instructions can control the axis to do the corresponding motion after servo axis is powered on. Except for the virtual axis, all motion control instructions can not be executed when axis is powered off.

4.4.9. MC_Reset

API	MC_Reset	Reset instruction	Controller
09			10MC11T

Explanation of the Instruction:

MC_Reset is applied to clear the axis error state in 10MC and the axis alarm information. When virtual axis or axis configured in 10MC enters the state of ErrorStop which could be found via MC_ReadStatus, MC_Reset just can be executed. Otherwise, the error will be alarmed by executing the instruction.

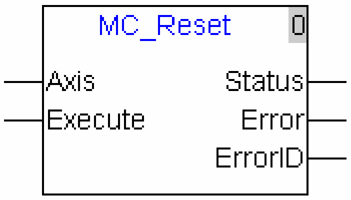
When axis alarms, offline or state machine switching problem happen, axis enters the state of ErrorStop and the motion instructions being executed will stop being executed. When axis alarms, executing the instruction could clear the alarm information of axis. After the execution of the instruction is finished, the axis status enters the state of Disable. For axis status explanation, see section 4.2.

When D6532=1, the alarm axis enters the state of ErrorStop in 10MC after axis alarms (excluding the alarm for meeting the limit in process of homing). After the instruction is executed, the axis alarm can be eliminated if “Done” is on; If “Error” bit is on, the axis alarm can not be eliminated and check if the factor causing the alarm still exists.

When D6532=0, the alarm axis will not enter the state of ErrorStop in 10MC after axis alarms and the axis alarm information can not be cleared via the instruction.

After axis is enabled, the axis which is offline will enter the state of ErrorStop in 10MC. And 10MC will try to make connection with the offline axis again. After the connection is made between 10MC and the offline axis again, the instruction is executed successfully and then10MC could control the offline axis again.

When axis has not been enabled, there is no state change for the axis which is offline in 10MC. After the connection is made between 10MC and the offline axis again, the motion instruction can be used for controlling the axis without execution of the instruction.

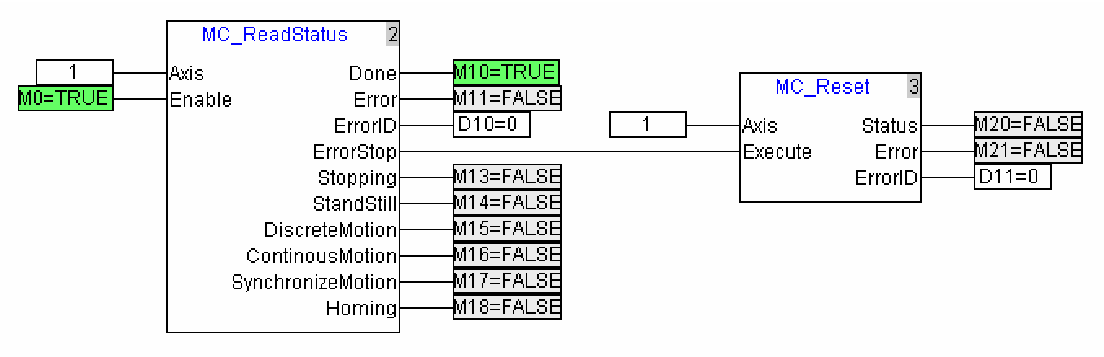


Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Axis	The node address of servo drive	UINT	Constant, D
Execute	This instruction is executed when “Execute” turns Off –> On.	BOOL	M,I,Q, Constant
Status	“Status” turns on after axis state in the controller is reset to StandStill state; “Execute” turns on -> off, “Status” is reset.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Execute" turns on -> off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

Exmaple:

When M0 is on, MC_ReadStatus will detect the state of the axis of number 1. When the axis of number 1 enters the state of ErrorStop due to offline or alarm, the ErrorStop bit of MC_ReadStatus is on and MC_Reset instruction is executed.

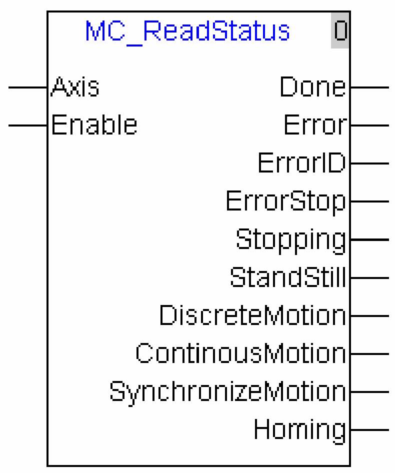


4.4.10. MC_ReadStatus

API	MC_ReadStatus	Read axis status	Controller
10			10MC11T

Explanation of the Instruction:

MC_ReadStatus is applied to read the servo axis state in the controller. For the details on the axis state, please refer to section 4.2.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Axis	The node address of servo drive	UINT	Constant, D
Enable	This instruction is executed when “Enable” turns on.	BOOL	M,I,Q, Constant
Done	When status reading is completed, "Done" turns on; when “Enable” turns on -> off, "Done" is reset.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Enable" turns on -> off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	M,Q
ErrorStop	“ErrorStop” turns on as axis in abnormal stop status; “ErrorStop” is reset as “Enable” turns on -> off.	BOOL	M,Q
Stopping	“Stopping” turns on as axis is in normal stop status;” Stopping” is reset as “Enable” turns on -> off.	BOOL	M,Q
StandStil	“StandStill” turns on as axis is in standstill status; “StandStill” is reset as “Enable” turns on -> off.	BOOL	M,Q
DiscreteMo tion	“DiscreteMotion” bit is on as axis is in discrete motion status; “DiscreteMotion” is reset as “Enable” turns on -> off.	BOOL	M,Q
Continous Motion	“ContinousMotion” bit is on as axis is in continuous motion status; “ContinousMotion” is reset as “Enable” turns on -> off.	BOOL	M,Q

Parameter name	Explanation	Data type	Available device
SynchronizeMotion	“SynchronizeMotion” is on as axis is in synchronous motion status; “SynchronizeMotion” is reset as “Enable” turns on -> off.	BOOL	M,Q
Homing	“Homing” bit turns on as axis is in homing status; “Homing” is reset as “Enable” turns on -> off.	BOOL	M,Q

Note:

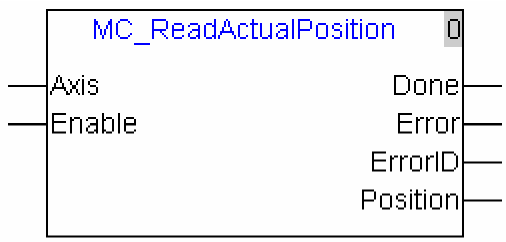
1. After the execution of this instruction is finished, the servo drive axis state will be reflected on the corresponding bit device.
2. This instruction triggered by high level will read the axis state constantly when “Enable” is on.

4.4.11. MC_ReadActualPosition

API	MC_ReadActualPosition	Read actual position	Controller
11			10MC11T

Explanation of the Instruction:

MC_ReadActualPosition is applied to read the actual position of the terminal actuator. This instruction triggered by high level will read the actual position of the terminal actuator constantly when “Enable” is on.



Explanation of input and output parameter of the instruction:

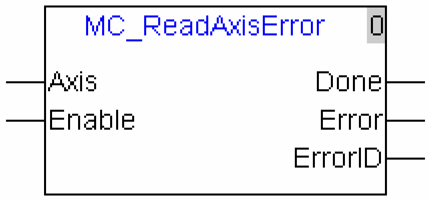
Parameter name	Explanation	Data type	Available device
Axis	The node address of servo drive	UINT	Constant, D
Enable	This instruction is executed as “Enable” turns on.	BOOL	M,I,Q, Constant
Done	When actual position reading is completed, ""Done" turns on; when “Enable” turns on -> off, "Done" is reset.	BOOL	M,Q
Error	I If any error is detected, "Error" turns on; when "Enable" turns on -> off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D
Position	The actual position of the terminal actuator. (Unit: unit)	REAL	D

4.4.12. MC_ReadAxisError

API	MC_ReadAxisError	Read axis error	Controller
12			10MC11T

Explanation of the instruction:

MC_ReadAxisError is applied to read the error information of the servo axis such as the alarm of an error or the state if servo axis is offline or not and so on, which are displayed on the panel of the servo drive. This instruction triggered by high level will read the axis error information when “Enable” is on.



Explanation of input and output parameter of the instruction:

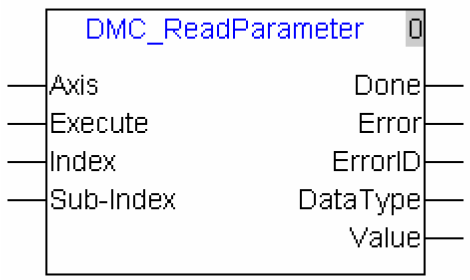
Parameter name	Explanation	Data type	Available device
Axis	The node address of servo drive	UINT	Constant, D
Enable	This instruction is executed when “Enable” turns on.	BOOL	M,I,Q, Constant
Done	After axis error reading is completed, "Done" turns on; when “Enable” is off, "Done" is reset.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Enable" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	1. When “Done” is on, “Error ID” is 1xxx（hex）which indicates the alarming of servo drive and xxx is the alarm code of servo drive. Eg. If alarm code of servo drive is AL303, “Error ID” is 1303(hex). 2. When “Done” is on, “Error ID” is 2000（hex）which indicates servo drive is offline maybe because there is a problem on the bus connection between 10MC and servo drive or the interference in the field is two strong. 3. When “Error” is on, Error ID value indicates the error cause for execution of the instruction. (For the explanation of ErrorID values, see section 5.3.)	UINT	D

4.4.13. DMC_ReadParameter

API	DMC_ReadParameter	Read parameters	Controller
13			10MC11T

Explanation of the Instruction:

DMC_ReadParameter is applied to read the parameter value of the servo axis. User could specify the index and sub-index of the parameter desired to be read.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Axis	The node address of servo drive	UINT	Constant, D
Execute	This instruction is executed when" Execute" turns Off –> On.	BOOL	M,I,Q, Constant
Index	To read the index of the parameter	UINT	Constant, D
Sub-Index	To to read the sub-index of the parameter	UINT	Constant, D
Done	When reading the parameter content is finished, "Done" turns on; when "execute" turn on -> off, "Done" is reset.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Execute" turns on -> off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D
Data Type	To read the data type of the parameter. 1: Byte 2: word 4: Double Word.	UINT	D
Value	The already read parameter value	UDINT	D

Note:

1. The data type of D device is identical to that of the read parameter when "Value" is D device and touch panel is used to monitor the parameter value.
2. The calculation formula of the index and sub-index corresponding to the servo drive parameter to be read is:

   Index= the address of the servo drive parameter (Hex) + 2000 (Hex), sub-index= 0

   For instance, the calculation of the index of the servo drive parameter P6-10 is:

   2000+060A (hexadecimal number of P6-10) =260A, sub-index= 0.

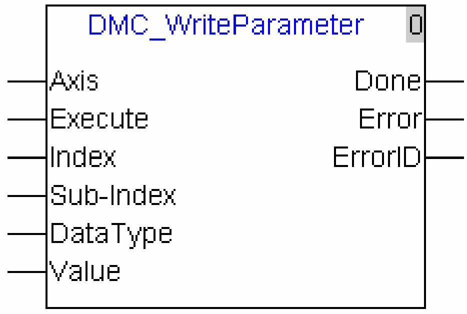
   The index and sub-index calculated here are both hex, please pay attention to the conversion for the input in the software.

4.4.14. DMC_WriteParameter

API	DMC_WriteParameter	Write parameters	Controller
14			10MC11T

Explanation of the Instruction:

DMC_WriteParameter is applied to set the parameter value of the servo axis. User could specify the index and sub-index of the parameter to be set.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Axis	The node address of servo drive	UINT	Constant, D
Execute	This instruction is executed when “Execute” turns off -> on.	BOOL	M,I,Q, Constant
Index	To write the index of the parameter	UINT	Constant, D
Sub-Index	To write sub-index of the parameter	UINT	Constant, D
Data Type	To write the data type of the parameter. 1: Byte 2 : word 4 : double word	UINT	D
Value	The written parameter value	UDINT	D
Done	When writing the parameter value is finished, "Done" turns on; when “Execute” turns on to off, "Done" is reset.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Execute" turns on -> off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

Note:

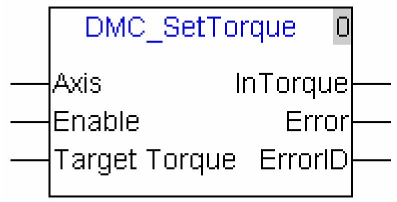
1. "Data Type" must be the data type of the written parameter. If the filled value is incorrect, the instruction will be alarmed that the error occurs with the error ID. The data type of D device is identical to that of the written parameter when "Value" is D device and touch screen is used to input data.
2. For the calculation method of the index and sub-index, please refer to section 4.4.13

4.4.15. DMC_SetTorque

API	DMC_SetTorque	Set torque	Controller
15			10MC11T

Explanation of the Instruction:

DMC_SetTorque is applied to set the torque of the servo axis. When this instruction is executed, the servo axis works in mode of torque.



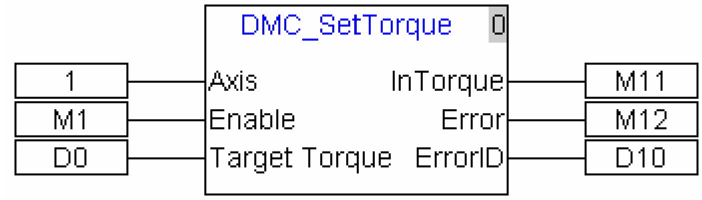
Explanation of input and output parameter of the instruction:

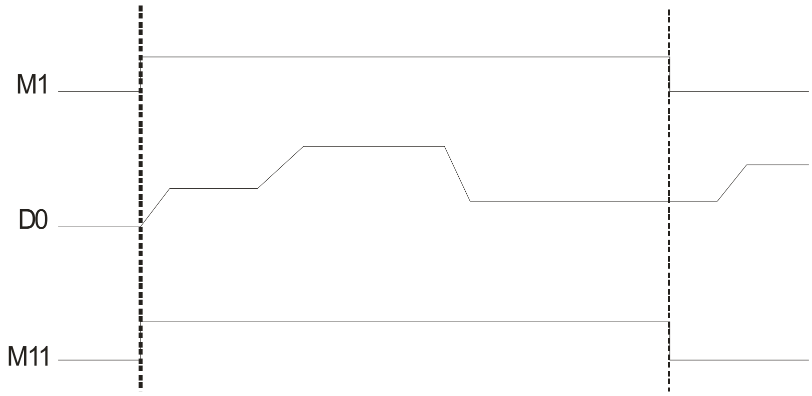
Parameter name	Explanation	Data type	Available device
Axis	The node address of servo drive	UINT	Constant, D
Enable	This instruction is executed when “Enable” is on.	BOOL	M,I,Q, Constant
TargetTorque	For setting the size of the torque needed; the torque size is denoted with the permillage, e.g. the setting is 30, so the set torque is 30‰ the rated torque. When “Enable” is on, the torque size wil directly be changed following the changing “TargetTorque”.	INT	Constant, D
InTorque	“InTorque” turns on as “Enable” is on; “InTorque” is reset as “Enable” is off	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Enable" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	Constant, D

Note:

1. When the input value of "TargetTorque" is positive, the servo will move forward; when "TargetTorque" is negative, the servo will move reversely.
2. As “Enable” is on, this instruction remains in the effective status. The torque size will directly be changed following the changing “TargetTorque”. This instruction can not be aborted by other instructions including “Stop” instruction. When this instruction is reset, the execution of it will be terminated and then other instruction can start to be executed.

Program Example





- When M1 of "Enable" is on, the instruction is in execution status and M11 is on. Torque size will changed accordingly if D0 value is changed.
- When M1 of " Enable" is off, the instruction stops being executed and M11 is reset

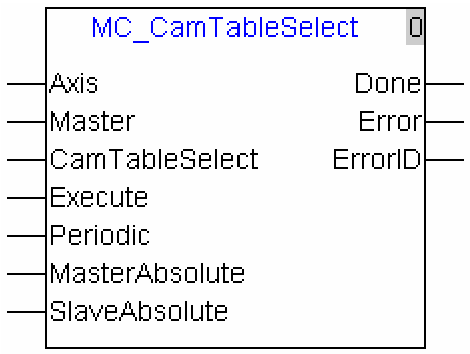
4.5. Multi-Axis Instruction

4.5.1. MC_CamTableSelect

API	MC_CamTableSelect	Select Cam table	Controller
64			10MC11T

Explanation of the Instruction:

MC_CamTableSelect is applied to choose the cam curve and meanwhile to specify the mode when master axis establishes the relation with the slave axis.



Explanation of input and output parameter of the instruction:

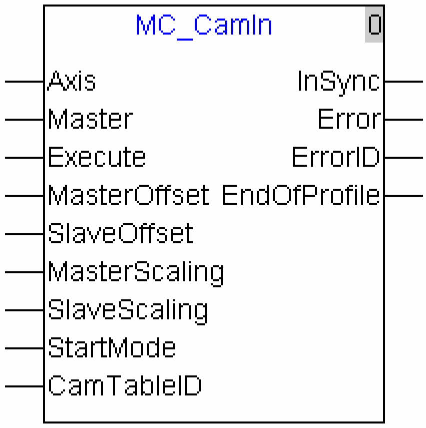
Parameter name	Explanation	Data type	Available device
Axis	The node address of slave axis	UINT	Constant,D
Master	The node address of master axis	UINT	Constant,D
CamTableSelect	Corresponds to serial number of CAM in CANopen Builder software. Setting range: 1~16.	UINT	Constant,D
Execute	This instruction is executed when “Execute” turns Off –> On.	BOOL	M,I,Q, Constant
Periodic	Slave axis will perform electronic CAM motion periodically as the parameter is 1; Slave axis will perform electronic CAM motion only for a cycle as the parameter is 0.	BOOL	M,I,Q, Constant
MasterAbsolute	Master axis is in absolute mode as the parameter is 1; Master axis is in relative mode as the parameter is 0. (This mode is explained in the note of MC_CamIn instruction).	BOOL	M,I,Q, Constant
SlaveAbsolute	Slave axis is in absolute mode as the parameter is 1; Slave axis is in relative mode as the parameter is 0. (This mode is explained in the note of MC_CamIn instruction)	BOOL	M,I,Q, Constant
Done	“Done” is on as setting cam parameter is successful; “Done” is reset as “Execute” is off.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

4.5.2. MC_CamIn

API	MC_CamIn	Cam-in instruction	Controller
65			10MC11T

Explanation of the Instruction:

MC_CamIn is applied to establish the cam relation between master axis and slave axis. When the cam relation is established, this instruction can be used to specify the offset value, scaling and start mode of the master axis and slave axis according to the application demand. After the execution of this instruction is completed, slave axis will make the motion following the master axis in accordance with the cam curve.



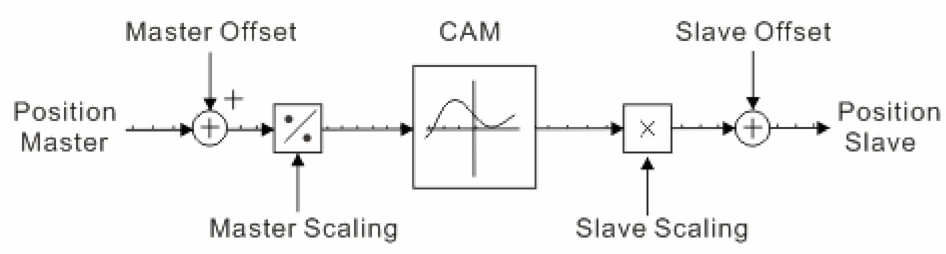
Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Axis	The node address of slave axis	UINT	Constant, D
Master	The node address of master axis	UINT	Constant, D
Execute	This instruction is executed when “Execute” turns Off –> On.	BOOL	M,I,Q, Constant
MasterOffset	The cam position offset of master axis. Unit: unit.	REAL	Constant, D
SlaveOffset	The cam position offset of slave axis. Unit: unit.	REAL	Constant, D
MasterScaling	The configuration parameter of master axis scaling, which is used for scaling the cam curve. (>0)	REAL	Constant, D
SlaveScaling	The configuration parameter of slave axis scaling, which is used for scaling the cam curve. (>0)	REAL	Constant, D
StartMode	Start mode: 0: start up by jumping to the positive target position immediately; 1: Start up by taking the shortest way; 2: start up toward positive direction; 3: start up toward negatively direction.	UINT	Constant, D
CamTableID	Corresponds to the node address of the electronic cam in CANopen Builder software. Setting range: 1~16.	UINT	Constant, D

Parameter name	Explanation	Data type	Available device
InSync	"InSync" turns on after master axis and slave axis establish the cam relation; When "Execute" turns off, InSync is reset.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset。	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D
EndOfProfile	If "MC_CamTableSelect" is executed and Periodic parameter is 0 (non-cyclic): "EndOfProfile" turns on after the execution of MC_CamIn is finished once; "EndOfProfile" is reset as "Execute" turns off.	BOOL	M,Q

Note:

1. In a cam system, to call one cam curve, "CamTableSelect" should be called to select the corresponding cam table first and then "CamIn" is executed; if the cam curve is to be changed into another one, "MC_CamTableSelect" is called again to select another cam table.
2. As axis is in absolute mode, the offset parameter (Master Offset or SlaveOffset) is valid but they can not be negative value; as axis is in relative mode, the offset parameter is invalid.
3. Electronic cam curve can be edited in CANopen Builder software and it defines the corresponding position relation between terminal actuators of master axis and slave axis with the unit: unit.
4. The position in the cam curve of master axis or slave axis is the remainder of actual axis position of divided by modulo; after MC_CamIn is executed, the method of calculating the meshing point in the cam curve is shown as below.



Slave position = f [(master position + master offset)/ master scaling]* slave scaling + slave offset

Method of calculating the master position in the above formula:

When master is in absolute mode, master position is the remainder of the current position of master axis divided by modulo;

When master is in relative mode, master position is the starting point position of master axis in the corresponding cam curve (usually 0).

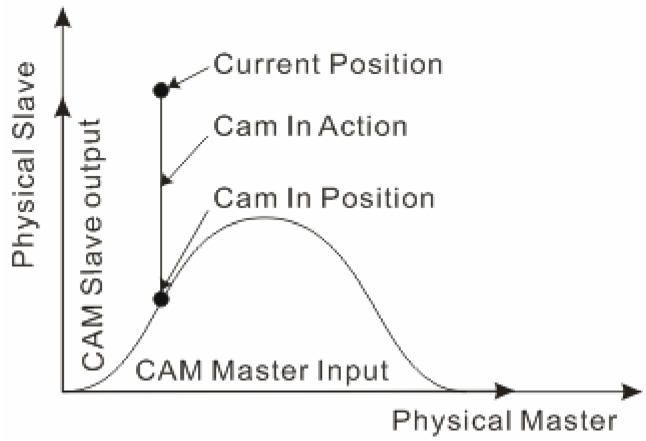
"f" in above formula represents the cam curve relation between master and slave axis. (CAM).

5. Relations between master/slave axis modes and start modes.

◈ Master axis is absolute and slave axis is absolute

➢ Relation explanation when master and slave axis are in absolute mode.

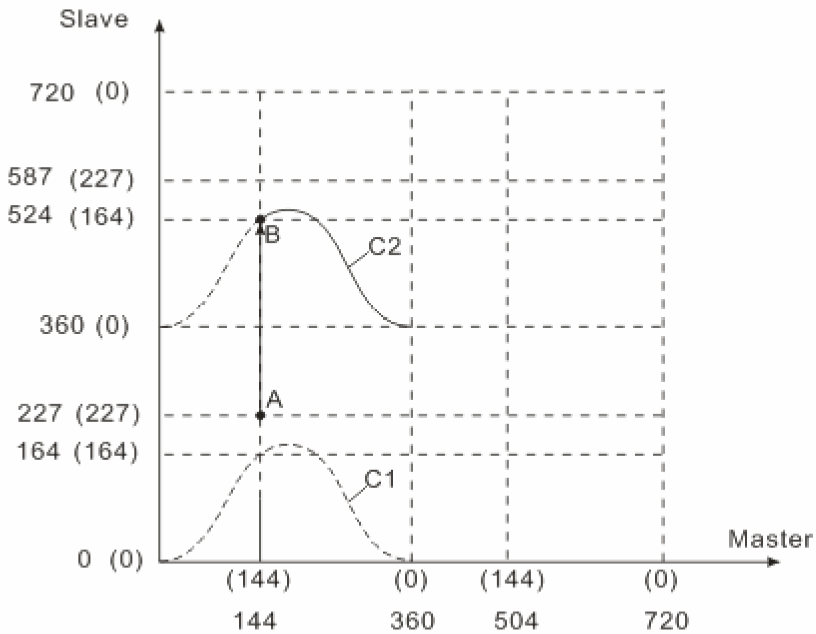
In the system where master and slave axis are in absolute mode, master axis starts moving with the physical position of current point as the starting position when CamIn is executed. Slave axis will make the cam motion following master axis with the current physical position corresponding to master position as the starting position, which conforms to the corresponding cam relation.



➢ StartMode parameters explanation

In the following figure, master and slave axis are both static before and after meshing. Point A is the position of master and slave axis before meshing; Point B is the meshing point; C1 is the preplanned cam curve and C2 is the electronic cam curve for actual motion.

❶ Start-up mode 0: start up by jumping to the positive target position immediately. In one synchronous cycle, slave axis jumps from current position to the target position. The meshing time is the shortest and the vibration is the strongest in process of meshing.



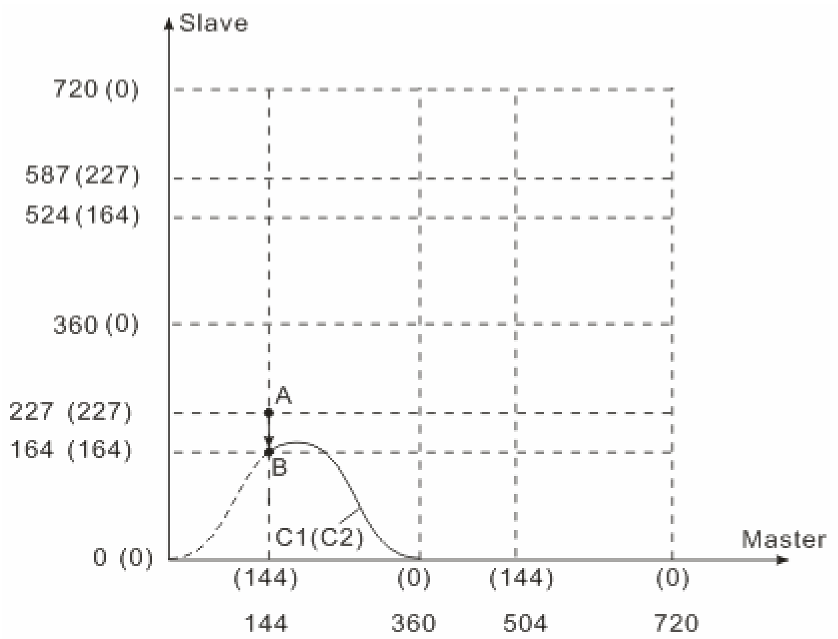
<1> When master axis is in absolute mode, master position in cam curve = (master position 144 + master offset 0) / master scaling 1 =144.

<2> From cam curve, slave position is 164 when master position is 144. Calculation method: f (144) =164.

<3> When slave axis is in absolute mode, slave position= 164* slave scaling 1 + slave offset 0 =164

<4> Because startup mode 0 is to start up by jumping to the positive target position direction immediately, slave axis need move from current position to the position 164 in the next cycle, i.e. actual position 524 and thus the coordinate of the meshing point B is (144, 524). When master axis moves, following master axis, slave axis starts to move from point B according to C2 curve.

❷ Start-up mode 1: start up toward the shortest distance and slave axis judges whether to mesh toward the positive or negative direction according to the distance between current position and target position. Slave axis moves from point A to point B to mesh with master axis at the max. speed, max acceleration and max deceleration in the axis parameters.



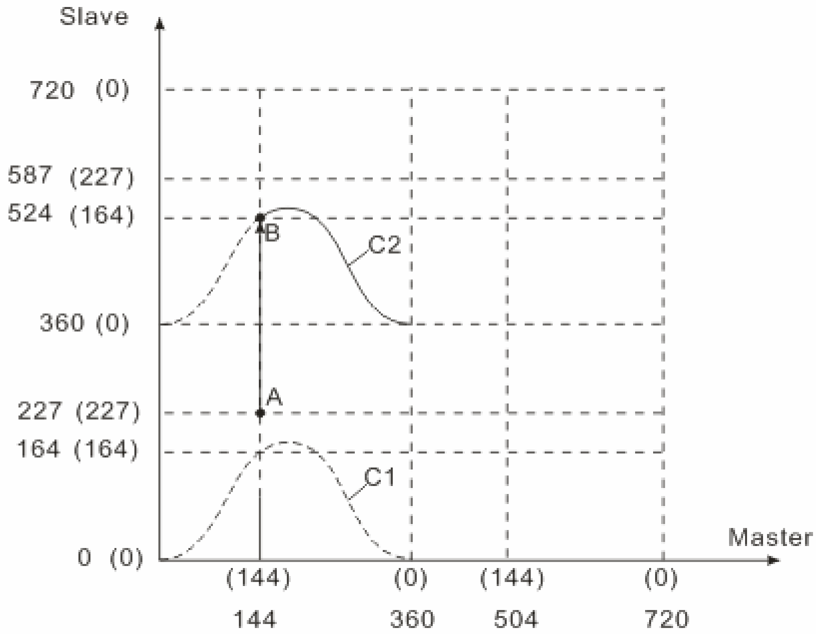
<1> When master axis is in absolute mode, master position in cam curve = (master position 144 + master offset 0) / master scaling 1 =144.

<2> From cam curve, slave position is 164 when master position is 144. Calculation method: f (144) =164.

<3> When slave axis is in absolute mode, slave position= 164* slave scaling 1 + slave offset 0 =164

<4> Because startup mode 1 is to start up toward the shortest distance and the position 164 in the current cycle is the most closest to current slave position, slave axis need move from current position to the position 164 in the current cycle, i.e. actual position 164 and thus the coordinate of the meshing point B is (144,164). When master axis moves, following master axis, slave axis starts to move from point B according to C2 curve.

❸ Start-up mode 2: start up toward positive direction. Slave axis moves from point A to point B to mesh with master axis at the max. speed, max acceleration and max deceleration.



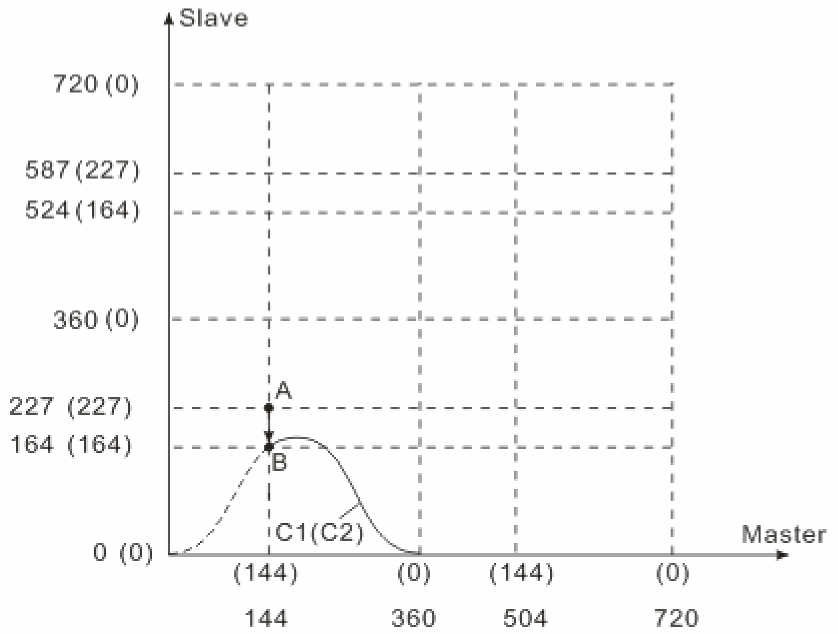
<1> When master axis is in absolute mode, master position in cam curve = (master position 144 + master offset 0) / master scaling 1 =144.

<2> From cam curve, slave position is 164 when master position is 144. Calculation method: f (144) =164.

<3> When slave axis is in absolute mode, slave position= 164* slave scaling 1 + slave offset 0 =164

<4> Because startup mode 2 is to rotate toward the positive direction, slave axis should move from current position to the position 164 in the next cycle, i.e. actual position 524 and thus the coordinate of the meshing point B is (144,524). When master axis moves, following master axis, slave axis starts to move from point B according to C2 curve.

❹ Start-up mode 3: start up toward negative direction. Slave axis moves from point A to point B to mesh with master axis at the max. speed, max acceleration and max deceleration



<1> When master axis is in absolute mode, master position in cam curve = (master position 144 + master offset 0) / master scaling 1 =144.

<2> From cam curve, slave position is 164 when master position is 144. Calculation method: f (144) =164.

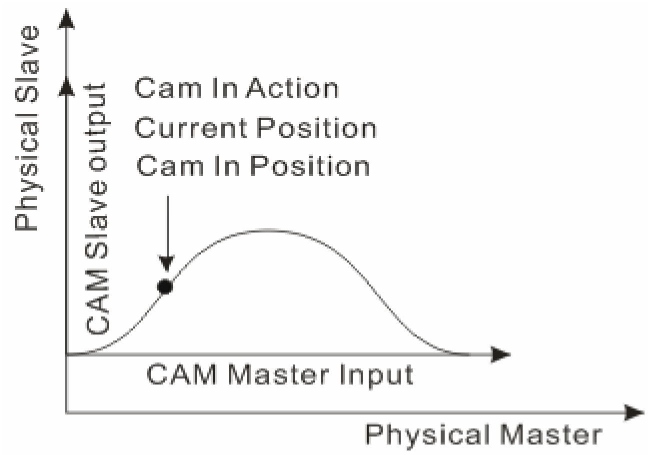
<3> When slave axis is in absolute mode, slave position= 164* slave scaling 1 + slave offset 0 =164

<4> Because startup mode 3 is to rotate toward the negative direction, slave axis need move from current position to the position 164 in the current cycle, i.e. actual position 164 and thus the coordinate of the meshing point B is (144,164). When master axis moves, following master axis, slave axis starts to move from point B according to C2 curve.

◈ Master axis is absolute and slave axis is relative

➢ Relation explanation when master axis and slave axis are in absolute and relative mode respectively

In the system where master and slave axis are in absolute and relative mode respectively, master axis starts moving with the physical position of current point as the starting point of the cam when “CamIn” is executed. Slave axis will make the cam motion following master axis with the current physical position corresponding to the master position as the starting position, which conforms to the corresponding cam relation).



➢ Explanation of StartMode parameters

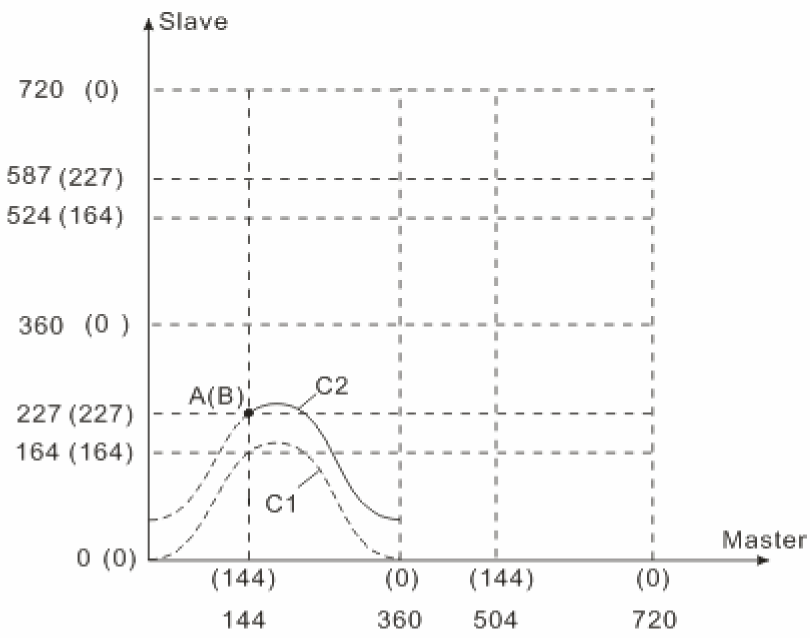
In the following figure, master and slave axis are both static before and after meshing. Point A is the position of master and slave axis before meshing; Point B is the meshing point; C1 is the preplanned electronic cam curve and C2 is the electronic cam curve for actual motion.

❶ Start-up mode 0 : Start up by jumping to the positive target position immediately (Point A overlaps with point B)

❷ Start-up mode 1: Start up by taking the shortest distance (Point A overlaps with point B)

❸ Start-up mode 2 : Start up toward the positive direction (Point A overlaps with point B)

❹ Start-up mode 3 : Start up toward the negative direction (Point A overlaps with point B)



<1> When master axis is in absolute mode, master position in cam curve
= (master position 144 + master offset 0) / master scaling 1 =144.

<2> From cam curve, slave position is 164 when master position is 144. Calculation method: f (144) =164.

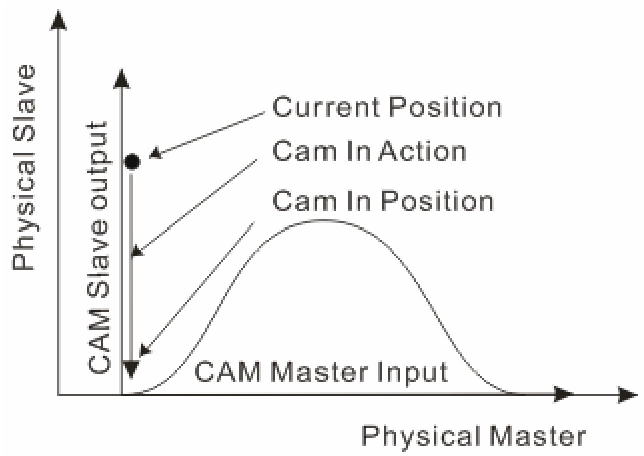
<3> When slave axis is in relative mode, slave position= 164* slave scaling 1 =164

<4> When slave axis is in relative mode as well as any start-up mode, its actual position at point B is 227 and the corresponding position in the cam curve is 164. And so the coordinate of the meshing point B is (144,227). When master axis moves, following master axis, slave axis starts to move from point B according to C2 curve

◈ Master axis is relative and slave axis is absolute

- Relation explanation when master and slave axis are in relative and absolute mode respectively.

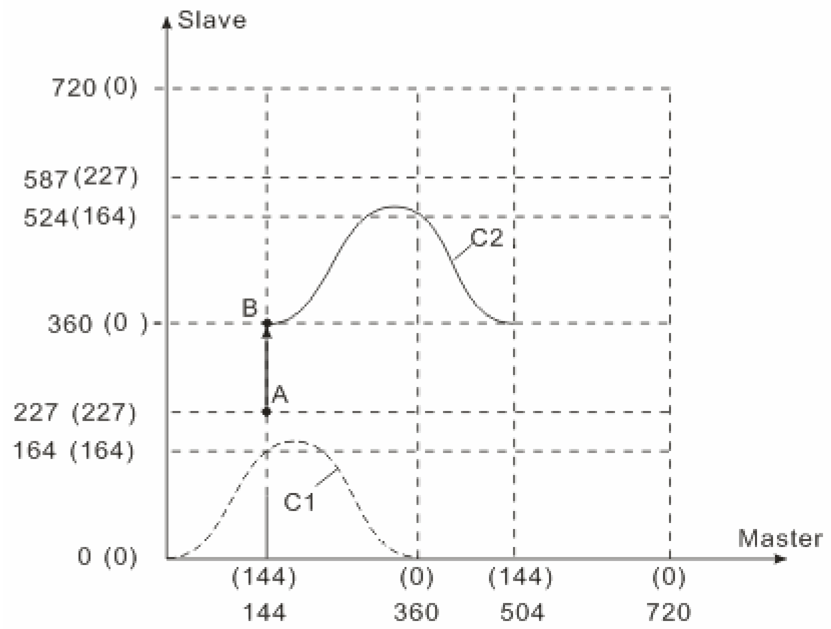
In the system where master and slave axis are in relative and absolute mode respectively, master axis starts moving with the physical position of current point as the starting point of the cam system when “MC_CamIn” is executed. Slave axis will start the cam motion following master axis from its position corresponding to the starting point of master axis in the cam system.



- StartMode parameters explanation:

In the following figure, master and slave axis are both static before and after meshing. Point A is the position of master and slave axis before meshing; Point B is the meshing point; C1 is the preplanned electronic cam curve and C2 is the electronic cam curve for actual motion.

❶ Start-up mode 2: Start up toward the positive direction. Slave axis moves in the positive direction from point A to point B at the max. velocity, acceleration and deceleration in axis parameters to mesh with master axis.



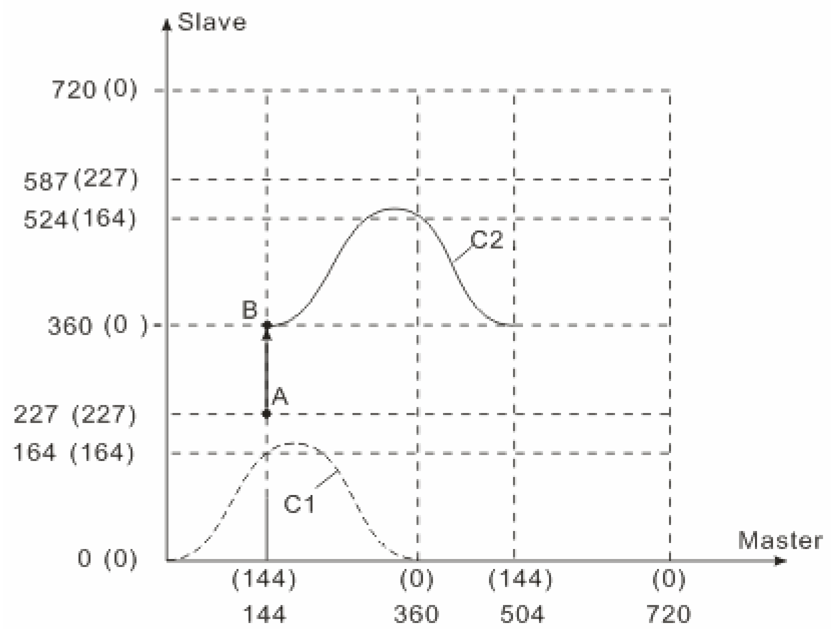
<1> When master axis is in relative mode, master position in cam curve = (master position 0 + master offset 0) / master scaling 1 =0.

<2> From cam curve, slave position is 0 when master position is 0. Calculation method: f (0) =0.

<3> When slave axis is in absolute mode, slave position= 0* slave scaling 1 + slave offset 0 =0

<4> Because startup mode 2 is to rotate toward the positive direction, slave axis need move from current position to the position 0 in the next cycle, i.e. actual position 360 and thus the coordinate of the meshing point B is (144, 360). When master axis moves, following master axis, slave axis starts to move from point B according to C2 curve.

❷ Start-up mode 3: Start up toward the negative direction. Slave axis moves in the negative direction from point A to point B at the max. velocity, acceleration and deceleration in axis parameters to mesh with master axis.



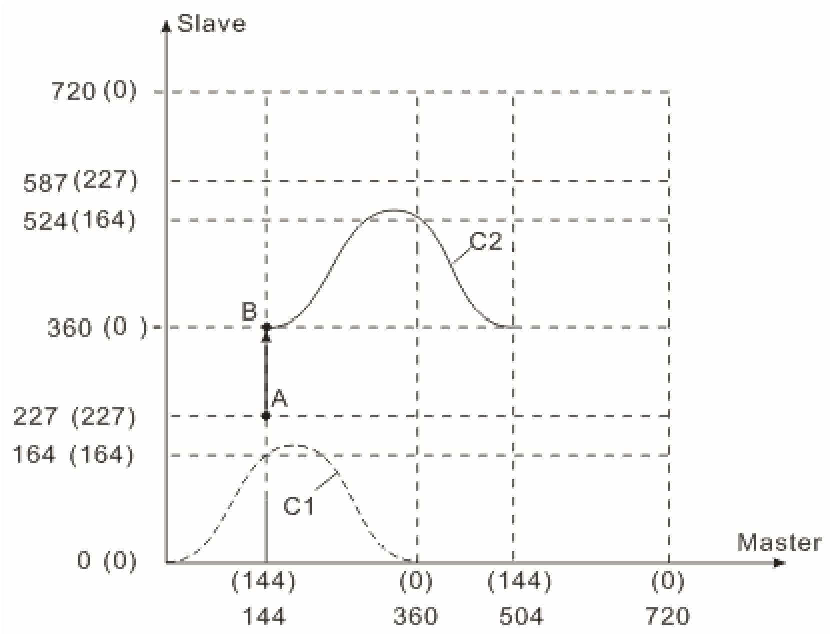
<1> When master axis is in relative mode, master position in cam curve = (master position 0 + master offset 0) / master scaling 1 =0.

<2> From cam curve, slave position is 0 when master position is 0. Calculation method: f (0) = 0.

<3> When slave axis is in absolute mode, slave position= 0* slave scaling 1 + slave offset 0 =0

<4> Because startup mode 3 is to rotate toward the negative direction, slave axis need move from current position to the position 0 in the current cycle, i.e. actual position 0 and thus the coordinate of the meshing point B is (144, 0). When master axis moves, following master axis, slave axis starts to move from point B according to C2 curve.

❸ Start-up mode 1: start up toward the shortest distance and slave axis judges whether to mesh toward the positive or negative direction according to the distance between current position and target position. Slave axis moves from point A to point B to mesh with master axis at the max. speed, acceleration and deceleration in the axis parameters.



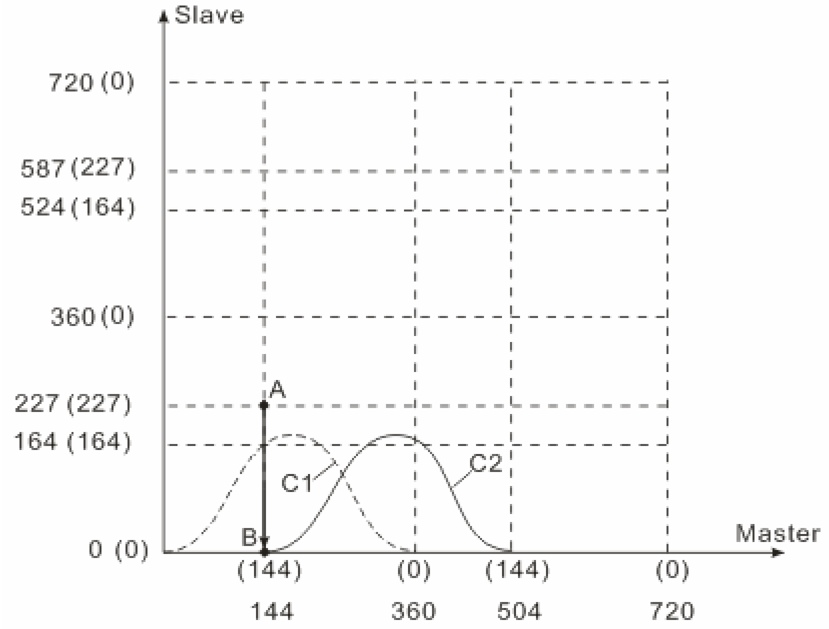
<1> When master axis is in relative mode, master position in cam curve = (master position 0 + master offset 0) / master scaling 1 =0.

<2> From cam curve, slave position is 0 when master position is 0. Calculation method: f (0) =0.

<3> When slave axis is in absolute mode, slave position= 0* slave scaling 1 + slave offset 0 = 0

<4> Because startup mode 1 is to start up toward the shortest distance and the position 0 in the next cycle is the most closest to current slave position, slave axis need move in negative direction from current position to the position 0 in the next cycle, i.e. actual position 360 and thus the coordinate of the meshing point B is (144, 360). When master axis moves, following master axis, slave axis starts to move from point B according to C2 curve.

❹ Start-up mode 0: start up by jumping to the positive target position immediately. In one synchronous cycle, slave axis jumps from point A to the point B to mesh with master axis.



<1> When master axis is in relative mode, master position in cam curve
= (master position 0 + master offset 0) / master scaling 1 = 0.

<2> From cam curve, slave position is 0 when master position is 0. Calculation method: f (0) =0.

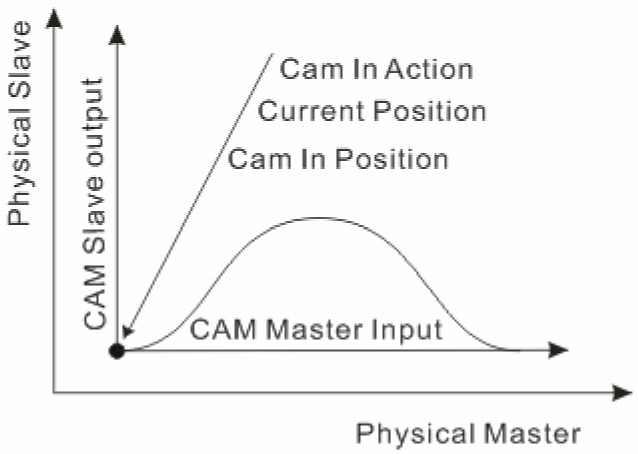
<3> When slave axis is in absolute mode, slave position= 0* slave scaling 1 + slave offset 0 =0

<4> Because startup mode 0 is to start up by jumping to the positive target position immediately, slave axis need move from current position to the position 0 in the next cycle, i.e. actual position 360 and thus the coordinate of the meshing point B is (144, 360). When master axis moves, following master axis, slave axis starts to move from point B according to C2 curve.

◈ Master axis is relative and slave axis is relative

➢ Relation explanation when master axis and slave axis are both in relative mode

In the system where master and slave axis are both in relative mode, master axis starts moving with the physical position of current point as the starting point of the cam system when "CamIn" is executed. Slave axis will start the cam motion following master axis with current physical position as the starting point.



➢ StartMode parameters explanation:

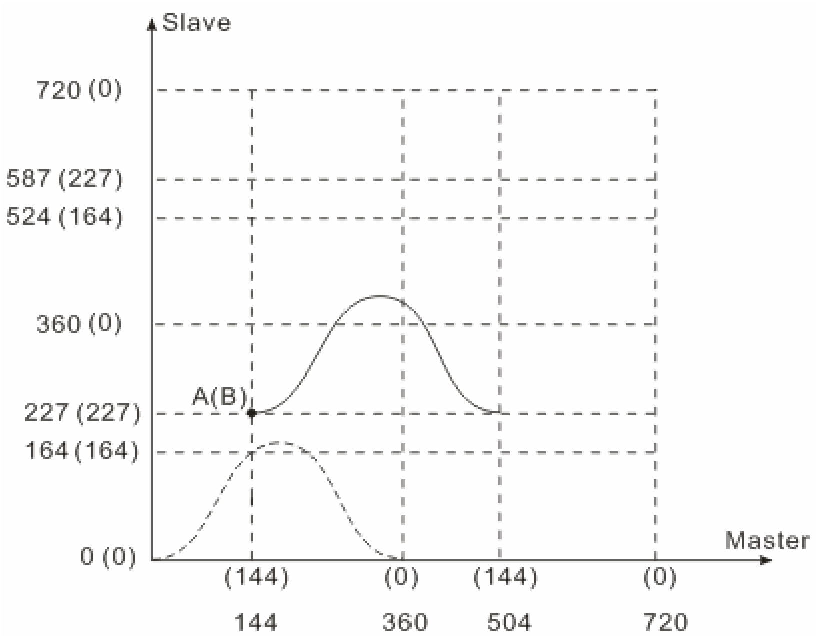
In the following figure, master and slave axis are both static before and after meshing. Point A is the position of master and slave axis before meshing; Point B is the meshing point; C1 is the preplanned electronic cam curve and C2 is the electronic cam curve for actual motion.

❶ Start-up mode 2 : Start up toward the positive direction (Point A overlaps with point B)

❷ Start-up mode 3 : Start up toward the negative direction (Point A overlaps with point B)

❸ Start-up mode 1: Start up by taking the shortest distance (Point A overlaps with point B)

❹ Start-up mode 0 : Start up by jumping to the positive target position immediately (Point A overlaps with point B)



<1> When master axis is in relative mode, master position in cam curve = (master position 0 + master offset 0) / master scaling 1 = 0.

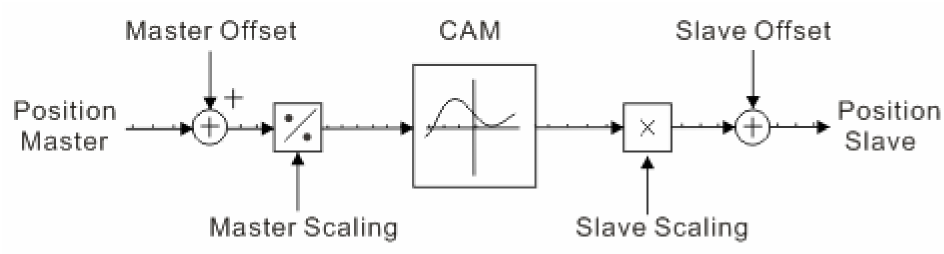
<2> From cam curve, slave position is 0 when master position is 0. Calculation method: f (0) = 0.

<3> When slave axis is in relative mode, slave position= 0* slave scaling 1 = 0

<4> When slave axis is in relative mode as well as any start-up mode, its actual position at point B is 227 and the corresponding position in the cam curve is 0. And so the coordinate of the meshing point B is (144, 227). When master axis moves, following master axis, slave axis starts to move from point B according to C2 curve.

6. Explanation of relation between scaling and offset

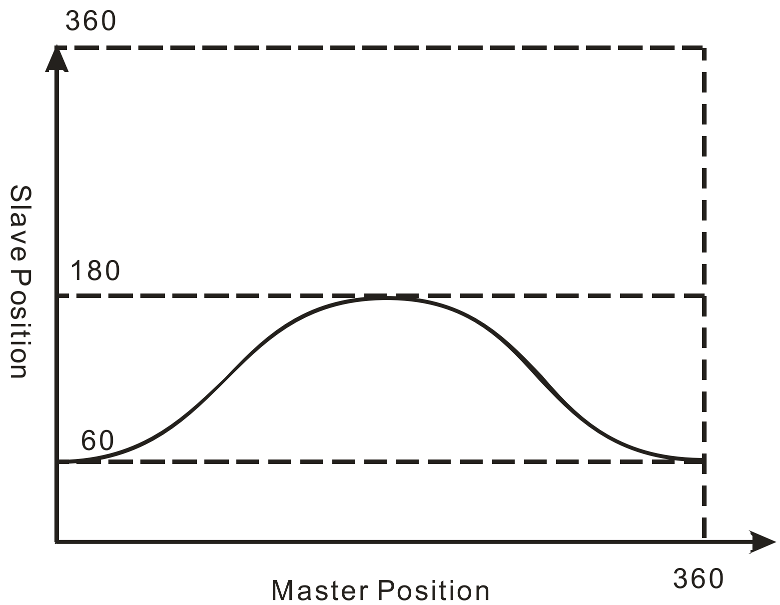
The same formula reflects the relation between scaling and offset as below.



Slave position = f [(master position + master offset)/ master scaling]* slave scaling + slave offset

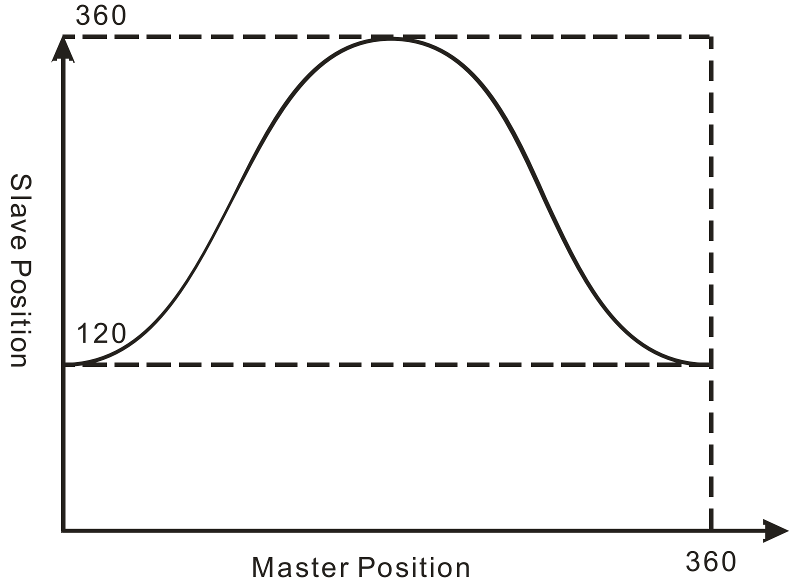
When the axis is in absolute mode, Master Offset or Slave Offset is valid but must not be negative value; when the axis is in relative mode, offset parameter is invalid. The scaling parameter is not affected by the absolute/ relative mode of master and slave axis.

- Master scaling =1, slave scaling = 1, master offset = 0, slave offset = 0



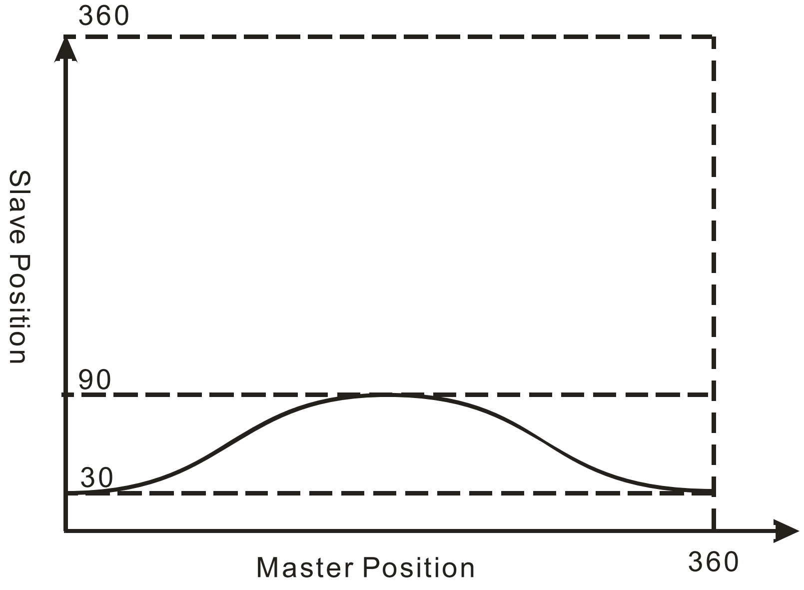
Suppose cam is planned as above figure, master and slave scaling are both 1, offsets are 0, the cam curve will not make any change.

◆ Master scaling =1, slave scaling = 2, master offset = 0, slave offset = 0



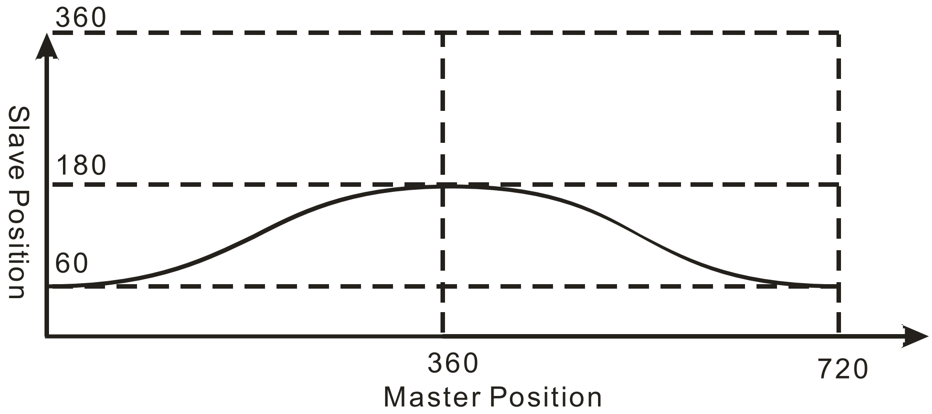
When master scaling =1, slave scaling = 2, master offset = 0, slave offset = 0, slave position is twice that in original cam curve.

◆ Master scaling =1, slave scaling = 0.5, master offset = 0, slave offset = 0



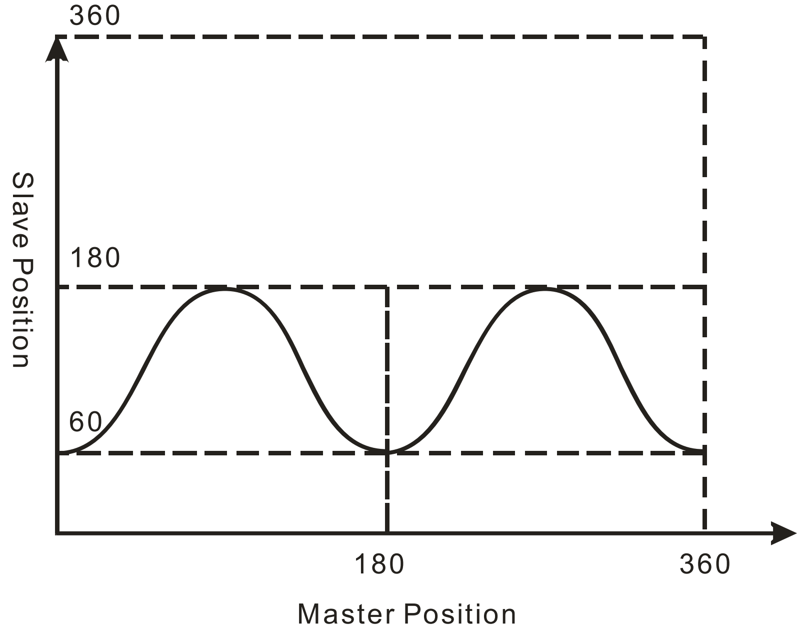
When master scaling =1, slave scaling = 0.5, master offset = 0, slave offset = 0, slave position is half of that in original cam curve.

◆ Master scaling = 2, slave scaling = 1, master offset = 0, slave offset = 0



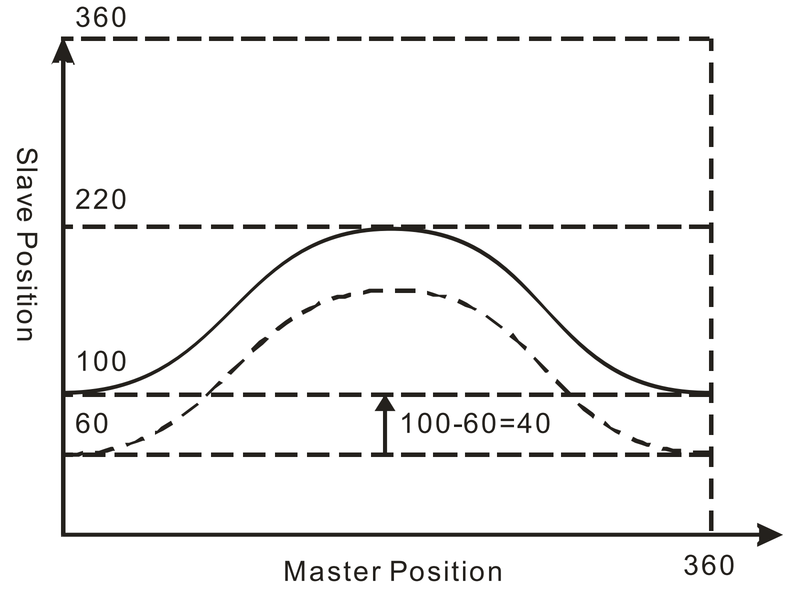
When master scaling = 2, slave scaling = 1, master offset = 0, slave offset = 0, the cam curve cycle is twice the original one and master axis takes 720°（360°*2）as the corresponding current cycle.

◆ Master scaling = 0.5, slave scaling = 1, master offset = 0, slave offset = 0



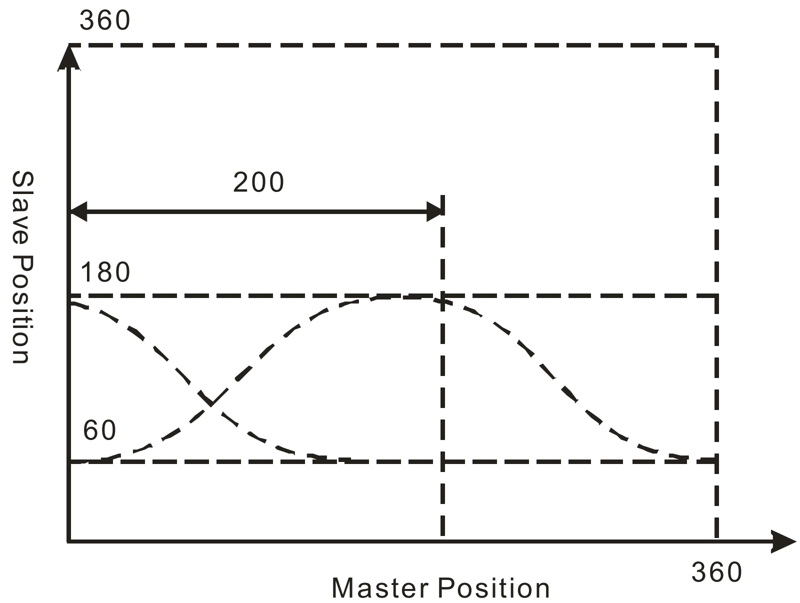
When master scaling = 0.5, slave scaling = 1, master offset = 0, slave offset = 0, the cam curve cycle is half of the original one and master axis takes180°（360°/2）as the corresponding current cycle.

◆ Master scaling =1, slave scaling = 1, master offset = 0, slave offset = 40



When master scaling = 1, slave scaling = 1, master offset = 0, slave offset = 40, slave position is that in the original cam curve plus 40°

◆ Master scaling =1, slave scaling = 1, master offset = 200, slave offset = 0

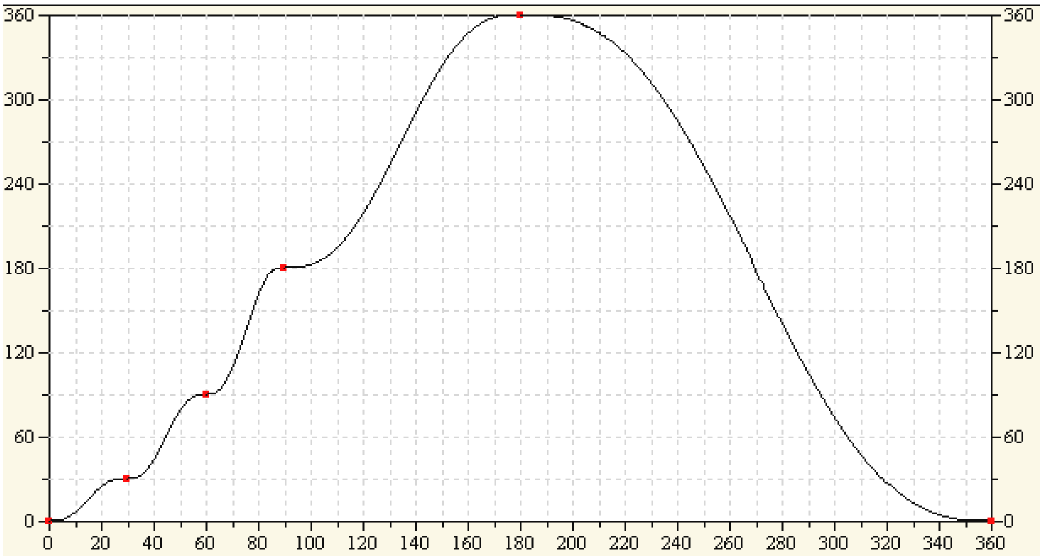


When master scaling = 1, slave scaling = 1, master offset = 200, slave offset = 0, slave position shifts 200 corresponding to the master position. When master position is 0, slave position is the 180 corresponding to the master position 200 in the original cam curve.

Electronic cam example:

The electronic cam curve parameters have impact on the actual cam curve. The following are explained in detail.

- The preplanned cam curve:



Element	Master Position	Slave Position	Velocity	Acceleration
Start Point	0.000000	0.000000	0.000000	0.000000
Point	30.000000	30.000000	0.000000	0.000000
Point	60.000000	90.000000	0.000000	0.000000
Point	90.000000	180.000000	0.000000	0.000000
Point	180.000000	360.000000	0.000000	0.000000
End Point	360.000000	0.000000	0.000000	0.000000

Conditions:

Parameter name	Value& explanation
Modulo for master and slave axis	360
Scaling for master and slave axis	2
Master offset	30
Slave offset	30
Master axis: absolute/ relative	Absolute
Slave axis: absolute/relative	Absolute
Cycle/non-cycle	Cycle
Start-up mode	Jump to the positive target position

- Calculation of the coordinate of the key point in the corresponding cam curve

  Current position (30, 180), module is 360 and thus the point corresponding to the cam curve is (30, 180), i.e. point A in the figure. The corresponding point position in cam curve can be calculated via the following formula.

  Slave position = f [(master position + master offset) / master scaling] * slave scaling + slave offset

- Calculation of slave position:

  Master position in the cam curve = (master position 30 + master offset 30) / master scaling 2 = 30

  From cam curve, slave position is 30 when master position is 30. Calculation method: f (30) = 30.

  Slave position= 30* slave scaling 2 + slave offset 30 =90

  Therefore, the coordinate of the first point is (30, 90), i.e. point B in the figure after "MC_CamIn" is executed.

  While master axis is moving, slave axis will cyclically follow master axis to move according to the cam curve with pint B as the starting point.

- Actual master and slave position corresponding to the terminal point of cam curve

  Actual master position:

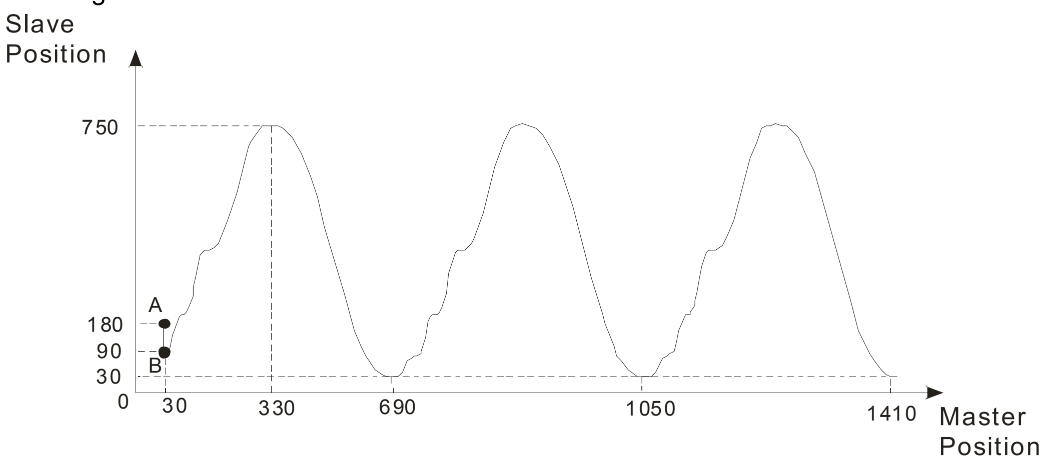
  From step 2, master position need move 330 from position 30 to complete one cam cycle. Since master scaling is 2, actually master axis need move another 660 from current position, i.e. 30+660=690.

  Actual slave position:

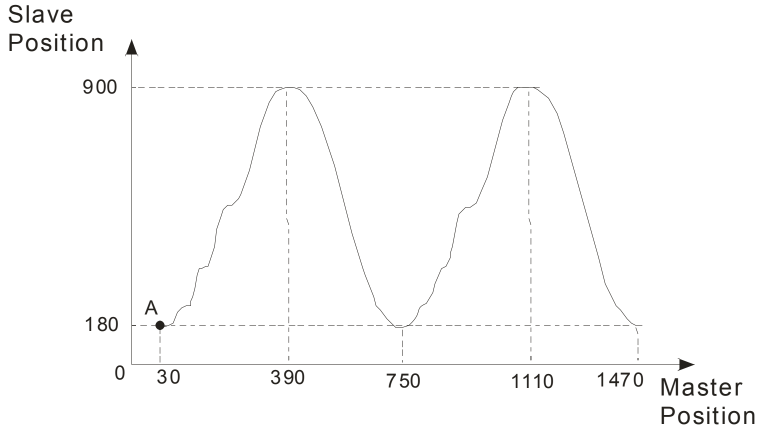
  From step 2, f (30) =30, therefore slave axis need move 330 so as to reach max. value. Since slave scaling is 2, actually slave axis need move another 660 from current position before reaching the max. value, i.e. 90+660=750.

  Since slave scaling is 2, the difference between max. and min. of actual slave position is 360*2=720 and the actual slave position corresponding to terminal point of cam curve is 750-720=30. Therefore, the axis position corresponding to terminal point is (690, 30).

- Curve figure for actual motion:



- When master and slave axis are in relative mode, the position curve figure for the actual motion is displayed below:



- Derivation process of the coordinates of the key point is shown below:
  - Current master position is 30; when master axis is in relative mode, master position corresponding to cam curve is 0 and any offset is invalid.
  - Master position in cam curve = (master position 0 + master offset 0)/ master scaling 2 = 0
  - It can be seen from cam curve that slave position is 0 when master position is 0. Calculation method: f (0) =0.
  - Slave position = 0* slave scaling 2 + slave offset 0 = 0. Therefore, after “MC_CamIn” is executed, the coordinate of the first point is current point (30,180) which corresponds to the point (0, 0) in the cam curve.
  - Actual master and slave position corresponding the terminal point of cam curve
- Actual master position:

  It can be seen from cam curve that master axis need move 360 from point (0, 0) to complete one cam cycle. Since master scaling is 2, actually master axis need move another 720 from current position to complete one cycle, i.e. 30+720=750.
- Actual slave position:

  It can be seen from cam curve that slave axis need move 360 to reach the max. value starting from point (0, 0). Since slave scaling is 2, actually slave axis need move another 720 from current position so as to reach the max. value, i.e. 180+720=900.

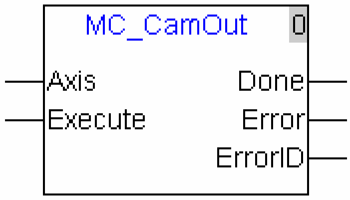
  The actual slave position corresponding to the terminal point of cam curve is 900-720=180 and so the axis position corresponding to terminal point is (750,180).

4.5.3. MC_CamOut

API	MC_CamOut	Cam-out instruction	Controller
66			10MC11T

Explanation of the instruction:

This instruction is applied to disconnect the cam relation between master and slave axis. After the cam relation is disconnected, slave will keep moving at the speed when the cam relation is disconnected.

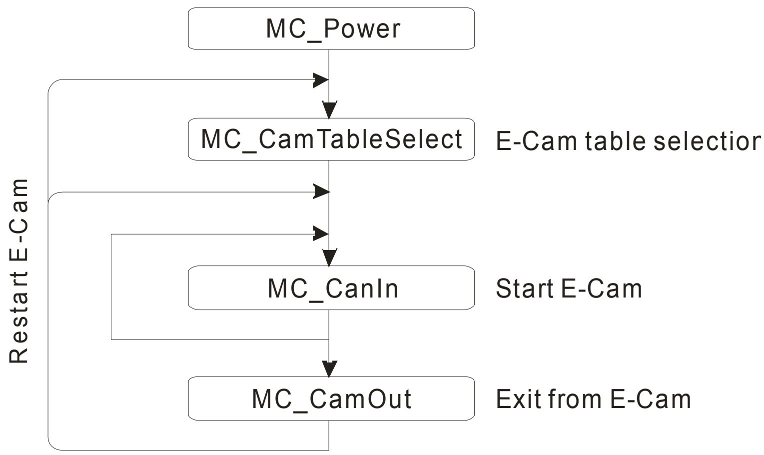


Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Axis	The node address of slave axis	UINT	Constant, D
Execute	This instruction is executed when “Execute” Off –> On.	BOOL	M,I,Q, Constant
Done	"Done" is on as executing "MC_CamOut" is finished; "Done" is reset as “Execute” is off.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

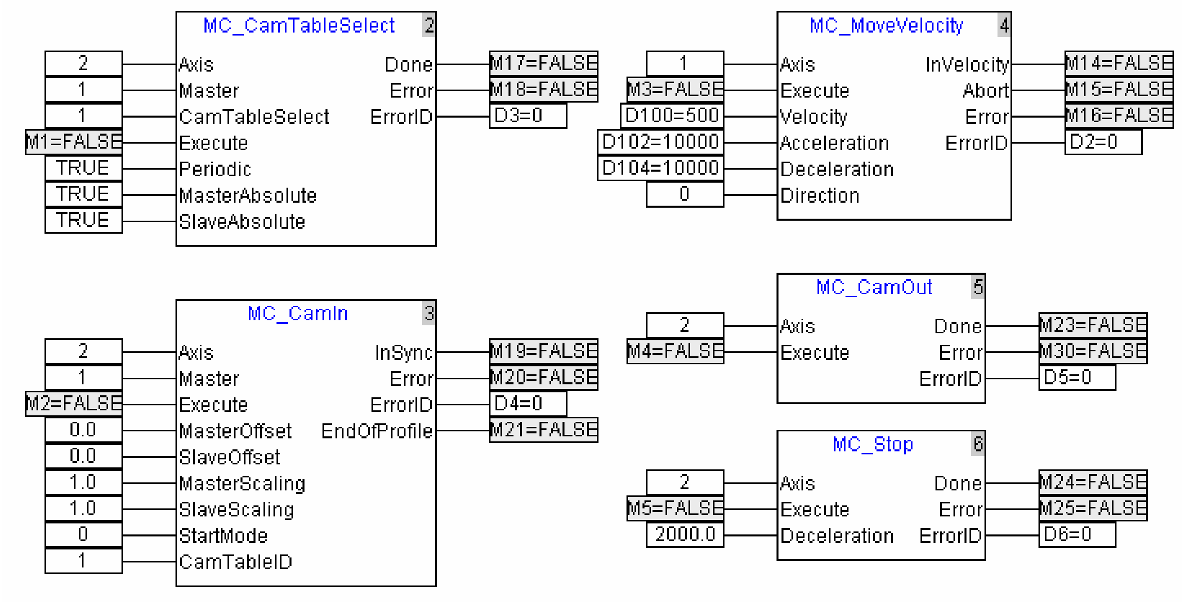
Note:

1. In E-Cam system, slave axis will keep running at the speed of the departure point if it succeeds in escaping from cam relation via MC_CamOut instruction.
2. The sequence for execution of the instructions related with electronic cam:

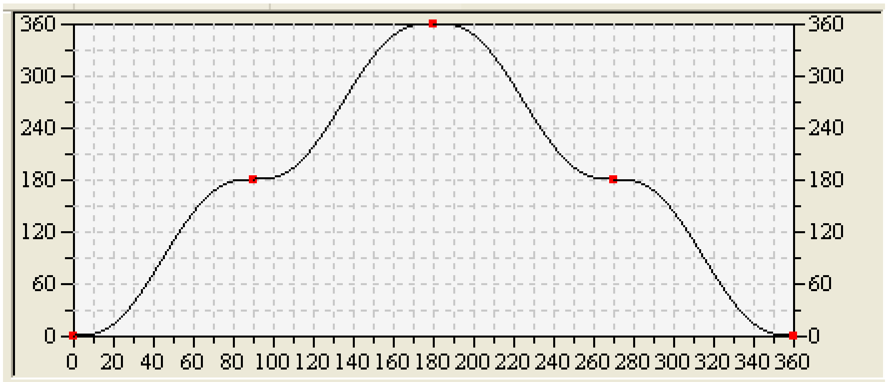


Program Example:

The following example describes the corresponding motion state when and after cam relation is established or when cam relation is disconnected via CAM-related instructions.



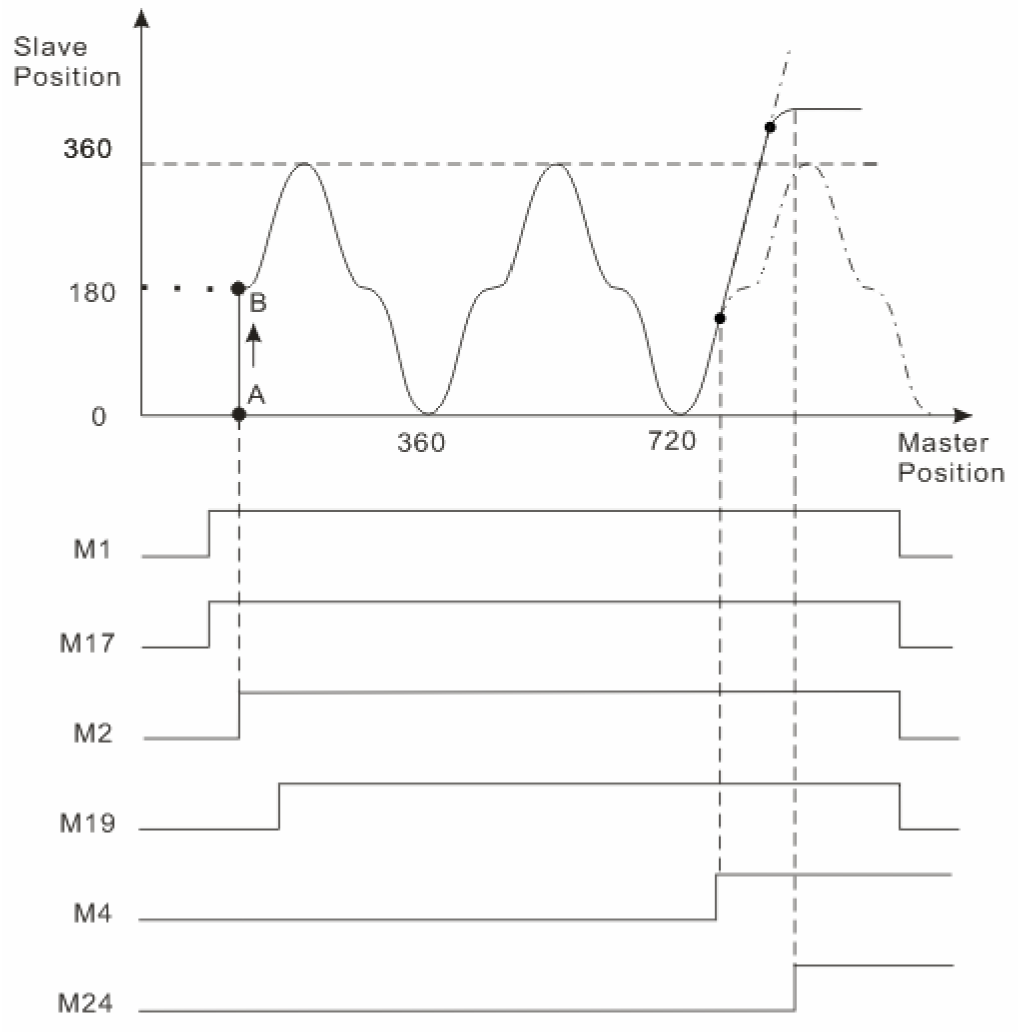
When CamTableID is 2, the corresponding curve is planned as below:



Element	Master Position	Slave Position	Velocity	Acceleration
Start Point	0.000000	0.000000	0.000000	0.000000
Point	90.000000	180.000000	0.000000	0.000000
Point	180.000000	360.000000	0.000000	0.000000
Point	270.000000	180.000000	0.000000	0.000000
End Point	360.000000	0.000000	0.000000	0.000000

Motion curve:

Suppose the current physical positions of axis 2 and axis 1 are 0 and 90 respectively, i.e. point A below and the two axes have been enabled. The motion curve is shown below after the cam function is performed.



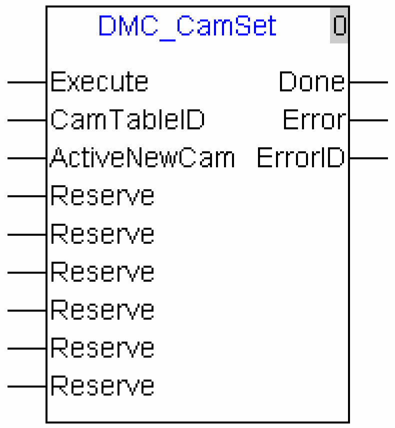
- ◆ As M1 turns Off ->On, “CamTableSelect” is executed. M17 is on after the execution of “CamTableSelect“ is finished.
- ◆ As M2 turns Off ->On, “CamIn” is executed. According to cam meshing method, we can see that slave axis will jump from point A to point B immediately and meanwhile, M19 is on.
- ◆ As M3 turns Off ->On, master axis executes the velocity instruction and slave axis will start the motion following master axis according to cam curve.
- ◆ As M4 turns Off ->On, “CamOut” is executed and the master-slave relation is disconnected; Slave axis will move at the speed when master-slave relation is disconnected.
- ◆ As M5 turns Off ->On and M24 is on, slave axis stops moving and master axis moves at a constant speed.

4.5.4. DMC_CamSet

API	MC_CamSet	Set cam	Controller
67			10MC11T

Explanation of the instruction:

The instruction is applied to modify the relevant parameters of the cam.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Execute	"DMC_CamSet" instruction is executed as "Execute" turns Off –> On.	BOOL	M,I,Q, Constant
CamTableID	The corresponding CAM (electronic CAM table) serial no. in CANopen Builder software. Range: 1~16.	UINT	Constant, D
ActiveNewCam	When "ActiveNewCam" is on and "Execute" is on the rising edge, the revised cam curve is activated.	BOOL	M,I,Q, Constant
Reserve	——	——	——
Done	"Done" is set on after cam parameter setting is completed.	BOOL	M,Q
Error	"Error" is set on if any error is detected; if "Execute" goes off from on, "Error" is reset.	BOOL	M,Q
ErrorID	Error codes. Please refer to section 5.3.	UINT	D

Note:

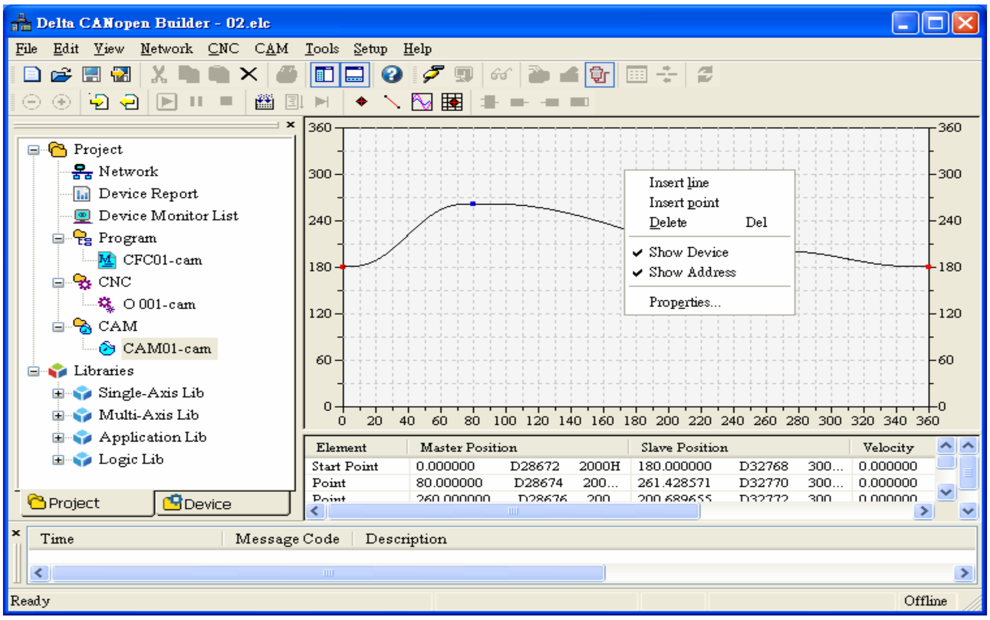
1. DVP10MC11T provides 2048 electronic cam key points and the parameter of every key point is set via 4 registers. The key point register is used to modify electronic cam curve dynamically and its register value can be revised through communication and program.

The register number of the key point and the corresponding communication address are shown below.

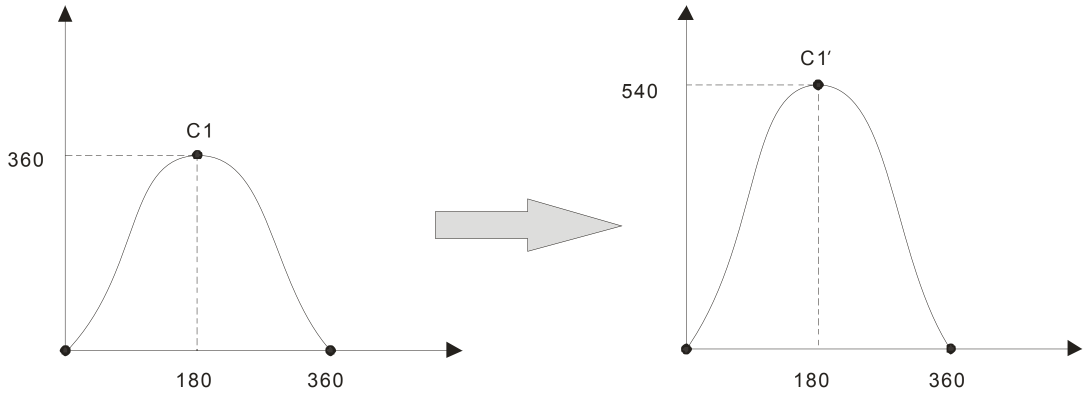
Key point serial no.	Master axis position		Slave axis position		Velocity		Acceleration	
	D register no.	MODBUS address (hex)	D register no	MODBUS address (hex)	D register no.	MODBUS address (hex)	D register no.	MODBUS address (hex)
1	D28672	2000	D32768	3000	D36864	4000	D40960	5000
	D28673	2001	D32769	3001	D36865	4001	D40961	5001
2	D28674	2002	D32770	3002	D36866	4002	D40962	5002
	D28675	2003	D32771	3003	D36867	4003	D40963	5003
3	D28676	2004	D32772	3004	D36868	4004	D40964	5004
	D28677	2005	D32773	3005	D36869	4005	D40965	5005
4	D28678	2006	D32774	3006	D36870	4006	D40966	5006
	D28679	2007	D32775	3007	D36871	4007	D40967	5007
5	D28680	2008	D32776	3008	D36872	4008	D40968	5008
	D28681	2009	D32777	3009	D36873	4009	D40969	5009
6	D28682	200A	D32778	300A	D36874	400A	D40970	500A
	D28683	200B	D32779	300B	D36875	400B	D40971	500B
7	D28684	200C	D32780	300C	D36876	400C	D40972	500C
	D28685	200D	D32781	300D	D36877	400D	D40973	500D
8	D28686	200E	D32782	300E	D36878	400E	D40974	500E
	D28687	200F	D32783	300F	D36879	400F	D40975	500F
9	D28688	2010	D32784	3010	D36880	4010	D40976	5010
	D28689	2011	D32785	3011	D36881	4011	D40977	5011
10	D28690	2012	D32786	3012	D36882	4012	D40978	5012
	D28691	2013	D32787	3013	D36883	4013	D40979	5013
11	D28692	2014	D32788	3014	D36884	4014	D40980	5014
	D28693	2015	D32789	3015	D36885	4015	D40981	5015
12	D28694	2016	D32790	3016	D36886	4016	D40982	5016
	D28695	2017	D32791	3017	D36887	4017	D40983	5017
…	…	…	…	…	…	…	…	…
	…	…	…	…	…	…	…	…
2047	D32764	2FFC	D36860	3FFC	D40956	4FFC	D45052	5FFC
	D32765	2FFD	D36861	3FFD	D40957	4FFD	D45053	5FFD
2048	D32766	2FFE	D36862	3FFE	D40958	4FFE	D45054	5FFE
	D32767	2FFF	D36863	3FFF	D40959	4FFF	D45055	5FFF

Note: The data type of the key point register is 32-bit floating number. To change the master axis position of the key point serial no 2048, write the master axis position into D32766.

The key point number and its corresponding communication address can also be checked in the following CANopen Builder software.



2. Suppose two cam curves are built in CANopen Builder. There are 3 points for the first cam curve, 5 points for the second cam curve, and so there are totally 8 key points for the electronic cam curve (the sum of the key points for the first cam curve plus the key points for the second cam curve). The register parameter with serial no. 4 is the first point parameter of the second cam curve, for other register parameters, the corresponding point of the second curve can be presumed in the same way
3. The revised key point parameter of electronic cam is effective immediately if “MC_ CamSet” is executed first and then “MC_CamIn” is executed. Otherwise, The revised key point parameter of electronic cam is ineffective till the old cam curve cycle is over

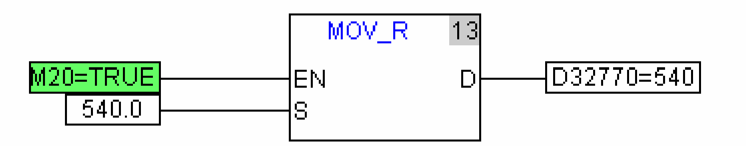


Curve 1 is changed into curve 1´ as above in process of running.

From curve 1, you can see three key points of e- cam with the serial no 1, 2, and 3 respectively corresponding to the special D in the following table.

Key point serial no.	Master axis position	Slave axis position	Velocity	Acceleration
1	D28672=0	D32768=0	D36864=0	D40960=0
2	D28674=180	D32770=360	D36866=0	D40962=0
3	D28676=360	D32772=0	D36868=0	D40964=0

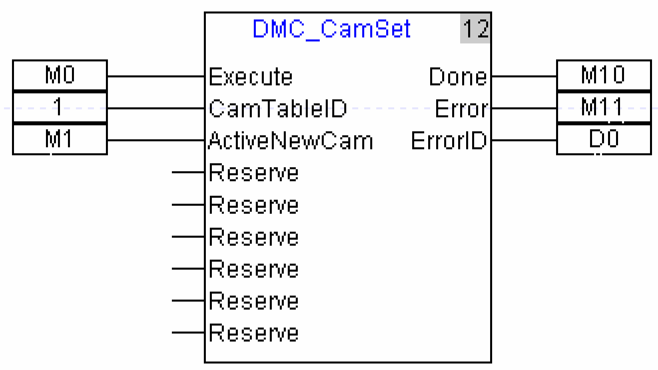
From the figures above, you can see the slave axis position of the second key point need be modified, i.e. the value of D32770 need be done. Modify the value from 360 to 540 via the instruction "MOV-R".



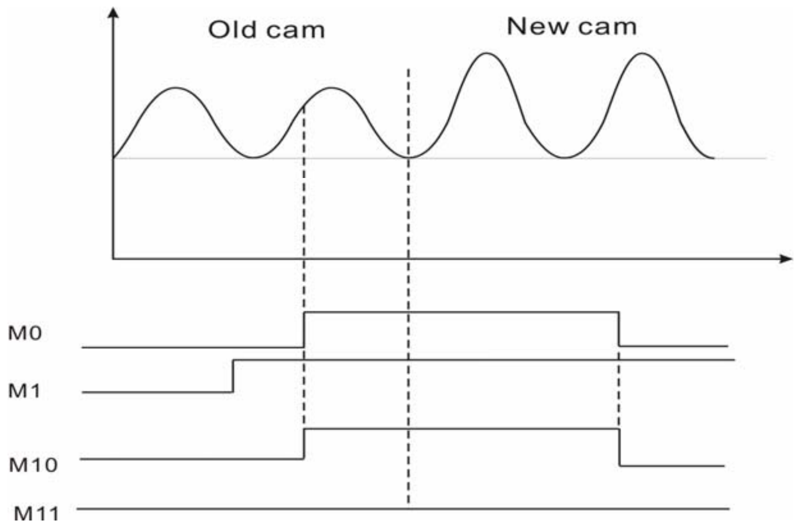
The cam curve parameter table is shown below after being modified.

Key point serial no.	Master axis position	Slave axis position	Velocity	Acceleration
1	D28672=0	D32768=0	D36864=0	D40960=0
2	D28674=180	D32770=540	D36866=0	D40962=0
3	D28676=360	D32772=0	D36868=0	D40964=0

And then switch electronic cam curve by executing the instruction "DMC_CamSet".



Sequence chart as below:



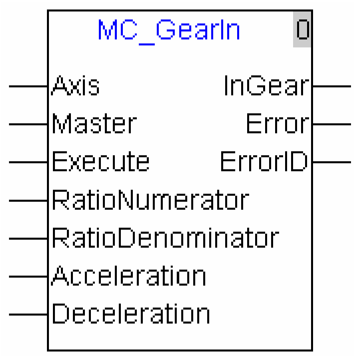
- When M1= On and M0 turns off -> on, “DMC_CamSet” is executed; M10 turns On after the execution of “DMC_CamSet” is finished , which indicates that the register value of e-cam key point has been switched to the newest key point parameter. The revised parameter value will be ineffective till the current cam cycle is over.
- Please carefully check the master axis position, slave axis position, velocity, and acceleration of the cam key point which need be revised so as to make sure the new cam curve is reasonable.

4.5.5. MC_GearIn

API	MC_GearIn	Gear-in instruction	Controller
68			10MC11T

Explanation of the instruction:

The instruction is applied to establish the gear relation between master and slave axis. While the gear relation is being established, the parameters like gear ratio can be set. After the gear relation is established, slave axis will follow master axis to move at the given proportional relationship to accomplish the synchronized control of master and slave axis. Master and slave axis could be real or virtual axis or the external encoder master axis and etc.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Axis	The node address of slave axis	UINT	Constant, D
Master	The node address of master axis	UINT	Constant, D
Execute	This instruction is executed when “Execute” turns Off –> On.	BOOL	M,I,Q, Constant,
RatioNumerator	Numerator data of electronic gear (This parameter can not be 0)	REAL	Constant, D
Ratio Denominator	Denominator data of e-gear (this parameter can not be 0); when gear ratio is negative, it indicates the directions for the master and slave axis are opposite. Gear ratio represents the ratio of the numbers of the teeth.	REAL	Constant, D
Acceleration	When CAM-in, the acceleration of the terminal actuator corresponding to slave axis, unit: Unit/ second2 (The parameter is always positive).	REAL	Constant, D
Deceleration	When CAM-in, the deceleration of the terminal actuator corresponding to slave axis, unit: Unit/ second2 (The parameter is always positive).	REAL	Constant, D
InGear	When master axis makes the e-gear relation with slave axis, "InGear" is on; As “Execute” turns on -> off, “InGear” is reset.	BOOL	M,Q

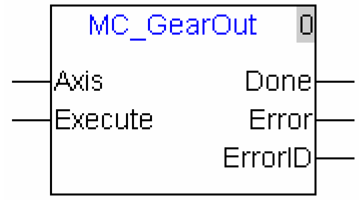
Parameter name	Explanation	Data type	Available device
Error	If any error is detected, "Error" turns on; when "Execute" turns on -> off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

4.5.6. MC_GearOut

API	MC_GearOut	Gear-out instruction	Controller
69			10MC11T

Explanation of the instruction

The instruction is applied to disconnect the gear relation between master and slave axis. After disconnection, slave will keep moving at the speed when the gear relation is disconnected.

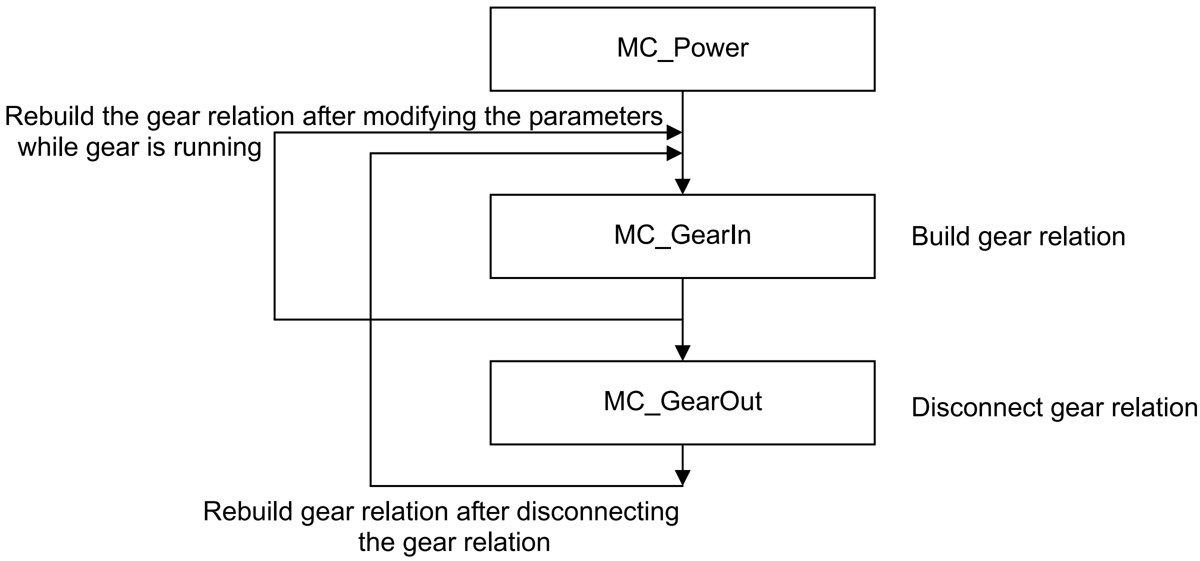


Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Axis	The node address of slave axis.	UINT	D
Execute	The instruction is executed when “Execute" turns Off –> On.	BOOL	M,I,Q,Constant
Done	As executing "MC_GearOut" is finished, "Done" is on; As "Execute" is off, "Done" is reset.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

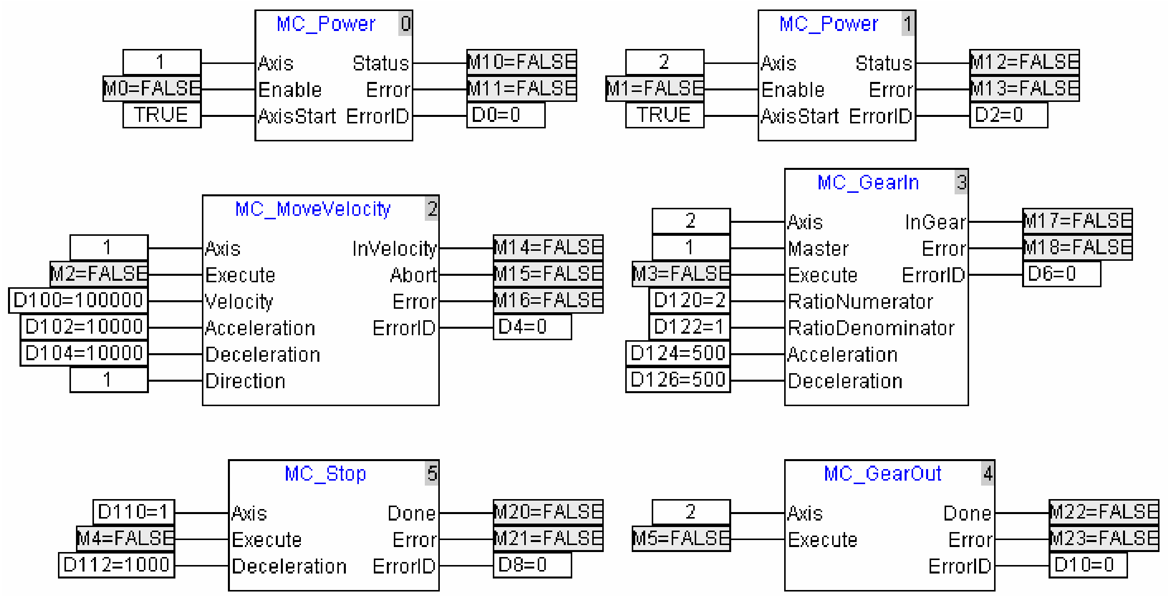
Note:

1. After the execution of MC_GearOut is finished, the slave axis in the original gear relationship can execute other motion instruction.
2. The sequence for execution of the instructions related with electronic gear

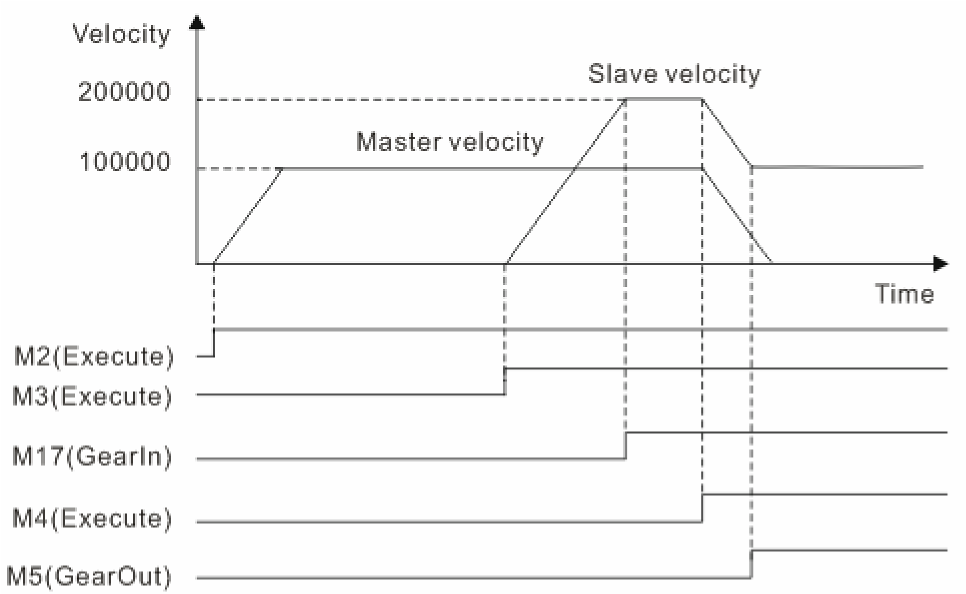


Program Example:

The following example describes the corresponding motion state when and after gear relation is established or when gear relation is disconnected via Gear-related instructions.



Motion curve:



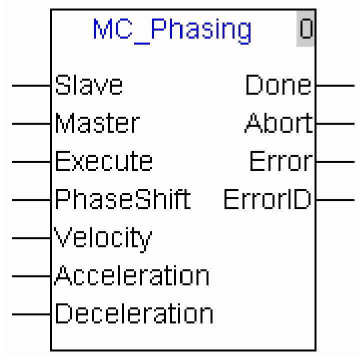
- When M2 turns Off ->On, master axis starts to move.
- When M3 turns Off ->On, slave axis starts to move following master axis. When the velocity of slave axis reaches 2 times the velocity of master axis, the execution of GearIn instruction is finished and meanwhile, M17 turns Off -> On.
- When M4 turns Off ->On, master axis executes the stop instruction.
- In process of stop of master axis motion, when M5 turns Off->On, “MC_GearOut” is executed; after the execution is finished, M22 turns Off->On and slave axis will keep moving at the speed when the gear relation is disconnected.

4.5.7. MC_Phasing

API	MC_Phasing	Phase shift	Controller
70			10MC11T

Explanation of the instruction

The instruction is applied to adjust the phase difference between master and slave axis. When the two axes have established the master-slave relation, master axis can be added by one virtual phase through execution of this instruction to impact the slave axis. “MC_Phasing” can be executed only when the two axes have established the relation



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Slave	The node address of slave axis	UINT	Constant, D
Master	The node address of master axis	UINT	Constant, D
Execute	The instruction is executed when "Execute" turns Off –> On.	BOOL	M,I,Q, constant
PhaseShift	The virtual position shift occurring in master axis. Actual phase shift quantity = PhaseShift*(pulse number/ turn) / modulo If this parameter is positive value, it indicates to shift toward the positive direction; If this parameter is negative value, it indicates to shift toward the negative direction.	REAL	Constant, D
Velocity	As "MC_Phasing" is executed, adjust the speed of phase shift. Unit: unit/second, the parameter is always positive.	REAL	Constant, D
Acceleration	As "MC_Phasing" is executed, adjust the acceleration of phase shift. Unit: unit/second2, the parameter is always positive.	REAL	Constant, D
Deceleration	As "MC_Phasing" is executed, adjust the deceleration of phase shift. Unit: unit/second, the parameter is always positive.	REAL	Constant, D

Parameter name	Explanation	Data type	Available device
Done	As adjustment of phase shift is completed, “Done” is on; As "Execute" is off, "Done" is reset.	BOOL	M,Q
Abort	When executing "MC_Phasing" is aborted, "Abort" is on; As "Execute" is off, "Abort" is reset.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

Note:

Every time “MC_Phasing” is executed, PhaseShift value regards the initial relationship between master and slave axis as the reference point.

The MC_Phasing instruction will afftect the velocity and position of the slave axis when the gear relation between the master and slave axis is established. The following example explains it in deail.

Example:

When the gear relation is built between two axes, the MC_Phasing instruction has impact on the slave speed and position.

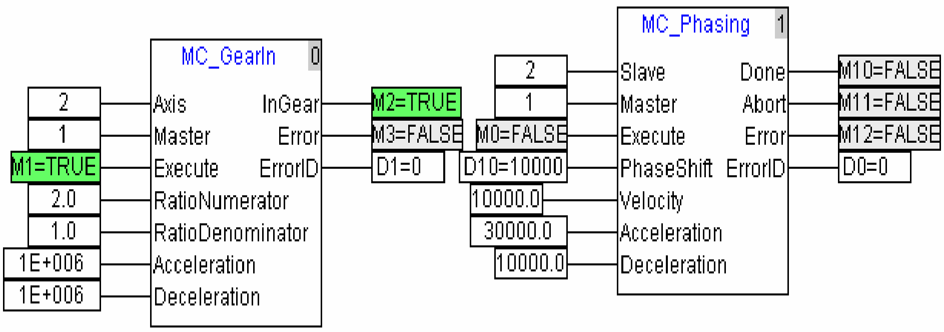
1. As the following instruction figure shows, the gear relation between master and slave axis is established after M2 is on and the velocity ratio and position ratio between master and slave axis are both 1:2.

   Suppose master axis moves at a constant speed of 5000; when M0 turns off -> on, the velocity, acceleration and deceleration and phase shift set in "MC_Phasing" instruction will be superimposed to master axis. The execution of "MC_Phasing" does not affect the running of master axis but the running of slave axis according to gear relation.

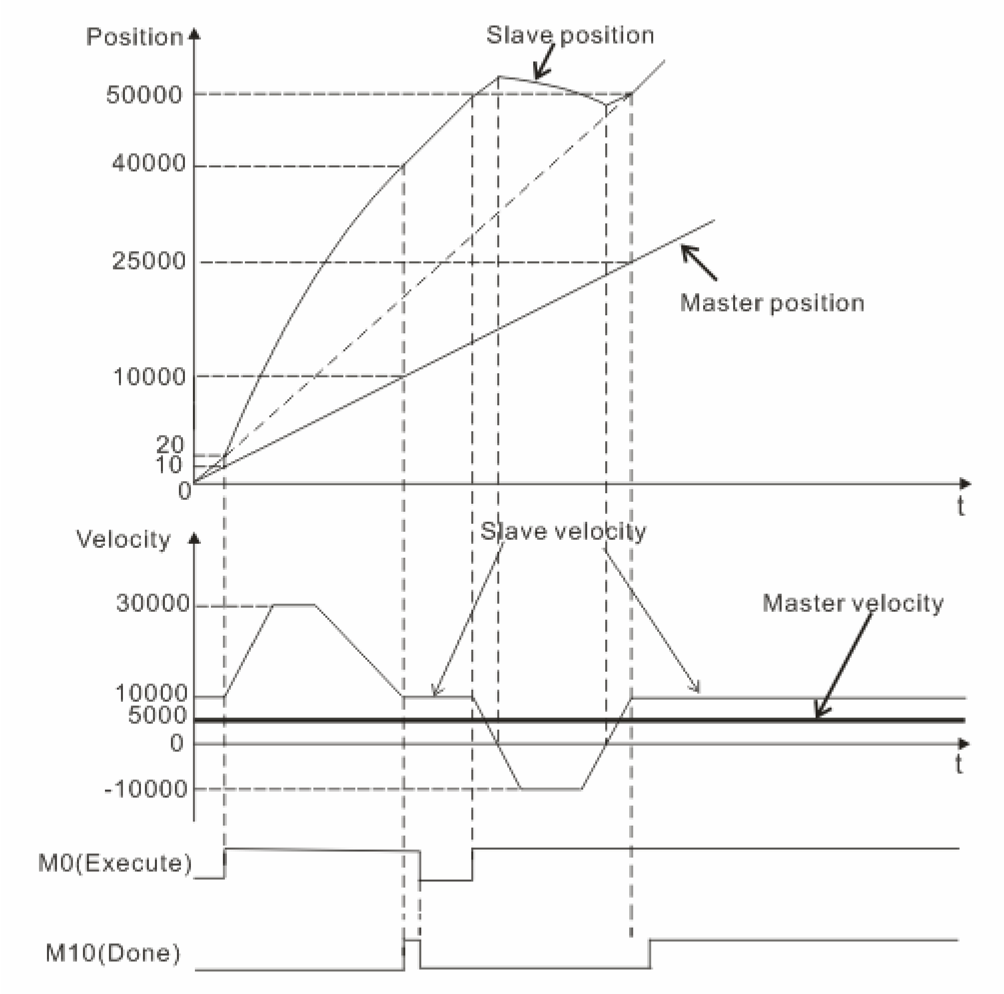
   As the sequence diagram shows below, when M10 is on, master position is 10000 and slave position= (actual master position + phase shift) * 2 = (10000+10000） *2= 40000.

2. After M10 is on, D10 is changed into 0; when M0 turns off -> on again, the phase relation between master and slave axis returns to the initial status since phase shift is 0. When M10 is on, master position is 25000 and slave position= (actual master position + phase shift) *2= （25000+0） *2= 50000.

   Instruction Figure



Sequence Diagram

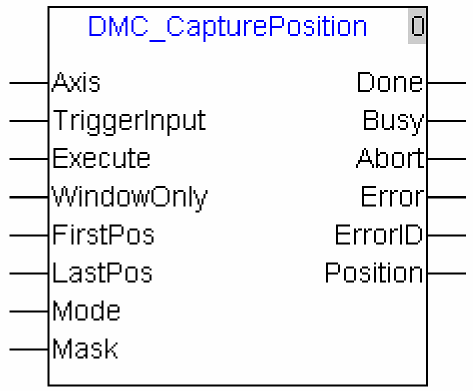


4.5.8. DMC_CapturePosition

API	DMC_CapturePosition	Capture position	Controller
71			10MC11T

Explanation of the instruction:

The instruction is applied to capture the position of the terminal actuator and the captured position can be applied in error correcting. It also supports multiple kinds of trigger methods and data source. In the case of the preciser position to be captured, please perform the position capture in mode 1, 2, 3, 10 and 11.



Explanation of input and output parameter of the instruction:

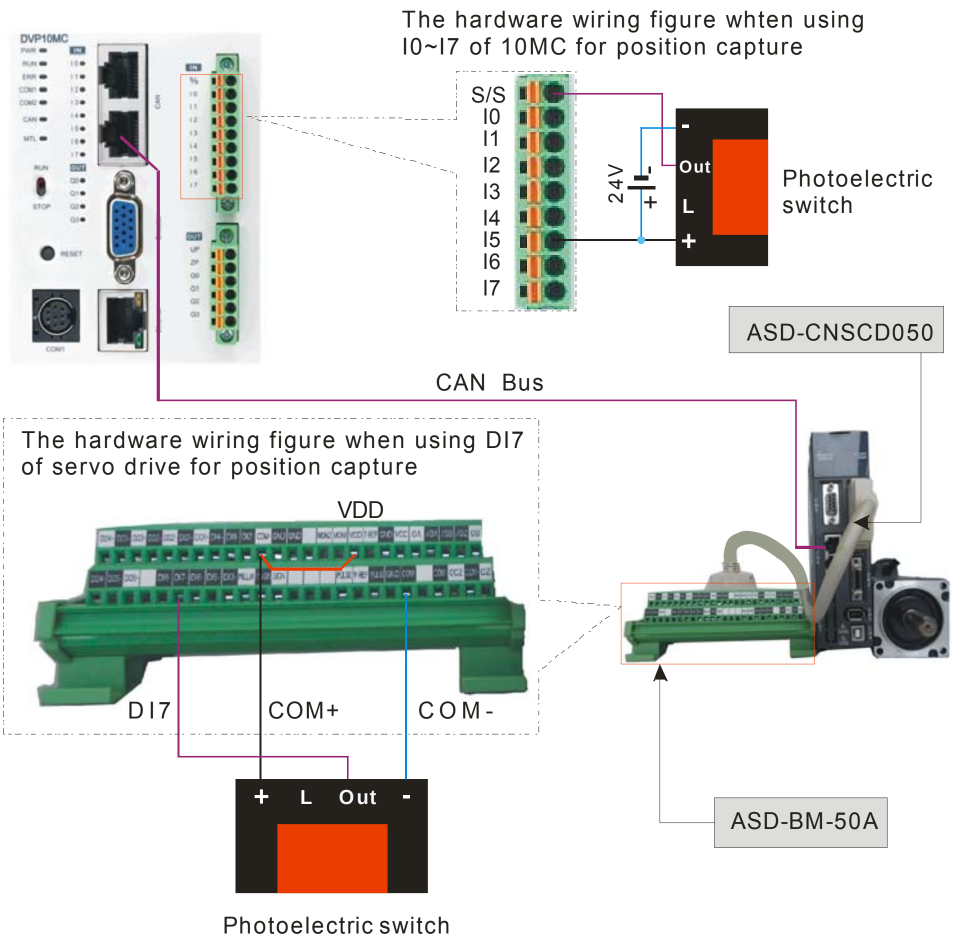
Parameter name	Explanation	Data type	Available device
Axis	The node address of axis.	UINT	Constant, D
TriggerInput	The signal of “TriggerInput” bit comes from the trigger signal of the input point of DVP10MC11T. When “Mode” is 0 or 10 and “TriggerInput” bit turns Off-> On, position capture is executed. And the “TriggerInput” bit can be only the input point: I0~I7 of 10MC; When “Mode” is 11 and “TriggerInput” bit turns On-> Off, position capture is executed. And the “TriggerInput” bit can be only the input point: I0~I7 of 10MC; When “Mode” is 1or 2, “TriggerInput” bit is invalid.	BOOL	I
Execute	This instruction is executed when “Execute” turns Off –> On.	BOOL	M,I,Q, constant
WindowOnly	1. Window function is not started up as the parameter is 0; 2. Window function is started up as the parameter is 1.	BOOL	M,I,Q, constant
FirstPos	“FirstPos” is the starting position of captured area after window function is started up	REAL	Constant, D
LastPos	“LastPos” is the end position of captured area after window function is started up.	REAL	Constant, D

Parameter name	Explanation	Data type	Available device
Mode	Mode 0: The trigger signal comes from the input point: I0~I7 of DVP10MC11T specified by TriggerInput bit. The captured position is the actual position of the terminal actuator connected to the axis. Mode 1: The trigger signal comes from the high-speed input point: DI7 of the drive. The captured position is the actual position of the terminal actuator connected to the axis. Mode 2: The trigger signal comes from the high-speed input point: DI7 of the drive. The captured position is the value that converted from the pulse number received at the interface CN1 of servo drive via the axis parameter. For more details, see item 4 in the following note. Mode 3: The trigger signal comes from the high-speed input point: DI7 of the drive. The captured position is the value that converted from the pulse number received at the interface CN5 of servo drive via the axis parameter. For more details, see item 4 in the following note. Mode 10: The trigger signal comes from the input point: I0~I7 of DVP10MC11T specified by TriggerInput bit. The position captured via the rising edge of the trigger bit is the value that converted from the pulse number received at the interface of the external ecoder of the controller via the axis parameter. For more details, see item 4 in the following note. Mode 11: The trigger signal comes from the input point: I0~I7 of DVP10MC11T specified by TriggerInput bit. The position captured via the falling edge of the trigger bit is the value that converted from the pulse number received at the interface of the external ecoder of the controller via the axis parameter. For more details, see item 4 in the following note.	UINT	Constant, D
Mask	When “Mask” is 0 or 1, every trigger signal is valid; When “Mask” is N (N>1), position capture is executed after N trigger signals are received. “Mask” should be between 0～255. If the window function is started up, only the trigger signal in the window is valid.	UINT	Constant, D
Done	"Done" is on as position is captured successfully; "Done" is reset as "Execute" is off.	BOOL	M,Q
Busy	"Busy" bit is on as "Execute" bit is on and position capture is not completed yet; "Busy" bit is reset as "Execute" bit is off or position capture is completed.	BOOL	M,Q

Parameter name	Explanation	Data type	Available device
Abort	"DMC_CapturePosition" instruction is aborted when being executed, "Abort" bit is on; When "Execute" is off, "Abort" is reset.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D
Position	The position captured after execution of the CapturePosition instruction is completed. Unit: unit	REAL	R

Note:

1. When "FirstPos", "LastPos" and "Position" are set via human-computer interface, their value type should be set as Double Word (Floating).
2. "Execute" bit must turn Off -> On again so as to perform another position capture when position capture is completed. According to different modes, position capture is performed by triggering of I0~I7 of the controller or DI7 of servo drive.
3. The hardware wiring figure is shown below for position capture when using I0~I7 of 10MC or DI7 of the servo drive.



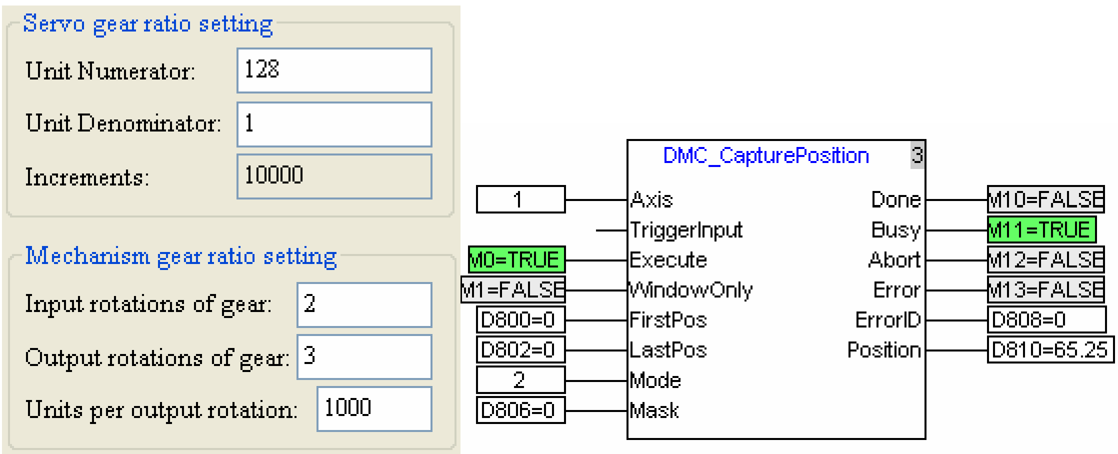
Note: The “Out”and “-” of the photoelectric switch are conducted when the photoelectric signal comes.

4. Position capture

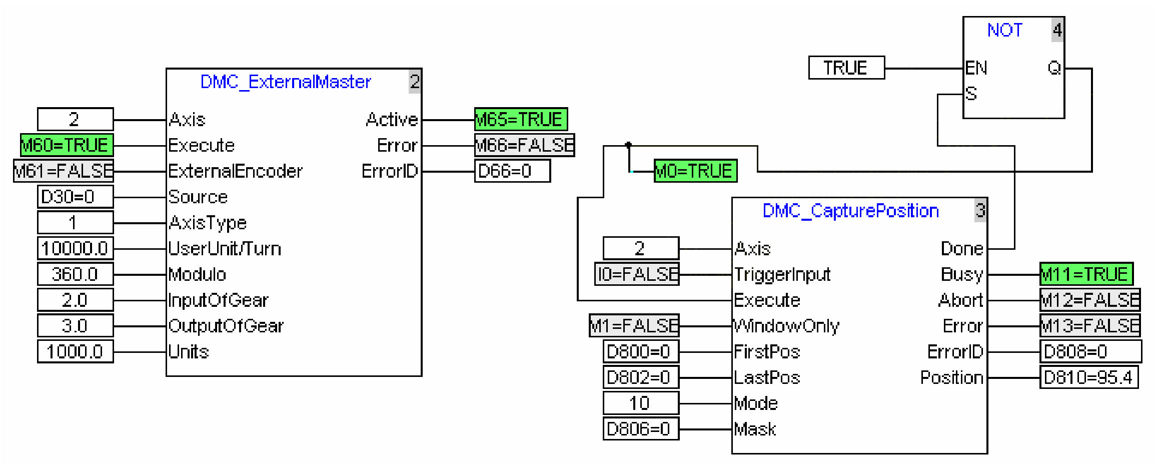
1) The “Position” captured by using the DMC_Capture Position instruction is converted from other value

Mode	Data source
Mode 0, mode 1	The pulse number that servo motor feeds back to servo drive.
Mode 2	The pulse number received at the input terminal pulse、/pule、sign、/sign or hpulse、 /hpule、hsign、/hsign of CN1 port of servo drive.
Mode 3	The pulse number received at the input terminal A 、/A、B 、/B of CN5 port of servo drive.
Mode 10, mode 11	The pulse number received at the external encoder interface of 10MC.

2) The position captured by using the DMC_Capture Position instruction is converted according to the axis parameter. For different modes, the conversion data sources are different. When “Servo gear ratio setting” and “Mechanism gear ratio setting” in the axis parameters are as following figure is and mode is 2, the pulse number received at the CN1 terminal: pulse、/pule、sign、/sign is 435 and the captured position is 65.25. The calculation formula: 435×（3×1000）÷（2×10000）=65.25. 1000, 2, 3 and1000 in the formula correspond to 1000, 2, 3, and 1000 in the left figure below respectively. In other mode, the calculation method for the positon captured via the instruction is same as above mentioned but the data source is different.



3) When Mode=10 or 11 in DMC_CapturePosition instruction, the captured position value can be calculated according to the method mentioned above as well. In actual application, the position capture is generally performed by building the external encoder master axis. When the input parameters of DMC_ExternalMaster instruction are shown as left figure below and the pulse number received at the external encoder interface of 10MC is 638, the position captured via DMC_CapturePosition instruction is 95.4. The calculation formula: 638×(3×1000)÷(2×10000) =95.4. 1000,2,3 and 1000 in the formula correspond to 1000,2,3 and1000 of the input parameters of DMC_ExternalMaster instruction in the left figure below respectively. When I0 turns OFF->ON once in the DMC_CapturePosition instruction displayed in the right figure below, the position capture is performed once.



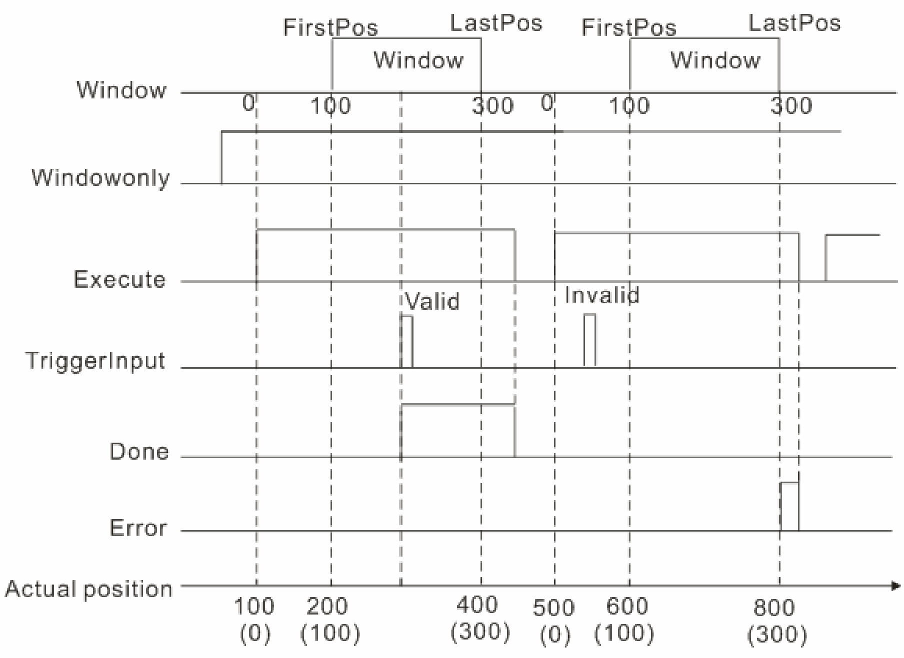
Note:

When the instruction is used for position capture in mode 1, D6527 value is the pulse number that servo motor feeds back to servo drive and the data type is 32-bit signed number. The instruction utilizes I0 for position capture in mode 10, D6529 value is the pulse number received at the encoder interface of 10MC and the data type is 32-bit signed number.

5. Introduction to WindowOnly

<1> When WindowOnly =1, FirstPos and LastPos are valid, which regards the actual terminal actuator position as the reference point when “Execute” turns Off -> On. In the following figure, FirstPos and LastPos are 100 and 300 respectively and the actual terminal actuator position is 100 when “Execute” turns Off -> On. And so when the actual actuator position is between 200~400, the actual position of the terminal actuator just can be captured by triggering of the rising edge of TriggerInput bit or DI7 of servo drive.

<2> When the actual position of the terminal actuator is out of the window, the triggering of the rising edge of the “TriggerInput” bit is invalid. When the actual position of terminal actuator is above the lastPos and the rising edge of “TriggerInput” bit is not detected, “Error” bit of CapturePosition instruction is on; position capture could be done again by triggering of the rising edge of “TriggerInput” bit after “Execute” turns Off -> On again.

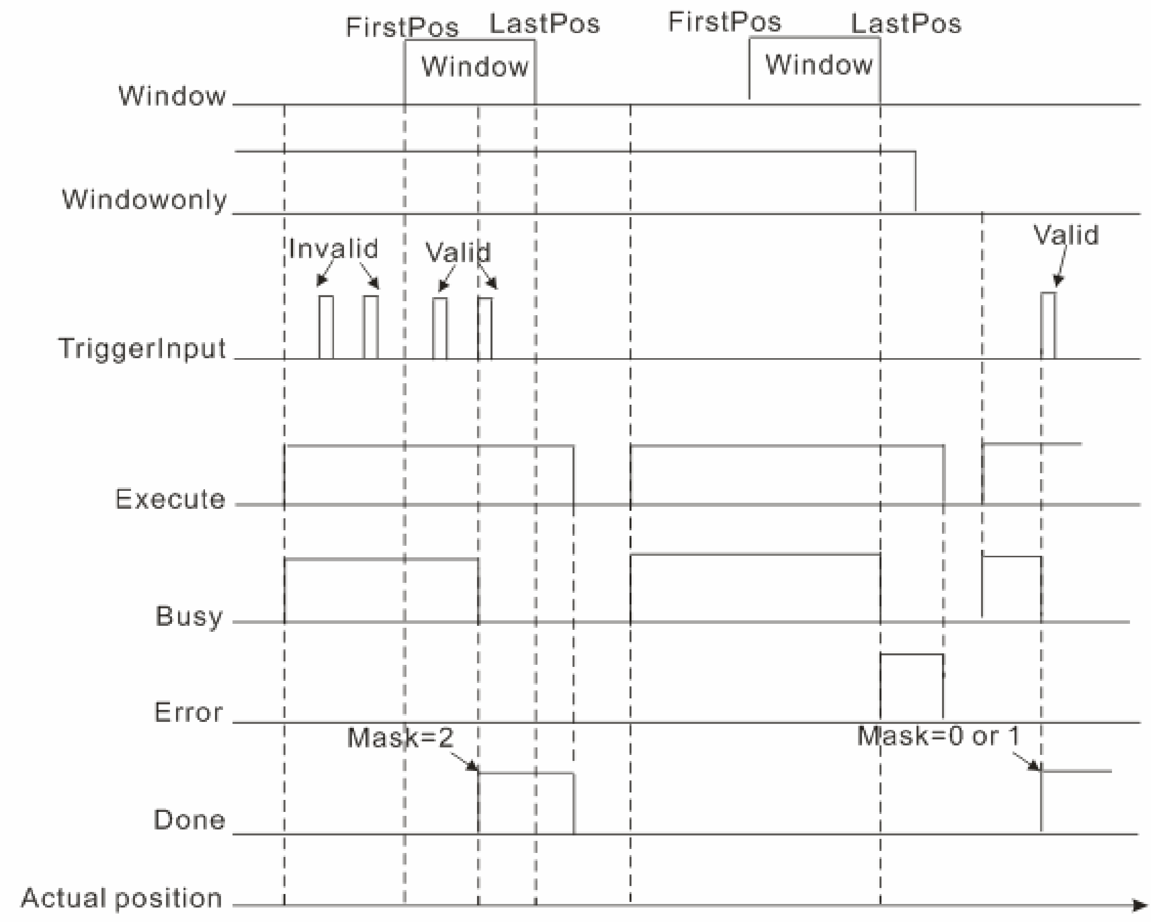


6. Introduction to Mask

<1> As the figure shows below, one position capture is completed after the trigger times for rising edge of the TriggerInput bit reach Mask value when Windowonly=1, “Execute” turns Off -> On, and the actual position of terminal actuator is within the Window zone; The trigger of rising edge of the TriggerInput bit is invalid when the actual position of terminal actuator is out of the Window zone.

When the actual position of the terminal actuator exceeds LastPos and no position is captured, the “Error” bit of CapturePosition instruction is on; position capture could be done again by triggering of the rising edge of “TriggerInput” bit after “Execute” turns Off -> On again.

<2> When Windowonly=0 and “Execute” turns Off -> On, one position capture is completed after the trigger times for rising edge of the TriggerInput bit reach Mask value (Mask=0 or 1, one position capture is completed after the triggering of the rising edge of the TriggerInput bit occurs once).

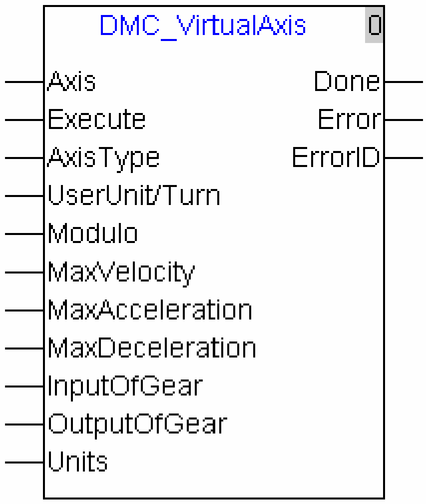


4.5.9. DMC_VirtualAxis

API 72	DMC_VirtualAxis	Create virtual axis	Controller 10MC11T

Explanation of the instruction:

The instruction is applied to constitute a virtual axis. DVP10MC11T supports max. 18 virtual axes. The motion control method of virtual axes is same as the real axes. Through execution of the instructions related with axes, the virtual axis establishes the relation of gear, cam and etc. with other virtual axis or real axis.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Axis	The node address of virtual axis （Range: 1～18）	UINT	Constant,D
Execute	This instruction is executed when "Execute" turns Off –> On.	BOOL	M,I,Q, constant
Axis Type	0: rotary axis; 1: linear axis.	UINT	Constant,D
UserUnit/Turn	The number of pulses needed when the virtual axis rotates for a circle.	REAL	Constant, D
Modulo	The cycle used to divide equally the terminal actuator position.	REAL	Constant, D
MaxVelocity	The allowed maximum speed. The parameter is always positive, unit: unit/second.	REAL	Constant, D
MaxAcceleration	The allowed maximum acceleration. The parameter is always positive, unit: unit/second2	REAL	Constant, D
Max Deceleration	The allowed maximum deceleration. The parameter is always positive, unit: unit/second2	REAL	Constant, D
InputOfGear	To constitute the mechanical gear ratio with OutputOfGear	REAL	Constant, D

Parameter name	Explanation	Data type	Available device
OutputOfGear	To constitute the mechanical gear ratio with InputOfGear	REAL	Constant, D
Units	The position that terminal actuator moves when motor rotates for one circle.	REAL	Constant,D
Done	"Done" is on when virtual axis is established successfully; "Done" is reset when "Execute" turns off.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

Note:

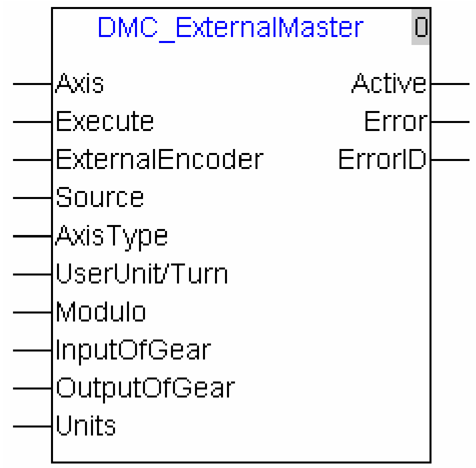
1. After virtual axis is established successfully, virtual axis can be controlled directly in no need of executing "MC_Power" makes servo powered on.
2. The virtual axis No. must be different with other axis No.
3. One virtual axis can be established only once and it will exist after establishment of "MC-VirtualAxis" is completed. When "Execute" bit of "MC-VirtualAxis" turns off -> on again, "Error" bit will turn on.
4. The explanation of virtual axis input parameters is the same as that of real axis parameters which can be seen in section 2.3.1.

4.5.10. DMC_ExternalMaster

API	DMC_ExternalMaster	Create external virtual master axis	Controller
73			10MC11T

Explanation of the instruction:

The instruction is applied to constitute a virtual master axis which could not serve as slave axis but master axis. DVP10MC11T supports max. 18 virtual master axes. The source of virtual master axis is the pulse received at the encoder port or the variable of the internal register. Through execution of the instructions related with axis, virtual master axis could establish the relation of gear, cam and etc. with other virtual axis or real axis.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Axis	The node address of virtual master axis. （Range: 1～18）	UINT	Constant,D
Execute	This instruction is executed when “Execute” turns Off –> On.	BOOL	M,I,Q, constant
External-Encoder	As the parameter is 0, pulse comes from the set value of “Source”; As the parameter is 1, pulse comes from external pulser, and “Source” is invalid.	BOOL	M,I,Q, constant
Source	When ExternalEncoder=1, usually, the data of virtual master axis comes from the register inside the controller.	DINT	Constant, D
AxisType	0: Rotary axis 1: Linear axis	UINT	Constant, D
UserUnit/Turn	The number of the pulses needed when the virtual axis rotates for one circle or the variables of “Source”.	REAL	Constant,D
Modulo	The cycle used to divide equally the terminal actuator position.	REAL	Constant, D
InputOfGear	To constitute the mechanical gear ratio with “OutputOfGear”	REAL	Constant, D
OutputOfGear	To constitute the mechanical gear ratio with “InputOfGear”	REAL	Constant, D

Parameter name	Explanation	Data type	Available device
Units	The corresponding number of the units which the terminal actuator moves when the output terminal of gear box rotates for one circle.	REAL	Constant, D
Done	"Done” is on when virtual axis is established successfully; "Done” is reset when “Execute” turns off.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

Note:

1. After virtual axis is established successfully, virtual axis can be controlled directly in no need of executing "MC_Power" makes servo powered on.
2. The virtual axis No. must be different with other axis No.
3. One virtual axis can be established only once and it will exist after establishment of "MC-VirtualAxis" is completed. When "Execute" bit of ”MC-VirtualAxis" turns off -> on again, "Error" bit will turn on.
4. Virtual master axis will make the motion with the variable of the parameter value specified by Source or the external encoder interface as the order; when variable is 0, virtual master axis will not rotate.

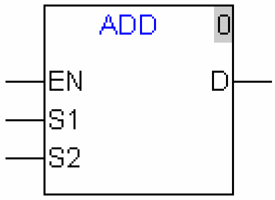
4.6. Logical Instruction

4.6.1. ADD

API	ADD	Addition of 16-bit integer	Controller
128			10MC11T

Explanation of the instruction:

ADD is used for addition operation of 16-bit integers. As EN is on, add S1 to S2 and their sum value is saved in D register.



Explanation of input and output parameter of the instruction

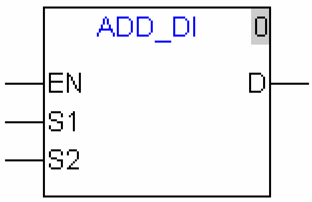
Parameter name	Explanation	Data type	Available device
EN	“Add” instruction is executed as “EN” is on.	BOOL	M,I,Q, constant
S1	Augend	INT	Constant, D
S2	Addend	INT	Constant, D
D	Sum	INT	D

4.6.2. ADD_DI

API	ADD_DI	Addition of 32-bit integer	Controller
129			10MC11T

Explanation of the instruction:

ADD_DI is used for addition operation of 32-bit integers. As EN is on, add S1 to S2 and their sum value is saved in D register.



Explanation of input and output parameter of the instruction:

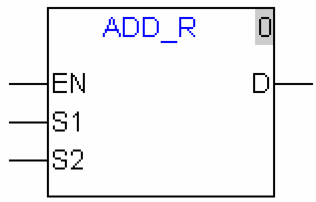
Parameter name	Explanation	Data type	Available device
EN	“Add_DI” instruction is executed as “EN” turns on	BOOL	M,I,Q, constant
S1	Augend	DINT	Constant,D
S2	Addend	DINT	Constant, D
D	Sum	DINT	D

4.6.3. ADD_R

API	ADD_R	Addition of floating number	Controller
130			10MC11T

Explanation of the instruction:

ADD_R is used for addition operation of 32-bit floating numbers. As EN is on, add S1 to S2 and their sum value is saved in D register.



Explanation of input and output parameter of the instruction:

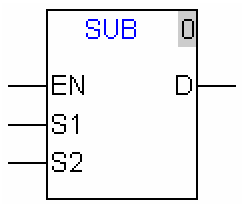
Parameter name	Explanation	Data type	Available device
EN	“Add_R” instruction is executed as “EN” turns on	BOOL	M,I,Q, constant
S1	Augend	REAL	Constant, D
S2	Addend	REAL	Constant, D
D	Sum	REAL	D

4.6.4. SUB

API	SUB	Subtraction of 16-bit integer	Controller
131			10MC11T

Explanation of the instruction:

SUB is used for subtraction operation of 16-bit integers. As EN is on, subtract S2 from S1 and their result value is saved in D register.



Explanation of input and output parameter of the instruction:

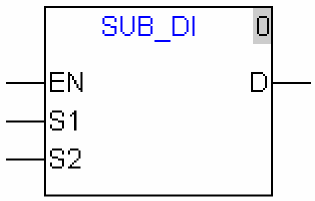
Parameter name	Explanation	Data type	Available device
EN	“SUB” instruction is executed as “EN” turns on	BOOL	M,I,Q, constant
S1	Minuend	INT	Constant, D
S2	Subtrahend	INT	Constant, D
D	Remainder	INT	D

4.6.5. SUB_DI

API 132	SUB_DI	Subtraction of 32-bit integer	Controller 10MC11T

Explanation of the instruction:

SUB_DI is used for subtraction operation of 32-bit integers. As EN is on, subtract S2 from S1 and their result value is saved in D register.



Explanation of input and output parameter of the instruction.

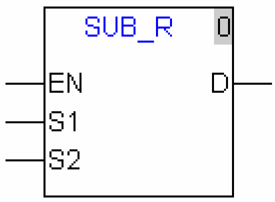
Parameter name	Explanation	Data type	Available device
EN	"SUB_DI" instruction is executed as "EN" turns on	BOOL	M,I,Q, constant
S1	Minuend	DINT	Constant, D
S2	Subtrahend	DINT	Constant, D
D	Remainder	DINT	D

4.6.6. SUB_R

API 133	SUB_R	Subtraction of floating number	Controller 10MC11T

Explanation of the instruction:

SUB_R is used for subtraction operation of 32-bit floating number. As EN is on, subtract S2 from S1 and their result value is saved in D register.



Explanation of input and output parameter of the instruction

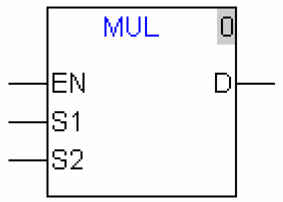
Parameter name	Explanation	Data type	Available evice
EN	"SUB_R" instruction is executed as "EN" turns on	BOOL	M,I,Q, constant
S1	Minuend	REAL	Constant, D
S2	Subtrahend	REAL	Constant, D
D	Remainder	REAL	D

4.6.7. MUL

API 134	MUL	Multiplication of 16-bit integer	Controller 10MC11T

Explanation of the instruction:

MUL is used for multiplying operation of 16-bit integers. As EN is on, multiply S1 by S2 and their result value is saved in D register.



Explanation of input and output parameter of the instruction:

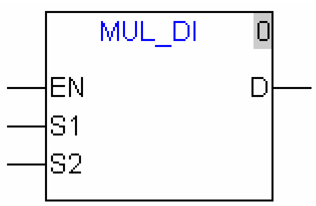
Parameter name	Explanation	Data type	Available device
EN	“MUL” instruction is executed as “EN” turns on	BOOL	M,I,Q, constant
S1	Multiplicand	INT	Constant, D
S2	Multiplier	INT	Constant, D
D	Product	INT	D

4.6.8. MUL_DI

API 135	MUL_DI	Multiplication of 32-bit integer	Controller 10MC11T

Explanation of the instruction:

MUL_DI is used for multiplying operation of 32-bit integers. As EN is on, multiply S1 by S2 and their result value is saved in D register.



Explanation of input and output parameter of the instruction:

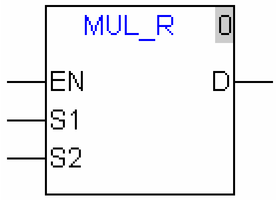
Parameter name	Explanation	Data type	Available device
EN	“MUL_DI” instruction is executed as “EN” turns on.	BOOL	M,I,Q, constant
S1	Multiplicand	DINT	Constant, D
S2	Multiplier	DINT	Constant, D
D	Product	DINT	D

4.6.9. MUL_R

API 136	MUL_R	Multiplication of floating number	Controller 10MC11T

Explanation of the instruction:

MUL_R is used for multiplying operation of 32-bit floating number. As EN is on, multiply S1 by S2 and their result value is saved in D register.



Explanation of input and output parameter of the instruction:

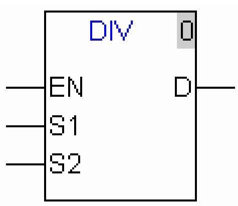
Parameter name	Explanation	Data type	Available device
EN	“MUL_R” instruction is executed as “EN” turns on	BOOL	M,I,Q, constant
S1	Multiplicand	REAL	Constant, D
S2	Multiplier	REAL	Constant, D
D	Product	REAL	D

4.6.10. DIV

API 137	DIV	Division of 16-bit integer	Controller 10MC11T

Explanation of the instruction:

DIV is used for division operation of 16-bit integer. As EN is on, divide S1 by S2 and their result value is saved in D register.



Explanation of input and output parameter of the instruction:

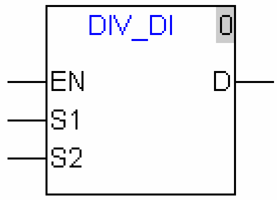
Parameter name	Explanation	Data type	Available device
EN	“DIV” instruction is executed as “EN” turns on	BOOL	M,I,Q, constant
S1	Dividend	INT	Constant, D
S2	Divisor (0 is forbidden)	INT	Constant, D
D	Quotient	INT	D

4.6.11. DIV_DI

API	DIV_DI	Division of 32-bit integer	Controller
138			10MC11T

Explanation of the instruction:

DIV_DI is used for division operation of 32-bit integer. As EN is on, divide S1 by S2 and their result value is saved in D register.



Explanation of input and output parameter of the instruction:

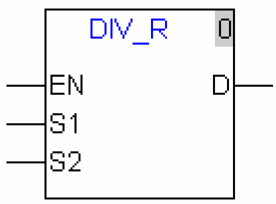
Parameter name	Explanation	Data type	Available device
EN	“DIV_DI” instruction is executed as “EN” turns on	BOOL	M,I,Q, constant
S1	Dividend	DINT	Constant, D
S2	Divisor (0 is forbidden)	DINT	Constant, D
D	Quotient	DINT	D

4.6.12. DIV_R

API	DIV_R	Division of floating number	Controller
139			10MC11T

Explanation of the instruction:

DIV_R is used for division operation of 32-bit floating number. As EN is on, divide S1 by S2 and their result value is saved in D register.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“DIV_R” instruction is executed as “EN” turns on	BOOL	M,I,Q, constant
S1	Dividend	REAL	Constant, D
S2	Divisor (0 is forbidden)	REAL	Constant, D
D	Quotient	REAL	

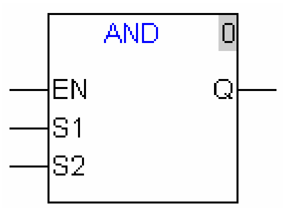
4.6.13. AND

API	AND	Logical AND operation	Controller
140			10MC11T

Explanation of the instruction:

AND is used for logical AND operation of two bit devices.

When “EN” is on, AND operation of S1 and S2 is conducted and the result is saved to the bit device specified by Q; when “EN” is off, the state of Q is unchanged.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“AND” is executed as “EN” turns on	BOOL	M,I,Q,constant
S1	Operand S1	BOOL	M,I,Q,constant
S2	Operand S2	BOOL	M,I,Q,constant
Q	The result from AND operation of operand S1and S2	BOOL	M,Q

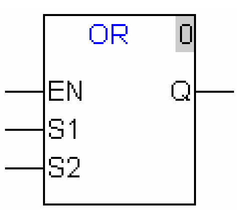
4.6.14. OR

API	OR	Logical OR operation	Controller
141			10MC11T

Explanation of the instruction:

OR is used for logical OR operation of two bit devices.

When “EN” is on, OR operation of S1 and S2 is conducted and the result is saved to the bit device specified by Q; when “EN” is off, the state of Q is unchanged.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“OR” is executed as “EN” turns on	BOOL	M,I,Q,constant
S1	Operand S1	BOOL	M,I,Q,constant
S2	Operand S2	BOOL	M,I,Q,constant
Q	The result from OR operation of operand S1and S2	BOOL	M,Q

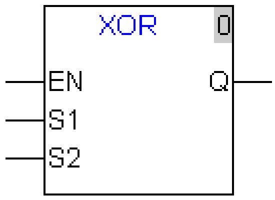
4.6.15. XOR

API	**XOR**	Logical XOR operation	Controller
142			10MC11T

Explanation of the instruction:

XOR is used for logical XOR operation of two bit devices.

When “EN” is on, XOR operation of S1 and S2 is conducted and the result is saved to the bit device specified by Q; when “EN” is off, the state of Q is unchanged.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“XOR” is executed as “EN” turns on	BOOL	M,I,Q,constant
S1	Operand S1	BOOL	M,I,Q,constant
S2	Operand S2	BOOL	M,I,Q,constant
Q	The result from XOR operation of operand S1and S2	BOOL	M,Q

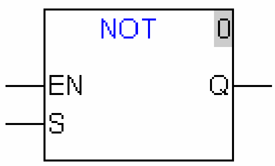
4.6.16. NOT

API	**NOT**	Logical NOT operation	Controller
143			10MC11T

Explanation of the instruction:

NOT is used for logical NOT operation of one bit device.

When “EN” is on, NOT operation of S is conducted and the result is saved to the bit device specified by Q; when “EN” is off, the state of Q is unchanged.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“NOT” is executed as “EN” turns on	BOOL	M,I,Q,constant
S	Operand S	BOOL	M,I,Q,constant
Q	The result from NOT operation of operand S	BOOL	M,Q

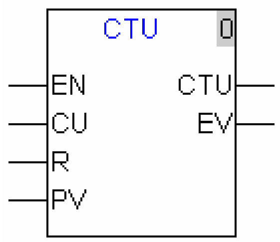
4.6.17. CTU

API	CTU	Up counter	Controller
144			10MC11T

Explanation of the instruction:

CTU is used to achieve the function of upcounter.

When EN is on, R is off and the count-up input CU turns off -> on, the current value EV of the counter is increased by 1; as the value of EV is greater than or equal to the preset value PV, the output CTU is on; as EV reaches the maximum 4294967295, the counter stops counting. As R is on, CTU is reset and the current value EV of the counter is cleared as 0.

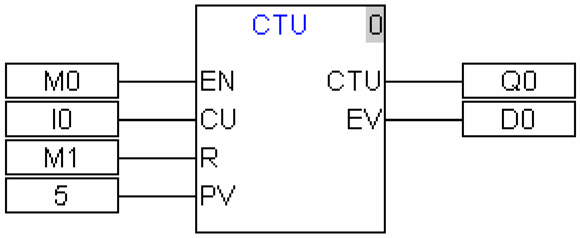


Explanation of input and output parameter of the instruction:

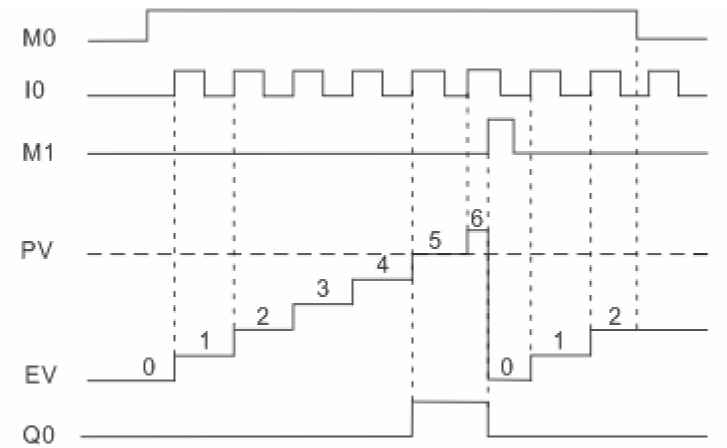
Parameter name	Explanation	Data type	Available device
EN	The execution condition of this instruction. “CTU” instruction is executed as “EN” turns on; CTU and EV value keep unchanged as “EN” turns off.	BOOL	M,I,Q,constant
CU	Once “CU” turns off -> on, the current value of the counter is added by 1.	BOOL	M,I,Q,constant
R	When “R” turns on, the current value “EV” is cleared to 0 and “CTU” is reset.	BOOL	M,I,Q,constant
PV	The preset value of the counter.	UDINT	Constant, D
CTU	When “EN” is on and the current value of “EV” is greater than or equal to that of “PV”, “CTU” turns on.	BOOL	M,Q
EV	The current value of the counter. When “EN” turns on , “R” is off and the count-up input CU turns off -> on, the current value is added by 1; as the value of “EV” is up to the maximum 4294967295, the counter stops counting.	UDINT	D

Program example:

The value of "PV" is set as 5 and the current value is saved to "D0".



Sequence chart:



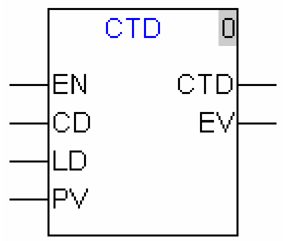
4.6.18. CTD

API 145	CTD	Down counter	Controller 10MC11T

Explanation of the instruction:

CTD is used to achieve the function of downcounter.

When EN is on and the loading input LD turns off -> on, the counter writes the preset value of PV into the current value of EV and the output CTD is reset. Each time the count-down input CD turns off -> on , the current value of EV is decreased by 1. When EV is decreased to 0, the output CTD turns on and the counter stops counting.

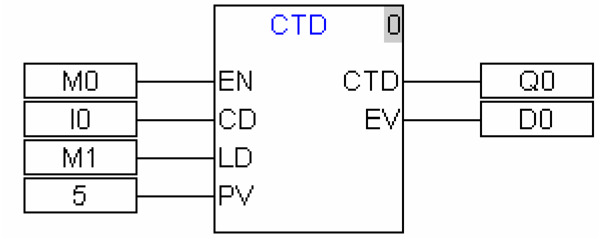


Explanation of input and output parameter of the instruction:

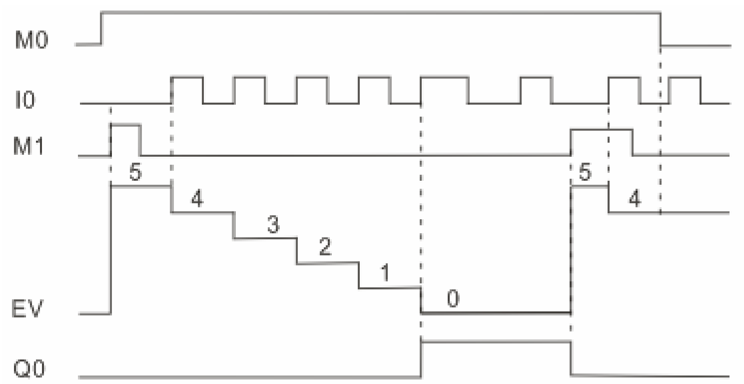
Parameter name	Explanation	Data type	Available device
EN	The execution condition of this instruction. “CTU” instruction is executed as “EN” turns on; “CTD” and “EV” value keep unchanged as “EN” turns off.	BOOL	M,I,Q, constant
CD	When the count-down input “CD” turns off -> on, the current value of the counter is decreased by1.	BOOL	M,I,Q, constant
LD	When “LD” turns off -> on, the counter writes the preset value of “PV” into current value of “EV” and “CTD” is reset.	BOOL	M,I,Q, constant
PV	The preset value of the counter.	UDINT	Constant, D
CTD	When “EN” turns on and the current value of the counter is decreased to 0, the output bit “CTD” turns on.	BOOL	M,Q
EV	The current value of the counter. When “EN” turns on and the count-down input “CD” turns off -> on, the current value of the counter is decreased by 1; as the current value of the counter decreased to 0, counting is stopped.	UDINT	D

Program example:

The value of "PV" is set to 5 and the current value is saved to "D0".



Sequence chart:



4.6.19. CTUD

API 146	CTUD	Up/down counter	Controller 10MC11T

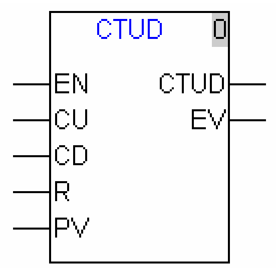
Explanation of the instruction:

CTUD is used to achieve the function of upcounter or downcounter.

As EN is on, R is off and the count-up input CU turns off -> on, the current value EV of the counter is increased by 1; as the count-down input CD turns off -> on, the current value EV of the counter is decreased by 1; as the current value of the counter is greater than or equal to the preset value of the counter, CTUD is on.

As R turns on, the output CTUD is reset and the current value EV of the counter is cleared as 0.

As EV is up to maximum 4294967295 and the countup bit CU turns off -> on, EV gets minimum 0; as EV reaches minimum 0, the count-down input CD turns on -> off, EV gets maximum 4294967295.

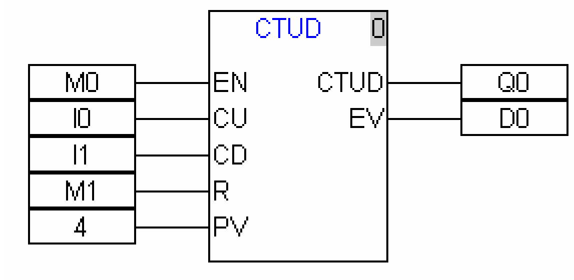


Explanation of input and output parameter of the instruction:

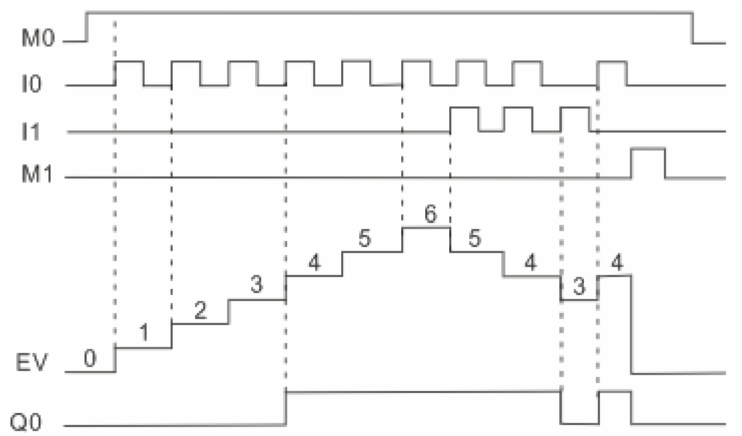
Parameter name	Explanation	Data type	Available device
EN	The execution condition of this instruction. “CTUD” instruction is executed as “EN” turns on; “CTUD” and “EV” value keep unchanged as “EN” turns off.	BOOL	M,I,Q, constant
CU	As “CU” turns off -> on, the current value of the counter is added by 1.	BOOL	M,I,Q, constant
CD	When “CD” turns off -> on, the current value of the counter is reduced by 1.	BOOL	M,I,Q, constant
R	When “R” turns on, the current value of the counter is reset to 0 and output “CTUD” turns off.	BOOL	M,I,Q, constant
PV	The preset value of the counter.	UDINT	Constant, D
CTUD	The output bit “CTUD” turns on when the current value of the counter is greater than or equal to the preset value of the counter.	BOOL	M,Q
EV	The current value of the counter.	UDINT	D

Program example:

The value of "PV" is set to 5 and the current value is saved to "D0".



Sequence chart:



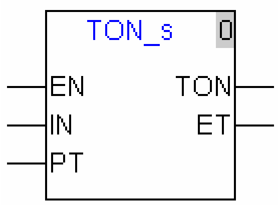
4.6.20. TON_s

API	TON_s	On-delay timer	Controller
147			10MC11T

Explanation of the instruction:

TON_s is used as an on-delay timer with 1s as the timing unit.

When EN is on, the input IN is On, the current value ET starts timing from 0 on; as the current value ET is greater than or equal to the preset value PT, the output TON turns on. After ET reaches PT value, the timing will not be stopped till ET reaches maximum 4294967295. When the input IN is off, the current value ET of the timer is cleared as 0 and the output TON is reset. The preset value PT is effective immediately after being changed.

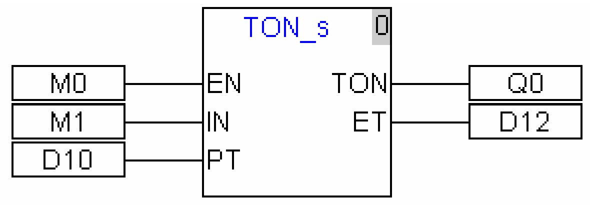


Explanation of input and output parameter of the instruction:

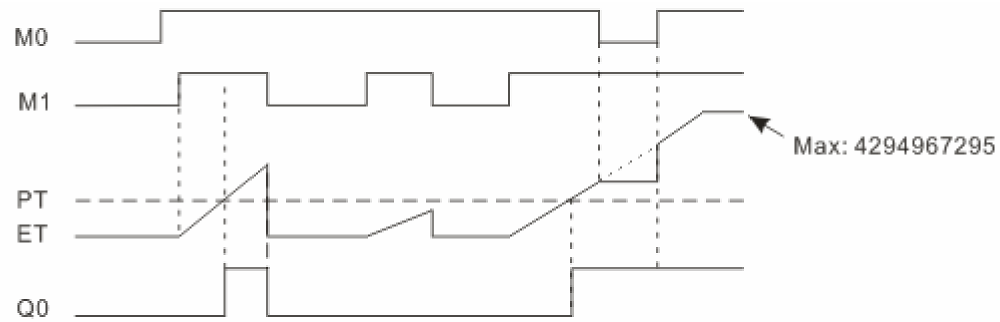
Parameter name	Explanation	Data type	Available device
EN	The execution condition of this instruction. "TON_s" instruction is executed as "EN" turns on; the output TON and the current value ET keep unchanged as "EN" turns off.	BOOL	M,I,Q, constant
IN	As "IN" is on, the timer starts timing; as "IN" is off, the current value ET of the timer is cleared as 0 and the output TON is reset.	BOOL	M,I,Q, constant
PT	Preset timing value of the timer	UDINT	Constant,D
TON	"TON" is on as the current value of the timer is greater than or equal to the preset value PT.	BOOL	M,Q
ET	The current value of the timer.	UDINT	D

Program example:

"PT" is set as D10 and the current value is saved into D12 (ET).



Sequence chart:



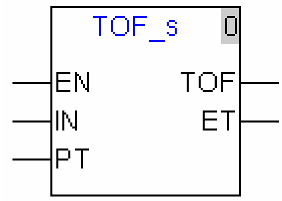
4.6.21. TOF_s

API	TOF_s	Off-delay timer	Controller
148			10MC11T

Explanation of the instruction:

TOF_s is used as an off-delay timer with 1s as the timing unit.

When EN is On and the input IN is On, the output TOF turns On and the current value ET is cleared as 0. When the input bit IN turns On -> Off, the current value ET starts timing from 0 on; as the current value ET is greater than or equal to the preset value PT, the output TOF turns Off. After ET reaches PT value, the timing will not be stopped till ET reaches maximum 4294967295. The preset value PT is effective immediately after being changed.

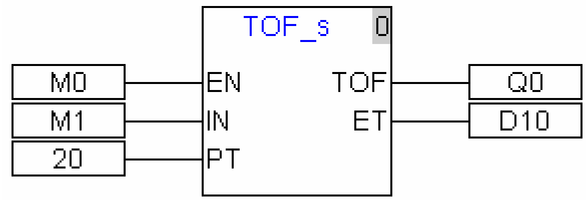


Explanation of input and output parameter of the instruction:

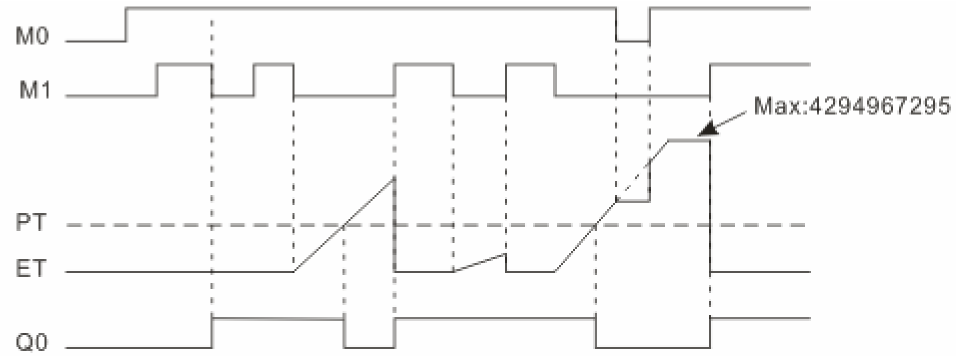
Parameter name	Explanation	Data type	Available device
EN	The execution condition of this instruction. “TOF_s” instruction is executed as “EN” turns on; the output TOF and the current value ET keep unchanged as “EN” turns off.	BOOL	M,I,Q, constant
IN	As “IN” turns on -> off, the timer starts timing; as “IN” turns on, TOF is on and ET is cleared as 0.	BOOL	M,I,Q, constant
PT	Preset value of the timer	UDINT	Constant
TOF	“TOF” is off as the current value of the timer is greater than or equal to the preset value PT.	BOOL	M,Q
ET	The current value of the timer.	UDINT	D

Program example:

The value of “PT” is set as 20s and the current value is saved to D10 (ET).



Sequence chart:



4.6.22. TONR_s

API	TONR_s	Retentive on-delay timer	Controller
149			10MC11T

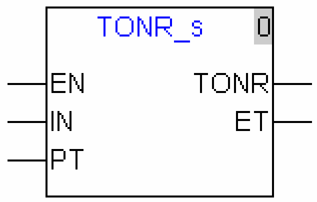
Explanation of the instruction:

TONR_s is a retentive on-delay timer with 1s as the timing unit.

When EN is on and IN is on, the current value ET of the timer starts timing;

When IN is off, the current value ET is maintained. When IN turns on once again, the timing is continued based on the maintained value ET and the output TONR will be on when ET is greater than or equal to the preset value PT. After ET reaches PT value, the timing will not be stopped till ET reaches maximum 4294967295.

When EN is off, the current value ET of the timer is cleared as 0 and the output bit is reset.

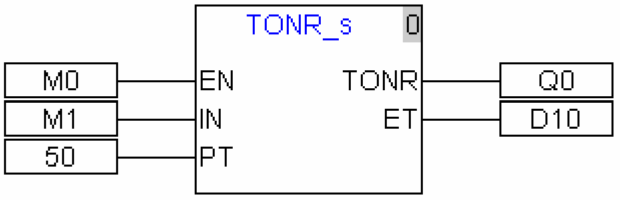


Explanation of input and output parameter of the instruction:

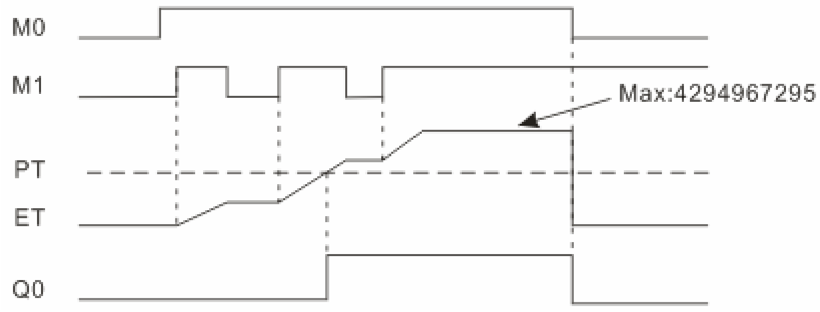
Parameter name	Explanation	Data type	Available device
EN	The execution condition of this instruction. “TONR_s” instruction is executed as “EN” turns on; the output “TON” is reset and the current value “ET” is cleared as 0 as “EN” turns off.	BOOL	M,I,Q, constant
IN	As “IN” is on, the timer starts timing; as “IN” is off, the current value “ET” is maintained.	BOOL	M,I,Q, constant
PT	Preset value of the timer	UDINT	Constant,D
TONR	The current value “ET” is greater than or equal to the prest value PT, “TONR” is on.	BOOL	M,Q
ET	The current value of the timer.	UDINT	D

Program example:

The vaule of PT is set as 50s and the current value is saved in the register D10.



Sequence chart:



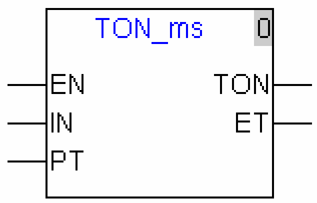
4.6.23. TON_ms

API 150	TON_ms	On-delay timer	Controller 10MC11T

Explanation of the instruction:

TON_ms is an on-delay timer with 1ms as the timing unit.

When EN is on, the input IN is On, the current value ET starts timing from 0 on; as the current value ET is greater than or equal to the preset value PT, the output TON turns on. After ET reaches PT value, the timing will not be stopped till ET reaches maximum 4294967295. When the input IN is off, the current value ET of the timer is cleared as 0 and the output TON is reset. The preset value PT is effective immediately after being changed.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	The execution condition of this instruction. "TON_ms" instruction is executed as "EN" turns on; the output TON and the current value ET keep unchanged as "EN" turns off.	BOOL	M,I,Q, constant
IN	As "IN" is on, the timer starts timing; as "IN" is off, the current value ET of the timer is cleared as 0 and the output TON is reset.	BOOL	M,I,Q, constant
PT	Preset timing value of the timer	UDINT	Constant,D
TON	"TON" is on as the current value of the timer is greater than or equal to the preset value PT.	BOOL	M,Q
ET	The current value of the timer.	UDINT	D

Note: For the sequence chart of TON_ms, please refer to the program example of TON_s.

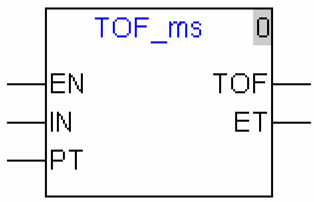
4.6.24. TOF_ms

API	TOF_ms	Off-delay timer	Controller
151			10MC11T

Explanation of the instruction:

TOF_ms is used as an off-delay timer with 1ms as the timing unit.

When EN is On and the input IN is On, the output TOF turns On and the current value ET is cleared as 0. When the input bit IN turns On -> Off, the current value ET starts timing from 0 on; as the current value ET is greater than or equal to the preset value PT, the output TOF turns Off. After ET reaches PT value, the timing will not be stopped till ET reaches maximum 4294967295. The preset value PT is effective immediately after being changed.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	The execution condition of this instruction. “TOF_ms” instruction is executed as “EN” turns on; the output TOF and the current value ET keep unchanged as “EN” turns off.	BOOL	M,I,Q, constant
IN	As “IN” turns on -> off, the timer starts timing; as “IN” turns on, TOF is on and ET is cleared as 0.	BOOL	M,I,Q, constant
PT	Preset value of the timer	UDINT	Constant
TOF	“TOF” is off as the current value of the timer is greater than or equal to the preset value PT.	BOOL	M,Q
ET	The current value of the timer.	UDINT	D

Note: For the sequence chart of TOF_ms, please refer to the program example of TOF_s.

4.6.25. TONR_ms

API			Controller
152	TONR_ms	Retentive on-delay timer	10MC11T

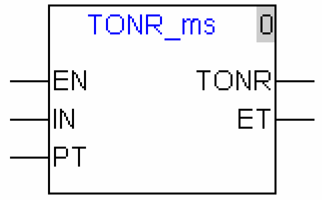
Explanation of the instruction:

TONR_ms is a retentive on-delay timer with 1ms as the timing unit.

When EN is on and IN is on, the current value ET of the timer starts timing;

When IN is off, the current value ET is maintained. When IN turns on once again, the timing is continued based on the maintained value ET and the output TONR will be on when ET is greater than or equal to the preset value PT. After ET reaches PT value, the timing will not be stopped till ET reaches maximum 4294967295.

When EN is off, the current value ET of the timer is cleared as 0 and the output bit is reset.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	The execution condition of this instruction. “TONR_ms” instruction is executed as “EN” turns on; the output “TON” is reset and the current value “ET” is cleared as 0 as “EN” turns off.	BOOL	M,I,Q, constant
IN	As “IN” is on, the timer starts timing; as “IN” is off, the current value “ET” is maintained.	BOOL	M,I,Q, constant
PT	Preset value of the timer	UDINT	Constant,D
TONR	The current value “ET” is greater than or equal to the prest value PT, “TONR” is on.	BOOL	M,Q
ET	The current value of the timer.	UDINT	D

Note: For the sequence chart of TONR_ms, please refer to the program example of TONR_s.

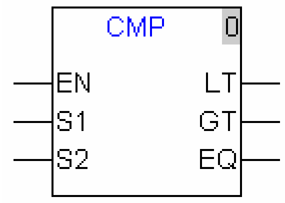
4.6.26. CMP

API	CMP	Comparison of 16-bit integers	Controller
153			10MC11T

Explanation of the instruction:

CMP is used for comparison of two 16-bit signed integers with the result value displayed in one of the three output bit devices.

When EN is On, compare S1 less than or greater than, or equal to S2 with the result placed in the corresponding LT, GT or EQ. When EN is Off, the status of the bit device where the comparison result is placed will keep unchanged.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“CMP” is executed as “EN” turns on.	BOOL	M,I,Q, constant
S1	The compared value 1	INT	Constant,D
S2	The compared value 2	INT	Constant,D
LT	“LT” turns on as the operand S1 is less than the operand S2.	BOOL	M,Q
GT	“GT” turns on as the operand S1 is greater than the operand S2.	BOOL	M,Q
EQ	“EQ” turns on as the operand S1 is equal to the operand S2.	BOOL	M,Q

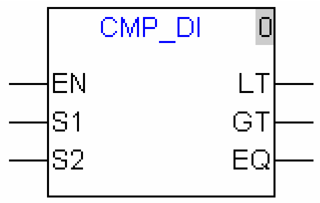
4.6.27. CMP_DI

API	CMP_DI	Comparison of 32-bit integers	Controller
154			10MC11T

Explanation of the instruction:

CMP-DI is used for comparison of two 32-bit signed integers with the result value displayed in one of the three output bit devices.

When EN is On, compare S1 less than or greater than, or equal to S2 with the result placed in the corresponding LT, GT or EQ. When EN is Off, the status of the bit device where the comparison result is placed will keep unchanged.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	"CMP_DI" is executed as "EN" turns on.	BOOL	M,I,Q, constant
S1	The compared value 1	DINT	Constant
S2	The compared value 2	DINT	Constant
LT	"LT" turns on as the operand S1 is less than the operand S2.	BOOL	M,Q
GT	"GT" turns on as the operand S1 is greater than the operand S2.	BOOL	M,Q
EQ	"EQ" turns on as the operand S1 is equal to the operand S2.	BOOL	M,Q

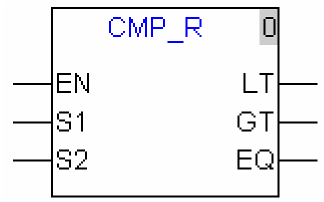
4.6.28. CMP_R

API	CMP_R	Comparison of floating numbers	Controller
155			10MC11T

Explanation of the instruction:

CMP-R is used for comparison of two 32-bit floating number with the result value displayed in one of the three output bit devices.

When EN is On, compare S1 less than or greater than, or equal to S2 with the result placed in the corresponding LT, GT or EQ. When EN is Off, the status of the bit device where the comparison result is placed will keep unchanged.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“CMP_R” is executed as “EN” turns on.	BOOL	M,I,Q, constant
S1	The compared value 1	REAL	Constant
S2	The compared value 2	REAL	Constant
LT	“LT” turns on as the operand S1 is less than the operand S2.	BOOL	M,Q
GT	“GT” turns on as the operand S1 is greater than the operand S2.	BOOL	M,Q
EQ	“EQ” turns on as the operand S1 is equal to the operand S2.	BOOL	M,Q

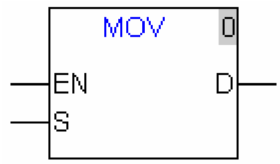
4.6.29. MOV

API	MOV	Move 16-bit integer	Controller
156			10MC11T

Explanation of the instruction:

MOV is used for sending the 16-bit integer to the target register.

When EN is On, the content of S will be moved to D without changing the original value in S.

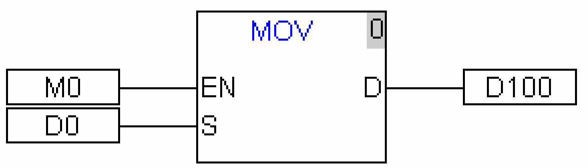


Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“MOV” is executed as “EN” turns on.	BOOL	M,I,Q, constant
S	The source where the data comes from.	INT	Constant
D	The target register	INT	D

Note: This instruction is used for moving the 16-bit integer only.

Program example:



- When M0 turns Off -> On and keeps in ON status, this instruction will be being executed ever after for sending the content of register D0 to register D100.
- When M0 turns On→Off, this instruction will stop execution.

4.6.30. MOV_DI

API	MOV_DI	Move 32-bit integer	Controller
157			10MC11T

Explanation of the instruction:

MOV_DI is used for sending the 32-bit integer to the target register.

When EN is On, the content of S will be moved to D without changing the original value in S.

Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“MOV_DI” is executed as “EN” turns on.	BOOL	M,I,Q, constant
S	The source where the data comes from.	DINT	Constant,D
D	The target register	DINT	D

Note: This instruction is used for moving the 32-bit integer only.

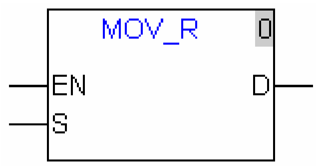
4.6.31. MOV_R

API	MOV_R	Move floating number	Controller
158			10MC11T

Explanation of the instruction:

MOV_R is used for sending the 32-bit floating number to the target register.

When EN is On, the content of S will be moved to D without changing the original value in S.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“MOV_R” is executed as “EN” turns on.	BOOL	M,I,Q, constant
S	The source where the data comes from.	REAL	Constant,D
D	The target register	REAL	D

Note: This instruction is used for moving the floating number only.

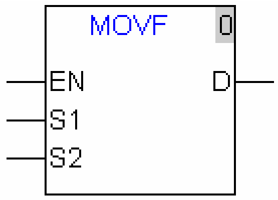
4.6.32. MOVF

API	MOVF	Move 16-bit integer to multiple registers	Controller
159			10MC11T

Explanation of the instruction:

MOVF is used for sending one 16-bit integer to multiple target registers.

When EN is on, the content of S1 is sent to the zone with D as the starting register and the data length is specified by S2. When the data length S2 is larger than maximum 64, it is counted as 64. And the part above 64 is invalid.

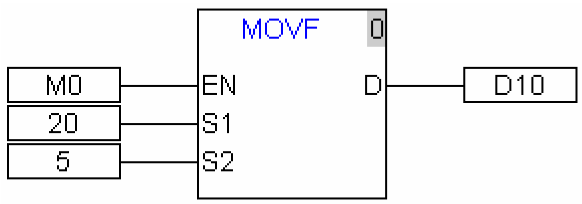


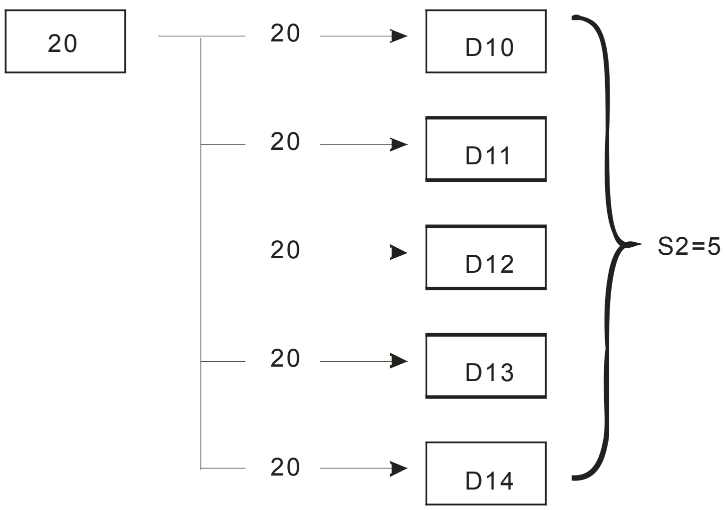
Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“MOVF” is executed as “EN” turns on.	BOOL	M,I,Q, constant
S1	The source where the data comes from.	INT	Constant,D
S2	The length of the transmitted zone, the max value for S2 is 64.	UINT	Constant,D
D	The starting one of the target registers	INT	D

Note: This instruction can be used for multi-point transmission of 16-bit integer only.

Program example:





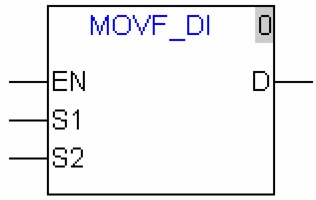
4.6.33. MOVF_DI

API	MOVF_DI	Move 32-bit integer to multiple registers	Controller
160			10MC11T

Explanation of the instruction:

MOVF_DI is used for sending one 32-bit integer to multiple target registers.

When EN is on, the content of S1 is sent to the zone with D as the starting register and the data length is specified by S2. When the data length S2 is larger than maximum 64, it is counted as 64. And the part above 64 is invalid.

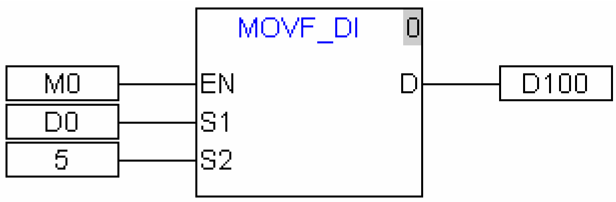


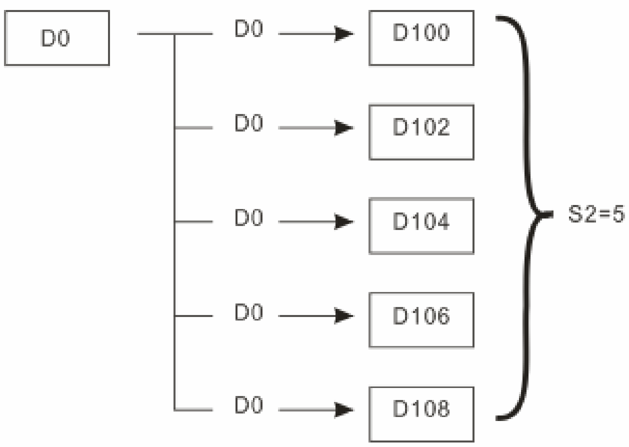
Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“MOVF_DI” is executed as “EN” turns on.	BOOL	M,I,Q, constant
S1	The source where the data comes from.	DINT	Constant,D
S2	The length of the transmitted zone, the max value for S2 is 64.	UINT	Constant,D
D	The starting one of the target registers	DINT	D

Note: When the content of the register is 32-bit data, it will occupy two consecutive registers.

Program example:





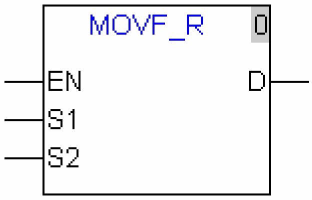
4.6.34. MOVF_R

API	MOVF_R	Move floating number to multiple registers	Controller
161			10MC11T

Explanation of the instruction:

MOVF_R is used for sending one 32-bit floating number to multiple target registers.

When EN is on, the content of S1 is sent to the zone with D as the starting register and the data length is specified by S2. When the data length S2 is larger than maximum 64, it is counted as 64. And the part above 64 is invalid.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“MOVF_R” is executed as “EN” turns on.	BOOL	M,I,Q, constant
S1	The source where the data comes from.	REAL	Constant,D
S2	The length of the transmitted zone, the max value for S2 is 64.	UINT	Constant,D
D	The starting one of the target registers	REAL	D

Note: This instruction can be used for multi-point transmission of the floating point only. For detailed application, please refer to the example on MOVF instruction.

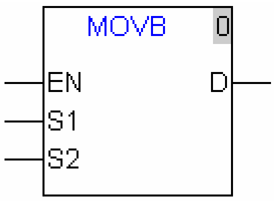
4.6.35. MOVB

API	MOVB	Move multiple register data to the target registers	Controller
162			10MC11T

Explanation of the instruction:

MOVB is used for sending multiple source register values to the corresponding multiple target registers.

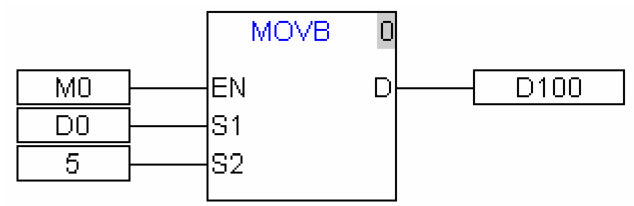
When EN is on, the zone data with S1 as the starting register data is sent to the zone with D as the starting register and the data length is specified by S2. When the data length S2 is larger than maximum 64, it is counted as 64. And the part above 64 is invalid.

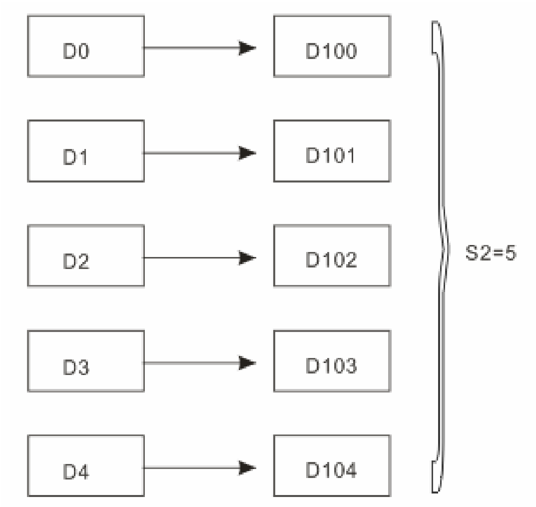


Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	"MOVB" is executed as "EN" turns on.	BOOL	M,I,Q, constant
S1	The starting register of the source zone where the data comes from.	INT	D
S2	The length of the transmitted zone, the max value for S2 is 64.	UINT	Constant,D
D	The starting register of the target zone	INT	D

Program example :





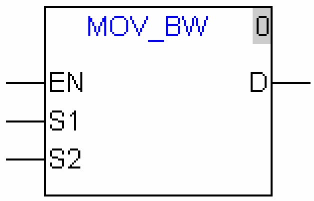
4.6.36. MOV_BW

API	MOV_BW	Move multiple bit device values to multiple registers	Controller
163			10MC11T

Explanation of the instruction:

MOV_BW is used for sending multiple bit device values to the word devices.

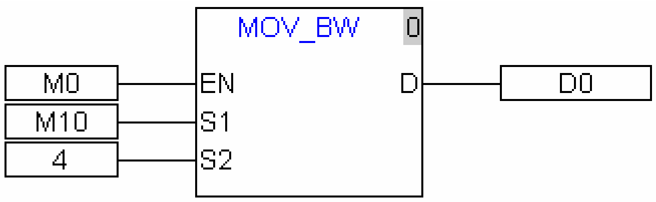
When EN is on, the bit device data with S1 as the starting bit device data is sent to the register zone with D as the starting register and the bit device length is specified by S2. When the data length S2 is larger than maximum 64, it is counted as 64. And the part above 64 is invalid.

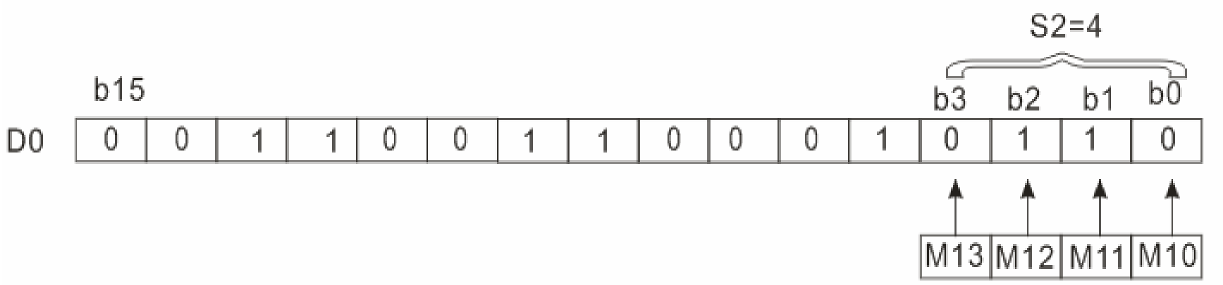


Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“MOV_BW” is executed as “EN” turns on.	BOOL	M,I,Q, constant
S1	The source where the data comes from.	BOOL	M,I,Q
S2	The length of the bit device of the transmitted zone, the max value for S2 is 64.	UINT	Constant,D
D	The starting register of the target zone	INT	D

Note: If the bit device of the instruction exceeds the range of that of the controller, only the data in the bit device within the valid range can be sent.





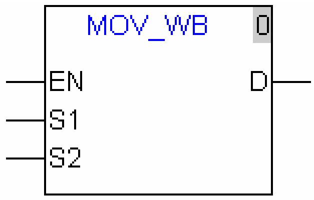
4.6.37. MOV_WB

API	MOV_WB	Move multiple register values to multiple bit devices	Controller
164			10MC11T

Explanation of the instruction:

MOV_WB is used for sending multiple word device values to the bit devices.

When EN is on, the register value with S1 as the starting one is sent to the bit device with D as the starting one. The sent word device data length is specified by S2. When the data length S2 is larger than maximum 64, it is counted as 64. And the part above 64 is invalid.

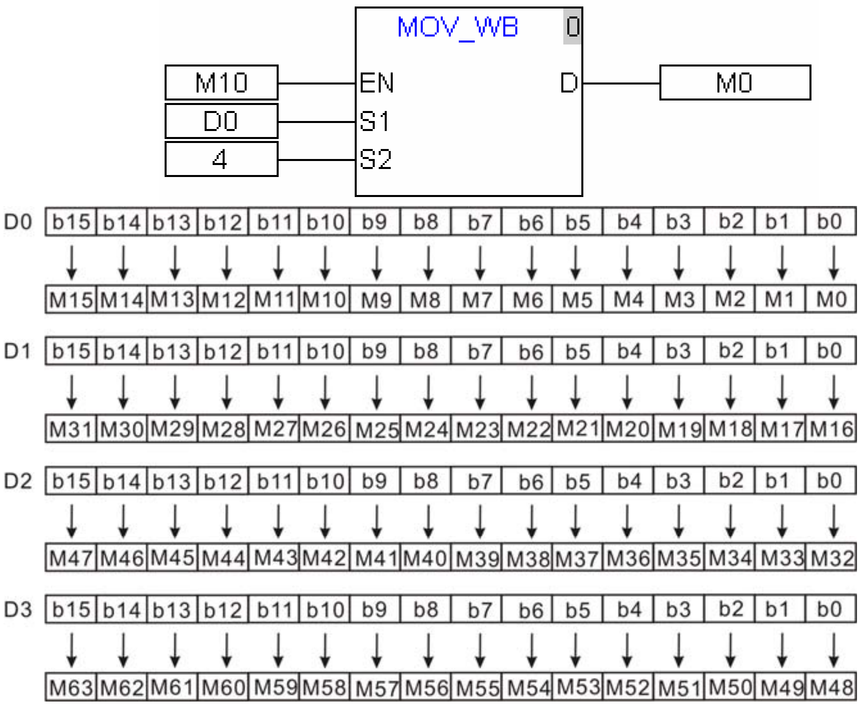


Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“MOV_WB” is executed as “EN” turns on.	BOOL	M,I,Q, constant
S1	Storage area for data source	INT	D
S2	The length of the register of the transmitted zone, the max value for S2 is 64.	UINT	Constant,D
D	The starting one of the target bit device.	BOOL	M,Q

Note: If the register of the instruction exceeds the range of register of the controller, only the data in the register within the valid range can be sent.

Program example:



4.6.38. ZCP

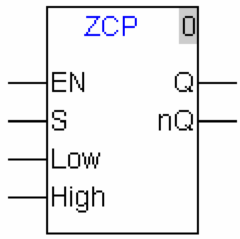
API	ZCP	Compare 16-bit integer to the values in one zone	Controller
165			10MC11T

Explanation of the instruction:

ZCP is used for comparison of one 16-bit signed integer with one zone.

When EN is on, S is within the range from Low value to High value, Q=On and nQ=Off; if S value is out of the range from Low value to High value, nQ =On and Q=Off;

When EN is Off, the status of Q and nQ keeps unchanged.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“ZCP” is executed as “EN” turns on.	BOOL	M,I,Q, constant
S	The compared value	INT	Constant,D
Low	The lower limit for zone comparison	INT	Constant,D
High	The high limit for zone comparison	INT	Constant,D
Q	As the instruction is executed and Low≤S ≤High, the “Q” bit is on.	BOOL	M,Q
nQ	As the instruction is executed and High＜S or S＜Low, the “nQ” bit is on.	BOOL	M,Q

4.6.39. ZCP_DI

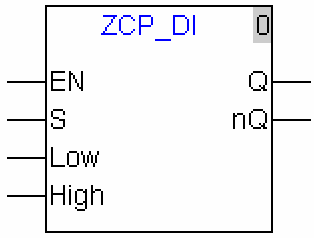
API	ZCP_DI	Compare 32-bit integer to the values in one zone	Controller
166			10MC11T

Explanation of the instruction:

ZCP_DI is used for comparison of the signed 32-bit integer with one zone.

When EN is on, S value is within the range from Low value to High value, Q=On and nQ=Off; if S value is out of the range from Low value to High value, nQ =On, Q=Off;

When EN is Off, the status of Q and nQ keeps unchanged.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	"ZCP_DI" is executed as "EN" turns on.	BOOL	M,I,Q, constant
S	The compared value	DINT	Constant,D
Low	The lower limit for zone comparison	DINT	Constant,D
High	The high limit for zone comparison	DINT	Constant,D
Q	As the instruction is executed and Low ≤S ≤High, the "Q" bit is on.	BOOL	M,Q
nQ	As the instruction is executed and High＜S or S＜Low, the "nQ" bit is on.	BOOL	M,Q

4.6.40. ZCP_R

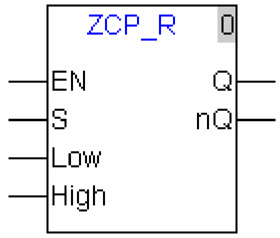
API	ZCP_R	Compare floating number to the values in one zone	Controller
167			10MC11T

Explanation of the instruction:

ZCP_R is used for comparison of the 32-bit floating number with one zone.

When EN is on, S value is within the range from Low value to High value, Q=On and nQ=Off; if S value is out of the range from Low value to High value, nQ =On, Q=Off;

When EN is Off, the status of Q and nQ keeps unchanged.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“ZCP_R” is executed as “EN” turns on.	BOOL	M,I,Q, constant
S	The compared value	REAL	Constant,D
Low	The lower limit for zone comparison	REAL	Constant,D
High	The high limit for zone comparison	REAL	Constant,D
Q	As the instruction is executed and Low≤S ≤High, the “Q” bit is on.	BOOL	M,Q
nQ	As the instruction is executed and High<S or S<Low, the “nQ” bit is on.	BOOL	M,Q

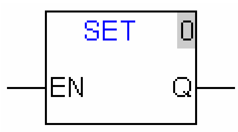
4.6.41. SET

API 168	SET	Setting instruction	Controller 10MC11T

Explanation of the instruction:

SET is used to set one single bit device to On status.

When EN of the instruction is on, Q is on; as EN is off, Q is still on.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“SET” is executed as “EN” turns on.	BOOL	M,I,Q, constant
Q	The output bit Q is set to ON status as the instruction is executed.	BOOL	M,Q

4.6.42. RESET

API 169	RESET	Reset instruction	Controller 10MC11T

Explanation of the instruction:

RESET is used to reset one single bit device.

When EN of the instruction is on, Q is reset to Off state; as EN is off, Q status keeps unchanged.

Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“RESET” is executed as “EN” turns on.	BOOL	M,I,Q, constant
Q	The output bit Q is reset when the instruction is executed.	BOOL	M,Q

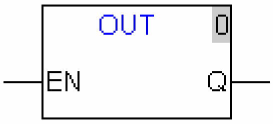
4.6.43. OUT

API 170	**OUT**	Coil driving	Controller
			10MC11T

Explanation of the instruction:

OUT is used to drive one single bit device.

When EN of the instruction is on, Q is On; when EN is off, Q is off.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“OUT” is executed as “EN” turns on.	BOOL	M,I,Q, constant
Q	The output bit Q is set to On state when the instruction is executed.	BOOL	M,Q

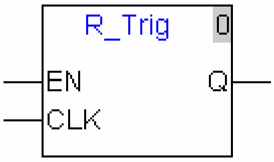
4.6.44. R_Trig

API 171	**R_Trig**	Rising edge triggering	Controller
			10MC11T

Explanation of the instruction:

R_Trig is used to trigger via CLK bit rising edge to make Q bit generate the high level for one scan cycle.

When EN is On and CLK turns off -> on, Q outputs the high level for one scan cycle.

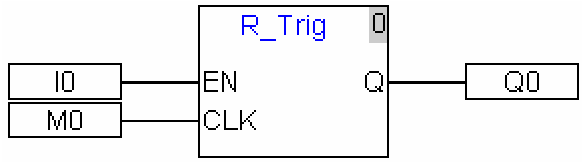


Explanation of input and output parameter of the instruction:

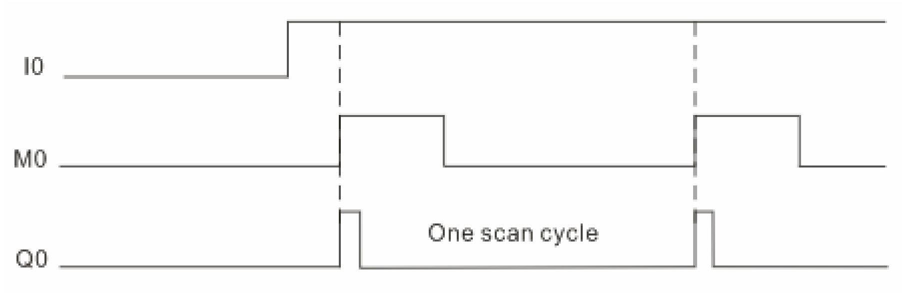
Parameter name	Explanation	Data type	Available device
EN	“R_Trig” is executed as “EN” turns on.	BOOL	M,I,Q, constant
CLK	The rising edge triggering bit	BOOL	M,I,Q, constant
Q	The rising edge of CLK makes Q be in on status for one cycle when the instruction is being executed.	BOOL	M,Q

Program example:

As I0=On and M0 turns off -> on via the trigger of the rising edge, ”R_Trig" instruction is executed; "Q0“ outputs the pulse once and the length of the pulse is one scan cycle.



Sequence chart:

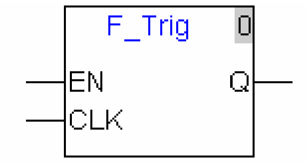


4.6.45. F_Trig

API	F_Trig	Falling edge triggering	Controller
172			10MC11T

Explanation of the instruction:

F_Trig is used to trigger via falling edge of CLK bit to make Q bit generate the high level for one scan cycle. When EN is On and CLK turns on -> off, Q outputs the high level for one scan cycle.

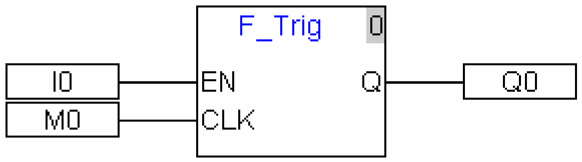


Explanation of input and output parameter of the instruction

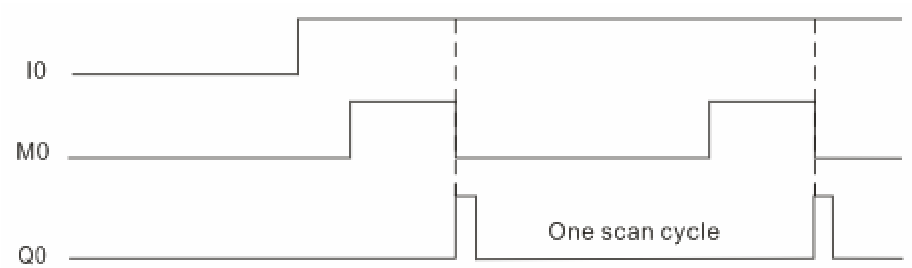
Parameter name	Explanation	Data type	Available device
EN	“F _Trig” is executed as “EN” turns on.	BOOL	M,I,Q, constant
CLK	The falling edge triggering	BOOL	M,I,Q, constant
Q	The falling edge of CLK makes Q be in on status for one cycle when the instruction is being executed.	BOOL	M,Q

Program example:

As I0=On and M0 turns on -> off via the trigger of the falling edge, "F_Trig" instruction is executed; "Q0" outputs the pulse once and the length of the pulse is one scan cycle.



Sequence chart:



4.6.46. ZRSTM

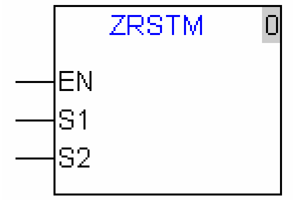
API	ZRSTM	Reset one zone of bit devices	Controller
173			10MC11T

Explanation of the instruction:

ZRSTM is used to reset multiple continuous bit devices.

When EN is on, the bit devices with S1 as the starting device are reset and the length of the reset bit devices is specified by S2;

When EN is off, the status of the bit devices is unchanged. If the length specified by S2 exceeds maximum 64, it is counted as 64 and the part above 64 is invalid.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“ZRSTM” is executed as “EN” turns on.	BOOL	M,I,Q, constant
S1	The starting bit device reset	BOOL	M,Q
S2	Specify the quantity of the bit device; the max value of S2 is 64.	UINT	Constant, D

4.6.47. ZRSTD

API	ZRSTD	Reset one zone of registers	Controller
174			10MC11T

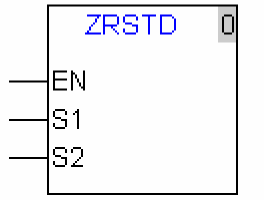
Explanation of the instruction:

ZRSTD is used to reset multiple continuous registers.

When EN is on, the registers with S1 as the starting register are cleared as 0; and the number of the registers is specified by S2;

When EN is off, the values of the registers are unchanged.

If the length specified by S2 exceeds maximum 64, it is counted as 64 and the part above 64 is invalid.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“ZRSTD” is executed as “EN” turns on.	BOOL	M,I,Q, constant
S1	The reset starting register	INT	D
S2	Specify the quantity of the registers; the max value of S2 is 64.	UINT	Constant, D

4.6.48. SQRT_R

API 175	SQRT_R	Square root of floating number	Controller 10MC11T

Explanation of the instruction:

SQRT_R is used for arithmetic square root operation of 32-bit floating number.

When EN is on, arithmetic square root operation of the floating number specified by S is conducted and the result is saved in D device.

Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“SQRT_R” is executed as “EN” turns on.	BOOL	M,I,Q, constant
S1	Radicand	REAL	Constant, D
D	Arithmetic square root	REAL	D

Note: Operand S1 must be the floating number. When S1 is equal to or less than 0, the result value stored in D device is 0.

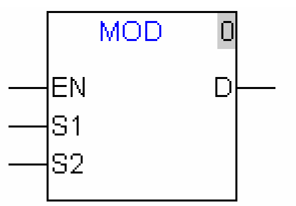
4.6.49. MOD

API 176	MOD	Get remainder of 16-bit integer	Controller 10MC11T

Explanation of the instruction:

MOD is used for getting the remainder of 16-bit integer through division operation.

When EN is on, divide S1 by S2 and the remainder of S1 is stored in D device.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“MOD” is executed as “EN” turns on.	BOOL	M,I,Q, Constant
S1	Dividend	INT	Constant, D
S2	Divisor	INT	Constant, D
D	Remainder	INT	D

Note: Operand S1 and S2 must be 16-bit integers.

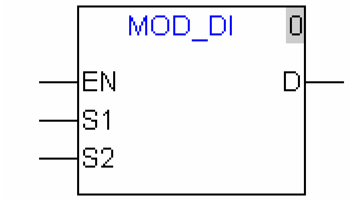
4.6.50. MOD_DI

API	**MOD_DI**	Get remainder of 32-bit integer	Controller
177			10MC11T

Explanation of the instruction:

MOD_DI is used for getting the remainder of 32-bit integer through division operation.

When EN is on, divide S1 by S2 and the remainder of S1 is stored in D device.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“MOD_DI” is executed as “EN” turns on.	BOOL	M,I,Q, Constant
S1	Dividend	DINT	Constant, D
S2	Divisor	DINT	Constant, D
D	Remainder	DINT	D

Note: Operand S1 and S2 must be the 32-bit integers.

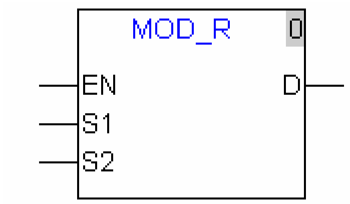
4.6.51. MOD_R

API	**MOD_R**	Get remainder of floating number	Controller
178			10MC11T

Explanation of the instruction:

MOD_R is used for getting the remainder of floating number through division operation.

When EN is on, divide S1 by S2 and the remainder of S1 is stored in D device.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“MOD_R” is executed as “EN” turns on.	BOOL	M,I,Q, constant
S1	Dividend	REAL	Constant, D
S2	Divisor	REAL	Constant, D
D	Remainder	REAL	D

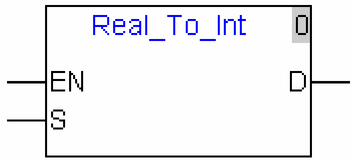
Note: Operand S1 and S2 must be the floating numbers.

4.6.52. Real_To_Int

API 179	Real_To_Int	Convert floating number into 16-bit integer	Controller 10MC11T

Explanation of the instruction:

Real_To_Int is used for converting 32-bit floating numbers into the signed 16-bit integer. When EN is on, floating number S value is converted into the signed 16-bit integer which is stored in D device and S value keeps unchanged.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“Real_To_Int” is executed as “EN” turns on.	BOOL	M,I,Q, Constant
S	The floating point to be converted	REAL	Constant, D
D	The 16-bit integer which has been converted	INT	D

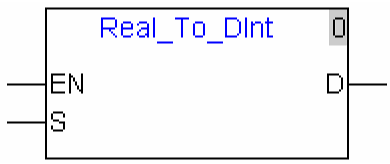
4.6.53. Real_To_DInt

API 180	Real_To_DInt	Convert floating number into 32-bit integer	Controller 10MC11T

Explanation of the instruction:

Real_To_DInt is used for converting 32-bit floating number into the signed 32-bit integer.

When EN is on, floating number S value is converted into the signed 32-bit integer which is stored in D device and S value keeps unchanged.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	"Real_To_DInt” is executed as “EN” turns on.	BOOL	M,I,Q, Constant
S	The floating point to be converted	REAL	Constant, D
D	The 32-bit integer which has been converted	DINT	D

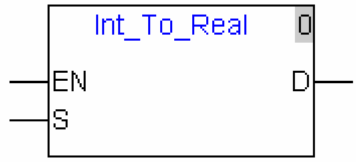
4.6.54. Int_To_Real

API	**Int _To_Real**	Convert 16-bit integer into floating number	Controller
181			10MC11T

Explanation of the instruction:

Int_To_Real is used for converting the signed 16-bit integer into 32-bit floating number.

When EN is on, the signed 16-bit integer S value is converted into the 32-bit floating number which is stored in D device and S value keeps unchanged.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“Int_To_Real” is executed as “EN” turns on.	BOOL	M,I,Q, Constant
S	The 16-bit integer to be converted	INT	Constant, D
D	The floating number which has been converted	REAL	D

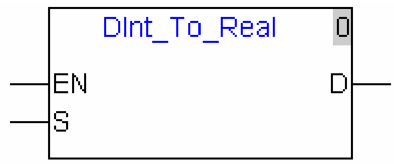
4.6.55. DInt_To_Real

API	**DInt _To_Real**	Convert 32-bit integer into floating number	Controller
182			10MC11T

Explanation of the instruction:

DInt_To_Real is used for converting the signed 32-bit integer into 32-bit floating number.

When EN is on, the signed 32-bit integer S value is converted into the 32-bit floating number which is stored in D device and S value is unchanged.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	“DInt_To_Real” is executed as “EN” turns on.	BOOL	M,I,Q, Constant
S	The 32-bit integer to be converted	DINT	Constant, D
D	The floating point which has been converted	REAL	D

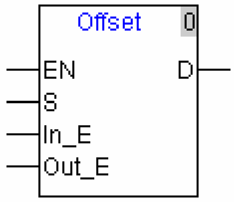
4.6.56. Offset

API	Offset	16-bit integer index register instruction	Controller
183			10MC11T

Explanation of the instruction:

Offset instruction is used for operation of 16-bit integer index register.

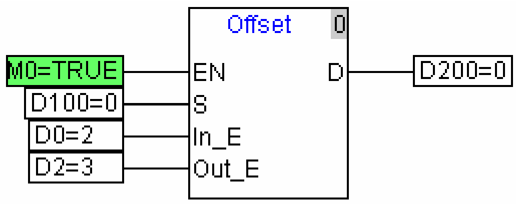
When EN is on, add the In_E value to S register address and the result is the address of source index register; add the Out_E value to D register address and the result is the address of the destination index register. The destination index register value changes with the changing source index register value. When S is linked to the output pin of other instruction with a line, the In_E value is invalid; When D is linked to the input pin of other instruction with a line, the Out _E value is invalid.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
EN	"Offset" is executed as "EN" turns on.	BOOL	M,I,Q, constant
S	The start address of source register	INT	D
In_E	Address offset length of source register	INT	D
Out_E	Address offset length of destination register	INT	D
D	The start address of destination register	INT	D

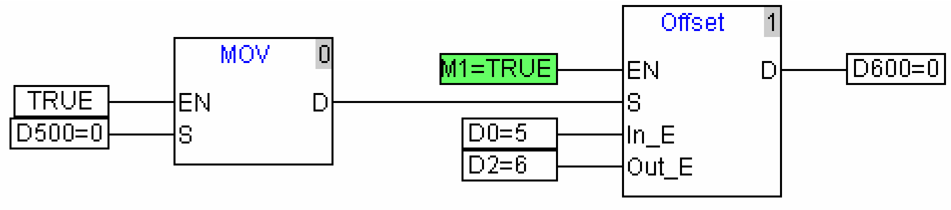
Example 1:



Program Explanation:

- When M0= on, S is D100; In_E=2 and the source index register address is D(100+2)=D102.
- When D is D200 and Out_E=3, the destination index register address is D(200+3)=D203 and meanwhile, the content of D102 is moved to D203.

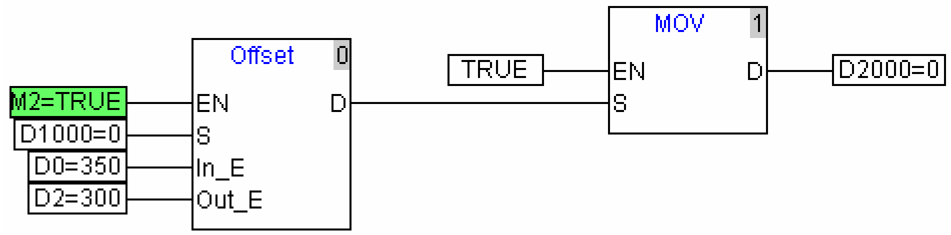
Example 2:



Program Explanation:

- When the input pin S of Offset instruction and the output pin D of MOV instruction are linked with a line, the In_E value is invalid.
- When M1 is on, the source index register address of Offset instruction is the input device (S) address of MOV function block, which is fixed to D500.
- The output D of Offset instruction is D600, Out_E= 6, the destination index register address is D(600+6)=D606.
- Move the content of D500 to D606.
- When Out_E value changes, the content of D500 can be moved to different registers.

Example 3:



Program Explanation:

- The output pin D of Offset instruction and the input pin S of MOV instruction are linked with a line, the Out_E value is invalid.
- When M2 is on, the input S of Offset instruction is D1000, In_E=350 and the source index register address is D(1000+350)=D1350.
- The vaule of the source index register address is moved to the output D of Offset instruction and the D1350 value is moved to D2000.
- When In_E value changes, the content of different registers can be moved to D2000.

4.6.57. Offset _DI

API	Offset_DI	32-bit integer index register instruction	Controller
184			10MC11T

Explanation of the instruction:

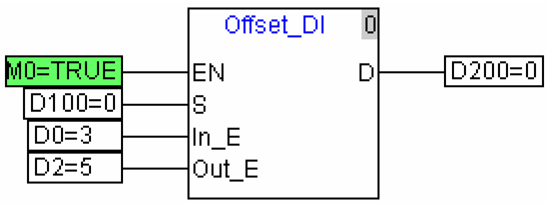
Offset_DI is used for operation of 32-bit integer index register.

When EN is on, add the In_E value to S register address and the result is the address of source index register; add the Out_E value to D register address and the result is the address of the destination index register. The destination index register value changes with the changing source index register value. When S is linked to the output pin of other instruction with a line, the In_E value is invalid; When D is linked to the input pin of other instruction with a line, the Out _E value is invalid.

Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Type	Available device
EN	“Offset_DI” is executed as “EN” turns on.	BOOL	M,I,Q, constant
S	The start address of source register	DINT	D
In_E	The address offset length of source register	INT	D
Out_E	The address offset length of destination register	INT	D
D	The start address of destination register	DINT	D

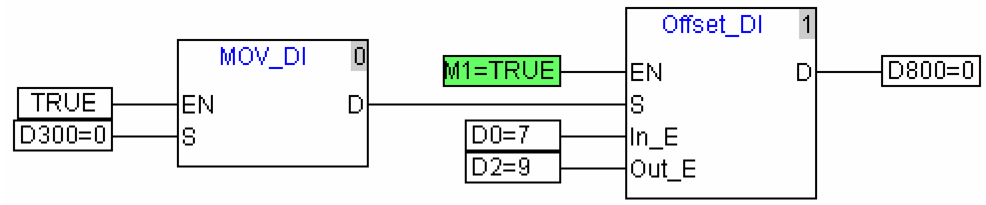
Example 1:



Program Explanation:

- ◆ When M0 is on, S is D100; In_E= 3 and the source index register address is D(100+3)=D103;
- ◆ D is D200; Out_E= 5 and the destination index register address is D(200+5)=D205;
- ◆ At the moment, move the content of D103 to D205.

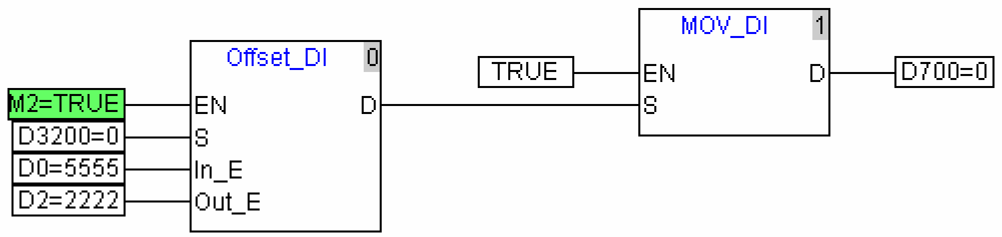
Example 2:



Program Explanation:

- ◆ When the input pin S of Offset_DI instruction and the output pin D of MOV_DI instruction are linked with a line, the In_E value is invalid.
- ◆ When M1 is on, the source index register address of Offset_DI instruction is the input device (S) address of MOV_DI function block, which is fixed to D300.
- ◆ The output D of Offset_DI instruction is D800, Out_E= 9, the destination index register address is D(800+9)=D809.
- ◆ Move the content of D300 to D809.
- ◆ When Out_E value changes, the content of D300 can be moved to different registers.

Example 3:



Program Explanation:

- ◆ The output pin D of Offset_DI instruction and the input pin S of MOV_DI instruction are linked with a line, the Out_E value is invalid.
- ◆ When M2 is on, the input S of Offset_DI instruction is D3200, In_E=5555 and the source index register address is D(3200+5555)=D8755.
- ◆ The vaule of the source index register address is moved to the output D of MOV_DI instruction and the D8755 value is moved to D700.
- ◆ When In_E value changes, the content of different registers can be moved to D700.

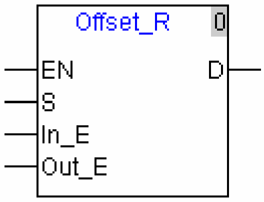
4.6.58. Offset _R

API	Offset_R	Floating-point number index register instruction	Controller
185			10MC11T

Explanation of the instruction:

Offset_R is used for operation of 32-bit floating-point number index register.

When EN is on, add the In_E value to S register address and the result is the address of source index register; add the Out_E value to D register address and the result is the address of the destination index register. The destination index register value changes with the changing source index register value. When S is linked to the output pin of other instruction with a line, the In_E value is invalid; When D is linked to the input pin of other instruction with a line, the Out _E value is invalid.



Explanation of input and output parameter of the instruction:

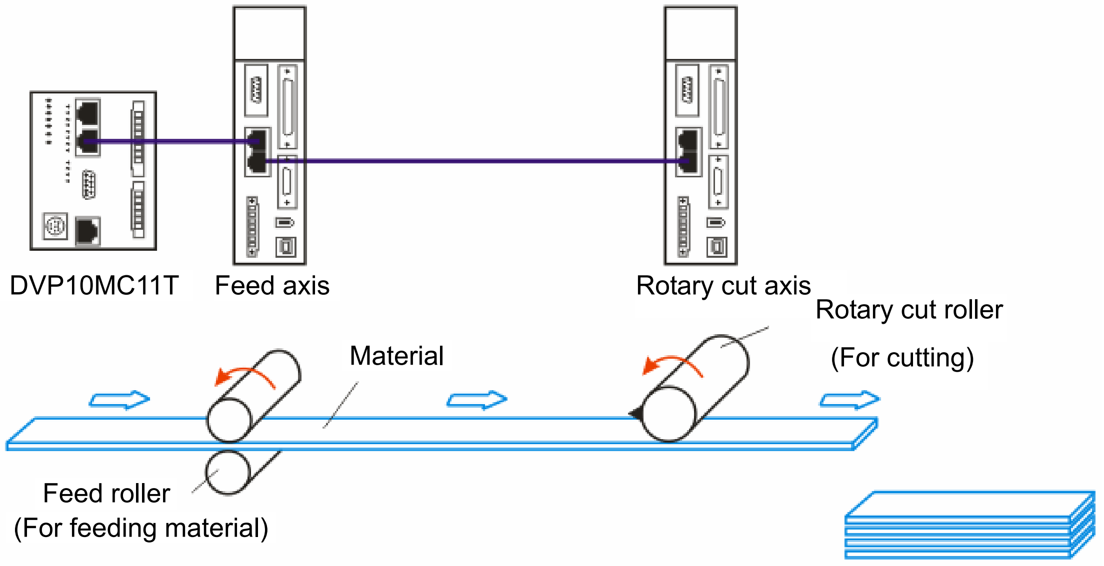
Parameter name	Explanation	Type	Available device
EN	"Offset_R" is executed as "EN" turns on.	BOOL	M,I,Q, constant
S	The start address of source register	REAL	D
In_E	The address offset length of source register	INT	D
Out_E	The address offset length of destination register	INT	D
D	The start address of destination register	REAL	D

Note: For the example of Offset_R, please refer to the program example of Offset_DI.

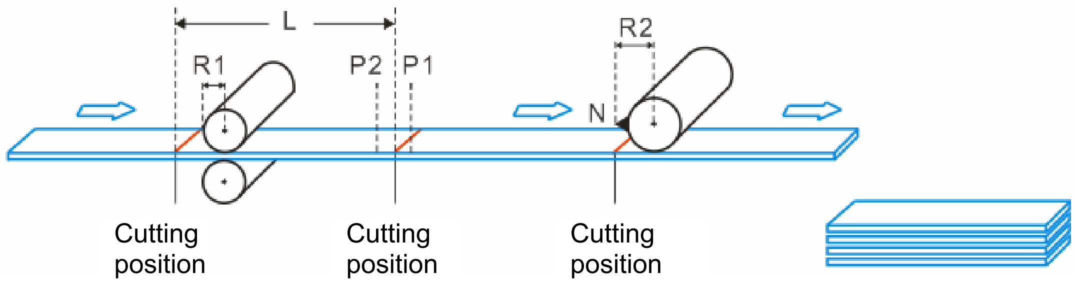
4.7. Application Instruction

4.7.1. Rotary Cut Technology

Rotary cut is the technology to cut the material in transmission vertically. The knife conducts cutting on the cut surface periodically with the rotation of the rotary cut axis.



Note: The feed axis is to control the feed roller; the rotary cut axis is to control rotary cut roller with the knife mounted on the rotary cut roller. The rotary cut function is usually used for cutting of the thin material or the material of medium thinness and can be applied in packaging machine, cutting machine, punching machine, printing machine etc.

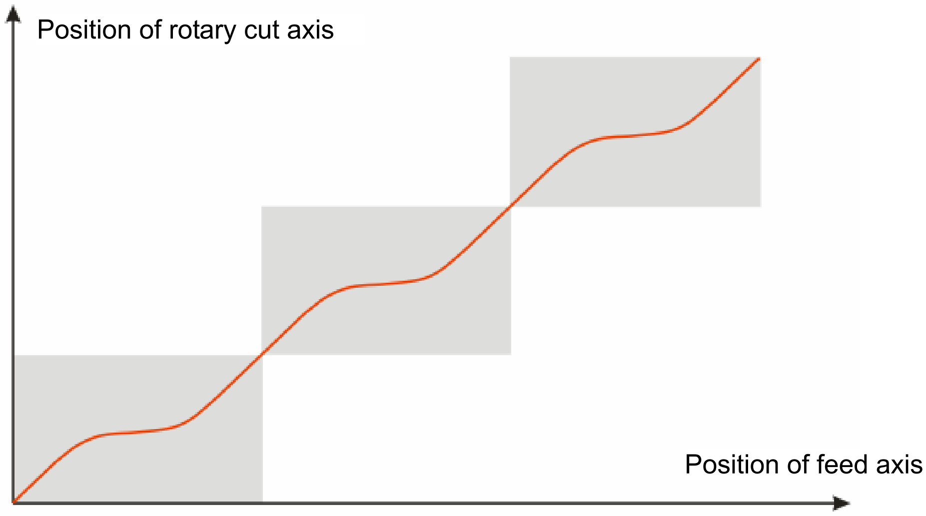


4.7.2. Rotary Cut Parameters

Parameter in figure	Explanation	Instruction name
L	The cutting length of the processed material	FdAxis_CutLength
R1	The radius of feed axis, i.e. the radius length of the feed roller.	FdAxis_Radius
R2	The radius of rotary axis, i.e. the distance from center of the rotary roller to tool bit.	RotAxis_Radius
N	The number of the knife in the rotary roller. The knife number is 1 in figure above.	RotAxis_KnifeNum
P1	The starting position of the synchronous area.	FdAxis_SyncStartPos
P2	The end position of the synchronous area.	FdAxis_SyncStopPos

4.7.3. Control feature of rotary cut function

Rotary cut function is a type of special electronic cam function. The figure of cam curve is shown below for continuous cutting.



1) User can set the cutting length freely according to the technological requirement and the cutting length could be less or more than the circumference of the cutter.
2) In the sync area, the knife and feed axis keep synchronous in speed to complete the cutting action.
3) DVP10MC11T supports the rotary roller with multiple knives.
4) The feed axis is able to make the motion at a constant speed, acceleration, or deceleration during cutting.
5) When rotary cut relation is broken off, the knife stops at the zero point of the system, i.e. the entry position for rotary cutting.

4.7.4. Introduction to the Cam with Rotary Cut Function

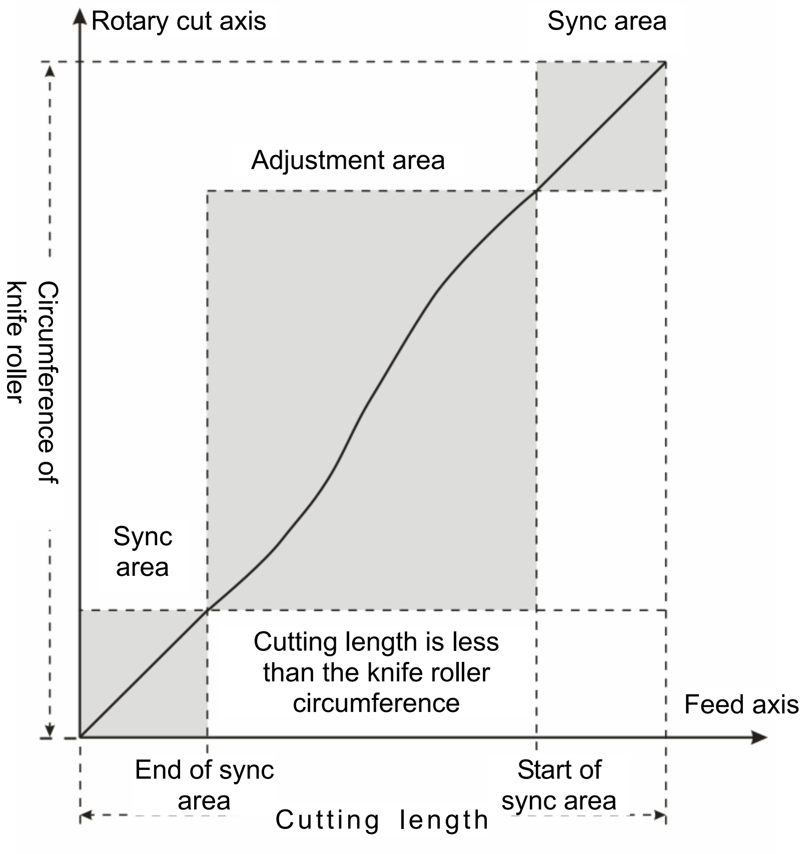
The function curve of the cam with rotary cut function could be divided into sync area and adjustment area.

Sync area: Feed axis and rotary axis make the motion at a fixed ratio (Linear speed of knife is usually equal to that of the cut surface), and material cutting takes place in sync area.

Adjustment area: Due to different cutting length, position need be adjusted accordingly. Adjustment area can be in the following three situations based on various cutting length.

■ **Short material cutting**

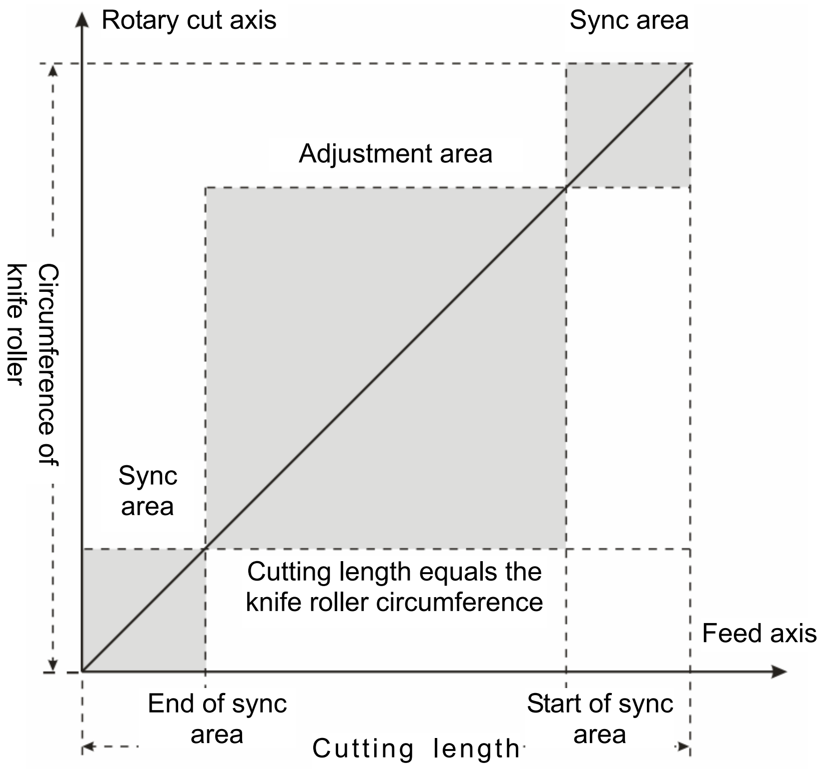
When cutting length is less than the knife roller circumference, the rotary cut curve for any cycle is shown below.



For the cutting of the short material, rotary cut axis must accelerate first in adjustment area, and then decelerate to the synchronous speed.

■ **Equal length cutting**

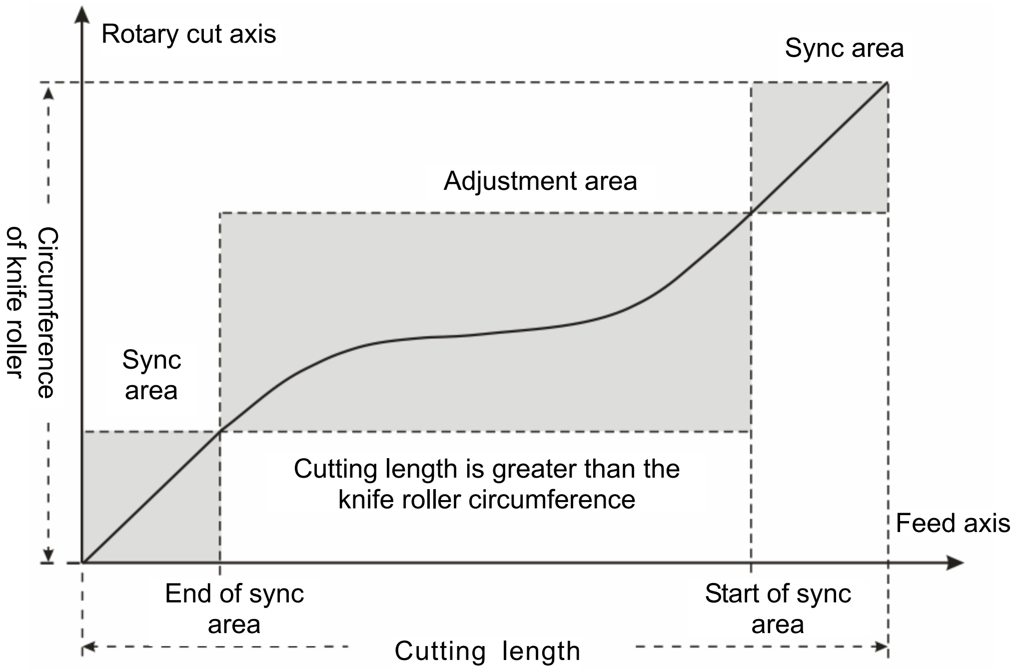
When the cutting length is equal to knife roller circumference, the rotary cut curve for any cycle is shown below.



In this situation, feed axis and rotary cut axis in sync area and non-sync area keep synchronous in speed. The rotary cut axis does not need to make any adjustment.

■ **Long material cutting**

When the cutting length is greater than the knife roller circumference, the rotary cut curve for any cycle is shown below.

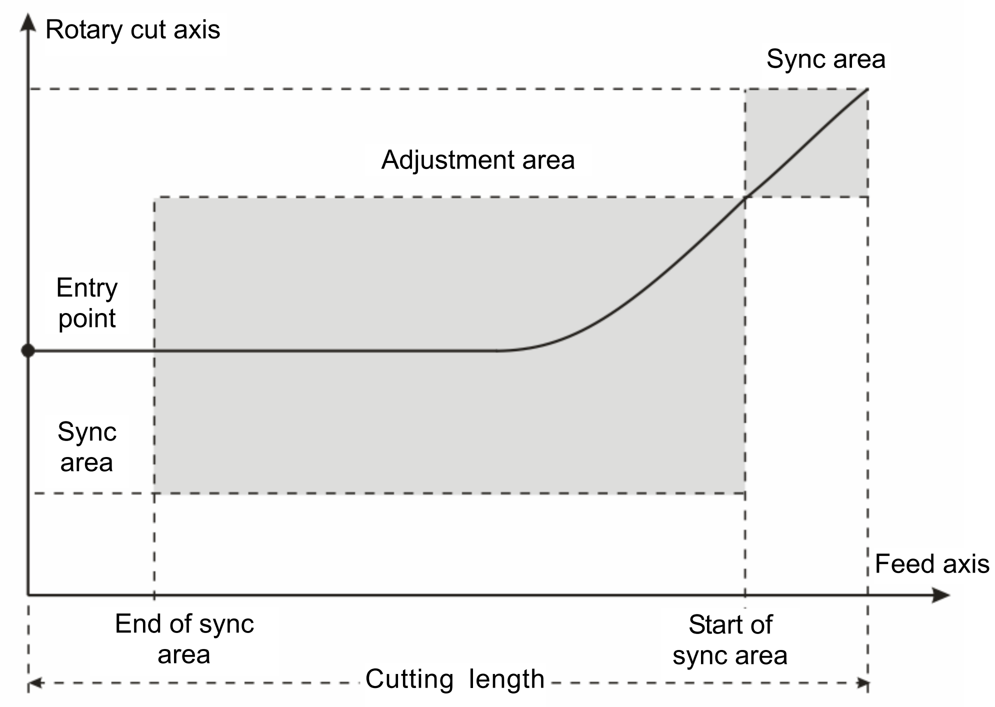


In this situation, rotary cut axis should decelerate first in adjustment area and then accelerate to synchronous speed. If the cutting length is far greater than rotary cut roller circumference, the roller may decelerate to 0 and then stay still for a while; finally, accelerate up to synchronous speed. The greater the cutting length is, the longer the roller stays.

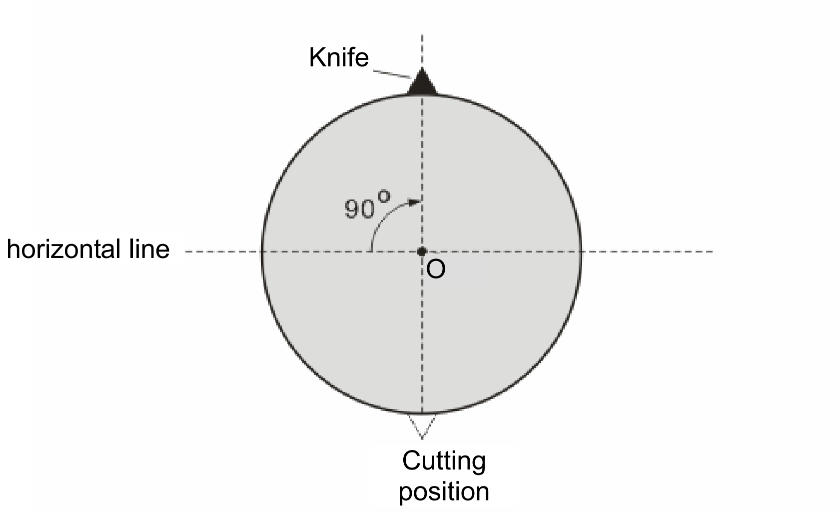
Additionally, when rotary cut function is started or broken off, the cam curves used are different.

- **The entry curve**

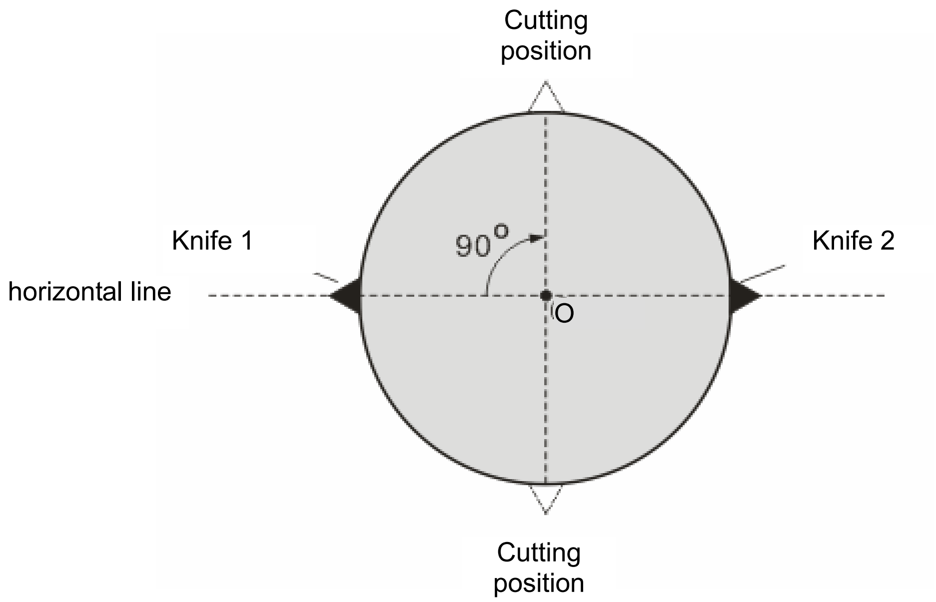
It is the rotary cut curve when rotary cut function is started



The curve is the rotary cut function entry curve. When the rotary cut function is started up, the rotary cut axis will follow the feed axis to rotate according to the curve. The entry position is based on the rotary cut axis. For the single knife, the cutting position is directly below the rotary cut roller if the entry position is over the rotary cut roller in the following figure. Before the rotary cut function is started up, the knife must be turned to the upper of the rotary roller. Otherwise, the cutting may happen in the adjustment area.

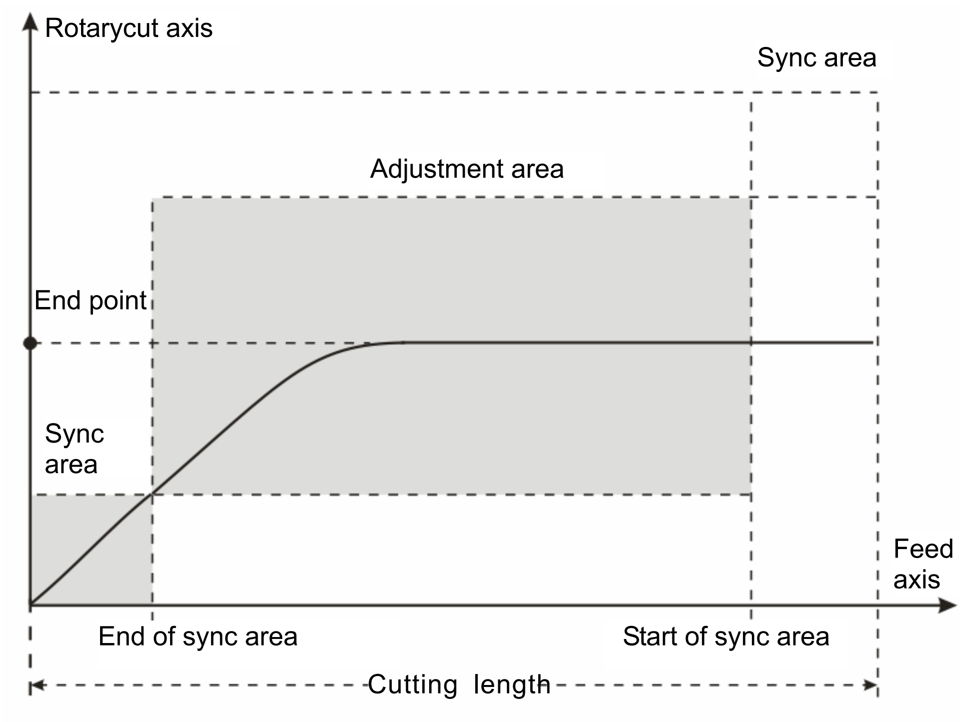


When the rotary roller is mounted with multiple knives, the distance between knives should be the same and the cutting position is at the center of the knife distance. See the two-knife figure below.



■ **The end curve**

It is the rotary cut curve when the rotary cut function is broken away.



After the instruction “APF_RotaryCut_Out” is started up, the system will use the curve to make the rotary cut axis break away from the rotary cut state. Eventually, the knife stops at the end position as shown in the figure above.

The end position is based on the rotary axis. For the single knife, the end position is the entry position and it is also over the rotary cut roller.

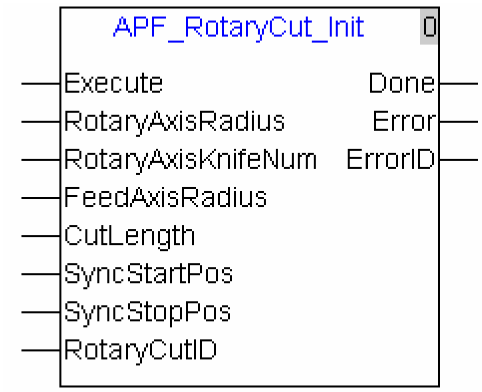
4.7.5. Rotary Cut Instructions

4.7.5.1. APF_RotaryCut_Init

API	APF_RotaryCut_Init	Initialize rotary cut	Controller
220			10MC11T

Explanation of the instruction:

The instruction is used for initializing the radius of rotary axis and feed axis, the cutting length, synchronous area and etc if the rotary cut relation has not been established. After execution of the instruction is completed, the relevant parameters are loaded so as to be called while the rotary cut relation is being established. If the rotary cut relation has been established, the instruction is used for modifying the rotary cut parameters. And the newly set parameters will be effective in the following period after the execution of the instruction is finished.



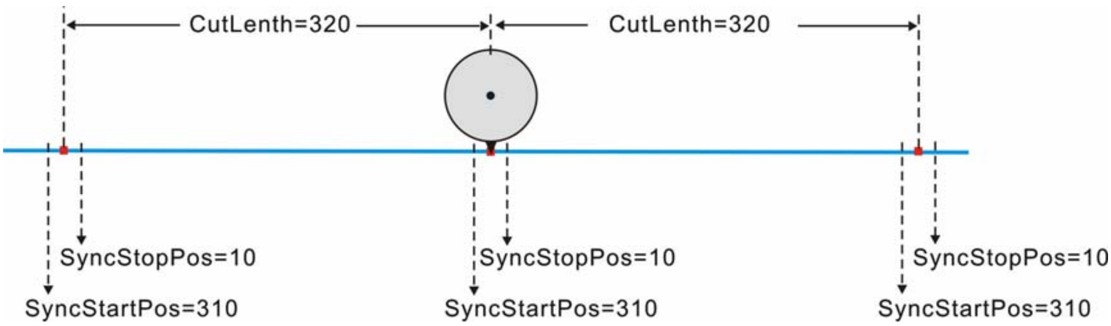
Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Execute	When “Execute” turns off -> on, the instruction is executed.	BOOL	M,I,Q, constant
RotaryAxisRadius	The radius of rotary cut axis, i.e. the distance from center of the rotary cut roller to the knife.	REAL	Constant, D
RotaryAxisKnifeNum	The number of the knife of rotary axis, i.e. the number of knife mounted on the rotary roller	UINT	Constant, D
FeedAxisRadius	The radius of feed axis; i.e. the radius length of the feed roller	REAL	Constant, D
CutLenth	The cutting length of material	REAL	Constant, D
SyncStartPos	The start position of the sync area, i.e. the corresponding feed axis position when the sync area starts.	REAL	Constant, D
SyncStopPos	The end position of the sync area, i.e. the corresponding feed axis position when the sync area ends.	REAL	Constant, D
RotCutID	The number for a group of rotary cut instructions; a group of rotary cut instructions use the uniform number. Setting range: 0~7.	UINT	Constant, D

Parameter name	Explanation	Data type	Available device
Done	When parameter setting is completed, "Done" turns on; when “Execute” turns off, "Done" is reset.	BOOL	M,Q
Error	When any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

Note:

1. The value of "SyncStartPos" in sync area is always greater than "SyncStopPos" in sync area. As below figure shows, the cutting length is 320; "SyncStartPos" is 310; "SyncStopPos": 10.



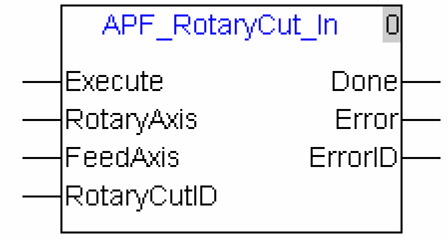
2. The limit for sync area is that it must not be larger than the half of cutting length. In above figure, sync area is 20, and the half of the cutting length is 160.
3. The length parameters in the function are RotaryAxisRadius, FeedAxisRadius, CutLenth, SyncStartPos, and SyncStopPos with the uniform unit. For example, if the unit for one of the parameters is CM (centimeter), the units for other parameters must be CM as well.

4.7.5.2. APF_RotaryCut_In

API	APF_RotaryCut_In	Rotary cut-in	Controller
221			10MC11T

Explanation of the instruction:

The instruction is used for establishing the rotary cut relation and specifying the axis number of the rotary axis and feed axis according to the application requirement. After the execution of the instruction succeeds, the rotary cut axis follows the feed axis to make the motion according to the rotary cut curve.



Explanation of input and output parameter of the instruction:

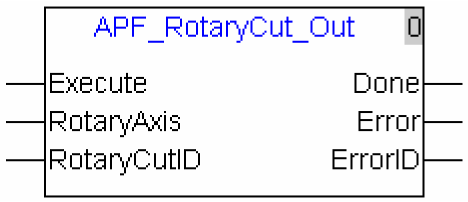
Parameter name	Explanation	Data type	Available device
Execute	When “Execute” turns off -> on, the instruction is executed.	BOOL	Constant, D
RotaryAxis	The axis number of rotary axis	UINT	M,I,Q, constant
FeedAxis	The axis number of feed axis.	UINT	Constant, D
RotCutID	The number for a group of rotary cut instructions; a group of rotary cut instructions use the uniform number. Setting range: 0~7.	UINT	Constant, D
Done	When the execution of “APF_RotaryCut_In" is completed, "Done" turns on; when “Execute” turns off, "Done" is reset.	BOOL	M,Q
Error	When any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

4.7.5.3. APF_RotaryCut_Out

API 222	APF_RotaryCut_Out	Rotary cut-out	Controller 10MC11T

Explanation of the instruction:

The instruction is used for disconnecting the already established rotary cut relation between the rotary axis and feed axis. After the rotary cut relation is disconnected, the knife of the rotary axis will stop at the entry point and will not follow the feed axis any more. The instruction has no impact on the motion of the feed axis.

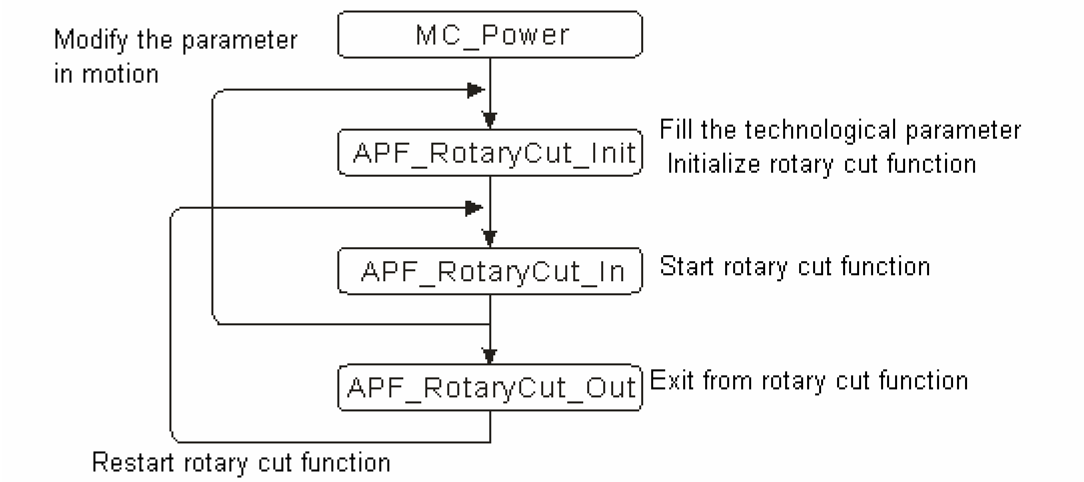


Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Execute	When “Execute” turns off -> on, the instruction is executed.	BOOL	Constant, D
RotaryAxis	The axis number of rotary axis	UINT	M,I,Q, constant
RotCutID	The number for a group of rotary cut instructions; a group of rotary cut parameters use the uniform number. Setting range: 0~7	UINT	constant, D
Done	When “APF_RotaryCut_Out” execution is completed, "Done" turns on; when “Execute” turns off, "Done" is reset.	BOOL	M,Q
Error	When any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

Note:

1. Rotary cut function control sequence:



2. When the rotary cut function is executed, the rotary cut axis can only execute APF_RotaryCut_Out and MC_Stop instruction and other instructions are invalid.

4.7.6. Application Example of Rotary Cut Instructions

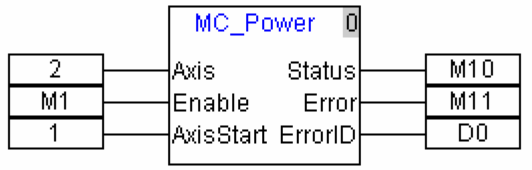
The section explains the setting of rotary cut parameters, establishment and disconnection of rotary cut relation. The following is the program example.

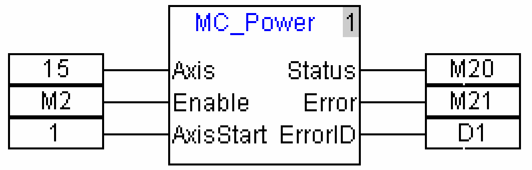
The key parameters in the example:

Parameter	Current value
RotaryAxis	15
FeedAxis	2
RotaryAxisRadius	10 (Unit: units)
RotaryAxisKnifeNum	1
FeedAxisRadius	20 (Unit: units)
CutLenth	30 (Unit: units)
SyncStartPos	19 (Unit: units)
SyncStopPos	1 (Unit: units)

Program Example

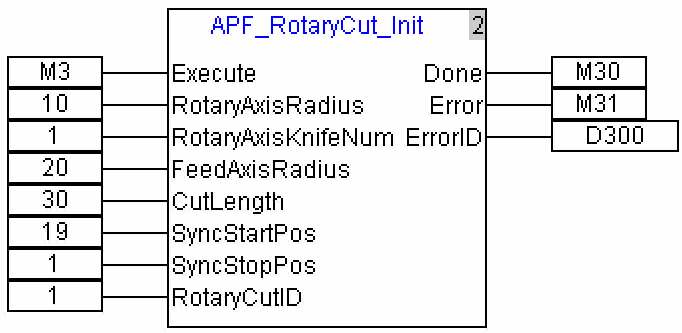
1）As M1 is on, the servo with the node address 2 turns "Servo On"; as M2 is on, the servo with the node address 1 will turn "Servo On".



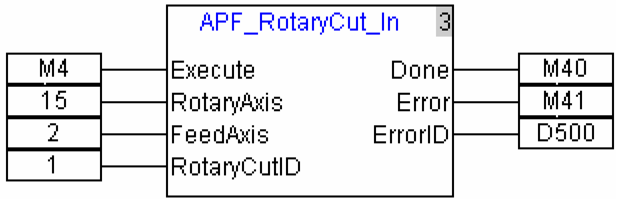


2）Set the rotary cut technology parameters of master axis and slave axis. Radius of rotary axis is 10, knife quantity of rotary axis is 1, and cutting length of feed axis is 30.

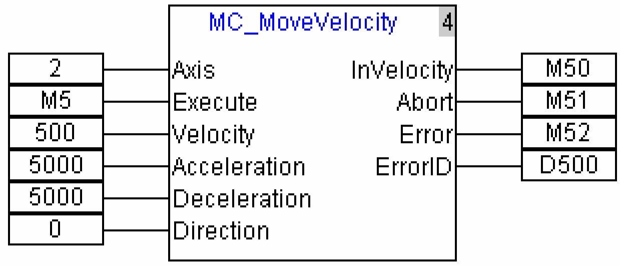
The start position of synchronous area is 19, end position of synchronous area is 1, and the rotary cut group number is 1. When M3 is on, rotary cut technology parameters will be initialized.



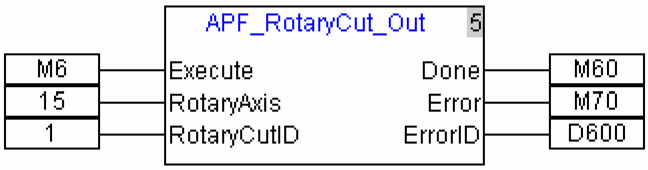
3）When M4 is on, the rotary cut relation starts being established. When M40 is on, it indicates the relation between rotary axis and feed axis is made successfully. Servo 2 is feed axis (master axis) and servo 1 is rotary axis (slave axis). The servo of node ID 15 is the rotary cut axis.



4）When M5 is on, feed axis starts to execute the velocity instruction. At this moment, rotary axis executes the rotary cut action based on the phase of feed axis.



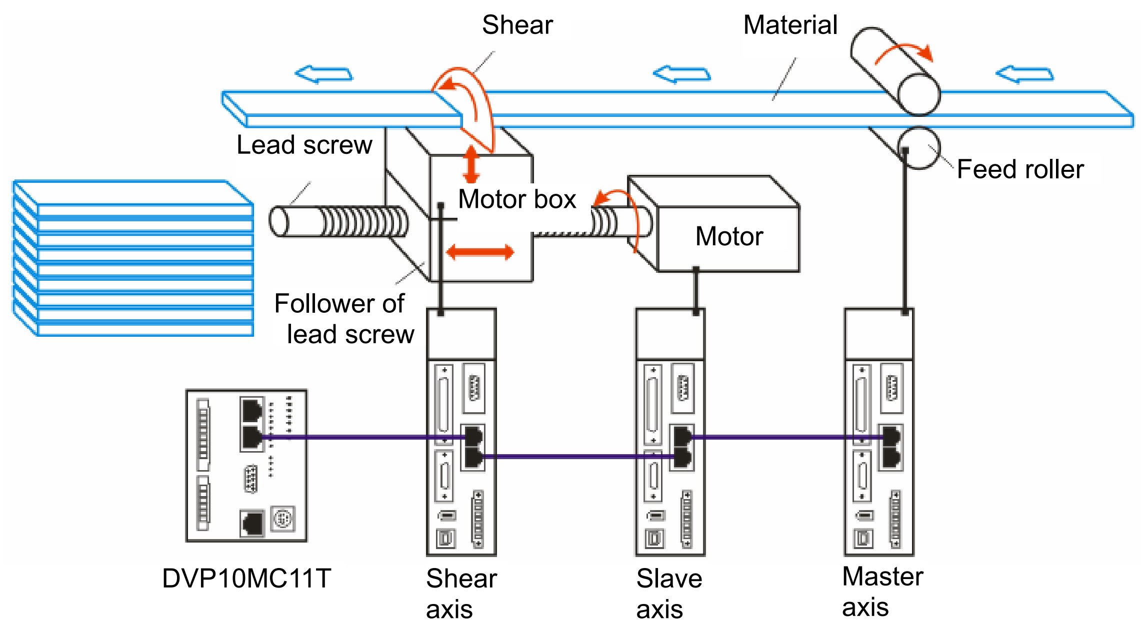
5）When M6 is on, rotary axis starts to break away from feed axis. When M60 is on, it symbolizes rotary axis breaks away from feed axis successfully. After rotary axis breaks away from feed axis, it will return to the entry point and feed axis motion will not impact rotary axis any more.



4.7.7. Flying Shear Technology

Flying shear is the technology to cut the material in transmission vertically. The slave axis starts to accelerate from the wait position. After its speed is up to the synchronous speed, the follower of the lead screw and material move at the same speed; they are relatively static; the Insync bit is on and the shear axis is triggered to control the shear to do the cutting upward.

The structure figure of flying shear is shown as follows.

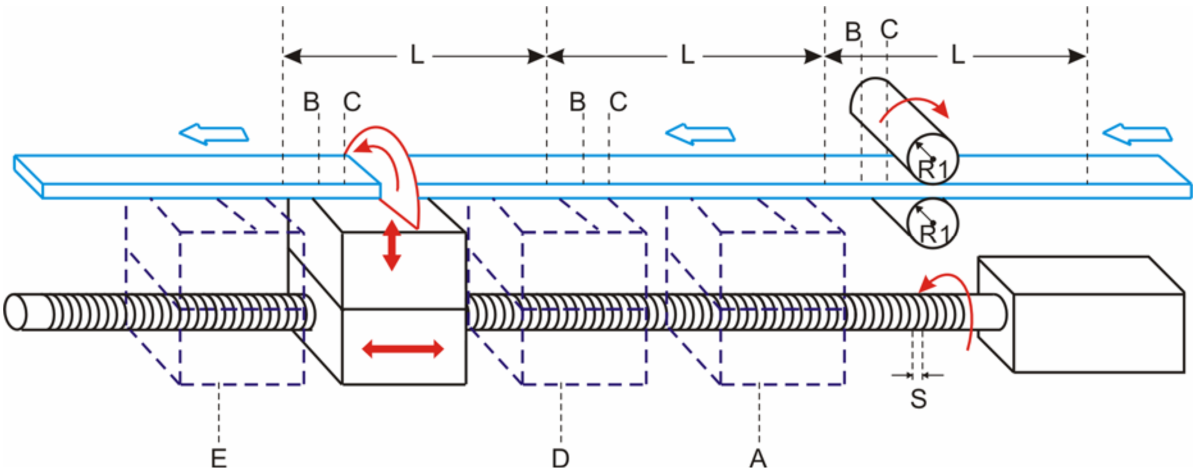


After the cutting is completed, the shear will return to the motor box first and then slave axis will return to the wait position. In continuous cutting, these actions will be executed in cycles.

The flying shear function is applied in cutting of the thick material usually.

4.7.8. The technological parameters of flyingshear function

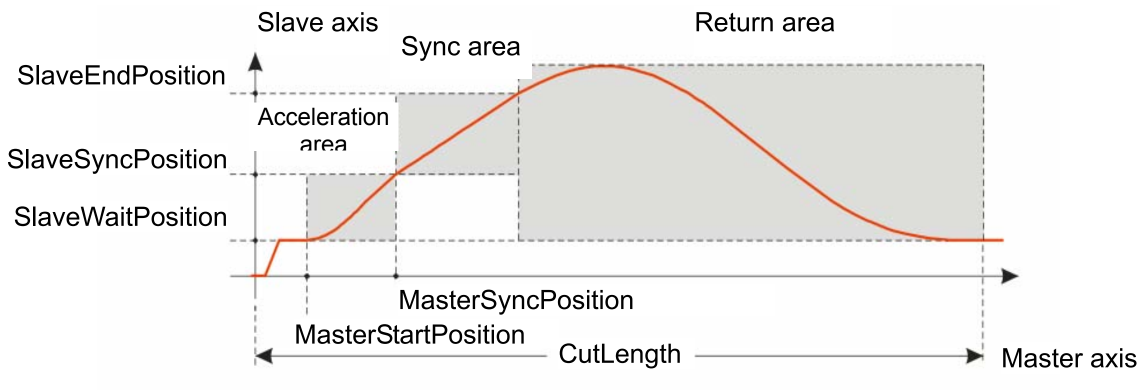
The figure of flying shear function:



Parameter in figure	Description	Name in the instruction
R1	The radius of master axis, i.e. the radius of the feed roller	MasterRaduis
R2	The radius of slave axis, i.e. the radius of the corresponding roller of slave axis. By adopting the lead screw, R2= Lead of the lead screw / 2π =S/2π	SlaveRadius
A	The wait position of slave axis. After the flying shear function is started up, slave axis will run to the position automatically.	SlaveWaitPosition
B	The start position of master axis. When master axis reaches this position, slave axis will chase the master axis starting from the wait position to realize the synchronous speed.	MasterStartPosition
C	The corresponding master position when synchronous area starts.	MasterSyncPosition
D	The corresponding slave position when synchronous area starts.	SlaveSyncPosition
E	The corresponding slave position when synchronous area ends.	SlaveEndPosition
L	The cutting length of material	CutLength

4.7.9. Control feature of flying shear function

Flying shear is a kind of special e-cam function. In continuous shearing, the flying shear curve for the first cycle is shown below.



■ **Explanation of areas**

Acceleration area: After the flying shear relation is established successfully and when master axis runs to MasterStartPosition, slave axis starts to accelerate from static state and finally slave axis and master keeps the synchronous speed. The process is named as the Acceleration area.

Sync area: In this area, slave axis and master axis run at the fixed speed ratio (1:1 usually). And the cutting of material occurs in this area.

Return area: After the Sync area finishes, slave axis starts to decelerate and finally slave axis rotates reversely to the SlaveWaitPosition and then stops. The process is named as the Return area.

■ **Steps for flying shear**

1. After the flying shear function is started up, slave axis runs to the SlaveWaitPosition and stops there.
2. When master axis runs to the MasterStartPosition, slave starts to chase after master axis and the flying shear function enters the acceleration area.
3. When the sync area starts, master axis is in the MasterSyncPosition and slave axis is in the SlaveSyncPosition. Meanwhile, slave axis and master axis keep the synchronous speed and the synchronous bits of relevant instructions turn on.
4. The shear axis will run according to user program after the sync bit is on
5. When slave axis reaches the SlaveEndPosition, the synchronous area ends and the sync bit is reset. Meanwhile, slave axis starts to decelerate and the flying shear function enters the return area.
6. In the end, slave rotates reversely to the SlaveWaitPosition.

■ **Function feature**

1. User could set up the cutting length freely according to the technological requirement
2. User could set up the position and length of the sync area freely according to the technological requirement
3. In sync area, slave axis and master axis run at the fixed speed ratio (speeds are same usually). And the cutting of material occurs in this area.
4. After the flying shear function is started up, slave axis runs following the phase of the master axis. Therefore, master axis could move at a constant speed, acceleration, deceleration and irregular speed.
5. After flying shear function ends, slave axis will still return to the SlaveWaitPosition.

■ **Reference zero point of master axis position**

When the Enable bit of the flying shear instruction is on, the current position of master axis is regarded as the reference zero point of master axis position. Therefore, the reference zero point of master axis position is relative.

■ **Reference zero point of slave axis position**

Slave axis always regards the servo zero point as the reference zero point of its position. Therefore, the reference zero point of slave axis position is absolute.

■ **Shear axis**

The function is to control the shear axis via the sync bit and so the shear axis could be the servo drive, AC motor drive and etc. Severely speaking, the shear axis is excluded in the flying shear system and so user could design it freely.

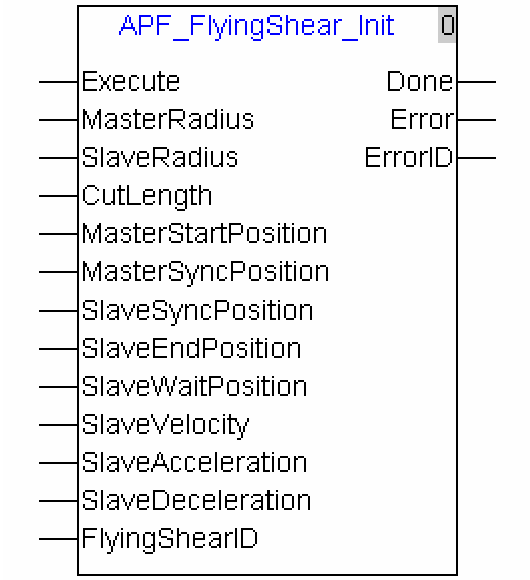
4.7.10. Flying Shear Instructions

4.7.10.1. APF_FlyingShear_Init

API	APF_ FlyingShear_Init	Initialize flying shear	Controller
223			10MC11T

Explanation of the instruction:

The instruction is used for initializing the radius of master axis and slave axis, the cutting length, synchronous area and etc if the flying shear relation has not been established. After execution of the instruction is completed, the relevant parameters are loaded so as to be called while the flying shear relation is being established. If the flying shear relation has been established, the instruction is used for modifying the flying shear parameters. And the newly set parameters will be effective in the following cycle after the execution of the instruction is finished.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Execute	When “Execute” turns off -> on, the instruction is executed.	BOOL	M,I,Q, constant
MasterRadius	The radius of master axis, i.e. the radius of the feed roller	REAL	Constant, D
SlaveRaduis	The radius of slave axis, i.e. the radius of the corresponding roller of slave axis. By adopting the lead screw, R2= Lead of the lead screw / 2 π	REAL	Constant, D
CutLength	The cutting length of material	REAL	Constant, D
MasterStartPosition	The start position of master axis. When master axis reaches this position, slave axis will chase the master axis starting from the wait position to realize the synchronous speed.	REAL	Constant, D

Parameter name	Explanation	Data type	Available device
MasterSyncPosition	The corresponding master position when synchronous area starts.	REAL	Constant, D
SlaveSyncPosition	The corresponding slave position when synchronous area starts.	REAL	Constant, D
SlaveEndPosition	The corresponding slave position when synchronous area ends.	REAL	Constant, D
SlaveWaitPosition	The wait position of slave axis. After the flying shear function is started up, slave axis will run to the position automatically.	REAL	Constant, D
SlaveVelocity	The rotation speed of the terminal actuator of slave axis, the parameter is always positive.(Unit: unit/second)	REAL	Constant, D
SlaveAcceleration	The acceleration of the terminal actuator of slave axis, the parameter is always positive.(Unit: unit/second^2)	REAL	Constant, D
SlaveDeceleration	The deceleration of the terminal actuator of slave axis, the parameter is always positive.(Unit: unit/second^2)	REAL	Constant, D
FlyingShearID	The number for a group of the flying shear instructions; a group of flying shear parameters use the uniform number. Setting range: 0~7	UINT	Constant, D
Done	As the instruction execution is finished, “Done” is on; as “Execute” is off, “Done” is reset.	BOOL	M,Q
Error	When any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

Note:

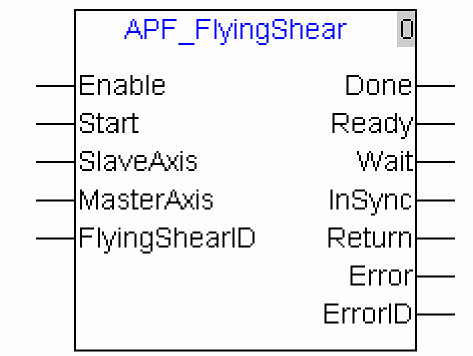
1. The speed, acceleration and deceleration for the slave axis to move to the wait position are specified by this instruction.
2. The value size of the relevant parameters should follow the relations below.

4.7.10.2. APF_FlyingShear

API	APF_FlyingShear	Flying shear instruction	Controller
224			10MC11T

Explanation of the instruction:

The instruction is used for establishing the flying shear relation and specifying the axis number of the master and slave axis according to the application requirement. When the instruction is being executed, its output device can display the zone where the flying shear is. The instruction is also used for disconnection of the flying shear relation.



Explanation of input and output parameter of the instruction

Parameter name	Explanation	Data type	Available device
Enable	When “Enable” turns off -> on, the instruction is executed. And then slave axis moves from current position to SlaveWaitPosition.	BOOL	M,I,Q, constant
Start	When "Start” bit is a high level, the shearing will be done continuously; In the continuous shearing, if “Start” bit turns from high to low level, the flying shear relation will be disconnected automatically and slave will stand still at the wait position after the shearing action in current cycle is completed.	BOOL	M,I,Q, constant
MasterAxis	The number of master axis	UINT	Constant, D
SlaveAxis	The number of slave axis	UINT	Constant, D
FlyingShearID	The number of a group of flying shear instructions; a group of flying shear parameters use the uniform number. Setting range: 0~7	UINT	Constant, D
Done	After “Done” is on, it indicates that the already established flying shear relation is disconnected successfully.	BOOL	M,Q
Ready	After slave axis reaches the wait position, “Ready” bit is on; when slave axis reaches the synchronous area, “Ready” is reset.	BOOL	M,Q

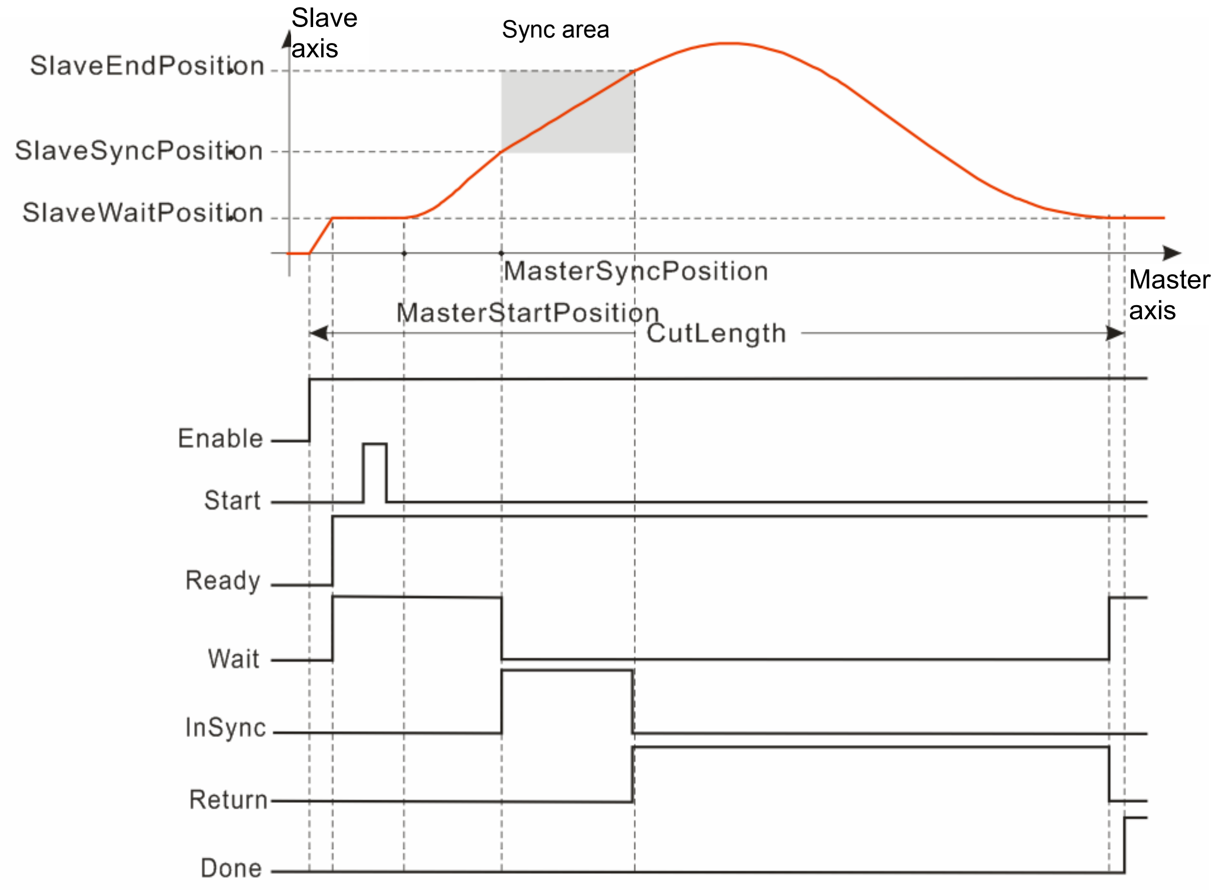
Parameter name	Explanation	Data type	Available device
Wait	“Wait” turns on as chase area starts; “Wait” is reset as chase area ends.	BOOL	M,Q
Insync	“Insync” turns on as synchronous area starts; “Insync” is reset as synchronous area ends.	BOOL	M,Q
Return	“Return” turns on as return area starts; “Return” is reset as return area ends.	BOOL	M,Q
Error	When any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

Note:

1. The flying shear function can be performed again after "Enable" and “Start” are on again. “Enable” is used to establish the flying shear relation. If the flying shear relation is established successfully, “Enable” bit is reset and “Start” bit still can control the flying shear relation.
2. "Start" is used to disconnect the flying shear relation. If “Start” bit is a high level, the shearing will be done continuously; if the flying shear relation need be disconnected, reset “Start” bit.
3. The flying shear relation is disconnected successfully right after “Done” is on; if the shearing action is done once again, “Enable” bit must be triggered again.
4. When the instruction “R_Trig” is used to control “Start” bit, the shearing will be performed for only one cycle. After shearing is finished, “Done” is on; slave axis stops at the wait position and disconnects the flying shear relation with the master axis.
5. The “Start” bit is triggered after “Wait” bit is on. Otherwise, the triggering is invalid.

4.7.11. Sequence Chart on Flying Shear Function

Master axis is in state of constant motion and the sequence chart is shown below:



4.7.12. Application Example of Flying Shear Instructions

This chapter describes the setting of the flying shear parameters, establishment of the flying shear relation and disconnection of the flying shear relation. See the program example below.

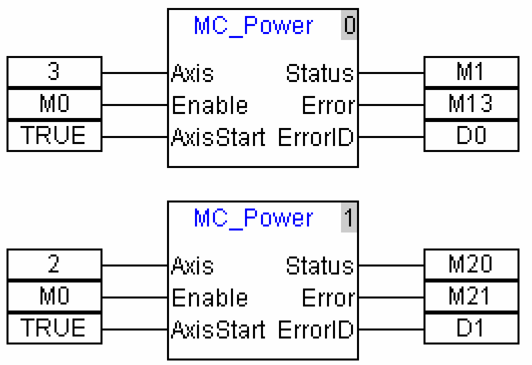
The key parameters in the example:

Parameter	Current value
MasterAxis	2
SlaveAxis	3
MasterRadius	18
SlaveRadius	30 (Unit: units)
CutLength	328 (Unit: units)
MasterStartPosition	50 (Unit: units)
MasterSyncPosition	80 (Unit: units)）
SlaveSyncPosition	50 (Unit: units)
SlaveEndPosition	70 (Unit: units)
SlaveWaitPosition	20 (Unit: units)

Program Explanation

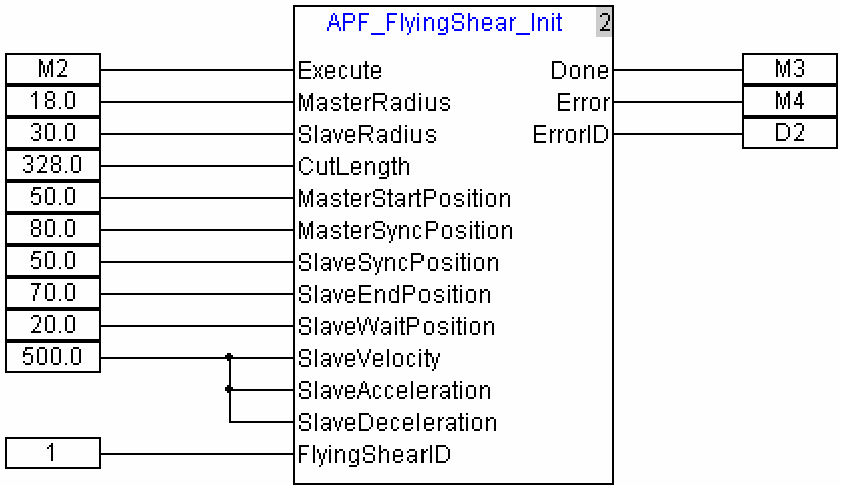
When Error is On, it indicates that an error occurs in the current instruction.

1) When M0 is on, the servos with the station no. of 2 and 3 are Servo ON.



- When M1 is On, it indicates that the servo with the station no. of 3 is Servo ON successfully;
- When M20 is On, it indicates that the servo with the station no. of 2 is Servo ON successfully.

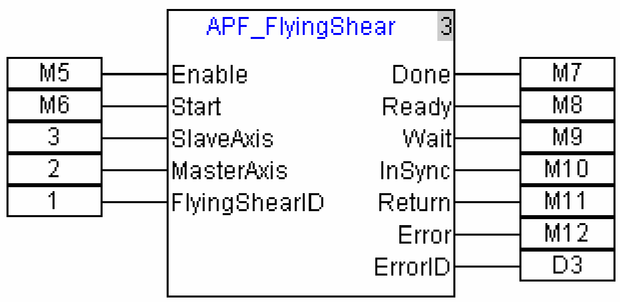
2) When M2 is on, the relevant parameters of flying shear function is imported so that APF_FlyingShear is called for use.



◆ When M3 is On, it indicates that the relevant parameters of the flying shear function are imported successfully.

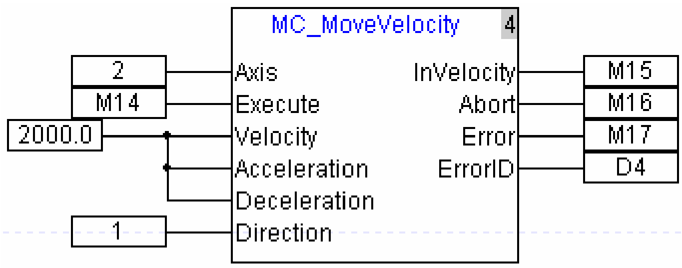
3) M5 is set to the On state firstly; when M8 and M9 are both On, slave axis reaches the wait position and the flying shear relation is established successfully.

After M8 and M9 are both on, M6 is set to the On state and then slave axis will conduct the shearing following the master axis.



4) After M14 is on, master axis executes the velocity instruction MC_Move Velocity.

When M15 is on, master axis will make the constant motion and the system will conduct the shearing continuously.



◆ If M6 of APF_FlyingShear is reset, slave axis will break away from the flying shear relation and will stop at the wait position after the shearing is finished.

4.8. Explanation of G Codes and Coordinate Motion Instruction

4.8.1. G Code Input Format

G codes that 10MC supports and the input format:

G Code	Function	Format
G0	Rapid positioning	N_G0 X_Y_Z_A_B_C_P_Q_
G1	Linear interpolation	N_G1 X_Y_Z_A_B_C_P_Q_ E_E_ F_
G2	Clockwise circular/ helical interpolation	N_G2 X_Y_Z_A_B_C_P_Q_I_J_T_E_E_F_ N_G2 X_Y_Z_A_B_C_P_Q_I_K_T_E_E_F_ N_G2 X_Y_Z_A_B_C_P_Q_J_K_T_E_E_F_
		N_G2 X_Y_Z_A_B_C_P_Q_R_T_ E_E_ F_
G3	Anticlockwise circular/ helical interpolation	N_G3 X_Y_Z_A_B_C_P_Q_I _J_T_ E_E_F N_G3 X_Y_Z_A_B_C_P_Q_I_ K_T_ E_E_F N_G3 X_Y_Z_A_B_C_P_Q_J_K_T_ E_ E_F
		N_G3 X_Y_Z_A_B_C_P_Q_R_T_ E_ E_ F_
G4	Dwell instruction	N_G4 K_
G36	Set/Reset	N_G36 M0 K1 N_G36 M0 K0
G37	Status judgment	N_G37 M_ K1 N_G37 M_ K0
G17	XY plane selection	N_G17
G18	ZX plane selection	N_G18
G19	YZ plane selection	N_G19
G90	Absolute mode	N_G90
G91	Relative mode	N_G91

Note:

The underline in the format box refers to the parameter value to be set. When inputting G codes in the CNC program in the CANopen Builder software, N_ should be input to the left of G code; N_ means the row number of G code in the NC program; only one G code can be input in one row. The input format of G code in the CANopen Builder software: N0 G0 X100 Y100

4.8.2. Explanation of G Code Format

- G code Unit

  The position unit of axis X_, Y_, Z_, A_, B_, C_, P_, Q_ in G code is consistent with that of axis parameter. Please set the same physical unit for each axis. For example, the unit is set as mm. And thus G0 X100.5 Y300 Z30.6 indicates that axis X, Y, Z move to the place of 100.5mm, 300mm, and 30.6mm respectively.

- G code parameter omitting

  - One or more items among X_, Y_, Z_, A_, B_, C_, P_, Q_ in G0 instruction can be omitted.
  - One or more items among X_, Y_, Z_, A_, B_, C_, P_, Q_, E_, E_, F_ in G1 instruction can be omitted.
  - One or more items among X_, Y_, Z_, A_, B_, C_, P_, Q_, E_, E_, F_ in G2 and G3 instruction can be omitted except I_, J_, K_, R_.
  - The parameters to the right of G4, G36, G37 instruction can not be omitted.
  - The G code identifier such as G0, G1, G2, G3, G4, G36, G37, G17, G18, G19, G90, G91 can be omitted. The omitted instruction identifier in the first row is G0 by default in the CNC program. The G code identifier omitted in the middle row is the G code instruction in the last row by default. When the G code instructions in the two continuous rows are different, the G code identifiers can not be omitted. Take the following example:

    N00 G0 X100 Y200

    N01 X200 Y200，

    The G code in the first row above is G0 instruction; there is no instruction identifier in the second row and so the default identifier is G0 for the second row. But N01 K04 can not be written in the second row. I.e. the parameter in G code in the second row should comply with G0 format.
  - Only one G code can be written in the same row in CNC programming area in the CANopen Builder software.

- Special function of G code

  - D device can be used to represent the key value in G code.

    For example, X_, Y_, Z_, A_, B_, C_, P_, Q_, E_, F_,　I_, J_, K_, R_,T_,E_, F_ all can use D device and "$" should be added to the right and left of D device. T means UNIT and others are Real type.

    Example: N0 G0 X$D0$ Y$D2$ Z$D4$　（D0=100, D2=200, D4=300）

    Explanation: After the G codes are executed, axis X moves to 100 units; axis Y moves to 200 units and axis Z moves to 300 units
  - M_ in G36 M_ can not be replaced by D device.

    Example: N0 G36 M2 K1

    Explanation: M2 can not be written into M$D0$ in the above example.

- Defaults

Relative, absolute default: The default mode is absolute mode and could be set via G90/G91.

Plane default: The default plane is XY plane and could be switched via G17/G18/G19.

G0-related default: The velocity, acceleration, deceleration are the maximum velocity, maximum acceleration, maximum deceleration respectively and can be modified via E, F parameter. E+ and E- in G code can be input to set the different acceleration and deceleration.

Example: G1 X10000 Y32105.6 E+20000 E-90000

Explanation: When the instruction is executed, the cutter moves at the acceleration of 20000 units/second^2 for speeding up and at the deceleration of 90000 units/second^2 for reducing the speed

4.8.3. Introduction to G Code Function

4.8.3.1 G90: Absolute Mode

- Function: After G90 is executed, the terminal position of each axis in G code is based on 0 unit and G91 can be used to switch into the relative mode. It is absolute mode for NC program by default.
- Format: N_G90
- Parameter Explanation:

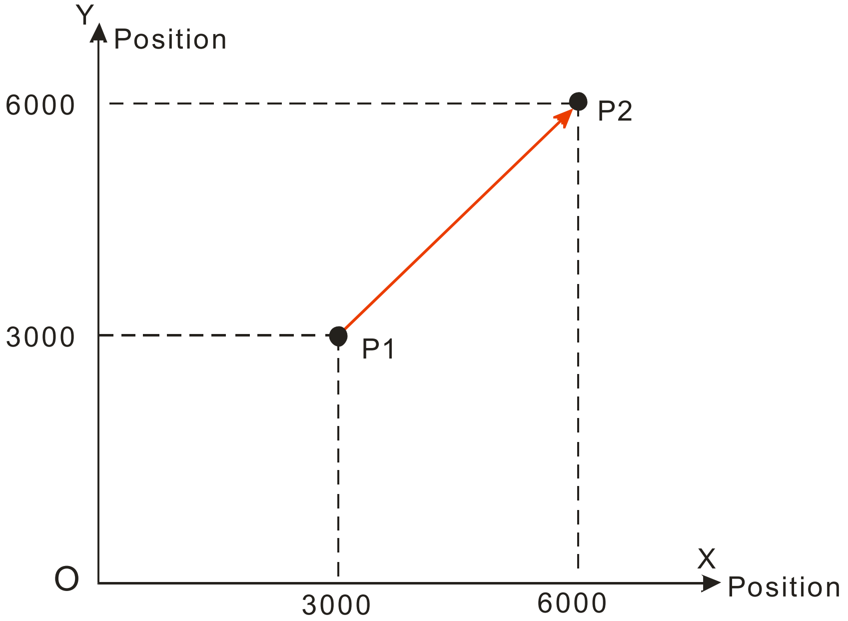
  N_: The row number of G code in NC program
- Example:

  The initial positions of axis X and Y are both 3000 units and the axis parameters are both default values. The G codes to be executed are as follows:

  N0 G90

  N1 G0 X6000 Y6000

  After G codes are executed, the Y/X curve for the whole movement process is shown below:



4.8.3.2 G91: Relative Mode

- Function: After G91 is executed, the terminal position of each axis in G code is counted in incremental method beginning from the current position and G90 can be used to switch into the absolute mode.
- Format: N_G91
- Parameter Explanation:

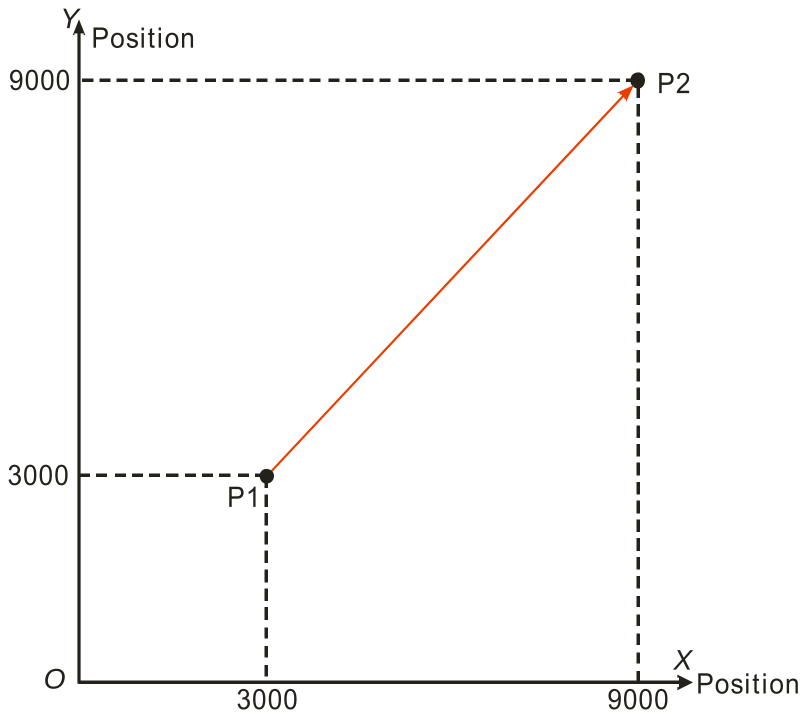
  N_: The row number of G code in NC program
- Example:

  The initial positions of axis X and Y are both 3000 units and the axis parameters are both default values. The G codes to be executed are as follows:

  N0 G91

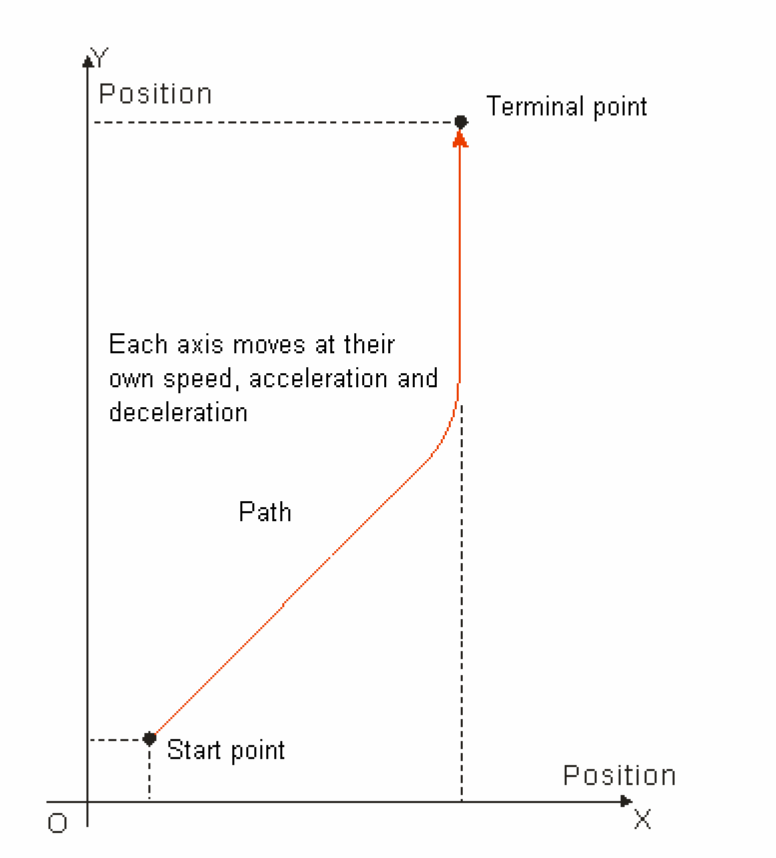
  N1 G0 X6000 Y6000

  After G codes are executed, the Y/X curve for the whole movement process is shown below:



4.8.3.3 G0: Rapid Positioning

- Function: Each axis moves from current position to the terminal position at the given speed. Maximum 8 axes can be controlled and each axis is independent with each other in motion. And the motion path figure is displayed below.



- Format: N_G0 X_Y_Z_A_B_C_P_Q_
- Parameter explanation:

  N_: The row number of G code in NC program

  X_: Specify the terminal position of axis X, Unit: unit, data type: REAL.

  Y_: Specify the terminal position of axis Y, Unit: unit, data type: REAL.

  Z_: Specify the terminal position of axis Z, Unit: unit, data type: REAL.

  A_: Specify the terminal position of axis A, Unit: unit, data type: REAL.

  B_: Specify the terminal position of axis B, Unit: unit, data type: REAL.

  C_: Specify the terminal position of axis C, Unit: unit, data type: REAL.

  P_: Specify the terminal position of axis P, Unit: unit, data type: REAL.

  Q_: Specify the terminal position of axis Q, Unit: unit, data type: REAL.
- Instruction explanation:
  - G0 can control one or more axes and other axis can be omitted.
  - The speed, acceleration, deceleration of each axis in motion depend on their axis parameters such as "maximum speed", " maximum acceleration" and "maximum deceleration".
  - Absolute mode decided by G90: The terminal position of G0 is based on 0 unit.
  - Relative mode decided by G91: The terminal position of G0 is an incremental value beginning from the current position.

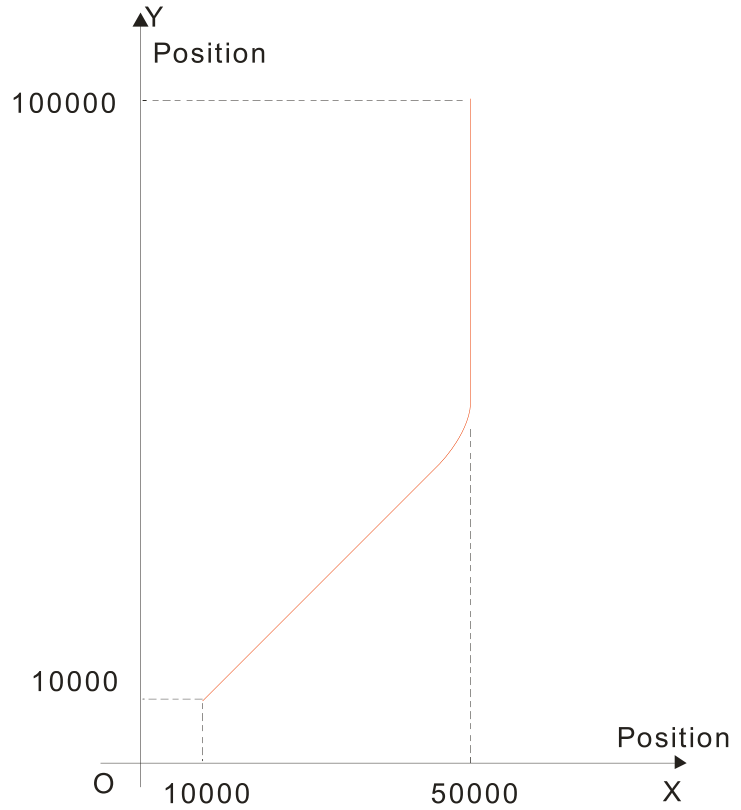
- Absolute mode example:

  The initial positions of axis X, Y are both 10000 units and their axis parameters are both default value. The G codes to be executed are:

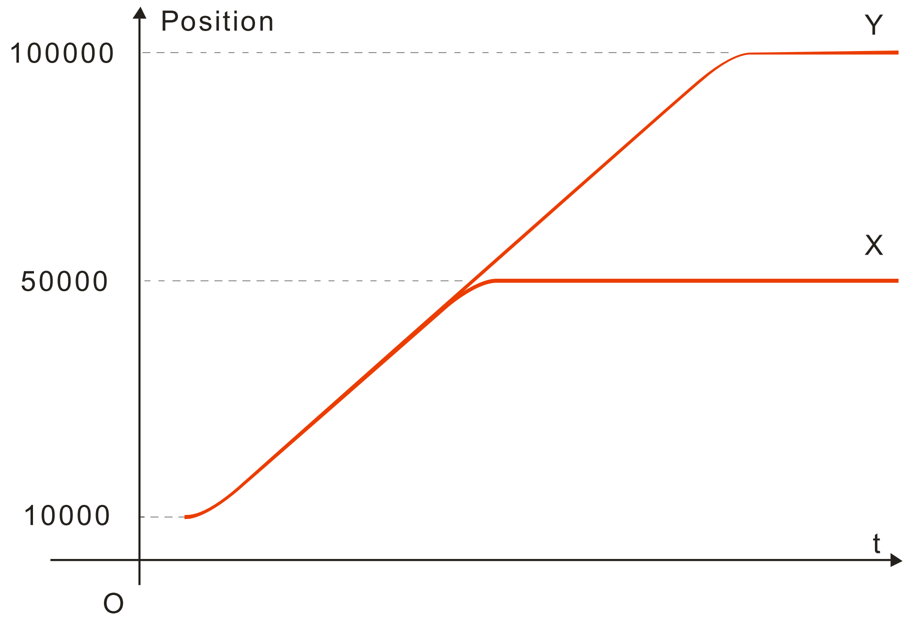
  N0 G90

  N1 G0 X50000 Y100000

  After G codes are executed, the Y/X curve for the whole movement process is shown below:



After G codes are executed, the Position/Time curve for the whole movement process is shown below:



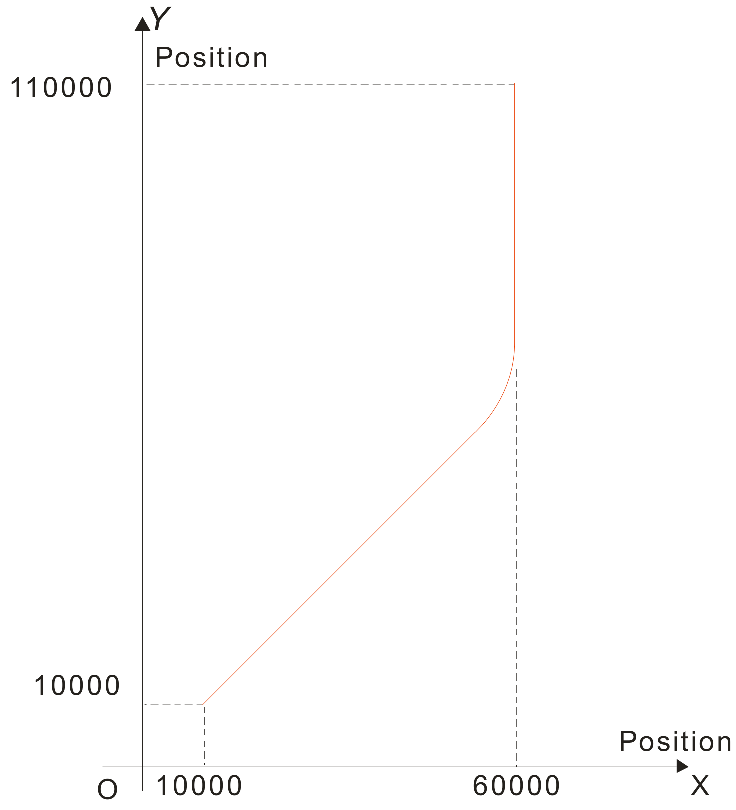
- Relative mode example:

  The initial positions of axis X, Y are both 10000 units and their axis parameters are both default value. The G codes to be executed are:

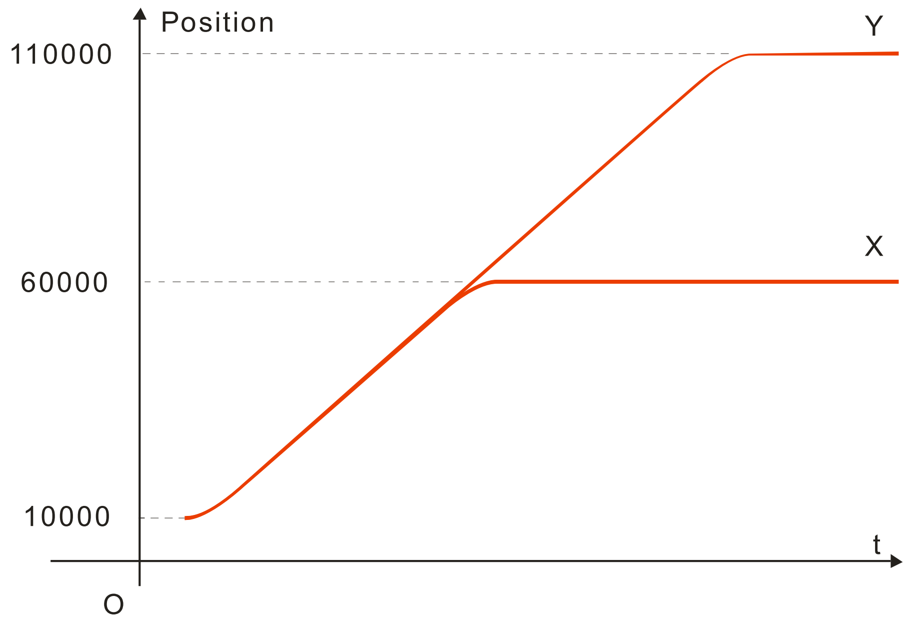
  N0 G91

  N1 G0 X50000 Y100000

  After G codes are executed, the Y/X curve for the whole movement process is shown below:

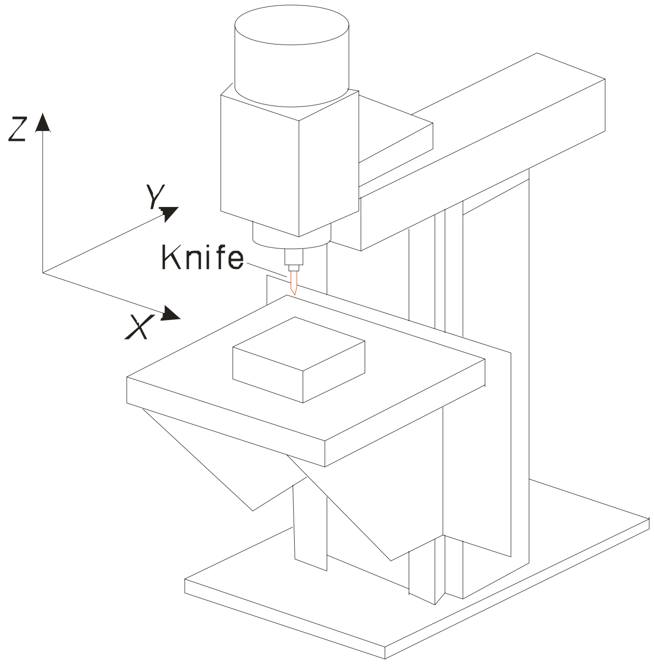


  After G codes are executed, the Position/Time curve for the whole movement process is shown below:



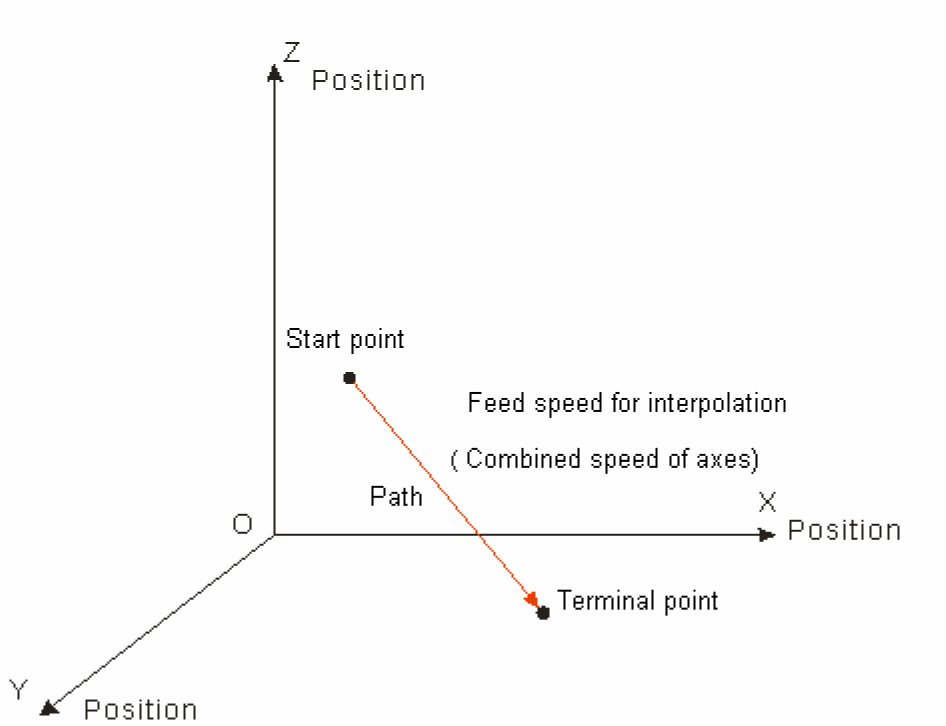
4.8.3.4 G1: Linear Interpolation

- Function: The cutter starts off from one point and moves straight to the target position at a given speed. The instruction can control up to 8 axes and all axes start up or stop simultaneously. Three axes control the position of the cutter together as the figure shows below.



Vertical Milling Machine

Motion path figure:



- Format: N_G1 X_Y_Z_A_B_C_P_Q_ E_ E_F_

- Parameter explanation:

  N_: The row number of G code in NC program

  X_: Specify the terminal position of axis X, Unit: unit, data type: REAL.

  Y_: Specify the terminal position of axis Y, Unit: unit, data type: REAL.

  Z_: Specify the terminal position of axis Z, Unit: unit, data type: REAL.

  A_: Specify the terminal position of axis A, Unit: unit, data type: REAL.

  B_: Specify the terminal position of axis B, Unit: unit, data type: REAL.

  C_: Specify the terminal position of axis C, Unit: unit, data type: REAL.

  P_: Specify the terminal position of axis P, Unit: unit, data type: REAL.

  Q_: Specify the terminal position of axis Q, Unit: unit, data type: REAL.

  E_: Specify the acceleration and deceleration of the cutter. The positive number refers to the acceleration; the negative number refers to the deceleration, unit: unit/second2, data type: REAL.If only the acceleration is specified, the deceleration is decided by the "maximum deceleration" in axis X parameter; If only the deceleration is specified, the acceleration is decided by the "maximum acceleration" in axis X parameter.

  F: Specify the feed speed of the cutter, unit: unit/second, data type: REAL.When the cutter moves at a constant speed, the combined speed of all axes in G code is equal to F value. The method of calculation is shown below.

  When two axes exist, $F=\sqrt{V_1^2+V_2^2}$.

  When three axes exist, $F=\sqrt{V_1^2+V_2^2+V_3^2}$.

  For more axes, F value could be calculated in the same way as above.

- Instruction explanation:
  - G1 can control one or more axes and other axis can be omitted.
  - Both of E and F can be omitted. If there is only one row of code in the CNC programming area and E, F are omitted, the velocity, acceleration, deceleration are decided by the parameters of X axis, i.e. "maximum velocity", "maximum acceleration", "maximum deceleration" in the parameters of X axis.

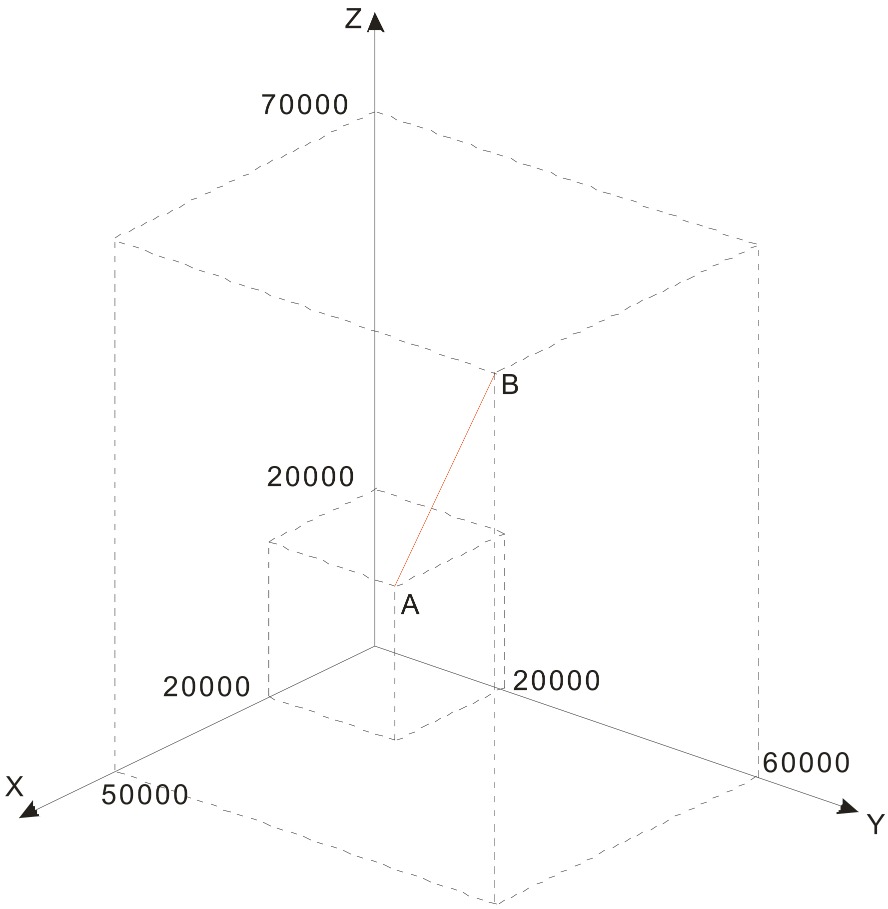
    If there are multiple rows of codes and E and F in G1 code are omitted, the velocity, acceleration, deceleration of the cutter are based on E and F in the previous rows of codes before the row where G2 is. If the previous rows of G codes have not specified E and F, "maximum velocity", "maximum acceleration", "maximum deceleration" in the parameters of X axis will be taken as reference.
  - Absolute mode decided by G90: The terminal position of G1 is based on 0 unit.
  - Relative mode decided by G91: The terminal position of G1 is an incremental value beginning from the current position.
    - Absolute mode example:

      The initial positions of axis X, Y, Z are all 20000 units and their axis parameters are all default value. The G codes to be executed are:

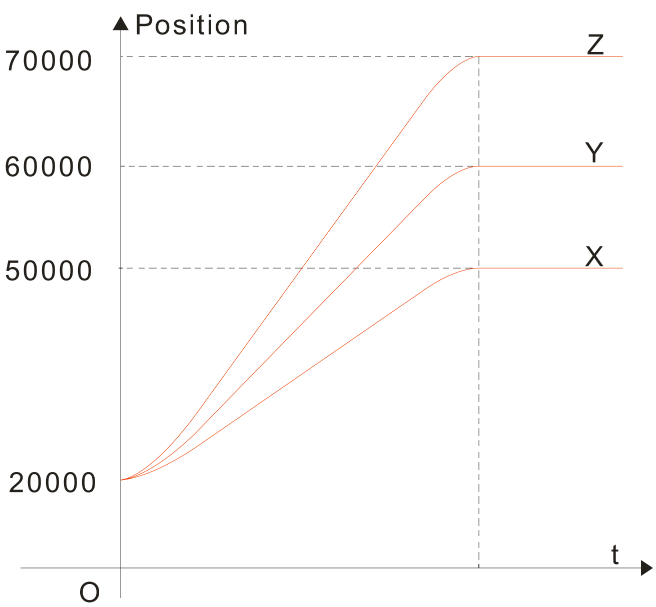
      N0 G90

      N1 G1 X50000 Y60000 Z70000

      After G codes are executed, the Y/X curve for the whole movement process is shown below:



After G codes are executed, the Position/Time curve for the whole movement process is shown below:



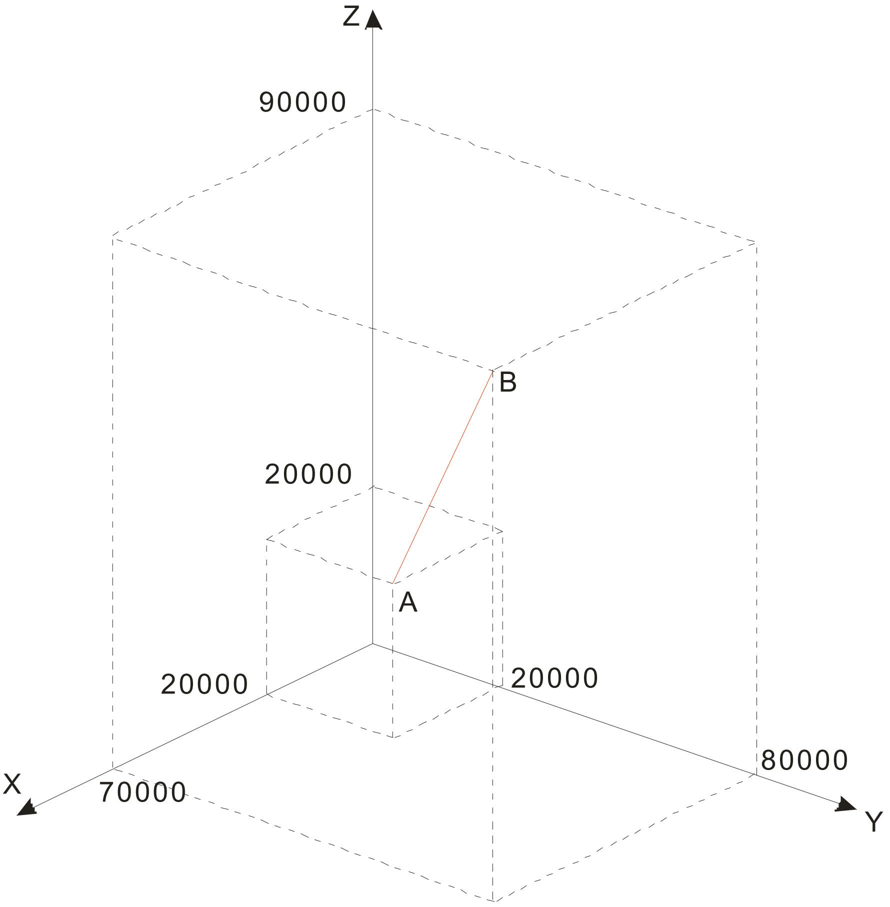
- Relative mode example:

  The initial positions of axis X, Y, Z are all 20000 units and their axis parameters are all default value. The G codes to be executed are:

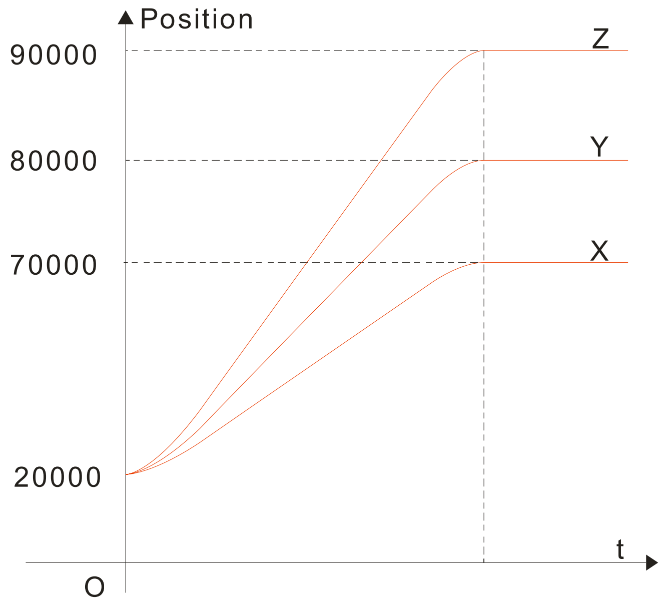
  N0 G91

  N1 G1 X50000 Y60000 Z70000

After G codes are executed, the Y/X curve for the whole movement process is shown below:



After G codes are executed, the Position/Time curve for the whole movement process is shown below:

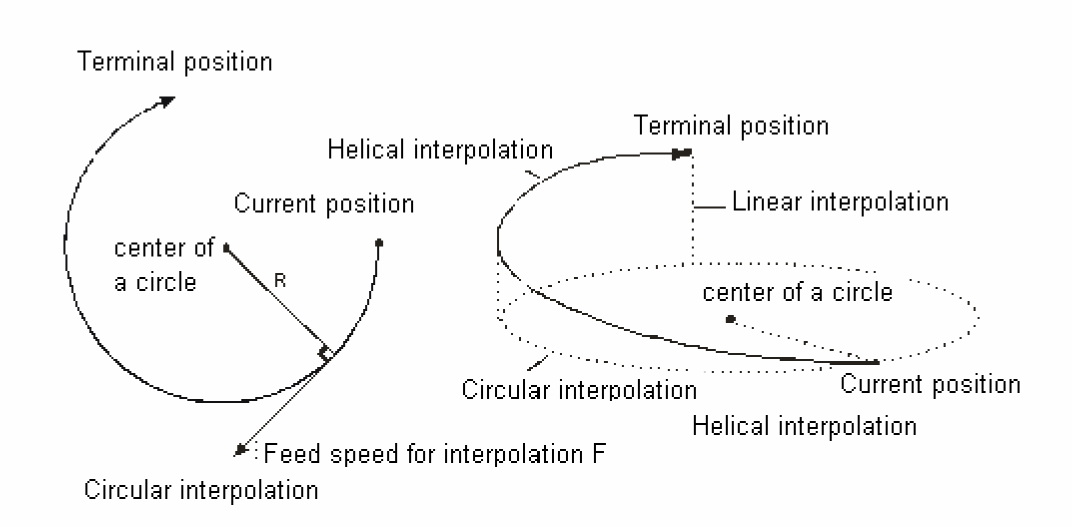


4.8.3.5 G2: Clockwise Circular/ Helical Interpolation

➢ Function:

Circular interpolation: The cutter conducts the cutting of the processed object in the clockwise direction at the feed speed given by parameter F on the circular arc with the fixed radius or the fixed center of a circle of the specified plane.

Helical interpolation: The cutter moves in the clockwise direction on the circular arc of the specified plane，which is circular interpolation and simultaneously moves in the vertical direction of the specified plane at the feed speed given by parameter F, which is linear interpolation.



➢ Format:
Format 1: N_G2 X_Y_Z_A_B_C_P_Q_I_J_(I_K_/J_K_)T_ E_E_F_
Format 2: N_G2 X_Y_Z_A_B_C_P_Q_R_T_ E_E_F_

➢ Parameter explanation:

N_: The row number of G code in NC program

X_Y_Z_: Specify the terminal positions of axis X, Y and Z corresponding to the terminal point of circular arc; Unit: unit, data type: REAL.

A_B_C_P_Q_: Specify the terminal position of each added axis, Unit: unit, data type: REAL.

I_J_: Specify the coordinate position of the center of a circle of XY plane, Unit: unit, data type: REAL.

I_K_: Specify the coordinate position of the center of a circle of XZ plane, Unit: unit, data type: REAL.

J_K_: Specify the coordinate position of the center of a circle of YZ plane, Unit: unit, data type: REAL.

T_: Specify the quantity of one full circle, Unit: circle, data type: UINT.

E_: Specify the acceleration and deceleration of the cutter. The positive number refers to the acceleration; the negative number refers to the deceleration, Unit: unit/second2, data type: REAL.

F: Specify the feed speed of the cutter, Unit: unit/second, data type: REAL.

➢ Instruction explanation:

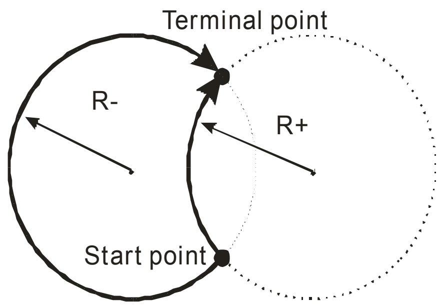
◆ Two axes among axis X, Y and Z make the circular interpolation on the plane specified by instruction G17/G18/G19. The 3rd axis specifies the plane to make the linear interpolation vertically.

◆ The added axis A, B, C, P and Q make the linear interpolation. The linear interpolation and circular interpolation and start up or stop simultaneously.

- Both of E and F can be omitted. If there is only one row of code in the CNC programming area and E,F are omitted, the velocity, acceleration, deceleration are decided by the parameters of X axis, i.e. “maximum velocity”, “maximum acceleration”, “maximum deceleration” in the parameters of X axis.

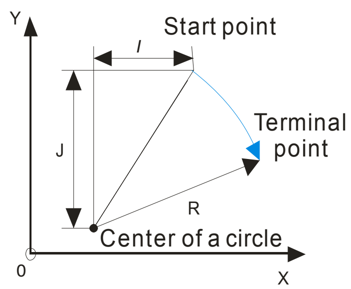
  If there are multiple rows of codes and E and F in G2 code are omitted, the velocity, acceleration, deceleration of the cutter are based on E and F in the previous rows of codes before the row where G2 is. If the previous rows of G codes have not specified E and F, “maximum velocity”, “maximum acceleration”, “maximum deceleration” in the parameters of X axis will be taken as reference.
- In absolute mode for G90, the terminal point of circular arc is the absolute coordinate value regarding 0 unit in their own directions as reference. In relative mode for G91, the terminal point of circular arc is the incremental value of the start point of circular arc.
- No matter whether in the absolute mode or in relative mode, the coordinates of the center of a circle I_J_(I_K_/J_K_) are always the relative coordinates with the start point as reference
- T is the quantity of the full circle; the path is the length of arc when T=0; the path is the corresponding full circles plus the arc length when T is a constant.
- The difference between Format 2 and format 1 is that format 2 decides a segment of circular arc via the start point, terminal point and radius. If the input value to the right of R parameter is positive number (R+), the circular arc is the minor arc less than 180 degrees; if the input value to the right of R parameter is negative number (R-), the circular arc is the major arc more than 180 degrees.

  The following full lines are the motion path when G2 selects R+ and R- and the arrows on the arc refer to the motion direction.

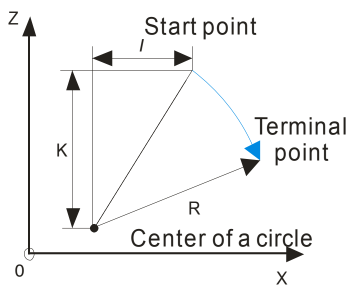


Clockwise motion

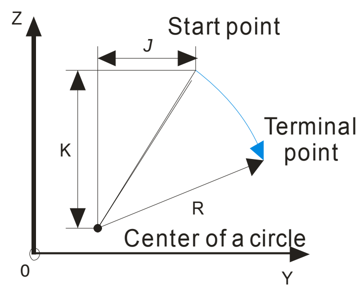
The coordinate relations on different planes:



a) XY plane circular arc



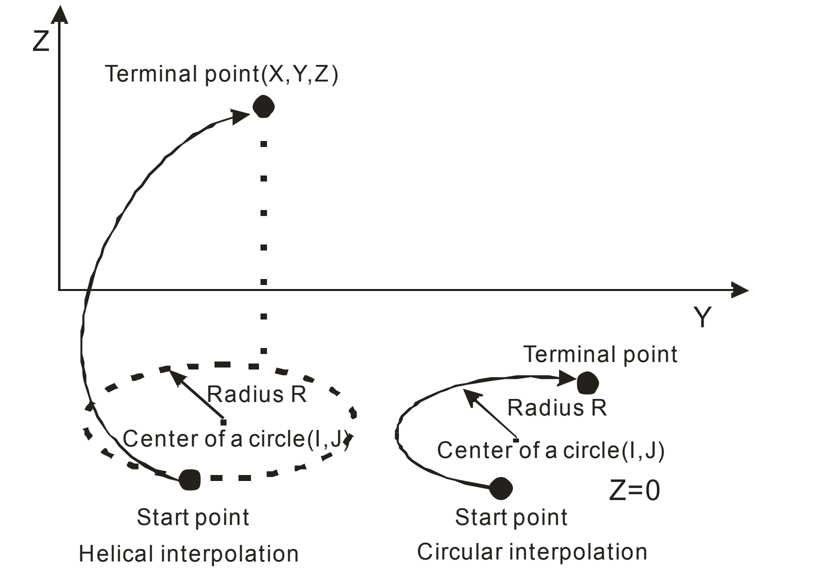
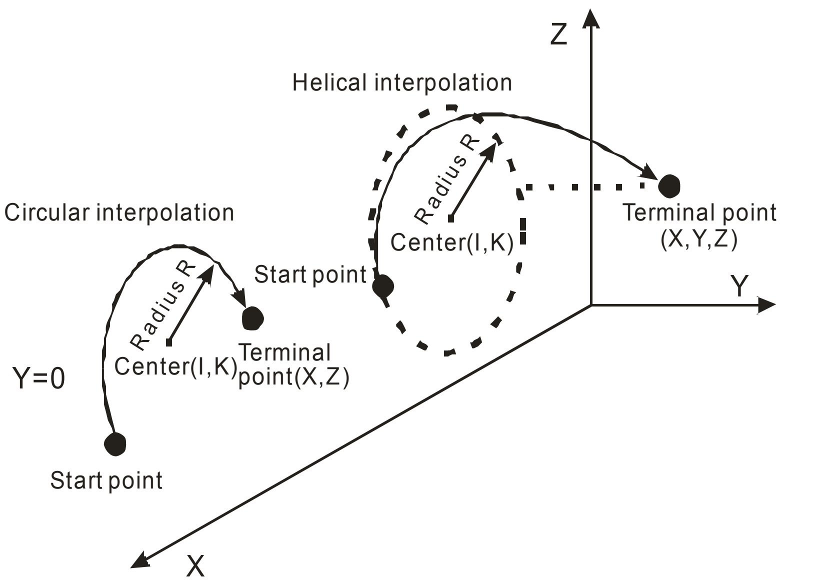
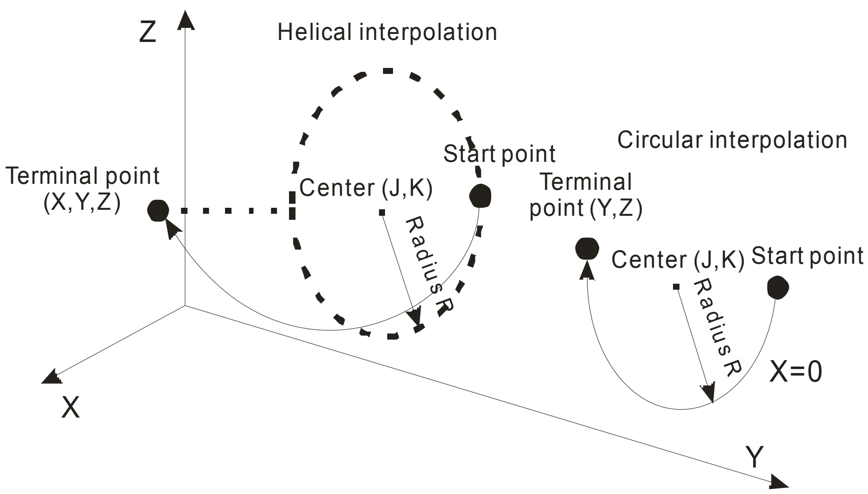
a) XZ plane circular arc



a) YZ plane circular arc

Please note the relations between the coordinate planes and I, J, K. Only two of I, J and K exist in one circular arc instruction. Which two exist depends on the corresponding plane, e.g. on XY plane, only I and J show.

The coordinate plane can be set by G17, G18 and G19. The circular and helical motion paths for G2 on different coordinate planes are shown as below.

G code	Function	Path figure
G17	XY plane: When there is no variation for the start point and terminal point corresponding to Z axis coordinates, the motion is circular interpolation. Otherwise, it is helical interpolation.	
G18	XZ plane: When there is no variation for the start point and terminal point corresponding to Y axis coordinates, the motion is circular interpolation. Otherwise, it is helical interpolation.	
G19	YZ plane: When there is no variation for the start point and terminal point corresponding to X axis coordinates, the motion is circular interpolation. Otherwise, it is helical interpolation.	

Example 1: Specify the center of a circle and circular interpolation in absolute mode

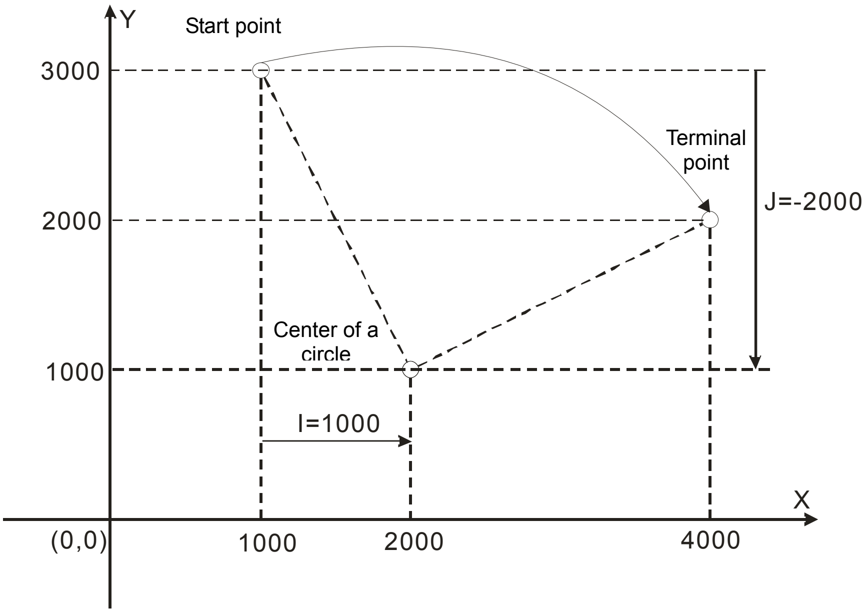
Current position (1000, 3000), axis parameters: default values, the G codes to be executed:

N0 G90

N1 G17

N2 G2 X4000 Y2000 I1000 J-2000 E5000 F5000

After G codes are executed, the Y/X curve for the whole movement process is shown below:



Example 2: Specify the center of a circle and circular interpolation in relative mode

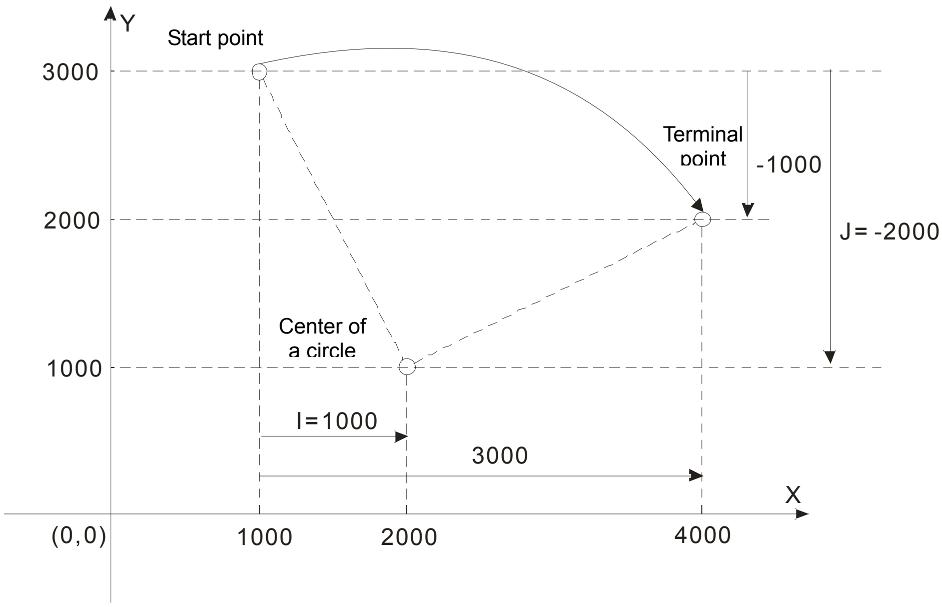
Current position (1000, 3000), axis parameters: default values, the G codes to be executed:

N0 G91

N1 G17

N2 G2 X3000 Y-1000 I1000 J-2000

After G codes are executed, the Y/X curve for the whole movement process is shown below:



Example 3: Specify the center of a circle and circular interpolation with T in relative mode

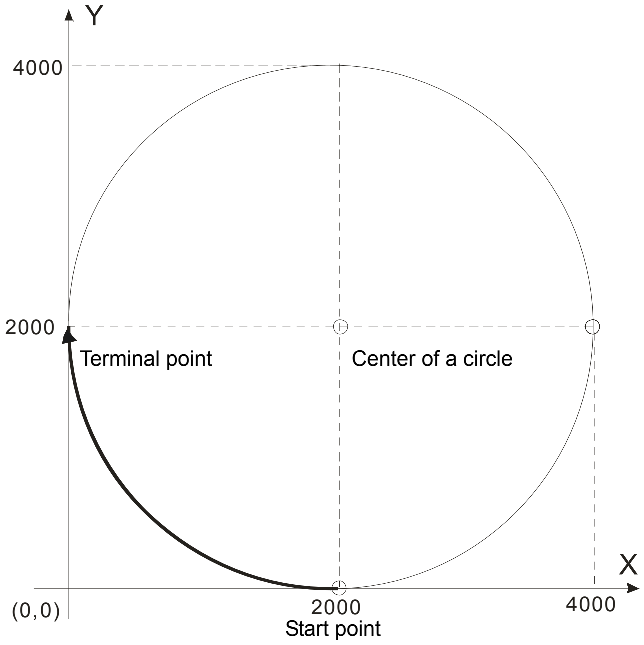
Current position (2000, 0), axis parameters: default values, the G codes to be executed:

N0 G91

N1 G17

N2 G2 X-2000 Y2000 I0 J2000 T3

After G codes are executed, the path of the circular arc is 3 circles plus thick 1/4 of a circle and the Y/X curve for the whole movement process is shown below:



Example 4: The helical interpolation with the center of a circle specified by XY plane

Current position (0, 0), axis parameters: default values, the G codes to be executed:

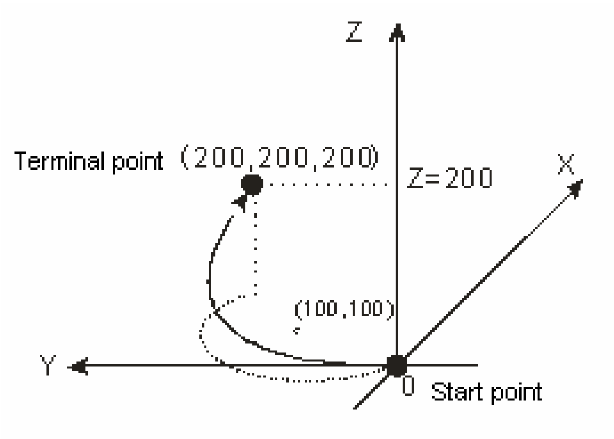
N0 G17

N1 G91

N2 G2 X200 Y200 Z200 I100 J100 E+10000 E-20000 F1000

Instruction explanation:

While G2 is being executed, axis regards 0 as the start point and axis parameters as the terminal points; produces the circular arc in clockwise direction; finally the motion path is helical curve. The projection on XY plane is an half of the circle with the center of a circle (100,100).



Example 5: Omission format

The G codes to be executed:

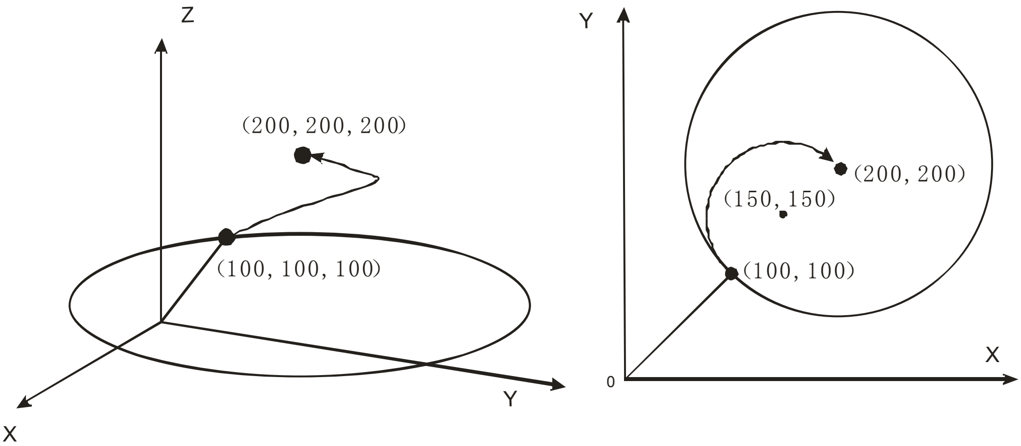
N00 G0 X0 Y0 Z0

N01 G1 X100 Y100 Z100

N02 G2 I100 J100

N03 G91

N04 G2 I50 J50



Instruction explanation:

The axis position is (100, 100,100) after execution of N01 row of instruction is finished;

In N02 row of instruction, there are only I and J parameters and other omitted parameter values are based on the last instruction, i.e. N02 instruction: N02 X100 Y100 Z100 I100 J100; the start point and terminal point are (100, 100, 100) and so the motion path is a full circle.

N03 row of instruction is G91 and the following rows of codes after G91 are in relative mode.

N04 row of instruction is equivalently N04 G2 X100 Y100 Z100 I50 J50. The terminal coordinates are (200, 200, 200) due to the relative mode and the coordinates of the center of a circle for the projection on XY plane are (150,150)

Example 6: Helical interpolation with the radius specified by XY plane (Current position: 0)

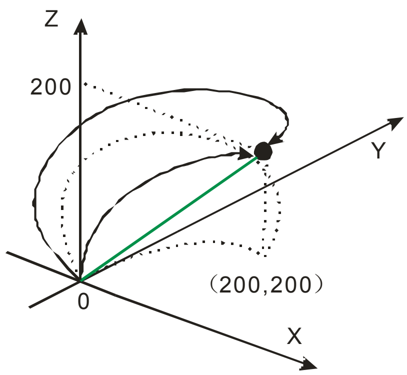
The G codes to be executed:

N1 G2 X200 Y200 Z200 R-200

N0 G0 X0 Y0 Z0

N1 G2 X200 Y200 Z200 R200

The motion path is a major arc while the first G2 code is executed and it is a minor arc while the second G2 code is executed.

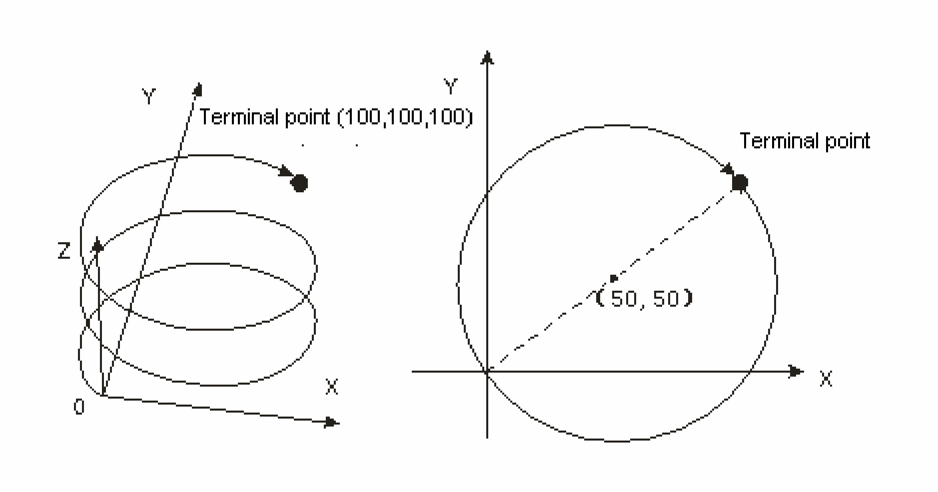


Example 7: The helical interpolation with T and the center of a circle specified by XY plane (Current position: 0)

The G codes to be executed:

N1 G2 X100 Y100 Z100 I50 J50 T2

Instruction explanation: The motion path is a helical curve and the projection on XY plane is a full circle with the center of a circle (50, 50).

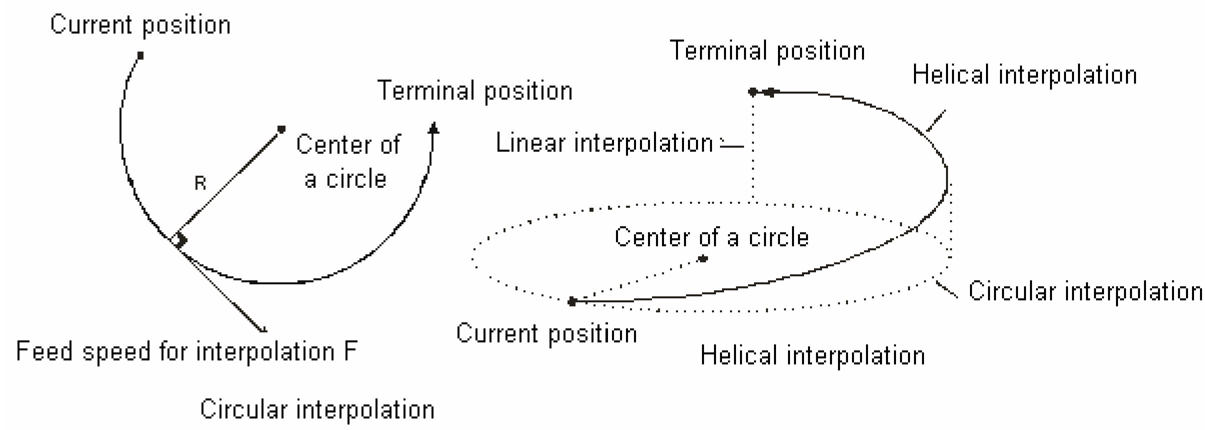


4.8.3.6 G3: Anticlockwise circular /helical interpolation

- Function explanation:

  Circular interpolation: The cutter conducts the cutting of the processed object in the anticlockwise direction at the feed speed given by parameter F on the circular arc with the fixed radius or the fixed center of a circle of the specified plane.

  Helical interpolation: The cutter moves in the anticlockwise direction on the circular arc of the specified plane，which is circular interpolation and simultaneously moves in the vertical direction of the specified plane at the feed speed given by parameter F, which is linear interpolation.



- Format:

  Format1: N_G3 X_Y_Z_A_B_C_P_Q_I_J_(I_K_/J_K_)T_ E_E_F_

  Format2: N_G3 X_Y_Z_A_B_C_P_Q_R_T_ E_E_F_

- Parameter explanation:

  N_: The row number of G code in NC program

  X_Y_Z_: Specify the terminal positions of axis X, Y and Z corresponding to the terminal point of circular arc; Unit: unit, data type: REAL.

  A_B_C_P_Q_: Specify the terminal positions of added axes, Unit: unit, data type: REAL.

  I_J_: Specify the coordinate position of the center of a circle of XY plane, Unit: unit, data type: REAL.

  I_K_: Specify the coordinate position of the center of a circle of XZ plane, Unit: unit, data type: REAL.

  J_K_: Specify the coordinate position of the center of a circle of YZ plane, Unit: unit, data type: REAL.

  T_: Specify the quantity of one full circle, Unit: circle, data type: UINT.

  E_: Specify the acceleration and deceleration of the cutter. The positive number refers to the acceleration; the negative number refers to the deceleration, Unit: unit/second2, data type: REAL.

  F: Specify the feed speed of the cutter, Unit: unit/second, data type: REAL.

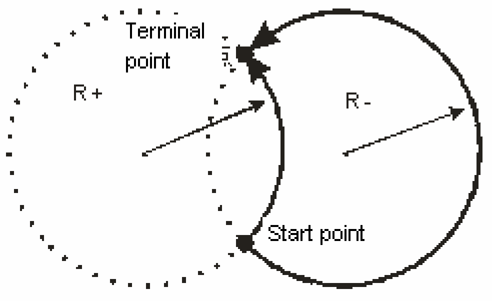
- Instruction explanation:

  - Two axes among axis X, Y and Z make the circular interpolation on the plane specified by G17/G18/G19. The 3rd axis specifies the plane to make the linear interpolation vertically.
  - The added axis A, B, C, P and Q make the linear interpolation. The linear interpolation and circular interpolation and start up or stop simultaneously.
  - Both of E and F can be omitted. If there is only one row of code in the CNC programming area and E, F are omitted, the velocity, acceleration, deceleration are decided by the parameters of X axis, i.e. “maximum velocity”, “maximum acceleration”, “maximum deceleration” in the parameters of X axis.

If there are multiple rows of codes and E and F in G2 code are omitted, the velocity, acceleration, deceleration of the cutter are based on E and F in the previous rows of codes before the row where G2 is. If the previous rows of G codes have not specified E and F, “maximum velocity”, “maximum acceleration”, “maximum deceleration” in the parameters of X axis will be taken as reference.

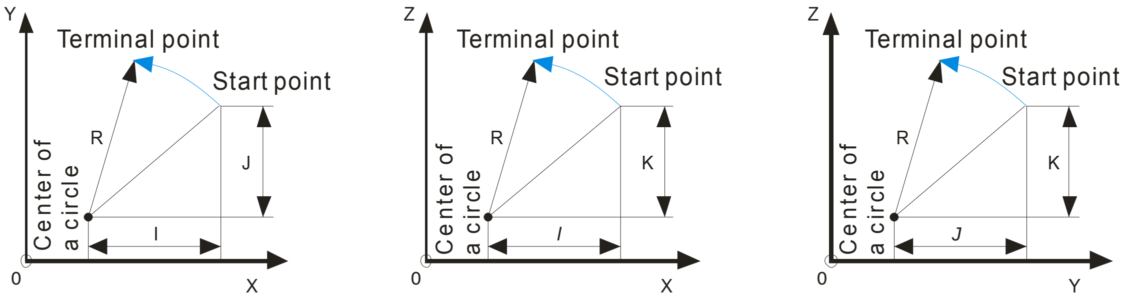
- In absolute mode for G90, the terminal point of circular arc is the absolute coordinate value regarding 0 unit in their own directions as reference. In relative mode for G91, the terminal point of circular arc is the incremental value of the start point of circular arc.
- No matter whether in the absolute mode or in relative mode, the coordinates of the center of a circle I_J_(I_K_/J_K_) are always the relative coordinates with the start point as reference
- T is the quantity of one full circle; the path is the length of arc when T=0; the path is the corresponding full circles plus the arc length when T is a constant.
- The difference between Format 2 and format 1 is that format 2 determines a segment of circular arc via the start point, terminal point and radius. If the input value to the right of R parameter is positive number (R+), the circular arc is the minor arc less than 180 degrees; if the input value to the right of R parameter is negative number (R-), the circular arc is the major arc more than 180 degrees.

The following full lines are the motion path when G3 selects R+ and R- and the arrows on the arc refer to the motion direction.



Anticlockwise motion

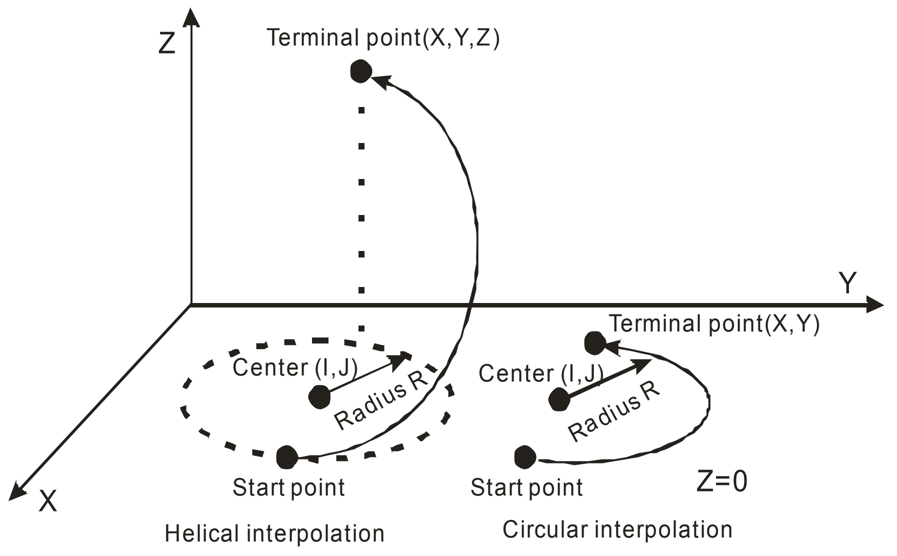
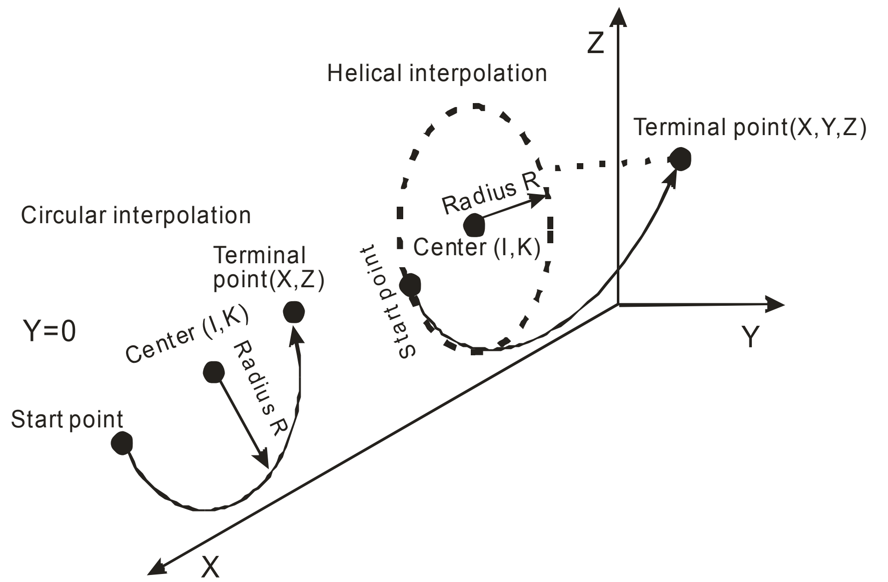
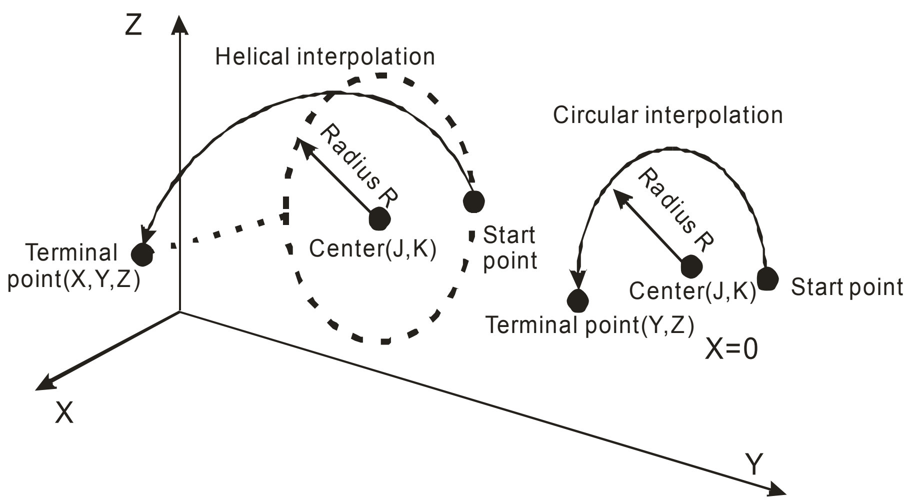
The coordinate relations on different planes:



a) XY plane circular arc b) XZ plane circular arc C) YZ plane circular arc

Please note the relations between the coordinate planes and I, J, K. Only two of I, J and K exist in one circular arc instruction. Which two exist depends on the corresponding plane, e.g. on XY plane, only I and J show.

The coordinate plane can be set by G17, G18 and G19. The circular and helical motion paths for G3 on different coordinate planes are shown as below.

G code	Function	Path figure
G17	XY plane: When there is some variation for the start point and terminal point corresponding to Z axis coordinates, the motion is helical interpolation. Otherwise, it is circular interpolation on XY plane.	
G18	XZ plane: When there is variation for the start point and terminal point corresponding to Y axis coordinates, the motion is helical interpolation. Otherwise, it is circular interpolation on XZ plane.	
G19	YZ plane: When there is variation for the start point and terminal point corresponding to X axis coordinates, the motion is helical interpolation. Otherwise, it is circular interpolation on YZ plane.	

Example 1: Specify the center of a circle and circular interpolation in absolute mode

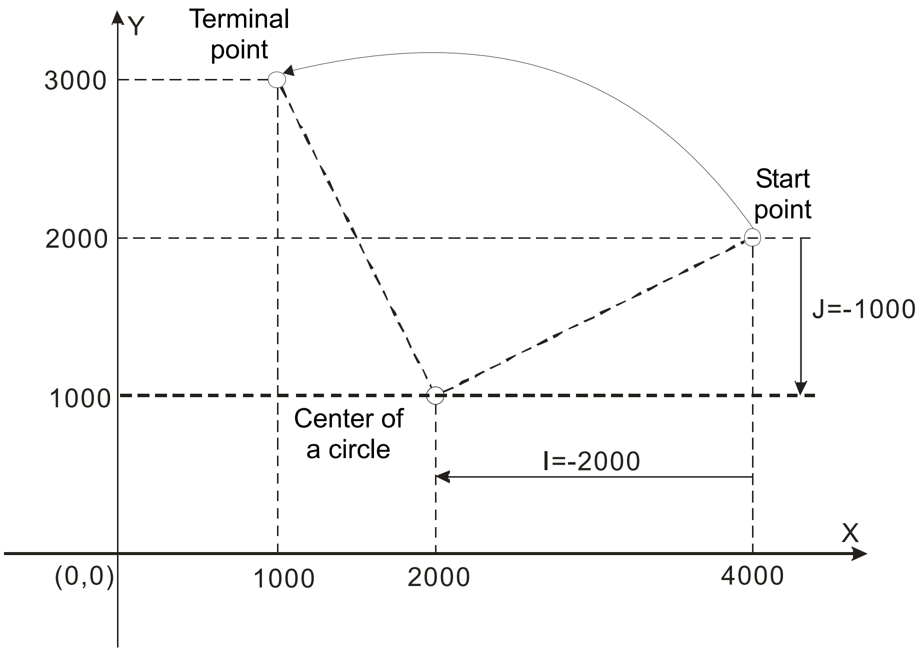
Current position (4000, 2000), axis parameters: default values, the G codes to be executed:

N0 G90

N1 G17

N2 G3 X1000 Y3000 I-2000 J-1000

After G codes are executed, the Y/X curve for the whole movement process is shown below:



Example 2: Specify the center of a circle and circular interpolation in relative mode

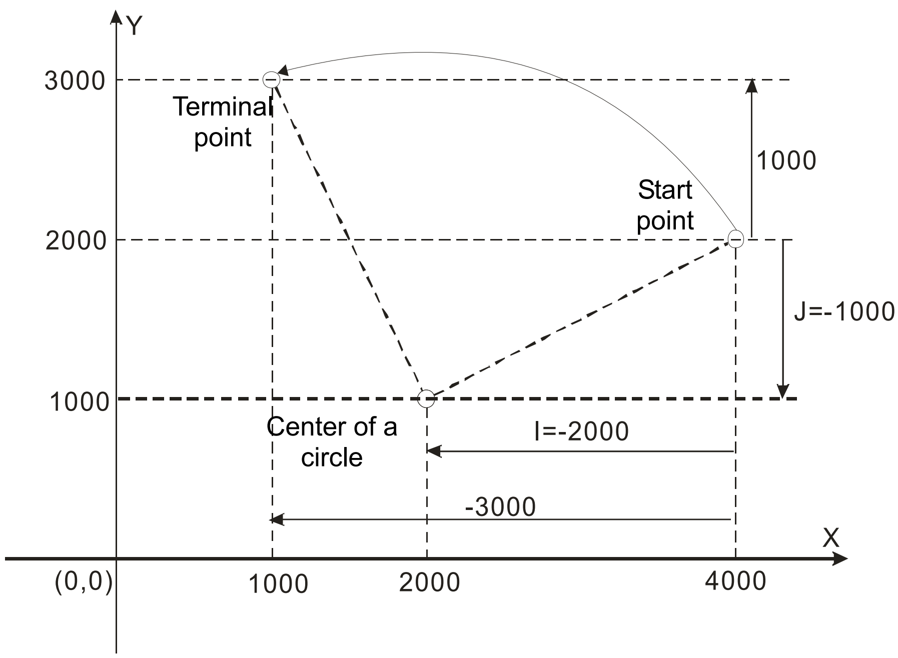
Current position (4000, 2000), axis parameters: default values, the G codes to be executed:

N0 G91

N1 G17

N2 G3 X-3000 Y1000 I-2000 J-1000

After G codes are executed, the Y/X curve for the whole movement process is shown below:



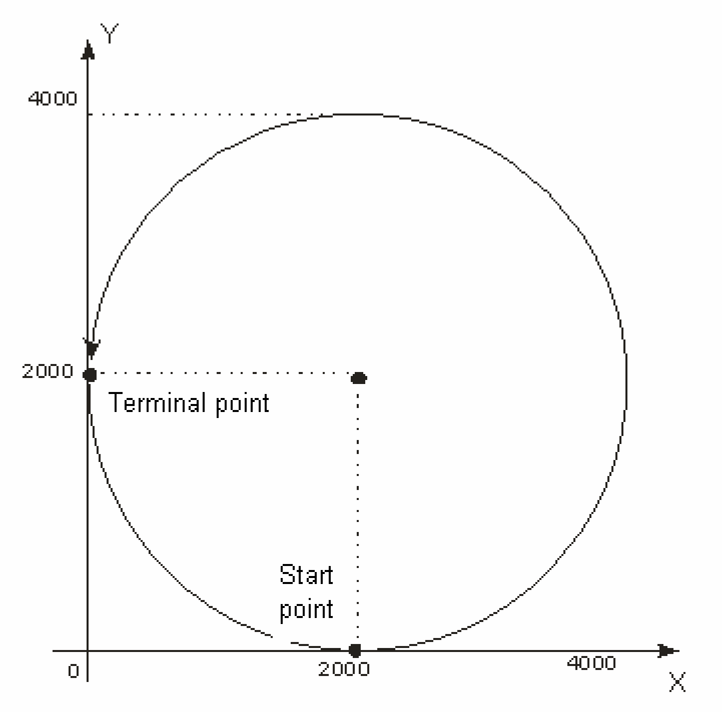
Example 3: Specify the center of a circle and circular interpolation with T in relative mode

Current position (2000, 0), axis parameters: default values, the G codes to be executed:

N0 G91

N1 G17

N2 G3 X-2000 Y2000 I0 J2000 T3



After G codes are executed, the motion path is the arc on XY plane and the arc length is (3+3/4） times the circumference of a circle.

Example 4: The helical interpolation with the center of a circle specified by XY plane

Current position (0, 0), axis parameters: default values, the G codes to be executed:

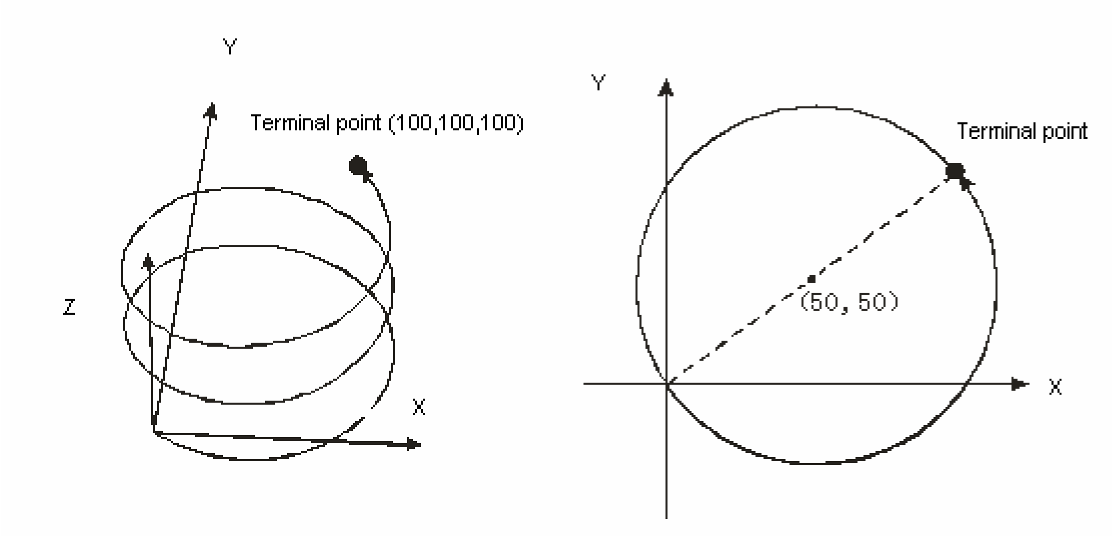
N0 G17

N1 G3 X100 Y100 Z100 I50 J50 T2

Instruction explanation:

Since the variation of Z axis is 100, the motion path is helical curve and the projection on XY plane is a full circle.

If there is no variation for Z axis, the motion path is the circular arc on XY plane with the center (50,50) and the arc length of 2.5 times the circumference of a full circle.



Example 5: The helical interpolation with the specified radius

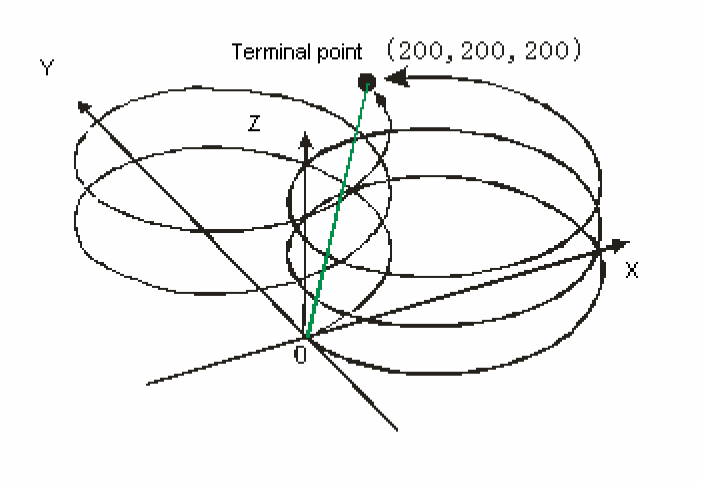
The G codes to be executed:

N0 G0 X0 Y0 Z0

N1 G3 X200 Y200 Z200 R-200 T2

N2 G0 X0 Y0 Z0

N3 G3 X200 Y200 Z200 R200



Instruction explanation:

In this example, T is set in G2 code in N1 row and so the motion path for N1 row of instruction is the helical curve as the right thick curve in the figure above. Return to the origin after G0 in N2 row is executed and then execute the N3 row of instruction. Since the T parameter is omitted in this row, the T in last row is taken as reference. And the motion path is also the helical curve.

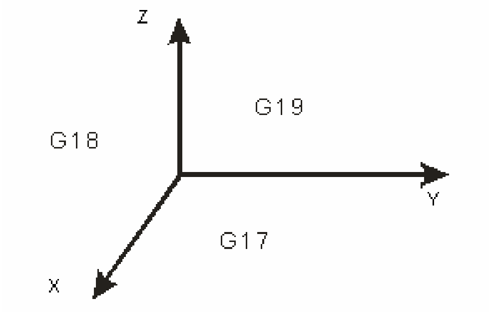
4.8.3.7 G17, G18, G19: to specify the circular interpolation plane

- Function:

The three instructions are used for deciding the selection of circular interpolation or helical interpolation plane and have no impact on the linear interpolation.

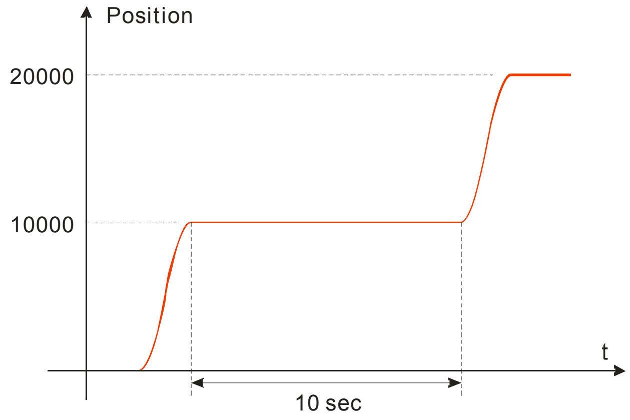
While the program is being executed, the three work planes can be switched with each other. If no plane option is set, the initial state of system is XY plane (G17).

- Format: N_G17
  N_G18
  N_G19
- Parameter Explanation:
  N_: The row number of G code in NC program
- The figure of planes is shown as follows:



4.8.3.8 G4: Dwell Instruction

- Function: Dwell instruction
- Format: N_G4 K_
- Parameter explanation:
  N_: The row number of G code in NC program
  K_: Specify the delay time, unit: second. Range: 0.001 second ~100000 seconds
- Instruction explanation:
  After the lathe completes the processing for some phase, the cutter need be stopped moving temporarily. At this moment, G4 can be utilized to make the cutter stopped for a period of time.
  Instruction example:
  N00 G1 X10000
  N01 G4 K10
  N02 G1 X20000



After execution of the instruction of number N00 is finished, the program will be delayed for 10 seconds and afterwards, the instruction of number N02 will continue to be executed.

4.8.3.9 G36: Set/Reset Instruction

- Function: The instruction is used to make M device set or reset.
- Format: N_G36 M_ K1 or N_G36 M_ K0
- Parameter explanation:

N_: The row number of G code in NC program

M_ K1: Make the specified M device set

M_ K0: Make the specified M device reset

Instruction example 1:

G36 M0 K1

Set the bit device M0 to ON

Instruction example 2:

G36 M100 K0

Set the bit device M100 to OFF.

4.8.3.10 G37: Status Judgment Instruction

- Function: The instruction is used to judge the state of M device. When the state is same as the setting, the following G codes will be executed. Otherwise, the waiting state will last.
- Format: N_G37 M_ K1 或 N_G37 M_ K0
- Parameter explanation:

N_: The row number of G code in NC program

M_ K1: If the specified M device is ON, execute the next CNC code; if the specified M device is OFF, keep waiting here.

M_ K0: If the specified M device is OFF, execute the next CNC code; if the specified M device is ON, keep waiting here.

Instruction example:

N00 G0 X0 Y0

N01 G37 M0 K1

N02 G1 X10000 Y34598

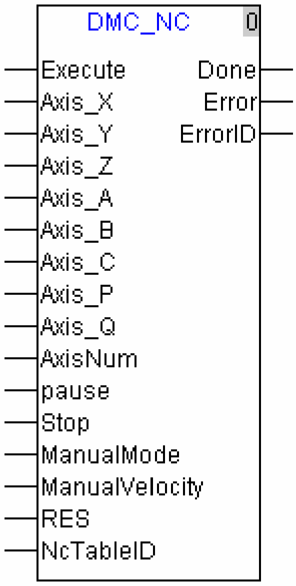
When the program is executed till N01, the system will judge the state of M0 device. If M0 is ON, continue to execute the instruction of number N02; if M0 is OFF, the system will keep waiting.

4.8.4. DMC_NC

API	DMC_NC	CNC instruction	Controller
260			10MC11T

Instruction explanation:

The instruction is used for calling and executing NC program which can be input, edited and previewed in the CANopen Builder software. It supports both static and dynamic download. The NC program downloaded statically will be stored in DVP10MC11T and will not be lost when the power is off. The NC program downloaded dynamically is executed while being downloaded and the program after being executed will be dumped. The function is applied for processing the complicate workpiece. When the axes related with the instruction are all in Standstill state, the instruction just can be executed. When the execution of the instruction has not been finished, axis is in CNC state and at the moment, axis can not execute other motion instruction unless the execution of the instruction is finished (Execution of the G codes in the specified NC program is finished or is stopped). For the details on the axis state, please refer to section 4.2.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Execute	This instruction is executed when "Execute" turns Off ->On.	BOOL	M, I, Q, constant
Axis_X	The node address of X axis	UINT	Constant, D
Axis_Y	The node address of Y axis	UINT	Constant, D
Axis_Z	The node address of Z axis	UINT	Constant, D
Axis_A	The node address of A axis	UINT	Constant, D
Axis_B	The node address of B axis	UINT	Constant, D
Axis_C	The node address of C axis	UINT	Constant, D
Axis_P	The node address of P axis	UINT	Constant, D
Axis_Q	The node address of Q axis	UINT	Constant, D
AxisNum	The number of the valid axis, no more than 8.	UINT	Constant, D

Parameter name	Explanation	Data type	Available device
Pause	When “Pause” is on, execution of NC program is stopped temporarily and the state value of axis is (9) unchanged; when “Pause” is off, execution of NC program will continue.	BOOL	M, I, Q
Stop	When “Stop” is on, execution of NC program is stopped and the state value of axis is Stand Still.	BOOL	M, I, Q
ManualMode	When “ManualMode” is on, manual function is started up.	BOOL	M, I, Q
ManualVelocity	The feed speed in manual mode	REAL	Constant, D
RES	Reserved		
NcTableID	The CNC program number, range: 0~32. If NcTableID=0, it indicates to dynamically download NC program. When “Execute” turns off-> on, the system will wait for the superior equipment to send the NC code; the code will be executed on being received and will be dumped after execution is completed and afterwards, the system will keep waiting for the superior equipment to send the next NC code. DVP10MC11T can store 32 NC programs with the serial number range: 1~32. When the value of NcTableID is within 1~32 and “Execute” turns off-> on, the NC code with the corresponding number will be executed.	UINT	Constant, D
Done	When NC program is executed statically and the CNC codes in NC program finish being executed, “Done” is on; When NC program is executed statically or dynamically and “Stop” bit is on, “Done” is on after axis stops. When “Execute” is off, “Done” is off.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

Note:

1. Multiple DMC_NC instructions can be executed simultaneously and the called NcTableIDs can be same or not. But make sure that the axis numbers of DMC_NC instructions being executed must be different with each other.
2. AxisNum:

   AxisNum gets effective according to the pins of Axis_X/Y/Z/A/B/C/P/Q from top to bottom. The node address of the middle axis can not be omitted and repeated. If AxisNum is set to 5, set the corresponding axis node addresses for Axis_X/Y/Z/A/B among the axis parameters. They could be virtual axes. Axis_C/P/Q can be omitted. Only the valid axis exists in the G code in NC program.

3. Pause:

   If CNC codes (G0/G1/G2/G3) in NC program are being executed, set “Pause” to ON and the execution of the corresponding G0/G1/G2/G3 will be stopped temporarily at the deceleration in G code. If “Pause” is on when G90/G91/G4/G36/G37/G17/G18/G19 is being executed, the next CNC code will not be executed.

   When “Pause” is off, the execution of the CNC codes which have not finished being executed will continue. The state value of axis will be unchanged after and before the pause function is executed.

4. Stop:

   If the CNC codes (G0/G1/G2/G3) in NC program are being executed and then “Stop” is set to ON, the execution of the corresponding G0/G1/G2/G3 will be stopped at the deceleration in the CNC codes. When G90/G91/G4/G36/G37/G17/G18/G19 is being executed, the next CNC code will not be executed.

   Before NC program is executed again, reset “Stop” and then execute DMC_NC instruction again. Please note that the current position of axis must be consistent with the coordinate position of the G code to be executed when NC program is executed again. If the instruction to be executed in CNC codes is the circular instruction, consider if the current point, the terminal point of arc, center of a circle or radius can make up a circular arc in case of any abnormality.

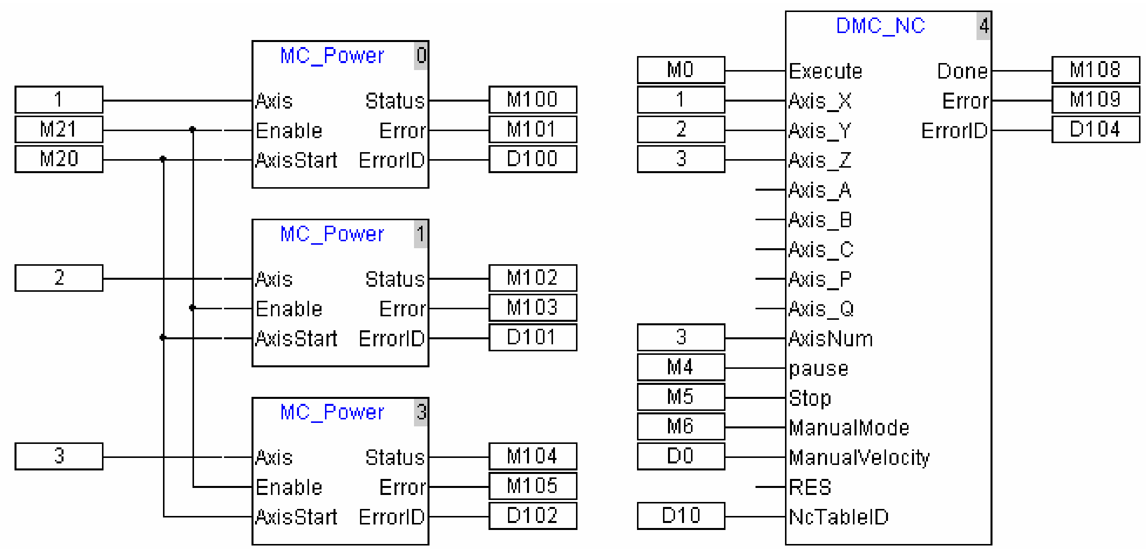
5. Manual function:

   After “Manualmode” is started up, the running speed of CNC code in NC program comes from the parameter setting of manual velocity. When “ManualMode” is off, the execution of the CNC code which has not completed being executed can continue. The source of manual speed can be a constant or some register.

Program example 1:

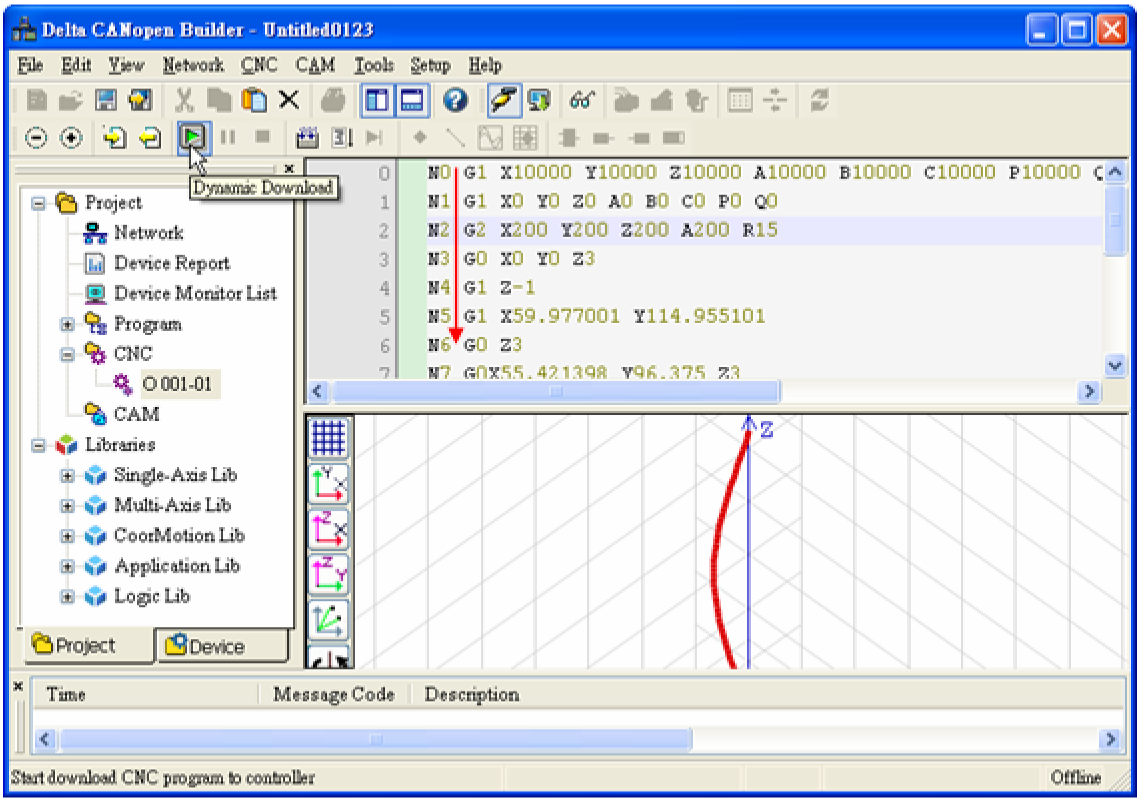
The example focuses on the usage of calling G codes statically and dynamically. For relative information, please refer to section 2.3.3 on CNC function.

➢ Program:



➢ Steps:

- When M20 and M21 turn off-> on, axis 1, axis 2 and axis 3 are enabled. After correct execution is finished, M100, M102 and M104 are on.
- When D10 is set to 0 and then M0 set to ON, the G codes will be executed dynamically by clicking the “Dynamic download” icon in the CANopen Builder software as below to download G codes which are executed while being downloaded.

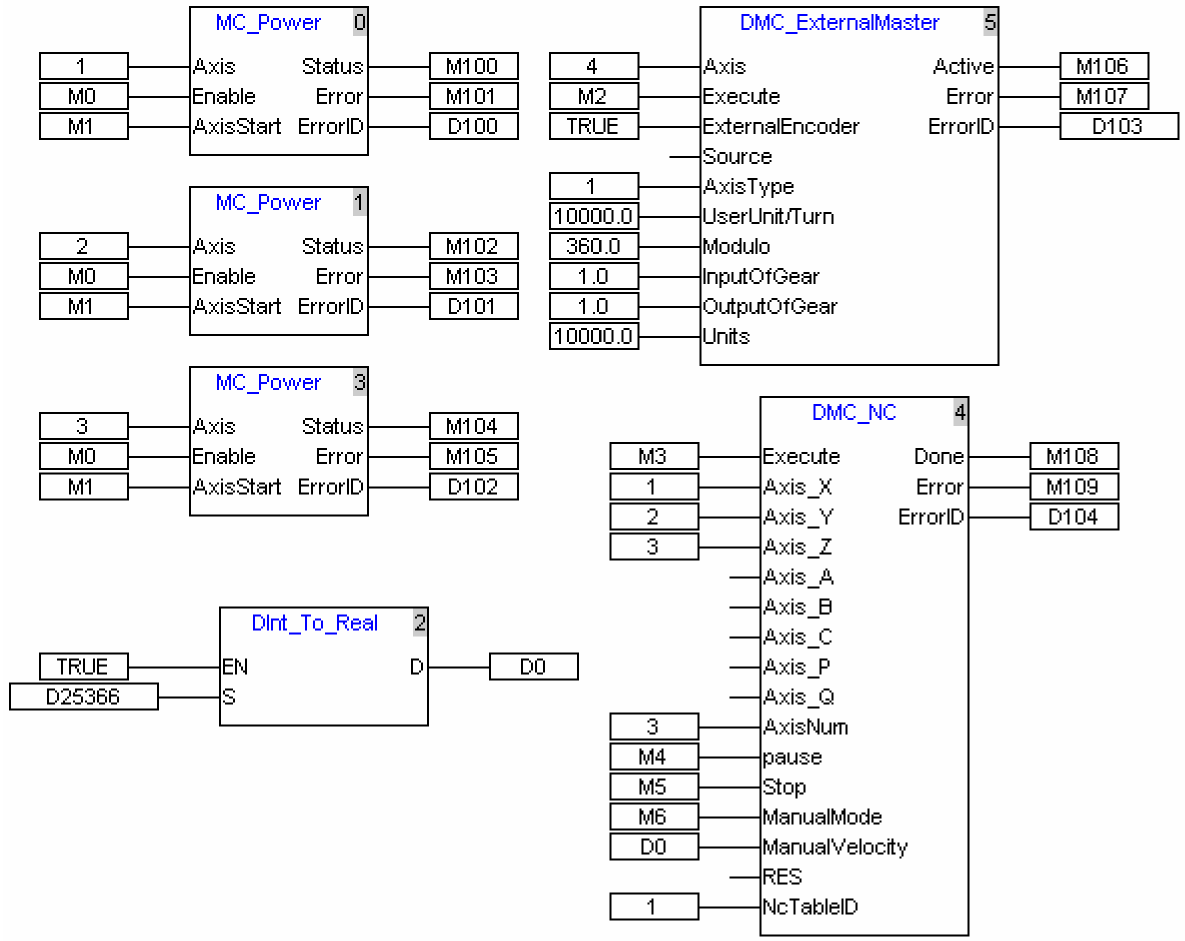


If D10 is set to 1 and then set M0 to ON, G codes will be executed statically and the CNC program with ID 1 will be called directly and the G codes are executed from top to bottom one by one.

Program example 2:

The program mainly demonstrates the function of manual mode and consists of one virtual master axis via ExternalMaster instruction. The source of the virtual master axis is the external encoder and the execution of G codes in NC instruction is controlled through the variation on the encoder interface.

➢ Program:



➢ Steps:

- When M1 and M0 turn off-> on, axis 1, axis 2 and axis 3 are enabled. After correct execution is finished, M100, M102 and M104 are on.
- When M2 turns off-> on, build a virtual master axis with the number: 4.
- When M3 turns off-> on, the G codes in NC program with the number: 1 starts to be executed.
- When M5 is on, start the manual function and the G codes which have not finished executed yet in NC program will be executed with the D0 value as the speed command.

As D25366 value is the given speed of axis 4, the operation speed of G codes can be controlled through the rotation speed of external encoder.

The data type of D25366 is DINT and so the logic instruction DINT_To_Real is used for conversion and the result is stored in D0.

Note: Currently, DMC_NC only supports the forward rotation of encoder.

4.8.5. Coordinate Motion Instructions

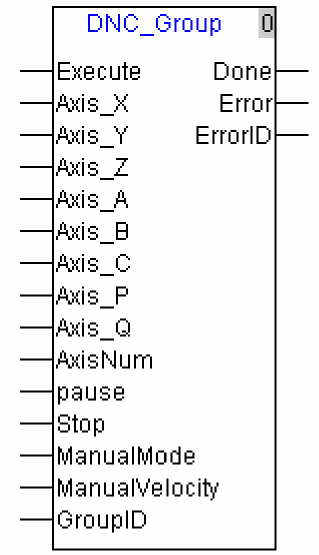
4.8.5.1 DNC_Group （Build Coordinate Motion Instruction Group）

API	DNC_Group	Build coordinate motion instruction group	Controller
261			10MC11T

Instruction explanation:

The instruction is used to build the coordinate motion group through its parameter GroupID. The coordinate motion instructions with the same GroupID can be executed after the coordinate motion group is built and the coordinate motion instruction being executed can be paused or stopped through parameter “Pause” and “Stop”.

After parameter “ManualMode” is started up, the “Velocity” values of the coordinate motion instructions with same GroupID are invalid and the “ManualVelocity” value will be taken as the speed of coordinate motion instructions.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Execute	This instruction is executed when “Execute” turns Off ->On.	BOOL	M, I, Q, constant
Axis_X	The node address of X axis	UINT	Constant, D
Axis_Y	The node address of Y axis	UINT	Constant, D
Axis_Z	The node address of Z axis	UINT	Constant, D
Axis_A	The node address of A axis	UINT	Constant, D
Axis_B	The node address of B axis	UINT	Constant, D
Axis_C	The node address of C axis	UINT	Constant, D
Axis_P	The node address of P axis	UINT	Constant, D
Axis_Q	The node address of Q axis	UINT	Constant, D
AxisNum	The number of the valid axis, no more than 8.	UINT	Constant, D

Parameter name	Explanation	Data type	Available device
Pause	When “Pause” is on, the execution of the coordinate motion instruction with the same GroupID as that of DNC_Group will be paused. When “Pause” is off, the execution of the coordinate motion instruction with the same GroupID as that of DNC_Group will continue.	BOOL	M, I, Q
Stop	When “Stop” is on, the execution of the coordinate motion instruction with the same GroupID as that of DNC_Group instruction will be stopped.	BOOL	M, I, Q
ManualMode	When “ManualMode” is on, start the manual function; when “ManualMode” is off, close the manual function.	BOOL	M, I, Q
ManualVelocity	The speed in manual mode	REAL	Constant, D
GroupID	The number of the coordinate motion instruction group, range: 0~7.	UINT	Constant, D
Done	When “Stop” is on, “Done” is on; when “Execute” is off, “Done” is reset.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

Note:

1. AxisNum

   AxisNum value gets effective according to the pins of Axis_X/Y/Z/A/B/C/P/Q from top to bottom. The node address of the middle axis can not be omitted and repeated. If AxisNum is set to 5, set the corresponding axis node addresses for Axis_X/Y/Z/A/B among the axis parameters. They could be virtual axes.

2. Pause

   If the coordinate motion instruction is being executed, set “Pause” to ON and the execution of the corresponding coordinate motion instruction will be stopped temporarily at the deceleration in coordinate motion instruction.

   When “Pause” is off, the execution of the coordinate motion instruction which have not finished being executed will continue. The state of axis will be unchanged after and before the pause function is executed.

3. Stop

   If the coordinate motion instruction is being executed, set “Stop” to ON and the execution of the corresponding coordinate motion instruction will be stopped at the deceleration in coordinate motion instruction and the state of each axis is Standstill.

   If the coordinate motion instruction is executed again, reset “Stop” and then execute DNC_Group instruction again. Please note that the current position of axis must be consistent with the terminal position of the coordinate motion instruction to be executed when coordinate motion instruction is executed again. If the instruction to be executed is the circular instruction, consider if the current point, the terminal point of arc, center of a circle or radius can make up a circular arc in case of any abnormality.

4. ManualMode

   After “Manualmode” is started up, the running speed of the corresponding coordinate motion instruction comes from the parameter setting of manual velocity. When “ManualMode” is off, the execution of the G code which has not completed being executed can continue at the speed and acceleration set in the original instruction. The source of manual speed can be a constant or some register.

4.8.5.2 Absolute/ Relative Mode Switching Instruction

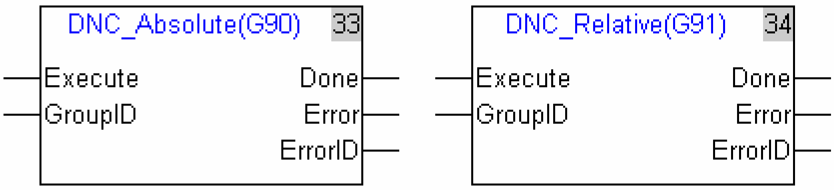
API	DNC_Absolute（G90）	In absolute mode	Controller
262	DNC_Relative（G91）	In relative mode	10MC11T

Instruction explanation:

The two instructions are used to specify the mode for dealing with the terminal position of each axis such as absolute mode or relative mode. After the instruction ” DNC_Group” with same GroupID is executed, the two instructions just can be executed.

After DNC_Absolute (G90) is executed, the terminal position of each axis in the coordinate motion instruction which is executed later is based on 0 unit and DNC_Relative (G91) can be used to switch to the relative mode. It is absolute mode for the program by default.

After DNC_ Relative (G91) is executed, the terminal position of each axis in the coordinate motion instruction which is executed later is calculated with the incremental value beginning from current position and DNC_Absolute (G90) is used to switch to the absolute mode.



Explanation of input and output parameter of the instruction:

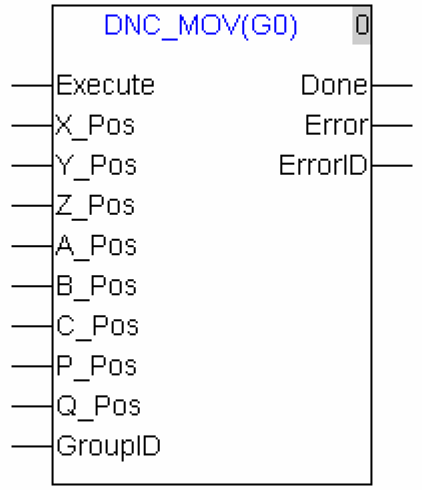
Parameter name	Explanation	Data type	Available device
Execute	This instruction is executed when “Execute” turns Off ->On.	BOOL	M, I, Q, constant
GroupID	The number of the coordinate motion instruction group, range: 0~7. When the instruction is executed, the group ID should be consistent with that of DNC_Group.	UINT	Constant, D
Done	When execution of the instruction is finished, “Done” is on; when “Execute” is off, “Done” is reset.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

4.8.5.3 DNC_MOV(G0)（Rapid positioning instruction）

API	DNC_MOV(G0)	Rapid positioning instruction	Controller
263			10MC11T

Instruction explanation:

The instruction is used to do the rapid positioning of the servo axis in the specified group and control each axis to move from current position to the terminal position at the specified speed. In motion, each axis is independent with each other. The instruction is similar to G0 in function.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Execute	This instruction is executed when “Execute” turns Off ->On.	BOOL	M, I, Q, constant
X_Pos	The terminal position of axis X, unit: unit.	REAL	Constant, D
Y_Pos	The terminal position of axis Y, unit: unit.	REAL	Constant, D
Z_Pos	The terminal position of axis Z, unit: unit.	REAL	Constant, D
A_Pos	The terminal position of axis A, unit: unit.	REAL	Constant, D
B_Pos	The terminal position of axis B, unit: unit.	REAL	Constant, D
C_Pos	The terminal position of axis C, unit: unit.	REAL	Constant, D
P_Pos	The terminal position of axis P, unit: unit.	REAL	Constant, D
Q_Pos	The terminal position of axis Q, unit: unit.	REAL	Constant, D
GroupID	The number of the coordinate motion instruction group, range: 0~7. When the instruction is executed, the group ID should be consistent with that of DNC_Group.	UINT	Constant, D
Done	When parameter setting is finished, “Done” is on; when “Execute” is off, “Done” is reset.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

Note:

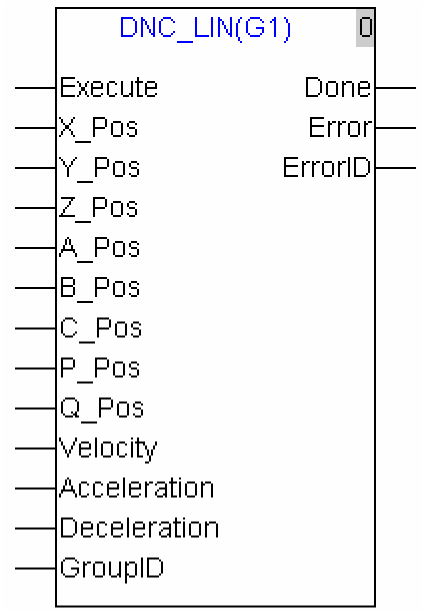
1. The function of the instruction is same as that of G0 in G codes and the input parameters X_Pos~ Q_Pos in the instruction and the parameters of X_, Y_, Z_, A_, B_, C_, P_, Q_ in G0 have same explanation. For more details on G0, please refer to section 4.8.3.3.
2. The state of axis related with the instruction is Standstill. After “DNC_Group” is executed, the instruction just can be executed and its GroupID must be same as that of DNC_Group.
3. The instruction can be switched to absolute mode via DNC_Absolute (90). In absolute mode, the system will regard the position of each axis as absolute value for operation.
4. The instruction can be switched to relative mode via DNC_Relative (91). In relative mode, the system will regard the position of each axis as incremental value beginning from current position for operation.
5. It is absolute mode for the instruction by default. Therefore, it is absolute mode for DNC_MOV (G0) if DNC_Absolute (90) and DNC_Relative (91) have not been executed.

4.8.5.4 DNC_LIN(G1)（Linear Interpolation Instruction）

API	DNC_LIN(G1)	Linear interpolation instruction	Controller
264			10MC11T

Instruction explanation:

The instruction is used for linear interpolation and can control the cutter to move from current position to the terminal position at the specified speed. The cutter always moves along the same straight line and all axes which control the cutter are started up or stopped simultaneously.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Execute	This instruction is executed when “Execute” turns Off ->On.	BOOL	M, I, Q, constant
X_Pos	The terminal position of axis X, unit: unit.	REAL	Constant, D
Y_Pos	The terminal position of axis Y, unit: unit.	REAL	Constant, D
Z_Pos	The terminal position of axis Z, unit: unit.	REAL	Constant, D
A_Pos	The terminal position of axis A, unit: unit.	REAL	Constant, D

Parameter name	Explanation	Data type	Available device
B_Pos	The terminal position of axis B, unit: unit.	REAL	Constant, D
C_Pos	The terminal position of axis C, unit: unit.	REAL	Constant, D
P_Pos	The terminal position of axis P, unit: unit.	REAL	Constant, D
Q_Pos	The terminal position of axis Q, unit: unit.	REAL	Constant, D
GroupID	The number of the coordinate motion instruction group, range: 0~7. When the instruction is executed, the group ID should be consistent with that of DNC_Group.	UINT	Constant, D
Done	When parameter setting is finished, “Done” is on; when “Execute” is off, “Done” is reset.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

Note:

1. The function of the instruction is same as that of G1 in G codes and the input parameters X_Pos~Deceleration in the instruction and the parameters of X_, Y_, Z_, A_, B_, C_, P_, Q_,F_,E_,E_ in G1 have same explanation. For more details on G1, please refer to section 4.8.3.4.
2. The state of axis related with the instruction is Standstill. After “DNC_Group” is executed, the instruction just can be executed and its GroupID must be same as that of DNC_Group.
3. The instruction can be switched to absolute mode via DNC_Absolute (90). In absolute mode, the system will regard the position of each axis as absolute value for operation.
4. The instruction can be switched to relative mode via DNC_Relative (91). In relative mode, the system will regard the position of each axis as incremental value beginning from current position for operation.
5. It is absolute mode for the instruction by default. Therefore, it is absolute mode for DNC_LIN(G1) if DNC_Absolute (90) and DNC_Relative (91) have not been executed.

4.8.5.5 Circular/ Helical Interpolation（The Coordinates of Center of a Circle are Set）

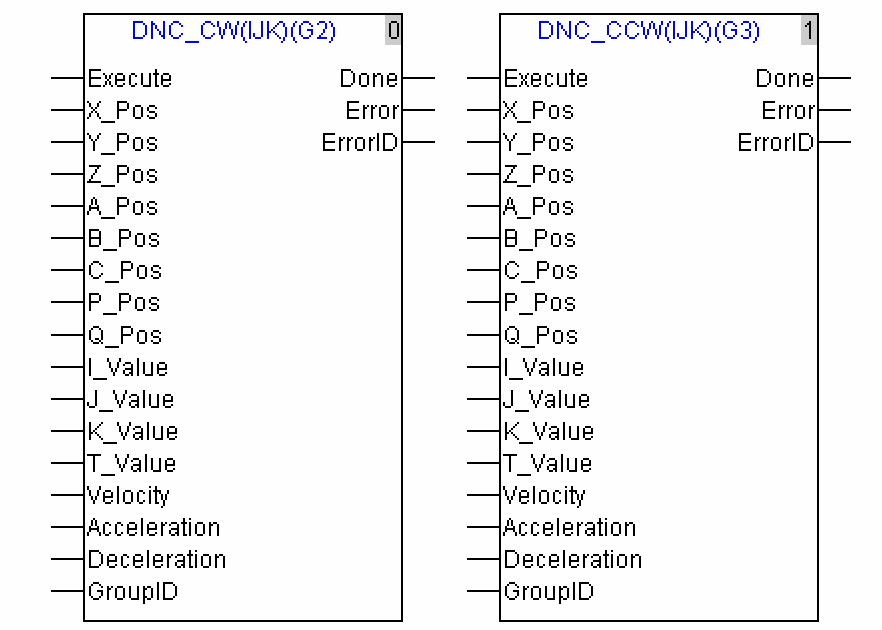
<table>
<tr><td>API</td><td rowspan="1">DNC_CW（IJK）（G2）</td><td>Clockwise circular/ helical interpolation
（The coordinates of center of a circle are set）</td><td>Controller</td></tr>
<tr><td>265</td><td>DNC_CCW（IJK）（G3）</td><td>Anticlockwise circular/ helical interpolation
（The coordinates of center of a circle are set）</td><td>10MC11T</td></tr>
</table>

Instruction explanation:

The two instructions are used for circular/helical interpolation. DNC_CW(IJK) (G2) is for clockwise motion and DNC_CCW(IJK) (G3) is for anticlockwise motion.

Circular interpolation: The cutter performs the arc cutting of the processed workpieces at the feed speed specified by parameter Velocity on the circular arc with the fixed center of a circle (IJ/IK/JK) on the specified plane.

Helical interpolation: The cutter moves on the circular arc on the specified plane, which is circular interpolation, meanwhile, makes the linear interpolation vertically on the specified plane at the feed speed specified by parameter Velocity.



Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Execute	This instruction is executed when “Execute” turns Off ->On.	BOOL	M, I, Q, constant
X_Pos	The corresponding X-axis coordinates of the terminal point of the circular arc	REAL	Constant, D
Y_Pos	The corresponding Y-axis coordinates of the terminal point of the circular arc	REAL	Constant, D
Z_Pos	The corresponding X-axis coordinates of the terminal point of the circular arc	REAL	Constant, D
A_Pos	The coordinate position of terminal point of the added axis	REAL	Constant, D
B_Pos	The coordinate position of terminal point of the added axis	REAL	Constant, D

Parameter name	Explanation	Data type	Available device
C_Pos	The coordinate position of terminal point of the added axis	REAL	Constant, D
P_Pos	The coordinate position of terminal point of the added axis	REAL	Constant, D
Q_Pos	The coordinate position of terminal point of the added axis	REAL	Constant, D
I_Value	The corresponding X-axis coordinates of the center of a circle	REAL	Constant, D
J_Value	The corresponding Y-axis coordinates of the center of a circle	REAL	Constant, D
K_Value	The corresponding Z-axis coordinates of the center of a circle	REAL	Constant, D
T_Value	The quantity of the full circle	UINT	Constant, D
Velocity	The feed speed of the circular arc	REAL	Constant, D
Acceleration	Acceleration	REAL	Constant, D
Deceleration	Deceleration	REAL	Constant, D
GroupID	The number of the coordinate motion instruction group, range: 0~7. When the instruction is executed, the group ID should be consistent with that of DNC_Group.	UINT	Constant, D
Done	When the execution of the instruction is finished, “Done” is on; when “Execute” turns off, “Done” is reset.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

Note:

1. The function of the instruction DNC_CW(IJK) (G2) and DNC_CCW(IJK) (G3) is same as that of G2 and G3 in G codes and the input parameters X_Pos~Deceleration in the instruction and the parameters of X_, Y_, Z_, A_, B_, C_, P_, Q_, I_, J_, K_,T_, F_,E_,E_ in G2 and G3 have same explanation. For more details on G2 and G3, please refer to section 4.8.3.5.
2. The state of axis related with the instruction is Standstill. After “DNC_Group” is executed, the instruction just can be executed and its GroupID must be same as that of DNC_Group.
3. The instruction can be switched to absolute mode via DNC_Absolute (90). In absolute mode, the terminal position of each axis is based on 0 unit.
4. The instruction can be switched to relative mode via DNC_Relative (91). In relative mode, the terminal position of each axis is calculated as incremental value beginning from current position.

5. No matter whether in absolute mode or relative mode, the coordinates of the center of a circle I_Value, J_Value, K_Value are always the relative coordinates with the start point as reference.
6. It is absolute mode for the instruction by default. Therefore, it is absolute mode for DNC_CW (IJK) (G2) and DNC_CCW(IJK) (G3) if DNC_Absolute (90) and DNC_Relative (91) have not been executed.

4.8.5.6 Circular/ Helical Interpolation（Radius is Set）

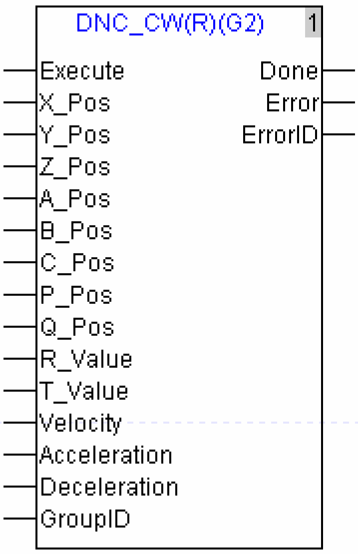
API			Controller
266	**DNC_CW（R）（G2）**	Clockwise circular/ helical interpolation （Radius is set）	10MC11T
	DNC_CCW（R）（G3）	Anticlockwise circular/ helical interpolation （Radius is set）	

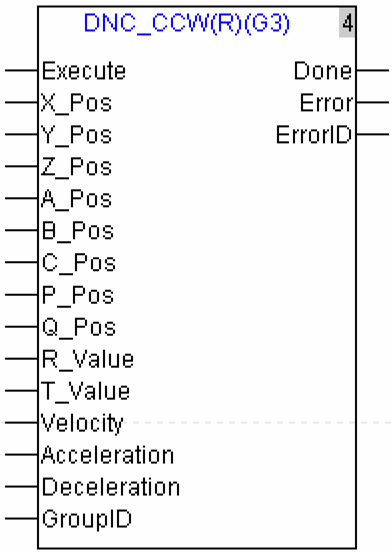
Instruction explanation:

The two instructions are used for circular/helical interpolation. DNC_CW(R) (G2) is for clockwise motion and DNC_CCW(R) (G3) is for anticlockwise motion.

Circular interpolation: The cutter performs the arc cutting of the processed workpieces at the feed speed specified by parameter Velocity on the circular arc with the fixed radius on the specified plane

Helical interpolation: The cutter moves on the circular arc on the specified plane, which is circular interpolation, meanwhile, makes the linear interpolation vertically on the specified plane at the feed speed specified by parameter Velocity.





Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Execute	This instruction is executed when “Execute” turns Off ->On.	BOOL	M, I, Q, constant
X_Pos	The corresponding X-axis coordinates of the terminal point of the circular arc	REAL	Constant, D
Y_Pos	The corresponding Y-axis coordinates of the terminal point of the circular arc	REAL	Constant, D
Z_Pos	The corresponding Z-axis coordinates of the terminal point of the circular arc	REAL	Constant, D

A_Pos	The coordinate position of terminal point of the added axis	REAL	Constant, D
B_Pos	The coordinate position of terminal point of the added axis	REAL	Constant, D
C_Pos	The coordinate position of terminal point of the added axis	REAL	Constant, D
P_Pos	The coordinate position of terminal point of the added axis	REAL	Constant, D
Q_Pos	The coordinate position of terminal point of the added axis	REAL	Constant, D
R_Value	The radius of the circular arc. Positive number is minor arc and negative number is major arc.	REAL	Constant, D
T_Value	The quantity of the full circle	UINT	Constant, D
Velocity	The feed speed of the circular arc	REAL	Constant, D
Acceleration	Acceleration	REAL	Constant, D
Deceleration	Deceleration	REAL	Constant, D
GroupID	The number of the coordinate motion instruction group, range: 0~7. When the instruction is executed, the group ID should be consistent with that of DNC_Group.	UINT	Constant, D
Done	When the execution of the instruction is finished, “Done” is on; when “Execute” turns off, “Done” is reset.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

Note:

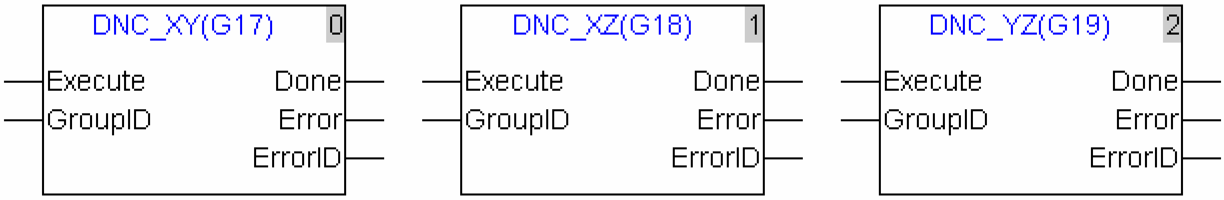
1. The function of the instruction DNC_CW(R) (G2) and DNC_CCW(R) (G3) is same as that of G2 and G3 in G codes and the input parameters X_Pos~Deceleration in the instruction and the parameters of X_, Y_, Z_, A_, B_, C_, P_, Q_, R_,T_, F_,E_,E_ in G2 and G3 have same explanation. For more details on G2 and G3, please refer to section 4.8.3.5.
2. The state of axis related with the instruction is Standstill. After “DNC_Group” is executed, the instruction just can be executed and its GroupID must be same as that of DNC_Group.
3. The instruction can be switched to absolute mode via DNC_Absolute (90). In absolute mode, the terminal position of each axis is based on 0 unit.
4. The instruction can be switched to relative mode via DNC_Relative (91). In relative mode, the terminal position of each axis is calculated as incremental value beginning from current position.
5. It is absolute mode for the instruction by default. Therefore, it is absolute mode for DNC_CW (R) (G2) and DNC_CCW(R) (G3) if DNC_Absolute (90) and DNC_Relative (91) have not been executed.

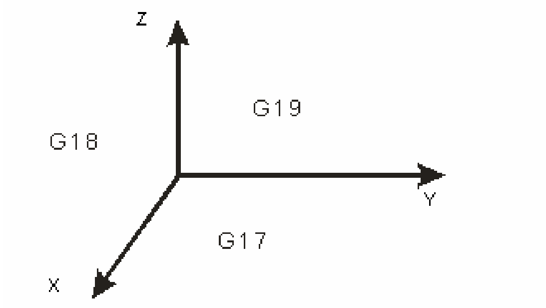
4.8.5.7 Plane Selection Instruction

API	DNC_XY（G17）	XY plane selection	Controller
267	DNC_XZ（G18）	XZ plane selection	10MC11T
	DNC_YZ（G19）	YZ plane selection	

Instruction explanation:

The three instructions are used for determining the circular/ helical interpolation plane selection and the three work planes can be switched with each other while the program is being executed. If there is no plane selection in the program, the initial plane of system is XY plane by default.





Explanation of input and output parameter of the instruction:

Parameter name	Explanation	Data type	Available device
Execute	This instruction is executed when “Execute” turns Off ->On.	BOOL	M, I, Q, constant
GroupID	The number of the coordinate motion instruction group, range: 0~7. When the instruction is executed, the group ID should be consistent with that of DNC_Group.	UINT	Constant, D
Done	When the execution of the instruction is finished, “Done” is on; when “Execute” turns off, “Done” is reset.	BOOL	M,Q
Error	If any error is detected, "Error" turns on; when "Execute" turns off, "Error" is reset.	BOOL	M,Q
ErrorID	Error code. Please refer to section 5.3.	UINT	D

Note:

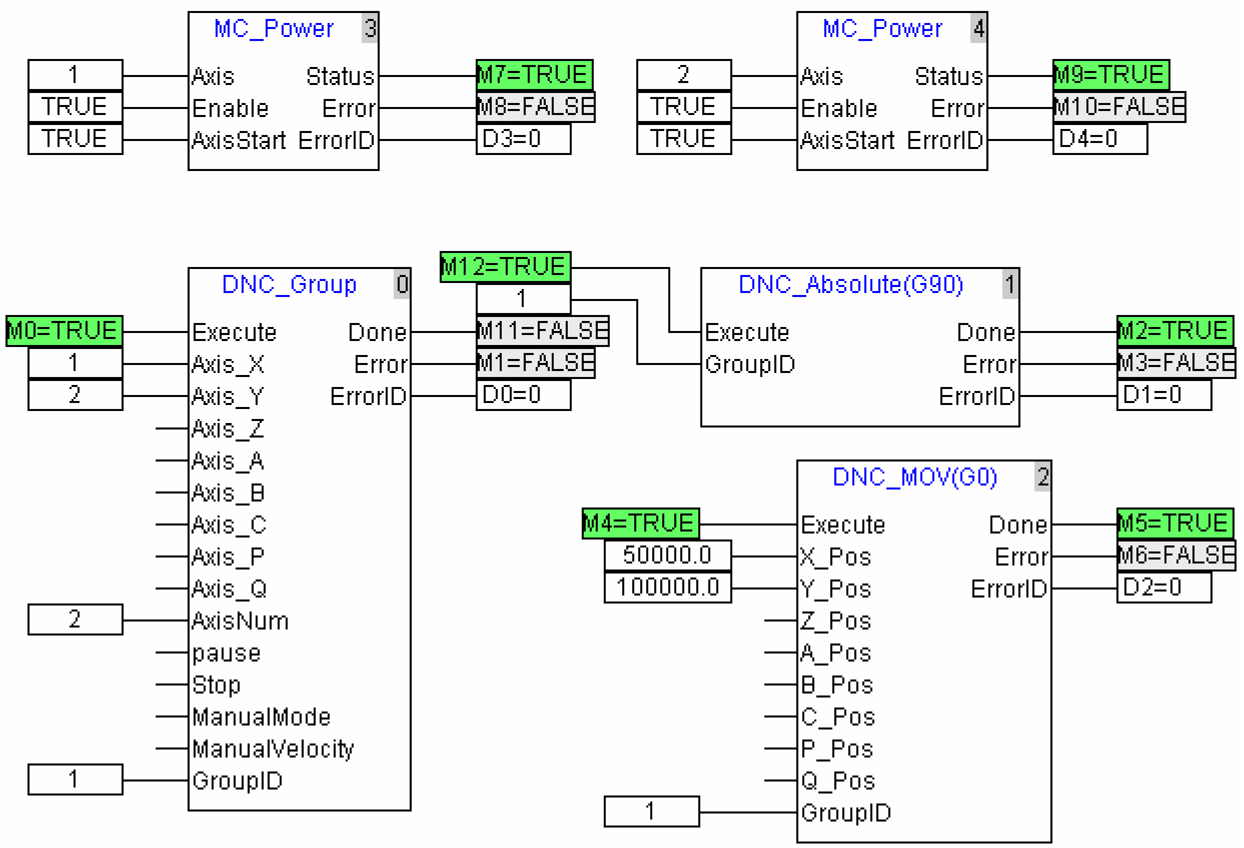
1. The function of DNC_XY (G17), DNC_XY (G18) and DNC_XY (G19) is the same as that of G17, G18 and G19 in G codes.
2. After “DNC_Group” is executed, the instruction just can be executed and its GroupID must be same as that of DNC_Group.

4.8.5.8 Program Example

Program example 1: DNC_MOV (G0) in absolute mode

The initial positions of axis X and Y are both 10,000 units and the axis parameters are all default.

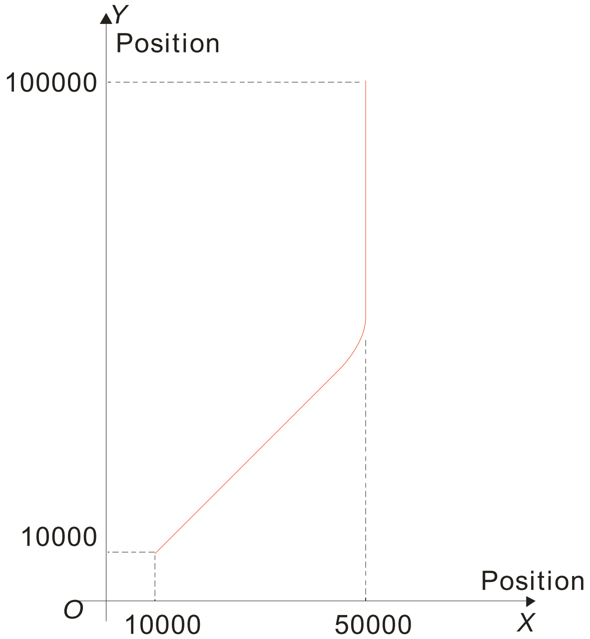
➢ The program to be executed:



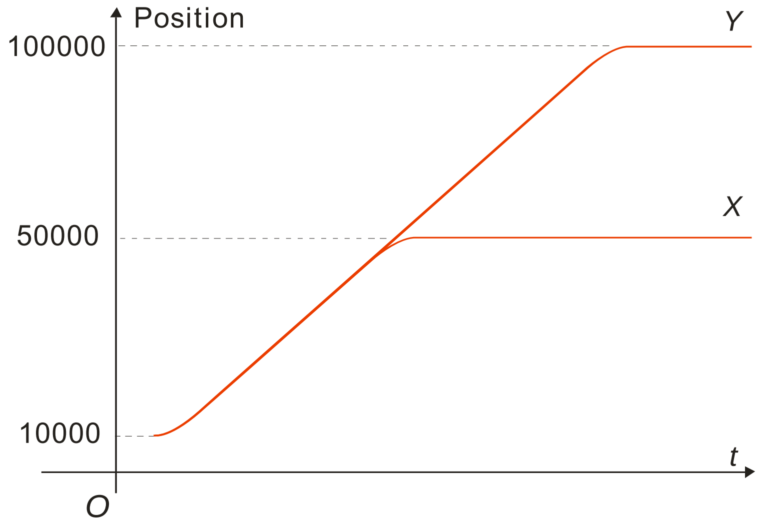
➢ Program explanation:

- 1. After the connection between DVP10MC11T and servo axis is made successfully, M7 and M9 are on. After M7 is on, the servo axis of number 1 Servo On; after M9 is on, the servo axis of number 2 Servo On.
- 2. After M0 is on, DNC_Group instruction starts to construct the coordinate system.
- After M12 is on, each servo axis is switched to the absolute positioning mode. When M2 is on, each axis enters the absolute mode.
- 4. After M4 is on, DNC_MOV (G0) starts to be executed. When M5 is on, the execution of DNC_MOV (G0) is finished.

➢ After the program is executed, the Y/X curve of the whole process is as below.



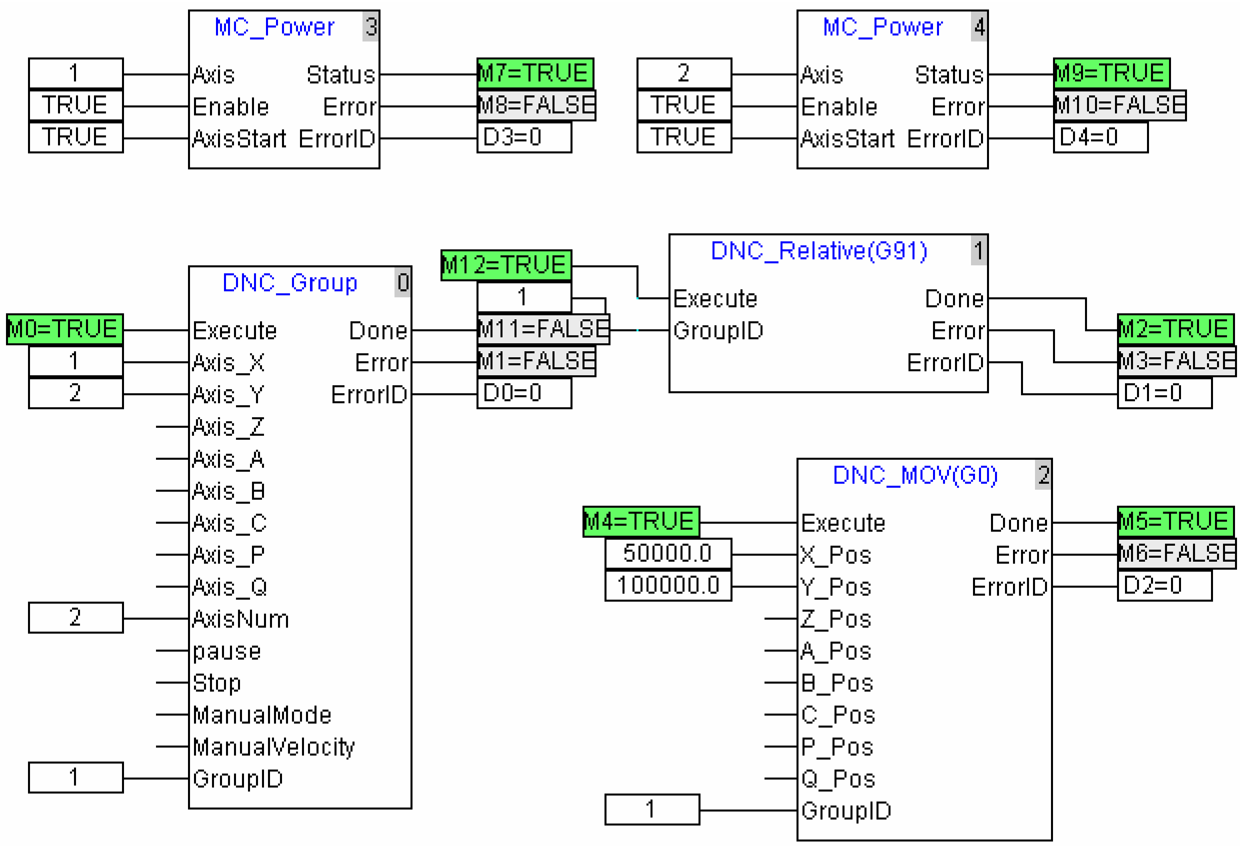
➢ After the program is executed, the Position/time curve of the whole process is as below.



Program example 2: DNC_MOV (G0) in relative mode

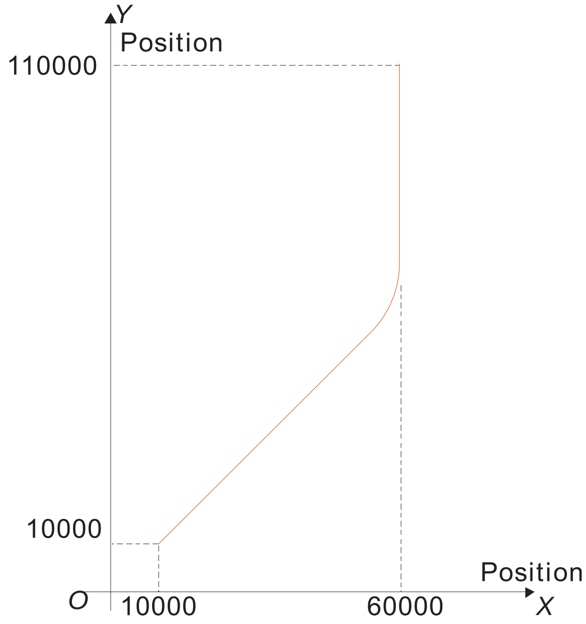
The initial positions of axis X and Y are both 10,000 units and the axis parameters are all default.

- The program to be executed:

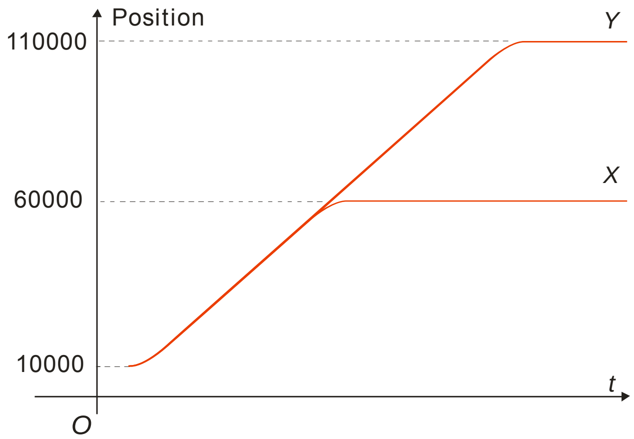


- Program explanation:
  - 1. After the connection between DVP10MC11T and servo axis is made successfully, M7 and M9 are on. After M7 is on, the servo axis of number 1 Servo On; after M9 is on, the servo axis of number 2 Servo On.
  - 2. When M0 is on, DNC_Group starts to construct the coordinate system.
  - 3. After M12 is on, each servo axis is switched to the relative positioning mode. When M2 is on, each axis enters the relative positioning mode.
  - 4. After M4 is on, DNC_MOV (G0) starts to be executed. When M5 is on, the execution of DNC_MOV (G0) is finished.

- After the program is executed, the Y/X curve of the whole process is as below.



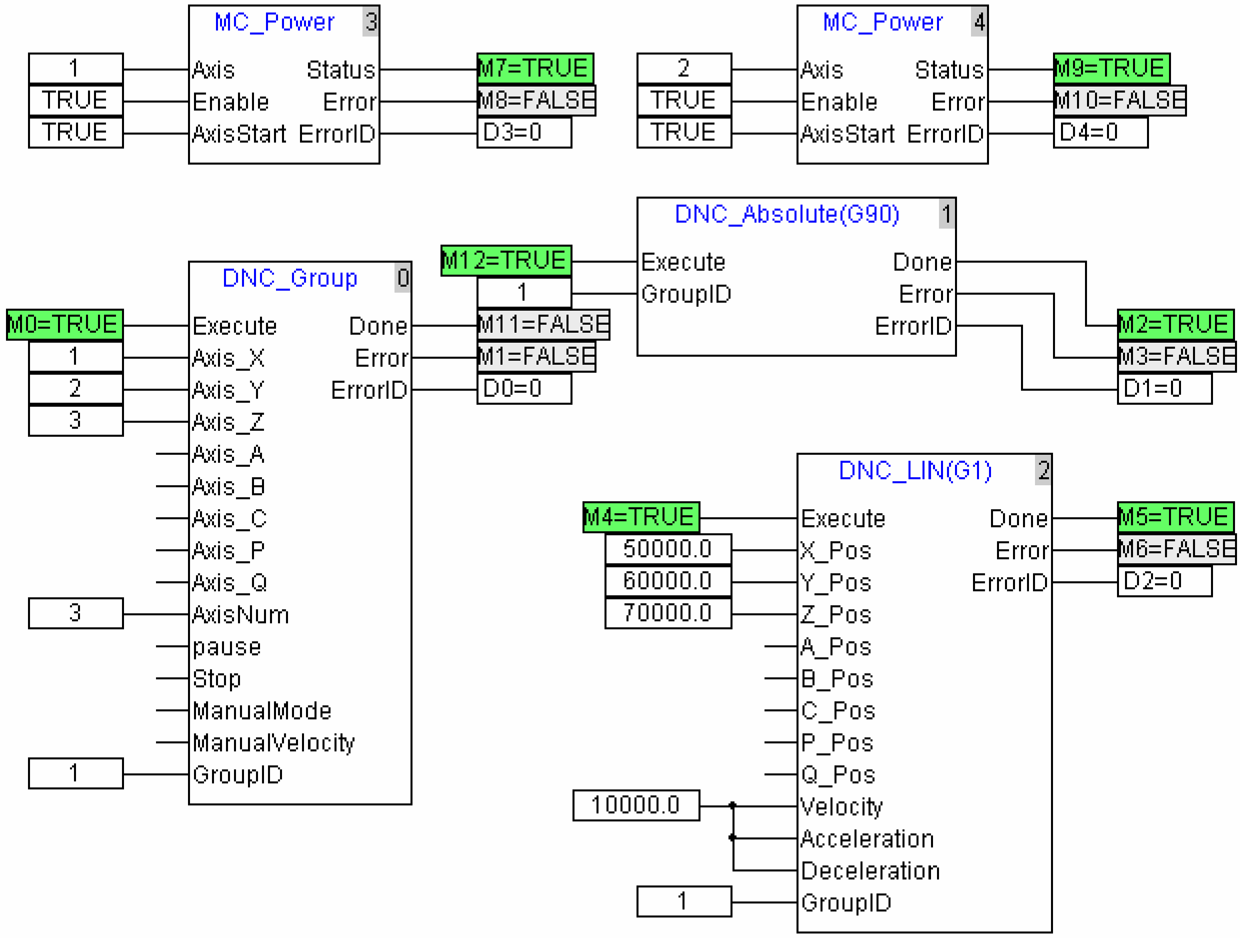
- After the program is executed, the Position/time curve of the whole process is as below.



Program example 3: DNC_LIN (G1) in absolute mode

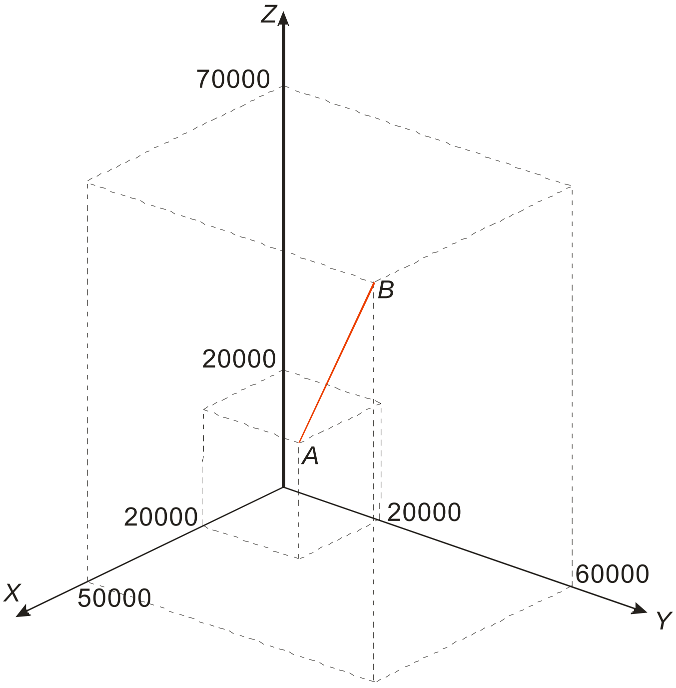
The initial positions of axis X, Y and Z are all 20,000 units and the axis parameters are all default.

- The program to be executed:

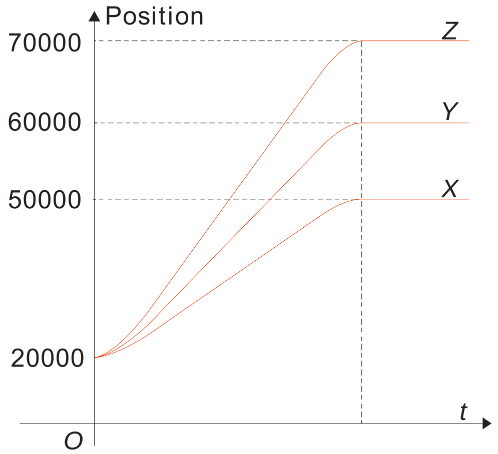


- Program explanation:
  - After the connection between DVP10MC11T and servo axis is made successfully, M7 and M9 are on. After M7 is on, the servo axis of number 1 Servo On; after M9 is on, the servo axis of number 2 Servo On.
  - After M0 is on, DNC_Group instruction starts to construct the coordinate system.
  - After M12 is on, each servo axis is switched to the absolute positioning mode. When M2 is on, each axis enters the absolute positioning mode.
  - After M4 is on, DNC_ LIN (G1) starts to be executed. When M5 is on, the execution of DNC_LIN (G1) is finished.

- After the program is executed, the Y/X curve of the whole process is as below.



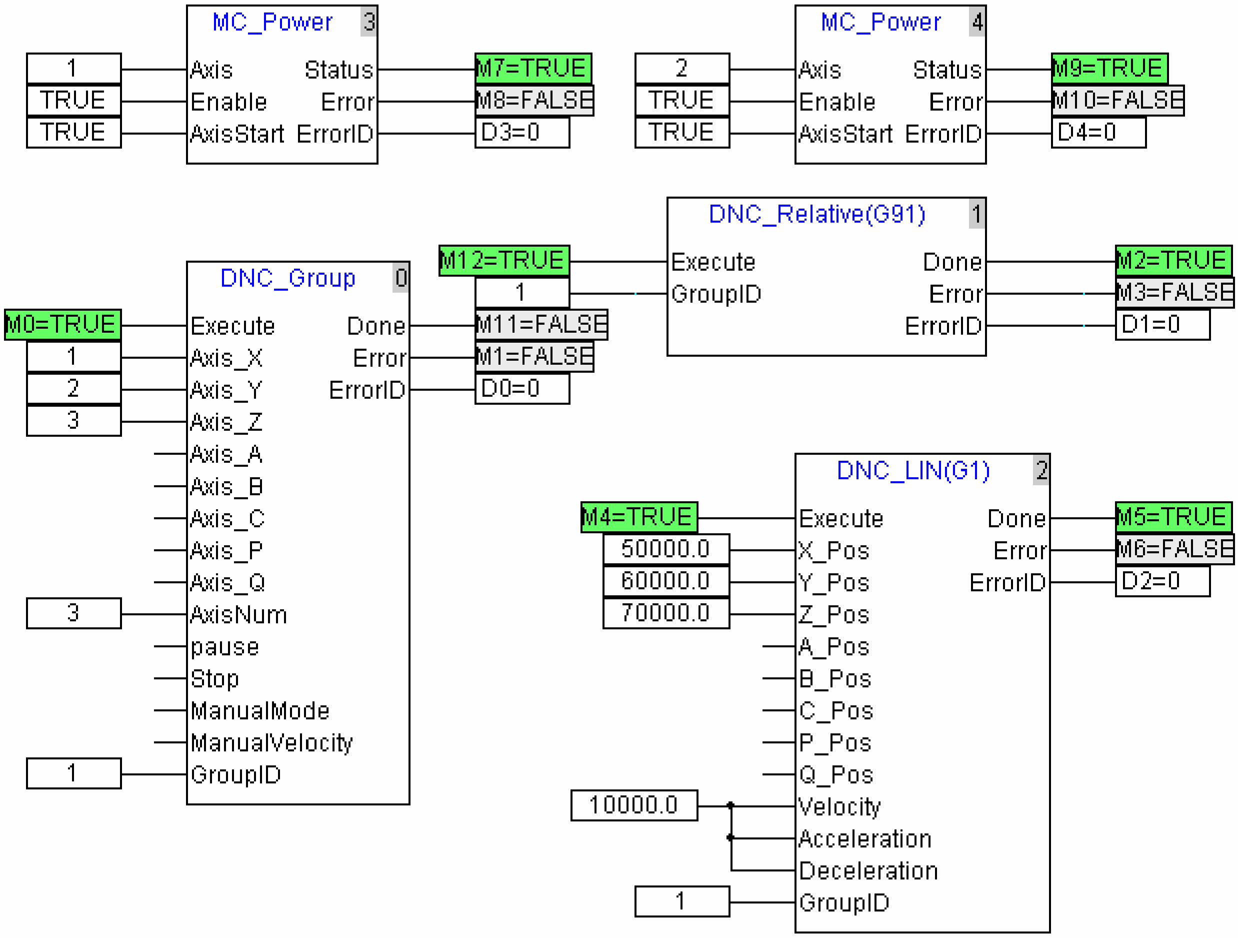
- After the program is executed, the Position /time curve of the whole process is as below.



Program example 4: DNC_LIN (G1) in relative mode

The initial positions of axis X, Y and Z are all 20,000 units and the axis parameters are all default.

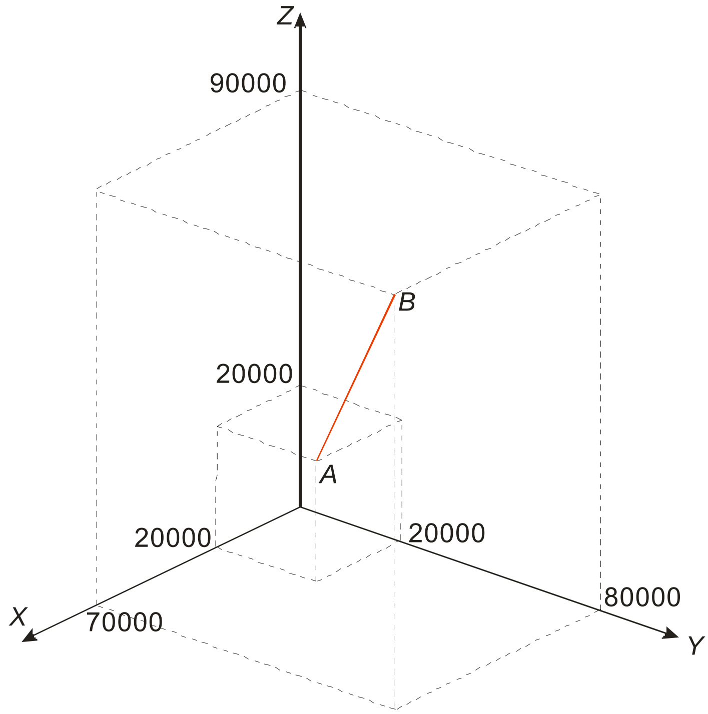
➢ The program to be executed:



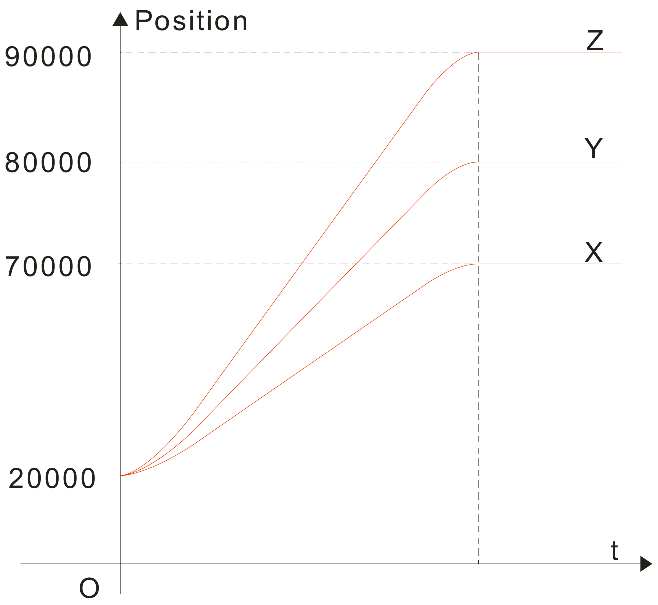
➢ Program explanation:

- 1. After the connection between DVP10MC11T and servo axis is made successfully, M7 and M9 are on. After M7 is on, the servo axis of number 1 Servo On; after M9 is on, the servo axis of number 2 Servo On.
- 2. When M0 is on, DNC_Group starts to construct the coordinate system.
- 3. After M12 is on, each servo axis is switched to the relative positioning mode. When M2 is on, each axis enters the relative positioning mode.
- 4. After M4 is on, DNC_ LIN (G1) starts to be executed. When M5 is on, the execution of DNC_LIN (G1) is finished.

➢ After the program is executed, the Y/X curve of the whole process is as below.



➢ After the program is executed, the Position /time curve of the whole process is as below.



5. Troubleshooting

5.1. LED Indicator Explanation

■ POWER LED

POWER LED indicates if the power supply of DVP10MC11T is normal.

LED state	Explanation	How to deal with
Green LED on	Power supply is normal	--
LED off or flash	Power supply is abnormal	Check if the power supply for DVP10MC11T is normal.

■ RUN LED

RUN LED indicates the state of PLC module.

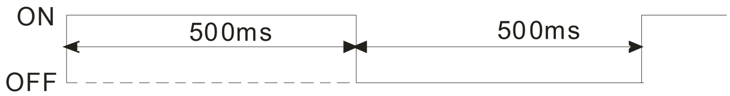
LED state	Explanation	How to deal with
Green LED on	PLC module is in run state.	--
LED off	PLC module is in stop state.	Switch PLC to the RUN state according to demand

■ ERR LED

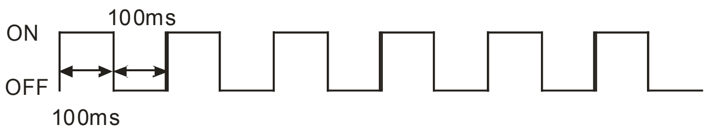
ERR LED indicates the state of execution of PLC module program or the state of power supply of DVP10MC11T.

LED state	Explanation	How to deal with
LED off	PLC module is in the state of normal work.	--
Red LED flash	1. There are syntax errors in the program user writes in the PLC module; 2. Or PLC device or instruction exceeds the allowed range.	1. Judge the error cause according to the value of special register D1004 of PLC module. 2. Judge the position of program error according to D1137 value. For more details, please see the operation manual of DVP-ES2/EX2/SS2/SA2/SX2 (Programming).
Red LED blinking quickly	DVP10MC11T power supply is insufficient.	Check if the power supply for DVP10MC11T is normal.

ERR LED: red light flashes (1HZ)



ERR LED: red light blinks quickly (10HZ)

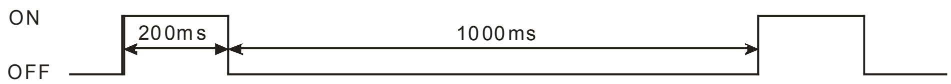


■ CAN LED

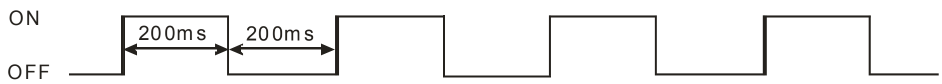
CAN LED indicates the state of CANopen network of MC module.

LED state	Explanation	How to deal with
Green light single flash	CANopen network is in stop state.	PC is downloading the program and waiting that download is finished.
Green light blinking	CANopen network is in preoperational state	1. Check if CANopen network connection is correct. 2. Check if the configured slave in the network exists. 3. The baud rates of DVP10MC11T and slaves are same. 4. Check if some slave is offline.
Green light on	CANopen network is in Run state.	--
Red light single flash	Bus error exceeds the alarm level	1. Check if it is standard cable for CANopen bus connection. 2. Check if the terminal resistors have been connected to the two ends of CANopen bus. 3. Check if the interference around CANopen bus cable is too strong.
Red light on	Bus-Off	1. Check if the wiring in CANopen network is correct. 2. The baud rates of DVP10MC11T and slaves are same.

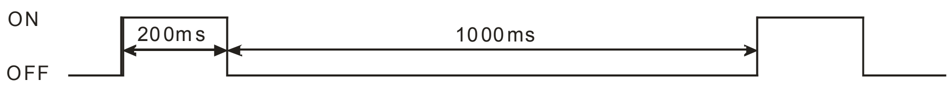
CAN LED: green light single flashes



CAN LED: green light blinks



CAN LED: red light single flashes.



■ MTL

MTL LED indicates if MC module state is normal.

LED state	Explanation	How to deal with
Light off	No data has been configured in MC module.	Via CANopen Builder software, configure and program the controller and then re-download.
Green light on	MC module is in Run state and the motion control program is being executed.	--

LED state	Explanation	How to deal with
Green light flash	The communication with the axis configured is not ready.	Check if the communication with each axis is normal.
Red light on	Hardware error in MC module	After power on once again, return the goods to factory for repair if the error still exists.
Red light blinking	MC module runs abnormally	1. Check if the setting value for synchronous cycle is too small. After increasing the synchronous cycle value, re-download. 2. Check if there is slave offline in CANopen network. 3. Check if the motion control program is stopped after it is executed. 4. Check if there are unsupportive instructions in the program.

■ **Ethernet LED**

DVP10MC11T has two Ethernet LED indicators like orange light and green light. Green light indicates the Ethernet communication state and orange light indicates Ethernet baud rate.

LED	State	Indication
Orange light	Light on	Ethernet baud rate:100Mbps
	Light off	Ethernet baud rate is 10Mbps or 10MC has not been put in Ethernet.
Green light	Light flash	The Ethernet communication port for 10MC is receiving and sending data.
	Light off	The Ethernet communication port for 10MC is not receiving and sending data.

■ **COM 1 LED**

COM1 LED is an indicator of RS-232 communication port of PLC module. It indicates the communication state of RS-232 communication port of PLC module.

LED state	Indication
Yellow light flash	There is response data at RS-232（COM1）port.
Light off	There is no response data at RS-232（COM1）port .

■ **COM 2 LED**

COM2 LED is the indicatior of RS-485 shared by motion control module and PLC module to indicate the state of RS-485 communication port.

RUN LED state	Indication
Yellow light flash	There is response data at RS-485（COM2）port.
Light off	There is no response data at RS-485（COM2）port.

■ **Input Point LED**

There are 8 input-point LED indicators (I0~I7) for showing if DVP10MC11T digital input point is on- state or off-state.

Input point LED state	Indication
Green light on（I0~I7）	Input point is on-state.
Light off（I0~I7）	Input point is off-state.

■ **Output Point LED**

There are 4 output-point LED indicators (Q0~Q3) for showing if DVP10MC11T digital output point is on-state or off-state.

Output point LED state	Indication
Green light on（Q0~Q3）	Output point is on-state.
Light off（Q0~Q3）	Output point is off-state.

5.2. Status Word Instruction

When an error emerges in MC module of DVP10MC11T, user could judge the error cause according to the values of D6511 and D6512. The indication of each bit of D6511 and D6512 is shown below.

Bit device	Indication when the value of each bit of D6511 is 1.	How to deal with
Bit0	MC module is in error mode; The running motion control program is terminated	Press “Reset” key to restart DVP10MC11T.
Bit1	The configuration data is being downloaded to MC module by the PC.	No correction is needed and DVP10MC11T will resume to run after download is finished.
Bit2	Node list is empty and no slave is configured.	Via CANopen Builder, add the slave into the node list of MC module and re-download.
Bit3	The current configuration data is invalid.	Check if there is any error in configuration data; redownload it after configuration data is modified.
Bit4	Buffer area sending the data is full.	1. Check if CANopen bus connection is normal. 2. Check if the baud rates of master and slave of CANopen bus are same. 3. Check if the terminal resistors are connected to the two ends of CANopen bus.
Bit5	Buffer area receiving the data is full.	1. Check if CANopen bus connection is normal. 2. Check if the baud rates of master and slave of CANopen bus are same. 3. Check if the terminal resistors are connected to the two ends of CANopen bus.
Bit6	Power supply is insufficient.	Check if 24V power supply is normal.
Bit7	The internal memory operation error	After power on once again, return it to factory for repair if the error still exists.

Bit device	Indication when the value of each bit of D6511 is 1.	How to deal with
Bit8	GPIO operation error	After power on once again, return it to factory for repair if the error still exists.
Bit9	SRAM operation error	After power on once again, return it to factory for repair if the error still exists.
Bit10	There is some slave offline in CANopen network	Check if the CANopen bus connection is normal.
Bit11	The program in MC module is running	--
Bit12	Reserved	--
Bit13	The setting value of the synchronous cycle is too small	Enlarge the synchronous cycle value in CANopen Builder and then redownload.
Bit14	The instruction does not match the firmware of the controller	Update the firmware
Bit15	The program is overlarge in capacity	Check if the program, CAM and G codes are overlarge in capacity.

Note: D6512 is reserved for future development.

5.3. Error ID in Motion Instructions

Error ID	Indication	How to deal with
1	When the motion instruction is executed, the axis is not enabled.	Enable the axis via the MC_Power instruction.
2	The motion instruction which has not been finished execution is interrupted by other instruction.	No correction is needed. (The newly executed instruction can be executed normally, and the interrupted instruction will be stopped executing.
3	The node address of the servo drive in the motion instruction exceeds the allowed range.	The station no. of the servo drive in the motion control instruction should be set between 1~18.
6	The input parameter value in the motion instruction is invalid.	Check if the input parameter value in the motion instruction is consistent with the instruction explanation. (When the acceleration of the MC_MoveVelocity instruction is 0, this error will be alarmed)
9	10MC does not recognize the G code in NC program. The input parameter value in G code or coordinate motion instruction is invalid.	Check if input format of G code is consistent with section 4.8 explanation. When the G2,G3 or coordinate motion instruction related with arc is executed,if the current point, the terminal point of arc, center of a circle or radius can make up a circular arc in case of any abnormality.

Error ID	Indication	How to deal with
10	The axis that the motion instruction controls has not been configured to 10MC	Configure the axis to be operated to 10MC in the software and then redownload.
11	The MC_PassiveHome instruction is interrupted by the MC_Stop instruction when the execution of it has not finished	No correction is needed. (The MC_Stop instruction can be executed normally.)
12	The DMC_CapturePosition instruction did not receive any capture signal in the window range and the capturing failed.	Check if the setting of the instruction window range is proper.
13	The DMC_SetTorque instruction can not be executed.	Only when the axis is in standstill state, the torque setting instruction can be executed.
83	SDO reading and writing is time-out	Check if the CANopen bus connection between 10MC and the written and read slave is normal.
85	SDO response error	1. Check if the index/sub-index in the DMC_ReadParameter / DMC_WriteParameter instructions exists. 2. Check if the data type in the DMC_WriteParameter instruction is correct and the written parameter value exceeds the allowed range. 3. Check the error codes to get the detailed information.
112	The execution of the motion instruction is not consistent with the state machine in the controller.	Refer to section 4.2 on the motion instruction switching. (Other motion instruction can be executed only when the "Execute" bit of the DMC_SetTorque instruction is Off.)
256	When rotary cut initializing has not finished, APF_RotaryCut_In is executed.	After initializing is finished, execute APF_RotaryCut_In.
257	Parameter setting error in the rotary cut instruction	Check if the parameter setting of the instruction related with the rotary cut is proper.
258	Parameter setting error in the flying shear instruction	Check if the parameter setting of the instruction related with the flying shear is proper.

Appendix A Modbus Communication

■ **DVP10MC11T Modbus Communication Port:**

DVP10MC11T covers two communication ports such as COM1 and COM2.

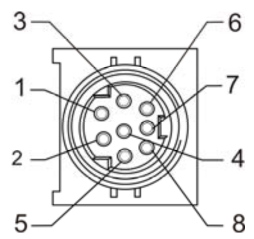
COM1: COM1 is a RS-232 communication port possessed by PLC module supporting Modbus ASCII or RTU mode. It can serve as Modbus master or slave to upload and download the program, monitor PLC device, connect the human machine interface and etc.

COM2: COM2 is a RS-485 communication port supporting Modbus ASCII or RTU mode and is the hardware port shared by motion control module and PLC. Via the port, the motion control module and PLC can be accessed respectively according to their different node addresses. So the node address of motion control module and PLC must be different when COM2 is used. When COM2 is possessed by PLC module, it could serve as Modbus master or slave. When COM2 is possessed by motion control module, it could only serve as Modbus slave.

The Pin definition of DVP10MC11T Modbus communication port:

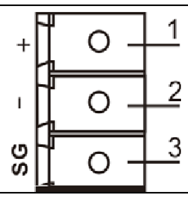
The Pin definition of DVP10MC11T RS-232（COM1）:

Pin	Signal	Description
1，2	+5V	5V Power positive pole
3	GND	Grounding
4	Rx	For receiving the data
5	Tx	For sending the data
6	GND	Grounding
7	NC	Reserved



The Pin definition of DVP10MC11T RS-485（COM2）:

Pin	Signal	Description
1	+	Signal+
2	_	Signal-
3	SG	--



■ **DVP10MC11T Modbus Communication Port Setting**

1. COM1 communication format is set by D1036 and the meaning for each bit of D1036 can be seen in table 1. its communication node adress is determined by D1121. If the value of D1121 is 1, it indicates that the communication node address of PLC module is 1. The default communication format for COM1: Baud rate=9600bps, Data bits=7, Parity=E, Stop bits=1, Mode=ASCII, Address=1

   Note:

   ✓ After COM1 communication format is modified, if RUN/STOP switch of DVP10MC11T turns RUN→STOP, the communication format keeps unchanged.

   ✓ After COM1 communication format is modified, DVP10MC11T power is switched on from off, COM1 will be restored to the communication format of factory setting

2. When COM2 is possessed by PLC, its format is set by D1120 and the meaning of each bit of D1120 can be seen in table 1. its communication node adress is set by D1121. If the value of D1121 is 1, it indicates that the communication node address of PLC module is 1. The default communication format for COM2: Baud rate=9600bps, Data bits=7, Parity=E, Stop bits=1, Mode=ASCII, Address=1

   Note:

   - ✓ When COM2 serves as Slave communication port, no communication instrument is allowed to exist in the program.
   - ✓ After COM2 communication format is modified, if RUN/STOP switch of DVP10MC11T turns RUN→STOP, the communication format keeps unchanged.
   - ✓ After COM2 communication format is modified, DVP10MC11T power is switched on from off, COM2 will be restored to the communication format of factory setting

3. When COM2 is possessed by motion control module, its format is set by D6516 of motion control module and the meaning of each bit of D6516 can be seen in table 2. If the value of D6516 is revised, the communication format will be changed immediately. The default communication format for COM2: Baud rate=9600bps, Data bits=7, Parity=E, Stop bits=1, Mode=ASCII, Address=2.

   Note:

   - ✓ After COM2 communication format is modified, RUN/STOP switch of DVP10MC11T turns RUN→STOP, the communication format keeps unchanged.
   - ✓ After COM2 communication format is modified, DVP10MC11T power is switched on from off, the communication format keeps unchanged.

Table 1

D1036 or D1120 bit no.	Explanation	Communication format setting		
b0	Data length	b0=0: 7		b0=1: 8
b2, b1	Parity bit	b2, b1=00	:	None
		b2, b1=01	:	Odd
		b2, b1=11	:	Even
b3	Stop bit	b3=0：1 bit		b3=1：2 bit
b7~b4	Baud rate	b7~b4=0001（H1）	:	110bps
		b7~b4=0010（H2）	:	150bps
		b7~b4=0011（H3）	:	300bps
		b7~b4=0100（H4）	:	600bps
		b7~b4=0101（H5）	:	1200bps
		b7~b4=0110（H6）	:	2400bps
		b7~b4=0111（H7）	:	4800bps
		b7~b4=1000（H8）	:	9600bps
		b7~b4=1001（H9）	:	19200bps
		b7~b4=1010（HA）	:	38400bps
		b7~b4=1011（HB）	:	57600bps
		b7~b4=1100（HC）	:	115200bps
b8	Selection of the start character	b8=0: none		b8=1: D1124
b9	Selection of the first end character	b9=0: none		b9=1: D1125
b10	Selection of the second end character	b10=0: none		b10=1: D1126
b15~b11	Undefined			

Explanation of relevant special M for communication at COM1 port :

Special M no.	Function	Remark
M1139	Selection of ASCII/RTU mode	M1139=On, communication mode is RTU M1139=Off, communication mode is RTU
M1138	Communication format is retained	When M1138=On, Change the value of D1036, but the communication format of COM1 is unchanged.

Explanation of relevant special M when COM2 port is possessed by motion control module:

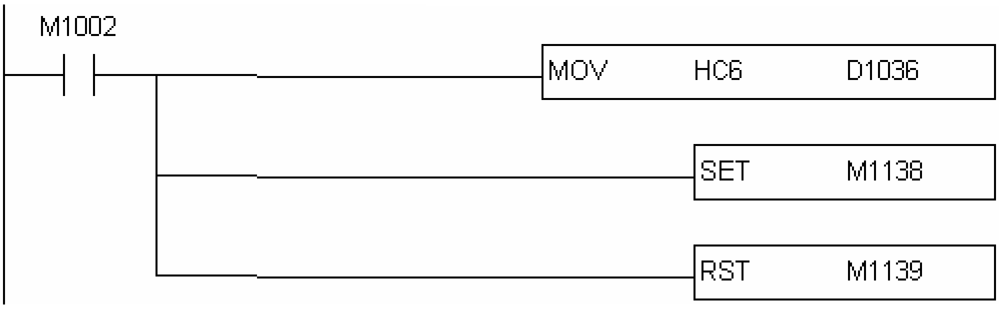
Special M no.	Function	Remark
M1143	Selection of ASCII/RTU mode	M1143=On, communication mode is RTU. M1143=Off, communication mode is ASCII.
M1120	Communication format is retained	When M1120=On, Change the value of D1120, but the communication format of COM2 is unchanged.

Table 2

D6516 bit no.	Explanation	D6516 Communication format setting	
b3~b0	Communication format	b3~b0=0000（H0）	Data bits =7, Parity =E, Stop bits =1
		b3~b0=0001（H1）	Data bits =7, Parity=O, Stop bits =1
		b3~b0=0010（H2）	Data bits =7, Parity =N, Stop bits =1
		b3~b0=0100（H4）	Data bits =8，Parity =N, Stop bits =2
b7~b4	Baud rate	b7~b4=0000（H0）	9600bps
		b7~b4=0001（H1）	19200bps
		b7~b4=0010（H2）	38400bps
		b7~b4=0011（H3）	57600bps
		b7~b4=0100（H4）	115200bps
b15~b8	Communication address	b15~b8=00000010（H2）	Communication address is 2

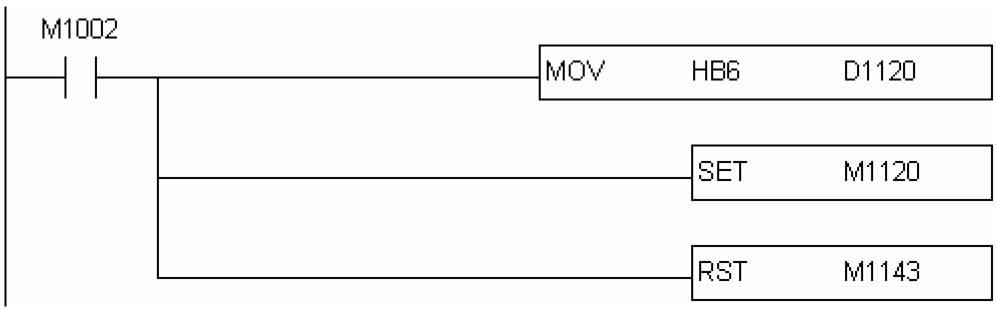
➢ Example 1: the method of revising COM1 communication format.

To revise COM1 communication format, add the following program codes to the WPLSoft software. When DVP10MC11T turns from STOP to RUN, PLC would detect if M1138 is on in the first scan cycle. If M1138 is on, the setting of COM1 will be revised according to D1036 value. In the following graph, COM1 communication format is revised into ASCII mode, 115200bps（Baud rate）, 7（Data bits）, E（Parity）, 1 （Stop bits）.



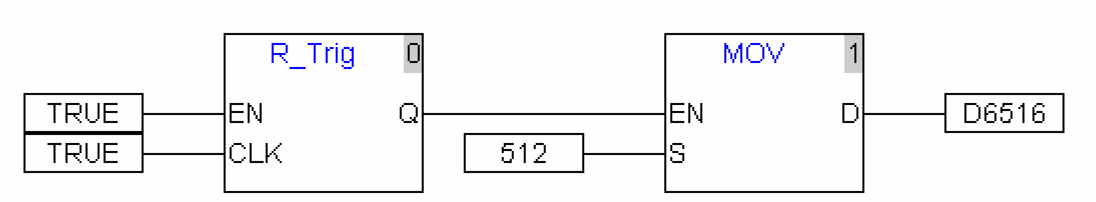
➢ Example 2: the method of revising COM2 communication format (COM2 is possessed by PLC）.

To revise COM2 communication format, add following program codes to WPLSoft software. When DVP10MC11T turns from STOP to RUN, PLC would detect if M1120 is on in the first scan cycle. If M1120 is on, the setting of COM2 will be revised according to D1120 value. In the following graph, COM2 communication format is revised into ASCII mode, 57600bps（Baud rate）, 7（Data bits）, E（Parity）, 1（Stop bits）.



➢ Example 3: the method of revising COM2 communication format (COM2 is possessed by motion control module）.

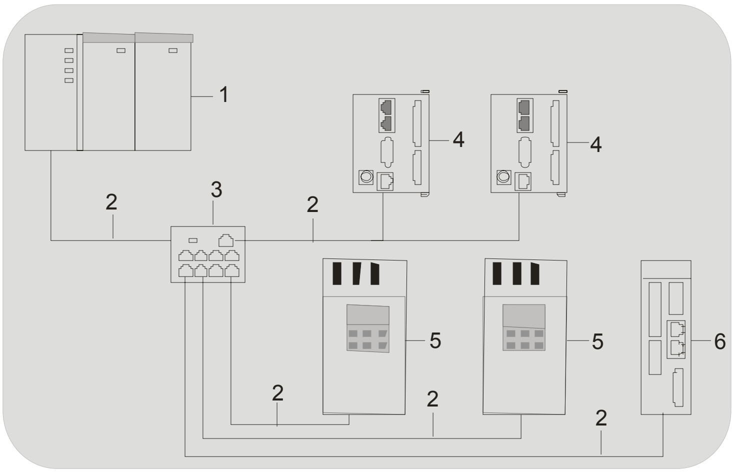
To revise COM2 communication format, add the following program codes to CANopen Builder software. As below figure shows, a rising edge occurs in the program and K512 (H200) is sent to D6516. Meanwhile, COM2 communication format is revised into ASCII mode, 9600bps（Baud rate）, 7（Data bits）, E（Parity）, 1 (Stop bits).



Note: For Modbus communication of DVP10MC11T PLC, please refer to < DVP-ES2/EX2/SS2/SA2/SX2 operating manual【Program】>.

■ **Example on Connection of DVP10MC11T into Modbus Network:**

DVP10MC11T is connected to Modbus network via RS-485 as figure below:



Device no.	1	2	3	4	5	6
Device name	Modbus master	Communication cable	VFD-CM08	DVP10MC11T	AC motor drive	Servo drive

■ **RS-485 Wiring:**

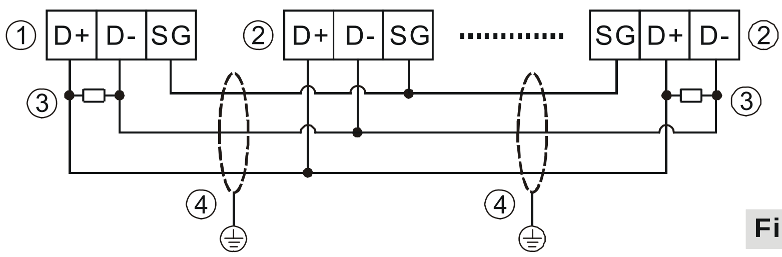


Figure 19

①	②	③	④
Master	Slave	Terminal resistor	Shielded cable

Note:

1. It is suggested that the two ends of the bus should be connected with one resistor of the value: 120Ω respectively.
2. To ensure the communication quality , the double shielded and twisted-pair cable is recommended （20AWG）.
3. When the internal voltages of two devices are different, make SG（Signal Ground）of the two device connected with each other to balance their SG voltages and make the communication more stable.

■ **ASCII Mode**

1. Communication data structure

Field name	Components	Explanation
Start character	STX	Start character :":", the corresponding ASCII code: 0x3A
Communication address	ADR 1	Communication address consists of two ASCII codes.
	ADR 0	
Function code	CMD 1	Function code consists of two ASCII codes.
	CMD 0	
Data	DATA （0）	Data content consists of 2n ASCII codes, n≤205.
	DATA （1）	
	……….	
	DATA （n-1）	
LRC Check	LRC CHK 1	LRC check consists of two ASCII codes.
	LRC CHK 0	
End character	END1	End character consists of two ASCII codes. END1 = CR （0x0D）， END0 = LF （0x0A）
	END0	

The corresponding relation between hexadecimal character and ASCII code:

Hexadecimal character	"0"	"1"	"2"	"3"	"4"	"5"	"6"	"7"
ASCII code	0x30	0x31	0x32	0x33	0x34	0x35	0x36	0x37
Hexadecimal character	"8"	"9"	"A"	"B"	"C"	"D"	"E"	"F"
ASCII code	0x38	0x39	0x41	0x42	0x43	0x44	0x45	0x46

2. ADR (Communication address)

The valid range of communication address:0～254.

Communication address: 0 means the broadcast message is sent to all slaves and the slaves which have received the message will not make any response. If communication address is not 0, slaves will respond to master after receiving the message normally. For instance, ASCII codes for the communication address of 16 are denoted below.

Decimal 16 is equal to hexadecimal 10. （ADR 1, ADR 0）='10'， '1'=31H, '0' = 30H

3. Function code and data

The data format is determined by function codes. E.g. to read the two continuous address data with hexadecimal 0x1000 as the start address in DVP10MC11T. The communication address of DVP10MC11T is 1, 0x1000 is the Modbus address of D0 in DVP10MC11T PLC.

The data explanation is shown as below:

PC→DVP10MC11T：

3A 30 31 30 33 31 30 30 30 30 30 30 32 45 41 0D 0A

DVP10MC11T→PC：

3A 30 31 30 33 30 34 30 30 30 31 30 30 30 32 46 35 0D 0A

Request message:

Field name	Field character	ASCII code corresponding to field character
Start character	":"	3A
Communication address: 01	"0"	30
	"1"	31
Function code: 03	"0"	30
	"3"	33
Start address: 0x1000	"1"	31
	"0"	30
	"0"	30
	"0"	30
Data number （Counted by words）: 2	"0"	30
	"0"	30
	"0"	30
	"2"	32
LRC check code: 0xEA	"E"	45
	"A"	41
End character 1	"CR"	0D
End character 0	"LF"	0A

Response message:

Field name	Field character	ASCII code corresponding to field character
Start character	“：”	3A
Communication address: 01	“0”	30
	“1”	31
Function code: 03	“0”	30
	“3”	33
Read data number （Counted by bytes）	“0”	30
	“4”	34
Read content of 0x1000 address	“0”	30
	“0”	30
	“0”	30
	“1”	31
Read content of 0x1001 address	“0”	30
	“0”	30
	“0”	30
	“2”	32
LRC check code: 0xF5	“F”	46
	“5”	35
End character 1	“CR”	0D
End character 0	“LF”	0A

4. LRC check（Check sum）

LRC check code is the value by firstly getting the inverse values of every bit of the result value of addition operation of the data from communication ID to the last data content (Hex.) and then adding 1 to the final inverse value.

For instance, LRC check code value: 0xF6. The method of calculating LRC check code value: 0x01+0x03+0x10+0x00+0x00+0x02 = 0x16, the result is 0xEA by getting the inverse values of every bit of 0x16 and then adding 1 to the final inverse value.

Field name	Field character	ASCII code corresponding to field character
Start character	“:”	3A
Communication address: 01	“0”	30
	“1”	31
Function code: 03	“0”	30
	“3”	33
Start data address: 0x1000	“1”	30
	“0”	30
	“0”	30
	“0”	30

Field name	Field character	ASCII code corresponding to field character
Data number (Counted by words): 2	“0”	30
	“0”	30
	“0”	30
	“2”	32
LRC check code: 0xEA	“E”	45
	“A”	41
End character 1: LF	CR	0D
End character 0: CR	LF	0A

■ **Communication in RTU mode**

1. Communication data structure

Start	No input data for more than 10ms
Communication address	Slave address: 8-bit binary address
Function code	Function code: 8-bit binary address
Data（n-1）	Data content n × 8 bit binary data, n<=202
…….	
Data 0	
Low byte of CRC check	CRC check sum CRC check sum is composed of two 8-bit binary data
High byte of CRC check	
End	No input data for more than 10ms

2. Communication address

The valid communication address is 0～254. The communication address 0 indicates to broadcast the message to all slaves and the slaves which have received the broadcast message do not make any response. If the communication address is not 0, slaves will reply to master as normal. For example, to communication with the slave with the communication address of 16, the address of the slave is set as 0x10 since decimal 16 is equal to hexadecimal 10.

3. Function code and data

The data format is determined by function codes. For example, to read the data of two continuous addresses with 0x1000 as start address in DVP10MC11T, the address of DVP10MC11T is 1, 0x1000 is the Modbus address of D0 in DVP10MC11T PLC.

The data in the communication cable and the explanation on them are shown below:

PC→DVP10MC11T: “01 03 10 00 00 02 C0 CB”

DVP10MC11T→PC: “01 03 04 01 00 02 00 FA AF”

Request message:

Field name	Character
Start	No input data for more than 10ms
Communication address	01
Function code	03
High byte of Modbus address	10
Low byte of Modbus address	00
Read high byte of data number	00
Read low byte of data number	02
Low byte of CRC check sum	C0
High byte of CRC check sum	CB
End	No input data for more than 10ms

Response message:

Field name	Character
Start	No input data for more than 10ms
Communication address	01
Function code	03
Read data number（Counted by bytes）	04
Read high byte of data content	01
Read low byte of data content	00
Read high byte of data content	02
Read low byte of data content	00
Low byte of CRC check sum	FA
High byte of CRC check sum	AF
End	No input data for more than 10ms

4. CRC check （check sum）

CRC check starts from “Communication address” to the last “Data content”. The calculation method is shown below.

Step 1: Download a 16-bit hex register (CRC register) with the content value FFFF.

Step 2: Make the XOR operation between the 8-bit data of the first byte in the command and the 8-bit data of the low byte in CRC register and then store the operation result in CRC register.

Step 3: Move the content value of CRC register by one bit towards the right and fill 0 in the highest bit.

Step 4: Check the value of the lowest bit in CRC register. If the value is 0, repeat the action of step 3; if 1, make XOR operation between the content in CRC register and hex. A001 and then store the result in CRC register.

Step 5: Repeat step 3 and step 4 till the content in CRC register is moved by 8 bits towards the right. At this moment, the first byte of the command message is finished processing.

Step 6: Repeat the action of step 2 and step 5 for the next byte in the command message till all bytes are finished processing. The last content in CRC register is CRC check value. When CRC check value in command message is transmitted, the high and low byte in calculated CRC check value must exchange with each other, i.e. the low byte is transmitted first.

Example on calculation of CRC check value with C language

```
Unsigned char* data      ← // Pointer of command message content
Unsigned char length    ← // Length of command message content
unsigned int crc_chk（unsigned char* data, unsigned char length）
{
int j;
unsigned int reg_crc=0Xffff;
while（length--）
{
reg_crc ^= *data++;
for （j=0;j<8;j++）
{
If （reg_crc & 0x01） reg_crc=（reg_crc>>1） ^ 0Xa001; /* LSB（b0）=1 */
else reg_crc=reg_crc >>1;
}
}
return reg_crc;     // the value that sent back to the CRC register finally
}
```

■ Device Address in DVP10MC11T

Device no. and the corresponding device address of motion control module in DVP10MC11T

Device name	Device no.	Explanation	Address（hex）	Attribute
I	0~7	Bit device register	0400~0407	Read only
Q	0~3		0500~0503	Read/write
M	0~1535		0800~0DFF	Read/write
M	1536~4095		B000~B9FF	Read/write
D	0~4095	Word device register for common purpose	1000~1FFF	Read/write
D	4096~5999		9000~976F	Read/write
D	7000~24575		9B58~DFFF	Read/write
D	6000~6226	Word device register for special purpose	9770~9852	Read/write
D	6250~6476		986A~994C	Read only
D	6500~6508		9964~996C	Read only
D	6509		996D	Read/write
D	6511~6514		996F~9972	Read only
D	6515~6516		9973~9974	Read/write
D	6517~6518		9975~9976	Read only
D	24576~24628	Axis parameter register	E000~E034	Read only
D	24832~24884		E100~E134	Read only
D	25088~25140		E200~E234	Read only
D	25344~25396		E300~E334	Read only
D	25600~25652		E400~E434	Read only
D	25856~25908		E500~E534	Read only
D	26112~26164		E600~E634	Read only
D	26368~264415		E700~E734	Read only
D	26624~26676		E800~E834	Read only
D	26880~26932		E900~E934	Read only
D	27136~27188		EA00~EA34	Read only
D	27392~27444		EB00~EB34	Read only
D	27648~27700		EC00~EC34	Read only
D	27904~27956		ED00~ED34	Read only
D	28160~28212		EE00~EE34	Read only
D	28416~28468		EF00~EF34	Read only
D	28672~45055	Cam key point register	2000~5FFF	Read only

Device no. and the corresponding device address of PLC module in DVP10MC11T

Device name	Device no.	Type	Address（hex）
S	000~255	bit	0000~00FF
S	256~511	bit	0100~01FF
S	512~767	bit	0200~02FF
S	768~1023	bit	0300~03FF
X	000~377 （Octal）	bit	0400~04FF
Y	000~377 （Octal）	bit	0500~05FF
T	000~255	bit	0600~06FF
C	000~199	bit	0E00~0EC7
C	200~255	bit	0EC8~0EFF
M	000~255	bit	0800~08FF
M	256~511	bit	0900~09FF
M	512~767	bit	0A00~0AFF
M	768~1023	bit	0B00~0BFF
M	1024~1279	bit	0C00~0CFF
M	1280~1535	bit	0D00~0DFF
M	1536~1791	bit	B000~B0FF
M	1792~2047	bit	B100~B1FF
M	2048~2303	bit	B200~B2FF
M	2304~2559	bit	B300~B3FF
M	2560~2815	bit	B400~B4FF
M	2816~3071	bit	B500~B5FF
M	3072~3327	bit	B600~B6FF
M	3328~3583	bit	B700~B7FF
M	3584~3839	bit	B800~B8FF
M	3840~4095	bit	B900~B9FF
T	000~255	Word	0600~06FF
C	000~199	Word	0E00~0EC7
C	200~255	double Word	0700~076F
D	000~255	Word	1000~10FF
D	256~511	Word	1100~11FF
D	512~767	Word	1200~12FF
D	768~1023	Word	1300~13FF
D	1024~1279	Word	1400~14FF

Device name	Device no.	Type	Address（hex）
D	1280~1535	Word	1500~15FF
D	1536~1791	Word	1600~16FF
D	1792~2047	Word	1700~17FF
D	2048~2303	Word	1800~18FF
D	2304~2559	Word	1900~19FF
D	2560~2815	Word	1A00~1AFF
D	2816~3071	Word	1B00~1BFF
D	3072~3327	Word	1C00~1CFF
D	3328~3583	Word	1D00~1DFF
D	3584~3839	Word	1E00~1EFF
D	3840~4095	Word	1F00~1FFF
D	4096~4351	Word	9000~90FF
D	4352~4607	Word	9100~91FF
D	4608~4863	Word	9200~92FF
D	4864~5119	Word	9300~93FF
D	5120~5375	Word	9400~94FF
D	5376~5631	Word	9500~95FF
D	5632~5887	Word	9600~96FF
D	5888~6143	Word	9700~97FF
D	6144~6399	Word	9800~98FF
D	6400~6655	Word	9900~99FF
D	6656~6911	Word	9A00~9AFF
D	6912~7167	Word	9B00~9BFF
D	7168~7423	Word	9C00~9CFF
D	7424~7679	Word	9D00~9DFF
D	7680~7935	Word	9E00~9EFF
D	7936~8191	Word	9F00~9FFF
D	8192~8447	Word	A000~A0FF
D	8448~8703	Word	A100~A1FF
D	8704~8959	Word	A200~A2FF
D	8960~9215	Word	A300~A3FF
D	9216~9471	Word	A400~A4FF
D	9472~9727	Word	A500~A5FF
D	9728~9983	Word	A600~A6FF

Device name	Device no.	Type	Address（hex）
D	9984~9999	Word	A700~A70F

■ Modbus Function code

The function code and abnormality response code when COM2 port is possessed by motion control module are listed in the following table.

Function code	Explanation	Available device
0x02	Read bit-device register value; the data of 256 bits at most can be read one time.	M,I,Q
0x03	Read one single or multi word register value; the data of 64 words at most can be read one time.	D
0x05	Write one single bit-device register value.	M ,Q
0x06	Write one single word-device register value.	D
0x0F	Write multi bit-device register value; the data of 256 bits at most can be written one time.	M,Q
0x10	Write multi word-device register value; the data of 64 words at most can be written one time.	D

Abnormality response code	Explanation
0x01	Unsupportive function code
0x02	Unsupportive Modbus address
0x03	The data length is out of the valid range.

The function code and abnormality response code when COM1 and COM2 ports are possessed by PLC module in DVP10MC11T are listed in the following table.

Function code	Explanation	Available device
0x01	Read bit-device register value excluding the input point state	S, Y, M, T, C
0x02	Read the bit-device register value including the input point state	S, X, Y, M,T, C
0x03	Read one single or multi word device register value	T, C, D
0x05	Write one single bit-device register value	S, Y, M, T, C
0x06	Write one single word-device register value	T, C, D
0x0F	Write multi bit-device register value	S, Y, M, T, C
0x10	Write multi word-device register value	T, C, D

Abnormality response code	Explanation
0x01	Illegal command code: command code in the command message PLC receives is invalid.
0x02	Illegal device address: the address in the command message PLC receives is invalid.
0x03	Illegal device value: the data content in the command message PLC receives is invalid.
0x07	1. Check sum error 1.1 Check if the checksum value is correct 2. Illegal command message 2.1 Command message is too short 2.2 Command message exceed the range

Function code: 03 to read one single or multi word-device register value

Data structure of request message:

Data order	Name	Byte
Byte0	Modbus ID	Single byte
Byte1	Function code	Single byte
Byte2	Read the start address of the word devices in DVP10MC11T	High byte
Byte3		Low byte
Byte4	Read the address number of the word devices in DVP10MC11T （Counted by Words）	High byte
Byte5		Low byte
Byte6	Low byte of CRC check sum	Low byte
Byte7	High byte of CRC check sum	High byte

Data structure of response message:

Data order	Name	Byte
Byte0	Modbus ID	Single byte
Byte1	Function code	Single byte
Byte2	Read the address number of the word devices in DVP10MC11T （Counted by Bytes）	Single byte
Byte3	The address content of the word devices in DVP10MC11T	High byte
Byte4		Low byte
…	The address content of the word devices in DVP10MC11T	High byte
…		Low byte
Byte n	The address content of the word devices in DVP10MC11T	High byte
Byte n+1		Low byte

Data order	Name	Byte
Byte n+2	Low byte of CRC check sum	Low byte
Byte n+3	High byte of CRC check sum	High byte

Data structure of abnormality response message:

Data order	Name	Byte
Byte0	Modbus ID	Single byte
Byte1	0x80+ function code	Single byte
Byte2	abnormality response code	Single byte
Byte3	Low byte of CRC check sum	Low byte
Byte4	High byte of CRC check sum	High byte

Note: The byte number in response message is determined by the DVP10MC11T device address number to be read in the request message. Thus n of "Byte n" in response message can be calculated through reading DVP10MC11T device address number.

- **Example:** To read the address content of 0x1000, 0x1001 in DVP10MC11T via function code 03.

  0x1000, 0x1001 are the Modbus address of D0 and D1 in DVP10MC11T respectively.

  Suppose the value of D0 is 0x0100; D1 is 0x020

  Request message: " 01 03 10 00 00 02 C0 CB"

  Response message: "01 03 04 01 00 02 00 FA AF"

Function code: 06 to write single word-device register value

Data structure of request message:

Data order	Name	Byte
Byte0	Modbus ID	Single byte
Byte1	Function code	Single byte
Byte2	DVP10MC11T device address where to write the value	High byte
Byte3		Low byte
Byte4	The written value	High byte
Byte5		Low byte
Byte6	Low byte of CRC check sum	Low byte
Byte7	High byte of CRC check sum	High byte

Data structure of response message:

Data order	Name	Byte
Byte0	Modbus ID	Single byte
Byte1	Function code	Single byte
Byte2	DVP10MC11T word device address where to write the value	High byte
Byte3		Low byte

Data order	Name	Byte
Byte4	The written value	High byte
Byte5		Low byte
Byte6	Low byte of CRC check sum	Low byte
Byte7	High byte of CRC check sum	High byte

Data structure of abnormality response message:

Data order	Name	Byte
Byte0	Modbus ID	Single byte
Byte1	0x80+ function code	Single byte
Byte2	Abnormality response code	Single byte
Byte3	Low byte of CRC check sum	Low byte
Byte4	High byte of CRC check sum	High byte

- **Example:** Write 0x0100 to 0x1000 address in DVP10MC11T via function code 06.。

  Request message: " 01 06 10 00 01 00 8C 9A".

  Response message: " 01 06 10 00 01 00 8C 9A".

Function code: 0x10 to write multi word-device register value

Data structure of request message:

Data order	Name	Byte
Byte0	Modbus ID	Single byte
Byte1	Function code	Single byte
Byte2	The start address of DVP10MC11T word device where to write the value.	High byte
Byte3		Low byte
Byte4	The address number of DVP10MC11T word device where to write the value.（Counted by words）	High byte
Byte5		Low byte
Byte6	The address number of DVP10MC11T word device where to write the value. （Counted by bytes）	Single byte
Byte7	The address value written into DVP10MC11T word device.	High byte
Byte8		Low byte
…	The address value written into DVP10MC11T word device.	High byte
…		Low byte
Byte n	The address value written into DVP10MC11T word device.	High byte
Byte n+1		Low byte

Data order	Name	Byte
Byte n+2	Low byte of CRC check sum	Low byte
Byte n+3	High byte of CRC check sum	High byte

Data structure of response message:

Data order	Name	Byte
Byte0	Modbus ID	Single byte
Byte1	Function code	Single byte
Byte2	The start address of DVP10MC11T word device where to write the value.	High byte
Byte3		Low byte
Byte4	The address number of DVP10MC11T word device where to write the value. （Counted by Words）	High byte
Byte5		Low byte
Byte6	Low byte of CRC check sum	Low byte
Byte7	High byte of CRC check sum	High byte

Data structure of abnormality response message:

Data order	Name	Byte
Byte0	Modbus ID	Single byte
Byte1	0x80+ function code	Single byte
Byte2	Abnormality response code	Single byte
Byte3	Low byte of CRC check sum	Low byte
Byte4	High byte of CRC check sum	High byte

Note:How many bytes of data in request message are determined by the number of word-device address where to write the value in the response message. Thus n of “Byte n” in request message can be calculated through the number of device address where to write the value.

- **Example:** Write 0x0100 and 0x0200 to 0x1000 and 0x1001 address in DVP10MC11T respectively via function code 0x10. 0x1000 and 0x1001 are Modbus address of D0 and D1 in DVP10MC11T.

  Request message: “ 01 10 10 00 00 02 04 01 00 02 00 3E F3”

  Response message: “01 10 10 00 00 02 45 08”.

Function code: 0x02 to read bit-device register value

The data structure of function code of 0x01 is the same as that of 0x02. So 0x01will not be introduced additionally. When COM2 is possessed by PLC in DVP10MC11T, the input point status can not be read via 0x01 function code.

Data structure of request message:

Data order	Name	Byte
Byte0	Modbus ID	Single byte
Byte1	Function code	Single byte
Byte2	The start address of DVP10MC11T bit device to be read.	High byte
Byte3		Low byte
Byte4	The number of DVP10MC11T bit device to be read.	High byte
Byte5		Low byte
Byte6	Low byte of CRC check sum	Low byte
Byte7	High byte of CRC check sum	High byte

Data structure of response message:

Data order	Name	Byte
Byte0	Modbus ID	Single byte
Byte1	Function code	Single byte
Byte2	Read byte number of bit device.	Single byte
Byte3	Read state value of bit device.	Single byte
…	Read state value of bit device.	Single byte
Byte n	Read state value of bit device.	Single byte
Byte n+1	Low byte of CRC check sum	Low byte
Byte n+2	High byte of CRC check sum	High byte

Data structure of abnormality response message:

Data order	Name	Byte
Byte0	Modbus ID	Single byte
Byte1	0x80+ function code	Single byte
Byte2	Abnormality response message	Single byte
Byte3	Low byte of CRC check sum	Low byte
Byte4	High byte of CRC check sum	High byte

Note:

The value of Byte 2 in response message is determined by Byte 4 and Byte 5. For example, the number of the read bit device in request message is A. Dividing A by 8 produces B. If the quotient is an integer, the byte number in response message is B; if the quotient is not an integer, the byte number will be the integer part of the quotient plus 1.

➢ **Example:** Read the state value of M0~M19 in DVP10MC11T via function code 02. M0 address is 0x0800.

Suppose M0~M7=1000 0001, M8~M15=0001 1000, M16~M19=0110.

Request message: “01 02 08 00 00 14 7A 65”

Response message: “01 02 03 81 18 06 A2 64”

Function code: 0x05 to set one single bit-device register value

Data structure of request message:

Data order	Name	Byte
Byte0	Modbus ID	Single byte
Byte1	Function code	Single byte
Byte2	Modbus address of bit device	High byte
Byte3		Low byte
Byte4	The written value of bit device	High byte
Byte5		Low byte
Byte6	Low byte of CRC check sum	Low byte
Byte7	High byte of CRC check sum	High byte

Data structure of response message:

Data order	Name	Byte
Byte0	Modbus ID	Single byte
Byte1	Function code	Single byte
Byte2	Modbus address of bit device	High byte
Byte3		Low byte
Byte4	The written value of bit device	High byte
Byte5		Low byte
Byte6	Low byte of CRC check sum	Low byte
Byte7	High byte of CRC check sum	High byte

Data structure of abnormality response message:

Data order	Name	Byte
Byte0	Modbus ID	Single byte
Byte1	0x80+ function code	Single byte
Byte2	Abnormality response code	Single byte
Byte3	Low byte of CRC check sum	Low byte
Byte4	High byte of CRC check sum	High byte

Note: The written value 0x0000 in the bit device in request or response message means that the value written in the bit device is 0. 0xFF00 means that the value written in the bit device is 1.

➢ **Example:** The value of M0 in DVP10MC11T is set as 1 via function code 05; M0 address is 0x0800.

Request message: “01 05 08 00 FF 00 8E 5A”

Response message: “01 05 08 00 FF 00 8E 5A”

Function code: 0x0F, write multi bit-device register values

Data structure of request message:

Data order	Name	Byte
Byte0	Modbus ID	Single byte
Byte1	Function code	Single byte
Byte2	The start address of DVP10MC11T bit device where to read state.	High byte
Byte3		Low byte
Byte4	The number of DVP10MC11T bit device where to write value.	High byte
Byte5		Low byte
Byte7	The value written in DVP10MC11T bit device	Single byte
…	The value written in DVP10MC11T bit device	Single byte
Byte n	The value written in DVP10MC11T bit device	Single byte
Byte n+1	Low byte of CRC check sum	Low byte
Byte n+2	High byte of CRC check sum	High byte

Data structure of response message:

Data order	Name	Byte
Byte0	Modbus ID	Single byte
Byte1	Function code	Single byte
Byte2	The start address of DVP10MC11T bit device where to write the value	High byte
Byte3		Low byte
Byte4	The number of DVP10MC11T bit devices where to write the value	High byte
Byte5		Low byte
Byte6	Low byte of CRC check sum	Low byte
Byte7	High byte of CRC check sum	High byte

Data structure of abnormality response message:

Data order	Name	Byte
Byte0	Modbus ID	Single byte
Byte1	0x80+ function code	Single byte
Byte2	Abnormality response code	High byte
Byte3	Low byte of CRC check sum	Low byte
Byte4	High byte of CRC check sum	High byte

Note: How many bytes of data in request message are determined by the number of bit device where to write the value in the response message.

- Set DVP10MC11T M0~M7=1000 0001, M8~M15=0001 1000, M16~M19=0110 via function code 0F; M0 address: 0x0800

  Request message: “01 0F 08 00 00 14 03 81 18 06 8B F9”

  Response message: “01 0F 08 00 00 14 57 A4”

■ The Indication of Modbus Communication Port LED

COM1 LED is RS-232 communication port indicator used by PLC module to show RS-232 communication state.

LED state	Indication
Yellow light flash	There are response data at RS-232（COM1）port.
Off	There are no response data at RS-232（COM1）port.

COM2 LED is RS-485 communication port indicator commonly used by motion control module and PLC module to show RS-485 communication state.

RUN state	Indication
Yellow light flash	There are response data at RS-485（COM2）port
Off	There are no response data at RS-485（COM2）port

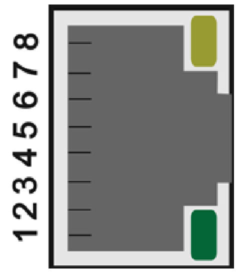
Appendix B Ethernet Communication

■ Ethernet Communication Port in DVP10MC11T:

DVP10MC11T provides an Ethernet port possessed by motion control module supporting Modbus TCP protocol. CANopen Builder software could be used to download CANopen motion control network configuration, motion program, G codes and monitor devices via this port. DVP10MC11T can only serve as slave in Ethernet network and also accept the access from 4 masters. Besides, this port supports auto jumper function as well. When connected to computer or switchboard, DVP10MC11T does not need to be handled in jumper specially. LED of Ethernet port is used to indicate the current connection state of Ethernet so that user could check conveniently.

Pin Definition and LED Indicator Instruction

Pin Definition of Ethernet Communication Port in DVP10MC11T:

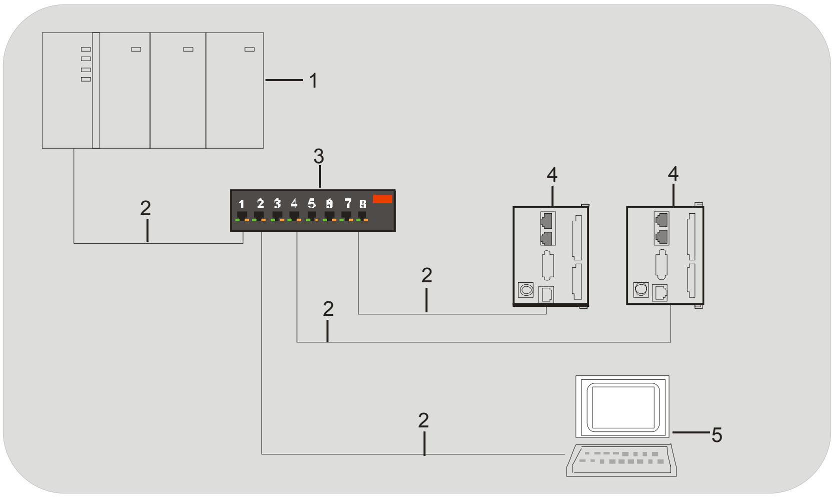
Terminal No.	Definition	Explanation	RJ -45 figure
1	Tx+	Positive pole for transmitting data	
2	Tx-	Negative pole for transmitting data	
3	Rx+	Positive pole for receiving data	
4	--	N/C	
5	--	N/C	
6	Rx-	Negative pole for receiving data	
7	--	N/C	
8	--	N/C	

LED Indicator of Ethernet Communication Port in DVP10MC11T

DVP10MC11T possesses two Ethernet LED indicators like orange light and green light. Green light is to indicate the communication state of Ethernet network; orange light is to indicate communication rate of Ethernet network.

LED indicator	State	Indication
Orange light	On	The communication rate of Ethernet: 100Mbps。
	Off	The communication rate of Ethernet is 10Mbps or DVP10MC11TT is not connected to Ethernet.
Green light	Green light flash	The Ethernet port of DVP10MC11T is sending or receiving data.
	Off	The Ethernet port of DVP10MC11T is not sending or receiving data.

Figure of Ethernet connected with DVP10MC11T



Device no. and the corresponding device name in above figure are listed below.

Device no.	1	2	3	4	5
Device name	Ethernet master	Ethernet communication cable	Concentrator	DVP10MC11T	Computer

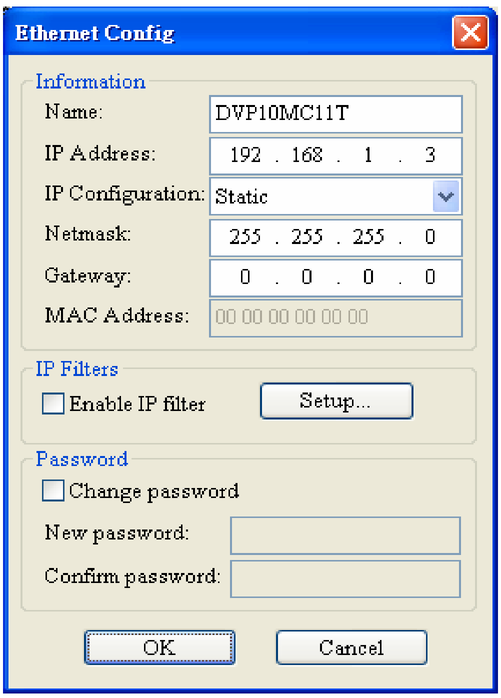
Note:

Please use the shielded twisted pair as Ethernet communication cable.

The master of Ethernet network containing DVP10MC11T can be Delta Ethernet equipment such as DVPEN01-SL, IFD9506, IFD9507 and touch panel with Ethernet port. The equipment supplied from other vendors supporting Modbus TCP protocol as well as master function can also serve as master of DVP10MC11T.

■ **Communication Setting of Ethernet connected with DVP10MC11T (Software setting）**

The dialog box for setting Ethernet parameters in CANopen Builder software is shown as below.



Explanation of Ethernet parameters setting:

name	Equipment name which users could name by themselves.
IP Address	The IP address of DVP10MC11T
IP Configuration	There are Static and DHCP selections for DVP10MC11T Ethernet. If DHCP (dynamic) is selected, the Ethernet parameters are obtained by DVP10MC11T itself; if Static is selected, the parameters will be set by user.
Netmask	Subnet mask of DVP10MC11T
Getway	Gateway address of DVP10MC11T

■ **Modbus TCP Communication:**

1. Modbus TCP message structure:

Data order	Name		Explanation
Byte0	Transaction identifier	High byte	0
Byte1		Low byte	
Byte2	Protocol identifier	High byte	0
Byte3		Low byte	
Byte4	Modbus data length	High byte	The number of bytes for Modbus address and the data after it
Byte5		Low byte	
Byte6	Modbus ID	Single byte	0～0xFF
Byte7	Function code	Single byte	
Byte8	Device address in DVP10MC11T	High byte	0~0xFFFF
Byte9		Low byte	
Byte10	Modbus data	High byte	The byte number of Modbus data is determined by function code.
Byte11		Low byte	

2. Modbus function code DVP10MC11T supports:

Function code	Function	Device
0x02	Read bit-device register value; maximum 256 bits of data could be read once.	M,I,Q
0x03	Read one single or multi word-device register value; maximum 64 words of data could be read once.	D
0x05	Write one single bit-device register value.	M ,Q
0x06	Write one single word-device register value	D
0x0F	Write multi bit-device register value; maximum 256 bits of data could be written once.	M,Q
0x10	Write multi word-device register value; maximum 64 words of data could be written.	D

3. Modbus abnormality response code DVP10MC11T supports:

Abnormality response code	Indication
0x01	Unsupportive function code
0x02	Unsupportive Modbus address
0x03	Data length exceeds the range

4. Modbus Function Code:

Function code: 03 to read one single or multi word-device register value

Request message data structure:

Data order	Name	Byte
Byte0	Transaction identifier	High byte
Byte1		Low byte
Byte2	Protocol identifier	High byte
Byte3		Low byte
Byte4	Modbus data length	High byte
Byte5		Low byte
Byte6	Modbus ID	Low byte
Byte7	Function code	Single byte
Byte8	Read the start address of the word device in DVP10MC11T	High byte
Byte9		Low byte
Byte10	Read the device address number in DVP10MC11T （Counted by Words）	High byte
Byte11		Low byte

Response message data structure:

Data order	Name	Byte
Byte0	Transaction identifier	High byte
Byte1		Low byte
Byte2	Protocol identifier	High byte
Byte3		Low byte
Byte4	Modbus data length	High byte
Byte5		Low byte
Byte6	Modbus ID	Single byte
Byte7	Function code	Single byte
Byte8	The data length of the read word device content value in DVP10MC11T （Counted by Bytes）	Single byte

Data order	Name	Byte
Byte9	Device address content in DVP10MC11T	High byte
Byte10		Low byte
…	Device address content in DVP10MC11T	High byte
Byte n		Low byte

Abnormality response message data structure:

Data order	Name	Byte
Byte0	Transaction identifier	High byte
Byte1		Low byte
Byte2	Protocol identifier	High byte
Byte3		Low byte
Byte4	Modbus data length	High byte
Byte5		Low byte
Byte6	Modbus ID	Single byte
Byte7	0x80+ function code	Single byte
Byte8	Abnormality response code	Single byte

Note: How many bytes of data in response message depend on the read device address number in DVP10MC11T in request message. So n value in Byte n in response message can be calculated through reading device address number in DVP10MC11T.

- Example: To read the content of 0x1000 and 0x1001 address in DVP10MC11T

  0x1000 and 0x1001 are the Modbus address of D0 and D1 in DVP10MC11T respectively. Suppose D0 value is 0x0100 and D1 is 0x0200.

  Request message: “ 00 00 00 00 00 06 01 03 10 00 00 02”

  Response message: “00 00 00 00 00 07 01 03 04 01 00 02 00”

Function code: 06 to write one single word-device register value

Request message data structure:

Data order	Name	Byte
Byte0	Transaction identifier	High byte
Byte1		Low byte
Byte2	Protocol identifier	High byte
Byte3		Low byte
Byte4	Modbus data length	High byte
Byte5		Low byte
Byte6	Modbus ID	Single byte
Byte7	Function code	Single byte
Byte8	The word device address where to write value in DVP10MC11T	High byte
Byte9		Low byte
Byte10	The value written in word devices in DVP10MC11T	High byte
Byte11		Low byte

Response message data structure:

Data order	Name	Byte
Byte0	Transaction identifier	High byte
Byte1		Low byte
Byte2	Protocol identifier	High byte
Byte3		Low byte
Byte4	Modbus data length	High byte
Byte5		Low byte
Byte6	Modbus ID	Single byte
Byte7	Function code	Single byte
Byte8	The word device address where to write value in DVP10MC11T	High byte
Byte9		Low byte
Byte10	The value written in word devices in DVP10MC11T	High byte
Byte11		Low byte

Abnormality response message data structure:

Data order	Name	Byte
Byte0	Transaction identifier	High byte
Byte1		Low byte

Data order	Name	Byte
Byte2	Protocol identifier	High byte
Byte3		Low byte
Byte4	Modbus data length	High byte
Byte5		Low byte
Byte6	Modbus ID	Single byte
Byte7	0x80+ function code	Single byte
Byte8	Abnormality response code	Single byte

➢ Example: To write value 0x0100 to 0x1000 address in DVP10MC11T via function code 06

Request message: “ 00 00 00 00 00 06 01 06 10 00 01 00”.

Response message: “ 00 00 00 00 00 06 01 06 10 00 01 00”.

Function code: 0x10 to write multiple word-device register values

Request message data structure:

Data order	Name	Byte
Byte0	Transaction identifier	High byte
Byte1		Low byte
Byte2	Protocol identifier	High byte
Byte3		Low byte
Byte4	Modbus data length	High byte
Byte5		Low byte
Byte6	Modbus ID	Single byte
Byte7	Function code	Single byte
Byte8	The start address of word devices where to write values in DVP10MC11T	High byte
Byte9		Low byte
Byte10	The address number of word devices where to write values. （Counted by Words）	High byte
Byte11		Low byte
Byte12	The address number of word devices where to write values. （Counted by Bytes）	Single byte
Byte13	The address value written in word devices in DVP10MC11T	High byte
Byte14		Low byte
…	The address value written in word devices in DVP10MC11T	High byte
Byte n		Low byte

Response message data structure:

Data order	Name	Byte
Byte0	Transaction identifier	High byte
Byte1		Low byte
Byte2	Protocol identifier	High byte
Byte3		Low byte
Byte4	Modbus data length	High byte
Byte5		Low byte
Byte6	Modbus ID	Single byte
Byte7	Function code	Single byte
Byte8	The start address of word devices where to write values in DVP10MC11T	High byte
Byte9		Low byte
Byte10	The address number of word devices where to write values.（Counted by Words）	High byte
Byte11		Low byte

Abnormality response message data structure:

Data order	Name	Byte
Byte0	Transaction identifier	High byte
Byte1		Low byte
Byte2	Protocol identifier	High byte
Byte3		Low byte
Byte4	Modbus data length	High byte
Byte5		Low byte
Byte6	Modbus ID	Single byte
Byte7	0x80+ function code	Single byte
Byte8	Abnormality response code	Single byte

Note:

How many bytes of data in response message depend on the read device address number in DVP10MC11T in request message. So n value in Byte n in response message can be calculated through reading device address number in DVP10MC11T.

- Example: To write 0x0100 and 0x0200 to 0x1000 and 0x1001 address via function code 06.

  0x1000 and 0x1001 are the Modbus address of D0 and D1 in DVP10MC11T respectively.

  Request message: “ 00 00 00 00 00 0B 01 10 10 00 00 02 04 01 00 02 00”

  Response message: “00 00 00 00 00 06 01 10 10 00 00 02”

Function code: 0x02 to read bit-device register value

Request message data structure:

Data order	Name	Byte
Byte0	Transaction identifier	High byte
Byte1		Low byte
Byte2	Protocol identifier	High byte
Byte3		Low byte
Byte4	Modbus data length	High byte
Byte5		Low byte
Byte6	Modbus ID	Single byte
Byte7	Function code	Single byte
Byte8	The start address of the read bit device in DVP10MC11T	High byte
Byte9		Low byte
Byte10	The number of the read bit device in DVP10MC11T	High byte
Byte11		Low byte

Response message data structure:

Data order	Name	Byte
Byte0	Transaction identifier	High byte
Byte1		Low byte
Byte2	Protocol identifier	High byte
Byte3		Low byte
Byte4	Modbus data length	High byte
Byte5		Low byte
Byte6	Modbus ID	Single byte
Byte7	Function code	Single byte
Byte8	The Byte number of the read bit device	Single byte
Byte9	The status value of the bit device which has been read	Single byte
…	The status value of the bit device which has been read	Single byte
Byte n	The status value of the bit device which has been read	Single byte

Abnormality response message data structure:

Data order	Name	Byte
Byte0	Transaction identifier	High byte
Byte1		Low byte
Byte2	Protocol identifier	High byte
Byte3		Low byte
Byte4	Modbus data length	High byte
Byte5		Low byte
Byte6	Modbus ID	Single byte
Byte7	0x80+ function code	Single byte
Byte8	Abnormality response code	Single byte

Note: Suppose the number of the bit device to be read in DVP10MC11T in request message is A (Byte 10, Byte 11), If A is divided by 8 with no remainder, the quotient is B; otherwise, the quotient is B +1. B or B+1 is the Byte number (Byte 8) of bit devices in response message.

The low bit（Byte 9）of the state value of the read bit device in response message is the state value of the start address of bit devices in DVP10MC11T.

- Example: To read the state value of M0~M19 in DVP10MC11T via function code 02

The address of M0 is 0x0800; suppose M7...M0=1000 0001, M15...M8=0001 1000, M19...M16=0110

Request message: “ 00 00 00 00 00 06 01 02 08 00 00 14”

Response message: “00 00 00 00 00 06 01 02 03 81 18 06”

Function code: 0x05 to write one single bit-device register value

Request message data structure:

Data order	Name	Byte
Byte0	Transaction identifier	High byte
Byte1		Low byte
Byte2	Protocol identifier	High byte
Byte3		Low byte
Byte4	Modbus data length	High byte
Byte5		Low byte
Byte6	Modbus ID	Single byte
Byte7	Function code	Single byte
Byte8	Modbus address of the bit device	High byte
Byte9		Low byte

Data order	Name	Byte
Byte10	The value written in bit device	High byte
Byte11		Low byte

Response message data structure:

Data order	Name	Byte
Byte0	Transaction identifier	High byte
Byte1		Low byte
Byte2	Protocol identifier	High byte
Byte3		Low byte
Byte4	Modbus data length	High byte
Byte5		Low byte
Byte6	Modbus ID	Single byte
Byte7	Function code	Single byte
Byte8	Modbus address of bit device	High byte
Byte9		Low byte
Byte10	The value written in bit device	High byte
Byte11		Low byte

Abnormality response message data structure:

Data order	Name	Byte
Byte0	Transaction identifier	High byte
Byte1		Low byte
Byte2	Protocol identifier	High byte
Byte3		Low byte
Byte4	Modbus data length	High byte
Byte5		Low byte
Byte6	Modbus ID	Single byte
Byte7	0x80+ function code	Single byte
Byte8	Abnormality response code	Single byte

Note: The written value 0x0000 for bit device in request message or response message indicates be value written in device is 0; the written value 0xFF00 for bit device indicates the value written in device is 1.

- Example: Set the value of M0 in DVP10MC11T as 1 via function code 05; the address of M0 is 0x0800.

  Request message: “ 00 00 00 00 00 06 01 05 08 00 FF 00”

  Response message: 00 00 00 00 00 06 01 05 08 00 FF 00”

Function code：0x0F to write multi bit-device register value

Request message data structure:

Data order	Name	Byte
Byte0	Transaction identifier	High byte
Byte1		Low byte
Byte2	Protocol identifier	High byte
Byte3		Low byte
Byte4	Modbus data length	High byte
Byte5		Low byte
Byte6	Modbus ID	Single byte
Byte7	Function code	Single byte
Byte8	The start address of the bit devices where to write values in DVP10MC11T	High byte
Byte9		Low byte
Byte10	The number of bit devices where to write values in DVP10MC11T	High byte
Byte11		Low byte
Byte12	The Byte number of bit devices where to write values in DVP10MC11T	Single byte
Byte13	The value written in bit device in DVP10MC11T	Single byte
Byte n	The value written in bit device in DVP10MC11T	Single byte

Response message data structure:

Data order	Name	Byte
Byte0	Transaction identifier	High byte
Byte1		Low byte
Byte2	Protocol identifier	High byte
Byte3		Low byte
Byte4	Modbus data length	Single byte
Byte5	ModbusID	High byte
Byte6		Low byte
Byte7	Function code	Single byte
Byte8	The start address of the bit devices in DVP10MC11T	High byte
Byte9		Low byte
Byte10	The number of the bit devices where to write values in DVP10MC11T	High byte
Byte 11		Low byte

Abnormality response message data structure:

Data order	Name	Byte
Byte0	Transaction identifier	High byte
Byte1		Low byte
Byte2	Protocol identifier	High byte
Byte3		Low byte
Byte4	Modbus data length	High byte
Byte5		Low byte
Byte6	Modbus ID	Single byte
Byte7	0x80+ function code	Single byte
Byte8	Abnormality response code	Single byte

Note:

Suppose the number of the bit device where to be written in DVP10MC11T in request message is A (Byte 10, Byte 11), If A is divided by 8 with no remainder, the quotient is B; otherwise, the quotient is B +1. B or B+1 is the Byte number (Byte12) of bit devices in request message.

The low bit（Byte 13）of the value to be written in the bit device in DVP10MC11T in request message is the values of the start address (Byte8, Byte9) of bit devices in DVP10MC11T.

- Example: To set M0~M7=1000 0001,M8~M15=0001 1000, M16~M19=0110 in DVP10MC11T; the address of M0 is 0x0800

  Request message: “ 00 00 00 00 00 0A 01 0F 08 00 00 14 03 81 18 06”

  Response message: “00 00 00 00 00 06 01 0F 08 00 00 14”

Devices in DVP10MC11T and the corresponding addresses are listed below:

Device name	Device no.	Explanation	Address（hex）	Attribute
I	0~7	Bit device register	0400~0407	Read only
Q	0~3		0500~0503	Read/write
M	0~1535		0800~0DFF	Read/write
M	1536~4095		B000~B9FF	Read/write
D	0~4095	Word device register for common purpose	1000~1FFF	Read/write
D	4096~5999		9000~976F	Read/write
D	7000~24575		9B58~DFFF	Read/write
D	6000~6226	Word device register for special purpose	9770~9852	Read/write
D	6250~6476		986A~994C	Read only
D	6500~6508		9964~996C	Read only
D	6509		996D	Read/write
D	6511~6514		996F~9972	Read only
D	6515~6516		9973~9974	Read/write
D	6517~6518		9975~9976	Read only
D	24576~24628	Axis parameter register	E000~E034	Read only
D	24832~24884		E100~E134	Read only
D	25088~25140		E200~E234	Read only
D	25344~25396		E300~E334	Read only
D	25600~25652		E400~E434	Read only
D	25856~25908		E500~E534	Read only
D	26112~26164		E600~E634	Read only
D	26368~264415		E700~E734	Read only
D	26624~26676		E800~E834	Read only
D	26880~26932		E900~E934	Read only
D	27136~27188		EA00~EA34	Read only
D	27392~27444		EB00~EB34	Read only
D	27648~27700		EC00~EC34	Read only
D	27904~27956		ED00~ED34	Read only
D	28160~28212		EE00~EE34	Read only
D	28416~28468		EF00~EF34	Read only
D	28672~45055	Cam key point register	2000~5FFF	Read only

Appendix C　Special Registers Related with Axis

■ **Special registers related with axis 1**

Special D	Modbus address（HEX）	Function explanation	Range	Type	Latched	Attribute
D24576	E000	Type（0: rotary 1: linear）	0-1	UINT	No	Read only
D24577	E001	Modulo	--	DINT	No	Read only
D24578	E002				No	Read only
D24579	E003	Acceleration and deceleration type（0:T 1: S 2:JERK）	0-2	UINT	No	Read only
D24580	E004	Numerator of electronic gear	0 - 65535	UINT	No	Read only
D24581	E005	Denominator of electronic gear	0 - 65535	UINT	No	Read only
D24582	E006	Software limit（0:disable, 1:enable）	0-1	UINT	No	Read only
D24583	E007	The positive position limit	--	DINT	No	Read only
D24584	E008		--		No	Read only
D24585	E009	The negative position limit	--	DINT	No	Read only
D24586	E00A		--		No	Read only
D24587	E00B	Homing mode; please refer to appendix D	1-35	UINT	No	Read only
D24588	E00C	Homing speed (Unit: r/min)	--	UDINT	No	Read only
D24589	E00D		--		No	Read only
D24590	E00E	Maximum speed (Unit: unit/second)	--	UDINT	No	Read only
D24591	E00F		--		No	Read only
D24592	E010	Maximum acceleration（Unit: unit/second^2）	--	UDINT	No	Read only
D24593	E011		--		No	Read only
D24594	E012	Maximum deceleration（Unit: unit/second^2）	--	UDINT	No	Read only
D24595	E013		--		No	Read only
D24596	E014	Given position（Unit: pulse）	--	DINT	No	Read only
D24597	E015		--		No	Read only
D24598	E016	Given speed (Unit: pulse/second)	--	DINT	No	Read only
D24599	E017		--		No	Read only
D24600	E018	Given acceleration（Pulse/second^2）	--	DINT	No	Read only
D24601	E019		--		No	Read only
D24602	E01A	Current position（Unit: pulse）	--	DINT	No	Read only
D24603	E01B		--		No	Read only
D24604	E01C	Current position error（Unit: pulse）	--	DINT	No	Read only
D24605	E01D		--		No	Read only

Special D	Modbus address（HEX）	Function explanation	Range	Type	Latched	Attribute
D24606	E01E	Axis current state（see section 4.2）		UINT	No	Read only
D24613	E025	The pulse number needed when servo motor rotates for one circle)	--	DINT	No	Read only
D24614	E026		--		No	Read only
D24615	E027	The allowed error between the given and feedback pulse number	--	UINT	No	Read only
D24619	E02B	Current torque (Rated torque permillage)	--	INT	No	Read only
D24620	E02C	Current speed （Unit: 0.1 r/min）	--	DINT	No	Read only
D24621	E02D				No	Read only
D24622	E02E	Present current（Rated current permillage）	--	INT	No	Read only
D24623	E02F	Custom parameter value	--	DINT	No	Read only
D24624	E030		--		No	Read only
D24625	E031	The phase of the terminal actuator	0~modulo	REAL	No	Read only
D24626	E032					
D24627	E033	The position of the terminal actuator	-2147483648 ~ 2147483647	DINT	No	Read only
D24628	E034					

Note: The axis parameters such as Position, Velocity, Torque, Current and User defines parameter can be read via special D only when they are selected. For the method of selecting the relevant parameter, see section 2.3.1.

Special registers related with axis 2

Special D	Modbus address （HEX）	Function	Range	Type	Latched	Attribute
D24832	E100	Type（0: rotary 1: linear）	0-1	UINT	No	Read only
D24833	E101	Modulo	--	DINT	No	Read only
D24834	E102				No	Read only
D24835	E103	Acceleration and deceleration type（0:T 1: S 2:JERK）	0-2	UINT	No	Read only
D24836	E104	Numerator of electronic gear	0 - 65535	UINT	No	Read only
D24837	E105	Denominator of electronic gear	0 - 65535	UINT	No	Read only
D24838	E106	Software limit（0:disable, 1:enable）	0-1	UINT	No	Read only
D24839	E107	The positive position limit	--	DINT	No	Read only
D24840	E108		--		No	Read only
D24841	E109	The negative position limit	--	DINT	No	Read only
D24842	E10A		--		No	Read only
D24843	E10B	Homing mode; please refer to appendix D	1-35	UINT	No	Read only
D24844	E10C	Homing speed (Unit: r/min)	--	UDINT	No	Read only
D24845	E10D		--		No	Read only
D24846	E10E	Maximum speed（Unit: unit/ second）	--	UDINT	No	Read only
D24847	E10F		--		No	Read only
D24848	E110	Maximum acceleration（Unit: unit/ second^2）	--	UDINT	No	Read only
D24849	E111		--		No	Read only
D24850	E112	Maximum deceleration（Unit: unit/ second^2）	--	DINT	No	Read only
D24851	E113		--		No	Read only
D24852	E114	Given position（Unit: pulse）	--	DINT	No	Read only
D24853	E115		--		No	Read only
D24854	E116	Given speed (Unit: pulse/second）	--	DINT	No	Read only
D24855	E117		--		No	Read only
D24856	E118	Given acceleration（Pulse/second^2）	--	DINT	No	Read only
D24857	E119		--		No	Read only
D24858	E11A	Current position (Unit: pulse)	--	DINT	No	Read only
D24859	E11B		--		No	Read only
D24860	E11C	Current position error (Unit: pulse)	--	DINT	No	Read only
D24861	E11D		--		No	Read only
D24862	E11E	Axis current state (See section 4.2）		UINT	No	Read only

Special D	Modbus address (HEX)	Function	Range	Type	Latched	Attribute
D24869	E125	Pulse number needed when servo motor rotates for one circle.	--	DINT	No	Read only
D24870	E126		--		No	Read only
D24871	E127	The allowed error between the given and feedback pulse number	--	UINT	No	Read only
D24875	E12B	Current torque (Rated torque permillage)	--	INT	No	Read only
D24876	E12C	Current speed (Unit: 0.1 r/min)	--	DINT	No	Read only
D24877	E12D		--		No	Read only
D24878	E12E	Present current (Rated current permillage)	--	INT	No	Read only
D24879	E12F	Custom parameter value	--	DINT	No	Read only
D24880	E130		--		No	Read only
D24881	E131	The phase of the terminal actuator	0~ modulo	REAL	No	Read only
D24882	E132					
D24883	E133	The position of the terminal actuator	-2147483648 ~ 2147483647	DINT	No	Read only
D24884	E134					

Note: The axis parameters such as Position, Velocity, Torque, Current and User defines parameter can be read via special D only when they are selected. For the method of selecting the relevant parameter, see section 2.3.1.

■ **Special registers related with axis 3**

Special D	Modbus address （HEX）	Function	Range	Type	Latched	Attribute
D25088	E200	Type（0: rotary 1: linear）	0-1	UINT	No	Read only
D25089	E201	Modulo	--	DINT	No	Read only
D25090	E202				No	Read only
D25091	E203	Acceleration and deceleration type（0:T 1: S 2:JERK）	0-2	UINT	No	Read only
D25092	E204	Numerator of electronic gear	0 - 65535	UINT	No	Read only
D25093	E205	Denominator of electronic gear	0 - 65535	UINT	No	Read only
D25094	E206	Software limit（0:disable, 1:enable）	0-1	UINT	No	Read only
D25095	E207	The positive position limit	--	DINT	No	Read only
D25096	E208		--		No	Read only
D25097	E209	The negative position limit	--	DINT	No	Read only
D25098	E20A		--		No	Read only
D25099	E20B	Homing mode; please refer to appendix D	1-35	UINT	No	Read only
D25100	E20C	Homing speed (Unit: r/min)	--	UDINT	No	Read only
D25101	E20D		--		No	Read only
D25102	E20E	Maximum speed （Unit: unit/ second）	--	UDINT	No	Read only
D25103	E20F		--		No	Read only
D25104	E210	Maximum acceleration （Unit: unit/ second^2）	--	UDINT	No	Read only
D25105	E211		--		No	Read only
D25106	E212	Maximum deceleration （Unit: unit/ second^2）	--	DINT	No	Read only
D25107	E213		--		No	Read only
D25108	E214	Given position（Unit: pulse）	--	DINT	No	Read only
D25109	E215		--		No	Read only
D25110	E216	Given speed (Unit: pulse/second）	--	DINT	No	Read only
D25111	E217		--		No	Read only
D25112	E218	Given acceleration （Pulse/second^2）	--	DINT	No	Read only
D25113	E219		--		No	Read only
D25114	E21A	Current position (Unit: pulse)	--	DINT	No	Read only
D25115	E21B		--		No	Read only
D25116	E21C	Current position error (Unit: pulse)	--	DINT	No	Read only
D25117	E21D		--		No	Read only
D25118	E21E	Axis current state (See section 4.2）		UINT	No	Read only

Special D	Modbus address（HEX）	Function	Range	Type	Latched	Attribute
D25125	E225	Pulse number needed when servo motor rotates for one circle.	--	DINT	No	Read only
D25126	E226		--		No	Read only
D25127	E227	The allowed error between the given and feedback pulse number	--	UINT	No	Read only
D25131	E22B	Current torque (Rated torque permillage)	--	INT	No	Read only
D25132	E22C	Current speed (Unit: 0.1 r/min）	--	DINT	No	Read only
D25133	E22D		--		No	Read only
D25134	E22E	Present current (Rated current permillage)	--	INT	No	Read only
D25135	E22F	Custom parameter value	--	DINT	No	Read only
D25136	E230		--		No	Read only
D25137	E231	The phase of the terminal actuator	0~ modulo	REAL	No	Read only
D25138	E232					
D25139	E233	The position of the terminal actuator	-2147483648 ~ 2147483647	DINT	No	Read only
D25140	E234					

Note: The axis parameters such as Position, Velocity, Torque, Current and User defines parameter can be read via special D only when they are selected. For the method of selecting the relevant parameter, see section 2.3.1.

■ **Special registers related with axis 4**

Special D	Modbus address（HEX）	Function	Range	Type	Latched	Attribute
D25344	E300	Type（0: rotary 1: linear）	0-1	UINT	No	Read only
D25345	E301	Modulo	--	DINT	No	Read only
D25346	E302				No	Read only
D25347	E303	Acceleration and deceleration type（0:T 1: S 2:JERK）	0-2	UINT	No	Read only
D25348	E304	Numerator of electronic gear	0 - 65535	UINT	No	Read only
D25349	E305	Denominator of electronic gear	0 - 65535	UINT	No	Read only
D25350	E306	Software limit（0:disable, 1:enable）	0-1	UINT	No	Read only
D25351	E307	The positive position limit	--	DINT	No	Read only
D25352	E308		--		No	Read only
D25353	E309	The negative position limit	--	DINT	No	Read only
D25354	E30A		--		No	Read only
D25355	E30B	Homing mode; please refer to appendix D	1-35	UINT	No	Read only
D25356	E30C	Homing speed (Unit: r/min)	--	UDINT	No	Read only
D25357	E30D		--		No	Read only
D25358	E30E	Maximum speed（Unit: unit/ second）	--	UDINT	No	Read only
D25359	E30F		--		No	Read only
D25360	E310	Maximum acceleration（Unit: unit/ second^2）	--	UDINT	No	Read only
D25361	E311		--		No	Read only
D25362	E312	Maximum deceleration（Unit: unit/ second^2）	--	DINT	No	Read only
D25363	E313		--		No	Read only
D25364	E314	Given position（Unit: pulse）	--	DINT	No	Read only
D25365	E315		--		No	Read only
D25366	E316	Given speed (Unit: pulse/second）	--	DINT	No	Read only
D25367	E317		--		No	Read only
D25368	E318	Given acceleration（Pulse/second^2）	--	DINT	No	Read only
D25369	E319		--		No	Read only
D25370	E31A	Current position (Unit: pulse)	--	DINT	No	Read only
D25371	E31B		--		No	Read only
D25372	E31C	Current position error (Unit: pulse)	--	DINT	No	Read only
D25373	E31D		--		No	Read only
D25374	E31E	Axis current state (See section 4.2）		UINT	No	Read only
D25381	E325	Pulse number needed when servo motor rotates for one circle.	--	DINT	No	Read only
D25382	E326		--		No	Read only

Special D	Modbus address（HEX）	Function	Range	Type	Latched	Attribute
D25383	E327	The allowed error between the given and feedback pulse number	--	UINT	No	Read only
D25387	E32B	Current torque (Rated torque permillage)	--	INT	No	Read only
D25388	E32C	Current speed (Unit: 0.1 r/min）	--	DINT	No	Read only
D25389	E32D		--		No	Read only
D25390	E32E	Present current (Rated current permillage)	--	INT	No	Read only
D25391	E32F	Custom parameter value	--	DINT	No	Read only
D25392	E330		--		No	Read only
D25393	E331	The phase of the terminal actuator	0~ modulo	REAL	No	Read only
D25394	E332					
D25395	E333	The position of the terminal actuator	-2147483648 ~ 2147483647	DINT	No	Read only
D25396	E334					

Note: The axis parameters such as Position, Velocity, Torque, Current and User defines parameter can be read via special D only when they are selected. For the method of selecting the relevant parameter, see section 2.3.1.

■ Special registers related with axis 5

Special D	Modbus address（HEX）	Function	Range	Type	Latched	Attribute
D25600	E400	Type（0: rotary 1: linear）	0-1	UINT	No	Read only
D25601	E401	Modulo	--	DINT	No	Read only
D25602	E402				No	Read only
D25603	E403	Acceleration and deceleration type（0:T 1: S 2:JERK）	0-2	UINT	No	Read only
D25604	E404	Numerator of electronic gear	0 - 65535	UINT	No	Read only
D25605	E405	Denominator of electronic gear	0 - 65535	UINT	No	Read only
D25606	E406	Software limit（0:disable, 1:enable）	0-1	UINT	No	Read only
D25607	E407	The positive position limit	--	DINT	No	Read only
D25608	E408		--		No	Read only
D25609	E409	The negative position limit	--	DINT	No	Read only
D25610	E40A		--		No	Read only
D25611	E40B	Homing mode; please refer to appendix D I	1-35	UINT	No	Read only
D25612	E40C	Homing speed (Unit: r/min)	--	UDINT	No	Read only
D25613	E40D		--		No	Read only
D25614	E40E	Maximum speed（Unit: unit/ second）	--	UDINT	No	Read only
D25615	E40F		--		No	Read only
D25616	E410	Maximum acceleration（Unit: unit/ second^2）	--	UDINT	No	Read only
D25617	E411		--		No	Read only
D25618	E412	Maximum deceleration（Unit: unit/ second^2）	--	DINT	No	Read only
D25619	E413		--		No	Read only
D25620	E414	Given position（Unit: pulse）	--	DINT	No	Read only
D25621	E415		--		No	Read only
D25622	E416	Given speed (Unit: pulse/second）	--	DINT	No	Read only
D25623	E417		--		No	Read only
D25624	E418	Given acceleration（Pulse/second^2）	--	DINT	No	Read only
D25625	E419		--		No	Read only
D25626	E41A	Current position (Unit: pulse)	--	DINT	No	Read only
D25627	E41B		--		No	Read only
D25628	E41C	Current position error (Unit: pulse)	--	DINT	No	Read only
D25629	E41D		--		No	Read only

Special D	Modbus address（HEX）	Function	Range	Type	Latched	Attribute
D25630	E41E	Axis current state (See section 4.2）		UINT	No	Read only
D25637	E425	Pulse number needed when servo motor rotates for one circle.	--	DINT	No	Read only
D25638	E426		--		No	Read only
D25639	E427	The allowed error between the given and feedback pulse number	--	UINT	No	Read only
D25643	E42B	Current torque (Rated torque permillage)	--	INT	No	Read only
D25644	E42C	Current speed (Unit: 0.1 r/min）	--	DINT	No	Read only
D25645	E42D		--		No	Read only
D25646	E42E	Present current (Rated current permillage)	--	INT	No	Read only
D25647	E42F	Custom parameter value	--	DINT	No	Read only
D25648	E430		--		No	Read only
D25649	E431	The phase of the terminal actuator	0~ modulo	REAL	No	Read only
D25650	E432					
D25651	E433	The position of the terminal actuator	-2147483648 ~ 2147483647	DINT	No	Read only
D25652	E434					

Note: The axis parameters such as Position, Velocity, Torque, Current and User defines parameter can be read via special D only when they are selected. For the method of selecting the relevant parameter, see section 2.3.1.

Special registers related with axis 6

Special D	Modbus address (HEX)	Function	Range	Type	Latched	Attribute
D25856	E500	Type（0: rotary 1: linear）	0-1	UINT	No	Read only
D25857	E501	Modulo	--	DINT	No	Read only
D25858	E502				No	Read only
D25859	E503	Acceleration and deceleration type（0:T 1: S 2:JERK）	0-2	UINT	No	Read only
D25860	E504	Numerator of electronic gear	0 - 65535	UINT	No	Read only
D25861	E505	Denominator of electronic gear	0 - 65535	UINT	No	Read only
D25862	E506	Software limit（0:disable, 1:enable）	0-1	UINT	No	Read only
D25863	E507	The positive position limit	--	DINT	No	Read only
D25864	E508		--		No	Read only
D25865	E509	The negative position limit	--	DINT	No	Read only
D25866	E50A		--		No	Read only
D25867	E50B	Homing mode; please refer to appendix D	1-35	UINT	No	Read only
D25868	E50C	Homing speed (Unit: r/min)	--	UDINT	No	Read only
D25869	E50D		--		No	Read only
D25870	E50E	Maximum speed（Unit: unit/ second）	--	UDINT	No	Read only
D25871	E50F		--		No	Read only
D25872	E510	Maximum acceleration（Unit: unit/ $second^2$）	--	UDINT	No	Read only
D25873	E511		--		No	Read only
D25874	E512	Maximum deceleration（Unit: unit/ $second^2$）	--	DINT	No	Read only
D25875	E513		--		No	Read only
D25876	E514	Given position（Unit: pulse）	--	DINT	No	Read only
D25877	E515		--		No	Read only
D25878	E516	Given speed (Unit: pulse/second）	--	DINT	No	Read only
D25879	E517		--		No	Read only
D25880	E518	Given acceleration（Pulse/$second^2$）	--	DINT	No	Read only
D25881	E519		--		No	Read only
D25882	E51A	Current position (Unit: pulse)	--	DINT	No	Read only
D25883	E51B		--		No	Read only
D25884	E51C	Current position error (Unit: pulse)	--	DINT	No	Read only
D25885	E51D		--		No	Read only
D25886	E51E	Axis current state (See section 4.2）		UINT	No	Read only
D25893	E525	Pulse number needed when servo motor rotates for one circle.	--	DINT	No	Read only
D25894	E526		--		No	Read only

Special D	Modbus address（HEX）	Function	Range	Type	Latched	Attribute
D25895	E527	The allowed error between the given and feedback pulse number	--	UINT	No	Read only
D25899	E52B	Current torque (Rated torque permillage)	--	INT	No	Read only
D25900	E52C	Current speed (Unit: 0.1 r/min）	--	DINT	No	Read only
D25901	E52D		--		No	Read only
D25902	E52E	Present current (Rated current permillage)	--	INT	No	Read only
D25903	E52F	Custom parameter value	--	DINT	No	Read only
D25904	E530		--		No	Read only
D25905	E531	The phase of the terminal actuator	0~ modulo	REAL	No	Read only
D25906	E532					
D25907	E533	The position of the terminal actuator	-2147483648 ~ 2147483647	DINT	No	Read only
D25908	E534					

Note: The axis parameters such as Position, Velocity, Torque, Current and User defines parameter can be read via special D only when they are selected. For the method of selecting the relevant parameter, see section 2.3.1.

■ **Special registers related with axis 7**

Special D	Modbus address （HEX）	Function	Range	Type	Latched	Attribute
D26112	E600	Type（0: rotary 1: linear）	0-1	UINT	No	Read only
D26113	E601	Modulo	--	DINT	No	Read only
D26114	E602				No	Read only
D26115	E603	Acceleration and deceleration type（0:T 1: S 2:JERK）	0-2	UINT	No	Read only
D26116	E604	Numerator of electronic gear	0 - 65535	UINT	No	Read only
D26117	E605	Denominator of electronic gear	0 - 65535	UINT	No	Read only
D26118	E606	Software limit（0:disable, 1:enable）	0-1	UINT	No	Read only
D26119	E607	The positive position limit	--	DINT	No	Read only
D26120	E608		--		No	Read only
D26121	E609	The negative position limit	--	DINT	No	Read only
D26122	E60A		--		No	Read only
D26123	E60B	Homing mode; please refer to appendix D	1-35	UINT	No	Read only
D26124	E60C	Homing speed (Unit: r/min)	--	UDINT	No	Read only
D26125	E60D		--		No	Read only
D26126	E60E	Maximum speed （Unit: unit/ second）	--	UDINT	No	Read only
D26127	E60F		--		No	Read only
D26128	E610	Maximum acceleration （Unit: unit/ second^2）	--	UDINT	No	Read only
D26129	E611		--		No	Read only
D26130	E612	Maximum deceleration （Unit: unit/ second^2）	--	DINT	No	Read only
D26131	E613		--		No	Read only
D26132	E614	Given position（Unit: pulse）	--	DINT	No	Read only
D26133	E615		--		No	Read only
D26134	E616	Given speed (Unit: pulse/second）	--	DINT	No	Read only
D26135	E617		--		No	Read only
D26136	E618	Given acceleration （Pulse/second^2）	--	DINT	No	Read only
D26137	E619		--		No	Read only
D26138	E61A	Current position (Unit: pulse)	--	DINT	No	Read only
D26139	E61B		--		No	Read only
D26140	E61C	Current position error (Unit: pulse)	--	DINT	No	Read only
D26141	E61D		--		No	Read only
D26142	E61E	Axis current state (See section 4.2）		UINT	No	Read only

Special D	Modbus address（HEX）	Function	Range	Type	Latched	Attribute
D26149	E625	Pulse number needed when servo motor rotates for one circle.	--	DINT	No	Read only
D26150	E626		--		No	Read only
D26151	E627	The allowed error between the given and feedback pulse number	--	UINT	No	Read only
D26155	E62B	Current torque (Rated torque permillage)	--	INT	No	Read only
D26156	E62C	Current speed (Unit: 0.1 r/min）	--	DINT	No	Read only
D26157	E62D		--		No	Read only
D26158	E62E	Present current (Rated current permillage)	--	INT	No	Read only
D26159	E62F	Custom parameter value	--	DINT	No	Read only
D26160	E630		--		No	Read only
D26161	E631	The phase of the terminal actuator	0~ modulo	REAL	No	Read only
D26162	E632					
D26163	E633	The position of the terminal actuator	-2147483648 ~ 2147483647	DINT	No	Read only
D26164	E634					

Note: The axis parameters such as Position, Velocity, Torque, Current and User defines parameter can be read via special D only when they are selected. For the method of selecting the relevant parameter, see section 2.3.1.

■ **Special registers related with axis 8**

Special D	Modbus address（HEX）	Function	Range	Type	Latched	Attribute
D26368	E700	Type（0: rotary 1: linear）	0-1	UINT	No	Read only
D26369	E701	Modulo	--	DINT	No	Read only
D26370	E702				No	Read only
D26371	E703	Acceleration and deceleration type（0:T 1: S 2:JERK）	0-2	UINT	No	Read only
D26372	E704	Numerator of electronic gear	0 - 65535	UINT	No	Read only
D26373	E705	Denominator of electronic gear	0 - 65535	UINT	No	Read only
D26374	E706	Software limit（0:disable, 1:enable）	0-1	UINT	No	Read only
D26375	E707	The positive position limit	--	DINT	No	Read only
D26376	E708		--		No	Read only
D26377	E709	The negative position limit	--	DINT	No	Read only
D26378	E70A		--		No	Read only
D26379	E70B	Homing mode; please refer to appendix D	1-35	UINT	No	Read only
D26380	E70C	Homing speed (Unit: r/min)	--	UDINT	No	Read only
D26381	E70D		--		No	Read only
D26382	E70E	Maximum speed（Unit: unit/ second）	--	UDINT	No	Read only
D26383	E70F		--		No	Read only
D26384	E710	Maximum acceleration（Unit: unit/ second^2）	--	UDINT	No	Read only
D26385	E711		--		No	Read only
D26386	E712	Maximum deceleration（Unit: unit/ second^2）	--	DINT	No	Read only
D26387	E713		--		No	Read only
D26388	E714	Given position（Unit: pulse）	--	DINT	No	Read only
D26389	E715		--		No	Read only
D26390	E716	Given speed (Unit: pulse/second）	--	DINT	No	Read only
D26391	E717		--		No	Read only
D26392	E718	Given acceleration（Pulse/second^2）	--	DINT	No	Read only
D26393	E719		--		No	Read only
D26394	E71A	Current position (Unit: pulse)	--	DINT	No	Read only
D26395	E71B		--		No	Read only
D26396	E71C	Current position error (Unit: pulse)	--	DINT	No	Read only
D26397	E71D		--		No	Read only
D26398	E71E	Axis current state (See section 4.2）		UINT	No	Read only
D26405	E725	Unit number per turn	--	DINT	No	Read only
D26406	E726		--		No	Read only
D26407	E727	The allowed position error	--	UINT	No	Read only

Special D	Modbus address (HEX)	Function	Range	Type	Latched	Attribute
D26411	E72B	Current torque	--	INT	No	Read only
D26412	E72C	Current speed (Unit: 0.1 rpm)	--	DINT	No	Read only
D26413	E72D		--		No	Read only
D26414	E72E	Present current (permillage of rated current)	--	INT	No	Read only
D26415	E72F	Custom parameter value	--	DINT	No	Read only
D26416	E730		--		No	Read only
D26417	E731	The phase of the terminal actuator	0~ modulo	REAL	No	Read only
D26418	E732					
D26419	E733	The position of the terminal actuator	-2147483648 ~ 2147483647	DINT	No	Read only
D26420	E734					

Note: The axis parameters such as Position, Velocity, Torque, Current and User defines parameter can be read via special D only when they are selected. For the method of selecting the relevant parameter, see section 2.3.1.

■ **Special registers related with axis 9**

Special D	Modbus address （HEX）	Function	Range	Type	Latched	Attribute
D26624	E800	Type（0: rotary 1: linear）	0-1	UINT	No	Read only
D26625	E801	Modulo	--	DINT	No	Read only
D26626	E802				No	Read only
D26627	E803	Acceleration and deceleration type（0:T 1: S 2:JERK）	0-2	UINT	No	Read only
D26628	E804	Numerator of electronic gear	0 - 65535	UINT	No	Read only
D26629	E805	Denominator of electronic gear	0 - 65535	UINT	No	Read only
D26630	E806	Software limit（0:disable, 1:enable）	0-1	UINT	No	Read only
D26631	E807	The positive position limit	--	DINT	No	Read only
D26632	E808		--		No	Read only
D26633	E809	The negative position limit	--	DINT	No	Read only
D26634	E80A		--		No	Read only
D26635	E80B	Homing mode; please refer to appendix D	1-35	UINT	No	Read only
D26636	E80C	Homing speed (Unit: r/min)	--	UDINT	No	Read only
D26637	E80D		--		No	Read only
D26638	E80E	Maximum speed （Unit: unit/ second）	--	UDINT	No	Read only
D26639	E80F		--		No	Read only
D26640	E810	Maximum acceleration （Unit: unit/ second^2）	--	UDINT	No	Read only
D26641	E811		--		No	Read only
D26642	E812	Maximum deceleration （Unit: unit/ second^2）	--	DINT	No	Read only
D26643	E813		--		No	Read only
D26644	E814	Given position（Unit: pulse）	--	DINT	No	Read only
D26645	E815		--		No	Read only
D26646	E816	Given speed (Unit: pulse/second）	--	DINT	No	Read only
D26647	E817		--		No	Read only
D26648	E818	Given acceleration （Pulse/second^2）	--	DINT	No	Read only
D26649	E819		--		No	Read only
D26650	E81A	Current position (Unit: pulse)	--	DINT	No	Read only
D26651	E81B		--		No	Read only
D26652	E81C	Current position error (Unit: pulse)	--	DINT	No	Read only
D26653	E81D		--		No	Read only

Special D	Modbus address (HEX)	Function	Range	Type	Latched	Attribute
D26654	E81E	Axis current state (See section 4.2)		UINT	No	Read only
D26661	E825	Pulse number needed when servo motor rotates for one circle.	--	DINT	No	Read only
D26662	E826		--		No	Read only
D26663	E827	The allowed error between the given and feedback pulse number	--	UINT	No	Read only
D26667	E82B	Current torque (Rated torque permillage)	--	INT	No	Read only
D26668	E82C	Current speed (Unit: 0.1 r/min)	--	DINT	No	Read only
D26669	E82D		--		No	Read only
D26670	E82E	Present current (Rated current permillage)	--	INT	No	Read only
D26671	E82F	Custom parameter value	--	DINT	No	Read only
D26672	E830		--		No	Read only
D26673	E831	The phase of the terminal actuator	0~ modulo	REAL	No	Read only
D26674	E832					
D26675	E833	The position of the terminal actuator	-2147483648 ~ 2147483647	DINT	No	Read only
D26676	E834					

Note: The axis parameters such as Position, Velocity, Torque, Current and User defines parameter can be read via special D only when they are selected. For the method of selecting the relevant parameter, see section 2.3.1.

■ **Special registers related with axis 10**

Special D	Modbus address（HEX）	Function	Range	Type	Latched	Attribute
D26880	E900	Type（0: rotary 1: linear）	0-1	UINT	No	Read only
D26881	E901	Modulo	--	DINT	No	Read only
D26882	E902				No	Read only
D26883	E903	Acceleration and deceleration type（0:T 1: S 2:JERK）	0-2	UINT	No	Read only
D26884	E904	Numerator of electronic gear	0 - 65535	UINT	No	Read only
D26885	E905	Denominator of electronic gear	0 - 65535	UINT	No	Read only
D26886	E906	Software limit（0:disable, 1:enable）	0-1	UINT	No	Read only
D26887	E907	The positive position limit	--	DINT	No	Read only
D26888	E908		--		No	Read only
D26889	E909	The negative position limit	--	DINT	No	Read only
D26890	E90A		--		No	Read only
D26891	E90B	Homing mode; please refer to appendix D	1-35	UINT	No	Read only
D26892	E90C	Homing speed (Unit: r/min)	--	UDINT	No	Read only
D26893	E90D		--		No	Read only
D26894	E90E	Maximum speed（Unit: unit/ second）	--	UDINT	No	Read only
D26895	E90F		--		No	Read only
D26896	E910	Maximum acceleration（Unit: unit/ second^2）	--	UDINT	No	Read only
D26897	E911		--		No	Read only
D26898	E912	Maximum deceleration（Unit: unit/ second^2）	--	DINT	No	Read only
D26899	E913		--		No	Read only
D26900	E914	Given position（Unit: pulse）	--	DINT	No	Read only
D26901	E915		--		No	Read only
D26902	E916	Given speed (Unit: pulse/second）	--	DINT	No	Read only
D26903	E917		--		No	Read only
D26904	E918	Given acceleration（Pulse/second^2）	--	DINT	No	Read only
D26905	E919		--		No	Read only
D26906	E91A	Current position (Unit: pulse)	--	DINT	No	Read only
D26907	E91B		--		No	Read only
D26908	E91C	Current position error (Unit: pulse)	--	DINT	No	Read only
D26909	E91D		--		No	Read only
D26910	E91E	Axis current state (See section 4.2）		UINT	No	Read only
D26917	E925	Pulse number needed when servo motor rotates for one circle.	--	DINT	No	Read only
D26918	E926		--		No	Read only

Special D	Modbus address（HEX）	Function	Range	Type	Latched	Attribute
D26919	E927	The allowed error between the given and feedback pulse number	--	UINT	No	Read only
D26923	E92B	Current torque (Rated torque permillage)	--	INT	No	Read only
D26924	E92C	Current speed (Unit: 0.1 r/min）	--	DINT	No	Read only
D26925	E92D		--		No	Read only
D26926	E92E	Present current (Rated current permillage)	--	INT	No	Read only
D26927	E92F	Custom parameter value	--	DINT	No	Read only
D26928	E930		--		No	Read only
D26929	E931	The phase of the terminal actuator	0~ modulo	REAL	No	Read only
D26930	E932					
D26931	E933	The position of the terminal actuator	-2147483648 ~ 2147483647	DINT	No	Read only
D26932	E934					

Note: The axis parameters such as Position, Velocity, Torque, Current and User defines parameter can be read via special D only when they are selected. For the method of selecting the relevant parameter, see section 2.3.1.

■ **Special registers related with axis 11**

Special D	Modbus address（HEX）	Function	Range	Type	Latched	Attribute
D27136	EA00	Type（0: rotary 1: linear）	0-1	UINT	No	Read only
D27137	EA01	Modulo	--	DINT	No	Read only
D27138	EA02				No	Read only
D27139	EA03	Acceleration and deceleration type（0:T 1: S 2:JERK）	0-2	UINT	No	Read only
D27140	EA04	Numerator of electronic gear	0 - 65535	UINT	No	Read only
D27141	EA05	Denominator of electronic gear	0 - 65535	UINT	No	Read only
D27142	EA06	Software limit（0:disable, 1:enable）	0-1	UINT	No	Read only
D27143	EA07	The positive position limit	--	DINT	No	Read only
D27144	EA08		--		No	Read only
D27145	EA09	The negative position limit	--	DINT	No	Read only
D27146	EA0A		--		No	Read only
D27147	EA0B	Homing mode; please refer to appendix D	1-35	UINT	No	Read only
D27148	EA0C	Homing speed (Unit: r/min)	--	UDINT	No	Read only
D27149	EA0D		--		No	Read only
D27150	EA0E	Maximum speed（Unit: unit/ second）	--	UDINT	No	Read only
D27151	EA0F		--		No	Read only
D27152	EA10	Maximum acceleration（Unit: unit/ $second^2$）	--	UDINT	No	Read only
D27153	EA11		--		No	Read only
D27154	EA12	Maximum deceleration（Unit: unit/ $second^2$）	--	DINT	No	Read only
D27155	EA13		--		No	Read only
D27156	EA14	Given position（Unit: pulse）	--	DINT	No	Read only
D27157	EA15		--		No	Read only
D27158	EA16	Given speed (Unit: pulse/second）	--	DINT	No	Read only
D27159	EA17		--		No	Read only
D27160	EA18	Given acceleration（Pulse/$second^2$）	--	DINT	No	Read only
D27161	EA19		--		No	Read only
D27162	EA1A	Current position (Unit: pulse)	--	DINT	No	Read only
D27163	EA1B		--		No	Read only
D27164	EA1C	Current position error (Unit: pulse)	--	DINT	No	Read only
D27165	EA1D		--		No	Read only
D27166	EA1E	Axis current state (See section 4.2）		UINT	No	Read only
D27173	EA25	Pulse number needed when servo motor rotates for one circle.	--	DINT	No	Read only
D27174	EA26		--		No	Read only

Special D	Modbus address（HEX）	Function	Range	Type	Latched	Attribute
D27175	EA27	The allowed error between the given and feedback pulse number	--	UINT	No	Read only
D27179	EA2B	Current torque (Rated torque permillage)	--	INT	No	Read only
D27180	EA2C	Current speed (Unit: 0.1 r/min）	--	DINT	No	Read only
D27181	EA2D		--		No	Read only
D27182	EA2E	Present current (Rated current permillage)	--	INT	No	Read only
D27183	EA2F	Custom parameter value	--	DINT	No	Read only
D27184	EA30		--		No	Read only
D27185	EA31	The phase of the terminal actuator	0~ modulo	REAL	No	Read only
D27186	EA32					
D27187	EA33	The position of the terminal actuator	-2147483648 ~ 2147483647	DINT	No	Read only
D27188	EA34					

Note: The axis parameters such as Position, Velocity, Torque, Current and User defines parameter can be read via special D only when they are selected. For the method of selecting the relevant parameter, see section 2.3.1.

■ **Special registers related with axis 12**

Special D	Modbus address（HEX）	Function	Range	Type	Latched	Attribute
D27392	EB00	Type（0: rotary 1: linear）	0-1	UINT	No	Read only
D27393	EB01	Modulo	--	DINT	No	Read only
D27394	EB02				No	Read only
D27395	EB03	Acceleration and deceleration type（0:T 1: S 2:JERK）	0-2	UINT	No	Read only
D27396	EB04	Numerator of electronic gear	0 - 65535	UINT	No	Read only
D27397	EB05	Denominator of electronic gear	0 - 65535	UINT	No	Read only
D27398	EB06	Software limit（0:disable, 1:enable）	0-1	UINT	No	Read only
D27399	EB07	The positive position limit	--	DINT	No	Read only
D27400	EB08		--		No	Read only
D27401	EB09	The negative position limit	--	DINT	No	Read only
D27402	EB0A		--		No	Read only
D27403	EB0B	Homing mode; please refer to appendix D	1-35	UINT	No	Read only
D27404	EB0C	Homing speed (Unit: r/min)	--	UDINT	No	Read only
D27405	EB0D		--		No	Read only
D27406	EB0E	Maximum speed（Unit: unit/ second）	--	UDINT	No	Read only
D27407	EB0F		--		No	Read only
D27408	EB10	Maximum acceleration（Unit: unit/ second^2）	--	UDINT	No	Read only
D27409	EB11		--		No	Read only
D27410	EB12	Maximum deceleration（Unit: unit/ second^2）	--	DINT	No	Read only
D27411	EB13		--		No	Read only
D27412	EB14	Given position（Unit: pulse）	--	DINT	No	Read only
D27413	EB15		--		No	Read only
D27414	EB16	Given speed (Unit: pulse/second）	--	DINT	No	Read only
D27415	EB17		--		No	Read only
D27416	EB18	Given acceleration（Pulse/second^2）	--	DINT	No	Read only
D27417	EB19		--		No	Read only
D27418	EB1A	Current position (Unit: pulse)	--	DINT	No	Read only
D27419	EB1B		--		No	Read only
D27420	EB1C	Current position error (Unit: pulse)	--	DINT	No	Read only
D27421	EB1D		--		No	Read only
D27422	EB1E	Axis current state (See section 4.2）		UINT	No	Read only
D27429	EB25	Pulse number needed when servo motor rotates for one circle.	--	DINT	No	Read only
D27430	EB26		--		No	Read only

Special D	Modbus address（HEX）	Function	Range	Type	Latched	Attribute
D27431	EB27	The allowed error between the given and feedback pulse number	--	UINT	No	Read only
D27435	EB2B	Current torque (Rated torque permillage)	--	INT	No	Read only
D27436	EB2C	Current speed (Unit: 0.1 r/min）	--	DINT	No	Read only
D27437	EB2D		--		No	Read only
D27438	EB2E	Present current (Rated current permillage)	--	INT	No	Read only
D27439	EB2F	Custom parameter value	--	DINT	No	Read only
D27440	EB30		--		No	Read only
D27441	EB31	The phase of the terminal actuator	0~ modulo	REAL	No	Read only
D27442	EB32					
D27443	EB33	The position of the terminal actuator	-2147483648 ~ 2147483647	DINT	No	Read only
D27444	EB34					

Note: The axis parameters such as Position, Velocity, Torque, Current and User defines parameter can be read via special D only when they are selected. For the method of selecting the relevant parameter, see section 2.3.1.

■ **Special registers related with axis 13**

Special D	Modbus address（HEX）	Function	Range	Type	Latched	Attribute
D27648	EC00	Type（0: rotary 1: linear）	0-1	UINT	No	Read only
D27649	EC01	Modulo	--	DINT	No	Read only
D27650	EC02				No	Read only
D27651	EC03	Acceleration and deceleration type（0:T 1: S 2:JERK）	0-2	UINT	No	Read only
D27652	EC04	Numerator of electronic gear	0 - 65535	UINT	No	Read only
D27653	EC05	Denominator of electronic gear	0 - 65535	UINT	No	Read only
D27654	EC06	Software limit（0:disable, 1:enable）	0-1	UINT	No	Read only
D27655	EC07	The positive position limit	--	DINT	No	Read only
D27656	EC08		--		No	Read only
D27657	EC09	The negative position limit	--	DINT	No	Read only
D27658	EC0A		--		No	Read only
D27659	EC0B	Homing mode; please refer to appendix D	1-35	UINT	No	Read only
D27660	EC0C	Homing speed (Unit: r/min)	--	UDINT	No	Read only
D27661	EC0D		--		No	Read only
D27662	EC0E	Maximum speed（Unit: unit/ second）	--	UDINT	No	Read only
D27663	EC0F		--		No	Read only
D27664	EC10	Maximum acceleration（Unit: unit/ second^2）	--	UDINT	No	Read only
D27665	EC11		--		No	Read only
D27666	EC12	Maximum deceleration（Unit: unit/ second^2）	--	DINT	No	Read only
D27667	EC13		--		No	Read only
D27668	EC14	Given position（Unit: pulse）	--	DINT	No	Read only
D27669	EC15		--		No	Read only
D27670	EC16	Given speed (Unit: pulse/second）	--	DINT	No	Read only
D27671	EC17		--		No	Read only
D27672	EC18	Given acceleration（Pulse/second^2）	--	DINT	No	Read only
D27673	EC19		--		No	Read only
D27674	EC1A	Current position (Unit: pulse)	--	DINT	No	Read only
D27675	EC1B		--		No	Read only
D27676	EC1C	Current position error (Unit: pulse)	--	DINT	No	Read only
D27677	EC1D		--		No	Read only
D27678	EC1E	Axis current state (See section 4.2）		UINT	No	Read only
D27685	EC25	Pulse number needed when servo motor rotates for one circle.	--	DINT	No	Read only
D27686	EC26		--		No	Read only

Special D	Modbus address （HEX）	Function	Range	Type	Latched	Attribute
D27687	EC27	The allowed error between the given and feedback pulse number	--	UINT	No	Read only
D27691	EC2B	Current torque (Rated torque permillage)	--	INT	No	Read only
D27692	EC2C	Current speed (Unit: 0.1 r/min）	--	DINT	No	Read only
D27693	EC2D		--		No	Read only
D27694	EC2E	Present current (Rated current permillage)	--	INT	No	Read only
D27695	EC2F	Custom parameter value	--	DINT	No	Read only
D27696	EC30		--		No	Read only
D27697	EC31	The phase of the terminal actuator	0~ modulo	REAL	No	Read only
D27698	EC32					
D27699	EC33	The position of the terminal actuator	-2147483648 ~ 2147483647	DINT	No	Read only
D27700	EC34					

Note: The axis parameters such as Position, Velocity, Torque, Current and User defines parameter can be read via special D only when they are selected. For the method of selecting the relevant parameter, see section 2.3.1.

■ **Special registers related with axis 14**

Special D	Modbus address（HEX）	Function	Range	Type	Latched	Attribute
D27904	ED00	Type（0: rotary 1: linear）	0-1	UINT	No	Read only
D27905	ED01	Modulo	--	DINT	No	Read only
D27906	ED02				No	Read only
D27907	ED03	Acceleration and deceleration type（0:T 1: S 2:JERK）	0-2	UINT	No	Read only
D27908	ED04	Numerator of electronic gear	0 - 65535	UINT	No	Read only
D27909	ED05	Denominator of electronic gear	0 - 65535	UINT	No	Read only
D27910	ED06	Software limit（0:disable, 1:enable）	0-1	UINT	No	Read only
D27911	ED07	The positive position limit	--	DINT	No	Read only
D27912	ED08		--		No	Read only
D27913	ED09	The negative position limit	--	DINT	No	Read only
D27914	ED0A		--		No	Read only
D27915	ED0B	Homing mode; please refer to appendix D	1-35	UINT	No	Read only
D27916	ED0C	Homing speed (Unit: r/min)	--	UDINT	No	Read only
D27917	ED0D		--		No	Read only
D27918	ED0E	Maximum speed （Unit: unit/ second）	--	UDINT	No	Read only
D27919	ED0F		--		No	Read only
D27920	ED10	Maximum acceleration （Unit: unit/ second^2）	--	UDINT	No	Read only
D27921	ED11		--		No	Read only
D27922	ED12	Maximum deceleration （Unit: unit/ second^2）	--	DINT	No	Read only
D27923	ED13		--		No	Read only
D27924	ED14	Given position（Unit: pulse）	--	DINT	No	Read only
D27925	ED15		--		No	Read only
D27926	ED16	Given speed (Unit: pulse/second）	--	DINT	No	Read only
D27927	ED17		--		No	Read only
D27928	ED18	Given acceleration （Pulse/second^2）	--	DINT	No	Read only
D27929	ED19		--		No	Read only
D27930	ED1A	Current position (Unit: pulse)	--	DINT	No	Read only
D27931	ED1B		--		No	Read only
D27932	ED1C	Current position error (Unit: pulse)	--	DINT	No	Read only
D27933	ED1D		--		No	Read only
D27934	ED1E	Axis current state (See section 4.2）		UINT	No	Read only

Special D	Modbus address（HEX）	Function	Range	Type	Latched	Attribute
D27941	ED25	Pulse number needed when servo motor rotates for one circle.	--	DINT	No	Read only
D27942	ED26		--		No	Read only
D27943	ED27	The allowed error between the given and feedback pulse number	--	UINT	No	Read only
D27947	ED2B	Current torque (Rated torque permillage)	--	INT	No	Read only
D27948	ED2C	Current speed (Unit: 0.1 r/min）	--	DINT	No	Read only
D27949	ED2D		--		No	Read only
D27950	ED2E	Present current (Rated current permillage)	--	INT	No	Read only
D27951	ED2F	Custom parameter value	--	DINT	No	Read only
D27952	ED30		--		No	Read only
D27953	ED31	The phase of the terminal actuator	0~ modulo	REAL	No	Read only
D27954	ED32					
D27955	ED33	The position of the terminal actuator	-2147483648 ~ 2147483647	DINT	No	Read only
D27956	ED34					

Note: The axis parameters such as Position, Velocity, Torque, Current and User defines parameter can be read via special D only when they are selected. For the method of selecting the relevant parameter, see section 2.3.1.

■ **Special registers related with axis 15**

Special D	Modbus address（HEX）	Function	Range	Type	Latched	Attribute
D28160	EE00	Type（0: rotary 1: linear）	0-1	UINT	No	Read only
D28161	EE01	Modulo	--	DINT	No	Read only
D28162	EE02				No	Read only
D28163	EE03	Acceleration and deceleration type（0:T 1: S 2:JERK）	0-2	UINT	No	Read only
D28164	EE04	Numerator of electronic gear	0 - 65535	UINT	No	Read only
D28165	EE05	Denominator of electronic gear	0 - 65535	UINT	No	Read only
D28166	EE06	Software limit（0:disable, 1:enable）	0-1	UINT	No	Read only
D28167	EE07	The positive position limit	--	DINT	No	Read only
D28168	EE08		--		No	Read only
D28169	EE09	The negative position limit	--	DINT	No	Read only
D28170	EE0A		--		No	Read only
D28171	EE0B	Homing mode; please refer to appendix D	1-35	UINT	No	Read only
D28172	EE0C	Homing speed (Unit: r/min)	--	UDINT	No	Read only
D28173	EE0D		--		No	Read only
D28174	EE0E	Maximum speed（Unit: unit/ second）	--	UDINT	No	Read only
D28175	EE0F		--		No	Read only
D28176	EE10	Maximum acceleration（Unit: unit/ second^2）	--	UDINT	No	Read only
D28177	EE11		--		No	Read only
D28178	EE12	Maximum deceleration（Unit: unit/ second^2）	--	DINT	No	Read only
D28179	EE13		--		No	Read only
D28180	EE14	Given position（Unit: pulse）	--	DINT	No	Read only
D28181	EE15		--		No	Read only
D28182	EE16	Given speed (Unit: pulse/second）	--	DINT	No	Read only
D28183	EE17		--		No	Read only
D28184	EE18	Given acceleration（Pulse/second^2）	--	DINT	No	Read only
D28185	EE19		--		No	Read only
D28186	EE1A	Current position (Unit: pulse)	--	DINT	No	Read only
D28187	EE1B		--		No	Read only
D28188	EE1C	Current position error (Unit: pulse)	--	DINT	No	Read only
D28189	EE1D		--		No	Read only
D28190	EE1E	Axis current state (See section 4.2）		UINT	No	Read only

Special D	Modbus address（HEX）	Function	Range	Type	Latched	Attribute
D28197	EE25	Pulse number needed when servo motor rotates for one circle.	--	DINT	No	Read only
D28198	EE26		--		No	Read only
D28199	EE27	The allowed error between the given and feedback pulse number	--	UINT	No	Read only
D28203	EE2B	Current torque (Rated torque permillage)	--	INT	No	Read only
D28204	EE2C	Current speed (Unit: 0.1 r/min）	--	DINT	No	Read only
D28205	EE2D		--		No	Read only
D28206	EE2E	Present current (Rated current permillage)	--	INT	No	Read only
D28207	EE2F	Custom parameter value	--	DINT	No	Read only
D28208	EE30		--		No	Read only
D28209	EE31	The phase of the terminal actuator	0~ modulo	REAL	No	Read only
D28210	EE32					
D28211	EE33	The position of the terminal actuator	-2147483648 ~ 2147483647	DINT	No	Read only
D28212	EE34					

Note: The axis parameters such as Position, Velocity, Torque, Current and User defines parameter can be read via special D only when they are selected. For the method of selecting the relevant parameter, see section 2.3.1.

■ **Special registers related with axis 16**

Special D	Modbus address（HEX）	Function	Range	Type	Latched	Attribute
D28416	EF00	Type（0: rotary 1: linear）	0-1	UINT	No	Read only
D28417	EF01	Modulo	--	DINT	No	Read only
D28418	EF02				No	Read only
D28419	EF03	Acceleration and deceleration type（0:T 1: S 2:JERK）	0-2	UINT	No	Read only
D28420	EF04	Numerator of electronic gear	0 - 65535	UINT	No	Read only
D28421	EF05	Denominator of electronic gear	0 - 65535	UINT	No	Read only
D28422	EF06	Software limit（0:disable, 1:enable）	0-1	UINT	No	Read only
D28423	EF07	The positive position limit	--	DINT	No	Read only
D28424	EF08		--		No	Read only
D28425	EF09	The negative position limit	--	DINT	No	Read only
D28426	EF0A		--		No	Read only
D28427	EF0B	Homing mode; please refer to appendix D	1-35	UINT	No	Read only
D28428	EF0C	Homing speed (Unit: r/min)	--	UDINT	No	Read only
D28429	EF0D		--		No	Read only
D28430	EF0E	Maximum speed（Unit: unit/ second）	--	UDINT	No	Read only
D28431	EF0F		--		No	Read only
D28432	EF10	Maximum acceleration（Unit: unit/ second^2）	--	UDINT	No	Read only
D28433	EF11		--		No	Read only
D28434	EF12	Maximum deceleration（Unit: unit/ second^2）	--	DINT	No	Read only
D28435	EF13		--		No	Read only
D28436	EF14	Given position（Unit: pulse）	--	DINT	No	Read only
D28437	EF15		--		No	Read only
D28438	EF16	Given speed (Unit: pulse/second）	--	DINT	No	Read only
D28439	EF17		--		No	Read only
D28440	EF18	Given acceleration（Pulse/second^2）	--	DINT	No	Read only
D28441	EF19		--		No	Read only
D28442	EF1A	Current position (Unit: pulse)	--	DINT	No	Read only
D28443	EF1B		--		No	Read only
D28444	EF1C	Current position error (Unit: pulse)	--	DINT	No	Read only
D28445	EF1D		--		No	Read only

Special D	Modbus address（HEX）	Function	Range	Type	Latched	Attribute
D28446	EF1E	Axis current state (See section 4.2）		UINT	No	Read only
D28453	EF25	Pulse number needed when servo motor rotates for one circle.	--	DINT	No	Read only
D28454	EF26		--		No	Read only
D28455	EF27	The allowed error between the given and feedback pulse number	--	UINT	No	Read only
D28459	EF2B	Current torque (Rated torque permillage)	--	INT	No	Read only
D28460	EF2C	Current speed (Unit: 0.1 r/min）	--	DINT	No	Read only
D28461	EF2D		--		No	Read only
D28462	EF2E	Present current (Rated current permillage)	--	INT	No	Read only
D28463	EF2F	Custom parameter value	--	DINT	No	Read only
D2864	EF30		--		No	Read only
D28465	EF31	The phase of the terminal actuator	0~ modulo	REAL	No	Read only
D28466	EF32					
D28467	EF33	The position of the terminal actuator	-2147483648 ~ 2147483647	DINT	No	Read only
D28468	EF34					

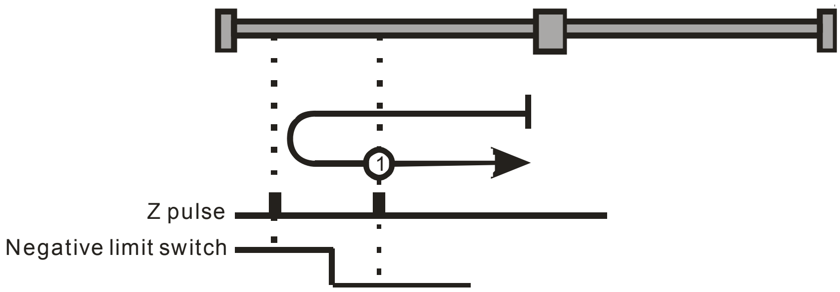
Note: The axis parameters such as Position, Velocity, Torque, Current and User defines parameter can be read via special D only when they are selected. For the method of selecting the relevant parameter, see section 2.3.1.

Appendix D Explanation of Homing Methods

10MC11T provides several homing methods from which user can choose the appropriate one in accordance with on-site condition and technical requirement.

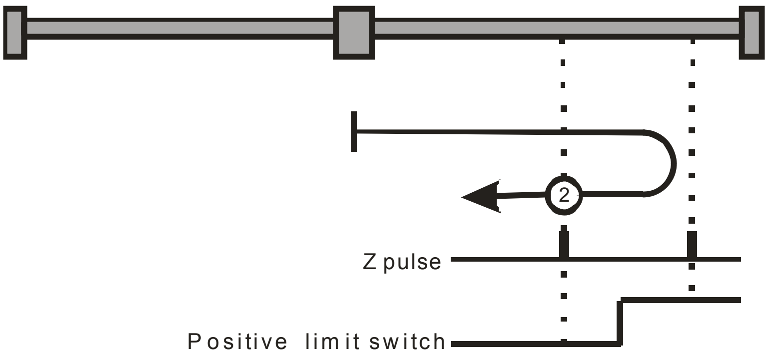
- Method 1 Homing on the negative limit switch and Z pulse

  In this homing method, when negative limit switch is inactive, the initial movement direction is negative; when negative limit switch is active, movement direction starts to be changed; the home position is where the first Z pulse is when negative limit switch is inactive as shown below.



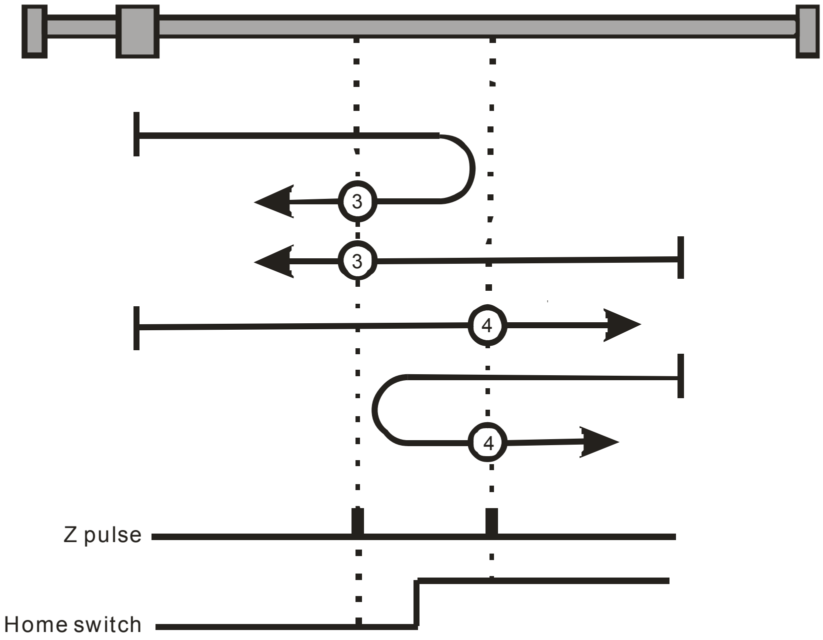
- Method 2 Homing on the positive limit switch and Z pulse

  In this homing method, when positive limit switch is inactive, the initial movement direction is positive; when positive limit switch is active, movement direction starts to be changed; the home position is where the first Z pulse is when positive limit switch is inactive as shown below.



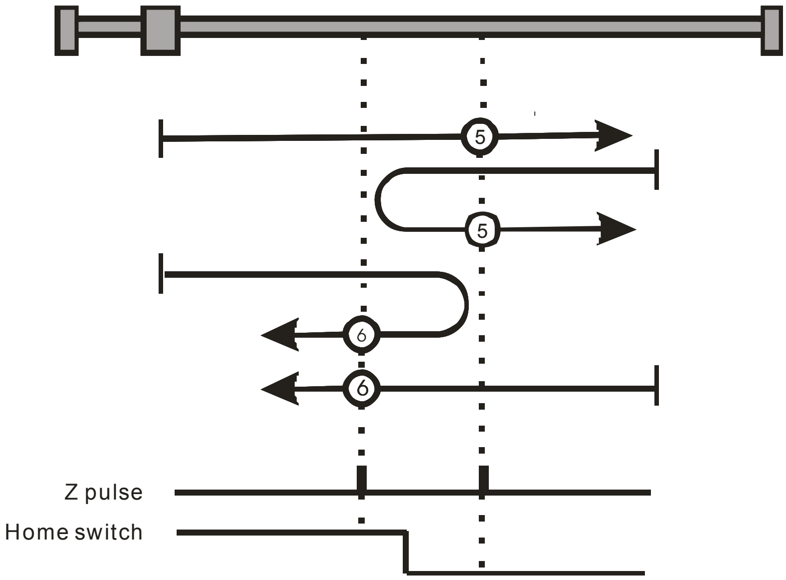
- Method 3 and 4 Homing on positive home switch and Z pulse

  In method 3 and 4, the initial movement direction depends on whether the positive home switch is active or inactive. The home position in method 3 is at the place of the first Z pulse after positive home switch changes the status from active to inactive. The home position in method 4 is at the place of the first Z pulse after positive home switch changes from inactive status to active status or from active status to inactive status.



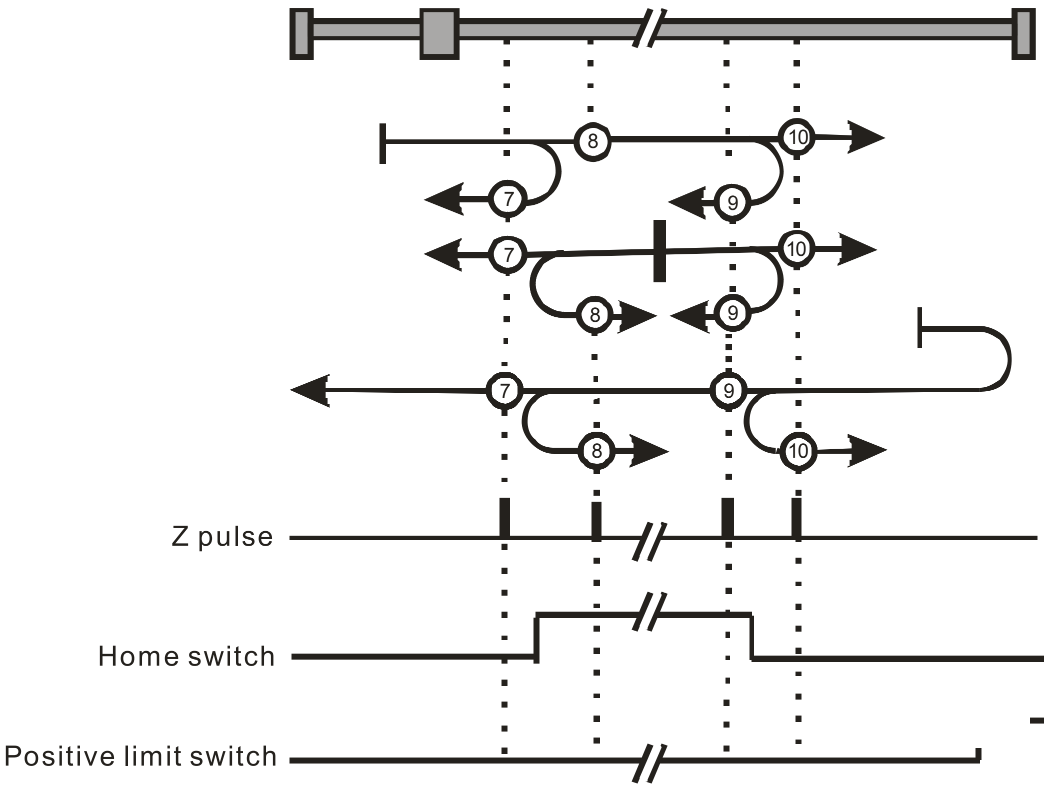
➢ Method 5 and 6   Homing on negative home switch and Z pulse

In method 5 and 6, the initial movement direction depends on whether the negative home switch is active or inactive. (Note: the initial direction of method 5 is just the reverse of that of method 3; and the initial direction of method 6 is just the reverse of that of method 4.)   The home position in method 5 is at the place of the first Z pulse after negative home switch changes from active status to inactive status. The home position in method 6 is at the place of the first Z pulse after negative home switch changes from active status to inactive status or from inactive status to active status.

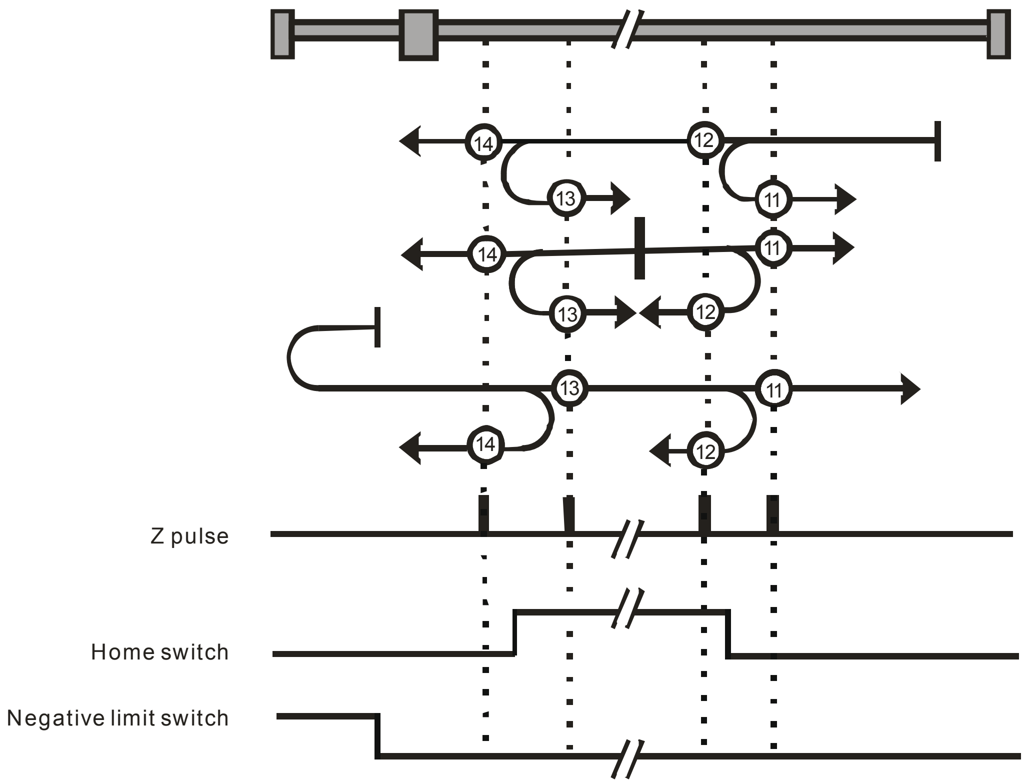


➢ Method 7 ~10   Homing on home switch and Z pulse

In method 7 ~10, the initial direction depends on the status of home switch and the positive limit switch. Their home positions are at the place of the first Z pulse after home switch changes from active status to inactive status or from inactive status to active status.



➢ In mode 11 ~ 14, the initial movement direction depends on the status of home switch and the status of the negative limit switch. Their home positions are at the place of the first Z pulse after home switch changes from active status to inactive status or from inactive status to active status.

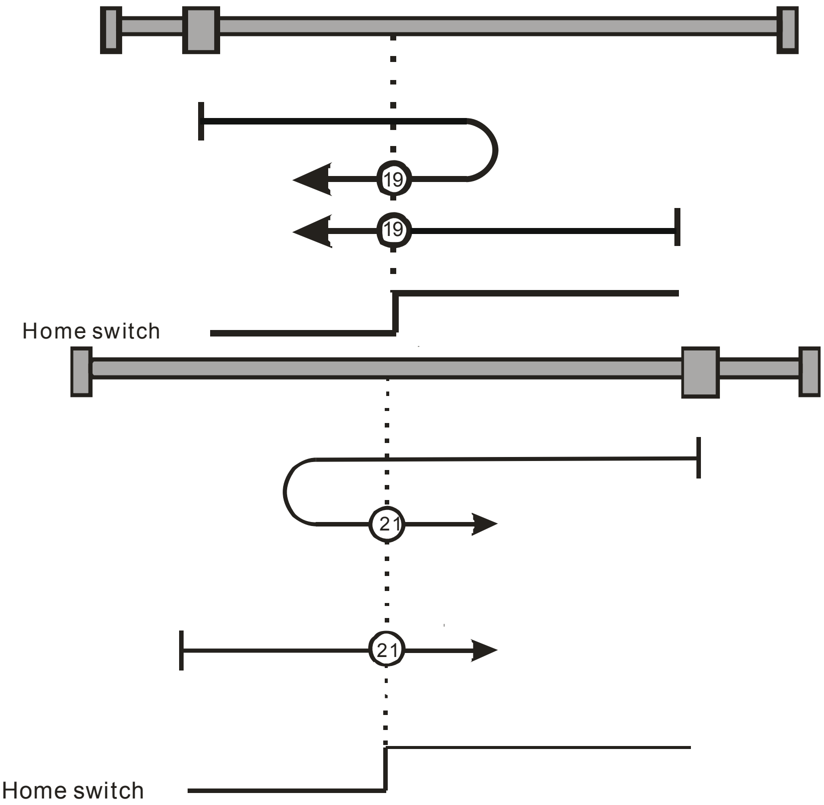


➢ Method 15 and 16: Reserved

Method 15 and 16 are reserved for future expansion as homing mode.

- Method 17~30 are the homing methods which do not need Z pulse.

  Method 17~30 are similar to method 1 to method 14 except that home position is not dependent on Z pulse but dependent on the relevant home switches and limit switches status. Method 17 is similar to method 1; method 18 is similar to 2; method 19 and method 20m are similar to method 3; method 21 and method 22 are similar to method 5; method 23 and method 24 are similar to method 7; method 25 and method 26 are similar to method 9; method 27 and method 28 are similar to method 11; method 29 and method 30 are similar to method 13. Take an example of method 19 and method 21, their home positions are shown in the following diagram.

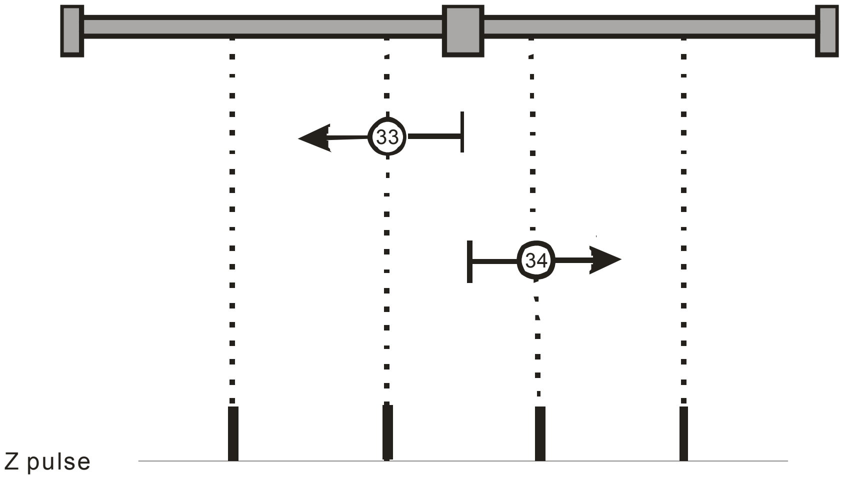


- Method 31 and 32: reserved.

  Method 31 and 32 are reserved for future expansion as homing mode.

- Method 33 and 34 depend on the homing of Z pulse.

  The homing directions in method 33 and 34 are positive and negative respectively and their homing position is at the place of the first Z pulse found in the selected direction.



- Method 35 Homing on the current position

  In method 35, the current position of servo is taken to be the home position.

Appendix E PLC Module Devices

<table>
<tr><th colspan="4">Item</th><th colspan="2">Range</th></tr>
<tr><td colspan="4">Control method</td><td colspan="2">Stored program, cyclic scan system</td></tr>
<tr><td colspan="4">Input/output method</td><td colspan="2">Batch processing method (when END instruction is executed)</td></tr>
<tr><td colspan="4">Execution speed</td><td colspan="2">LD command - 0.54μs, MOV command - 3.4μs</td></tr>
<tr><td colspan="4">Program language</td><td colspan="2">Instruction list+ Ladder+SFC</td></tr>
<tr><td colspan="4">Program capacity</td><td colspan="2">15872 steps</td></tr>
<tr><td rowspan="13">Bit relay</td><td>X</td><td colspan="2">External input relay</td><td>X0~X377, octal code, 256 points</td><td rowspan="2">Total 480+14 points (*4)</td></tr>
<tr><td>Y</td><td colspan="2">External output relay</td><td>Y0~Y377, octal code, 256 points</td></tr>
<tr><td rowspan="3">M</td><td rowspan="3">Auxiliary relay</td><td>General purpose</td><td>M0~M511, 512 points (*1)M768~M999，232 points (*1)M2000~M2047，48 points (*1)</td><td rowspan="3">Total 4096 points</td></tr>
<tr><td>Latched</td><td>M512~M767, 256 points (*2)
M2048~M4095, 2048 points (*2)</td></tr>
<tr><td>Special purpose</td><td>M1000~M1999, 1000 points, some are latched.</td></tr>
<tr><td rowspan="6">T</td><td rowspan="6">Timer</td><td rowspan="3">100ms (M1028=On, T64~T126 is10ms) (*1)</td><td>T0~T126, 127 points (*1)
T128~T183, 56 points</td><td rowspan="6">Total 256 points</td></tr>
<tr><td>T184~T199 (used by sub-program), 16 points (*1)</td></tr>
<tr><td>T250~T255(accumulated type), 6 points (*1)</td></tr>
<tr><td rowspan="2">10ms (M1038=On, T200~T245 is 1ms)</td><td>T200~T239, 40 points (*1)</td></tr>
<tr><td>T240~T245(accumulated type), 6 points (*1)</td></tr>
<tr><td>1ms</td><td>T127, 1 points (*1)
T246~T249(accumulated type), 4 points (*1)</td></tr>
<tr><td rowspan="9">Bit relay</td><td rowspan="4">C</td><td rowspan="4">Counter</td><td rowspan="2">16-bit counting up</td><td>C0~C111, 112 points (*1)
C128~C199, 72 points (*1)</td><td rowspan="4">Total 232 points</td></tr>
<tr><td>C112~C127, 16 points (*2)</td></tr>
<tr><td rowspan="2">32-bit counting up/down</td><td>C200~C223, 24 points (*1)</td></tr>
<tr><td>C224~C231, 8 points (*2)</td></tr>
<tr><td rowspan="5">S</td><td rowspan="5">Step</td><td>Initialized step point</td><td>S0~S9, 10 points (*2)</td><td rowspan="5">Total 1024 points</td></tr>
<tr><td>Zero return</td><td>S10~S19, 10 points (used by matching IST command) (*2)</td></tr>
<tr><td>latched</td><td>S20~S127, 108 points (*2)</td></tr>
<tr><td>General purpose</td><td>S128~S911, 784 points (*1)</td></tr>
<tr><td>Used for alarming</td><td>S912~S1023, 112 points (*2)</td></tr>
</table>

<table>
<tr><th colspan="4">Item</th><th colspan="2">Range</th></tr>
<tr><td rowspan="8">Word register</td><td>T</td><td colspan="2">Timer current value</td><td colspan="2">T0~T255, 256 words</td></tr>
<tr><td rowspan="2">C</td><td colspan="2" rowspan="2">Counter current value</td><td colspan="2">C0~C199, 16-bit counter, 200 words</td></tr>
<tr><td colspan="2">C200~C254, 32 -bit counter, 55 words</td></tr>
<tr><td rowspan="5">D</td><td rowspan="5">Data register</td><td>General purpose</td><td>D0~D407, 408 words (*1)
D600~D999, 400 words (*1)
D3920~D9999, 6080 words (*1)</td><td rowspan="5">Total
1000 words</td></tr>
<tr><td>Latched</td><td>D408~D599, 192 words (*2)
D2000~D3919, 1920 words (*2)</td></tr>
<tr><td>Special purpose</td><td>D1000~D1999, 1000words, some are latched.</td></tr>
<tr><td>Used by special module</td><td>D9900~D9999, 100 words (*1)</td></tr>
<tr><td>Used for changing address</td><td>E0~E7, F0~F7, 16 words (*1)</td></tr>
<tr><td rowspan="4">Pointer</td><td>N</td><td colspan="2">Used by main circuit loop</td><td colspan="2">N0~N7, 8 points</td></tr>
<tr><td>P</td><td colspan="2">Pointer</td><td colspan="2">P0~P255, 256 points</td></tr>
<tr><td rowspan="2">I</td><td rowspan="2">Interruption</td><td>Timed interruption</td><td colspan="2">I602~I699, I702~I799, 2 points (time base = 1ms)</td></tr>
<tr><td>Communication interruption</td><td colspan="2">I140(COM1), I150(COM2), 2points (*3)</td></tr>
<tr><td rowspan="2">Constant</td><td>K</td><td colspan="2">Decimal</td><td colspan="2">K-32,768 ~ K32,767 (16-bit operation),
K-2,147,483,648 ~ K2,147,483,647 (32-bit operation).</td></tr>
<tr><td>H</td><td colspan="2">hexadecimal</td><td colspan="2">H0000 ~ HFFFF (16-bit operation),
H00000000 ~HFFFFFFFF (32-bit operation).</td></tr>
<tr><td colspan="4">Communication port</td><td colspan="2">COM1: built-in RS-232 (master/ slave), the commonly used program editing COM port.
COM2: Built-in RS-485 (master/ slave).</td></tr>
<tr><td colspan="4">Special extension module</td><td colspan="2">Max. 8 analog extension modules connected to the right side of PLC.
Max. 7 high-speed extension modules connected to the left side of PLC.</td></tr>
</table>

Notes:

1) Non- latched area can not be modified.
2) Latched area can not be modified.
3) COM1: built-in RS-232 communication port; COM2: built-in RS-485 communication port.