

Position Control with SIMATIC S7-1500 and SINAMICS V90 via IRT PROFINET

SINAMICS V90 PROFINET

<https://support.industry.siemens.com/cs/ww/en/view/109739053>

Siemens
Industry
Online
Support



Legal information

Use of application examples

Application examples illustrate the solution of automation tasks through an interaction of several components in the form of text, graphics and/or software modules. The application examples are a free service by Siemens AG and/or a subsidiary of Siemens AG ("Siemens"). They are non-binding and make no claim to completeness or functionality regarding configuration and equipment. The application examples merely offer help with typical tasks; they do not constitute customer-specific solutions. You yourself are responsible for the proper and safe operation of the products in accordance with applicable regulations and must also check the function of the respective application example and customize it for your system.

Siemens grants you the non-exclusive, non-sublicensable and non-transferable right to have the application examples used by technically trained personnel. Any change to the application examples is your responsibility. Sharing the application examples with third parties or copying the application examples or excerpts thereof is permitted only in combination with your own products. The application examples are not required to undergo the customary tests and quality inspections of a chargeable product; they may have functional and performance defects as well as errors. It is your responsibility to use them in such a manner that any malfunctions that may occur do not result in property damage or injury to persons.

Disclaimer of liability

Siemens shall not assume any liability, for any legal reason whatsoever, including, without limitation, liability for the usability, availability, completeness and freedom from defects of the application examples as well as for related information, configuration and performance data and any damage caused thereby. This shall not apply in cases of mandatory liability, for example under the German Product Liability Act, or in cases of intent, gross negligence, or culpable loss of life, bodily injury or damage to health, non-compliance with a guarantee, fraudulent non-disclosure of a defect, or culpable breach of material contractual obligations. Claims for damages arising from a breach of material contractual obligations shall however be limited to the foreseeable damage typical of the type of agreement, unless liability arises from intent or gross negligence or is based on loss of life, bodily injury or damage to health. The foregoing provisions do not imply any change in the burden of proof to your detriment. You shall indemnify Siemens against existing or future claims of third parties in this connection except where Siemens is mandatorily liable.

By using the application examples you acknowledge that Siemens cannot be held liable for any damage beyond the liability provisions described.

Other information

Siemens reserves the right to make changes to the application examples at any time without notice. In case of discrepancies between the suggestions in the application examples and other Siemens publications such as catalogs, the content of the other documentation shall have precedence.

The Siemens terms of use (<https://support.industry.siemens.com>) shall also apply.

Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the Internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that may be implemented, please visit <https://www.siemens.com/industrialsecurity>.

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed at: <https://www.siemens.com/industrialsecurity>.

Table of contents

	Legal information	2
1	Task.....	4
	1.1 Overview.....	4
2	Solution.....	5
	2.1 Solution overview	5
	2.2 Hardware and Software Components	6
	2.2.1 Validity	6
	2.2.2 Used Components.....	6
3	Basics	7
	3.1 Basics regarding SINAMICS V90 PN version	7
	3.2 Installation and startup	8
	3.2.1 Hardware installation.....	8
	3.2.2 Startup (JOG from drive side)	8
4	Configuration	9
	4.1 Basic parameter configuration regarding SINAMICS V90 PN	9
	4.1.1 Configure PROFINET settings via SINAMICS V-ASSISTANT	9
	4.1.2 Configure PROFINET settings via the TIA Portal	11
5	Operation of the application.....	20
6	Related literature	32
7	Contact.....	32
8	History.....	32

1 Task

1.1 Overview

Introduction

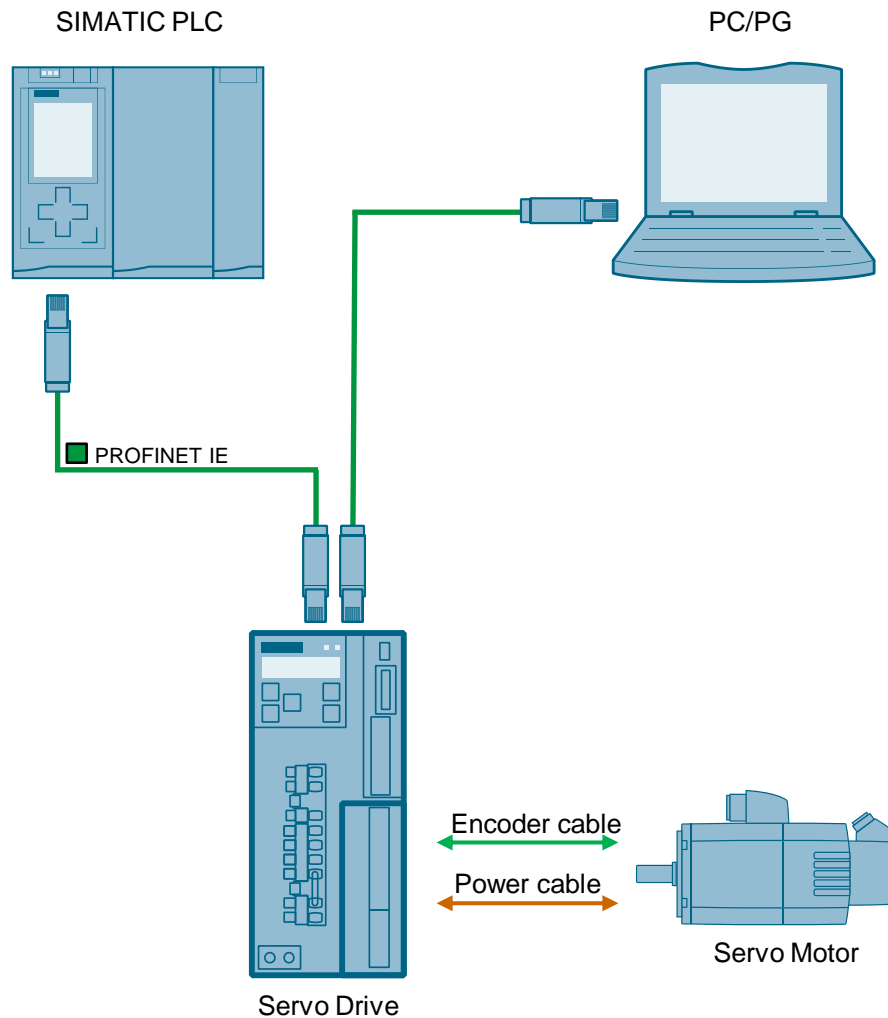
Position control is one of the three basic functions for SINAMICS V90 and PROFINET communication is a new and advanced feature. In this manual, the basic application of position control with PROFINET IRT communication for SINAMICS V90 will be described in detail.

The described solution in this document contains the variation which doesn't have any detailed technical issues to look at it.

Overview of the automation task

The figure below provides an overview of the automation task.

Figure 1-1



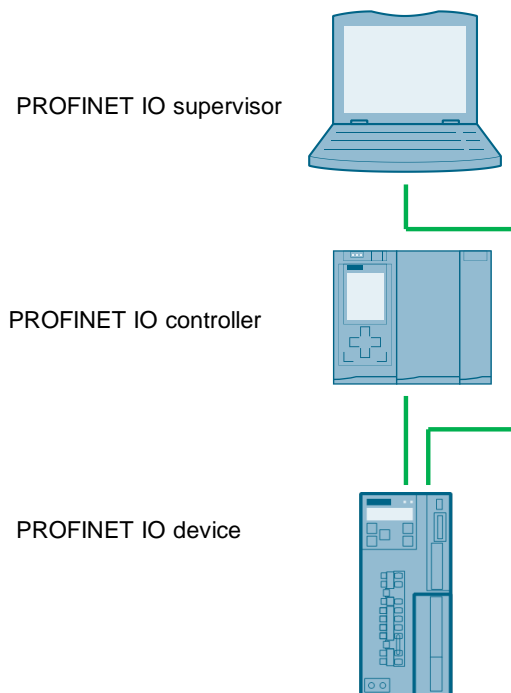
2 Solution

2.1 Solution overview

Schema Display

The following figure displays the most important components of the solution:

Figure 2-1



Delimitation

This application does not include a description of

- PROFINET communication
- SINAMICS V90 PN version
- BOP operation of SINAMICS V90

Basic knowledge of these topics is assumed.

Required knowledge

Basic knowledge on TIA Portal is assumed.

2.2 Hardware and Software Components

2.2.1 Validity

This application example is valid for

- TIA Portal V15
- S7-1500 CPU with PN interface
- SINAMICS V90 PN FW V10100
- SIMOTICS S-1FL6 Li motor

2.2.2 Used Components

The application was generated with the following components:

Hardware components

Table 2-1

Component	No.	Article number	Note
SIMATIC S7-1500 CPU 1515-2 PN	1	6ES7515-2AM00-0AB0	V1.7
SINAMICS V90 PN 200V	1	6SL3210-5FB10-1UF0	100W
SIMOTICS S-1FL6 Li motor	1	1FL6024-2AF21-1AA1	100W

Standard software components

Table 2-2

Component	No.	Article number	Note
TIA Portal	1		V15
SINAMICS V-ASSISTANT	1		V1.04.00.04

Sample files and projects

The following list includes all files and projects that are used in this example.

Table 2-3

Component	Note
109739053_PosControl_V90_S7-1500_Tel3_PROJ_V15.zip	Project file
109739053_PosControl_V90_S7-1500_DOC_en_V1.1.pdf	Reference document

3 Basics

3.1 Basics regarding SINAMICS V90 PN version

SINAMICS V90 PN supports the following telegrams:

- Standard telegram 1
- Standard telegram 2
- Standard telegram 3
- Standard telegram 5
- Siemens telegram 102
- Siemens telegram 105

The standard telegram 1 can be used only for RT mode.

The standard telegram 2, the standard telegram 3 and the Siemens telegram 102 can be used either for RT mode or IRT mode depending on the IO controller.

The standard telegram 5 and the Siemens telegram 105 can only support IRT mode.

If SIMATIC S7-1500 is used for positioning control, TO (Technology Object) of positioning axis must be used. The technology object of positioning axis supports the standard telegram 3, the standard telegram 5 and the Siemens telegram 105.

Thus, the standard telegram 3 will be used in this basic application.

3.2 Installation and startup

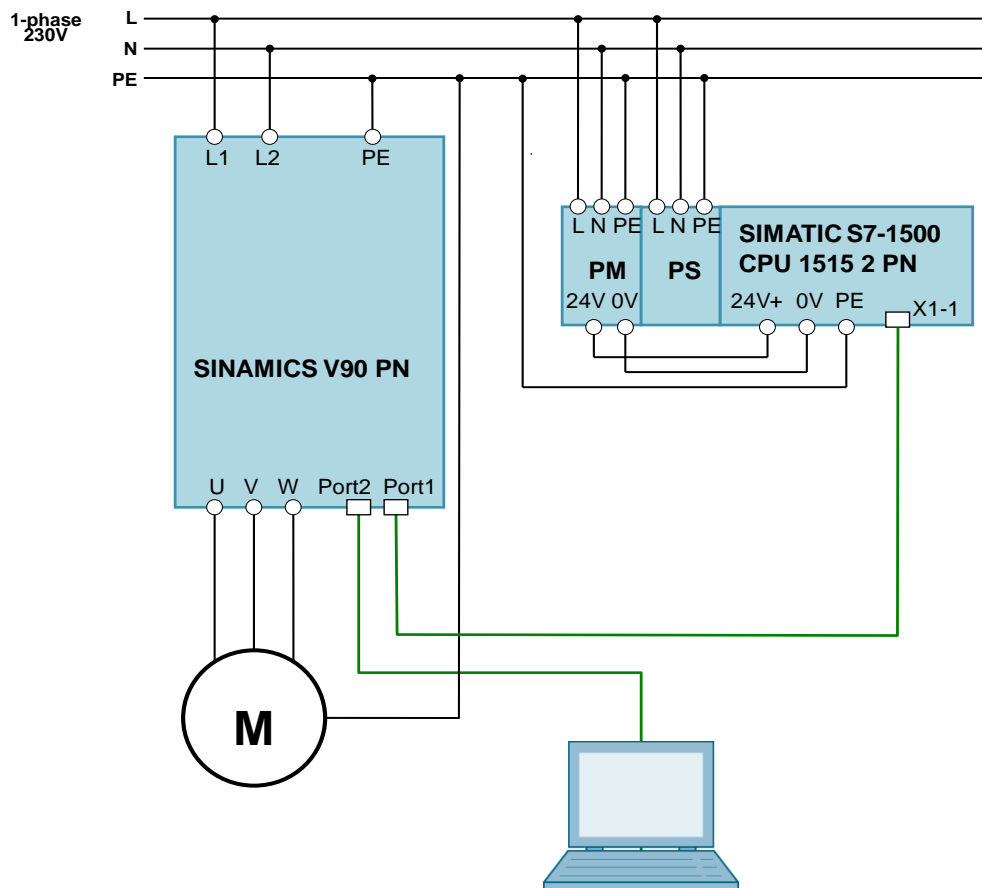
3.2.1 Hardware installation

The figure below shows the hardware configuration of the application:

CAUTION **Wrong wiring can damage the drive!**

In this application, the one phase 230V power supply is used. It is a must for you to check the supply voltage; otherwise, the drive can be damaged!

Figure 3-1



3.2.2 Startup (JOG from drive side)

Table 3-1

No.	Action	Remarks
1.	Set drive parameter p29108 to be 1.	JOG function is enabled when p29108=1
2.	Switch to JOG menu with drive BOP operation.	
3.	Press ▲ or ▼ button to run the motor.	

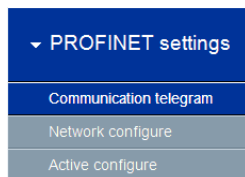
4 Configuration

In this section, the configurations for position control with IRT mode will be described in details. The used standard telegram is “3”.

4.1 Basic parameter configuration regarding SINAMICS V90 PN

4.1.1 Configure PROFINET settings via SINAMICS V-ASSISTANT

The following parameters can be configured with the SINAMICS V-ASSISTANT from the PROFINET settings menu field:



In this menu filed, you can configure:

- **Communication telegram:** in this tab you can also check the PZD structure and values:

Speed control mode

Telegram selection

The current telegram: 3 : Standard telegram 3, PZD-5/9

The PZD fields structure of current telegram and values of PZD fields are shown in below tables .

PZD structure and values

Receptive direction (PZD count=5):

STW1 (PZD1)

Transmit direction (PZD count=9):

ZSW1 (PZD1)

Telegram	Description	Value
STW1	Control word 1	400H
bit0	rising edge = ON (pulses can be enabled)...	0
bit1	1 = No OFF2 (enable is possible); 0 = OFF2	0
bit2	1 = No OFF3 (enable possible); 0 = OFF3	0
bit3	1 = Enable operation (pulses can be enabl...	0
bit4	1 = Operating condition (the ramp-function...	0
bit5	1 = Continue ramp-function generator; 0 =...	0
bit6	1 = Enable setpoint; 0 = Inhibit setpoint (\$...	0
bit7	rising edges: 1. Acknowledge faults	0
bit8	Reserved	0
bit9	Reserved	0
bit10	1 = Control via PLC	1
bit11	1 = Setpoint inversion	0
bit12	1 = Unconditionally open the holding brake	0
bit13	1 = Motorized potentiometer setpoint raise	0
bit14	1 = Motorized potentiometer setpoint lower	0
bit15	Reserved	0

Telegram	Description	Value
ZSW1	Status word 1	60224
bit0	1 = Ready for switching on	0
bit1	1 = Ready for operation	0
bit2	1 = Operation enabled	0
bit3	1 = Fault present	0
bit4	1 = No coast down active (OFF2 inactive)	0
bit5	1 = No fast stop active (OFF3 inactive)	0
bit6	1 = Switching on inhibited active	1
bit7	1 = Alarm present	0
bit8	1 = Speed setpoint - actual value deviatio...	1
bit9	1 = Control requested	1
bit10	1 = f or n comparison value reached/exce...	0
bit11	1 = I, M, or P limit reached	1
bit12	1 = Open the holding brake	0
bit13	1 = No motor overtemperature alarm	1
bit14	1 = Motor rotates forwards (n_act >= 0); 0 ...	1
bit15	1 = No alarm, thermal overload, power unit	1

- **Network:**

Speed control mode	
PI name of station	
sinamics v90-pn	
15 / 240	
Note: Only numbers(0-9) and letters in lower case(a-z) in English are acceptable.	
IP protocol	
PI IP address	0 . 0 . 0 . 0
PI subnet mask	0 . 0 . 0 . 0
PI default gateway	0 . 0 . 0 . 0
PI interface configuration operation	
<input type="button" value="Save configuration"/> <input type="button" value="Delete configuration"/>	
<p>Note:</p> <p>(1) All the configuration items will be active when they are saved and the servo driver is restarted.</p> <p>(2) When clicks the Save button, all the configuration items will be saved into non-volatile memory, and to activate the configuration, you need to restart the servo driver.</p> <p>(3) When clicks the Delete button, all above configuration will be cleared to factory default values.</p>	

NOTE

the configurations must be saved for activation

- **Active configure:** The active PROFINET settings can be checked from the tab.

Speed control mode	
PN name of station:	sinamics-v90-pn
PN IP address:	192.168.0.2
PN subnet mask:	255.255.255.0
PN default gateway:	192.168.0.2
PN MAC address:	00-1C-06-2D-FA-1C

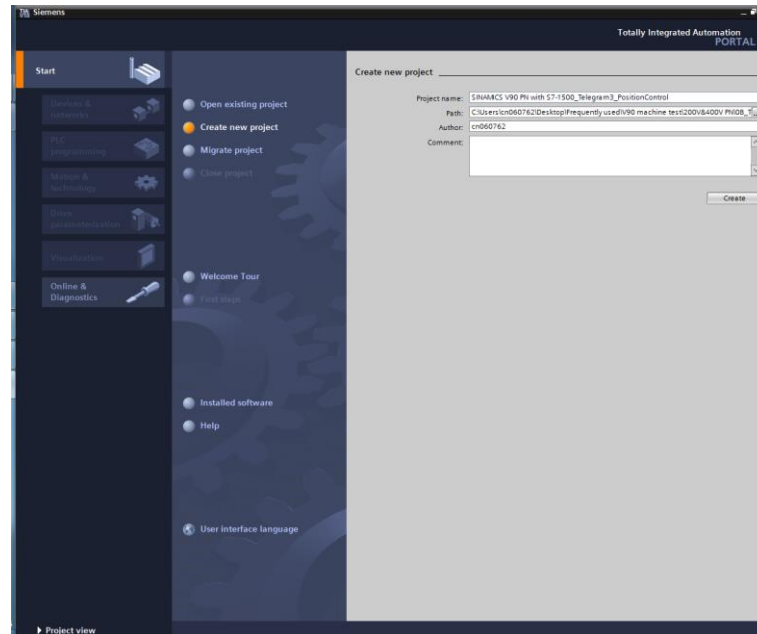
Table 3-1: PROFINET relevant parameters

Par. No.	Description	Set value
P922	Telegram selection	3
P8921	PN IP address. There are four indexes. Each index maps to a segment of the IP address. Note: after successful configuration, the values will be changed to 0 automatically.	Example IP address: 192.168.0.2 P8921[0]=192 P8921[1]=168 P8921[2]=0 P8921[3]=2
P8923	PN Subnet Mask of Station. There are four indexes. Each index maps to a segment of the subnet mask. Note: after successful configuration, the values will be changed to 0 automatically.	Example Subnet mask: 255.255.255.0 P8923[0]=255 P8923[1]=255 P8923[2]=255 P8923[3]=0
P8925	PN interface configuration Note: after successful configuration, the values will be changed to 0 automatically.	2 Note: after setting p8921 and p8923, p8925 should be set to be 2 for activating the PN communication.
r8931	PN IP address of station active	
r8932	PN default gateway of station active	
r8933	PN MAC address of station	

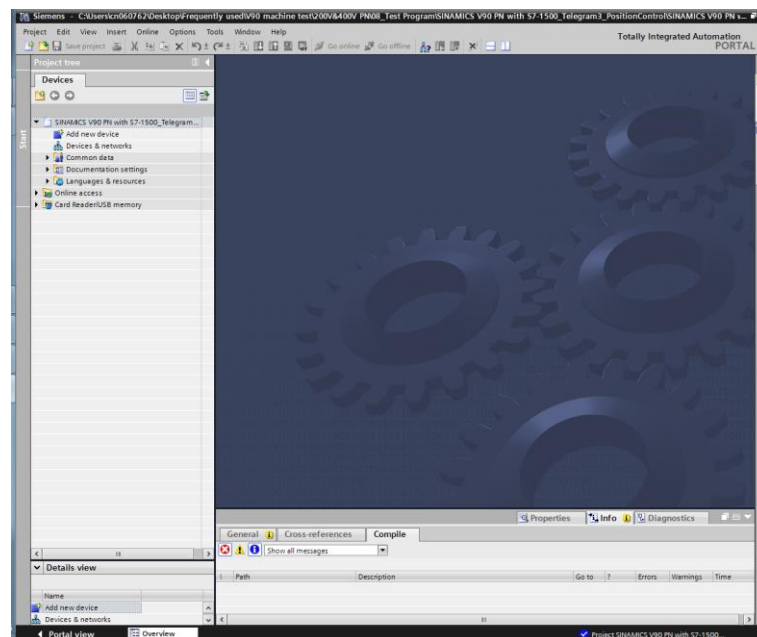
4.1.2 Configure PROFINET settings via the TIA Portal

4.1.2.1 Create a new project

1. Open the TIA Portal and create a new project:



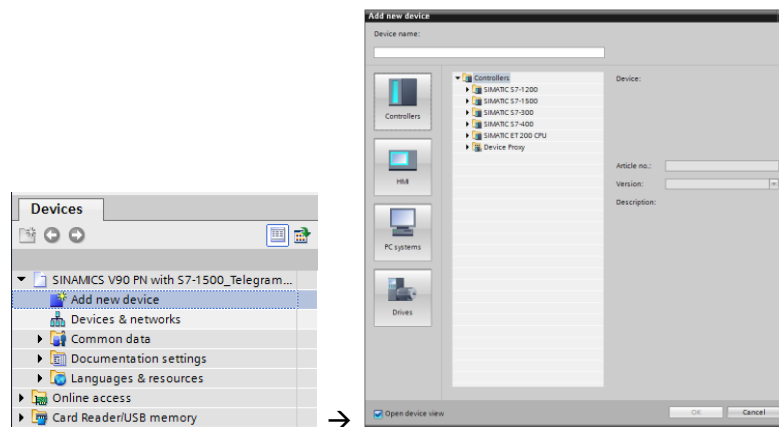
2. Switch to "Project view":



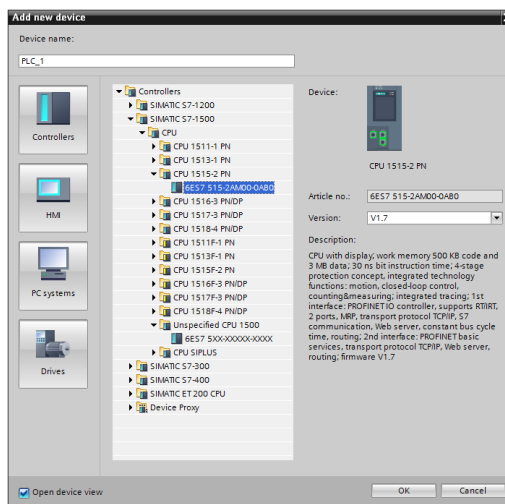
4.1.2.2 Add S7-1500 CPU into the project

Add S7-1500 CPU into the project as follows:

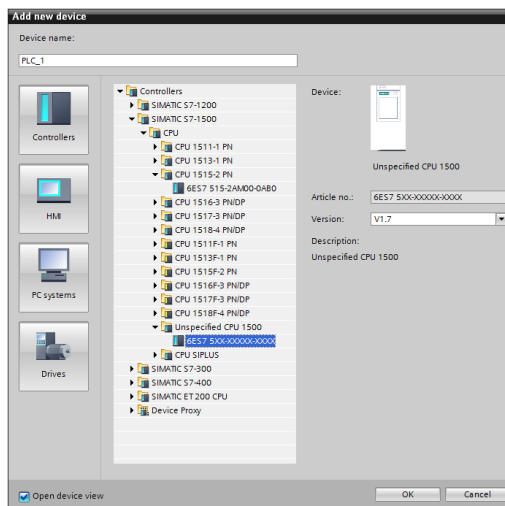
1. Double-click the node **"Add new device"** from the Device tree:



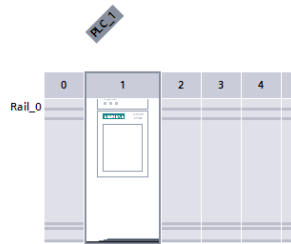
2. Here, if you know the detailed information about the S7-1500 modules, you can directly find the type and add it into the project



Otherwise, you can add an unspecified CPU 1500 into the project:

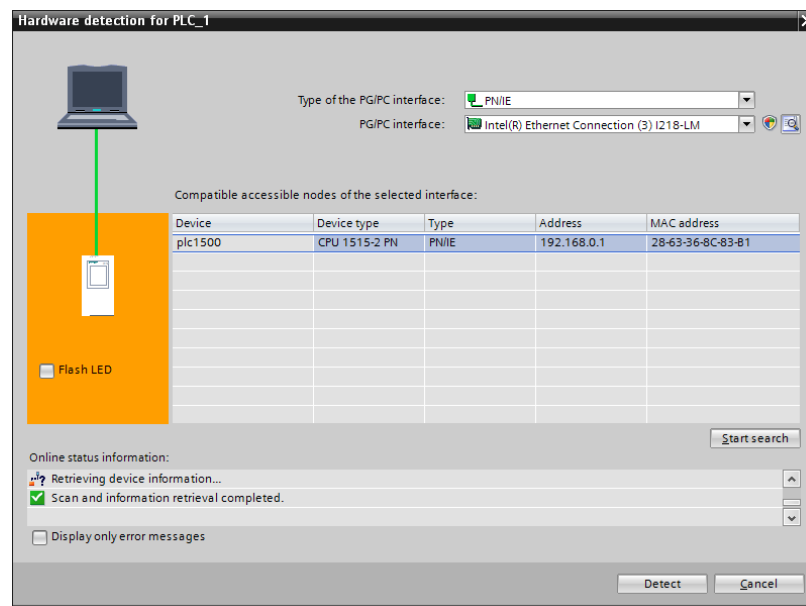


- If an unspecified 1500 CPU has been added into the project, you can detect the connected CPU by clicking the **"Detect"** and search it with online access:



The device is not specified.
 → Please use the [Hardware catalog](#) to specify the CPU.
 → **detect** the configuration of the connected device.

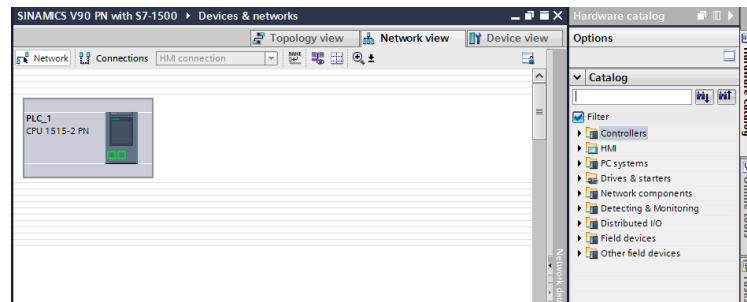
Start the search by clicking the **"Start search"** button, and the connected S7-1500 CPU will be found if the PROFINET network communication works properly:



- Press **"Detect"** button to detect the connected CPU:



- Switch to the **Network view** and open the **Hardware catalog**:

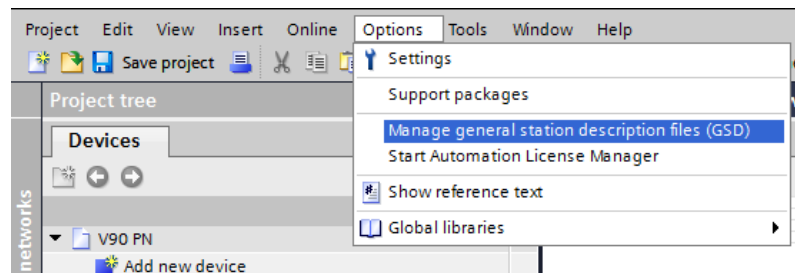


4.1.2.3 Add SINAMICS V90 PN into the project

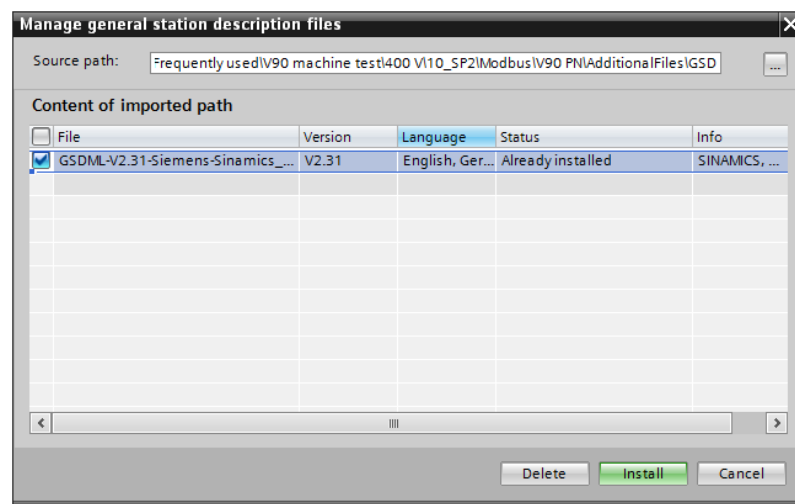
Add SINAMICS V90 PN into the project in the TIA Portal as follows:

- Input the V90 PN GSD file.

Note For the GSD file, you can download from following internet site:
<https://support.industry.siemens.com/cs/ww/en/view/109737269>

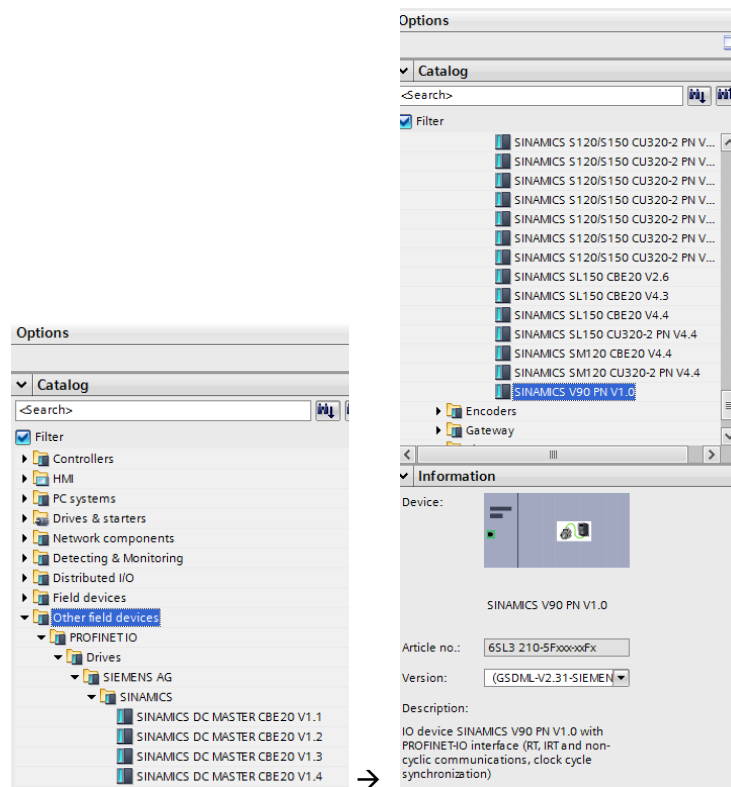


- Find the GSD file and select it. Press the **“Install”** button to install it.

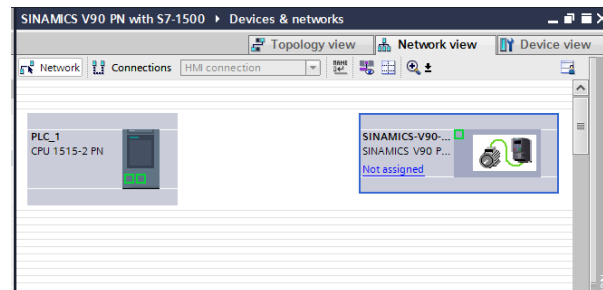


4 Configuration

3. Select V90 PN from the “other field devices” of catalog tree on the right side.



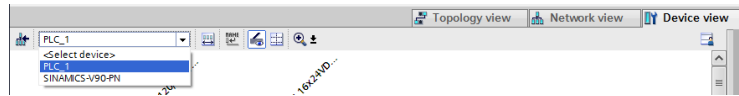
4. Double-click the V90 PN node or drag it to the network view:



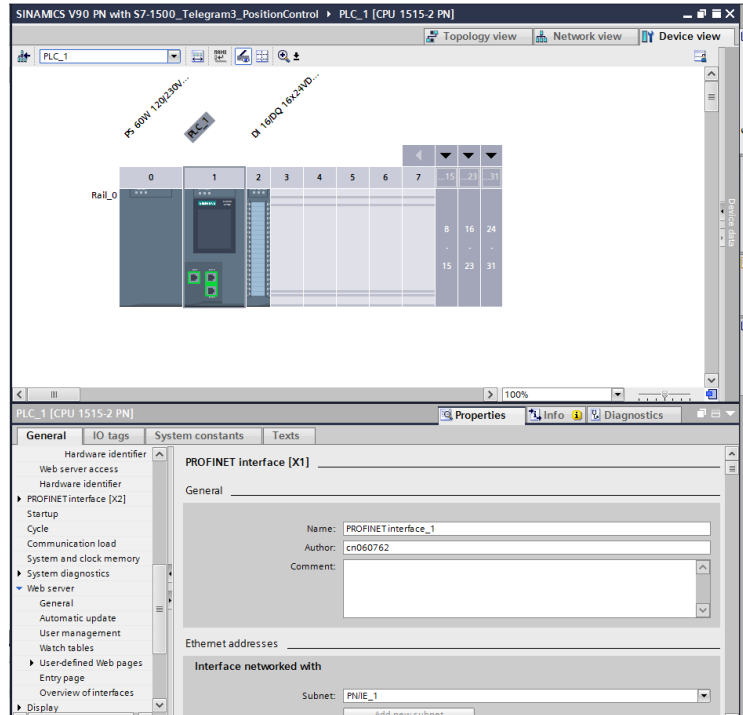
4.1.2.4 Device configuration for S7-1500 CPU

Make device configurations for S7-1500 CPU as follows:

1. In the device view, select the PLC:

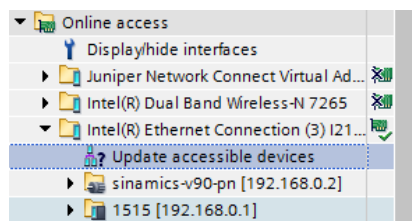


2. Double-click the PLC CPU to enter properties of the CPU:



Here, you can configure information about the device name, Ethernet address...

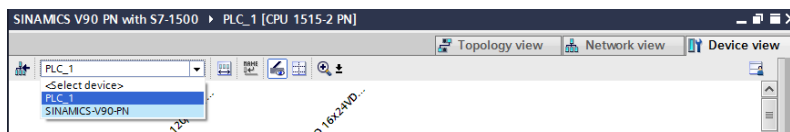
You can also use the “**Online access**” to find the accessible device and make sure the information is consistent:



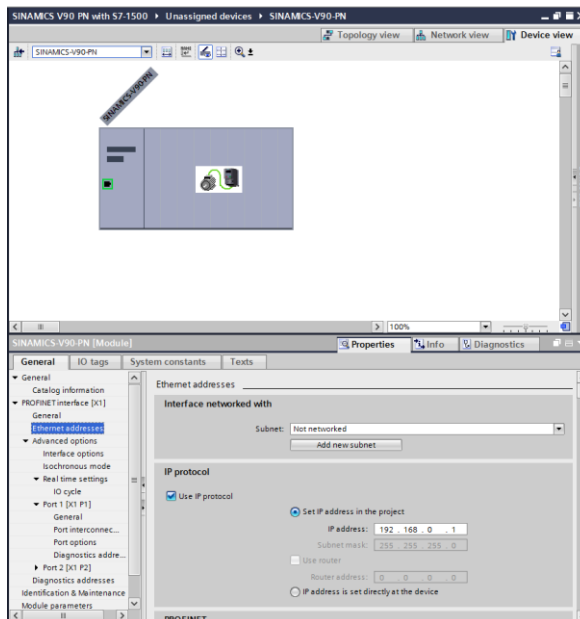
4.1.2.5 Device configuration for SINAMICS V90 PN

Make device configurations for S7-1500 CPU as follows:

1. In the device view, select the SINAMICS V90 PN:



2. Double-click the V90 PN to enter the properties field:

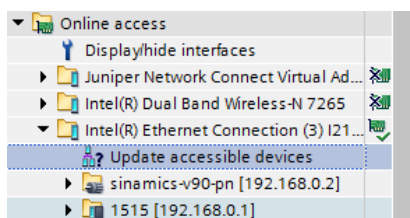


Here, you can configure information about the device name, Ethernet address...

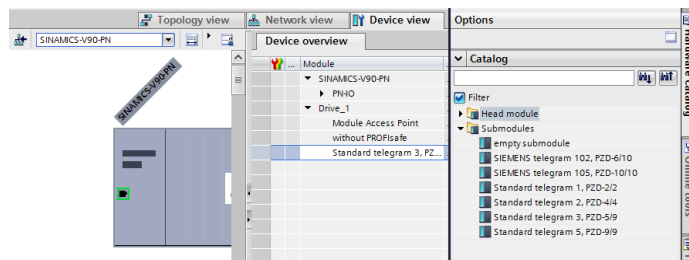
NOTE Important!

The PROFINET name is very important. You must double-check such information in the SINAMICS V90 PN configuration.

You can also use the “**Online access**” to find the accessible device and make sure the information is consistent:



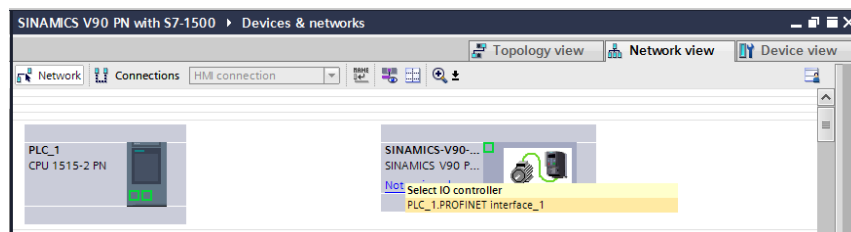
3. In the device view of SINAMICS V90 PN, select the standard telegram 3 from the submodules:



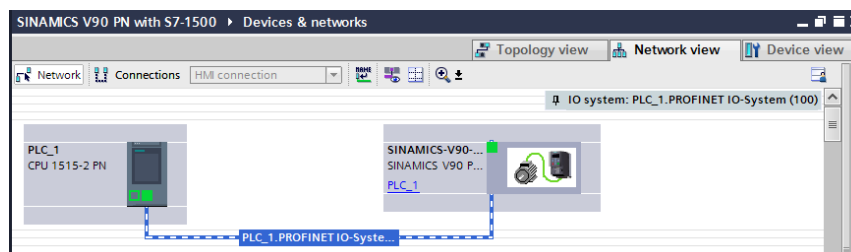
4.1.2.6 Connect SINAMICS V90 PN with S7-1500 CPU

After the configurations of both SINAMICS V90 PN and S7-1200 CPU, you need to connect SINAMICS V90 PN to S7-1500 CPU:

1. In the network view, click the **"Not assign"** and select **"PLC_1.PROFINET Interface_1"**:



2. And the connected network view is shown as follows:



4.1.2.7 Configure the topology between SINAMICS V90 PN and S7-1500 CPU

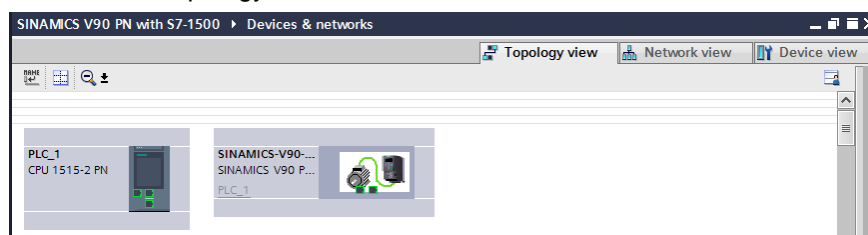
NOTICE

Important!

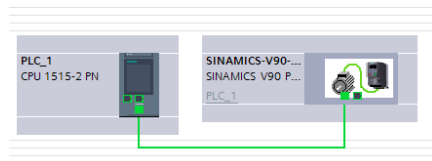
The topology is absolutely necessary and important!

After the network connection between SINAMICS V90 PN and S7-1500 CPU, configure the topology as follows:

1. Switch to the topology view:



2. Configure topology according to actual connection by dragging and dropping:

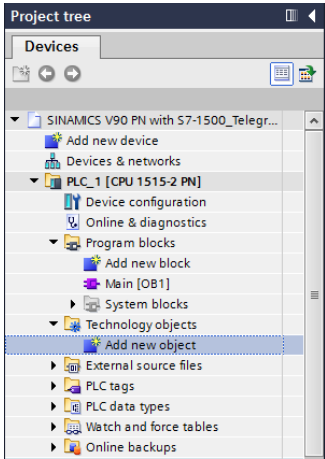
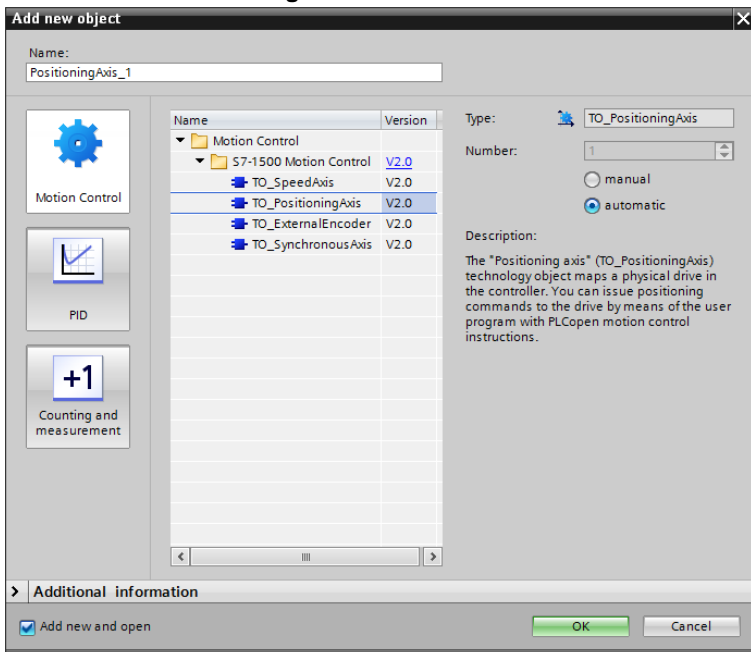


In this example, the X1 Port 1 of the S7-1500 CPU is connected to the port 1 at the drive side.

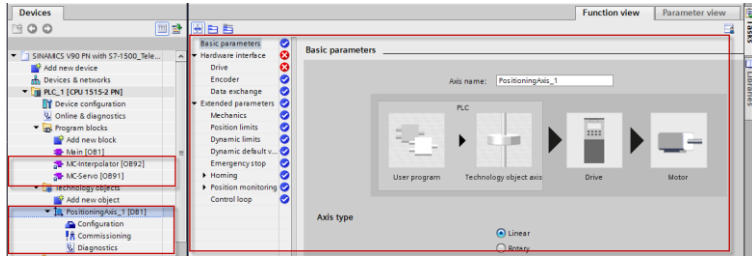
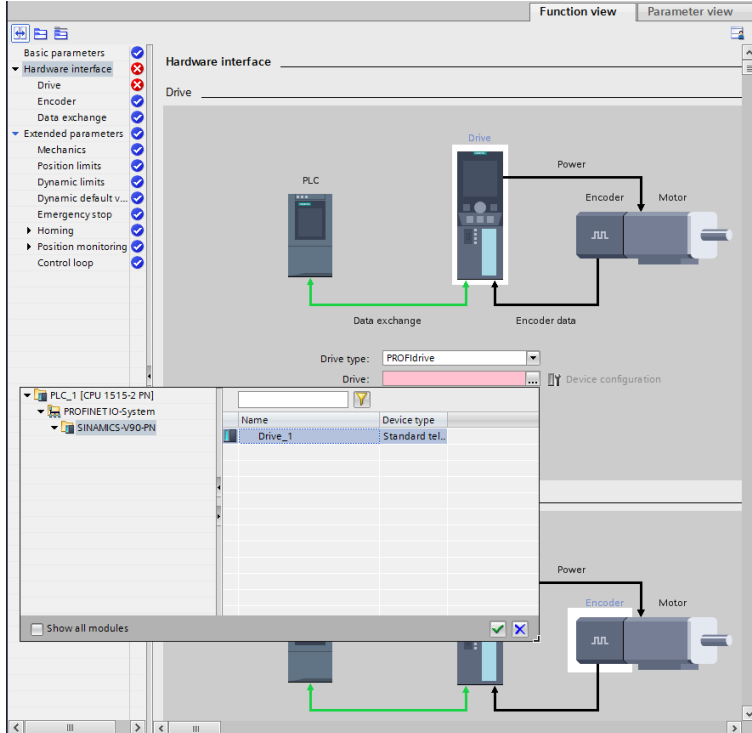
5 Operation of the application

In the following paragraph, we will use TO (Technology Object) of positioning axis for programming and run the motor:

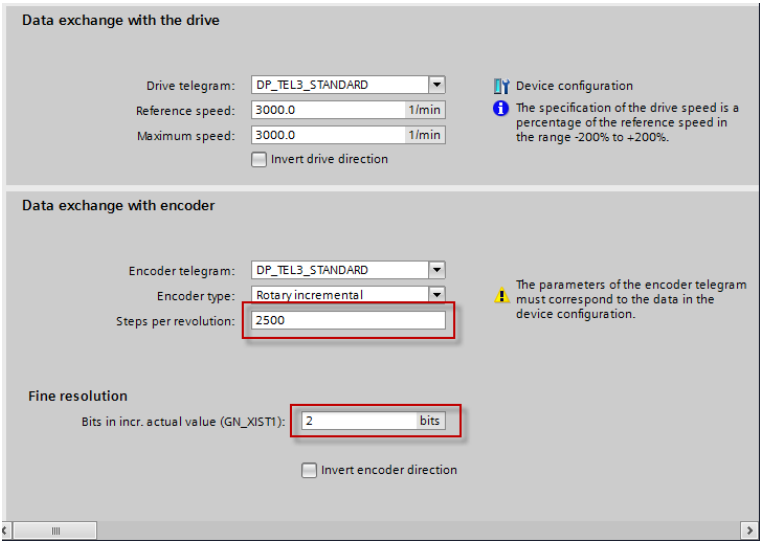
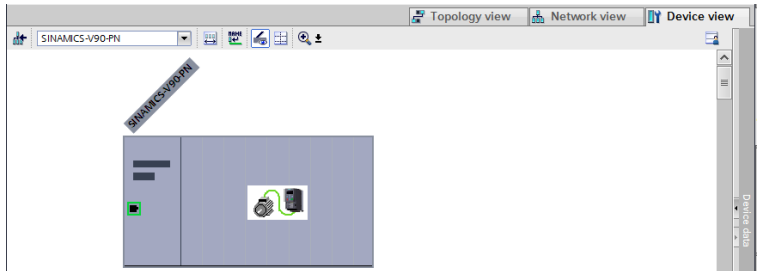
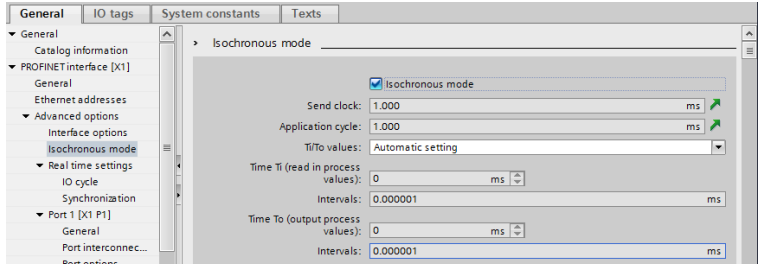
Table 5-1

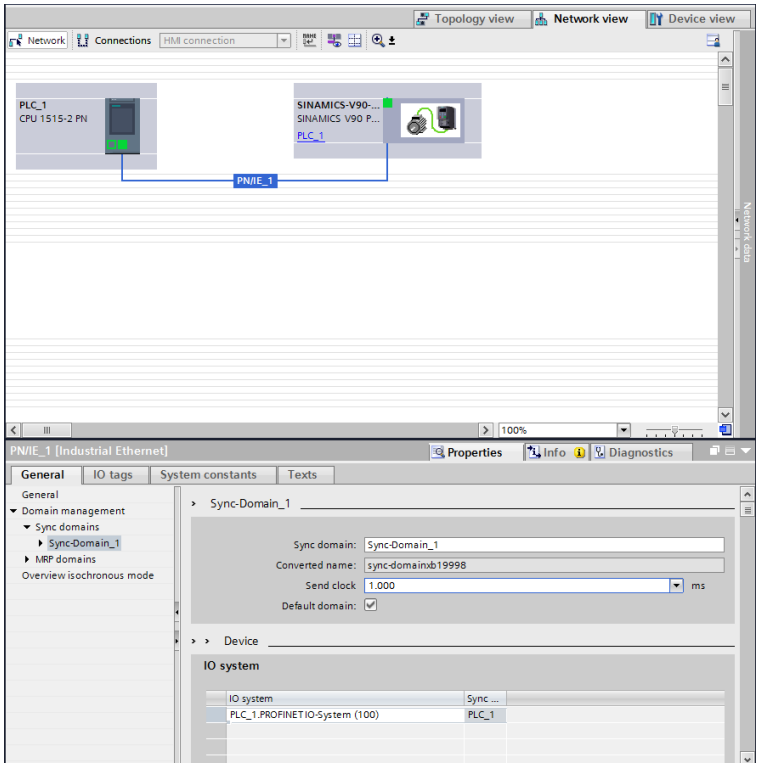
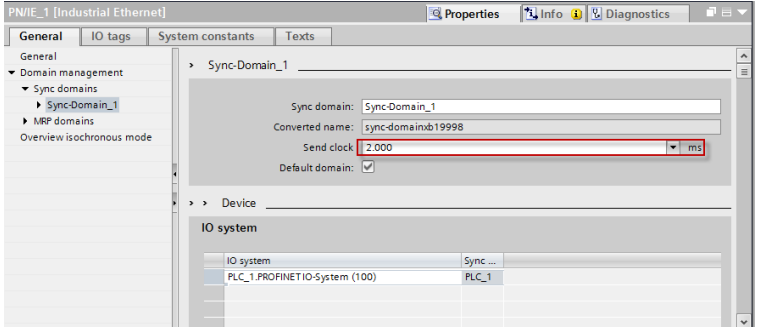
No.	Action	Remarks
1.	<p>Add a new object by double-click “Add new object” from the project tree:</p> 	
2.	<p>Select the “TO_Positioning” from the “Motion Control” list:</p> 	

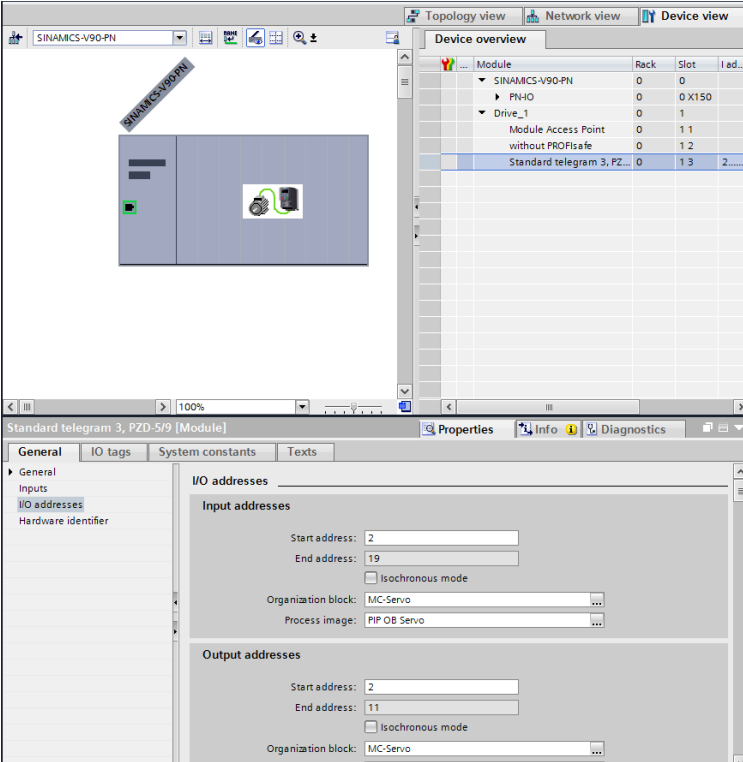
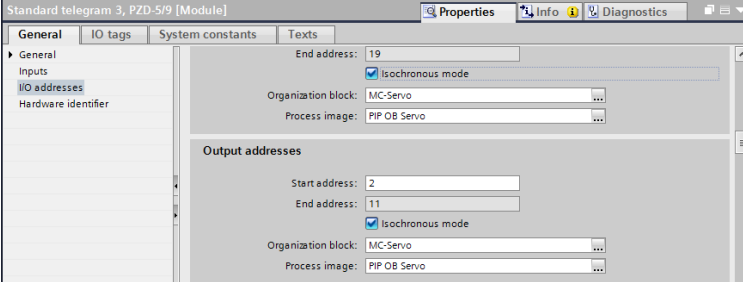
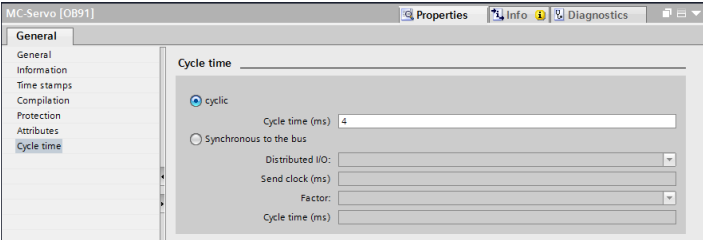
5 Operation of the application

No.	Action	Remarks
3.	<p>When a new object has been added successfully, the object node is added into the device tree and the configuration panel for this newly added axis is opened:</p> 	
4.	<p>Make configurations step by step. In this example, we firstly need to configure the drive under the hardware interface:</p> 	

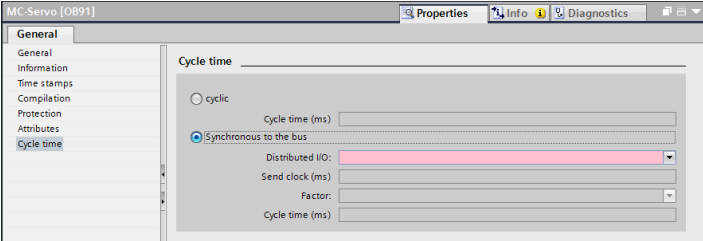
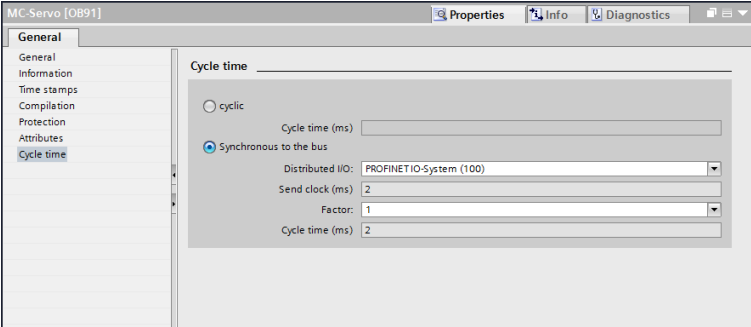
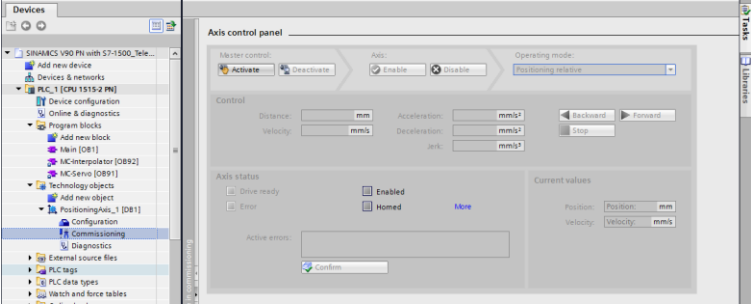
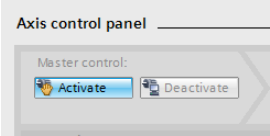
5 Operation of the application

No.	Action	Remarks
5.	<p>After that, change the steps per revolution to 2500 and the fine resolution to 2 bits because an TTL incremental encoder with the resolution of 2500 ppr is used in our example:</p> 	
6.	<p>Switch to the device view of the SINAMICS V90 PN:</p> 	
7.	<p>Open the device properties of SINAMICS V90 PN by double-clicking the V90 PN image.</p> <p>Select the checkbox of "Isochronous mode" from the tab of "Isochronous mode" to activate the IRT mode:</p> 	

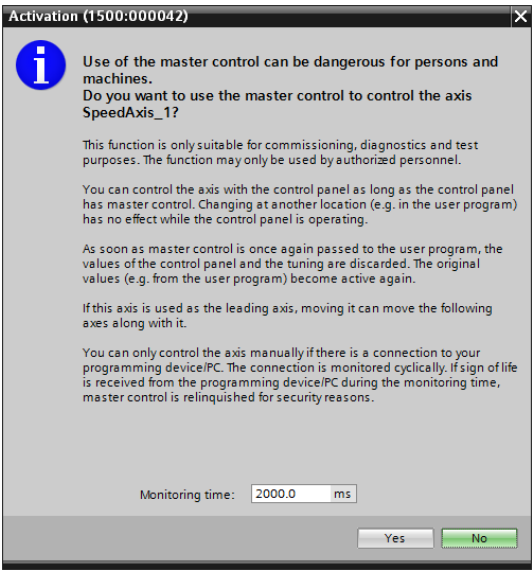
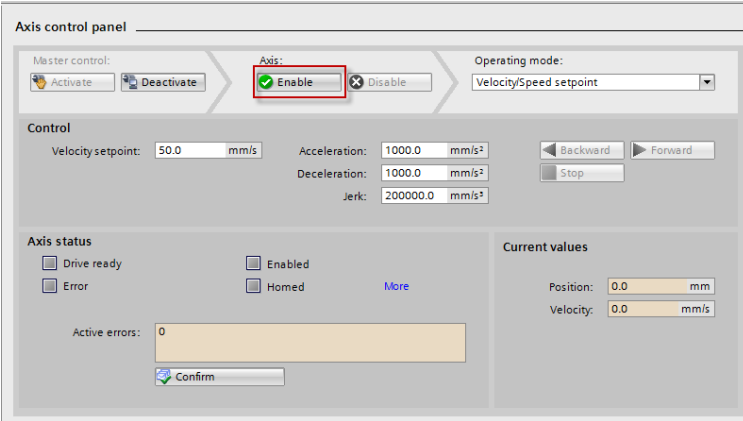
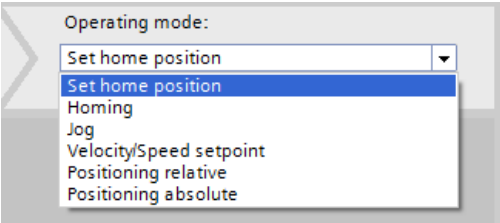
No.	Action	Remarks
8.	<p>Press the green arrow to switch to property overview of Industrial Ethernet:</p> 	
9.	<p>Select "2 ms" from the selection list of send clock:</p> 	<p>Note: The send clock for SINAMICS V90 PN now is limited to 2 ms.</p>

No.	Action	Remarks
10.	<p>Open the properties of configured telegram in the device overview:</p> 	
11.	<p>Select the checkbox of "Isochronous mode" in the I/O addresses:</p> 	<p>Note: A correct Organization block must be selected. In most cases, it is the "MC-Servo".</p>
12.	<p>Double-click the "MC-Servo[OB91]" from the program block tree to open the properties of the program block OB91:</p> 	

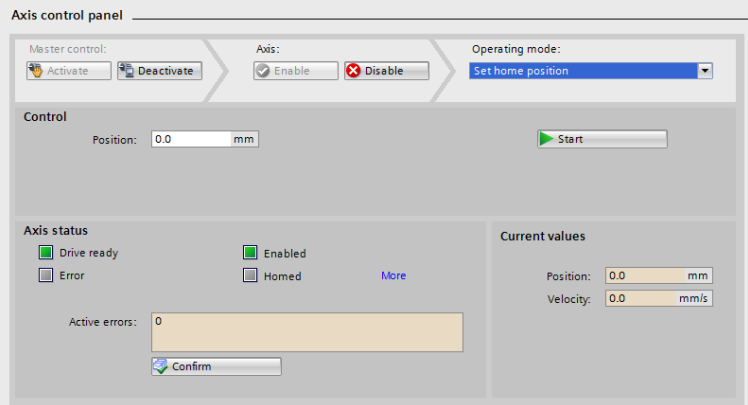
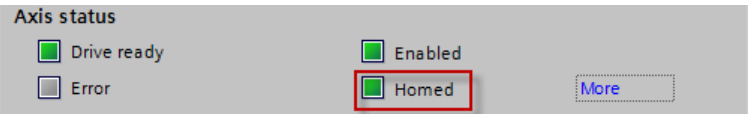
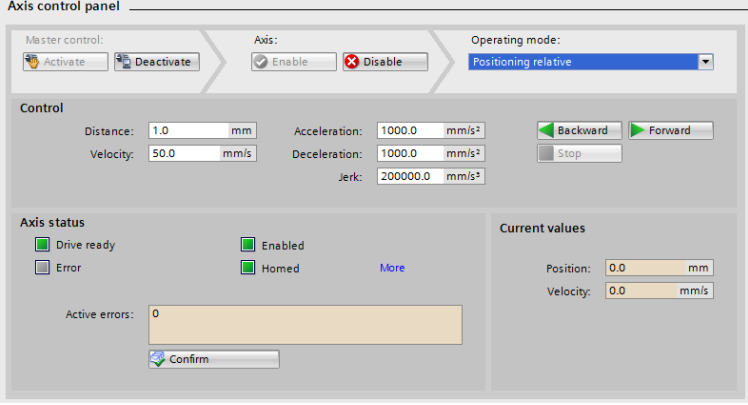
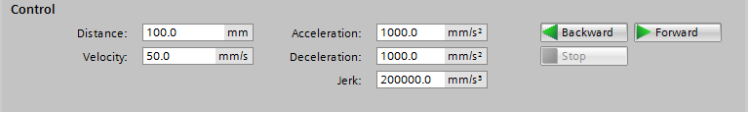
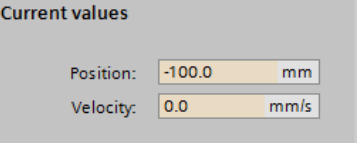
5 Operation of the application

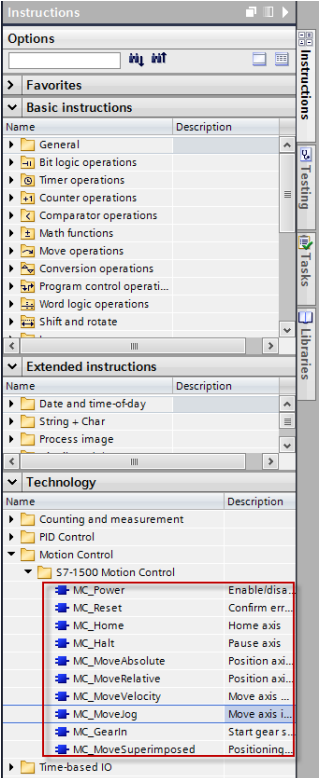
No.	Action	Remarks
13.	<p>Select the option of “Synchronous to the bus”:</p> 	
14.	<p>Select “PROFINET IO-System (100)” for the distributed I/O:</p> 	
15.	Compile the project and then download it into device.	
16.	<p>Switch to the commissioning panel by double-clicking the “Commissioning” under the technology object tree:</p> 	
17.	<p>Click the “Activate” button:</p> 	

5 Operation of the application

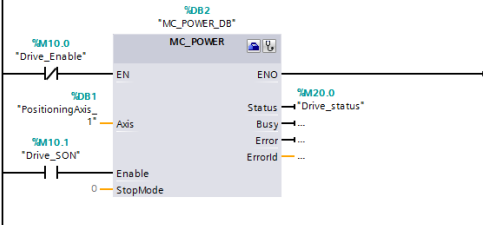
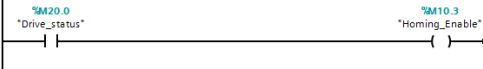
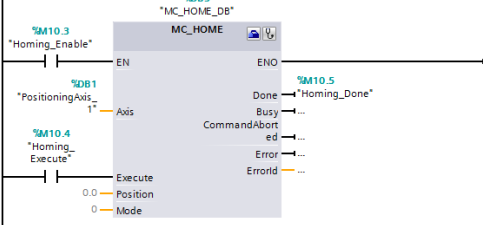
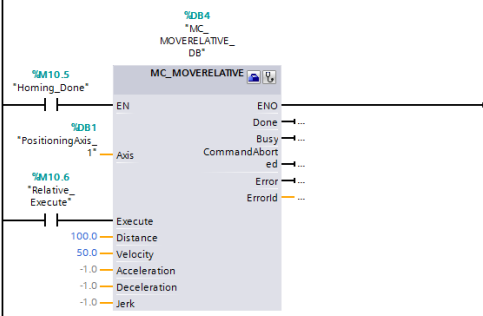
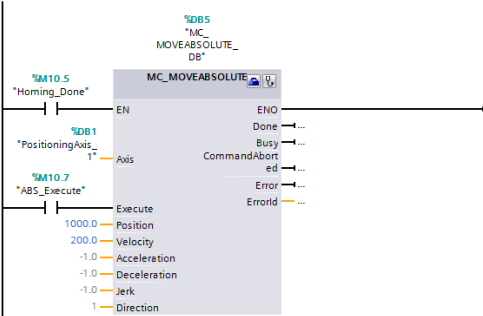
No.	Action	Remarks
18.	<p>Set the monitoring time for the master control. In this example, we use the default 2000 ms. Click “Yes” button to proceed:</p> 	
19.	<p>Click the “Enable” button to make servo drive at SON state:</p> 	
20.	<p>Here you can select an operating mode from the drop list:</p> 	

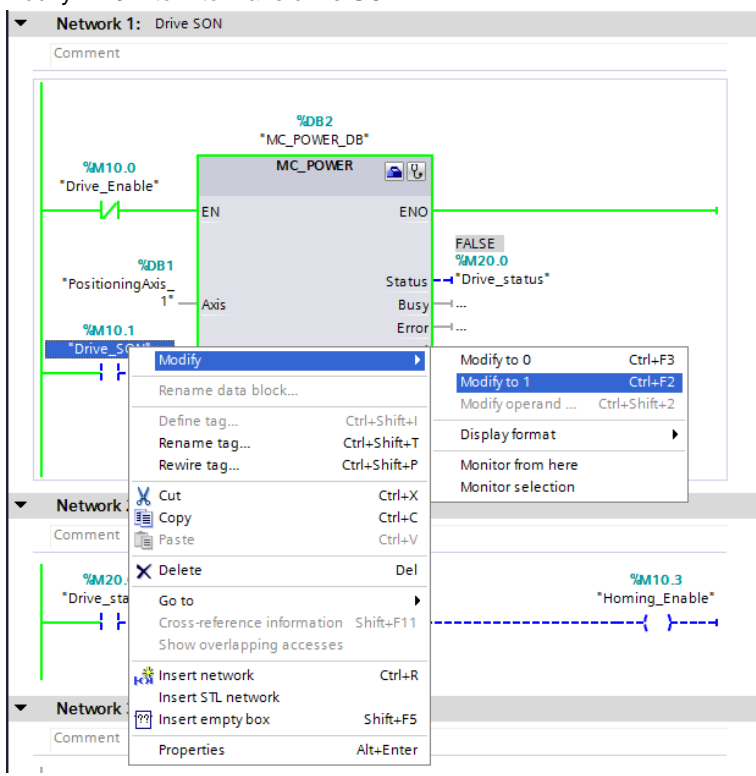
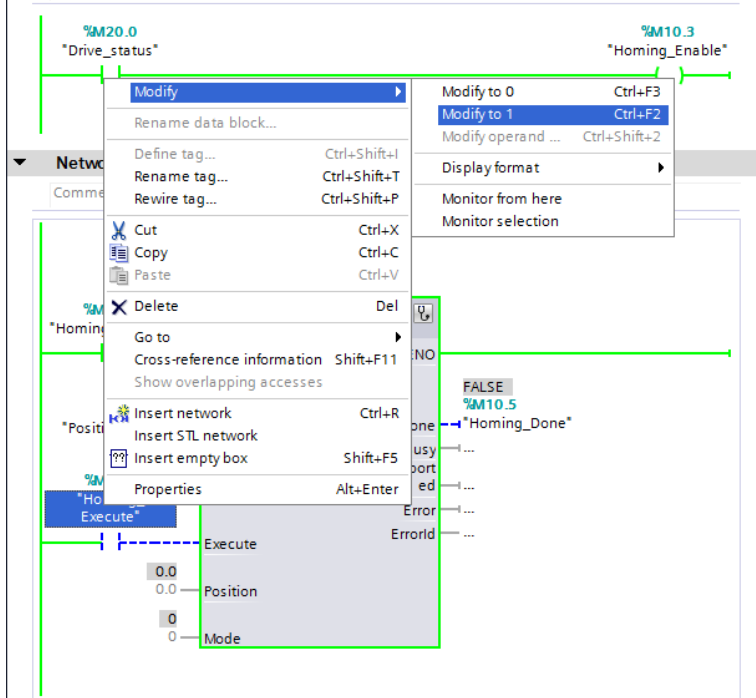
5 Operation of the application

No.	Action	Remarks
21.	<p>Select the operating mode “Set home position”:</p> 	
22.	<p>Press the “Start” button and then current position is set as the home position. After that, the axis status indicates that the homing operation has been finished:</p> 	
23.	<p>Select the operating mode “Positioning relative”:</p> 	
24.	<p>Input “100” into the distance field:</p> 	According to the configuration of mechanics, 100 mm means 10 motor revolutions.
25.	<p>Press “Backward” or “Forward” button, and then the motor starts running to the relative position of 100 mm. The current position and speed values are indicated in the “Current values” field:</p> 	
26.	Switch to offline mode and open the main program block OB1.	

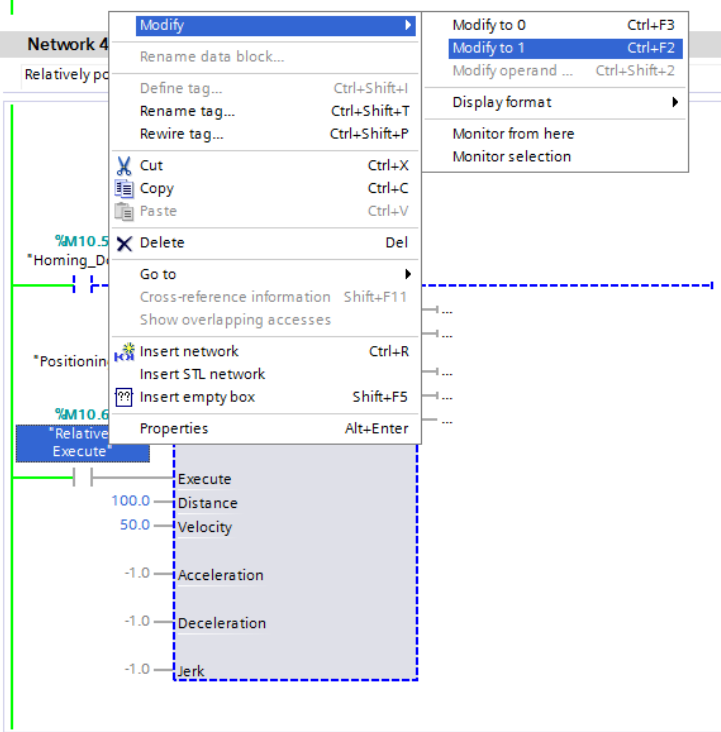
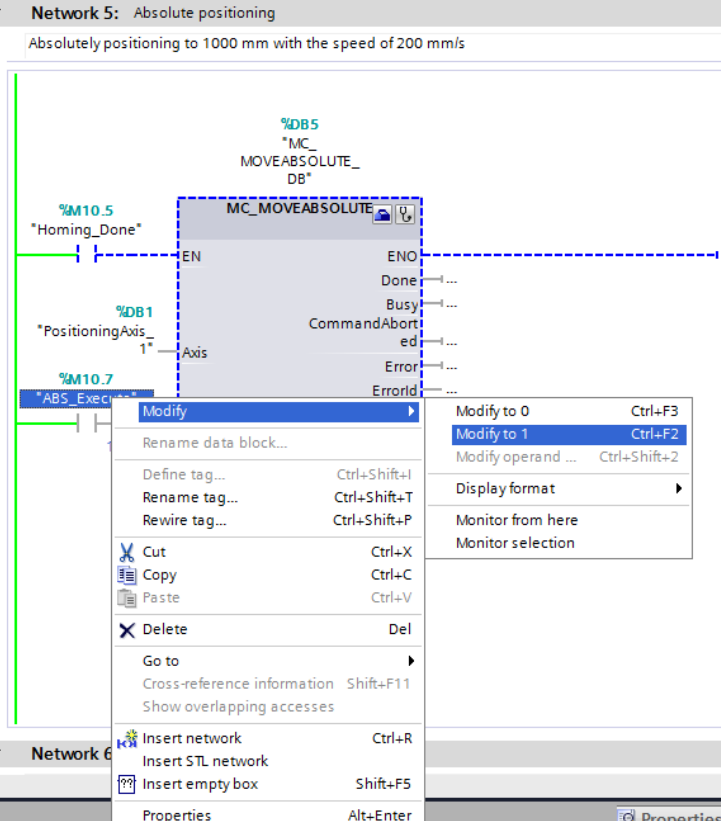
No.	Action	Remarks
27.	<p>Program with the technology instructions at the right side:</p> 	

5 Operation of the application

No.	Action	Remarks
28.	<p>Program as follows:</p> <p>Network 1: Drive SON</p> <p>Comment</p>  <p>Network 2:</p> <p>Comment</p>  <p>Network 3: Homing</p> <p>Comment</p>  <p>Network 4: Relative positioning</p> <p>Relatively positioning for 100 mm with the speed of 50 mm/s</p>  <p>Network 5: Absolute positioning</p> <p>Absolutely positioning to 1000 mm with the speed of 200 mm/s</p> 	
29.	Compile and load the project into devices.	
30.	Switch to online mode and activate the monitoring function.	

No.	Action	Remarks
31.	<div>Modify M10.1 to 1 to make drive SON: </div>	
32.	<div>Modify M10.4 to 1 to perform homing: </div>	

5 Operation of the application

No.	Action	Remarks
33.	<p>Modify M10.6 to 1 to perform relative positioning for 100 mm with the speed of 50 mm/s:</p> 	
34.	<p>Modify M10.7 to 1 to move to absolute position of 1000 mm with the speed of 200 mm/s:</p> 	

6 Related literature

Table 6-1

	Topic
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Download page of this entry https://support.industry.siemens.com/cs/ww/en/view/109739053
\3\	

7 Contact

Siemens Ltd., China
DF M3-BF GMC

No. 18 Siemens Road
Jiangning Development Zone
Nanjing, 211100
China
mailto: mc_gmc_mp_asia.cn@siemens.com

8 History

Table 8-1

Version	Date	Modifications
V1.0	03/2016	First version
V1.1	05/2018	Upgrade project to TIA Portal V15