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Learn-/Training Document

Siemens Automation Cooperates with Education (SCE) | From Version V14 SP1

TIA Portal Module 011-101
Specified Hardware Configuration with SIMATIC S7-1200

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We wish to thank the TU Dresden, particularly Prof. Dr.-Ing. Leon Urbas and the Michael Dziallas Engineering Corporation and all other involved persons for their support during the preparation of this Learn-/Training Document.

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Specified Hardware Configuration – SIMATIC S7-1200

1 Goal

In this chapter, you will first learn how to ***create a project***. You are then shown how the ***hardware is configured***.

The SIMATIC S7 controllers listed in Chapter 3 can be used.

2 Prerequisite

You do not need any previous knowledge from other chapters to successfully complete this chapter. You only need an S7-1200 controller and a PC with the STEP 7 Basic V14 (TIA Portal V14) software.

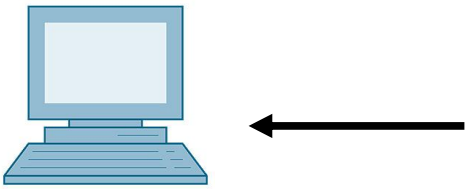
3 Required hardware and software

1 Engineering station: Requirements include hardware and operating system (for additional information, see Readme on the TIA Portal Installation DVDs)

2 SIMATIC STEP 7 Basic software in TIA Portal – as of V14 SP1

3 SIMATIC S7-1200 controller, e.g. CPU 1214C DC/DC/DC with ANALOG OUTPUT SB1232 signal board, 1 AO – Firmware as of V4.2.1

4 Ethernet connection between engineering station and controller



1 Engineering Station

2 SIMATIC STEP 7 Basic (TIA Portal) as of V14 SP1

4 Ethernet connection

3 SIMATIC S7-1200 controller

4 Theory

4.1 SIMATIC S7-1200 automation system

The SIMATIC S7-1200 automation system is a modular microcontroller system for the lower performance range.

A comprehensive range of modules is available to optimally adapt the system to the automation task. The S7 controller consists of a power supply and a CPU with integrated inputs and outputs or additional input and output modules for digital and analog signals.

If necessary, communication processors and function modules are also used for special tasks such as stepper motor control.

The programmable logic controller (PLC) uses the S7 program to monitor and control a machine or process. In doing so, the IO modules are scanned in the S7 program using input addresses (%I) and addressed using output addresses (%Q).

The system is programmed with the TIA Portal Basic or Professional software.

4.1.1 Range of modules

The SIMATIC S7-1200 is a modular automation system and offers the following range of modules:

Central processing units (CPUs) with different performance, integrated inputs/outputs, and PROFINET interface (e.g. CPU 1214C)

Power supply module (PM) with input 120/230 V AC, 50 Hz / 60 Hz, 1.2 A / 0.7 A and output 24 V DC / 2.5 A

Signal boards (SBs) for adding analog or digital inputs/outputs, in which case the size of the CPU remains unchanged. (Signal boards can be used with CPUs 1211C / 1212C and 1214C.)

Signal modules (SMs) for digital and analog inputs and outputs (a maximum of 2 SMs can be used for CPU 1212C and a maximum of 8 SMs for CPU 1214C.)

Communication modules (CMs) for serial communication RS232 / RS 485 (Up to 3 CMs can be used for CPUs 1211C / 1212C and 1214C.)

Compact switch module (CSM) with 4x RJ45 sockets 10/100 Mbps

SIMATIC memory cards from 2 MB to 32 MB for storing program data and for easy exchange of CPUs during maintenance.

Note: *Only a single CPU (any type) with integrated digital inputs and digital outputs is needed for this module.*

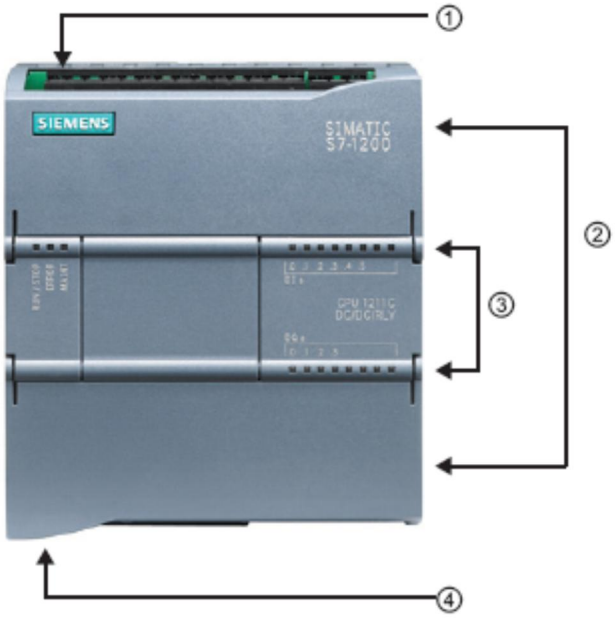
4.2 Operator control and display elements of the CPU 1214C DC/DC/DC

4.2.1 Front view of the CPU 1214C DC/DC/DC

With integrated power supply (24 V connection) and integrated inputs and outputs, the CPU 1214C DC/DC/DC is immediately ready for use without any other components.

The CPU has an integrated TCP/IP connection for communication with a programming device.

The CPU can thus communicate with HMI devices or other CPUs via an Ethernet network.



- 24 V connection
- , Plug-in terminal block for user wiring (behind the cover flaps)
- *f* Status LEDs for the integrated IO and the operating state of the CPU
- „ TCP/IP connection (on the underside of the CPU)

4.2.2 SIMATIC memory card (MC)

The optional **SIMATIC memory card (MC)** stores a program as well as data, system data, files and projects. It can be used for:

– Transferring a program to multiple CPUs

– Firmware update of CPUs, signal modules (SMs) and communication modules (CMs)

– Easy replacement of the CPU

4.2.3 Operating states of the CPU

The CPU can have the following three operating states:

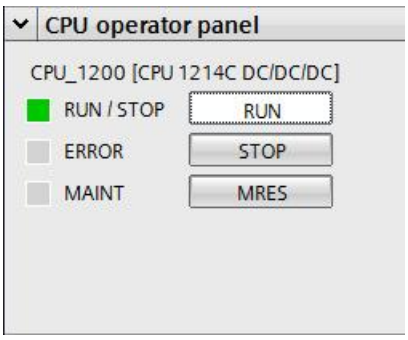
– In the **STOP** operating state, the CPU is not executing the program and you can download a project.

– In the **STARTUP** operating state, the CPU is starting up.

– In the **RUN** operating state, the program is cyclically executed.

The CPU does not have a physical switch for changing the operating state.

You use the button on the operator panel of the STEP 7 Basic software to change the operating state (**STOP** or **RUN**). The operator panel also contains an **MRES** button for performing a memory reset and displays the status LEDs of the CPU.



4.2.4 Status and error displays

The **RUN/STOP status LED** on the front side of the CPU indicates the current operating state of the CPU by the color of the display.

- **Yellow** light indicates **STOP** operating state.
- **Green** light indicates **RUN** operating state.
- A **flashing light** indicates **STARTUP** operating state.

There are two additional LEDs here: **ERROR** LED for indicating errors and **MAINT** LED for indicating that maintenance is required.

4.3 STEP 7 Basic V14 (TIA Portal V14) programming software

The STEP 7 Basic V14 (TIA Portal V14) software is the programming tool for the following automation systems:

- SIMATIC S7-1200
- Basic Panels

STEP 7 Basic V14 provides the following functions for automation of a system:

- Configuration and parameter assignment of the hardware
- Specification of the communication
- Programming
- Testing, commissioning and servicing with operational/diagnostic functions
- Documentation
- Creation of visualizations for SIMATIC Basic Panels using the integrated WinCC Basic software

Support is provided for all functions through detailed online help.

4.3.1 Project

To implement a solution for an automation and visualization task, you create a project in the TIA Portal. A project in the TIA Portal contains the configuration data for the configuration and internetworking of devices as well as the programs and the configuration of the visualization.

4.3.2 Hardware configuration

The *hardware configuration* includes the configuration of the devices, consisting of the hardware of the automation system, the field devices on the PROFINET bus system and the hardware for visualization. The configuration of the networks specifies the communication between the various hardware components. Individual hardware components are *inserted in the hardware configuration* from catalogs.

The hardware of SIMATIC S7-1200 automation systems comprises the controller (CPU), the signal modules for input and output signals (SMs), the communication modules (CMs) and other special-purpose modules.

The signal modules and the field devices connect the input and output data of the process to be automated and visualized to the automation system.

The hardware configuration enables the downloading of automation and visualization solutions to the automation system and access to the connected signal modules by the controller.

4.3.3 Planning the hardware

Before you can configure the hardware, you must plan it (hardware planning). In general, you begin by selecting which controllers are needed and how many. You then select the communication modules and signal modules. The selection of signal modules is based on the number and type of inputs and outputs needed. As the final step, a power supply that ensures the necessary power supply must be selected for each controller or field device.

The functionality required and the ambient conditions are of vital importance for planning the hardware configuration. For example, the temperature range in the application area sometimes limits which devices are available for selection. Fail-safe operation might be another requirement.

The TIA Selection Tool (Select automation technology ® TIA Selection Tool and follow the instructions) provides you support. Note: The TIA Selection Tool requires Java.

Note for online research: *If more than one manual is available, you should look for the description "Device Manual", "Product Manual" or simply "Manual" (as opposed to "Function Manual", "List Manual", "System Manual", etc.) in order to find the device specifications.*

4.3.4 TIA Portal – Project view and portal view

The TIA Portal has two important views. When started, the TIA Portal displays the portal view by default. This view makes getting started easier, especially for beginning users.

The portal view provides a task-oriented view of the tools for working on the project. Here, you can quickly decide what you want to do and open the tool for the task at hand. If necessary, a change to the project view takes place automatically for the selected task.

Figure 1 shows the portal view. At the bottom left, there is an option to switch between this view and the project view.

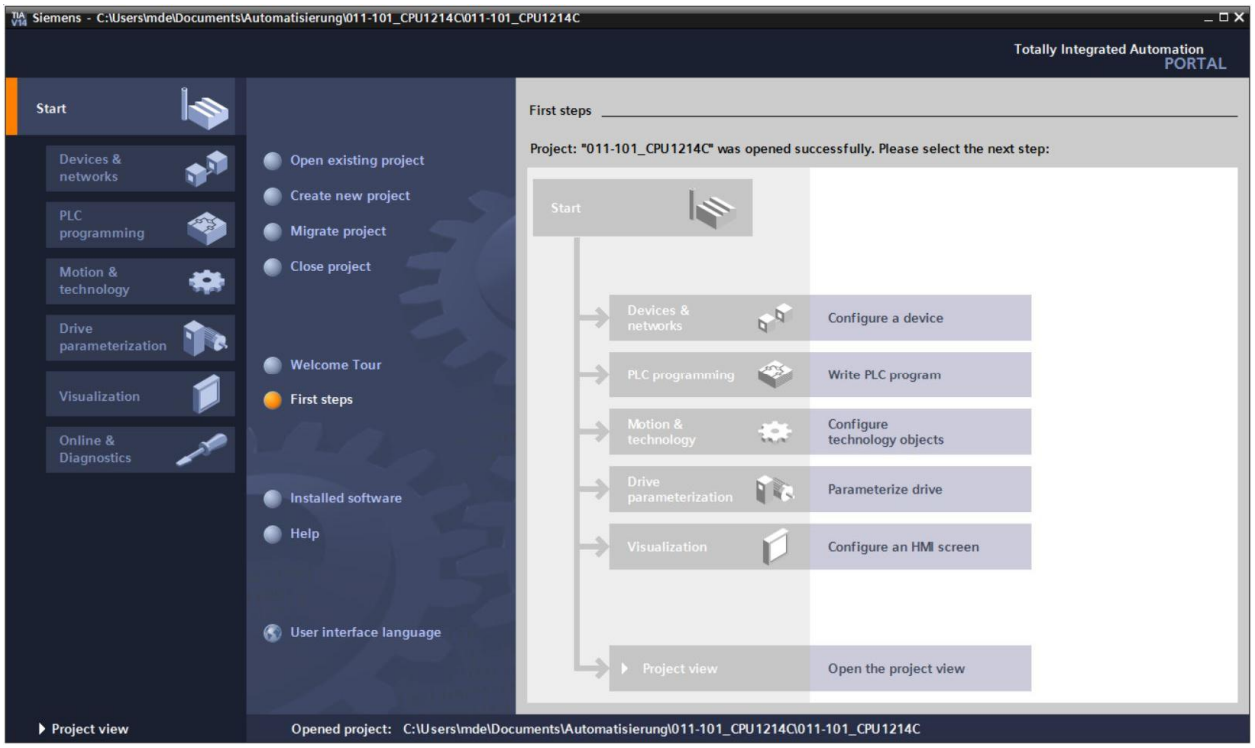


Figure 1: Portal view

The project view, as shown in Figure 2, is used for hardware configuration, programming, creation of the visualization and many other tasks.

By default, the project view displays the menu bar with the toolbars at the top, the project tree with all components of a project on the left and the so-called "task cards" with instructions and libraries, for example, on the right.

If an element (for example, the device configuration) is selected in the project tree, it is displayed in the center and can be worked on there.

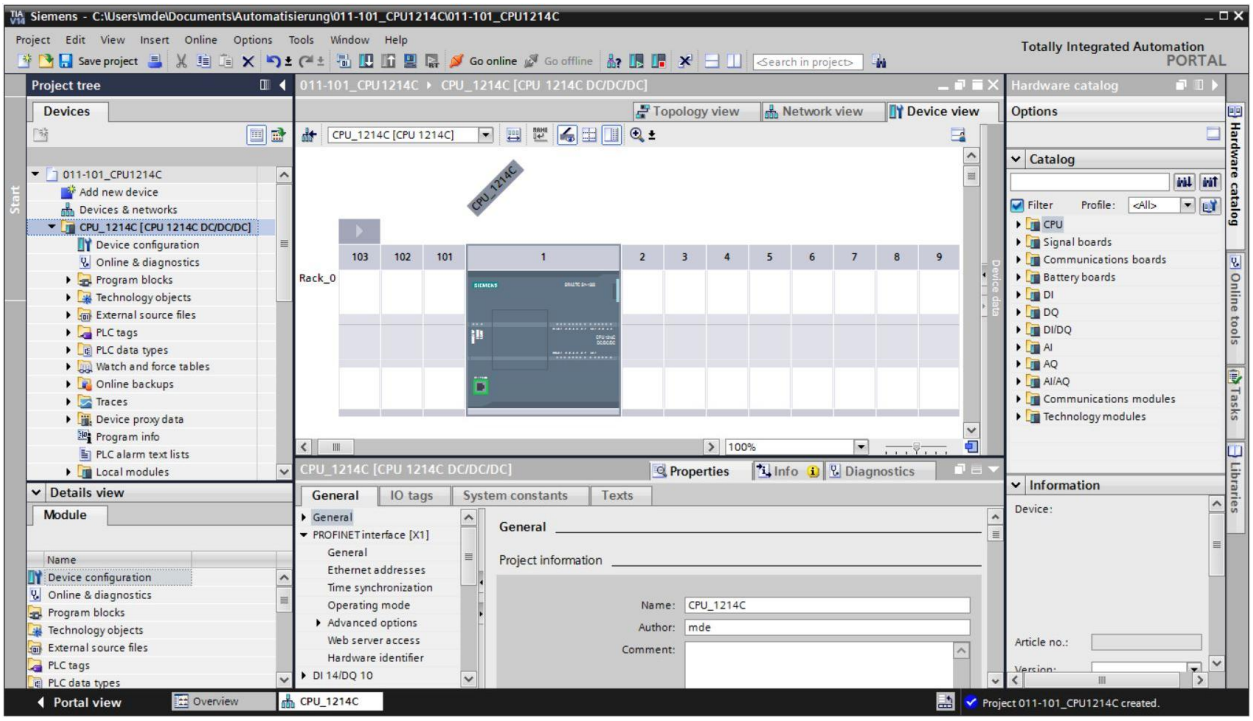
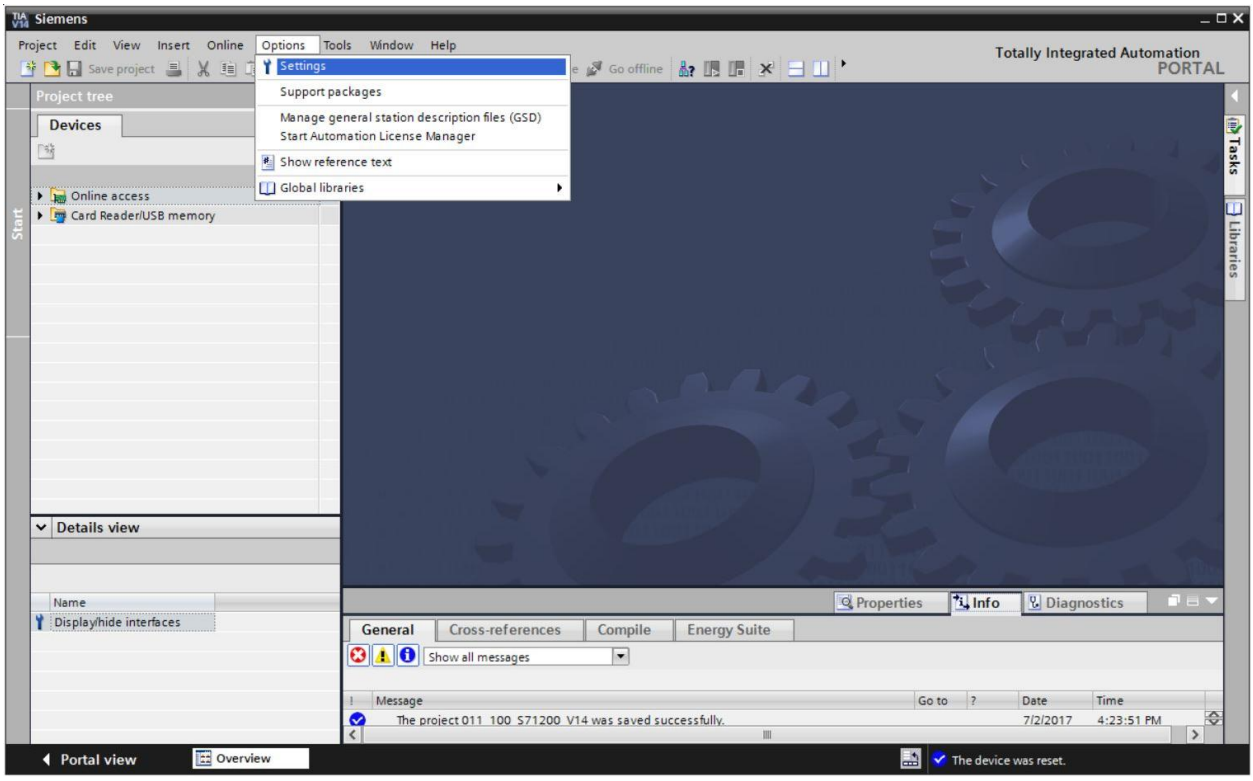


Figure 2: Project view

4.3.5 Basic settings for the TIA Portal

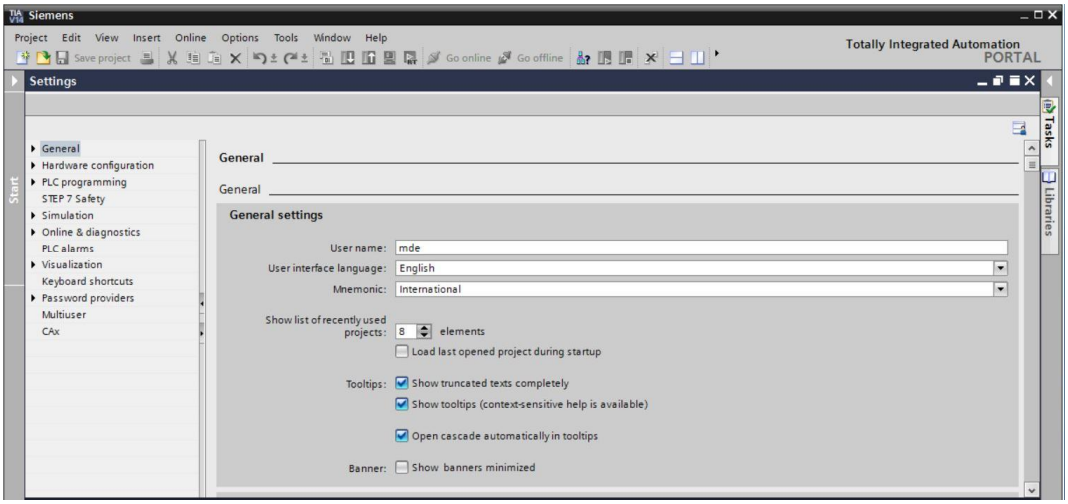
® Users can specify their own default settings for certain settings in the TIA Portal. A few important settings are shown here.

® In the project view, select the ® "Options" menu and then ® "Settings".



® One basic setting is the selection of the user interface language and the language for the program display. In the curriculums to follow, "English" will be used for both settings.

® Under "General" in "Settings", select ® "User interface language ® English" and "Mnemonic ® International".



Note: *These settings can always be changed.*

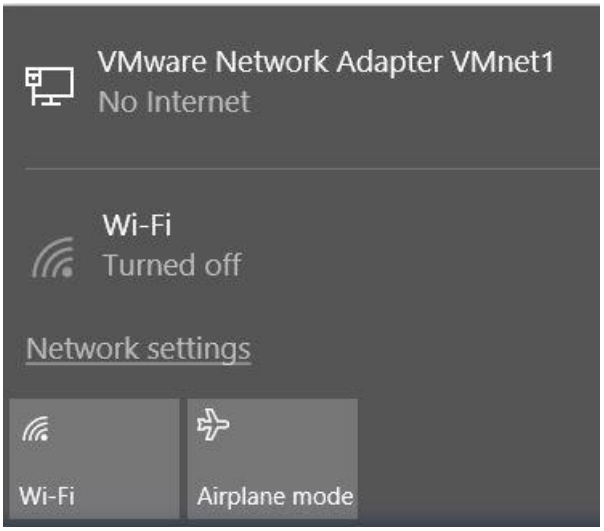
4.3.6 Set the IP address on the programming device

To program the SIMATIC S7-1200 controller from the PC, the programming device or a laptop, you need a TCP/IP connection or an optional PROFIBUS connection.

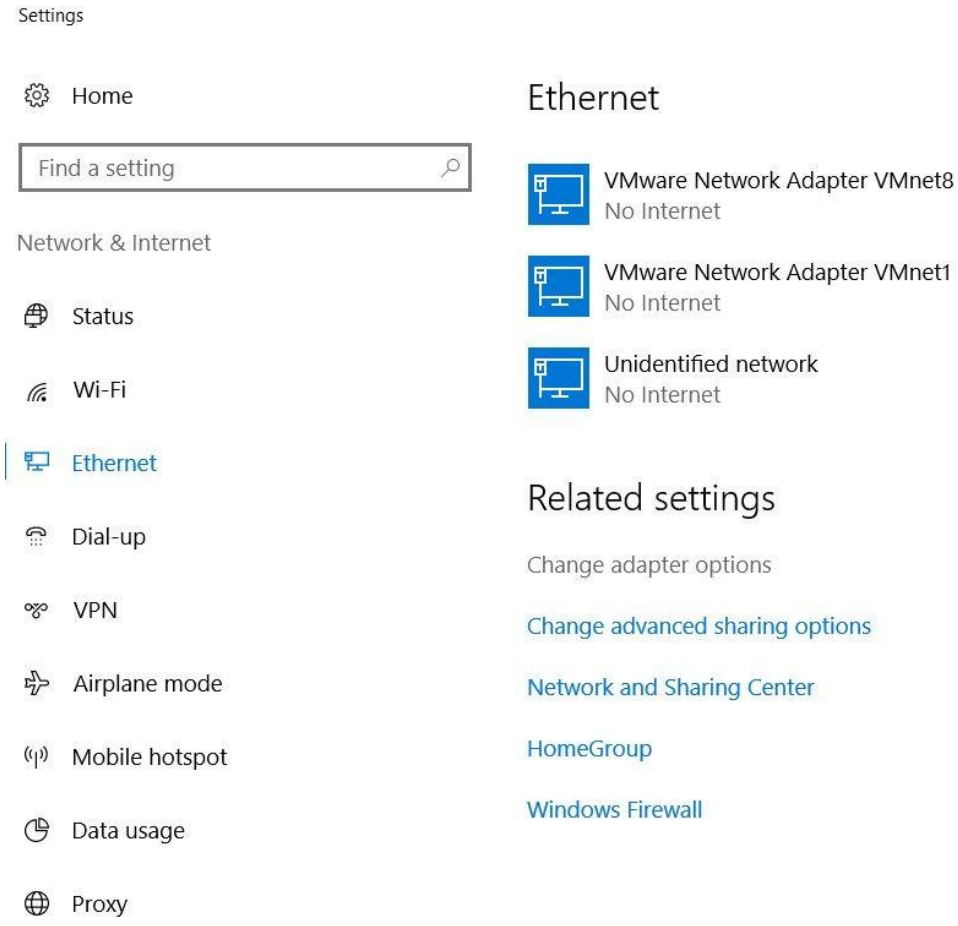
For the PC and SIMATIC S7-1200 to communicate with each other via TCP/IP, it is important that the IP addresses of both devices match.

First, we show you how to set the IP address of a PC with Windows 7 operating system.

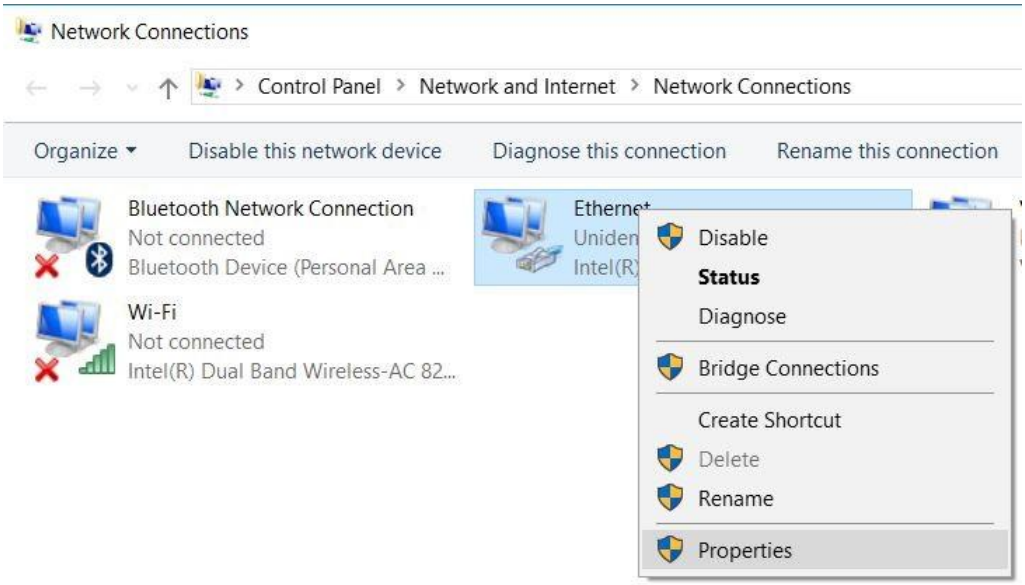
® Locate the network icon in the taskbar at the bottom  and click ® "Open Network and Sharing Center".



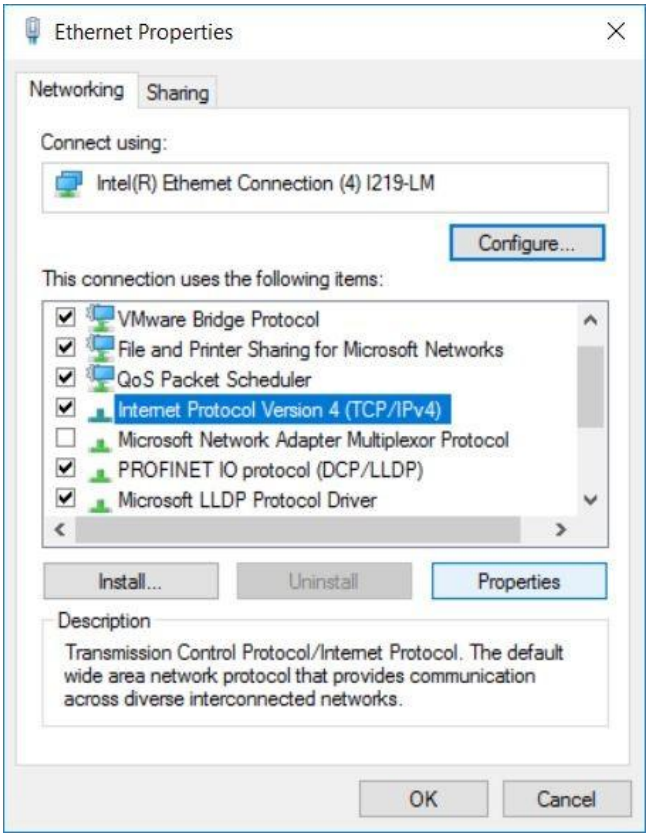
® In the open Network and Sharing Center window, click ® "Change adapter settings".



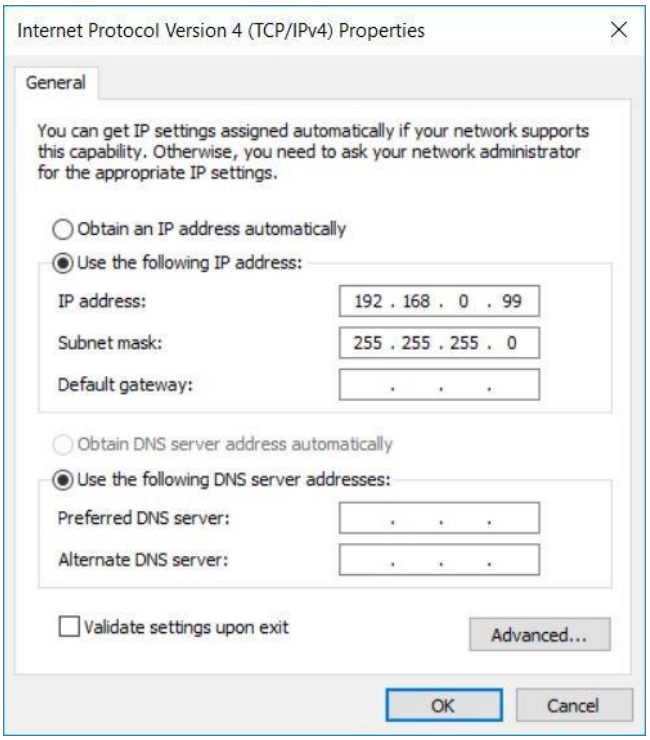
® Select the desired ® "Local Area Connection" that you want to use to connect to the controller and click ® "Properties".



® Next, select ® "Properties" for ® "Internet Protocol Version 4 (TCP/IP)".



® You can use the following address, for example ® IP address: 192.168.0.99 ® Subnet mask 255.255.255.0 and accept the settings (® "OK")

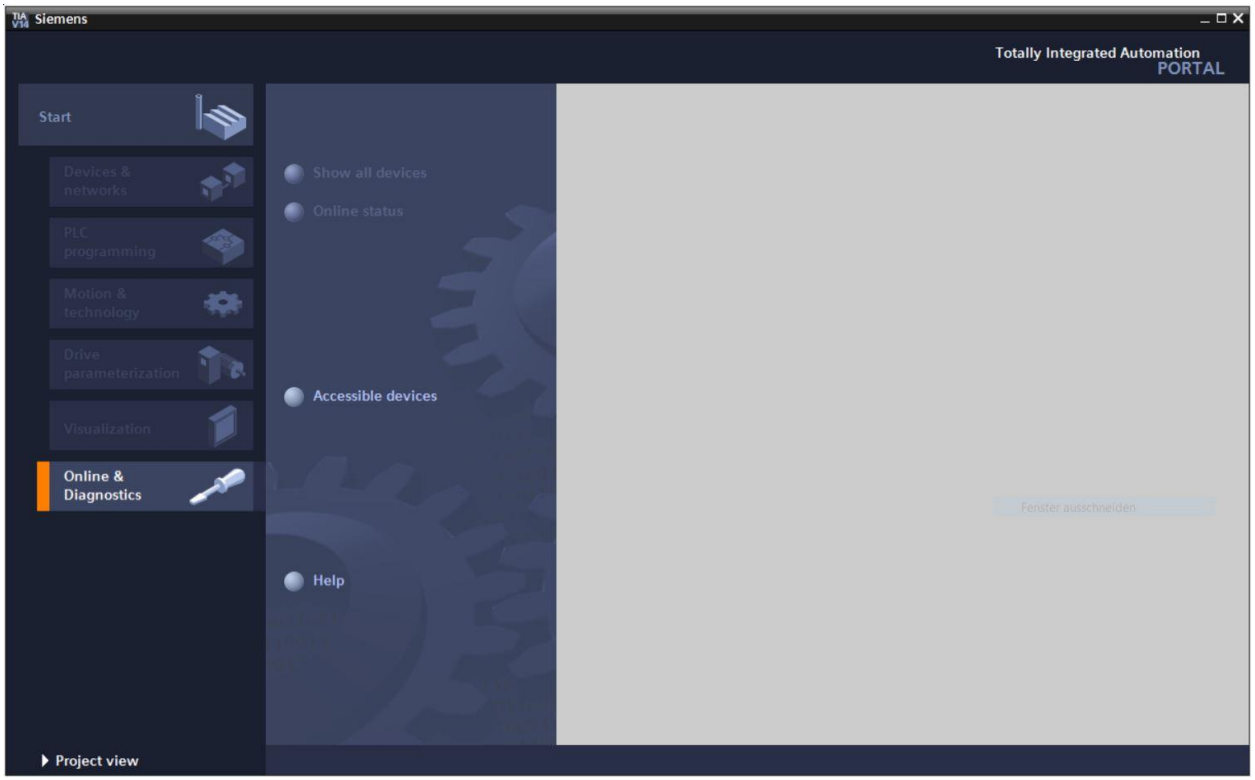


4.3.7 Set the IP address in the CPU

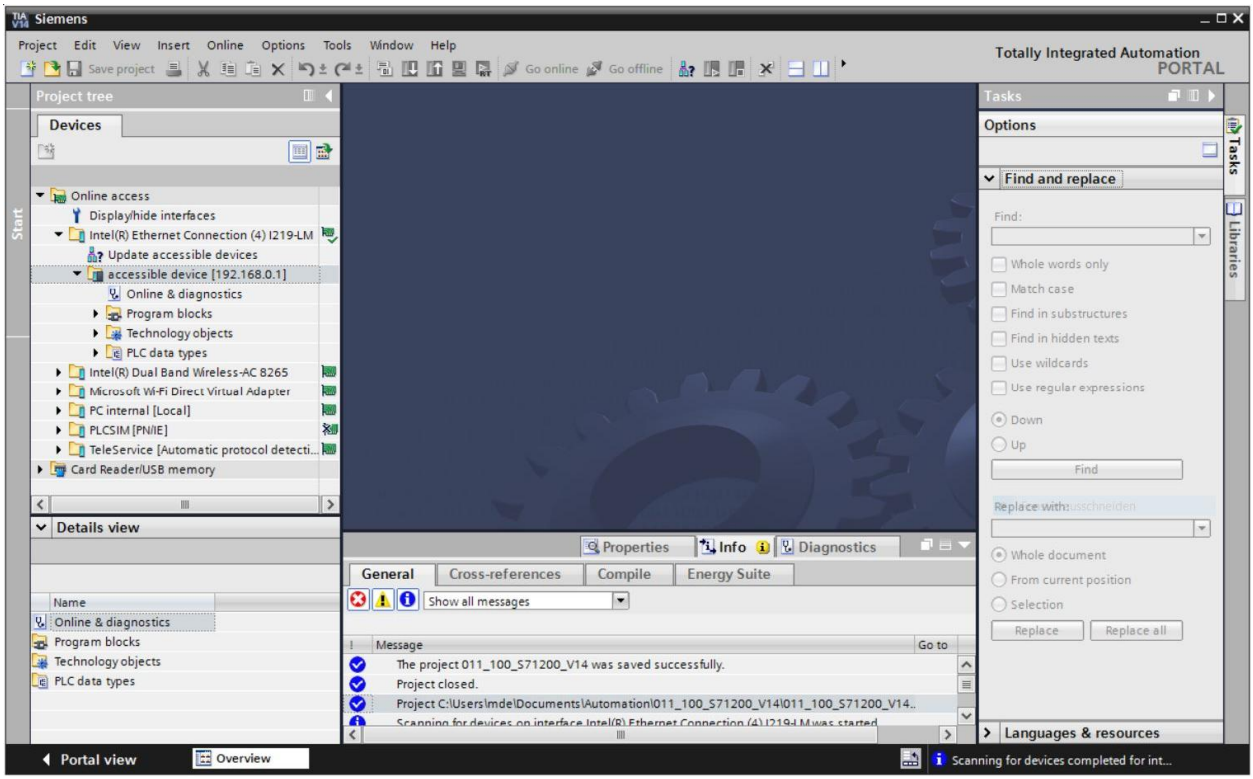
The IP address of SIMATIC S7-1200 is set as follows.

® Select the Totally Integrated Automation Portal for this, which is opened here with a double-click (® TIA Portal V14)

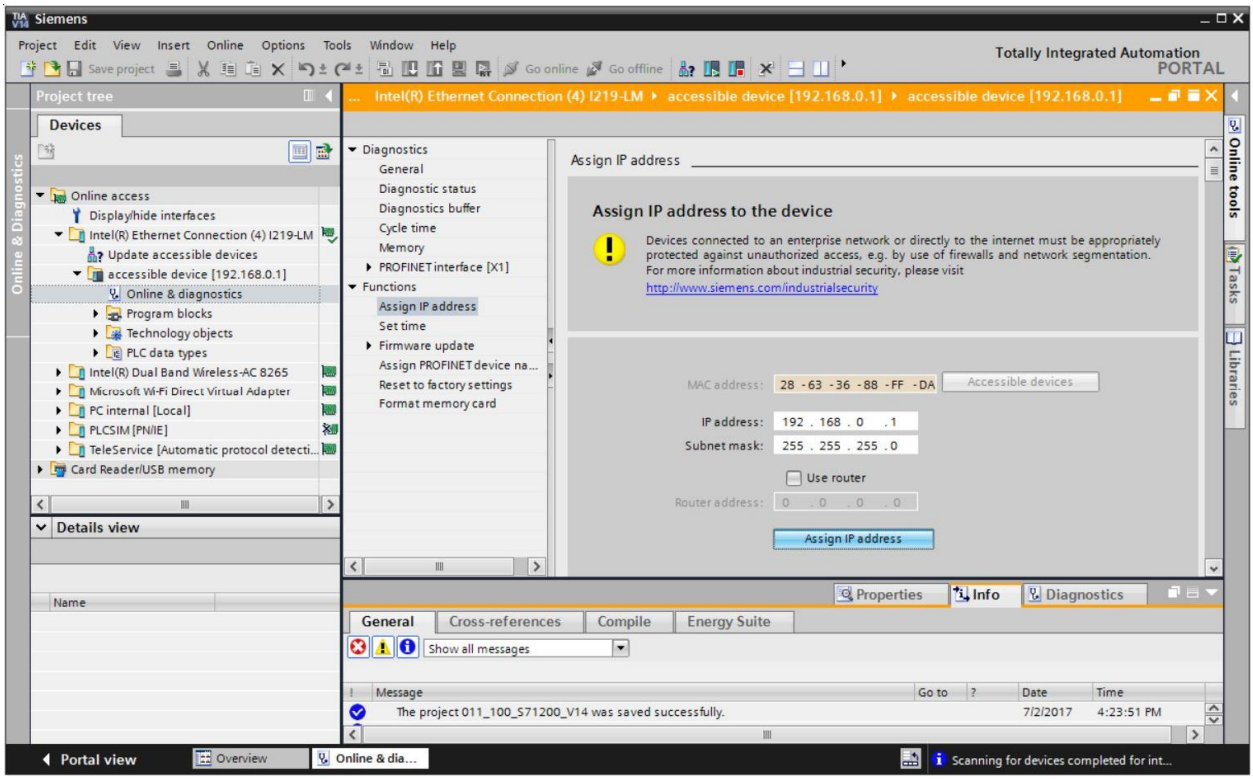
® Select ® "Online&Diagnostics", and open the ® "project view".



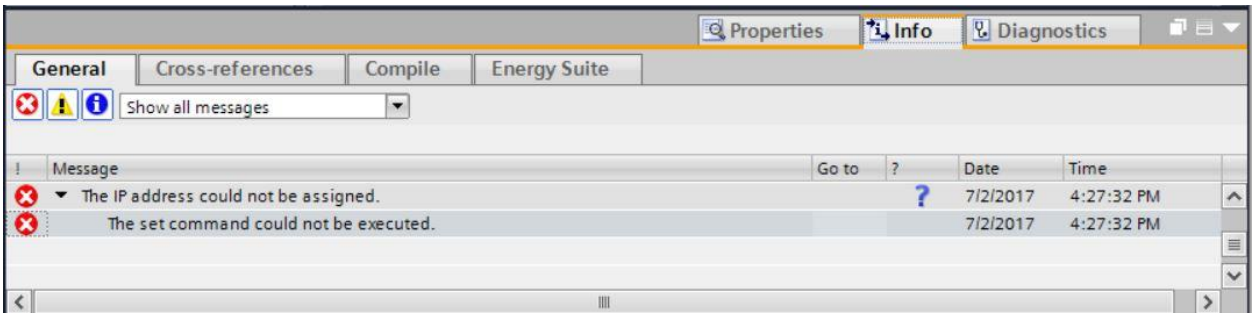
® In the project tree under ® "Online access", select the network adapter that was set previously. If you click ® "Update accessible devices" here, you see the IP address (if previously set) or the MAC address (if IP address not yet assigned) of the connected SIMATIC S7-1200. Select ® "Online&Diagnostics" here.



® Under ® "Functions", you now find the ® "Assign IP address" item. Enter the following IP address here (example): ® IP address: 192.168.0.1 ® Subnet mask 255.255.255.0. Click ® "Assign IP address" and this new address will be assigned to your SIMATIC S7-1200.

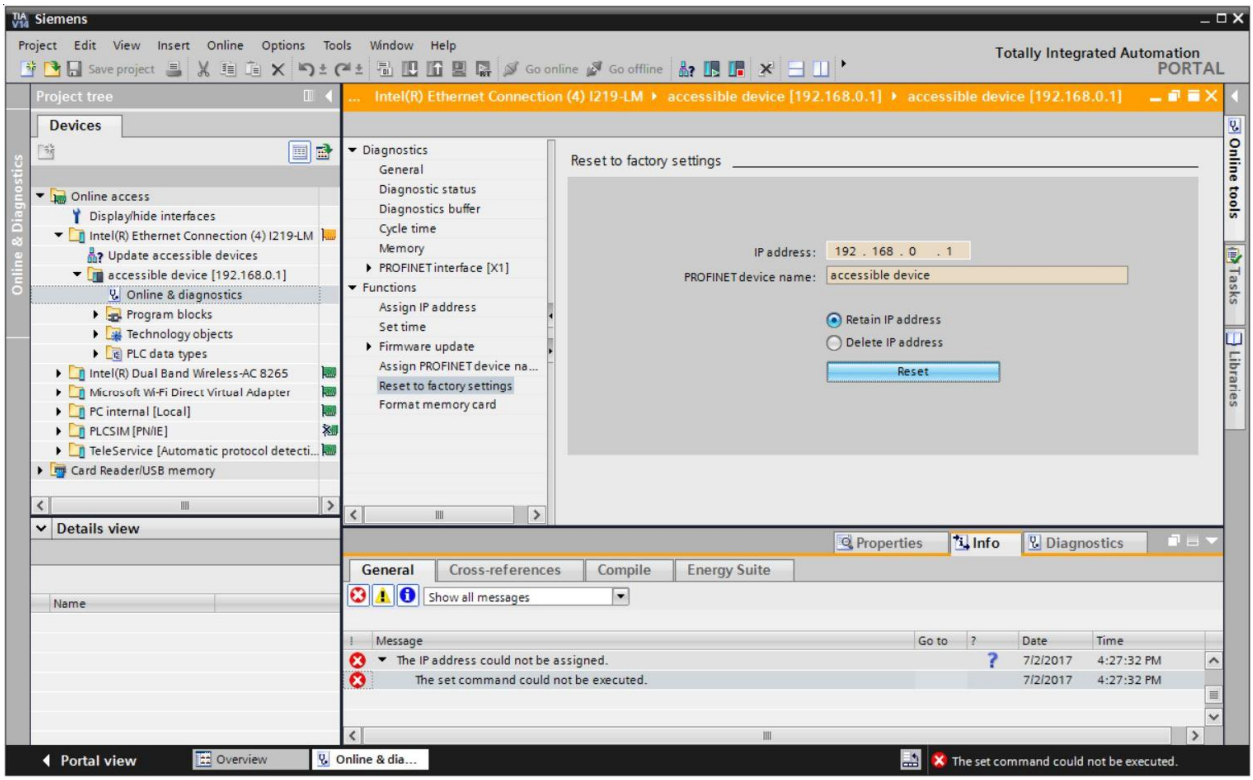


® If the IP address was not successfully assigned, you will receive a message in the ® "Info" window under ® "General".

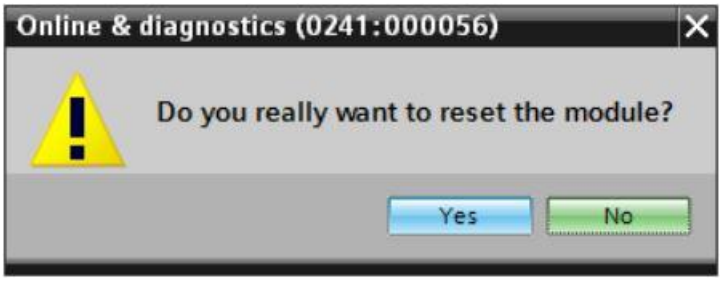


4.3.8 Restore the factory settings of the CPU

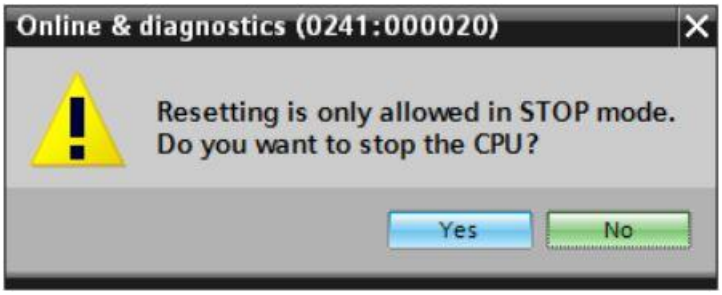
® If the IP address could not be assigned, the program data on the CPU must be deleted. This is done by resetting the CPU. To reset the controller, select the ® "Reset to factory settings" function and click ® "Reset".



® Confirm the prompt asking if you really want to reset the module with ® "Yes".



® If necessary, stop the CPU. (® "Yes")



5 Task

Create a project und configure the compact CPU of your hardware, which corresponds to one part of the **SIMATIC S7-1200 with CPU 1214C** DC/DC/DC Trainer Package.

– SIMATIC S7-1200, CPU 1214C DC/DC/DC
(Order number: 6ES7 214-1AG40-0XB0)

6 Planning

Because this is a new system, a new project must be created.

The hardware for this project is already specified with the SIMATIC S7-1200, CPU 1214C DC/DC/DC Trainer Package, Therefore, a selection does not have to be made. Instead, the listed CPU of the Trainer Package only has to be inserted in the project. To ensure that the correct module is inserted, the order number from the Task should be checked again directly on the installed device (see Table 1).

The Ethernet interface must be set for the configuration of the CPU. For the digital and analog inputs and outputs, the address areas corresponding to Table 1 will be set.

Module	Order number	Slot	Address area
CPU 1214C DC/DC/DC	6ES7 214-1AG40-0XB0	1	DI 0.0 -1.5 DQ 0.0 - 1.1 AI 64 / 66

Table 1: Overview of the planned configuration

As the final step, the hardware configuration must be compiled and downloaded. Any errors present can be detected during compiling and incorrect modules can be detected when the controller is started *(only possible when hardware is present and installed identically)*.

The tested project must be saved and archived.

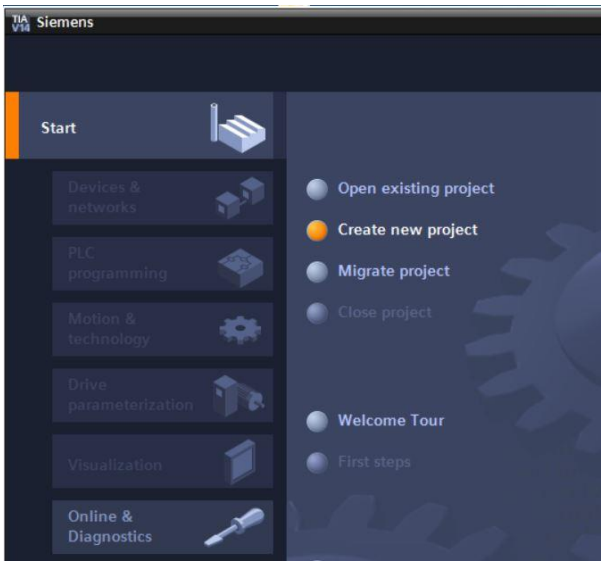
7 Structured step-by-step instructions

You can find instructions on how to carry out planning below. If you already have the relevant previous knowledge, it will be sufficient to focus on the numbered steps. Otherwise, simply follow the detailed steps in the instructions.

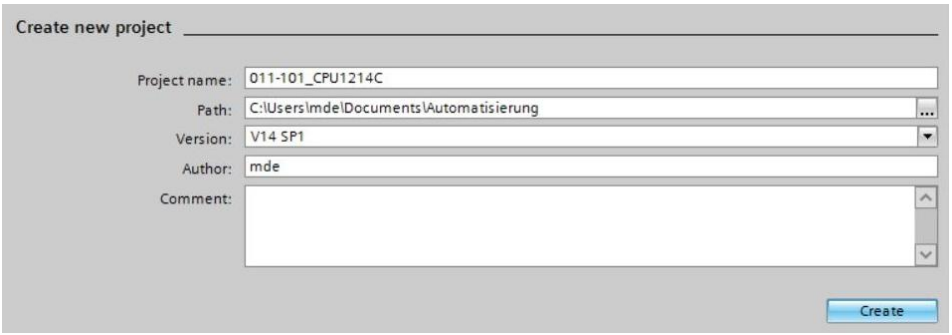
7.1 Create a new project

® Select the Totally Integrated Automation Portal for this, which is opened here with a double-click (® TIA Portal V14)

® In the portal view under the "Start" menu, select the command ® "Create new project".



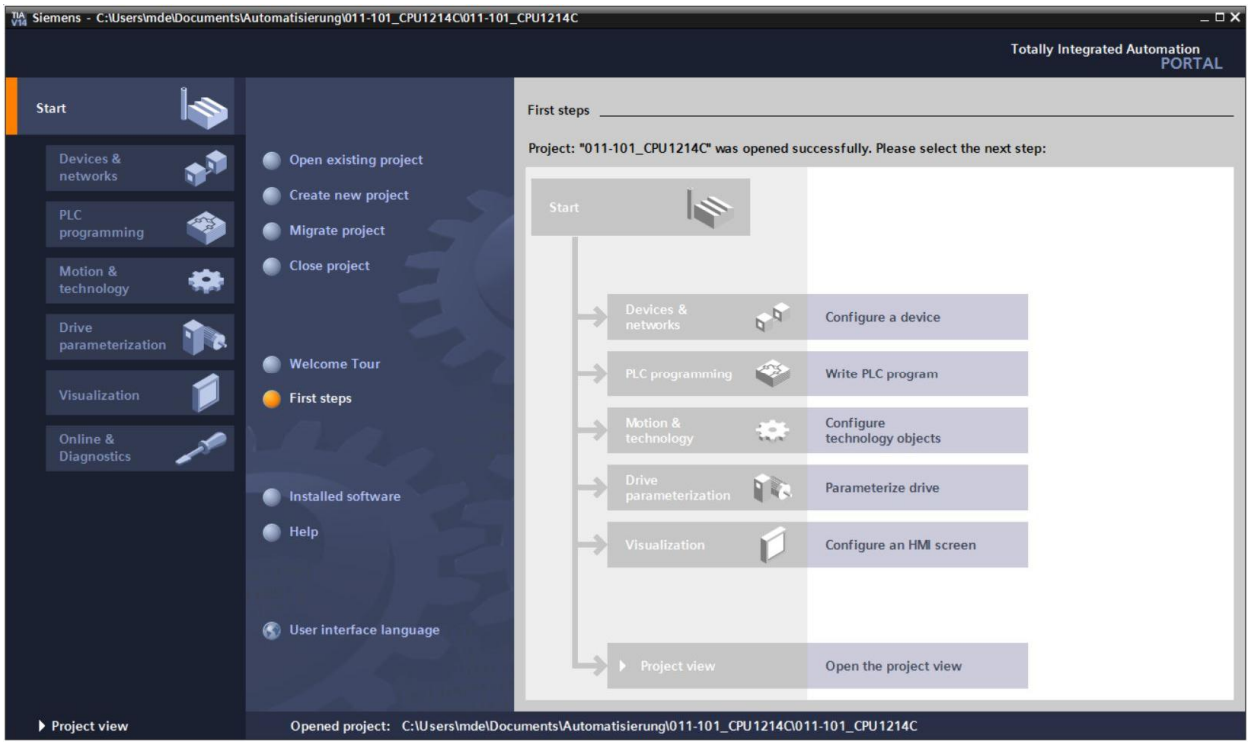
® Modify Project name, Path, Author and Comment as appropriate and click ® "Create".



® The project will be created and opened and the "Start" menu, "First steps" will open automatically.

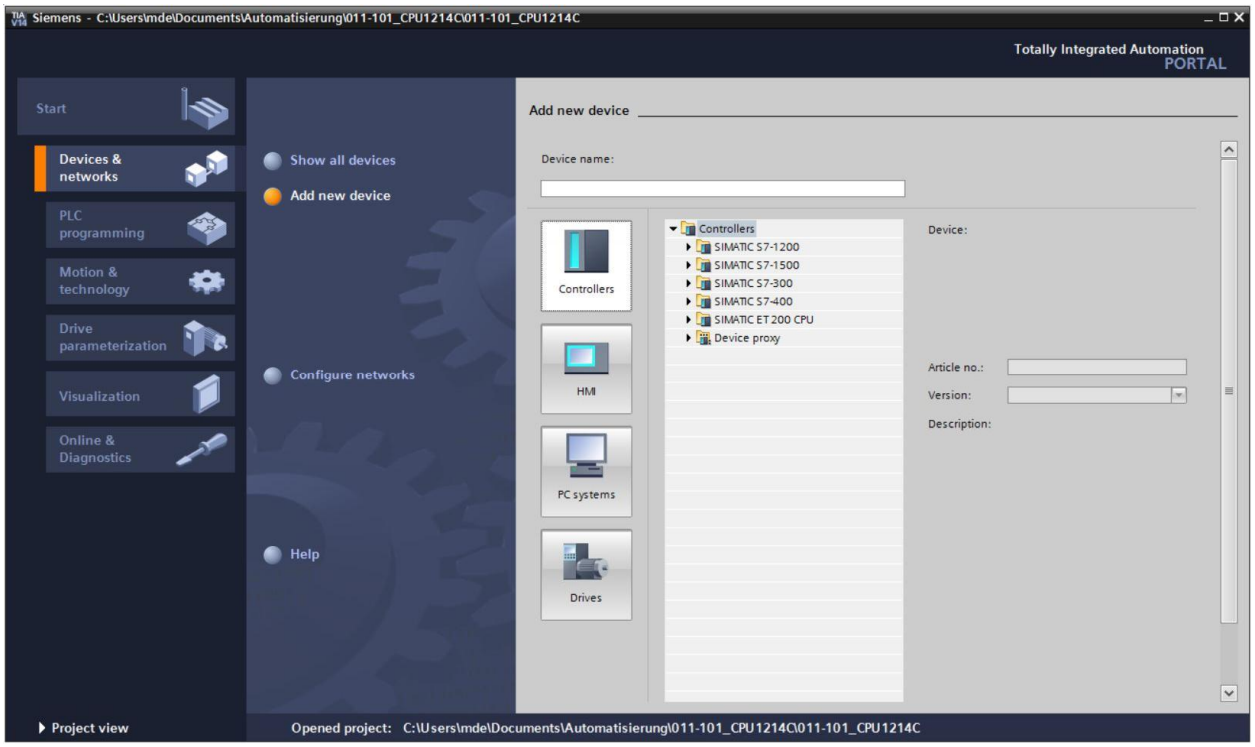
7.2 Insert the CPU 1214C DC/DC/DC

® In the ® "Start" portal, select ® "First steps" ® "Devices & Networks" ® "Configure a device".



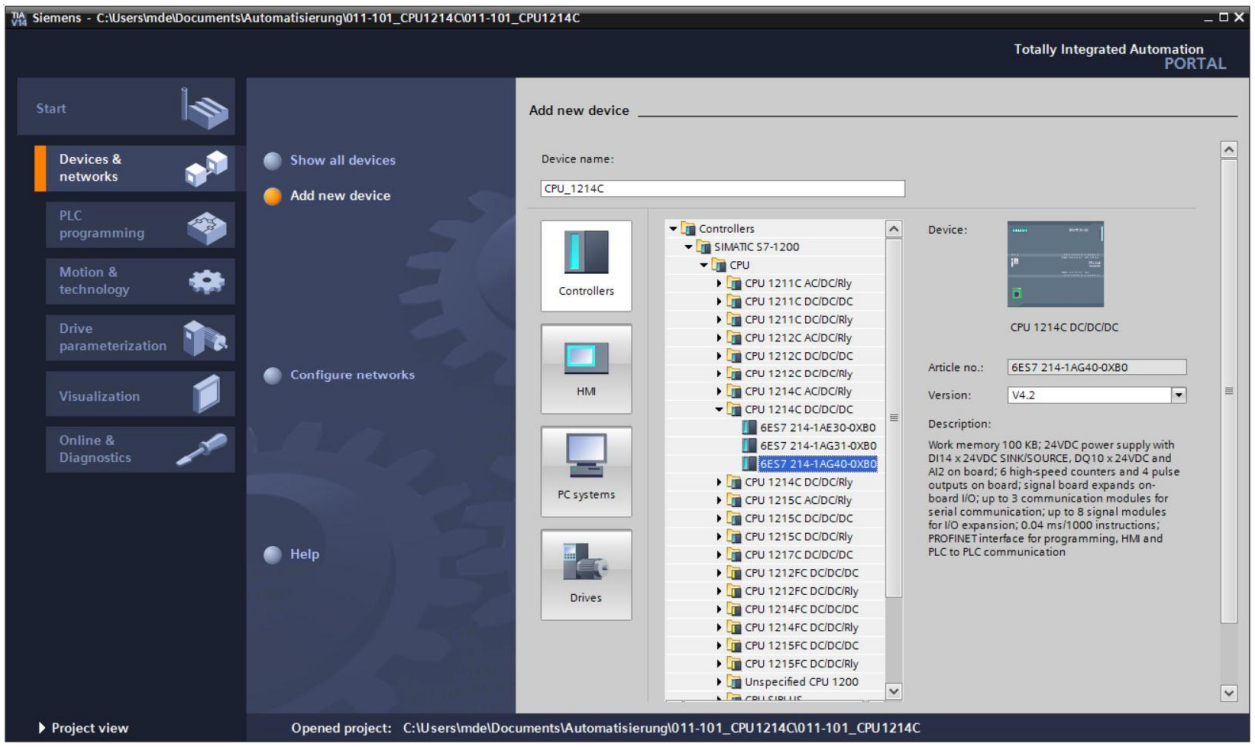
® The "Show all devices" menu opens in the "Devices & Networks" portal.

® Switch to the "Add new device" menu.



® The specified model of the CPU will now be added as a new device.

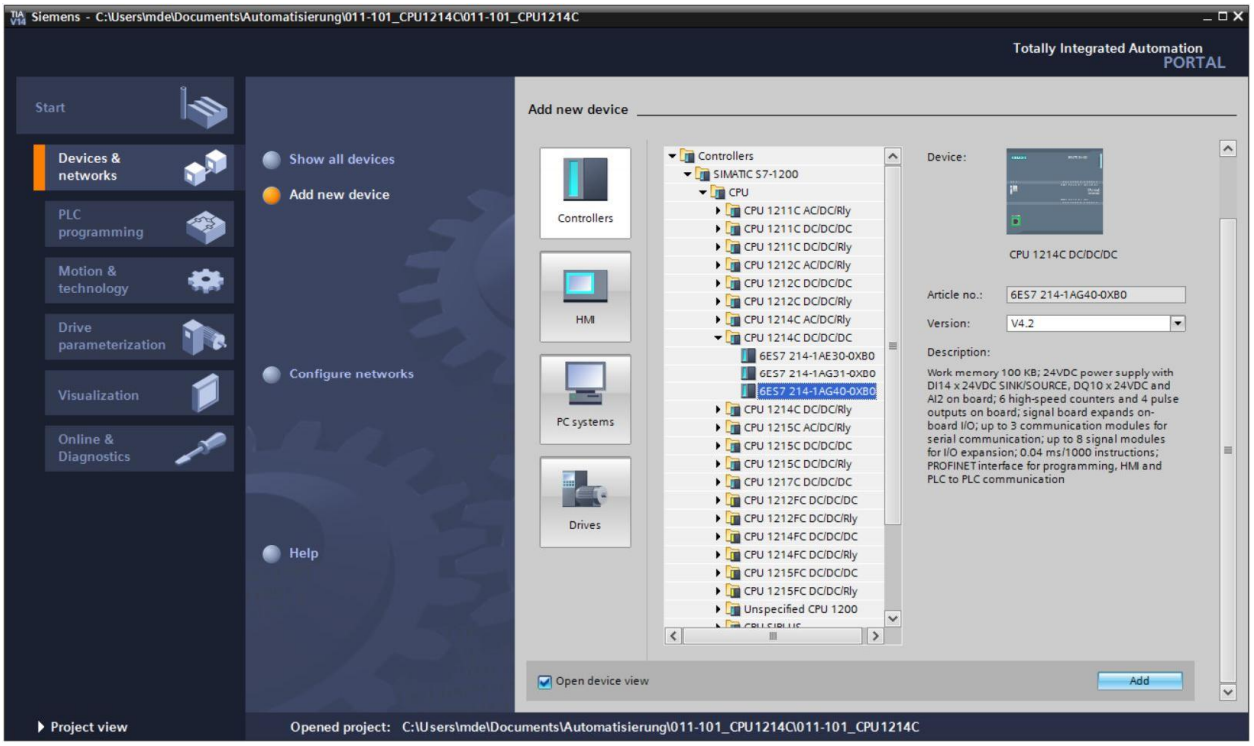
® (Controllers ® SIMATIC S7-1200 ® CPU ® CPU 1214C DC/DC/DC® 6ES7214-1AG40-0XB0 ® V4.2)



® Assign a device name (Device name ® "CPU_1214C").

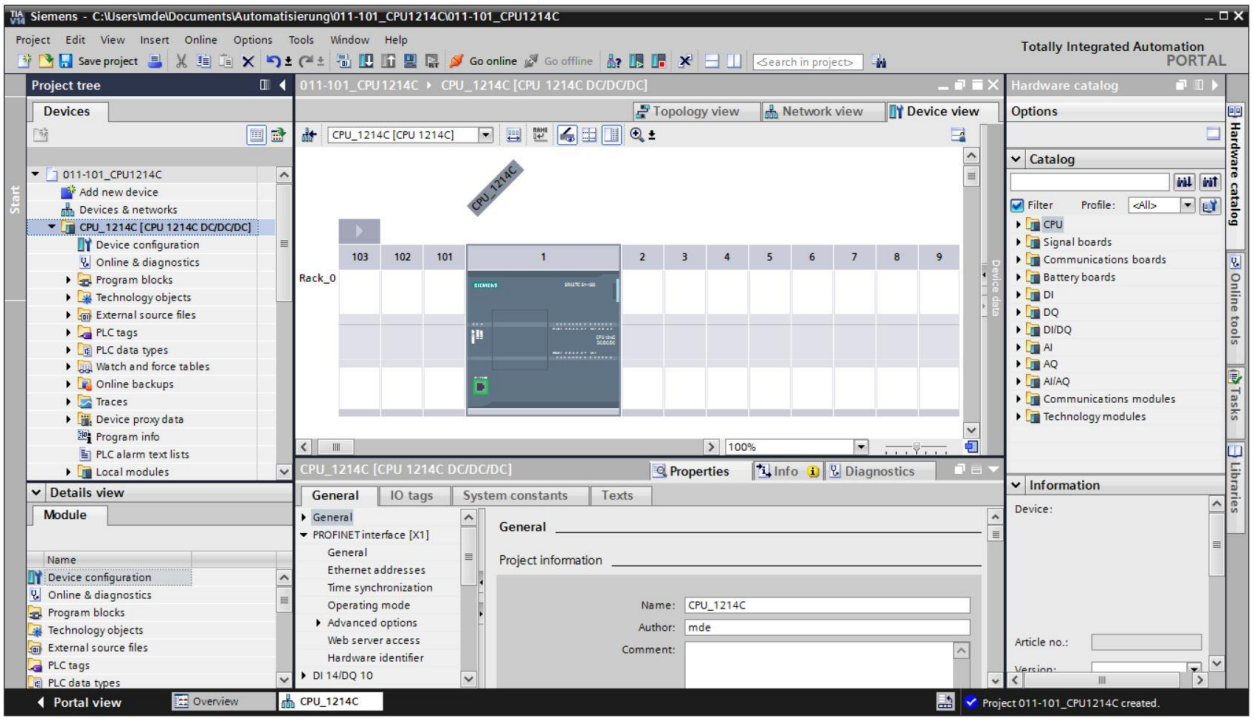
® Select "Open device view".

® Click "Add".



Note: *The desired CPU may have multiple versions that differ in functionality (work memory, integrated memory, technology functions, etc.). In this case, you should ensure that the selected CPU meets the requirements placed on it.*

The TIA Portal now switches automatically to the project view and displays the selected CPU in the device configuration on slot 1 of a rail.

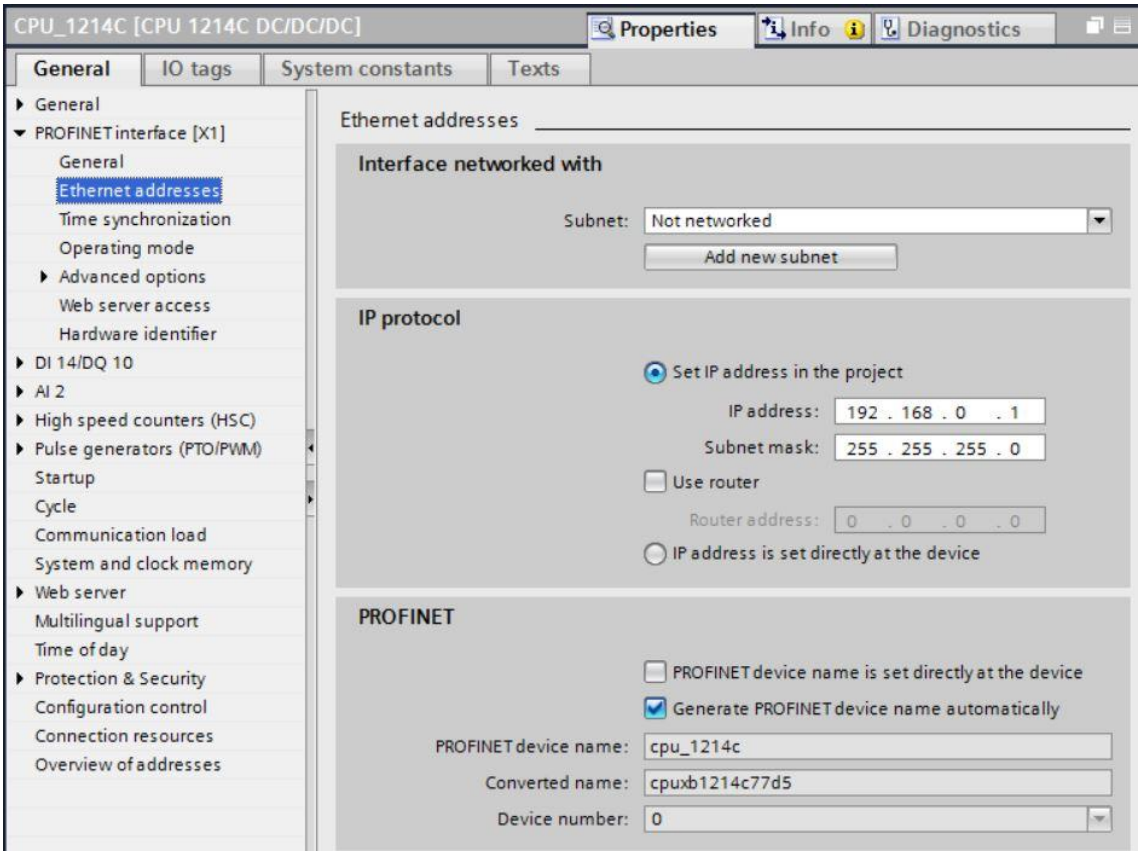


Note: *You can now configure the CPU according to your specifications there. Possible settings include the PROFINET interface, startup characteristics, cycle, password protection, communication load and many more.*

7.3 Configure the Ethernet interface of the CPU 1214C DC/DC/DC

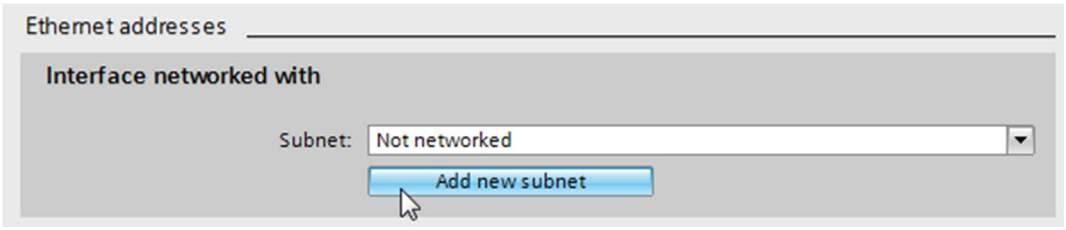
® Select the CPU with a double-click

® Under ® "Properties", open the ® "PROFINET interface [X1]" menu and select the ® "Ethernet addresses" entry.

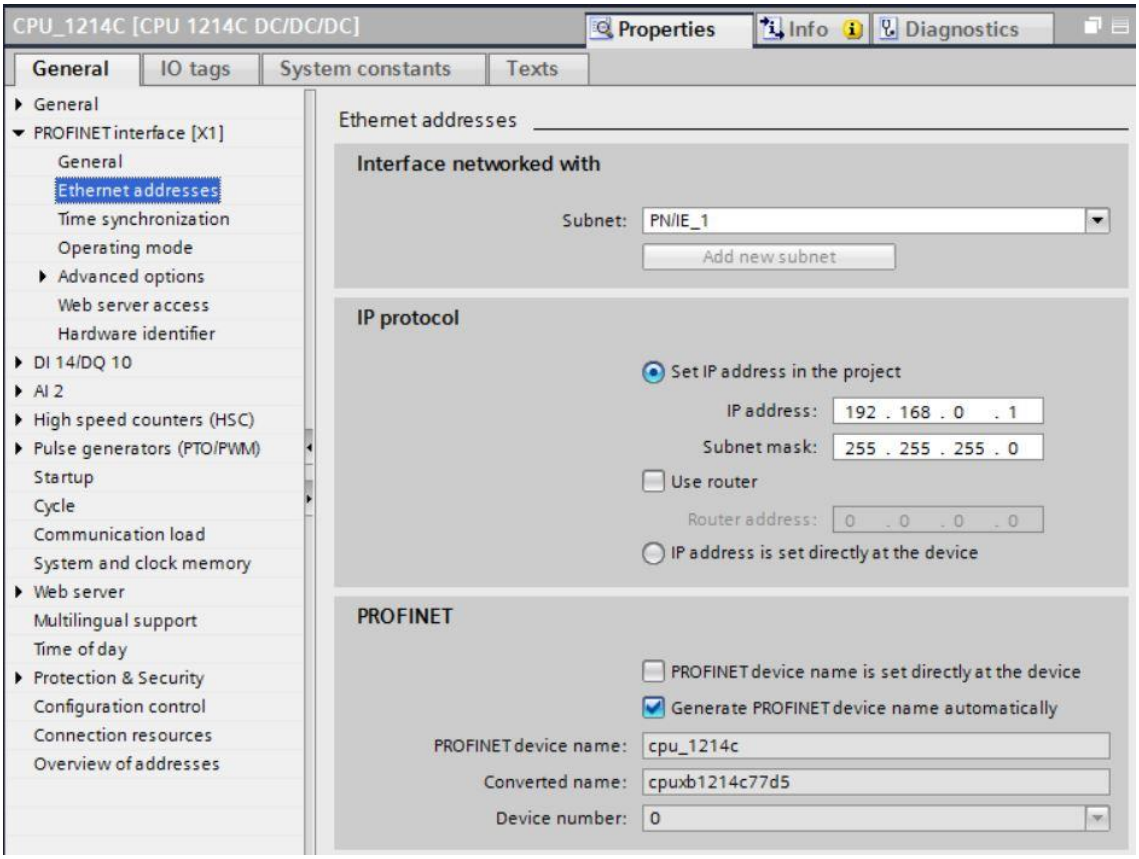


® Under "Interface networked with", only the "Not networked" entry is available.

® Add an Ethernet subnet with the ® "Add new subnet" button.

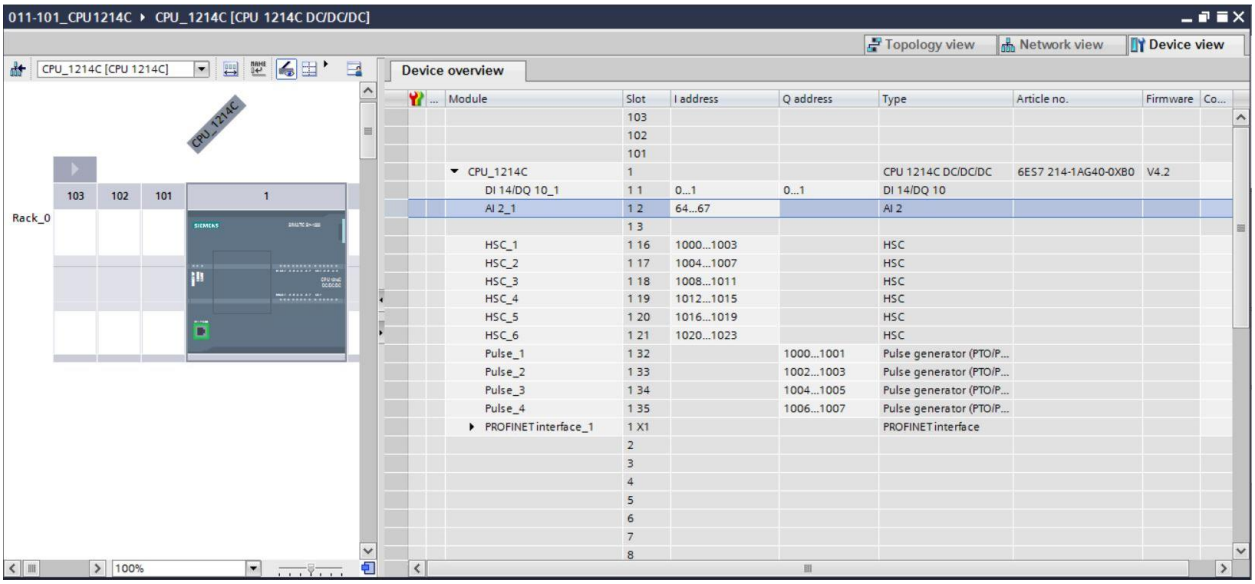


® Keep the preassigned "IP address" and "Subnet mask".

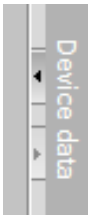


7.4 Configure the address areas

® The next step is to check the address areas of the inputs and outputs and adapt them if necessary. DI/DO should have an address area of 0…1 and AI should have an address area of 64…67. (® Device overview ® DI 14/DQ 10_1 ® I address: 0..1® Q address: 0...1 ® AI 2_1 ® I address: 64…67)

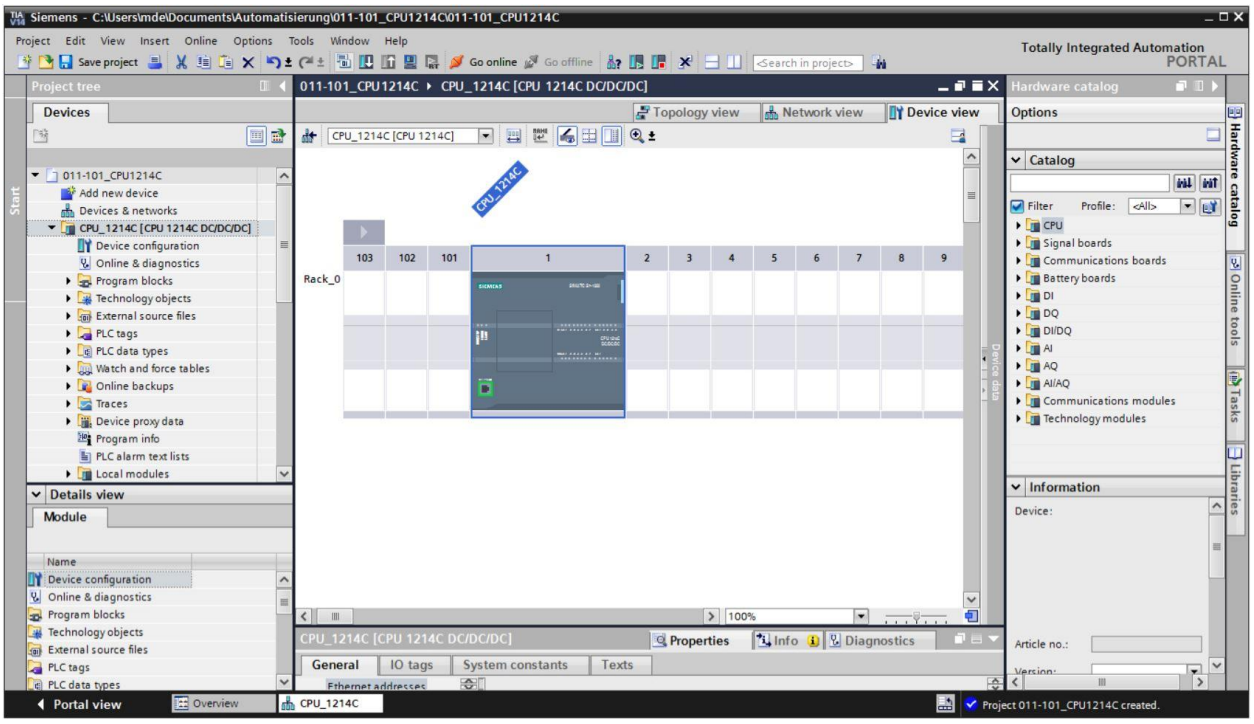


Note: *To show and hide the Device overview, you need to click the small arrow next to "Device data" on the right side of the hardware configuration.*



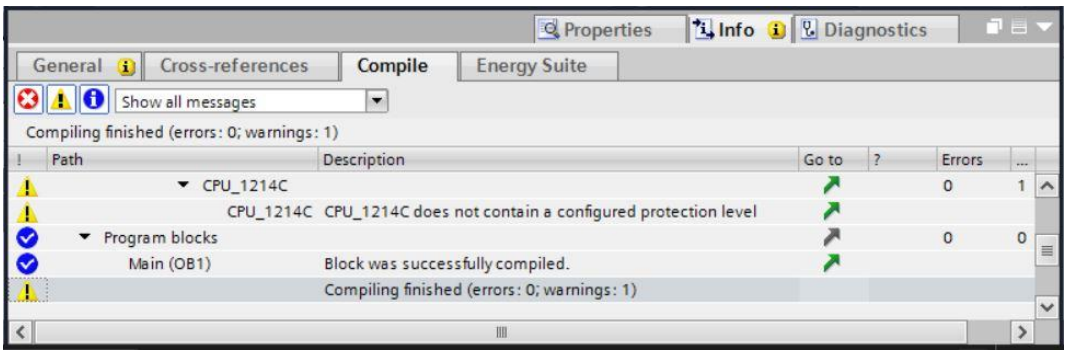
7.5 Save and compile the hardware configuration

® Before you compile the configuration, you should save your project by clicking the ® Save project button. To compile your CPU with the device configuration, first select the ® "CPU_1214C [CPU1214C DC/DC/DC]" folder and click the ® "Compile" icon.



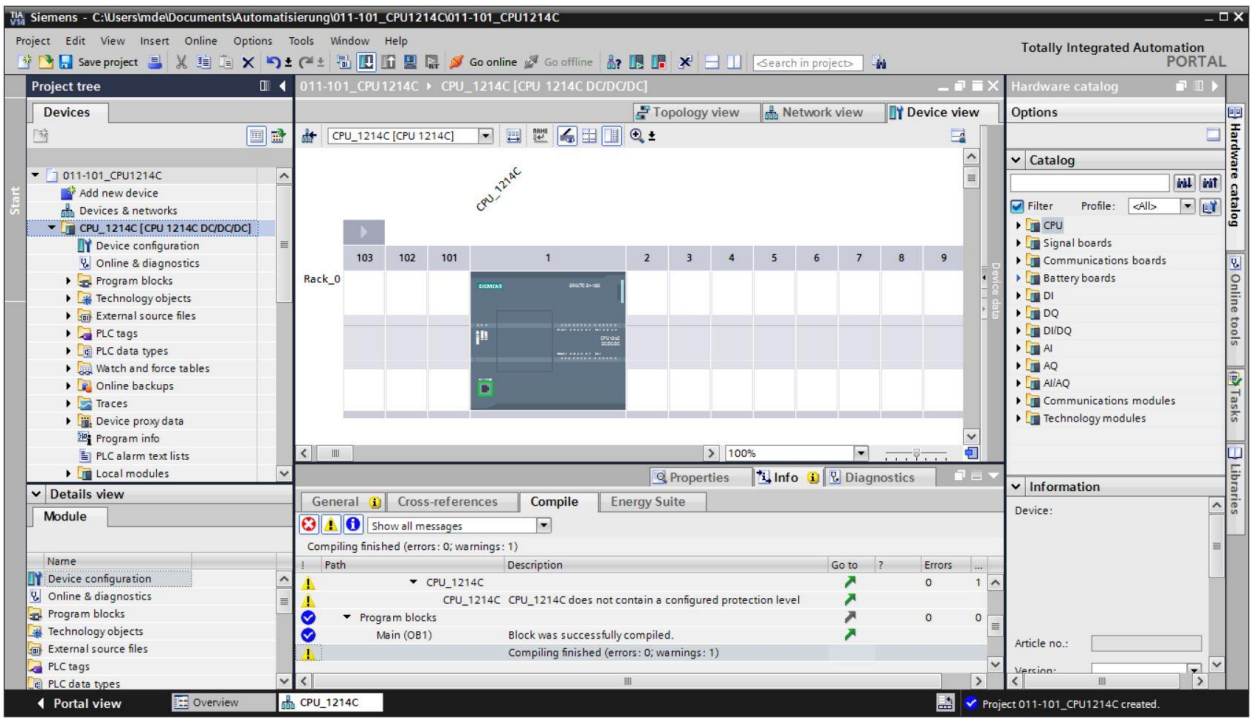
Note: *"Save project" should be used again and again when working on a project since this does not happen automatically. A prompt to save the project only occurs when the TIA Portal is closed.*

® If the project was compiled without errors, you see the following screen.

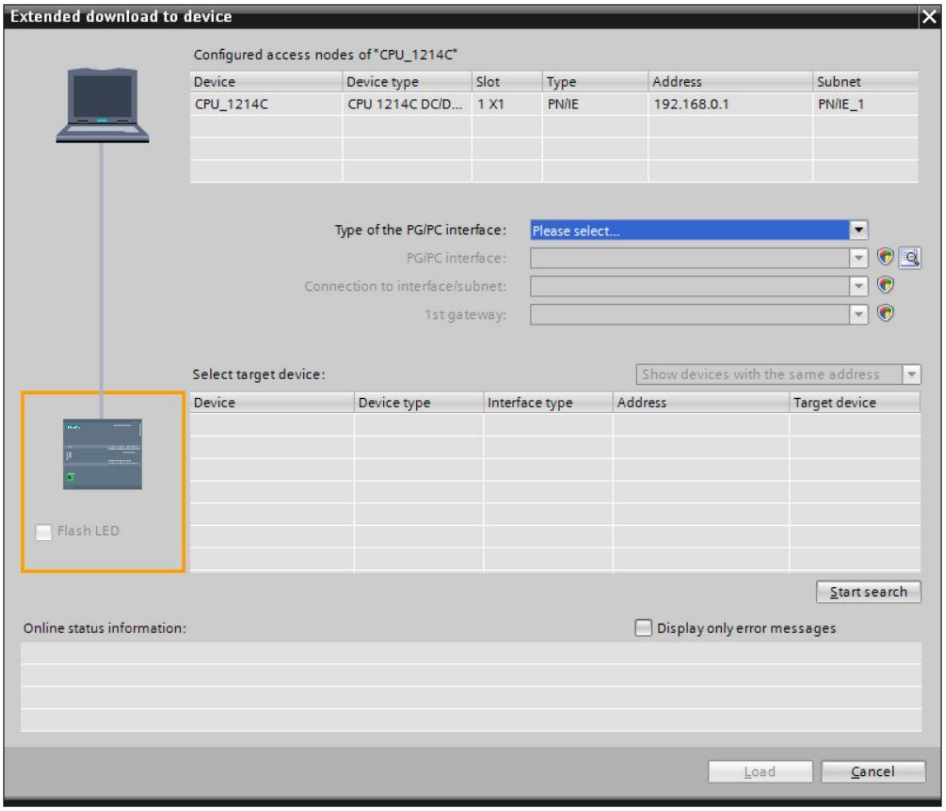


7.6 Download the hardware configuration to the device

® To download your complete CPU, select the ® "CPU_1214C [CPU1214C DC/DC/DC]" folder and click the  ® "Download" icon.

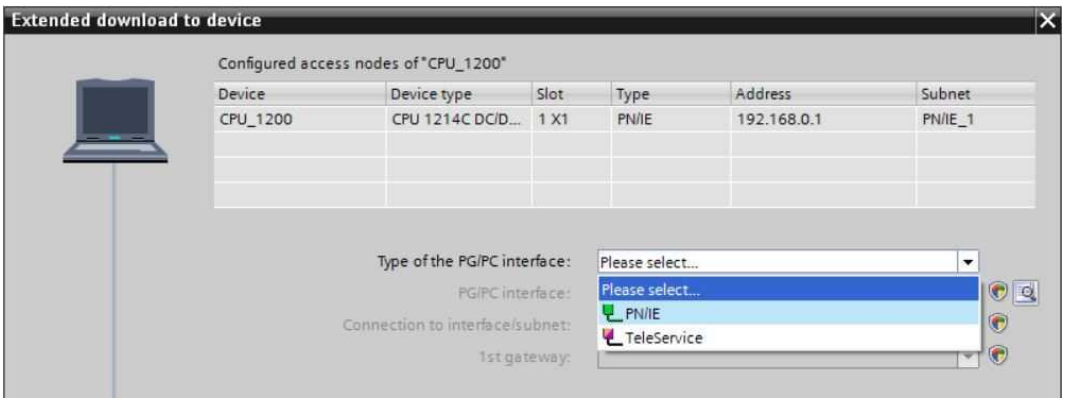


® The manager for configuring the connection properties (extended download) opens.

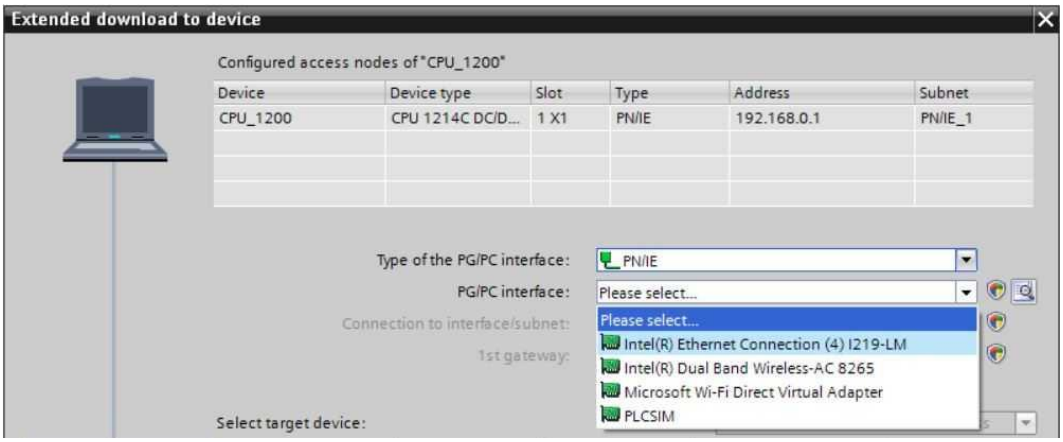


® First, the interface must be correctly selected. This happens in three steps.

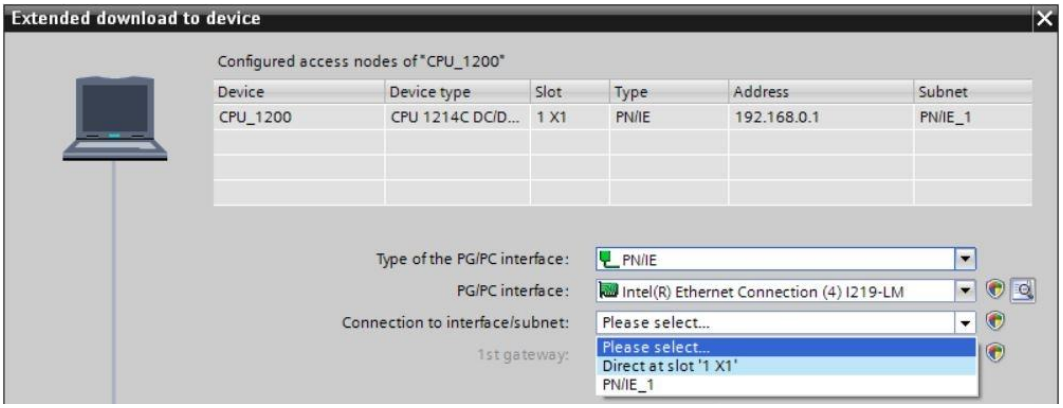
® Type of the PG/PC interface ® PN/IE



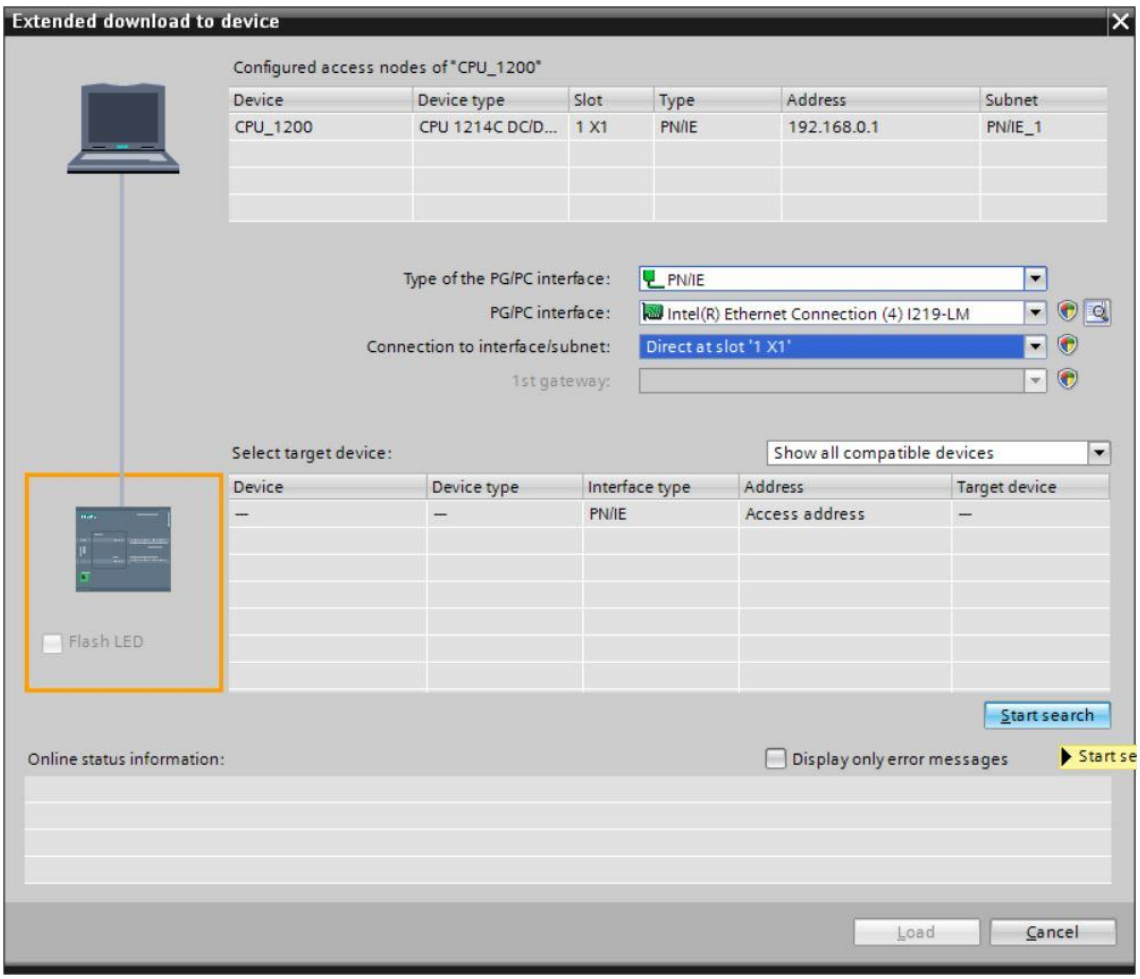
® PG/PC interface ® here: Intel(R) Ethernet Connection (4) I219-LM



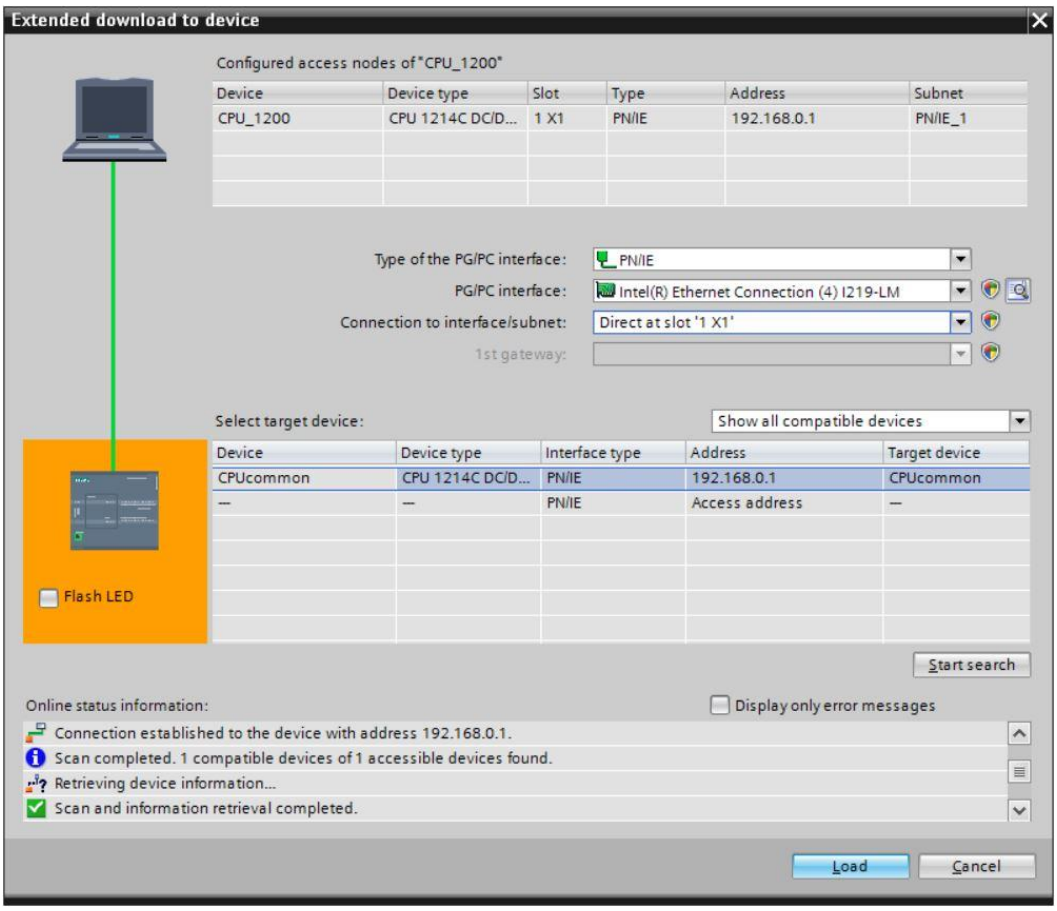
® Connection to interface/subnet ® "PN/IE_1"



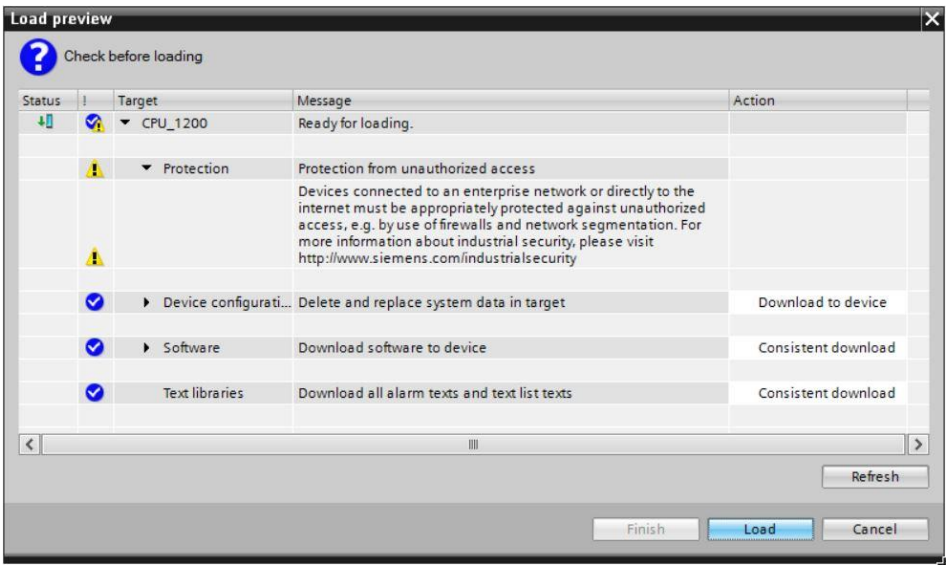
® The ® "Show all compatible devices" check box must be selected. The search for devices in the network is started by clicking the ® Start search button.



® If your CPU is shown in the "Compatible devices in target subnet" list, you must select it. The download can then be started (® CPU 1214C DC/DC/DC ® "Load").

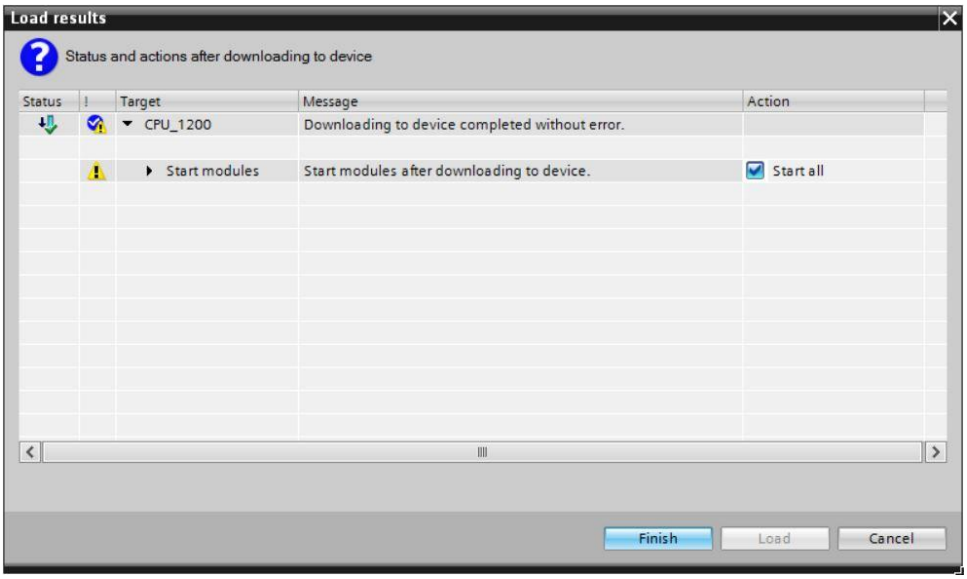


® You first obtain a preview. Confirm the prompt ® "Overwrite all" and continue with ® "Load".

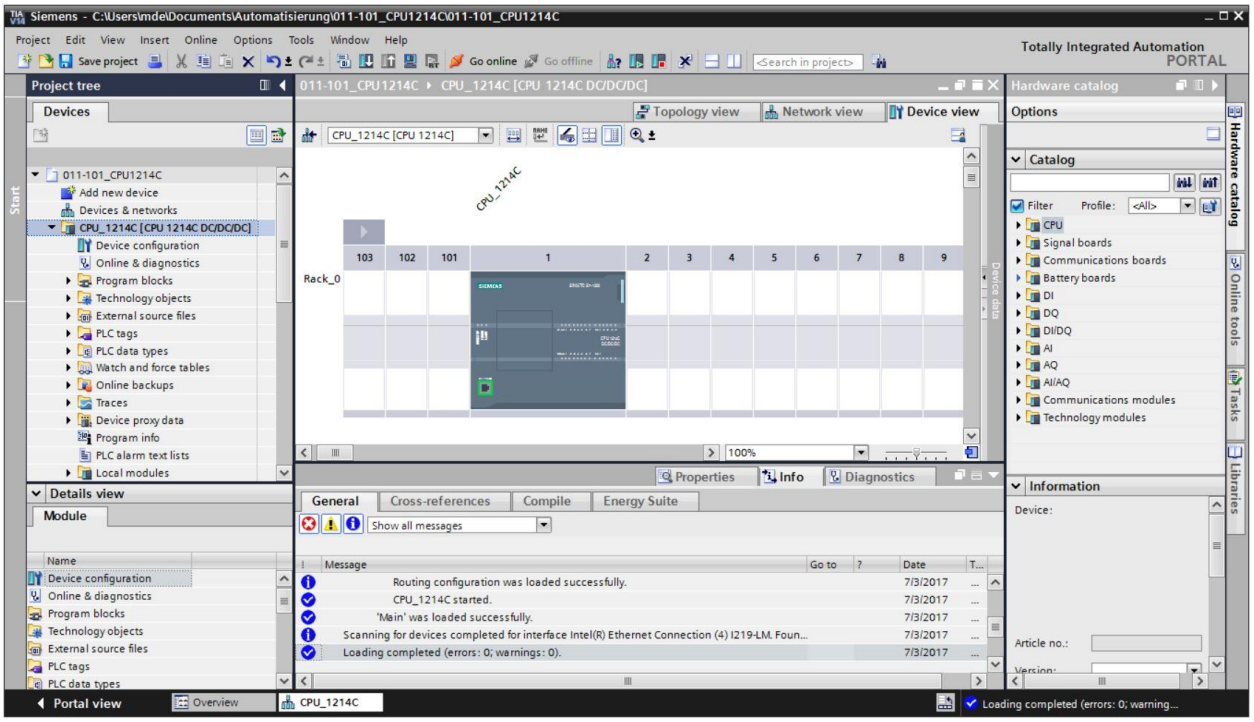


Note: *The*  *symbol should be visible in every line of the "Load preview". You can find additional information in the "Message" column.*

The ® "Start all" option will be selected next before the download operation can be completed with ® "Finish".



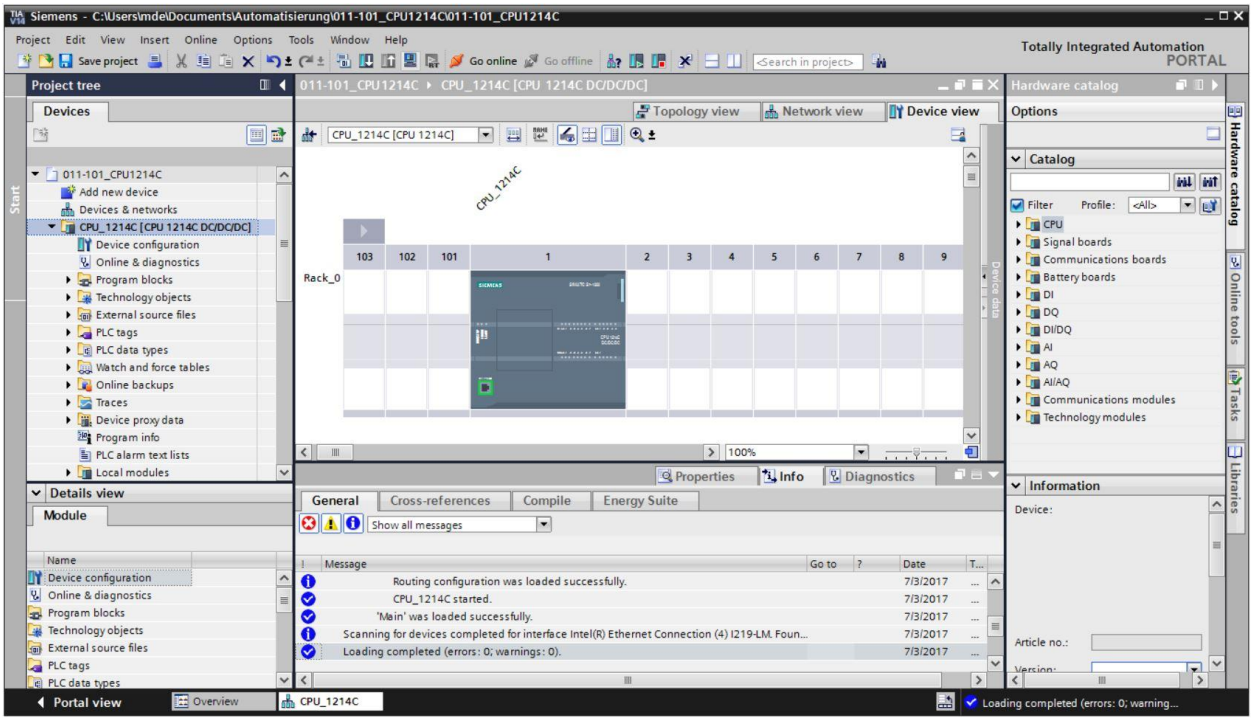
® After a successful download, the project view will open again automatically. A loading report appears in the information field under "General". This can be helpful when troubleshooting an unsuccessful download.



7.7 Download the hardware configuration to the PLCSIM simulation (optional)

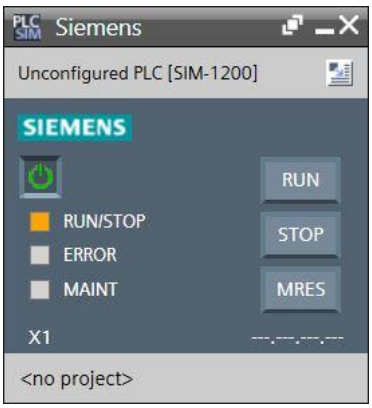
® If no hardware is present, the hardware configuration can **alternatively** be downloaded to a PLC simulation (S7-PLCSIM).

® To do so, you must first start the simulation by selecting the ® "CPU_1214C [CPU1214C DC/DC/DC]" folder and clicking the  ® "Start simulation" icon.

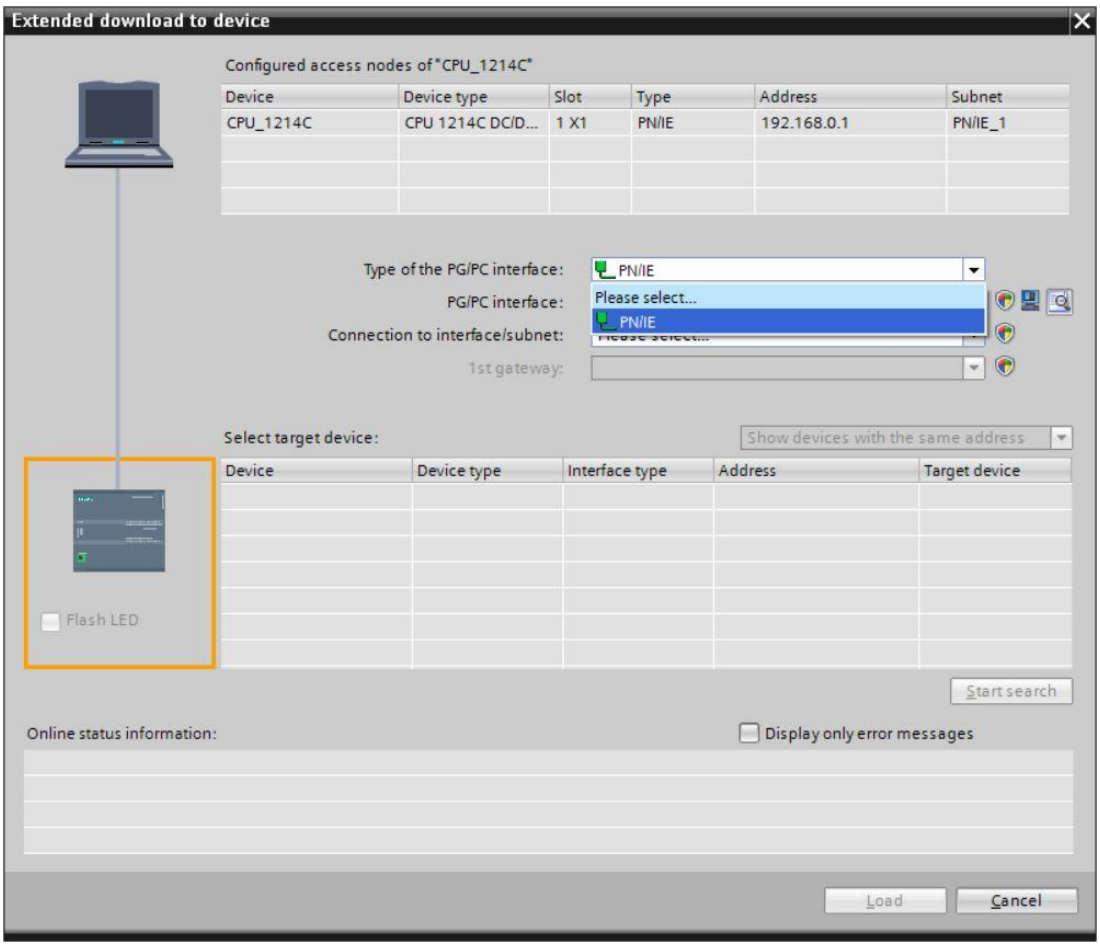


® The prompt that all other online interfaces will be disabled is confirmed with ® "OK".

® The "S7 PLCSIM" software is started in a separate window in the compact view.

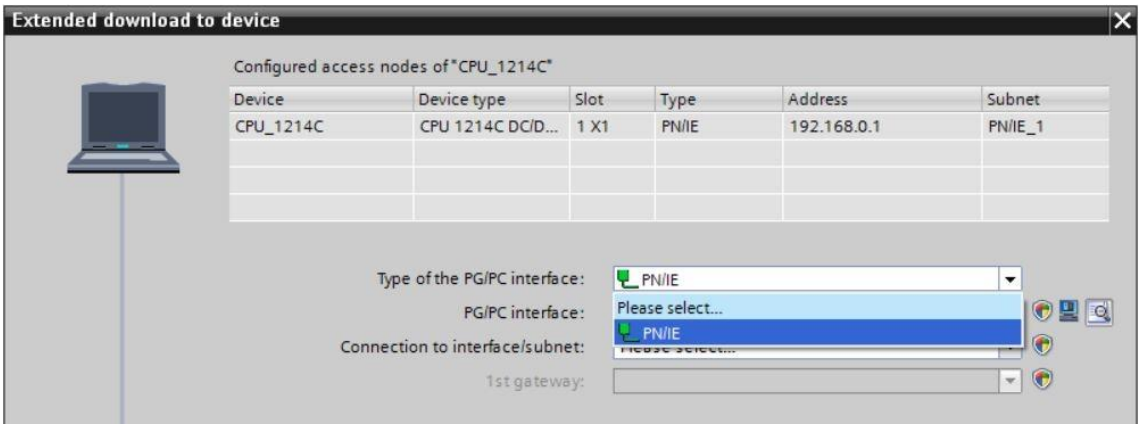


® The manager for configuring the connection properties (extended download) opens shortly thereafter.

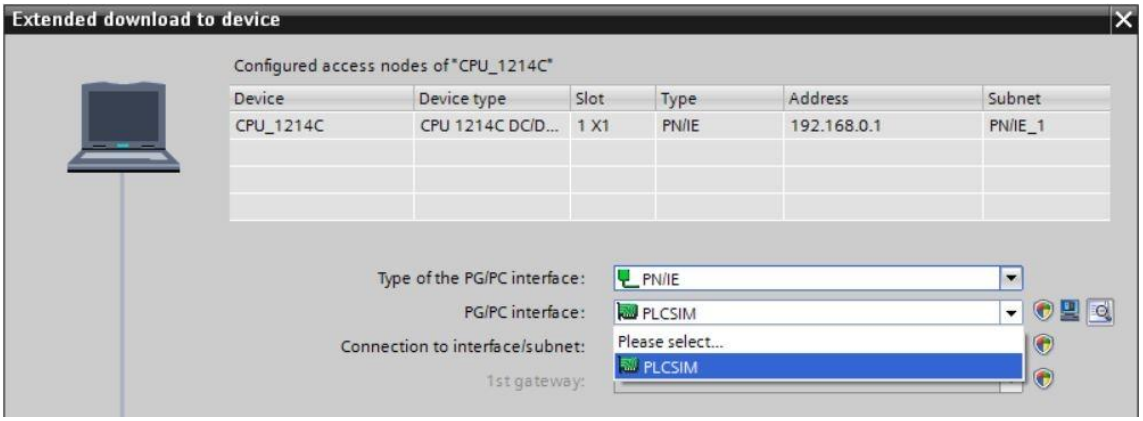


First, the interface must be correctly selected. This happens in three steps.

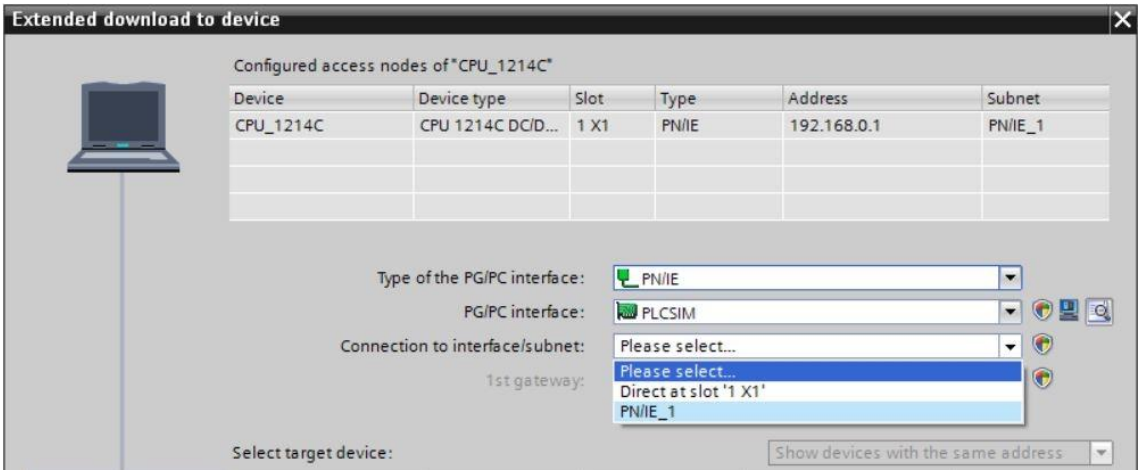
® Type of the PG/PC interface ® PN/IE



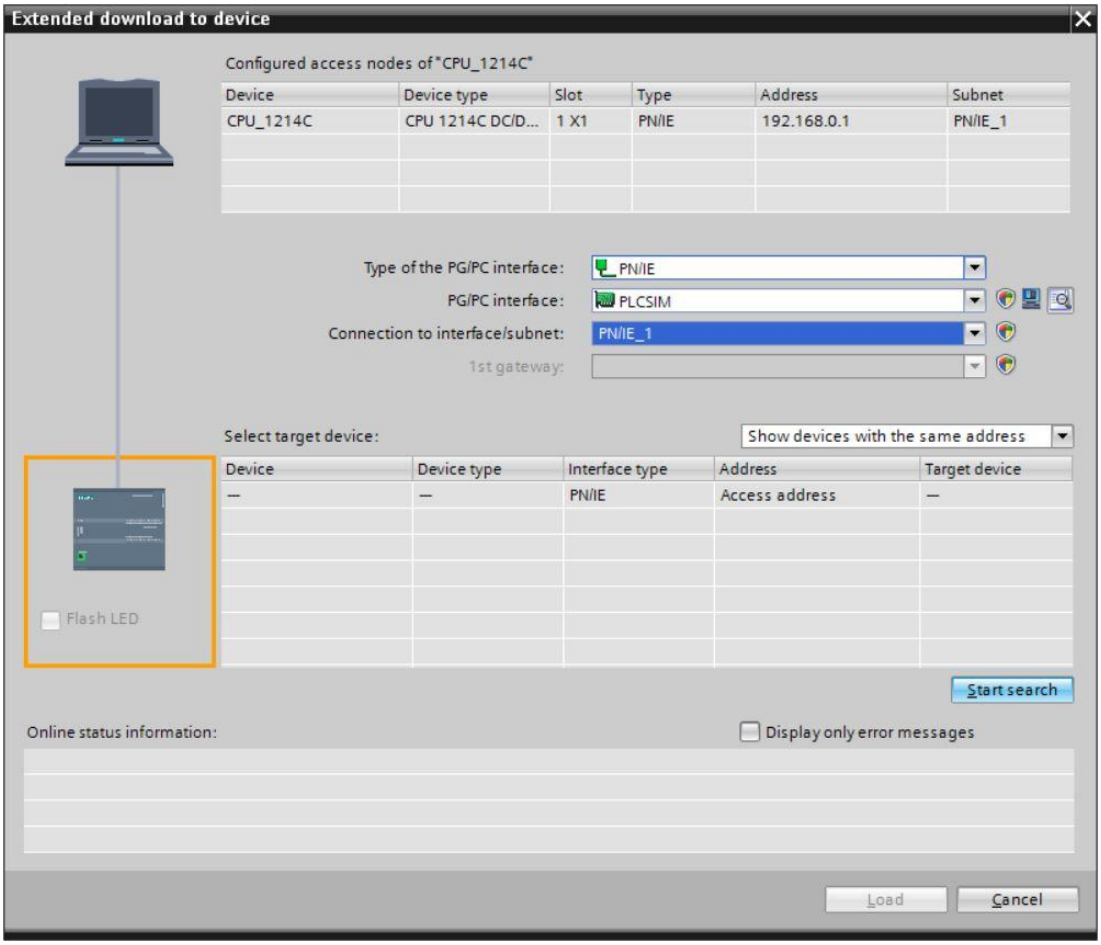
® PG/PC interface ® PLCSIM



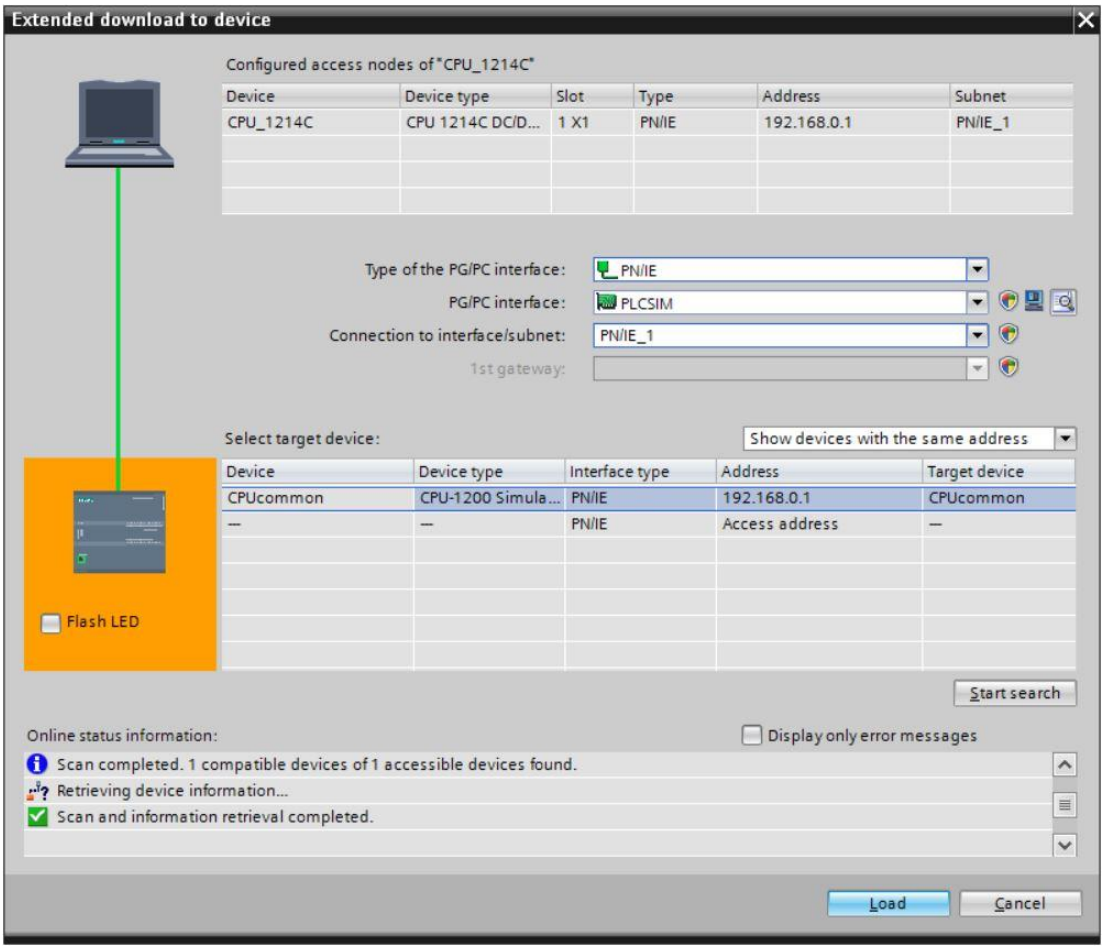
® Connection to interface/subnet ® "PN/IE_1"



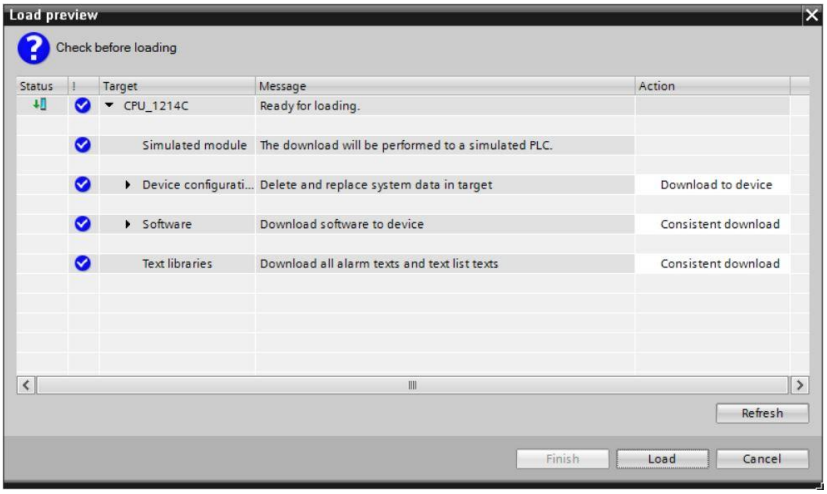
® The ® "Show all compatible devices" check box must be selected. The search for devices in the network is started by clicking the ® Start search button.



® If the simulation is shown in the "Compatible devices in target subnet" list, it must be selected before the download can be started (® "CPU-1200 Simulation" ® "Load")

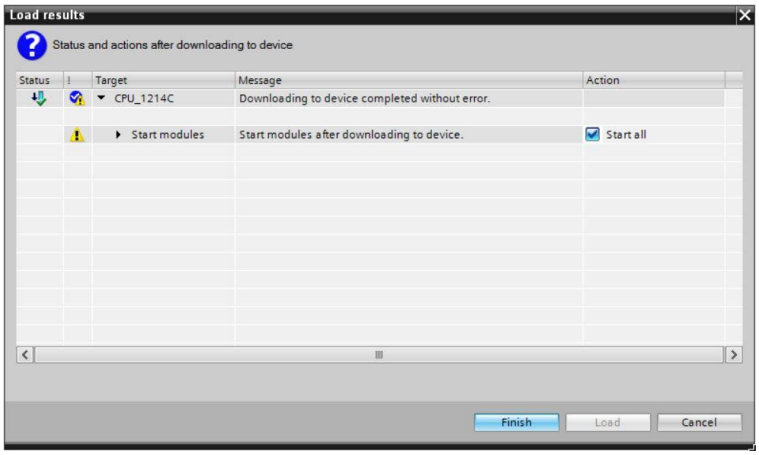


® You first obtain a preview. Continue with ® "Load".

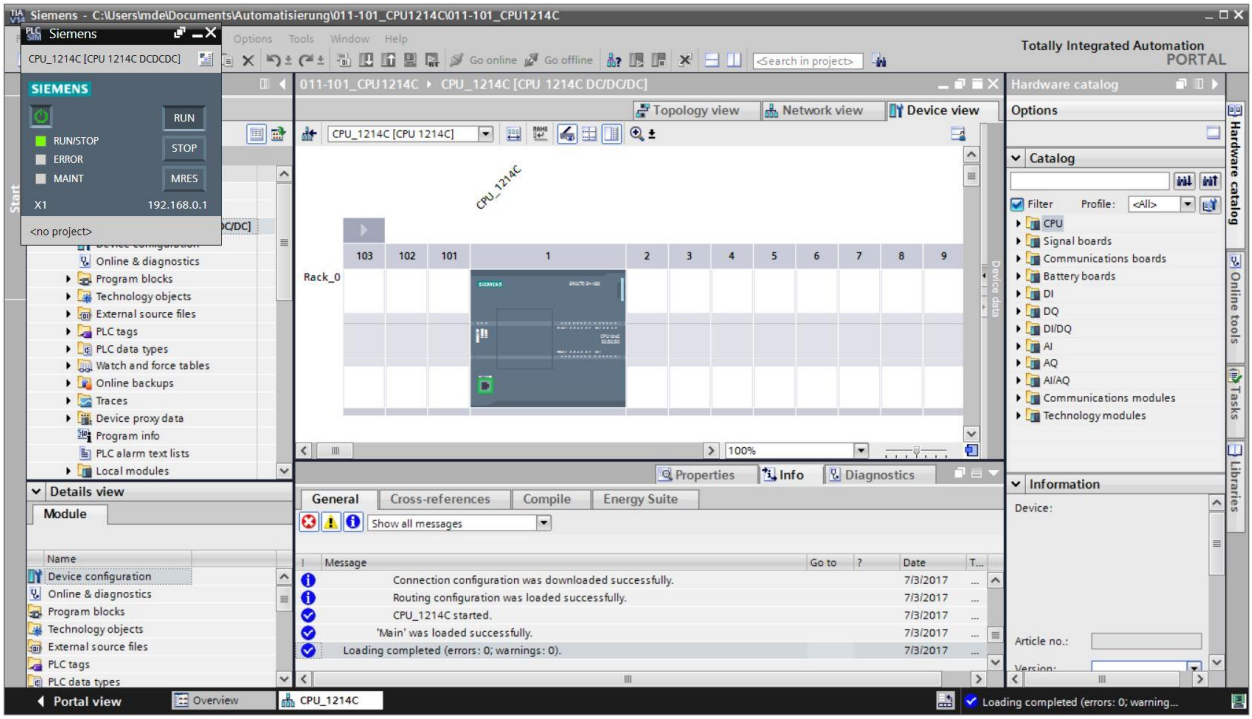


Note: *The ✔ symbol should be visible in every line of the "Load preview". You can find additional information in the "Message" column.*

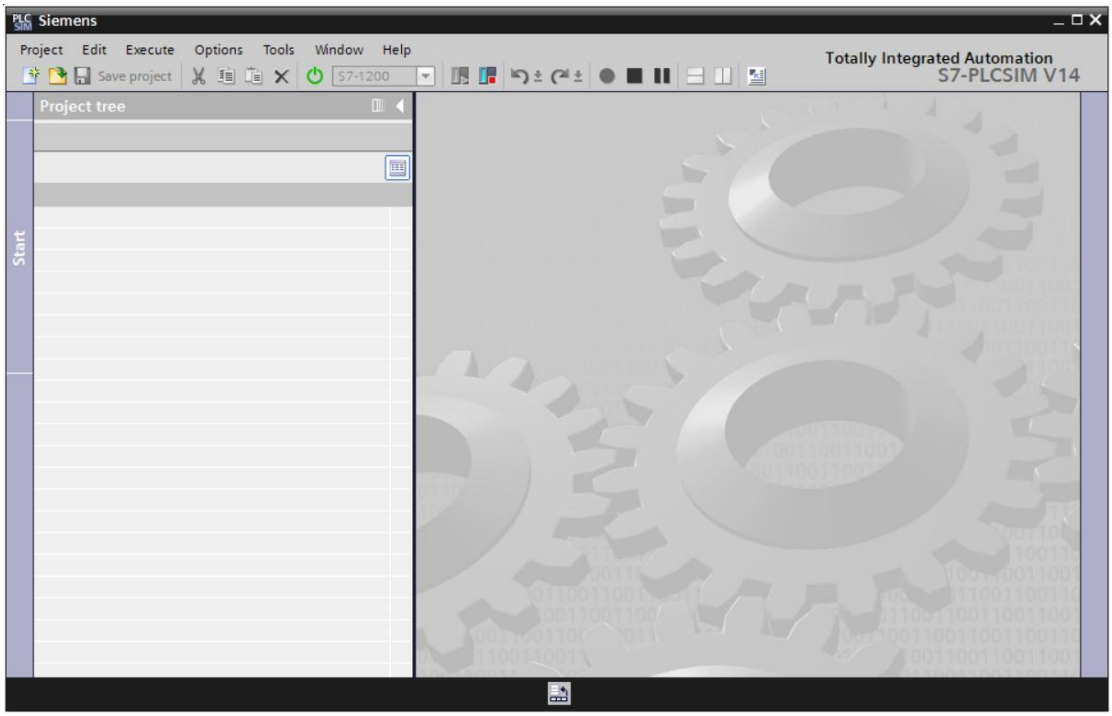
® The ® "Start all" option will be selected next before the download operation can be completed with ® "Finish".



® After a successful download, the project view will open again automatically. A loading report appears in the information field under "General". This can be helpful when troubleshooting an unsuccessful download.

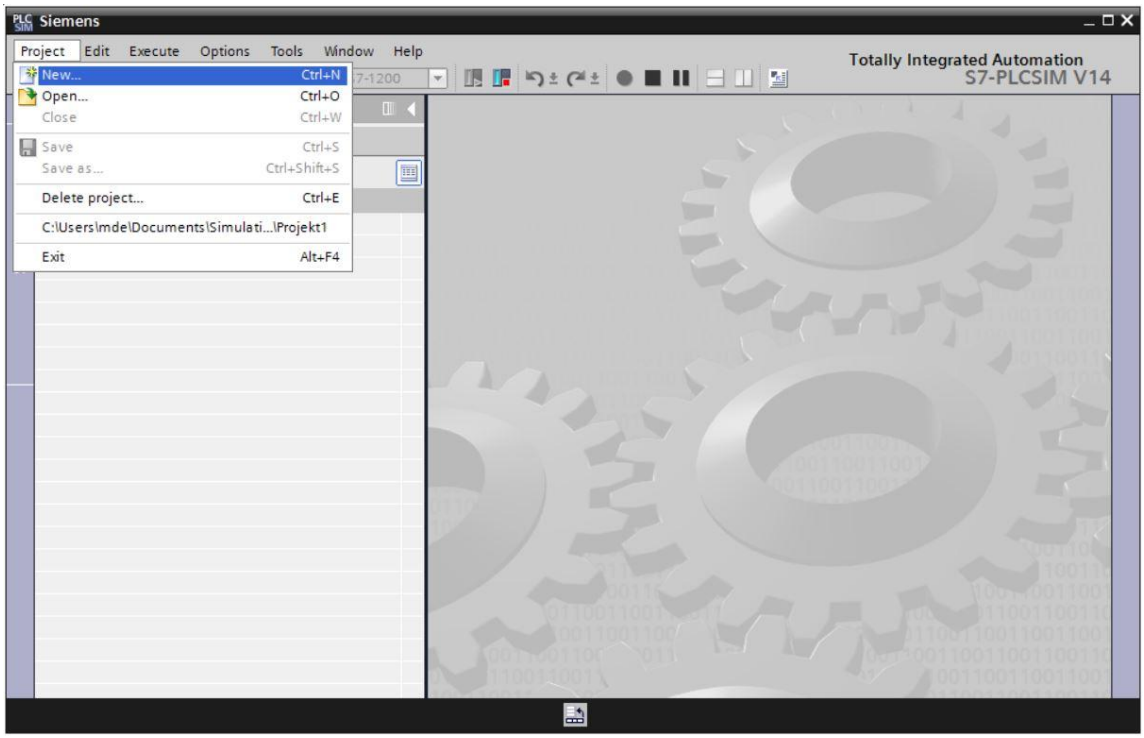


® The PLCSIM simulation has the following appearance in the project view. You can switch to the compact view of the simulation by clicking the ®  icon in the menu bar.

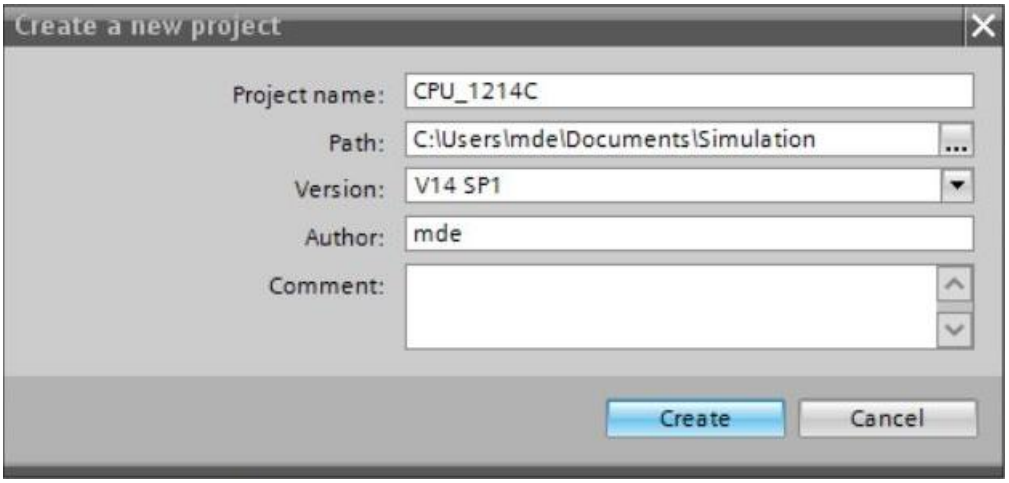


® The compact view of the PLCSIM simulation has the following appearance. You can switch back to the project view by clicking the ®  icon.

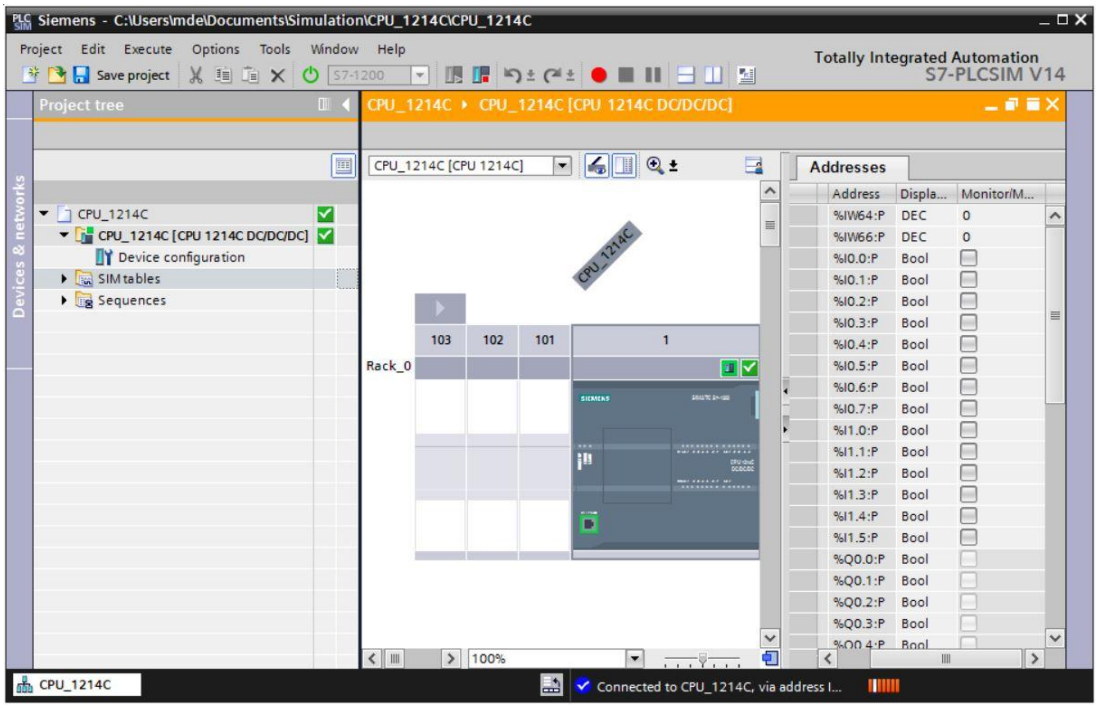
® In the project view you have to create a new simulation project by clicking ® “Project” ® “New”.



® Assign a “Project name” ® „CPU_1214C“ and select a ® “Path” where you want to create your project. Then click ® „Create“.



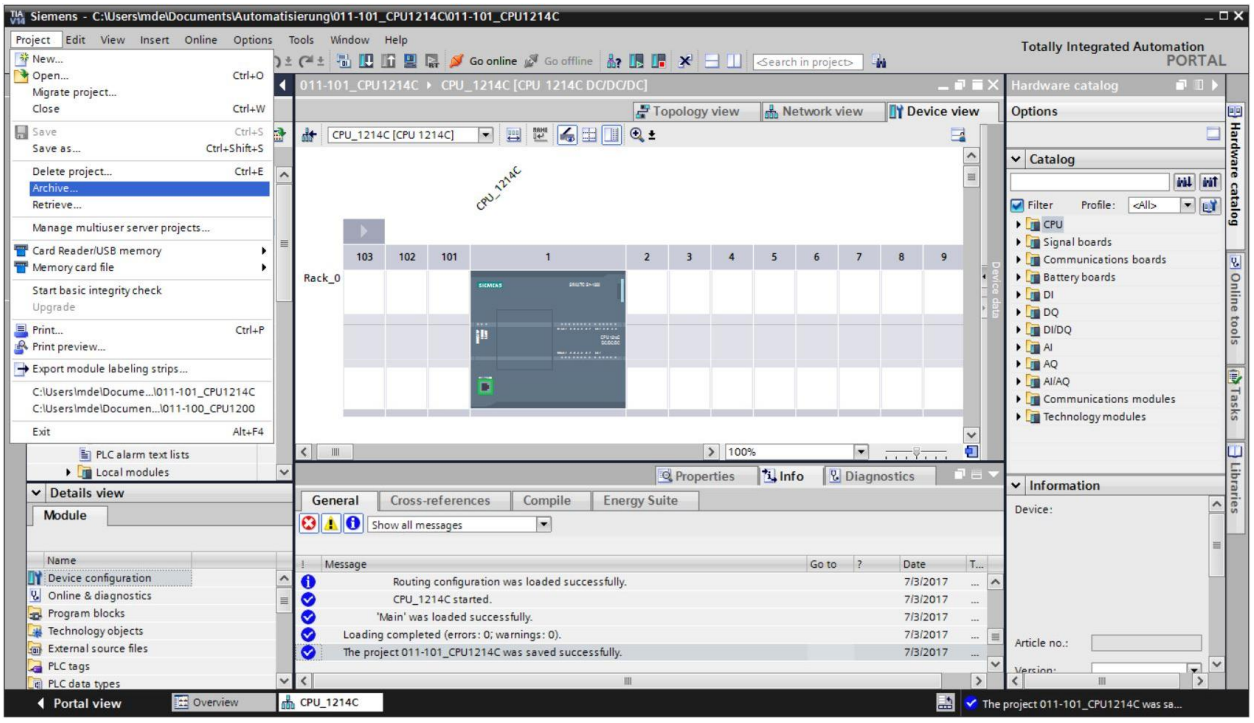
® You can see the downloaded configuration with the status of all inputs and outputs in the project view by double-clicking ® "Device configuration". Here you can also create your own ® „Sim tables“ with selected input and output signals. You can modify the input signals used in your program to test the program in the PLCSIM simulation.



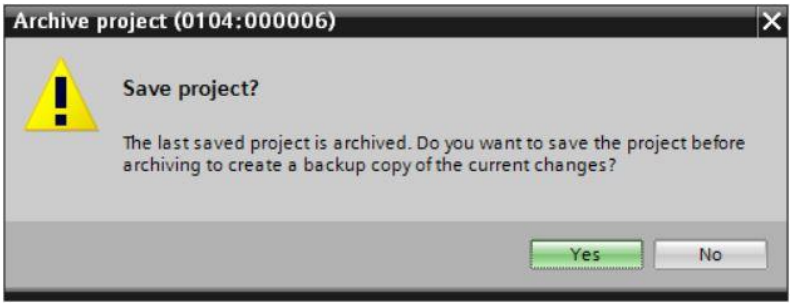
Note: *Because this is a simulation, you cannot detect errors in the hardware configuration in this case.*

7.8 Archive the project

® To archive the project, select the ® "Archive ..." command in the ® "Project" menu.



® Confirm the prompt to save the project with ® "Yes".



® Select a folder where you want to archive your project and save it as file type "TIA Portal project archive" (® "TIA Portal project archive" ® "SCE_EN_011-101_Hardware configuration_S7-1214C..." ® "Save").

7.9 Checklist

No.	Description	Completed
1	Project was created	
2	Slot 1: CPU with correct order number	
3	Slot 1: CPU with correct firmware version	
4	Address area of the digital inputs correct	
5	Address area of the digital outputs correct	
6	Address area of the analog inputs correct	
7	Hardware configuration was compiled without error message	
8	Hardware configuration was downloaded without error message	
9	Project was successfully archived	

8 Exercise

8.1 Task – Exercise

The hardware configuration of the SIMATIC CPU 1214C DC/DC/DC Trainer Package is not quite complete. Insert the following missing signal board. Use the address area starting from 64 for the analog output.

– 1X SIMATIC S7-1200, signal board ANALOG OUTPUT SB1232, 1 AO (Order number: 6ES7 232-4HA30-0XB0)

8.2 Planning

Plan the implementation of the task on your own.

8.3 Checklist – Exercise

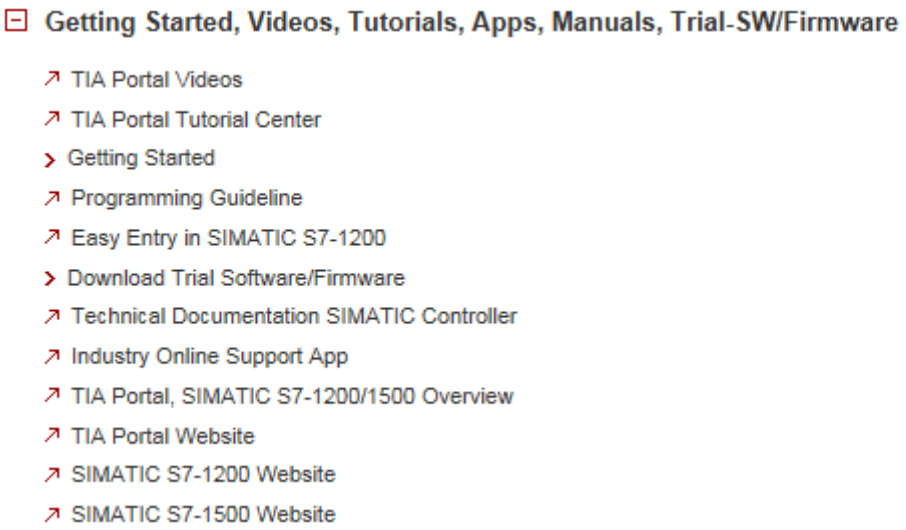
No.	Description	Completed
1	Signal board with correct order number	
2	Signal board with correct firmware version	
3	Signal board address area of analog output correct	
4	Hardware configuration was compiled without error message	
5	Hardware configuration was downloaded without error message	
6	Project was successfully archived	

9 Additional information

More information for further practice and consolidation is available as orientation, for example: Getting Started, videos, tutorials, apps, manuals, programming guidelines and trial software / firmware, under the following link:

www.siemens.com/sce/s7-1200

Preview „Additional information“



Further Information

Siemens Automation Cooperates with Education
siemens.com/sce

SCE Learn-/Training Documents
siemens.com/sce/documents

SCE Trainer Packages
siemens.com/sce/tp

SCE Contact Partners
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