docs

ATOM / Fieldbus / PROFINET

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ATOM / Fieldbus / PROFINET / Overview

INFO

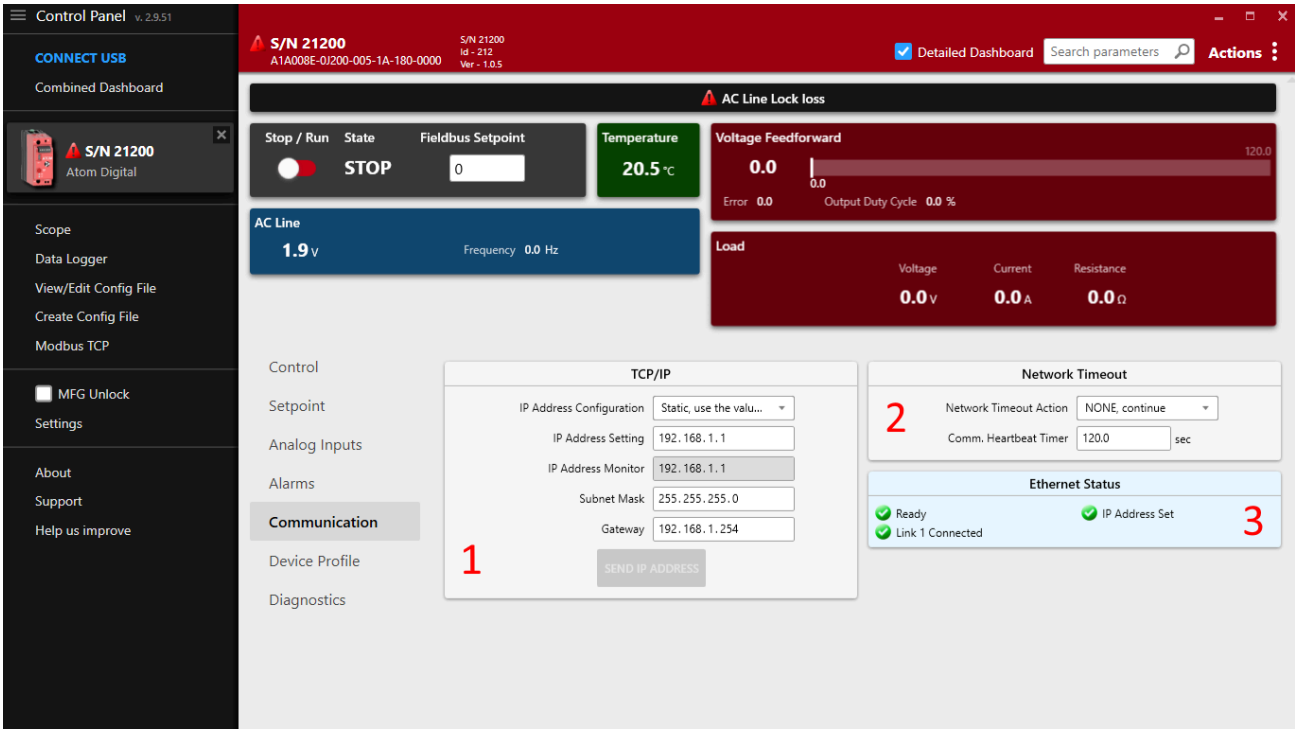
GSDML

A general station description markup language file (**gsdml**) for ATOM is available. This file can be imported into most PLC software to easily interface with ATOM.

INFO

You can download the GSDML file for ATOM **here**.

Control Panel Communication Settings



Some communication settings can be configured in the **Communication** tab in Control Panel.

- Section `1`: TCP/IP settings
  - **IP Address Configuration**
    - `Static`: Use the IP address, subnet mask, and gateway specified below.
    - `DHCP`: Use DHCP to obtain an IP address.
  - **IP Address Setting**: The IP address of the ATOM controller.
  - **IP Address Monitor**: The current IP address of the ATOM controller.
  - **Subnet Mask**: The subnet mask of the ATOM controller.
  - **Gateway**: The gateway address for the ATOM controller.
- Section `2`: Network Timeout
  - The EtherNet/IP heartbeat timeout (Encapsulation Inactivity Timeout) in seconds.
  - You can configure a network timeout action to perform when the device loses communication with the PLC:
    - `None`: Do nothing

    - `STOP, fault shutdown`: STOP the controller, disabling output
    - `Use network timeout setpoint`: Configure an alternative setpoint to use when the controller loses communication with the PLC.
- Section `3`: Ethernet status
    - Indicates the status of both RJ45 ports, IP address configuration, conflict detection, and any other errors with the EtherNet/IP connection.

> **INFO**
>
> ## Control Panel and PLC software
>
> These settings are synchronized with your PLC environment. You do not have to use Control Panel to change these settings - you can stay in your PLC software. Control Panel merely provides them as an altnerative way to configure ATOM's EtherNet/IP settings.
>
> You can use Control Panel simultaneously with your PLC software without issues.

> **WARNING**
>
> ## IP Address Conflict Detection
>
> ATOM uses **IP Address Conflict Detection** to detect IP address conflicts on the network. If ATOM detects another device using the same IP address, it will disable all network communication until the conflict is resolved.
>
> Please ensure all devices on the network are assigned unique a IP address.

Hardware considerations

WARNING

Daisy chaining

As ATOM has two RJ45 ports, it can be easily daisy-chained. When daisy-chaining ATOM, take care to avoid a loop in the network. In some loop configurations, ATOM is susceptible to network broadcast storms, which can cause the controller to become unresponsive. If you are daisy-chaining ATOM, ensure that the network is loop-free.

ATOM works with both unmanaged and managed switches. We recommend a managed switch for larger networks to give you more control over the network topology.

Parameters

Overview

ATOM makes 30 parameters accessible to Profinet. These parameters are made available through the input and output modules.

Table

#	Name	Type	Description	Read/Write
1	Digital setpoint	DINT	A value between 0 and 10,000 indicating the desired output current. The value is scaled to the output range of ATOM. For example, if the output range is 0-	Read/Write

#	Name	Type	Description	Read/Write
			100A, a value of 5000 would set the output to 50A.	
2	Digital run enable	BOOL	Enables or disables the output current. When disabled, the output current is set to 0A.	Read/Write
3	Inhibit Alarm Status	BYTE	A bitfield indicating alarms that are preventing controller operation. See Inhibit Alarm Status.	Read
4	Warning Alarm Status	BYTE	A bitfield indicating warning alarms. See Warning Alarm Status.	Read
5	Feedback Read Status	BOOL	A bitfield indicating if controller has acquired feedback. See Feedback Read Status.	Read
6	AC Line Frequency	REAL	The AC line frequency in Hz.	Read
7	AC Line Voltage	REAL	The AC line voltage in volts.	Read
8	Load Voltage	REAL	The load voltage in volts.	Read
9	Load Current	REAL	The load current in amps.	Read
10	Load Resistance	REAL	The load resistance in ohms.	Read

#	Name	Type	Description	Read/Write
11	Heatsink Temperature	REAL	Heatsink temperature, in degrees celsius.	Read
12	Output Duty Cycle %	REAL	Indicates the amount, in percent, that the output of the controller is ON	Read
13	Setpoint reference	REAL	Reference input to control compensation loop in units determined by "feedback type"	Read
14	Feedback	REAL	The control output supplied to the load in units determined by "feedback type"	Read
15	Partial Load Fault Target Resistance	REAL	Expected nominal resistance, in Ohms, of the load. Used for partial load fault detection.	Read
16	Partial Load Fault Resistance	REAL	The actual load resistance in Ohms. Compared with #15 to determine if a partial load fault has occurred.	Read
17	Partial Load Fault Resistance Deviation	REAL	The tolerable percentage that parameter #15 and #16 may differ by until a partial load fault will be triggered.	Read
18	Firmware ID	DINT	Indicates the version of firmware that is loaded, dictating which	Read

#	Name	Type	Description	Read/Write
			features are available.	
19	Firmware major revision	DINT	Indicates which revision of the firmware is loaded. Major revisions fix critical bugs or add significant new features.	Read
20	Firmware minor revision	DINT	Indicates which minor revision of the firmware is loaded. Minor revisions fix minor issues and/or add minor improvements.	Read
21	Full Scale Voltage	DINT	The expected output voltage when the controller output is fully on.	Read
22	Full Scale Current	REAL	The expected current when the controller output is fully on.	Read
23	AC Line Status	BYTE	A bitfield indicating the status of the connected AC Line. See AC Line Status.	Read
24	Load Status	BYTE	A bitfield indicating the load status. See Load status.	Read
25	Controller Status	BYTE	A value indicating the operational status of the controller. See Controller status.	Read

#	Name	Type	Description	Read/Write
26	Controller State	BYTE	A value indicating the controller state. See Controller state.	Read
27	EEPROM Status	WORD	A bitfield indicating the EEPROM status. Seee EEPROM Status.	Read
28	EEPROM Status 2	WORD	Identical to parameter #27	Read
29	Error Latch	BYTE	A bitfield used for diagnostic troubleshooting. See Error Latch.	Read
30	Miscellaneous Status	BYTE	A bitfield indicating miscellaneous status information. See Miscellaneous Status.	Read

Additional parameter descriptions

Inhibit Alarm Status

Inhibit alarm status is a 8-bit bitfield:

7	6	5	4	3	2	1
Reserved	Reserved	Reserved	Reserved	Feedback Loss	Over Temperature	Over Current Trip

If any bit is set to 1, the controller will *not* be allowed to run.

Warning Alarm Status

Warning alarm status is a 8-bit bitfield:

7	6	5	4	3	2	1	0
Reserved	Reserved	High temperature	Shorted SCR	Open Load	Partial Load Fault	Current Limit	Voltage Limit

Warning alarms are not considered critical and will not prevent the controller from running.

Feedback Read Status

Feedback status is a 8-bit bitfield:

7	6	5	4	3	2	1	
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Ti

Indicates whether the controller has acquired feedback on the line. If any bit is set to 1, then the controller has lost feedback.

AC Line Status

AC Line status is a 8-bit bitfield:

7	6	5	4	3	2	1	0
Reserved	Reserved	Sync-Locked (to AC Line)	Pre-Lock 2	Pre-Lock 1	Reserved	AC Line B OK	AC Line A OK

Bits 5 must be set to 1 before the controller can provide power to the load.

Load Status

Load status is a 8-bit bitfield:

7	6	5	4	3	2	1	0
Reserved	Reserved	Reserved	Open Load	Reserved	Reserved	Reserved	Short SCR

Controller Status

Controller status is one of:

Value	Description
0	Disabled
1	Initialization
2	Normal, operating
3	Calibration

Value	Description
4	Diagnostic

Controller State

Controller state is one of:

Value	State	Description
0	STOP	The state the controller is in when AC Line voltage is not present.
1	RUN	The state the controller is in when AC Line voltage is present and the controller is synchronized to the AC line.
2	FAULT	A latching state of output shutdown caused by over current or over temperature alarms. A power cycle or processor reset is required to clear this state.
3	FAULT RESET	Used as a temporary state to transition from FAULT to RUN once again.

EEPROM Status

EEPROM status is an 16-bit bitfield. EEPROM is used to store controller configuration and calibration data. Any errors in EEPROM may indicate that the firmware is corrupted.

Bit	Description
0	EEPROM Initialization

Bit	Description
1	SP Table Error
2	MFG CP Table Error
3	Calibration Table Error
4	Reserved
5	Reserved
6	Backup Calibration Table Error
7	Bottom Board Calibration Table Error
8	SP Definition Table needs updating
9	Bottom Board Calibration Backup Error
10	Reserved
11	Reserved
12	EEPROM is write protected
13	Reserved
14	Reserved
15	Feedback Calibration Table has changed, store to EEPROM

Error Latch

Error latch is a 8-bit bitfield:

7	6	5	4	3	2	1	0
Reserved	Reserved	Reserved	Feedback loss	SCR timing loss	Line Frequency failure	Phase loss or missing cycle	Line Lock Loss

Error latch is provided as a diagnostic troubleshooting aid.

Miscellaneous Status

Miscellaneous status is an 8-bit bitfield:

7	6	5	4	3	2	1
Reserved	Initialization in progress	Reserved	Reserved	Waiting for ENTER key during initialization	Reserved	USB Powered

Data types

The data types listed above in the parameter table are defined in the CIP standard as:

Type	Size	Description
BOOL	1 byte	Boolean value

Type	Size	Description
BYTE	1 byte	8-bit bitmap
WORD	2 bytes	16-bit bitmap
DWORD	4 bytes	32-bit bitmap
LWORD	8 bytes	64-bit bitmap
USINT	1 byte	Unsigned 8-bit integer
UINT	2 bytes	Unsigned 16-bit integer
UDINT	4 bytes	Unsigned 32-bit integer
ULINT	8 bytes	Unsigned 64-bit integer
SINT	1 byte	Signed 8-bit integer
INT	2 bytes	Signed 16-bit integer
DINT	4 bytes	Signed 32-bit integer
LINT	8 bytes	Signed 64-bit integer
REAL	4 bytes	32-bit floating point number
LREAL	8 bytes	64-bit floating point number

Advanced

ATOM has many more parameters beyond the 30 made available through Prrofinet. The default profile listed above should be sufficient for the majority of use cases.

If this is not the case, you can use Control Panel to adjust or monitor all parameters.

In the rare case that you need more parameters available through ATOM's Profinet profile, Control Concepts does have the ability to make additional parameters available or to change the data type of included parameters. Please contact us if you would like a custom Profinet profile. There may be a service fee for custom Profinet profiles as they require new GSDML files, device-reconfiguration and testing.

ATOM / Fieldbus / PROFINET / TIA Portal V18

In this tutorial, you'll learn how to connect Atom to a Siemens PLC over Profinet. You'll learn how to update the run/stop and setpoint parameters, and monitor the heatsink temperature.

If you haven't yet, please review ATOM's Profinet Profile.

If you'd like to skip the tutorial, you can download a completed example project in TIA Portal V18:

- Download AtomExample.zip

Requirements

1. TIA Portal V18
2. A Siemens PLC (optional, you can still follow along by simulating the PLC on your PC).
    i. We use a `S7-1511-1 6ES7 511-1AK02-0BA0` in this example.
    ii. You can easily follow along with a different PLC if you have a different one.
3. Download Atom's GSDML file

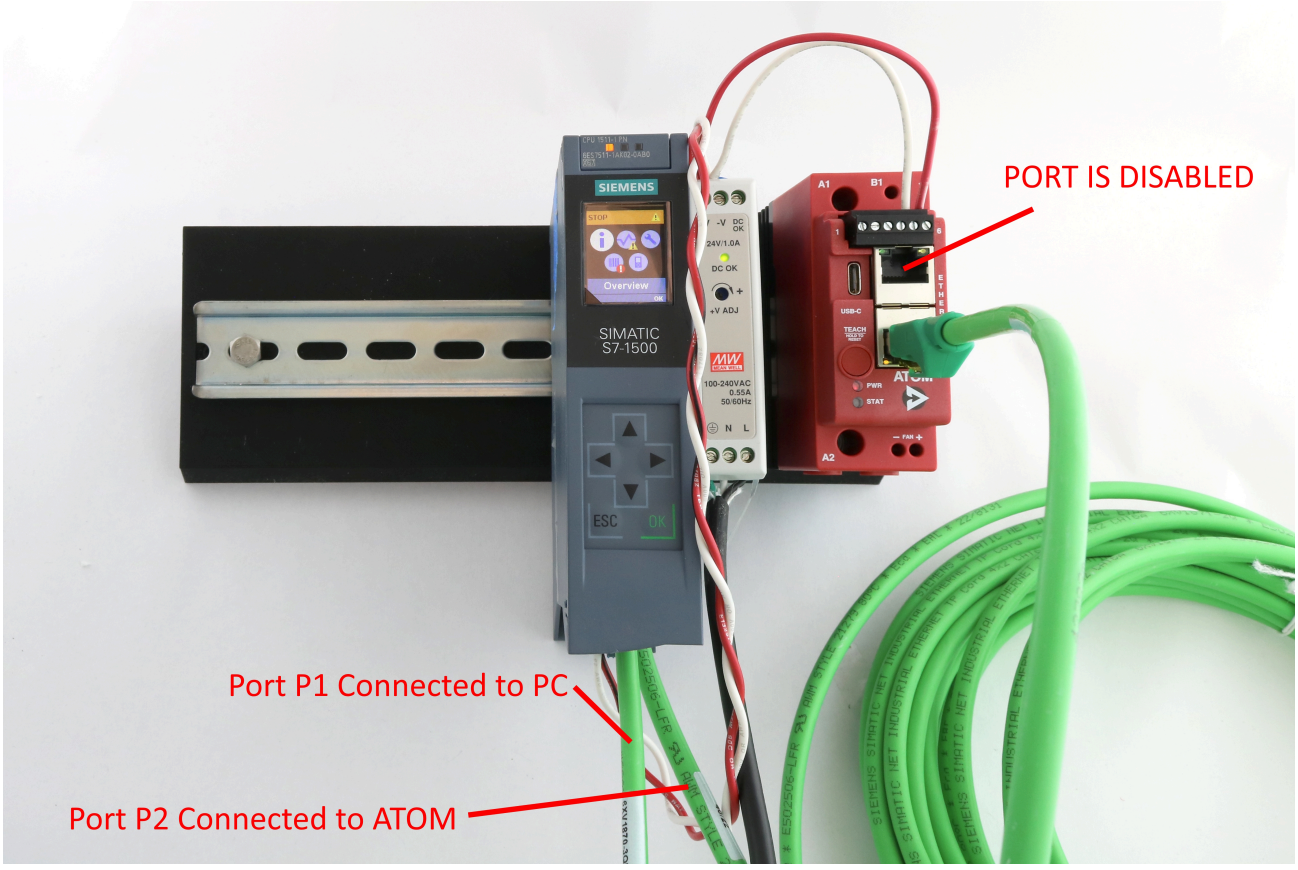
Hardware setup

> **INFO**
>
> If you're using the PLC simulator, skip to the next section.

> **IMPORTANT**
>
> When Atom is configured for Profinet, the Ethernet port closest to the 24V power connector is **disabled**.

Connect 24V to your PLC and Atom unit with the provided power cable. Connect two Ethernet cables to the PLC:

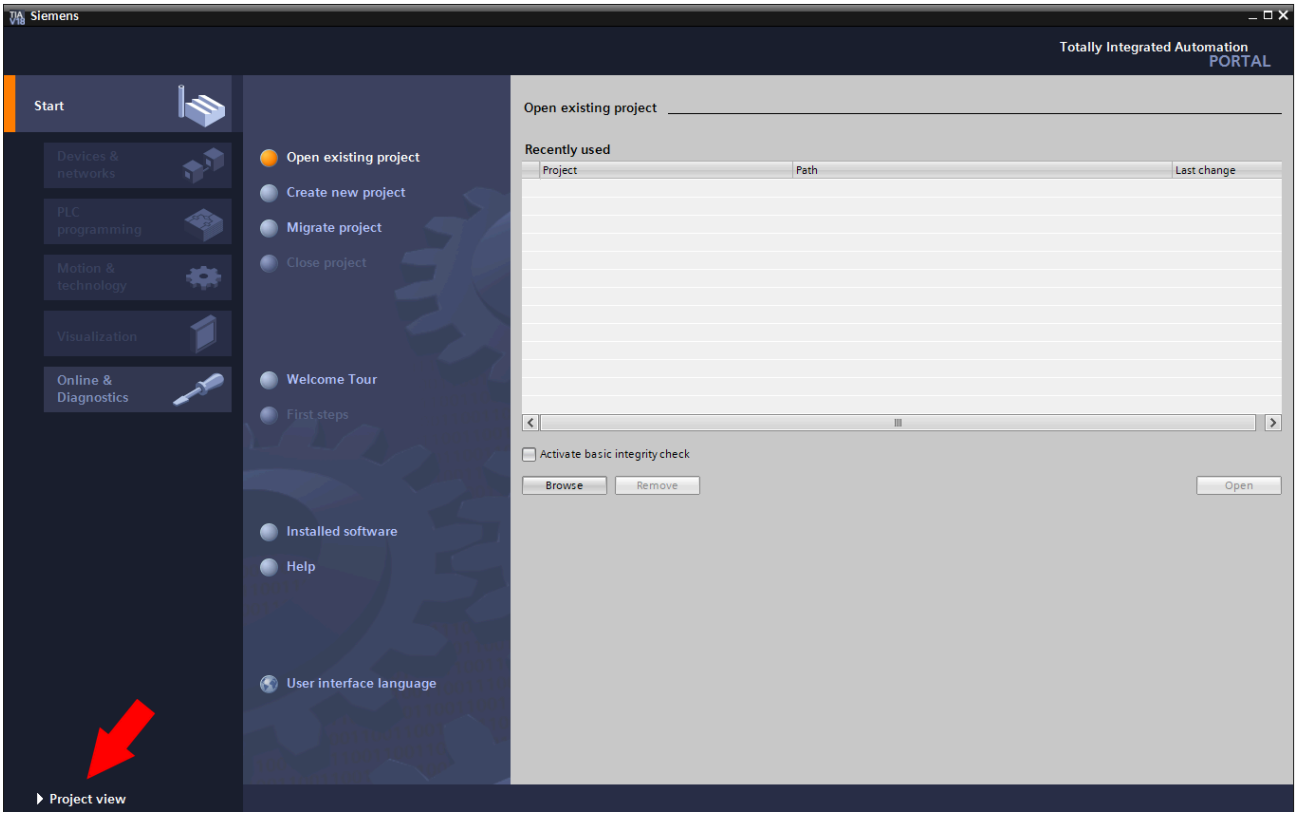
- P1: Connect to your PC
- P2: Connect to your Atom unit



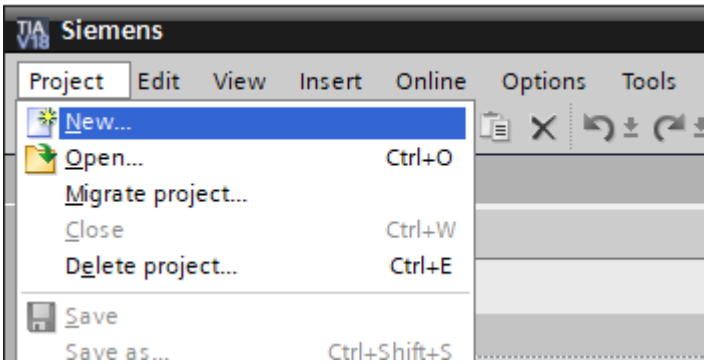
> **INFO**
>
> To simplify this diagram, we have not connected a load to Atom.
>
> If you do not connect a load, you can still verify your PLC is working by connecting a USB cable to Atom and using Control Panel to watch the parameters change/verify the PLC is receiving the correct monitor data.

Creating a project in TIA Portal V18

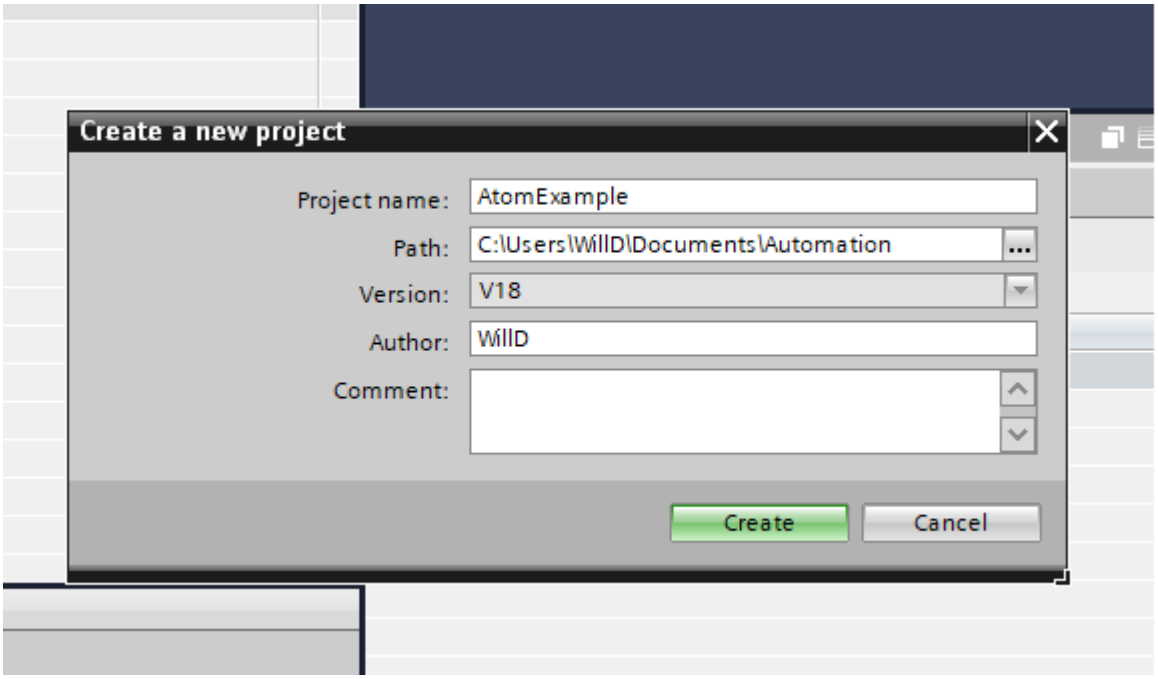
Open TIA Portal V18. If you're in the *Portal view* (shown below), switch to *Project view* by clicking in the lower left:



Next, select **Project** > **New**:



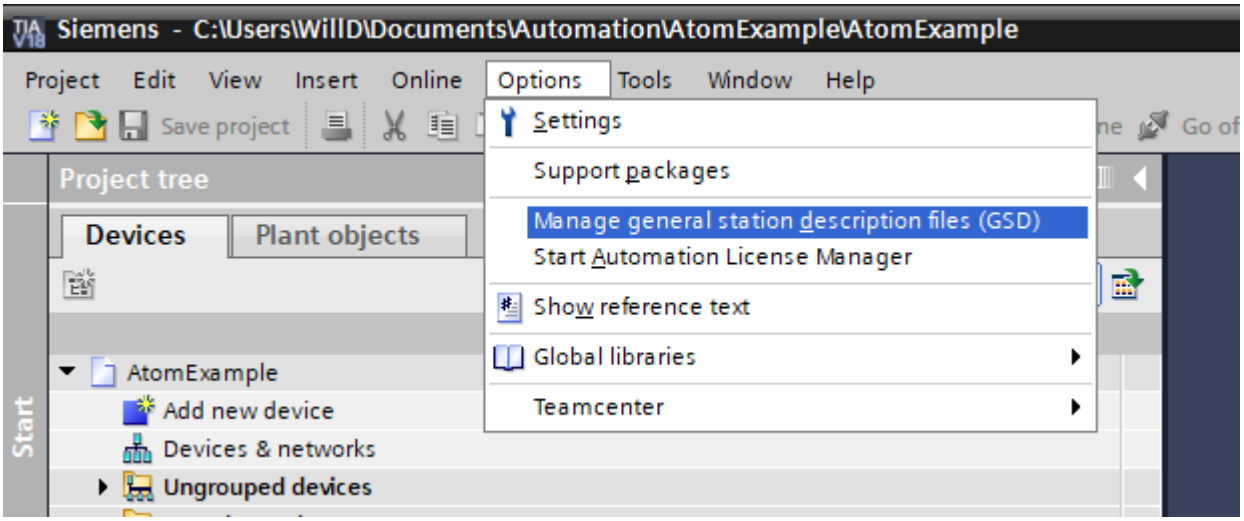
Give your project a name, like `AtomExample`, then click **Create**:



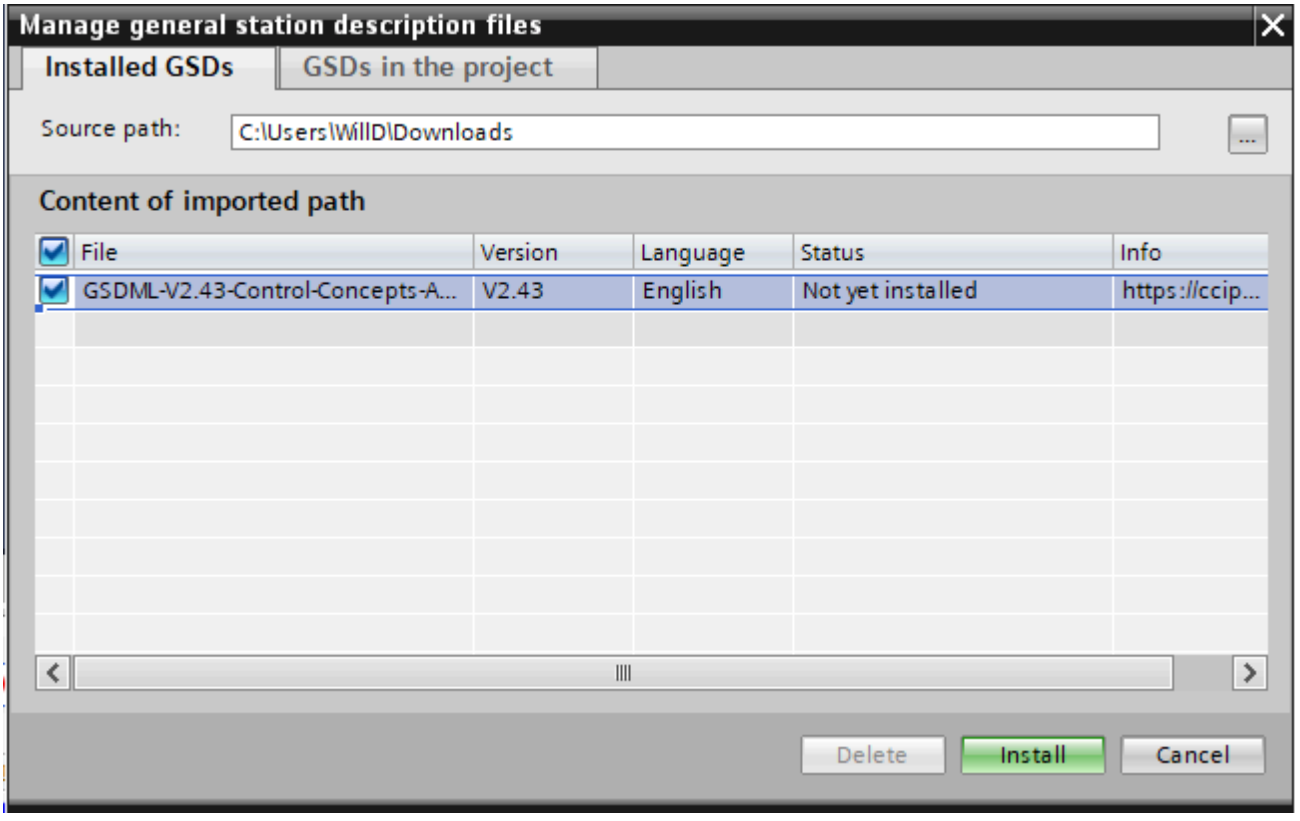
Importing Atom's GSDML file into TIA

A GSDML file describes the capabilities of a Profinet device — the parameters, communication modes, diagnostics (and more) that the device supports. We'll import Atom's GSDML file into TIA so that TIA knows how to talk to Atom.

Select **Options** > **Manage general station description files**:



Enter the path of the folder containing your GSDML file, check `GSDML-V2.43-Control-Concepts-ATOM-20231108.xml`, then click **Install**:

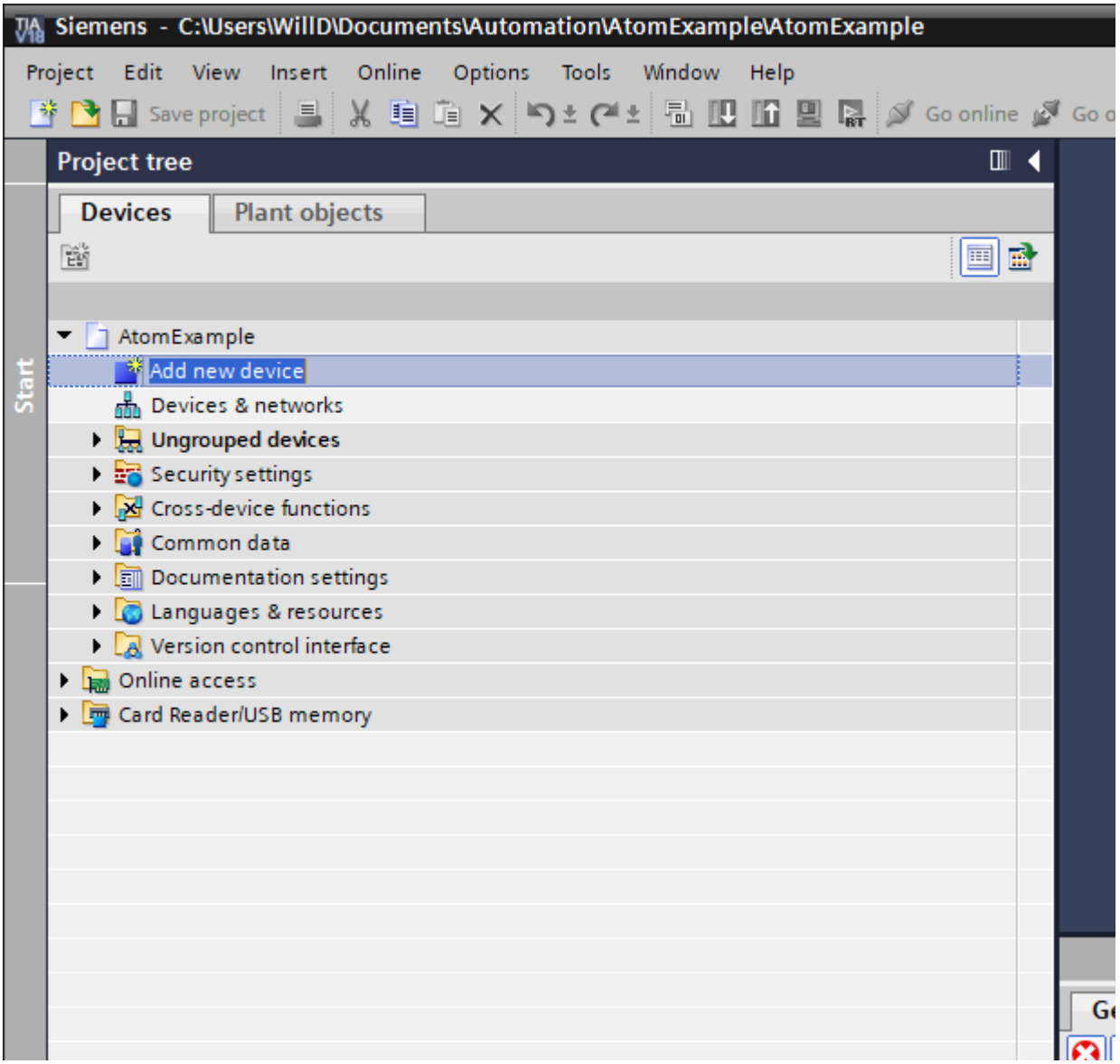


If everything goes well, a dialog should appear "Installation was completed successfully". Click **Close**.

Adding and configuring your PLC

> **INFO**
>
> Even if you're using the PLC simulator, still follow this section and add a Siemens PLC to your project. TIA is capable of simulating the S7-1500 series PLCs.

In the **Project tree** pane, within the **Devices** tab, double click **Add new device**:

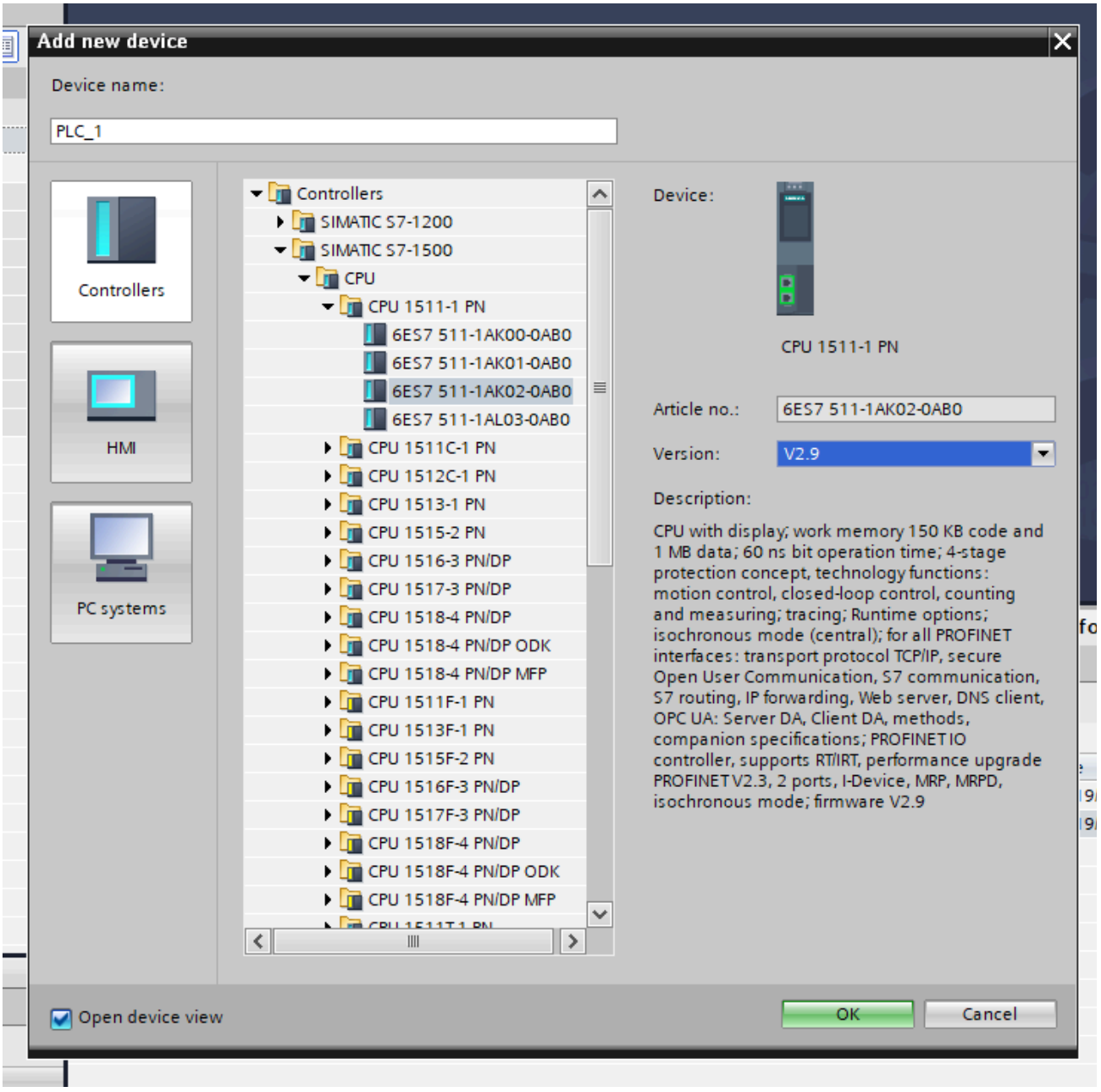


Select the **Controllers** tab, and browse to **Controllers** > **SIMATIC S7-1500** > **CPU** > **CPU 1511-1 PN** > **6ES7 511-1AK02-0AB0** (if you're using a different PLC, select that PLC instead):

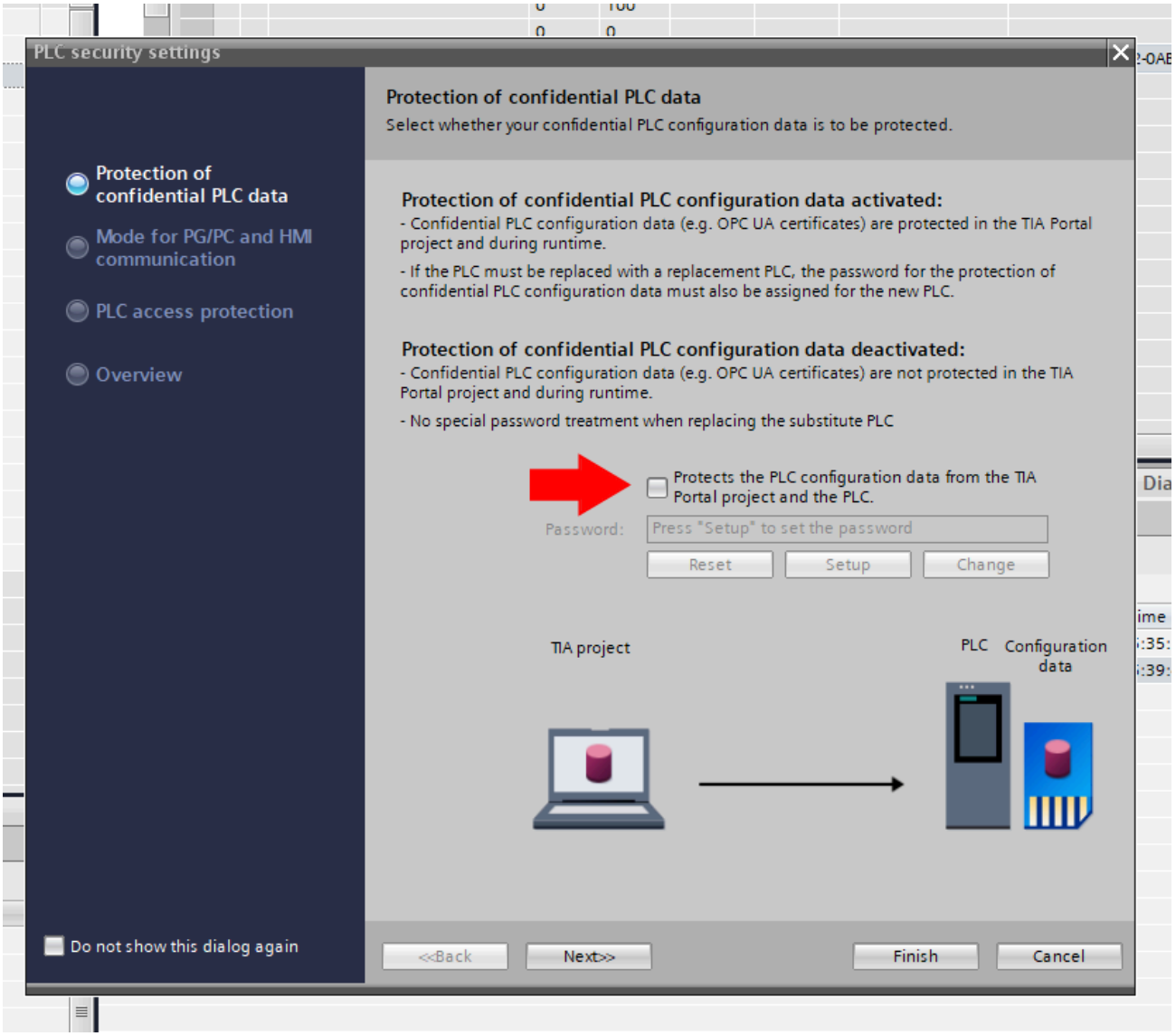
INFO

You can generally find your PLC's model number on the frame of your PLC. You can also check the firmware version (and model number) within the **Overview** page on your PLC:

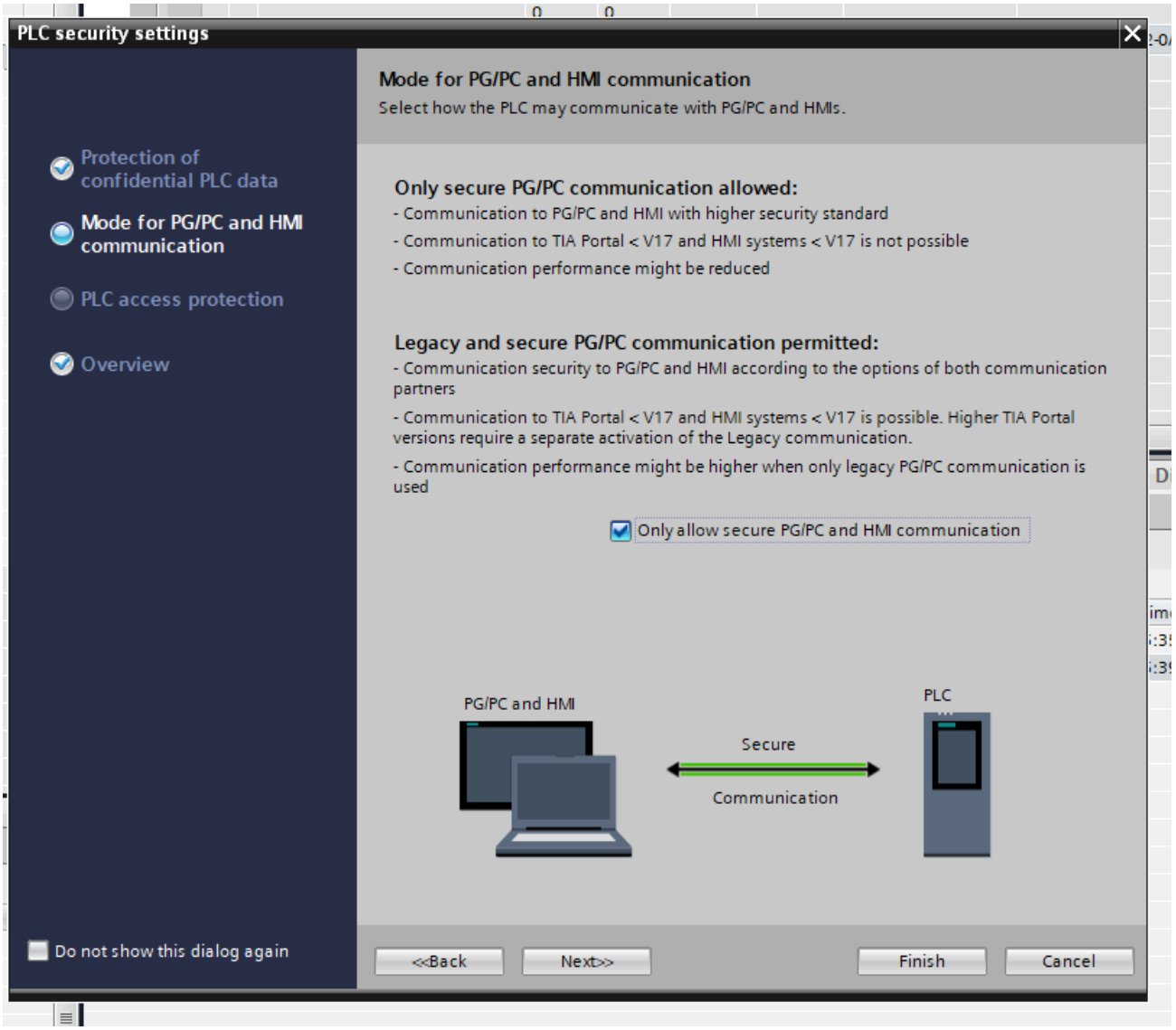
Then, click **Ok**:



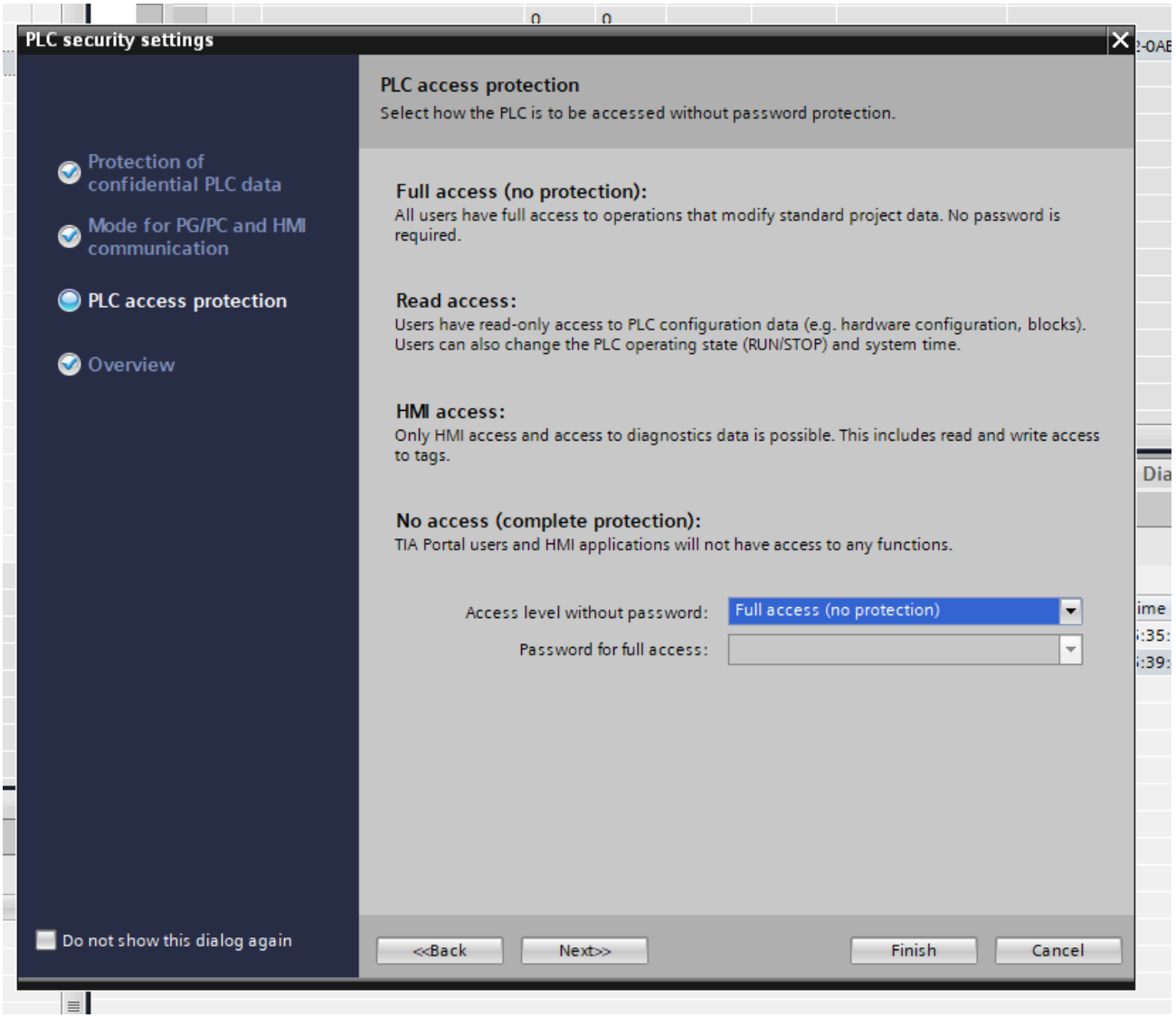
A **PLC security settings** dialog will popup. For this example, we'll disable the PLC password (unchecked):



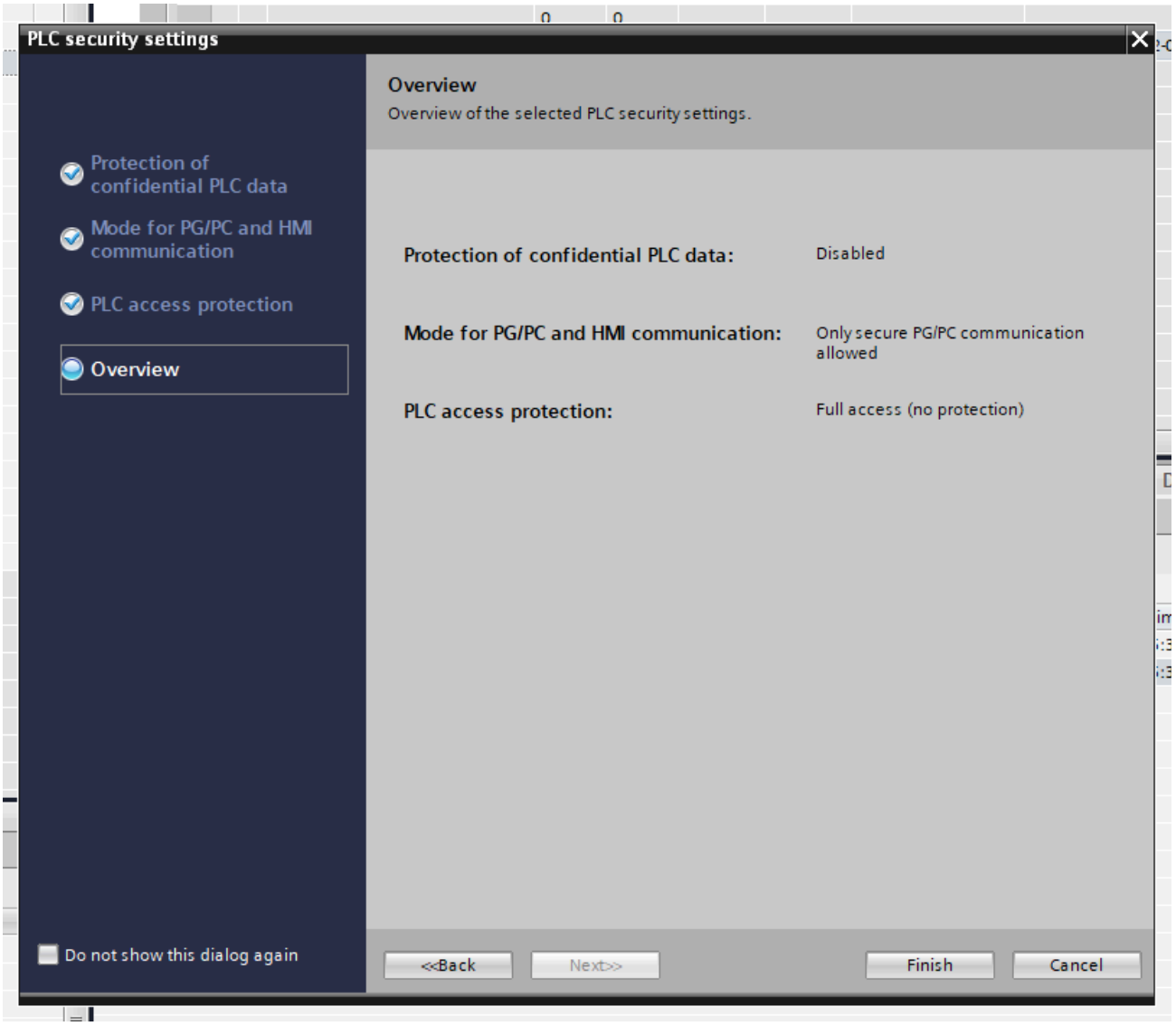
Leave **Only allow secure PG/PC and HMI communications** checked, then click **Next>>**:



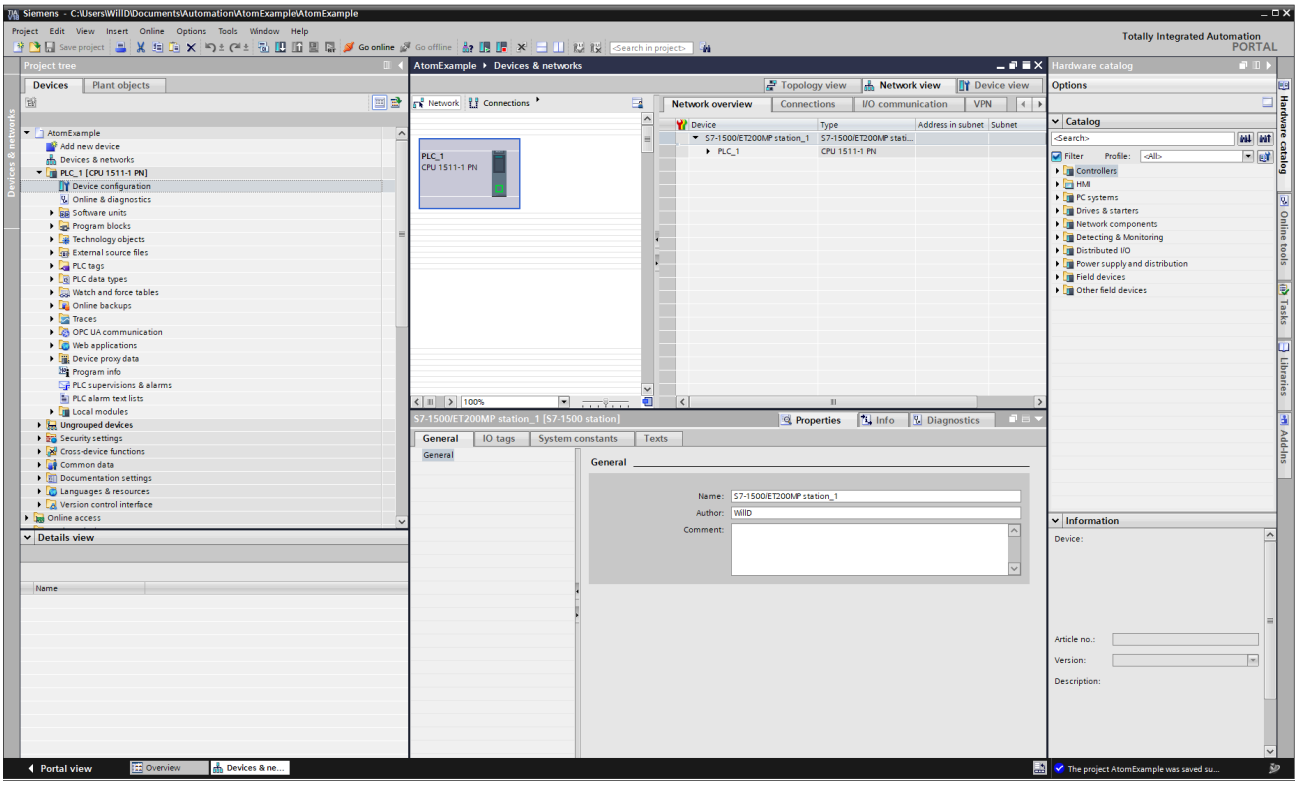
For this example, change **Access level without password** to **Full access (no protection)**, then click **Next>>**:



Then, click **Finish**:

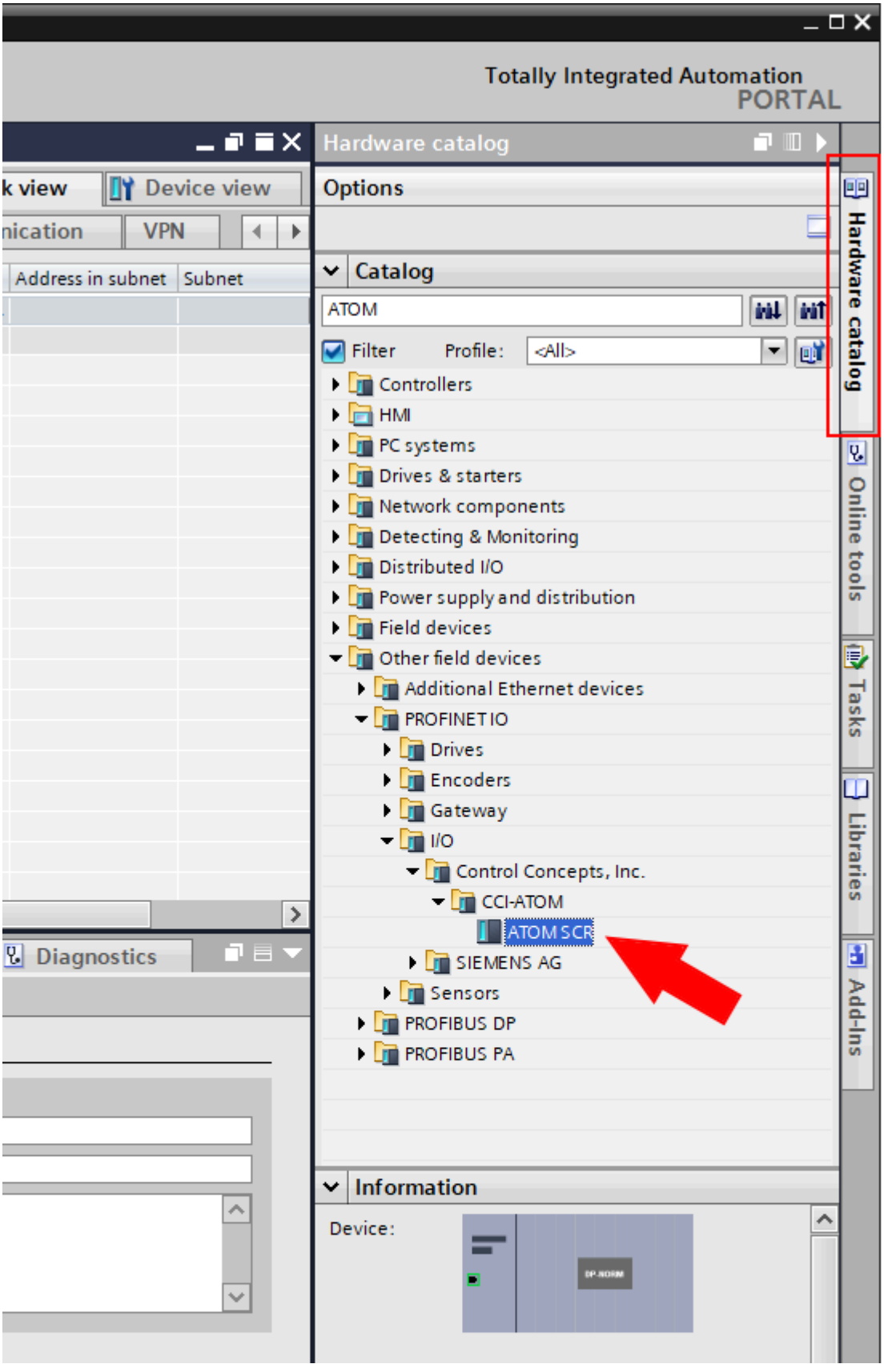


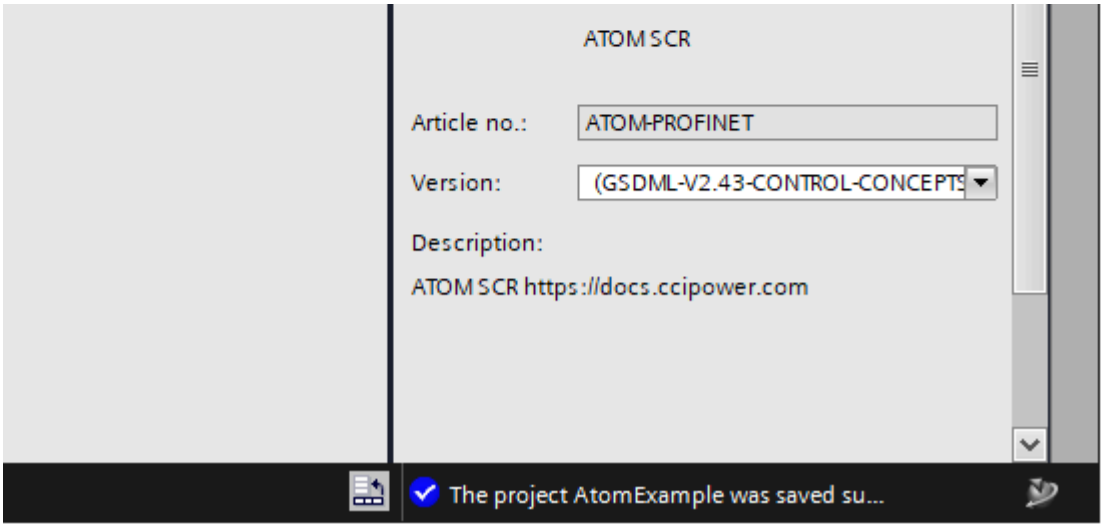
The PLC should appear in the **Network view**:



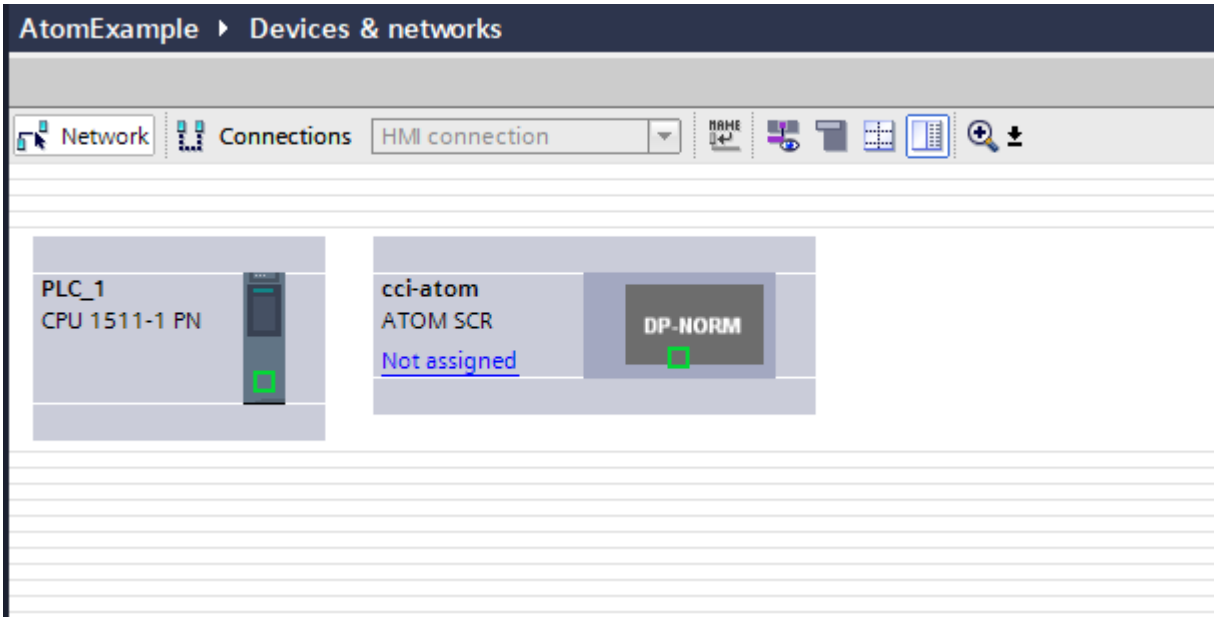
Adding and configuring Atom

To add Atom to your project, select the **Hardware catalog** tab on the right side of the screen. Enter `ATOM` in the search box and double click **ATOM SCR**:

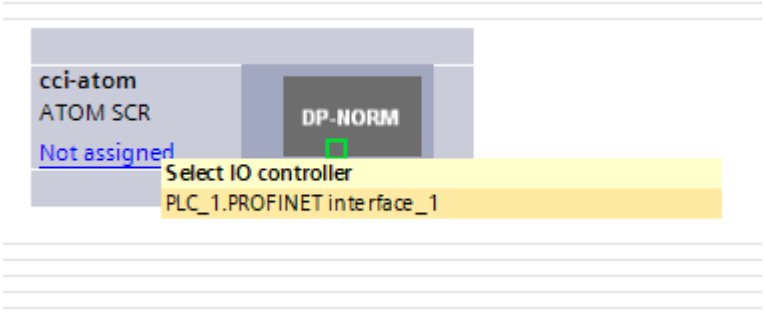

Totally Integrated Automation
PORTAL
Hardware catalog
Device view
VPN
Address in subnet
Subnet
Options
Catalog
ATOM
Filter
Profile:
<All>
Controllers
HMI
PC systems
Drives & starters
Network components
Detecting & Monitoring
Distributed I/O
Power supply and distribution
Field devices
Other field devices
Additional Ethernet devices
PROFINET IO
Drives
Encoders
Gateway
I/O
Control Concepts, Inc.
CCI-ATOM
ATOM SCR
SIEMENS AG
Sensors
PROFIBUS DP
PROFIBUS PA
Hardware catalog
Online tools
Tasks
Libraries
Add-Ins
Diagnostics
Information
Device:



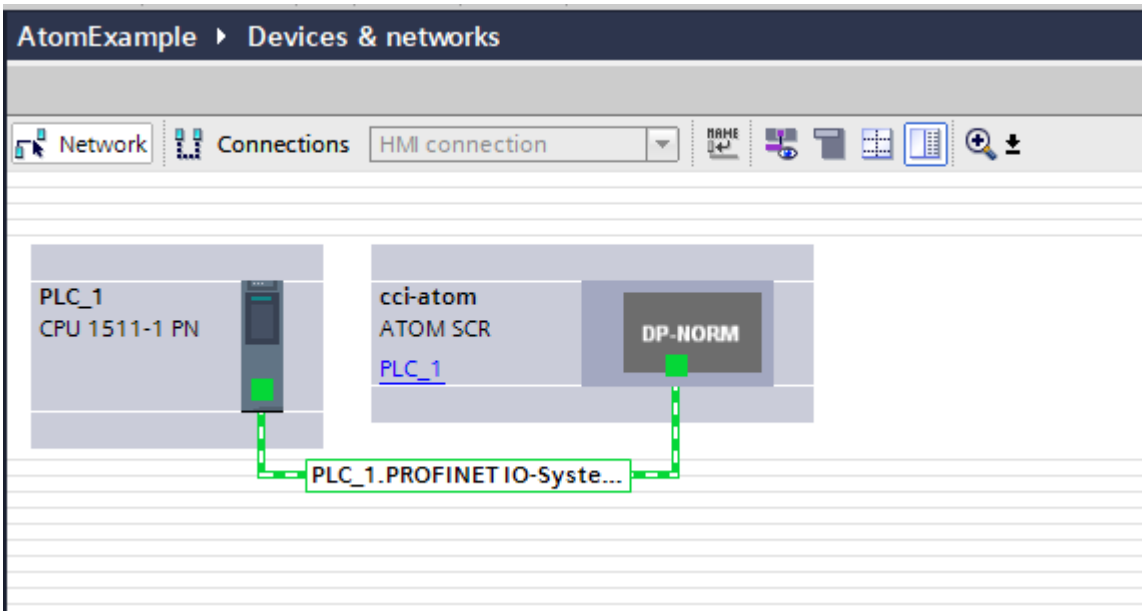
Atom should appear in the **Network view** of your project:



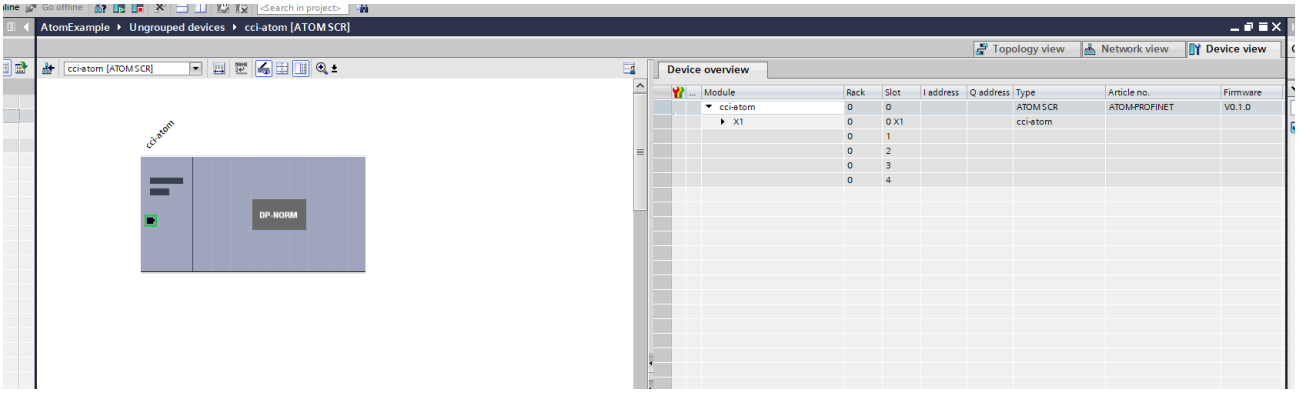
Click **Not assigned** on the Atom block, and select **PLC_1.PROFINET interface_1**:



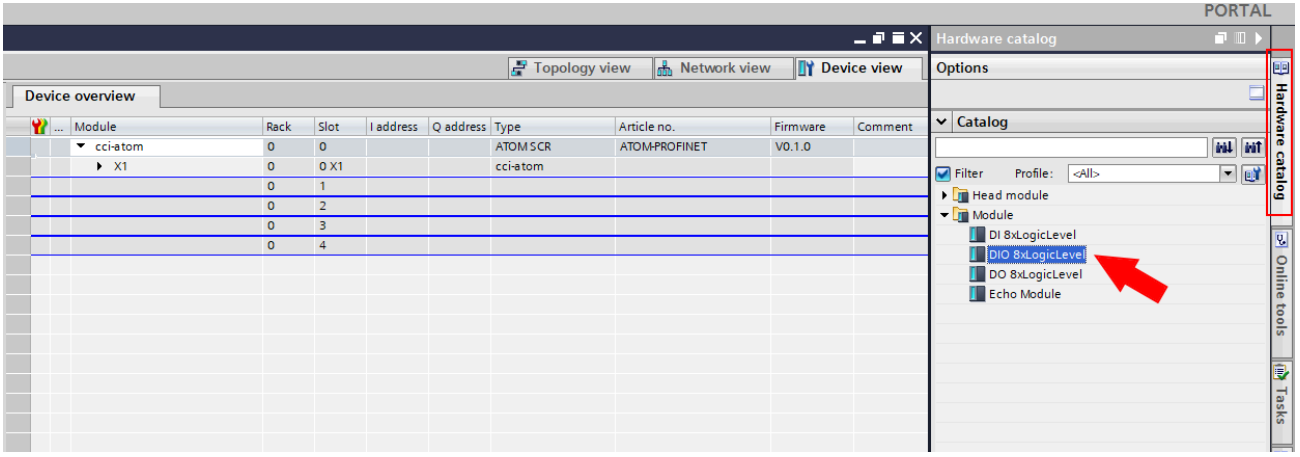
After doing so, a network connection should appear between the PLC and Atom:



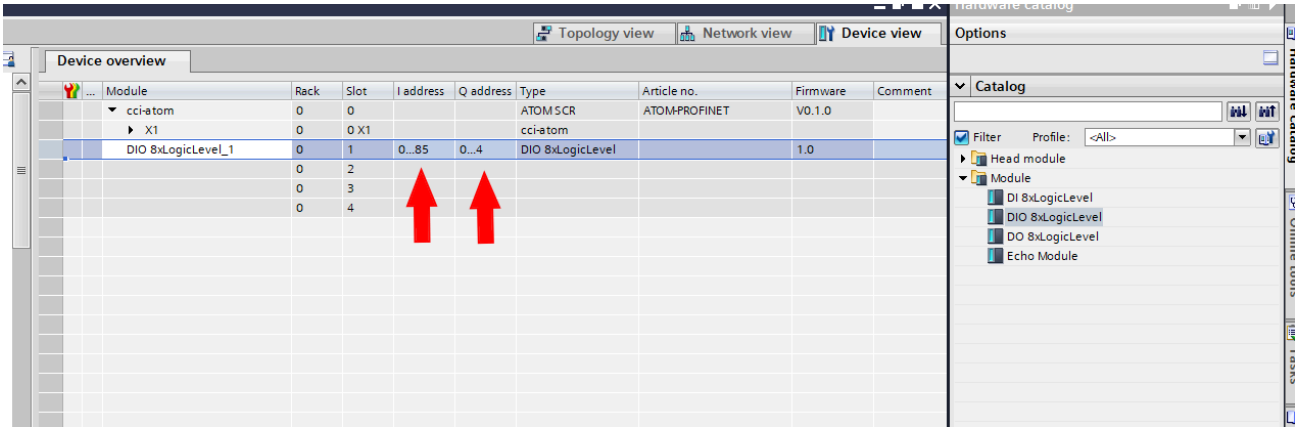
Next, double click on the Atom block to open its **Device view**:



Select the **Hardware catalog** tab on the right side, expand **Module** and select drag the **DIO 8xLogicLevel** module into **Slot 1** of Atom:



Your Atom module configuration should look like this:



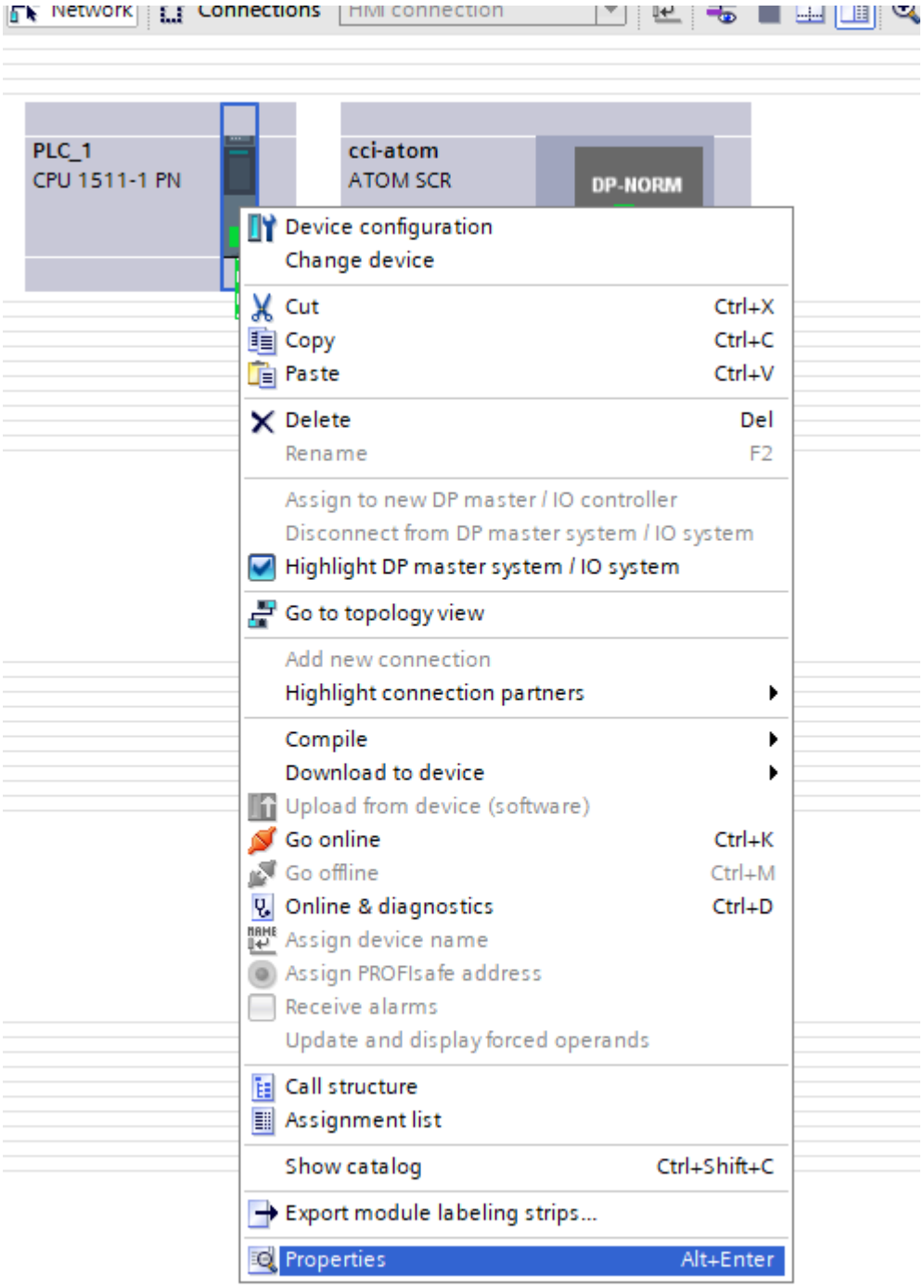
> **INFO**
>
> The two red arrows indicate the number of input and output parameters that Atom supports. In this case, the addresses `IW0` to `IW85` are input parameters and `QW0` to `QW85` are output parameters. Check out the Profinet Profile for more information on the available parameters.

Network provisioning

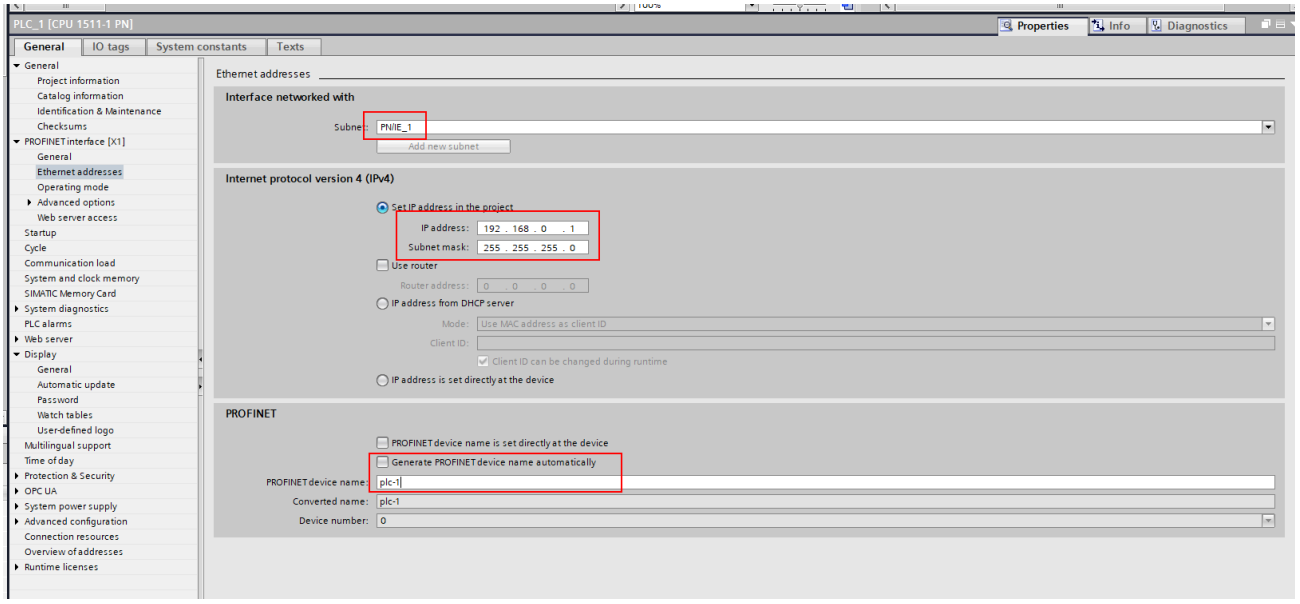
Let's set up a basic Profinet network. We'll provision a basic network like so:

- PC
  - IP address `192.168.0.25`
  - Subnet mask `255.255.255.0`
  - Only used for loading the PLC program
- Siemens PLC
  - Station name `plc-1`
  - IP address `192.168.0.1`
  - Subnet mask `255.255.255.0`
  - Port P1 connected to PC
  - Port P2 connected to Atom
- Atom
  - Station name `atom-1`
  - IP address `192.168.0.2`
  - Subnet mask `255.255.255.0`

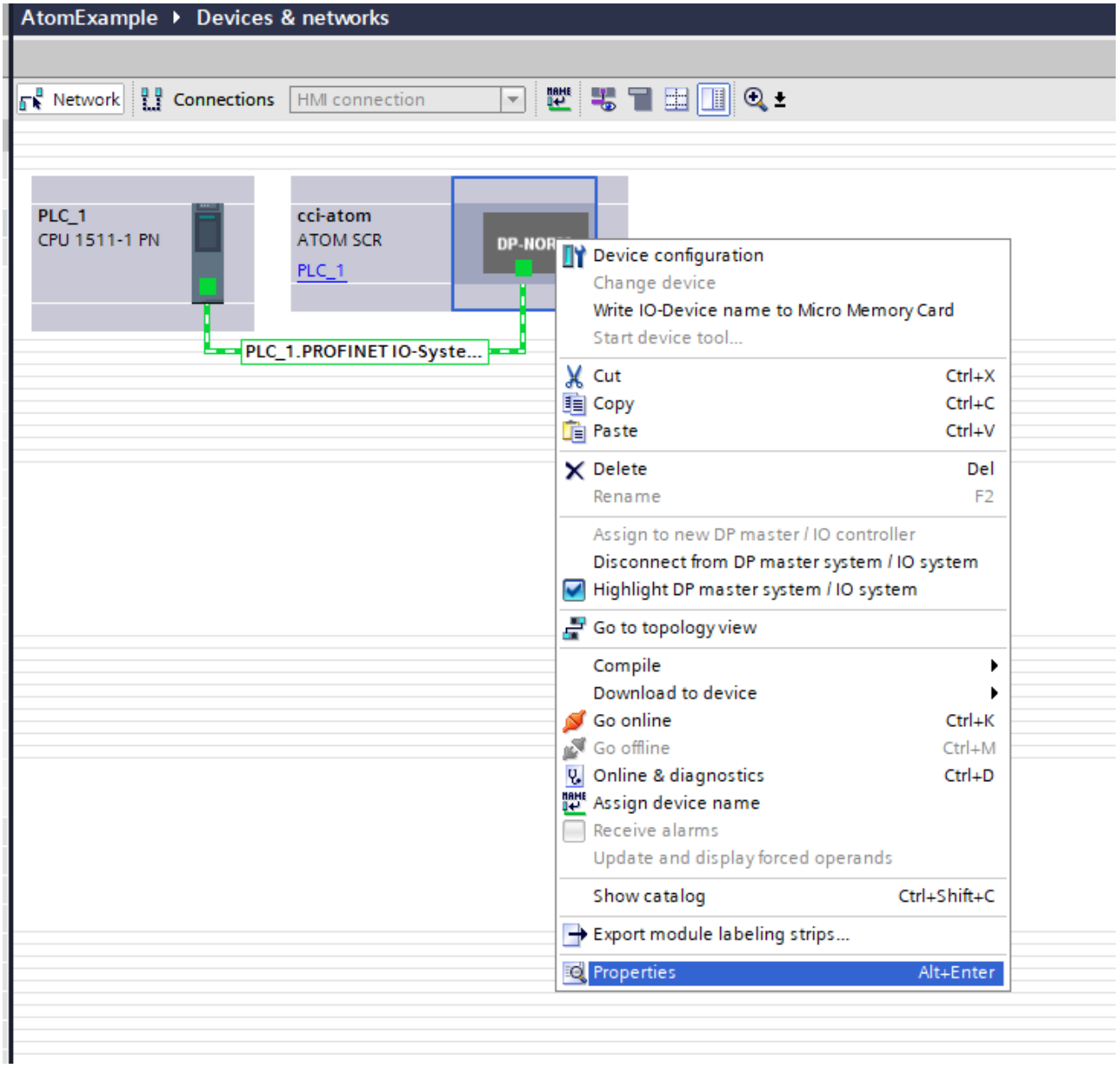
Return to the **Network view**, right click the PLC block (make sure to right click directly on the graphic) and select **Properties**:



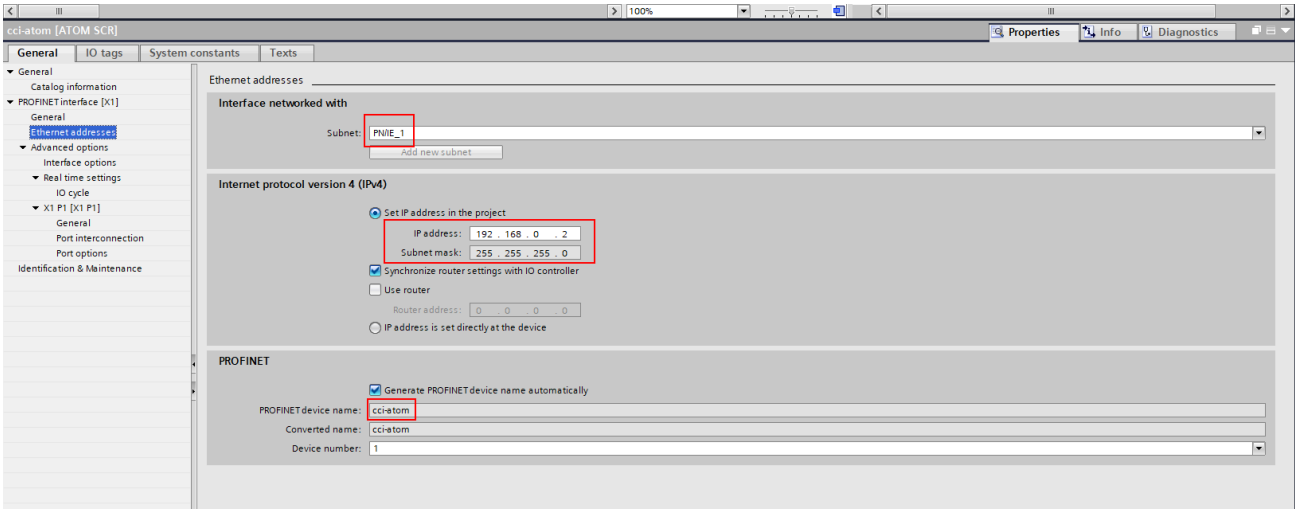
Navigate to **PROFINET interface [X1]** and select **Ethernet addresses**. Change these to match our network provisioning above:



Navigate back to the **Network view**, right click the Atom block (make sure to right click directly on the graphic) and select **Properties**:



Navigate to **PROFINET interface [X1]** and select **Ethernet addresses**. Check these to match our network provisioning above:

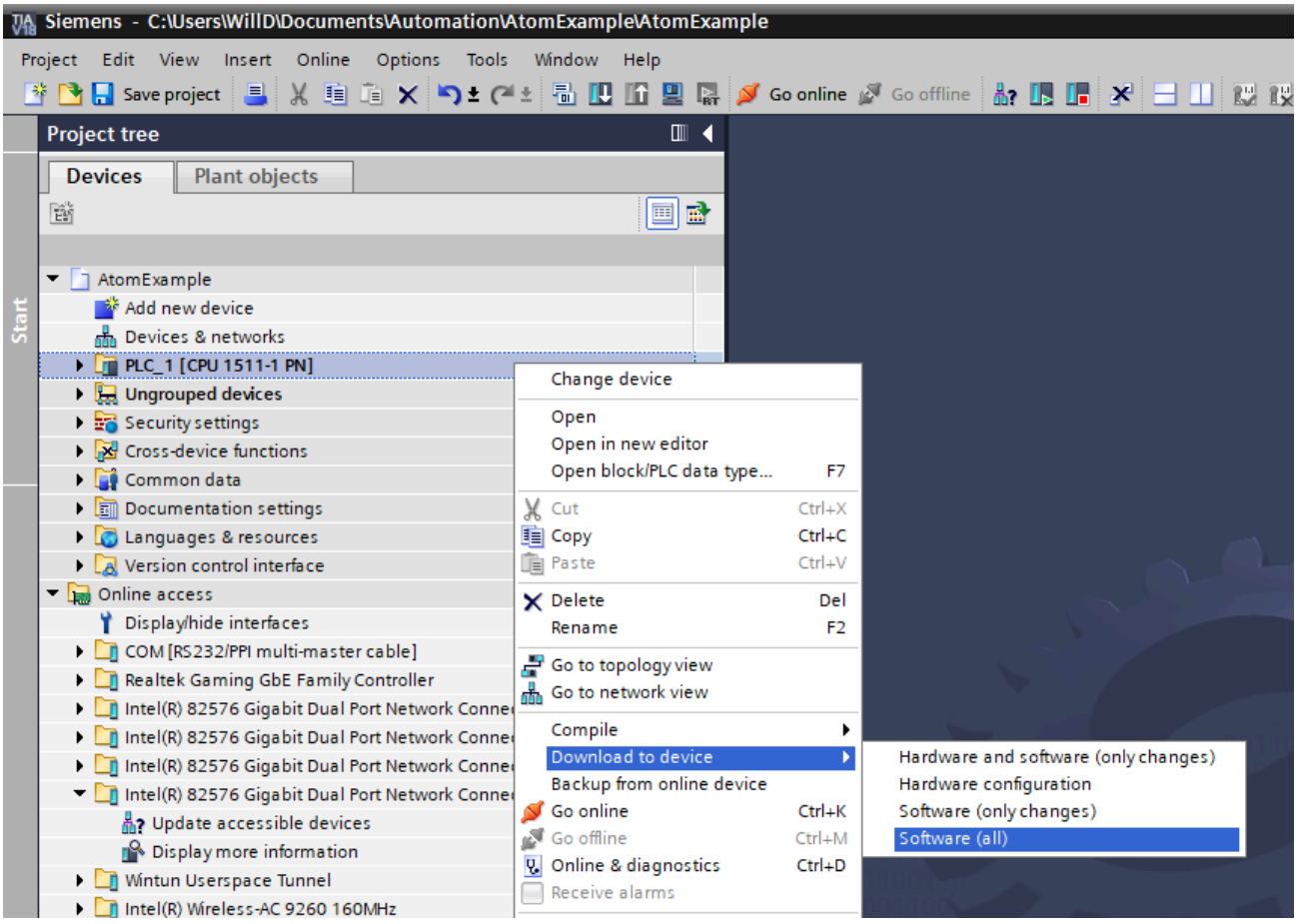


A basic test

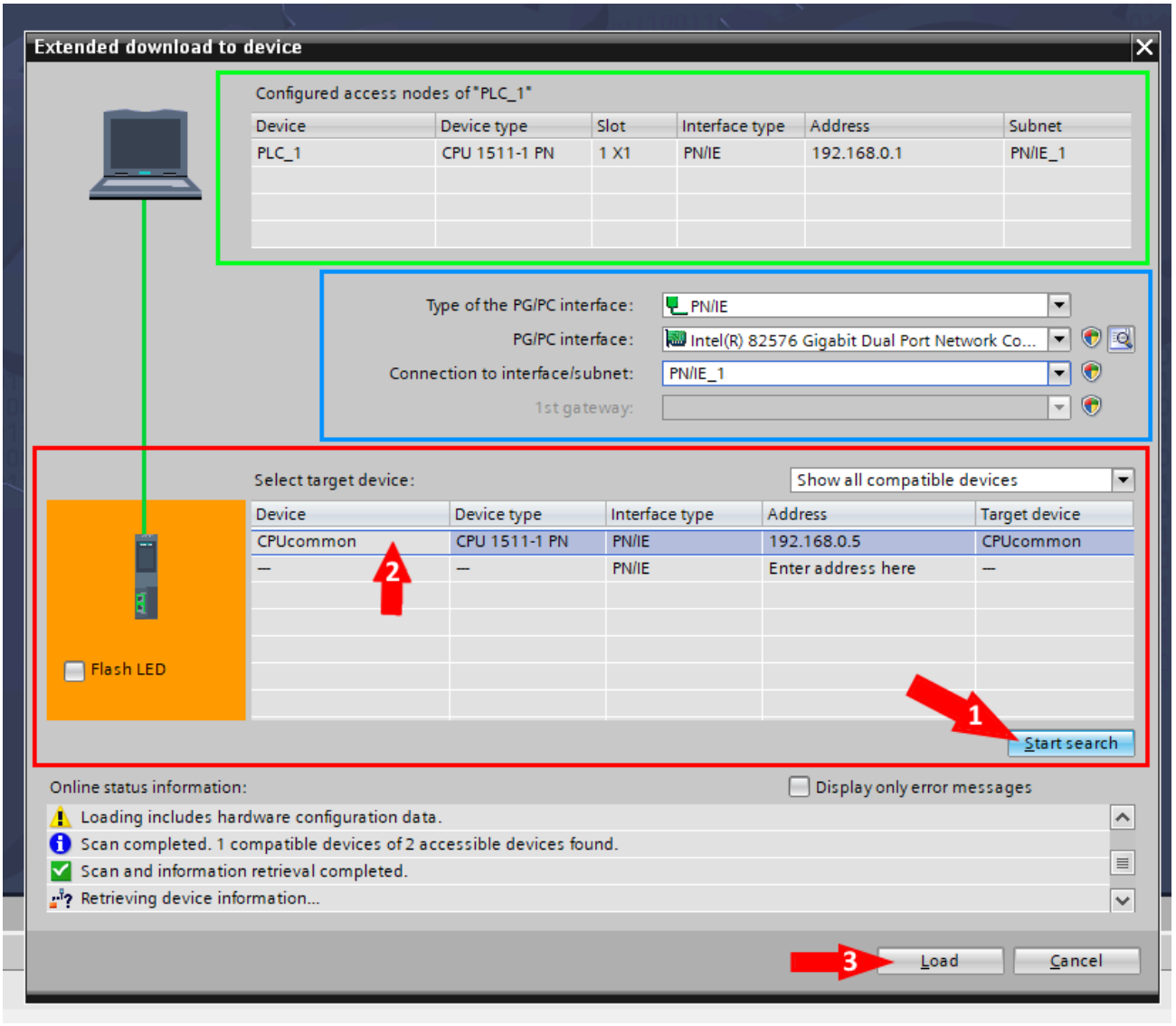
Now that we've configured our network, we should be able to run a simple test to make sure everything is working.

Download to your PLC

Right click on **PLC_1** in the device tree and select **Download to device** > **Software (all)**:



The **Extended download to device dialog** will appear.


Extended download to device
Configured access nodes of "PLC_1"
Device
Device type
Slot
Interface type
Address
Subnet
PLC_1
CPU 1511-1 PN
1 X1
PN/IE
192.168.0.1
PN/IE_1
Type of the PG/PC interface:
PN/IE
PG/PC interface:
Intel(R) 82576 Gigabit Dual Port Network Co...
Connection to interface/subnet:
PN/IE_1
1st gateway:
Select target device:
Show all compatible devices
Device
Device type
Interface type
Address
Target device
CPUcommon
CPU 1511-1 PN
PN/IE
192.168.0.5
CPUcommon

PN/IE
Enter address here

Flash LED
1
2
Start search
Online status information:
Display only error messages
Loading includes hardware configuration data.
Scan completed. 1 compatible devices of 2 accessible devices found.
Scan and information retrieval completed.
Retrieving device information...
3
Load
Cancel

INFO

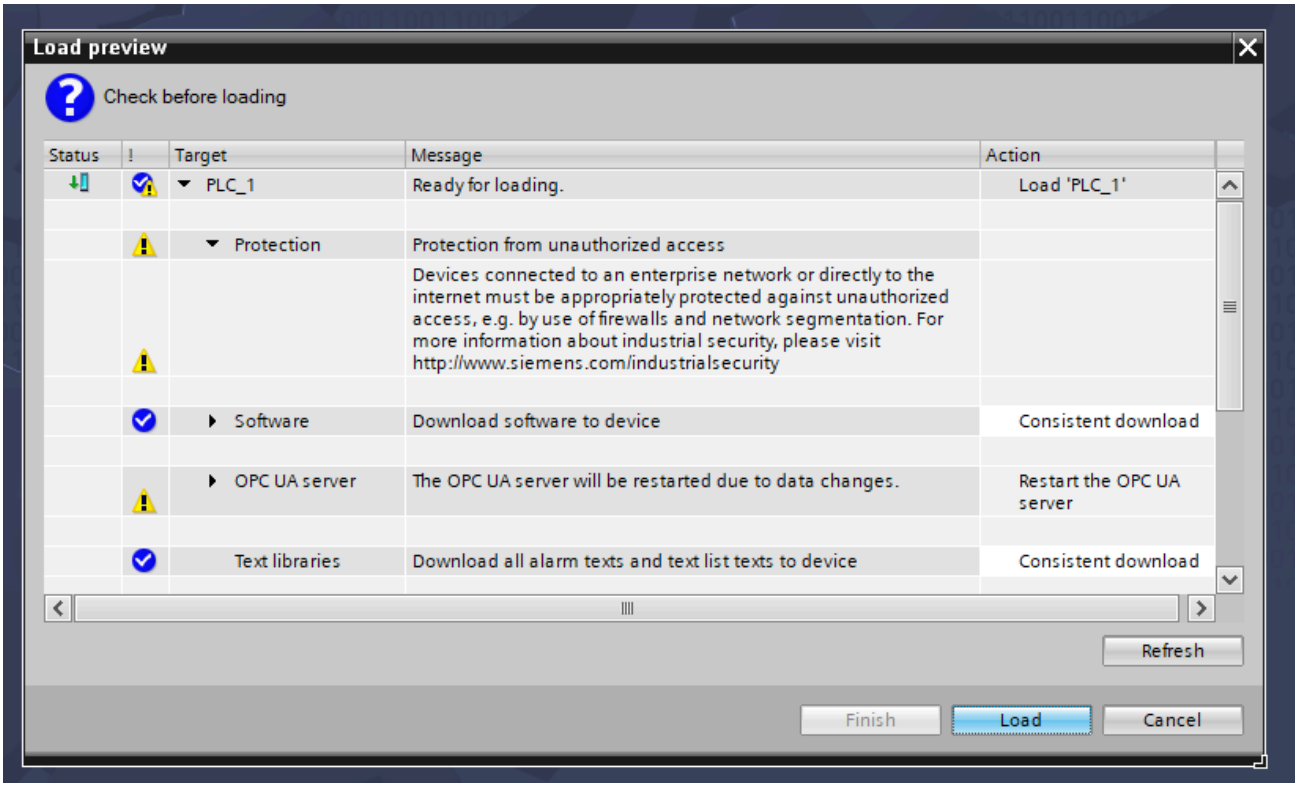
- The green box shows your provisioned network settings, in other words, what you *want* them to be.
- The red box shows the actual (current) network settings — the actual IP addresses of the PLC, Atom, etc.
- The blue box lets you configure the Ethernet interface on your PC and Profinet subnet to search for your PLC on.

Your PLC will automatically update the station names, IP addresses, and subnet masks that you set up in network provisioning when you start your PLC program, so you don't need to change them manually. The reason this dialog shows up is so that you can tell TIA which PLC to load the program on to.

Make sure **Show compatible devices** is selected, click **Start search**, wait for your PLC to appear, select it, then click **Load**. Notice that our PLC's actual IP address (`192.168.0.5`) isn't the same as the IP address we provisioned for it (`192.168.0.1`). This is fine, because we've linked our provisioned PLC to an actual PLC on the network, TIA knows whichs PLC to program and subsequently will update its network settings along with the network settings of all other Profinet devices on your provisioned network.

You may get a warning dialog like "**X.X.X.X** might not be a trustworthy device", click **Connect**:

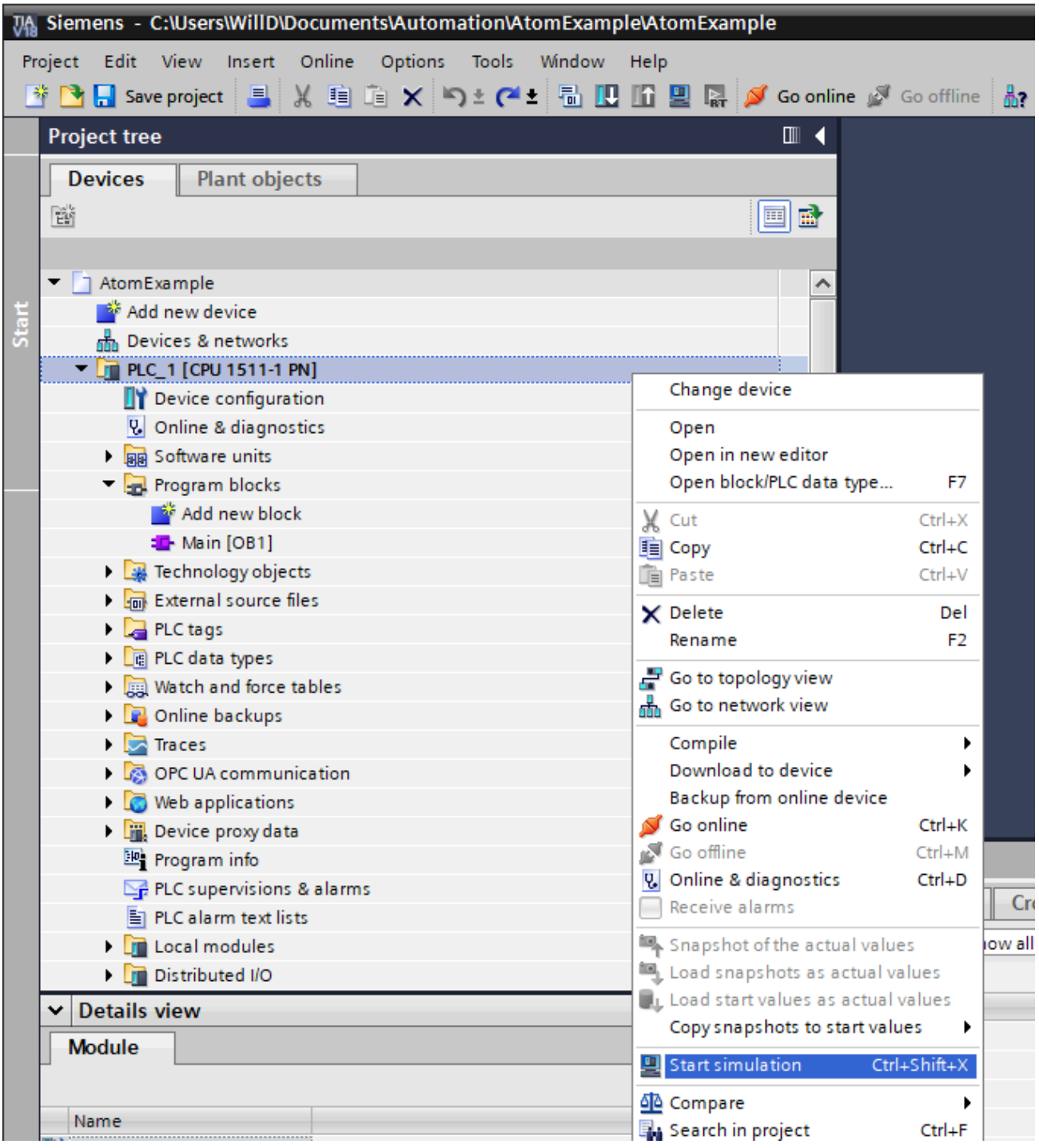
The **Load preview** dialog will open, when it finishes preparing, click **Load**.



> **INFO**
>
> If the load fails, see Troubleshooting.

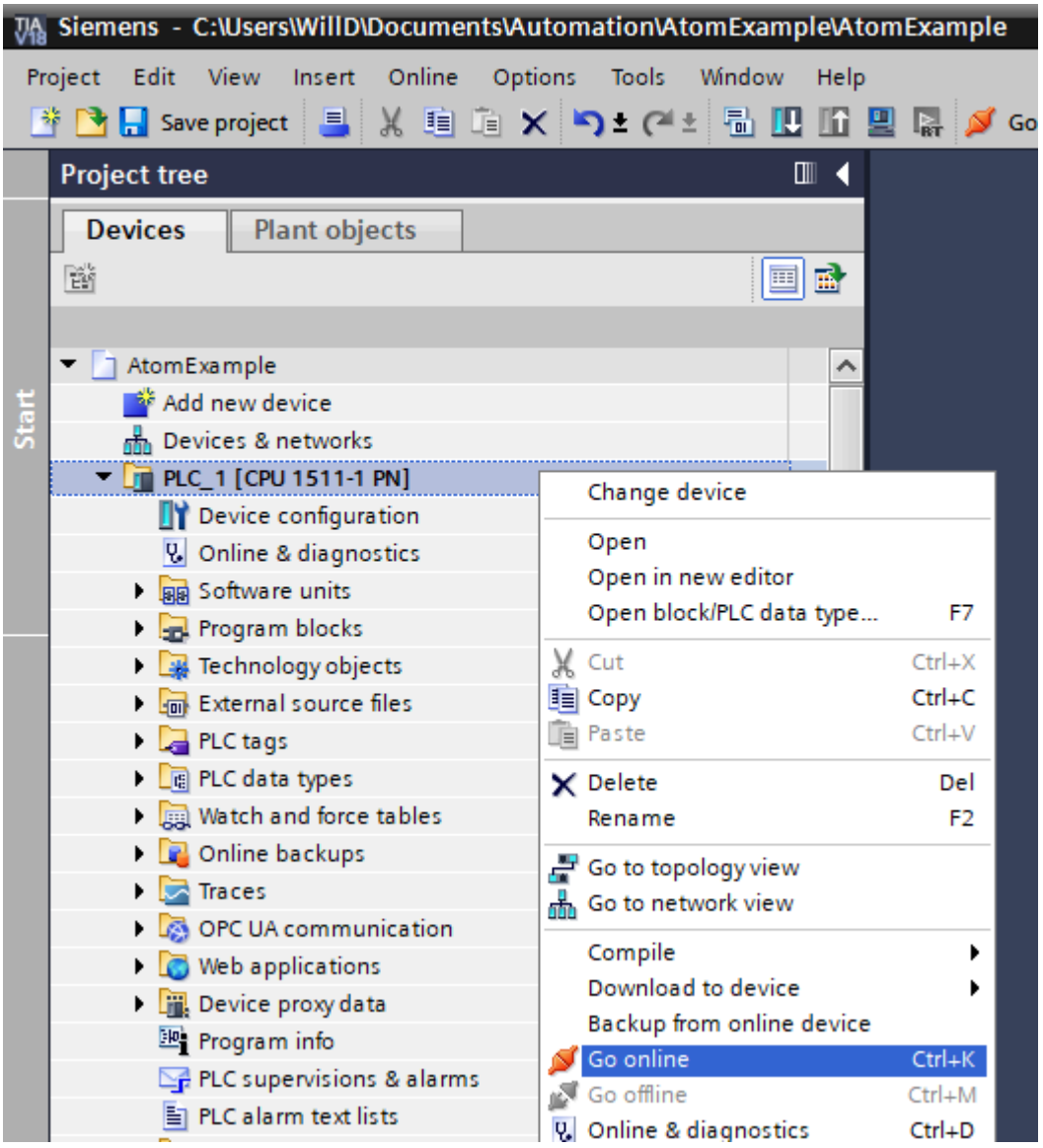
Use a simulator

If you don't have a real PLC handy, you can instead start the PLC simulator by right clicking **PLC_1** in the devices tree and selecting **Start simulation**:

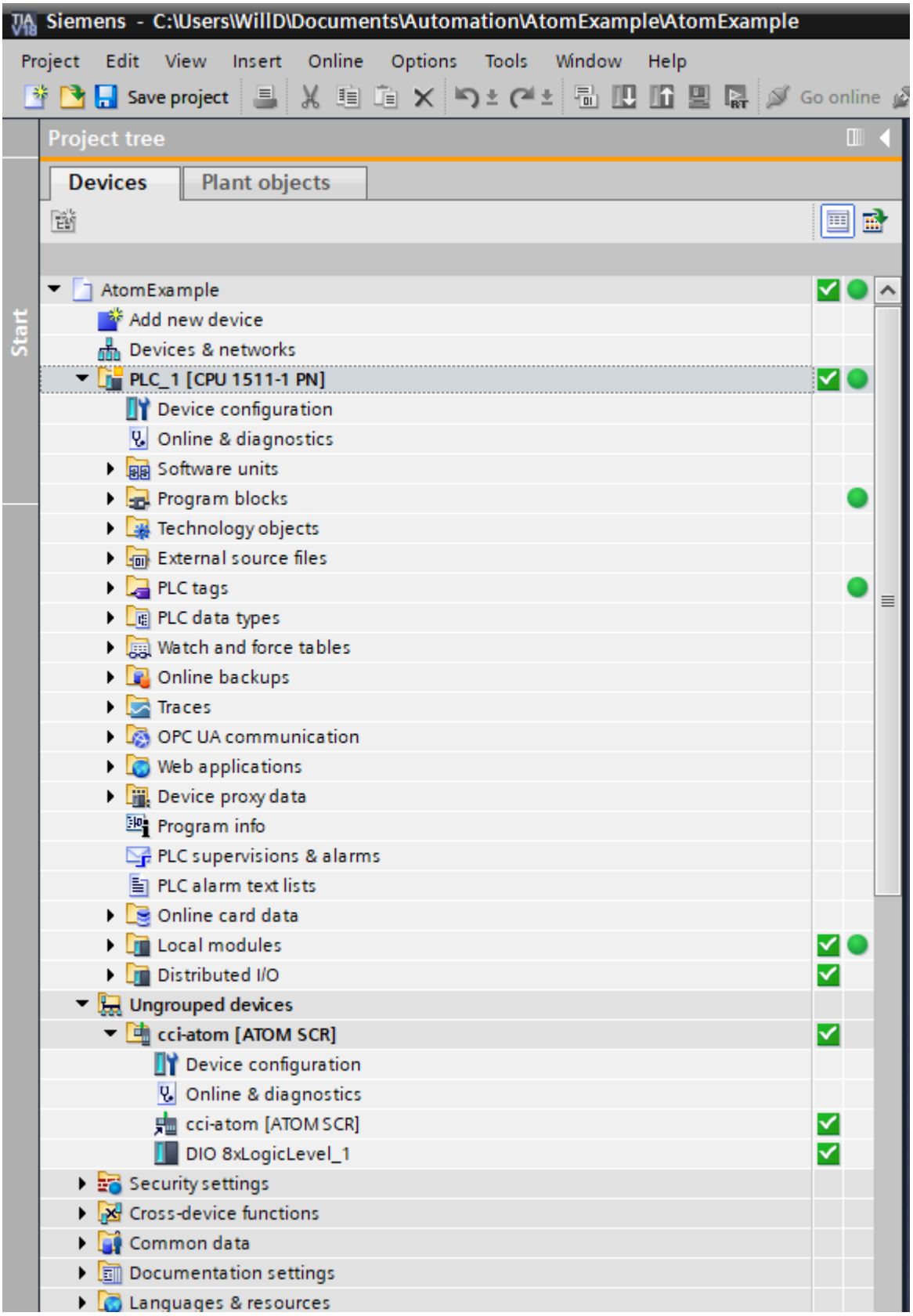


Monitor the heatsink temperature

Next, right click **PLC_1** in the device tree and select **Go online**:

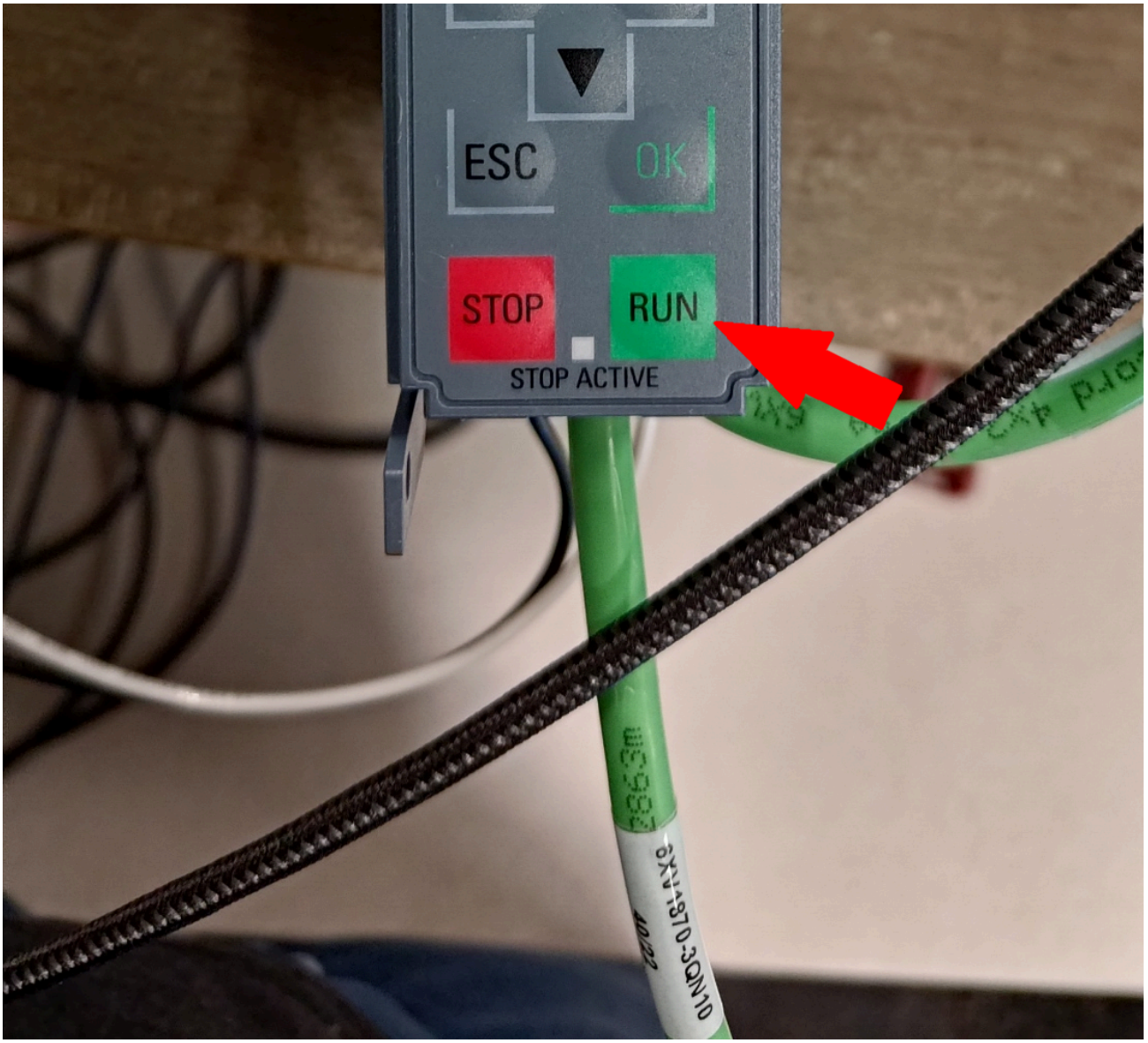


If everything goes well, your device tree should display green checkmarks over each device and their associated modules:

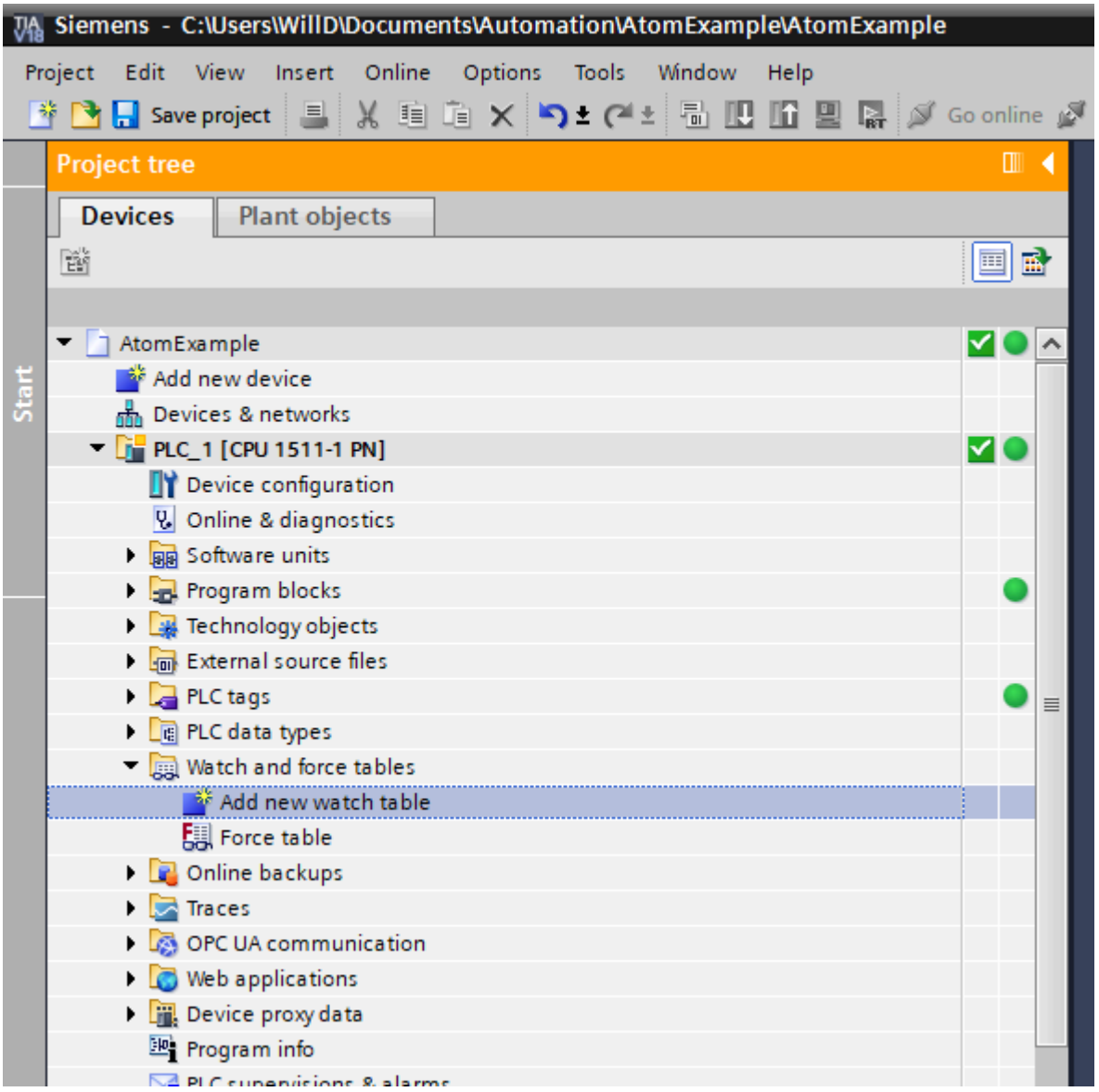

Siemens - C:\Users\WillD\Documents\Automation\AtomExample\AtomExample
Project Edit View Insert Online Options Tools Window Help
Save project
Go online
Project tree
Devices
Plant objects
Start
AtomExample
Add new device
Devices & networks
PLC_1 [CPU 1511-1 PN]
Device configuration
Online & diagnostics
Software units
Program blocks
Technology objects
External source files
PLC tags
PLC data types
Watch and force tables
Online backups
Traces
OPC UA communication
Web applications
Device proxy data
Program info
PLC supervisions & alarms
PLC alarm text lists
Online card data
Local modules
Distributed I/O
Ungrouped devices
cci-atom [ATOM SCR]
Device configuration
Online & diagnostics
cci-atom [ATOM SCR]
DIO 8xLogicLevel_1
Security settings
Cross-device functions
Common data
Documentation settings
Languages & resources

Open the case of your PLC and put it into **RUN** mode (or, if you're using the simulator, click **RUN** in the PLC simulator popup):

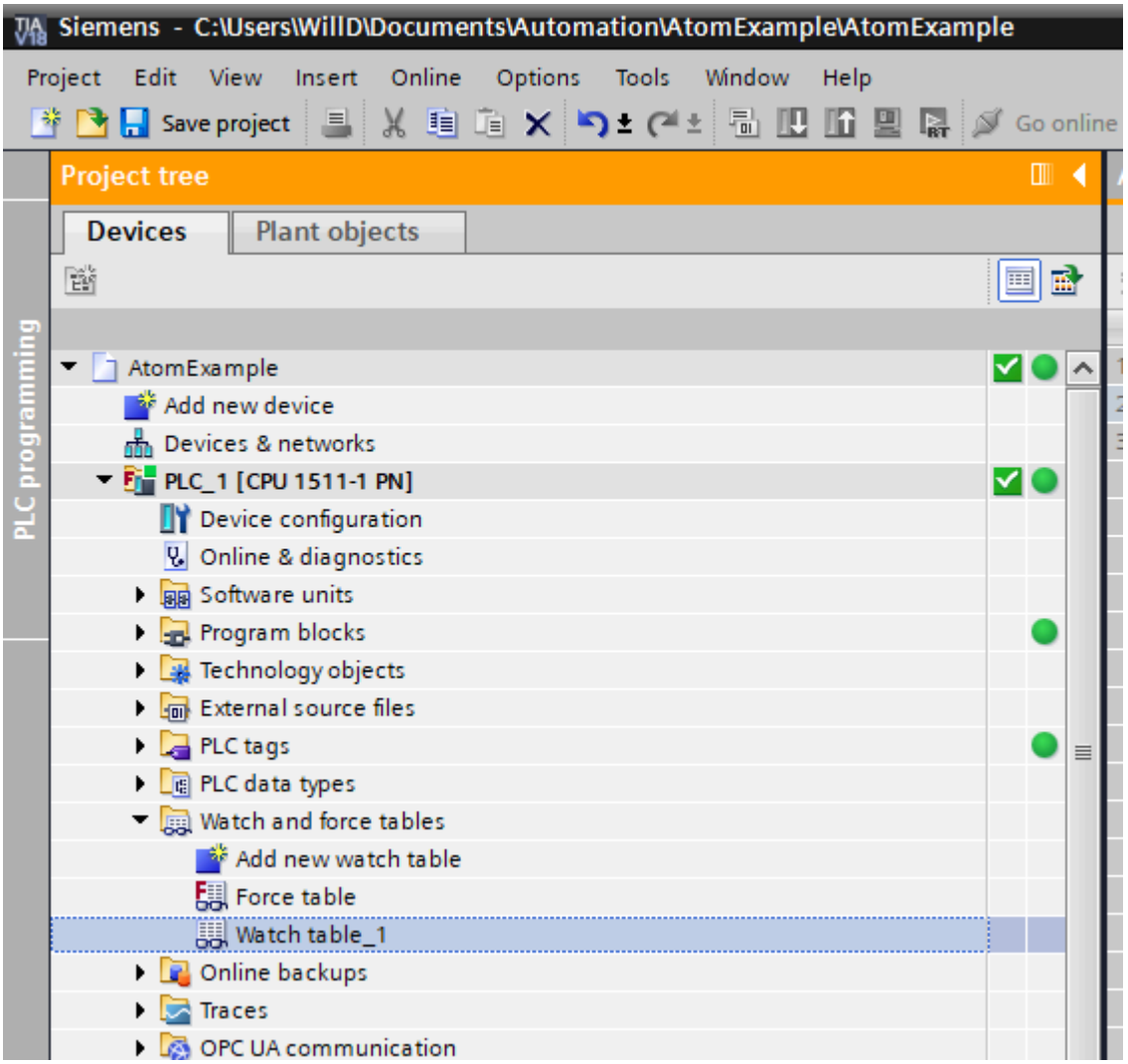

CPU 1511-1 PN
6ES7511-1AK02-0AB0
X67
RUN
Overview
OK
X1P1
X1P2
LINK
TX/RX
MAC ADD1
EC-1C-5D-
89-48-C3
MEAN WELL



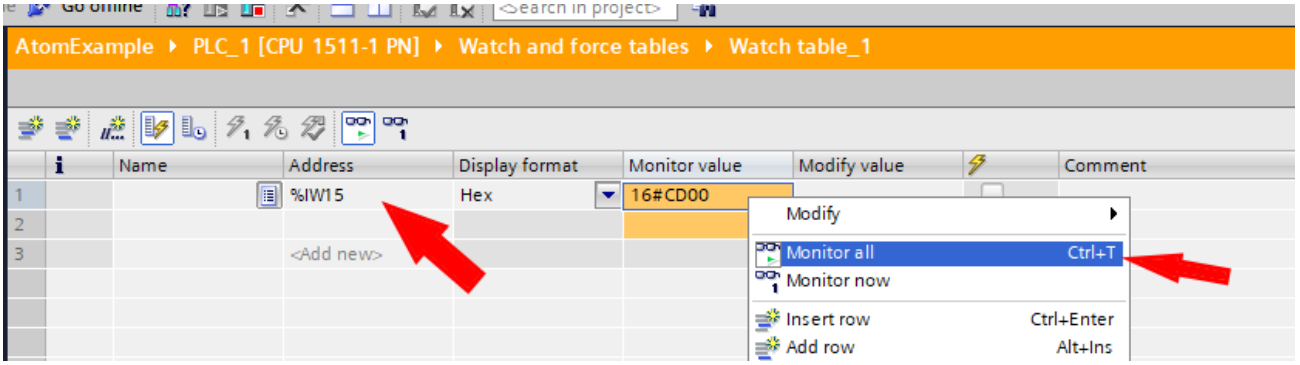
Next, expand **Watch and force tables** under **PLC_1** in the device tree and double click **Add new watch table**:



Double click the newly created watch table **Watch table_1** to open it:



On the first row, enter `%IW15`, then right click the row and select **Monitor all**. `%IW15` is short for input word #15, which corresponds to the low-order word of the heatsink temperature parameter. After clicking **Monitor all**, you should see the value update to a non-zero value. If it does, this means your PLC is successfully talking to Atom over Profinet!

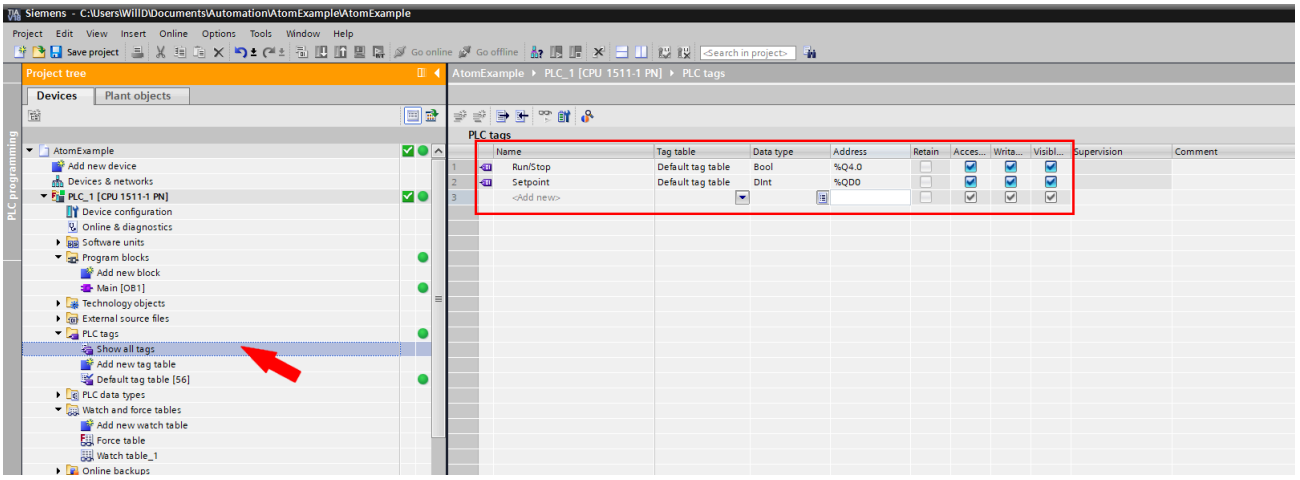


Building a simple PLC program to control Atom

Writing some ladder logic

In the devices tree, expand **PLC_1** > **PLC tags** and double click **Show all tags**. Create two tags:

- Tag #1
  - Name: `Run/Stop`
  - Data type: `Bool`
  - Address: `%Q4.0`
- Tag #2
  - Name: `Setpoint`
  - Data type: `Dint`
  - Address: `%QD0`



Next, in the device tree, expand **PLC_1** > **Program blocks** and double click **Main [OB1]**.

First, create two constants:

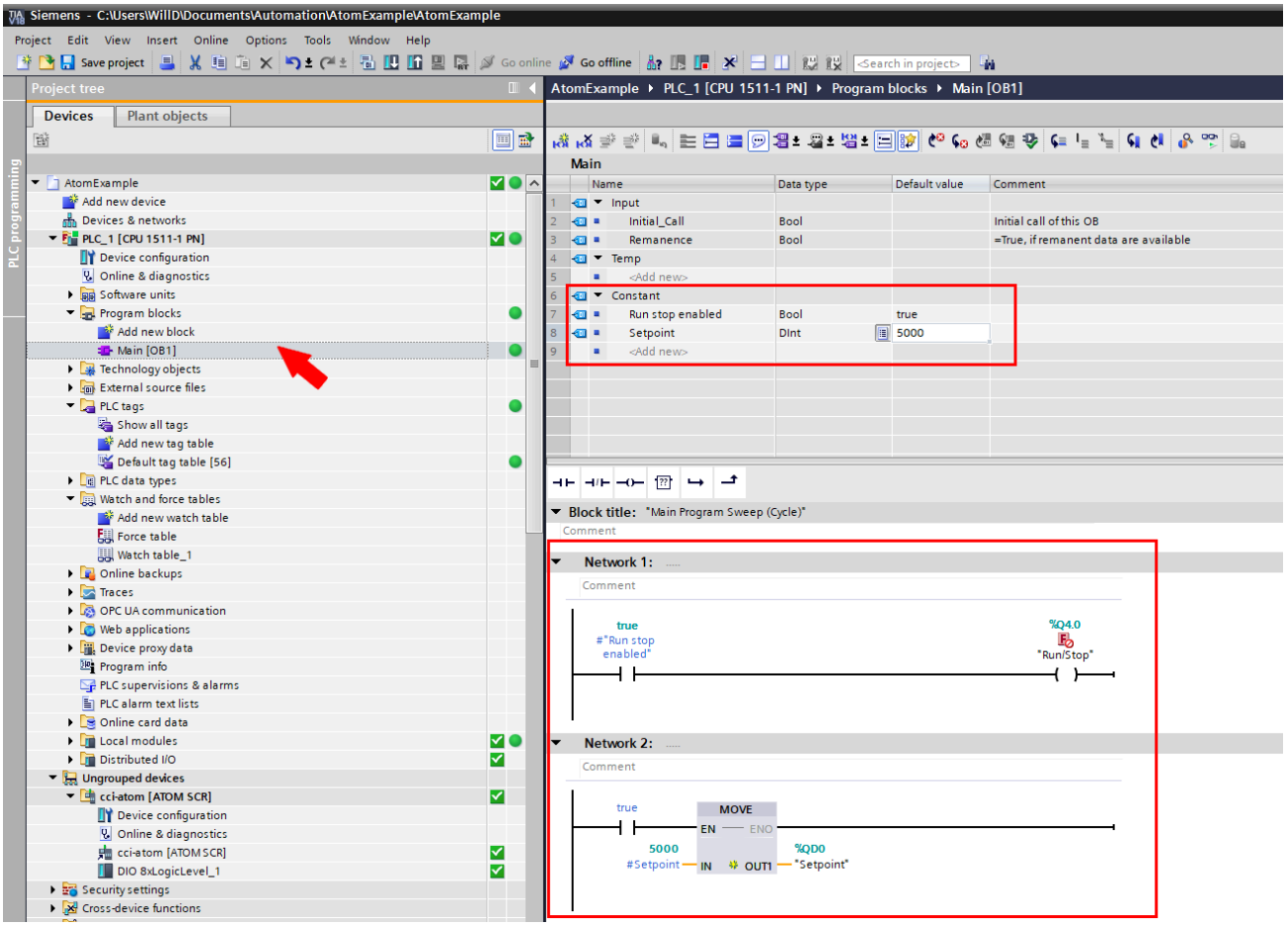
- Name: `Run stop enabled`, Data type: `Bool`, Default value: `true`
- Name: `Setpoint`, Data type: `Dint`, Default value: `5000`

These are the values we will ultimately set to Atom.

Next, create two networks.

- Network #1
  - Insert a **contact** on the left, and drag the `Run stop enabled` constant into it.
  - Insert an **assignment** on the right, and enter `%Q4.0`
- Network #2
  - Insert a **MOVE** block
    - Insert a **contact** on the **EN** input, and set its value to `true`
    - Drag the `Setpoint` constant into the **IN** input
    - Enter `%QD0` into the **OUT1** output

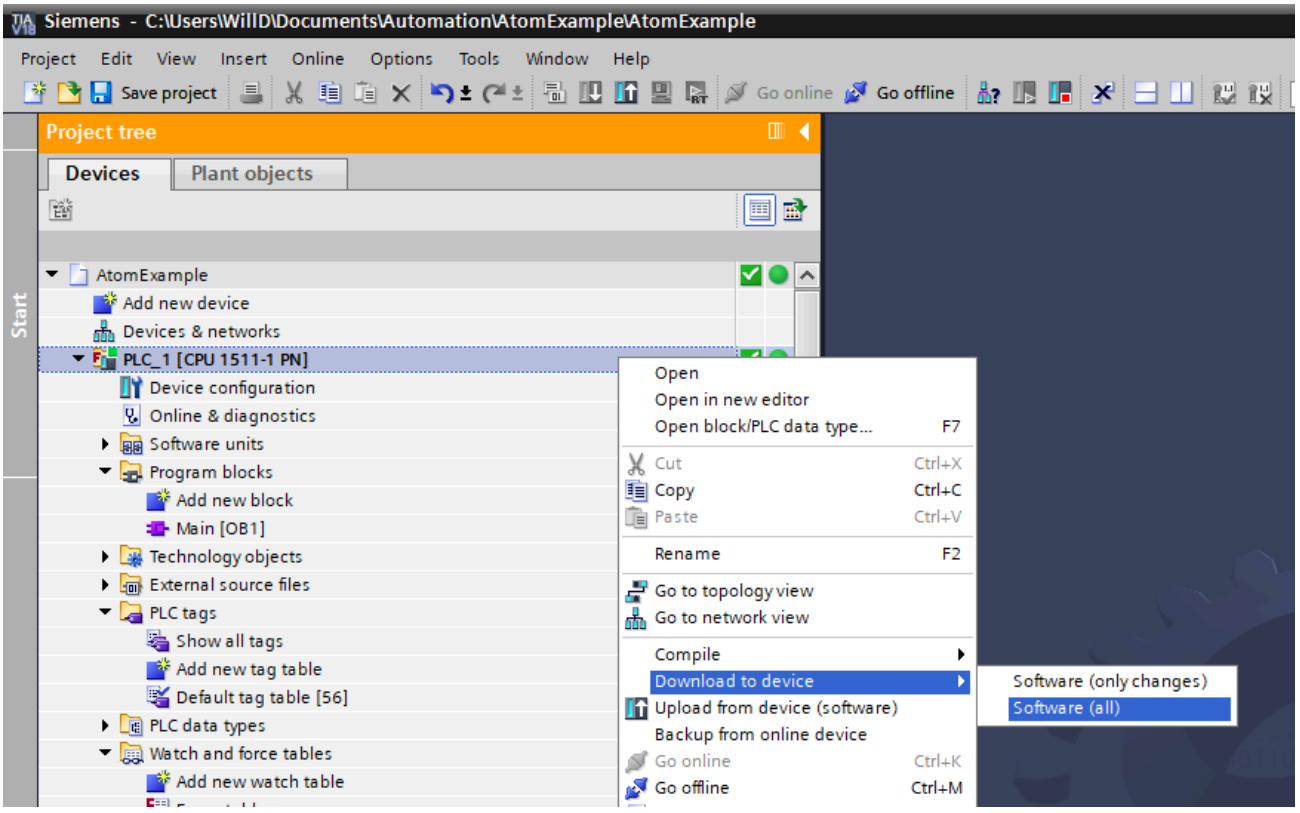
After you're done, your PLC program should look like this (you can also download the example project with the completed program):



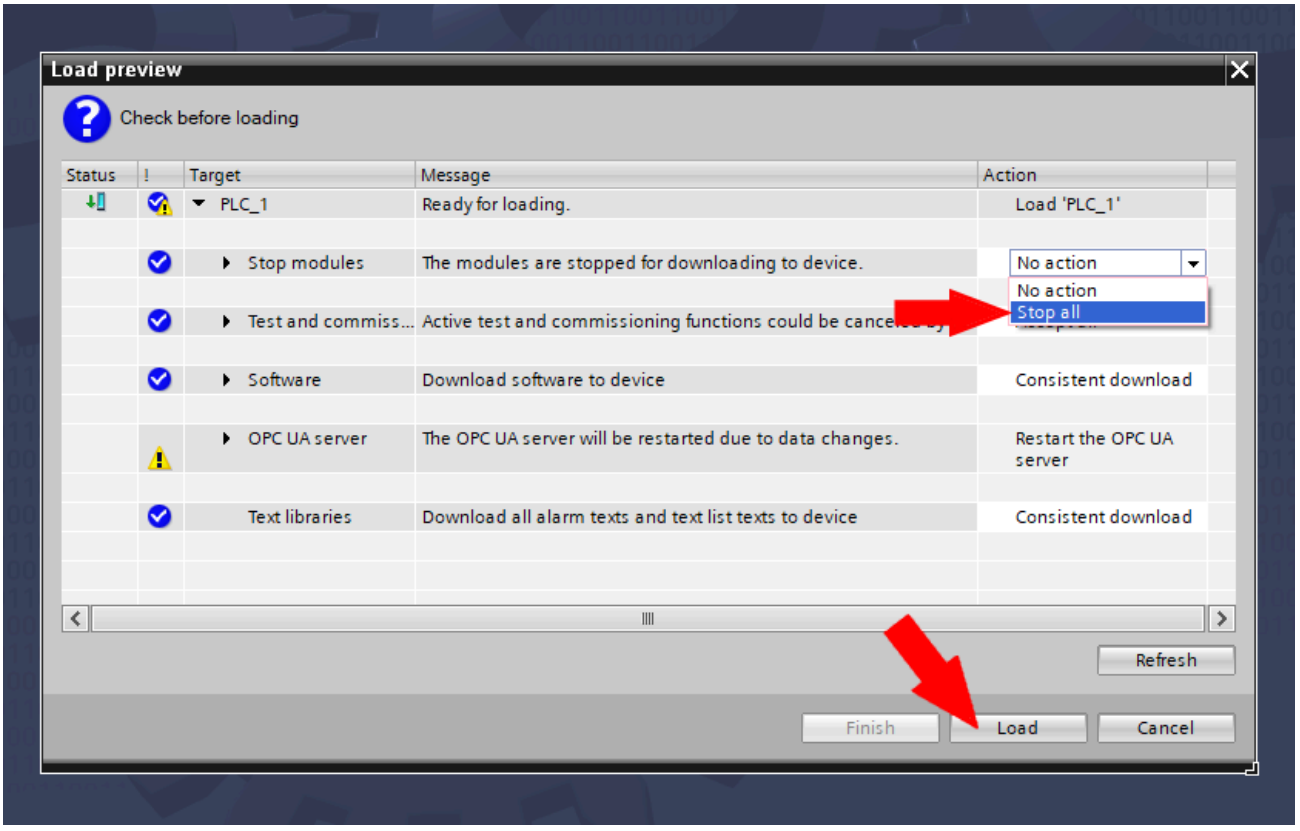
Running on your PLC

> **INFO**
>
> This will still work if you're running a simulator, make sure you started the simulation as shown in Use a simulator.

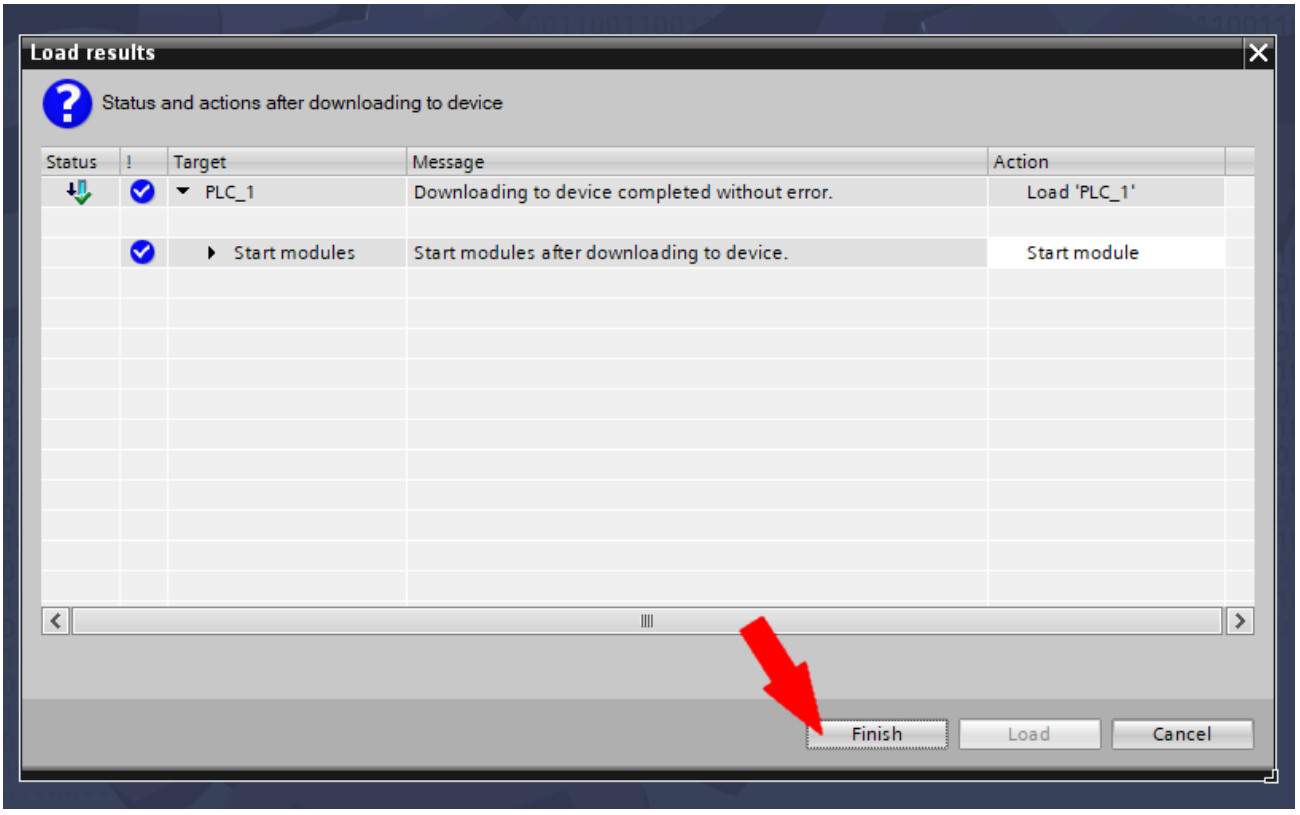
Right click **PLC_1** in the devices tree, select **Download to device** > **Software (all)**:



A **Load preview** dialog will show up, if your PLC was previously running, you may have to set the **Stop modules** action to **Stop all**. Then, click **Load**:

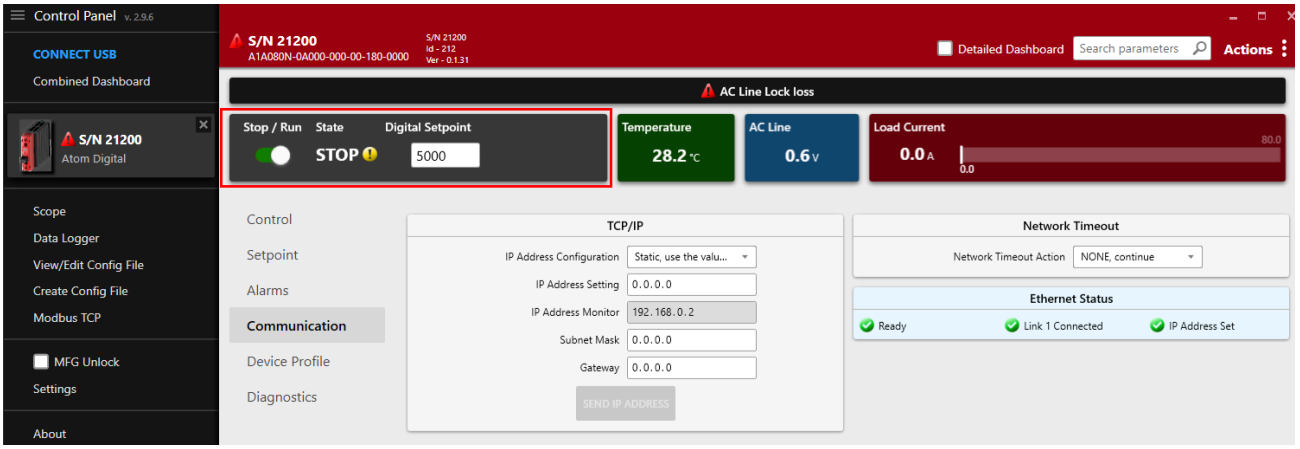


If the load fails, check out Troubleshooting. Otherwise, click **Finish**:



Make sure your PLC is set to RUN. If everything worked, the PLC will put Atom into RUN with a setpoint of `5000`. If you connect a USB cable to your Atom and look in Control Panel, you should see the setpoint and run/stop parameters update.

> **INFO**
>
> Try switching the **Stop / Run** switch *off* in Control Panel or updating the setpoint. Notice that the PLC immediately sets the run/stop and setpoint parameters back to their original values.

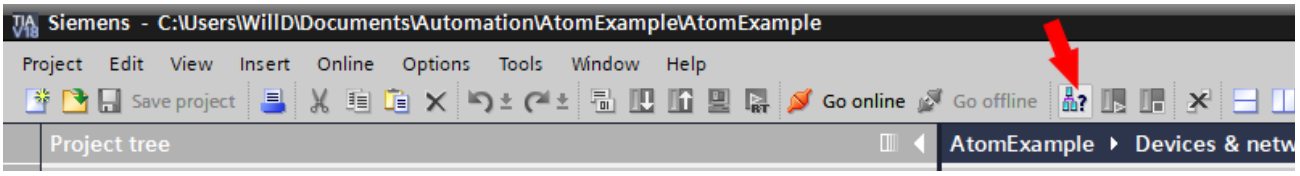


Troubleshooting

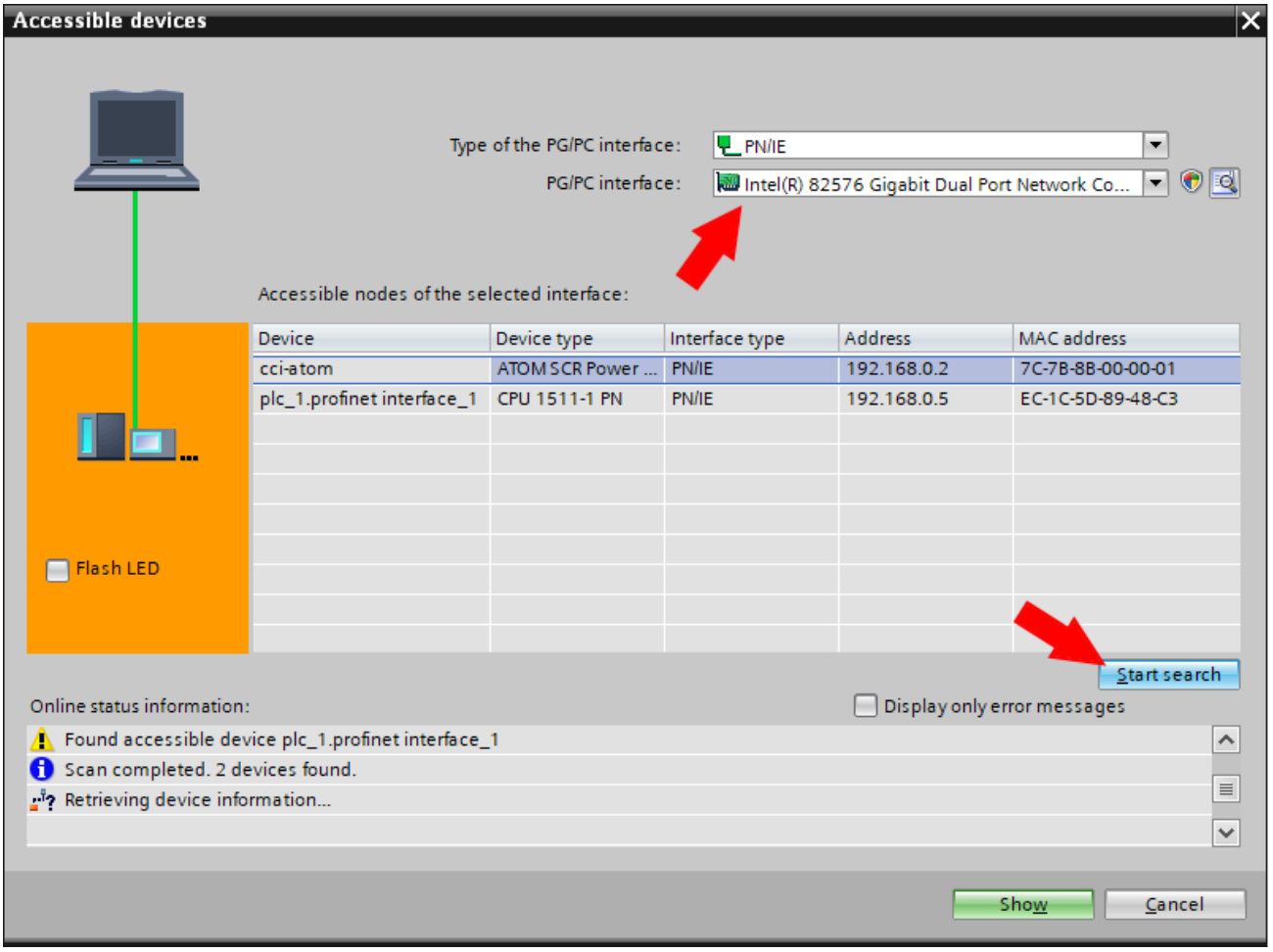
Download to PLC fails

If the download to your PLC fails, you can try resetting your PLC.

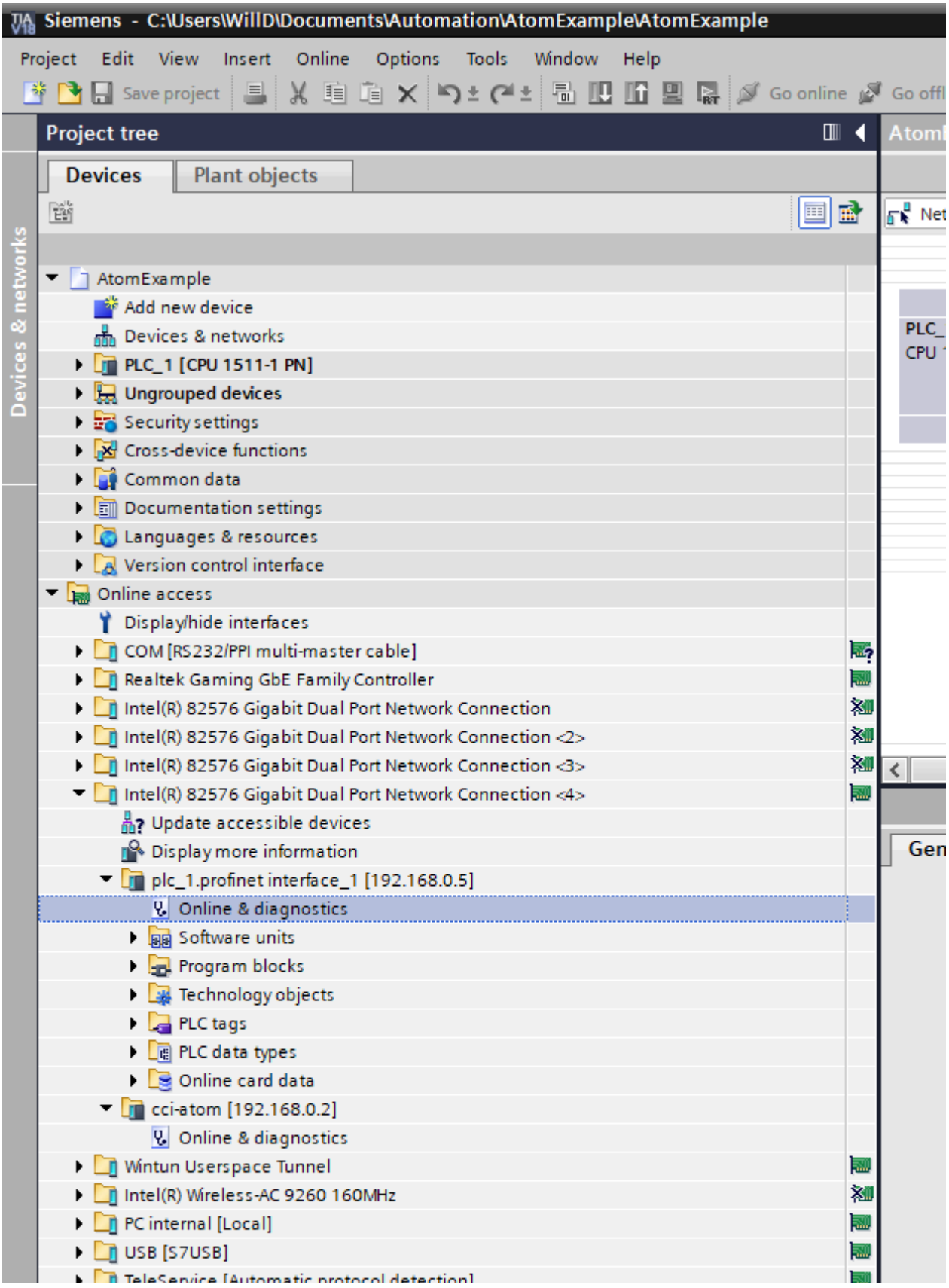
First, click the **Accessible devices** icon in the menu bar:

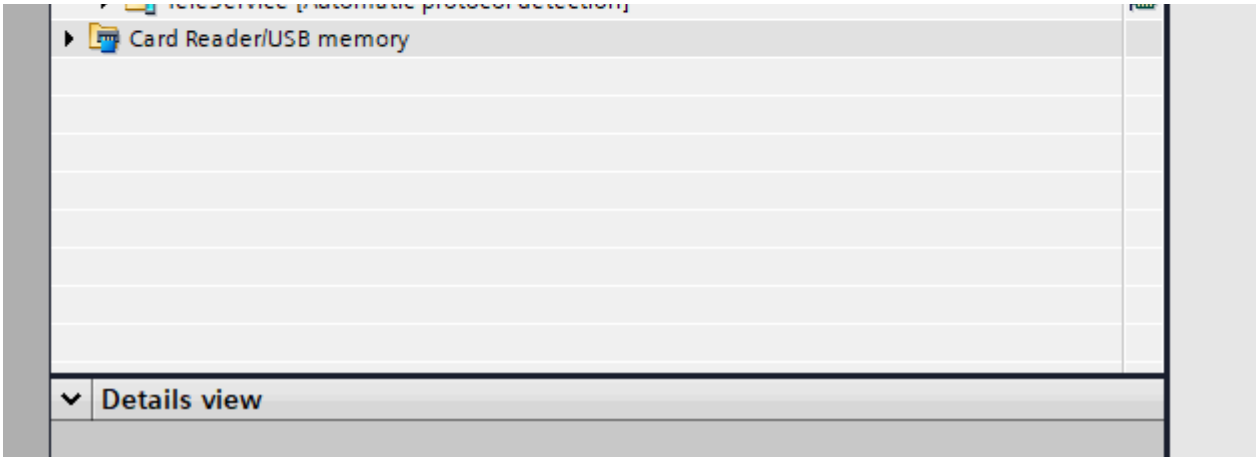


When the **Accessible devices** dialog appears, select the network adapter on your PC that is connected to your PLC and click **Start search**:

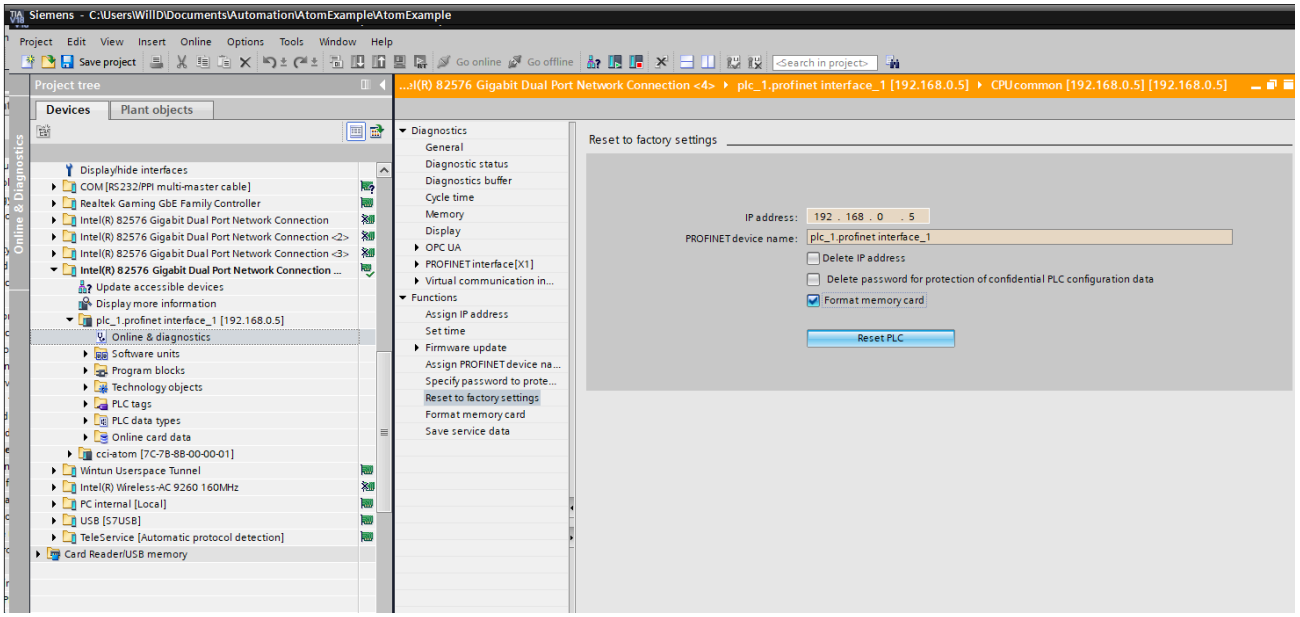


In the devices tree, expand **Online access** > Your PC's network adapter connected to your PLC > **plc_1.profinet interface_1 (192.168.0.05)** (may be different for you) > **Online & diagnostics**:


Siemens - C:\Users\WillD\Documents\Automation\AtomExample\AtomExample
Project Edit View Insert Online Options Tools Window Help
Save project
Go online
Project tree
Devices
Plant objects
Devices & networks
AtomExample
Add new device
Devices & networks
PLC_1 [CPU 1511-1 PN]
Ungrouped devices
Security settings
Cross-device functions
Common data
Documentation settings
Languages & resources
Version control interface
Online access
Display/hide interfaces
COM [RS232/PPI multi-master cable]
Realtek Gaming GbE Family Controller
Intel(R) 82576 Gigabit Dual Port Network Connection
Intel(R) 82576 Gigabit Dual Port Network Connection <2>
Intel(R) 82576 Gigabit Dual Port Network Connection <3>
Intel(R) 82576 Gigabit Dual Port Network Connection <4>
Update accessible devices
Display more information
plc_1.profinet interface_1 [192.168.0.5]
Online & diagnostics
Software units
Program blocks
Technology objects
PLC tags
PLC data types
Online card data
cci-atom [192.168.0.2]
Online & diagnostics
Wintun Userspace Tunnel
Intel(R) Wireless-AC 9260 160MHz
PC internal [Local]
USB [S7USB]



Expand **Functions** > **Reset to factory settings**, check **Format memory card**, then click **Reset PLC**:



ATOM / Fieldbus / PROFINET / Codesys

In this tutorial, you'll learn how to use Codesys with the SoftPLC emulator to connect to ATOM using Profinet and perform some basic operations and monitor data. You can follow along using the SoftPLC emulator or your own PLC.

We provide examples for both ladder logic and structured text.

If you haven't yet, please review ATOM's Profinet Profile.

If you'd like to skip the tutorial, you can download a completed example project:

- Download ATOM_Codesys_Profinet_LadderLogic_Example.zip
- Download ATOM_Codesys_Profinet_StructuredText_Example.zip

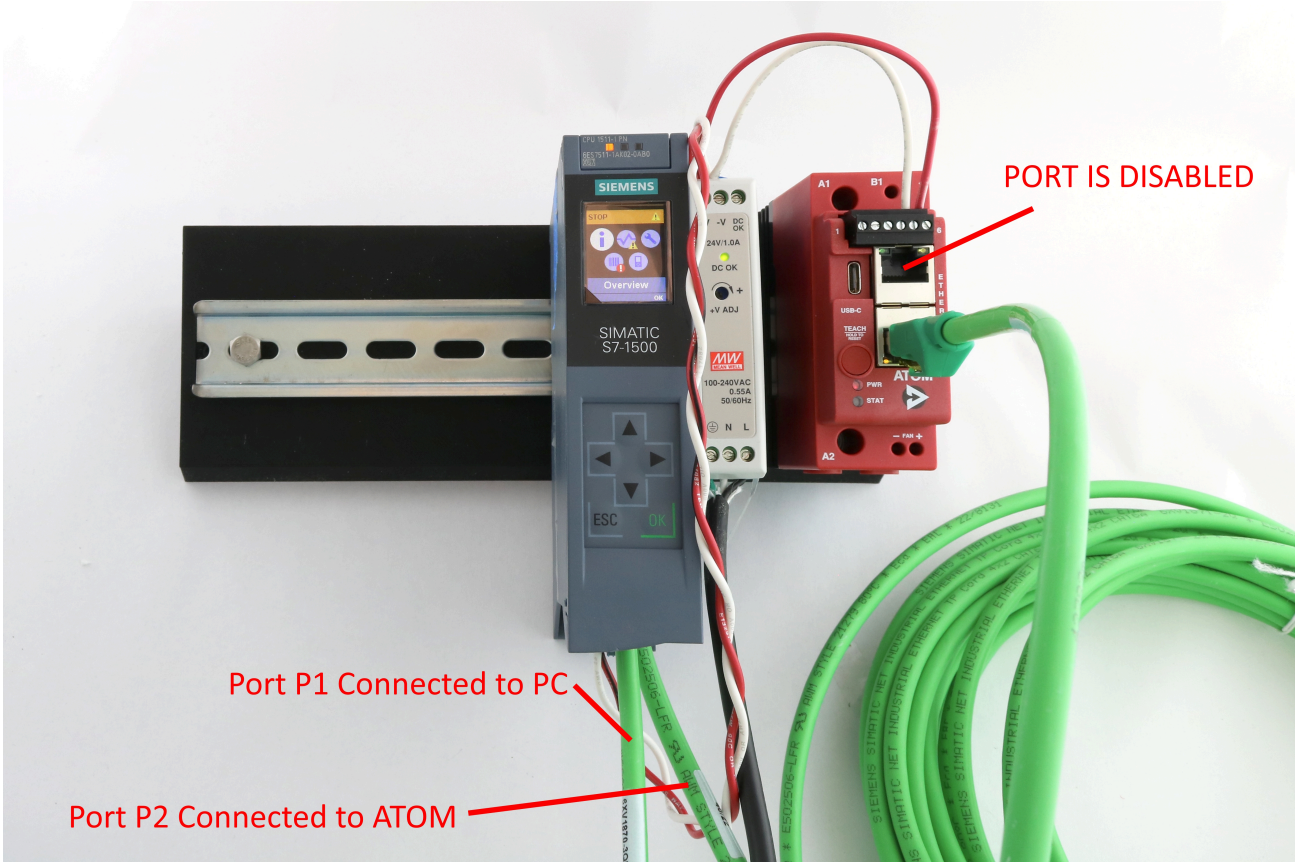
Prerequisites

1. Install Codesys
2. Download ATOM's GSDML file

Hardware setup

> **IMPORTANT**
>
> When Atom is configured for Profinet, the Ethernet port closest to the 24V power connector is **disabled**. You must use opposing Ethernet port nearest the reset button as shown below or the PLC won't be able to connect to Atom.

Connect 24V to your PLC and Atom unit with the provided power cable. Connect Atom to your PC with an Ethernet cable.



INFO

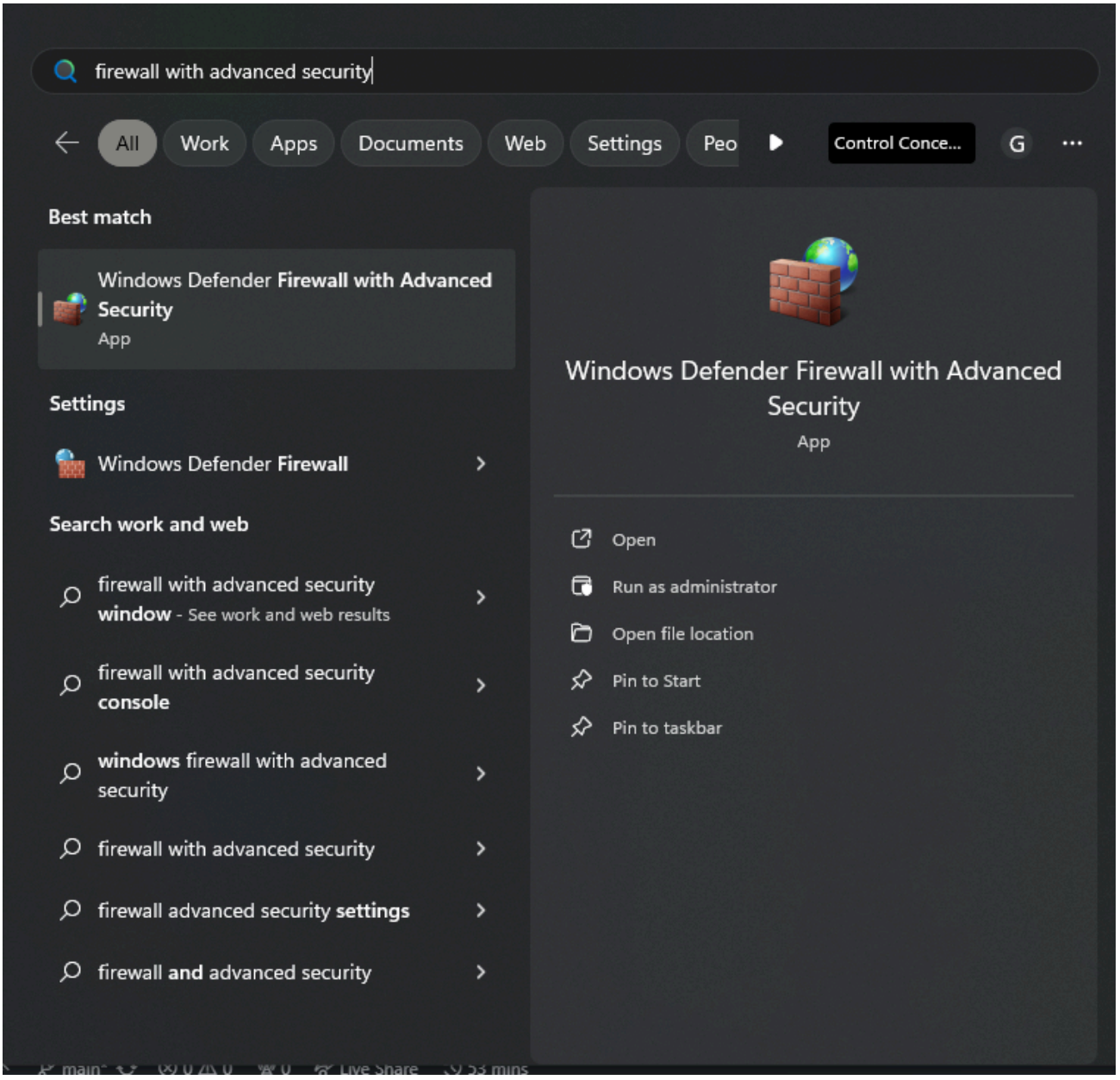
To simplify this diagram, we have not connected a load to Atom. You may connect a load or leave it disconnected, either way is fine for the purposes of this tutorial.

If you do not connect a load, you can still verify your PLC is working by connecting a USB cable to Atom and using Control Panel to watch the parameters change/verify the PLC is receiving the correct monitor data.

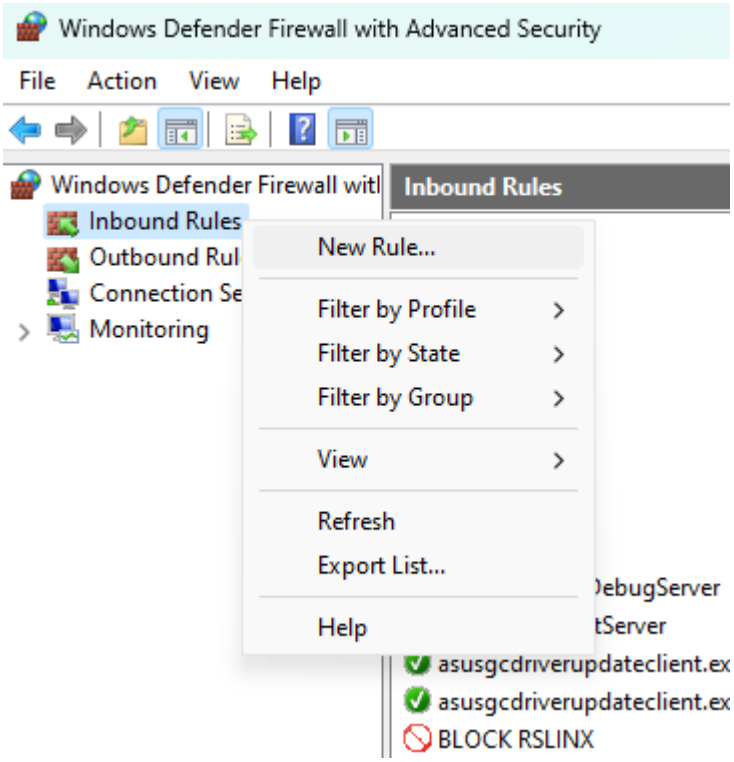
Configure Windows firewall

Codesys requires you to allow incoming Profinet UDP packets through the Windows firewall so that the SoftPLC is able to receive UDP Profinet requests from Atom.

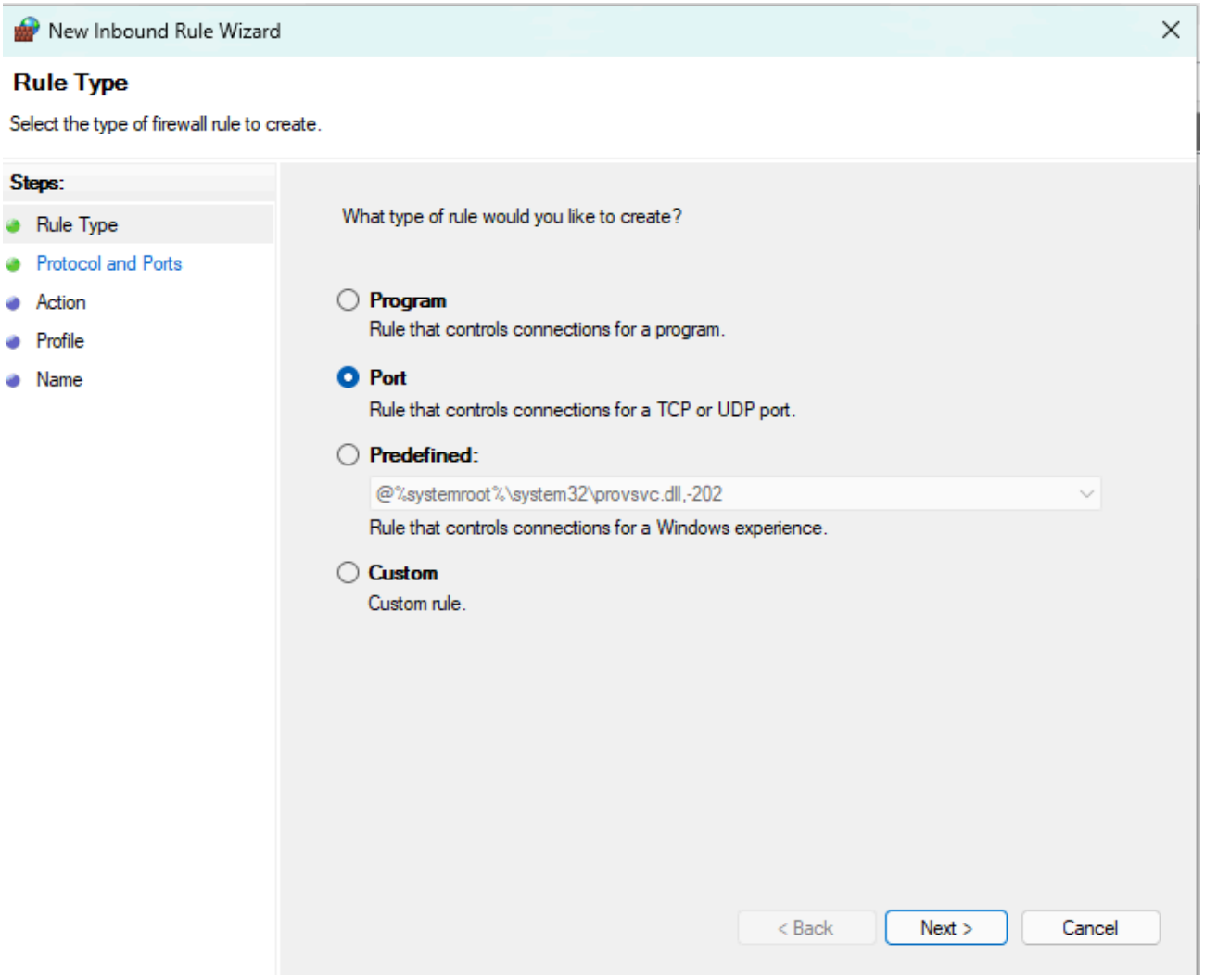
1. First, search for **Windows Defender Firewall with Advanced Security** and open it:



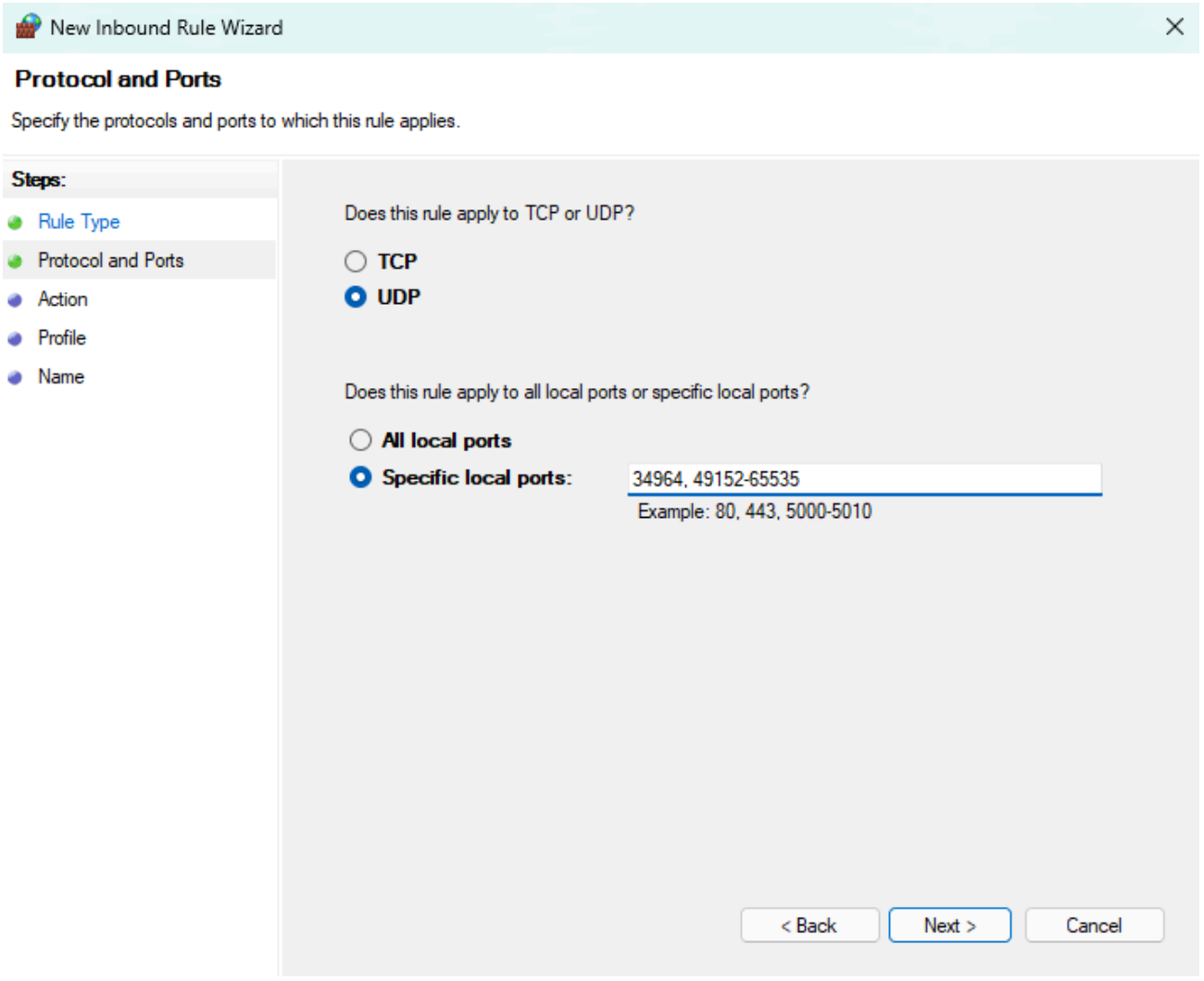
2. Right click on **Inbound Rules** and select **New Rule**:



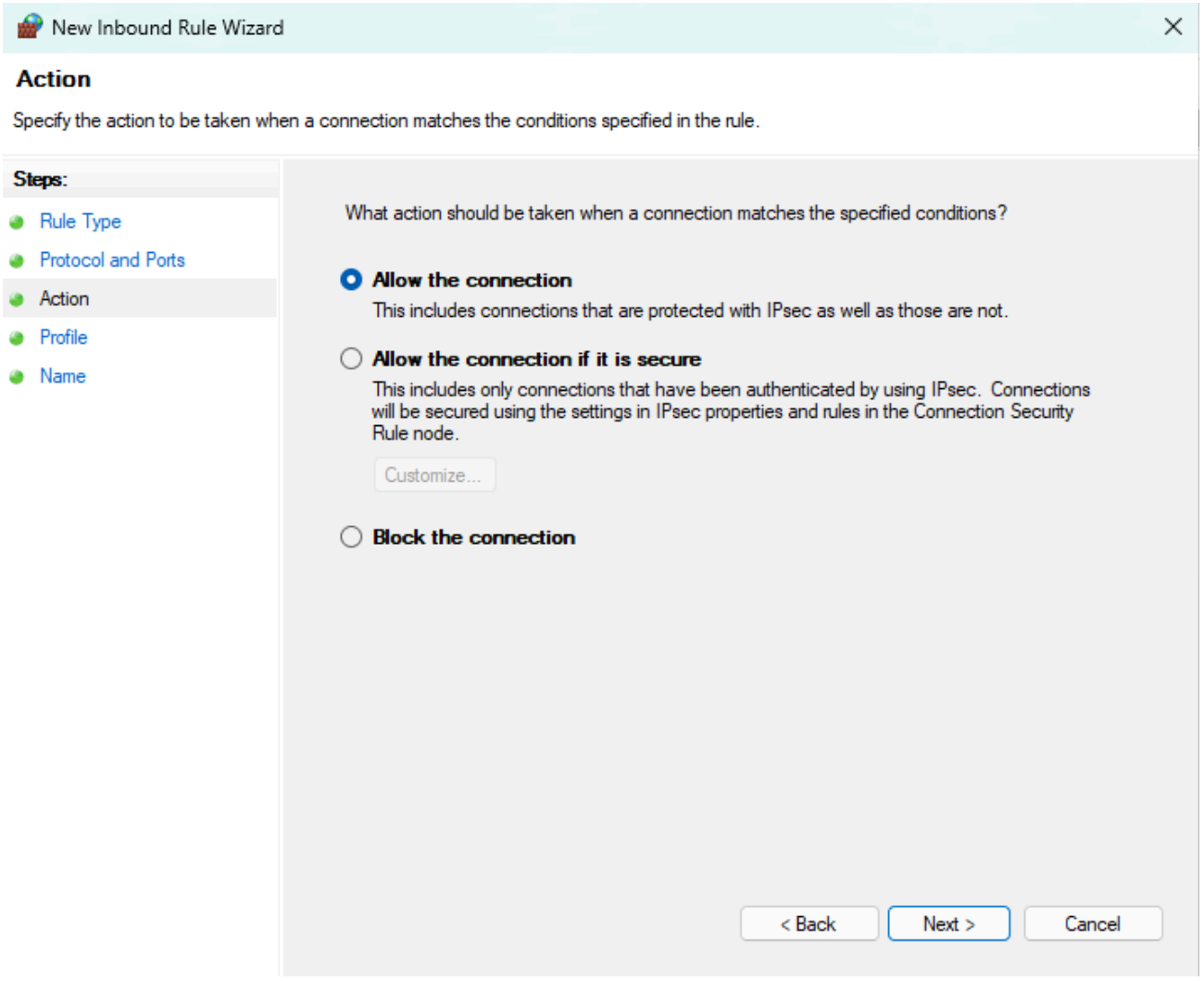
3. Select **Port**, then click **Next**:



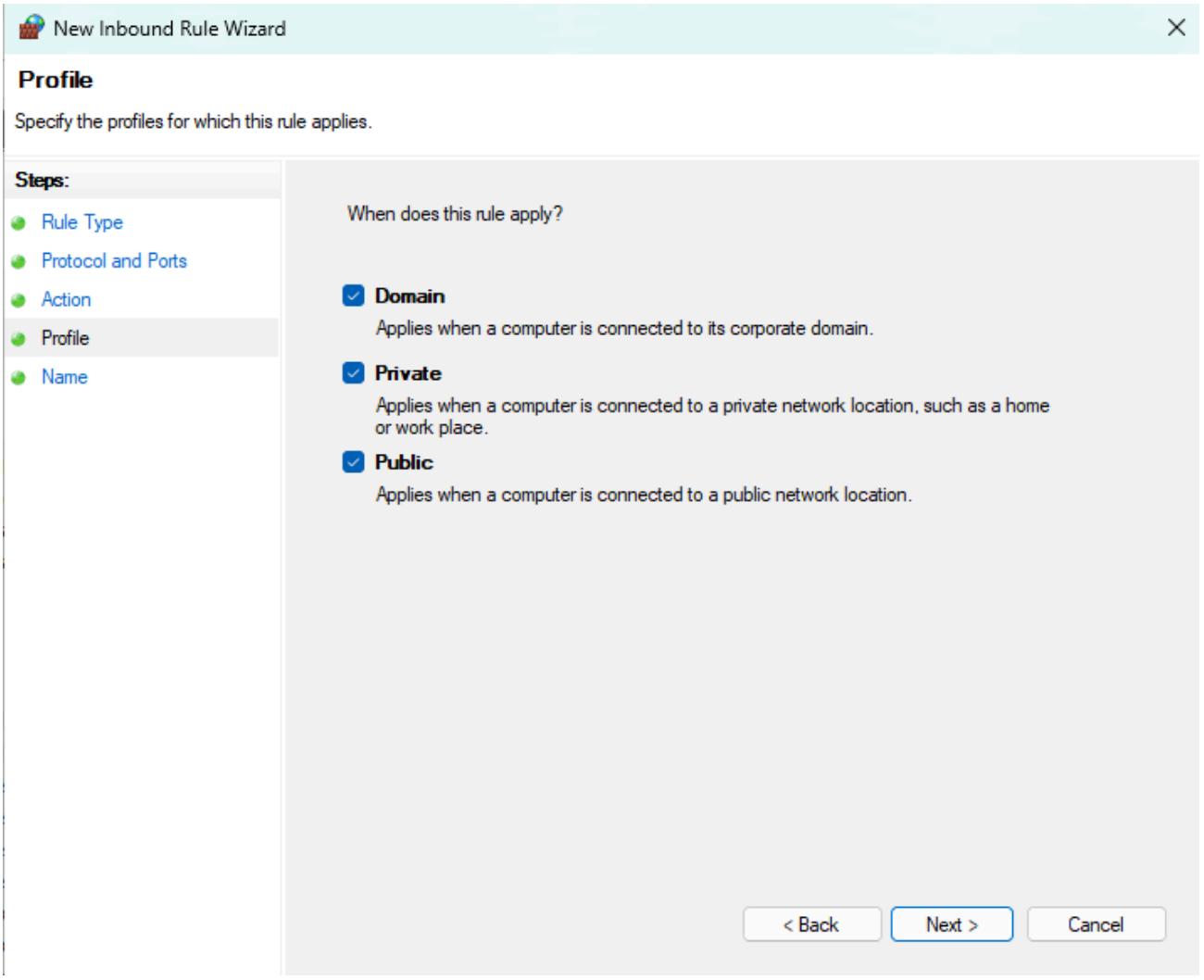
4. Select **UDP**, then select **Specific local ports** and enter `34964, 49152-65535`, then click **Next**:



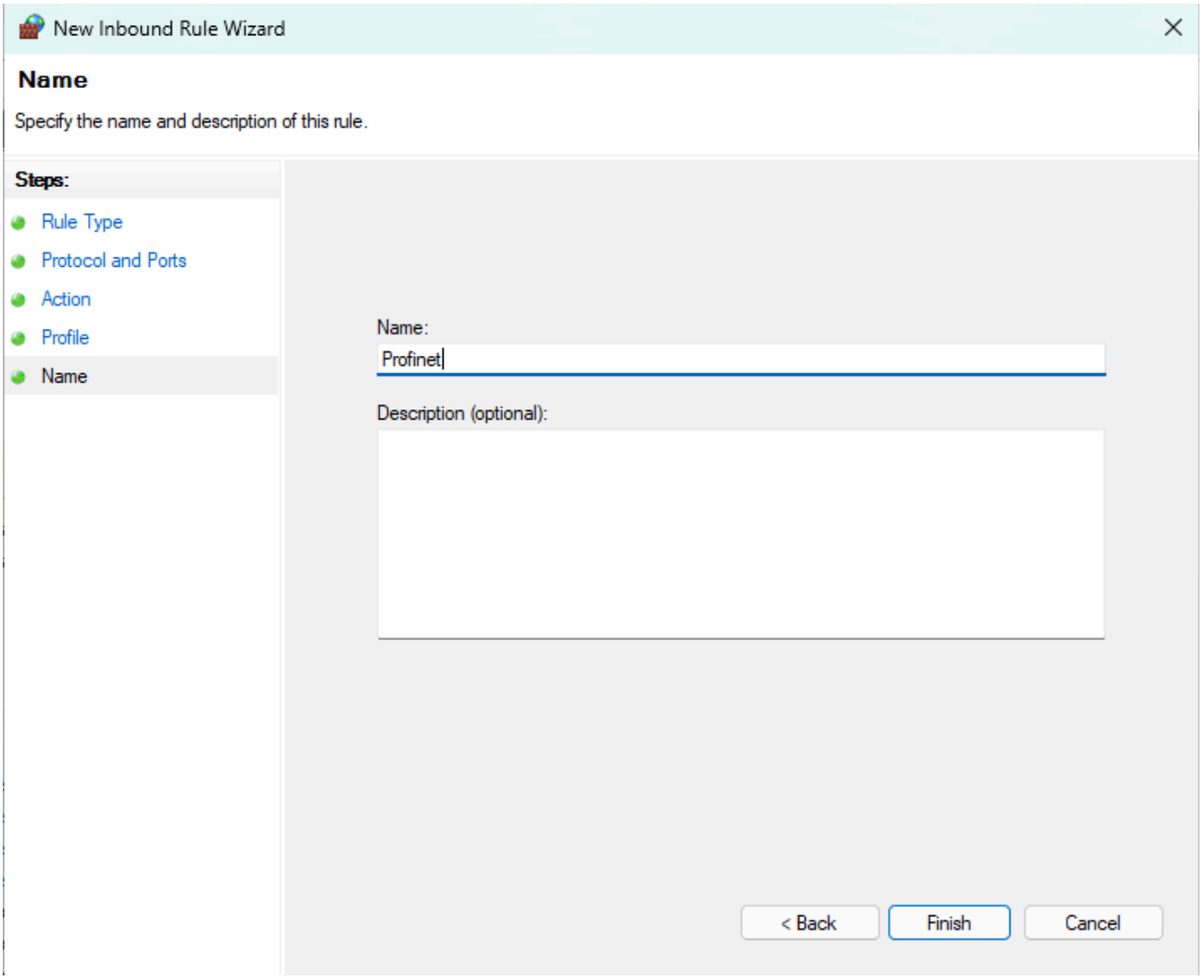
5. Select **Allow the connection**, then click **Next**:



6. Select which network types this rule applies to, then click **Next**:

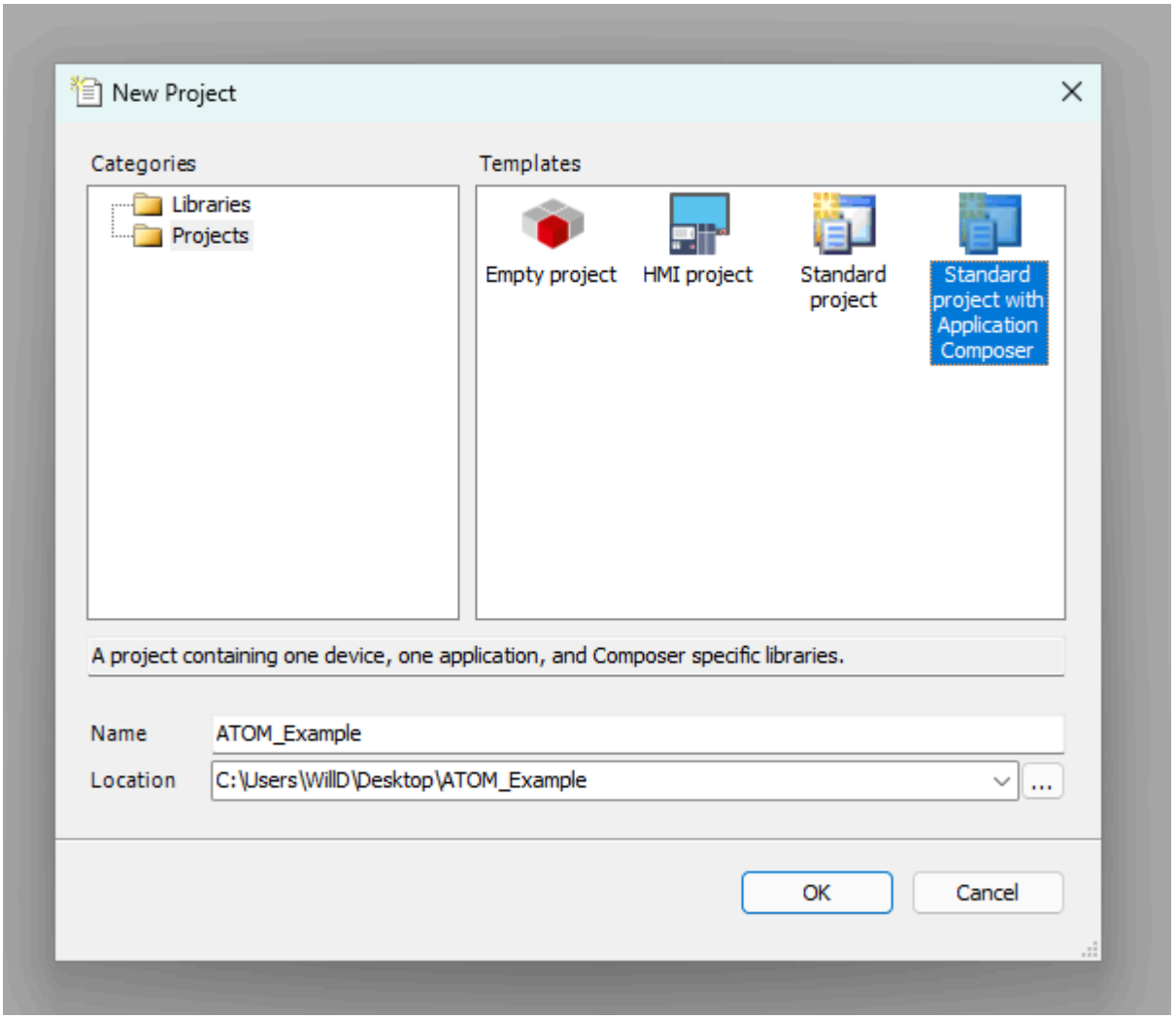


7. Name the rule **Profinet**, then click **Finish**:

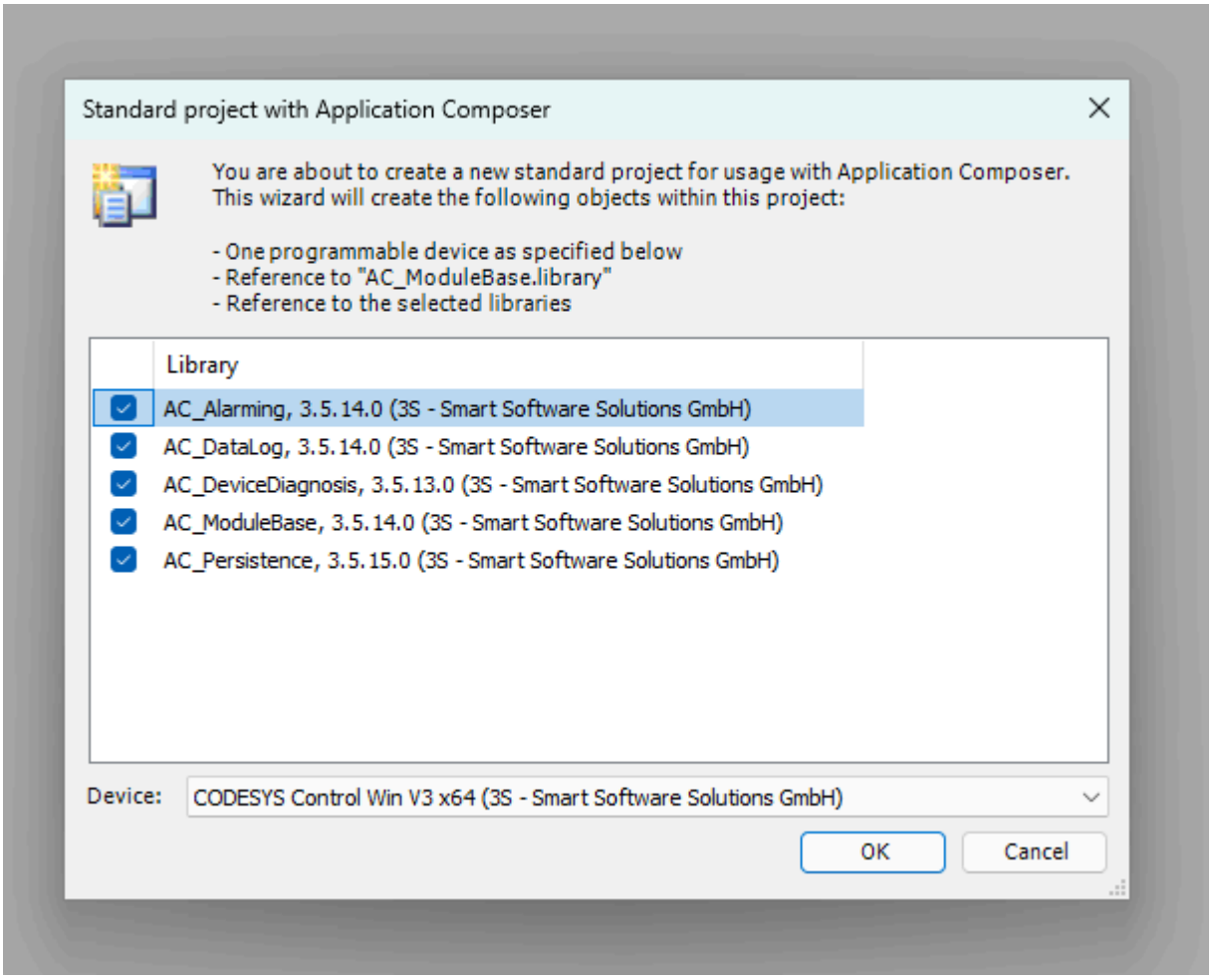


Create a Codesys project

Create a new Codesys project using the **Standard project with Application Composer** template:



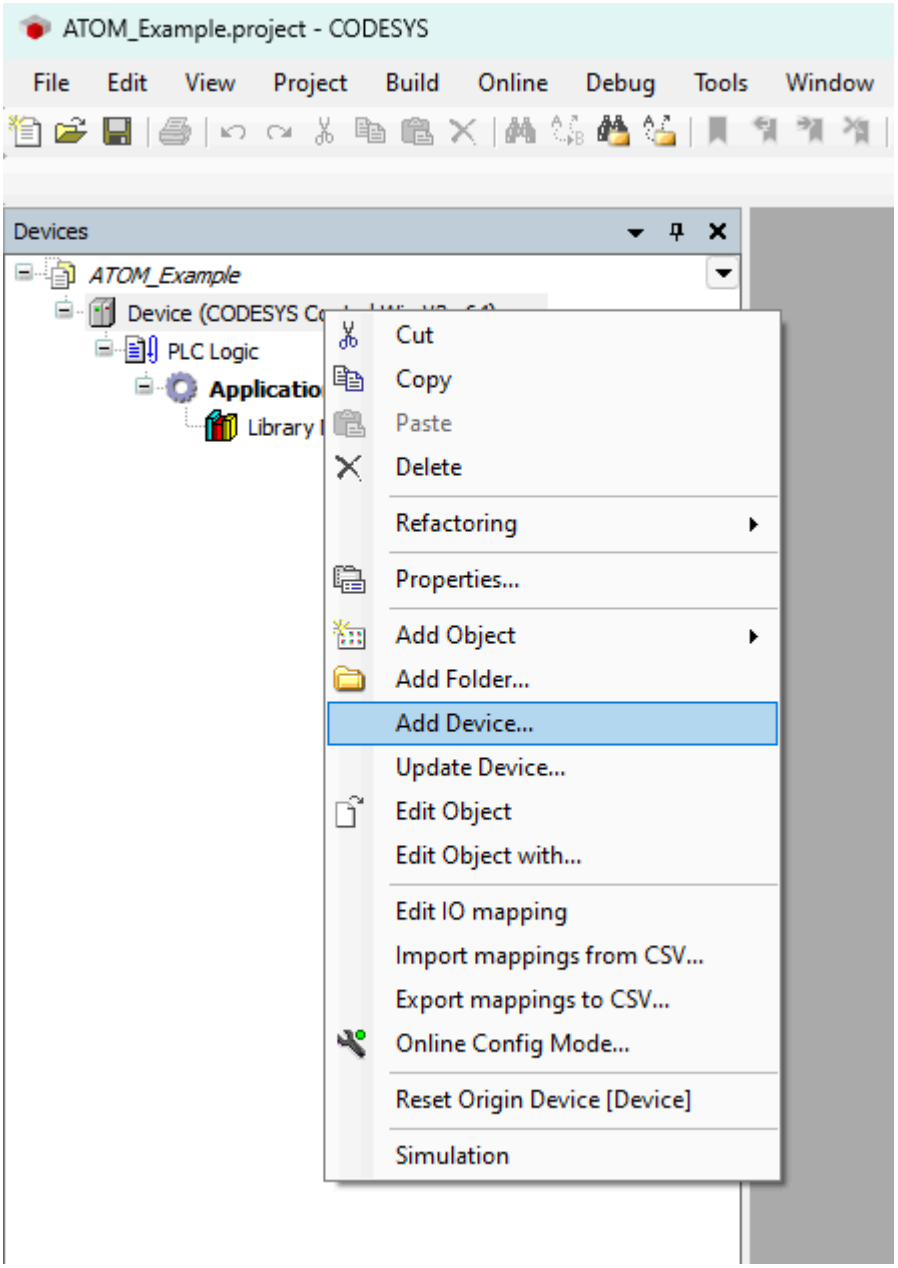
Check each library to include it in the project and select **CODESYS Control WIN V3 x64** as the device:



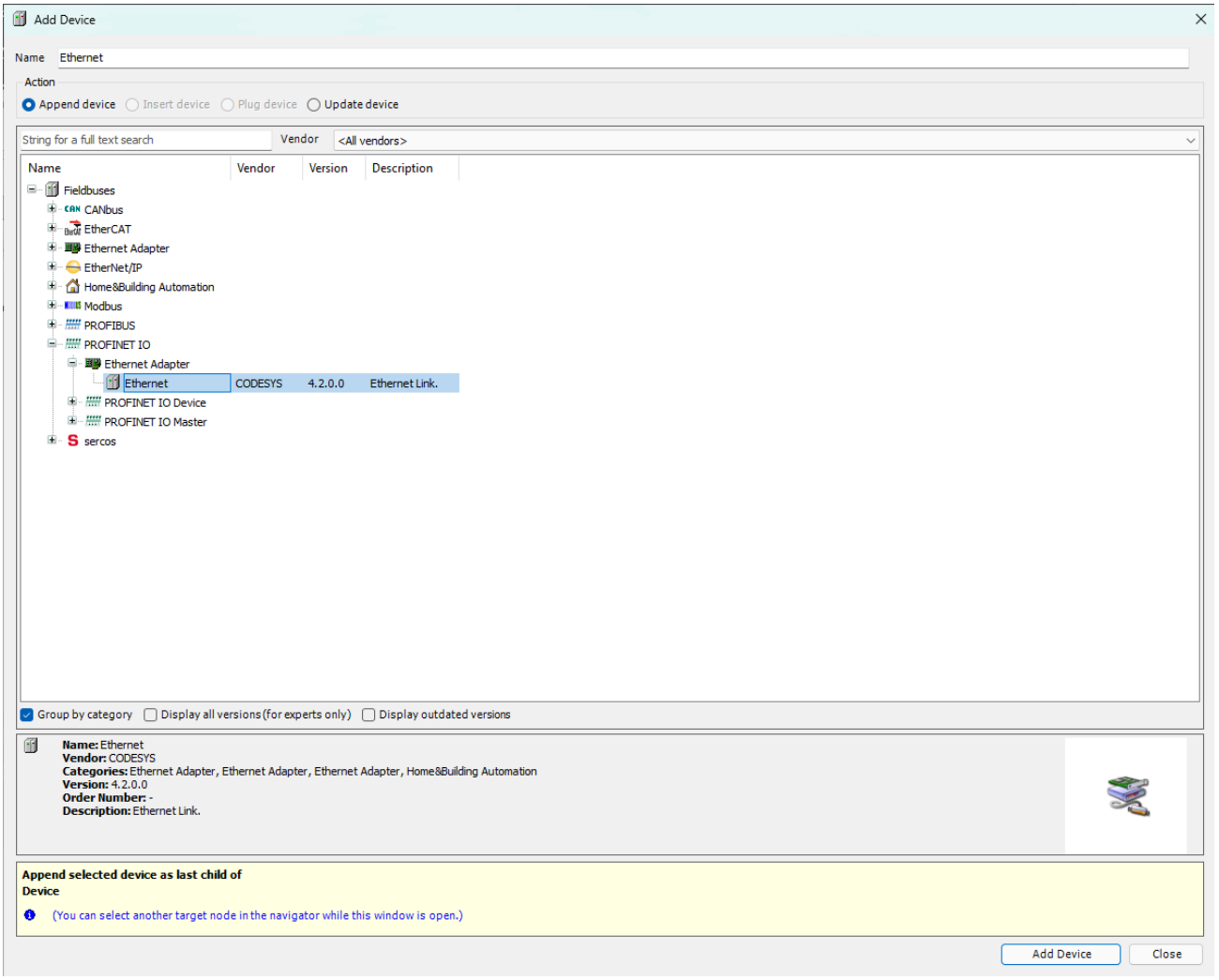
Adding a Profinet Controller

Next we'll add a Profinet Controller device. This allows the SoftPLC to discover Profinet I/O devices on the network (in our case, ATOM) and establish a connection with them.

First, right click **Device** and select **Add Device**:

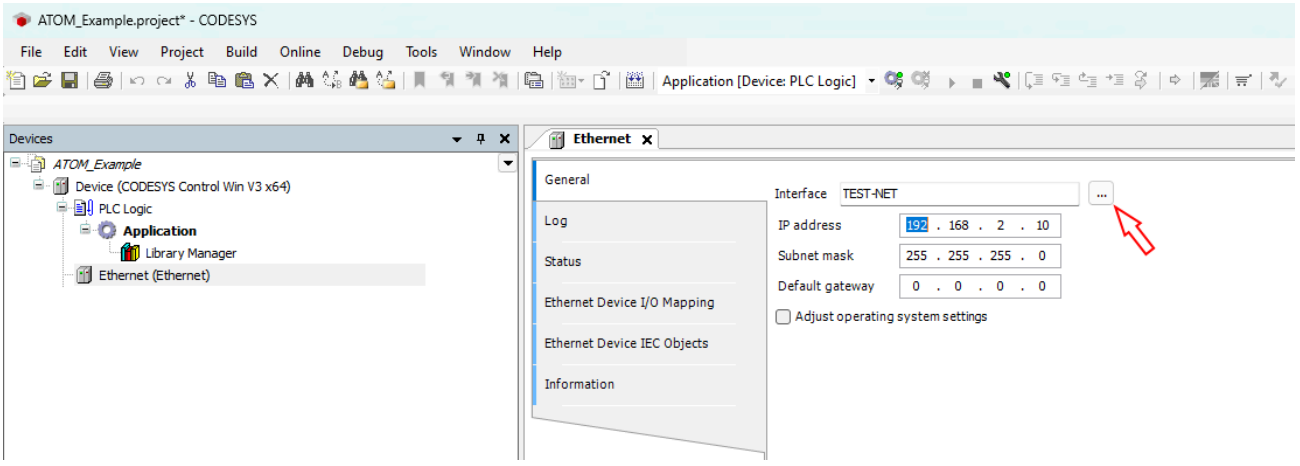


Next, expand **PROFINET IO > Ethernet Adapter** and select **Ethernet**, then click **Add Device**:

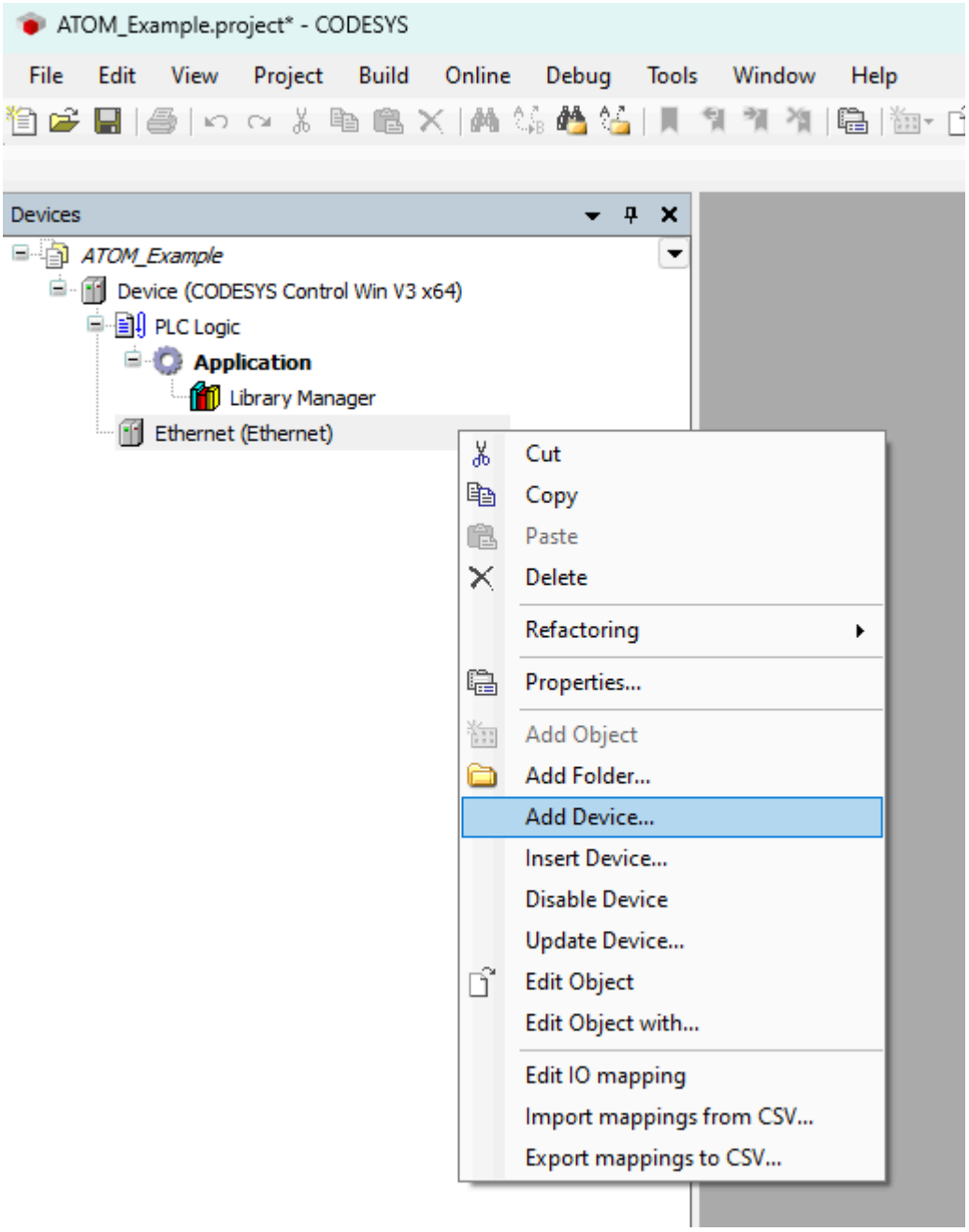


The newly added **Ethernet** device will now appear in the device tree. Double click **Ethernet (Ethernet)** to open its configuration tab. Within the **General** configuration tab, use the button indicated by the red arrow to select the network interface of the host machine that will be used to communicate with ATOM. In our case, we have a `TEST-NET` interface but this will be different for you.

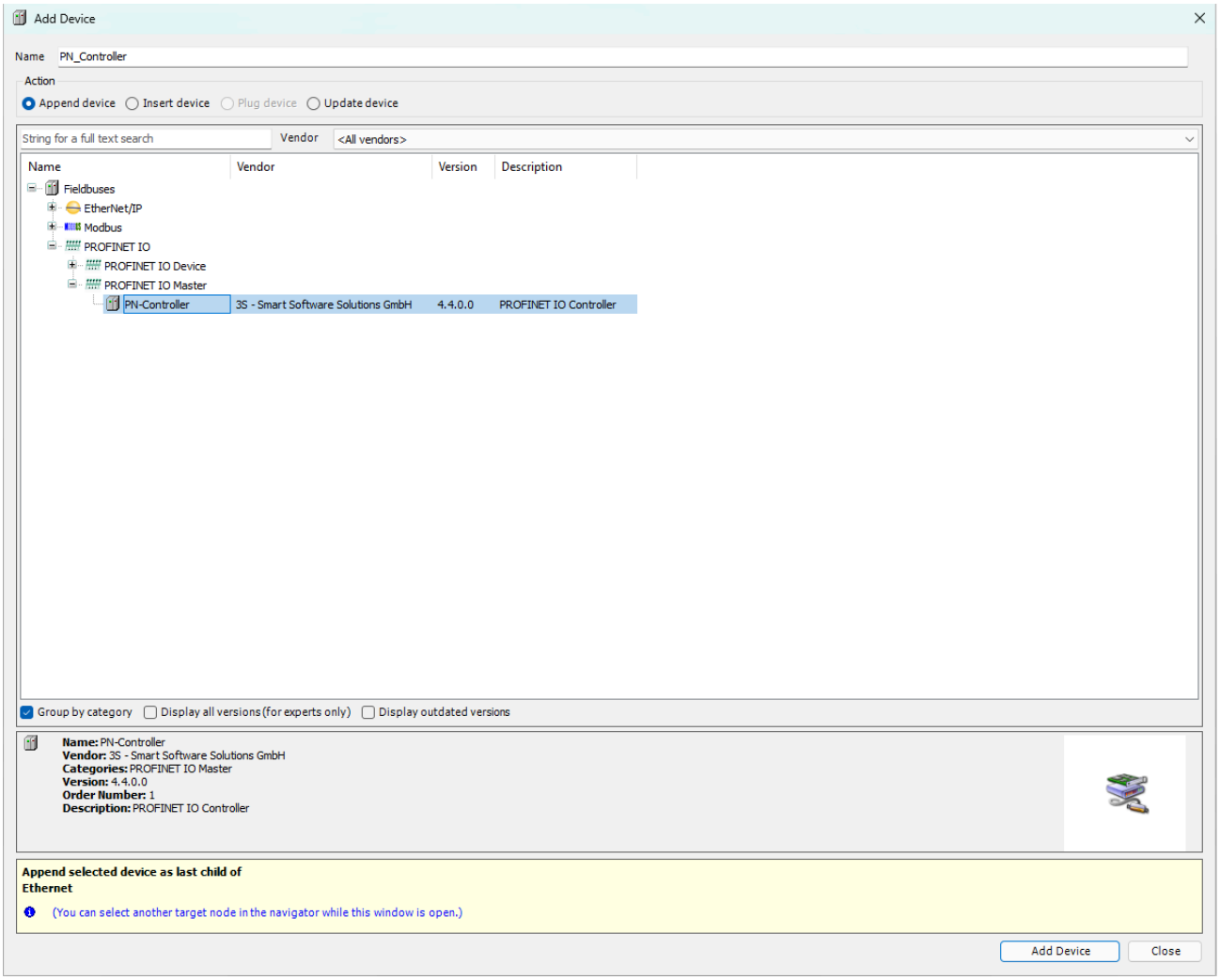
> **INFO**
>
> Note, you may get an error dialog displaying "Gateway not configured properly". If this is the case, make sure your SoftPLC is online by right-clicking the Codesys Win SysTray icon and starting the PLC. Navigate to the CODESYS Control Win V3 device in Codesys and use **Scan Network** to make sure the gateway is detected. Then, you can select the network interface.



Next, right click **Ethernet (Ethernet)** and select **Add Device**:



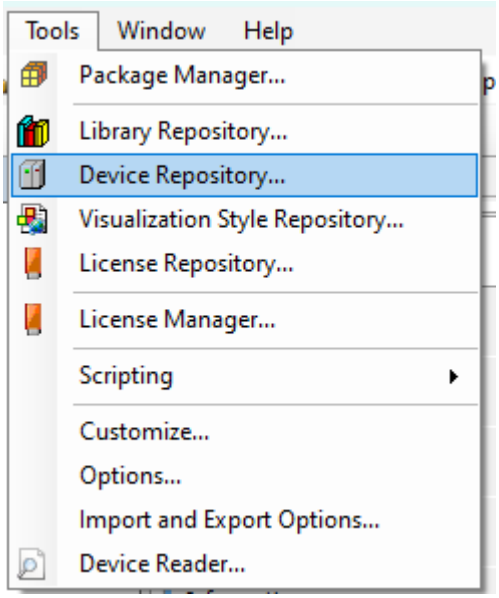
Expand **PROFINET IO > PROFINET IO Master**, select **PN-Controller** then click **Add Device**:



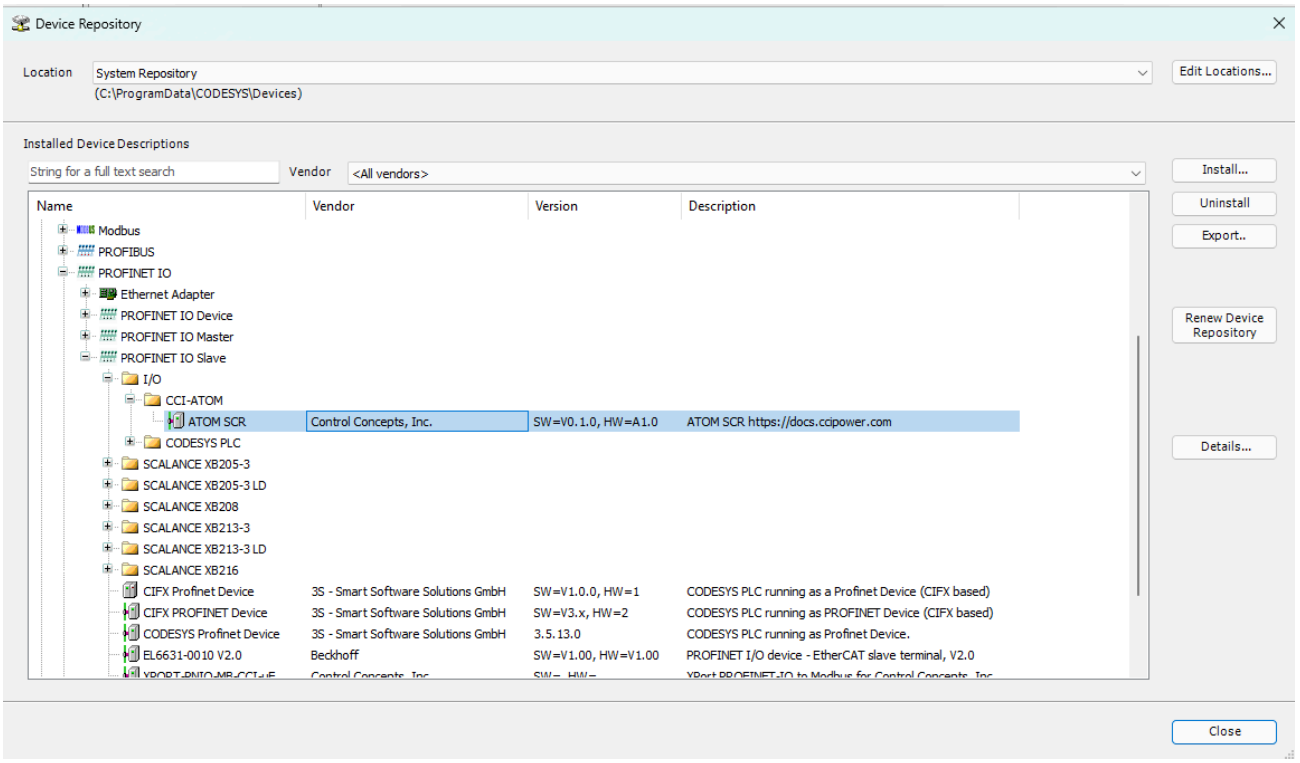
Your device tree should update to include the **PN-Controller** device.

Adding ATOM to the controller

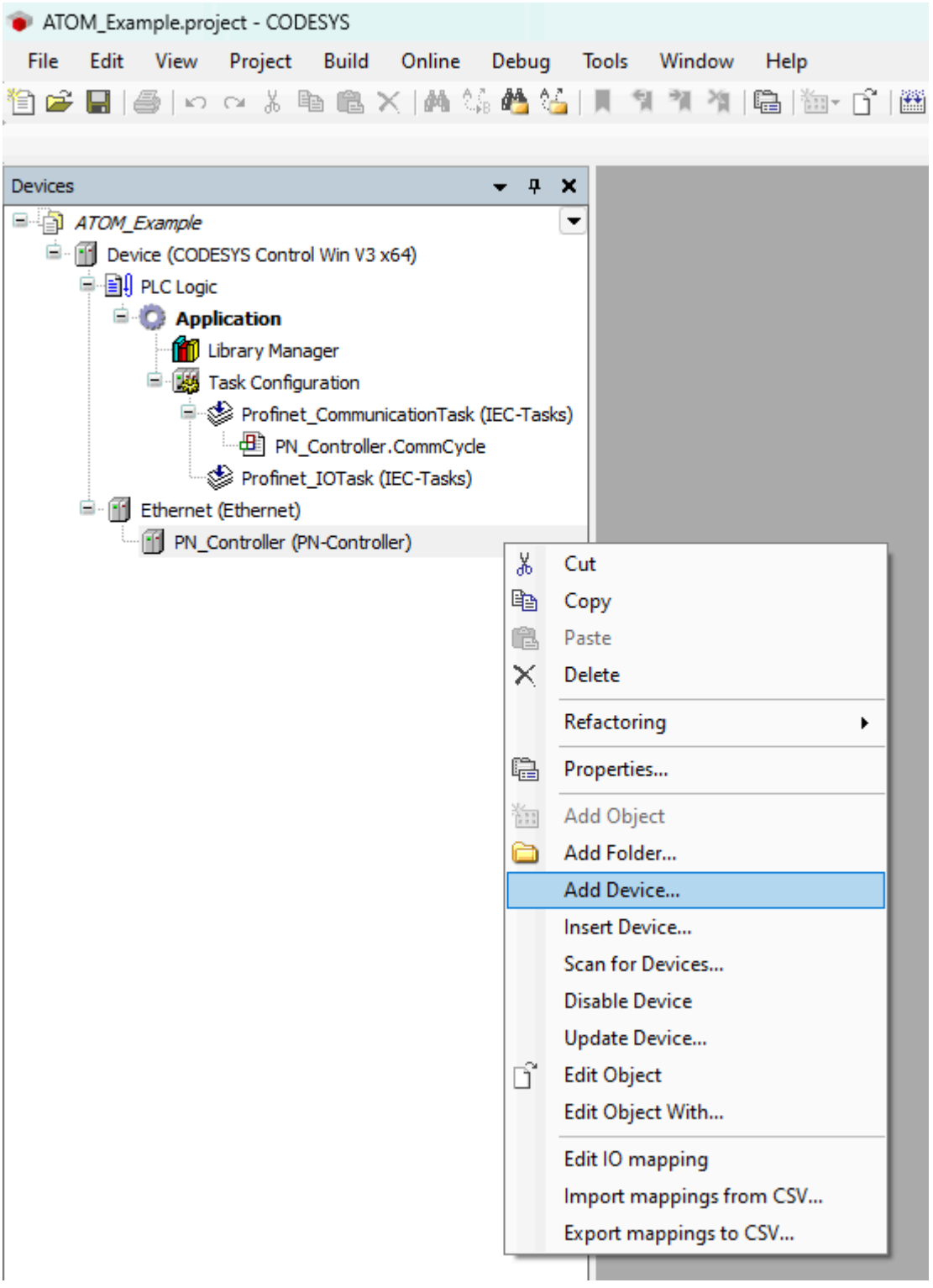
First, we'll import ATOM's GSDML file you downloaded earlier into our Codesys device library. Open the tools menu and select **Device repository**:



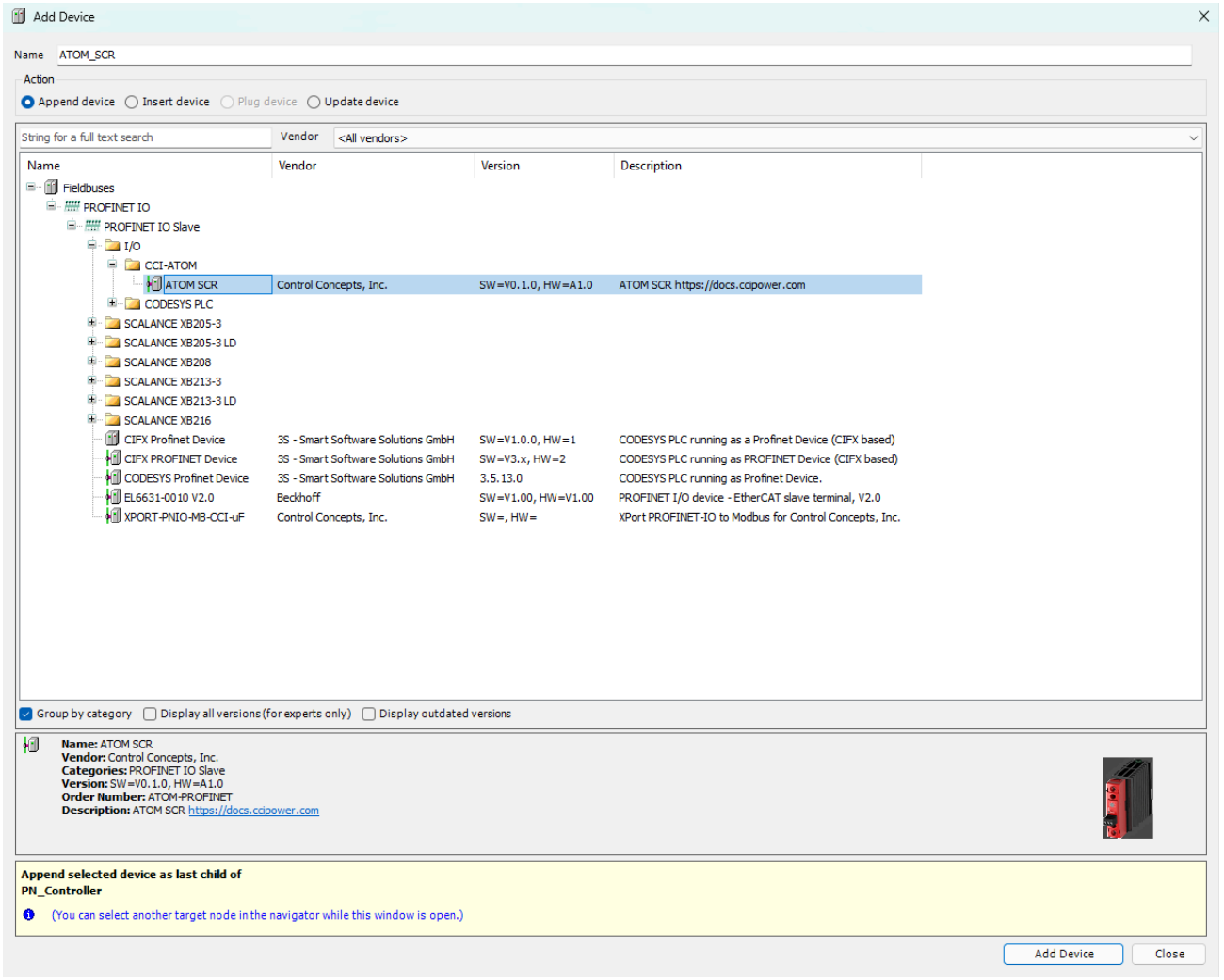
Next, click **Install** and select the `GSDML-V2.43-Control-Concepts-ATOM_20231108.xml` file. After you click install, **Atom** will appear under the **PROFINET IO > PROFINET IO Slave > I/O** category. Click **Close** to dismiss the dialog:



Now, we'll add ATOM to the PN-Controller. Right click **EtherNet/IP Scanner (EtherNet/IP Scanner)** and select **Add Device**:



Expand **PROFINET IO > PROFINET IO Slave > I/O > CCI-ATOM** and select **ATOM SCR**, then click **Add Device**:



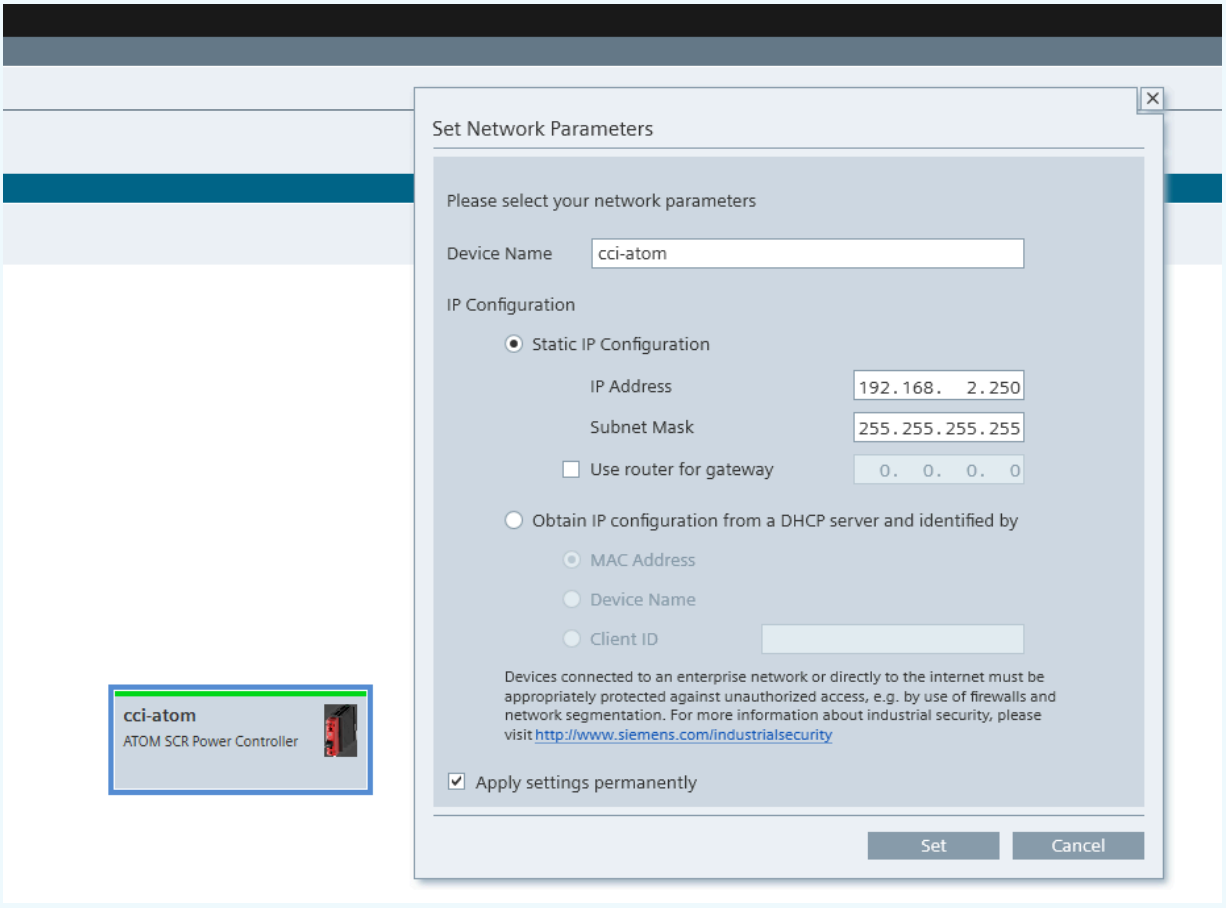
Finally, double click **Atom (Atom)** to open its configuration tab. In the **General** tab, set the **Station name**, **IP Address**, and **Subnet mask** for your ATOM SCR:

INFO

You can find or change these parameters in Control Panel, or using a tool like Proneta. Make sure your station name and IP settings on Atom are properly set to the same values you enter here so that Codesys can connect to ATOM.

Proneta

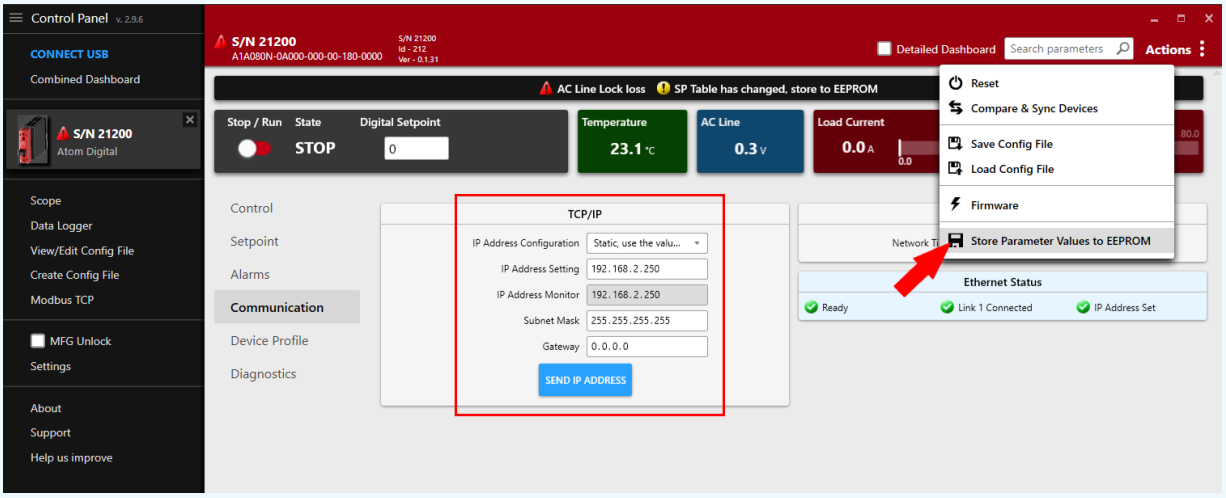
If you're using Proneta, make sure to change the IP settings with **Store permanently** checked.

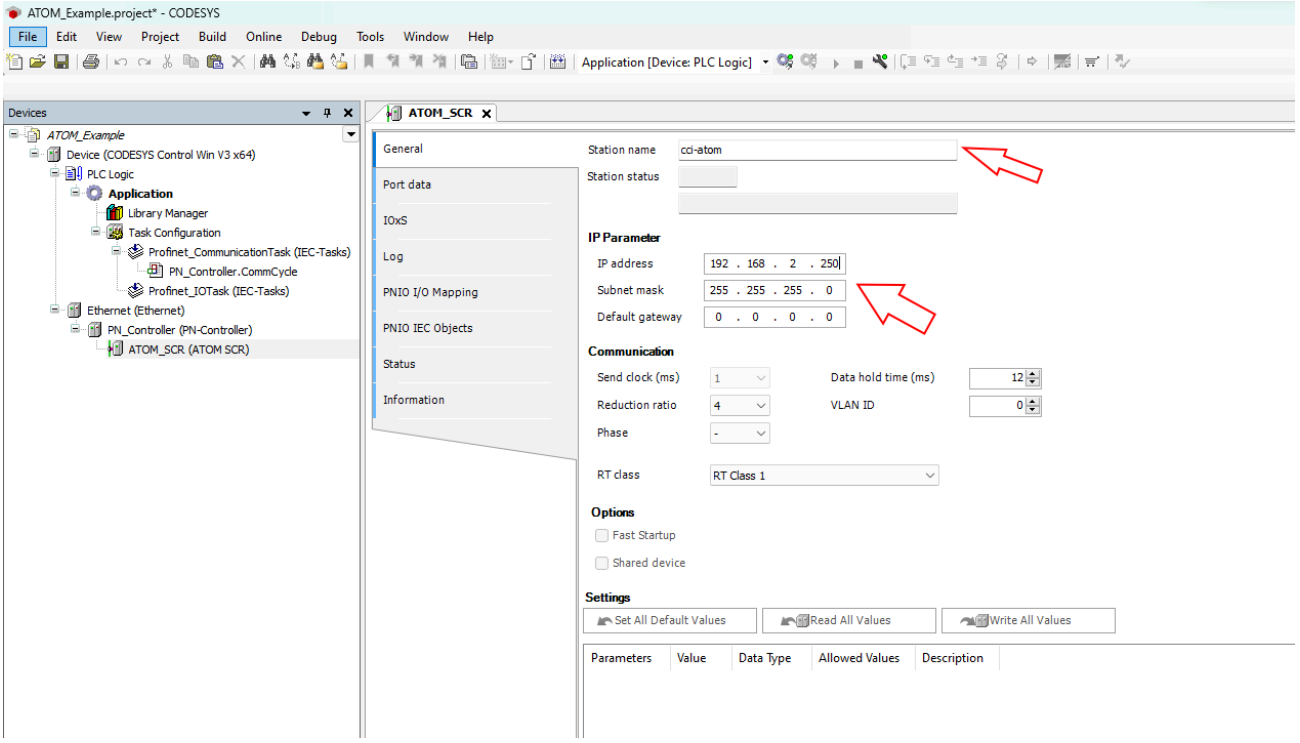


Control Panel

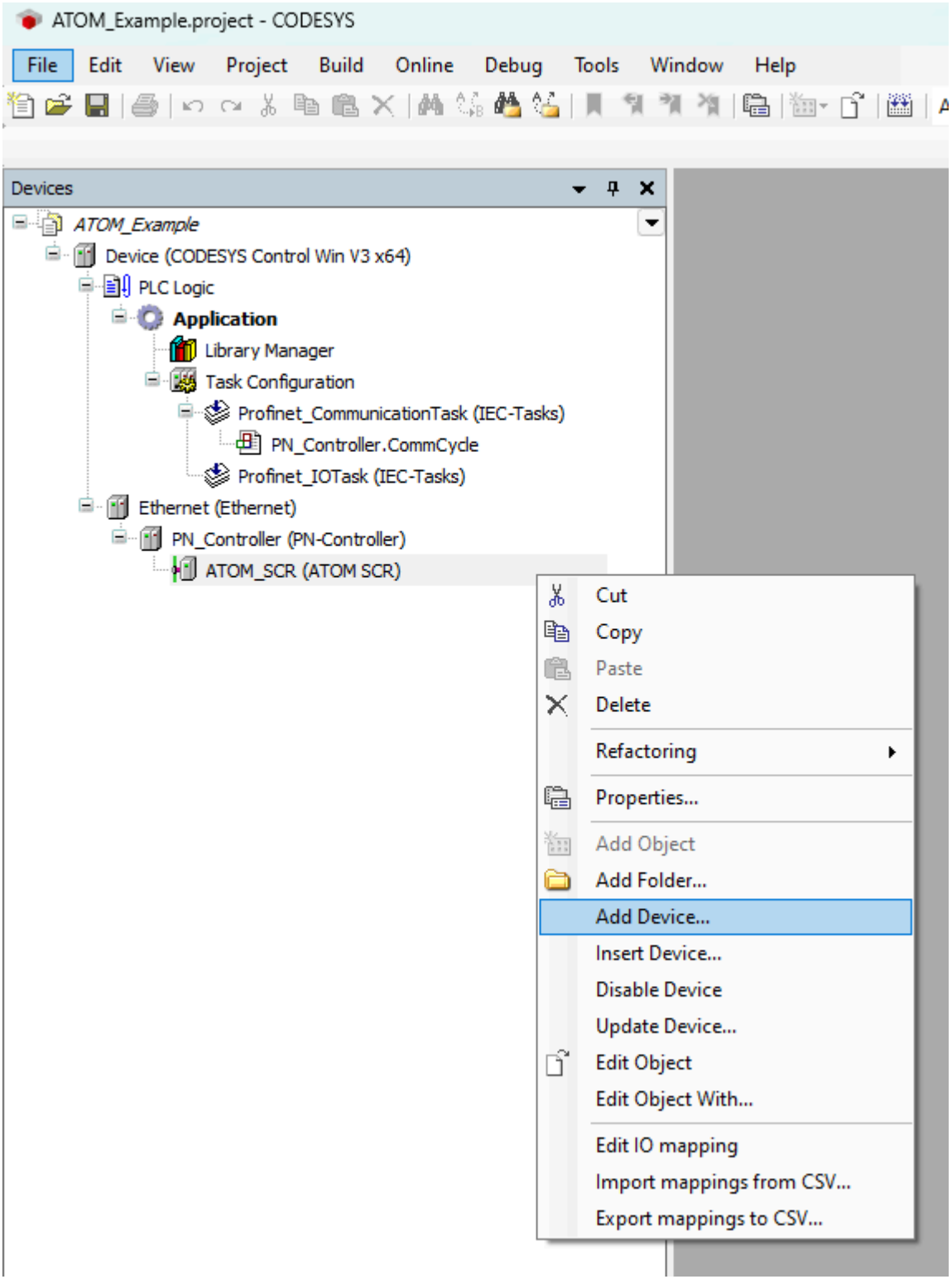
Connect your Atom unit to your PC using a USB cable. Open Control Panel and update your Atom's communication parameters. When you're finished, click **Send IP**

Address, then go to **Actions** in the upper right and select **Store Parameter Values to EEPROM**:



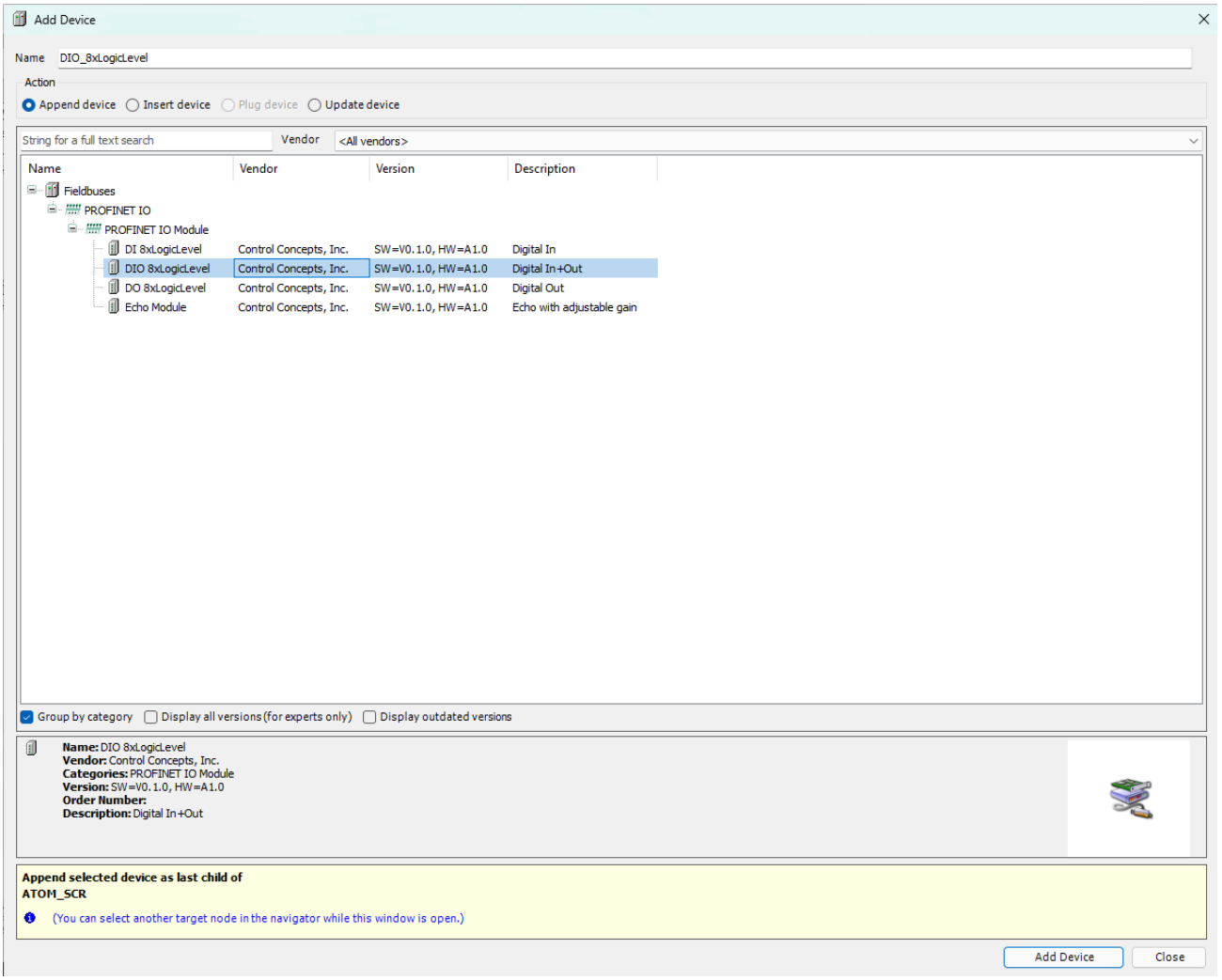


Next, right click **ATOM_SCR (ATOM SCR)** and select **Add Device**:



Here, you can choose which Profinet I/O modules to enable for your Atom. Select **DIO 8xLogicLevel** which allows both input and output of data to/from Atom. You can add other

I/O modules if needed. Then, click **Add Device**:



Create a program

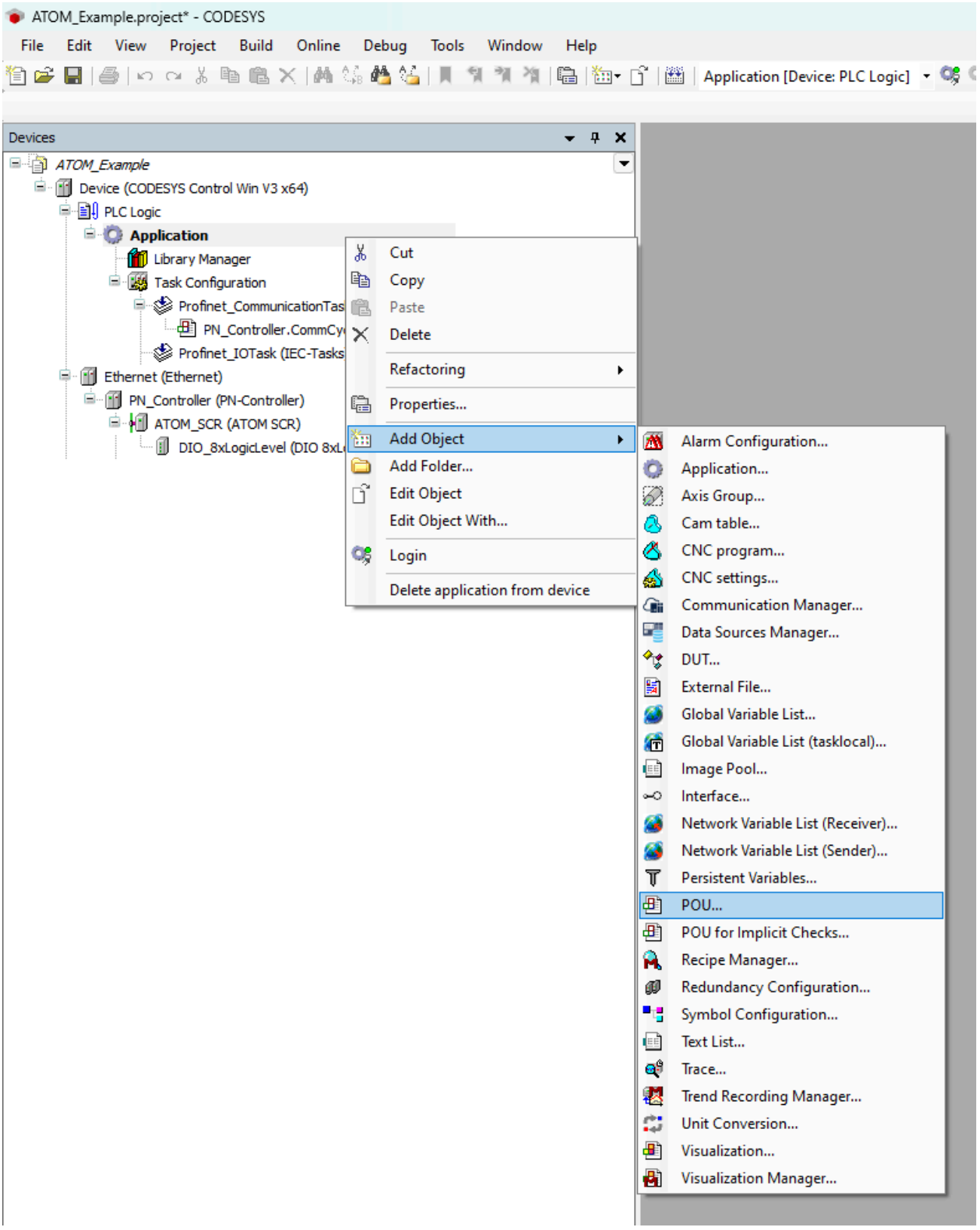
Next, we'll create a PLC program. We provide examples for both ladder logic and structured text:

- Program with ladder logic
- Program with structured text

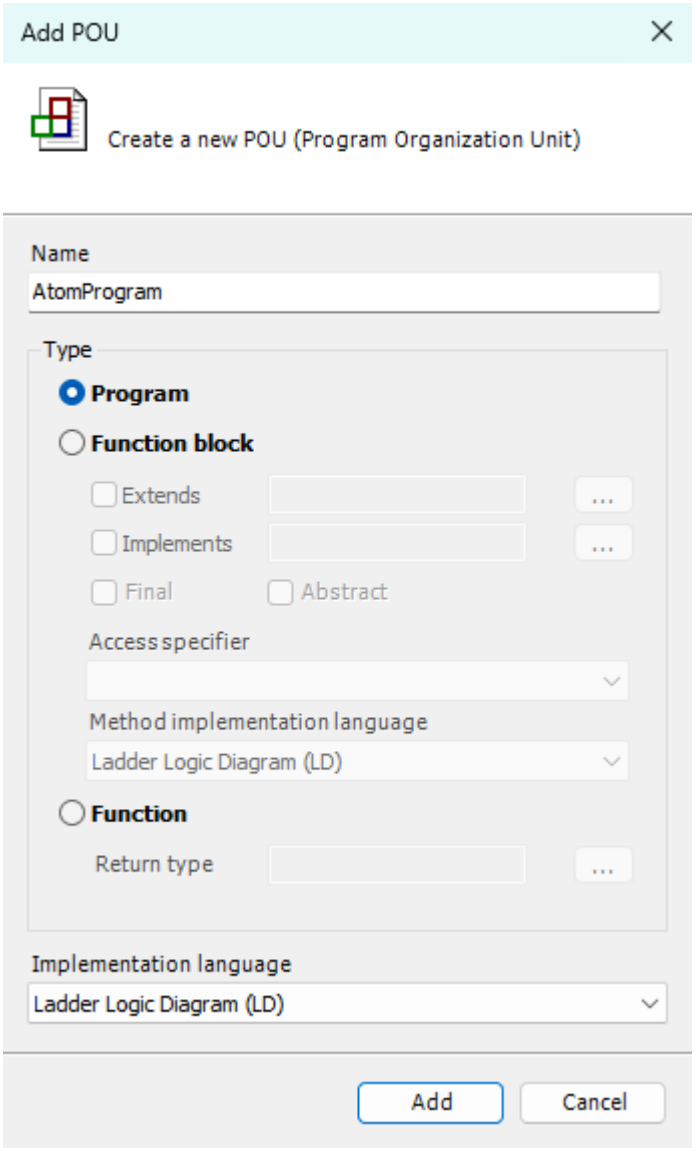
Example: Ladder logic

Creating the program

Right click **Application** and select **Add Object > POU**:


ATOM_Example.project* - CODESYS
File Edit View Project Build Online Debug Tools Window Help
Application [Device: PLC Logic]
Devices
ATOM_Example
Device (CODESYS Control Win V3 x64)
PLC Logic
Application
Library Manager
Task Configuration
Profinet_CommunicationTas
PN_Controller.CommCy
Profinet_IOTask (IEC-Tasks
Ethernet (Ethernet)
PN_Controller (PN-Controller)
ATOM_SCR (ATOM SCR)
DIO_8xLogicLevel (DIO 8xL
Cut
Copy
Paste
Delete
Refactoring
Properties...
Add Object
Add Folder...
Edit Object
Edit Object With...
Login
Delete application from device
Alarm Configuration...
Application...
Axis Group...
Cam table...
CNC program...
CNC settings...
Communication Manager...
Data Sources Manager...
DUT...
External File...
Global Variable List...
Global Variable List (tasklocal)...
Image Pool...
Interface...
Network Variable List (Receiver)...
Network Variable List (Sender)...
Persistent Variables...
POU...
POU for Implicit Checks...
Recipe Manager...
Redundancy Configuration...
Symbol Configuration...
Text List...
Trace...
Trend Recording Manager...
Unit Conversion...
Visualization...
Visualization Manager...

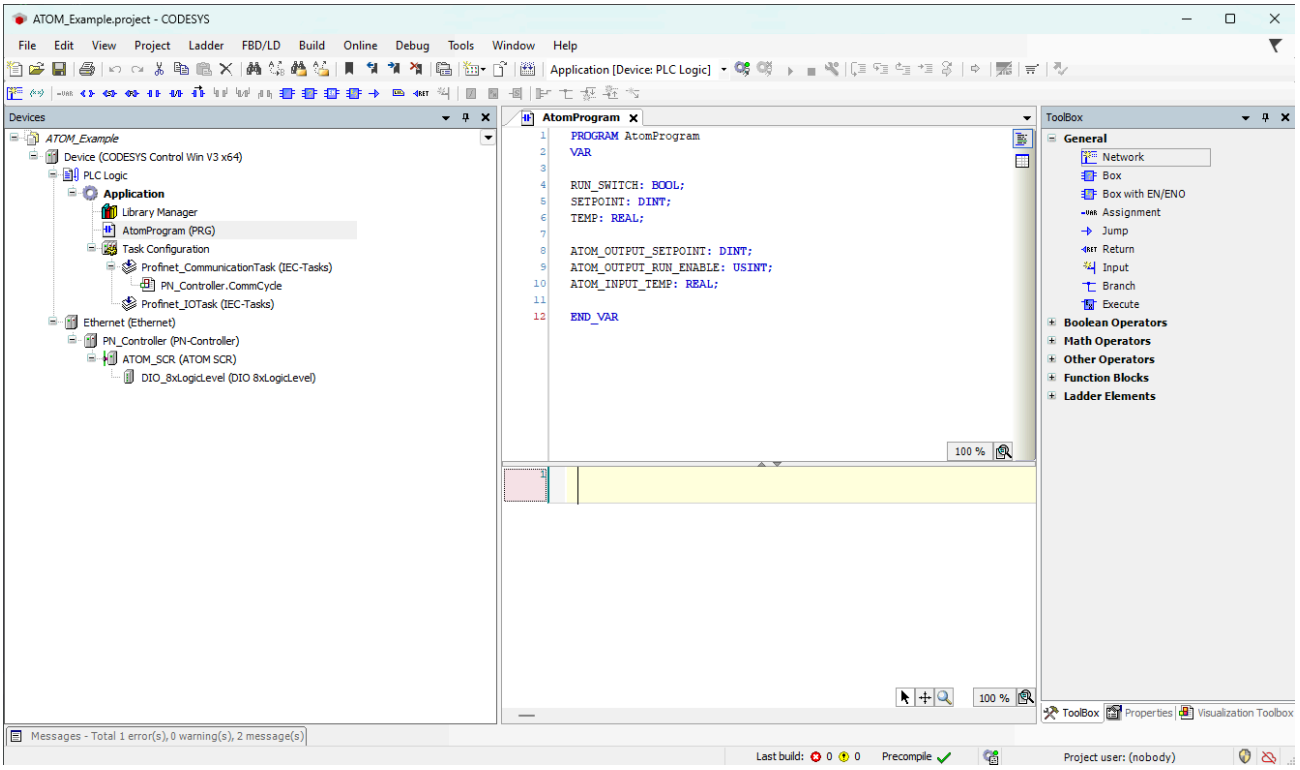
Set the name to `AtomProgram` and select **Ladder Diagram (LD)** as the Implementation language:



Copy the following code into the top panel of the **AtomProgram** editor:

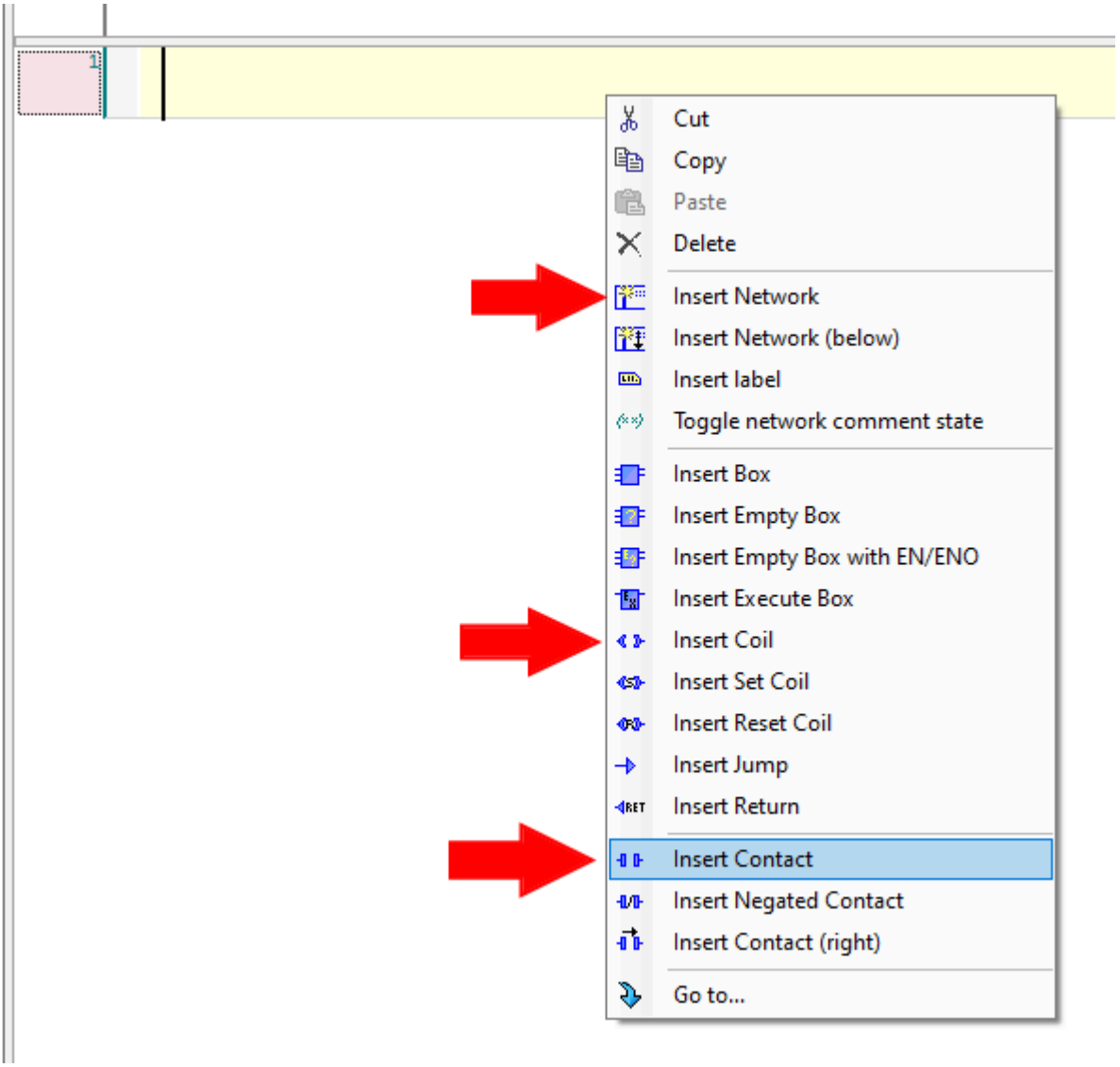
```
PROGRAM AtomProgram
VAR

RUN_SWITCH: BOOL;
SETPOINT: DINT;
TEMP: REAL;

ATOM_OUTPUT_SETPOINT: DINT;
ATOM_OUTPUT_RUN_ENABLE: USINT;
ATOM_INPUT_TEMP: REAL;

END_VAR
```

After you've copied the code over, the editor for **AtomProgram** should look like this:

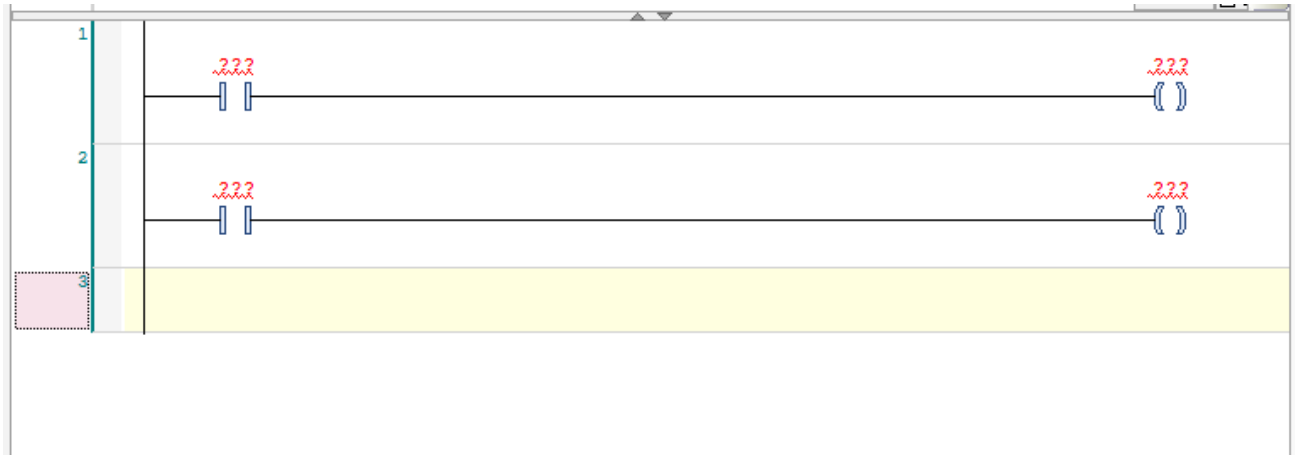


In the bottom panel of the editor, we'll create a simple ladder logic program using the variables we just added above.

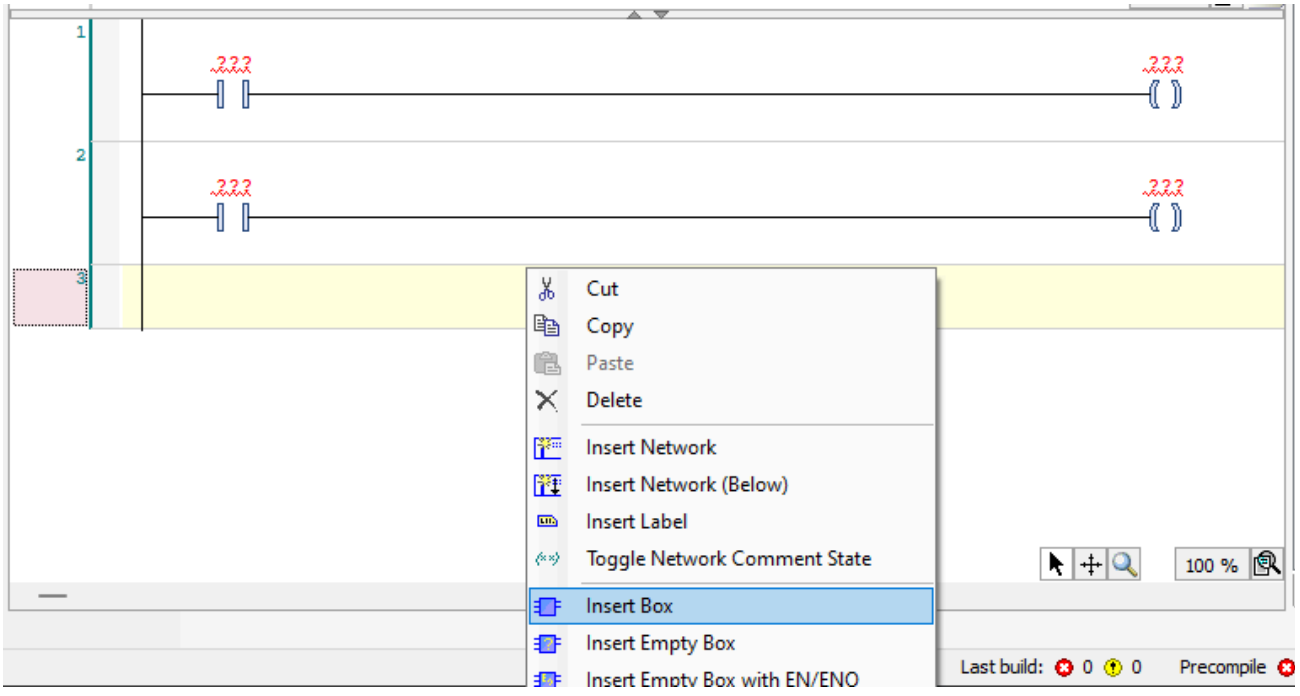
1. Create **3** networks total by right-clicking and selecting **Insert Network** three times.
2. For the first *two* rungs (networks), insert a contact and a coil.



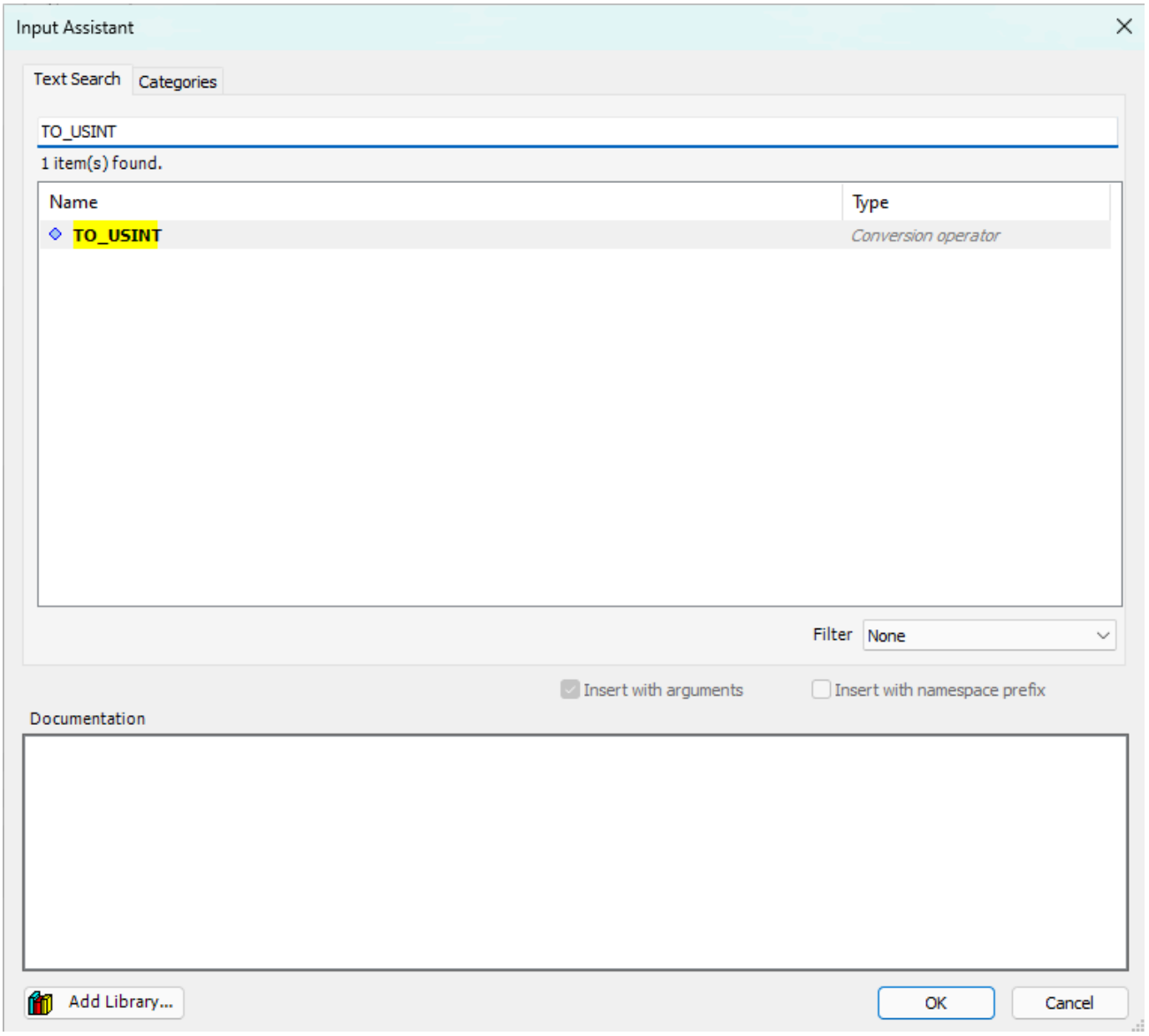
After you're finished, your ladder logic program should look like:



On the third rung, right click and select **Insert Box**:



Add a **TO_USINT** box:



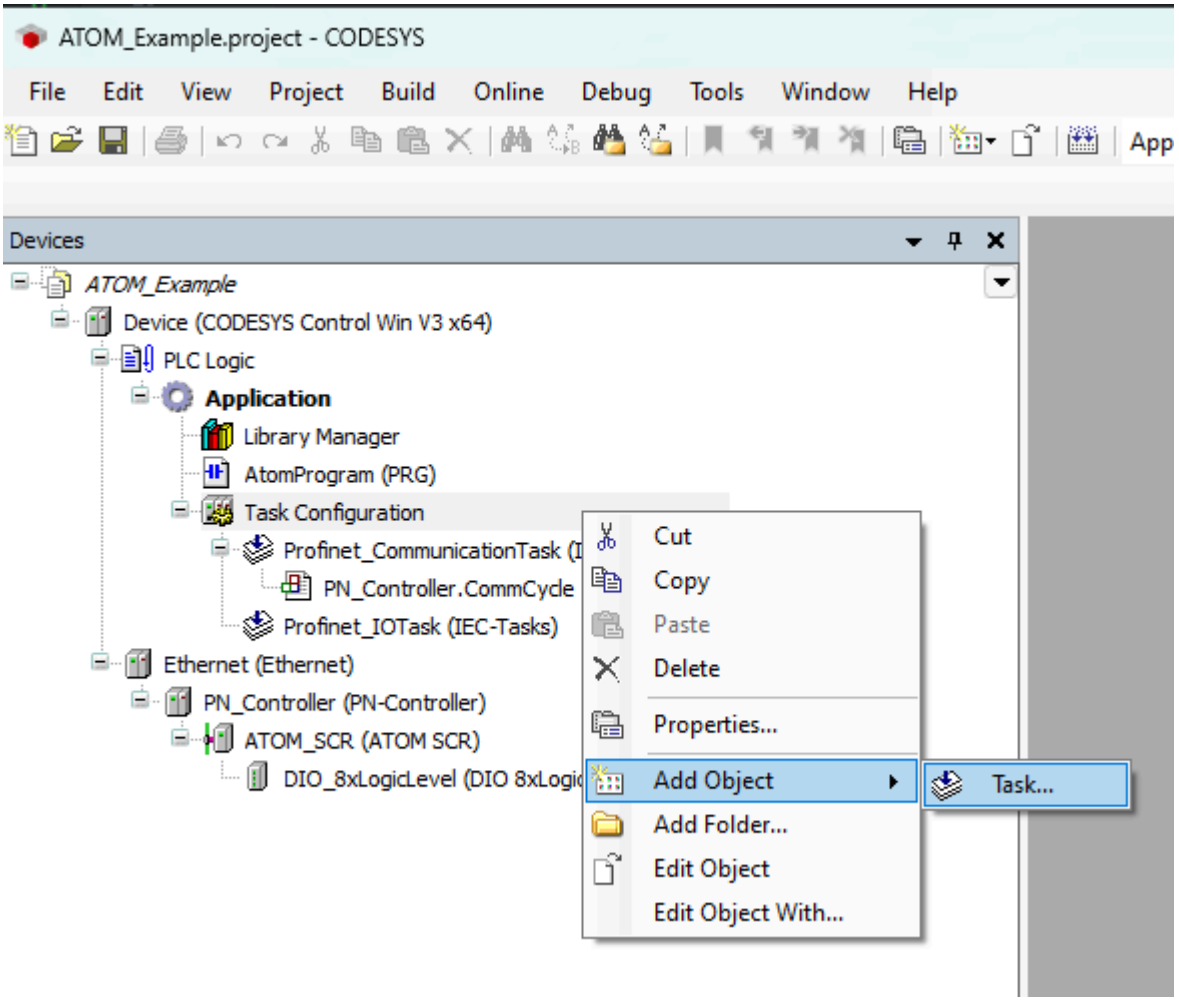
For the first two rungs, replace the `???` with the corresponding variables:

1. **Rung #1** - `ATOM_INPUT_TEMP` and `TEMP`
2. **Rung #2** - `SETPOINT` and `ATOM_OUTPUT_SETPOINT`

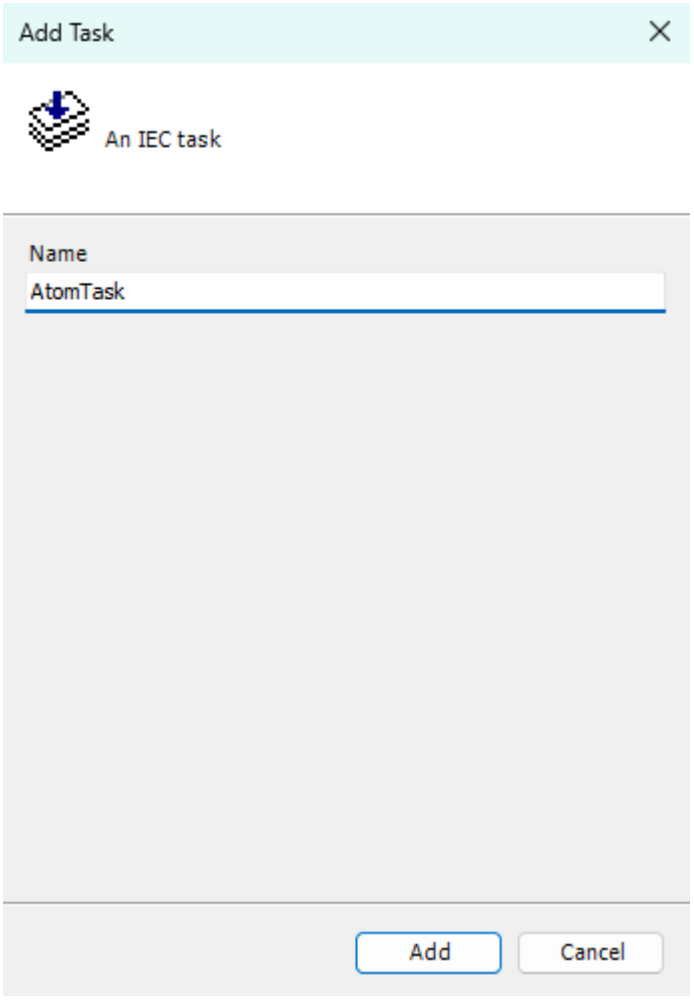
On the third rung, set the input to `EN` to `TRUE` and set the input parameter to `RUN_SWTICH` and output parameter to `ATOM_OUTPUT_RUN_ENABLE`. After you're finished, your ladder logic program should look like:

Finally, we'll add a task to call **AtomProgram** from the PLC's control loop:

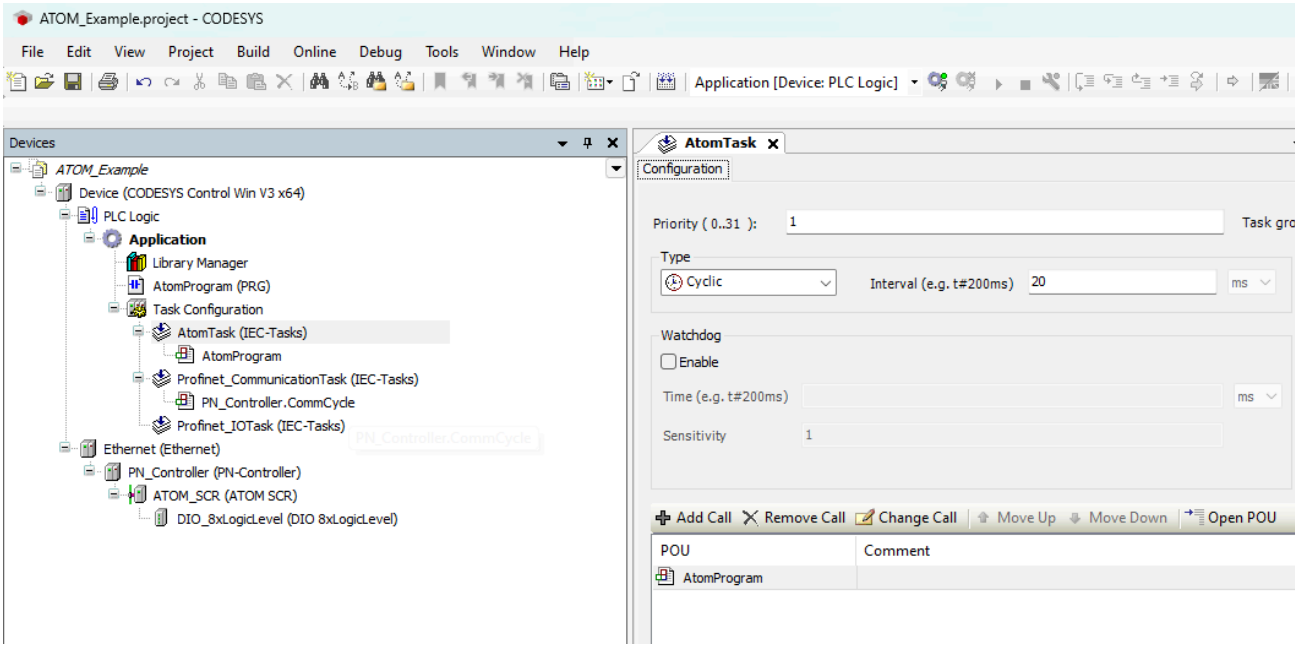
Right click **Task Configuration** and select **Add Object > Task**:



Name your task `AtomTask` and click **OK**:



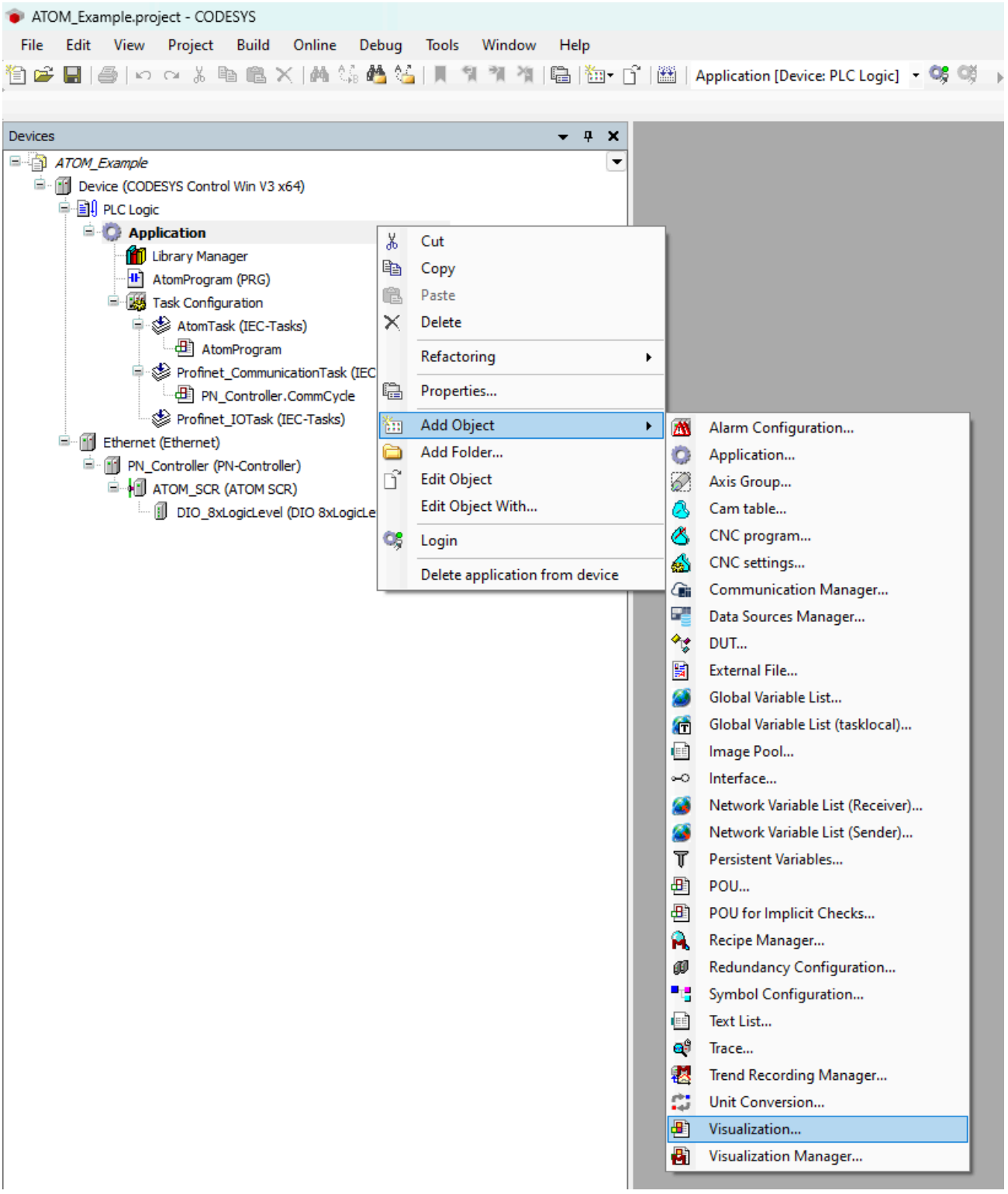
Next, double click **AtomTask (IEC-Tasks)** to open its configuration tab. Click **Add Call** and select **Application > AtomProgram**. After doing so, AtomTask's configuration should look like:



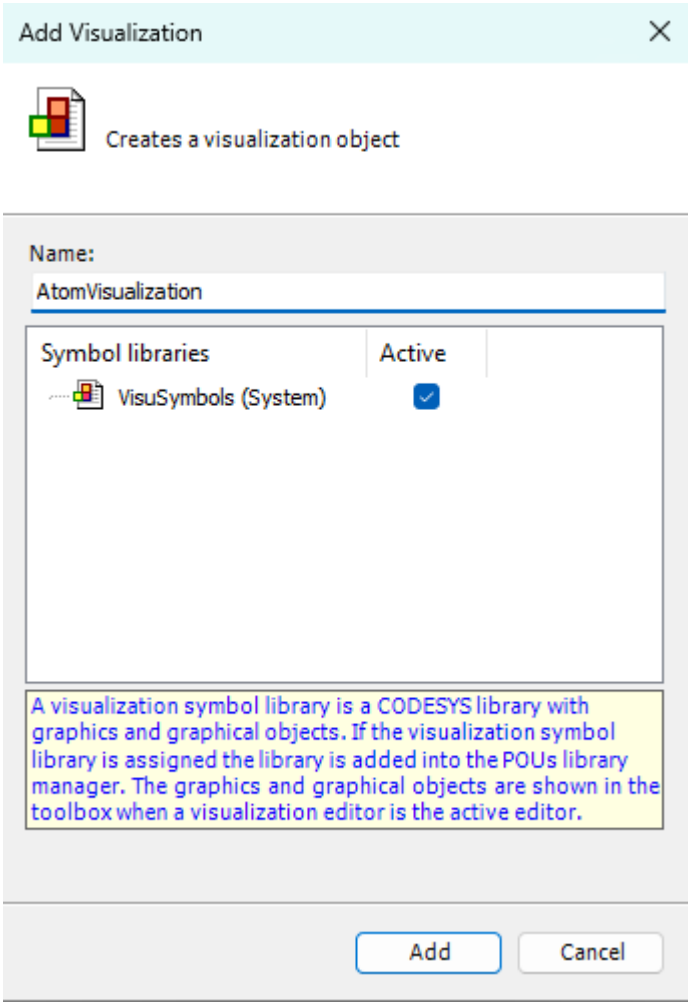
Setting up visualization

Next, we'll set up a simple visualization display to control and monitor ATOM.

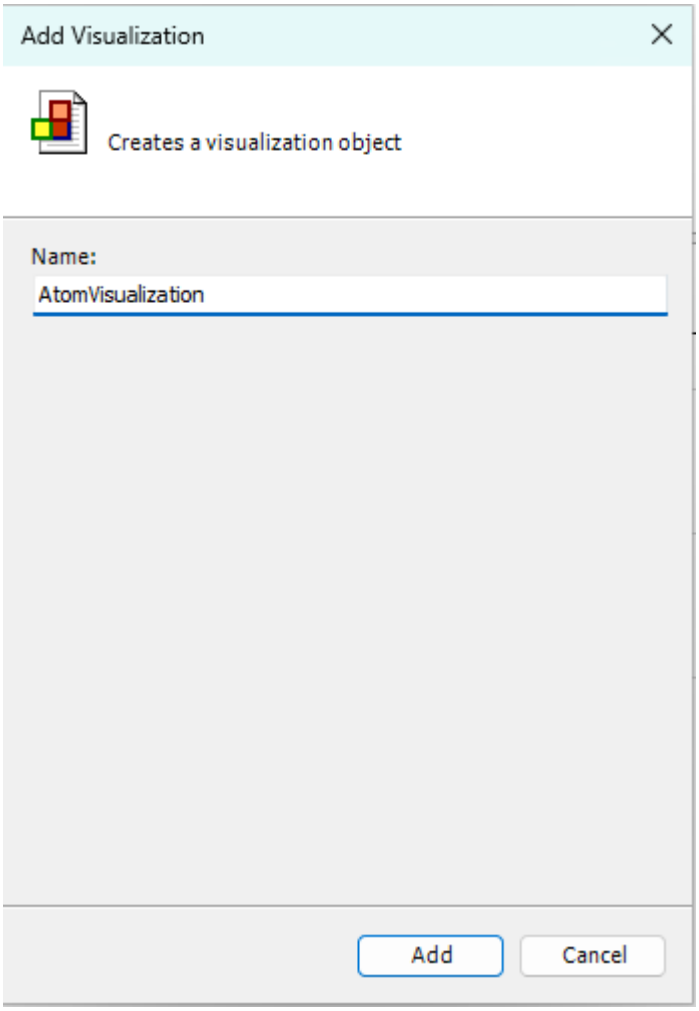
Right click **Application** and select **Add Object > Visualization**:



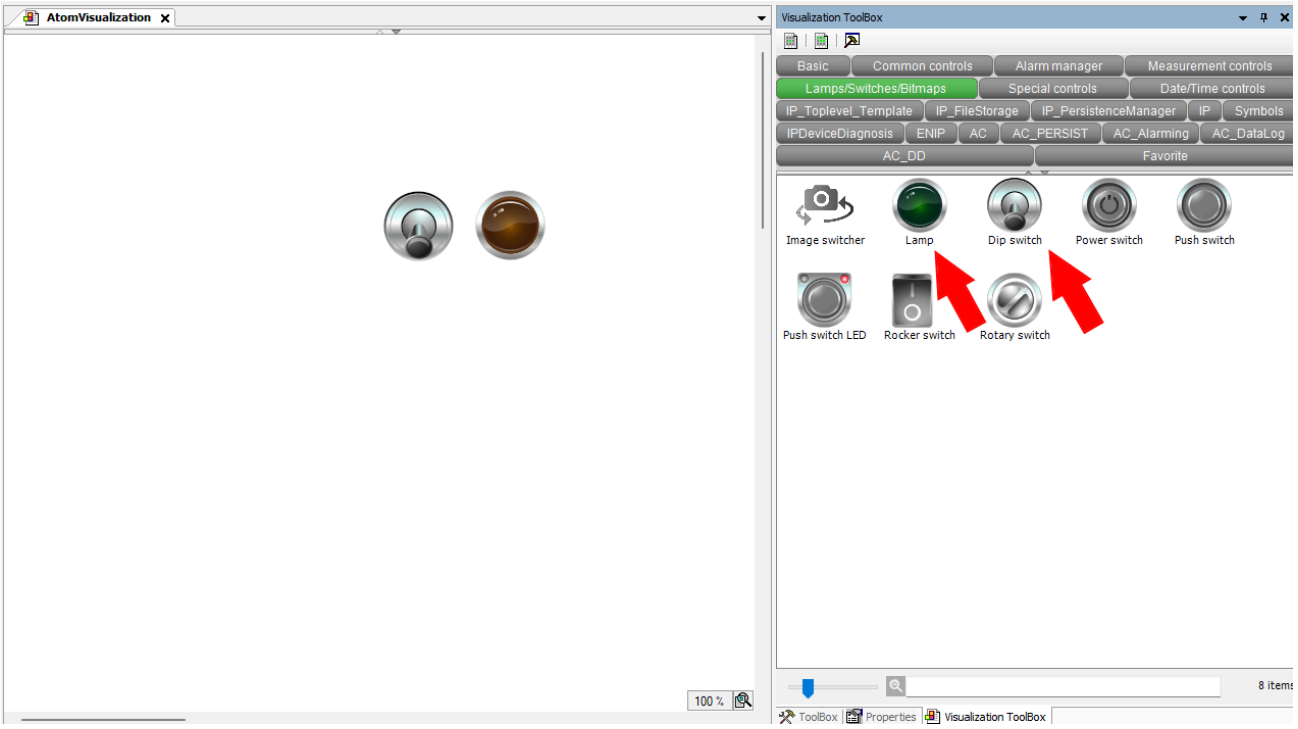
Make sure to check **Active** for **VisuSymbols (System)**, then click **Add**:



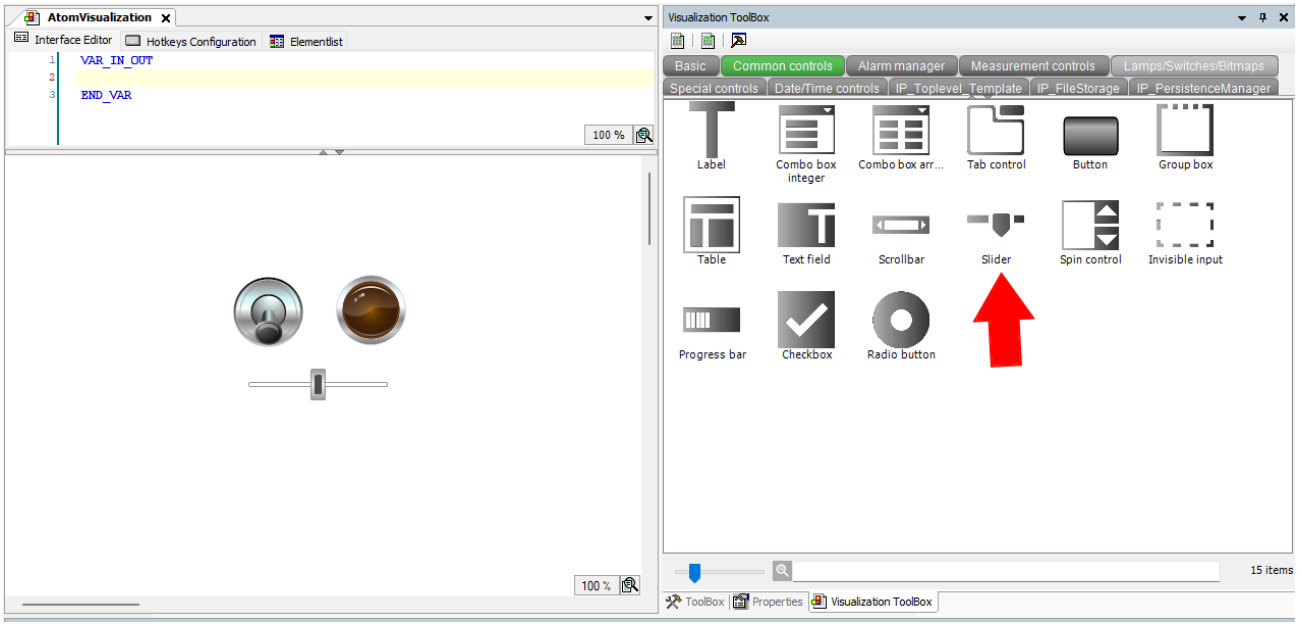
Name your visualization `AtomVisualization` and click **Add**:



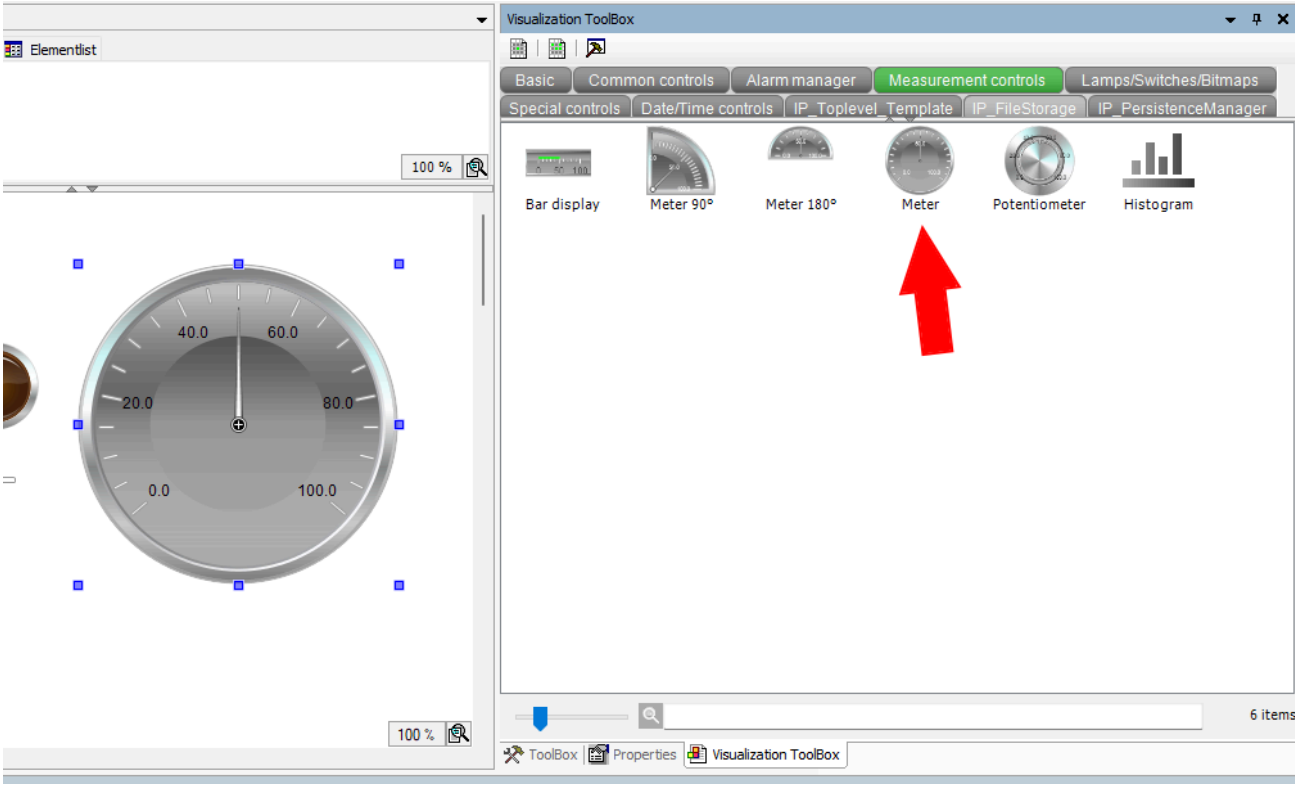
Double click **AtomVisualization** to open its configuration editor. From the **Visualization ToolBox** panel on the right, select the **Lamps/Switches/Bitmaps** category and add a lamp and a dip switch:



Next, in the **Common controls** category, add a slider:

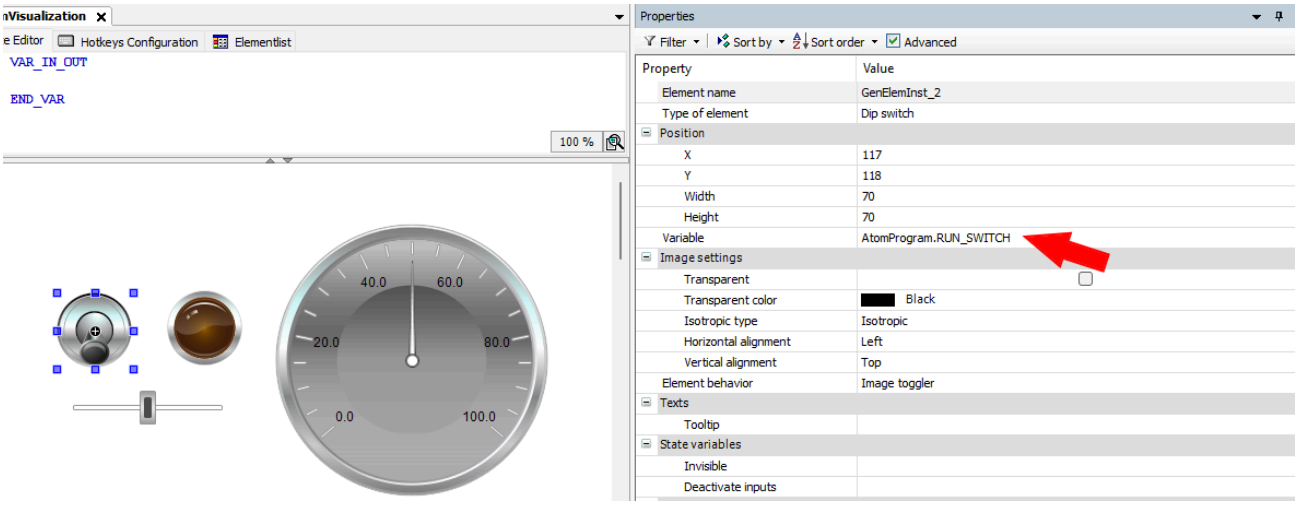


Finally, in the **Measurement controls** category, add a meter:

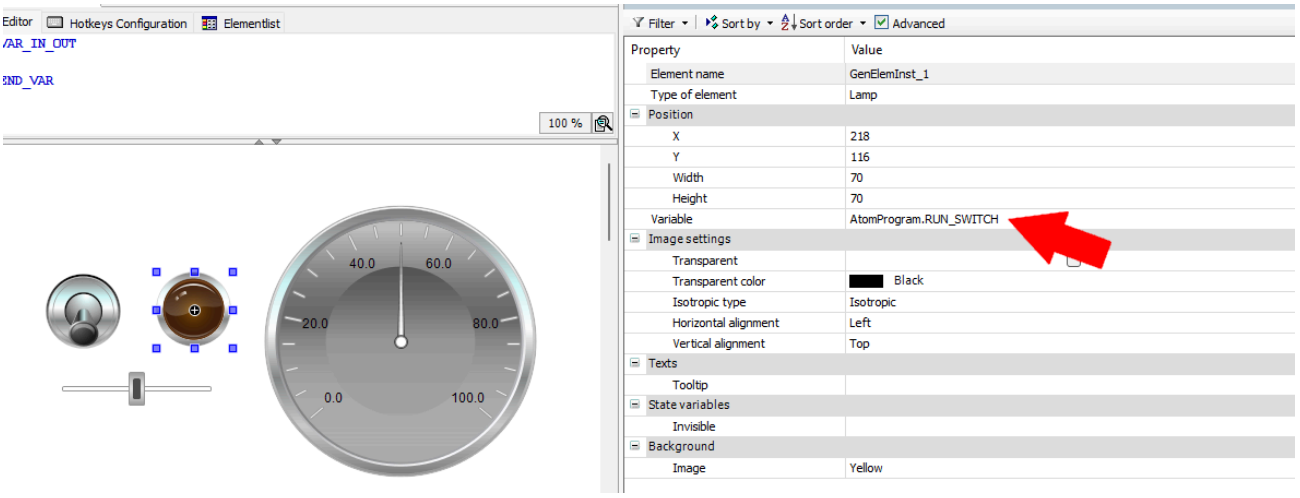


Wiring up the controls

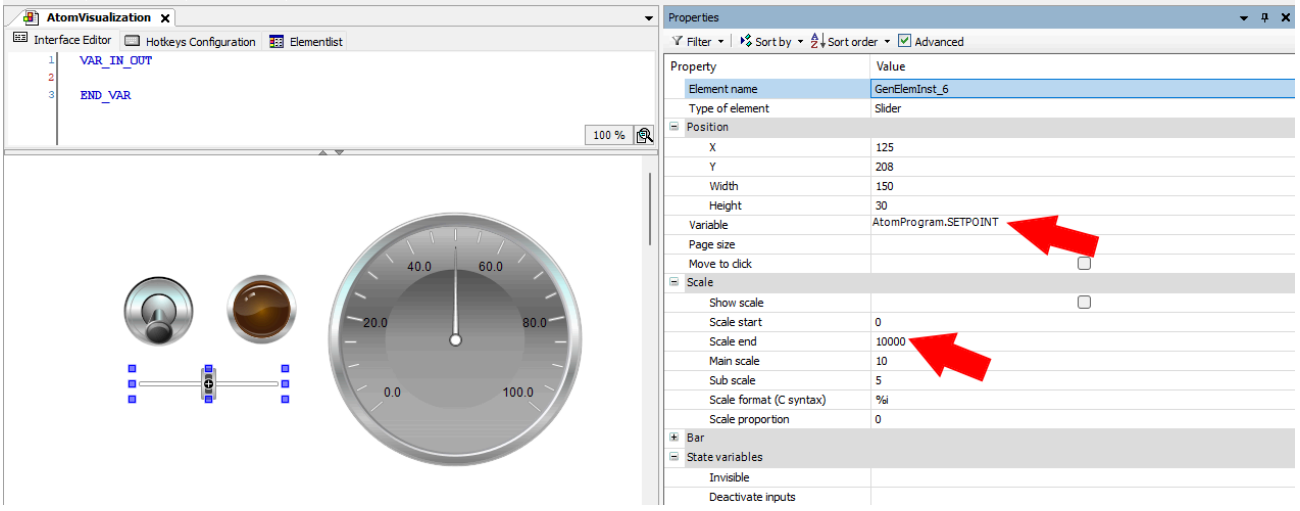
Next, we'll connect the controls to our PLC program. Select the dip switch and set the **Variable** field to `AtomProgram.RUN_SWITCH` as indicated by the red arrow:



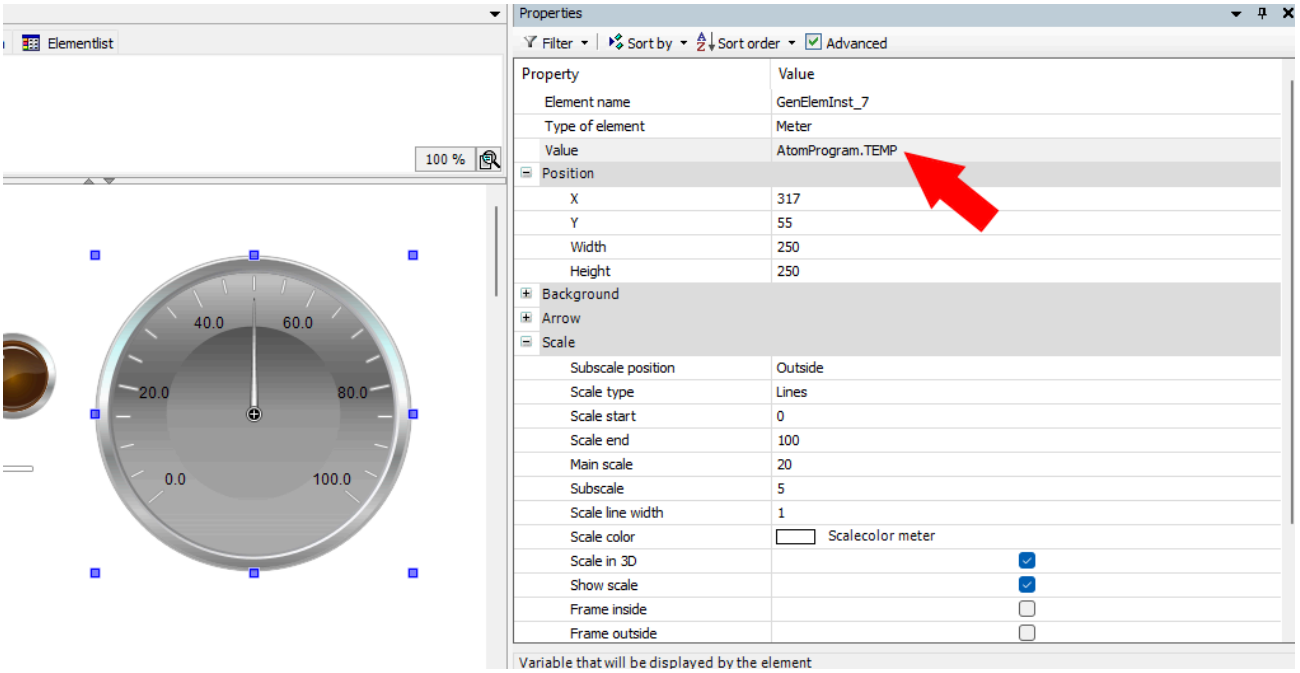
Select the lamp and set the **Variable** field to `AtomProgram.RUN_SWITCH` as indicated by the red arrow:



Select the slider and set the **Variable** field to `AtomProgram.SETPOINT` and set **Scale end** to `10000`:

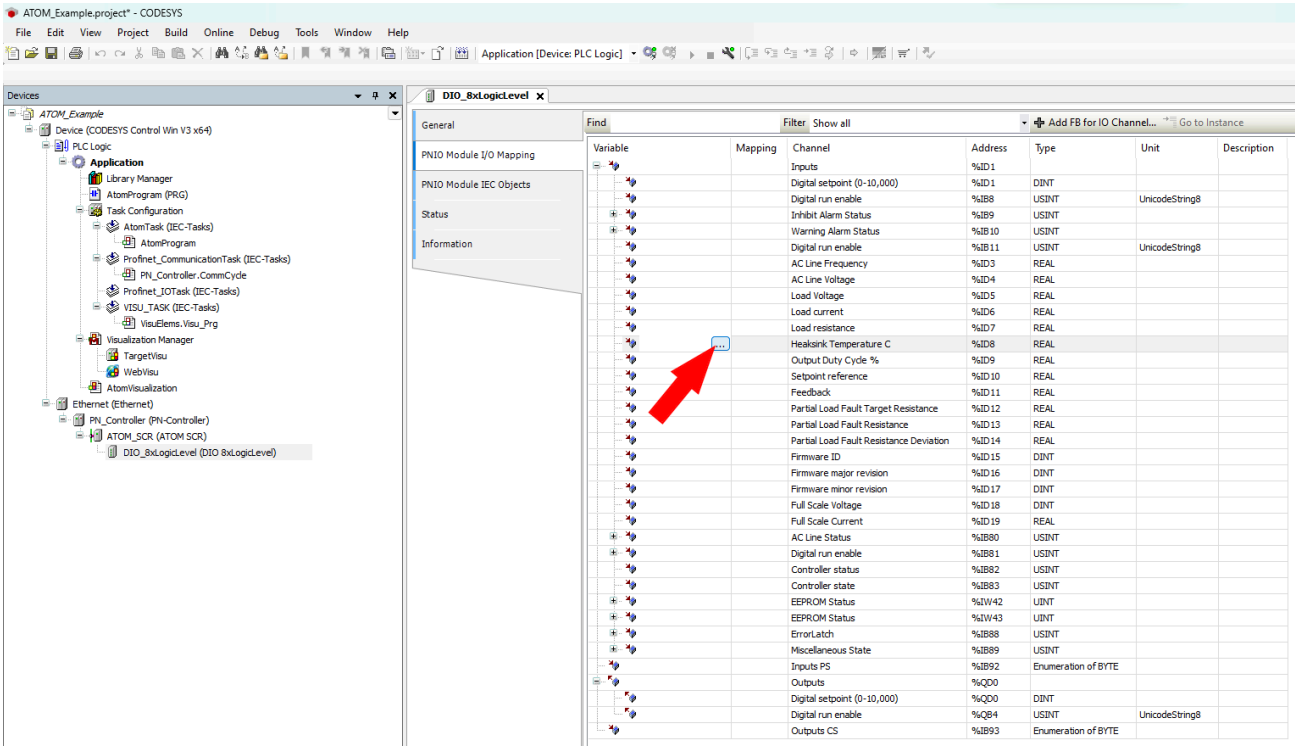


Select the meter and set the **Variable** field to `AtomProgram.TEMP`:

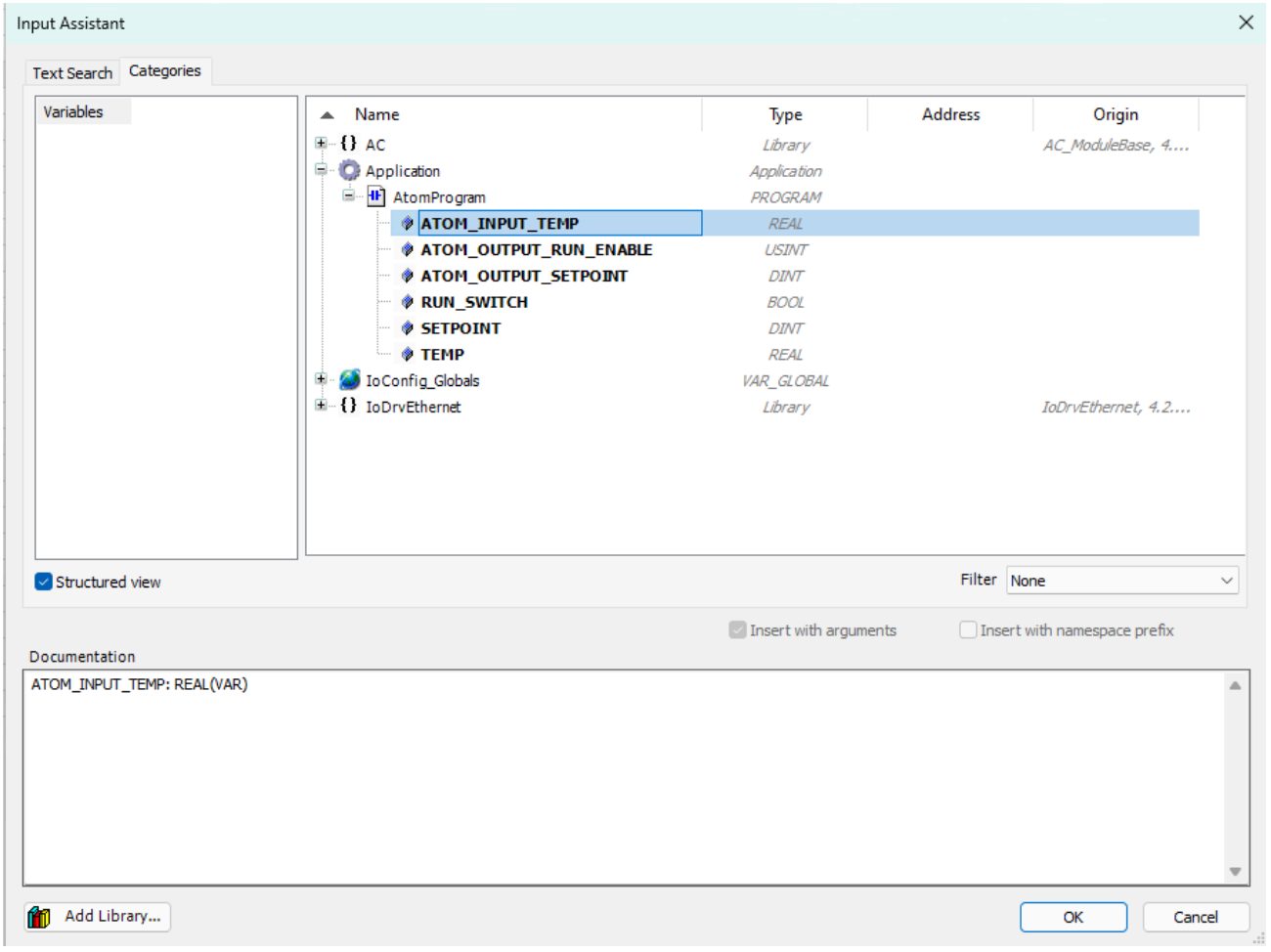


Mapping variables

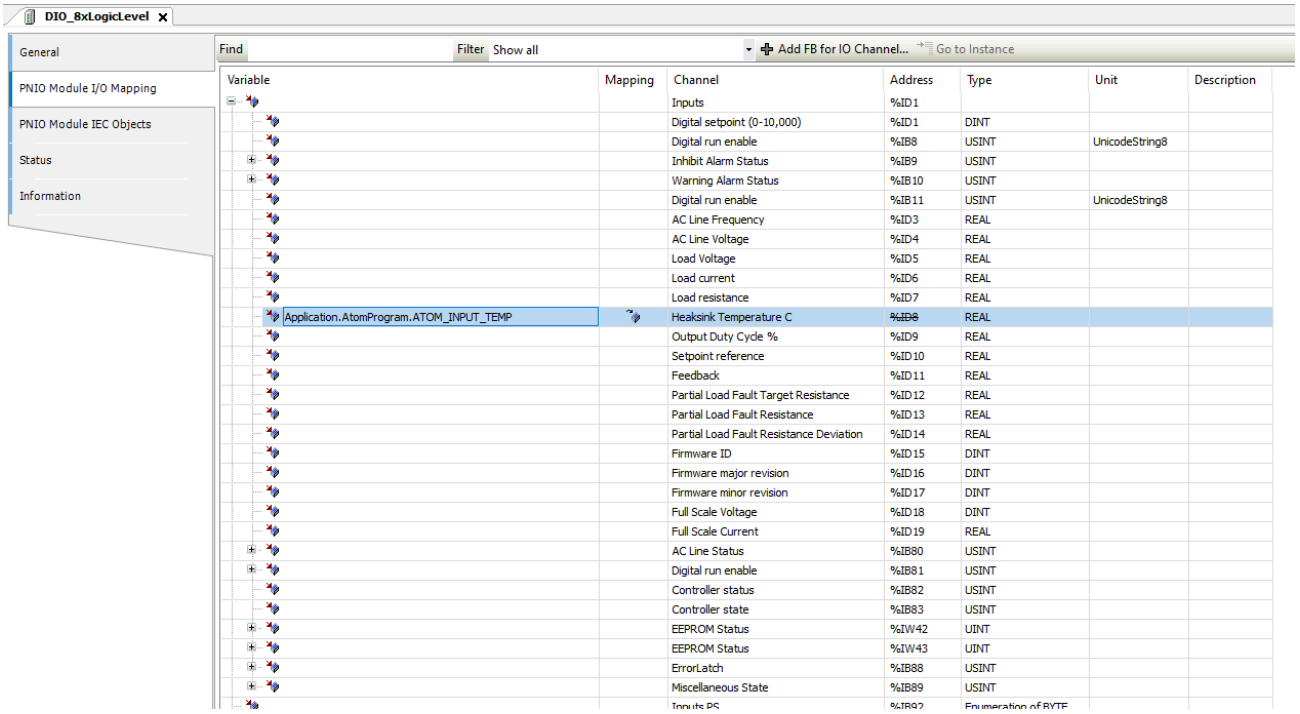
Finally, we'll map our PLC variables to ATOM. Double click **DIO_8xLogicLevel (DIO 8xLogicLevel)** in the device tree to open its configuration window. Select the **PNIO Module I/O Mapping** tab:



Above, select the button indicated by the red arrow. This will open the **Input Assistant** dialog. Select **Application > AtomProgram > ATOM_INPUT_TEMP** and click **Add**:



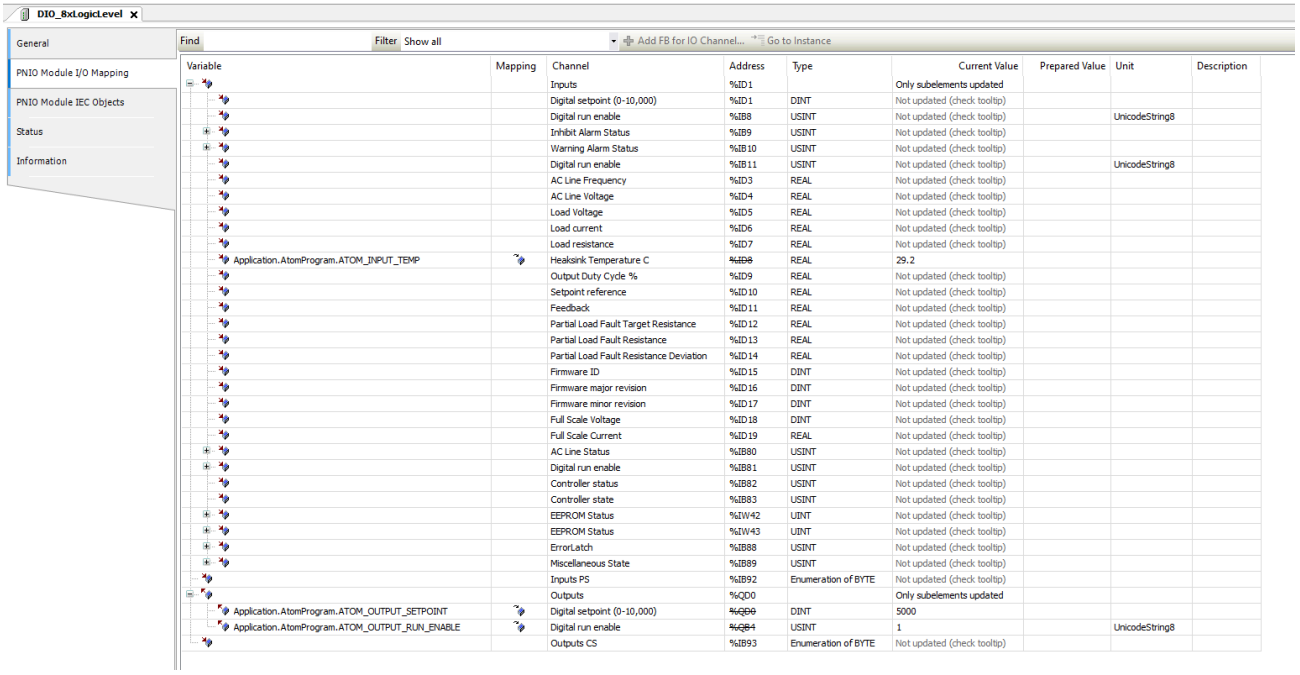
After doing so, your input I/O mappings should look like:



Repeat this for your output I/O mappings:

1. Map **Digital setpoint** to `Application.AtomProgram.ATOM_OUTPUT_SETPOINT`
2. Map **Digital run enable** to `Application.AtomProgram.ATOM_OUTPUT_RUN_ENABLE`

Change the **Filter** to **Show only outputs** and repeat the process for the outputs. Map **Digital setpoint** to `Application.AtomProgram.ATOM_OUTPUT_SETPOINT` and **Digital RUN Enable** to `Application.AtomProgram.ATOM_OUTPUT_RUN_ENABLE`.



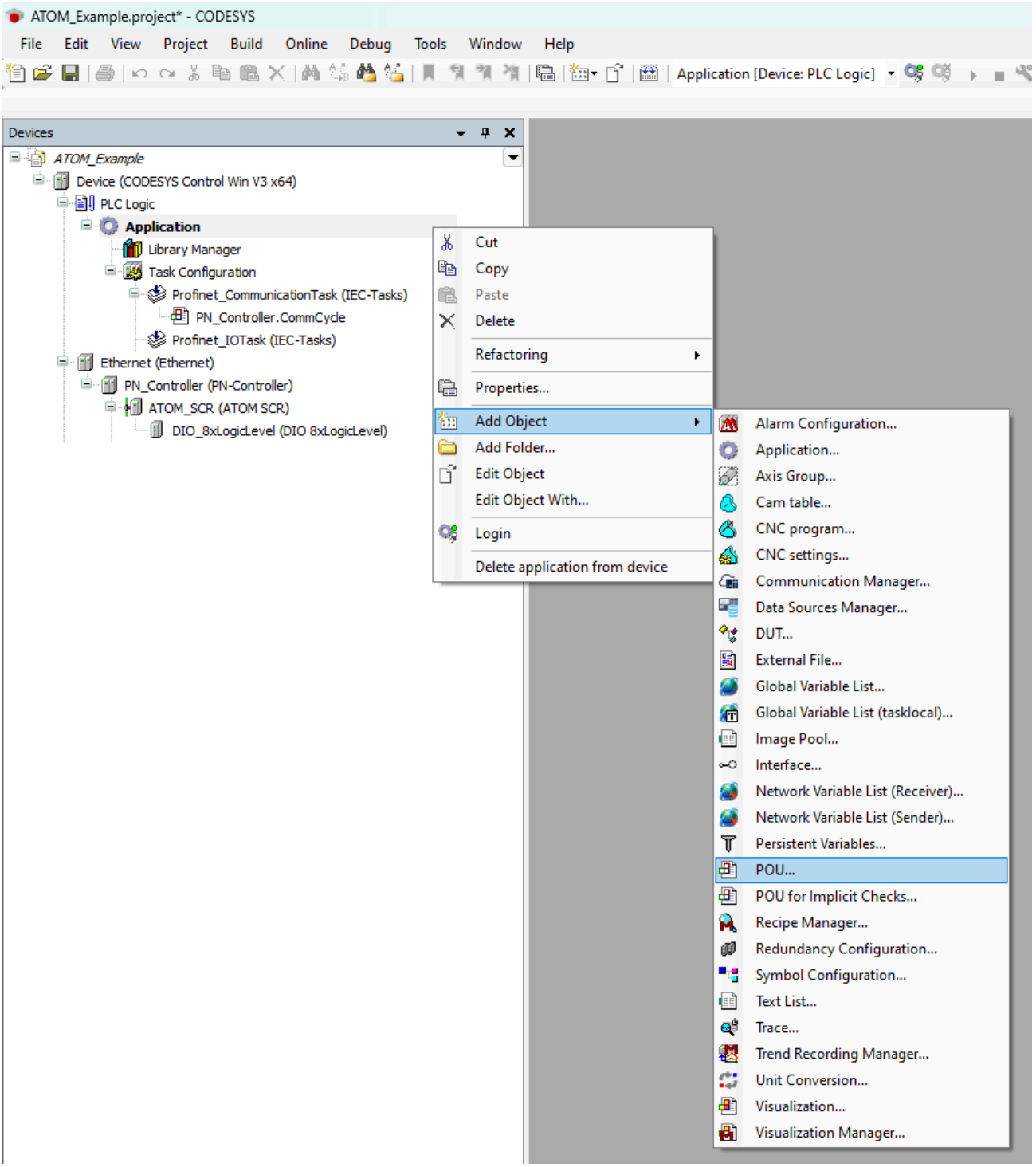
Variable	Mapping	Channel	Address	Type	Current Value	Prepared Value	Unit	Description
		Inputs	%ID1		Only subelements updated			
		Digital setpoint (0-10,000)	%ID1	DINT	Not updated (check tooltip)			
		Digital run enable	%IB8	USINT	Not updated (check tooltip)		UnicodeString8	
		Inhibit Alarm Status	%IB9	USINT	Not updated (check tooltip)			
		Warning Alarm Status	%IB10	USINT	Not updated (check tooltip)			
		Digital run enable	%IB11	USINT	Not updated (check tooltip)		UnicodeString8	
		AC Line Frequency	%ID3	REAL	Not updated (check tooltip)			
		AC Line Voltage	%ID4	REAL	Not updated (check tooltip)			
		Load Voltage	%ID5	REAL	Not updated (check tooltip)			
		Load current	%ID6	REAL	Not updated (check tooltip)			
		Load resistance	%ID7	REAL	Not updated (check tooltip)			
Application.AtomProgram.ATOM_INPUT_TEMP		Heaksink Temperature C	~~%ID8~~	REAL	29.2			
		Output Duty Cycle %	%ID9	REAL	Not updated (check tooltip)			
		Setpoint reference	%ID10	REAL	Not updated (check tooltip)			
		Feedback	%ID11	REAL	Not updated (check tooltip)			
		Partial Load Fault Target Resistance	%ID12	REAL	Not updated (check tooltip)			
		Partial Load Fault Resistance	%ID13	REAL	Not updated (check tooltip)			
		Partial Load Fault Resistance Deviation	%ID14	REAL	Not updated (check tooltip)			
		Firmware ID	%ID15	DINT	Not updated (check tooltip)			
		Firmware major revision	%ID16	DINT	Not updated (check tooltip)			
		Firmware minor revision	%ID17	DINT	Not updated (check tooltip)			
		Full Scale Voltage	%ID18	DINT	Not updated (check tooltip)			
		Full Scale Current	%ID19	REAL	Not updated (check tooltip)			
		AC Line Status	%IB80	USINT	Not updated (check tooltip)			
		Digital run enable	%IB81	USINT	Not updated (check tooltip)			
		Controller status	%IB82	USINT	Not updated (check tooltip)			
		Controller state	%IB83	USINT	Not updated (check tooltip)			
		EEPROM Status	%IW42	UINT	Not updated (check tooltip)			
		EEPROM Status	%IW43	UINT	Not updated (check tooltip)			
		ErrorLatch	%IB88	USINT	Not updated (check tooltip)			
		Miscellaneous State	%IB89	USINT	Not updated (check tooltip)			
		Inputs PS	%IB92	Enumeration of BYTE	Not updated (check tooltip)			
		Outputs	%QD0		Only subelements updated			
Application.AtomProgram.ATOM_OUTPUT_SETPOINT		Digital setpoint (0-10,000)	~~%QD0~~	DINT	5000			
Application.AtomProgram.ATOM_OUTPUT_RUN_ENABLE		Digital run enable	~~%QB4~~	USINT	1		UnicodeString8	
		Outputs CS	%IB93	Enumeration of BYTE	Not updated (check tooltip)			

You're all set! Go to the Running the program with SoftPLC section to run your program.

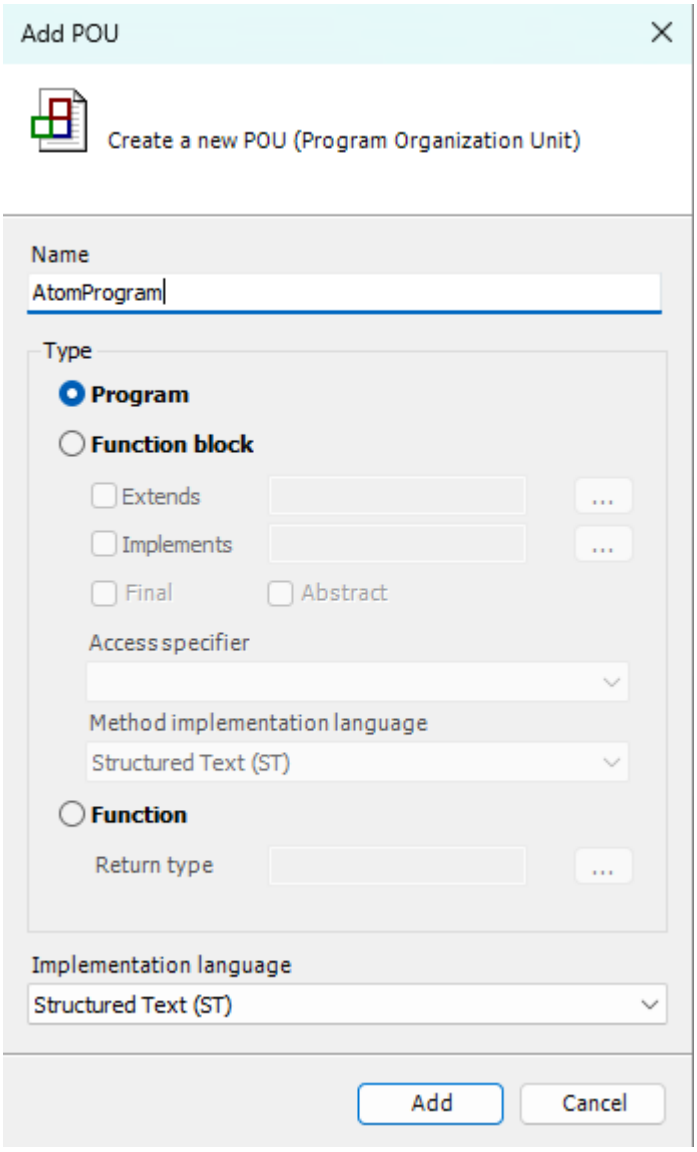
Example: Structured text

Creating the program

Right click **Application** and select **Add Object > POU**:



Name your **POU** `AtomProgram` and select **Structured Text (ST)** as the language:



Next, let's create a basic program. We'll check to make sure no alarms are active and then write a setpoint value of `8000` and set run enable to `true`.

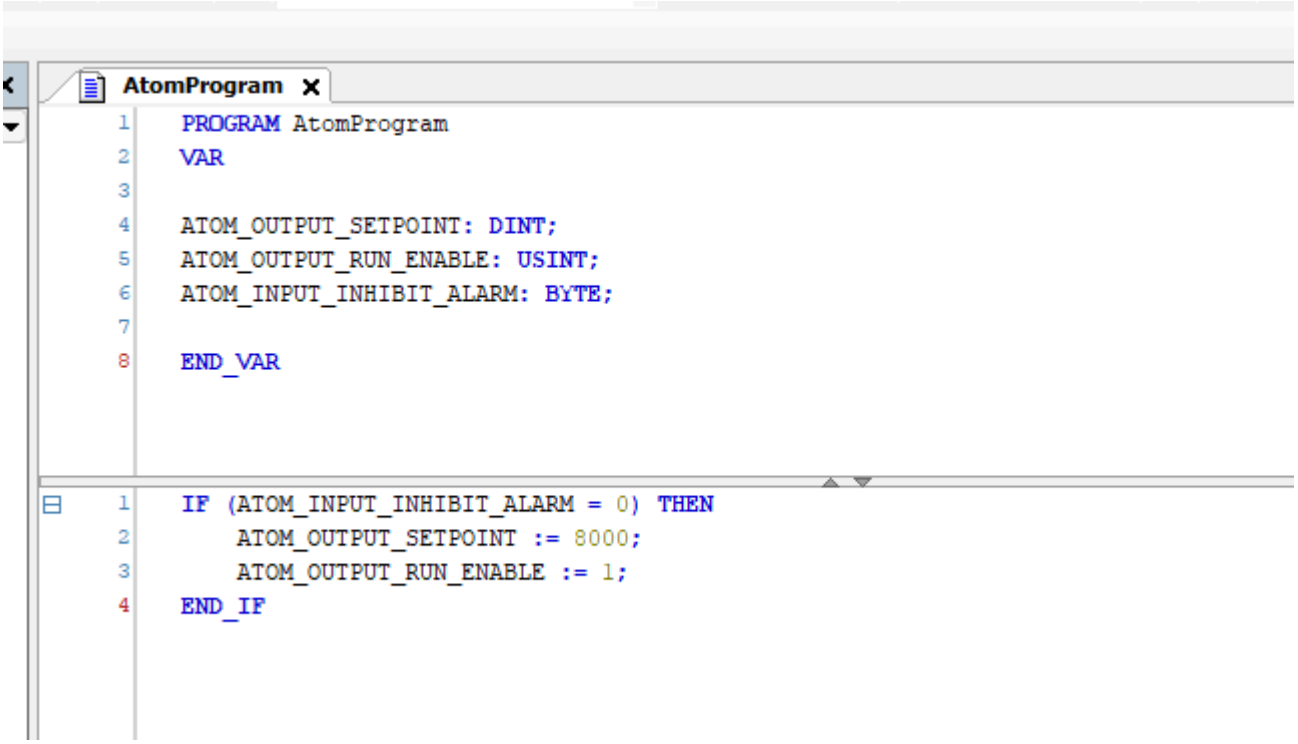
Copy the following code into the top panel of the **AtomProgram** editor:

```
PROGRAM AtomProgram
VAR

ATOM_OUTPUT_SETPOINT: DINT;
ATOM_OUTPUT_RUN_ENABLE: USINT;
ATOM_INPUT_INHIBIT_ALARM: BYTE;

END_VAR
```

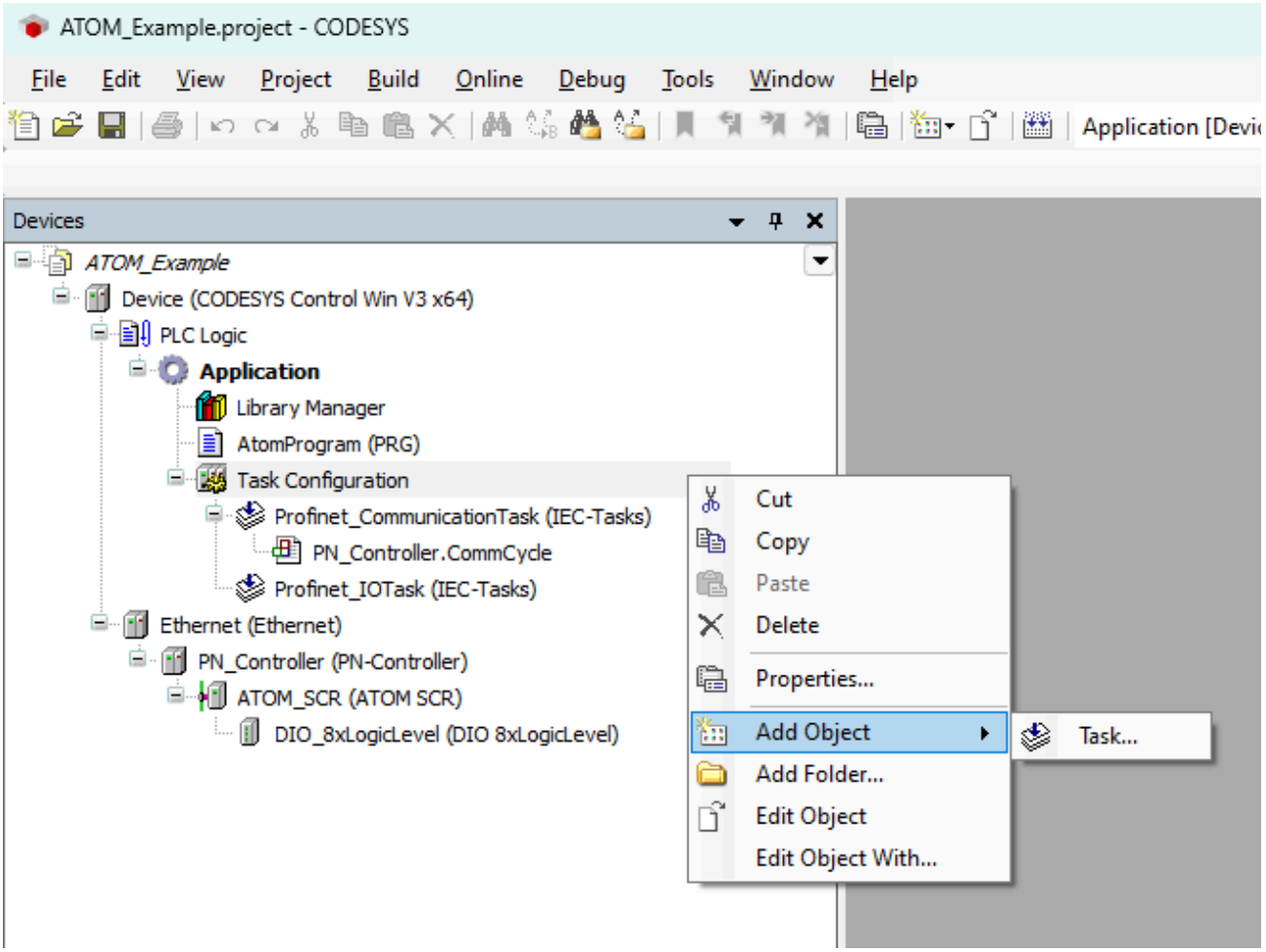
Copy the following code into the main program section:

```
IF (ATOM_INPUT_INHIBIT_ALARM = 0) THEN
        ATOM_OUTPUT_SETPOINT := 8000;
        ATOM_OUTPUT_RUN_ENABLE := 1;
END_IF
```

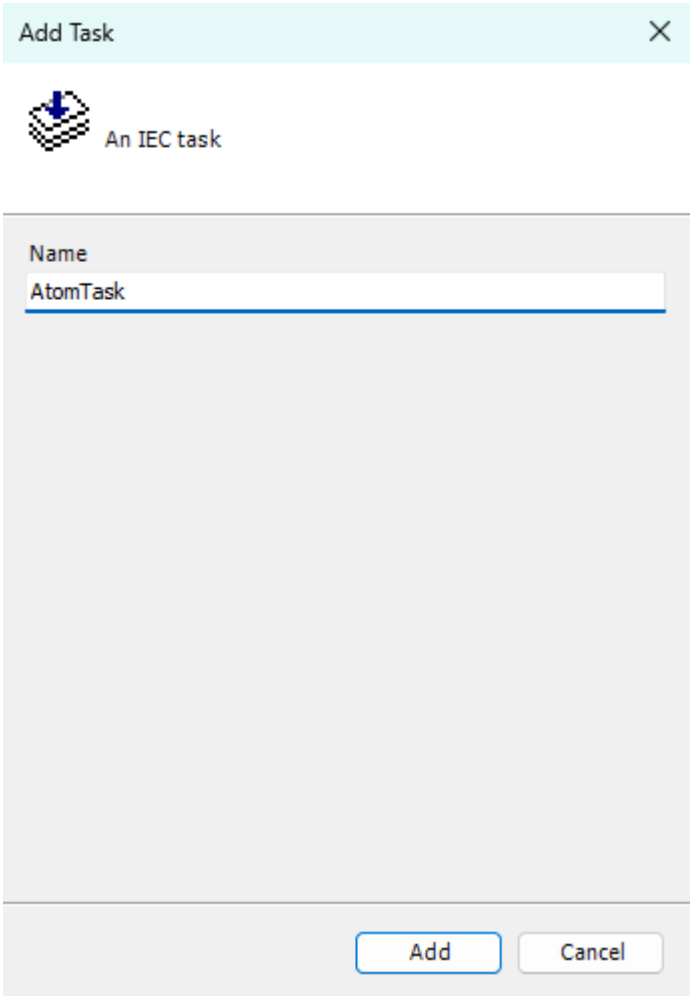
Your editor should look like:



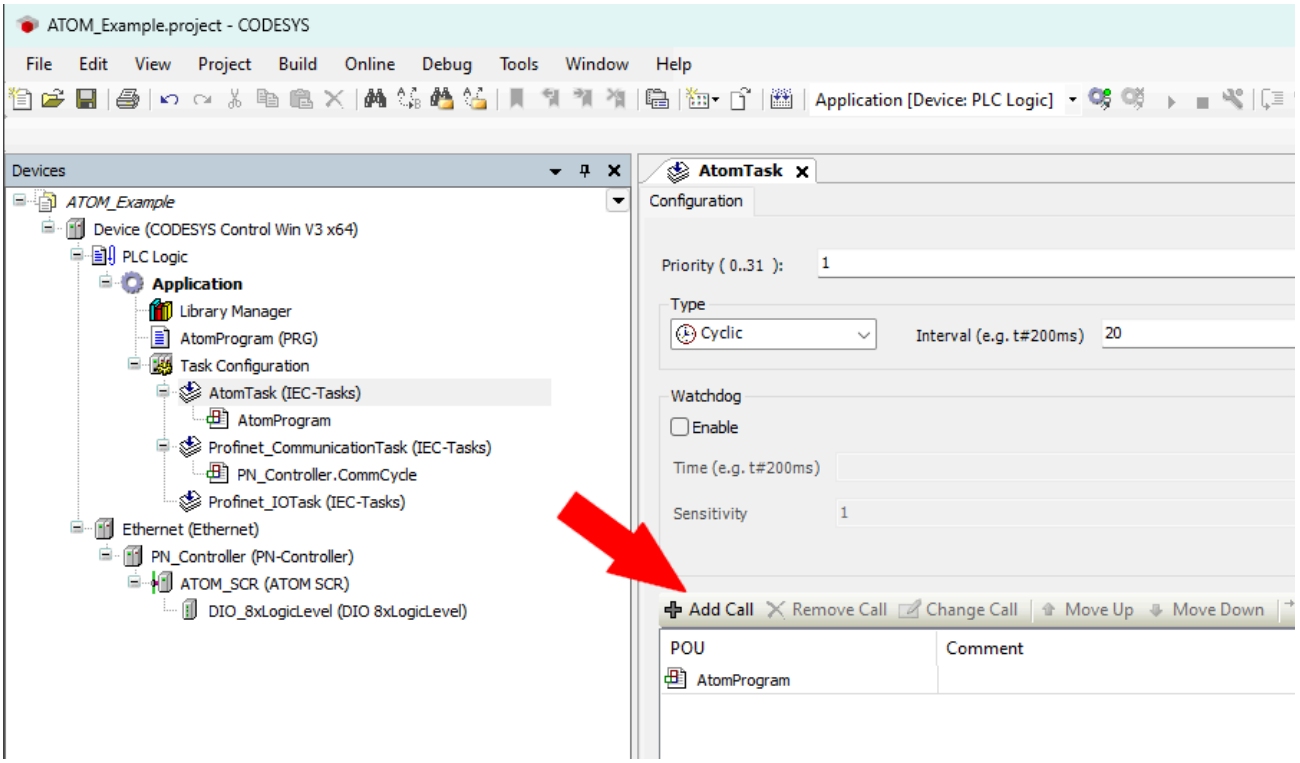
Next, we'll add a new task to call our program. Right click **Task Configuration** and Select **Add Object > Task**:



Name your task `AtomTask` and click **Add**:

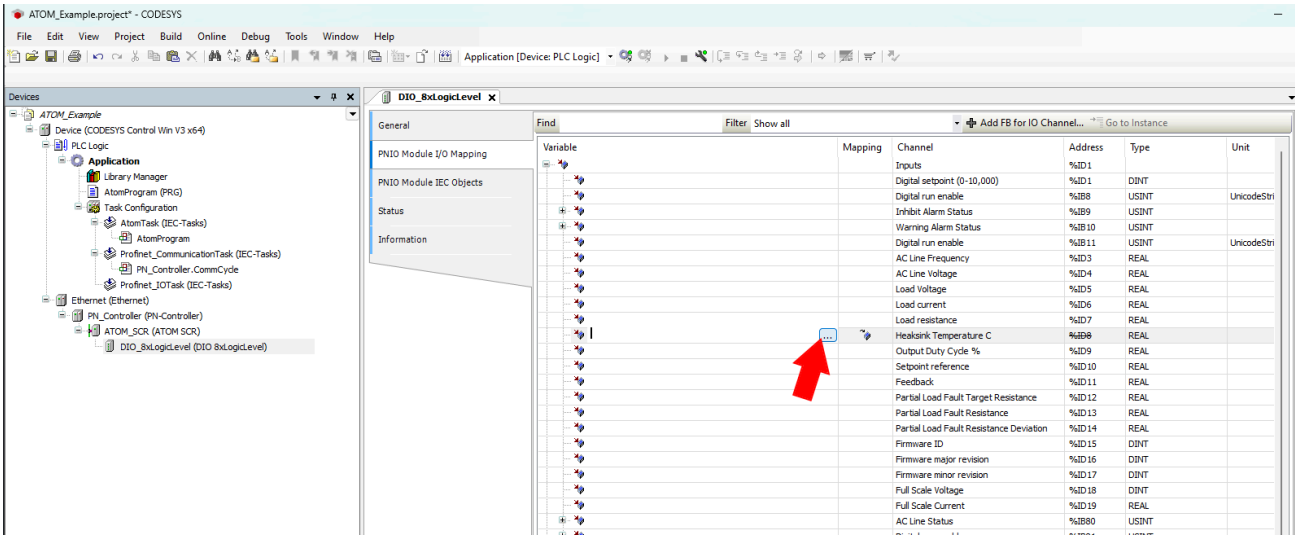


Next, double click **AtomTask (IEC-Tasks)** to open its configuration tab. Click **Add Call** and select **Application > AtomProgram**. After doing so, **AtomTask**'s configuration should look like:

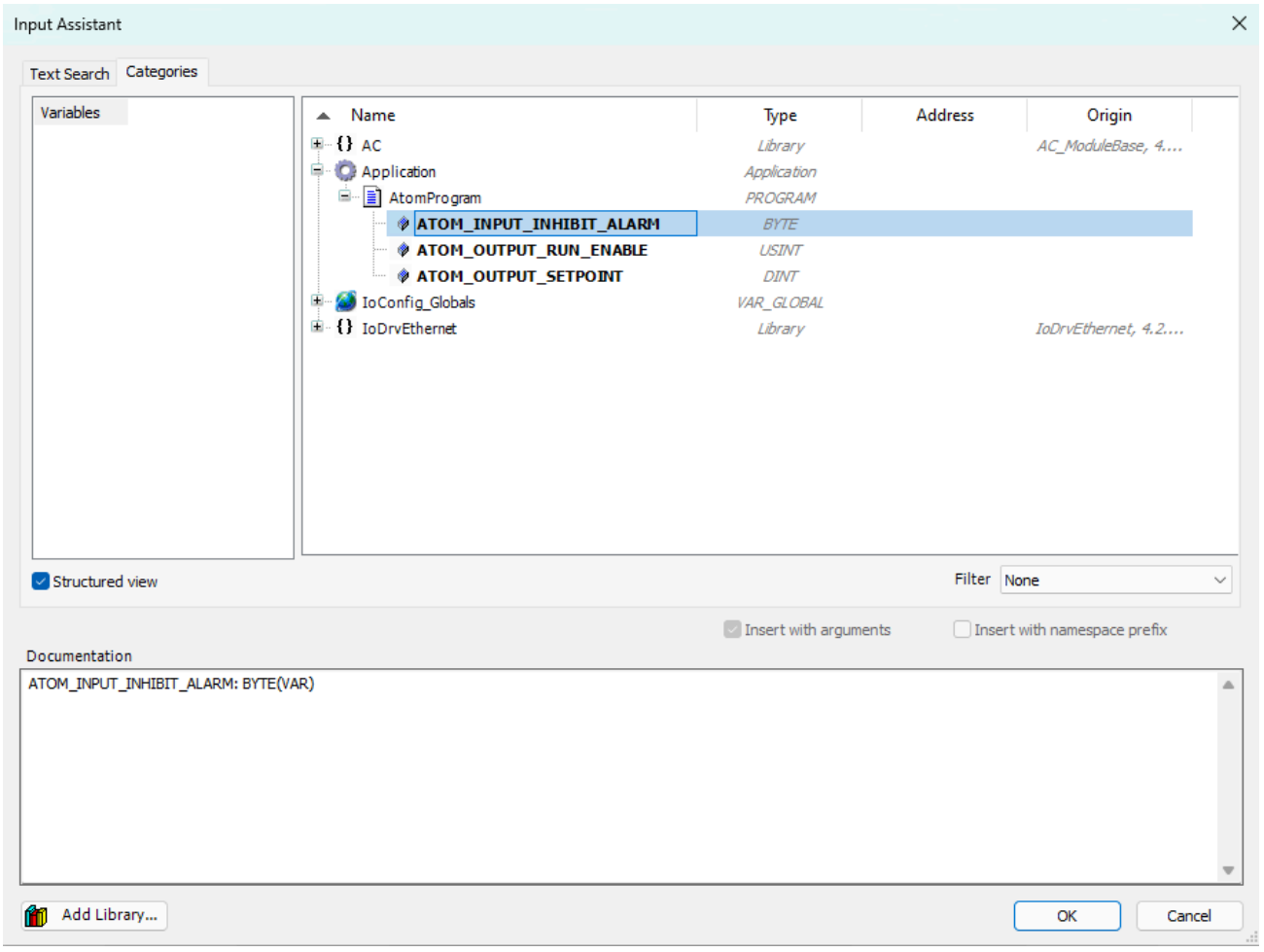


Mapping variables

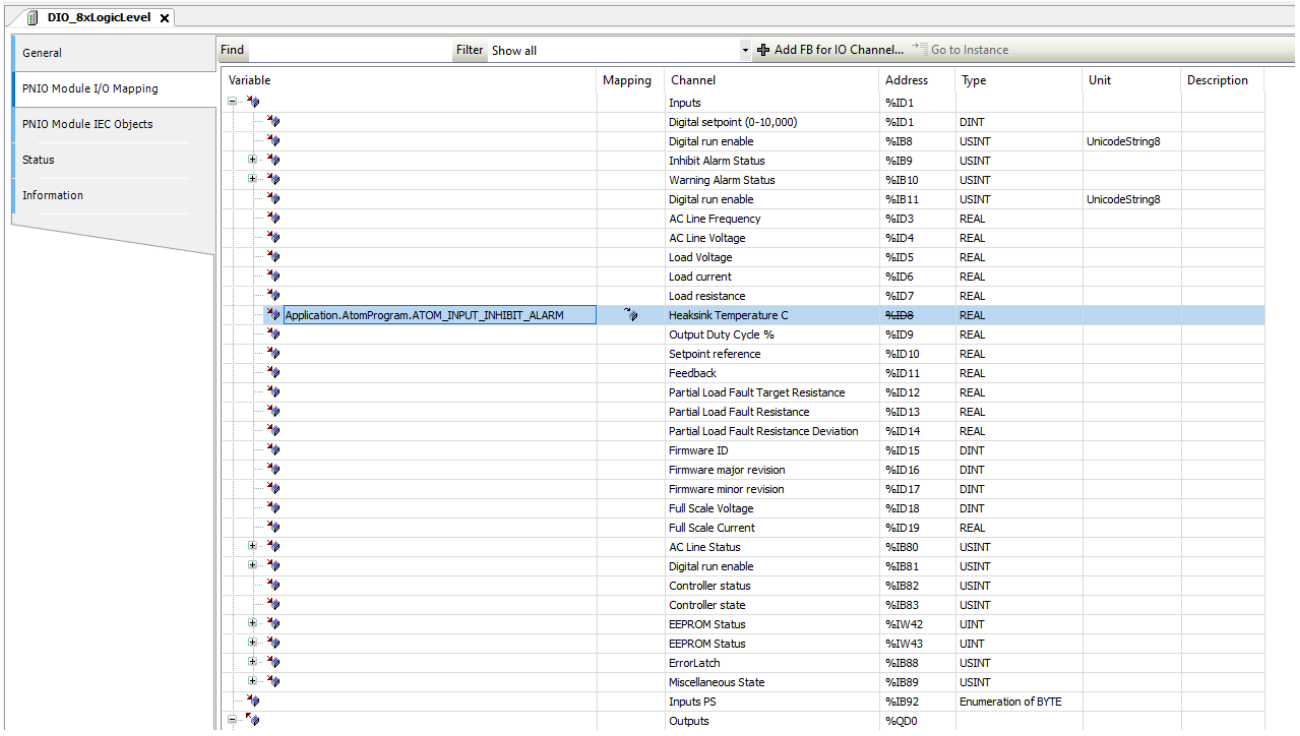
Finally, we'll map our PLC variables to ATOM. Double click **DIO_8xLogicLevel (DIO 8xLogicLevel)** in the device tree to open its configuration window. Select the **PNIO Module I/O Mapping** tab:



Above, select the button indicated by the red arrow. This will open the **Input Assistant** dialog. Select **Application > AtomProgram > ATOM_INPUT_INHIBIT_ALARM** and click **Add**:



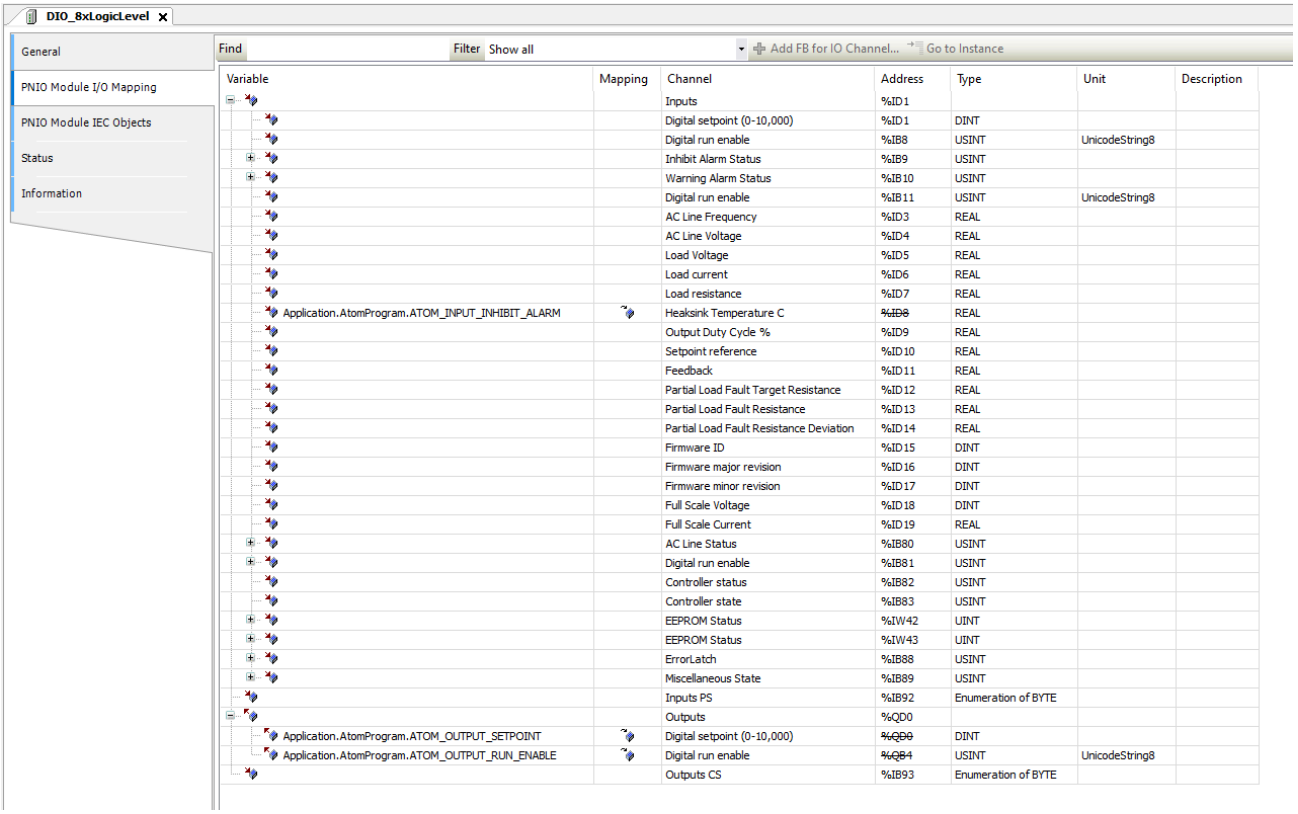
After doing so, your input I/O mappings should look like:



Repeat this for your output I/O mappings:

1. Map **Digital setpoint** to `Application.AtomProgram.ATOM_OUTPUT_SETPOINT`
2. Map **Digital run enable** to `Application.AtomProgram.ATOM_OUTPUT_RUN_ENABLE`

Change the **Filter** to **Show only outputs** and repeat the process for the outputs. Map **Digital setpoint** to `Application.AtomProgram.ATOM_OUTPUT_SETPOINT` and **Digital RUN Enable** to `Application.AtomProgram.ATOM_OUTPUT_RUN_ENABLE`.



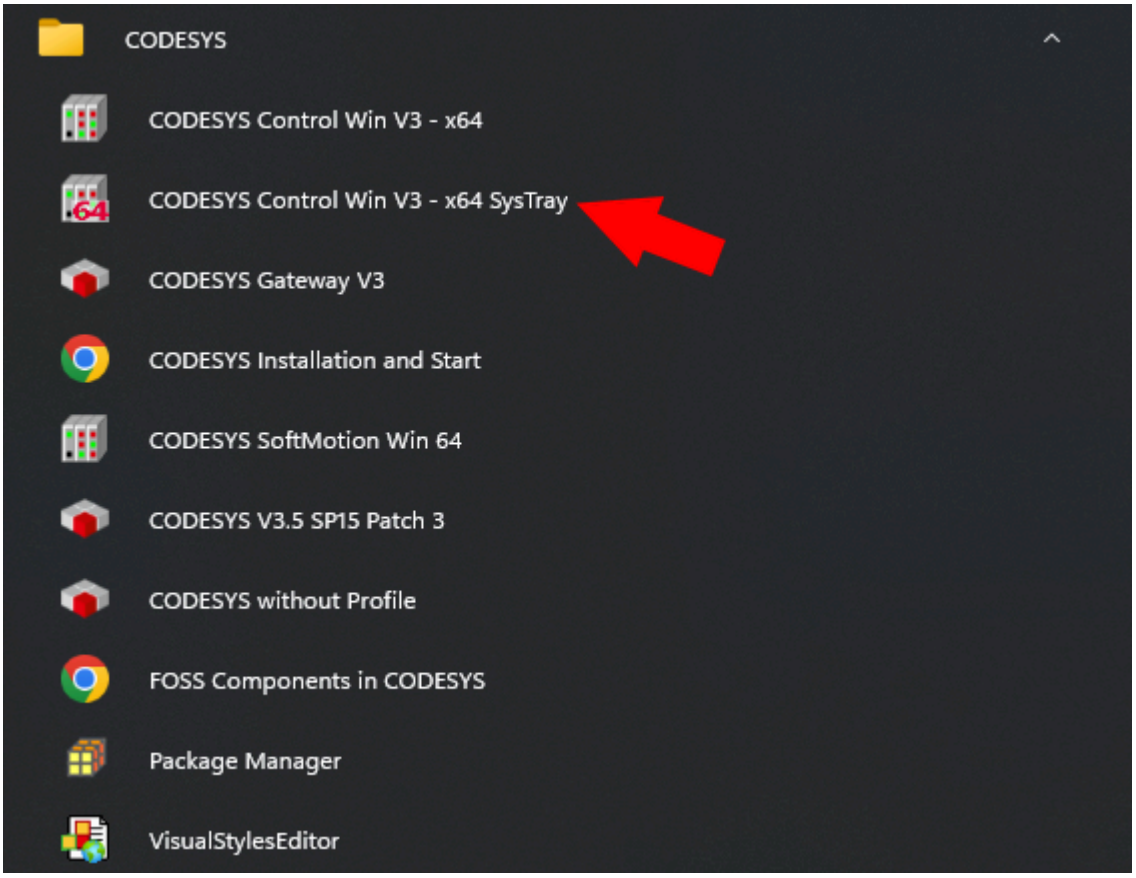
Variable	Mapping	Channel	Address	Type	Unit	Description
		Inputs	%ID1			
		Digital setpoint (0-10,000)	%ID1	DINT		
		Digital run enable	%IB8	USINT	UnicodeString8	
		Inhibit Alarm Status	%IB9	USINT		
		Warning Alarm Status	%IB10	USINT		
		Digital run enable	%IB11	USINT	UnicodeString8	
		AC Line Frequency	%ID3	REAL		
		AC Line Voltage	%ID4	REAL		
		Load Voltage	%ID5	REAL		
		Load current	%ID6	REAL		
		Load resistance	%ID7	REAL		
Application.AtomProgram.ATOM_INPUT_INHIBIT_ALARM		Heaksink Temperature C	~~%ID8~~	REAL		
		Output Duty Cycle %	%ID9	REAL		
		Setpoint reference	%ID10	REAL		
		Feedback	%ID11	REAL		
		Partial Load Fault Target Resistance	%ID12	REAL		
		Partial Load Fault Resistance	%ID13	REAL		
		Partial Load Fault Resistance Deviation	%ID14	REAL		
		Firmware ID	%ID15	DINT		
		Firmware major revision	%ID16	DINT		
		Firmware minor revision	%ID17	DINT		
		Full Scale Voltage	%ID18	DINT		
		Full Scale Current	%ID19	REAL		
		AC Line Status	%IB80	USINT		
		Digital run enable	%IB81	USINT		
		Controller status	%IB82	USINT		
		Controller state	%IB83	USINT		
		EEPROM Status	%IW42	UINT		
		EEPROM Status	%IW43	UINT		
		ErrorLatch	%IB88	USINT		
		Miscellaneous State	%IB89	USINT		
		Inputs PS	%IB92	Enumeration of BYTE		
		Outputs	%QD0			
Application.AtomProgram.ATOM_OUTPUT_SETPOINT		Digital setpoint (0-10,000)	~~%QD0~~	DINT		
Application.AtomProgram.ATOM_OUTPUT_RUN_ENABLE		Digital run enable	~~%QB4~~	USINT	UnicodeString8	
		Outputs CS	%IB93	Enumeration of BYTE		

You're all set! Go to the Running the program with SoftPLC section to run your program.

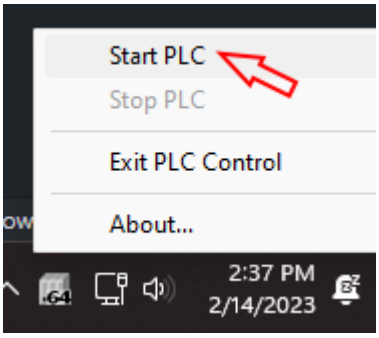
Running the program with SoftPLC

> **INFO**
>
> The instructions to run your program are the same regardless of whether you are using ladder logic or structured text.
>
> The only difference is that in the ladder logic example, a visualization window will open that allows you to control ATOM.

To debug the program, first make sure you start **Codesys WIN Control V3 - x64 SysTray**

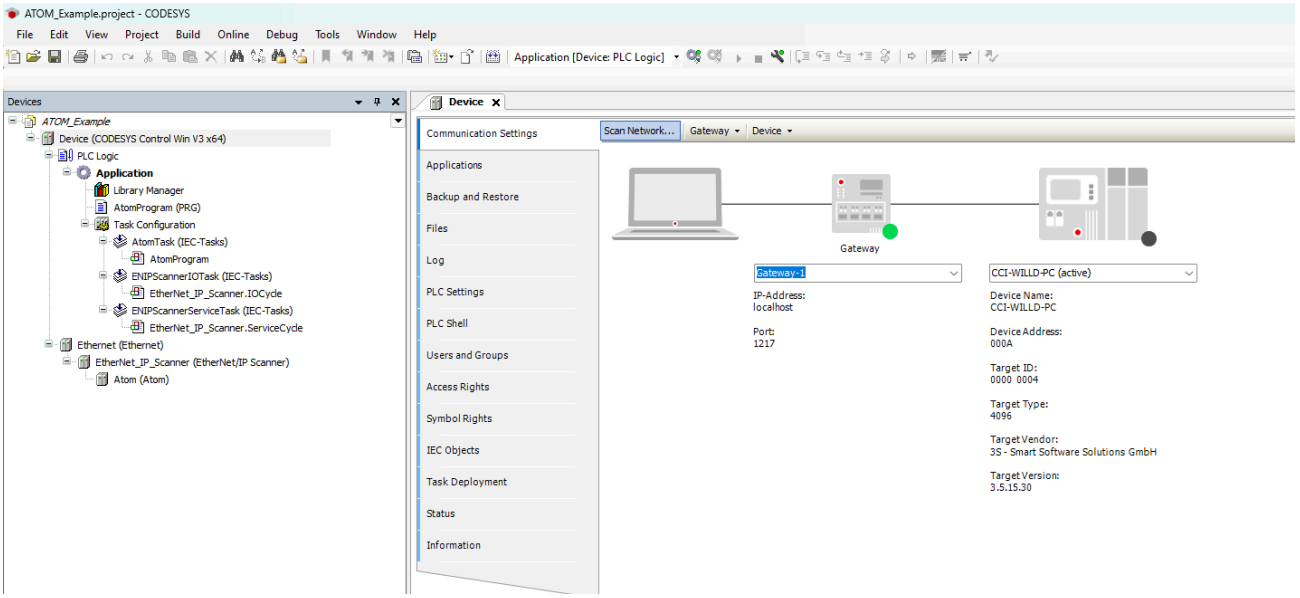


This will launch the Codesys SoftPLC. You should see an icon appear in your systray and you can right click it and select **Start PLC** to start the SoftPLC:

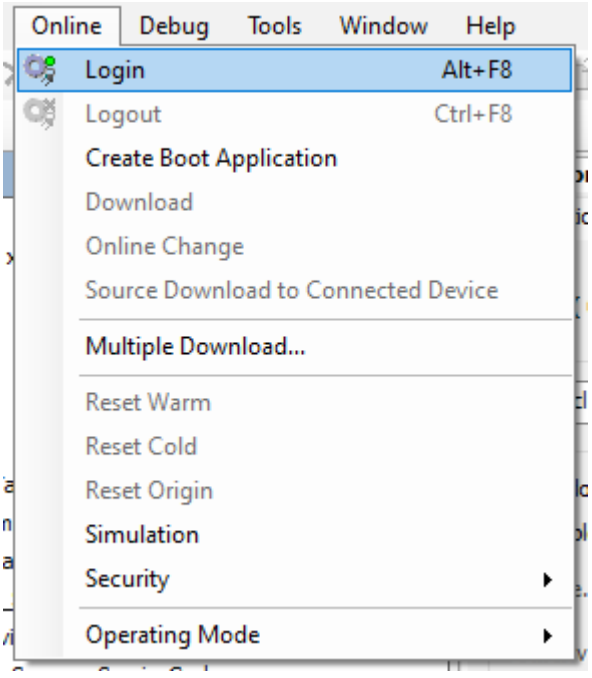


Next, connect your Atom to your PC via an Ethernet cable, ensuring to use the network interface you specified in the Adding a Profinet controller section.

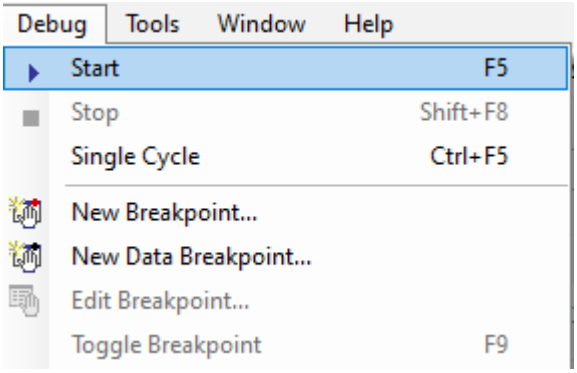
Next, in Codesys double click **Application** to open its configuration window. Here you can select **Scan Network** to discover your SoftPLC:



Finally, **Login** to your SoftPLC:



Then you can start debugging the program:



If you use Control Panel to monitor ATOM, you should see the **Stop / Run** state and the **Digital Setpoint** values change to reflect the PLC program's instructions. If you followed the structured text example, the values will change once and remain fixed. If you followed the ladder logic example, a visualization control panel will appear. Flipping the dip switch or adjusting the slider will immediately update ATOM and the changes should reflect in real-time: