FATEK

M Series

Programmable Controller

M-Series PLC Motion User Manual

NEXT Level SOLUTION

The contents of the manual will be revised as the version changes, and this version may not be the final version. Please go to www.fatek.com technical support area to download the latest version of the manual.

FATEK AUTOMATION CORP.

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Precautions on Using the Product

Compliance with the application-related conditions

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

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

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

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

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

Disclaimers

Dimensions and weight

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

Performance data

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

Errors and negligence

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

Change of specifications

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

Amendment Record

Version	Date	Content	Page	Editor
VX.X.XX	2021/11/18	Version 1	137	

1

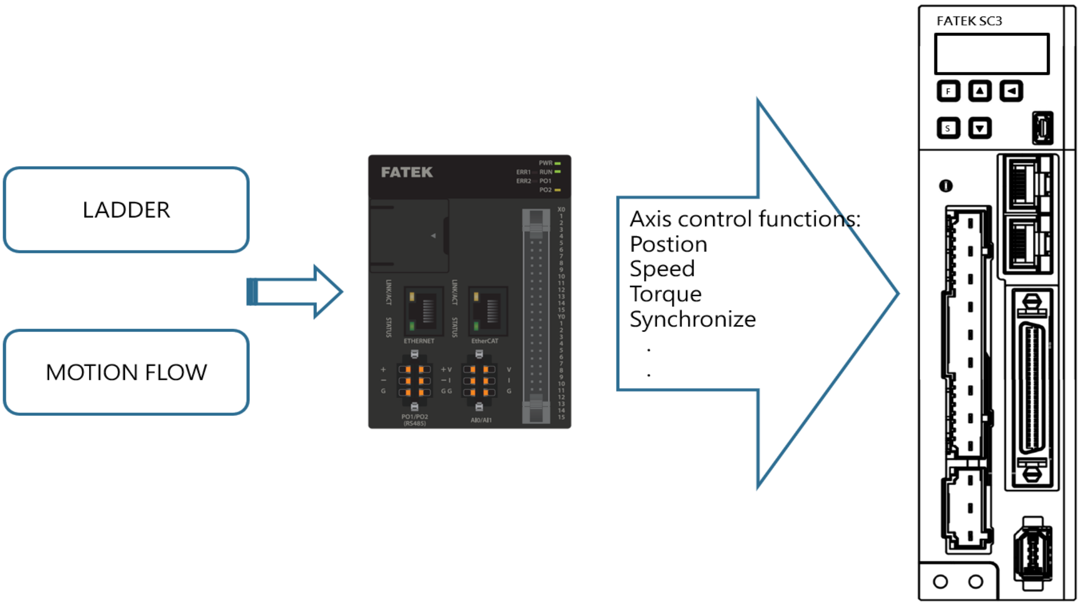
Summary of M-PLC Motion Control Unit

This section describes the function and overview of the M-PLC Motion Control Unit. In design, the M-PLC provides the communication-based EtherCAT axial motion control function. It can be used to control the operation of maximum 16 axes. In the meantime, it also provides the impulse motion control for a number of 4 axes. In the aspect of programming, the M-PLC provides the motion control required for calling the ladder diagram as well as the motion control calling required for the Motion Flow.

*The 32-Axis EtherCAT Motion Control is still being planned, please refer to FATEK official website for related information and manual.

1-1 Motion Unit Function Diagram

The M-PLC Motion Control Unit can issue the motion command to the servodriver while providing the axis control related functions such as position control, speed control and synchronizing control.



Program Function:

In terms of programming function, the M-PLC program provides conventional ladder diagram related program design and the Motion Flow related motion flow block required for the motion control.

Axis Control Function:

With the axis control function, it allows the user to output the action commands such as position control, speed control or synchronizing control for the connected axis servo and the created servo.

Servo EtherCAT I/O Function:

Through the EtherCAT communication, the user will be allowed to read the servo I/O status such as HOME signal and limit signal, etc.

1-2 Axis Control Function and Reference

Provided below are the axis motion control functions and the references

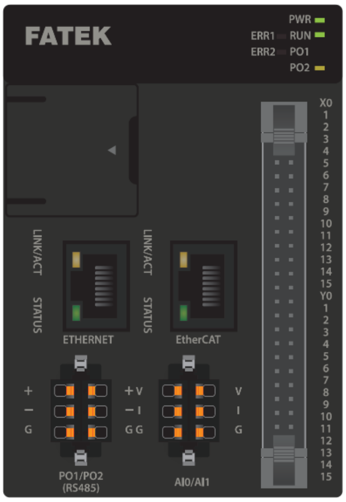
Axis motion control function	**Reference**
HOME Return	HOME Return
Position Control	Position Control and Interpolation
Speed Control	Velocity Control
Torque Control	Torque Control
Synchronous Control	Synchronous Control
Interpolation Control	Multi-axis Interpolation
JOG Control	JOG Mode

In addition to the aforesaid axis functions reference, it also allows the user to use the following functions:

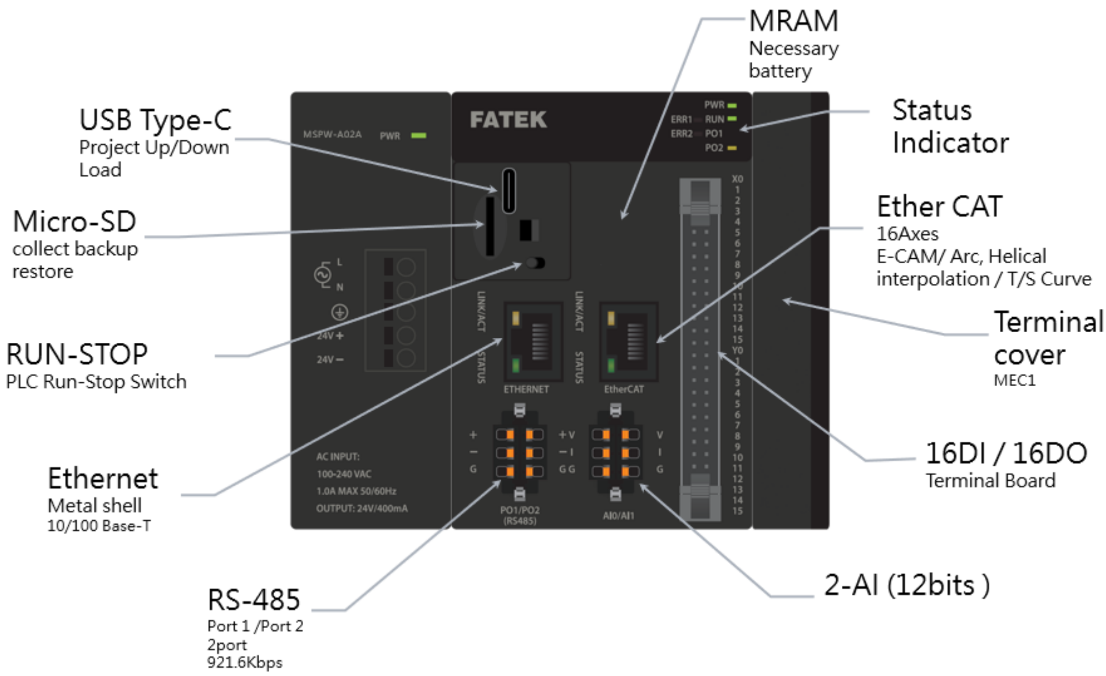
Function Unit	**Reference**
Special Motion Register and Relay	Special Register and Relay
EtherCAT Function	EtherCAT Function and Configuration
Axis Parameters and Point Parameters	Axis Parameters and Setting Point Table and Point Parameters
Ladder Command	Ladder Motion Command
Motion Flow Block	Introduction of Motion Flow
Motion Parameter Mapping Table	Motion Parameter Mapping Table
Test Run	Test Run

1-3 Axis Control Function and Reference

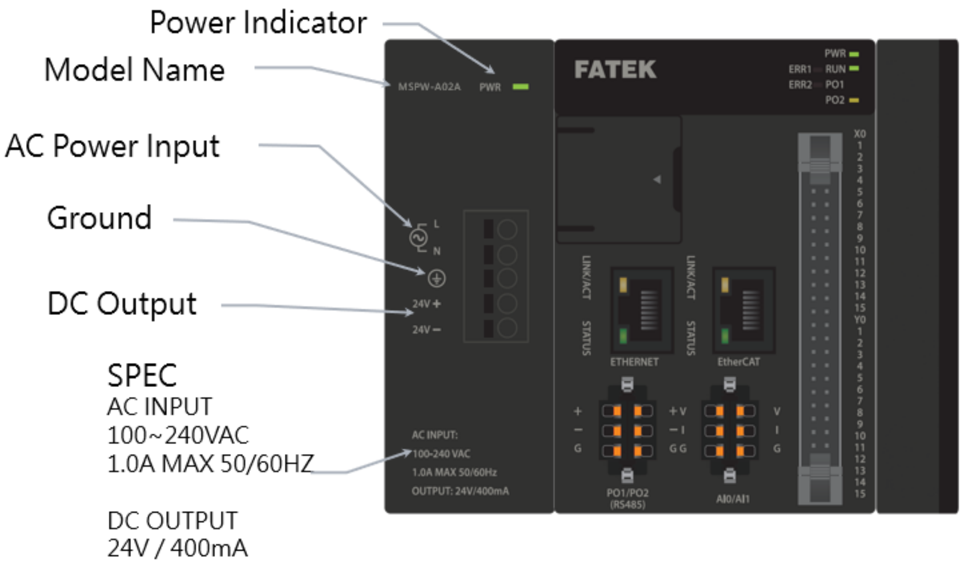
Described below are the unit hardware interfacing port between M-PLC units and the indicator status, as per the M-PLC Unit indicated below. The left-hand side port is provided for connecting to the power module and communication module, and the right-hand side port is designed for connecting to the AIO, DIO and temperature module, etc. Further, the right-hand side should also be provided with a terminal module for using as the terminal end.



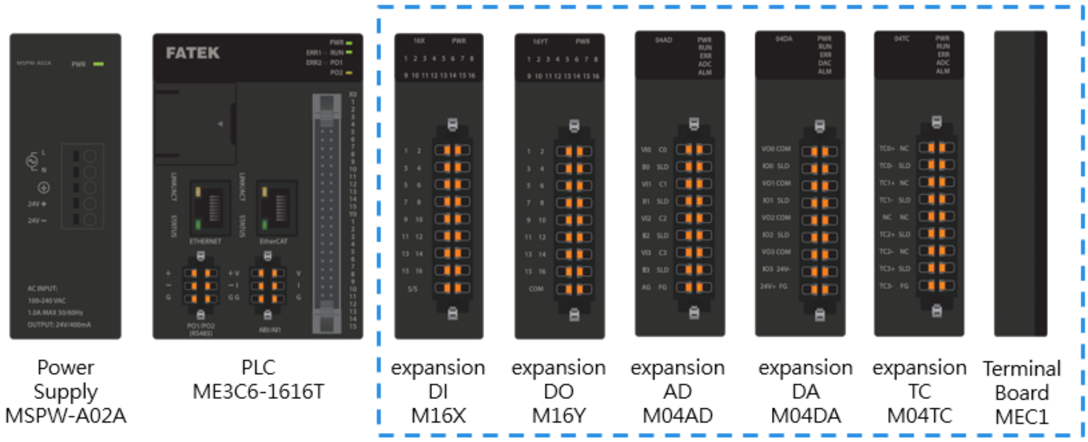
Indicated below are the M-PLC unit related ports:



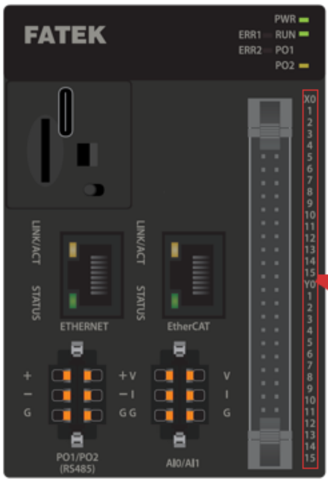
Indicated below is the M-PLC Power Module:



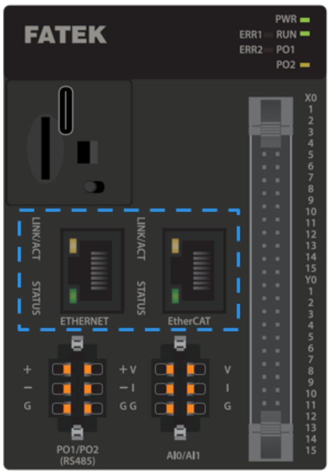
The M-PLC also provides the extension function of expanding the right-hand side module. It allows the user to apply such function to other equipment for expanding the AIO/DIO/temperature modules, as per the figure below:



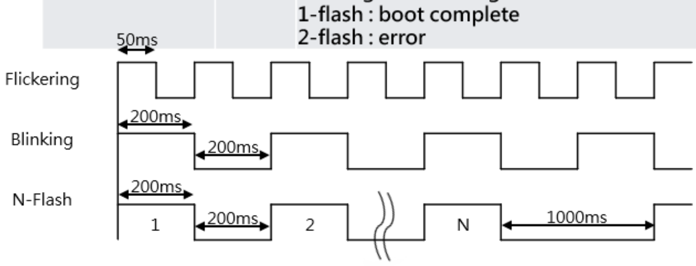
Described below are the M-PLC status indicators:



Indicator light	Color	Definition
PWR	Red	Always on when power is on
RUN	Green	Slow flashing when stopped Flashing fast when running
ERR1	Red	Warning or Alarm occur
ERR2	Red	Reserve
PO1	Orange	Port1 Blinks when communicating
PO2	Orange	Port2 Blinks when communicating
X0~X15	Orange	Lights up when ON Lights off when OFF
Y0~Y15	Orange	Lights up when ON Lights off when OFF
Ethernet RJ45 Port	Yellow	Steady light means that the network line is connected, it will flash during communication, and off means the network line is not connected
Ethernet RJ45 Port	Green	Blinking light in DHCP mode indicates IP is in progress Steady light indicates IP is set via DHCP Constant dark light indicates invalid IP A special flashing light indicates that the I-Monitor is connected



Indicator light	Color	Definition
Ether CAT RJ45 Port	Yellow	Steady light means that the network line is connected, it will flash during communication, and off means the network line is not connected
Ether CAT RJ45 Port	Green	off : on : Err Trap flickering : In action blinking : Connecting 1-flash : boot complete 2-flash : error

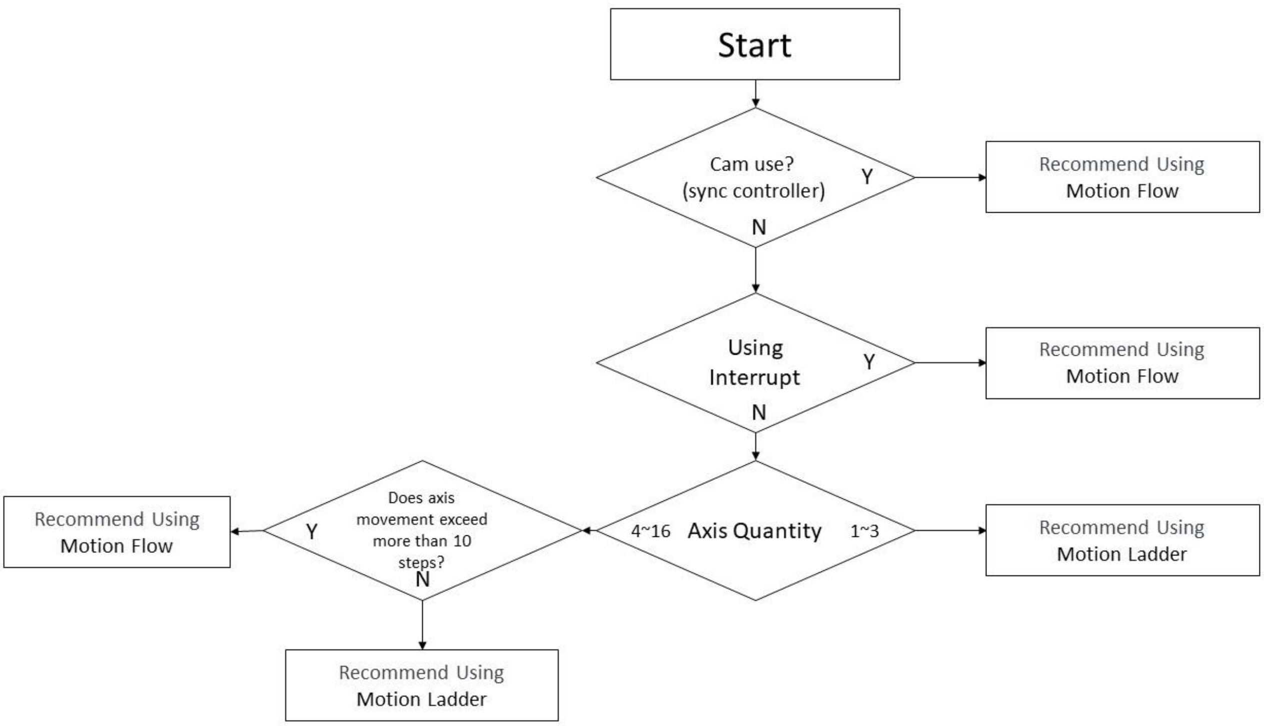


1-4 Action before M-PLC Position Control

Before executing the position control with the M-PLC, the user is required to execute the following basic start-up steps:

Step	Action	Remark
1	Installation/Wiring Wiring installation of M-PLC, SC3 EtherCAT servo and external devices.	
2	Install the M-PLC editing software: UperLogic.	Please refer to Software User Manual
3	Set [Motion Axis Link] and [Motion Axis Parameter] with Uperlogic.	Please refer to Chapter 4
4	Programming and use Fun187 to initialize SC3 EtherCAT Servo.	Please refer to Section 6-1
5	Programming and use special register M10520 to enable SC3 EtherCAT Servo.	Please refer to Chapter 2
6	Programming and use Ladder and Motion Control Flow to eecute motion control.	Please refer to Chapter 5-7
7	Downloading projects to M-PLC.	Enabling download through USB or Network.
8	Starting test run.	

Ladder Diagram and Selection of Motion Control:



2

Motion Parameters and Status (Special Register and Relay)

This section will introduce the layout of memory in the M-PLC and the details of the register. The scope of Motion Registers starts from R36880 for using as the starting register, and the scope of Relays starts from M10512.

	Type	Start Address	Size Per axis
Motion System Register (word)	R	R36880	
Motion Axis Register (word)	R	R36980	150
Motion System Relay (Bit)	M	M10512	
Motion Axis Relay (Bit)	M	M10600	40
Motion Flow Block is done (Bit)	M	M12000	
Motion Flow Block is in progress (Bit)	M	M16160	

2-1 Motion Flow_ Special Register

※Described below are the current axis number of N.

※Please refer to Chapter 17 – Motion Flow Alarm for the description of error codes of each register and relay.

R Register

Register No.	Function	System Tag Symbol
R36880	Motion controller state	UNIT_STATE
R36881	Motion controller error code	UNIT_ERR
R36882	Unit Program State	UNIT_PROGRAM_STATE
R36883	Unit Error Code	UNIT_ERR_CODE
R36884 - 36903	Current Step	CURRENT_STEP_1 - CURRENT_STEP_20
R36904 - 36923	Current Block State	CURRENT_BLOCK_STATE_1 - CURRENT_BLOCK_STATE_20
R36924 - 36943	Flow State ID	FLOW_STATE_ID_1 - FLOW_STATE_ID_20
DR36964 - 36970	Encoder value	ENCODER_VALUE_2 - ENCODER_VALUE_4
DR36972	Gray code encoder value	GRAY_CODE_ENCODER_VALUE
DR36974	Gray code encoder turns	GRAY_CODE_ENCODER_TURNS

R36880 Motion Controller Status：

- Status of Motion Control Card, the normal will be 0.
- Display a number when function 187 fails to activate Motion.
- Display a number when there is an EtherCAT communication abnormality during the motion process.
- Display a number when a significant abnormality occurs during the motion process.

R36881 Motion Controller Error Code：

- Error codes of Motion Control Card, the normal will be 0.
- Display the error codes when Motion controller status is not 0.

R36882 Motion Program Status：

- Displaying status after enabling Motion function.
- The value is the maximum value within the motion flow states (R36924 - 36943).
- 0 : Motion is not started.

  4：Motion activated, EtherCAT connection in progress.

  6：Motion flow control in progress.

9：Motion flow in error

R36883 Motoin Program Error Code：

- The value is the error code of the last occurrence within the motion flow states (R36924 - 36933)

R36884 – 36903 Motion Branch Flow Block Number：

- Current floe block number of Motion branch.
- When a new motion flow is initiated or the motion flow enters a parallel branch, the foremost idle branch will be utilized.

R36904 – 36923 Motion Branch Flow Block Status：

- Current flow block status of Motion branch.
- 0：Idle branch

  1：Flow block in control

  2：Flow block completed

R36924 – 36943 Motoin Flow Status：

- Status codes of Motion flow.
- After Function 187 initiates the Motion, set it to 4
- 0 : Motion is not started

  4：Motion activated, EtherCAT connection in progress.

  6：Motion flow control in progress.

  9：Motion flow in error

DR36964 – 36970 External Encoder Value：

- HSC 4 - HSC 7 Pulse Counts.
- Need to enable HSC 4 - HSC 7 in the I/O configuration settings

DR36972 Gray Code Encoder Value：

- Value of gray code encoder.
- There are 8 bits for X8 - X15, with a range of 0 to 255.

DR36974 Gray Code Encoder Turns：

- Turns of gray code encoder , with positive and negative signs.

2-2 Motion Control_Special Relay

When setting the bit for motion control special register, each axis will be added with 40 bits. For example, if the HOME sensor of Axis-1 is M10605, then the HOME sensor of Axis-2 will become M10645, and so on.

Relay No.	Function	System Tag Symbol
M10520	All axes: Servo ON	ALL_SERVO_ON
M10521	All axes: Servo Reset	ALL_SERVO_FAULT_RST
M10522	Write all mapping parameters during initialization.	Reserve
M10523	Motion control card restart.	Reserve
M10600 + 40*(n-1)	Axis control command: Servo ON	AX1_SERVO_ON
M10601+ 40*(n-1)	Axis control command: Fault Reset	AX1_FAULT_RST
M10602+ 40*(n-1)	Axis control command: Deceleration Stop	AX1_DEC_STOP
M10603+ 40*(n-1)	Axis control command: Emergency stop	AX1_EMG_STOP
M10604+ 40*(n-1)	Axis Synchronous main clutch ON	AX1_SYNC_ON
M10605+ 40*(n-1)	Axis Origin On	AX1_ORG_SIG
M10606+ 40*(n-1)	Axis limit(+) on	AX1_POST_SIG
M10607+ 40*(n-1)	Axis limit(-) on	AX1_NEG_SIG
M10608+ 40*(n-1)	Z Count Signal	AX1_Z_SIG
M10609+ 40*(n-1)	Axis Synchronous main clutch ON Disable	AX1_SYNC_ON_DIS
M10610+ 40*(n-1)	Axis Synchronous main clutch OFF Disable	AX1_SYNC_OFF_DIS
M10611+ 40*(n-1)	Axis Synchronous auxiliary clutch ON	AX1_SYNC_AUX_CLU_ON
M10612+ 40*(n-1)	Axis Synchronous auxiliary clutch ON Disable	AX1_SYNC_AUX_CLU_ON_BAN

Relay No.	Function	System Tag Symbol
M10613+ 40*(n-1)	Axis Synchronous auxiliary clutch OFF Disable	AX1_SYNC_AUX_CLU_OFF_BAN
M10614+ 40*(n-1)	Reserved	
M10615+ 40*(n-1)	Reserved	
M10616+ 40*(n-1)	Reserved	
M10617+ 40*(n-1)	Axis Probe 1 Function ON	AX1_PROBE1_ON
M10618+ 40*(n-1)	Axis Probe 1 Function Reset	RESET_AX1_PROBE1
M10619+ 40*(n-1)	Axis Probe 2 Function ON	AX1_PROBE2_ON
M10620+ 40*(n-1)	Axis Probe 2 Function Reset	RESET_AX1_PROBE2
M10621+ 40*(n-1)	Axis Synchronization Parameter Immediate Effect Request	AX1_SYNC_PARM_APPLY_IMMED
M10622+ 40*(n-1)	Axis Synchronization Parameter Next Period Effect Request	AX1_SYNC_PARM_APPLY_NXT_PER
M10623+ 40*(n-1)	Axis Syncronizationc Clutch Edge Trigger Buffer On	AX1_SYNC_CLU_EDGE_TRIG_CACHE_ON
M10624+ 40*(n-1)	Initialization of the Cam phase when the axis synchronous clutch is OFF	OUTPUT_PHASE_INIT_WHEN_AX1_SYNC_CLU_OFF
M10625+ 40*(n-1)	Axis Rotation Angle Choose Near	AX1_ROTA_ANG_CHOOSE_NEAR
M10626+ 40*(n-1)	Axis Rotation Angle Target Direction	AX1_ROTA_ANG_TGT_DIR
M10627+ 40*(n-1)	Axis Syncronizationc Mode ON	AX1_SYNC_MODE_ON
M10628+ 40*(n-1)	Pause Current Action	AX1_PAUSE_CURR_ACTN
M10629+ 40*(n-1)	High speed homing mode ON	Reserve

Relay No.	Function	System Tag Symbol
M10630+ 40*(n-1)	Axis specifies current coordinates	AX1_SPEC_CURR_COORD
M10631+ 40*(n-1)	Axis operation mode ON	AX1_OP_MODE_ON
M10632+ 40*(n-1)	Axis operation mode unit	AX1_OP_MODE_UNIT
M10633+ 40*(n-1)	Axis operation mode absolute coordinates	AX1_OP_MODE_ABS_COORD
M11240 + 40*(n-1)	Servo On	AX1_SERVO_IS_ON
M11241+ 40*(n-1)	Operation Ready	AX1_OP_READY
M11242+ 40*(n-1)	Axis error in progress	AX1_IN_ERR
M11243+ 40*(n-1)	Axis warning in progress	AX1_IN_WARN
M11244+ 40*(n-1)	Control in progress	AX1_IN_CTRL
M11245+ 40*(n-1)	Homing in progress	AX1_IN_HOM
M11246+ 40*(n-1)	Homing done	AX1_HOM_DN
M11247+ 40*(n-1)	Positioning in progress	AX1_IN_POSI
M11248+ 40*(n-1)	Positioning done	AX1_POSI_DN
M11249+ 40*(n-1)	JOG in progress	AX1_IN_JOG
M11250+ 40*(n-1)	JOG done	AX1_JOG_DN
M11251+ 40*(n-1)	Synchronizing in progress	AX1_IN_SYNC
M11252+ 40*(n-1)	Synchronizing done	AX1_SYNC_ON
M11253+ 40*(n-1)	Speed mode in progress	AX1_SPEED_MODE
M11254+ 40*(n-1)	Speed mode done	AX1_SPEED_MODE_IS_DONE

Relay No.	Function	System Tag Symbol
M11255+ 40*(n-1)	Torque mode in progress	AX1_TORQ_MODE
M11256+ 40*(n-1)	Torque mode done	AX1_TORQ_MODE_IS_DONE
M11257+ 40*(n-1)	Axis soft limit(+) status	AX1_SOFT_LIM_POS_STATUS
M11258+ 40*(n-1)	Axis soft limit(-) status	AX1_SOFT_LIM_NEG_STATUS
M11259+ 40*(n-1)	Axis origin limit status	AX1_ORIG_LIM_STATUS
M11260+ 40*(n-1)	Axis limit(+) status	AX1_LIM_POS_STATUS
M11261+ 40*(n-1)	Axis limit(-) status	AX1_LIM_NEG_STATUS
M11262+ 40*(n-1)	Axis Probe 1 triggered state	TRIG_STATUS_OF_AX1_PROBE1
M11263+ 40*(n-1)	Axis Probe 2 triggered state	TRIG_STATUS_OF_AX1_PROBE2
M11264+ 40*(n-1)	Axis synchronization parameter effective state	VALID_STATUS_OF_AX1_SYNC_PARM
M11265+ 40*(n-1)	Axis tracking error state	AX1_FLO_ERR_STATUS
M11266+ 40*(n-1)	Axis Pause Status	AX1_PAUSE_STATUS
M11267+ 40*(n-1)	Homing mode Z-phase signal	Reserve
M11268+ 40*(n-1)	Axis operation mode action	AX1_OP_MODE_ACT
M11269+ 40*(n-1)	Axis operation mode done	AX1_OP_MODE_DN

Motion control special temporary register R + 150 per axis. For example, axis 1 position control state R36980, axis 2 position control state R37130, and so on.

Relay No.	Function	System Tag Symbol
R36980 + 150*(n-1)	Axis properties	-
R36984+ 150*(n-1)	Current Control Mode	AX1_CTRL_MODE
R37004+ 150*(n-1)	Error Detail Information 1	AX1_ERR_INFO_1
R37005+ 150*(n-1)	Error Detail Information 2	AX1_ERR_INFO_2

Relay No.	Function	System Tag Symbol
R37006+ 150*(n-1)	Warning Detail Information 1	AX1_WARN_INFO_1
R37007+ 150*(n-1)	Warning Detail Information 2	AX1_WARN_INFO_2
R37012+ 150*(n-1)	Axis Control	AX1_AX_CTRL
R37013+ 150*(n-1)	Axis Warning Code	AX1_WARN_CODE
DR37014+ 150*(n-1)	Command Coordinate	AX1_CMD_COORD
DR37016+ 150*(n-1)	Command Speed	AX1_CMD_SPD
DR37018+ 150*(n-1)	Command Position	AX1_CMD_POSI
R37020+ 150*(n-1)	Positioning Current Point No.	AX1_POSI_CUR_PT_NUM
DR37021+ 150*(n-1)	Current Coordinate	AX1_CUR_COORD
DR37023+ 150*(n-1)	Feedback Speed Monitor	AX1_SPD
DR37025+ 150*(n-1)	Position Deviation Monitor	AX1_POSI_DEV
DR37027+ 150*(n-1)	Digital Input from Driver	AX1_DRIVE_DI
R37029+ 150*(n-1)	Current Flow ID	CURRENT_AX_FLOW_NUM
DR37030+ 150*(n-1)	Contact Output	AX1_CNTA_OUT
R37032+ 150*(n-1)	Current Torque	AX1_CUR_TORQ
DR37033+ 150*(n-1)	E-Cam Input Phase	AX1_ECAM_IN_PHASE
DR37035+ 150*(n-1)	Origin Position	AX1_ORG_POSI
R37037 - R37039+ 150*(n-1)	Axis Status Word 1-3	AX1_CONTROL_STATUS_WORD1 - AX1_CONTROL_STATUS_WORD3
DR37040+ 150*(n-1)	Main Clutch Output Phase	AX1_MAIN_CLUTCH_OUTPUT_PHASE
DR37042+ 150*(n-1)	Probe 1 Coordinate	AX1_DRIVER_PROBE1_COORDINATES
DR37044+ 150*(n-1)	Probe 2 Coordinate	AX1_DRIVER_PROBE2_COORDINATES
DR37050+ 150*(n-1)	Axis specifies coordinates	AX1_SPEC_COORD
DR37052+ 150*(n-1)	Axis operation control mode	AX1_OP_CRTL_MODE
DR37054+ 150*(n-1)	Axis operation mode instruction 1	AX1_OP_ MODE_INS1
DR37056+ 150*(n-1)	Axis operation mode instruction 2	AX1_OP_ MODE_INS2
DR37058+ 150*(n-1)	Axis operation mode instruction 3	AX1_OP_ MODE_INS3

M10520 All axes servo on：

- Rising: All axis servo on
- Falling: All axis servo off
- Axis enabled (M10600+40*(n-1)) will also change accordingly.

M10521 All axis servo reset：

- Rising: All axis clearing error
- 1.The motion program status (R36882) should change from 9 to 4 or 6, and (R36924 - R36933) should change from 9 to 4

  2. The motion program error code (R36883) should change to 0.
  3. If there is an error in the drive, it should be cleared at the same time.
  4. Axis Error Info (R37004 + 150*(n-1)) and (R37005 + 150*(n-1)) should change to 0.
  5. Axis Alarm Info (R37006 + 150*(n-1)) and (R37007 + 150*(n-1)) should change to 0.
  6. Axis Status is in error (M11242 + 40*(n-1)) and Error Status is in alarm (M11243 + 40*(n-1)) should be reset.

M10522 Write all mapping parameters during initialization.：

- On: Complete write during initialization.
- Off: Write according to the mapping table settings.
- Enable：Synchronously write all items from the mapping table after Fun187 is executed and completed.
- Not enable：Write the items according to the mapping table settings after Fun187 is executed and completed..

M10523 Motion control card restart.：

- Rising: Restart the motion control card .
- Enable：Cease all current motion control and restore to the status at PLC restart.
- When encountering a system emergency stop, it can be used to restart the motion control card.

M10600 + 40*(n-1) Axis control command Servo ON：

- Rising: Single axis servo on
- Falling: Single axis servo off
- Will change accordingly when all axes servo on (M10520) changes.

M10601 + 40*(n-1) Axis control command Fault Reset：

- Rising: Single axis clearing error
- Motoin flow status (R36924 - R36933) of current axis motion flow No. (R37029) should change from 9 to 4.

  2. If there is an error in the drive, it should be cleared at the same time.
  3. Axis Error Info (R37004 + 150*(n-1)) and (R37005 + 150*(n-1)) should change to 0.
  4. Axis Alarm Info (R37006 + 150*(n-1)) and (R37007 + 150*(n-1)) should change to 0.

5. Axis Status is in error (M11242 + 40*(n-1)) and Error Status is in alarm (M11243 + 40*(n-1)) should be reset.

M10602 + 40*(n-1) Axis deceleration stop：

- Rising: Single axis deceleration stop.
- Using the stop mode from the axis table to stop axis and deceleration uses the deceleration setting value from the axis table.
- Trigger axis stop warning.

M10603 + 40*(n-1) Axis emergency stop：

- Rising: Single axis emergency stop
- Trigger axis stop warning

M10604 + 40*(n-1) Axis Synchronous main clutch ON：

- High: On
- Low: Off
- Enable：Set by clutch ON condition in sync parameters.

M10605 + 40*(n-1) Axis origin on：

- High: On
- Low: Off
- Enable：Set by homing IO source in motion axis parameters.
- The axis origin limit status (M11259 + 40*(n-1)) should change accordingly.

M10606 + 40*(n-1) Axis limit(+) on：

- High: On
- Low: Off
- Enable：Set by homing IO source in motion axis parameters.
- The axis limit(+) status (M11260 + 40*(n-1)) should change accordingly.

M10607 + 40*(n-1) Axis limit(-) on：

- High: On

- Low: Off
- Enable：Set by homing IO source in motion axis parameters.
- The axis limit(-) status (M11261 + 40*(n-1)) should change accordingly

M10608 + 40*(n-1) Z Count Signal：

- High: On
- Low: Off
- Enable：Set by homing IO source in motion axis parameters.

M10609 + 40*(n-1) Axis Synchronous main clutch ON Disable：

- High: On
- Low: Off
- Enable：Does not act when axis sync main clutch ON condition is met.

M10610 + 40*(n-1) Axis Synchronous main clutch OFF Disable：

- High: On
- Low: Off
- Enable：Does not act when axis sync main clutch OFF condition is met.

M10611 + 40*(n-1) Axis Synchronous auxiliary clutch ON：

- High: On
- Low: Off
- Enable：Set by auxiliary clutch on condition in sync parameter.

M10612 + 40*(n-1) Axis Synchronous auxiliary clutch ON Disable：

- High: On
- Low: Off
- Enable：Does not act when axis sync aux clutch ON condition is met.

M10613 + 40*(n-1) Axis Synchronous auxiliary clutch OFF Disable：

- High: On
- Low: Off

- Enable：Does not act when axis sync aux clutch OFF condition is met

M10617 + 40*(n-1) Axis Probe 1 on：

- Enable：Enable the drive probe 1 function.
- When the probe is triggered, set the trigger status of axis probe 1 (M11262 + 40*(n-1)) to ON, and the axis driver probe 1 coordinates (DR37042 + 150*(n-1)) value will be updated.

M10618 + 40*(n-1) Axis Probe 1 Function Reset：

- Rising Trigger
- When triggered on the rising edge, the trigger status of axis probe 1 (M11262 + 40*(n-1)) will be reset to OFF.

M10619 + 40*(n-1) Axis Probe 2 on：

- Enable：Enable the drive probe 2 function.
- When the probe is triggered, set the trigger status of axis probe 2 (M11263 + 40*(n-1)) to ON, and the axis driver probe 2 coordinates (DR37044 + 150*(n-1)) value will be updated.

M10620 + 40*(n-1) Axis Probe 2 Function Reset：

- Rising Trigger
- When triggered on the rising edge, the trigger status of axis probe 2 (M11263 + 40*(n-1)) will be reset to OFF.

M10621 + 40*(n-1) Axis Synchronization Parameter Immediate Effect Request：

- High: On
- Low: Off
- Enable：Immediately update the sync parameters to the axis in synchronous control.

M10622 + 40*(n-1) Axis Synchronization Parameter Next Period Effect Request：

- High: On
- Low: Off
- Enable：At the beginning of the next cam cycle, update the sync parameters to the axis in sync control.

M10623 + 40*(n-1) Axis Syncronizationc Clutch Edge Trigger Buffer On：

- High: On
- Low: Off
- Enable：When the clutch ON is set as edge-triggered, the caching function takes effect.

M10624 + 40*(n-1) Initialization of the Cam phase when the axis synchronous clutch is OFF：

- High: On
- Low: Off
- Enable：When the clutch is OFF, set the phase between the master clutch output end and the cam to the default value.

M10625 + 40*(n-1) Axis rotation angle choose near：

- High: Off
- Low: On
- When the command is in absolute coordinates, it is determined based on axis rotation angle choose near (M10625 + 40*(n-1)) and axis rotation angle target direction (M10626 + 40*(n-1)) .
- (High) Off：Approach the target angle in axis rotation angle target direction (M10626 + 40*(n-1)) .
- (Low) On：When the unit is set to display in 360 degrees, choose the nearest direction for the target position.

M10626 + 40*(n-1) Axis rotation angle target direction：

- High: +
- Low: -
- Positive direction: Always approach the target angle in the positive direction.
- Negative direction: Always approach the target angle in the negative direction.

M10627 + 40*(n-1) Axis Syncronizationc Mode ON：

- High: On
- Low: Off
- On：Setting the axis to sync control, if the axis is not in free control, it will trigger an axis occupancy alarm.
- Off：Axis exits sync mode, but if there is deceleration stop in sync parameters, it must wait for the deceleration completion before setting the axis to free control.

M10628 + 40*(n-1) Axis pauses current action：

- High: On
- Low: Off
- On：Pause the current action, and the action issued after the pause will be executed once the pause is released.
- Off：Continue with the current action.

M10629 + 40*(n-1) High speed homing mode ON：

- High: On
- Low: Off
- On：No longer need to approach the home position at creeping velocity in homing mode.

M10630 + 40*(n-1) Axis specifies current coordinates：

- Rising Trigger
- When the rising edge is triggered, the value of the special register DR37050 will be set to the current coordinate.
- Only be used in axis uncontrolled or synchronous mode.
- Must be used when M10524 custom PDO packet is not enabled.

M10631 + 40*(n-1) Axis operation mode ON：

- High: On
- Low: Off
- Must be used when M10524 custom PDO packet is not enabled.
- Only be used under the synchronous mode.
- The value of special register DR37052 is regarded as the control mode: 0 for no control, 1 for position control, 2 for speed control, and 3 for torque control.
- When switching control modes, it is necessary to toggle M10631 again or set DR37052 to 0 (no control) state
- The value of special register DR37054 is considered as the control command.
- When the mode is speed mode or torque mode, the value of special register DR37056 is considered as the torque limit or speed limit.
- The default units are as follows:
  Position mode：axis coordinate units
  Speed mode：axis coordinate units per second
  Torque mode：0.1%.
- Can pre-enable M10632 to specify the units as follows:
  Position mode：PLS (Pulse)

Speed mode：PLS/s (Pulse per second)

Torque mode：0.1%.

M10632 + 40*(n-1) Axis operation mode unit：

- High: Pulse Unit
- Low: Axis Table Unit
- Pulse Unit：

  Position mode：axis coordinate units

  Speed mode：axis coordinate units per second

  Torque mode：0.1%.
- Axis Table Unit：The decimal point position refers to the number of decimal places set on the motion axis table.

M10633 + 40*(n-1) Axis operation mode absolute coordinates：

- High: absolute coordinate
- Low: relative coordinate
- Absolute coordinates: Start at the origin position.
- Relative coordinates: Start at the position triggered by M10631.
- When M10631 is set to high, the modification is ineffective.

M11240 + 40*(n-1) Axis servo on：

- High: Servo on
- Low: Servo off
- Should change after M10520 or M10600+40*(n-1) trigger.

M11241 + 40*(n-1) Operation Ready：

- High: Done preparing
- Low: Still preparing
- Should change after function 187 activate Motion .
- When unchanged, status codes should be visible in R36880 and R36881.

M11242 + 40*(n-1) Axis error in progress：

- High: In error
- Low: No error
- The axis should stop.

- Error info should be visible in R37004 + 150*(n-1) and R37005 + 150*(n-1) .
- Can use M10521 or M10601 + 40*(n-1) to reset.

M11243 + 40*(n-1) Axis warning in progress：

- High: In alarm
- Low: No alarm
- The axis will not stop.
- Alarm info should be visible in R37006 + 150*(n-1) and R37007 + 150*(n-1) .
- Can use M10521 or M10601 + 40*(n-1) to reset.

M11244 + 40*(n-1) Control in progress：

- High: In control
- Low: No control
- When current axis control mode (R36984 + 150*(n-1)) has a value, set it to the high bit.
- After completion, set it to the low bit.

M11245 + 40*(n-1) Homing in progress：

- High: In HOME Return mode
- Low: HOME Return mode is complete
- When current axis control mode (R36984 + 150*(n-1)) displays as the homing mode, set it to the high bit.
- After completion, set it to the low bit.

M11246 + 40*(n-1) Homing done：

- High: HOME Return mode is complete
- Reset：To be reset when Axis HOME Returing (M11245 + 40*(n-1)) in the high bit.

M11247 + 40*(n-1) Positioning in progress：

- High: In Positioning mode
- Low: Positioning mode is complete
- When current axis control mode (R36984 + 150*(n-1)) displays as the position control mode, set it to the high bit.
- After completion, set it to the low bit.

M11248 + 40*(n-1) Positioning done：

- High: Positioning mode is complete
- Reset：To be reset when in axis positioning mode (M11247 + 40*(n-1)) in the high bit

M11249 + 40*(n-1) JOG in progress：

- High: In JOG mode
- Low: JOG mode is complete
- When current axis control mode (R36984 + 150*(n-1)) displays as the jogging mode, set it to the high bit.
- After completion, set it to the low bit

M11250 + 40*(n-1) JOG done：

- High: JOG mode is complete
- Reset：To be reset when axis jogging (M11247 + 40*(n-1)) in the high bit.

M11251 + 40*(n-1) Synchronizing in progress：

- High: Clutch connect / apart act
- Low: Clutch connect / apart done
- When main clutch ON / OFF connection method is set to sliding/following, set to the high bit during the connection process.
- After completion, set it to the low bit.

M11252 + 40*(n-1) Sychronization done：

- High: Clutch connect done
- Low: Clutch apart done
- The status of the axis synchronous master clutch ON / OFF.

M11253 + 40*(n-1) Speed mode in progress：

- High: In Speed mode
- Low: Speed mode is complete
- When current axis control mode (R36984 + 150*(n-1)) displays as the speed mode, set it to the high bit.
- After completion, set it to the low bit.

M11254 + 40*(n-1) Speed mode done：

- High: Target speed reaxhed / Upper speed limit reached
- 1.Speed mode reaches the target speed.
  2.Torque mode reaches the speed limit.

M11255 + 40*(n-1) Torque mode in progress：

- High: In Torque mode
- Low: Torque mode is complete
- When current axis control mode (R36984 + 150*(n-1)) displays as the torque mode, set it to the high bit.
- After completion, set it to the low bit.

M11256 + 40*(n-1) Torque mode done：

- High: Target torque reached / Upper torque limit reached
- 1.Torque mode reaches the target speed.
  2.Speed mode reaches the speed limit.

M11257 + 40*(n-1) Axis soft limit(+) status：

- High: Status ON
- Low: Status OFF
- Display the current software limit status within Motion.

M11258 + 40*(n-1) Axis soft limit(-) status：

- High: Status ON
- Low: Status OFF
- Display the current software limit status within Motion.

M11259 + 40*(n-1) Axis origin limit status：

- High: Status ON
- Low: Status OFF
- Display the actual limit status received within Motion.

M11260 + 40*(n-1) Axis limit(+) status：

- High: Status ON
- Low: Status OFF
- Display the actual limit status received within Motion.

M11261 + 40*(n-1) Axis limit(-) status：

- High: Status ON
- Low: Status OFF
- Display the actual limit status received within Motion.

M11262 + 40*(n-1) Axis Probe 1 triggered state：

- High: Status ON
- Low: Status OFF
- Display that servo probe 1 is triggered, and the axis drive probe 1 coordinate (DR37042 + 150*(n-1)) value will be updated.

M11263 + 40*(n-1) Axis Probe 2 triggered state：

- High: Status ON
- Low: Status OFF
- Display that servo probe 2 is triggered, and the axis drive probe 2 coordinate (DR37044 + 150*(n-1)) value will be updated.

M11264 + 40*(n-1) Axis synchronization parameter effective state：

- High: Valid
- Display that sync parameters have been written to the axis in sync control.
- Reset condition: When both the axis sync parameter apply immediately (M10621 + 40*(n-1)) and Axis sync parameter apply next period (M10622 + 40*(n-1)) are in the low state.

M11265 + 40*(n-1) Axis tracking error state：

- High: Triggered
- 1.Display whether the axis following error exceeds the axis following error window.
- 2.Enable when the axis following error timeout is not zero.

M11266 + 40*(n-1) Axis pause status：

- High: Paused.
- Display whether the axis is currently in pause mode.

M11267 + 40*(n-1) Homing mode Z-phase signal：

- High: Z-phase signal is triggered.
- Display Motion internally actual received Z-phase signal status.

M11268 + 40*(n-1) Axis operation mode action：

- High: The operation mode is in progress.
- Low: Operation mode completed/left operation mode
- The axis operation mode is in progress.

M11269 + 40*(n-1) Axis operation mode done：

- High: Operation mode completed.
- Low: The operation mode is in progress /left operation mode
- Operation mode completed.

R36980+ 150*(n-1) Axis Attribute：

- Display the actual axis as real or virtual axis.
- Configured through motion network links or modified by Function 235.
- 0：Not used

  1：Actual axis

  2：Virtual axis

R36984+ 150*(n-1) Current Axis Control Mode：

- Display current control mode.
- After ending any control mode, it should return to 0.
- 0：Not controled

  1：Position control mode

  2：Homing mode

  3：Jogging mode

  4：Speed mode

  5：Torque mode

  6：Sync control mode

R37004+ 150*(n-1) Axis Error Info 1：

- Display axis error number.

- Can be cleared by M10521 (reset all axes) or M10601 + 40*(n-1) (reset an axis).
- Refer to the alarm list for error codes.

R37005+ 150*(n-1) Axis Error Info 2：

- Display current axis error flow block number.
- Can be cleared by M10521 (reset all axes) or M10601 + 40*(n-1) (reset an axis).
- Refer to the alarm list for error codes.

R37006+ 150*(n-1) Axis Alarm Info 1：

- Display axis alarm number.
- Can be cleared by M10521 (reset all axes) or M10601 + 40*(n-1) (reset an axis).
- Refer to the alarm list for error codes.

R37007+ 150*(n-1) Axis Alarm Info 2：

- Display current axis alarming flow block number.
- Can be cleared by M10521 (reset all axes) or M10601 + 40*(n-1) (reset an axis).
- Refer to the alarm list for error codes.

R37012+ 150*(n-1) Axis in control：

- Display axis is in control.
- Same as M11244 + 40*(n-1) .

R37013+ 150*(n-1) Axis in alarm：

- Display axis is in alarm.
- 0：Not in alarm.

  1：In warning,same as M11243 + 40*(n-1) .

  2：In error,same as M11242 + 40*(n-1) .

DR37014+ 150*(n-1) Axis Command Coordinates：

- Display the coordinate command calculated by the controller for axis.
- Reciprocal coordinate transformation relationship with axis command position (DR37018 + 150*(n-1)) .
- Includes decimal places, determined by the decimal point position in the motion axis settings (axis table) parameters.

DR37016+ 150*(n-1) Axis Command Speed：

- Position, HOME, Jogging, Synchronous Mode: Change rate of command coordinate (DR37014) .
- Speed Mode: Displays the speed command of the controller for the axis.

- Torque Mode: Meaningless.
- Includes decimal places, determined by the decimal point position in the motion axis settings (axis table) parameters.

DR37018+ 150*(n-1) Axis Command Position：

- Display the controller's (pulse) position command for this axis.
- Units are pulses.
- The drive end should receive the same value.

R37020+ 150*(n-1) Current Axis Controlling Point No.：

- Display the current control point number of position mode.
- Display the current cam number of sync mode.
- Should be the motion point number (motion point table) identifier.
- In the case of continuous points, it will display the number of the previous point when traveling along a continuous path between two points.

DR37021+ 150*(n-1) Current Axis Coordinates：

- Display the actual axis coordinate.
- The displayed value is obtained by performing coordinate conversion on the position (pulse) value feedback from the driver end.
- The displayed value is obtained by coordinate transformation from the feedback position (pulse) value received at the drive end.
- Includes decimal places, determined by the decimal point position in the motion axis settings (axis table) parameters.

DR37023+ 150*(n-1) Axis feedback speed：

- Display the actual axis speed.
- Feedback speed from the drive end.
- The unit of the feedback speed at the drive end should be filled in with the velocity unit and velocity gain set in the unit settings of the motion axis (axis table) parameters.

DR37025+ 150*(n-1) Axis p.osition deviation monitor：

- Display axis position deviation.
- This value is equal to the axis commanded position (DR37014) minus current axis position (DR37021) .
- Reference the following error in the operational setting of the motion axis configuration (axis table) parameters.

DR37027+ 150*(n-1) Axis Driver Digital Input：

- Display the digital input value of the axis driver feedback.
- The definition of each bit is determined by the driver.

R37029+ 150*(n-1) Current Axis Motion Flow No.：

- Display the motion flow number of the current control axis.
- 0 when there is no control or when using ladder instructions.

DR37030+ 150*(n-1) Axis contact output：

- Display axis contact output status.
- The current axis control mode (R36984) needs to be in sync control.
- The axis contact output is only effective when the current axis control mode (R36984) is in sync control, and synch control requires the use of E-Cam, that is., the cam data number in the synch parameters is not 0.
- The axis electronic cam input phase (DR37033) can be compared with the axis contact output.

R37032+ 150*(n-1) Current Axis Torque：

- Display the torque feedback from the axis driver.
- Units are 0.1% .

DR37033+ 150*(n-1) Axis Electronic Cam Input Phase：

- Display the input phase of the axis-synchronized electronic cam.
- The axis electronic cam input phase is only effective when the current axis control mode (R36984) is in sync control.
- The range of axis electronic cam input phase is from 0 to the input axis period in sync parameters.

DR37035+ 150*(n-1) Axis HOME Position：

- Display the HOME (pulse) position of the axis.
- Should be power-off hold.

R37037 - R37039+ 150*(n-1) Axis control status words：

- Display axis control status words.
- The bit status from axis status enable (M11240 + 40*(n-1)) to axis pause status (M11266 + 40*(n-1)).

DR37040+ 150*(n-1) Axis main clutch output phase：

- Display the output phase of the axis sync main clutch.
- The axis main clutch output phase is only effective when the current axis control mode (R36984) is in sync control.
- The range of axis main clutch output phase is from 0 to the input axis period in sync parameters.

DR37042+ 150*(n-1) Axis Driver Probe 1 Coordinates：

- Display the coordinate of probe 1 from axis driver feedback.
- When axis probe 1 on (M10617 + 40*(n-1)) is triggered, trigger status of axis probe 1 (M11262 + 40*(n-1)) is set to ON.

DR37044+ 150*(n-1) Axis Driver Probe 2 Coordinates：

- Display the coordinate of probe 2 from axis driver feedback.
- When axis probe 2 on (M10619 + 40*(n-1)) is triggered, trigger status of axis probe 2 (M11263 + 40*(n-1)) is set to ON.

DR37050+ 150*(n-1) Axis specifies coordinates：

- The unit is the same as the motion axis table unit, and the decimal point corresponds to the number of decimal places on the motion axis table.
- When M10630 axis specifies the current coordinate, set DR37050 to the current coordinate.

DR37052+ 150*(n-1) Axis operation control mode：

- The value of special register DR37052 is regarded as the control mode: 0 for no control, 1 for position control, 2 for speed control, and 3 for torque control.
- When switching control modes, it is necessary to toggle M10631 again or set DR37052 to 0 (no control) state.

DR37054+ 150*(n-1) Axis operation mode instruction 1：

- In position and speed modes, the unit is the same as the motion axis table unit, and the decimal point corresponds to the number of decimal places on the motion axis table.
- The unit can be switched to PLS, PLS/s using M10632.
- In torque mode, the unit is fixed at 0.1%.

DR37056+ 150*(n-1) Axis operation mode instruction 2：

- In position mode, it represents the maximum speed, with units in coordinate units per second (coordinate unit/s), or can be switched to PLS/s using M10632.
- In speed mode, it represents the torque limit, with units at 0.1%.
- In torque mode, it represents the speed limit, with units in RPM.

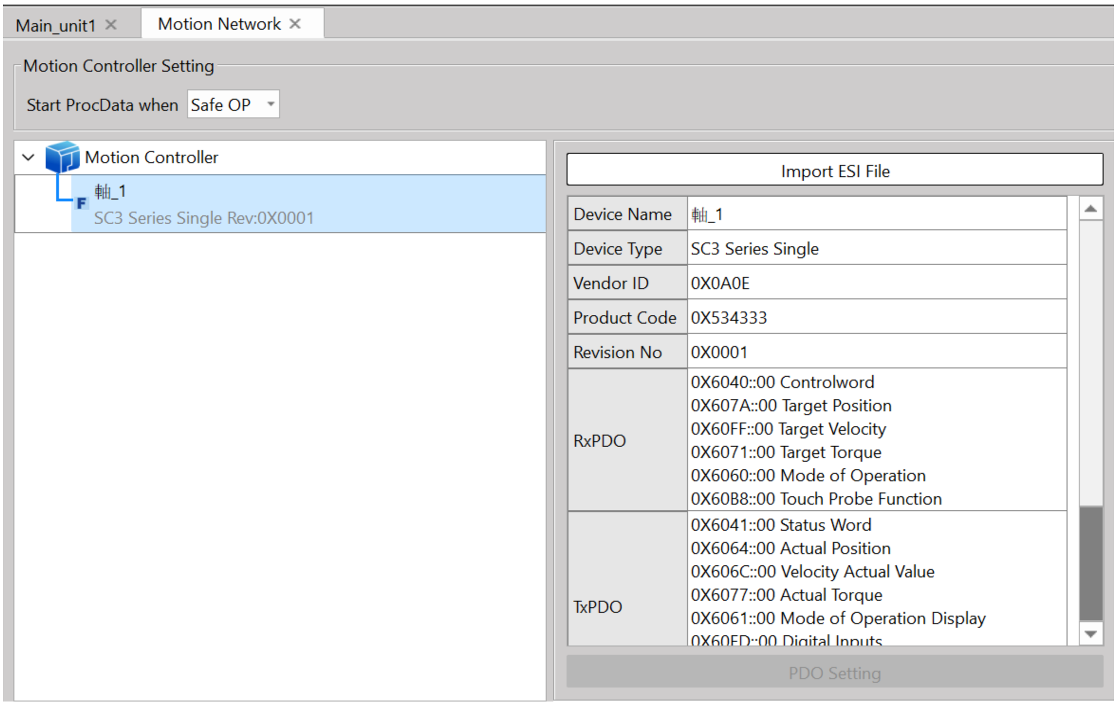
DR37058+ 150*(n-1) Axis operation mode instruction 3：

- In position mode, it represents the maximum acceleration/deceleration, with units in coordinate units per second squared (coordinate unit/s^2), or can be switched to PLS/s^2 using M10632.

3

EtherCAT Function and Configuration

This section describes the EtherCAT related function and configuration. EtherCAT is an industrial Ethernet technology developed by Beckhoff Automation in Germany. The connection type is a network system with one master station and multiple slave stations. It is also a configuration tool based on EtherCAT Slave Information (ESI). Currently, the PDO is designed in fixed type and it is not opened for the user to set manually. Indicated below is the setting page:



Listed below is the PDO setting:

PDO Type	Index	Name
RxPDO	0x6040	Control word
	0x607A	Target position
	0x60FF	Target velocity
	0x6071	Target Torque
	0x6060	Mode Of Operation
	0x60B8	Touch Probe Function
TxPDO	0x6041	Status Word
	0x6064	Actual Position
	0x606C	Velocity actual value
	0x6077	Actual Torque
	0x6061	Mode Of Operation Display
	0x60FD	Digital inputs
	0x603F	Error code
	0x60BA	Touch Probe Pos1 Pos Value

Provided below are the parameters and the unit required for the cyclic synchronous position, speed and torque control modes.

Target under Cyclic Synchronous Position Control Mode:

Index	Name	Unit	Type	Access	PDO Mapping
603Fh	Error Code	-	U16	RO	TxPDO
6040h	Control Word	-	U16	RW	RxPDO
6041h	Status Word	-	U16	RO	TxPDO
6062h	Position Demand Value	pulse	I32	RO	TxPDO
6064h	Position Actual Value	pulse	I32	RO	TxPDO
6065h	Following Error Window	pulse	U32	RW	No
6072h	Max Torque	0.1%	U16	RW	RxPDO
6077h	Torque Actual Value	0.1%	I16	RO	TxPDO
607Ah	Target Position	pulse	I32	RW	RxPDO
6080h	Max Motor Speed	r/min	U32	RW	RxPDO
60B0h	Position Offset	pulse	I32	RW	RxPDO
60B1h	Velocity Offset	Command unit/s	I32	RW	RxPDO
60B2h	Torque Offset	0.1%	I16	RW	RxPDO
60F4h	Following Error Actual value	pulse	I32	RO	TxPDO
60FDh	Digital Inputs	-	U32	RO	TxPDO

Target under Cyclic Synchronous Speed Control Mode:

Index	Name	Unit	Type	Access	PDO Mapping
603Fh	Error Code	-	U16	RO	TxPDO
6040h	Control Word	-	U16	RW	RxPDO
6041h	Status Word	-	U16	RO	TxPDO
6072h	Max Torque	0.1%	U16	RW	RxPDO
6080h	Max Motor Speed	r/min	U32	RW	RxPDO
60B1h	Velocity Offset	Command unit/s	I32	RW	RxPDO
60B2h	Torque Offset	0.1%	I16	RW	RxPDO
60FFh	Target Velocity	Command unit/s	I32	RW	RxPDO

Target under Cyclic Synchronous Torque Control Mode:

Index	Name	Unit	Type	Access	PDO Mapping
603Fh	Error Code	-	U16	RO	TxPDO
6040h	Control Word	-	U16	RW	RxPDO
6041h	Status Word	-	U16	RO	TxPDO
6071h	Target Torque	0.1%	U16	RW	RxPDO
6072h	Max Torque	0.1%	U16	RW	RxPDO
6080h	Max Motor Speed	r/min	U32	RW	RxPDO
60B2h	Torque Offset	0.1%	I16	RW	RxPDO

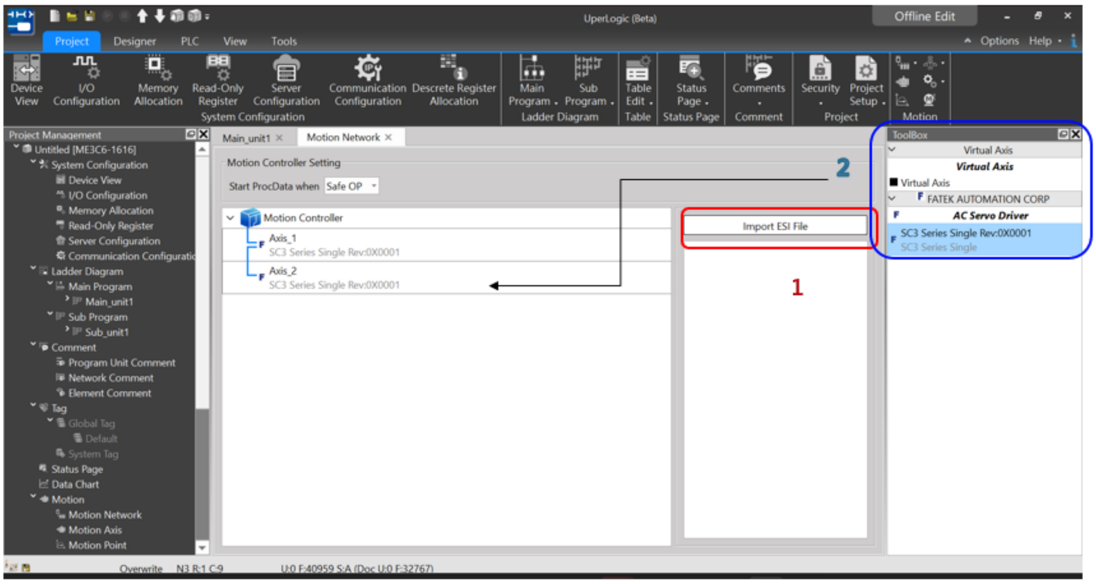
4

Axis Parameters and Setting

This section describes the parameter setting and the axis connection setting related information that will be required for connecting M-PLC to EtherCAT Servo. The user will be allowed to set the axis connection and axis parameter setting through FATEK program editing software UperLogic.

4-1 Motion Network Setting

To run the UperLogic editing software, it is required to click open the motion connecting setting page on the left-hand side window. To add the EtherCAT Servo for both axes, input the EtherCAT Servo ESI File by pressing the import ESI button. After importing the ESI File, drag the right-hand side toolkit column to the field underneath the left-hand side Motion Control and then the system will log the Axis model number and brand automatically.



If the axis connection setting is different from the equipment actually connected, such as unit number, type and sequence, then the system will indicate an error and will not execute the communication.

※ Notes for connecting FATEK SC3

Use Speed mode Pn002 □□□1h must be set

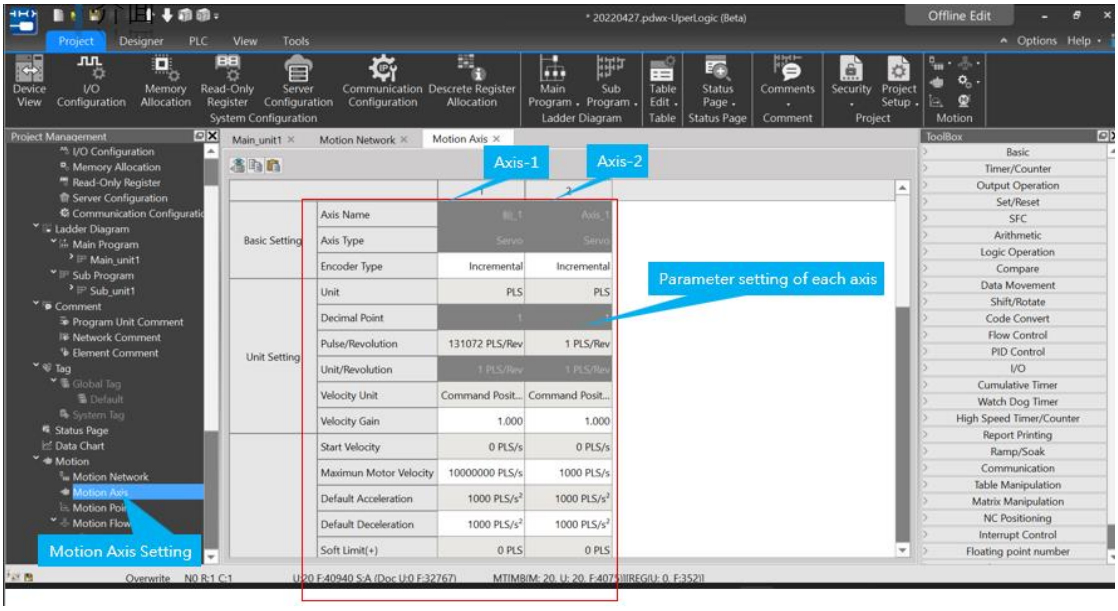
Use Torque mode Pn002 □□1□h must be set

Use Absolute Value encoder Pn002 □0□□h must be set

4-2 Motion Axis Parameter Setting

After completing the motion axis connection, the user may set up the parameters for each axis through UperLogic. Described below is the detailed parameter setting.

Indicated below is the UperLogic axis parameter setup page.



		1.Axis_1
Basic Setting	Axis Name	Axis_1
	Axis Type	Virtual Servo
	Encoder Type	Incremental
Unit Setting	Unit	PLS
	Decimal Point	1
	Pulse/Revolution	1 PLS/Rev
	Unit/Revolution	1 PLS/Rev
	Velocity Unit	Command Position/...
	Velocity Gain	1.000
Operation Setting	Start Velocity	0 PLS/s
	Max Motor Velocity	No Limit
	Default Acceleration	No Limit
	Default Deceleration	No Limit
	Soft Limit(+)	0 PLS
	Soft Limit(-)	0 PLS
	Following Error Window	0 PLS
	Following Error Timeout	0 ms
	Pos Done Tolerance	0 PLS
	Pos Done Check Time	10 ms
	Maximum Motor Torque	No Limit

	Maximum Torque Limit(+)	No Limit
	Maximum Torque Limit(-)	No Limit
Touch Probe	Touch Probe 1 Source	Disabled
	Touch Probe 1 Mode	Rising Edge Single
	Touch Probe 2 Source	Disabled
	Touch Probe 2 Mode	Rising Edge Single
Stop	Stop Mode	Immediately Stop
	Stop Deceleration	1000 PLS/s^2
Homing	Homing Mode	Homing on current ...
	Homing IO Source	From Servo Driver
	Homing Start Direction	Positive
	Homing Origin Offset	0 PLS
	Homing Find Velocity	10000 PLS/s
	Homing Creep Velocity	1000 PLS/s
	Homing Deceleration	1000 PLS/s^2
	Limit Switch(-)(DI)	60FD:00
	Limit Switch(+)(DI)	60FD:01
	Home Switch(DI)	60FD:02
	Homing Z Count	0
Jogging	Jogging Base Velocity	1 PLS/s
	Jogging Velocity	1 PLS/s
	Jogging Acceleration	1 PLS/s^2
	Jogging Deceleration	1 PLS/s^2
	Inching Distance	1 PLS

Basic Setting:

Axis name: To change the axis name, set up the "Device Name" on motion link. By changing the axis name, the user will be allowed to differentiate the application of each axis.

Encoder type: Incremental (the location information will disappear once the power is turned off), Absolute (the location information is kept, so it can continue to operate without HOME return after the power is restored)

Axis Type:

Servo: Physical axis

Virtual Servo: Virtual axis

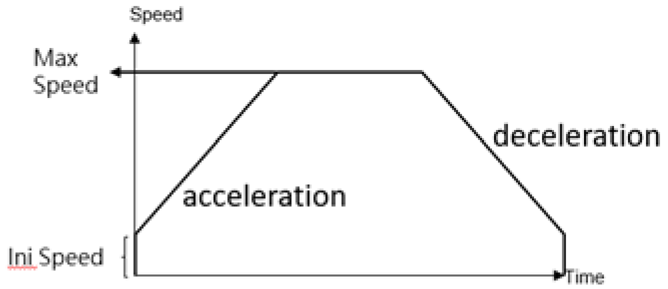
Unit Setting:

Unit: Comprising 4 kinds of units and they are PLS, mm, deg and inch.

Decimal point: It allows the user to set up smaller units during the setup process (mm/deg/inch) for

up to 3 places after the decimal point.
Pulse/Revolution: The pulse number of the motor during each revolution of operation.
Unit/Revolution: The distance achieved by the motor during each revolution of operation.
Velocity Unit: The watch table displays the velocity unit returned by the selected driver.
Velocity Gain: Select the minimum scale of the velocity returned by the driver.

Operation Setting:
Initial Speed: The initial speed required for running the motor.
Max. Motor Speed: The maximum speed for limiting the motor at PLC end. If the command exceeds such speed, the PLC will signal the alarm and the servo will remain inactive accordingly.
Maximum Acceleration: The maximum acceleration required for limiting the motor at PLC end.
Maximum Deceleration: The maximum deceleration required for limiting the motor at PLC end.



Soft Limit (+): The limit required for restricting forward running at PLC end.
Soft Limit (-): The limit required for restricting backward running at PLC end.

If the same value is set for soft limit (+) and soft limit (-), then the soft limit shall be regarded as limitless. For example, if both of them are set as “0”, then the soft limit will not provide the protection.

Tracking error allowable scope: Allowable error range between motor feedback position and PLC command position.
Tracking error allowable time: Allowable error timeout between motor actual position and command position.
Positioning complete allowable error: The error scope within which the motor has reached the command position.
Positioning complete checking time: The error timeout within which the motor has reached the command position.
Max. Motor Torque: The maximum torque required for limiting the motor at the driver end. It must be lower than the motor specifications and shall be carried to the first place after the decimal point.

Note: Speed mode and torque mode will be excluded.

Max. Torque Limit (+): The torque limit required for restricting forward running at the PLC end, and it shall be carried to the first place after the decimal point.
Max. Torque Limit (-): The torque limit required for restricting backward running at the PLC end, and

it shall be carried to the first place after the decimal point.

Probe:

When to use: The Probe Function is also called the Position Latch Function. The value of the servo axis or encoder is latched in real time through the external DI signal and Z signal. The probe function is suitable for applications where position synchronization is required, such as die-cutting and printing.

Probe 1 source: Set the probe number and source of the drive to be used.

Probe 1 mode: Set the mode to trigger the drive probe function.

Probe 2 source: Set the probe number and source of the drive to be used.

Probe 2 mode: Set the mode to trigger the drive probe function.

Stop:

Stop Mode: Set up the motor stop mode when the action alarm is running.

Stop deceleration: Set up the deceleration during the deceleration stopping.

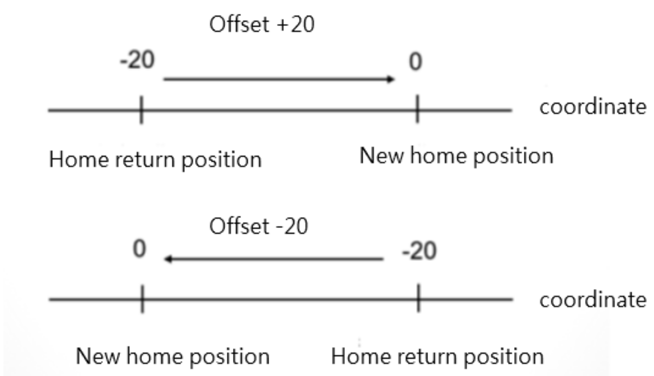
HOME Return:

Return mode: Select the HOME Return mode for the axis. For details, please refer to Chapter 10: HOME Return Mode.

Return IO Source: It can upload the signal from the driver to the PLC through EtherCAT or the PLC special register.

Return Start Direction: The start direction required for setting up the HOME searching.

HOME Return Offset: 設定原點復歸完成後 + 偏移量為原點, as indicated in the figure below.



Return searching speed: Set up the speed required for searching the HOME (can be faster than the set value).

Return crawl speed: Set up the crawling speed required for entering the scope of HOME (to be set at slower speed).

Return deceleration: Set up the deceleration required for entering the scope of HOME.

Limit Switch (-) (DI): Set up the bit when Limit Switch reaches 60FDh, and it is normally preset as “0”. For detailed bit, please refer to Driver Manual.

Limit Switch (-) (DI): Set up the bit when Limit Switch reaches 60FDh, and it is normally preset as “1”. For detailed bit, please refer to Driver Manual.

HOME Sensor (DI): Set up the bit when HOME Sensor reaches 60FDh, and it is normally preset as “2”. For detailed bit, please refer to Driver Manual.

HOME Z-phase signal number: When finding out the Z-HOME Mode, the Zth signal that has blocked the Dog Sensor will be regarded as the HOME. If setting at “0”, then it will be regarded as the HOME when blocking the Dog Sensor.

JOG:

JOG Start Speed: The starting speed when operating under JOG Mode.

JOG Speed: The max. speed when operating under JOG Mode.

JOG Acceleration: The acceleration when operating under JOG Mode.

JOG Deceleration: The deceleration when operating under JOG Mode.

JOG Distance: The JOG distance when operating under JOG Mode.

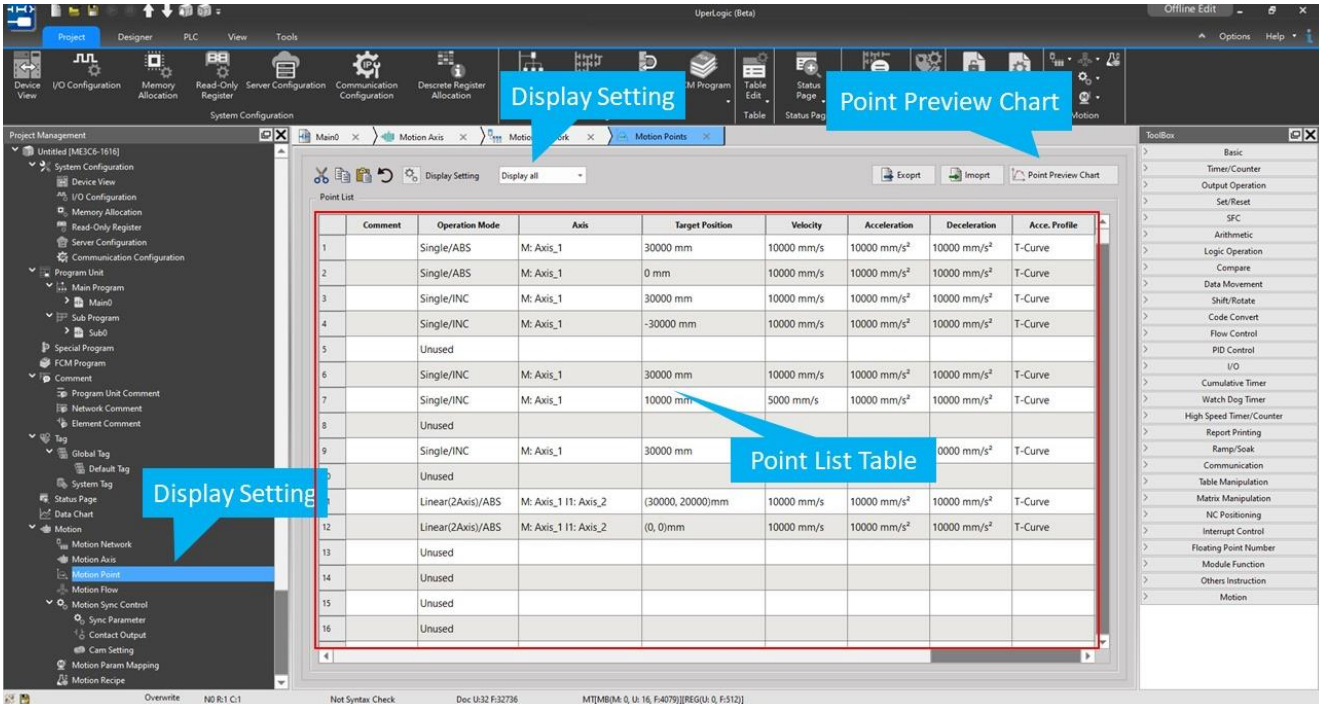
5

Point Table and Point Parameter

This section describes the setting method and the parameters required for the motion point. The information of the Motion Flow motion point such as target position/max. speed/ acceleration/deceleration and acceleration type are set according to the point table and the point parameters. When using the PLC to change the content of the point table and point parameter setup value, please refer to Chapter 8: Motion Parameter Mapping Table.

5-1 Motion Point Setting Interface

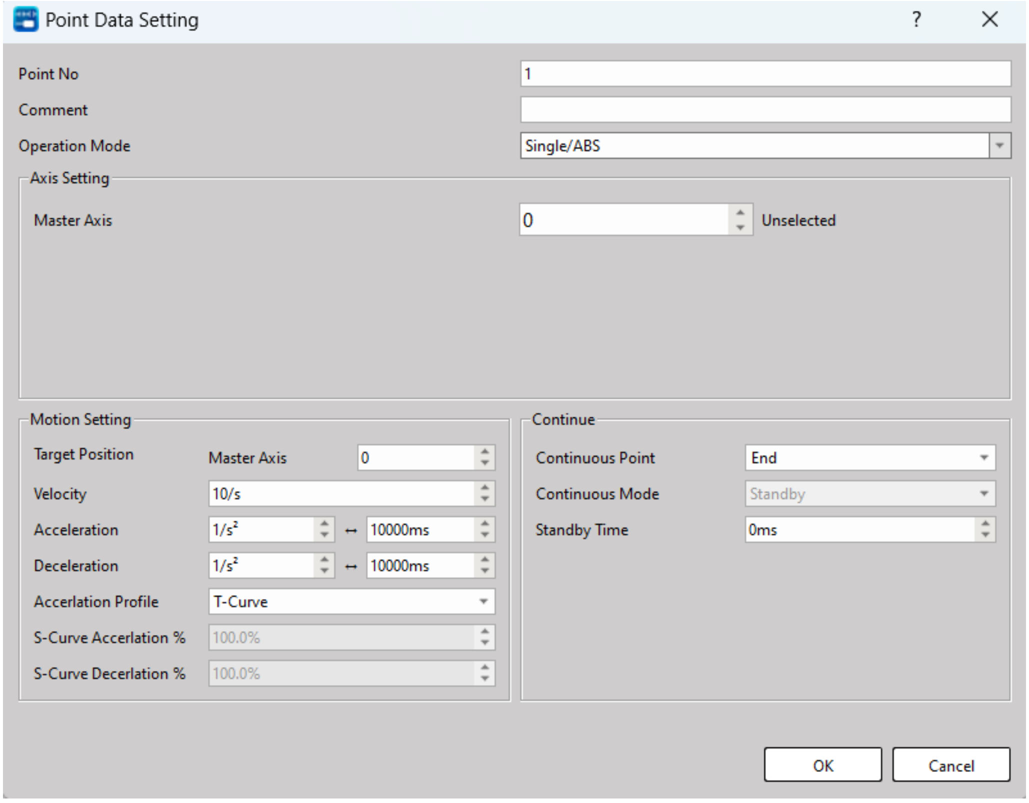
The setup interface required for setting the motion point is provided by the FATEK project editing software UperLogic, as per below:



Corresponding upper limit is created for the capacity of the motion point when using the selected PLC.

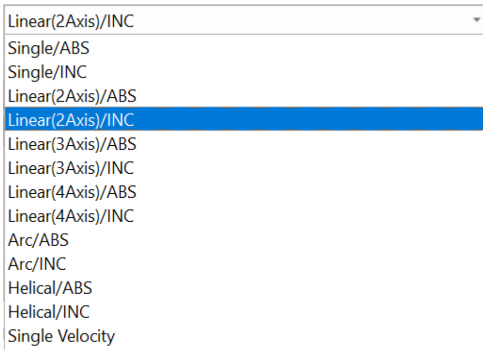
PLC Memory	Motion Memory
20K Words	256 pts
30K Words	512 pts
40K Words	1024 pts

Introduction of Point Data Setting:



Point Number: The number of the point that will be executed for the Ladder or the process.

Operation mode:



Master Axis: The axis to be operated.

If multi-axis interpolation is selected as the axis mode, then UI will display the following:

Interpolation Axis 2: The Interpolated Axis 2 to be operated.

Interpolation Axis 3: The Interpolated Axis 3 to be operated.

Interpolation Axis 4: The Interpolated Axis 3 to be operated.

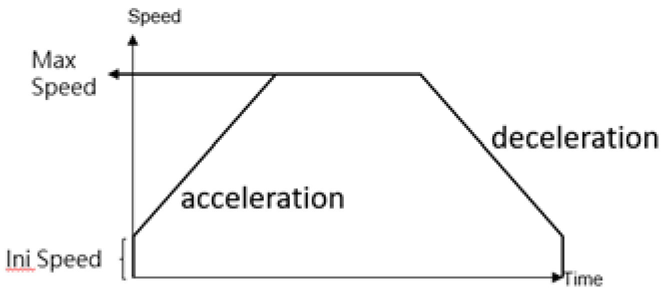
Target Position:

Master Axis: The Master Axis target position represents the travel (relative)/position (absolute) that will be run by the axis.

Interpolation Axis 1: The target position of Interpolation Axis 1, which is determined according to the mode selected.

Interpolation Axis 2: The target position of Interpolation Axis 2, which is determined according to the mode selected.

Interpolation Axis 3: The target position of Interpolation Axis 3, which is determined according to the mode selected.



Speed: The exported speed or the maximum speed required for frequency movement. Such value cannot be reached if the distance is too short for acceleration to the maximum.

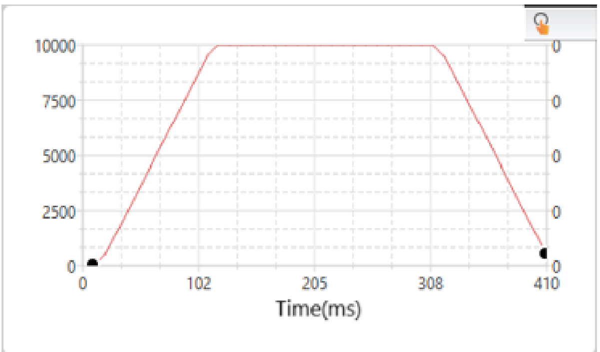
Acceleration: The acceleration required for increasing the initial speed to the desired value.

Deceleration: The acceleration required for decreasing the initial speed to the desired value.

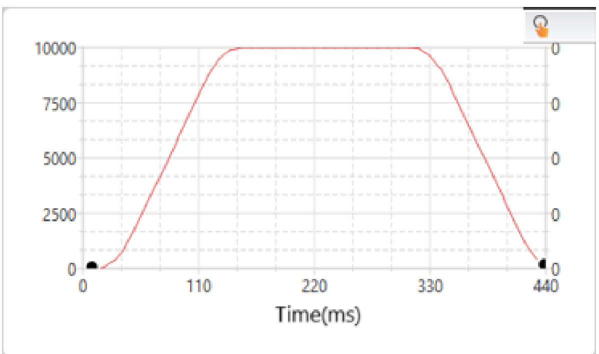
Acceleration type: T-Curve / S-Curve

S Acceleration Curve percentage scope: 1%–100%

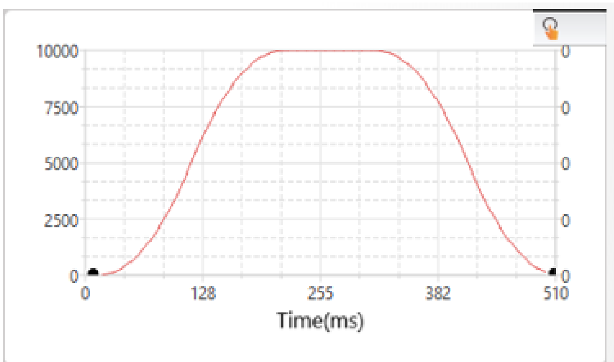
S Deceleration Curve percentage scope: 1%–100%



T-curve



S-curve 50%



S-curve 100%

Continue Point: Set “End” or “Continue Point” (select the point data to be executed on the point table).

Continue Mode:

Standby: The “ms” duration that should be paused before moving to the next point after completing the operation at the current point.

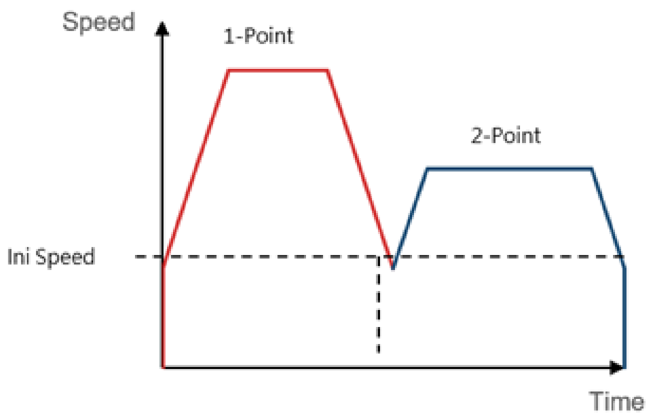
Continue next point speed: Moving to the next point after completing the acceleration or deceleration for such point.

Continue current point speed: Moving to the next point through acceleration or deceleration after completing current speed.

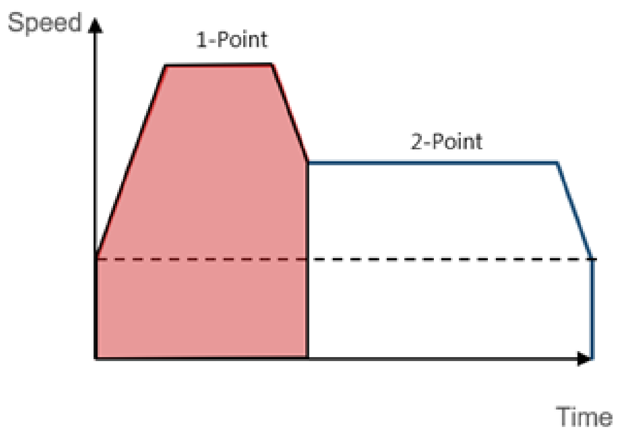
Continue initial speed: Moving to the next point after reducing to the initial speed.

Standby time: The standby time when operating under Standby Mode (unit: ms).

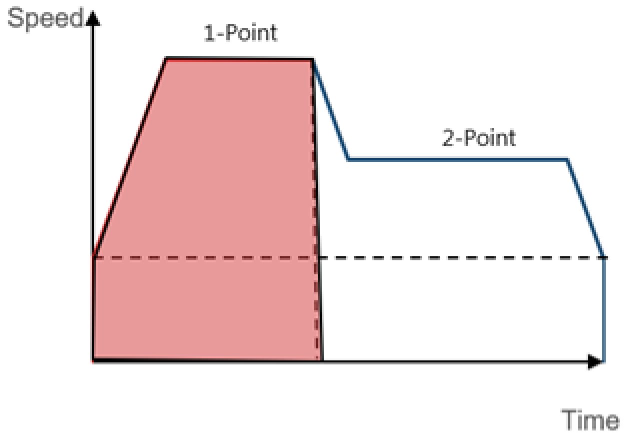
➢ Continue initial speed



➢ Continue next point speed

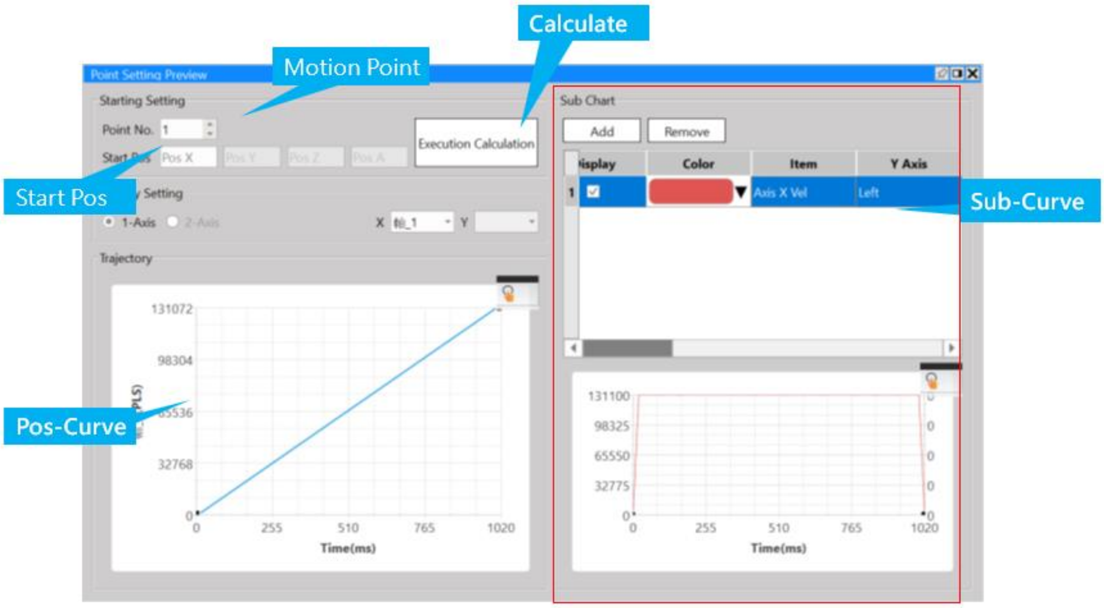


➢ Continue current point speed

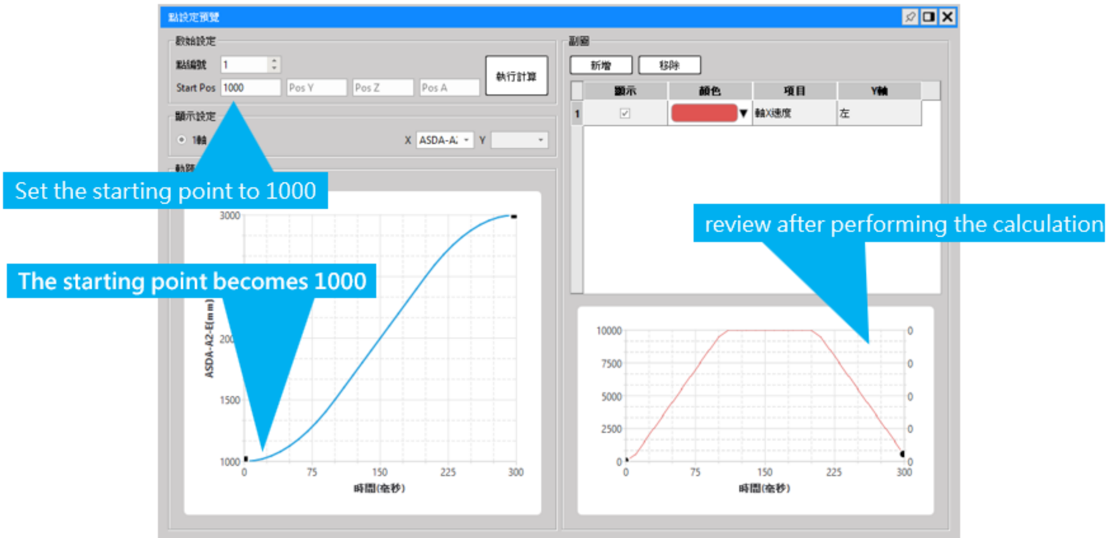


5-2 Point Preview Picture

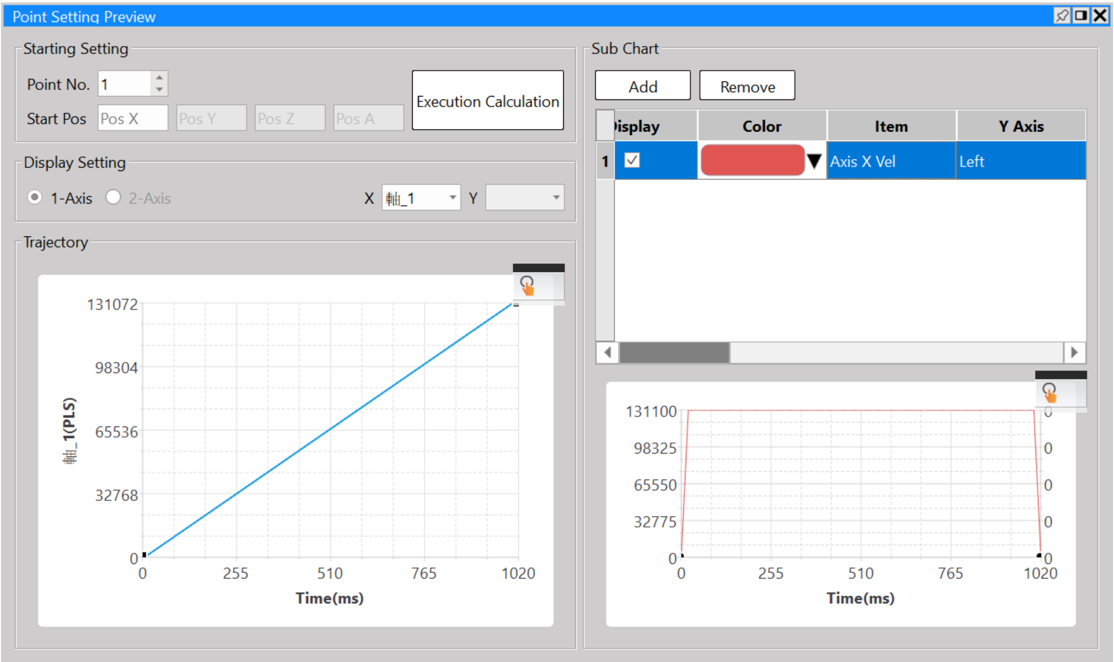
In Point Preview Picture, you may preview the track and the speed relating to the travel that will be set for the point parameter.



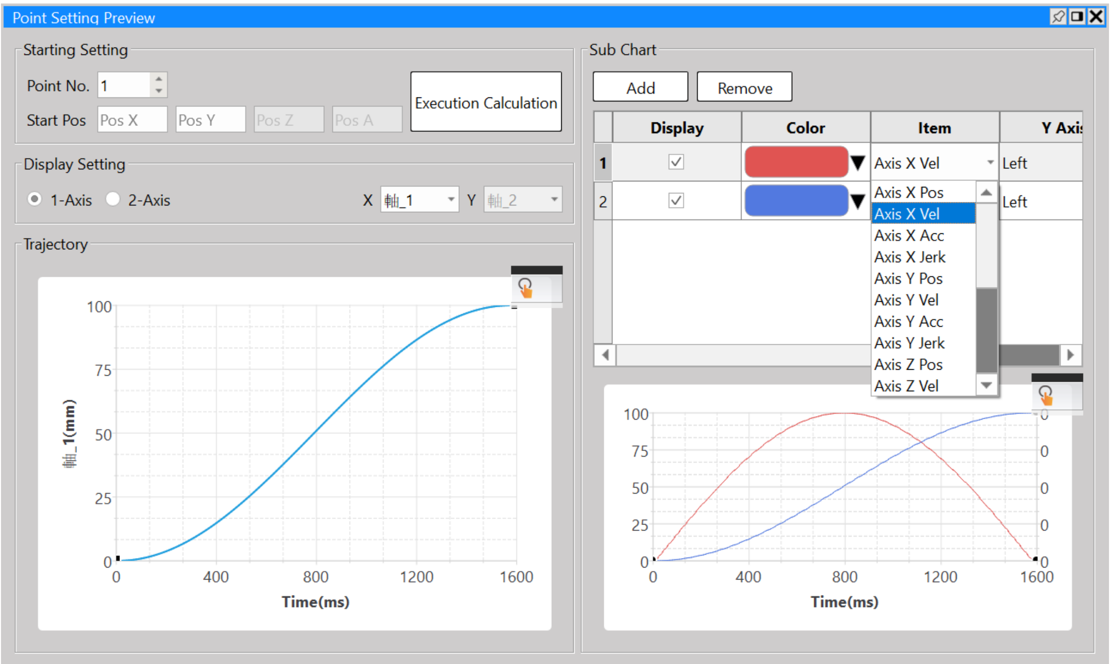
Example: Move Absolute Position 1000 to 3000.



In Point Preview Picture, you may preview the track and the speed relating to the travel that will be set for 2D.



You may use the auxiliary picture to check the speed change of the axis.



6

Ladder Motion Commands

To execute Motion Control, the M-PLC Controller realizes the user motion sequence control by using motion flow with point table. When moving at the respective axis point, the JOG or the HOME. M-PLC also provides the ladder motion related block commands to the user.

The M-PLC Motion Control can be achieved through the following three methods: 1. Ladder control (refer to the ladder motion commands described in this chapter); 2. Motion Flow control (refer to Chapter 6: Introduction of Motion Flow); 3. Test Run (refer to Chapter 12: Introduction of Test Run). Described below is the application timing of the aforesaid three control methods:

Motion Control	Content	Application Timing	Remark
Ladder Control	1. Position Control 2. JOG control 3. HOME Return 4. Handwheel 5. Speed Control 6. Torque Control 7. single axis positioning	The Ladder is suitable for the convenient JOG control and the HOME return, etc.	Please use the Motion Flow control method for controlling the complicated or continuous motion flow.
Motion Flow Control	1. Position Control 2. Speed Control 3. Torque control 4. HOME Return 5. Branch Control (the motion behavior required for controlling more than two processes concurrently). 6. Selective Control (conditional control) 7. Standby Setting 8. Merging 9. GoTo Conditional Jumping	The Motion Flow is suitable for controlling complicated motion and continuous motion flow because it is very convenient and easier to use.	The Motion Flow is also suitable for the multi-axis interpolated motion and Cam synchronization.
Test Run	1. Position Control 2. Speed Control 3. Torque Control 4. JOG Control	During Test Run, convenient motion behavior adjustment will be executed or allow the first timer to test the quick motion.	Such mode only applies to the test and inspection or adjustment, and it does not provide motion program control writing function.

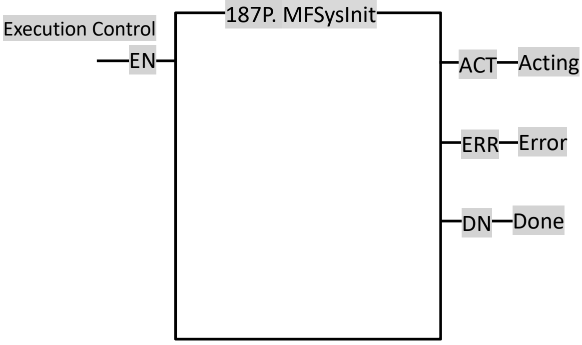
6-1 Fun187 System Initialization (MFSysInit)

Fun187 P MFSysInit	System Initialization	Fun187 P MFSysInit

Command Description

Ladder Symbol

No Operand

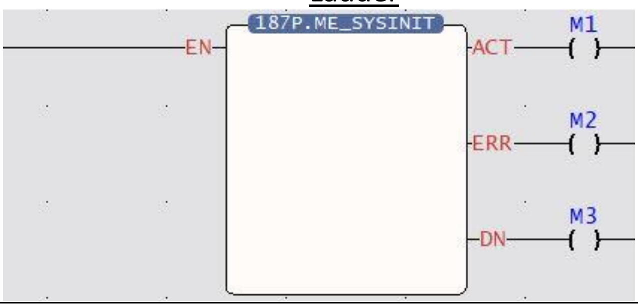


unction Description

- If you want to control the servo through EtherCAT communication, you must execute this command before executing any motion control.
- If you want to use Fun 235 to convert the physical axis to the virtual axis, it must be executed before this command.
- EN = 1: Motion Initialization is enabled (Trigger conditions support up and down differential input)
- ACT = 1: Motion Initialization is running
- ERR – 1: Motion Initialization error
- DN = 1: Motion Initialization is done

Program Example

Ladder



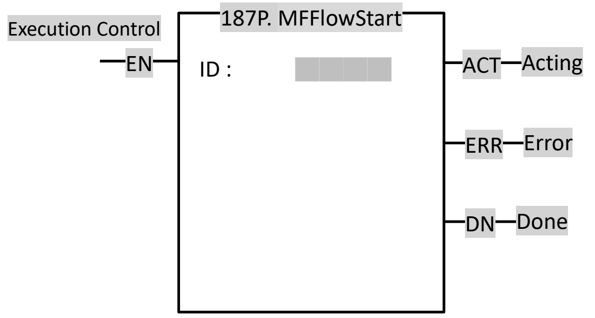
- When the execution control "EN" = 1, the motion control function initialization action will be executed.
- If there is no response during execution, please confirm whether the motion link setting is consistent with the actual link.
- After initialization, the servo needs to be turned on to continue subsequent operations, for example,all axis servo on register (M10520)

6-2 Fun176 Start Motion Flow (MFFlowStart)

Fun176 P MFFlowStart	Start Motion Flow	Fun176 P MFFlowStart

Command Description

Ladder Symbol



Operand

ID: Motion Flow ID

Relay and Register

Operand \ Range	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K	XR
	WX0 ∣ WX1008	WY0 ∣ WY1008	WM0 ∣ WM9104	WS0 ∣ WS3088	T0 ∣ T1023	C0 ∣ C1279	R0 ∣ R34767	R34768 ∣ R35023	R35024 ∣ R35279	R35280 ∣ R43223	R43224 ∣ R47319	D0 ∣ D11999		V, Z P0 ~ P9
ID	○	○	○	○	○	○	○	○	○	○	○	○	1~16	

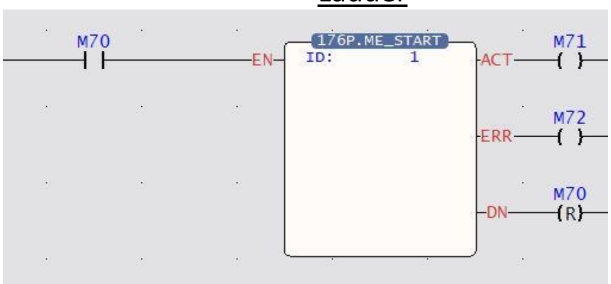
Function Description

Enable the Motion Flow with designated ID.

- EN = 1: Motion Flow is enabled
- ACT = 1: Motion Flow is running
- ERR = 1: Motion Flow error
- DN = 1: Motion Flow is done
- ID: The Flow ID to be triggered

Program Example

Ladder



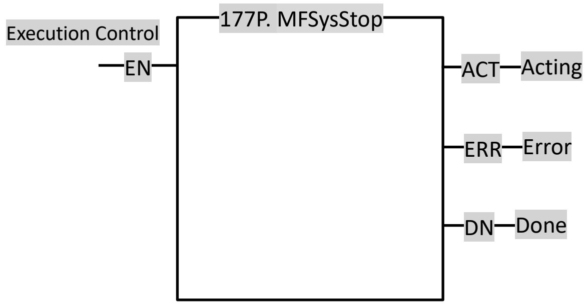
- When the execution control "EN" = 1, the motion flow corresponding to the ID will be executed.
- If the ID does not correspond to the motion flow, ERR = 1 will be triggered.

6-3 Fun177 Motion System Emergency Stop (MFSysStop)

Fun177 P MFSysStop	Motion System Emergency Stop	Fun177 P MFSysStop

Command Description

Ladder Symbol



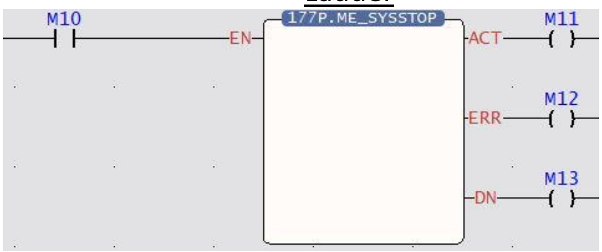
No Opearand

Function Description

- Stop the entire Motion Flow and stop the EtherCAT communication. To start the flow again, run the ME_INIT again in order to trigger the EtherCAT communication.
- EN = 1 : Stop the entire Motion Flow
- EN = 1 : Motion System Emergency Stop is enabled
- ACT = 1 : The emergency stop is acting
- ERR = 1 : Emergency Stop error
- DN = 1 : The emergency stop is done

Program Example

Ladder



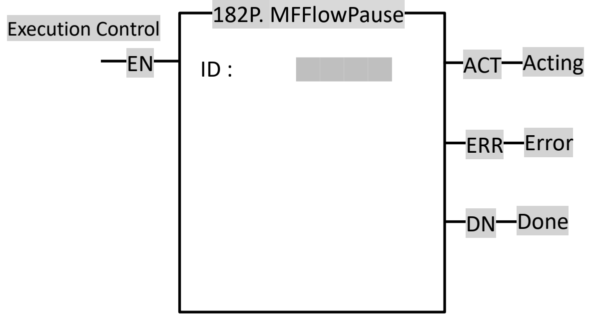
- When the execution control "EN" = 1, the motion control in execution will be stopped in an emergency.
- If you want to restart the operation after execution, you need to perform initialization and start.

6-4 Fun182 Pause Motion Flow (MFFlowPause)

Fun182 P MFFlowPause	Pause Motion Flow	Fun182 P MFFlowPause

Command Description

Ladder Symbol



Operand

ID: Motion Flow ID

Relay and Register

Type	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K	XR
Range	WX0 | WX1008	WY0 | WY1008	WM0 | WM9104	WS0 | WS3088	T0 | T1023	C0 | C1279	R0 | R34767	R34768 | R35023	R35024 | R35279	R35280 | R43223	R43224 | R47319	D0 | D11999		V, Z P0 ~ P9
ID	○	○	○	○	○	○	○	○	○	○	○	○	1-16	

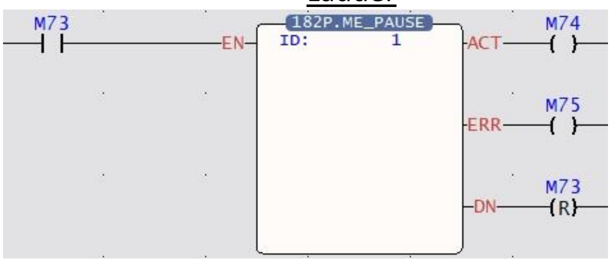
Function Description

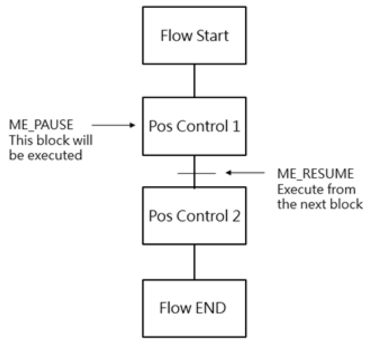
Pause the motion flow with specified ID, and stop after executing the current flow block; to resume the paused motion flow, execute “Fun183 MFFlowResume” function.

- EN = 1 : Stop entering the next step after executing the current flow block
- ACT = 1 : Pause is acting
- ERR = 1 : Pause error
- DN = 1 : Pause is dine
- ID : Motion Flow UID to be paused

Program Example

Ladder





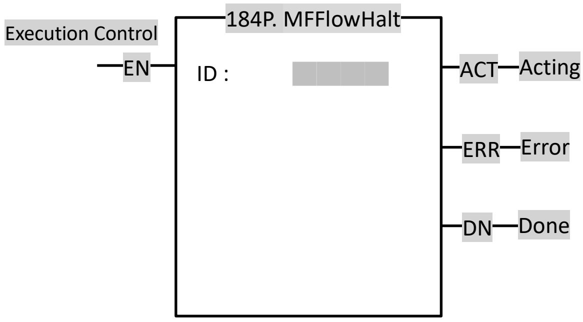
- When the execution control "EN" = 1, it will pause and not execute the next step after executing the current motion flow block.

6-5 Fun184 Halt Motion Flow (MFFlowHalt)

Fun184 P MFFlowHalt	Halt Motion Flow	Fun184 P MFFlowHalt

Command Description

Ladder Symbol



Operand

ID: Motion Flow ID

Relay and Register

Operand \ Range	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K	XR
	WX0 | WX1008	WY0 | WY1008	WM0 | WM9104	WS0 | WS3088	T0 | T1023	C0 | C1279	R0 | R34767	R34768 | R35023	R35024 | R35279	R35280 | R43223	R43224 | R47319	D0 | D11999		V, Z P0 ~ P9
ID	○	○	○	○	○	○	○	○	○	○	○	○	1-16	

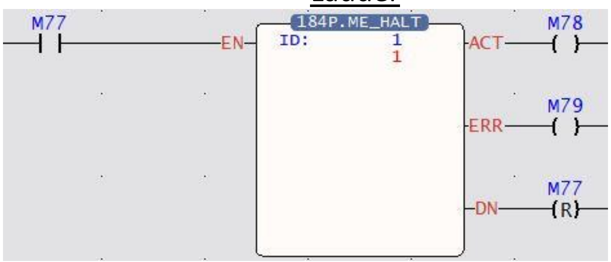
Function Description

Immediately stop the currently executing process block; to continue the stopped motion flow, use "Fun183 MFFlowResume" to resume execution.

- EN = 1 : Stop Motion Flow
- ACT = 1 : Stop is acting
- ERR = 1 : Stop error
- DN = 1 : Stop is done
- ID : Motion Flow UID to be halted

Program Example

Ladder



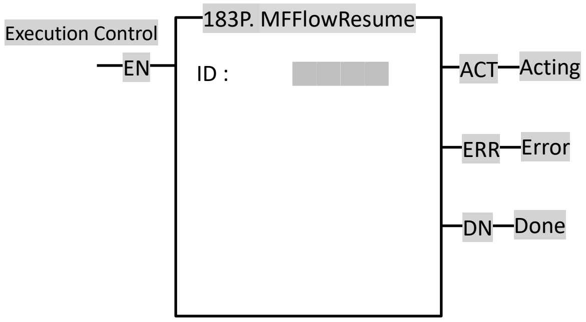
- When the execution control "EN" = 1, it will immediately halt the execution of the motion flow block.

6-6 Fun183 Resume Motion Flow (MFFlowResume)

Fun183 P MFFlowResume	Resume Motion Flow	Fun183 P MFFlowResume

Command Description

Ladder Symbol



Operand

ID: Motion Flow ID

Relay and Register

Operand \ Range	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K	XR
	WX0 | WX1008	WY0 | WY1008	WM0 | WM9104	WS0 | WS3088	T0 | T1023	C0 | C1279	R0 | R34767	R34768 | R35023	R35024 | R35279	R35280 | R43223	R43224 | R47319	D0 | D11999		V, Z P0 ~ P9
ID	○	○	○	○	○	○	○	○	○	○	○	○	1-16	

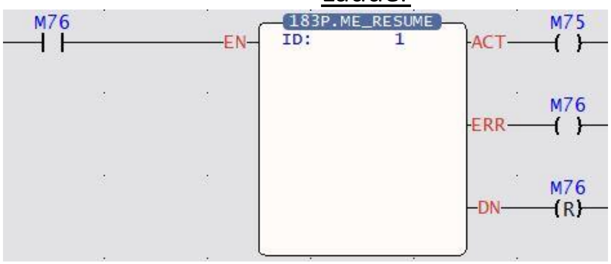
Function Description

Resume and continue the execution of the paused or halted motion flow.

- EN = 1 : Resume the motion flow
- ACT = 1 : Resume is acting
- ERR = 1 : Resume error
- DN = 1 : Resume is done

Program Example

Ladder



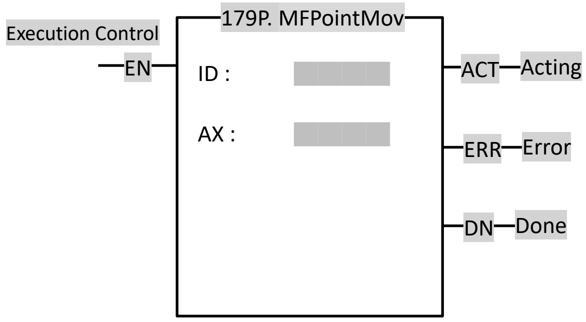
- When the execution control "EN" = 1, the motion flow suspended due to the execution of Fun182 (MFFlowPause) or Fun184 (MFFlowHalt) will be resumed.

6-7 Fun179 Position Control (MFPointMov)

Fun179 P MFPointMov	Position Control	Fun179 P MFPointMov

Command Description

Ladder Symbol



Operand

PT : Point number of the executing position control point table
AX : Master axis of the executing position control

Relay and Register

Type	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K	XR
Range	WX0 WX1008	WY0 WY1008	WM0 WM9104	WS0 WS3088	T0 T1023	C0 C1279	R0 R34767	R34768 R35023	R35024 R35279	R35280 R43223	R43224 R47319	D0 D11999		V, Z P0 ~ P9
ID	○	○	○	○	○	○	○	○	○	○	○	○	1~256	
AX	○	○	○	○	○	○	○	○	○	○	○	○	1~16	

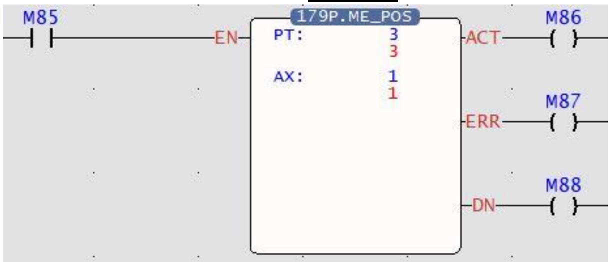
Function Description

Execute the point table position control commands.

- EN = 1: Position control is triggered
- ACT = 1: Position control is acting
- ERR = 1: Position control error
- DN = 1: Position control is done
- PT: Select the motion point related parameter position
- ID: The Flow ID to be executed.
- Special Register:
- Axis 1: Position control is running – M10623
- Axis 1: Position control is done – M10624

Program Example

Ladder



- When the execution control "EN" = 1, the axis specified by AX will execute the point table with the number specified by PT.
- When the execution control "EN" = 0, the motion will stop immediately.
- The following table is used as an example.
  When PT = 1 and AX = 1, axis 1 will run according to the parameters in point table 1.
  However, if PT=2 and AX=1 are set, it will fail due to the difference from the point table setting, and ERR will be triggered.

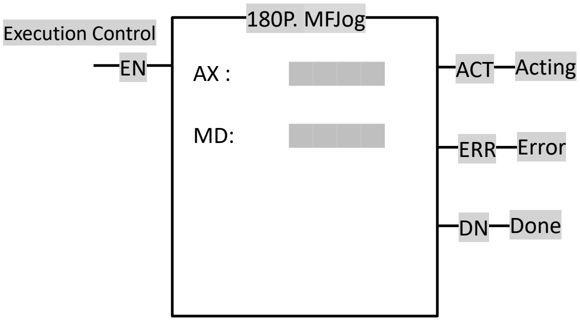
	Axis
1	M： Axis_1
2	M： Axis_2
3	M： Axis_1

6-8 Fun180 JOG Control (MFJog)

Fun180 P MFJog	JOG Control	Fun180 P MFJog

Command Description

Ladder Symbol



Operand

AX : Axis to execute JOG control
MD : Execution mode

Relay and Register

Type	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K	XR
Range	WX0 ｜ WX1008	WY0 ｜ WY1008	WM0 ｜ WM9104	WS0 ｜ WS3088	T0 ｜ T1023	C0 ｜ C1279	R0 ｜ R34767	R34768 ｜ R35023	R35024 ｜ R35279	R35280 ｜ R43223	R43224 ｜ R47319	D0 ｜ D11999		V, Z P0 ~ P9
AX	○	○	○	○	○	○	○	○	○	○	○	○	1~16	
MD													0~3	

Function Description

Specify a motion axis to execute JOG function according to JOG parameters and setting modes.

- EN = 1 : Trigger JOG control
- D/R = 1 Forward / = 0 Backward
- ACT = 1 : JOG is acting
- ERR = 1 : JOG error
- DN = 1 : JOG is done
- AX : Axis to be executed
- MD : Mode 0 – Mode 3

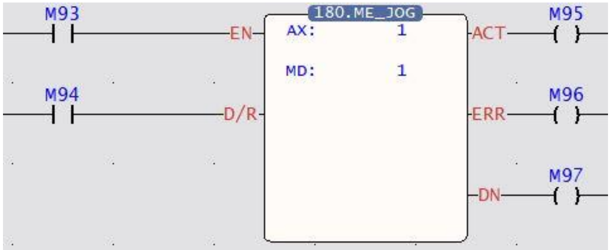
  Mode 0 : Continue going at JOG initial speed.
  Mode 1 : Advance at the JOG initial speed, advance the JOG distance and then stop.
  Mode 2 : Start at the JOG initial speed, accelerate to the JOG speed with the JOG acceleration and continue moving forward 。
  Mode 3 : Start at the JOG initial speed, accelerate to the JOG speed with the JOG acceleration, and stop after moving forward with JOG distance.

- Special Register
- Axis 1 : JOG is acting - M10625
- Axis 1 : JOG is done - M10626

- Please refer to Chapter 11 for JOG instruction modes and details.

Program Example

Ladder



- When the execution control "EN" = 1, the axis specified by AX will execute the mode specified by MD.
- When the execution control "EN" = 0, the motion will stop immediately.
- Take the following table as an example:
  When AX = 1 and MD = 1, it means axis 1 will run a distance of 100mm at a speed of 1mm/s.

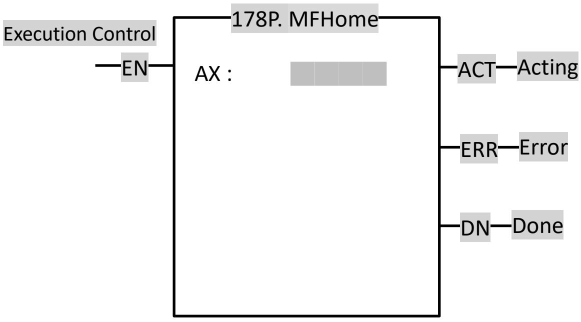
	Axis 1
JOG Initial Speed	1mm/s
JOG Speed	10mm/s
JOG Acceleration	1000mm/s^2
JOG Deceleration	1000mm/s^2
JOG Distance	100mm

6-9 Fun178 HOME Return (MFHome)

Fun178 P MFHome	HOME Return	Fun178 P MFHome

Command Description

Ladder Symbol



Operand

AX : Axis to execute HOME Return

Relay and Register

Type	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K	XR
Range	WX0 – WX1008	WY0 – WY1008	WM0 – WM9104	WS0 – WS3088	T0 – T1023	C0 – C1279	R0 – R34767	R34768 – R35023	R35024 – R35279	R35280 – R43223	R43224 – R47319	D0 – D11999		V, Z P0 ~ P9
AX							○				○	○	1~16	

Function Description

Fun178 P MFHome	HOME Return	Fun178 P MFHome

Specify a motion axis to execute HOME Return.

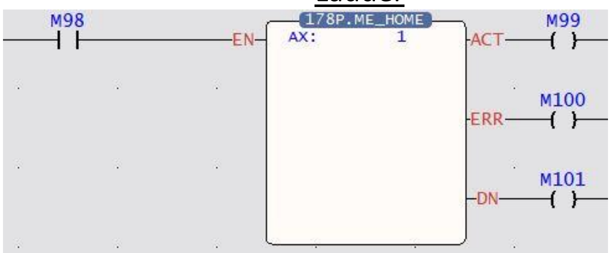
- EN = 1 : Trigger HOME Return
- ACT = 1 : HOME Return is acting
- ERR = 1 : HOME Return error
- DN = 1 : HOME Return is done
- AX : Axis to be executed

Special Register
Axis 1: HOME Return is acting - M10621
Axis 1: HOME Return is done - M10622

- For the modes and details of the HOME command, please refer to Chapter 10.

Program Example

Ladder



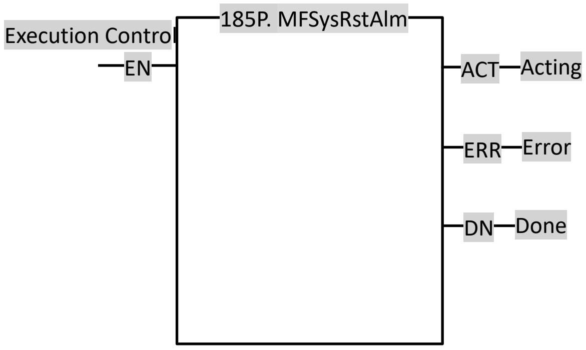
- When the execution control "EN" = 1, the HOME Return will be performed according to the parameters on the motion axis setting page.

6-10 Fun185 Reset Motion Error Alarm (MFSysRstAlm)

Fun185 P MFSysRstAlm	Reset Motion Error Alarm	Fun185 P MFSysRstAlm

Command Description

Ladder Symbol



Operand

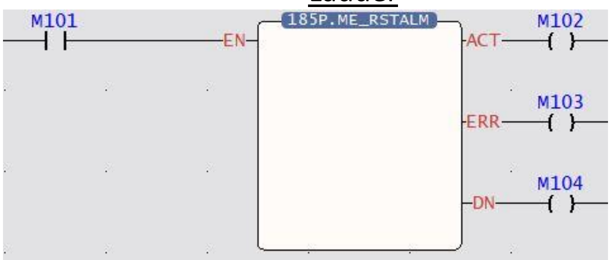
Function Description

Clears all motion flow and driver error alarms. However, the communication alarm of the driver cannot be cleared by this command and needs to be powered on again.

- EN = 1 : Rising Trigger clears motion error alarm
- ACT = 1 : Clearing motion error alarm is acting
- ERR = 1 : Clearing motion error alarm error
- DN = 1 : Clearing motion error alarm is done

Program Example

Ladder



- When the execution control "EN" = 1, it will clear the motion flow and errors occurred in the driver.

6-11 Fun186 Stop Motion Flow (MFFlowStop)

Fun186 P MFFlowStop	Stop Motion Flow	Fun186 P MFFlowStop

Command Description

Ladder Symbol

Operand

ID: Motion Flow ID

Relay and Register

Operand \ Range	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K	XR
	WX0 ｜ WX1008	WY0 ｜ WY1008	WM0 ｜ WM9104	WS0 ｜ WS3088	T0 ｜ T1023	C0 ｜ C1279	R0 ｜ R34767	R34768 ｜ R35023	R35024 ｜ R35279	R35280 ｜ R43223	R43224 ｜ R47319	D0 ｜ D11999		V, Z P0 ~ P9
ID	○	○	○	○	○	○	○	○	○	○	○	○	1-16	

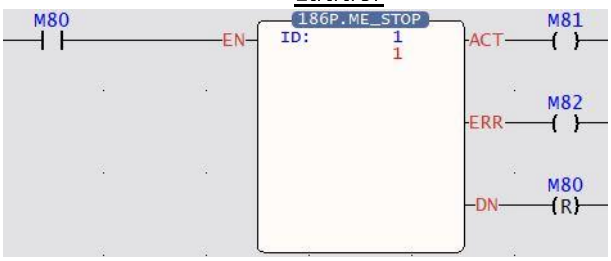
Function Description

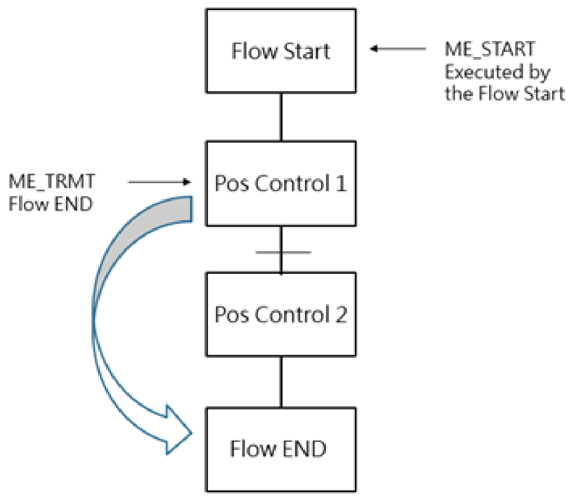
Immediately stop the motion flow of the specified ID.
When execution of this command is done, MFFlowResume cannot be used to resume execution.
Need to use MFFlowStart to restart the process.

- EN = 1 : Rising Trigger Motion Flow stops
- ACT = 1 : Stopping motion flow is acting
- ERR = 1 : Stopping motion flow error
- DN = 1 : Stopping motion flow is done

Program Example

Ladder





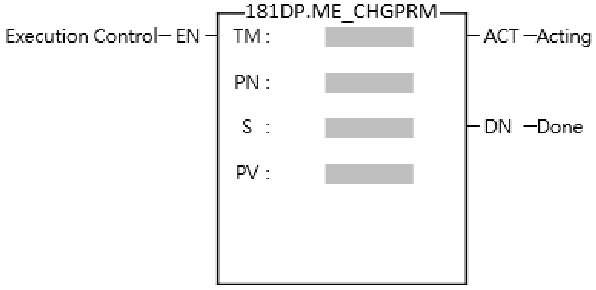
- When the execution control "EN" = 1, the motion flow of the specified ID end immediately.

6-12 Fun181 Change Motion Control Parameter

Fun181 MFChgTbPrm	Change Motion Control Parameter	Fun181 MFChgTbPrm

Command Description

Ladder Symbol



Operand

TM: Table Number
PN: Point Number
S: Item Number
PV: Written Value

Relay and Register

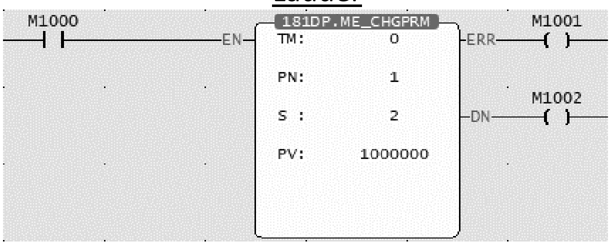
Range / Operand	HR	IR	OR	SR	ROR	DR	K	XR
	R0 ∣ R34767	R34768 ∣ R35023	R35024 ∣ R35279	R35280 ∣ R43223	R43224 ∣ R47319	D0 ∣ D11999		V, Z P0 ~ P9
TM							0~128	
PN							1~4096	
S	○	○	○	○	○	○	0~50	
PV	○	○	○	○	○	○	0~2147482647	

Function Description

- Operand
  TM (Table Number): 0 Point Table, 1 Axis Table, 2 Synchronous Table, 128 Flow Table
  PN (Point Number): According to the table to be modified by TM, it corresponds to different types of numbers, such as Point Table Number, Axis Number, and Flow Block Number.
  S (Item Number): Please refer to the table below.
  PV (Written Value): The value to write, with fixed Double Word.
- When the execution control [EN] changes from 0→1, Fun181 will write the PV value into the specified motion control parameter.
- When the execution control [EN] changes from 1→0, all output indications are reset
- When there is an error while writing in the motion control parameters, the output indication shows [ERR] ON.
- When the writing of motion control parameters is done, the output indication shows [DN] ON.

Program Example

Ladder



- When M1000 OFF→ON, change the point table parameters (TM: 0 point table, PN: 1 point table 1, S: 2 master axis coordinates, PV: change to 1000.000mm), and change the master axis movement distance of point table 1 to 1000.000mm.

Fun181 Parameter Table

TM		PN		S		PV Type	
0	Motion Point Table	1-1024	Point Table No.	0	Operantion Mode	16Bit	UINT
				1	Acceleration Curve Type	16Bit	UINT
				2	Master Axis Coordinates	32Bit	INT
				3	Interpolation Axis 1 Coordinates	32Bit	INT
				4	Interpolation Axis 2 Coordinates	32Bit	INT
				5	Interpolation Axis 3 Coordinates	32Bit	INT
				6	Speed	32Bit	UINT
				7	Accelearation	32Bit	UINT
				8	Deceleration	32Bit	UINT
				9	S Acceleration Percentage	16Bit	UINT
				10	S Deceleration Percentage	16Bit	UINT
				11	Arc Mode	16Bit	UINT
				12	Arc Direction	16Bit	UINT
				13	Arc X Coordinate	32Bit	INT
				14	Arc Y Coordinate	32Bit	INT
				15	Arc Radius	32Bit	UINT
				16	Auxiliary Arc Radius	32Bit	UINT
				17	Waiting Time	32Bit	UINT
				18	Next Point No.	16Bit	UINT
				19	Revolution No.	16Bit	UINT
				20	Consecutive Point Mode	16Bit	UINT
				21	Arc Z Coordinate	32Bit	INT
				22	3D Consecutive Point Percentage	16Bit	UINT
1	Motion Axis Table	1-16	Axis No.	0	Start Speed	32Bit	UINT
				1	Max. Rotating Speed	32Bit	UINT
				2	Default Acceleration	32Bit	UINT
				3	Default Ceceleration	32Bit	UINT
				4	Soft Limit(+)	32Bit	INT
				5	Soft Limit(-)	32Bit	INT
				6	Following Error Window	32Bit	UINT
				7	Following Error Timeout	32Bit	UINT
				8	Pos Done Tolerance	32Bit	UINT
				9	Pos Done Check Time	32Bit	UINT
				10	Maximum Motor Torque	16Bit	UINT
				11	Maximum Torque Limit(+)	16Bit	UINT
				12	Maximum Torque Limit(-)	16Bit	UINT
				13	HOME Return Mode	16Bit	UINT

				14	HOME Return Direction	16Bit	UINT
				15	HOME Return Movement	32Bit	INT
				16	Home Return Speed	32Bit	UINT
				17	HOME Return Crawl Speed	32Bit	UINT
				18	JOG Initial Speed	32Bit	UINT
				19	JOG Speed	32Bit	UINT
				20	JOG Acceleration	32Bit	UINT
				21	JOG Deceleration	32Bit	UINT
				22	JOG Distannce	32Bit	UINT
2	Synchronous Parameter Table	1-16	Axis No.	0	Sync OFF time at deceleration stop	32Bit	UINT
				1	Master Axis compensation change mode	32Bit	INT
				2	Master Axis compensation change time	16Bit	UINT
				3	Aux Axis compensation command value	32Bit	UINT
				4	Aux Axis compensation change mode	32Bit	INT
				5	Aux Axis compensation change time	16Bit	UINT
				6	Master Axis compensation change mode	32Bit	UINT
				7	Variable gear retio numerator	32Bit	INT
				8	Variable gear retio denominator	32Bit	INT
				9	Gear retio change mode	16Bit	UINT
				10	Variable gear retio change time	32Bit	UINT
				11	Main clutch ON setting value	32Bit	UINT
				12	Main clutch ON delay	32Bit	INT
				13	Main clutch ON sliding curve	32Bit	INT
				14	Main clutch ON sliding time	32Bit	UINT
				15	Main clutch ON following time	32Bit	UINT
				16	Main clutch ON follow-ups	32Bit	INT
				17	Main clutch OFF setting value	32Bit	UINT
				18	Main clutch OFF delay	32Bit	INT
				19	Main clutch OFF sliding curve	32Bit	INT
				20	Main clutch OFF sliding time	32Bit	UINT
				21	Aux clutch ON setting value	32Bit	UINT
				22	Aux clutch ON delay	32Bit	INT

				23	Aux clutch ON sliding curve	32Bit	INT
				24	Aux clutch ON sliding time	32Bit	UINT
				25	Aux clutch ON following time	32Bit	UINT
				26	Aux clutch ON follow-ups	32Bit	INT
				27	Aux clutch OFF setting value	32Bit	UINT
				28	Aux clutch OFF delay	32Bit	INT
				29	Aux clutch OFF sliding curve	32Bit	INT
				30	Aux clutch OFF sliding time	32Bit	UINT
				31	Reserve		
				32	Reserve		
				33	Step Angle Compensation Base speed	32Bit	UINT
				34	Step Angle Compensation Base value	32Bit	INT
				35	Step Angle Compensation value change mode	16Bit	UINT
				36	Step Angle Compensation value change time	32Bit	UINT
				37	Eletronic Cam Number	16Bit	UINT
				38	Sync contact output No.	16Bit	UINT
				39	Filter Pulse Time	32Bit	UINT
				40	Input Axis Cyclic	32Bit	UINT
				41	Sync master axis phase default value	32Bit	UINT
				42	Master axis phase default value after phase compensation	32Bit	UINT
				43	Main clutch input axis phase default value	32Bit	UINT
				44	Auxiliary clutch input axis phase default value	32Bit	UINT
				45	Main clutch output axis phase default value	32Bit	UINT
				46	Auxiliary clutch output axis phase default value	32Bit	UINT
				47	Reserve		
				48	Cam input axis phase default value	32Bit	UINT
				49	Cam output axis base coordinate	32Bit	UINT
				50	Cam stroke	32Bit	UINT

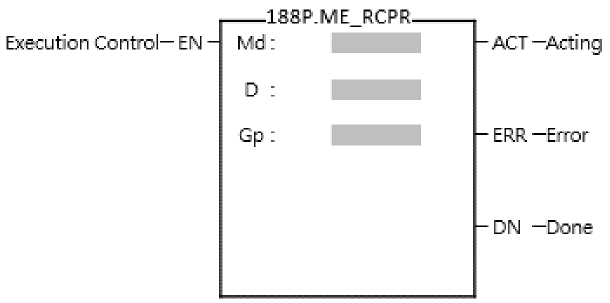
3	Reserve						
4	Axis Velocity Mode Parameter	1-16	Axis No.	0	Target Rotating Speed	32Bit	INT
				1	Torque Limit	16Bit	UINT
5	Axis Torque Mode Parameter	1-16	Axis No.	0	Target Torque	16Bit	INT
				1	Rotating Speed Limit	32Bit	UINT
128	Flow Table	1-4096	Flow Block No.	0	Modify Standby Time	32Bit	UINT
				116	Modify the positioning control block axis number	32Bit	INT
				17	Modify the set speed value	32Bit	UINT

6-13 Fun188 Read Motion Control Recipe

Fun188 MFSysRCPR	Read Motion Control Recipe	Fun188 MFSysRCPR

Command Description

Ladder Symbol



Operand

Md: Mode

D: Initial register of Recipe

Gp: Read the column of the recipe table

Relay and Register

Operand \ Range	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K	XR
	WX0 | WX1008	WY0 | WY1008	WM0 | WM9104	WS0 | WS3088	T0 | T1023	C0 | C1279	R0 | R34767	R34768 | R35023	R35024 | R35279	R35280 | R43223	R43224 | R47319	D0 | D11999		V, Z P0 ~ P9
ID	○	○	○	○	○	○	○	○	○	○	○	○	0~1	
D	○	○	○	○	○	○	○	○	○	○	○	○		○
Gp	○	○	○	○	○	○	○	○	○	○	○	○	0~100	

Function Description

- [Fun188 Recipe Read] and [Fun189 Recipe Write] are used to read or write a large number of motion control parameters. If you only need to modify a single or a few parameters, you can use [Fun181 Change Motion Control Parameters] or [Fun198 Mapping Table] .
- Parameters can only be read when the axis action stops.
- Operand
  Md (Mode): 0 uses PLC Register , 1 gets data from the SD card
  D (Recipe Initial Register): Md = 0 meaningless , Md = 1 SD card recipe file number
  Gp (Read the column of the recipe table): Read the column of the recipe table, 0 read all
- When the execution control [EN] changes from 0→1, Fun188 will read the specified recipe to the specified register.

  When the execution control [EN] changes from 1→0, all output indications are reset.
- When reading the recipe, the output indication [ACT] will be ON
- When reading the recipe, if there is an error, the output indication [ERR] will be ON.
- When the reading of the recipe is done, the output indication [DN] will be ON.

Recipe Table

【Project Management】>【Motion Control】>【Motion Recipe】

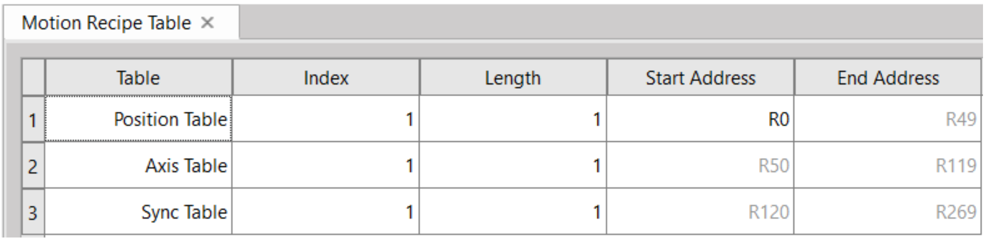

Motion Recipe Table ×

	Table	Index	Length	Start Address	End Address
1	Position Table	1	1	R0	R49
2	Axis Table	1	1	R50	R119
3	Sync Table	1	1	R120	R269

- Motion Recipe Table
  Tables: Point table, Axis table, Synchronization table
- Index: Point table (number of points), axis table (number of axes), synchronization table (number of axes)
  Length : consecutive point table or consecuitive axis
  Initial Address: The initial address of the register for reading and writing recipes
- Please refer to the following table for the value definition of the register of the Motion Recipe Table.

Recipe Point Table

Start Addres+N	Item	Size	Type	L	Definition
R+0	Operation Mode	WORD	INT	1	0. Unuse 1. Single/ABS 2. Single/INC 3. Linear(2Axis)/ABS 4. Linear(2Axis)/INC 5. Linear(3Axis)/ABS 6. Linear(3Axis)/INC 7. Linear(4Axis)/ABS 8. Linear(4Axis)/INC 9. Arc/ABS 10. Arc/ INC 11. Arc 3D/ABS 12. Arc 3D/ INC 13. Helical/ABS 14. Helical/ INC 15. Single Velocity
R+1	Accerlation Profile	WORD	INT	1	0. T Curve

					1. S Curve
R+2	Master Axis	WORD	INT	1	1~16 Non use = 0
R+3	Interpolation 1	WORD	INT	1	1~16 Non use = 0
R+4	Interpolation 2	WORD	INT	1	1~16 Non use = 0
R+5	Interpolation 3	WORD	INT	1	1~16 Non use = 0
R+6	Target Position Master Axis	DWORD	INT	2	Precision: Decimal Place (negative number allow)
R+8	Target Position Interpolation 1	DWORD	INT	2	Precision: Decimal Place (negative number allow)
R+10	Target Position Interpolation 2	DWORD	INT	2	Precision: Decimal Place (negative number allow)
R+12	Target Position Interpolation 3	DWORD	INT	2	Precision: Decimal Place (negative number allow)
R+14	Velocity	DWORD	INT	2	Precision: Decimal Place (positive number only)
R+16	Acceleration	DWORD	INT	2	Precision: Decimal Place (positive number only)
R+18	Deceleration	DWORD	INT	2	Precision: Decimal Place (positive number only)
R+20	Acceleration S Curve	WORD	INT	1	Precision: 0.1
R+21	Deceleration S Curve	WORD	INT	1	Precision: 0.1
R+22	Arc Mode	WORD	INT	1	0. Border Point 1. Center 2. Radius
R+23	Arc Direction	WORD	INT	1	0. CW 1. CCW
R+24	Arc (Border/Center) X coordinate	DWORD	INT	2	Precision: Decimal Place (negative number allow)
R+26	Arc (Border/Center) Y coordinate	DWORD	INT	2	Precision: Decimal Place (negative number allow)
R+28	Arc Radius	DWORD	INT	2	Precision: Decimal Place (positive number only)
R+30	Aux Radius	DWORD	INT	2	Precision: Decimal Place (positive number only)
R+32	Standby Time	DWORD	UINT	2	Unit: ms
R+34	Continuous Point	WORD	INT	1	1~1024 End = 0
R+35	Circle Revolution	WORD	UINT	1	0~65535
R+36	Continuous Mode	WORD	INT	1	0. Standby 1. Next Point Speed Continue 2. Current Point Speed Continue 3. Starting Speed Continue
R+37-41	Reserve			5	
R+42	Arc (Border/Center) Z coordinate	DWORD	INT	2	Precision: Decimal Place (negative number allow)

Recipe Axis Table

Start Addres+N	Item	Size	Type	L	Definition
R+0	Encoder Type	WORD		1	0 = Incremental 1 = Absolute
R+1	Unit	WORD		1	0. PLS

					1. Mm 2. Deg 3. inch
R+2	Decimal Point	WORD		1	1000: 1 100: 0.1 10: 0.01 1: 0.001
R+3	Pulse/Revolution	DWORD		2	Precision: Decimal Place
R+5	Unit/Revolution	DWORD		2	Precision: Decimal Place
R+7	Velocity Unit	DWORD		1	0. PLS/Sec 1. PLS/min 2. RPM
R+8	Velocity Gain	DWORD		2	Precision: 0.001
R+10	Start Velocity	DWORD		2	Precision: Decimal Place
R+12	Max Motor Velocity	DWORD		2	Precision: 1 Unit: RPM
R+14	Default Acceleration	DWORD		2	Precision: Decimal Place
R+16	Default Deceleration	DWORD		2	Precision: Decimal Place
R+18	Soft Limit(+)	DWORD		2	Precision: Decimal Place (positive number only)
R+20	Soft Limit(-)	DWORD		2	Precision: Decimal Place (positive number only)
R+22	Following Error Window	DWORD		2	Precision: Decimal Place
R+24	Following Error Timeout	DWORD		2	Unit: ms
R+26	Pos Done Tolerance	DWORD		2	Precision: Decimal Place
R+28	Pos Done Check Time	DWORD		2	Unit: ms
R+30	Maximum Motor Torque	WORD		1	Precision: 0.1
R+31	Maximum Torque Limit(+)	WORD		1	Precision: 0.1
R+32	Maximum Torque Limit(-)	WORD		1	Precision: 0.1
R+33	Touch Probe1 Source	WORD		1	0. Disable 1. Input 2. Z Signal
R+34	Touch Probe1 Mode	WORD		1	0. Rising Edge Single 1. Rising Edge Continue 2. Falling Edge Single 3. Falling Edge Continue
R+35	Touch Probe2 Source	WORD		1	0. Disable 1. Input 2. Z Signal
R+36	Touch Probe2 Mode	WORD		1	0. Rising Edge Single 1. Rising Edge Continue 2. Falling Edge Single 3. Falling Edge Continue
R+37-40	Reserve			4	
R+41	Stop Mode	WORD		1	5. Deceleration Stop 7. Immediately Stop
R+42	Stop Deceleration	DWORD		2	Precision: Decimal Place
R+44	Homing Mode	WORD		1	99. Homing on current position 100. Forward-Falling Trigger 101. Backward-Falling Trigger 102. Z Signal-Forward-Rising Trigger 103. Z Signal-Forward-Falling Trigger 104. Forward- Rising Trigger

					105. Backward-Rising Trigger 106. Z Signal-Backward-Rising Trigger 107. Z Signal-Backward-Falling Trigger
R+45	Homing IO Source	WORD		1	0. From Servo Driver 1. From PLC
R+46	Homing Start Direction	WORD		1	0. Negative 1. Positive
R+47	Homing Origin Offset	DWORD		2	Precision: Decimal Place (negative number allow)
R+49	Homing Find Velocity	DWORD		2	Precision: Decimal Place
R+51	Homing Creep Velocity	DWORD		2	Precision: Decimal Place
R+53	Homing Deceleration	DWORD		2	Precision: Decimal Place
R+55	Limit Switch(-)(DI)	WORD		1	
R+56	Limit Switch(+)(DI)	WORD		1	
R+57	Homing Switch(DI)	WORD		1	
R+58	Homing Z Count	DWORD		2	
R+60	Jogging Base Velocity	DWORD		2	Precision: Decimal Place
R+62	Jogging Velocity	DWORD		2	Precision: Decimal Place
R+64	Jogging Acceleration	DWORD		2	Precision: Decimal Place
R+66	Jogging Deceleration	DWORD		2	Precision: Decimal Place
R+68	Inching Distance	DWORD		2	Precision: Decimal Place

Recipe Synchronous Table

Start Addres+N	Item	Size	Type	L	Definition
R+0	Input axis coordinate Unit	WORD		1	
R+1	Input axis coordinate decimal point	WORD		1	
R+2	Input axis period	DWORD		2	Precision: Decimal Place
R+4	Clutch OFF sliding time at deceleration stop	DWORD		2	
R+6	Input axis phase init method	WORD		1	
R+7	Sync master axis phase default value	DWORD		2	Precision: Decimal Place
R+9	Master axis phase default value after phase compensation	DWORD		2	Precision: Decimal Place
R+11	Main clutch input axis phase default value	DWORD		2	Precision: Decimal Place
R+13	Auxiliary clutch input axis phase default value	DWORD		2	Precision: Decimal Place
R+15	Cam input axis/clutch output axis phase init method	WORD		1	

R+16	Main clutch output axis phase default value	DWORD		2	Precision: Decimal Place
R+18	Auxiliary clutch output axis phase default value	DWORD		2	Precision: Decimal Place
R+20	Reserve	DWORD		2	
R+22	Cam input axis phase default value	DWORD		2	Precision: Decimal Place
R+24	Cam output axis base coordinate	DWORD		2	Precision: Decimal Place
R+26	Master Axis 1 input selection	WORD		1	
R+27	Master Axis 1 external reference number	WORD		1	
R+28	Master Axis 1 prevent reverse	WORD		1	
R+29	Master Axis 1 coordinate transformation setting	WORD		1	
R+30	Master Axis 1 coordinate transformation numerator	DWORD		2	
R+32	Master Axis 1 coordinate transformation denominator	DWORD		2	
R+34	Master Axis 2 input selection	WORD		1	
R+35	Master Axis 2 external reference number	WORD		1	
R+36	Master Axis 2 prevent reverse	WORD		1	
R+37	Master Axis 2 coordinate transformation setting	WORD		1	
R+38	Master Axis 2 coordinate transformation numerator	DWORD		2	
R+40	Master Axis 2 coordinate transformation denominator	DWORD		2	
R+42	Aux Axis input selection	WORD		1	
R+43	Aux Axis external reference number	WORD		1	
R+44	Aux Axis prevent reverse	WORD		1	
R+45	Aux Axis coordinate transformation setting	WORD		1	
R+46	Aux Axis coordinate	DWORD		2	

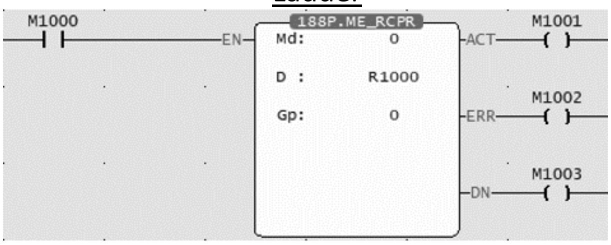
	transformation numerator				
R+48	Aux Axis coordinate transformation denominator	DWORD		2	
R+50	Master Axis compensation command value	DWORD		2	Precision: Decimal Place
R+52	Master Axis compensation change mode	WORD		1	
R+53	Master Axis compensation change time	DWORD		2	
R+55	Aux Axis compensation command value	DWORD		2	Precision: Decimal Place
R+57	Aux Axis compensation change mode	WORD		1	
R+58	Aux Axis compensation change time	DWORD		2	
R+60	Variable gear retio numerator	DWORD		2	
R+62	Variable gear retio denominator	DWORD		2	
R+64	Gear retio change mode	WORD		1	
R+65	Variable gear retio change time	DWORD		2	
R+67	Main clutch ON condition	WORD		1	
R+68	Main clutch ON setting value	DWORD		2	Precision: Decimal Place
R+70	Main clutch ON delay	DWORD		2	Precision: Decimal Place
R+72	Reserve	WORD		1	
R+73	Main clutch ON connection method	WORD		1	
R+74	Reserve	WORD		1	
R+75	Main clutch ON sliding curve	WORD		1	
R+76	Reserve	DWORD		2	
R+78	Main clutch ON sliding time	DWORD		2	
R+80	Main clutch ON following time	DWORD		2	
R+82	Main clutch ON follow-ups	DWORD		2	Precision: Decimal Place
R+84	Main clutch OFF condition	WORD		1	
R+85	Main clutch OFF setting value	DWORD		2	Precision: Decimal Place
R+87	Main clutch OFF delay	DWORD		2	Precision: Decimal Place
R+87	Reserve	WORD		1	
R+90	Main clutch OFF connection method	WORD		1	

R+91	Reserve	WORD		1	
R+92	Main clutch OFF sliding curve	WORD		1	
R+93	Reserve	DWORD		2	
R+95	Main clutch OFF sliding time	DWORD		2	
R+97	Aux clutch ON condition	WORD		1	
R+98	Aux clutch ON setting value	DWORD		2	Precision: Decimal Place
R+100	Aux clutch ON delay	DWORD		2	Precision: Decimal Place
R+102	Reserve	WORD		1	
R+103	Aux clutch ON connection method	WORD		1	
R+104	Reserve	WORD		1	
R+105	Aux clutch ON sliding curve	WORD		1	
R+106	Reserve	DWORD		2	
R+108	Aux clutch ON sliding time	DWORD		2	
R+110	Aux clutch ON following time	DWORD		2	
R+112	Aux clutch ON follow-ups	DWORD		2	Precision: Decimal Place
R+114	Aux clutch OFF condition	WORD		1	
R+115	Aux clutch OFF setting value	DWORD		2	Precision: Decimal Place
R+117	Aux clutch OFF delay	DWORD		2	Precision: Decimal Place
R+119	Reserve	WORD		1	
R+120	Aux clutch OFF connection method	WORD		1	
R+121	Reserve	WORD		1	
R+122	Aux clutch OFF sliding curve	WORD		1	
R+123	Reserve	DWORD		2	
R+125	Aux clutch OFF sliding time	DWORD		2	
R+127	Reserve	WORD*5		5	
R+132	Step Angle Compensation Base speed	DWORD		2	Precision: Decimal Place
R+134	Step Angle Compensation Base value	DWORD		2	Precision: Decimal Place
R+136	Step Angle Compensation value change mode	WORD		1	
R+137	Step Angle Compensation value change time	DWORD		2	
R+139	Cam data No.	WORD		1	
R+140	Cam stroke	DWORD		2	Precision: Decimal Place
R+142	Cam contact output No.	WORD		1	
R+143	Output filter time	DWORD		2	

	constant				
R+145-149	Reserve				

Program Example

Ladder



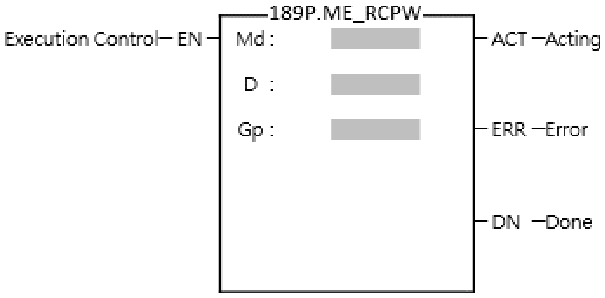
- When M1000 is from OFF→ON, read all recipe tables and store them in R1000.
- Read the parameters of PLC point table 1 and store them in R1000-R1049
- Read the parameters of the PLC axis table (axis 1) and store them in R1050-R1119
- Read the parameters of the PLC synchronous table (axis 1) and store them in R1120-R1269

6-14 Fun189 Write Motion Control Recipe

Fun189 MFSysRCPW	Write Motion Control Recipe	Fun189 MFSysRCPW

Command Description

Ladder Symbol



Operands

Md: Mode

D: Initial Recipe Register

Gp: Write to the column of the recipe table

Relay and Register

Operand \ Ranga	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K	XR
	WX0 | WX1008	WY0 | WY1008	WM0 | WM9104	WS0 | WS3088	T0 | T1023	C0 | C1279	R0 | R34767	R34768 | R35023	R35024 | R35279	R35280 | R43223	R43224 | R47319	D0 | D11999		V, Z P0 ~ P9
Md	○	○	○	○	○	○	○	○	○	○	○	○	0~1	
D	○	○	○	○	○	○	○	○	○	○	○	○		
Gp	○	○	○	○	○	○	○	○	○	○	○	○	0~100	

Function Description

- [Fun188 Read Recipe] and [Fun189 Write Recipe] are used to read or write a large number of motion control parameters. If you only need to modify a single or a few parameters, you can use [Fun181 Change Motion Control Parameters] or [Fun198 Mapping Table].
- Parameters can only be written when the axis action stops.
- Operands
  Md (Mode): 0 uses PLC Register , 1 gets data from the SD card
  D (Initial Recipe Register): Md = 0 meaningless , Md = 1 SD card recipe file number
  Gp (Write to the column of the recipe table): Write to the column of the recipe table, 0 Write into the all.
- When the execution control [EN] changes from 0→1, Fun188 will write the specified register to the specified recipe.
- When the execution control [EN] changes from 1→0, all output indications are reset.
- When writing into the recipe, the output indication [ACT] is ON.
- When writing in the recipe, if there is an error, the output indication [ERR] is ON.
- When writing the recipe is completed, the output indication [DN] is ON.

Recipe Table

【Project Management】>【Motion Control】>【Motion Recipe】

Motion Recipe Table ×

	Table	Index	Length	Start Address	End Address
1	Position Table	1	1	R0	R49
2	Axis Table	1	1	R50	R119
3	Sync Table	1	1	R120	R269

- Motion Recipe Table
  Table: Point Table, Axis Table, Synchronous Table
  Index ： Point Table (Point No.), Axis Table (Axis No.), Synchronous Table (Axis No.)
  Length ：Consecutive point table or consecutive axis
  Iniyial Address ：Initial address of recipe register
- Please refer to the following table for the definition of the register value of the motion recipe table

Recipe Point Table

Start Addres+N	Item	Size	Type	L	Definition
R+0	Operation Mode	WORD	INT	1	16. Unuse 17. Single/ABS 18. Single/INC 19. Linear(2Axis)/ABS 20. Linear(2Axis)/INC 21. Linear(3Axis)/ABS 22. Linear(3Axis)/INC 23. Linear(4Axis)/ABS 24. Linear(4Axis)/INC 25. Arc/ABS 26. Arc/ INC 27. Arc 3D/ABS 28. Arc 3D/ INC 29. Helical/ABS 30. Helical/ INC 31. Single Velocity

R+1	Accerlation Profile	WORD	INT	1	2. T Curve 3. S Curve
R+2	Master Axis	WORD	INT	1	1~16 Non use = 0
R+3	Interpolation 1	WORD	INT	1	1~16 Non use = 0
R+4	Interpolation 2	WORD	INT	1	1~16 Non use = 0
R+5	Interpolation 3	WORD	INT	1	1~16 Non use = 0
R+6	Target Position Master Axis	DWORD	INT	2	Precision: Decimal Place (negative number allow)
R+8	Target Position Interpolation 1	DWORD	INT	2	Precision: Decimal Place (negative number allow)
R+10	Target Position Interpolation 2	DWORD	INT	2	Precision: Decimal Place (negative number allow)
R+12	Target Position Interpolation 3	DWORD	INT	2	Precision: Decimal Place (negative number allow)
R+14	Velocity	DWORD	INT	2	Precision: Decimal Place (positive number only)
R+16	Acceleration	DWORD	INT	2	Precision: Decimal Place (positive number only)
R+18	Deceleration	DWORD	INT	2	Precision: Decimal Place (positive number only)
R+20	Acceleration S Curve	WORD	INT	1	Precision: 0.1
R+21	Deceleration S Curve	WORD	INT	1	Precision: 0.1
R+22	Arc Mode	WORD	INT	1	3. Border Point 4. Center 5. Radius
R+23	Arc Direction	WORD	INT	1	2. CW 3. CCW
R+24	Arc (Border/Center) X coordinate	DWORD	INT	2	Precision: Decimal Place (negative number allow)
R+26	Arc (Border/Center) Y coordinate	DWORD	INT	2	Precision: Decimal Place (negative number allow)
R+28	Arc Radius	DWORD	INT	2	Precision: Decimal Place (positive number only)
R+30	Aux Radius	DWORD	INT	2	Precision: Decimal Place (positive number only)
R+32	Standby Time	DWORD	UINT	2	Unit: ms
R+34	Continuous Point	WORD	INT	1	1~1024 End = 0
R+35	Circle Revolution	WORD	UINT	1	0~65535
R+36	Continuous Mode	WORD	INT	1	4. Standby 5. Next Point Speed Continue 6. Current Point Speed Continue 7. Starting Speed Continue
R+37-41	Reserve			5	
R+42	Arc (Border/Center) Z coordinate	DWORD	INT	2	Precision: Decimal Place (negative number allow)

Recipe Axis Table

Start Addres+N	Item	Size	Type	L	Definition
R+0	Encoder Type	WORD		1	0 = Incremental 1 = Absolute

R+1	Unit	WORD		1	4. PLS 5. Mm 6. Deg 7. inch
R+2	Decimal Point	WORD		1	1000: 1 100: 0.1 10: 0.01 1: 0.001
R+3	Pulse/Revolution	DWORD		2	Precision: Decimal Place
R+5	Unit/Revolution	DWORD		2	Precision: Decimal Place
R+7	Velocity Unit	DWORD		1	3. PLS/Sec 4. PLS/min 5. RPM
R+8	Velocity Gain	DWORD		2	Precision: 0.001
R+10	Start Velocity	DWORD		2	Precision: Decimal Place
R+12	Max Motor Velocity	DWORD		2	Precision: 1 Unit: RPM
R+14	Default Acceleration	DWORD		2	Precision: Decimal Place
R+16	Default Deceleration	DWORD		2	Precision: Decimal Place
R+18	Soft Limit(+)	DWORD		2	Precision: Decimal Place (positive number only)
R+20	Soft Limit(-)	DWORD		2	Precision: Decimal Place (positive number only)
R+22	Following Error Window	DWORD		2	Precision: Decimal Place
R+24	Following Error Timeout	DWORD		2	Unit: ms
R+26	Pos Done Tolerance	DWORD		2	Precision: Decimal Place
R+28	Pos Done Check Time	DWORD		2	Unit: ms
R+30	Maximum Motor Torque	WORD		1	Precision: 0.1
R+31	Maximum Torque Limit(+)	WORD		1	Precision: 0.1
R+32	Maximum Torque Limit(-)	WORD		1	Precision: 0.1
R+33	Touch Probe1 Source	WORD		1	3. Disable 4. Input 5. Z Signal
R+34	Touch Probe1 Mode	WORD		1	4. Rising Edge Single 5. Rising Edge Continue 6. Falling Edge Single 7. Falling Edge Continue
R+35	Touch Probe2 Source	WORD		1	3. Disable 4. Input 5. Z Signal
R+36	Touch Probe2 Mode	WORD		1	4. Rising Edge Single 5. Rising Edge Continue 6. Falling Edge Single 7. Falling Edge Continue
R+37-40	Reserve			4	
R+41	Stop Mode	WORD		1	5. Deceleration Stop 7. Immediately Stop
R+42	Stop Deceleration	DWORD		2	Precision: Decimal Place
R+44	Homing Mode	WORD		1	99. Homing on current position 100. Forward-Falling Trigger 101. Backward-Falling Trigger 102. Z Signal-Forward-Rising Trigger 103. Z Signal-Forward-Falling Trigger

					104. Forward- Rising Trigger 105. Backward-Rising Trigger 106. Z Signal-Backward-Rising Trigger 107. Z Signal-Backward-Falling Trigger
R+45	Homing IO Source	WORD		1	2. From Servo Driver 3. From PLC
R+46	Homing Start Direction	WORD		1	2. Negative 3. Positive
R+47	Homing Origin Offset	DWORD		2	Precision: Decimal Place (negative number allow)
R+49	Homing Find Velocity	DWORD		2	Precision: Decimal Place
R+51	Homing Creep Velocity	DWORD		2	Precision: Decimal Place
R+53	Homing Deceleration	DWORD		2	Precision: Decimal Place
R+55	Limit Switch(-)(DI)	WORD		1	
R+56	Limit Switch(+)(DI)	WORD		1	
R+57	Homing Switch(DI)	WORD		1	
R+58	Homing Z Count	DWORD		2	
R+60	Jogging Base Velocity	DWORD		2	Precision: Decimal Place
R+62	Jogging Velocity	DWORD		2	Precision: Decimal Place
R+64	Jogging Acceleration	DWORD		2	Precision: Decimal Place
R+66	Jogging Deceleration	DWORD		2	Precision: Decimal Place
R+68	Inching Distance	DWORD		2	Precision: Decimal Place

Recipe Synchronous Table

Start Addres+N	Item	Size	Type	L	Definition
R+0	Input axis coordinate Unit	WORD		1	
R+1	Input axis coordinate decimal point	WORD		1	
R+2	Input axis period	DWORD		2	Precision: Decimal Place
R+4	Clutch OFF sliding time at deceleration stop	DWORD		2	
R+6	Input axis phase init method	WORD		1	
R+7	Sync master axis phase default value	DWORD		2	Precision: Decimal Place
R+9	Master axis phase default value after phase compensation	DWORD		2	Precision: Decimal Place
R+11	Main clutch input axis phase default value	DWORD		2	Precision: Decimal Place
R+13	Auxiliary clutch input axis phase default value	DWORD		2	Precision: Decimal Place
R+15	Cam input axis/clutch output axis phase init	WORD		1	

	method				
R+16	Main clutch output axis phase default value	DWORD		2	Precision: Decimal Place
R+18	Auxiliary clutch output axis phase default value	DWORD		2	Precision: Decimal Place
R+20	Reserve	DWORD		2	
R+22	Cam input axis phase default value	DWORD		2	Precision: Decimal Place
R+24	Cam output axis base coordinate	DWORD		2	Precision: Decimal Place
R+26	Master Axis 1 input selection	WORD		1	
R+27	Master Axis 1 external reference number	WORD		1	
R+28	Master Axis 1 prevent reverse	WORD		1	
R+29	Master Axis 1 coordinate transformation setting	WORD		1	
R+30	Master Axis 1 coordinate transformation numerator	DWORD		2	
R+32	Master Axis 1 coordinate transformation denominator	DWORD		2	
R+34	Master Axis 2 input selection	WORD		1	
R+35	Master Axis 2 external reference number	WORD		1	
R+36	Master Axis 2 prevent reverse	WORD		1	
R+37	Master Axis 2 coordinate transformation setting	WORD		1	
R+38	Master Axis 2 coordinate transformation numerator	DWORD		2	
R+40	Master Axis 2 coordinate transformation denominator	DWORD		2	
R+42	Aux Axis input selection	WORD		1	
R+43	Aux Axis external reference number	WORD		1	
R+44	Aux Axis prevent reverse	WORD		1	
R+45	Aux Axis coordinate transformation setting	WORD		1	
R+46	Aux Axis	DWORD		2	

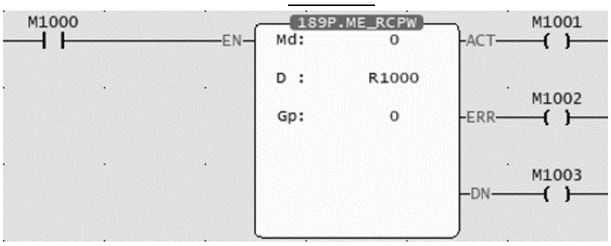
	coordinate transformation numerator				
R+48	Aux Axis coordinate transformation denominator	DWORD		2	
R+50	Master Axis compensation command value	DWORD		2	Precision: Decimal Place
R+52	Master Axis compensation change mode	WORD		1	
R+53	Master Axis compensation change time	DWORD		2	
R+55	Aux Axis compensation command value	DWORD		2	Precision: Decimal Place
R+57	Aux Axis compensation change mode	WORD		1	
R+58	Aux Axis compensation change time	DWORD		2	
R+60	Variable gear retio numerator	DWORD		2	
R+62	Variable gear retio denominator	DWORD		2	
R+64	Gear retio change mode	WORD		1	
R+65	Variable gear retio change time	DWORD		2	
R+67	Main clutch ON condition	WORD		1	
R+68	Main clutch ON setting value	DWORD		2	Precision: Decimal Place
R+70	Main clutch ON delay	DWORD		2	Precision: Decimal Place
R+72	Reserve	WORD		1	
R+73	Main clutch ON connection method	WORD		1	
R+74	Reserve	WORD		1	
R+75	Main clutch ON sliding curve	WORD		1	
R+76	Reserve	DWORD		2	
R+78	Main clutch ON sliding time	DWORD		2	
R+80	Main clutch ON following time	DWORD		2	
R+82	Main clutch ON follow-ups	DWORD		2	Precision: Decimal Place
R+84	Main clutch OFF condition	WORD		1	
R+85	Main clutch OFF setting value	DWORD		2	Precision: Decimal Place
R+87	Main clutch OFF delay	DWORD		2	Precision: Decimal Place
R+87	Reserve	WORD		1	
R+90	Main clutch OFF connection	WORD		1	

	method				
R+91	Reserve	WORD		1	
R+92	Main clutch OFF sliding curve	WORD		1	
R+93	Reserve	DWORD		2	
R+95	Main clutch OFF sliding time	DWORD		2	
R+97	Aux clutch ON condition	WORD		1	
R+98	Aux clutch ON setting value	DWORD		2	Precision: Decimal Place
R+100	Aux clutch ON delay	DWORD		2	Precision: Decimal Place
R+102	Reserve	WORD		1	
R+103	Aux clutch ON connection method	WORD		1	
R+104	Reserve	WORD		1	
R+105	Aux clutch ON sliding curve	WORD		1	
R+106	Reserve	DWORD		2	
R+108	Aux clutch ON sliding time	DWORD		2	
R+110	Aux clutch ON following time	DWORD		2	
R+112	Aux clutch ON follow-ups	DWORD		2	Precision: Decimal Place
R+114	Aux clutch OFF condition	WORD		1	
R+115	Aux clutch OFF setting value	DWORD		2	Precision: Decimal Place
R+117	Aux clutch OFF delay	DWORD		2	Precision: Decimal Place
R+119	Reserve	WORD		1	
R+120	Aux clutch OFF connection method	WORD		1	
R+121	Reserve	WORD		1	
R+122	Aux clutch OFF sliding curve	WORD		1	
R+123	Reserve	DWORD		2	
R+125	Aux clutch OFF sliding time	DWORD		2	
R+127	Reserve	WORD*5		5	
R+132	Step Angle Compensation Base speed	DWORD		2	Precision: Decimal Place
R+134	Step Angle Compensation Base value	DWORD		2	Precision: Decimal Place
R+136	Step Angle Compensation value change mode	WORD		1	
R+137	Step Angle Compensation value change time	DWORD		2	
R+139	Cam data No.	WORD		1	
R+140	Cam stroke	DWORD		2	Precision: Decimal Place
R+142	Cam contact output No.	WORD		1	

R+143	Output filter time constant	DWORD		2	
R+145-149	Reserve				

Program Example

Ladder



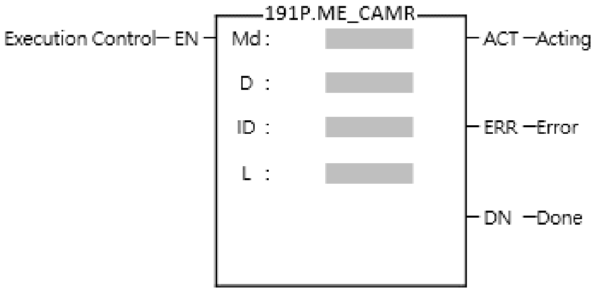
- When M1000 is from OFF to ON, write all recipe tables from R1000.

6-15 Fun191 Read Motion Control Cam

Fun191 MFSysCAMR	Read Motion Control Cam	Fun191 MFSysCAMR

Command Description

Ladder Symbol



Operands

Md: Mode
D: Initial Cam Register
ID: Cam Number
L: Cam Resolution

Relay and Register

Operand \ Ranga	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K	XR
	WX0 | WX1008	WY0 | WY1008	WM0 | WM9104	WS0 | WS3088	T0 | T1023	C0 | C1279	R0 | R34767	R34768 | R35023	R35024 | R35279	R35280 | R43223	R43224 | R47319	D0 | D11999		V, Z P0 ~ P9
Md	○	○	○	○	○	○	○	○	○	○	○	○	0~1	
D	○	○	○	○	○	○	○	○	○	○	○	○		
ID	○	○	○	○	○	○	○	○	○	○	○	○	1~16	
L													2048~32767	

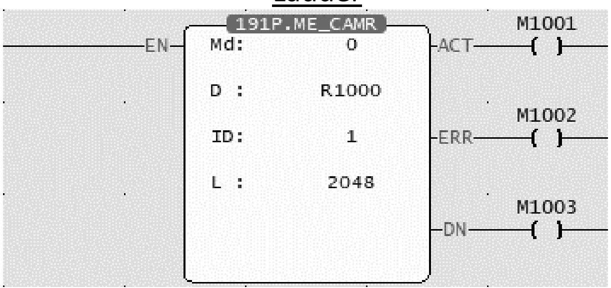
Function Description

- Operands
  Md (Mode): 0 uses PLC Register , 1 gets data from the SD card
  D (Initial Cam Register): Md = 0 The initial address of the register to be stored after reading the Cam , Md = 1 SD card recipe file number
  ID (Cam Number): Cam number
  L (Cam Resolution): The length of the register to be stored after reading the Cam
- When the execution control [EN] changes from 0→1, Fun191 will read the specified Cam to the specified register.

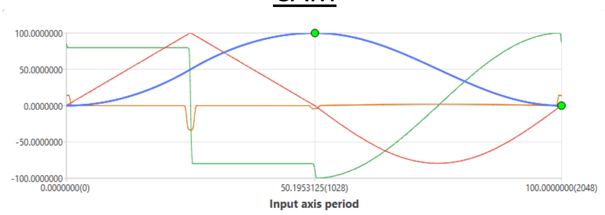
  When the execution control [EN] changes from 1→0, all output indications are reset
- When the Cam is being read, the output indication [ACT] is ON.
- When reading the Cam, if there is an error, the output indication [ERR] will be ON.
- When the reading of the Cam is completed, the output indication [DN] is ON.

Program Example

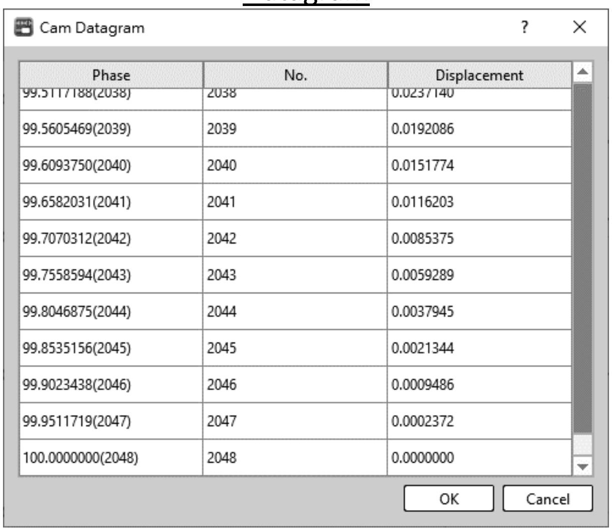
Ladder



CAM



Datagram



Cam Datagram

Phase	No.	Displacement
99.5117188(2038)	2038	0.0237140
99.5605469(2039)	2039	0.0192086
99.6093750(2040)	2040	0.0151774
99.6582031(2041)	2041	0.0116203
99.7070312(2042)	2042	0.0085375
99.7558594(2043)	2043	0.0059289
99.8046875(2044)	2044	0.0037945
99.8535156(2045)	2045	0.0021344
99.9023438(2046)	2046	0.0009486
99.9511719(2047)	2047	0.0002372
100.0000000(2048)	2048	0.0000000

OK Cancel

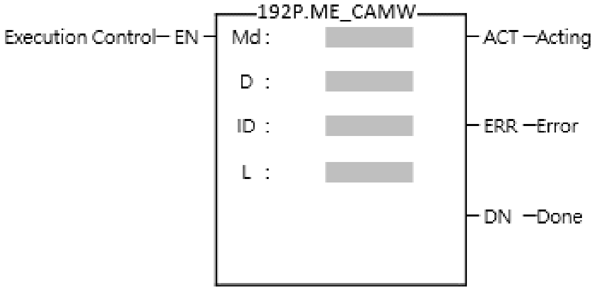
- When M1000 is from OFF→ON, 讀取凸輪 ID:1 資料表 2048 個存放至 DR1000~DR5094。

6-16 Fun192 Write Motion Control Cam

Fun192 MFSysCAMW	Write Motion Control Cam	Fun192 MFSysCAMW

Symbol

Ladder Symbol



Operands

Md: Mode
D: C Initial am Address
ID: Cam Number
L: Cam Resolution

Relay and Register

Operand \ Range	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K	XR
	WX0 | WX1008	WY0 | WY1008	WM0 | WM9104	WS0 | WS3088	T0 | T1023	C0 | C1279	R0 | R34767	R34768 | R35023	R35024 | R35279	R35280 | R43223	R43224 | R47319	D0 | D11999		V, Z P0 ~ P9
Md	○	○	○	○	○	○	○	○	○	○	○	○	0~1	
D	○	○	○	○	○	○	○	○	○	○	○	○		
ID	○	○	○	○	○	○	○	○	○	○	○	○	1~16	
L													2048~32767	

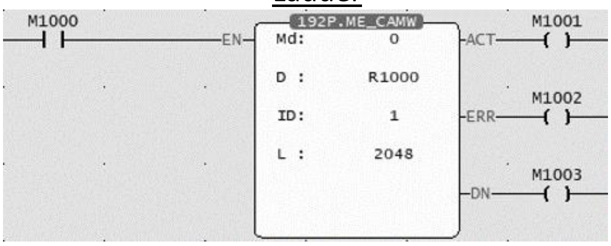
Function Description

- Operands
  Md (Mode): 0 use PLC register , 1 gets data from the SD card
  D (Initial Cam Register): Md = 0 Write the initial address of the initial register of the cam , Md = 1 SD card recipe file number
  ID (Cam Number): Cam number
  L (Cam Resolution): The initial length of the register written to the cam
- When the execution control [EN] changes from 0 to 1, Fun191 will write the designated register to the designated Cam.

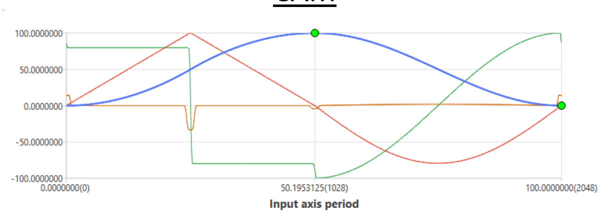
  When the execution control [EN] changes from 1→0, all output indications are reset.
- When writing to the Cam, the output indication [ACT] is ON.
- When writing to the Cam, if there is an error, the output indication [ERR] is ON.
- When writing to the Cam is completed, the output indication [DN] is ON.

Program Example

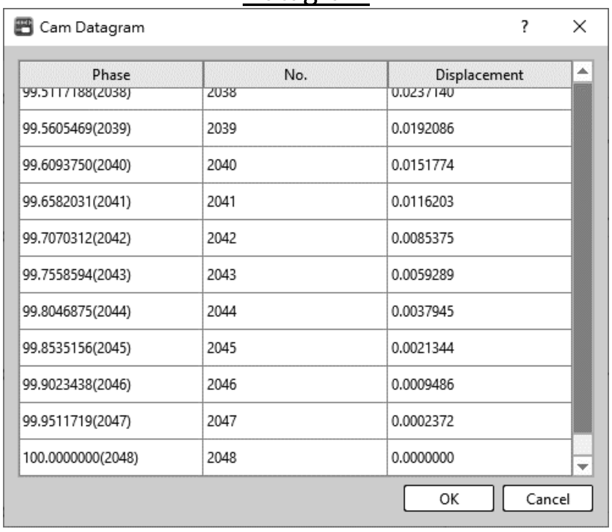
Ladder



CAM



Datagram



Phase	No.	Displacement
99.5117188(2038)	2038	0.0237140
99.5605469(2039)	2039	0.0192086
99.6093750(2040)	2040	0.0151774
99.6582031(2041)	2041	0.0116203
99.7070312(2042)	2042	0.0085375
99.7558594(2043)	2043	0.0059289
99.8046875(2044)	2044	0.0037945
99.8535156(2045)	2045	0.0021344
99.9023438(2046)	2046	0.0009486
99.9511719(2047)	2047	0.0002372
100.0000000(2048)	2048	0.0000000

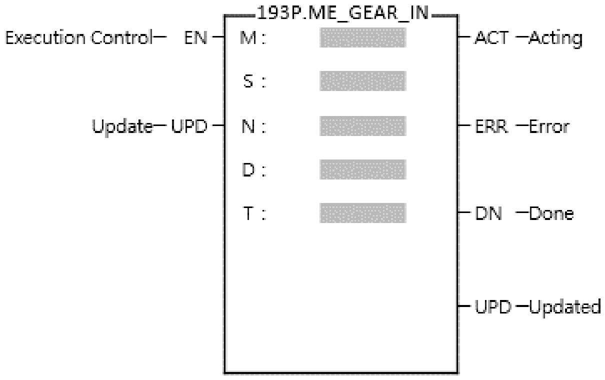
- When M1000 is from OFF to ON, 從 DR1000~DR5094 寫入凸輪 ID:1 資料表 2048 個。

6-17 Fun193 EtherCAT Handwheel (MFGearMPG)

Fun193 D MFGearMPG	EtherCAT Handwheel	Fun193 D MFGearMPG

Command Description

Ladder Symbol



Operands

M : Master Axis Input Source
S: Slave Axis Output Target
N: Variable Gear Ratio Numerator
D: Variable Gear Ratio Denominator
T: Transition Time (ms)

Relay and Register

Operand \ Range	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K	XR
	WX0 | WX1008	WY0 | WY1008	WM0 | WM9104	WS0 | WS3088	T0 | T1023	C0 | C1279	R0 | R34767	R34768 | R35023	R35024 | R35279	R35280 | R43223	R43224 | R47319	D0 | D11999		V, Z P0 ~ P9
M	○	○	○	○	○	○	○	○	○	○	○	○	1~16,100~108	
S	○	○	○	○	○	○	○	○	○	○	○	○	1~16	
N	○	○	○	○	○	○	○	○	○	○	○	○		
D	○	○	○	○	○	○	○	○	○	○	○	○		
T	○	○	○	○	○	○	○	○	○	○	○	○		

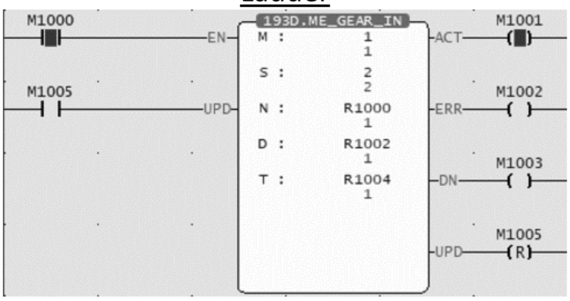
Function Description

- Fun 193 (EtherCAT Handwheel) integrates the relevant settings of the handwheel for position synchronization, providing users with quick setting of the handwheel.
- Operands
  M (Master Axis Input Source): EtherCAT_Axis Number 1-16
  : Encoder_Gray Code 100 (X8-X15)
  : Encoder_Hardware High-speed Counter Number 101-108 (HSC0~HSC7)
  S (Slave Axis Output Target): EtherCAT_Axis Number 1-16 ([M Master Input Source] cannot be the same as [S Slave Axis Output Target])
  N (Variable Gear Ratio Numerator): Positive and negative numbers, including the [Decimal Point Position] of [Motion Axis Setting] in [Motion Control]. ([Axis unit] set mm, [Decimal point position] set 0.001, N: DR0 = 1000 is equal to 1.000mm)
  D (Variable Gear Ratio Denominator): Positive number (a real number greater than zero), including the [Decimal Point Position] of [Motion Axis Setting] in [Motion Control]
  T (Transition Time (ms)): Positive number (real number greater than zero), the unit is ms

- When the execution control [EN] changes from 0→1, Fun193 uses the current parameters to start the synchronous control of the handwheel position
- When the execution control [EN] changes from 1 to 0, Fun193 stops the synchronous control of the handwheel position and resets all output indications
- In handwheel synchronous control, if the update parameter [UPD] changes to 1, this command will update the handwheel parameters (N, D, T) immediately.
- When the handwheel is under synchronous control, the output indication [ACT] is ON.
- During the synchronous control of the manual wheel, if an error occurs, the output indication [ERR] will be ON.
- When the update of the manual wheel parameters is completed, the output indication [UPD] will be ON.

Program Example

Ladder

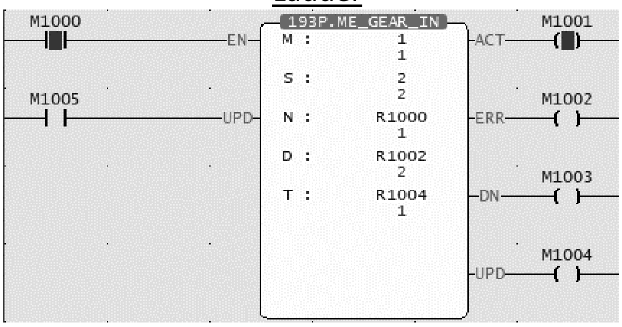


Axis Parameter Setting

		1	2
Basic Setting	Axis Name	軸_1	軸_2
	Axis Type	Servo	Servo
	Encoder Type	Incremental	Incremental
Unit Setting	Unit	mm	mm
	Decimal Point	0.001	0.001
	Pulse/Revolution	131072 PLS/Rev	131072 PLS/Rev
	Unit/Revolution	1.000 mm/Rev	1.000 mm/Rev
	Velocity Unit	Command Position/sec	Command Position/sec
	Velocity Gain	1.000	1.000

- When M1000 is from OFF to ON, start the handwheel according to the current Fun193 parameters (M: EtherCAT Axis 1, N: EtherCAT Axis 2, N: Variable gear ratio numerator 0.001, D Variable gear ratio denominator 0.001, T: 1ms) to start synchronizing.

Ladder



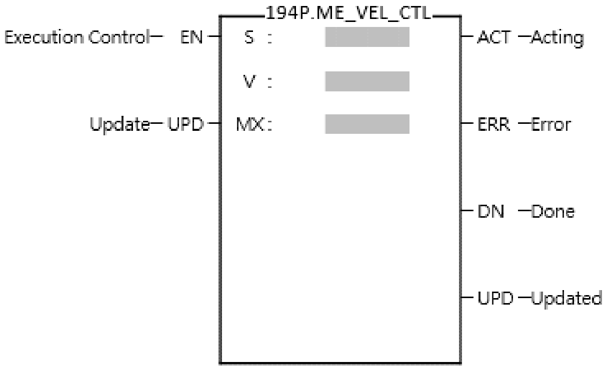
- After changing the parameters (D Variable gear ratio denominator 0.002), when M1005 is from OFF to ON, update the handwheel according to the changed parameters. After the parameter update is completed, the output indication [UPD] is ON, and the stroke of the slave axis of the handwheel is halved. .

6-18 Fun194 Velocity Control (MFVelCtl)

Fun194 D MFVelCtl	Velocity Control Mode	Fun194 D MFVelCtl

Command Description

Ladder Symbol



Operands

S: EtherCAT Velocity Control Axis

V: Velocity

MX: Max. Torque Limit

Relay and Register

Operand \ Range	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K	XR
	WX0 | WX1008	WY0 | WY1008	WM0 | WM9104	WS0 | WS3088	T0 | T1023	C0 | C1279	R0 | R34767	R34768 | R35023	R35024 | R35279	R35280 | R43223	R43224 | R47319	D0 | D11999		V, Z P0 ~ P9
S	○	○	○	○	○	○	○	○	○	○	○	○	1~16	
V	○	○	○	○	○	○	○	○	○	○	○	○		
MX	○	○	○	○	○	○	○	○	○	○	○	○		

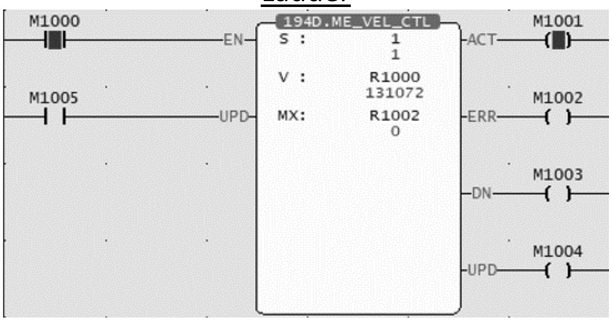
Function Description

- Operands
  S (Speed Control Axis): EtherCAT_ Axis Number 1-16
  V (Velocity): Setting velocity value, unit: Pulses/s
  MX (Maximum Torque Limit): The maximum torque limit when the speed cannot reach the speed setting value, 0 equals no limit, unit 0.0%
- When the execution control [EN] changes from 0→1, Fun194 uses the current parameter to start the axis velocity control.

  When the execution control [EN] changes from 1→0, Fun194 stops the axis velocity control and resets all output indications.
- In axis velocity control, if the update parameter [UPD] becomes 1, this command will update the speed control parameters (V, MX) immediately.
- When the axis velocity is under control, the output indicator [ACT] woll be ON.
- During axis velocity control, if an error occurs, the output indication [ERR] will be ON.
- When updating the velocity control parameters is completed, the output indication [UPD] will be ON.

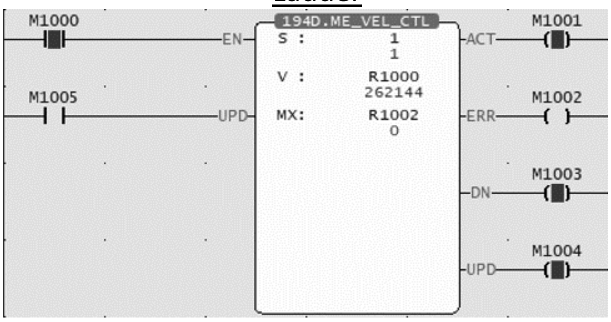
Program Example

Ladder



- When M1000 is from OFF→ON, start the speed control according to the current Fun194 parameters (S: EtherCAT Axis 1, V: 131072 pulses per second, MX: No torque limit).

Ladder



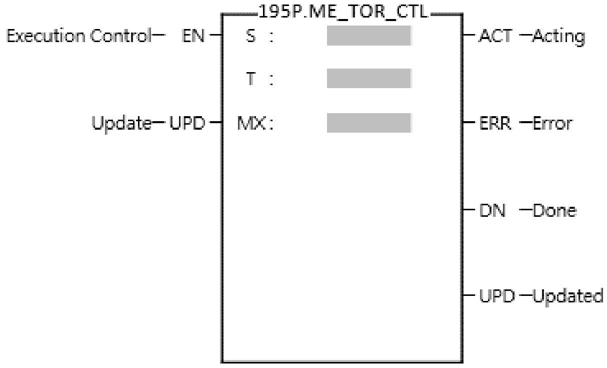
- After changing the parameter (V: 262144 pulses per second), when M1005 changes from OFF to ON, the parameter update is completed according to the changed parameter update speed, and the output indicator M1004 [UPD] ON is turned on, and the speed doubles.

6-19 Fun195 Torque Control (MFTorqCtl)

Fun195 D MFTorqCtl	Torque Control Mode	Fun195 D MFTorqCtl

Command Description

Ladder Symbol



Operands

S: EtherCAT Torque Control Axis

T: Set Torque

MX: Max. Speed Limit

Relay and Register

Operand \ Range	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K	XR
	WX0 | WX1008	WY0 | WY1008	WM0 | WM9104	WS0 | WS3088	T0 | T1023	C0 | C1279	R0 | R34767	R34768 | R35023	R35024 | R35279	R35280 | R43223	R43224 | R47319	D0 | D11999		V, Z P0 ~ P9
S	○	○	○	○	○	○	○	○	○	○	○	○	1~16	
T	○	○	○	○	○	○	○	○	○	○	○	○		
MX	○	○	○	○	○	○	○	○	○	○	○	○		

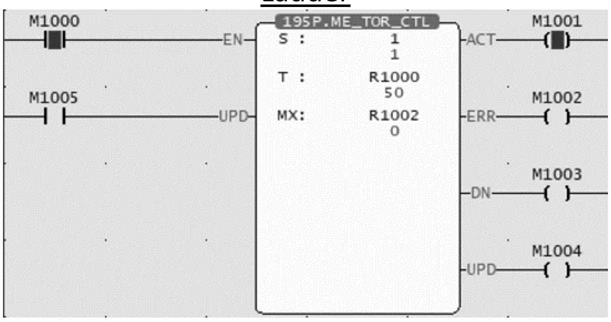
Function Description

- Operands
  S (Torque Control Axis): EtherCAT_ Axis Number 1-16
  T (Torque): Torque setting value, unit: 0.0%
  MX (Maximum Speed Limit): The maximum speed limit when the torque cannot reach the torque setting value, 0 equals no limit, the unit is rpm.
- When the execution control [EN] changes from 0→1, Fun195 uses the current parameters to start the axis torque control.

  When the execution control [EN] changes from 1→0, Fun195 stops the axis torque control and resets all output indications.
- In axis torque control, if the update parameter [UPD] becomes 1, this command will update the torque control parameters (T, MX) immediately.
- When the axis torque is under control, the output indicator [ACT] will be ON.
- During axis torque control, if an error occurs, the output indication [ERR] will be ON.
- When updating the torque control parameters is completed, the output indication [UPD] will be ON.

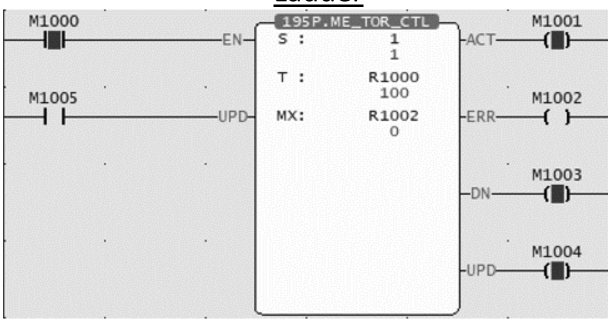
Program Example

Ladder



- When M1000 is from OFF to ON, torque control is started according to the current Fun194 parameters (S: EtherCAT Axis 1, T: 5.0%, MX: No speed limit).

Ladder



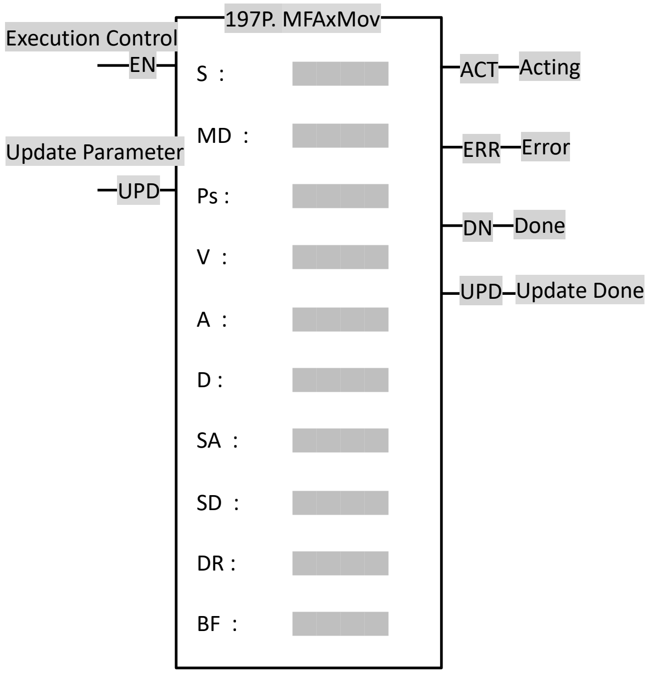
- After changing the parameter (T : 10.0%), when M1005 is turned from OFF to ON, the torque will be updated according to the changed parameter. After the parameter update is completed, the output indication M1004 [UPD] ON, and will double the torque.

6-20 Fun197 Single Axis Positioning(MFAxMov)

Fun197 D P MFAxMov	Single Axis Positioning	Fun197 D P MFAxMov

Command Description

Ladder Symbol



Operands

S: EtherCAT Control Axis
MD: Opearating Mode
PS: Target Position
V: Velocity
A: Acceleration
D: Deceleration
SA: S Acceleration Curve %
SD: S Deceleration Curve %
DR: Direction
BF: Consecutive Velocity Mode

Relay and Register

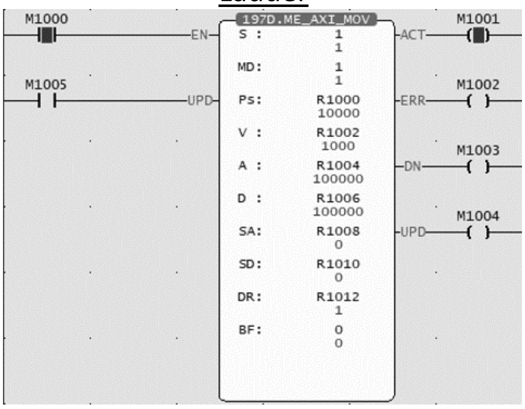
Range / Operand	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K	XR
	WX0 | WX1008	WY0 | WY1008	WM0 | WM9104	WS0 | WS3088	T0 | T1023	C0 | C1279	R0 | R34767	R34768 | R35023	R35024 | R35279	R35280 | R43223	R43224 | R47319	D0 | D11999		V, Z P0 ~ P9
S	○	○	○	○	○	○	○	○	○	○	○	○	1~16	
MD													0~2	
Ps	○	○	○	○	○	○	○	○	○	○	○	○		
V	○	○	○	○	○	○	○	○	○	○	○	○		
A	○	○	○	○	○	○	○	○	○	○	○	○		
D	○	○	○	○	○	○	○	○	○	○	○	○		
SA	○	○	○	○	○	○	○	○	○	○	○	○		
SD	○	○	○	○	○	○	○	○	○	○	○	○		
DR	○	○	○	○	○	○	○	○	○	○	○	○	1~2	
BF													0~5	

Function Description

- Operands
  S (EtherCAT Control Axis): EtherCAT_Axis No.1-16
  MD (Operating Mode): 0 Absolute, 1 Relative, 2 Infinite distance mode
  PS)Target Position): Positive and negative numbers, including the [Decimal Point Position] of the [Motion Axis Setting] in [Motion Control].
  ([Axis Unit]: mm, [Decimal Point Position]: 0.001, PS: DR0 = 1000 is equal to 1.000mm)
  V (Velocity): Positive number (a real number greater than zero), including the [Decimal Point Position] of the [Motion Axis Setting] in [Motion Control].
  A (Acceleration): Positive number (a real number greater than zero), including the [Decimal Point Position] of the [Motion Axis Setting] in [Motion Control].
  D (Deceleration): Positive number (a real number greater than zero), including the [Decimal Point Position] of the [Motion Axis Setting] in [Motion Control].
  SA (S Acceleration Curve %): Positive integer, 0-1000 ‰
  SD (S Deceleration Curve %): Positive integer, 0-1000 ‰
  DR (Direction): 1 positive direction, 2 negative direction
  BF(Consecutive Velocity Mode): 0 executes the current command immediately, 1 waits for the end of the previous command, 2 selects the lower consecutive speed, 3 selects the previous consecutive command speed, 4 selects the current consecutive command speed, 5 selects the higher consecutive speed.
- When the execution control [EN] is triggered by the upper differential, Fun197 executes the axis position control.
  When the execution control [EN] is triggered by the lower differential, Fun197 stops the axis position control and resets all output indications.
- In axis position control, if the Update Parameter [UPD] becomes 1, this command will immediately update the position control parameters (S, PS, V, A, D, SA, SD, DR).
- When the axis position is under control, the output indicator [ACT] will be ON.
- During axis position control, if an error occurs, the output indication [ERR] will be ON.
- When the axis position control is completed, the output indication [DN] will be ON.
- When updating the position control parameters is completed, the output indication [UPD] ON.

Program Example

Ladder



Axis Parameter Setting

		1	2
Basic Setting	Axis Name	Axis_1	Axis_2
	Axis Type	Virtual Servo	Virtual Servo
	Encoder Type	Incremental	Incremental
Unit Setting	Unit	mm	mm
	Decimal Point	0.001	0.001
	Pulse/Revolution	131072 PLS/Rev	131072 PLS/Rev
	Unit/Revolution	1.000 mm/Rev	1.000 mm/Rev
	Velocity Unit	Command Position/...	Command Position/...
	Velocity Gain	1.000	1.000

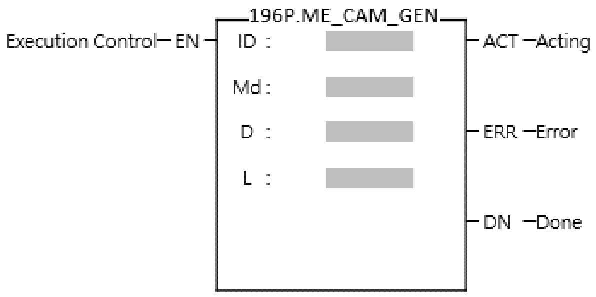
- When M1000 is from OFF→ON, according to the current Fun197 parameters (S: EtherCAT axis 1, MD: Relative position, PS: Move to 10.000mm, V: Velocity 1.000mm/s, A: Acceleration 100.000 $\mathrm{mm/s^2}$, D: Deceleration 100.000 $\mathrm{mm/s^2}$, SA: S Acceleration Curve 0.0%, SD: S Deceleration Curve 0.0%, DR: Forward Direction, BF: Execute current command immediately) to execute position control.

6-21 Fun196 Generate Cam (MFSysCAMGen)

Fun196 D MFSysCAMGen	Generate Cam	Fun196 D MFSysCAMGen

Command Description

Ladder Symbol



Operands

ID: Cam No.

Md: Cam Generating Mode

D: Register Starting Address

L: Cam Curve Stage No.

Relay and Register

Operand \ Range	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K	XR
	WX0 | WX1008	WY0 | WY1008	WM0 | WM9104	WS0 | WS3088	T0 | T1023	C0 | C1279	R0 | R34767	R34768 | R35023	R35024 | R35279	R35280 | R43223	R43224 | R47319	D0 | D11999		V, Z P0 ~ P9
ID	○	○	○	○	○	○	○	○	○	○	○	○	1~16	
Md													0~1	
D	○	○	○	○	○	○	○	○	○	○	○	○		
L	○	○	○	○	○	○	○	○	○	○	○	○		

Function Description

- Operands
  ID (Cam No.): 1-16
  Md (Cam Generating Mode): 0 same as the cam table, 2 teccentric shaf
  D (Register Starting Address): Set starting register of the Cam
  L (Cam Curve Stage No.): Only Mode 0 has the setting of each stage of the Cam, and other modes do not need to be set.
- When the execution control [EN] changes from 0→1, Fun196 will generate Cams according to the set mode.

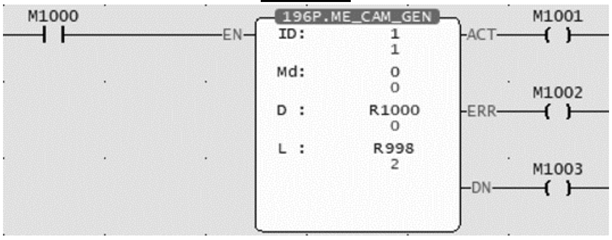
  When the execution control [EN] changes from 1→0, all output indications are reset.
- When the Cam is being generated, the output indication [ACT] will be ON
- When the Cam is generating, if an error occurs, the output indication [ERR] will be ON
- When the Cam generation is completed, the output indication [DN] will be ON.

Mode 0

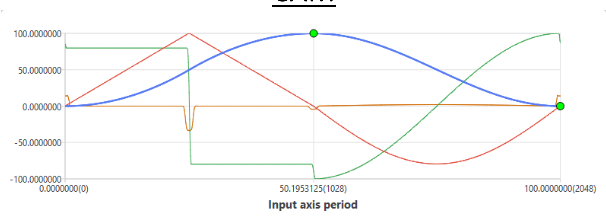
Register	Item	Definition	
D+0	Start Phase	0~Cam Resolution	first stage cam
D+2	End Phase	0~Cam Resolution (Link to the start phase of the next segment)	
D+4	offset	0~1000000000 (0~100.0000000%)	
D+6	CAM Profile	0:Constant Velocity 1:Constant Acceleration 2:Cycloid 3:Simple Harmonic 4:Modified Constant Velocity 5:Modified Trapezoid 6:Modified Harmonic 7:Trapezoid 8:One-Dwell Cycloid , M=1 9:One-Dwell Cycloid, M=2/3 10:One-Dwell Trapezoid, Ferguson 11:One-Dwell Modified Harmonic 12:One-Dwell Trapezoid 13:No-Dwell Modified Trapezoid 14:No-Dwell Modified Constant Velocity 15:NC2 16:Asymmertic Cycloid 17:Asymmertic Modified Trapezoid 18:Cubic Curve 19:Quintic Curve	
D+8	Start Speed	Fixed 3 decimal places	
D+10	End Speed	Fixed 3 decimal places	
D+12	Start Acceleration	Fixed 3 decimal places	
D+14	End Acceleration	Fixed 3 decimal places	
D+15	Start Phase	0~Cam Resolution	second stage cam
D+16	End Phase	0~Cam Resolution (Link to the start phase of the next segment)	
		⋮	

Program Example

Ladder



CAM



CAM Parameters

	Start Phase	End Phase	Offset	Cam Profile
1	0.0000000(0)	50.1953125(1028)	100.0000000	Constant Acceleration
2	50.1953125(1028)	100.0000000(2048)	0.0000000	Simple Harmonic

D

Register	Item	Definition	
R1000	Start Phase	0	first stage cam
R1001	End Phase	1028	
R1002	offset	1000000000	
R1003	CAM Profile	1:Constant Acceleration	
R1004	Start Speed	0	
R1005	End Speed	0	
R1006	Start Acceleration	0	
R1007	End Acceleration	0	
R1008	Start Phase	1028	second stage cam
R1009	End Phase	2048	
R1010	offset	0	
R1011	CAM Profile	3:Simple Harmonic	
R1012	Start Speed	0	
R1013	End Speed	0	
R1014	Start Acceleration	0	
R1015	End Acceleration	0	

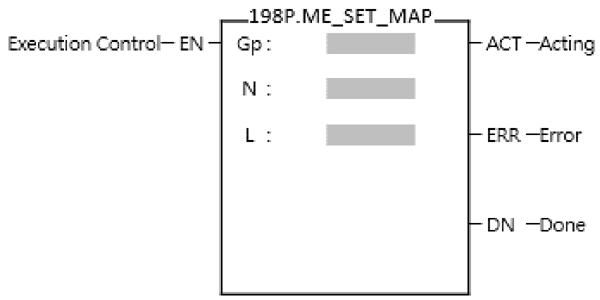
- When M1000 is from OFF to ON, the Cam is generated according to the current Fun196 number (ID: Cam number 1, Md: Mode 0, D: Setting the cam generation parameters from R1000, L: second stage cam curve).

6-22 Fun198 Set Mapping Table (MFMapTbPrm)

Fun198 MFMapTbPrm	Set Mapping Table	Fun198 MFMapTbPrm

Command Description

Ladder Symbol



Operands

Gp: Mapping Table Group No.

N: Mapping Starting Table No.

L: Consecutive Mapping Length

Relay and Register

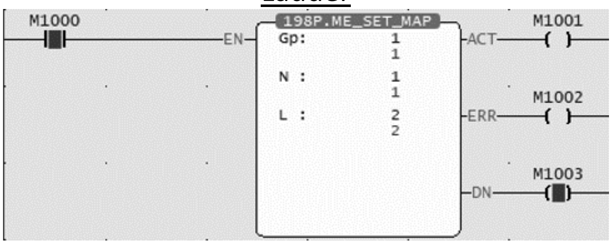
Operand \ Range	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K	XR
	WX0 | WX1008	WY0 | WY1008	WM0 | WM9104	WS0 | WS3088	T0 | T1023	C0 | C1279	R0 | R34767	R34768 | R35023	R35024 | R35279	R35280 | R43223	R43224 | R47319	D0 | D11999		V, Z P0 ~ P9
Gp													0~64	
N	○	○	○	○	○	○	○	○	○	○	○	○	0~1024	
L	○	○	○	○	○	○	○	○	○	○	○	○	1~1024	

Function Description

- Operands
  Gp (Mapping Table Groups No.): Group 1-16, 0 means all groups.
  N (Mapping Table Starting Table No.): Mapping table number 1-1024, 0 means the entire mapping table.
  L (Consecutive Mapping Length): Number of consecutive mapping items, 0 means mapping to the last item in the page.
- When the execution control [EN] changes from 0→1, Fun198 will map (write) the PLC register to the motion control parameters.
  When the execution control [EN] changes from 1→0, all output indications are reset.
- When the mapping is being written, the output indication [ACT] will be ON.
- When the mapping is being written, if an error occurs, the output indication [ERR] will be ON.
- When the mapping is written in, the output indication [DN] will be ON..

Program Example

Ladder



Mapping Table

	Comment	Table	Index	Item	Address
1		Axis Table	1	19.Jogging Velocity	R9000
2		Axis Table	1	22.Inching Distance	R9002

Motion Axis Setting Table

Jogging	Jogging Base Velocity	0.100 mm/s
	Jogging Velocity	1.000 mm/s[2.000 mm/s]
	Jogging Acceleration	1000.000 mm/s²
	Jogging Deceleration	1000.000 mm/s²
	Inching Distance	5.000 mm[6.000 mm]

- When M1000 is turned from OFF to ON, write the mapping table according to the current Fun198 parameters (Gp 1: mapping table 1(1:PM), N: starting from the first line of the mapping table (1:PM1), L: length 1). It can be seen from the motion axis setting table that the JOG speed has been modified to 2.000mm/s^2, and the JOG distance has been modified to 6.000mm.

7

Introduction of Motion Flow

This section describes the motion control method specially designed for FATEK M-PLC and it is named as Motion Flow Control here. Such function is able to display, monitor and design the motion control flow in a more complete manner. Further, it can achieve the designed logic control and continuous motion control more effectively. The Motion Flow can execute 16 rounds of independent Flow at the same time, and each individual Flow contains up to 16 branches. When using the Motion Flow, do not execute over 16 Flows or 16 branches at the same time. Described below is the control module of the Motion Flow. Listed in the table below are the maximum motion points and the maximum Motion Flow Block that can be supported by the Motion Flow.
*In the future, there will be models with more capacity, so you can pay more attention to the latest news and manuals on Fatek's official website.

List of EtherCAT motion control specifications for each model of M PLC

Model No.	PLC Memory	EtherCAT Motion Control Program Capacity	EtherCAT Motion Control Specification
MA1N1-1616◇	20K Words	-	-
MA1N2-1616◇	20K Words	-	-
MA1N3-1616◇	20K Words	-	-
MA1I4-1616◇	20K Words	-	-
MA1M3-1616◇	20K Words	-	-
MA2M3-1616◇	30K Words	-	-
MA3M3-1616◇	40K Words	-	-
MS1C1-1616◇	20K Words	P-Table 128 pts, 512 M-Block (370KB)	EtherCAT 2-axis, Arc Interpolation
MS1C2-1616◇	20K Words	P-Table 192 pts, 768 M-Block (556KB)	EtherCAT 4-axis, Arc Interpolation
MS2C4-1616◇	30K Words	P-Table 512 pts, 1024 M-Block (1.1MB)	EtherCAT 8-axis, Arc Interpolation
MS2C5-1616◇	30K Words	P-Table 512 pts, 2048 M-Block (1.5MB)	EtherCAT 12-axis, Arc Interpolation
MS3C6-1616◇	40K Words	P-Table 1024 pts, 4096 M-Block (3MB)	EtherCAT 16-axis, Arc Interpolation
ME1C1-1616◇	20K Words	P-Table 128 pts, 512 M-Block (370KB)	EtherCAT 2-axis, Arc Interpolation + E-CAM
ME2C3-1616◇	30K Words	P-Table 192 pts, 768 M-Block (556KB)	EtherCAT 4-axis, Spiral Interpolation + E-CAM
ME2C4-1616◇	30K Words	P-Table 512 pts, 1024 M-Block (1.1MB)	EtherCAT 8-axis, Spiral Interpolation + E-CAM
ME2C5-1616◇	30K Words	P-Table 512 pts, 2048 M-Block (1.5MB)	EtherCAT 12-axis, Spiral Interpolation + E-CAM
ME3C6-1616◇	40K Words	P-Table 1024 pts, 4096 M-Block (3MB)	EtherCAT 16-axis, Spiral Interpolation + E-CAM

7-1 Using Motion Flow

1. Initialize EtherCAT communication
2. Enable the motor

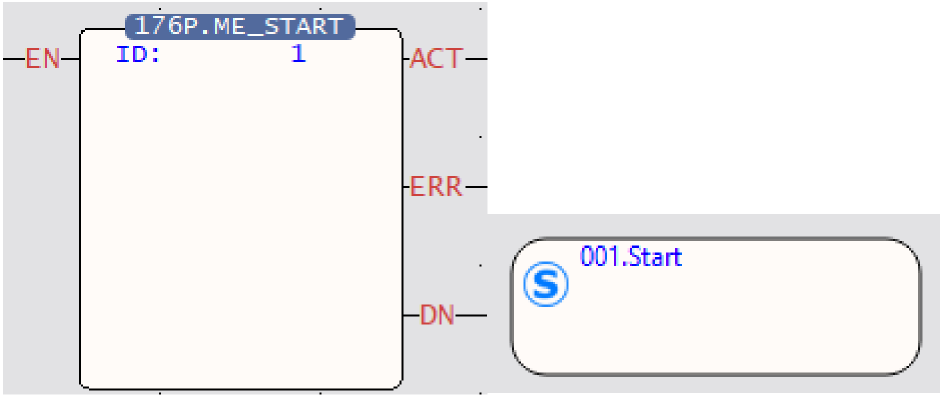
To enable the motor, the following A/B/C methods can be used:

A. Enable all axes (M10520).

B. Enable specific axis (M10600+(40*n-1), n=1-16 axes)

C. Enable the axis enable relay

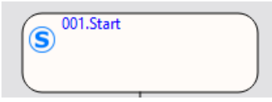
3. Use FUN 176 to enter the number of the motion flow to be executed. The following figure shows the flow chart to enter number 1, which corresponds to the number in Chapter 7-2.



4. It will start to execute the set flow.

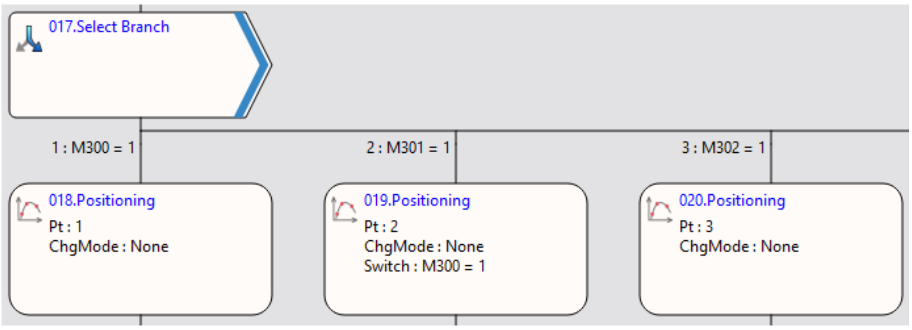
7-2 Start Motion Flow

Indicated in the figure below is the Motion Flow starting block where "001" refers to the flow block ID. Such ID is designated by the system and it cannot be changed by the user.



7-3 Select Branch

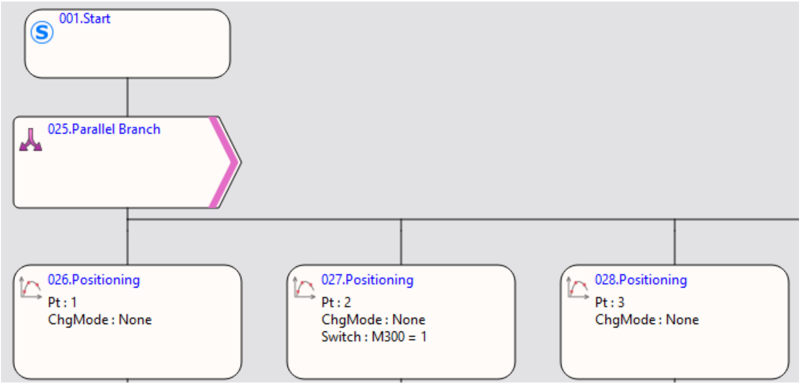
By selecting the branch, you can execute the designated branch according to the conditions; these conditions can be regarded as the internal variables, and it can also be determined according to the external I/O. By selecting the flow block ID of the desired branch, it allows the user to set the desired ID.



Please note that the selected branch cannot contain another branch and the branch can be imported one at a time. As per the example on the right-hand side figure, M300=1 means that Branch 1 should be executed; M301=1 means Branch 2 should be executed; and M302=1 means Branch 3 should be executed. Do not allow M300=1 and M301=1 to be established at the same time, otherwise it will enter the first established branch from left to right, resulting in a wrong order.

7-4 Parallel Branch

The parallel branch can execute an individual branch. When running the parallel branch, it is not required to set up the conditions and you may access the block to execute all of the following branches directly. The flow block ID of the parallel branch can be set by the user, and the maximum number of branches shall be 20. As per the example in the right-hand side figure, access the parallel branch and then execute all of the following branches.



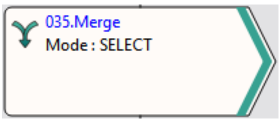
7-5 Merge

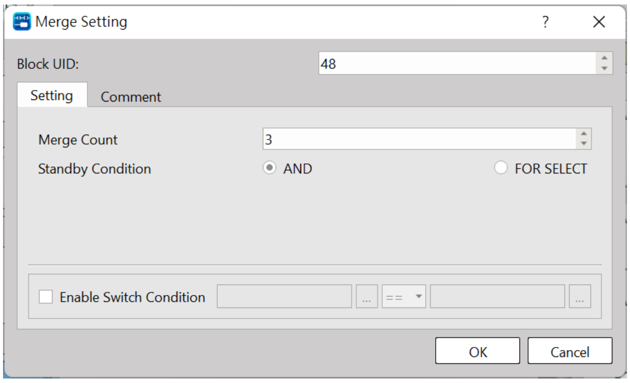
When selecting the branch and the parallel branch with the converging, the selected branch shall appear in pairing type. In this case, it means the branch is the end.

The flow block ID required for merging can be set by the user.

The merged number can be divided into 2–20 branches. The standby condition AND is required for merging the parallel branch, and the selection block is required for selecting the branch merging. By using the jump conditions, you may set the conditions required for jumping to the next flow block. If jump condition remains inactive, you may jump to the next flow block directly. The user may input the notation in the function or the application of such flow block.

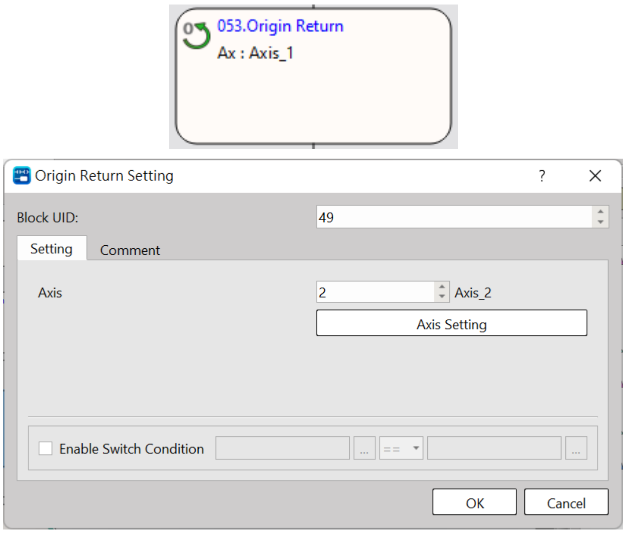
When using parallel branch merging function, all branches should be executed at the same time and the sub-flow completed first will enter the converging flow block, waiting for the system to complete other branches.





7-6 Origin Return

The function block is required for executing the Origin Return of the designated axis. As per the figure below, reset the Origin for Axis_1. If the Origin is duly set, the axis will jump to next flow as soon as M300=1 jumping condition is established.



7-7 Positioning

Select the parameters of the designed point for executing positioning control, as per the following:

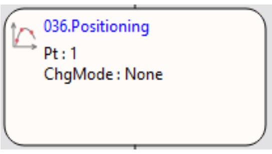
Flow Block ID: The ID will be assigned by the system automatically, but it can be changed by the user as desired.

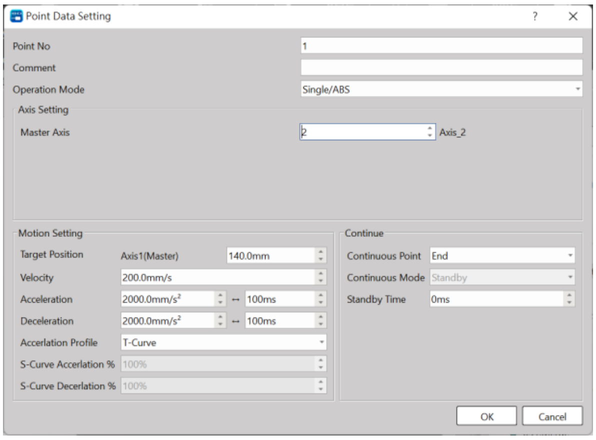
Point: As per the corresponding Point Parameter Table, if the motion parameter in Point 9 equals to point parameter 9, then the user may set up the desired point motion parameter in the motion parameters. You may set the point motion related data when writing the flow and then it will be created in the Point Parameter Table by the system automatically.

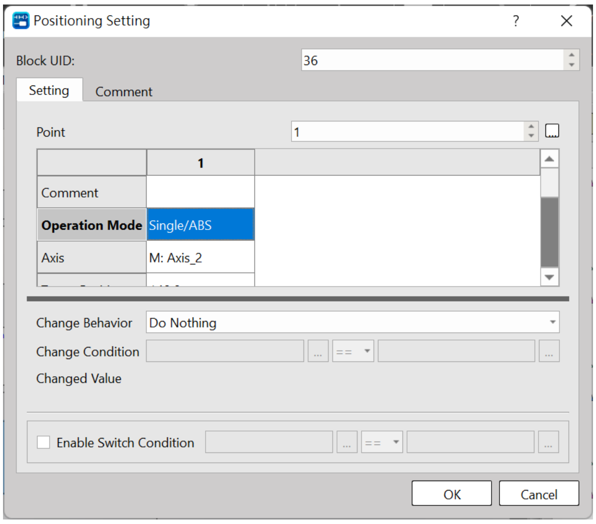
Change Behavior: No change/Change current coordinate/Change target position/Change speed

Change Condition: The conditions required for changing the behavior. To set the behavior change, then it will be required to set up the change conditions.

Switch Condition: The conditions required for jumping to the next flow block. If jump condition remains inactive, you may jump to the next flow block directly.







7-8 Speed Control

For executing the speed control of the designated axis, per the following:

Flow Block ID: The ID will be assigned by the system automatically, but it can be changed by the user as desired.

Axis: The axis required for executing the speed control.

Velocity Command: The speed required for executing the speed control.

Torque Limit: If setting the torque limit at “100”, then the Servo torque will be limited to 10% (0 means limitless).

Switch Condition: The conditions required for jumping to the next flow block. If jump condition remains inactive, you may jump to the next flow block directly. If the jump conditions are not set when using the speed control, the motor will jump to the next flow block immediately after running.

Note: You may input the function or the application notation of such flow block.

Example: When setting at SC3 for one turn =131072 = 1000mm

Assume that you want to set as per turn per second and that the unit of FATEK SERVO speed control is expressed as Pulse, therefore you have the following result: 131072 = Running for 131072 pulses per second.

Monitoring Table_Speed setting:

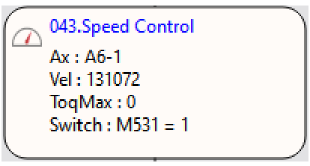
Motion axis speed setting:

Speed unit: The speed unit used by the monitoring table to display the transmitting speed of the selected Driver.

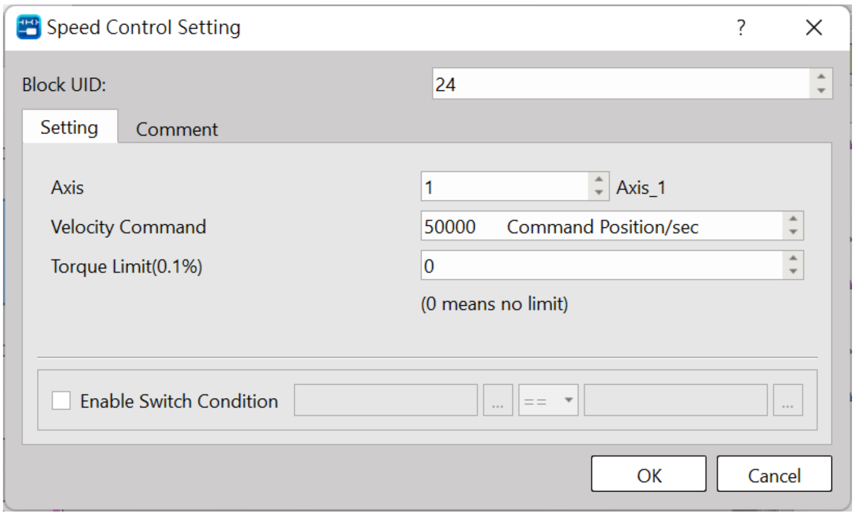
Speed gain: Min. speed graduation mark transmitted by the selected Driver.

The speed shall be set as (command position/sec)

The gain shall be set as “1”.



Unit Setting	Unit	PLS
	Decimal Point	1
	Pulse/Revolution	131072 PLS/Rev
	Unit/Revolution	1 PLS/Rev
	Velocity Unit	Command Position/sec
	Velocity Gain	1.000



	A6-1	A6-2
Axis : Command coordinate	102122 mm	0 mm
Axis : Command speed	1000 mm/s	0 mm/s
Axis : Current coordinate	102122 mm	0 mm
Axis : Servo is on	Servo On	Servo On
Axis : Operation ready	Ready	Ready
Axis : Axis error in progress	-	-
Axis : Axis warning in progress	-	-

7-9 Torque Control

For executing the torque control of the designated axis, per the following:

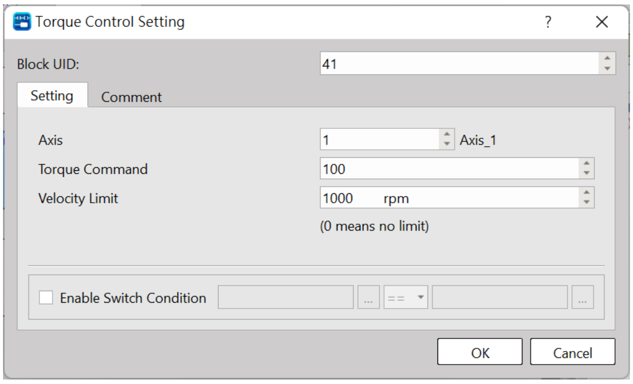
Flow Block ID: The ID will be assigned by the system automatically, but it can be changed by the user as desired.

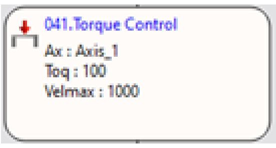
Axis: The axis required for executing the torque control.

Torque command: The output torque required for executing the torque control, and the unit is expressed as 0.1%.

Velocity Limit: 0 means limitless

If the switch conditions are not set when using the torque control, the motor will jump to the next flow block immediately after running.





7-10 Standby

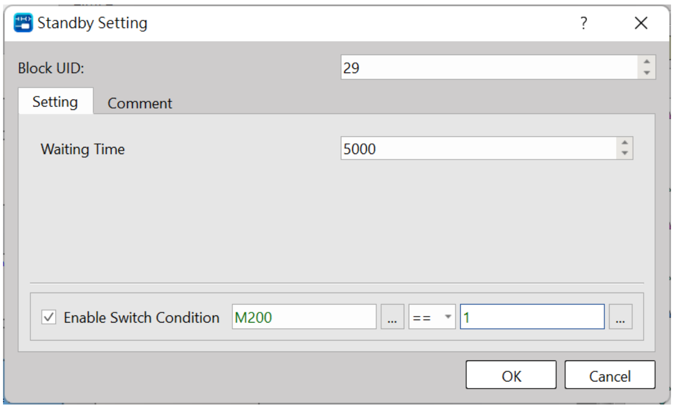
With “Standby”, you may set the delay time and wait for triggering conditions for the Motion Flow.

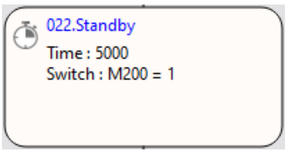
Waiting time: Standby waiting time (unit: ms)

Switch Condition: The condition required for jumping to the next flow block. The system will execute the jumping condition after counting the waiting time.

If the jumping condition remains inactive, then the system will jump to the next flow block directly after counting the waiting time.

Example: When on standby for 5000ms, the system will jump to the next flow block as soon after jumping condition M200=1 is established.





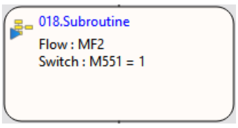
7-11 Subroutine

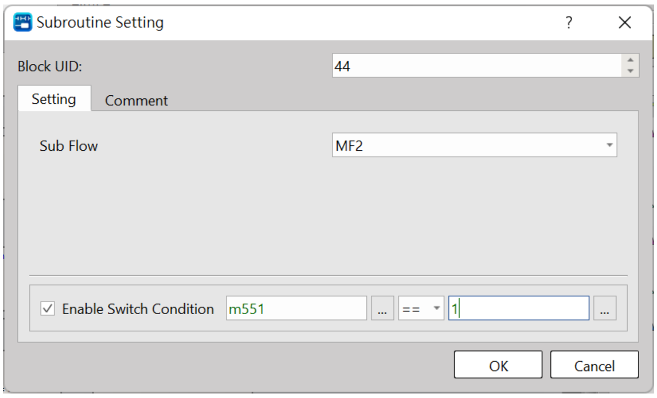
Execute the intended sub-flow, per the following:

Sub Flow: The target sub-flow

Switch Condition: The condition required for jumping to the next flow block.

When jumping to the sub-flow for the first time, the sub-flow will jump back to the flow block where the original sub-flow exists and then it will jump to the next flow block in the main flow during the second jumping. If jump condition remains inactive, then it will jump to the next flow block directly.

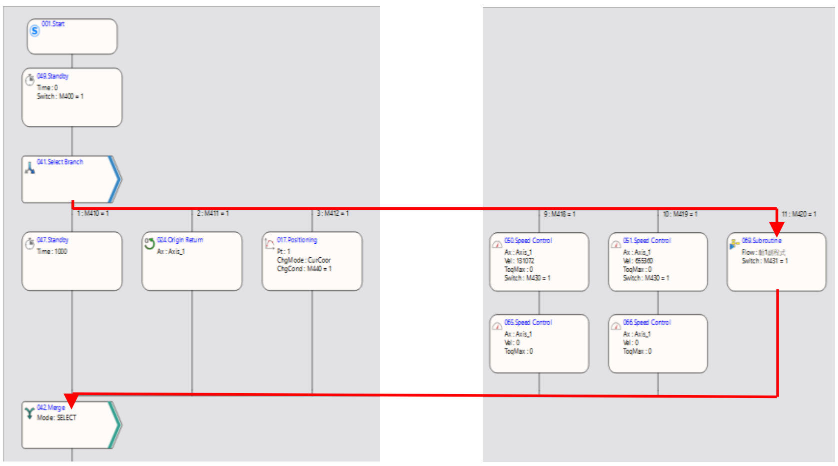




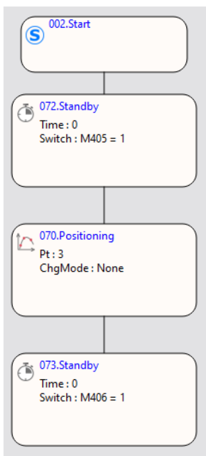
Example:

1. M420=1: Jump to 69 flow box and then wait at 69 flow block.
2. When the first jump condition reaches M431=1 , it will jump to sub-program for running the program.
3. After running the sub-program, it will jump back to flow block 18 and then wait for next round.
4. When the second jump condition reaches M431=1 , it will jump to flow block 42.

Main Flow



Subroutine



7-12 GoTo

With jumping function block, you may jump to the flow block before or after the same flow block, but you cannot jump to another flow.

Flow Block: For setting the jumping to the designated flow block ID.

Condition: The condition required for jumping to the designated flow block.

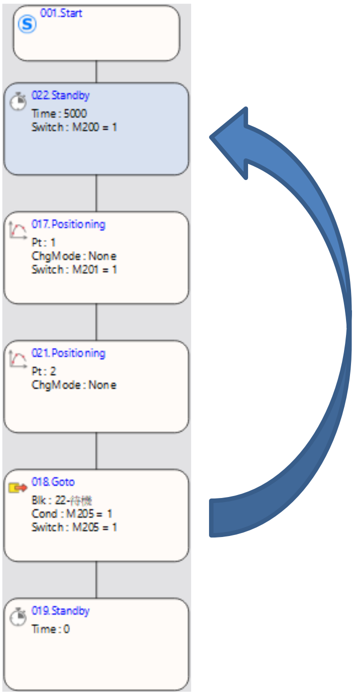
Switch Condition: The condition required for jumping to the next flow block.

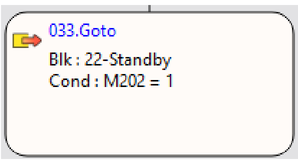
If jump condition remains inactive, then it will jump to the next flow block directly.

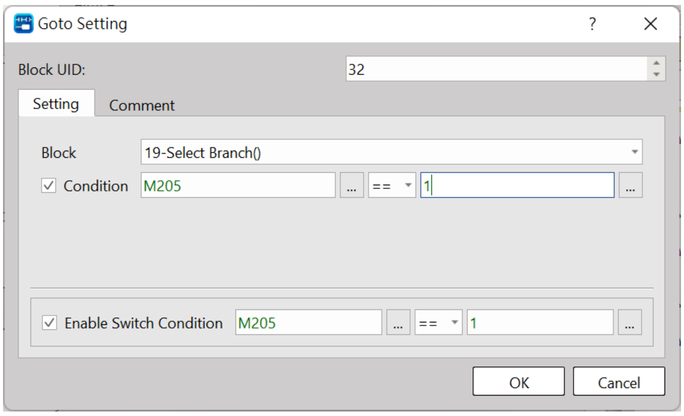
Example:

If M205=1 condition and M205=1 condition are established, it will jump to flow block 22.

If M205=0 condition is not established but M205=1 jump condition is established, it will jump to the next flow block 19.







7-13 Sync

For setting the axis that will be run synchronously.

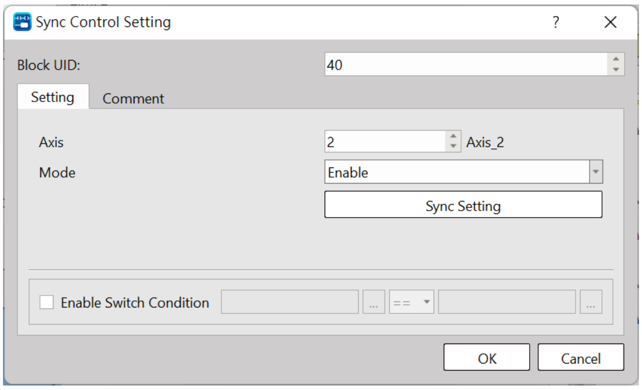
Flow Block ID: The ID will be assigned by the system automatically, but it can be changed by the user as desired.

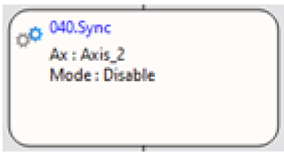
Axis: The axis being designated for executing the synchronous running.

Mode: It comprises enable and disenable

Switch Condition: The condition required for jumping to the next flow block. If jump condition remains inactive, then it will jump to the next flow block directly.

Note: You may input the function or the application notation of such flow block.



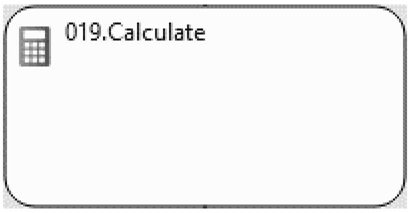


7-14 Calculate

【Calculate】	Calculate (Perform simple digital logic calculation)	【Calculate】

Command Description

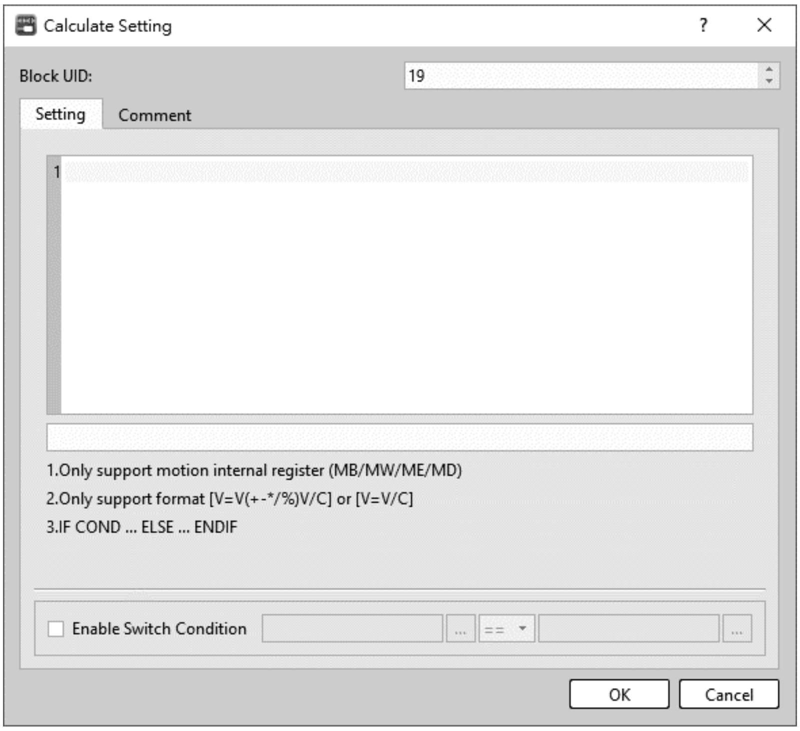
Motion Flow Symbol



Displyed Info

Block UID: The system automatically generates the flow block UID number.

Calculate Setting



Block UID: The flow block number automatically generated by the system and can be replaced with an unused number.

Setting: Editing simple digital logic calculation, starting from the first line and going down.

Comment: Comment the functional description of this flow block.

Enable Switch Condition: After executing this [Calculate] flow block, use the switch condition to limit the jump to the next flow block.

Relay and Register

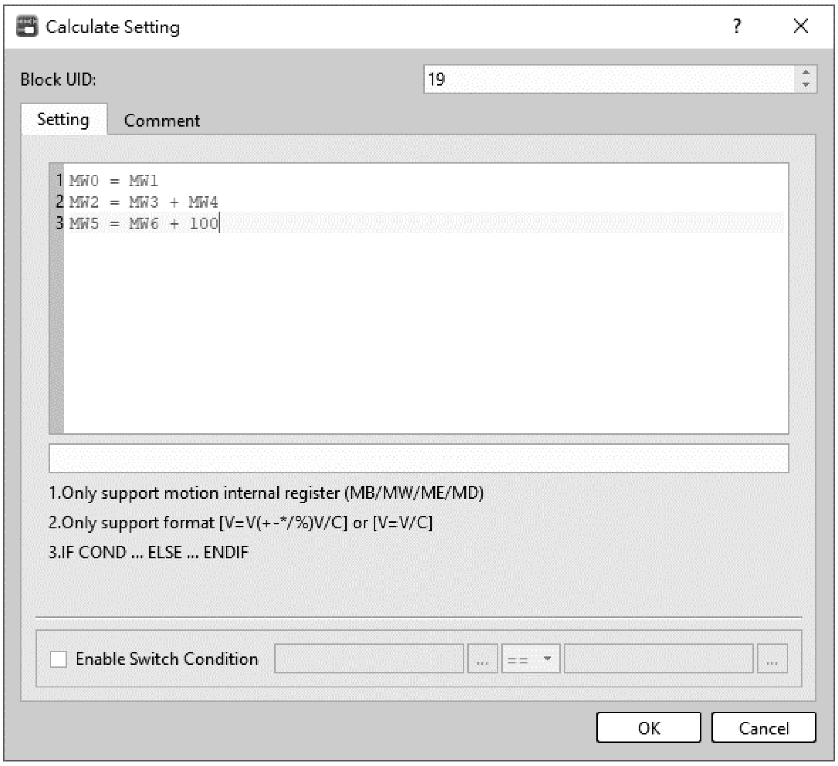
Operand	MB (Motion Bit)	MW (Motion Word)	ME (M16XXX)	MD (M12XXX)	X	Y	M	R	D	K
Range	MB0 | MB255	MW0 | MW255	ME160 | ME1183	MD0 | MD1023	X0 | X1023	Y0 | Y1023	M | M9119	R0 | R34767	D0 | D11999	16位或32位正負數
Calculate	○	○	○	○						
Switch Condition					○	○	○	○	○	

Function Description

- Only support internal motion relays and registers (MB/MW/ME/MD)
- Supported calculation:
  V=V(+,-,*,/,%)V
  V=V(+,-,*,/,%)C
  IF COND(==, > , >=, < ,<=, !=)…ELSE…ENDIF
- Limit 9 rows of operation

Program Exmample

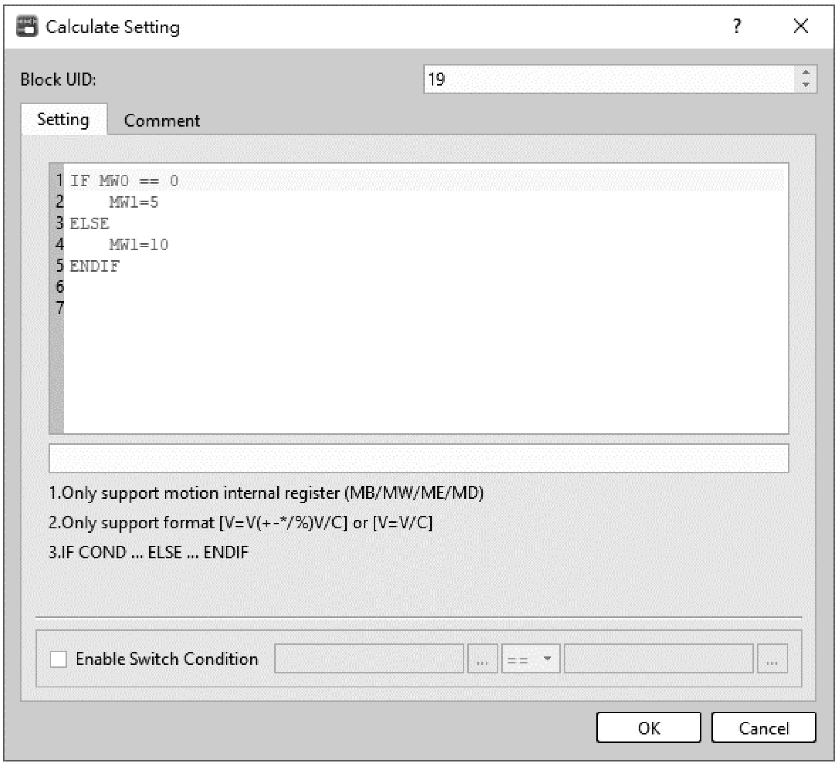
V=V(+,-,*,/,%)V , V=V(+,-,*,/,%)C



{MW0 = MW1 }	Copy value from MW1 to MW0
{MW2 = MW3 + MW4 }	MW3 adds MW4, and put the result to MW2
{MW5 = MW6 + 100 }	MW6 adds 100, and put the result to MW5

Program Example

IF COND(==, > , >=, < ,<=, !=)…ELSE…ENDIF



{IF MW0 == 0

MW1 = 5

ELSE

MW1 = 10

ENDIF}

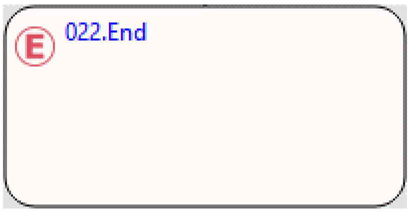
If MW0 is equal to 0, write 5 to MW1, if MW0 is not equal to 0, write 10 to MW1.

7-15 End

【END】	End (The flow block that ends the flow)	【END】

Command Description

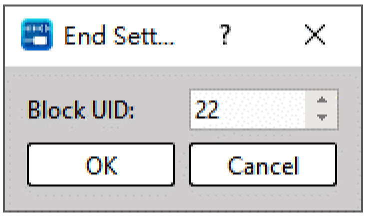
Motion Flow Symbol



Displayed Info

Block UID: The system automatically generates the flow block UID number.

End Setting

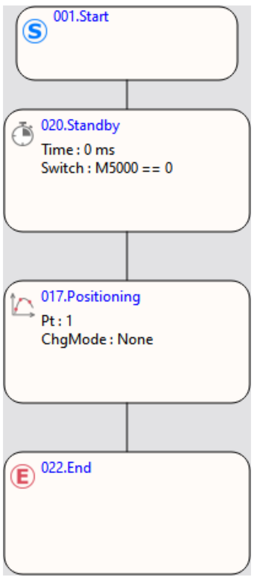


Block UID: The flow block number automatically generated by the system and can be replaced with an unused number.

Function Description

- Placed at the end of the flow to end the flow.

Program Example Motion Flow



Execute [Positioning] and then execute [End] to switch to this motion flow.

8

Position Control and Interpolation

This section describes the positioning control and the interpolation functions. When using the positioning and the motion control functions, you may use the action type of each axis as the reference for setting the desired point parameters such as action mode, target coordinates, acceleration/deceleration or other settings like the number of next point as well as the continuing mode and the transfer conditions, etc. The point parameters can be set according to the number of the point desired. By changing the designated point code, the user will be allowed to run the desired positioning motion with the positioning program that is listed in the point table of the Motion Flow Block.

8-1 Using M-PLC Position Control Flow

Listed below are the steps required for using the Motion Flow related positioning control or interpolation functions:

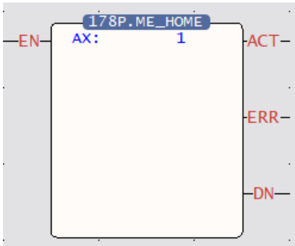
No.	**Action**	**Remark**
1	Complete the setting of motion link	Refer to Section 3.1
2	Compete the setting of motion axis parameters	Refer to Section 3.2
3	Create Ladder and Motion Flow	Refer to Section 6
4	Set the positioning point parameter	Refer to Section 4
Action Flow after PLC execution:		
5	Execute Initial EtherCAT communication through Ladder programming	Refer to Section 5.1
6	Execute Servo ON through Ladder programming	Refer to Section 1.2 Ex. Axis 1 turn on M10600
7	Execute return to HOME if accessing the mechanism.	Refer to Section 6.7 and Section 10
8	Execute the positioning control	Refer to Section 6.6

8-2 Using Ladder Position Control

8-2-1 HOME Return (MFHome)

FUN 178 MFHome	HOME Return (MFHome)	FUN 178 MFHome

Command Description



AX ： Axis No. to execute HOME Return

EN ： = 1, indicates that a HOME Return is to be performed

ACT ： = 1, indicates that the HOME Return operation is in progress

ERR ： = 1, indicates HOME Return error

DN ： = 1, indicates HOME Return is done

Type	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K	XR
Range	WX0 | WX1008	WY0 | WY1008	WM0 | WM9104	WS0 | WS3088	T0 | T1023	C0 | C1279	R0 | R34767	R34768 | R35023	R35024 | R35279	R35280 | R43223	R43224 | R47319	D0 | D11999		V, Z P0 ~ P9
AX							○				○	○	1~16	

Function Description

- This command is mainly to execute the HOME Return action, and its related settings are based on the “HOME Return Setting” in “Motion Axis Setting”.
- HOME Return are provided with 9 modes.
- Trigger only supports up and down differentiation.
- AX ranges from 1 to 16 .

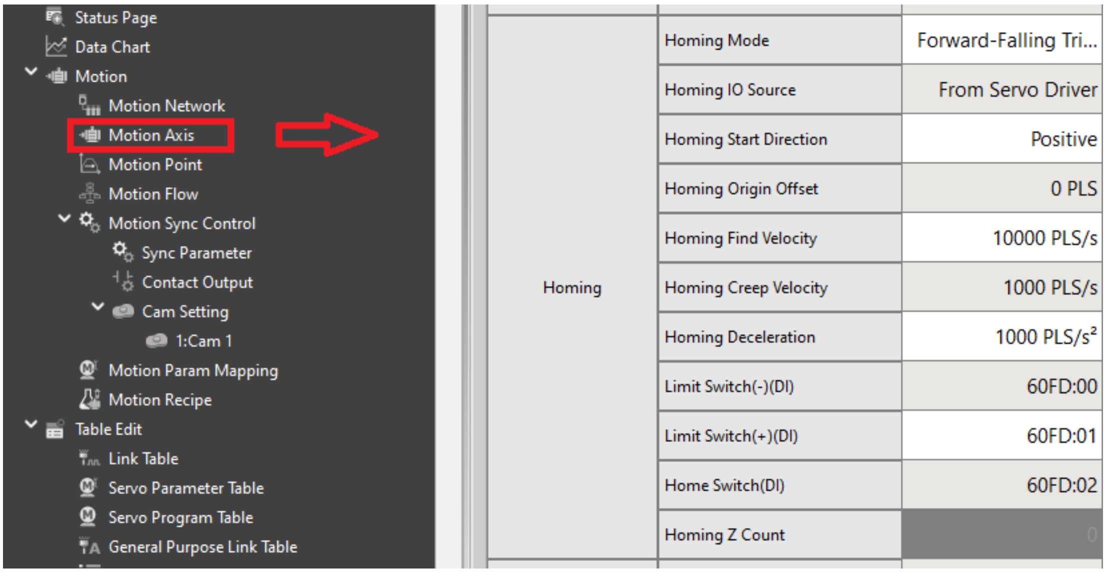
In the special register, there are also corresponding contacts to indicate the state of homing, as follows:

M11245: Axis 1 is returning to HOME
M11246: Axis 1 HOME return operation completed
M10605: Axis 1 HOME signal

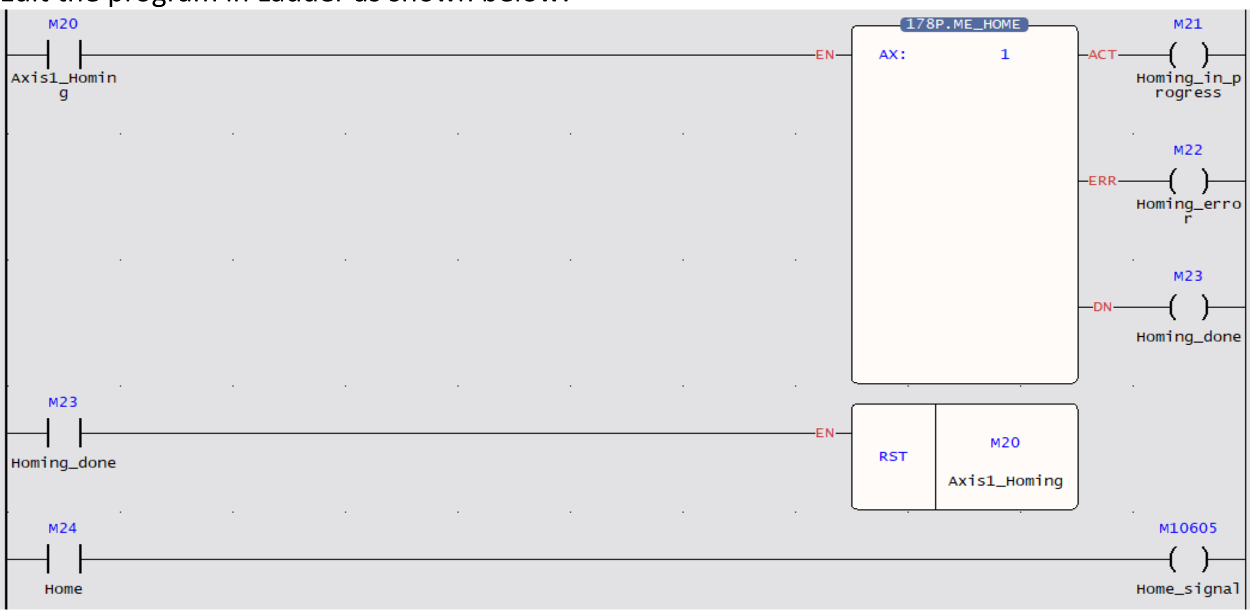
- For details of this command, please refer to the instructions in the motion control manual.

FUN178P MFHome	HOME Return (MFHome)	FUN178P MFHome
Program Example		

If users want to make the homing of the axis in Dog Forward mode, and the homing IO source signal is controlled by PLC, it will decelerate to a homing crawling speed of 250 mm/s^2 when encountering the Dog signal, and stop until it leaves the Dog signal , set in axis 1 of “Motion Axis Setting”, as shown in the figure below.

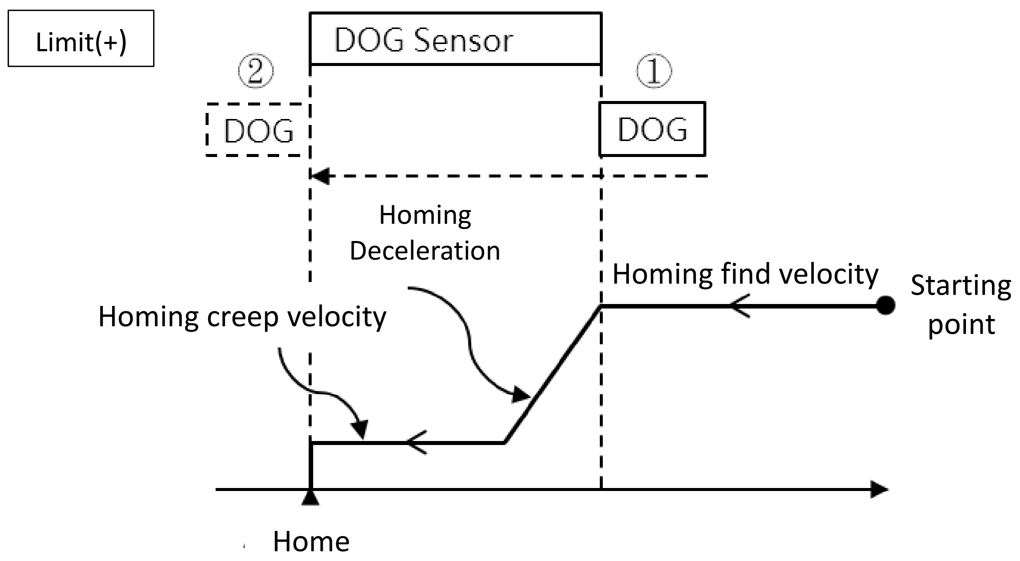


Edit the program in Ladder as shown below:



FUN178P MFHome	HOME Return (MFHome)	FUN178P MFHome
Program Example		

The program and action description are shown in the figure below:



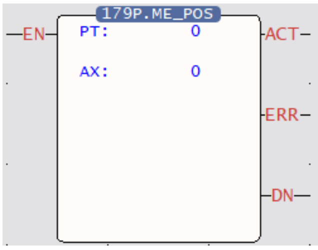
When M 20 is turned ON by the upper edge trigger, it will move forward at the return search speed of 500 mm/s.

- When encountering the Dog signal (M10605 or M24 = On), it will decelerate to the crawl speed of 10 mm/s at the reset deceleration rate of 250 mm/s2 and continue to move forward.
- Until the moment of leaving the Dog signal (M10605 or M24 = OFF), this point is the HOME

8-2-2 Position Control (MFPointMov)

Fun179P MFPointMov	Position Control (MFPointMov)	Fun179P MFPointMov

Command Description



PT ：Command No. of Motion Point Table

AX ：Motion control axis No.

ACT：Acting

ERR：Error

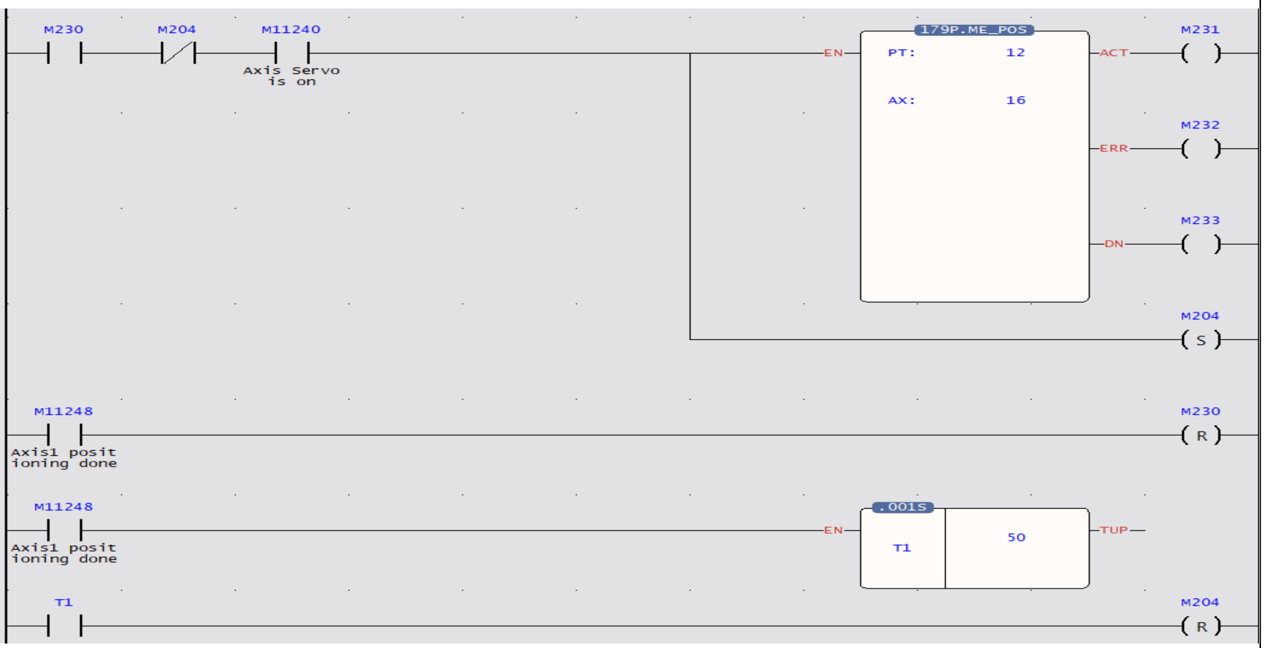
DN：Done

Range / Operand	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K
	WX0 | WX1008	WY0 | WY1008	WM0 | WM29584	WS0 | WS3088	T0 | T1023	C0 | C1279	R0 | R34767	R34768 | R34895	R35024 | R35151	R35280 | R43223	R43224 | R47319	D0 | D11999	-32768 | 32767
PT	○	○	○	○	○	○	○	○	○	○*	○*	○	○
AX	○	○	○	○	○	○	○	○	○	○	○	○	○

Function Description

- Execute Position control of Point Table.
- Please refer to Chapter 5 for Point Table Setting.

Fun179P MFPointMov	Position Control (MFPointMov)	Fun179P MFPointMov
Program Eample		

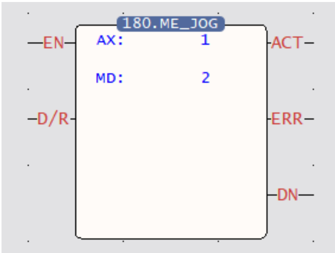


1. Trigger M230 to perform position control
2. When the position control action is completed, use M11248 to clear M230
*Use M204 to prevent other Fun179 triggers from causing errors

8-2-3 JOG (MFJog)

Fun 180 MFJog	JOG (MFJog)	Fun 180 MFJog

Command Description



AX ：Indicates the axis to perform JOG

MD ： There are 4 modes in total, mode 0-mode 3, for detailed information, please refer to the instructions in the motion control manual.

EN ： = 1, indicates Indicates that JOG is to be triggered.

D/R ： = 1, Forward ; D/R ： = 0, Backward

ACT ： = 1, JOG is acting

ERR ： = 1, JOG error

DN ： = 1, JOG is done

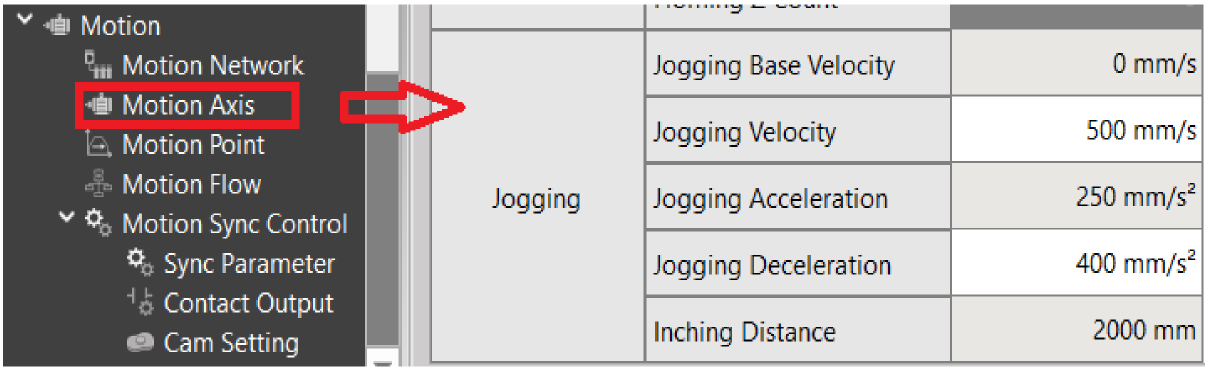
Type	WX	WY	WM	WS	TMR	CTR	HR	IR	OR	SR	ROR	DR	K	XR
Range	WX0 | WX1008	WY0 | WY1008	WM0 | WM9104	WS0 | WS3088	T0 | T1023	C0 | C1279	R0 | R34767	R34768 | R35023	R35024 | R35279	R35280 | R43223	R43224 | R47319	D0 | D11999		V, Z P0 ~ P9
ID	○	○	○	○	○	○	○	○	○	○	○	○	1~256	
AX	○	○	○	○	○	○	○	○	○	○	○	○	1~16	

Function Description

- This command is mainly to execute the movement of the specified axis, and execute it in the specified mode, and its related settings are based on the "JOG Motion" setting in the "Motion Axis Setting".
- AX ranges from 1 to 16 。
- In the special register, there are also corresponding contacts to indicate the status of homing, as follows
  M10625: Axis 1 is in JOG operation.
  M11240: The JOG operation of axis 1 is completed.
- For details of this part, please refer to Chapter 11.

Fun180 MFJog	JOG (MFJog)	Fun180 MFJog
Program Example		

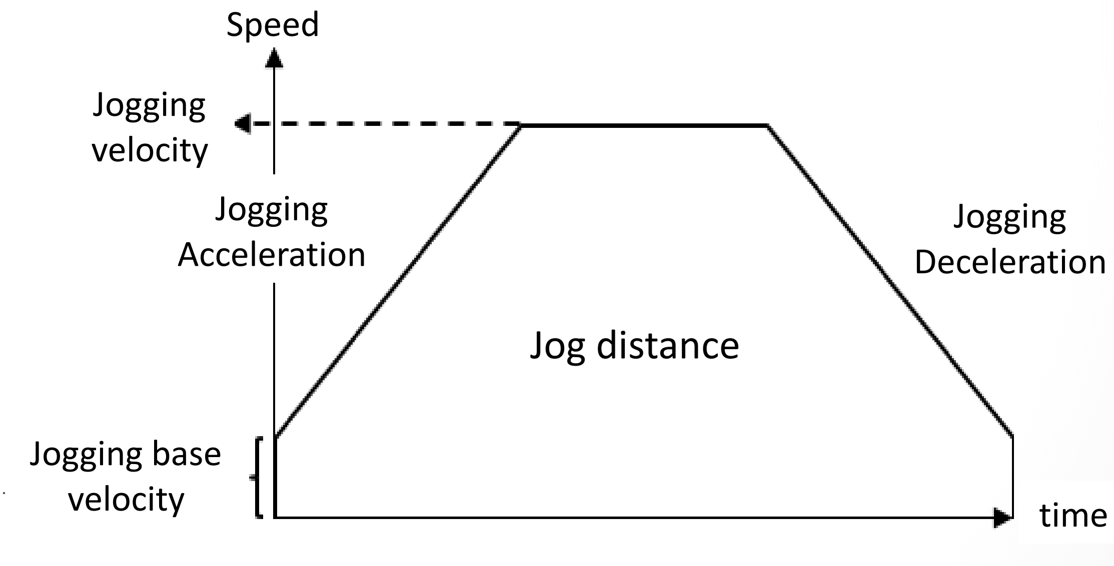
If users want to move the axis by 2000 mm, accelerate to 500 mm/s with JOG acceleration 250 mm/s^2, and decelerate with JOG deceleration 400 mm/s^2, set axis 1 in “Motion Axis Setting”, As shown below:



Edit the program in Ladder as shown below:

Fun180 MFJog	JOG (MFJog)	Fun180 MFJog
Program Example		

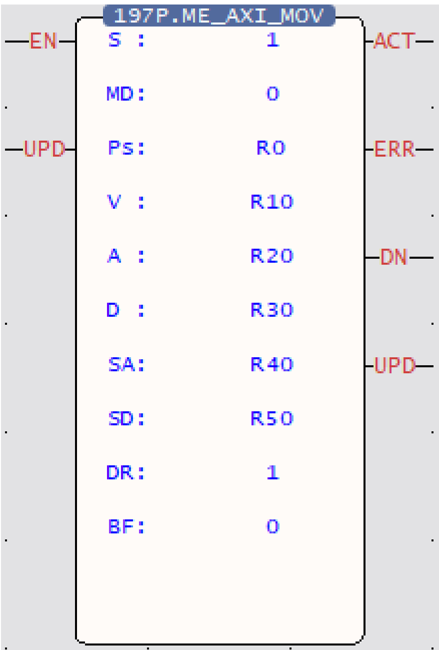
The program and action description are shown in the figure below:



- When M30 is ON and M31 is ON, because the mode is set to 3, it will advance at the JOG start speed, but because the JOG start speed is set to 0 mm/s, the speed will start at 0 mm/s, and the JOG acceleration will be accelerated at 250 mm/s^2 , accelerate to JOG speed 500 mm/s and move forward.
- Then it will decelerate at the JOG deceleration rate of 400 mm/s^2, advance to the jogging distance and stop.

8-2-4 Axis Movement (ME_AXI_MV)

FUN197 ME_AXI_MV	Axis Movement	FUN197 ME_AXI_MV
Command Description		



S： Axis No.

Md ： Mode

0：Abbsolute

1：Relative

Ps：Coordinates, unit: 0.01

V： Velocity

A： Acceleration

D： Deceleration

SA ： Accelerated S Curve

SD ： Decelerated S Curve

DR ： Direction; 1: Forward, 2 : Backward

BF : Consecutive Velocity Mode
0 = Execute the current command immediately
1 = Wait for the previous command to finish
2 = Select lower consecutive velocity
3 = Select the previous velocity command
4 = Select the current velocity command
5 = Select higher consecutive velocity

EN：Trigger command

UPD：Updated rising parameter

ACT：Master axis and Slave axis are synchronozing

ERR：Parameter error or axis error

DN： Motion OS ： v_0.5.9 currently has no features

UPDN：Updating parameter is done

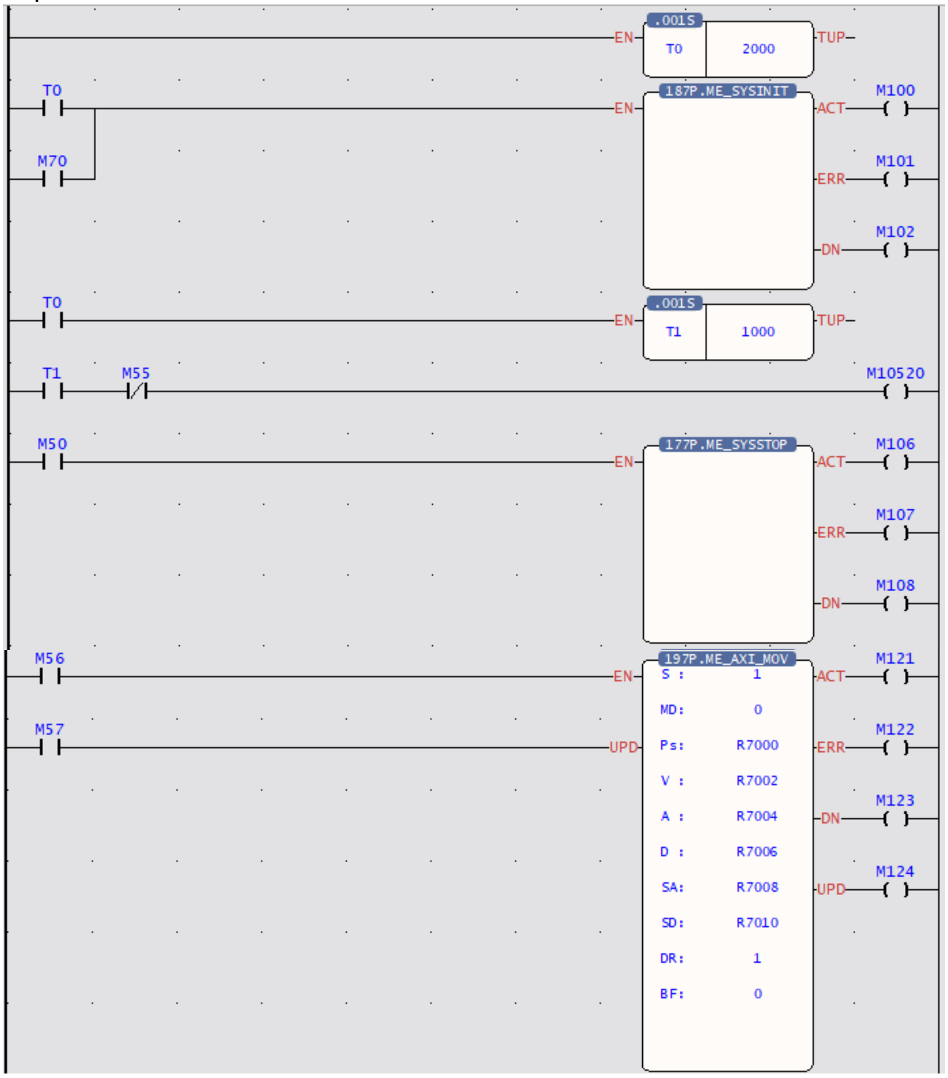
FUN 197 ME_AXI_MV	Axis Movement	FUN 197 ME_AXI_MV

Function Decription

- This command is for axis movement.
- For details of this command, please refer to the instructions in the motion control manual.

Program Example

Program example is shown below:



FUN 197 ME_AXI_MV	Axis Movement	FUN 197 ME_AXI_MV

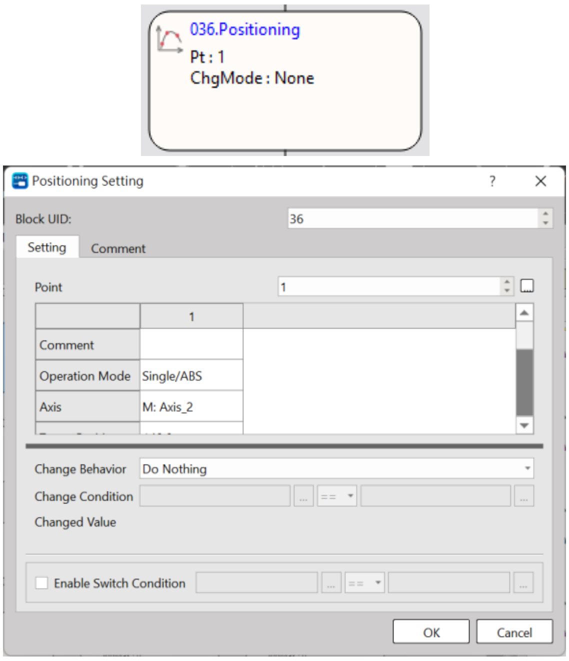
In accordance with the register location of the command plan, fill in the parameters in the following table:

R7000	DEC	0
R7001	DEC	0
R7002	DEC	300
R7003	DEC	0
R7004	DEC	100
R7005	DEC	0
R7006	DEC	100
R7007	DEC	0
R7008	DEC	100
R7009	DEC	0
R7010	DEC	100
R7011	DEC	0

This program example will initialize the motion control system 3 seconds after the first execution, and will enable all axes (Servo on) after 3 seconds, and then fill in the parameters in order, and then turn M56 on to execute the position according to The set acceleration and deceleration etc. move to the place where the absolute position is plus 300.

8-3 Using Motion Flow Positioning

The M-PLC positioning can be controlled with the following two methods, Ladder and Motion Flow. To control with Motion Flow method, you need to select positioning control Block from the PLC program. When using Motion Flow to execute the positioning control, you need to select the parameter from the point table.



Flow Block ID: The ID will be assigned by the system automatically, but it can be changed by the user as desired.

Point: Point Parameter Table. I. If the motion parameter data in Point 9 equals to Point Parameter 9, then the user may set up the point motion parameter in motion parameter. When running the flow, you may write the motion data for the desired point and the system will log such data in the Point Parameter Table automatically.

Change Behavior: No change / Change current coordinate / Change target position / Change speed / Interrupt Constant Feed / Interrupt Constant Angle

Provided below are the rules that should be followed when executing the speed change, target coordinates change and current coordinates change:

1. Speed change rules:

a. If the residual moving distance is too short after changing the speed, then the system will not change the speed. In this case, the system will run the flow according to the speed previously used.

b. Change the Master Axis speed. In case of arc or linear interpolation, change the composition speed created for the interpolation.

c. After changing the speed for the current point, the composite speed or the Master Axis speed will not be changed when using the point parameter of the next point. The system will change the speed when setting the speed of the subsequent point parameter at “-1”.
Note: The Error will present when setting the starting point speed at “-1”.
d. When setting the speed change value at “0”, the flow will slow down and then stop.

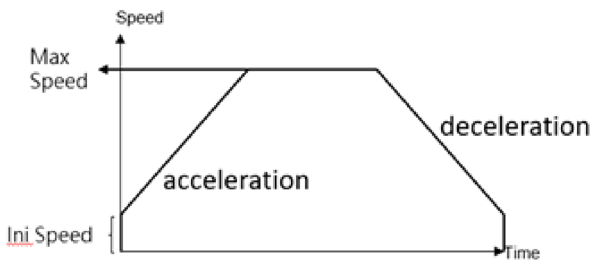
2. Target coordinates change rules:
a. When executing continuous parameter action, you cannot change current coordinates.
b. If current action is arc spiral interpolation type, then the change will be ineffective.

3. Change current coordinates
a. When executing the positioning control, you cannot change the coordinates.
b. You may select Standby after current point parameters are running. After selecting Standby, you may change the coordinates and then use the changed coordinate system for the next point.

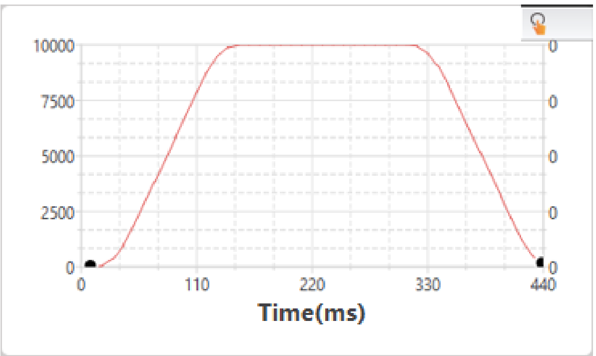
Change Condition: The condition required for changing the behavior. If the change behavior has been set, then you need to set up the required change condition.
Switch Condition: The condition required for switching to the next flow block. If the switch condition remains inactive, then you may jump to the next flow block directly.

In addition, you can use FUN181 to change the motion control parameter command, and make various numerical changes according to the above rules. For detailed operation methods, please refer to Chapter 6-12.

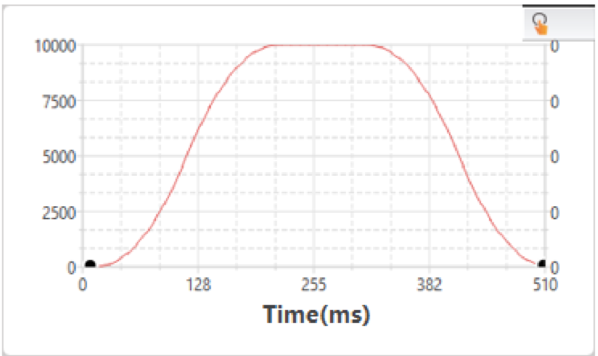
Introduction of motion point parameter setting:
Point ID: The ID number of the point that will be executed on Ladder.
Motion mode: Such option is used for selecting absolute/relative/interpolation motions.
Master Axis: The ID number of the axis that will be executed.
Target Position: Master Axis target position, which means the travel (relative/absolute) that will be moved.
Speed: Output speed or the maximum speed of frequency motion. Such value will not be added if the distance is not enough for accelerating to the maximum.



Acceleration: The acceleration required for increasing the initial speed to the desired speed.
Deceleration: The deceleration required for reducing the initial speed to the desired speed.
Acceleration type: T-curve/ S-curve
S-acceleration curve percentage scope: 1%–100%



S-Curve 50%



S-Curve100%

S-deceleration curve percentage scope: 1%–100%
Where, 0% means pure T-curve and 100% refers to pure S-curve (without uniform acceleration/deceleration field)

Consecutive Point: The point required for ending or continuing the motion. If continue motion will be required, then select Continue Mode.
Consecutive Mode:
Standby: The “ms” duration that should be elapsed after completing the current point so as to move to the next point.
Next point consecutive speed: The speed for accelerating/decelerating to the next point and then run the next point.
Current point consecutive speed: Complete with current speed and then execute acceleration/deceleration until reaching the next point.
Start consecutive speed: Reduce the speed to starting speed and then run the next point.
Standby time: The standby duration under Standby Mode (unit: ms)

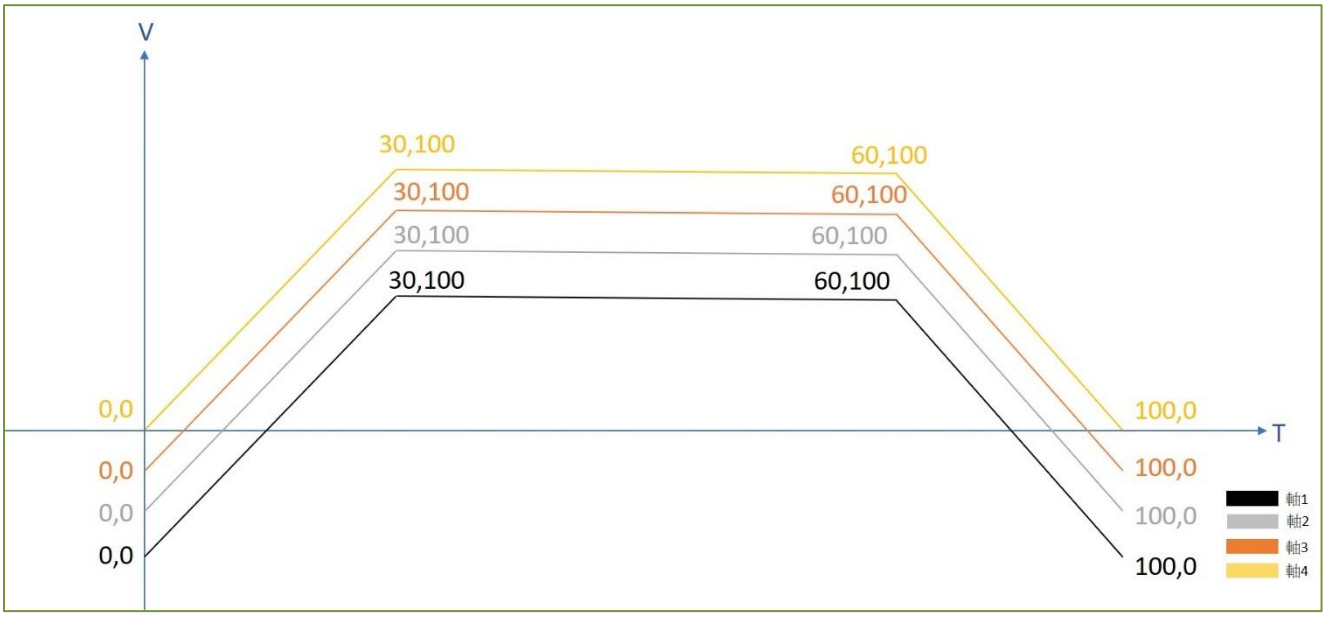
8-4 Description of Multi-axis Interpolation

M-PLC positioning control is composed by Linear Interpolation, Arc Interpolation and Spiral Interpolation modes.
The Linear Interpolation provides maximum 4-axis linear interpolation control.
The Arc Interpolation provides maximum 2-axis arc interpolation control.
The Spiral Interpolation provides maximum 3-axis spiral interpolation control.
Listed below is the classification of action mode:

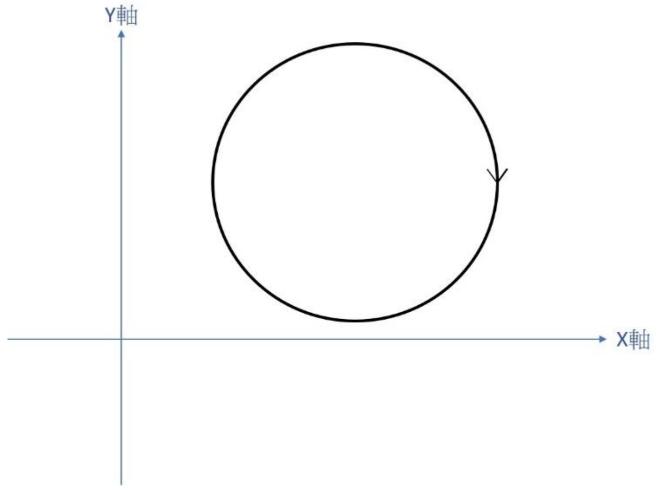
Interpolation Mode	Linear Interpolation	Arc Interpolation	Spiral Interpolation
Control System	Position control	Position control	Position control
Coordinates System	Absolute / relative	Absolute / relative	Absolute / relative
Action Mode	Absolute linear position Relative linear position	Absolute arc position Relative arc position	Absolute spiral position Relative spiral position

The master axis is the control axis, and the slave axis will move with the position of the main axis. In the spiral mode, the slave axis 1 is fixed for arc, and the slave axis 2 is fixed for vertical movement.

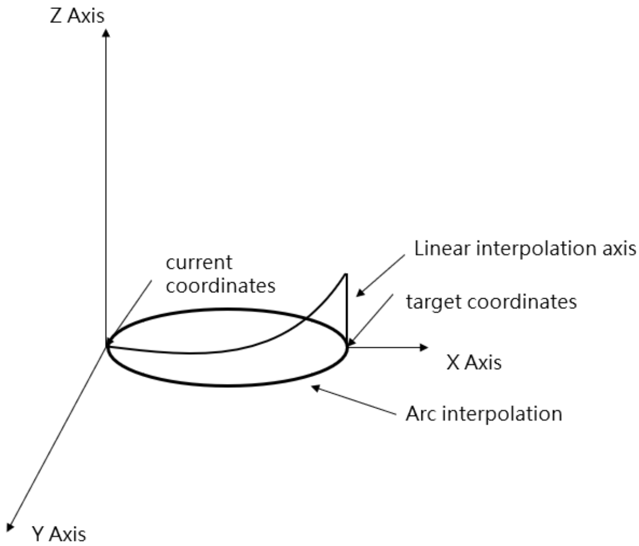
Under Linear Interpolation Mode, it allows the system to execute single linear action on 4 axes.



Under Arc Interpolation Mode, it allows the system to execute single linear action on 2 axes.



The Spiral Interpolation can run the arc interpolation and then coordinate with Axis-2 required for executing the linear motion so that the motion track will form the spiral shape.



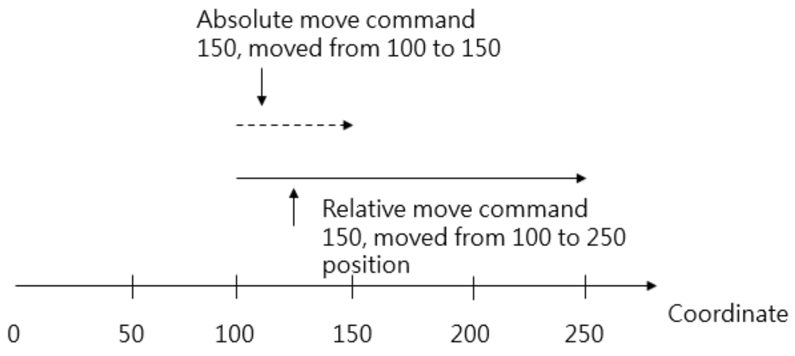
Described below is the type of coordinates system:

Absolute coordinates:

The target position moved by the designated axis, and it shall be set according to the HOME coordinates. It is the coordinates system established for assigning the number of positions that should be run by the control axis from the HOME coordinates.

Relative coordinates:

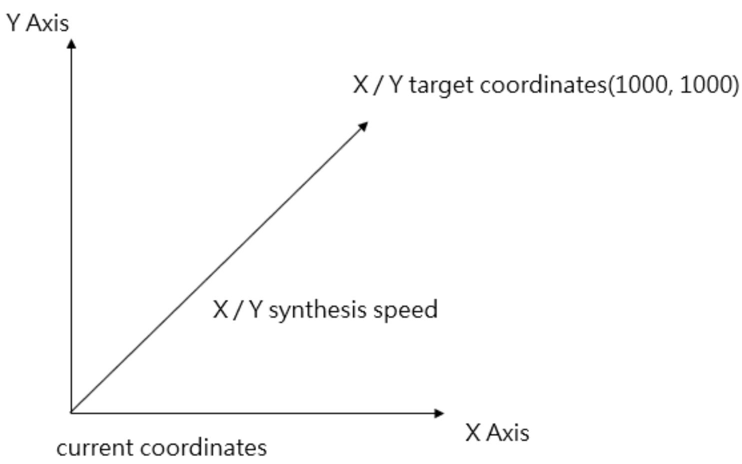
The target position moved by the designated axis, and it shall be set according to current coordinates. It is the coordinates system established for assigning the number of positions that should be run by the control axis from current coordinates.


Absolute move command
150, moved from 100 to 150
Relative move command
150, moved from 100 to 250
position
Coordinate
0
50
100
150
200
250

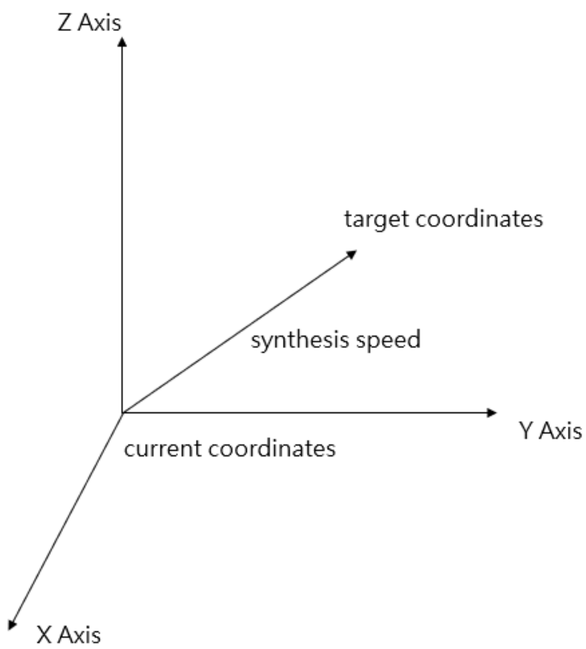
8-5 Linear Interpolation

The Linear Interpolation provides maximum 4-axis interpolated motion and it comprises the following two action modes, “linear/position/absolute” and “linear/position/relative” modes. indicated below is the example of Linear Interpolation.

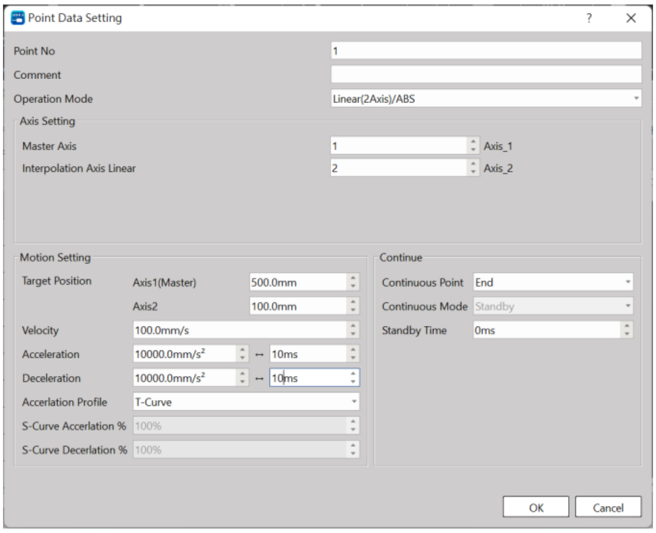
A. 2-axis Linear Interpolation

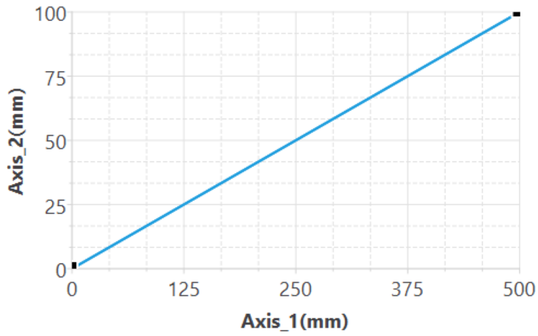


B. 3-axis Linear Interpolation

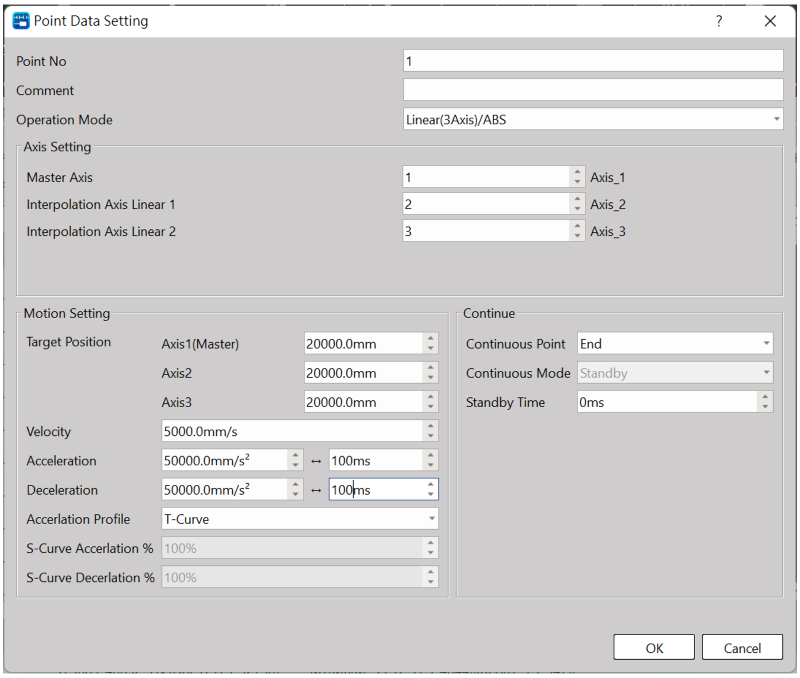


Indicated below is the setting example for 2-axis Absolute Linear Interpolation: Axis_1 is selected as the Master Axis and the axis to be interpolated is Axis_2. The target position Axis_1 is set as 500mm and Axis_2 is set as 100mm. The speed is set as 100 synthesis speed. The acceleration/deceleration behavior is expressed by T-curve and the acceleration/deceleration duration is set as 10ms.



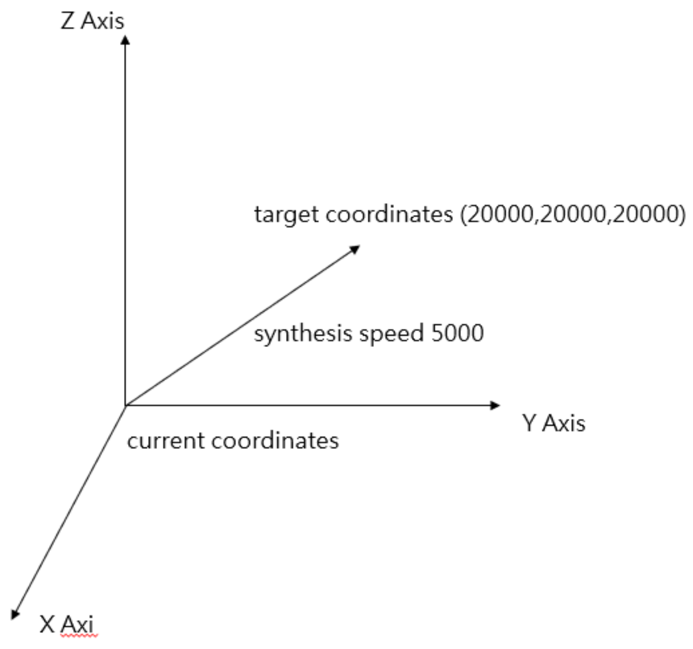


Indicated in the figure is the example showing the setting of 3-axis absolute linear interpolation: Axis_1 is selected as the Master Axis and the interpolated axes to be interpolated are Axis_2 and Axis_3. The target position Axes_1/2/3 are set as 20000 absolute value. The speed is set as 5000 synthesis speed. The acceleration/deceleration behavior is expressed by T-curve and the deceleration duration is set as 100ms.



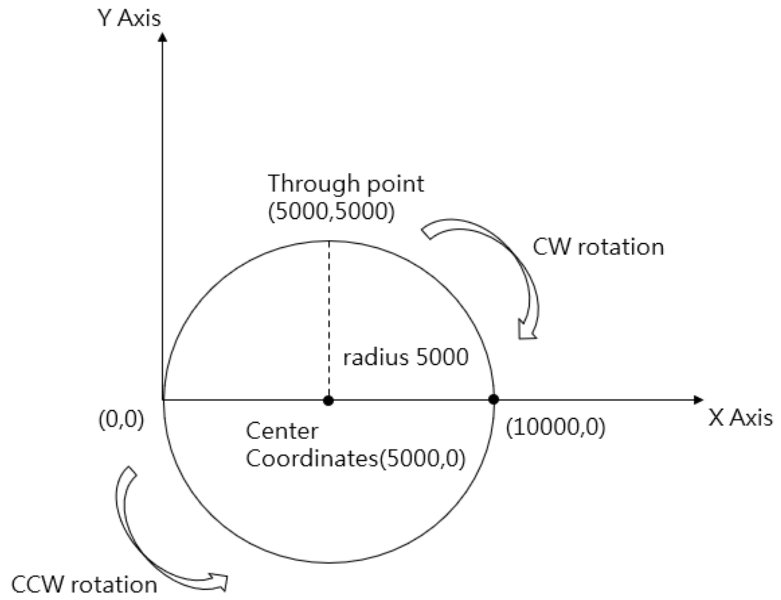
In this regard, the interpolated Master Axis and the interpolated Slave Axis can be freely organized. For example, selecting Axis_1 as Master Axis, selecting Axis_3 as Linear Interpolation Axis_1, and selecting Axis_5 as Linear Interpolation Axis_2.

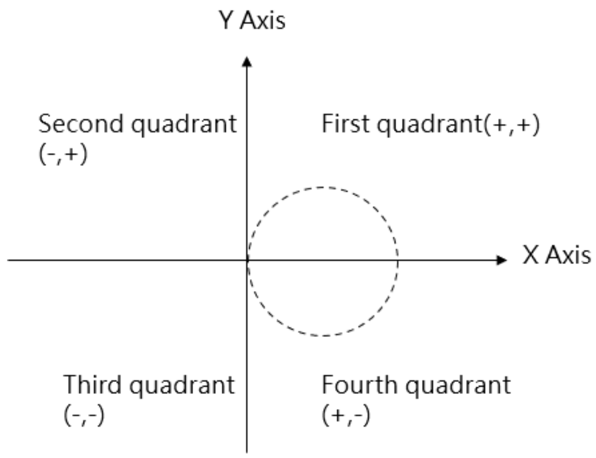
The speed and the acceleration/deceleration are expressed as synthesis speed.
The axis without being set with axis link cannot be selected as the interpolation axis.



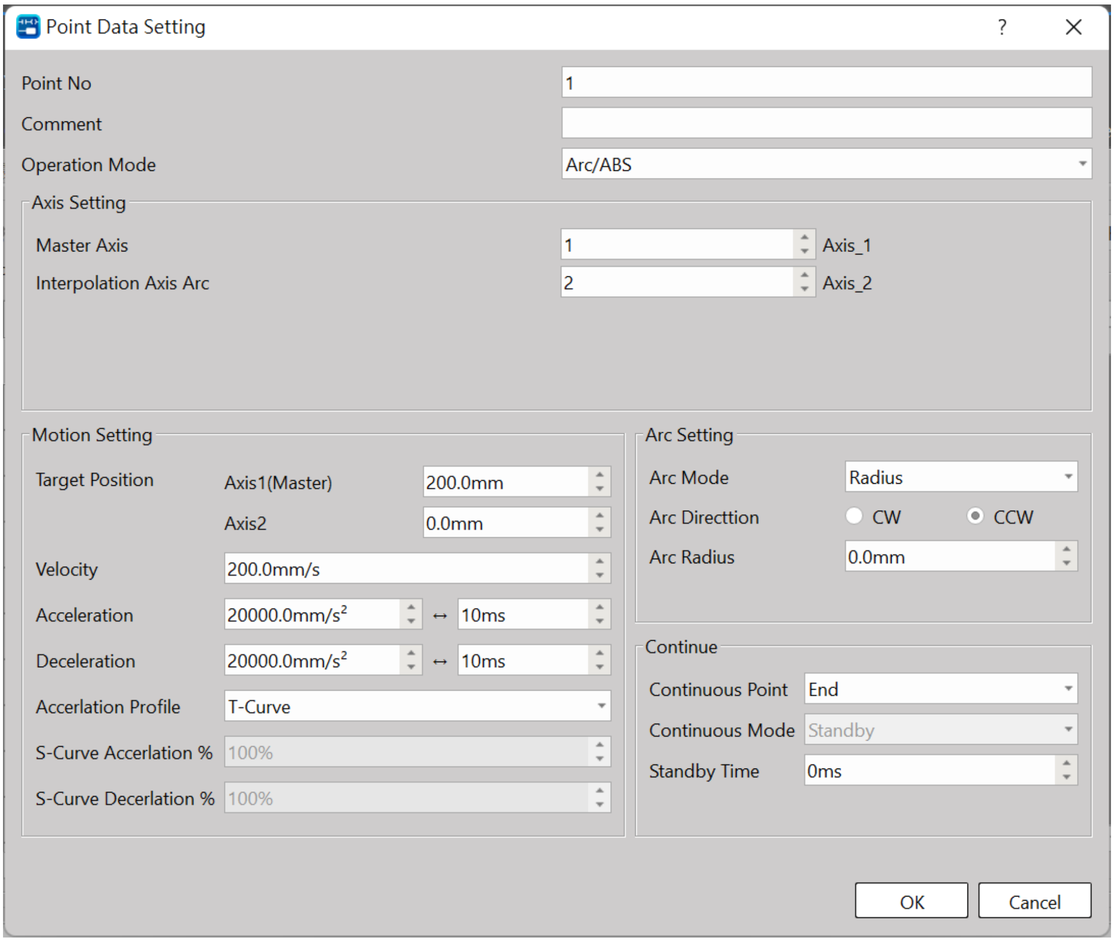
8-6 Arc Interpolation

The Arc Interpolation provides maximum 2-axis arc interpolation control and it comprises the following two action modes, "Arc/Position/Absolute" and "Arc/Position/Relative" modes. Described below are the point parameters and setting relating to the arc interpolation running for which three arc appointing methods are provided, and these are through point, center and radius. In this regard, the Master Axis and Slave Axis required for interpolation can be freely organized; for example, selecting Axis_2 as the master axis and selecting Axis_5 as the arc interpolation axis. Indicated below is the circle encompassing Quadrant 1 and Quadrant 4 and its diameter is set as 10000mm. Its radius is 5000mm, center coordinates is expressed as (5000,0) for which, lots of arc through points are also provided.





Arc interpolation related parameter setting:



Opearation Mode:

“Arc/Absolute” and “Arc/Relative” modes.

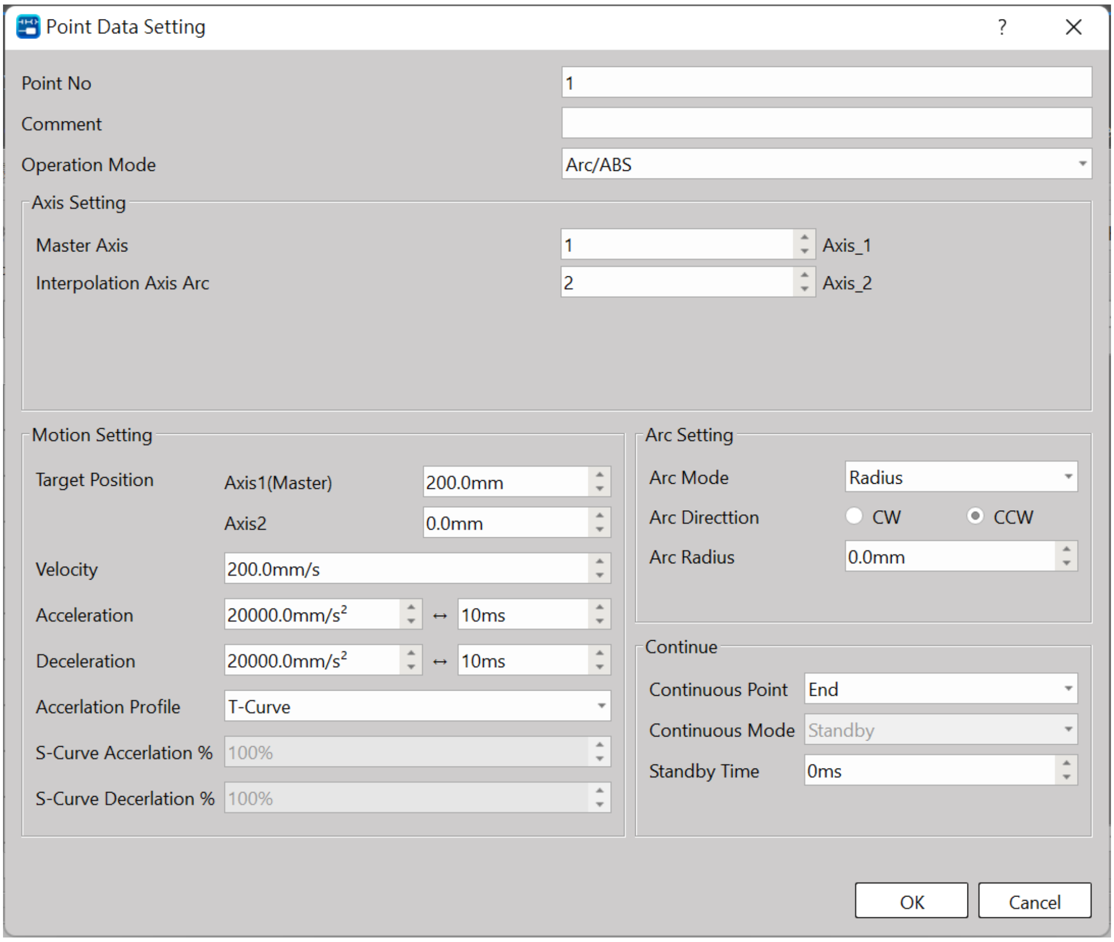
Arc Mode:

Radius, Center Point and Through Point modes.

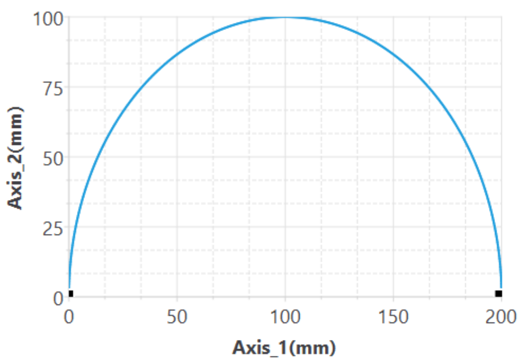
When designating radius for Arc Mode:

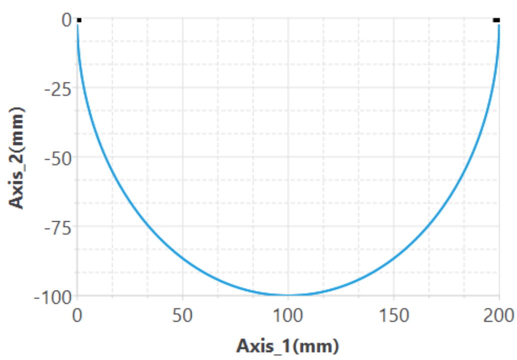
The radius can be designated according to the target position of Master Axis and Interpolation Axis for running one round of arc interpolated motion.

Per the example indicated below:

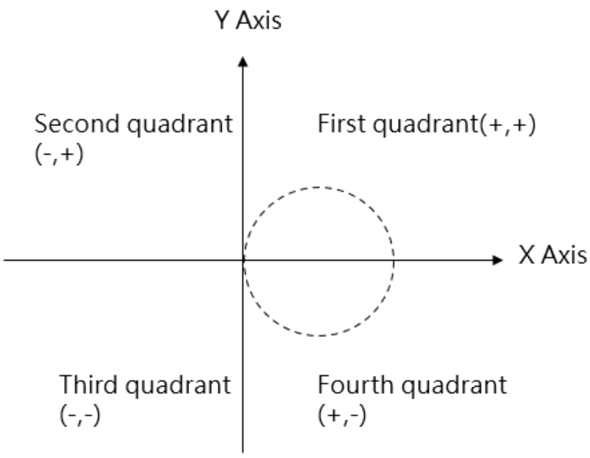


When setting the Arc Mode as the radius, the initial coordinates are set as (0,0), the target position of Axis_1 is set as coordinates 200mm and the target position of Axis_2 is set as coordinates 0mm. The speed is set as 100mm/s and the arc direction is as CW. When setting the arc radius as 100mm, the system will draw a 100mm radius semi-circle on Quadrant-1. When selecting CCW, the system will draw a 100mm radius semi-circle on Quadrant-4. However, an error will appear when the difference between the front coordinates and the target coordinates is over 2 times the radius.



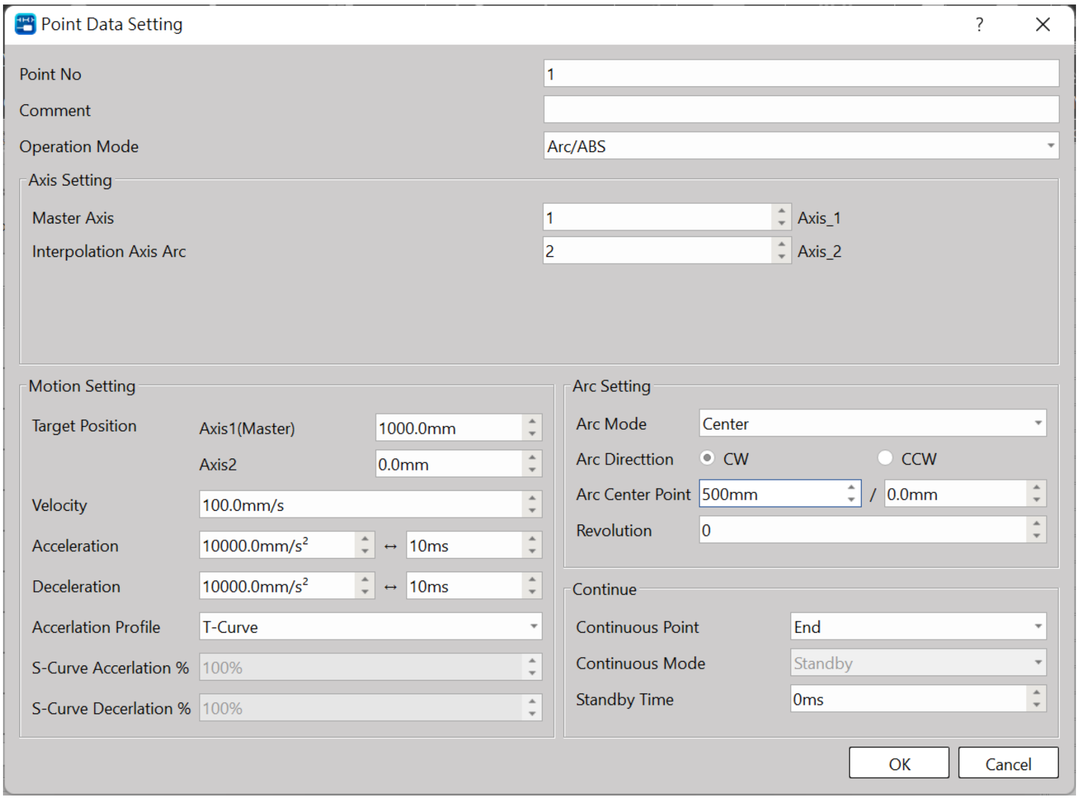


If the arc radius is wrongly set such that the arc cannot be run as intended, then the system will signal the error code before starting the designed motion. Through the point diagram preview function of UperLogic, the user will be allowed to preview the arc path, as below.



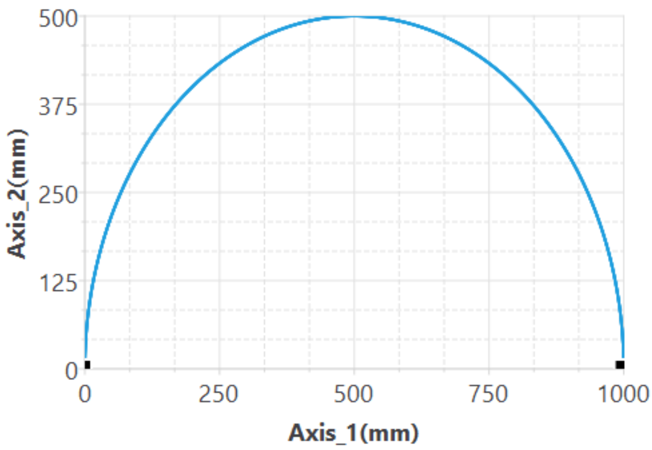
When designating Center point for Arc Mode:

By using the target position of the interpolated Master Axis and the interpolation axis as well as designating the center coordinate of the arc, you will be allowed to run the arc interpolated motion. The arc path is the circle formed by using the current coordinates and designated center coordinates as the radius. When setting the circle by using the target coordinates as the arc, you may designate an arc that can rotate for over 180 degrees. If the current coordinates are the same as the target coordinates, then it can be converted to a full-circle arc. You may also designate the “revolution” as 1 in order to rotate over one circle, as per the example provided below:



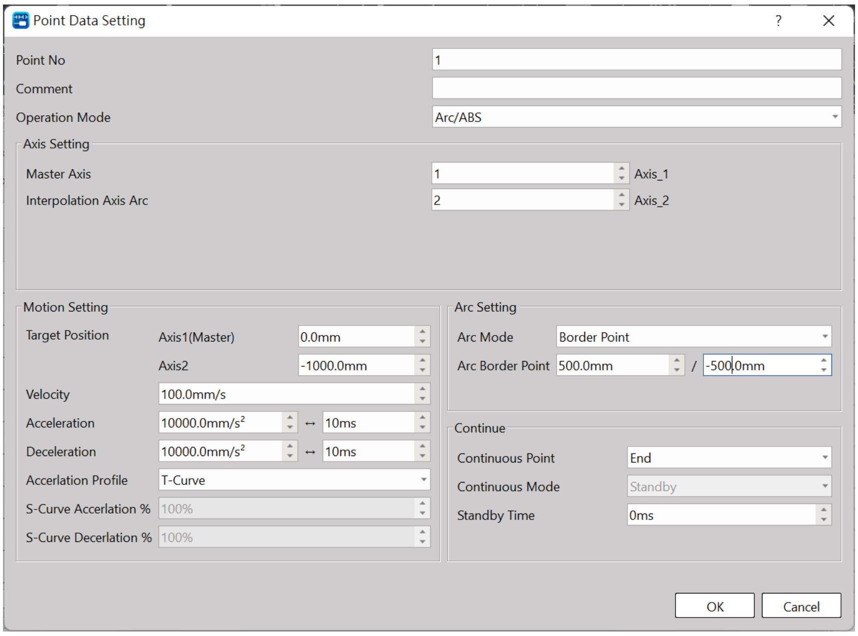
When setting the Arc Mode as the center, the initial coordinates are set as (0,0), the target position of Axis_1 is set as coordinate 1000mm and the target position of Axis_2 is set as coordinate 0mm. The speed is set as 100mm/s and the arc direction is as CW. When setting the arc center point Axis_1 as 500mm and Axis_2 as 0mm, the system will draw a circular arc on Quadrant-1 where the center coordinate is located at (500, 0).

If current coordinate, target coordinate and center coordinate are the same, then the system will signal an error code before starting the designed motion. Through the point diagram preview function of UperLogic, the user will be allowed to preview the arc path, as per below:

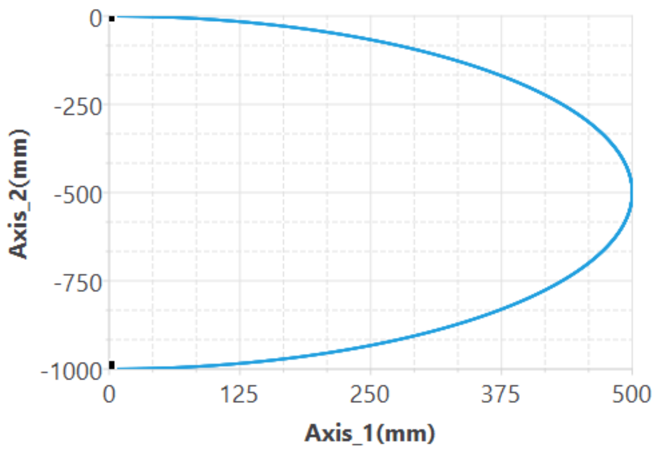


When designating Through point for Arc Mode:

By using the target position of the interpolated Master Axis and the interpolation axis as well as designating the pass point coordinate of the arc, you will be allowed to run the arc interpolated motion. The arc path is the circle being formed by starting from the current coordinate and the pass point of the designated arc to the target coordinate. You may designate the arc that can rotate over 180 degrees, but you cannot designate the entire circular arc. If the current coordinate, target coordinate and through point coordinate are the same, then it means an error is present, as per the example indicated below:



When setting the Arc Mode as the pass point, the initial coordinates are set as (0,0), the target position of Axis_1 is set as coordinate 0mm and the target position of Axis_2 is set as coordinate -1000mm. The speed is as 100mm/s and the arc direction is as CW. When setting the arc pass point Axis_1 as 500mm and Axis_2 as -500mm, the system will draw a circular arc on Quadrant-4 where the center coordinate is located at (500,-500). If the current coordinate, target coordinate and center coordinate are the same, then the system will signal an error code before starting the designed motion. Through the point diagram preview function of UperLogic, the user will be allowed to preview the arc path, as per below:



Arc direction:

CW (Clockwise) and CCW (Counterclockwise)

Continuous Point: Select end or continue next motion point table.

Note: 2D is allowed to continue 2D point action and 1D is allowed to continue 1D point action.

Continue Mode:

Standby: The “ms” duration that should be paused before moving to next point after completing the operation at the current point.

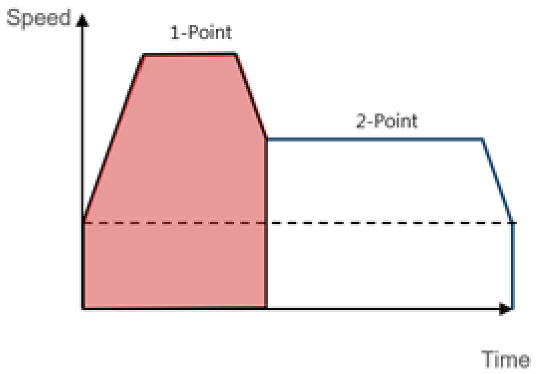
Continue next point speed: Moving to the next point after completing the acceleration or deceleration for such point.

Continue current point speed: Moving to the next point through acceleration or deceleration after completing current speed.

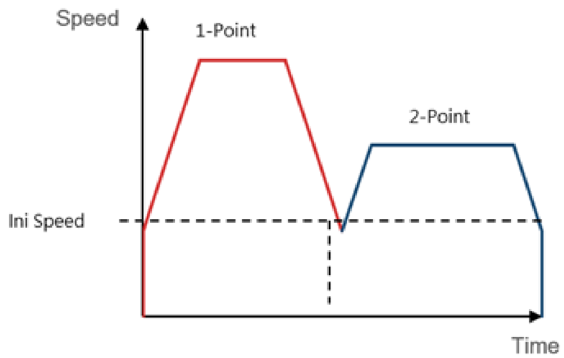
Continue initial speed: Moving to the next point after reducing to the initial speed.

Standby time: The standby time when operating under Standby Mode (unit: ms)

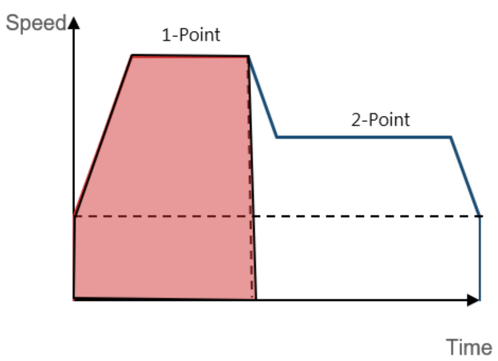
- Continue next point speed



- Continue initial speed

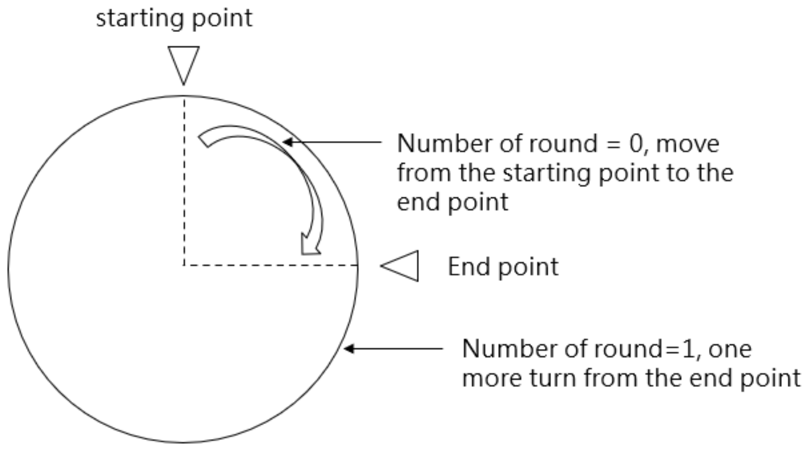


- Continue current point speed



Nimber of round:

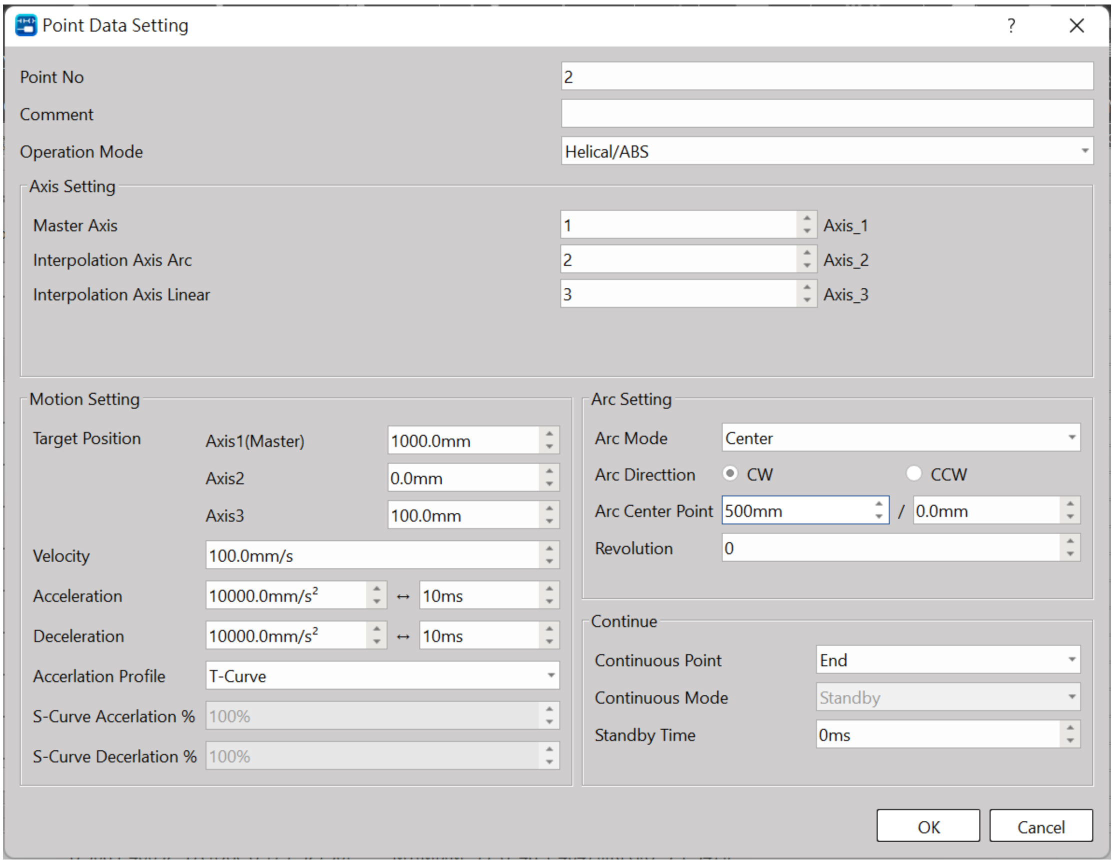
When designating the center point for the arc, the system provides the circle count function. The circle count means the function by drawing another circular arc from the arc interpolated target coordinate to the intended target coordinate. If the starting point is not the same as the ending point, it means the designated circle count will be moved along the arc track from the starting point to ending point. If the starting point is equivalent to the ending point, it means one more circle is executed on top of the designated “nimber of count”.


starting point
Number of round = 0, move from the starting point to the end point
End point
Number of round=1, one more turn from the end point

8-7 Spiral Interpolation

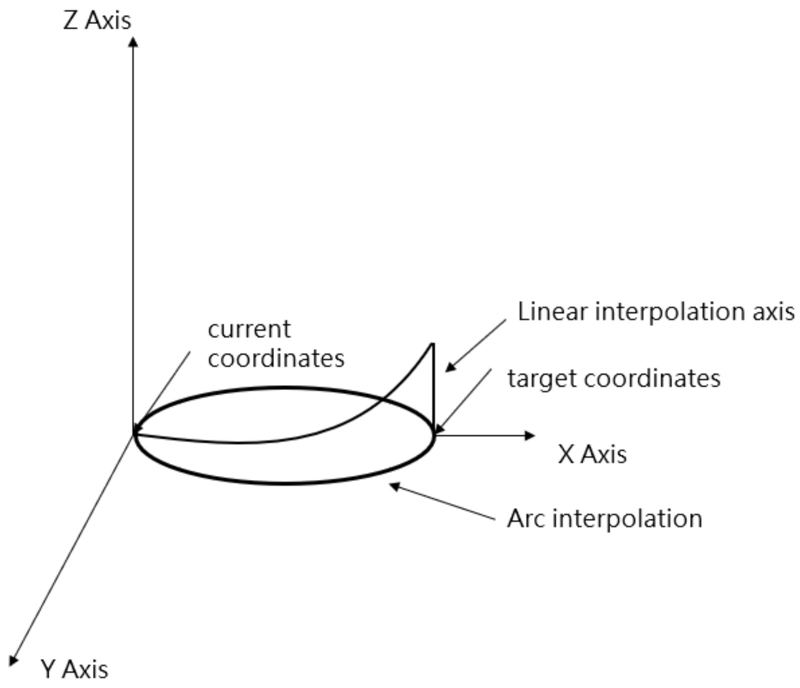
The arc interpolation can be executed on the spiral interpolation. It can be used to coordinate with Axis_3 required for running the linear motion so as to form a spiral shape of moving track. The spiral interpolation comprises the following two action modes, i.e. “Spiral/Position/Absolute” and “Spiral/Position/Relative”. In Spiral Interpolation, the Master Axis and the interpolated Slave Axis can be freely organized.

The spiral interpolation can be used to control all three axes where 2 axes serve as the Master Axis and the Slave Axis during the arc interpolation. While performing arc interpolation, perform interpolation on the linear axis on the third axis for synchronization, and then perform a spiral track motion.



Example:

Master Axis is set as Axis_1. Arc interpolated axis is set as Axis_2. Linear interpolated axis is set as Axis_3, and synthesis speed is set as 100mm/s. Arc mode is set as center point, and Axis_1=500mm, Axis_2=0mm. Target position of linear interpolated Axis_3 is set as 100mm.



9

Motion Parameter Mapping Table

9-1 Introduction of Motion Parameter Mapping Table

The motion parameter mapping table allows users to dynamically modify motion control related parameters in the PLC Ladder program. Users can dynamically modify related motion parameters in the PLC Ladder program by specifying registers and corresponding to the parameter items to be modified through MFMapTbPrm. At present, the sports parameters are not open to all sports parameters for dynamic modification in the user Ladder. Currently, the modifiable motion parameters are provided in the following table:

Motion Parameter Group	Dynamically Modifiable Item	Modified Item Position
Point Table	Mode Acceleration Curve Type Position (Master Axis) Position (Slave Axis 1) Position (Slave Axis 2) Position (Slave Axis 3) Speed Acceleration Deceleration S Acceleration Ratio S Deceleration Ratio Arc Mode Arc Direction Arc Point X Arc Point Y Arc Point Radius Auxiliary Radius Standby Time Next Point No. Arc Rounds Continue Mode Arc Point Z Synthesis Rate	Motion Parameter → Motion Point Setting
Axis Table	Initial Speed Max. Motor Speed Default Acceleration Default Deceleration Soft Limit (+) Soft Limit (-)	Motion Control → Motion Axis Setting

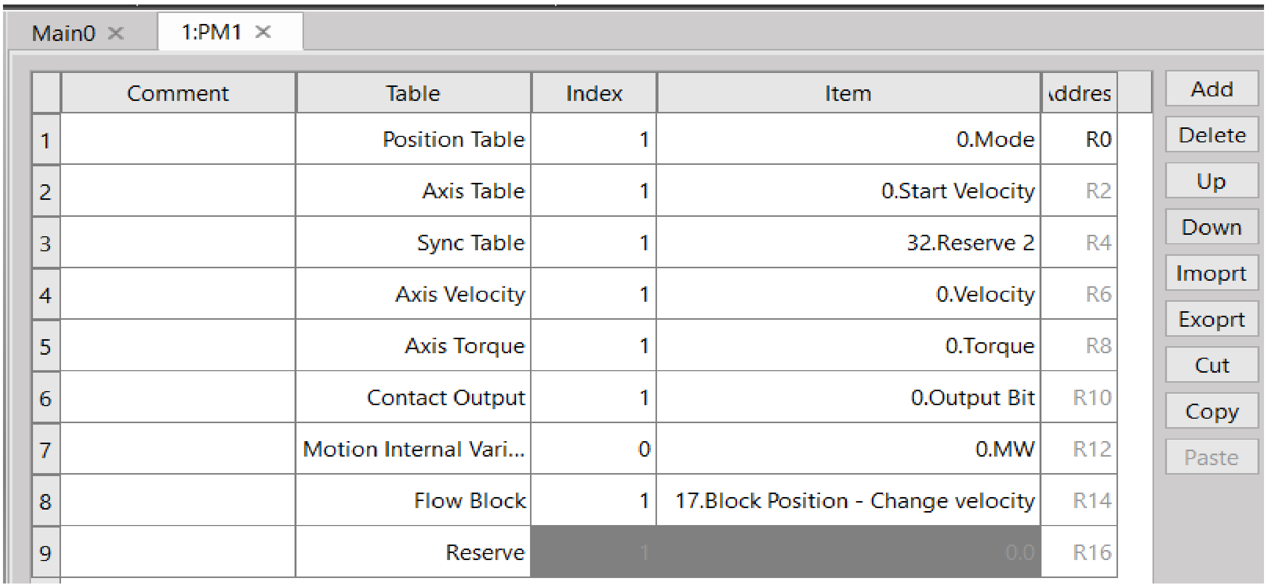
Motion Parameter Group	Dynamically Modifiable Item	Modified Item Position
	Following Error Window Following Error Timeout Positioning Completion Tolerance Positioning Completion Check Time Max. Motor Torque Max. Torque Limit (+) Max. Torque Limit (-) HOME Mode HOME Return Direction HOME Return Offset HOME Return Searching Speed HOME Return Crawling Speed JOG Initial Speed JOG Speed JOG Acceleration JOG Deceleration JOG Distance	
Synchronous Table	Clutch OFF sliding time at deceleration time Master Axis Phase Compensation: Compensation Instruction Amount Master Axis Phase Compensation: Compensation Change Mode Master Axis Phase Compensation: Compensation Change Time Auxiliary Axis Phase Compensation: Compensation Command Amount Auxiliary Axis Phase Compensation: Compensation Change Mode Auxiliary Axis Phase Compensation: Compensation Change Time Variable Gear Ratio Numerator Variable Gear Ratio Denominator Variable Gear Ratio Change Mode Variable Gear Ratio Change Time Clutch ON Setting Value Clutch ON Delay Main Clutch: Clutch ON Offset Main Clutch: Clutch ON Offset Time	Motion Control → Motion Synchronizing Setting → Synchronizing Parameters

Motion Parameter Group	Dynamically Modifiable Item	Modified Item Position
	Main Clutch: Clutch ON Following Time Main Clutch: Clutch ON Following Offset Main clutch: Clutch OFF Setting Value Main Clutch: Clutch OFF Delay Main Clutch: Clutch OFF Offset Main Clutch: Clutch OFF Offset Time Auxiliary Clutch: Clutch ON Setting Value Auxiliary clutch: Clutch OFF delay Auxiliary Clutch: Clutch OFF Offset Auxiliary Clutch: Clutch OFF Offset Time Reserve 1 (Do not use) Reserve 2 (Do not use) Step Angle Compensation: Reference Speed Step angle compensation: reference amount Step Angle Compensation: Compensation Value Change Method Step Angle Compensation: Compensation Value Change Time Cam Profile No. Synchronization Contact No. Output Filter Time Constant Cam Input Cycle Synchronous Master Axis Phase Default Value Master Axis Phase Default Value after Phase Compensation Main Clutch Input Phase Default Value Auxiliary Clutch Input Phase Default Value	

Motion Parameter Group	Dynamically Modifiable Item	Modified Item Position
	Main Clutch Output Axis Phase Default Value Auxiliary Clutch Output Axis Phase Default Value Torque Limiting Clutch Input Axis Phase Default Value Cam Input Axis Phase Default Value Cam Output Axis Reference Coordinates Cam Travel	
Axis Speed	Speed Max. Torque	The speed and torque limit of the current control mode of the axis in "Speed Mode"
Axis Torque	Torque Max. Speed	The speed and torque limit of the current control mode of the axis in "Torque Mode"
Synchronous Contacts	Output Position ON Setting Value OFF Setting Value	Motion Control → Motion Synchronizing Setting → Synchronizing Contacts
Internal Motion Variables	MW	Motion Control → Motion Flow, Dedicated internal register within the motion flow
Flow Block	Syandby Flow Block – Waiting Time	Motion Control → Motion Flow → Standby Flow Block → Waiting Time

Motion Parameter Group	Dynamically Modifiable Item	Modified Item Position
	Positioning Block - Axis 1 Change Value Positioning Block - Axis 2 Change Value Positioning Block – Axis 3 Change Value Positioning Block - Axis 4 Change Value Positioning Block - Axis 5 Change Value Positioning Block – Axis 6 Change Value Positioning Block - Axis 7 Change Value Positioning Block - Axis 8 Change Value Positioning Block - Axis 9 Change Value Positioning Block - Axis 10 Change Value Positioning Block – Axis 11 Change Value Positioning Block – Axis 12 Change Value Positioning Block – Axis 13 Change Value Positioning Block – Axis 14 Change Value Positioning Block – Axis 15 Change Value Positionig Block - Axis 16 Change Value	運動控制 → 運動流程 → 定位控制流程塊 → 更改行為：改變當前座標、改變目標位置、中斷定長以及中斷定角 → 軸 1 到軸 16 更改值
	Positioning Block – Change Speed	Motion Control → Motion Flow → Position Control Flow Block → Change Behavior: Speed Change → Changed Value
	Positionig Block – Change Behavior	Motion Control → Motion Flow → Position Control Flow Block → Change Behavior

Uperlogic Motion Parameter Mapping Table is shown below:



	Comment	Table	Index	Item	ιddres
1		Position Table	1	0.Mode	R0
2		Axis Table	1	0.Start Velocity	R2
3		Sync Table	1	32.Reserve 2	R4
4		Axis Velocity	1	0.Velocity	R6
5		Axis Torque	1	0.Torque	R8
6		Contact Output	1	0.Output Bit	R10
7		Motion Internal Vari...	0	0.MW	R12
8		Flow Block	1	17.Block Position - Change velocity	R14
9		Reserve	1	0.0	R16

Mapping table operation bit usage timing:

1. When the FUN198 MFMapTbPrm mapping table writing command is triggered by the rising edge, it will write the value in the R register set by the PLC into the table corresponding to MOTION, and output the DN signal after the writing is completed. Once writing, the command must be reset first, and then perform the same action.

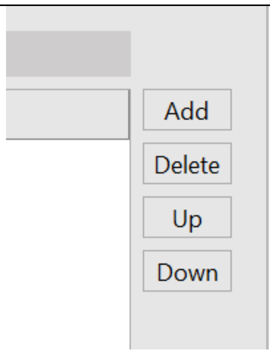
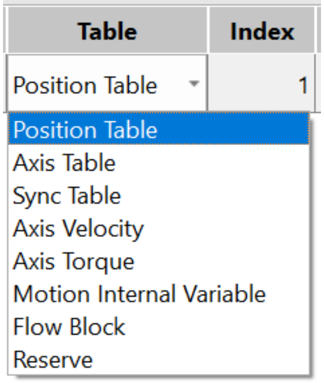
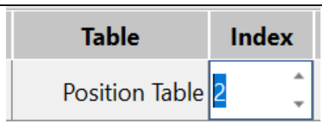
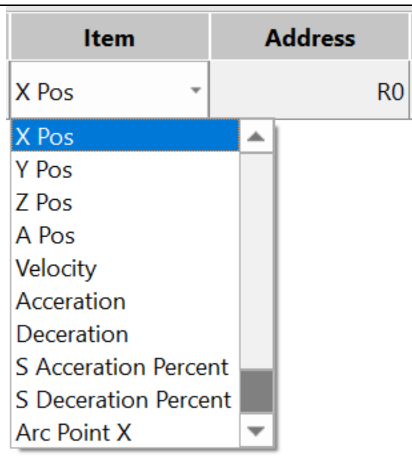
2. Please pay attention to the timing of writing and calling the motion control table data. The mapping table writing command can be used at any time and will be written into the motion control table immediately. The timing of calling the motion control table data is divided into Immediate Effect and Effective on First Entry. There are two types of effect, immediate effect means that the current value is directly overwritten during the call, and the effect when entering for the first time means that the value already in the call will not be overwritten, so it will not take effect until the next call. Please see table below for the timing of data call in different control modes :

Motion Control Parameter Table	Control Mode	Call Timing
Point Table	Position Control Mode	Effective on First Entry
Axis Table	Arbitrarily Control Mode	Effective on First Entry
Synchronous Table	Syncgronous Control Mode	Immediate Effect
Axis Speed	Speed Control Mode	Immediate Effect
Axis Torque	Torque Control Mode	Immediate Effect
Synchronous Contacts	Sychronous Control Mode	Immediate Effect
Internal Variables	Arbitrarily Control Mode	Immediate Effect
Flow Block	Arbitrarily Control Mode	Immediate Effect

* : In synchronous mode, the axis special relay can decide to take effect immediately or in the next synchronous cycle.

9-2 Motion Parameter Mapping Table Using Method

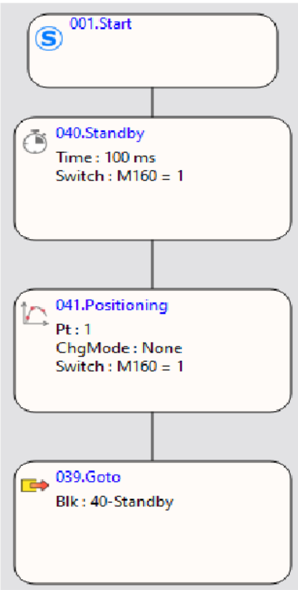
Provided below is the Motion Parameter Mapping Table using method;

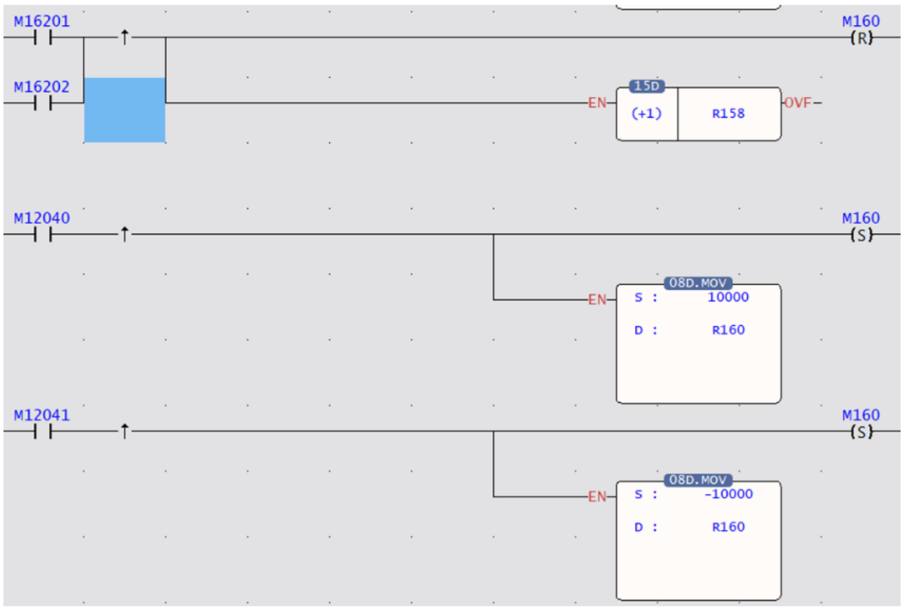
<table>
<tr><th>No.</th><th>Action</th><th>Remark</th></tr>
<tr><td>1</td><td>Click “Add” in Motion Parameter Mapping Table.</td><td>
</td></tr>
<tr><td>2</td><td>Select motion parameter group
Point table/axis table/or synchronization table</td><td>
</td></tr>
<tr><td>3</td><td>Select index
When the Point Table index is the desired No. xx Point motion parameter
When the Axis Table index is the desired No. xx Axis parameter
When the Synchronization Table index is the No. xx axis parameter</td><td>
</td></tr>
<tr><td>4</td><td>Select the item
Each motion parameter group contains its own motion parameters</td><td>
</td></tr>
</table>

5	Designate address R	Item | Address X Pos | R0
6	The designated initial bit required for the operating bit shall be a multiple of “8”.	Address | Operation Bit R0 | M0
7	Write the value to be changed in “R”.	Bigger value will occupy 2 units of “R”.
8	By turning on the operating bit, the PLC program will write the designated motion parameter in R.	

Ladder program example:
Block status signal M16000: 000= 160+block number
Block end signal M12000: 000= block number
M160 = Operating bit
R160 = Mapping address

1. When Flow begins and when PLC reads M16021 is ON, it will run the initialization for M160 OFF.
2. When Flow is under standby and when PLC reads M12040, it will execute M160 ON and then write “10000” value in R160 (mapping address).
3. When Flow executes the positioning control and when PLC reads M12041, it will execute M160 ON and then write “-10000” value in R160 (mapping address).





9-3 Precautions for Use

Description of instructions on using the Motion Parameter Mapping Table:

1. In the Motion Parameter Table, the operating bit and the address user needs to designate the first position only and the rest will be arranged by the system automatically.
2. If the axis is moving when changing the motion command, such as position and speed, then the parameters in the Motion Point Table will remain unchanged. The motion mapping change won't become effective until the next round of motion after stopping the current motion.
3. If the Motion Synchronization Table has been changed, the mapping parameter can be used after being included even though the synchronous control is executed by the system at that time.
4. Reminder: If the “R” designated by the mapping parameter is set as shutdown non-holding type, then “R” will become zero after restarting the PLC. If the user wishes to hold the mapping parameter “R” after restarting the PLC, please set it as the shutdown holding type.
5. When writing the mapping parameter in PLC Ladder, such action should be executed according to “motion control flow block end signal” and “motion control flow block running signal”.

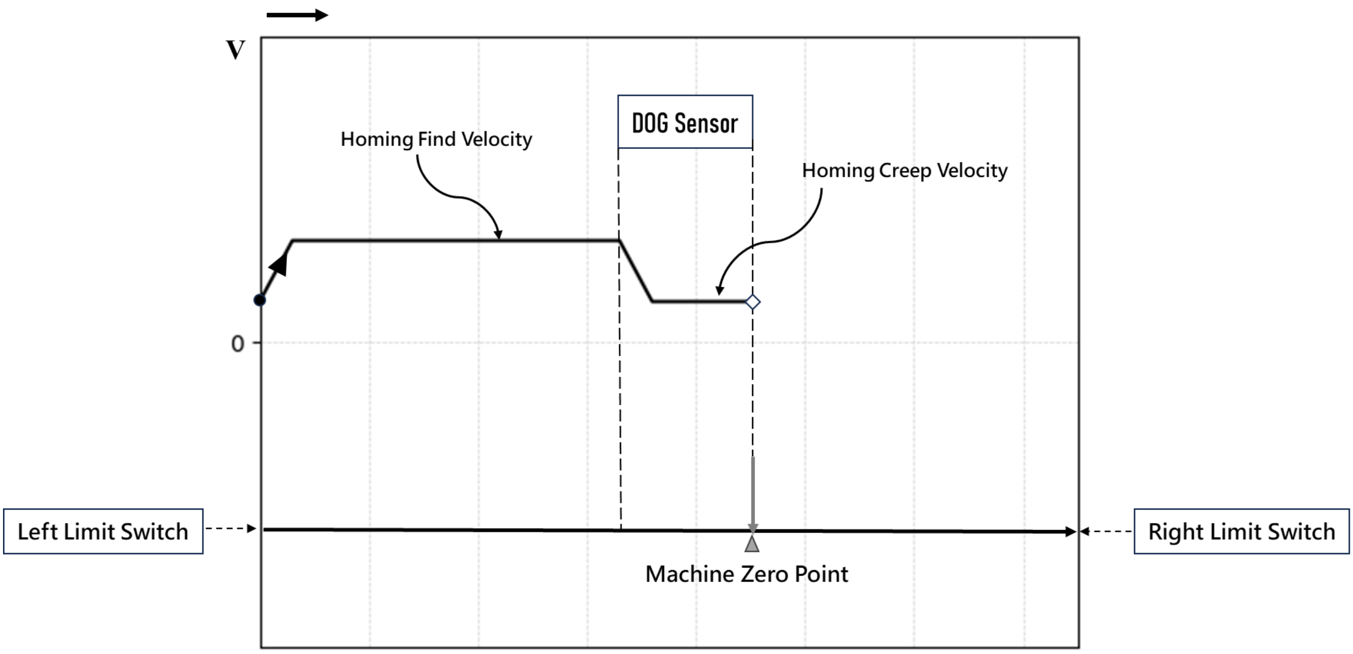
Motion control flow block end signal	M12000 + block number	0: Standby 1: Flow block running done * Set at “OFF” when running such flow block next time.	Read Only
Motion control flow block running signal	M16160 + block number	0: Flow block is not running 1: Flow block is running	Read Only

10

HOME Return

When using Relative Encoder as the displacement detector, normally the user needs to execute the return action for use as the reference of creating the positioning coordinate and such action is called mechanical HOME return (searching for mechanical zero point).
Indicated below is the mechanical HOME reset mode for NC Servo:

10-1 Mode 100: Forward-Falling Trigger



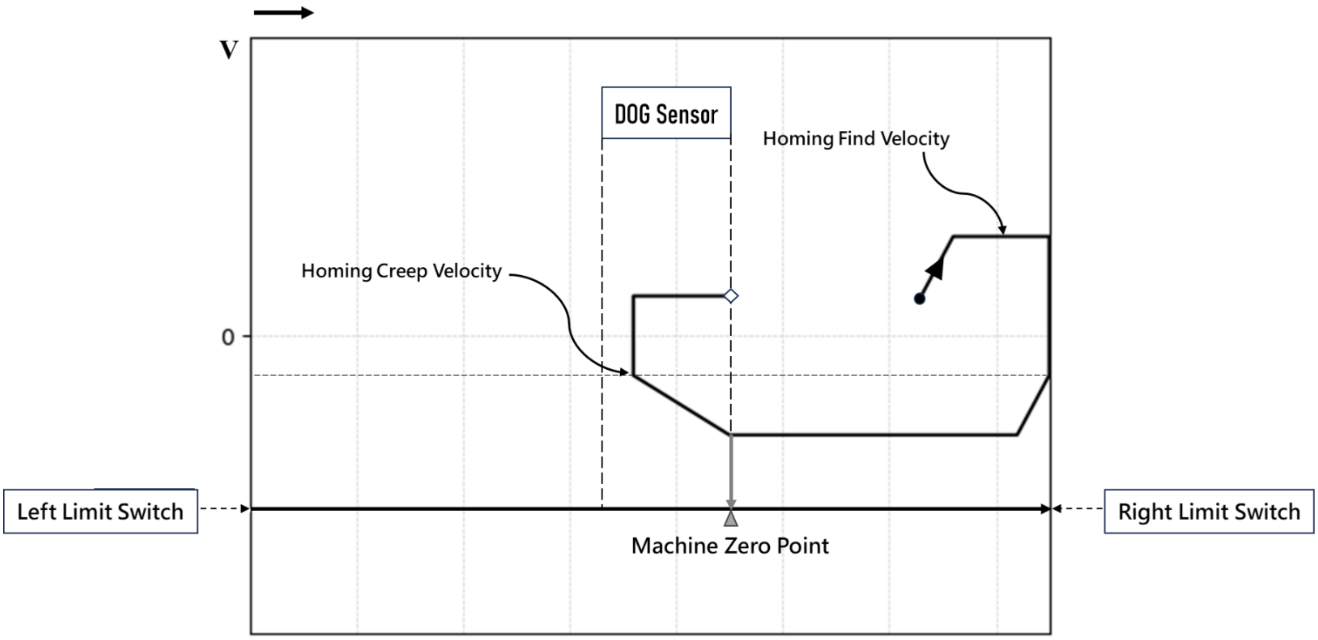
Action Description

The zero starting point is located to the left of the DOG sensor.

a. Move to the right limit direction at the Homing Find Velocity.

b. When encountering the Zero sensing signal, the speed decreases to the Homing Creep Velocity and continue to move forward.

c. The moment the signal is sensed away from Zero, this point is the Machine Zero Position.



Action Description

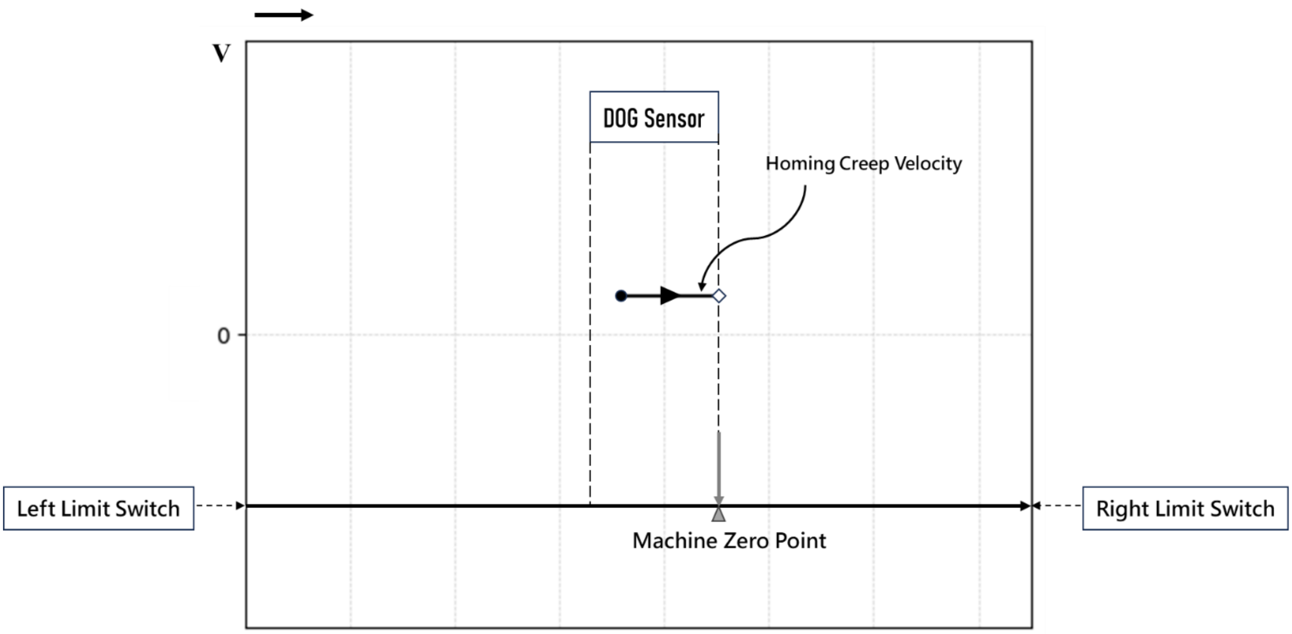
The zero starting point is located to the right of the DOG sensor.

a. Move to the right limit direction at the Homing Find Velocity.

b. When encountering the right limit, move in the opposite direction towards the left limit.

c. When encountering the Zero sensing signal, the speed decreases to the Homing Creep Velocity and then move forward reversely.

d. The moment the signal is sensed away from Zero, this point is the Machine Zero Position.



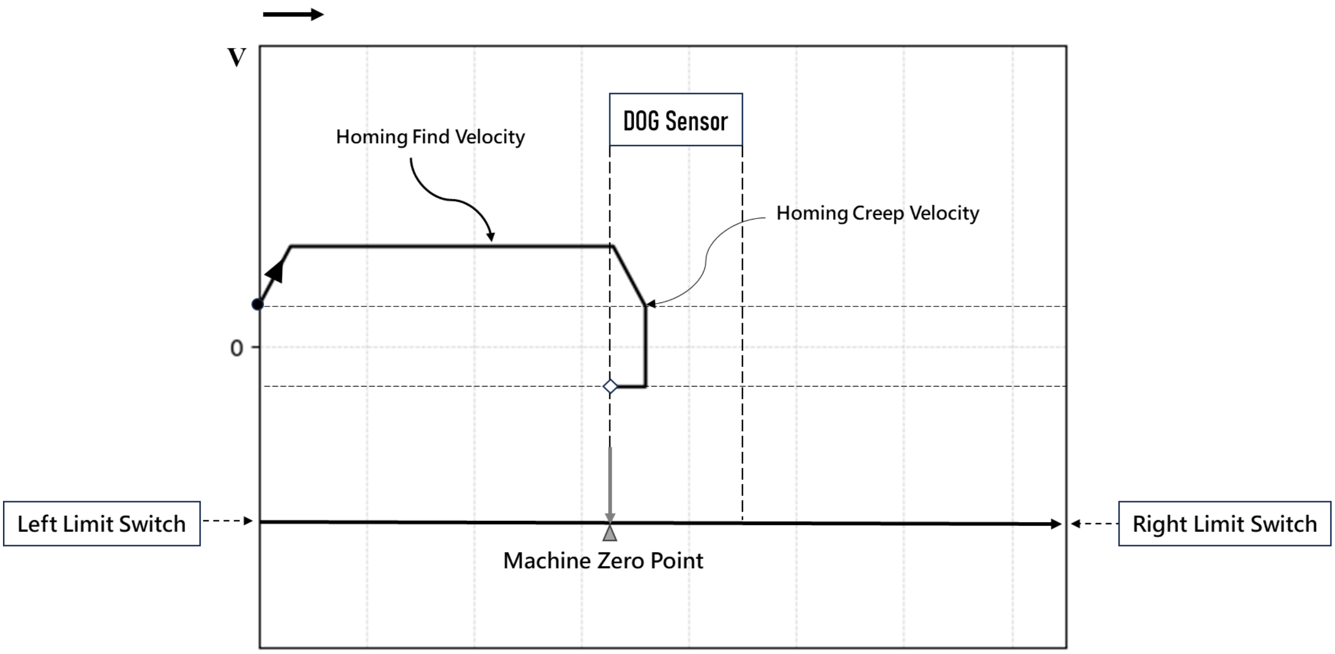
Action Description

The zero starting point is within the DOG sensor.

a. Move to the right limit direction at the Homing Creep Velocity.

b. The moment the signal is sensed away from Zero, this point is the Machine Zero Position.

10-2 Mode 101: Backward-Falling Trigger



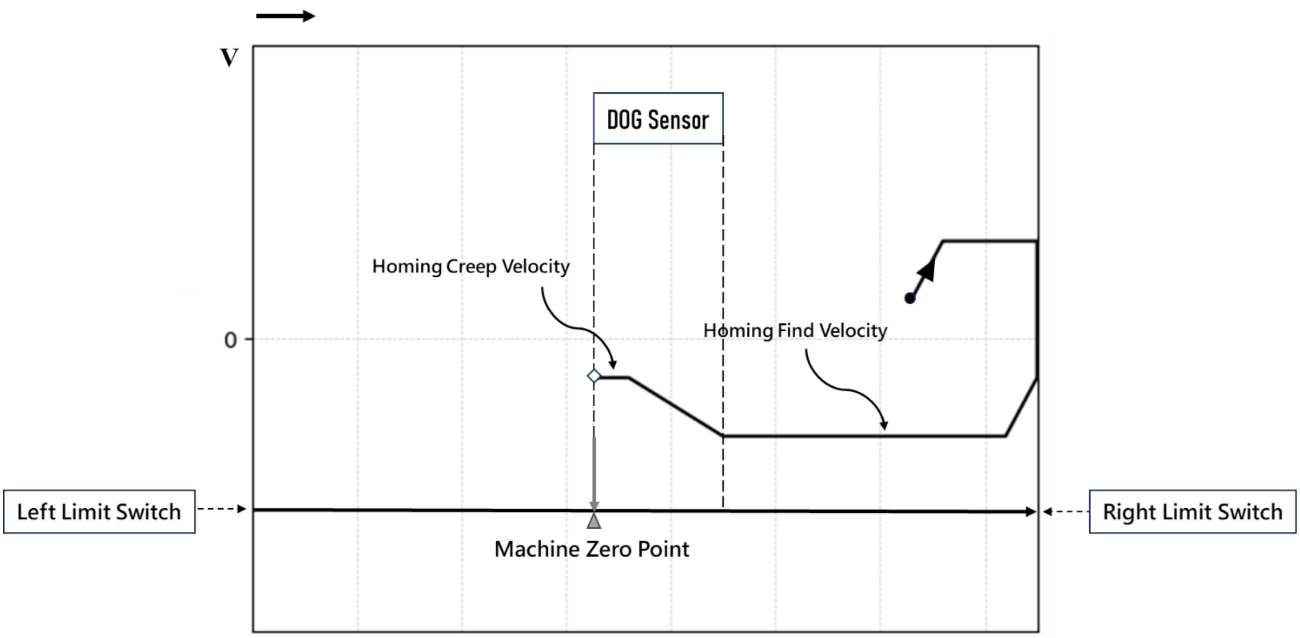
Action Description

The zero starting point is located to the left of the DOG sensor.

a. Move to the right limit direction at the Homing Find Velocity.

b. When encountering the Zero sensing signal, the speed decreases to the Homing Creep Velocity and then move forward reversely.

c. The moment the signal is sensed away from Zero, this point is the Machine Zero Position.



Action Description

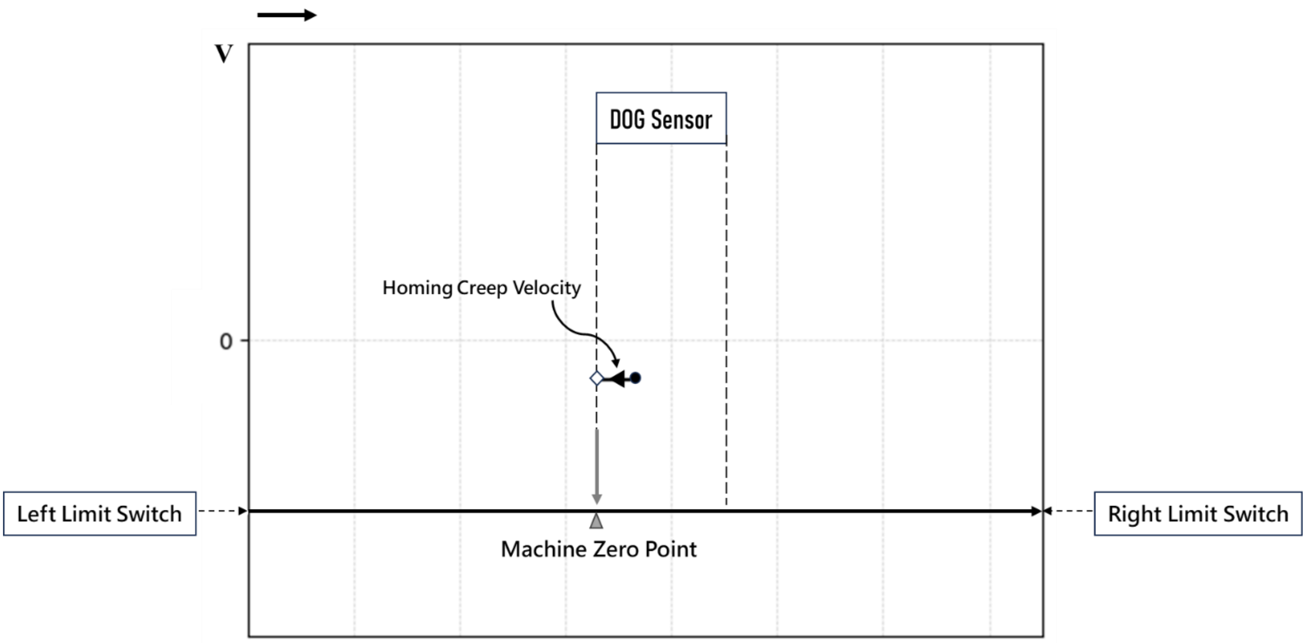
The zero starting point is located to the right of the DOG sensor.

a. Move to the right limit direction at the Homing Find Velocity.

b. When encountering the right limit, move in the opposite direction towards the left limit.

c. When encountering the Zero sensing signal, the speed decreases to the Homing Creep Velocity and continue to move forward.

d. The moment the signal is sensed away from Zero, this point is the Machine Zero Position.



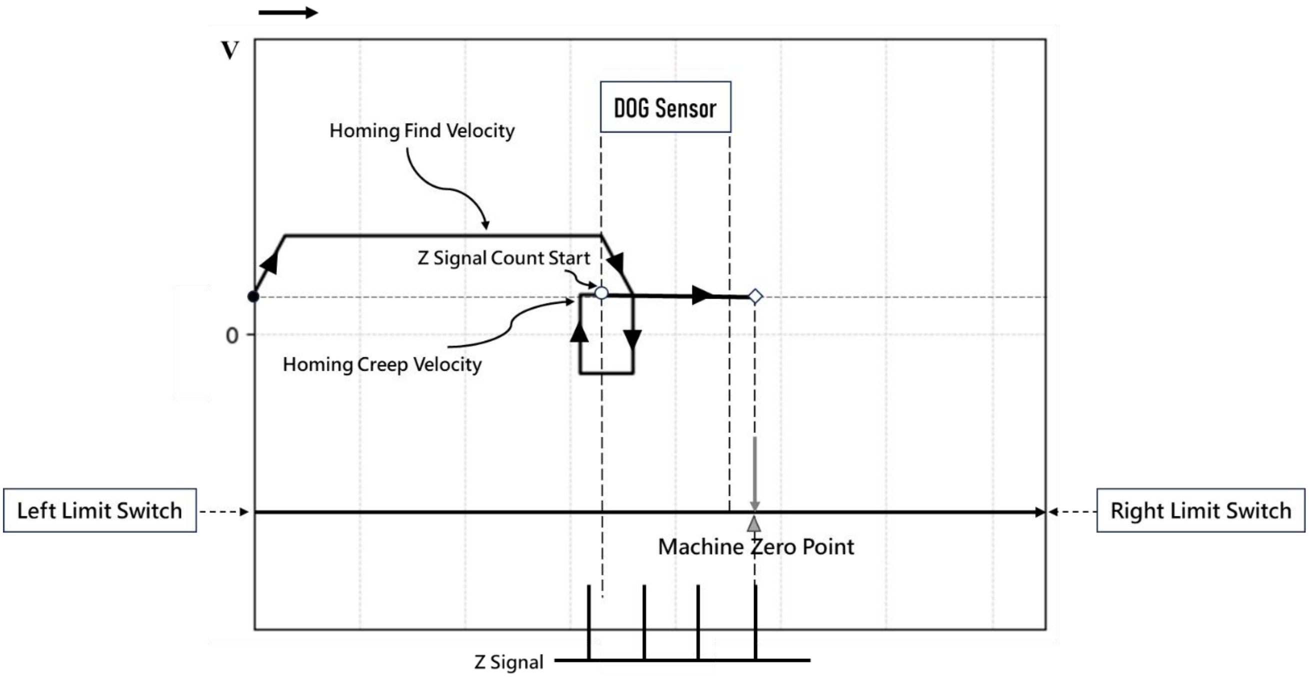
Action Description

The zero starting point is within the DOG sensor.

a. Move to the left limit direction at the Homing Creep Velocity.

b. The moment the signal is sensed away from Zero, this point is the Machine Zero Position.

10-3 Mode 102: Z Signal-Forward-Rising Trigger



Action Description

The zero starting point is located to the left of the DOG sensor. Homing Z Count = 3.

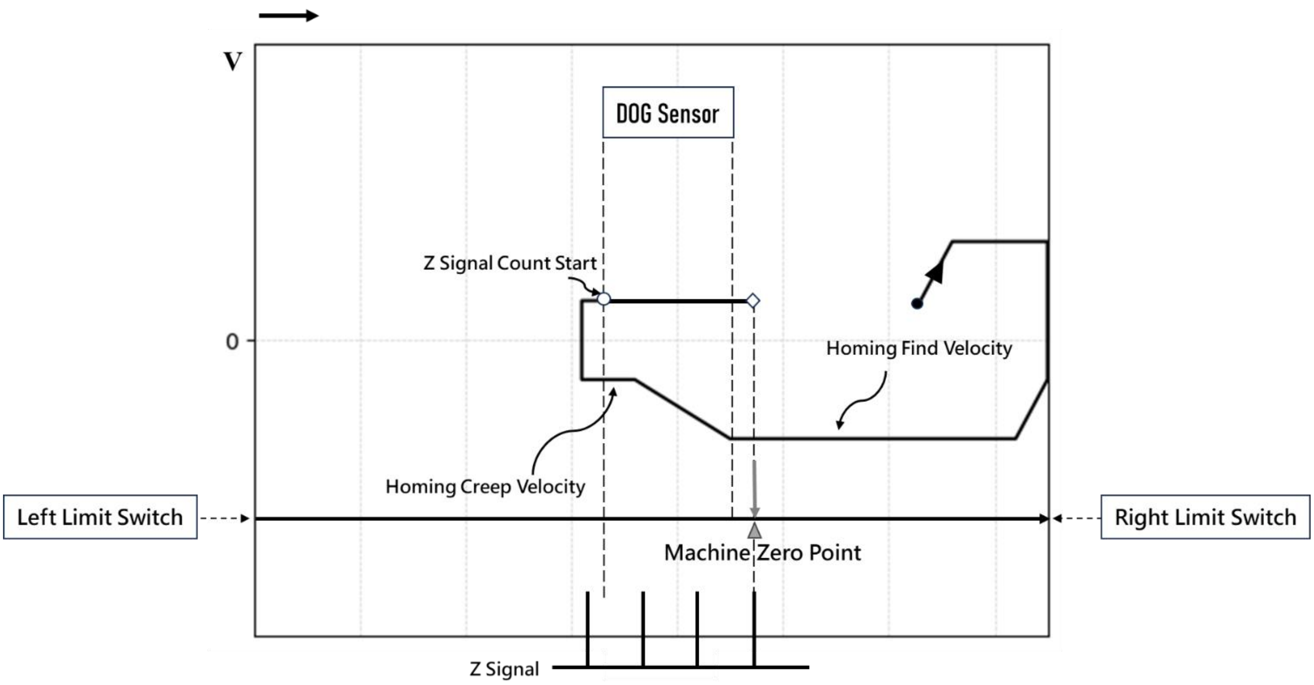
a. Move to the right limit direction at the Homing Find Velocity.

b. When encountering the Zero sensing signal, the speed decreases to the Homing Creep Velocity and then move forward reversely.

c. When departing from Zero sensing signal, reverse search for the Zero sensing signal at the Homing Creep Velocity.

d. When the signal is sensed away from Zero, start counting the Z-phase signal

e. When the count value of the Z-phase signal is equal to the set value of Homing Z Count, this point is the Machine Zero Position.



Action Description

The zero starting point is located to the right of the DOG sensor. Homing Z Count = 3.

a. Move to the right limit direction at the Homing Find Velocity.

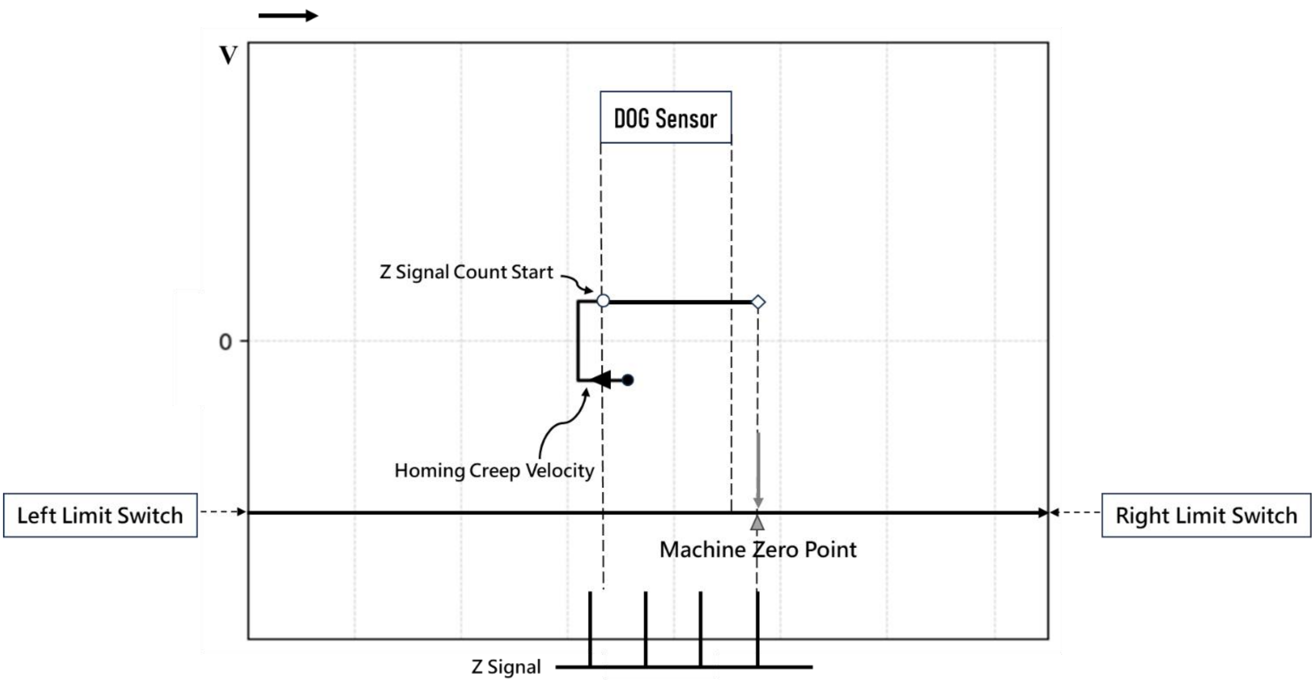
b. When encountering the right limit, move in the opposite direction towards the left limit.

c. When encountering the Zero sensing signal, the speed decreases to the Homing Creep Velocity and continue to move forward.

d. When departing from Zero sensing signal, reverse search for the Zero sensing signal at the Homing Creep Velocity.

e. When the signal is sensed away from Zero, start counting the Z-phase signal

f. When the count value of the Z-phase signal is equal to the set value of Homing Z Count, this point is the Machine Zero Position.



Action Description

The zero starting point is within the DOG sensor. Homing Z Count = 3.

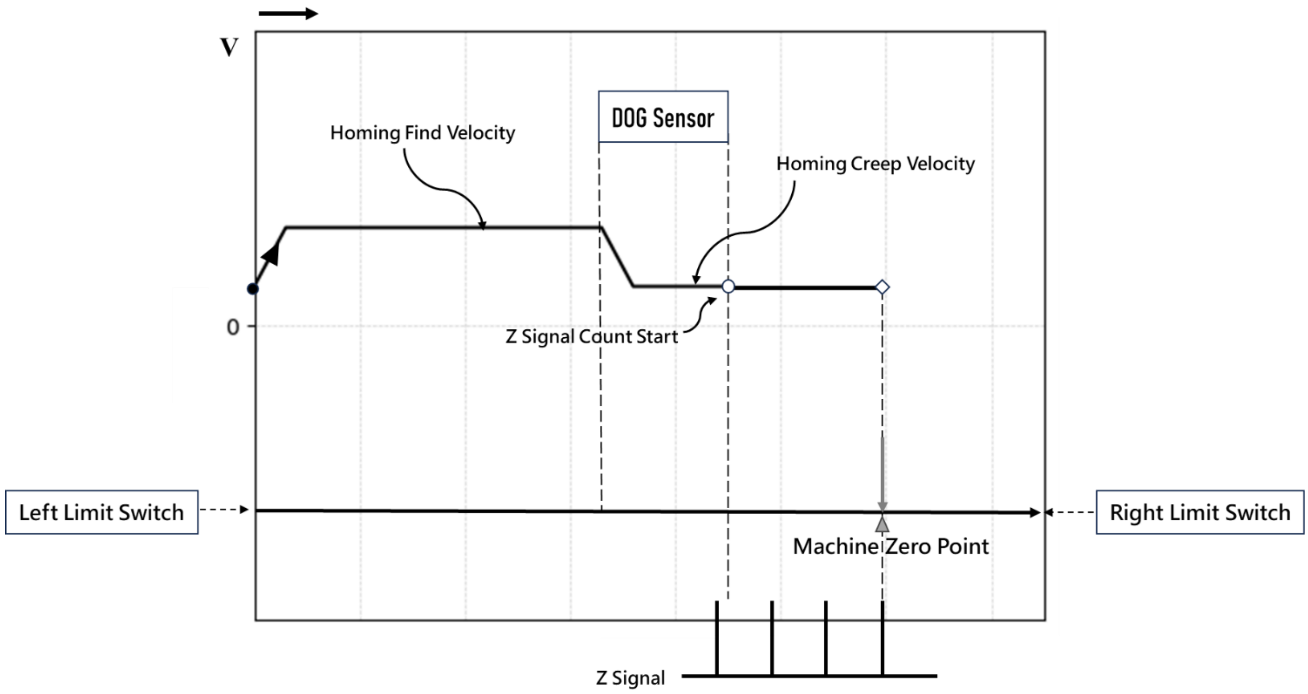
a. Move to the left limit direction at the Homing Creep Velocity.

b. When departing from Zero sensing signal, reverse search for the Zero sensing signal at the Homing Creep Velocity.

d. When the signal is sensed away from Zero, start counting the Z-phase signal

e. When the count value of the Z-phase signal is equal to the set value of Homing Z Count, this point is the Machine Zero Position.

10-4 Mode 103: Z Signal-Forward-Falling Trigger



Action Description

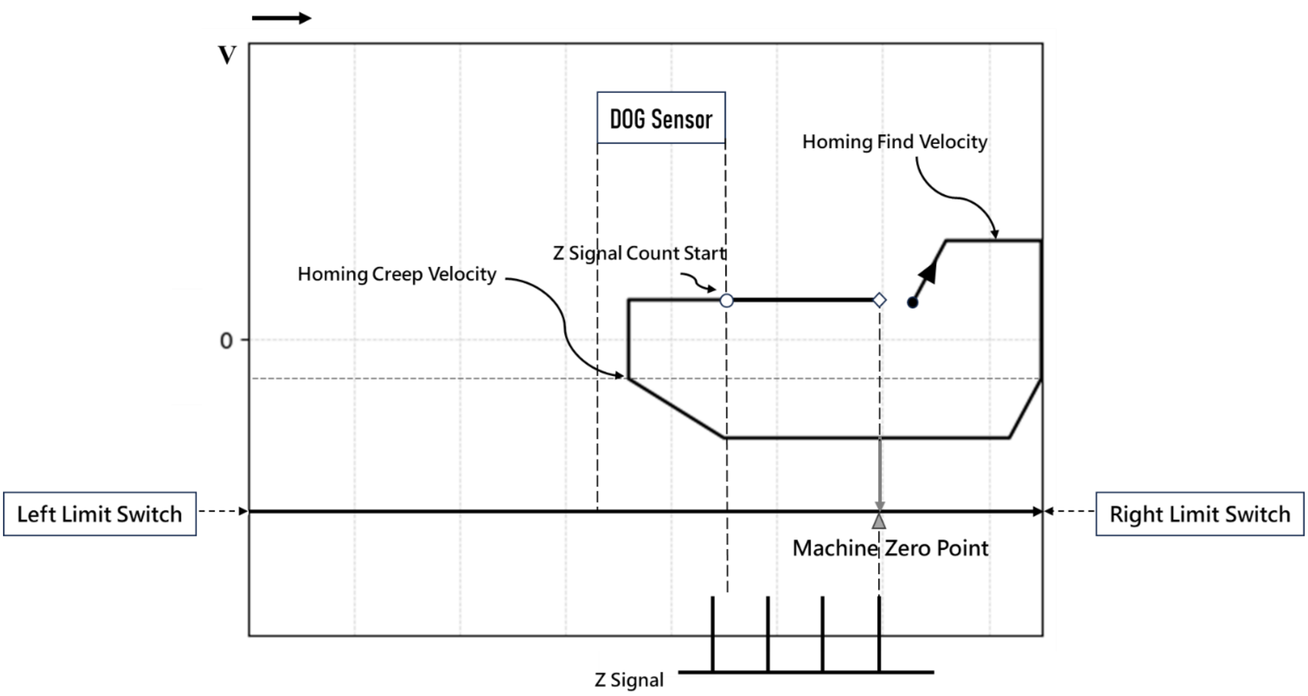
The zero starting point is located to the left of the DOG sensor. Homing Z Count = 3.

a. Move to the right limit direction at the Homing Find Velocity.

b. When encountering the Zero sensing signal, the speed decreases to the Homing Creep Velocity and continue to move forward.

c. When the signal is sensed away from Zero, start counting the Z-phase signal

d. When the count value of the Z-phase signal is equal to the set value of Homing Z Count, this point is the Machine Zero Position.



Action Description

The zero starting point is located to the right of the DOG sensor. Homing Z Count = 3.

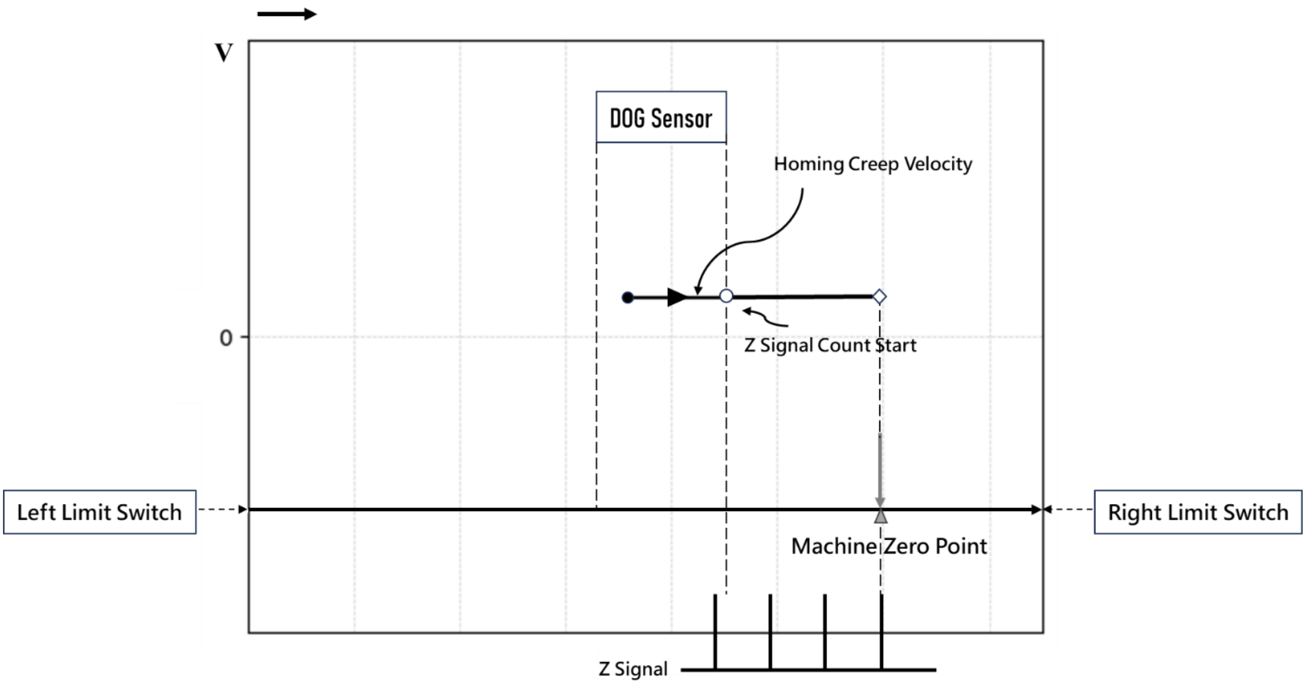
a. Move to the right limit direction at the Homing Find Velocity.

b. When encountering the right limit, move in the opposite direction towards the left limit.

c. When encountering the Zero sensing signal, the speed decreases to the Homing Creep Velocity and then move forward reversely.

d. When the signal is sensed away from Zero, start counting the Z-phase signal

e. When the count value of the Z-phase signal is equal to the set value of Homing Z Count, this point is the Machine Zero Position.



Action Description

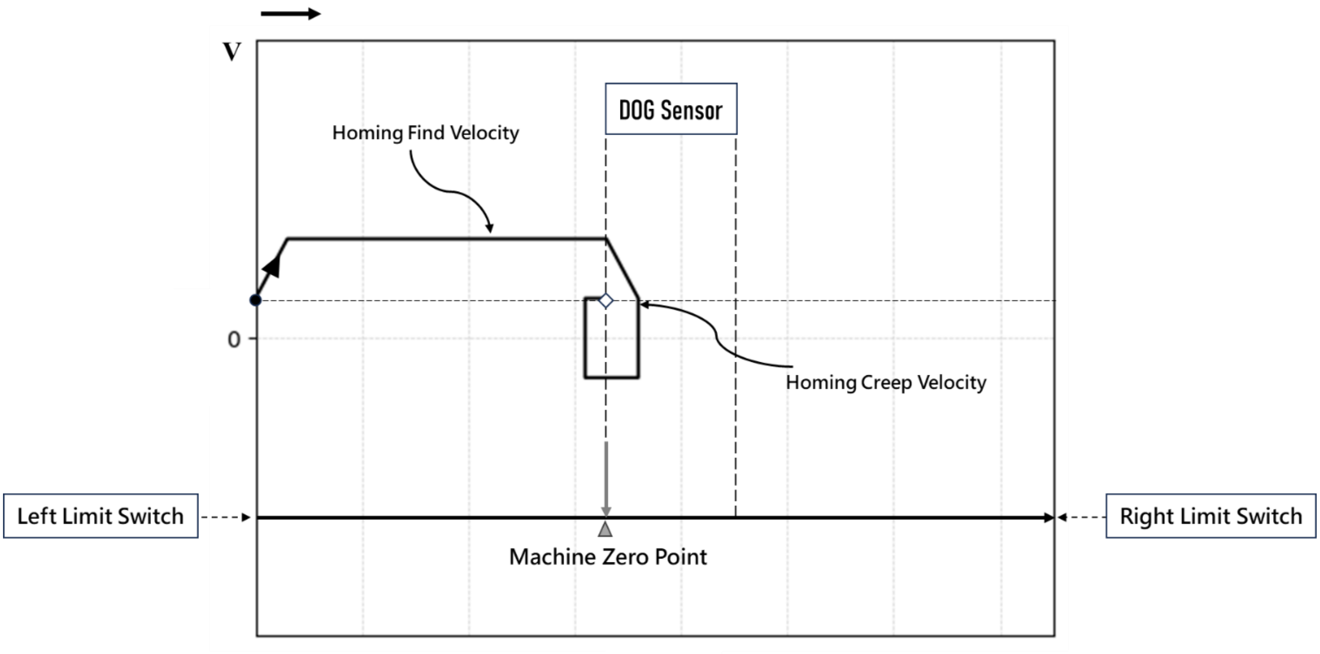
The zero starting point is within the DOG sensor. Homing Z Count = 3.

a. Move to the right limit direction at the Homing Creep Velocity.

b. When the signal is sensed away from Zero, start counting the Z-phase signal

c. When the count value of the Z-phase signal is equal to the set value of Homing Z Count, this point is the Machine Zero Position.

10-5 Mode 104: Forward-Rising Trigger



Action Description

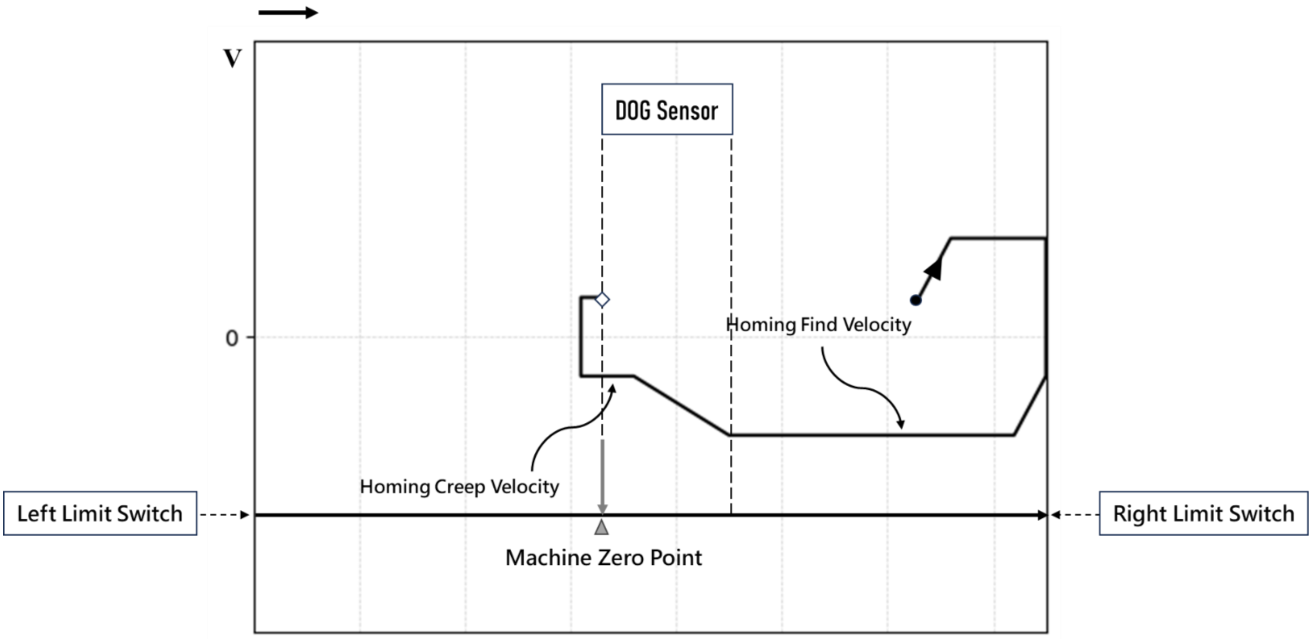
The zero starting point is located to the left of the DOG sensor.

a. Move to the right limit direction at the Homing Find Velocity.

b. When encountering the Zero sensing signal, the speed decreases to the Homing Creep Velocity and then move forward reversely.

c. When departing from Zero sensing signal, reverse search for the Zero sensing signal at the Homing Creep Velocity.

d. The moment the signal is sensed at Zero, this point is the Machine Zero Position.



Action Description

The zero starting point is located to the right of the DOG sensor.

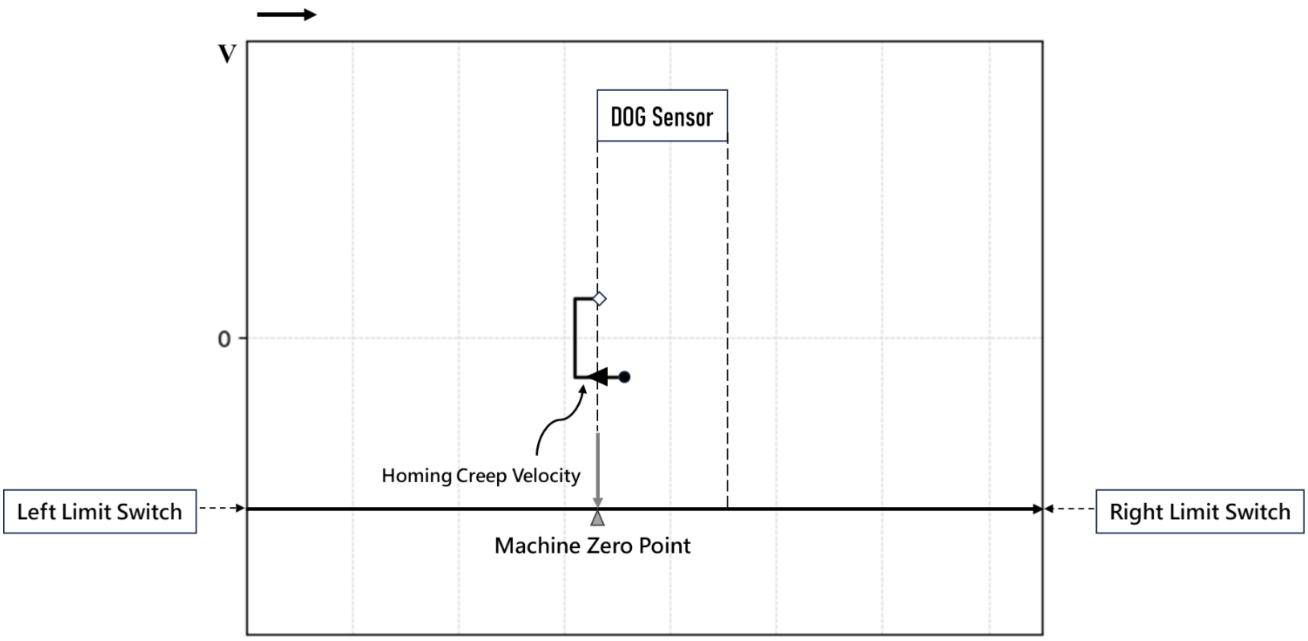
a. Move to the right limit direction at the Homing Find Velocity.

b. When encountering the right limit, move in the opposite direction towards the left limit.

c. When encountering the Zero sensing signal, the speed decreases to the Homing Creep Velocity and continue to move forward.

d. When departing from Zero sensing signal, reverse search for the Zero sensing signal at the Homing Creep Velocity.

e. The moment the signal is sensed at Zero, this point is the Machine Zero Position.



Action Description

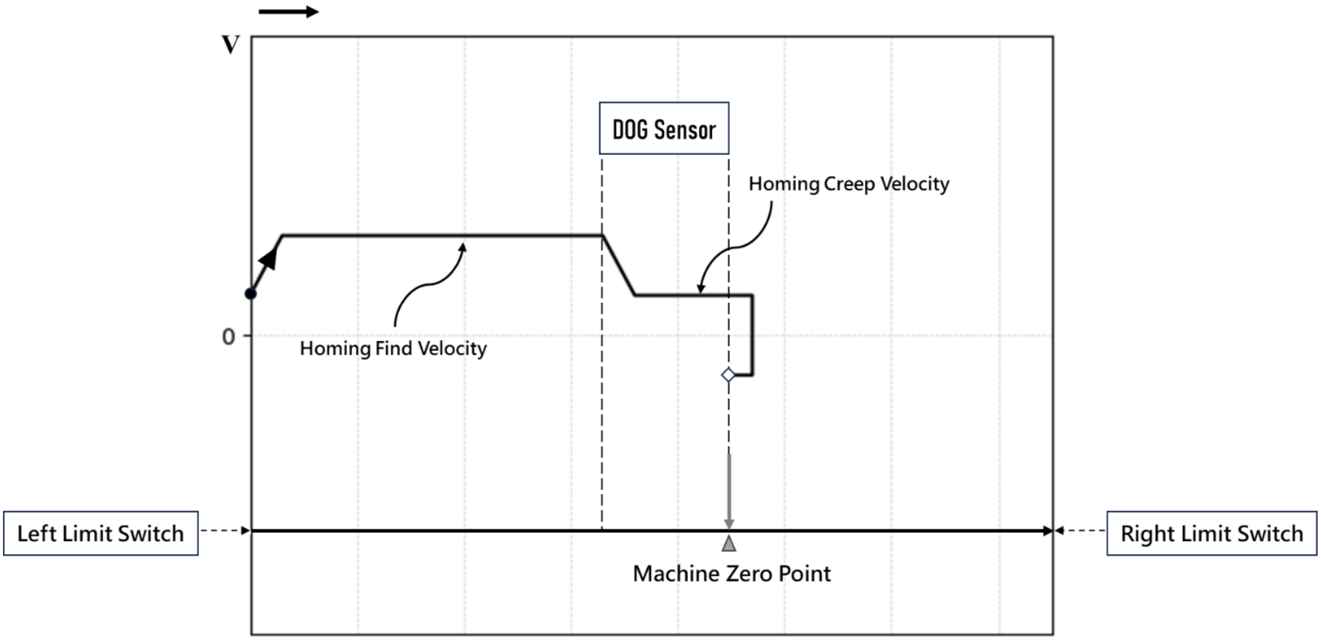
The zero starting point is within the DOG sensor.

a. Move to the left limit direction at the Homing Creep Velocity.

b. When departing from Zero sensing signal, reverse search for the Zero sensing signal at the Homing Creep Velocity.

c. The moment the signal is sensed at Zero, this point is the Machine Zero Position.

10-6 Mode 105: Backward-Rising Trigger



Action Description

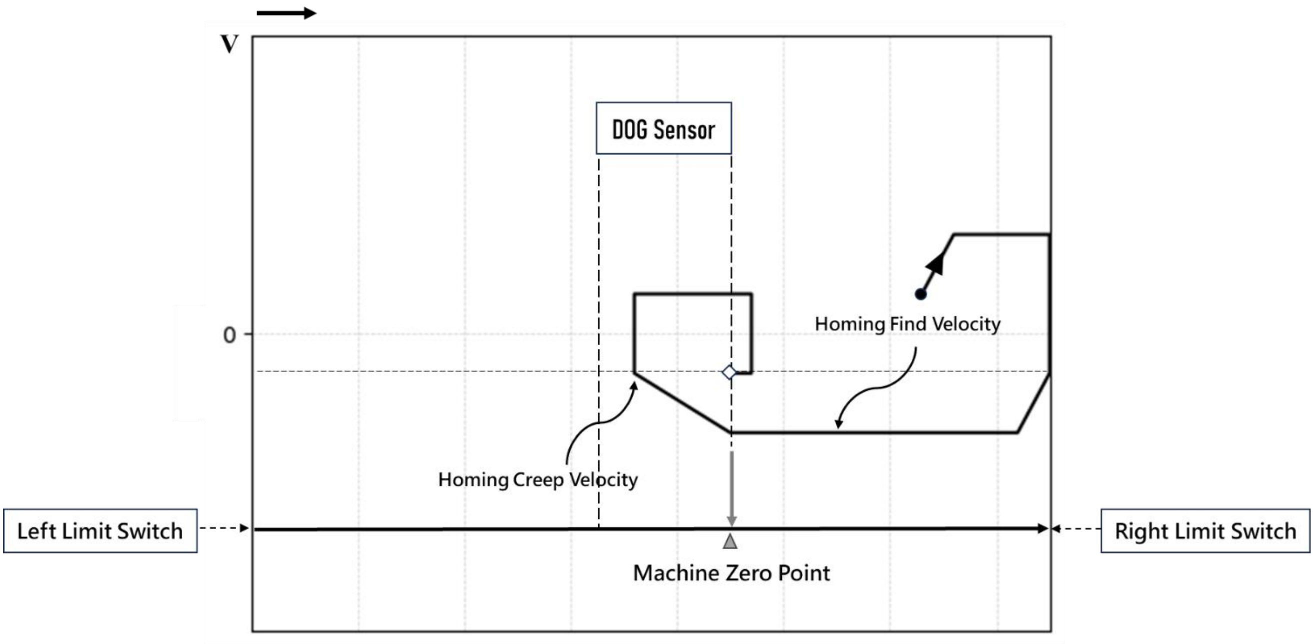
The zero starting point is located to the left of the DOG sensor.

a. Move to the right limit direction at the Homing Find Velocity.

b. When encountering the Zero sensing signal, the speed decreases to the Homing Creep Velocity and continue to move forward.

c. When departing from Zero sensing signal, reverse search for the Zero sensing signal at the Homing Creep Velocity.

d. The moment the signal is sensed at Zero, this point is the Machine Zero Position.



Action Description

The zero starting point is located to the right of the DOG sensor.

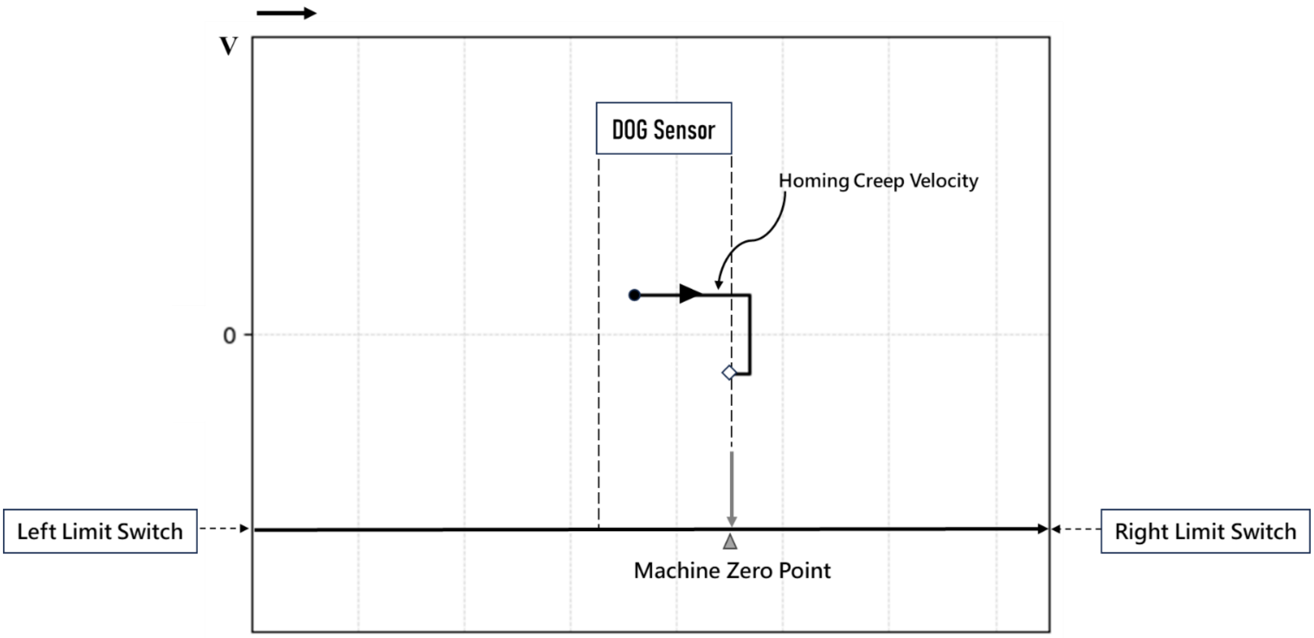
a. Move to the right limit direction at the Homing Find Velocity.

b. When encountering the right limit, move in the opposite direction towards the left limit.

c. When encountering the Zero sensing signal, the speed decreases to the Homing Creep Velocity and then move forward reversely.

d. When departing from Zero sensing signal, reverse search for the Zero sensing signal at the Homing Creep Velocity.

e. The moment the signal is sensed at Zero, this point is the Machine Zero Position.



Action Description

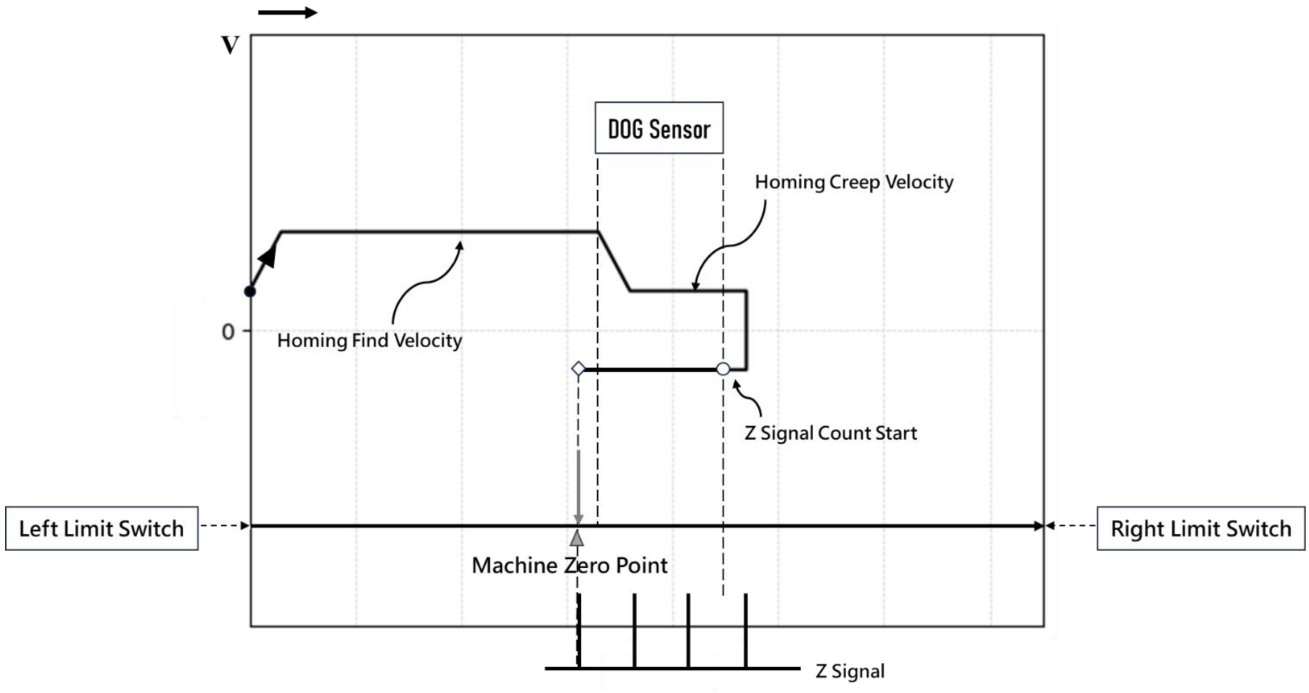
The zero starting point is within the DOG sensor.

a. Move to the right limit direction at the Homing Creep Velocity.

b. When departing from Zero sensing signal, reverse search for the Zero sensing signal at the Homing Creep Velocity.

c. The moment the signal is sensed at Zero, this point is the Machine Zero Position.

10-7 Mode 106: Z Signal-Backward-Rising Trigger



Action Description

The zero starting point is located to the left of the DOG sensor. Homing Z Count = 3.

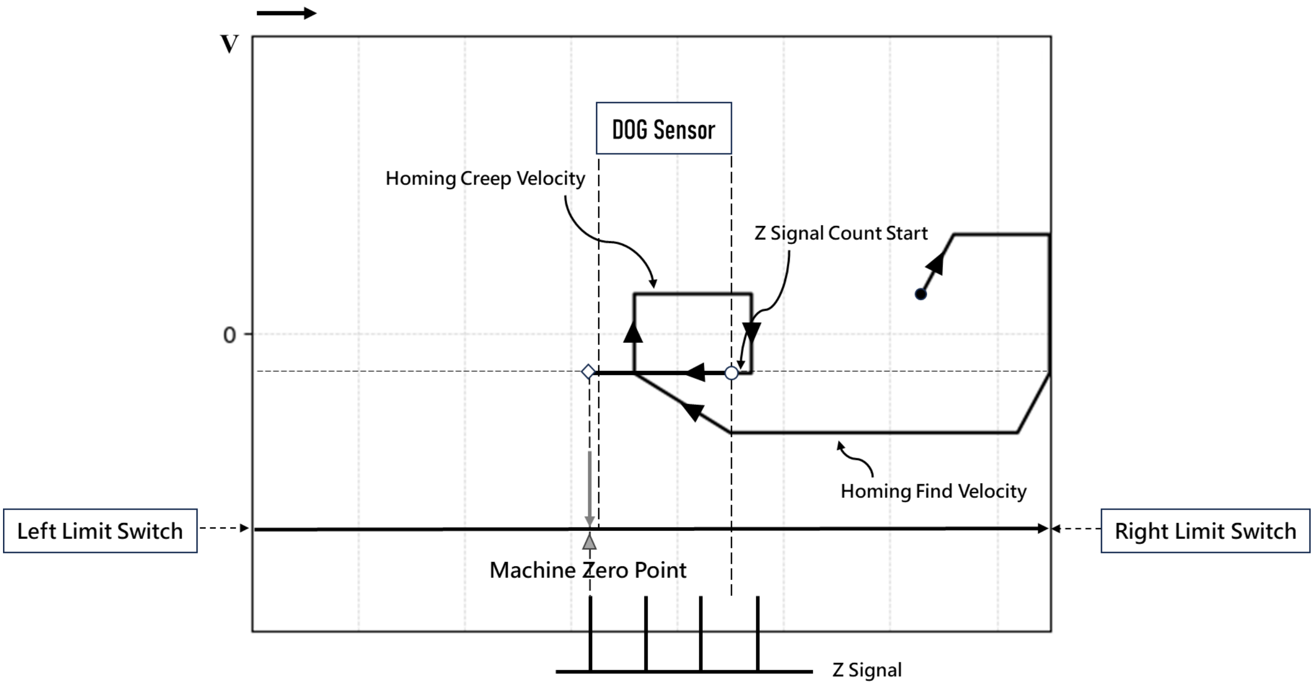
a. Move to the right limit direction at the Homing Find Velocity.

b. When encountering the Zero sensing signal, the speed decreases to the Homing Creep Velocity and continue to move forward.

c. When departing from Zero sensing signal, reverse search for the Zero sensing signal at the Homing Creep Velocity.

d. When the signal is sensed away from Zero, start counting the Z-phase signal

e. When the count value of the Z-phase signal is equal to the set value of Homing Z Count, this point is the Machine Zero Position.



Action Description

The zero starting point is located to the right of the DOG sensor. Homing Z Count = 3.

a. Move to the right limit direction at the Homing Find Velocity.

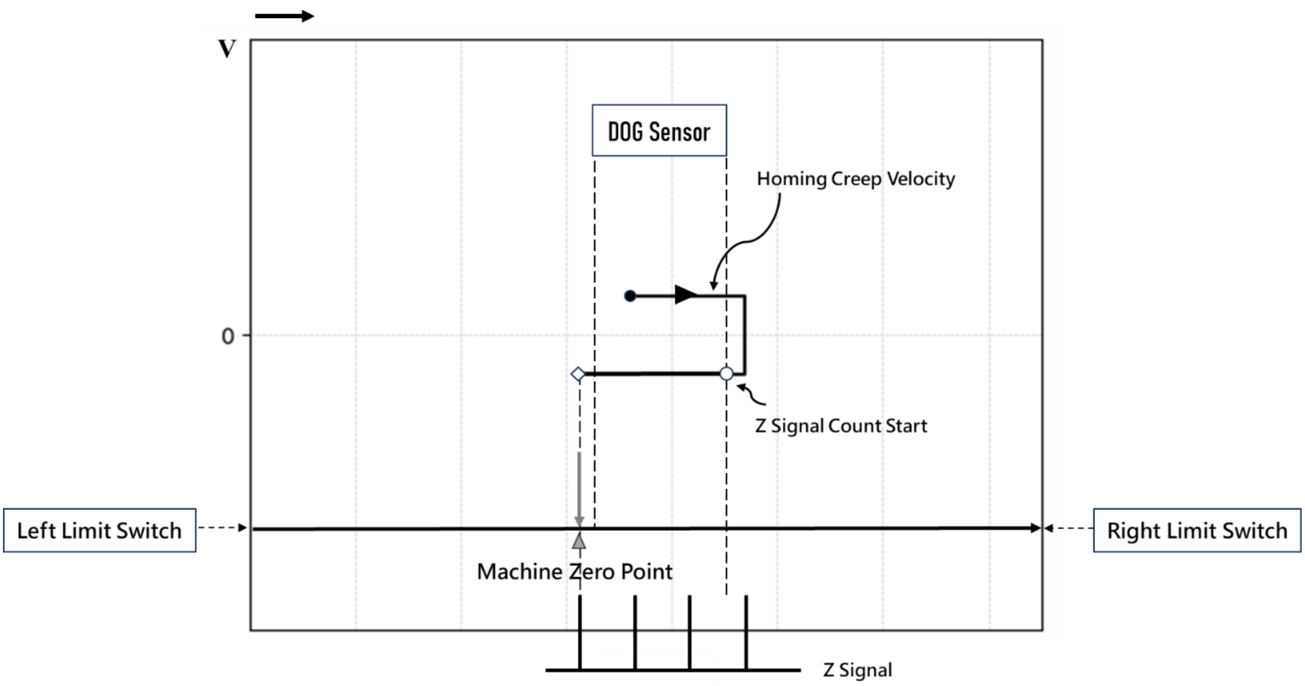
b. When encountering the right limit, move in the opposite direction towards the left limit.

c. When encountering the Zero sensing signal, the speed decreases to the Homing Creep Velocity and then move forward reversely.

d. When departing from Zero sensing signal, reverse search for the Zero sensing signal at the Homing Creep Velocity.

e. When the signal is sensed away from Zero, start counting the Z-phase signal

f. When the count value of the Z-phase signal is equal to the set value of Homing Z Count, this point is the Machine Zero Position.



Action Description

The zero starting point is within the DOG sensor. Homing Z Count = 3.

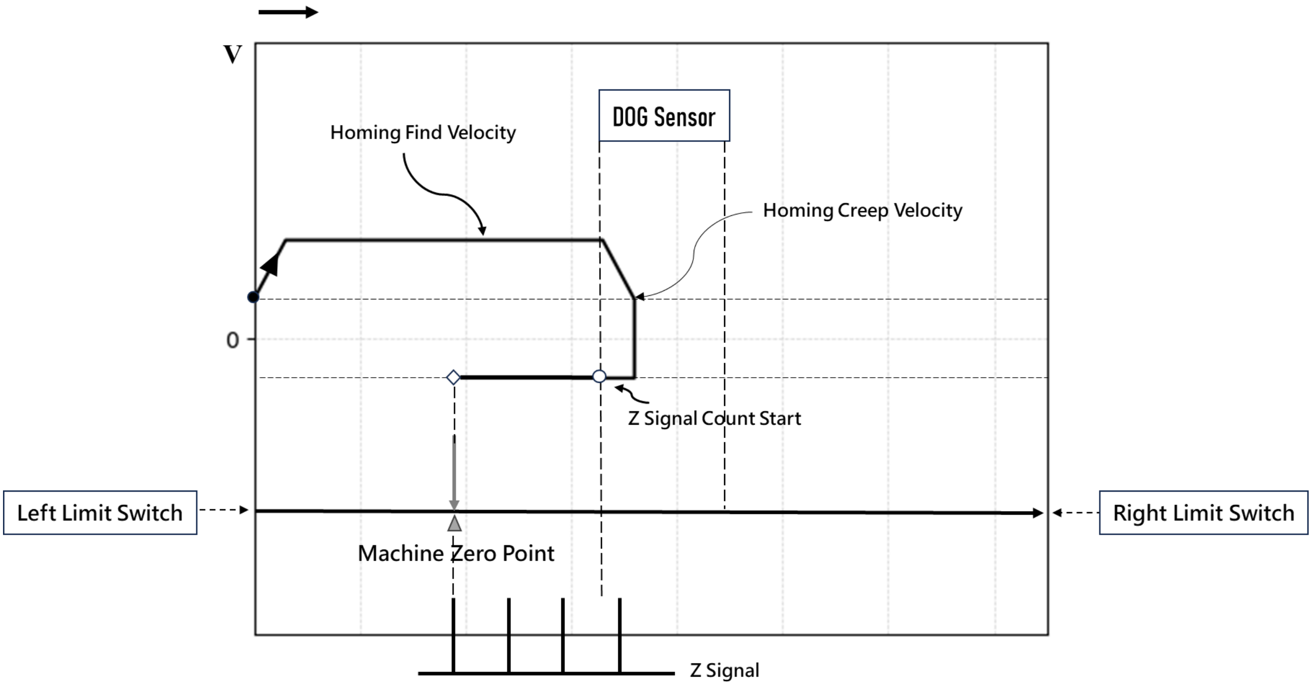
a. Move to the right limit direction at the Homing Creep Velocity.

b. When departing from Zero sensing signal, reverse search for the Zero sensing signal at the Homing Creep Velocity.

c. When the signal is sensed away from Zero, start counting the Z-phase signal

d. When the count value of the Z-phase signal is equal to the set value of Homing Z Count, this point is the Machine Zero Position.

10-8 Mode 107: Z Signal-Backward-Falling Trigger



Action Description

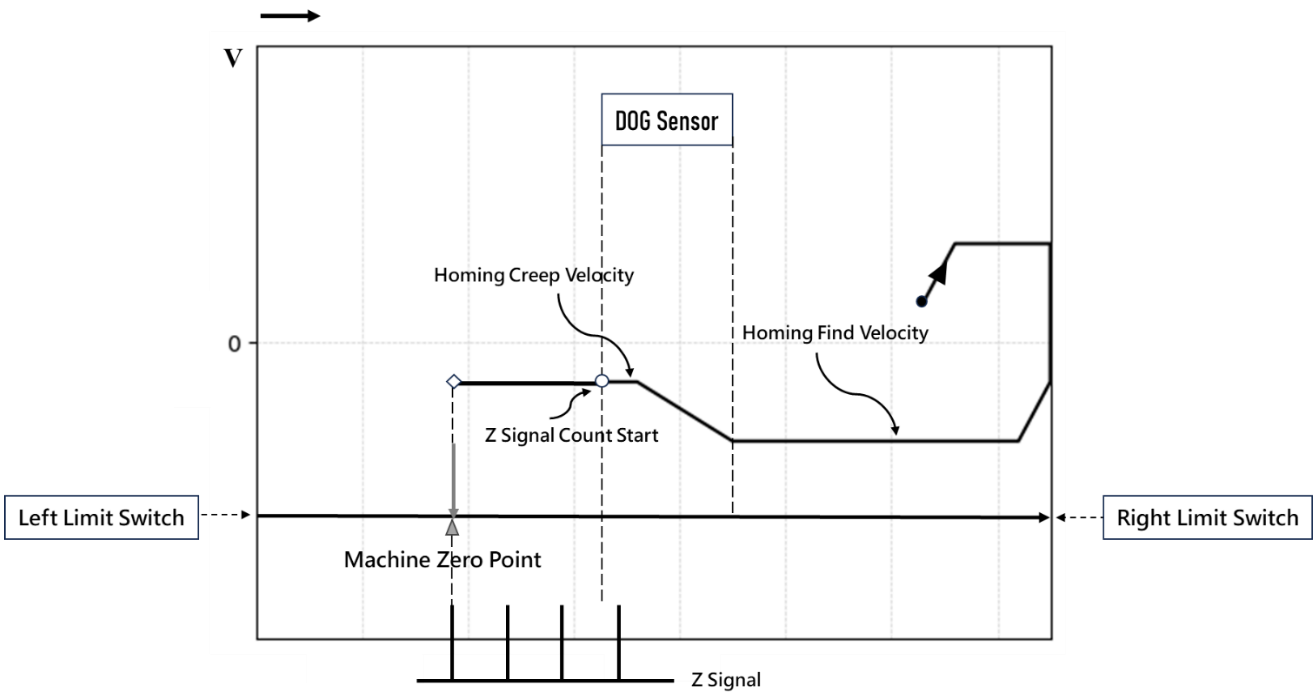
The zero starting point is located to the left of the DOG sensor. Homing Z Count = 3.

a. Move to the right limit direction at the Homing Find Velocity.

b. When encountering the Zero sensing signal, the speed decreases to the Homing Creep Velocity and then move forward reversely.

c. When the signal is sensed away from Zero, start counting the Z-phase signal

d. When the count value of the Z-phase signal is equal to the set value of Homing Z Count, this point is the Machine Zero Position.



Action Description

The zero starting point is located to the right of the DOG sensor. Homing Z Count = 3.

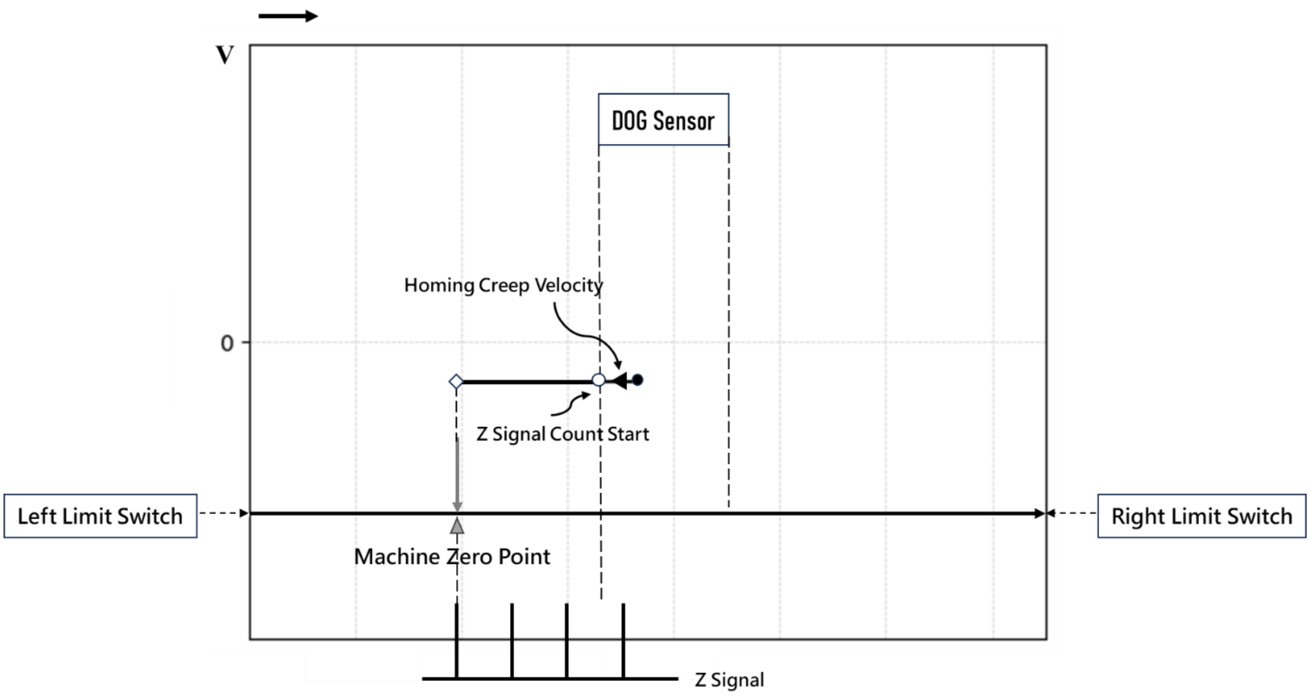
a. Move to the right limit direction at the Homing Find Velocity.

b. When encountering the right limit, move in the opposite direction towards the left limit.

c. When encountering the Zero sensing signal, the speed decreases to the Homing Creep Velocity and continue to move forward.

d. When the signal is sensed away from Zero, start counting the Z-phase signal

e. When the count value of the Z-phase signal is equal to the set value of Homing Z Count, this point is the Machine Zero Position.



Action Description

The zero starting point is within the DOG sensor. Homing Z Count = 3.

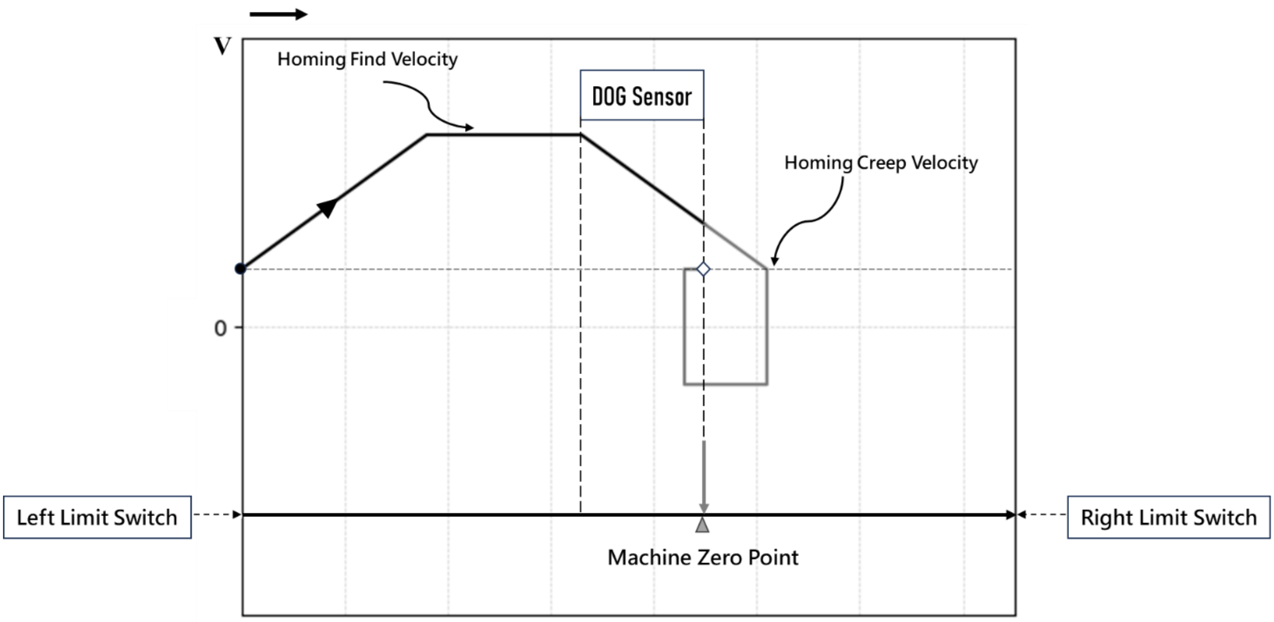
a. Move to the left limit direction at the Homing Creep Velocity.

b. When the signal is sensed away from Zero, start counting the Z-phase signal

c. When the count value of the Z-phase signal is equal to the set value of Homing Z Count, this point is the Machine Zero Position.

10-9 The Situation of Insufficient Deceleration.

DOG Sensor detects a distance that is too short or insufficient deceleration, which may result in the speed not decreasing to the Homing Creep Velocity before leaving the Zero sensing signal. This means that the Homing may not be completed at this point.



Action Description

As an example, using the Forward-Falling Trigger mode.

The zero starting point is located to the left of the DOG sensor.

a. Move to the right limit direction at the Homing Find Velocity.

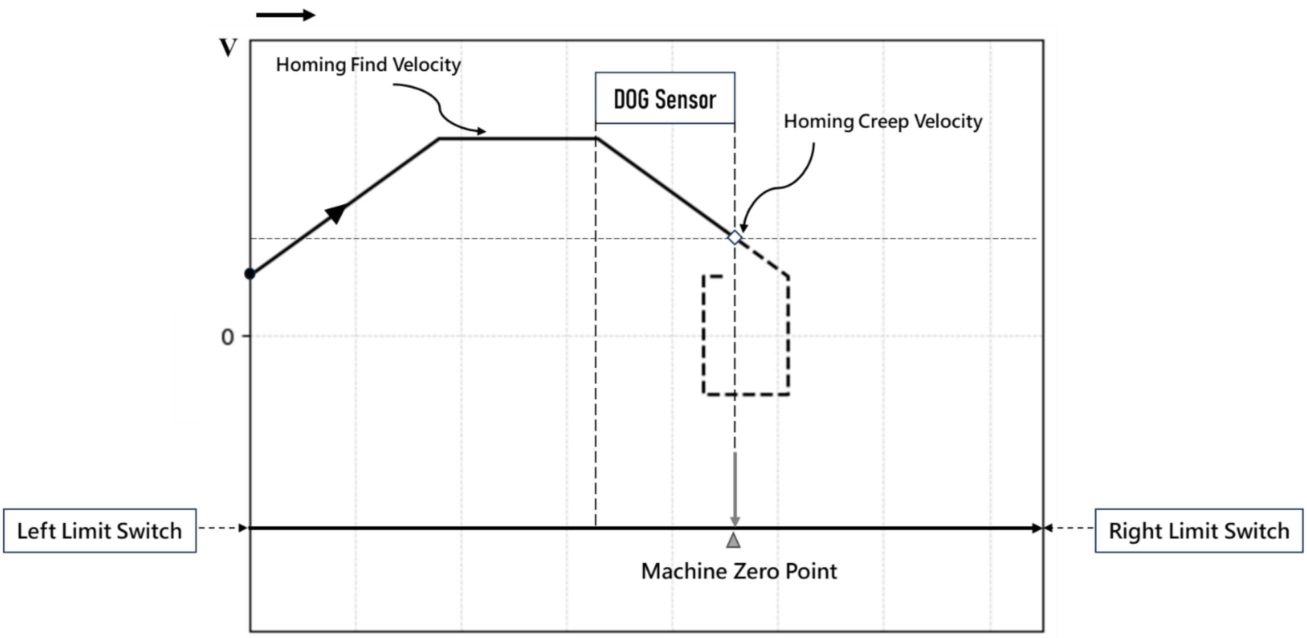
b. When encountering the Zero sensing signal, decelerate at the Homing Deceleration.

c. When leaving the Zero sensing signal, the speed has not decreased to the Homing Creep Velocity.

d. The gray line segment indicates the compensation mechanism, continuing to reverse after reducing to the Homing Creep Velocity.

e. When encountering the Zero sensing signal, moving forward reversely.

f. The moment the signal is sensed away from Zero, this point is the Machine Zero Position.



Action Description

If user wish to skip steps d~f in the previous diagram, activate special register M10629 (High speed homing mode ON)

The zero starting point is located to the left of the DOG sensor.

a. Move to the right limit direction at the Homing Find Velocity.

b. When encountering the Zero sensing signal, decelerate at the Homing Deceleration.

c. The moment the signal is sensed away from Zero, stop at the current speed to complete the Homing, this point is the Machine Zero Position.

d. The dashed line represents the path of the gray line segment in the previous diagram. At this point, the Homing has been completed, so this path is not executed.

10-10 Description of HOME Return Related Parameters

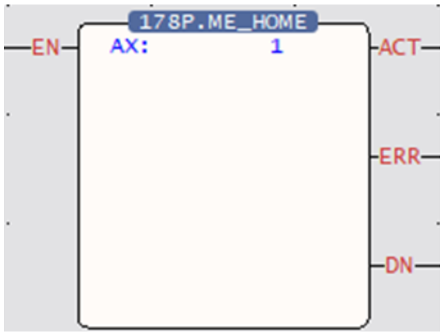
- **HOME return**
  - **Definition: Executing the HOME return**
  - **Fun178P. MFHome**

    EN = 1: Rising edge triggers HOME return

    ACT = 1: HOME return is running

    ERR = 1: HOME return error

    DN = HOME return is done



  - **Internal Parameters**

    AX: Axis No.
  - **Special Register**

    Axis 1: HOME return is running – M10621

    Axis 1: HOME return is done – M10622

		1
Homing	Homing Start Direction	Positive
	Homing Origin Offset	0 PLS
	Homing Find Velocity	10000 PLS/s
	Homing Creep Velocity	1000 PLS/s
	Homing Deceleration	1000 PLS/s^2
	Limit Switch(-)(DI)	60FD:00
	Limit Switch(+)(DI)	60FD:01
	Home Switch(DI)	60FD:02
	Homing Z Count	0
Jogging	Jogging Base Velocity	1 PLS/s
	Jogging Velocity	1 PLS/s
	Jogging Acceleration	1 PLS/s^2
	Jogging Deceleration	1 PLS/s^2
	Inching Distance	1 PLS

- **HOME return**
  - Source of return

    From PLC: PLC receives HOME/Forward Limit/Backward Limit signals

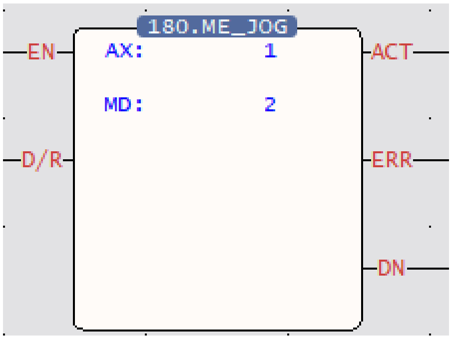
    From Servo Driver: Servo Driver receives HOME/Forward Limit/ Backward Limit signals
  - Homing Start Direction: Forward/Backward

- Homing Origin Offset: The offsetting quantity for compensating the HOME return and positioning
- Homing Find Velocity: Search the HOME speed
- Homing Creep Velocity: Reduce to creep speed after touching the HOME
- Homing Deceleration: The deceleration required for reducing the reset crawl speed after touching the HOME
- Limit Switch (+)
- Limit Switch (-)
- HOME Switch
- Homing Z Count
- Source of Homing Z Count

11

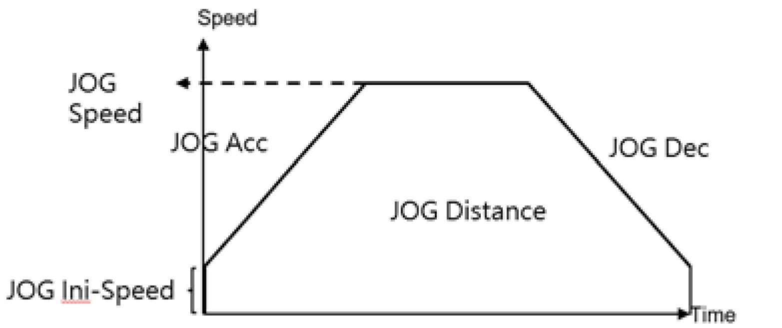
JOG Mode

This product provides Fun180 for the user to quickly complete the JOG function for the Servo. The relevant description of Fun180 MFJog will be described below, and users can also learn about this Function through chapters 6-8.

<table>
<tr><th>Fun180. MFJog</th><th>Parameter Description</th></tr>
<tr><td>
</td><td>

➢ **Ladder Symbol**
EN = 1: JOG is triggered
D/R = 1: CW / 0 = CCW
ACT = 1: JOG is running
ERR = 1: JOG error
DN = 1: JOG running is done
➢ **Internal Parameters**
AX: Axis No.
MD: Mode 0 – Mode 3
➢ **Special Register**
Axis 1: JOG is running M10625
Axis 1: JOG running is done M10626
</td></tr>
<tr><th>Motion Axis Setting</th><th>Corresponding Diagram of Motion Axis Setting</th></tr>
<tr><td>

Jogging	Jogging Base Velocity	10 PLS/s
	Jogging Velocity	1000 PLS/s
	Jogging Acceleration	50 PLS/s²
	Jogging Deceleration	50 PLS/s²
	Inching Distance	2000 PLS

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

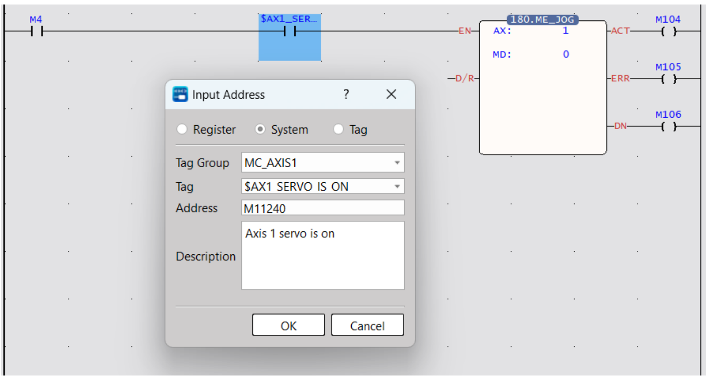
The Fun180 JOG comprises 4 kinds of modes for options, as below:

11-1 JOG Mode 0

- **Function Description**

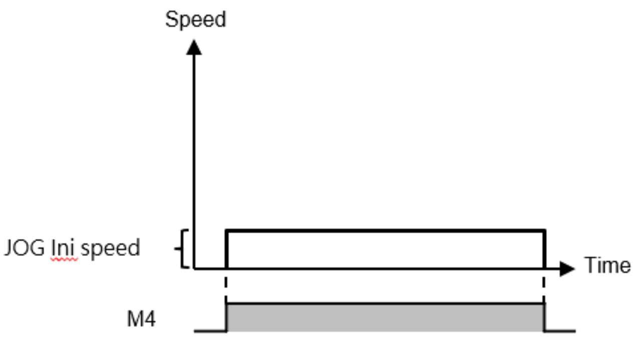
  When EN of FUN180 = 1, it will move at the JOG initial speed set by the motion axis, until EN = 0 of FUN180, it will stop the servo operation immediately.

- **Ladder Example**



  Note 1: It is recommended that users add a special register - SERVO_IS_ON as shown in the figure above before using the function to reduce unnecessary errors that may occur when using the JOG function.
  Note 2: The AXIS of the label needs to be the same as the AX of the function to achieve the protection effect.

- **Operation Diagram**



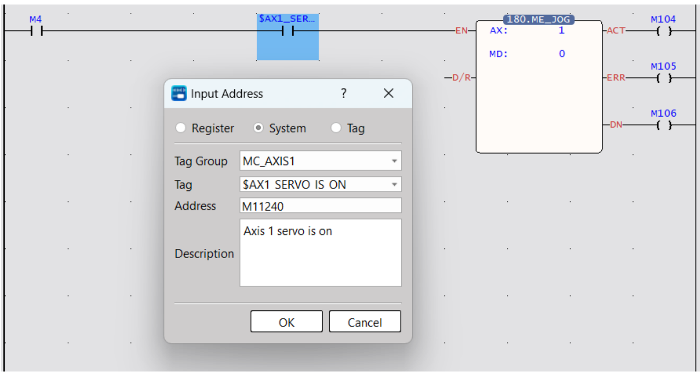
➢ Description
JOG starts when M4 = 1
JOG stops when M4 = 0

11-2 JOG Mode 1

- **Function Description**

  When EN= 1 of FUN180, it will move at the JOG start speed set by the motion axis until the JOG distance set by the motion axis is executed, and the servo operation will stop immediately.

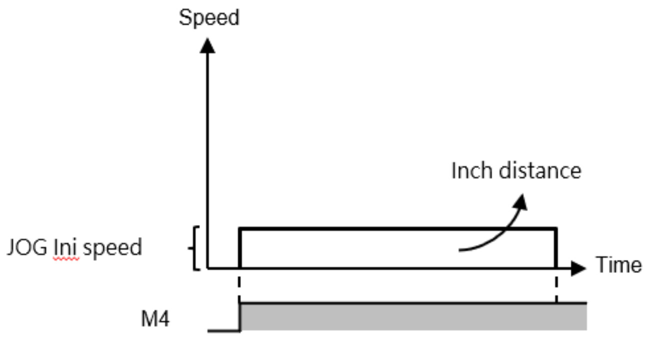
- **Ladder Example**



  Note 1: It is recommended that users add a special register - SERVO_IS_ON as shown in the figure above before using the function to reduce unnecessary errors that may occur when using the JOG function.

  Note 2: The AXIS of the label needs to be the same as the AX of the function to achieve the protection effect.

- **Operation Diagram**



➢ Description

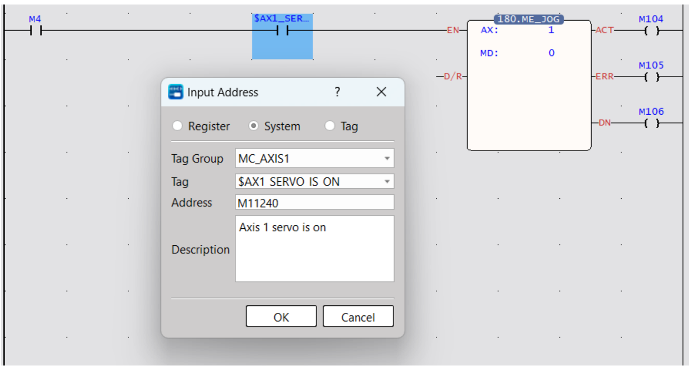
When M4 = 1, the JOG starts to move forward, and the JOG stops automatically when the moving distance is completed.

11-3 JOG Mode 2

- **Function Description**

  When EN = 1 of FUN180, it will advance from the JOG initial speed set by the motion axis, and accelerate to the JOG speed set by the motion axis with the JOG acceleration set by the motion axis, until EN=0 of FUN180, it will start at the JOG speed set by the motion axis after the set JOG deceleration decreases to the set JOG start speed of the motion axis, the servo operation will stop immediately.

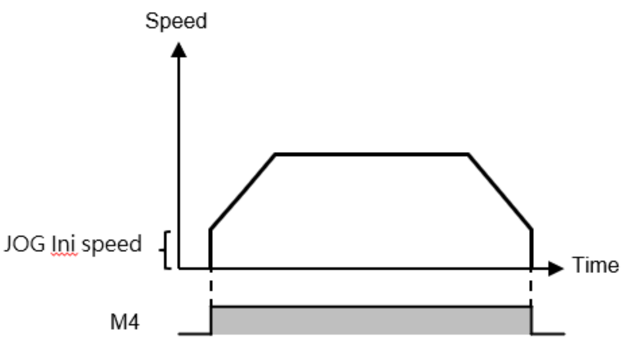
- **Ladder Example**



Note 1: It is recommended that users add a special register - SERVO_IS_ON as shown in the figure above before using the function to reduce unnecessary errors that may occur when using the JOG function.

Note 2: The AXIS of the label needs to be the same as the AX of the function to achieve the protection effect.

- **Operation Diagram**



➢ Description

When M4 = 1, move forward at the JOG initial speed, and accelerate to the JOG speed at the JOG acceleration.

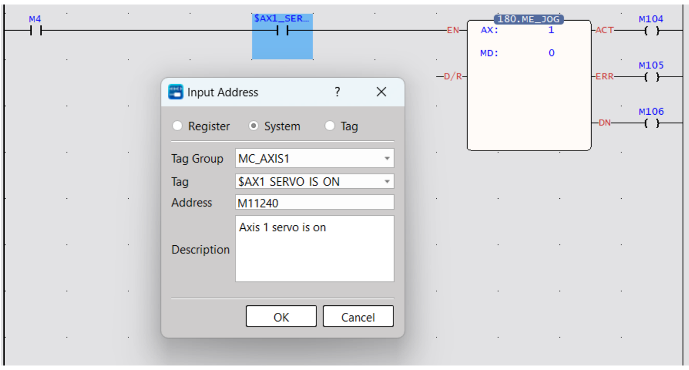
When M4 = 0, the JOG deceleration decreases to the JOG initial speed and stops.

11-4 JOG Mode 3

- **Function Descripition**

  When EN of FUN180 = 1, it will move forward from the JOG initial speed set by the motion axis, and accelerate to the JOG speed set by the motion axis with the JOG acceleration set by the motion axis until the JOG distance set by the motion axis is executed. After the JOG deceleration set by the motion axis decreases to the JOG start speed set by the motion axis, the servo will stop immediately.

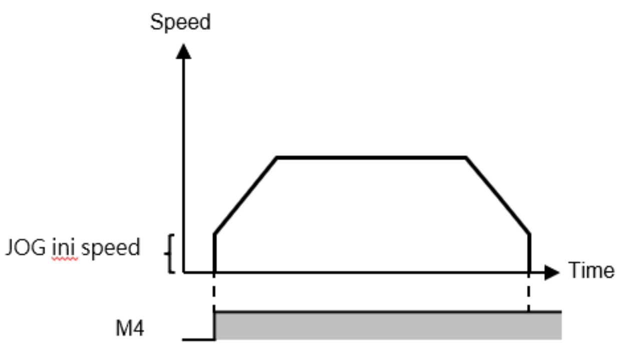
- **Ladder Exxample**



  Note 1: It is recommended that users add a special register - SERVO_IS_ON as shown in the figure above before using the function to reduce unnecessary errors that may occur when using the JOG function.

  Note 2: The AXIS of the label needs to be the same as the AX of the function to achieve the protection effect.

- **Operation Diagram**



➢ Description

When M4 = 1, move forward at the JOG start speed, and accelerate to the JOG speed at the JOG acceleration. The JOG stops automatically when the inch travel distance is completed.

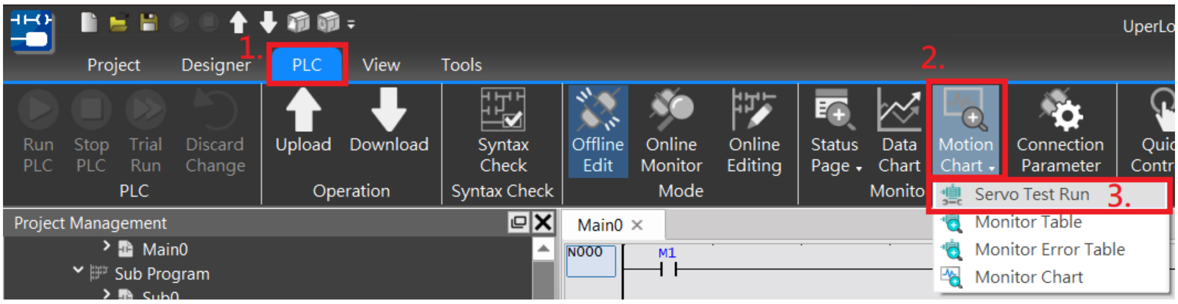
12

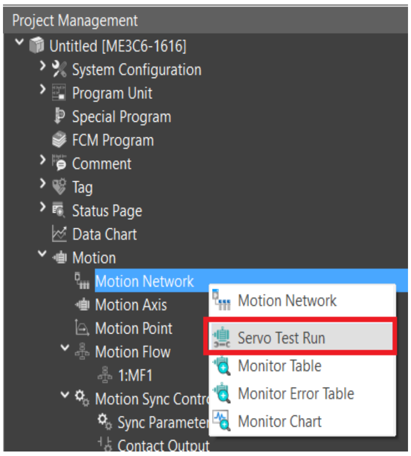
Test Run

The Test Run is the motion control function specially designed for UperLogic and it belongs to built-in features. To run the Motion control with M-PLC Controller, it can be achieved with the following three methods: 1) Ladder control; 2) Motion Flow; and 3) Test Run. When using this product for the first time, the Test Run function is the quickest, most convenient and easiest method because it allows the user to conduct the Servo operation test without the need of writing any line of the PLC Ladder program and Motion Flow control process.

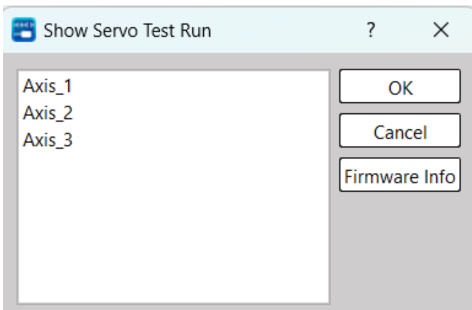
12-1 Starting Test Run

Users can view the servo test run through PLC > Motion Diagram > Servo Test Run at the top, or right-click the motion link setting in the project management on the left.
Note: You need to enter the online monitoring first and execute the PLC before you can execute this function.



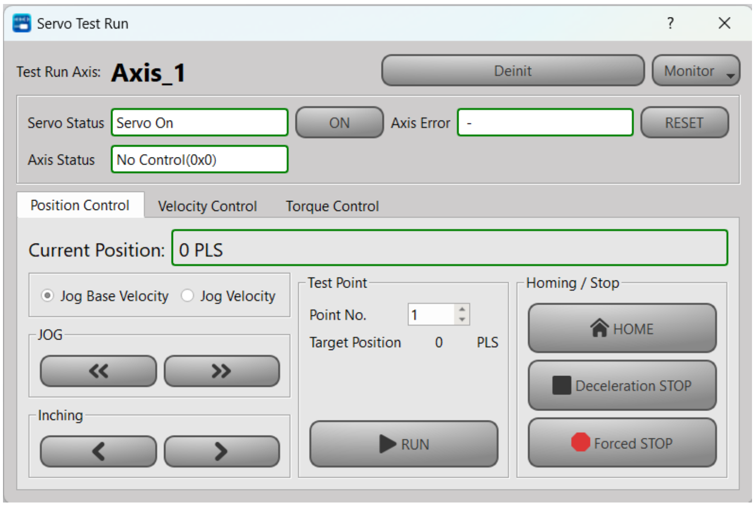


After clicking, select the axis to be tested, and press OK to perform test run control.



12-2 Description of Motion Test Run

The UperLogic test run allows the user to do running tests without editing any Ladder and motion flows. It provides users with three control methods: Position Control, Speed Control, and Torque Control. Each control will be described in subsequent chapters.



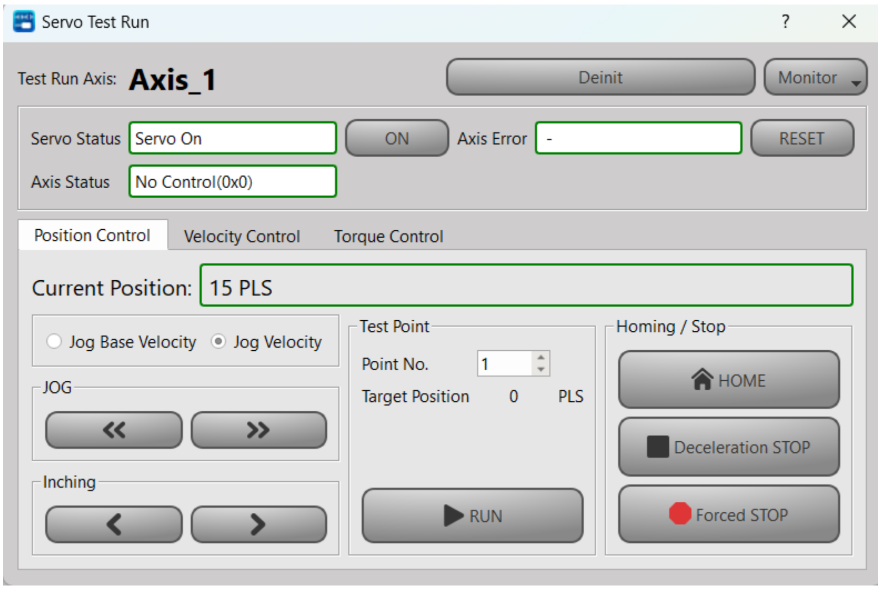
After turning on the test run function, the user must first click Initialization > Servo ON, and then the corresponding control test can be carried out after no abnormalities are found.
Note: The test run function can only be executed when the EtherCAT connection is normal and enabled (Servo on).

Introduction of Motion Test Run Basic Function	
Function	**Description**
Test Run Axis	Display the name of current test run axis.
Initialize&Deinitialize	After clicking, it will be possible to initialize or deinitialize the axis currently in test run.
Monitor	Provide shortcut buttons for monitoring tables and monitoring graphs for users to monitor. Users can also find monitoring tables and monitoring graphs through the motion graph on the top or the project management on the left. Note: Users can refer to the chapters of Watch Table and Watch Graph for details.
Servo Status (ON/OFF)	The current status of the axis will be provided in the green box, and the user can control it through the right button.
Axis Error	The error information of the current axis will be provided in the green box. If "–" is displayed, there is no error, and the user can reset the error through the "Reset" button on the right.
Axis Status	The status information of the current axis will be provided in the green box.
Position Control	Provide users with functional tests such as JOG, movement point and HOME return, which will be introduced in detail in subsequent chapters. Note: Motion points can only perform single-axis motion control, and cannot perform tests such as linear or arc interpolation.

Speed Control	It provides users with speed control, which will be introduced in detail in subsequent chapters.
Torque Control	It provides users with torque control, which will be introduced in detail in subsequent chapters.

12-3 Description of Test Run Position Control

The screen of the position control for trial run is as shown in the figure below. The position control provides a total of three control methods: “JOG” , “Test Point” and “HOME Return” , which will be explained one by one below.



- **JOG Fintion Description**

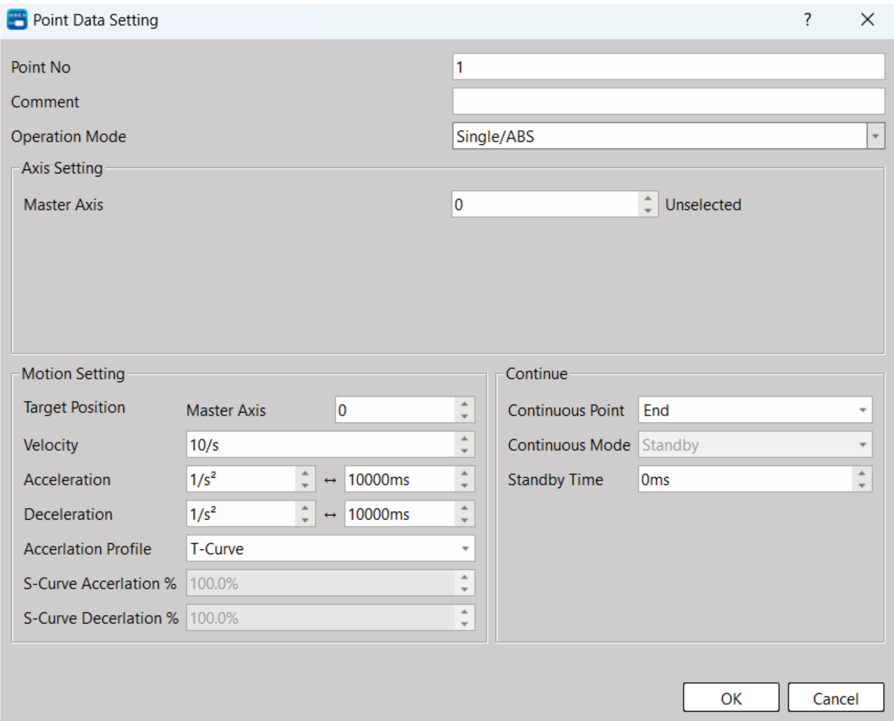
The control of the JOG mode is on the left side of the position control, and the user can perform forward and backward tests by selecting different modes, and view it from the current position.

Mode Collocation	Description
JOG Base Speed & JOG	After clicking, it will move at the JOG start speed set by the motion axis until the user releases it, and the servo operation will stop immediately. (Same as JOG mode 0)
JOG Base Speed & JOG	After clicking, it will move at the JOG start speed set by the motion axis until the JOG distance set by the motion axis is executed, and the servo operation will be stopped immediately. (Same as JOG mode 1)
JOG Speed & JOG	After clicking, it will move forward from the JOG start speed set by the motion axis, and accelerate to the JOG speed set by the motion axis with the JOG acceleration set by the motion axis, until the user releases it, and decelerate to the JOG deceleration set by the motion axis After the set JOG start speed, stop the servo operation immediately.

	(Same as JOG mode 2)
JOG Speed & JOG	After clicking, it will advance from the JOG start speed set by the motion axis, and accelerate to the JOG speed set by the motion axis with the JOG acceleration set by the motion axis, until the JOG distance set by the motion axis is executed, and decelerate with the JOG set by the motion axis. After the speed decreases to the JOG start speed set by the motion axis, the servo operation will stop immediately. (Same as JOG mode 3)

- **Test Point Function Description**

Test Point provides the user with a test point table to see if the setting is correct. Before the test run, the user must first set the corresponding test point in the motion point setting, and then the test run can be performed.



Operation Mode:

During the test run, only single-axis motion control is provided, and other controls such as linear or arc interpolation cannot be performed.

Axis Setting (Master Axis): To select the same axis No. as in the test run.

Motion Setting: Select the target position to be moved, as well as the axis speed and acceleration and deceleration, the initial speed will be the same as the motion axis setting.

Continue: Set whether there is a need to continue to the next point.

Users can test according to the above settings, or refer to the chapter of movement points for more details of the settings.

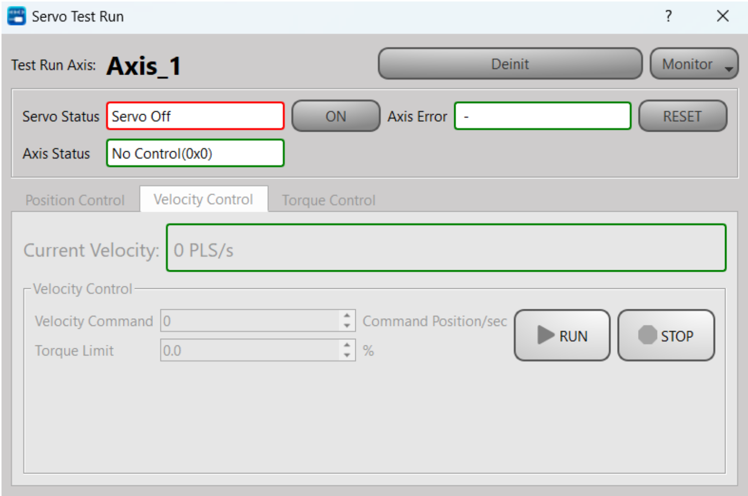
- **HOME Return Function Description**

  Provide the user with the test of homing, the operation mode is the same as the homing set by the motion axis. When the user does not set the origin, the motor will continue to run. At this time, the function of HOME return can be stopped through the function of deceleration and stop. If an abnormality is about to occur, the motor can also be stopped by forced stop.

Homing	Homing Mode	Homing on current ...
	Homing IO Source	From Servo Driver
	Homing Start Direction	Positive
	Homing Origin Offset	0 PLS
	Homing Find Velocity	10000 PLS/s
	Homing Creep Velocity	1000 PLS/s
	Homing Deceleration	1000 PLS/s^2
	Limit Switch(-)(DI)	60FD:00
	Limit Switch(+)(DI)	60FD:01
	Home Switch(DI)	60FD:02
	Homing Z Count	0

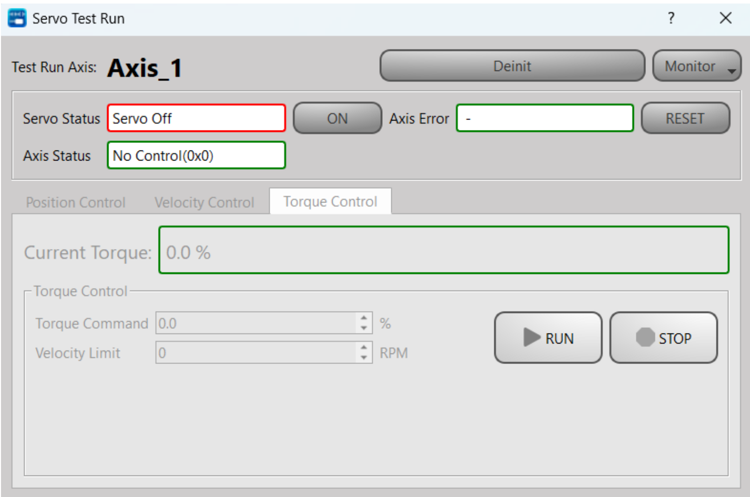
12-4 Description of Test Run Velocity Control

The screen of the test run velocity control is as shown in the figure below. In the test velocity mode, please input the velocity command and torque limit first. After starting, the motor will quickly reach the velocity set by the velocity command, and keep running at the same velocity until the user stops or the torque limit is exceeded.



12-5 Description of Test Run Torque Control

The screen of the test run torque control is as shown in the figure below. In the test torque mode, please input the torque command and speed limit first. After starting, the motor will quickly reach the velocity set by the speed command, and keep running at the same velocity until the user stops or exceeds the speed limit.



Note: In order to avoid accidents, when the load is not increased, do not set the torque command too large, and set a velocity limit within a safe range, so as to avoid the machine from not reaching the corresponding torque because there is no load, and then continue to accelerate, resulting in errors.

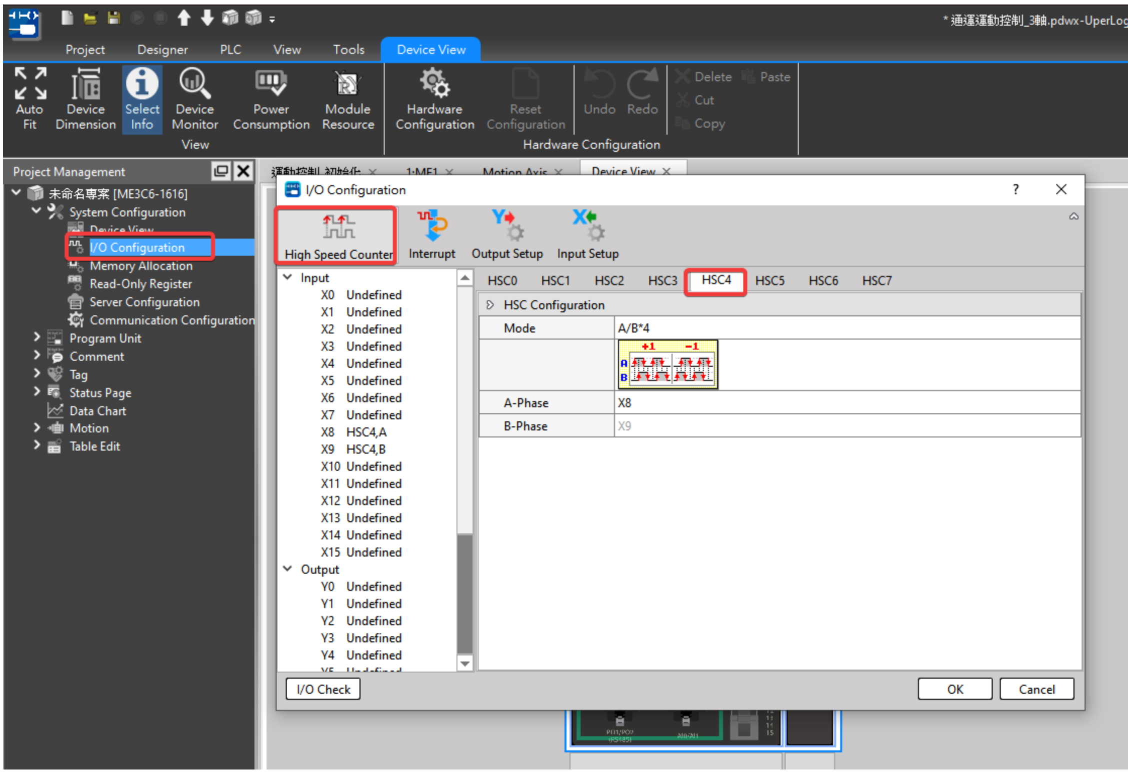
13

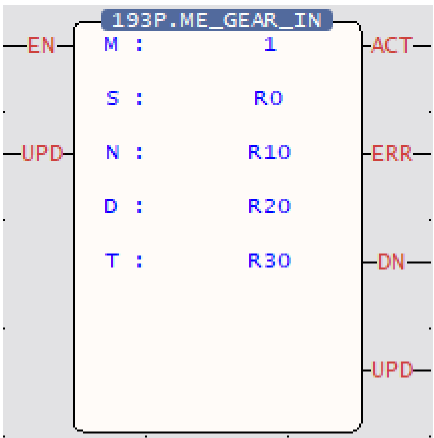
Hand Wheel Mode

The hand wheel is mainly used to control the pulse number of the input axis. When using the hand wheel function, the user must first set the EtherCAT hand wheel input points X8-X15 to high-speed counting HSC4~HSC7.

Users can find the settings in [I/O Configuration] > [High Speed Counter] > HSC4 - HSC7. Currently only A/B*4 is provided, and A/B*4 will amplify the output pulse number by 4 times.

HSC4 = External Reference Number 1, HSC5 = External Reference Number 2, etc. The synchronization parameters will be used later.



<table>
<tr><th>Fun193. MFGearMPG</th><th>Parameter Description</th></tr>
<tr><td>
</td><td>

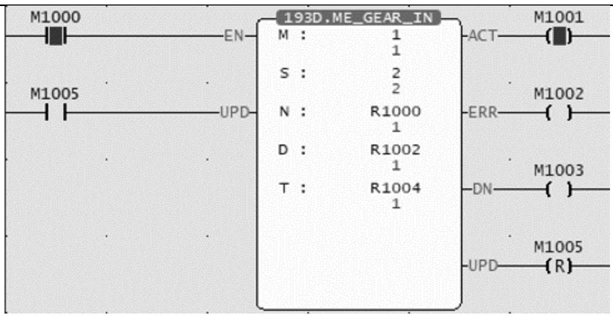
Ladder Symbol	
EN = 1	Output Control
UPD = 1	Updating Parameter
ACT = 1	Acting
ERR = 1	Error
DN = 1	Output is done
UPD =1	Update is done

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

Internal Prameter	
Input Source of M Master Axis	EtherCAT_Axis No. 1-16
	Encoder_Gray Code 100 (X8-X15)
	Encoder_Hardware High-Speed Counter No. 101-104 (HSC4~HSC7)
Ouput Target of S Slave Axis	EtherCAT_Axis No. 1-16 ([Input Source of M Master Axis] cannot be same as [Ouput Target of S Slave Axis])
N Variable Gear Ratio Numerator	Positive and negative numbers, including [Decimal Point Position] in [Motion Axis Setting] in [Motion Control].
D Variable Gear Ratio Denominator	Positive number (a real number greater than zero), including the [Decimal Point Position] of the [Motion Axis Setting] in [Motion Control].
T Transition Time (ms)	Positive number (a real number greater than zero), unit: ms

Example

Ladder



Axis Parameter Setting

		1.Axis_1	2.Axis_2
Basic Setting	Axis Name	Axis_1	Axis_2
	Axis Type	Servo	Servo
	Encoder Type	Incremental	Incremental
Unit Setting	Unit	mm	mm
	Decimal Point	0.001	0.001
	Pulse/Revolution	131072 PLS/Rev	131072 PLS/Rev
	Unit/Revolution	1.000 mm/Rev	1.000 mm/Rev
	Velocity Unit	Command Position/...	Command Position/...
	Velocity Gain	1.000	1.000

- When M1000 is from OFF→ON, it will follow the current Fun193 parameter (M: EtherCAT axis 1, N: EtherCAT axis 2, N: variable gear ratio numerator 0.001, D variable gear ratio denominator 0.001, T: 1ms) to start hand wheel synchronization.
- When EtherCAT axis 1 moves by 100 mm, EtherCAT axis 2 moves by 100 mm.

14

Speed Control and Torque Control

This section describes the speed control and the torque control required for the M-PLC. You cannot retrieve the speed control and the torque control from the PLC. To use the speed and torque control functions, please retrieve through the Motion Flow function. The speed control is the function required for setting the speed/torque control mode to enable status.

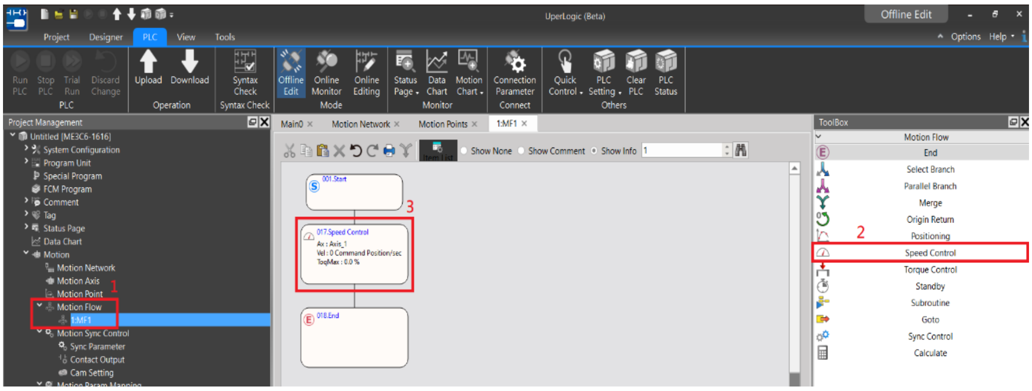
14-1 Speed Control

In the speed control mode, it is mainly to control the rotation speed of the motor, and the maximum torque limit protection can be set in the speed control mode. To execute the speed control of the specified axis, it can be called by the motion flow speed control module or the ladder diagram instruction. The following will explain how to use it individually:

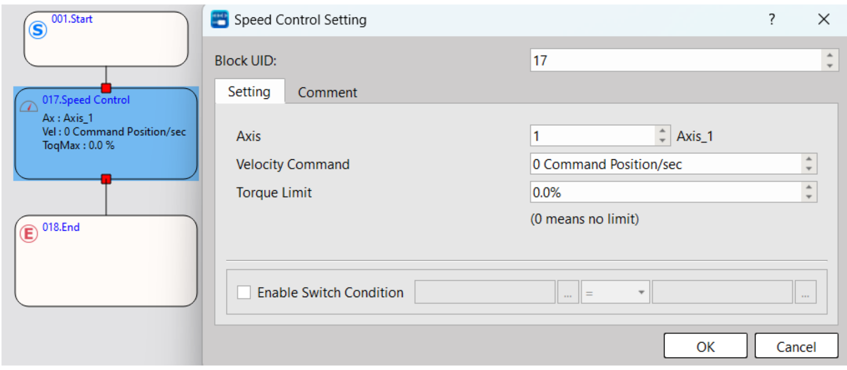
- **Motion Flow – Speed Control Module**

  Before using the flow block, the user must first set the motion link setting and motion axis setting.

  Then add a new motion flow by clicking [Motion Flow] in [Project Management], and drag the speed control from the toolbox to the motion flow, as shown in the figure below. If no other motion flow is required, add an end flow block at the end.



  Double-click the speed control in the motion flow to set the axis to be controlled, speed command and torque limit.



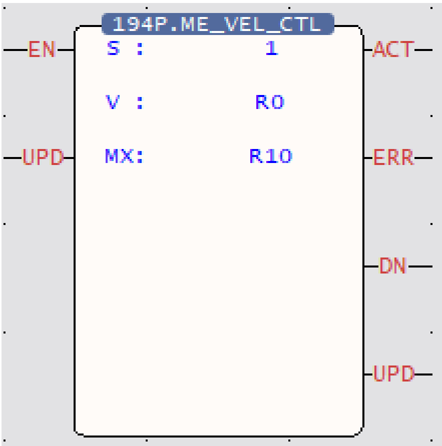
Introduction of Flow Block Function	
Function	**Description**
Flow Block No.	The system will assign it automatically, and the user can change it by himself (but the flow block number cannot be

	repeated).
Axis	Axis to execute speed control
Speed Command	Speed to execute speed control, the speed command can be entered with a minus sign, which means reverse rotation. (unit is command position/second).
Torque Limit	If the torque limit is set to 100, the servo torque limit will be 10%, if it is set to 0, it will not be limited. (in units of 0.1%)
Switch Condition	Set the conditions for switching to the next flow block. If the user does not enable switch conditions,then jump directly to the next flow block with the current motor state.
Comment	The user can input the function of this flow block or application comments, etc.

- **Speed Control Ladder**

  Before using FUN194 speed control, the user must first set the motion link setting and motion axis setting.

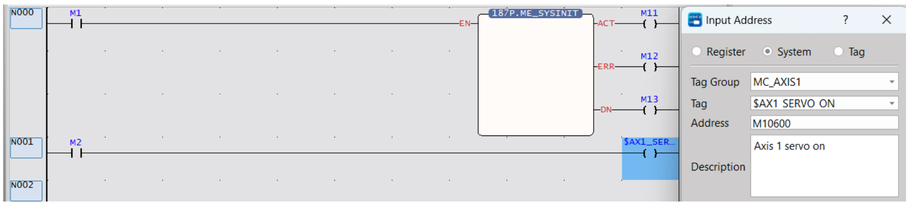
  The following is the description of the speed control function. The user can use it after setting it on the ladder diagram, and there is no need to set the motion flow block.

Fun194. MFVelCtl	Parameter Description
	➢ **Ladder Symbol** EN = 1 : Output Control UPD = 1 : Updating Parameter ACT = 1 : Acting ERR = 1 : Error DN = 1 : Ouput is done UPD =1 : Update is done ➢ **Internal Parameter** S : EtherCAT Speed Control Axis V : Velocity MX : Max. Torque Limit

Simple Speed Control Example

1. After completing the setting of the above motion flow block, trigger the function of servo initialization (FUN187) in the ladder diagram, and set the enable (SERVO ON) ladder diagram logic (M10600).

Note: If you need a detailed description of the special register, please refer to the instruction manual - special register chapter.

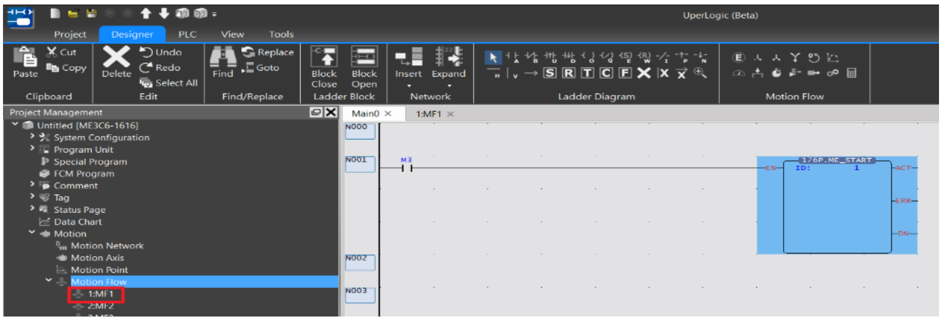


The following will introduce the control methods of the ladder diagram and the motion flow chart respectively.

2. Control through the flow chart. If the user wants to use the ladder diagram control, please skip to step 3.

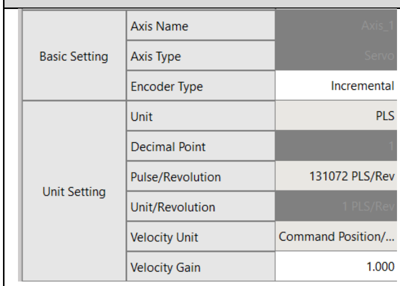
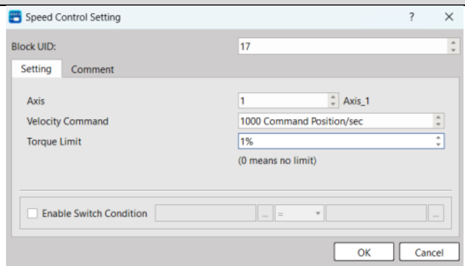
Then use FUN176 to control the programmed motion flow, and then you can perform the speed control function of the flow block.

Note: The ID of FUN176 must be the same as the number of the motion flow to be controlled.



Users can also refer to the settings below for a simple test.

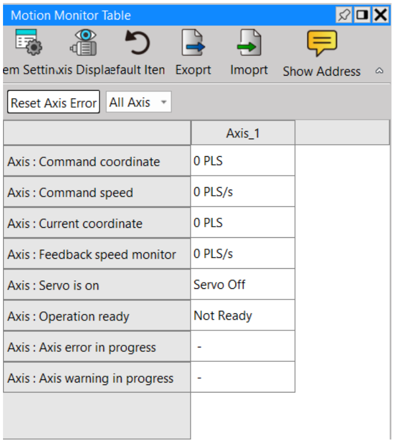
Note: The following parameters are based on SC3 as an example. Since the servo parameters may be changed, it is recommended that the user perform a test run to ensure safety before use.

Motion Axis Setting	Flow Block Setting
	

3. Control through the ladder diagram. If the user wants to use the flow block control, he needs to go to step 2 and then directly jump to step 4.

Drag FUN194 to the ladder diagram, and set R0 to 1000 and R10 to 1 to download and execute the project.

4. Regardless of whether you use the ladder diagram or the motion flow, you can check the status of the axis through the motion monitoring table after execution. The motion monitoring table is in the upper PLC > Motion Graph > Motion Monitoring Table.



14-2 Torque Control

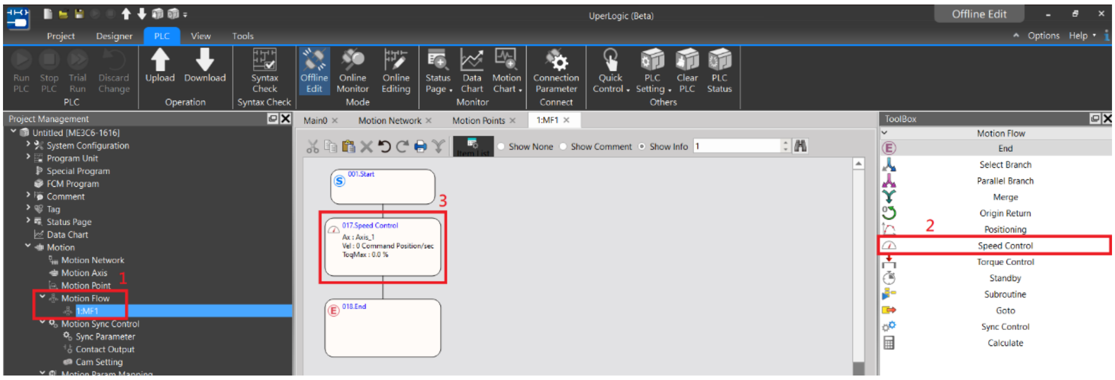
In the torque control mode, it mainly controls the rotation torque of the motor, and the maximum speed limit protection can be set in the torque control mode. To execute the speed control of the specified axis, it is called by the motion flow speed control module. As explained below:

Note: When the motor implements torque control, if the torque does not reach the set value, the speed will continue to rise. Therefore, please add the speed limit appropriately when using it to ensure the safety of operation.

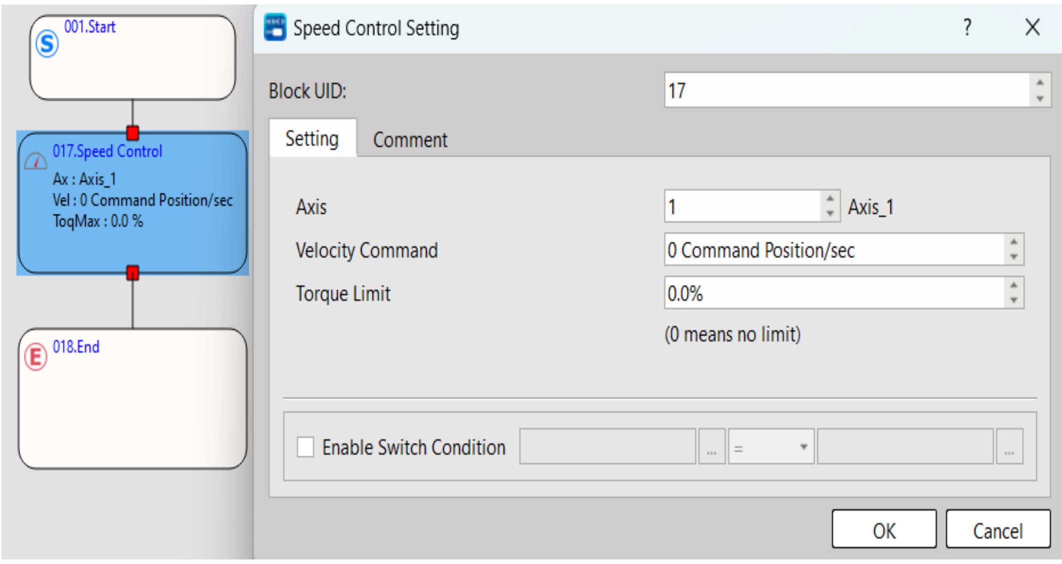
- **Motion Flow – Torque Control Module**

  Before using the flow block, the user must first set the motion link setting and motion axis setting.

  Then add a new motion flow by clicking [Motion Flow] in [Project Management], and then drag the speed control from the toolbox to the motion flow, as shown in the figure below. If no other motion flow is required, add an end process flow at the end.



  Double-click the torque control in the motion flow to set the axis to be controlled, speed command and torque limit.

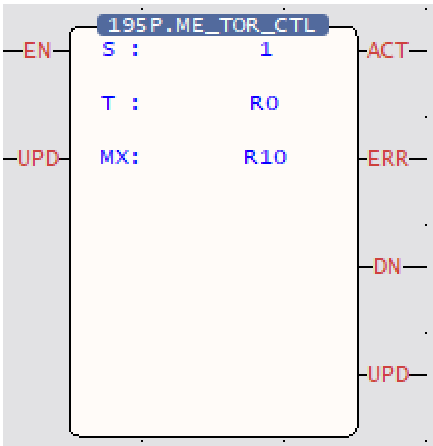


Introduction of Flow Block Function	
Function	**Description**
Flow Block No.	The system will assign it automatically, and the user can change it by himself (but the flow block number cannot be repeated).
Axis	Axis to execute speed control
Torque Command	Torque to execute torque control, the torque command can be entered with a minus sign, which means the direction. (in units of 0.1%).
Speed Limit	Maximum speed limit, if it is set to 0, it will not be limited. (unit is command position/second).
Switch Condition	Set the conditions for switching to the next flow block. If the user does not enable switch conditions,then jump directly to the next flow block with the current motor state.
Comment	The user can input the function of this flow block or application comments, etc.

- **Ladder Diagram Speed Control**

  Before using the FUN195 torque control, the user must first set the motion link setting and motion axis setting.

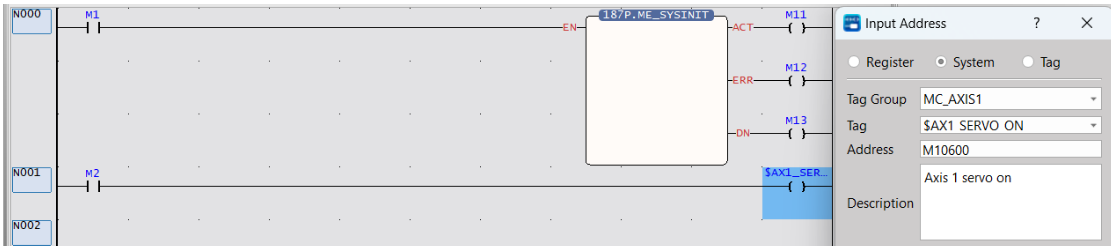
  The following is the description of the torque control function. The user can use it after setting it on the ladder diagram, and there is no need to set the motion flow block.

Fun194. MFVelCtl	Parameter Description
	➢ **Ladder Symbol** EN = 1 ： Output Control UPD = 1 ： Updating Parameter ACT = 1 ： Acting ERR = 1 ： Error DN = 1 ： Ouput is done UPD =1 ： Update is done ➢ **Internal Parameter** S ： EtherCAT Speed Control Axis ➢ T ： Torque MX ： Max. Speed Limit

Simple Torque Control Example

1. After completing the setting of the above motion flow block, trigger the function of servo initialization (FUN187) in the ladder diagram, and set the enable (SERVO ON) command (M10600).

Note: If the user wants to know more about this part, please refer to the corresponding chapter.

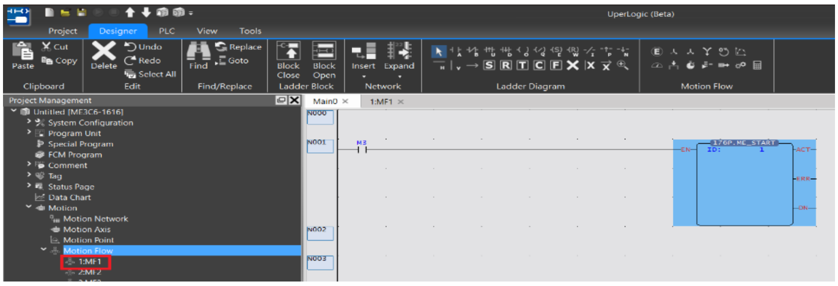


The following will introduce the control methods of the ladder diagram and the motion flow chart respectively.

2. Control through the flow chart. If the user wants to use the ladder diagram control, please skip to step 3.

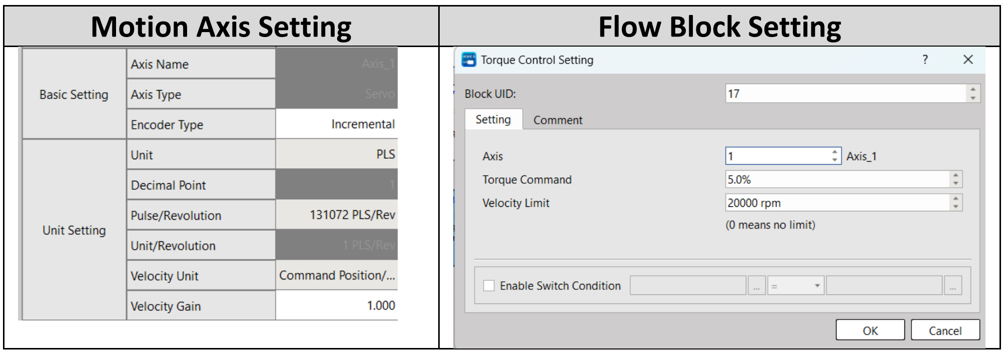
Then use FUN176 to control the programmed motion flow, and then you can perform the torque control function of the flow block.

Note: The ID of FUN176 must be the same as the number of the motion flow to be controlled.



Users can also refer to the settings below for a simple test.

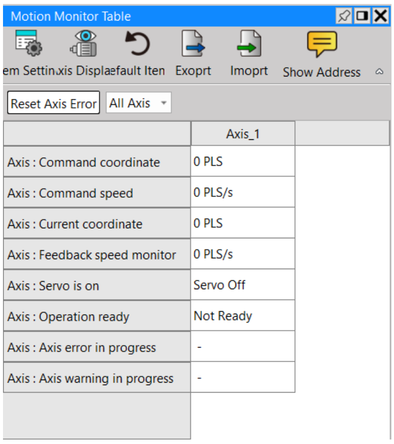
Note: The following parameters are based on SC3 as an example. Since the servo parameters may be changed, it is recommended that the user perform a test run to ensure safety before use.



3. Control through the ladder diagram. If the user wants to use the process block control, he needs to go to step 2 and then directly jump to step 4.

Drag FUN195 to the ladder diagram, and set R0 to 5, R10 to 20000 to download and execute the project.

4. Regardless of whether you use the ladder diagram or the motion flow, you can check the status of the axis through the motion monitoring table after execution.
The motion monitoring table is in the upper PLC > Motion Graph > Motion Monitoring Table.



15

Synchronous Control, Flying Cut (Synchronization Function Parameter Table/Electronic Cam Setting)

This section describes the basic operation and the parameter setting required for the synchronous control. The synchronous control is also one of the axis motion control functions and it can be effectively applied in the gantry mechanism and flying shear purposes. Therefore, it is a very efficient function when operating under position control mode.

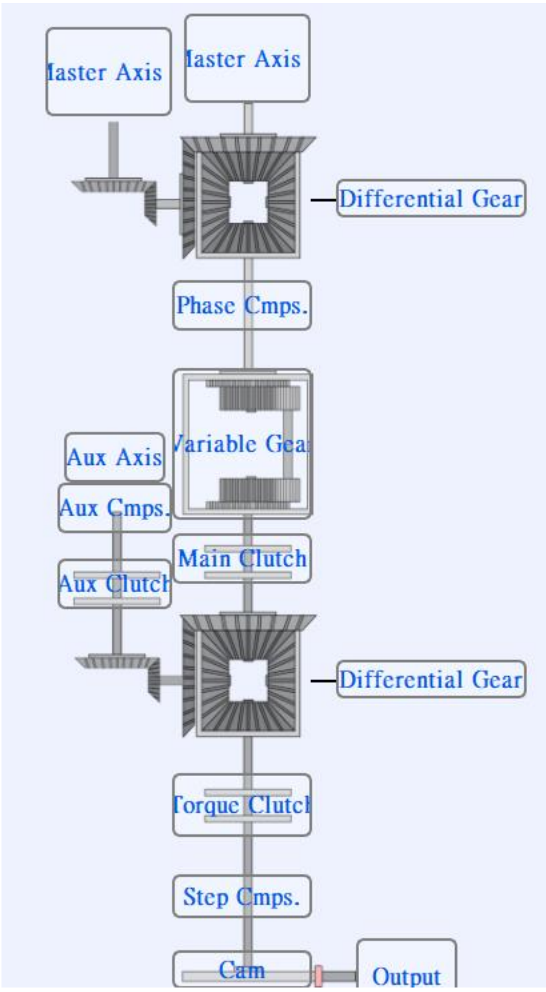
15-1 What is synchronous control?

The synchronous control is a kind of motion control function that can be used for simulating the mechanical cam through the position sensor such as Rotary Encoder. Through the Encoder, it transmits the position information to the PLC where such position information will be decoded by the CPU. Through the synchronous parameter, it will compute the cam (curve) data, gear setting, clutch setting and offset setting and then transmit the resulting data to the Slave Axis.
Here, the synchronous Master Axis is termed as Input Axis and the synchronous trailing axis is termed as Output Axis. Based on the coordinate of Master Axis, the cycle of Input Axis will be created in order to repeat the Cam action quickly and effectively.

15-2 Synchronous Parameter Setting Group

Groups will be created for setting the synchronous parameters so that they will be classified according to the designated group in helping the user find out the corresponding parameter.

A. Basic Setting	B. Initialization Setting
C. Master Axis 1 input	D. Slave Axis 2 Input
E. Master Axis Phase Offset	F. Variable Gear
G. Main Clutch	H. Step Angle Offset
I. Cam	J. Output Filter



15-3 Introduction of Synchronous Parameter

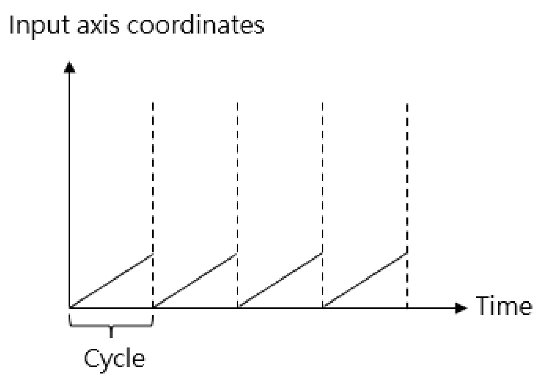
Basic setting:

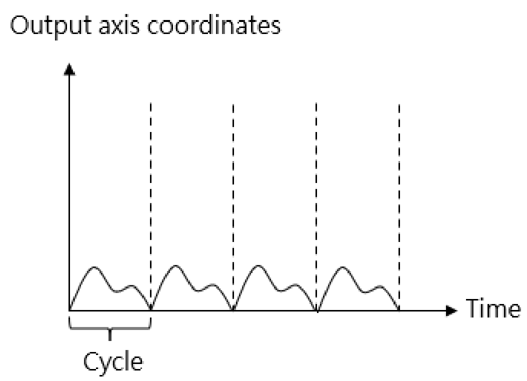
Basic Setting	Input axis coordinate Unit	PLS
	Input axis coordinate decimal point	1
	Input axis period	1000 PLS
	Clutch OFF sliding time at deceleration stop	1000 ms

1. Input axis coordinate unit: The unit required for setting and displaying the coordinate, preset as PLS. It comprises the following units for option, pls/mm/deg/inch.

2. Input axis decimal point place: For setting the bit following the decimal point. It is preset as “1” and can be set to 3 places following the decimal point. For example, setting the Input Axis as 100mm per turn. If setting the bit following the decimal point as “0.1”, then the resolution of the input axis cycle can be set to the first place following the decimal point, such as “100.5”.

3. Input axis period: Means the cycle quantity of the Input Axis required for the Output Axis to complete one round of Cam motion. By setting the Input Axis cycle, you can execute the Cam action repeatedly, as per the figure below:





4. Clutch OFF sliding time when deceleration stops: The time required for setting the Main Clutch at OFF when stopping the deceleration process. The synchronous control comprises deceleration stop and immediate stop functions and the duration is preset as 1000ms for each. It is also the Stop Mode for the user to release the synchronous control or when an error is detected.

Initialization setting:

Iinitialization Setting	Input axis phase init method	Use parameter
	Sync master axis phase default value	0 PLS
	Master axis phase default value after phase compensation	0 PLS
	Main clutch input axis phase default value	0 PLS
	Auxiliary clutch input axis phase default value	0 PLS
	Cam input axis/clutch output axis phase init method	Use parameter
	Cam input axis phase default value	0 PLS
	Cam output axis base coordinate	0 PLS

1. Input Axis phase init method: It can be set according to the following three parameters.

- ✓ Operating parameter: Execute the initialization according to the Main Clutch input phase preset value.
- ✓ Operating Input Axis coordinate: Execute the initialization according to the preset value created for Input Axis coordinate and Main Clutch input phase.
- ✓ Maintaining previous value: Initialized as the phase and coordinate being created when previous synchronization ends.

2. Main clutch input axis phase default value: When the aforesaid parameter is set as the operating parameter, access such parameter to create the Main Clutch input phase preset value in order to begin the initialization.

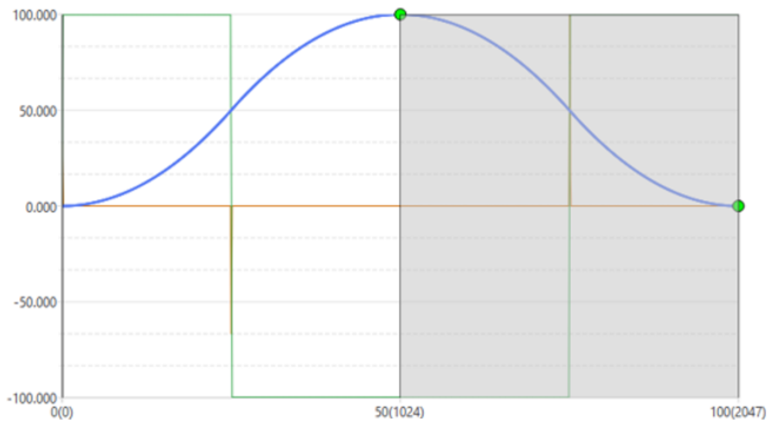
3. Cam input axis/clutch output axis phase init method:

- ✓ Operating parameter: Execute the initialization according to the Parameter Cam Input Axis phase preset value.
- ✓ Operating Cam Output Axis baseline coordinate: Execute the initialization according to the preset value created for Cam Output Axis baseline coordinate and Cam Input Axis phase.
- ✓ Maintaining previous value: Initialized as the phase and coordinate being created when previous synchronization ends.

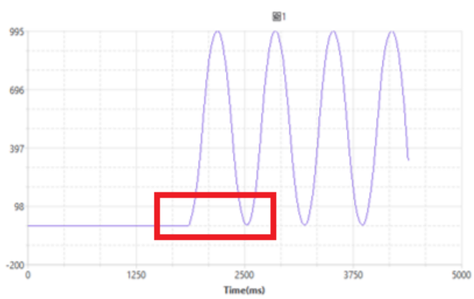
4. Cam input axis phase default value: To be set when setting the aforesaid parameter as the operating parameter.

Example:

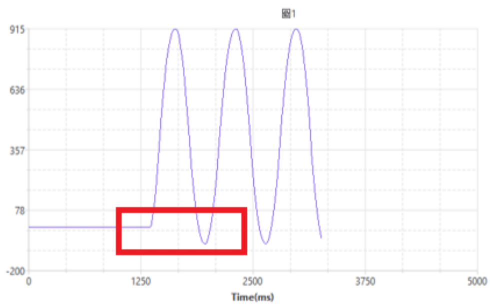
When selecting the operating parameter for initializing the phase of Cam Input Axis/Clutch Output Axis and where the preset value of Cam Input Axis phase is set as 100mm, indicated below is the example showing the Input Axis cycle being set as 1000mm:



Input axis cycle 1000mm



Cam input axis phase preset value 0



Cam input axis phase preset value 100mm

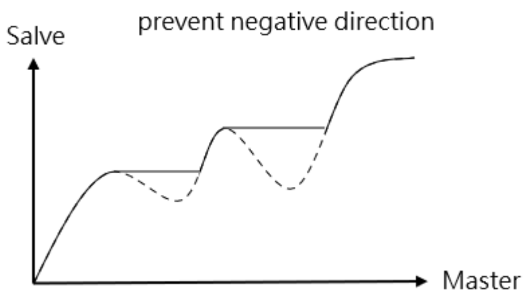
In the figure above, we see that when the preset value of Cam Input Axis phase is set as 0mm and 100mm, the synchronous motion of the Output Axis will start moving by falling behind by 100mm.

5. Cam output axis base coordinate: The aforesaid parameter is used for setting the Cam Output Axis baseline coordinate.

Master Axis input:

Master Axis1 Input	Input axis selection	Current coordinate: ...
	External reference number	0
	Prevent reverse	None
	Coordinate transformation setting	Same as setting of se...
	Coordinate transformation numerator	1
	Coordinate transformation denominator	1

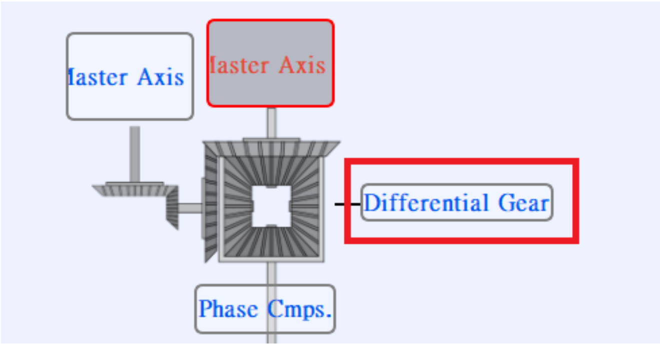
1. Input axis selection
   - ✓ Operating parameter: Using the external reference Encoder as the Master Axis input.
   - ✓ Current coordinate: Using the current coordinate transmitted back by the Master Axis as the reference.
   - ✓ Command coordinate: using the command coordinate of the Master Axis as the reference.
2. External reference number: Selecting Input Axis as the number source of the operating parameter.
3. Prevent reverse (per the schematic below)
   - ✓ Prevent backward change: Limiting the Slave Axis from reversing
   - ✓ Prevent forward change: Limiting the Slave Axis from advancing.
   - ✓



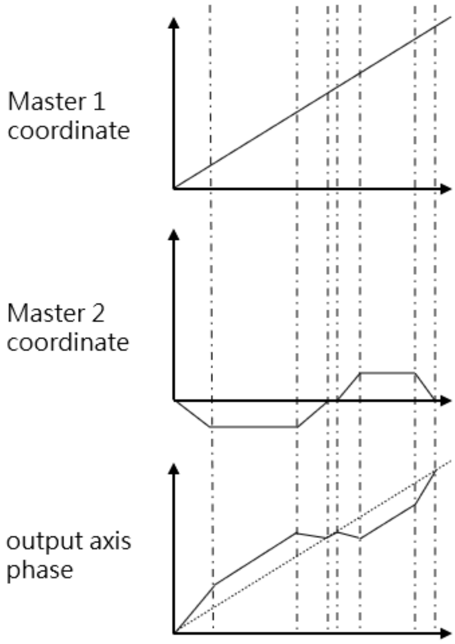
4. Coordinate transformation setting
   - ✓ Same setting as the selected axis: Maintaining same setting as the selected axis.
   - ✓ Through synchronous parameter: Use coordinate transformation numerator and denominator for executing the transformation (normally used when the external input value is different from the baseline of current coordinate or command coordinate).
5. Coordinate transformation numerator: Refer to the formula provided below.
6. Coordinate transformation denominator: Refer to the formula provided below.

$$\text{Input axis coordinates} = \text{position command} \times \frac{\text{(Synchronization parameter) Coordinate conversion numerator}}{\text{(Synchronization parameter) Coordinate conversion denominator}}$$

Differential Gear:



The Differential Gear can be used as the Output Axis coordinate by deducting Master Axis 2 coordinate from Master Axis 1 coordinate, as per the figure below:

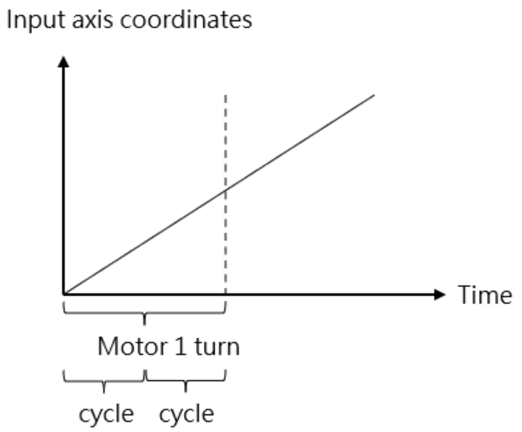


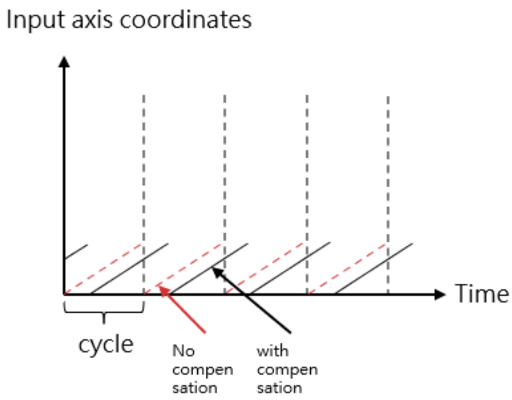
Master Axis Phase Compensation:

Master Axis Phase Compensation	Compensation command value	0 PLS
	Compensation change mode	Direct
	Compensation change time	0 ms

The Master Axis phase offsetting can compensate the fixed deviation and it can be compensated during the motion flow.

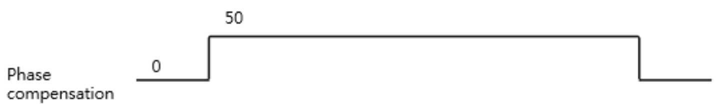
1. Compensation command value
2. Compensation change mode
   - ✓ Direct: Compensating the phase directly
   - ✓ Linear: Compensating the phase by means of slope.



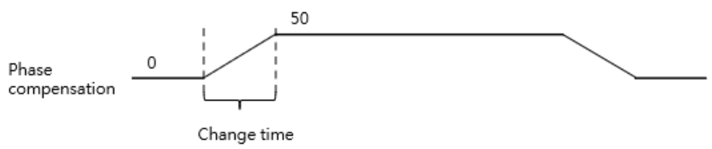


3. Compensation change time: The time required for changing the offset mode to the linear mode, and it will be expressed as “ms”.

➢ Direct Mode



➢ Linear Mode



Variable Gear:

Variable Gear	Variable gear ratio numerator	1
	Variable gear ratio denominator	1
	Gear ratio change mode	Direct
	Variable gear ratio change time	0 ms

The Variable Gear can be used to convert the Input Axis phase to the Output Axis moving quantity according to the set variable gear ratio.

1. Variable gear ratio numerator: Refer to the formula provided below
2. Variable gear ratio denominator: Refer to the formula provided below

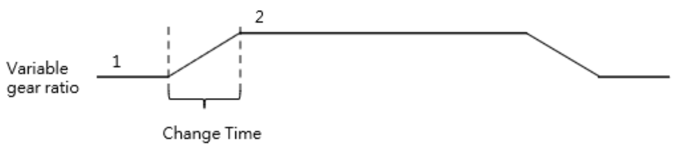
$$\textbf{Movement amount of output shaft} = \textbf{Movement amount of input shaft} \times \frac{\textbf{Variable gear ratio numerator}}{\textbf{Variable gear ratio denominator}}$$

3. Gear ratio change mode:
   - ✓ Direct: Changed directly when changing the Variable Gear Ratio.
   - ✓ Linear: When changing the Variable Gear Ratio, it should be executed according to the slope of "Variable Gear Ratio change time".
4. Variable gear ratio change time: The time required for changing the Variable Gear Ratio mode to linear mode.

** You may change the Variable Gear Ratio through the program.

➤ Direct Mode

➤ Linear Mode

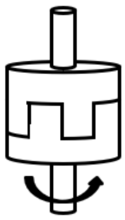


Main Clutch:

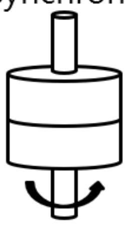
Main Clutch	Clutch ON condition	Always ON
	Clutch ON setting value	0 PLS
	Clutch ON delay	0 PLS
	Clutch ON connection method	Direct
	Clutch ON sliding curve	Exponential
	Clutch ON sliding time	1000 ms
	Clutch ON following time	1000 ms

Clutch ON/OFF controls the synchronization or operation stopping for the Output Axis phase.
The clutch connection and disconnection can be executed with the following three methods: direct, sliding and slave.

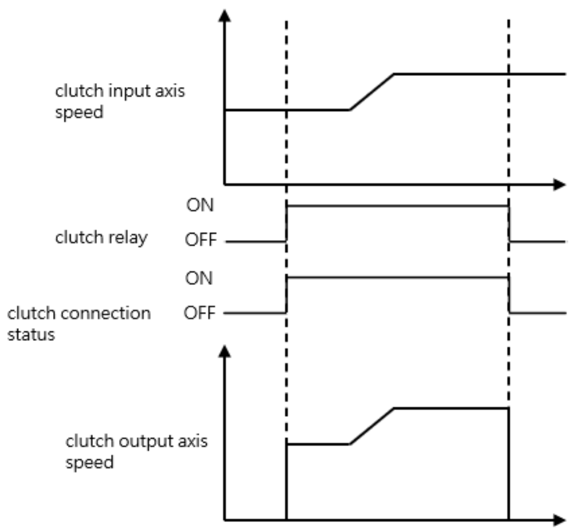
- Direct



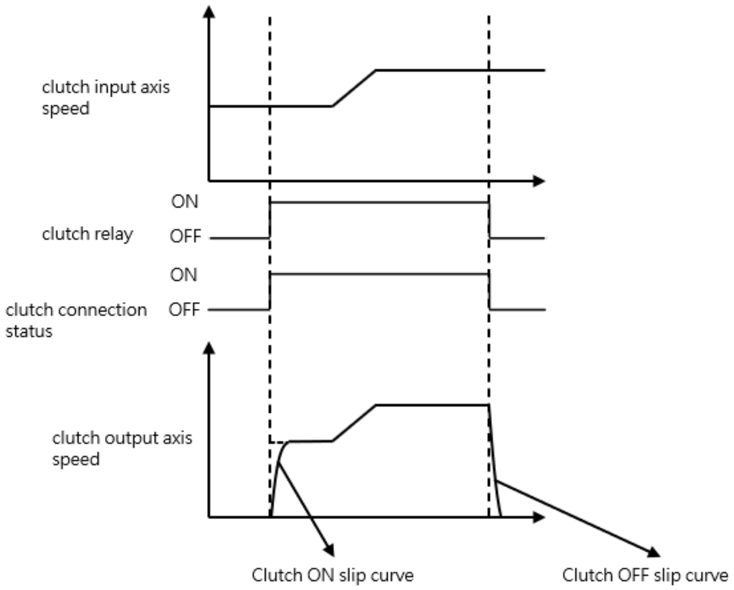
- Sliding/following The output axis is gradually synchronized with the input axis



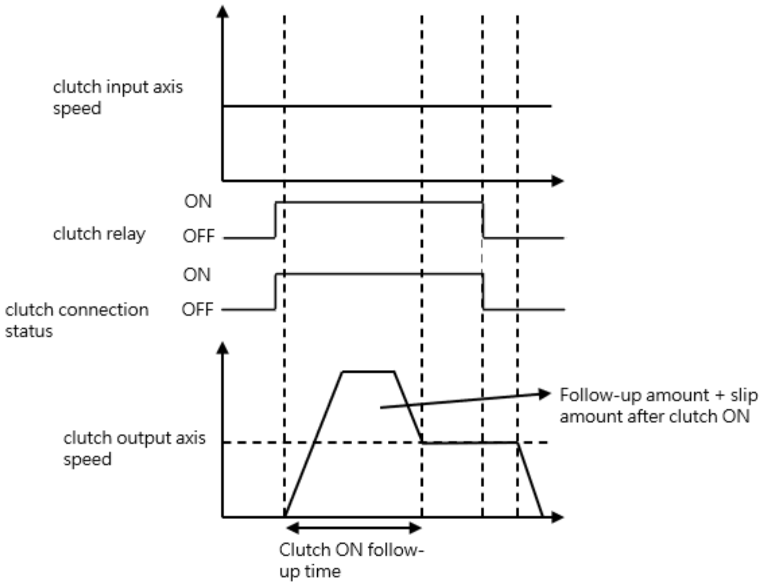
- Direct



● slide



● follow



1. The Main Clutch ON condition comprises the following methods:
   - ✓ Constant ON: Maintaining the connected status.
   - ✓ Constant ON (single direction forward)
   - ✓ Constant ON (single direction backward). Its concept is the same as constant ON (single direction forward).
   - ✓ Clutch control relay (level): Set to ON when the axis synchronous master clutch switch M10604 + (40*n-1) or axis synchronous auxiliary clutch switch M10611 + (40*n-1) is high, and set to OFF when it is low.

For example, if M10604 is continuously ON, the clutch is ON, which is the level function.

- ✓ Clutch ON Request Relay (Edge): Set ON when the state of axis synchronous main clutch switch M10604 + (40*n-1) or axis synchronous auxiliary clutch switch M10611 + (40*n-1) becomes high.
  For example, when the upper edge of M10604 triggers ON, the clutch will continue to be On, which is an edge function.
- ✓ Clutch input axis phase: When the input phase reaches the ON setting value, the clutch starts to transmit the variation

2. Clutch ON setting value: Enabled when the clutch ON condition is set to "Clutch Input Axis Phase"
   Settable range 0-4294967295
3. Clutch ON delay: After the ON condition is met, the input phase is set to ON after the ON delay setting value.
   Settable range 0-4294967295
4. Clutch ON connection mode:
   Direct: Indicates the way the clutch is directly connected
   Slide: The output phase accelerates smoothly until fully synchronized, ignoring errors in the process
   Follow: The output phase accelerates smoothly until it is completely synchronized, and the error in the compensation process is added to the distance of the compensation following amount before it is set to ON
5. Clutch ON slide curve: Indicates the error in the slide process.
   ※If the input axis changes to 0 during the sliding process, set it to ON directly
6. Clutch ON slide time: Set the specified time. Indicates that the sliding process needs to be completed within the instruction time, ignoring the error in the process.
7. Clutch ON follow time: unit is ms
8. Clutch ON follow amount: Indicates the error in the compensation process, and it is set to ON after adding the distance of the compensation follow amount.
   Settable range 0-4294967295
9. Clutch OFF Condition:
   Servo off: No OFF condition
   Synchronous OFF Register (Edge): Set to OFF when state of axis synchronous main clutch switch M10604 + (40*n-1) or axis synchronous auxiliary clutch switch M10611 + (40*n-1) goes low.
   Input axis phase: Set to OFF when the input phase reaches the OFF setting value.
   Output axis movement: Set to OFF when the phase change of the output shaft reaches the OFF setting value.
   Output axis phase: Set to OFF when the output phase reaches the OFF setting value.
   Settable range 0-4294967295
10. Clutch OFF Setting Value:
    Enabled when the OFF condition is set to input axis phase, output axis movement amount, and output axis phase.
    Settable range 0-4294967295
11. Clutch OFF Delay:
    Indicates that after the OFF condition is met, the input phase is set to OFF after the OFF delay setting value.
    Settable range 0-4294967295

12. Clutch OFF Connecting Method:
    Direct: Indicates the way to set OFF
    Slide: Slide means that the output phase is smoothly decelerated until completely separated, ignoring the error in the process.
13. Clutch OFF slide curve: Settable range 0-4294967295
14. Clutch OFF slide time: Unit is ms, settable range 0-4294967295

Step Angle Compensation:

Step Angle Compensation	Base speed	1 PLS/s
	Base value	0 PLS
	Compensation value change mode	Direct
	Compensation value change time	100 ms

The Step Angle offset is used to compensate the delay when the Cam is operating at different speeds.

Base speed: Refer to the formula provided below.

Base value: Refer to the formula provided below.

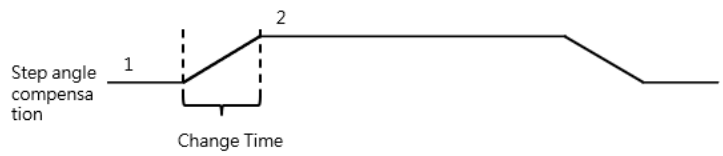
$$\text{Step Angle Compensation} = \text{Input Axis speed} \times \frac{\text{Base value}}{\text{Base speed}}$$

Compensation value change method

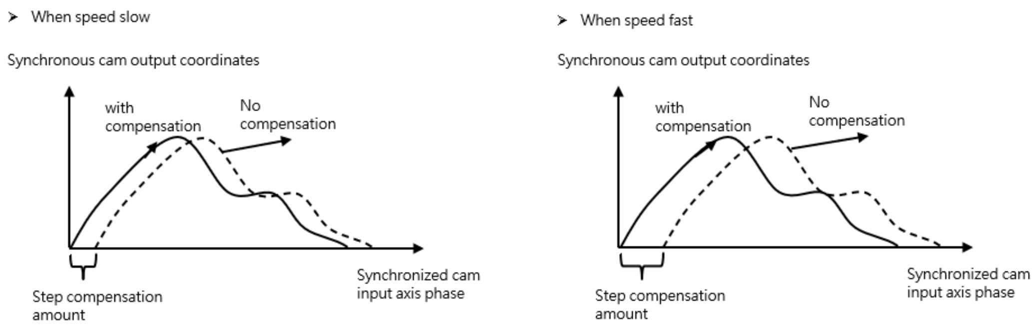
- ✓ Direct: Change directly
- ✓ Linear: Change the slope of [Compensate Change Time].

➢ Direct Mode

➢ Linear Mode



Compensation value change time: The time required for changing the offset value change method as Linear Mode (unit: ms)



Cam:

Cam	Cam data No.	Display	0
	Cam stroke		1000 mm
	Contact output No.		0

Cam data No.: Setting the ID for the Cam that will be used by the Slave Axis.

* If the Cam data is coded as “0”, then it will be irrelevant to the cycle and Cam travel values of the Input Axis. Such data will be used to execute the proportional (1:1) action for Input Axis cycle and feeding quantity.

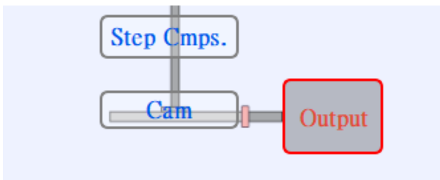
Cam stroke: The travel of the Slave Axis

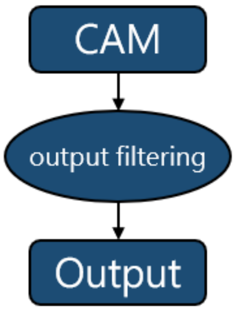
Synchronous contact ID: (not supported for now)

Output filtered wave:

Output filter	Output filter time constant	100 ms

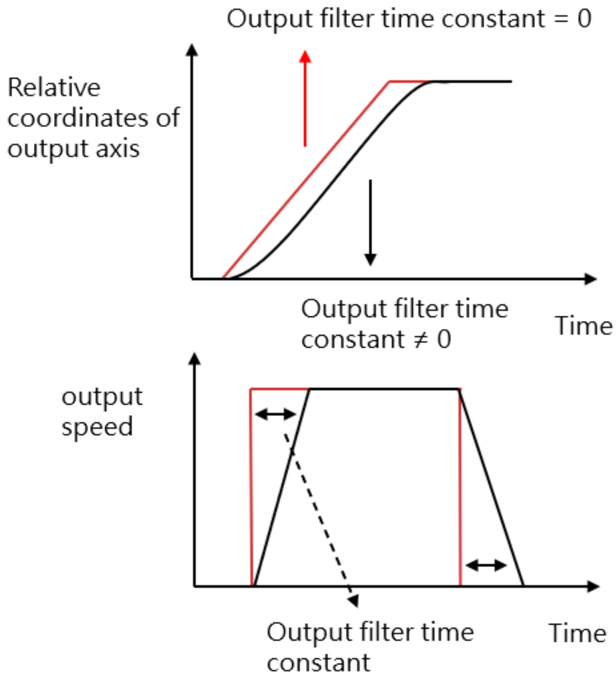
When using the output filtered wave, a filter device can be added for the Cam output.





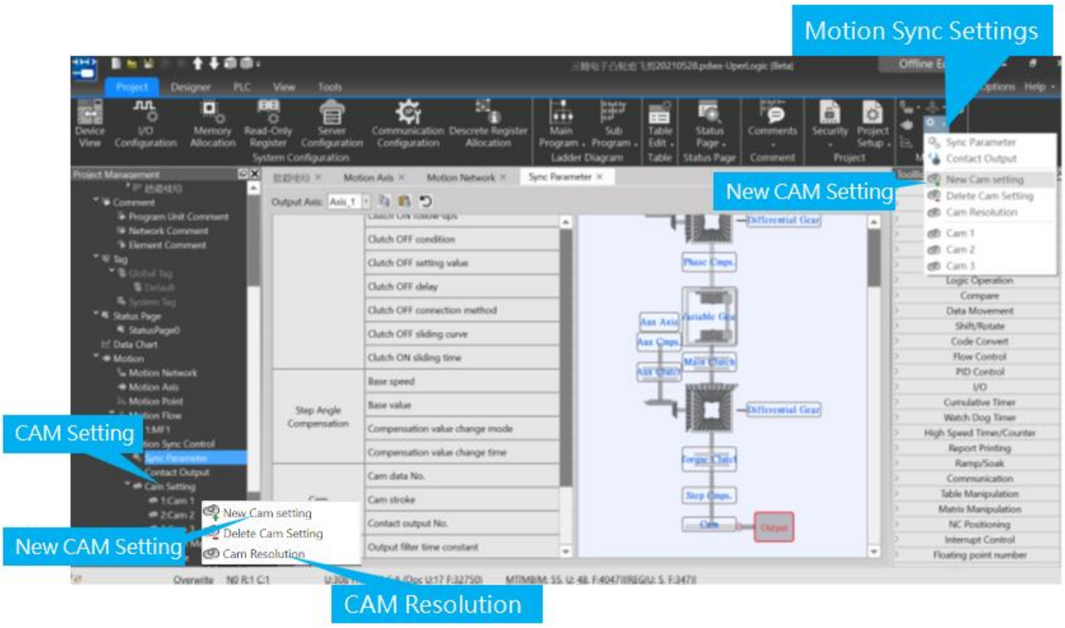
The output filtered wave can inhibit the frequency fluctuation. Even though significant change has occurred at the axis position within a short period of time, the frequency change of the Slave Axis can be inhibited through output filtered wave function.

* If the output filtered wave is too large, it may cause the delay of moving quantity. Therefore, it should be set by considering the delay of moving quantity.

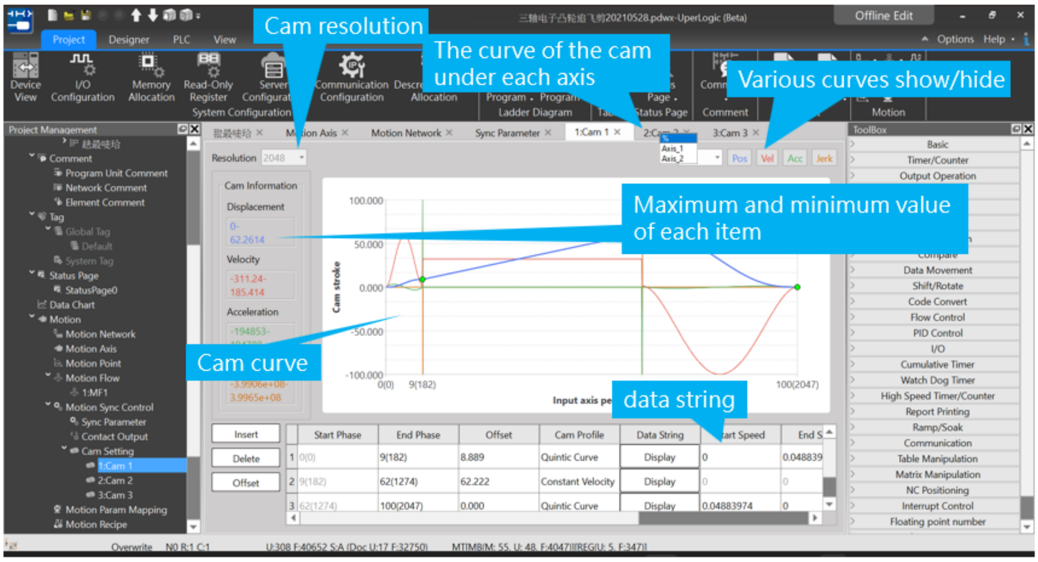


15-4 Synchronous Cam Setting

Please use UperLogic to set the Synchronous Cam. Indicated below is the software homepage after opening the project and it also introduces the Synchronous Cam related functions and setting.

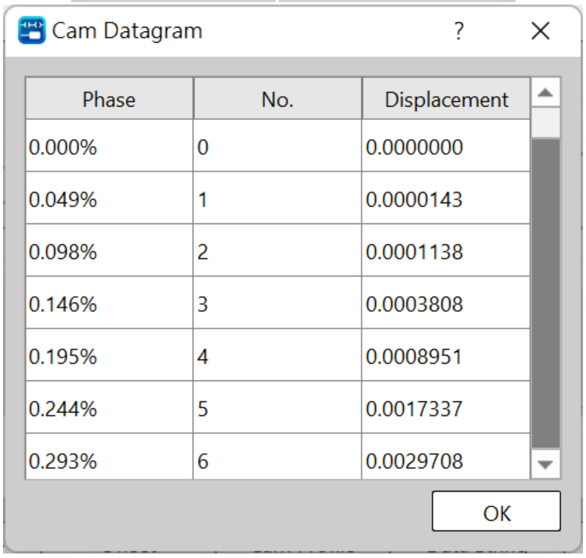


To set the Cam in the homepage, press the mouse right key and click Add New Cam and then the resulting Cam curve will be indicated as in the figure below.



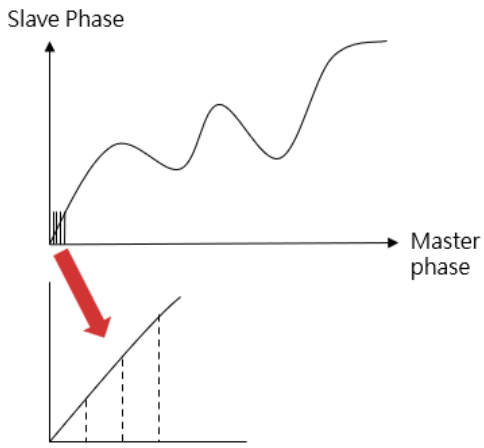
Cam resolution: The resolution of Cam curve. The higher the resolution, the smoother the curve. Based on the point and the Cam profile set by the user, the software will calculate the position of each resolution. Listed below is the relationship of Cam resolution and maximum Cam number. The lower the Cam maximum number, the better the Cam resolution; on the contrary, the higher the Cam maximum number, the lower the Cam resolution.

Cam resolution	Maximum number of cams
2048	16
4096	8
8192	4
16384	2
32768	1


Cam Datagram

Phase	No.	Displacement
0.000%	0	0.0000000
0.049%	1	0.0000143
0.098%	2	0.0001138
0.146%	3	0.0003808
0.195%	4	0.0008951
0.244%	5	0.0017337
0.293%	6	0.0029708

OK

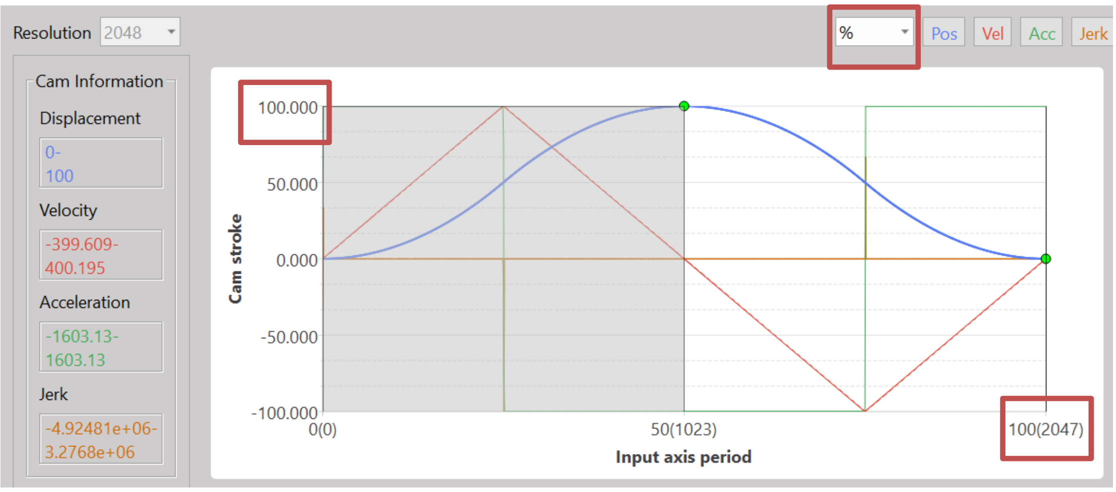


Example: If two sets of Cam curves are used, then the Slave Cam curve of each Master Axis cycle will be segmented into resolution for 16384 points. The finer the resolution, the smoother the curve.

The curve of Cam under different percentage ratios.

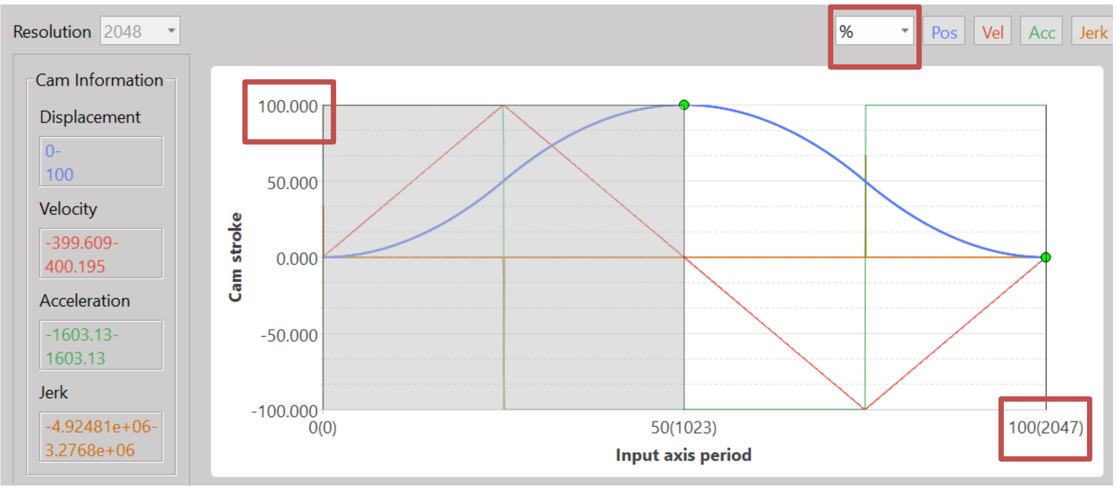
- ➢ Percentage Mode
  - ✓ The Input Axis travel is displayed with percentage (Axis-X)
  - ✓ The Output Axis travel is displayed with percentage (Axis-Y)

Per the figure below:

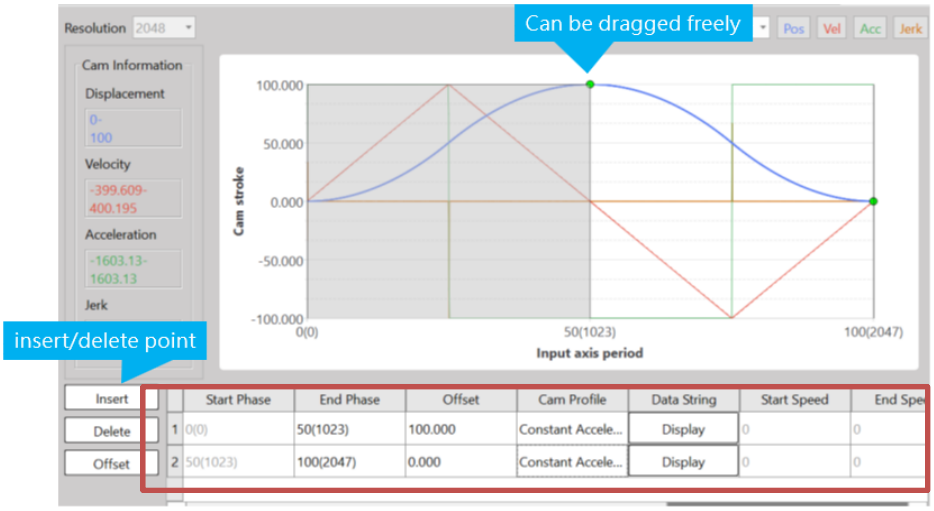


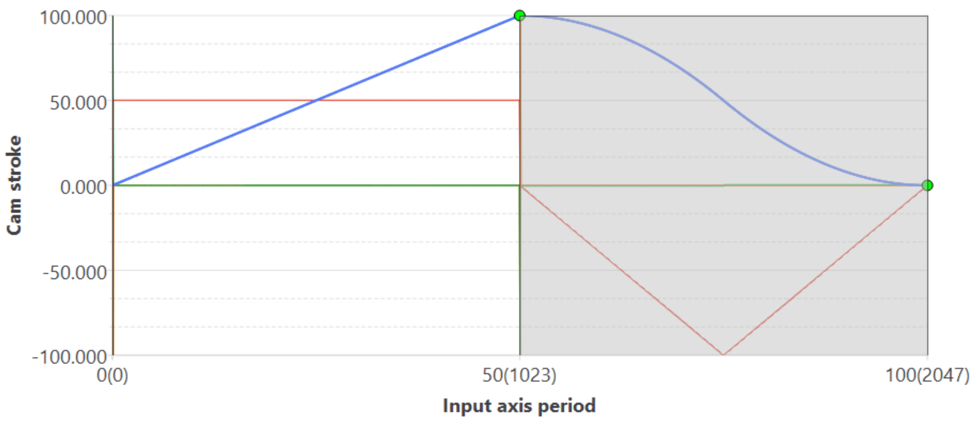
- Such Cam will be used with Axis-2
  - ✓ Input Axis travel: 1000mm (Axis-X)
  - ✓ Output Axis travel: 1000mm (Axis-Y)

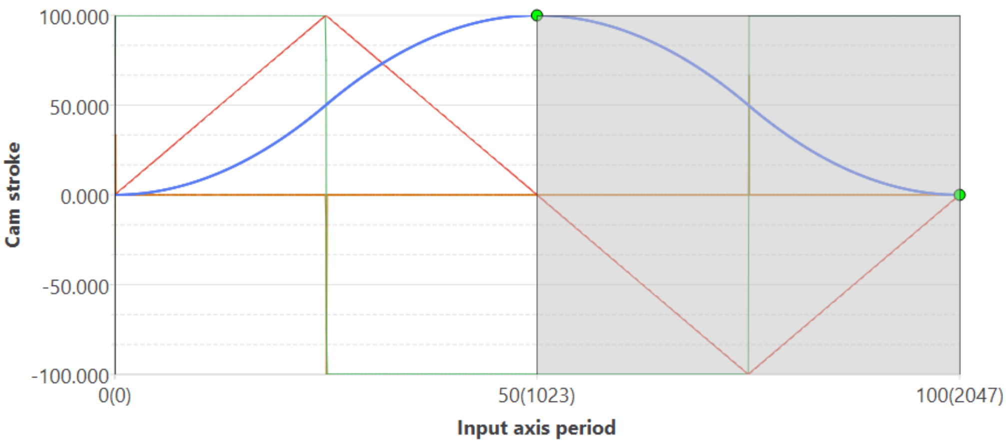
Per the figure below:



To implement the Electronic Cam curve, click the plug-in button and a point will appear in the picture automatically. The user may drag the position of such point directly with the mouse, and the user will also be allowed to change the set value through the table highlighted with the red frame in the figure below.







Definition of Cam curve color:

Blue line: Position

Red line: Speed

Green line: Acceleration

Orange line: Jerk

15-5 Characteristics of Cam Profile

Described below are the characteristics of Cam profile:

The characteristics of Cam profile curve are mainly determined by velocity, acceleration and jerk. Described below are the representing characteristics and meaning:

Velocity (V): The physical quantity used to describe the motion speed and direction of the object and it is proportional to the motion quantity of the Workpiece (P=mV). In terms of control, the faster and heavier the load, the more difficult the control. Steadier control can be achieved by reducing the maximum value of velocity.

Acceleration (A): The acceleration is the rate of change between velocity vector and time, and it is used to describe the velocity direction and the speed resulting from the change of size. Because F=mA is presented in proportional type, the higher the acceleration, the larger the resulting torque and the easier the interference. Therefore, it should be appropriately adjusted according to the required load and inertia.

Jerk (J): It is also termed as jerk, impulse and jump, etc., and is the physical quantity used to describe the changing speed of acceleration. The Jerk is determined by the acceleration changing rate and time. The bigger the jump, the more violent the resulting torque changing rate, and it may lead to collisions or vibrations as well.

When using the Cam profile, it should be selected depending on the intended purpose, such as heavy load control in order to reduce the maximum speed. When executing the high-speed control, it can stabilize the control by reducing the jerk so as to avoid the vibration that may affect the stability and the accuracy of the control.

Provided below are the purpose and description of Cam profile:

1. Constant velocity line: Normally used in reducing the speed and executing the iso-linear motion. It is suitable for controlling the heavy load and low-speed running.
2. Uniform Acceleration: When the maximum value of the acceleration reaches its minimal level, the smallest torque will be produced. Because the speed of uniform acceleration will be discontinued at the point when shifting from acceleration to deceleration, it is therefore more suitable for medium speed.
3. Cycloid: The cycloid speed and the acceleration are continual. It is suitable for high-speed and light-load purposes.
4. Simple harmonic: Because the acceleration at the phase starting and ending point will be discontinued, it would be vulnerable to vibration and is not suitable for high-speed purposes. When executing the turn-around action, it will be suitable for continuous back-and-forth action.
5. Deformed constant velocity: It is suitable for medium-low speed and heavy-load purposes; the

curve characteristics will become steeper in acceleration and displacement change.

6. Deformed trapezoid: The Cam curve widely used. Due to smaller maximum acceleration value, it is suitable for high-speed and light-load purposes.
7. Deformed sinusoidal: Such curve is presented in balanced smooth type. Compared to the deformed trapezoid curve, it will inhibit the maximum speed value. Therefore, it will be safe for use in unknown load or variable purposes.
8. Trapezoid: The maximum speed value of trapezoid curve is higher. Because the acceleration will be executed continuously, it will not produce vibration and is suitable for light-load and high-speed purposes.
9. Single stay cycloid m=1: The cycloid curve applied by single stay. Because it will not become “0” acceleration at the ending phase, it can reduce the maximum value of speed and acceleration; further, the change of acceleration curve will become smoother. Therefore, it will be suitable for high-speed purposes.
10. Single stay cycloid m=2/3: Compared to single stay cycloid m=1, its acceleration curve will become smaller during deceleration. Therefore, it can reach the ending phase in a much smoother way.
11. Single stay trapezoid curve: Because it will not become “0” acceleration at the ending phase, it can achieve a lower maximum speed and acceleration value. Therefore, it will be suitable for light-load and high-speed purposes.
12. Single stay deformed sinusoidal: Because it will not become “0” acceleration at the ending phase, it can reduce the maximum speed and acceleration value. It belongs to a smoother curve showing lower speed and acceleration. Therefore, it will be suitable for medium-load and high-speed purposes.

16

Motion Alarm List

The alarms included in the FATEK M-PLC Alarm List are mainly divided into the following three types: Motion Flow Error Alarm, EtherCAT Communication Error Alarm and Axial Error Alarm. The aforesaid alarms will be stored in the respective Special Register.

16-1 Motion Flow Alarm

The Motion Flow error alarm comprises ID 1–ID 16 Motion control flow error codes and they are stored in R36932–R36947 special registers separately, as per the list below:

Motion Flow ID	**Corresponding Register**
ID 1	R36884
ID 2	R36885
ID 3	R36886
ID 4	R36887
ID 5	R36888
ID 6	R36889
ID 7	R36890
ID 8	R36891
ID 9	R36892
ID 10	R36893
ID 11	R36894
ID 12	R36895
ID 13	R36896
ID 14	R36897
ID 15	R36898
ID 16	R36899
ID 17	R36900
ID 18	R36901
ID 19	R36902
ID 20	R36903

M-PLC Motion Flow error alarm list:

Error Code	**Symptom**	**Description**	**Solution**	**Stop Method**
1	Motion Flow action axis error	Axis error detected when the Flow is running.	Remove the problem according to axis error instructions.	Stop instantly
2	Motion Flow action axis driver error	Driver error detected when the Flow is running.	Remove the problem according to Driver Manual.	Stop running the error axis

3	Motion Flow action axis driver alarm	Driver alarm detected when the Flow is running.	Remove the problem according to Driver Manual.	Stop the axis
4	Motion Flow action error	Computation error detected when the Flow is running.	Recheck the parameter set for the action.	Stop instantly
10	Position action positioning finish overtime	Inspection overtime after completing the action.	Extend the inspection time or add the allowable tolerance.	Stop the error axis
11	Position change target position error	Positioning curve type is incorrect, and only the linear interpolation can be used to change the target position.	Close or change the target position function.	Stop the error axis
20	Position action: Arc auxiliary circle error			Stop the error axis
21	Position action: Arc circular center mode error			Stop the error axis
22	Position action: Arc pass point mode error			Stop the error axis
23	Position action: Arc radius mode error			Stop the error axis

M-PLC Motion Flow error alarm list：R36882, R36883

R36882	**R36883 display**	**Description**	**cause**	**Solution**
1	Motion flow number (01~16) + 00 + error code (1)	Axis error occurred	Axis error occurred	Check the axis error information and troubleshoot the error.
2	Motion flow number (01~16) + 00 + error code (2)	Drive error occurred	Drive error occurred	Check the drive panel and troubleshoot the error.
3	Motion flow number (01~16) + 00 + error code (3)	Drive error occurred	Drive error occurred	Check the drive panel and troubleshoot the error.
4	Motion flow number (01~16) + branch number (01~20) + error code (4) Ex: When a motion block number 11 encounters an initialization error in the second branch, the code will be displayed as 11024.	Motion block initialization error.	Positioning point parameter error.	Identify the error branch , find the point number where the error flow block is running , use software or commands to read the recipe, and obtain and check the parameters of the error point.

16-2 EtherCAT Communication Error Alarm

The error code of EtherCAT communication error alarm is displayed by Special Register R36883. Provided below are the R36883 error alarm codes:

Motion controller status	R36880	R36881	Description	cause	Solution
STATUS_CODE_LINK_LOST	1	0	EtherCAT offline	The EtherCAT cable connecting PLC has been removed.	
STATUS_CODE_INIT_FAILED	2	0	EtherCAT initialization failed	Manually added EtherCAT configuration file is abnormal.	Report the defective drive configuration file to the manufacturer.
STATUS_CODE_ERRTRAP	4	61	EtherCAT slavestation offline	The EtherCAT cable connecting servo drive has been removed.	Check if there is EtherCAT contact failure in the connection cable.
	4	9998	PLC emergency stop.	PLC emergency stop.	After solving the PLC error, restart the system.
	4	others	Other errors.		Note the number of R36881 and report to the manufacturer.

16-3 Action Axis Alarm

The action axis error alarm is stored in Special Register R37004, and each action axis shall correspond to the respective register. Regarding this, "R37004" is used as the special register required for storing Axis-1 error alarm, Axis-2 error alarm special register is R37004+150 and Axis-3 is R37004+300, and so on. Each axis shall accommodate 150 error alarms. Provided below is the special register list for each axis:

Action axis error alarm	**Corresponding Register**
Axis 1	R37004
Axis 2	R37154
Axis 3	R37304
Axis 4	R37454
Axis 5	R37604
Axis 6	R37754
Axis 7	R37904
Axis 8	R38054
Axis 9	R38204
Axis 10	R38354
Axis 11	R38504
Axis 12	R38654
Axis 13	R38804
Axis 14	R38954
Axis 15	R39104
Axis 16	R39254

M-PLC Action Axis Error Alarm List:

Information 1	**code**	**Information 2**	**Description**	**cause**	**Solution**
AXIS_NOT_ENABLE	1	Current flow block number	Action axis is not enabled	Action axis is not enabled before running Motion Flow	Check if the enable relay of the motion axis is off or not triggered.
AXIS_NOT_READY	2	Current flow block number	Action axis is not ready	Encoder not ready before running Motion Flow.	Check if drive status is normal.
AXIS_POS_SW_LIMIT	3	Current flow block numberv	Action axis positive software limit	Action axis reaches positive software limit.	1. Check the axis table setting. 2. Check the

			limit		target position coordinate.
AXIS_NEG_SW_LIMIT	4	Current flow block number	Action axis negative software limit	Action axis reaches negative software limit	1. Check the axis table setting. 2. Check the target position coordinate.
AXIS_POS_LS	5	Current flow block number	Action axis positive software limit switch	Positive limit switch is triggered.	1. Check the device wiring. 2. Check the switch pin configuration. 3. Check the target position coordinate.
AXIS_NEG_LS	6	Current flow block number	Action axis negative software limit switch	Negative limit switch is triggered.	1. Check the device wiring. 2. Check the switch pin configuration. 3. Check the target position coordinate.
AXIS_POS_LS_TRIG_NEG_MOV	7	Current flow block number	The positive limit switch is triggered when moving in negative direction.	The motion direction is opposite to the direction of the limit switches.	1. Check the device wiring. 2. Check the switch pin configuration.
AXIS_NEG_LS_TRIG_POS_MOV	8	Current flow block number	The negative limit switch is triggered when moving in positive direction.	The motion direction is opposite to the direction of the limit switches.	1. Check the device wiring. 2. Check the switch pin configuration.
AXIS_BASE_VEL_OVER_MAX_VEL	9	Current flow block number	The start speed of the axis is higher than the maximum speed value.	The start speed of the axis is higher than the maximum speed value.	Check the maximum speed and start speed set in the axis table.
AXIS_CMD_VEL_OVER_MAX_VEL	10	Current flow block number	The command speed of the axis is higher than the maximum speed value.	The command speed of the axis is higher than the maximum speed value.	1. Check the maximum speed of the target point. 2. Check the maximum speed

					set in the axis table.
AXIS_OCCUPIED	11	Current flow block number	Axis is in use.	The called axis is currently in control.	1. Ensure to wait for the completion of the previous action." 2. Check if the same command is called repeatedly.
AXIS_TORQ_PROTECT	12	Current flow block number	Torque protection is triggered.	The torque feedback exceeds the torque limit scope indicated in the Axis Table.	1. Check if there is any interference between mechanisms. 2. Set the maximum torque in the positive or negative direction to a appropriate value in the axis table settings.
AXIS_POS_ARC_AUXPAR	20	Current flow block number	Positioning: Auxiliary circle calculation error	The auxiliary circle radius setting in position mode is too large.	Set the auxiliary circle radius to an appropriate size.
AXIS_POS_ARC_CENTER	21	Current flow block number	Positioning: Arc circular center mode error	The center of the circular interpolation arc is set incorrectly.	Center of circle,start point and end point coordinates cannot lie on the same line.
AXIS_POS_ARC_BORDER	22	Current flow block number	Positioning: Arc Border Point mode error	The circular interpolation border point is set incorrectly.	Border point,start point and end point coordinates cannot lie on the same line.
AXIS_POS_ARC_RADIUS	23	Current flow block number	Positioning: Arc radius mode error	The circular interpolation radius is set incorrectly.	The diameter length cannot be less than the linear distance between the start and end points.
AXIS_POS_TIME_OUT	24	Current flow block number	Positioning check completed timeout	Positioning check timeout	1. Check if the drive's positioning control response

					is too slow. 2. Increase the pos don tolerance in the axis table. 3. Increase the pos don check time in the axis table.
FLOW_POS_CHG_WRONG_TYPE	25	Current flow block number	Positioning control interruption not supported in the current mode.	Positioning control is using an incorrect interrupt mode.	Interrupt constant feed and interrupt constant angle cannot be used in multi-axis interpolation.
AXIS_HOMING_FAIL	29	Current flow block number	Homing failure	Doesn't found the home signal during homing process.	1. Check the device wiring. 2. Check the switch pin configuration.
AXIS_POS_PTYE	30	Current flow block number	Point table parameter operation mode error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_POS_CTYPE	31	Current flow block number	Point table parameter acceleration profile error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_POS_PROFILE	32	Current flow block number	Point table parameter speed planning error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of

					the mapping parameters from the manual.
AXIS_POS_ACCPER	33	Current flow block number	Point table parameter S-curve acceleration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_POS_DECPER	34	Current flow block number	Point table parameter S-curve deceleration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_POS_CIRMODE	35	Current flow block number	Point table parameter arc mode error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_POS_CIRDIR	36	Current flow block number	Point table parameter arc direction error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_POS_CIRRAD	37	Current flow block number	Point table parameter arc radius error.	Mapping illegal values.	1. Confirm the correct range from the PLC software.

					2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_POS_NEXTPOINT	38	Current flow block number	Point table parameter continuous point number error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_POS_CONTIMODE	39	Current flow block number	Point table parameter continuous mode error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_OVER_REVERSE	50	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_ECAM_SWITCH	51	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_UNIT	52	Current flow	Sync	Mapping illegal	1. Confirm the

		block number	parameter table configuration error.	values.	correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_FRACTION	53	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_INPUT_INIT	54	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_CAM_INIT	55	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_IN1_TYPE	56	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping

					parameters from the manual.
AXIS_SYNC_IN1_EXTNUM	57	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_IN1_AXISNUM	58	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_IN1_REVERSE	59	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_IN1_TRANS_METHOD	60	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_IN1_TRANS_DEN	61	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the

					correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_IN2_TYPE	62	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_IN2_EXTNUM	63	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_IN2_AXISNUM	64	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_IN2_REVERSE	65	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_IN2_TRANS_METHOD	66	Current flow block number	Sync parameter	Mapping illegal values.	1. Confirm the correct range

			table configuration error.		from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_IN2_TRANS_DEN	67	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_INA_TYPE	68	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_INA_EXTNUM	69	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_INA_AXISNUM	70	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from

					the manual.
AXIS_SYNC_INA_REVERSE	71	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_INA_TRANS_METHOD	72	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_INA_TRANS_DEN	73	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_MAIN_CMP_MODE	74	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_AUX_CMP_MODE	75	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data

					length and sign of the mapping parameters from the manual.
AXIS_SYNC_GEAR_DEN	76	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_GEAR_MODE	77	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_MCLUTCH_ON_COND	78	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_MCLUTCH_ON_METHOD	79	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_MCLUTCH_ON_SLIDE_MODE	80	Current flow block number	Sync parameter table	Mapping illegal values.	1. Confirm the correct range from the PLC

			configuration error.		software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_MCLUTCH_ON_SLIDE_CURVE	81	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_MCLUTCH_OFF_COND	82	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_MCLUTCH_OFF_METHOD	83	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_MCLUTCH_OFF_SLIDE_MODE	84	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.

AXIS_SYNC_MCLUTCH_OFF_SLIDE_CURVE	85	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_ACLUTCH_ON_COND	86	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_ACLUTCH_ON_METHOD	87	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_ACLUTCH_ON_SLIDE_MODE	88	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_ACLUTCH_ON_SLIDE_CURVE	89	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of

					the mapping parameters from the manual.
AXIS_SYNC_ACLUTCH_OFF_COND	90	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_ACLUTCH_OFF_METHOD	91	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_ACLUTCH_OFF_SLIDE_MODE	92	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_ACLUTCH_OFF_SLIDE_CURVE	93	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_TCLUTCH_STOP_METHOD	94	Current flow block number	Sync parameter table configuration	Mapping illegal values.	1. Confirm the correct range from the PLC software.

			error.		2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_TCLUTCH_CON_METHOD	95	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_TCLUTCH_JOGSPEED	96	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_STEP_CMP_MODE	97	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_ECAM_ID	98	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_CONT	99	Current flow	Sync	Mapping illegal	1. Confirm the

ACT_NUM		block number	parameter table configuration error.	values.	correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_SYNC_PERIOD_ZERO	100	Current flow block number	Sync parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software.2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_DATA_ENCFALG	110	Current flow block number	Motion axis parameter table configuration error	Mapping illegal values.	1. Confirm the correct range from the PLC software.2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_DATA_UNIT	111	Current flow block number	Motion axis parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software.2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_DATA_FRACTION	112	Current flow block number	Motion axis parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software.2. Confirm the correct data length and sign of the mapping

					parameters from the manual.
AXIS_DATA_VELUNIT	113	Current flow block number	Motion axis parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software.2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_DATA_STOPMETHOD	114	Current flow block number	Motion axis parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software.2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_DATA_QSTOPDEC	115	Current flow block number	Motion axis parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software.2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_DATA_HOMEMODE	116	Current flow block number	Motion axis parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software.2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_DATA_SIGSOURCE	117	Current flow block number	Motion axis parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software.2. Confirm the

					correct data length and sign of the mapping parameters from the manual.
AXIS_DATA_HOMEDIR	118	Current flow block number	Motion axis parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software.2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_DATA_HOMEBIT	119	Current flow block number	Motion axis parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software.2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_DATA_JOGPROFILE	120	Current flow block number	Motion axis parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software. 2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_DATA_SOFTLIMIT	121	Current flow block number	Motion axis parameter table configuration error.	Mapping illegal values.	1. Confirm the correct range from the PLC software.2. Confirm the correct data length and sign of the mapping parameters from the manual.
AXIS_FLOW_ERROR	190	Current flow block number	Motion flow error	Motion flow occurs an error	Troubleshoot the faulty axis or

				and sync control stop.	other factors causing the error.
AXIS_MAPPING_ERROR	193	Error mapping table number	Mapping parameter error	Parameter out of range in mapping table or function 181.	Confirm the correct mapping parameter number from the manual.
AXIS_UPDATE_ERROR	194	0	Ladder instruction update parameter error	Ladder instruction UPD updated an invalid value.	Identify the instruction reporting ERR and check for inputted values that might be inappropriate.
AXIS_DRIVE_ERROR	200	Current flow block number	Drive error.	After connecting the axis, a drive error. occurred.	1. After troubleshooting, restart the device. 2. After troubleshooting, reset axis to clear the error.

M-PLC Axis warning detail information：

Information 1	code	Information 2	Description	cause	Solution
AXIS_HOMING_SMALL_DEC	27	Current flow block number	Homing deceleration zone beyond the home position range.	During the deceleration process to creeping velocity while homing, the deceleration should be completed within the home sensing area.	1. Increase homing mode deceleration value. 2. Increase the range of the home sensing area.
AXIS_FLOW_END	189	Current flow number	Motion flow stops when axis control is active.	Motion flow is stopped or enters the end flow block when axis is in control.	1. Check if the logic is correct. 2. Reset axis to clear the error.
AXIS_FLOW_ESTOP	191	Current flow block number	Motion flow emergency stop	Motion aborted while in axis control.	1. Check if the logic is correct. 2. Reset axis to clear the error.
AXIS_FLOW_DECS	192	Current flow	Motion flow	Motion aborted	1. Check if the

TOP		block number	deceleration stop	while in axis control.	logic is correct. 2. Reset axis to clear the error.

17

Motion Probe

17-1 Probe Number

0: Off

1: Input with external signal

2: Use encoder Z-phase signal

17-2 Probe Mode

0: Single trigger, Rising trigger

1: Continuous trigger, Rising trigger

2: Single trigger, Falling trigger

3: Continuous trigger, Falling trigger

17-3 Information of Probe Register

No.	Name	Description
M10617	Axis Probe Function ON	High Pos: ON Low Pos: Off
M10618	Axis Probe Function Reset	Rising Trigger
M11268	Axis Probe Triggering Status	High Pos: Status ON Low Pos: StatusOFF
DR37042	Axis Driver Probe Coordinates	Displays probe coordinates for axis drive feedback

18

Motion Example Application

18-1 Interrupt Constant Feed

Background

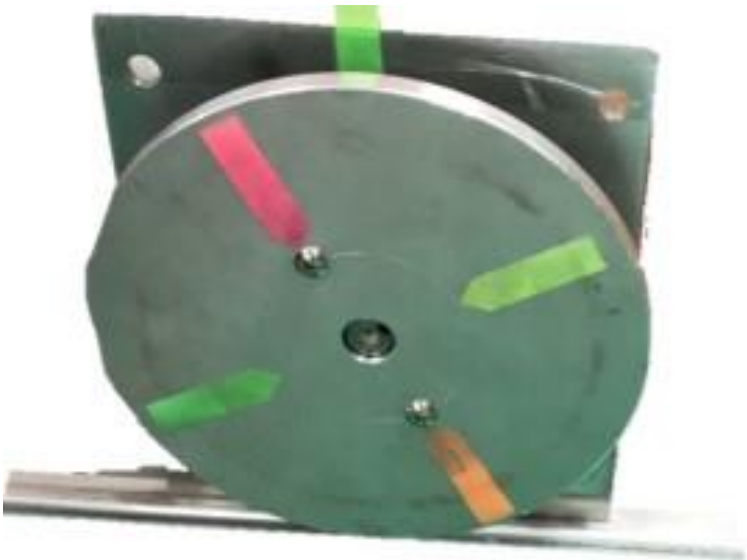
The grinding machine is a common grinding tool, which uses the grinding wheel to grind or cut the surface of the material to be processed when it rotates at a high speed, so as to achieve the purpose of processing and dressing.

The grinding machine is mainly composed of motor, grinding wheel, grinding wheel support, support arm, protective cover and other components. The grinding wheel is the most critical part of the grinding machine, and its material, shape, size and abrasive grains will affect the processing effect and safety performance of the grinding machine.

Grinding machines are widely used, for example, in metal processing, wood processing, glass processing, ceramic processing, stone processing, rubber processing and other industries. If the grinding wheel needs to be replaced, it needs to be replaced from a fixed angle due to the fixing method of the grinding wheel; therefore, the interrupt constant angle function will be used. When the stop button is pressed, the grinding wheel will decelerate and stop according to the set deceleration and stop at the specified angle.

The case is the control situation that needs to be used when simulating the control of the grinding machine.

The structure of this case is as follows:



Use the disc to simulate the mechanism of the grinding wheel (high inertia), and use the note paper as a positioning aid:

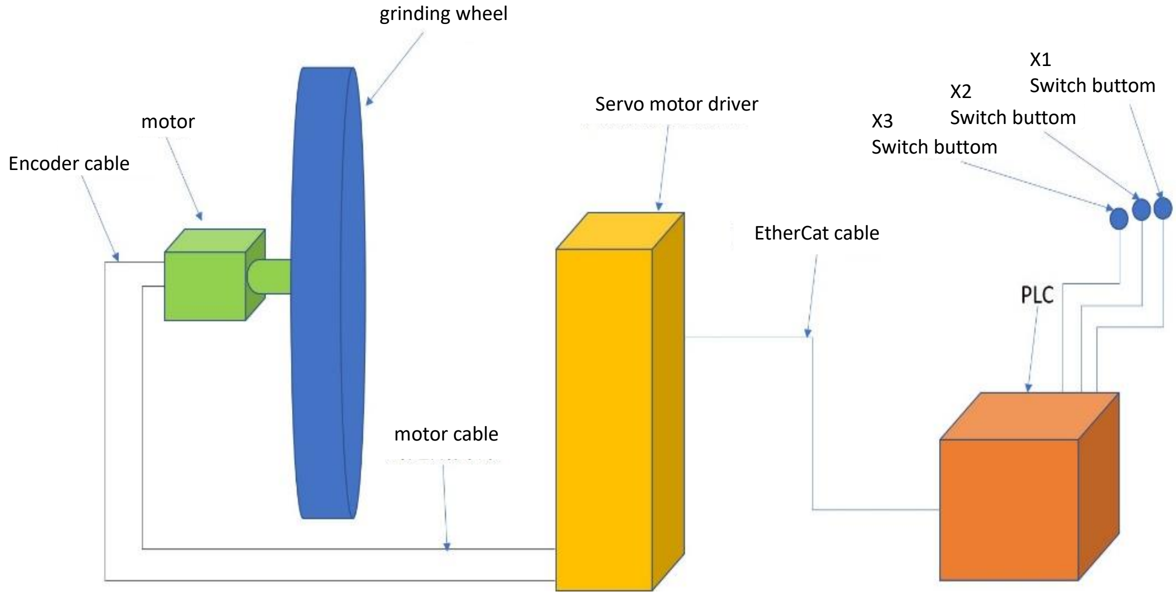
Connect the driver of the servo motor and use Ether Cat communication to communicate with M PLC:

As a button switch for cutting speed and controlling the rotation and stopping of the disc at a specific angle, X1 is used for rotation or stop, X2 is 3000deg/s, X4 is 15000deg/s, and if neither is used, it is 9000deg/s.

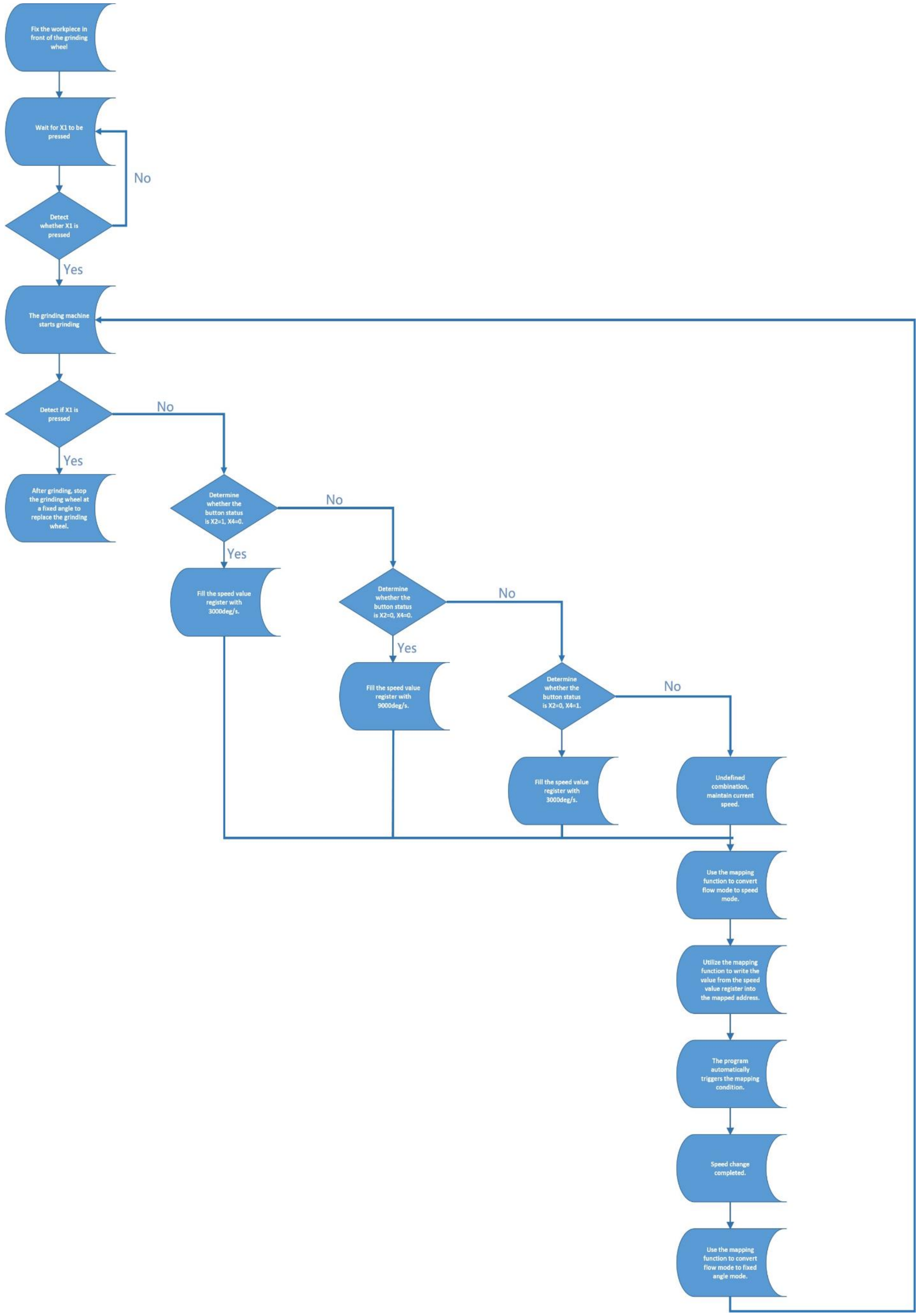
Flow Control

This case consists of 1-axis rotation. By setting different speed controls, the different speeds required to deal with different materials can be simulated, thereby improving the grinding efficiency. After use or when the grinding wheel needs to be replaced, it can stop at a fixed position to For the replacement and maintenance of the subsequent grinding wheel, and because the inertia of the grinding wheel is generally large and the grinding wheel cannot be retracted, it is necessary to decelerate and stop with the set deceleration when stopping, and let the final stop position be the desired position. For the set angle, the direction cannot be reversed during the process.

The schemetic diagram is as follows:



Flow control of the case is as follows:



Program Design

This case simulates the need to switch the speed of the grinding wheel due to different material properties of the object to be ground, and it will maintain a fixed speed after switching until the speed is changed or stopped.

Because it needs to be combined with the interrupt fixed angle function, the single-axis speed operation mode of the point table can be used to keep the disc running at a fixed speed.

The Point Table setting is as below:

	Comment	Operation Mode	Axis	Target Position	Velocity	Acceleration	Deceleration	Acce. Profile
1		Single Velocity	M: Axis_1	Negative	9000 deg/s	9000 deg/s²	4500 deg/s²	T-Curve
2		Unused						
3		Unused						
4		Unused						

Fig. 1: Control Point Table of the case

In the program behavior part, the motor needs to be excited after the EtherCat communication is completed, and the command FUN176 MFFlowStart is used to enter the FLOW control process execution point table. The motion control process part is as follows:

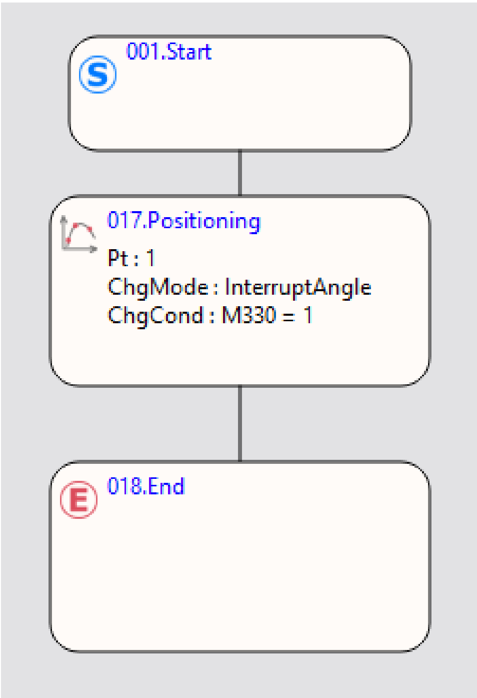


Fig. 2: Flow Chart

Among them, you need to double-click the positioning control box twice to set the change behavior, change the change behavior to "Interrupt Constant Angle", and write the change condition. This uses M330=1 as the condition,

Because axis 1 is used, check axis 1 to enable it. Part of the changed value must be filled in the fixed angle when stopping. The positioning control setting is as shown in the figure below:

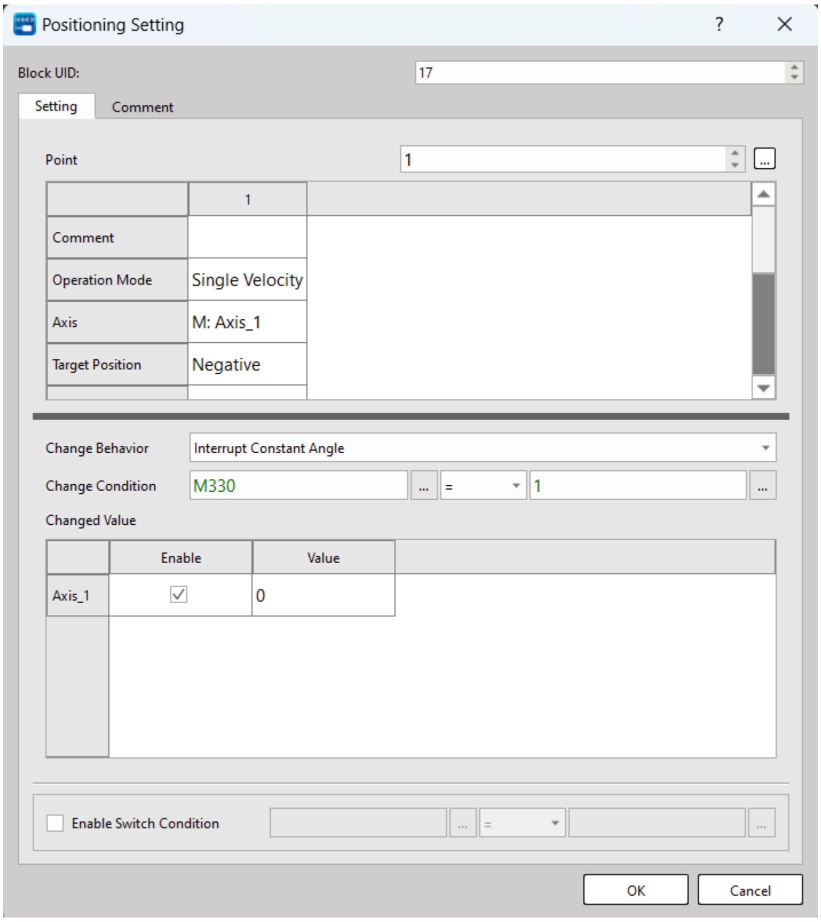


Fig. 3: Position Control setting

After the setting is completed, due to the design requirement, this case can switch the speed during operation. When the speed switch button is triggered, the speed value corresponding to the button combination will be written into the register to be mapped, and the change of the button combination will be proposed. The signal M340 ON is used for the Ladder program that subsequently changes the mode to change the speed value.

After the speed cut button is triggered, the ladder diagram program for writing the speed value and signal is as follows:

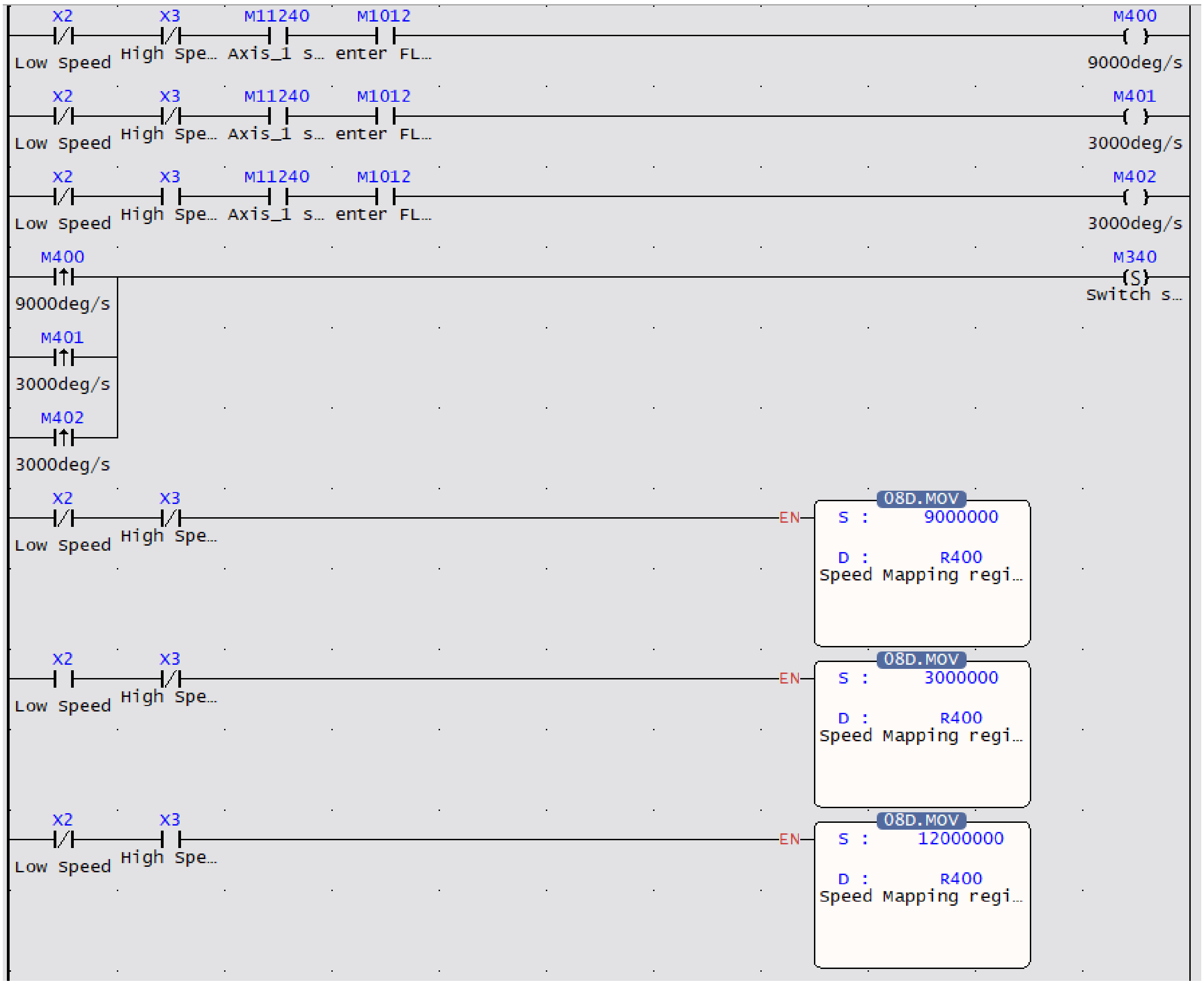


Fig. 4: Ladder diagram of speed triggered switch button

When the button changes, it will automatically change the mode to the speed change mode, and write the value into the value of the changed value through the different speed (variable) of the command FUN181 MFChgTbPrm, and trigger the change condition, that is, M330 ON, and then change Return to the interrupt fixed angle mode, wait for the next change of the shift button or the stop button (triggered by the interrupt fixed angle change button), the Ladder automatically changes the mode to write the speed and then switch back to the fixed angle program part as shown in the figure below:

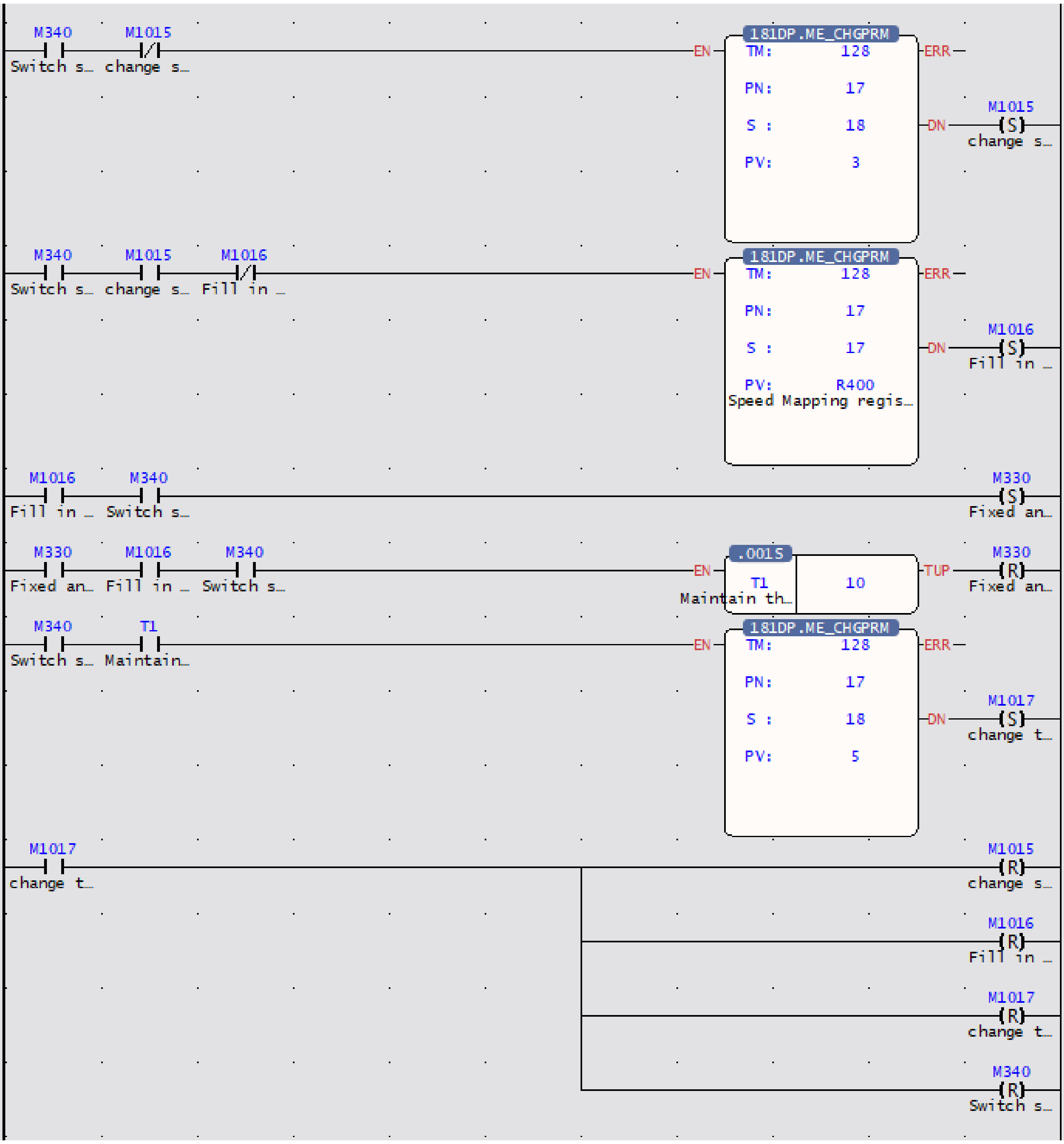
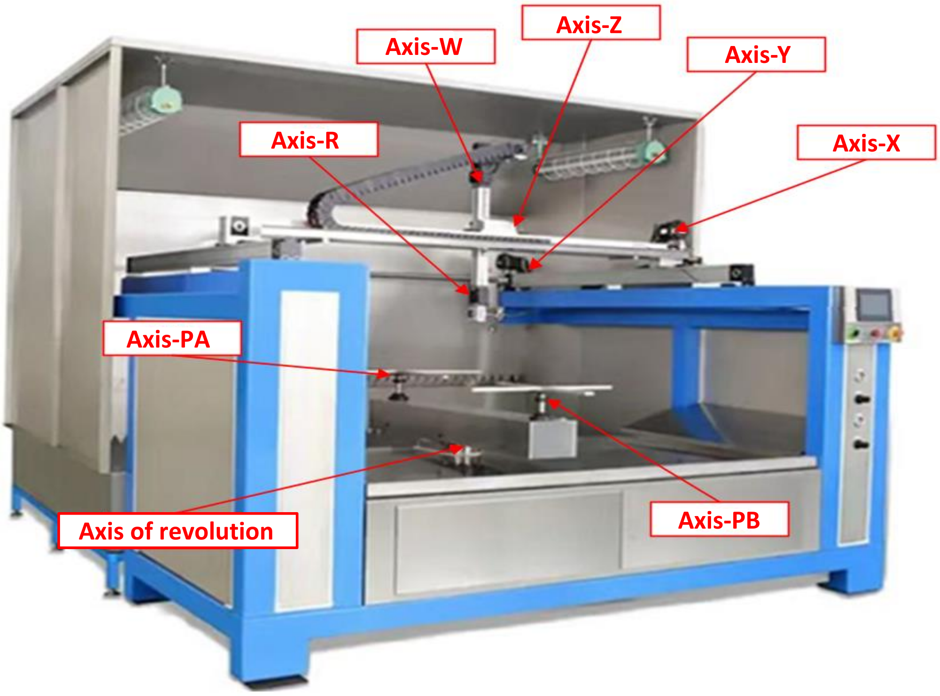


Fig. 5: Ladder diagram for switching modes to write speed

18-2 6-axis Spraying Machine

Mechanic Structure

The 6-axis bus spraying machine is a mechanical reciprocating spraying method that is different from robot automatic spraying and fixed automatic spraying equipment. As the name implies, reciprocating is from left to right, then from right to left (similarly from front to back, from back to front). The paint spraying machine is to fix the spray gun and the spraying machine together, so that reciprocating spraying can be realized. Its main advantages are whether it can track the spraying of the workpiece and improve a certain production efficiency. In addition, it can save part of the paint by allowing the gun to follow the spraying of the workpiece. The second is that it is more flexible and can set the speed repeatedly, and the program is simple, which is much cheaper than the cost of robots and operating costs. The structural analysis 6-axis bus spraying machine of the is as follows:



Axis-X：Move left and right　　Axis-W：Spray gun swings up and down

Axis-Y：Move forward and backward　　Axis-R：Rotating parallel to the spraying gun

Axis-Z：Move up and down

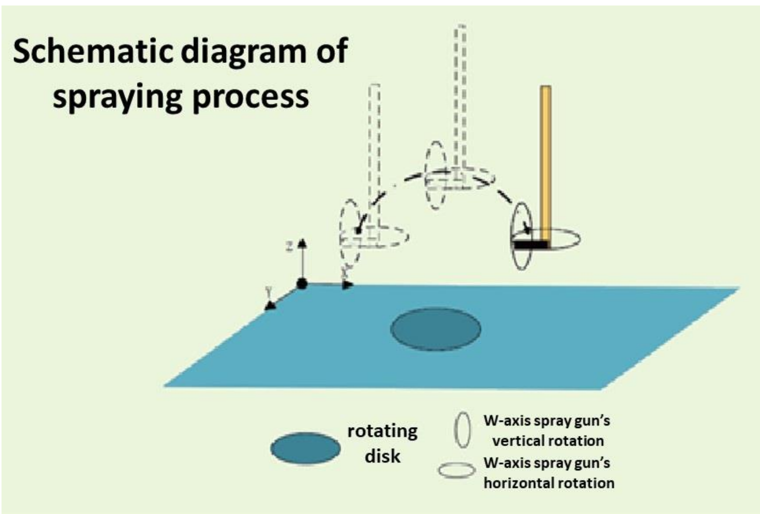
Axis-PA, PB：Rotating parallel to the product spraying platform

Axis of revolution：Switch product spraying platform

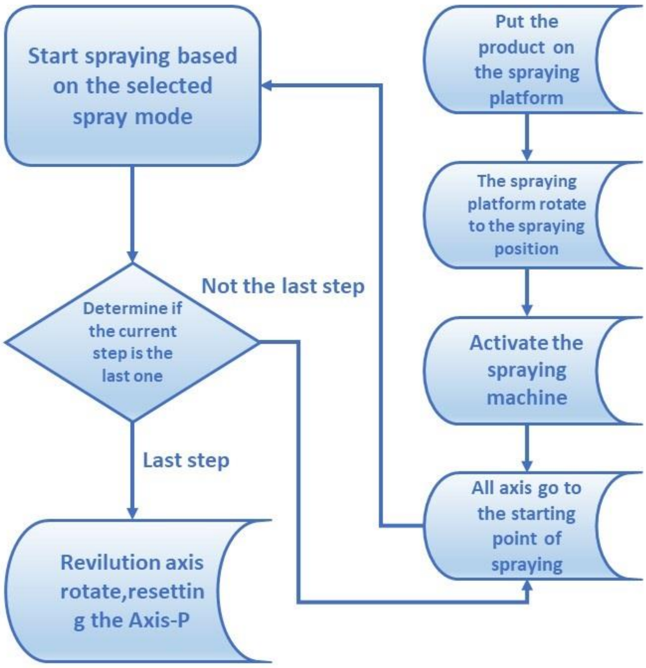
Axis-X of 6-axis reciprocating spraying machine is responsible for the left and right movement of the painting module as shown in the figure below. The Y axis is responsible for the forward and backward movement of the painting module. The Z axis is responsible for the up and down movement of the spray gun. The W axis is responsible for the up and down swing of the spray gun. The R axis is responsible for the rotating parallel to the spraying gun. The rotation on the spraying platform, through the multi-axis coordinated action, can ensure that all surfaces of the product can be painted, and the revolution axis is responsible for switching the worktable, so that when one workbench is painting, the other workbench can carry out the product The loading and unloading work ensures that the painting work can be carried out at all times, which greatly improves the spraying efficiency of the product.

Flow Control

According to the requirements of the production process, the 6-axis spraying machine is mainly composed of X-axis, Y-axis, Z-axis, W-axis, R-axis, P-axis plus a revolution. By setting the cooperation between different axes, the spray gun can move along different The trajectory action constitutes the spraying action process. The schematic diagram of the spraying process of the 6-axis bus spraying machine is as follows.



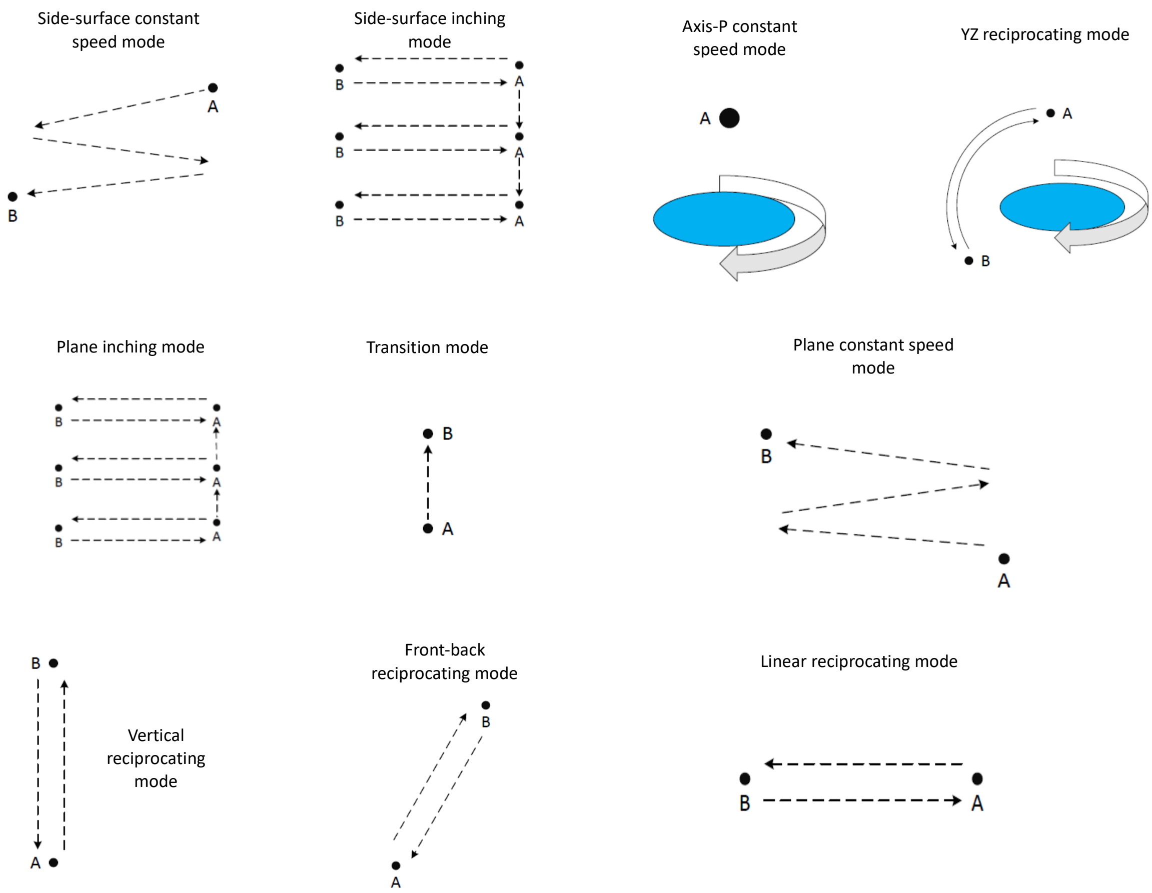
Control Flow of the 6-axis bus spraying machine is sjown below:



Program Design

Ordinary Plane Spraying

6-axis bus spraying machine can carry out Ordinary Plane Spraying and special-shaped curved surface spraying. Ordinary plane spraying is suitable for products with regular and flat surfaces, such as flat plates in furniture, some flat parts in toys and auto parts; special-shaped Arc surface spraying is usually used for spraying on the surface of arc-shaped parts of automobiles. During the spraying process, the angle between the spray gun and the product surface needs to be kept consistent to ensure the pass rate of the product. Ordinary plane spraying mode is shown in the figure below:



Schematic diagram of ordinary plane spraying mode

The motion trajectory of the 6-axis bus spraying machine is to select the set motion mode, modify the starting point and end point, and set the motion control mode of each step in the form of position control data table. At the same time, the acceleration and deceleration time can be set separately. The acceleration and deceleration mode can also be set to S-shaped acceleration and deceleration, and the speed of each step can also be modified independently; in this way, the action coordination of 60 steps can be realized, which further meets the process requirements of product spraying. The motion control point table of the 6-axis bus spraying machine is shown in Figure 1, and the setting program is shown in Figure 2

Display Setting | Display all | Exoprt | Imoprt | Point Preview Chart

Point List

	Comment	Operation Mode	Axis	Target Position	Velocity	Acceleration	Deceleration
26	Plane X-axis to start point	Single/ABS	M: Axis-1	10 mm	100 mm/s	10000 mm/s²	10000 mm/s²
27	Plane YZ interpolation	Linear(2Axis)/A...	M: Axis-2 I1: Axis-3	(10, 10)mm	100 mm/s	10000 mm/s²	10000 mm/s²
28	Plane W-axis to end point	Single/ABS	M: Axis-4	10.0 mm	100.0 mm/s	10000.0 mm/s²	10000.0 mm/s²
29	Plane R-axis to start point	Single/ABS	M: Axis-5	10.0 mm	100.0 mm/s	10000.0 mm/s²	10000.0 mm/s²
30	Plane inching,X-axis to end point	Single/ABS	M: Axis-1	10 mm	1000 mm/s	50000 mm/s²	50000 mm/s²
31	Plane inching,X-axis to start point	Single/ABS	M: Axis-1	100 mm	1000 mm/s	50000 mm/s²	50000 mm/s²
32	Plane inching,Y-axis inching	Single/INC	M: Axis-2	10 mm	1000 mm/s	50000 mm/s²	50000 mm/s²
33	Side-surface constant speed,X-axis to end point	Single/ABS	M: Axis-1	10 mm	1000 mm/s	50000 mm/s²	50000 mm/s²
34	Side-surface constant speed,X-axis to start point	Single/ABS	M: Axis-1	100 mm	1000 mm/s	50000 mm/s²	50000 mm/s²
35	Side-surface constant speed,Z-axis to end point	Single/ABS	M: Axis-3	10 mm	1000 mm/s	10000 mm/s²	10000 mm/s²
36	Side-surface inching,X-axis to end point	Single/ABS	M: Axis-1	10 mm	1000 mm/s	50000 mm/s²	50000 mm/s²
37	Side-surface inching,X-axis to start point	Single/ABS	M: Axis-1	100 mm	1000 mm/s	50000 mm/s²	50000 mm/s²
38	Side-surface inching,Z-axis inching	Single/INC	M: Axis-3	10 mm	1000 mm/s	100000 mm/s²	100000 mm/s²
39	Vertical reciprocating,Z-axis to end point	Single/ABS	M: Axis-3	10 mm	1000 mm/s	100000 mm/s²	100000 mm/s²
40	Vertical reciprocating,Z-axis to start point	Single/ABS	M: Axis-3	10 mm	1000 mm/s	100000 mm/s²	100000 mm/s²
41	Front-back reciprocating,Y-axis to end point	Single/ABS	M: Axis-2	10 mm	1000 mm/s	100000 mm/s²	100000 mm/s²

Fig. 1: Table of motion control points of 6-axis bus spraying machine

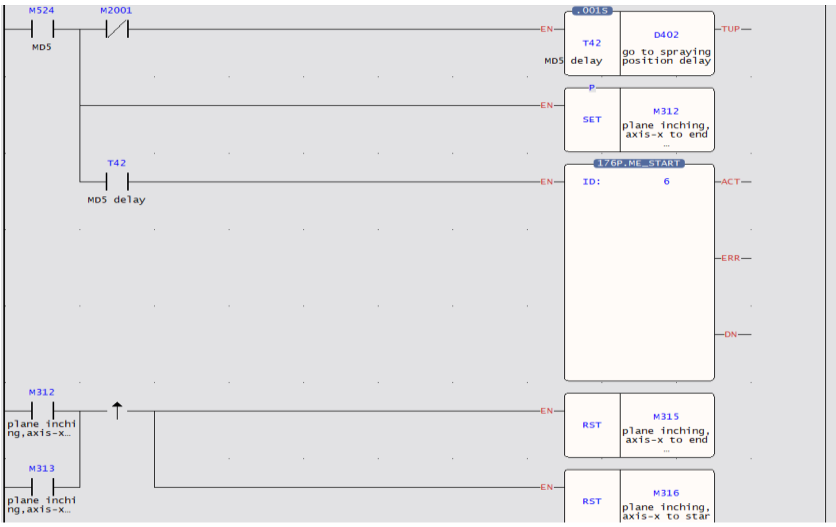


Fig. 2: Part of the program of the motion control trajectory of the 6-axis bus spraying machine

Special-shaped Curved Surface Spraying

The special-shaped curved surface spraying needs to determine the spraying mode according to the size and placement of the product. There are X, Y axis arc R axis follow, X, Z axis arc W axis follow, Y, Z axis arc W axis follow 3 arc mode It can be selected by customers, and the speed of action and the size of the arc can be adjusted. According to the customer's product requirements, choose to walk the arc or the arc surface, so as to meet the customer's spraying process requirements. Figure 4-8 shows the schematic diagram of the special-shaped curved surface spraying mode.

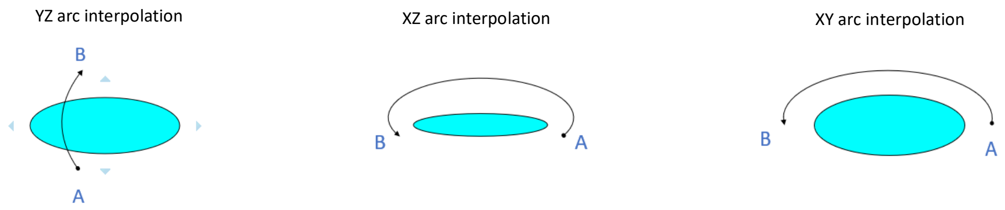


Fig. 3: Schematic diagram of spraying mode on special-shaped curved surface

The arc or arc spraying trajectory of the 6-axis bus spraying machine is mainly determined by selecting the preset position control table, setting the passing point, starting point, end point and speed of the trajectory on the host computer operation interface, and saving these data in the HMI downloads all motion trajectory data to PLC when actions are required, and PLC then performs spraying process actions according to the order of the trajectory selected by the steps. The motion trajectory preset table of the 6-axis bus spraying machine is shown in Figure 3, and the trajectory setting table is shown in Figure 4.

Display Setting Display all Exoprt Imoprt Point Preview Chart

Point List

	Comment	Operation Mode	Axis	Target Position	Velocity	Acceleration	Deceleration
49		Unused					
50	XY arc interpolation to end point	Helical/ABS	M: Axis-1 I1: I2 I2: I3	(10, 10, 10)mm	1000 mm/s	10000 mm/s²	10000 mm/s²
51	XY arc interpolation to start point	Helical/ABS	M: Axis-1 I1: I2 I2: I3	(0, 0, 0)mm	1000 mm/s	10000 mm/s²	10000 mm/s²
52	XY arc interpolation, Z-axis to end point	Single/ABS	M: Axis-3	10 mm	1000 mm/s	100000 mm/s²	100000 mm/s²
53	XY arc interpolation to end point	Helical/ABS	M: Axis-1 I1: I2 I2: I3	(10, 10, 10)mm	1000 mm/s	10000 mm/s²	10000 mm/s²
54	XY arc interpolation to start point	Helical/ABS	M: Axis-1 I1: I2 I2: I3	(0, 0, 0)mm	1000 mm/s	10000 mm/s²	10000 mm/s²
55		Unused					
56		Unused					
57		Unused					
58		Unused					
59		Unused					
60	XZ arc interpolation to end point.	Helical/ABS	M: Axis-1 I1: I2 I2: I3	(10, 10, 10)mm	1000 mm/s	10000 mm/s²	10000 mm/s²
61	XZ arc interpolation to start point	Helical/ABS	M: Axis-1 I1: I2 I2: I3	(10, 10, 10)mm	1000 mm/s	10000 mm/s²	10000 mm/s²
62	XZ arc interpolation, Y-axis to end point	Single/ABS	M: Axis-2	10 mm	1000 mm/s	10000 mm/s²	10000 mm/s²
63	XZ arc interpolation to end point	Helical/ABS	M: Axis-1 I1: I2 I2: I3	(10, 10, 10)mm	1000 mm/s	10000 mm/s²	10000 mm/s²
64	XZ arc interpolation to start point	Helical/ABS	M: Axis-1 I1: I2 I2: I3	(10, 10, 10)mm	1000 mm/s	10000 mm/s²	10000 mm/s²

Fig. 4: Motion track preset table of 6-axis bus spraying machine

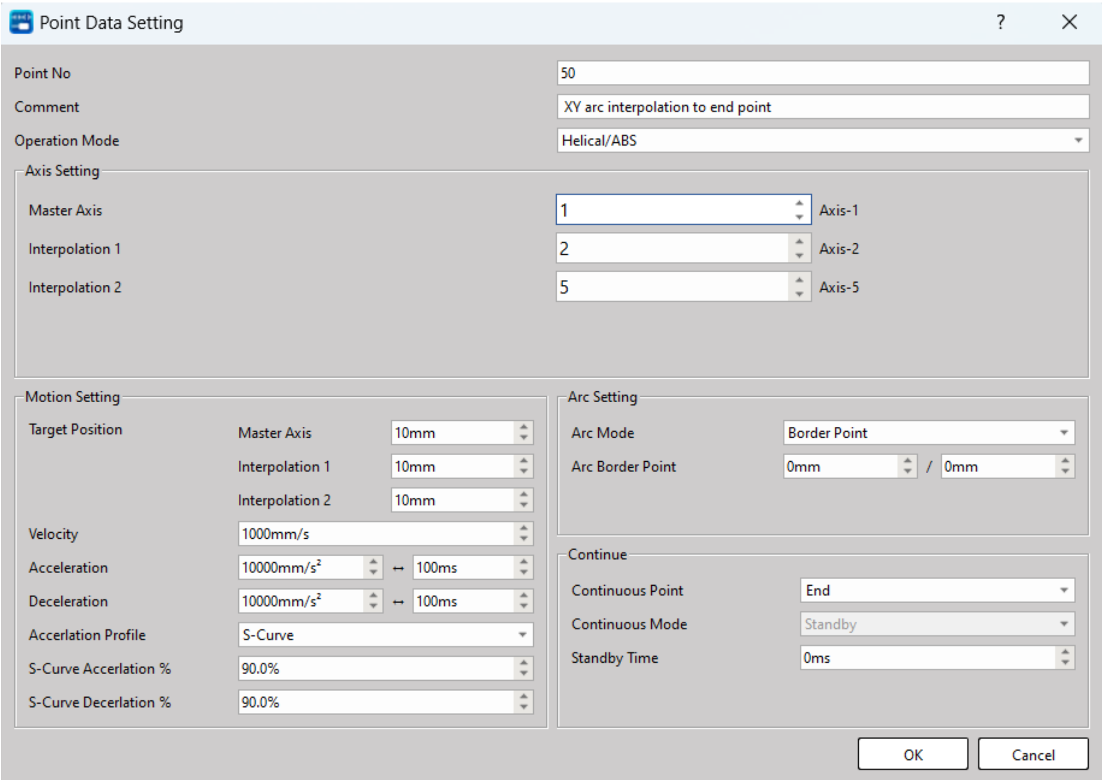
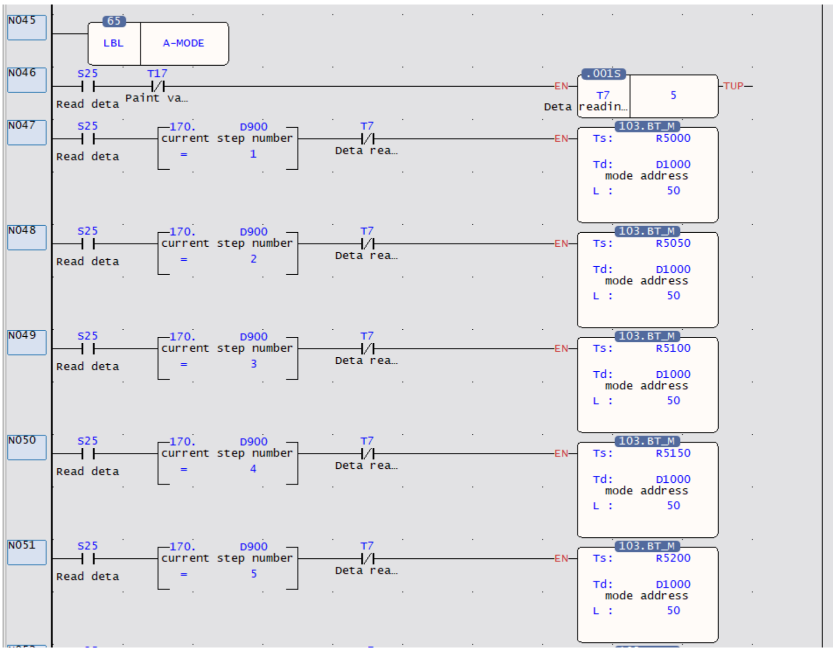


Fig. 5: Motion track setting form of 6-axis bus spraying machine

After the 6-axis bus spraying machine is started, it operates according to the set steps. After completing one step, it reads the data of the next step, and performs the next step according to the set data. When the program runs and reads the next step without setting the action, then Indicates that the spraying action of the current product has been completed, execute the revolution to rotate the current spraying platform, and restart the spraying work of the next product from the first step. The step reading program of the 6-axis bus spraying machine is as shown in the figure below.



6-axis bus spraying machine steps to read part of the program

Spiral Interpolation Control

In the spraying process of special-shaped curved surface products, the angle of the spray gun and the product needs to be consistent. Through the spiral interpolation algorithm, the two axes can draw arcs, and the third axis can follow the linear interpolation, so as to realize the circular arc. During the process, swing the spray gun from time to time so that the angle of the spray gun is consistent with the product. The helical interpolation trajectory demonstration is shown in Figure 5, and the spiral

interpolation program control of the 6-axis bus s is shown in Figure 6 。

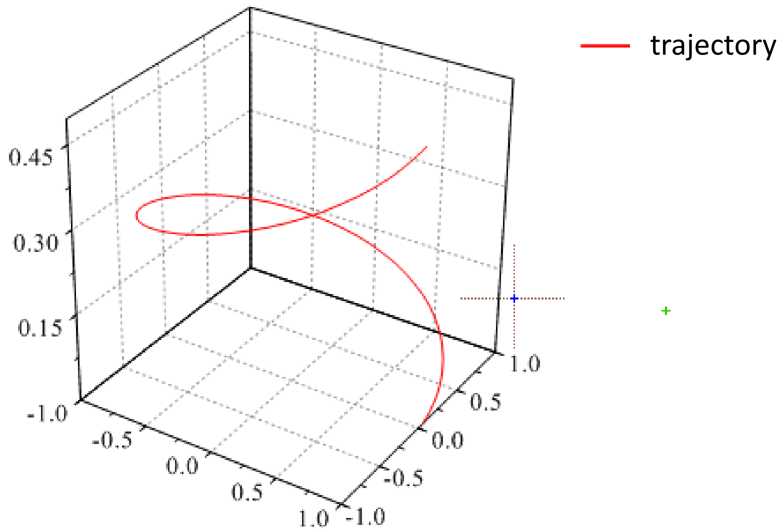


Fig 6: Demonstration of spiral interpolation trajectory

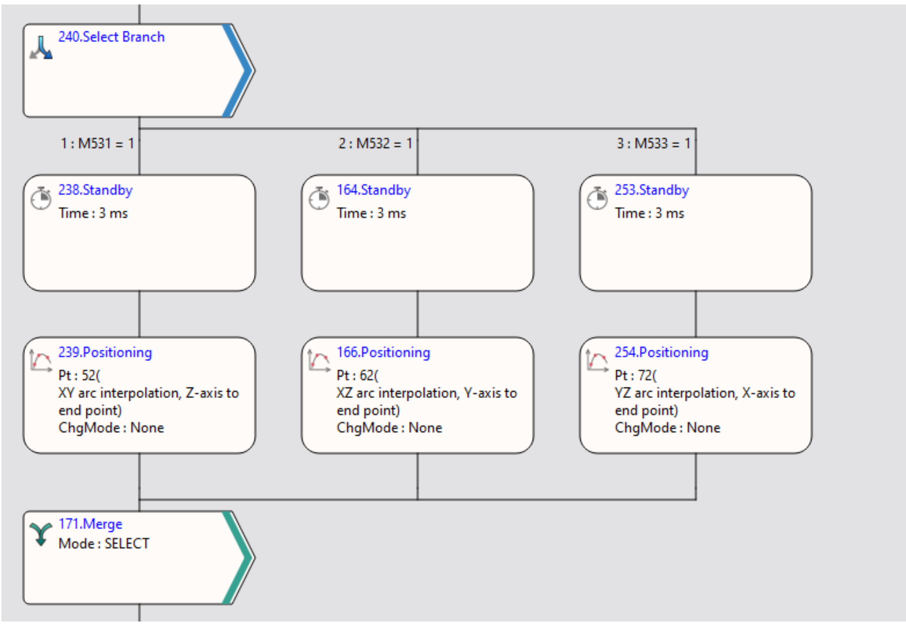


Fig. 6-2: 6-axis bus spiral interpolation program control

3D Arc Interpolation Control

In the spraying process of special-shaped curved surface products, some products cannot be placed flat on the spraying platform, and the placement position will have an angle with the spraying platform. At this time, the spiral interpolation cannot meet the current process requirements. It can make the action trajectory of the spray gun the same as the shape of the product, so as to meet the customer's spraying process requirements. The 3-axis space circular interpolation trajectory demonstration is shown in Figure 7, and the 6-axis bus 3-axis space arc interpolation trajectory is shown in Figure 8.

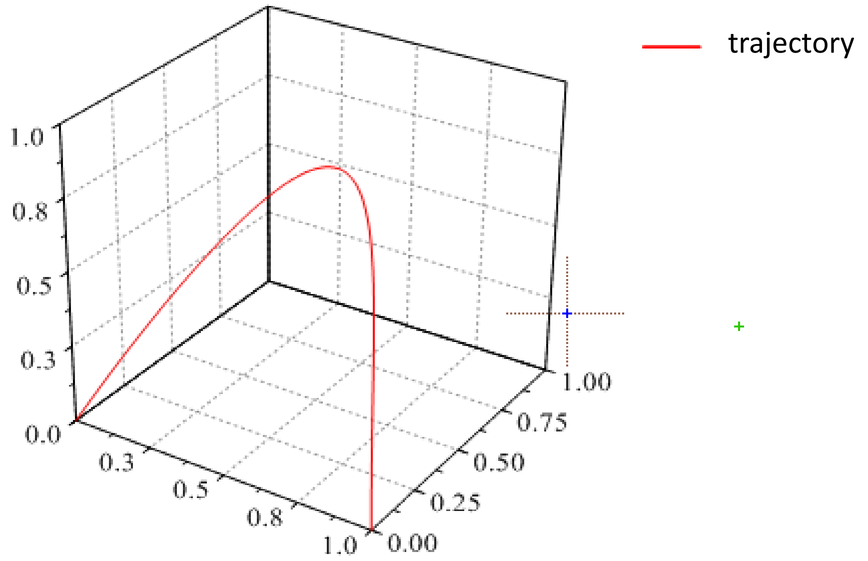


Fig. 7: Demonstration of axis space arc interpolation trajectory

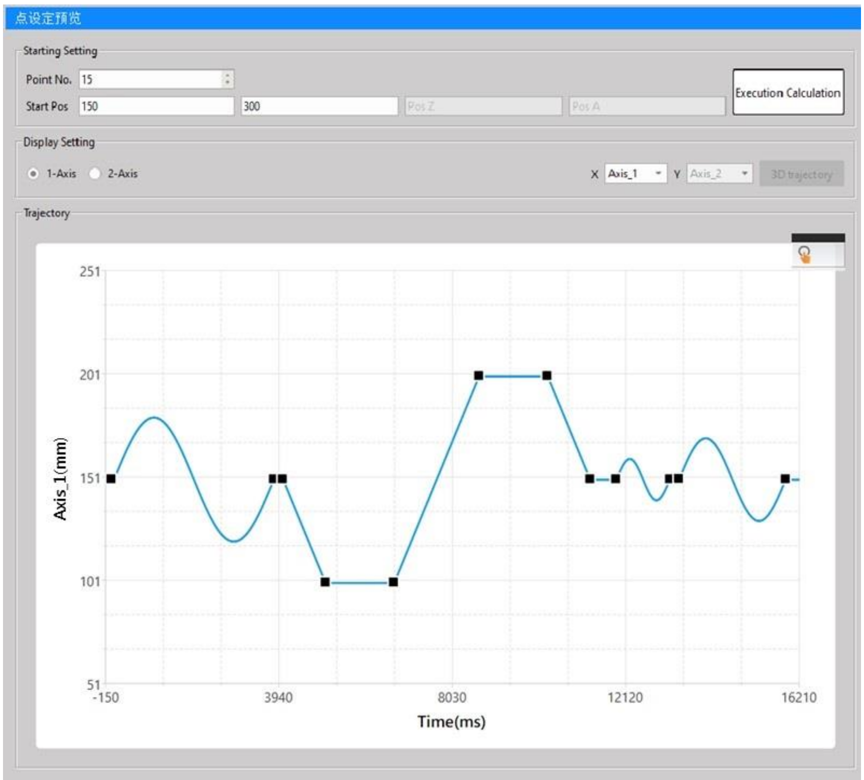


Fig. 8: 6-axis bus 3-axis space arc interpolation trajectory

18-3 VFFS Vertical Form Fill Seal machine

【Example 1】VFFS machine

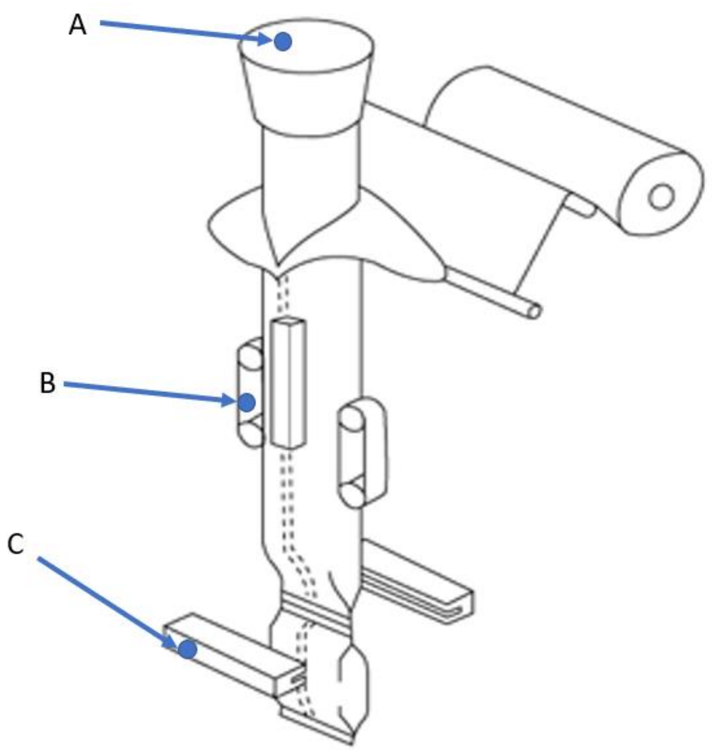
With E-CAM, use the **reference axis** to synchronously control the three axes of

A. Filling Machine/B. Drawing Machine/C. Sealing machine

In the following sample program, the axis numbers of Reference Axis 1/Reference Axis 2/Filling Machine/Drawing Machine/Sealing Machine correspond to Axis 5/Axis 1/Axis 4/Axis 3/Axis 2.

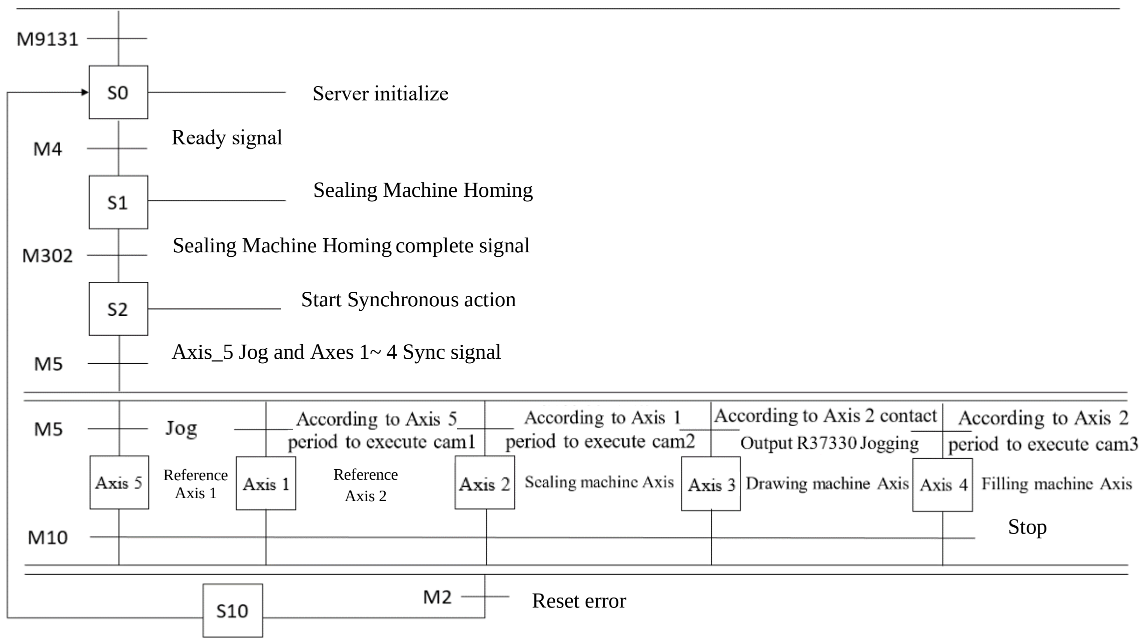
#In this example, two virtual axes are used as the motion curve of the reference axis, in order to demonstrate more motion control actions, so that users can be familiar with more motion control. After familiarizing with this example, users can The program of the synchronous input axis can be optimized according to the actual use.

Organization diagram

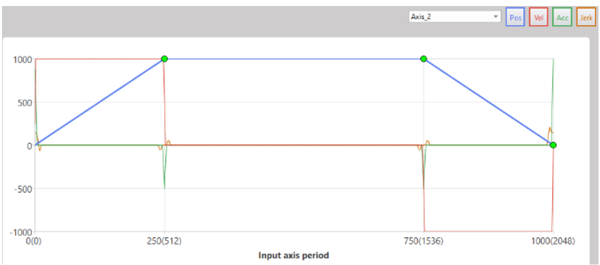


A. Filling machine – Axis_4
B. Drawing machine – Axis_3
C. Sealing machine – Axis_2

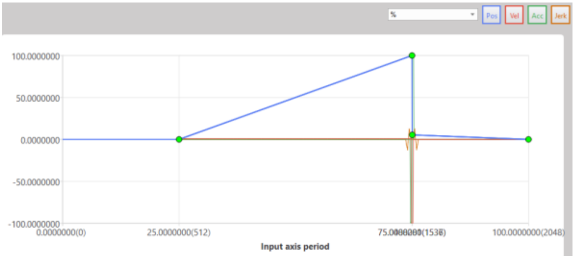
Stepping Ladder Diagram



CAM Curve ①

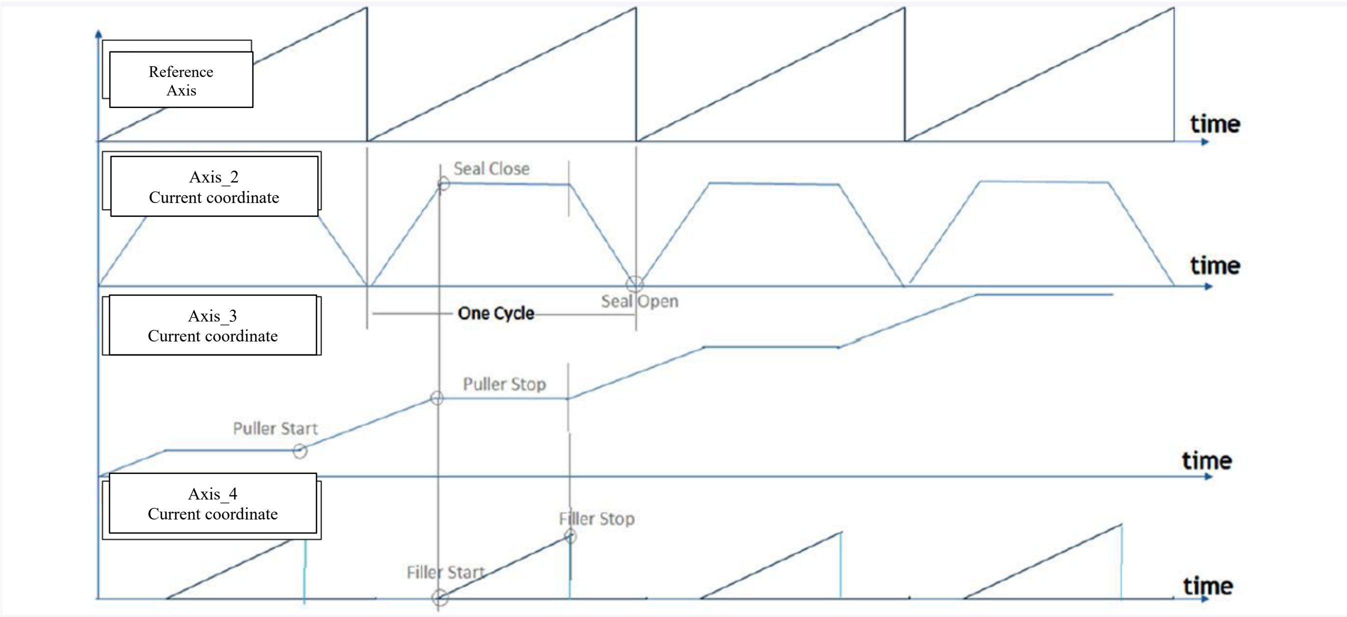


CAM Curve ②

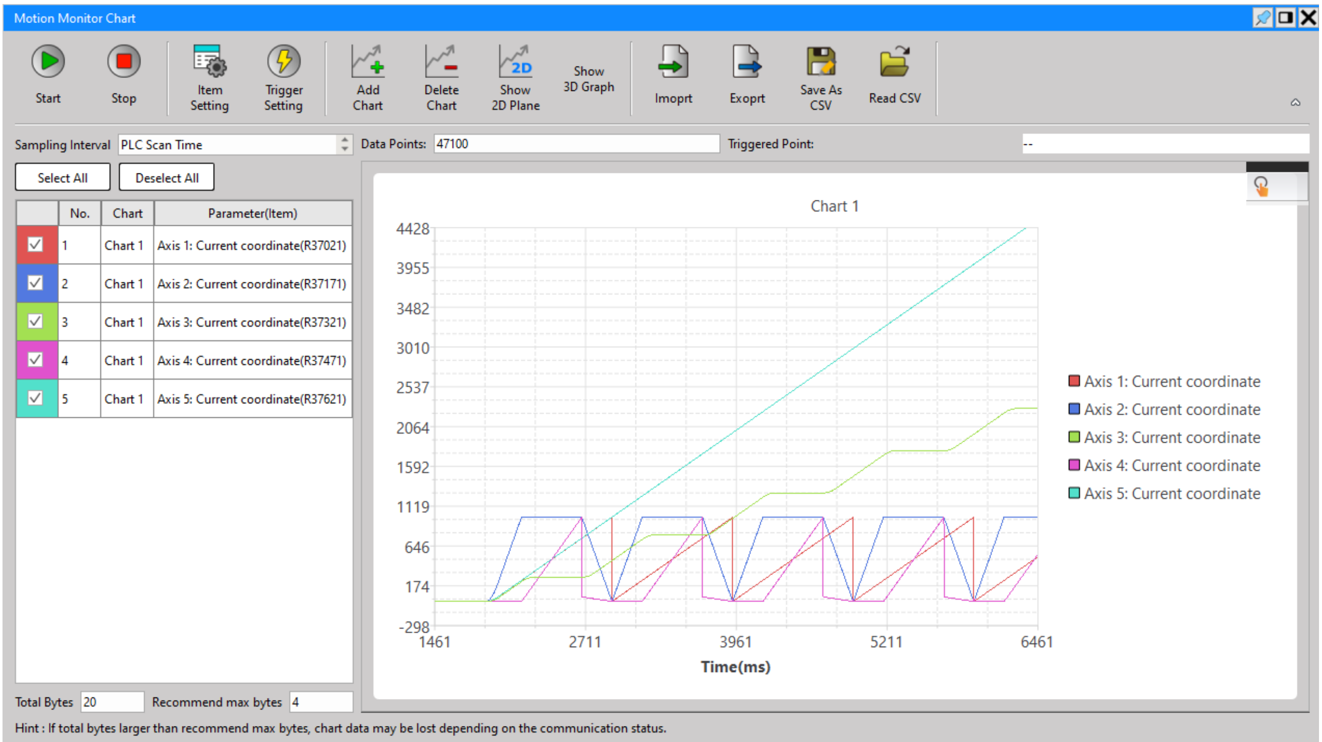

%
Pos
Vel
Acc
Jerk
100.0000000
50.0000000
0.0000000
-50.0000000
-100.0000000
0.0000000(0)
25.0000000(512)
100.0000000(2048)
Input axis period

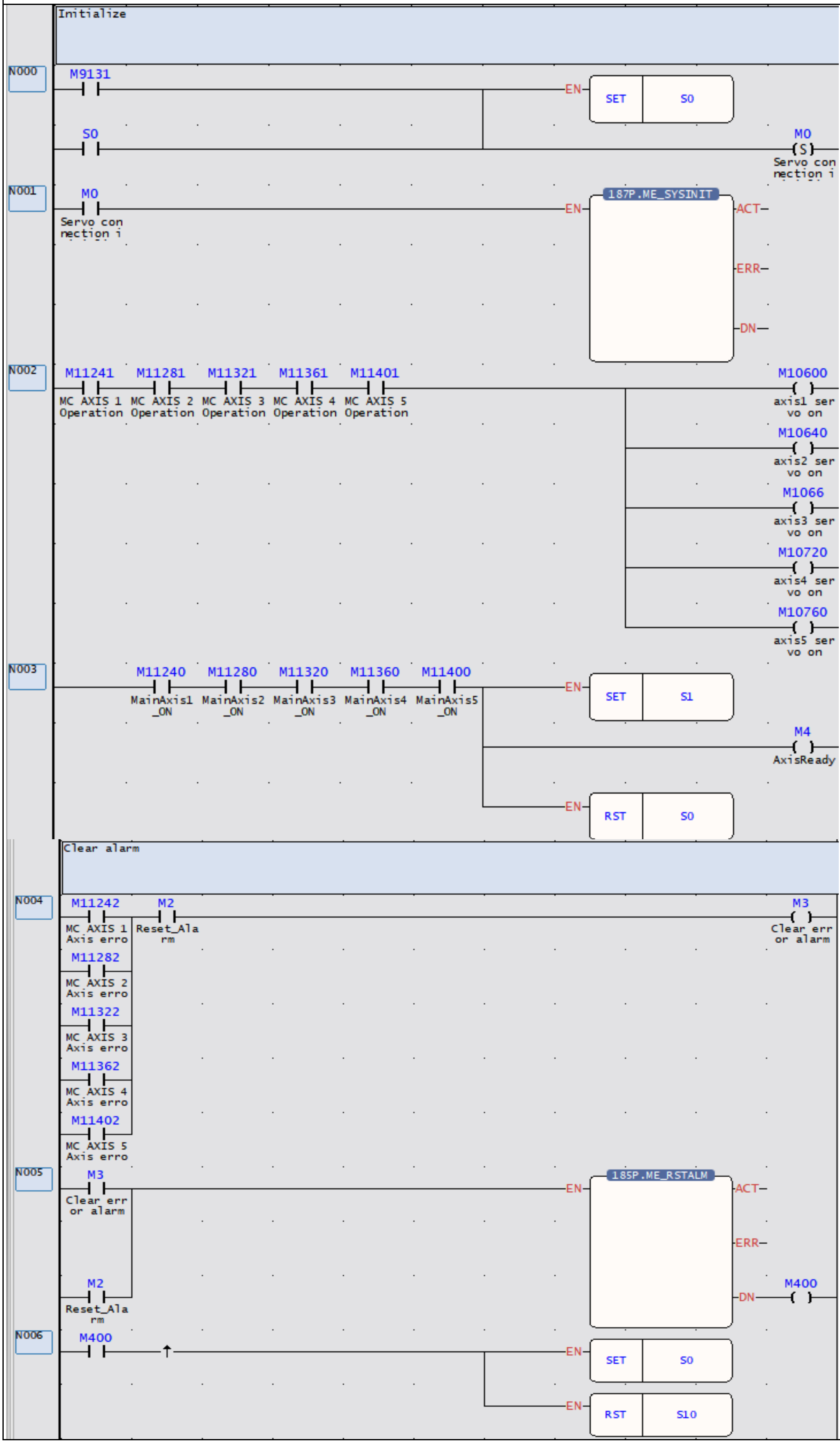
CAM Curve ③

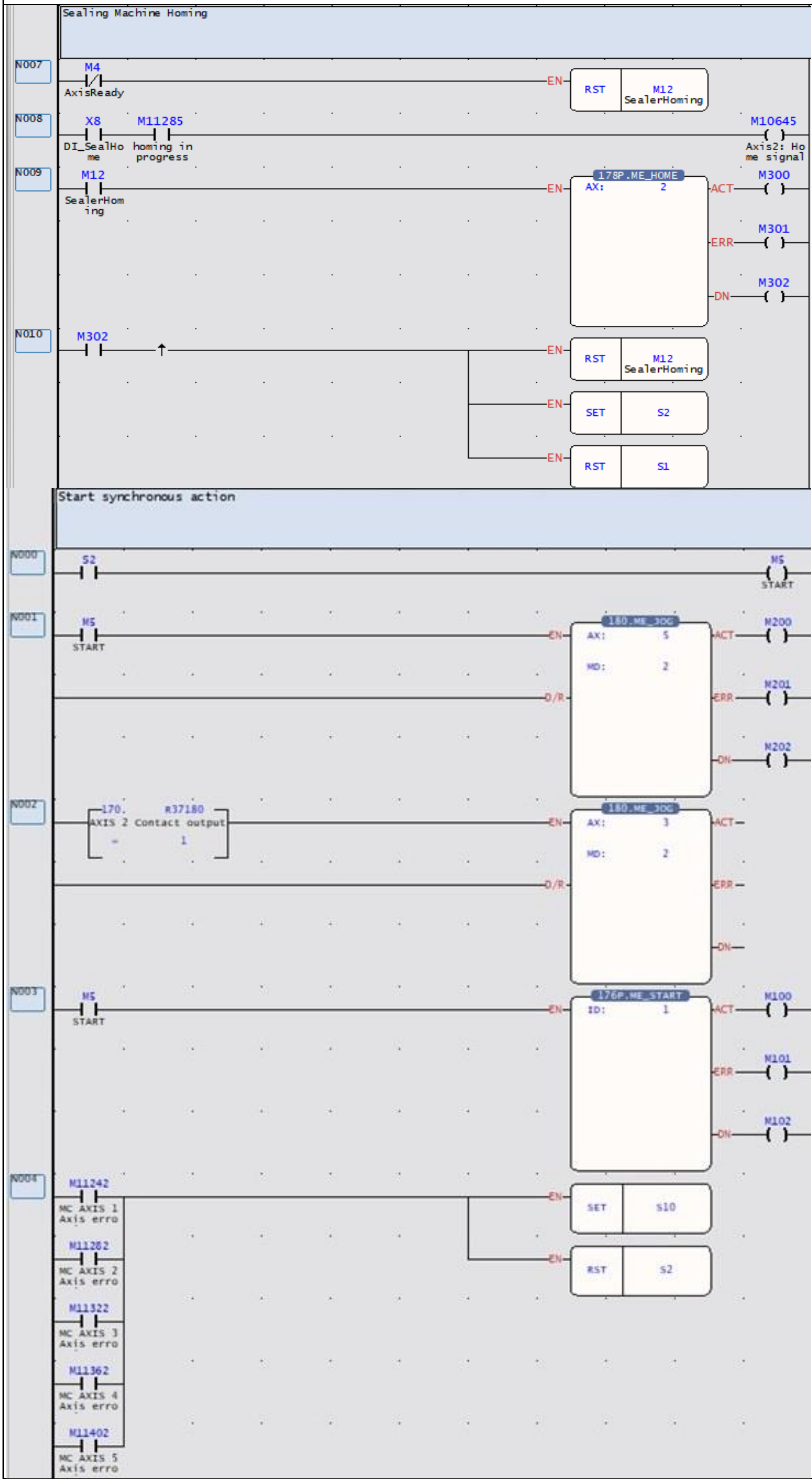
Time Order Chart

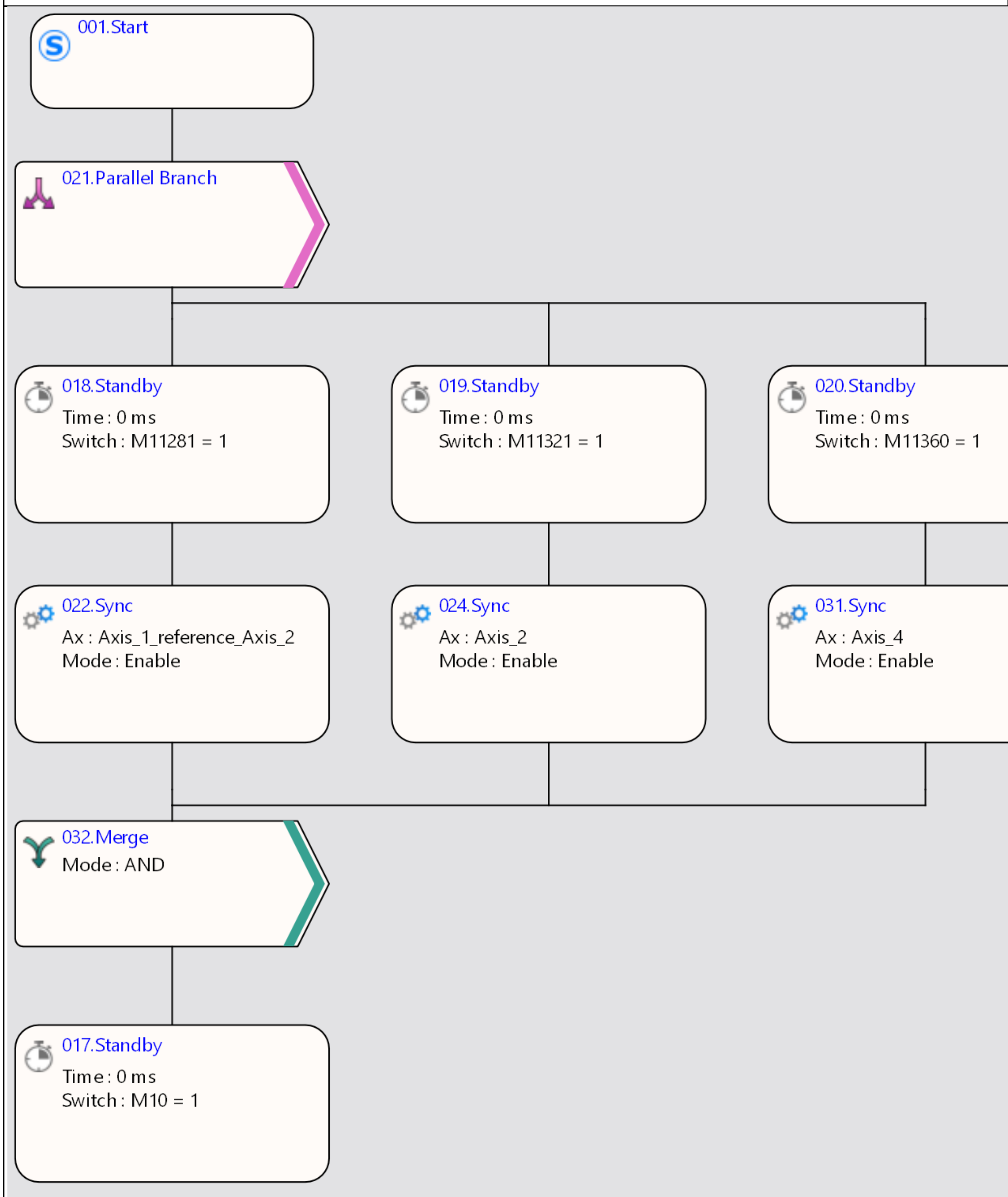


Monitoring chart during actual operation



Uperlogic	Description
	M9131 Initial Pulse Servo connection initialization When initialization is complete, servo control ready signal ON → Axis Servo on Servo on signal feedback All axes are Ready→M4 ON (Axis ready) When each axis alarm occurs M2 Manual→ON clear alarm M3→ON Clea eroor alarm M400→ON Back to initialization #For the definition of special register, please refer to the PLC instruction manual

Uperlogic	Description
	When an axis error occurs, the homing action cannot be performed In this example, the reset I/O signal is output from the PLC, so M10645 coil is required M12 ON→axis 3 starts homing Return to original action completed → M302 ON M5→ON starts motion flow control Axis 5 JOG start → operate according to the JOG parameters set by the motion axis MD: 2, jogging at JOG speed D/R: positive direction (ON) / negative direction (OFF) R37180: Axis 2 synchronous contact R37180=1, axis 3 JOG start M5→ON motion flow control Start When an error occurs on each axis, enter the error clearing step.

<table>
<tr><th>Uperlogic</th><th>Description</th></tr>
<tr><td>


</td><td>
Flow start → enter parallel branch

After entering each branch, confirm the servo ready signal

Start synchronous action

(For synchronization settings, please refer to the instructions on the next page)

After the synchronous action is enabled, the flow stops until the user flow M10

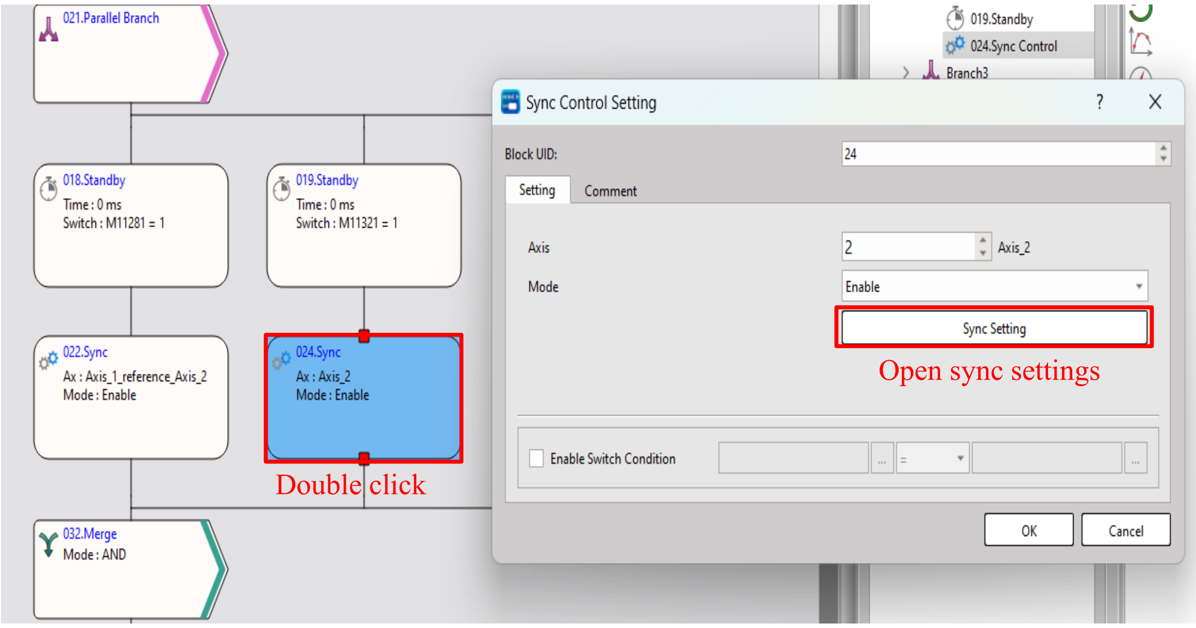
(The synchronous action will be canceled when the flow ends)
</td></tr>
</table>

Sync settings and CAM settings

After adding the “Synchronize” function block in the motion flow, it is necessary to perform CAM settings on this function block so that axes 1, 2, and 4 can correctly follow the master axis coordinates to perform synchronous E-CAM motion. For detailed steps, please refer to the following:

1. **Setting Funtion Block**

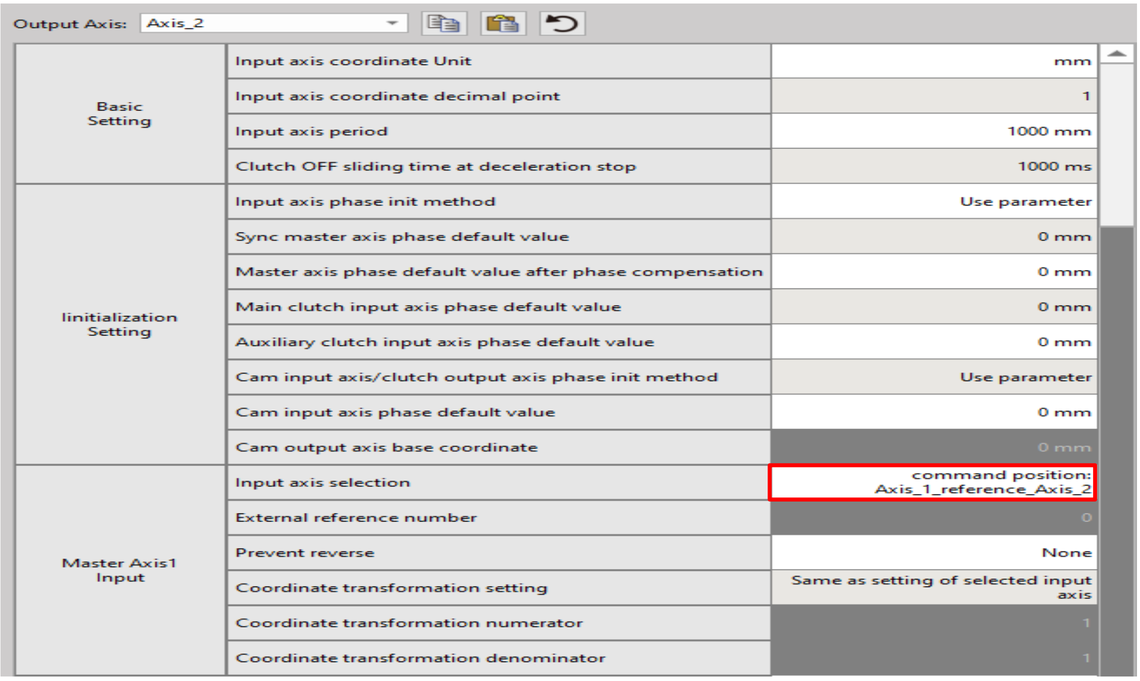
   Left click on the sync block → open sync settings



After enabling the synchronization setting, the setting window will appear as follows:

Take the sealed axis of axis 2 as an example, if the axis 2 synchronization setting is turned on, you can see that the “output axis” is axis 2.

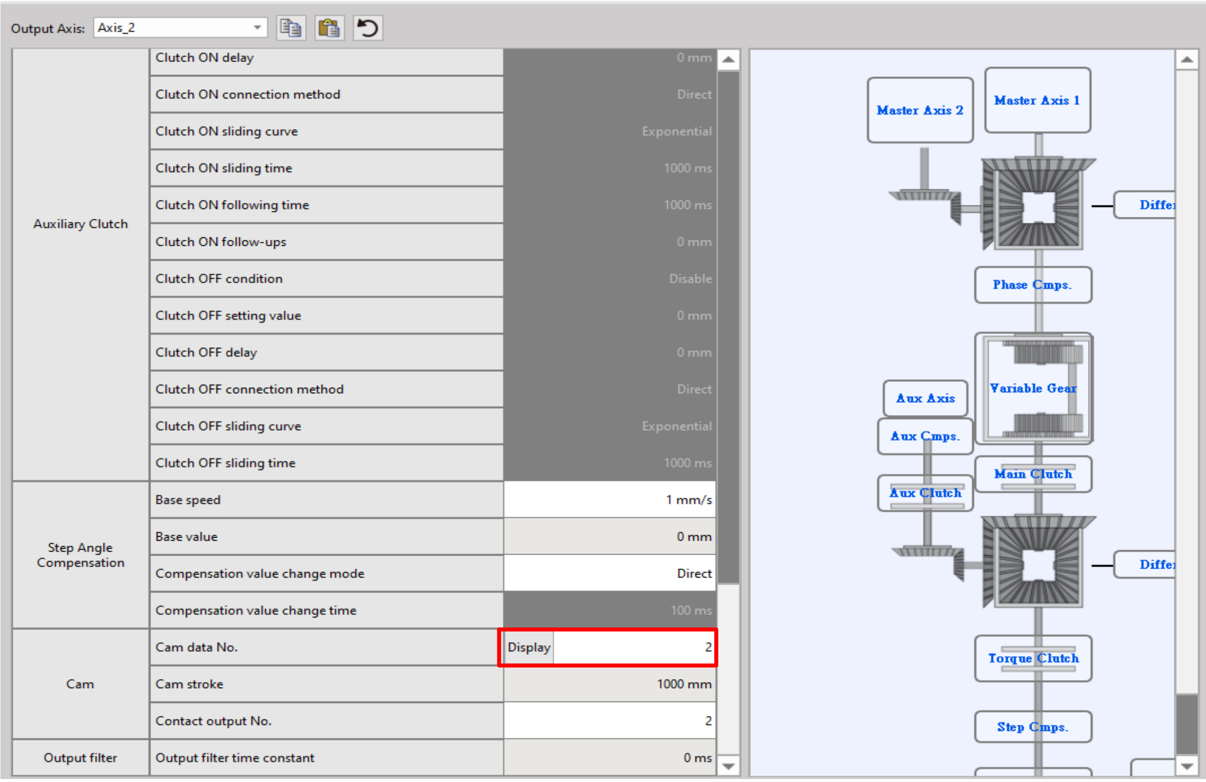
In addition, the input coordinates of the package axis refer to “reference axis 2”, so in “select input axis”, select “command position axis 1_reference axis 2”



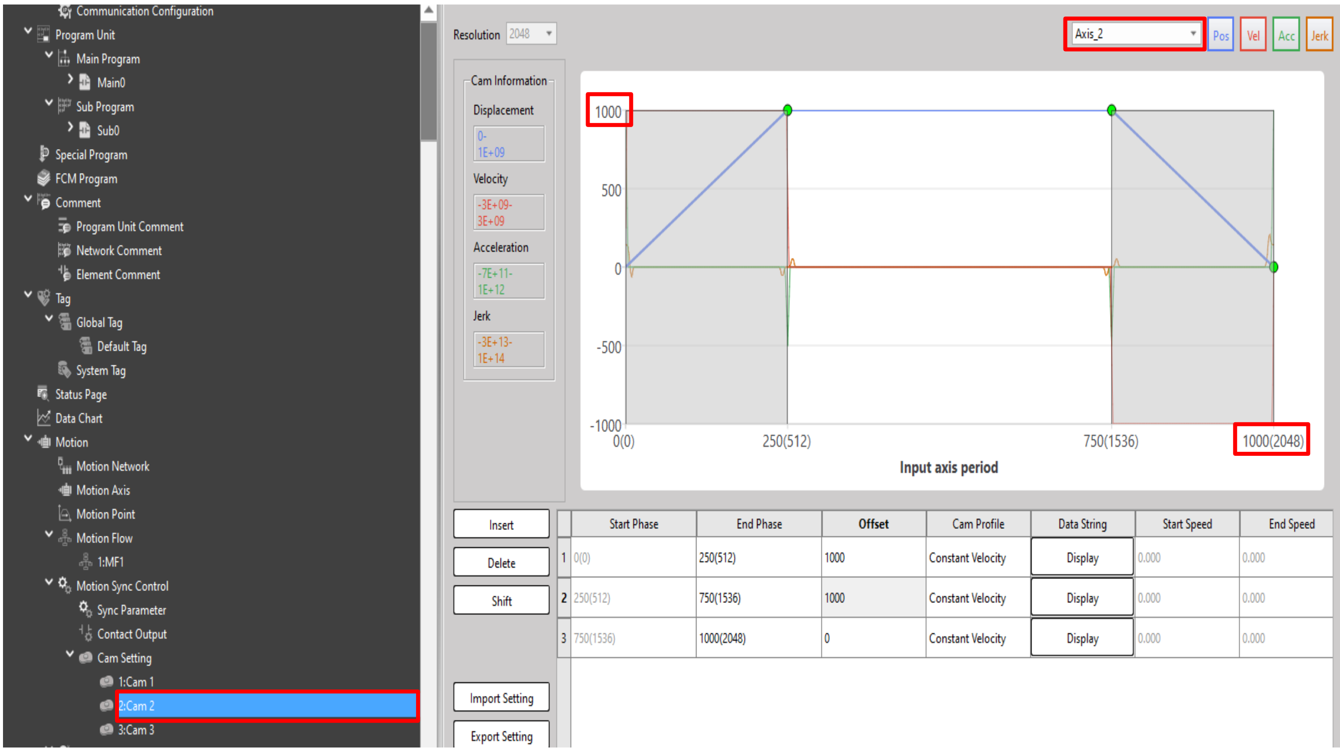
Output Axis: Axis_2

Basic Setting	Input axis coordinate Unit	mm
	Input axis coordinate decimal point	1
	Input axis period	1000 mm
	Clutch OFF sliding time at deceleration stop	1000 ms
Iinitialization Setting	Input axis phase init method	Use parameter
	Sync master axis phase default value	0 mm
	Master axis phase default value after phase compensation	0 mm
	Main clutch input axis phase default value	0 mm
	Auxiliary clutch input axis phase default value	0 mm
	Cam input axis/clutch output axis phase init method	Use parameter
	Cam input axis phase default value	0 mm
	Cam output axis base coordinate	0 mm
Master Axis1 Input	Input axis selection	command position: Axis_1_reference_Axis_2
	External reference number	0
	Prevent reverse	None
	Coordinate transformation setting	Same as setting of selected input axis
	Coordinate transformation numerator	1
	Coordinate transformation denominator	1

After setting the input and output axes, then set the “cam data number”, and the axis can move according to the cam stroke of this number.

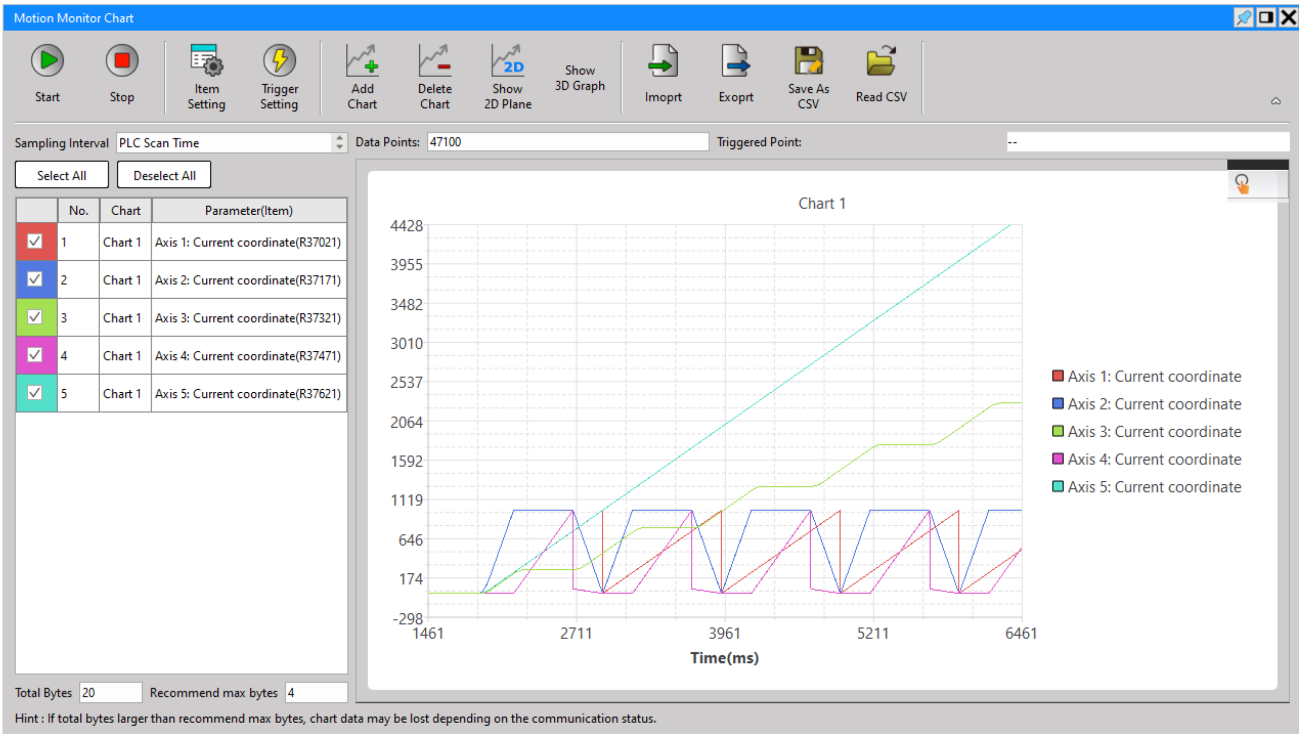


Take the package axis of axis 2 as an example, when I set the Cam numbered 2, the stroke is as shown in the figure below:



The cam curve of the display axis 2 packaging axis will move according to this stroke, the “1000” of the Y axis will be changed according to the “cam stroke” in the synchronization parameter, and the “1000(2048)” of the X axis will be changed according to the “input axis” in the synchronization parameter cycle to make changes. This example shows that the output axis “axis 2” will follow this cam curve, and when the input axis “axis 1” reaches the position of 1000mm, the position of axis 2 will change according to this curve.

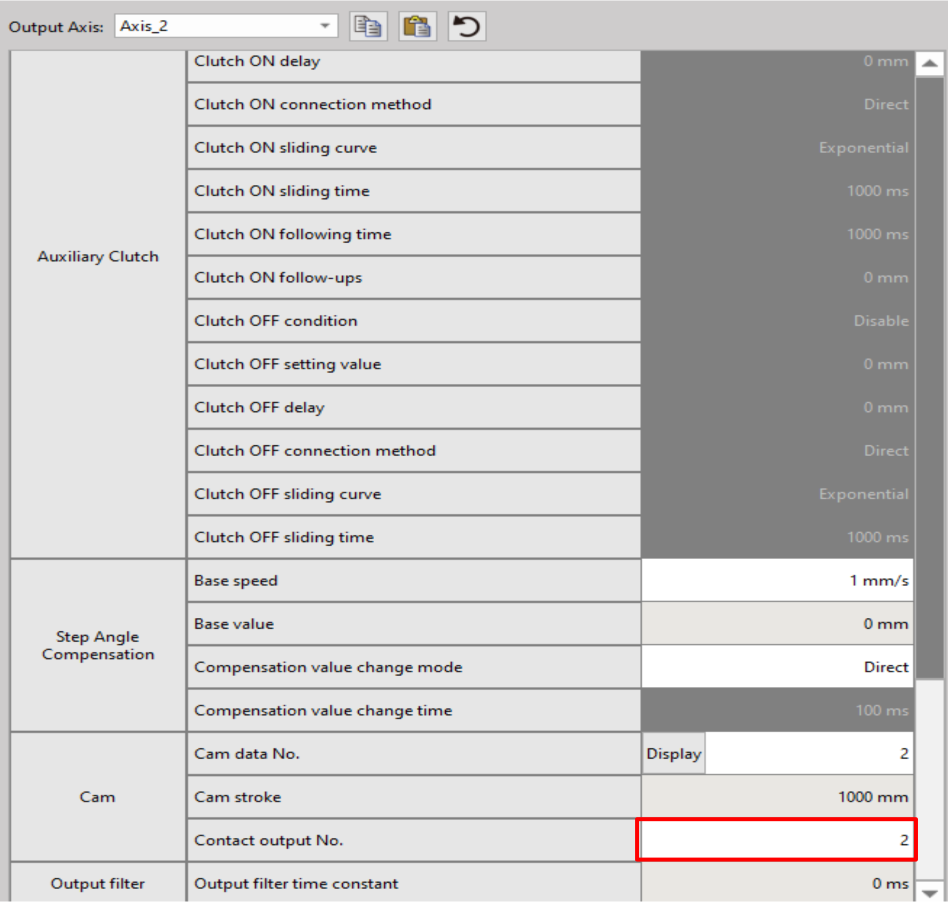
The action trajectory reference monitoring diagram is as follows:



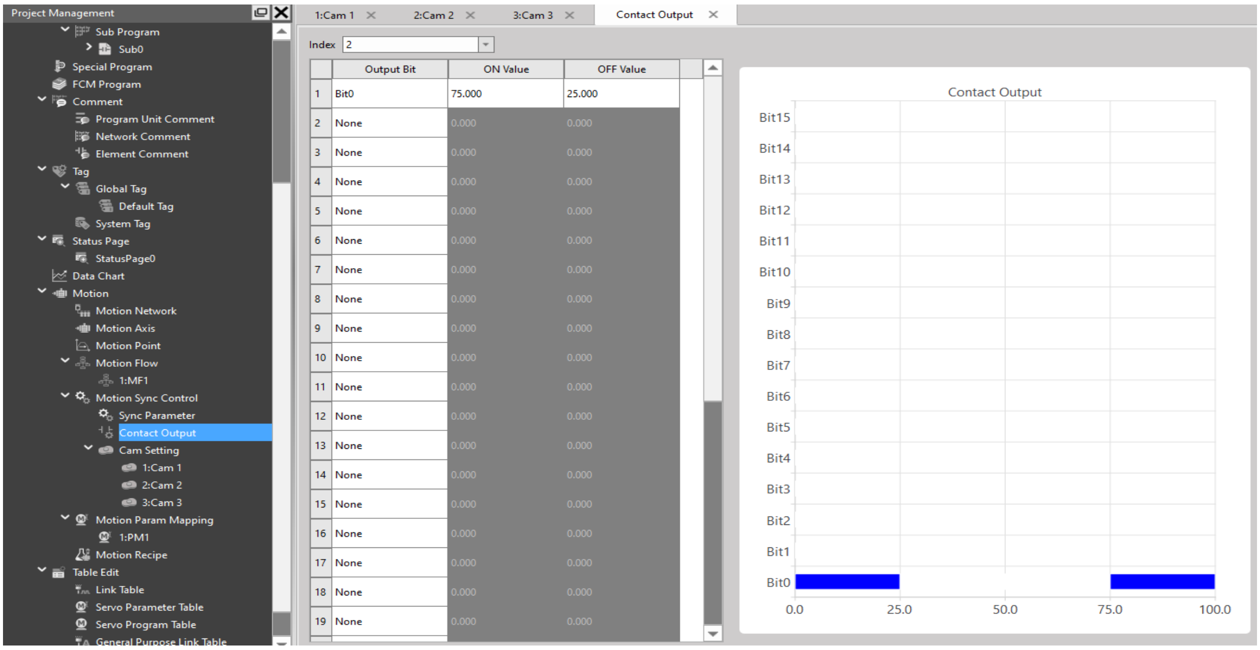
The same is true for other axes, when the synchronization and CAM travel of each axis are set Users can perform cam CAM control synchronously.

2. Setting synchronous contact

The action of axis 3 needs to be matched with the synchronous contact function of axis 2. Select the synchronous contact number 2 according to the figure below:

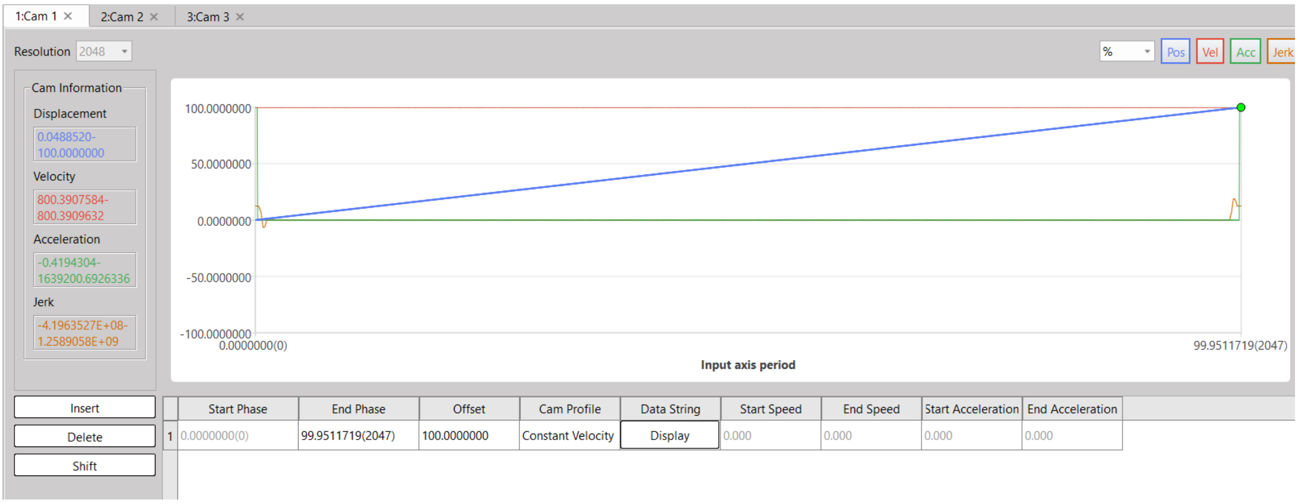


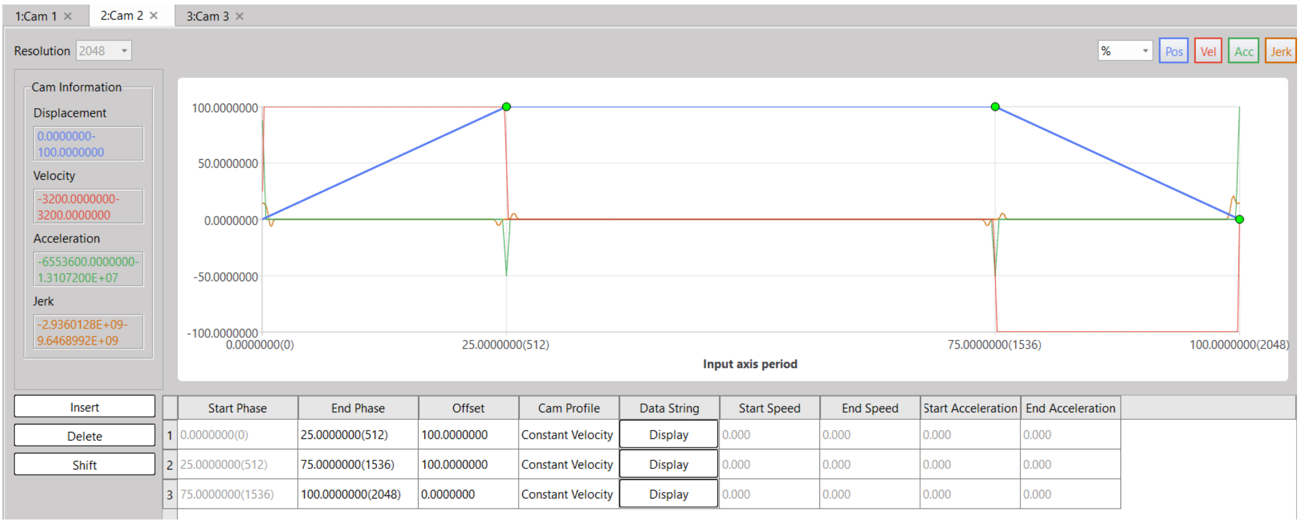
Axis-2 synchronous contact temporary register R37180 will change according to the settings in the figure below, take this figure as an example at the position of 75% of the cam curve R37180=1, 25% Position R37180=0

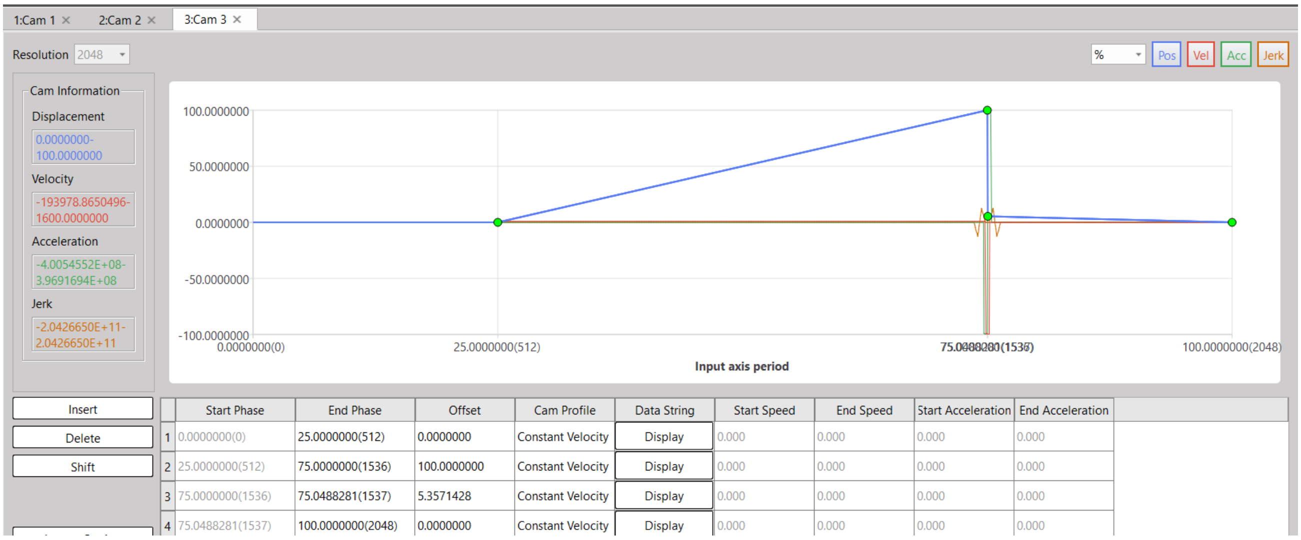


3. Setting E-CAM Stroke

The figure below shows the CAM settings of each axis







4. Motion Axis Setting Reference

		1	2	3	4	5
Basic Setting	Axis Name	Axis_1_reference_Axis_2	Axis_2	Axis_3	Axis_4	Axis_5_reference_Axis_1
	Axis Type	Virtual Servo	Virtual Servo	Virtual Servo	Virtual Servo	Virtual Servo
	Encoder Type	Incremental	Incremental	Incremental	Incremental	Incremental
Unit Setting	Unit	mm	mm	mm	mm	mm
	Decimal Point	1	1	1	1	1
	Pulse/Revolution	131072 PLS/Rev	131072 PLS/Rev	131072 PLS/Rev	131072 PLS/Rev	131072 PLS/Rev
	Unit/Revolution	100 mm/Rev	100 mm/Rev	100 mm/Rev	100 mm/Rev	100 mm/Rev
	Velocity Unit	Command Position/sec	Command Position/sec	Command Position/sec	Command Position/sec	Command Position/sec
	Velocity Gain	1.000	1.000	1.000	1.000	1.000
Operation Setting	Start Velocity	0 mm/s	0 mm/s	0 mm/s	0 mm/s	0 mm/s
	Max Motor Velocity	No Limit	No Limit	No Limit	No Limit	No Limit
	Default Acceleration	No Limit	No Limit	No Limit	No Limit	No Limit
	Default Deceleration	No Limit	No Limit	No Limit	No Limit	No Limit
	Soft Limit(+)	0 mm	0 mm	0 mm	0 mm	0 mm
	Soft Limit(-)	0 mm	0 mm	0 mm	0 mm	0 mm
	Following Error Window	0 mm	0 mm	0 mm	0 mm	0 mm
	Following Error Timeout	0 ms	0 ms	0 ms	0 ms	0 ms
	Pos Done Tolerance	0 mm	0 mm	0 mm	0 mm	0 mm
	Pos Done Check Time	10 ms	10 ms	10 ms	10 ms	10 ms
	Pos Done Check Time	10 ms	10 ms	10 ms	10 ms	10 ms
	Maximum Motor Torque	No Limit	No Limit	No Limit	No Limit	No Limit
	Maximum Torque Limit(+)	No Limit	No Limit	No Limit	No Limit	No Limit
	Maximum Torque Limit(-)	No Limit	No Limit	No Limit	No Limit	No Limit
Touch Probe	Touch Probe 1 Source	Disabled	Disabled	Disabled	Disabled	Disabled
	Touch Probe 1 Mode	Rising Edge Single	Rising Edge Single	Rising Edge Single	Rising Edge Single	Rising Edge Single
	Touch Probe 2 Source	Disabled	Disabled	Disabled	Disabled	Disabled
	Touch Probe 2 Mode	Rising Edge Single	Rising Edge Single	Rising Edge Single	Rising Edge Single	Rising Edge Single
Stop	Stop Mode	Immediately Stop	Immediately Stop	Immediately Stop	Immediately Stop	Immediately Stop
	Stop Deceleration	1000 mm/s^2	1000 mm/s^2	1000 mm/s^2	1000 mm/s^2	1000 mm/s^2
Homing	Homing Mode	Homing on current position	Homing on current position	Homing on current position	Homing on current position	Homing on current position
	Homing IO Source	From Servo Driver	From Servo Driver	From Servo Driver	From Servo Driver	From Servo Driver
	Homing Start Direction	Positive	Positive	Positive	Positive	Positive
	Homing Origin Offset	0 mm	0 mm	0 mm	0 mm	0 mm
	Homing Find Velocity	10000 mm/s	10000 mm/s	10000 mm/s	10000 mm/s	10000 mm/s
	Homing Creep Velocity	1000 mm/s	1000 mm/s	1000 mm/s	1000 mm/s	1000 mm/s
	Homing Deceleration	1000 mm/s^2	1000 mm/s^2	1000 mm/s^2	1000 mm/s^2	1000 mm/s^2
	Limit Switch(-)(DI)	60FD:00	60FD:00	60FD:00	60FD:00	60FD:00
	Limit Switch(+)(DI)	60FD:01	60FD:01	60FD:01	60FD:01	60FD:01
	Home Switch(DI)	60FD:02	60FD:02	60FD:02	60FD:02	60FD:02
	Homing Z Count	0	0	0	0	0
Jogging	Jogging Base Velocity	1 mm/s	1 mm/s	1 mm/s	1 mm/s	1 mm/s
	Jogging Velocity	1000 mm/s	100 mm/s	100 mm/s	1000 mm/s	2000 mm/s
	Jogging Acceleration	10000 mm/s^2	1000 mm/s^2	1000 mm/s^2	10000 mm/s^2	20000 mm/s^2
	Jogging Deceleration	10000 mm/s^2	1000 mm/s^2	1000 mm/s^2	10000 mm/s^2	20000 mm/s^2
	Inching Distance	1000 mm	1 mm	1 mm	1 mm	1 mm