Using Synapticon PROFINET Library - TIA Portal Example

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It is recommended to understand all components, safety information, and precautions for correct operation prior to use. Refer to, and retain, this documentation for reference.

ATTENTION
Synapticon products must be used in accordance with all specified safety requirements, i.e., all standards and regulations, applicable laws.

1.3. Warnings

Boxes are used to indicate potentially dangerous situations as follows:

NOTE
Background information that is not necessarily required for basic operation but for optimal performance.

IMPORTANT
Required for correct functionality. Ignoring these facts may result in erratic behavior or lack of function.

ATTENTION
Indicates a situation that could possibly lead to serious accidents and/or destruction of the servo drive.

DANGER
If these warnings are ignored, hazardous and potentially fatal situations may arise from improper or careless use.

1.4. Reporting Errors

It is in our best interest to provide detailed, user-oriented and error-free documentation. If something is missing, incomprehensible or incorrect, go to Suggest Documentation Improvement and complete the form displayed there. In the “Link to documentation page” field, enter **Using Synapticon PROFINET Library - TIA Portal Example v1.1**.

1.5. Versioning

This documentation will be constantly updated and improved. The version in the footer reflects the current documentation release.

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2. Disclaimer

This document provides an example of how to use SOMANET drives with the *Siemens TIA Portal*.

The included code is an example and should not be taken verbatim. When in doubt, refer to the original Siemens and/or Synapticon SOMANET documentation.

NOTE
Synapticon GmbH refuses any responsibility for any problem or damage that may be caused by the use of the example configuration and code!

3. Overview

This document explains the steps required to turn a BLDC motor by utilizing the TIA Portal on a Windows platform with PROFINET-based Synapticon products.

3.1. Hardware

Figure 3.1 below displays a block diagram of the wiring used in this example. The code and procedure described in this document assumes the use of the Siemens S7 1500 PLC; however, any PROFINET-compatible PLC can be used.

> **NOTE**
> Detailed instructions and wiring diagrams for all devices can be found in Synapticon's documentation.

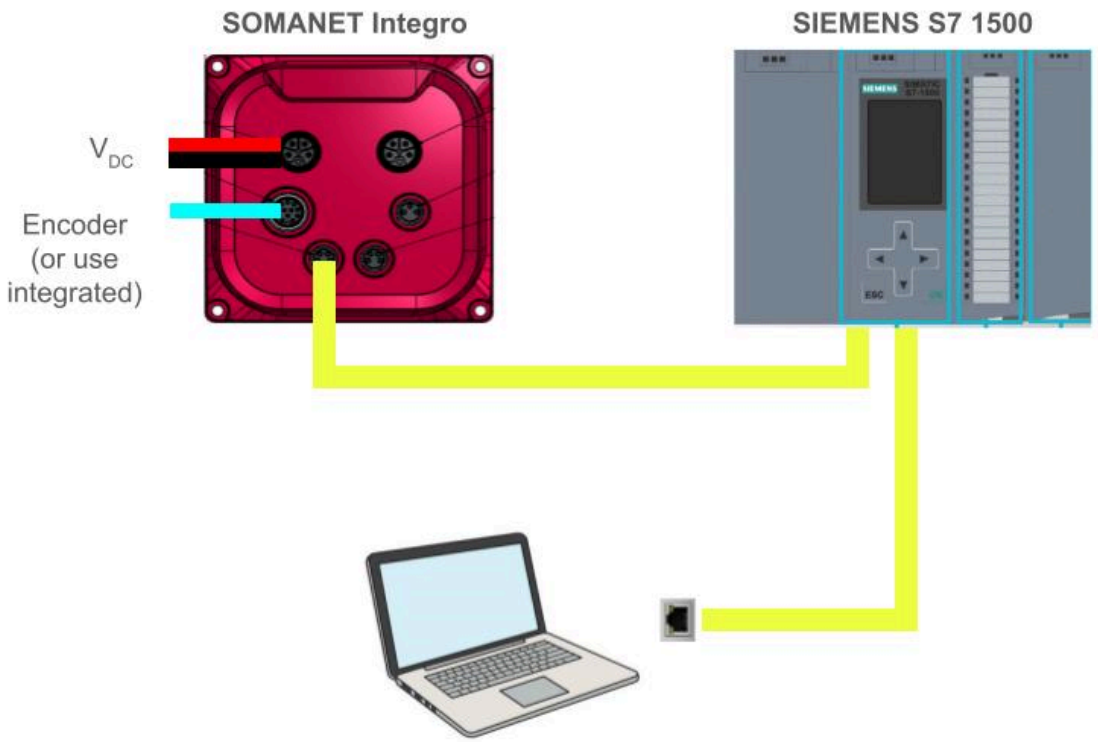

Figure 3.1 - Block diagram of the hardware setup

3.2. Software

To control the devices, *Siemens TIA Portal* software is used.
The download link of the version used in this example is available here.

> **NOTE**
> Registering with Siemens is required in order to be able to download the software.

In this section, a brief description of the installation procedure and system configuration is provided.

3.2.1. Installation

Before installing, ensure that the Microsoft .NET Framework 3.5 Service Pack 1 is installed and enabled in your Windows' features. If it is not, enable it:

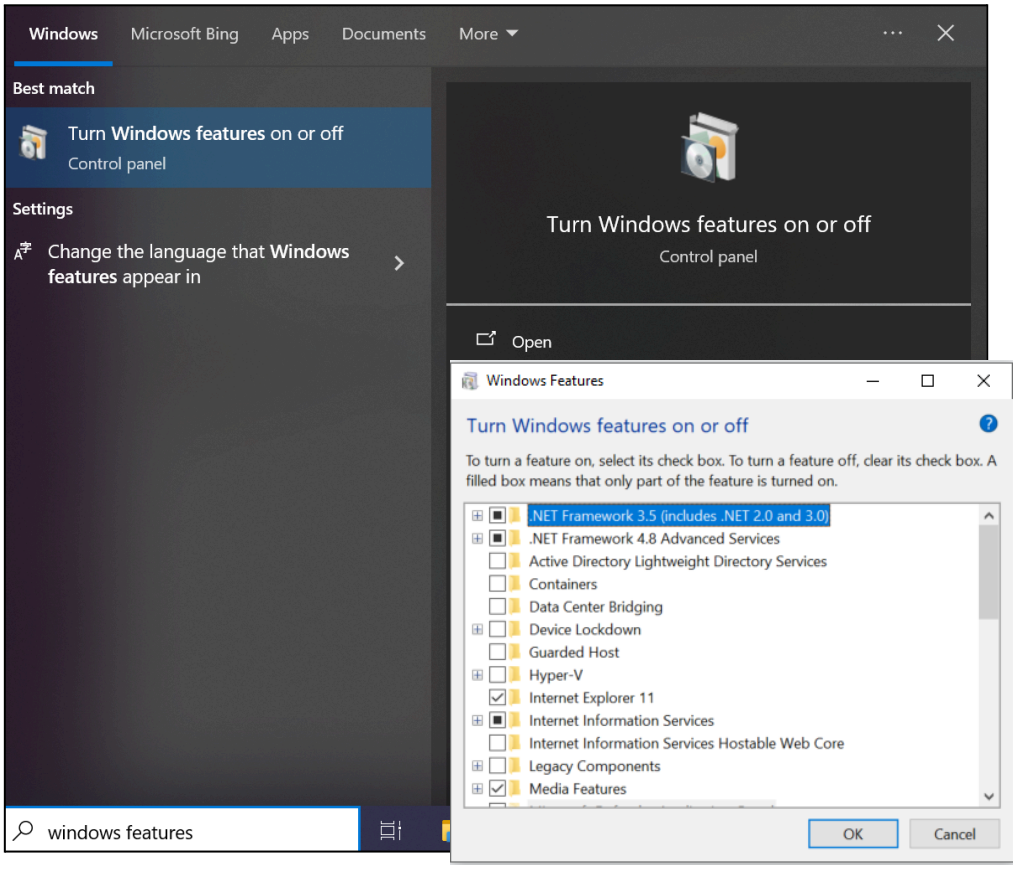

Figure 3.2 - Enable .NET Framework 3.5

Once the *.iso* file is downloaded, mount it and start the installation. Installation might require restarting your computer. Once the computer restarts, it displays a warning message that the installation medium is not found. Mount it again, press the retry button, and the installation begins.

Follow the installation instructions - selecting a typical installation as displayed in the image below - and wait until it completes the installation.

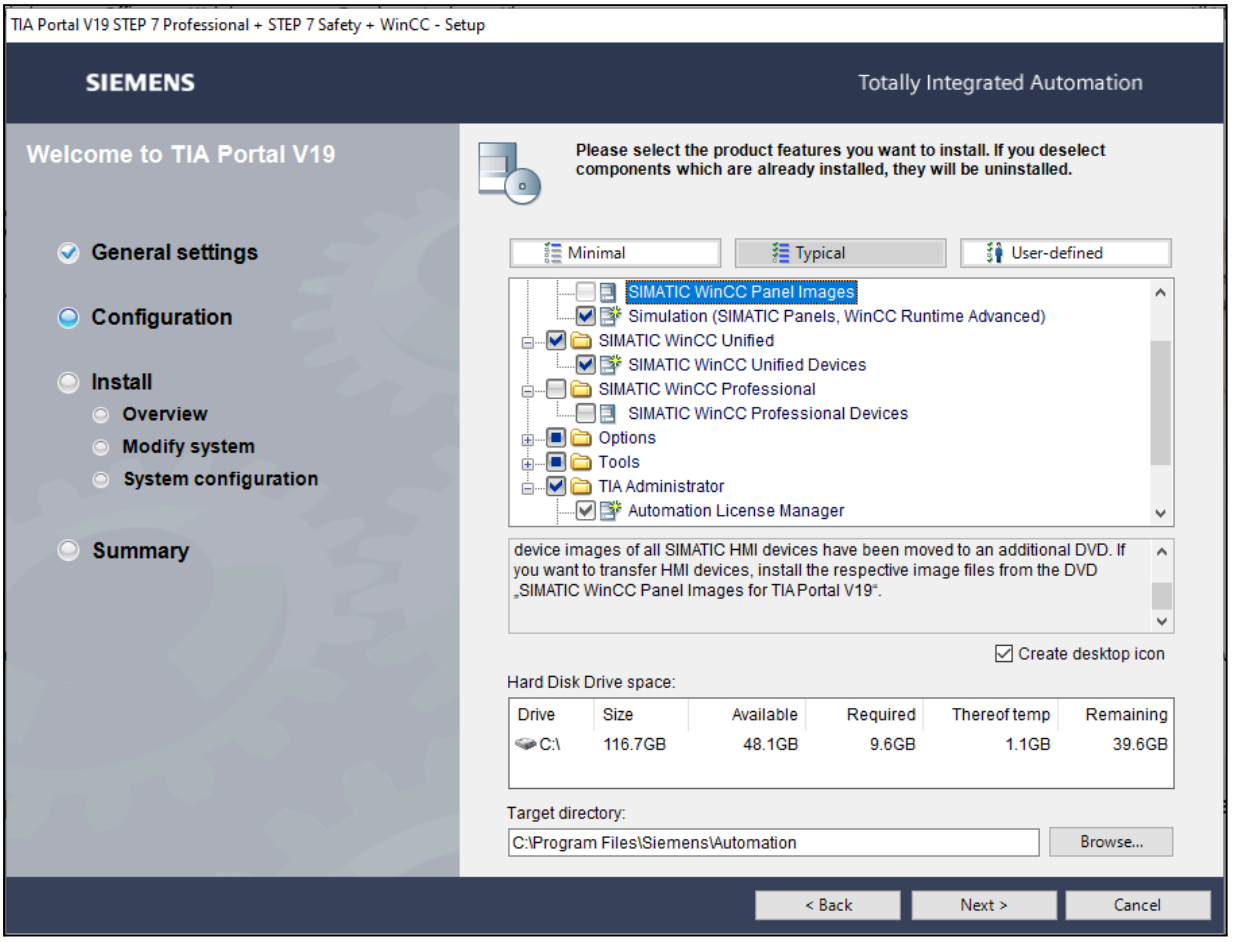

Figure 3.3 - Confirming the typical installation

Once the setup is complete, restart your computer.

3.2.2. Setting up the PG/PC Interface

A PG/PC interface - as displayed in the image below - must be established.

- Select the application access point to be an Ethernet device, which was connected to the PLC, and set the TCP/IP.Auto protocol.

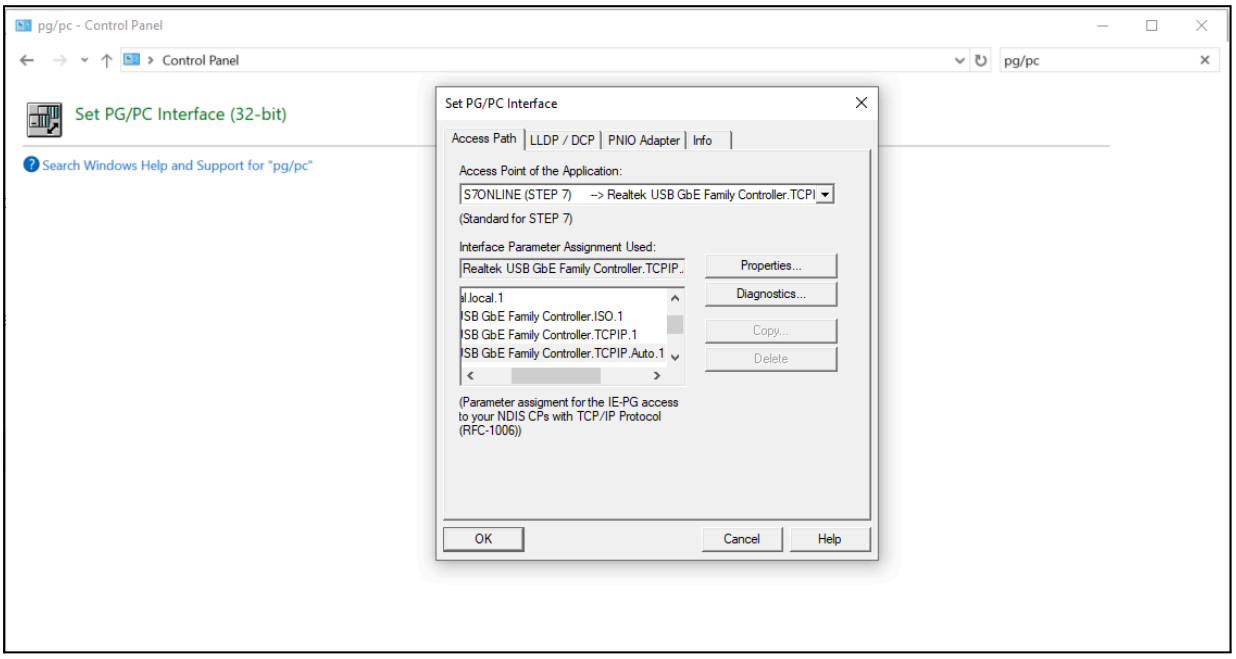

Figure 3.4 - Setting up the PG/PC interface

3.2.3. PLC IP Address

Determine the PLC's IP address. Typically, this occurs by using the PLC display and buttons. In most cases, it is displayed in the **Overview** menu.

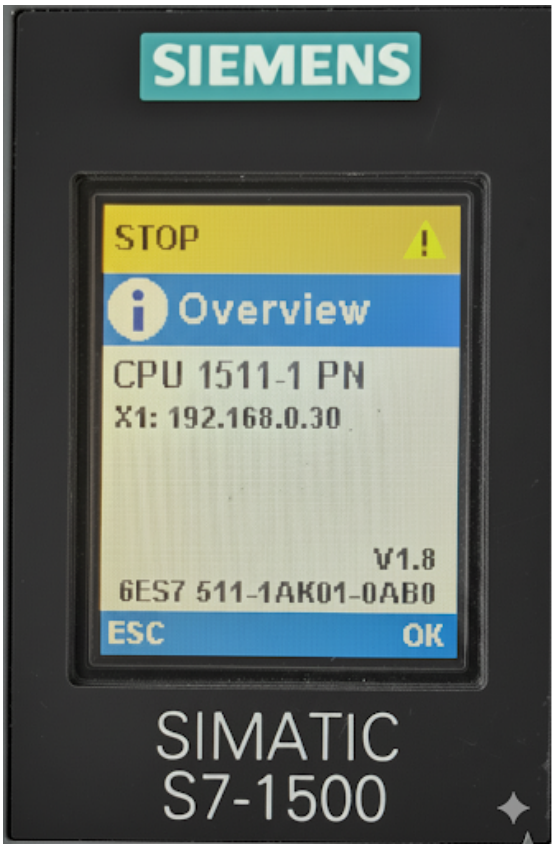

Figure 3.5 - IP address of the PLC

3.2.4. Setting up the IP Address

In order for the PC to find the PLC and Synapticon device, the Ethernet card IP must be set to have the same domain as your PLC.

To do this:

- Go to **Control Panel -> Network and Internet -> Network connections**.
- Select the Ethernet adapter, right click on it and select **Properties**.
- Next, select **Internet Protocol Version 4** and select **Properties**. Configure it as displayed in the image below.

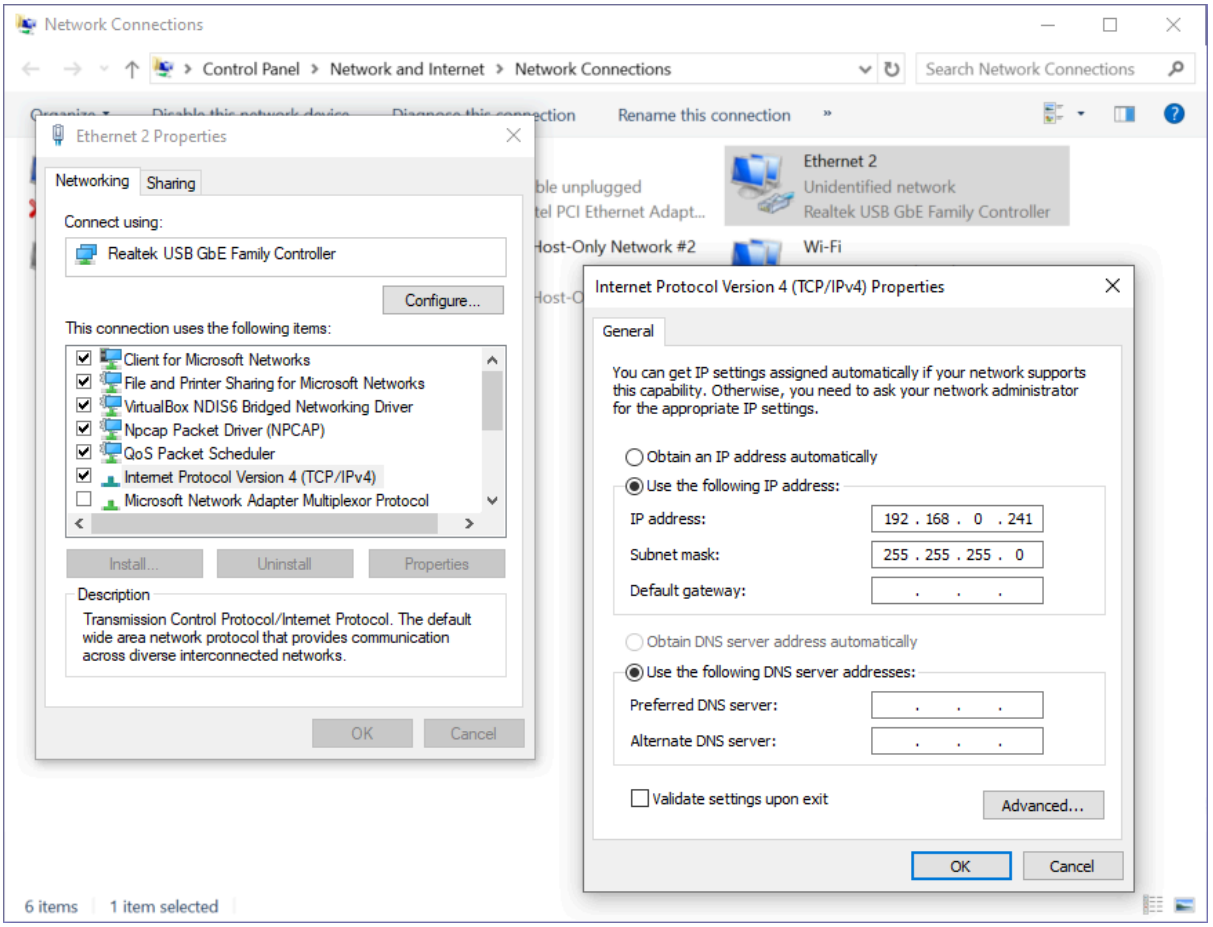

Figure 3.6 - Setting up the adapter IP address

4. Using the Synapticon Library - Example

An example program that demonstrates how to use the library can be downloaded here: Synapticon Library TIA Portal Example. This program includes all of the tags, variables and databases for the function blocks from the library itself.

To use the program, separately download the Synapticon Library.

IMPORTANT
The package provided assumes that the drive is already configured using OBLAC Drives.

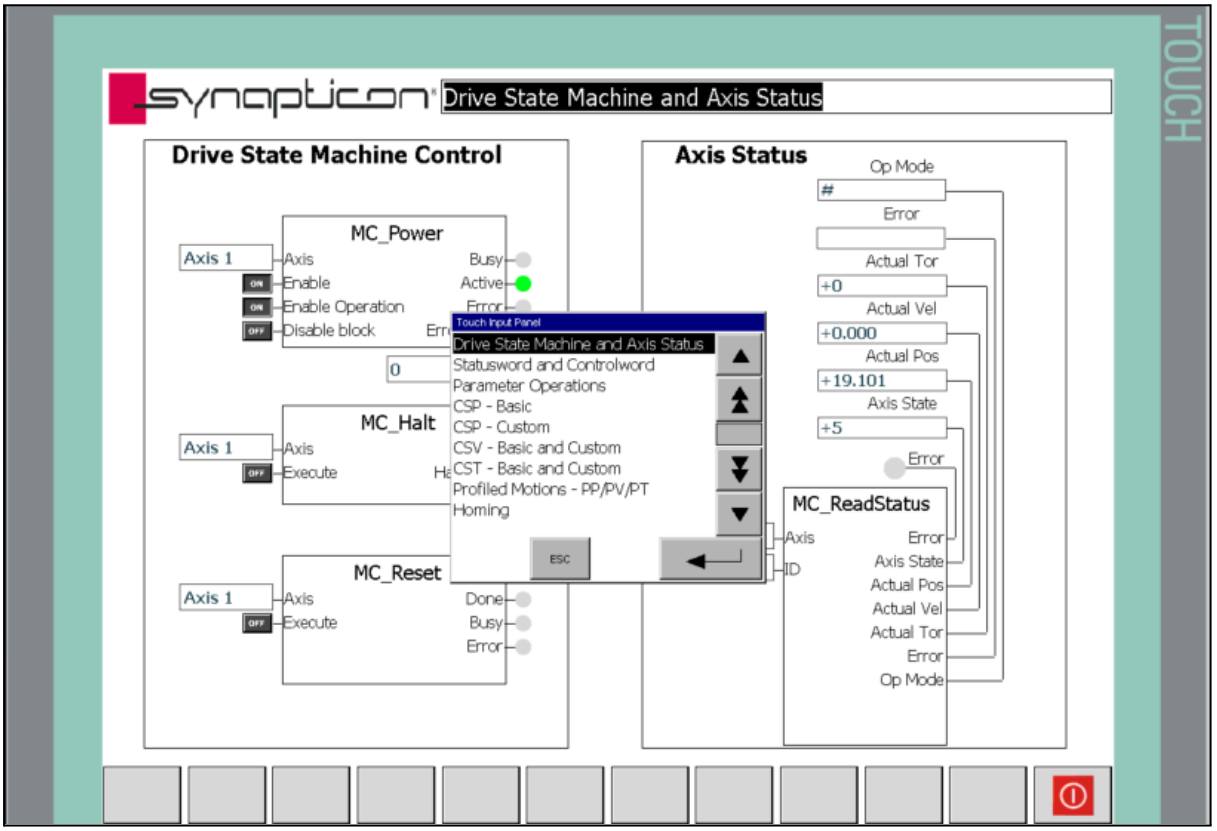

Figure 4.1 - Synapticon's Library Example in the TIA Portal - Visual Appearance

4.1. Importing the Synapticon Demo Project

Once the archived project is downloaded, it must be loaded.

To do so, in the file browser, select *Synapticon_Library_TIAPortal_example.zap19*

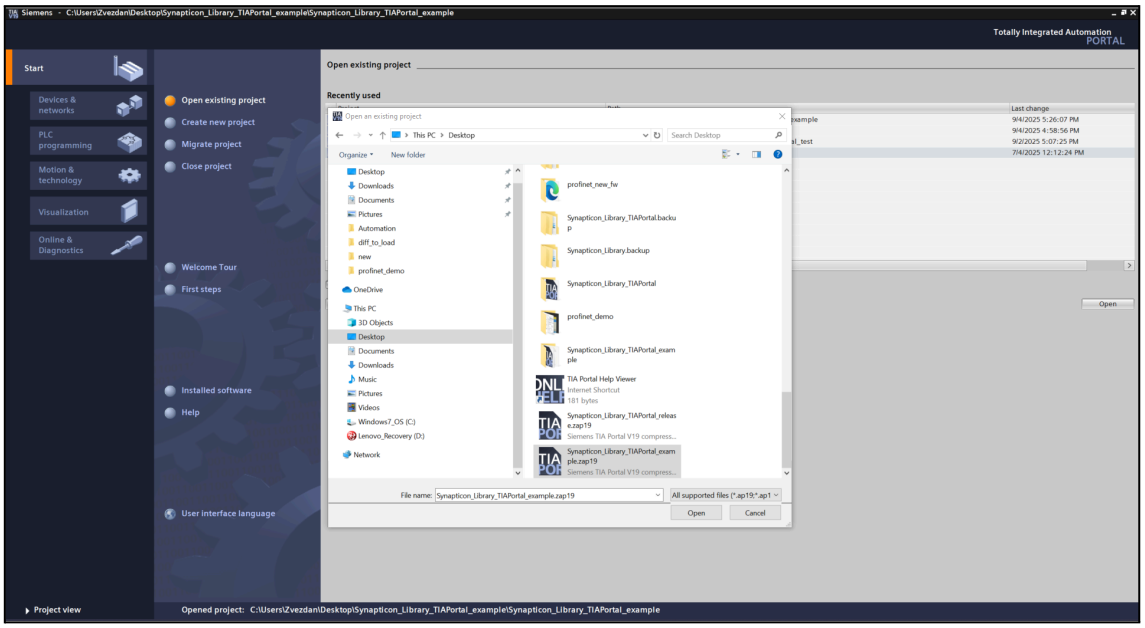

Figure 4.2 - Opening the Synapticon example archive

When loading the project, the TIA Portal prompts you to select where the unpacked project will be saved.

When this occurs, select the last option: **Open the project view**.

Figure 4.3 - Opening the project view

Once the project has opened successfully, the PLC and simulated HMI should be displayed in the left panel (as indicated in the image below):

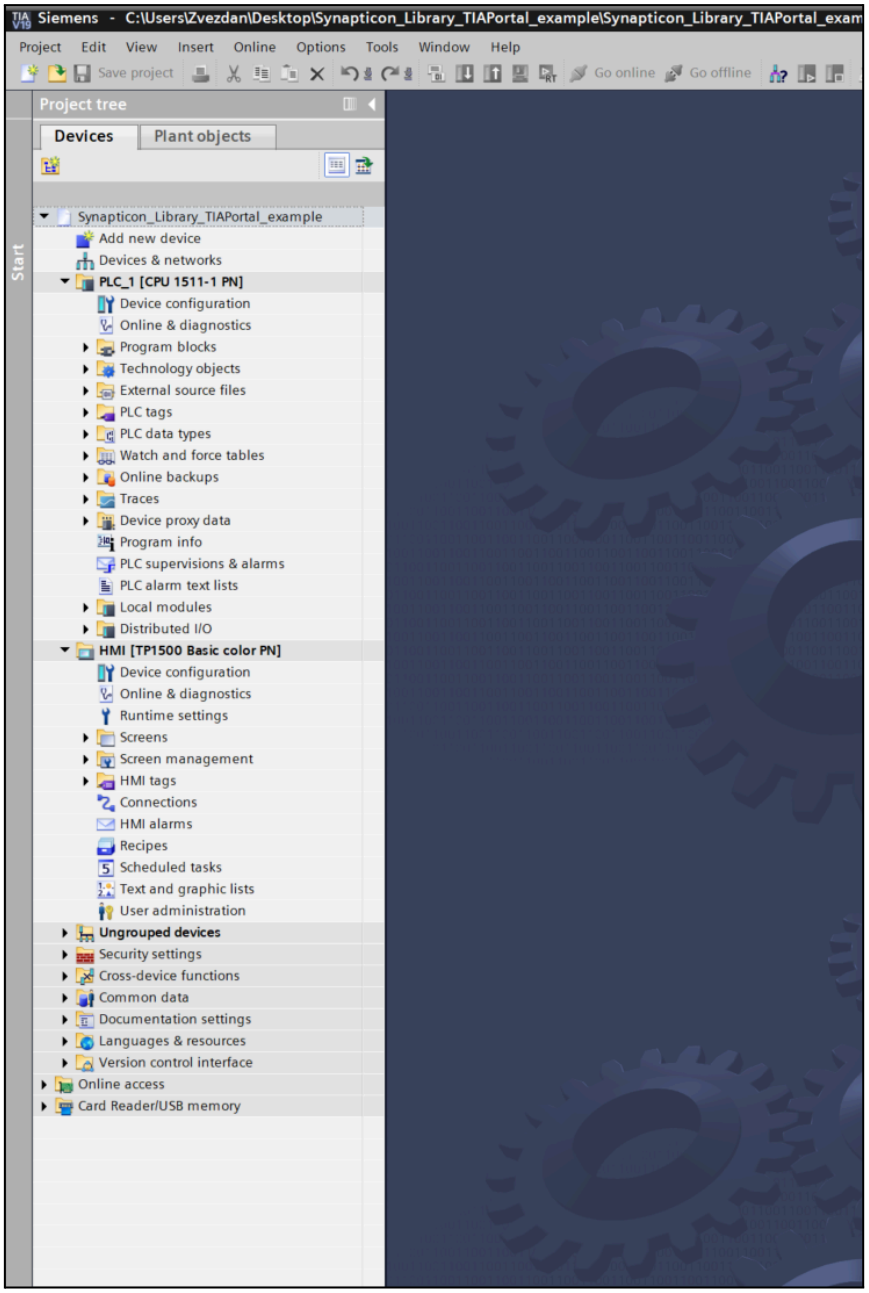

Figure 4.4 - Successfully loaded project

To select the desired PLC model to use:

- go to **Devices & networks** in the left side menu,
- select **Network view,** and
- double click on the predefined PLC.

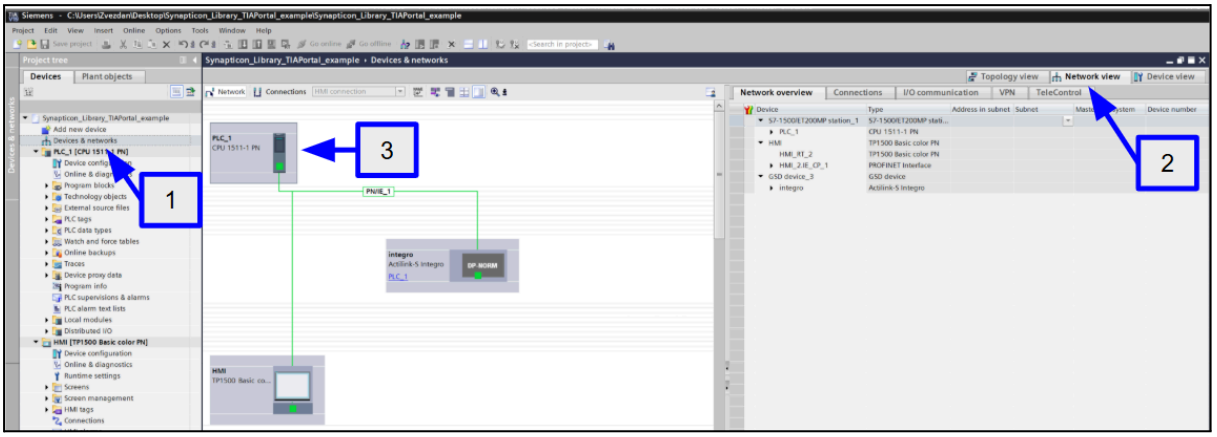

Figure 4.5 - Select the PLC in Network view

This opens the PLC in *Devices* view.

From the menu:

- right click on **PLC_1** and
- select **Change device**.

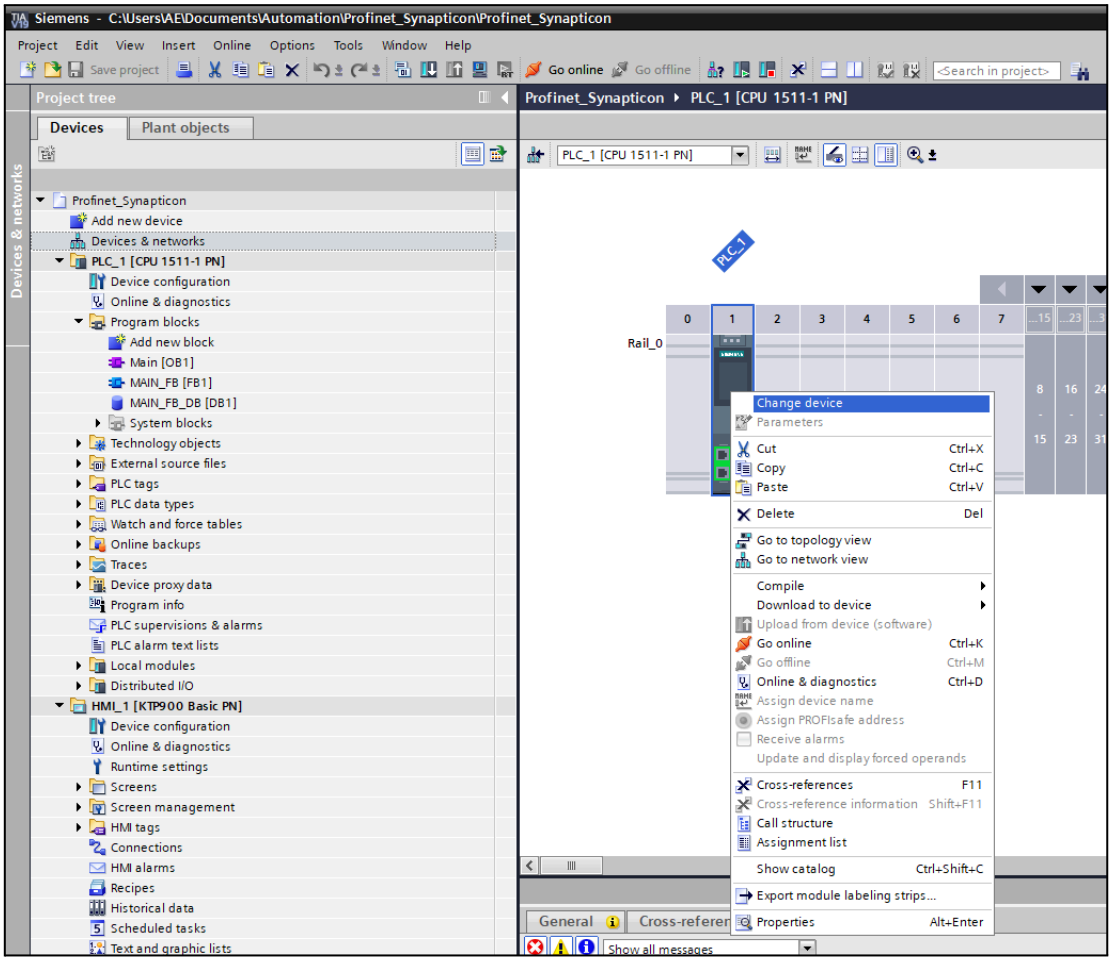

Figure 4.6 - PLC in Devices view

In the dialogue box that appears, select your new device:

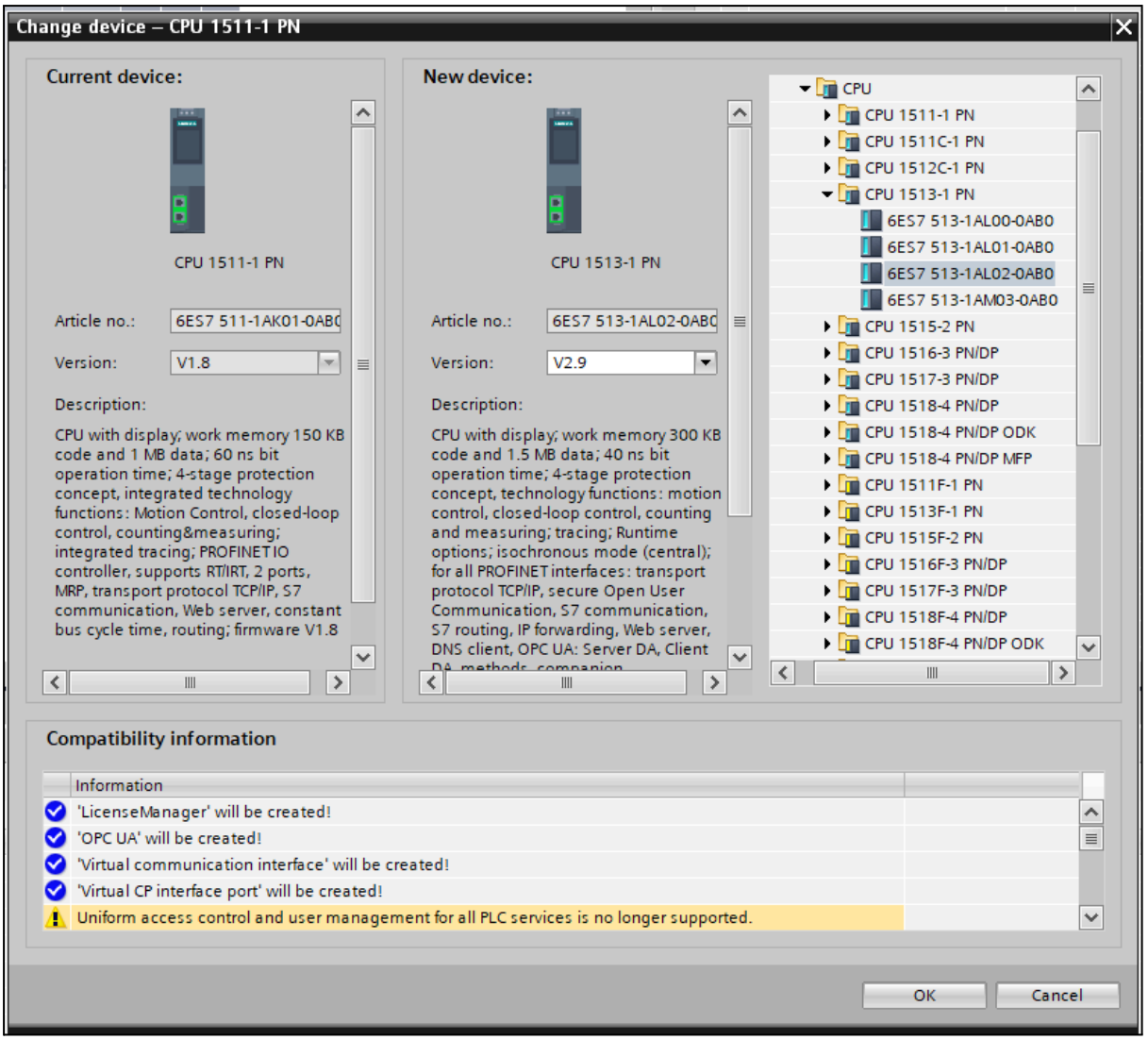

Figure 4.7 - Selecting your PLC

After confirming, a new dialogue window appears.

- Untick *Protection of confidential PLC data* and
- press the **Finish** button.

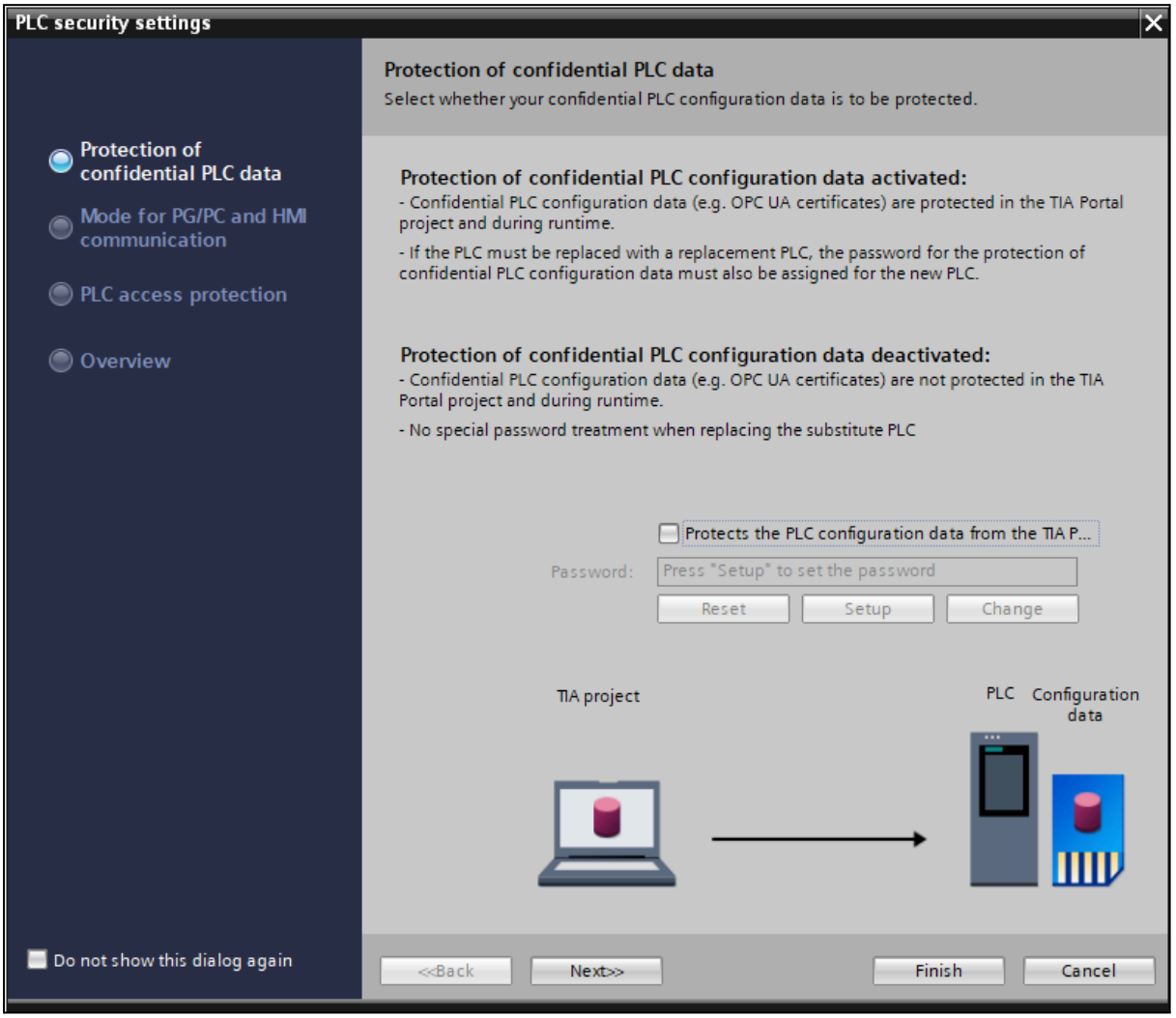

Figure 4.8 - Disable protection to avoid creating the password

The network can now be scanned for available devices:

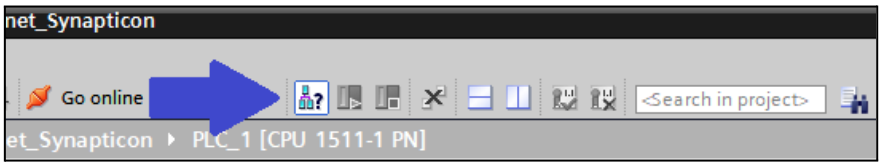

Figure 4.9 - Scan the network for available devices

- Select **PN/IE** as the type of PG/PC interface and your network card as the interface, then
- press the **Start search** button.

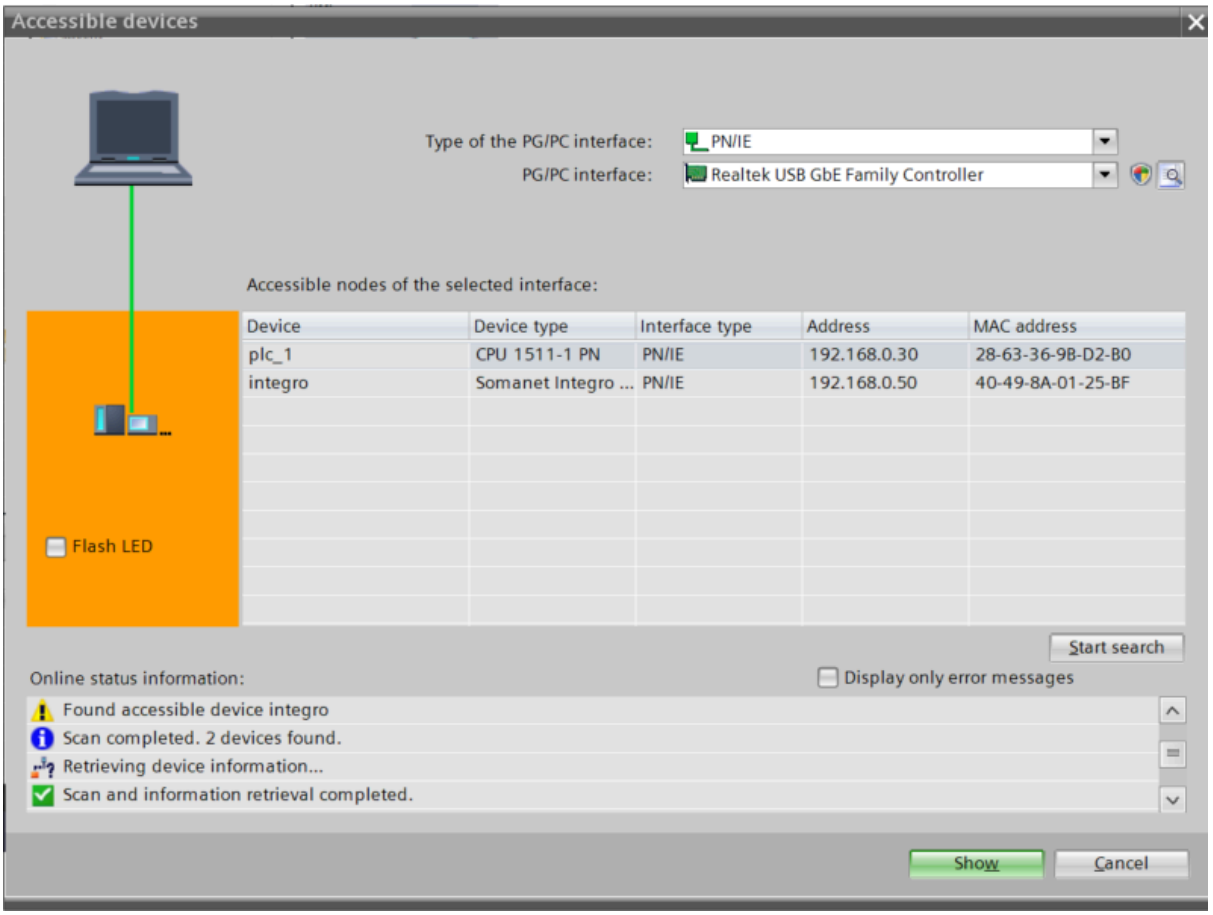

Figure 4.10 - List of Accessible devices

If both the PLC and the slave are found, remember their device name and address.

> **NOTE**
> The slave IP might not be set yet; however, the setup will be shown in the steps that follow.

- Press the **Cancel** button.

Check if the IP of the PLC is set correctly by going to the **Devices view** and double clicking on your PLC. In Ethernet addresses, enter the IP of your PLC and ensure that the name is the same as when the network was being scanned.

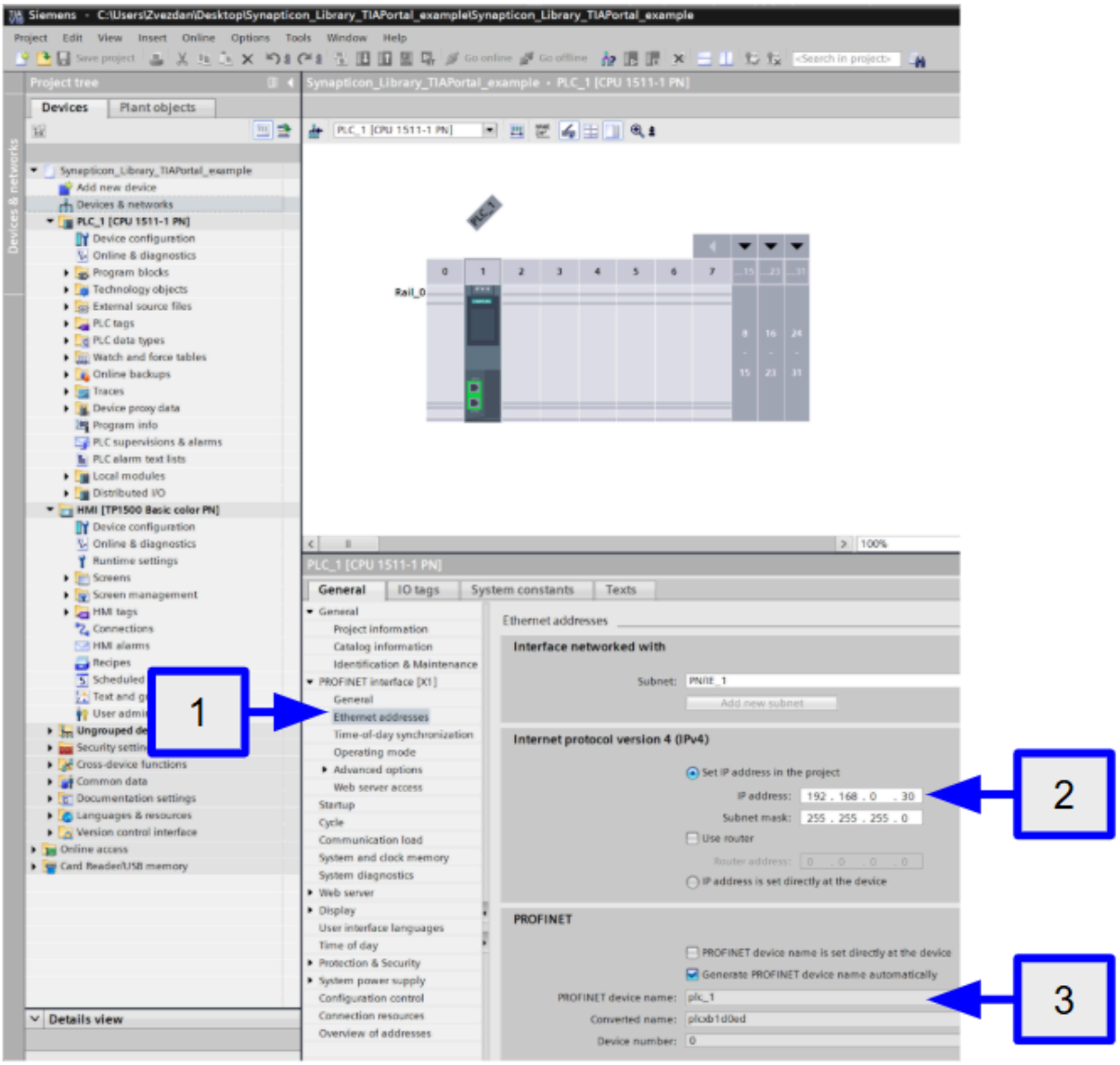

Figure 4.11 - Set the IP and the name of PLC

Additionally, the address and name of the slave must be set.
The steps are shown below:

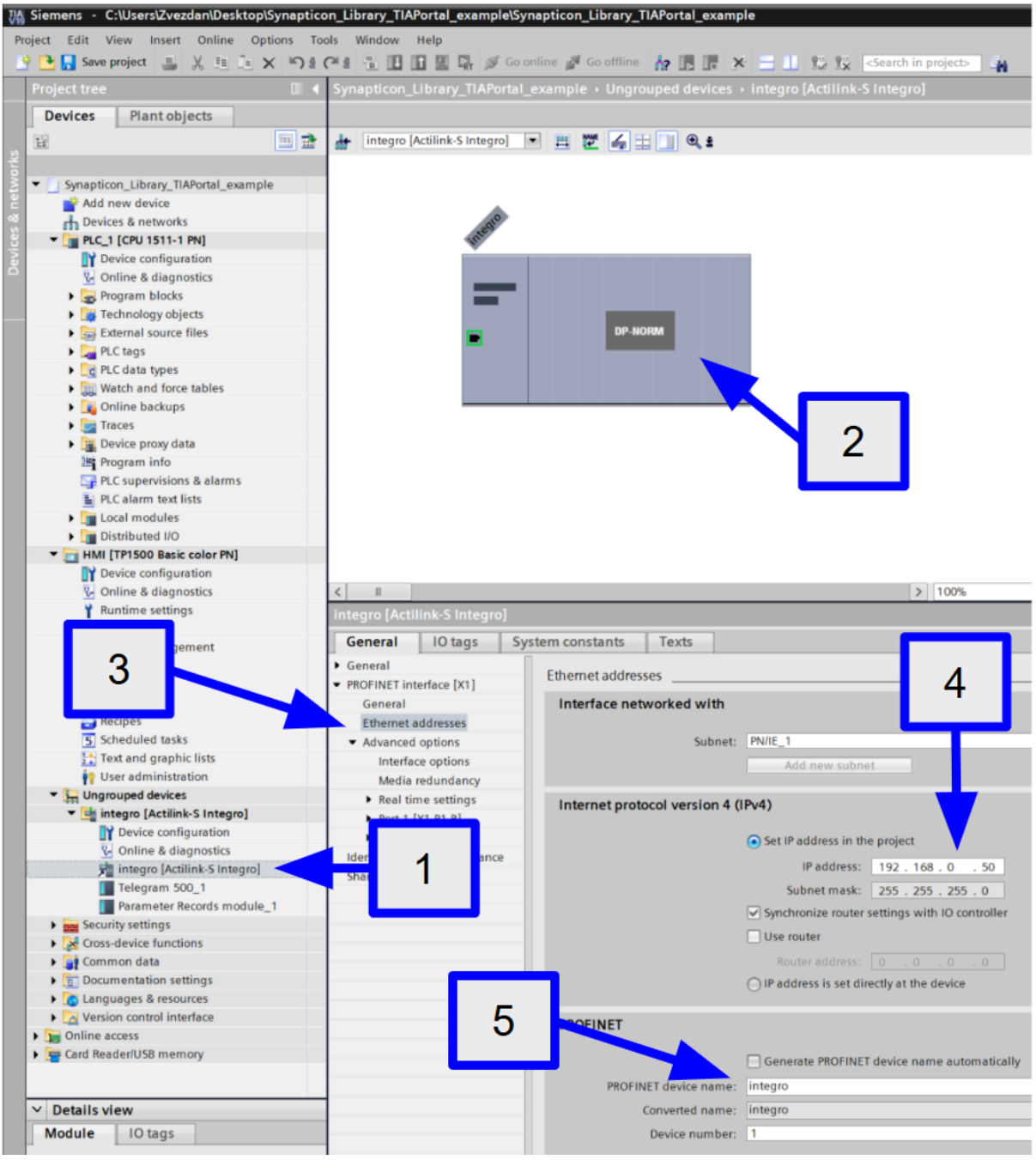

Figure 4.12 - Set the IP and the name of the drive

The IP for the simulated HMI must also be established:

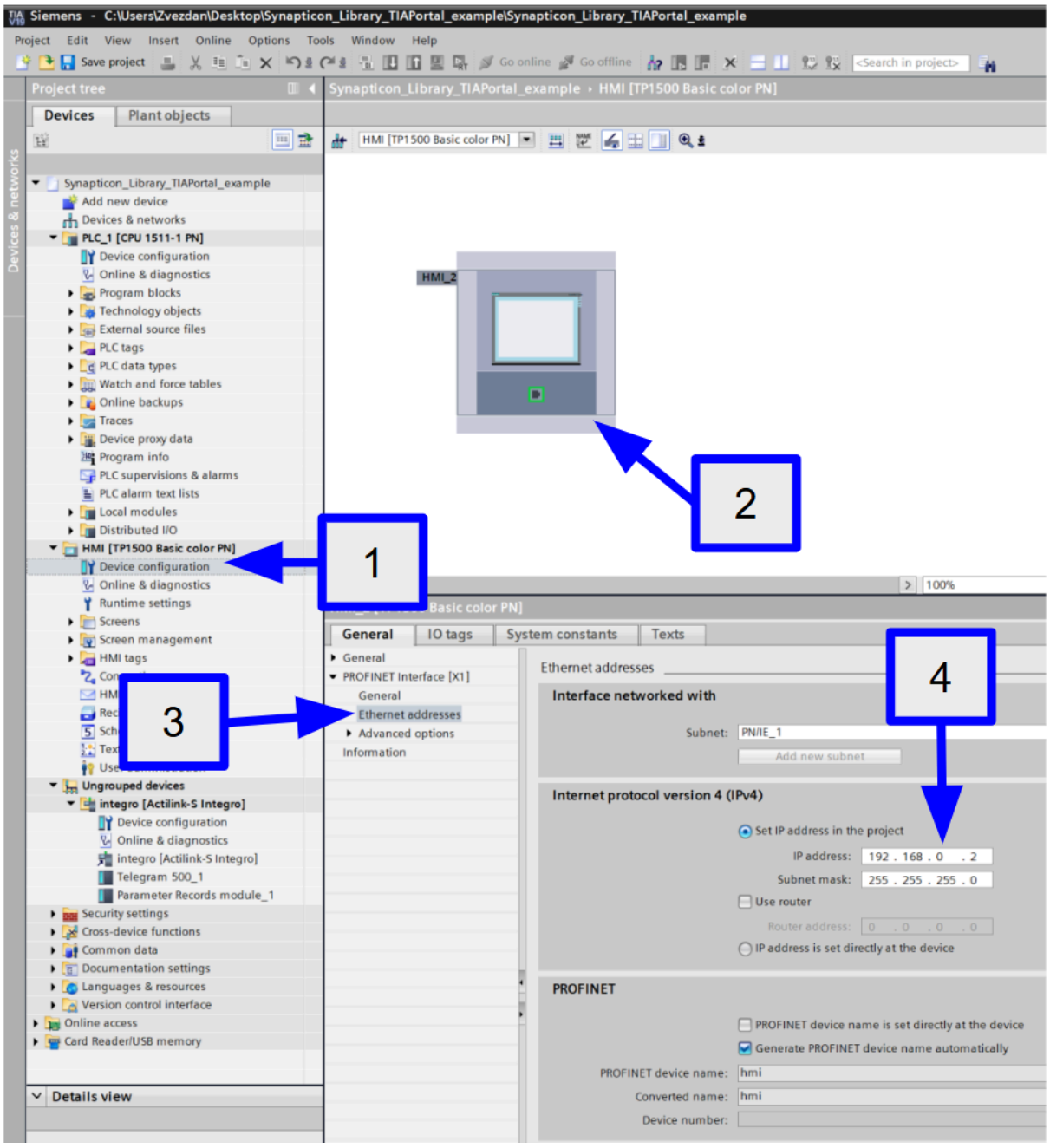

Figure 4.13 - Set the IP of the simulated HMI

To import the library file, follow the steps below as displayed in Figure 4.14.

1. Select the Libraries tab on the right.
2. Press “Open global library”
3. Switch the data type to compressed libraries.
4. Select the downloaded file.

After following the above steps, select the location for the extracted library.

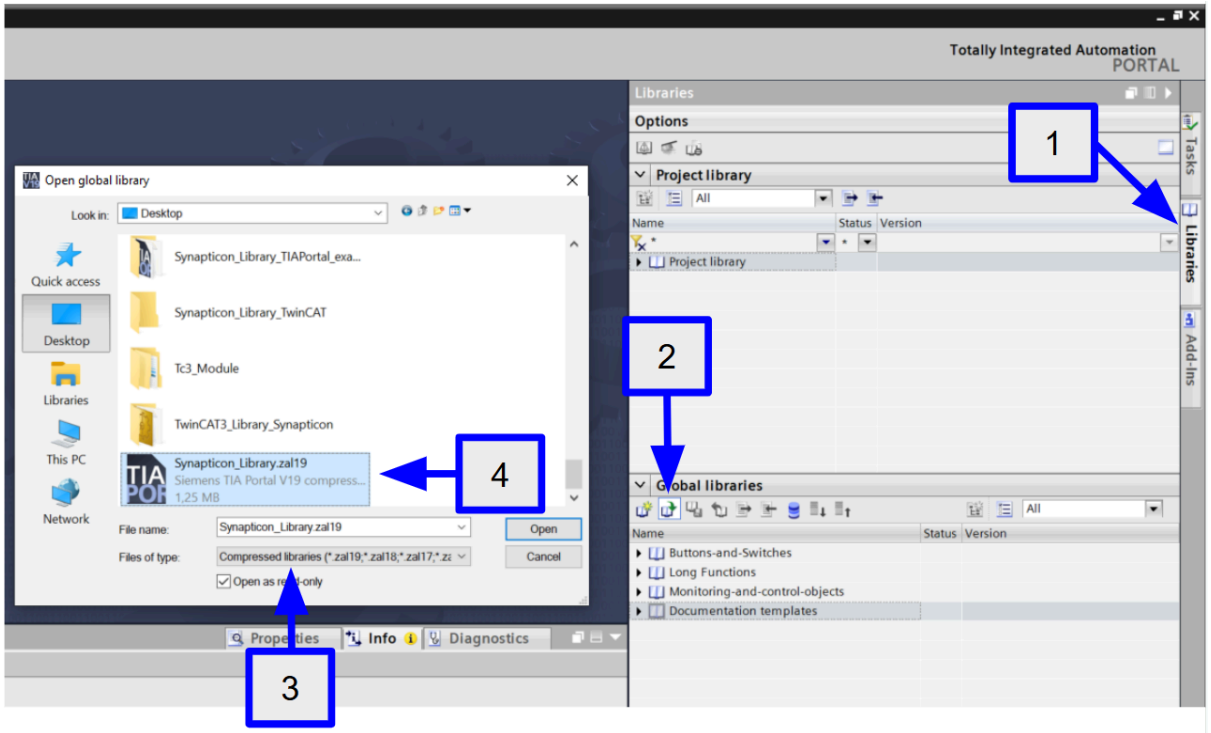

Figure 4.14 - Importing the library

Once the library is successfully loaded, it will appear at the *Global libraries* tab as displayed in the following image:

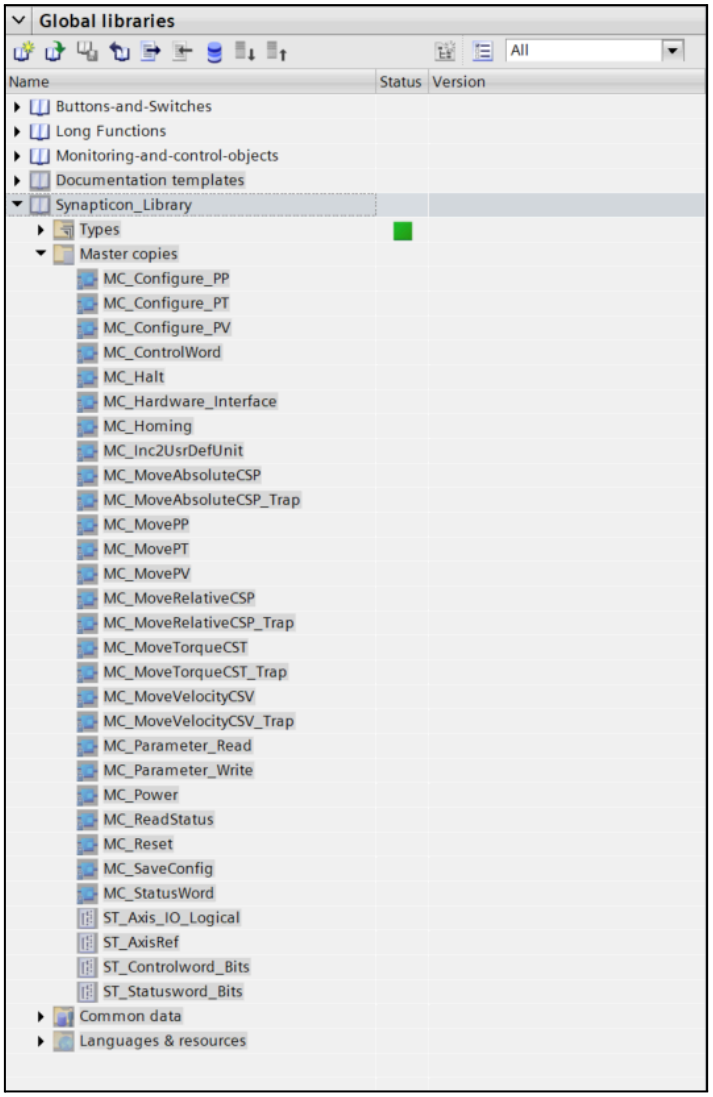

Figure 4.15 - Successfully imported library

To use the library within the example project:

- Drag and drop all of the function blocks starting with “MC_” to the *Program block* folder within the Project tree menu.
- Next, move all of the function blocks starting with “ST_” to the *PLC data types* folder.

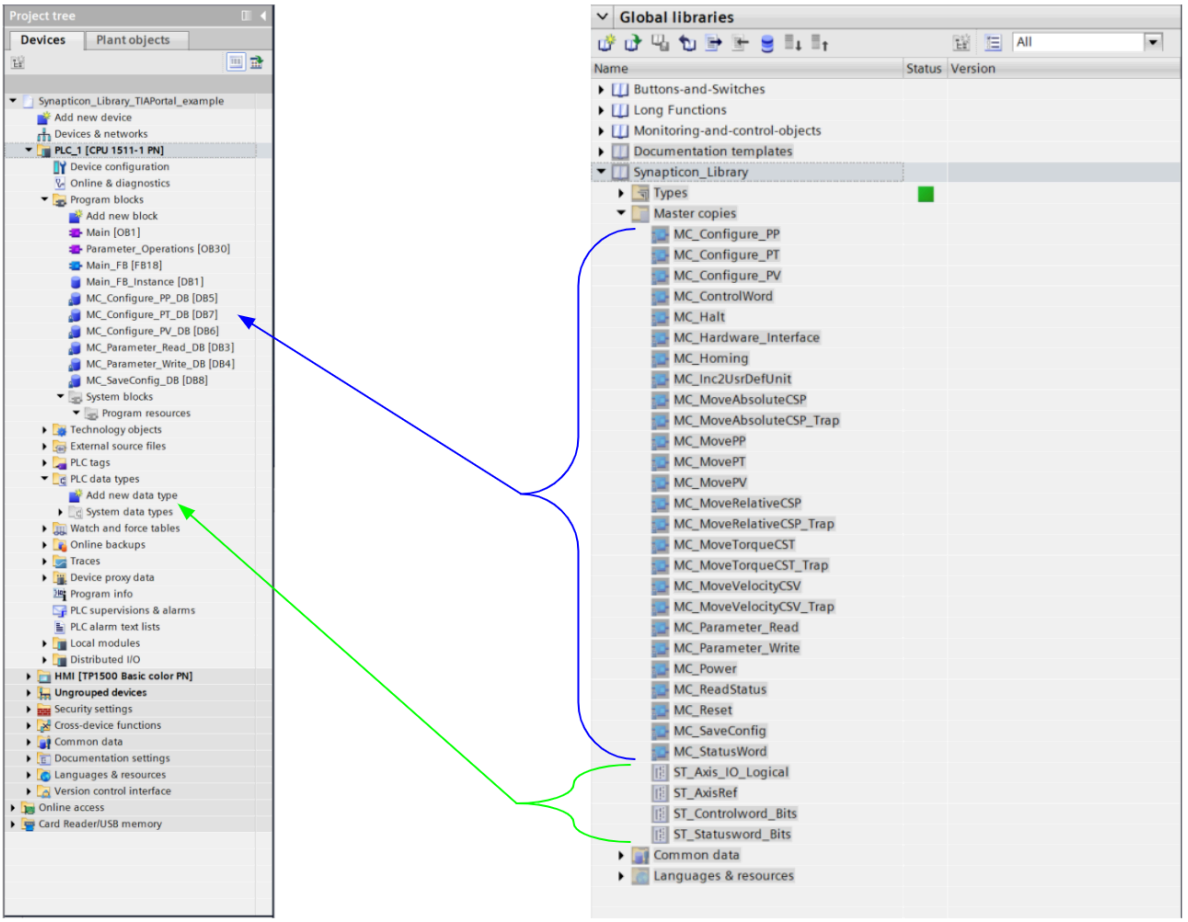

Figure 4.16 - Importing the library into the project

Not all devices have the same encoder resolution. If you want to use degrees (or any other units), set the scaling within the ST_AxisRef structure. This example scales the increments of the 18bit encoder to degrees; therefore, the scaling factor is 360/2^18 = 0.0013173.

ST_AxisRef

	Name	Data type	Default value	Accessible f...	Writa...	Visible in ...	Setpoint
1	IO	"ST_Axis_IO_Lo...		☑	☑	☑	☐
2	fScaleFactorPosition	LReal	0.00137329101	☑	☑	☑	☑
3	fScaleFactorVelocity	LReal	1.0	☑	☑	☑	☐
4	fScaleFactorTorque	LReal	1.0	☑	☑	☑	☐
5	bPowerEnabled	Bool	false	☑	☑	☑	☐
6	bError	Bool	false	☑	☑	☑	☐
7	eCurrentState	Int	0	☑	☑	☑	☐
8	sErrorDesctiption	String	''	☑	☑	☑	☑

Figure 4.17 - Establishing the axis scaling parameters

Next, compile the hardware and software by right clicking on the PLC and selecting the **Compile** option.

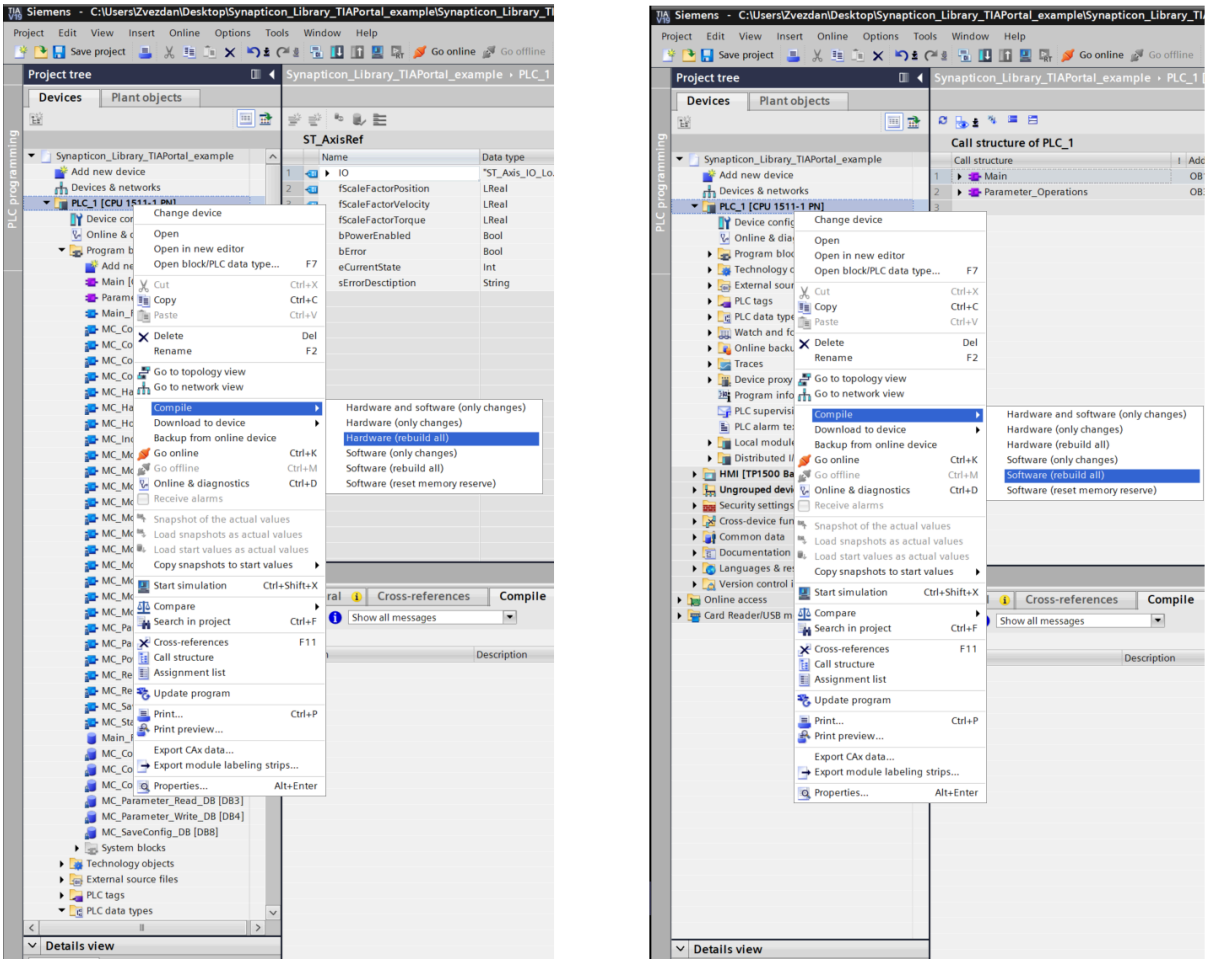

Figure 4.18 . Compiling the hardware and software configuration

After that, download the hardware…

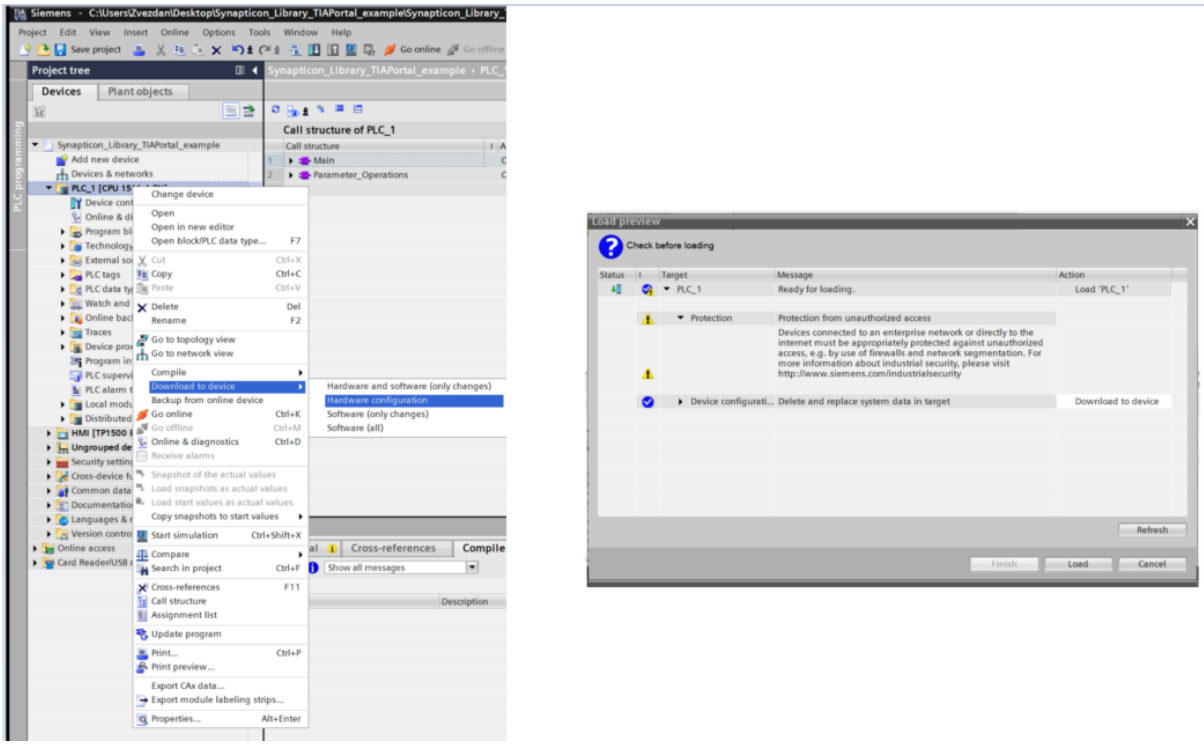

Figure 4.19 - Download the hardware configuration

…and the software:

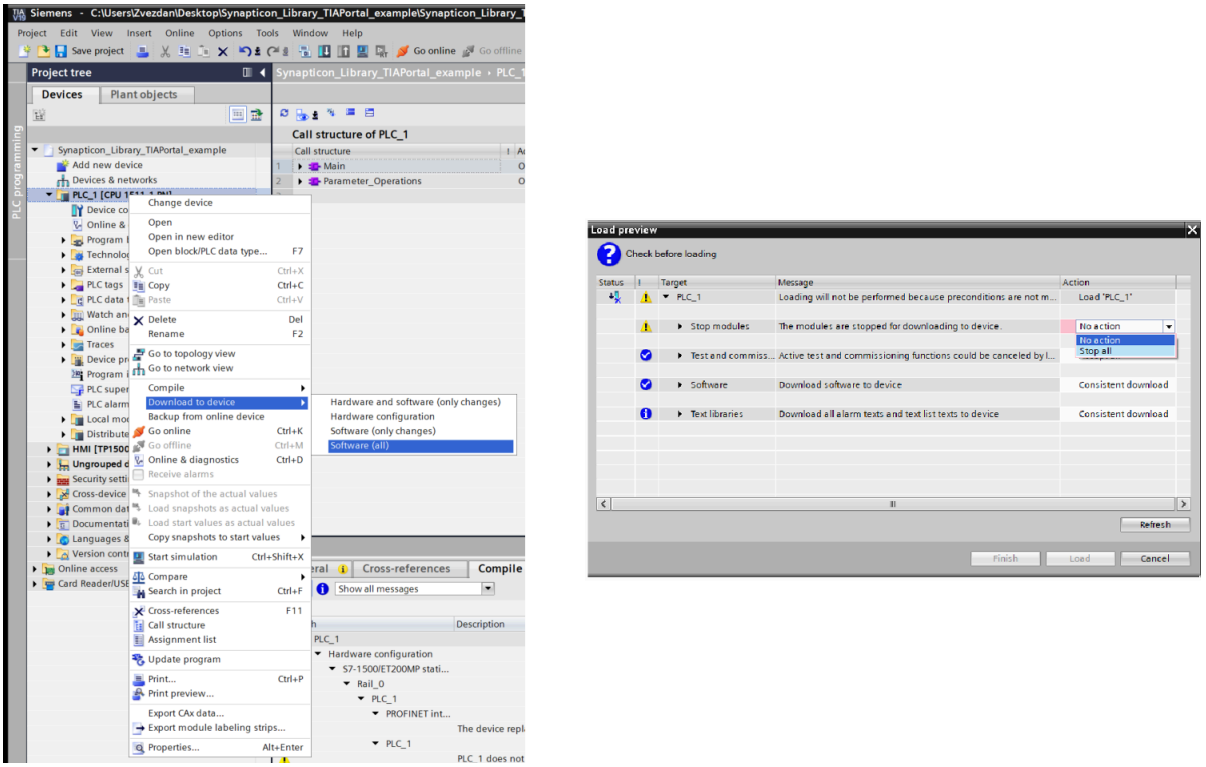

Figure 4.20 - Download the software configuration

Select the PLC in the left menu and go online:

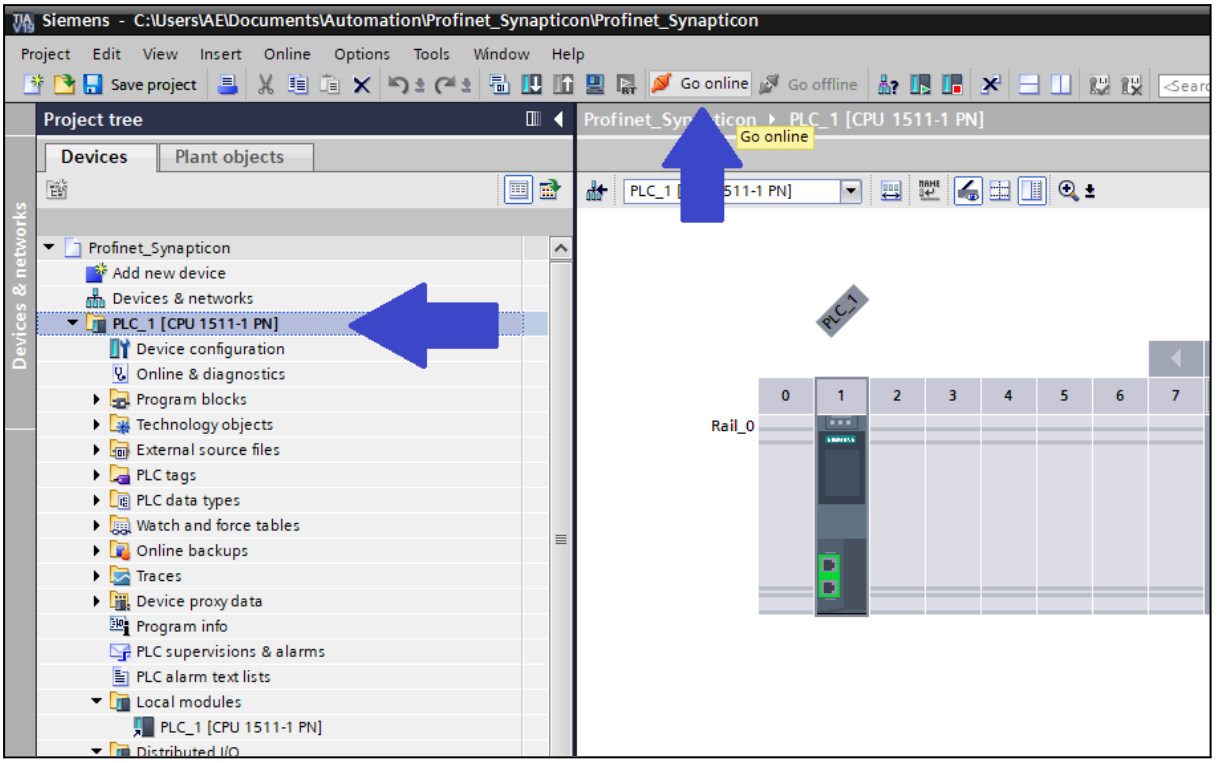

Figure 4.21 - Go online

If the PLC does not start automatically, start it with:

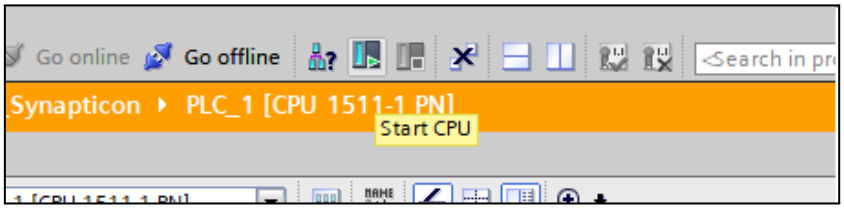

Figure 4.22 - Start CPU on PLC

Start the HMI simulation. As this will automatically rebuild it with the current settings, the process may take several seconds:

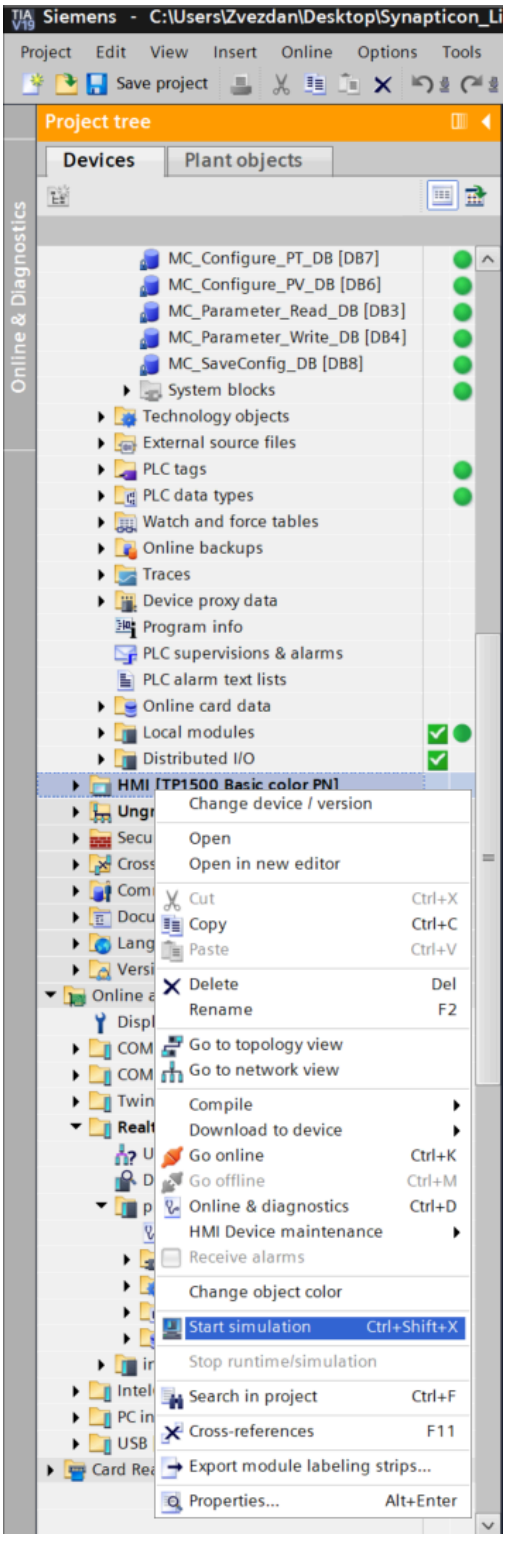

Figure 4.23 - Start the HMI simulation

The screen in Figure 4.23 appears.

Since the PLC was reset and the drive was on, the drive is initially in error state; therefore, there were missed frames in the communication.

To reset the error:

- Press the **Enable** button on the MC_Power function block.
- Press the **Execute** button on the MC_Reset function block to reset the error; the drive is ready for use.
- **Enable Operation** by pressing the button on the MC_Power function block.

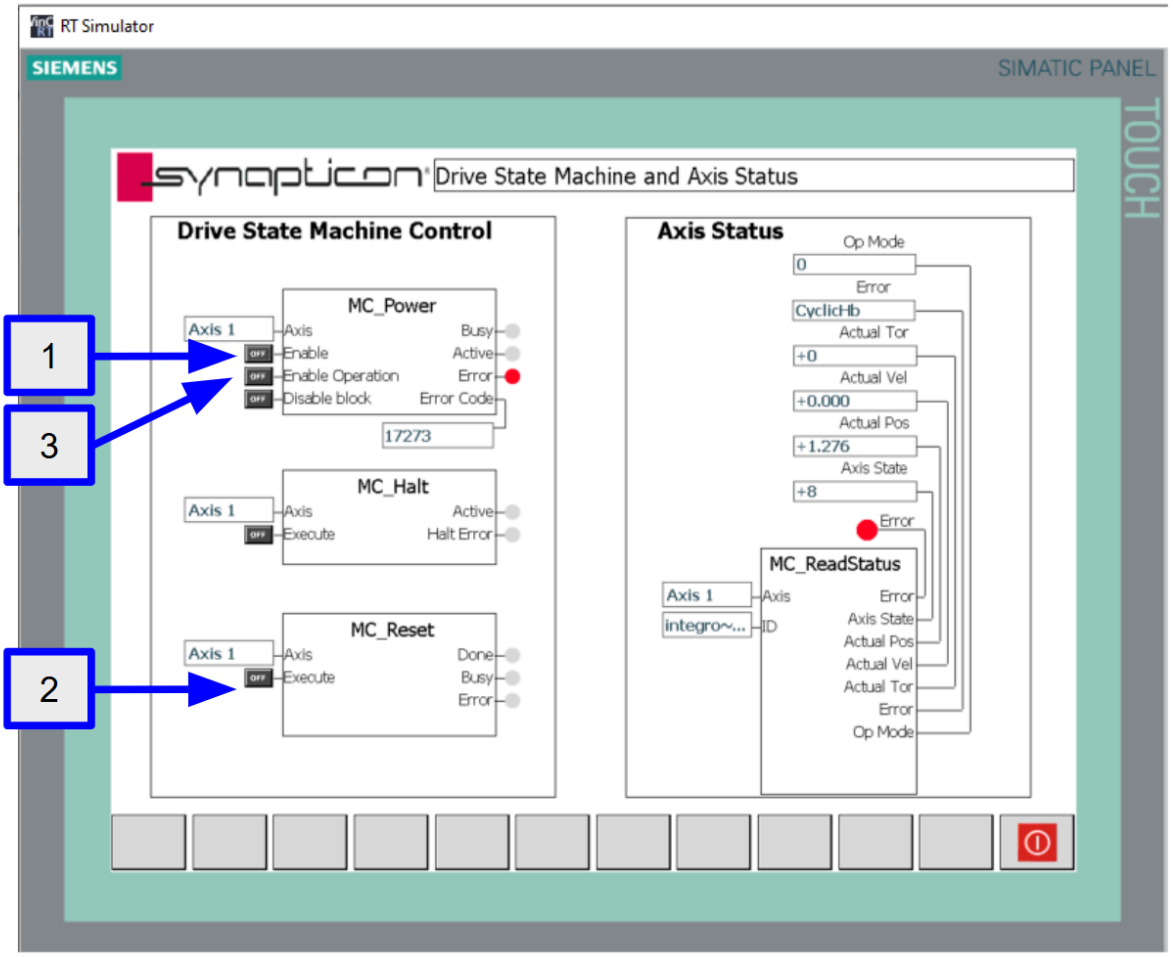

Figure 4.24 - First start of the drive

4.2. Usage

The PROFINET implementation allows the device to be controlled in cyclic sync and profile modes for the torque, velocity and position, as well as performing homing. Acyclic operations for writing the device parameters are also supported and implemented in the function blocks

This section provides a brief overview of each screen in the TIA Portal HMI example project. The main navigation is handled through a central menu, allowing a user to access all major functions for controlling and monitoring the drive. The **Axis Status** panel on the right side of most screens provides a constant overview of the drive's real-time position, velocity, torque, and operational state by using the MC_ReadStatus function block.

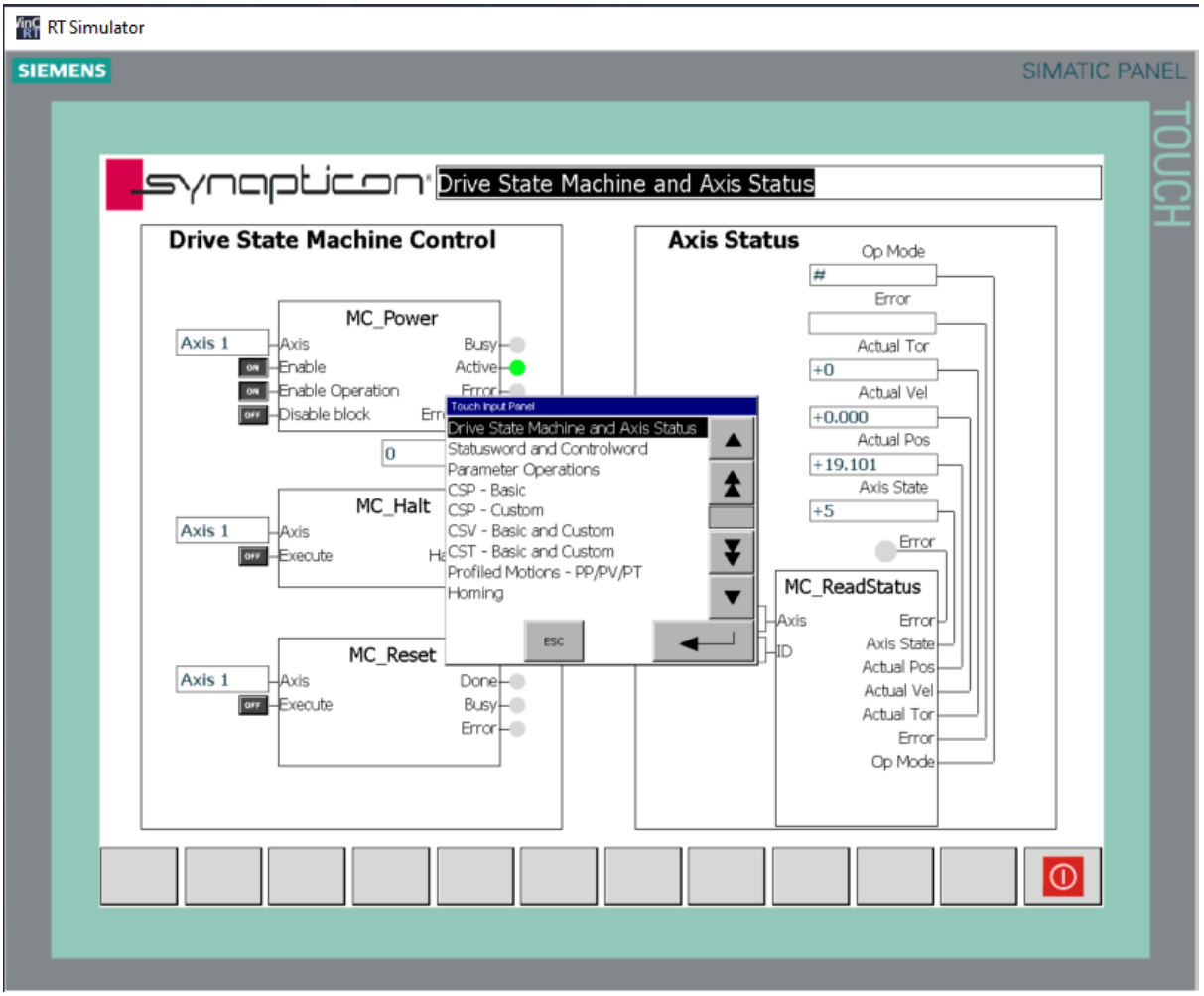

Figure 4.25 - Menu for selecting the screen

4.2.1. Drive State Machine and Axis Status

This is the main screen for controlling the fundamental state of the drive.

Control	Description
MC_Power	This is the most important control. Use the "Enable" and "Enable Operation" switches to power on the drive and progress it through the CiA 402 state machine to the Operation Enabled state, which is required for all motion commands.
MC_Halt	This provides a way to issue a halt command to the axis, stopping any active motion.
MC_Reset	Use the "Execute" button on this block to reset a drive fault.

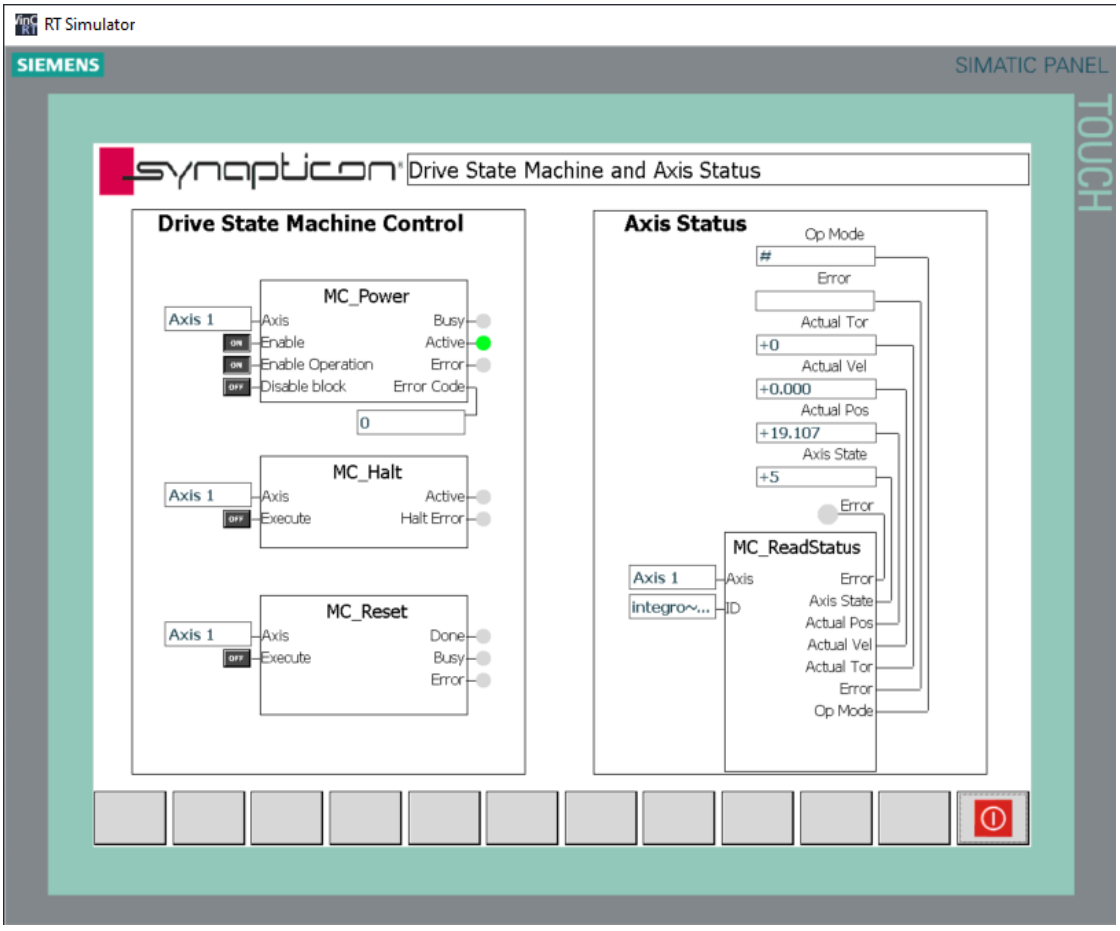

Figure 4.26 - HMI screen for Drive State Machine and Axis Status

4.2.2. Statusword and Controlword

The screen below displays a diagnostic tool. It dissects the raw 16-bit Statusword (from drive to PLC) and Controlword (from PLC to drive) into individual bits, allowing the low-level communication status to be monitored in real time. For testing purposes, a specific value to the Controlword can also be written manually.

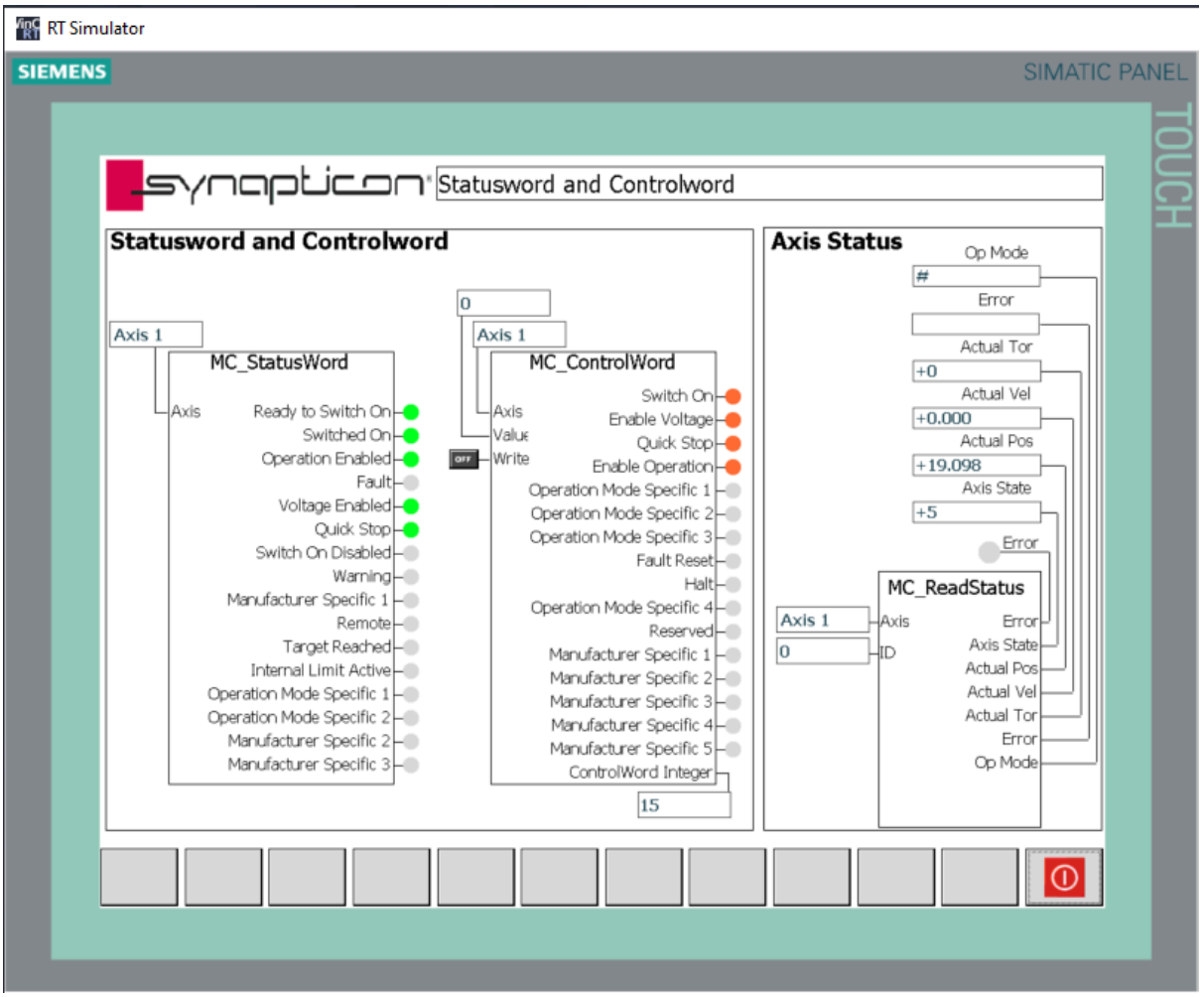

Figure 4.27 - HMI screen for Statusword and Controlword

4.2.3. Parameter Operations

From the screen below, acyclic SDO (parameter) read and write operations can be performed.

4.2.3.1. Basic Parameter Operations

Use MC_Parameter_Read and MC_Parameter_Write to read or write data to any parameter by specifying its Index and the data length.

4.2.3.2. Profile Motion Parameter Operations

These are specialized blocks (MC_Configure_PP, MC_Configure_PV, MC_Configure_PT) that simplify the process of setting up the parameters required for the drive's internal profile motion modes.

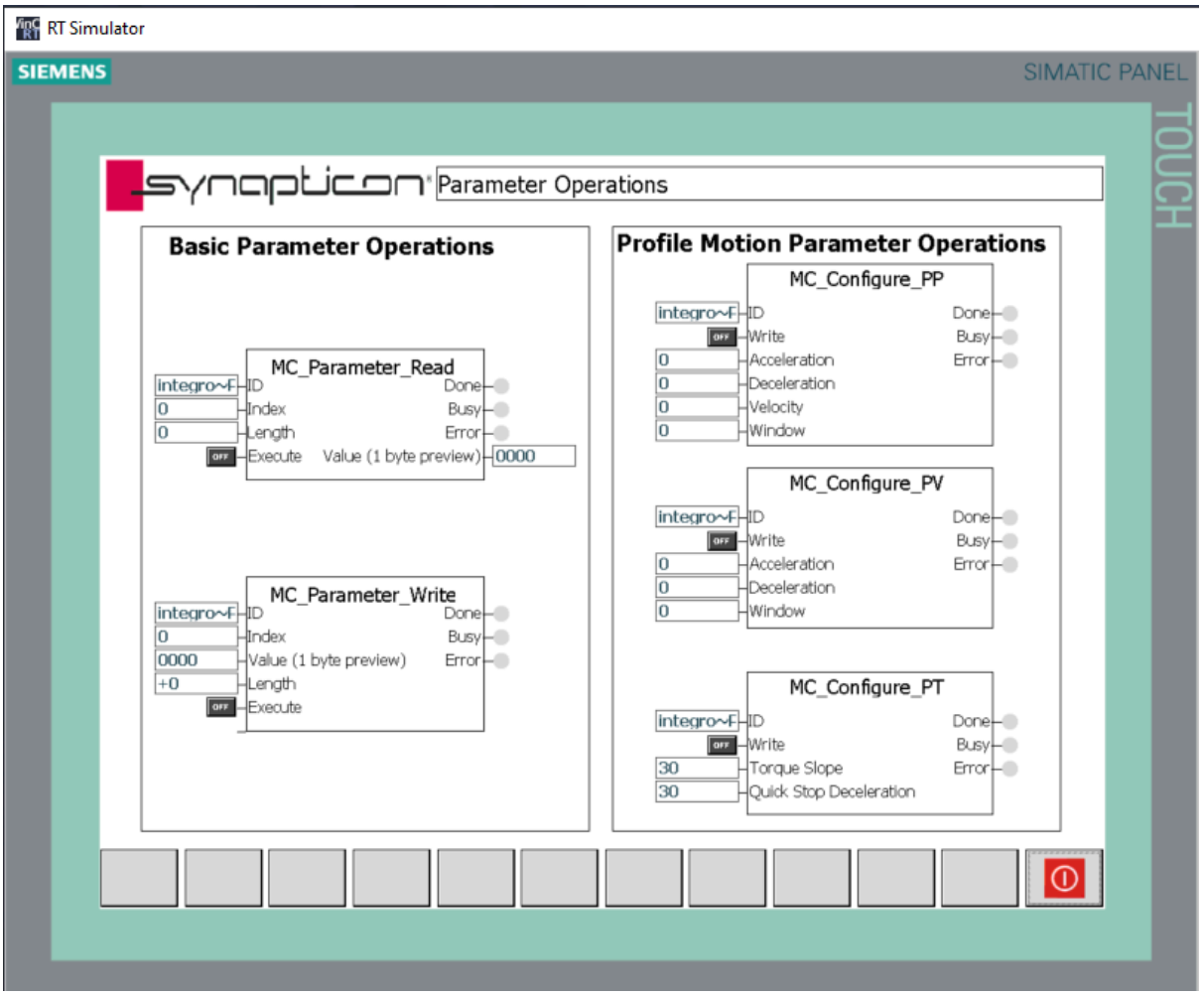

Figure 4.28 - HMI screen for Parameter Operations

4.2.4. CSP - Basic

Use the screen below for commanding motion using Cyclic Synchronous Position (CSP) mode, where the PLC provides a direct target position. It uses MC_MoveAbsolute_CSP and MC_MoveRelative_CSP to send position commands to the drive without any profile generation from the PLC.

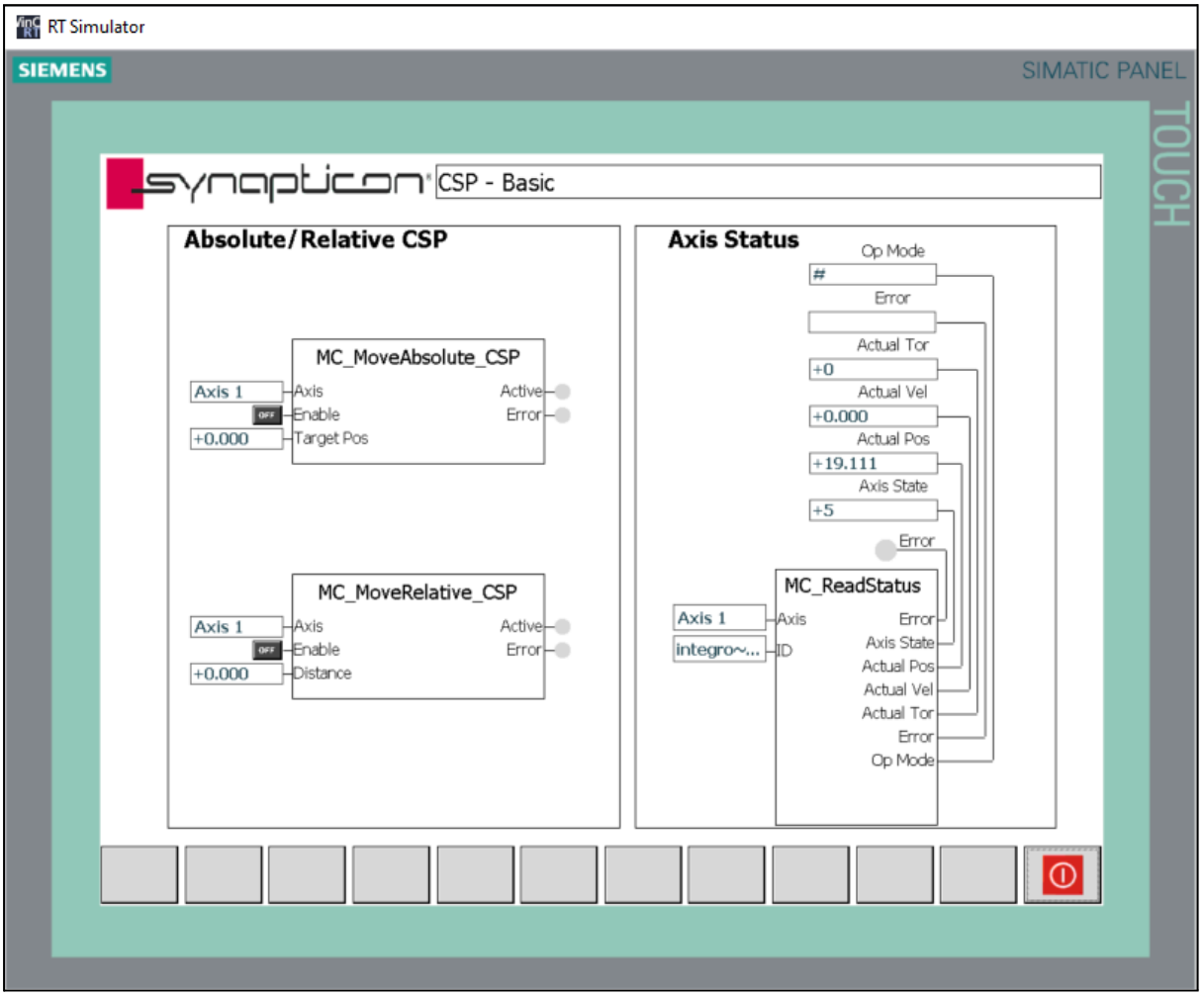

Figure 4.29 - HMI screen for basic CSP operations

4.2.5. CSP - Custom

The screen below also uses Cyclic Synchronous Position (CSP) mode; however, it generates a motion profile within the PLC. It uses MC_MoveAbsoluteCSP_Trap and MC_MoveRelativeCSP_Trap to create a trapezoidal profile, sending a continuous stream of setpoints to the drive for smooth acceleration and deceleration.

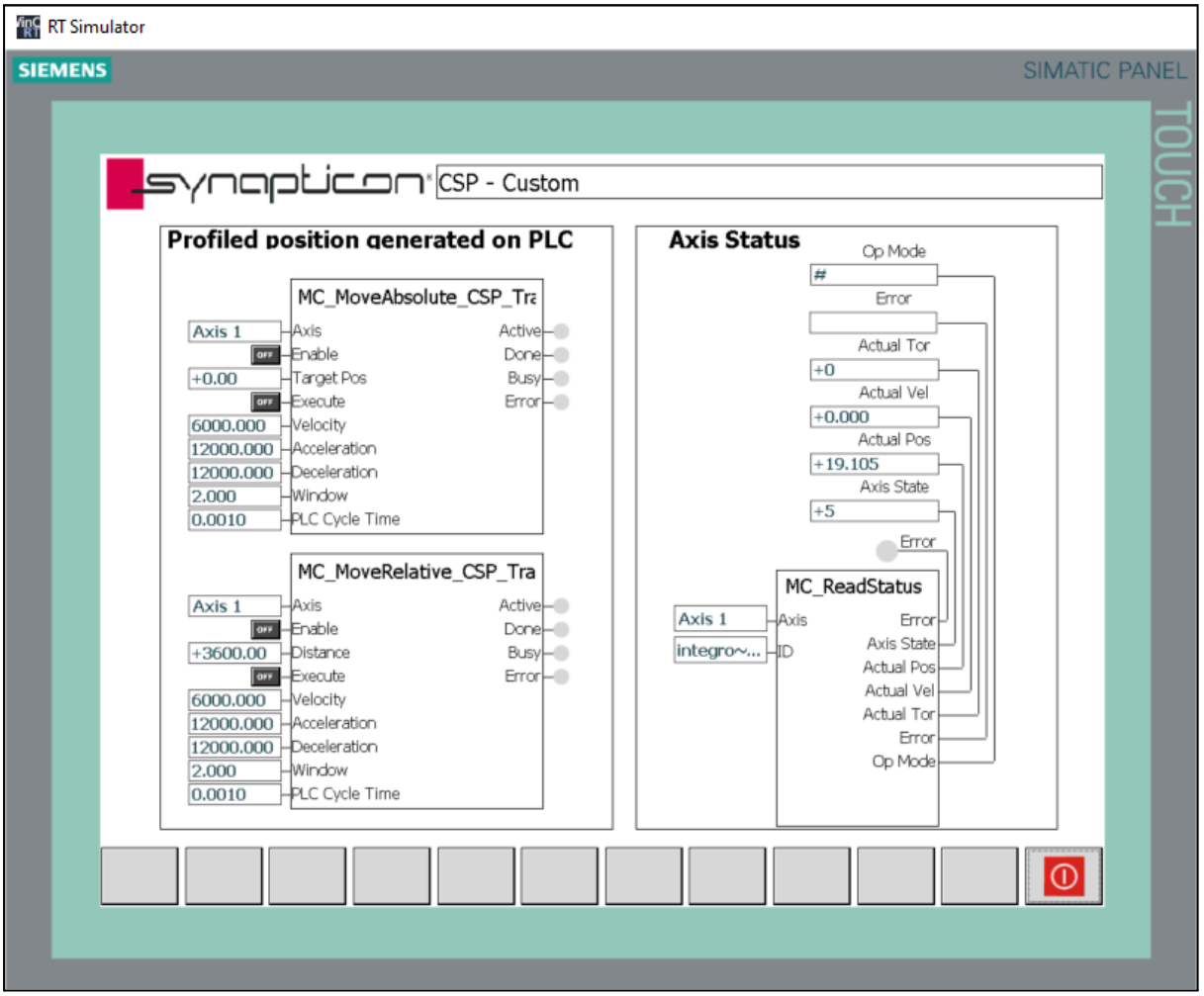

Figure 4.30 - HMI screen for the profiled motions using CSP mode

4.2.6. CSV - Basic and Custom

The screen below controls the drive using Cyclic Synchronous Velocity (CSV) mode, where the PLC provides the target velocity.

Control	Description
MC_MoveVel_CSV	Sends a direct, un-ramped target velocity to the drive.
MC_MoveVel_CSV_Trap	Generates a velocity ramp within the PLC to smoothly accelerate and decelerate to the target velocity.

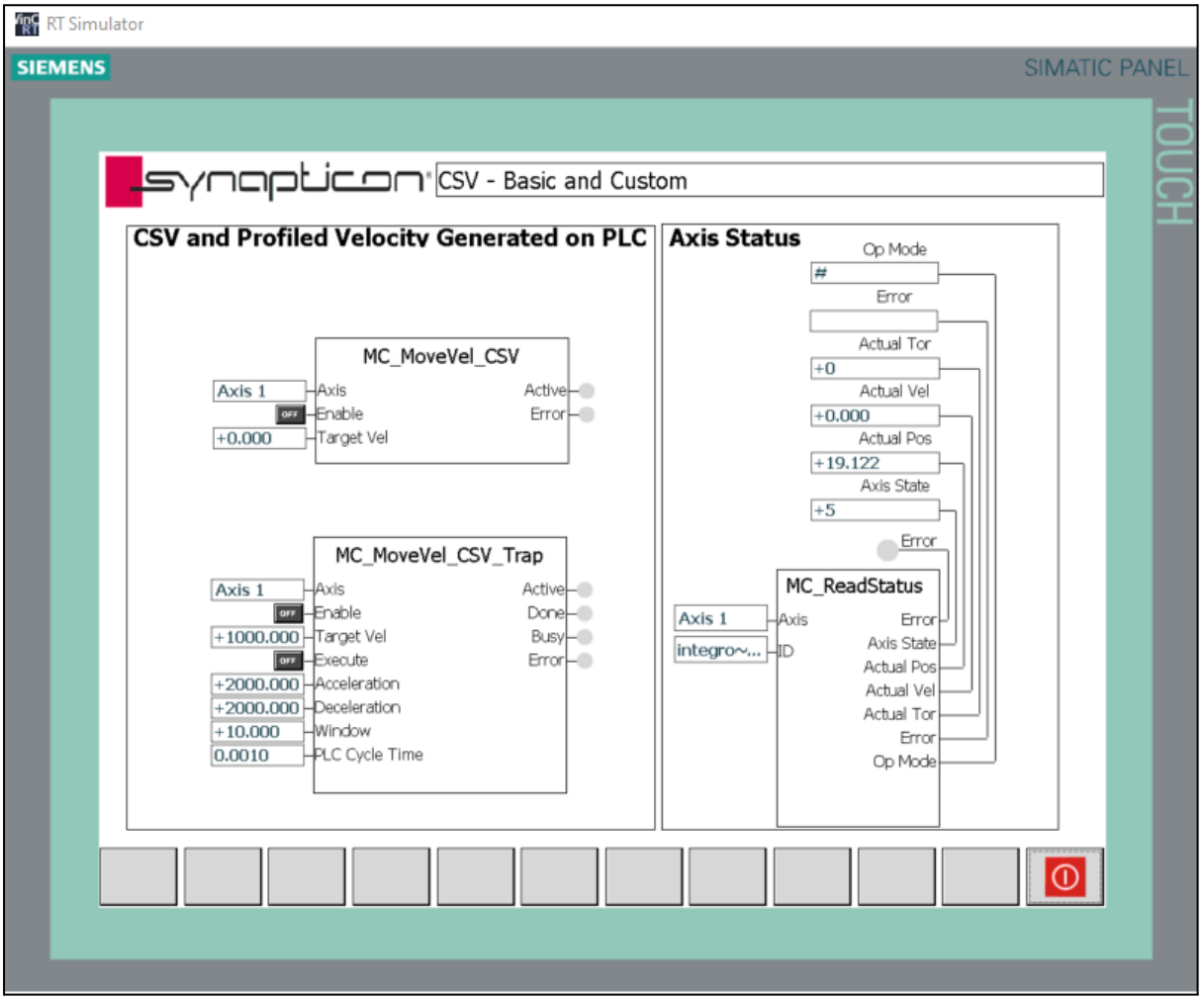

Figure 4.31 - HMI screen for the basic and profiled motions using CSV mode

4.2.7. CST - Basic and Custom

This screen below controls the drive using Cyclic Synchronous Torque (CST) mode, where the PLC provides the target torque.

Control	Description
MC_MoveTorque_CST	Sends a direct, un-ramped target torque to the drive.
MC_MoveTorqueCST_Trap	Generates a torque ramp within the PLC to smoothly apply or remove torque.

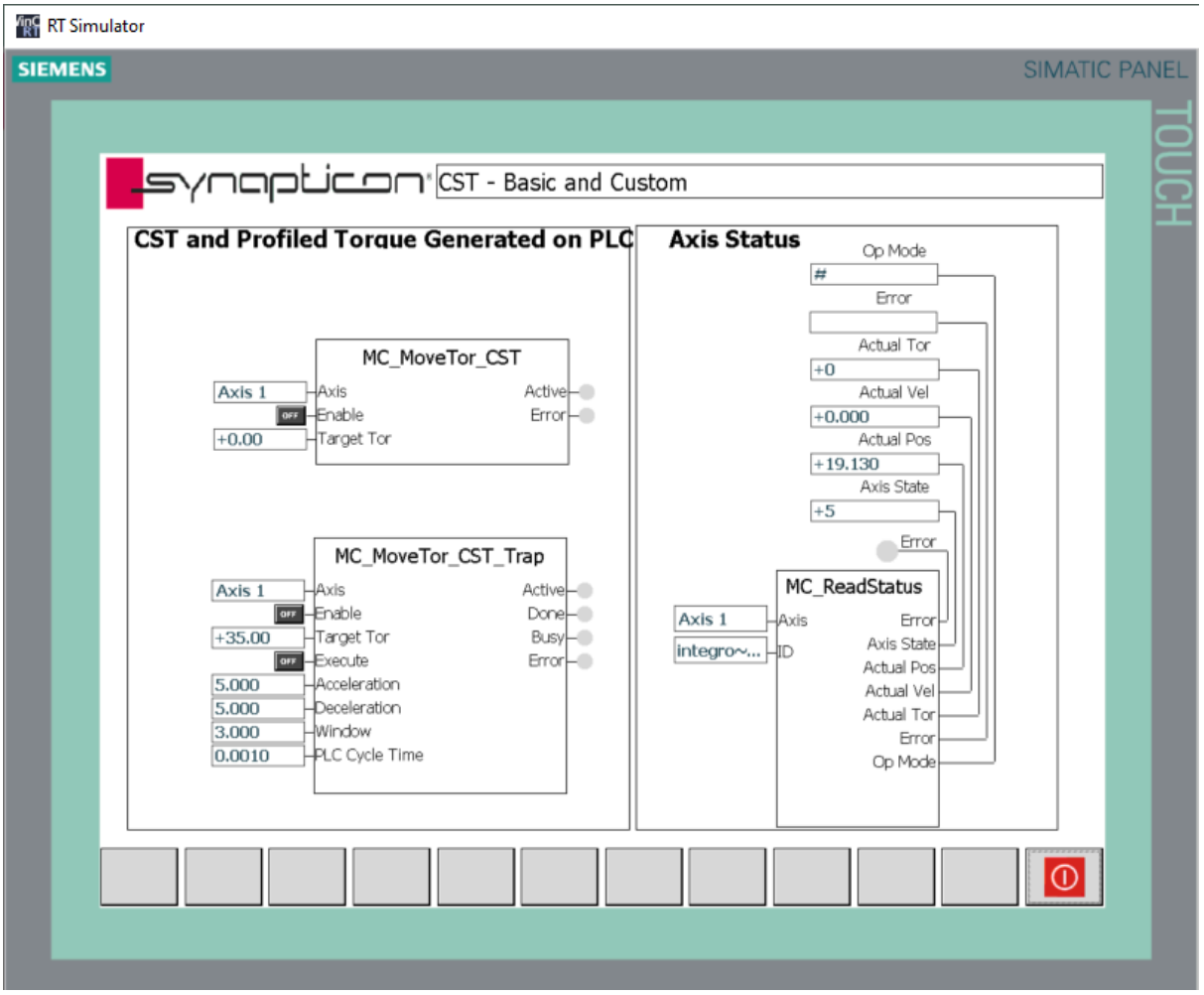

Figure 4.32 - HMI screen for the basic and profiled motions using CST mode

4.2.8. Profiled Motions - PP/PV/PT

The screen below is used to command motion using the drive's internal profile generators. The necessary parameters (acceleration, velocity, etc.) must be configured first on the "Parameter Operations" screen.

The MC_MovePP, MC_MovePV, and MC_MovePT blocks command the drive to execute a move using those pre-configured internal profiles.

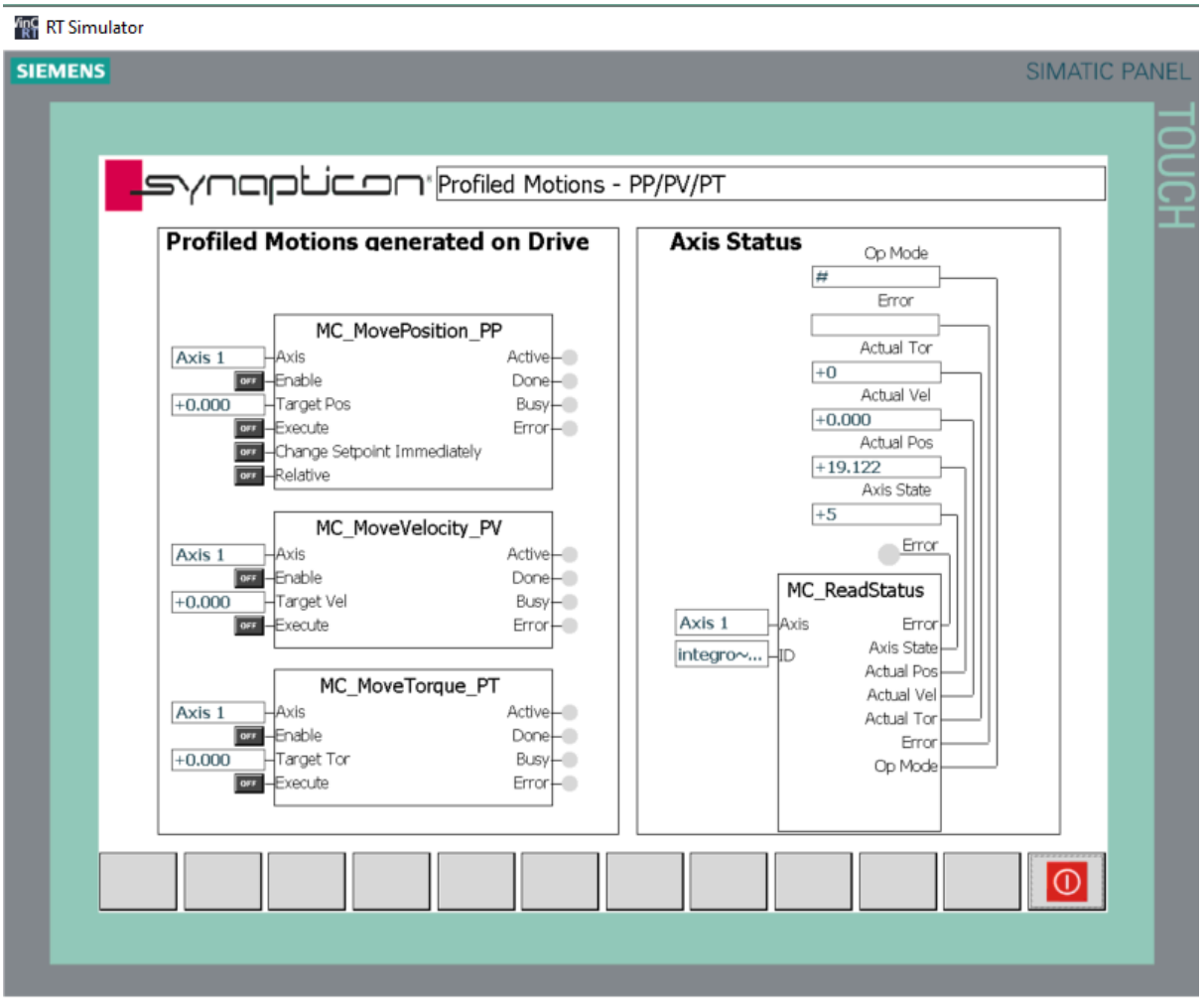

Figure 4.33 - HMI screen for Profiled Motions generated on the drive

4.2.9. Homing

The Homing screen (accessed from the menu) is used to execute a homing routine. You can select a specific homing method (as defined by the drive's CiA 402 implementation) and then use the MC_Homing block to start the procedure and monitor its completion.

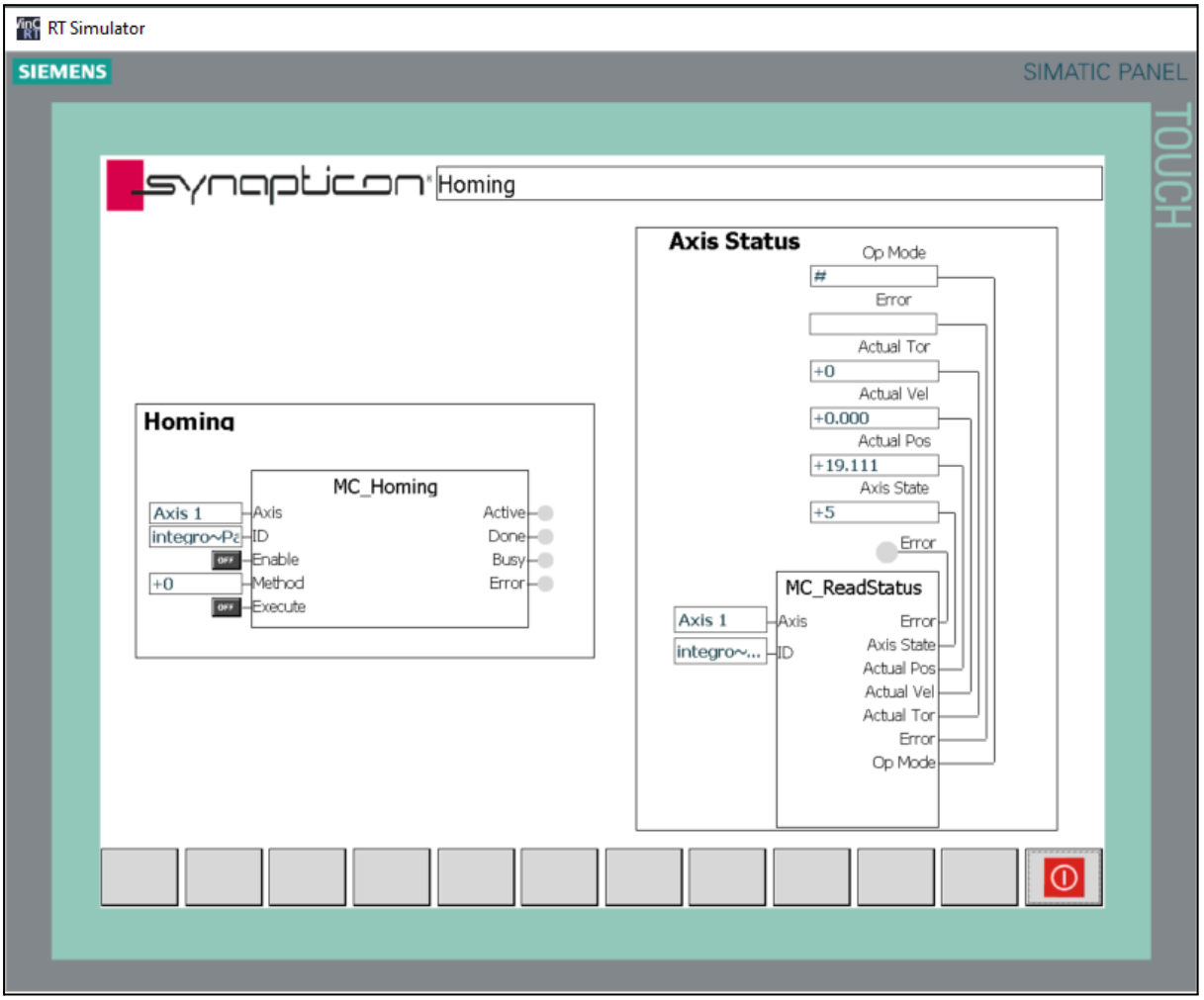

Figure 4.34 - HMI screen for the Homing method

4.2.10. Additional Functions

The screen below contains utility functions.

Control	Description
MC_SaveConfig	This block is used to save the drive's current parameter set to its non-volatile memory, preventing settings from being lost on a power cycle.
MC_Inc2UsrDefUnit	This is a simple utility that takes the raw encoder value and converts it into a user-friendly unit - such as millimeters or degrees - based on a scaling factor, which is useful for display purposes.

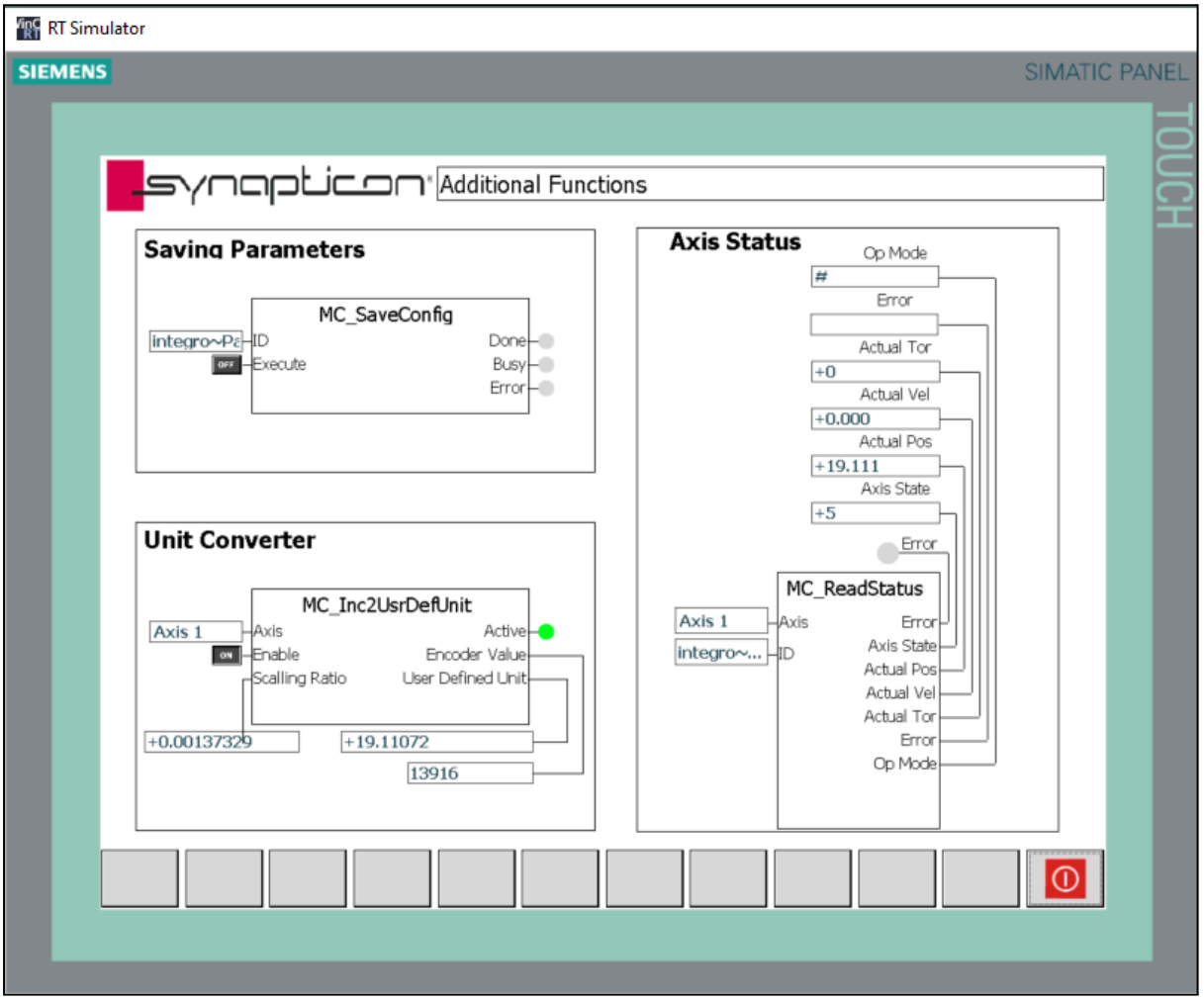

Figure 4.35 - HMI screen for the additional functions