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Learn-/Training Document

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

TIA Portal Module 011-100 Specified Hardware Configuration
with SIMATIC S7-1200 CPU 1215C, DC/DC/DC

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Specified Hardware Configuration – SIMATIC S7-1200 CPU 1215C, DC/DC/DC

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 Requirement

No prerequisites have to be met for successful completion of this chapter. You only need an S7-1200 controller and a PC with the STEP 7 Basic V14 (TIA Portal V14) software.

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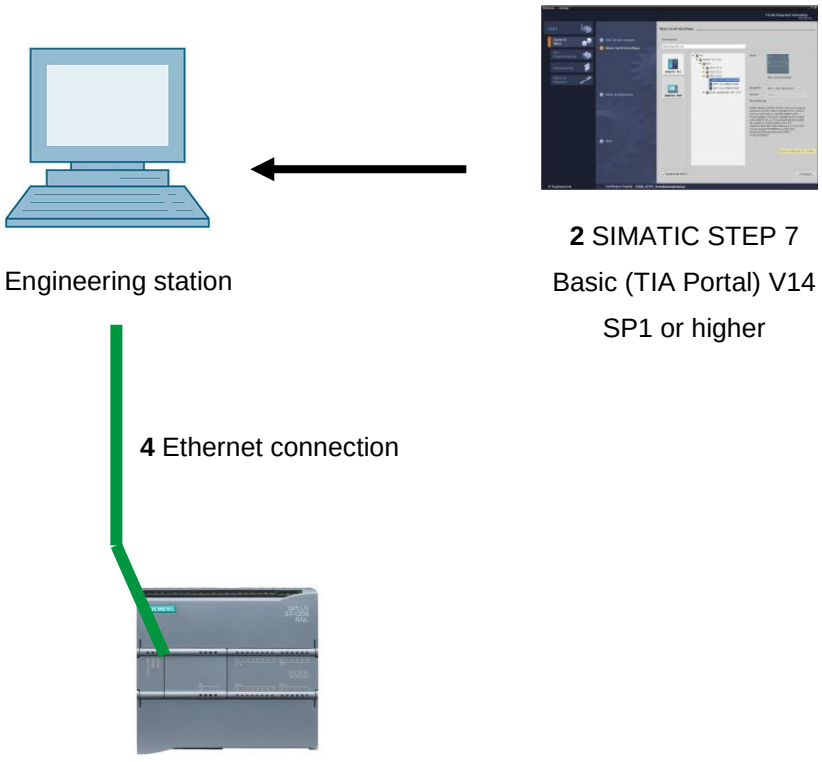
3 Required hardware and software

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

2 SIMATIC STEP 7 Basic software in the TIA Portal – V14 SP1 or higher

3 SIMATIC S7-1200 controller, e.g. CPU 1215C DC/DC/DC – firmware V4.2 or higher

4 Ethernet connection between engineering station and controller



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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 or output modules for digital and analog signals.

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

The programmable logic controller (PLC) uses the S7 program to monitor and control a machine or process. In doing so, the S7 program scans the I/O modules via input addresses (%I) and addresses their output addresses (%Q).

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

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4.1.1 Range of modules

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 1215C).

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

Signal boards (SB) for adding analog or digital inputs/outputs in which case the CPU size remains unchanged. (Signal boards can be used for CPUs 1211C/1212C and 1215C.)

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Signal modules (SM) for digital and analog inputs and outputs. (A maximum of 2 SMs can be used for CPUs 1212C and 8 SMs for 1215C.)

Communication modules (CM) for serial communication RS232/RS485. (Up to 3 CMs can be used for CPUs 1211C/1212C and 1215C.)

Compact Switch Module (CSM) with 4x RJ45 sockets 10/100 Mbps

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

Note:

All you need for this module is a CPU of your choice with integrated digital inputs and digital outputs.

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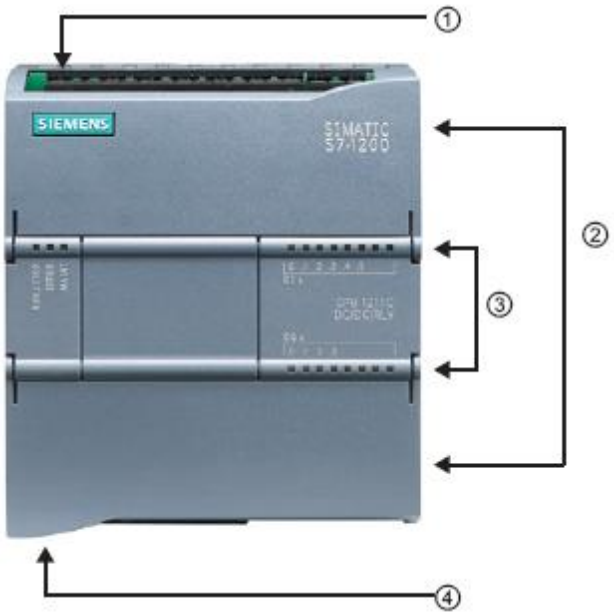
4.2 Operator controls and display elements of the CPU 1215C DC/DC/DC

4.2.1 Front view of the CPU 1215C DC/DC/DC

With an integrated power supply (24 V connection) and integrated inputs and outputs, the CPU 1215C DC/DC/DC is ready for immediate use without additional components.

For communication with a programming device, the CPU has an integrated TCP/IP connection.

The CPU can thus communicate with HMI devices or other CPUs over an ETHERNET network.



① 24 V connection

② Plug-in terminal block for user wiring (behind the cover flaps)

③ Status LEDs for the integrated I/O und the operating state of the CPU

④ TCP/IP connection (on the bottom of the CPU)

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4.2.2 SIMATIC Memory Card (MC)

The optional **SIMATIC Memory Card (MC)** stores the program, data, system data, files and projects. It can be used for:

– Transfer of a program to multiple CPUs

– Firmware update of CPUs, signal modules (SM) and communication modules (CM)

– Simple CPU replacement

4.2.3 Operating modes of the CPU

The CPU can have the following three operating modes:

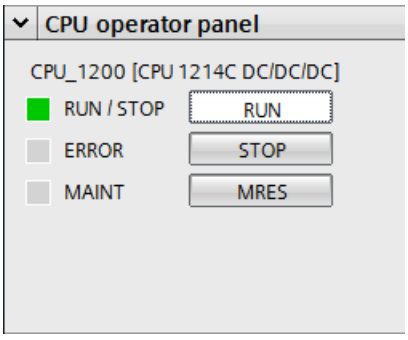
– In **STOP** mode, the CPU is not executing the program and you can download a project.

– In **STARTUP** mode, the CPU is starting up.

– In **RUN** mode, the program is being executed cyclically.

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

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



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4.2.4 Status and error displays

The **Status LED RUN/STOP** on the front of the CPU indicates the current operating mode of the CPU by the color indicated.

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

In addition, there is an **ERROR** LED for indicating errors and a **MAINT** LED for indicating a maintenance requirement.

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

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 plant automation:

– Configuration and parameter assignment of the hardware

– Specification of the communication

– Programming

– Testing, commissioning and service with operational/diagnostic functions

– Documentation

– Creation of visualizations for SIMATIC Basic Panels with the integrated WinCC Basic

– 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 networking 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 systems, 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 consists of the controller (CPU), the signal modules for input and output signals (SM), the communication modules (CM) and other special modules.

The signal modules and 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.

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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. Next you 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 that the necessary power is supplied 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 the devices available for selection. Fail-safe operation might be another requirement.

The TIA Selection Tool (Automation technology → select 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" in order to find the device specifications.

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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.

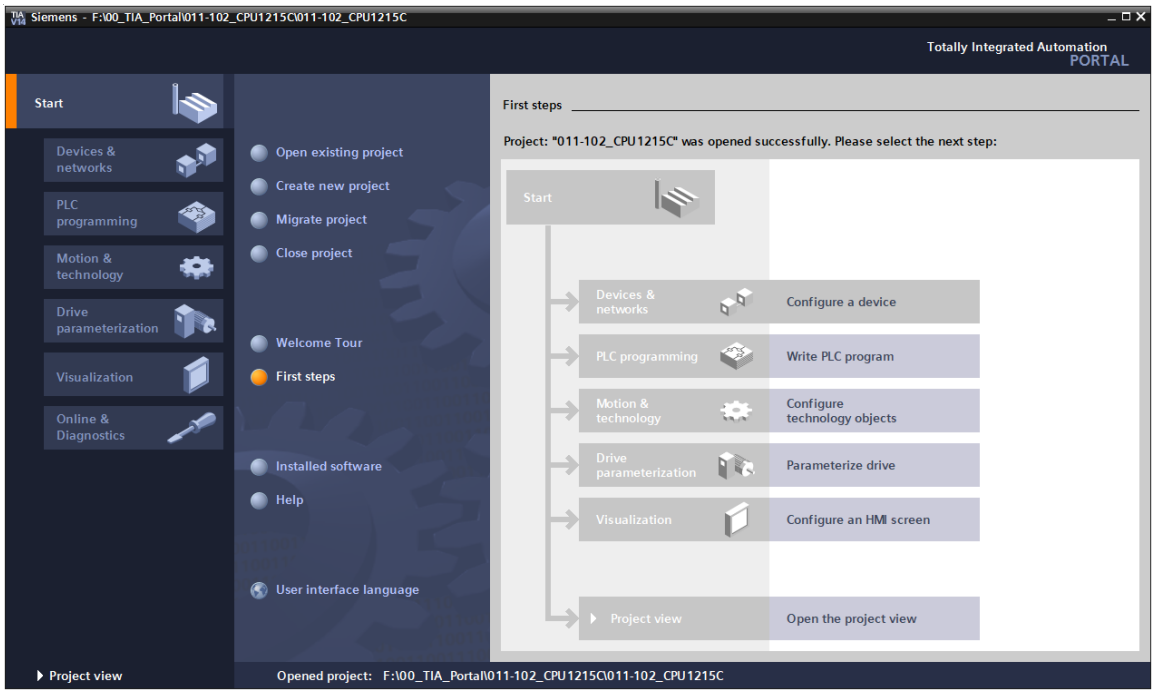

Figure 1: Portal view

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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.

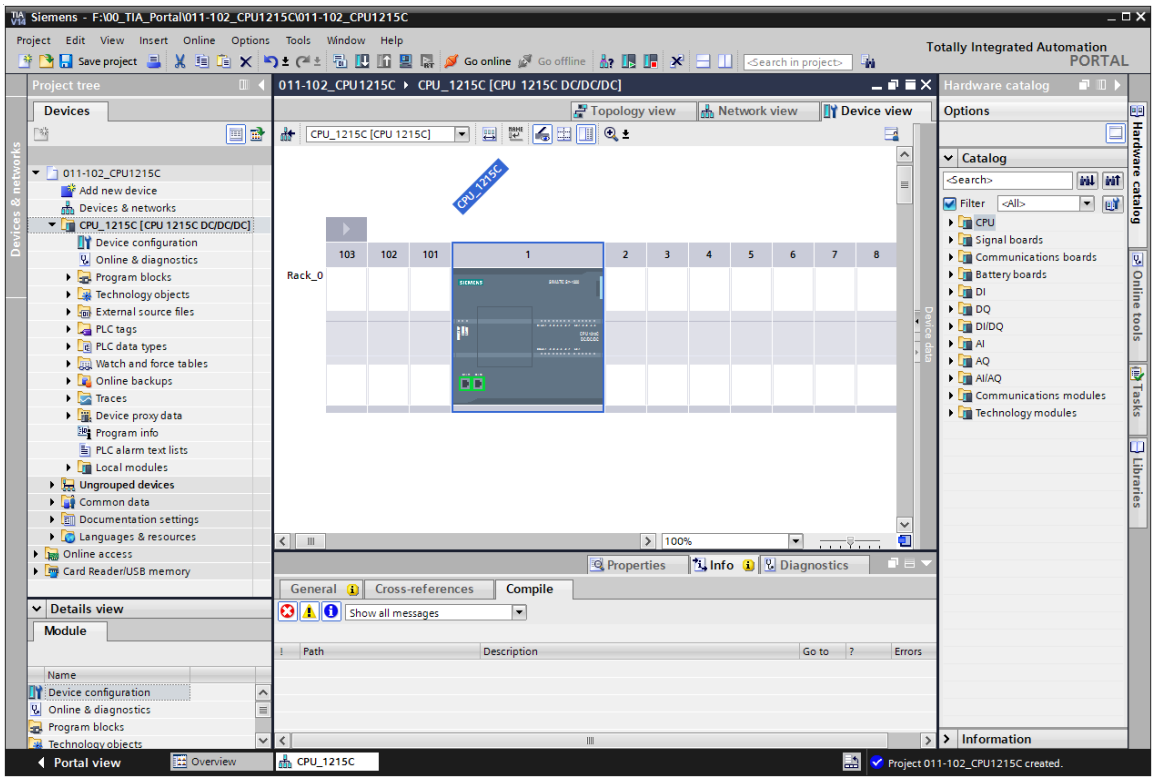

Figure 2: Project view

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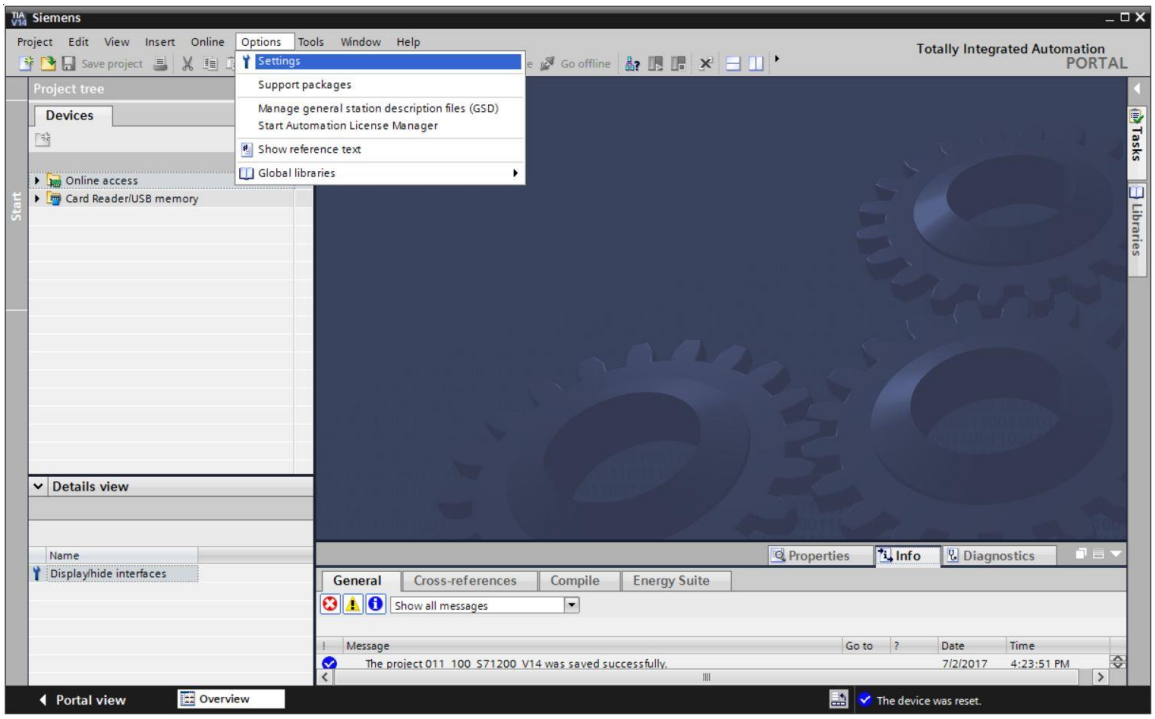
4.3.5 Basic settings for the TIA Portal

→ 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".



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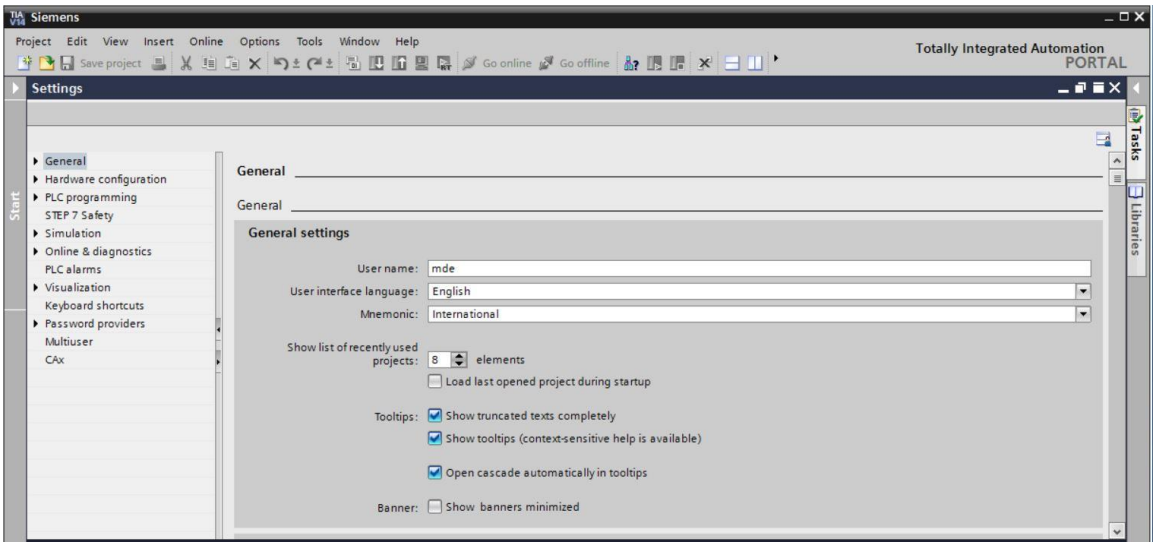
→ One basic setting is the selection of the user interface language and the language for the program display. In the curriculums to follow, "English" will be used for both settings.

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



Note:

These settings can always be changed.

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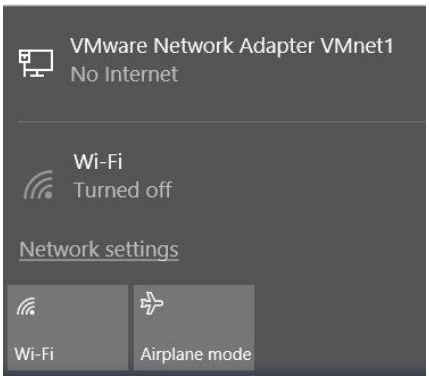
4.3.6 Setting the IP address on the programming device

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

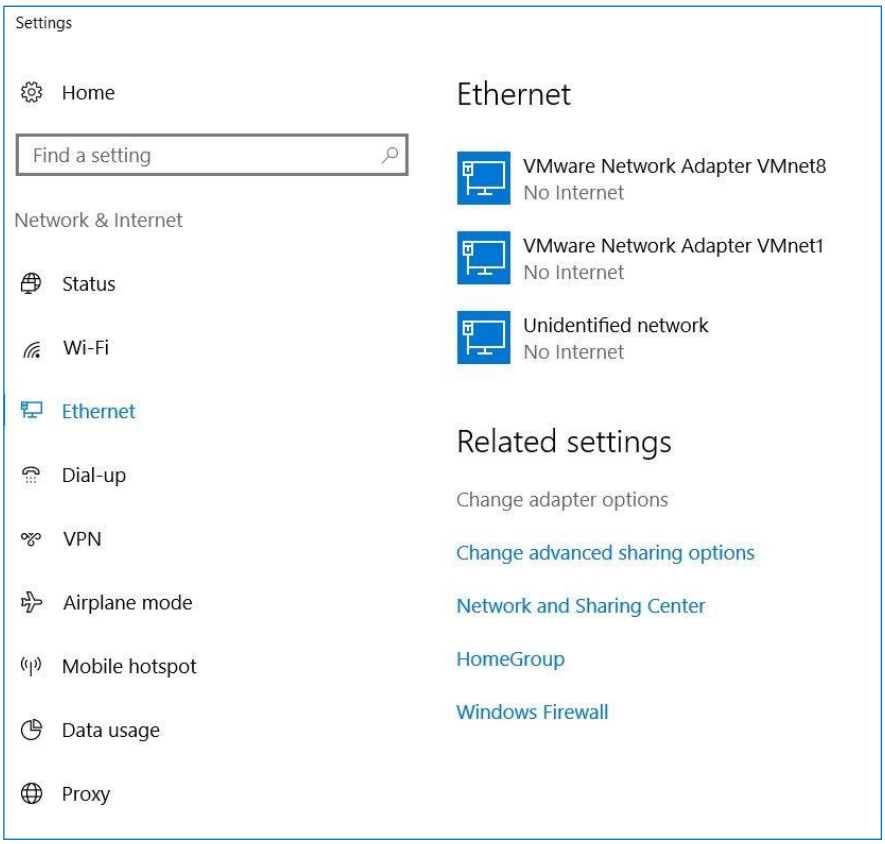
It is important that the IP addresses of both devices match for the PC and SIMATIC S7-1200 to communicate with each other via TCP/IP.

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 network settings window that opens, click → "Ethernet" and then on → "Change adapter options".



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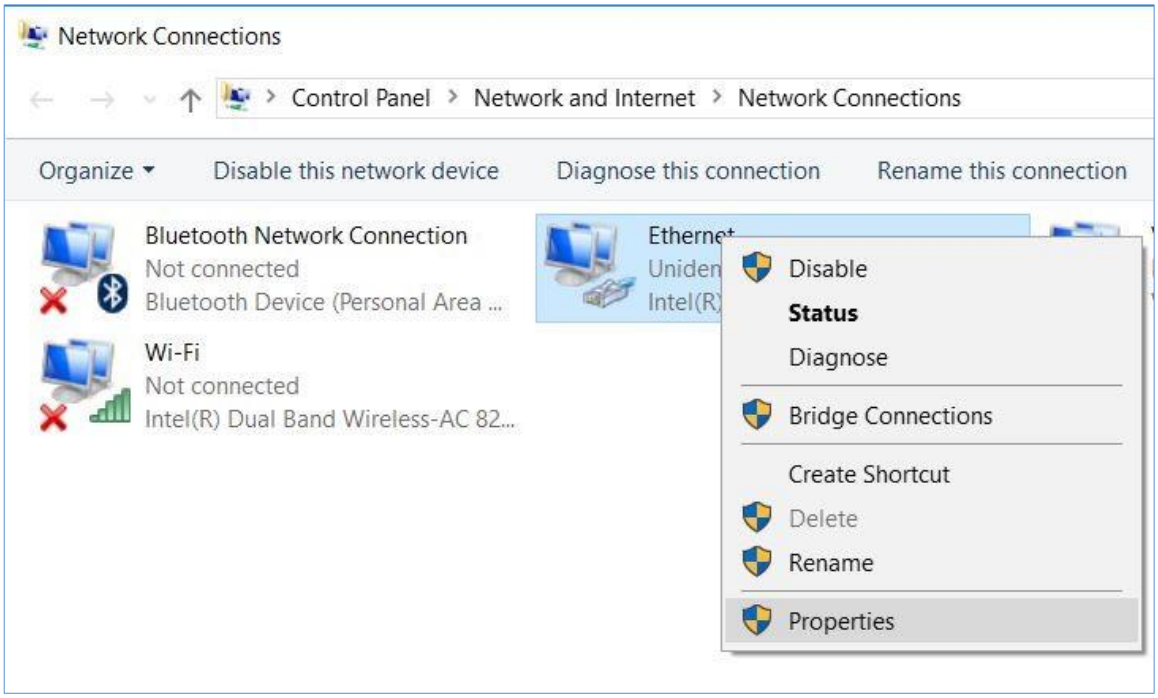
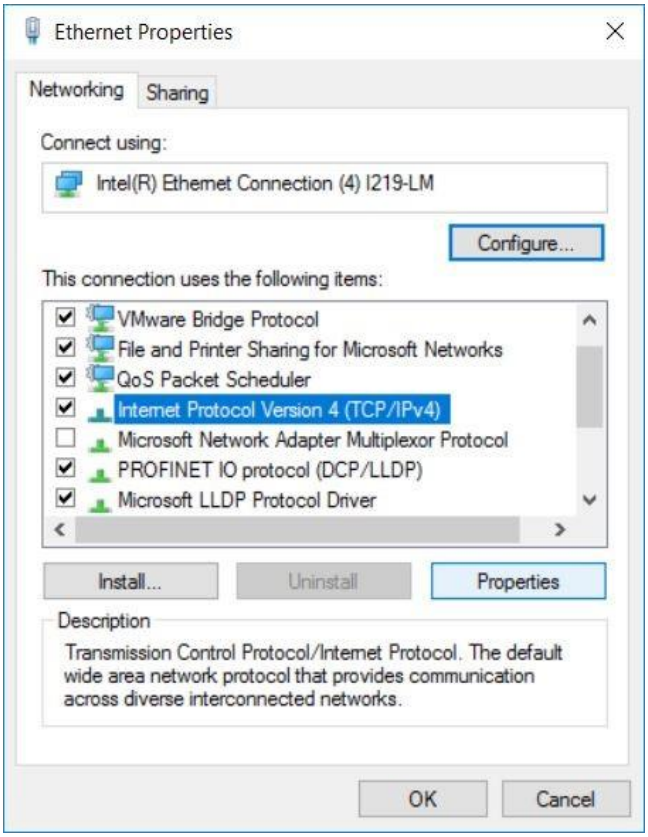
→ Select the desired → "Local Area Connection" that you want to use to connect to the controller and click → "Properties".



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



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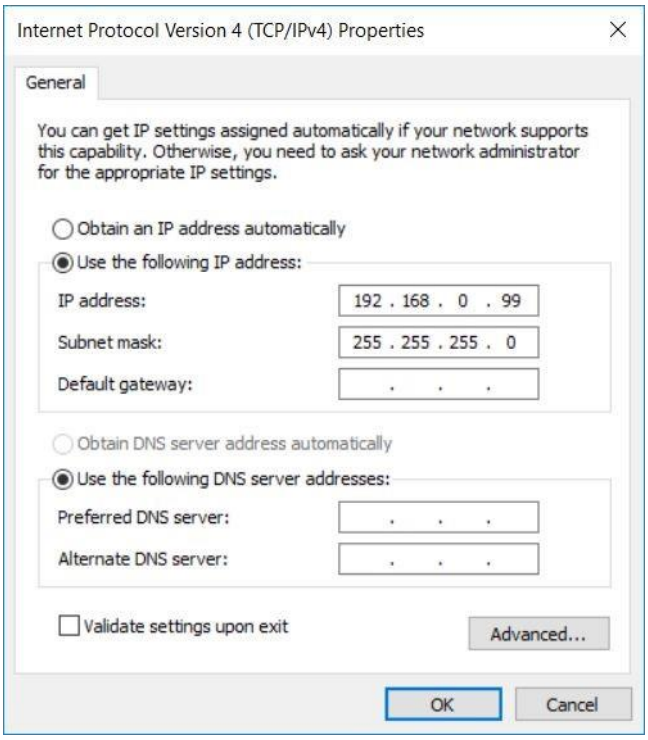
→ You can now use the following IP address, for example → IP address: 192.168.0.99 → Subnet mask 255.255.255.0 and accept the settings. (→ "OK")



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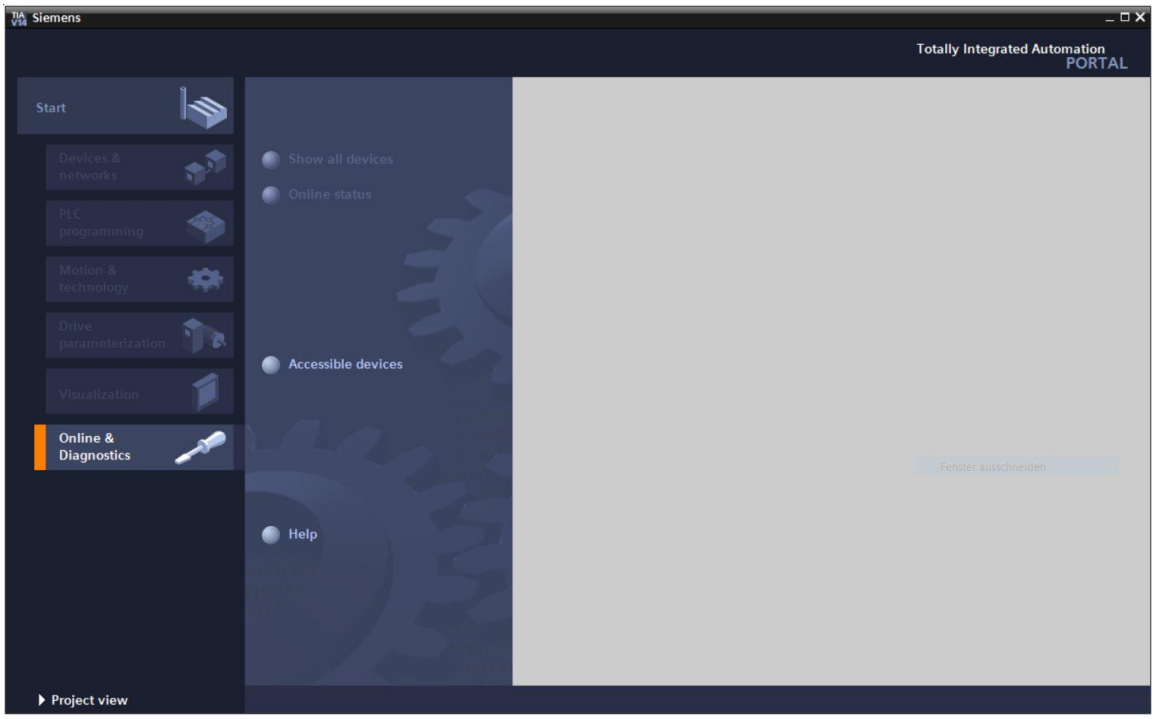
4.3.7 Setting the IP address in the CPU

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)

→ Then, select →"Online & Diagnostics" and open →"Project View".



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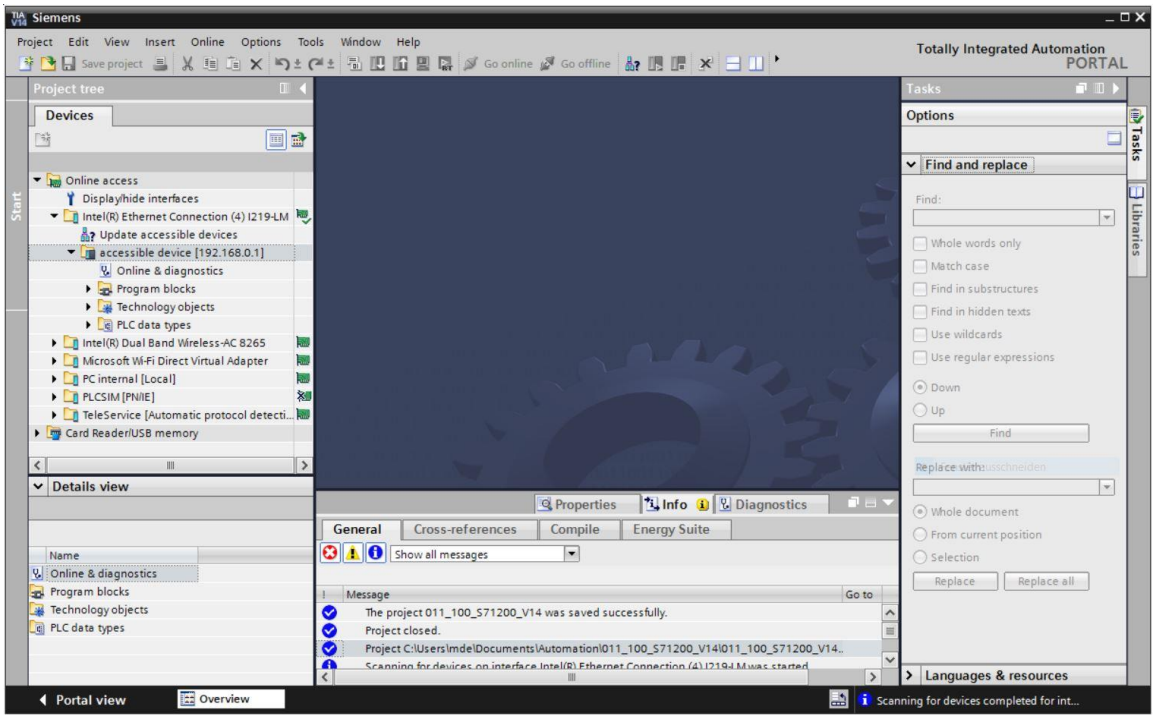
→ In the project tree under → "Online access", select the network adapter that was set previously. If you click → "Update accessible devices" here, you will see the IP address (if previously set) or the MAC address (if IP address has not yet been assigned) of the connected SIMATIC S7-1200. Select →"Online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



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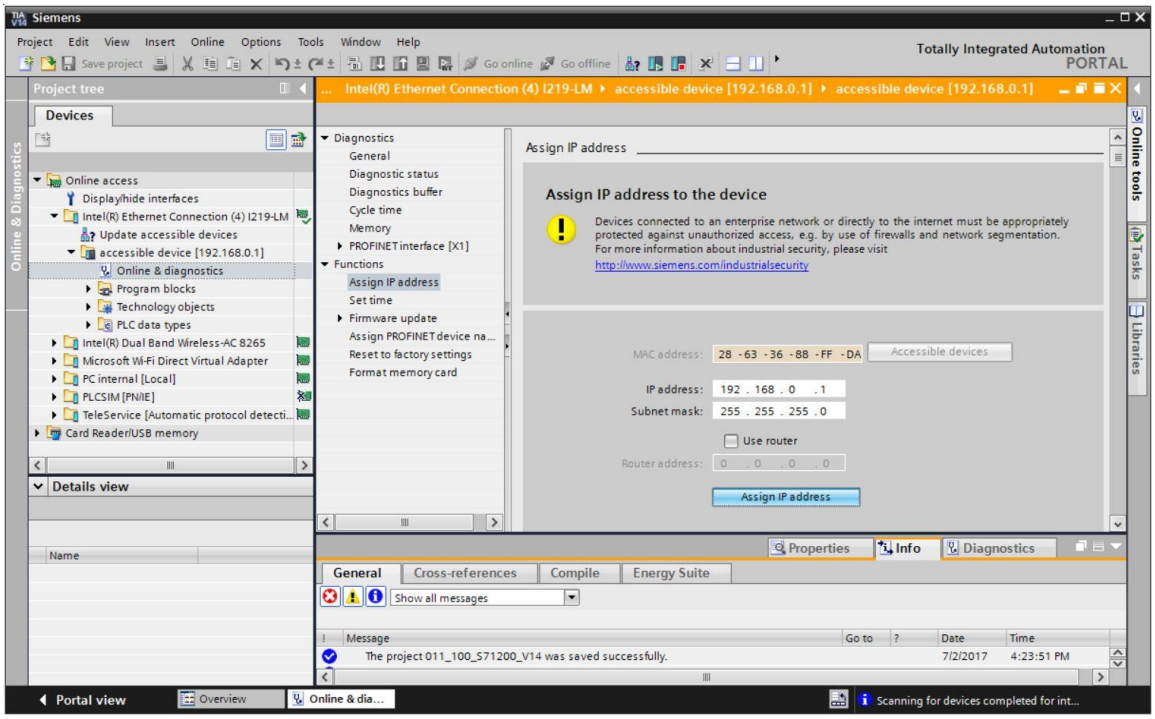
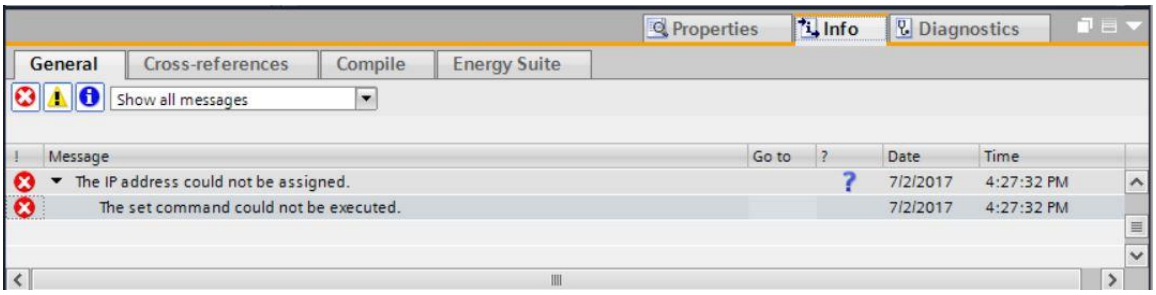
→ Under → "Functions", you now find the → "Assign IP address" item. Here, enter for example the following IP address: → IP address: 192.168.0.1 → Subnet mask 255.255.255.0. Next, click → "Assign IP address" and this new address will be assigned to your SIMATIC S7-1200.



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



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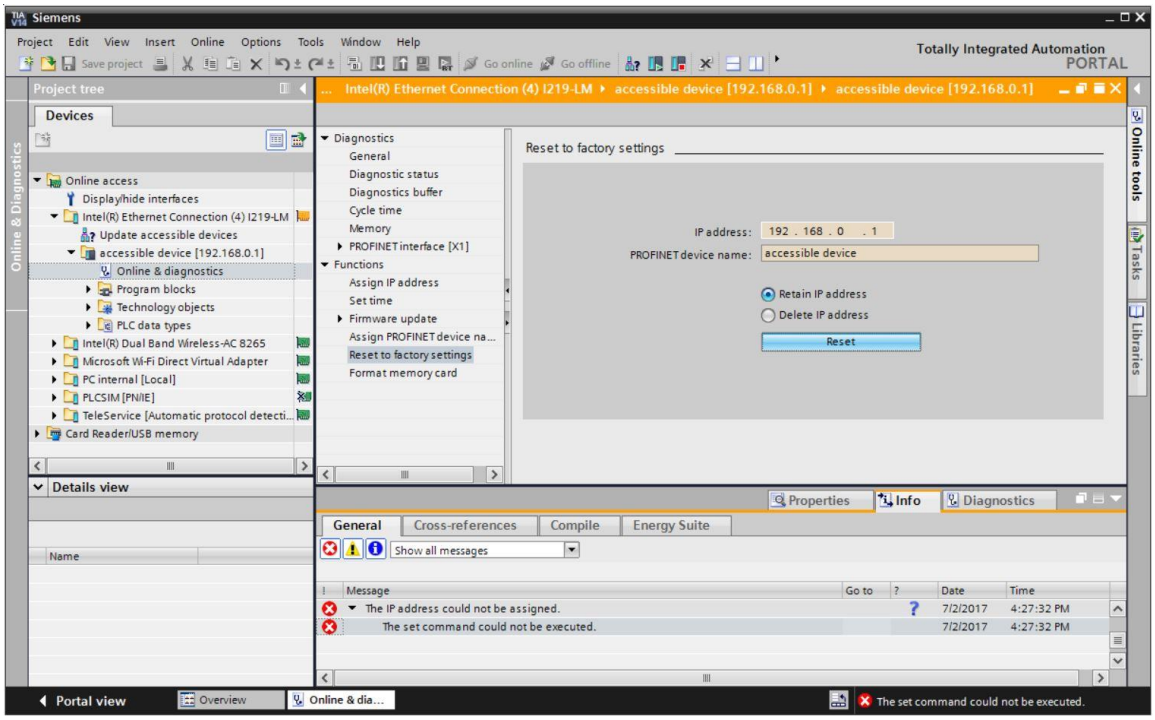
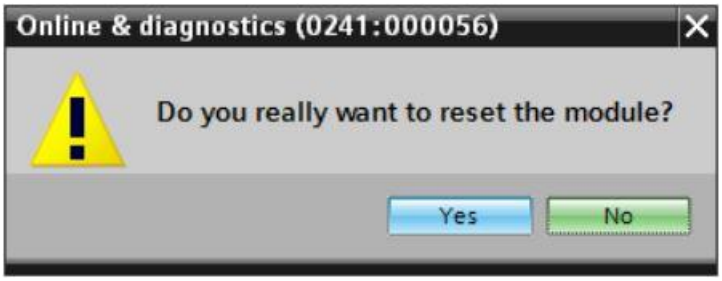
4.3.8 Restoring the factory settings of the CPU

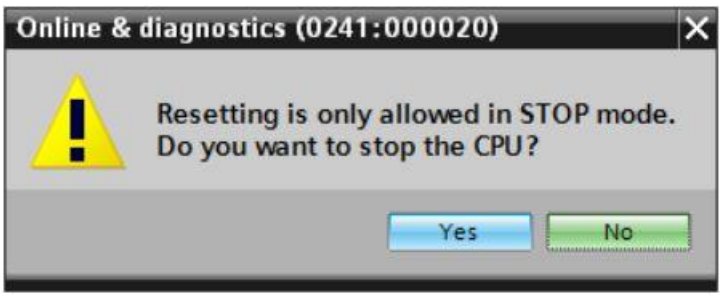
→ If the IP address could not be assigned, the program data on the CPU must be deleted. This is done by resetting the CPU. To reset the controller, select the → "Reset to factory settings" function and click → "Reset".



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



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



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5 Task

Create a project and configure the Compact CPU of your hardware, which correspond to one part of the trainer packages **SIMATIC S7-1200 with CPU 1215C DC/DC/DC**.

– SIMATIC S7-1200, CPU 1215C DC/DC/DC (order number: 6ES7 215-1AG40-0XB0)

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 1215C DC/DC/DC Trainer Package. Therefore, a selection does not have to be made. Instead, the listed modules of the Trainer Package only have to be inserted in the project. To ensure that the correct modules are inserted, the order number from the task should be re-checked directly on the installed device (see Table 1).

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

Module	Order number	Slot	Address range
CPU 1215C DC/DC/DC	6ES7 215-1AG40-0XB0	1	DI 0.0 -1.5 DQ 0.0 - 1.1 AI 64 / 66 AQ 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 compilation and incorrect modules can be detected when the controller is started.
This is only possible when hardware is present and structured identically.

The tested project must be saved and archived.

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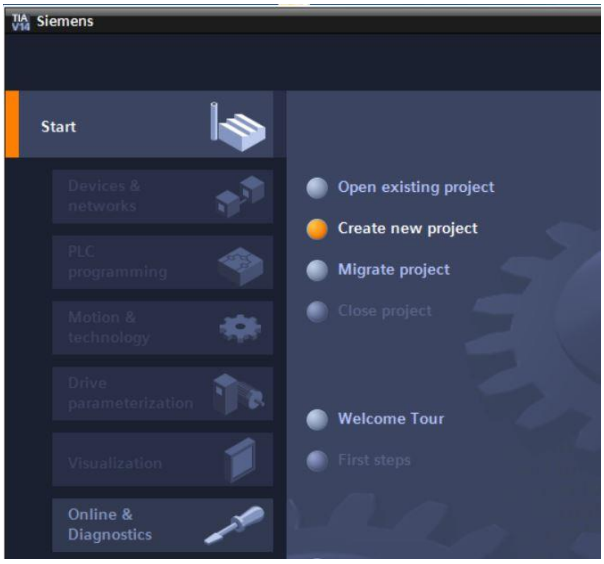
7 Structured step-by-step instructions

You can find instructions on how to carry out planning below. If you already have a good understanding of everything, it is sufficient to focus on the numbered steps. Otherwise, simply follow the steps in the instructions.

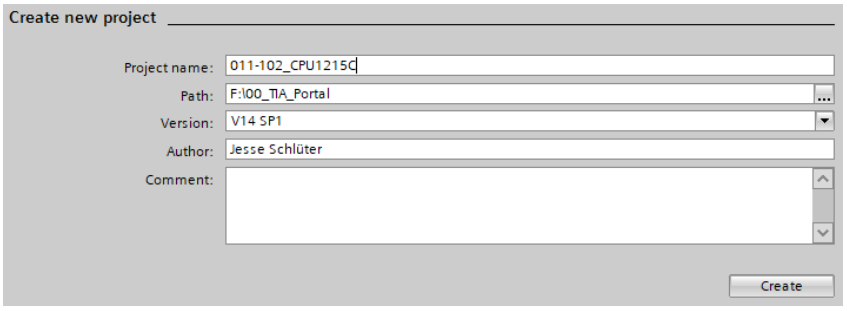
7.1 Creating a new project

→ 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 → "Create new project".



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



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

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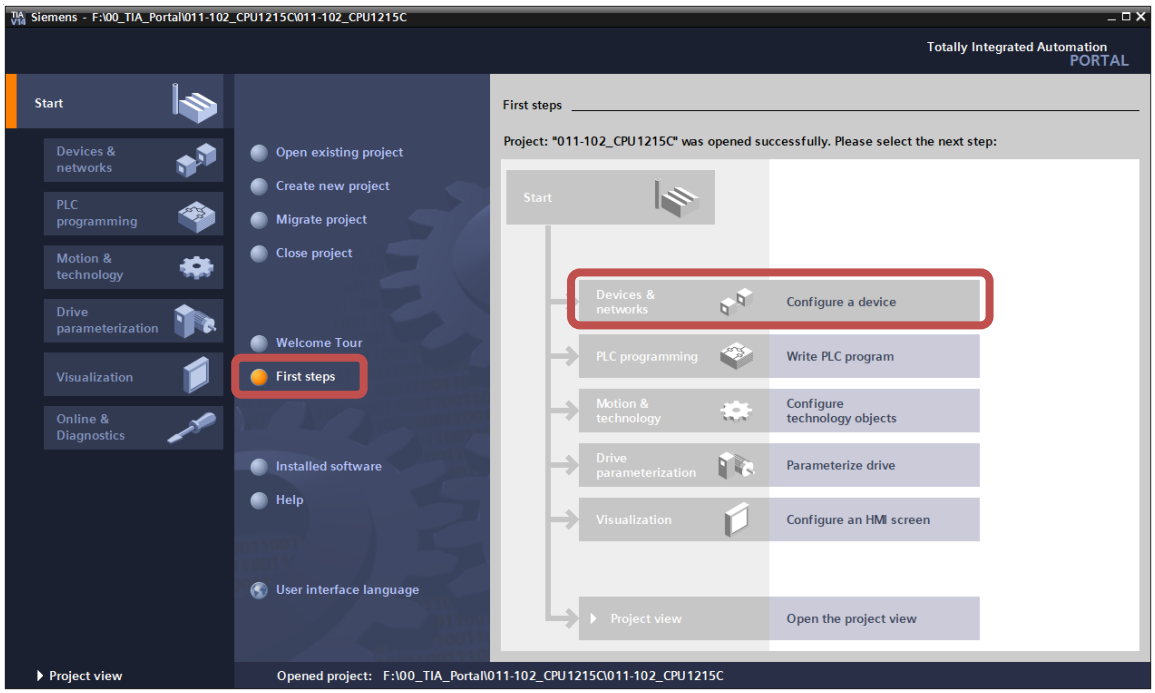
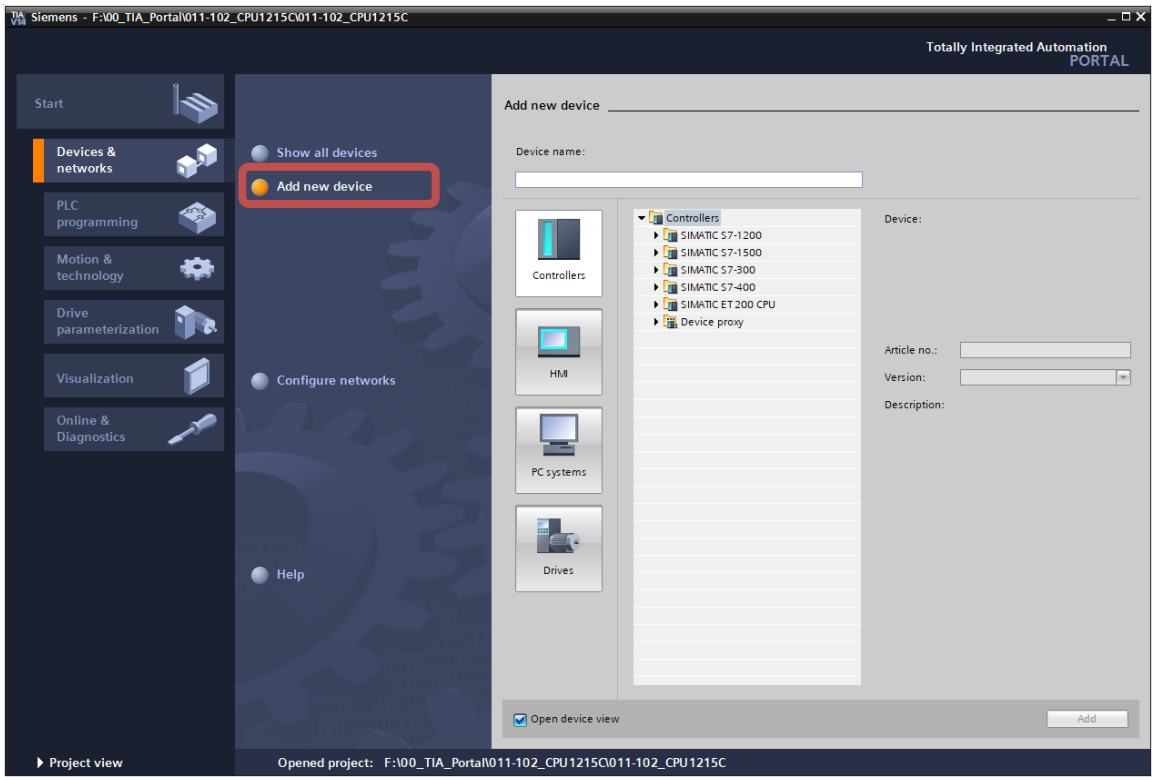
7.2 Inserting the CPU 1215C DC/DC/DC

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



→ In the "Devices & Networks" portal, the "Show all devices" menu opens

→ Switch to the "Add new device" menu.



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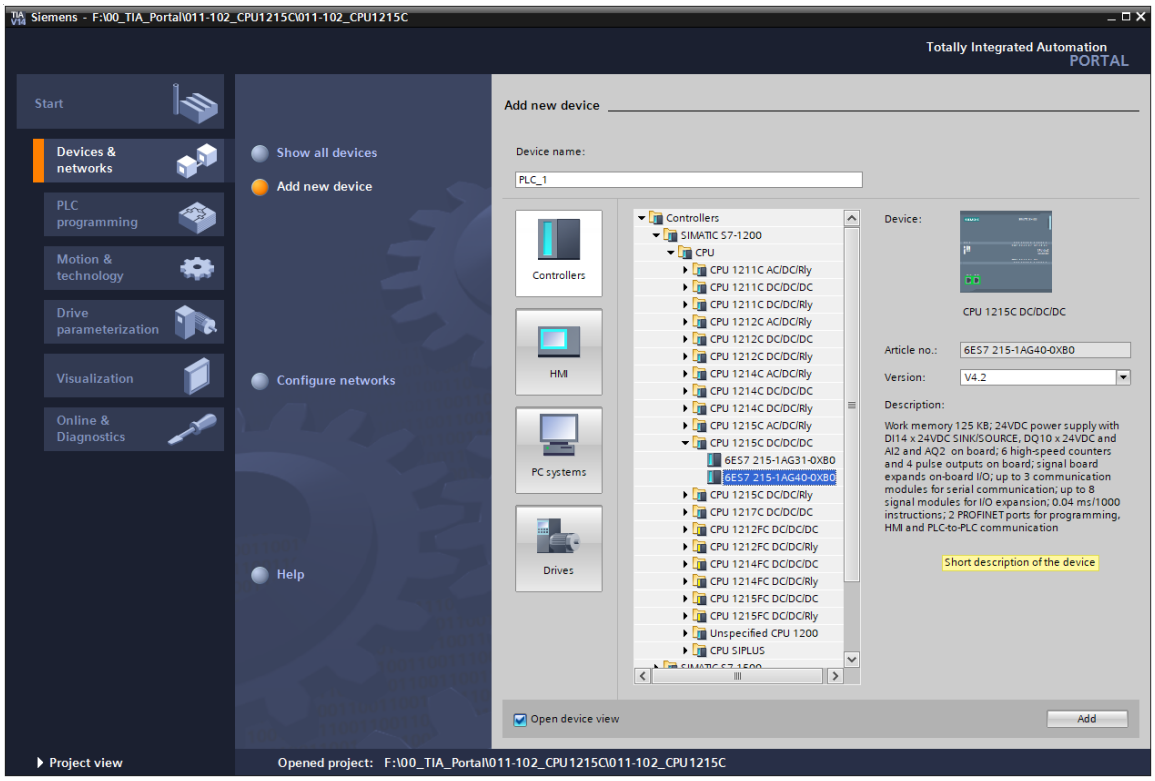
→ The specified model of the CPU will now be added as a new device. →

(Controller → SIMATIC S7-1200 → CPU → CPU 1215C DC/DC/DC → 6ES7215-1AG40-0XB0 → V4.1)



→ Assign a device name. (Device name → "CPU_1215C")

→ Select "Open device view".

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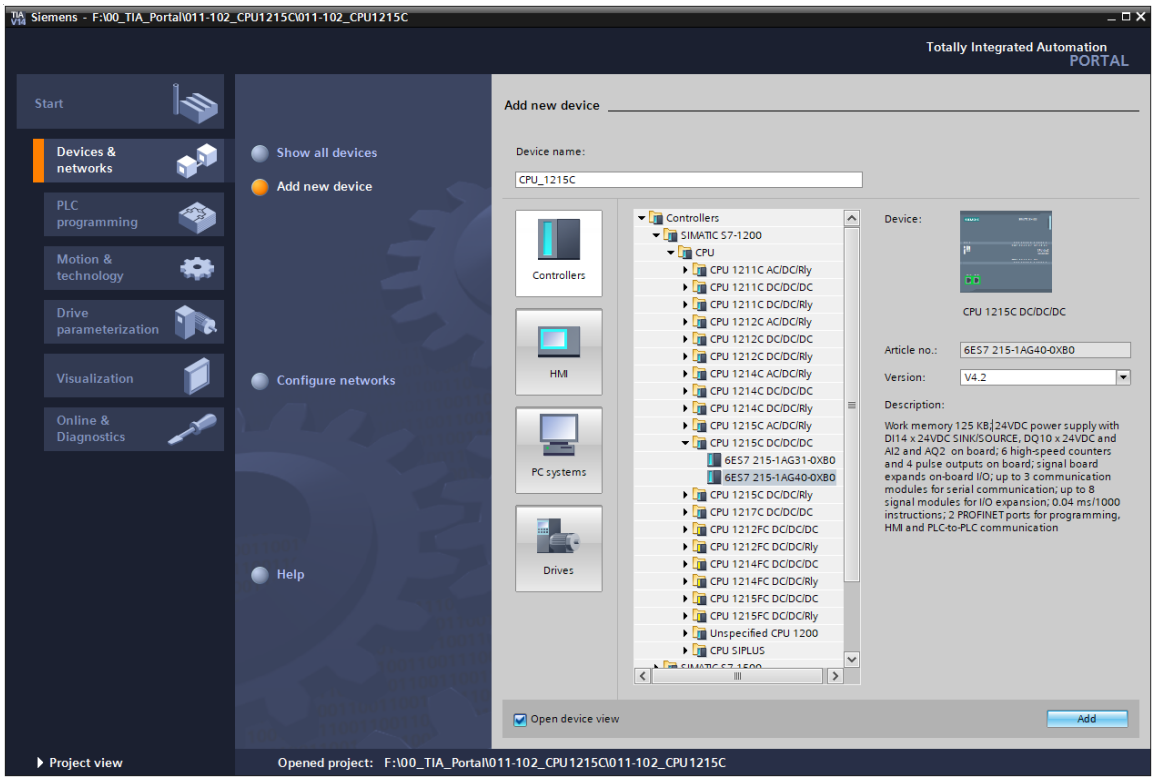
→ Then click Add .



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.

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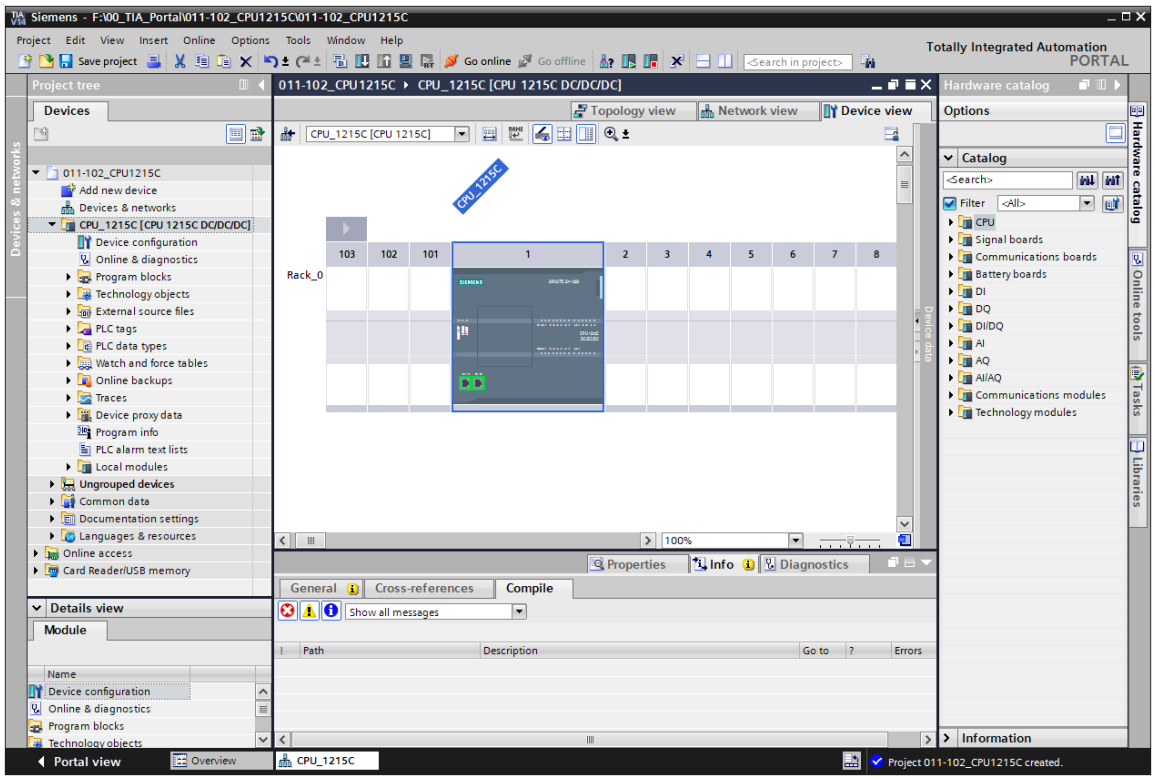
The TIA Portal now changes automatically to the project view and displays the selected CPU in the device configuration in slot 1 of a standard mounting rail.



Note:

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

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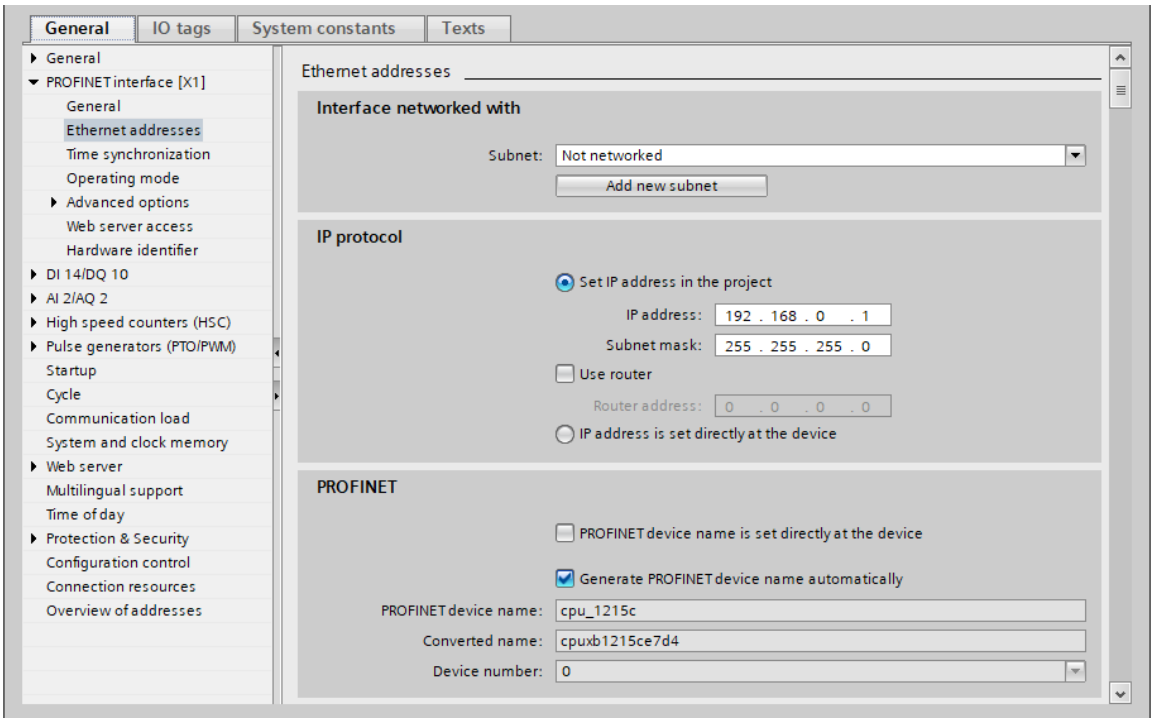
7.3 Configuration of Ethernet interface of the CPU 1215C DC/DC/DC

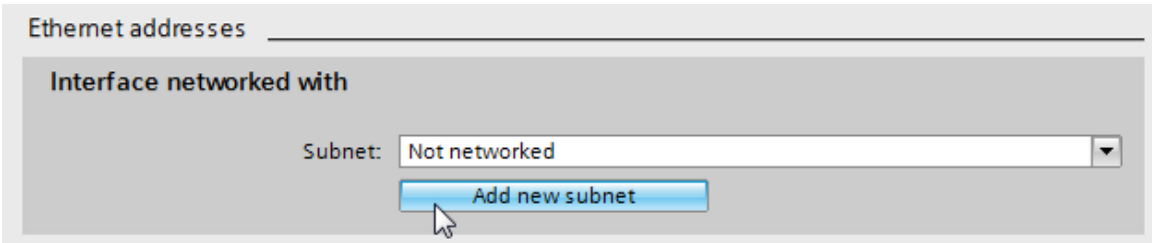
→ Select the CPU with a double-click.

→ Open the → "PROFINET interface [X1]" menu in → "Properties" 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.



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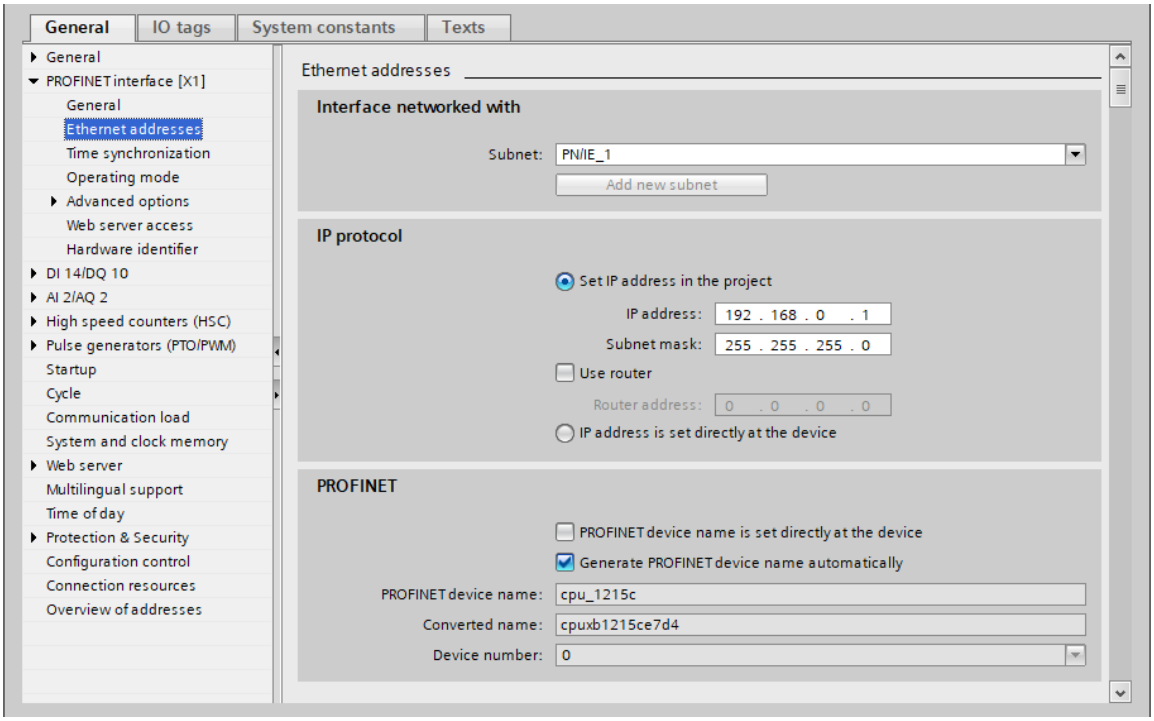
→ Keep the preassigned "IP address" and "Subnet mask".



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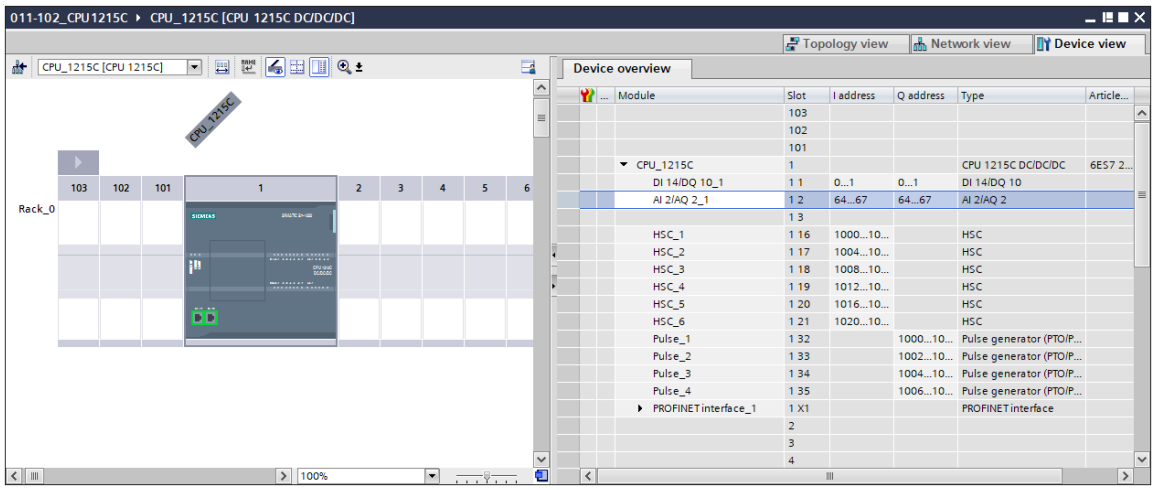
7.4 Configuring the address areas

→ 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 areas of 0…1 and AI 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 must click the small arrow next to "Device data" on the right side of the hardware configuration.

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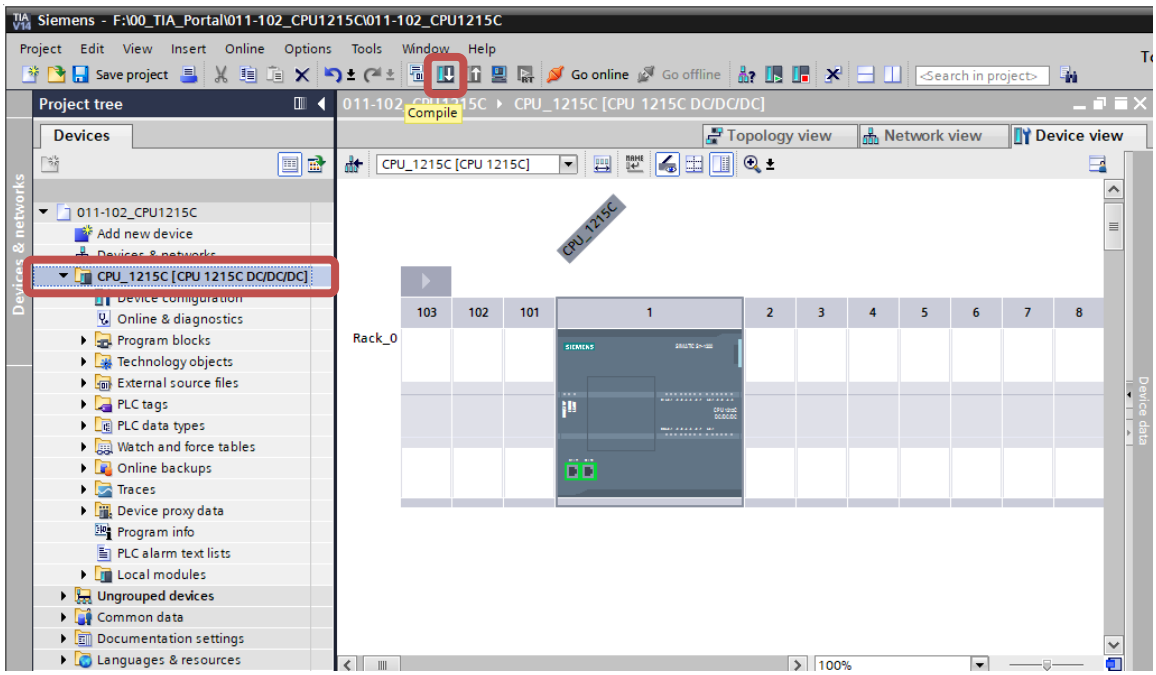
7.5 Saving and compiling the hardware configuration

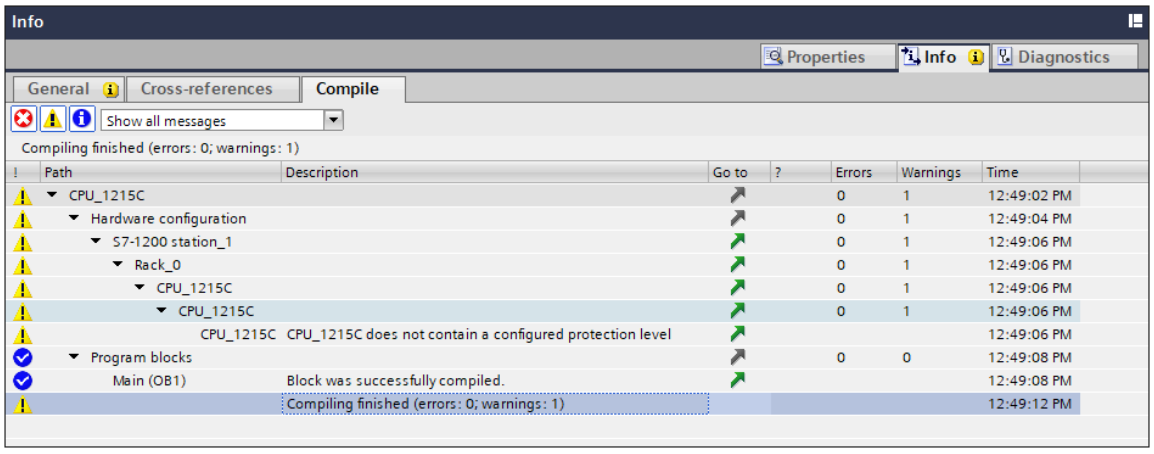
→ Before you compile the configuration, you should save your project by clicking the → Save project button. To compile your CPU with the device configuration, first select the → "CPU_1215C [CPU1215C DC/DC/DC]" folder and click the → "Compile" icon.



Note:

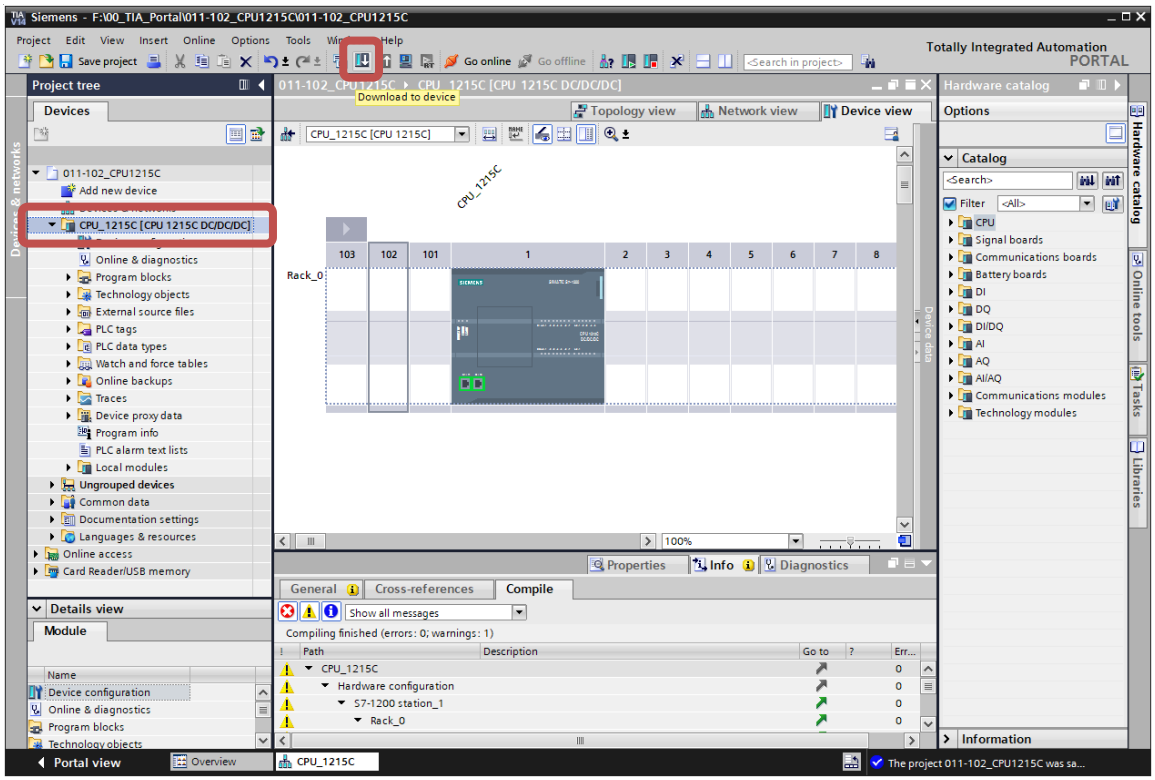
"Save project" should be used repeatedly when working on a project since this does not happen automatically. A prompt to save the project only occurs when the TIA Portal is closed.

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

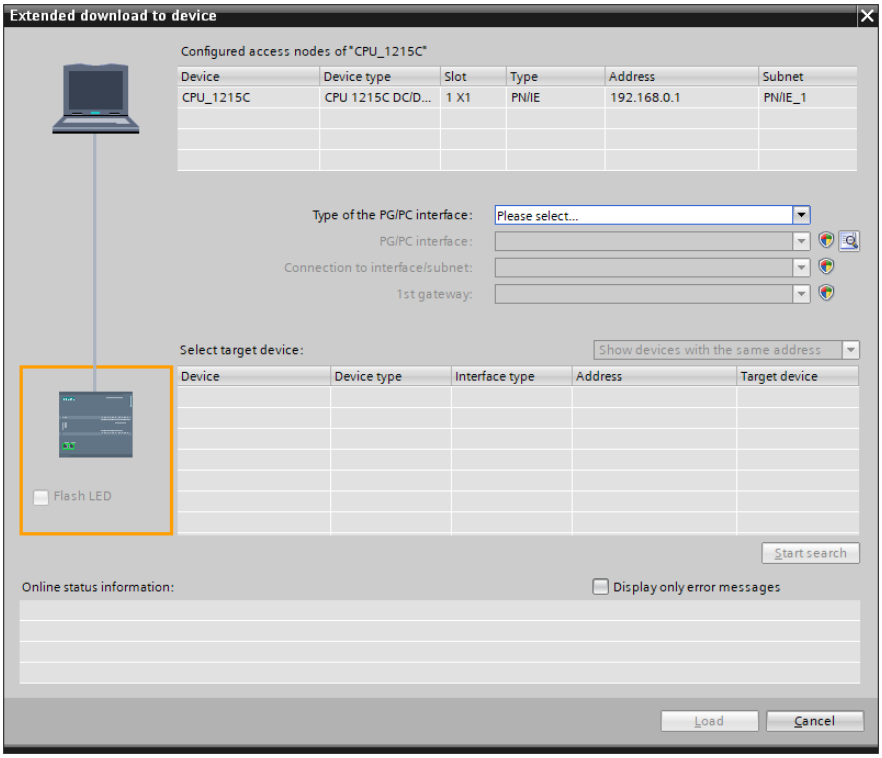


7.6 Download the hardware configuration to the device

→ To download your entire CPU, select the → "CPU_1215C [CPU1215C DC/DC/DC]" folder and click the → "Download to device" button.



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



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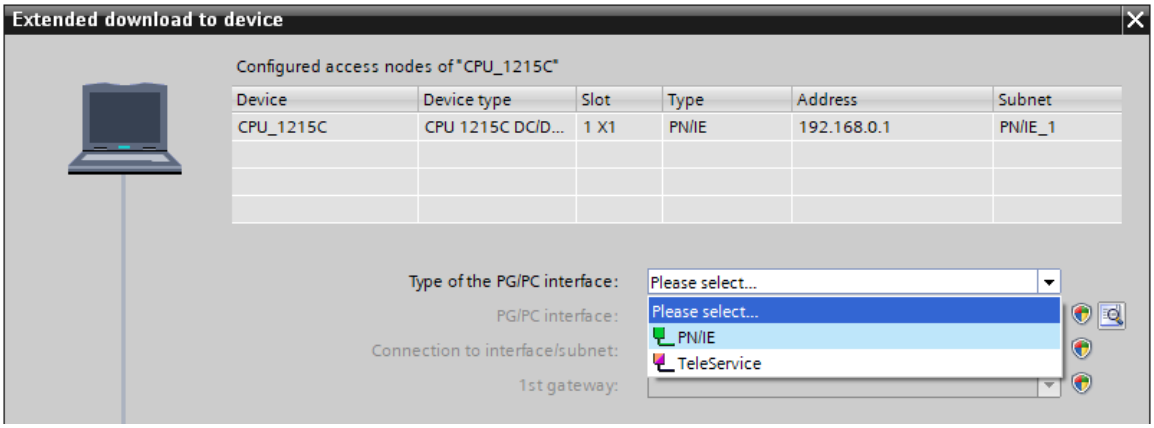
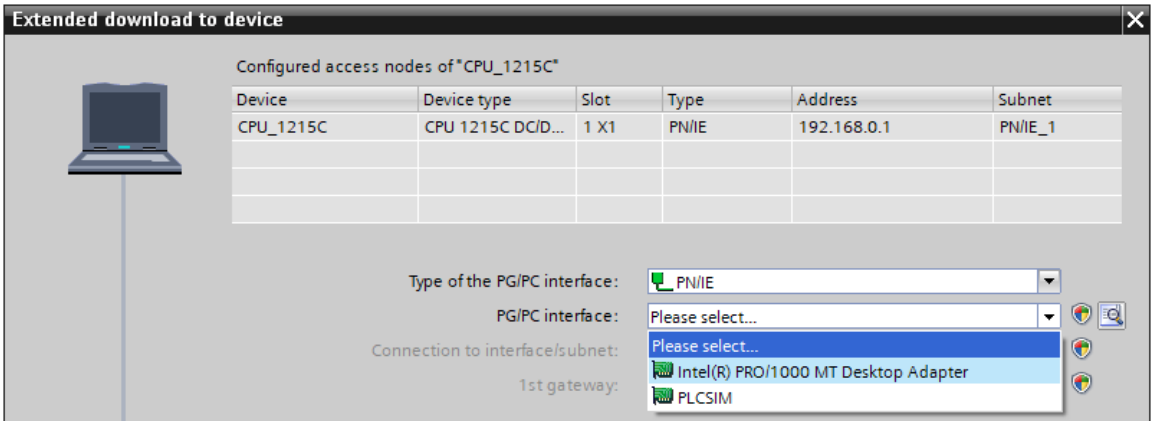
→ First, the interface must be correctly selected. This happens in three steps.

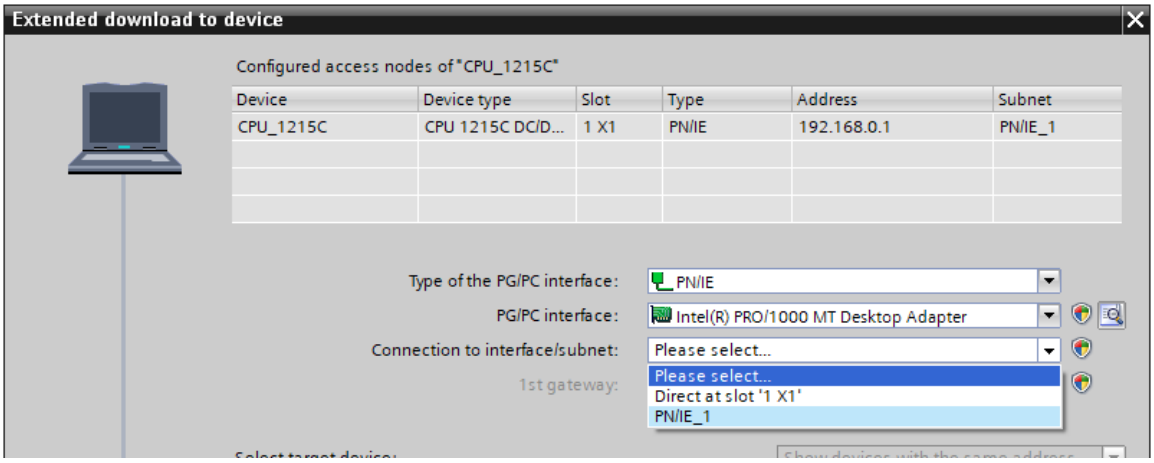
→ Step 1: Type of the PG/PC interface → PN/IE



→ Step 2: PG/PC interface → here: Intel(R) PRO/1000 MT Desktop Adapter



→ Step 3: Connection to interface/subnet → "PN/IE_1"



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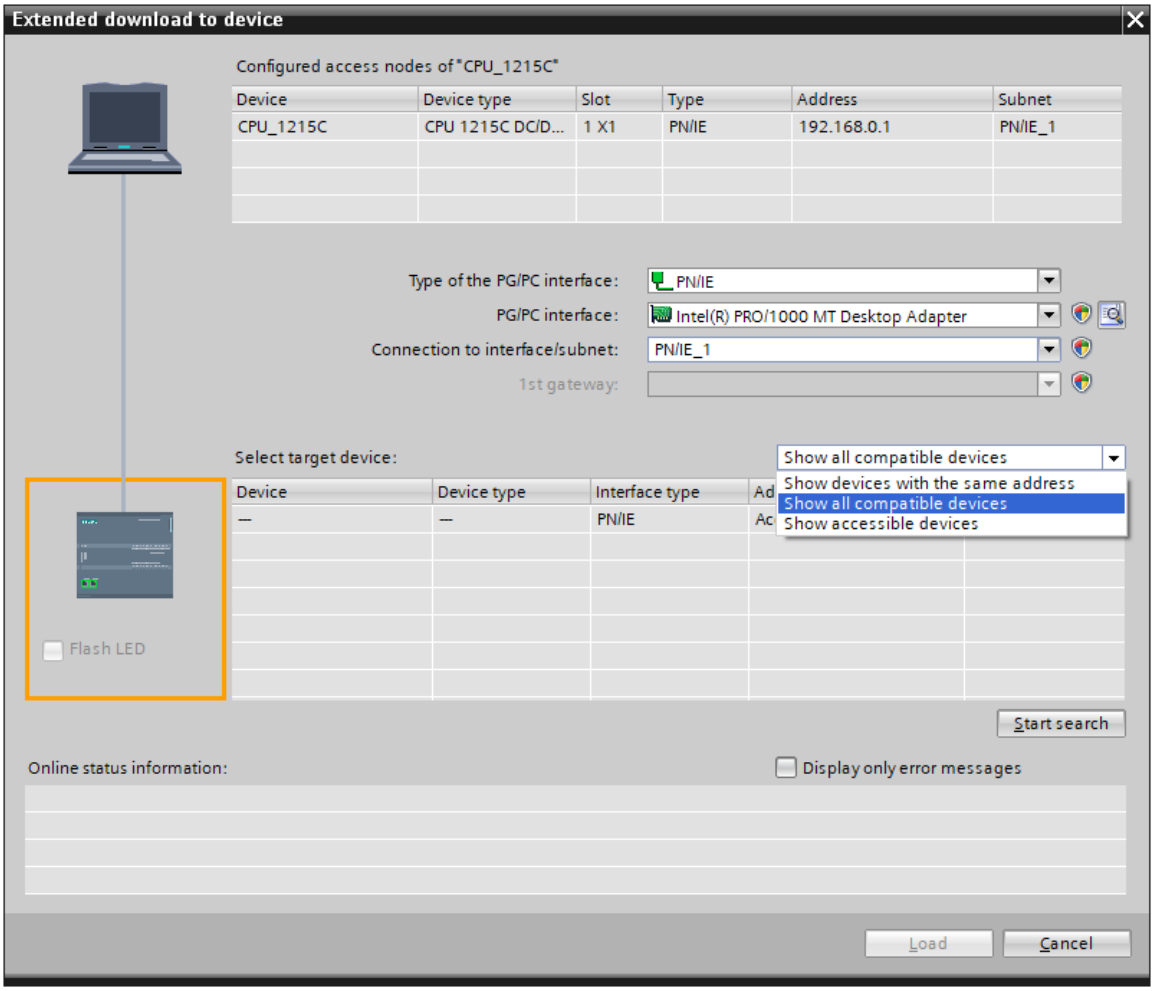
→ The → "Show all compatible devices" field must then be selected. The search for devices in the network is started by clicking the → Start search button.



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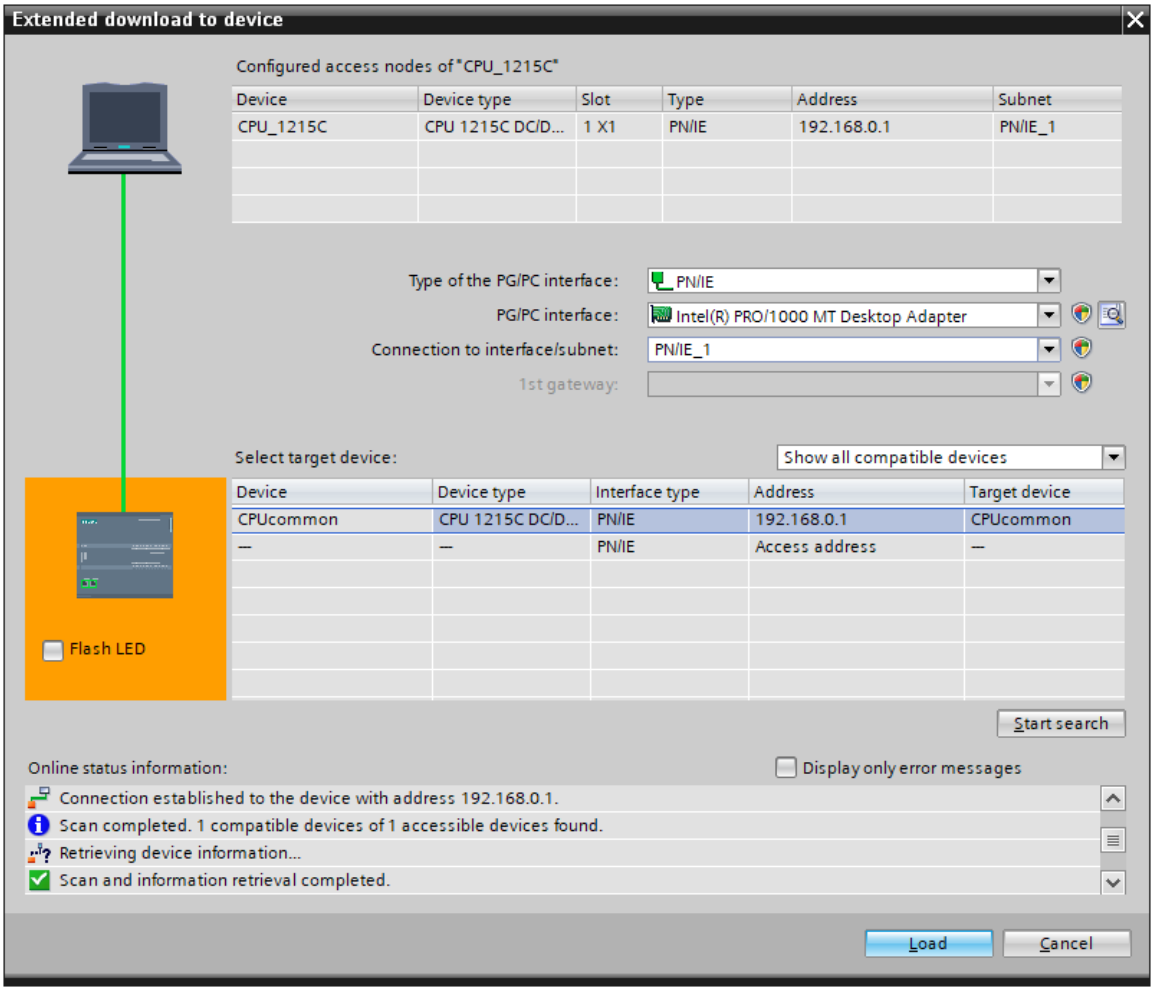
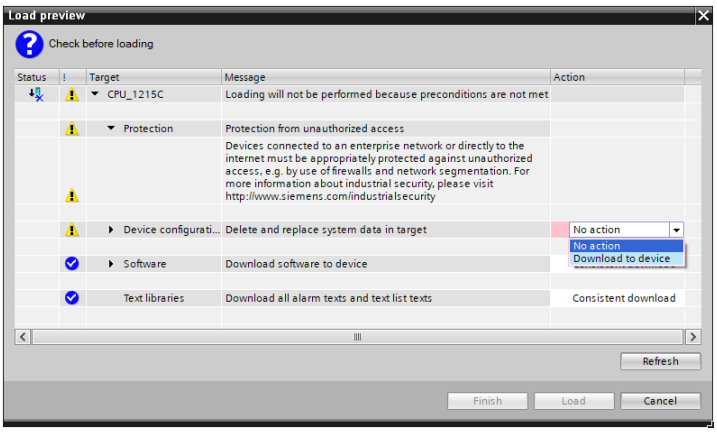
→ If your CPU is shown in the "Compatible devices in target subnet" list, it must be selected and the download started.

(→ CPU 1215C DC/DC/DC → Load)



→ You first obtain a preview. Any fields marked in red in the "Action" column must be confirmed manually. Continue with → Load .



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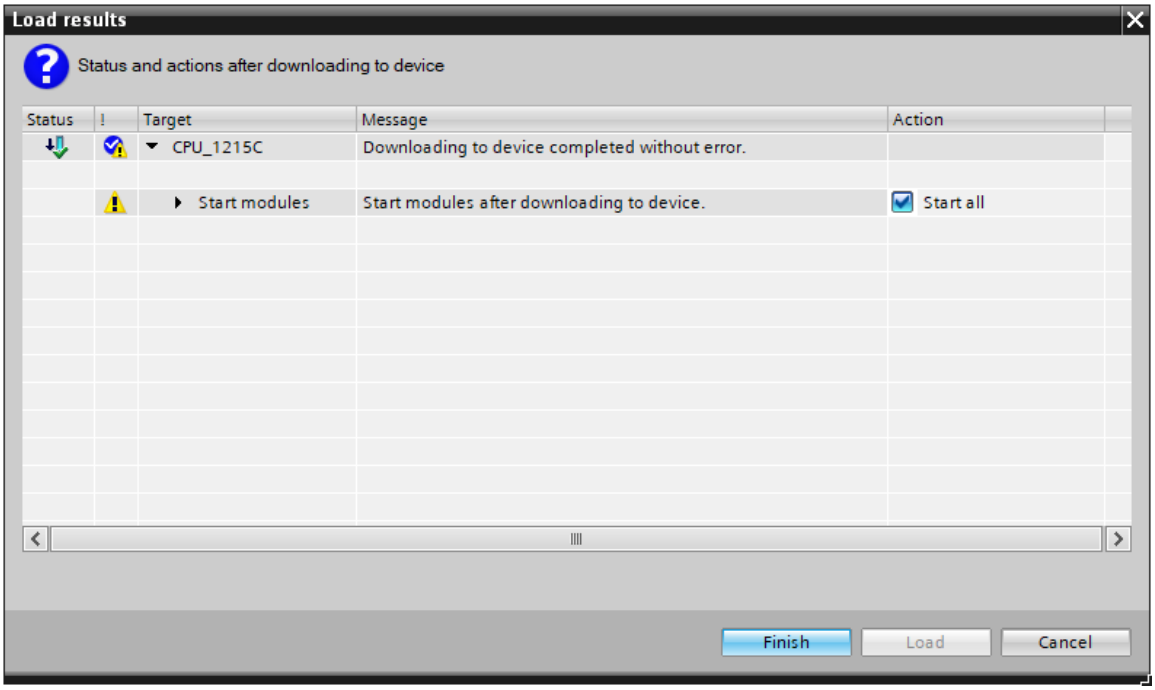
Note:

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 download report appears in the information field under "General". This can be helpful when troubleshooting an unsuccessful download.

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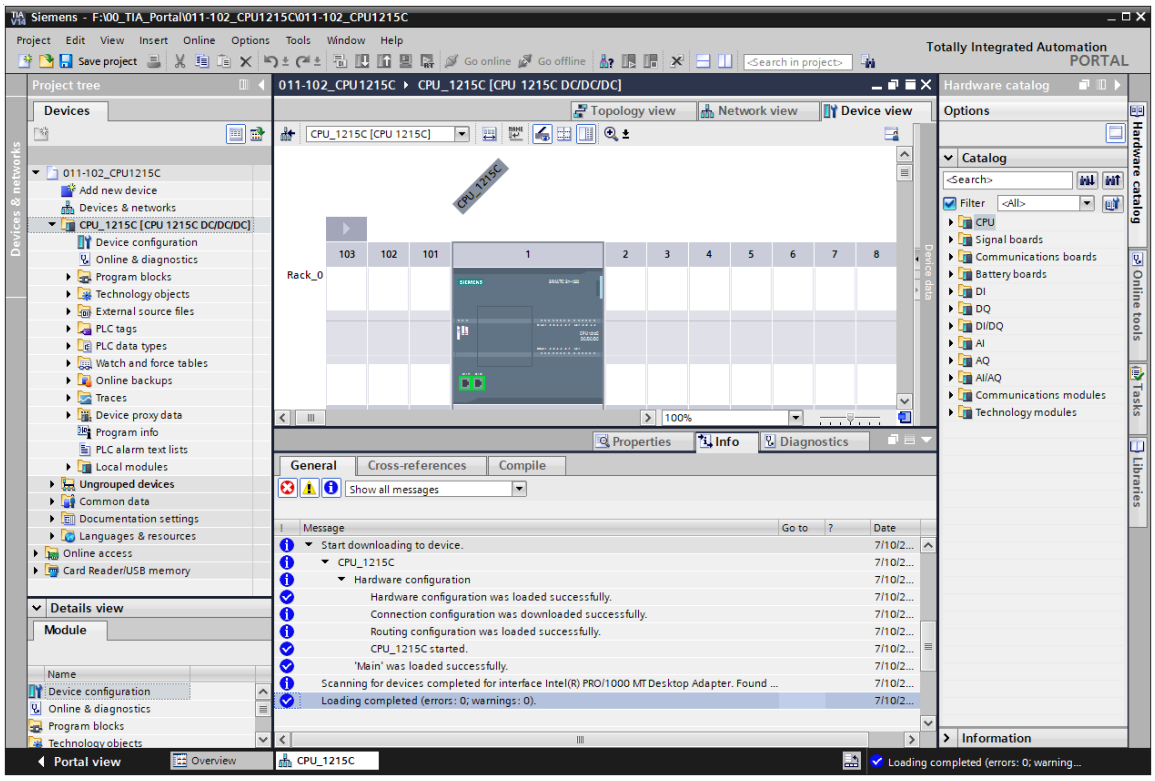

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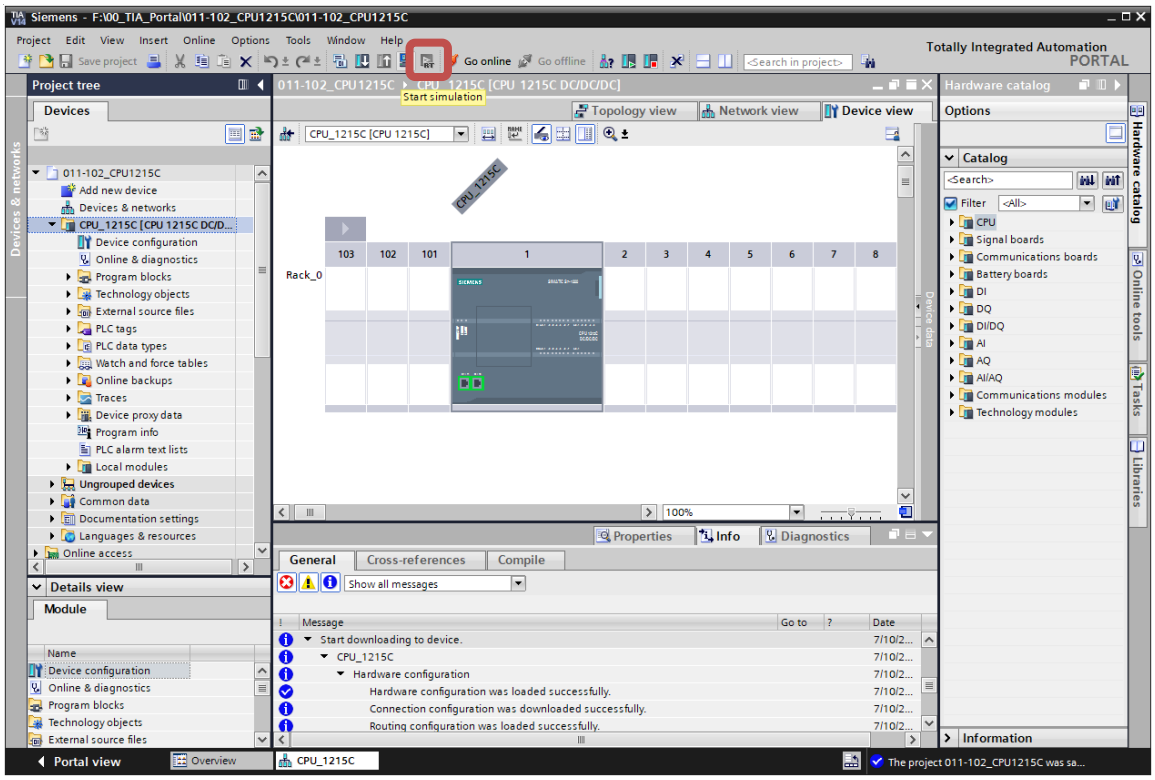
7.7 Downloading the hardware configuration to the PLCSIM simulation (optional)

→ 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_1215C [CPU1215C DC/DC/DC]" folder and then clicking the → "Start simulation" icon.



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

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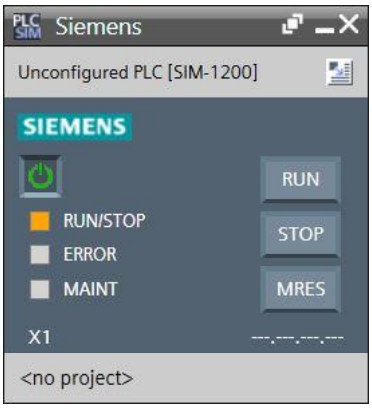
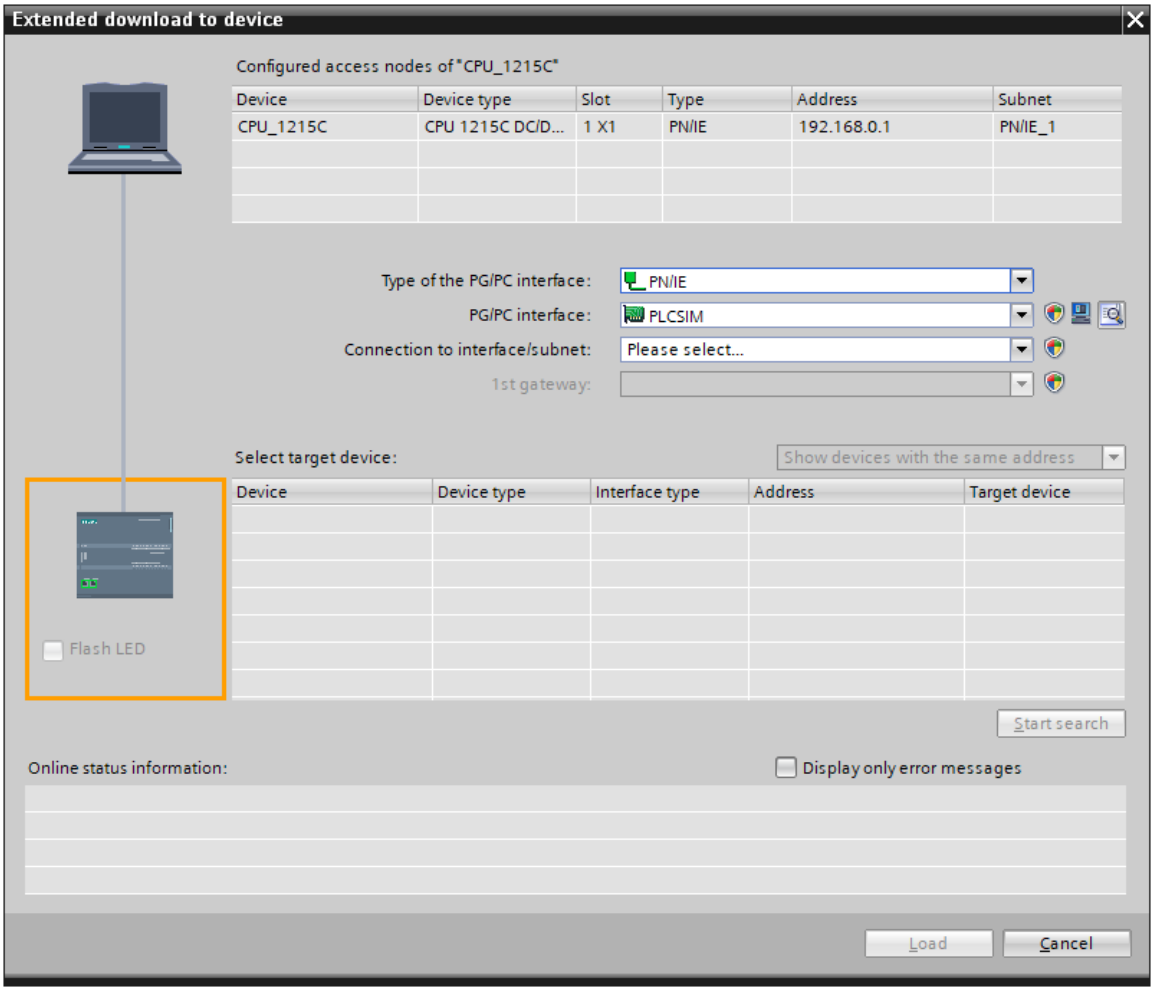
→ The "S7 PLCSIM" software is started in a separate window in the compact view.



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



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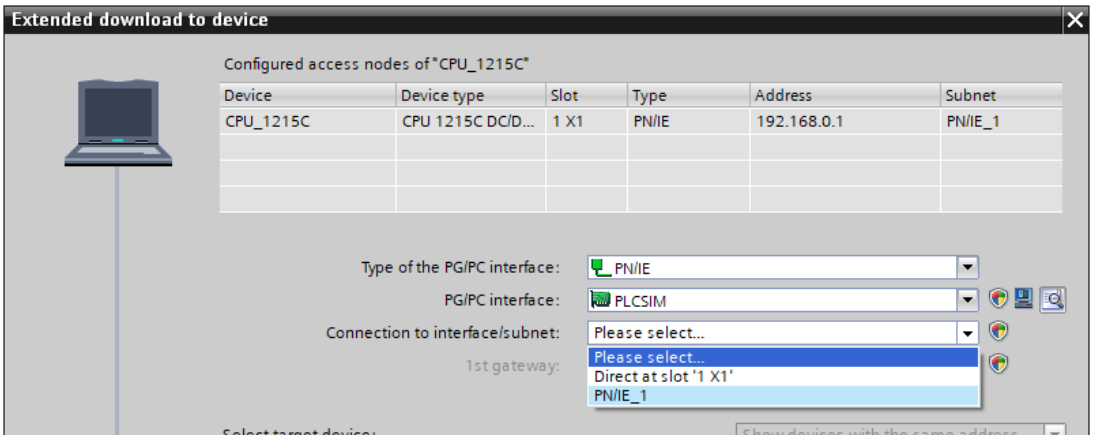
The correct interface must now be selected. "Type of the PG/PC interface" and the corresponding "PG/PC interface" should already be correctly preselected. The only thing left is the "Connection to interface/subnet":

→ Type of the PG/PC interface → PN/IE

→ PG/PC interface → PLCSIM

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



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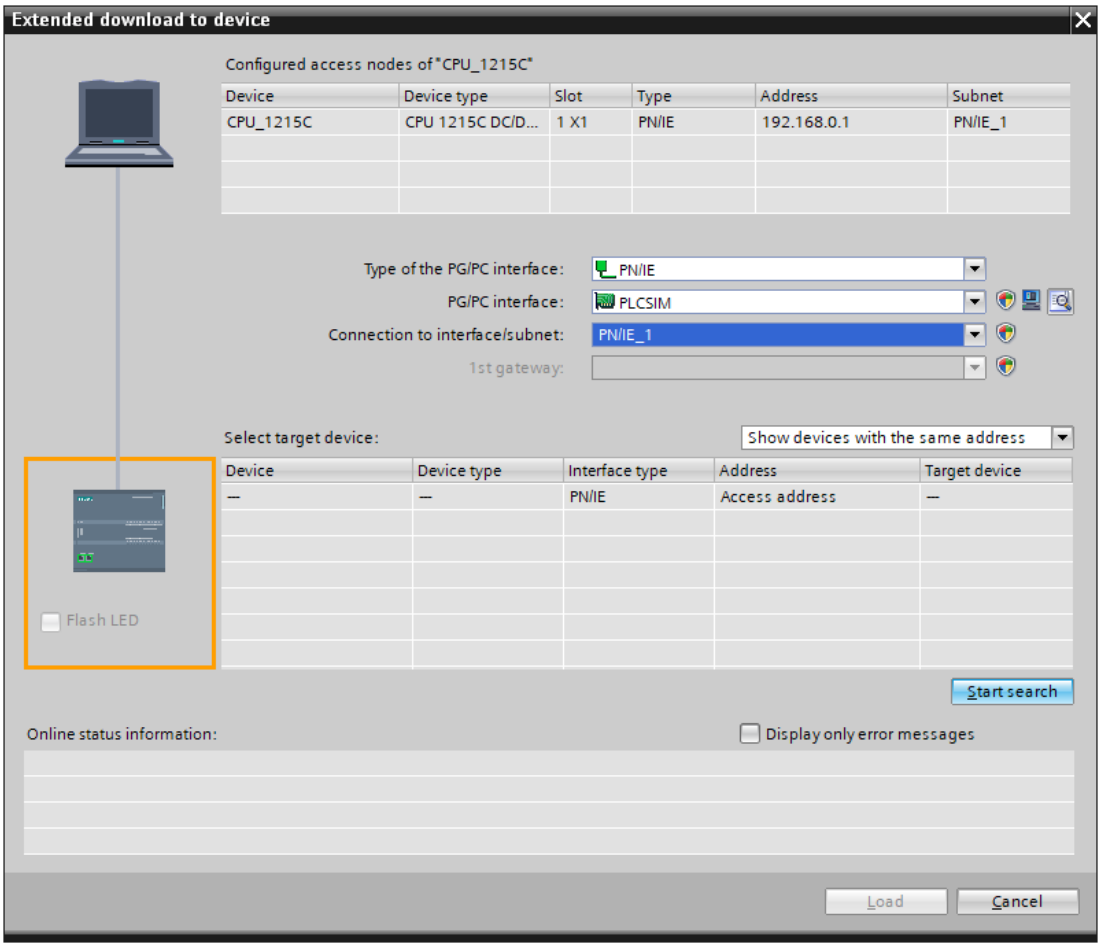
→ The search for devices in the network must then be started by clicking the → Start search button.



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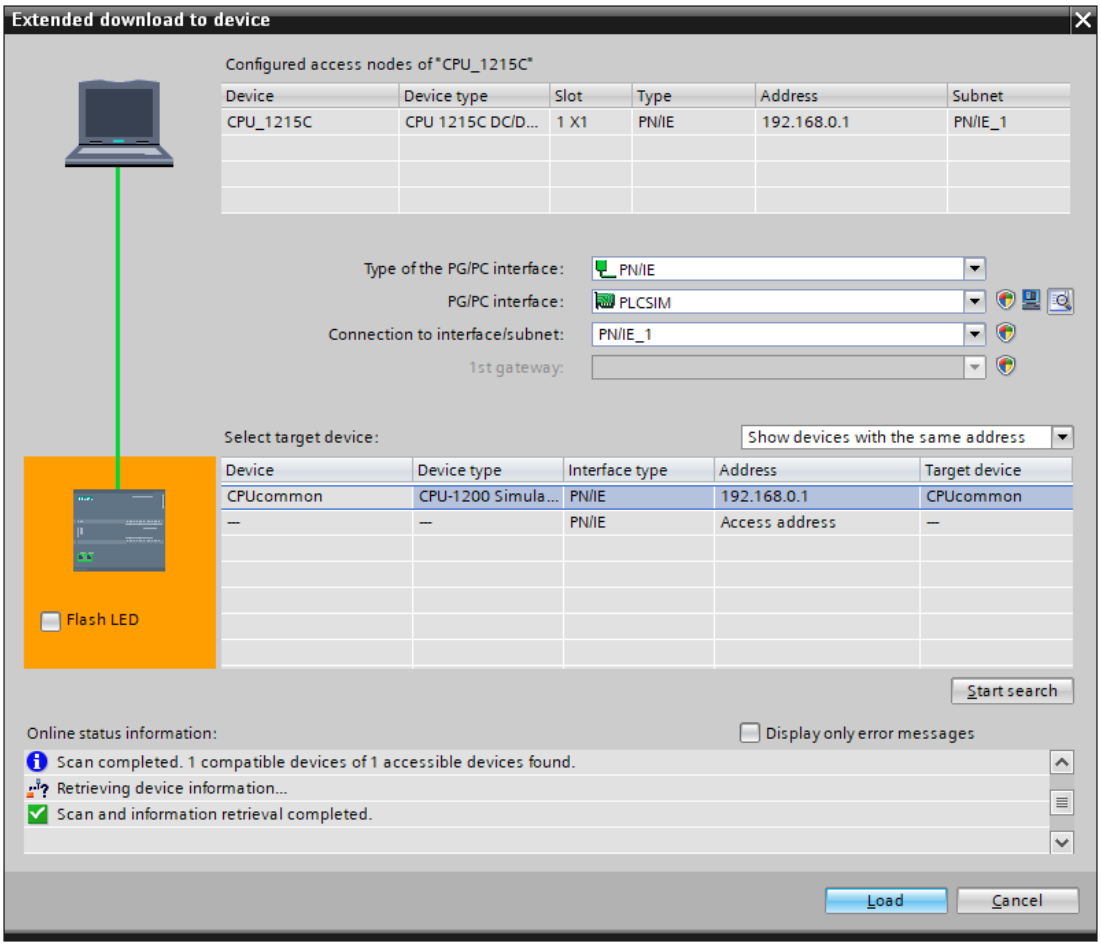
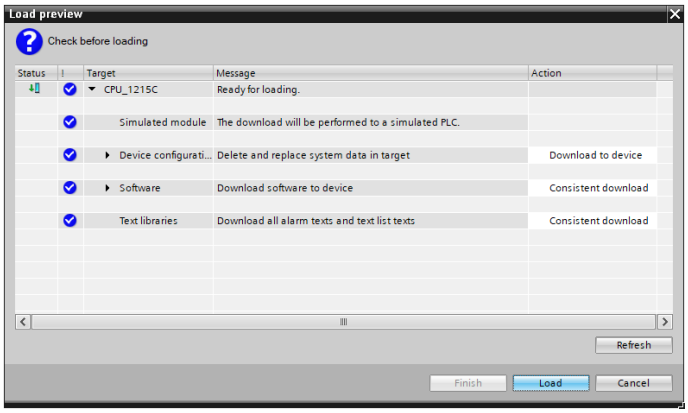
→ If the simulation is shown in the "Select target device" list, it must be selected before the download can be started (→ "CPU-1200 Simulation" → Load)



→ 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.

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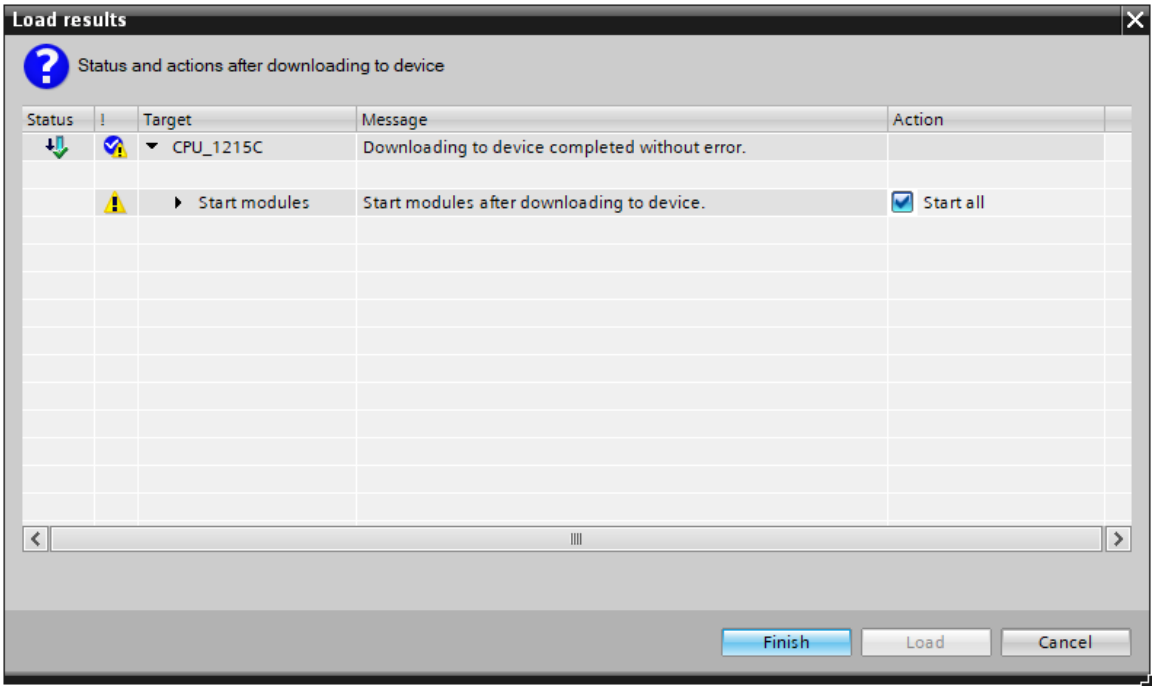
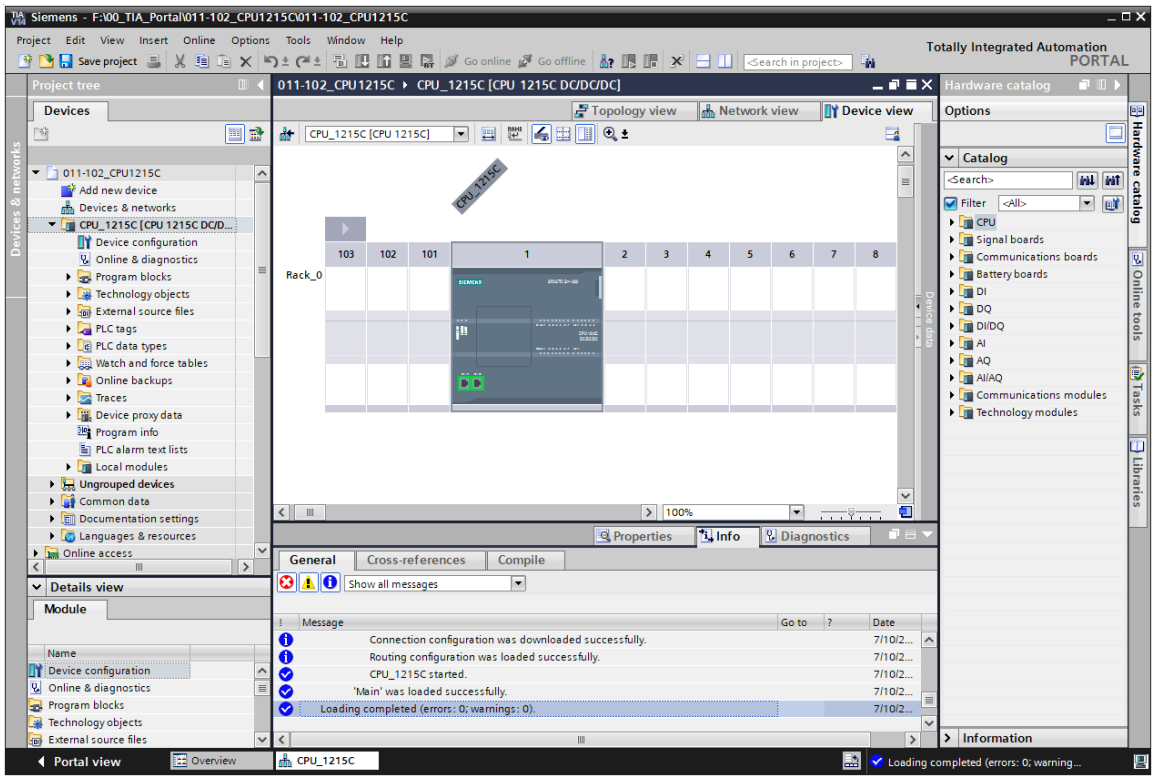
→ The → "Start all" option will be selected next before the download operation can be completed with → Finish.



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



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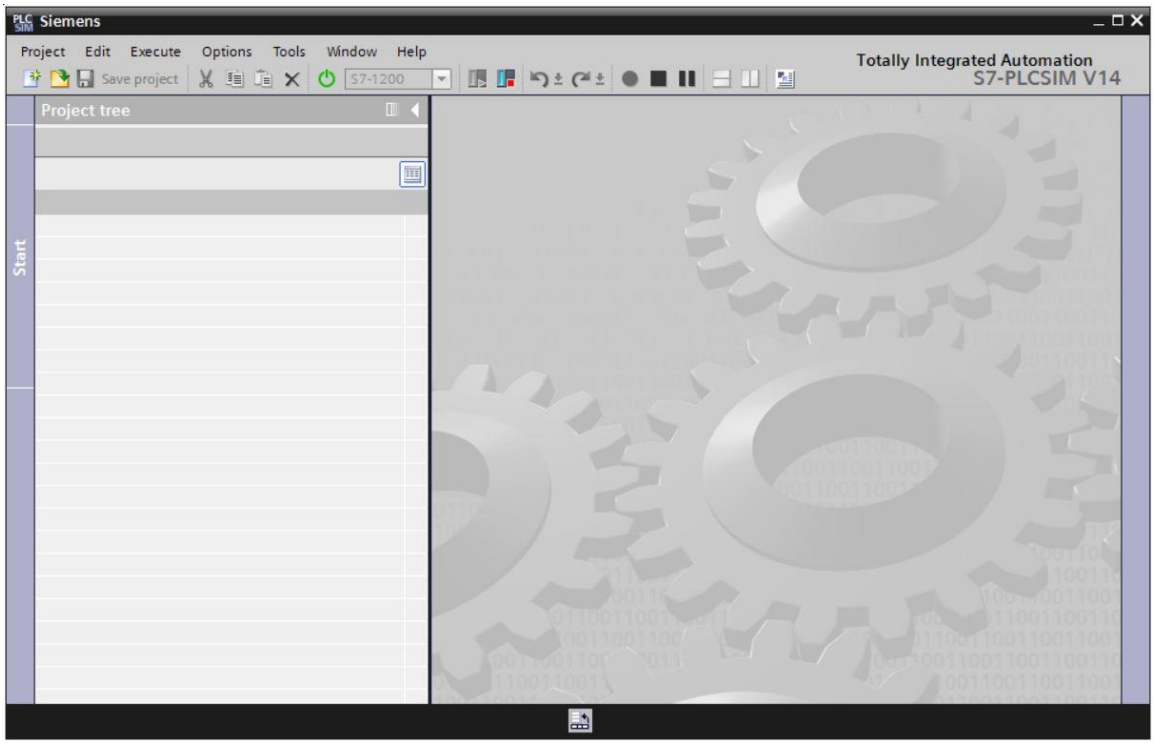
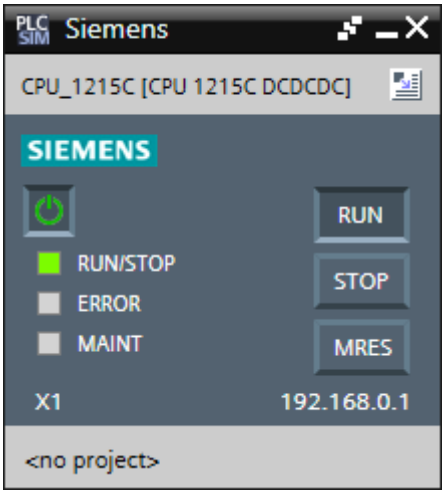
→ The PLCSIM simulation has the following appearance in the project view. You can switch to the compact view of the simulation by clicking the → icon in the menu bar.



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



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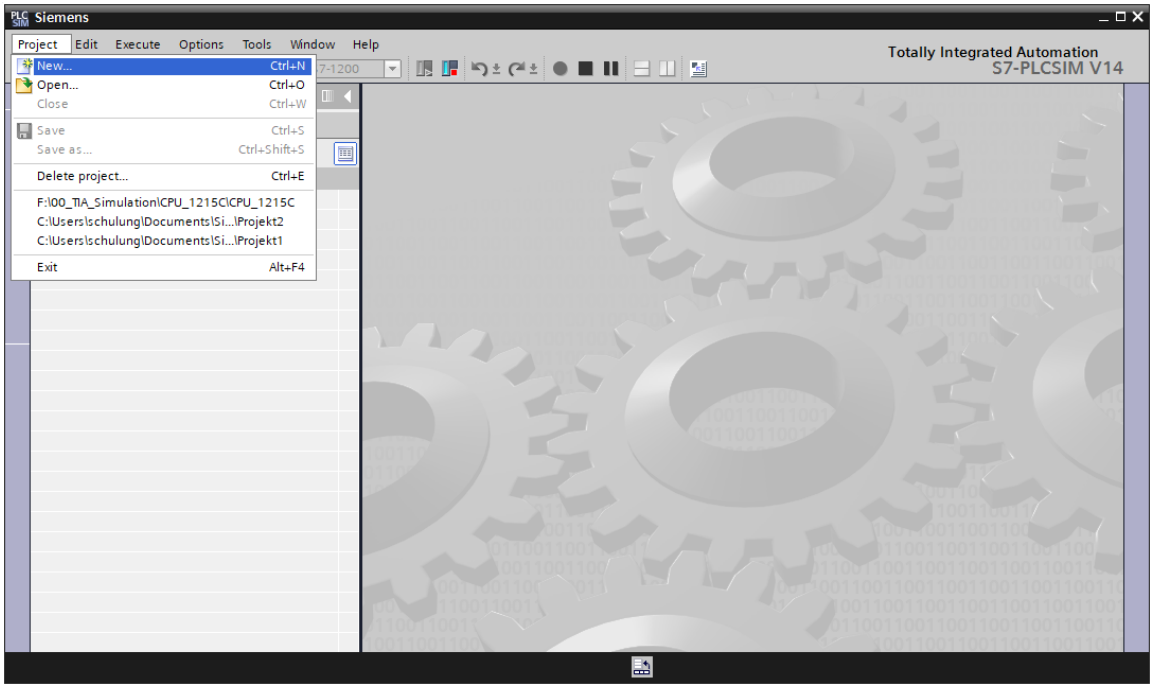
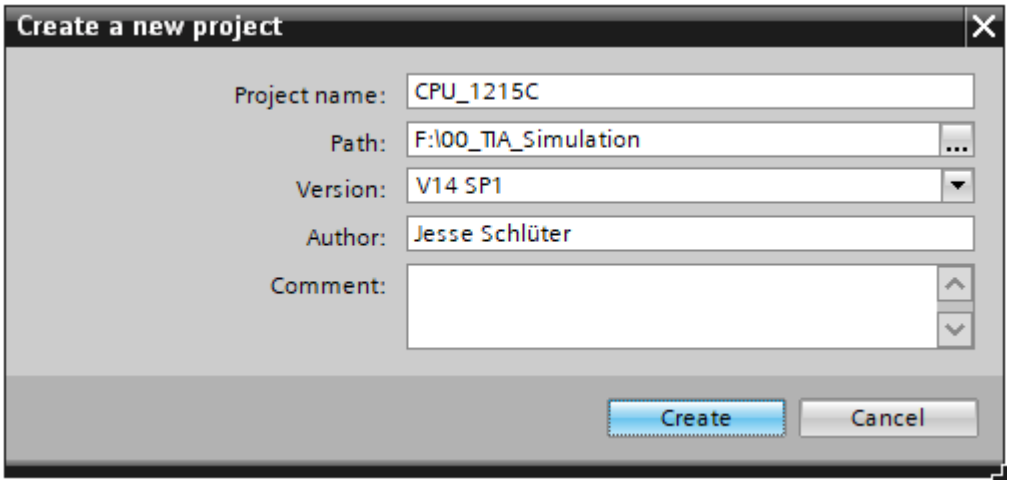
→ You must create a new simulation project in the project view by clicking → "Project" → "New".



→ Assign a "Project name" → "CPU_1215C" and select a → "Path" under which you want to create your project. Then click → Create.



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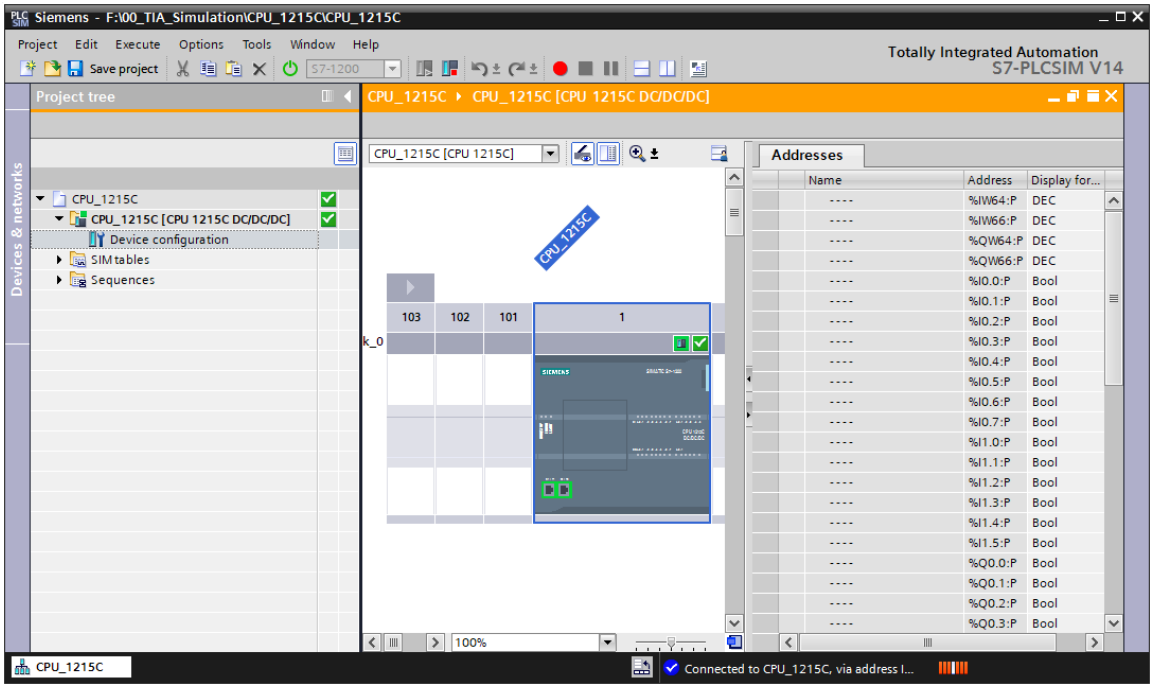
→ You see the downloaded configuration with the status of all inputs and outputs in the project view by double-clicking → "Device configuration". Here you can also create your own → "SIM tables" with selected input and output signals. You can change the input signals used in your program to test the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



Note:

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

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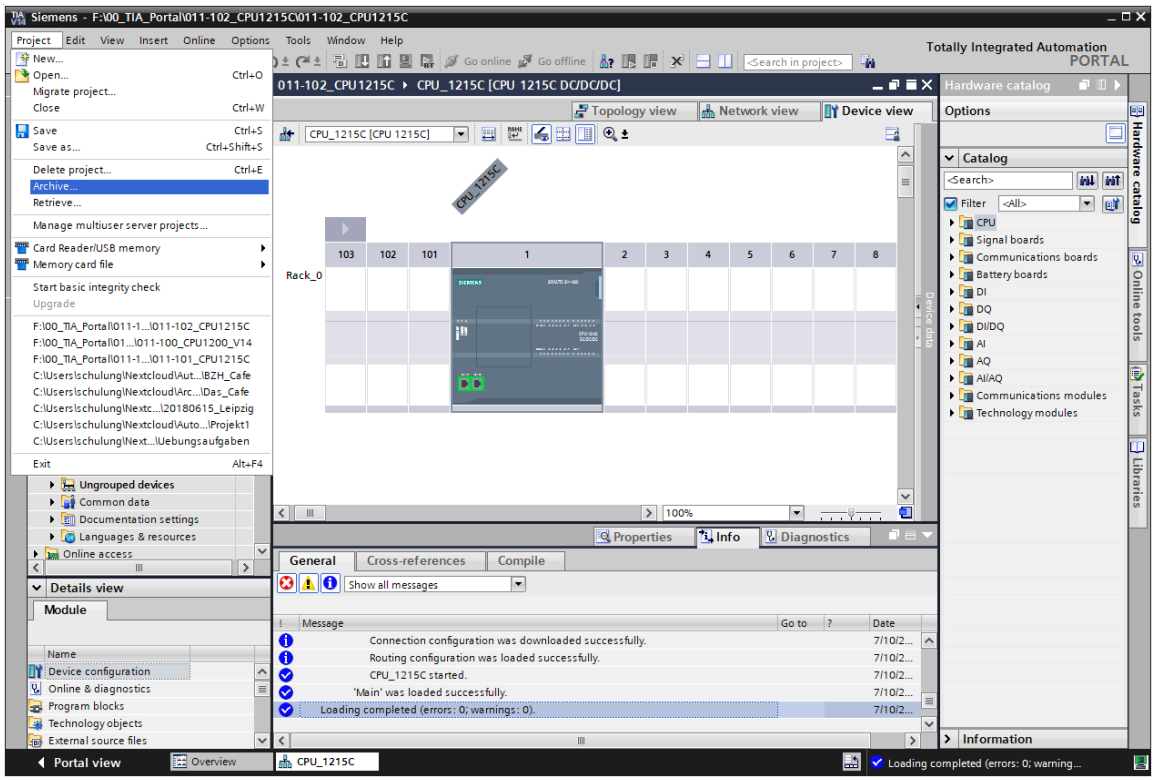
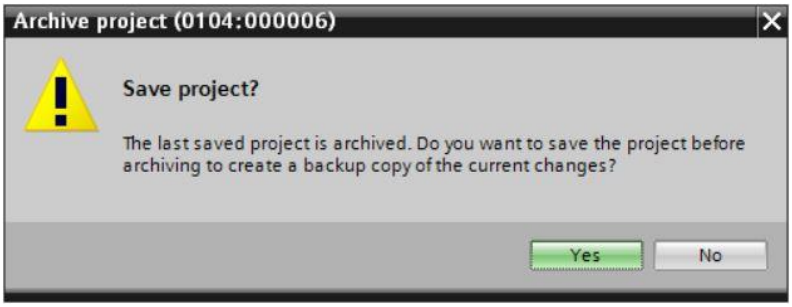
7.8 Archive the project

→ 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 a "TIA Portal project archive" file type. (→ "TIA Portal project archive" → "SCE_EN_011-102_Hardware Configuration_S7-1215C..." → "Save")

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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 range 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	

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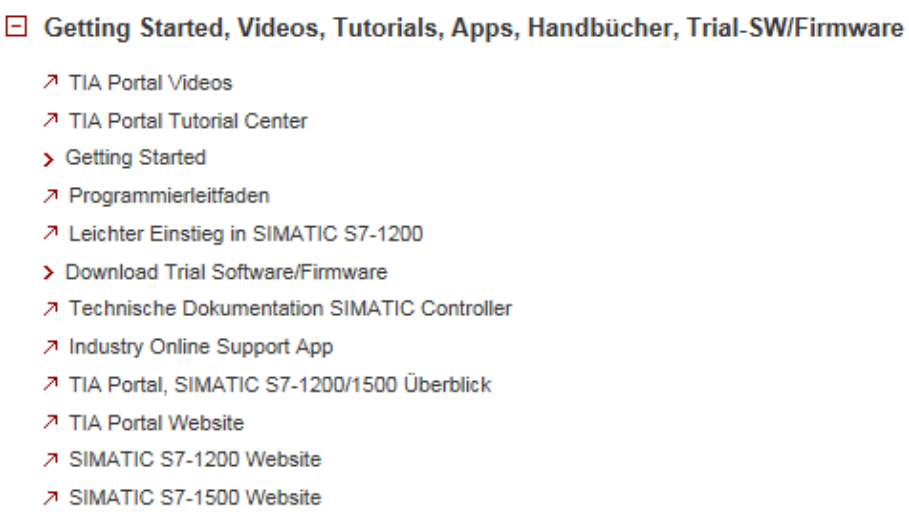
8 Additional information

You can find additional information as an orientation aid to familiarize yourself or deepen your knowledge, for example: Getting Started, videos, tutorials, apps, manuals, programming guidelines and trial software/firmware, at the following link:

www.siemens.com/sce/s7-1200

Preview "Additional information"



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Further Information

Siemens Automation Cooperates with Education
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SCE Learn-/Training Documents
siemens.com/sce/documents

SCE Trainer Packages
siemens.com/sce/tp

SCE Contact Partners
siemens.com/sce/contact

Digital Enterprise
siemens.com/digital-enterprise

Industrie 4.0
siemens.com/future-of-manufacturing

Totally Integrated Automation (TIA)
siemens.com/tia

TIA Portal
siemens.com/tia-portal

SIMATIC Controller
siemens.com/controller

SIMATIC Technical Documentation
siemens.com/simatic-docu

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