Contents

4

4. Devices & Networks: Online Functions and Hardware Configuration

At the end of the chapter the participant will ...

... be able to establish an online connection between PG and CPU via Industrial Ethernet

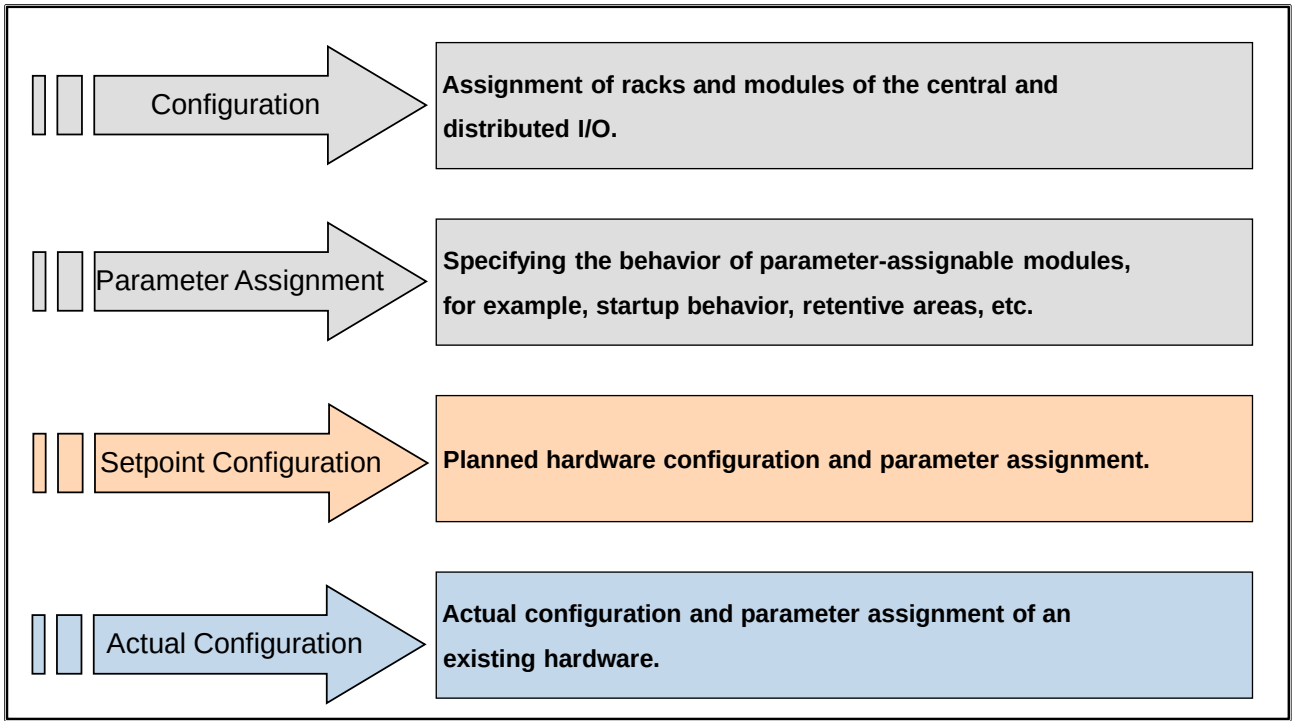
… be able to use online functions to start and stop the CPU and to reset it to factory settings

... be able to create and parameterize a new station

... be able to create and parameterize a setpoint (offline) configuration

... be familiar with addressing the input and output modules of an S7-1500 and be able to do it

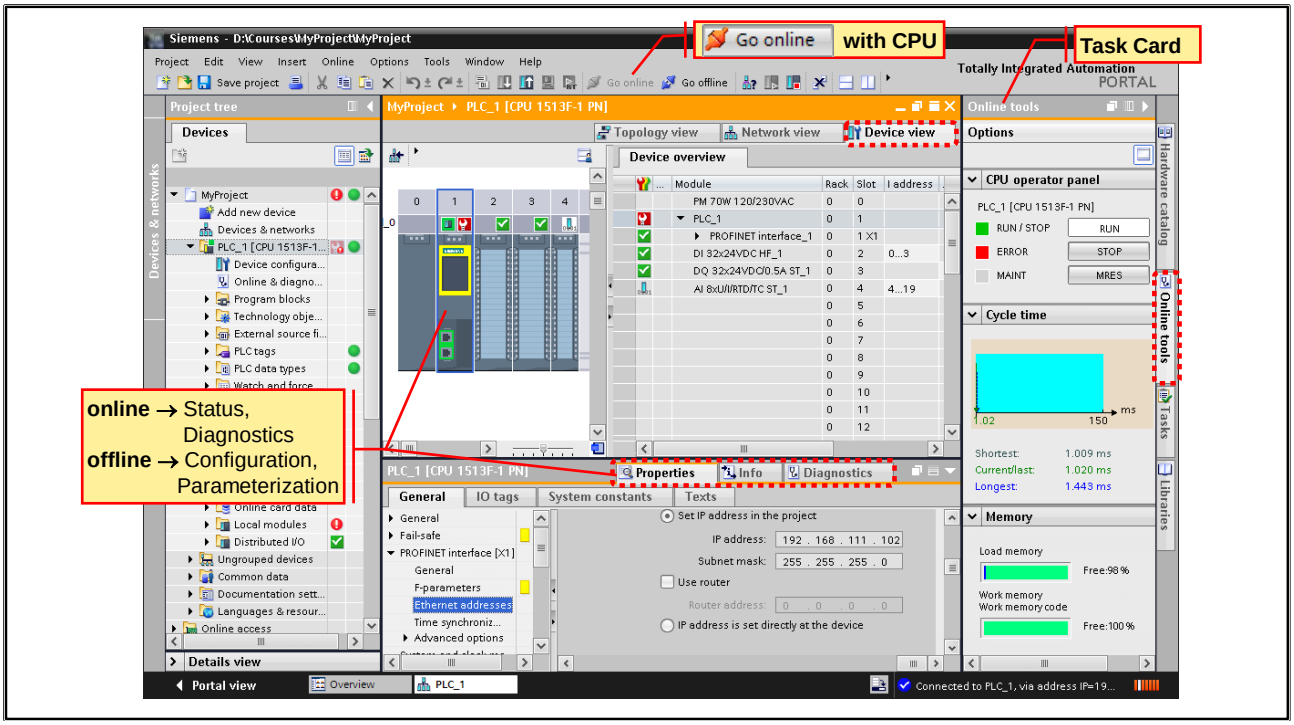
4.1. Setpoint and Actual Configuration



Setpoint (Offline) and Actual Configuration

When you configure a system, a setpoint (offline) configuration is created. It contains a hardware station with the planned modules and the associated parameters. The PLC system is assembled according to the setpoint (offline) configuration. During commissioning, the setpoint (offline) configuration is downloaded to the CPU.

4.2. Online Tools, Configuring and Parameterizing the Hardware



Online Tools

If it is possible to establish an online connection to the CPU, diagnostics and status information of all modules can be called.

With CPUs that can be accessed online, the mode can also be controlled using the "Online tools" task card and further status information (cycle time statistics and memory load) can be called.

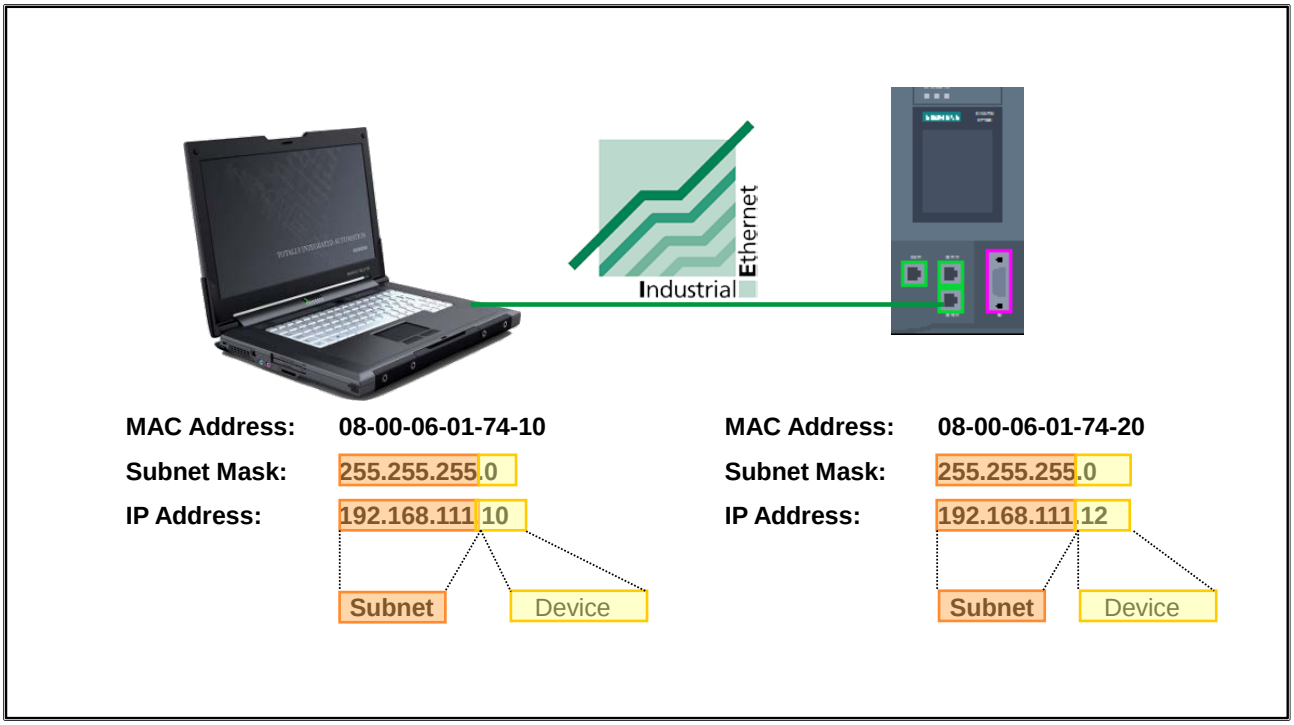
Configuring and Parameterizing the Hardware

Almost all devices or components of an automation solution such as PLCs or touch panels can be assigned parameters. The parameter assignment of the devices and network settings required for commissioning is handled using the Hardware and Network Editor.

With this, for example, all components of an Ethernet network are assigned IP addresses via which they communicate during later operation.

But even inside the automation device, address areas of the I/O modules must be specified and the cycle monitoring time of the CPU must be set, for example.

4.3. Online Connection via Industrial Ethernet: IP Address and Subnet Mask



Internet Protocol

The **I**nternet **P**rotocol (**IP**) is the basis for all TCP/IP networks. It creates the so-called datagrams (data packets specially tailored to the Internet protocol) and handles their transport within the local subnet or their "routing" (forwarding) to other subnets.

IP Addresses

IP addresses are not assigned to a specific computer, but rather to the network interfaces of the computer. A computer with several network connections (for example routers) must therefore be assigned an IP address for each connection.

IP addresses consist of 4 bytes. With the dot notation, each byte of the IP address is expressed by a decimal number between 0 and 255. The four decimal numbers are separated by dots (see picture).

MAC Address

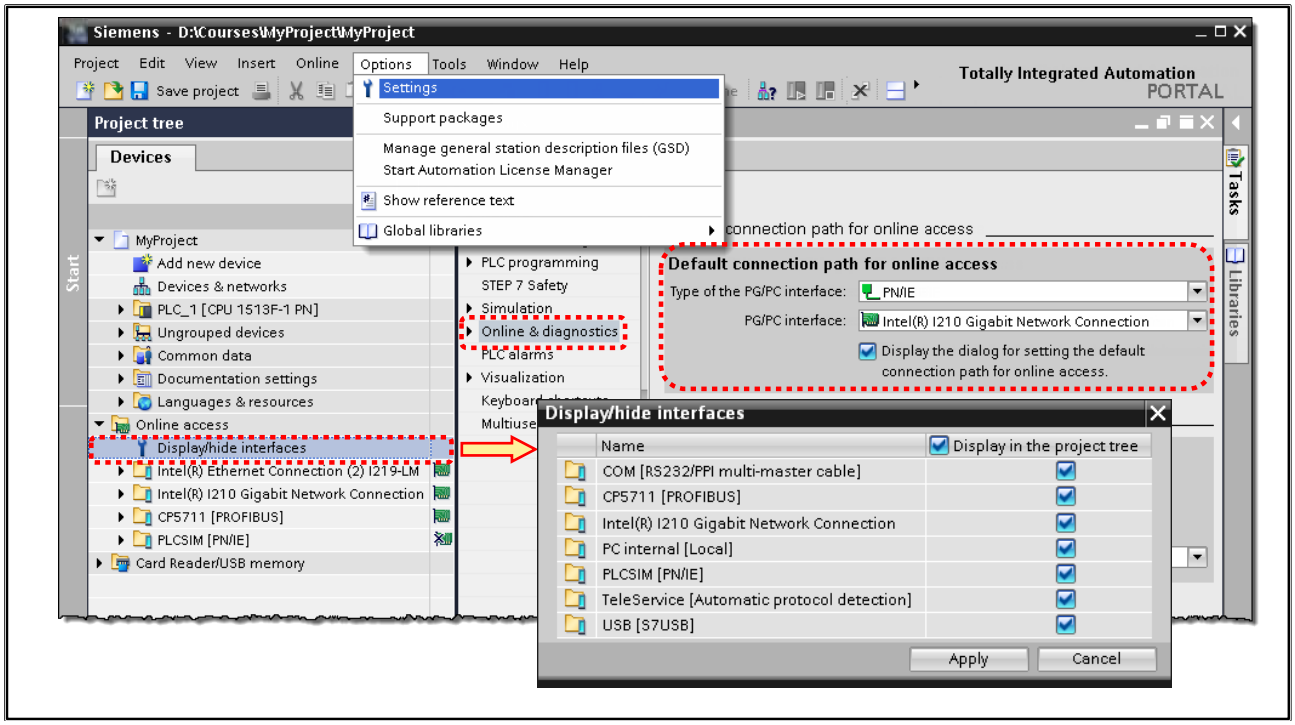
Every Ethernet interface is assigned a fixed address by the manufacturer that is unique worldwide. This address is referred to as the hardware or MAC address (Media Access Control). It is stored on the network card and uniquely identifies the Ethernet interface in a local network. Cooperation among the manufacturers ensures that the address is unique worldwide.

Subnet Mask

The subnet mask specifies which IP addresses in the local network can be accessed. It separates the IP address into the network and device part.

Only IP addresses whose network part is the same can be accessed.
e.g.: Subnet mask = **255.255.255.0** and IP address = **192.168.111.10**
accessible IP addresses: **192.168.111.1** to **192.168.111.254**

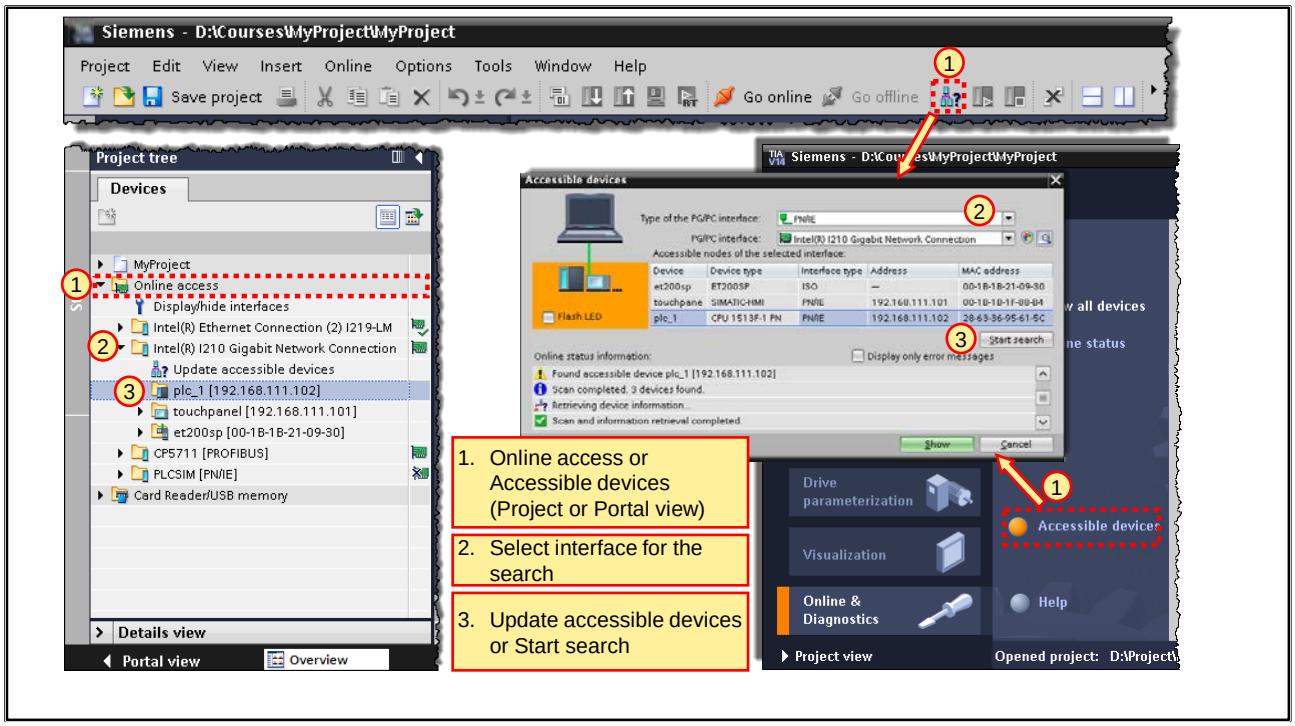
4.4. Default for Online Access and Visible Interfaces



In the Settings, you can have a default setting for the connection path for online access.

In the Online access folder, all possible interfaces of the PG/PC are displayed. Since not all of these are required or can be used, interfaces can be hidden for better clarity.

4.4.1. Online Access: Accessible Devices



Accessible Devices in the Portal View

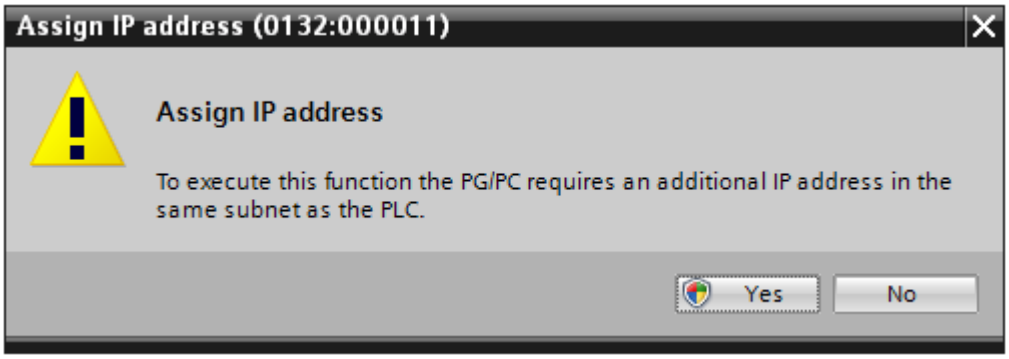
This function provides the option of fast access (for example for service purposes) even when **there is no offline project data for the target systems on the PG**.

All accessible, programmable modules (CPUs, FMs CPs, HMI devices) are listed in the Portal view, even if they are located in other subnets.

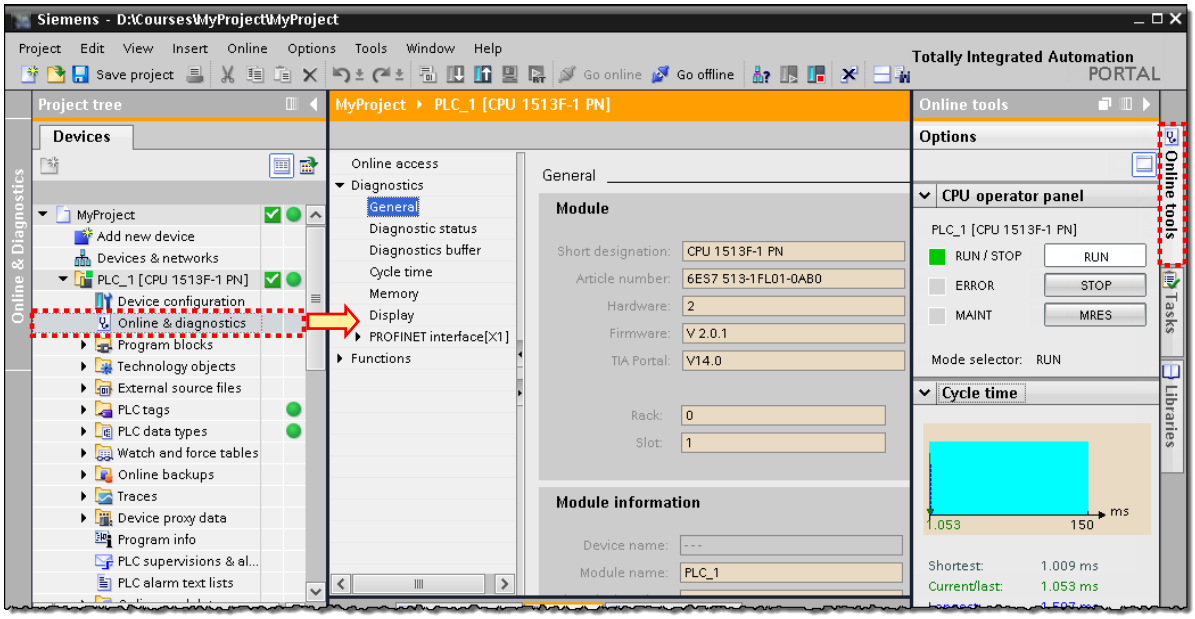
Access Online Functions → Show Button

Whenever there is an attempt to access a module online with the "Show" button and this is located in a different subnet from the PG, a dialog opens asking whether an additional IP address should be assigned to the PG.

Following confirmation, an additional IP address is assigned to the PG that is located in the same subnet as the address of the CPU. After that, all online functions can be used.



4.4.1.1. Accessible Devices: Online & Diagnostics, Task Card: Online Tools



CPU Operator Panel: Mode Selector Switch

The operating mode of the CPU can be changed.

- RUN → STOP:
  If there is a change from RUN to STOP, the CPU terminates the running user program.
- STOP → RUN:
  If there is a change from STOP to RUN, the CPU performs a restart.

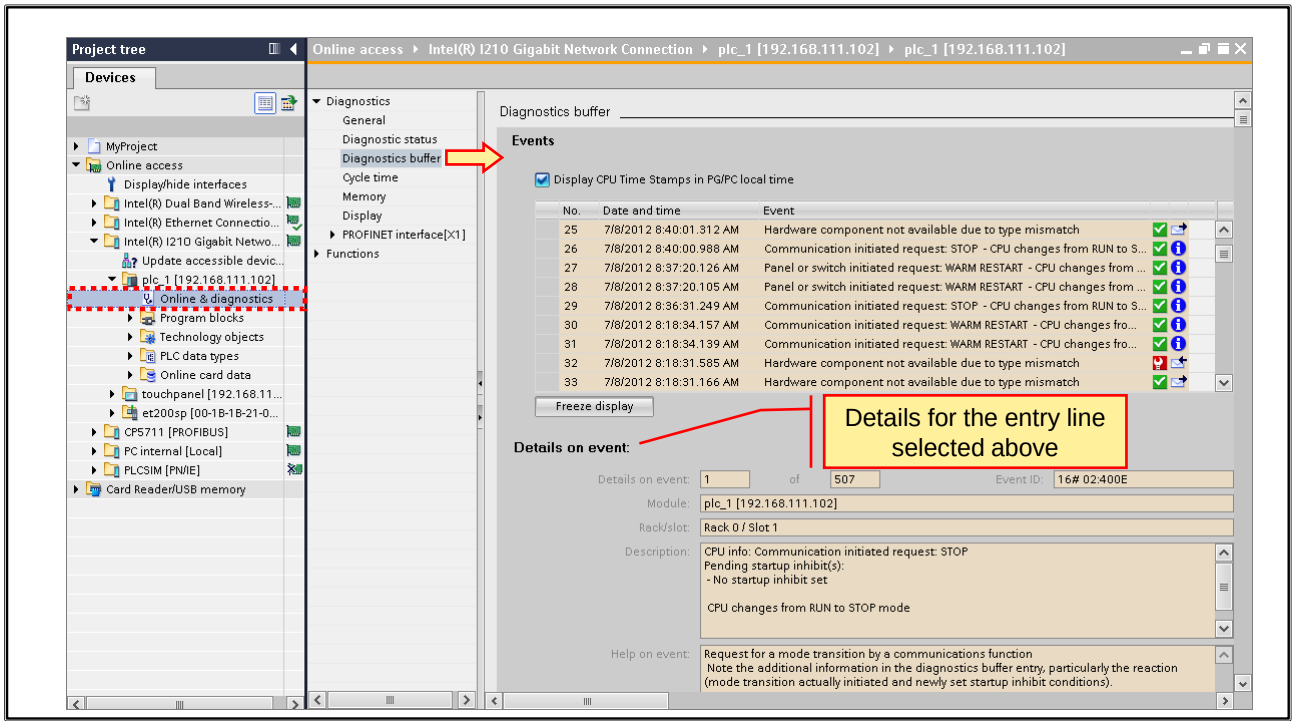
Cycle Time:

"Shortest", "Current" and "Longest" are the cycle times since the last CPU restart

With a Memory Reset (MRES), a CPU reset is carried out:

- All user data (even the retentive) is deleted (delete work memory)
  (process images, memory bits, timers, counters, all program/data blocks)
- Retained are: IP addresses, the retentive part of the diagnostics buffer, operating hours counter, time-of-day.

4.4.1.2. Accessible Devices: Online & Diagnostics: Diagnostics Buffer



Online Access to the CPU

If the PG and the target system (for example CPU) are located in the same subnet, various Online & diagnostics functions are available in the "Accessible devices" function.

- in the working area of the TIA Portal
- in the "Online tools" task card (see next page)

Diagnostics Buffer

The diagnostics buffer is a buffered memory area on the CPU organized as a circular buffer. It contains all diagnostics events (error alarms, diagnostics interrupts, start-up information etc.) of the CPU in the order in which they occurred. The highest entry is the last event to occur.

All events can be displayed on the programming device in plain language and in the order in which they occurred.

All events can be displayed on the programming device in plain language and in the order in which they occurred. In addition, not the entire diagnostics buffer is buffered with Power OFF (only a part is retentive).

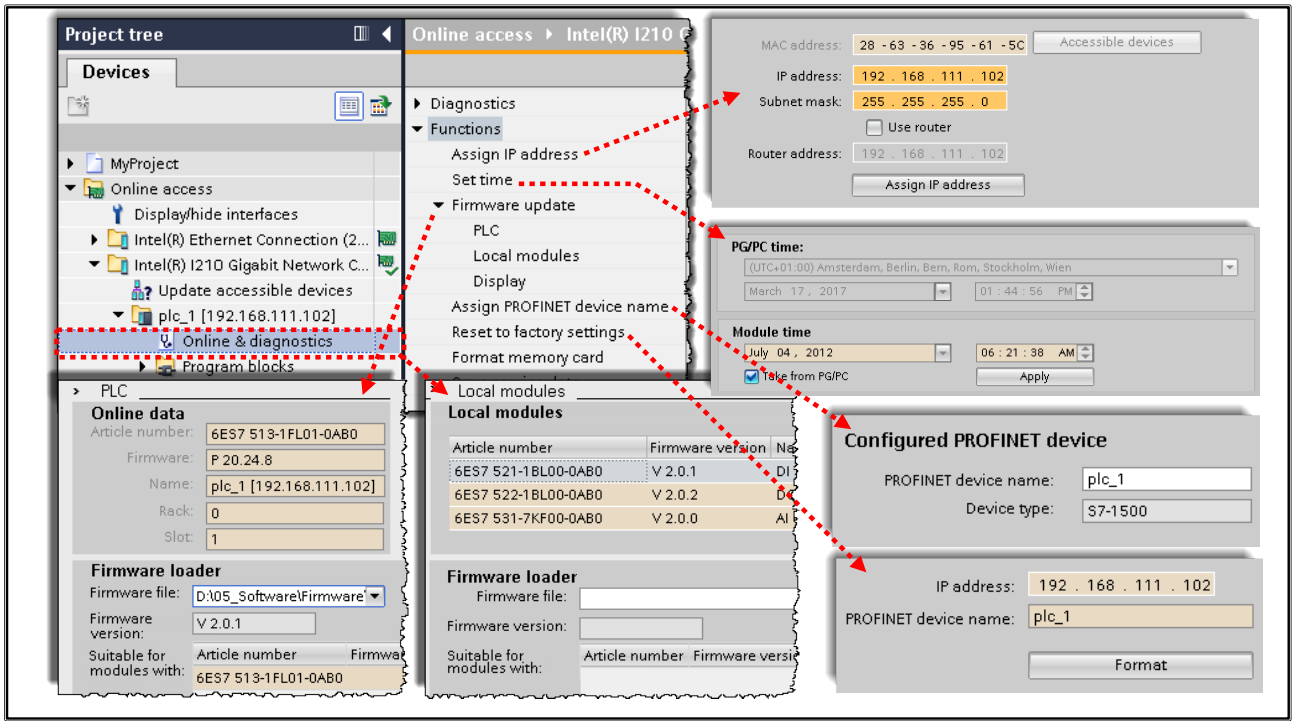
- Number of entries, 1000 to 3200
- Of that, retentive 250 to 500

Details on Event

Some additional information is also provided for the selected event in the "Details on event" box:

- Event name and number
- Additional information depending on the event, such as, the address of the instruction that caused the event etc.

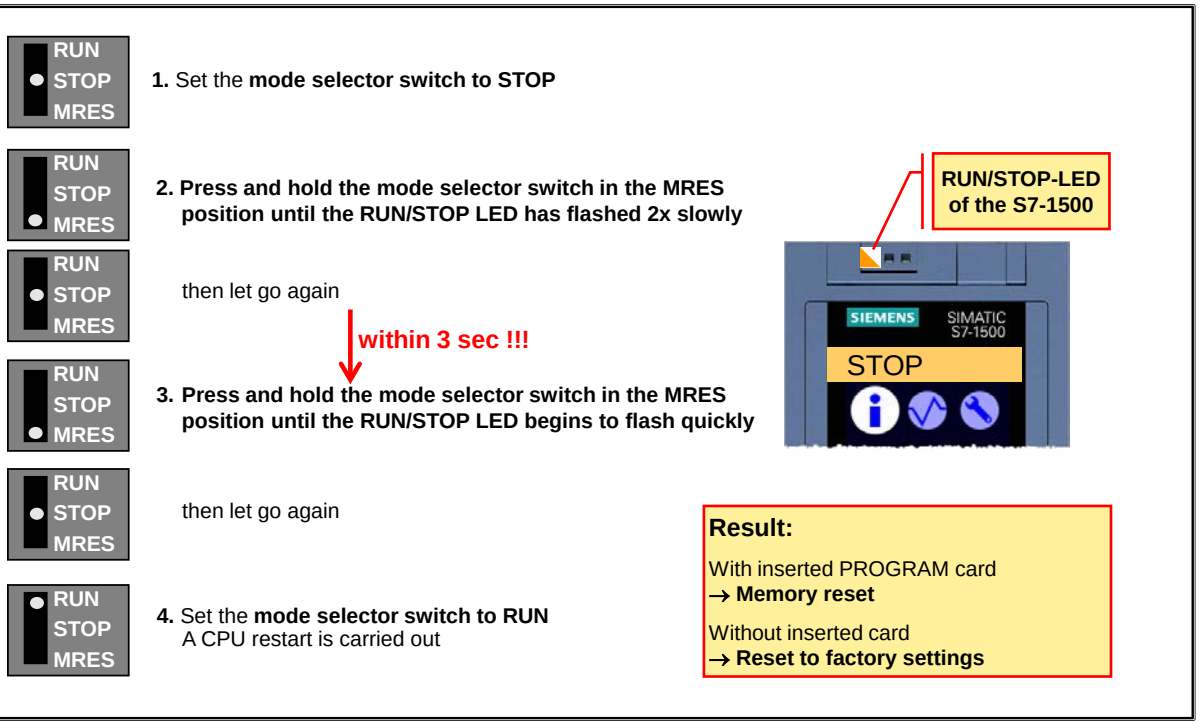
4.4.1.3. Accessible Devices: Online & Diagnostics: IP Address, Name, Time, FW Update, Memory Card



- **Set Time (of Day)**
  Each S7 CPU has a real-time clock that can be set here.
- **Assign IP Address**
  As long as no IP address has been specified already by a hardware configuration that was downloaded earlier, this can be assigned or modified here (this function is also available when the PG/PC and the CPU are not assigned to the same subnet).
- **Reset to Factory Settings**
  Unlike the "memory reset", all the memory areas of the CPU (work, load and retentive memory, diagnostics buffer and time) are deleted. Optionally (see dialog in the picture), the IP address can also be deleted so that the CPU then only has a MAC address (Media Access Control).
- **Format Memory Card**
  The CPU memory card can also be deleted in the CPU via this online function. After that, the CPU only has its IP address. All other data (including the device configuration) is deleted. The card cannot be deleted in the card reader via the Project tree. Device configuration and blocks have a gray background, that is, are write-protected (only status information or open with a double-click).
- **Assign Name**
  In PROFINET, each device must be assigned a unique device name that is stored retentively on the device. The device name identifies a distributed I/O module (PROFINET IO) and allows module replacement without a PG/PC.
- **Firmware Update**
  The firmware version of the device and the modules can be updated. Under "Diagnostics -> General", the current firmware version is displayed.

Caution: If the CPU and Display have to be updated, first the Display and then the CPU.

4.5. Resetting the CPU using the Mode Selector Switch



Particular Feature for CPU Memory Reset (MRES) using the Mode Selector Switch:

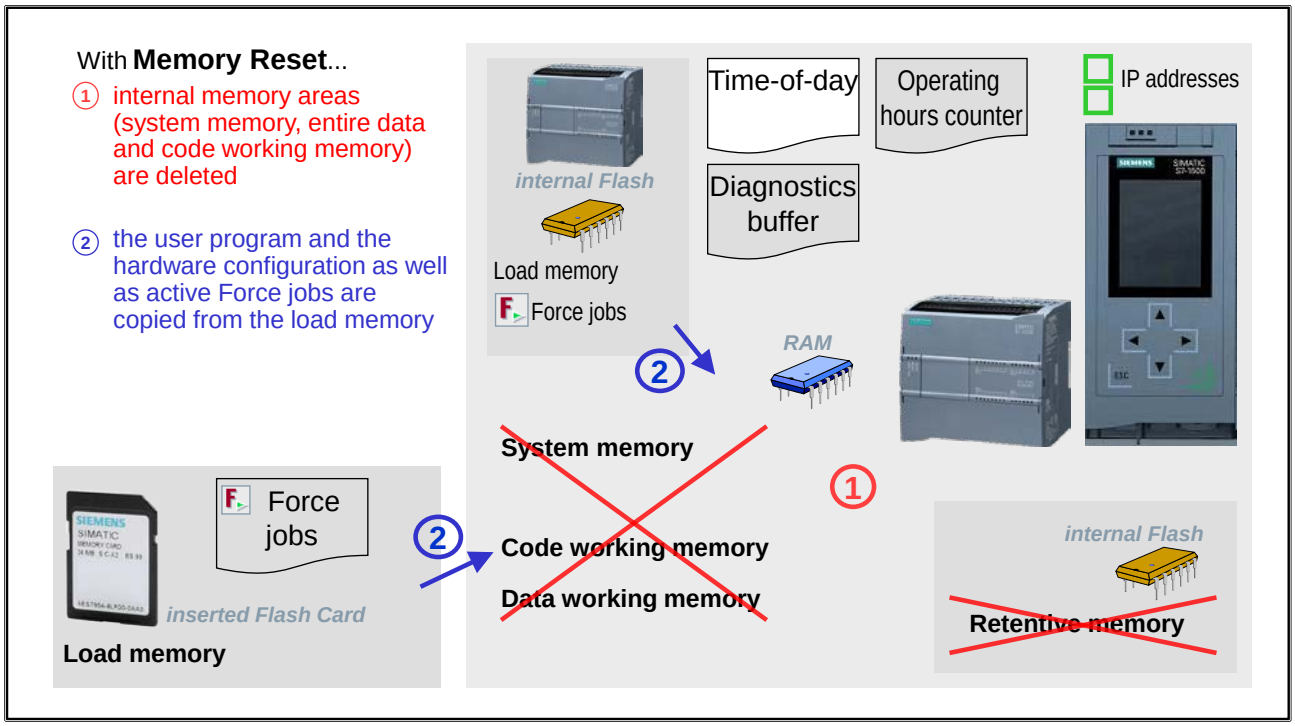
- **when SIMATIC Memory Card (SMC) is inserted => Memory Reset**
  - All user data is deleted (work memory, retentive memory)
    (process images, memory bits, counters, timers, all program/data blocks)
  - Retained are: parameter assignment of the X1 (Ethernet) interface, the retentive part of the diagnostics buffer, operating hours counter, CPU time-of-day
  - The CPU copies all load memory data relevant for execution (memory card) into the internal RAM work memory. (Data relevant for execution: device configuration, program blocks, data blocks).

- **when no SIMATIC Memory Card (SMC) is inserted => Reset to factory settings**
  - All memory areas of the CPU (work memory, retentive memory, diagnostics buffer, time-of-day) and the IP address are deleted.

    After the SMC is inserted, the load memory data relevant for execution is reloaded into the internal RAM work memory from the memory card:

    Device configuration (with IP address), program blocks, data blocks

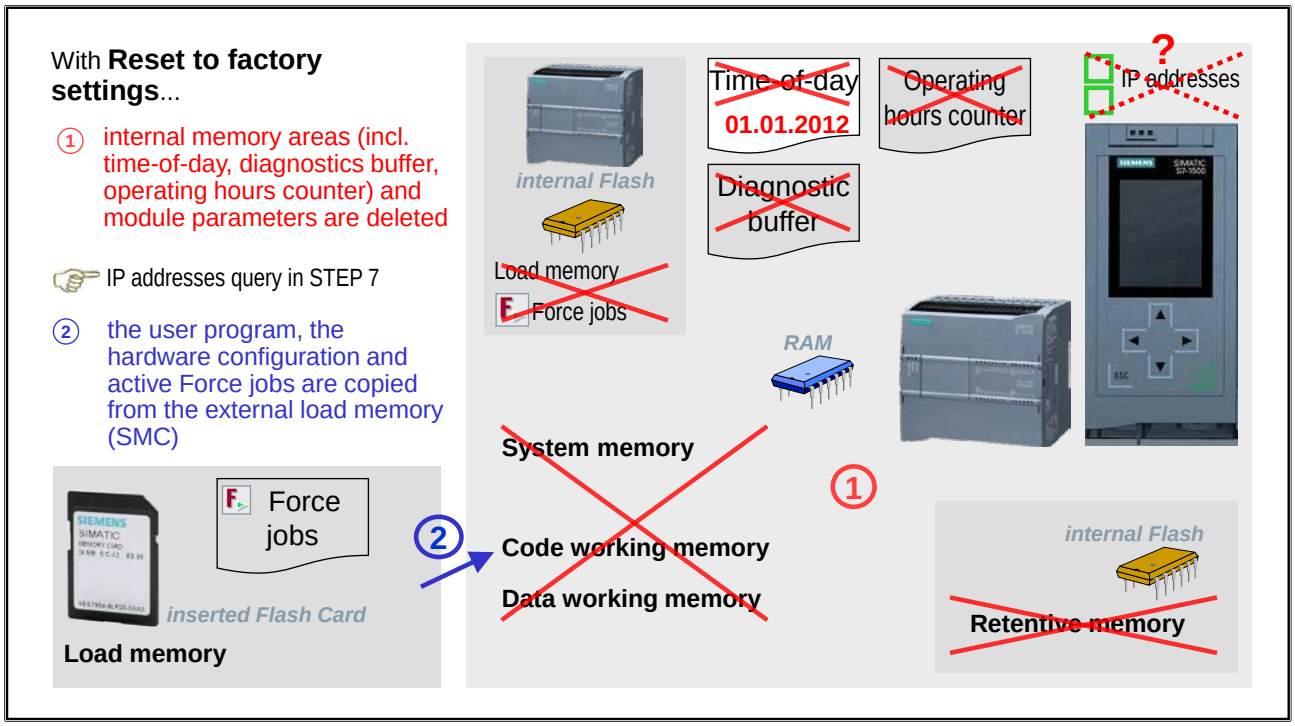
4.5.1. SIMATIC S7-1200/1500: Memory Concept for CPU Memory Reset



CPU Memory Reset

- **What to do**:
  - STEP 7 online function → MRES in "CPU operator panel" of "Test" and "Online tools" Task Cards
  - Display (only S7-1500) → Main menu "Settings", submenu "Memory reset"
  - CPU mode selector switch (with inserted memory card)
- **Impact**
  - An existing online connection between PG/PC and the CPU is disconnected.
  - The entire RAM work memory is deleted, that is, all user data (process images, bit memories, counters, timers, all program/data blocks, even the retentive ones)
  - Retained are: IP addresses, diagnostic buffer, operating hours counter, CPU time-of-day.
  - After that, the CPU copies all data relevant for execution into the RAM work memory from the memory card. (Data relevant for execution: device configuration, program blocks, data blocks, current Force jobs).

4.5.2. SIMATIC S7-1200/1500: Memory Concept for CPU Reset to Factory Settings

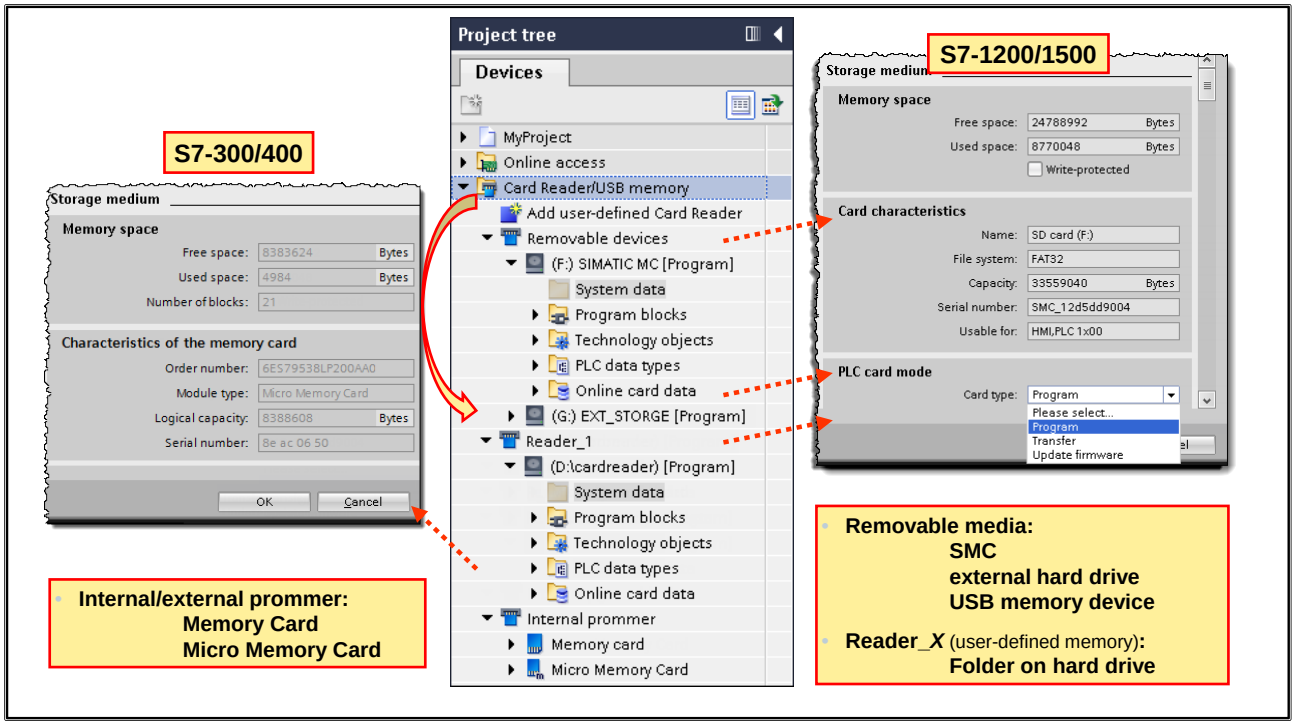


CPU Reset to Factory Settings

- **What to do**:
  - STEP 7 online function → MRES in "CPU operator panel" of "Test" and "Online tools" Task Cards
  - Display (only S7-1500) → Main menu "Settings", submenu "Memory reset"→ Factory Defaults
  - Mode selector switch (only without memory card)
- **Impact**
  - An existing online connection between PG/PC and the CPU is disconnected.
  - The entire RAM work memory is deleted, that is, all user data (process images, bit memories, counters, timers, all program/data blocks, even the retentive ones, diagnostic buffer), IP addresses are deleted if this is selected in STEP 7.
  - All IP addresses are retained if this was specified in STEP 7.

If a memory card is inserted (or is already inserted), the CPU copies all data relevant for execution into the internal RAM work memory from the memory card. (Data relevant for execution: device configuration incl. IP address, program blocks, data blocks, current Force jobs).

4.6. Card Reader / USB Memory Device



Card Reader / USB Memory

In the Card Reader/USB memory folder, you can access an SMC inserted in the SD Reader, the internal/external prommer, removable (media) devices or user-defined folders.

Card Type of the SIMATIC Card for S7-1200/1500:

The SIMATIC Memory Card is used as a Program card or a Transfer card or for Firmware Updates. Before the relevant data is stored on the SMC, the card type must be selected as shown in the picture.

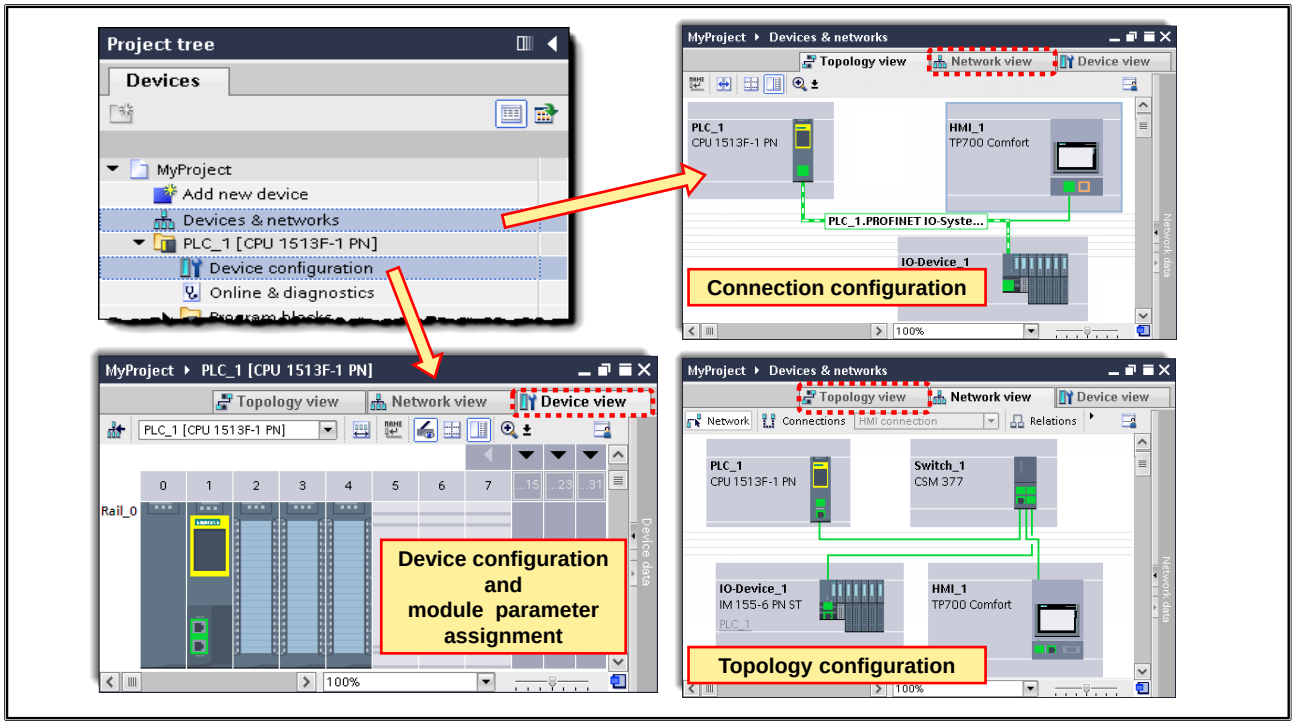
- **SIMATIC Memory Card as Program Card:**
  The card contains all configuration and parameterization data for the station as well as the entire user program with documentation. During operation, the card must remain inserted in the CPU because it is used as a replacement for the internal CPU load memory which remains unused.
- **SIMATIC Memory Card as Transfer Card (only for S7-1200):**
  The card contains the same data as a Program card but it doesn't have to remain inserted during operation. After inserting the card and subsequent Power ON, all data is copied into the internal load memory of the CPU. Then the card has to be removed and a restart has to take place.
- **SIMATIC Memory Card to Update Firmware:**
  The SIMATIC Memory Card contains the files required for a firmware update. After execution, the SIMATIC Memory Card must be removed.

S7-300/400:

An S7-300 or S7-400 CPU does not have an SMC as load memory but a Memory Card or Micro Memory Card. You can only access these cards with the help of an internal or external prommer.

Note: A SIMATIC Field PG has an internal prommer.

4.7. Working Areas of the Hardware and Network Editor



Components of the Hardware and Network Editor

The Hardware and Network editor consists of a Device, Network and Topology view.

Device View

The Device view is used for configuring and parameterizing devices and modules.

- Hardware configuration
- Device and module parameter assignment

Network View

The Network view is used for configuring, parameterizing and networking devices.

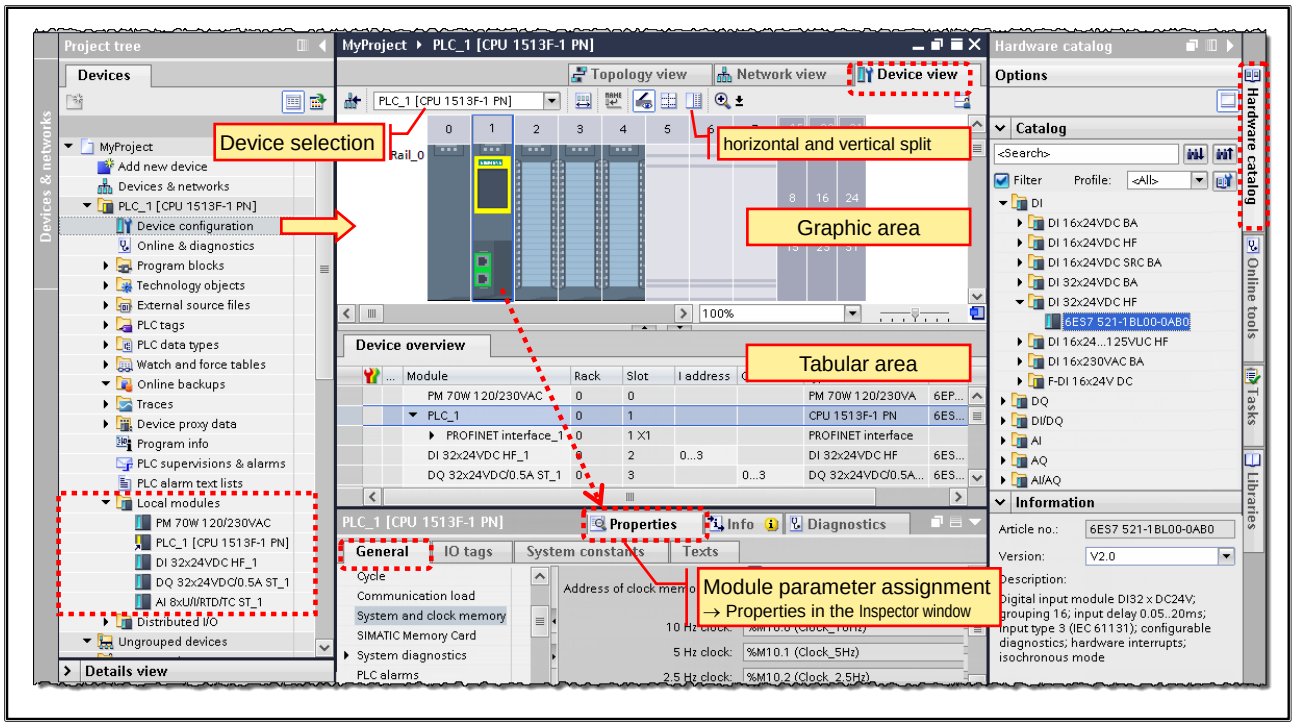
- Configure and parameterize devices
- Connection configuration

Topology View

The Topology view is used for displaying, configuring and determining the physical structure of networks.

- Configure the port assignment and the relationship between devices
- Online-Offline comparison as well as synchronization of the port assignment and relationships
- Topology makes it possible to exchange devices without a node initialization

4.7.1. Hardware and Network Editor: Device View



Components of the "Hardware and Network Editor"

"Device view" section in the working area
This editor consists of 2 areas, a tabular (left/top) and a graphic (right/bottom). The splitting left-right or top-bottom can be changed as required.

- Graphic area = module configuration
- Tabular area = Address parameterization of configured modules

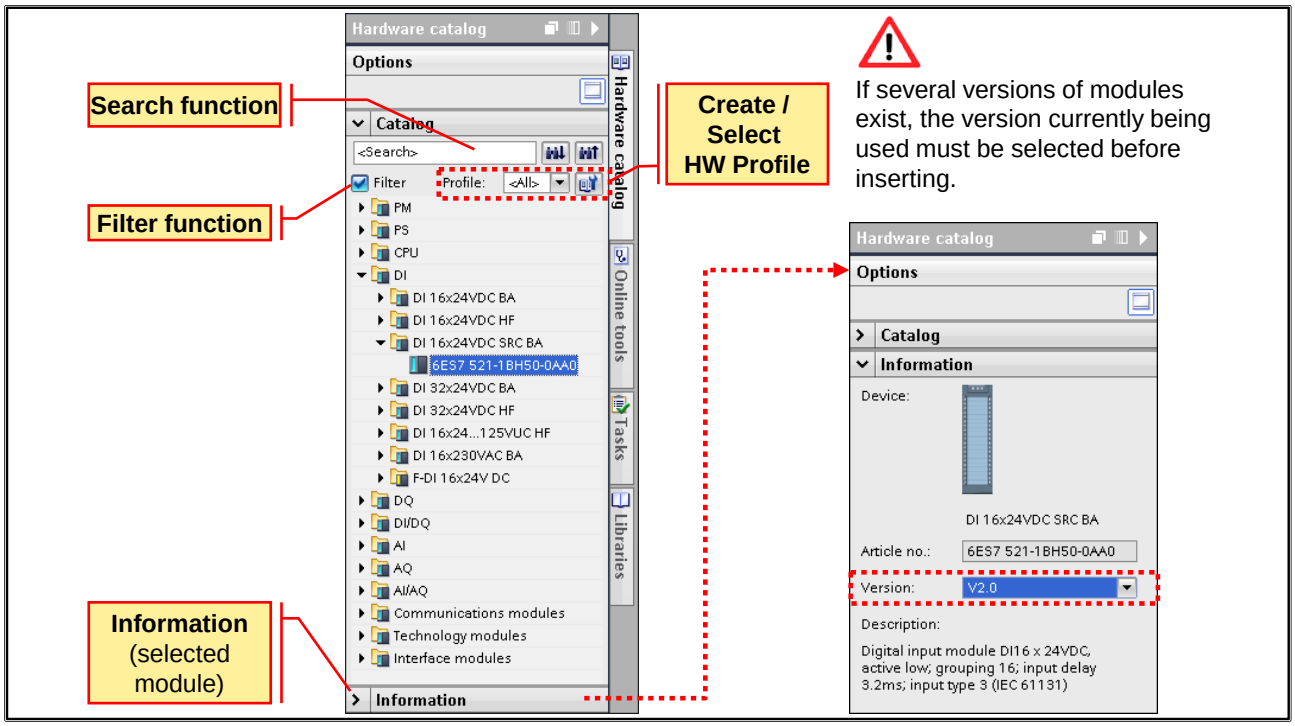
- **"Properties" tab** in the Inspector window
  This tab is used to assign parameters to the module selected in the working area. Here, all the properties or parameters of the selected module are displayed and can also be modified. In the left-hand part of the Properties tab there is a navigation section in which the parameters are arranged in groups.

- **"Hardware Catalog" Task Card**
  Module catalog for the configuration (module grouping) in the working area

Project Tree → "Local Modules"

In the Project tree, the modules along with their parameter assignments (for example, addresses) are stored under the relevant device in the "Local modules" folder.

4.7.2. Hardware Catalog



The Hardware catalog contains all devices and hardware components in a tree structure. From the catalog, selected devices or modules can be dragged to the graphic working area of the "Hardware and Network" editor.

Search Function

This allows a convenient search for specific hardware components. The search also includes the module description texts.

Filter Function

Filter enabled: Only modules that match the current context are displayed.

Filter disabled: All existing objects of the catalog are displayed

Contents of the Hardware Catalog for Enabled Filter

- Network view → only objects that can be networked
- Device view → all modules or, for enabled filter, only the modules that belong to the current device in the working area

Profile

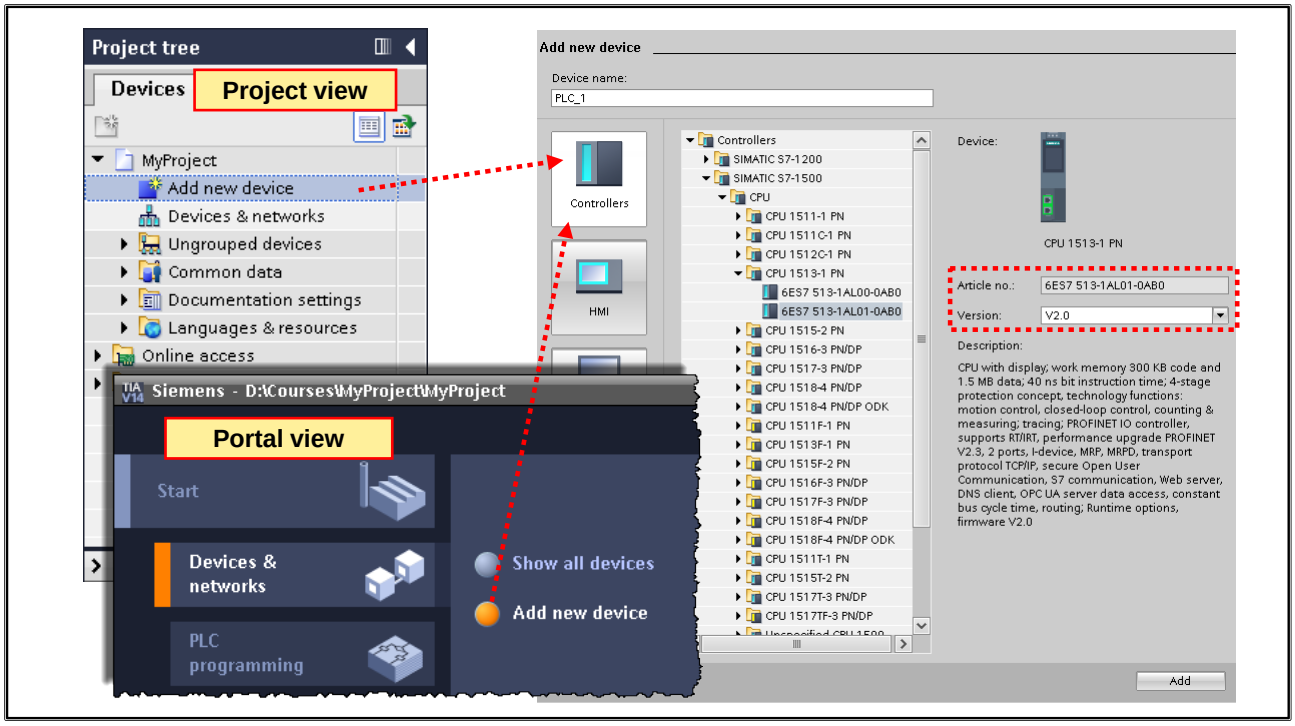
It is possible to create and to use your own profiles. This expands the filter possibilities.

Information

The "Information" pane shows detailed information about the object selected in the catalog.

- Name
- Order number (Article no.)
- Version number

4.8. Adding a New Device (Controller)



Add New Device

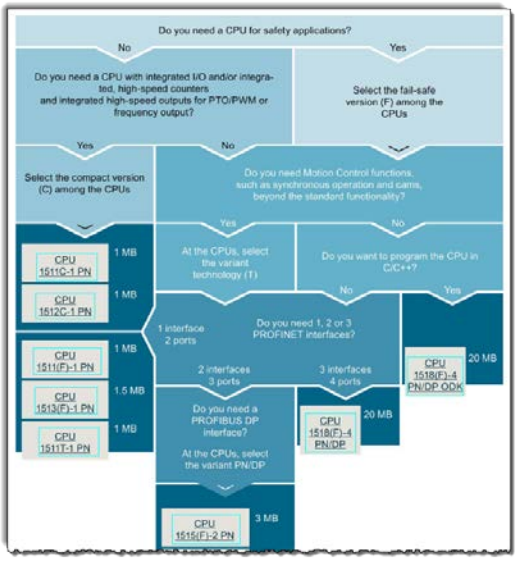
It is possible to create a new device in the project using the Hardware and Network editor with the help of the "Hardware catalog" task card or through the Project tree "Add new device".

When a new device is created, a suitable rack is also created automatically. The selected device is inserted into the first permitted slot in the rack.

Regardless of the method selected, the added device is visible in the Device view and in the Network view of the Hardware and Network editor.

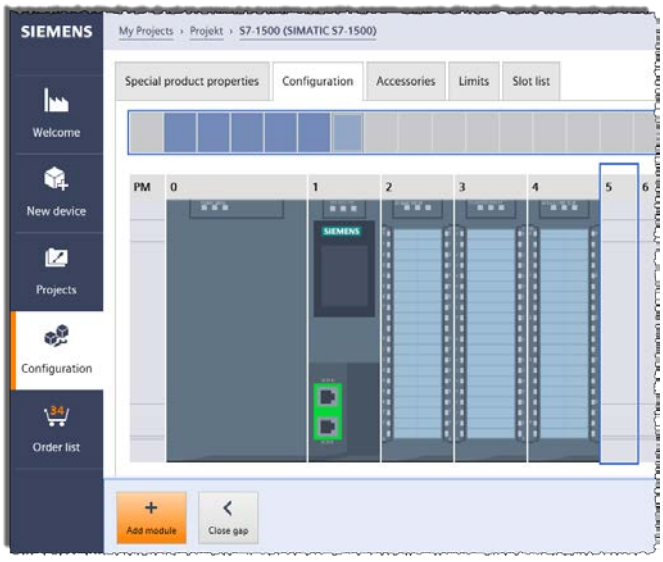
4.8.1. Selecting the Controller and the Modules

Manual: "SIMATIC S7-1500 / ET 200MP Automation system In a nutshell"



Entry ID: 109481357

Software: "TIA Selection Tool" (online or offline)



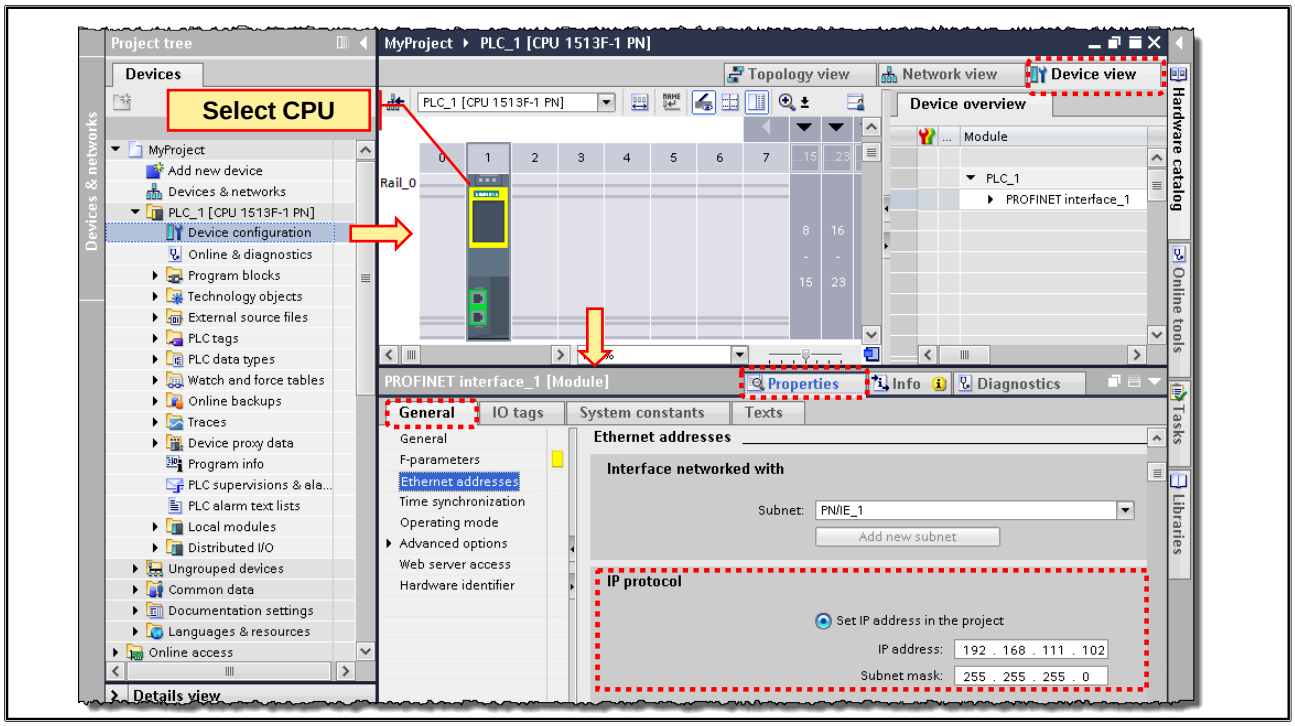
TIA Portal Information Center > Tools & Apps > Configurators

SIMATICS7-1500 provides you with a wide range of CPUs that can be integrated. You can expand each CPU with I/O modules, communication modules and technology modules. If, for example, the memory and performance of a CPU 1511-1 PN are sufficient for you, then you expand it with communication modules for PROFINET and PROFIBUS. For technology functions, technology CPUs and technology modules are available in addition to the Compact CPUs.

To select the correct controller there is the manual **"SIMATIC S7-1500 / ET 200MP Automation system In a nutshell"** which contains further useful guidelines. It can be found under the Entry ID: 109481357.

There is also the software **TIA Selection Tool** which provides an opportunity for selecting, configuring and ordering the devices for Totally Integrated Automation. After configuring the hardware in the TIA Selection Tool, you are given a list with all hardware components which are required (modules, plugs, cables, profile rails etc.).
In addition, the order via the Industry Mall can be started directly from the TIA Selection Tool.

4.8.2. CPU Properties: Ethernet Address

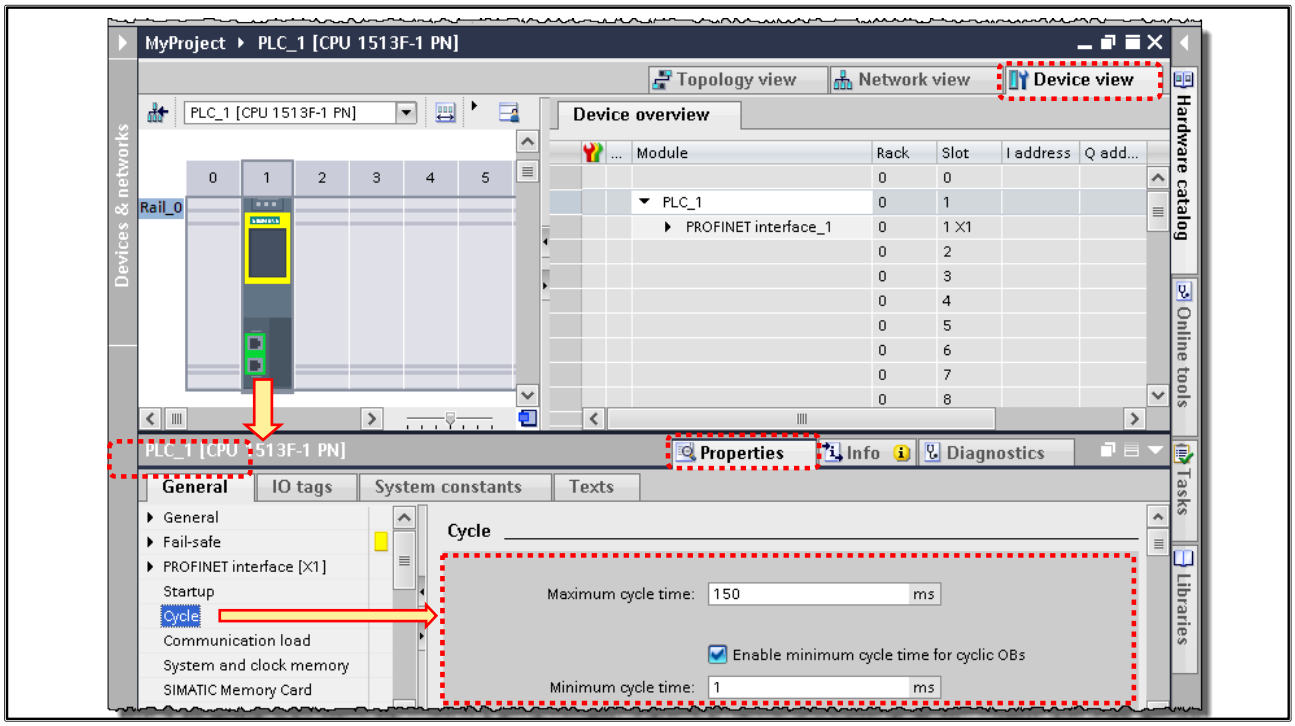


PROFINET Interface

Regardless of whether the editor is in the Device view or Network view, if the CPU is selected, the settings of the CPU PROFINET interface can be made in the Inspector window in the "Properties" tab.

If an online connection needs to be established between the programming device and CPU, both devices must be assigned the same subnet mask and the IP addresses must be located in the same subnet.

4.8.2.1. CPU Properties: Maximum Cycle Time



Cycle Time

This is the time that the CPU requires for one complete program execution, that is, one cycle. Since parts of the user program can also be processed conditionally and the program execution can also be interrupted (for example, by diagnostics interrupts, time interrupts, hardware interrupts etc.), the length of the cycle time is not the same in every cycle.

Maximum Cycle Time

The operating system monitors the runtime of the program for the configured upper limit.
If the runtime of the program is longer than the "Maximum cycle time" set here

- … the operating system calls the associated time error interrupt OB.
- … the operating system enters the event in the diagnostics buffer.
- … the operating system indicates the error on the error LED of the CPU.

Behavior when the maximum cycle time is exceeded:

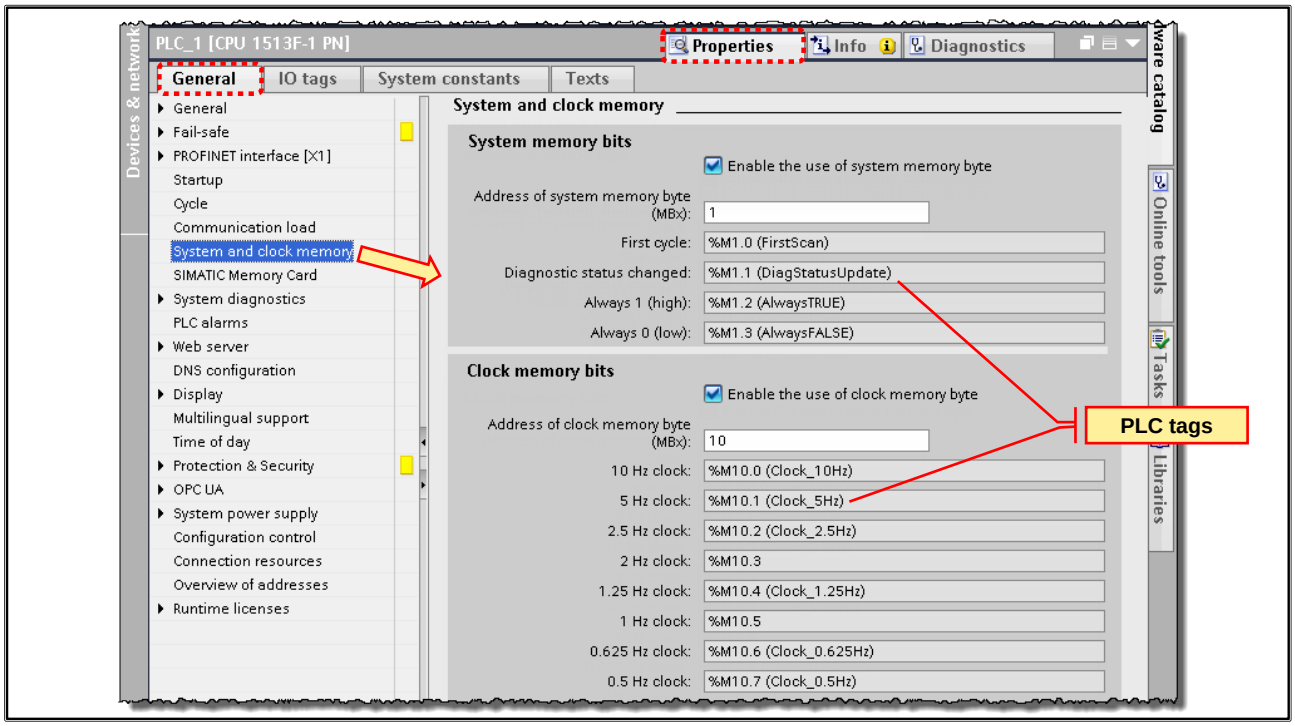
- **S7-1200:**
  The CPU remains in RUN mode even if no time error interrupt OB is programmed.
- **S7-1500:**
  If no time error interrupt OB is programmed, the CPU changes to STOP mode.

If the runtime of the S7-1200/1500 program is more than twice as long as the set maximum cycle time (2xMaxCycleTime error), the CPU changes to STOP mode without attempting to call the time error interrupt OB.
With the RE_TRIGR instruction, the monitoring of the cycle time can be retriggered or reset to 0.

Minimum Cycle Time

The minimum cycle time is the minimum time that should pass for the one-time execution of the cyclic user program and the updating of the associated I/O. The start of the next CPU cycle is delayed if this time has not yet expired.

4.8.2.2. CPU Properties: System and Clock Memory



A PLC tag is automatically created for each available system or clock memory bit.

System Memory (4 bits)

These are memory bits that provide system status information.

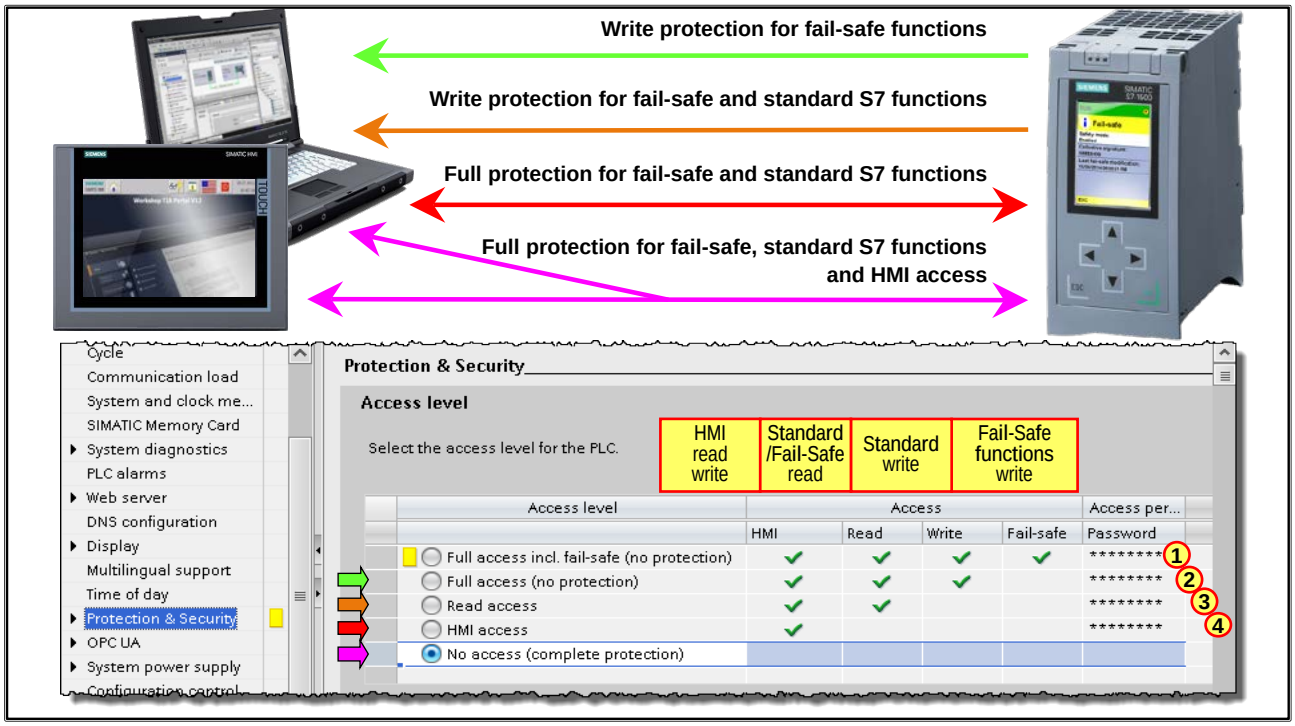
- "FirstScan" =1 in the first CPU cycle; otherwise =0,
- "DiagStatusUpdate" =1, if the diagnostic status has changed,
- One static 1-memory bit and 0-memory bit each ("AlwaysTRUE", "AlwaysFALSE"),

Clock Memory (8 bits)

These are memory bits whose binary state is changed periodically by the operating system of the CPU with a pulse-pause ratio of 1:1. The various frequencies are shown in the picture.
Clock memory (bits) is used to trigger actions periodically.
For example, to make an indicator light flash

Attention!
Clock memory (bits) are not synchronized with the CPU cycle; in other words, with long cycle times, the state of the clock memory (bits) can change more than once within one cycle.

4.8.2.3. CPU Properties: Password Protection



Protection Levels

With the following protection levels, the access rights (read / write) of the programming device to the CPU are specified:

- Full access incl. fail-safe (no protection): → Default setting for F-CPU
  Read and write access is always permitted.
- Full access (no protection): → Default setting for non-F-CPU
  Read access is always permitted, write access only to standard program.
- Read access: → Write protection
  Read-only access possible. No data can be changed in the CPU and no blocks or modified hardware configuration or parameter assignment can be downloaded to the CPU without specifying a password.
- HMI access: → Write and read protection for STEP 7
  No write or read access is possible from the engineering. Only the CPU type and identification data can be displayed in the Project tree under "Accessible devices". It is not possible to display online information or blocks under "Accessible devices" without entering a password.
- No access (complete protection): → General write and read protection for STEP 7 and HMI. Now, access for HMI devices without a configured password in the connection is also not possible.

Access Permitted through Passwords

In the example shown, "No access (complete protection)" is selected. This means that without a password, STEP 7 and HMI devices can neither read-access nor write-access the CPU.

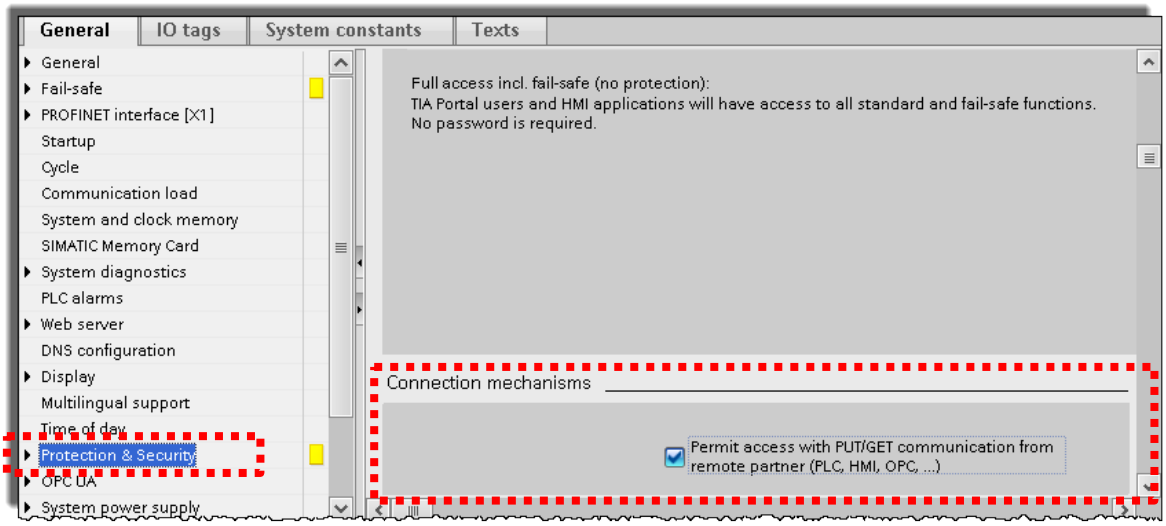
The above explained protection levels can, however, be lifted again with passwords:

- By specifying a password (4) an HMI device can once again read-access and write-access the CPU. For STEP 7, however, neither read-accesses nor write-accesses are possible.
- By specifying a password (3) an HMI device can once again read-access and write-access the CPU and for STEP 7, only read-accesses are permitted, not write-accesses.
- By specifying a password (2) read-accesses and write-accesses of the standard program of the CPU are possible for both an HMI device as well as for STEP 7.

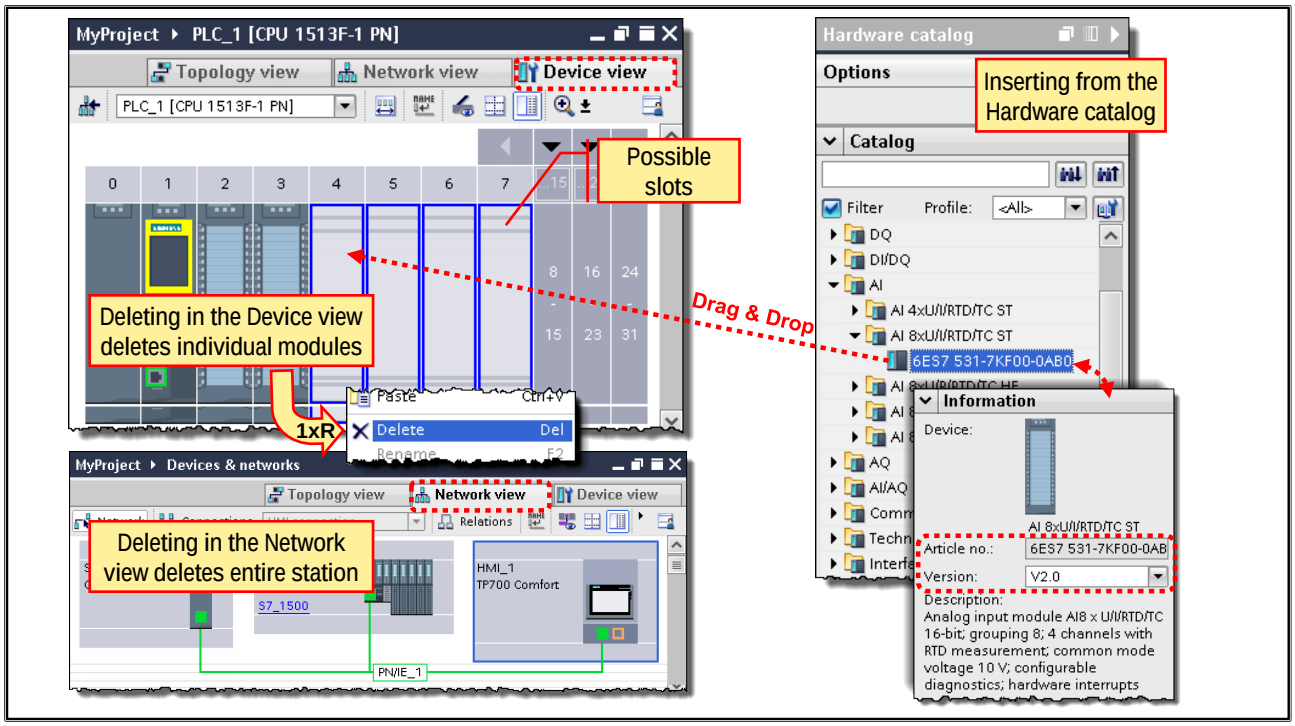
- By specifying a password (1) read-accesses and write-accesses of the CPU are possible for both an HMI device as well as for STEP 7.

Permitting Access by Means of PUT/GET Communication:

- So that other controllers can access the CPU by means of PUT and GET functions, this must be permitted in the Settings of the CPU under Protection & Security > Connection mechanisms.



4.8.3. Inserting / Deleting a Module



Inserting a Module

Modules can be inserted using drag & drop or by means of a double-click.

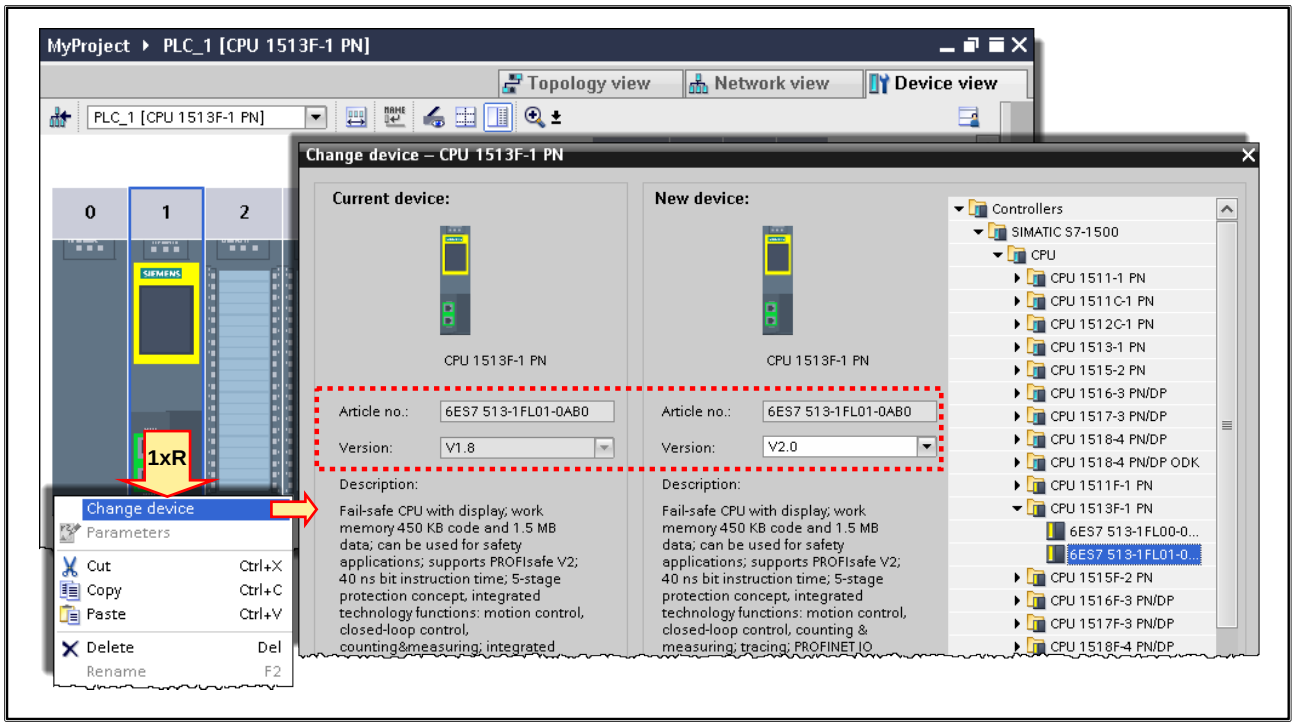
Selecting a Version

When selecting a module, you must pay attention to the correct version. If the module is selected (highlighted) in the task card "Hardware catalog > Catalog", the version can be selected in the task card "Hardware catalog > Information".

Deleting a Module

Deleted hardware components are removed from the system and assigned addresses are made available again.

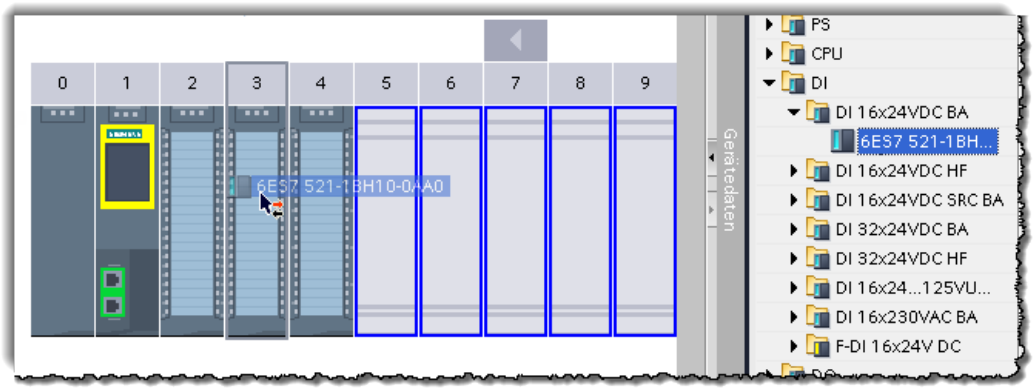
4.8.4. Changing a Device / Module



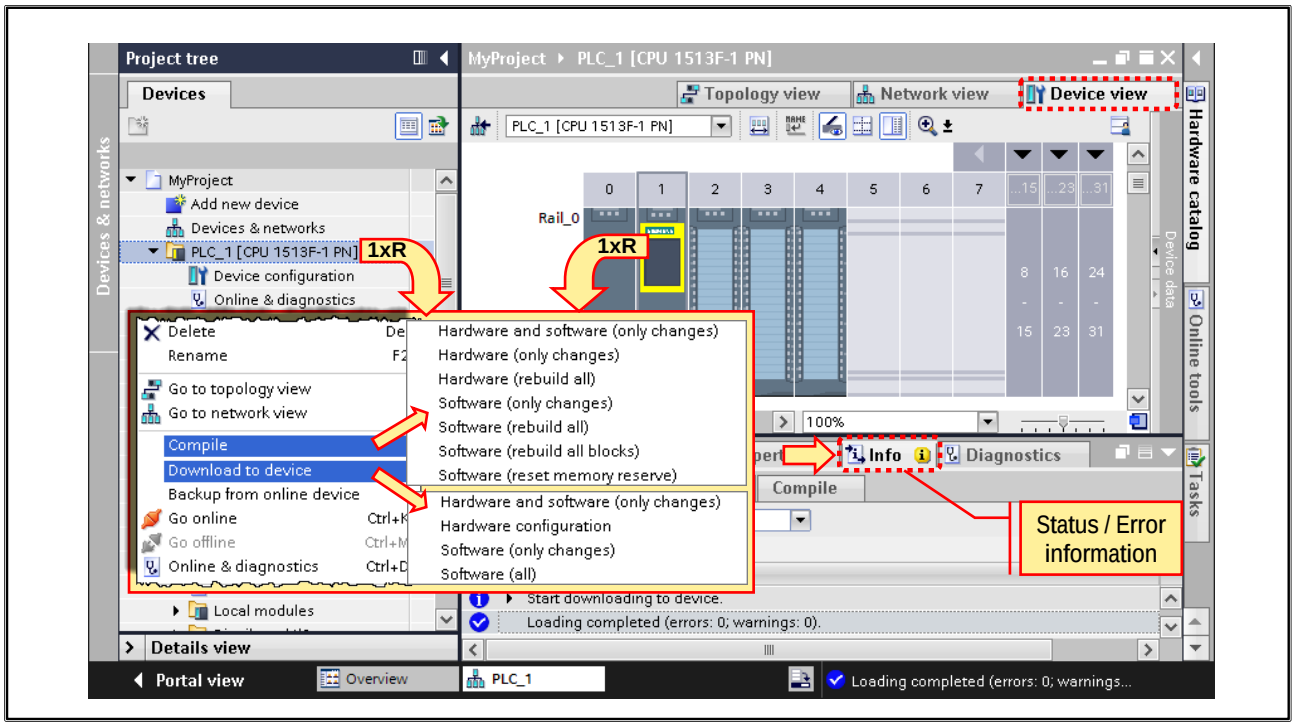
Changing a Module

Compared to deleting and then inserting a new module, the advantage of changing is that when a module is changed (replaced), all the parameters of the old module are adopted on the new module. A module exchange can, for example, then be necessary when the CPU version in the offline project is to be adapted to the CPU version (online) following a firmware update. Hardware components can only be exchanged if the components are compatible.

It is also possible to change a device by dragging the new module from the Hardware catalog onto the old module using drag & drop.



4.8.5. Compiling the Hardware / Software and Downloading it into the CPU

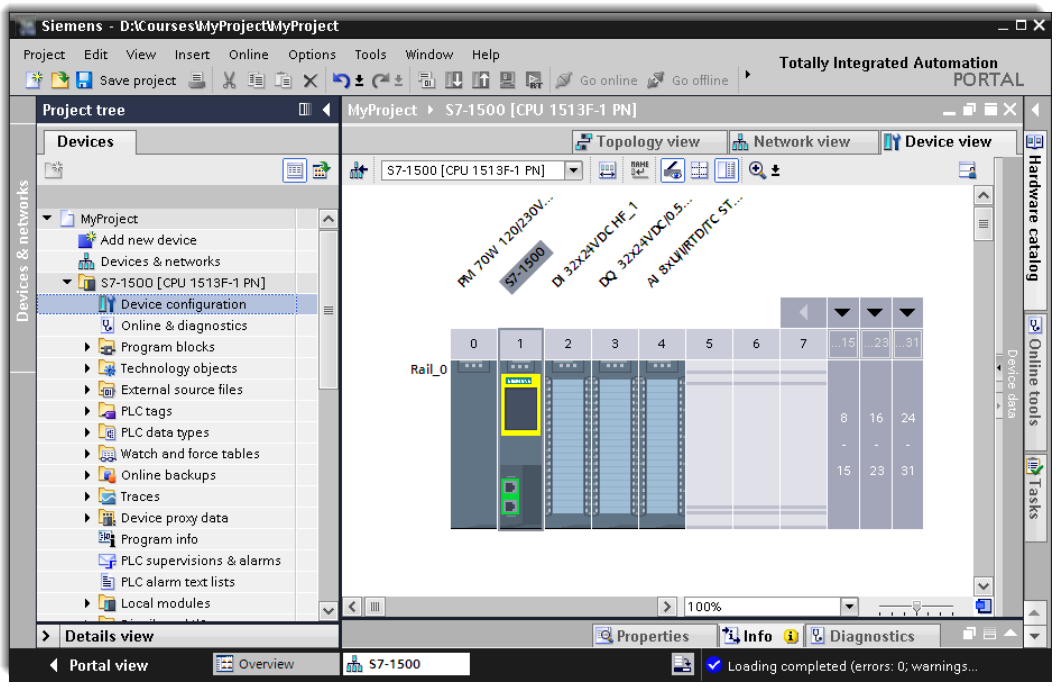


Compiling / Downloading the Hardware Configuration

The following components of a hardware station can be compiled and downloaded:

- Hardware and software (only changes)
  All changes to the hardware configuration and hardware parameter assignment as well as all changes to the user program are compiled/downloaded.
- Hardware (only changes) / Hardware configuration
  Only the changes are compiled/downloaded,
- Hardware (rebuild all)
  The entire hardware configuration and hardware parameter assignment is compiled/downloaded.

4.9. Task Description: Creating a Project with an S7-1500 Station



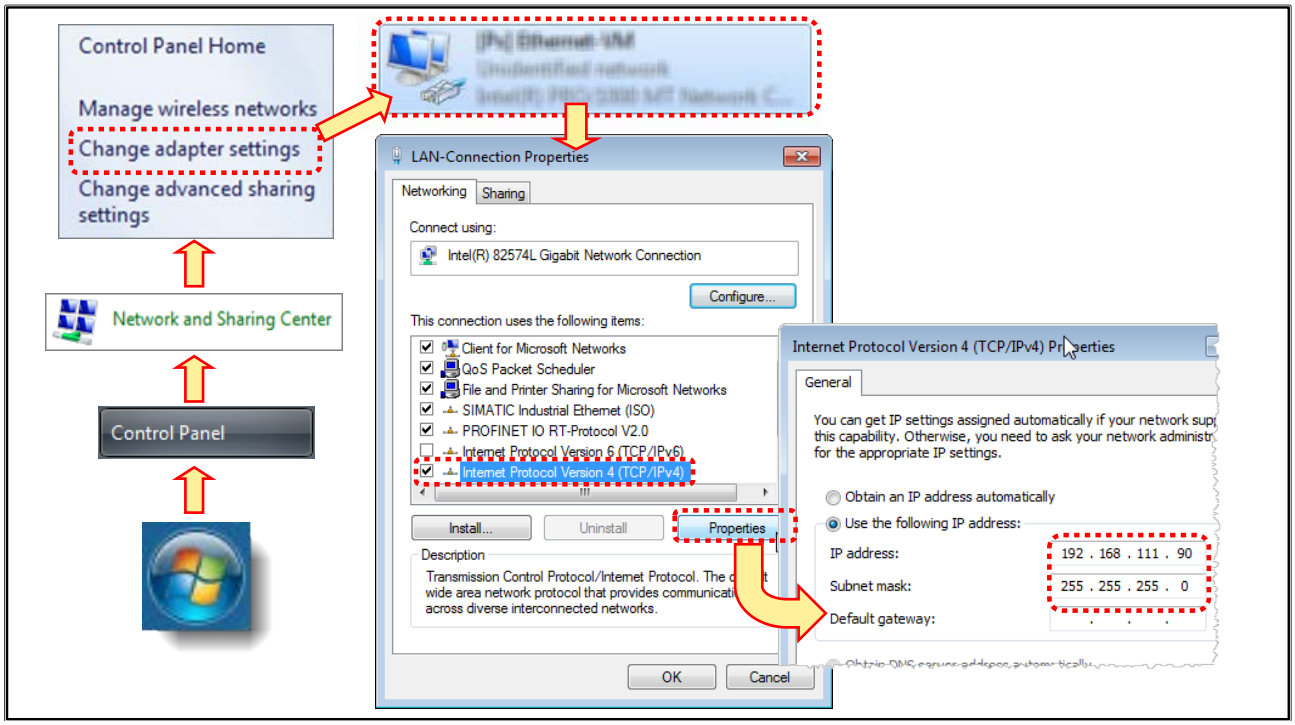
Task Description:

A new project with the name "MyProject2" is to be created. It is to contain an S7-1500 station whose configuration is to correspond exactly to that of your training device.

Furthermore, the modules are to be assigned parameters and the input and output addresses are to be set so that they match those specified in the chapter "Training Devices".

4.9.1. Exercise 1: Setting the IP Address of the PG

PG with Windows 7



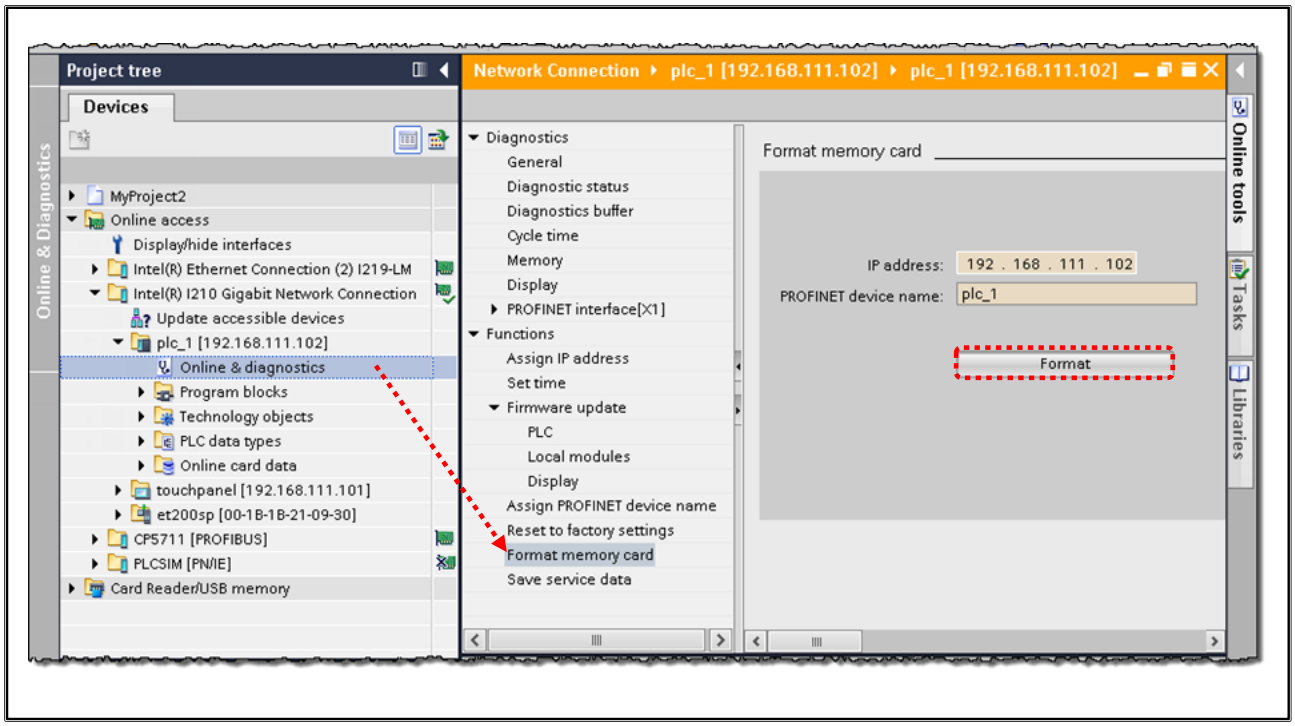
Task

You are to set the IP address of the Ethernet interface of the PG.

What to Do:

1. Connect the Ethernet interface of the PG to the "P2" connection on the training device using an Ethernet cable.
2. Assign the IP address 192.168.111.90 and the subnet mask 255.255.255.0 to this PG interface. Proceed as shown in the picture.

4.9.2. Exercise 2: Erasing the SIMATIC Memory Card of the CPU



Task

In order to completely erase the CPU, the SIMATIC Memory Card of the CPU must also be erased. This can be carried out as follows:

- with the Windows Explorer (SMC is inserted in the PG's Card Reader)
- with the TIA Portal (SMC is inserted in the PG's Card Reader)
- with the TIA Portal (SMC is inserted in the CPU)

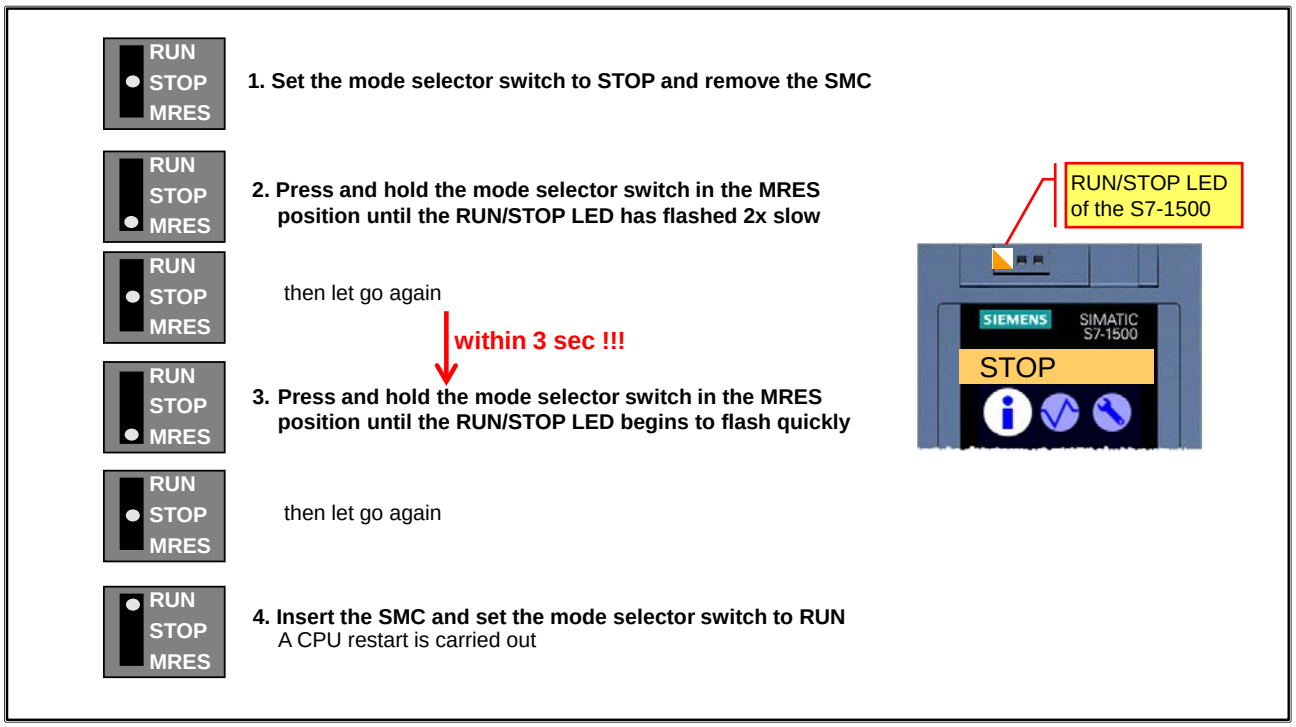
What to Do:

1. Check whether the SMC is inserted in the CPU.
2. In the Project view, under the interface through which there is a connection to the controller, display all "Accessible devices"
3. Under the S7-1500 station, activate "Online & diagnostics" (see picture)
4. There under "Functions", activate "Format memory card" (see picture)

Note

If a password is stored on the CPU that is unknown to you, it is only possible to erase the SMC if it is inserted in the PG's Card Reader.

4.9.3. Exercise 3: Resetting the CPU to Factory Settings using the Mode Selector Switch



Task

In the last exercise you erased the SMC of the CPU. Now, you are to reset the CPU to its factory settings using the mode selector switch.

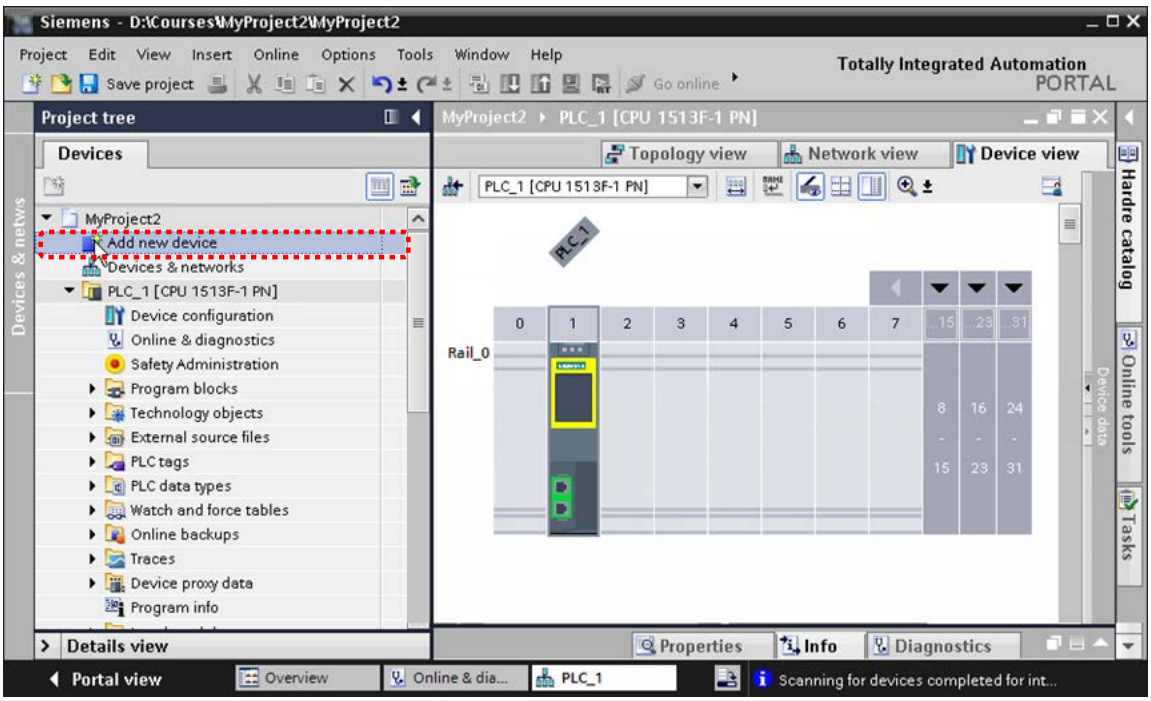
What to Do

1. Switch the CPU to STOP and remove the SMC.
2. Carry out the reset to factory settings directly on the CPU following the steps shown in the picture.

Note:

A CPU restart is not yet possible since no program (Organization Block) has been loaded.

4.9.4. Exercise 4: Creating a New Project and Adding a New Device (Controller)



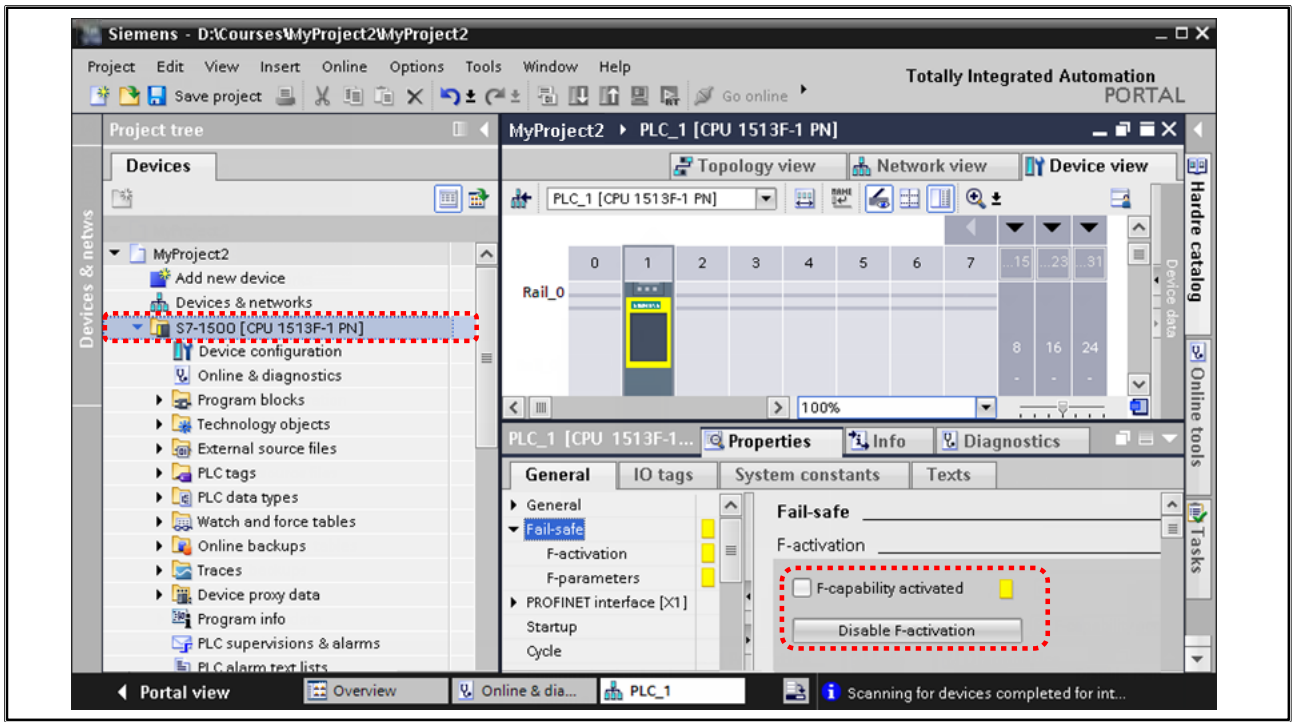
Task

You are to create a new project with the name "MyProject2" and you are to add a new device.

What to Do

1. Save your current project.
2. Create a new one and give it the name "MyProject2".
3. Add the controller off-line which corresponds to your training device as a new device.
   (In Exercise 1 of Chapter 2 "System Overview", you already read out the required information via the Display and made a note of it.)

4.9.5. Exercise 5: Changing the Device Name and Disabling the F-activation



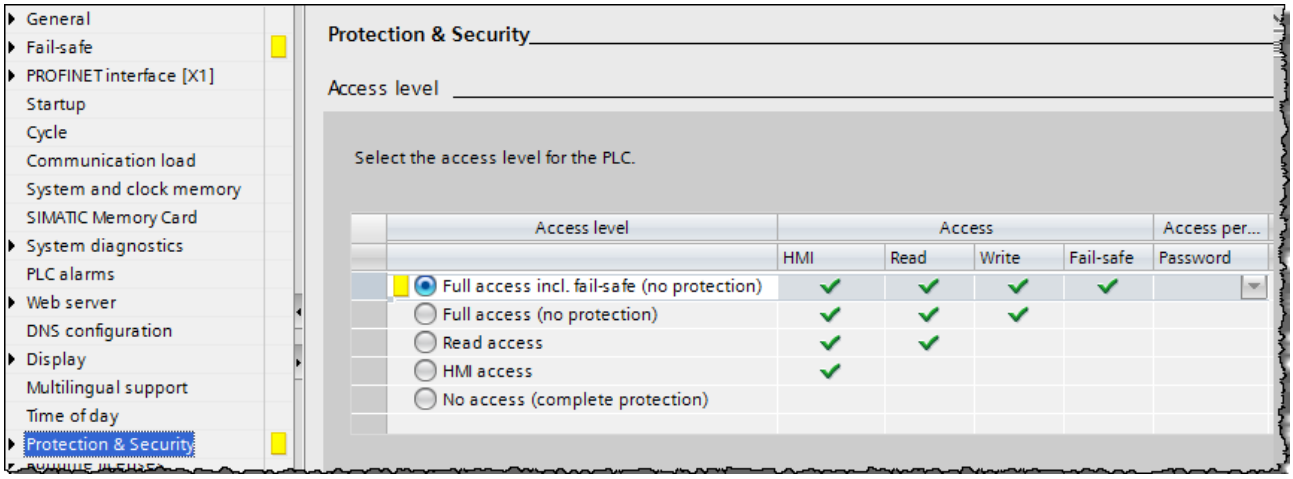
Task

You are to change the device name of the CPU and disable the F-activation.

What to Do

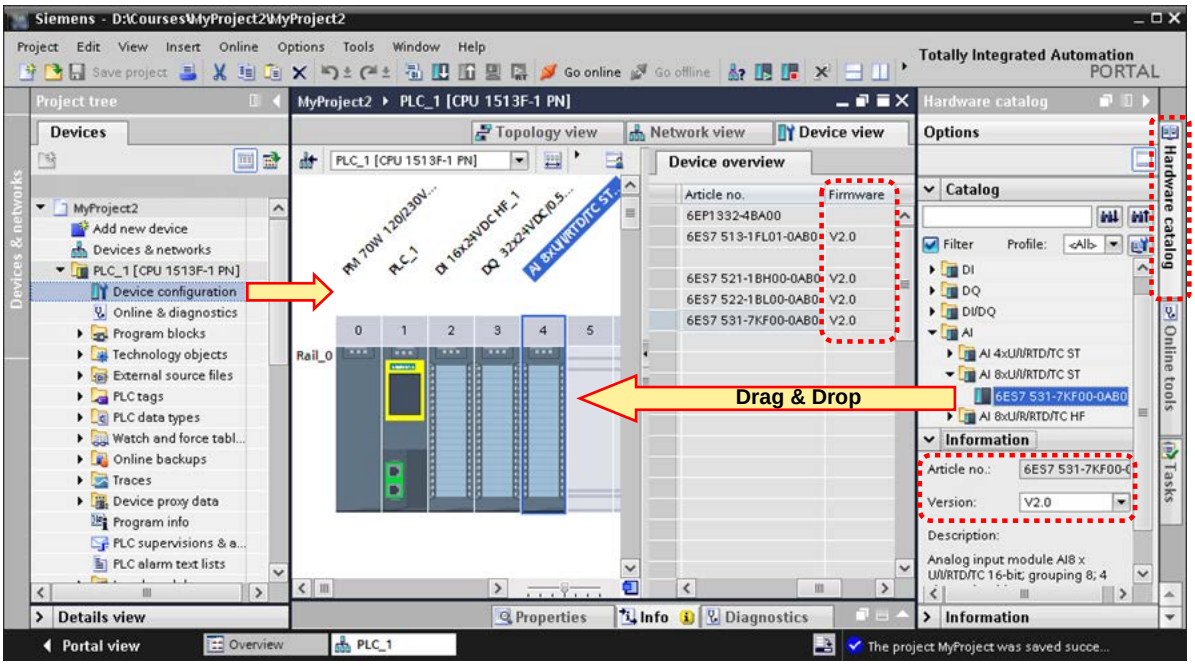
1. Select (highlight) the controller in the Project tree and rename it S7-1500.
2. Open the Device view and the Properties of the CPU in the Inspector window.
3. In the "Fail-safe" menu, deactivate the F-capability.

   Result: The folder "Safety Administration" is no longer visible in the Project tree.
4. Switch to the **"Protection & Security"** folder and activate the protection level **"Full access incl. fail-safe (no protection)"** (see picture below).



5. Save your project.

4.9.6. Exercise 6: Configuring the S7-1500 Station



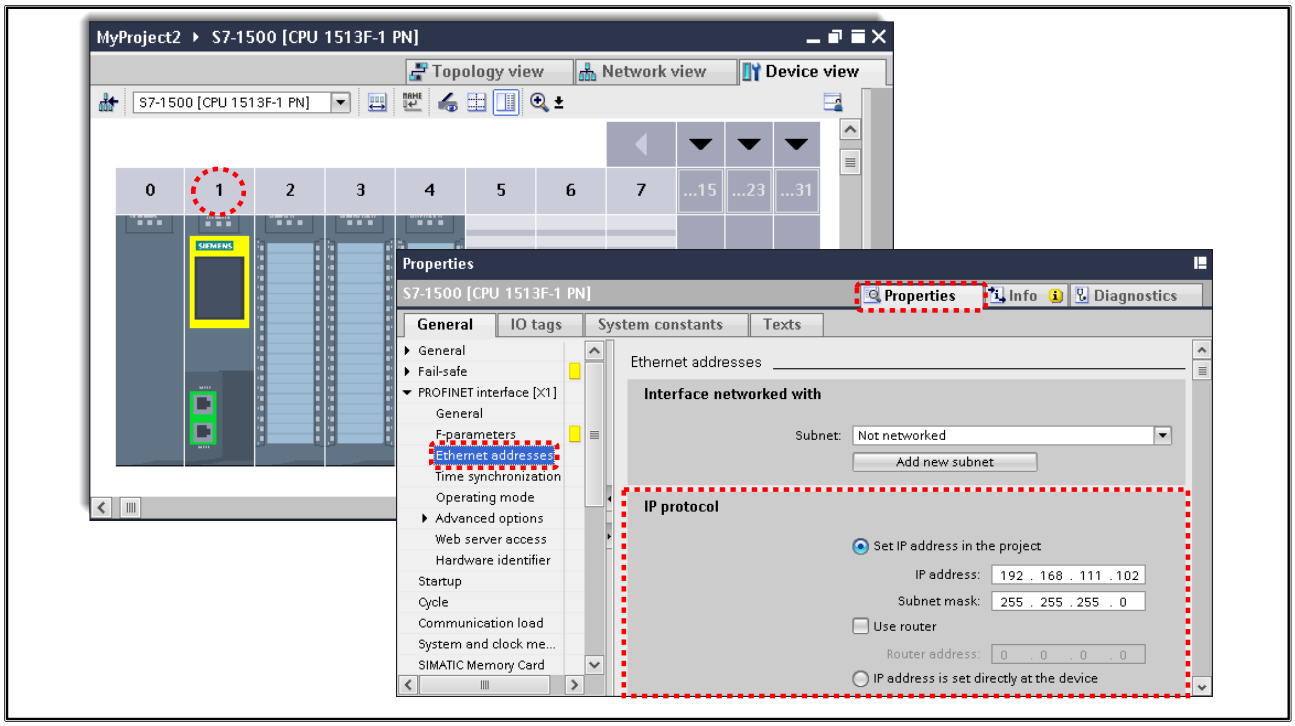
Task

In your offline project, you are to configure the S7-1500 station in such a way that the module arrangement matches that of your actual training device.

What to Do

1. In slots 2 to 4, add the I/O modules from the "Hardware catalog" task card using drag & drop. (In Exercise 1 of Chapter 2 "System Overview", you already read out the required information via the Display and made a note of it.)
2. Insert the appropriate power module from the Catalog into Slot 1.
3. Save your project.

4.9.7. Exercise 7: CPU Properties: IP Address



Task

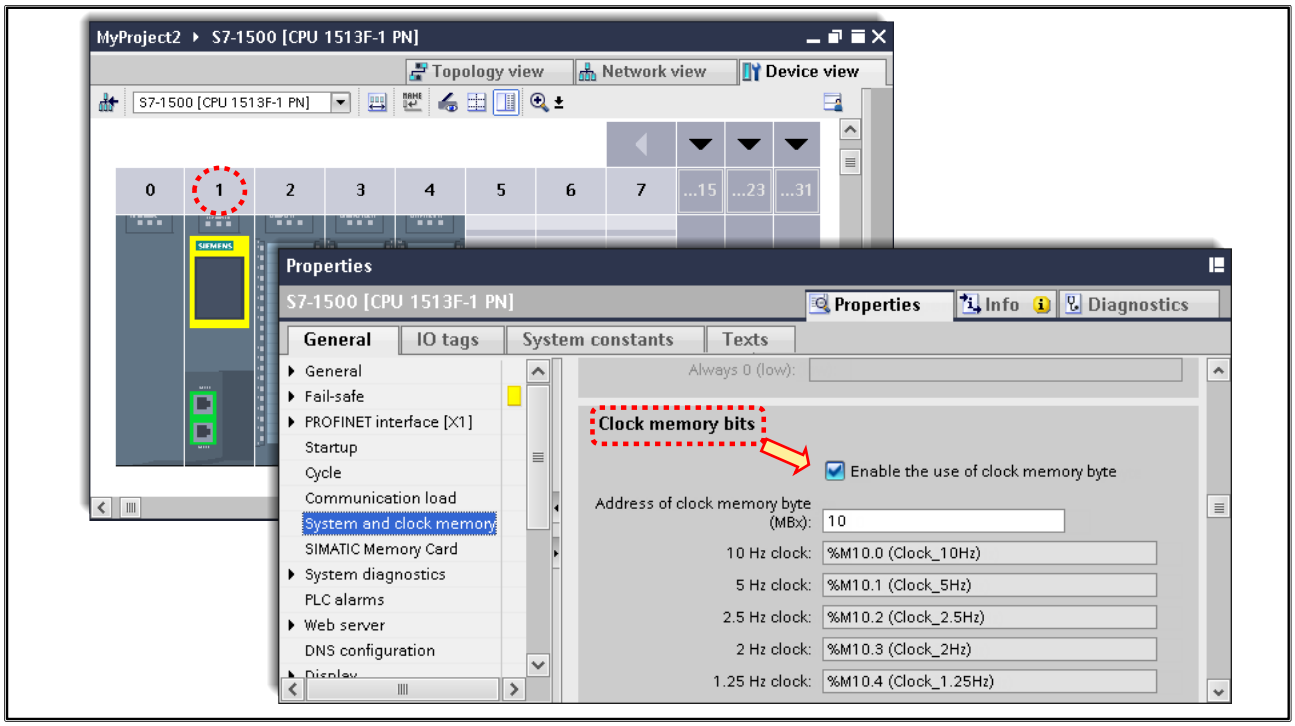
The S7-1500 CPU is to be assigned an IP address offline in the project.

For PROFINET-IO Controllers, a device name is not absolutely necessary. For IO-Devices, it is required for the device identification by the IO-Controller.

What to Do

1. In the "Device view", select the CPU.
2. In the Inspector window under "Properties", select the folder "PROFINET interface [X1] > Ethernet addresses". Enter the IP address and the subnet mask shown in the picture.
3. Save your project.

4.9.8. Exercise 8: CPU Properties: Parameterizing the Clock Memory Byte



Task

In the CPU Properties, you are to parameterize memory byte 10 as a clock memory byte.

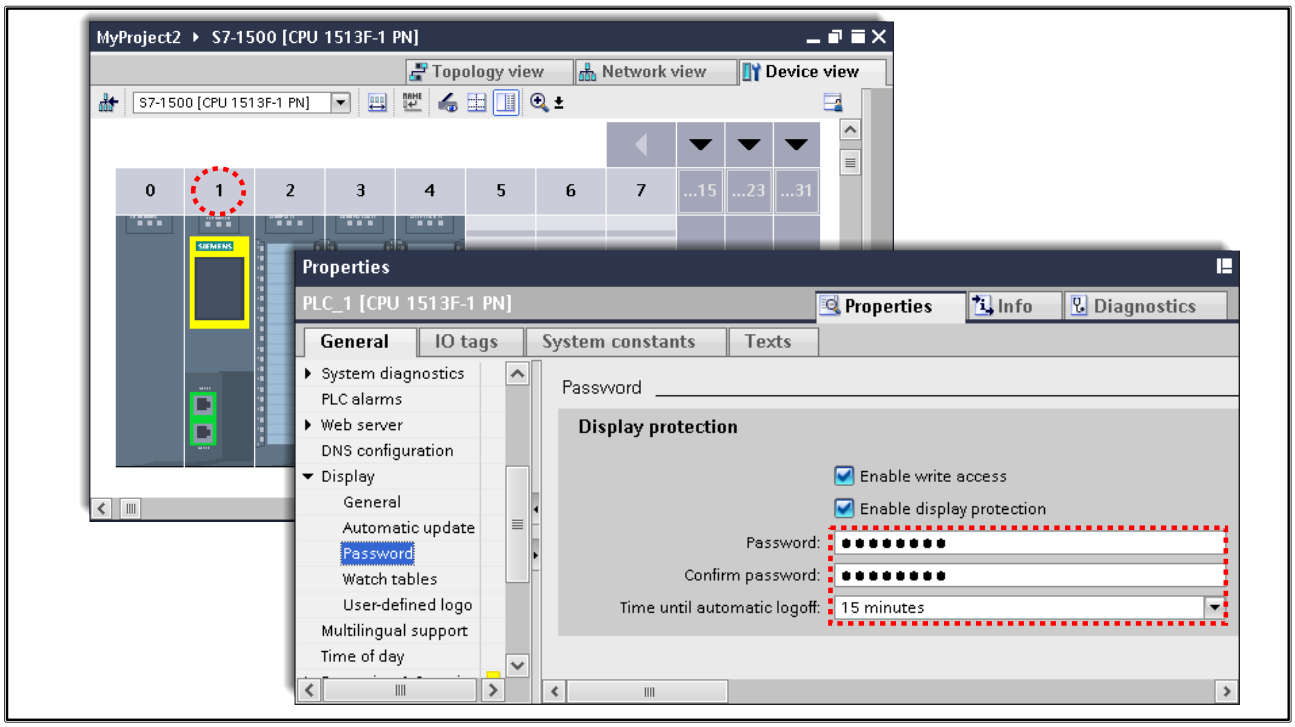
What to Do

1. In the "Properties" tab, select the folder "System and clock memory ".
2. Enable the clock memory (byte) and specify address 10 for the byte address.
3. Save your project.

Note:

Only the Clock memory and not the System memory is required. For that reason, deactivate the System memory byte.

4.9.9. Exercise 9: CPU Properties: Display Language and Display Protection



Task

In the CPU Properties, you are to parameterize the display language of the CPU-Display and the display protection.

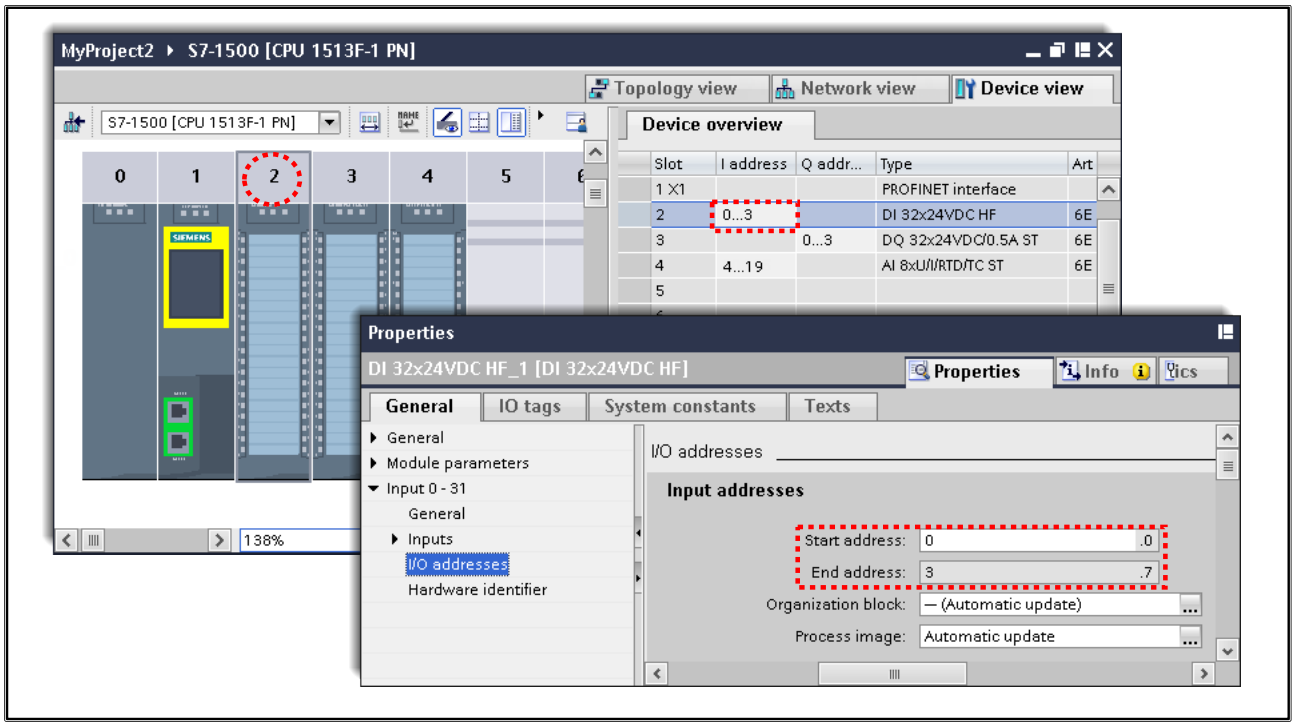
What to Do

1. In the "Properties" tab under "Display > General", select the item Display language and set the display language to "English".
2. In the Password menu, enable the display protection.
3. Enter a password.
4. Save your project.

Note on Password Assignment:

Upper and lower case is not relevant, since only the letters A to Z and digits 0 to 9 can be selected when making entries on the Display.
Since there is no Display keypad, it is recommended for this exercise that you select a simple (possibly only numerical) password.

4.9.10. Exercise 10: Addresses of the DI Module



Task

You are to parameterize the I/O addresses of the DI module as shown in the picture.

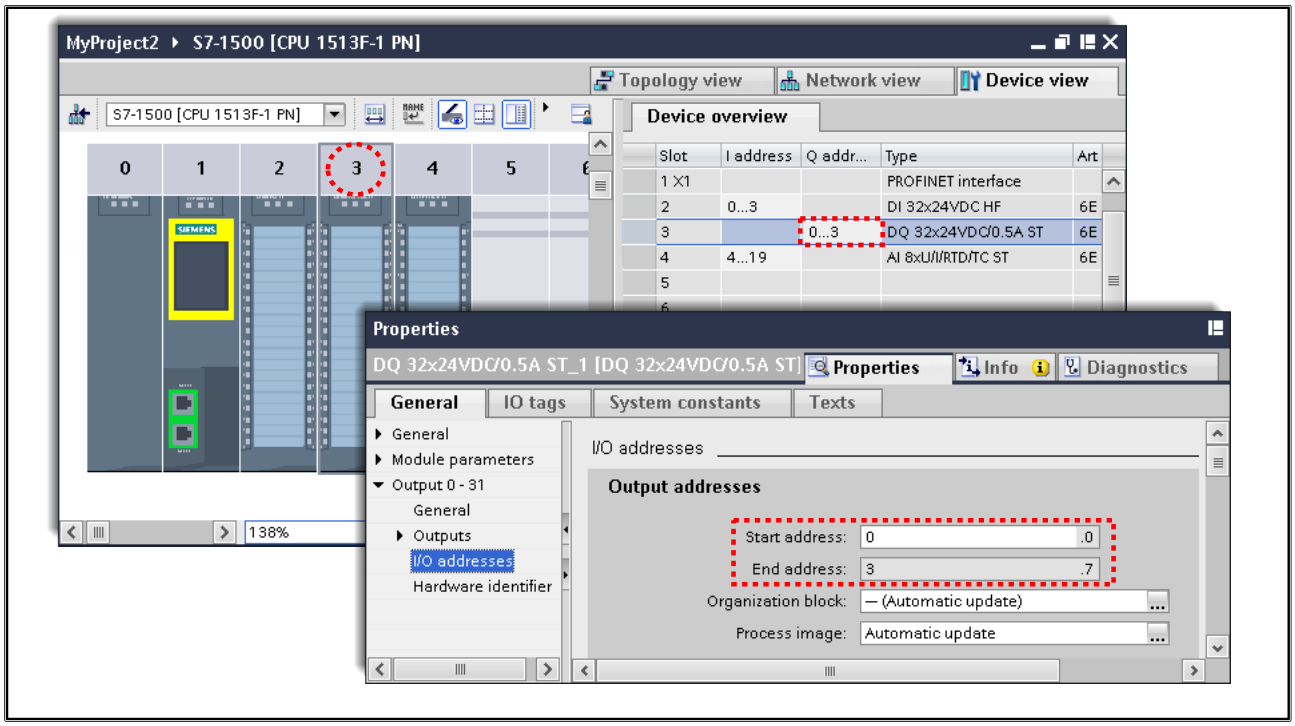
What to Do

1. In the Device view, select the DI module (see picture).
2. In the Inspector window, in the "Properties > General" tab, go to the point "Input 0 - 31 > I/O addresses".
3. Enter the I/O address 0 shown in the picture, (this can also be done in the tabular area of the Device view, see picture)
4. Set the update of the Process image to Automatic so that the address is automatically updated by the system in every program cycle.
5. Save your project.

Notes:

1. The 1500 CPU offers the possibility of using up to 31 process image partitions. "PIP 1" to "PIP 31" process image partitions can be assigned to certain Organization Blocks. After the OB is started, the assigned process image partition for the inputs is updated by the system. At the end of the OB, the outputs of the assigned process image partition are written to the I/O outputs by the system. The process image partitions are excluded from the automatic update.
2. A process image partition can be updated in the user program with special instructions. For this, there are the functions "UPDAT_PI" for the process image partition of inputs and "UPDAT_PO" for the process image partition of outputs.

4.9.11. Exercise 11: Addresses of the DO Module



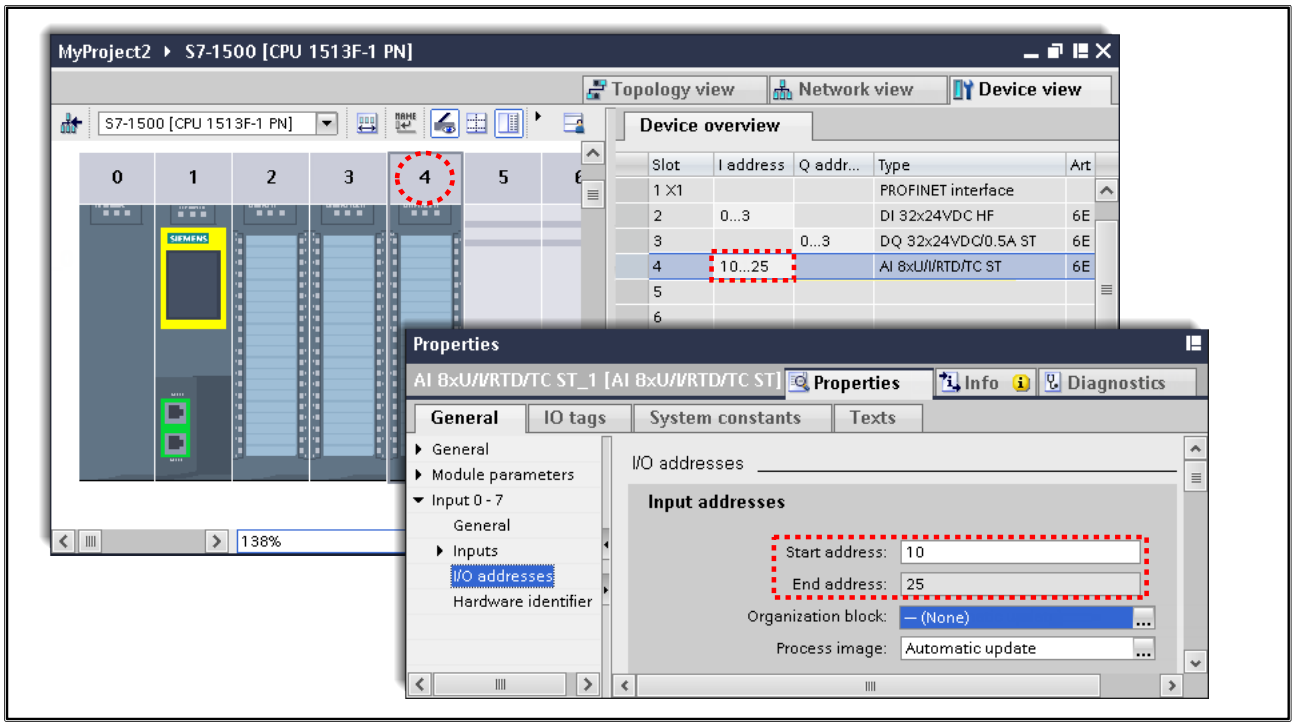
Task

You are to parameterize the I/O addresses of the DO module as shown in the picture.

What to Do

1. In the Device view, select the DO module (see picture).
2. In the Inspector window, in the "Properties > General" tab, go to the point "Output 0 - 31 > I/O addresses".
3. Enter the I/O address 0 shown in the picture and set the update of the Process image to Automatic.
4. Save your project.

4.9.12. Exercise 12: Addresses of the AI Module



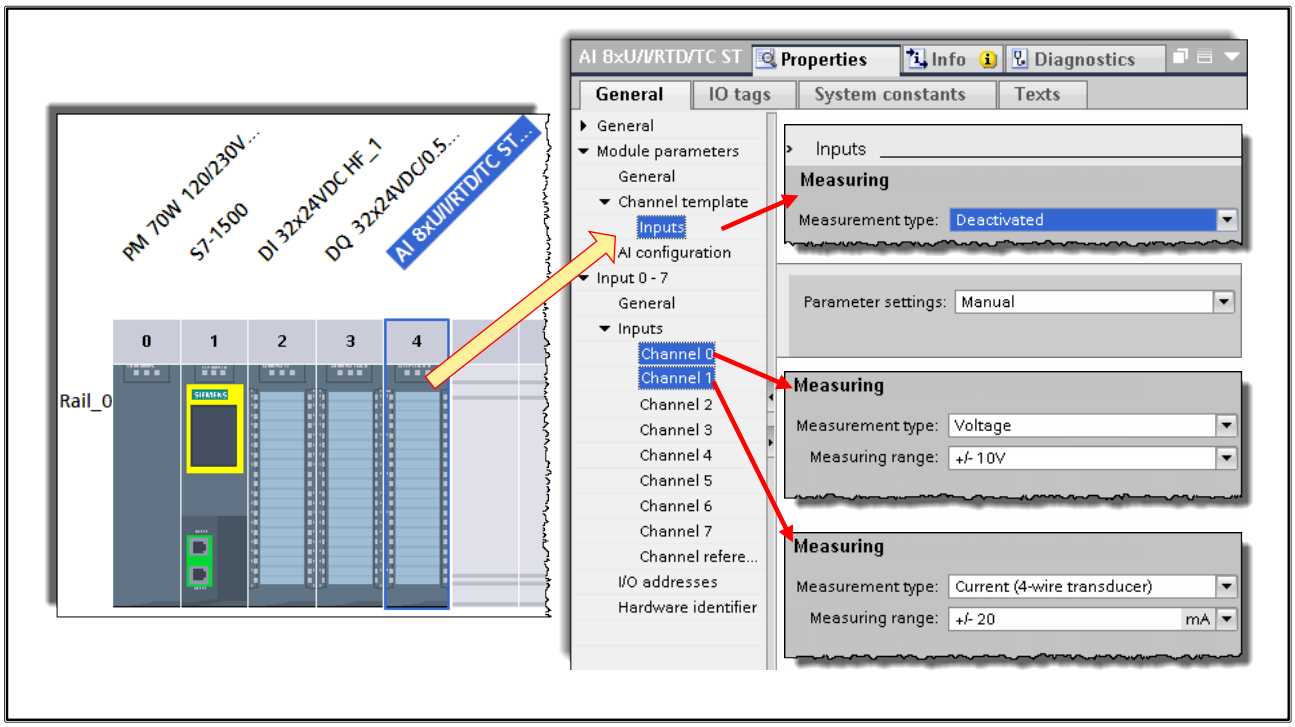
Task

You are to parameterize the I/O addresses of the AI module as shown in the picture.

What to Do

1. In the Device view, select the AI module (see picture).
2. In the Inspector window, in the "Properties > General" tab, go to the point "Input 0 - 7 > I/O addresses".
3. Enter the I/O address 10 shown in the picture.
4. In the assignment of the process image, set "None" since the analog value of the module is to be read directly by the I/O later in the program and thus does not have to be updated with any process image.
5. Save your project.

4.9.13. Exercise 13: Setting the Channel Parameters of the Analog Input Module



Task:

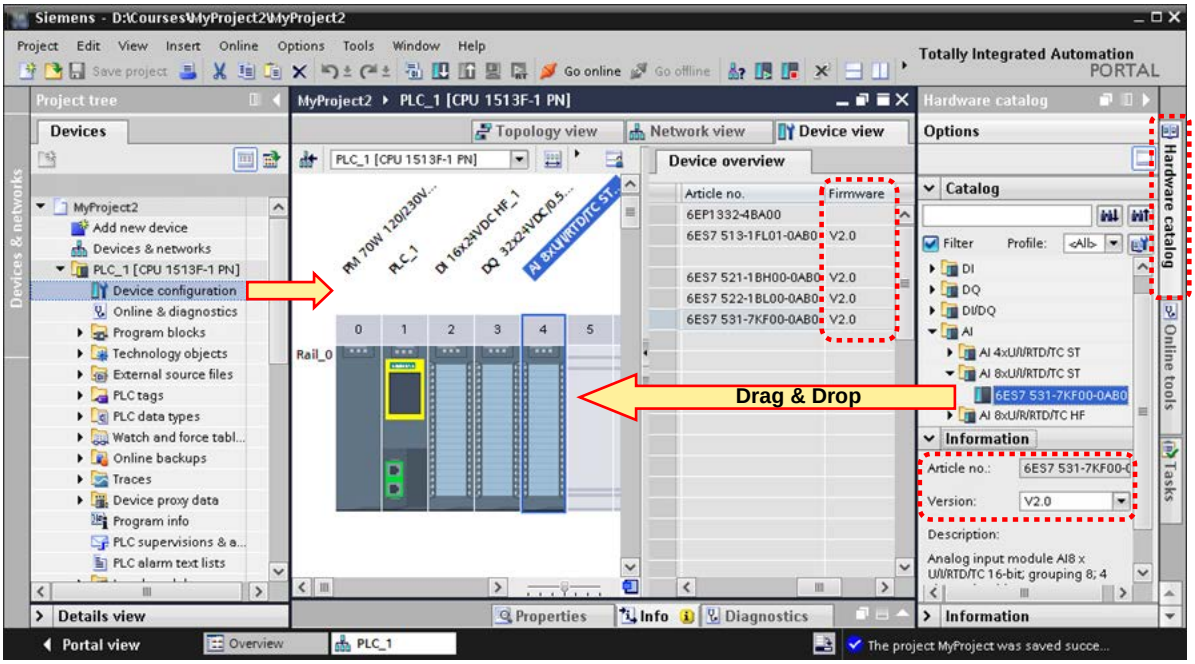
You are to set the analog channels to the appropriate parameters:

- Set the Channel template (Measurement type) to ‘Deactivated’
- Channel 0 → Voltage +/-10V
- Channel 1 → Current (4-wire transducer) +/-20 mA

What to Do

1. In the Inspector window, in the "Properties > Module parameters" tab, go to the point "Channel template > Inputs" and set Measurement type ‘Deactivated’ as the template.
2. Under "Properties > Input 0 - 7 > Inputs" set the Measurement type "Voltage" +/-10V for Channel 0 and for Channel 1 set the Measurement type "Current (4-wire transducer)" +/-20 mA.
3. Save your project.

4.9.14. Exercise 14: Compiling the Device Configuration and Downloading it into the CPU



Task

You are to compile the configuration and parameterization of the S7-1500 hardware station and then download it into the CPU.

Note:

As long as the CPU doesn't have a program, the CPU does not go into RUN mode when there is a restart! That is, if, as shown in the picture, you only download the hardware configuration into the CPU in this exercise, the CPU will not switch into the RUN mode with a subsequent restart!

What to Do

1. In the Project view, select your S7-1500 station.
2. Compile the HW-Station (right-click on the station, see picture)
3. After an error-free compilation, download the hardware configuration into the CPU (right-click on the station, see picture)

Note: When using the buttons shown here to the left, a Delta compilation or Delta download of the folder(s) and subfolder(s) selected in the Project tree is always carried out. That is, if a station (CPU) is selected, a Delta compilation or Delta download of the entire station, (hardware and software) is carried out.

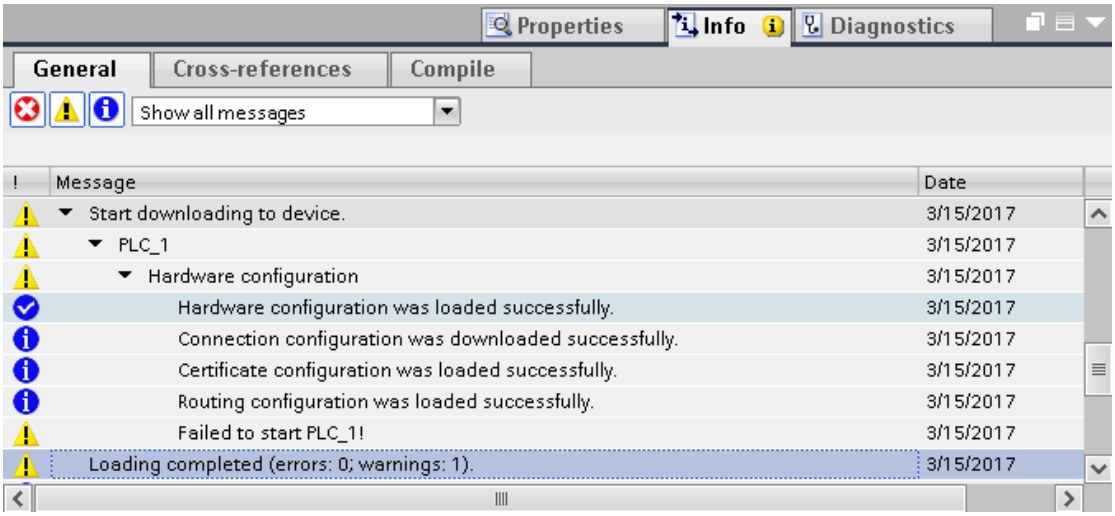
Continued on the next page

4. Confirm the information in the dialog by pressing the button "Load":

5. After you have activated "Load", another dialog appears which you fill-in as follows and then conclude with "Finish":

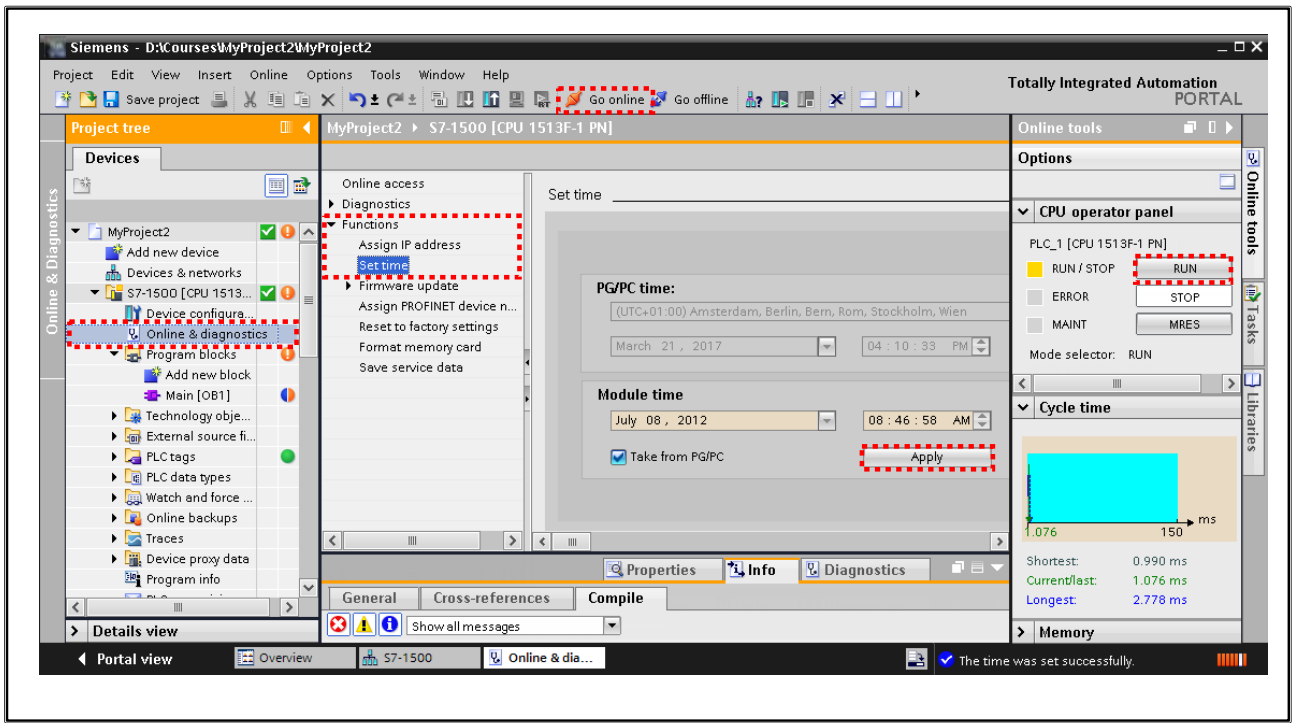
If you have only downloaded the hardware configuration into the CPU, the CPU should now remain in the STOP mode.

6. In the "Inspector window" under "Info -> General" check the result of the hardware configuration download:



7. Save your project.

4.9.15. Exercise 15: Setting the Time and Trying to Switch the Controller to RUN Mode



Task

By means of the TIA Portal, you are to set the time on the controller and try to start the controller.

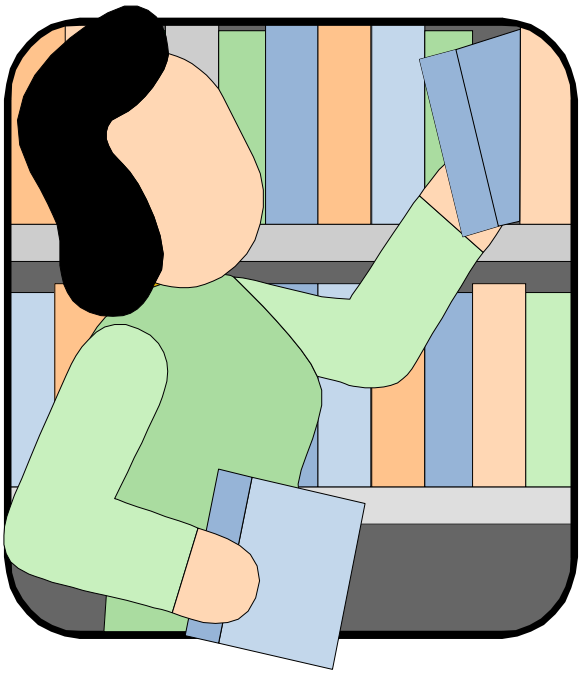
What to Do

1. Open the Online access of the S7-1500 CPU via the object "Online & diagnostics" in the Project tree.
2. Establish an online connection to the controller via the button "Go online" (The "Go online" button is located in the toolbar and in the ‘Online access’ window opened in the working area).
3. In the ‘Online access’ window, switch to the menu "Functions > Set time".
   (The PG/PC time and the Module time can be seen.)
4. Adopt the PG/PC’s time by activating the item "Take from PG/PC" and confirm with the "Apply" button.

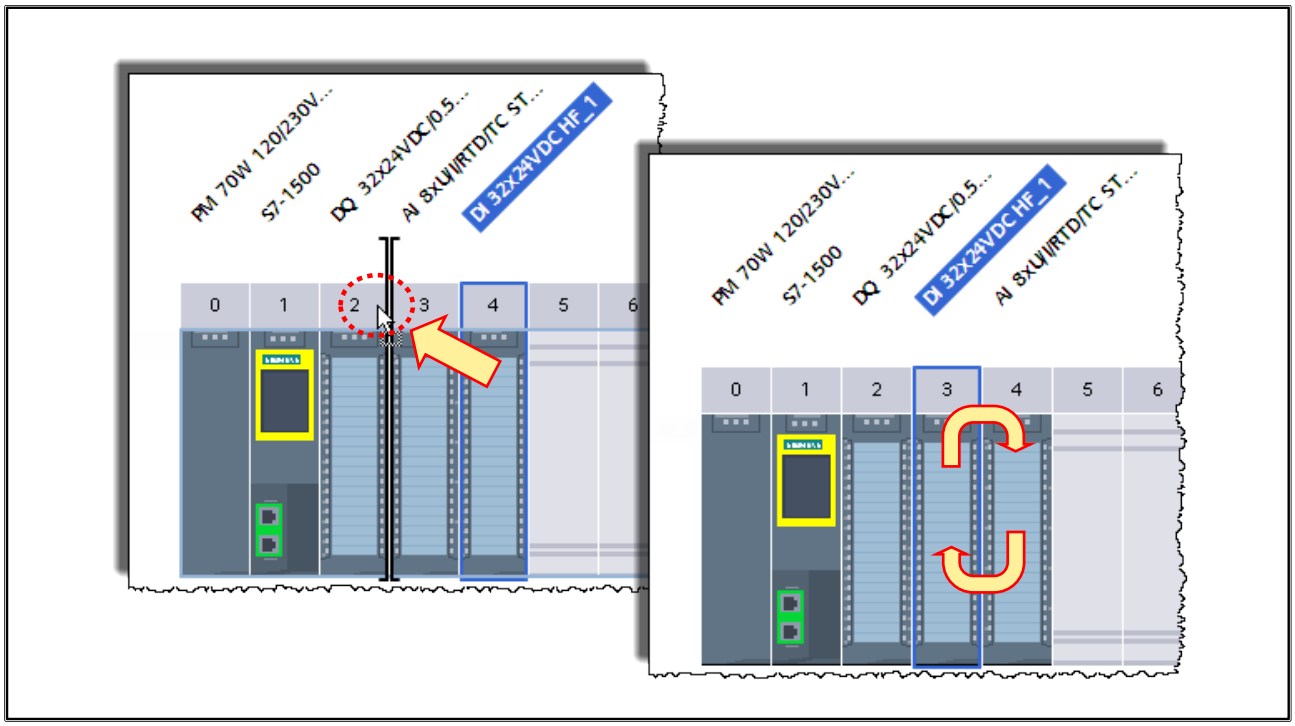
Note:

If the item "Take from PG/PC" is deactivated, the module time can be manually changed.

4.10. Additional Information



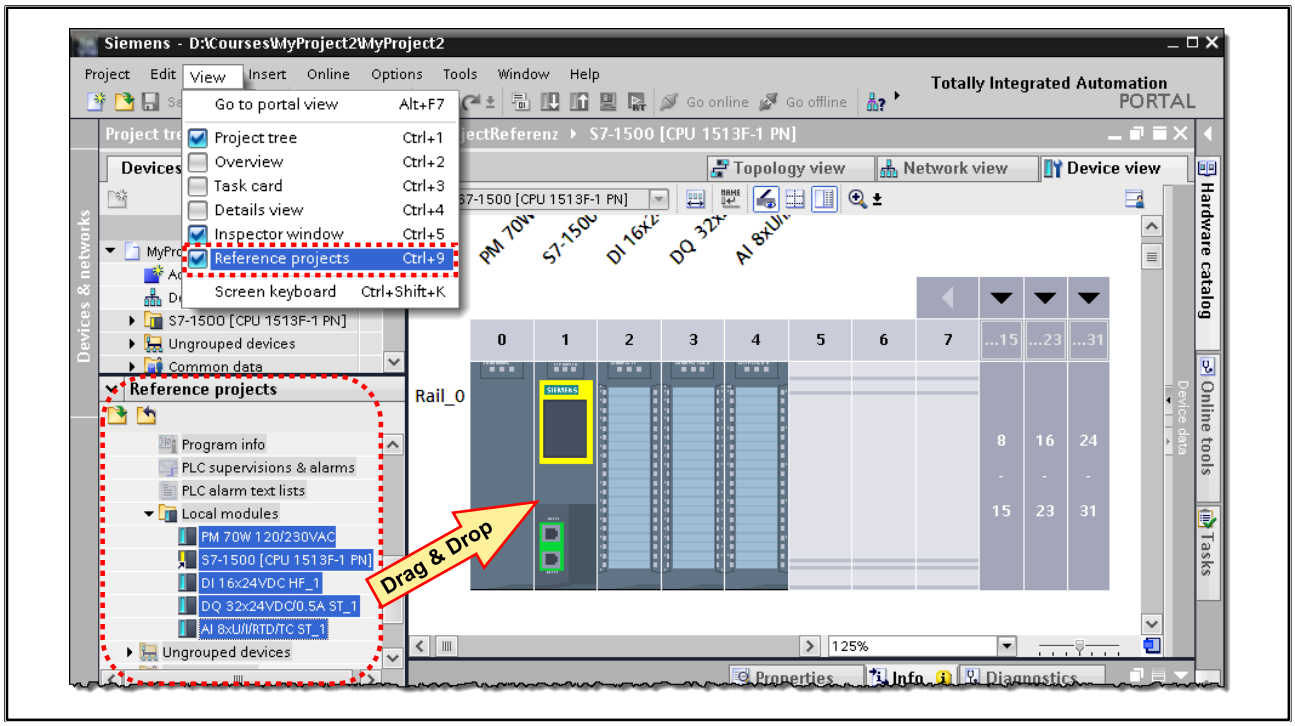
4.10.1. Swapping a Slot / Inserting a Module between Two Modules



Swapping a Slot or Inserting a Module between Two Modules.

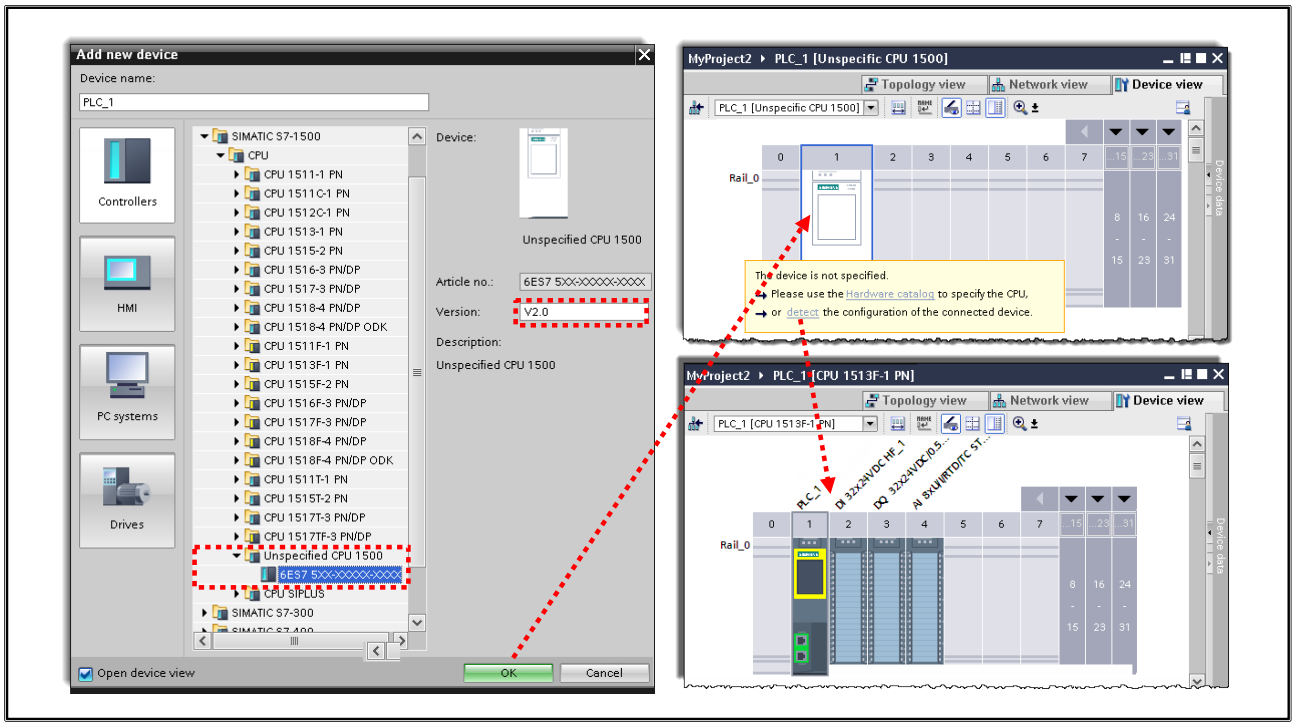
Using drag & drop, drag the modules in front of or behind the slot number until the marking appears at the desired location, as shown in the picture. The module is placed where the marking is and the modules behind it are moved one slot to the right.

4.10.2. Copying Modules from a Reference Project



Via the menu "View", the "Reference projects" view can be shown, in which projects can be opened as write-protected. Modules can be copied into the Device view from a Reference Project. In doing so, all parameter assignments are adopted.

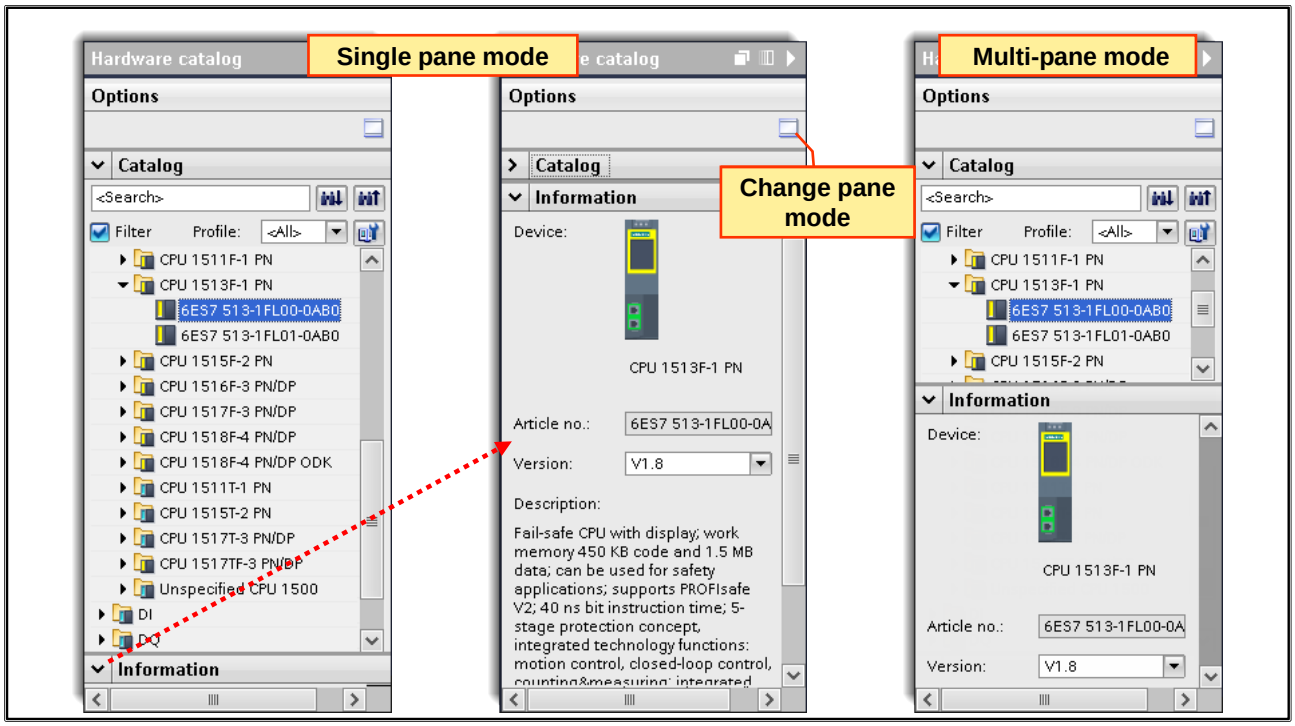
4.10.3. Unspecified CPU



For the selection of the controller, you can also choose an "Unspecified CPU". This is necessary when the real CPU is not yet known but you would already like to start programming. Here, you only need to specify the firmware of the CPU which is to be used later on. The firmware version must be specified since some functions and instructions which are used for programming depend on the firmware version.

Then, you can write the program without having configured the actual hardware. The hardware can later be configured from the Hardware catalog or determined online.

4.10.4. ‘View’ Settings of the Task Cards



You can choose between two pane modes:

- Single pane mode:
  There is only one pane open at a time. If a different pane is selected, the previously open pane is closed automatically.
- Multi-pane mode:
  Several panes can be open at the same time.

Setting for the Device Configuration

Since there is generally more than one version of a module when configuring the devices (CPUs, I/O modules), the required version must be selected.

Since this additional information on the modules selected in the catalog is shown in the "Information" pane, it is recommended that the **multi-pane mode** is set here.