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# 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>

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# 1 Task

## 1.1 Overview

### Introduction

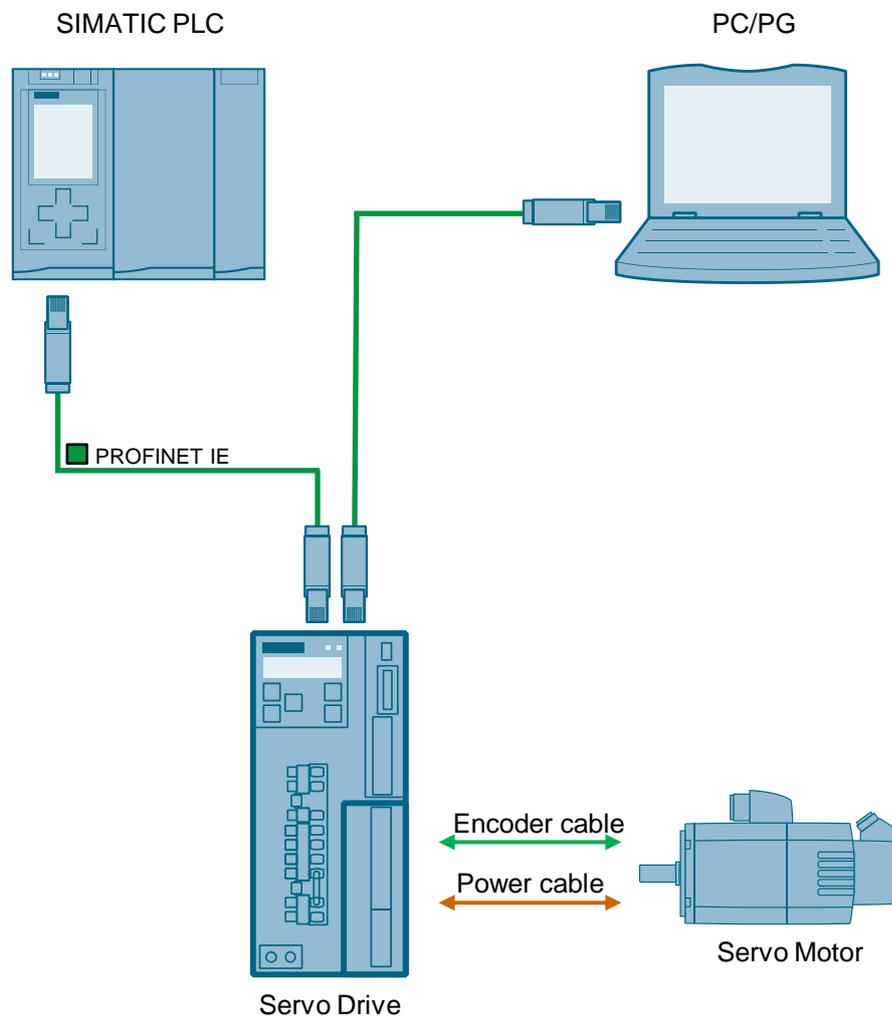
Position control is one of the three basic functions for SINAMICS V90 and PROFINET communication is a new and advanced feature. In this manual, the basic application of position control with PROFINET IRT communication for SINAMICS V90 will be described in detail.

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



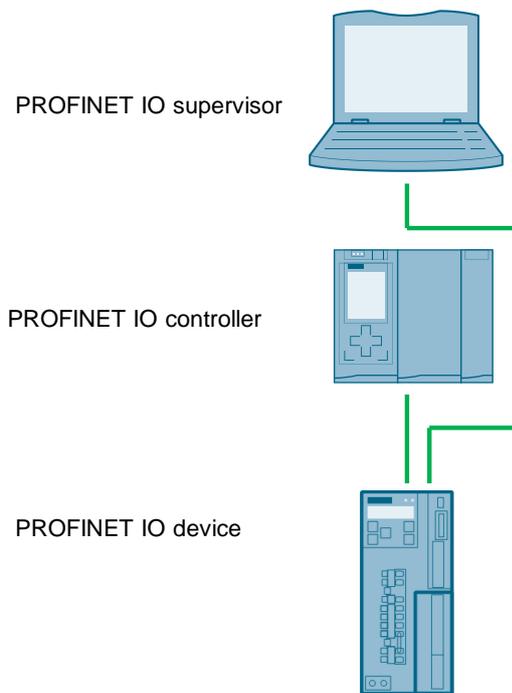
## 2 Solution

### 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.**

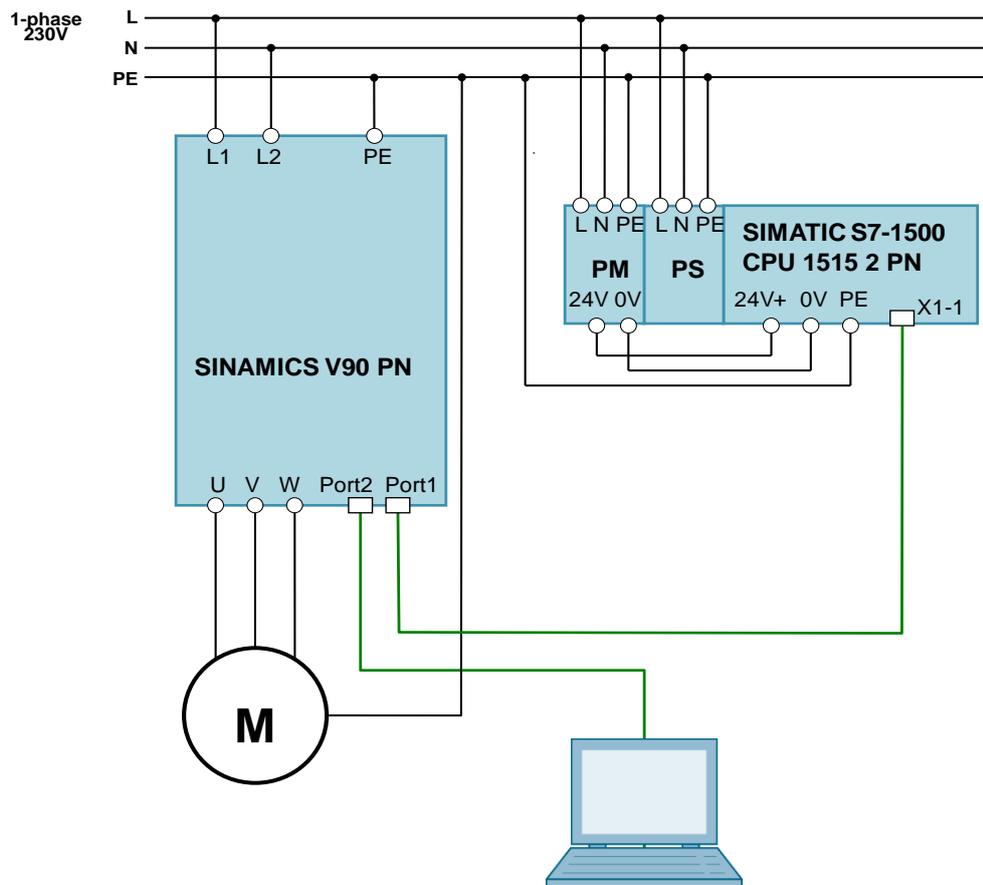
## 3.2 Installation and startup

### 3.2.1 Hardware installation

The figure below shows the hardware configuration of the application:

<b>CAUTION</b>	<b>Wrong wiring can damage the drive!</b> 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



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### 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.	

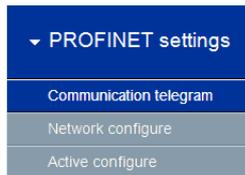
# 4 Configuration

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	Telegram	Description	Value
STW1	Control word 1	400H	ZSW1	Status word 1	60224
bit0	rising edge = ON (pulses can be enabled)...	0	bit0	1 = Ready for switching on	0
bit1	1 = No OFF2 (enable is possible); 0 = OF...	0	bit1	1 = Ready for operation	0
bit2	1 = No OFF3 (enable possible); 0 = OFF3 ...	0	bit2	1 = Operation enabled	0
bit3	1 = Enable operation (pulses can be enabl...	0	bit3	1 = Fault present	0
bit4	1 = Operating condition (the ramp-function...	0	bit4	1 = No coast down active (OFF2 inactive)	0
bit5	1 = Continue ramp-function generator; 0 =...	0	bit5	1 = No fast stop active (OFF3 inactive)	0
bit6	1 = Enable setpoint; 0 = Inhibit setpoint (s...	0	bit6	1 = Switching on inhibited active	1
bit7	rising edge= 1. Acknowledge faults	0	bit7	1 = Alarm present	0
bit8	Reserved	0	bit8	1 = Speed setpoint - actual value deviatio...	1
bit9	Reserved	0	bit9	1 = Control requested	1
bit10	1 = Control via PLC	1	bit10	1 = f or n comparison value reached/exce...	0
bit11	1 = Setpoint inversion	0	bit11	1 = I, M, or P limit reached	1
bit12	1 = Unconditionally open the holding brake	0	bit12	1 = Open the holding brake	0
bit13	1 = Motorized potentiometer setpoint raise	0	bit13	1 = No motor overtemperature alarm	1
bit14	1 = Motorized potentiometer setpoint lower	0	bit14	1 = Motor rotates forwards (n_act >= 0); 0 ...	1
bit15	Reserved	0	bit15	1 = No alarm, thermal overload, power unit	1

- **Network:**

Speed control mode

PN 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

PN IP address: 0 . 0 . 0 . 0

PN subnet mask: 0 . 0 . 0 . 0

PN default gateway: 0 . 0 . 0 . 0

PN interface configuration operation

Save configuration | Delete configuration

Note:

(1) All the configuration items will be active when they are saved and the servo driver is restarted.

(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.

(3) When clicks the Delete button, all above configuration will be cleared to factory default values.

**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

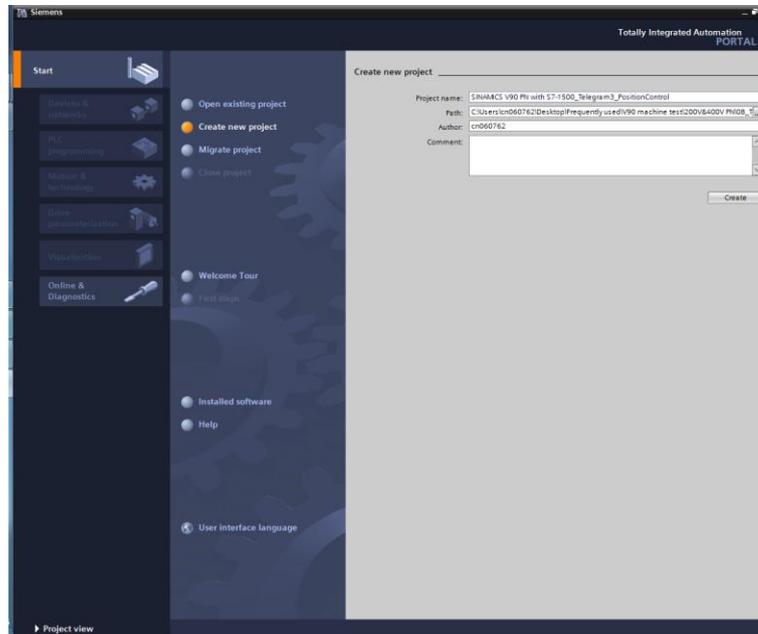
Table 3-1: PROFINET relevant parameters

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. <b>Note:</b> after successful configuration, the values will be changed to 0 automatically.	Example IP address: <b>192.168.0.2</b> 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. <b>Note:</b> after successful configuration, the values will be changed to 0 automatically.	Example Subnet mask: <b>255.255.255.0</b> P8923[0]=255 P8923[1]=255 P8923[2]=255 P8923[3]=0
P8925	PN interface configuration <b>Note:</b> 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	

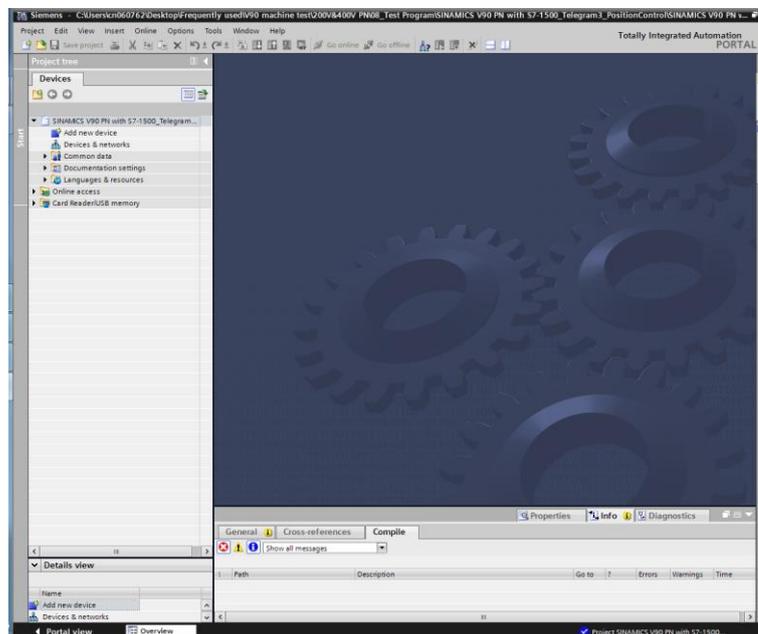
## 4.1.2 Configure PROFINET settings via the TIA Portal

### 4.1.2.1 Create a new project

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



2. Switch to "Project view":

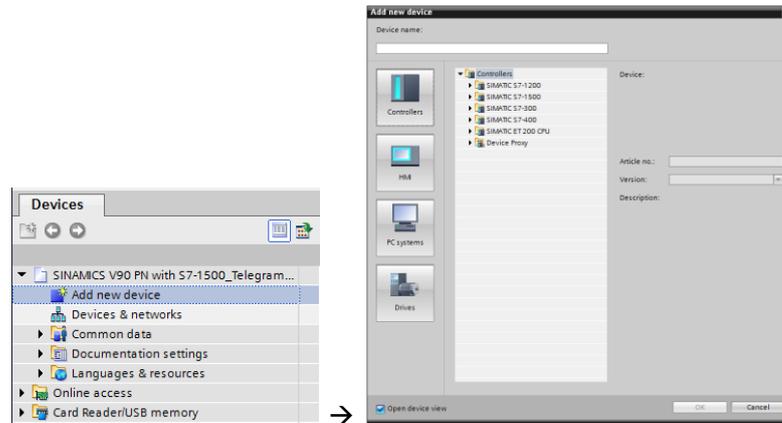


## 4 Configuration

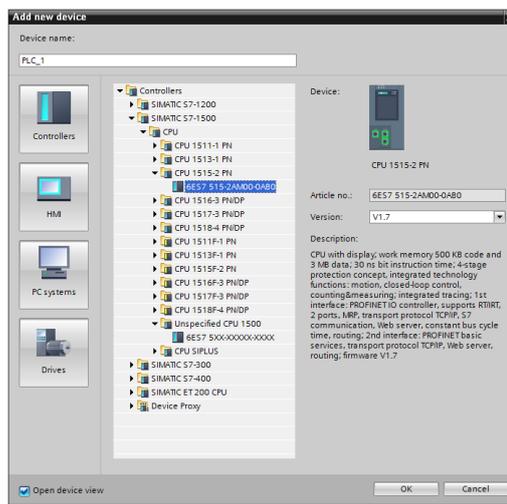
### 4.1.2.2 Add S7-1500 CPU into the project

Add S7-1500 CPU into the project as follows:

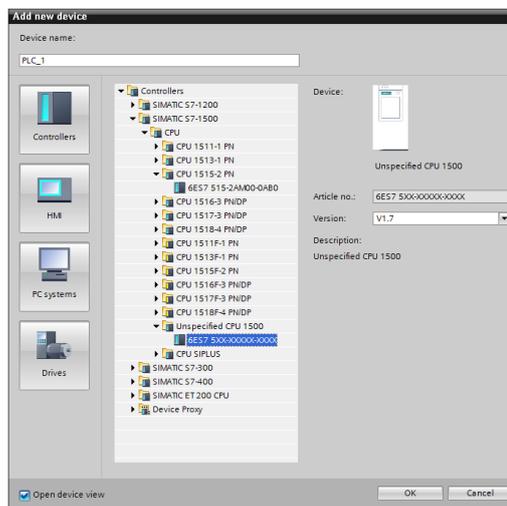
1. Double-click the node **"Add new device"** from the Device tree:



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

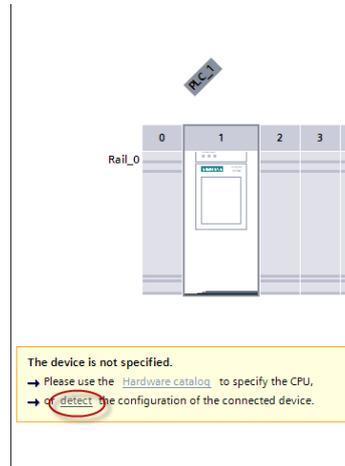


Otherwise, you can add an unspecified CPU 1500 into the project:

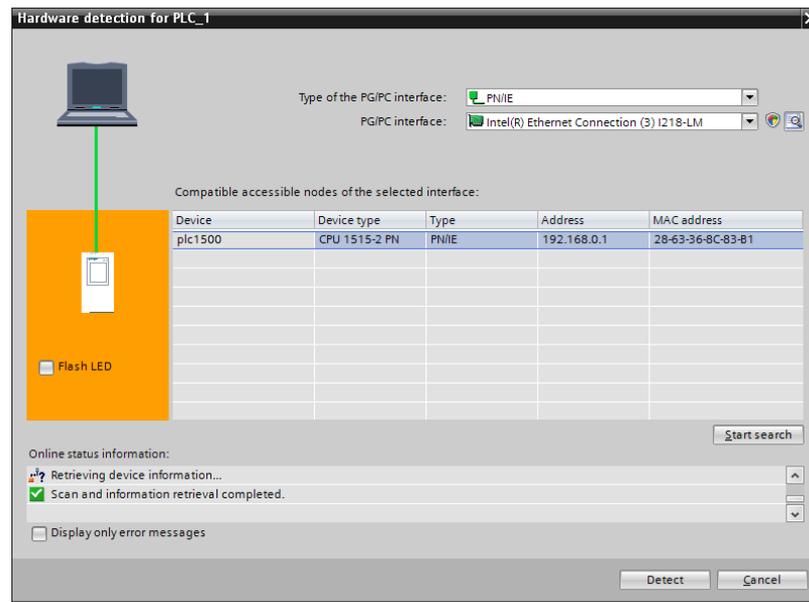


## 4 Configuration

- 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:



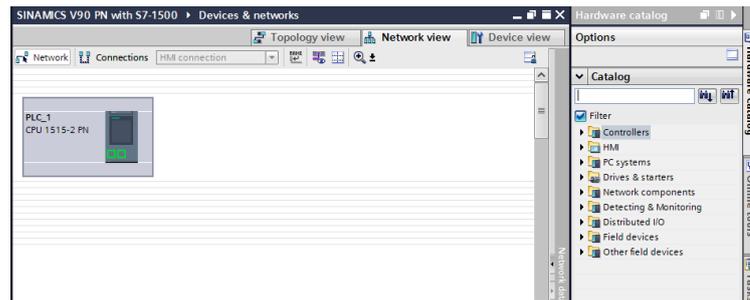
Start the search by clicking the **“Start search”** button, and the connected S7-1500 CPU will be found if the PROFINET network communication works properly:



- Press **“Detect”** button to detect the connected CPU:



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

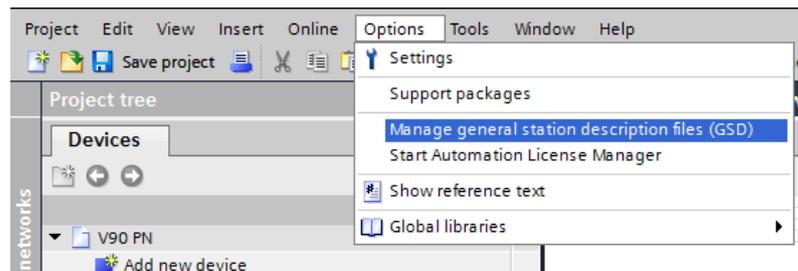


#### 4.1.2.3 Add SINAMICS V90 PN into the project

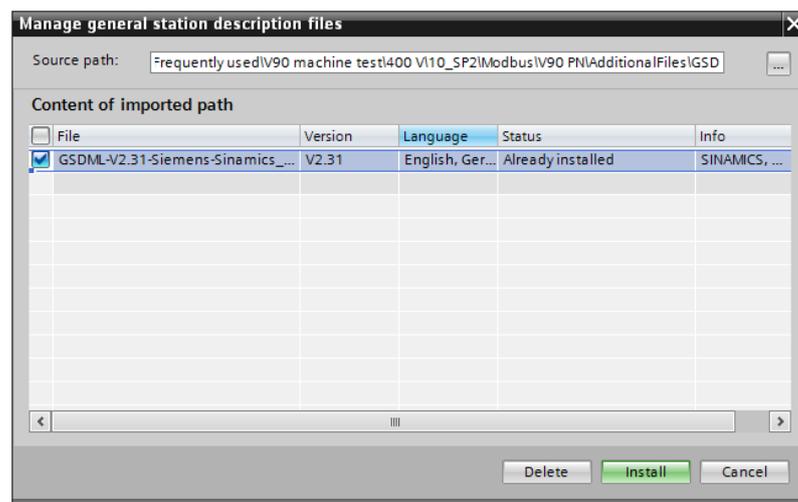
Add SINAMICS V90 PN into the project in the TIA Portal as follows:

- Input the V90 PN GSD file.

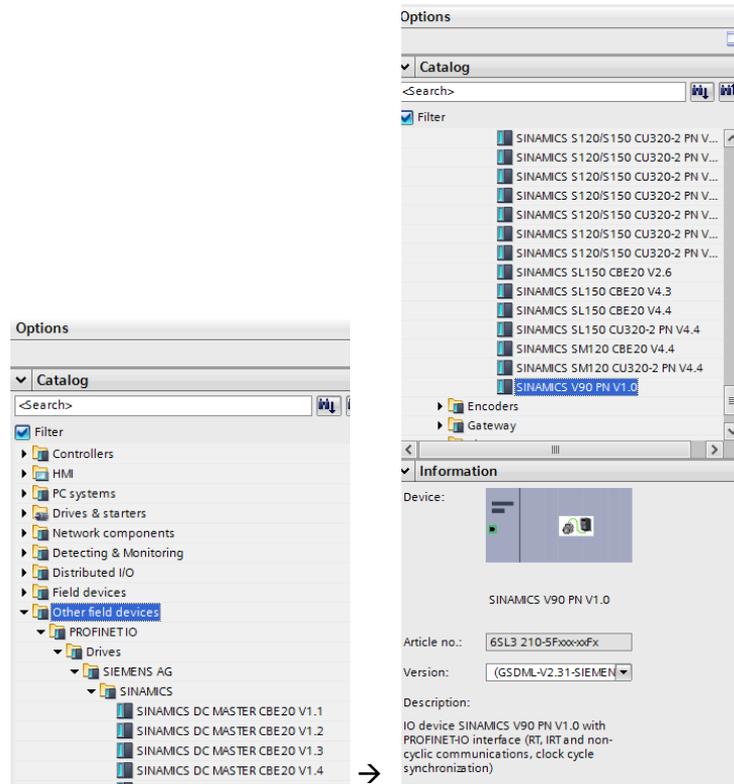
**Note** For the GSD file, you can download from following internet site:  
<https://support.industry.siemens.com/cs/ww/en/view/109737269>



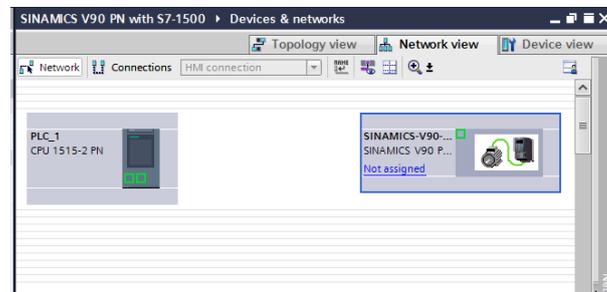
- Find the GSD file and select it. Press the **“Install”** button to install it.



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 Configuration

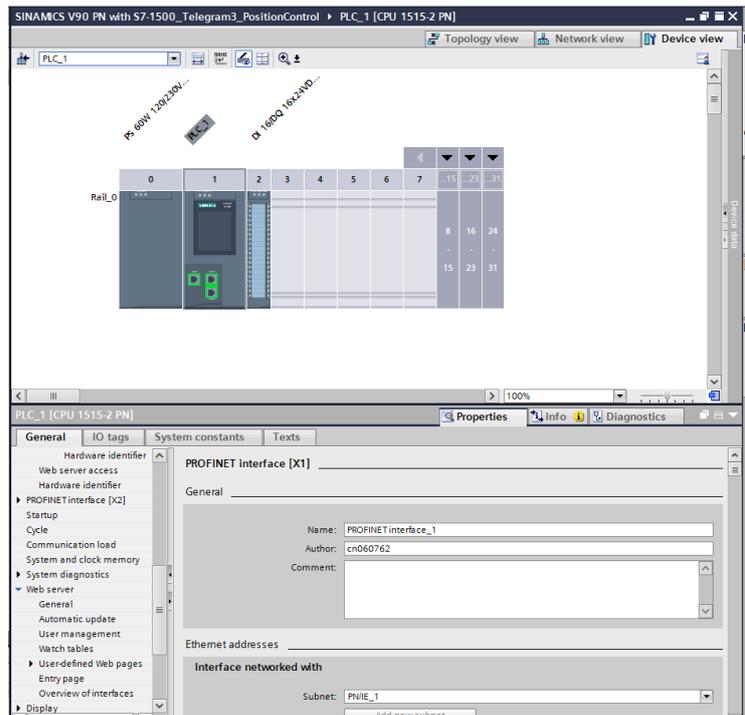
### 4.1.2.4 Device configuration for S7-1500 CPU

Make device configurations for S7-1500 CPU as follows:

1. In the device view, select the PLC:

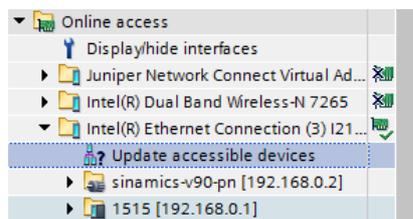


2. Double-click the PLC CPU to enter properties of the CPU:



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:



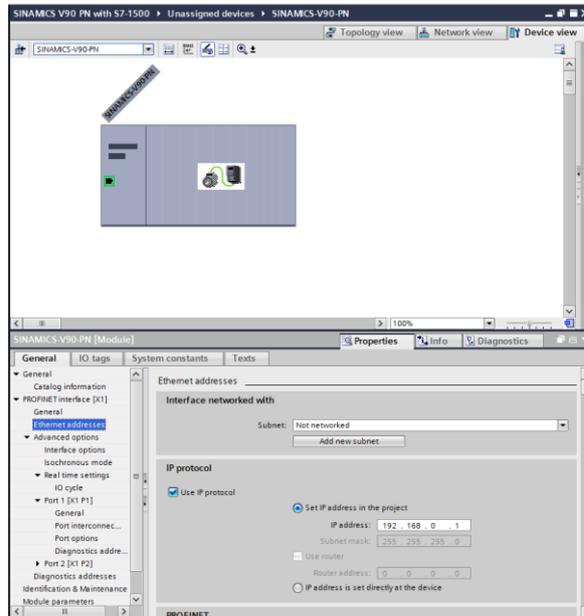
4.1.2.5 Device configuration for SINAMICS V90 PN

Make device configurations for S7-1500 CPU as follows:

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



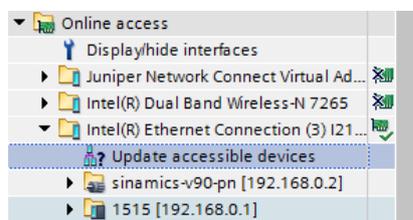
2. Double-click the V90 PN to enter the properties field:



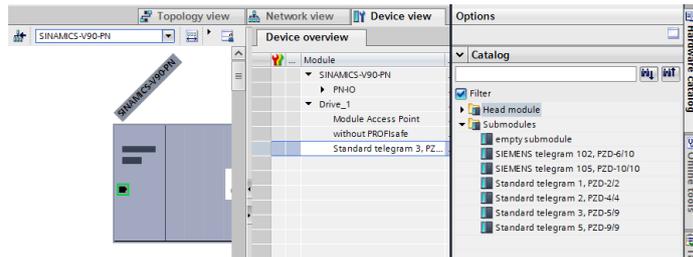
Here, you can configure information about the device name, Ethernet address...

<b>NOTE</b>	<b>Important!</b>
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:



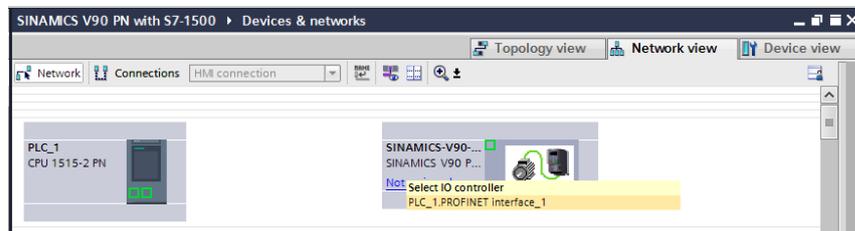
- In the device view of SINAMICS V90 PN, select the standard telegram 3 from the submodules:



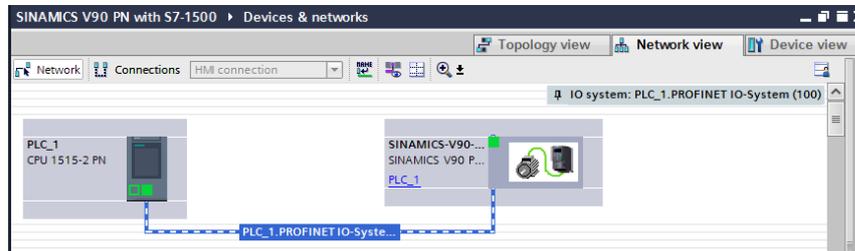
#### 4.1.2.6 Connect SINAMICS V90 PN with S7-1500 CPU

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

- In the network view, click the “Not assign” and select “PLC\_1.PROFINET Interface\_1”:



- And the connected network view is shown as follows:



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

<b>NOTICE</b>	<b>Important!</b> The topology is absolutely necessary and important!
---------------	--

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

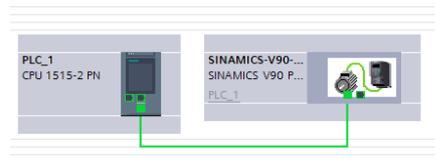
- Switch to the topology view:



## 4 Configuration

---

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

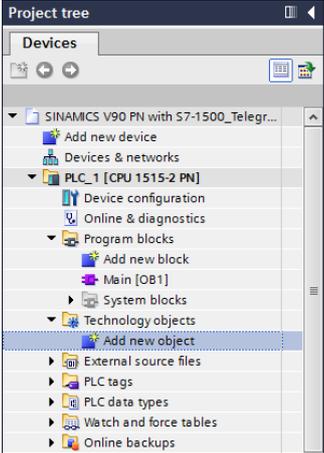
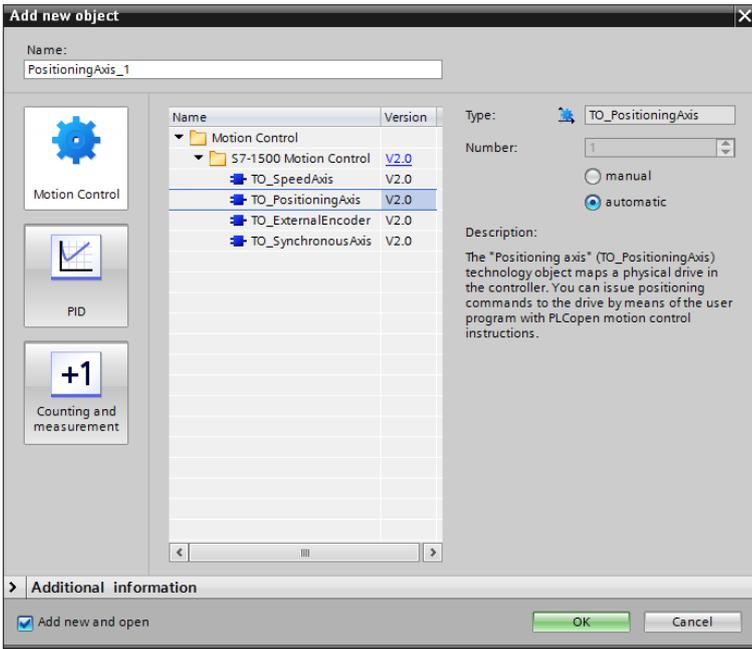


In this example, the X1 Port 1 of the S7-1500 CPU is connected to the port 1 at the drive side.

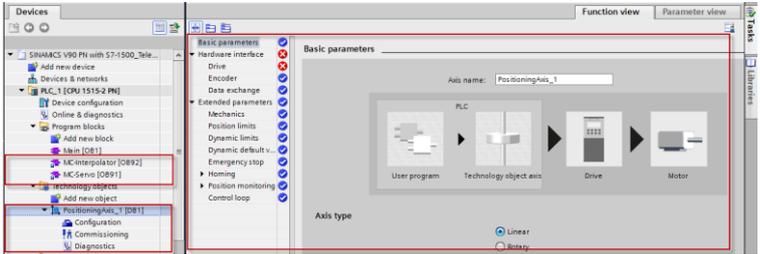
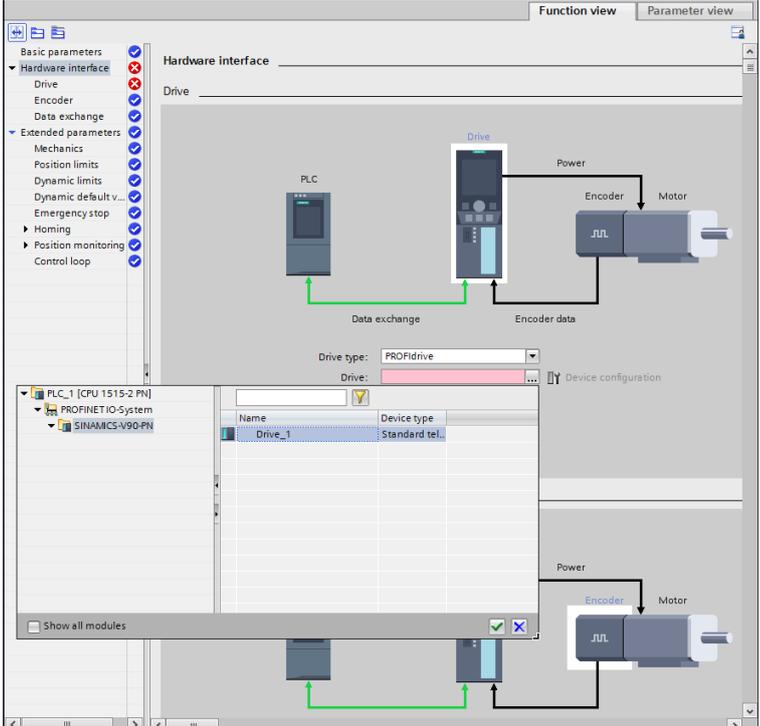
# 5 Operation of the application

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

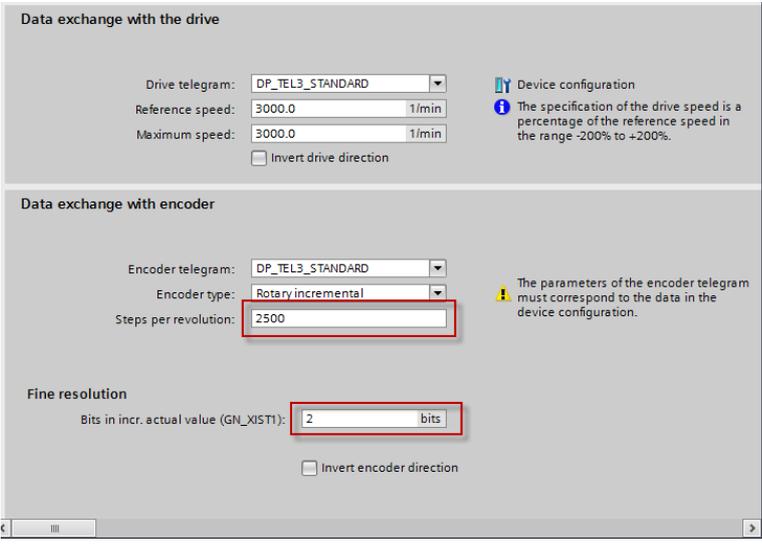
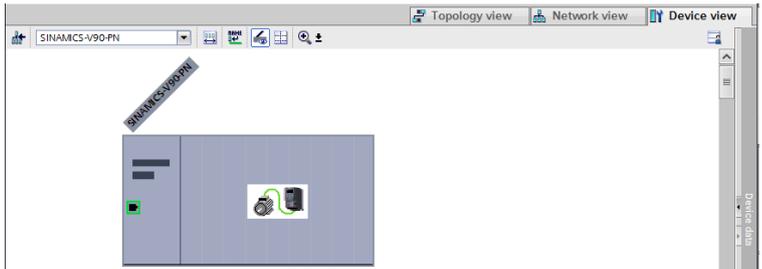
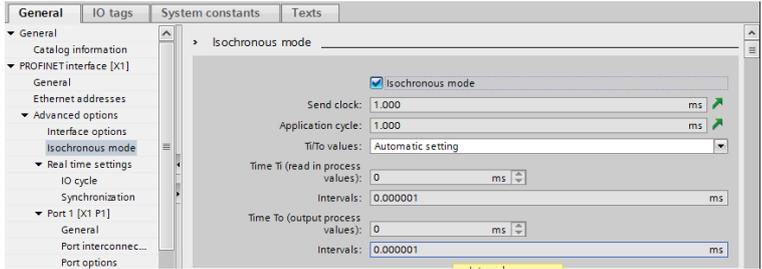
Table 5-1

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> 	

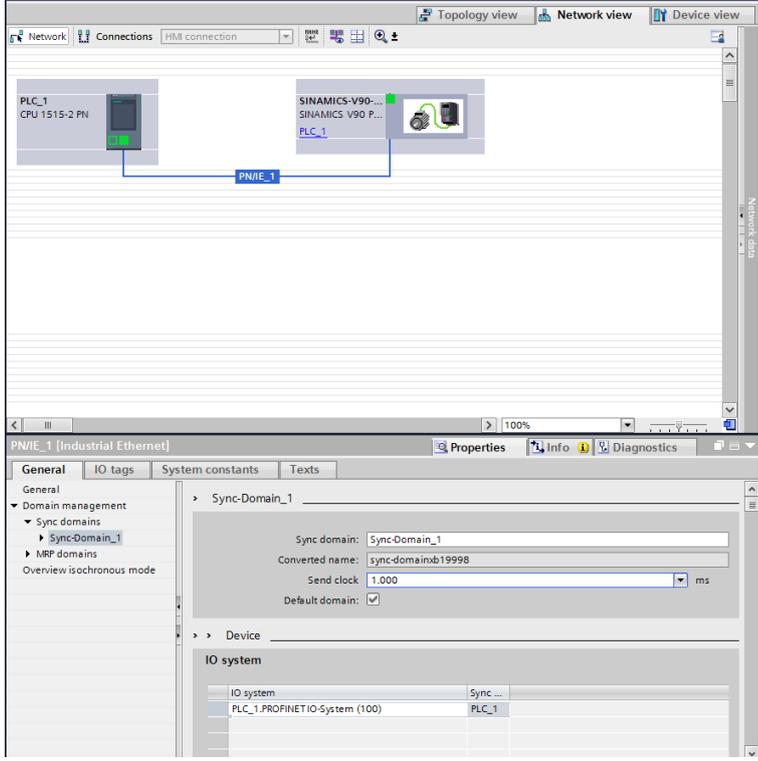
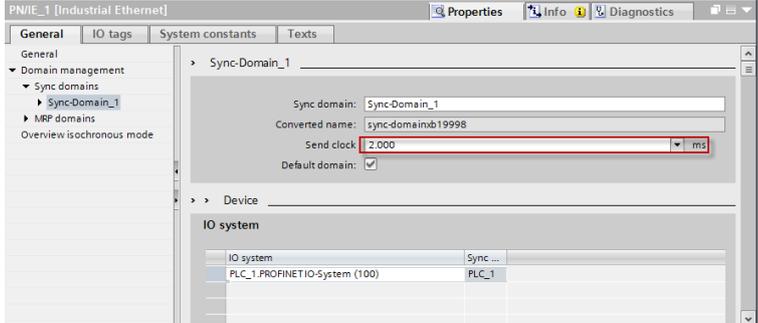
## 5 Operation of the application

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>  <table border="1" data-bbox="550 1064 869 1176"> <thead> <tr> <th>Name</th> <th>Device type</th> </tr> </thead> <tbody> <tr> <td>Drive_1</td> <td>Standard tel.</td> </tr> </tbody> </table>	Name	Device type	Drive_1	Standard tel.	
Name	Device type					
Drive_1	Standard tel.					

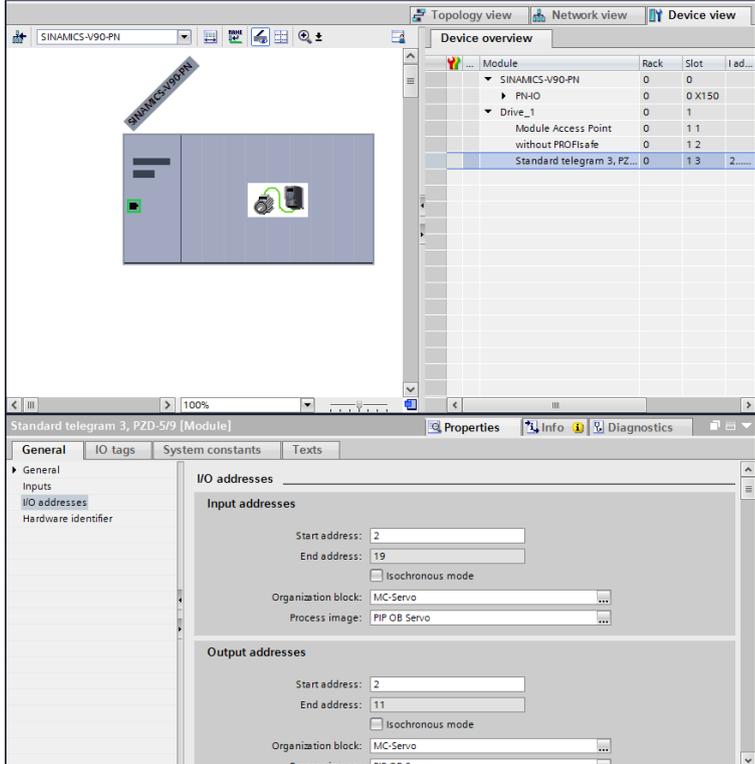
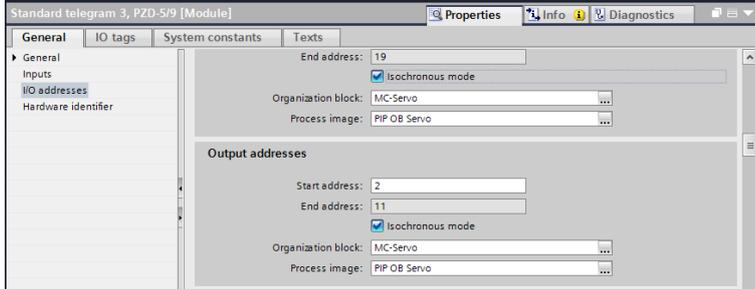
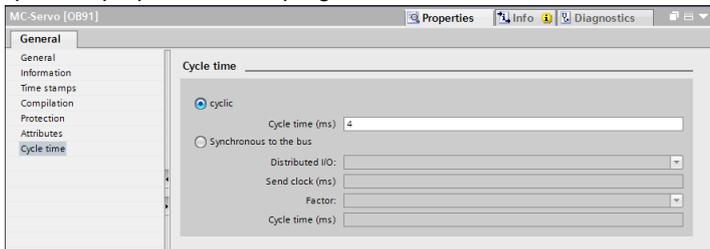
## 5 Operation of the application

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>  <p>The screenshot shows the 'Data exchange with encoder' section. The 'Encoder telegram' is set to 'DP_TEL3_STANDARD'. The 'Encoder type' is 'Rotary incremental'. The 'Steps per revolution' is '2500'. The 'Fine resolution' section shows 'Bits in incr. actual value (GN_XIST1)' set to '2 bits'. There are also sections for 'Data exchange with the drive' and 'Fine resolution'.</p>	
6.	<p>Switch to the device view of the SINAMICS V90 PN:</p>  <p>The screenshot shows the 'Device view' of the software. The 'SINAMICS-V90-PN' device is selected and displayed in a 3D perspective view.</p>	
7.	<p>Open the device properties of SINAMICS V90 PN by double-clicking the V90 PN image.</p> <p>Select the checkbox of <b>“Isochronous mode”</b> from the tab of <b>“Isochronous mode”</b> to activate the IRT mode:</p>  <p>The screenshot shows the 'Isochronous mode' configuration tab. The 'Isochronous mode' checkbox is checked. Other parameters include 'Send clock: 1.000 ms', 'Application cycle: 1.000 ms', 'TiTo values: Automatic setting', 'Time Ti (read in process values): 0 ms', 'Intervals: 0.000001 ms', 'Time To (output process values): 0 ms', and 'Intervals: 0.000001 ms'.</p>	

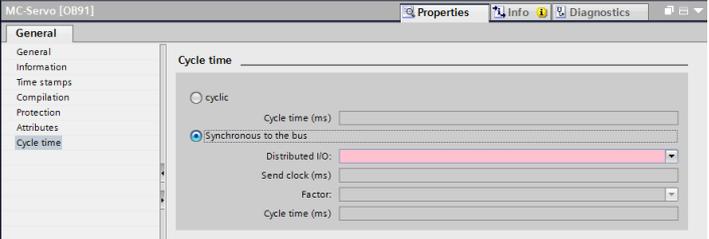
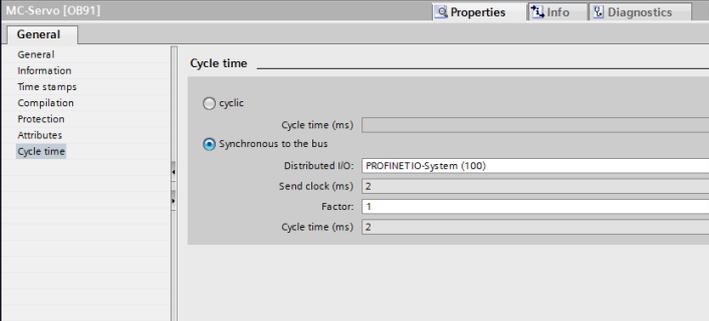
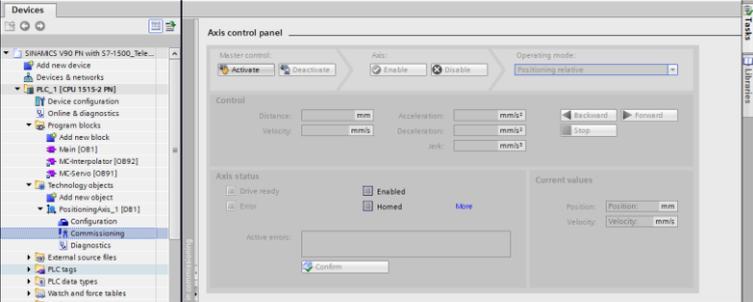
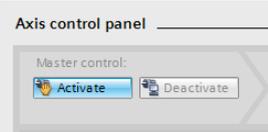
## 5 Operation of the application

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><b>Note:</b> The send clock for SINAMICS V90 PN now is limited to 2 ms.</p>

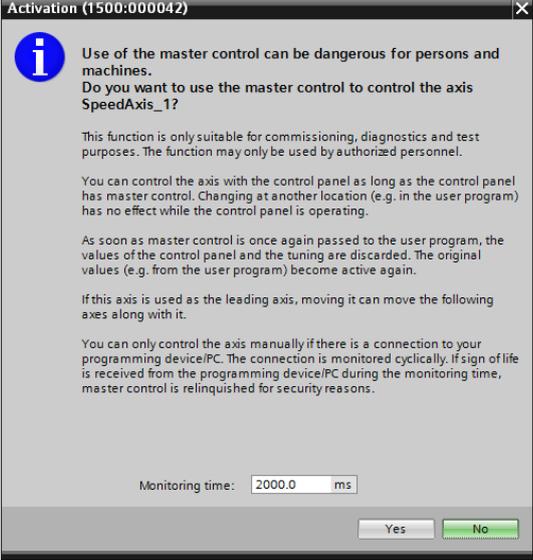
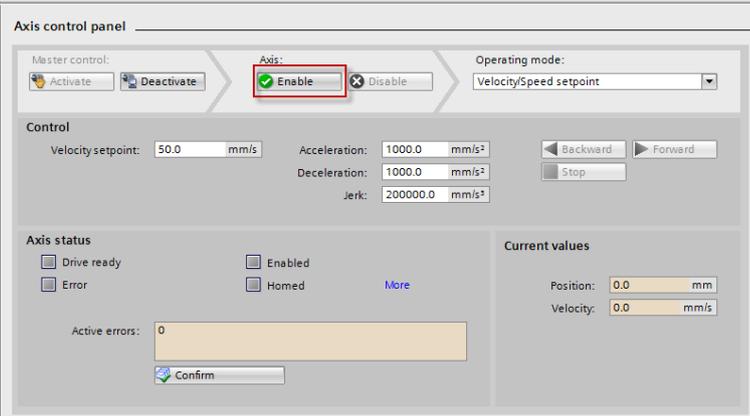
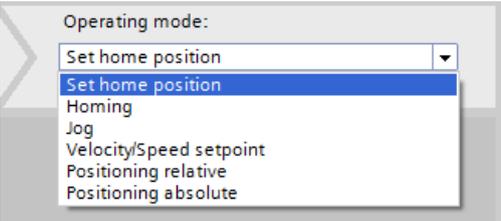
## 5 Operation of the application

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

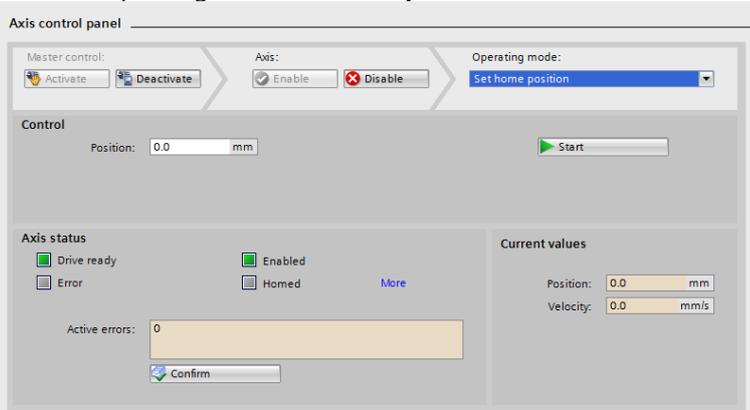
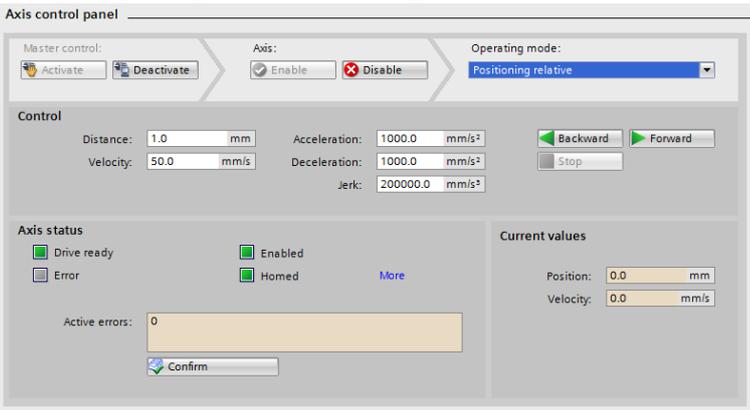
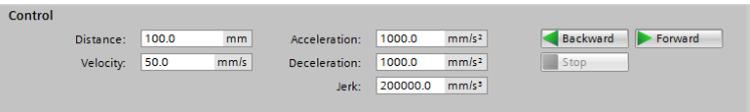
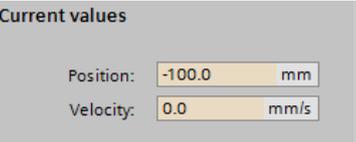
## 5 Operation of the application

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

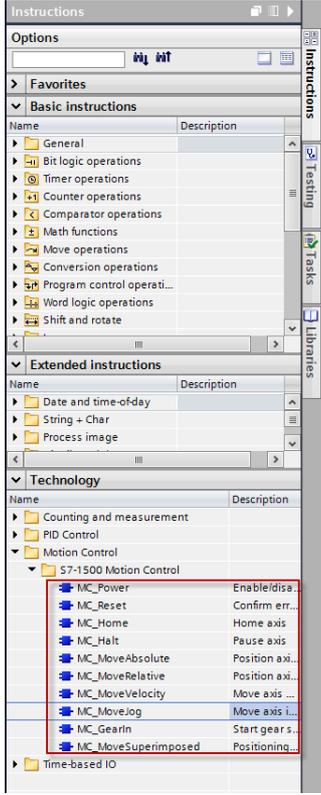
## 5 Operation of the application

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> 	

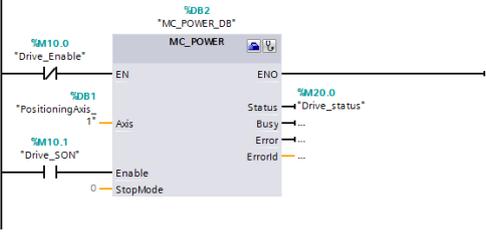
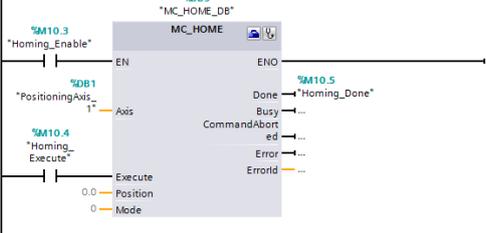
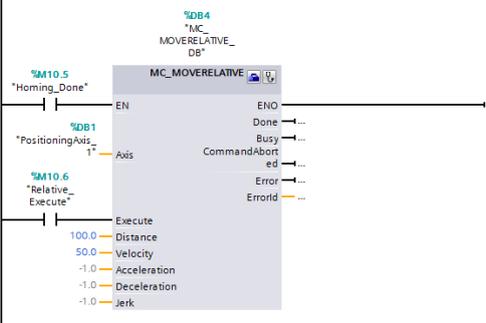
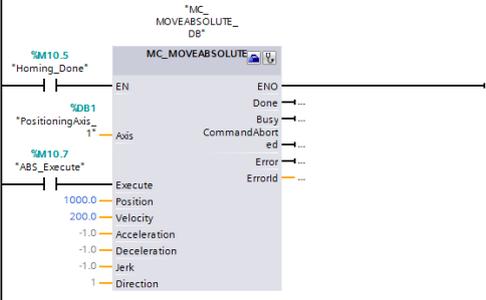
## 5 Operation of the application

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

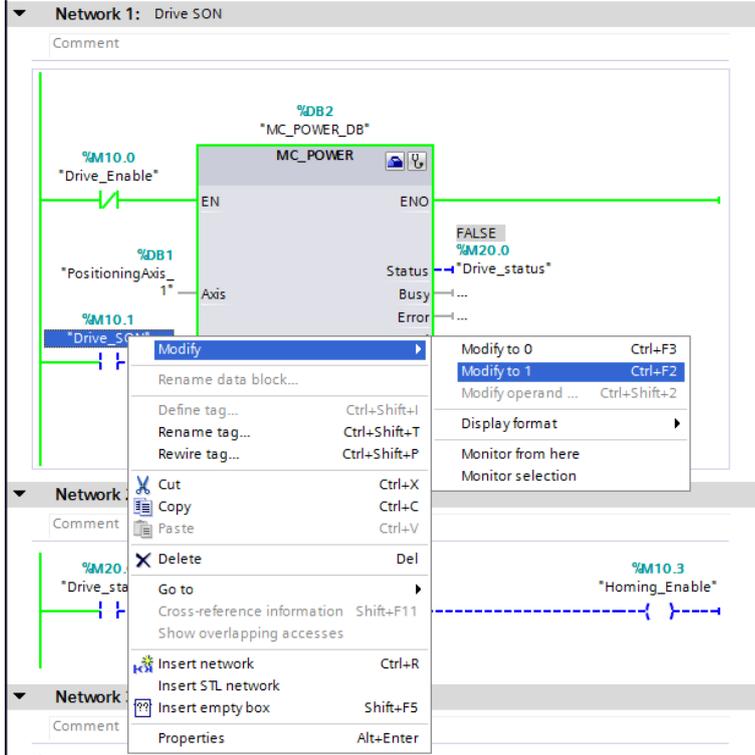
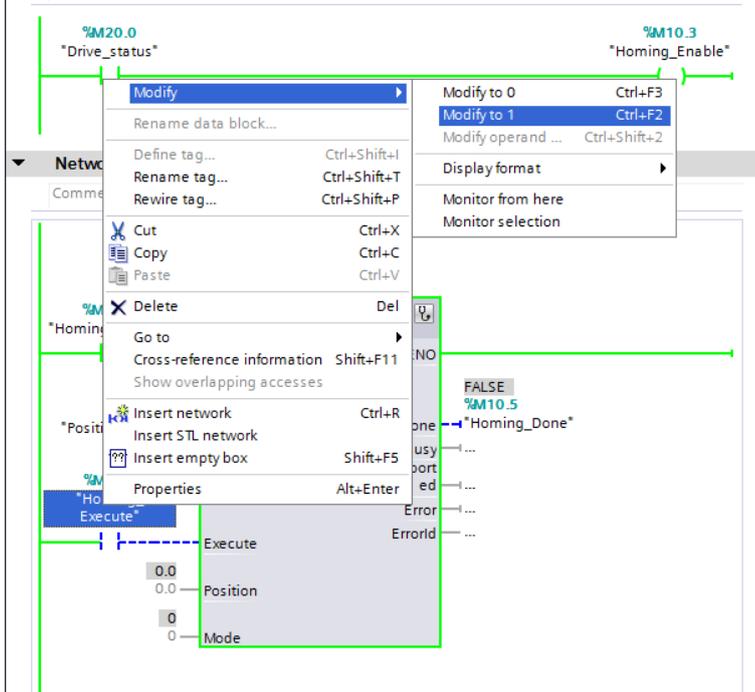
## 5 Operation of the application

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

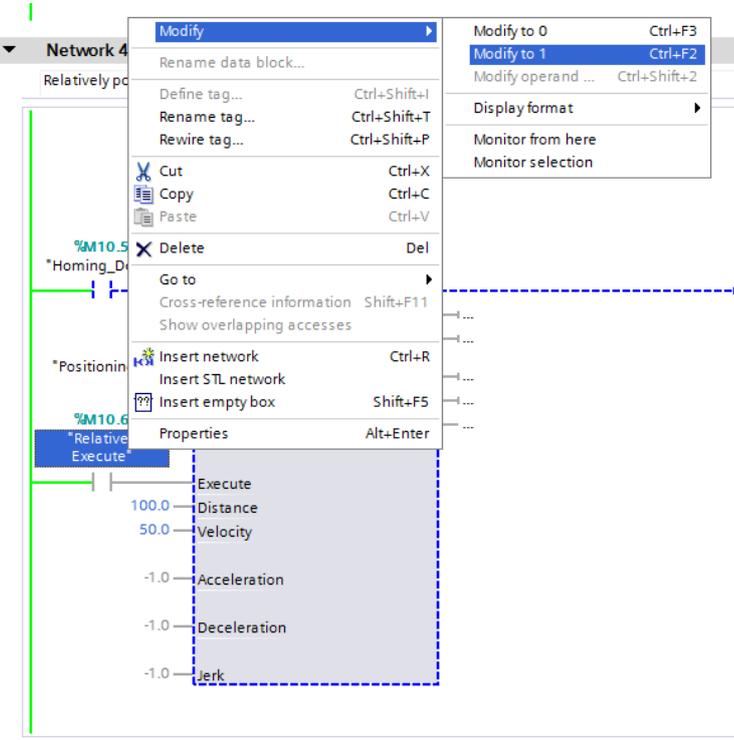
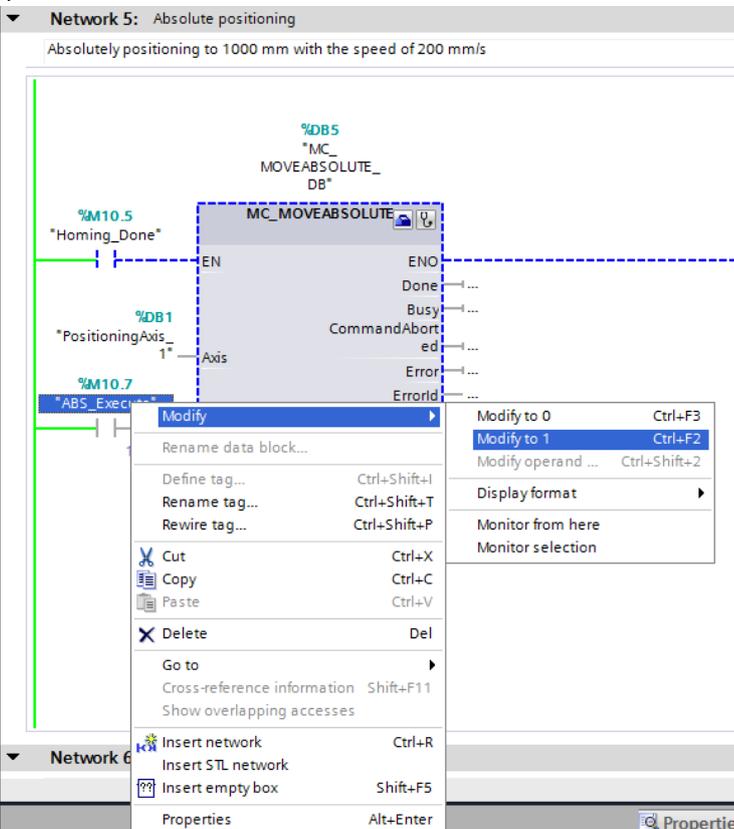
## 5 Operation of the application

No.	Action	Remarks
28.	<p>Program as follows:</p> <p><b>Network 1: Drive SON</b></p> <p>Comment</p>  <p><b>Network 2: ...</b></p> <p>Comment</p>  <p><b>Network 3: Homing</b></p> <p>Comment</p>  <p><b>Network 4: Relative positioning</b></p> <p>Relatively positioning for 100 mm with the speed of 50 mm/s</p>  <p><b>Network 5: Absolute positioning</b></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.	

## 5 Operation of the application

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

## 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 <a href="https://support.industry.siemens.com">https://support.industry.siemens.com</a>
\2\	Download page of this entry <a href="https://support.industry.siemens.com/cs/ww/en/view/109739053">https://support.industry.siemens.com/cs/ww/en/view/109739053</a>
\3\	

## 7 Contact

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## 8 History

Table 8-1

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