EtherCAT/ PROFINET Gateway

GT200-PN-EC

User Manual

V1.1

Rev A

SST Automation

E-mail: support@sstautomation.com

www.SSTAutomation.com

Important Information

Disclaimer

No part of this document may be reproduced without the express written permission of SST Automation. SST Automation reserves the right to make changes to the product described within this manual at any time without notice.

The examples and diagrams in this manual are included solely for illustrative purposes and are not intended as a substitute for determining the suitability of the product for specific user applications. It is the responsibility of any such user to ensure that all operations, evaluations, and testing comply with all safety requirements such as laws, rules, codes and standards applicable to the relevant fields. SST Automation shall not be responsible or liable for misuse of the information contained herein.

Copyright

Trademark

SST is the registered trade mark of SST Automation.

Technical Support Contact Information

www.sstautomation.com

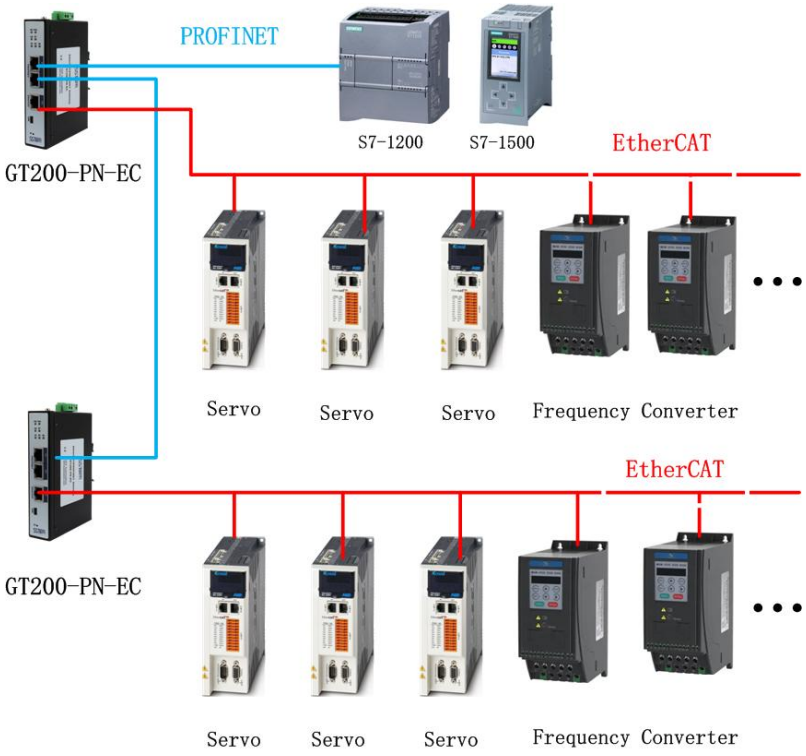
E-mail: support@sstautomation.com

Table of Contents

1 Product Overview

1.1 Product Introduction

The GT200-PN-EC is a protocol conversion gateway that provides a seamless connection between EtherCAT slave devices and a PROFINET master. It can connect up to 16 EtherCAT slave devices to a PROFINET IO Controller such as an S7 PLC to easily read and write data between EtherCAT and PROFINET. On the PROFINET side, the GT200-PN-EC functions as a PROFINET slave. On the EtherCAT side, the GT200-PN-EC functions as an EtherCAT master. The GT200-PN-EC gateway makes it easy and efficient to convert between these two industrial real-time Ethernet protocols, enabling seamless integration of EtherCAT industrial bus drivers to a PROFINET network.



1.2 Product Features

- The PROFINET bus supports RT-level communication, while the EtherCAT bus operates in DC mode, with both bus communication cycles at 2ms, ensuring fast response and timely data processing. A single GT200-PN-EC can connect up to 16 drives (servo/inverter/stepper) that support the EtherCAT bus and comply with the CiA402 standard.
- GT200-PN-EC supports PROFIdrive profiles and can automatically perform protocol conversion from PROFIdrive profiles to CiA402. Users do not need to understand the complexities of PROFIdrive profiles and CiA402 protocol specifications. Controlling EtherCAT bus drives through this gateway with a Siemens PLC is as simple as controlling multiple PROFINET bus drives.
- Supports various PROFIdrive standard messages, including Standard Message 1 (AC1), Standard Message 2 (AC1), Standard Message 3 (AC4), and Siemens Message 111 (AC3), and Siemens Message 102 (AC4). These five message types cover a wide range of applications, including variable frequency drives and Servo drives. Customers can utilize TIA Portal software's function blocks or process objects without changing their programming habits. GT200-PN-EC is compatible with the full range of Siemens CPUs, including S7-200 SMART, S7-1200, S7-1500, S7-1500T, SIMOTION, and more. Additionally, its usage is straightforward without the need for specialized configuration software, Siemens TIA Portal software allows one-stop configuration.

The current list of supported drives is shown in the following table:

Manufacturer	Part Number	PROFIdrive Telegrams Supported	Compatibility
Inovance	IS620N	1, 2, 3, 111	Full functionality
	SV660N		
Omron	R88D-1SN	1, 2, 3, 111	Electronic gear ratio needs to be set manually.
Delta	B3-E	1, 2, 3, 111	Full functionality
ETSUN	ED3L	1, 2, 3, 111	Full functionality
VEICHI	SD700	1, 2, 3, 111	EPOS doesn’t support "Intermediate Stop" The driver will be disabled After EPOS uses "Cancel Traversing"

HCFA	X3EB	1, 2, 3, 111	Full functionality
INVT	DA200	1, 2, 3, 111	Full functionality
Maxsine	EP3E-EC	1, 2, 3	Full functionality
XINJE	DS5C	1, 2, 3, 111	Full functionality
	DP3L	111	
MOONS	STF-ECT-H	1, 2, 3, 111	Full functionality
Kinco	FM560	1, 2	Full functionality
	FM423	1, 2, 3, 111	
Leadshine	CL3-EC	1, 2, 3, 111	Full functionality
Tsino-Dynatron	S7S	1, 2, 3	Electronic gear ratio needs to be set manually Mode switching is not allowed when enabled
Panasonic	A5B A6B	1, 2, 3, 111	Full functionality
YASKAWA	Σ-7S	1, 2, 3, 111	Full functionality
Servotronix	BDHD	1, 2, 3, 111	Full functionality
	CDHD		
	CDHD2		
EURA	SD25-E	1, 2, 3, 111	Full functionality
HIWIN	E1 series	1, 2, 3, 111	Full functionality
JMC	Full series	1, 2, 3, 111	Full functionality
Maxon	MAXPOS	1, 2, 3, 111	Full functionality
ELMO	GOLD DRUM SERIES	1, 2, 3, 111	Full functionality

1.3 Technical Specifications

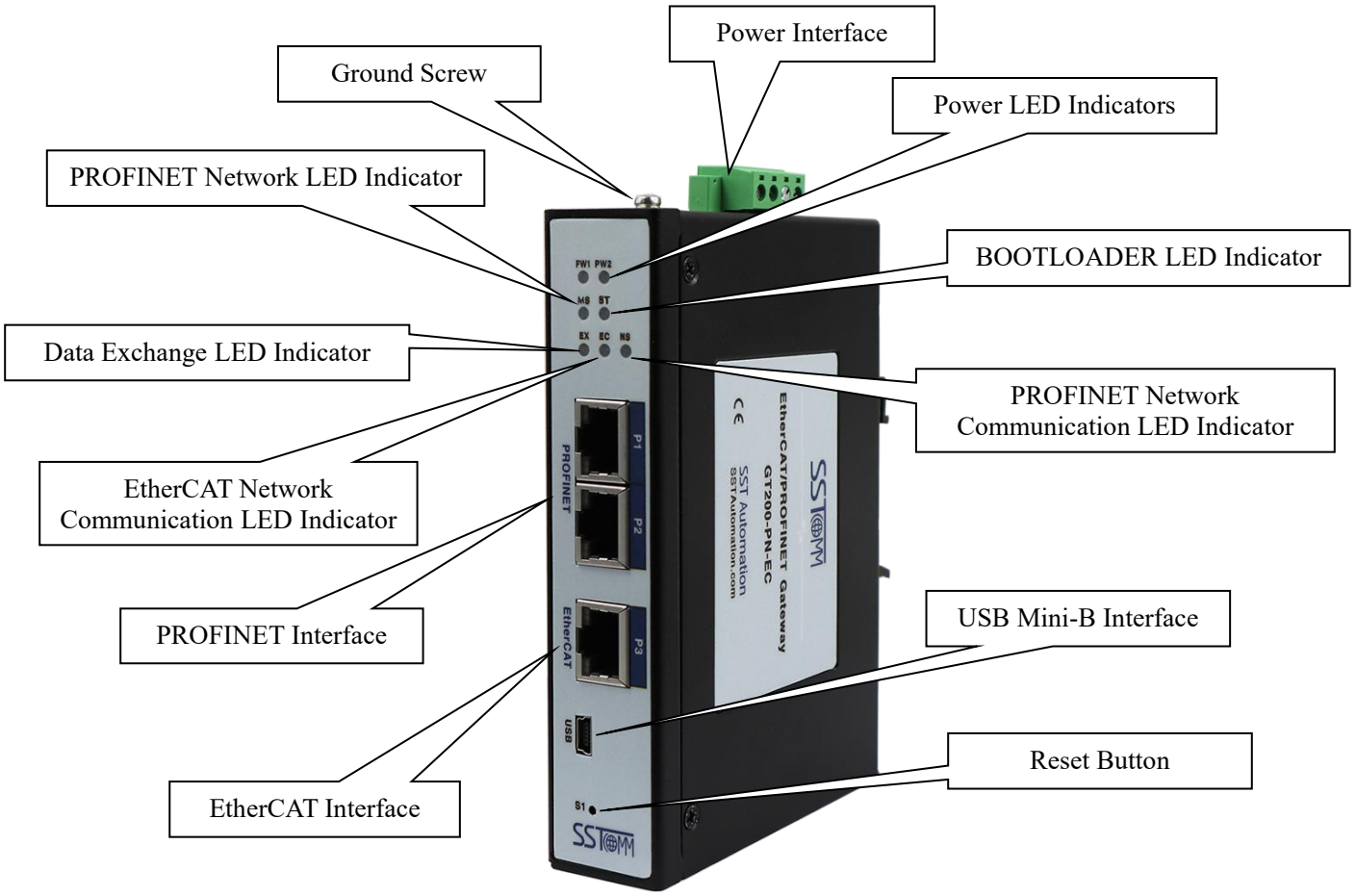
PROFINET Features	
Operation Mode	PROFINET IO (RT) Device
Maximum Slots	A maximum of 32 slots
Protocols	Support for standard PROFINET RT protocols
Real-Time Capability	Approximately 10ms
EtherCAT Features	
Operation Mode	EtherCAT Master (Scanner)
Maximum Number of Slave (Adapter) Connections	16 Servo devices
Supported Telegram Types	Standard telegram 1 , standard telegram 2 , standard telegram 3 , and Siemens telegram 111 , Siemens telegram 102
Electrical / Environmental	
DC Input Voltage	24 VDC nominal 12VDC to 36 VDC allowed
Operating Temperature	-40°F to 158°F (-40°C to 70°C)
Relative Humidity	5% to 95% RH with no condensation
Certification	CE Compliant
Physical	
Dimensions (W x H x D)	1.1in*3.9in*5.5in (28mm*100mm*140mm)
Mounting	35mm (1.4in) DIN Rail
Ethernet Port	(1) 10/100 Base-T, RJ45 Connector
Power Interface	(1) 4-Pin Terminal Block

1.4 Revision History

Revision	Date	Chapter	Description
V1.1, Rev A	4/1/2024	Chapters 1.3, 2.6, 2.7, 5.2, 5.3, 7.3.7, 7.3.8	Added technical specifications in Chapter 1.3 Added descriptions for the USB Mini-B and Ground Screw interfaces in Chapters 2.6 and 2.7. Added Output Signal descriptions for the SinaParaS function block in Chapter 5.2 Added illustrations for the Electronic Gear Ratio in Chapter 5.3 Added control timing diagrams in Chapters 7.3.7 and 7.3.8
V1.1	12/12/2023	ALL	Modified some document illustrations.
V1.0	3/22/2022	ALL	First Release

2 Hardware Overview

2.1 Product Layout



2.2 Power Interface

The GT200-PN-EC gateway features two power interfaces that are used to accept a 24VDC input voltage: a 5.08mm pitch screw terminal block and a 2.1mm DC barrel connector. The GT200-PN-EC can accept intput voltages between 12 to 36 VDC. Users can choose the power supply input interface that best fits their application.

Pin	Function
V1	24VDC Positive Terminal (12VDC-36VDC)
G	Negative Terminal Ground
PE	Protective Earth Grounding

2.3 PROFINET Bus Interface

The PROFINET slave interface features two Gigabit RJ45 ports, with an embedded switch that allows daisy-chaining with other PROFINET bus devices.

2.4 EtherCAT Bus Interface

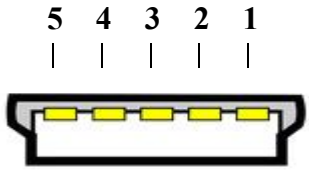
The EtherCAT master interface features a single Gigabit RJ45 interface that is used to connect to EtherCAT drives.

2.5 LED Status Indicators

Indicator	Status	Description
PW1/PW2	Solid Green	Power supply is normal
MS	Off	PROFINET network is normal
	Solid Green	One of the following conditions exists: • No physical connection detected on both of the 2 PROFINET ports. • A drive on the network has generated an alarm. • PROFINET network error.
BT	Solid Green	Bootloader Mode
EX	Flashing Green	Internal data exchange within the gateway is normal
	Solid Green	PROFINET communication chip firmware upgrade in progress. After the firmware update is completed, the LED indicator will resume flashing (this feature is supported after firmware version 0.4)
EC	Flashing Green	One of the following conditions exists: • No physical connection detected on the EtherCAT port. • An EtherCAT drive has lost connection.
	Solid Green	One of the following conditions exists: • The gateway is scanning for and connecting to EtherCAT drives on the network. • EtherCAT connection has been established. Communication is in operational mode (OP Mode).
NS	Off	No PROFINET connection to the PLC
	Solid Green	PROFINET connection to the PLC has been established. Communication is operational.

2.6 USB Mini-B Interface

The USB Mini Type B interface is defined as below:



Pin	Description
1	VBUS, +5V
2	D-, Data Negative
3	D+, Data Positive
4	ID, Not Connected
5	GND, Signal Ground

2.7 Ground Screw

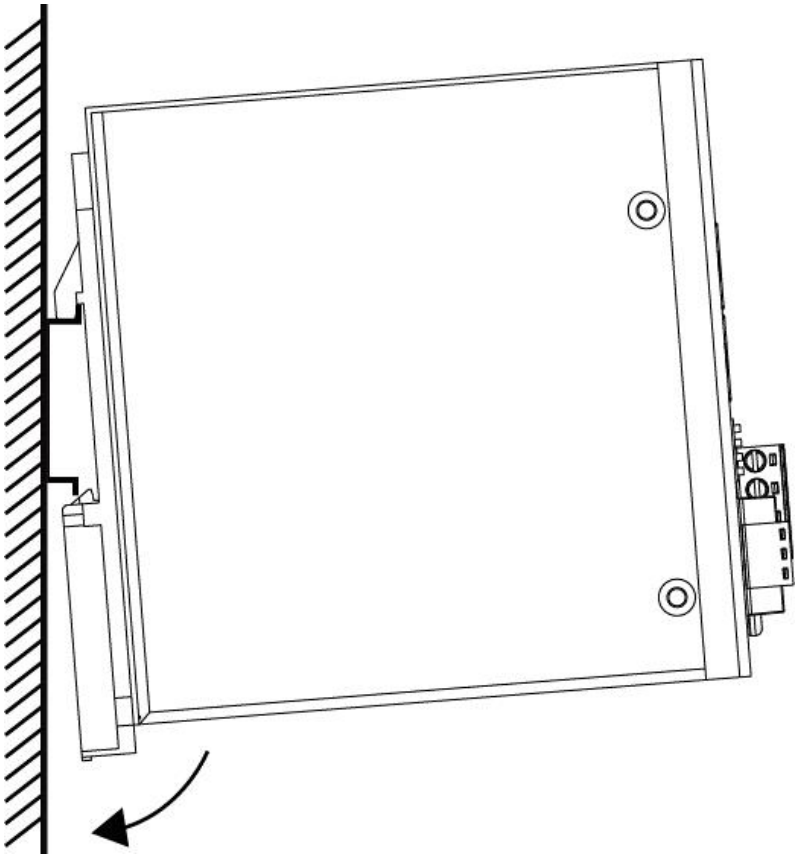
The GT200-PN-EC features a ground screw that can be used to provide a chassis ground for the gateway.

2.8 RESET Button

The RST button is used for firmware upgrades of the EtherCAT communication chip. Refer to Chapter 8.2 for specific usage instructions.

3 Hardware Mounting

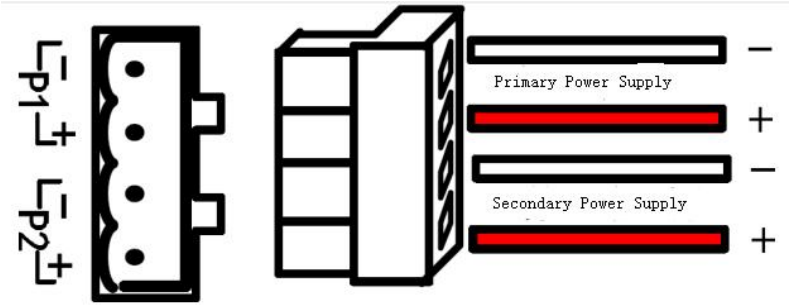
Hang the upper slot at the back of the gateway onto the upper hook of the guide rail, then press the gateway downward in the direction of the lower hook of the guide rail until it locks in place.



4 Getting Started - Quick Installation Guide

4.1 Hardware Installation

1. Securely attach the grounding wire to the grounding screw on the gateway to ensure a strong connection to ground.
2. Connect the EtherCAT interface of the gateway to the EtherCAT network of the servo drive. For more details about the EtherCAT interface, refer to Chapter 2.4.
3. Connect the PROFINET interface of the gateway to the PROFINET network of the PLC. For more details about the PROFINET interface, refer to Chapter 2.3.
4. Screw the power cable into the designated position of the phoenix terminal. It can support two power supply inputs. The power supply voltage range is DC 12-36V. Pay attention to the polarity, as incorrect connection may result in startup failure and damage to the equipment.



5 Servo Drive Configuration

5.1 Working Principle and Workflow

The core functionality of GT200-PN-EC is to connect EtherCAT drives to PROFINET by converting PROFIdrive profiles on the PROFINET bus to CiA402 standards on the EtherCAT bus. Both PROFIdrive and EtherCAT have a wide array of messages and modes that can be used during communication.. The following table shows the mapping relationship between PROFIdrive and EtherCAT:

PROFIDrive Telegram	EtherCAT Mode
1	CSV
2	CSV
3	CSV+Touch Probe
111	PV+PP+HOME
102	CSV+Touch Probe

Upon powering up the GT200-PN-EC, it does not immediately scan and detect EtherCAT bus drives connected to the bus. Instead, it first waits for communication between the PLC and the gateway over PROFINET. Once communication between the two is established, the gateway learns the PROFIdrive message number and electronic gear ratio information used by each drive.

Then, the GT200-PN-EC automatically scans the drives on the EtherCAT bus. During the PRE-OP (pre-operational) phase, it sets electronic gear ratio information and basic configurations in the drives. Afterward, it controls all drives to enter the OP (operational) mode, remaining in this state continuously.

It‘s important to note that GT200-PN-EC functions solely as a protocol converter and is not a debugging tool for EtherCAT drives. Before using the gateway for protocol conversion applications, it‘s recommended to debug the drives using the selected drive‘s upper-level software, addressing issues such as clearing drive alarms and configuring control parameters.

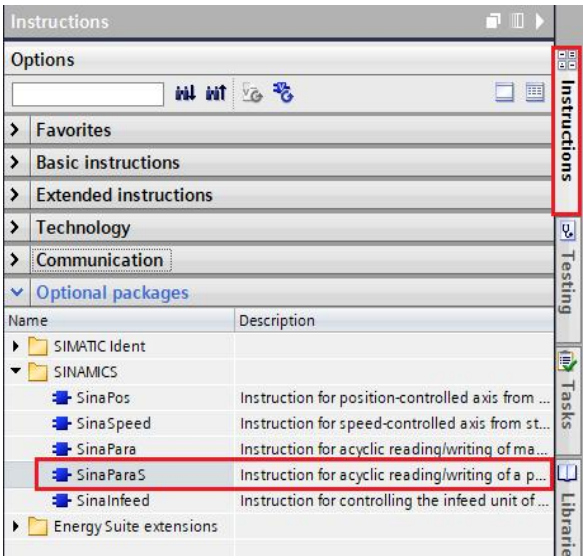
5.2 Drive Parameters

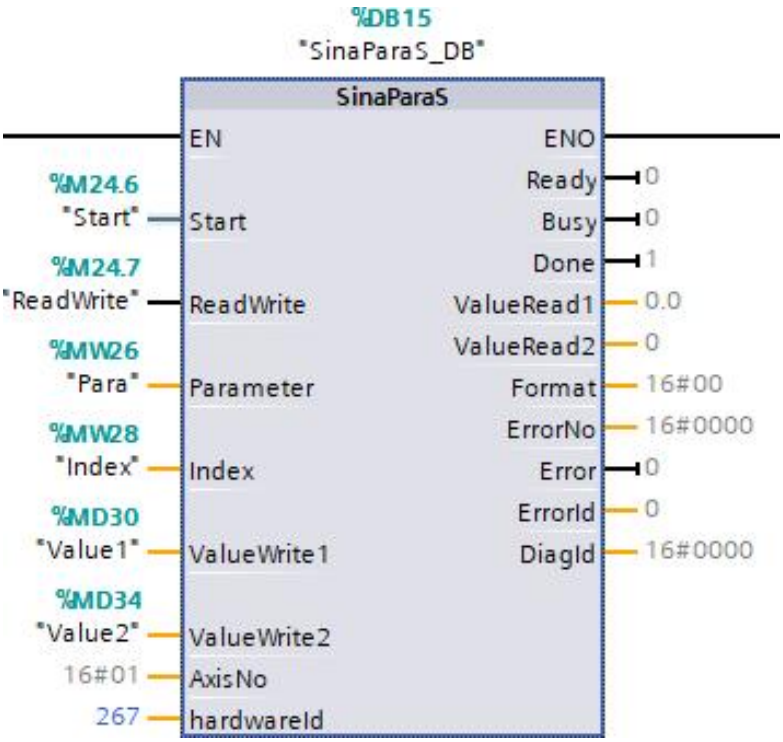
The servo drive can be configured by modifying the drive parameters in TIA Portal. The following parameters are supported by the GT200-PN-EC gateway:

Parameter Number	Parameter Name	Min Value	Max Value	Default Value	Units	Data Type	Data Access	PROFIdrive Telegrams Supported
		Parameter Description						
	EPOS Max Acceleration / Deceleration	1	65535	600	r/s^2	INT	N/A	111
		Maximum acceleration / deceleration for EPOS. The maximum acceleration / deceleration in rad/s^2.						
P100	Ramp Generator Slope			0x100000	/ms	DINT	RW	1, 2
		Slope of the ramp function generator. This parameter controls the rate of change of the ramp function generator. The change per millisecond is calculated as shown in the following formula: "(set value) / 0x40000000 * (parameter speed)"						
P60000	Reference Speed	1	65535	3000	rpm	INT	RO	ALL
		Reference value for rotation speed and frequency.						
	Homing Speed (Zero Position)	1	65535	30	rpm	INT	N/A	111
		Speed at which the drive searches for the homing signal. The speed at which the drive searches for the homing signal in EPOS mode to return to the zero position.						

Note: Parameters without a corresponding Parameter Number can be configured in TIA Portal. Navigate to the Device View window to configure the Telegram 111 Module Parameters. See Chapter 6.1 for more details.

Parameters can be read and written to using the SinaParaS function block in TIA Portal. The location of the function block is shown in the figure below:





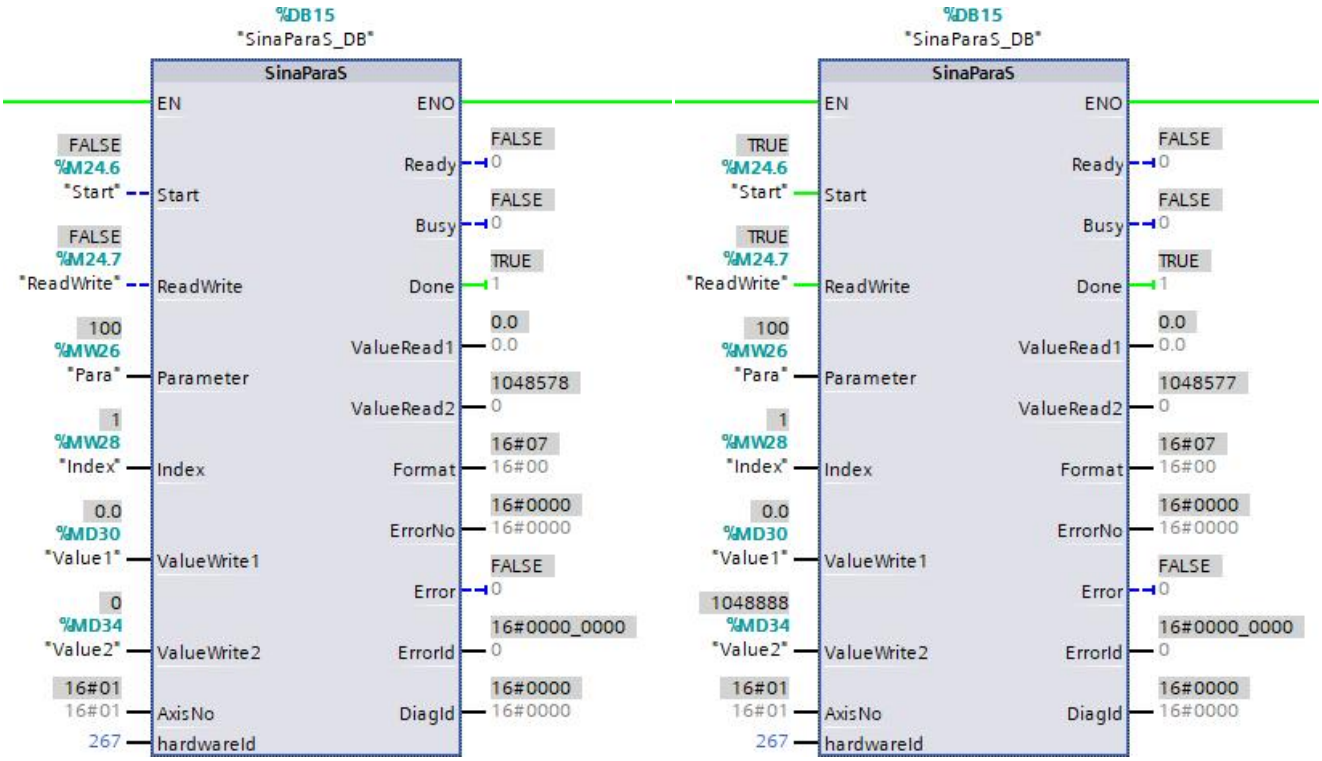
Input Signal	Data Type	Default Value	Description
Start	BOOL	0	Start of the job: 0 = No job or cancel job; 1 = Start or execute job
ReadWrite	BOOL	0	Job type: 0 = Read; 1 = Write
Parameter	UINT	1	Parameter number
Index	UINT	0	Index of the parameter
ValueWrite1	REAL	0.0	Value of the write parameter in REAL format
ValueWrite2	DINT	0	Value of the write parameter in DINT format
AxisNo	INT	1	Axis number / axis ID in a multi-axis system
HardwareID	HW IO	0	Hardware ID of the module access points / actual value telegram slot of the axis or drive

Note: To read the parameters from the GT200-PN-EC, the value of AxisNo should be set to 1.

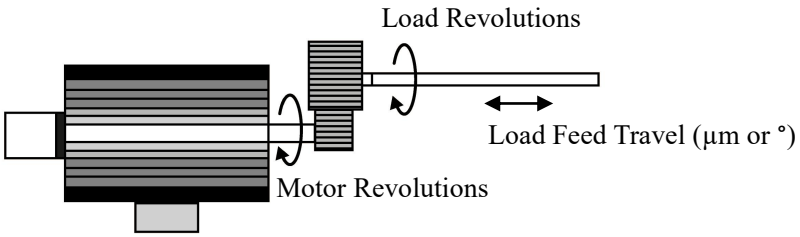
Output Signal	Data Type	Default Value	Description
Ready	BOOL	0	Checkback signal: 1 = Job ended or job canceled
Busy	BOOL	0	Current job status: 1 = Job in progress
Done	BOOL	0	Job completion: 1 = Job ended without errors
ValueRead1	REAL	0.0	Value of the read parameter in REAL format
ValueRead2	DINT	0	Value of the read parameter in DINT format
Format	INT	0	Format of the read parameter
ErrorNo	INT	0	Error number according to the PROFIdrive profile
Error	BOOL	0	Active group error: 1 = Error
Status	DWORD	0	1st Word: Indicates which parameter access is faulted 2nd Word: Type of fault
DiagID	WORD	0	Expanded communication error

ValueWrite1 is used for 16-bit inputs, while ValueWrite2 is used for 32-bit inputs. Similarly, ValueRead1 is used for 16-bit outputs, while ValueRead2 is used for 32-bit outputs. This means that when the data size of the parameter is 16-bits, it should be assigned using ValueWrite1. When the data size of the parameter is 32-bits, it should be assigned using ValueWrite2.

For example, to access the "Ramp Generator Slope" parameter using the SinaParaS function block, set the Parameter field to 100. The Index field is used to specify which axis to access (0 for the first axis, 1 for the second axis, etc.). The following diagram illustrates how to read and write this parameter to the second axis:



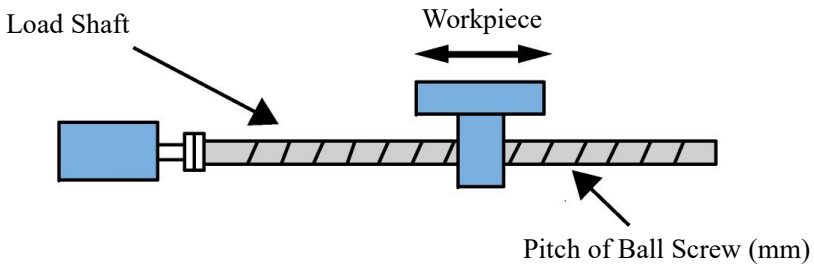
5.3 Electronic Gear Ratio



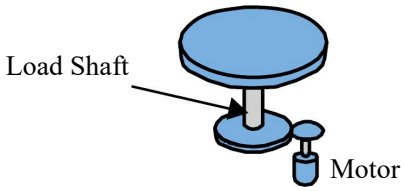
The servo motor drive can be configured with an electronic gear ratio to electronically enlarge or reduce the travel distance of the load shaft relative to the motor shaft. The electronic gear ratio for the drive can be configured by modifying the Load Travel Distance (LU) per Motor Revolution [LU/rev] parameter in PROFIdrive Telegram 111 (which corresponds to V90 PN parameter p29247). See Chapter 6.1 for more details.

The minimum travel distance of the load shaft is called a Length Unit (LU). The LU can be defined either in terms of length such as 1µm for linear loads, or angle such as 0.01° for rotational loads.

LU: 1µm



LU: 0.01°



The Position Factor is used to define the proportional relationship between the load travel distance (LU) per load revolution, and the load travel distance (LU) per motor revolution input parameter.

$$\text{LU per Motor Revolution}_{[\text{LU/Motor Rev}]} = (\text{LU per Load Revolution})_{[\text{LU/Load Rev}]} \times (\text{Position Factor})$$

The Position Factor is related to the desired mechanical reduction ratio (gear ratio), mechanical dimensions related to the feed rate, and motor resolution:

$$\text{Position Factor} = \frac{(\text{Motor Resolution})_{[\text{Pulse/Motor Rev}]} \times (\text{Desired Gear Ratio})}{(\text{Load Feed Rate})_{[\text{LU/Load Rev}]}}$$

Where the Desired Gear Ratio is defined as:

$$\text{Desired Gear Ratio} = \frac{\text{Motor Revolutions}}{\text{Load Revolutions}}$$

And where Load Feed Rate is defined as:

$$\text{Load Feed Rate}_{[\text{LU/Load rev}]} = \frac{\text{Load Feed Travel per Load Revolution}_{[(\mu\text{m or }^\circ)/\text{Load Rev}]}}{\text{LU Definition}_{[(\mu\text{m or }^\circ)/\text{LU}]}}$$

After setting the electronic gear ratio information, sending the position command information from the controller to the drive is greatly simplified. Additionally, since the target position command on the EtherCAT bus is a 32-bit number, using the electronic gear ratio with EPOS function blocks for drive point-to-point positioning can increase the travel distance.

To streamline user operations, for certain brands of drives the GT200-PN-EC gateway automatically configures the electronic gear ratio settings for the drive based on the gear ratio information set by the user during configuration. However, for some drive brands, the electronic gear ratio configuration needs to be done using the manufacturer's drive controller software and saved to the drive. The method for setting the electronic gear ratio may vary among different drive manufacturers:

Manufacturer	Part Number	Gear Ratio Configuration Method
Inovance	IS620N	Automatic
	SV660N	
VEICHI	SD700	Automatic
HCFA	X3EB	Automatic
XINJIE	DS5C	Automatic
Maxsine	EP3E-EC	Automatic
ETSUN	ED3L	Automatic
Tsino-Dynatron	S7S	Manufacturer’s drive controller software
Delta	B3-E	Automatic
Omron	R88D-1SN	Modify P1.44 and P1.45 parameter
Panasonic	A5B	Modify object 6092h-01 in the manufacturer’s drive controller software and save (takes effect after reboot)
	A6B	
YASKAWA	Σ-7S	Modify objects 2701h, 2702h, and 2703h in the manufacturer’s drive controller software and save (takes effect after reboot)
Servotronix	BDHDE	Automatic

Note 1: Currently, other brands of drive products are processed without the use of electronic gear ratios.

Note 2: The method for configuring electronic gear ratios is explained in Chapter 6.1.

Note 3: Since the gateway sets the electronic gear ratio information to the drive during the PRE-OP stage when the drive bus is in PRE-OP status, the entire system needs to be powered off and on again after modifying the gear ratio configuration during configuration.

5.4 EPOS Homing Method

When using the SINA_POS (FB284 or FB300) function block, it is required to use the drive's internal homing function. In the CiA402 standard followed by EtherCAT bus drives, a total of 36 standard homing methods (1-36) are defined. Additionally, drive manufacturers can customize homing methods beyond these standards. While the CiA402 standard clearly defines the execution process for each homing method, some drive manufacturers may not fully adhere to the standard in their implementation. Furthermore, certain servo drive manufacturers might only implement specific homing modes.

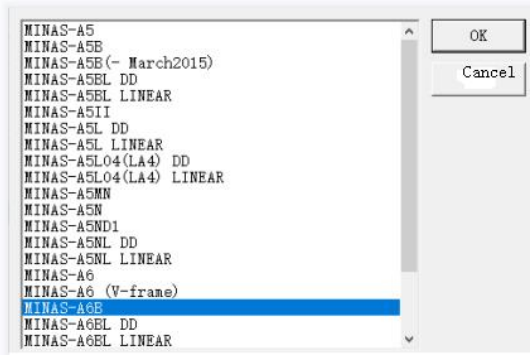
Because of this variance, the GT200-PN-EC does not enforce a specific homing method when using the SINA_POS function block for drive homing. Instead, it leaves the decision of which homing method to use to the user. If Siemens 111 messages are used during configuration, the user needs to configure which homing method the drive should use, which is detailed in Chapter 6.1 of this document. When selecting the drive's homing method, users should refer to the application manual of the EtherCAT bus drive in use. From the supported homing methods provided by the drive, users should choose the appropriate method based on the specific application and configure it in the device view. Some homing methods may require external I-point signals from the drive, and users should strictly follow the drive's application manual for proper operation.

5.5 Servo Drives with Special Settings

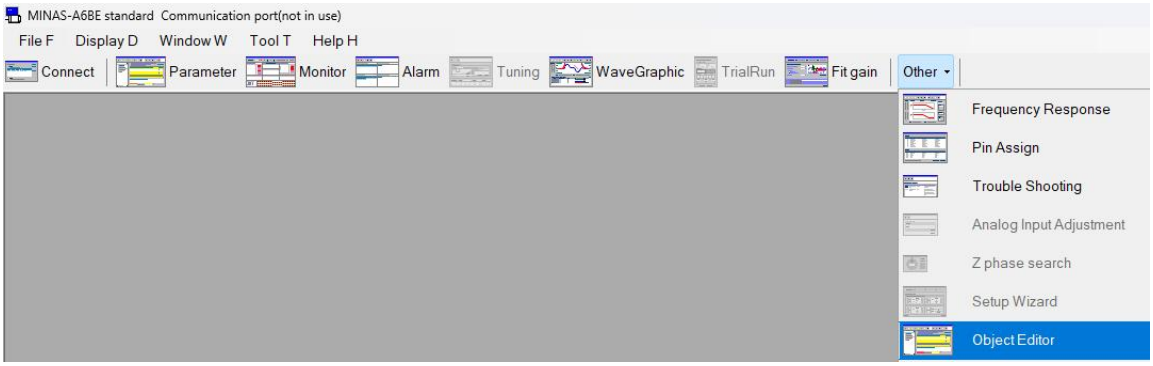
5.5.1 Panasonic

To simplify the connection to EtherCAT servos , the GT200-PN-EC standardizes the PDO mapping when connecting to servos. However, since Panasonic servos do not support dynamic PDO mapping, the servo needs to be manually configured in the manufacturer's drive controller software to connect to the GT200-PN-EC.

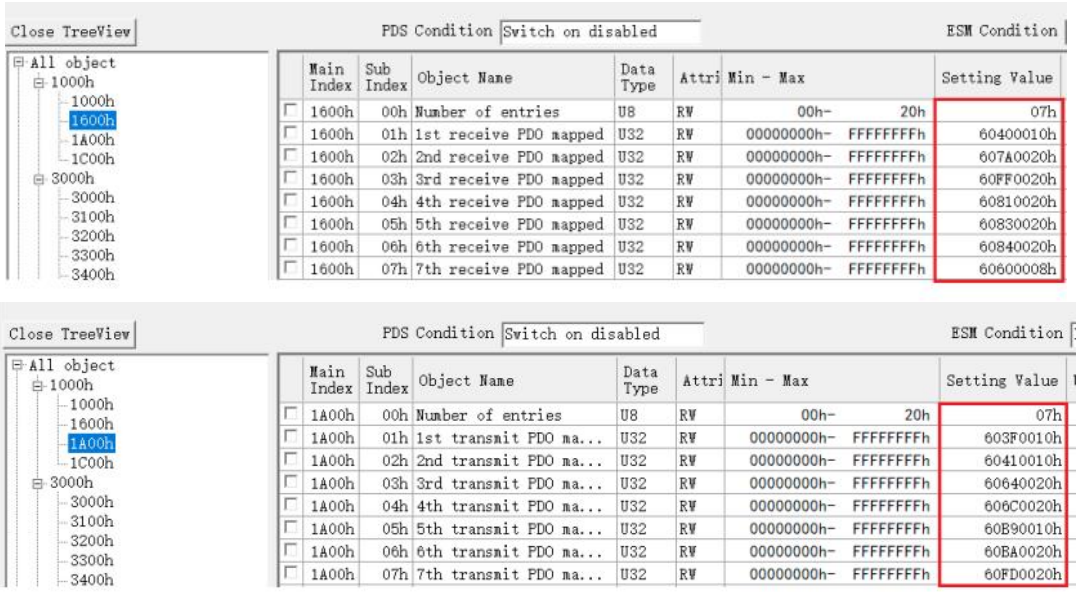
1. Connect to the Servo with Panasonic PANATERM Ver. 6.0.



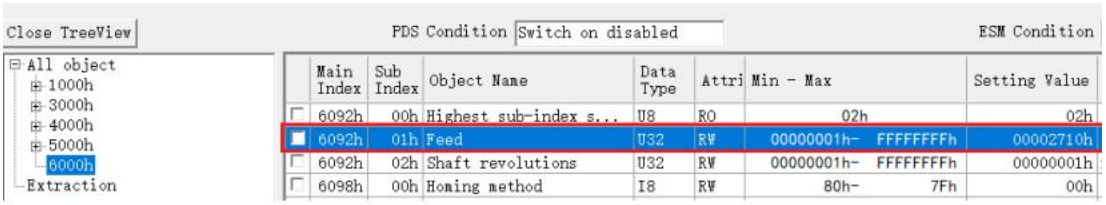
2. Open the Object Editor.



3. Enter the configuration settings for each RPDO and TPDO exactly as shown in the red boxes in the diagram below. Then click the "EEP" button to save the settings to the drive. After configuring, restart the drive for the changes to take effect.



4. Set the denominator of the electronic gear ratio to match the setting configured in TIA Portal. After configuring, restart the drive for the changes to take effect.

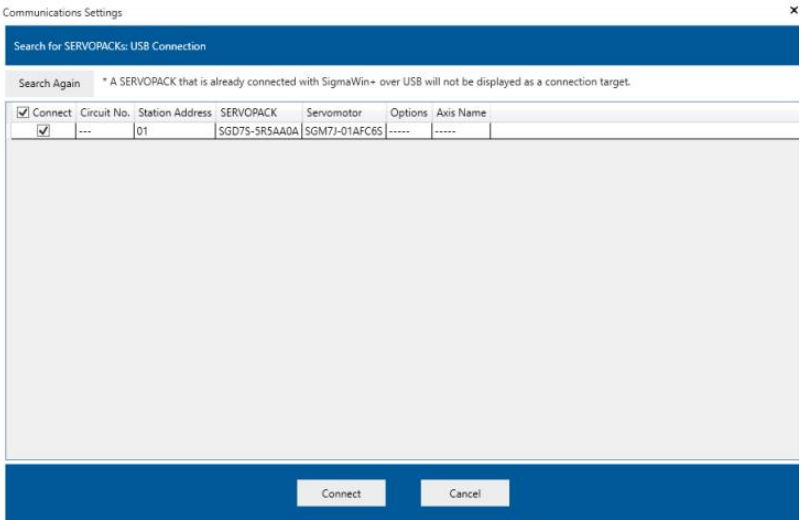


5. Set other motion-related parameters.

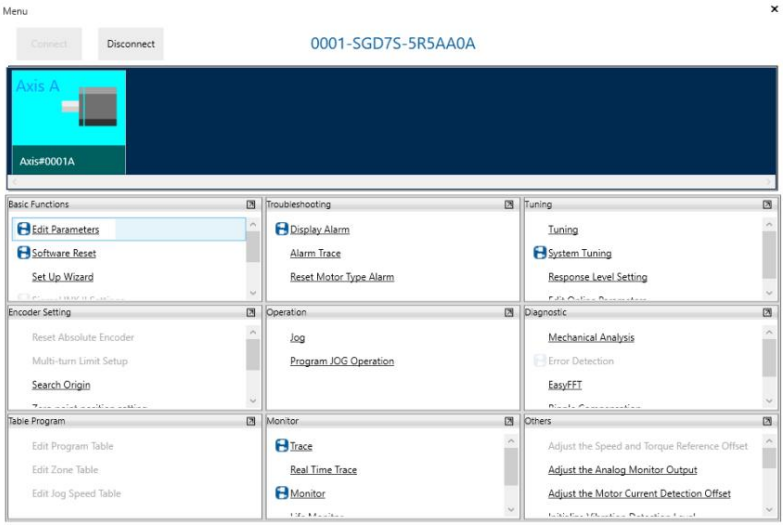
5.5.2 YASKAWA

To manually set the position gear ratio, speed gear ratio, and acceleration gear ratio parameters using the Yaskawa drive controller software, follow the instructions outlined in the steps below:

1. Import the model file for the Yaskawa Σ-7S series EtherCAT drive using the Yaskawa drive controller software SigmaWin+ Ver.7, then reopen the software to connect to the drive.



2. Open the parameter editing interface.



3. Configure the following parameters in the Yaskawa drive controller software:

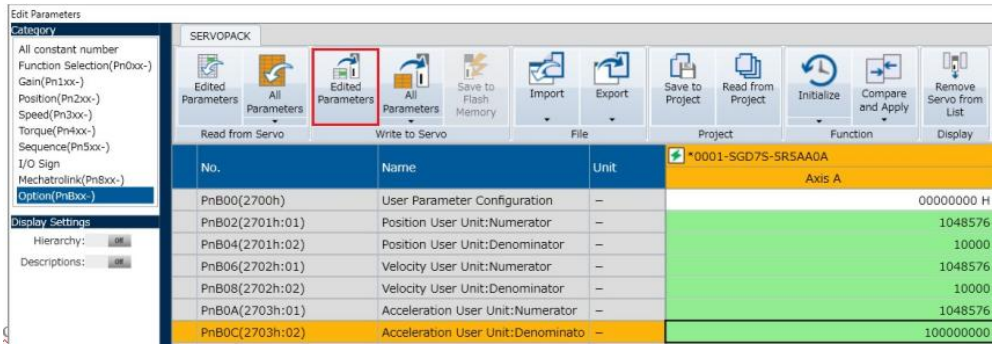
   Set 2701h-01, 2702h-01, and 2703h-01 as the numerator of the electronic gear ratio.

   Set 2701h-02 and 2702h-02 as the denominator of the electronic gear ratio.

   Set 2703h-02 with the following formula:

   $$(\text{denominator of the electronic gear ratio}) \times 10000.$$

After entering the settings, save the new configuration to the drive. The changes will take effect after performing a restart on the drive.

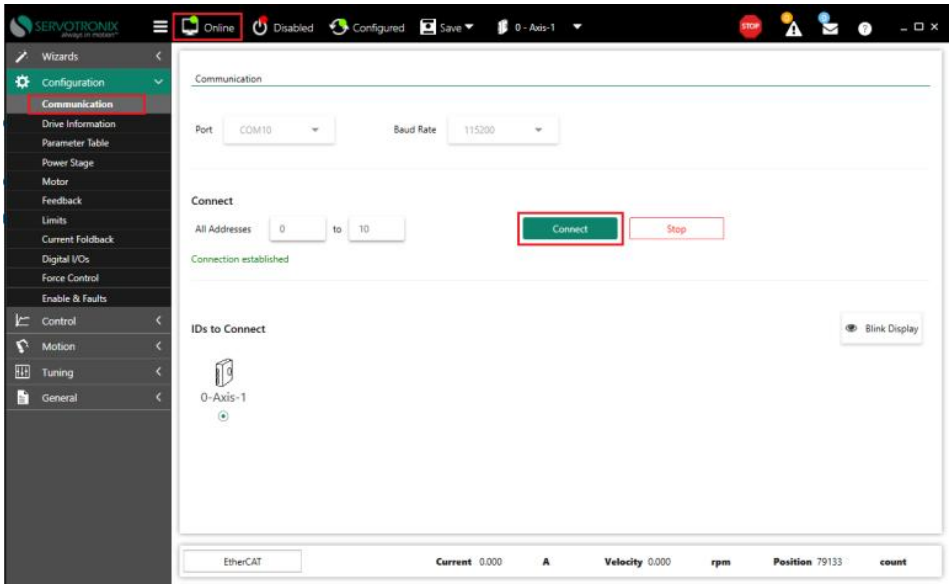


Note: When using a rotary servo motor with a 24-bit encoder resolution (16777216), Pn20E (Electronic Gear Ratio - Numerator) will be automatically set to 16, and Pn210 (Electronic Gear Ratio - Denominator) will be automatically set to 1. As a result of this, the effective encoder resolution in TIA Portal should be set to 20 bits (1048576).

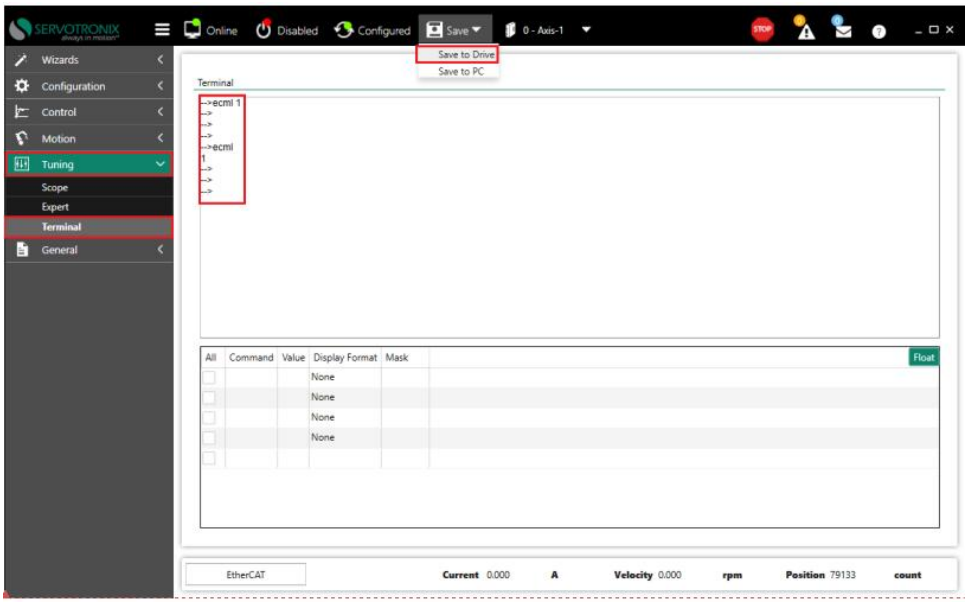
5.5.3 Servotronix

The Servotronix BDHDE drive has two different response modes for responding to SDO commands: normal mode and fast mode. When connecting to the GT200-PN-EC, the Servotronix drive needs to be switched to fast mode.

1. Connect to the drive using the ServoStudio 2 drive controller software.



2. Open the command terminal interface, enter the command 'ecml 1' and press Enter. Then, enter the command 'ecml' to confirm if it is set to 1. If it is 1, save it to the drive, and restart the drive to apply the changes.



5.5.4 HIWIN

To manually set the electronic gear ratio parameters for HIWIN E1 series drives using the drive controller software, follow the instructions outlined in the steps below:

1. Connect to the E1 drive using the drive controller software, then configure the following parameters in the software:

   Set Pt20E and Pt210 as the electronic gear ratio.

   After ensuring that the set values match those required for the configuration, save the new configuration to the drive.

Pt20E	32	1048576	1
Pt210	1	10000	1

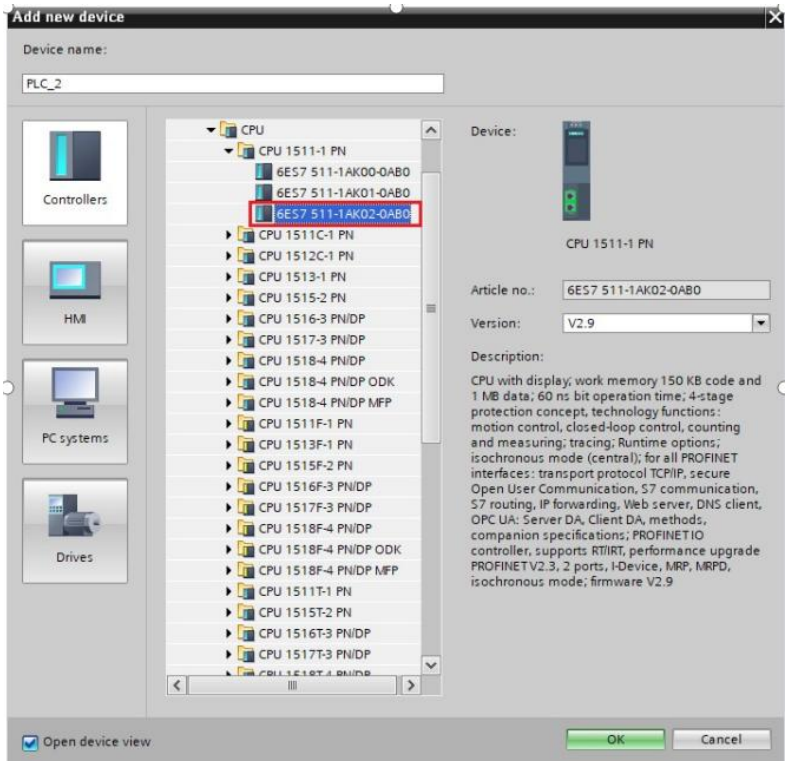
6 PLC Project Configuration

This manual takes the example of using Siemens 111 messages with an S7-1511 PLC to control 6 EtherCAT bus drives through GT200-PN-EC, explaining the project configuration steps for the PLC. This project is based on TIA Portal V17, and there may be slight differences in other versions.

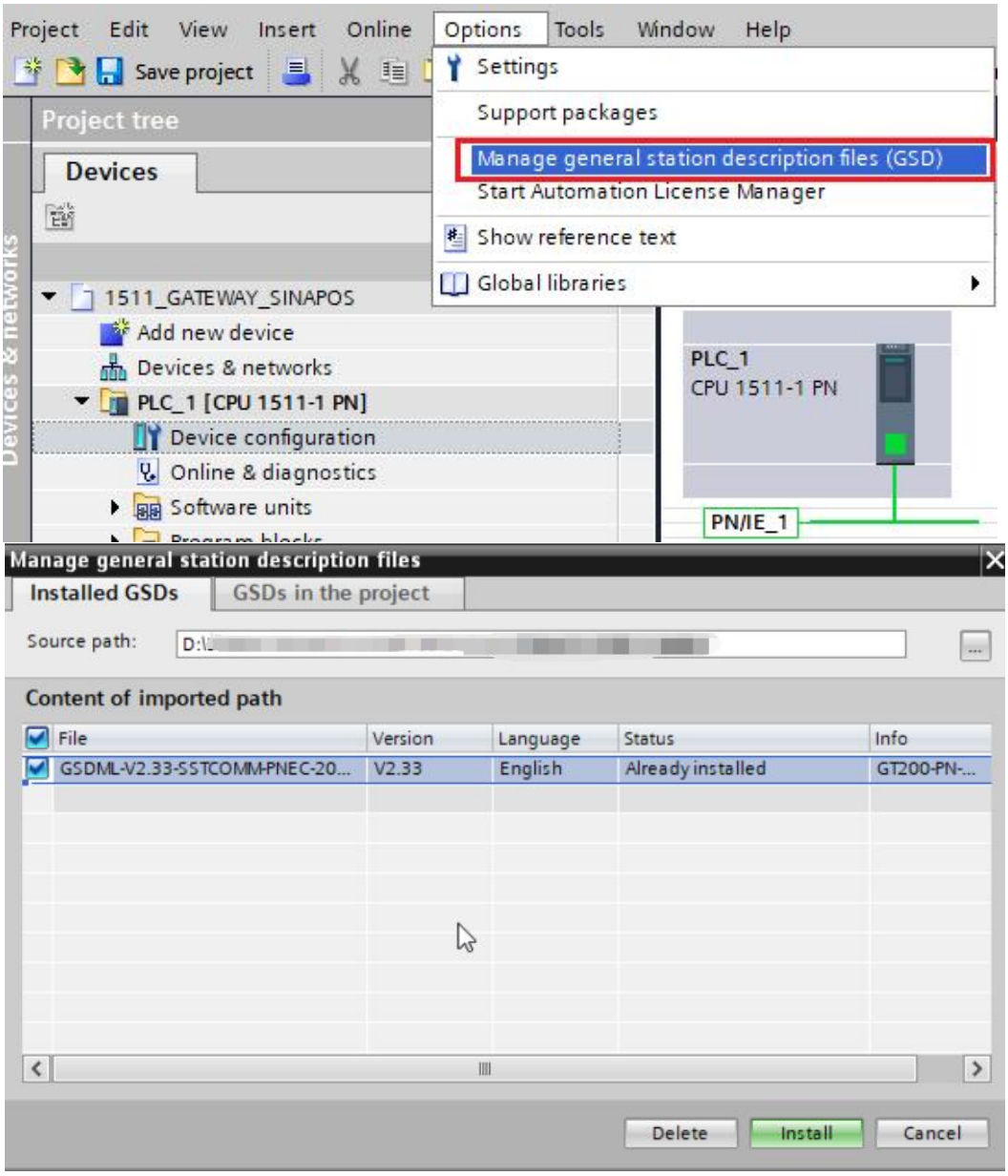
6.1 S7-1500 Project Configuration Steps

The steps for configuring an S7-1511 project using TIA Portal V17 software are as follows:

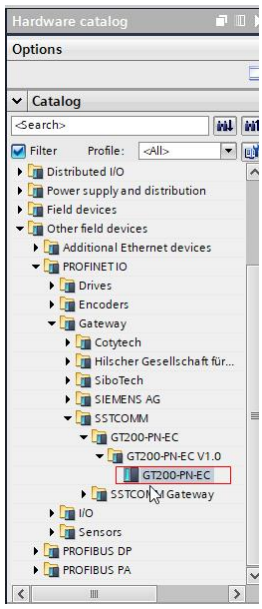
1. Create a new project and add a new device, S7-1500 PLC.



2. Install the GSDML file for GT200-PN-EC.

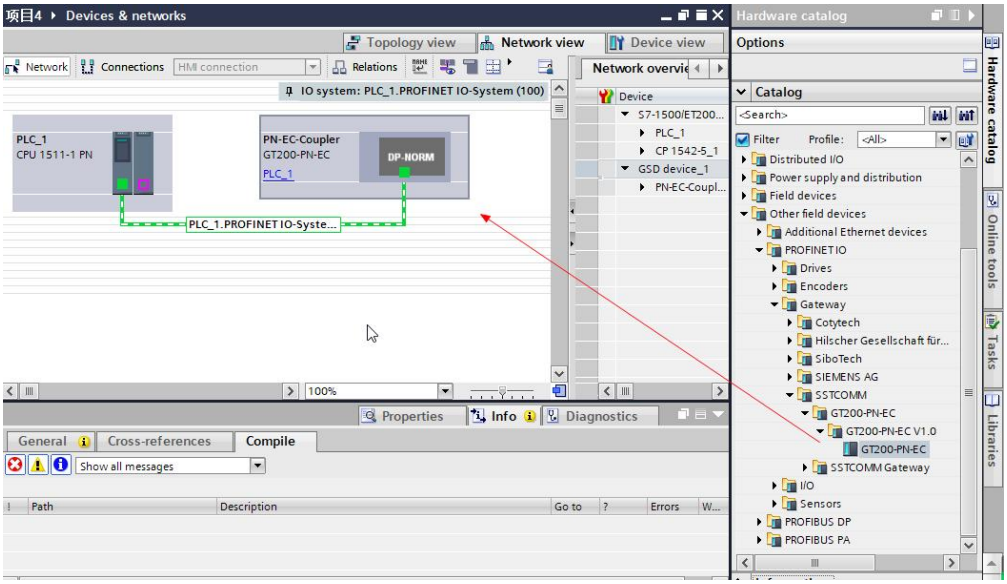


3. Add the GT200-PN-EC device and establish a network connection with the PLC. The GSDML file for GT200-PN-EC is located in the hardware directory at the following path.

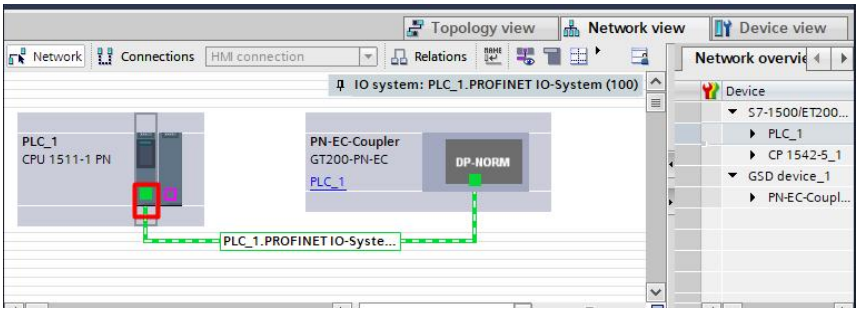


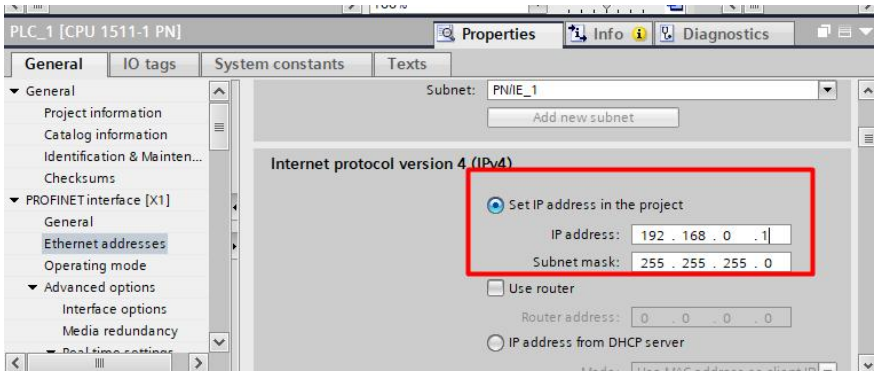
Add GT200-PN-EC to the network view.

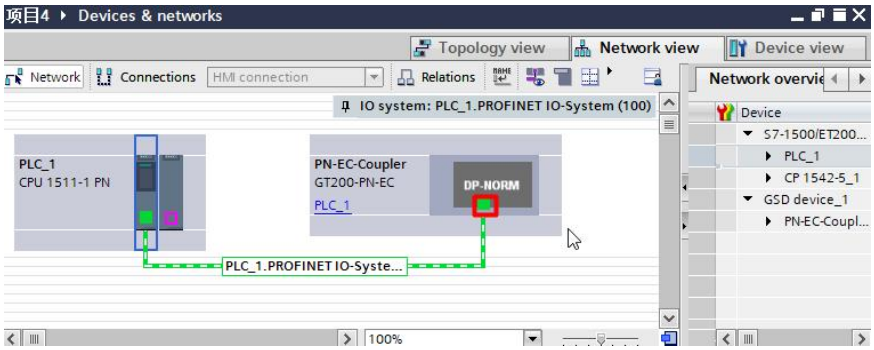
Note: Make sure to select the correct GSDML version, as shown in the diagram.

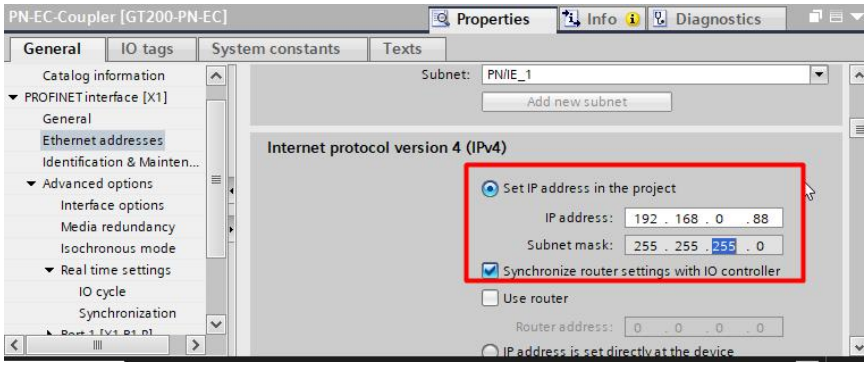


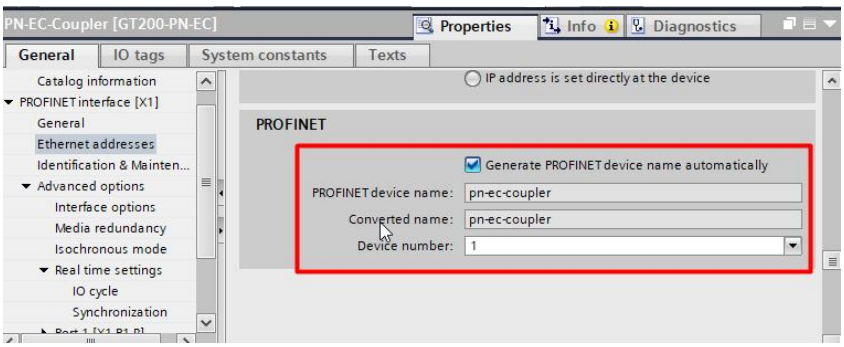
4. Set the IP address and device name for both S7-1511 and GT200-PN-EC separately.



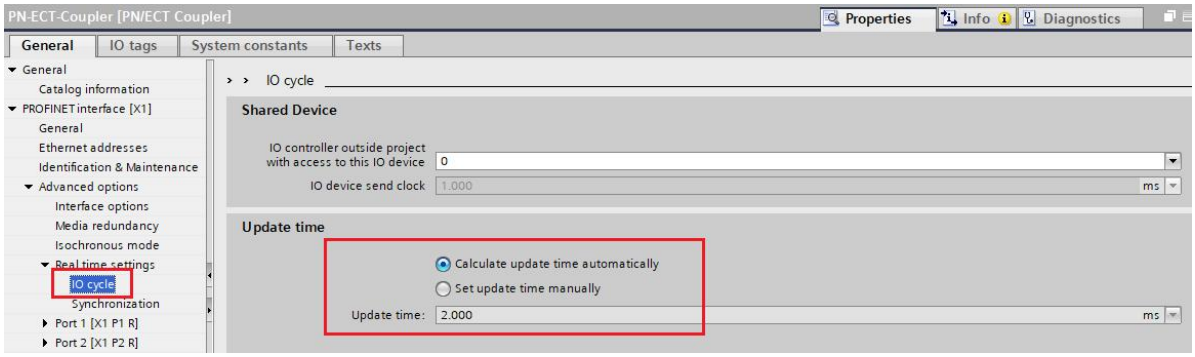




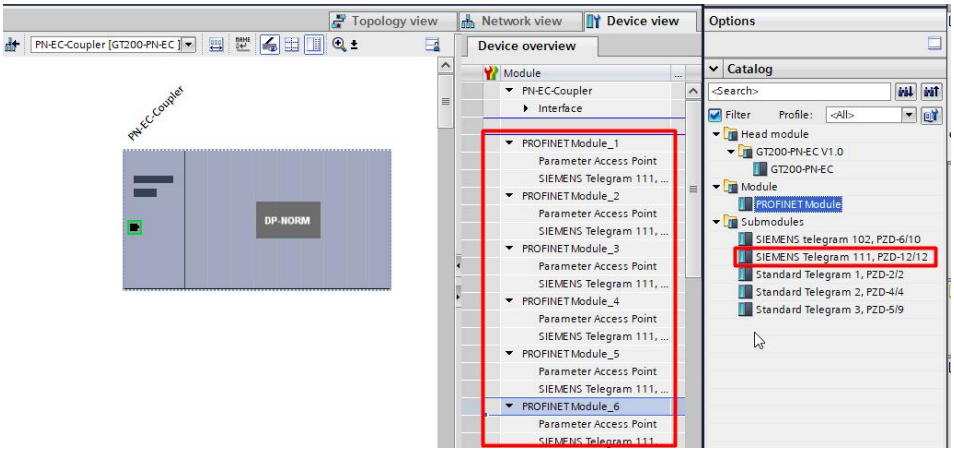




In the device properties, set the communication cycle for GT200-PN-EC. The default communication cycle is 2ms. If you wish to modify it, select the checkbox below to set it manually.



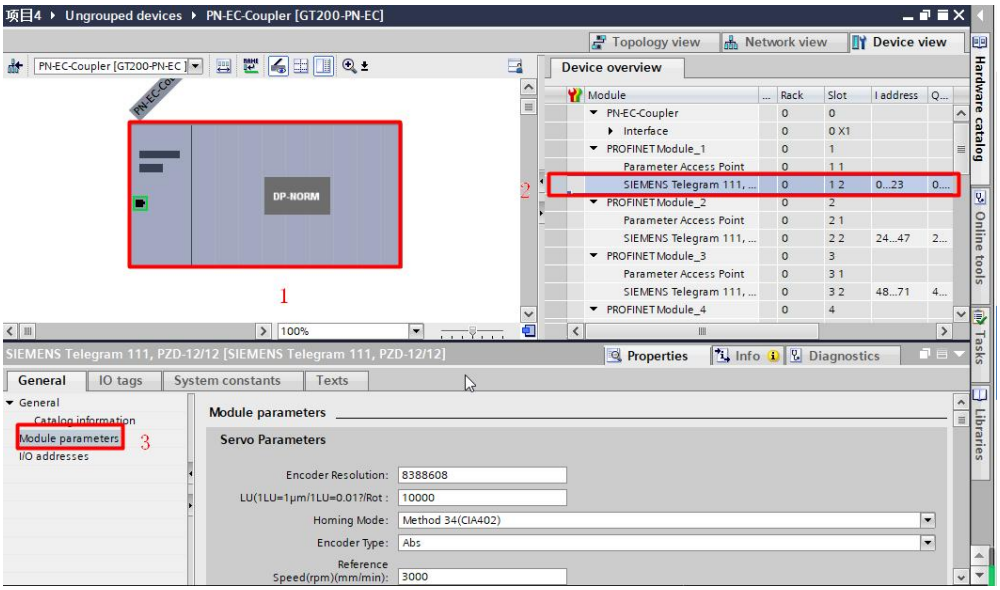
5. In the device view of GT200-PN-EC, insert the PROFINET Module from the right side six times (default to use Siemens 111 messages, can be replaced with other messages). Each module corresponds to one EtherCAT bus drive, and the order of module insertion corresponds to the cascade order of EtherCAT drives.



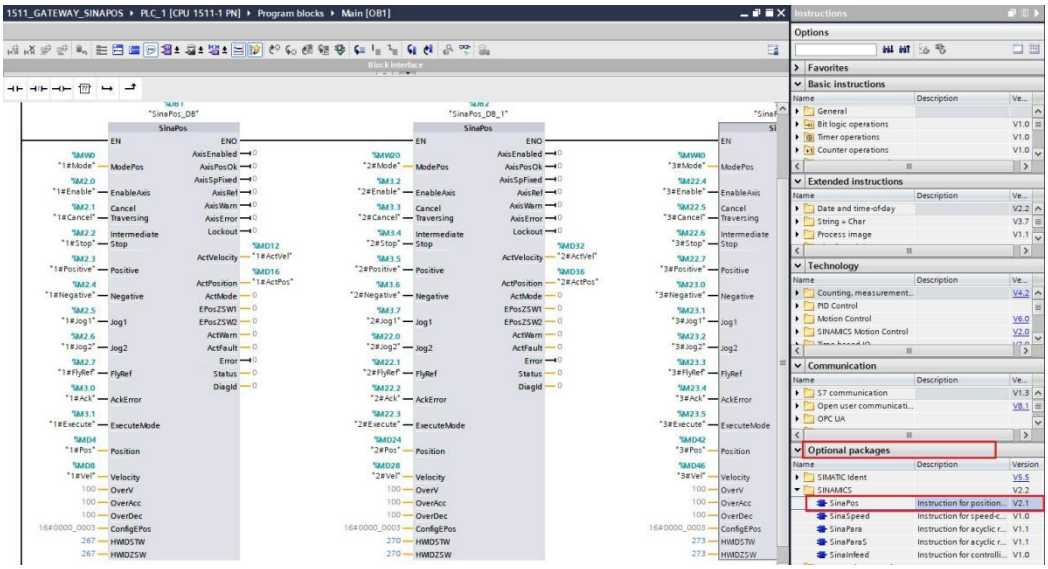
Depending on the actual conditions of the encoder and mechanics for each drive, set the electronic gear ratio parameters for each module (drive):

Parameter	Description
Encoder Resolution:	This parameter corresponds to the single-turn resolution of the encoder for the EtherCAT bus drive (the change in encoder counts when the drive's electronic gear ratio is 1:1, and the motor shaft completes one revolution).
Load Travel Distance per Motor Revolution (LU/Rev)	This parameter corresponds to the movement of the load axis in terms of Length Units (LU) when the motor shaft of the EtherCAT bus drive completes one revolution (which corresponds to V90 PN parameter p29247).
Homing Mode	This parameter corresponds to the active homing mode of the drive. It needs to be set based on the reference manual of the EtherCAT bus drive, choosing the appropriate mode (CiA402 standard defines 36 sub-modes for homing, and implementations may vary among different manufacturers).
Encoder Type	This parameter corresponds to the encoder type of the drive. If set to an absolute encoder (default setting, encoder position is not lost when the drive loses power), absolute positioning can be performed after system startup. If set to an incremental encoder, the corresponding drive needs to complete homing before absolute positioning can be performed (the homing flag is stored in GT200-PN-EC and is not saved; the flag disappears when GT200-PN-EC loses power).
Reference Speed	This parameter is the reference speed corresponding to the motor.
Max ACC/DEC	This parameter corresponds to the maximum acceleration and deceleration. A larger set value results in faster acceleration and deceleration.
Homing Position Window	This parameter corresponds to the positioning arrival range. When the difference between the current position and the target position is less than this set value, the positioning arrival flag is set.
Homing Speed (Zero Position)	This parameter corresponds to the search speed for the homing operation.

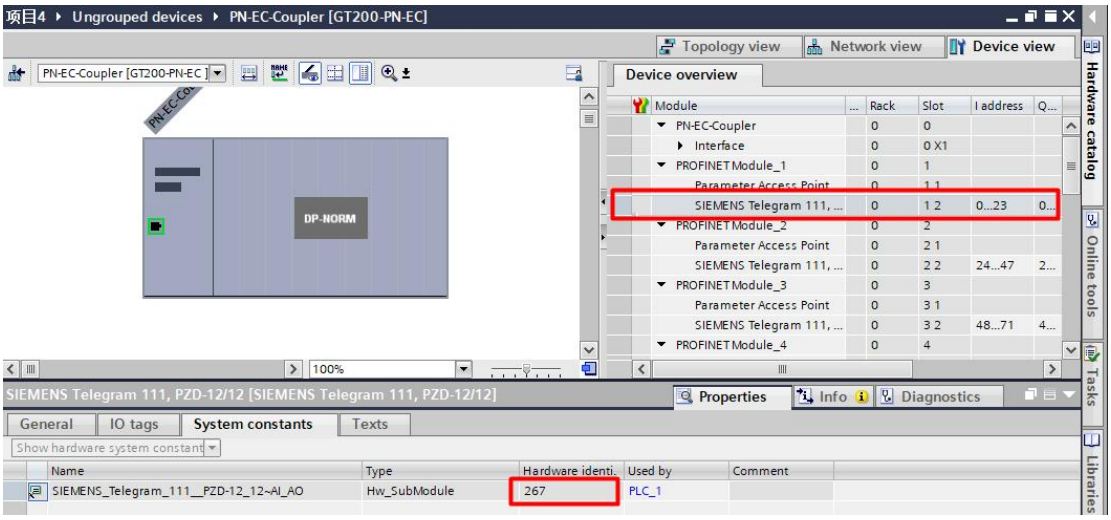
Note: After modifying parameters and downloading to the PLC, it is necessary to restart both the PLC and GT200-PN-EC for the configuration to take effect.



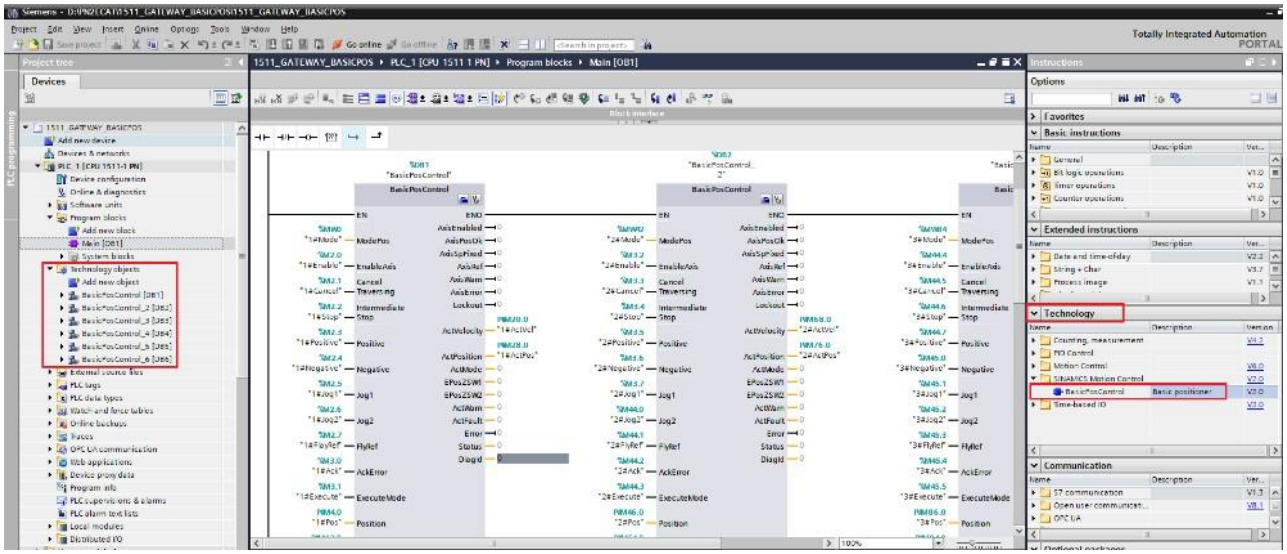
6. Drag the SINA_POS(FB284) function block into the programming network in OB1



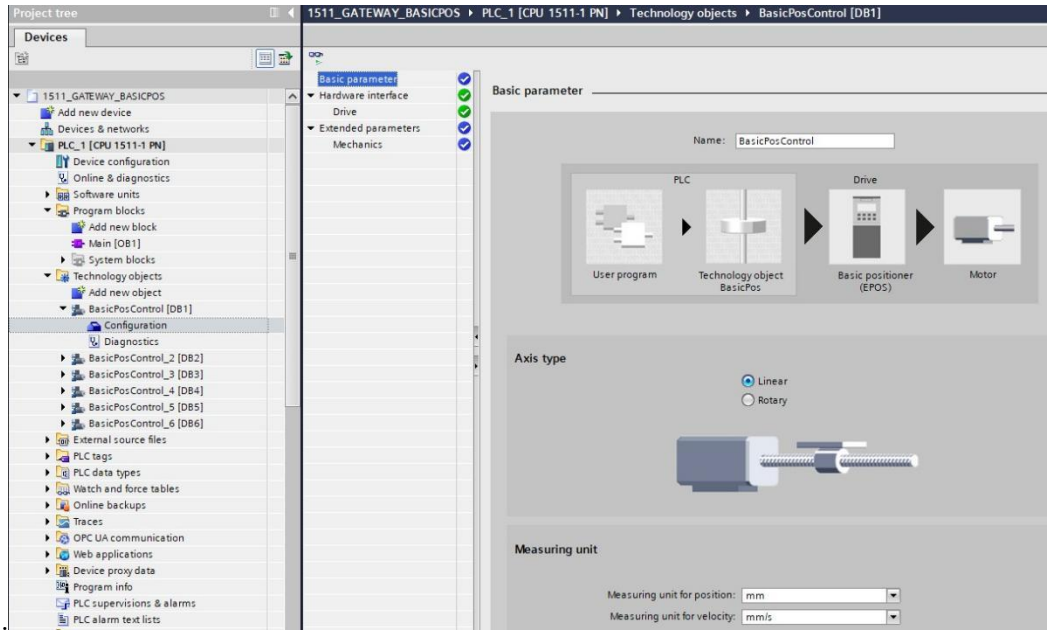
Note: Refer to the following diagram for the assignment of the pin values for HWIDSTW and HWIDZSW in the function block.



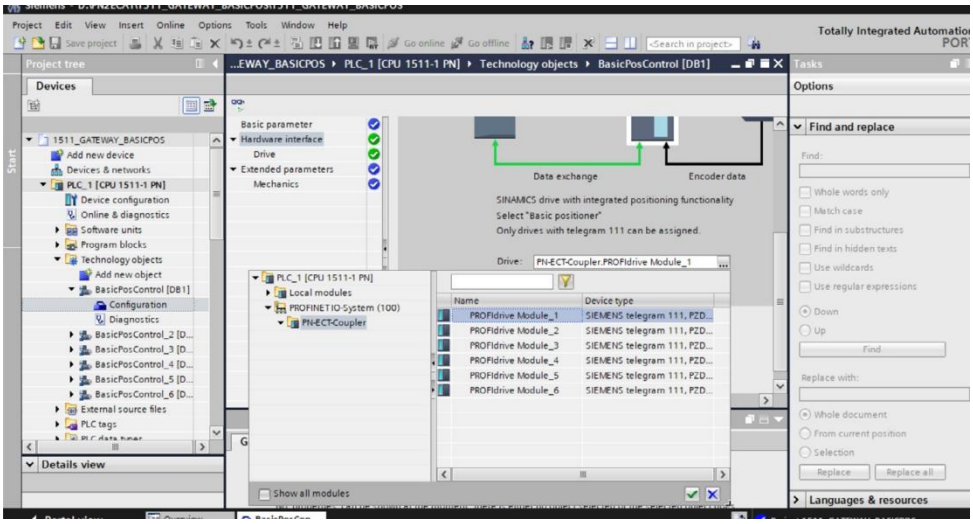
7. In TIA Portal V17 version, the "Basic Positioning Axis" function block has been added, allowing users to conveniently configure mechanical parameters using process objects. With the introduction of six basic positioning axis function blocks, six corresponding process objects for basic positioning axes will be added to the left-side process object bar.



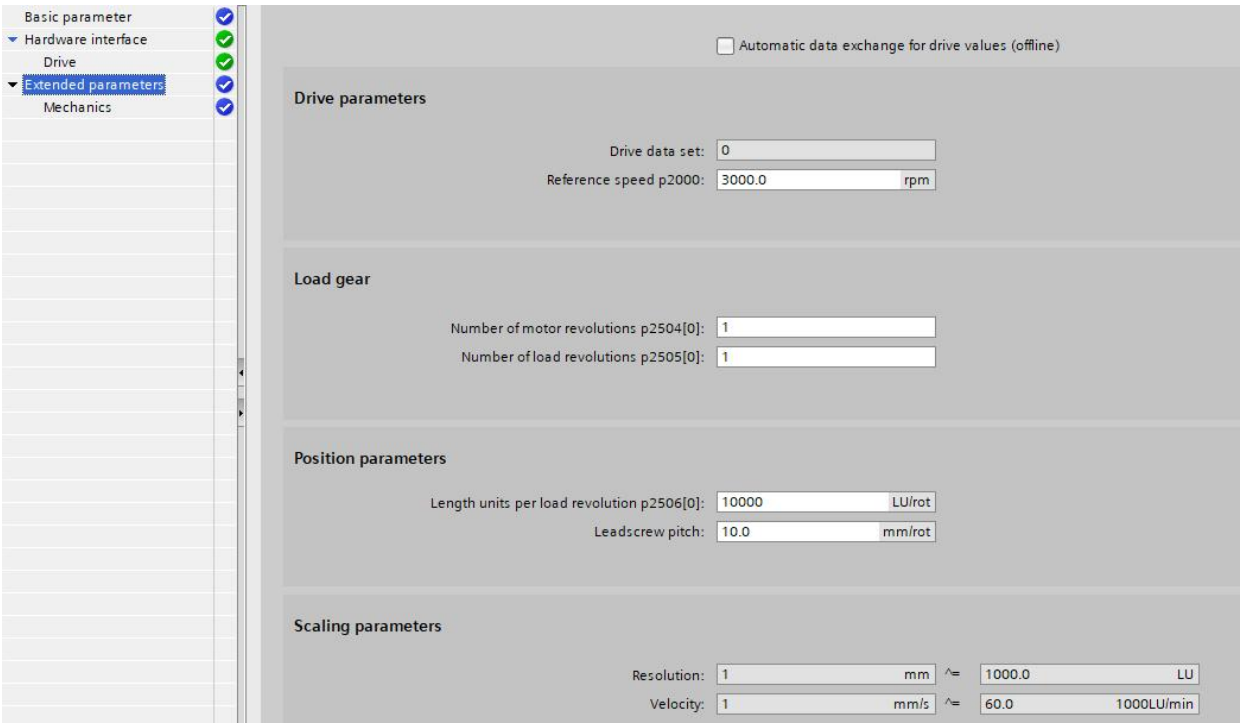
Set the respective process object axis forms.



Associate the process object axis with the modules during configuration.



Configure the mechanical parameters of the process object axis based on the actual mechanical connections.



7 SINA_POS Function Block

7.1 Overview

Supporting drives that comply with the PROFIdrive standard, such as the basic positioner (EPOS) of V90 PN, can be used for absolute and relative positioning of linear or rotary axes. The SINA_POS function block in TIA Portal can be used for basic positioner control of the drive. Using GT200-PN-EC is equivalent to adding basic positioner (EPOS) functionality to each EtherCAT bus drive. The main operating modes include Jog, Homing, MDI, and program segment. For detailed descriptions of the basic positioning functionality, refer to the V90 PN operating manual.

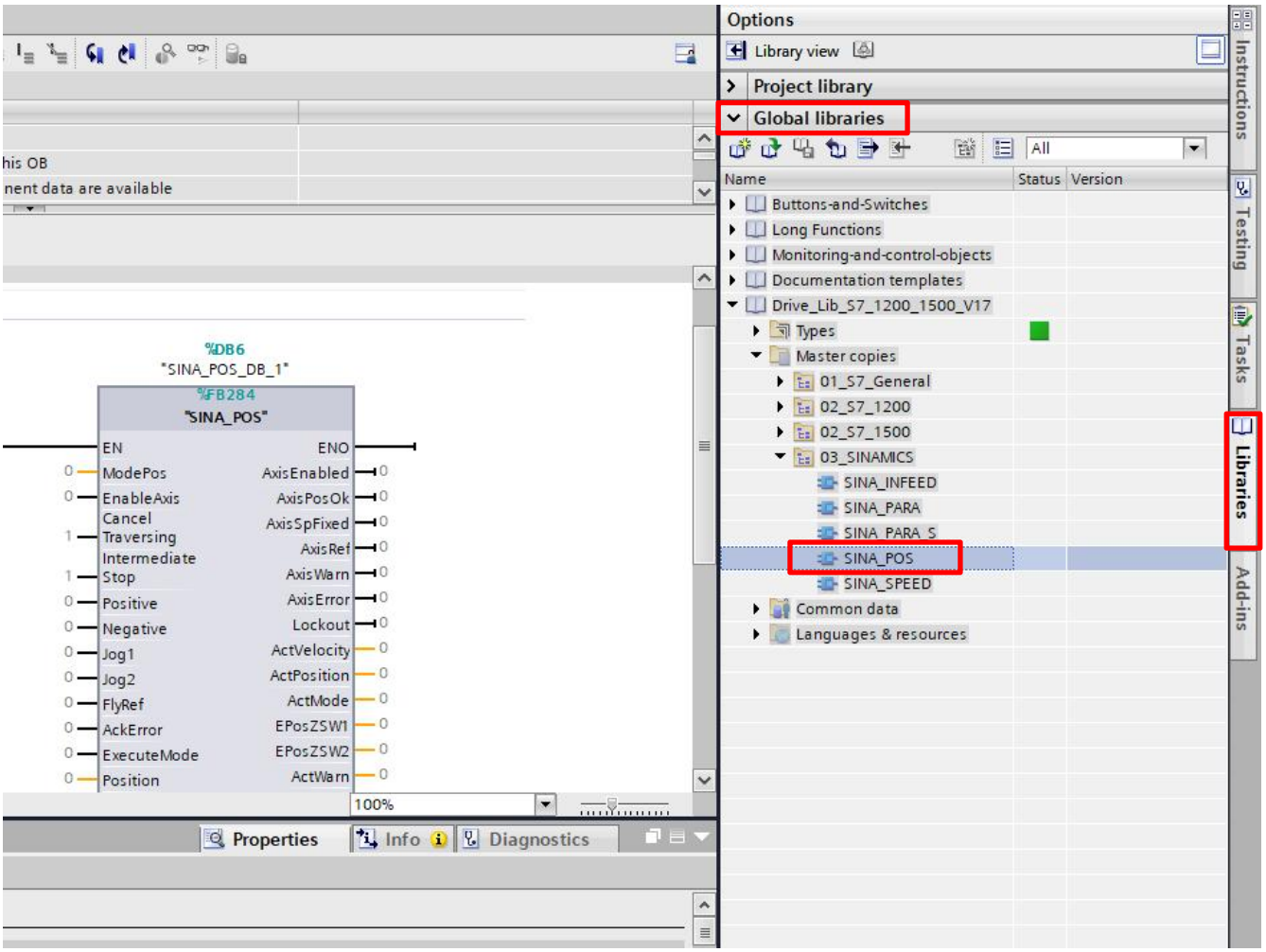
7.2 SINA_POS(FB284/FB300) Introduction

A S7-1200/1500 PLC can control multiple EtherCAT bus drives through PROFINET communication by connecting with GT200-PN-EC. The PLC can perform basic positioner control of EtherCAT bus drives using the FB284 function block (SINAPOS FB300 for TIA Portal V17) from Siemens‘ SINAMICS drive library. The method to obtain the FB284 function block is as follows:

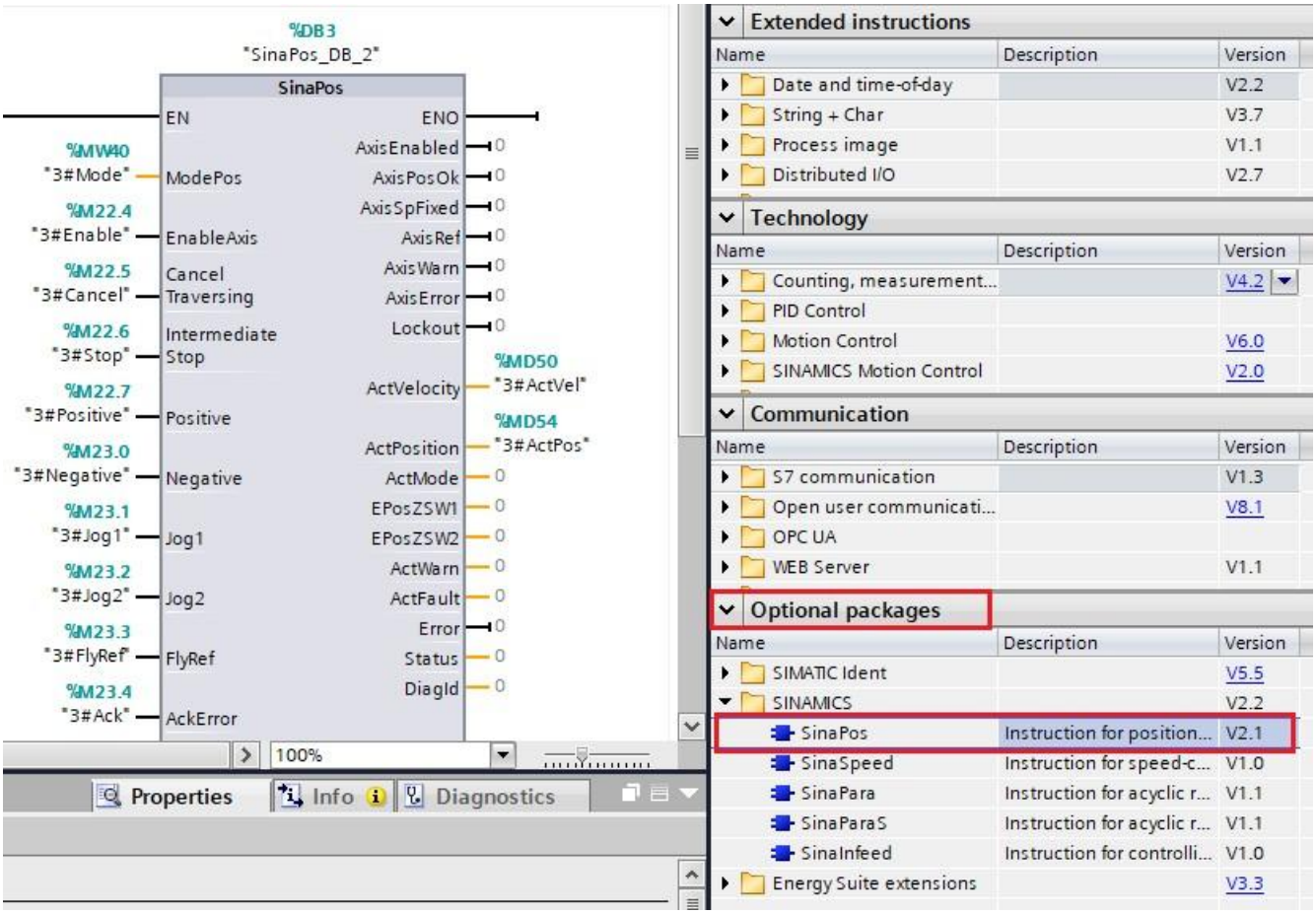
1. Install the "Drivelib" library in TIA Portal. The drive library files will be automatically installed in the Global Libraries tab in TIA Portal software. The download links for various versions of Startdrive are as follows:

   https://support.industry.siemens.com/cs/document/109475044/sinamics-communication-blocks-drivelib-for-reading-and-writing-drive-data-within-tia-portal-context

DriveLib:


Options
Library view
Project library
Global libraries
All
Name
Status
Version
Buttons-and-Switches
Long Functions
Monitoring-and-control-objects
Documentation templates
Drive_Lib_S7_1200_1500_V17
Types
Master copies
01_S7_General
02_S7_1200
02_S7_1500
03_SINAMICS
SINA_INFEED
SINA_PARA
SINA_PARA_S
SINA_POS
SINA_SPEED
Common data
Languages & resources
Instructions
Testing
Tasks
Libraries
Add-ins
%DB6
"SINA_POS_DB_1"
%FB284
"SINA_POS"
EN
ENO
ModePos
AxisEnabled
EnableAxis
AxisPosOk
Cancel Traversing
AxisSpFixed
AxisRef
Intermediate Stop
AxisWarn
Positive
AxisError
Negative
Lockout
Jog1
ActVelocity
Jog2
ActPosition
FlyRef
ActMode
AckError
EPosZSW1
ExecuteMode
EPosZSW2
Position
ActWarn
100%
Properties
Info
Diagnostics

TIAPortal V17 Built-in Library:



The function block can be called in either of the following organization blocks (OB):

- Cycle organization block: OB1
- Cyclic interrupt organization block: such as OB32

See the table below for an introduction to the FB284/FB300 function block:

Input Signal	Data Type	Default Value	Description
ModePos	INT	0	Operation mode: 1 = Relative Positioning Mode 2 = Absolute Positioning Mode 3 = Constant Velocity Mode 4 = Active Homing Mode 5 = Calibrate Home Position Mode 6 = Run a program segment 0 - 15(not supported) 7 = Velocity Jog Mode 8 = Position Jog Mode
EnableAxis	BOOL	0	Servo drive command: 0 = Stop (OFF1) 1 = Launch
CancelTraversing	BOOL	1	0 = Cancel the current running task 1 = Do not cancel the current running task
IntermediateStop	BOOL	1	0 = Halt the current running task 1 = Do not halt the current running task
Positive	BOOL	0	Positive direction
Negative	BOOL	0	Negative direction
Jog1	BOOL	0	Jog signal 1
Jog2	BOOL	0	Jog signal 2
FlyRef	BOOL	0	The input is not valid for GT200-PN-EC
AckError	BOOL	0	Reset from error
ExecuteMode	BOOL	0	Activate requested mode
Position	DINT	0[LU]	Position setting value when ModePos=1 or 2 Program segment no. when ModePos=6 (not supported)
Velocity	DINT	0 [1000LU/min]	Velocity setting value at ModePos=1,2,3 Velocity setting value of reference point at ModePos=4 Jog velocity setting value at ModePos=7 Jog incremental velocity setting value at ModePos=8

<table>
<tr><td>OverV</td><td>INT</td><td>100[%]</td><td>Velocity percentage 0 - 199%</td></tr>
<tr><td>OverAcc</td><td>INT</td><td>100[%]</td><td>Acceleration percentage of ModePos=1, 2, 3 set at 0 to 100%</td></tr>
<tr><td>OverDec</td><td>INT</td><td>100[%]</td><td>Deceleration percentage of ModePos=1, 2, 3 set at 0 to 100%</td></tr>
<tr><td>ConfigEPOS</td><td>DWORD</td><td>0</td><td>The corresponding relationship of bits for basic positioning can be controlled by this parameter, as shown in the table below.
<table>
<tr><th>ConfigEPos Bit</th><th>Description</th></tr>
<tr><td>ConfigEPos.%x0</td><td>OFF2 stop</td></tr>
<tr><td>ConfigEPos.%X1</td><td>OFF3 stop</td></tr>
<tr><td>ConfigEPos.%X2</td><td>Enable software limit</td></tr>
<tr><td>ConfigEPos.%X3</td><td>Enable hardware limit</td></tr>
<tr><td>ConfigEPos.%X6</td><td>Homing switch signal</td></tr>
<tr><td>ConfigEPos.%X7</td><td>External program block switch</td></tr>
<tr><td>ConfigEPos.%X8</td><td>The set value can be changed continuously and takes effect immediately at ModePos=2 and 3</td></tr>
</table>
Note: If this parameter is assigned a variable in the program, the initial value must be 3 (i.e.,ConfigEPos.%X0 and ConfigEPos.%X1must be equal to 1. If not activated, OFF2 and OFF3 stops will always be effective).</td></tr>
<tr><td>HWIDSTW</td><td>HW_IO</td><td>0</td><td>Hardware ID of message 111 in the GT200-PN-EC device view</td></tr>
<tr><td>HWIDZTW</td><td>HW_IO</td><td>0</td><td>Hardware ID of message 111 in the GT200-PN-EC device view</td></tr>
</table>

Output Signal	Data Type	Default Value	Description
AxisEnabled	BOOL	0	The driver is enabled
AxisPosOk	BOOL	0	Target positon arrived
AxisSpFixed	BOOL	0	Setting position arrived
AxisRef	BOOL	0	Reference point is set
AxisWarn	BOOL	0	Warning of driver
AxisError	BOOL	0	Error of driver
Lockout	BOOL	0	The driver is in the disabled state. Check if the bits 0 and 1 of the ConfigEPos pin control register are set to 1
ActVelocity	DINT	0	Actual velocity
ActPosition	DINT	0[LU]	Actual Location LU
ActMode	INT	0	Actual actived operating mode
EPosZSW1	WORD	0	EPOS ZSW1 status
EPosZSW2	WORD	0	EPOS ZSW2 status
ActWarn	WORD	0	Current warn code of driver
ActFault	WORD	0	Current error code of driver
Error	BOOL	0	1=Error
Status	WORD	0	16#7002: No error 16#8401: drive error 16#8402: The driver is disabled from starting 16#8403: Homing is disabled during operation 16#8600: DPRD_DAT error 16#8601: DPWR_DAT error 16#8202: incorrect selection of operating mode 16#8203: incorrect parameter value 16#8204: incorrect selection of program segment no.
DiagID	WORD	0	Communication error occurred during SFB call

7.3 Operation Modes of The Function Block

7.3.1 Operating Conditions

1. The axis is enabled by inputting **EnableAxis**=1. If the axis is ready and driven without faults (**AxisError**=0), the output signal **AxisEnabled** changes to 1.
2. The **ModePos** input is used to select the operating mode. It can be switched between different operating modes. For example, switching from continuous operation mode (**ModePos**=3) to absolute positioning mode (**ModePos**=2) during operation.
3. The input signals **CancelTraversing** and **IntermediateStop** are valid for all operating modes except for jog. They must be set to 1 during operation, and the settings are as follows:

   Set **CancelTraversing**=0: The axis stops with the maximum deceleration, abandoning the current running task. After the axis stops, you can switch between operating modes.

   Set **IntermediateStop**=0: Then use the currently set deceleration value for ramp stopping. The current running task is maintained. If **IntermediateStop** is set to 1 again, the axis will continue to run, which can be understood as a pause for the axis. You can switch between operating modes after the axis is stationary.

7.3.2 Relative Positioning Mode

The Relative Positioning Mode can be performed through the drive's relative positioning function. The PLC activates the internal position controller of the EtherCAT bus drive through the GT200-PN-EC to perform relative position control.

Requirements:

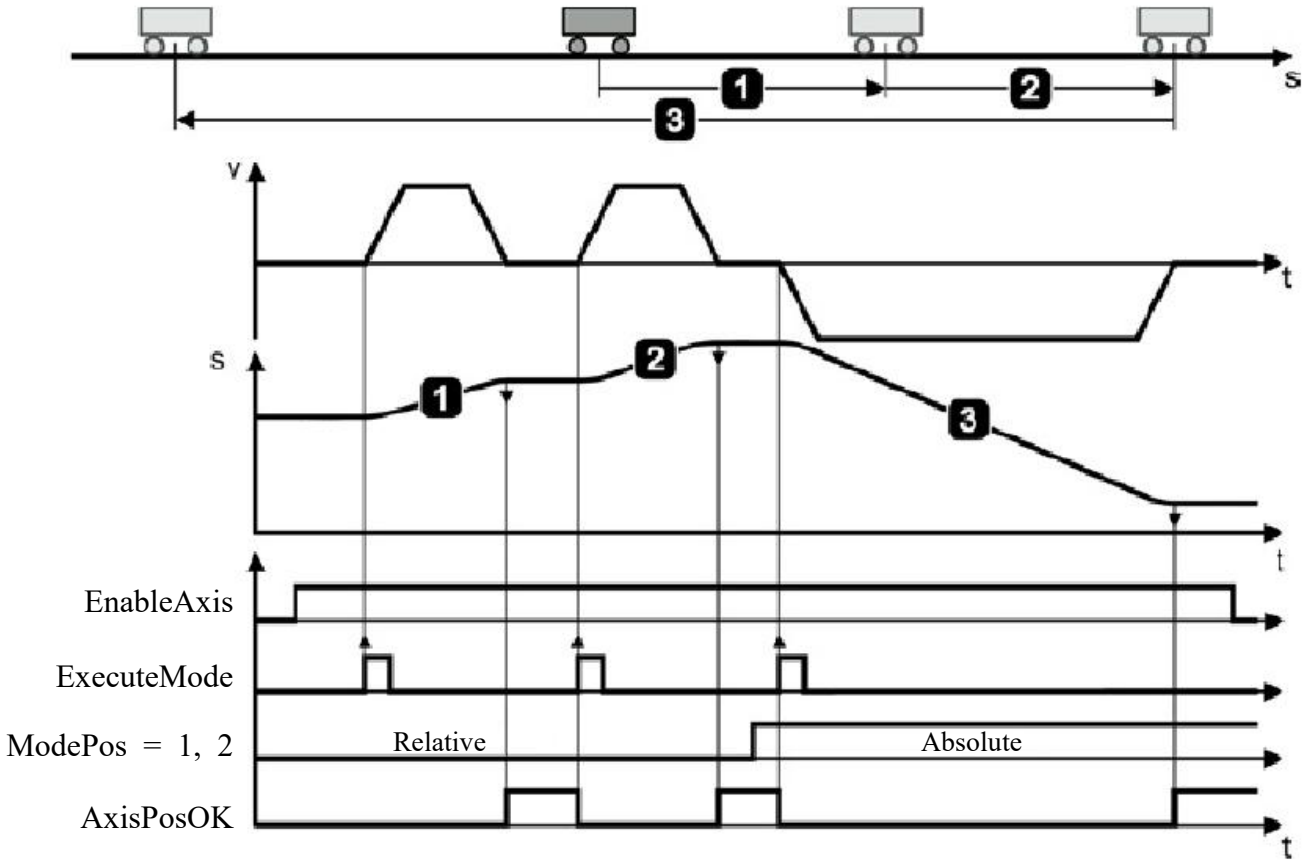
- Select operating mode **ModePos**=1
- Axis enable, **EnableAxis**=1
- The axis does not need to be homed, or the absolute value encoder can be in an uncalibrated state.
- If switching modes is greater than 3, the axis must be in a stationary state, and switching can occur at any time when **ModePos**=1, 2, or 3.

Steps:

1. Specify the target position and velocity through input parameters **Position** and **Velocity**.
2. Specify the percentage of speed, acceleration, and deceleration through input parameters **OverV**, **OverAcc**, and **OverDec**.
3. **CancelTraversing** and **IntermediateStop** must be set to 1, and **Jog1** and **Jog2** must be set to 0.
4. In relative positioning, the direction of motion is determined by the positive or negative value set in **Position**.
5. Initiate the positioning motion by the rising edge of **ExecuteMode**, activating the current state of the command or monitoring through **EPosZSW1** and **EPosZSW2**. When the target position is reached, **AxisPosOk** is set to 1. If an error occurs during the positioning process, the **Error** parameter is set to 1.

Note: The current running command can be replaced with a new command by the rising edge of ExecuteMode, but this is only applicable for running modes ModePos 1, 2, 3.

The control timing is as shown in the following diagram:



7.3.3 Absolute Positioning Mode

The Absolute Positioning Mode can be performed through the drive's absolute positioning functionality. The PLC activates the internal position controller of the EtherCAT bus drive via the GT200-PN-EC to perform absolute position control.

Requirements:

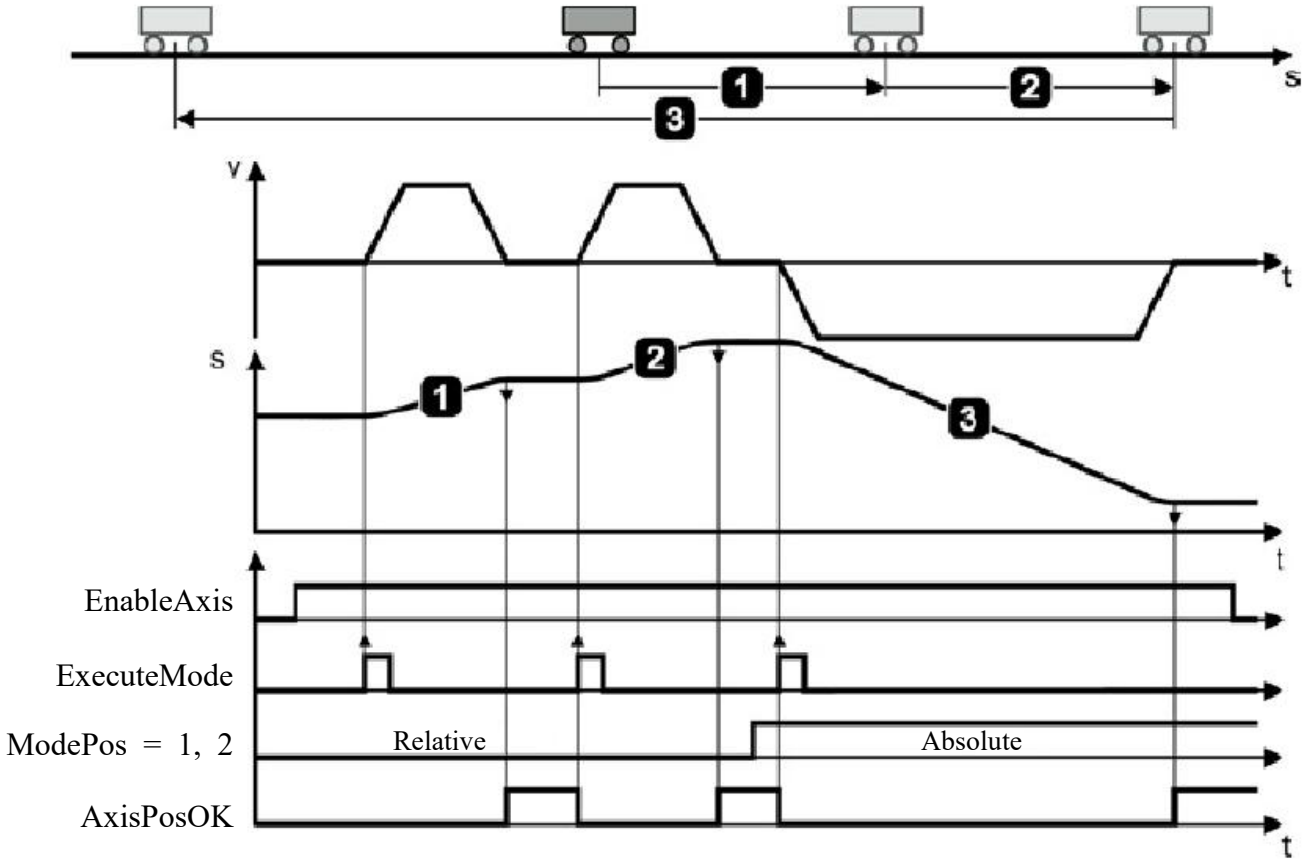
- Select operating mode **ModePos**=2
- Axis enable, **EnableAxis**=1
- The axis must be homed, or the encoder must be calibrated.
- If switching modes is greater than 3, the axis must be in a stationary state. Mode switching can occur at any time when **ModePos** is 1, 2, or 3.

Steps:

1. Specify the target position and velocity through input parameters **Position** and **Velocity**.
2. Specify the percentage of speed, acceleration, and deceleration through input parameters **OverV**, **OverAcc**, and **OverDec**.
3. **CancelTraversing** and **IntermediateStop** must be set to 1, and **Jog1** and **Jog2** must be set to 0.
4. In absolute positioning, the axis moves in the shortest path to the target position. In this case, input parameters **Positive** and **Negative** must be set to 0. If it is a modal axis, the direction can be specified through **Positive** or **Negative**.
5. Initiate the positioning motion by the rising edge of **ExecuteMode**, activating the current state of the command or monitoring through **EPosZSW1** and **EPosZSW2**. When the target position is reached, **AxisPosOk** is set to 1. If an error occurs during the positioning process, the **Error** parameter is set to 1.

Note: The current running command can be replaced with a new command by the rising edge of ExecuteMode, but this is only applicable for running modes ModePos 1, 2, 3.

The control timing is as shown in the following diagram:



7.3.4 Constant Velocity Mode

The Constant Velocity Mode allows the axis to run at a constant speed in the forward or reverse direction.

Requirements:

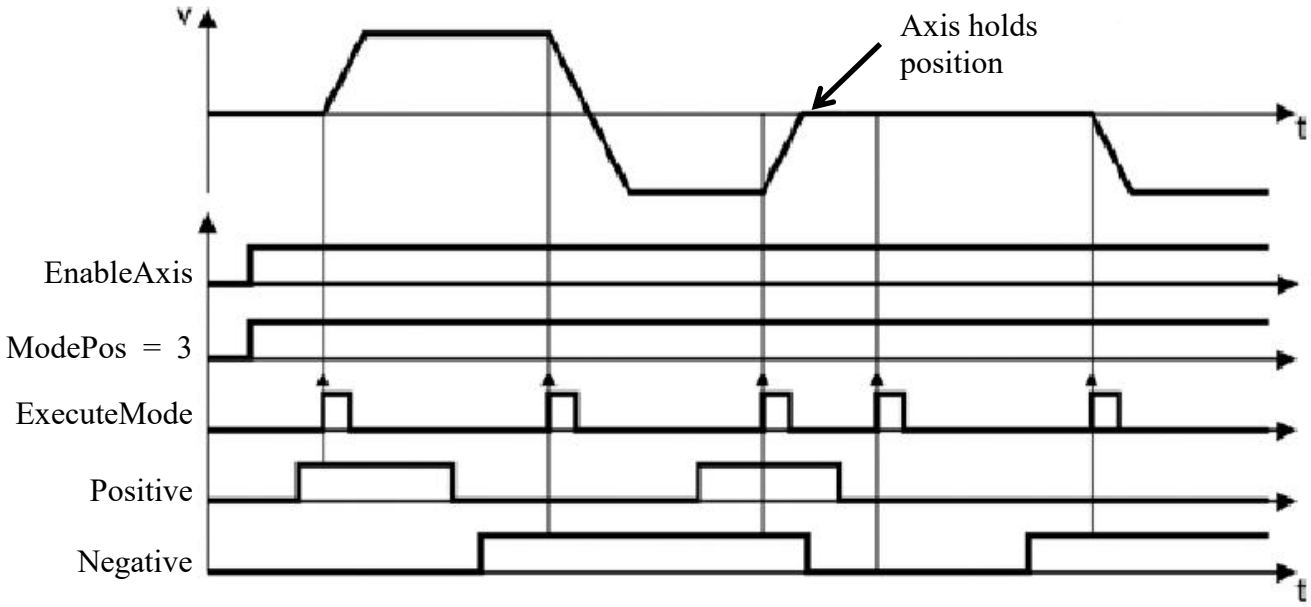
- Select operating mode **ModePos**=3
- Axis enable, **EnableAxis**=1
- The axis does not need to be homed, or the absolute value encoder can be in an uncalibrated state.
- If switching modes is greater than 3, the axis must be in a stationary state, and switching can occur at any time when **ModePos**=1, 2, or 3.

Steps:

1. Specify the target velocity through the **Velocity** input parameter.
2. Specify the percentage of speed, acceleration, and deceleration through input parameters **OverV**, **OverAcc**, and **OverDec**.
3. **CancelTraversing** and **IntermediateStop** must be set to 1, and **Jog1** and **Jog2** must be set to 0.
4. The running direction is determined by **Positive** and **Negative**.
5. The **ExecuteMode** rising edge triggers continuous motion, activating the current state of the command or monitoring through **EPosZSW1** and **EPosZSW2**. **AxisPosOk** is set to 1 when the axis stops after abandoning the task, and **Error** is set to 1 if an error occurs during the run.

Note: The current running command can be replaced with a new command by the rising edge of ExecuteMode, but this is only applicable for running modes ModePos 1, 2, 3.

The control timing is as shown in the following diagram:



7.3.5 Active Homing Mode

This function allows the axis to perform homing operation based on the preset homing method configured, activating the drive's active homing.

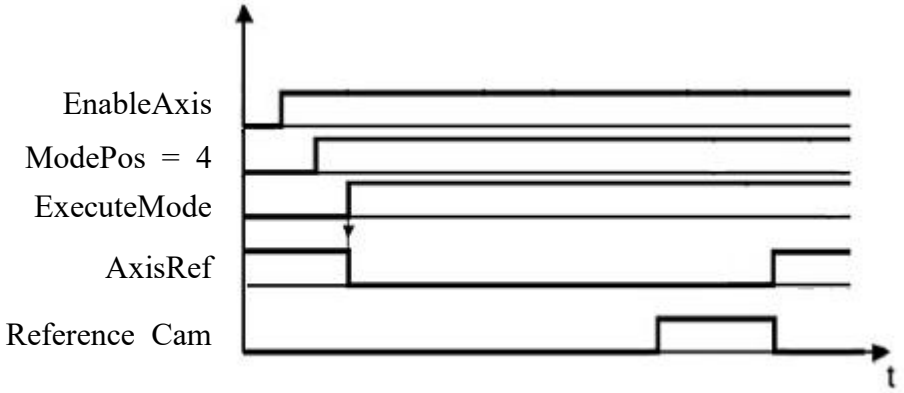
Requirements:

- Select operating mode **ModePos**=3
- Axis enable, **EnableAxis**=1
- The homing switch is connected to the designated digital input point on the drive.36

Steps:

1. Specify the target velocity through the **Velocity** input parameter.
2. Specify the percentage of speed, acceleration, and deceleration through input parameters **OverV**, **OverAcc**, and **OverDec**.
3. **CancelTraversing** and **IntermediateStop** must be set to 1, and **Jog1** and **Jog2** must be set to 0.
4. The homing method and direction are determined by the homing mode parameter set during configuration. Activating the **ExecuteMode**'s rising edge triggers the homing movement. Remain in a high state during the homing process. The current status of the command is activated, or monitoring through **EPosZSW1** and **EPosZSW2**. After homing completion, **AxisRef** is set to 1. If an error occurs during the process, the **Error** parameter is set to 1.

The control timing is as shown in the following diagram:



7.3.6 Calibrate Home Position Mode

This operating mode allows the axis to set the zero position at any position.

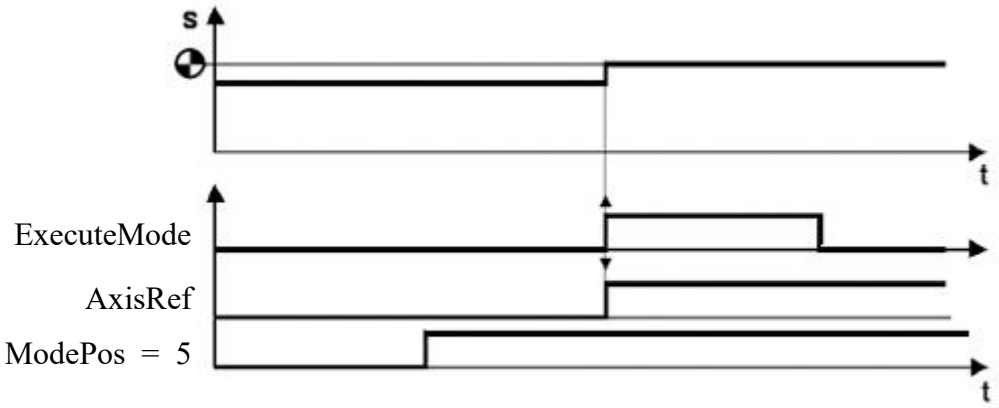
Requirements:

- Select operating mode **ModePos**=5
- The axis must be in the enabled state and in a stationary state during execution.

Steps:

1. Set the zero position of the axis by triggering the rising edge of **ExecuteMode** when the axis is stationary.

The control timing is as shown in the following diagram:



7.3.7 Velocity Jog Mode

The Velocity Jog Mode is implemented through the Jog operation function of the drive.

Requirements:

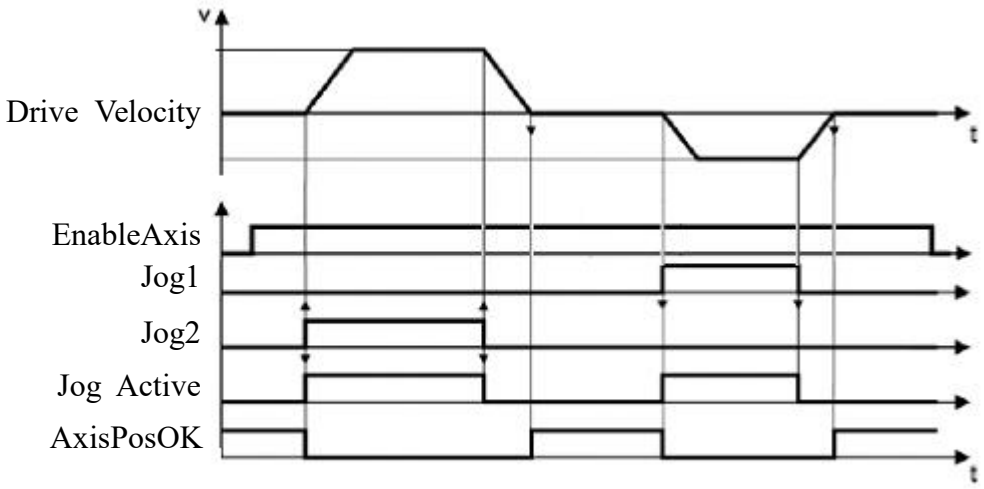
- Select operating mode **ModePos**=7
- Axis enable, **EnableAxis**=1
- The axis must be in a stationary state.
- The axis does not need to be homed, or the absolute value encoder can be in an uncalibrated state.

Steps:

1. Specify the jogging speed by the **Velocity** input parameter. The **OverV** parameter scales the jogging speed set value as a percentage.
2. The running conditions **CancelTraversing** and **IntermediateStop** are not relevant to jogging mode and are set to 1 by default.

Note: Jog1 and Jog2 are used to control the jogging operation of EPOS. The motion direction is determined by Jog1 and Jog2, where Jog1 is negative jogging, and Jog2 is positive jogging, independent of the Positive and Negative parameters. The current status of the activated command can be monitored through EPosZSW1 and EPosZSW2. When jogging is finished (Jog1 or Jog2 = 0), and the axis is stationary, AxisPosOK is set to 1. If an error occurs during the operation, the Error parameter is set to 1..

The control timing is as shown in the following diagram:



7.3.8 Position Jog Mode

The Position Jog Mode is implemented through the Jogging function of the drive.

Requirements:

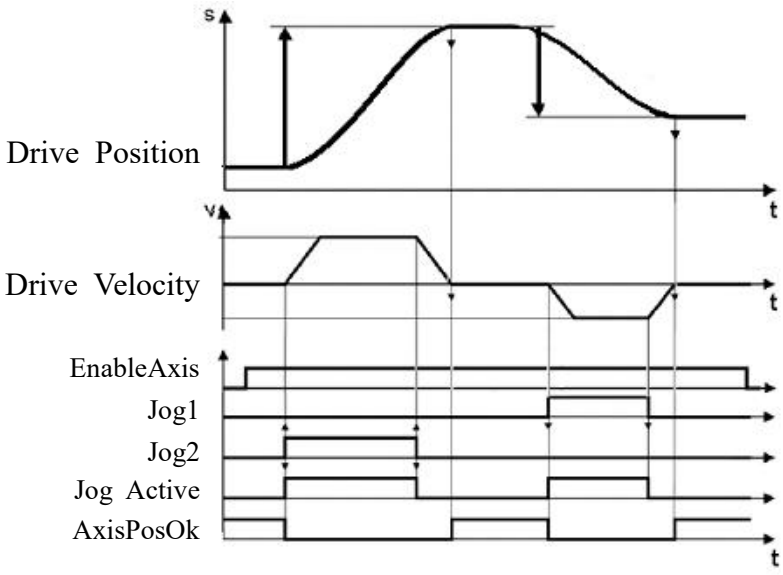
- Select operating mode **ModePos**=8
- Axis enable, **EnableAxis**=1
- The axis must be in a stationary state.
- The axis does not need to be homed, or the absolute value encoder can be in an uncalibrated state.

Steps:

1. Specify the jogging speed by the **Velocity** input parameter. The **OverV** parameter scales the jogging speed set value as a percentage.
2. The running conditions of **CancelTraversing** and **IntermediateStop** are not relevant to jogging mode and are set to 1 by default.

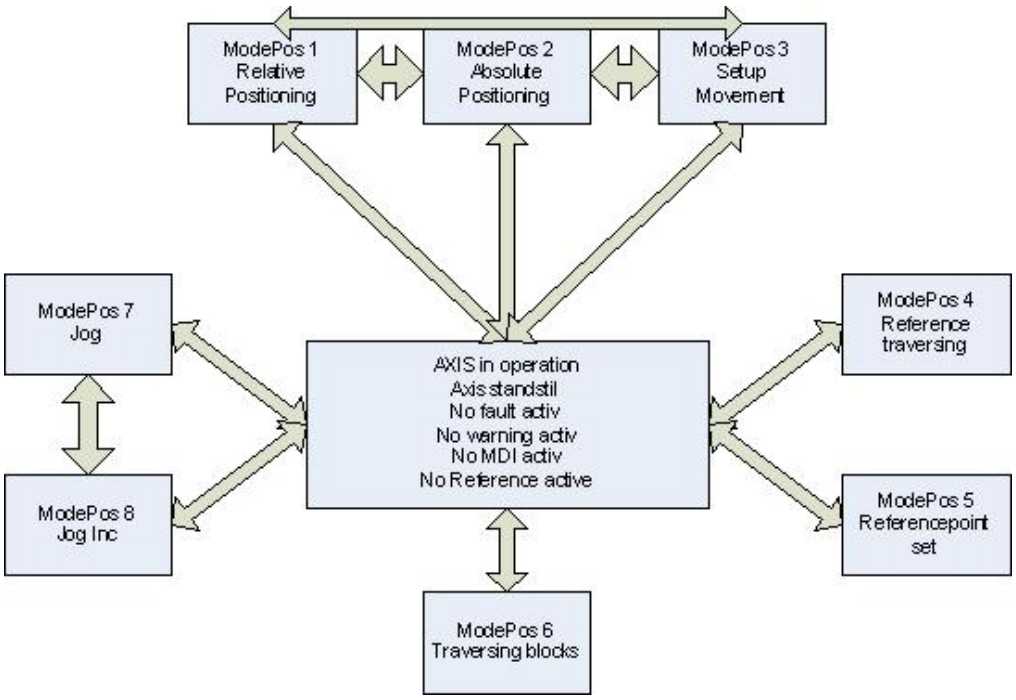
Note: Jog1 and Jog2 are used to control the axis to jog a specified distance. The direction of motion is determined by Jog1 and Jog2, and the jogging distance increment is fixed to Jog1 traversing distance / Jog2 traversing distance = 1000LU, which is independent of the Positive and Negative parameters. The current status of the activation command can be monitored through EPosZSW1 and EPosZSW2. When jogging is complete (Jog1 or Jog2 = 0), and the axis is stationary, AxisPosOK is set to 1. If an error occurs during the operation, the Error parameter is set to 1.

The control timing is shown in the following diagram:



7.4 Operating Mode Switching Instructions Based on ModePos

The following diagram illustrates potential operational mode transitions based on the ModePos value:



8 Expanding EtherCAT Bus IO

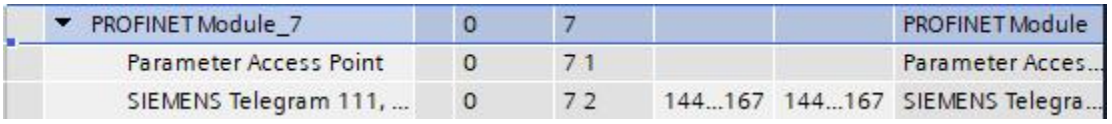
Currently, GT200-PN-EC supports up to 16 drives, but many installations may only require a few drives, along with some EtherCAT bus IO devices such as flow meters, sensors, integrated IO, etc. To facilitate the integration of these devices into the PROFINET bus system, GT200-PN-EC has added the capability to carry EtherCAT IO devices.

This feature is temporarily not supported

8.1 S7-1500 Project Configuration

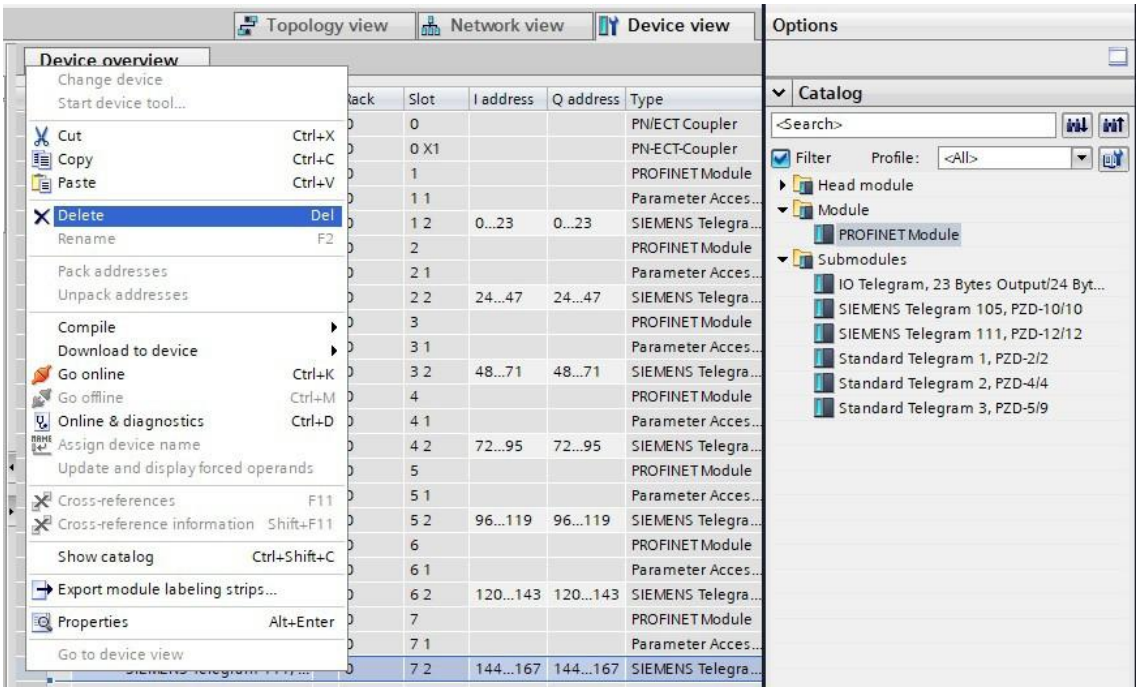
Please refer to Chapter 6.1 for the first five steps.

6. If the seventh device in the EtherCAT system is an IO-type device, insert a PROFINET Module in slot seven, and at this point, Subslot 2 will use the default Siemens 111 telegrams.

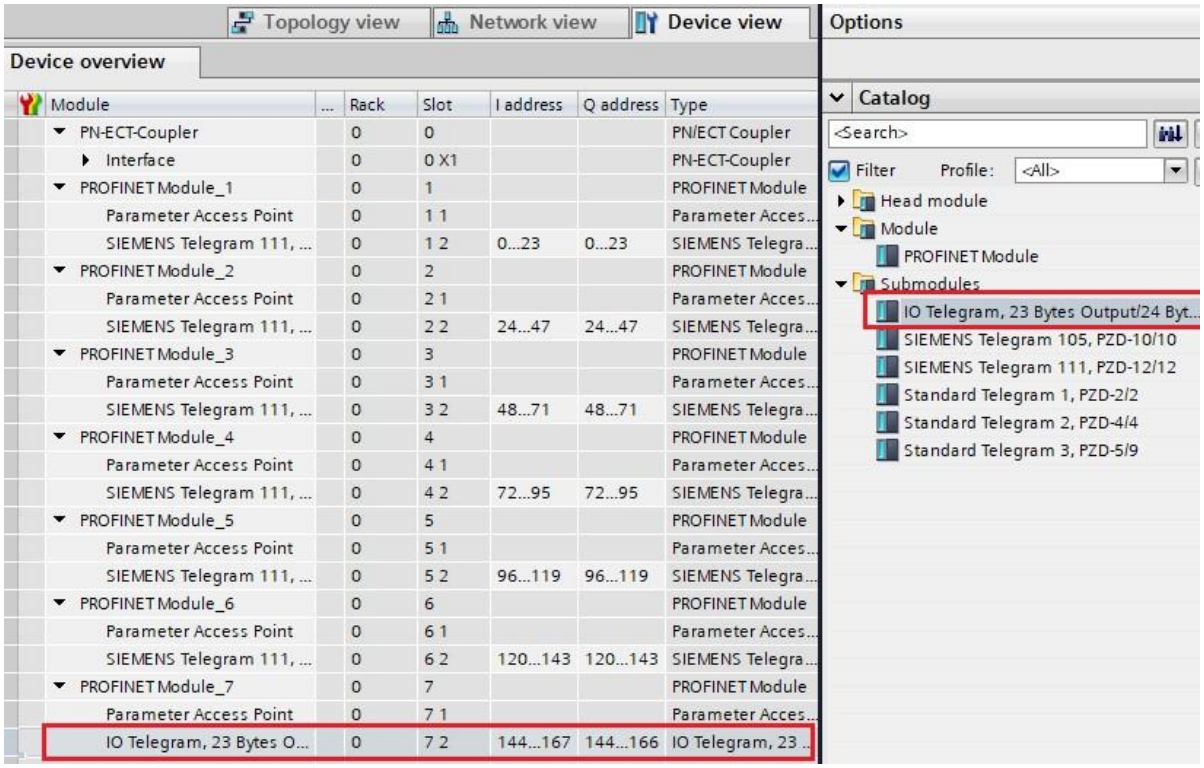


PROFINET Module_7	0	7			PROFINET Module
Parameter Access Point	0	7 1			Parameter Acces...
SIEMENS Telegram 111, ...	0	7 2	144...167	144...167	SIEMENS Telegra...

7. Right-click on the position of Subslot 2 and delete the Siemens 111 telegram.



Next, insert the "IO Telegram" module from the right-hand side submodule into Subslot 2.



8.2 Function Description

If a non-IO Telegram submodule is inserted into slot 2, GT200-PN-EC will consider the corresponding EtherCAT device as a drive (inverter, servo, etc.), and the gateway will perform internal conversion between PROFIdrive and DS402.

If an IO Telegram submodule is inserted into slot 2, GT200-PN-EC will treat the corresponding EtherCAT device as an IO device (flow meter, sensor, integrated IO, encoder, etc.), and the gateway will not process the data internally but will pass it through. The PLC can send a maximum of 23 bytes of data to EtherCAT IO devices and receive a maximum of 24 bytes of data from them.

For EtherCAT IO devices, GT200-PN-EC does not modify the device's PDO mapping during initialization but Uses the device's default PDO mapping.

If the device type is modified during configuration, after downloading the configuration project to the PLC, it is essential to power down the entire system to make the configuration effective.