M Series Tutorial_Encoder Axis Usage and Probe Command Introduction

Software: Sysctrl Studio (PLC programming software 2.4.0.1705)

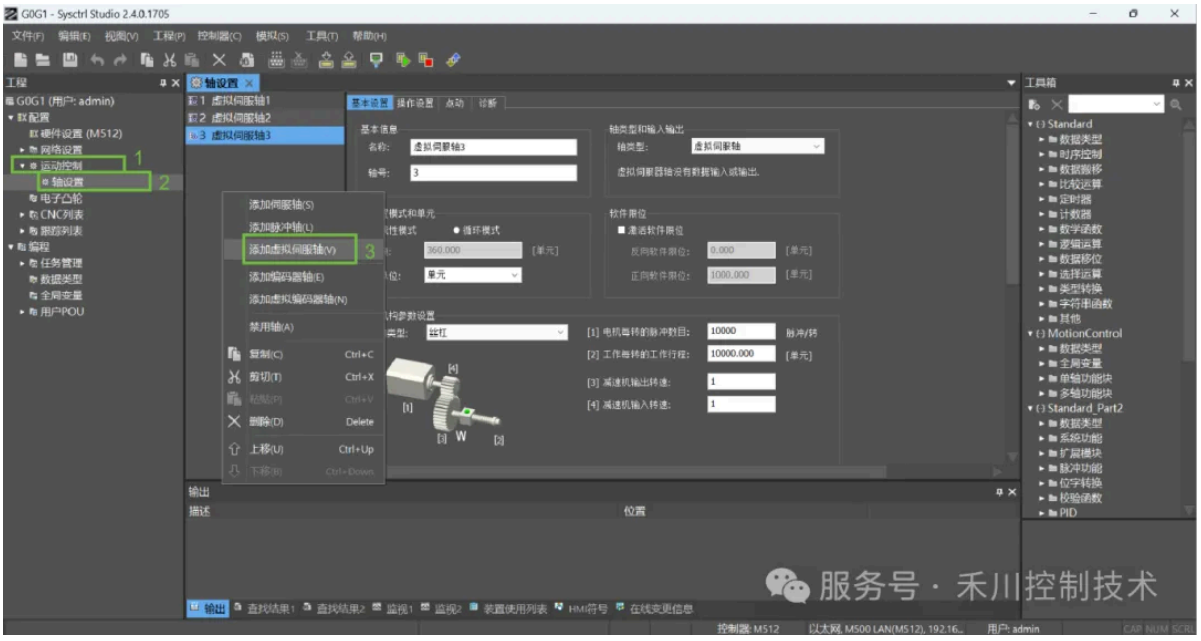
Hardware: M series controller (taking M511S as an example 2.01.03)

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

encoder

Wiring Connections

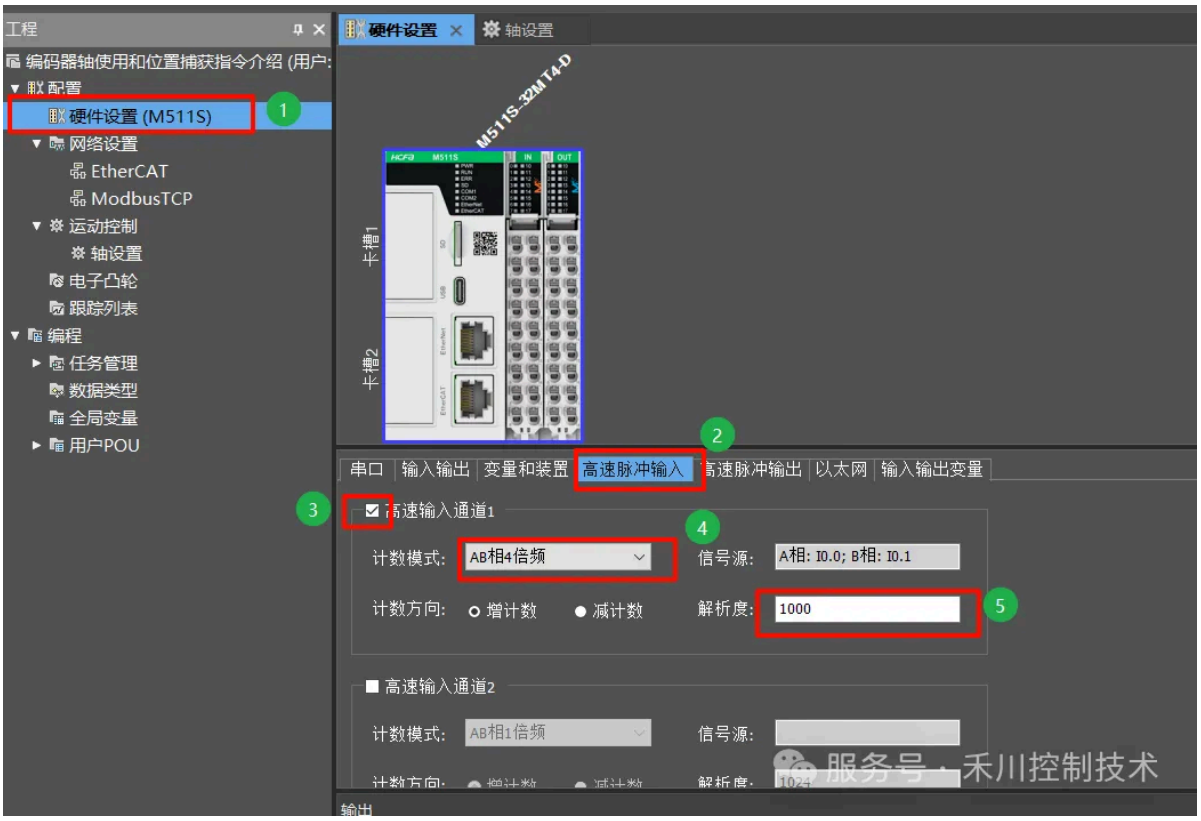
This tutorial uses the M controller HCM511S-32MT4-D, servo HN-Y7FB040A-S, and encoder. The connection method is shown in the figure below.



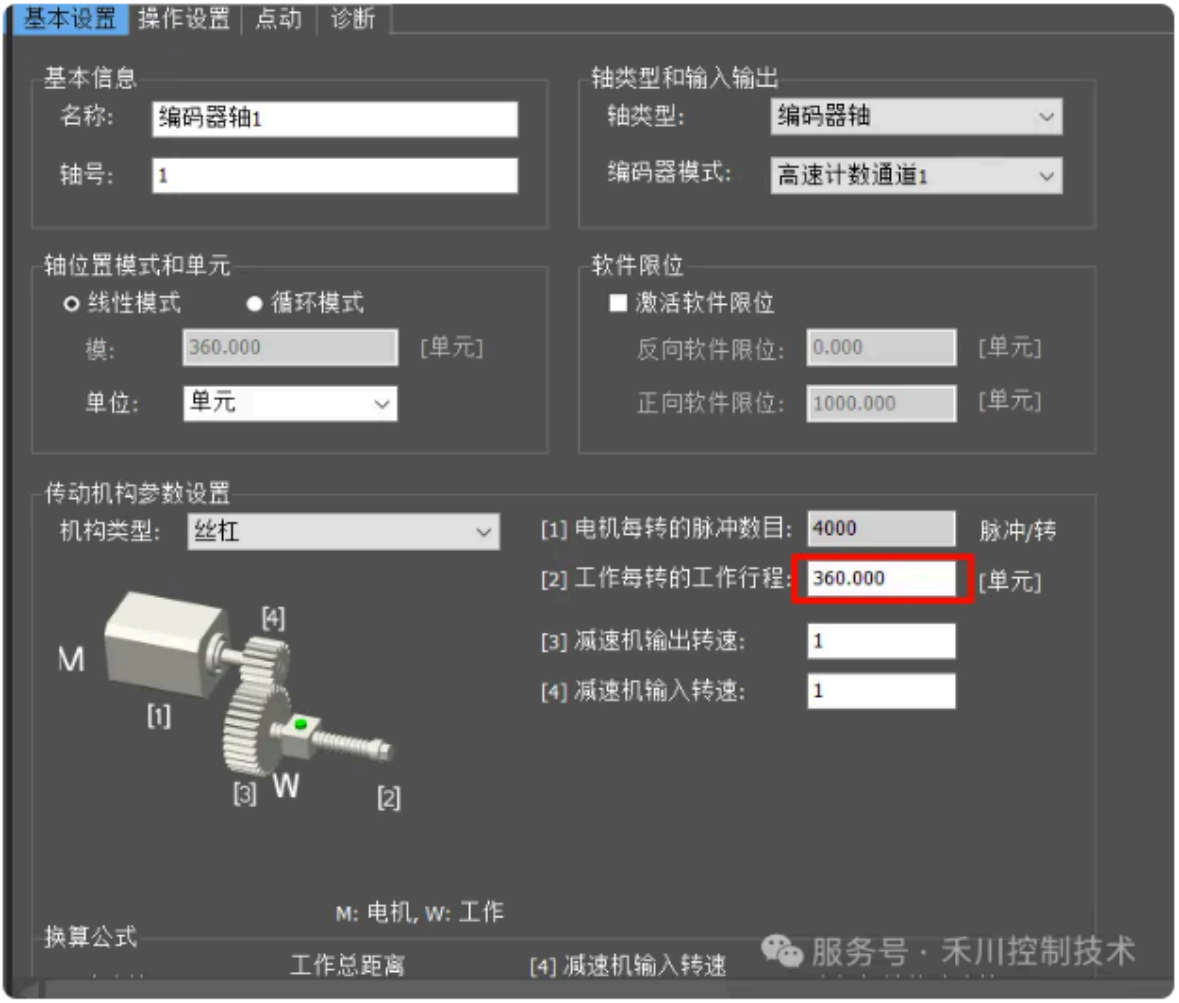
Sysctrl Studio project basic configuration

Basic Settings

[Hardware Setup] >> [High-speed pulse input] >> [High-speed counting channel] >> [High-speed pulse input] >> [Resolution] >> [Add encoder axis] >> [Select channel] >> [Input axis parameters]

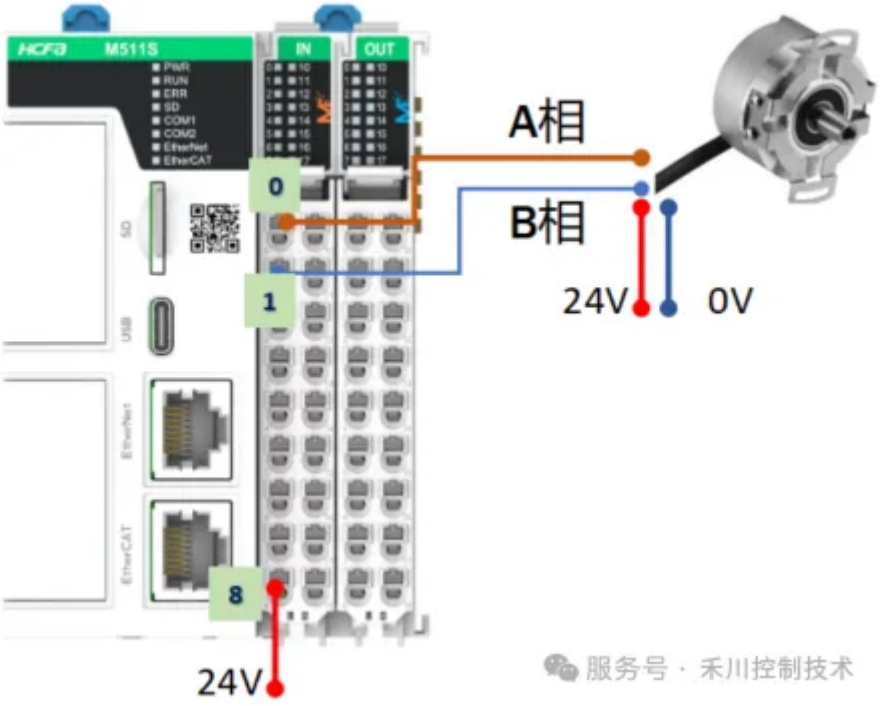

工程
编码器轴使用和位置捕获指令介绍 (用户:
PLC配置
硬件设置 (M511S)
网络设置
EtherCAT
ModbusTCP
运动控制
轴设置
电子凸轮
跟踪列表
编程
任务管理
数据类型
全局变量
用户POU
硬件设置
轴设置
M511S-32MT4-D
串口
输入输出
变量和装置
高速脉冲输入
高速脉冲输出
以太网
输入输出变量
高速输入通道1
计数模式:
AB相4倍频
信号源:
A相: I0.0; B相: I0.1
计数方向:
增计数
减计数
解析度:
1000
高速输入通道2
AB相1倍频
输出
1
2
3
4
5


硬件设置
轴设置
1 编码器轴1
2 伺服轴2
基本设置
操作设置
点动
诊断
基本信息
名称:
编码器轴1
轴号:
1
轴类型和输入输出
轴类型:
编码器轴
编码器模式:
高速计数通道1
轴位置模式和单元
线性模式
循环模式
模:
360.000
[单元]
单位:
单元
软件限位
激活软件限位
反向软件限位:
0.000
正向软件限位:
1000.000
传动机构参数设置
机构类型:
丝杠
[1] 电机每转的脉冲数目:
4000
脉冲/转
[2] 工作每转的工作行程:
360.000
[3] 减速机输出转速:
1
[4] 减速机输入转速:
1
M
W



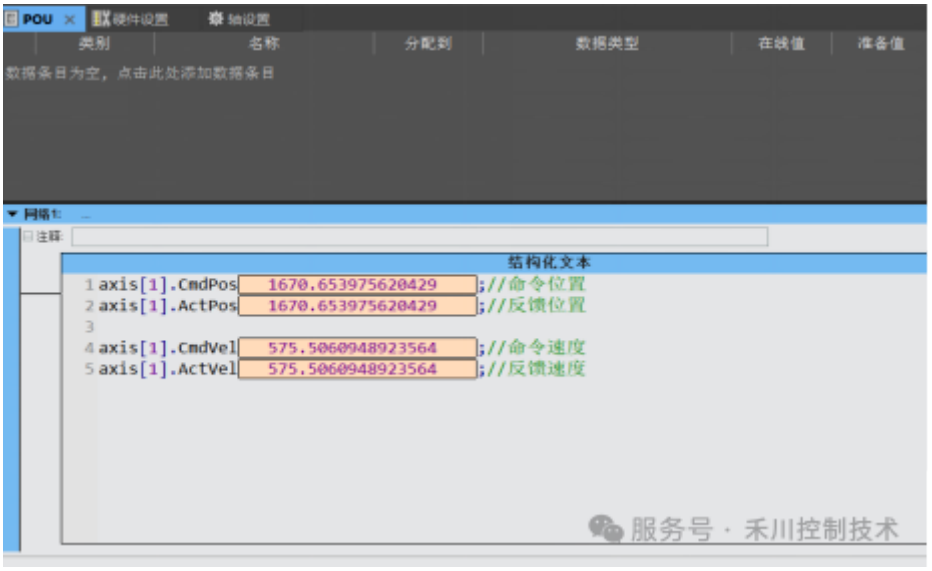
Use of encoder and probe instructions

Use of encoder



① Functional testing

The pulse counts are converted to user units based on the axis settings, making them easier to use. The encoder count position can be viewed in the encoder axis settings. You can also use the axis structure variables Axis[1].CmdPos and Axis[1].ActPos to view the encoder count position, and Axis[1].CmdVel and Axis[1].ActVel to view the encoder axis speed. After connecting the wires, double-click the POU to add an ST block to the grid. Enter the axis variable in the program so that the project can obtain the encoder counts. Download the project to the controller and click "Online Rotation Encoder Movement."



Probe instruction applications

The probe function, also known as the position latch function, enables position control based on a trigger signal from a sensor input, recording (latching) the axis position at the time of the trigger signal. This function is commonly used in applications requiring high position accuracy, such as in packaging equipment like pillow packaging machines, filling machines, and labeling machines, and in the printing industry, such as roller printing machines, paper cutters, and code printers.

MC_TouchProbe (lock axis position)

① Functional description

This instruction records the feedback position of a specified axis at the moment a trigger signal occurs. The specified axis can be a servo axis or an encoder axis. When Execute changes from FALSE to TRUE, the instruction executes according to the specified input variables. When the specified trigger condition is triggered, the position is output to RecordedPosition (locked position), and the instruction completes execution .

②Pin Description

■ Input variable

Name	Meaning	Data types	Valid range	Default	Description
Axis	Axis number	USINT	Depends 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
TriggerInput	Trigger input condition	MC_Triggerinput	0:mcTriggerinput_I0 1:mcTriggerinput_I1 ... 7: mcTriggerinput_I7 8:mcTriggerinputI_I10 9:mcTriggerinputI_I11 ... 15:mcTriggerinputI_17	0	This input variable is only valid when the encoder axis position is recorded, i.e., when Mode is set to 0 and 1. If this input variable is set to 0, the controller input channel %IX0.0 is used to lock the encoder axis position; if this input variable is set to 1, the controller input channel %IX0.1 is used to lock the encoder axis position
Windowonly	Window only	BOOL	Reserved	Reserved	Reserved
Firstops	First position	LREAL	Reserved	Reserved	Reserved
Lastops	Last position	LREAL	Reserved	Reserved	Reserved
Mode	Mode	INT	0、1、5、6	0	This input variable is used to set the mode for triggering the locking of the axis position. 0: Mode 0*1 The position of the encoder axis is reocorded by the rising edge of the controller's input channel, which input channel is specified by the input variable TriggerInput. RecordedPosition is the position of the controller's encoder interface after receiving the number of pulses converted by the axis. parameters. 1: Mode 1*1 The position of the encoder axis is

					reocorded by the falling edge of the controller's input channel, which input channel is specified by the input variable TriggerInput. RecordedPosition is the position of the controller's encoder interface after receiving the number of pulses converted by the axis 5: Mode 5*2 The position of the servo axis is reocorded by the rising edge of the input channel of the drive, the actual position of the servo axis is determined by the probe function of the drive. RecordedPosition is the motor's actual position converted by the axis parameters. 6: Mode 6*2 The position of the servo axis is reocorded by the falling edge of the input channel of the drive, the actual position of the servo axis is determined by the probe function of the drive. RecordedPosition is the motor's actual position converted by the axis parameters.
Mask	Mask	INT	Reserved	Reserved	Reserved

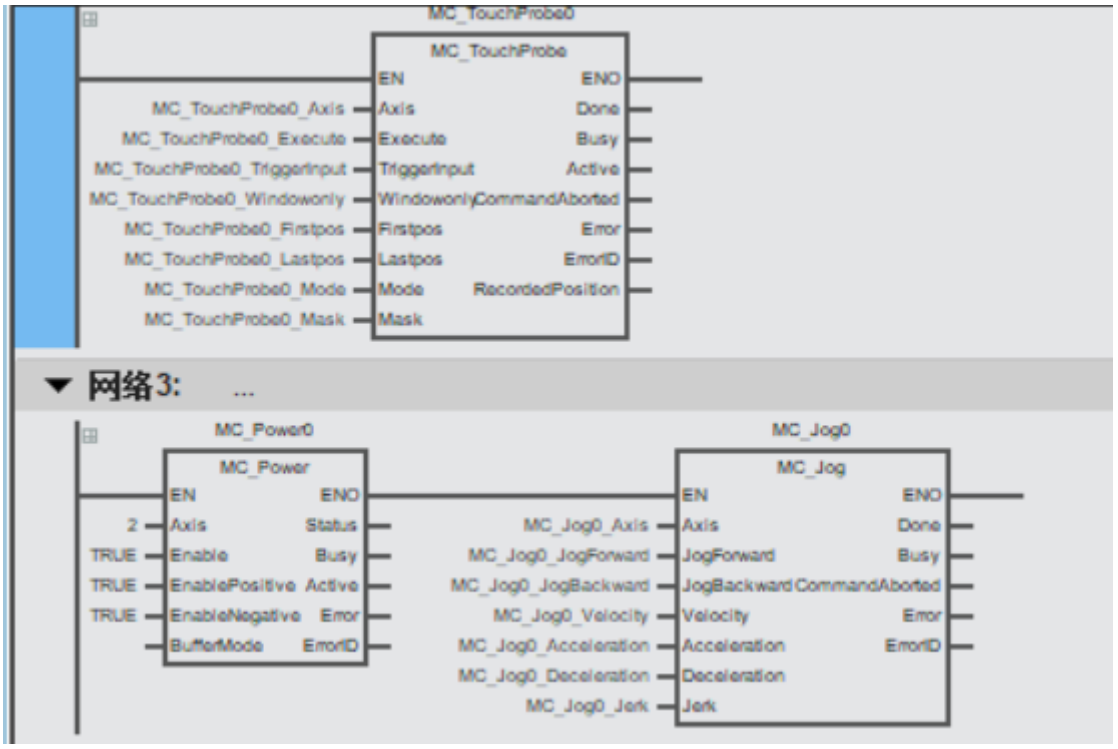
*1: When multiple MC_TouchProbe instructions use both mode 0 and mode 1, mode 0 and mode 1 cannot be specified as the same input point.
*2: Mode 5 and Mode 6 are only supported by M500S series and M500 series controllers.

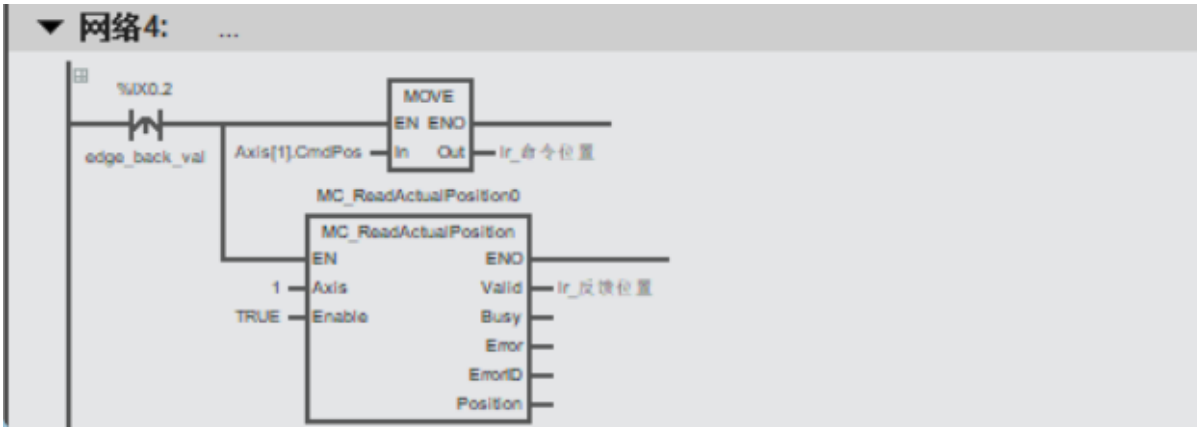
■ Output variable

Name	Meaning	Data types	Valid range	Description
Done	Completed	BOOL	TRUE or FALSE	TRUE when the trigger signal is executed and the position is recorded
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is executed
Active	Controlling	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 while there is an error
ErrorID	Error Code	WORD	0~65535	Contains the error code when an error occurs For the meaning of the value, please refer to "Instruction error code"
RecordedPosition	Recorded position	LREAL	Positive number, Negative number, 0	The actual position of the latched axis when the signal is triggered, which is the position of the motor or the position of the controller encoder interface after the number of pulses received and converted by the axis parameters.

Instruction Test

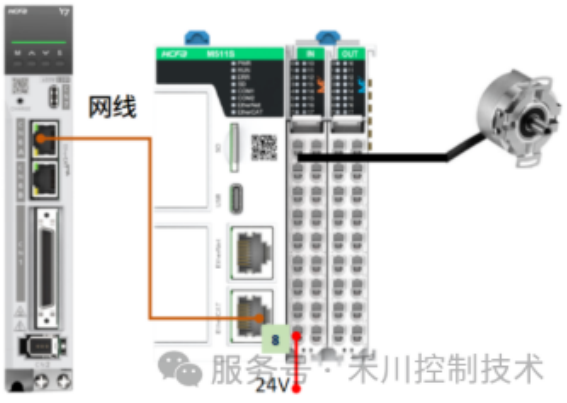
Encoder shaft position capture project settings





MC_TouchProbe FB test

Use the rising edge of the sensor's input point to obtain the command position and feedback position for calculation, jog the EtherCAT axis to drive the encoder input, and observe the captured position %IX0.2 point edge signal's command position and feedback position after passing the sensor.

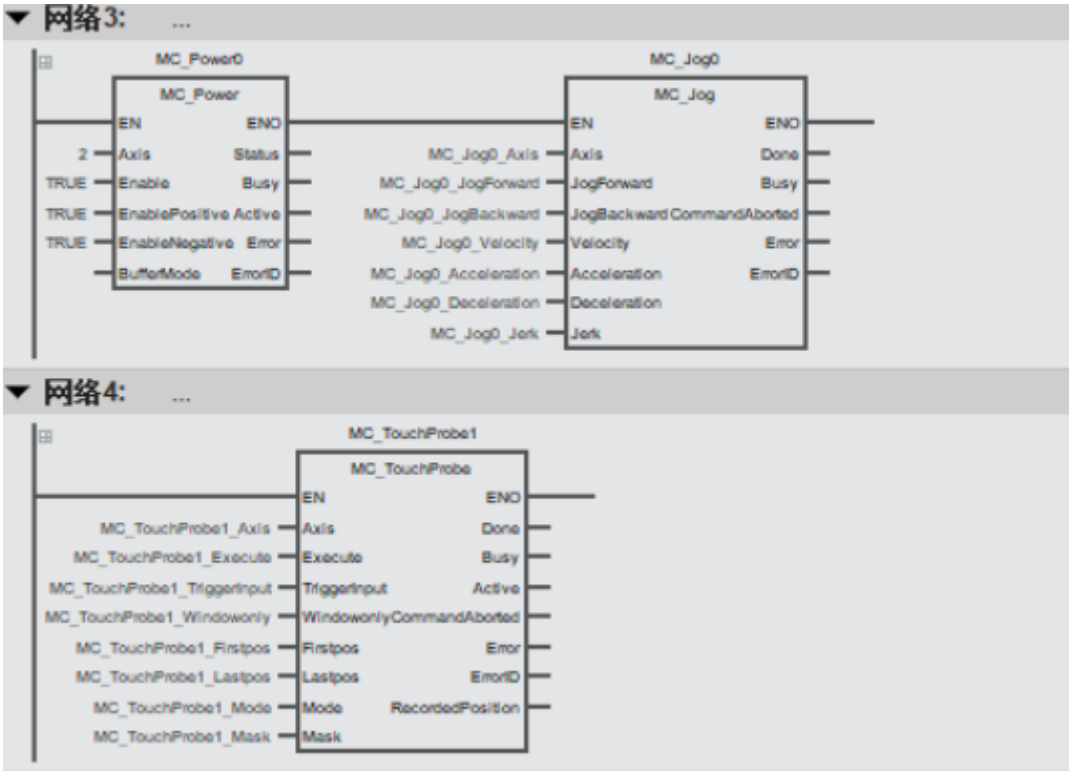


a. Enable the EtherCAT axis, trigger the MC_Jog function block, drive the encoder axis to move, and trigger the probe signal.

Result: When the probe signal is triggered by the sensor, the function block outputs the Done signal. The position captured by the probe is between the command position and the feedback position, which proves that the probe capture is not affected by the scanning cycle.

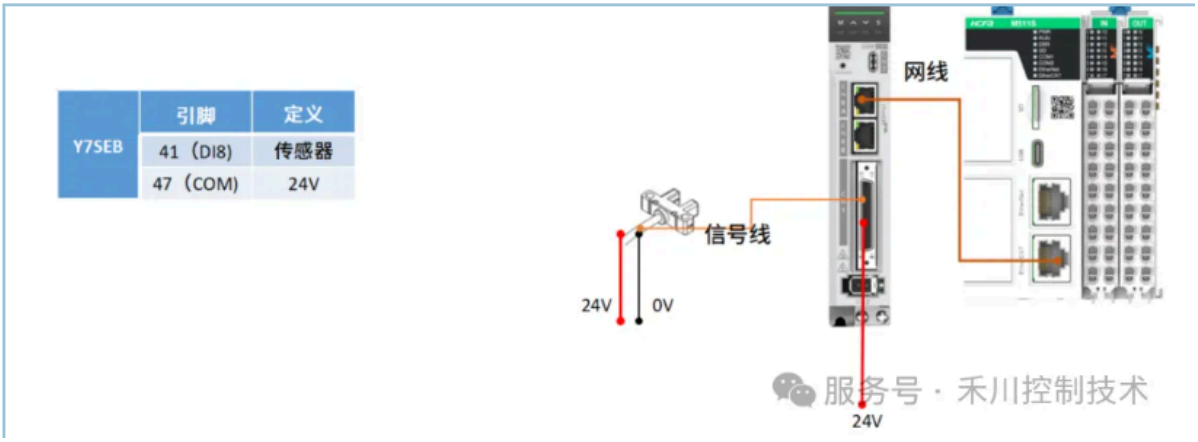
EtherCAT axis position capture project settings

10	VAR	MC_Power0		MC_Power	
11	VAR	MC_Jog0		MC_Jog	
12	VAR	MC_Jog0_Axis		USINT	2
13	VAR	MC_Jog0_JogForward		BOOL	
14	VAR	MC_Jog0_JogBackward		BOOL	
15	VAR	MC_Jog0_Velocity		LREAL	1
16	VAR	MC_Jog0_Acceleration		LREAL	100
17	VAR	MC_Jog0_Deceleration		LREAL	100
18	VAR	MC_Jog0_Jerk		LREAL	10000
19	VAR	MC_TouchProbe1		MC_TouchProbe	
20	VAR	MC_TouchProbe1_Axis		USINT	2
21	VAR	MC_TouchProbe1_Execute		BOOL	
22	VAR	MC_TouchProbe1_TriggerInput		MC_Triggerinput	
23	VAR	MC_TouchProbe1_Windowonly		BOOL	
24	VAR	MC_TouchProbe1_Firstpos		LREAL	
25	VAR	MC_TouchProbe1_Lastpos		LREAL	
26	VAR	MC_TouchProbe1_Mode		INT	5
27	VAR	MC_TouchProbe1_Mask		INT	



MC_TouchProbe function block test

For the Y7EB-S, select probe 1. Y7EB probe 1 is DI1, CN1 pin 41. For sensor wiring, select NPN. For a photoelectric sensor, for example, it turns ON when blocked from light.



a. Enable the EtherCAT axis, trigger the MC_Jog function block, start the EtherCAT axis, and trigger the sensor.

Result: When the sensor is triggered, the function block will output the Done signal, and the RecordedPosition pin will obtain the position captured by the servo and this position is not affected by the scan cycle .

[Explanation]:

The position captured by MC_TouchProbe is consistent with the command position and feedback position captured by the task in the project, which proves that the probe position captured by MC_TouchProbe is not affected by the scanning cycle .

MC_TouchProbeCyc (Cyclic lock axis position)

① Functional description

This instruction records the feedback position of the specified axis at the moment the trigger signal occurs. The specified axis can be a servo axis or an encoder axis. When Enable is TRUE, the feedback position of the specified axis at the moment of triggering is output to RecordedPosition (locked position) when the external trigger condition is met. The position is recorded once each time the external trigger condition is triggered. The difference between this instruction and the MC_Touchuprobe instruction is that this instruction does not require cyclic triggering execution. When Enable is TRUE, recording the locked position prepares for the next recording of the locked position and does not require program processing. When the MC_Touchuprobe instruction is executed, after recording the locked position, program processing is required to trigger the execution of this instruction again. After the instruction is executed again, the next locked position of the axis can be recorded only when the specified trigger condition is met.

②Pin Description

■ Input variable

Name	Meaning	Data types	Valid range|	Default	Description
Axis	Axis number	USINT	Depends on model	Required field	Specify the axis number of the control axis
Enable	Execute	BOOL	TRUE or FALSE	FALSE	Execute this instruction when the rising edge of this parameter is detected
TriggerInput	Trigger input condition	MC_Triggerinput	0:mcTriggerinput_I0 1:mcTriggerinput_I1 ... 7: mcTriggerinput_I7 8:mcTriggerinputI_I10 9:mcTriggerinputI_I11 ... 15:mcTriggerinputI_17	0	This input variable is only valid when the encoder axis position is locked, i.e., when Mode is set to 0 and 1. If this input variable is set to 0, the controller input channel %IX0.0 is used to lock the encoder axis position; if this input variable is set to 1, the controller input channel %IX0.1 is used to lock the encoder axis position
Windowonly	Window only	BOOL	Reserved	Reserved	Reserved
Firstops	First position	LREAL	Reserved	Reserved	Reserved
Lastops	Last position	LREAL	Reserved	Reserved	Reserved
Mode	Mode	INT	0、1、5、6	0	This input variable is used to set the mode in which the recording of the axis position is triggered. By setting the value of this variable, you can select whether the recording of the encoder axis position is triggered by the controller’ s input or the recording of the servo axis position is triggered by the driver’ s input . 0: Mode 0*1 The position of the encoder axis is recorded by the rising edge of the controller's input channel, which input

					channel is specified by the input variable TriggerInput. RecordedPosition is the position of the controller's encoder interface after receiving the number of pulses converted by the axis. parameters. 1: Mode 1*1 The position of the encoder axis is recorded ed by the falling edge of the controller's input channel, which input channel is specified by the input variable TriggerInput. RecordedPosition is the position of the controller's encoder interface after receiving the number of pulses converted by the axis 5: Mode 5*2 The position of the servo axis is recorded by the rising edge of the input channel of the drive, the actual position of the servo axis is determined by the probe function of the drive. RecordedPosition is the motor's actual position converted by the axis parameters. 6: Mode 6*2 The position of the servo axis is locked by the falling edge of the input channel of the drive, the actual position of the servo axis is determined by the probe function of the drive. RecordedPosition is the motor's actual position converted by the axis parameters.
Mask	Mask	INT	Reserved	Reserved	Reserved

*1: When multiple MC_TouchProbe instructions use both mode 0 and mode 1, mode 0 and mode 1 cannot be specified as the same input point.

*2: Mode 5 and Mode 6 are only supported by M500S series and M500 series controllers.

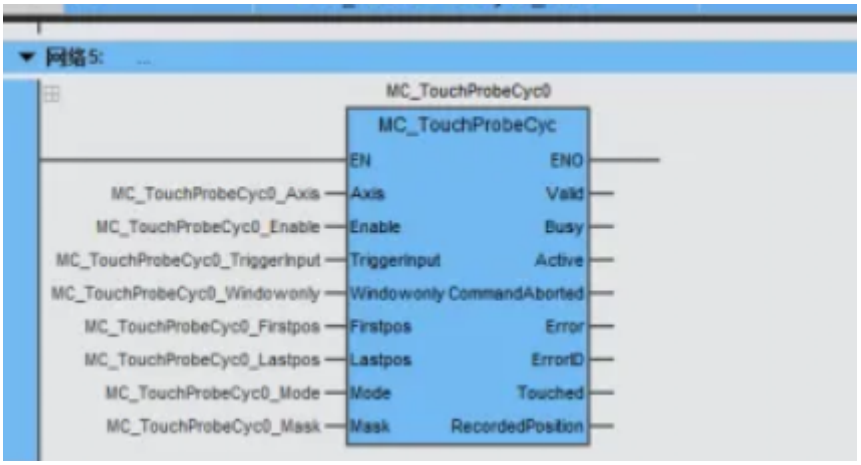
■ Output variable

Name	Meaning	Data types	Valid range	Description
Vaild	Vaild	BOOL	TRUE or FALSE	TRUE when the instruction executes normally
Busy	Executing	BOOL	TRUE or FALSE	TRUE when the instruction is acknowledged
Active	Controlling	BOOL	TRUE or FALSE	TRUE when the axis is being controlled
CommandAborted	Command Aborted	BOOL	TRUE or FALSE	TRUE when the instruction is aborted
Error	Error	BOOL	TRUE or FALSE	TRUE while there is an error
ErrorID	Error Code	WORD	0~65535	Contains the error code when an error occurs For the meaning of the value, please refer to "Instruction error code"
Touched	Record position complete	BOOL	TRUE or FALSE	TRUE when the trigger signal is executed and the position is recorded
RecordedPosition	Recorded position	LREAL	Positive number、Negative number、0	The actual position of the locked axis at the moment of the trigger signal, which is the position of the motor or the position of the controller encoder interface after the number of pulses received and converted by the axis parameters.

Instruction Test

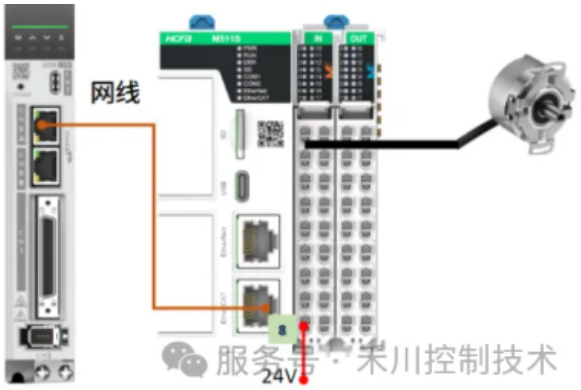
Encoder axis position capture project settings

	类别	名称	分配到	数据类型	初始值
29	VAR	MC_TouchProbeCyc0		MC_TouchProbeCyc	
30	VAR	MC_TouchProbeCyc0_Axis		USINT	1
31	VAR	MC_TouchProbeCyc0_Enable		BOOL	
32	VAR	MC_TouchProbeCyc0_TriggerInput		MC_TriggerInput	2
33	VAR	MC_TouchProbeCyc0_Windowonly		BOOL	
34	VAR	MC_TouchProbeCyc0_Firstpos		LREAL	
35	VAR	MC_TouchProbeCyc0_Lastpos		LREAL	
36	VAR	MC_TouchProbeCyc0_Mode		INT	0
37	VAR	MC_TouchProbeCyc0_Mask		INT	



MC_TouchProbeCyc FB Test

Use the rising edge of the sensor's input point to obtain the command position and feedback position for calculation, jog the bus axis to drive the encoder input, and observe the captured position %IX0.2 point edge signal's command position and feedback position after passing the sensor.

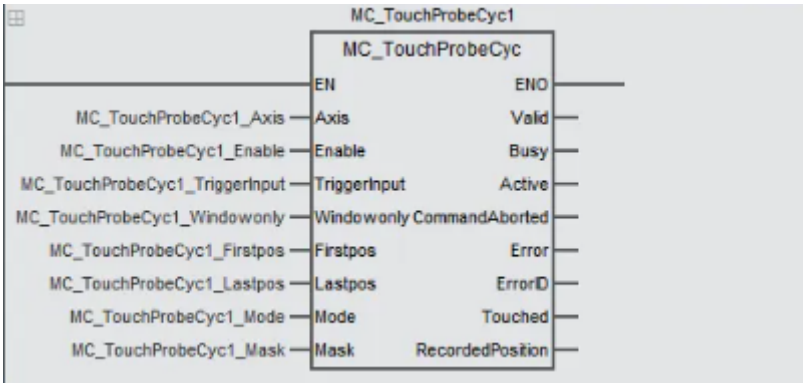


a. Enable the bus axis and trigger the MC_Jog function block to drive the encoder axis to move and continuously trigger the probe signal.

Result: When the probe signal is triggered by the sensor, the function block outputs a captured value, capturing the encoder position each time it passes the sensor. Compared to the MC_TouchProbe function block, it enters the next capture without re-triggering .

EtherCAT axis position capture project settings

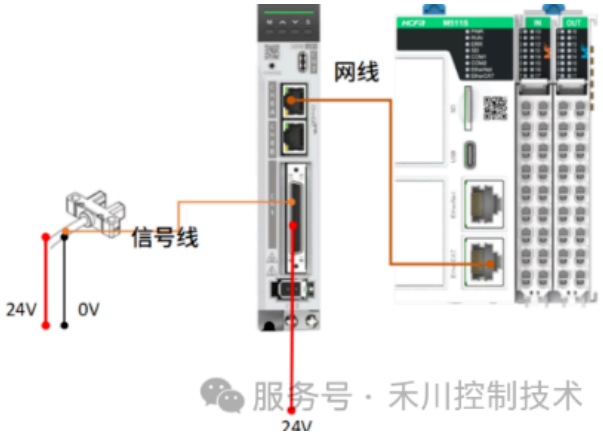
42	VAR	MC_TouchProbeCyc1		MC_TouchProbeCyc	
43	VAR	MC_TouchProbeCyc1_Axis		USINT	2
44	VAR	MC_TouchProbeCyc1_Enable		BOOL	
45	VAR	MC_TouchProbeCyc1_TriggerInput		MC_TriggerInput	
46	VAR	MC_TouchProbeCyc1_Windowonly		BOOL	
47	VAR	MC_TouchProbeCyc1_Firstpos		LREAL	
48	VAR	MC_TouchProbeCyc1_Lastpos		LREAL	
49	VAR	MC_TouchProbeCyc1_Mode		INT	5
50	VAR	MC_TouchProbeCyc1_Mask		INT	



MC_TouchProbeCyc Test

For the Y7EB-S, select probe 1. Y7EB probe 1 is DI1, CN1 pin 41. For sensor wiring, select NPN. For a photoelectric sensor, for example, it turns ON when blocked from light.

Y7SEB	引脚	定义
	41（DI8）	传感器
	47（COM）	24V



a. Enable the bus axis and trigger the MC_Jog function block. The EtherCAT axis starts moving and continuously triggers the probe signal.

Result: When the probe signal is triggered by the sensor, the function block outputs a captured value, capturing the encoder position each time it passes the sensor. Compared to the MC_TouchProbe function block, it enters the next capture without re-triggering .

[Explanation]

The difference between the MC_TouchuprobeCyc and MC_Touchuprobe instructions is that this instruction does not require cyclic triggering for execution. When Enable is TRUE, after recording the locked position, preparations are made for the next recording of the locked position, and no program processing is required .

When the MC_Touchuprobe instruction is executed, after recording the locked position, the program needs to trigger the execution of the instruction again. After the instruction is executed again, the next locked position of the axis can be recorded only when the specified trigger condition is met.