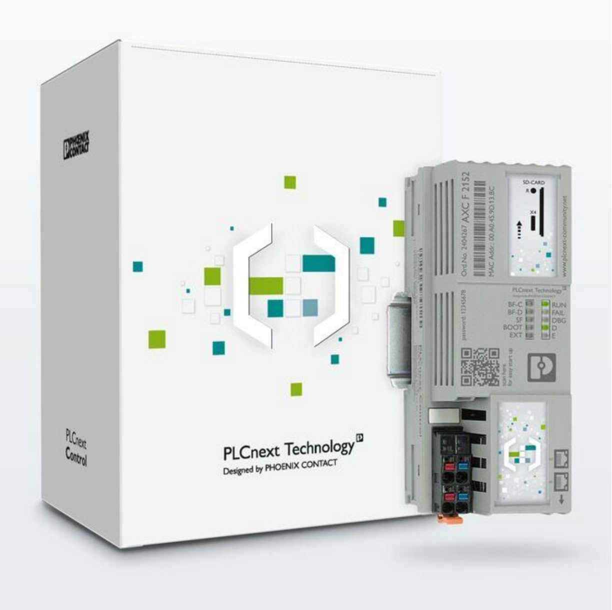
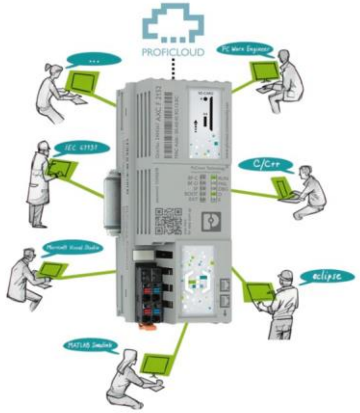
PLCnext Technology

Part 1 - Getting started and writing your first program



Acknowledgments: Thanks to Loren Brown and Yuri Chamarelli of Phoenix Contact, to Mark Mays of TC Energy, and to Rajvir Singh of Code and Compile for their help in revising this presentation.

Topics



- Introduction to PLCnext hardware – the PLCnext starter kit
- Connecting and communicating with the PLCnext controller
  - Accessing configuration interface for the PLCnext controller
    - Setting up the laptop to communicate with the PLCnext controller
- Initial configuration of the PLCnext controller
- Introduction to PLCnext software – PLCnext Engineer
- Acquiring and installing PLCnext Engineer software

…continued, next page

Topics, continued

- Getting started with PLCnext Engineer software
  - Opening a new project
  - Aligning communications between project and the controller
  - Adding input and output modules to the project
  - Parameterization of the I/O
  - Connecting to the controller, downloading and running the project
  - Creating variables, linking them to I/O in the program
- Programming preliminaries
  - Importing a function block into the program
  - Open a new program, and the code tab, drop in a function block

…continued on next page

Topics, continued

- Programming for real
  - Parameterization of the AI_Norm function block
    - Declaring variables
    - Specializing the blocks to handle our real-world inputs
  - Programming some digital I/O, working with a Greater Than function block
    - Program two Greater Than function blocks
      - Create new variables to “turn true” when the appropriate input reaches a threshold
      - Link these new variables to real digital outputs on the PLCnext controller
  - Download to the controller and run, verify proper operation
    - While online with the controller, check the program for real-time values

…continued on next page

Topics, continued

- Programming the HMI (Human-Machine Interface)
  - Accessing the HMI development area
  - Creating a page
  - Dropping an object onto the page, and configuring the object
  - Disabling the need to sign-in to view the HMI (safe for demo purposes)
  - Viewing the live HMI application in a browser
  - Detailed instructions in developing HMI pages, linking them to the program
    - Using Text, Objects and Symbols
      - Configuring settings, parameters, dynamics
- End
- Appendix
  - Accessing the PLCnext Community
  - Accessing more information on the PLCnext site on the internet

Useful resources - User manuals and data sheets

AXL F AI2 AO2 1H

Axioline F, analog input and output module, 2 inputs, 2 outputs

Data sheet
106048_en_05

© PHOENIX CONTACT 2019-06-12

1 Description

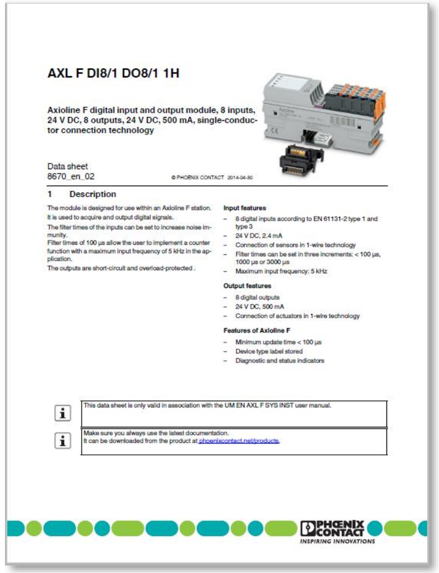
The module is designed for use within an Axioline F station. It is used to acquire and output analog voltage and current signals.

Features

- 2 analog differential input channels
- Connection of sensors in 2-wire technology
- Current ranges: 0 mA ... 20 mA, 4 mA ... 20 mA, ±20 mA
- Voltage ranges: 0 V ... 10 V, ±10 V, 0 V ... 5 V, ±5 V
- 2 analog outputs
- Connection of actuators in 2-wire technology
- Current ranges: 0 mA ... 20 mA, 4 mA ... 20 mA, ±20 mA
- Voltage ranges: 0 V ... 10 V, ±10 V, 0 V ... 5 V, ±5 V
- Process data update < 150 µs
- Device rating plate stored

This data sheet is only valid in association with the UM EN AXL F SYS INST user manual.

Make sure you always use the latest documentation.
It can be downloaded at: phoenixcontact.net/product/2702072



AXL F DI8/1 DO8/1 1H

Axioline F digital input and output module, 8 inputs, 24 V DC, 8 outputs, 24 V DC, 500 mA, single-conductor connection technology

Data sheet
8670_en_02

© PHOENIX CONTACT 2014-04-30

1 Description

The module is designed for use within an Axioline F station.

It is used to acquire and output digital signals.

The filter times of the inputs can be set to increase noise immunity.
Filter times of 100 µs allow the user to implement a counter function with a maximum input frequency of 5 kHz in the application.

The outputs are short-circuit and overload-protected .

Input features

- 8 digital inputs according to EN 61131-2 type 1 and type 3
- 24 V DC, 2.4 mA
- Connection of sensors in 1-wire technology
- Filter times can be set in three increments: < 100 µs, 1000 µs or 3000 µs
- Maximum input frequency: 5 kHz

Output features

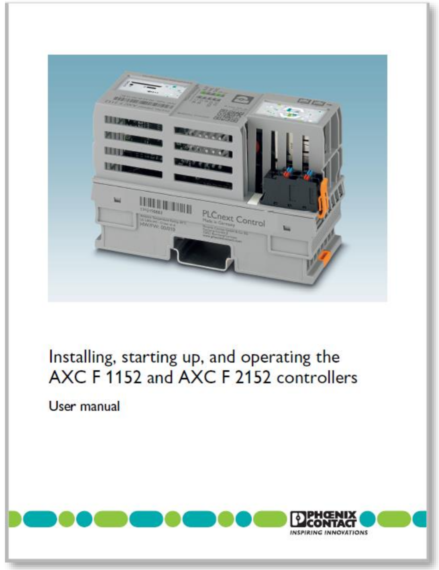
- 8 digital outputs
- 24 V DC, 500 mA
- Connection of actuators in 1-wire technology

Features of Axioline F

- Minimum update time < 100 µs
- Device type label stored
- Diagnostic and status indicators

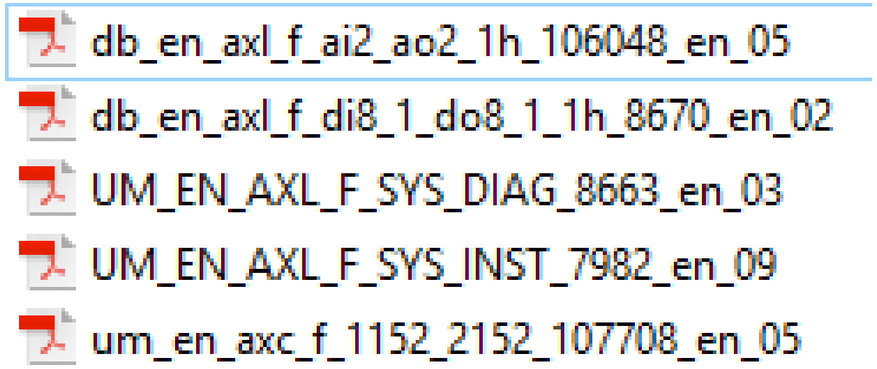
This data sheet is only valid in association with the UM EN AXL F SYS INST user manual.

Make sure you always use the latest documentation.
It can be downloaded from the product at phoenixcontact.net/products.



Installing, starting up, and operating the AXC F 1152 and AXC F 2152 controllers

User manual



db_en_axl_f_ai2_ao2_1h_106048_en_05

db_en_axl_f_di8_1_do8_1_1h_8670_en_02

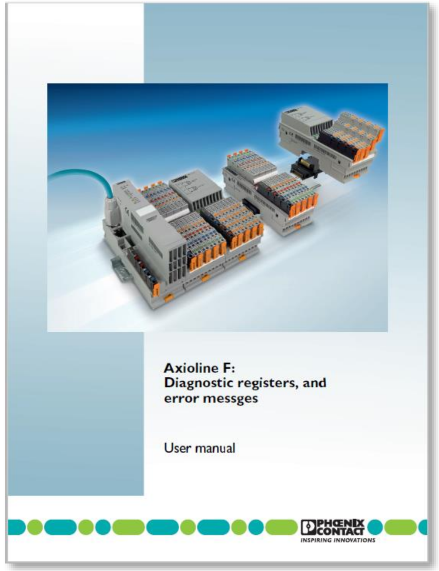
UM_EN_AXL_F_SYS_DIAG_8663_en_03

UM_EN_AXL_F_SYS_INST_7982_en_09

um_en_axc_f_1152_2152_107708_en_05

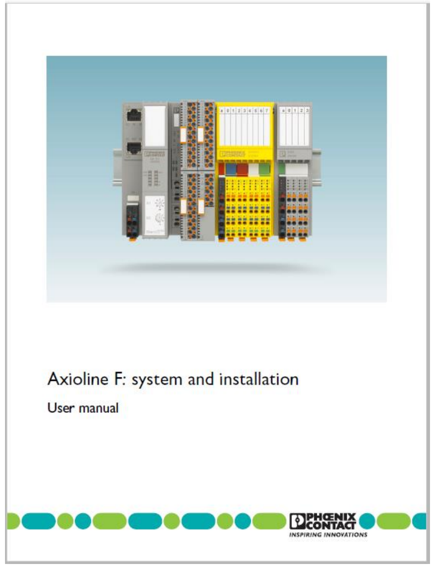
These can each be found under the "downloads" section for each of the components used in this system

They will help clarify wiring points, etc.



Axioline F:
Diagnostic registers, and error messges

User manual

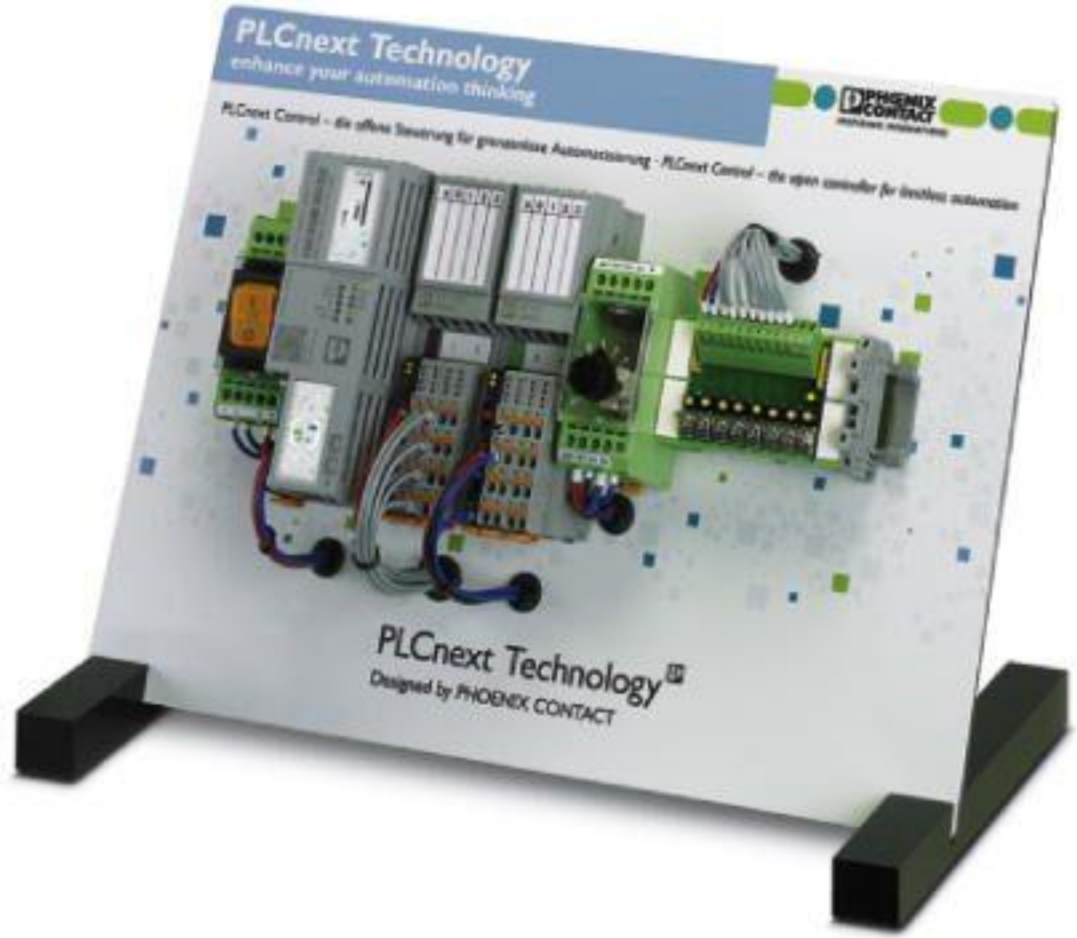


Axioline F: system and installation

User manual

Also – **CLICK HERE** to check out Rajvir Singh's Youtube channel for *several* PLCnext training videos

Hardware – PLCnext Starter Kit


PLCnext Technology
enhance your automation thinking
PHOENIX CONTACT
PLCnext Control – die offene Steuerung für grenzenlose Automatisierung · PLCnext Control – the open controller for limitless automation
PLCnext Technology
Designed by PHOENIX CONTACT

AXC F 2152 STARTERKIT

Order # **1046568**

…or build your own:

Controller - AXC F 2152 - **2404267**

DI/DO Module – DI8 /1 DO8 /1 – **2701916**

AI/AO Module – AI2 AO2 – **2702072**

*I/O Exerciser - **5603026**

*To follow the programming example in this training, a means for generating a 0-10vdc analog input signal and a 4-20mA analog input signal is needed.

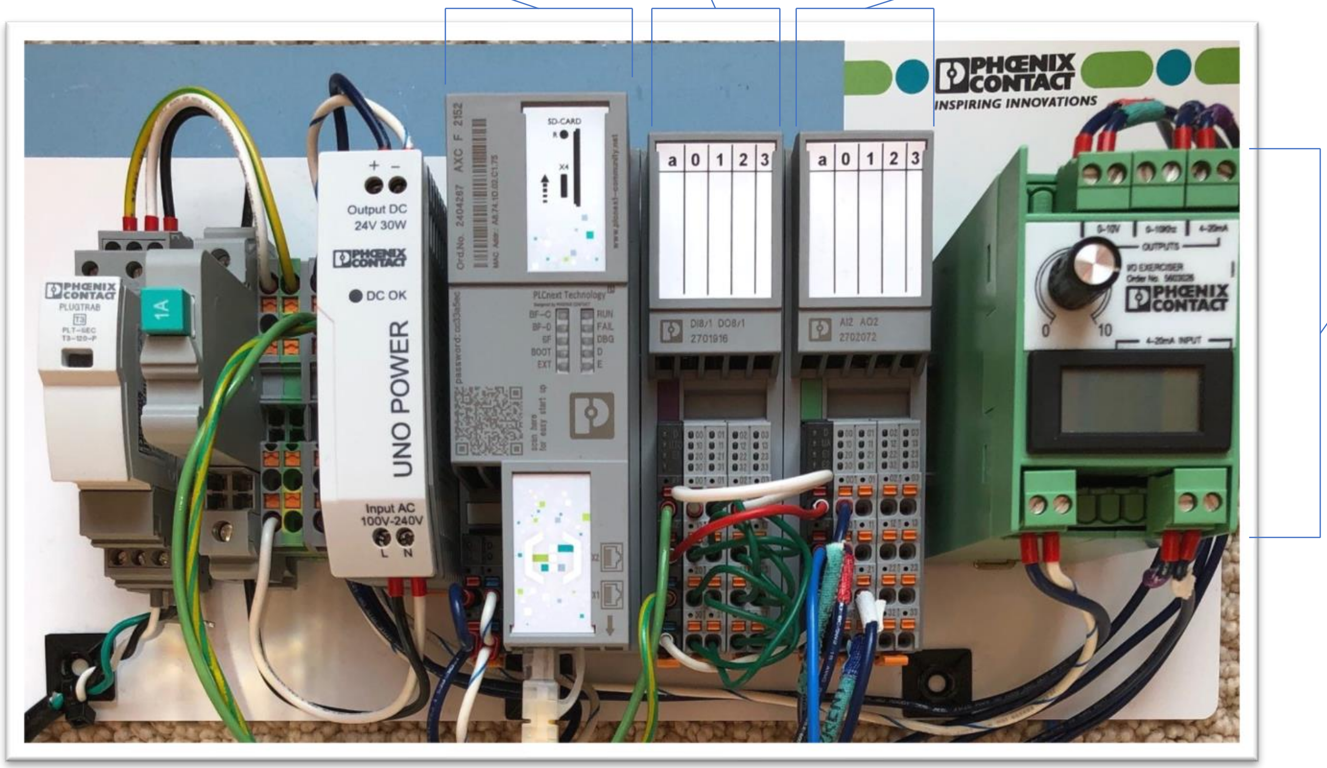
Hardware – Actual setup used for exercise

Controller - AXC F 2152
2404267

DI/DO Module – DI8 /1 DO8 /1
2701916

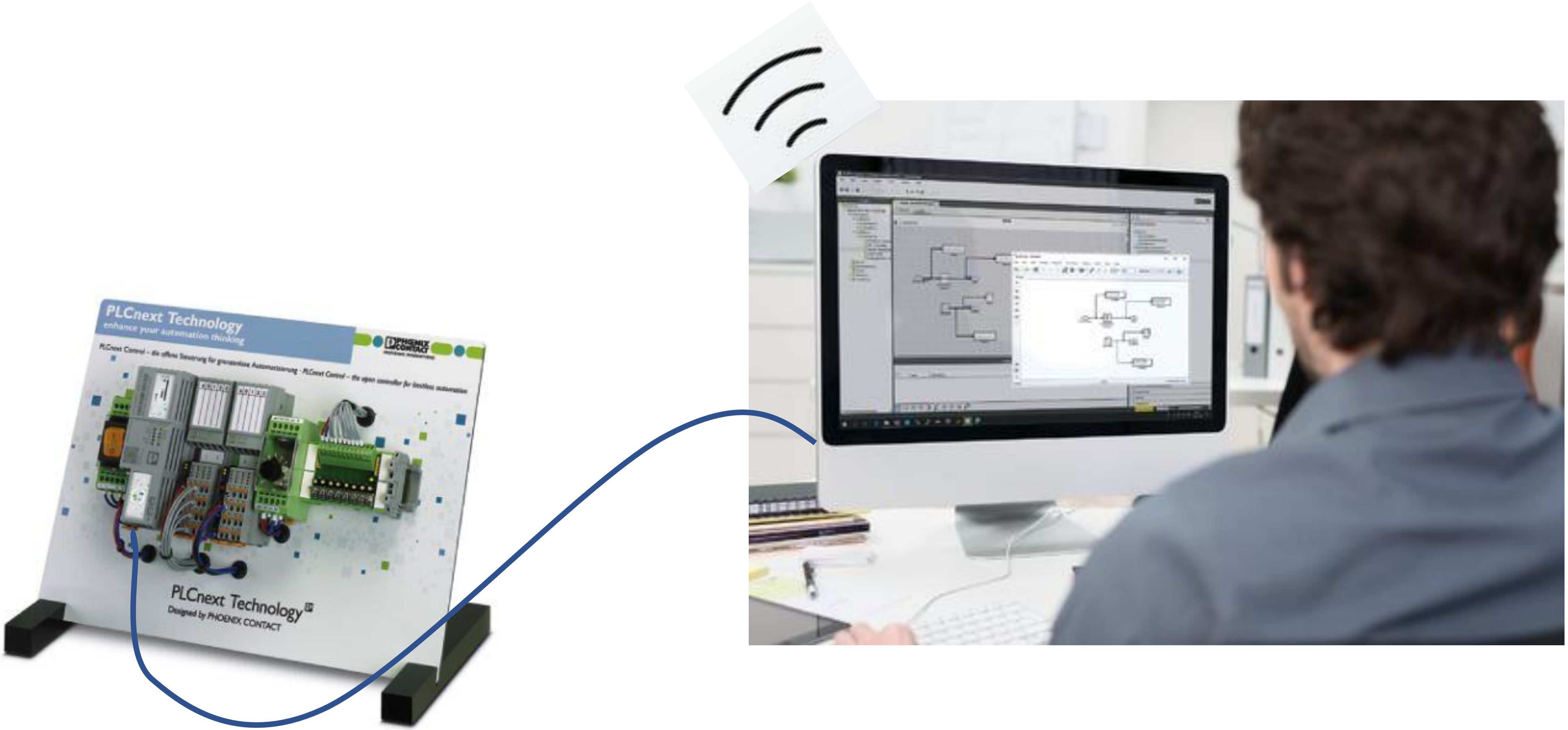
AI/AO Module – AI2 AO2
2702072

I/O Exerciser
5603026

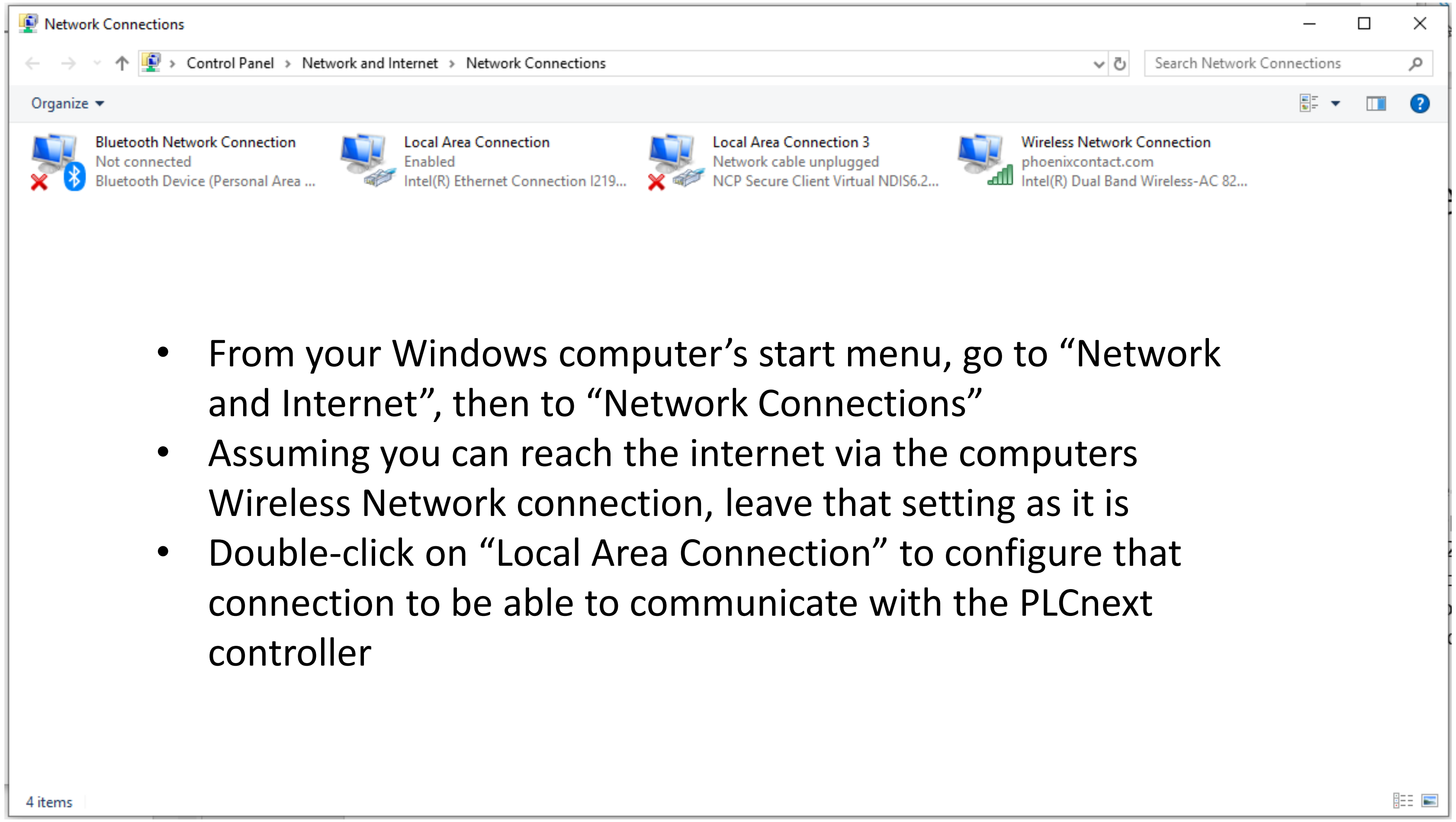


This hardware is powered with 24vdc, thus a power supply to convert from 120vac to 24vdc is required, as shown. Also shown on the DIN rail: terminal blocks, circuit breaker and surge protective device.

Connect to internet via WiFi, and to PLCnext controller via Ethernet cable



Configure your computer to communicate with the PLCnext controller


Network Connections
Control Panel > Network and Internet > Network Connections
Search Network Connections
Organize
4 items

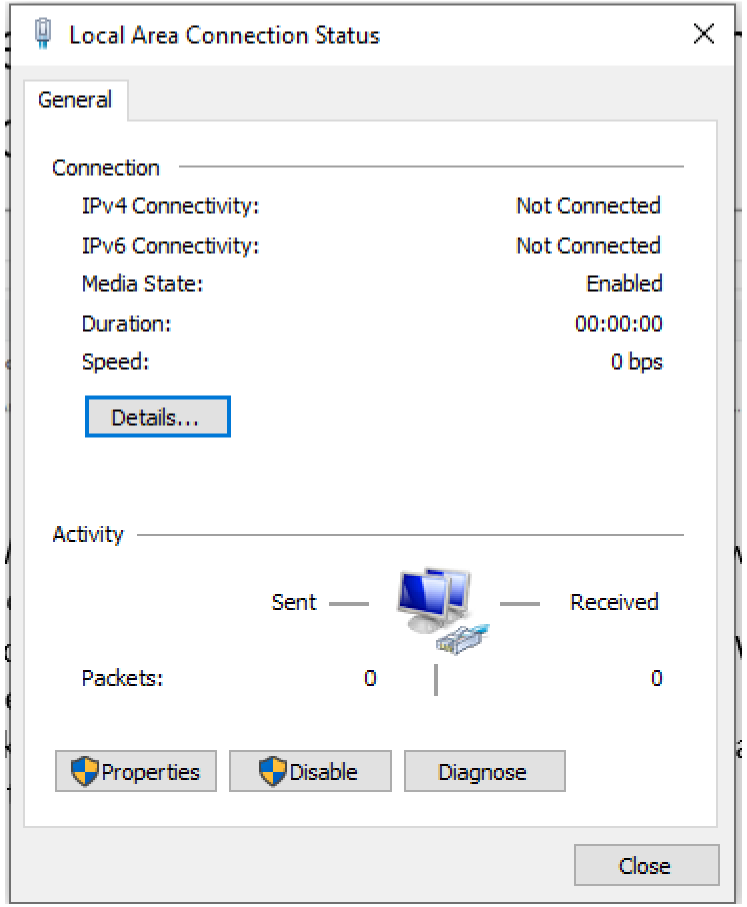
Bluetooth Network Connection
Not connected
Bluetooth Device (Personal Area ...

Local Area Connection
Enabled
Intel(R) Ethernet Connection I219...

Local Area Connection 3
Network cable unplugged
NCP Secure Client Virtual NDIS6.2...

Wireless Network Connection
phoenixcontact.com
Intel(R) Dual Band Wireless-AC 82...

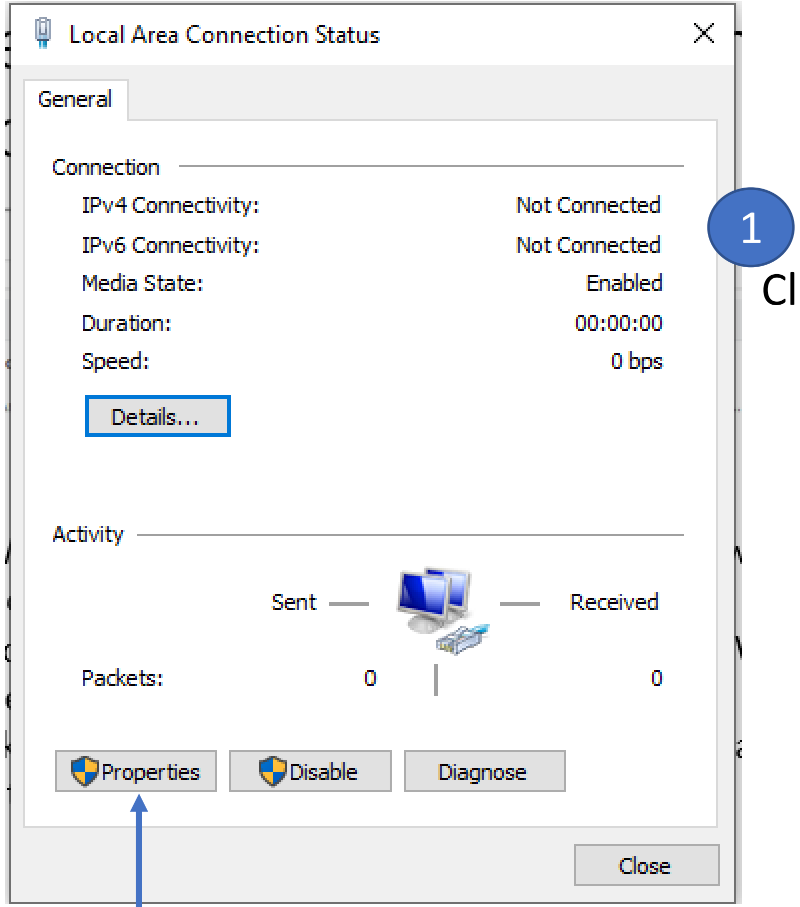
- From your Windows computer’s start menu, go to “Network and Internet”, then to “Network Connections”
- Assuming you can reach the internet via the computers Wireless Network connection, leave that setting as it is
- Double-click on “Local Area Connection” to configure that connection to be able to communicate with the PLCnext controller



IPv4 Connectivity: Not Connected
IPv6 Connectivity: Not Connected
Media State: Enabled
Duration: 00:00:00
Speed: 0 bps
Packets: Sent 0, Received 0

Communicating with the PLCnext controller

Setting a fixed IP address on your computer’s Ethernet adaptor



Local Area Connection Status

General

Connection

IPv4 Connectivity:	Not Connected
IPv6 Connectivity:	Not Connected
Media State:	Enabled
Duration:	00:00:00
Speed:	0 bps

Details...

Activity

	Sent	Received
Packets:	0	0

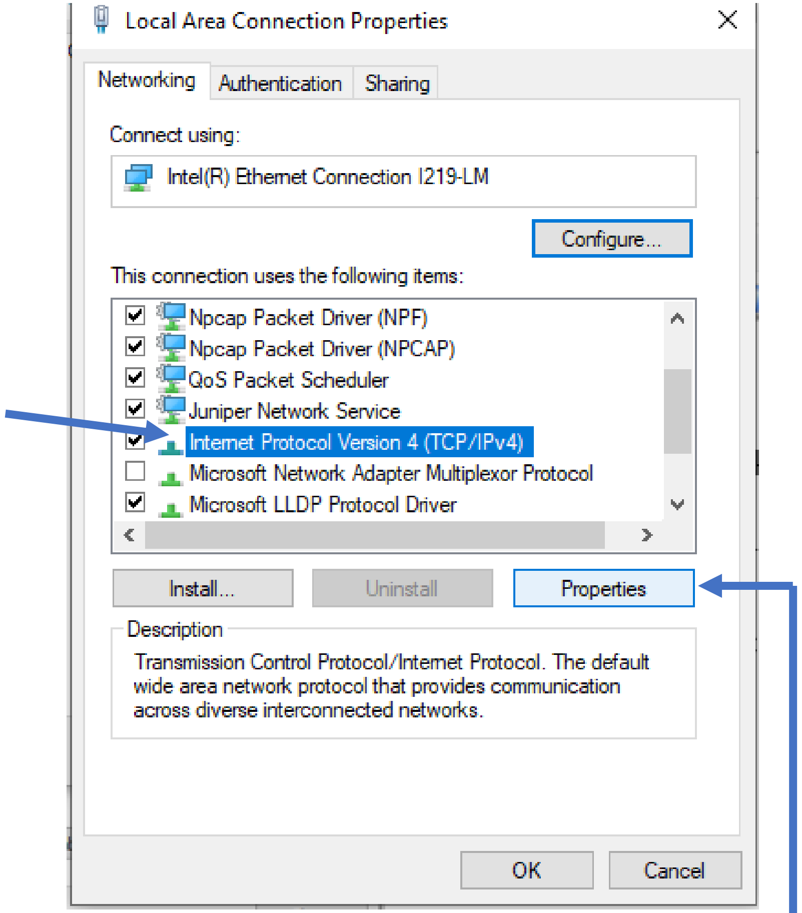
Properties   Disable   Diagnose

Close

1 Click on Properties here...

2 ...click this

3 ..and then here



Local Area Connection Properties

Networking   Authentication   Sharing

Connect using:

Intel(R) Ethernet Connection I219-LM

Configure...

This connection uses the following items:

- ☑ Npcap Packet Driver (NPF)
- ☑ Npcap Packet Driver (NPCAP)
- ☑ QoS Packet Scheduler
- ☑ Juniper Network Service
- ☑ Internet Protocol Version 4 (TCP/IPv4)
- ☐ Microsoft Network Adapter Multiplexor Protocol
- ☑ Microsoft LLDP Protocol Driver

Install...   Uninstall   Properties

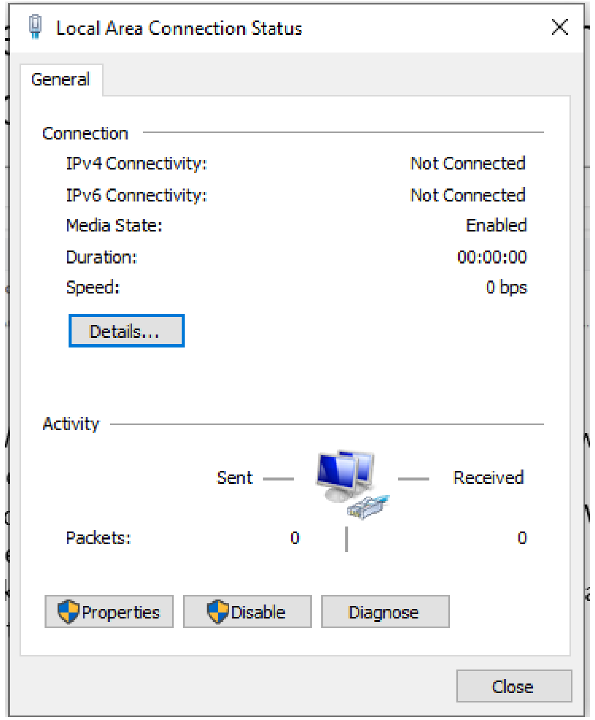
Description

Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.

OK   Cancel

Communicating with the PLCnext controller

Setting a fixed IP address on your computer’s Ethernet adaptor



Local Area Connection Status

General

Connection

IPv4 Connectivity:	Not Connected
IPv6 Connectivity:	Not Connected
Media State:	Enabled
Duration:	00:00:00
Speed:	0 bps

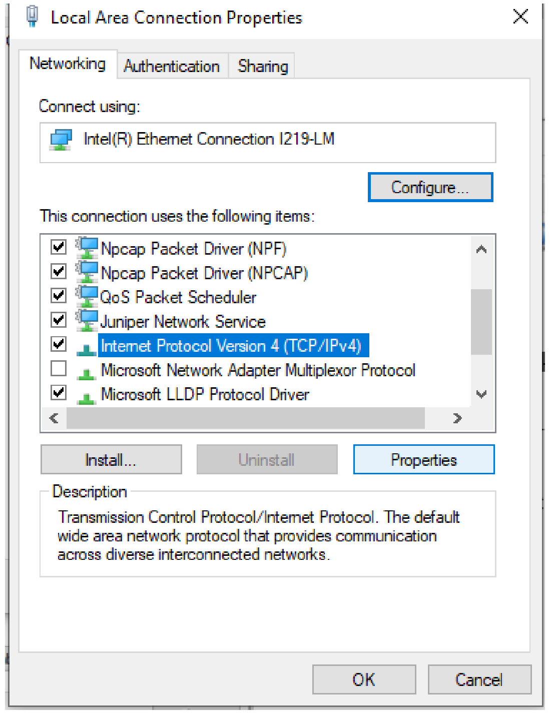
Details...

Activity

	Sent		Received
Packets:	0		0

Properties Disable Diagnose

Close



Local Area Connection Properties

Networking Authentication Sharing

Connect using:

Intel(R) Ethernet Connection I219-LM

Configure...

This connection uses the following items:

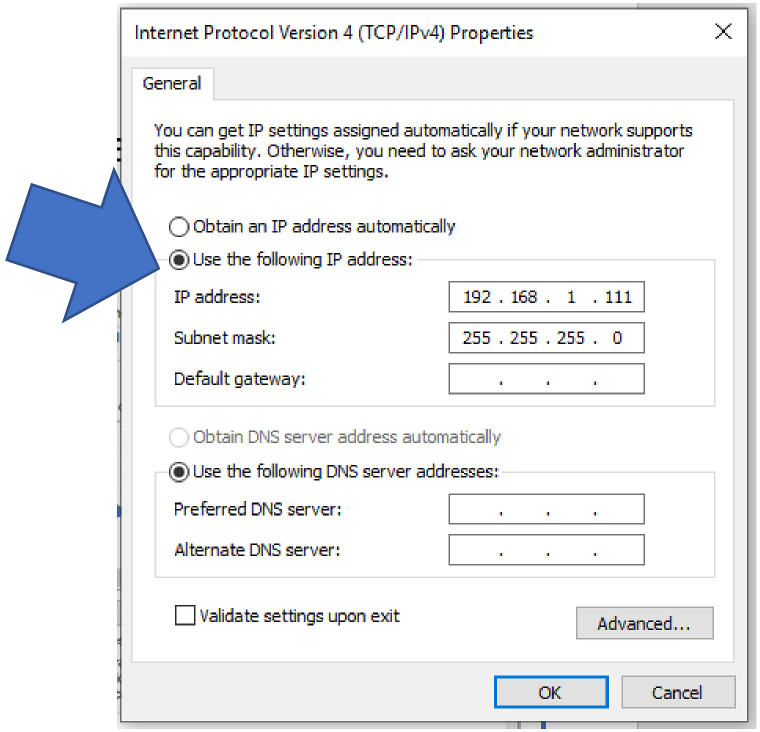
- ☑ Npcap Packet Driver (NPF)
- ☑ Npcap Packet Driver (NPCAP)
- ☑ QoS Packet Scheduler
- ☑ Juniper Network Service
- ☑ Internet Protocol Version 4 (TCP/IPv4)
- □ Microsoft Network Adapter Multiplexor Protocol
- ☑ Microsoft LLDP Protocol Driver

Install... Uninstall Properties

Description

Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.

OK Cancel



Internet Protocol Version 4 (TCP/IPv4) Properties

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

○ Obtain an IP address automatically

● Use the following IP address:

IP address:	192 . 168 . 1 . 111
Subnet mask:	255 . 255 . 255 . 0
Default gateway:	. . .

○ Obtain DNS server address automatically

● Use the following DNS server addresses:

Preferred DNS server:	. . .
Alternate DNS server:	. . .

□ Validate settings upon exit

Advanced...

OK Cancel

- Click on “Use the following IP address:”
- Type in 192.168.1.xxx
  - The value for xxx can be anything between 1 – 254, except 10
    - (192.168.1.10 is being used by the PLCnext controller)
- The Subnet mask number should automatically fill in
  - If not, type in the number shown
- Click Okay

Your computer’s Ethernet adaptor is now configured with the above fixed IP address, and will be able to communicate with the PLCnext controller

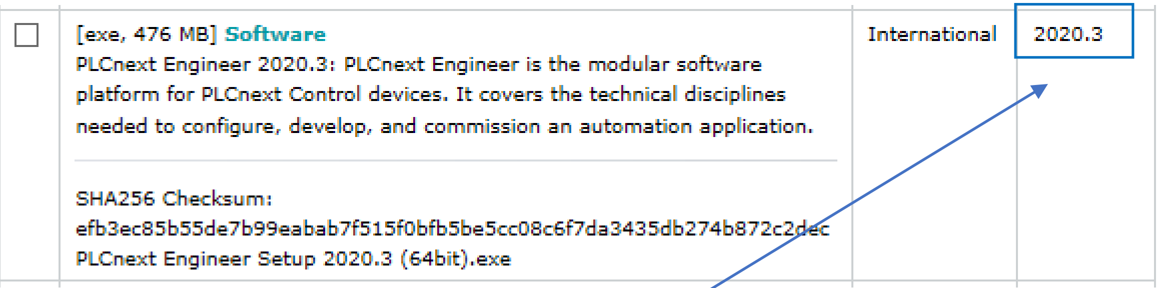
Communicating with the PLCnext controller

The PLCnext controller ships with a default IP address: 192.168.1.10

- We can communicate with the PLCnext controller by simply entering an IP address into a browser.
- If we want to change the IP address, we must use PLCnext Engineer to do so.
- We will download and install PLCnext now.

Software - PLCNEXT ENGINEER - 1046008

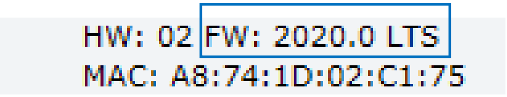
Don’t place an order for the software, just download it from the Phoenix Contact website!
https://www.phoenixcontact.com/online/portal/us



□	[exe, 476 MB] **Software** PLCnext Engineer 2020.3: PLCnext Engineer is the modular software platform for PLCnext Control devices. It covers the technical disciplines needed to configure, develop, and commission an automation application. SHA256 Checksum: efb3ec85b55de7b99eabab7f515f0bfb5be5cc08c6f7da3435db274b872c2dec PLCnext Engineer Setup 2020.3 (64bit).exe	International	2020.3

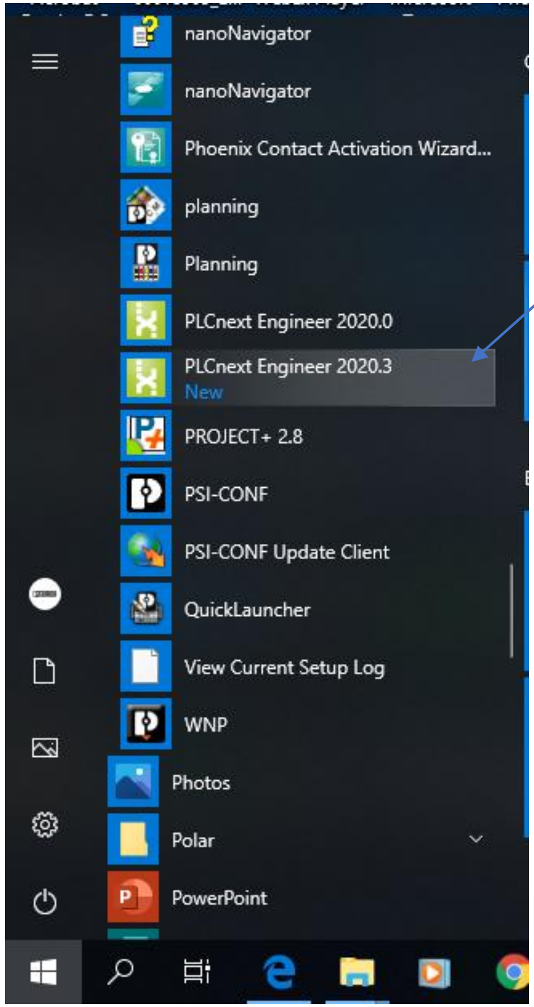
IMPORTANT!! Notice the software version (2020.3) must <u>match or be older than</u> the firmware revision on the PLCnext controller. If the firmware revision on the PLCnext controller is older than the version of PLCnext Engineer, then the PLCnext controller’s <u>firmware must be updated</u>.

Information from the PLCnext controller’s web-based management:

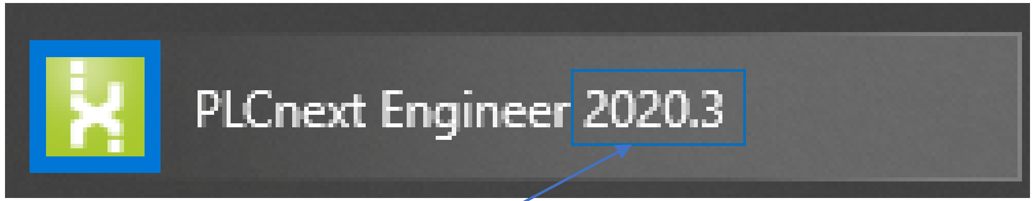


HW: 02 FW: 2020.0 LTS
MAC: A8:74:1D:02:C1:75

PLCnext Engineer – programming software



Once installed,* The PLCnext Engineer software will be visible under the Phoenix Contact folder after clicking on the Windows symbol at the bottom/left of the screen.



Notice the software version (2020.3). The PLCnext Engineer software must be of the same vintage, or older than the Firmware level on the controller.

* Once the software has been downloaded and unzipped, right-click and choose “install as Administrator” for best results.

Software and controller – ensuring compatibility

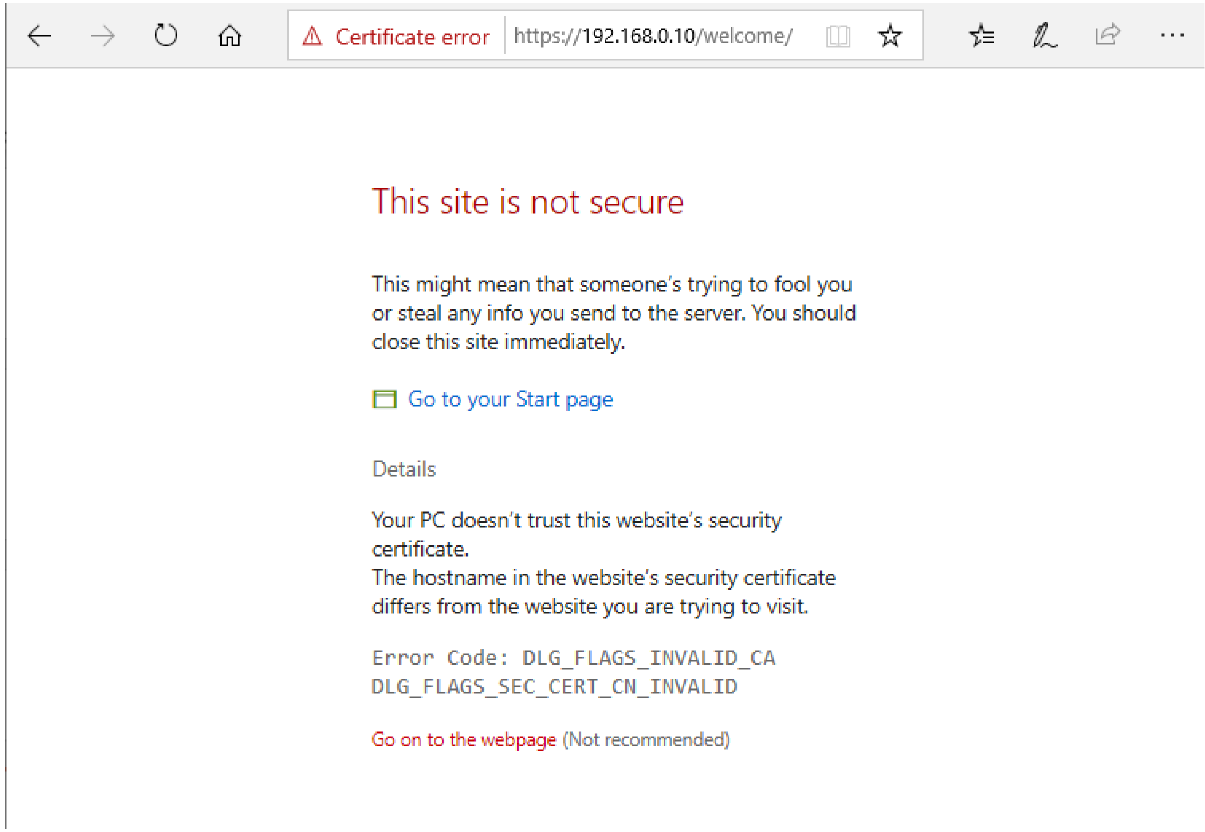
- Now that the PLCnext Engineer programming software has been downloaded and installed, let’s take a look at the PLCnext controller’s web-based management to note the firmware version
- If the firmware is older than the PLCnext Engineer software, then we will need to update the firmware

- Enter your PLCnext controller’s IP address into the address field of your browser.
    - (The default IP address is 192.168.1.10)
    - Make sure your laptop is set up to talk to the PLCnext controller. See slides 10 and 11 if you need to change your laptop’s IP settings.

Access the PLCnext controller’s internal webpage

When you’ve entered the PLCnext controller’s IP address in the browser and hit enter, you will get an error like the one shown here (Microsoft Edge browser).

- In this case, click “Details”, and then ignore the warnings about the site potentially being unsafe, and proceed to the PLCnext controller’s web interface.



This site is not secure

This might mean that someone’s trying to fool you or steal any info you send to the server. You should close this site immediately.

Go to your Start page

Details

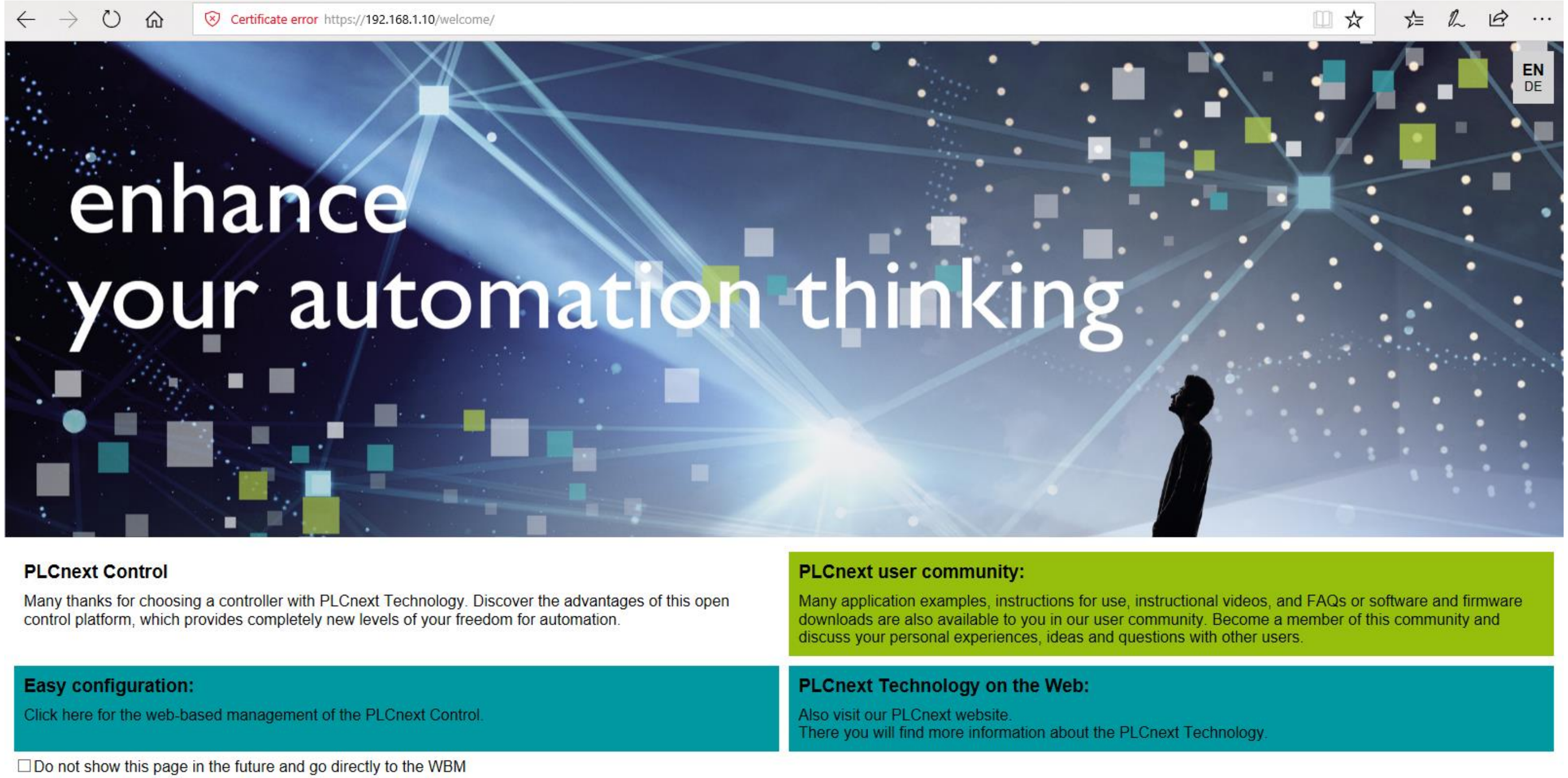
Your PC doesn’t trust this website’s security certificate.
The hostname in the website’s security certificate differs from the website you are trying to visit.

```
Error Code: DLG_FLAGS_INVALID_CA
DLG_FLAGS_SEC_CERT_CN_INVALID
```

Go on to the webpage (Not recommended)

Access the PLCnext controller's internal webpage

(Open a browser, type in: 192.168.1.10)



Certificate error https://192.168.1.10/welcome/

PLCnext Control

Many thanks for choosing a controller with PLCnext Technology. Discover the advantages of this open control platform, which provides completely new levels of your freedom for automation.

PLCnext user community:

Many application examples, instructions for use, instructional videos, and FAQs or software and firmware downloads are also available to you in our user community. Become a member of this community and discuss your personal experiences, ideas and questions with other users.

Easy configuration:

Click here for the web-based management of the PLCnext Control.

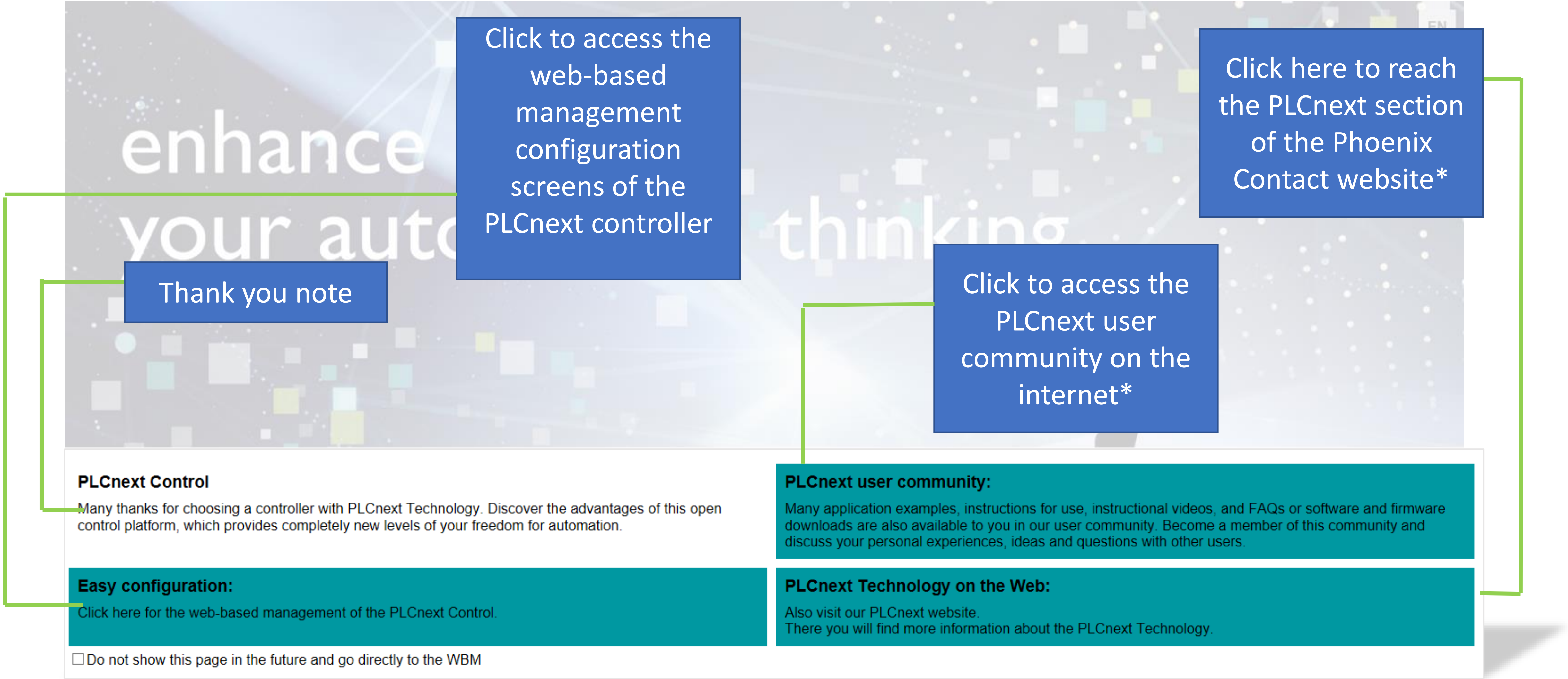
PLCnext Technology on the Web:

Also visit our PLCnext website.
There you will find more information about the PLCnext Technology.

□ Do not show this page in the future and go directly to the WBM

Note: You will get a warning from your browser that this may not be a safe site. It is safe. Proceed.

We will access the configuration pages. Skip to the end of this training for more information about the other links.



Click to access the web-based management configuration screens of the PLCnext controller

Thank you note

Click here to reach the PLCnext section of the Phoenix Contact website*

Click to access the PLCnext user community on the internet*

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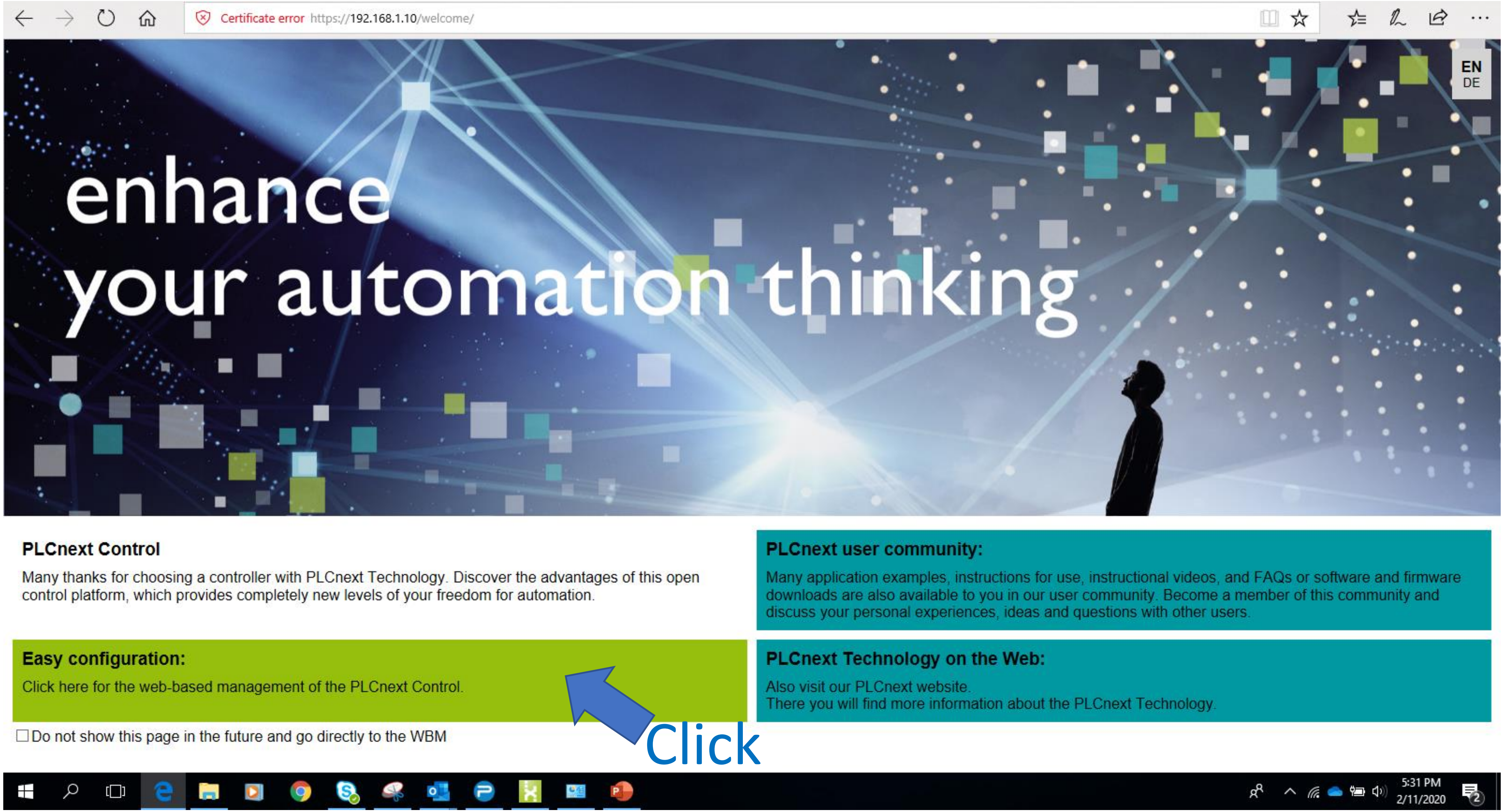
☐ Do not show this page in the future and go directly to the WBM

* Internet connection is necessary concurrently with your connection to the PLCnext controller. For example, WiFi connection to the internet, while the laptop’s Ethernet adaptor is attached to the PLCnext controller.



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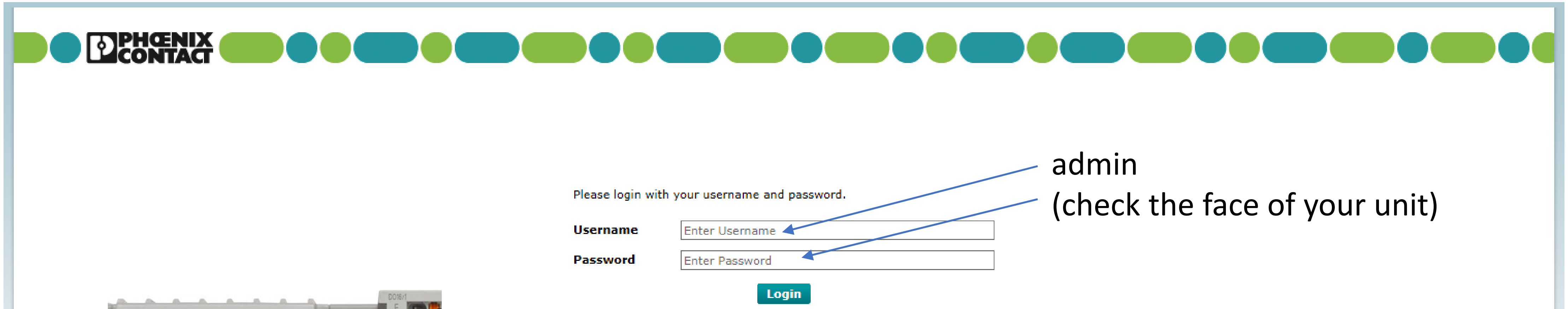
☐ Do not show this page in the future and go directly to the WBM

Click



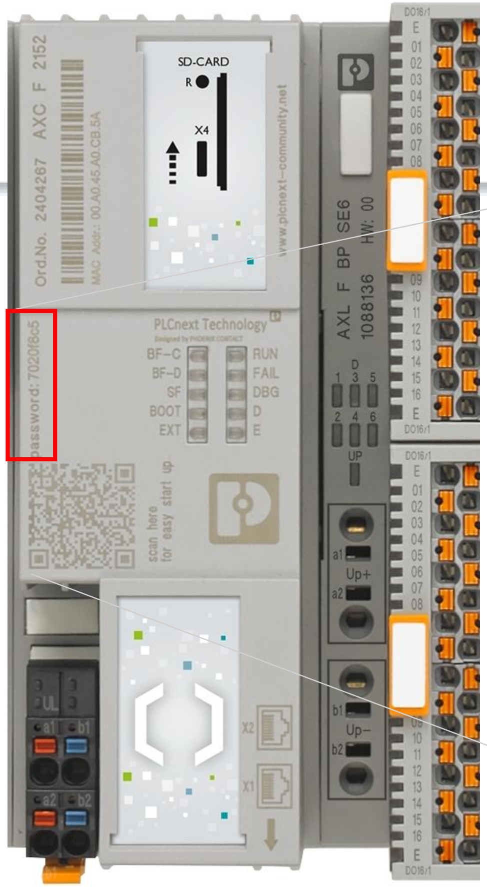
Please login with your username and password.

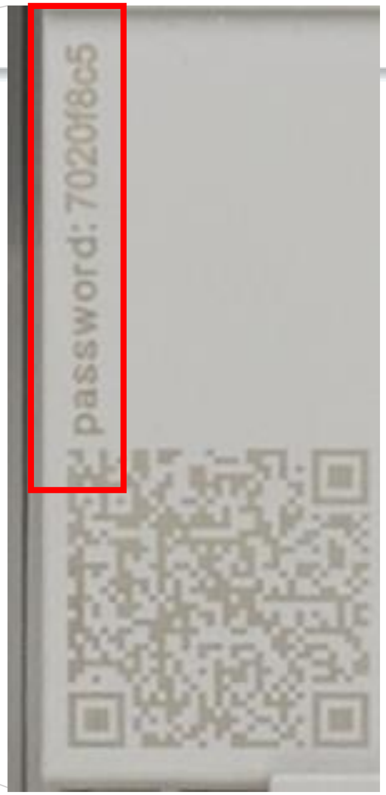
Username: Enter Username

Password: Enter Password

admin

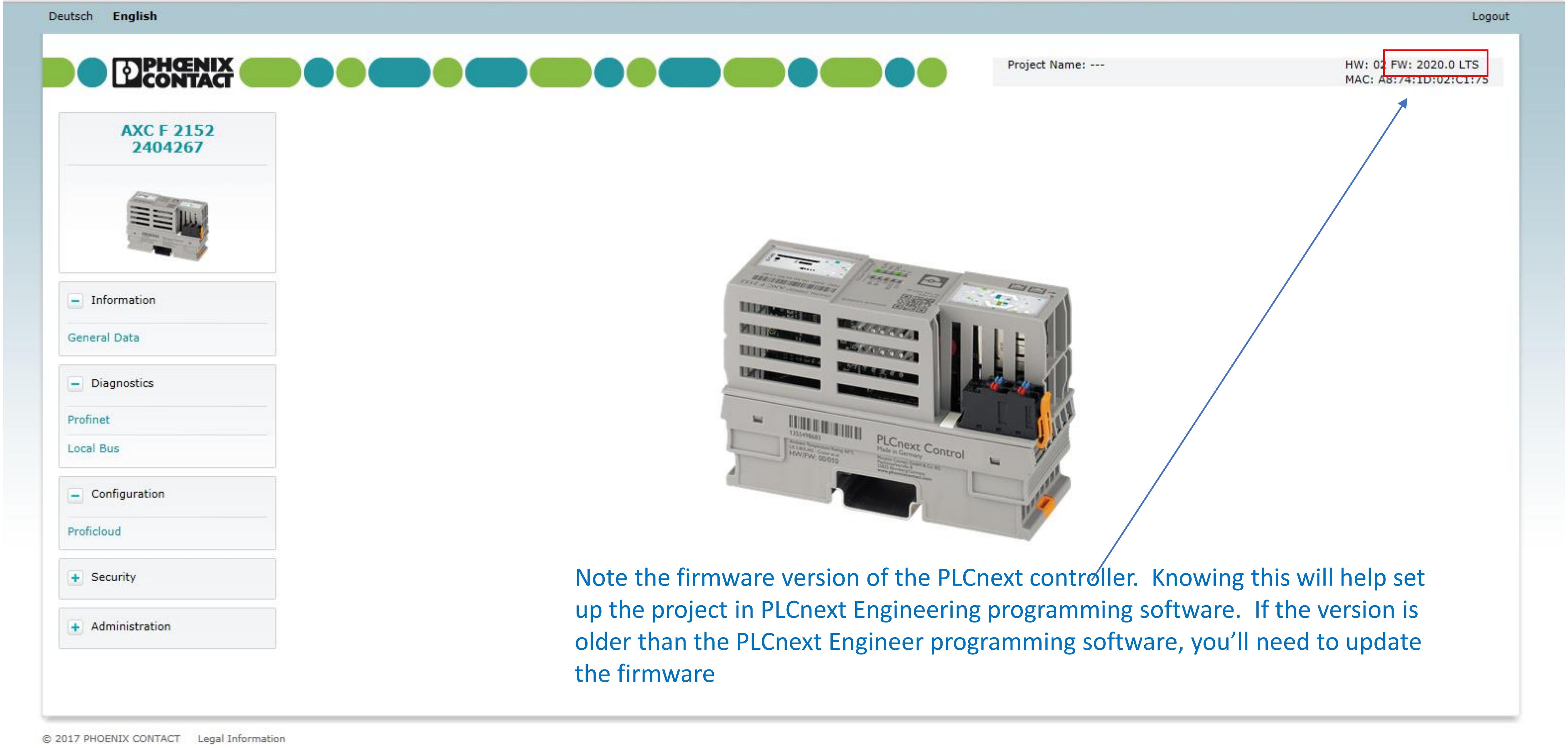
(check the face of your unit)





The password to the PLCnext controller is found on the face of the unit, directly above the QR code.

This password is unique to each unit.

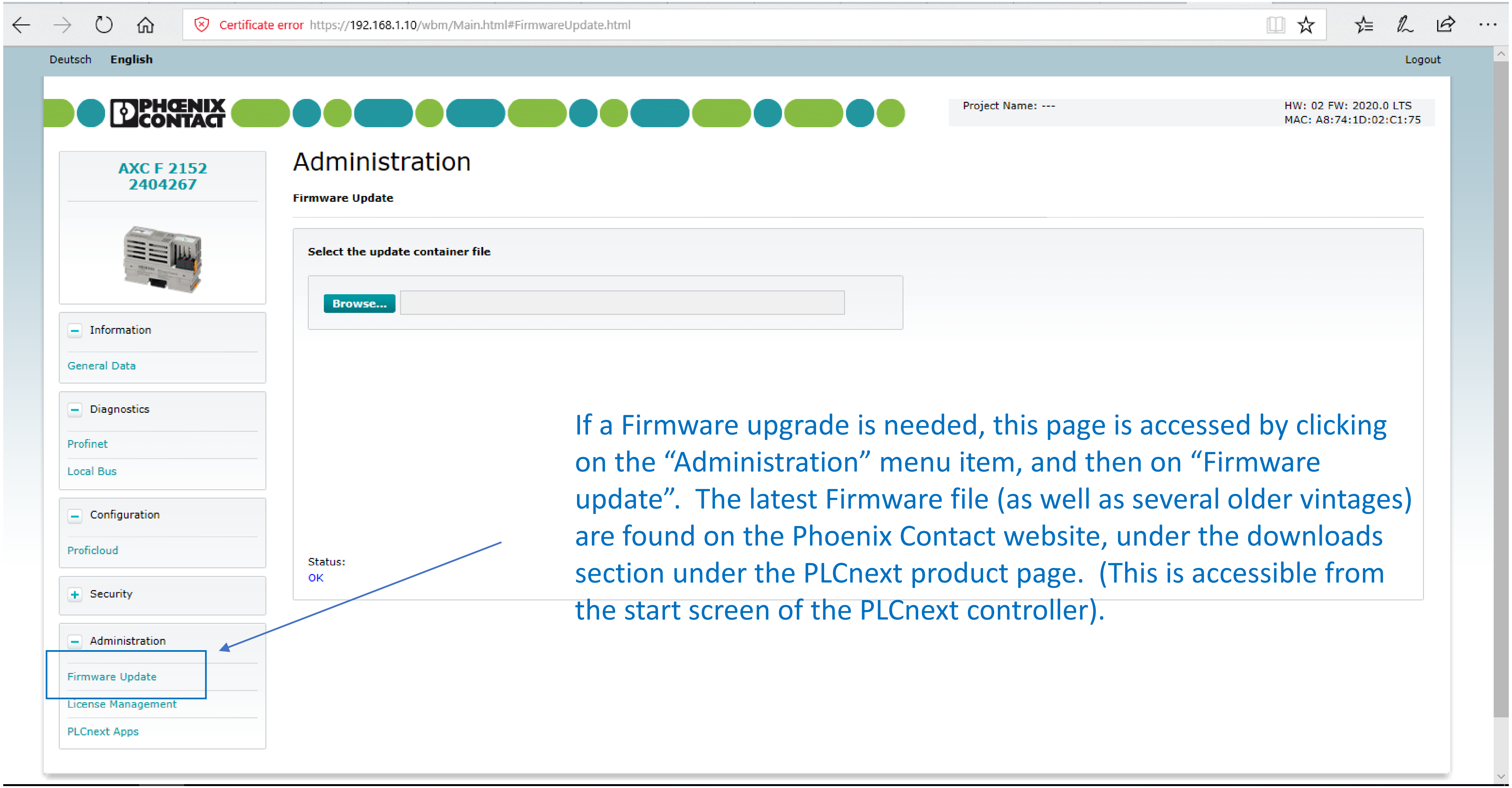


Project Name: ---

HW: 02 FW: 2020.0 LTS
MAC: A8:74:1D:02:C1:75

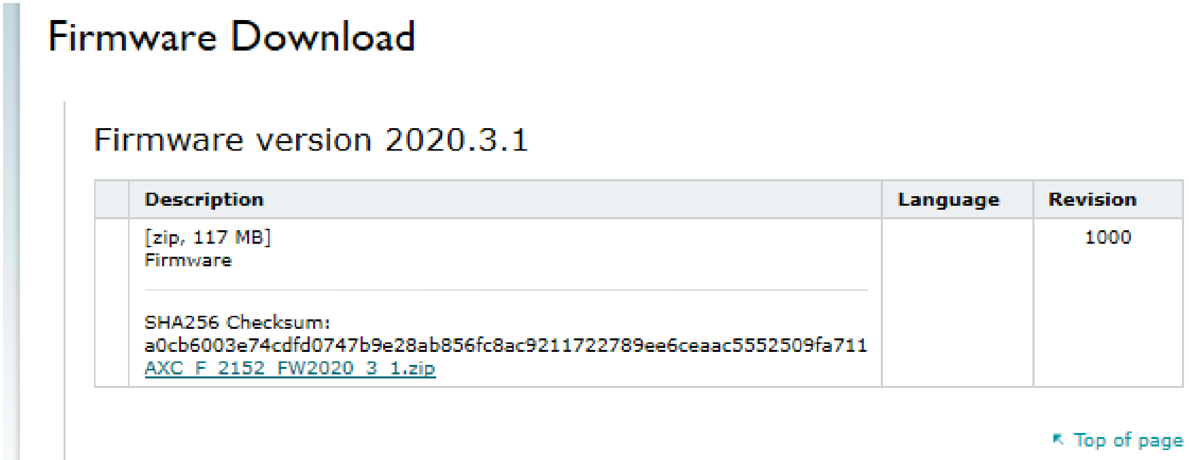
AXC F 2152
2404267

Note the firmware version of the PLCnext controller. Knowing this will help set up the project in PLCnext Engineering programming software. If the version is older than the PLCnext Engineer programming software, you'll need to update the firmware



If a Firmware upgrade is needed, this page is accessed by clicking on the “Administration” menu item, and then on “Firmware update”. The latest Firmware file (as well as several older vintages) are found on the Phoenix Contact website, under the downloads section under the PLCnext product page. (This is accessible from the start screen of the PLCnext controller).

Verifying firmware revision



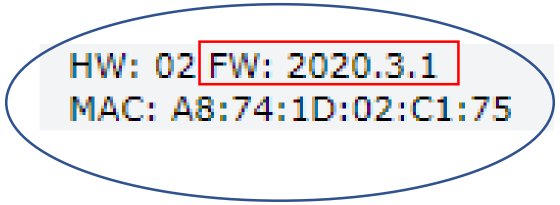
Firmware Download

Firmware version 2020.3.1

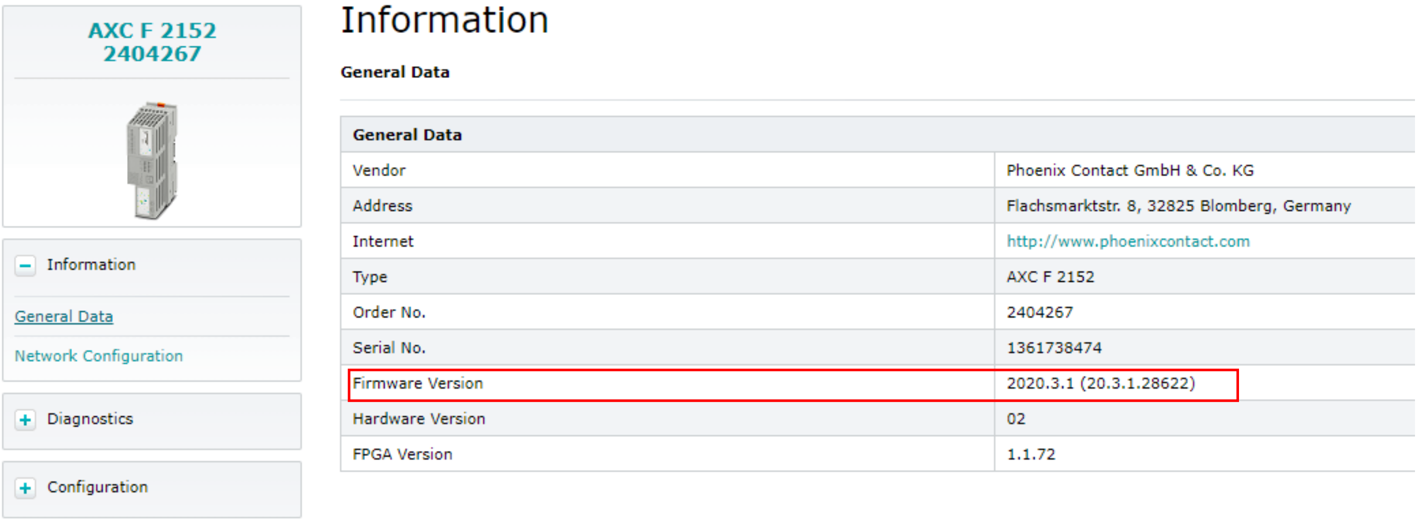
	Description	Language	Revision
	[zip, 117 MB] Firmware SHA256 Checksum: a0cb6003e74cdfd0747b9e28ab856fc8ac9211722789ee6ceaac5552509fa711 AXC_F_2152_FW2020_3_1.zip		1000

- Access the appropriate product page on the Phoenix Contact website, navigate to "Downloads", and download the latest firmware.
- Once downloaded, unzip and RUN the executable. You will then see the appropriate firmware file to load on the PLCnext controller.

Once the firmware has been loaded, and the PLCnext controller has been rebooted, check the device's web-based management to verify the firmware is up to date.



HW: 02 FW: 2020.3.1
MAC: A8:74:1D:02:C1:75



Information

General Data

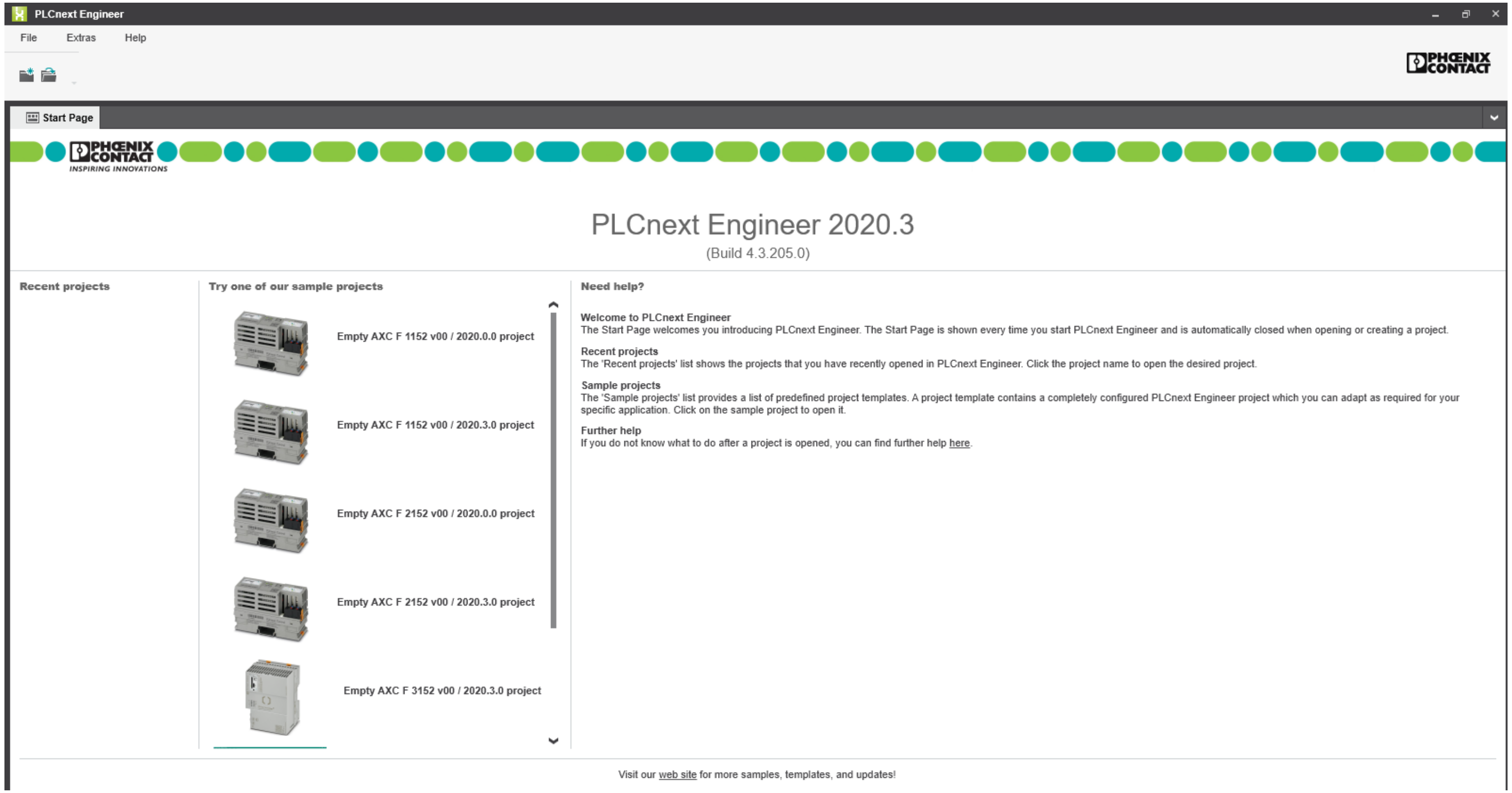
General Data	
Vendor	Phoenix Contact GmbH & Co. KG
Address	Flachsmarktstr. 8, 32825 Blomberg, Germany
Internet	http://www.phoenixcontact.com
Type	AXC F 2152
Order No.	2404267
Serial No.	1361738474
Firmware Version	2020.3.1 (20.3.1.28622)
Hardware Version	02
FPGA Version	1.1.72

Back to PLCnext Engineer

- Having verified we have the proper firmware revision running on the PLCnext controller, you can leave the web browser open or close it.
- Open PLCnext Engineer software.

PLCnext Engineer

- Opens to this start page
- Load existing project from left section (not applicable until you have created and saved projects)
- Start a new project from middle section, with a head start (be sure to choose correct hardware from list)
- Help accessible from right-most section



PLCnext Engineer 2020.3

(Build 4.3.205.0)

Recent projects

Try one of our sample projects

- Empty AXC F 1152 v00 / 2020.0.0 project
- Empty AXC F 1152 v00 / 2020.3.0 project
- Empty AXC F 2152 v00 / 2020.0.0 project
- Empty AXC F 2152 v00 / 2020.3.0 project
- Empty AXC F 3152 v00 / 2020.3.0 project

Need help?

Welcome to PLCnext Engineer
The Start Page welcomes you introducing PLCnext Engineer. The Start Page is shown every time you start PLCnext Engineer and is automatically closed when opening or creating a project.

Recent projects
The 'Recent projects' list shows the projects that you have recently opened in PLCnext Engineer. Click the project name to open the desired project.

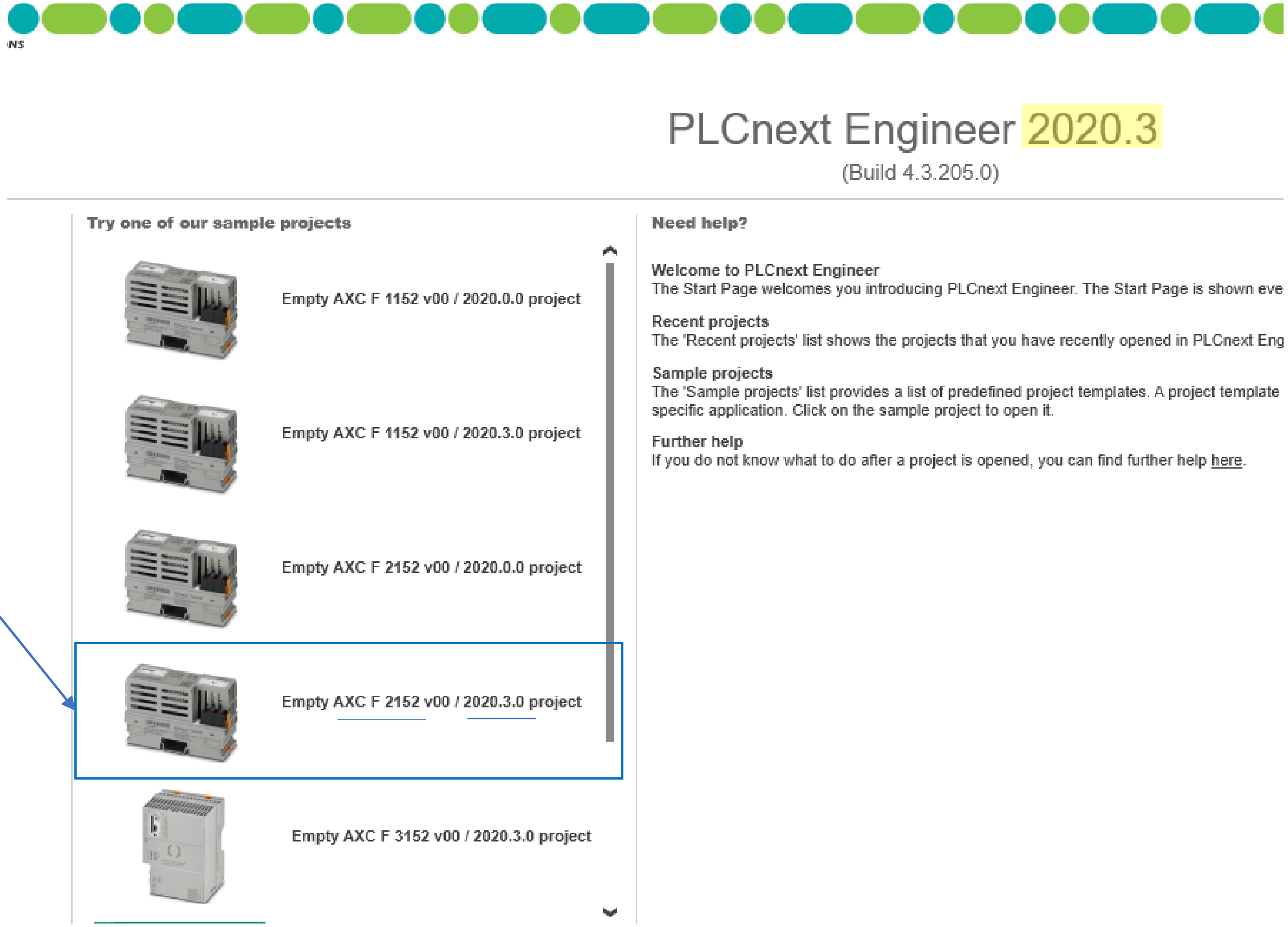
Sample projects
The 'Sample projects' list provides a list of predefined project templates. A project template contains a completely configured PLCnext Engineer project which you can adapt as required for your specific application. Click on the sample project to open it.

Further help
If you do not know what to do after a project is opened, you can find further help here.

Visit our web site for more samples, templates, and updates!

Creating a project in PLCnext Engineer

- Get started by selecting one of the options in the middle section.
- Match the hardware and firmware revision with the software’s revision (or make a selection with newer firmware than the software version you are using)



PLCnext Engineer 2020.3

(Build 4.3.205.0)

Try one of our sample projects

Empty AXC F 1152 v00 / 2020.0.0 project

Empty AXC F 1152 v00 / 2020.3.0 project

Empty AXC F 2152 v00 / 2020.0.0 project

Empty AXC F 2152 v00 / 2020.3.0 project

Empty AXC F 3152 v00 / 2020.3.0 project

Need help?

Welcome to PLCnext Engineer
The Start Page welcomes you introducing PLCnext Engineer. The Start Page is shown eve

Recent projects
The 'Recent projects' list shows the projects that you have recently opened in PLCnext Eng

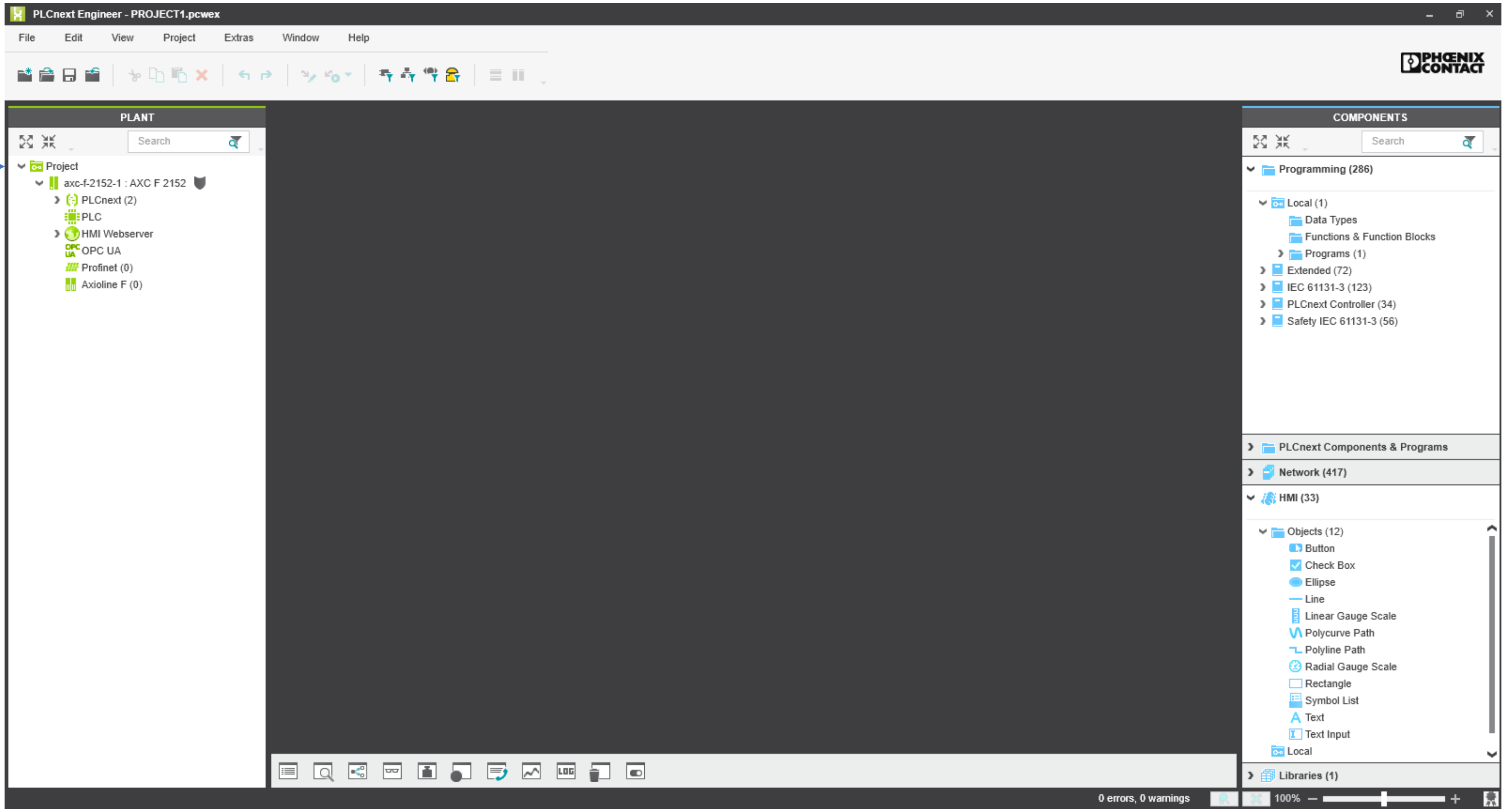
Sample projects
The 'Sample projects' list provides a list of predefined project templates. A project template specific application. Click on the sample project to open it.

Further help
If you do not know what to do after a project is opened, you can find further help here.

Initial setup

- This will be the initial programming screen

1. Double Click "Project" under the "PLANT" section.



0 errors, 0 warnings

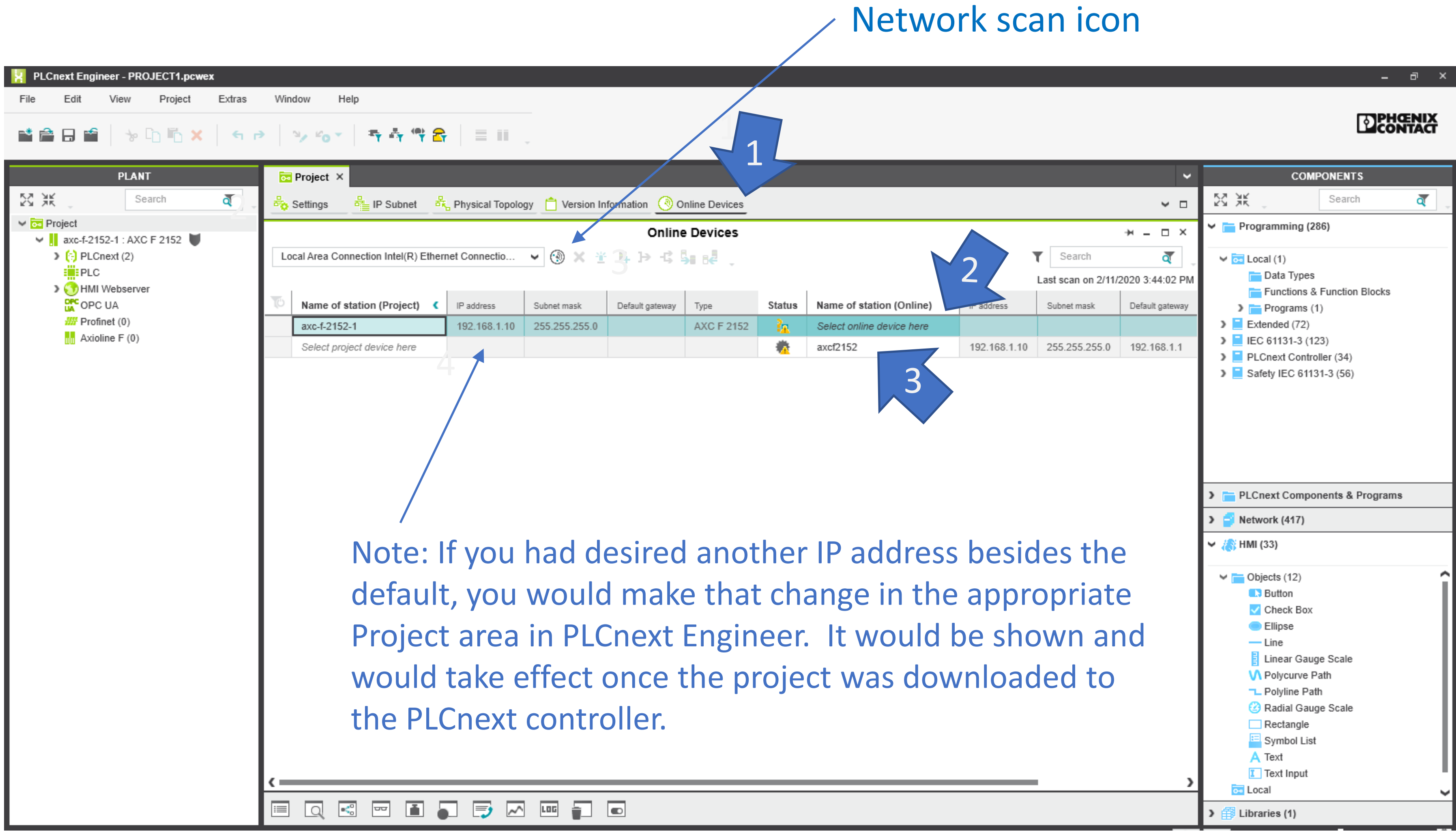
Align program communications with controller

1. Click on "Online Devices" tab on the Project menu
2. Click in the blue box that says "select online device here"
3. Choose the device that is shown (in the 2nd row).

The two rows should then collapse to one, with the device from the second row shown in the "Name of station" column.

A. Click the symbol indicated by the arrow to scan the network.

Under the status column, there should now be a checkmark.



Online Devices

Local Area Connection Intel(R) Ethernet Connectio...

Search

Last scan on 2/11/2020 3:44:02 PM

Name of station (Project)	IP address	Subnet mask	Default gateway	Type	Status	Name of station (Online)	IP address	Subnet mask	Default gateway
axc-f-2152-1	192.168.1.10	255.255.255.0		AXC F 2152	⚠	Select online device here			
Select project device here					⚠	axcf2152	192.168.1.10	255.255.255.0	192.168.1.1

Note: If you had desired another IP address besides the default, you would make that change in the appropriate Project area in PLCnext Engineer. It would be shown and would take effect once the project was downloaded to the PLCnext controller.

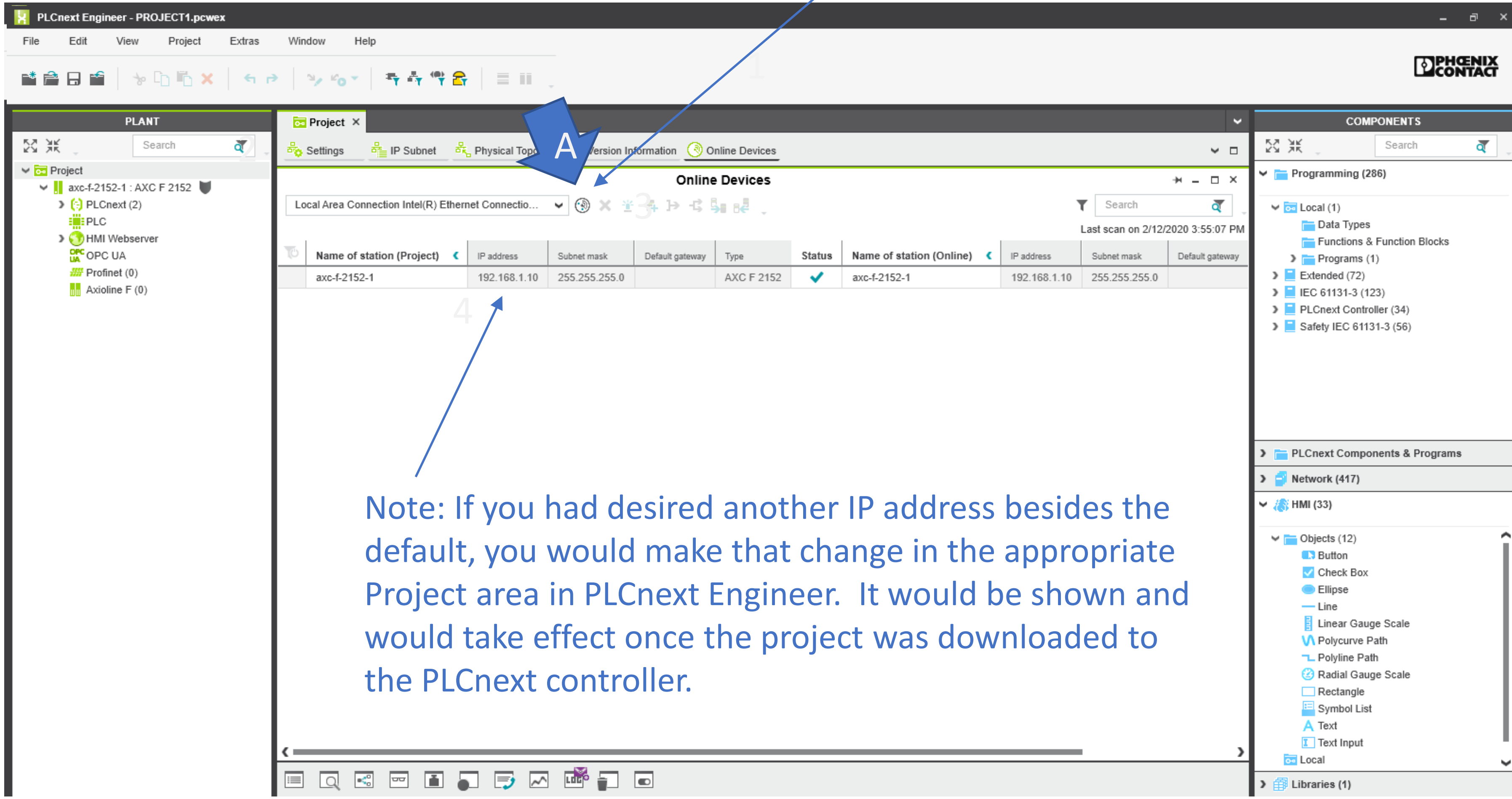
Align program communications with controller

The two rows should then collapse to one, with the device from the second row shown in the “Name of station” column.

A. Click the symbol indicated by the arrow to scan the network.

Under the status column, there should now be a checkmark.

Network scan icon



Local Area Connection Intel(R) Ethernet Connectio...

Last scan on 2/12/2020 3:55:07 PM

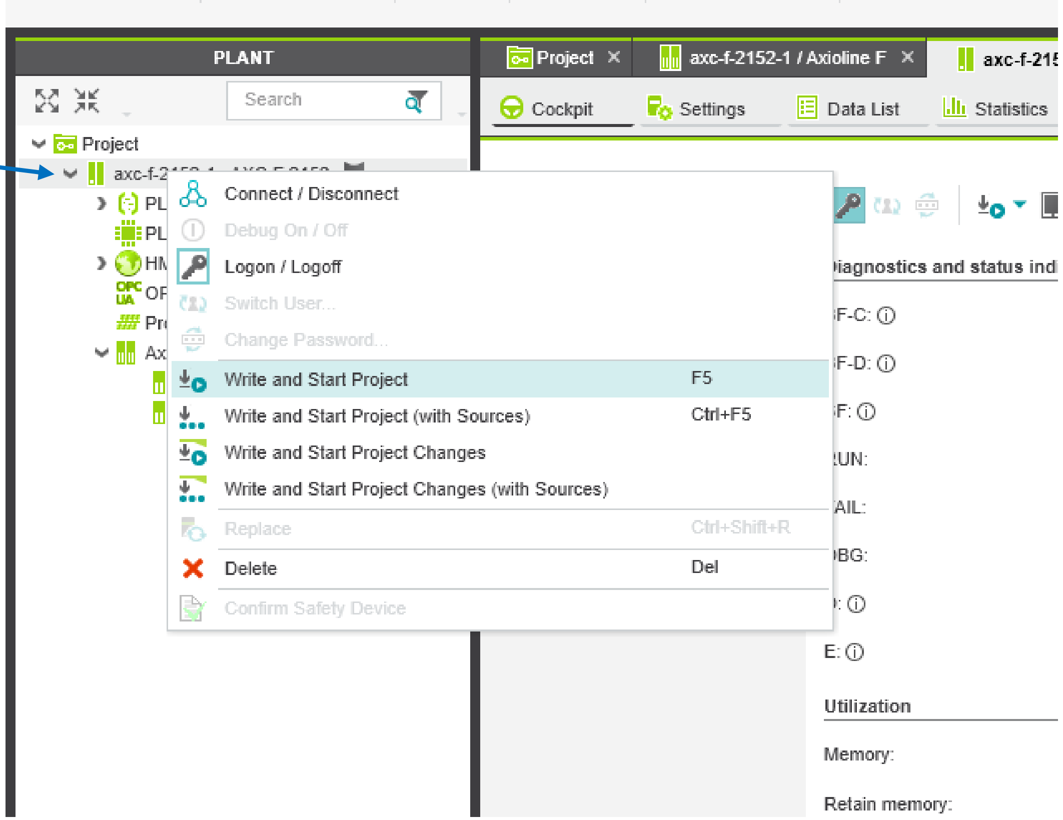
Name of station (Project)	IP address	Subnet mask	Default gateway	Type	Status	Name of station (Online)	IP address	Subnet mask	Default gateway
axc-f-2152-1	192.168.1.10	255.255.255.0		AXC F 2152	✓	axc-f-2152-1	192.168.1.10	255.255.255.0	

Note: If you had desired another IP address besides the default, you would make that change in the appropriate Project area in PLCnext Engineer. It would be shown and would take effect once the project was downloaded to the PLCnext controller.

Downloading the project to the controller

1. Right-click the axc-f-2152: AXC-F-2152 to expose the dropdown menu
2. Click on "Write and Start Project" to download the project to the controller.

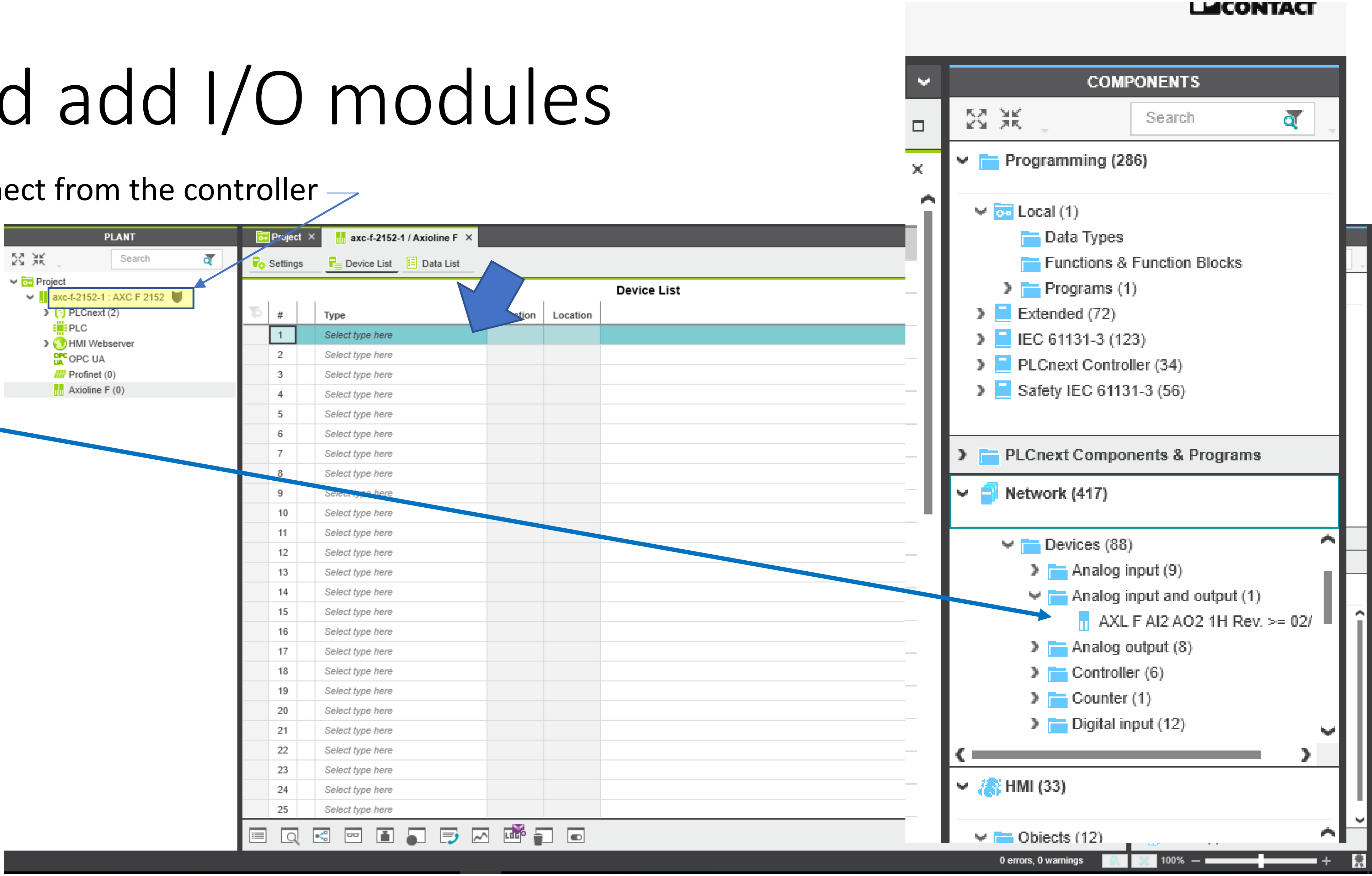
This will download the project, and hence the IP address to the PLCnext controller. Since we have not changed our IP address from the default, there is no need "Write and Start Project" at this point, but it is a task we will need to do often, so we might as well practice here.



Select and add I/O modules

First, right-click and disconnect from the controller

- Double click on “Axioline F” in the PLANT section
- Click on “Device List” tab (notice the table is blank)
- Under the COMPONENTS section, expand “Network” and the submenus until you find the module(s) you’ve added to the controller hardware.
- Drag the modules and drop them on the “Axioline F” under the PLANT tree
- ***OR click on the first unassigned row (see large arrow) and select module from the drop-down list that appears***

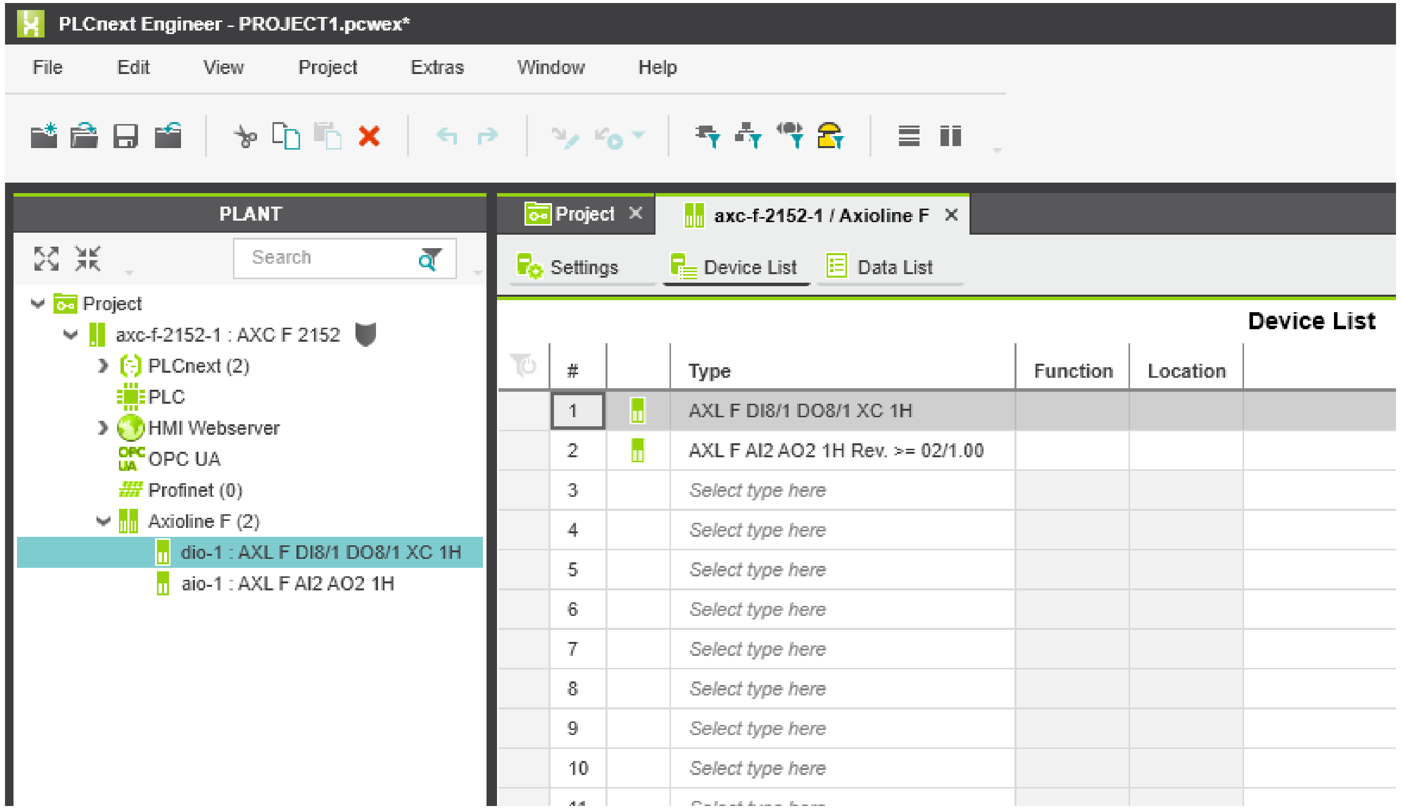


Device List

#	Type	tion	Location
1	Select type here		
2	Select type here		
3	Select type here		
4	Select type here		
5	Select type here		
6	Select type here		
7	Select type here		
8	Select type here		
9	Select type here		
10	Select type here		
11	Select type here		
12	Select type here		
13	Select type here		
14	Select type here		
15	Select type here		
16	Select type here		
17	Select type here		
18	Select type here		
19	Select type here		
20	Select type here		
21	Select type here		
22	Select type here		
23	Select type here		
24	Select type here		
25	Select type here		

Verify that I/O modules have been added to program

- Notice the relevant modules appear – nested under the "Axioline F" in the PLANT tree
- And they are shown on the Device List in the middle of the screen.



- Project
  - axc-f-2152-1 : AXC F 2152
    - PLCnext (2)
    - PLC
    - HMI Webserver
    - OPC UA
    - Profinet (0)
    - Axioline F (2)
      - dio-1 : AXL F DI8/1 DO8/1 XC 1H
      - aio-1 : AXL F AI2 AO2 1H

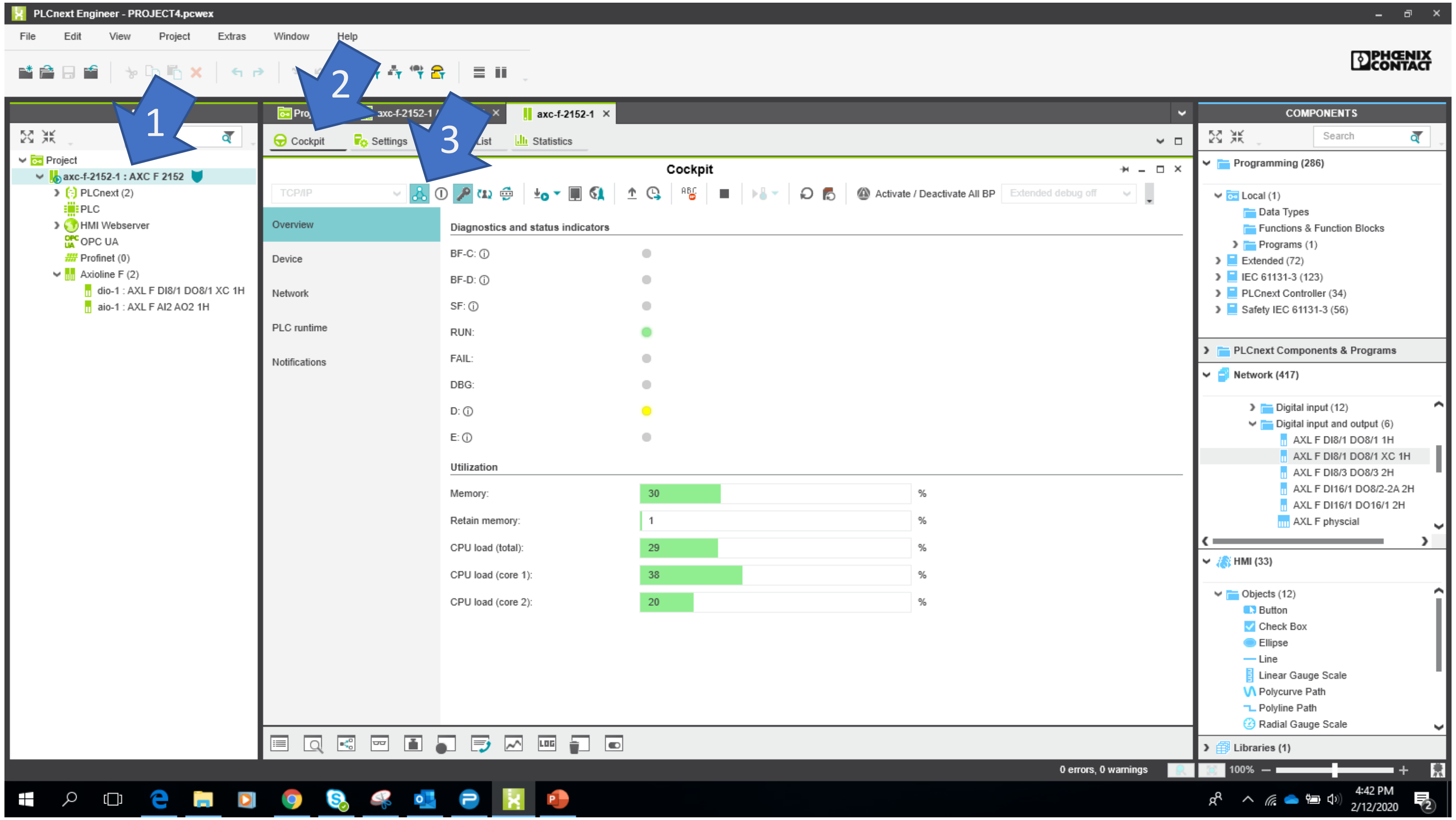
Device List

#		Type	Function	Location
1	▮	AXL F DI8/1 DO8/1 XC 1H		
2	▮	AXL F AI2 AO2 1H Rev. >= 02/1.00		
3		*Select type here*		
4		*Select type here*		
5		*Select type here*		
6		*Select type here*		
7		*Select type here*		
8		*Select type here*		
9		*Select type here*		
10		*Select type here*		
11		*Select type here*		

Verify connection between controller and software/program

1. Click on axc-f-2152: AXC-F-2152 directly under “Project” in the PLANT area
2. Verify the “Cockpit” tab is selected in the center workspace
3. Click on the triangular symbol next to the window that says “TCP/IP”

- This should make an Ethernet connection between the controller and the program. You should see active diagnostics in the software that mirror those on the hardware.



Cockpit

Diagnostics and status indicators

BF-C:	●
BF-D:	●
SF:	●
RUN:	🟩
FAIL:	●
DBG:	●
D:	🟨
E:	●

Utilization

Memory:	30	%
Retain memory:	1	%
CPU load (total):	29	%
CPU load (core 1):	38	%
CPU load (core 2):	20	%

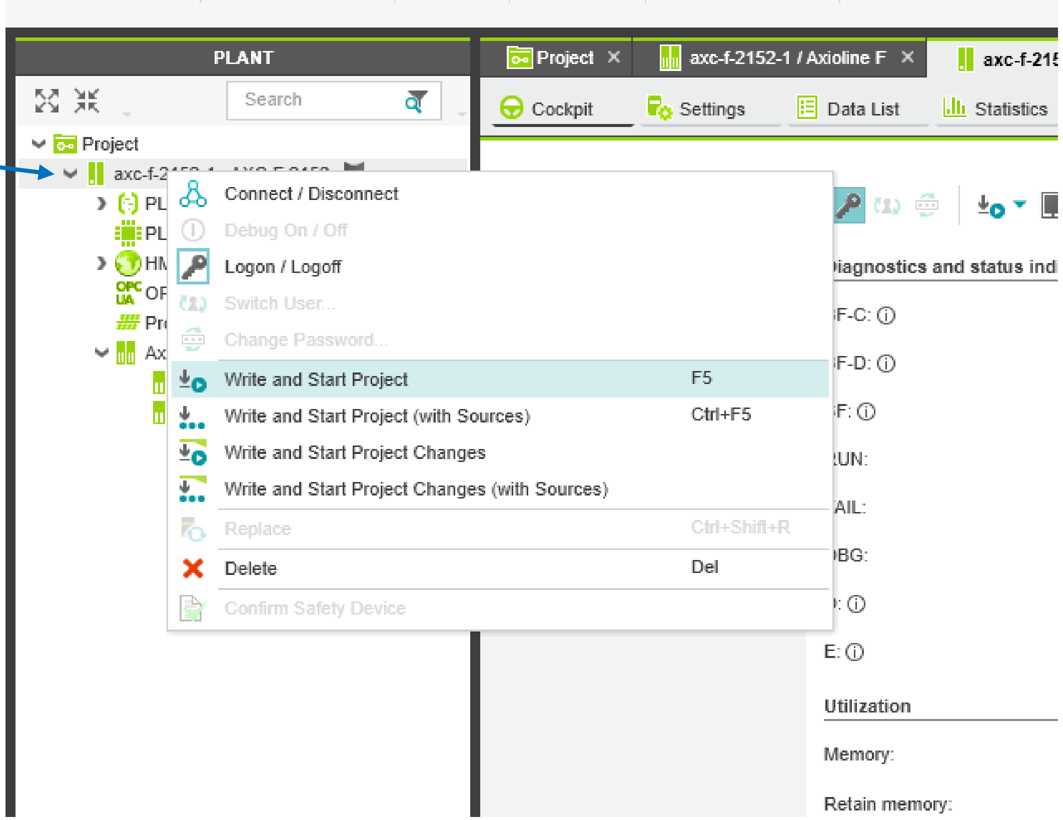
0 errors, 0 warnings

Downloading the project to the controller

1. Right-click the axc-f-2152: AXC-F-2152 to expose the dropdown menu
2. Click on “Write and Start Project” to download the project to the controller.

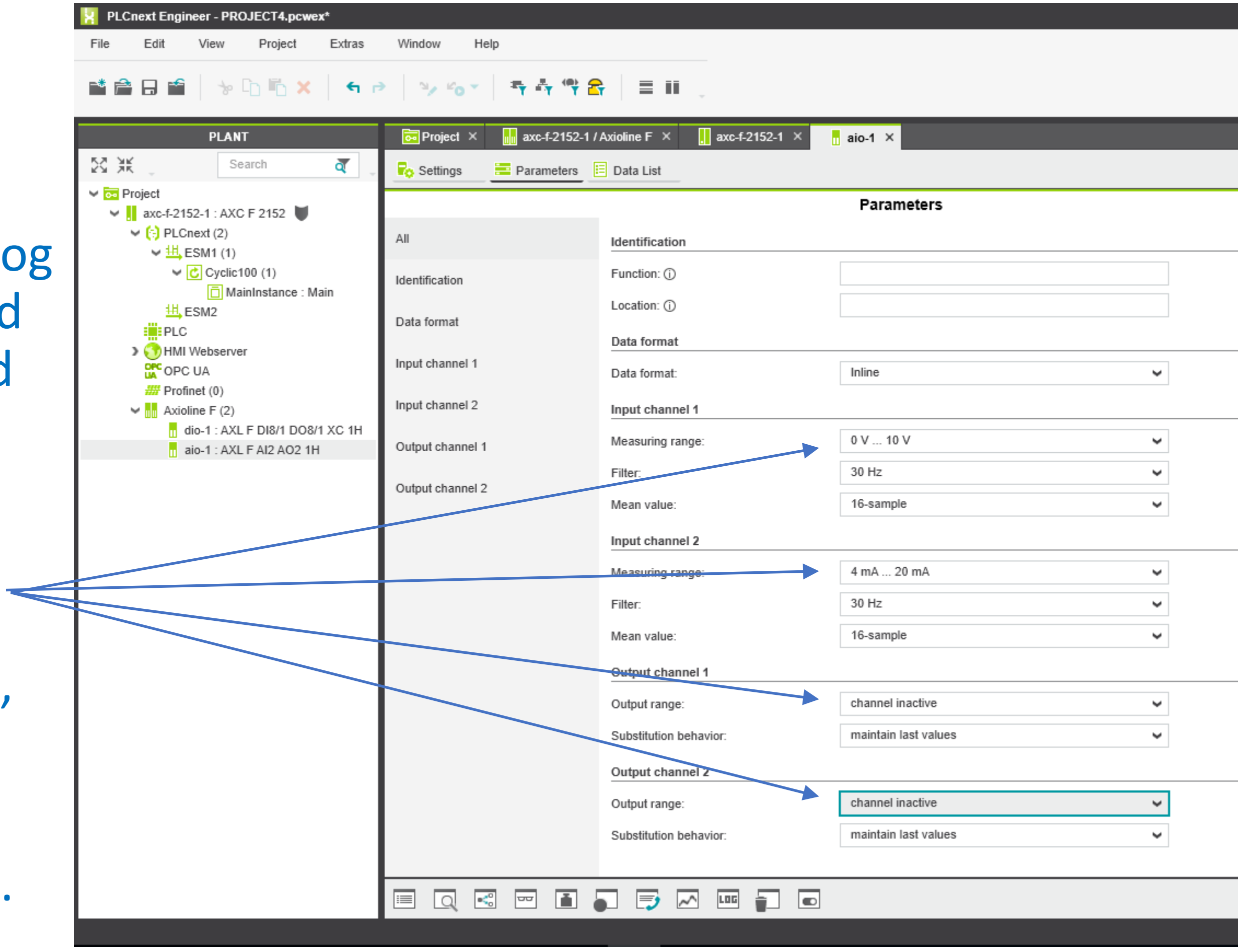
- You should notice that the “D” (diagnostic) LED on each of the I/O modules attached to the PLCnext controller are now blinking green rather than yellow.
  - This indicates that (by downloading the program), the controller now recognizes the I/O modules attached to it.
  - The blinking LED will turn solid green once all the I/O is assigned to variables in the program, or are disabled.

Before proceeding to the next step, right-click on axc-f-2152: AXC-F-2152 to expose the dropdown menu and click on “Connect/Disconnect to stop scanning.



Parameterize the analog I/O

- Double click on the analog module under “Axioline F” on the Project tree under the PLANT section.
- I have 0-10 vdc analog input wired to analog input 00, and a 4-20mA analog input wired to analog input 01. There is nothing wired to the analog outputs.
- Click the “Parameters” tab in the central workspace section, then select the appropriate measuring ranges for each input/output. (Make the outputs inactive, unless you have actuators to attach).
- Click to save the project, through the File menu (as you would with any application).



Parameters

Identification

Function:

Location:

Data format

Data format: Inline

Input channel 1

Measuring range: 0 V ... 10 V

Filter: 30 Hz

Mean value: 16-sample

Input channel 2

Measuring range: 4 mA ... 20 mA

Filter: 30 Hz

Mean value: 16-sample

Output channel 1

Output range: channel inactive

Substitution behavior: maintain last values

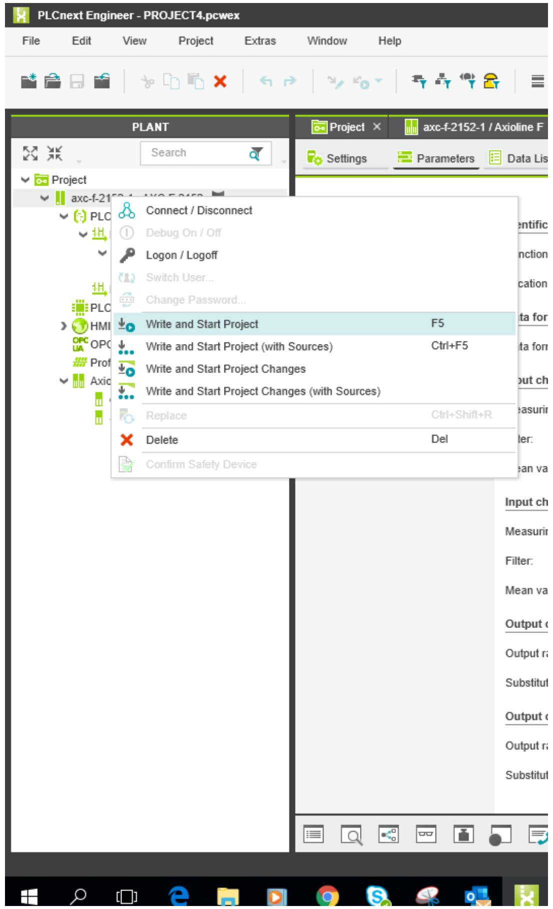
Output channel 2

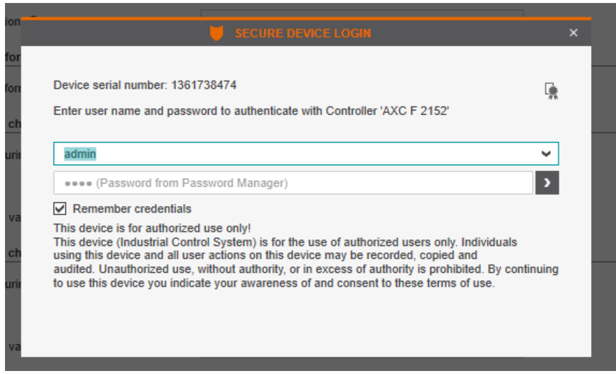
Output range: channel inactive

Substitution behavior: maintain last values

Download the project to the PLCnext controller

- Right click on the axf-c-2152 – 1: AXF-C-2152 under Project
- Select “Write and start project” from the drop-down menu to load the program onto the PLCnext controller, and to start the program running.
- If you haven’t been online with the controller in a while, you will need to sign in. The username is admin
- The Password is etched on the front of the PLCnext controller, above the QR code.





Device serial number: 1361738474

Enter user name and password to authenticate with Controller 'AXC F 2152'

admin

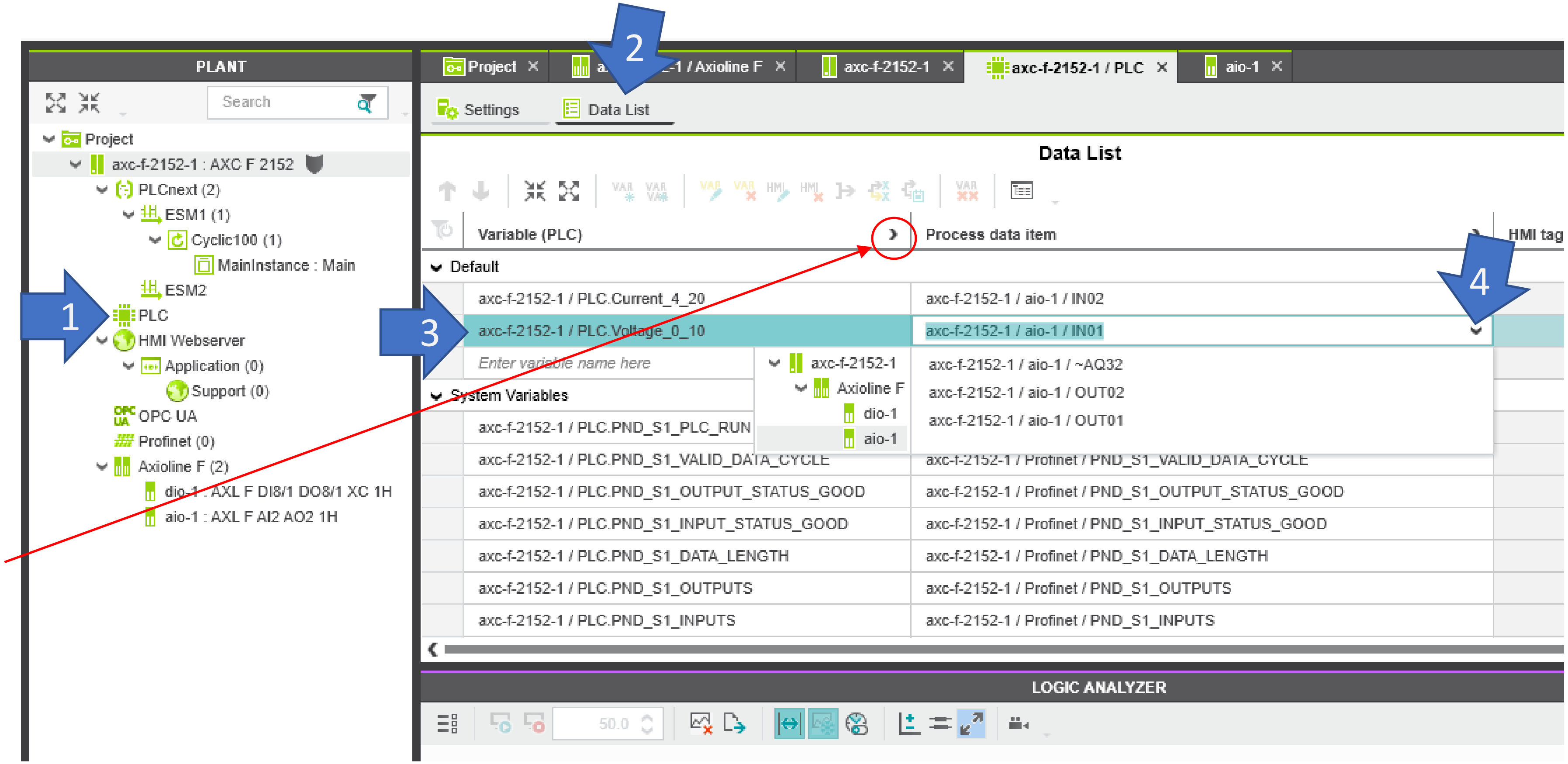
•••• (Password from Password Manager)

☑ Remember credentials

This device is for authorized use only!
This device (Industrial Control System) is for the use of authorized users only. Individuals using this device and all user actions on this device may be recorded, copied and audited. Unauthorized use, without authority, or in excess of authority is prohibited. By continuing to use this device you indicate your awareness of and consent to these terms of use.

Create a variable for the program to use, link it to an I/O point on the controller

- Double click on “PLC” under the project tree in the PLANT section.
- From “Data List” tab, under the “Default” section under Variable (PLC), enter a variable name in the space that says “Enter variable name here” (I entered: “Voltage_0_10”. The rest was automatically prepended onto the variable name).
- Click the dropdown arrow in the “Process Data Item field, and select the I/O point to associate to the variable



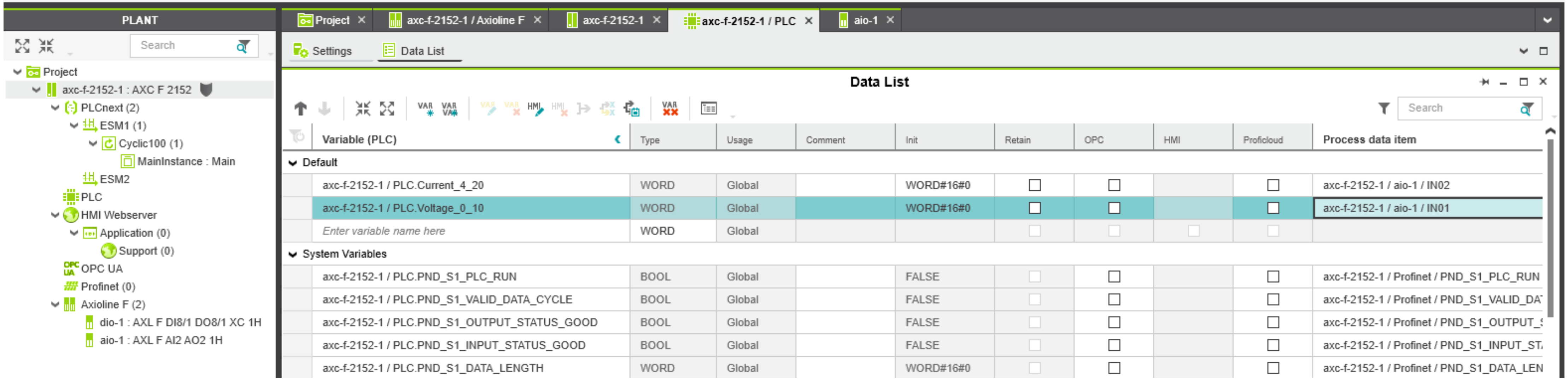
Data List

Variable (PLC)	Process data item	HMI tag
Default		
axc-f-2152-1 / PLC.Current_4_20	axc-f-2152-1 / aio-1 / IN02	
axc-f-2152-1 / PLC.Voltage_0_10	axc-f-2152-1 / aio-1 / IN01	
Enter variable name here	axc-f-2152-1 / aio-1 / ~AQ32 axc-f-2152-1 / aio-1 / OUT02 axc-f-2152-1 / aio-1 / OUT01	
System Variables		
axc-f-2152-1 / PLC.PND_S1_PLC_RUN		
axc-f-2152-1 / PLC.PND_S1_VALID_DATA_CYCLE	axc-f-2152-1 / Profinet / PND_S1_VALID_DATA_CYCLE	
axc-f-2152-1 / PLC.PND_S1_OUTPUT_STATUS_GOOD	axc-f-2152-1 / Profinet / PND_S1_OUTPUT_STATUS_GOOD	
axc-f-2152-1 / PLC.PND_S1_INPUT_STATUS_GOOD	axc-f-2152-1 / Profinet / PND_S1_INPUT_STATUS_GOOD	
axc-f-2152-1 / PLC.PND_S1_DATA_LENGTH	axc-f-2152-1 / Profinet / PND_S1_DATA_LENGTH	
axc-f-2152-1 / PLC.PND_S1_OUTPUTS	axc-f-2152-1 / Profinet / PND_S1_OUTPUTS	
axc-f-2152-1 / PLC.PND_S1_INPUTS	axc-f-2152-1 / Profinet / PND_S1_INPUTS	

* If you cannot find the I/O point that you need (ie. the analogs aren’t displayed in the drop-down list), click on the circled arrow, to expose more columns in the data list. This will enable you to change the data type (for example, from BOOL to WORD), which will expose more I/O types. ***Select type WORD for the analog I/O to show in the drop-down list.***

Create a variable for the program to use, link it to an I/O point on the controller

- Note the Data List has expanded columns, with “Type” now to the right of “Variable (PLC)”
- Click in the cell under “Type”, in the row of the variable you want to alter.
- A pop-up menu of different data types will be visible. You can freely select from the various data types.
    - Knowledge of programming conventions is necessary to understand which data types are appropriate for certain variables
    - This knowledge is beyond the scope of this training.

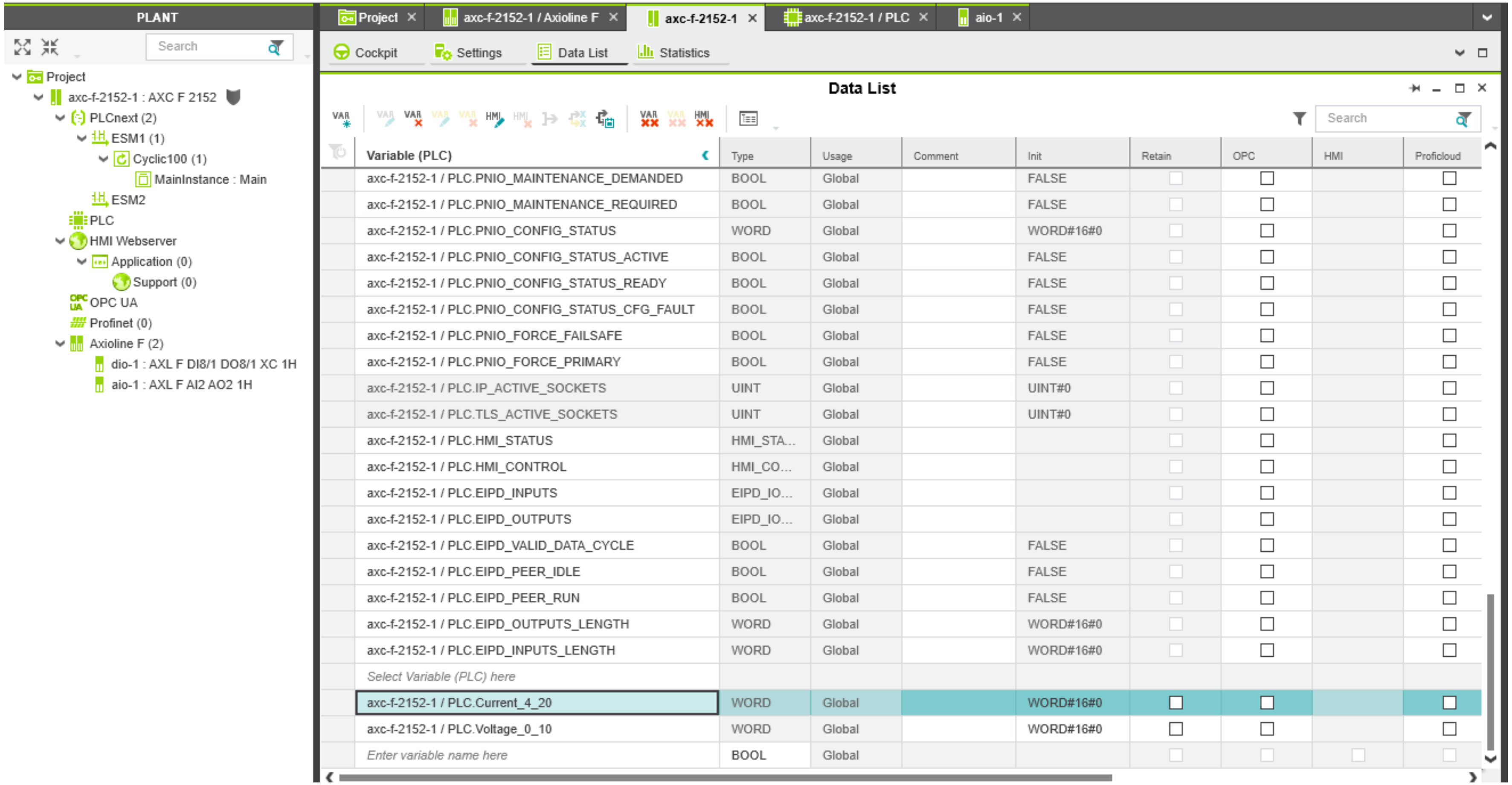


- Project
    - axc-f-2152-1 : AXC F 2152
        - PLCnext (2)
            - ESM1 (1)
                - Cyclic100 (1)
                    - MainInstance : Main
            - ESM2
        - PLC
        - HMI Webserver
            - Application (0)
                - Support (0)
        - OPC UA
        - Profinet (0)
        - Axioline F (2)
            - dio-1 : AXL F DI8/1 DO8/1 XC 1H
            - aio-1 : AXL F AI2 AO2 1H

Variable (PLC)	Type	Usage	Comment	Init	Retain	OPC	HMI	Proficloud	Process data item
Default									
axc-f-2152-1 / PLC.Current_4_20	WORD	Global		WORD#16#0	☐	☐		☐	axc-f-2152-1 / aio-1 / IN02
axc-f-2152-1 / PLC.Voltage_0_10	WORD	Global		WORD#16#0	☐	☐		☐	axc-f-2152-1 / aio-1 / IN01
Enter variable name here	WORD	Global			☐	☐	☐	☐	
System Variables									
axc-f-2152-1 / PLC.PND_S1_PLC_RUN	BOOL	Global		FALSE	☐	☐		☐	axc-f-2152-1 / Profinet / PND_S1_PLC_RUN
axc-f-2152-1 / PLC.PND_S1_VALID_DATA_CYCLE	BOOL	Global		FALSE	☐	☐		☐	axc-f-2152-1 / Profinet / PND_S1_VALID_DAT
axc-f-2152-1 / PLC.PND_S1_OUTPUT_STATUS_GOOD	BOOL	Global		FALSE	☐	☐		☐	axc-f-2152-1 / Profinet / PND_S1_OUTPUT_S
axc-f-2152-1 / PLC.PND_S1_INPUT_STATUS_GOOD	BOOL	Global		FALSE	☐	☐		☐	axc-f-2152-1 / Profinet / PND_S1_INPUT_ST
axc-f-2152-1 / PLC.PND_S1_DATA_LENGTH	WORD	Global		WORD#16#0	☐	☐		☐	axc-f-2152-1 / Profinet / PND_S1_DATA_LEN

Prepare to download to the controller

- Double click on “axc-f-2152-1 : AXC-F-2152” immediately under Project in the PLANT section
- Make sure “Data List” is selected from the tabs
- Locate the variable(s) you have added. (You may need to scroll down)



PLANT

Search

- Project
  - axc-f-2152-1 : AXC F 2152
    - PLCnext (2)
      - ESM1 (1)
        - Cyclic100 (1)
          - MainInstance : Main
      - ESM2
    - PLC
    - HMI Webserver
      - Application (0)
        - Support (0)
    - OPC UA
    - Profinet (0)
    - Axioline F (2)
      - dio-1 : AXL F DI8/1 DO8/1 XC 1H
      - aio-1 : AXL F AI2 AO2 1H

Project ✕ | axc-f-2152-1 / Axioline F ✕ | axc-f-2152-1 ✕ | axc-f-2152-1 / PLC ✕ | aio-1 ✕

Cockpit | Settings | Data List | Statistics

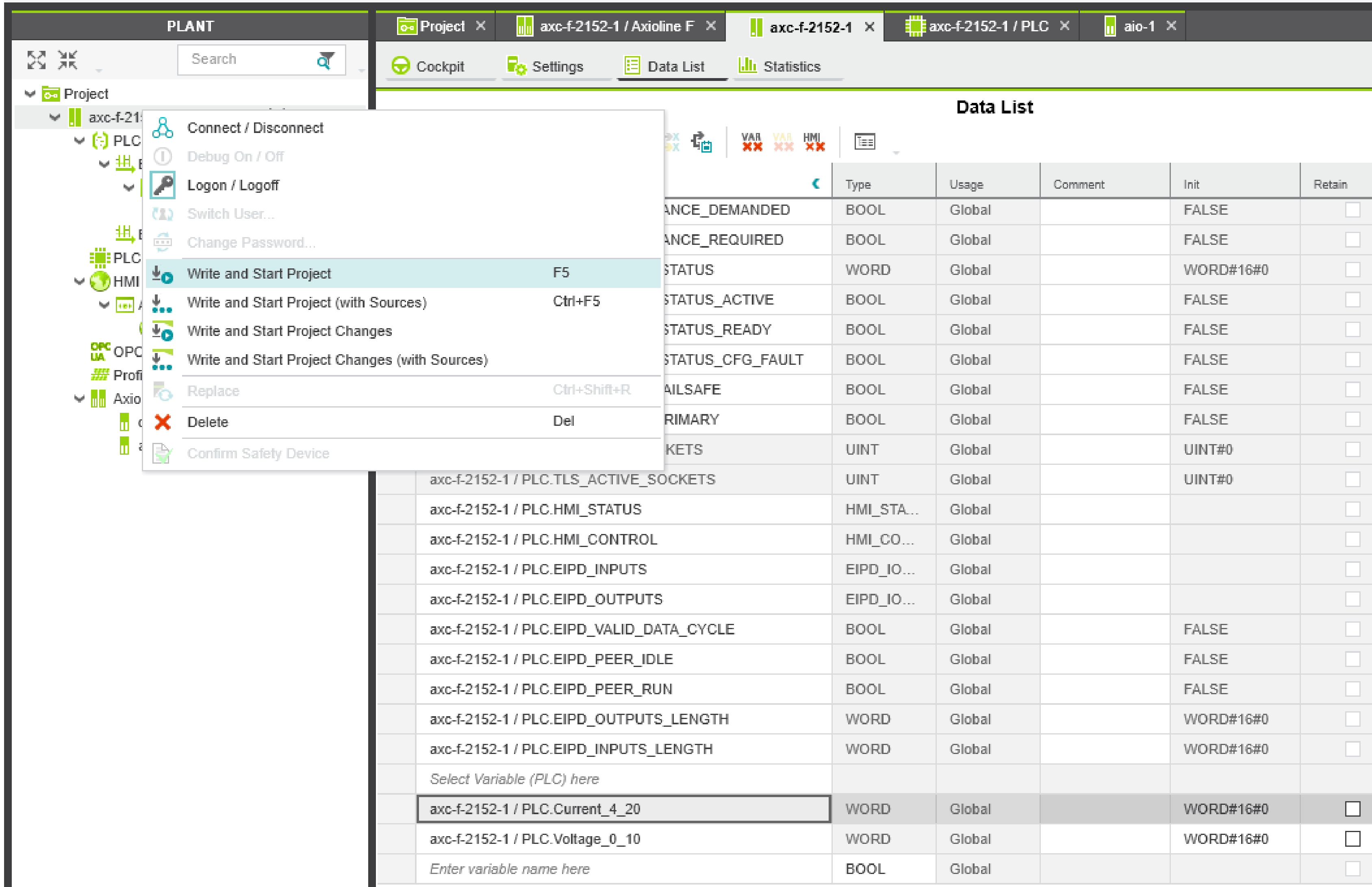
Data List

Search

Variable (PLC)	Type	Usage	Comment	Init	Retain	OPC	HMI	Proficloud
axc-f-2152-1 / PLC.PNIO_MAINTENANCE_DEMANDED	BOOL	Global		FALSE	□	□		□
axc-f-2152-1 / PLC.PNIO_MAINTENANCE_REQUIRED	BOOL	Global		FALSE	□	□		□
axc-f-2152-1 / PLC.PNIO_CONFIG_STATUS	WORD	Global		WORD#16#0	□	□		□
axc-f-2152-1 / PLC.PNIO_CONFIG_STATUS_ACTIVE	BOOL	Global		FALSE	□	□		□
axc-f-2152-1 / PLC.PNIO_CONFIG_STATUS_READY	BOOL	Global		FALSE	□	□		□
axc-f-2152-1 / PLC.PNIO_CONFIG_STATUS_CFG_FAULT	BOOL	Global		FALSE	□	□		□
axc-f-2152-1 / PLC.PNIO_FORCE_FAILSAFE	BOOL	Global		FALSE	□	□		□
axc-f-2152-1 / PLC.PNIO_FORCE_PRIMARY	BOOL	Global		FALSE	□	□		□
axc-f-2152-1 / PLC.IP_ACTIVE_SOCKETS	UINT	Global		UINT#0	□	□		□
axc-f-2152-1 / PLC.TLS_ACTIVE_SOCKETS	UINT	Global		UINT#0	□	□		□
axc-f-2152-1 / PLC.HMI_STATUS	HMI_STA...	Global			□	□		□
axc-f-2152-1 / PLC.HMI_CONTROL	HMI_CO...	Global			□	□		□
axc-f-2152-1 / PLC.EIPD_INPUTS	EIPD_IO...	Global			□	□		□
axc-f-2152-1 / PLC.EIPD_OUTPUTS	EIPD_IO...	Global			□	□		□
axc-f-2152-1 / PLC.EIPD_VALID_DATA_CYCLE	BOOL	Global		FALSE	□	□		□
axc-f-2152-1 / PLC.EIPD_PEER_IDLE	BOOL	Global		FALSE	□	□		□
axc-f-2152-1 / PLC.EIPD_PEER_RUN	BOOL	Global		FALSE	□	□		□
axc-f-2152-1 / PLC.EIPD_OUTPUTS_LENGTH	WORD	Global		WORD#16#0	□	□		□
axc-f-2152-1 / PLC.EIPD_INPUTS_LENGTH	WORD	Global		WORD#16#0	□	□		□
Select Variable (PLC) here								
axc-f-2152-1 / PLC.Current_4_20	WORD	Global		WORD#16#0	□	□		□
axc-f-2152-1 / PLC.Voltage_0_10	WORD	Global		WORD#16#0	□	□		□
Enter variable name here	BOOL	Global			□	□	□	□

Prepare to download to the controller

- Right click on “axc-f-2152-1 : AXC-F-2152” immediately under Project in the PLANT section
- Click on “Write and Start Project to download and start the project on the PLCnext controller.

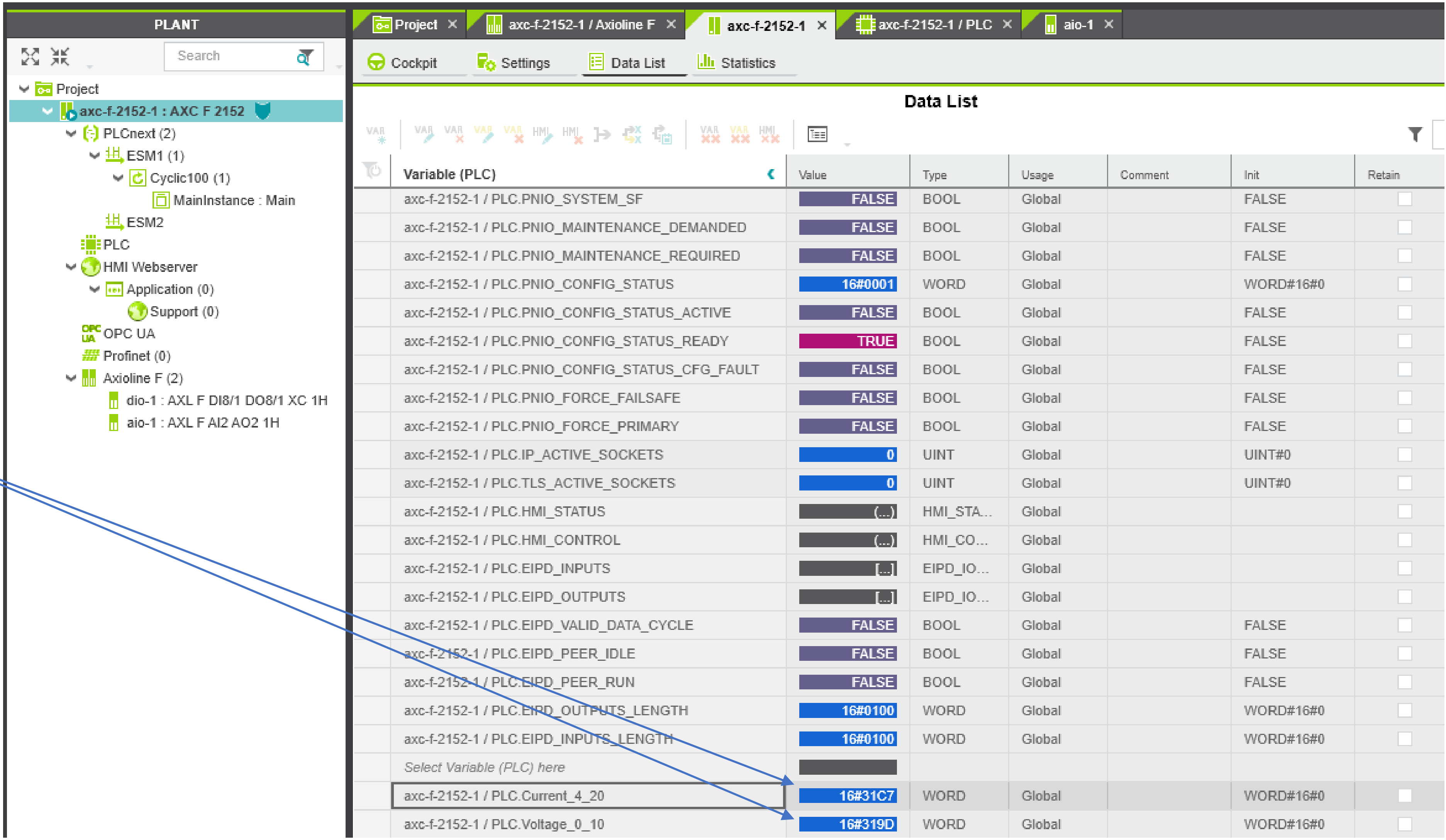


Data List

	Type	Usage	Comment	Init	Retain
ANCE_DEMANDED	BOOL	Global		FALSE	□
ANCE_REQUIRED	BOOL	Global		FALSE	□
STATUS	WORD	Global		WORD#16#0	□
STATUS_ACTIVE	BOOL	Global		FALSE	□
STATUS_READY	BOOL	Global		FALSE	□
STATUS_CFG_FAULT	BOOL	Global		FALSE	□
AILSAFE	BOOL	Global		FALSE	□
RIMARY	BOOL	Global		FALSE	□
KETS	UINT	Global		UINT#0	□
axc-f-2152-1 / PLC.TLS_ACTIVE_SOCKETS	UINT	Global		UINT#0	□
axc-f-2152-1 / PLC.HMI_STATUS	HMI_STA...	Global			□
axc-f-2152-1 / PLC.HMI_CONTROL	HMI_CO...	Global			□
axc-f-2152-1 / PLC.EIPD_INPUTS	EIPD_IO...	Global			□
axc-f-2152-1 / PLC.EIPD_OUTPUTS	EIPD_IO...	Global			□
axc-f-2152-1 / PLC.EIPD_VALID_DATA_CYCLE	BOOL	Global		FALSE	□
axc-f-2152-1 / PLC.EIPD_PEER_IDLE	BOOL	Global		FALSE	□
axc-f-2152-1 / PLC.EIPD_PEER_RUN	BOOL	Global		FALSE	□
axc-f-2152-1 / PLC.EIPD_OUTPUTS_LENGTH	WORD	Global		WORD#16#0	□
axc-f-2152-1 / PLC.EIPD_INPUTS_LENGTH	WORD	Global		WORD#16#0	□
Select Variable (PLC) here					
axc-f-2152-1 / PLC.Current_4_20	WORD	Global		WORD#16#0	□
axc-f-2152-1 / PLC.Voltage_0_10	WORD	Global		WORD#16#0	□
Enter variable name here	BOOL	Global			□

Witness interaction while online with PLCnext controller

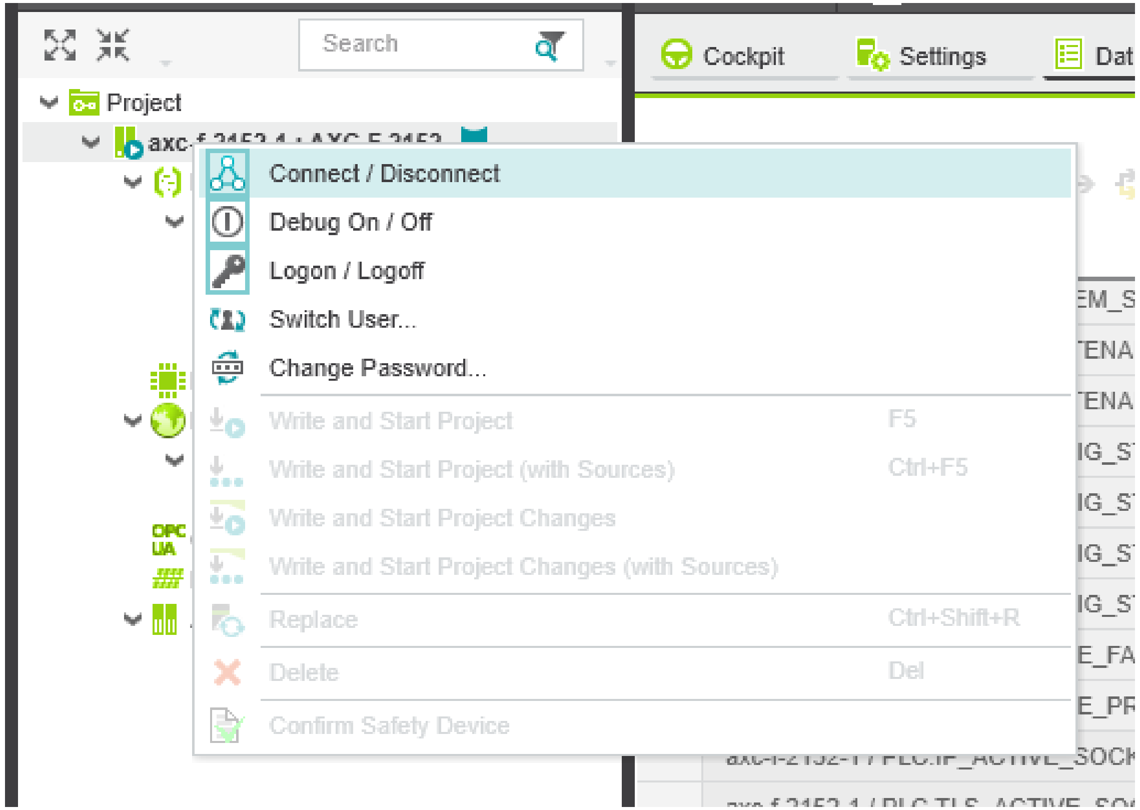
- Note the Data List becomes interactive as the PLC runs the program.
- The raw values of the analog inputs can be seen (in hexadecimal format).
- Twist the potentiometer and the values will change.



Variable (PLC)	Value	Type	Usage	Comment	Init	Retain
axc-f-2152-1 / PLC.PNIO_SYSTEM_SF	FALSE	BOOL	Global		FALSE	□
axc-f-2152-1 / PLC.PNIO_MAINTENANCE_DEMANDED	FALSE	BOOL	Global		FALSE	□
axc-f-2152-1 / PLC.PNIO_MAINTENANCE_REQUIRED	FALSE	BOOL	Global		FALSE	□
axc-f-2152-1 / PLC.PNIO_CONFIG_STATUS	16#0001	WORD	Global		WORD#16#0	□
axc-f-2152-1 / PLC.PNIO_CONFIG_STATUS_ACTIVE	FALSE	BOOL	Global		FALSE	□
axc-f-2152-1 / PLC.PNIO_CONFIG_STATUS_READY	TRUE	BOOL	Global		FALSE	□
axc-f-2152-1 / PLC.PNIO_CONFIG_STATUS_CFG_FAULT	FALSE	BOOL	Global		FALSE	□
axc-f-2152-1 / PLC.PNIO_FORCE_FAILSAFE	FALSE	BOOL	Global		FALSE	□
axc-f-2152-1 / PLC.PNIO_FORCE_PRIMARY	FALSE	BOOL	Global		FALSE	□
axc-f-2152-1 / PLC.IP_ACTIVE_SOCKETS	0	UINT	Global		UINT#0	□
axc-f-2152-1 / PLC.TLS_ACTIVE_SOCKETS	0	UINT	Global		UINT#0	□
axc-f-2152-1 / PLC.HMI_STATUS	(...)	HMI_STA...	Global			□
axc-f-2152-1 / PLC.HMI_CONTROL	(...)	HMI_CO...	Global			□
axc-f-2152-1 / PLC.EIPD_INPUTS	[...]	EIPD_IO...	Global			□
axc-f-2152-1 / PLC.EIPD_OUTPUTS	[...]	EIPD_IO...	Global			□
axc-f-2152-1 / PLC.EIPD_VALID_DATA_CYCLE	FALSE	BOOL	Global		FALSE	□
axc-f-2152-1 / PLC.EIPD_PEER_IDLE	FALSE	BOOL	Global		FALSE	□
axc-f-2152-1 / PLC.EIPD_PEER_RUN	FALSE	BOOL	Global		FALSE	□
axc-f-2152-1 / PLC.EIPD_OUTPUTS_LENGTH	16#0100	WORD	Global		WORD#16#0	□
axc-f-2152-1 / PLC.EIPD_INPUTS_LENGTH	16#0100	WORD	Global		WORD#16#0	□
Select Variable (PLC) here						
axc-f-2152-1 / PLC.Current_4_20	16#31C7	WORD	Global		WORD#16#0	□
axc-f-2152-1 / PLC.Voltage_0_10	16#319D	WORD	Global		WORD#16#0	□

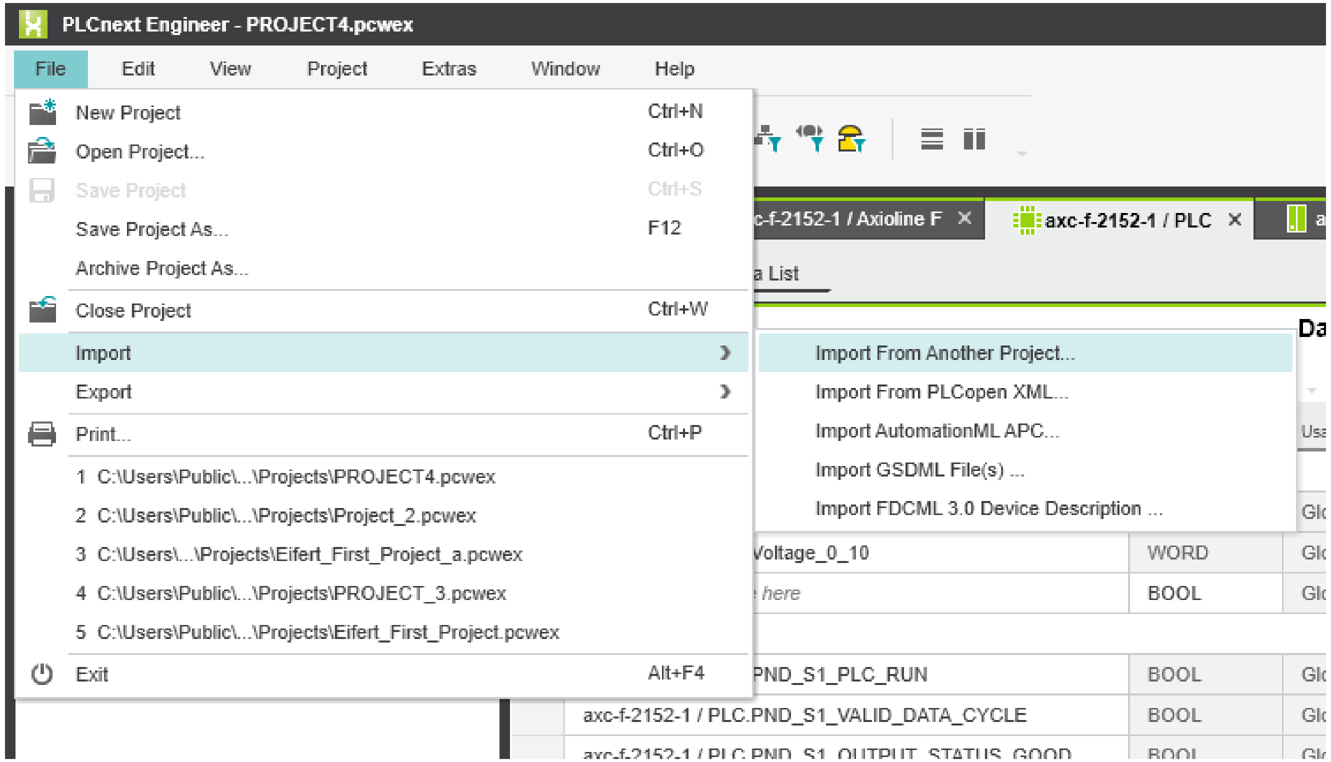
Prepare to do some programming

- Raw variables won't be of use in real-world applications. We will do some programming to scale those values to real-world engineering units.
- First, Right click on "axc-f-2152-1 : AXC-F-2152" immediately under Project in the PLANT section
- Then click on Connect / Disconnect (which will disconnect the program from the controller).


Search
Cockpit
Settings
Dat
Project
axc-f-2152-1 : AXC-F-2152
Connect / Disconnect
Debug On / Off
Logon / Logoff
Switch User...
Change Password...
Write and Start Project F5
Write and Start Project (with Sources) Ctrl+F5
Write and Start Project Changes
Write and Start Project Changes (with Sources)
Replace Ctrl+Shift+R
Delete Del
Confirm Safety Device
OPC UA
EM_S
ENA
ENA
IG_S
IG_S
IG_S
IG_S
E_FA
E_PR
axc-f-2152-1 / PLC.IP_ACTIVE_SOCK
axc-f-2152-1 / PLC.TLS_ACTIVE_SO

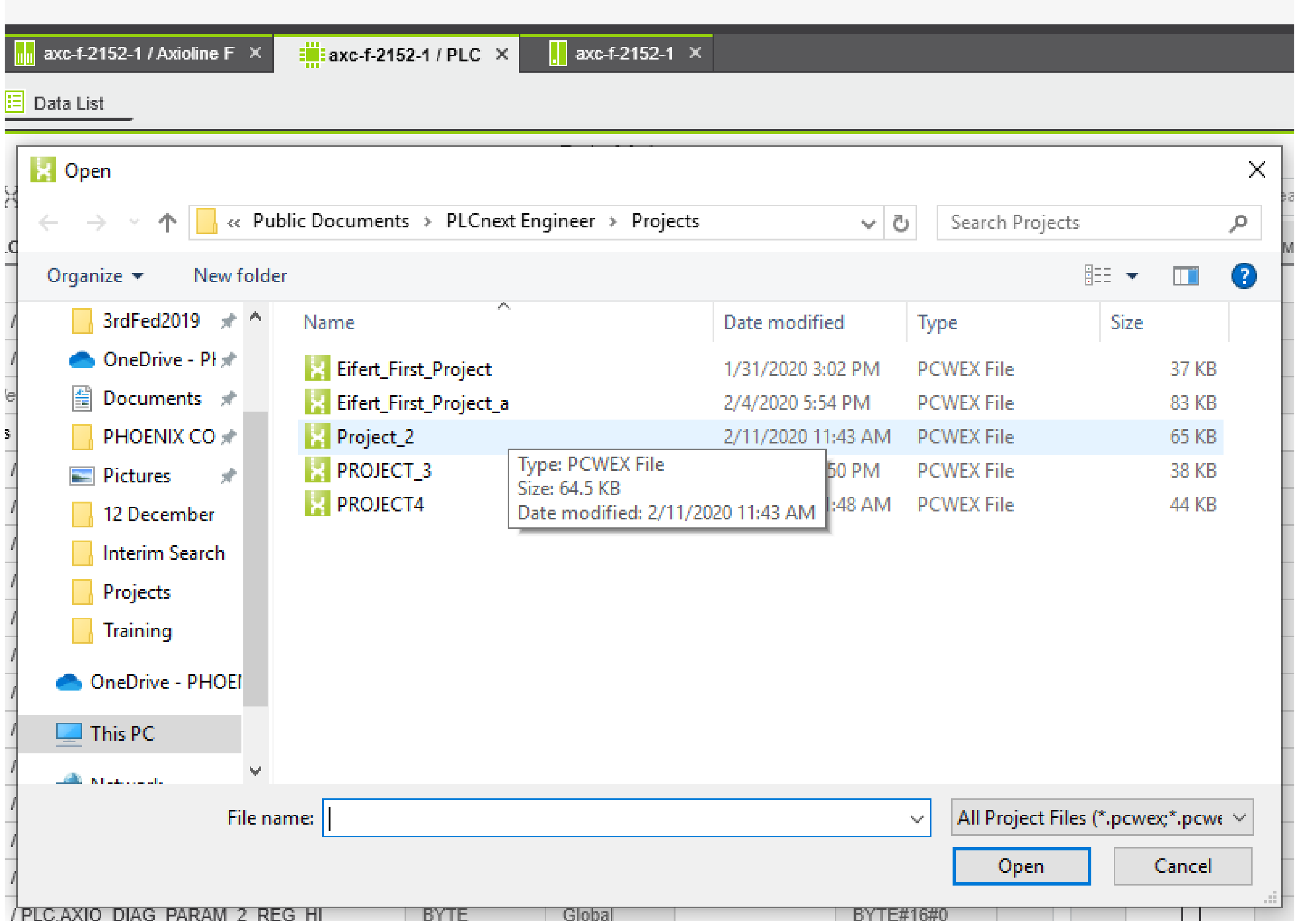
Prepare to do some programming

- Because the programming to scale the inputs is fairly complex, and since someone else has already created a function block to perform this task, I will import their function block rather than build it from scratch.
- It is located in another project “Project 2”.
- From within the project we are working in, click File – Import – Import from Another Project


PLCnext Engineer - PROJECT4.pcwex
File
Edit
View
Project
Extras
Window
Help
New Project Ctrl+N
Open Project... Ctrl+O
Save Project Ctrl+S
Save Project As... F12
Archive Project As...
Close Project Ctrl+W
Import
Export
Print... Ctrl+P
1 C:\Users\Public\...\Projects\PROJECT4.pcwex
2 C:\Users\Public\...\Projects\Project_2.pcwex
3 C:\Users\...\Projects\Eifert_First_Project_a.pcwex
4 C:\Users\Public\...\Projects\PROJECT_3.pcwex
5 C:\Users\Public\...\Projects\Eifert_First_Project.pcwex
Exit Alt+F4
Import From Another Project...
Import From PLCopen XML...
Import AutomationML APC...
Import GSDML File(s) ...
Import FDCML 3.0 Device Description ...
c-f-2152-1 / Axioline F
axc-f-2152-1 / PLC
a List
Voltage_0_10 WORD
here BOOL
PND_S1_PLC_RUN BOOL
axc-f-2152-1 / PLC.PND_S1_VALID_DATA_CYCLE BOOL
axc-f-2152-1 / PLC.PND_S1_OUTPUT_STATUS_GOOD BOOL

Import from the selected project

- Locate the existing project which contains the function block you need
- In this case, I know the function block I need is in the "Project_2" project



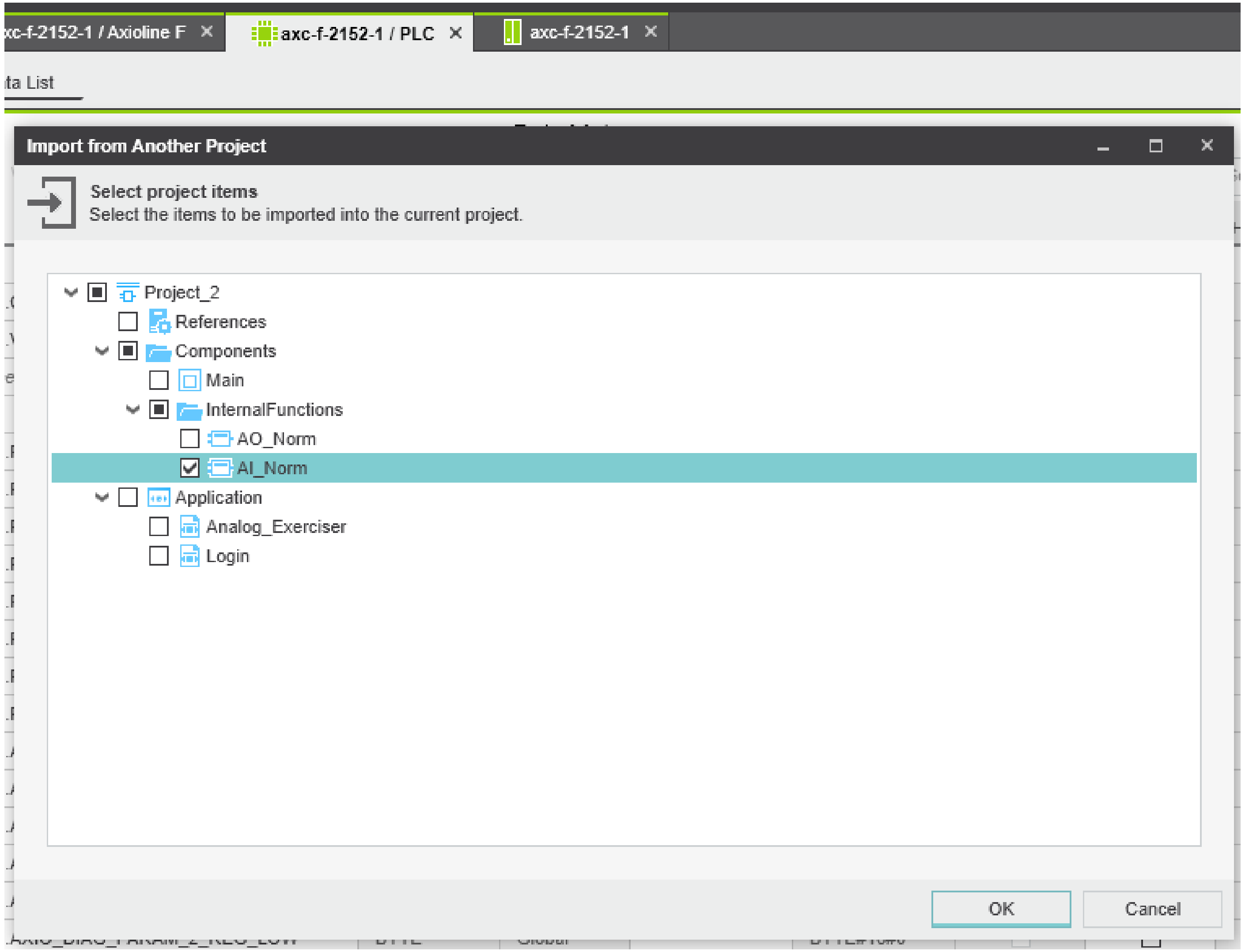
Name	Date modified	Type	Size
Eifert_First_Project	1/31/2020 3:02 PM	PCWEX File	37 KB
Eifert_First_Project_a	2/4/2020 5:54 PM	PCWEX File	83 KB
Project_2	2/11/2020 11:43 AM	PCWEX File	65 KB
PROJECT_3	50 PM	PCWEX File	38 KB
PROJECT4	:48 AM	PCWEX File	44 KB

Type: PCWEX File
Size: 64.5 KB
Date modified: 2/11/2020 11:43 AM

/ PLC.AXIO_DIAG_PARAM_2_REG_HI BYTE Global BYTE#16#0

Only select the content you want to import

- All items are selected by default, since we only want the "AI_Norm" function block, deselect everything and select just the "AI_norm" by checking its box.
- Click OK



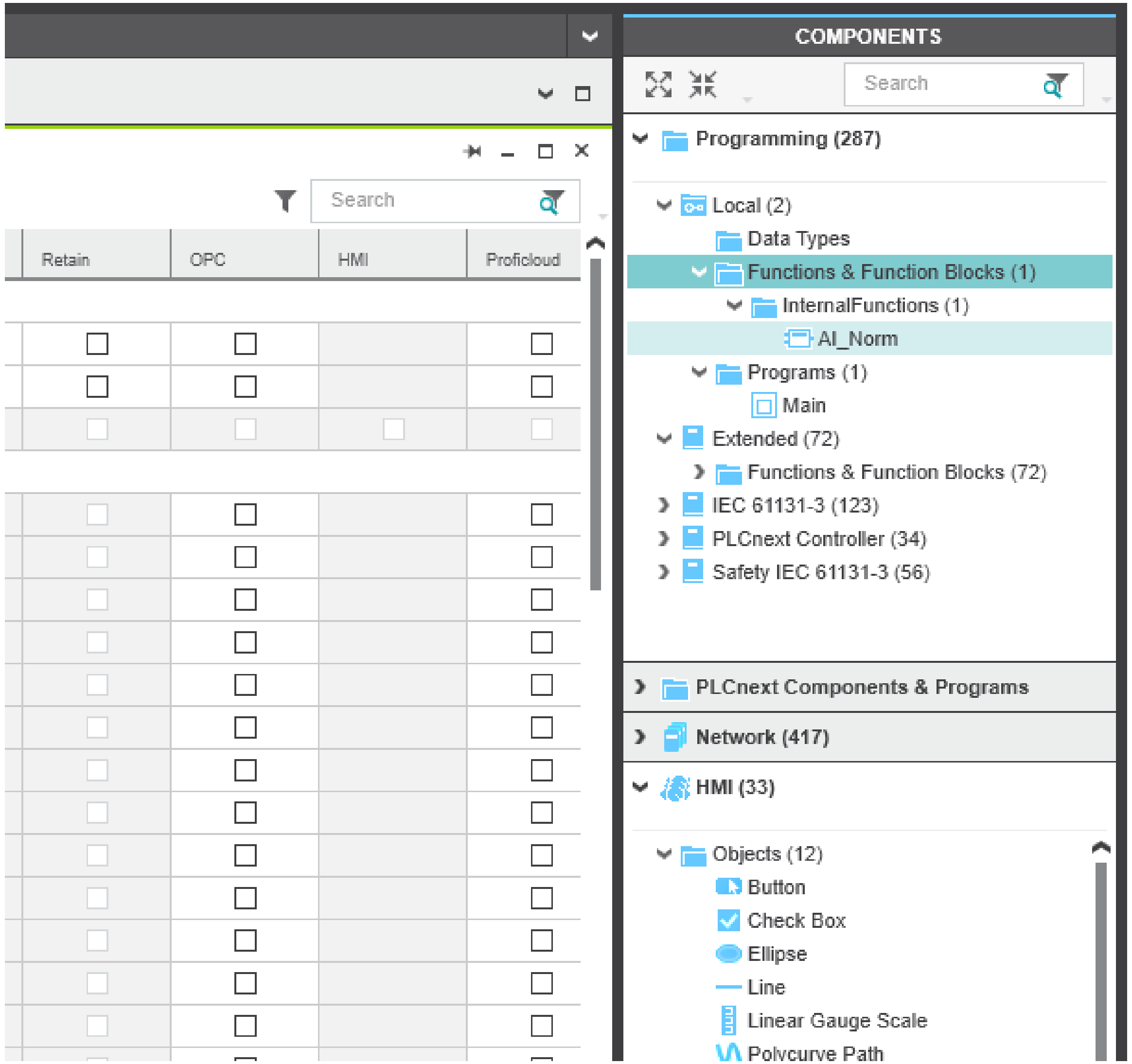
Import from Another Project

Select project items
Select the items to be imported into the current project.

- ■ Project_2
  - □ References
  - ■ Components
    - □ Main
    - ■ InternalFunctions
      - □ AO_Norm
      - ☑ AI_Norm
  - □ Application
    - □ Analog_Exerciser
    - □ Login

Function block is added to our project

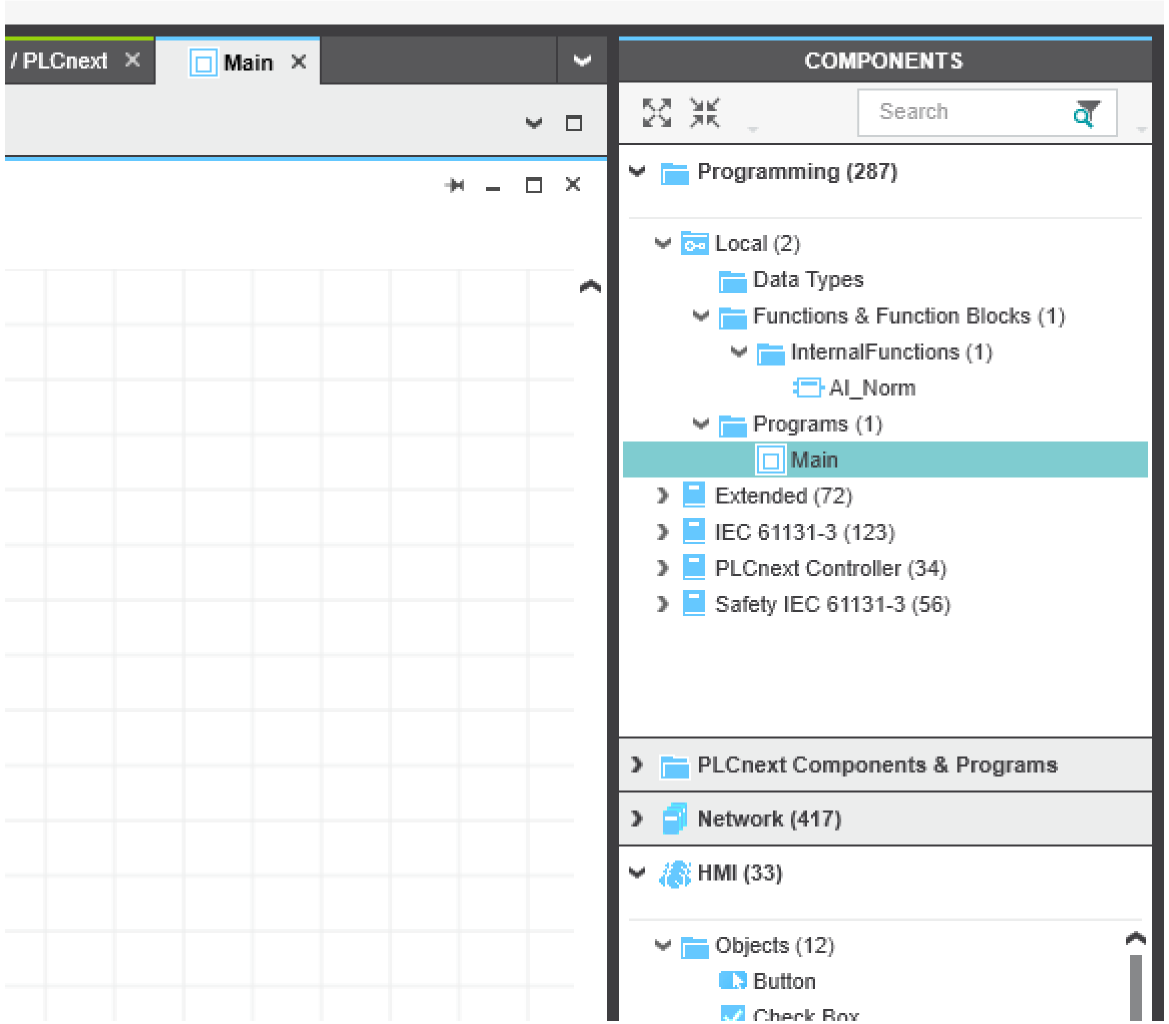
- Notice this new function block has been added to our new project.
- In the COMPONENTS section, under Programming/Local/Functions & Function Blocks/Internal Functions
- We now have the desired function block to scale our raw value: AI_Norm



Opening a program, so we can begin programming…

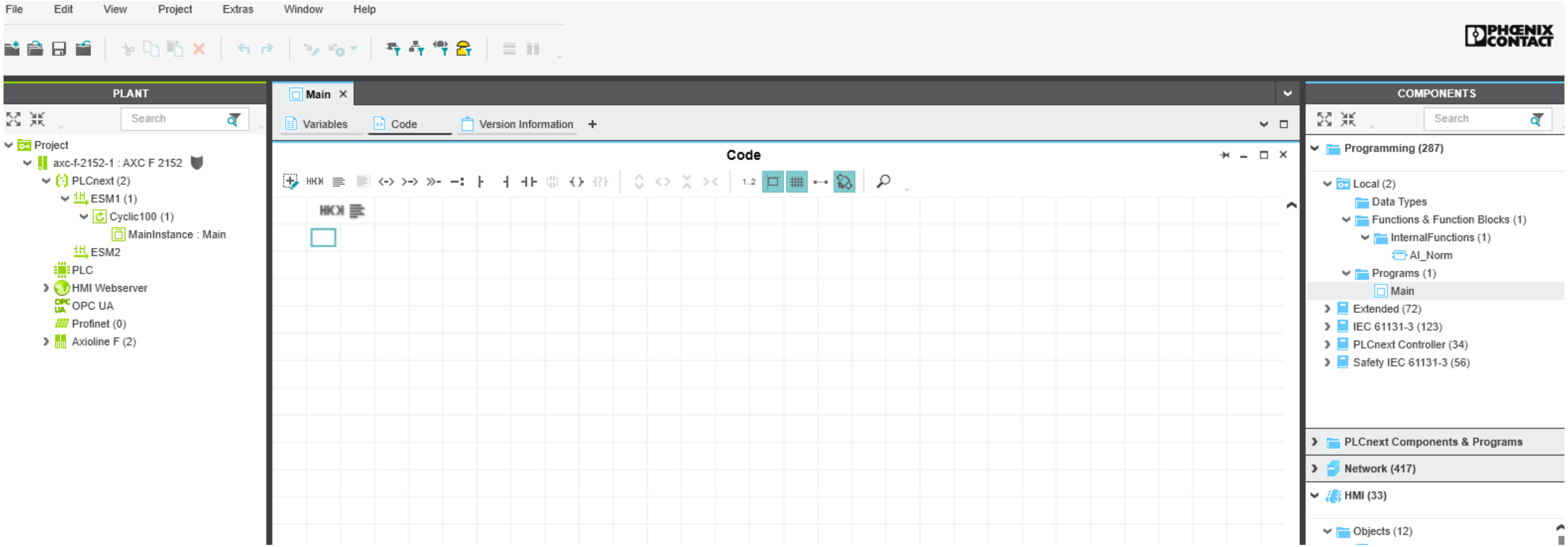
We've started a Project, we have added, and configured I/O, we have set up communications between the project and the PLCnext controller. Now we can begin to program.

- Still in the COMPONENTS section, under Programming/Local/Programs, double click on "Main" to open this blank new program.



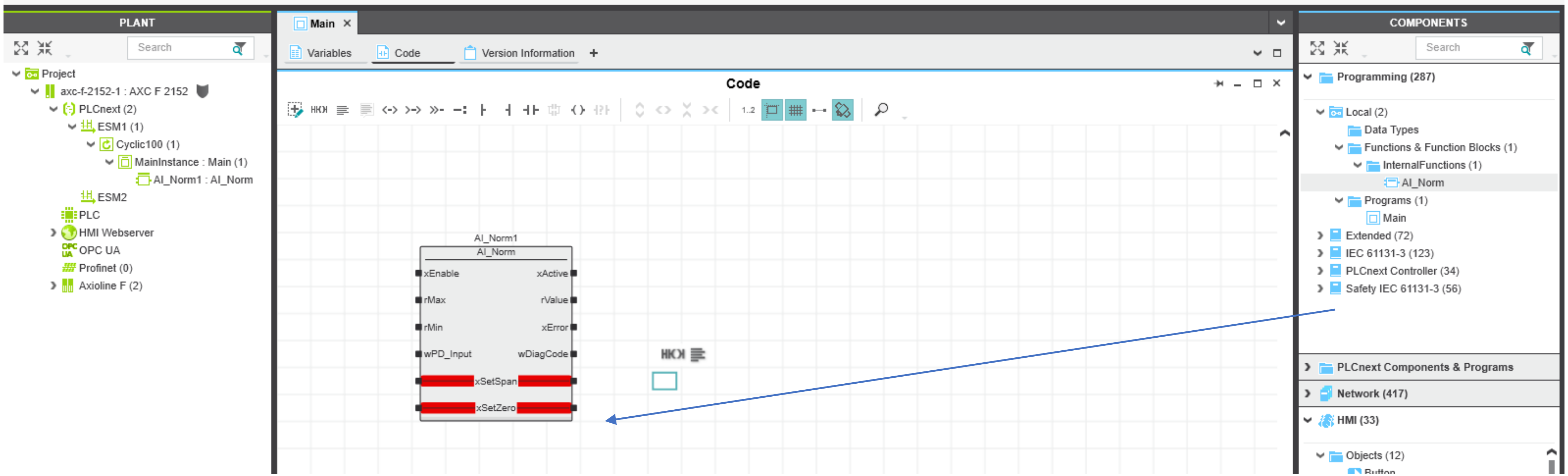
Getting ready to program

- You will see a new window open in the central working area
- The tab will have the program's name “Main”, and the “Code” sub-tab will be selected



Selecting a function block

- Drag and drop the “AI_Norm” function block onto the work surface.
  - Note, this training was developed prior to the development of the newest AI_Norm and AO_Norm function blocks…the current versions contain a few more parameters to aid in scaling the proper engineering units.

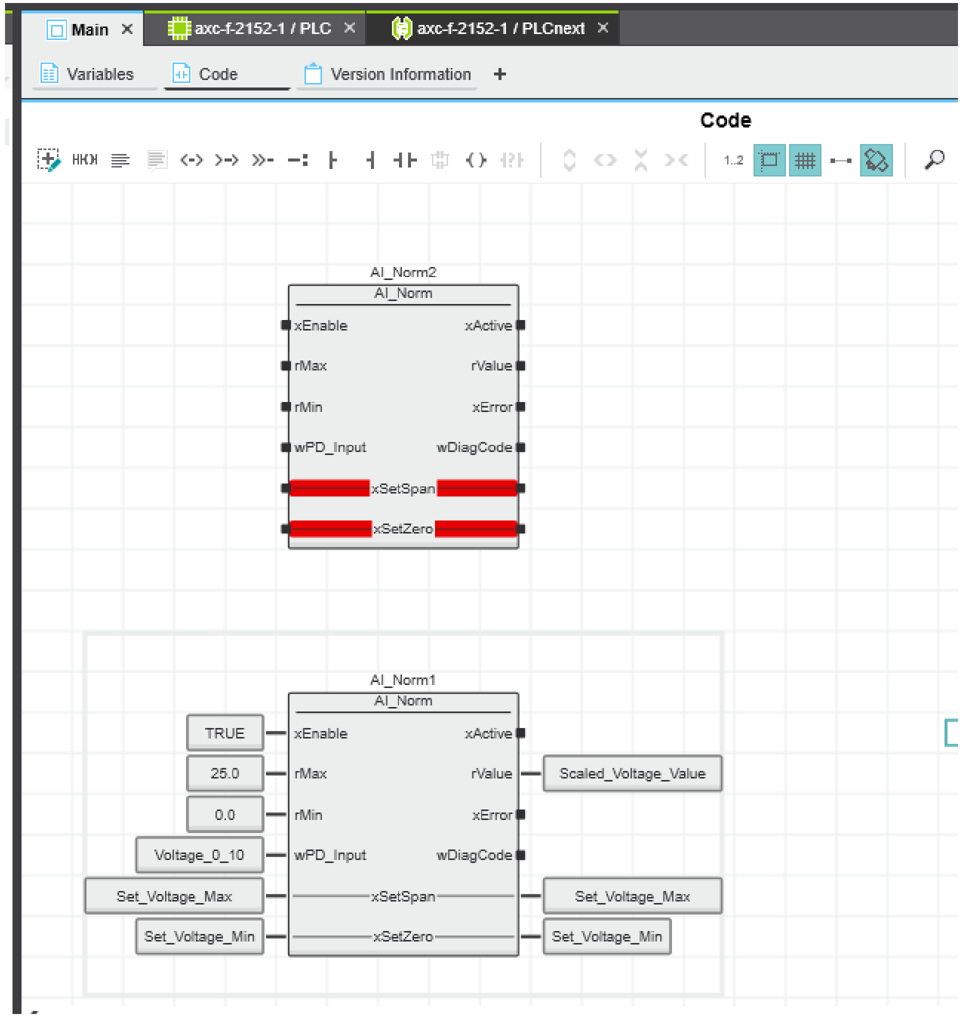


Programming using the AI_Norm function block

The purpose of this function block is to take the raw analog signal coming from the I/O exerciser, and giving it a high and low level, and scaling its raw signal to a “real-world” engineering value.

I have already completed parameterization of one input (below) and will now show step-by-step how to configure the second one.

1. Position the cursor near the black square near “xEnable”
2. Double click and type “TRUE” and return (this will enable this function block in the program)



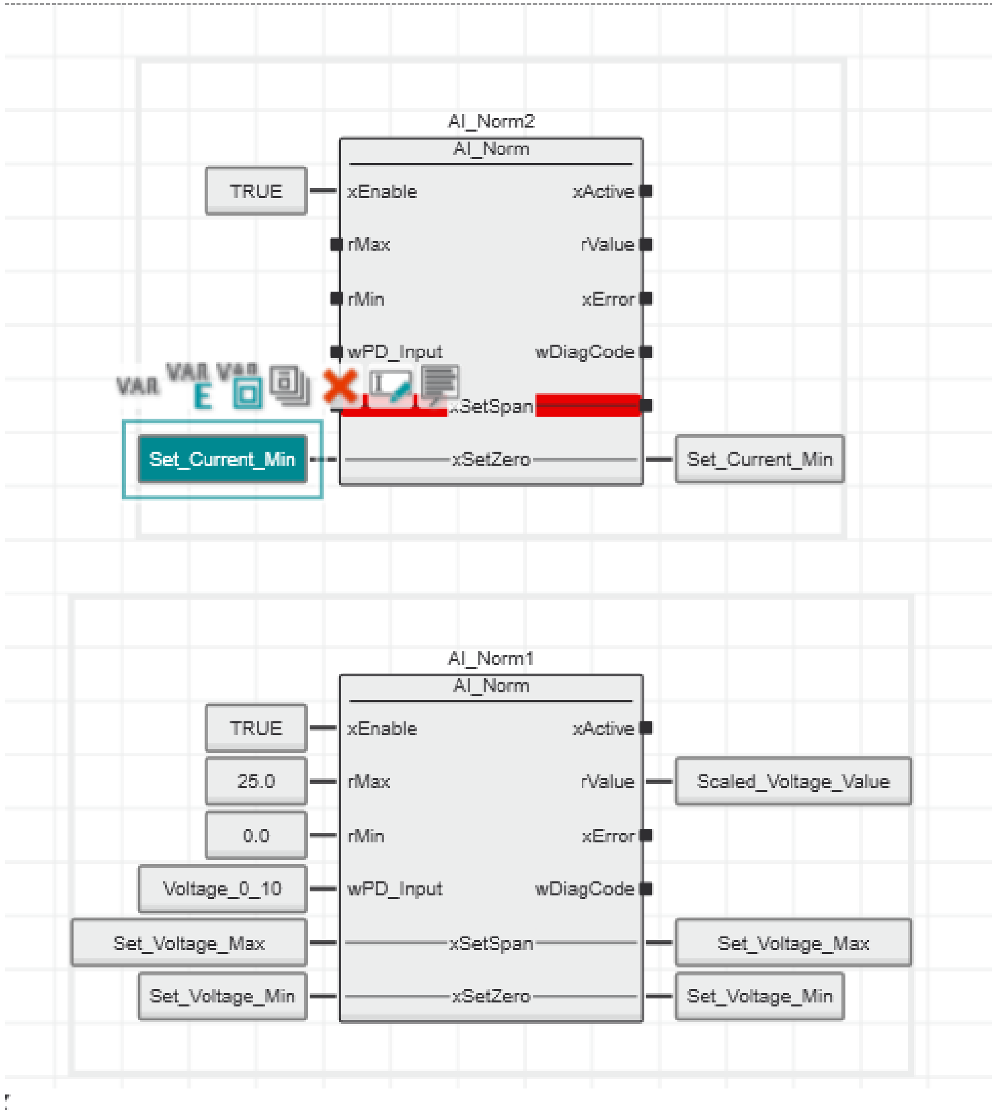
Programming using the AI_Norm function block

3 – On the left side position the cursor near the black square at xSetZero and double click. Type in “Set_Current_Min”. This is the name of a new variable.

4 – Click on this newly created variable, the field will turn blue. Select VAR E from the list above the variable to make this an External Variable

5 – Repeat steps 3 & 4 for “xSetSpan”, calling this new variable “Set_Current_Max”

6 – Repeat steps 3, 4 & 5 for the signals on the right side.



Programming using the AI_Norm function block

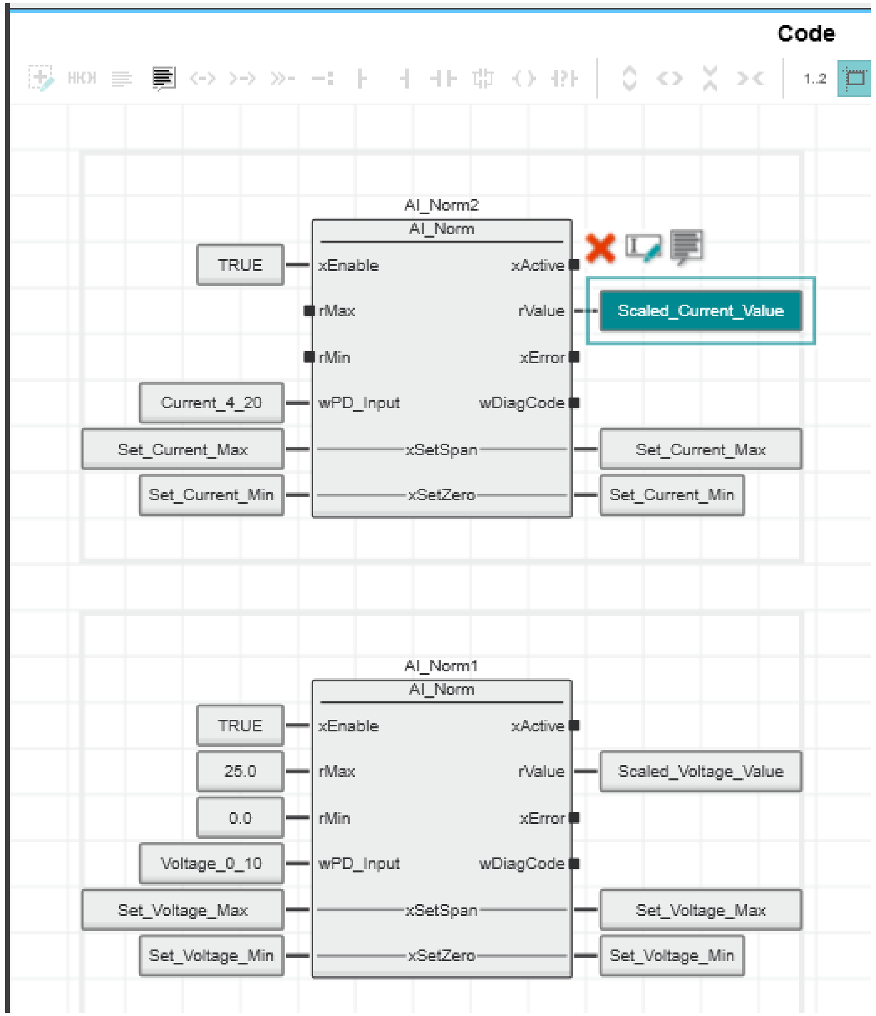
7 – repeat steps 3 & 4 for “wPD_Input”, calling this new variable “Current_4_20”

8 – repeat steps 3 & 4 for “rValue”, calling this new variable “Scaled_Current_Value”

9 – Think about what you want this 4-20mA signal to represent in the real world. Let’s say it represents a flow meter, and the flow can be between 0 gpm and 400 gpm…

10 – Double click on “rMin” and type in 0.0

11 - Double click on “rMax” and type in 400.0



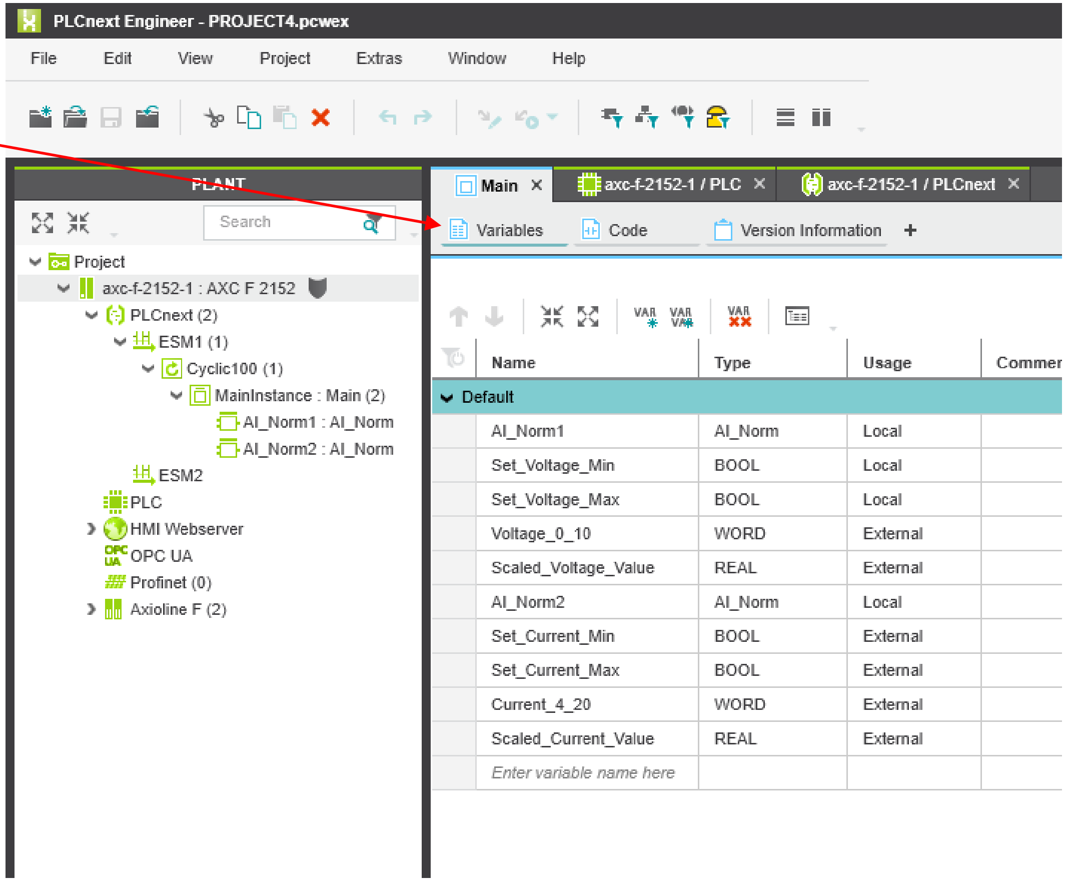
Checking that the variables have been properly assigned

Click on the “Variables” subtab to verify that all the new variables you have declared, have in fact been assigned.

If not, you probably forgot to click in the variable once you first created it, and then chosen to associate it to “VAR”, VAR E”, etc. from the menu above the variable tag.

If variables have not been assigned, there will be an error message at the bottom of the screen.

Save the project



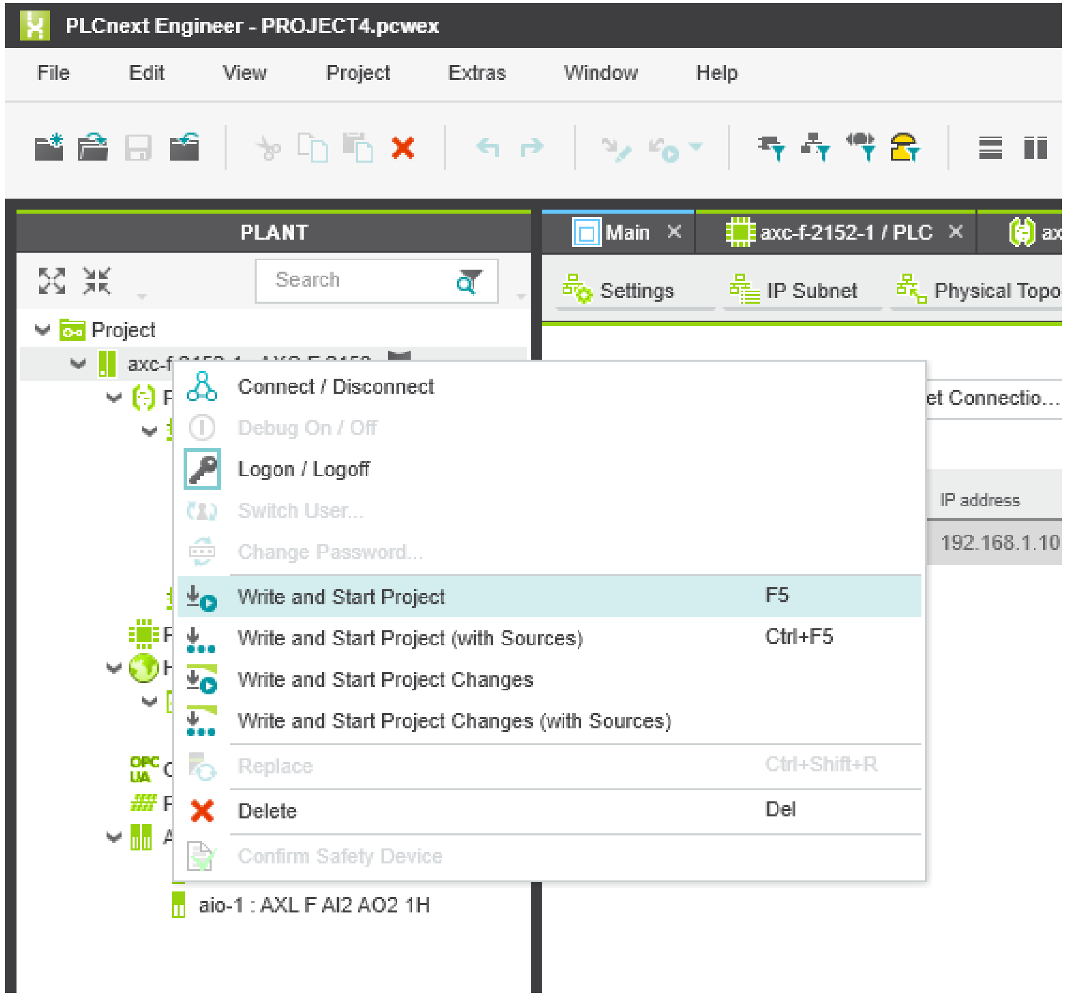
Name	Type	Usage	Commer
Default			
AI_Norm1	AI_Norm	Local	
Set_Voltage_Min	BOOL	Local	
Set_Voltage_Max	BOOL	Local	
Voltage_0_10	WORD	External	
Scaled_Voltage_Value	REAL	External	
AI_Norm2	AI_Norm	Local	
Set_Current_Min	BOOL	External	
Set_Current_Max	BOOL	External	
Current_4_20	WORD	External	
Scaled_Current_Value	REAL	External	
Enter variable name here			

Let’s confirm everything works so far…

Right click on “axc-f-2152 – 1 : AXC-F-2152” below “Project” in the PLANT section.

From the drop-down menu, select “Write and Start Project”

This will send our newly created program to the PLCnext controller and start running the program. It will take a minute or so.



Let’s confirm everything works so far…

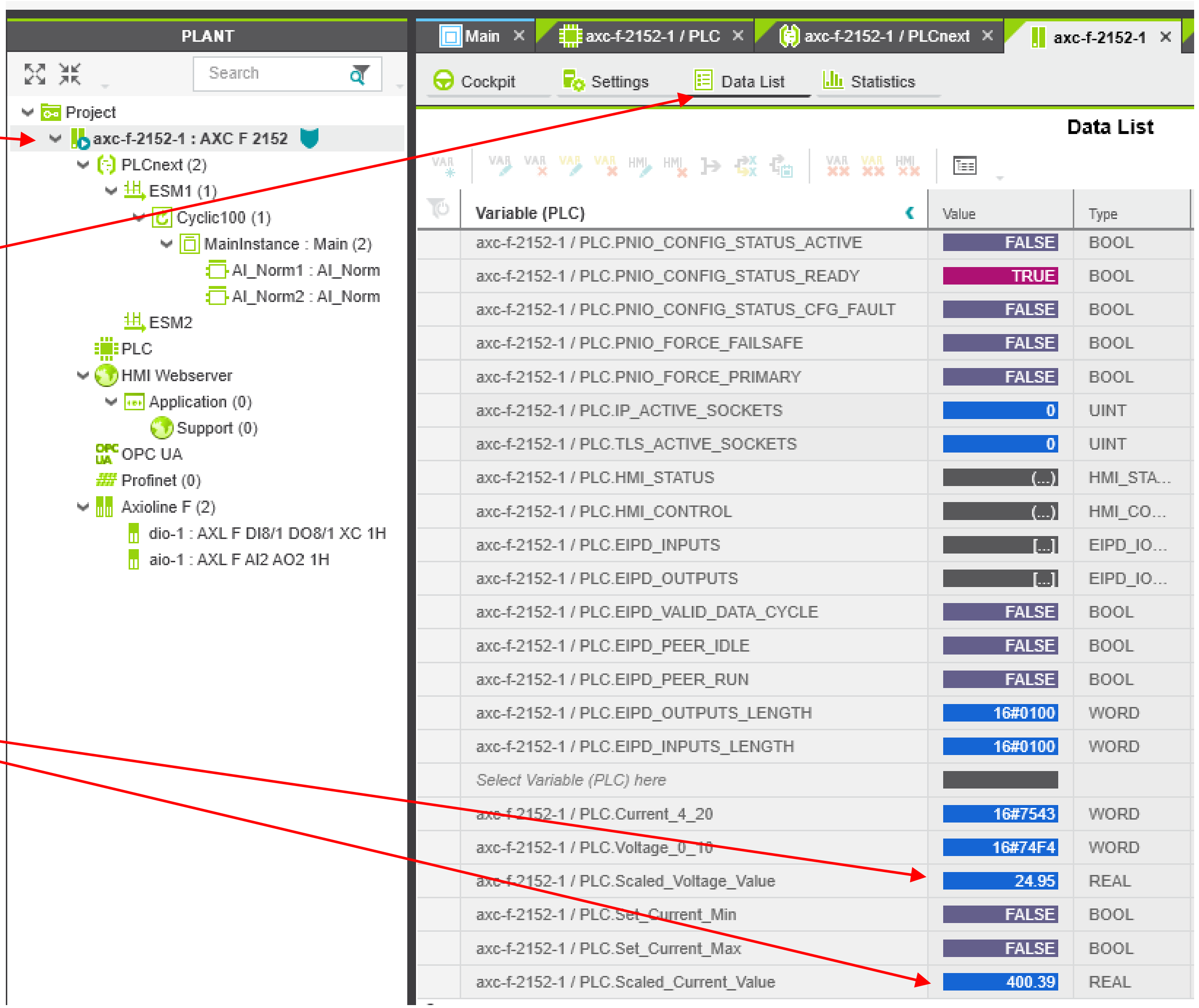
Double click on “axc-f-2152 – 1 : AXC-F-2152” below “Project” in the PLANT section.

Click on the “Data List” Subtab in the central working space

You may need to scroll to the bottom to find the scaled analog input variables we recently created

Note, when the potentiometer is turned all the way up, the max-scale values appear as we have parameterized! Success!

Twist the knob, and see those values change.



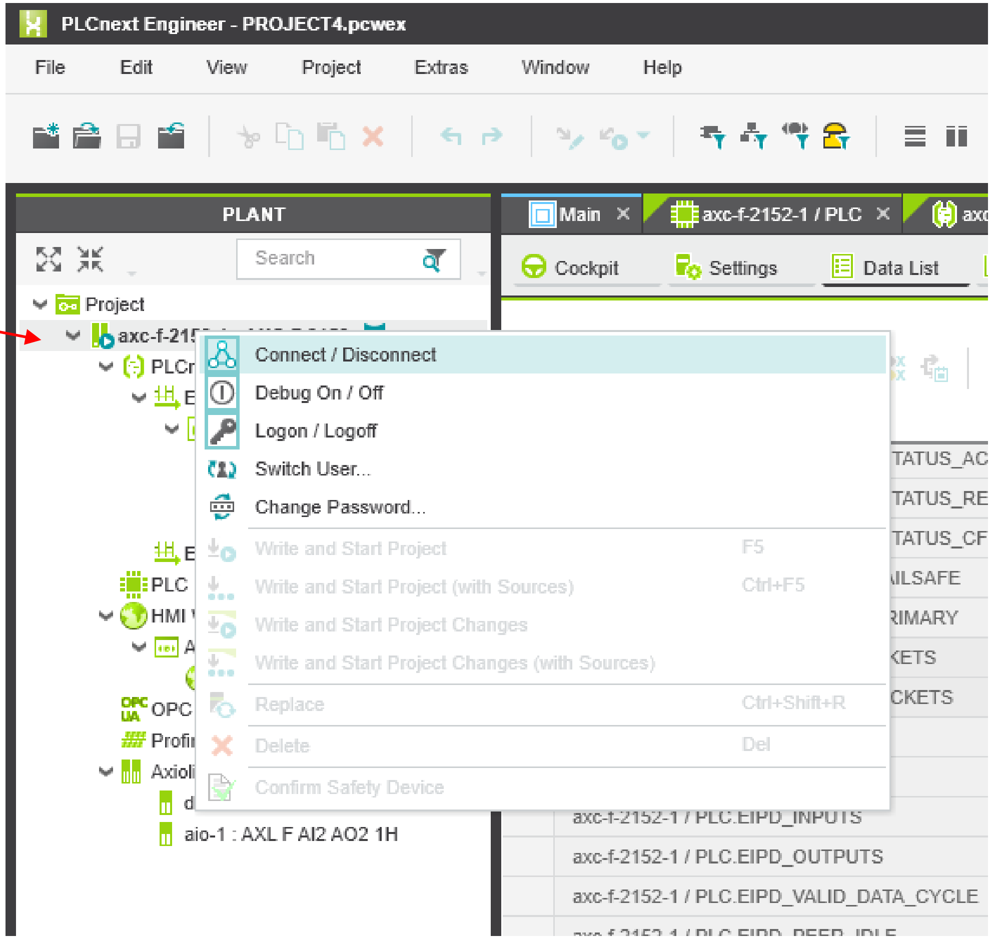
Project
- axc-f-2152-1 : AXC F 2152
  - PLCnext (2)
    - ESM1 (1)
      - Cyclic100 (1)
        - MainInstance : Main (2)
          - AI_Norm1 : AI_Norm
          - AI_Norm2 : AI_Norm
    - ESM2
  - PLC
  - HMI Webserver
    - Application (0)
      - Support (0)
  - OPC UA
  - Profinet (0)
  - Axioline F (2)
    - dio-1 : AXL F DI8/1 DO8/1 XC 1H
    - aio-1 : AXL F AI2 AO2 1H

Data List

Variable (PLC)	Value	Type
axc-f-2152-1 / PLC.PNIO_CONFIG_STATUS_ACTIVE	FALSE	BOOL
axc-f-2152-1 / PLC.PNIO_CONFIG_STATUS_READY	TRUE	BOOL
axc-f-2152-1 / PLC.PNIO_CONFIG_STATUS_CFG_FAULT	FALSE	BOOL
axc-f-2152-1 / PLC.PNIO_FORCE_FAILSAFE	FALSE	BOOL
axc-f-2152-1 / PLC.PNIO_FORCE_PRIMARY	FALSE	BOOL
axc-f-2152-1 / PLC.IP_ACTIVE_SOCKETS	0	UINT
axc-f-2152-1 / PLC.TLS_ACTIVE_SOCKETS	0	UINT
axc-f-2152-1 / PLC.HMI_STATUS	(...)	HMI_STA...
axc-f-2152-1 / PLC.HMI_CONTROL	(...)	HMI_CO...
axc-f-2152-1 / PLC.EIPD_INPUTS	[...]	EIPD_IO...
axc-f-2152-1 / PLC.EIPD_OUTPUTS	[...]	EIPD_IO...
axc-f-2152-1 / PLC.EIPD_VALID_DATA_CYCLE	FALSE	BOOL
axc-f-2152-1 / PLC.EIPD_PEER_IDLE	FALSE	BOOL
axc-f-2152-1 / PLC.EIPD_PEER_RUN	FALSE	BOOL
axc-f-2152-1 / PLC.EIPD_OUTPUTS_LENGTH	16#0100	WORD
axc-f-2152-1 / PLC.EIPD_INPUTS_LENGTH	16#0100	WORD
Select Variable (PLC) here		
axc-f-2152-1 / PLC.Current_4_20	16#7543	WORD
axc-f-2152-1 / PLC.Voltage_0_10	16#74F4	WORD
axc-f-2152-1 / PLC.Scaled_Voltage_Value	24.95	REAL
axc-f-2152-1 / PLC.Set_Current_Min	FALSE	BOOL
axc-f-2152-1 / PLC.Set_Current_Max	FALSE	BOOL
axc-f-2152-1 / PLC.Scaled_Current_Value	400.39	REAL

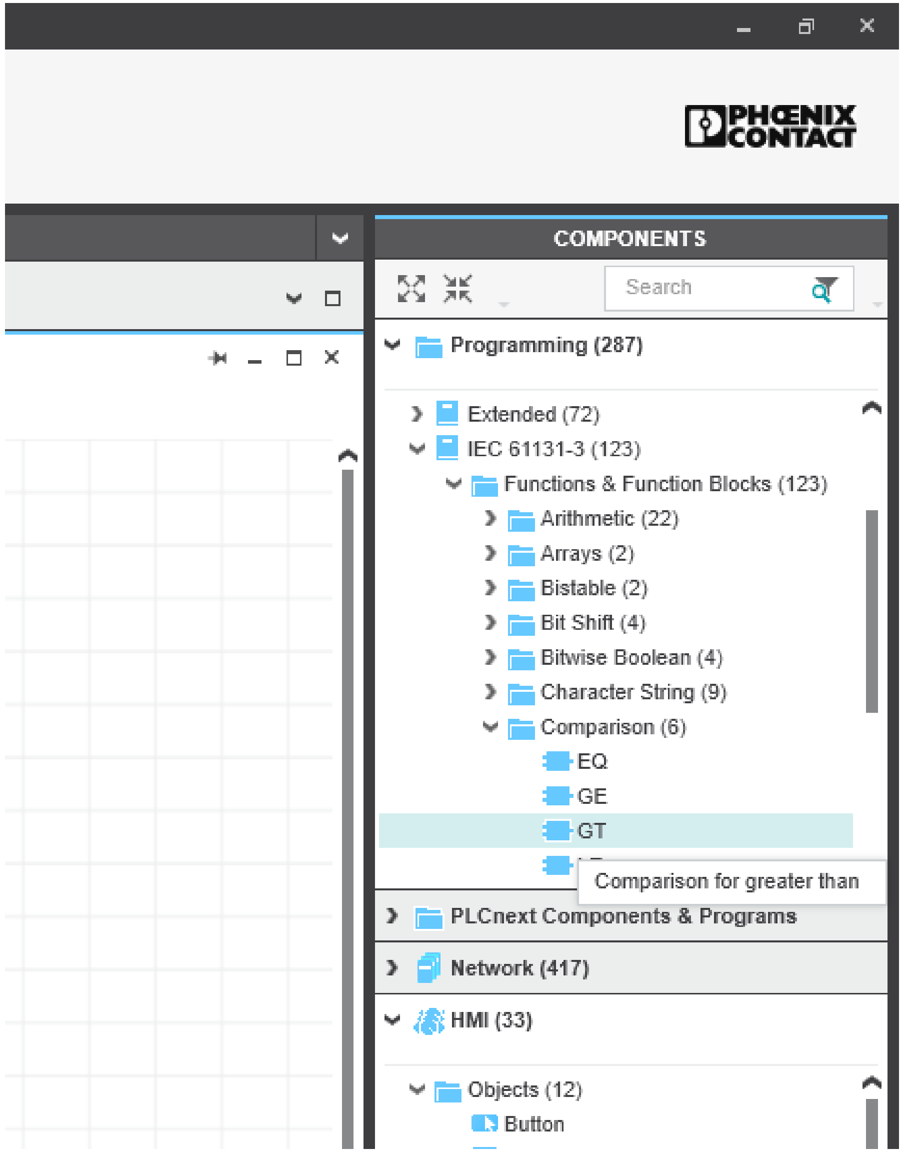
Disconnect from the controller to enter programming mode

- First, we must disconnect from the PLCnext controller
- Right-click on “axc-f-2152 – 1 : AXC-F-2152” below “Project” in the PLANT section.
- The click on Connect / Disconnect to disconnect
- Let’s make it interesting and activate two digital outputs when our scaled analog input values reach some thresholds.



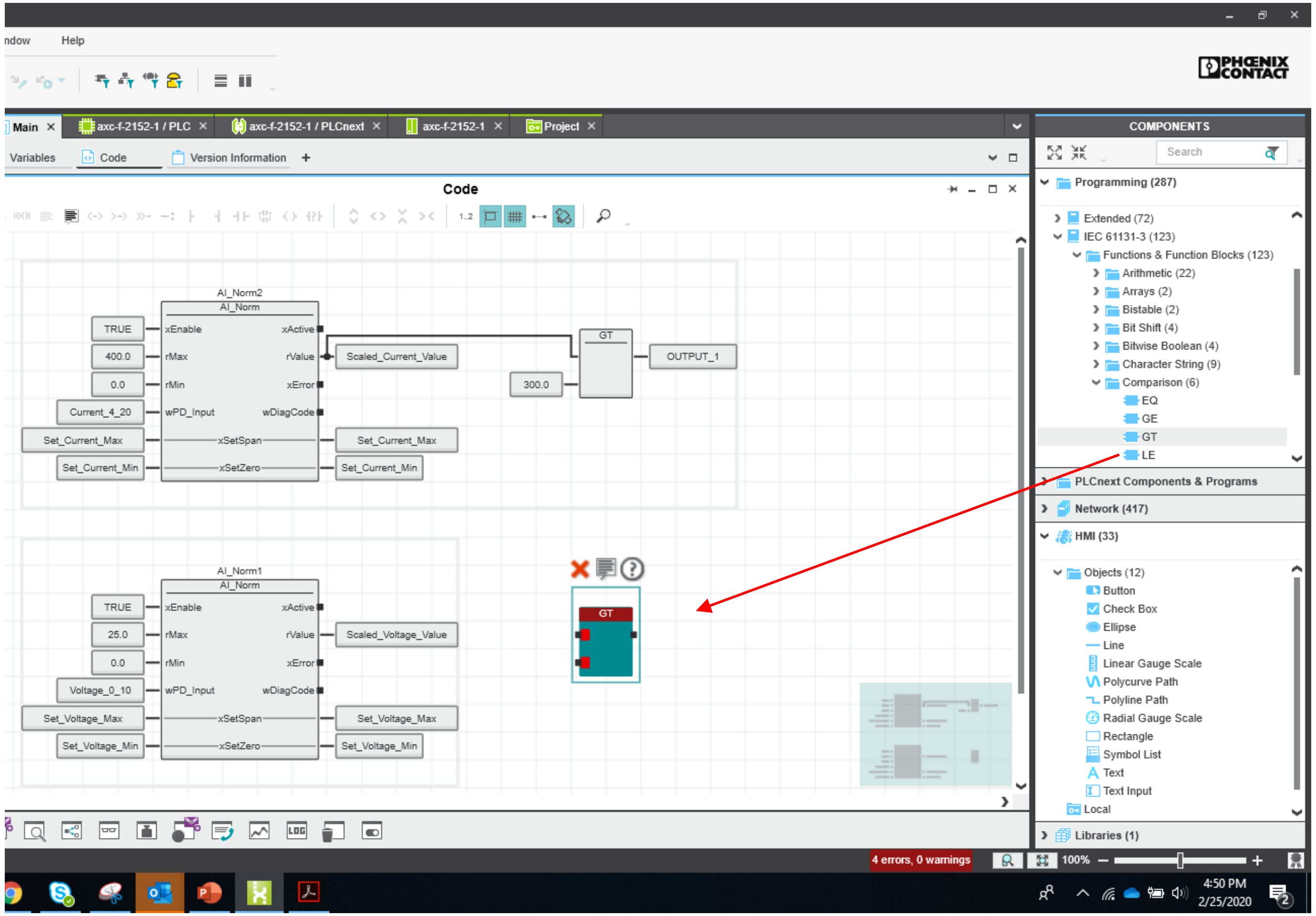
Let’s turn on a digital output, based on the value of one of the scaled analog inputs

- Expand the Programming tree in the COMPONENTS are as shown to the right.
- Drag the GT (Greater Than) comparison block onto the programming area (make sure the “Main” (program) tab is selected and the “Code” subtab is open, so you can see the programming workspace)



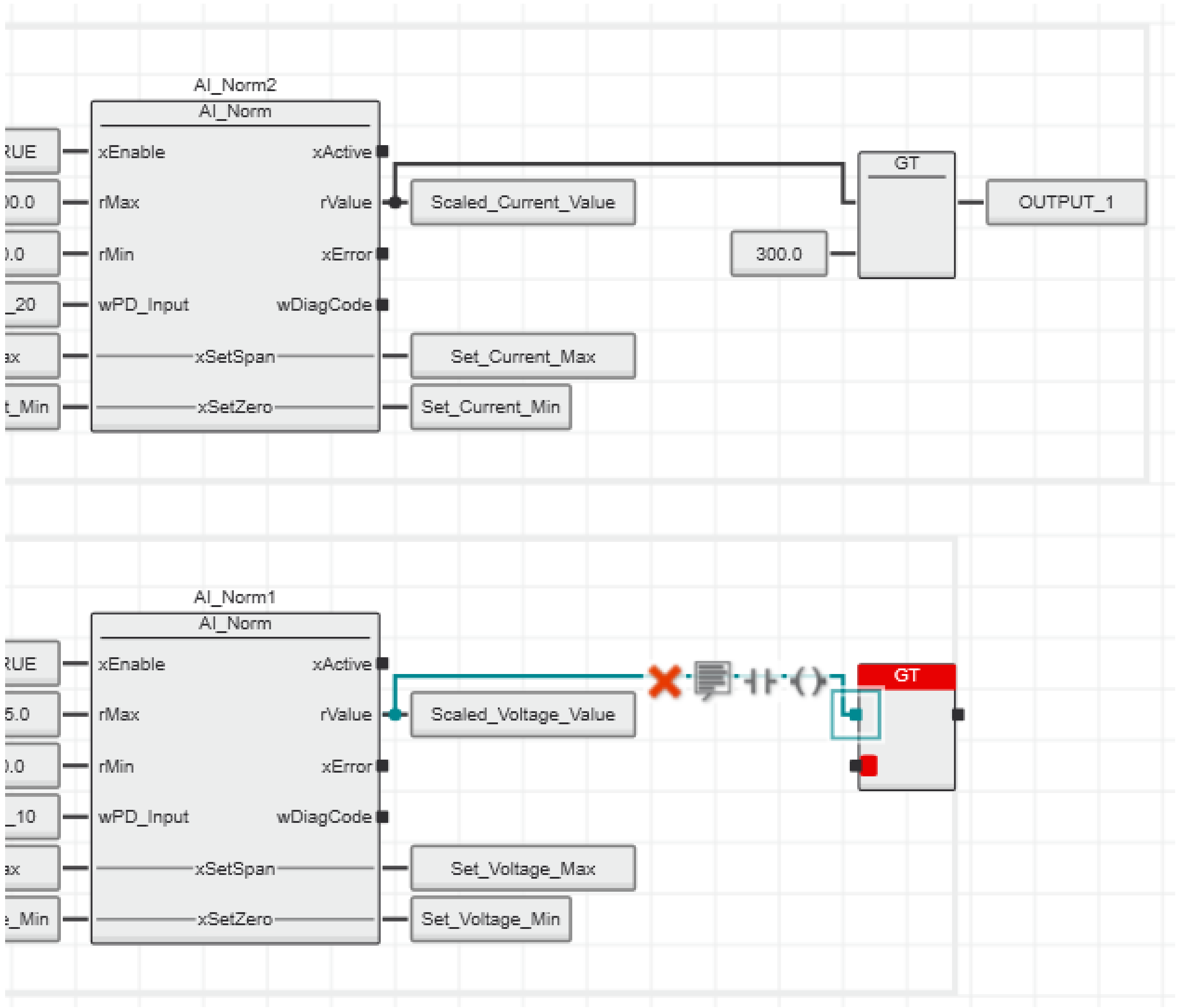
Using a Greater Than comparison function block

- Note I have already done the programming to turn on Output_1 when the Scaled_Current_Value exceeds 300.0 (Gallons per minute)
- Now we will activate another digital output when the Scaled_Voltage_Value exceeds a threshold.
- Repeat the steps that follow to go back and program the Greater Than function block for the Scaled_Current_Value.



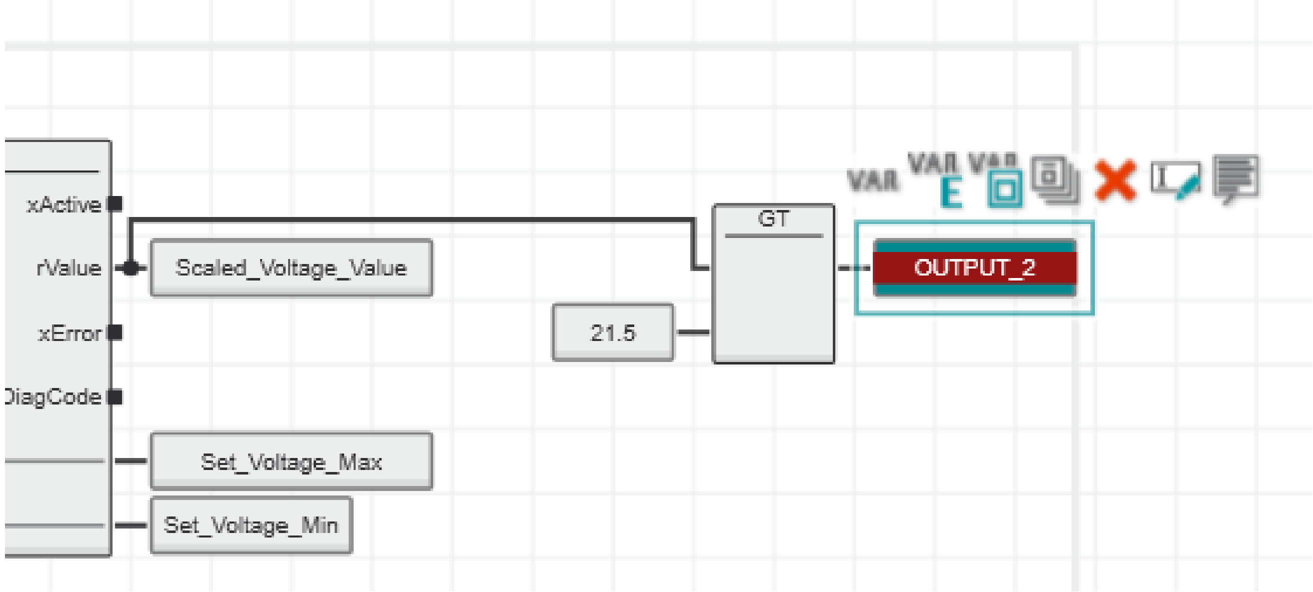
Connecting the GT block to the Scaled_Voltage_Value variable

- Click on the top/left red square of the “GT” function block and drag a line to the “rValue” junction on the AI_Norm1 function block, and release
- Double click on the bottom/left red square of the “GT” function block and type in the threshold value. I will use 21.5 (feet)



Programming Digital I/O

- Double click on the black square on the right side of the “GT” function block and type in a new variable name. I will use “OUTPUT_2”
- Click on this new variable and then select “VAR E” from the menu directly above to make this an external variable.
- Now we will need to link this newly created variable to a real physical output on the PLCnext controller



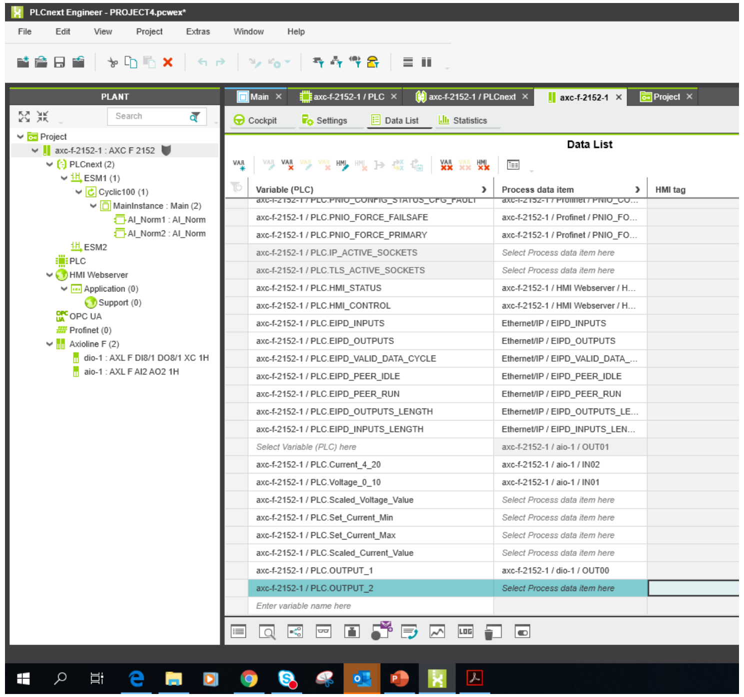
Linking a variable to a real I/O point on the PLCnext controller

Double click on “axc-f-2152 – 1 : AXC-F-2152” below “Project” in the PLANT section.

- Click on the “Data List” sub tab
- Scroll down to find this newly created variable “OUTPUT_2”
- Click in the box where is says “Select process data item here” next to the newly created variable.
- Choose the Digital Output you want from the drop-down list

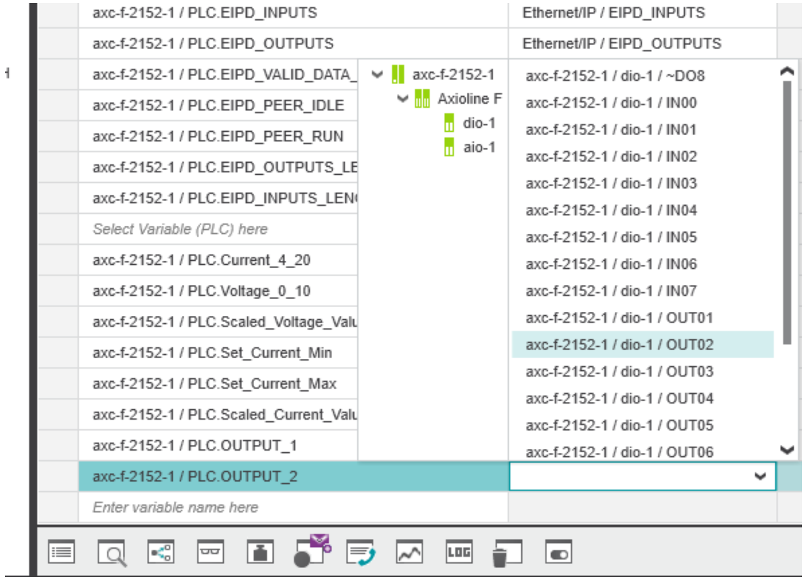
(I’ll pick …OUT2)

Click save to save the project



Data List

Variable (PLC)	Process data item	HMI tag
axc-f-2152-1 / PLC.PNIO_CONFIG_STATUS_CFG_FAULT	axc-f-2152-1 / Profinet / PNIO_CO...	
axc-f-2152-1 / PLC.PNIO_FORCE_FAILSAFE	axc-f-2152-1 / Profinet / PNIO_FO...	
axc-f-2152-1 / PLC.PNIO_FORCE_PRIMARY	axc-f-2152-1 / Profinet / PNIO_FO...	
axc-f-2152-1 / PLC.IP_ACTIVE_SOCKETS	Select Process data item here	
axc-f-2152-1 / PLC.TLS_ACTIVE_SOCKETS	Select Process data item here	
axc-f-2152-1 / PLC.HMI_STATUS	axc-f-2152-1 / HMI Webserver / H...	
axc-f-2152-1 / PLC.HMI_CONTROL	axc-f-2152-1 / HMI Webserver / H...	
axc-f-2152-1 / PLC.EIPD_INPUTS	Ethernet/IP / EIPD_INPUTS	
axc-f-2152-1 / PLC.EIPD_OUTPUTS	Ethernet/IP / EIPD_OUTPUTS	
axc-f-2152-1 / PLC.EIPD_VALID_DATA_CYCLE	Ethernet/IP / EIPD_VALID_DATA_...	
axc-f-2152-1 / PLC.EIPD_PEER_IDLE	Ethernet/IP / EIPD_PEER_IDLE	
axc-f-2152-1 / PLC.EIPD_PEER_RUN	Ethernet/IP / EIPD_PEER_RUN	
axc-f-2152-1 / PLC.EIPD_OUTPUTS_LENGTH	Ethernet/IP / EIPD_OUTPUTS_LE...	
axc-f-2152-1 / PLC.EIPD_INPUTS_LENGTH	Ethernet/IP / EIPD_INPUTS_LEN...	
Select Variable (PLC) here	axc-f-2152-1 / aio-1 / OUT01	
axc-f-2152-1 / PLC.Current_4_20	axc-f-2152-1 / aio-1 / IN02	
axc-f-2152-1 / PLC.Voltage_0_10	axc-f-2152-1 / aio-1 / IN01	
axc-f-2152-1 / PLC.Scaled_Voltage_Value	Select Process data item here	
axc-f-2152-1 / PLC.Set_Current_Min	Select Process data item here	
axc-f-2152-1 / PLC.Set_Current_Max	Select Process data item here	
axc-f-2152-1 / PLC.Scaled_Current_Value	Select Process data item here	
axc-f-2152-1 / PLC.OUTPUT_1	axc-f-2152-1 / dio-1 / OUT00	
axc-f-2152-1 / PLC.OUTPUT_2	Select Process data item here	
Enter variable name here		



axc-f-2152-1 / PLC.EIPD_INPUTS	Ethernet/IP / EIPD_INPUTS
axc-f-2152-1 / PLC.EIPD_OUTPUTS	Ethernet/IP / EIPD_OUTPUTS
axc-f-2152-1 / PLC.EIPD_VALID_DATA_	
axc-f-2152-1 / PLC.EIPD_PEER_IDLE	
axc-f-2152-1 / PLC.EIPD_PEER_RUN	
axc-f-2152-1 / PLC.EIPD_OUTPUTS_LE	
axc-f-2152-1 / PLC.EIPD_INPUTS_LEN	
Select Variable (PLC) here	
axc-f-2152-1 / PLC.Current_4_20	
axc-f-2152-1 / PLC.Voltage_0_10	
axc-f-2152-1 / PLC.Scaled_Voltage_Valu	
axc-f-2152-1 / PLC.Set_Current_Min	
axc-f-2152-1 / PLC.Set_Current_Max	
axc-f-2152-1 / PLC.Scaled_Current_Valu	
axc-f-2152-1 / PLC.OUTPUT_1	
axc-f-2152-1 / PLC.OUTPUT_2	
Enter variable name here	

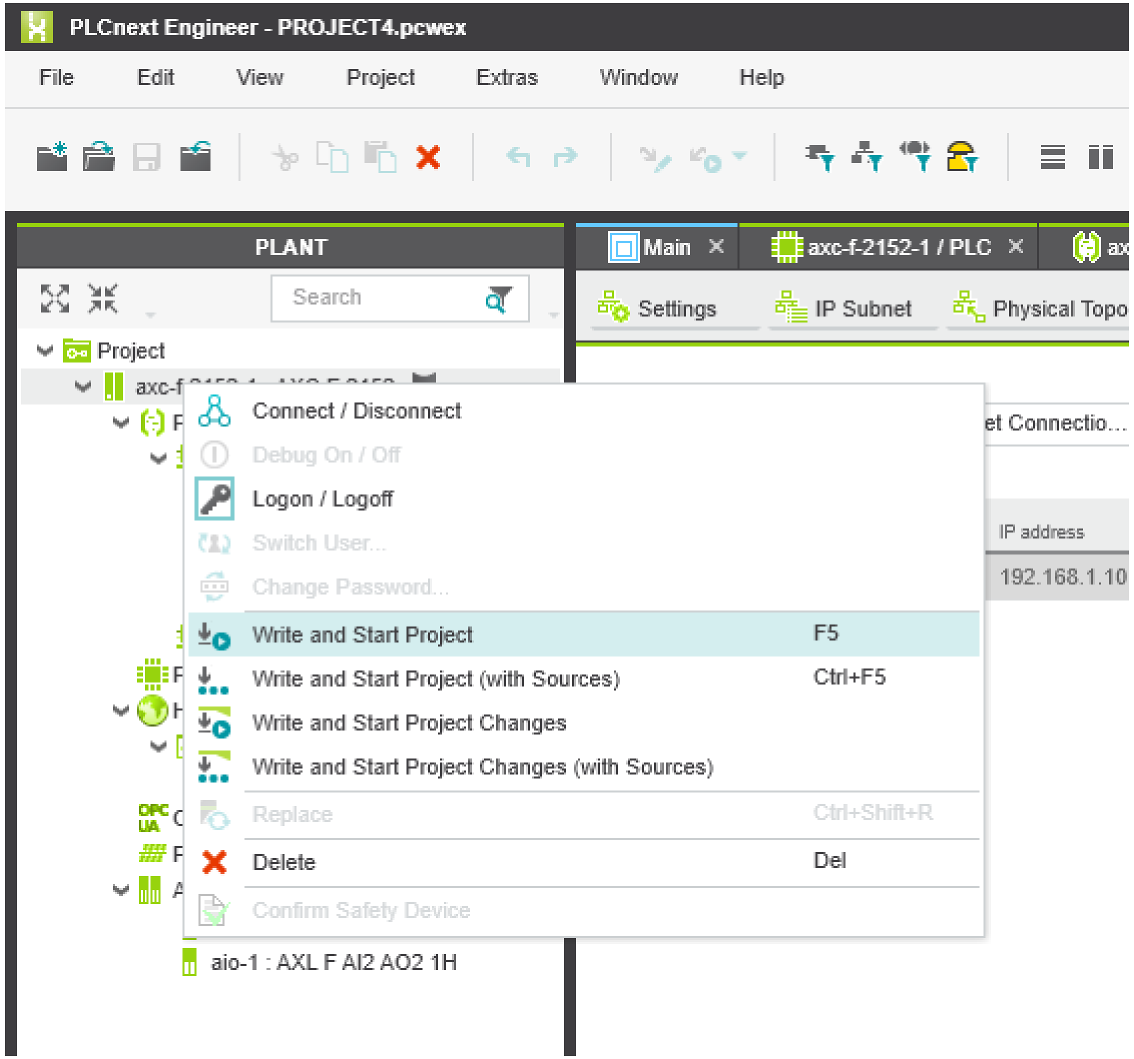
axc-f-2152-1 / dio-1 / ~DO8
axc-f-2152-1 / dio-1 / IN00
axc-f-2152-1 / dio-1 / IN01
axc-f-2152-1 / dio-1 / IN02
axc-f-2152-1 / dio-1 / IN03
axc-f-2152-1 / dio-1 / IN04
axc-f-2152-1 / dio-1 / IN05
axc-f-2152-1 / dio-1 / IN06
axc-f-2152-1 / dio-1 / IN07
axc-f-2152-1 / dio-1 / OUT01
axc-f-2152-1 / dio-1 / OUT02
axc-f-2152-1 / dio-1 / OUT03
axc-f-2152-1 / dio-1 / OUT04
axc-f-2152-1 / dio-1 / OUT05
axc-f-2152-1 / dio-1 / OUT06

Let’s test to see if the program works

Right click on “axc-f-2152 – 1 : AXC-F-2152” below “Project” in the PLANT section.

From the drop-down menu, select “Write and Start Project”

This will send our newly created program to the PLCnext controller and start running the program. It will take a minute or so.



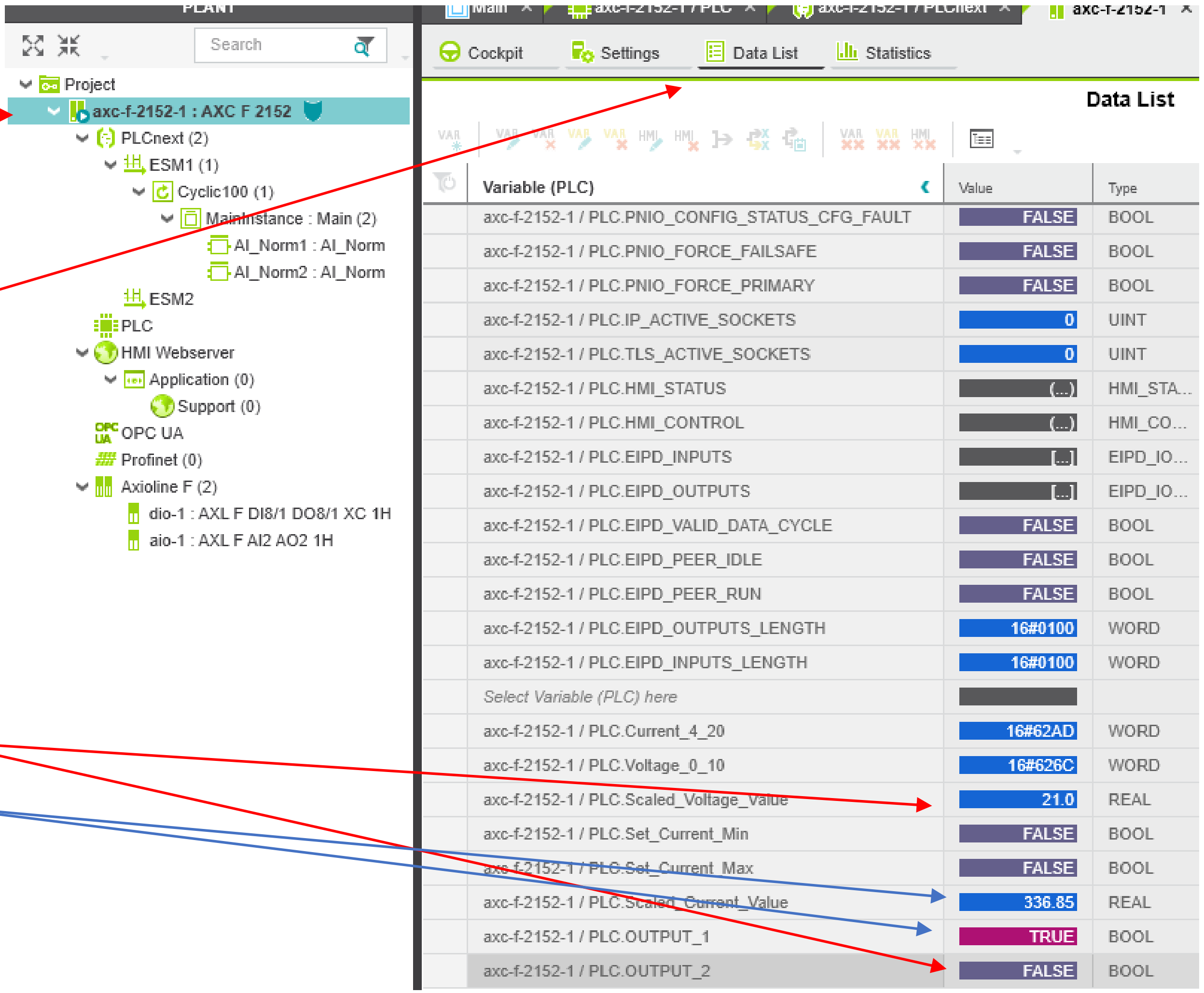
Let’s confirm everything works so far…

- Double click on “axc-f-2152 – 1 : AXC-F-2152” below “Project” in the PLANT section.

- Click on the “Data List” Subtab in the central working space

- You may need to scroll to the bottom to find the scaled analog input variables we recently created

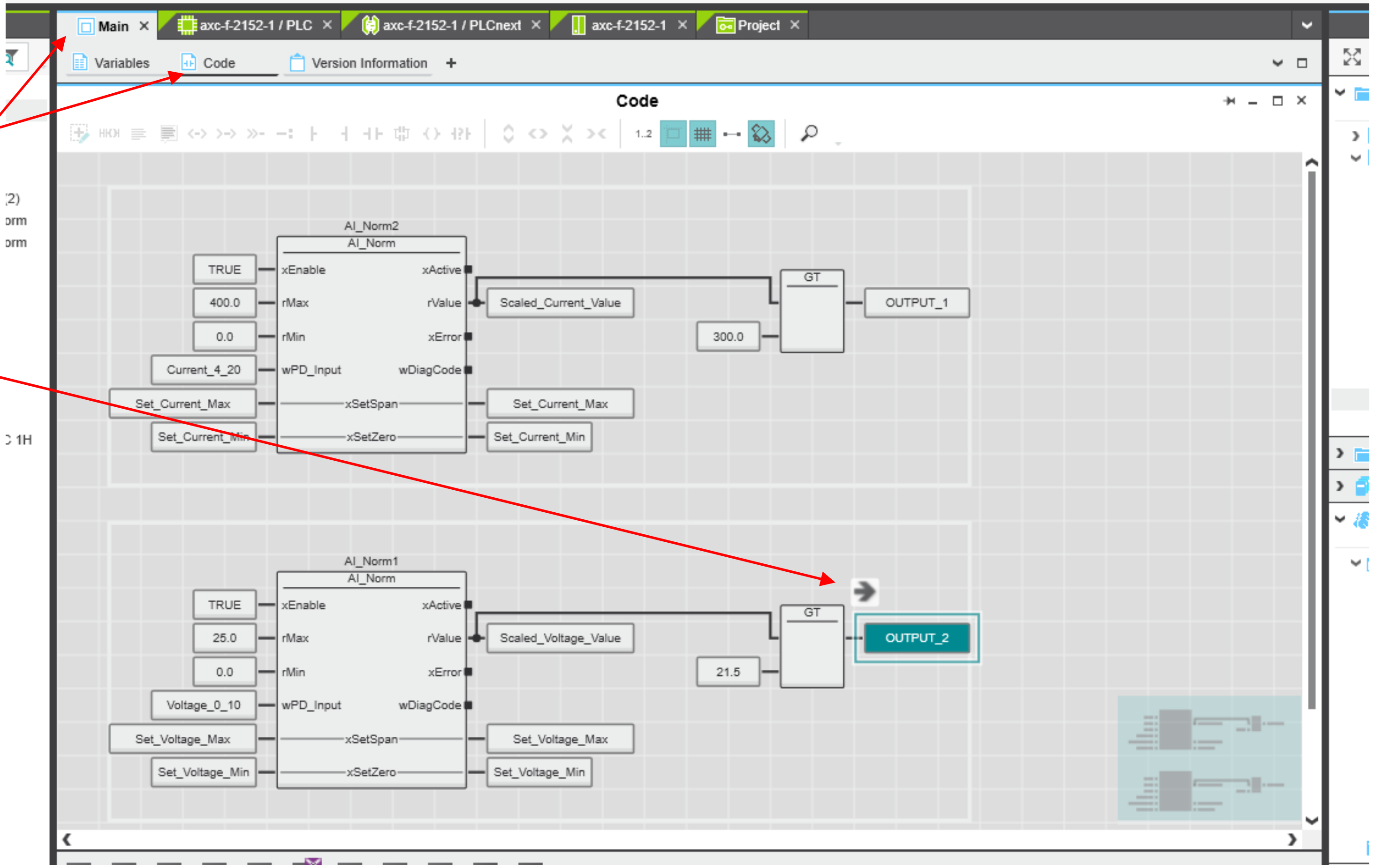
- Twist the knob and verify that Outputs 1 And 2 switch from False to True at the appropriate threshold values.



Variable (PLC)	Value	Type
axc-f-2152-1 / PLC.PNIO_CONFIG_STATUS_CFG_FAULT	FALSE	BOOL
axc-f-2152-1 / PLC.PNIO_FORCE_FAILSAFE	FALSE	BOOL
axc-f-2152-1 / PLC.PNIO_FORCE_PRIMARY	FALSE	BOOL
axc-f-2152-1 / PLC.IP_ACTIVE_SOCKETS	0	UINT
axc-f-2152-1 / PLC.TLS_ACTIVE_SOCKETS	0	UINT
axc-f-2152-1 / PLC.HMI_STATUS	(...)	HMI_STA...
axc-f-2152-1 / PLC.HMI_CONTROL	(...)	HMI_CO...
axc-f-2152-1 / PLC.EIPD_INPUTS	[...]	EIPD_IO...
axc-f-2152-1 / PLC.EIPD_OUTPUTS	[...]	EIPD_IO...
axc-f-2152-1 / PLC.EIPD_VALID_DATA_CYCLE	FALSE	BOOL
axc-f-2152-1 / PLC.EIPD_PEER_IDLE	FALSE	BOOL
axc-f-2152-1 / PLC.EIPD_PEER_RUN	FALSE	BOOL
axc-f-2152-1 / PLC.EIPD_OUTPUTS_LENGTH	16#0100	WORD
axc-f-2152-1 / PLC.EIPD_INPUTS_LENGTH	16#0100	WORD
Select Variable (PLC) here		
axc-f-2152-1 / PLC.Current_4_20	16#62AD	WORD
axc-f-2152-1 / PLC.Voltage_0_10	16#626C	WORD
axc-f-2152-1 / PLC.Scaled_Voltage_Value	21.0	REAL
axc-f-2152-1 / PLC.Set_Current_Min	FALSE	BOOL
axc-f-2152-1 / PLC.Set_Current_Max	FALSE	BOOL
axc-f-2152-1 / PLC.Scaled_Current_Value	336.85	REAL
axc-f-2152-1 / PLC.OUTPUT_1	TRUE	BOOL
axc-f-2152-1 / PLC.OUTPUT_2	FALSE	BOOL

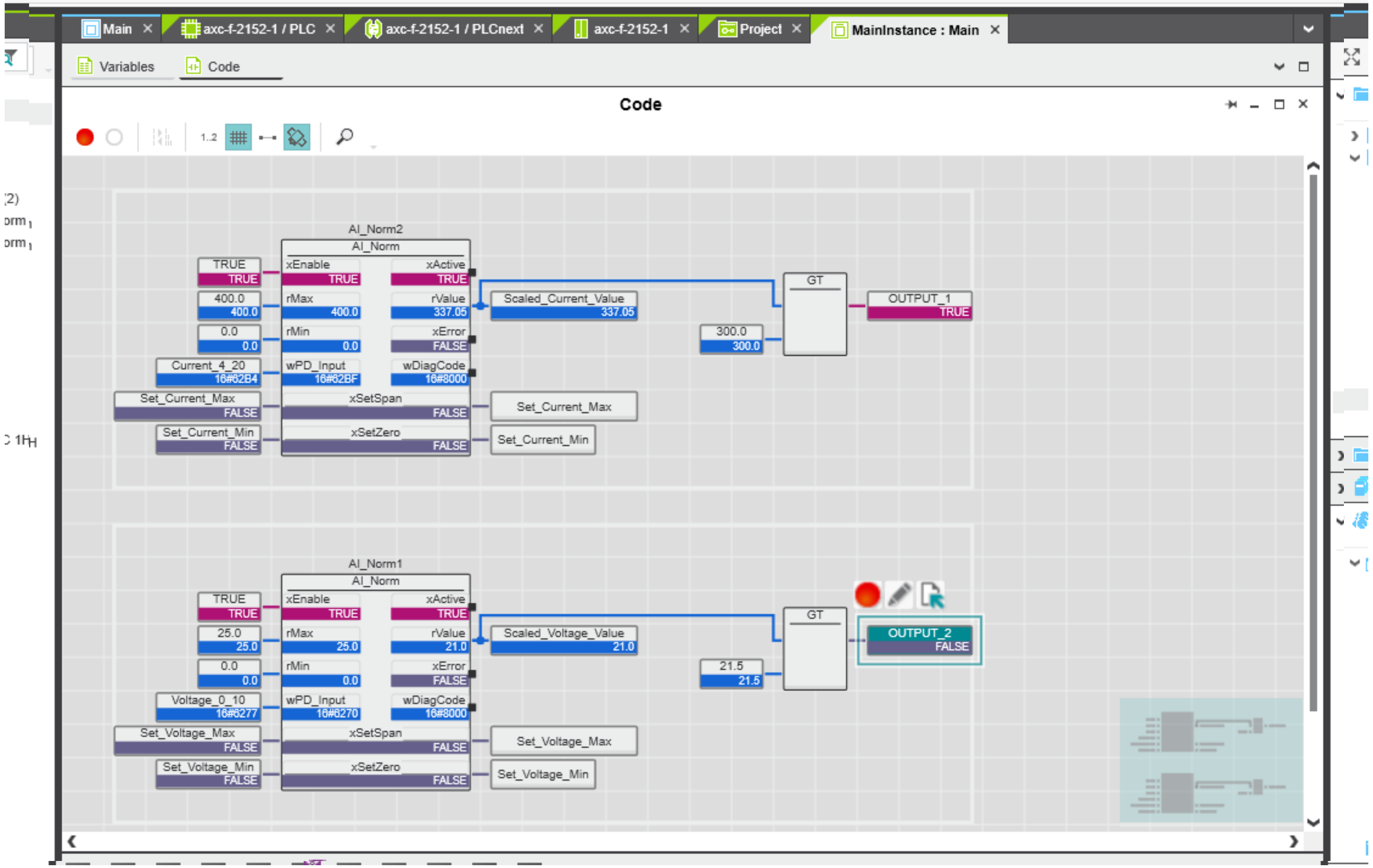
Let’s test to see if the program works

- Switch screens to see an alternate view.
- Go to the “Main” tab, and the “Code” sub tab.
- Click on the arrow to sync the programming environment with the online execution in the PLCnext controller



Let’s test to see if the program works

- Switch screens to see an alternate view.
- Go to the “Main” tab, and the “Code” sub tab.
- Click on the arrow to sync the programming environment with the online execution in the PLCnext controller.



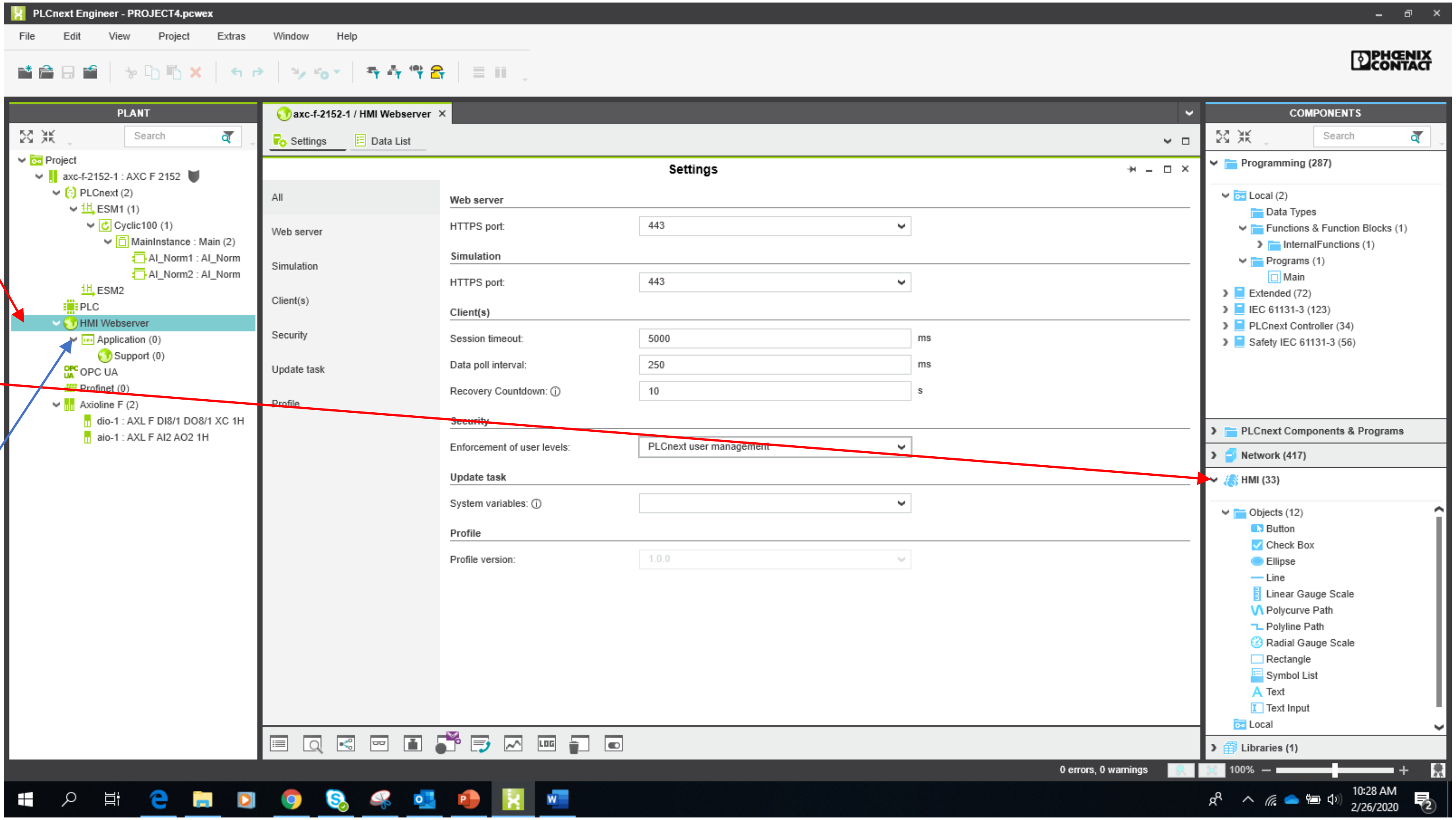
Programming the HMI

PLCnext Engineer has a built-in Human-Machine Interface (HMI) editor. The HMI pages that are created are downloaded onto the PLCnext controller which then serves them in HTML5 format to any connected device with an internet browser.

- Display the web-based HMI pages on
  - Laptop, desktop computer
  - Tablets, smartphones
  - HTML5 capable panel-mounted HMI operator interface screens

Getting started with HMI programming

- Click on “HMI Webserver” in the Project tree in the PLANT section.
- Go to the “HMI” section in the COMPONENTS area and expand the tree.
- Expand “Default” and then “Page templates”
- Find the “Blank Page” template. Drag it and drop it on “Application” in the Project tree in the PLANT area. (See next slide).



PLCnext Engineer - PROJECT4.pcwex

axc-f-2152-1 / HMI Webserver

Settings

Web server
HTTPS port: 443

Simulation
HTTPS port: 443

Client(s)
Session timeout: 5000 ms
Data poll interval: 250 ms
Recovery Countdown: 10 s

Security
Enforcement of user levels: PLCnext user management

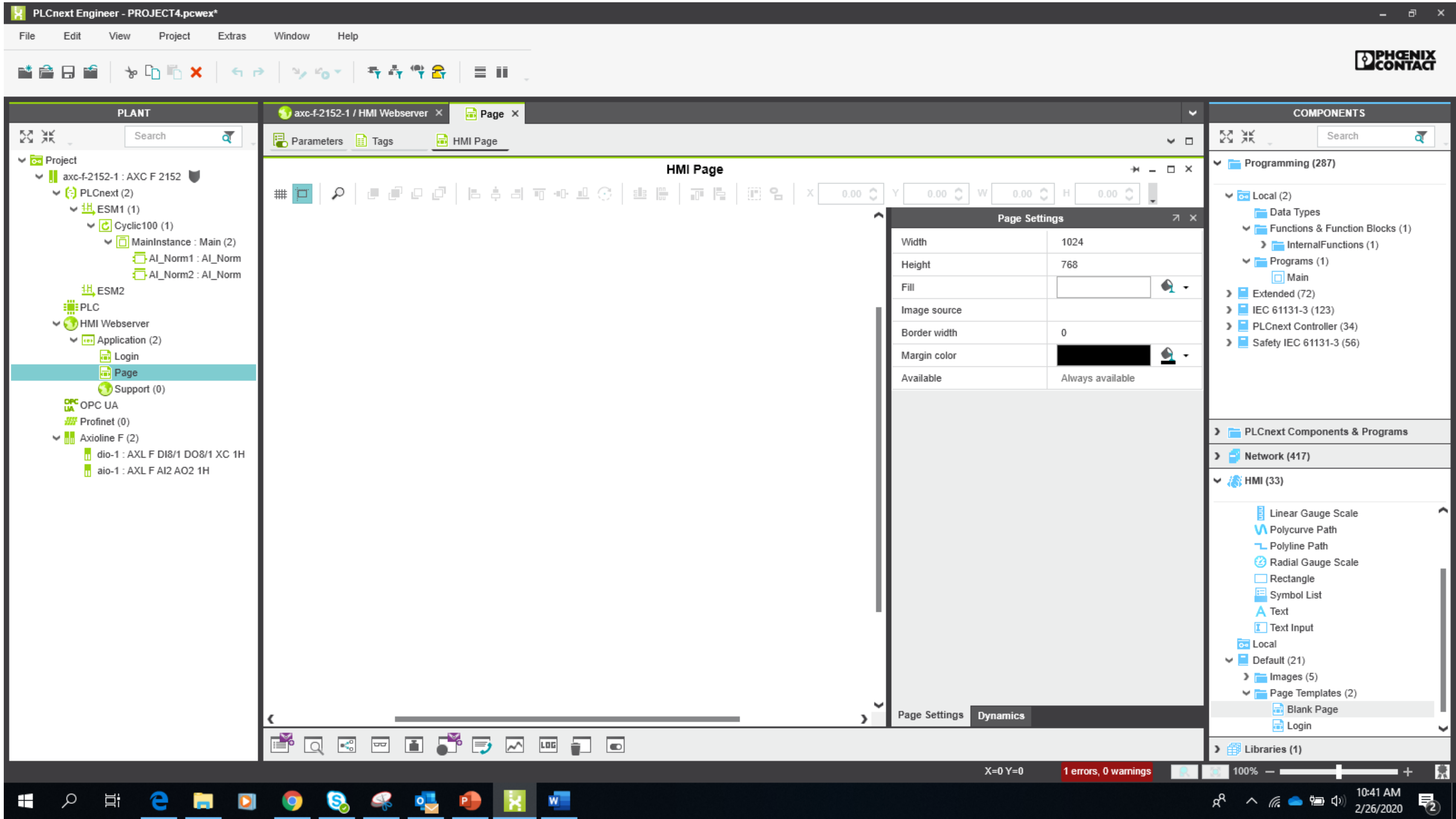
Update task
System variables:

Profile
Profile version: 1.0.0

0 errors, 0 warnings

Ready to start programming the HMI

You now have a blank page that is ready for objects to be drawn and linked to the program.



PLCnext Engineer - PROJECT4.pcwex*

Page Settings

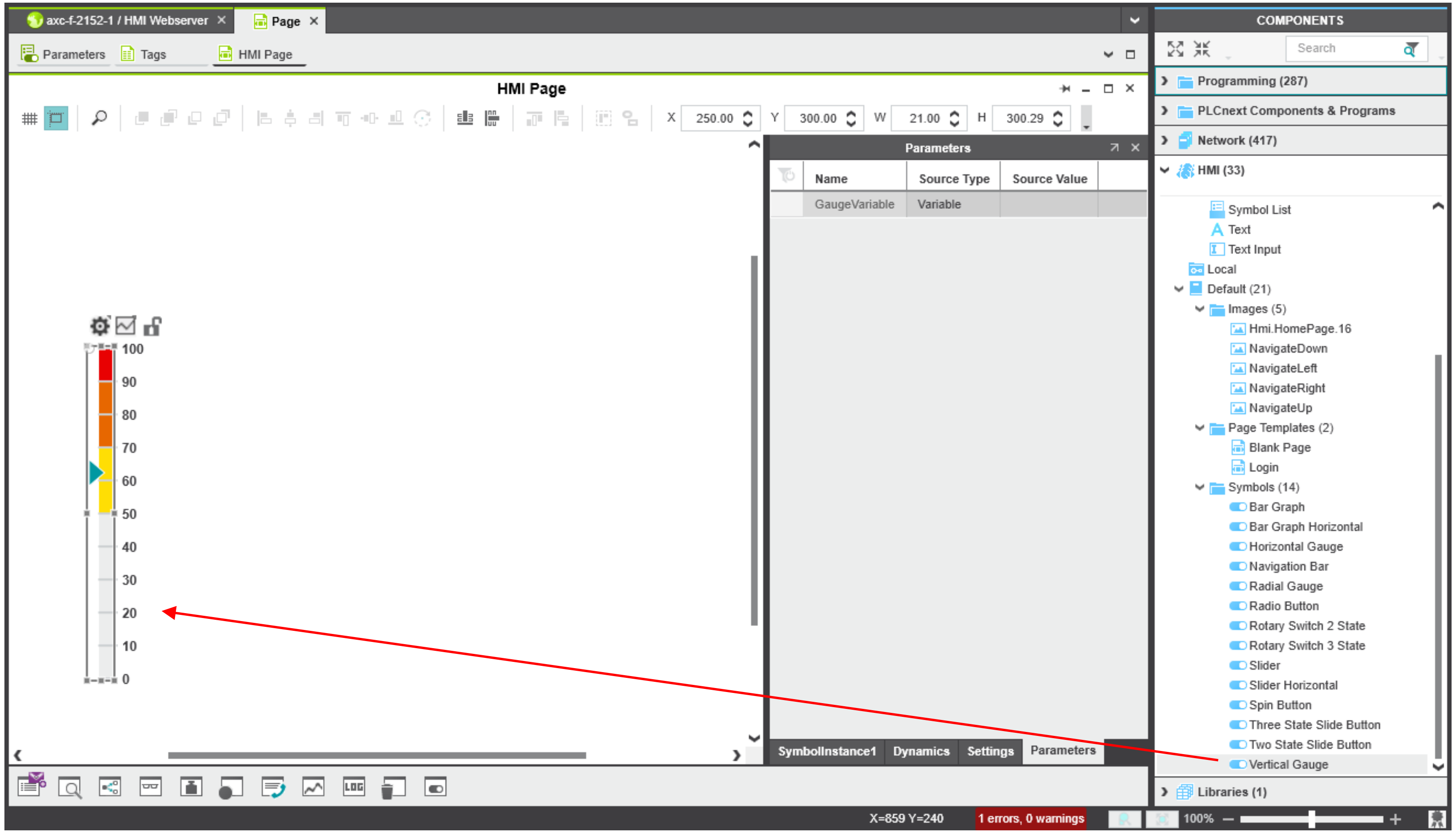
Width	1024
Height	768
Fill	
Image source	
Border width	0
Margin color	
Available	Always available

X=0 Y=0

1 errors, 0 warnings

Adding an object (symbol) to the project

- Since one of our analog inputs is a level sensor, it makes sense to use a vertical gauge as one of our symbols
- Drag and drop the symbol to the workspace



X 250.00 Y 300.00 W 21.00 H 300.29

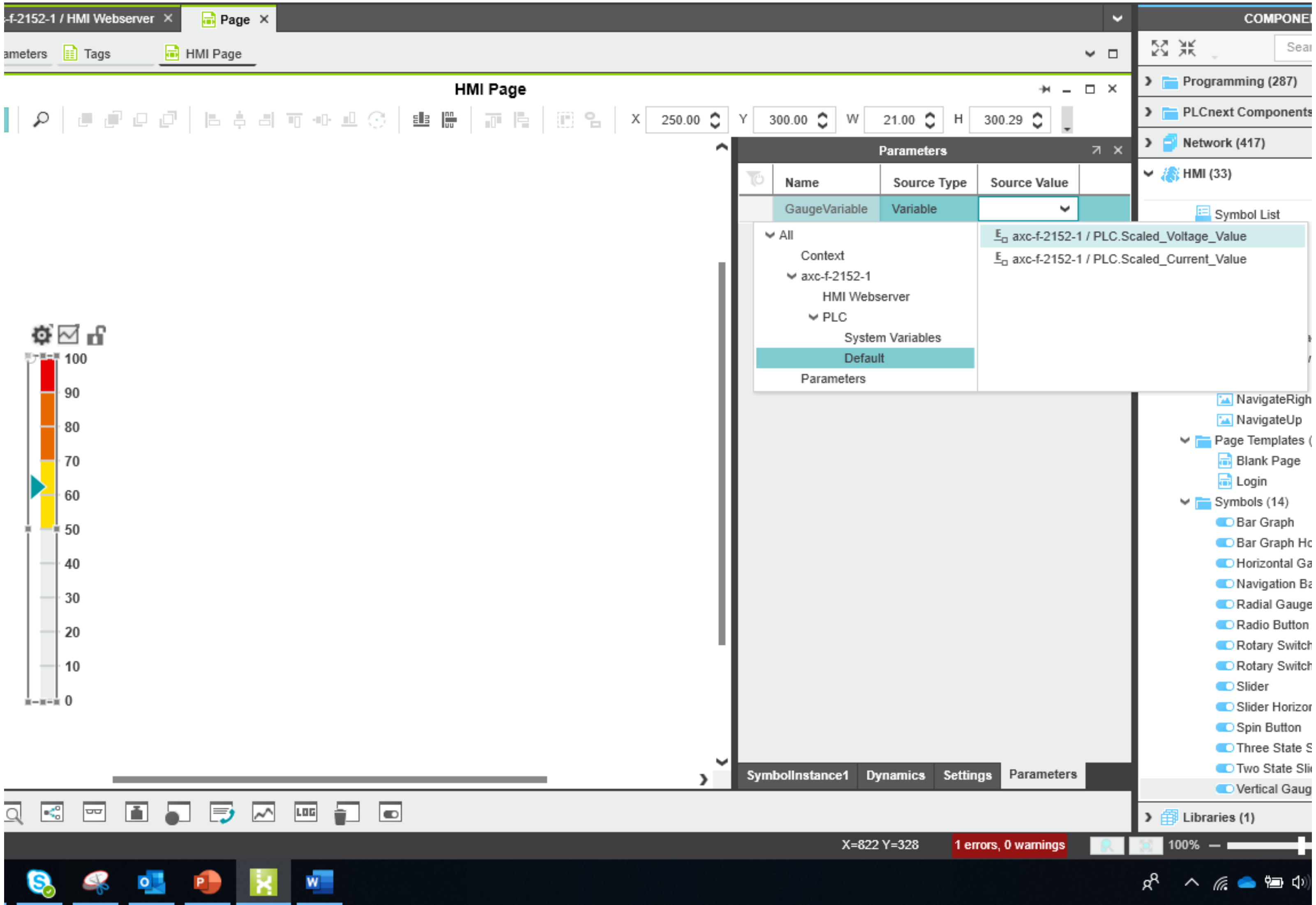
Parameters

Name	Source Type	Source Value
GaugeVariable	Variable	

X=859 Y=240 1 errors, 0 warnings 100%

Programming the HMI

- Click on this symbol so the configuration box displays.
- Click on the “Parameters” tab at the bottom of the configuration box
- Click in the “Source Value” box
- Since “Scaled_Voltage_Value” is the variable that represents level, select it.
- Now click on “Settings” at the bottom of the configuration box.



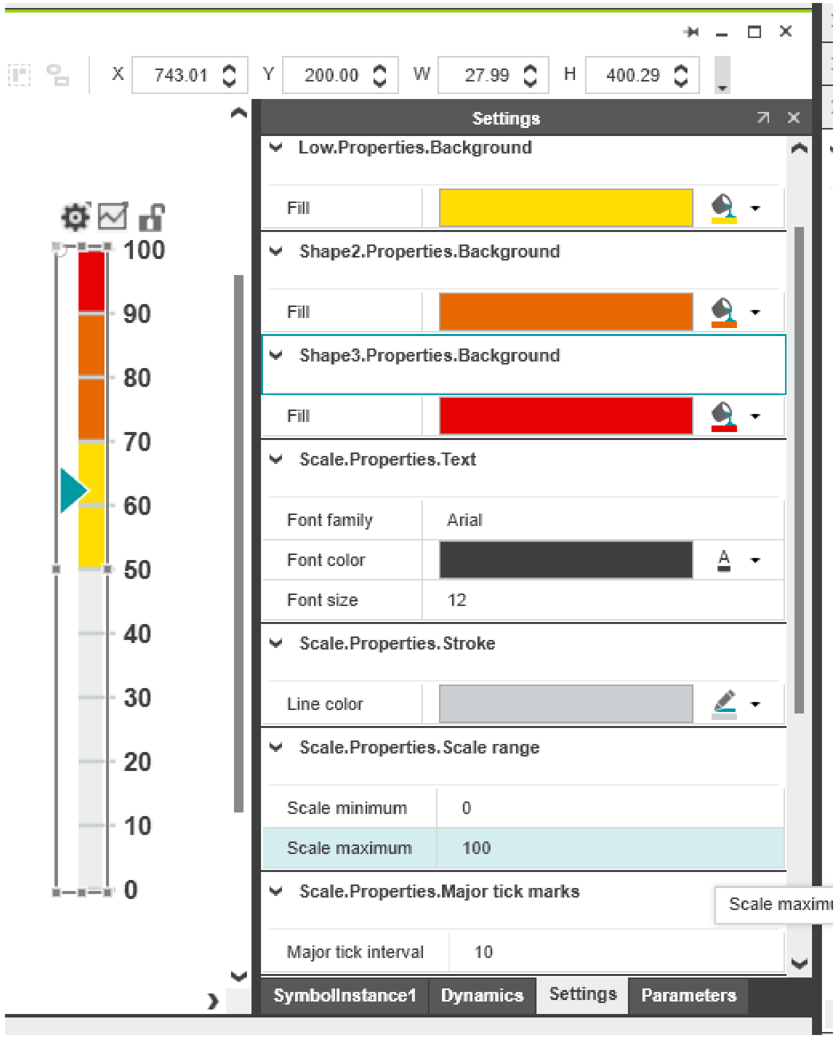
Name	Source Type	Source Value
GaugeVariable	Variable	

axc-f-2152-1 / PLC.Scaled_Voltage_Value

axc-f-2152-1 / PLC.Scaled_Current_Value

Configuring the HMI object

- Change the “Scale.Properties.Scale range” / “Scale maximum” to match (or approximate) the range of the input (which is 0-25 (feet)).
- Scroll down and change “Needle.dynamic.path” to match the value you enter for “scale maximum”.



X 743.01 Y 200.00 W 27.99 H 400.29

Settings

Low.Properties.Background

Fill 🟨

Shape2.Properties.Background

Fill 🟧

Shape3.Properties.Background

Fill 🟥

Scale.Properties.Text

Font family	Arial
Font color	⬛
Font size	12

Scale.Properties.Stroke

Line color ⬜

Scale.Properties.Scale range

Scale minimum	0
Scale maximum	100

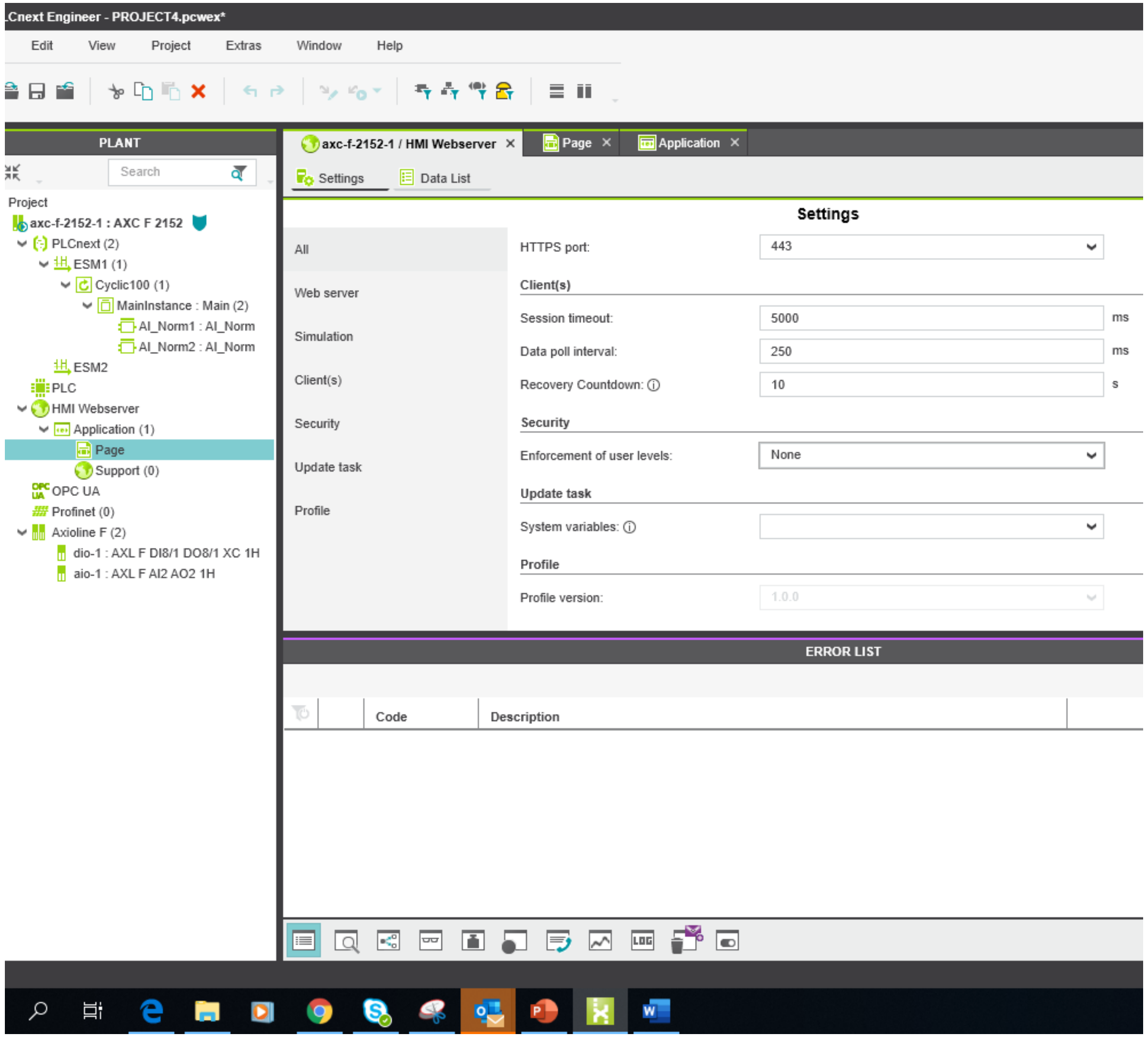
Scale.Properties.Major tick marks

Major tick interval 10

Scale maxim

Disabling security on web-HMI (for demo)

- To avoid the need to add password protection to access the Web HMI, access the tab shown by double clicking on “HMI Webserver” in the Project tree in the PLANT area.
- Select “None” for Enforcement of user levels



Settings

HTTPS port: 443

Client(s)

Session timeout: 5000 ms

Data poll interval: 250 ms

Recovery Countdown: 10 s

Security

Enforcement of user levels: None

Update task

System variables:

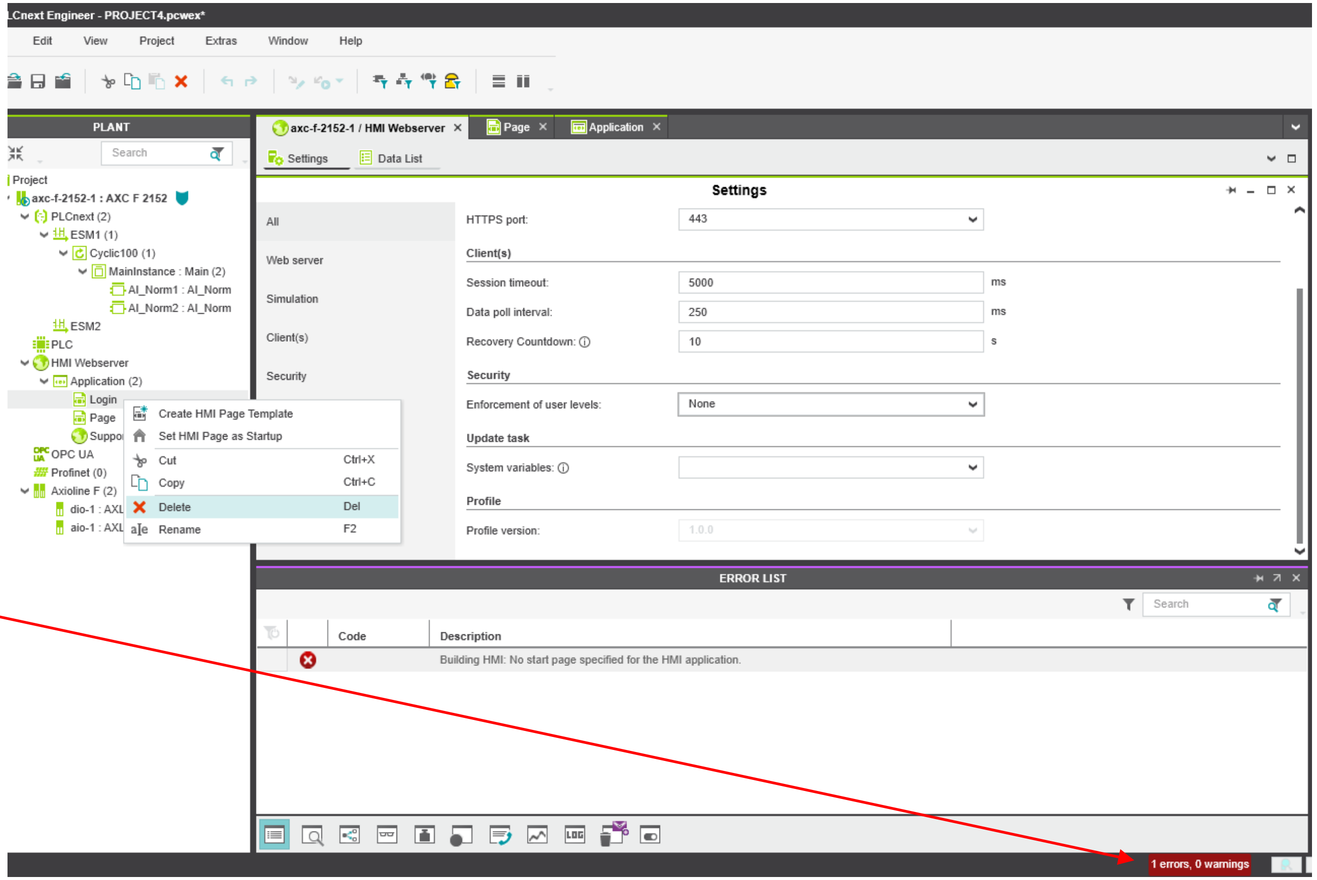
Profile

Profile version: 1.0.0

Code	Description

Simplify the HMI application by eliminating the login provision.

- Right click on the “Login” entry under “Application”
- Select “Delete” from the menu.
- This will remove the need to program the screen to include a sign-on interface, and for the user to log in every time.
- When you delete the “login” page, the error will go away.



Settings

HTTPS port: 443

Client(s)

Session timeout: 5000 ms

Data poll interval: 250 ms

Recovery Countdown: 10 s

Security

Enforcement of user levels: None

Update task

System variables:

Profile

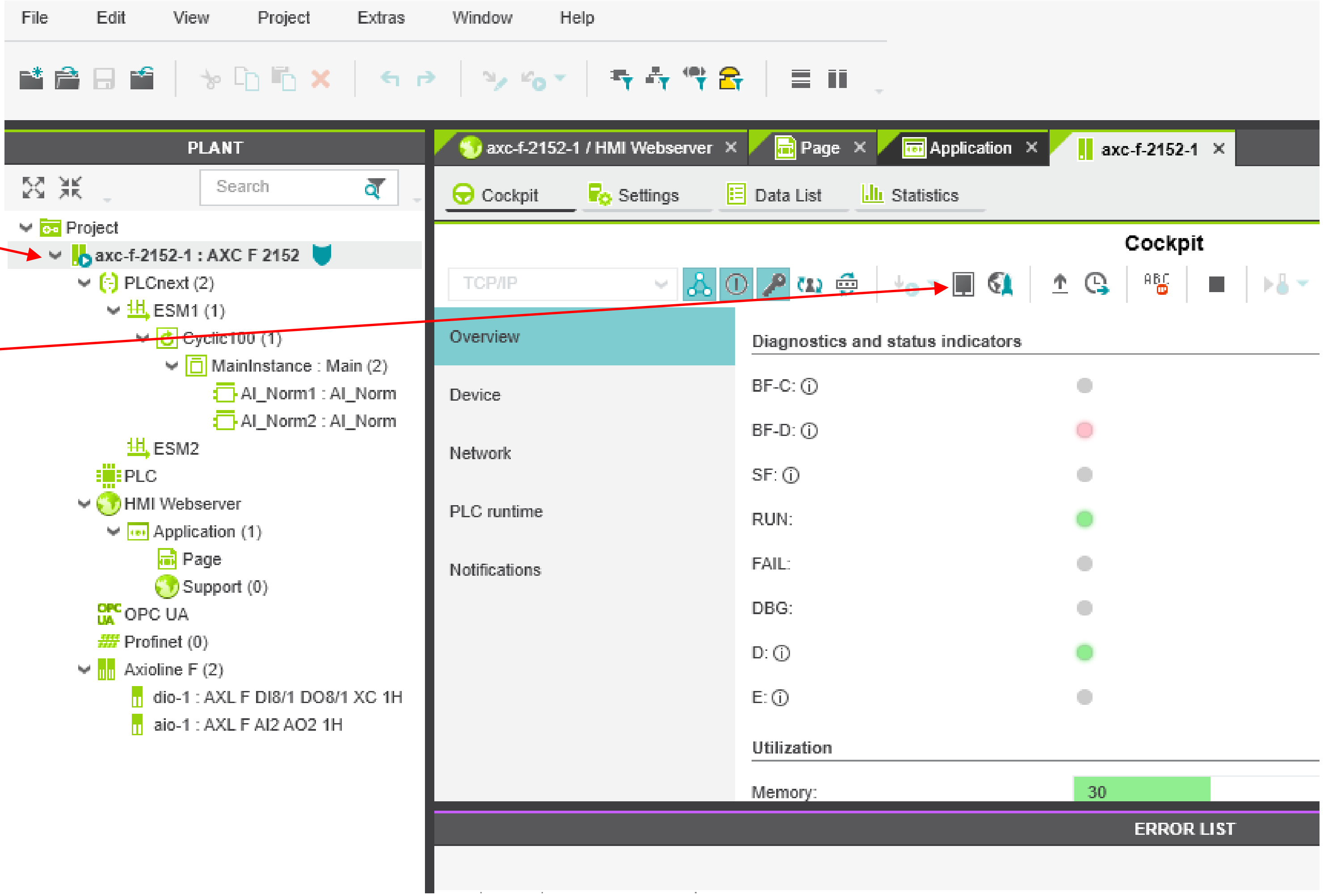
Profile version: 1.0.0

Code	Description
	Building HMI: No start page specified for the HMI application.

1 errors, 0 warnings

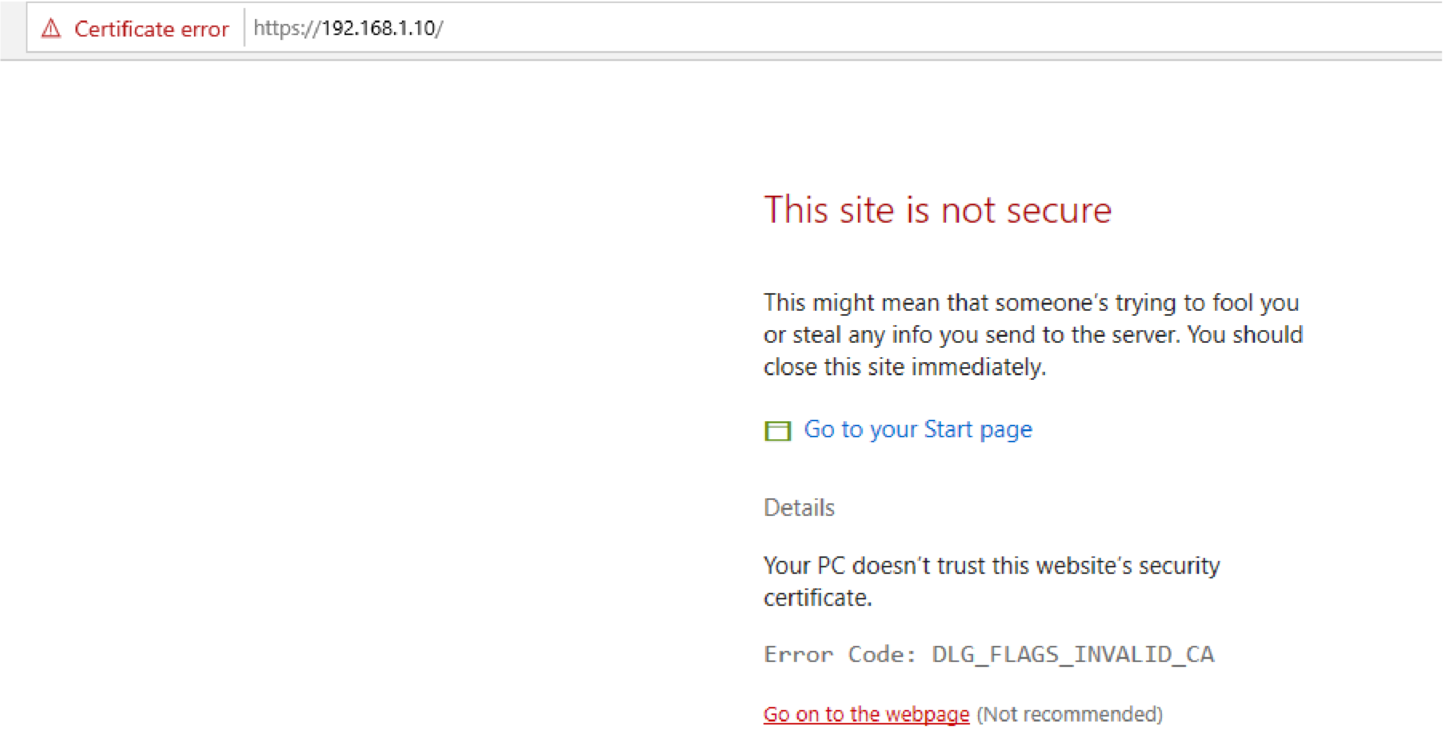
Check out the functioning HMI

- Double click here:
- Click on the “Cockpit” tab.
- Click on the icon that looks like a tablet (to the left of the rocket icon).
- This will launch the default web browser to let you see the “runtime” version of the HMI page we are creating.



View the HMI page, interact with it

- You will likely get an error warning you to avoid this webpage. The “web” page is internal to the PLCnext controller and it is safe.
- Navigate to the page, despite the warning. (This warning screen will look slightly different based on the internet browser being used.



⚠ Certificate error https://192.168.1.10/

This site is not secure

This might mean that someone's trying to fool you or steal any info you send to the server. You should close this site immediately.

Go to your Start page

Details

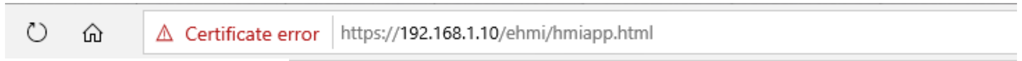
Your PC doesn't trust this website's security certificate.

Error Code: DLG_FLAGS_INVALID_CA

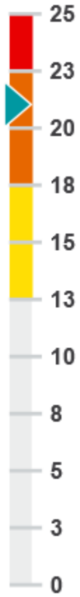
Go on to the webpage (Not recommended)

View the HMI page, interact with it

- You will likely get an error warning you to avoid this webpage. The “web” page is internal to the PLCnext controller and it is safe.
- Navigate to the page, despite the warning. (This warning screen will look slightly different based on the internet browser being used.



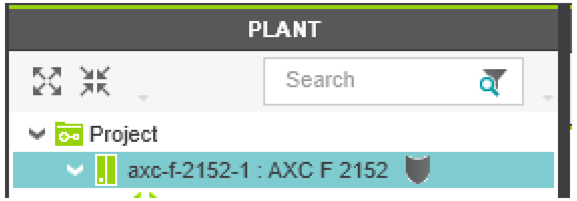
⚠ Certificate error https://192.168.1.10/ehmi/hmiapp.html



Twist the potentiometer now and watch the needle move, corresponding to the analog input representing level!

Get back into the PLCnext Engineer programming environment

- Once you are back in PLCnext Engineer, Right click on



PLANT

Search

Project

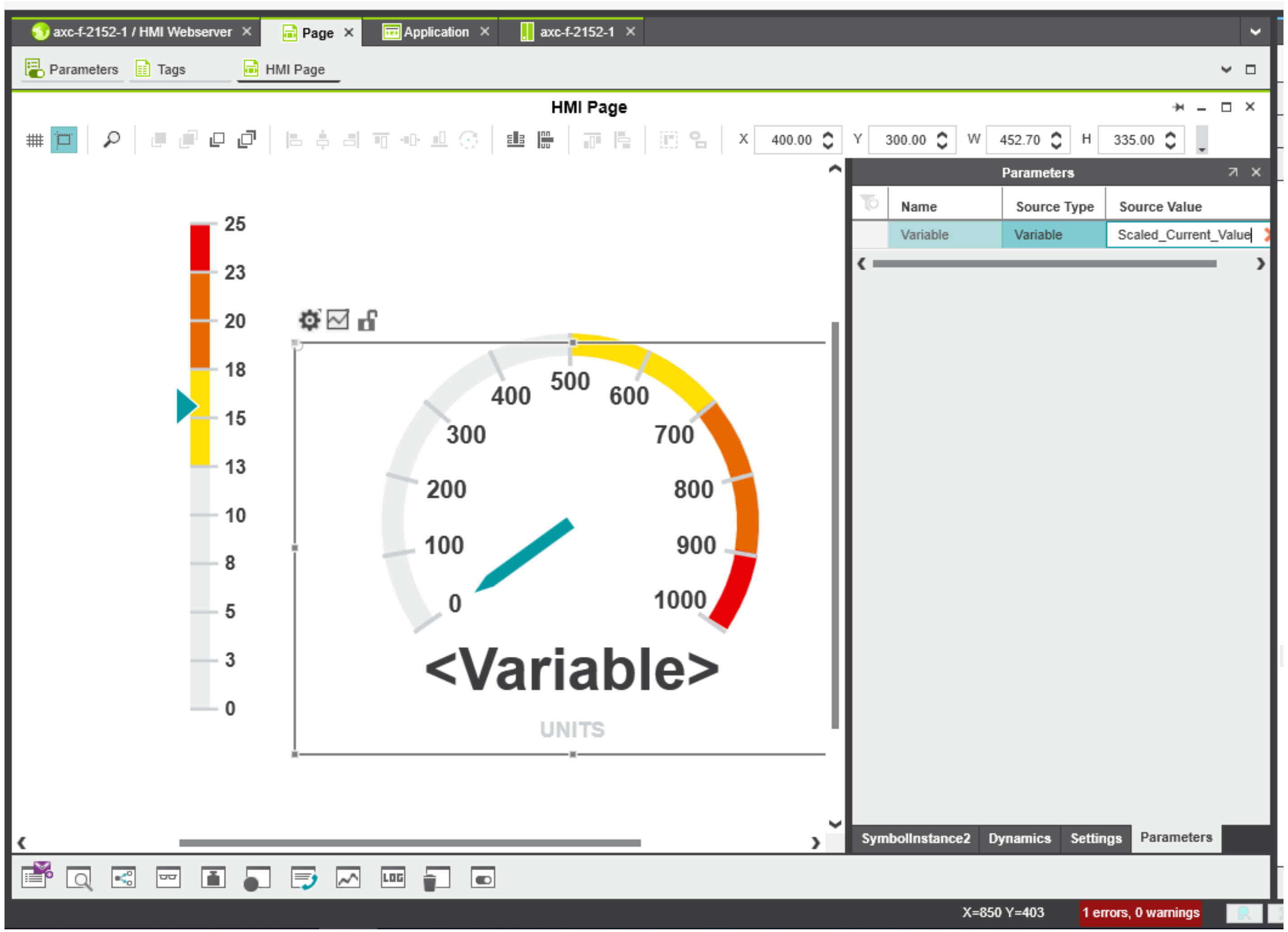
axc-f-2152-1 : AXC F 2152

And disconnect from the PLCnext controller.

- Double click on “Page” on the Project tree in the PLANT area, and make sure the “HMI Page” sub tab is selected.
- You should be back to the HMI development environment as seen on the next slide.

Add another symbol – to represent the other analog input

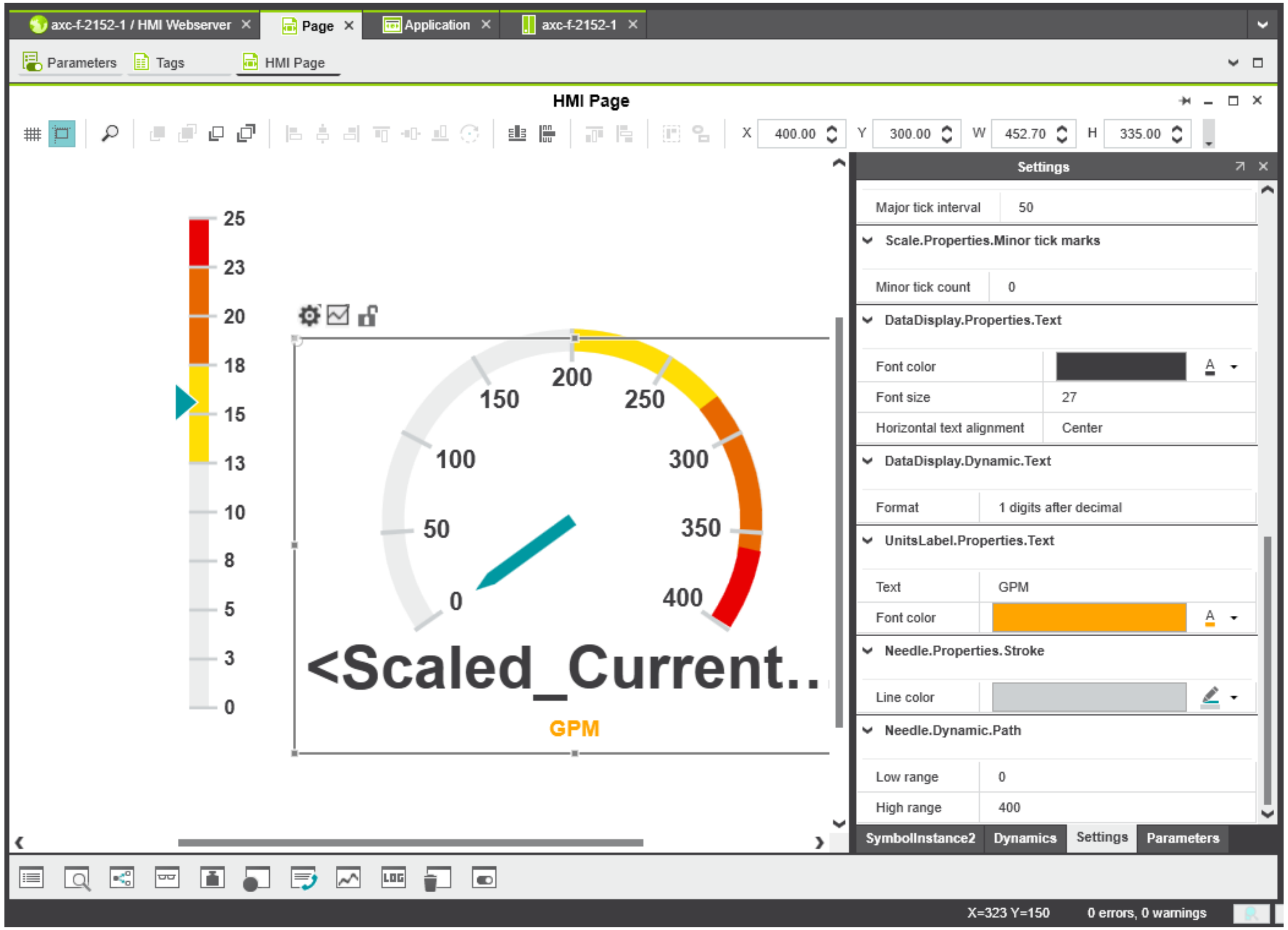
- Since the other analog input represents a flow rate, it makes sense to use an analog dial gauge.
- Use the same process as with the vertical gauge to drag and drop it into the workspace.
- From parameters tab, assign “Scaled_Current_Value” as the variable.
- Using the same methods when configuring the other symbol, configure this gauge.



Name	Source Type	Source Value
Variable	Variable	Scaled_Current_Value

Configuring the rotary gauge HMI object

- Your configuration should look *something* like this.



Settings

Major tick interval 50

Scale.Properties.Minor tick marks

Minor tick count 0

DataDisplay.Properties.Text

Font color

Font size 27

Horizontal text alignment Center

DataDisplay.Dynamic.Text

Format 1 digits after decimal

UnitsLabel.Properties.Text

Text GPM

Font color

Needle.Properties.Stroke

Line color

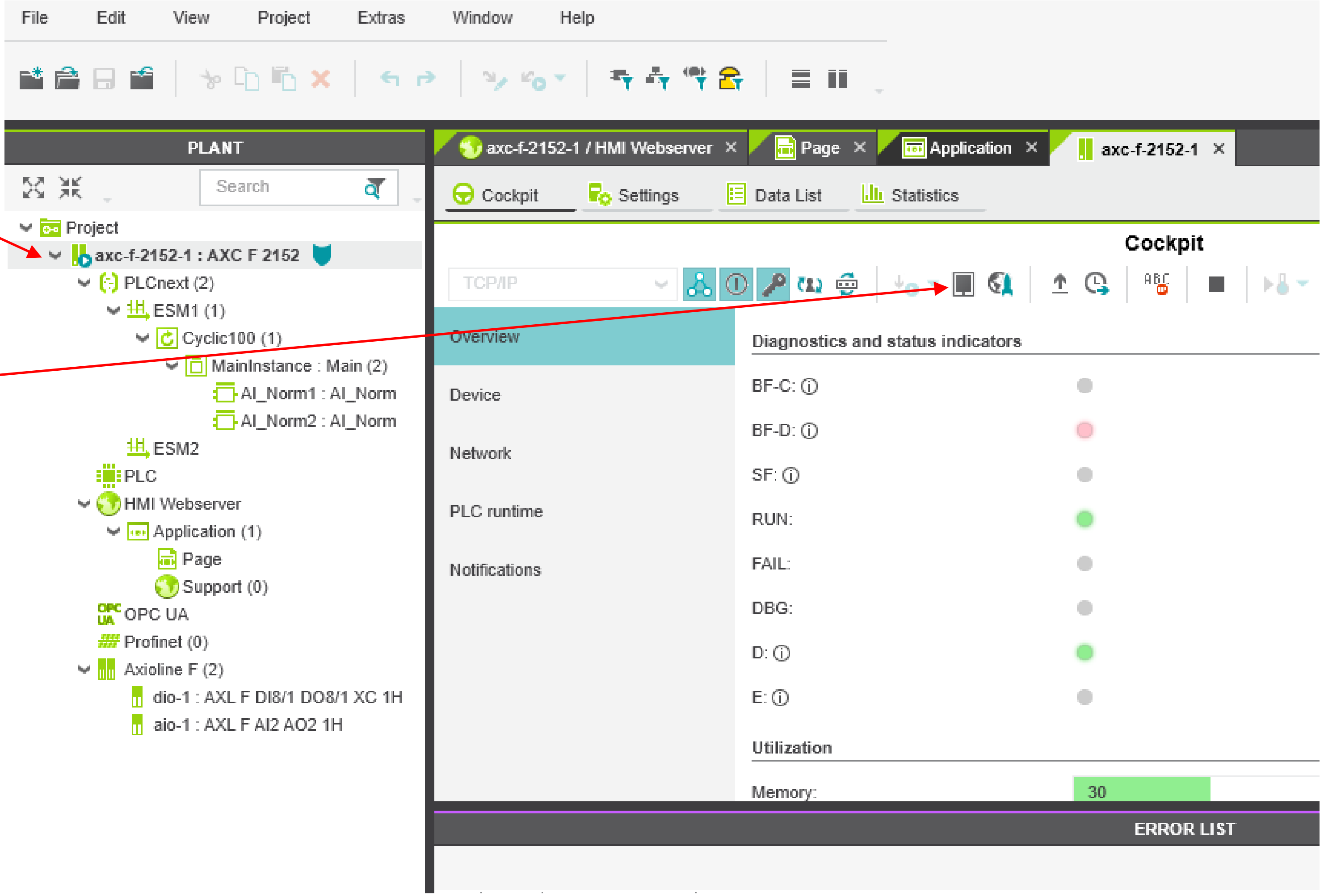
Needle.Dynamic.Path

Low range 0

High range 400

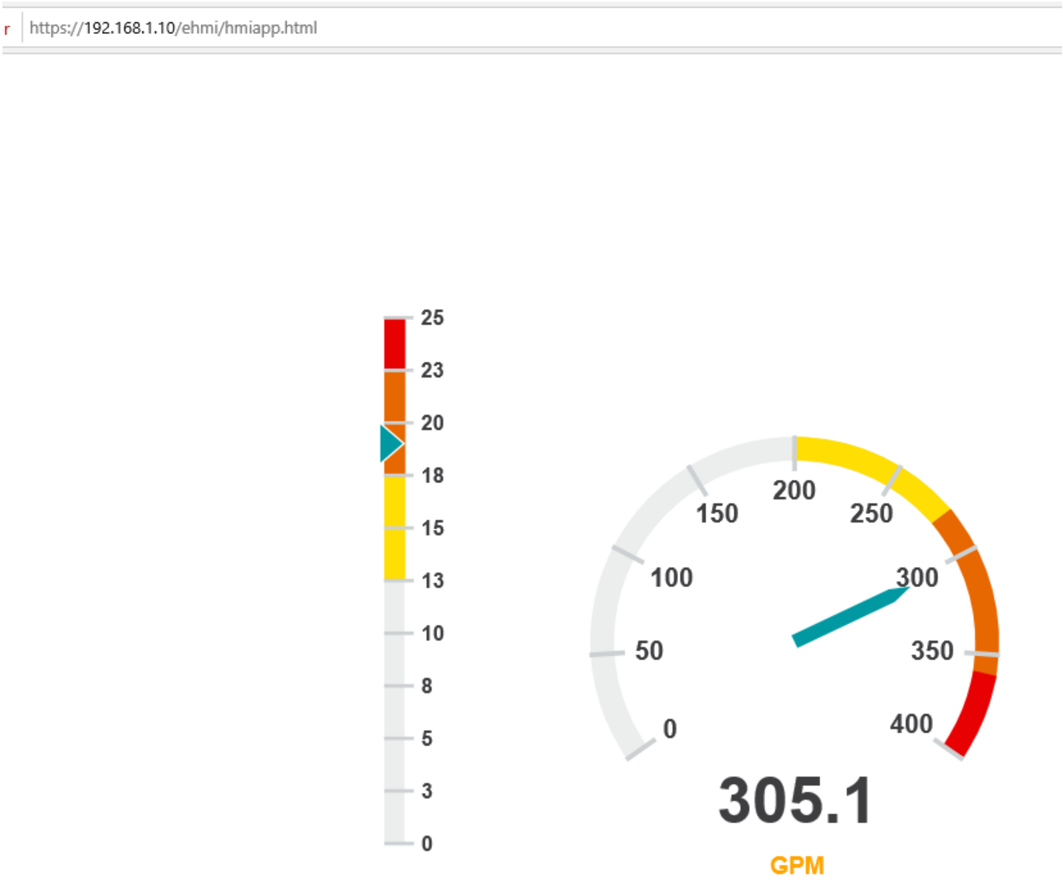
Check out the functioning HMI

- Double click here:
- Click on the “Cockpit” tab.
- Click on the icon that looks like a tablet (to the left of the rocket icon).
- This will launch the default web browser to let you see the “runtime” version of the HMI page we are creating.



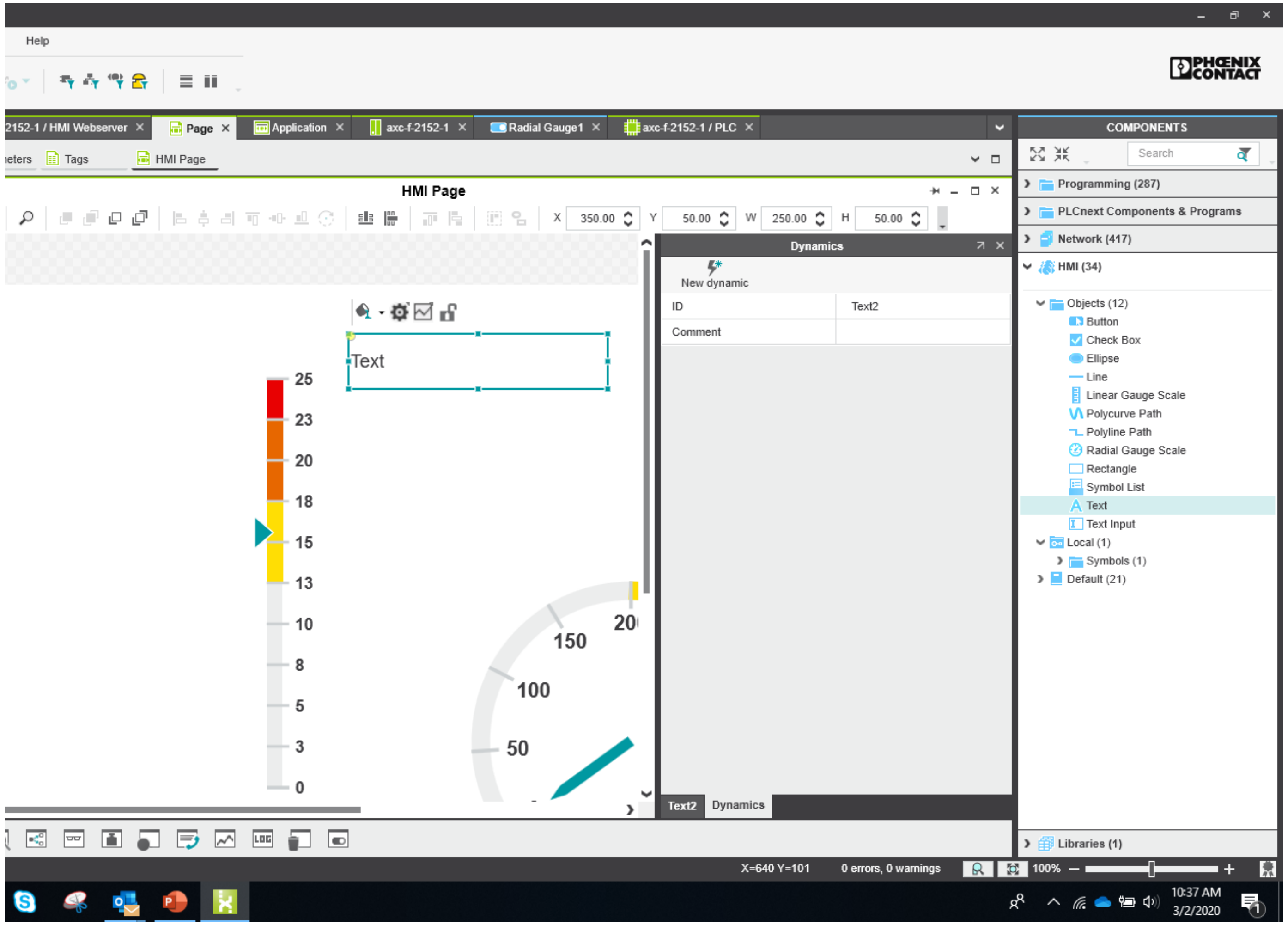
Review the HMI runtime…

- The HMI is displayed as we would expect
- Turn the potentiometer and the level will rise and fall, as the pressure increases and decreases
- Note: the pressure gauge shows the numerical value and the units of measure beneath the gauge. Let’s add these to the vertical gauge.



Adding text to the HMI page

- From the COMPONENTS section, under HMI, click on “Text” and drag it onto the work surface, then release.
- Double click on the object on the screen (textbox with the word “text”)
- The configuration window will appear (as shown).



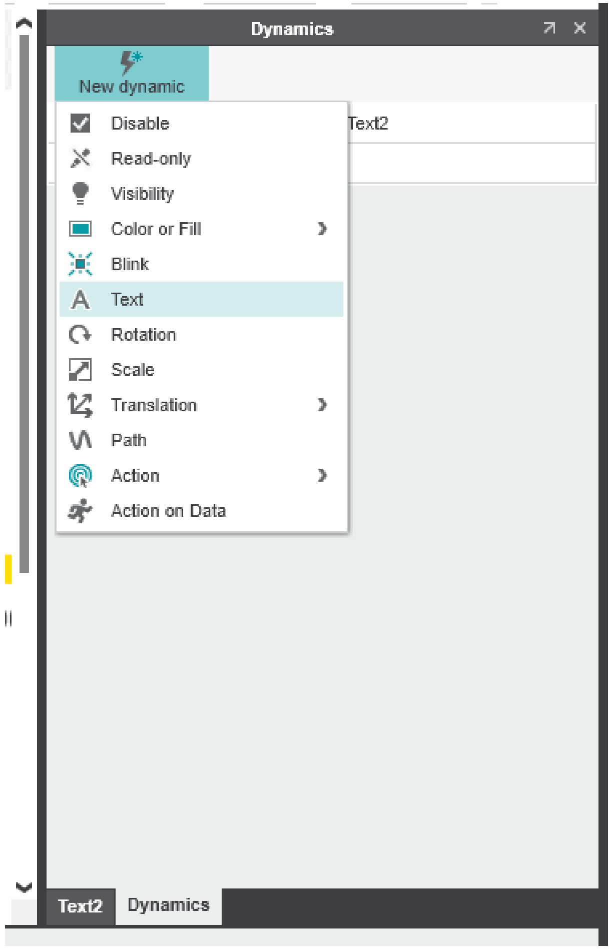
X 350.00 Y 50.00 W 250.00 H 50.00

ID	Text2
Comment	

X=640 Y=101 0 errors, 0 warnings 100%

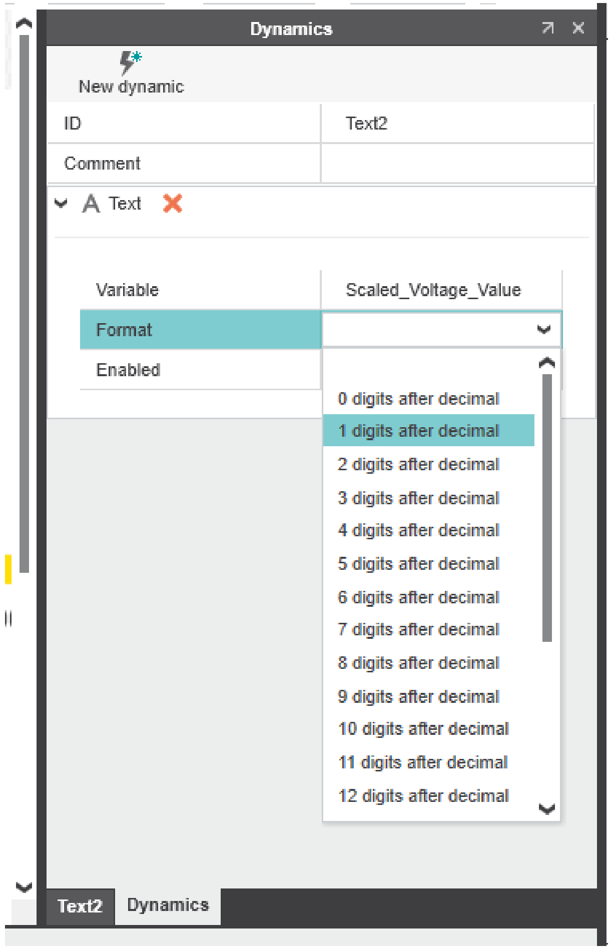
Configuring text dynamics

- In the configuration window, click on the “Dynamics” tab at the bottom.
- Click on “New dynamic” and select “Text” from the drop-down menu.
- Next click next to “variable” and select the “Scaled_Voltage_Value” since that is what will correspond to the gauge’s value. Hit the ENTER key



Configuring text dynamics

- In the configuration window, click on the “Dynamics” tab at the bottom.
- Click on “New dynamic” and select “Text” from the drop-down menu.
- Next click next to “variable” and select the “Scaled_Voltage_Value” since that is what will correspond to the gauge’s value. Hit the ENTER key
- Indicate the number of places after the decimal that you want to display.



Dynamics

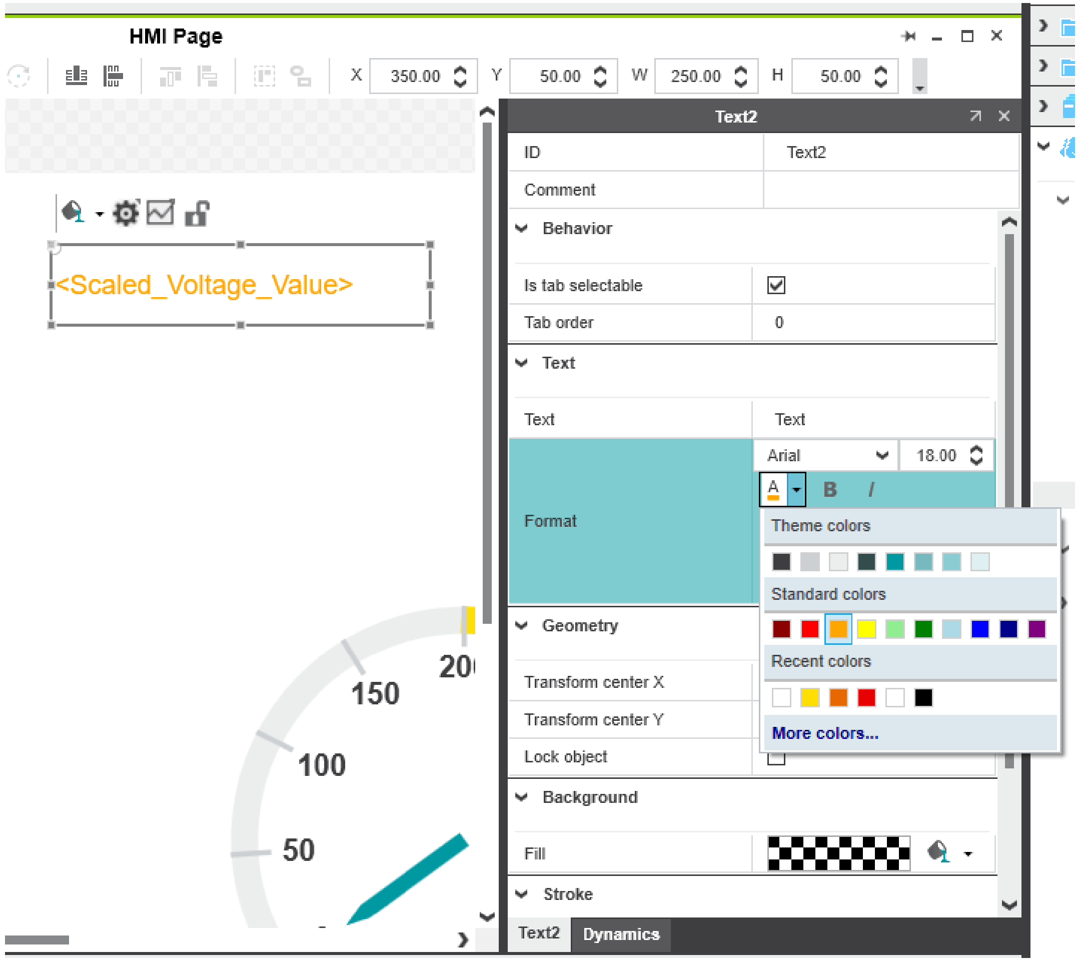
ID	Text2
Comment	

Text

Variable	Scaled_Voltage_Value
Format	
Enabled	

Further configuration of the text object

- Click on the Text tab at the bottom of the configuration window
- Under the “Text” section, click the down arrow near the font style is indicated
- Choose the color of the test to be displayed. I am choosing orange.
- You can change the font size and style here too.
- Click on the object, drag and drop beneath the vertical gauge.
- Save the project.



HMI Page

X 350.00 Y 50.00 W 250.00 H 50.00

<Scaled_Voltage_Value>

Text2

ID	Text2
Comment	

Behavior

Is tab selectable	☑
Tab order	0

Text

Text	Text
Format	Arial 18.00

Geometry

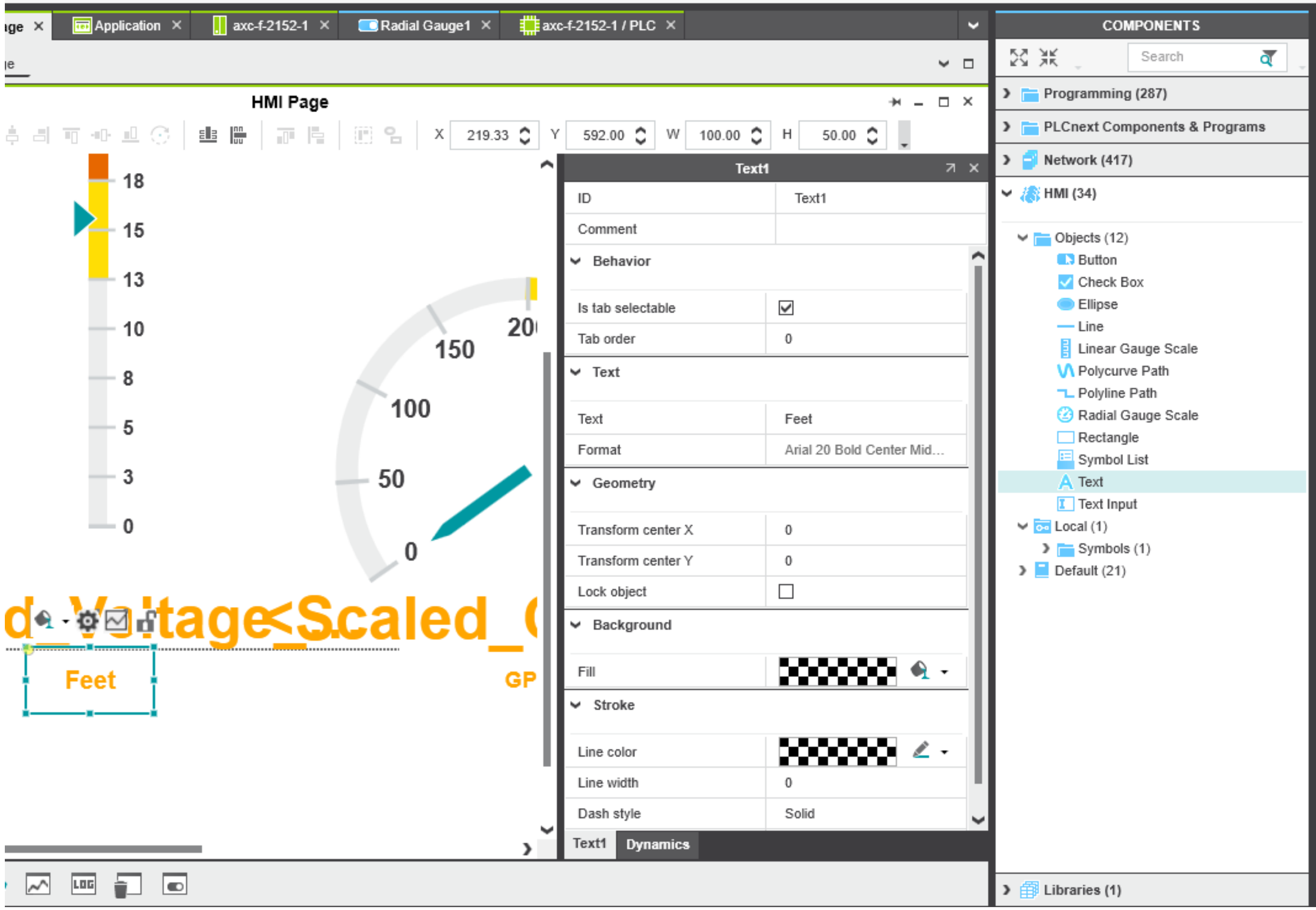
Transform center X	
Transform center Y	
Lock object	□

Background

Fill

Stroke

- Create an object to show the units for this variable.
- Since we are measuring level, something like "Feet" would be good.
- As before, choose "text" from the COMPONENTS section under "HMI"
- Drag and drop it under the last object, and enter the text "Feet" that you want to display
- Alter the text to your liking (color, size, font, etc.)
- Save the project, download to the PLCnext controller, and open the webpage to view.

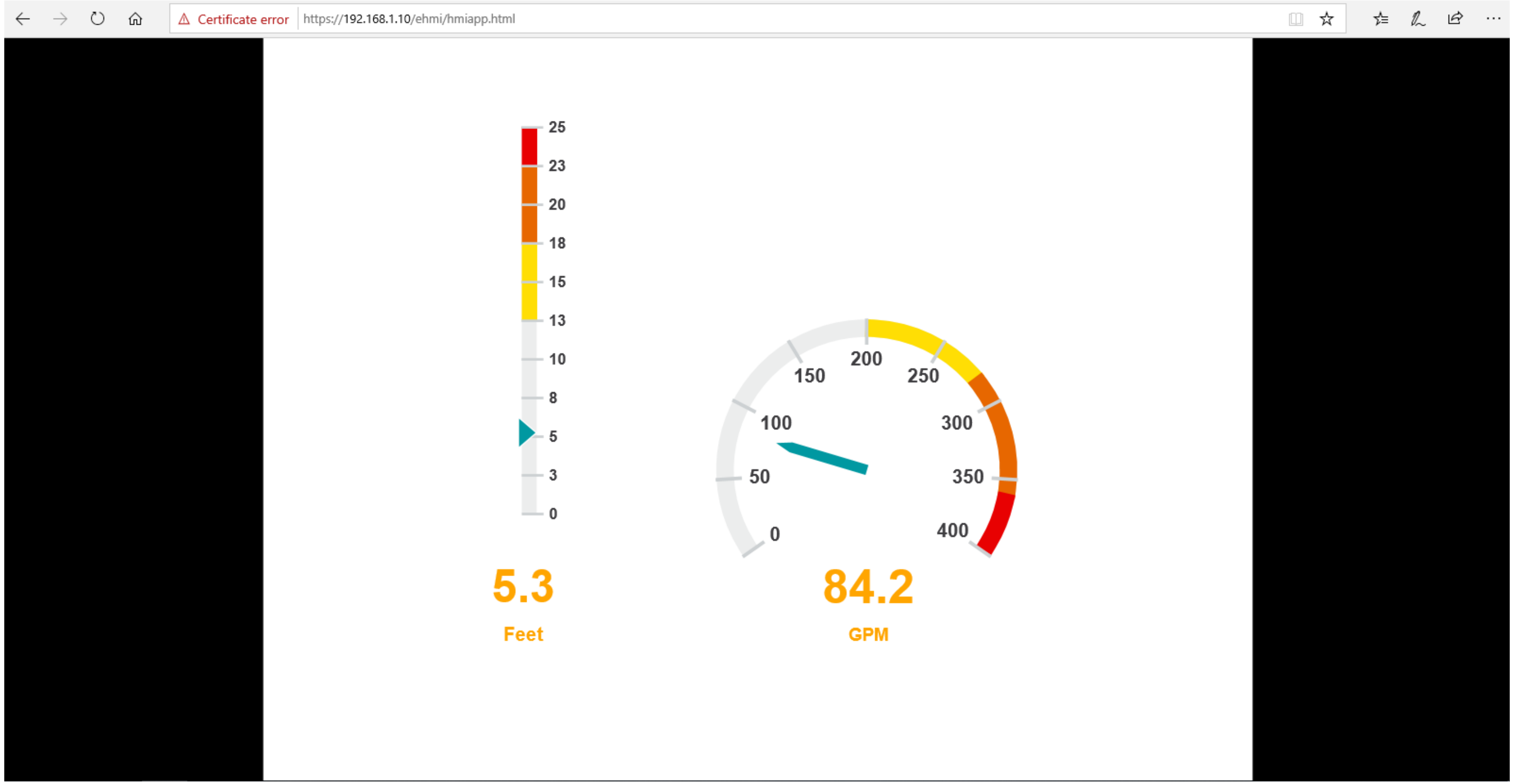


X 219.33 Y 592.00 W 100.00 H 50.00

Text1

ID	Text1
Comment	
Behavior	
Is tab selectable	☑
Tab order	0
Text	
Text	Feet
Format	Arial 20 Bold Center Mid...
Geometry	
Transform center X	0
Transform center Y	0
Lock object	□
Background	
Fill	▨
Stroke	
Line color	▨
Line width	0
Dash style	Solid

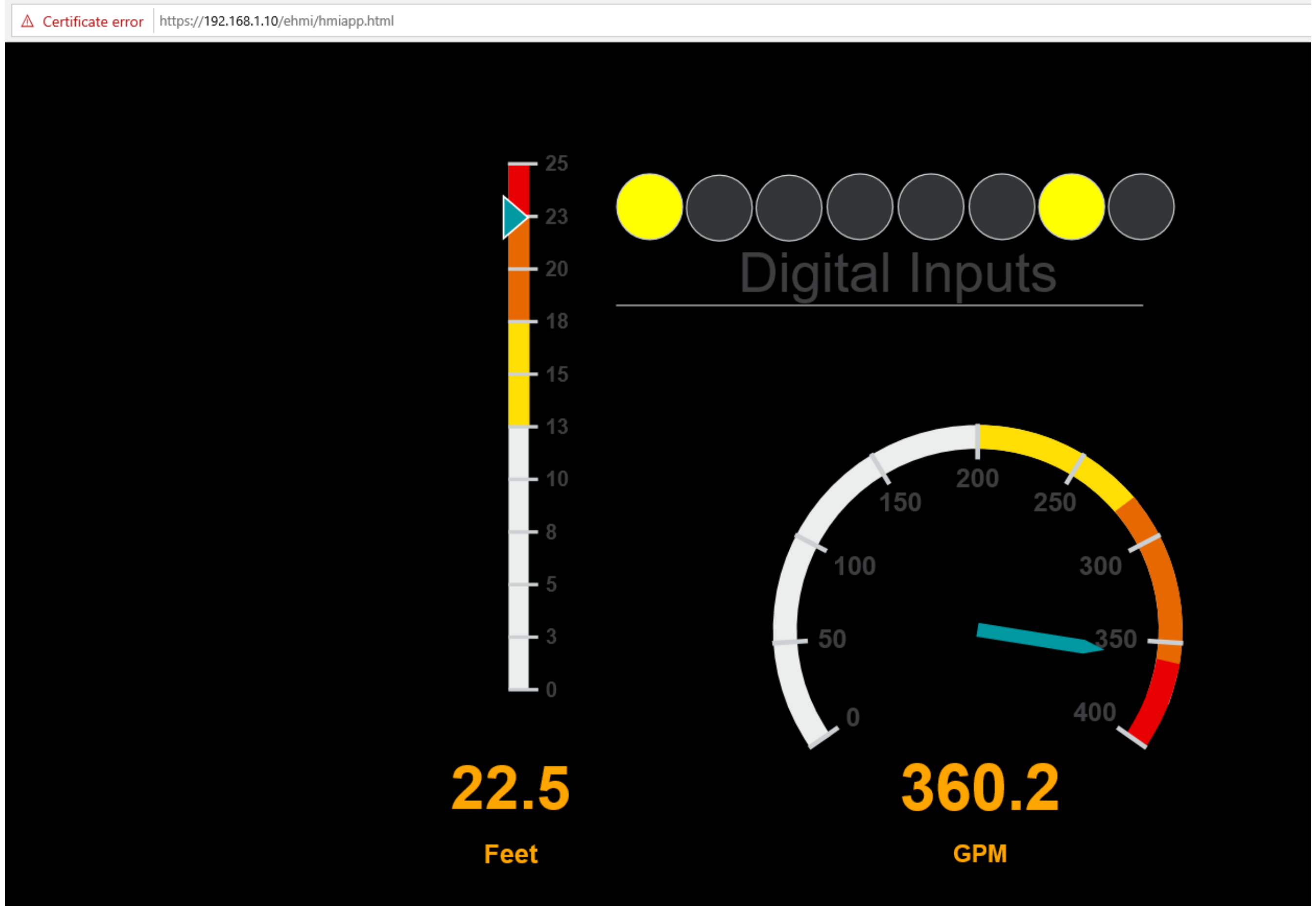
Two analog gauges, complete in HMI



Adding some digital inputs / outputs

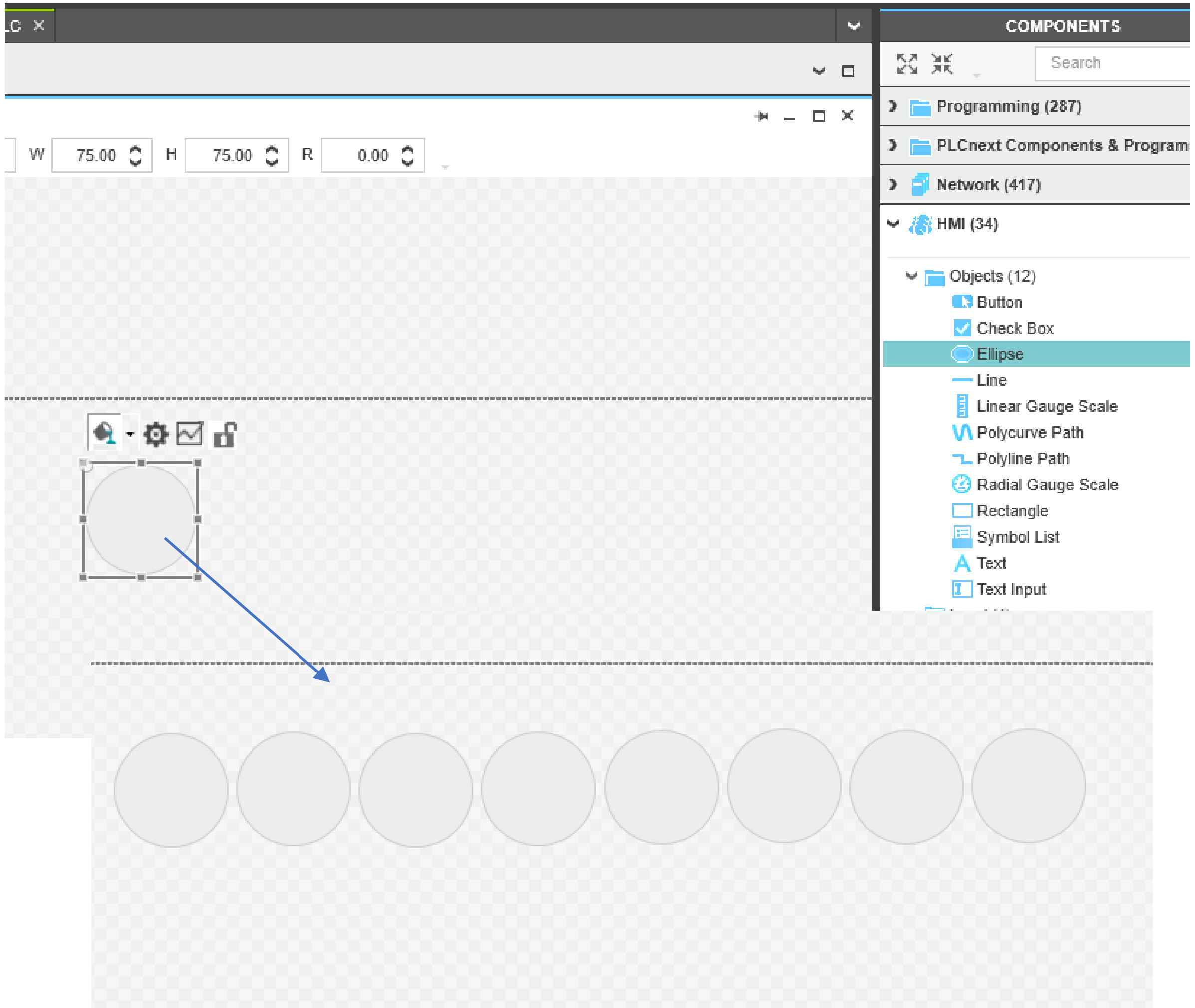
- We will add some digital inputs, and then some outputs.
- On the physical side, we will wire some of the PLCnext controller’s digital outputs to some of its digital inputs, so when an output turns on, a corresponding input will simultaneously turn on
- Earlier we programmed DO 1 and 2 to each turn on based on the values of the current and voltage inputs.

Note: I added black fill to the background for aesthetic reasons.



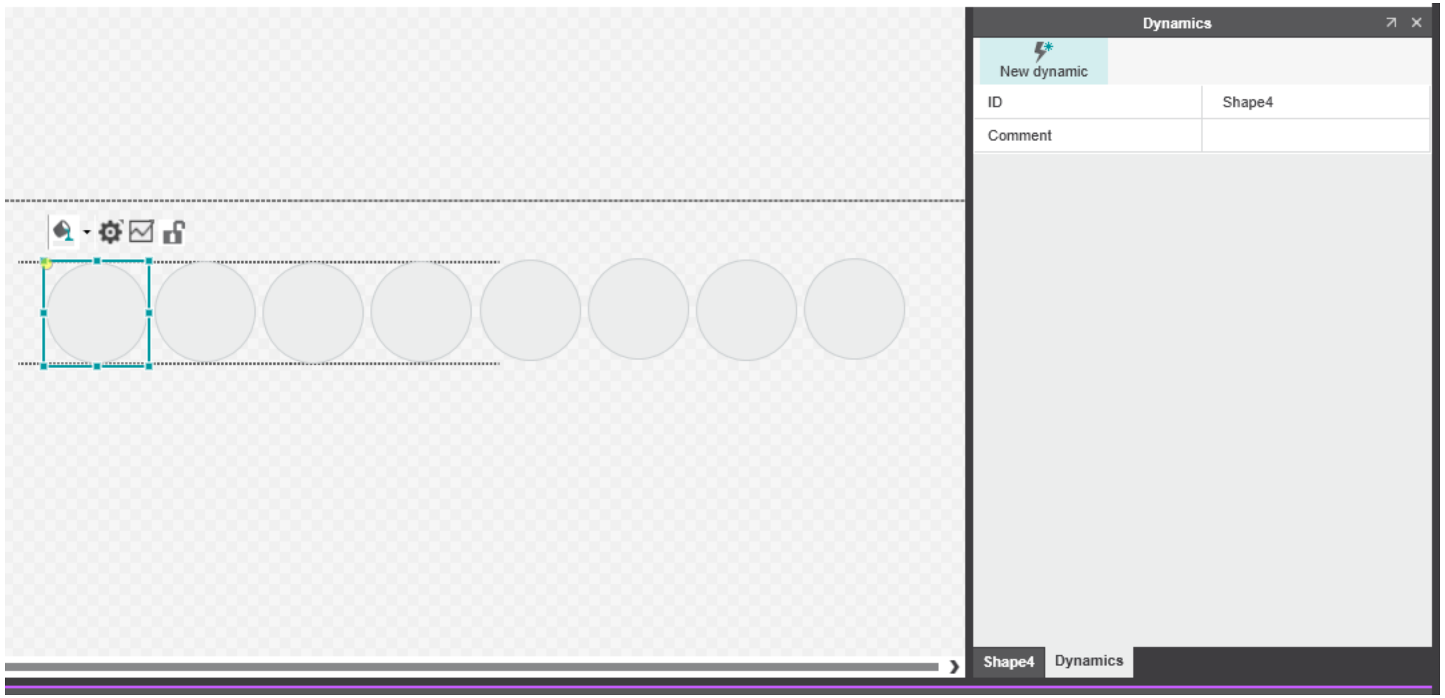
Creating “indicating lights” to show DI status

- Drag and drop an “Ellipse” object from the HMI menu under the COMPONENTS section.
- This will make a circle which will function as an indicator light which we will configure to “light up” when the corresponding digital input is turned ON.
- Since we have 8 digital inputs, copy and paste this object to make 8 circles, and arrange them as you desire.
- Simply use control C, control P to replicate the circles.



Adding dynamics to turn on and off the indicator lights based on digital input state

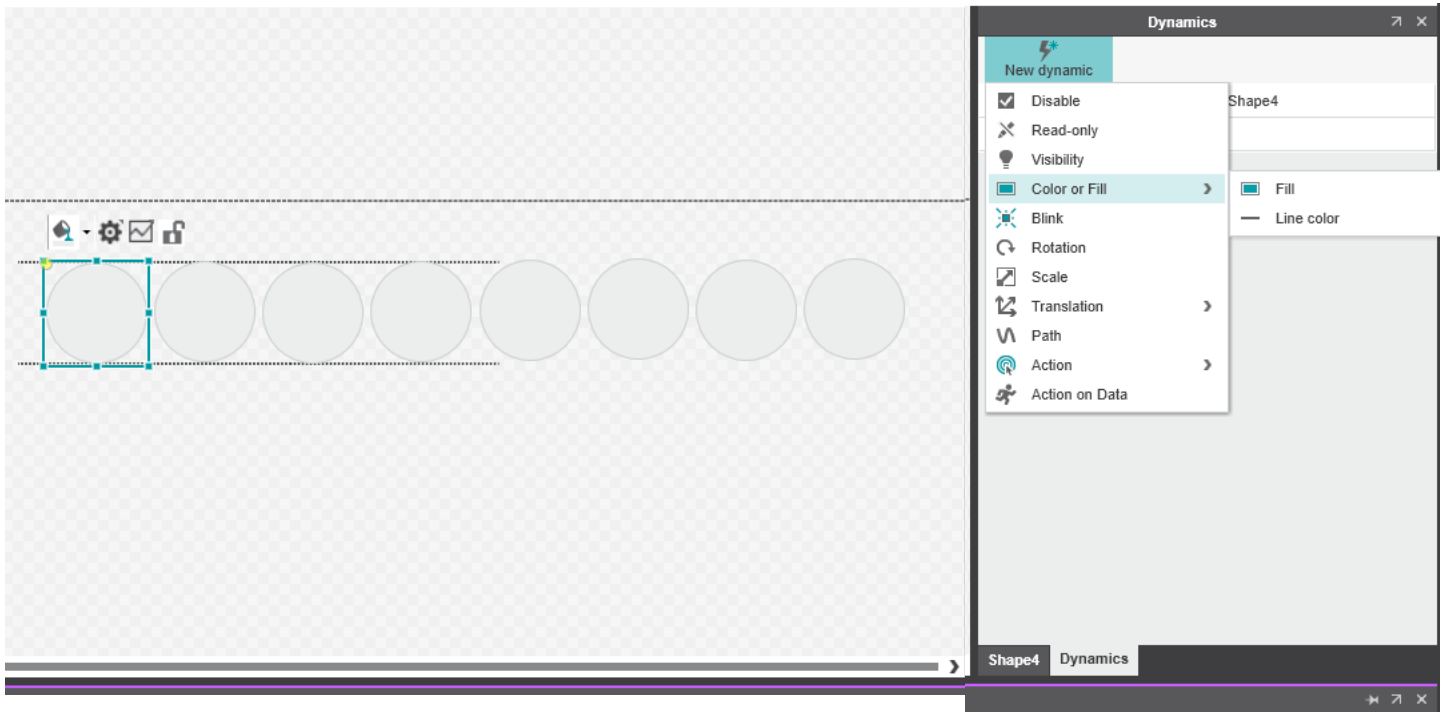
- Double click on one of the circles
- Click on the Dynamics tab



ID	Shape4
Comment	

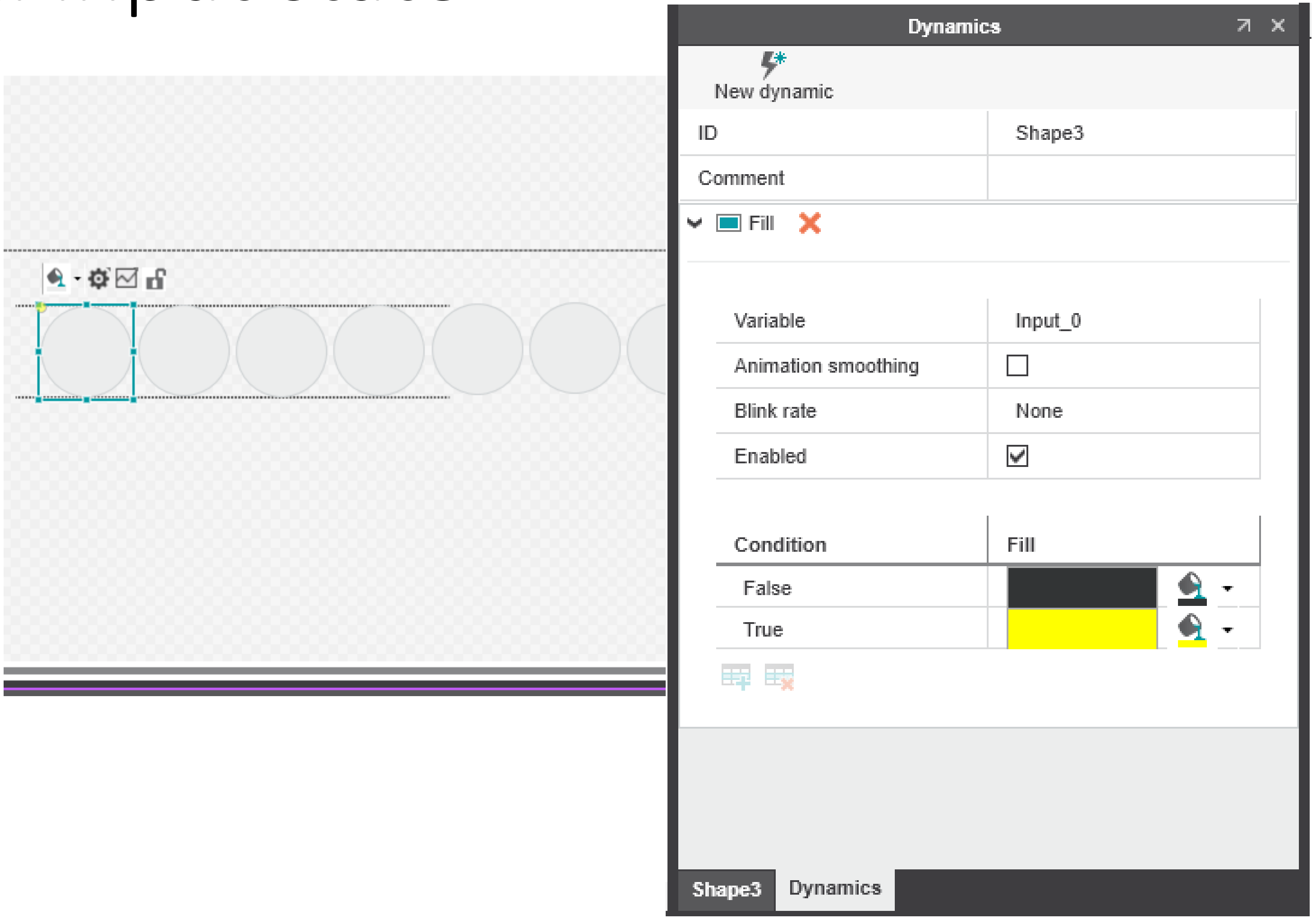
Adding dynamics to turn on and off the indicator lights based on digital input state

- Double click on one of the circles
- Click on the Dynamics tab
- Click on “New Dynamic”
- Click on “Color or Fill” from the drop-down menu, and click on “Fill”



Adding dynamics to turn on and off the indicator lights based on digital input state

- Double click on one of the circles
- Click on the Dynamics tab
- Click on “New Dynamic”
- Click on “Color or Fill” from the drop-down menu, and click on “Fill”
- Choose a variable to associate with this button, Input_0
- Make the fill a dark color when the condition is false, and a bright color when the condition is true. (light turns “on” when digital input is turned on)



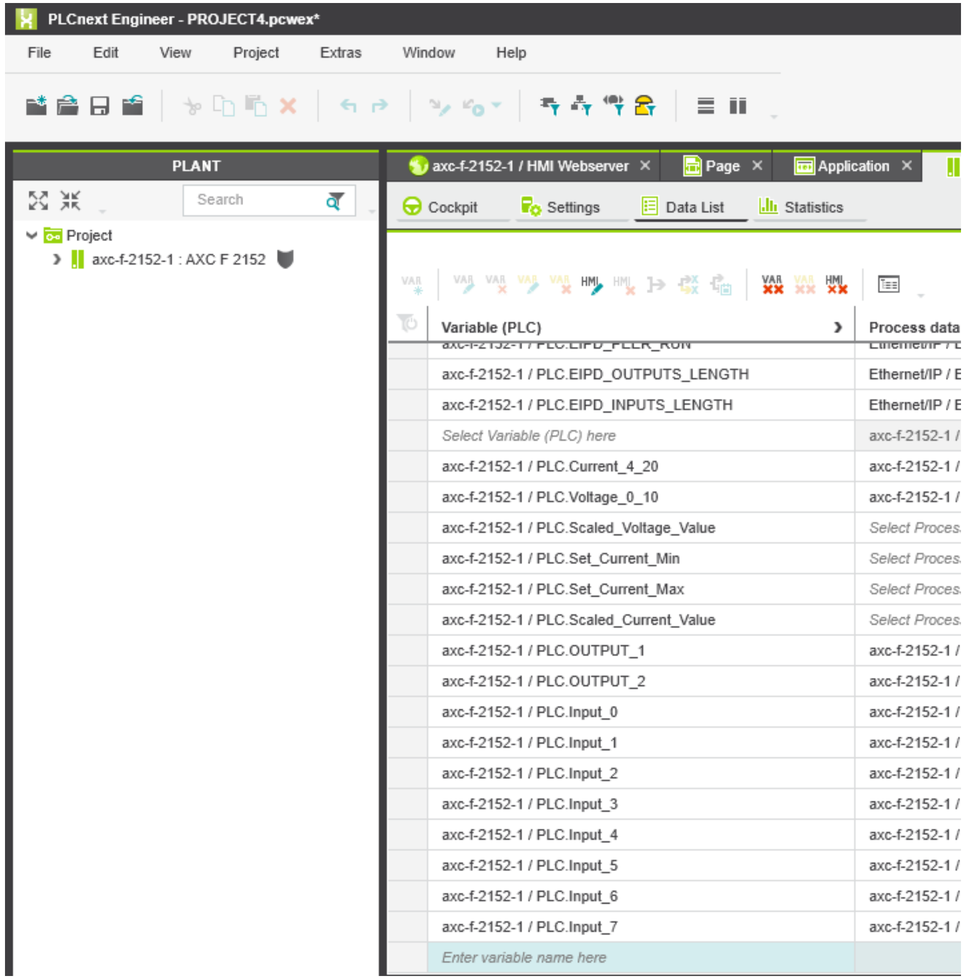
ID	Shape3
Comment	

Variable	Input_0
Animation smoothing	☐
Blink rate	None
Enabled	☑

Condition	Fill
False	⬛
True	🟨

Adding/configuring the variables in the Data list

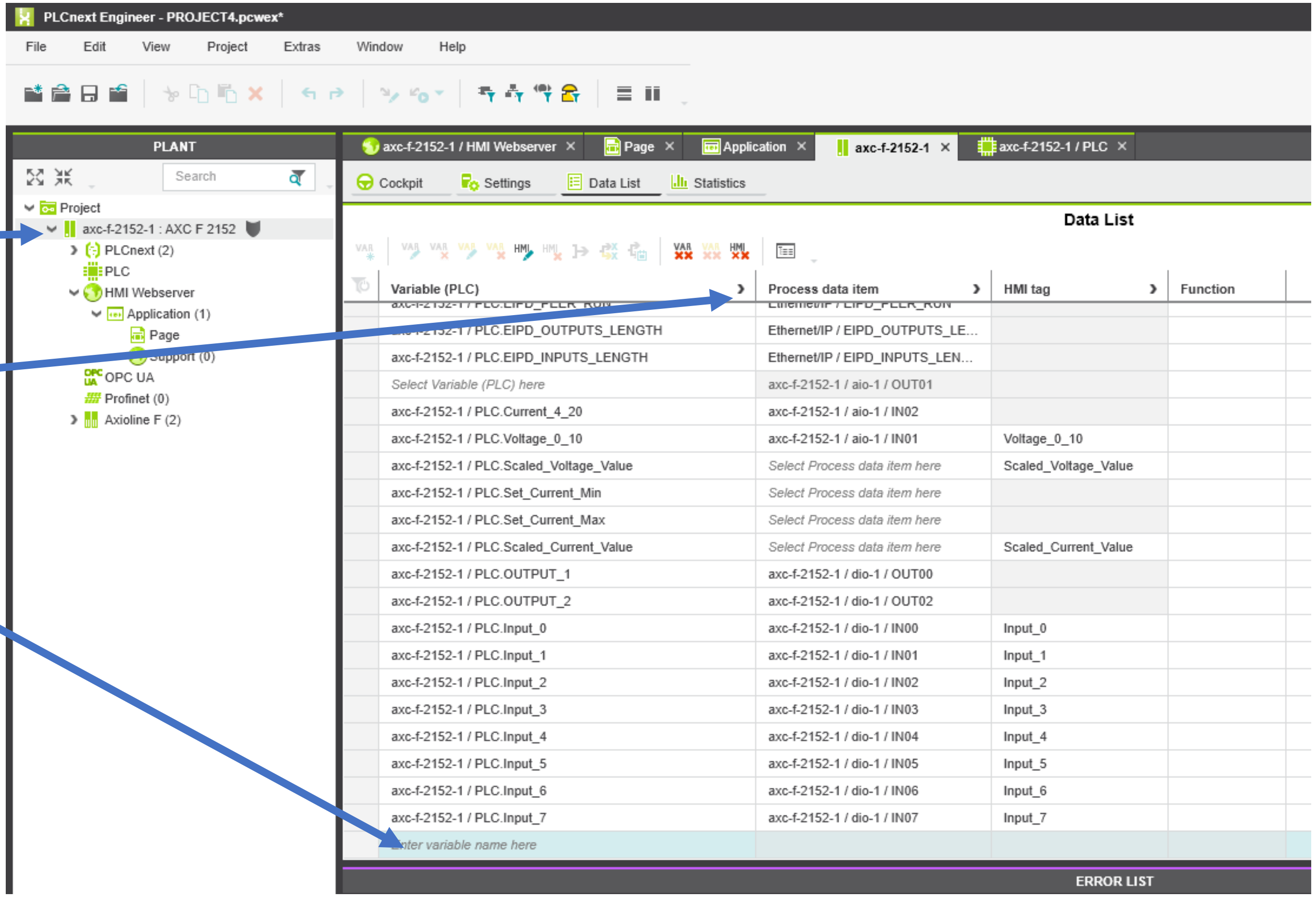
- Configure each input “indicator light” the same way. Just changing the Variable for each…Input_1, Input_2…Input_8
- (You could create any variable name you desire...maybe something more descriptive, like Pump 1 running, or dosing pump On….)
- You can create variable names in the HMI environment.
- **You will need to define them and link them on another screen.**



Variable (PLC)	Process data
axc-f-2152-1 / PLC.EIPD_PLCR_RUN	Ethernet/IP / E
axc-f-2152-1 / PLC.EIPD_OUTPUTS_LENGTH	Ethernet/IP / E
axc-f-2152-1 / PLC.EIPD_INPUTS_LENGTH	Ethernet/IP / E
Select Variable (PLC) here	axc-f-2152-1 /
axc-f-2152-1 / PLC.Current_4_20	axc-f-2152-1 /
axc-f-2152-1 / PLC.Voltage_0_10	axc-f-2152-1 /
axc-f-2152-1 / PLC.Scaled_Voltage_Value	*Select Proces*
axc-f-2152-1 / PLC.Set_Current_Min	*Select Proces*
axc-f-2152-1 / PLC.Set_Current_Max	*Select Proces*
axc-f-2152-1 / PLC.Scaled_Current_Value	*Select Proces*
axc-f-2152-1 / PLC.OUTPUT_1	axc-f-2152-1 /
axc-f-2152-1 / PLC.OUTPUT_2	axc-f-2152-1 /
axc-f-2152-1 / PLC.Input_0	axc-f-2152-1 /
axc-f-2152-1 / PLC.Input_1	axc-f-2152-1 /
axc-f-2152-1 / PLC.Input_2	axc-f-2152-1 /
axc-f-2152-1 / PLC.Input_3	axc-f-2152-1 /
axc-f-2152-1 / PLC.Input_4	axc-f-2152-1 /
axc-f-2152-1 / PLC.Input_5	axc-f-2152-1 /
axc-f-2152-1 / PLC.Input_6	axc-f-2152-1 /
axc-f-2152-1 / PLC.Input_7	axc-f-2152-1 /
Enter variable name here	

Adding/configuring the variables in the Data list

- Navigate to the “Data List” tab by double clicking here and choosing the “Data List” sub-tab
- If the list is expanded, contract it by clicking here (the arrow should be pointing to the right)
- Scroll to the bottom, add the variables you created on the HMI page by clicking and entering them here
- Associate each variable with a Process Data Item as shown

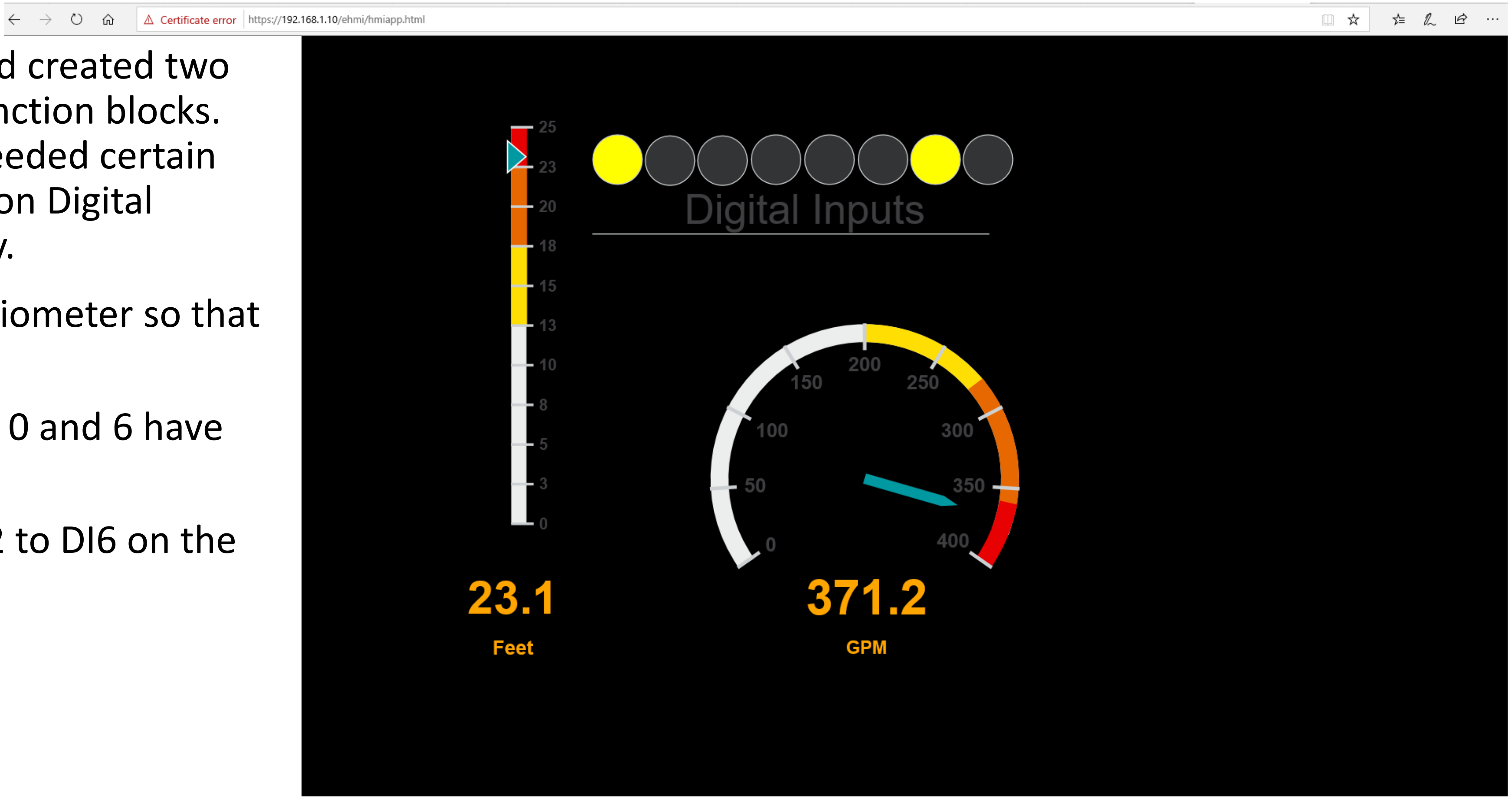


Data List

Variable (PLC)	Process data item	HMI tag	Function
axc-f-2152-1 / PLC.EIPD_PEER_RUN	EthernetIP / EIPD_PEER_RUN		
axc-f-2152-1 / PLC.EIPD_OUTPUTS_LENGTH	Ethernet/IP / EIPD_OUTPUTS_LE...		
axc-f-2152-1 / PLC.EIPD_INPUTS_LENGTH	Ethernet/IP / EIPD_INPUTS_LEN...		
Select Variable (PLC) here	axc-f-2152-1 / aio-1 / OUT01		
axc-f-2152-1 / PLC.Current_4_20	axc-f-2152-1 / aio-1 / IN02		
axc-f-2152-1 / PLC.Voltage_0_10	axc-f-2152-1 / aio-1 / IN01	Voltage_0_10	
axc-f-2152-1 / PLC.Scaled_Voltage_Value	Select Process data item here	Scaled_Voltage_Value	
axc-f-2152-1 / PLC.Set_Current_Min	Select Process data item here		
axc-f-2152-1 / PLC.Set_Current_Max	Select Process data item here		
axc-f-2152-1 / PLC.Scaled_Current_Value	Select Process data item here	Scaled_Current_Value	
axc-f-2152-1 / PLC.OUTPUT_1	axc-f-2152-1 / dio-1 / OUT00		
axc-f-2152-1 / PLC.OUTPUT_2	axc-f-2152-1 / dio-1 / OUT02		
axc-f-2152-1 / PLC.Input_0	axc-f-2152-1 / dio-1 / IN00	Input_0	
axc-f-2152-1 / PLC.Input_1	axc-f-2152-1 / dio-1 / IN01	Input_1	
axc-f-2152-1 / PLC.Input_2	axc-f-2152-1 / dio-1 / IN02	Input_2	
axc-f-2152-1 / PLC.Input_3	axc-f-2152-1 / dio-1 / IN03	Input_3	
axc-f-2152-1 / PLC.Input_4	axc-f-2152-1 / dio-1 / IN04	Input_4	
axc-f-2152-1 / PLC.Input_5	axc-f-2152-1 / dio-1 / IN05	Input_5	
axc-f-2152-1 / PLC.Input_6	axc-f-2152-1 / dio-1 / IN06	Input_6	
axc-f-2152-1 / PLC.Input_7	axc-f-2152-1 / dio-1 / IN07	Input_7	
Enter variable name here			

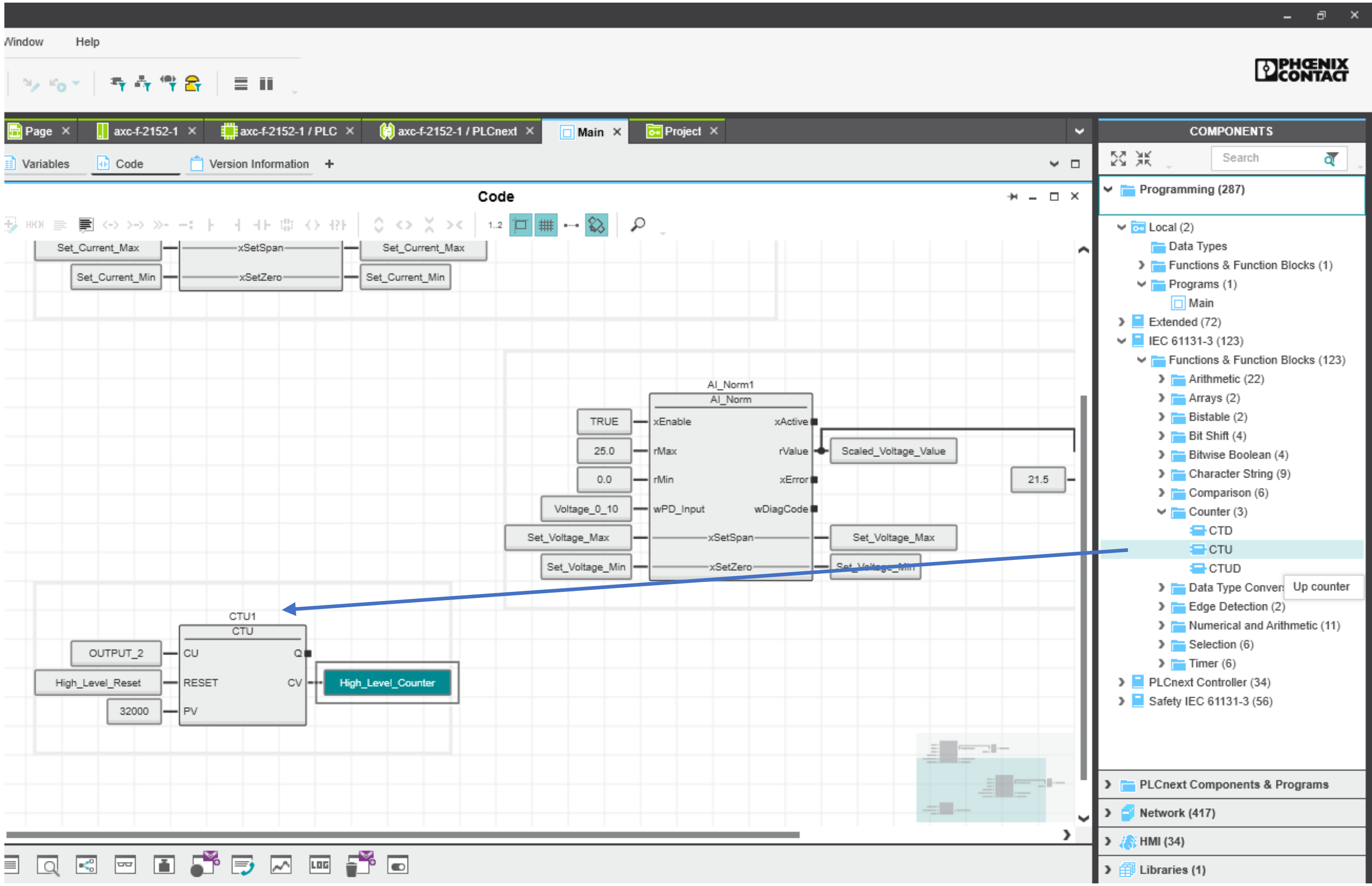
The HMI screen with digital input indication

- Earlier in this training, we had created two Greater Than comparison function blocks. When the analog inputs exceeded certain thresholds, they would turn on Digital Outputs 1 and 2, respectively.
- I have cranked up the potentiometer so that both outputs have turned on
- You'll note that digital inputs 0 and 6 have turned on.
- (I wired DO1 to DI0, and DO2 to DI6 on the PLCnext controller)



Adding a counter and reset to program/HMI

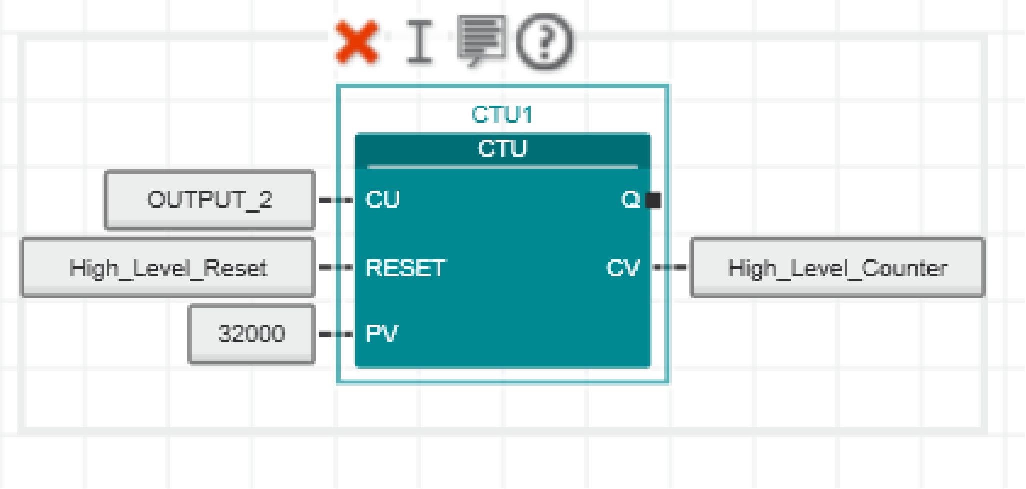
- Get back to the Project and the “Main” (program) tab, and the “code” sub-tab.
- Expand the Programming tree as seen in this screenshot and drag and drop the CTU (counter – up) function block onto the work surface.



Programming a counter-up function block

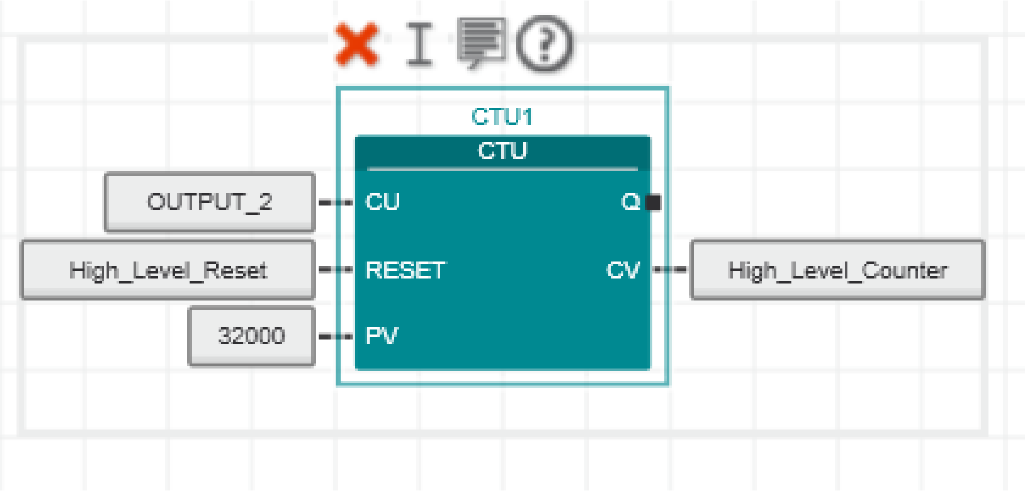
- This counter will count the number of times the high-level alarm is reached. We have a digital output which we have already programmed to turn on when the "Scaled_Voltage_Value" variable (which represents tank level) reaches a certain value (21.5 feet). That digital output is called "OUTPUT_2".

- Double-click on the "CU" element. Type in "OUTPUT_2" . Every time Output two turns on, the counter will increment up by one.



Programming a counter-up function block

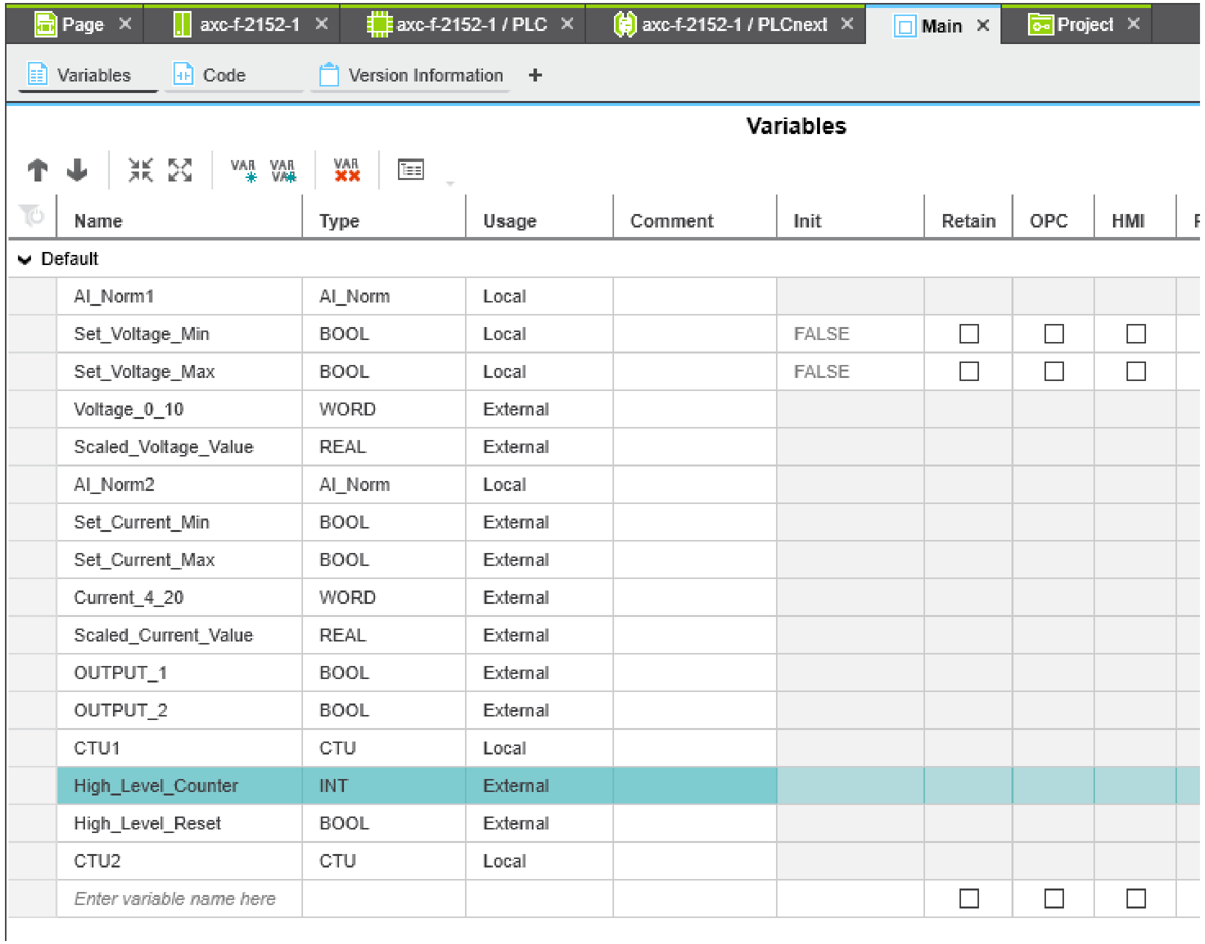
- Double click on “Reset” and type in “High_Level_Reset”. This is a new variable that we will have to define. It is on that we will use to reset the counter. (By clicking on a button on the HMI).
- Make sure you declare this new variable as a VAR E (External variable) from the menu items on this screen.
- Double click on “PV” and enter a value such as 32000. It just needs to be a high number so the counter doesn’t reach this number and stop counting.



- Double click on “CV” This is the counter value. Enter “High_Level_Counter” This is a new variable that keeps track of the count. Declare it as a VAR E on this screen.

Adding/configuring the variables in the Data list

- Click on the “Variables” sub tab*.
- Make sure you designate the “High_Level_Counter” as an INT (integer) Type, and the “High_Level_Reset” as a BOOL (Boolean) Type.
- These make sense since the counter will be able to produce an integer, and the reset will either be true or false.
- Save the project.

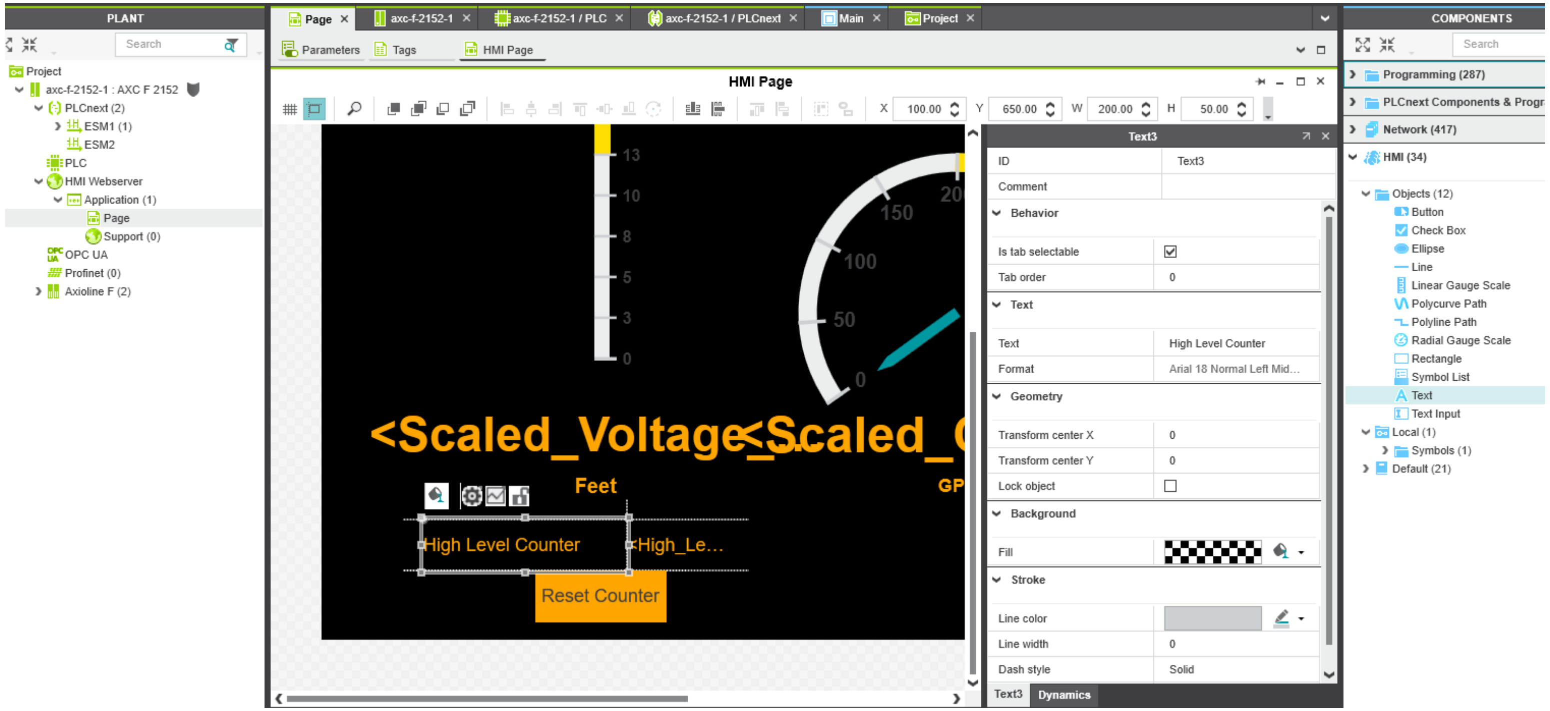


Name	Type	Usage	Comment	Init	Retain	OPC	HMI	F
Default								
AI_Norm1	AI_Norm	Local						
Set_Voltage_Min	BOOL	Local		FALSE	□	□	□	
Set_Voltage_Max	BOOL	Local		FALSE	□	□	□	
Voltage_0_10	WORD	External						
Scaled_Voltage_Value	REAL	External						
AI_Norm2	AI_Norm	Local						
Set_Current_Min	BOOL	External						
Set_Current_Max	BOOL	External						
Current_4_20	WORD	External						
Scaled_Current_Value	REAL	External						
OUTPUT_1	BOOL	External						
OUTPUT_2	BOOL	External						
CTU1	CTU	Local						
High_Level_Counter	INT	External						
High_Level_Reset	BOOL	External						
CTU2	CTU	Local						
Enter variable name here					□	□	□	

* Or choose “PLC” from the project tree in the PLANT area, and manipulate the variables via the Data List tab.

Representing the counter in the HMI

- Get back to the HMI development screen.
- We will use two text objects and one button object.
- Click and drag a “Text” object onto the work surface
- Double click it to open the configuration window



X 100.00 Y 650.00 W 200.00 H 50.00

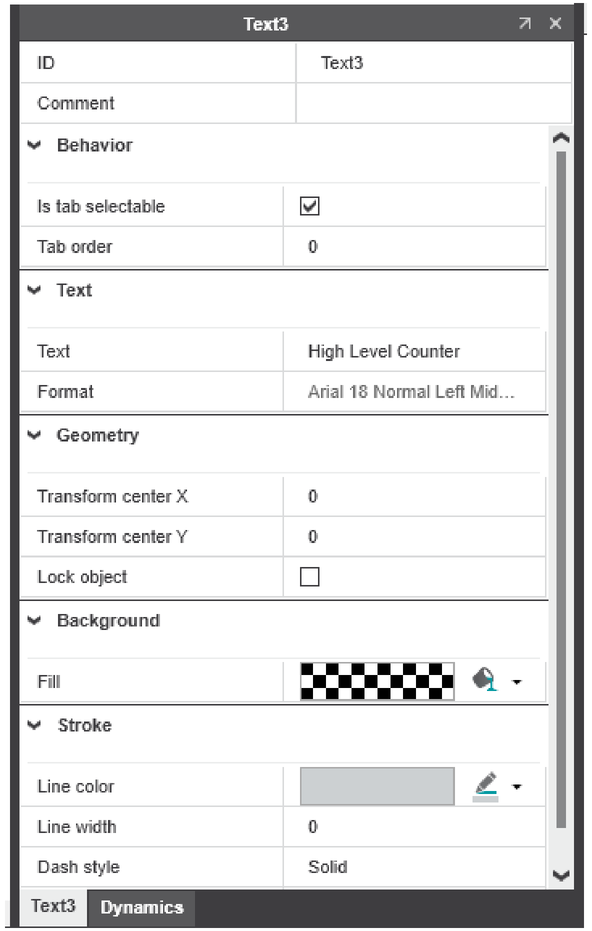
Text3

ID	Text3
Comment	
Behavior	
Is tab selectable	☑
Tab order	0
Text	
Text	High Level Counter
Format	Arial 18 Normal Left Mid…
Geometry	
Transform center X	0
Transform center Y	0
Lock object	□
Background	
Fill	▨
Stroke	
Line color	
Line width	0
Dash style	Solid

Text3 Dynamics

Configuring text associated with the counter

- Make sure you are on the Text tab (bottom of the window).
- Type in “High Level Counter” in the text field
- Click on format and format the text as you wish (refer to earlier section in this training if necessary)
- Enter
- Save project

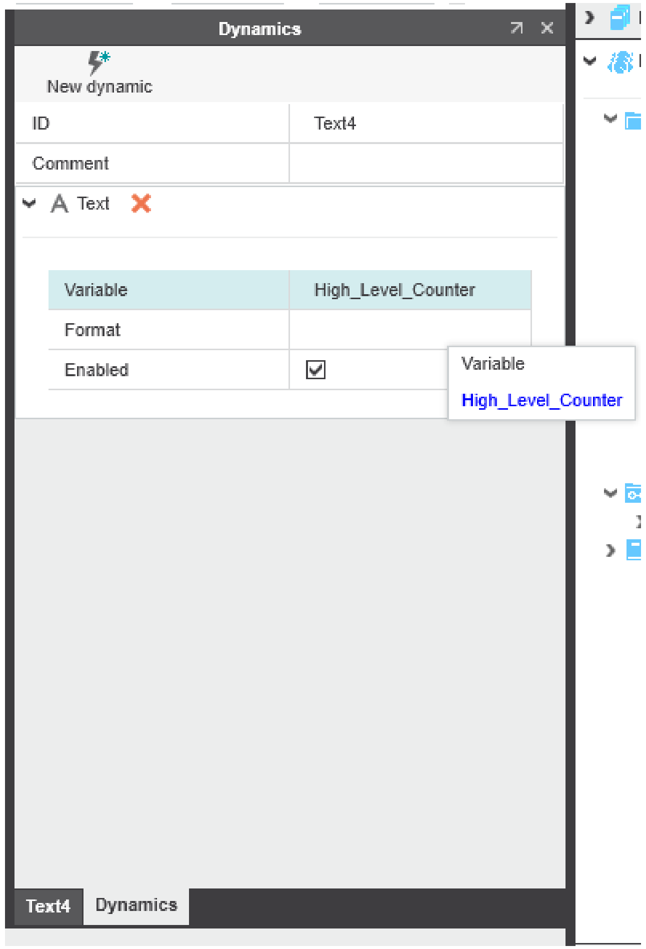


Text3

ID	Text3
Comment	
Behavior	
Is tab selectable	☑
Tab order	0
Text	
Text	High Level Counter
Format	Arial 18 Normal Left Mid...
Geometry	
Transform center X	0
Transform center Y	0
Lock object	□
Background	
Fill	▨
Stroke	
Line color	
Line width	0
Dash style	Solid

Configuring text associated with the counter

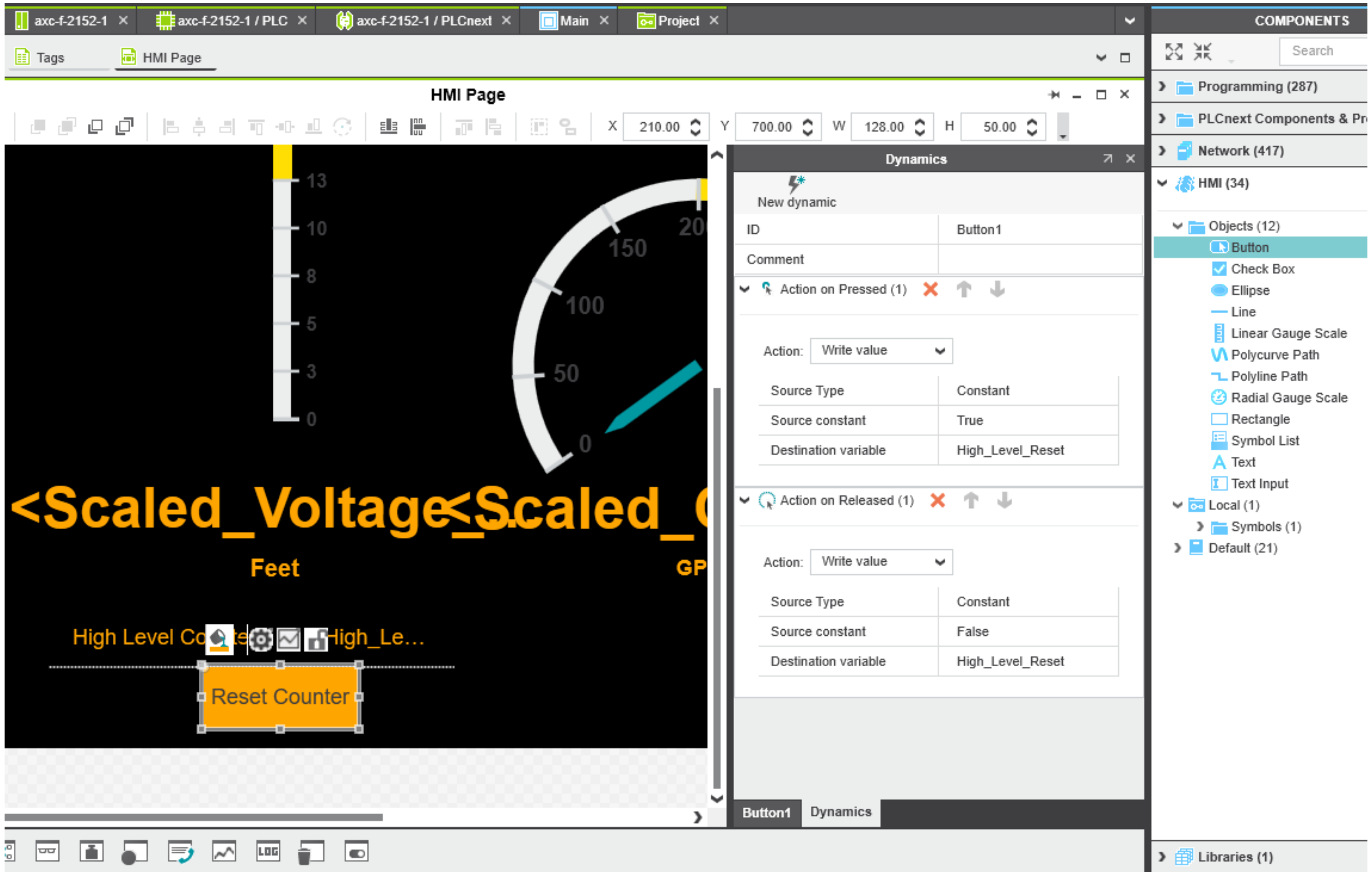
- Click and drag a “Text” object onto the work surface, to the right of the last one.
- Double click it to open the configuration window
- Go to the “Dynamics” tab
- Click “New Dynamic” and select “Text”
- Assign the “High_Level_Counter” variable as shown.
- Go to “Text” tab (at bottom) and format the text with the color, size, style you desire.
- Hit Enter and then Save the project



ID	Text4
Comment	
Variable	High_Level_Counter
Format	
Enabled	☑

Configuring text associated with the counter's reset button

- Drag and drop a "Button" object onto the work surface (near the text we just configured).
- Double click on it to open the configuration window.
- We'll add two new dynamics to make this reset button function.



Dynamics

New dynamic

ID	Button1
Comment	

Action on Pressed (1)

Action: Write value

Source Type	Constant
Source constant	True
Destination variable	High_Level_Reset

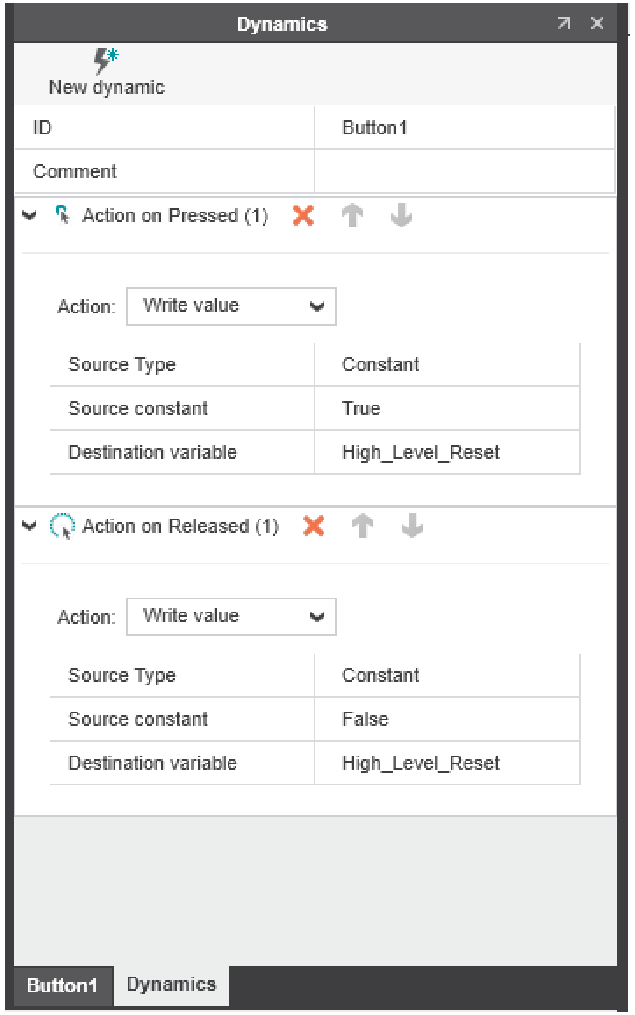
Action on Released (1)

Action: Write value

Source Type	Constant
Source constant	False
Destination variable	High_Level_Reset

Adding dynamics to the reset button

- Add a New Dynamic – “Action on Pressed” and configure as shown to the right.
- Add a New Dynamic – “Action on Released” and configure as shown to the right.
- Click to save the project as you would for any program (File/Save)….



ID	Button1
Comment	

Action on Pressed (1)

Action: Write value

Source Type	Constant
Source constant	True
Destination variable	High_Level_Reset

Action on Released (1)

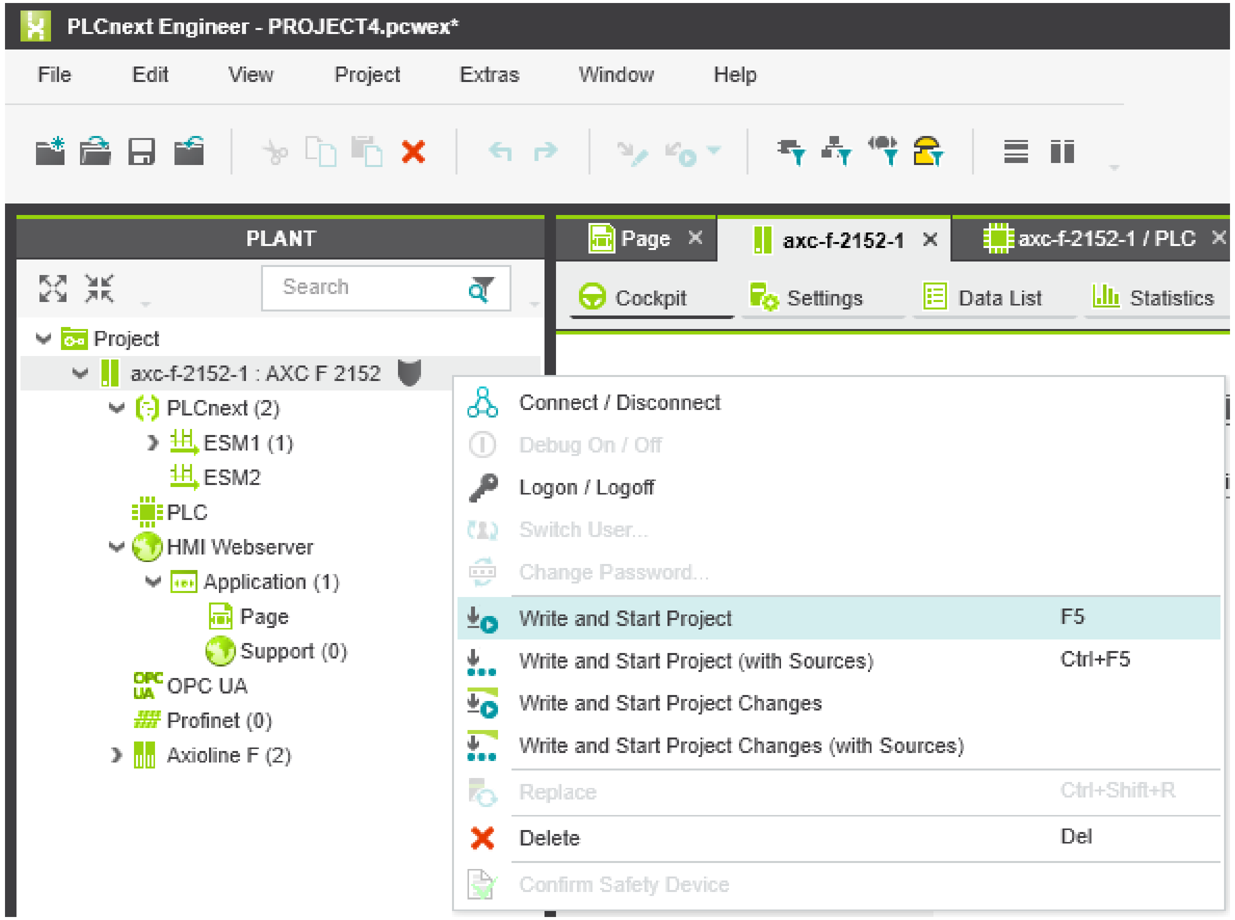
Action: Write value

Source Type	Constant
Source constant	False
Destination variable	High_Level_Reset

Download and test the HMI

- As we have done before, download the project to the PLCnext controller, and start execution of the program.
- *Then go to the “Cockpit” sub-tab and click the icon (that looks like a tablet) to go to the browser to check out the runtime version of the HMI

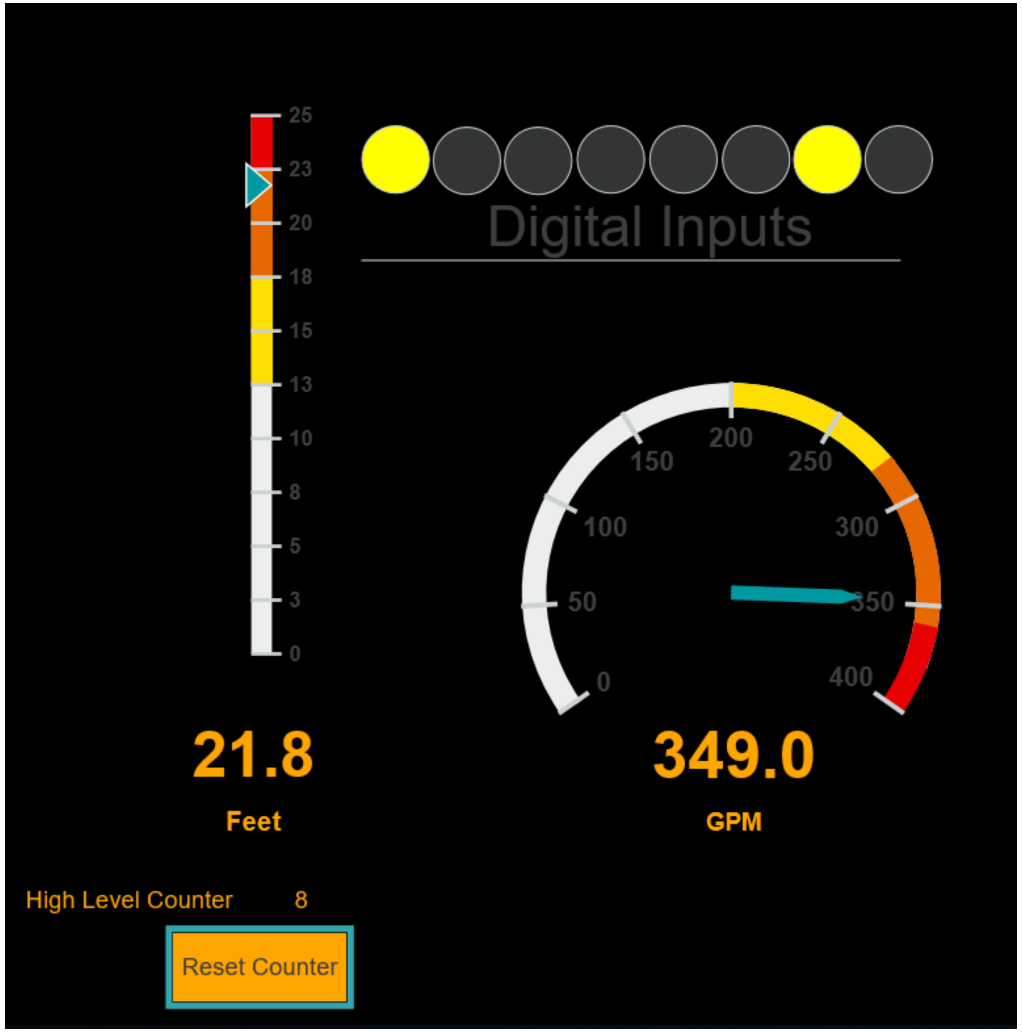
* Or simply open your internet browser, and type in the IP address of your PLCnext controller.



Viewing and interacting with the HMI

Success!

- Try cranking up the potentiometer until it exceeds 21.5 feet and see if the counter increments up by one each time.
- Then click on the button. Does the count reset to 0?
- And as you begin cranking up the level – does it resume counting?
- If so, you did everything correctly!

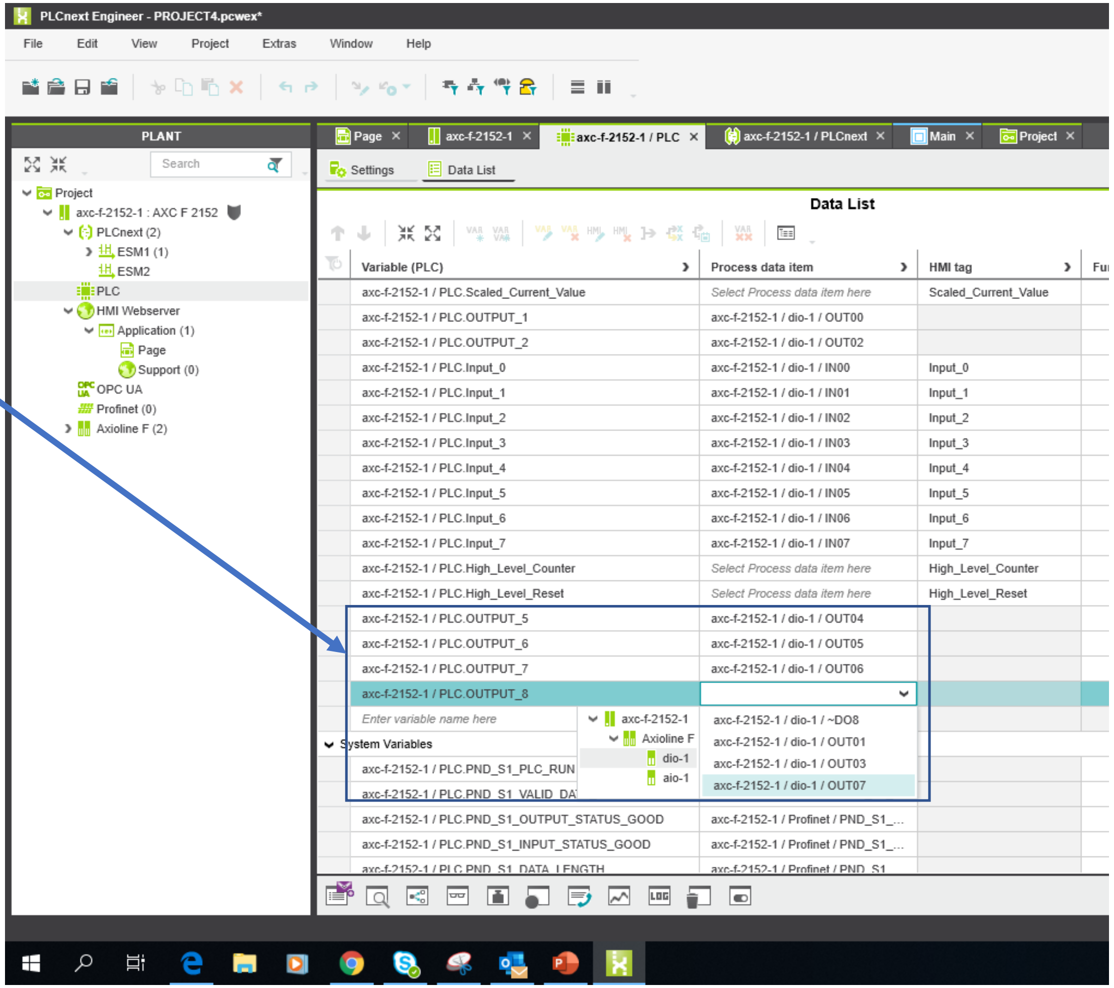


Let’s make some HMI buttons that turn on actual outputs on the PLCnext controller

- So far, we have turned on two digital outputs by doing some programming such that when one of two analog inputs reaches a prescribed value, the corresponding digital output turns on.
- We have also created a button that resets an internal variable representing a counting function.
- Let’s combine elements of these two concepts and create some virtual pushbuttons in the HMI that, when pressed, will directly turn on some digital outputs.
- Since DO1, and DO2 are already in use, lets use DO5, DO6, DO7, and DO8 for this exercise.

Create and define the digital output variables

- First, let’s create the variables and map them to the PLCnext controller’s digital outputs
- Follow the example shown to the right
- Click the right arrow symbol (>) in the header of the Variable column to expand this table.
- Verify that all the newly created variables are of Type: “BOOL”



Data List

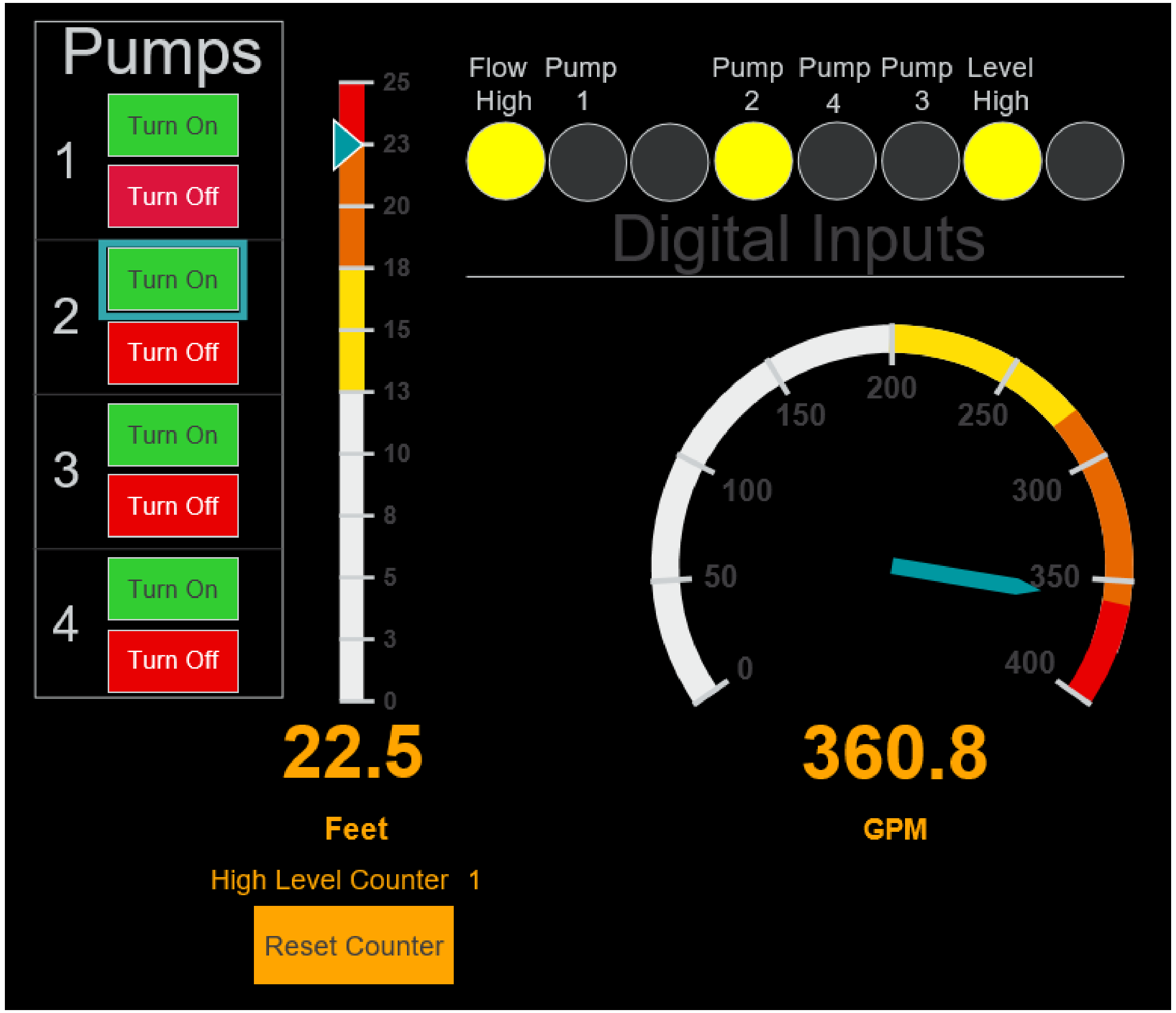
Variable (PLC)	Process data item	HMI tag
axc-f-2152-1 / PLC.Scaled_Current_Value	Select Process data item here	Scaled_Current_Value
axc-f-2152-1 / PLC.OUTPUT_1	axc-f-2152-1 / dio-1 / OUT00	
axc-f-2152-1 / PLC.OUTPUT_2	axc-f-2152-1 / dio-1 / OUT02	
axc-f-2152-1 / PLC.Input_0	axc-f-2152-1 / dio-1 / IN00	Input_0
axc-f-2152-1 / PLC.Input_1	axc-f-2152-1 / dio-1 / IN01	Input_1
axc-f-2152-1 / PLC.Input_2	axc-f-2152-1 / dio-1 / IN02	Input_2
axc-f-2152-1 / PLC.Input_3	axc-f-2152-1 / dio-1 / IN03	Input_3
axc-f-2152-1 / PLC.Input_4	axc-f-2152-1 / dio-1 / IN04	Input_4
axc-f-2152-1 / PLC.Input_5	axc-f-2152-1 / dio-1 / IN05	Input_5
axc-f-2152-1 / PLC.Input_6	axc-f-2152-1 / dio-1 / IN06	Input_6
axc-f-2152-1 / PLC.Input_7	axc-f-2152-1 / dio-1 / IN07	Input_7
axc-f-2152-1 / PLC.High_Level_Counter	Select Process data item here	High_Level_Counter
axc-f-2152-1 / PLC.High_Level_Reset	Select Process data item here	High_Level_Reset
axc-f-2152-1 / PLC.OUTPUT_5	axc-f-2152-1 / dio-1 / OUT04	
axc-f-2152-1 / PLC.OUTPUT_6	axc-f-2152-1 / dio-1 / OUT05	
axc-f-2152-1 / PLC.OUTPUT_7	axc-f-2152-1 / dio-1 / OUT06	
axc-f-2152-1 / PLC.OUTPUT_8		
Enter variable name here		
System Variables		
axc-f-2152-1 / PLC.PND_S1_PLC_RUN		
axc-f-2152-1 / PLC.PND_S1_VALID_DA		
axc-f-2152-1 / PLC.PND_S1_OUTPUT_STATUS_GOOD	axc-f-2152-1 / Profinet / PND_S1_...	
axc-f-2152-1 / PLC.PND_S1_INPUT_STATUS_GOOD	axc-f-2152-1 / Profinet / PND_S1_...	
axc-f-2152-1 / PLC.PND_S1_DATA_LENGTH	axc-f-2152-1 / Profinet / PND_S1	

axc-f-2152-1
Axioline F
dio-1
aio-1
axc-f-2152-1 / dio-1 / ~DO8
axc-f-2152-1 / dio-1 / OUT01
axc-f-2152-1 / dio-1 / OUT03
axc-f-2152-1 / dio-1 / OUT07

Adding virtual pushbuttons to the HMI

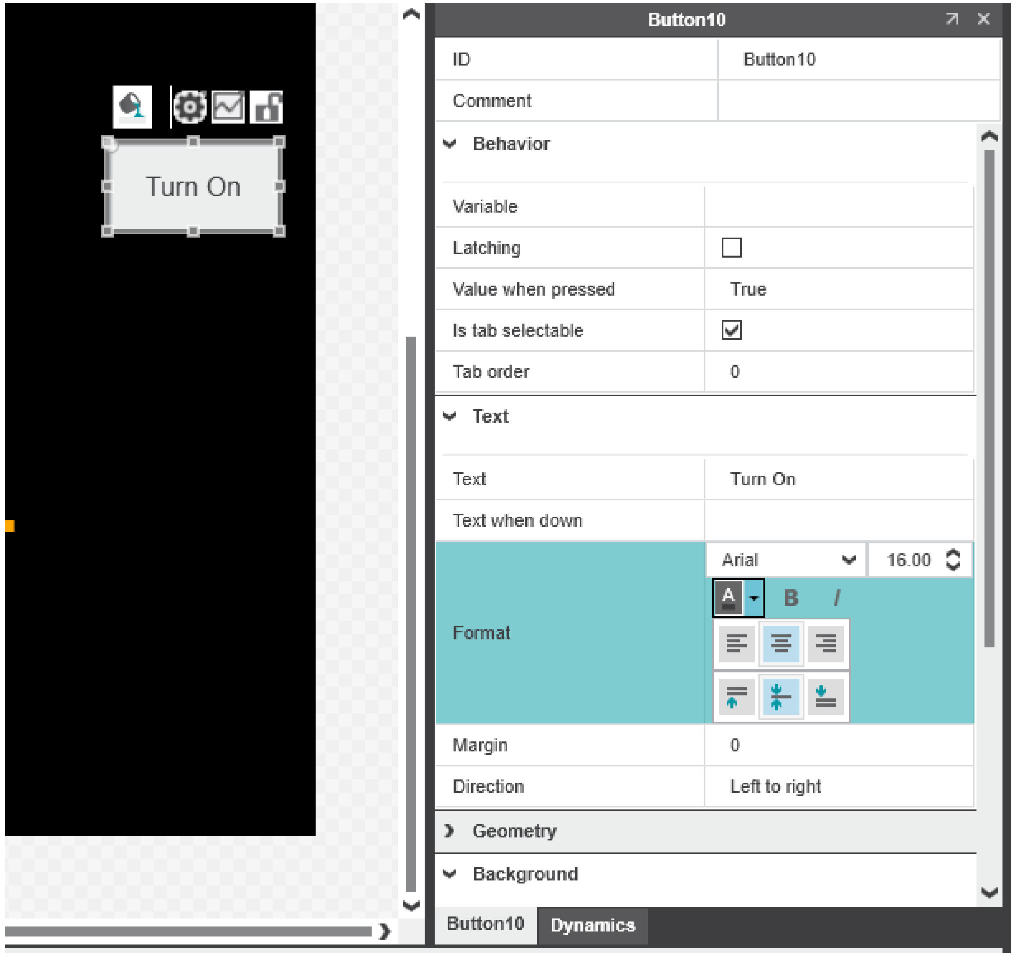
We'll end up making eight (8) buttons, a Start, and a Stop for each of four "pumps"

You can choose a color scheme for your buttons, and arrange them as you see fit



Adding and configuring pushbutton HMI objects

- Drag and drop a “Button” object onto the work surface.
- Double click on it to open the configuration window

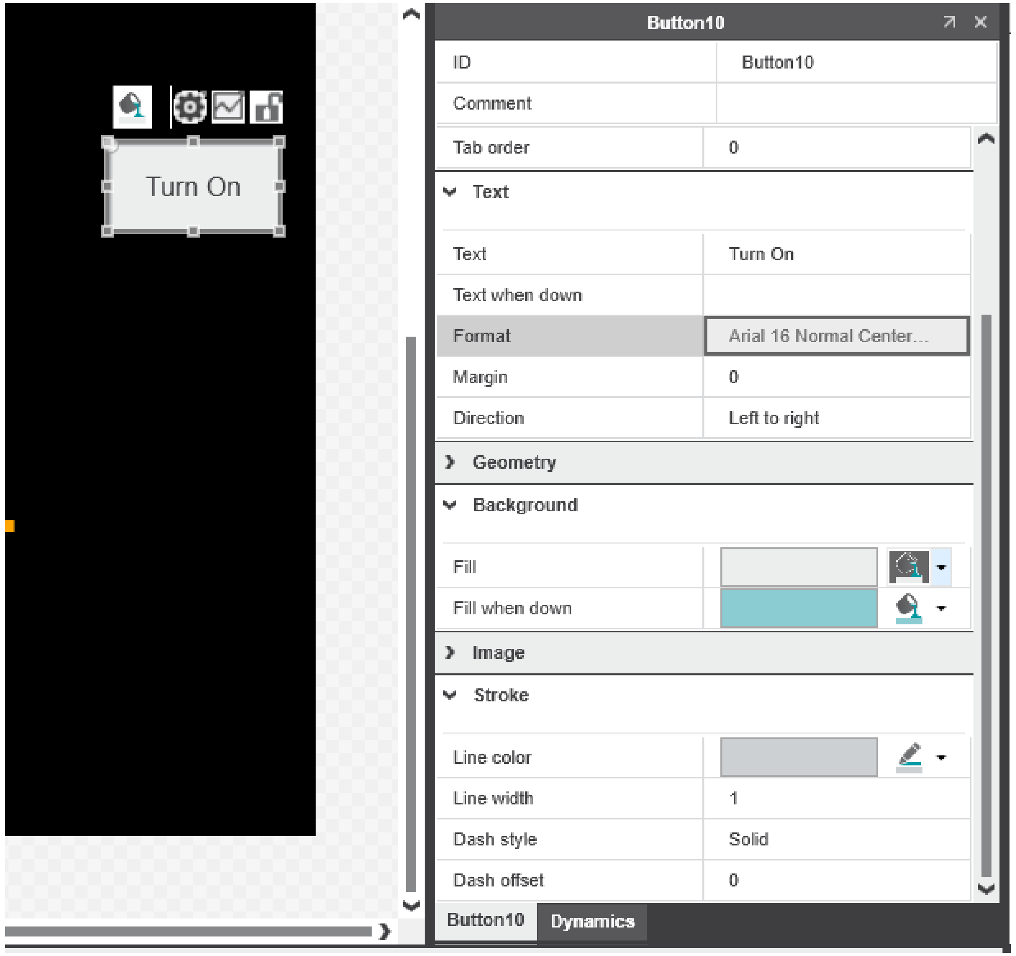


Button10

ID	Button10
Comment	
Behavior	
Variable	
Latching	□
Value when pressed	True
Is tab selectable	☑
Tab order	0
Text	
Text	Turn On
Text when down	
Format	Arial 16.00
Margin	0
Direction	Left to right
Geometry	
Background	

Adding and configuring pushbutton HMI objects

- Drag and drop a “Button” object onto the work surface.
- Double click on it to open the configuration window
- On the button tab, configure as seen to the right (you may elect to use “Start” instead of “Turn On”, etc.)

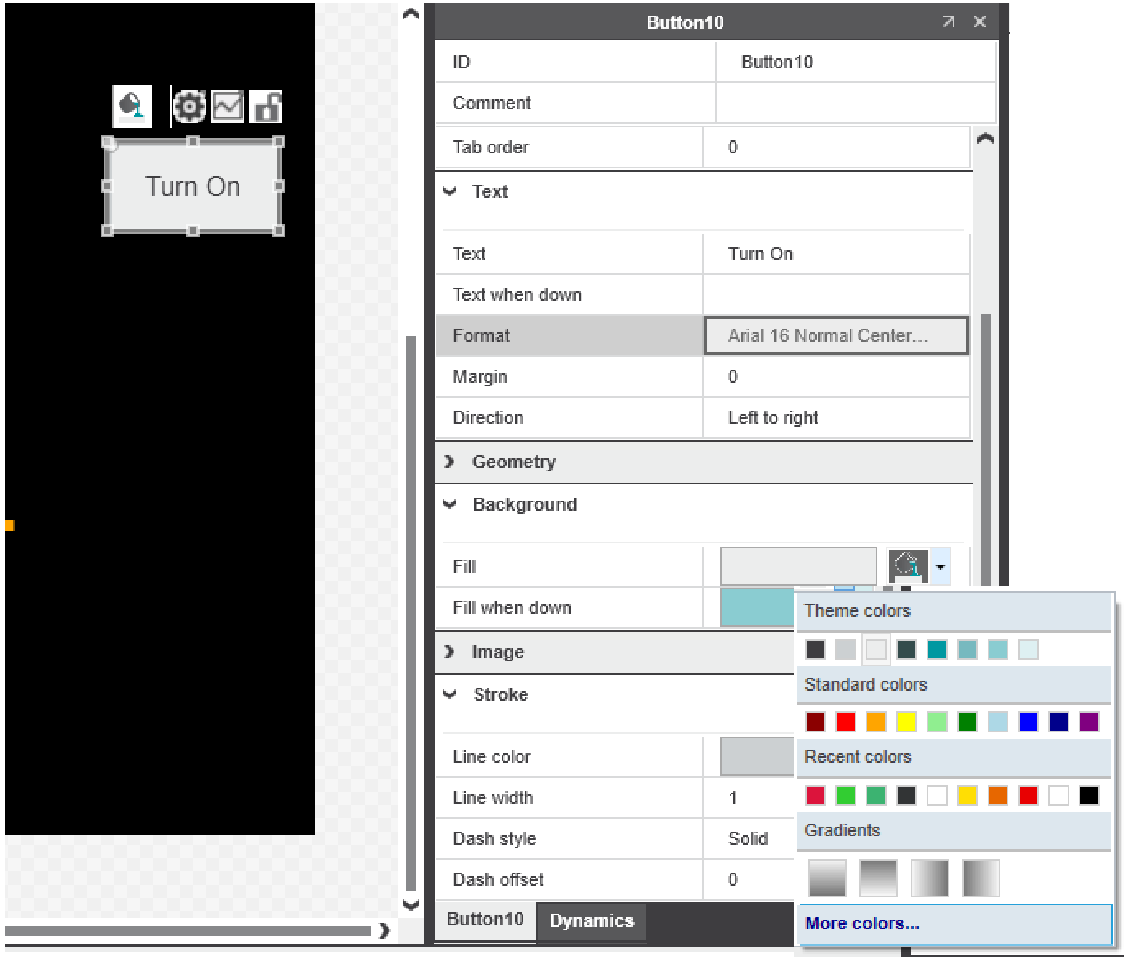


Button10

ID	Button10
Comment	
Tab order	0
Text	
Text	Turn On
Text when down	
Format	Arial 16 Normal Center...
Margin	0
Direction	Left to right
Geometry	
Background	
Fill	
Fill when down	
Image	
Stroke	
Line color	
Line width	1
Dash style	Solid
Dash offset	0

Adding and configuring pushbutton HMI objects

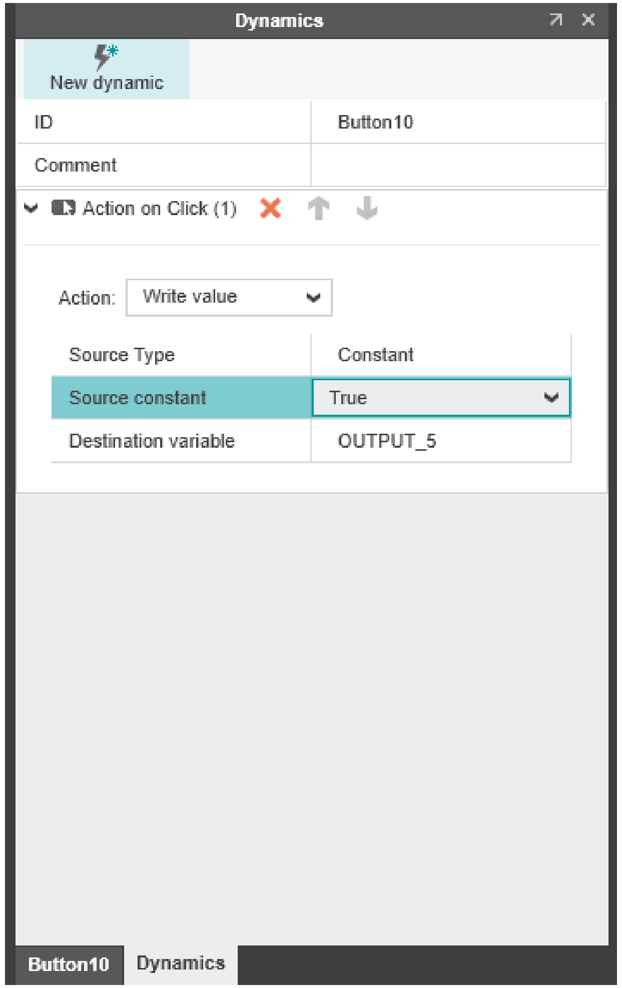
- Drag and drop a “Button” object onto the work surface.
- Double click on it to open the configuration window
- On the button tab, configure as seen to the right (you may elect to use “Start” instead of “Turn On”, etc.)
- Scroll to the bottom of this window if you want to change the button’s color



ID	Button10
Comment	
Tab order	0
Text	
Text	Turn On
Text when down	
Format	Arial 16 Normal Center...
Margin	0
Direction	Left to right
Geometry	
Background	
Fill	
Fill when down	
Image	
Stroke	
Line color	
Line width	1
Dash style	Solid
Dash offset	0

Set the dynamics of the button

- Click on the “Dynamics” tab
- Click “New dynamic / Action / Action on Click
- Choose “Write value” from the “Action” drop down menu
- Complete the configuration as seen to the right
- Each of the “Turn On” (or “Start”) buttons will be configured this way…only the Destination variable will change…OUTPUT_5 will be replaced by _6, _7, _8
- Each of the “Turn Off” (or “Stop”) buttons will have “False” selected for Source Constant, and the various buttons will each have the same Destination variable selected as their corresponding “Start” button



ID	Button10
Comment	

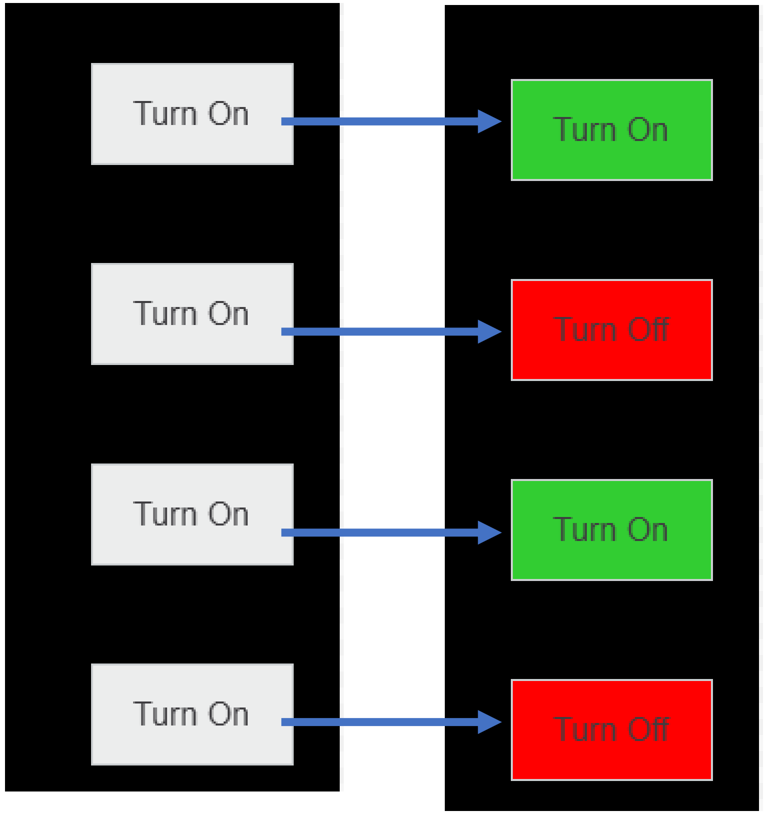
Action on Click (1)

Action: Write value

Source Type	Constant
Source constant	True
Destination variable	OUTPUT_5

Create and configure eight buttons

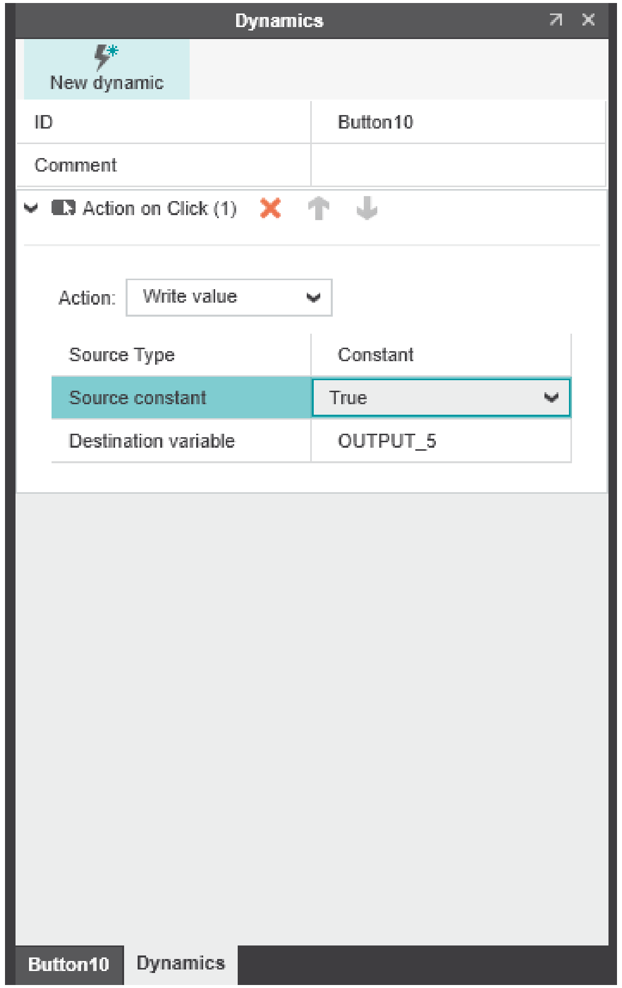
- Use Control C and Control V to copy and paste this button until you have a total of eight (8) buttons
- Double click on each button to configure each one appropriately.
- On the Button tab, you will want to keep the text as on the original button for the three other “Turn on” (or “Start) buttons. you may want to change these button’s color to green for example.
- On the other four buttons, on the button tab, make sure you change the text to “Turn off” or “Stop”…you may also want to change the button’s background color to red, for example.



Four buttons shown, you will create eight buttons, total

Set the dynamics of the button

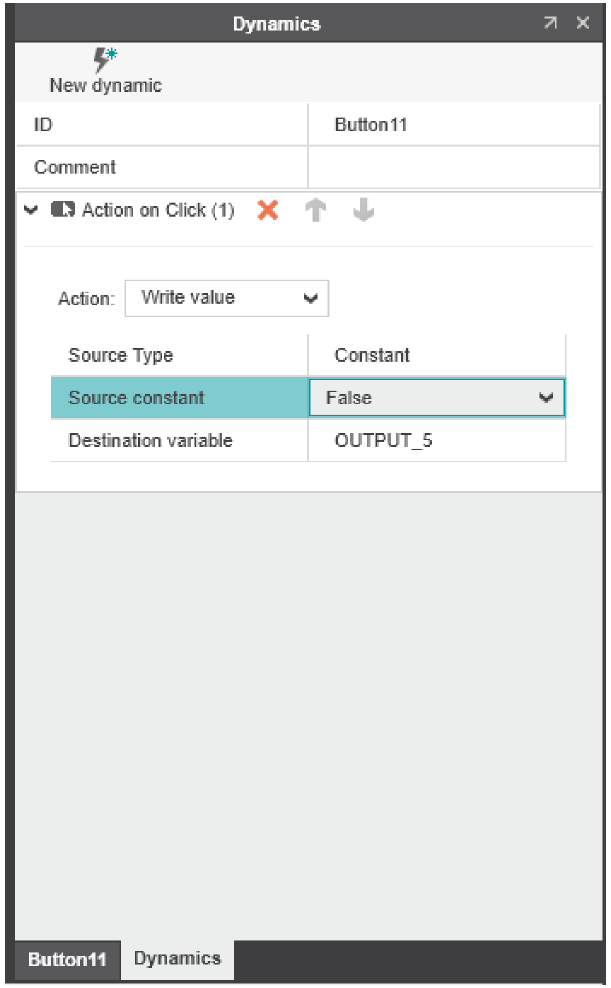
- Don’t forget to click on the Dynamics tab and change all the “Turn Off” (or “Stop”) buttons to have Source constant = False
- Remember also to increment each pair of buttons to the appropriate Destination variable… OUTPUT_5, then _6, then _7, then _8.
- Save then download to the PLCnext controller and run



ID	Button10
Comment	

Action: Write value

Source Type	Constant
Source constant	True
Destination variable	OUTPUT_5



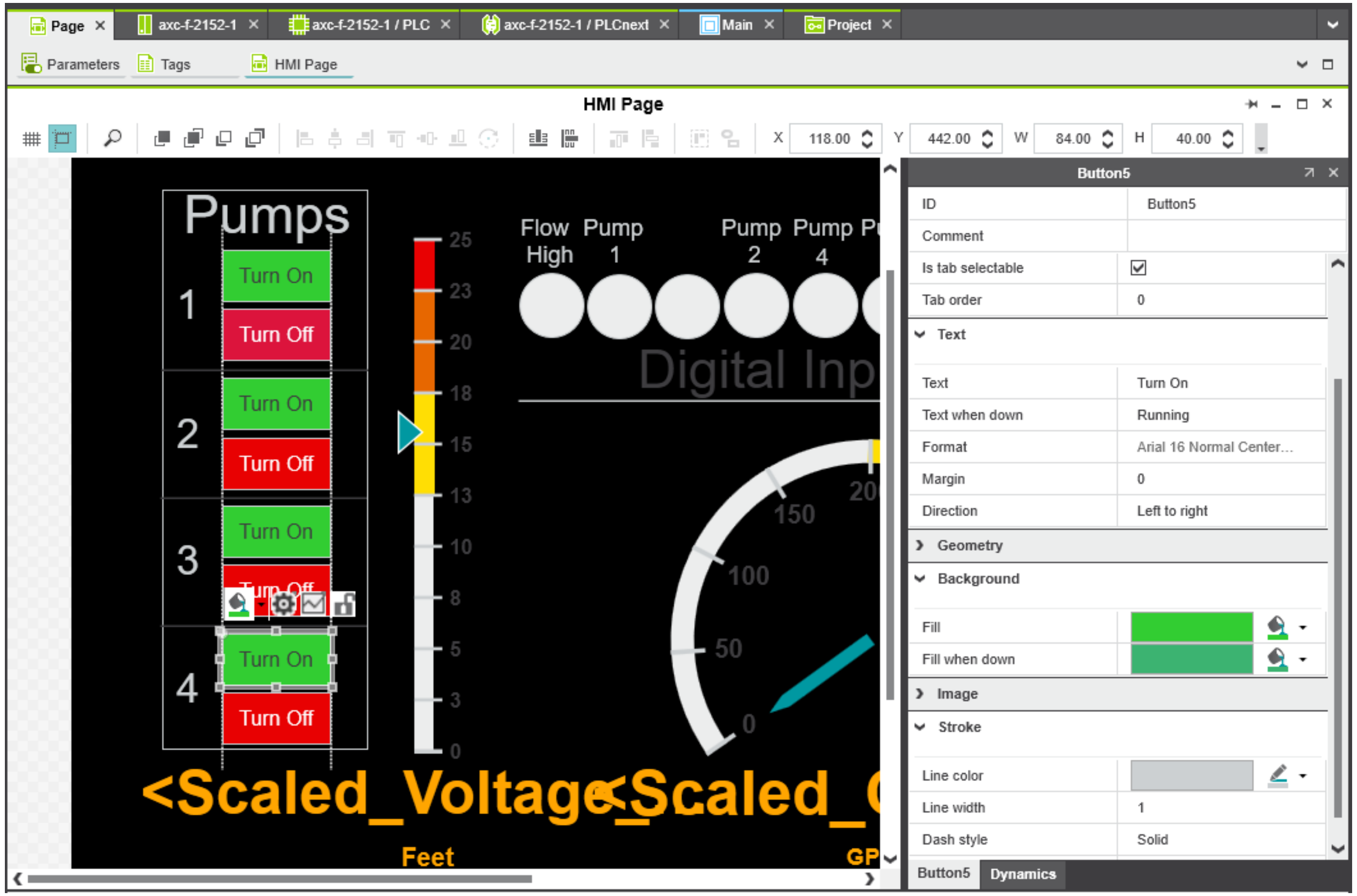
ID	Button11
Comment	

Action: Write value

Source Type	Constant
Source constant	False
Destination variable	OUTPUT_5

Final touches

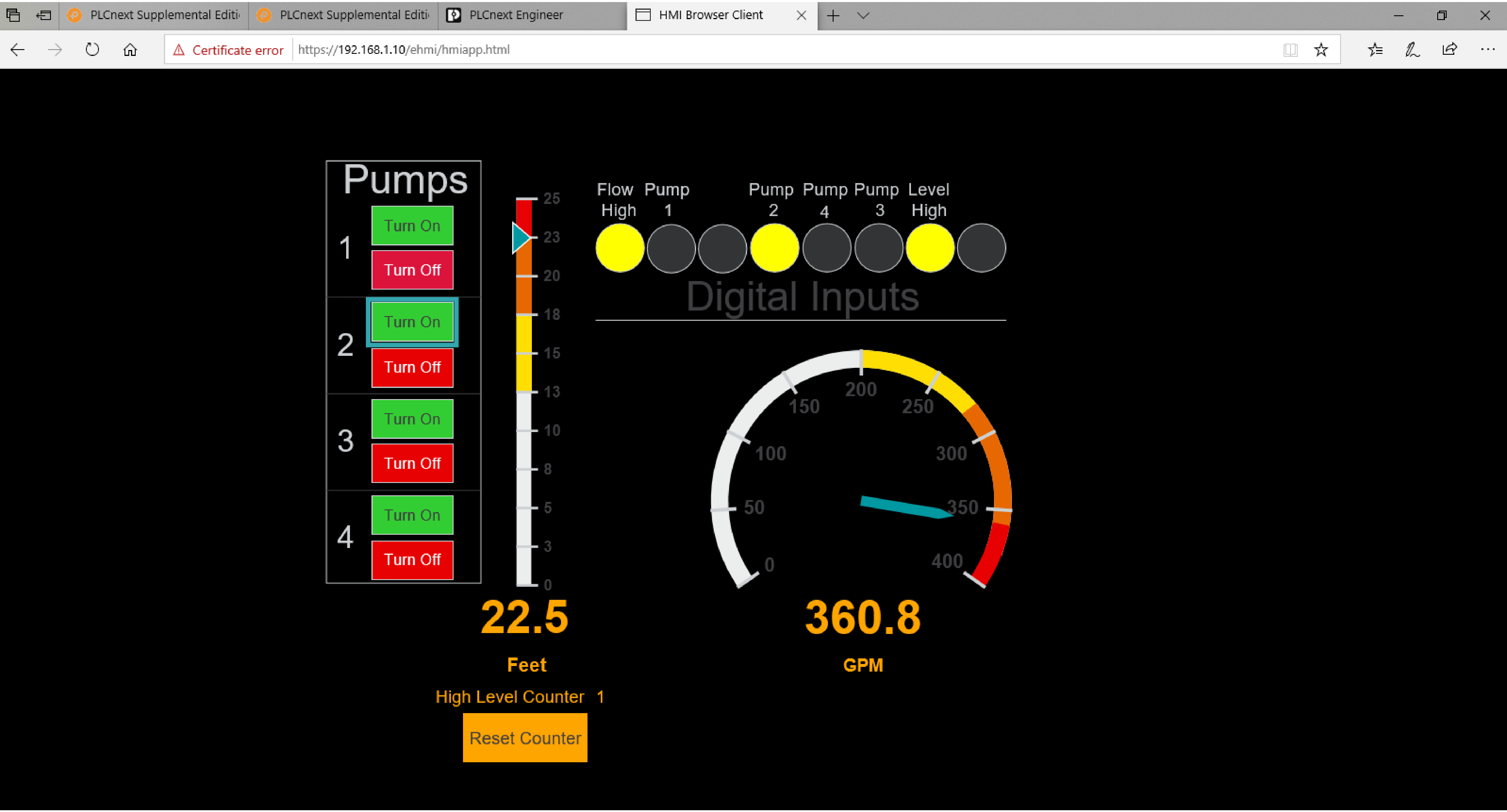
- After adding some text, rearranging the buttons, and tweaking the buttons’ configurations, I have a development screen that looks like this.
- The final result can be seen in runtime application in the browser as shown on the next slide



X 118.00 Y 442.00 W 84.00 H 40.00

Button5

ID	Button5
Comment	
Is tab selectable	☑
Tab order	0
Text	
Text	Turn On
Text when down	Running
Format	Arial 16 Normal Center...
Margin	0
Direction	Left to right
Geometry	
Background	
Fill	🟩
Fill when down	🟩
Image	
Stroke	
Line color	⬜
Line width	1
Dash style	Solid



22.5

Feet

360.8

GPM

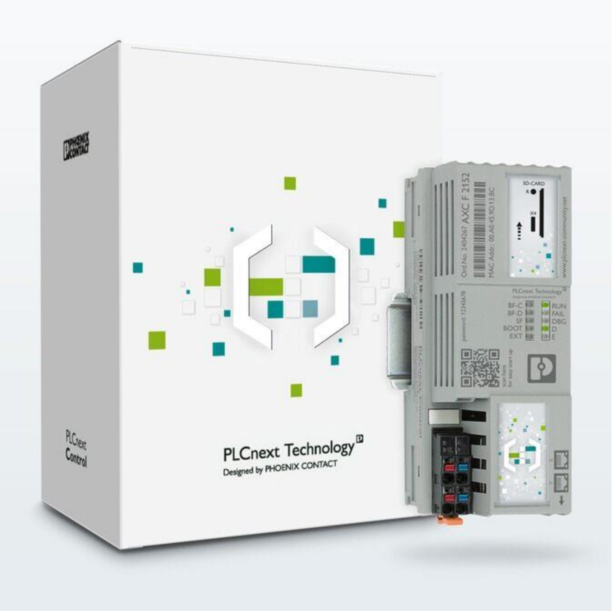
High Level Counter 1

Reset Counter

PLCnext Technology

Part 1 - Getting started and writing your first program

End of this training module



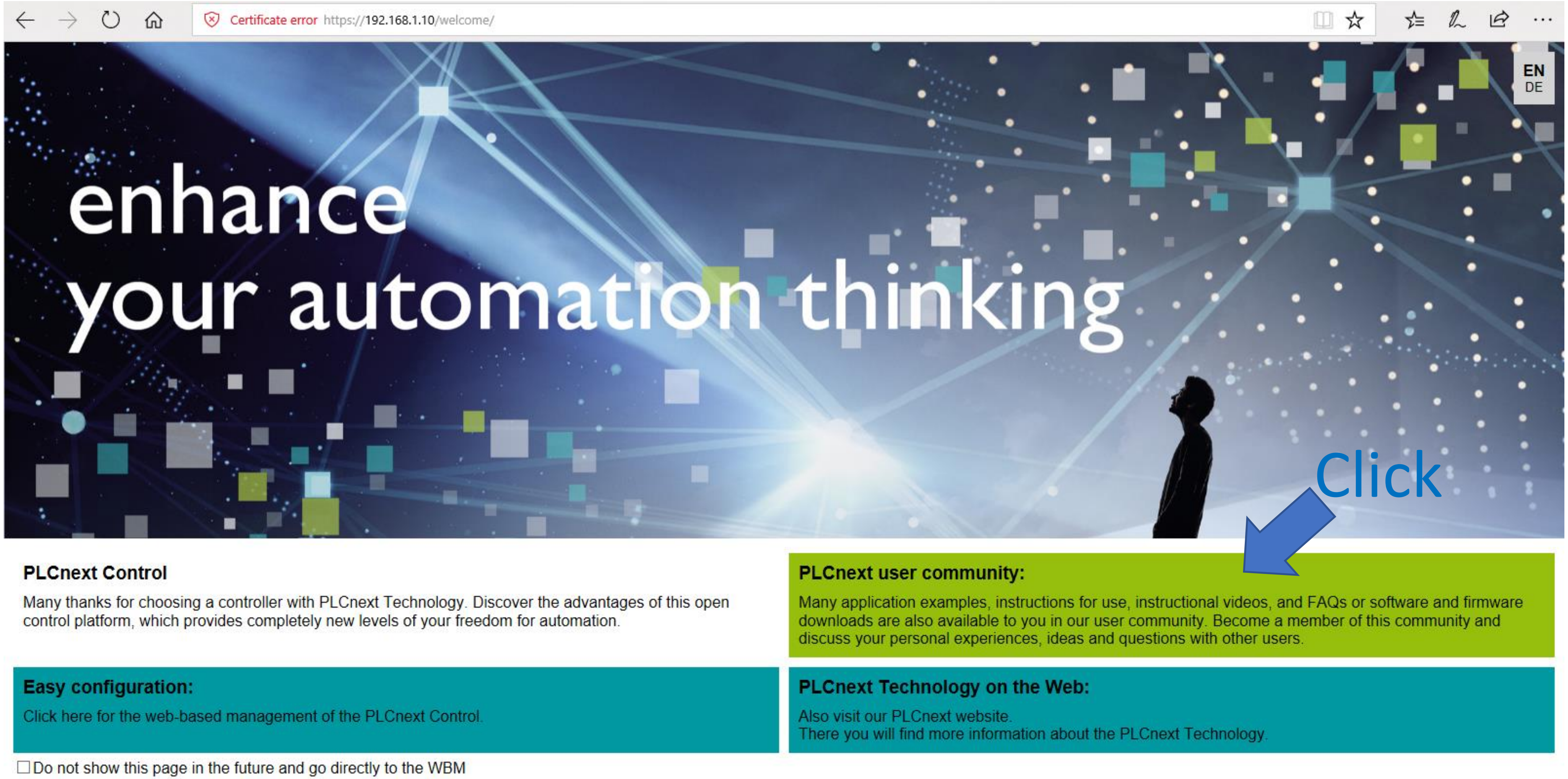
Appendix – More info on PLCnext’s web interface

We have used the web interface to access the WBM – web based management of the PLCnext controller.

It is possible* to also follow links (buttons) on the welcome screen to visit:

- The PLCnext Community
- The Phoenix Contact website

* Internet access required (obviously)



PLCnext Control

Many thanks for choosing a controller with PLCnext Technology. Discover the advantages of this open control platform, which provides completely new levels of your freedom for automation.

PLCnext user community:

Many application examples, instructions for use, instructional videos, and FAQs or software and firmware downloads are also available to you in our user community. Become a member of this community and discuss your personal experiences, ideas and questions with other users.

Easy configuration:

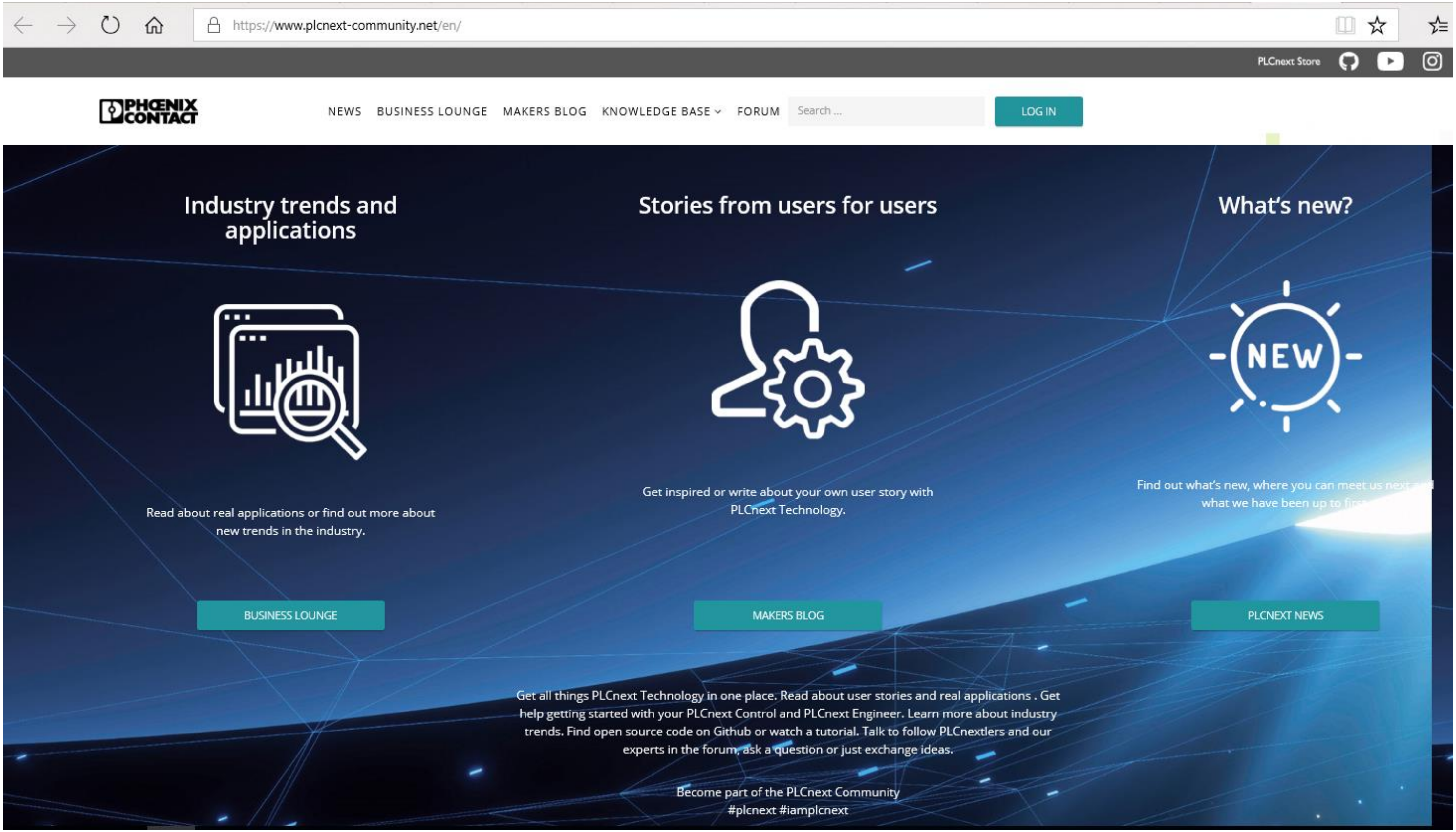
Click here for the web-based management of the PLCnext Control.

PLCnext Technology on the Web:

Also visit our PLCnext website.
There you will find more information about the PLCnext Technology.

☐ Do not show this page in the future and go directly to the WBM

To access the PLCnext user community, an Internet connection is necessary concurrently with your connection to the PLCnext controller. For example, WiFi connection to the internet, while the laptop’s Ethernet adaptor is attached to the PLCnext controller.



Industry trends and applications

Read about real applications or find out more about new trends in the industry.

Stories from users for users

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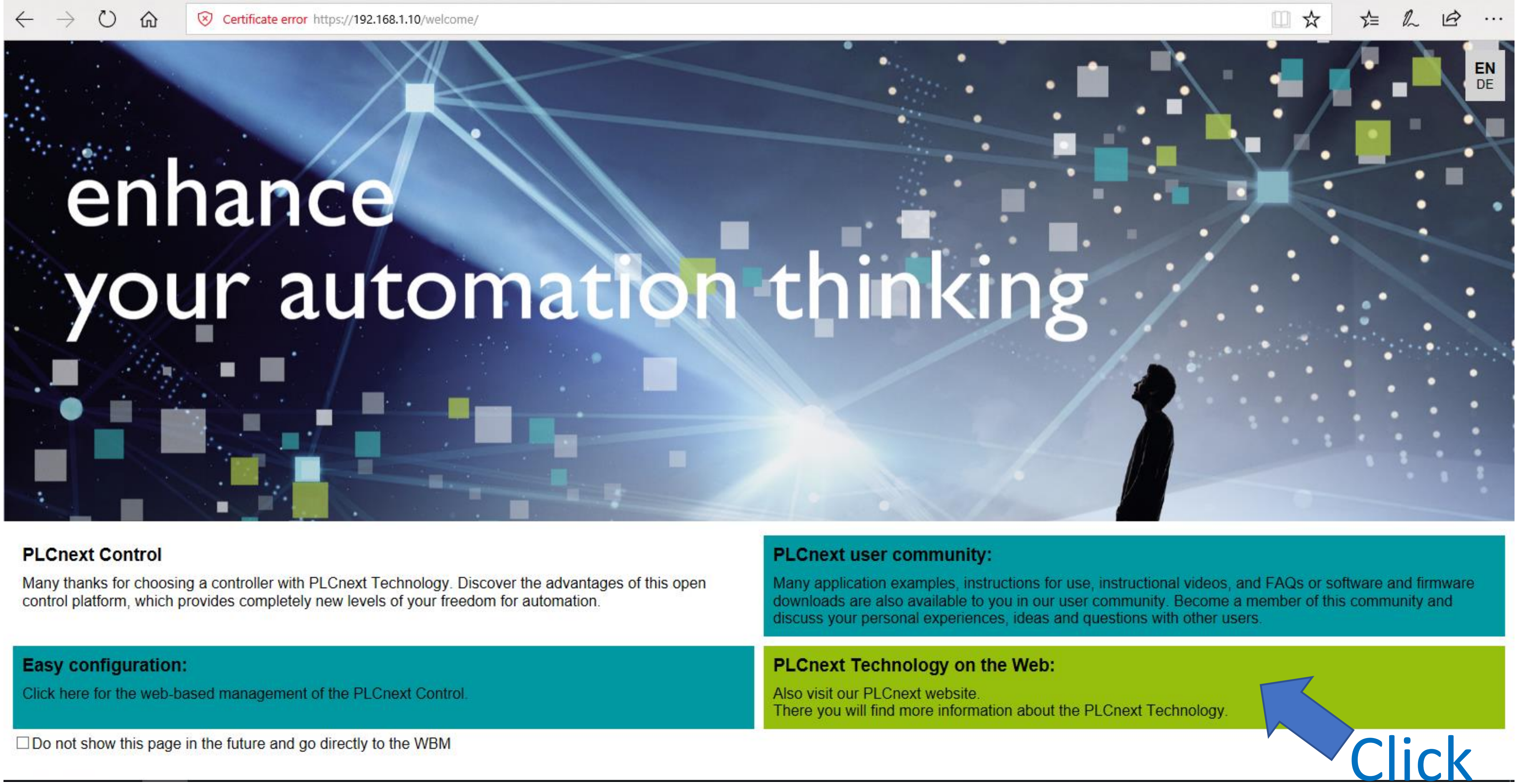
What's new?

Find out what's new, where you can meet us next and what we have been up to first

Get all things PLCnext Technology in one place. Read about user stories and real applications . Get help getting started with your PLCnext Control and PLCnext Engineer. Learn more about industry trends. Find open source code on Github or watch a tutorial. Talk to follow PLCnextlers and our experts in the forum, ask a question or just exchange ideas.

Become part of the PLCnext Community
#plcnext #iamplcnext



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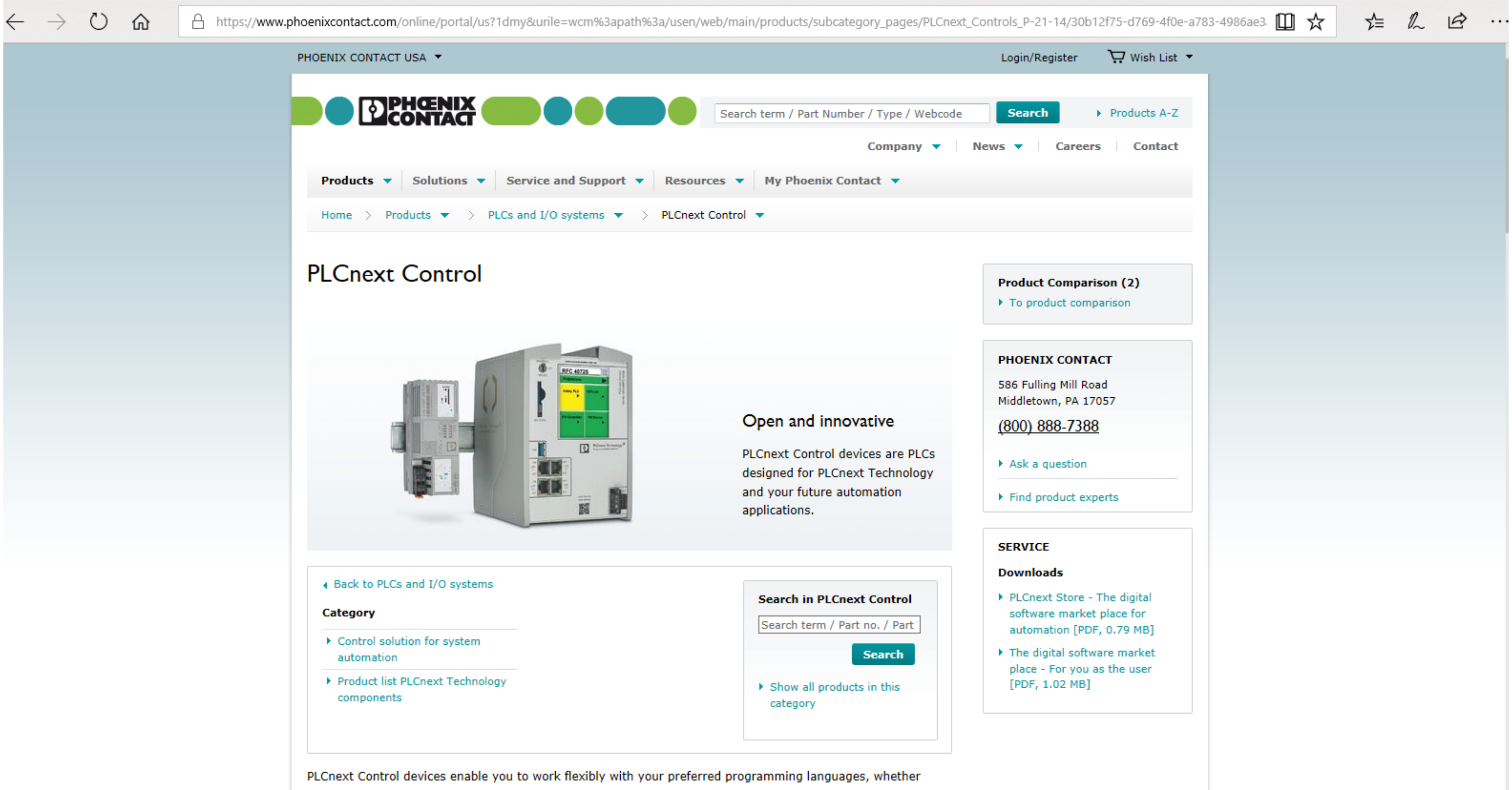
Click



https://www.phoenixcontact.com/online/portal/us?1dmy&urile=wcm%3apath%3a/usen/web/main/products/subcategory_pages/PLCnext_Controls_P-21-14/30b12f75-d769-4f0e-a783-4986ae3

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- PLCnext Store - The digital software market place for automation [PDF, 0.79 MB]
- The digital software market place - For you as the user [PDF, 1.02 MB]

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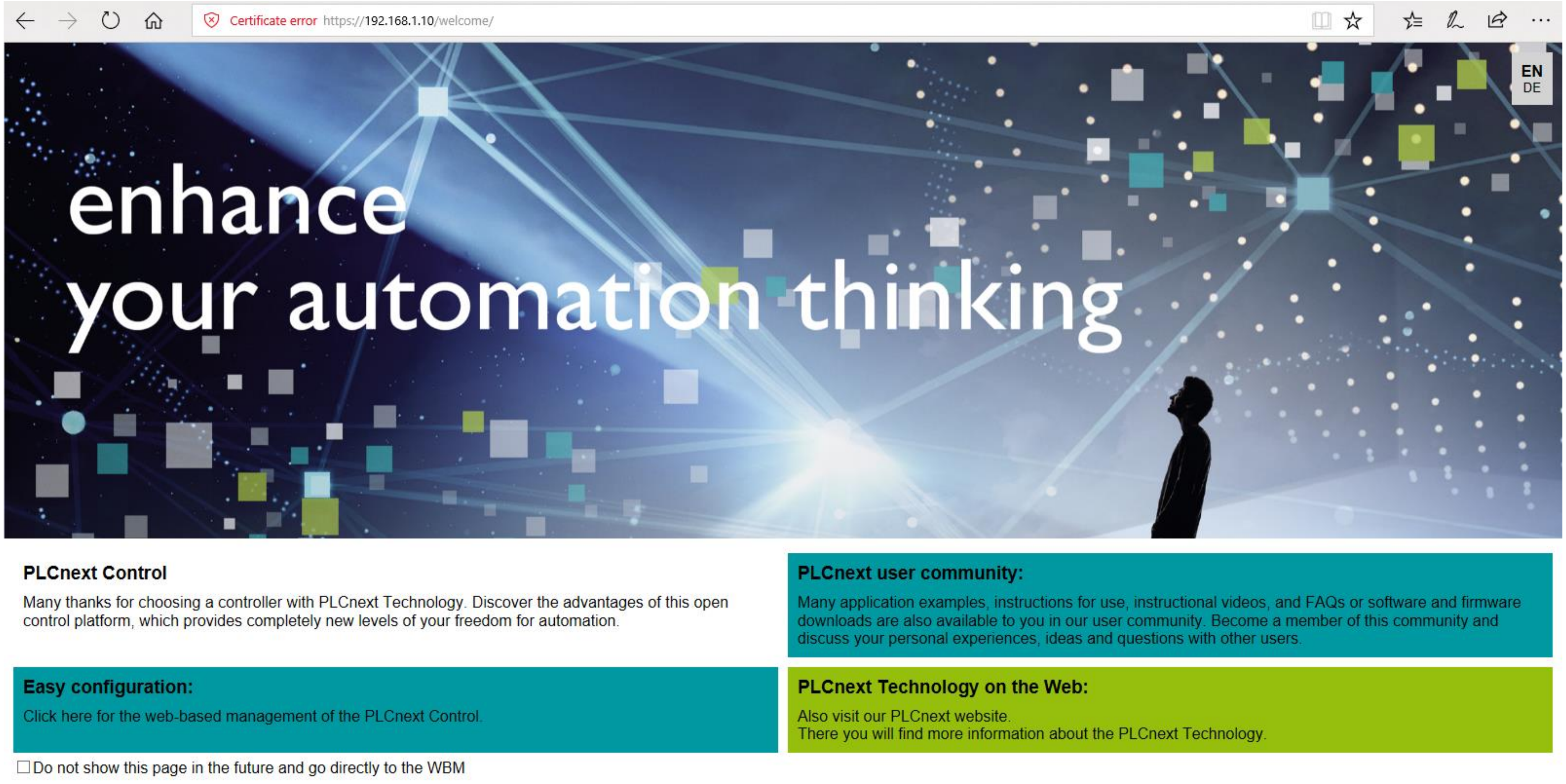

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□ Do not show this page in the future and go directly to the WBM

Close out of the browser and get back into PLCnext Engineer

PLCnext Technology

Thank You!