SD700-PROFInet Application Training

1. Preface

SD700-NA Servo、Siemens PLC、GSDML Document、Botu Software。

The panel displays supported messages：

Example of application of message 111

Example of application of message 3

2. Panel Display

Communication Status	
0	Servo power on
1	PLC not controlled
2	Connection Prohibited
3	Ready to connect
4	Connect
5	Run

Control Mode	
1	AC1
3	AC3
4	AC4

Port Connection Status

Port 1 (In) connection status

Port 2 (Out) connection status

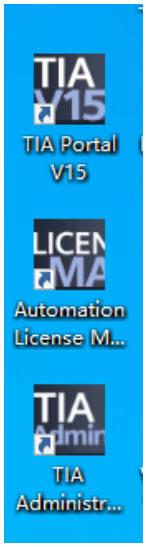
Status	Meaning	Status	Meaning
	Light on when the control power is ON, off when it is OFF		Light on when the main circuit power is ON, off when it is OFF
	Speed control: Light on when the speed consistent (/V-CMP) signal output **Position control:** Light on when the positioning completion signal (/COIN) output **Torque control:** always on		Light on when the rotation checkout (/TGON) signal output
			Speed control: Light on when the speed command is input **Position control:** Light on when the position command is input
	Light on when servo is OFF, off when servo is ON		**Torque control:** Light on when the torque command is input **Position control:** Light on when the pulse clear signal is input

3. Messages Supported

Messages	Maximum number of PZDs (one PZD per word)	
Standard message 1	2	2
Standard message 3	5	9
Siemens Message 102	6	10
Siemens Message 105	10	10
Siemens Message 111	12	12
Siemens Message 750（Auxiliary message）	3	1

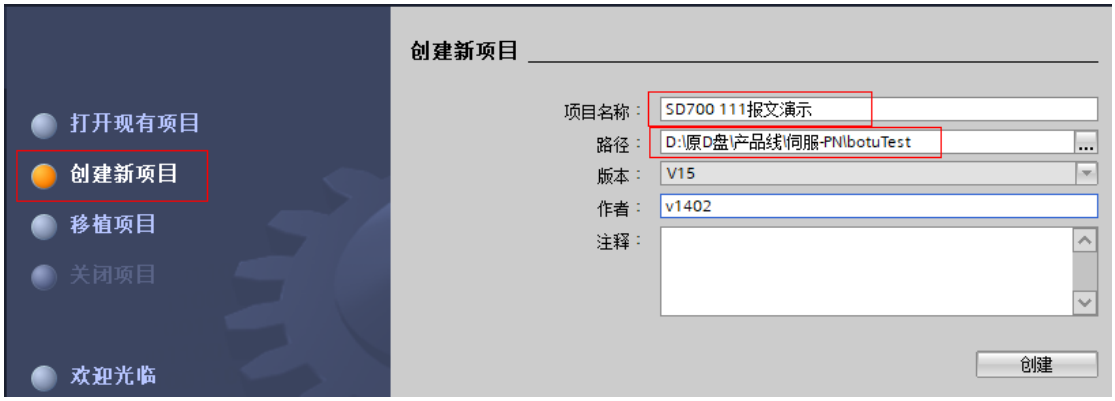
4. 111 Example of message application operation

Install the Botu software, open the Botu software

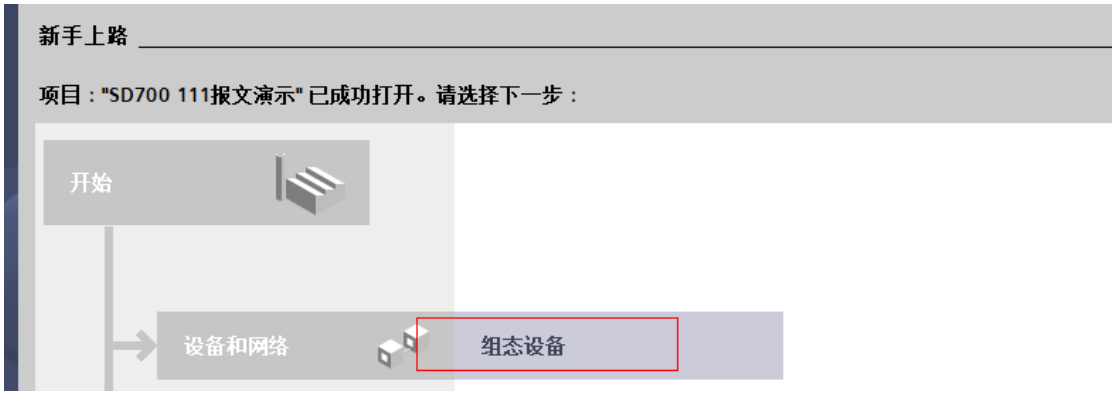


4.1 Create a new project

Open the software, click "Create New Project", enter the project name and select the project path. Then click "Create".



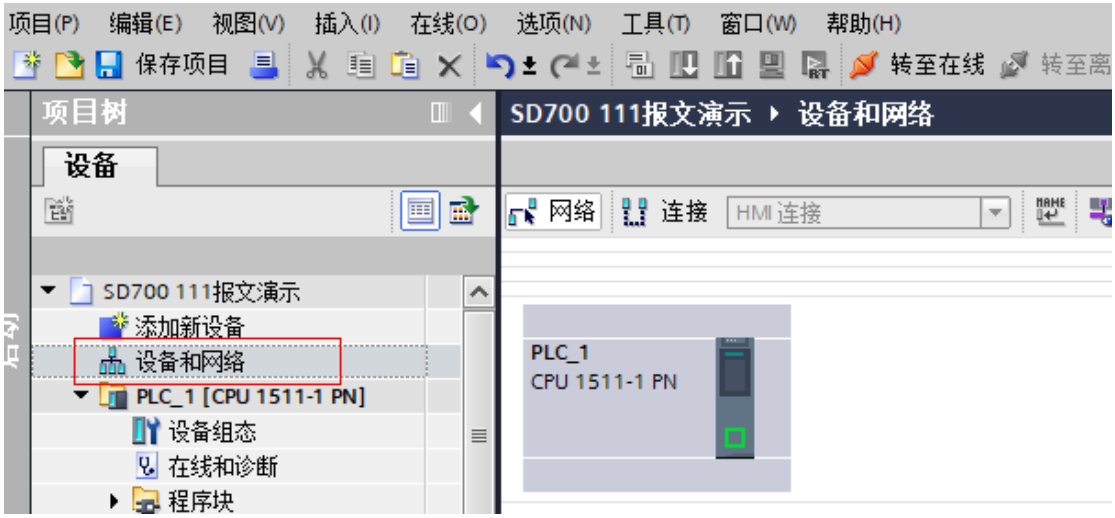
Click on "Configure Device"



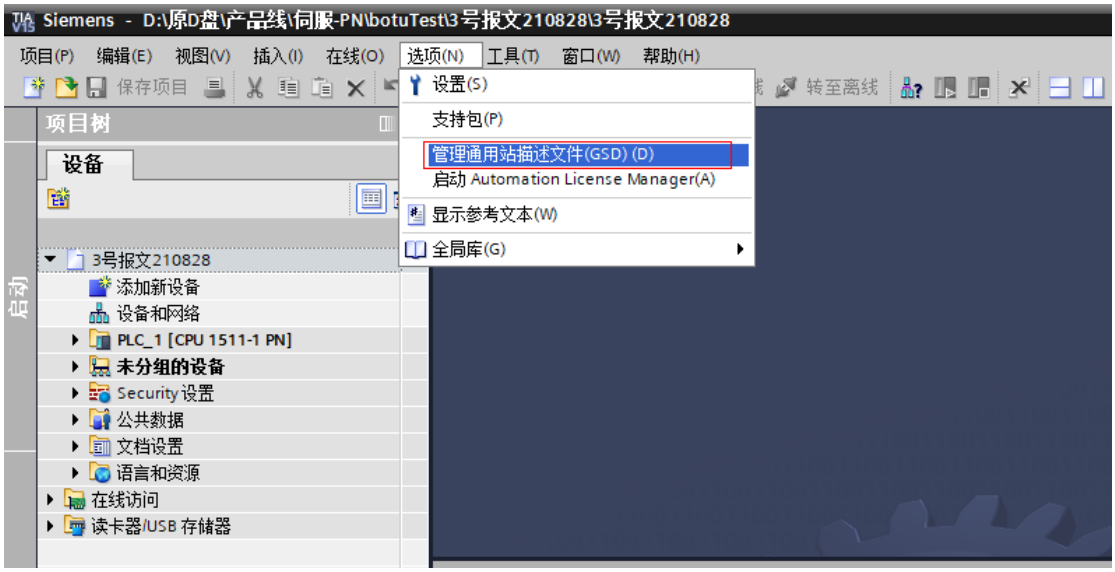
Click on "Add Device" and select the PLC model you are using。

4.2 Device Configuration

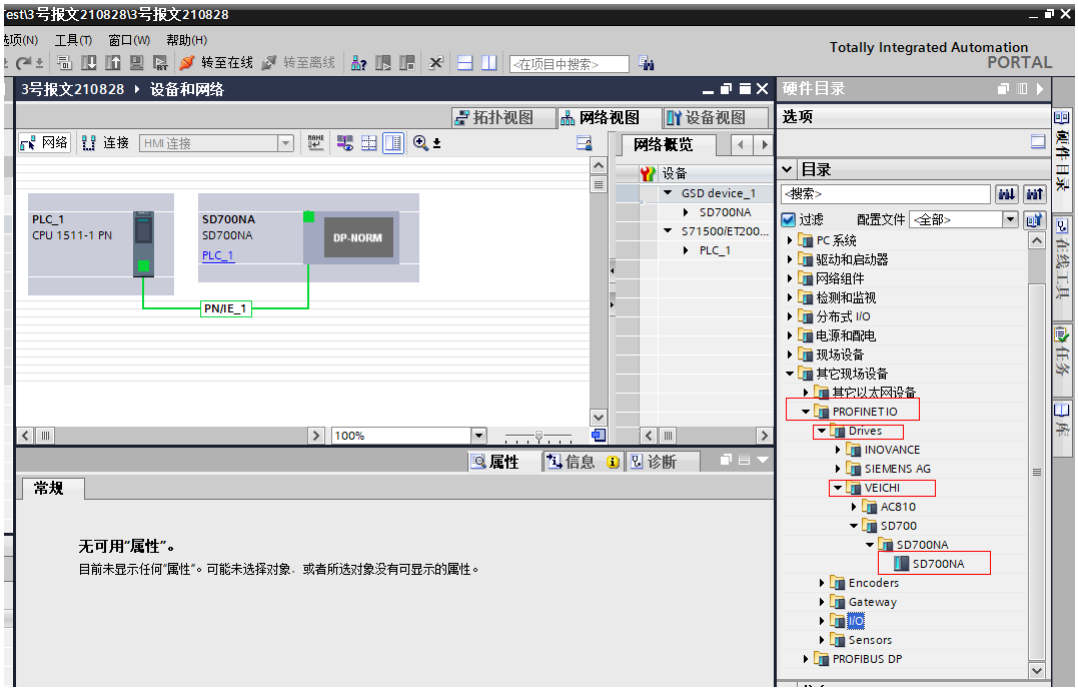
Click on "Devices and Networks"



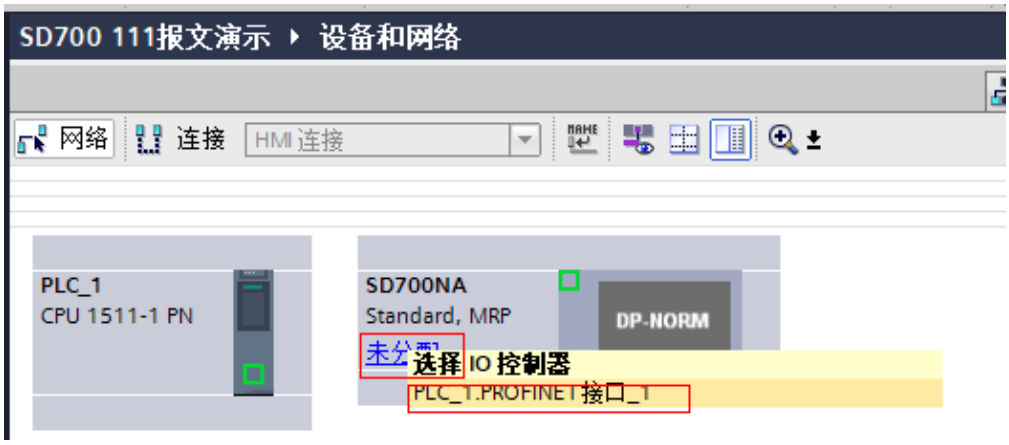
Installing GSDML files



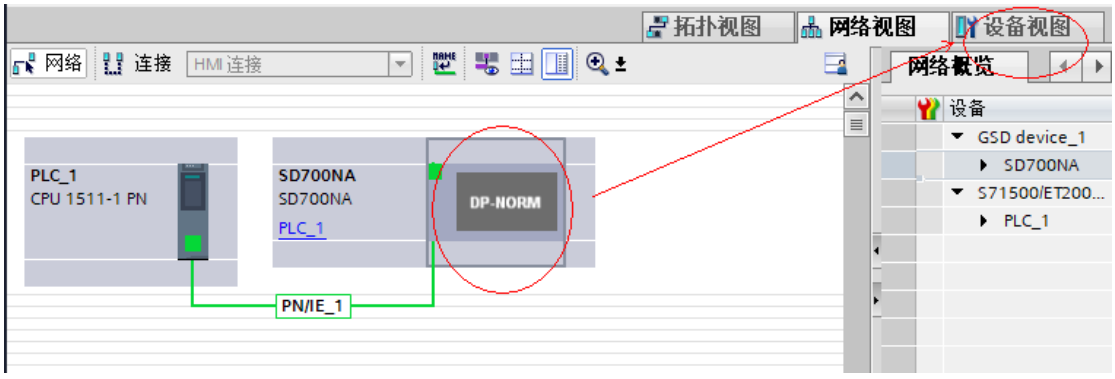
Find the SD700NA on the right side of the "Hardware content", double click or drag it into the "Network View”



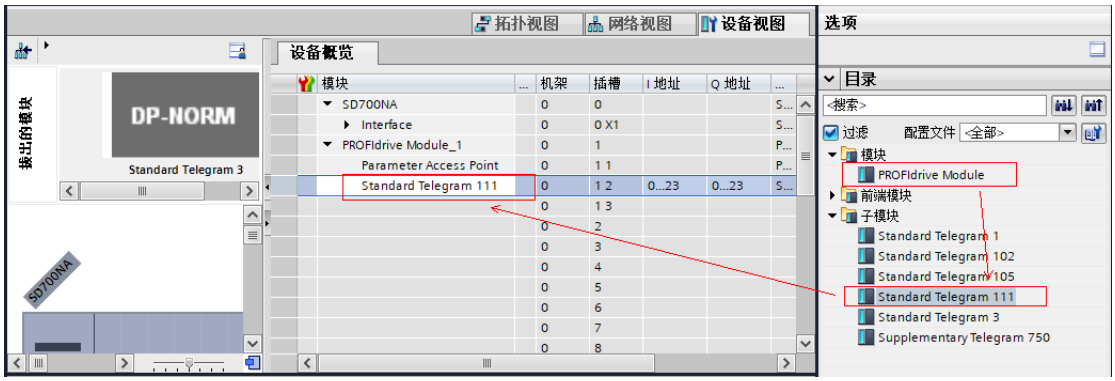
Click on "Unallocated" as follows



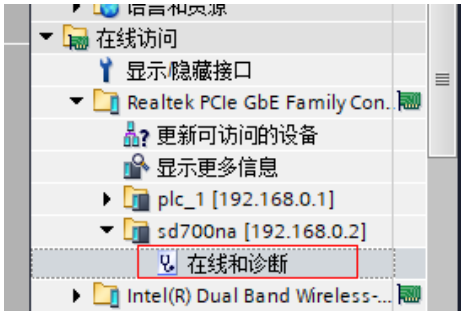
Add Message



Double click on "PROFIdrive Module" in the right menu directory and add the 111 message to it.



Click "Update Accessible Devices" in "Online Access" and click "Online Diagnostics" on the scanned servo.

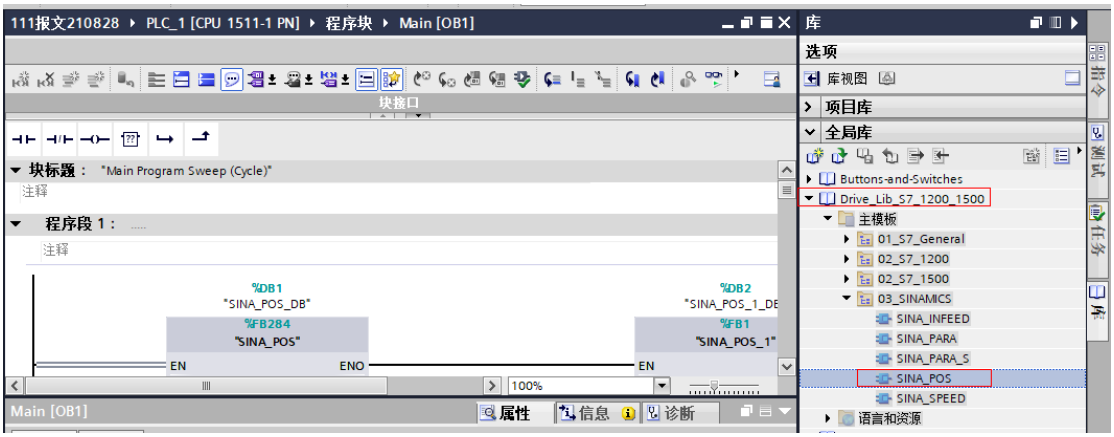


Assigning IP addresses and device names

4.3 Adding EPOS blocks

Double click on "Main[OB1]"

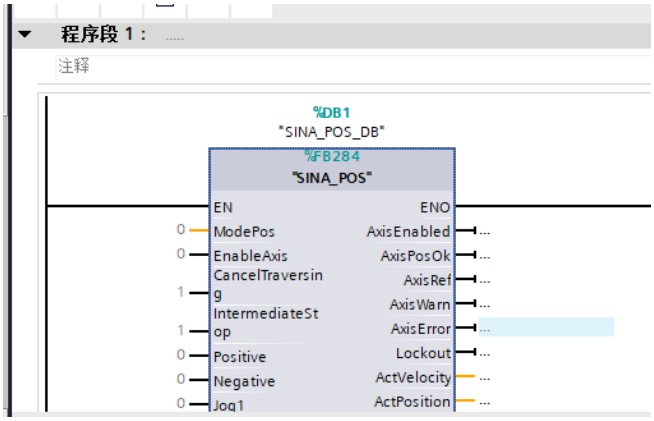
Select "Library" "Drive_Lib_S7_1200_1500" in the right menu, and select "SINA_POS".



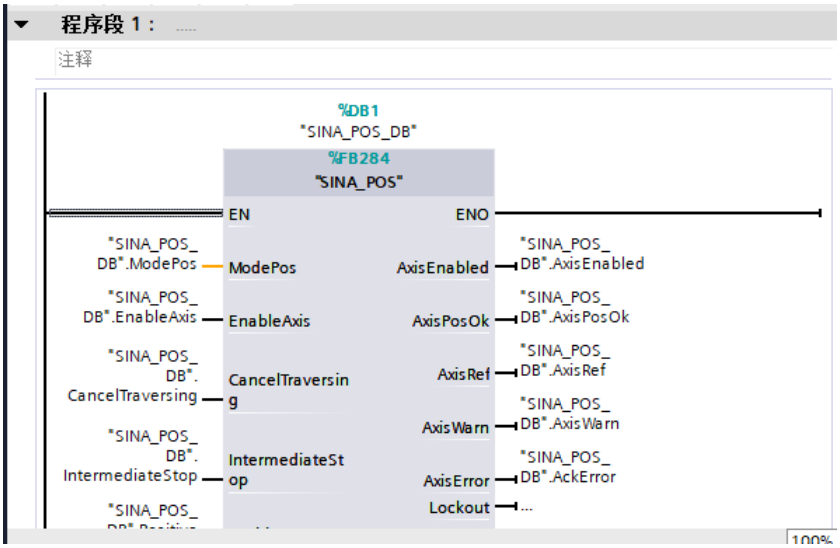
If the library is not complete, then you can download and install StartDrive software, the download link is

https://support.industry.siemens.com/cs/us/en/view/68034568

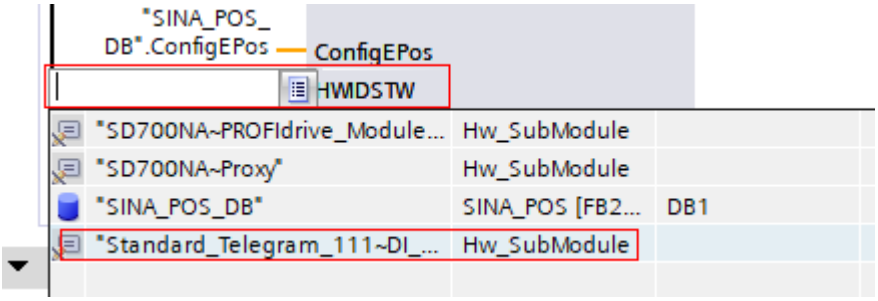
Drag "SINA_POS" into "Main[OB1]", and drag it in as shown below.



Dock the variables for each interface as follows



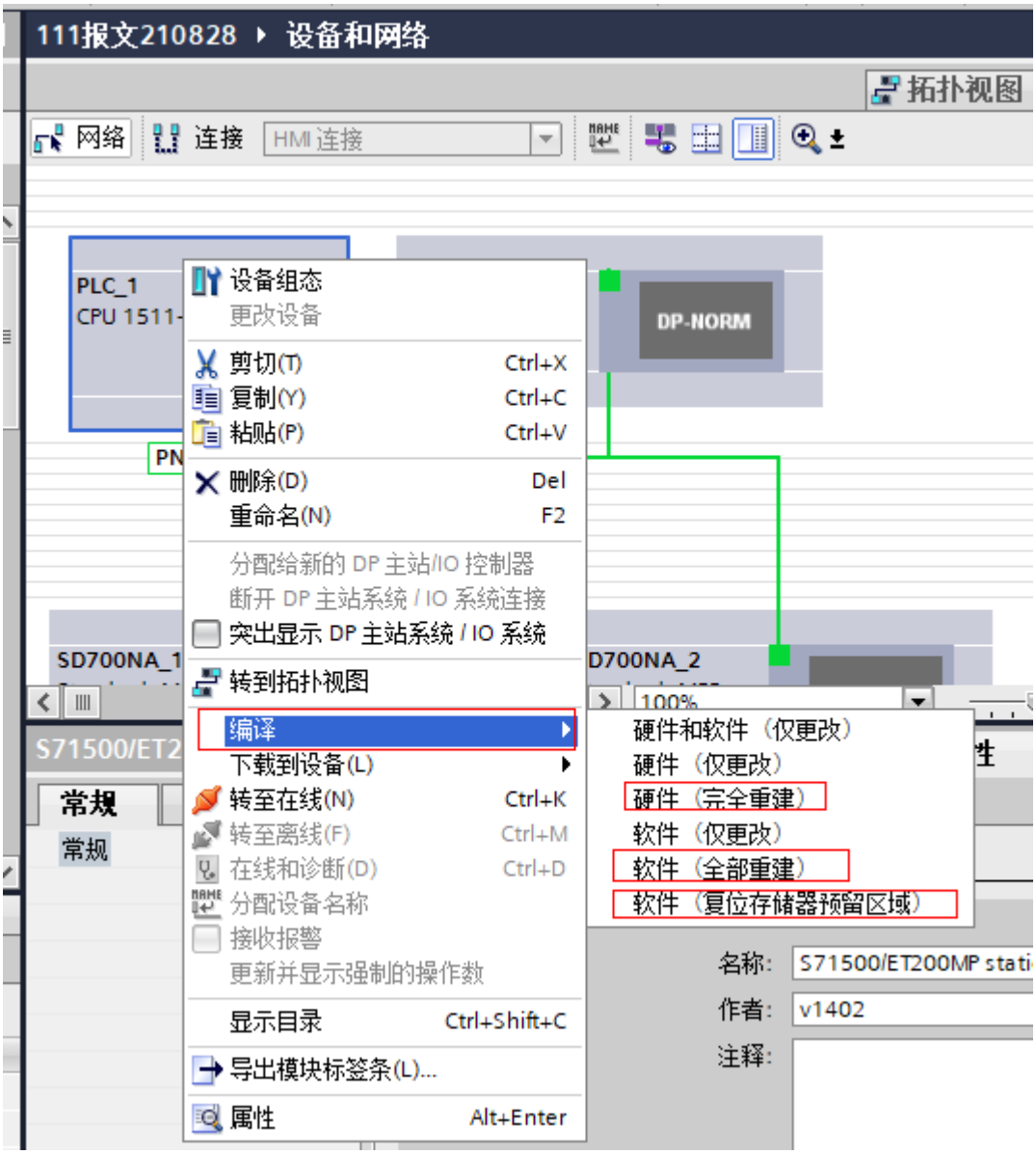
The hardware representation is added as follows, adding "Standard_Telegram_111"

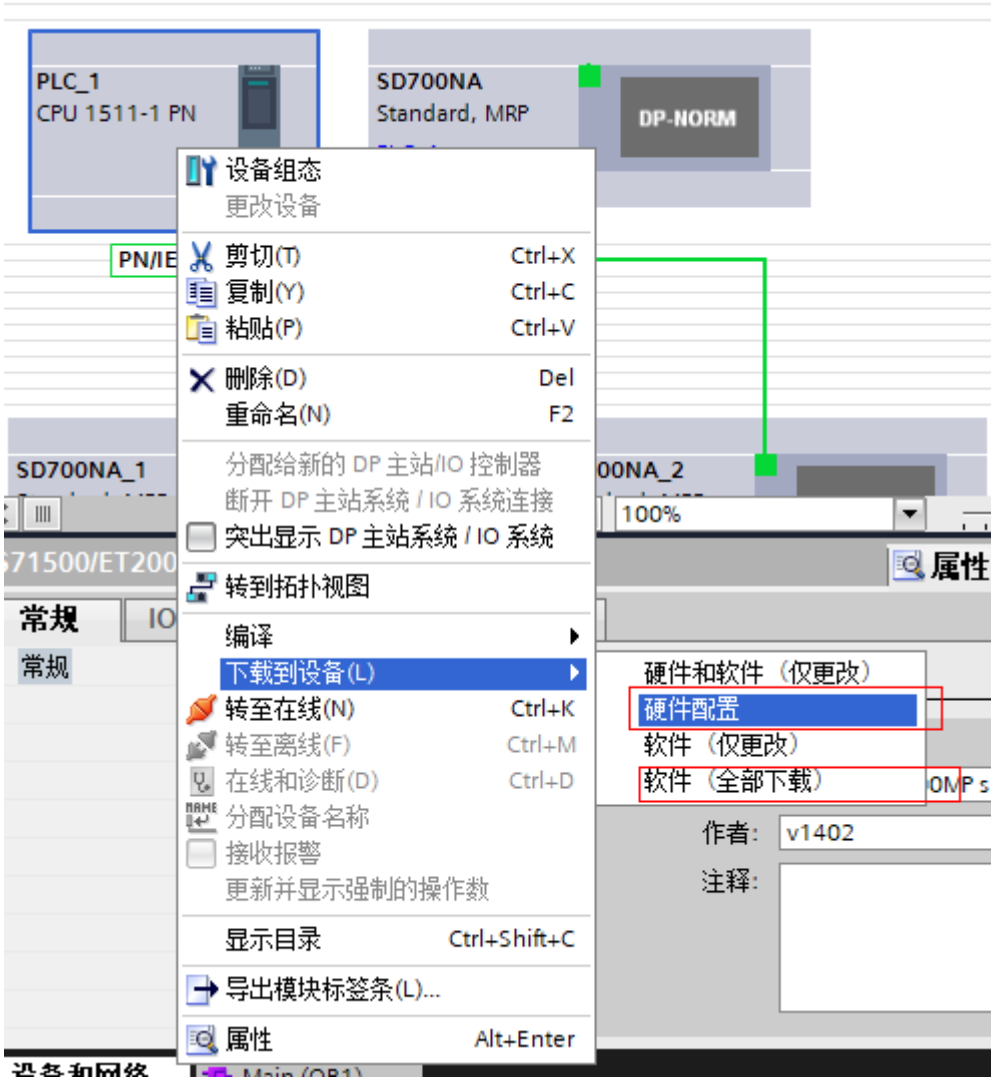


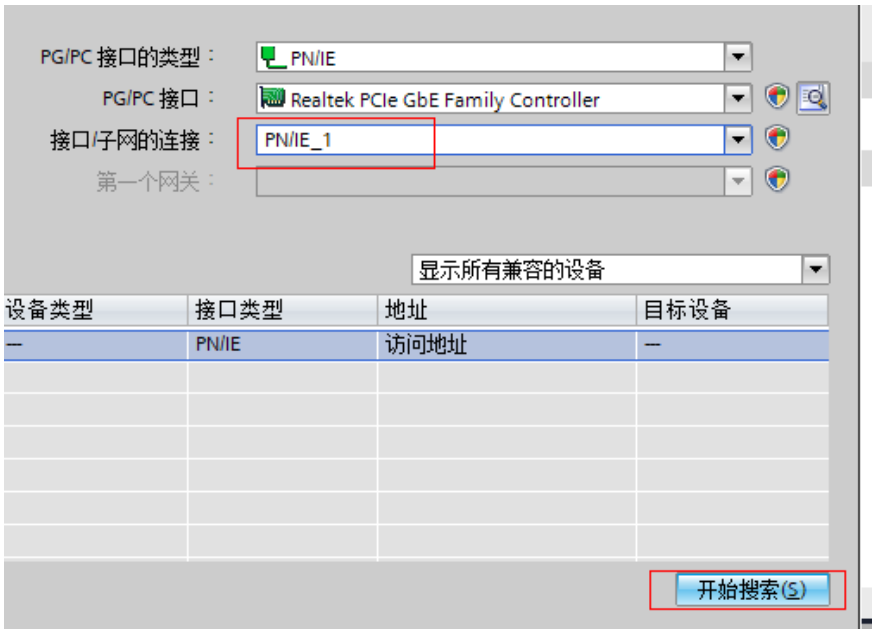
4.4 Compile and download

After adding, compile and download。

The following compilation and download is recommended here：



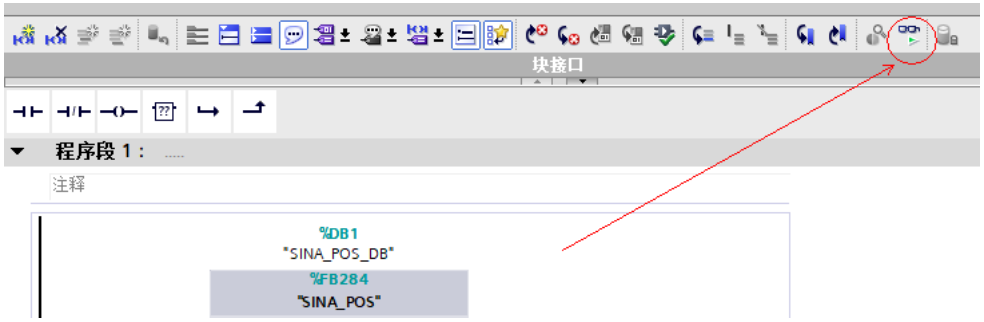




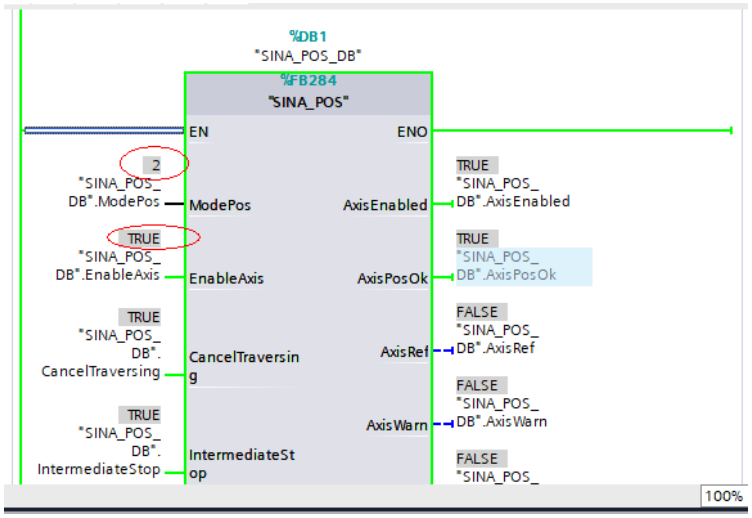
Click on "Download"

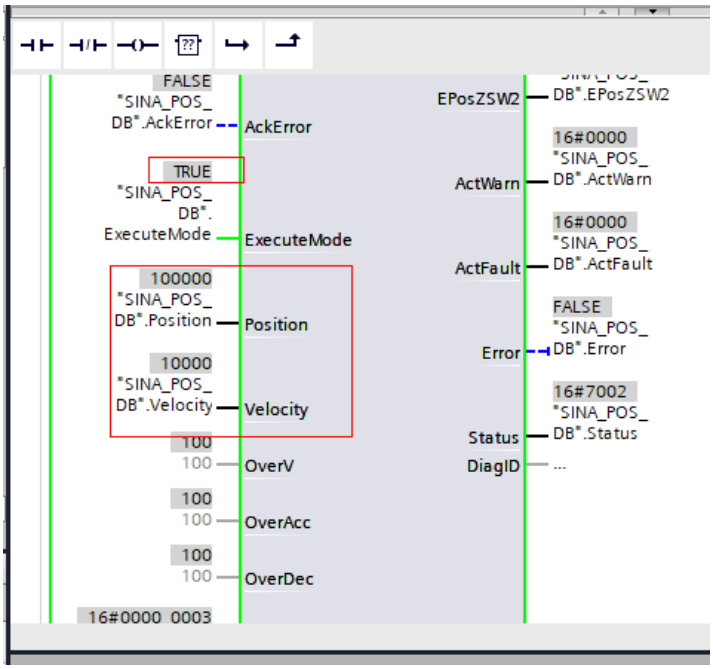
4.5 Trial run

After the program is downloaded, click on "Enable/Disable Monitoring".



ModePos input 2 for absolute position operation. Click Enable, enter target position and target speed，Trigger rising edge "ExecuteMode" to run the motor。



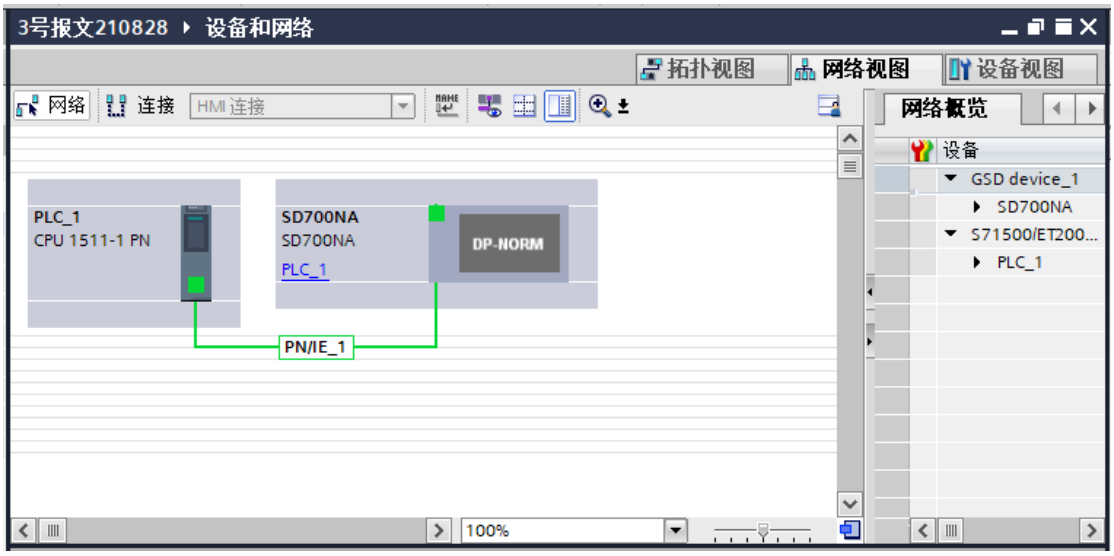


Detailed introduction can be viewed S7-1500 or S7-1200 with SD700 profinet to achieve AC3 (111 message) use case

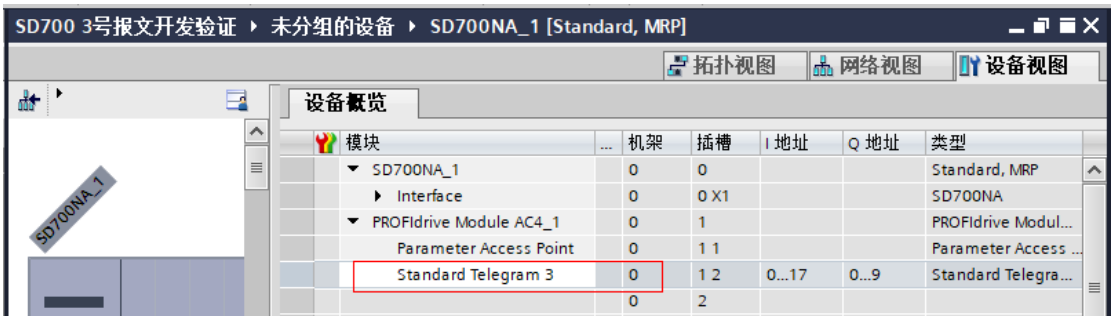
5、 Example of application operation of message No. 3

5.1 Configuration devices

First configure the device correctly

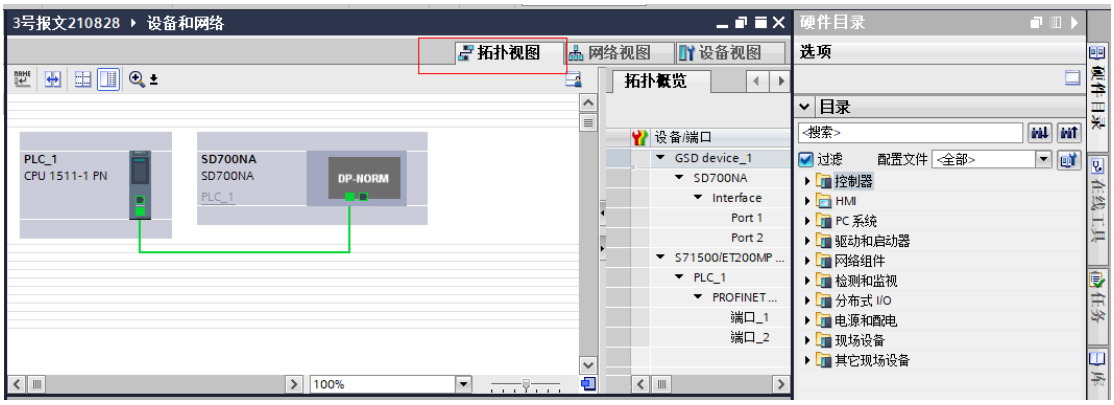


Add message 3



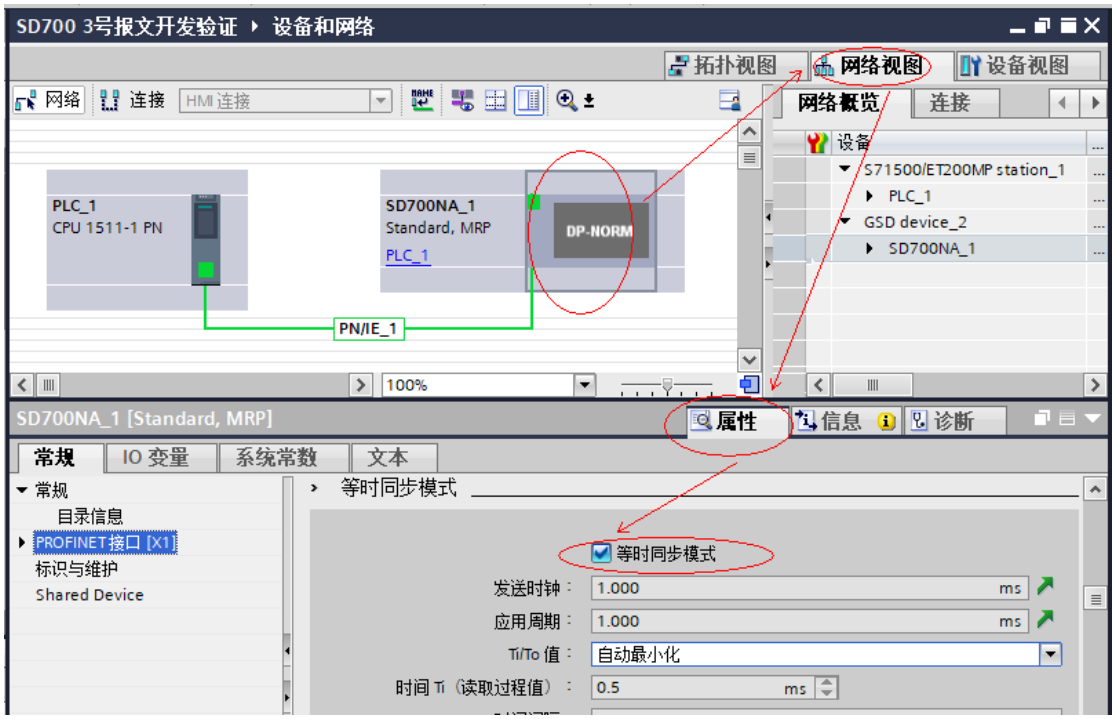
Assigning IP addresses and device names

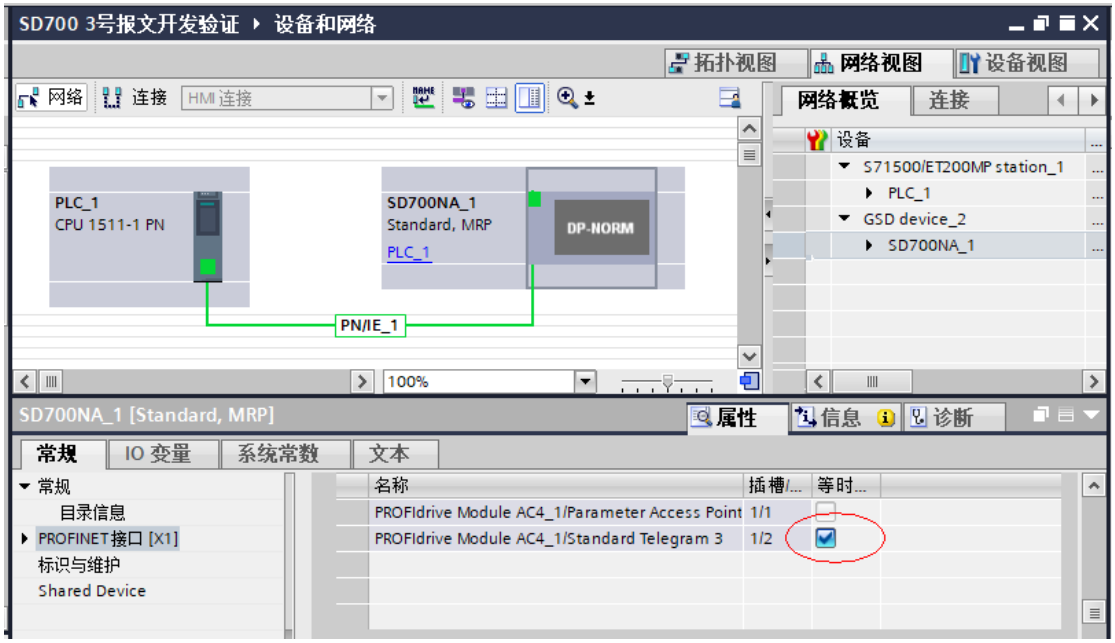
Switch to the "Topology View" interface and connect the PLC and the device according to the physical wiring. The interface on the left side of the device corresponds to the upper port of the physical device.



5.2 Isochronous synchronization function setting

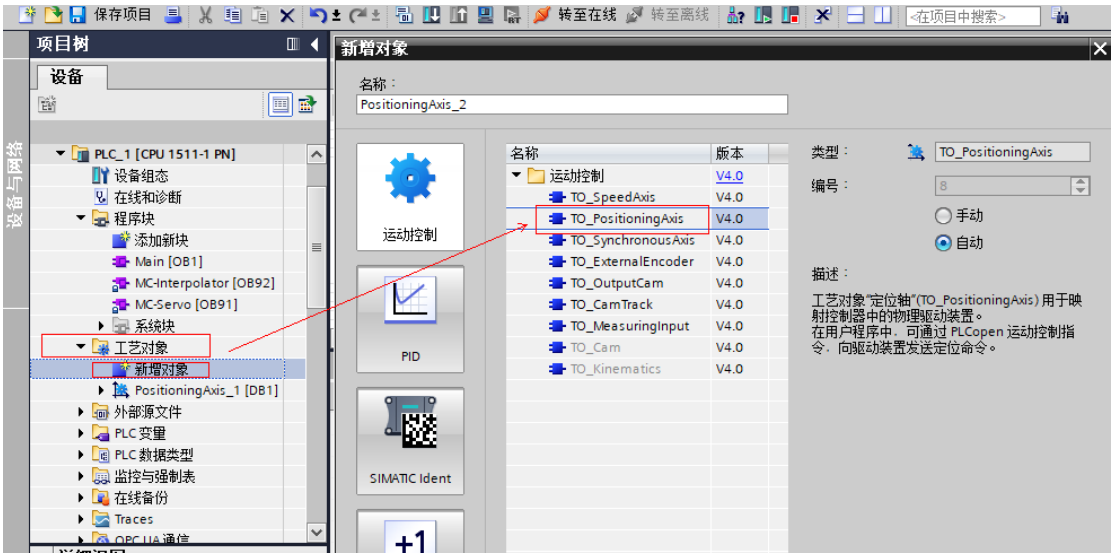
Find the isochronous sync as shown below and check the box。



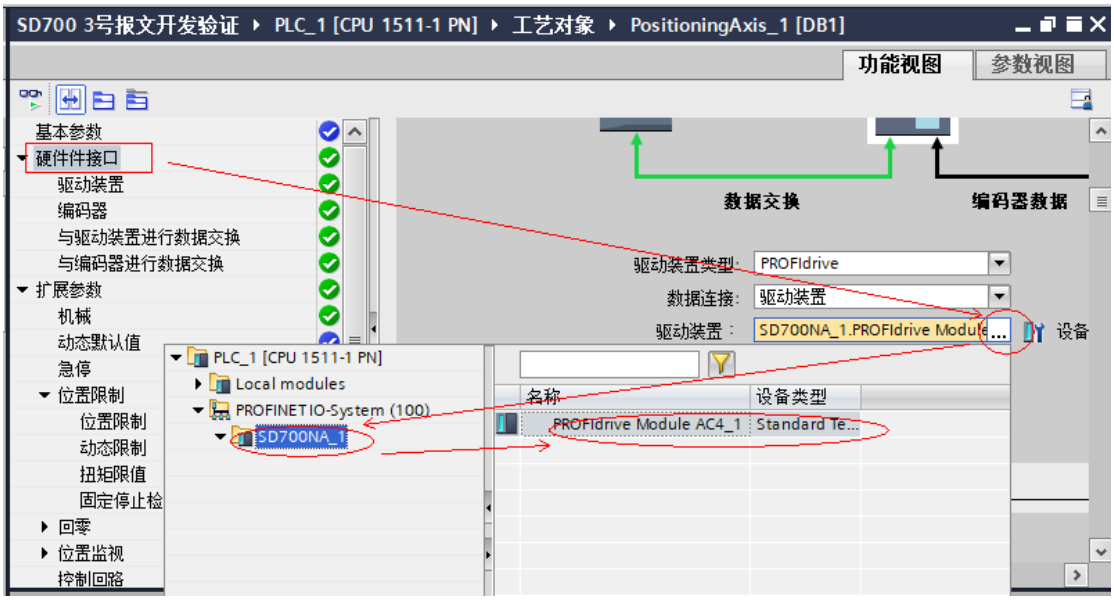


5.3 Adding process objects

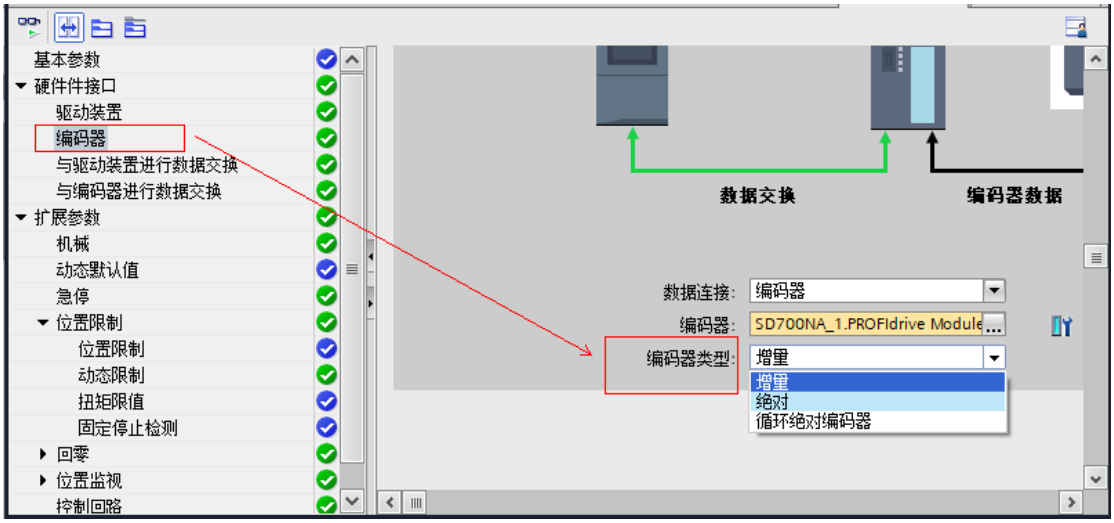
Click "Process Object" - "New Object", add "TO_PositioningAxis"



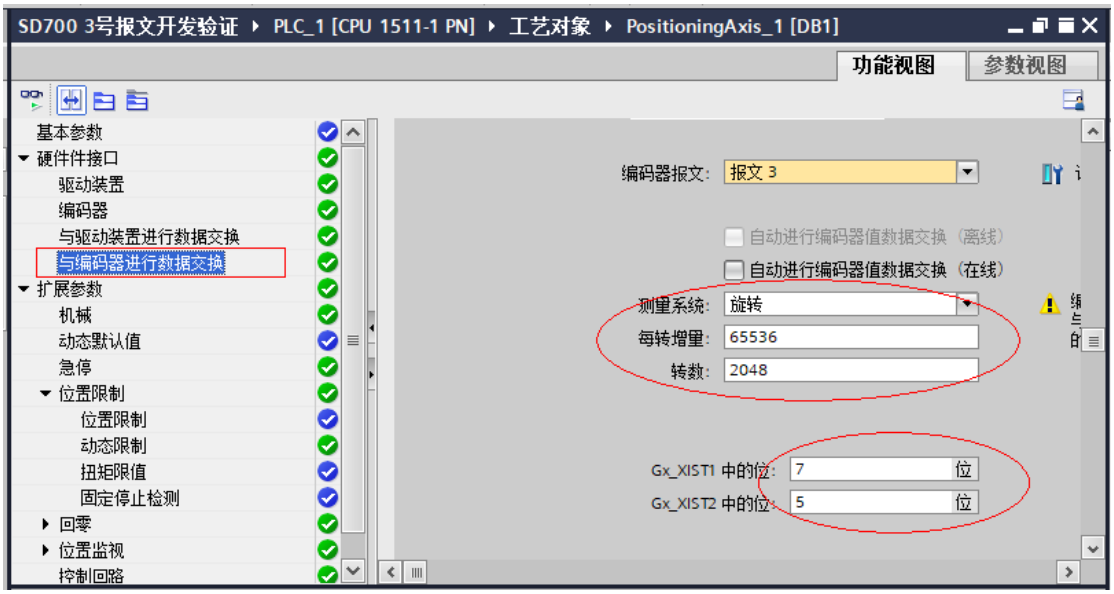
Add message 3 to the "Hardware Interface" as shown in the following figure：



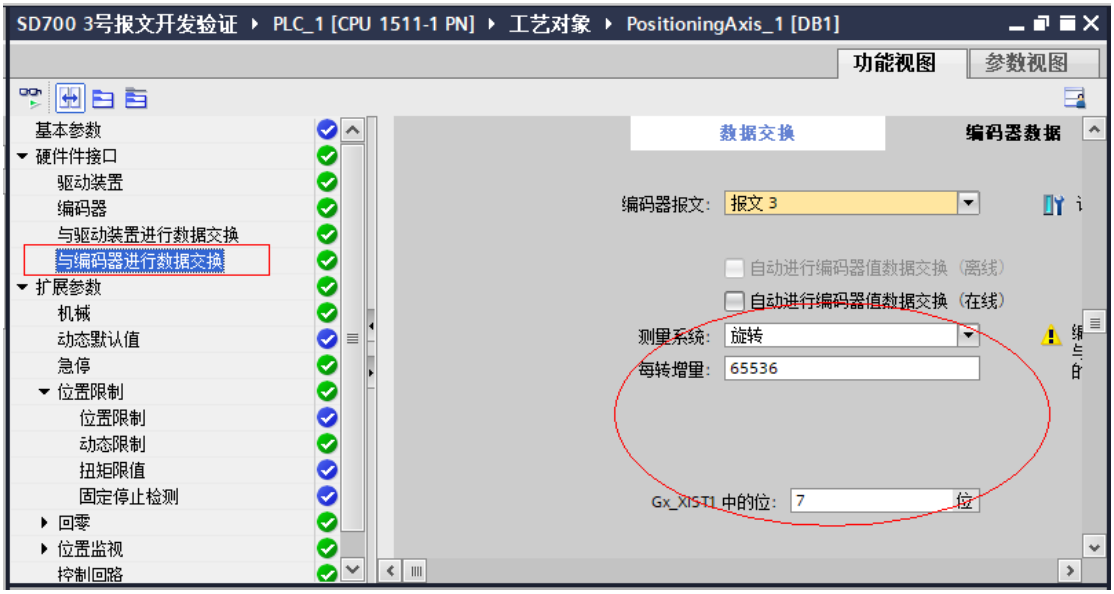
Select the encoder type according to the encoder type set by Pn040。



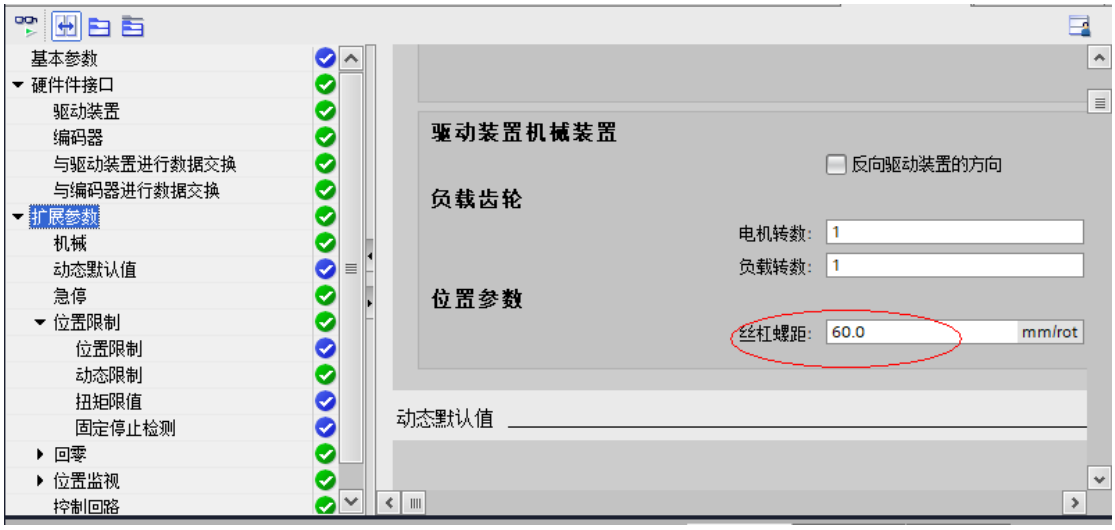
If an absolute encoder is used, set the following in the "Data exchange with encoder" section。



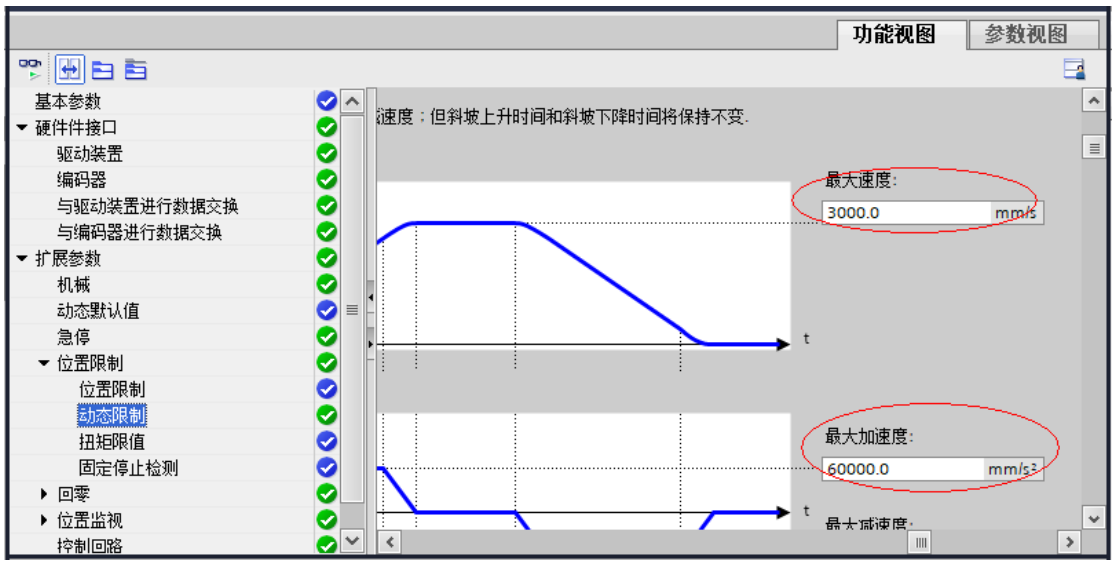
If an incremental encoder is used, set it according to the following diagram。



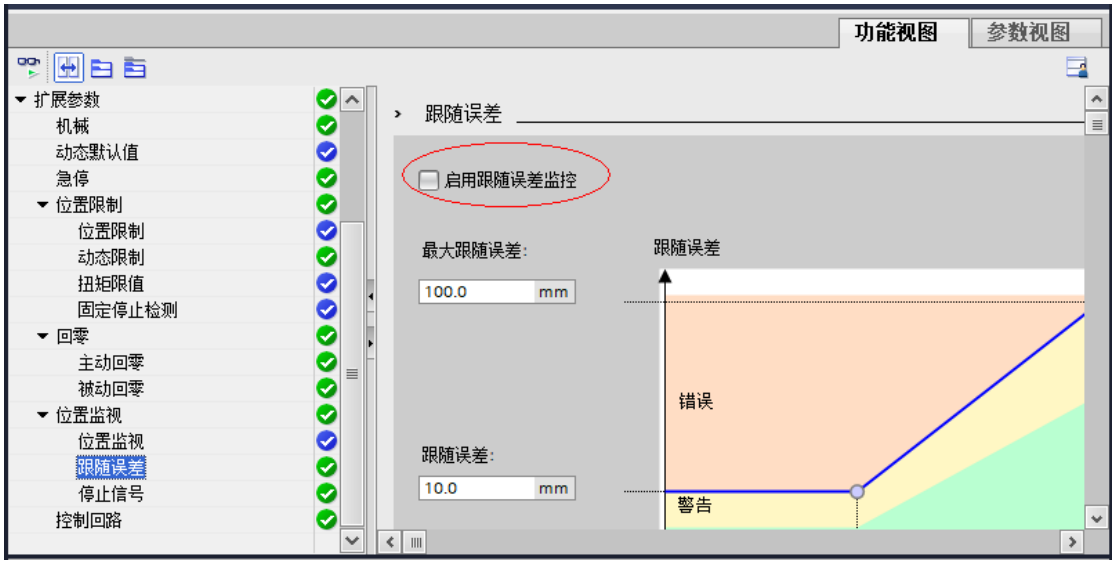
At "Extended Parameters", you can set the screw distance to 60mm/rot.



At dynamic limits, set maximum speed and maximum acceleration。

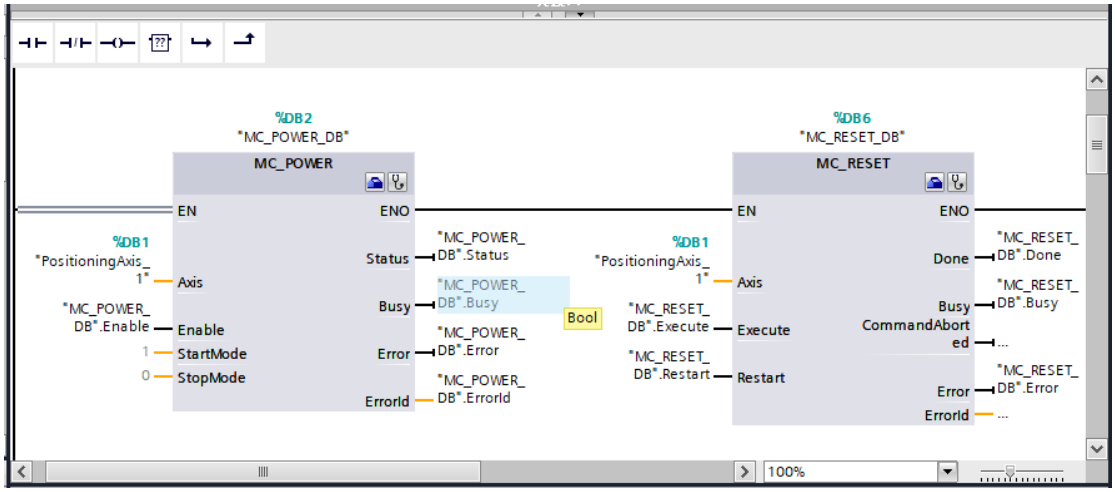


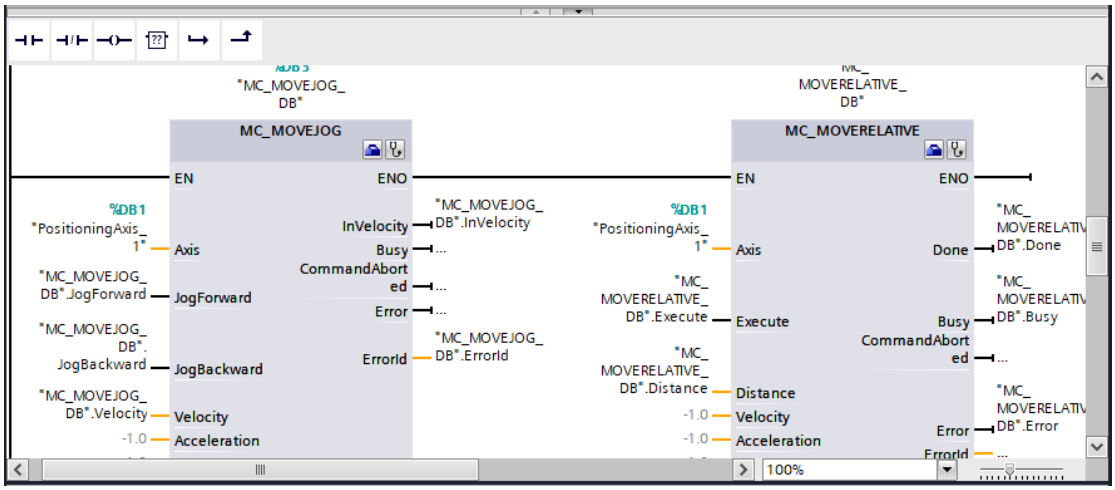
Do not check the "Enable follow error monitoring" box。



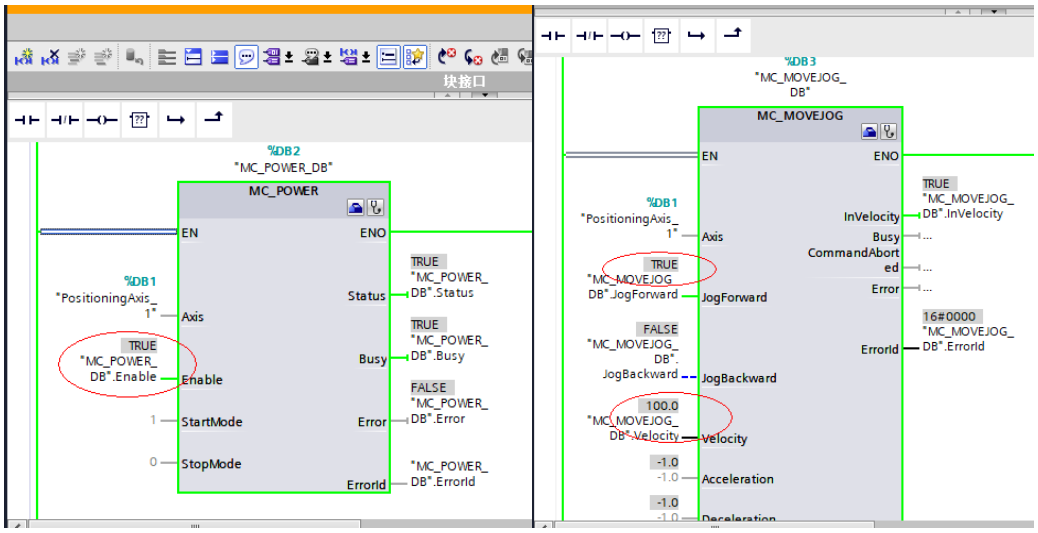
5.4 Pointing trial run

Add the program block as shown below





Enable servo online and enter the jogging speed. Point-action operation

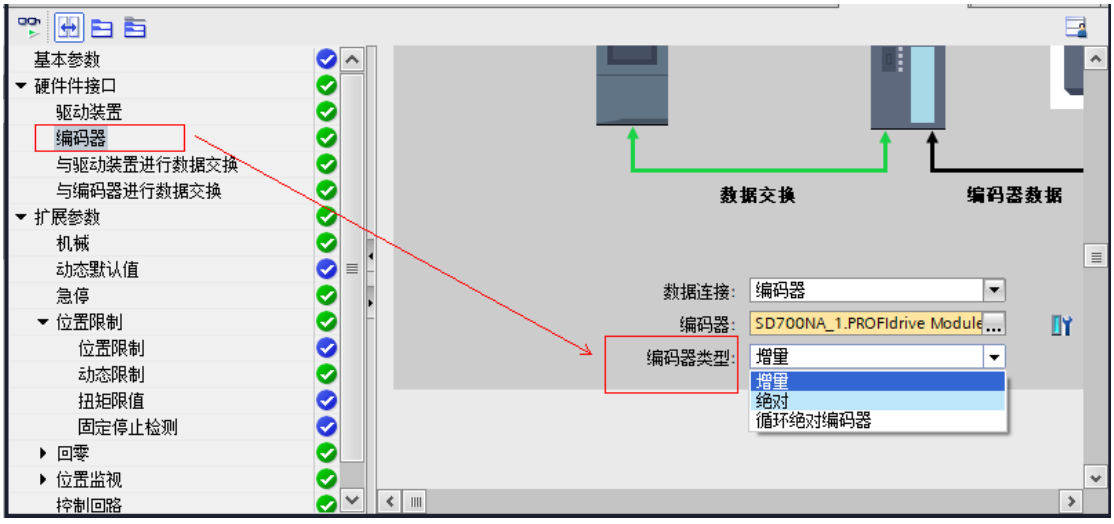


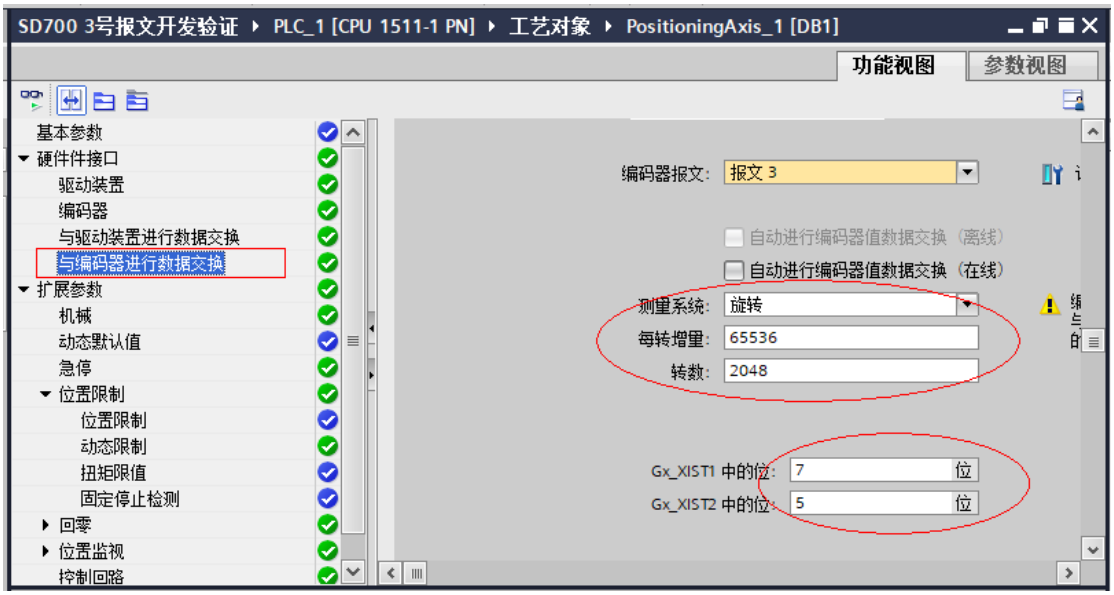
5.5 Encoder setting method

Absolute value equation

Regardless of the encoder, G1_XIST1 transmits only incremental values。

Absolute encoders are recommended to choose cyclic absolute encoders, the PLC calculates the multi-turn value itself。



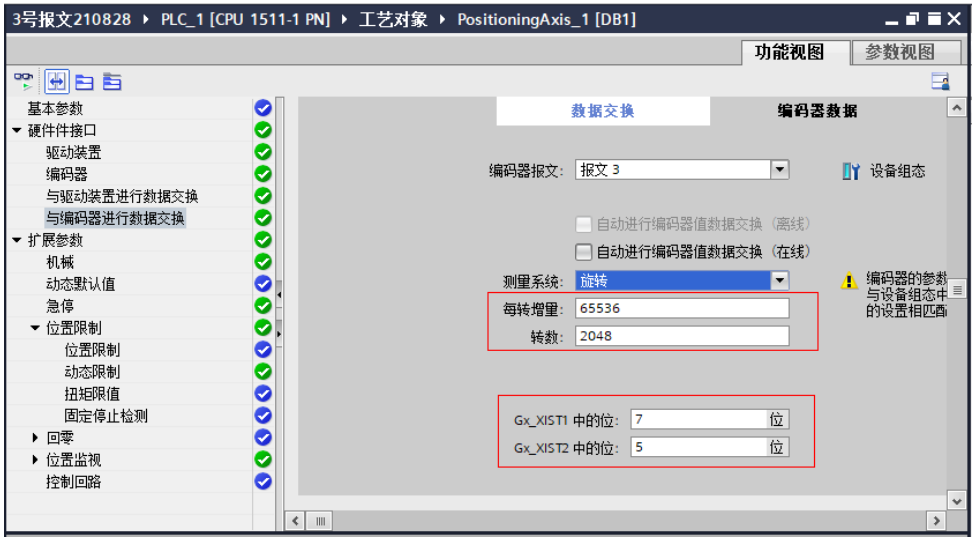


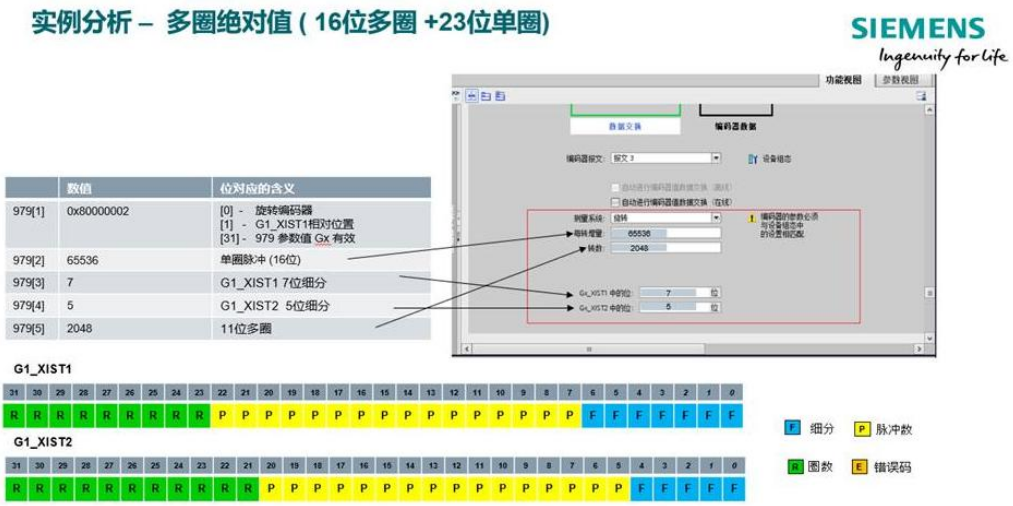
Incremental

Data setup rules

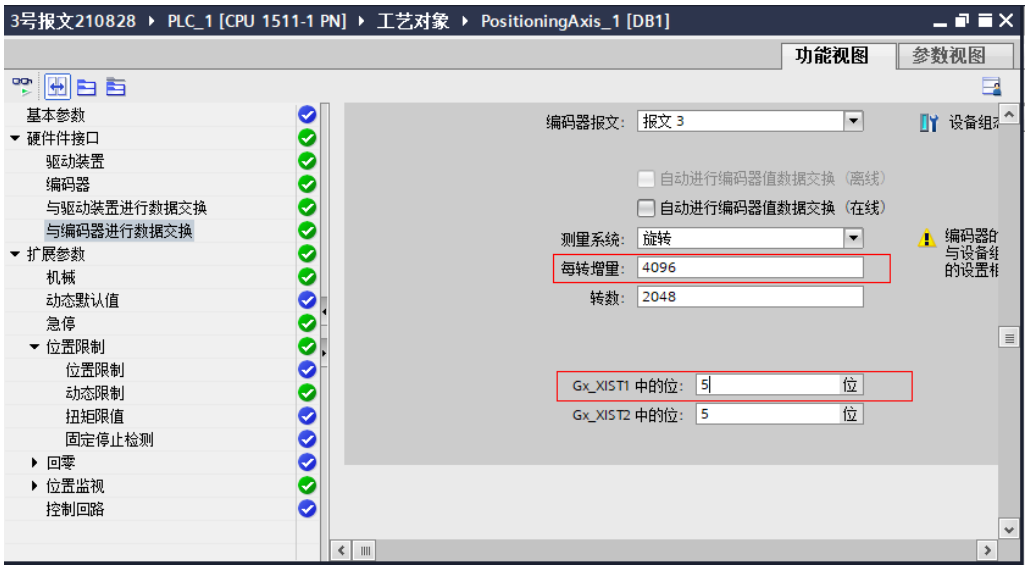
23-bit single-turn, 16-bit multi-turn

Can be written as：





17-bit single-turn, 16-bit multi-turn. It can be written as：

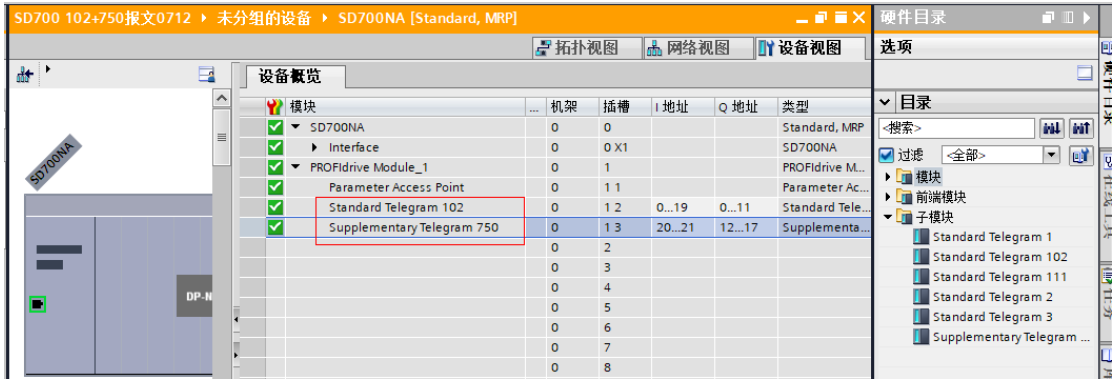


General setting principles：

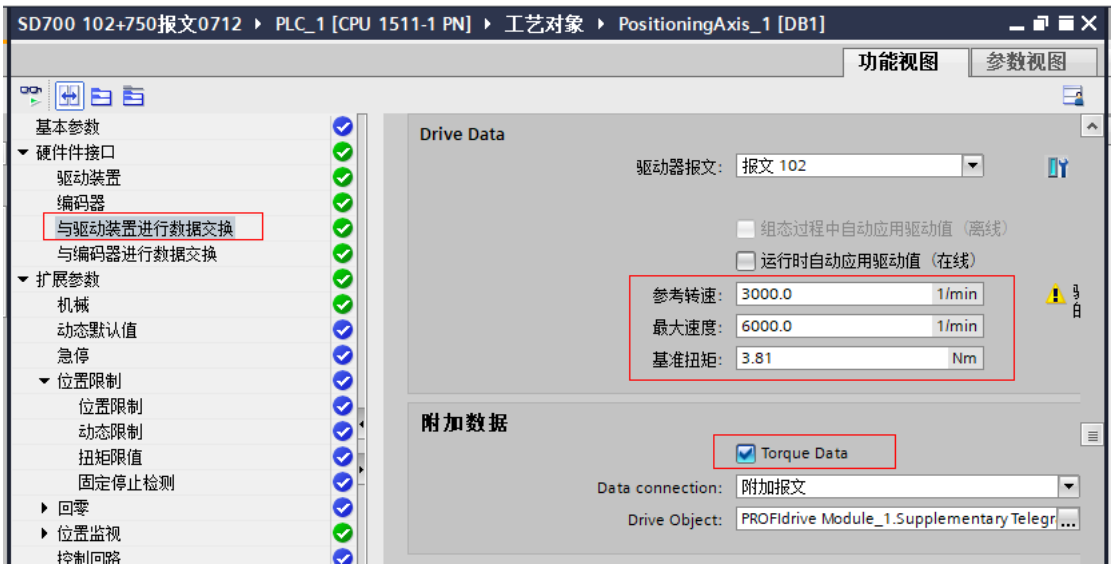
Single-turn pulse = Increment per turn $*2^{Gx\_XIST1}$; $2^{\text{Number of multi-turn positions}}$ = Number of turns $*2^{Gx\_XIST2}$

6. 102+750 Perform torque limiting

First configure the device correctly, add messages 102 and 750

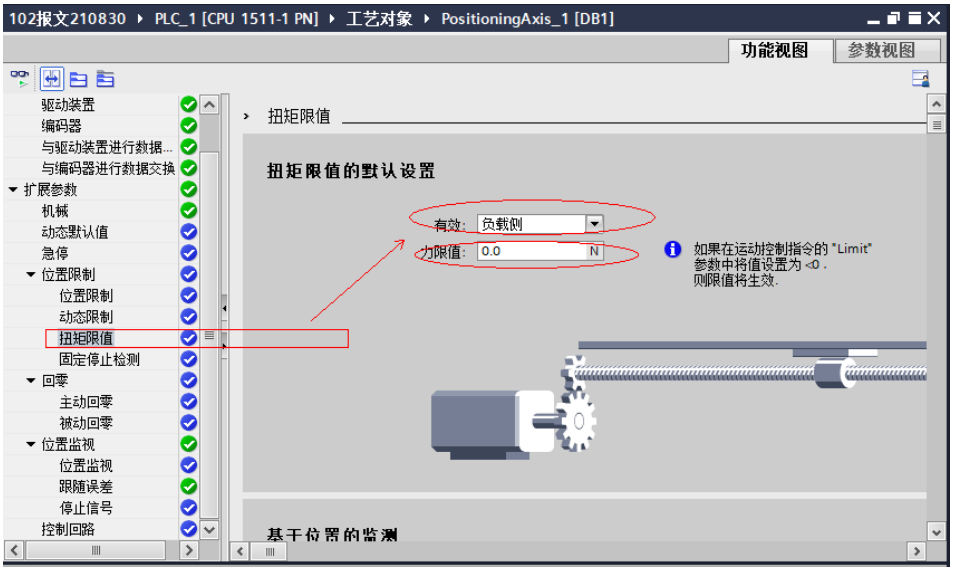


Set the "Base Torque" to 300% of the rated torque in the process object. And check the Torque Data



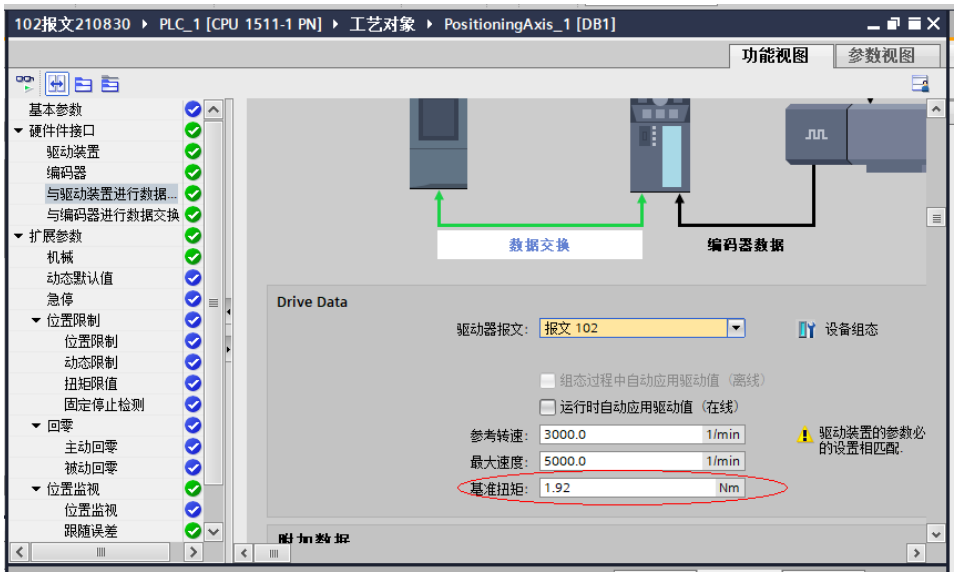
Adopt "MC_TORQUELIMITING" function block

This is inseparable from the configuration, first look at the process object inside the relevant configuration situation。



When load side is selected, the unit is N

Electronic gear ratio 1:1, screw pitch 60mm/rot. can also be set to other values。



The base torque is 300% of the actual motor rated torque

The conversion relationship for this limit is as follows

F=M*2*π*(η/S)*(molecule / Denominator)　The numerator and denominator are the numerator and denominator of the electronic gear ratio, such as the value set in the configuration of the above figure。

F= Power

M= Torque

S= Screw pitch

η= Screw axis efficiency

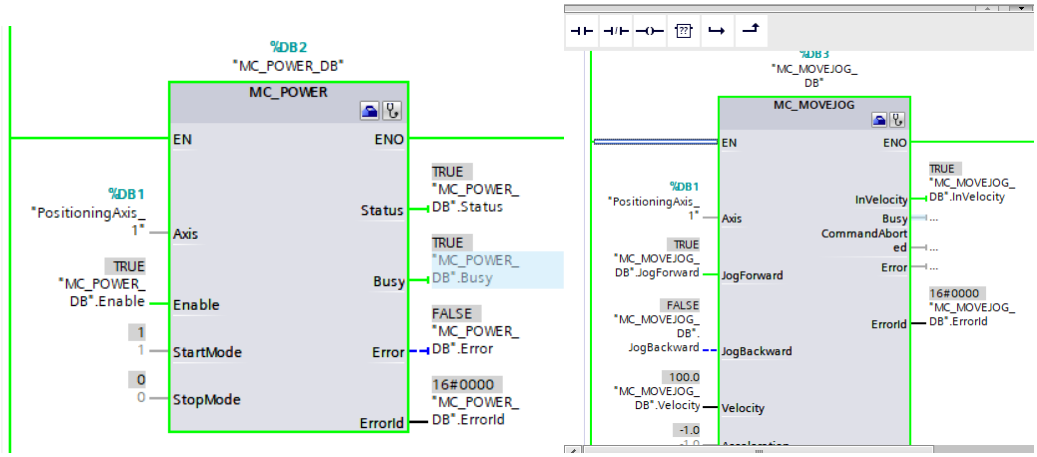
Can launch　M=F*S* Denominator /(2*π*1000* molecule) , Unit Nm。Where 1000mm is converted to 1m。

Example：

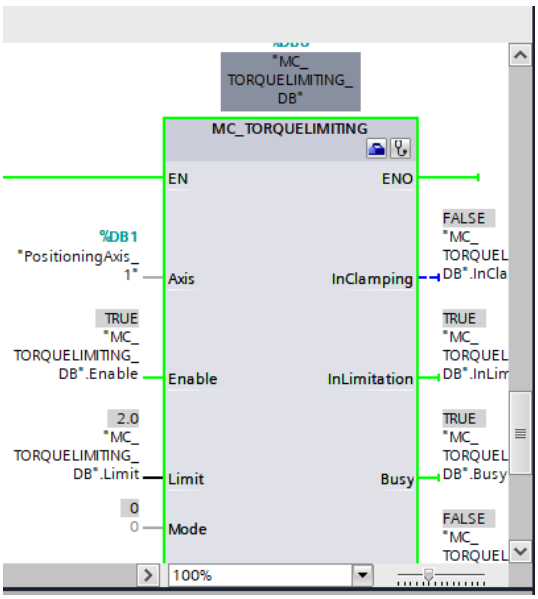
Torque reduction by MOMRED, default 0x4000 corresponds to 300% reduction of rated torque ，

Torque reduction is achieved with the block "MC_TORQUELIMITING" (PnA37 needs to be set to 0). The value of "Limit" in "MC_TORQUELIMITING" corresponds to the torque limit value.

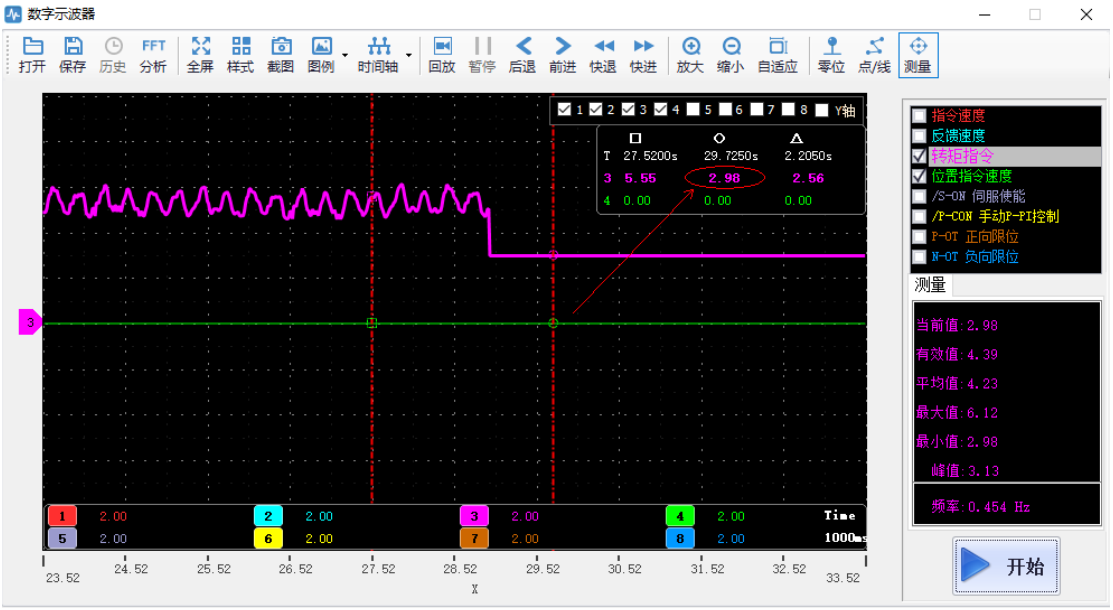
First enable the motor for point operation：



Then the torque is limited to 2N*100%. Enable the "MC_TORQUELIMITING" block：



The torque command is observed through the oscilloscope and the torque is limited to 2.98%



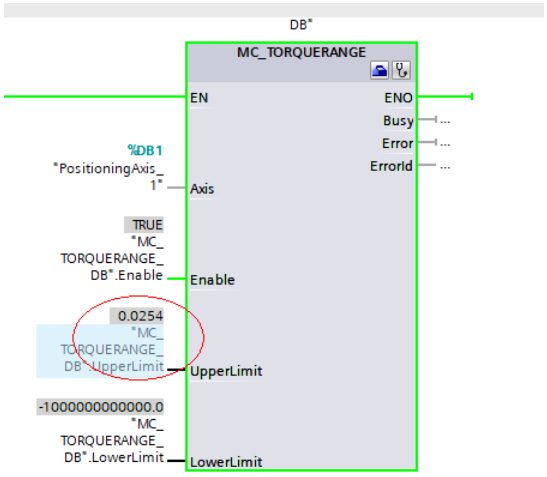
Why is the purpose of limiting achieved? By substituting the data of the configuration into the formula, the torque limiting value can be calculated

M = 2*60/(2*π*1000) = 0.019Nm

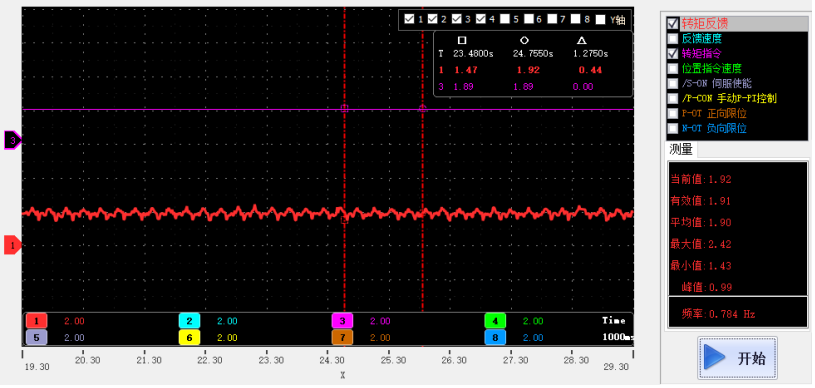
Percentage = 0.019/0.64 = 2.98% (The rated torque of the motor carried is 0.64Nm)

Torque limiting using MC_TORQUERANGE (function of 750 messages)

The servo is still enabled, and the forward operation is activated, and the forward torque is limited to 0.0254Nm (2% of the rated torque), as follows

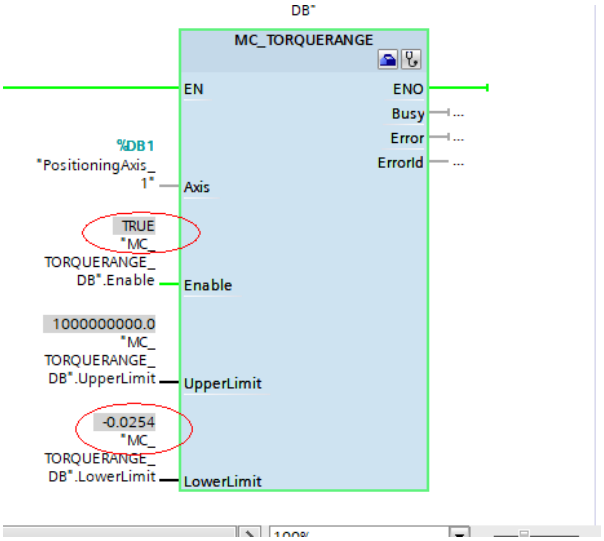


Observe the torque command and torque feedback waveforms as follows：

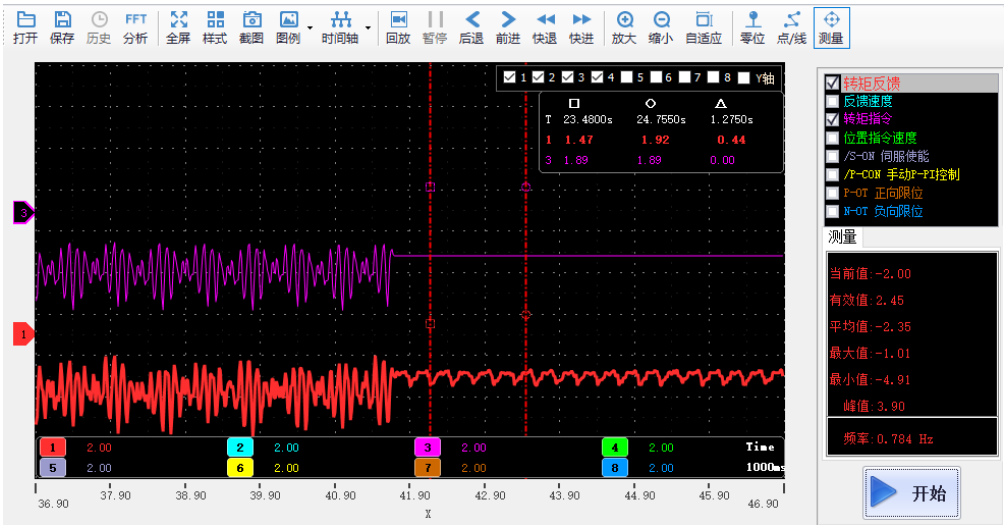


It can be seen that the torque is limited to about 2.0%。

Negative torque limit of -0.0254Nm when running in negative jogging

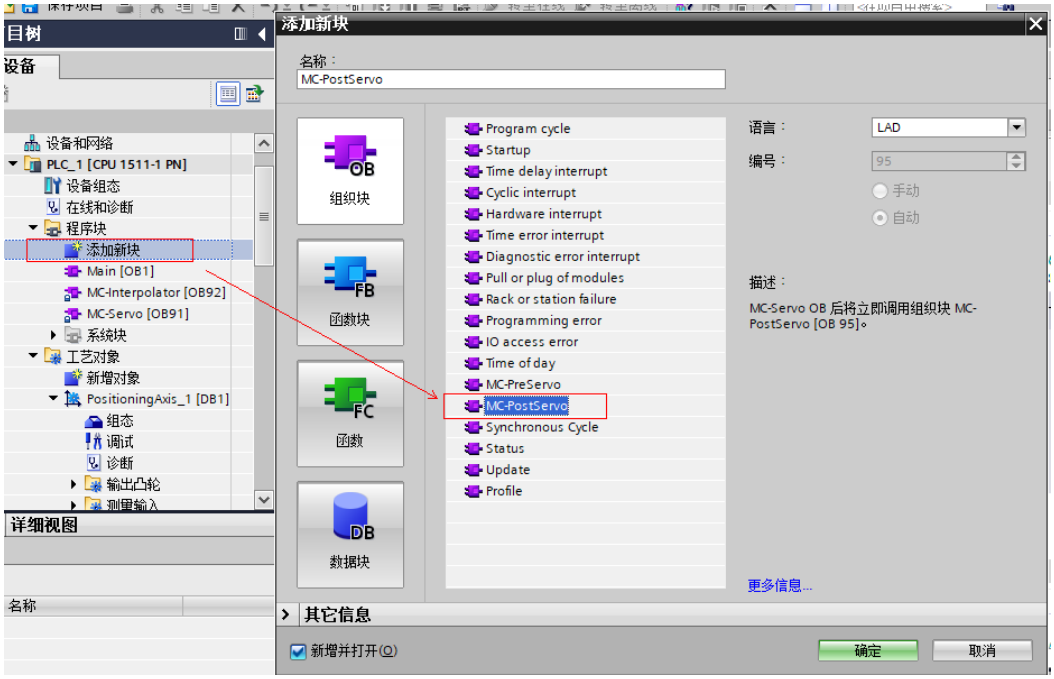


The waveform of the oscilloscope is shown below, and you can see that the torque is limited to about -2%.

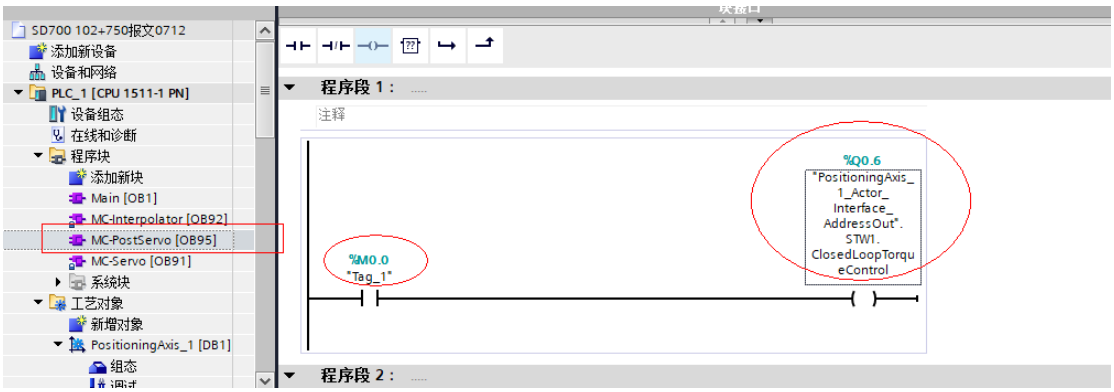


7. 102+750 for closed-loop torque control

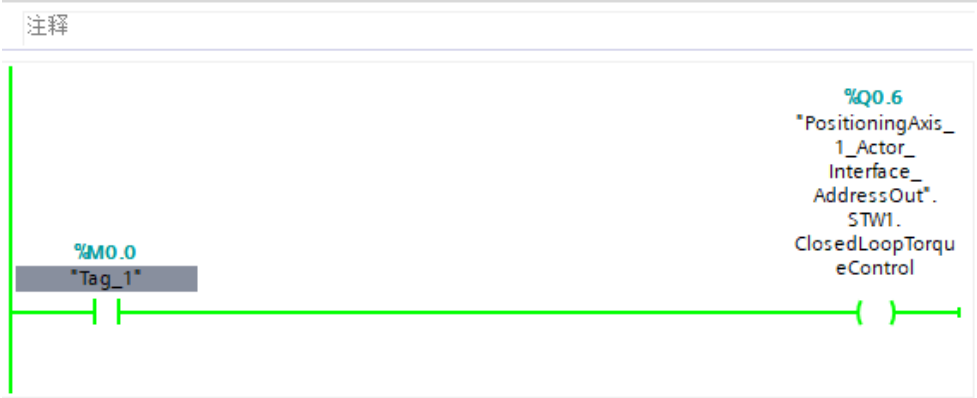
Based on the above, add the data block "MC-PostServo", as shown in the following figure：



Write the program in the data block as follows：



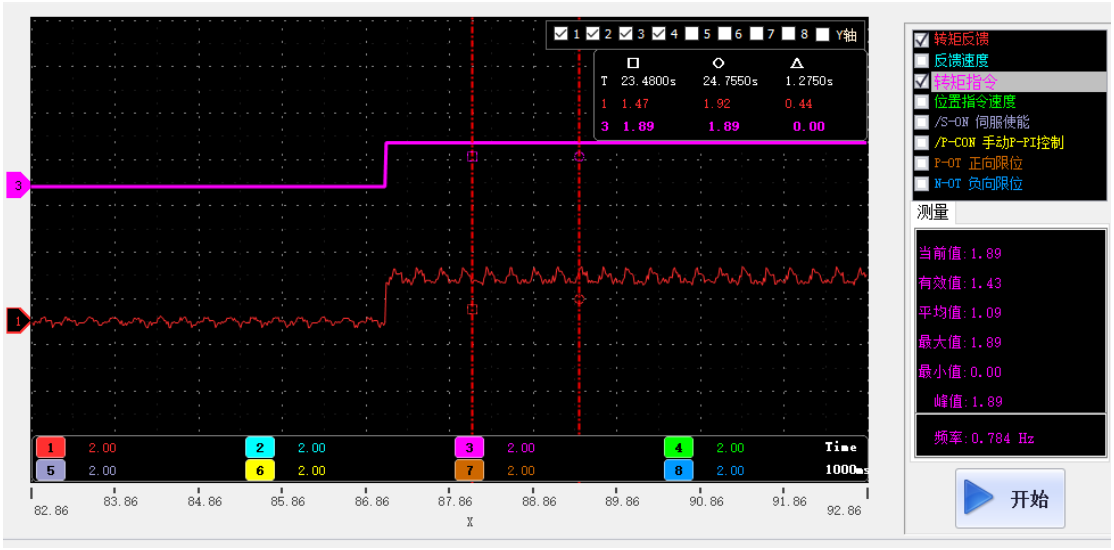
Compile and download the program, go to online, and lead Tag_1.



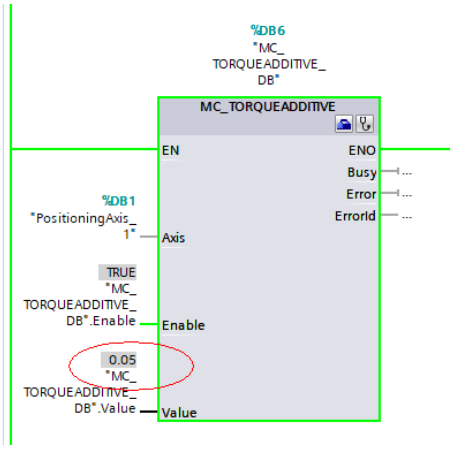
Call only MC_POWER、MC_TORQUEADDITIVE and MC_TORQUERANGE。After enable MC_TORQUEADDITIVE Given torque 0.0254（0.0254/1.27=2%）.（Motor rated torque

1.27Nm)

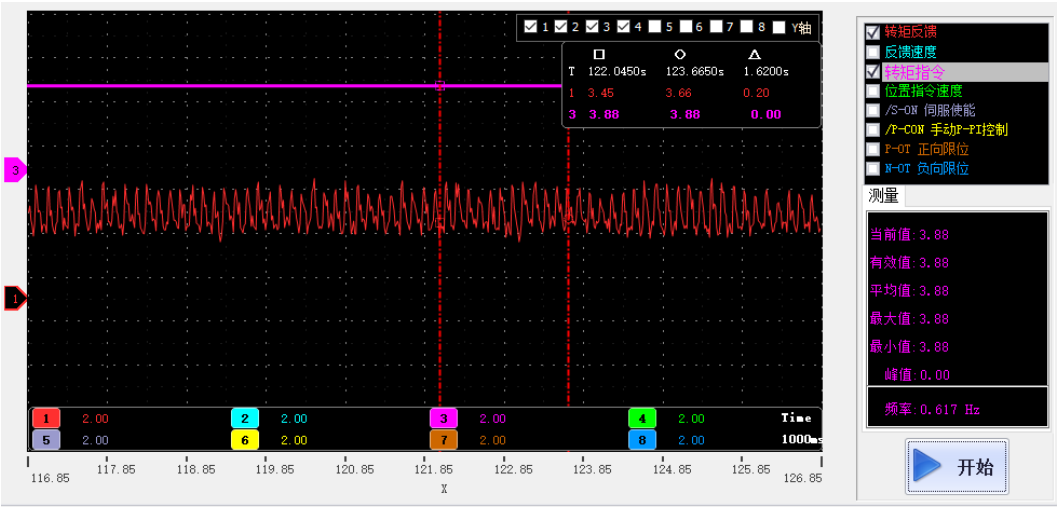
The waveform observes the torque command and torque feedback, as shown below. You can see that the torque command reaches 1.89%, which is close to 2%.



The additional torque becomes 0.05Nm, as follows. Torque command (0.05/1.27 = 3.9%)



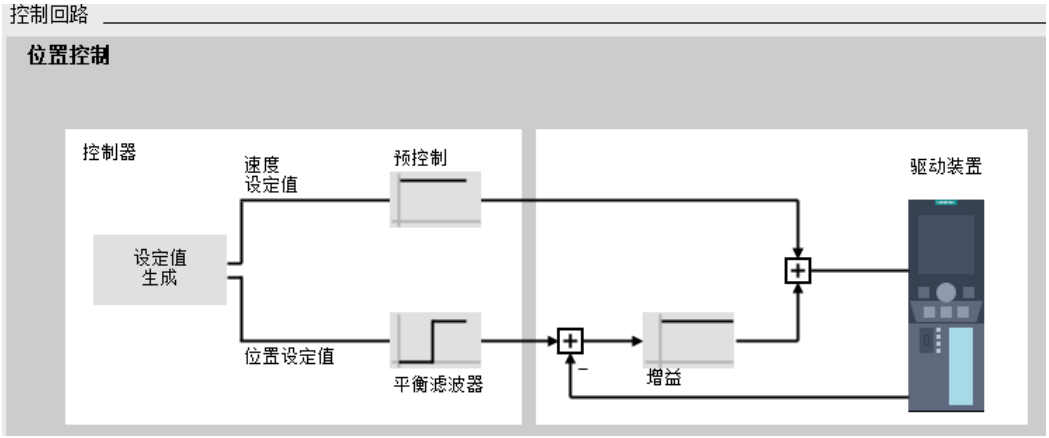
As you can see from the waveform, the torque command reaches 3.66%, which is close to 3.9%



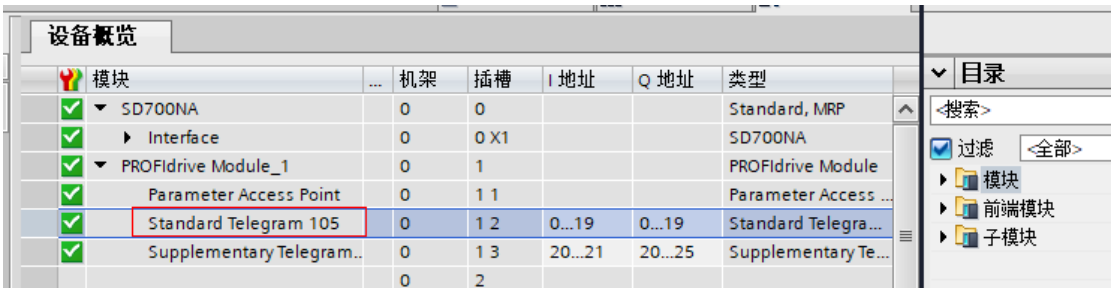
8. 105+DSC function

In DSC mode, the servo receives the position deviation, position gain and velocity feedforward from the PLC. Under the DSC function, the servo's original position gain, position deviation and feedforward are invalid, and three variables need to be set on the Bottu software。

After selecting the DSC function for 105 messages, you need to set PnA38 to 1； If the DSC function is not selected, the PnA38 needs to be set to 0. The following is the block diagram of the loop for DSC control。



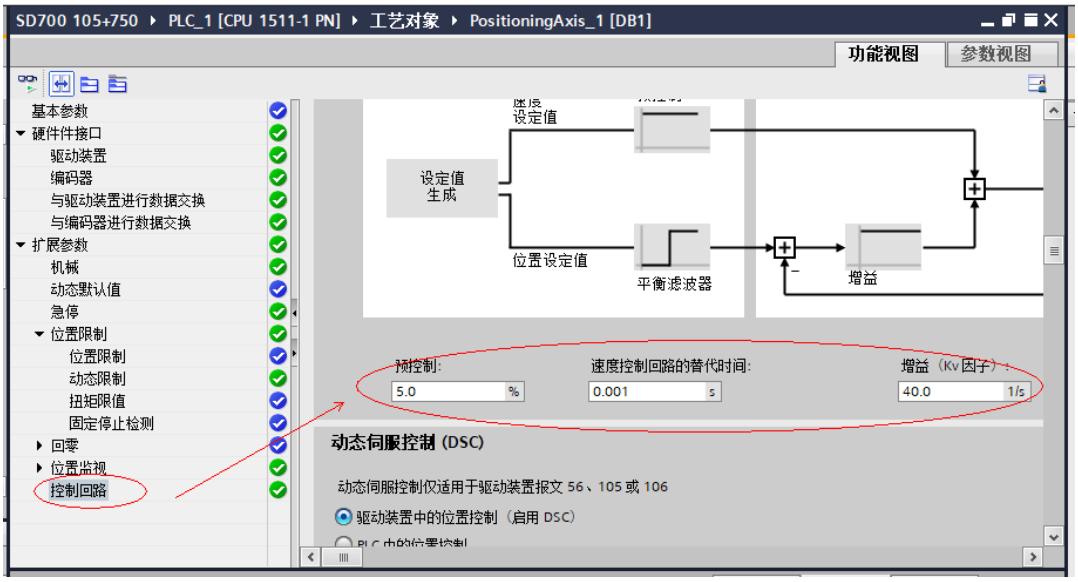
First select 105 messages for configuration：



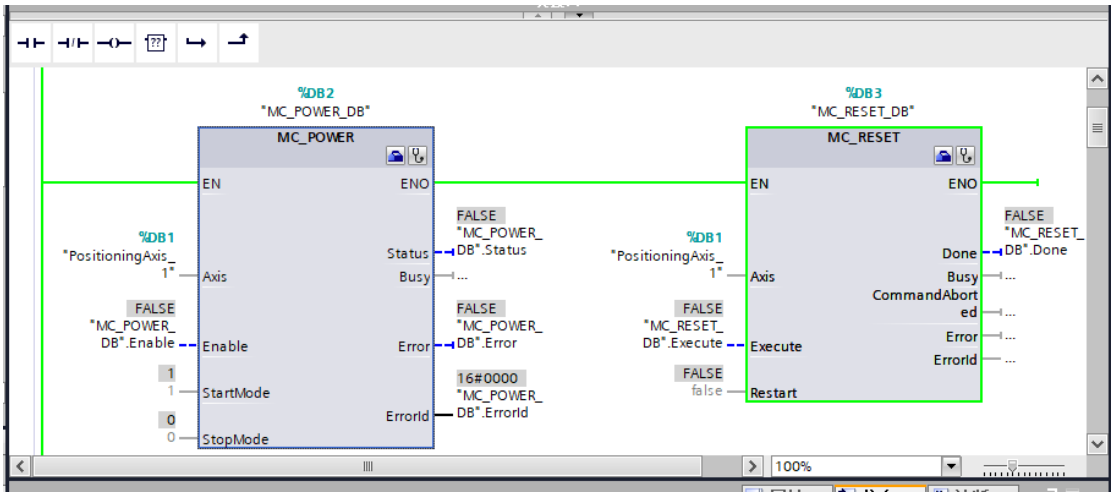
Then select Enable DSC in the process object

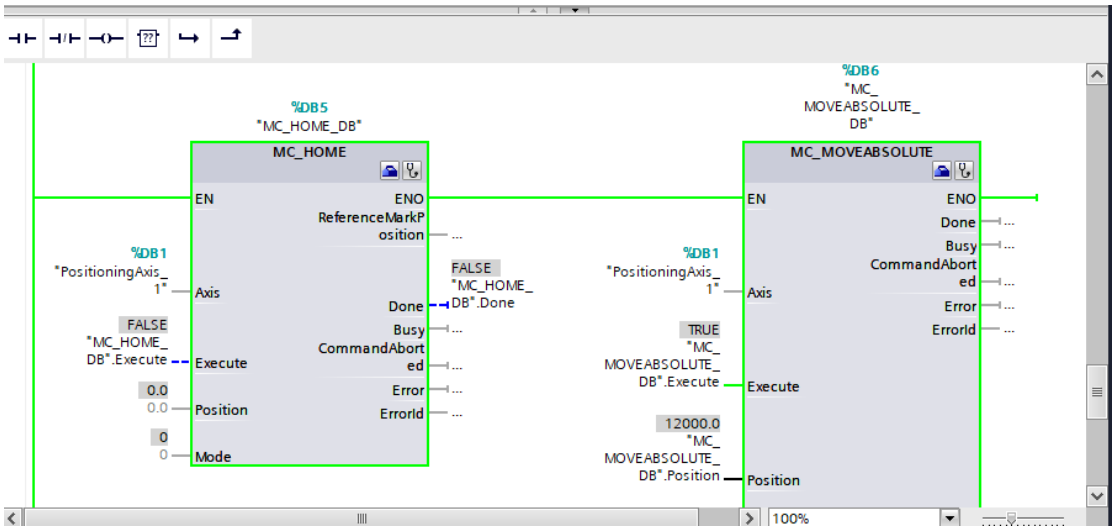
Set servo PnA38 to 1

Adjust the expected pre-control percentage, speed loop substitution time, gain factor, etc. (choose according to the actual working conditions)：

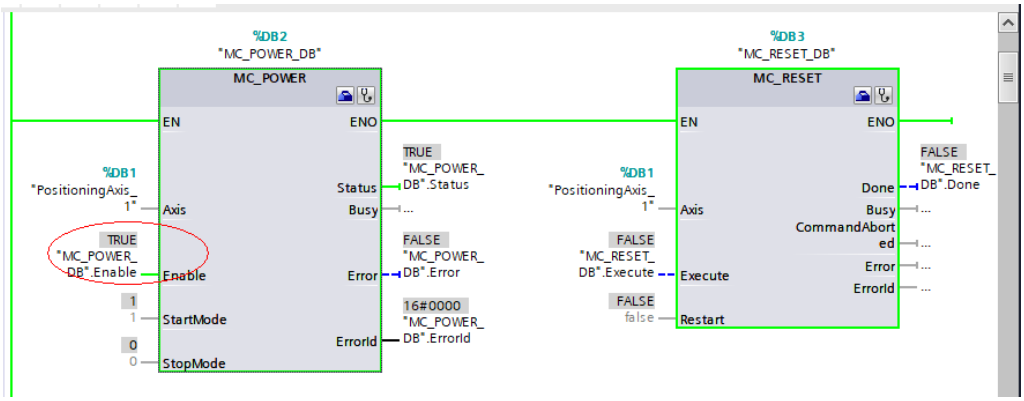


Call MC_POWER;MC_HOME;MC_MOVEABSOLUTE Module

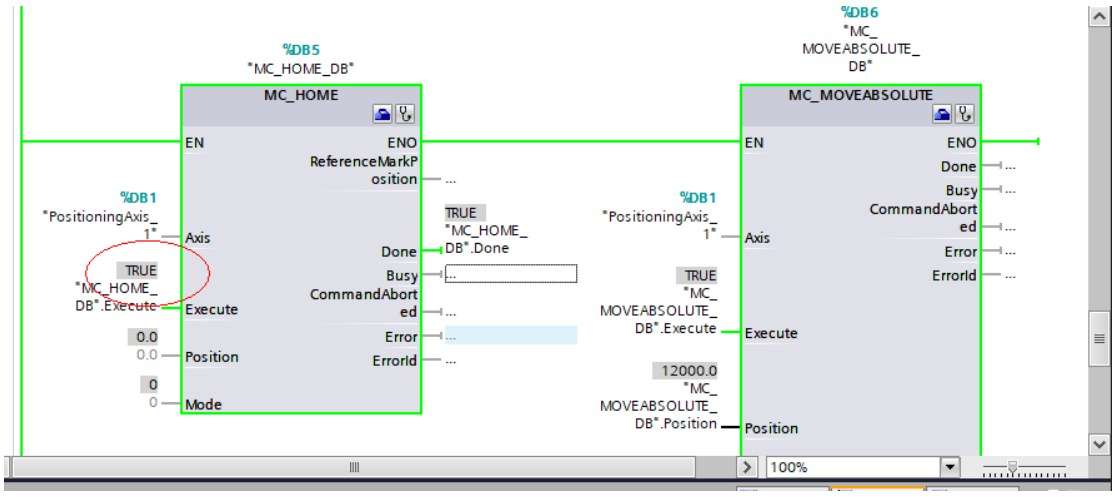




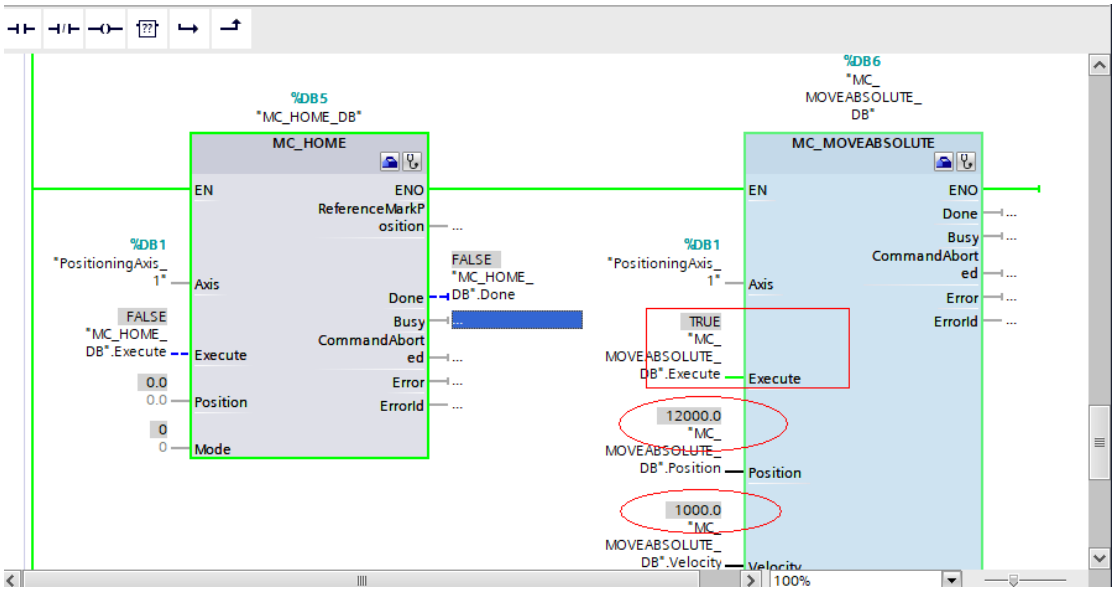
Enable：



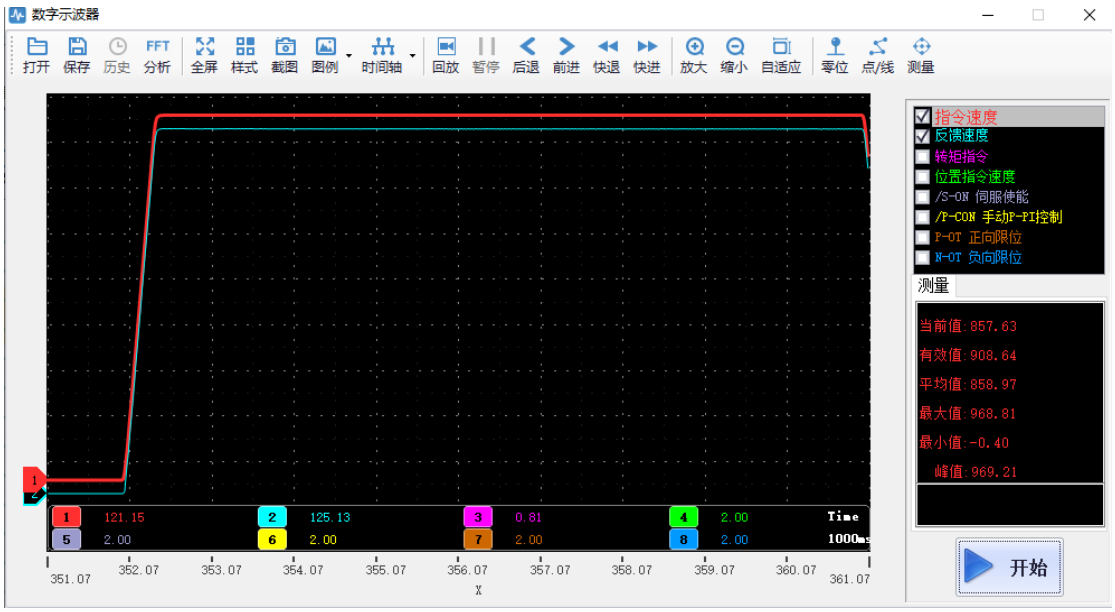
Perform zero return: Remember to cancel the zero return function after it is completed



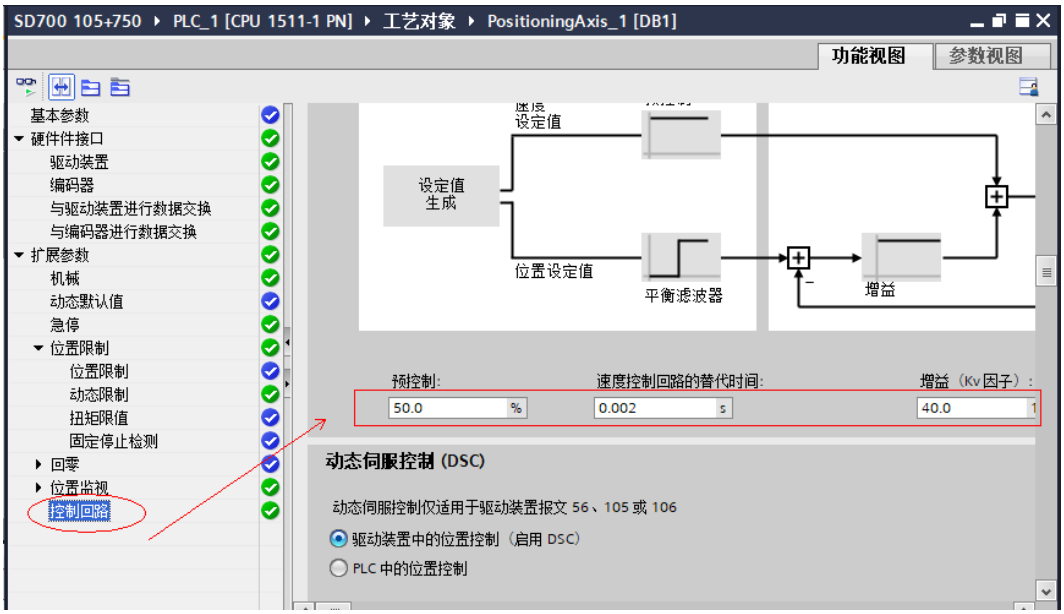
Given target position and speed, trigger operation：

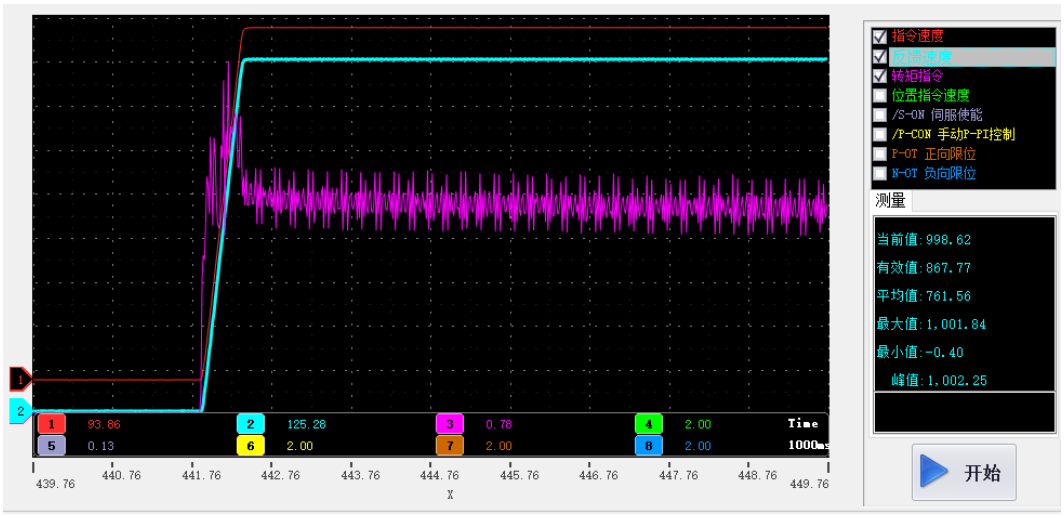


Observing the waveform, you can see that the operation condition is good。



If you need to improve the response, you can increase the percentage of "Pre-control", set the "Substitution time of speed control loop" and "Gain factor" parameters of the response. As shown below：


SD700 105+750 ▸ PLC_1 [CPU 1511-1 PN] ▸ 工艺对象 ▸ PositioningAxis_1 [DB1]
功能视图
参数视图
基本参数
硬件件接口
驱动装置
编码器
与驱动装置进行数据交换
与编码器进行数据交换
扩展参数
机械
动态默认值
急停
位置限制
位置限制
动态限制
扭矩限值
固定停止检测
回零
位置监视
控制回路
设定值
生成
位置设定值
平衡滤波器
增益
预控制:
50.0
%
速度控制回路的替代时间:
0.002
s
增益（Kv 因子）:
40.0
动态伺服控制 (DSC)
动态伺服控制仅适用于驱动装置报文 56、105 或 106
驱动装置中的位置控制（启用 DSC）
PLC 中的位置控制


指令速度
转矩指令
位置指令速度
/S-ON 伺服使能
/P-CON 手动P-PI控制
P-OT 正向限位
N-OT 负向限位
测量
当前值: 998.62
有效值: 867.77
平均值: 761.56
最大值: 1,001.84
最小值: -0.40
峰值: 1,002.25
开始
Time
439.76
440.76
441.76
442.76
443.76
444.76
445.76
446.76
447.76
448.76
449.76