Application Note

FESTO

Driver Block Library for PCS7

Commissioning devices using the PCS7 driver library- for CTEU and CPX Bus Nodes

CTEU, VTUG, CPX

100801

Title ..... Driver Block Library for PCS7

Version 1.10

Document no. 100801

Original ..... en

Author ..... Festo

Last saved 20.01.2026

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1 Introduction

This application note explains how to setup the Driver Library for PCS7 with CTEU and CPX remote valve terminal/IO nodes. The library is designed to integrate Festo devices seamlessly with PCS7 systems using an automated process that creates diagnostic function blocks according with the hardware configuration, supporting I/O simulation and Alarm handling with WINCC SCADA system. This library conforms with the standards of SIMATIC PCS7 Advanced Process Library (APL) or PCS7 Standard Library. This application note will through the steps of commissioning, operation and diagnostics using driver blocks from CTEU-PN with VTUG and CPX terminal.

1.1 Software Requirement

Software Name	Version (or) Firmware
SIMATIC PCS7	V9.1 SP2
CPX Driver Block Library	V2.2.0.2
CTEU Driver Block Library	V1.0.1.2

Table 1.1: Software requirements

➔ **Note**

- The CPX and CTEU libraries has been tested with Simatic PCS7 V9.1SP2

1.2 Hardware Requirement

Device Name	Part Number	Version (or) Firmware
CTEU-PN(2201471)	FESTO	V2.2.4
VAEM-L1-S-8-PT (573384)	FESTO	REV 10
VTUG-10-VRPT-B1T-Q6-U-Q6S-AVKVKG (573606)	FESTO	--
CPX (197310)	FESTO	--
CPX-GE-EV-S (195746)	FESTO	--
CPX-GE-EV (195742)	FESTO	--
CPX-EPR-EV(195714)	FESTO	--
CPX-M-FB44 (8110370)	FESTO	REV 55
CPX-AB-8-KL-4P M3 (546999)	FESTO	--
NEBU-M8G4-K-2.5-LE4 (541342)	FESTO	--
NEBC-D12G4-ES-3-S-R3G4-ET (8040452)	FESTO	--
CPU 414-3 PN/DP (6ES7 414-3EM06-0AB0)	SIEMENS	V8.1.2
PS 405 10A (405-0KA02-0AA0)	SIEMENS	--
UR2 (6ES7 400-1JA01-0AA0)	SIEMENS	--
Straight Ethernet Cables Cat.6	--	--

Table 1.2: Hardware requirements



Note

- The hardware mentioned above are considered for this Application Note.

1.3 FESTO Driver Block Library Versioning

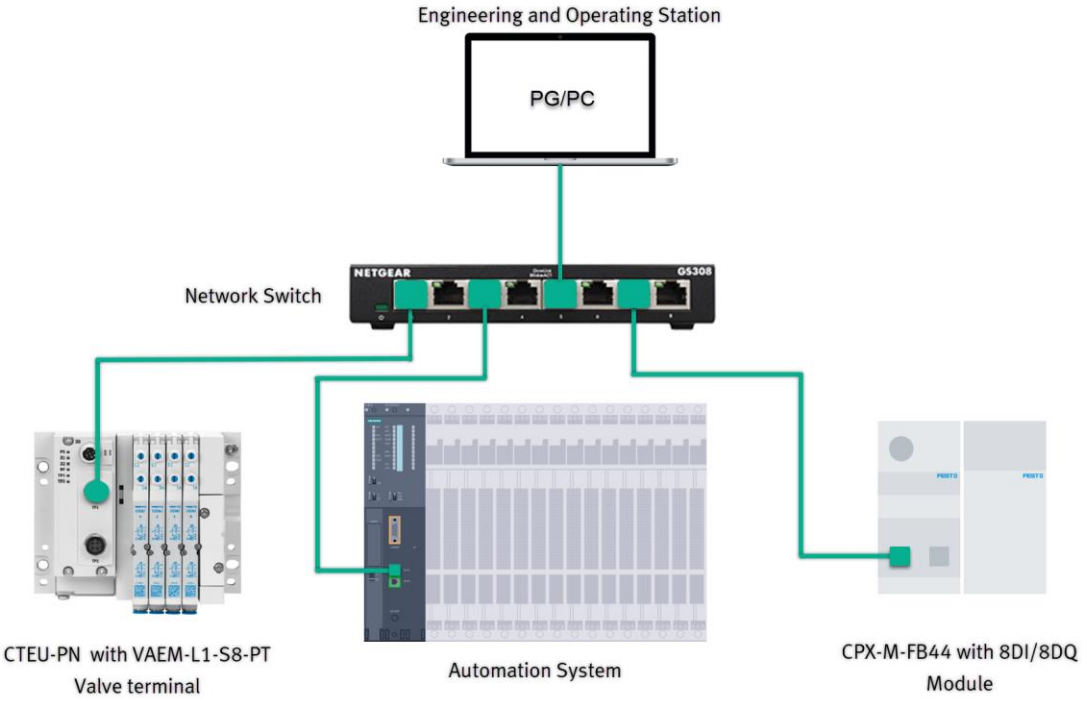
The table below shows the configuration possibilities from each Drive Block Library according with the available version:

Fieldbus	Feature	CTEU	CPX
Profibus/net	Automatic Module Driver Generation	All Versions	All Versions
Profinet	S2 type Redundancy	-	All Versions
Profinet	Media Redundancy Protocol (MRP)	All Versions	All Versions
Profibus	Y-link Coupler Configuration	V1.0.0.8	-

Table 1.3: Driver block versioning

1.4 Topology

This application note uses a standard architecture to establish communication. The engineering and/or operating station server (ES/OS) running **PCS7 V9.1SP2** is connected to a network switch. The automation station (AS) which has an **UR2** rack, a **PS405** power supply and **CPU 414-3PN/DP** is connected to the same network switch through **Ethernet cable**. A **CTEU-PN** mounted on valve terminal **VAEM-L1-S-8-PT** is connected to the switch through an **M12 to RJ45 Ethernet cable**. A **CPX** rack having **CPX-FB44 Profinet** module and an **8DI/8DO** module is connected to the network switch.



2 Documentation

2.1 Festo Documentation

This documentation intends to deliver supplementary information regarding the following Festo documentations:

- CTEU-PN (8067836):
  https://www.festo.com/net/en_gb/SupportPortal/Downloads/367656/464558/CTEU-PN_2017-03a_8067836g1.pdf

- VAEM-L-S-8-PT (8109570):
  https://www.festo.com/net/en_gb/SupportPortal/Downloads/385950/699669/VTUG-_-M_VTUG-_-V_instruction_2020-01h_8109570g1.pdf

- VTUG (8109570) :
  https://www.festo.com/net/en_gb/SupportPortal/Files/699669/VTUG-_-M_VTUG-_-V_instruction_2020-01h_8109570g1.pdf

- PCS7 Module Drivers for CTEU:
  https://www.festo.com/net/en-gb_gb/SupportPortal/Downloads/651992/718471/Festo%20CTEU%20Treiber%20Bibliothek%20EN.pdf

Note

Search keyword : **PCS7,** use search at the support portal with the mentioned keyword.

2.2 3rd Party Documentation

As research and bibliography , the following auxiliary documents has been used :

- Configuration Samples for SIMATIC S7-400:
  https://support.industry.siemens.com/cs/document/90885106/configuration-examples-for-s7-400h-with-profinet-simatic-s7-400h-as-of-v6-0?dti=0&lc=en-WW

- SIMATIC S7-300/S7-400 Software redundancy for SIMATIC S7:
  https://support.industry.siemens.com/cs/document/1137637/simatic-s7-300-s7-400-software-redundancy-for-simatic-s7?dti=0&lc=en-WW

- PCS7 APL Engineering Guide:
  https://cache.industry.siemens.com/dl/files/346/109482346/att_924010/v1/s7jal90b_en-US.pdf

- SIMATIC APL Operator Guide:
  https://cache.industry.siemens.com/dl/files/288/50249288/att_11932/v1/50249288_apl_v8_operator_guide_en.pdf

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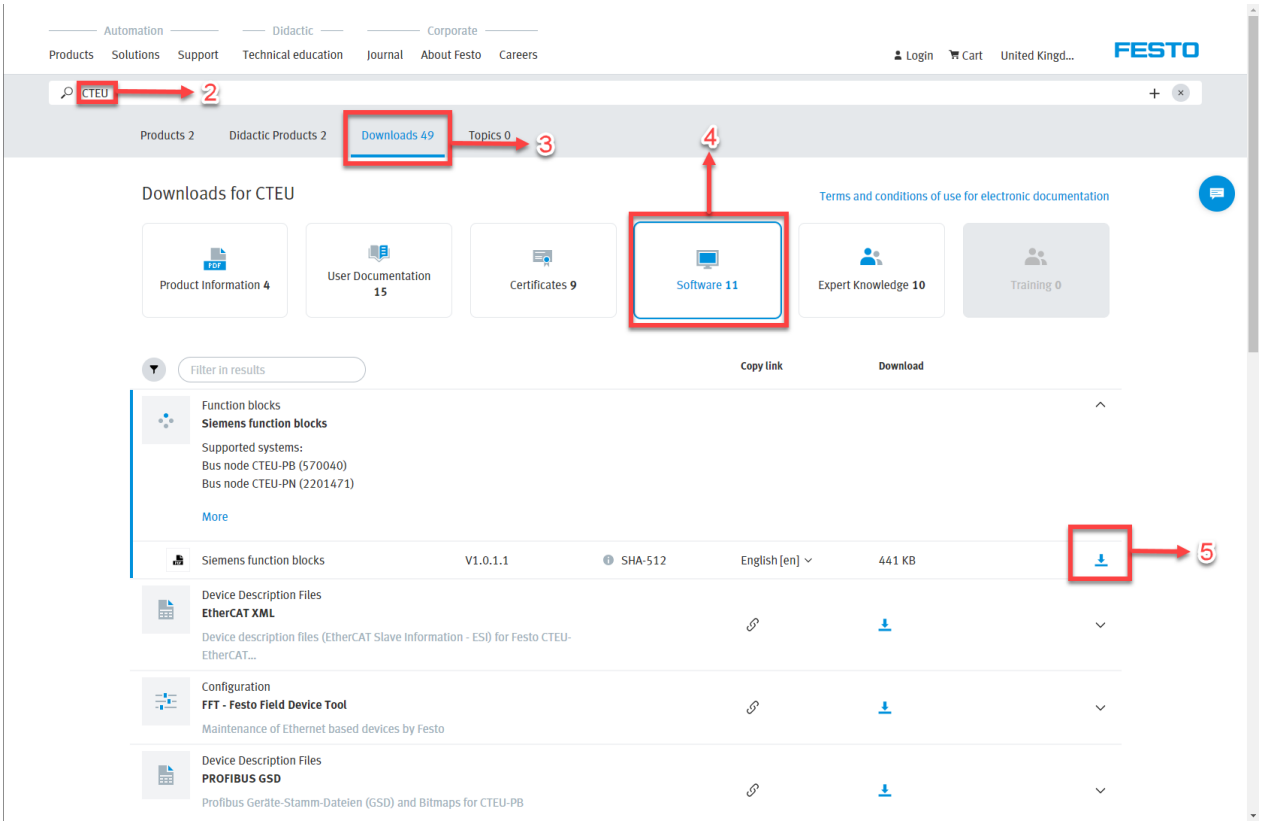
These documents were used for bibliography and research purposes. In case of problems with broken links and missing/wrong information it is advised to contact the manufacturer.

3 Driver Block Library Installation

3.1 Downloading CTEU Library from Festo Support Portal

Follow the steps below to download the CTEU Library for PCS7:

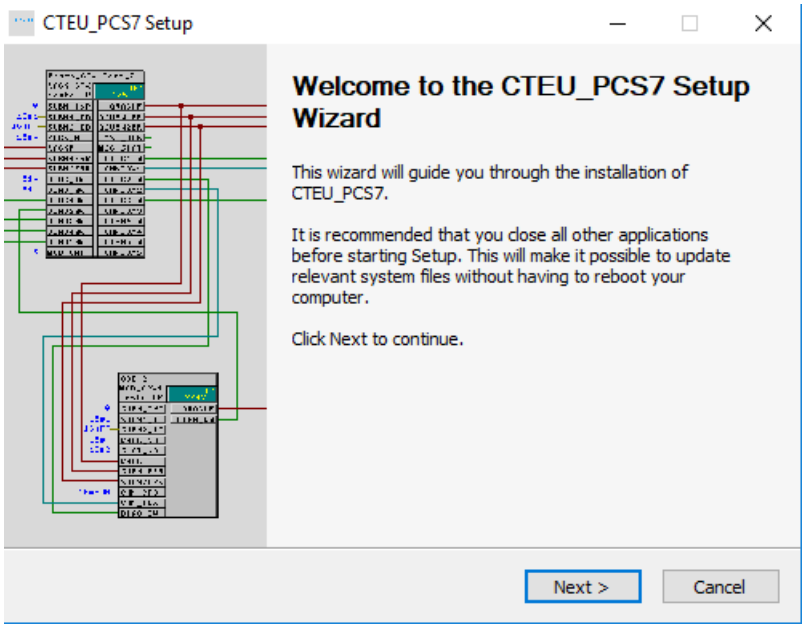
1. Driver blocks can be download at the support portal using the link : [Automation technology and technical education solutions | Festo GB]
2. Search for the term **“CTEU”**.
3. Select the tab **“Downloads”**.
4. Select **“Software”**.
5. Download the latest file under the tab **“Function Blocks”**

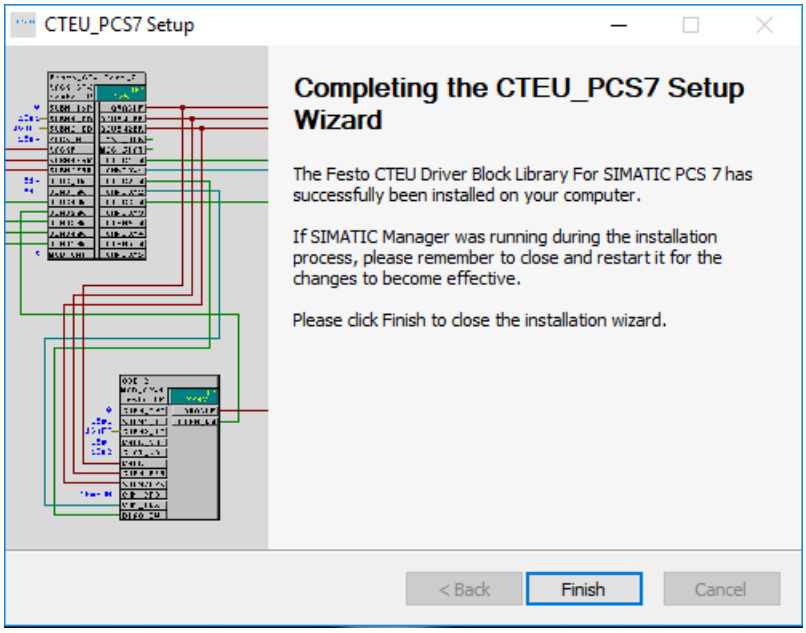


3.2 Installing and verifying Installation

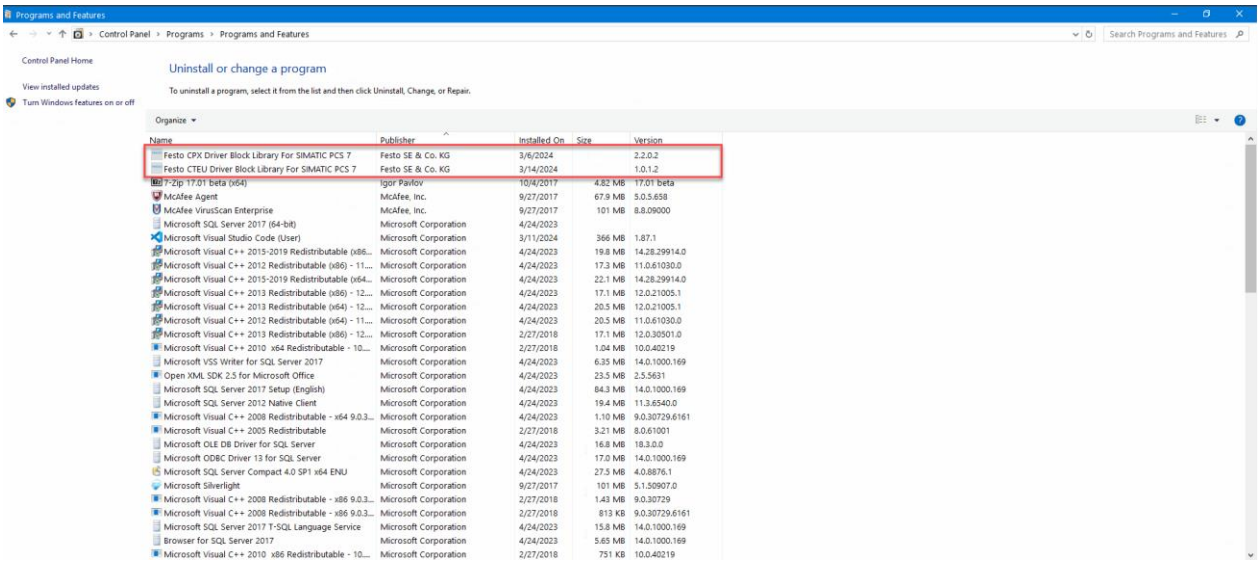
Follow the steps below to install the CTEU Library for PCS7:

1. Run the “installation package” and follow the instructions.





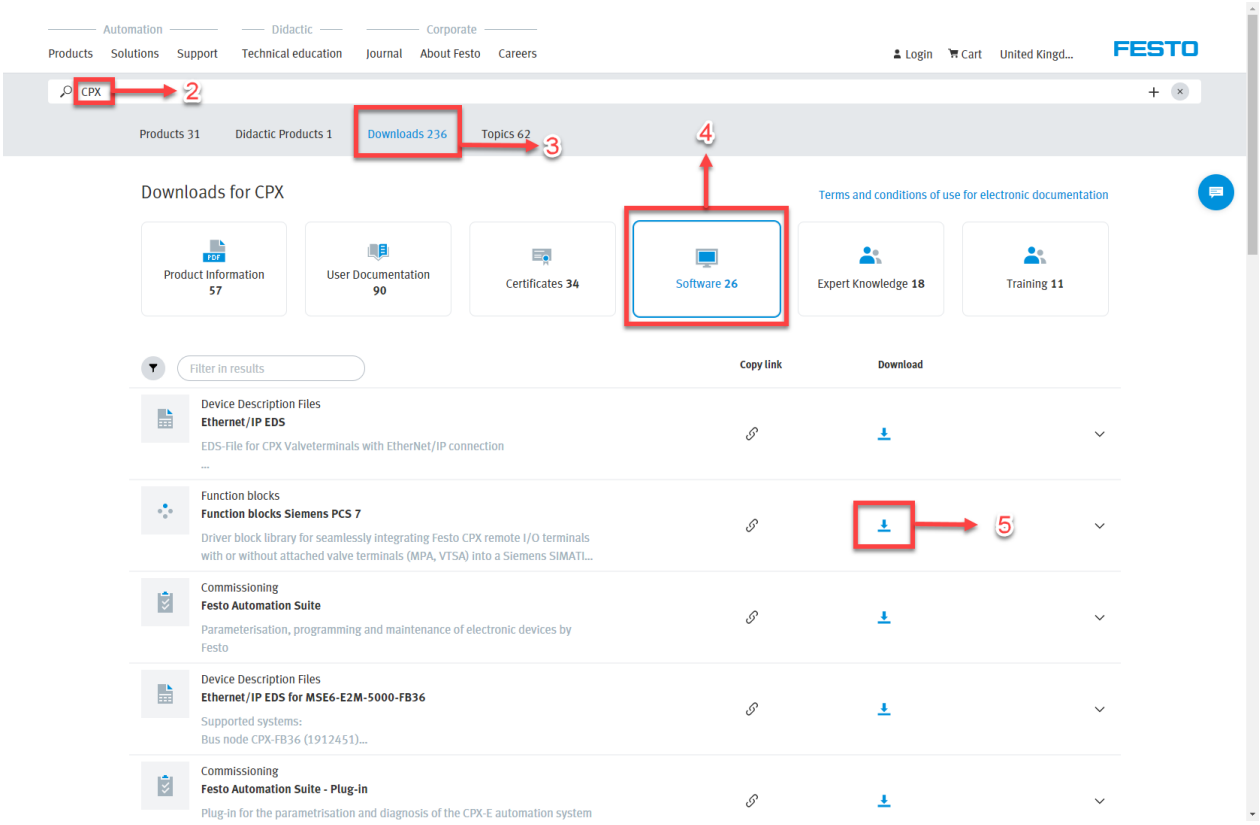
2. Verify the installation in the **“installed softwares”** by opening the **“control panel”**



3.3 Downloading CPX Library from Festo Support Portal

Follow the steps below to download the CPX Library for PCS7:

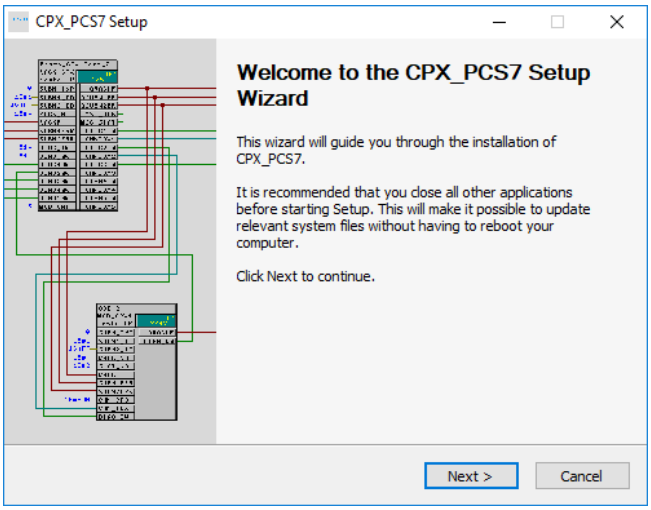
1. Driver blocks can be download at the support portal using the link : [Automation technology and technical education solutions | Festo GB]
2. Search for the term **“CPX”**.
3. Select the tab **“Downloads”**.
4. Select **“Software”**.
5. Download the latest file under the tab **“Function Blocks”**



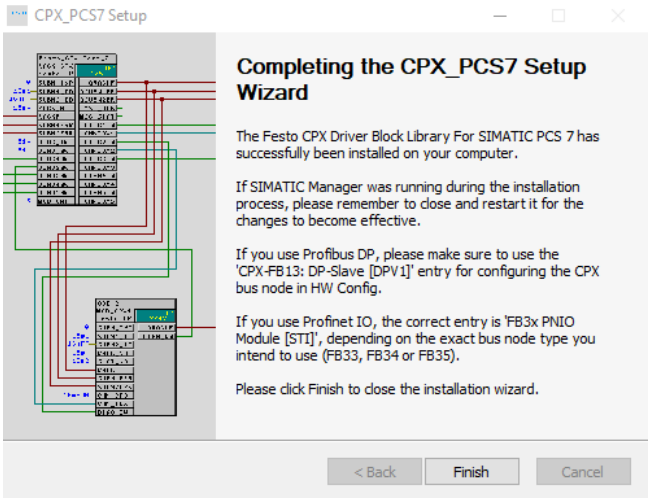
3.4 Installing and verifying Installation

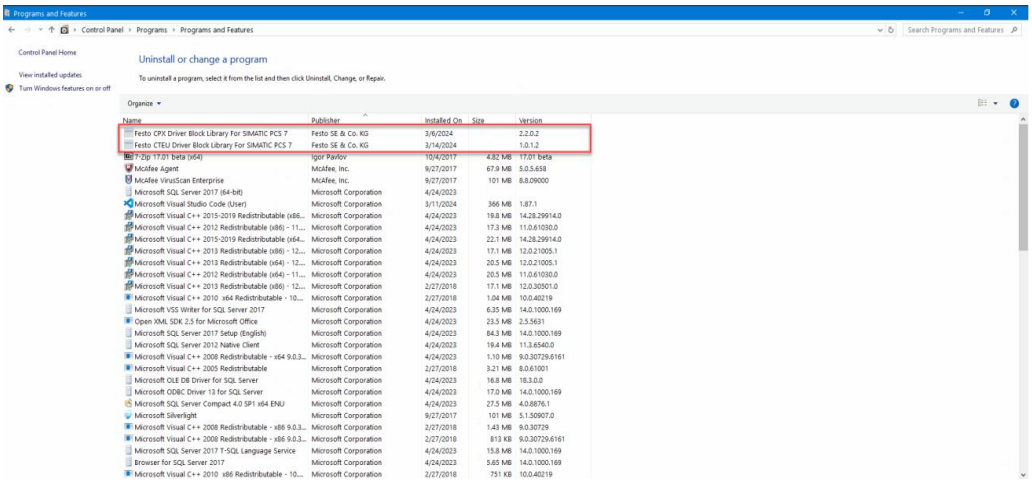
Follow the steps below to install the CPX Library for PCS7:

1. Run the “installation package” and follow the instructions.



2. Verify the installation in the **“installed softwares”** by opening the **“control panel”**



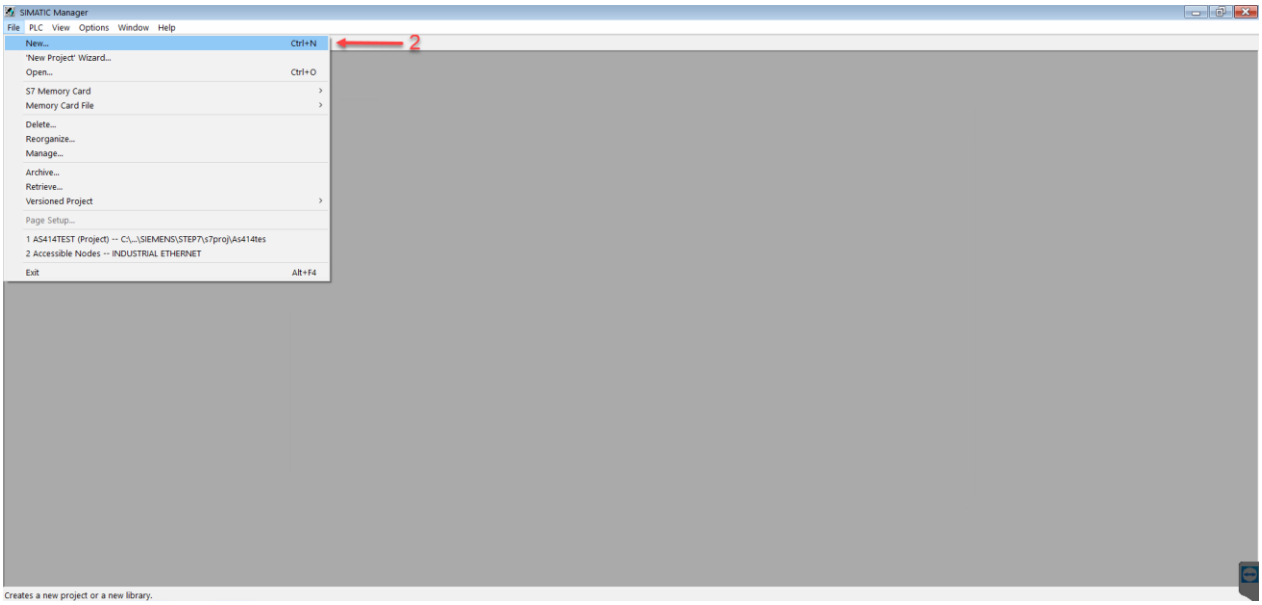


4 Automation System (AS) Configuration

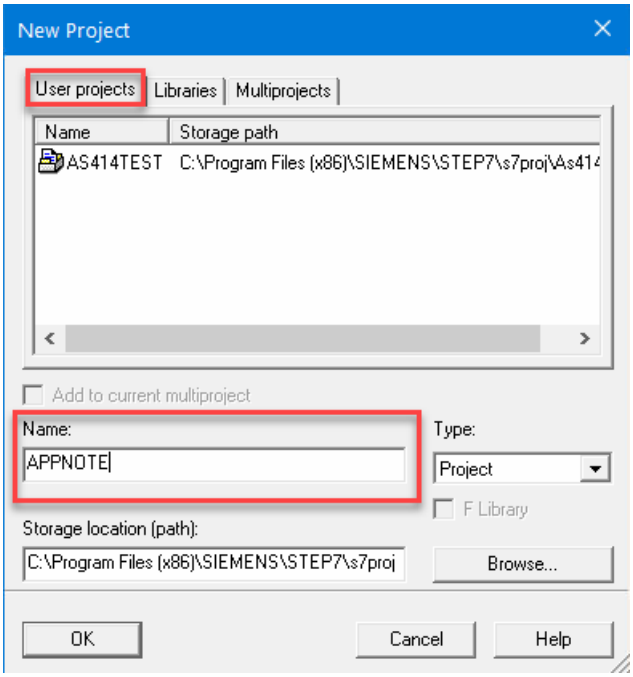
4.1 Creating a PCS7 Project

Follow the steps below to create a PCS7 Project.

1. Open Simatic Manager
2. Open File and Select **“New”**



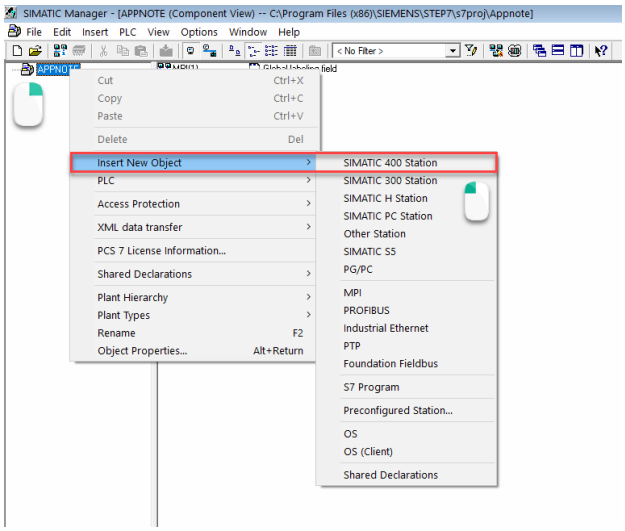
3. Select **“User Projects”** and give a suitable name for the project. Also specify the directory where the project is to be saved.



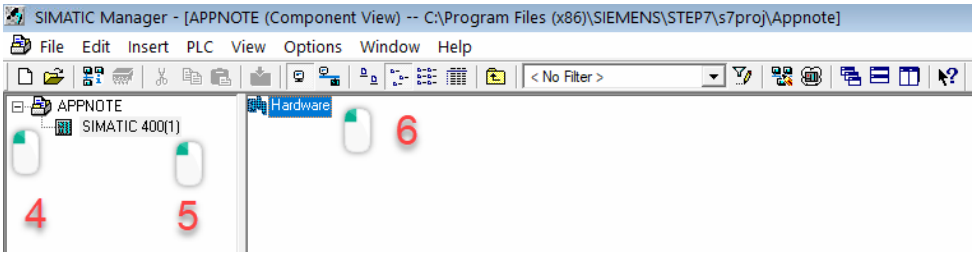
4.2 Automation System (AS) Hardware Configuration

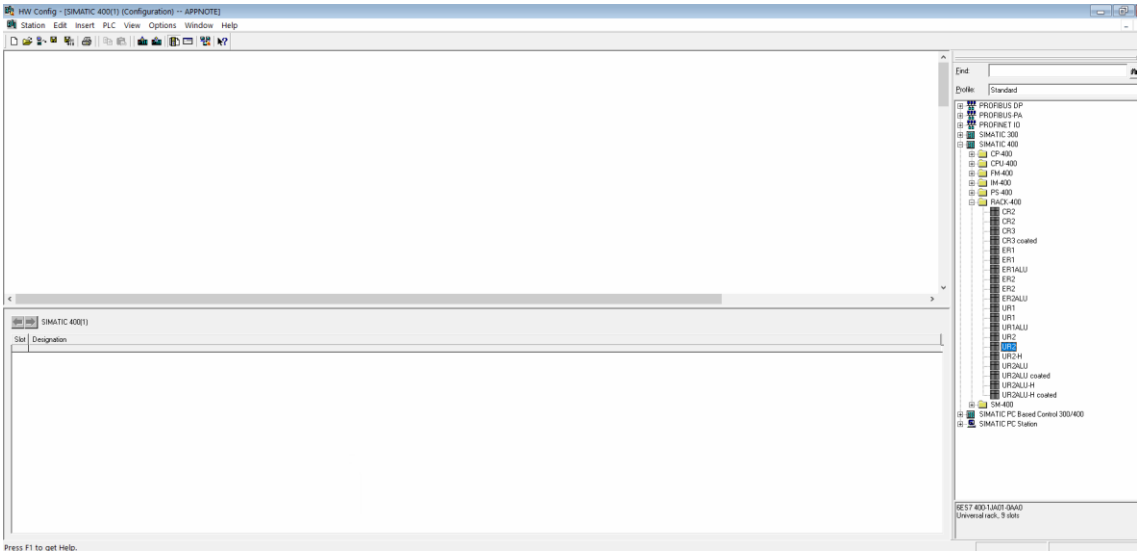
Follow the steps below toto configure Automation System (Controller or PLC) Hardware.

1. **Right Click** on the Project
2. Select **“Insert New Object”**
3. Select **“Simatic 400 Station”** and verify that Simatic 400 Station is added to the project.

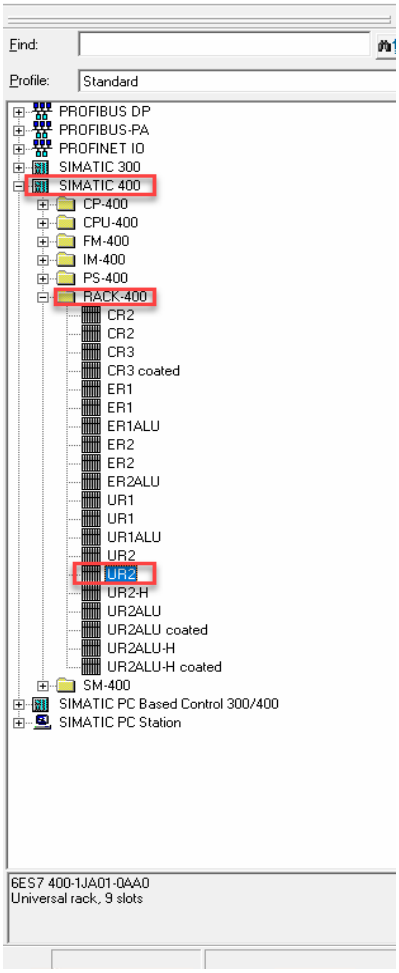


4. Now, expand the project tab.
5. Select **“SIMATIC400(1)”**.
6. Double click on **“Hardware”** to open the hardware configuration window.

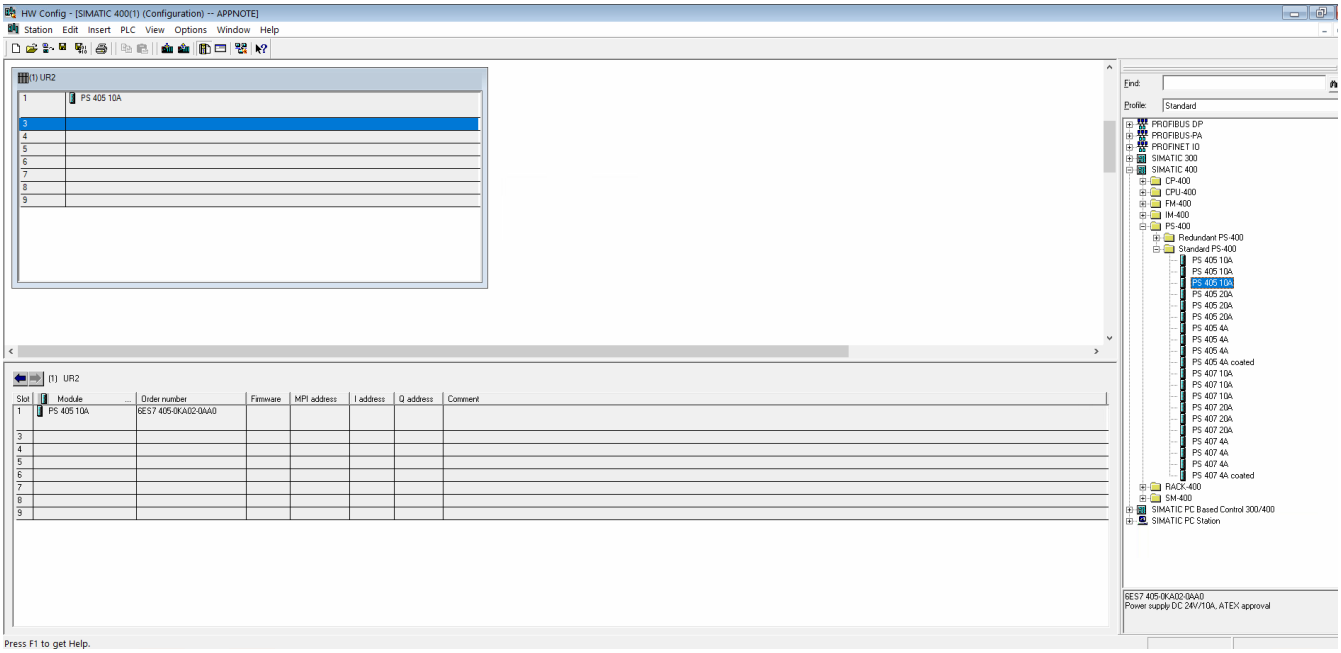




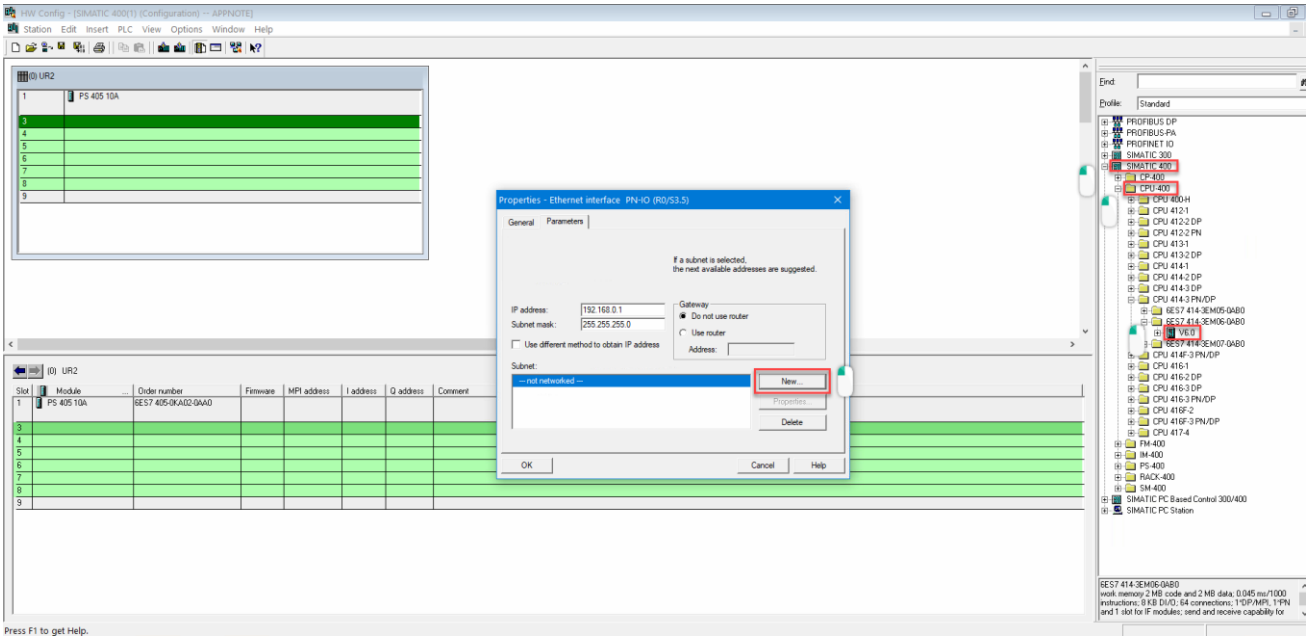
7. Start hardware configuration by adding the rack from the catalogue.



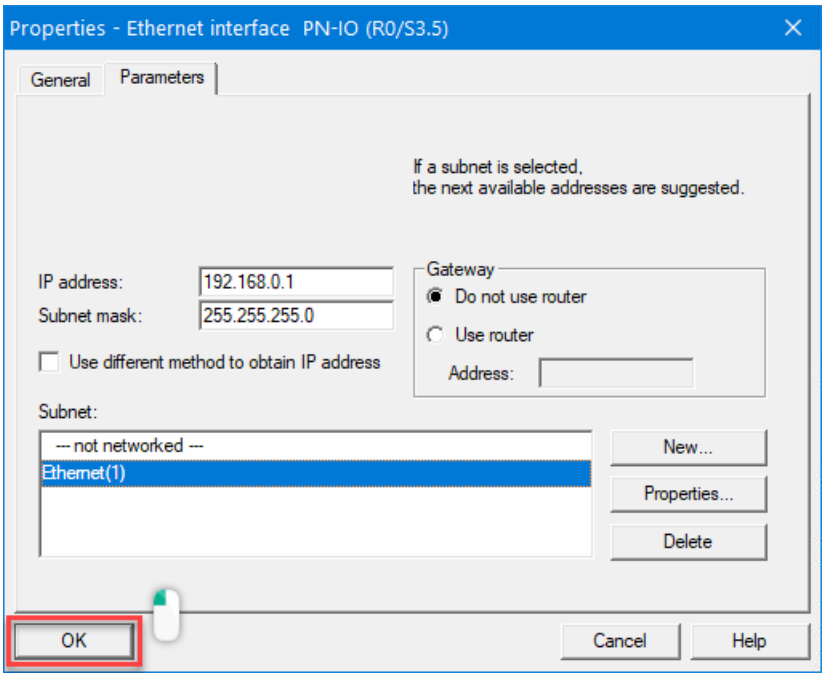
8. Add the Power supply module in the 1st slot of the rack.



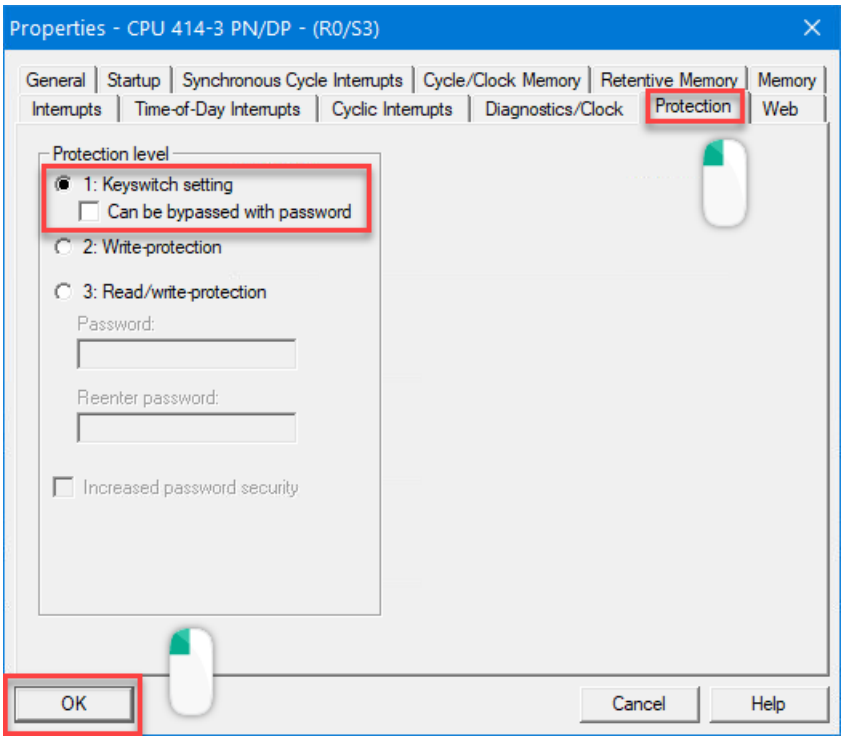
9. Add the CPU module next to the power supply module.



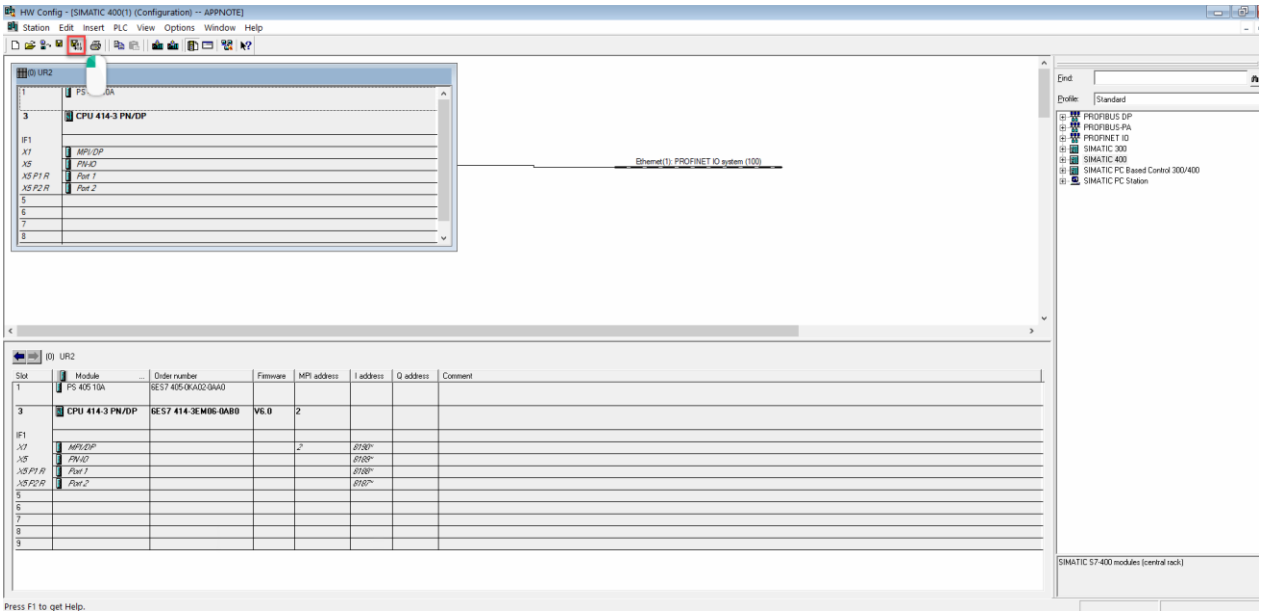
10. Assign IP address and Subnet mask and create a new ethernet network by Selecting **“New”**
11. Select **“OK”** and observe that **Ethernet(1)** is created.



12. Select **“OK”** and the properties of CPU is displayed.
13. Select Protection and set the level of PLC Protection.



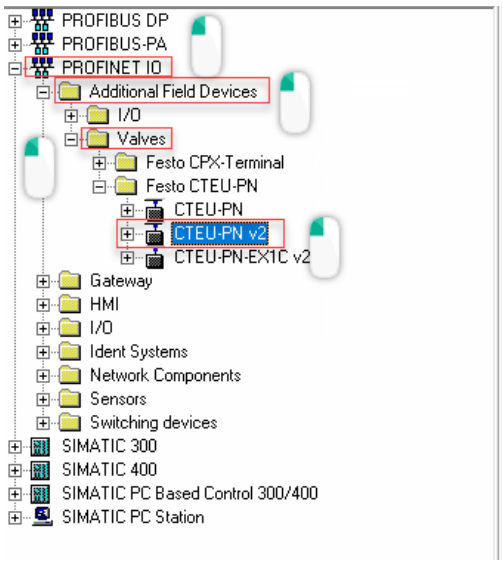
14. This completes the hardware configuration. Save and Compile the Hardware configuration as shown below.



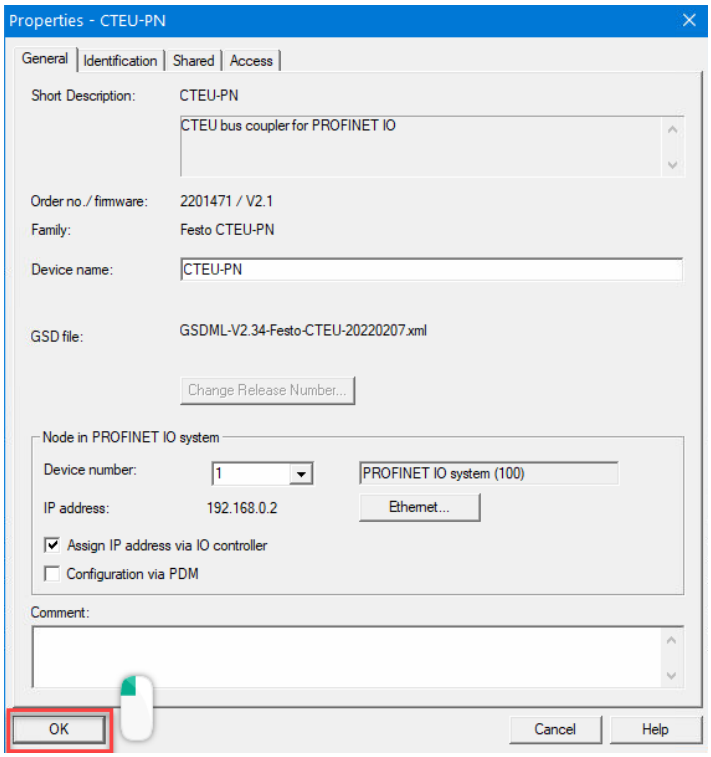
4.3 CTEU Hardware Configuration

Follow the steps below toto configure CTEU Hardware.

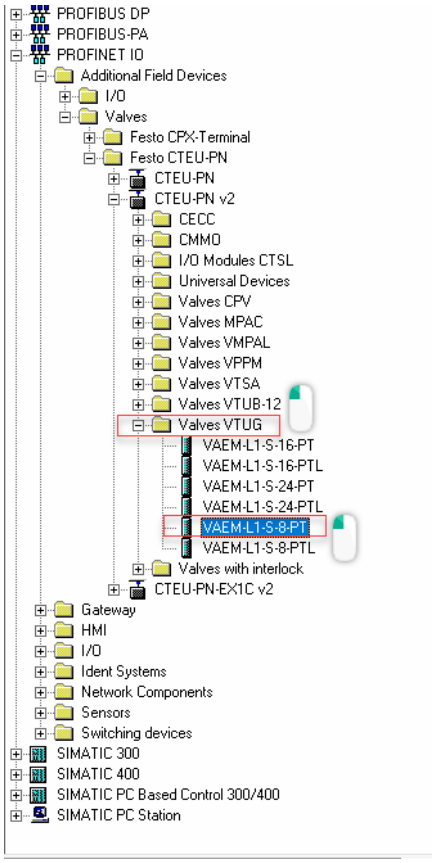
1. In the hardware catalogue, select **“Profinet IO” > “Additional Field Devices” > “Valves” > “Festo CTEU-PN V2”**



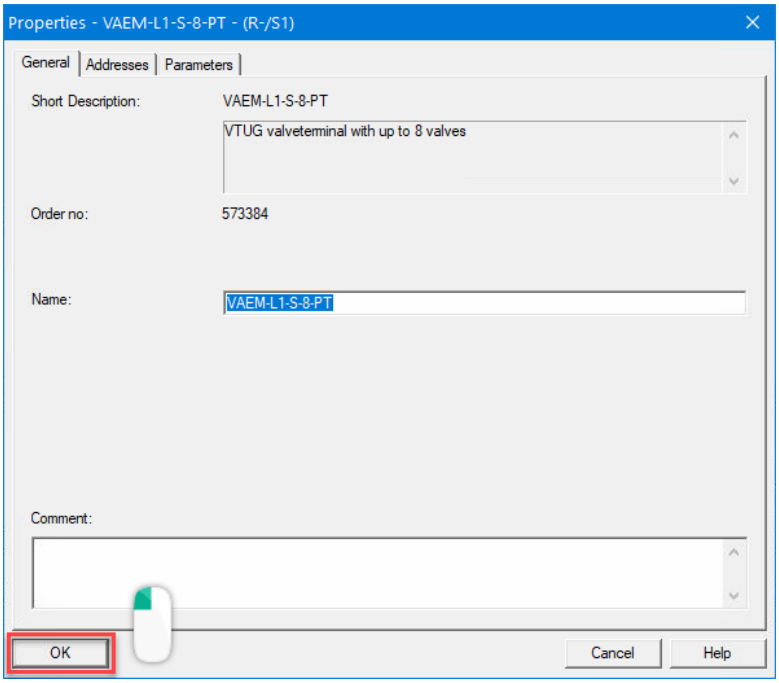
2. Drag and drop **“Festo CTEU-PN V2”** on the **“Ethernet(1)” .** The dialog box for setting IP address opens up.
3. Set the IP address and click **“OK”.** Now CTEU-PN is added.



4. Add the VTUG valve terminal from the hardware catalogue by selecting **“Valves VTUG”** and double clicking **“VAEM-L1-S-8-PT”**.



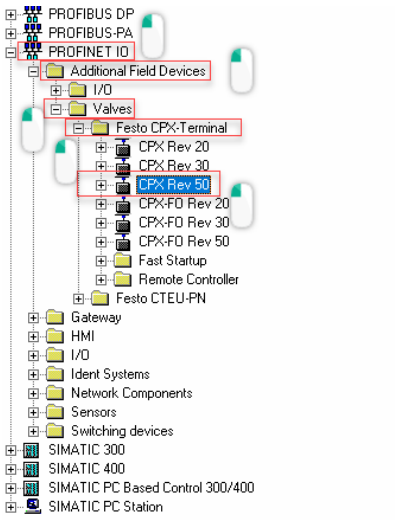
5. Click on “OK” to finish the setup of CTEU hardware.



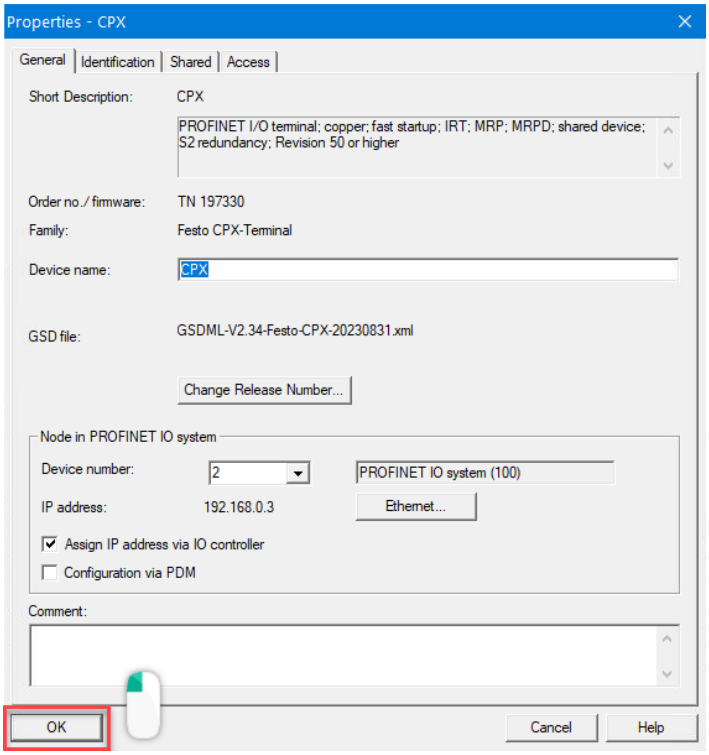
4.4 CPX Hardware Configuration

Follow the steps below toto configure CPX Hardware.

1. In the hardware catalogue, select **“Profinet IO” > “Additional Field Devices” > “Valves” > “Festo CPX-Terminal”**

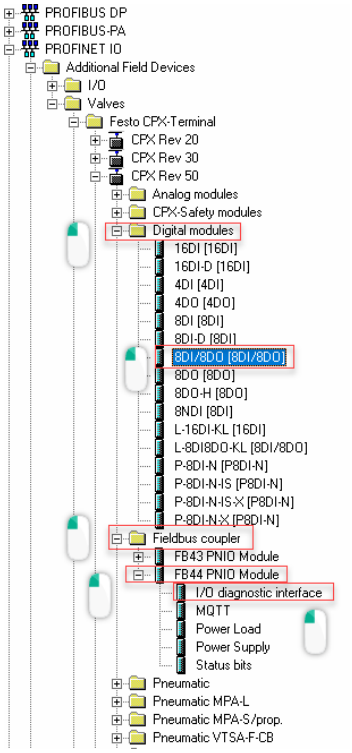


2. Drag and drop **“CPX Rev 50”** on the **“Ethernet(1)” .** The dialog box for setting IP address opens up.

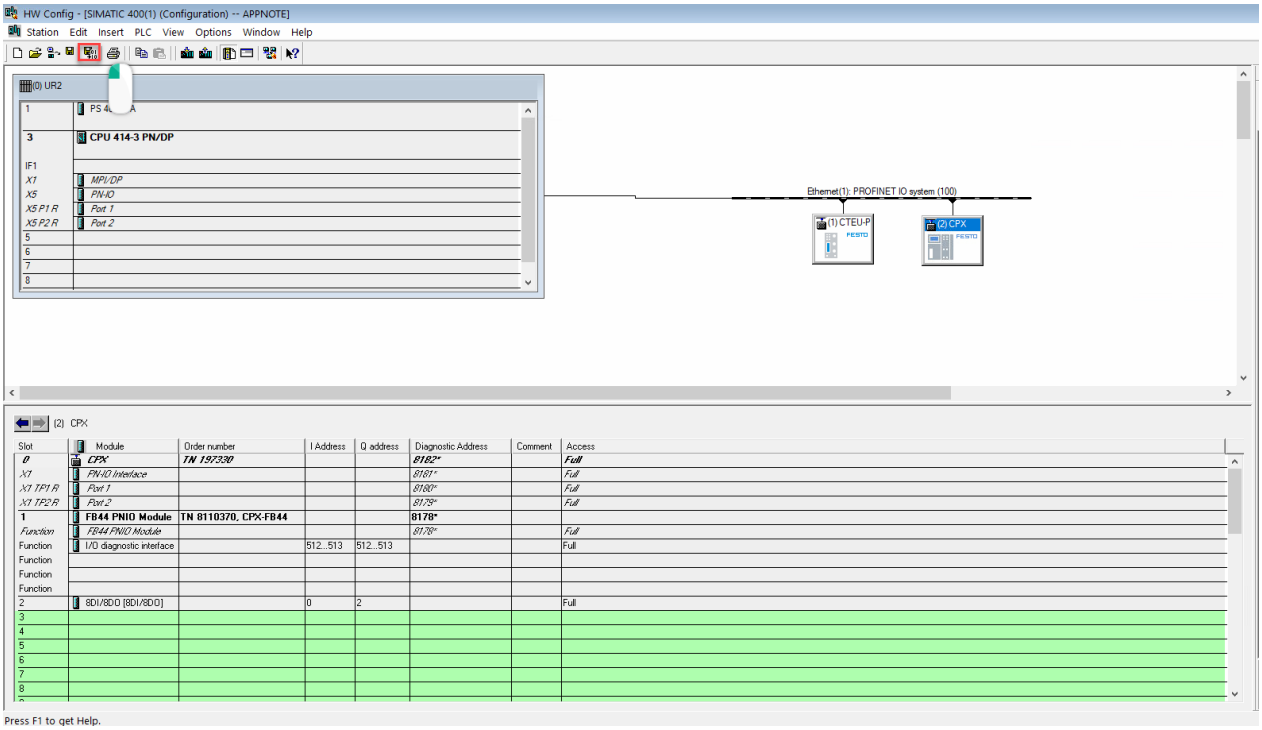


3. Set the IP address and click **“OK”.** Now CPX is added.

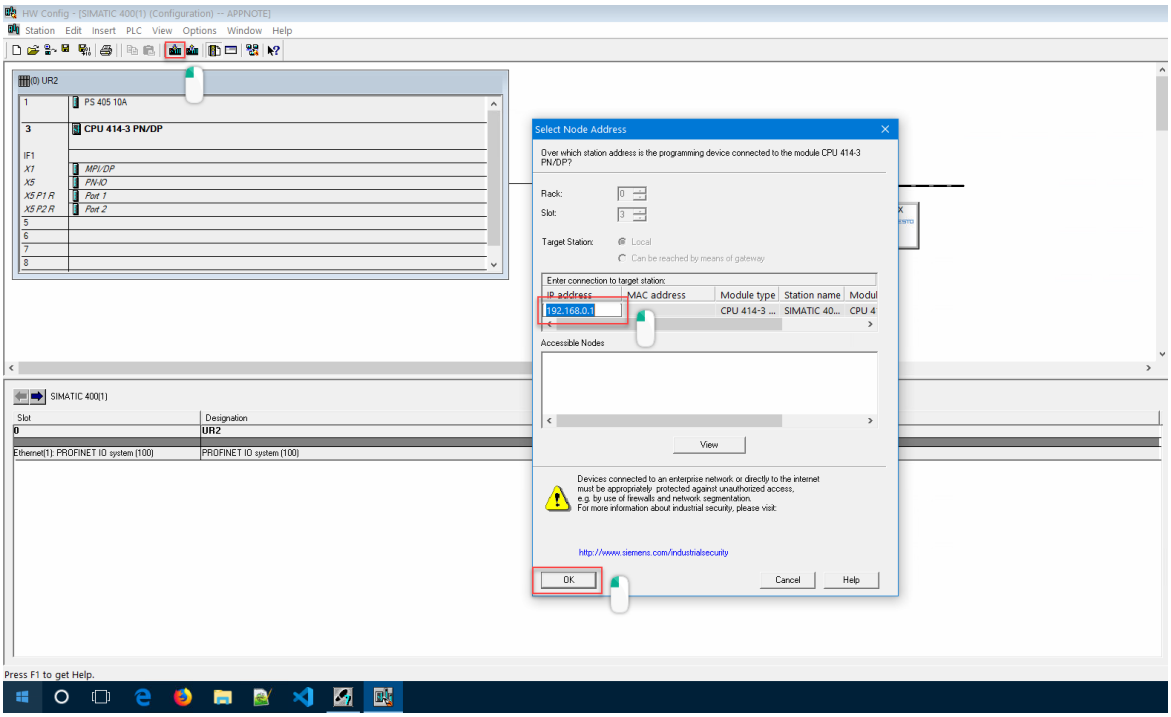
4. Add the **“FB44 PNIO”** and **“8DI/8DO”**module by selecting it from the hardware catalogue as shown. Also add the **“I/O Diagnostics Interface”** to enable diagnostics for module driver generation.



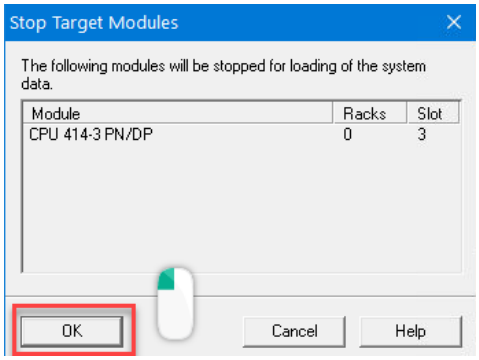
5. Complete the hardware Configuration by selecting **“Save and Compile”**



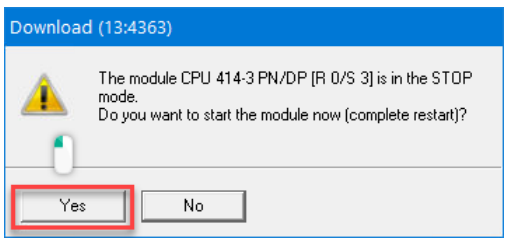
6. After compiling, download the hardware configuration generated to the controller.



7. Select “OK”



8. Select “OK” to Restart the CPU.



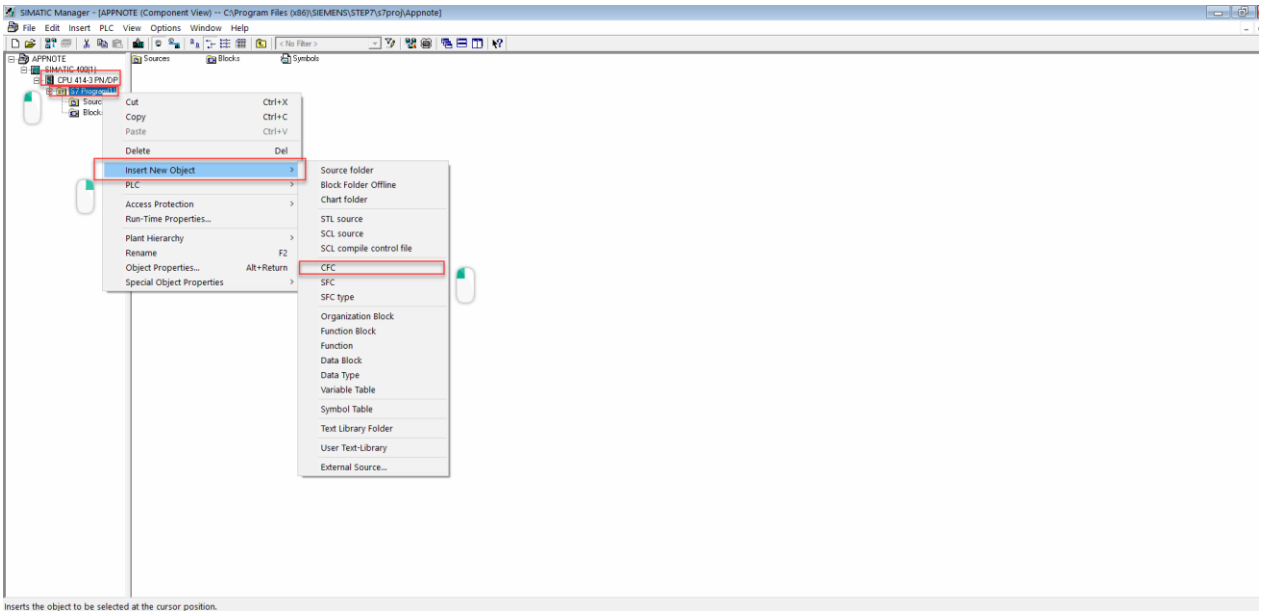
Note

- In some cases, errors can be found in the PLC when it is restarted. This is normal as the logic has not been downloaded to the PLC as of now.
- In some cases, the PLC may not go into **Run** mode which is also normal. All abnormalities occurring at this stage will be resolved after the module drivers are downloaded.

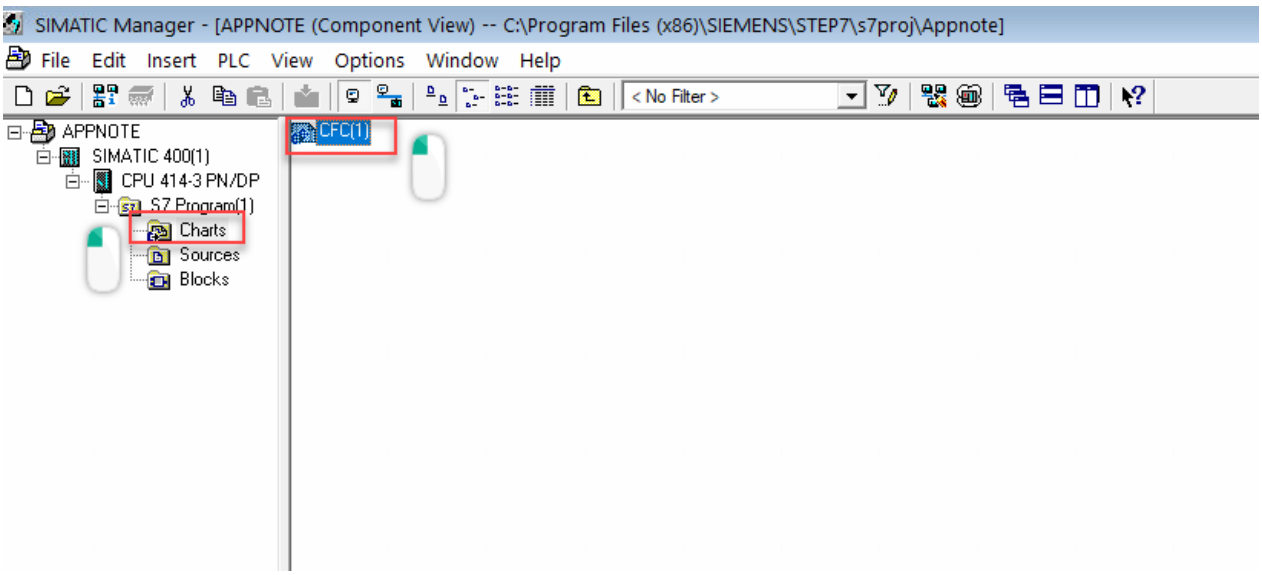
5 Engineering System (ES) Configuration

5.1 Creating a CFC

1. Open the project window. Expand **“CPU 414-3 PN/DP”**
2. Right Click on **“S7 Program(1)”**
3. Select **“Insert New Object”**
4. Select **“CFC”**



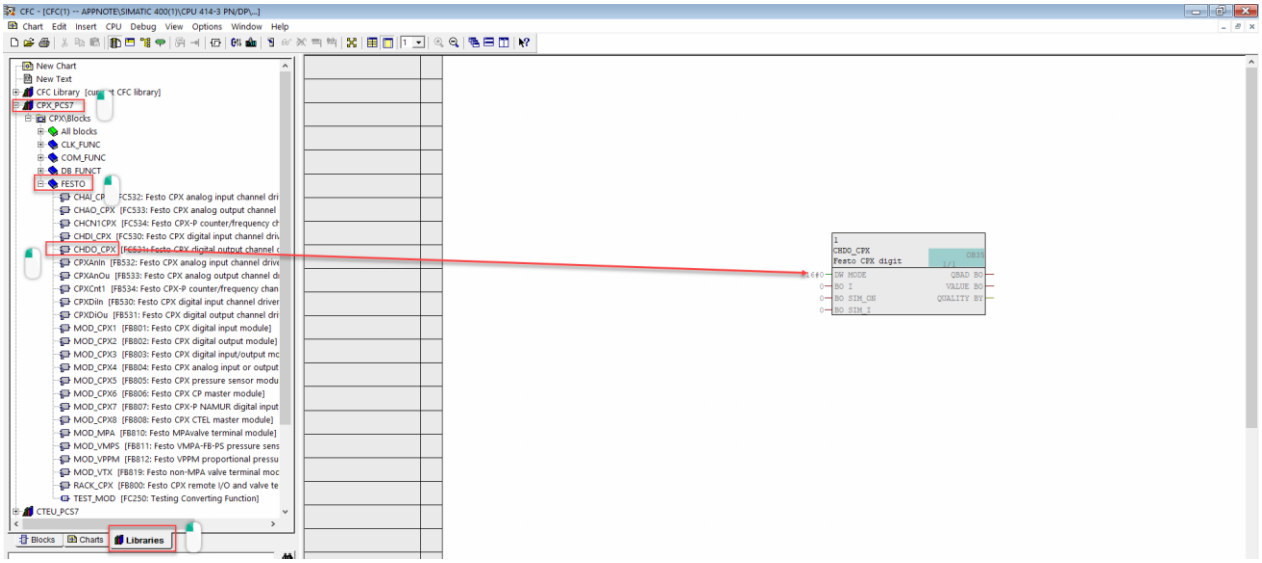
5. Observe that the Charts Folder is created in S7 Program(1) subfolder. Double click on **“CFC(1)”**. CFC(1) is opened in CFC editor.



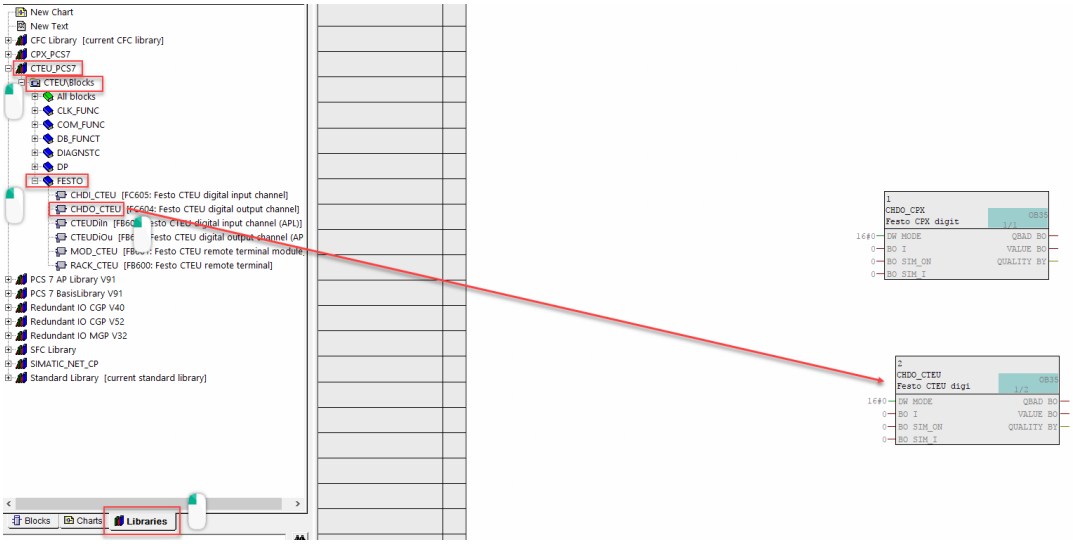
5.2 Configuring CTEU and CPX channel driver blocks

Use the following steps to call the channel drivers blocks.

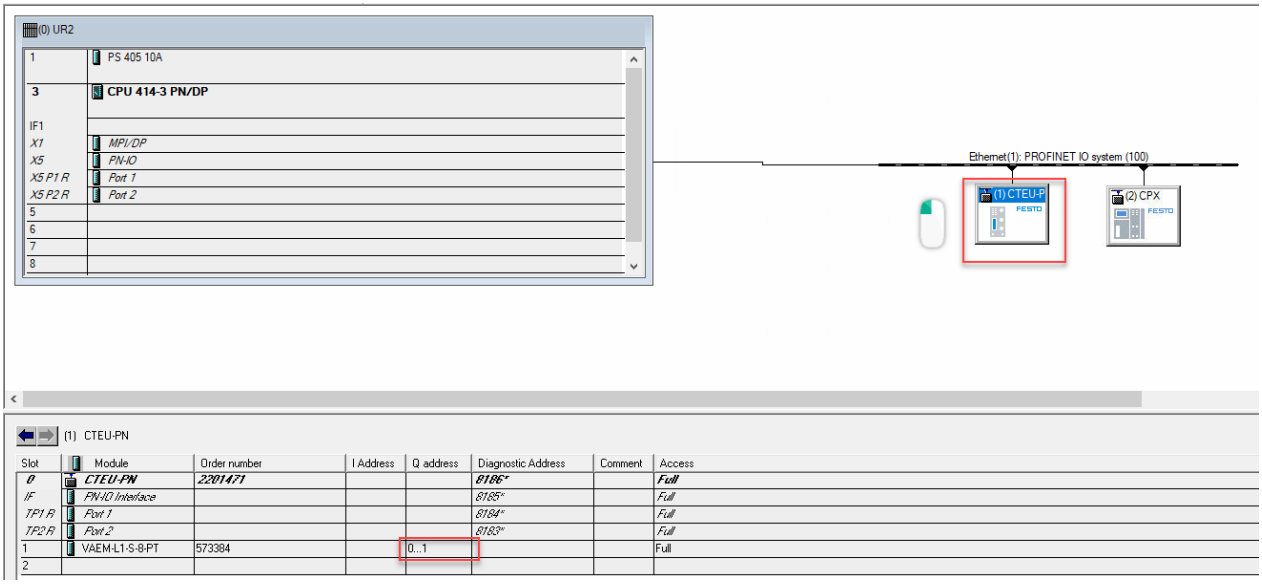
1. Select **“Libraries”**
2. Expand **“CPX_PCS7”**
3. Expand **“Festo”**
4. Drag and drop **“CHDO_CPX”** into empty space in the centre.



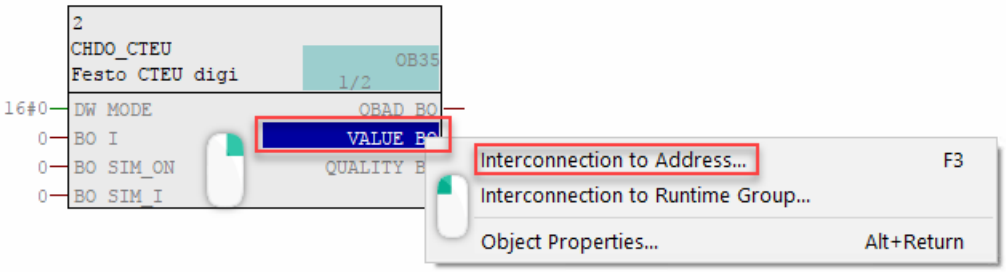
5. Select **“Libraries”**
6. Expand **“CTEU_PCS7”**
7. Expand **“Festo”**
8. Drag and drop **“CHDO_CTEU”** into empty space in the centre.



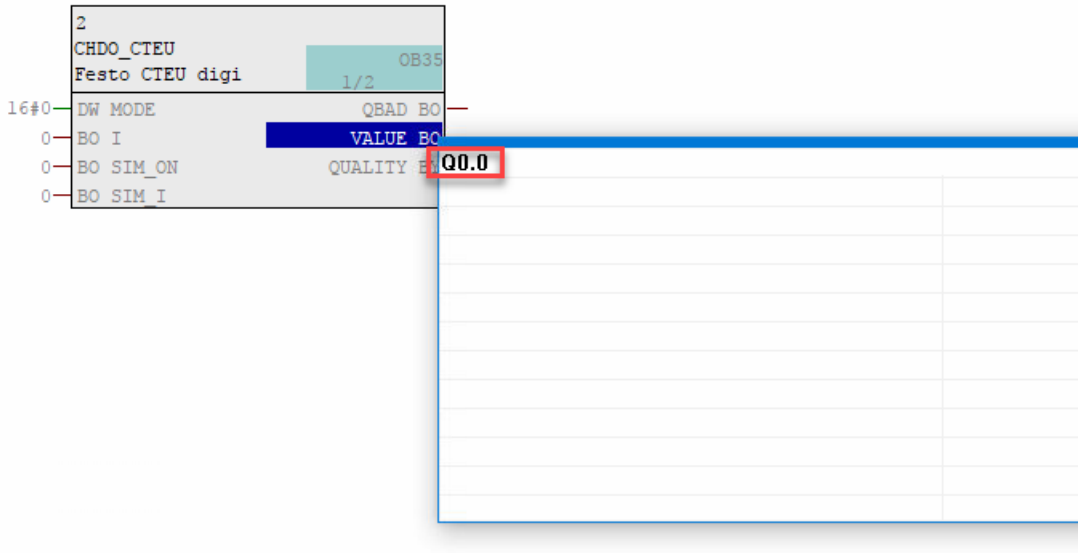
9. Open hardware configuration and select CTEU and note the addresses for the module. In this case **Q0.0 to Q0.7** is the assigned hardware for CTEU. Therefore, attach any one address (**Q0.0**) to the **CHDO_CTEU** block.



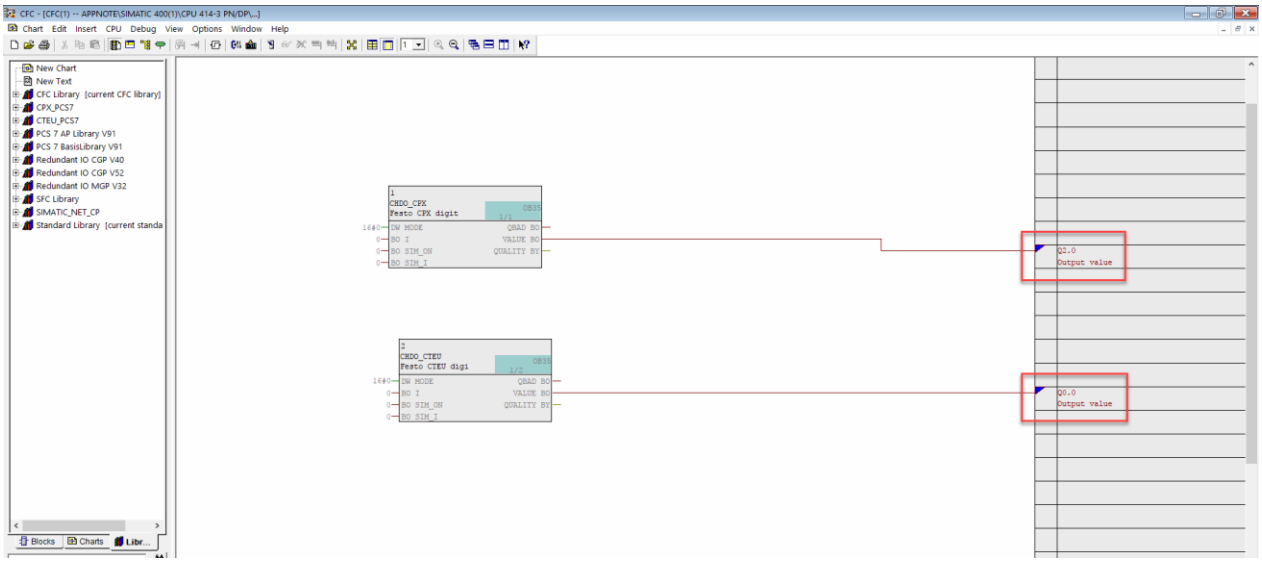
10. In the CFC editor, select CHDO_CTEU, right click on the parameter **“value”.**
11. Select **“Interconnection to Address”**



12. Type the address **“Q0.0”.**

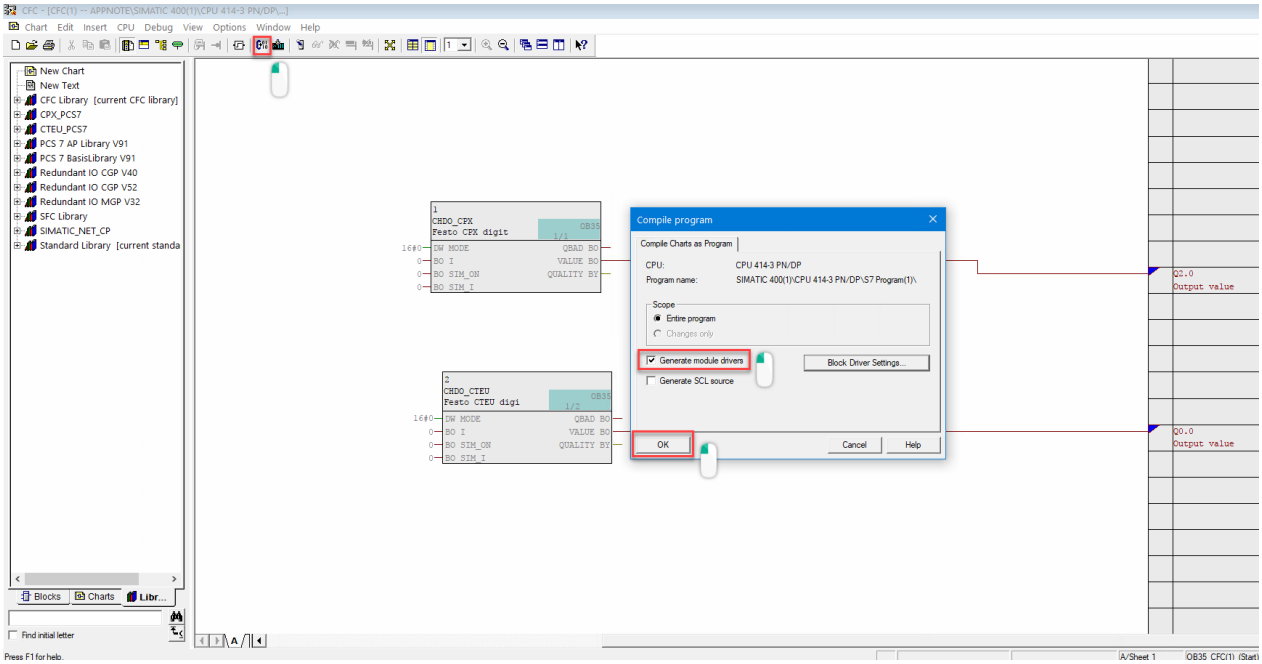


13. **Repeat Steps 9 to 12** to configure channel address **for CHDO_CPX**. The fully configured CFC should look like below:

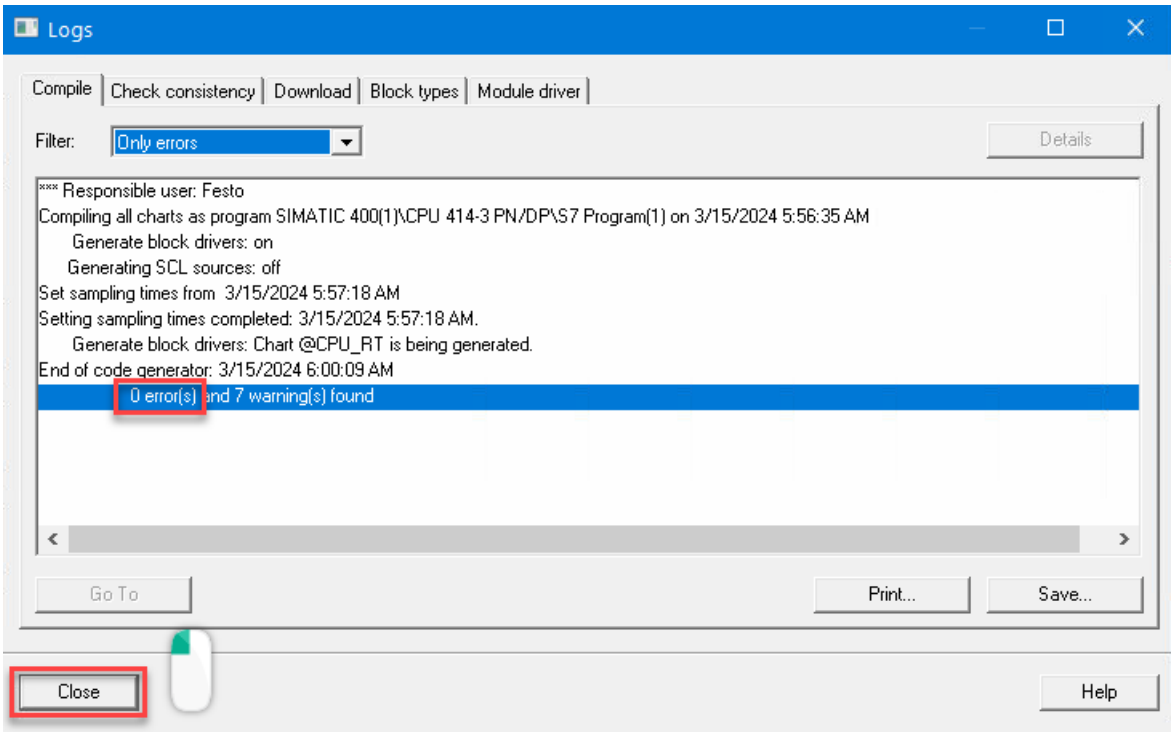


5.3 Generating module driver blocks and downloading to AS

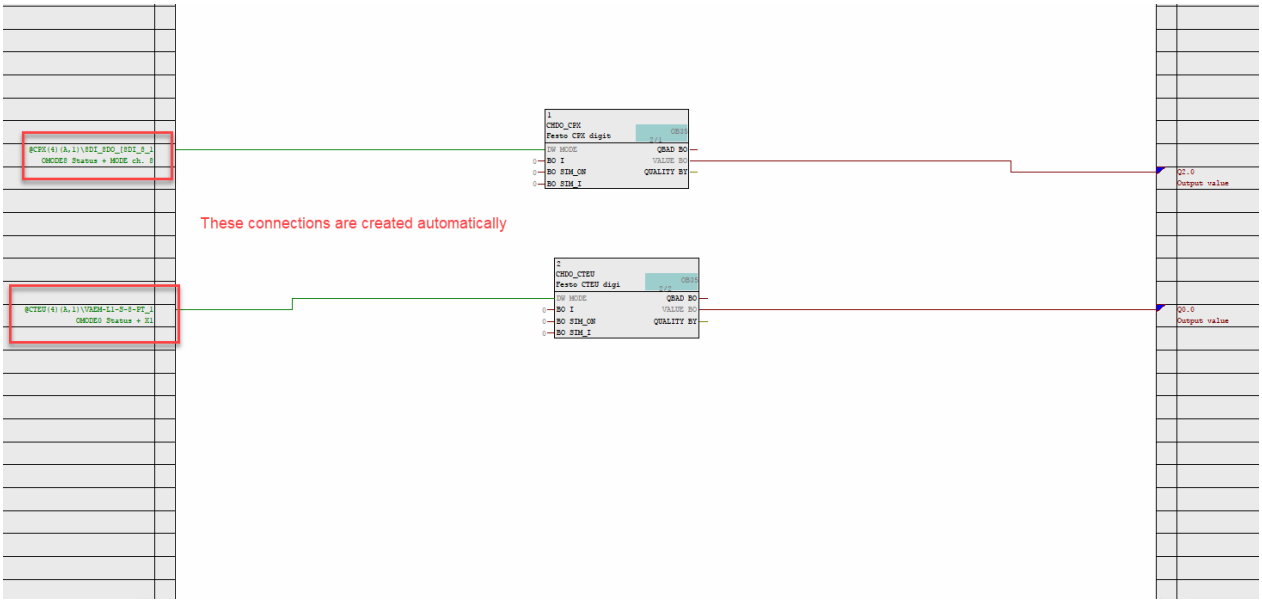
1. Open CFC editor Window and click on **"compile"** icon. The compile window appears.
2. Check mark the option **"Generate Module Drivers"**
3. Click **"OK"**



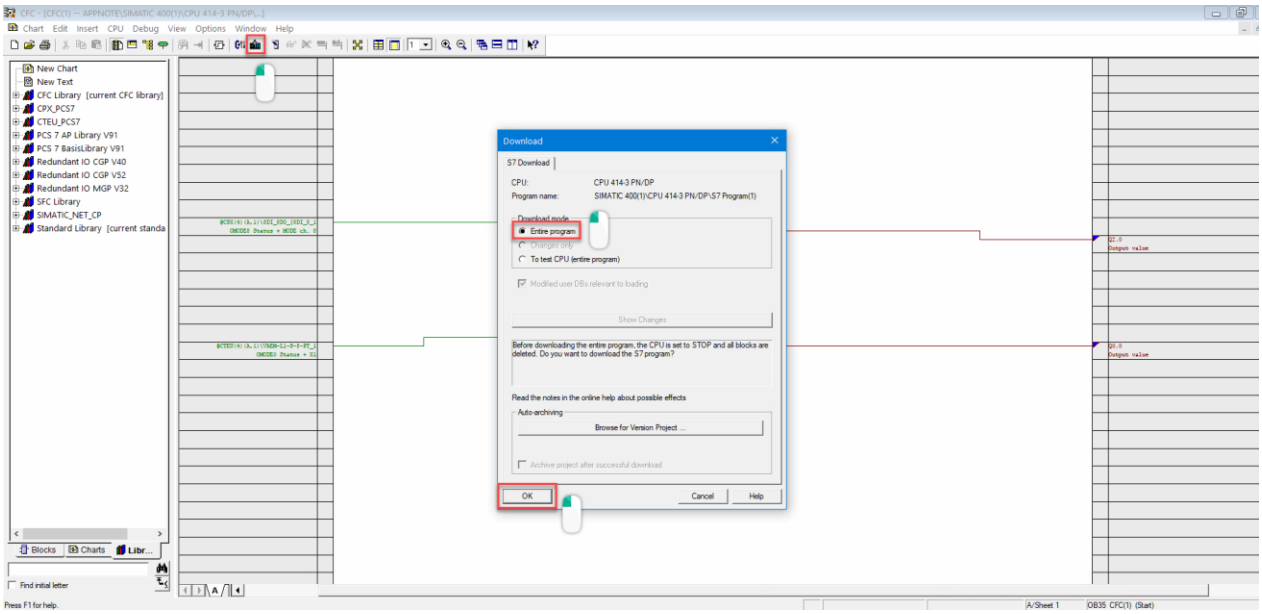
4. After compilation, error and warnings are displayed. Make sure that there is no error by watching the error window and click **“OK”**



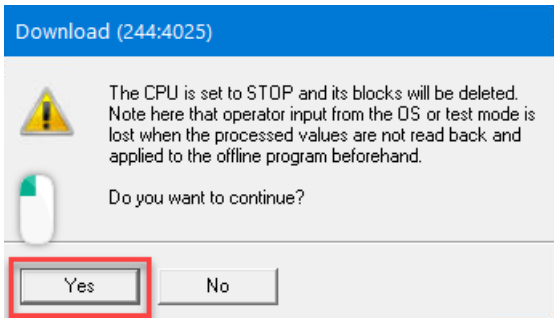
5. Click on a blank space in chart and press **“F5”** to refresh the chart. Also observe that many CFCs and connections are created automatically.



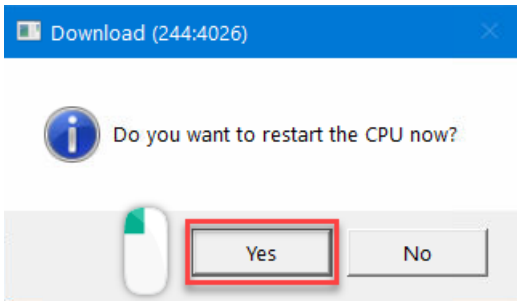
6. Click on “Download” icon.
7. Download window Pops up. Select “Entire Program”
8. Select “OK”



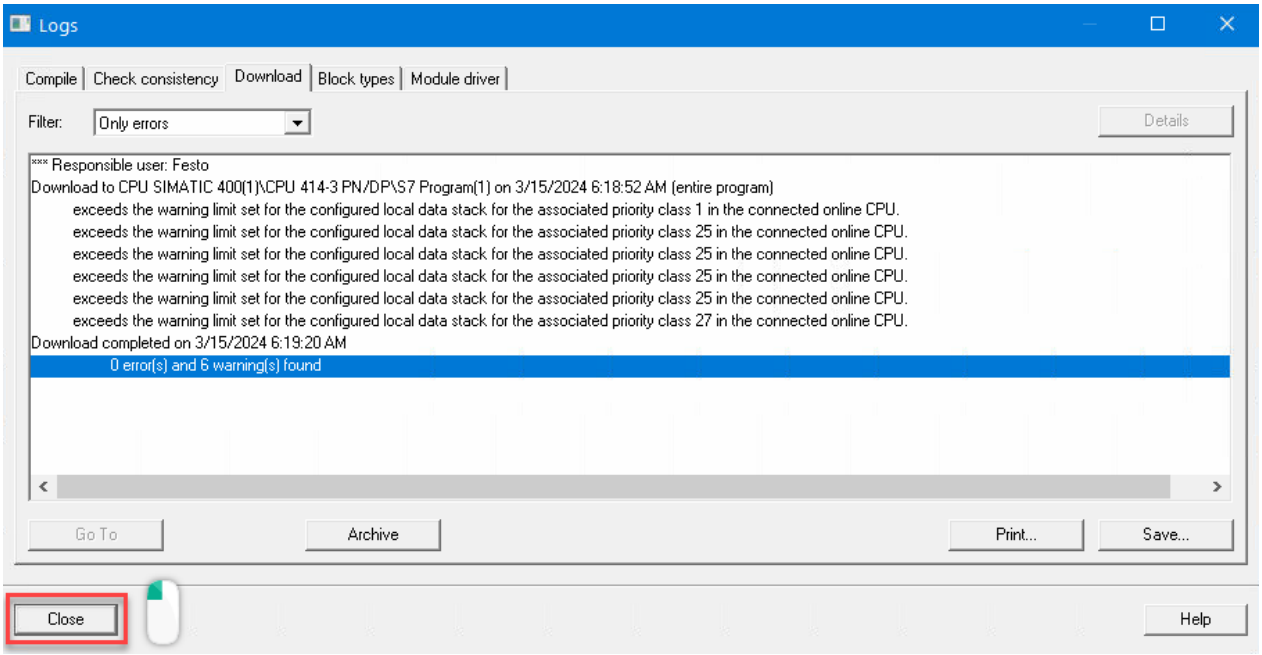
9. The stop PLC window pops up. Click on “Yes”



10. Restart PLC after download by clicking on “Yes”



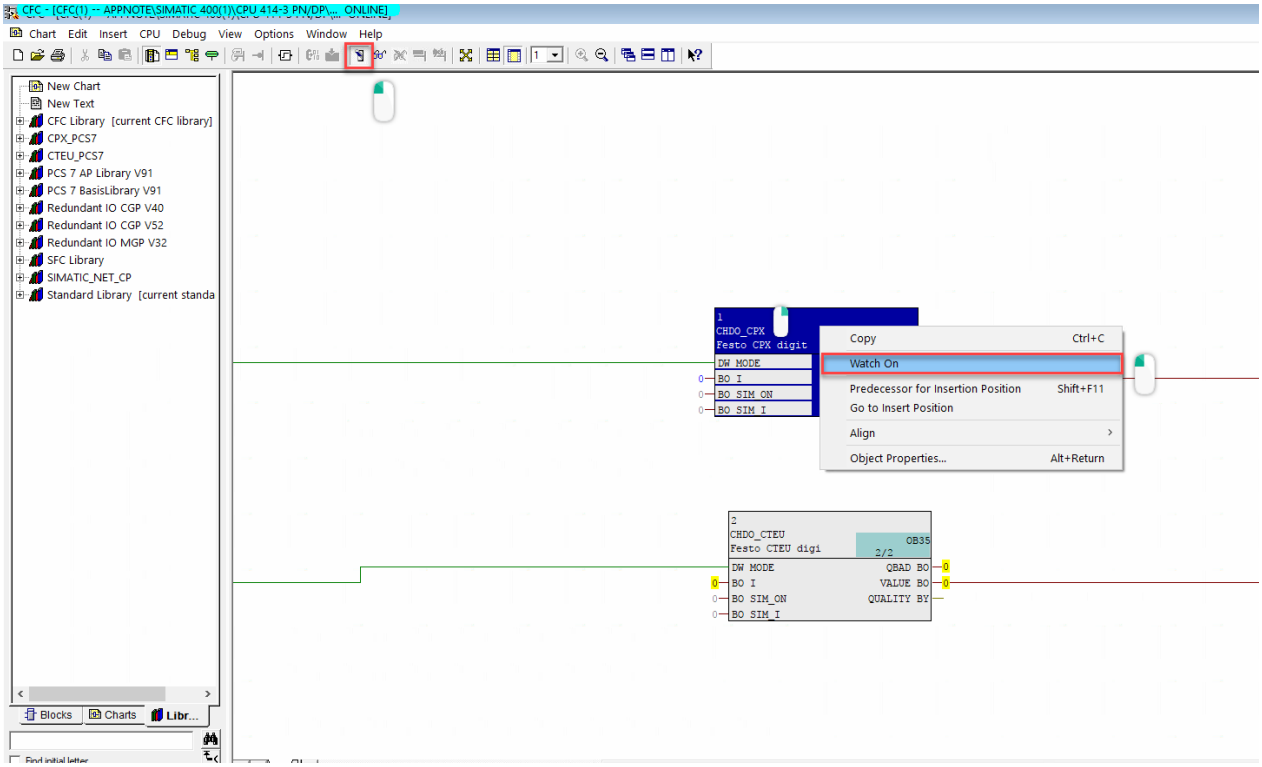
11. Check the logs and select “Close”



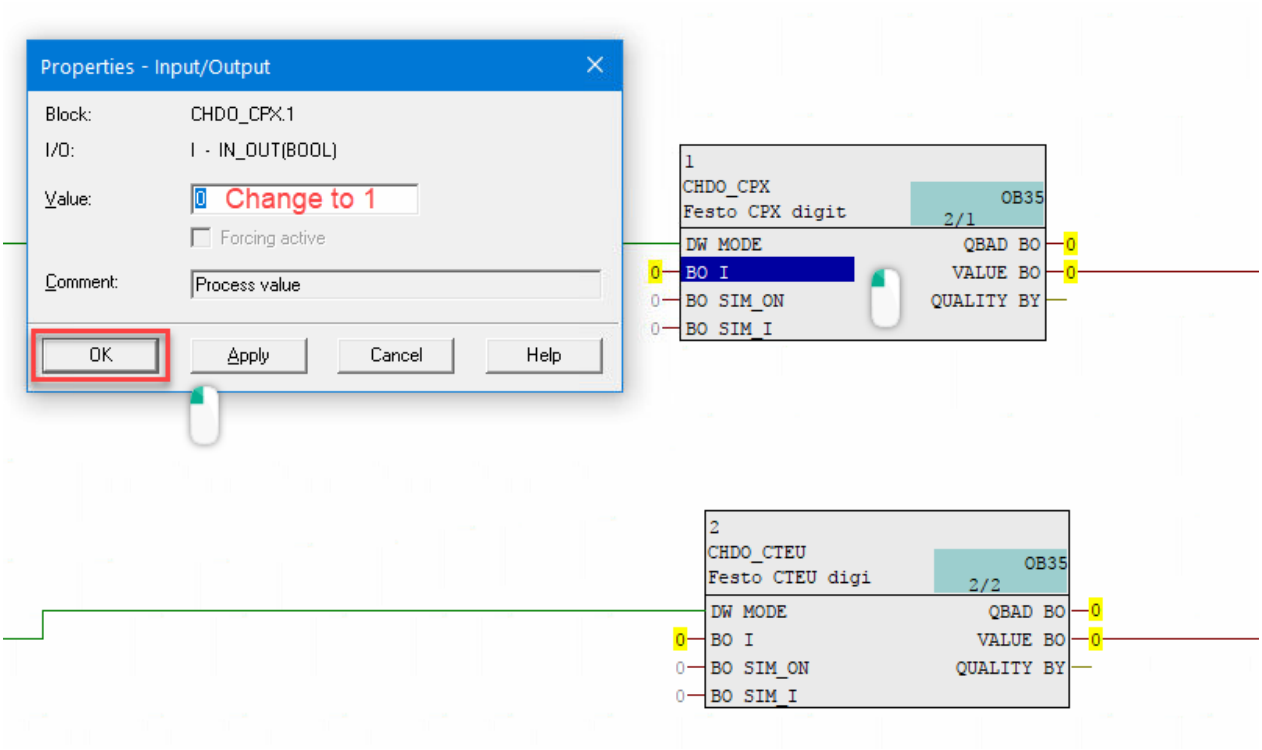
5.4 Testing the configured function blocks

1. Open CFC editor and click on **“test mode”**.
2. Right click on the block that are configured and select **“Watch On”.**
3. To monitor required parameters Hold CTRL key and left click on the required parameter.

Once the monitoring setup is complete the CFC editor should look like below:



4. Double click on **“I”**
5. The I/O window opens. Set the value as **“1”**
6. Click on **“OK”**

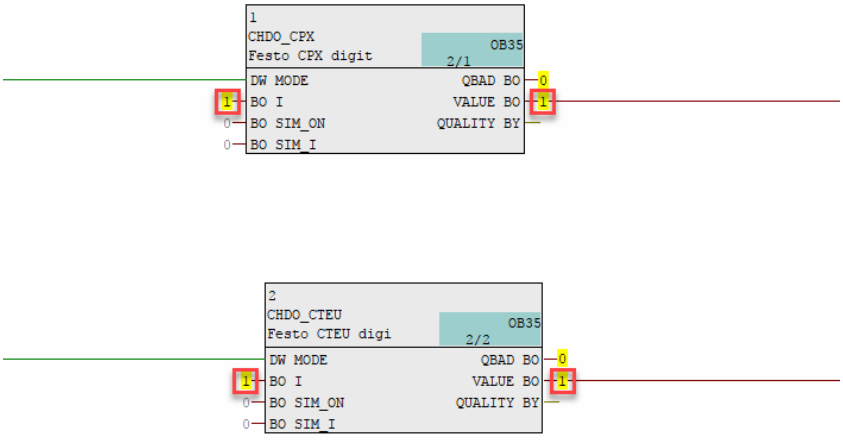


7. Observe that the output switches ON and Valve coil is ON for CTEU.

Warning

Mechanical Parts and actuators connected to PLC channels and Valve terminals

Be careful when switching ON the outputs. Make sure that the environment is safe and under control when operating online.



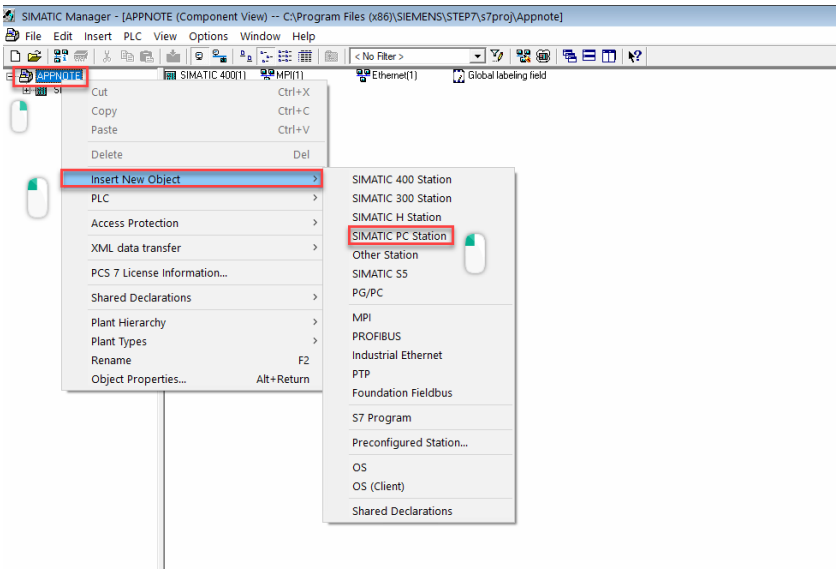
8. Switch OFF all Outputs and Test Mode as soon as testing is complete.

6 Configuring Operating Station (OS) or Simatic PC Station

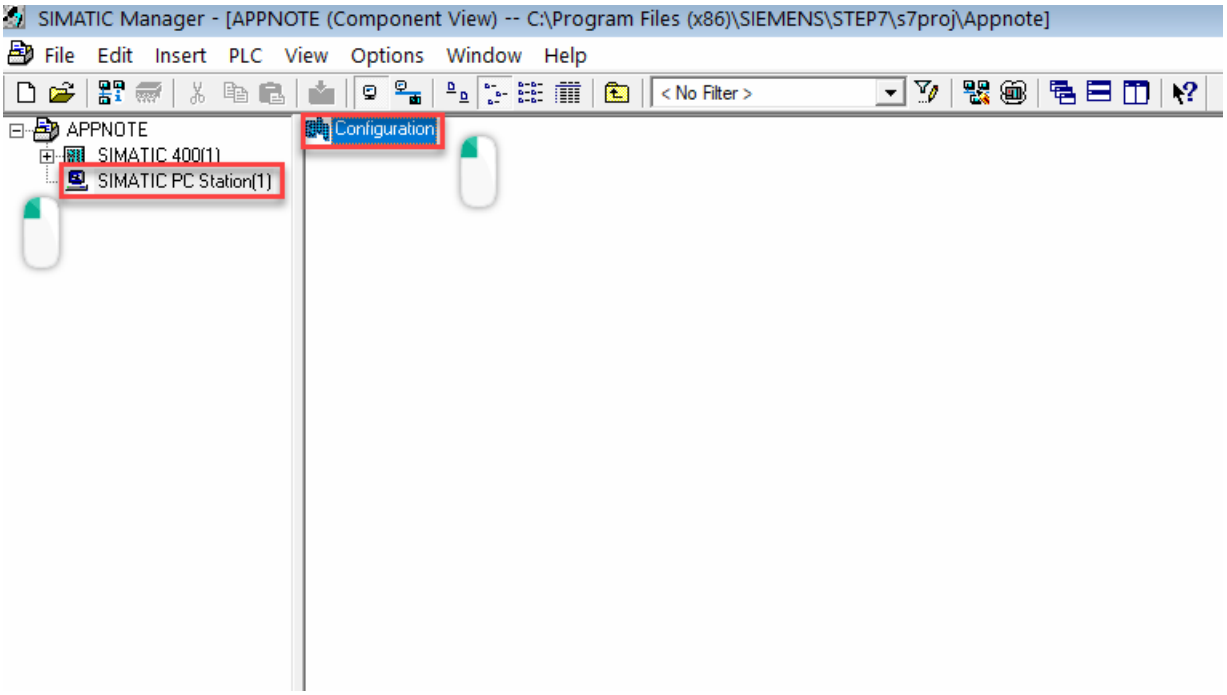
This section shows the configuration of Simatic PC Station or Operating Station (OS) in PCS7 system and observe the alarms in WinCC.

6.1 Configuring OS in Project

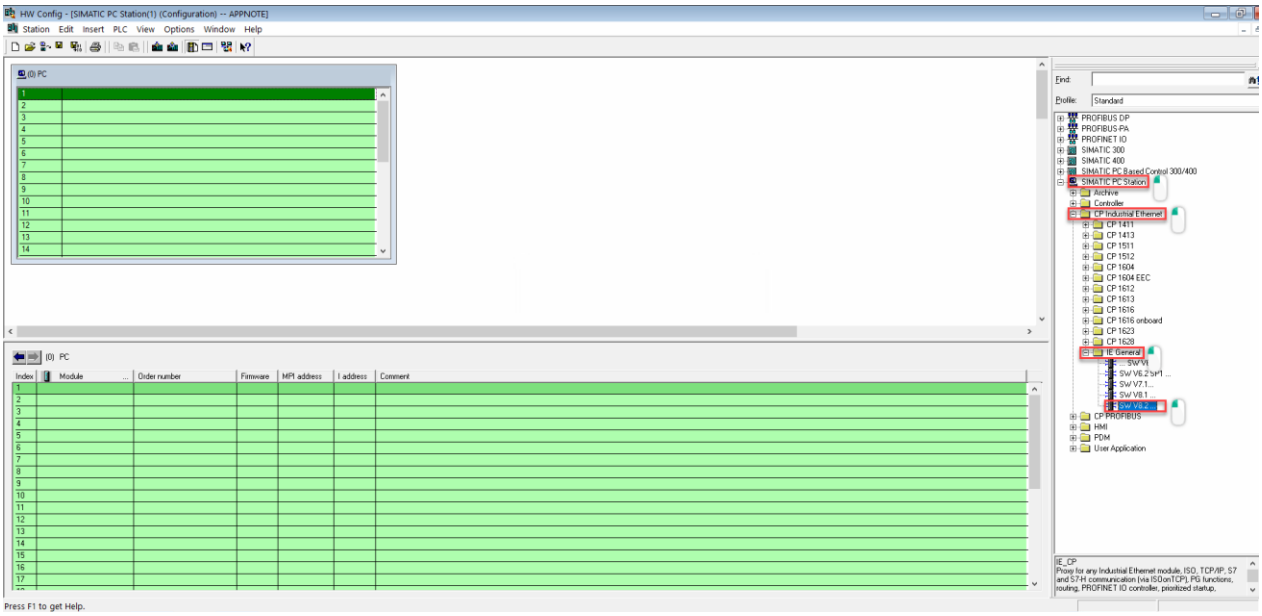
1. Open Project window and right click on project name.
2. Select “Insert new object”.
3. Select “Simatic PC Station”. The Simatic PC station object is created.



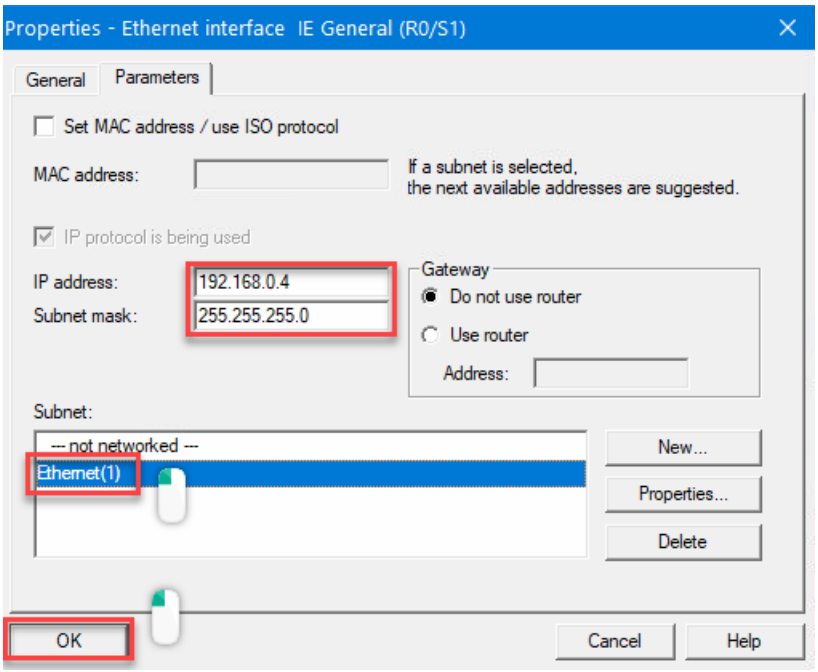
4. Click on “SIMATIC PC Station(1)”
5. Double click on “Configuration” to open the hardware configuration for WinCC.



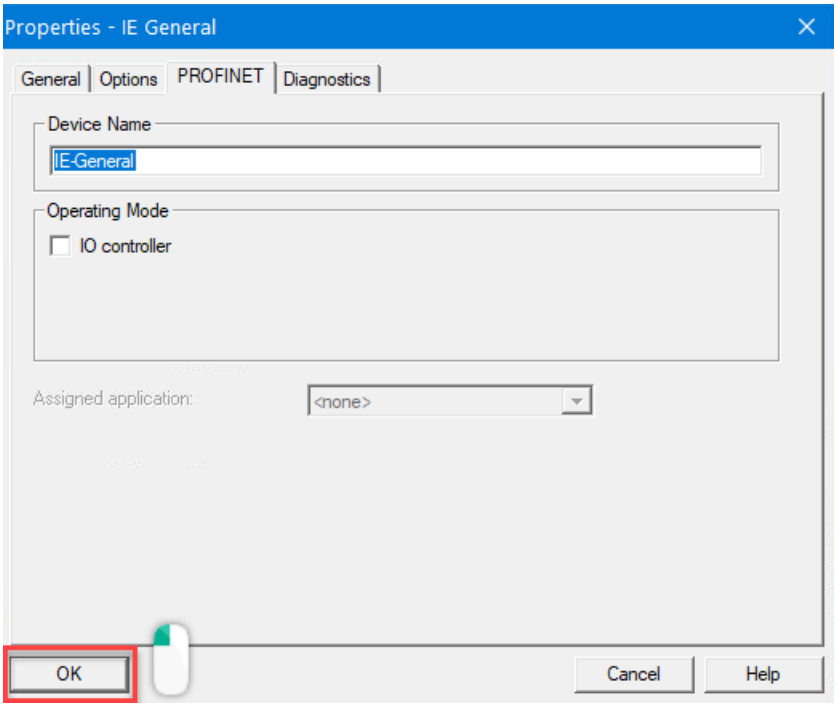
6. In the hardware configuration, select **“Simatic PC Station”.**
7. Select **“CP Industrial Ethernet”**
8. Select **“IE General”**
9. Select **“SW8.2”** and place it in the server.



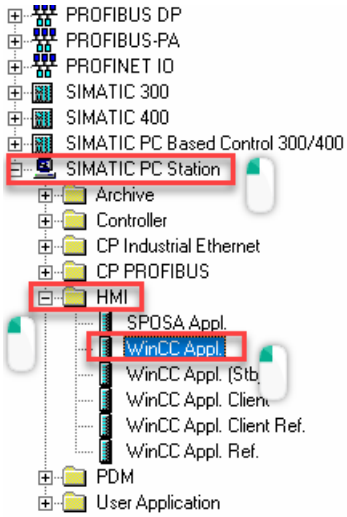
10. Select the IP address in window popped.
11. Select the network.
12. Click **“OK”**



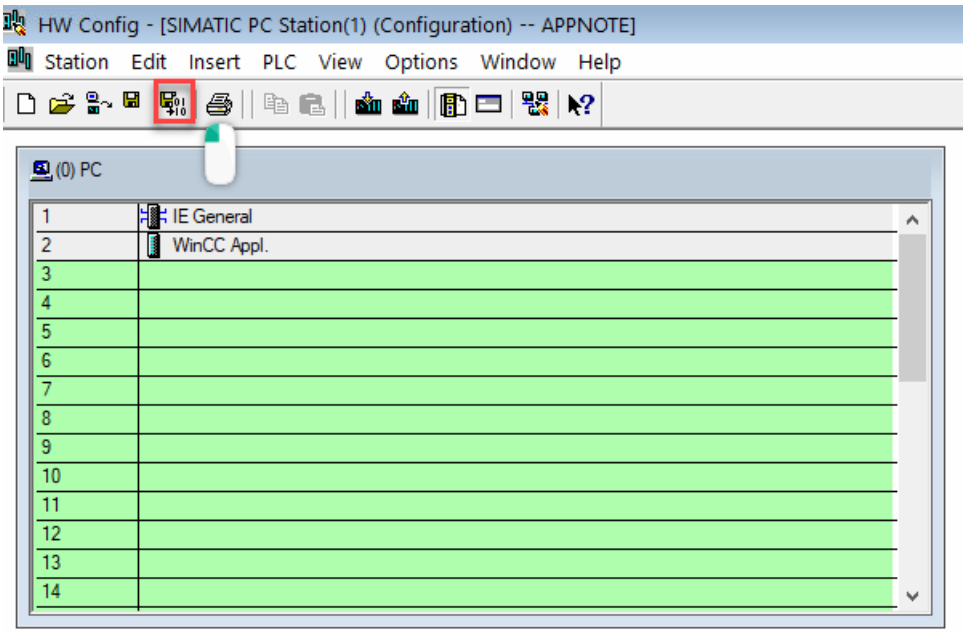
13. Select other option if necessary, else press **“OK”.**



14. Expand Simatic PC Station in hardware catalogue
15. Expand HMI
16. Add **“WinCC Appl.”**



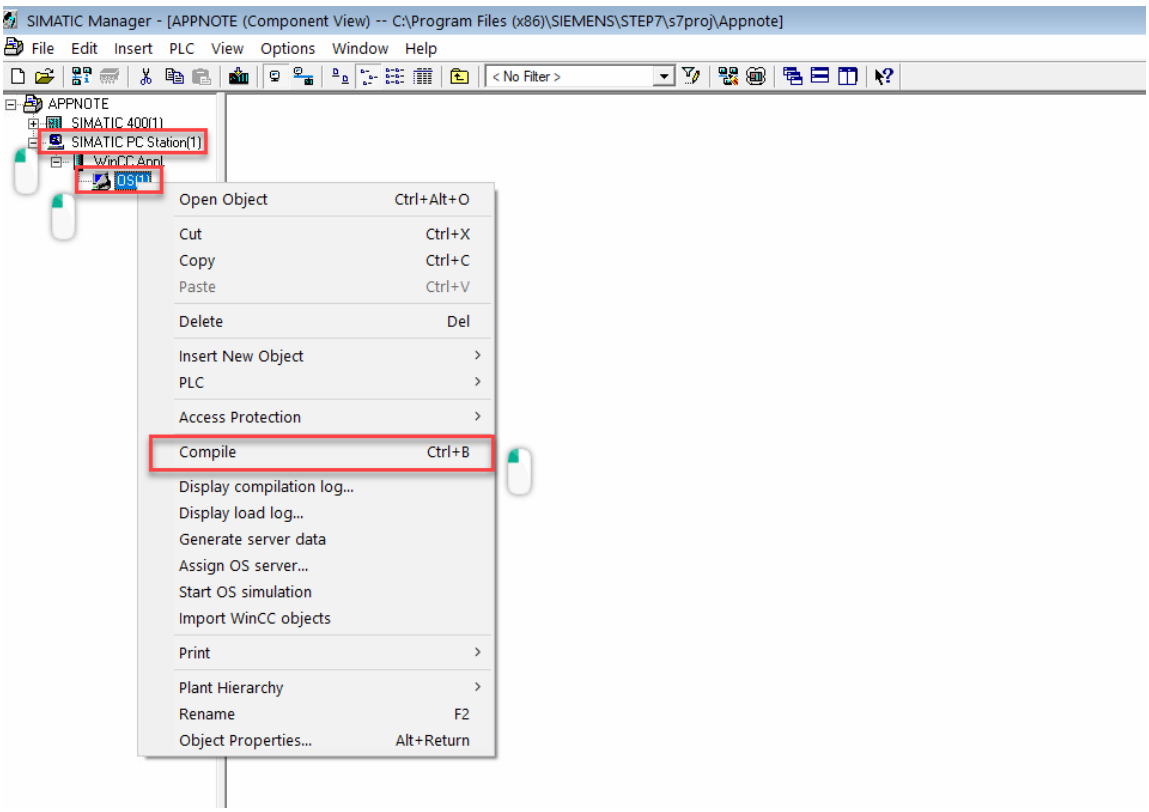
17. This is the end of Simatic PC Station hardware configuration. Save and compile the configuration as shown below.



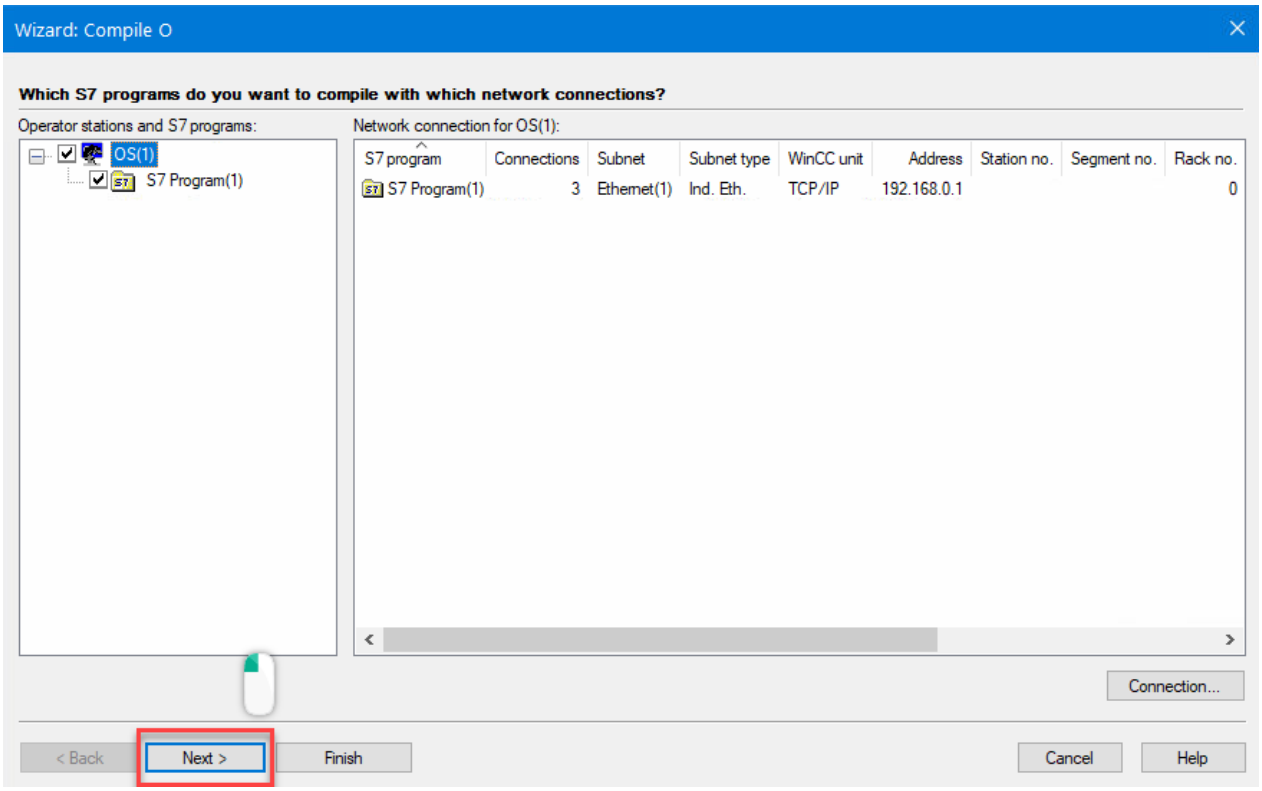
Note

- This may take some time, also sometimes the system may not respond. It is recommended to wait without closing the hardware configuration window.

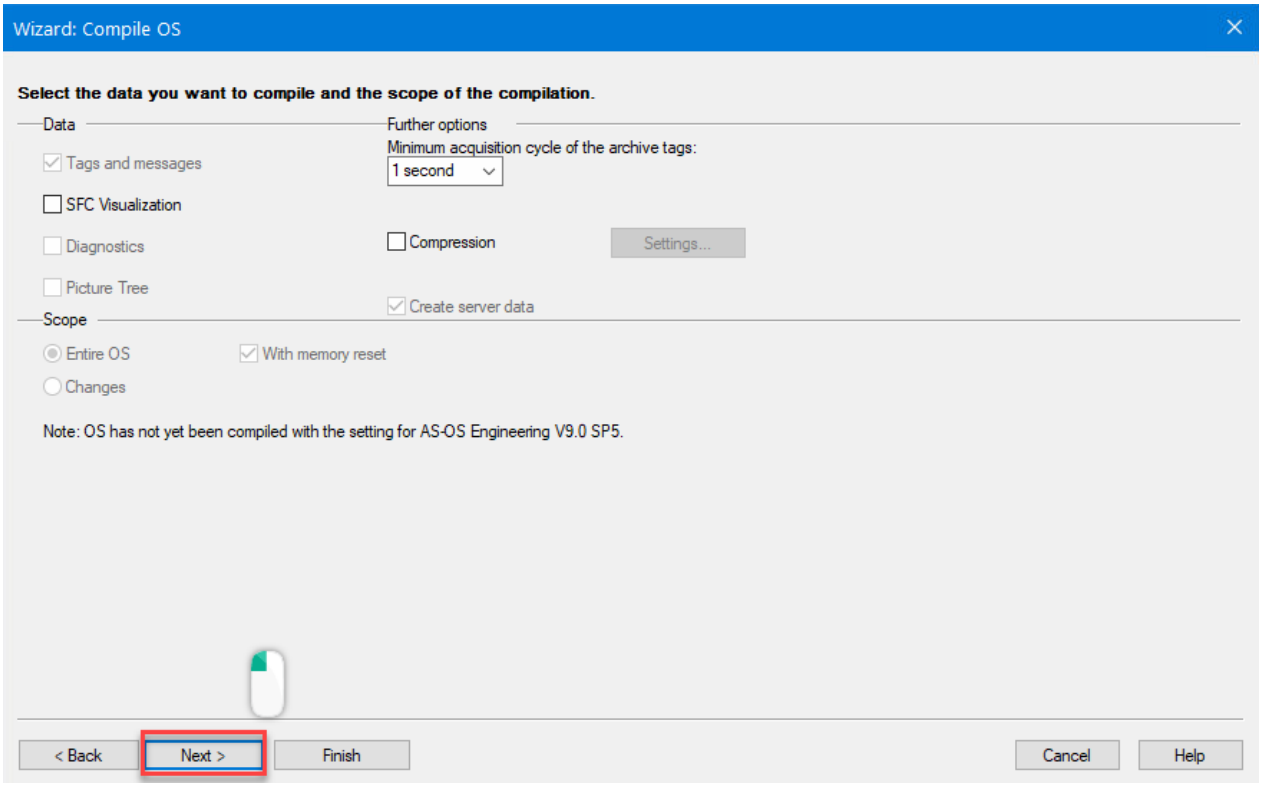
18. Open the Project Window and expand **"Simatic PC Station"**
19. Expand **"WinCC Appl"** and observe that **"OS(1)"** is created.
20. Right click on **OS(1)** and select **Compile**. Compile Window is opened.



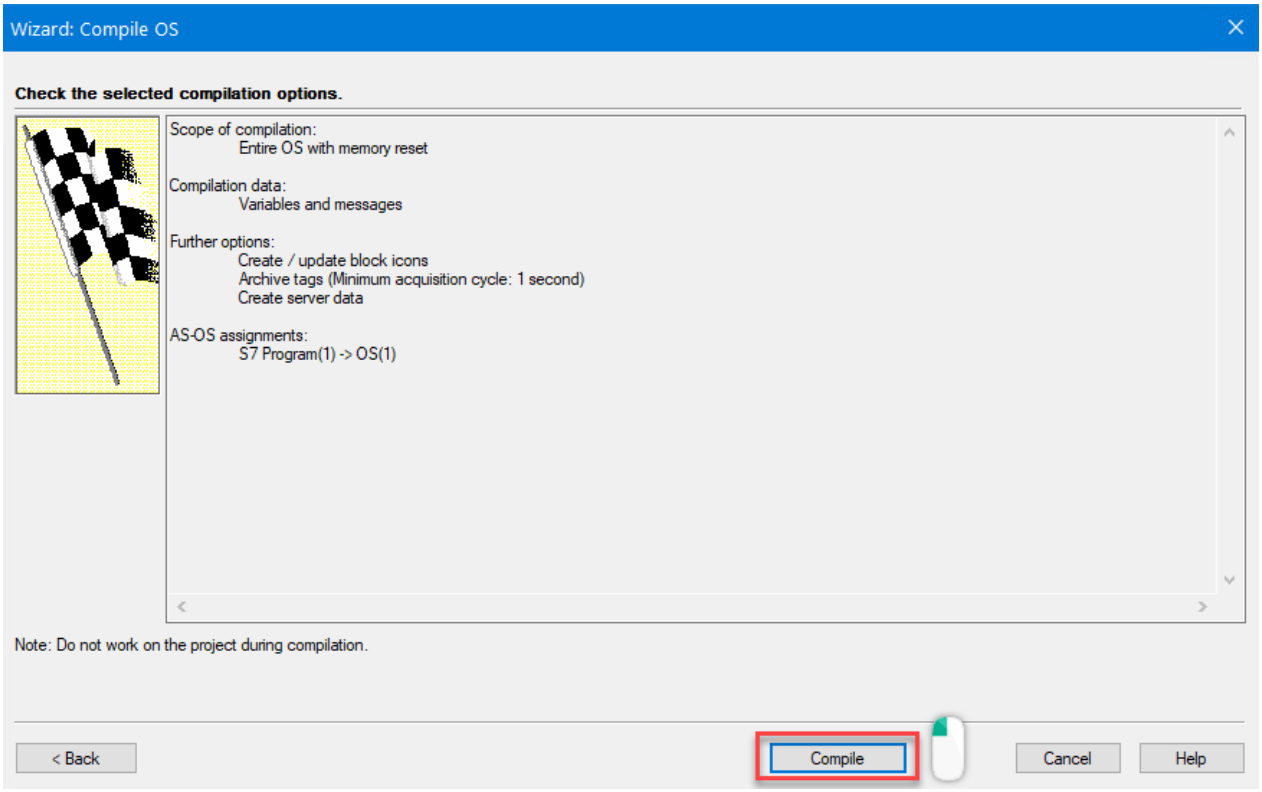
21. Click on **“Next”**



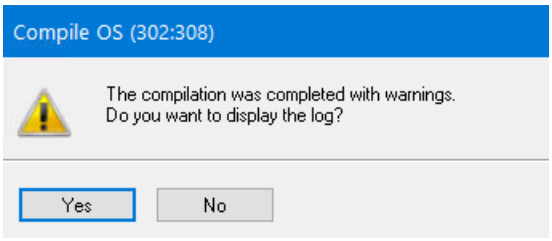
22. Click on **“Next”**



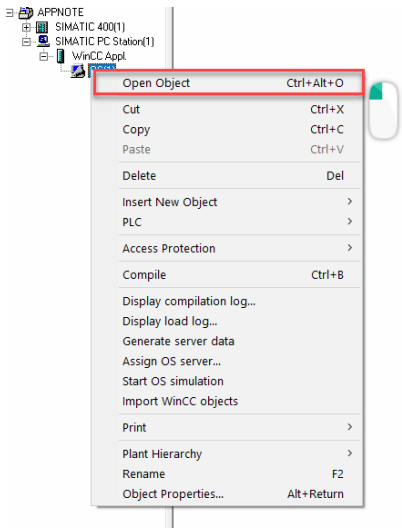
23. Click on **“Compile”**



24. Open and resolve warnings or error if any.

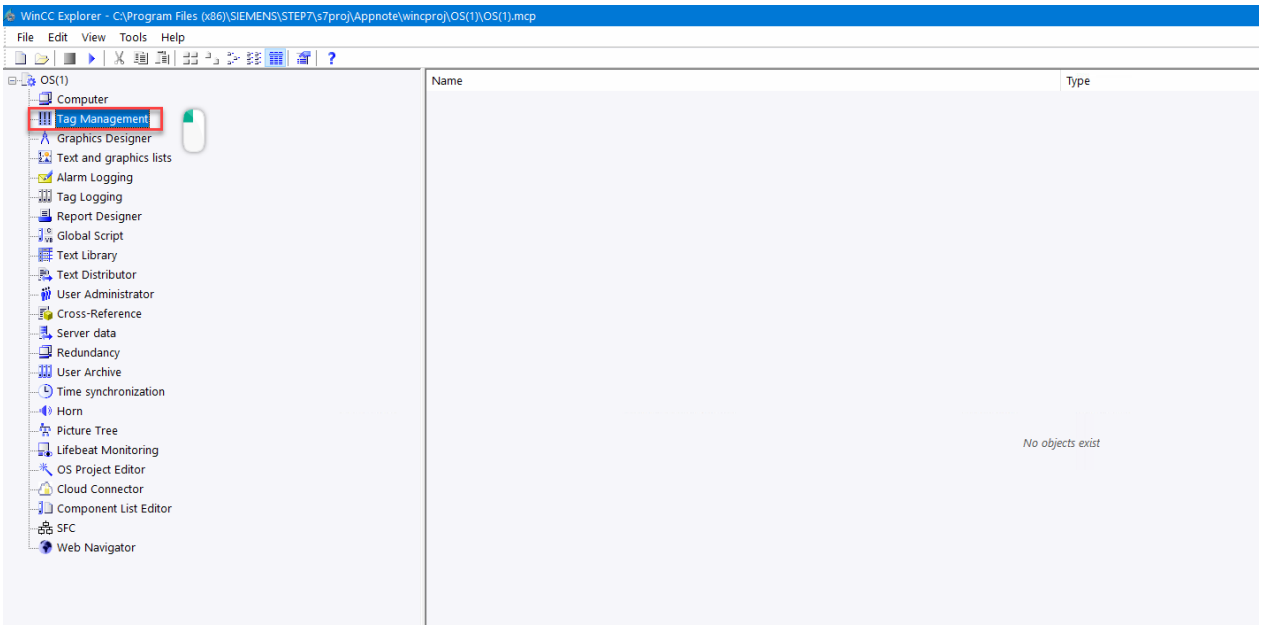


25. Right click on **OS(1)**
26. Select **“Open”** . Observe that WinCC project window is opened.

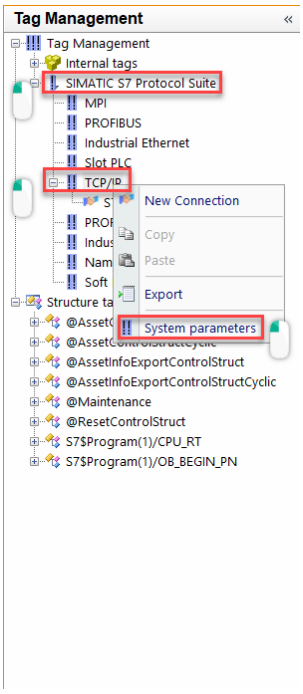


6.2 Setting parameters in WinCC Project and Viewing Alarms

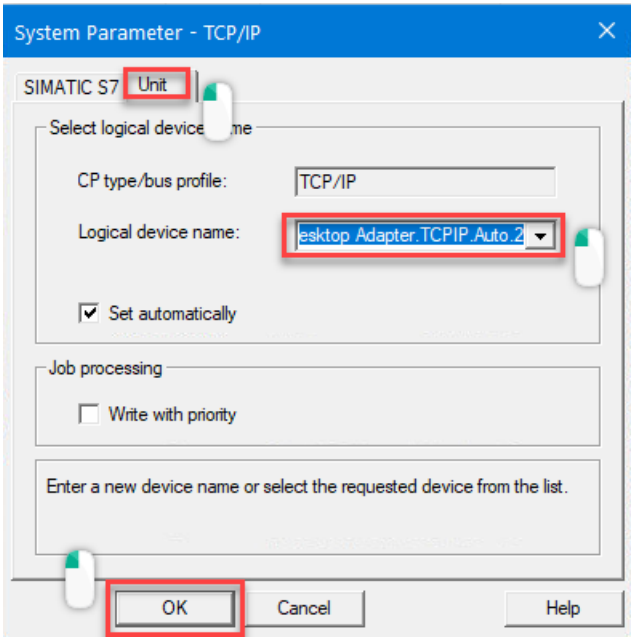
1. Open WinCC window.
2. Open **“Tag Management”**



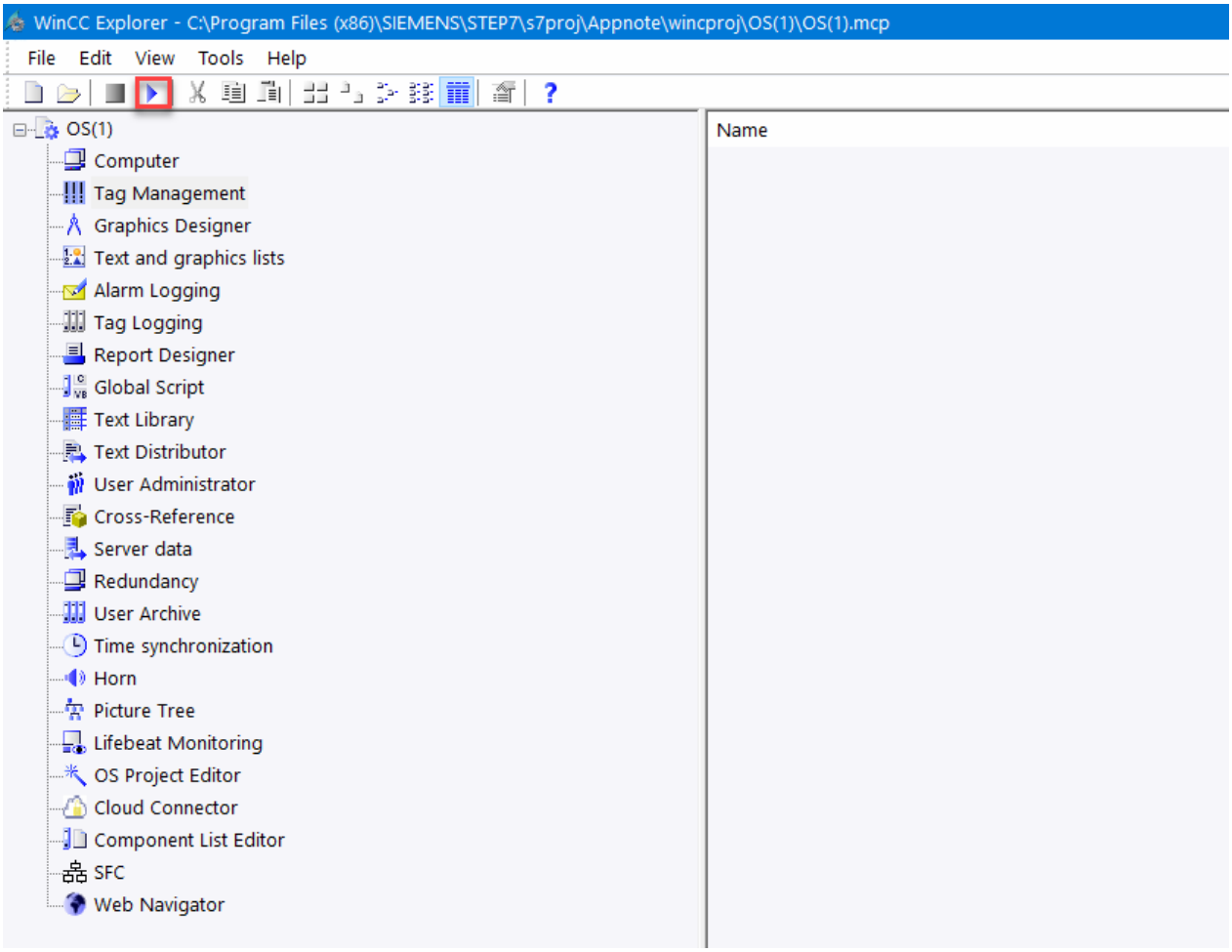
3. Expand **“Simatic S7 Protocol suite”**
4. Right click on **“TCP/IP”**
5. Select **“System Parameters”**



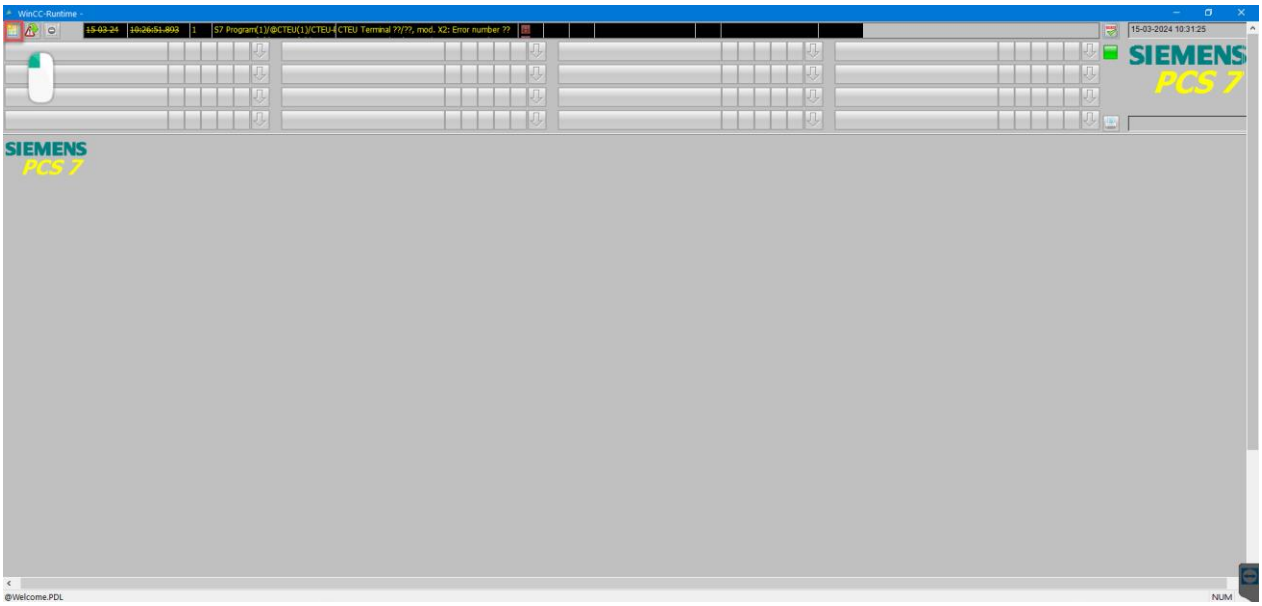
6. Selecting **“Unit”**
7. Set the PG-PC interface in **“Logical device name”**
8. Click **“OK”**



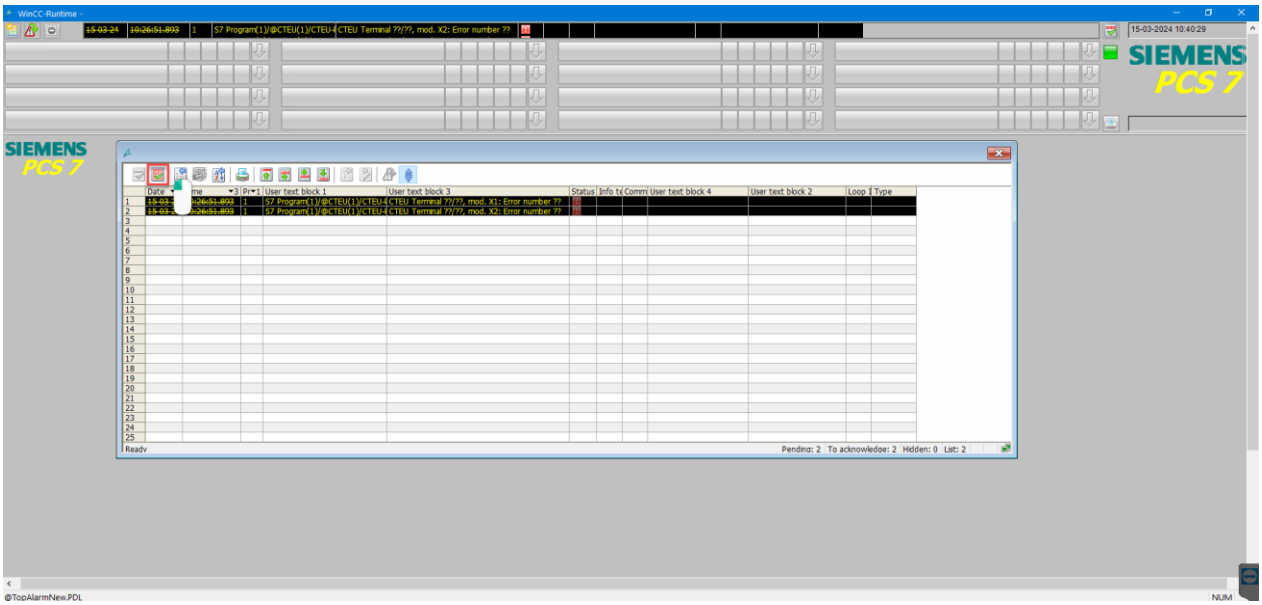
9. Open WinCC explorer window and click on the **“start project”** icon as shown below.



10. Runtime screen is opened. Click on the **“Alarm button”** to view Alarms.



11. Acknowledge old alarms by clicking on the group acknowledge button.



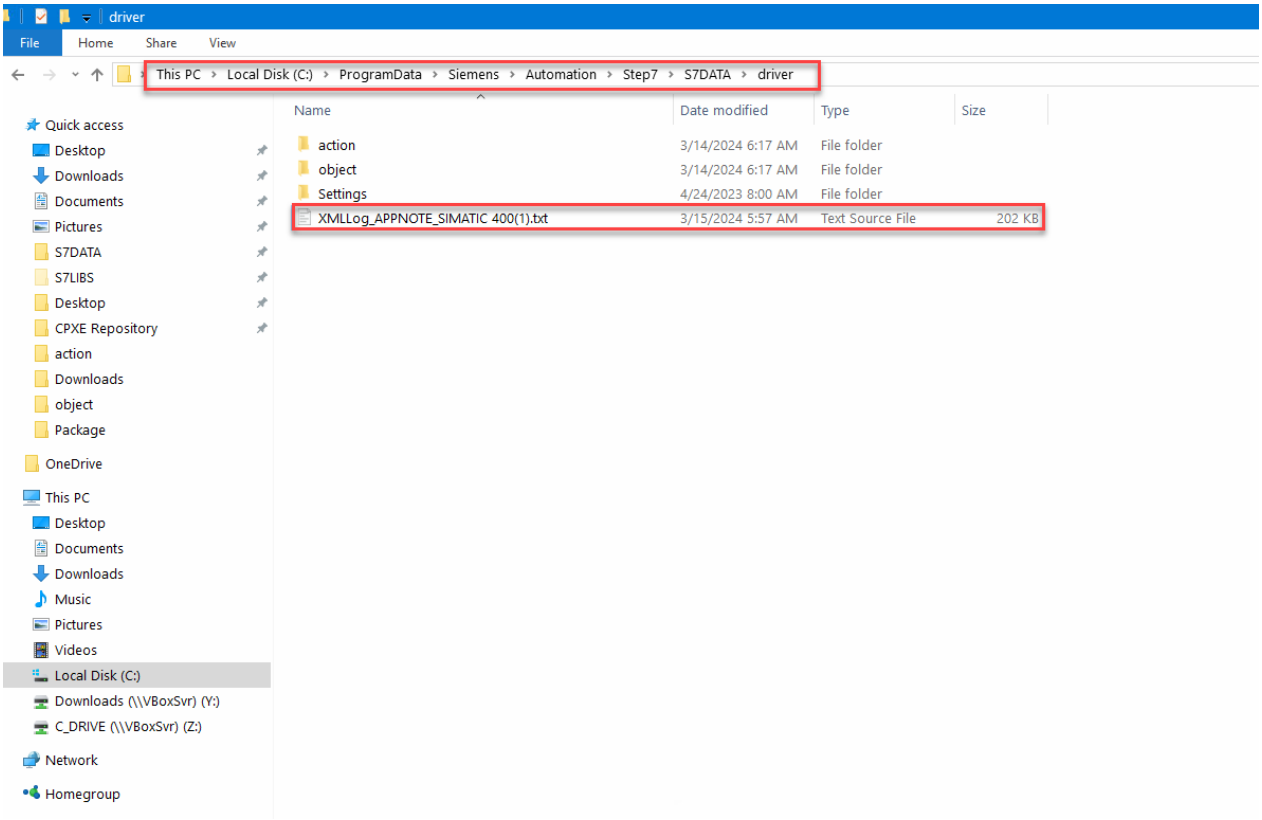
12. Multiple alarms can be verified depending on the setup.

7 Troubleshooting

7.1 Checking XML log files from Driver Blocks compilation

The CTEU and CPX Libraries contain certain XML files that fetch the data from hardware configuration and assign it to blocks in CFC. When the AS is compiled when selecting “generate module drivers” option, a log file is created which contains the information about the parameters of the blocks and the objects in hardware configuration. In case of module driver generation errors, the log file can be viewed to debug the CFC.

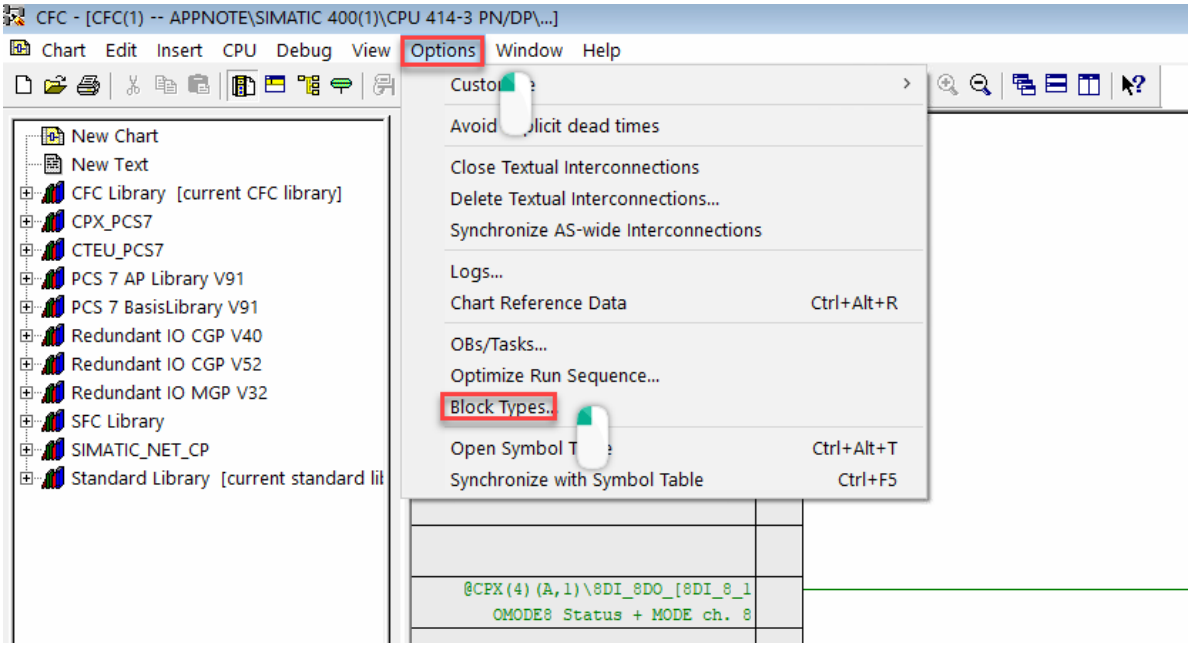
1. Open the location **“C:\ProgramData\Siemens\Automation\Step7\S7DATA\driver”**
2. Look for the file in the name of the project: **XMLLog_APPNOTE_SIMATIC 400(1).txt**



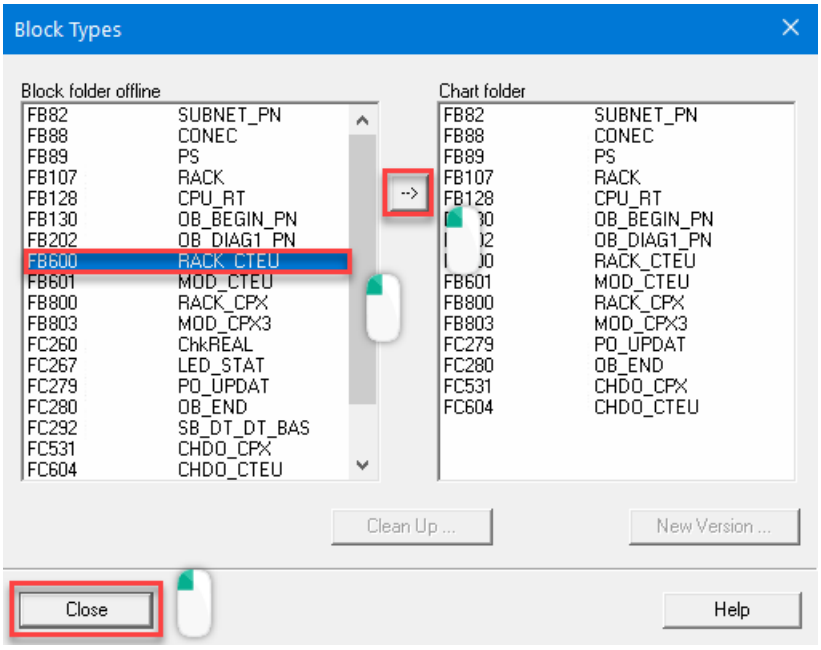
7.2 Checking/Upgrading the driver block version in CFC

When the driver library is updated, the blocks need to be upgraded from block folder to chart folder. To upgrade the block follow the steps.

1. Open CFC editor
2. Click on **“Options”**
3. Select **“Block types”**

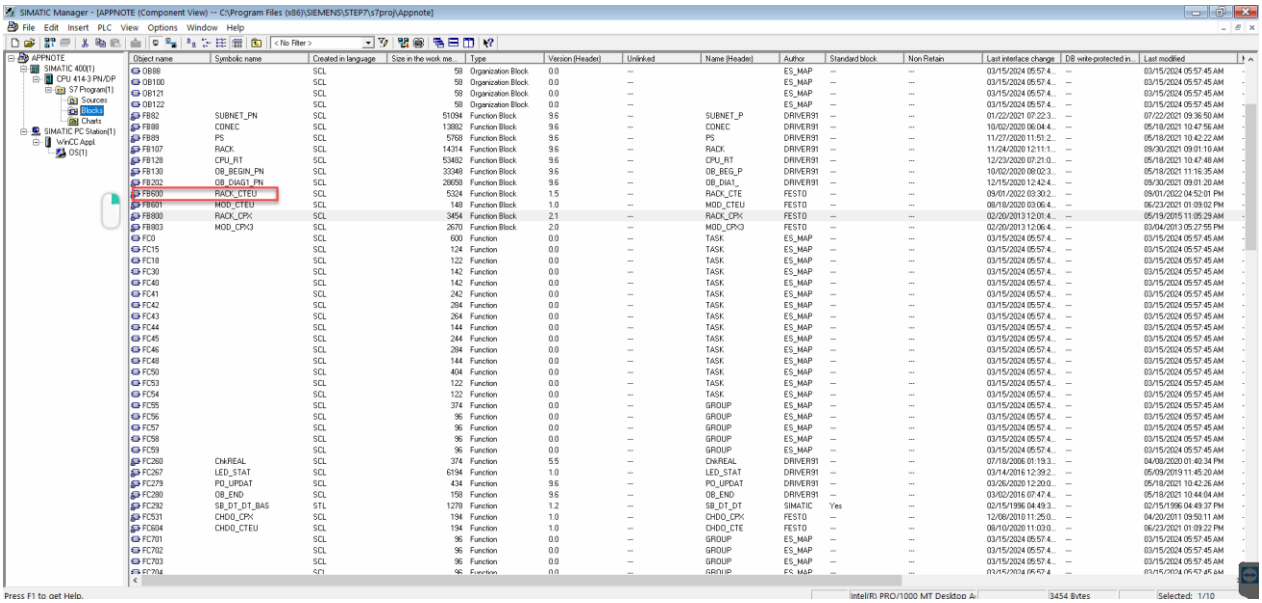


4. Click on the desired block
5. Click on the arrow
6. Click on **“Close”**

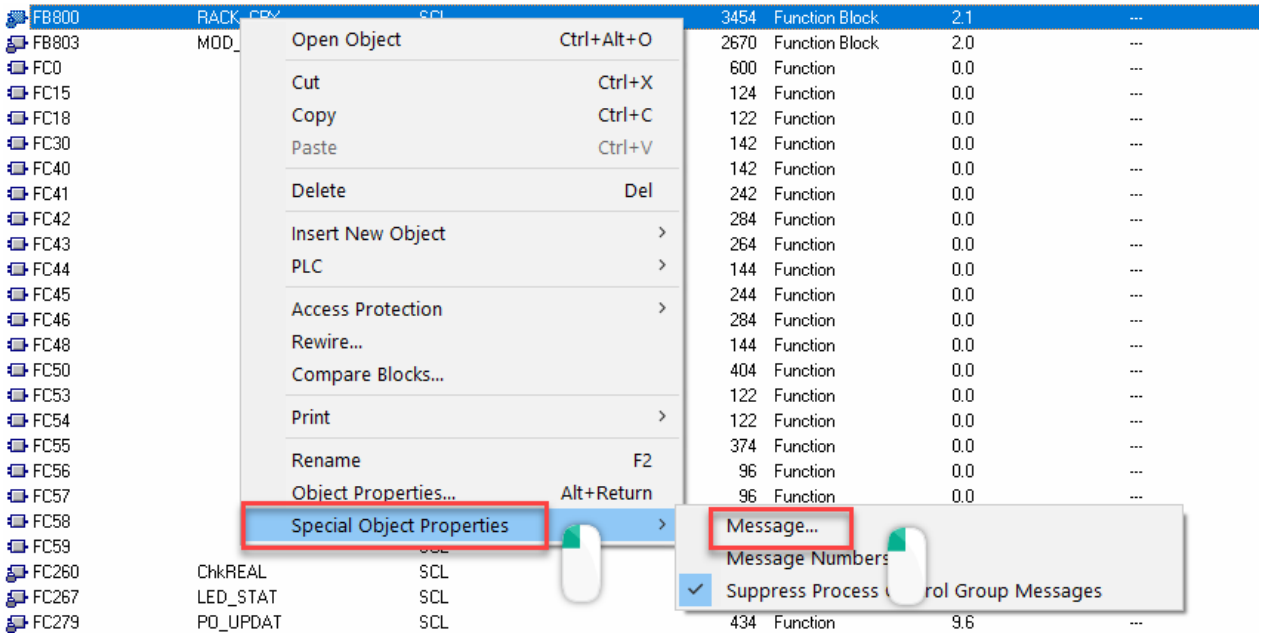


7.3 Checking and customization of block messages

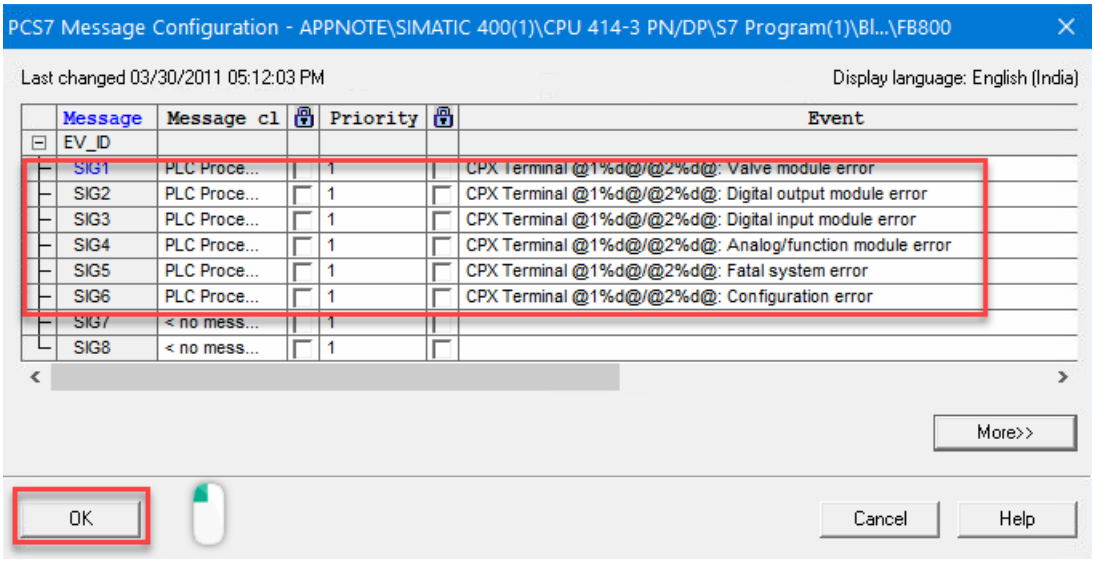
Open Simatic Manager project window. Select the blocks folder to display all the function blocks used in the project.



1. Click on “Special Object properties”
2. Click on “Messages”



3. Edit Individual messages and click on **“OK”**

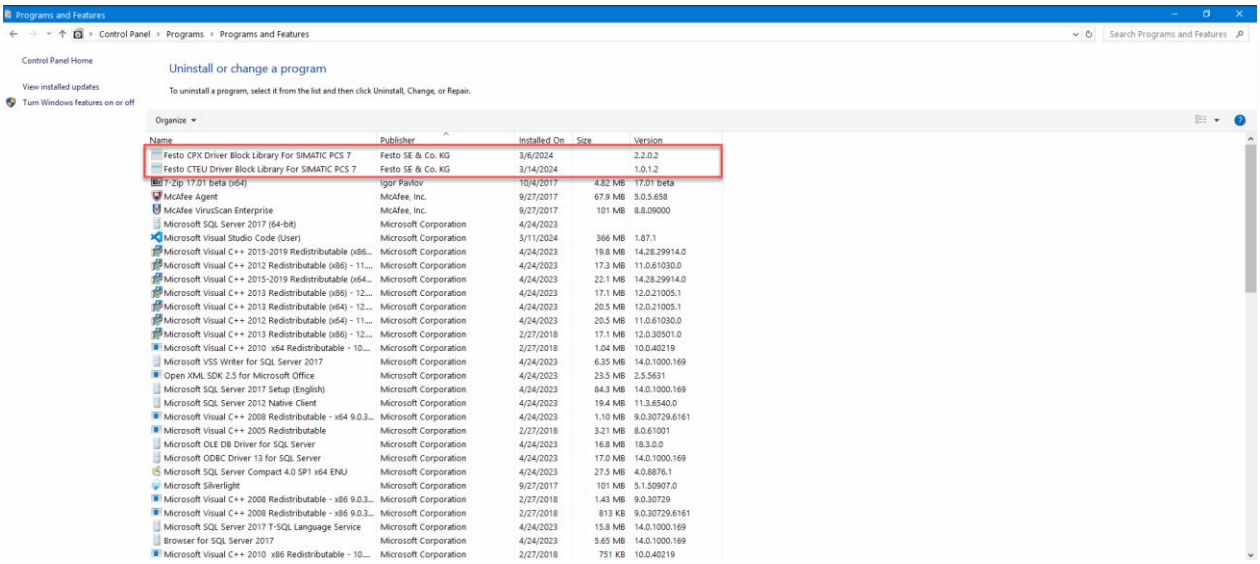


4. After editing perform AS compile and download.
5. Then perform ES compile and download.
6. Then perform OS Compile and Run the WinCC project to observe the changes.

7.4 Checking the installed library version

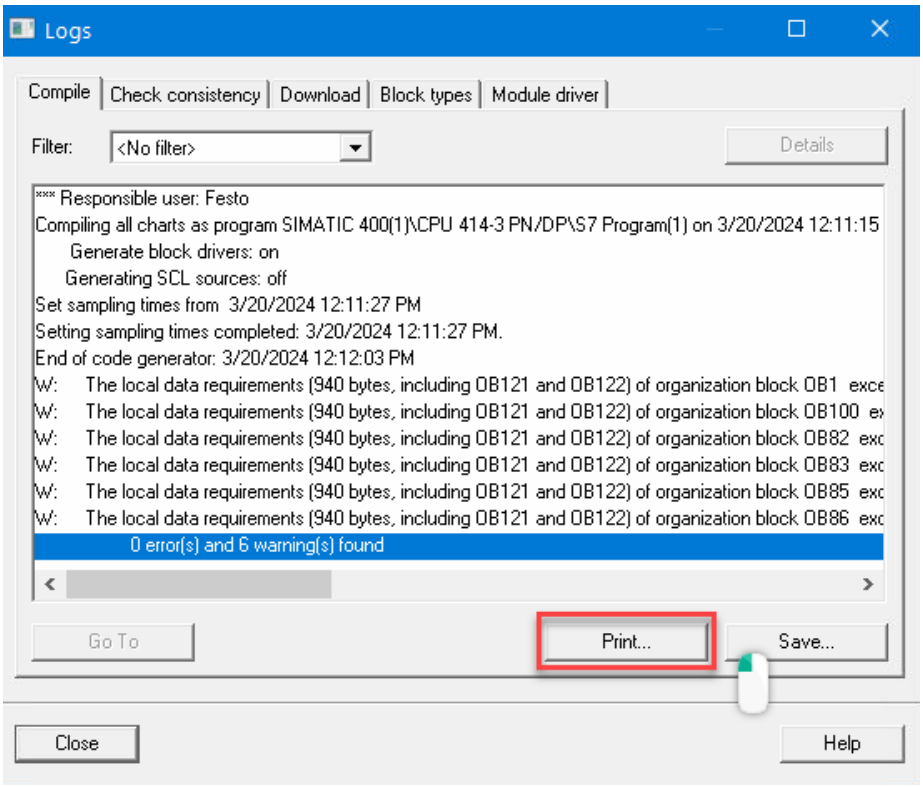
1. Open Control Panel.
2. Select “Programs and Features”.
3. Select “Uninstall or change a program”.

The window below is displayed. Filter Festo driver block library and the installed versions can be found under the version tab.

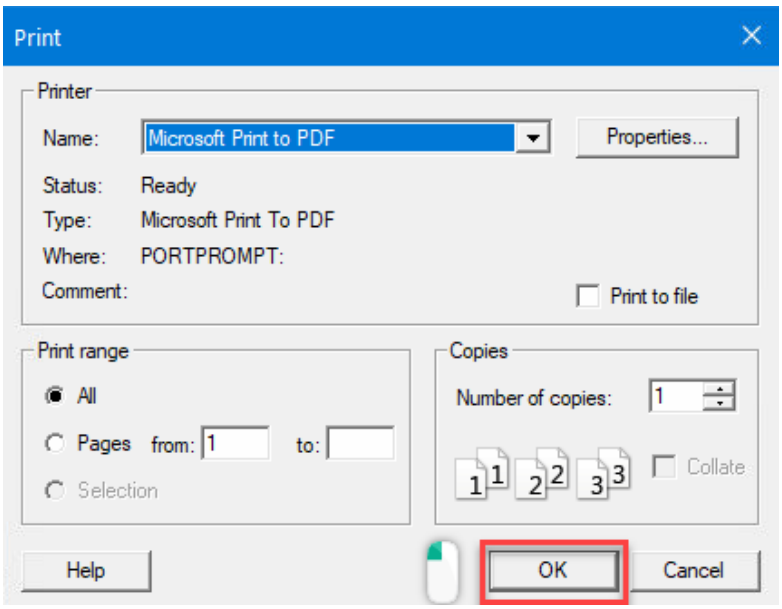


7.5 Exporting the CFC compilation log

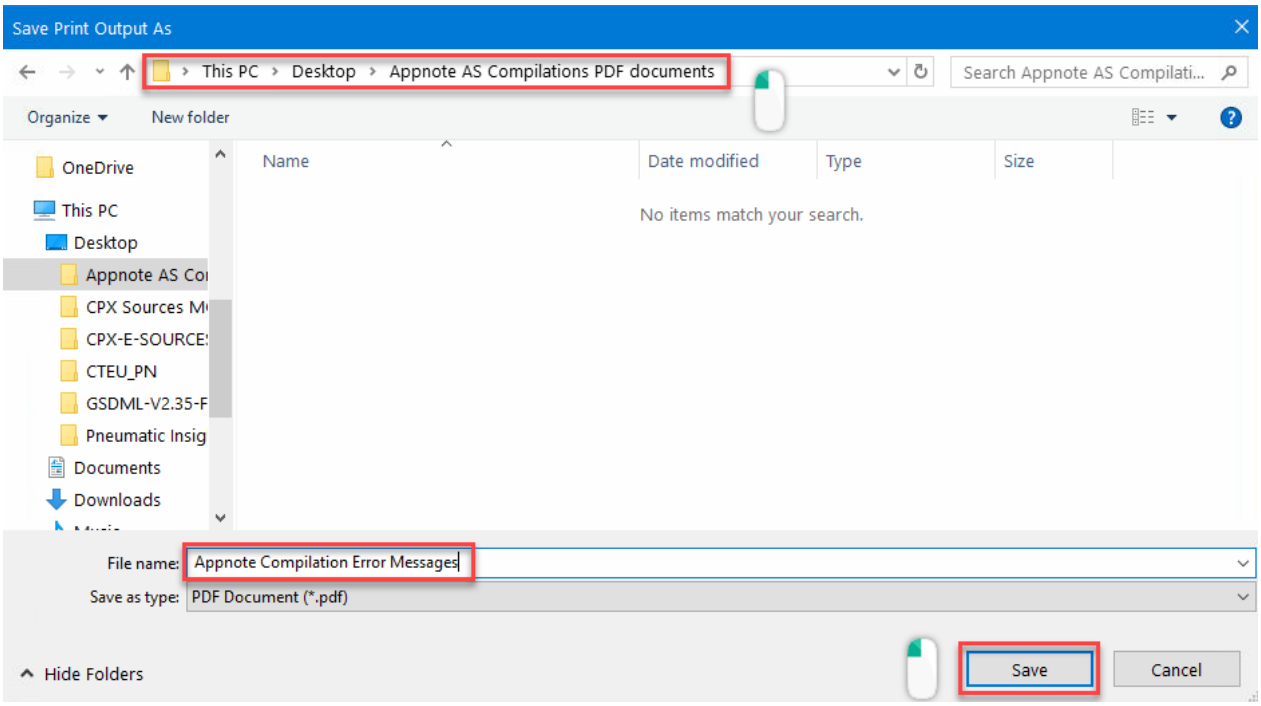
1. Open CFC Editor.
2. Compile CFC and the window below should display warnings/errors.
3. Click on **“Print…”**



4. Select print Options and click on **“OK”**



5. Select Save location, type File name and click on **“Save”**

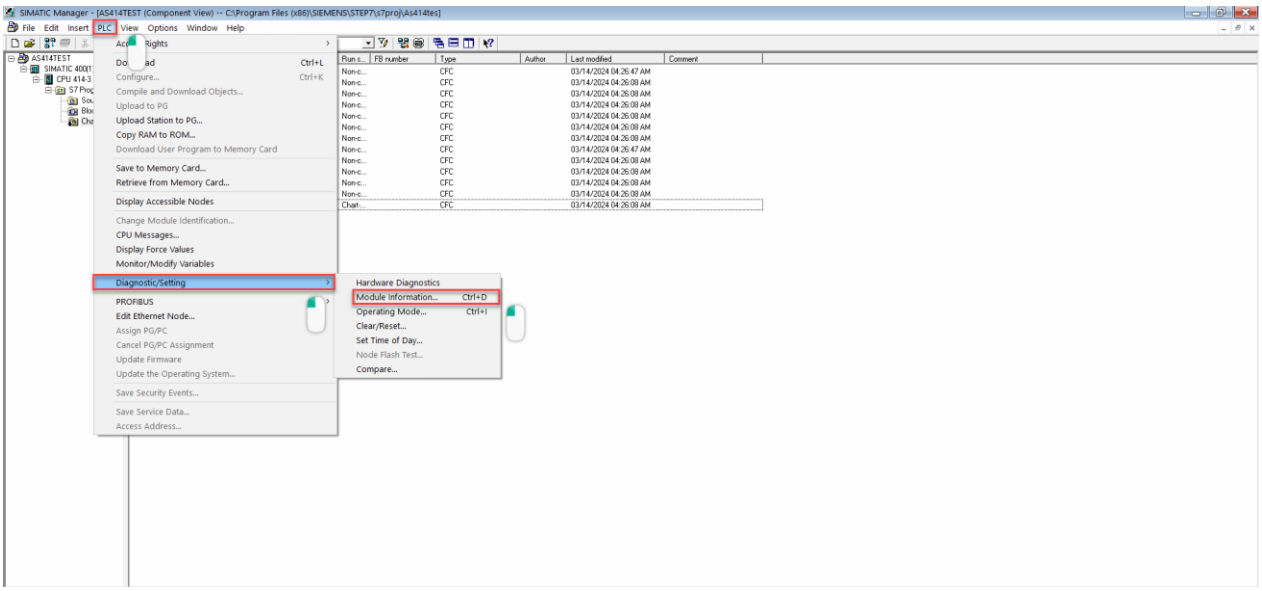


6. Close the compilation log window and open the PDF file created that contains compilation errors.

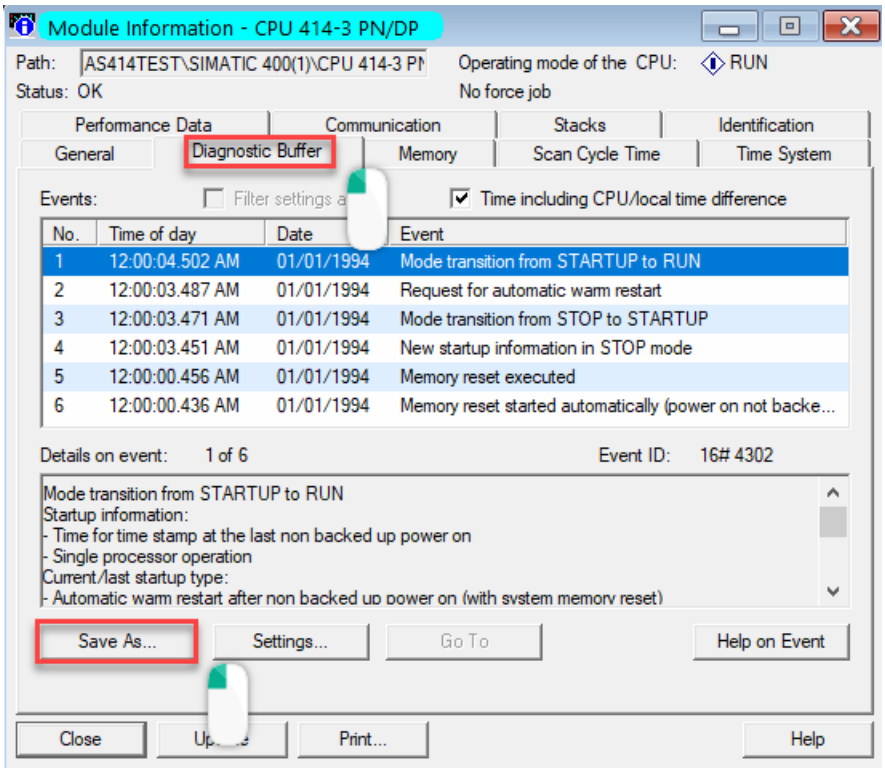
7.6 Exporting Diagnostic Buffer log

In some cases, the function blocks cause error entries in the diagnostic buffer of the CPU. To analyse these error, the generation of export is required.

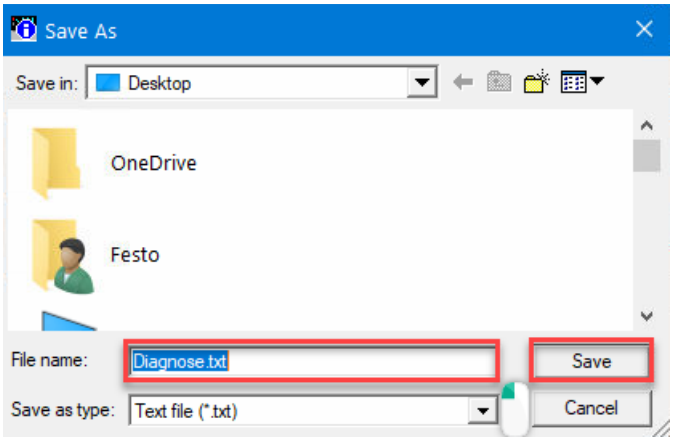
1. Open Project Window
2. In the Menu Bar, select “PLC”
3. Select “Module Information”



4. Select “Diagnostic Buffer”
5. Select “Save As”



6. Type Name of file to be saved.
7. Select “Save”

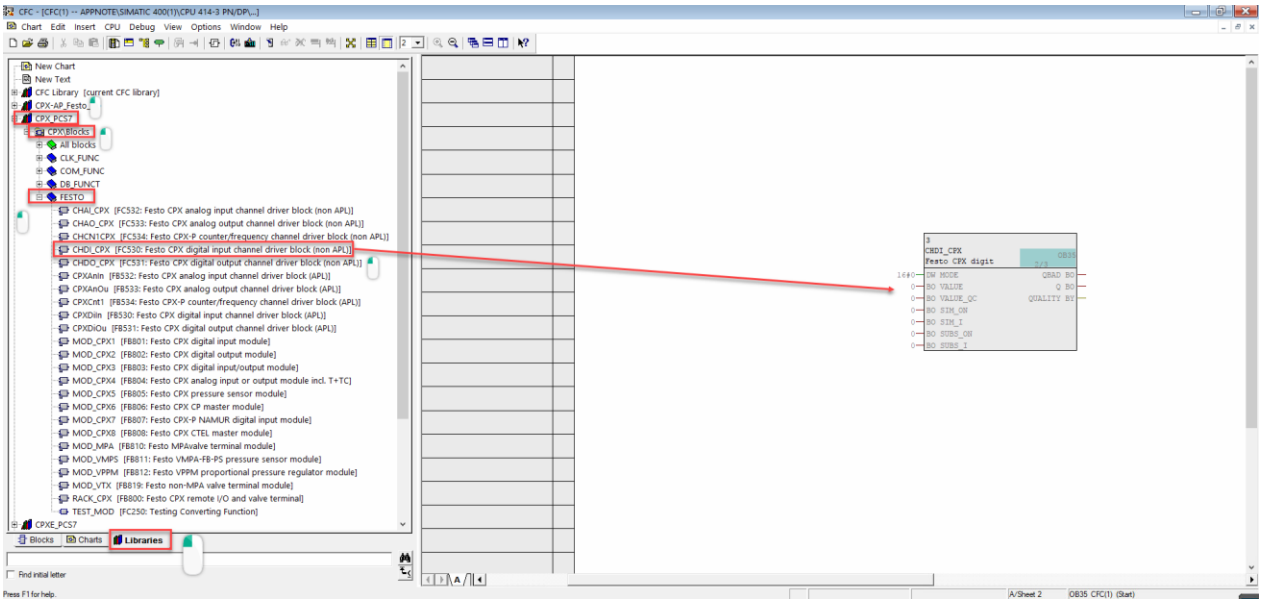


8. Close the Diagnostic buffer window.

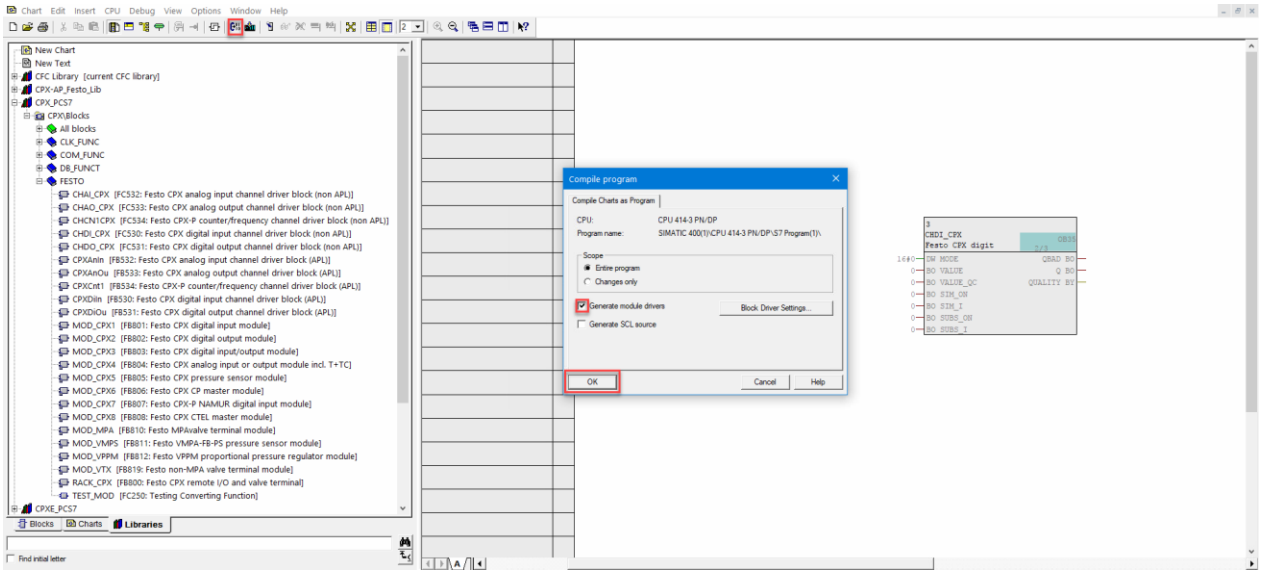
8 Extended Functions

8.1 Simulation

In some situations where process signals are unavailable, the driver blocks come with an option for simulation of process value. This can be shown by simulating a digital input in CPX terminal by following the steps below:

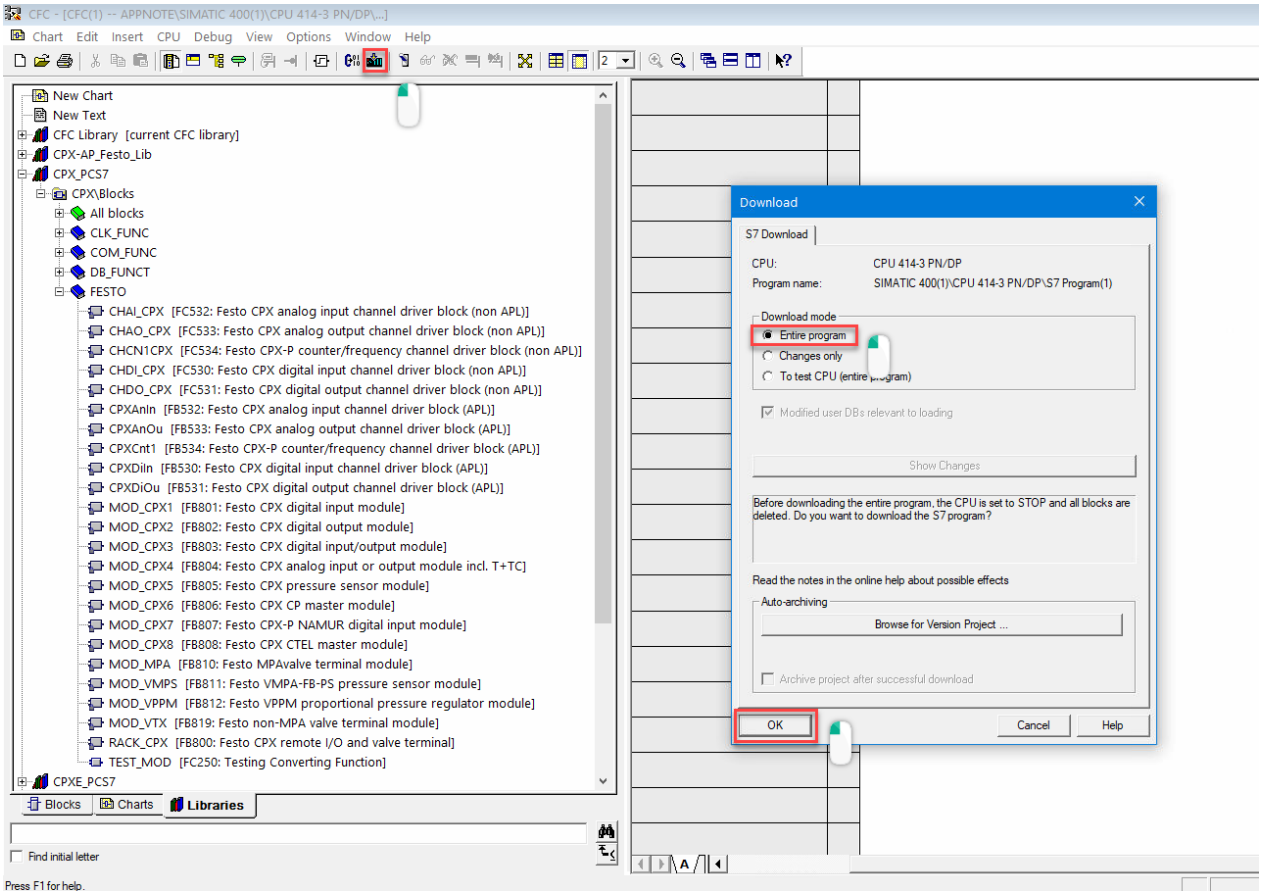


1. Open an empty CFC.
2. Select **“Libraries”**.
3. Expand **“CPX_PCS7”**.
4. Expand **“CPX\Blocks”**.
5. Expand **“FESTO”**.
6. Drag and drop the block named **“CHDI_CPX”** into an empty space in CFC.

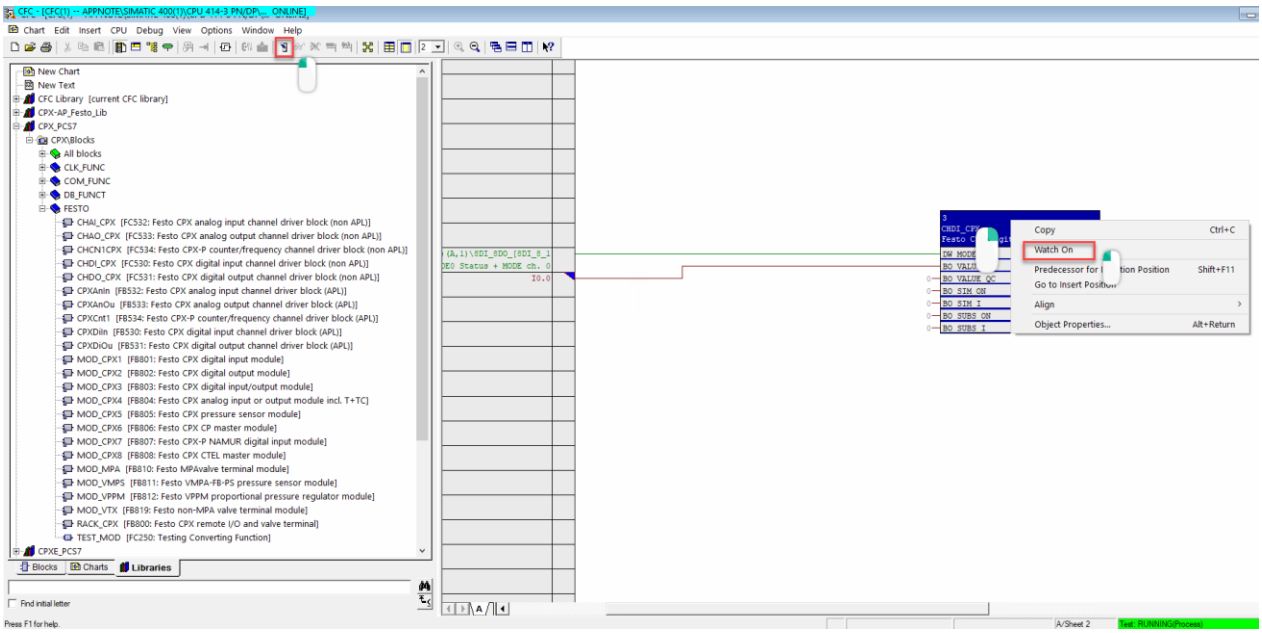


7. Click on **“Compile”** Icon.
8. Select **“Generate Module Drivers”** option.
9. Select **“OK”**.

10. Click on **“Download”** Icon.
11. Select **“Entire Program”**.
12. Select **“OK”**.

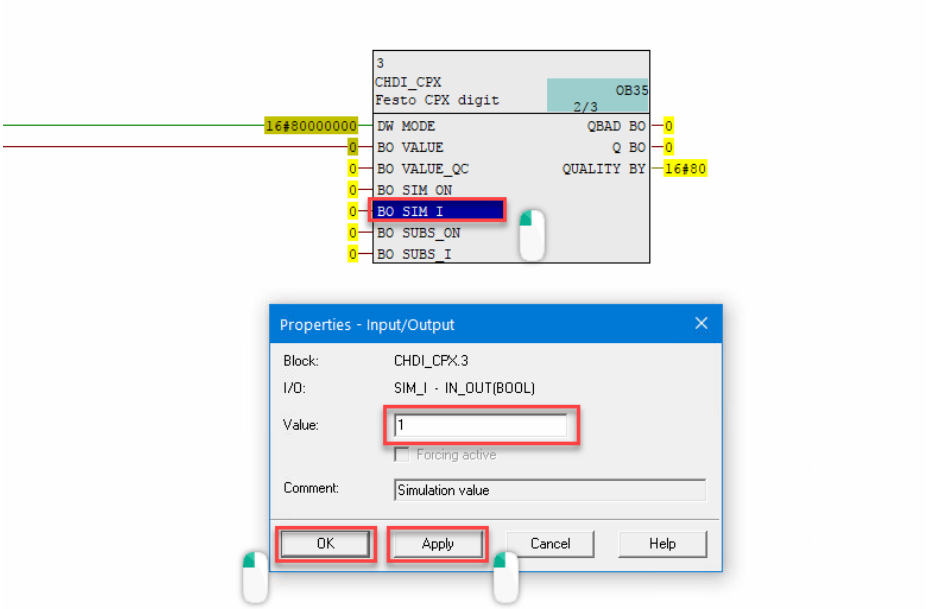


13. Select **“Test Mode”**.
14. Right Click on the block.
15. Select **“Watch On”.**

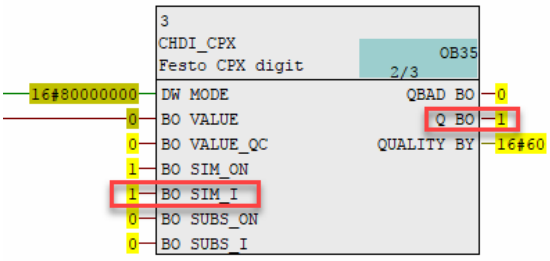


Now, the block is ready to be simulated. For demonstration purposes, let us assume that the DI I0.0 is unavailable in the field and **logic 1** has to be simulated for the same input. Proceed as shown below:

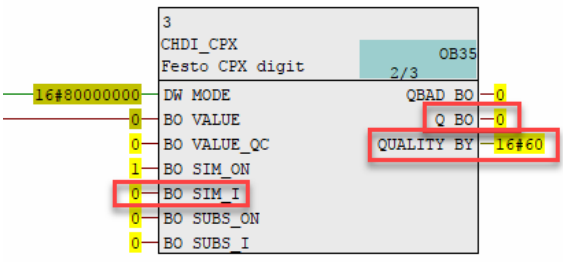
16. Double click on the parameter **"SIM_I"**. The dialog box opens where we can change the value.
17. Type **"1"**.
18. Select **"Apply"**.
19. Select **"OK"**.



20. Follow Steps 16 to 19 to enter the value **"1"** to **"SIM_ON"** Parameter. Observe that the Output **"Q"** is turned ON. Observe that **"QUALITY"** signal always changes to **16#60** when **"SIM_ON"** has the value **"1"**.

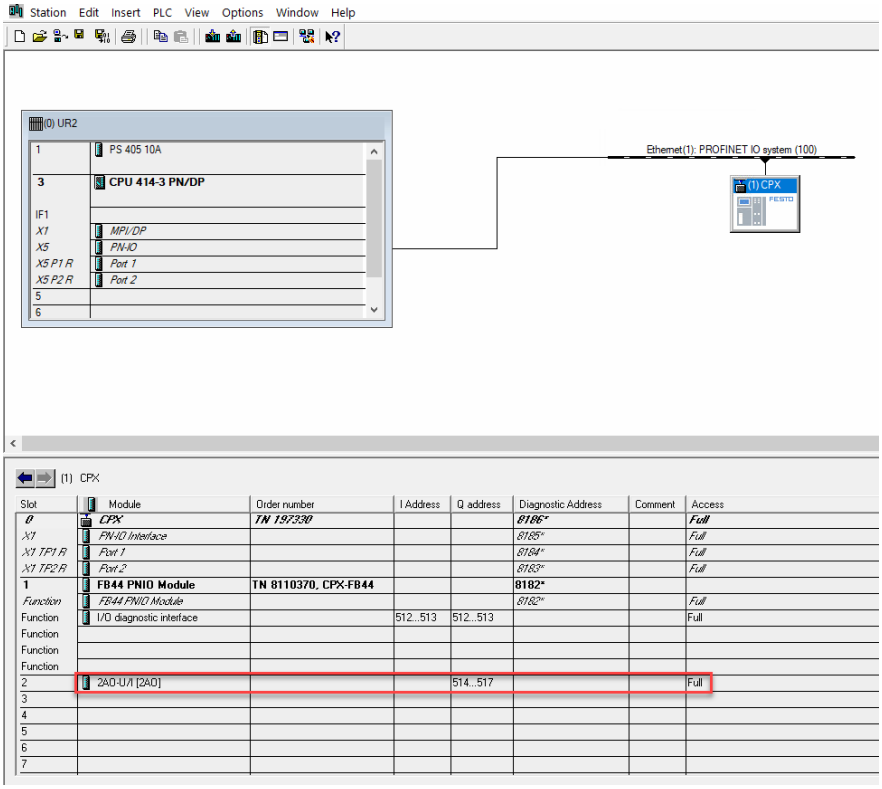


21. Change the value of **"SIM_I"** to simulate the output **"Q"**.

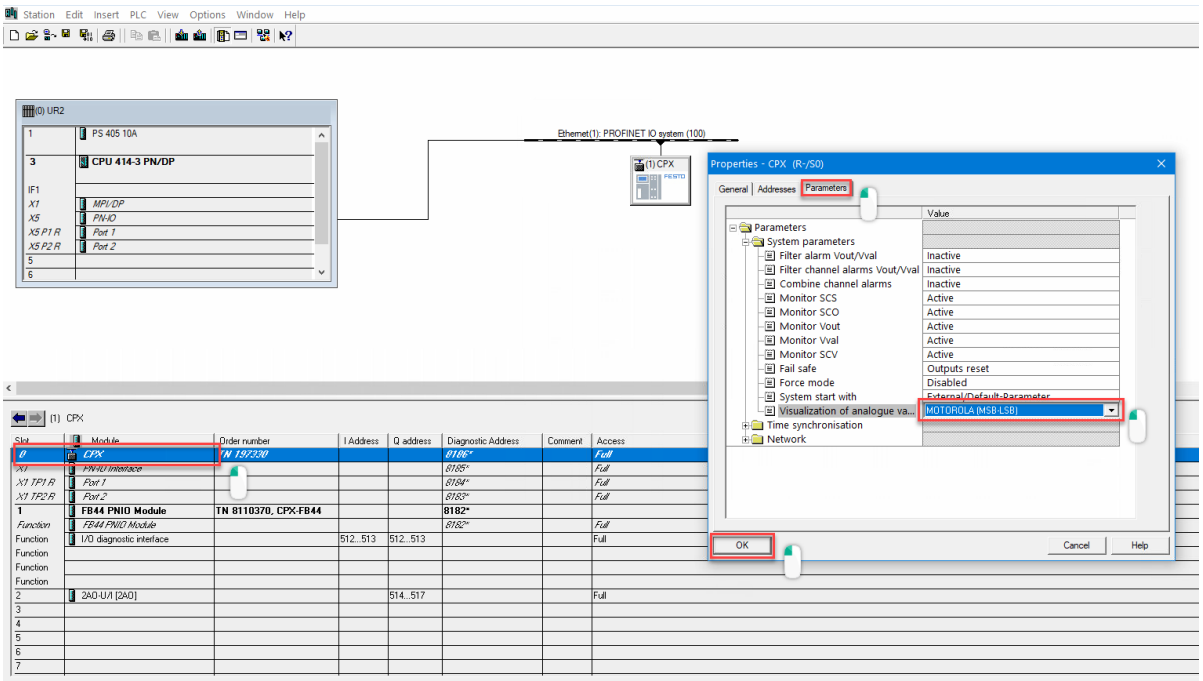


8.2 Working with Analog Signals

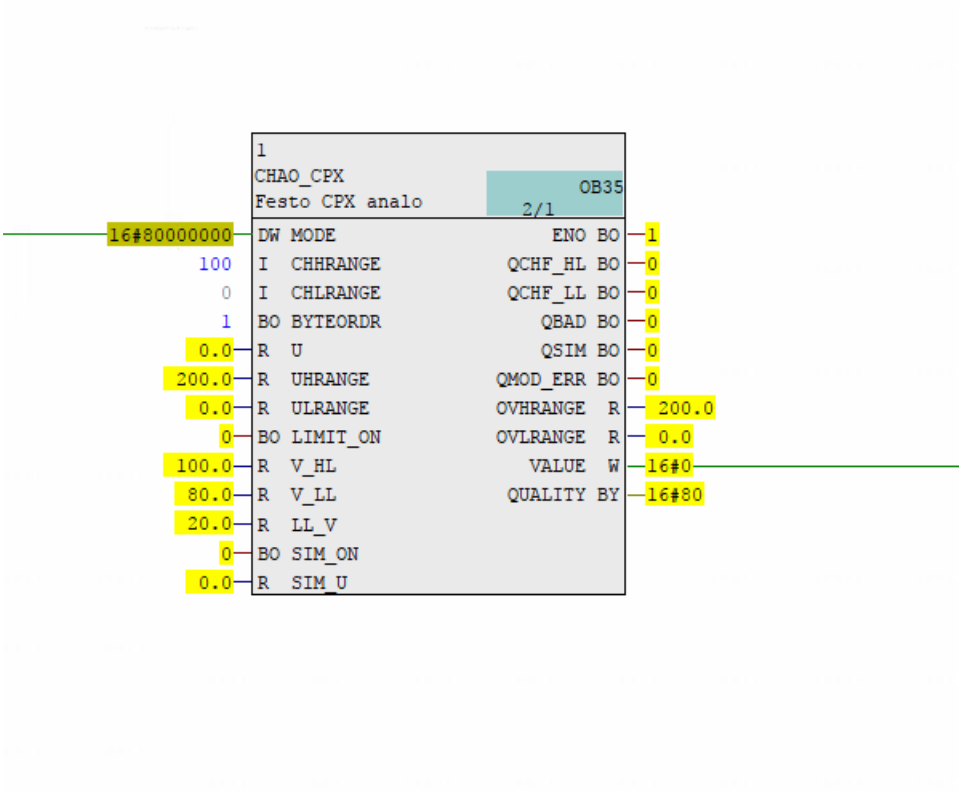
Analog signals are different from digital signals. The driver blocks have much more functions in these blocks. To realize these functions, hardware as well as CFC code has to be adapted. For this section, different hardware configuration is used as shown below:



Observe that **2AO-U/I** is being used in **slot 2** instead of the original CPX configuration. The parameters need to be set as below:

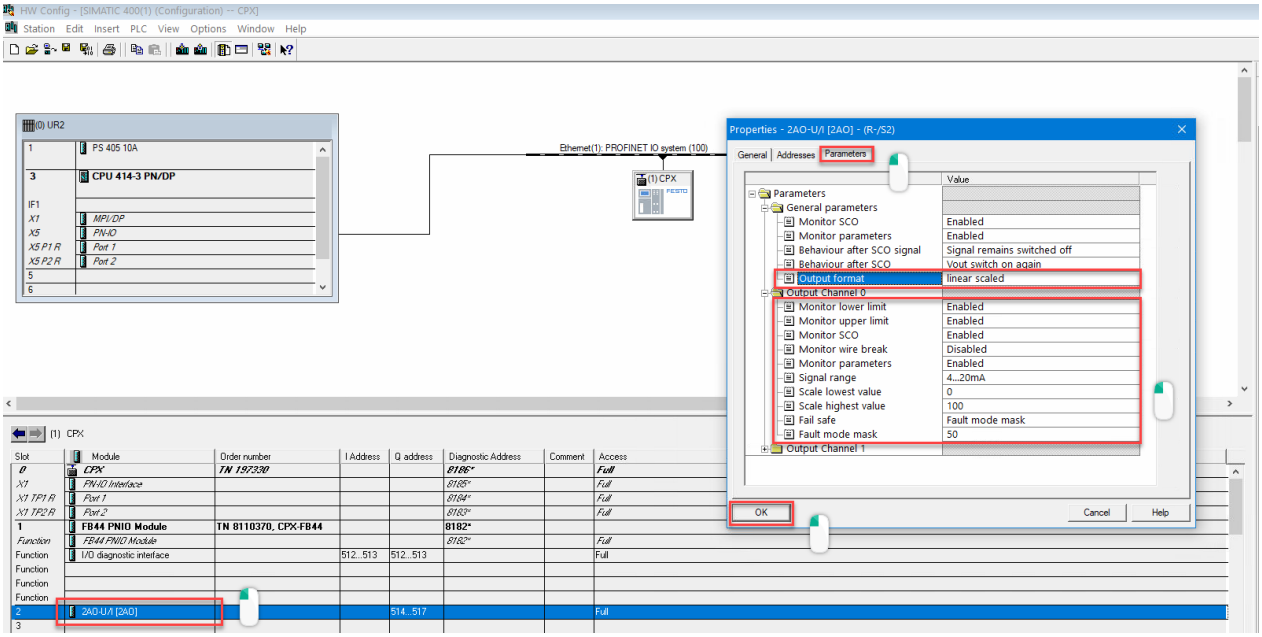


1. Open Hardware Configuration Window.
2. Double click on **“Slot 0, CPX”** to open its properties window.
3. Select **“Parameters”** tab.
4. Scroll to **“Visualisation of analogue values”** and select **“MOTORALA(MSB-LSB)”**. This is **NOT MANDATORY** step but it helps us to process the values easily.
5. Select **“OK”**
6. Compile and Download Hardware Configuration (**Refer section 4.4**).
7. Add **CHAO_CPX** block and Generate Module drivers again by compiling CFC (**Refer sections 5.2 & 5.3**).
8. Open CFC and go to Test Mode and Watch the block (**Refer section 8.1**).

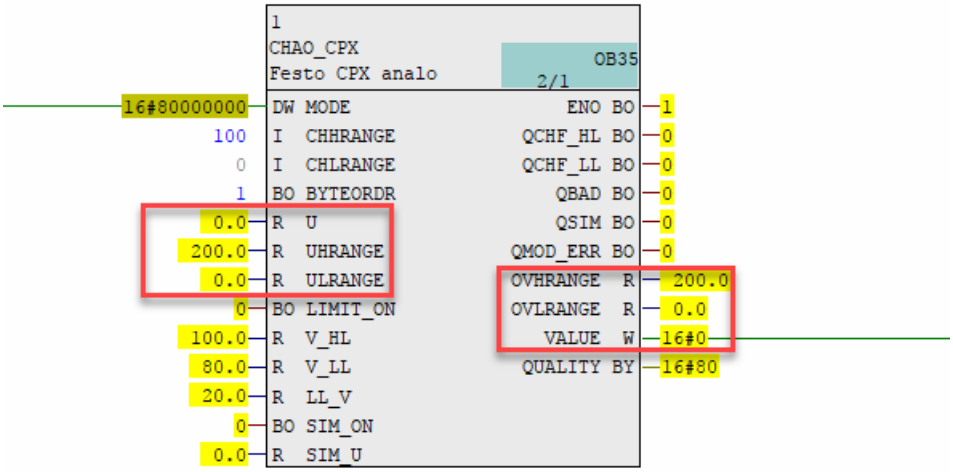


8.2.1 Scaling Analog Values

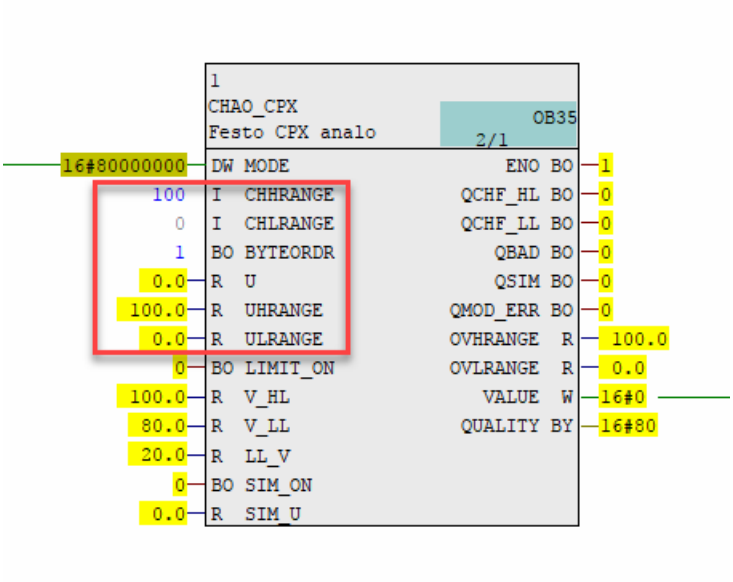
1. Open Hardware configuration.
2. Double click on **“2-AO-U/I”**.
3. Select **“Parameters”**.
4. Set output mode, signal range and other required settings.



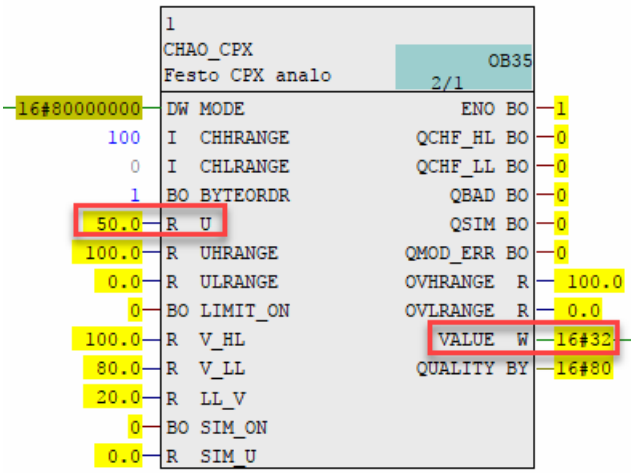
5. Open CFC editor and go to Test mode on the block **(refer section 8.1)**
6. Parameters **CHHRANGE**, **CHLRANGE** and **BYTEORDR** cannot be changed as they are set in hardware configuration.
7. Set Parameters **UHRANGE** and **ULRANGE** and observe the **OVHRANGE** and **OVLRANGE** parameters change. This is the limit for scaling of the output value.



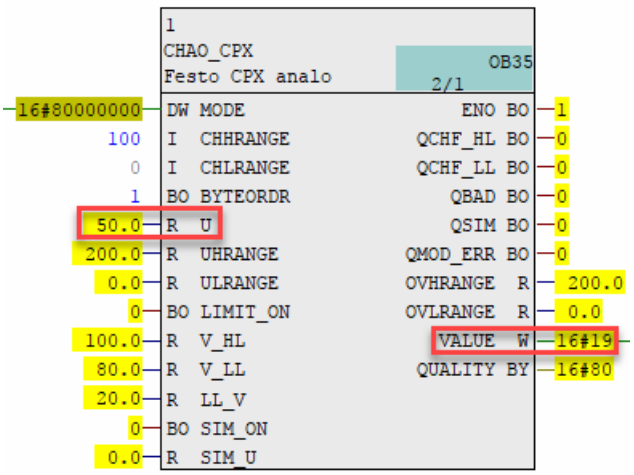
8. For establishing values without scaling, let us set **UHRANGE=CHRANGE** and **ULRANGE=CHLRANGE** to **100**.



9. Change the value of **"U"** to **10#50** and notice that the parameter **"VALUE"** is changed to **16#32** which is **10#50**.

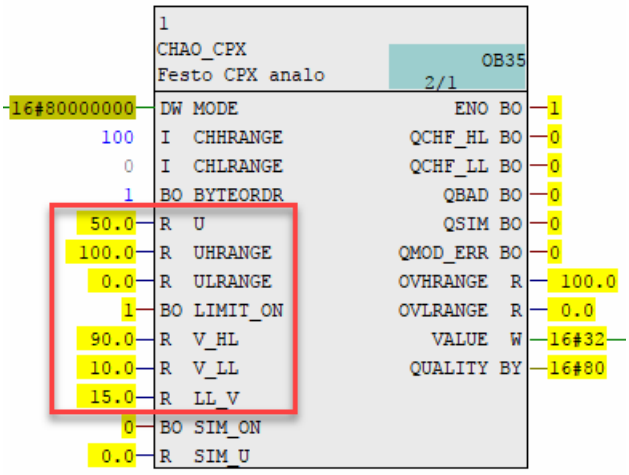


10. For establishing values without scaling, let us set **UHRANGE** to **200** and **ULRANGE** to **0**. Observe that the parameter **"VALUE"** changes to **"16#19"** which is **"10#25"**. We can see that the output gets scaled by setting the ranges.

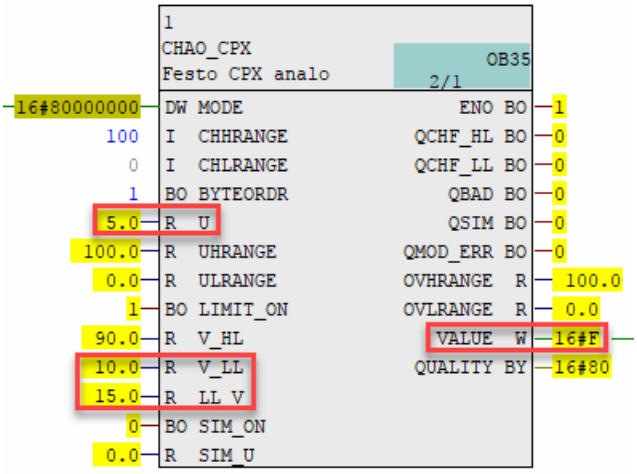


8.2.2 Limiting Analog Values

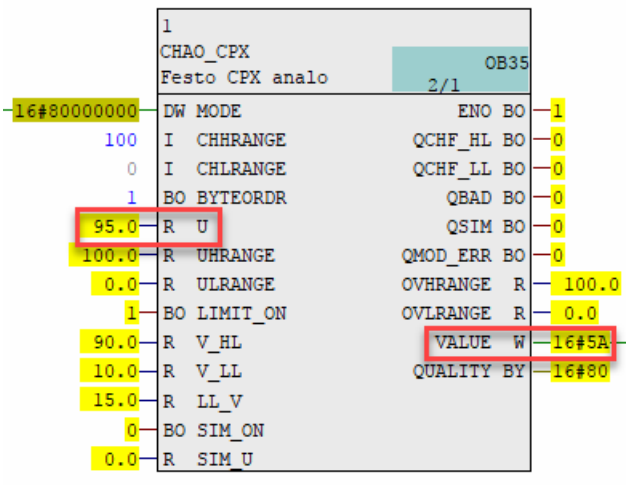
To demonstrate Limiting of Analogue values, the following configuration is made in the block.



In the image above, we can see that **UHRANGE=CHHRANGE=100**, **ULRANGE=CHLRANGE-0**, **V_HL=90 , V_LL=10** and **LL_V=15.**

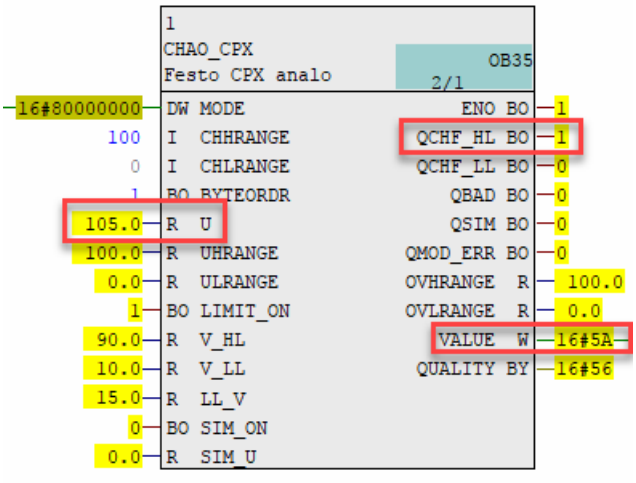


For simulating low limit, set the parameter **U=5**, observe that **VALUE** changes to **16#F** which is **10#15**.

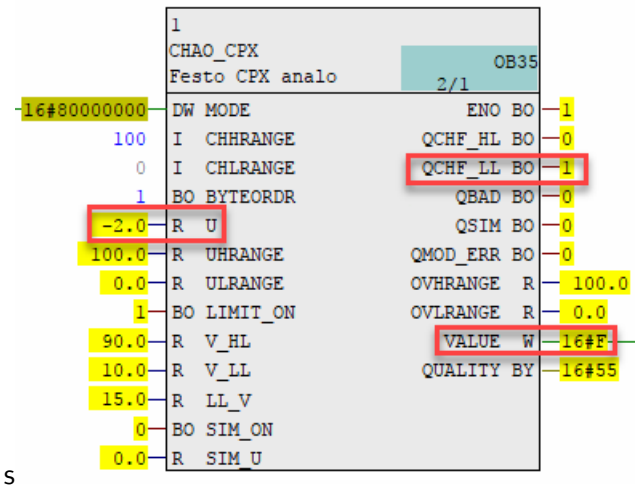


For simulating high limit, set the parameter **U=95**, observe that **VALUE** changes to **16#5A** which is **10#90**.

For simulating channel high limit, set the parameter **U=105**, observe that **VALUE** changes to **16#5A** which is **10#90**. Also, notice that the parameter **QCHF_HL** changes its value to **TRUE**.



For simulating channel low limit, set the parameter **U=”-2”**, observe that **VALUE** changes to **16#F** which is **10#15**. Also, notice that the parameter **QCHF_LL** changes its value to **TRUE**.



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