M Series Tutorial: Positioning Control Instructions
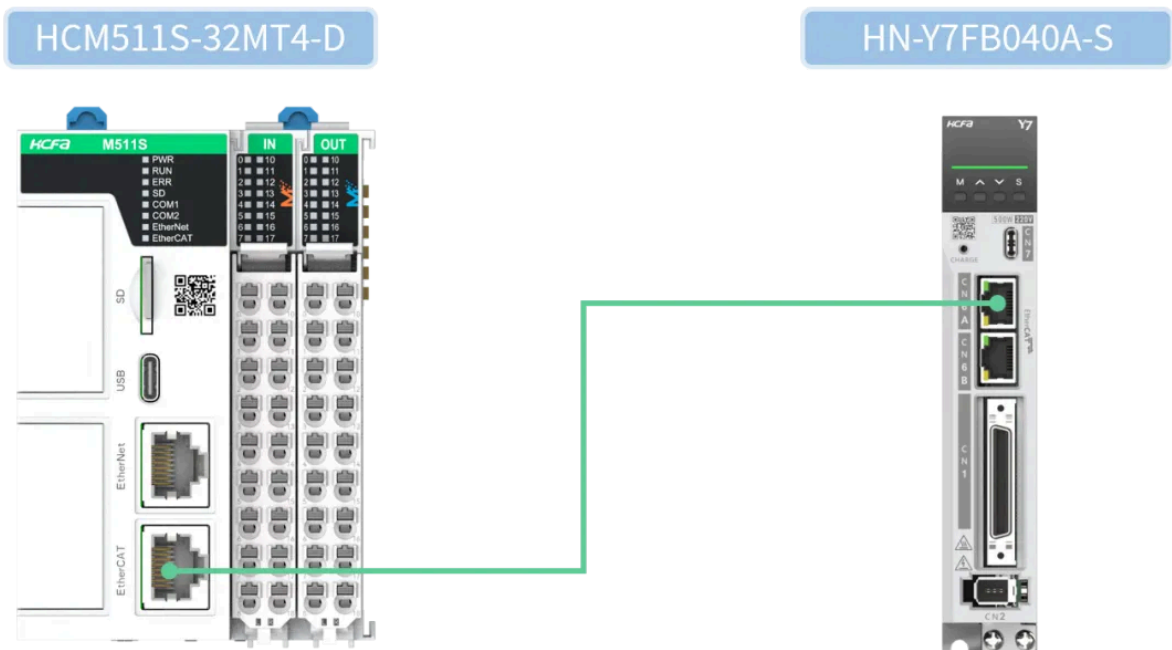
Software: Sysctrl Studio (PLC programming software)

Hardware: M series controller (taking M511S as an example)

Servo (taking HN-Y7FB040A-S as an example)
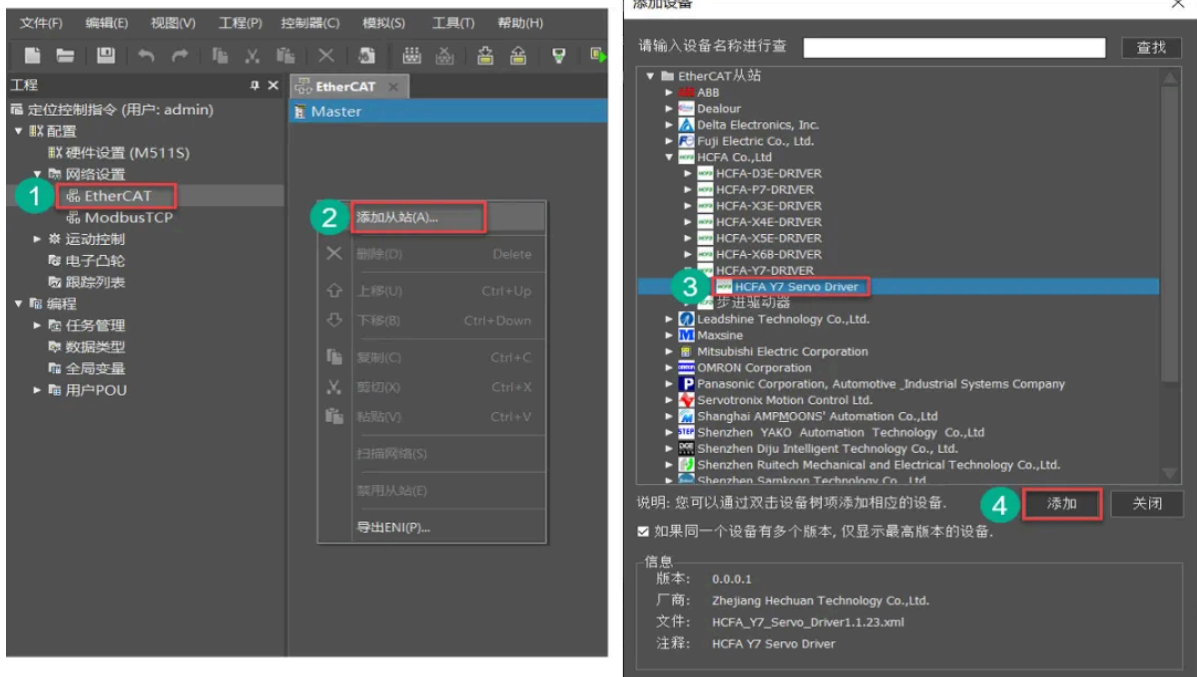
Communication connection

This tutorial uses the M controller HCM511S-32MT4-D and servo HN-Y7FB040A-S. The connection method is shown in the figure below.

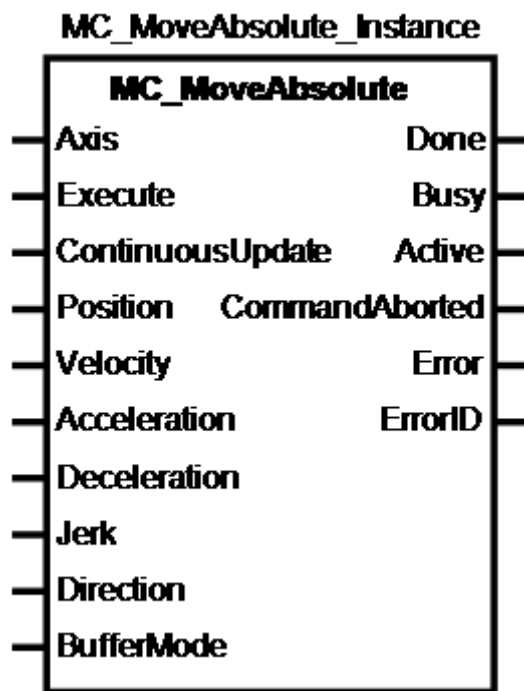## Sysctrl Studio project basic configuration

Basic Settings

[Add slave station] >> [Add servo axis] >> [Related equipment] >> [Mechanism parameter setting]

Positioning control instructions

MC_MoveAbsolute (absolute positioning instruction)

① Functional description

  The control axis moves to the position specified by Position according to the set speed, acceleration, deceleration, and acceleration rate. Position specifies the absolute position relative to 0.

②Pin Description

■ Input variable

Name	Meaning	Data type	Valid range	Default	Description
Axis	Axis number	USINT	Depend on model	Required field	Specify the axis number of the control axis
Execute	Start	BOOL	TRUE or FALSE	FALSE	Execute the instruction when the rising edge of the parameter is detected
ContinuousUpdate	Continuousupdate	BOOL	TRUE or FALSE	FALSE	Reserved
Position	Absolute position	LREAL	Positive number, negative number, 0	0	Specify the absolute position with the 0 point position as the reference point (Unit: travel unit) *2
Velocity	Target velocity	LREAL	Positive number	Required field	Specify target velocity *1 (Unit: travel unit/second) *2
Acceleration	Acceleration	LREAL	Positive number	Required field	Specify acceleration *1 (Unit: travel unit/second²) *2
Deceleration	Deceleration	LREAL	Positive number	Required field	Specify deceleration *1 (Unit: travel unit/second²) *2
Jerk	Jerk	LREAL	Positive number	Required field	Specify jerk *1 (Unit: travel unit/second³) *2
Direction	Direction	MC_Direction	1: mcPositiveDirection 2: mcShortestWay 3: mcNegativeDirection 4: mcCurrentDirection	1	Set the direction of axis operation 1: Positive direction 2: The shortest movement distance 3: Negative direction 4: Operate in the current direction and move in the positive direction when the axis is stationary
BufferMode	Buffer mode	MC_Buffer_Mode	0: mcAborting 1: mcBuffered 2: mcBlendingLow 3: mcBlendingPrevious 4: mcBlendingNext 5: mcBlendingHigh	0	Set the buffer mode between two instructions*3 0: aborted 1: buffered 2: buffer at low velocity 3: buffer at the previous velocity 4: buffer at the next velocity 5: buffer at low velocity

*1: For the relationship among Velocity, Acceleration, Deceleration, and Jerk, please refer to the *"Parameter description of motion control instructions"*.
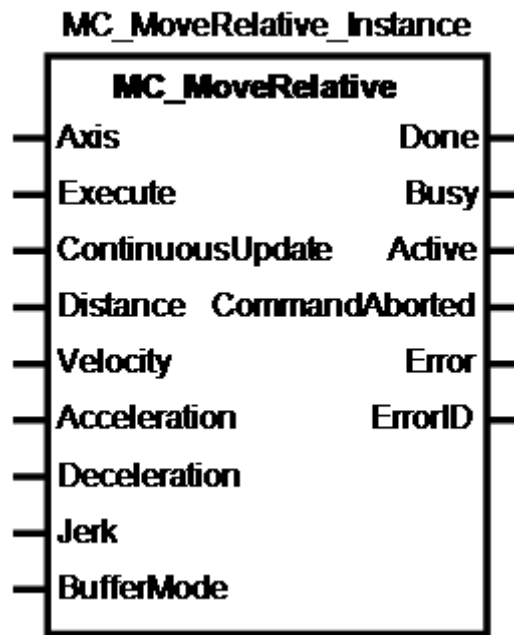
*2: For a detailed introduction to instruction units, please refer to the *"Parameter unit of motion control instructions"*.

*3: For a detailed introduction to BufferMode, please refer to the *"Buffer mode during multi-starting of the same axis"*.

■ Output variable

Name	Meaning	Data type	Valid range	Default
Done	Completed	BOOL	TRUE or FALSE	TRUE when the instruction is completed
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is executed
Active	Under control	BOOL	TRUE or FALSE	TRUE when the axis is under control
CommandAborted	aborted	BOOL	TRUE or FALSE	TRUE when the instruction is aborted
Error	Error	BOOL	TRUE or FALSE	TRUE when there is an error
ErrorID	Error code	WORD	0~65535	Refer to "*instruction error code description*" for the meaning of the output error code value when an instruction execution error occurs.

MC_MoveRelative (Relative Movement Instruction)

```
            MC_MoveRelative_Instance
                MC_MoveRelative
        ─┤Axis                      Done├─
        ─┤Execute                   Busy├─
        ─┤ContinuousUpdate        Active├─
        ─┤Distance        CommandAborted├─
        ─┤Velocity                 Error├─
        ─┤Acceleration           ErrorID├─
        ─┤Deceleration│
        ─┤Jerk│
        ─┤BufferMode│
```

① Functional description

  The control axis moves the distance specified by Distance based on the current position. The time when the instruction starts execution (control axis movement) is the reference position.

②Pin Description

- **Input variable**

Name	Meaning	Data type	Valid range	Default	Description
Axis	Axis number	USINT	Depend on model	Required field	Specify the axis number of the control axis
Execute	Start	BOOL	TRUE or FALSE	FALSE	Execute the command when the rising edge of the parameter is detected
ContinuousUpdate	Continuous update	BOOL	TRUE or FALSE	FALSE	Reserve
Distance	Moving distance	LREAL	Positive number, negative number, 0	0	Specify the movement distance based on the current position as the reference point (Unit: travel unit) *2
Velocity	Target velocity	LREAL	Positive number	Required field	Specify target velocity *1 (Unit: travel unit/second) *2
Acceleration	Acceleration	LREAL	Positive number	Required field	Specify acceleration*1 (Unit: travel unit/second²) *2
Deceleration	Deceleration	LREAL	Positive number	Required field	Specify deceleration *1 (Unit: travel unit/second²) *2
Jerk	Jerk	LREAL	Positive number	Required field	Specify jerk *1 (Unit: travel unit/second³) *2
BufferMode	Buffer mode	MC_Buffer_Mode	0: mcAborting 1: mcBuffered 2: mcBlendingLow 3: mcBlendingPrevious 4: mcBlendingNext 5: mcBlendingHigh	0	Set the buffer mode between two instructions*3 0: aborted 1: buffered 2: buffer at low velocity 3: buffer at the previous velocity 4: buffer at the next velocity 5: buffer at low velocity

*1: For the relationship among Velocity, Acceleration, Deceleration, and Jerk, please refer to the *"Parameter description of motion control instructions"*.
*2: For a detailed introduction to instruction units, please refer to the *"Parameter unit of motion control instructions"*.
*3: For a detailed introduction to BufferMode, please refer to the *"Buffer mode during multi-starting of the same axis"*.

- **Output variable**

Name	Meaning	Data type	Valid range	Default
Done	Completed	BOOL	TRUE or FALSE	TRUE when the instruction is completed
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is executed
Active	Under control	BOOL	TRUE or FALSE	TRUE when the axis is under control
CommandAborted	Aborted	BOOL	TRUE or FALSE	TRUE when the instruction is aborted
Error	Error	BOOL	TRUE or FALSE	TRUE when there is an error
ErrorID	Error code	WORD	0~65535	Refer to "instruction error code description" for the meaning of the output error code value when an instruction execution error occurs.

Instruction Test

Project Settings
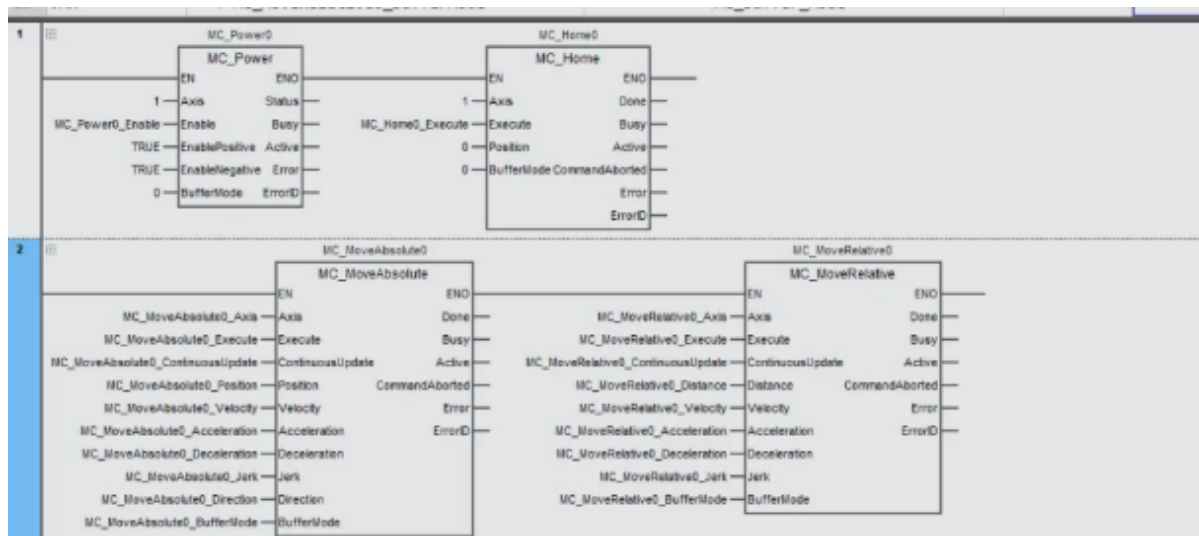
MC_MoveAbsolute, MC_MoveRelative **function block test** (following are the sequential steps)

```
a. Enable the axis and trigger the MC_MoveAbsolute function block

Result: The axis reaches 200 at a speed of 10

b. Trigger the MC_MoveRelative function block

Result: The axis reaches 400 at a speed of 15

c. Trigger the MC_MoveAbsolute function block again

Result: The axis reaches 200 at a speed of 10
```
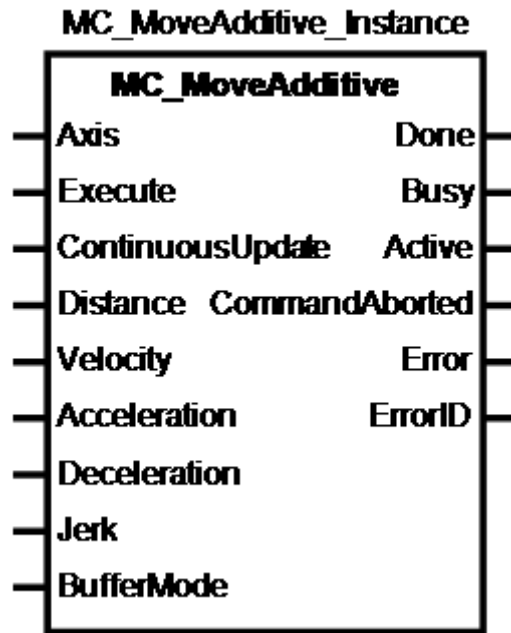
[Note] By comparing the results, we can find that the main difference between the MC_MoveAbsolute instruction and the MC_MoveRelative instruction is that one is based on 0 and the other is based on the current position of the axis.

MC_MoveAdditive (additional relative displacement instruction)

① Functional description

The control axis moves an additional distance (the value set by distance).

②Pin Description

■ Input variable

Name	Meaning	Data type	Valid range	Default	Description
Axis	Axis number	USINT	Depend on model	Required field	Specify the axis number of the control axis
Execute	Start	BOOL	TRUE or FALSE	FALSE	Execute the command when the rising edge of the parameter is detected
ContinuousUpdate	Continuous update	BOOL	TRUE or FALSE	FALSE	Reserve
Distance	Moving distance	LREAL	Positive number, negative number, 0	0	Specify the movement distance based on the current position as the reference point (Unit: travel unit) *2
Velocity	Target velocity	LREAL	Positive number	Required field	Specify target velocity *1 (Unit: travel unit/second) *2
Acceleration	Acceleration	LREAL	Positive number	Required field	Specify acceleration*1 (Unit: travel unit/second²) *2
Deceleration	Deceleration	LREAL	Positive number	Required field	Specify deceleration *1 (Unit: travel unit/second²) *2
Jerk	Jerk	LREAL	Positive number	Required field	Specify jerk *1 (Unit: travel unit/second³) *2
BufferMode	Buffer mode	MC_Buffer_Mode	0: mcAborting 1: mcBuffered 2: mcBlendingLow 3: mcBlendingPrevious 4: mcBlendingNext 5: mcBlendingHigh	0	Set the buffer mode between two instructions*3 0: aborted 1: buffered 2: buffer at low velocity 3: buffer at the previous velocity 4: buffer at the next velocity 5: buffer at low velocity

*1: For the relationship among Velocity, Acceleration, Deceleration, and Jerk, please refer to the *"Parameter description of motion control instructions"*.

*2: For a detailed introduction to instruction units, please refer to the *"Parameter unit of motion control instructions"*.

*3: For a detailed introduction to BufferMode, please refer to the *"Buffer mode during multi-starting of the same axis"*.

■ Output variable

Name	Meaning	Data type	Valid range	Default
Done	Completed	BOOL	TRUE or FALSE	TRUE when the instruction is completed
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is executed
Active	Under control	BOOL	TRUE or FALSE	TRUE when the axis is under control
CommandAborted	Aborted	BOOL	TRUE or FALSE	TRUE when the instruction is aborted
Error	Error	BOOL	TRUE or FALSE	TRUE when there is an error
ErrorID	Error code	WORD	0~65535	Refer to "instruction error code description" for the meaning of the output error code value when an instruction execution error occurs.

MC_MoveSuperimposed (superimposed relative displacement instruction)

① Functional description

The control axis adds a relative displacement based on the current motion.

②Pin Description

■ Input variable

Name	Meaning	Data type	Valid range	Default	Description
Axis	Axis number	USINT	Depend on model	Required field	Specify the axis number of the control axis
Execute	Execute	BOOL	TRUE or FALSE	FALSE	Execute this instruction when the rising edge of this parameter is detected
ContinuousUpdate	Continuous Update	BOOL	TRUE or FALSE	FALSE	Reserved
Distance	Additional distance	LREAL	Positive number, Negative number, 0	0	Specify the travel distance from the current position (Unit: Travel unit)[2]
Velocity	Target velocity	LREAL	Positive number	Required field	Specify the target velocity [1] (Unit: Travel unit/s)[2]
Acceleration	Acceleration rate	LREAL	Positive number	Required field	Specify the acceleration rate [1] (Unit: Travel unit/s²)[2]
Deceleration	Deceleration rate	LREAL	Positive number	Required field	Specify the deceleration rate [1] (Unit: Travel units/s²)[2]
Jerk	Jerk	LREAL	Positive number	Required field	Specify the jerk[1] (Unit: Travel units/s³)[2]

*1: For the relation among Velocity, Acceleration, Deceleration and Jerk, please refer to *"Parameter description of motion control instructions "*.
*2: For details of the instruction units, please refer to *"Parameter unit of motion control instructions"*.

■ Output variable

Name	Meaning	Data type	Valid range	Description
Done	Completed	BOOL	TRUE or FALSE	TRUE when the instruction is completed
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is executed
Active	Under control	BOOL	TRUE or FALSE	TRUE when the axis is under control
CommandAborted	Aborted	BOOL	TRUE or FALSE	TRUE when the instruction is aborted
Error	Error	BOOL	TRUE or FALSE	TRUE when there is an error
ErrorID	Error code	WORD	0~65535	Refer to "*instruction error code description*" for the meaning of the output error code value when an instruction execution error occurs.
CoveredDistance	Covered distance	LREA	Positive number, Negative number, 0	The distance that the command control axis has moved after this instruction is executed.

MC_HaltSuperimposed (Terminate superimposed displacement instruction)

① Functional description

 Terminates superimposed displacement (terminates MC_HaltSuperimposed instruction).

②Pin Description

■ Input variable

| Name	Meaning	Data type	Valid range	Default	Description
Axis	Axis number	USINT	Depend on model	Required field	Specify the axis number of the control axis
Execute	Execute	BOOL	TRUE or FALSE	FALSE	Execute this instruction when the rising edge of this parameter is detected
Deceleration	Deceleration rate	LREAL	Positive number	Required field	Specify the deceleration rate [*1] (Unit: Travel unit/s^2)[*2]
Jerk	Jerk	LREAL	Positive number	Required field	Specify the jerk[*1] (Unit: Travel unit/s^3)[*2]

*1: For the relation among Deceleration and Jerk, please refer to "Parameter description of motion control instructions ".
*2: For details of the instruction units, please refer to "Parameter unit of motion control instructions".

■ Output variable

Name	Meaning	Data type	Valid range	Description
Done	Completed	BOOL	TRUE or FALSE	TRUE when the instruction is completed
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is executed
Active	Under control	BOOL	TRUE or FALSE	TRUE when the axis is being controlled
CommandAborted	Aborted	BOOL	TRUE or FALSE	TRUE when the instruction is aborted
Error	Error	BOOL	TRUE or FALSE	TRUE when an error occurs
ErrorID	Error code	WORD	0~65535	Refer to "instruction error code description" for the meaning of the output error code value when an instruction execution error occurs.

Instruction Test
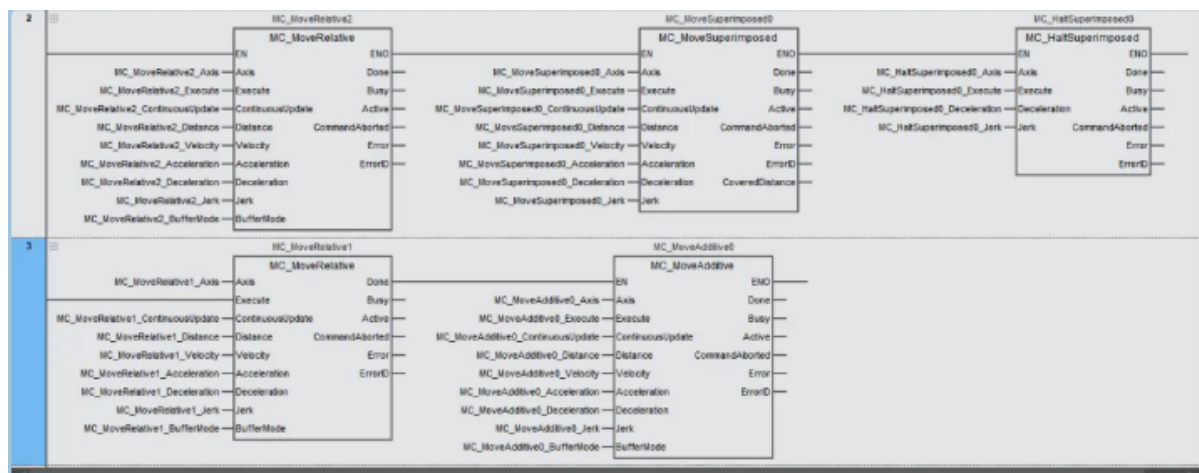
MC_MoveAdditive, MC_MoveSuperimposed, MC_HaltSuperimposed **function block test** (the following are sequential steps)

The first one: MC_MoveAdditive function block test

a. Enable the axis, return to the original position first, and trigger the MC_MoveRelative instruction

Result: The axis runs at a speed of 10

b. Then trigger the MC_MoveAdditive instruction

Result: This function block interrupts the executing MC_MoveRelative instruction, the axis runs at a speed of 20, and finally reaches a displacement of 500.

[Explanation] After the MC_MoveRelative function block is interrupted, the unfinished displacement will be completed by the MC_MoveAdditive instruction, and finally reach the position of **200+300=500** .

Second: MC_MoveSuperimposed function block test

a. Enable the axis, Homing first, and trigger the MC_MoveRelative instruction

Result: The axis runs at a speed of 10

b. Then trigger the MC_MoveSuperimposed instruction

Result: This function block does not interrupt the executing MC_MoveRelative instruction. The axis runs at a speed of 30 and finally reaches a displacement of 500.

[Note] Triggering the MC_MoveSuperimposed instruction does not affect the currently executing MC_MoveRelative instruction. The speed and displacement are the sum of the two instructions. The speed will run at **10 + 20 = 30 ,** and the final position will be **200 + 300 = 500** .

The third type: MC_HaltSuperimposed function block test

a. Enable the axis, Homing first, and trigger the MC_MoveRelative instruction

Result: The axis runs at a speed of 10

b. Trigger the MC_MoveSuperimposed instruction

Result: The axis runs at a speed of 30

c. Trigger the MC_HaltSuperimposed instruction

Result: The axis continues running at speed 10 and then stops.

[Note]: The MC_HaltSuperimposed instruction is only used for the MC_MoveSuperimposed instruction. Therefore, triggering this instruction will not affect the currently executing MC_MoveRelative instruction. The final displacement is the 200 of the MC_MoveRelative instruction plus the displacement of the MC_MoveSuperimposed instruction . The displacement of the MC_MoveSuperimposed instruction can be seen in the covered distance of this pin.

Instruction	Speed Superposition	Displacement Superposition	Interrupt the current instruction	Run without instructions
MC_MoveAdditive	No	Yes	Yes	Equivalent to relative displacement
MC_MoveSuperimposed	Yes	Yes	No	Equivalent to relative displacement