

**S7-1500, S7-1200** cooperate with SD700 profinet to realize **AC3** (111 messages) use case

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## 1 Overview

S7-1500 can be connected to the SD700NA servo drive through PROFINET communication, and the control mode of the SD700NA drive can be set to "Basic Position Control (EPOS)". The PLC can realize the SD700NA through the 111 message and the function block FB284 in the drive library provided by TIA Portal. EPOS basic positioning control.

## 2 SINA\_POS(FB284)Function block pin introduction

The position in the command library of the function block FB284 that S7-1500 controls SD700NA to realize EPOS basic positioning control is shown in Figure 2-1. If the library is not complete, you can download and install the StartDrive software. The download link is:

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

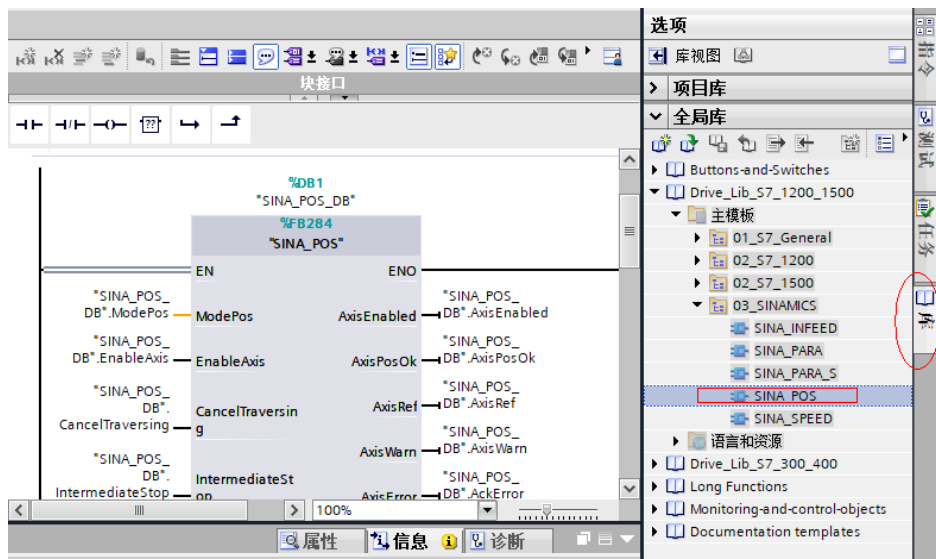


Figure 2-1 Function block FB284

Function blocks can be called in the following OBs:

- Cyclic task: OB1
- Cyclic interrupt OB: such as OB32

This function block can cyclically activate the basic positioning technology functions in the SINAMICS drive. Note that Siemens standard telegram 111 must be used on the drive side.

Refer to Table 2-1 for the pin description of FB284 function block:

Table 2-1 FB284 function block pin explanation

Pin number	Data type	Default value	Description
Input			
ModePos	INT	0	Operating mode 1: Relative positioning (support) 2: Absolute positioning (support) 3: Continuous position mode (support) 4: Return to zero operation (support) 5: Set the home position (not supported) 6: Running position block 0-16 (not

			supported) 7: Jog (support) 8: Jog increment (not supported)
EnableAxis	BOOL	0	Servo operation command: 0: OFF 1: ON
CancelTransing	BOOL	1	0: Reject the activating running task 1: Do not refuse
IntermediateStop	BOOL	1	Stop in the middle 0: Stop running tasks in the middle 1: Do not stop
Positive	BOOL	0	Positive direction (continuous position mode)
Negative	BOOL	0	Negative direction (continuous position mode)
Jog1	BOOL	0	Negative jog
Jog2	BOOL	0	Forward jog
FlyRef	BOOL	0	0: Do not select zero return during operation 1: Choose to return to zero during operation
AckError	BOOL	0	Fault reset
ExecuteMode	BOOL	0	Activate positioning task or receive set point
Position	DINT	0	For the operating mode, directly set the position value/MDI or the operating block number
Velocity	DINT	0	Speed setting in MDI operation mode
OverV	INT	100[%]	Speed override in all modes 0-199%
OverAcc	INT	100[%]	Direct setting value/Acceleration override in MDI mode 0-100%
OverDec	INT	100[%]	Direct setting value/Deceleration rate in MDI mode 0-100%

CofigEPOS	DWORD	0	<div>The bits in STW1, STW2, EPosSTW1, EPosSTW2, of the 111 message can be transmitted through this pin, and the corresponding relationship between the transmitted bits is shown in the following table:</div> <table><tr><td>ConfigEPos bit</td><td>111 Message bit</td></tr><tr><td>ConfigEPos.%X0</td><td>STW1.%X1</td></tr><tr><td>ConfigEPos.%X1</td><td>STW1.%X2</td></tr><tr><td>ConfigEPos.%X2</td><td>EPosSTW2.%X14</td></tr><tr><td>ConfigEPos.%X3</td><td>EPosSTW2.%X15</td></tr><tr><td>ConfigEPos.%X4</td><td>EPosSTW2.%X11</td></tr><tr><td>ConfigEPos.%X5</td><td>EPosSTW2.%X10</td></tr><tr><td>ConfigEPos.%X6</td><td>EPosSTW2.%X2</td></tr><tr><td>ConfigEPos.%X7</td><td>STW1.%X13</td></tr><tr><td>ConfigEPos.%X8</td><td>EPosSTW1.%X12</td></tr><tr><td>ConfigEPos.%X9</td><td>STW2.%X0</td></tr><tr><td>ConfigEPos.%X10</td><td>STW2.%X1</td></tr><tr><td>ConfigEPos.%X11</td><td>STW2.%X2</td></tr><tr><td>ConfigEPos.%X12</td><td>STW2.%X3</td></tr><tr><td>ConfigEPos.%X13</td><td>STW2.%X4</td></tr><tr><td>ConfigEPos.%X14</td><td>STW2.%X7</td></tr><tr><td>ConfigEPos.%X15</td><td>STW1.%X14</td></tr><tr><td>ConfigEPos.%X16</td><td>STW1.%X15</td></tr><tr><td>ConfigEPos.%X17</td><td>EPosSTW1.%X6</td></tr><tr><td>ConfigEPos.%X18</td><td>EPosSTW1.%X7</td></tr><tr><td>ConfigEPos.%X19</td><td>EPosSTW1.%X11</td></tr><tr><td>ConfigEPos.%X20</td><td>EPosSTW1.%X13</td></tr><tr><td>ConfigEPos.%X21</td><td>EPosSTW1.%X3</td></tr><tr><td>ConfigEPos.%X22</td><td>EPosSTW1.%X4</td></tr><tr><td>ConfigEPos.%X23</td><td>EPosSTW1.%X6</td></tr><tr><td>ConfigEPos.%X24</td><td>EPosSTW1.%X7</td></tr><tr><td>ConfigEPos.%X25</td><td>EPosSTW1.%X12</td></tr><tr><td>ConfigEPos.%X26</td><td>EPosSTW1.%X13</td></tr><tr><td>ConfigEPos.%X27</td><td>STW2.%X5</td></tr><tr><td>ConfigEPos.%X28</td><td>STW2.%X6</td></tr><tr><td>ConfigEPos.%X29</td><td>STW2.%X8</td></tr><tr><td>ConfigEPos.%X30</td><td>STW2.%X9</td></tr></table> <div>In this way, the hardware limit, enable, and zero return switch signals can be transmitted to SD700NA.</div> <div>If variables are allocated to this pin in the program, you must ensure that both</div>	ConfigEPos bit	111 Message bit	ConfigEPos.%X0	STW1.%X1	ConfigEPos.%X1	STW1.%X2	ConfigEPos.%X2	EPosSTW2.%X14	ConfigEPos.%X3	EPosSTW2.%X15	ConfigEPos.%X4	EPosSTW2.%X11	ConfigEPos.%X5	EPosSTW2.%X10	ConfigEPos.%X6	EPosSTW2.%X2	ConfigEPos.%X7	STW1.%X13	ConfigEPos.%X8	EPosSTW1.%X12	ConfigEPos.%X9	STW2.%X0	ConfigEPos.%X10	STW2.%X1	ConfigEPos.%X11	STW2.%X2	ConfigEPos.%X12	STW2.%X3	ConfigEPos.%X13	STW2.%X4	ConfigEPos.%X14	STW2.%X7	ConfigEPos.%X15	STW1.%X14	ConfigEPos.%X16	STW1.%X15	ConfigEPos.%X17	EPosSTW1.%X6	ConfigEPos.%X18	EPosSTW1.%X7	ConfigEPos.%X19	EPosSTW1.%X11	ConfigEPos.%X20	EPosSTW1.%X13	ConfigEPos.%X21	EPosSTW1.%X3	ConfigEPos.%X22	EPosSTW1.%X4	ConfigEPos.%X23	EPosSTW1.%X6	ConfigEPos.%X24	EPosSTW1.%X7	ConfigEPos.%X25	EPosSTW1.%X12	ConfigEPos.%X26	EPosSTW1.%X13	ConfigEPos.%X27	STW2.%X5	ConfigEPos.%X28	STW2.%X6	ConfigEPos.%X29	STW2.%X8	ConfigEPos.%X30	STW2.%X9
ConfigEPos bit	111 Message bit																																																																		
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ConfigEPos.%X3	EPosSTW2.%X15																																																																		
ConfigEPos.%X4	EPosSTW2.%X11																																																																		
ConfigEPos.%X5	EPosSTW2.%X10																																																																		
ConfigEPos.%X6	EPosSTW2.%X2																																																																		
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ConfigEPos.%X8	EPosSTW1.%X12																																																																		
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ConfigEPos.%X28	STW2.%X6																																																																		
ConfigEPos.%X29	STW2.%X8																																																																		
ConfigEPos.%X30	STW2.%X9																																																																		

			ConfigEPos.%X0 and ConfigEPos.%X1 are set to 1, the drive can run.
HWIDSTW	HW_IO	0	Symbolic name or SIMATIC S7-1200、S7-1500 HW ID of the set value slot (SetPoint)
HWIDZSW	HW_IO	0	Symbolic name or HW ID (Actual Value) of SIMATIC S7-1200, S7-1500 actual value slot
Output			
Error	BOOL	0	1: An error occurred
Status	WORD	0	Display state
DiagID	WORD	0	Extended communication failure
ErrorId	INT	0	Run mode error/block error: 0: no error 1: Communication activation 2: Incorrect operating mode selected 3: The parameter set is incorrect 4: Invalid operation block number 5: Drive failure activated 6: Switch prohibition activated 7: Zero return cannot start during operation
AxisEnabled	BOOL	0	Drive is enabled
AxisError	BOOL	0	Drive failure
AxisWarn	BOOL	0	Drive alarm
AxisPosOk	BOOL	0	The target position of the axis is reached
AxisRef	BOOL	0	Home position setting
ActVelocity	DINT	0[LU/min]	Actual speed (0x40000000 corresponds to rated speed)
ActPosition	DINT	0	Current position LU
ActMode	INT	0	Currently active operating mode
EPosZSW1	WORD	0	EPOS ZSW1 status
EPosZSW2	WORD	0	EPOS ZSW2 status

ActWarn	WORD	0	Current alarm code
ActFault	WORD	0	Current fault code

### 3 SINA\_POS Function realization of function block

#### 3.1 Overview

The basic positioning (EPOS) of SD700NA is a very important function for the position control of the drive. It can be used for absolute and relative positioning of linear axis or rotary axis, "SINA\_POS" function module in Portal software library file.

The closed-loop position controller includes the following parts:

Preparation of actual position value (including measurement input evaluation and finding reference point)

- Position controller (including limit, adaptation, pre-control calculation)
- Monitoring (stationary, positioning and dynamic tracking error monitoring)

The basic position controller can also achieve the following functions:

computer system:

- Gear backlash compensation (to be developed)
- Modal axis (to be developed)
- Location tracking/limitation
- Speed/acceleration/delay limit
- Software limit switch
- hardware limit switch
- Position/stationary monitoring
- Dynamic tracking error monitoring

The main operating modes include Jog, Homing, MDI, and program blocks. For a detailed description of the basic positioning functions of SD700NA, please refer to the operation manual of SD700NA.

#### 3.2 SINA\_POS(FB284) Operating mode

##### 3.2.1 Operating conditions

(1) Through the input pin EnableAxis=1, the axis has been set to 1 internally by OFF2 and OFF3. If the axis is ready and drive without failure (AxisErr="0"), the axis is enabled after EnableAxis is set to 1, and the output pin AxisEnabled signal becomes 1.

(2) The ModePos input pin is used to select the operating mode. It can be switched in different operation modes, such as continuous operation mode (ModePos=3), which can be switched to absolute positioning mode (ModePos=2) during operation.

(3) The input signal CancelTransing and IntermediateStop are valid for all operating modes except jog. It must be set to "1" when running EPOS. The setting instructions are as follows:

- Setting CancelTransing, the axis stops at the maximum deceleration, discards the work data, and switches the operating mode after the axis stops.

- Set IntermediateStop=0, use the currently applied deceleration value to stop on a ramp without discarding the work data. If you reset IntermediateStop=1, the axis will continue to run, which can be understood as a pause of the axis. The operating mode can be switched after the axis is stationary. In any operation mode, the function of zero return during operation can be selected through the FlyRef input.

- (4) Activate the hardware limit switch
  - If hardware limit switches are used, please refer to the servo function codes Pn601-Pn607.
- (5) Activate the software limit switch
  - If the software limit switch is used, the input pin ConfigEPos.%X2 (POS\_STW2.14) of the FB284 function block needs to be set to 1 to activate the software limit function of the SD700NA.
  - Set PnA2C (negative soft limit position) and PnA2A (positive soft limit position) in SD700NA.

### 3.2.2 Absolute positioning operation mode

The "absolute positioning" operating mode can be realized by the drive function "MDI absolute positioning", which uses an internal position controller driven by SINAMICS to achieve absolute position control.

Require:

- Operation mode selection ModePos=2
- Axis enable EnableAxis=1
- The axis must have been zeroed or the encoder has been calibrated
  - If the switching mode is greater than 3, the axis must be in a static state and can be switched in the MDI operating mode at any time (ModePos=1,2,3)

**step:**

- Specify the target position and dynamic response parameters through the input parameters Position, Velocity
- Specify the speed, acceleration and deceleration magnification through the input parameters OverV, OverAcc, OverDec
- Operating conditions "CancelTransing" and "IntermediateStop" must be set to "1", Jog1 and Jog2 must be set to "0"
- In absolute positioning, the running direction can follow the shortest path to the target position. At this time, the input parameters Positive and Negative must be "0"

Trigger positioning movement by the rising edge of ExecuteMode, activate the current state of the command or monitor it through EPosZSW1 and EPosZSW2. When the target position is reached, it is set to 1 by AxisPosOk. When an error occurs during positioning, the output parameter Error is set to 1.

**Notice:**

The currently running command can be replaced by a new command through the rising edge of ExecuteMode, but it is only used in the operating modes ModePos1,2,3. An example of control sequence is shown in Figure 3-1.



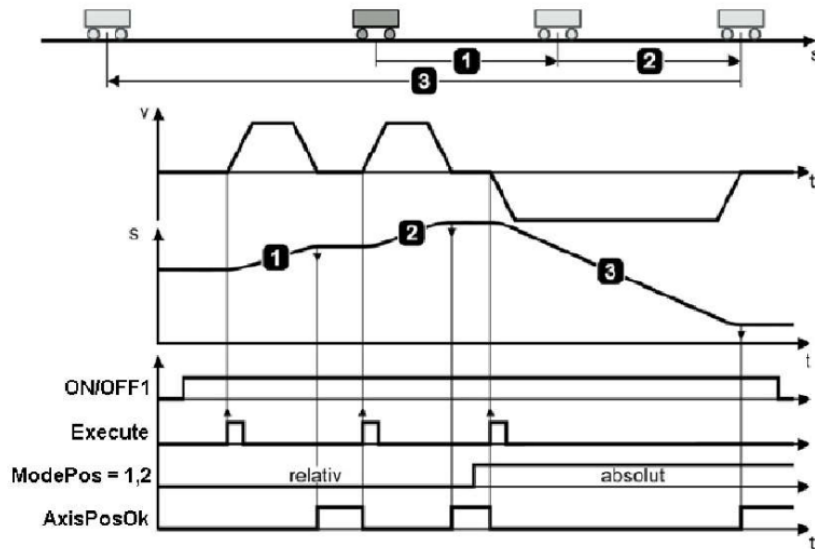


Figure 3-1 Absolute positioning mode control sequence

### 3.2.3 Relative positioning operation mode

The "Relative Positioning" operating mode can be realized by the drive function "MDI Relative Positioning", which uses an internal position controller driven by SINAMICS to achieve relative position control.

Require:

- Operation mode selection ModePos=1
- Drive running command EnableAxis=1
- The axis must not be zeroed or the encoder has not been calibrated
- If the switching mode is greater than 3, the axis must be in a static state and can be switched in the MDI operating mode at any time (ModePos=1,2,3)

step:

- Specify the target position and dynamic response parameters through the input parameters Position, Velocity
- Specify the speed, acceleration and deceleration magnification through the input parameters OverV, OverAcc, OverDec
- Operating conditions "CancelTransing" and "IntermediateStop" must be set to "1", Jog1 and Jog2 must be set to "0"
- In relative positioning, the running direction is determined by Positive and Negative Trigger positioning movement by the rising edge of ExecuteMode, activate the current state of the command or monitor it through EPosZSW1 and EPosZSW2. When the target position is reached, it is set to 1 by AxisPosOk. When an error occurs during positioning, the output parameter Error is set to 1.

**Notice:**

The currently running command can be replaced by a new command through the rising edge of ExecuteMode, but it is only used in the operating modes ModePos1,2,3. An example of the control sequence is shown in Figure 3-2.

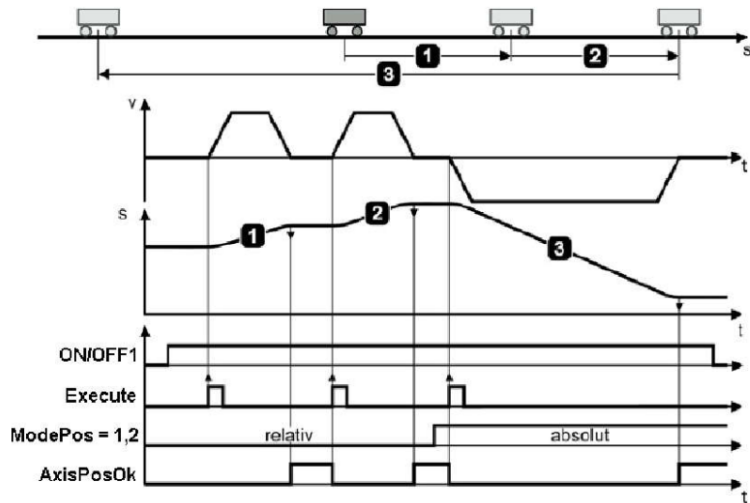


Figure 3-2 Relative positioning mode control sequence

### 3.2.4 Continuous operation mode (Setup mode)

The "continuous operation" mode allows the position controller of the axis to run at a constant speed in the forward or reverse direction. This is the "MDI setup" operating mode of the drive.

Require:

- Operation mode selection ModePos=3
- The operating command of the drive AxisEnable=1
- The axis does not need to be zeroed or the encoder is not calibrated
- If the switching mode is greater than 3, the axis must be at rest, and the mode can be run in MDI at any time. Switch within the formula (ModePos=1,2,3)

#### step:

- Specify the running speed through the input parameter Velocity
- Specify the speed, acceleration and deceleration magnification through the input parameters OverV, OverAcc, OverDec
- Operating conditions "CancelTransing" and "IntermediateStop" must be set to "1", Jog1 and Jog2 must be set to "0"
- The running direction is determined by Positive and Negative

Trigger positioning movement by the rising edge of ExecuteMode, activate the current state of the command or monitor through EPosZSW1 and EPosZSW2, and set it to 1 through AxisPosOk when the target position is reached. When an error occurs during positioning, the output parameter Error is set to 1.

#### Notice:

The currently running command can be replaced by a new command through the rising edge of ExecuteMode, but it is only used in the operating modes ModePos1,2,3. An example of the control sequence is shown in Figure 3-3.

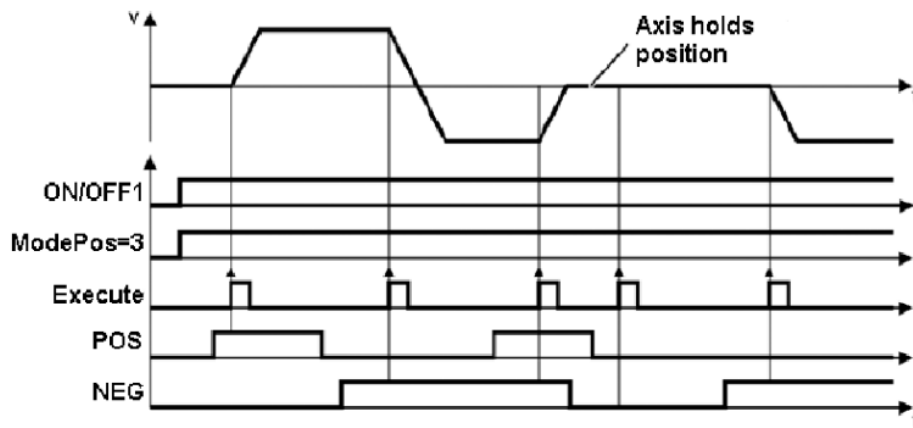


Figure 3-3 Control sequence of continuous operation mode

### 3.2.5 Return to zero

This function needs to set the servo function code PnA20-PnA25 to zero return mode and return speed and other operations to activate the drive's active zero return. Refer to the operation manual for the method of returning to zero.

This function allows the axis to perform the zero return operation in the forward or reverse direction according to the preset zero return speed and method, and activate the active zero return of the drive.

Require:

- Operation mode selection ModePos=4
- Drive running command EnableAxis=1
- The state of the home switch is transferred to SD700NA from the input pin ConfigEPos.%X6 (POS\_STW2.2) of the FB284 function block
- axis at rest

#### step:

- Specify the speed, acceleration and deceleration magnification through the input parameters OverV, OverAcc, OverDec
- Operating conditions "CancelTransing" and "IntermediateStop" must be set to "1", Jog1 and Jog2 must be set to "0"
- The running direction is determined by Positive and Negative

Trigger the zero return movement by the rising edge of ExecuteMode, activate the current status of the command or monitor through EPosZSW1 and EPosZSW2, and terminate the movement through the CancelTransing signal. After the zero return is completed, the AxisRef is set to 1. When an error occurs during the operation, the output parameter Error is set 1.

An example of control sequence is shown in Figure 3-4

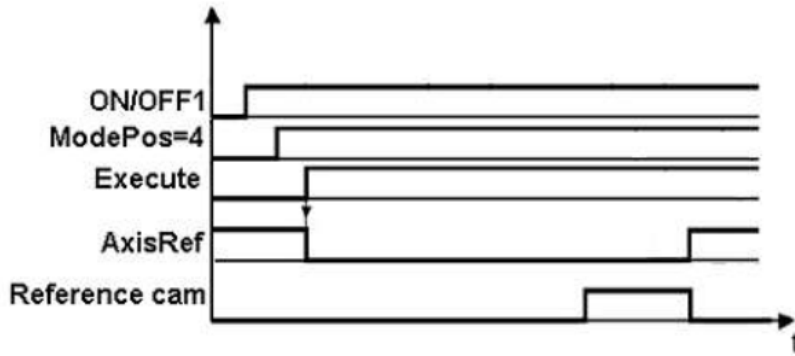


Figure 3-4 Return to zero control sequence

### 3.2.6 JOG

The jog operation mode is realized by the "Jog" function of the drive.

Require:

- Operation mode selection ModePos=7
- The operating command of the drive AxisEnable=1
- axis at rest
- The axis does not need to return to zero or absolute encoder correction

#### step:

• The jog speed is set in SD700NA (PnA2E PnA30), and the OverV parameter of the speed scales the jog speed setting value

• The operating conditions "CancelTransing" and "IntermediateStop" have nothing to do with the jog operation mode, the default setting is "1"

#### Notice:

• Jog1 and Jog2 are used to control the jog operation of EPOS. The default setting is Jog1=negative jog speed, Jog2=positive jog speed, which has nothing to do with the Positive and Negative parameters. The default setting is "0".

• The current status of the activation command or monitoring by EPosZSW1, EPosZSW2, Busy is 1 when the function block processes the command, and when the jog ends (Jog1 or Jog2 = 0) when the axis is stationary, "AxisPosOK" is set to 1, and it appears during operation Error, the output parameter Error is set to 1.

An example of control sequence is shown in Figure 3-5.

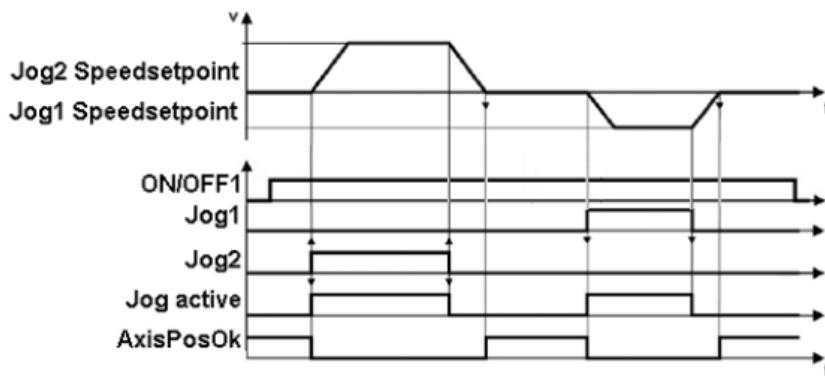


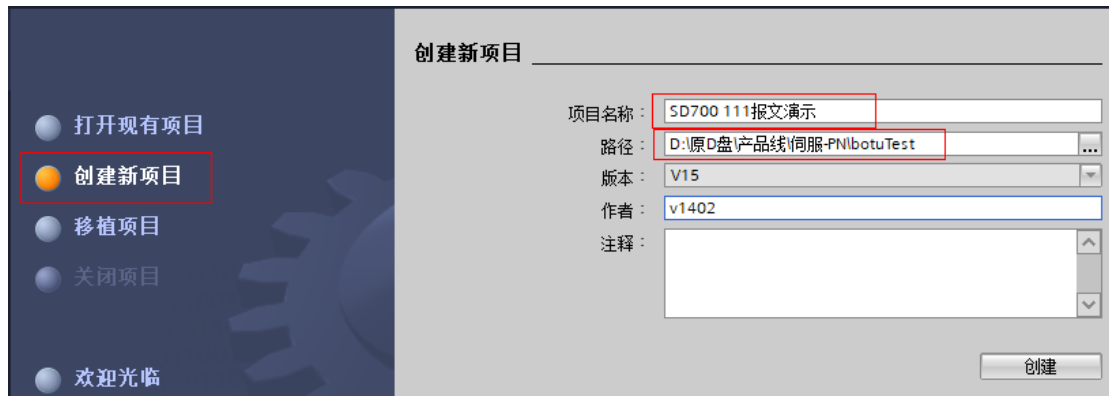
Figure 3-5 Jog control sequence

## 4. Example of operation of message 111

Message No. 111 needs to be carried out with the Botu program block EPOS. The following takes Siemens PLC S7-1500 as an example.

### 4.1 Create a new project

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



Click "Configure Device"

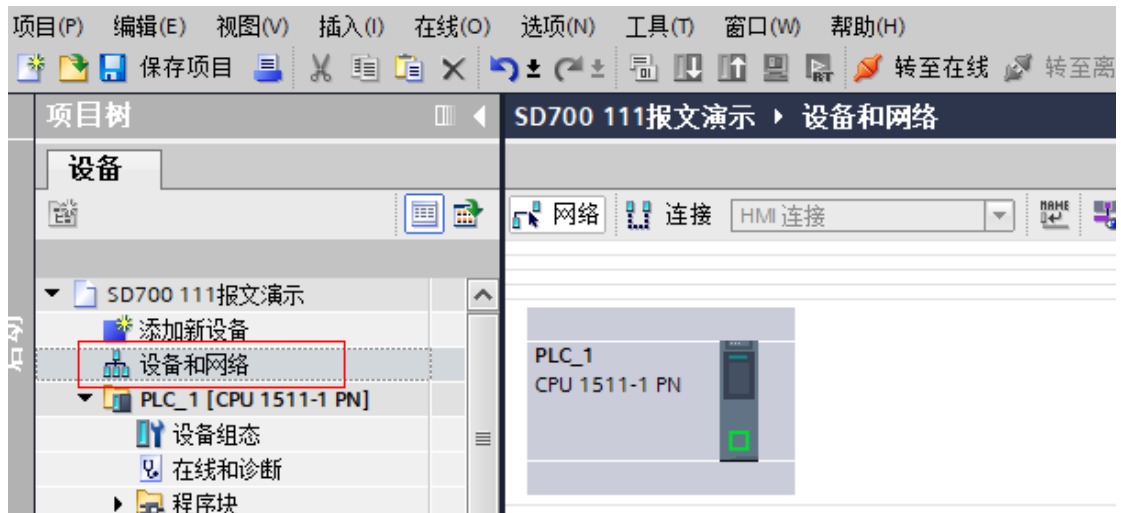


Click "Add Device" and select the PLC model you are using.

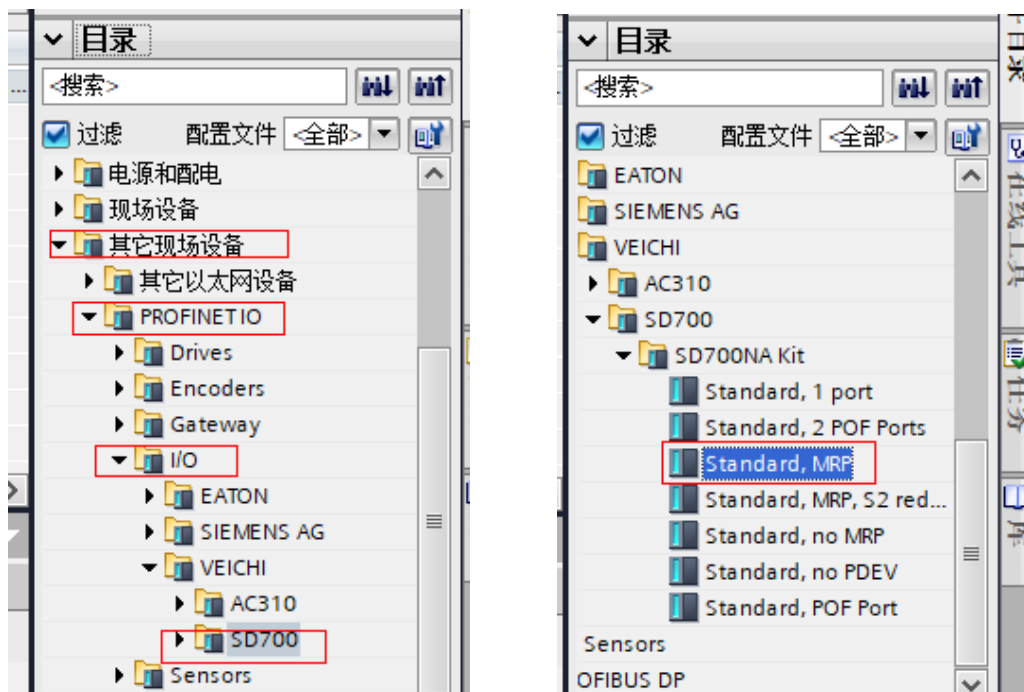


### 4.2 Configuration device

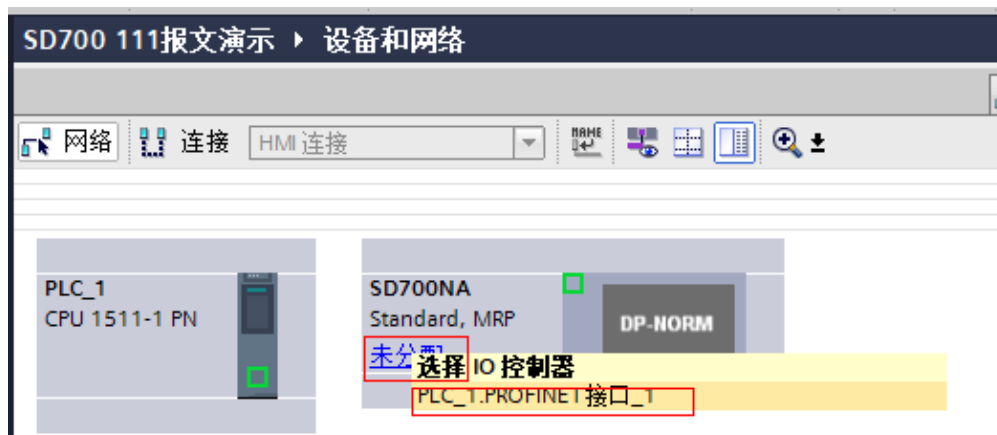
Click "Devices and Networks"



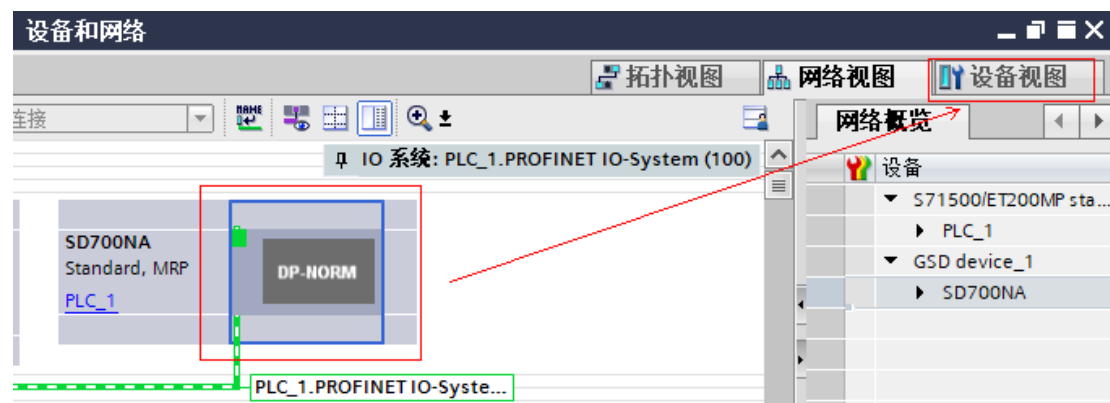
Find SD700 in the "Hardware Catalog" on the right, expand and double-click "Standard, MRP"



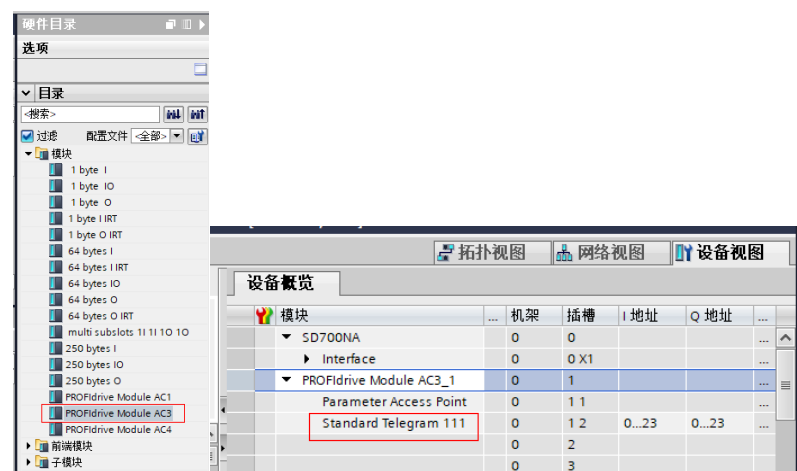
Click "Unassigned" as follows



Right click, assign device name

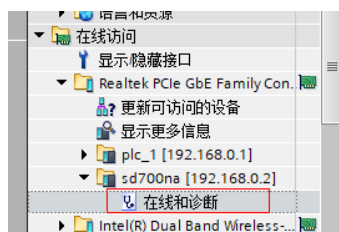


Double-click "PROFIdrive Module AC3" in the menu on the right, you can see that the 111th

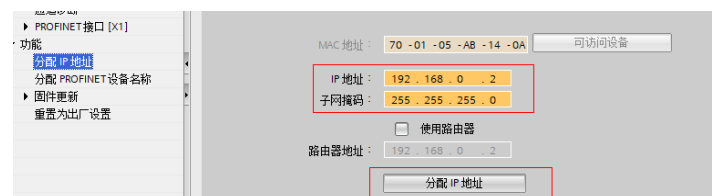


message has been added.

Click "Update Accessible Devices" in "Online Access", and click "Online Diagnosis" for the scanned servo



Assign IP address and device name

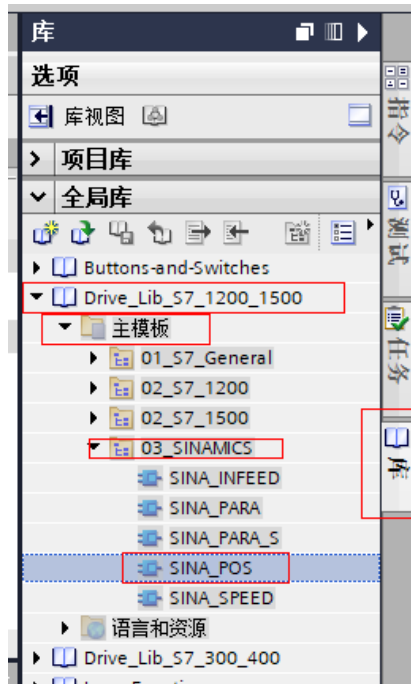


### 4.3 Add EPOS program block

Double click "Main[OB1]"

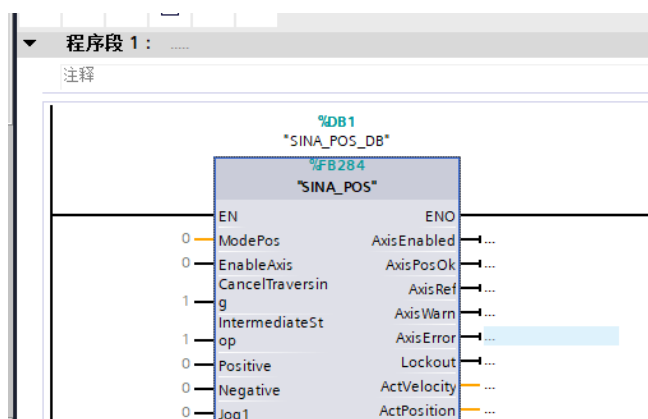


Select "Library" "Drive\_Lib\_S7\_1200\_1500" in the right menu, select "SINA\_POS"

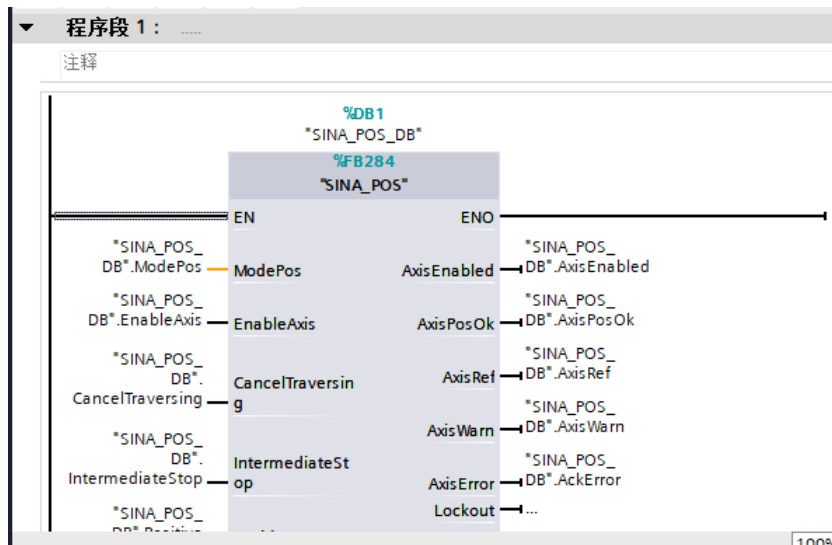


Drag "SINA\_POS" into "Main[OB1]", and then drag it in, as shown in the figure below.

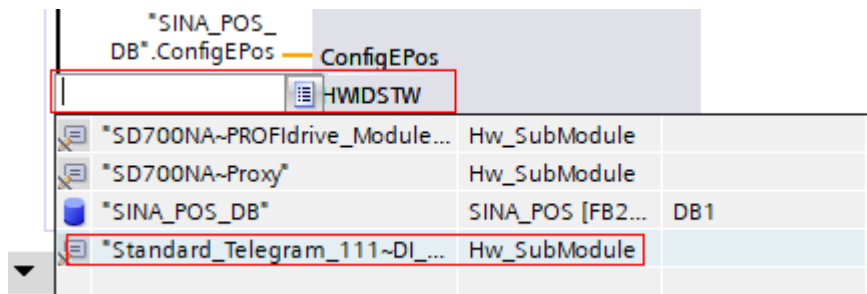
Connect variables to each interface as shown below.







The hardware representation is added as follows, add "Standard\_Telegram\_111.."



After adding, compile and download.

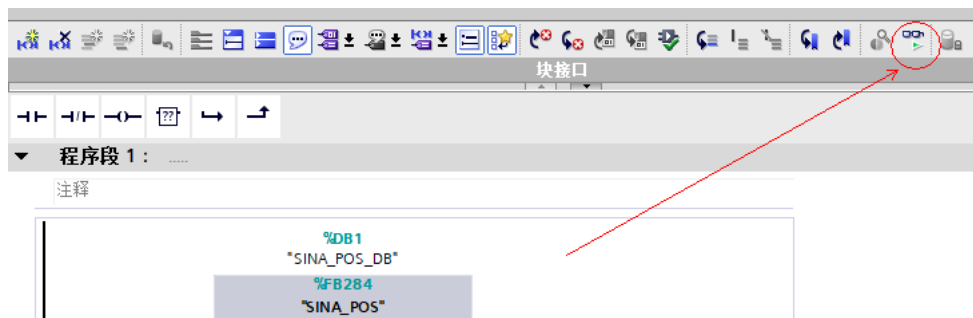


click to download"



#### 4.4 Trial run

After the program download is complete, click "Enable/Disable Monitoring"



Input 2 in ModePos to perform absolute position operation. Click Enable, enter the target position and target speed, and trigger the rising edge "ExecuteMode" to let the motor run.

