Application Note

FESTO

CPX-AP S2 Redundancy

S2 Redundancy with CPX-AP using Siemens PCS7 with S7-400 H-System

CPX-AP

100303

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1 Components/Software used

1.1 Software

Type/Name	Version Software	Date of manufacture
SIMATIC PCS7	V8.0	--
PRONETA	V3.0	--

Table 1.1: Software used

1.2 Hardware

Qty.	Type/Name	Manufacturer	Version Hardware/Firmware
1	CPX-AP-I-PN-M12 (8086607)	FESTO	REV 01
1	CPX-AP-I-4DI4DO-M12-5P (8086603)	FESTO	REV 01
1	NEBC-D8G4-ES-1-N-S-D8G4-ET (8065125)	FESTO	--
2	NEBU-M8G4-K-2.5-LE4 (541342)	FESTO	--
2	NEBC-D12G4-ES-3-S-R3G4-ET (8040452)	FESTO	--
2	CPU 410-5H (6ES7 410-5HX08-0AB0)	SIEMENS	V8.1.2
2	PS 407 10A (407-0KA02-0AA0)	SIEMENS	--
2	Fiber Optics (6ES7960-1AA04-5AA0)	SIEMENS	--
2	UR2ALU-H (6ES7 400-2JA10-0AA0)	SIEMENS	--
2	Straight Ethernet Cables Cat.6	--	--

Table 1.2: Components used

2 Documentation

2.1 Festo

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

- CPX-AP Automation System (8099720):
  http://ademsp00.de.festo.net/net/en-gb_gb/SupportPortal/Files/663529/CPX-AP_instruction_2019-06_8099722g1.pdf

- CPX-AP-I-4DI4DO-M12-5P (8099657):
  http://ademsp00.de.festo.net/net/en-gb_gb/SupportPortal/Files/663516/CPX-AP-I-4DI4DO-M12-5P_instruction_2019-06_8099659g1.pdf

- CPX-AP-I-PN-M12 (8099693) :
  http://ademsp00.de.festo.net/net/en-gb_gb/SupportPortal/Files/663527/CPX-AP-I-PN-M12_instruction_2019-06_8099695g1.pdf

2.2 3rd partner

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

Warning
Festo is not responsible for this documents
This documents where used for bibliography matters and research.
In case you might face problems with broken links and missing/wrong information , please check with the manufacturer.

3 Application Description

Nowadays is becoming even more common applications that uses different types of redundancy to increase the reliability during operation and avoid unexpected stops and , consequently, production drawbacks.

The S2 Redundancy type implies in the use of 2 synced master CPU´s for high availability system.
Each CPU uses different media access to the same device which should be able to handle multiple connections.

This type of redundancy is to avoid CPU fail syncing the different CPU. One of the CPU´s is a backup from the other , which means that if the Primary CPU enter in fail, the Backup CPU should be able to take over the process seamlessly.

In case from the S7-400 H system, the synchronization between the CPU´s are made by fiber optics that are directly connected between the CPU´s.

The hardware configuration implies in a “Open ring” topology whereas each of the CPU´s have just one media connection each to the configured slave and they don´t share connections or use MRP (media redundancy protocol).

The new CPX-AP devices have the capabilities to be integrated in applications with S2 redundancy level.
This document explain step-by-step how to do this configuration using a high availability system from Siemens (S7-400 – H-system) using PROFINET as network.

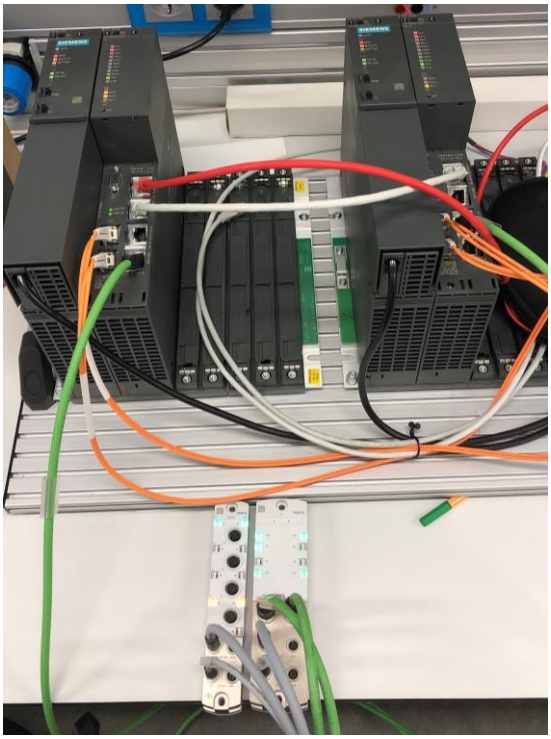


Fig. 3.1: Mounted hardware

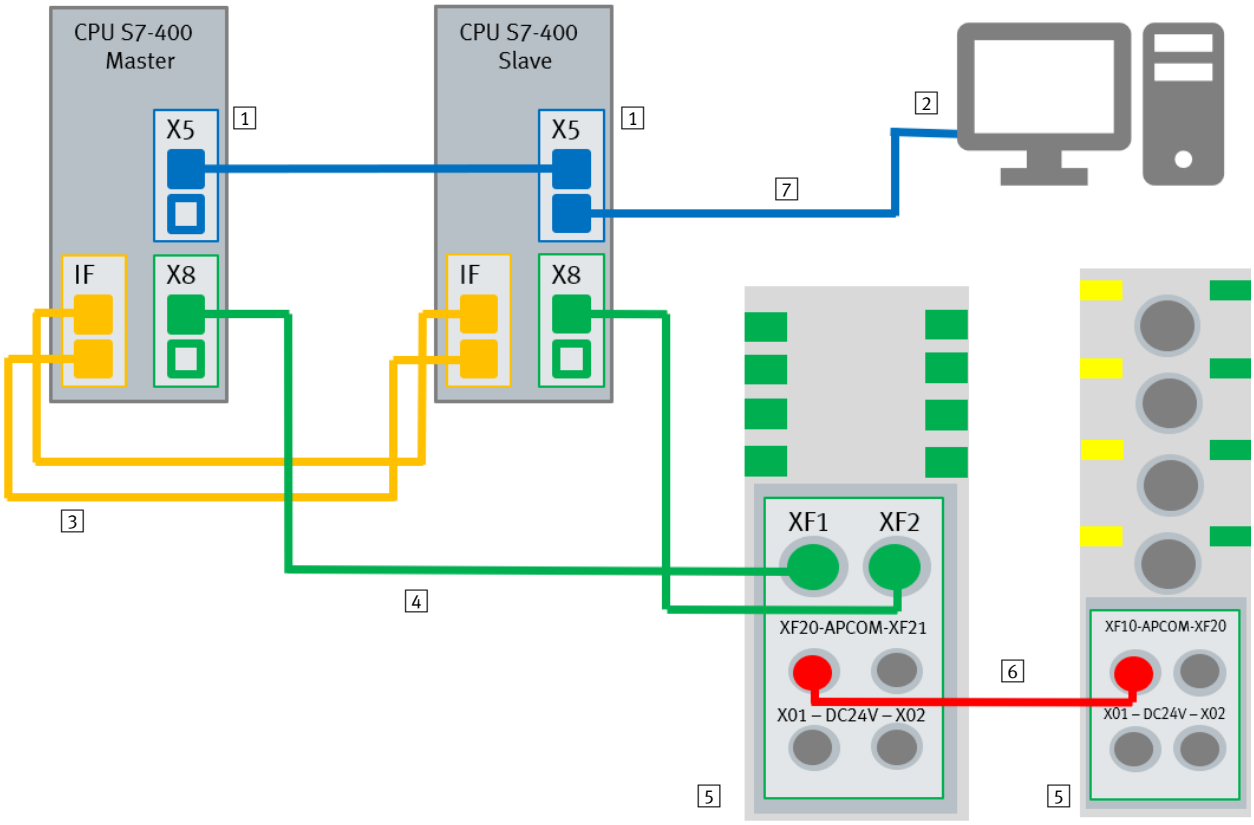
Information
You can find more information about type of redundancy at ➔ 2 (Documentation) ,

4 Electrical Connection

The electrical connection for this application should be described.

Check the instructions for Power Supply for the devices
All the based documentation that are described at Cap.2 (➔Components/Software used)

Warning
This application note is entirely based in the following HW configuration as described
Any possible modification into the hardware can be consider as a possible troubleshoot step.



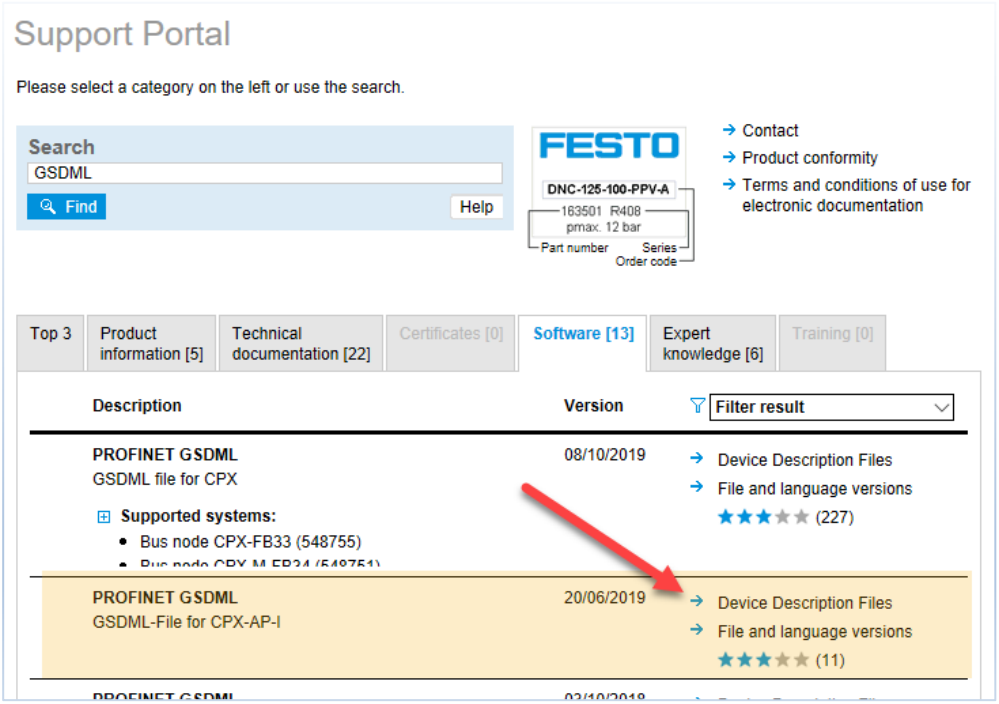
1 S7-400 CPU (Master & Slave) H-System
2 PC Terminal with PCS7 and PRONETA installed
3 Fiber-Optic Link for Sync H-System (Short)
4 PROFINET network cable
5 CPX-AP-I-PN-M12 and CPX-AP-I-4DI4DO-M12-5P
6 NEBC-D8G4-ES-1-N-S-D8G4-ET - CPX-AP Bus cable
7 Ethernet cable for programming

Fig. 4.1: Electrical Connection

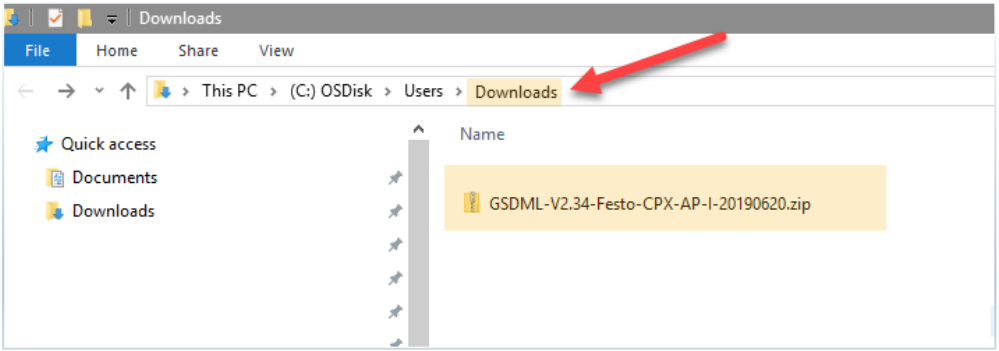
5 Commissioning

5.1 Download for GSDML file

- Open the browser;
- Open the link below ;
  https://www.festo.com/net/en-gb_gb/SupportPortal/default.aspx?q=GSDML&tab=4&s=t#result
- Download the “PROFINET GSDML file for CPX-AP-I“ clicking in “Device Description Files”;

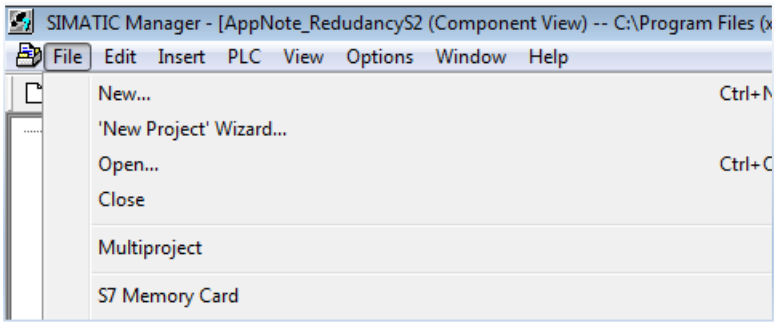


- Once that you downloaded, extract the file in a known place into your computer.

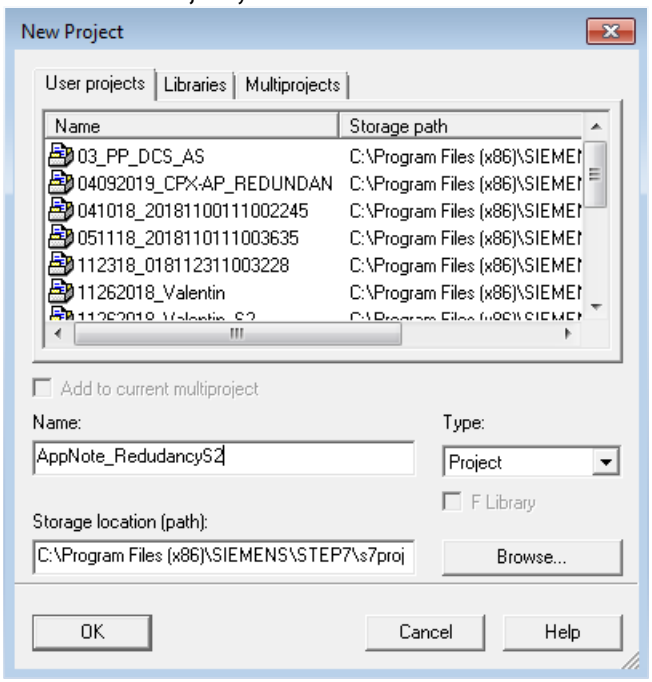


5.2 Creating a Project in SIMATIC with H-System

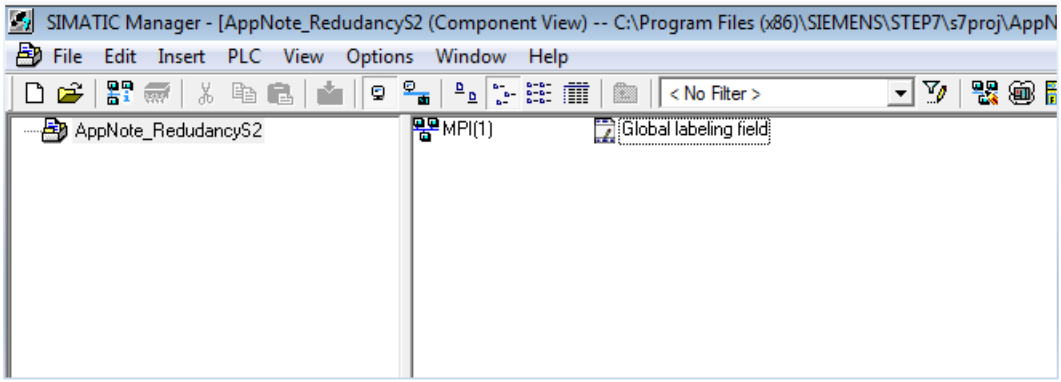
- Double Click in “Device configuration”;



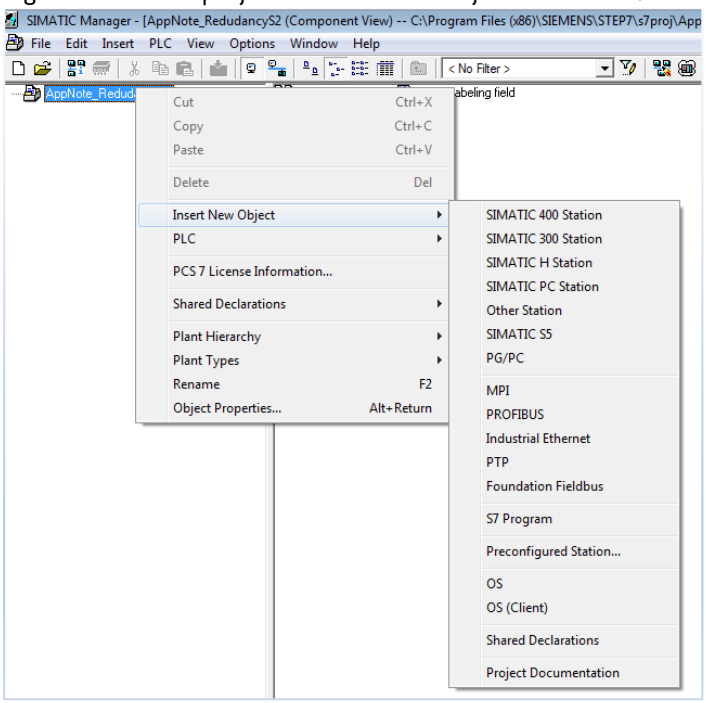
- Create a new Project you is not a must to consider the hardware for now;



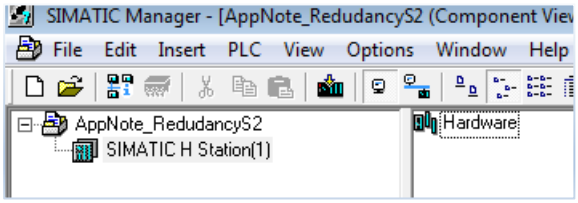
- The Project should be shown as below



- Right Click on the project -› Insert New Object -› Simatic 400



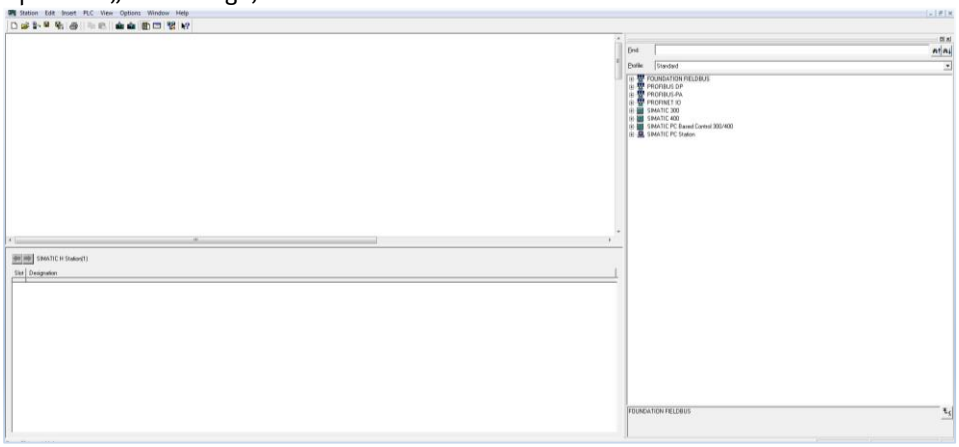
- Double-Click on “Hardware”



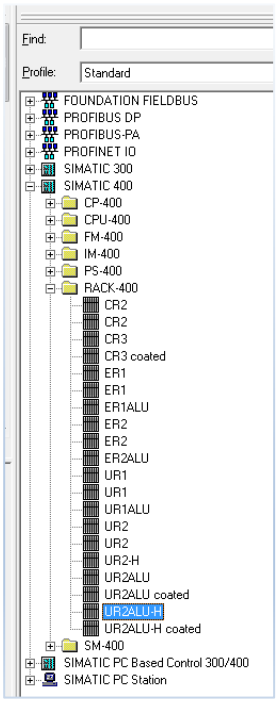
5.3 Hardware Configuration for H-Systems

5.3.1 Inserting a new H-rail and power Supply

- Open the „HW Config“;

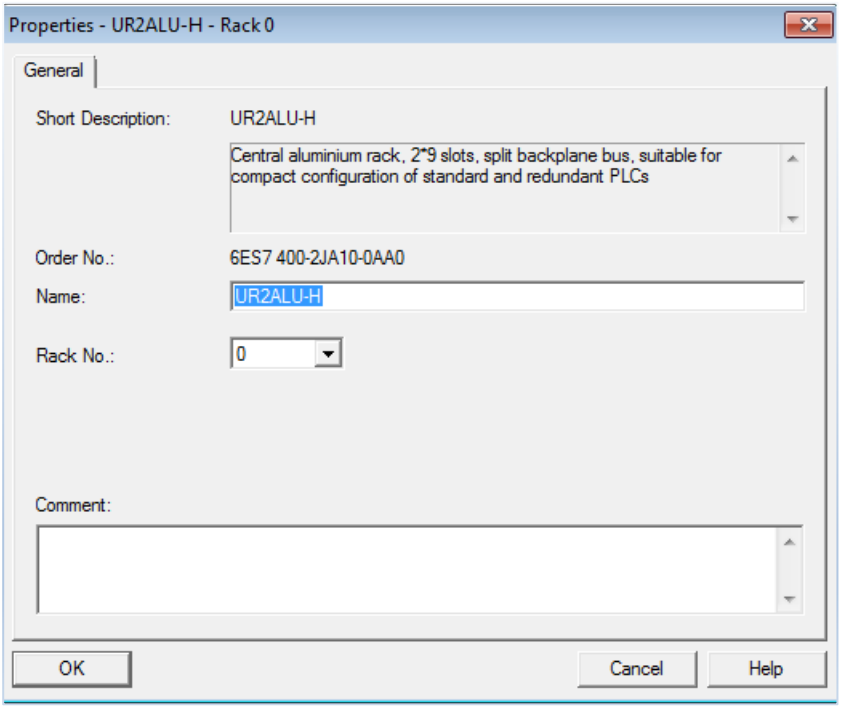


- Insert the correct rail for you project

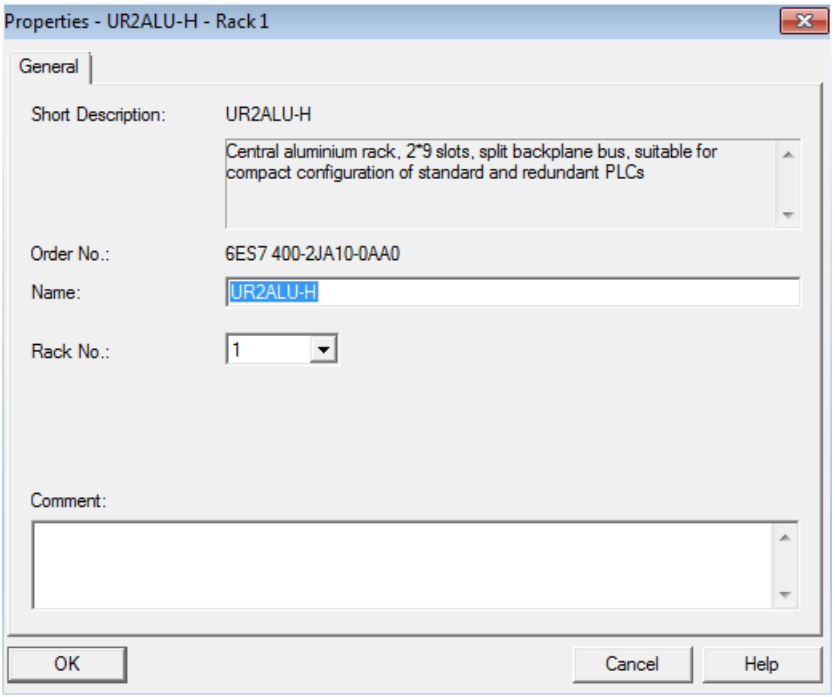


Warning
It this part is really important to select the right rail
Please, check if you rail allows the configuration for a h-system (UR2ALU-H).
If don´t , the configuration from H-system will not be available.

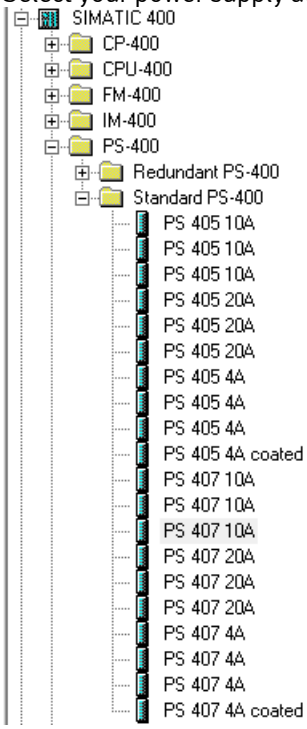
- Select the rail and name it;

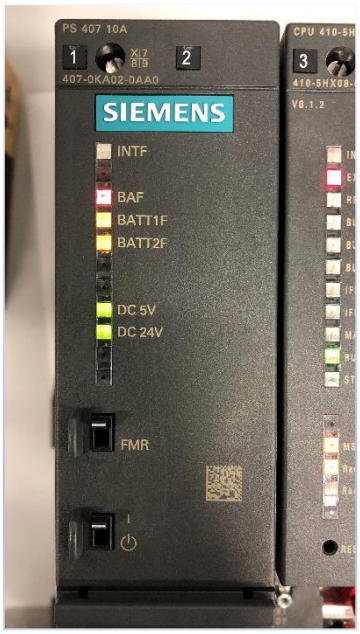


- Do it twice , one for each Controller;

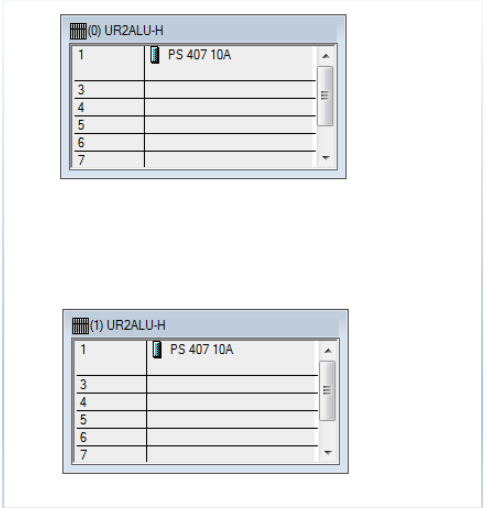


- Select your power supply according with your available Hardware:



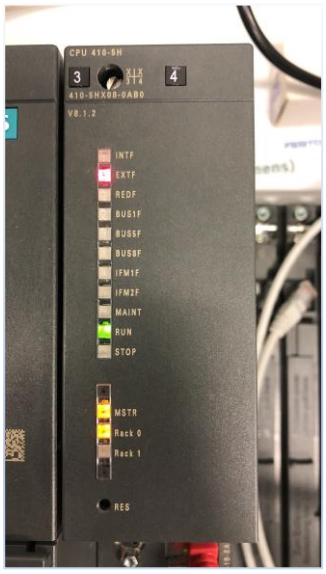


- Later on, your "HW configuration" should have the items as follow:

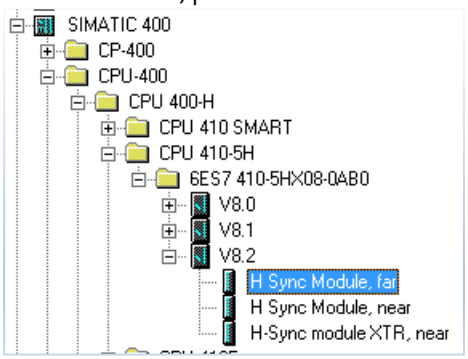


5.3.2 Inserting 1st CPU and Configuring Network

- The CPU that we used in this project is 410-5HX0B-0AB0:

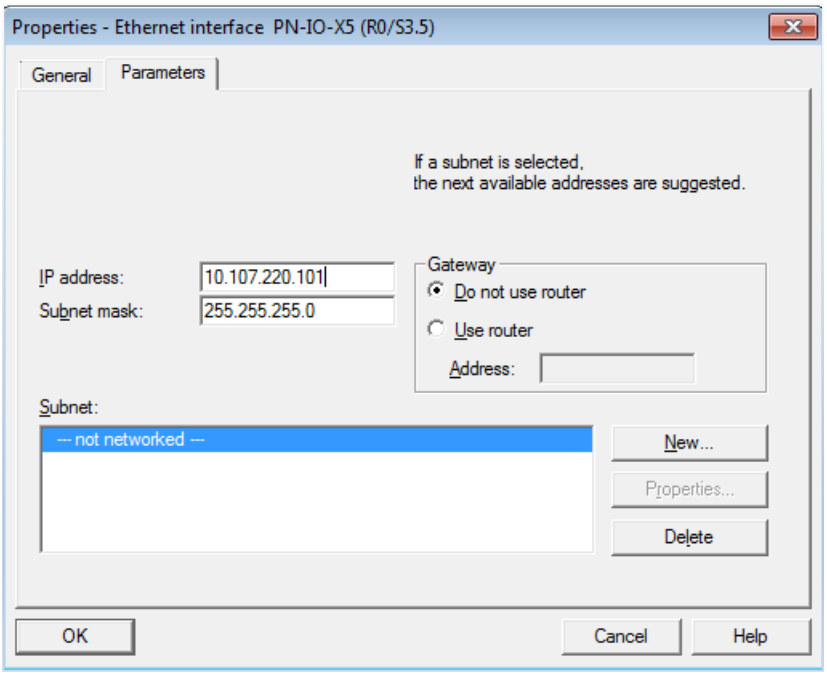


- In the selection , please consider the distance between your CPU´s to choose the right

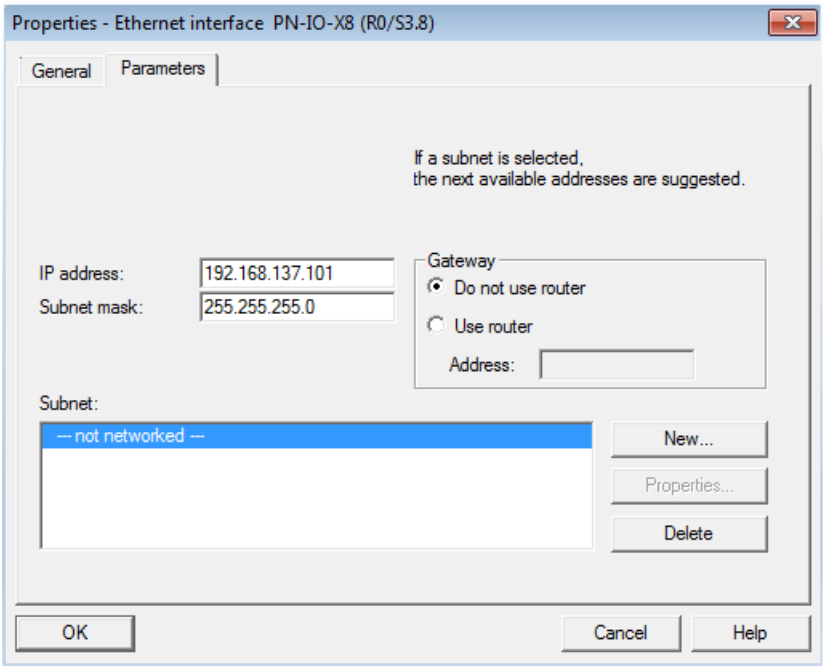


- Insert the Corresponding CPU in both Hacks

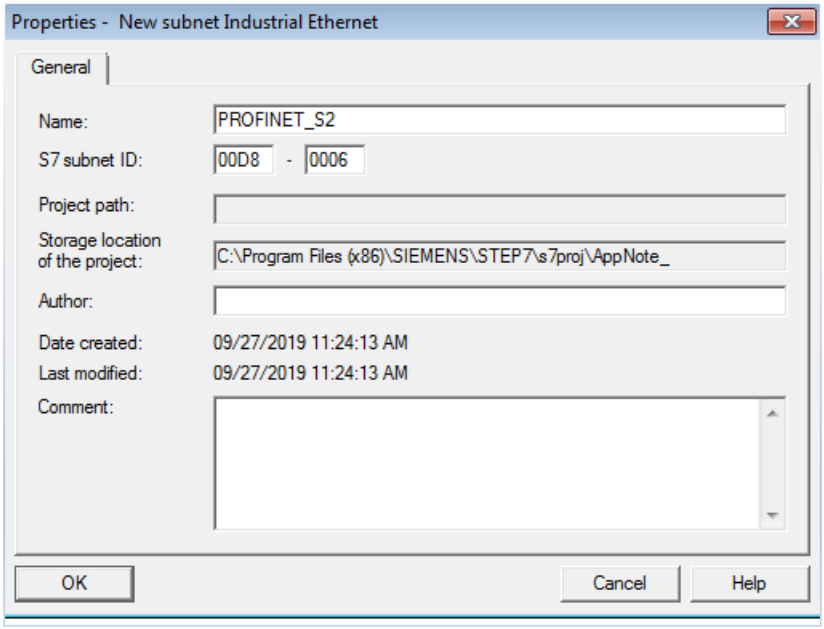
- When the CPU is added, a prompt will appear for each network interface that needs to be configured.
  In this application note it is been used the interface X8 , so there is no relevant configuration needed for some interfaces.
  In this case, it is the X5 interface, just click “OK” to go forward;



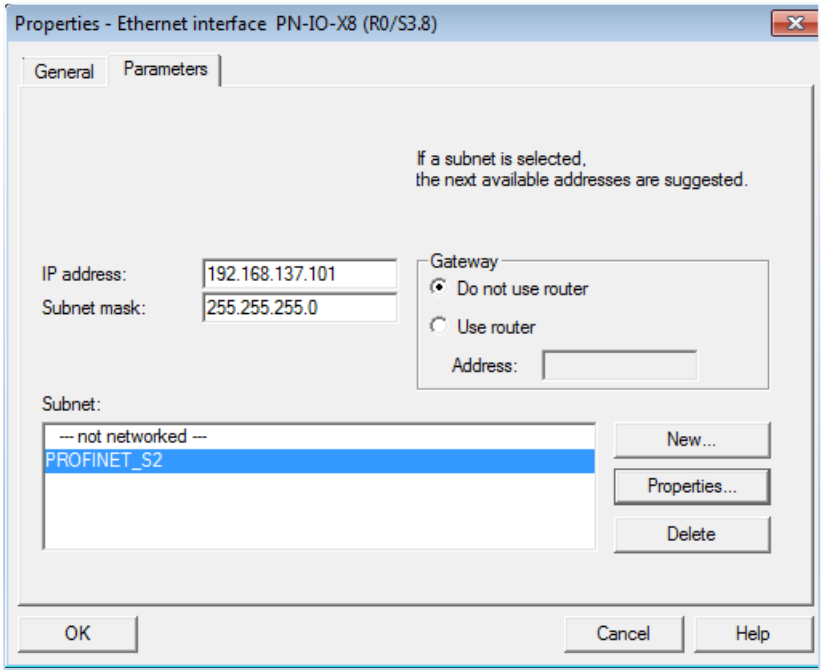
- At the Interface X8 , Click on “new” to create a network;



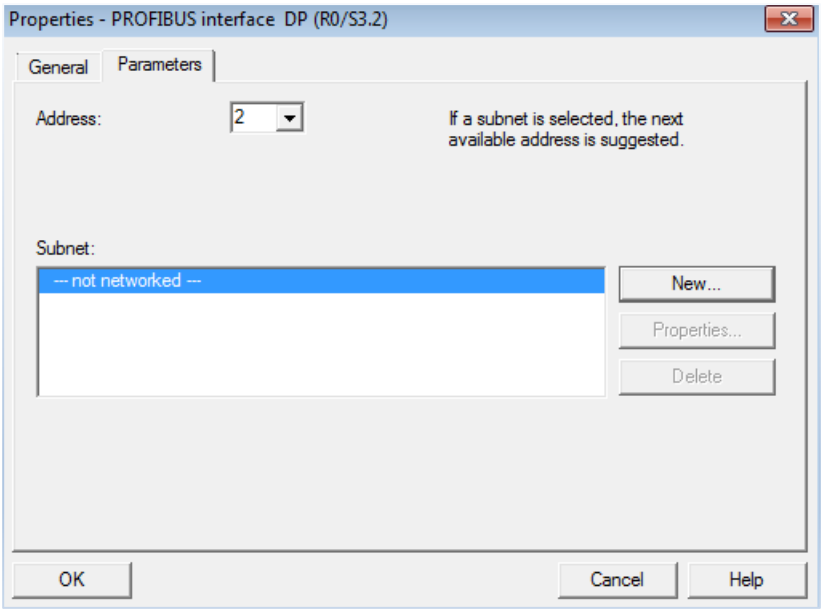
- Name you network and Click “OK”;



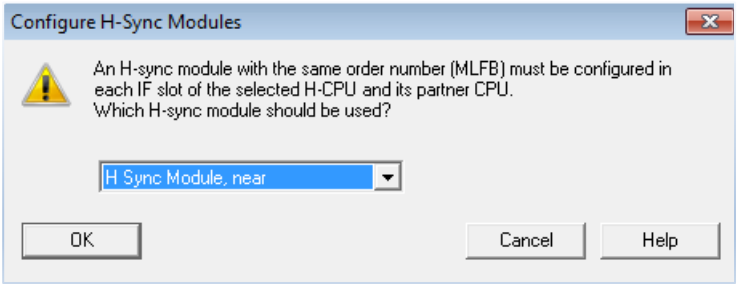
- A new network will be created, keep it selected and click “OK”;



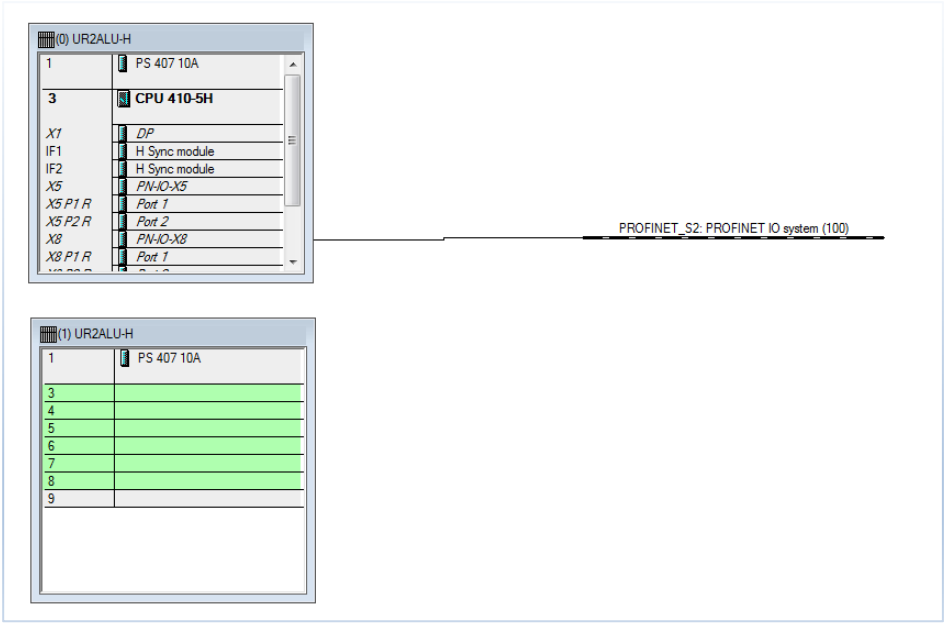
- This is the configuration for the PROFIBUS interface which is not relevant for the purpose of this project. Click “OK”;



- This prompt checks which kind of communication you have between the synced CPU´s from the H-system. Our tested hardware have a small cable for connection between each other, so for our hardware we selected “H sync Module, Near”:



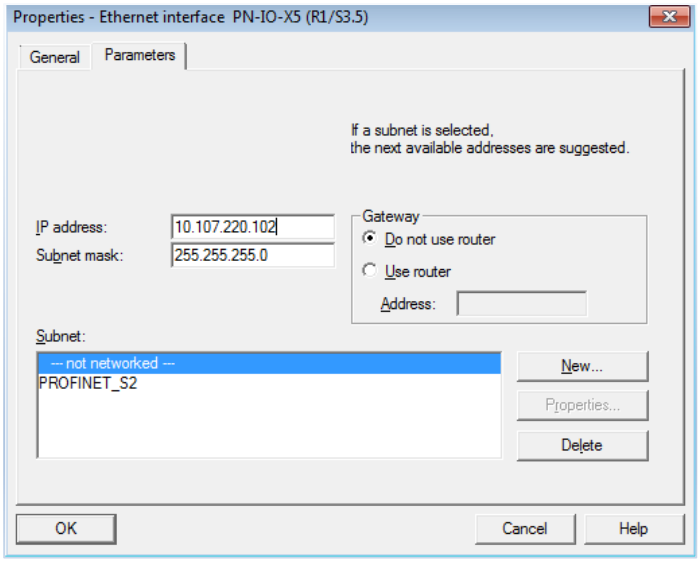
- Don’t forget to insert your Power Supply in the Hack;



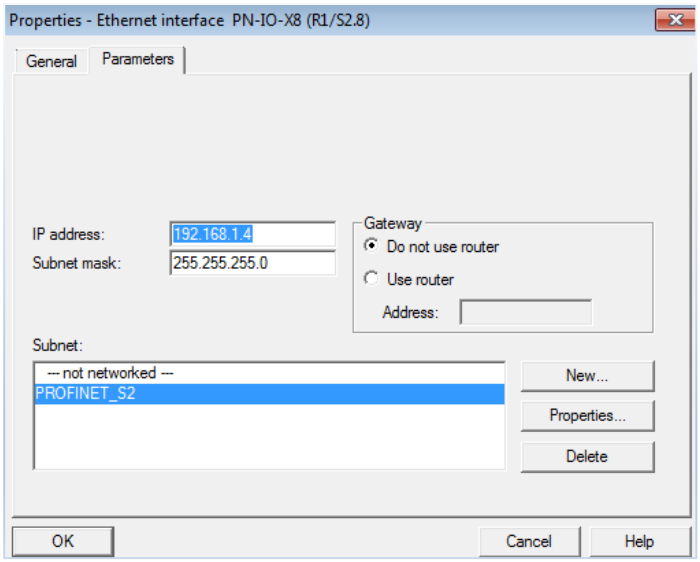
5.3.3 Inserting 2nd CPU and Configuring the Redundant Network

- After insert the Power supply, do the same procedure as the first CPU;

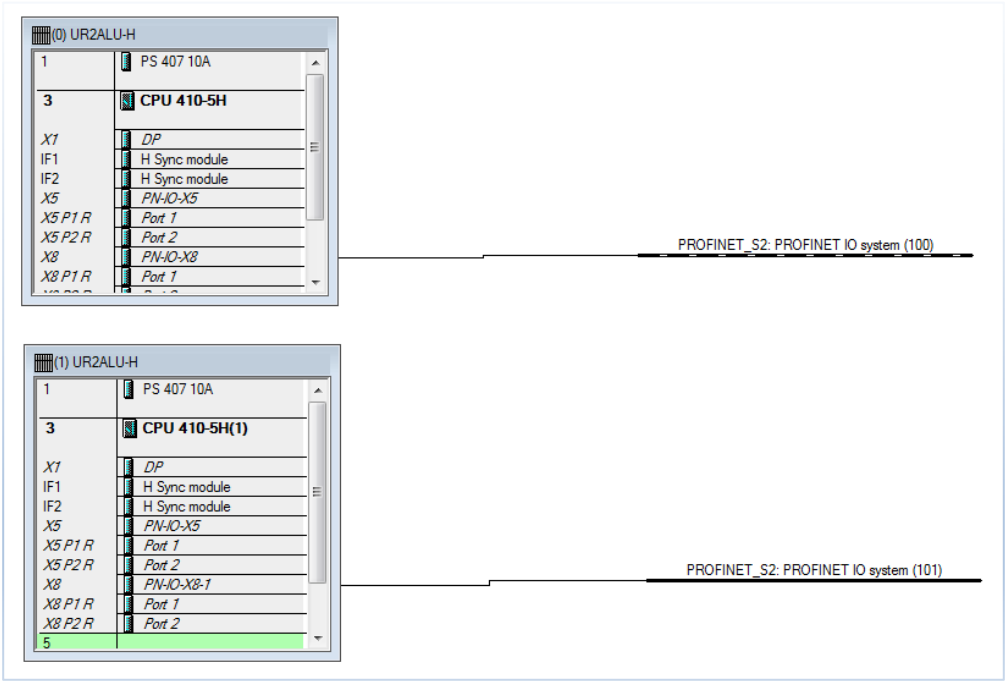
- No configuration at the interface X5;



- Assign the interface X8 at the same network as the first;

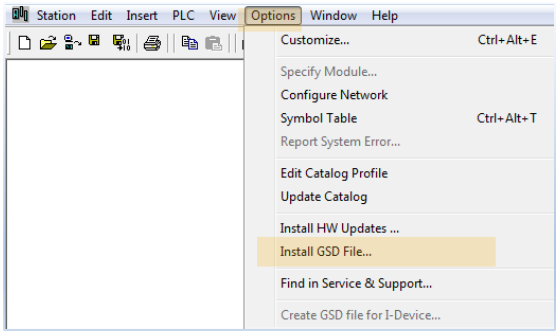


- I the end, the HW configuration should looks like below;

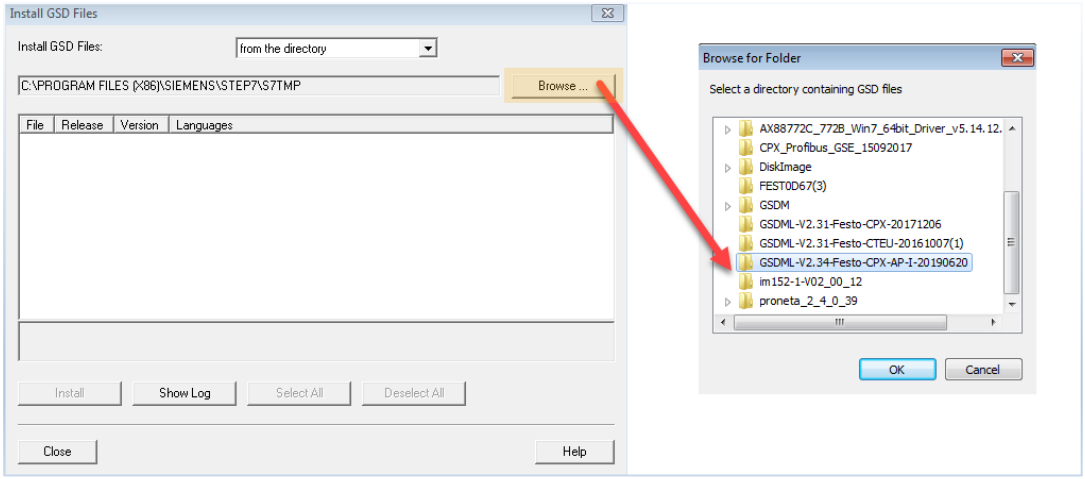


5.4 Installation for GSDML file into the SIMATIC

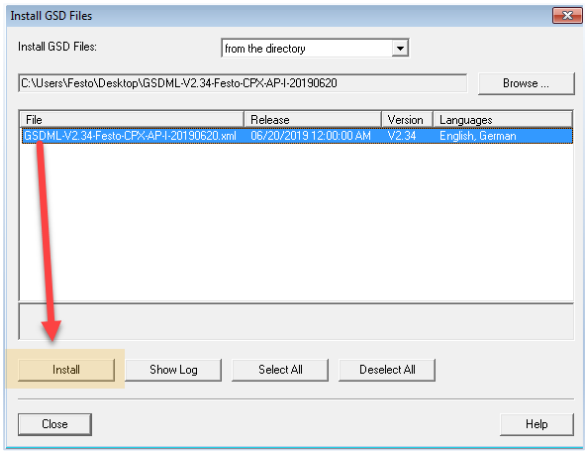
- In “HW Config” Click at “Option” -> “Install GSD FILE”;



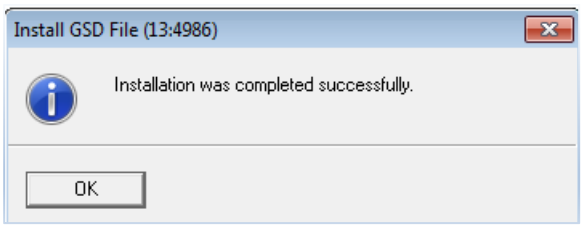
- In source path, select where the extracted files are located;



- Select all Files and clink at “Install”;

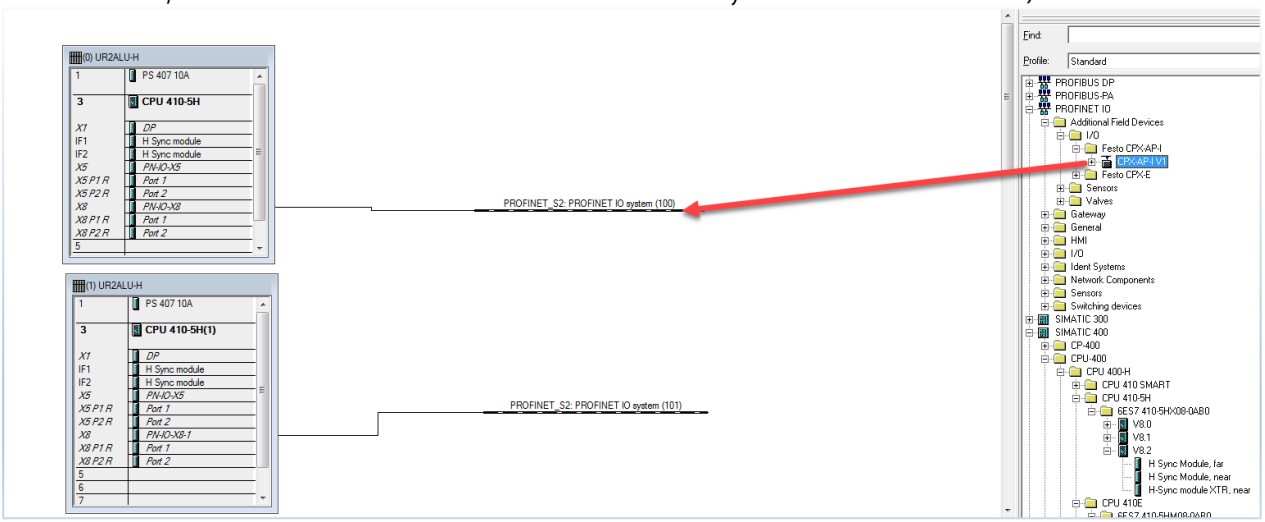


- You will get a message when is done.

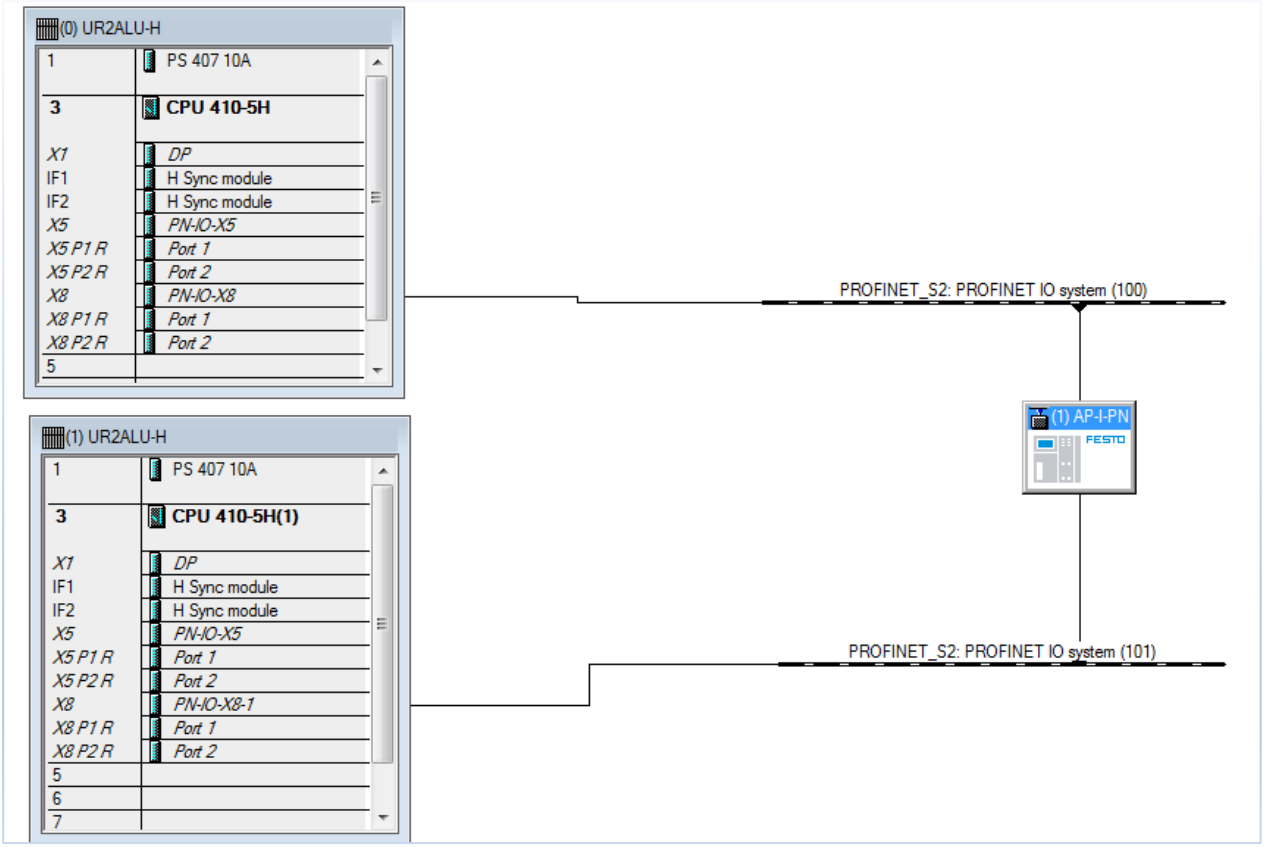


5.5 Adding The CPX-AP into your project

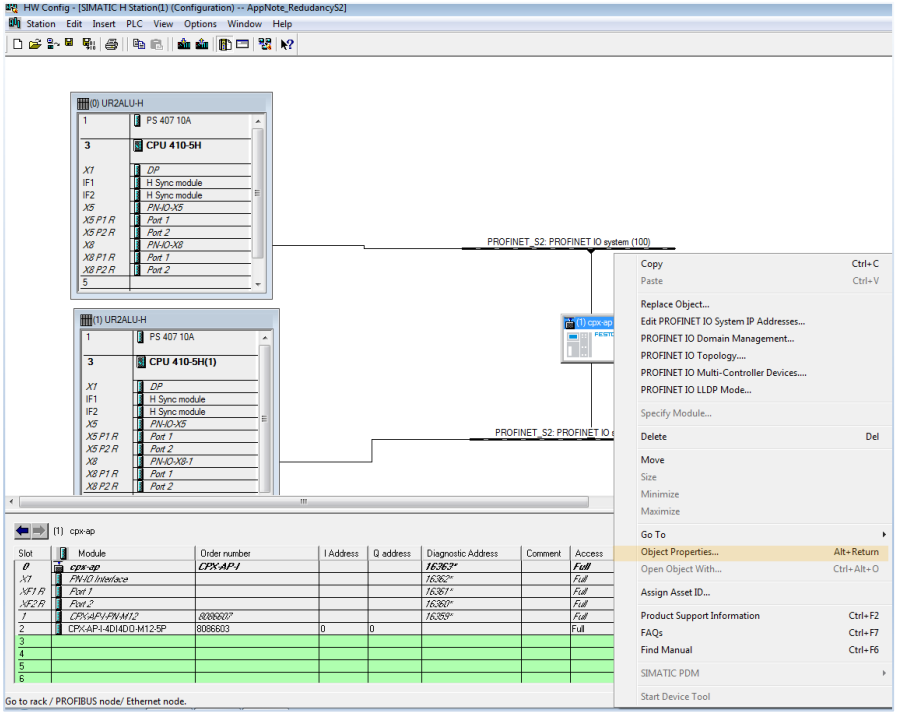
- At “PROFINET I/O -› Additional Field Devices -› Festo CPX-AP-V1 “ you can find the “CPX-AP” ;



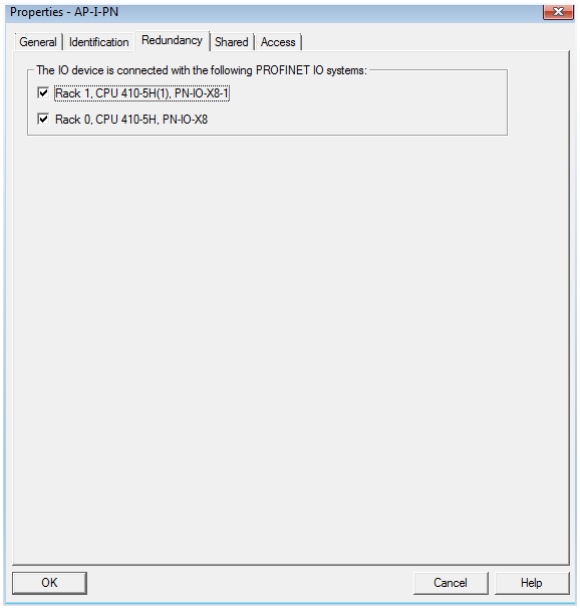
- Drag and Drop at the First CPU;



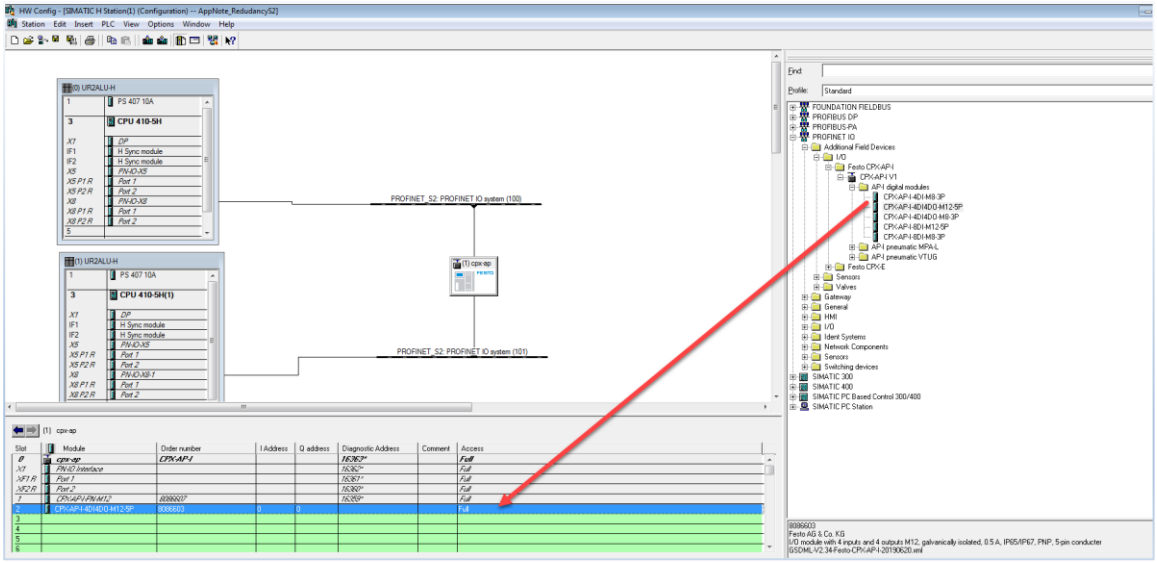
- It is possible that the link between both networks does not appear automatically.



- If this happens , check at object properties -> Redundancy if both networks are checked;

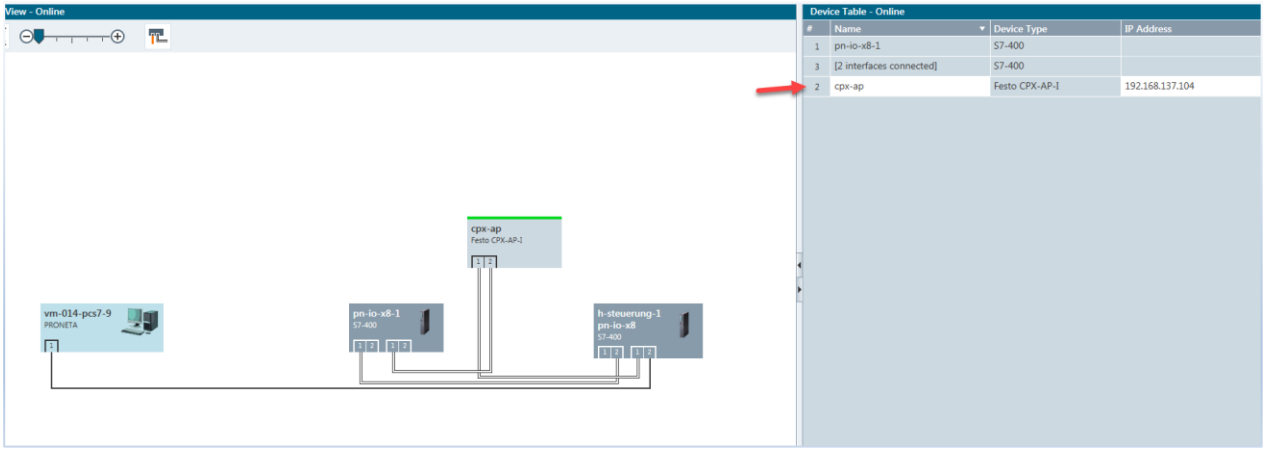


- Configure your hardware as your available device. In this document we are using one module CPX-AP-I-4DI4DO-M12-5P as I/O device.

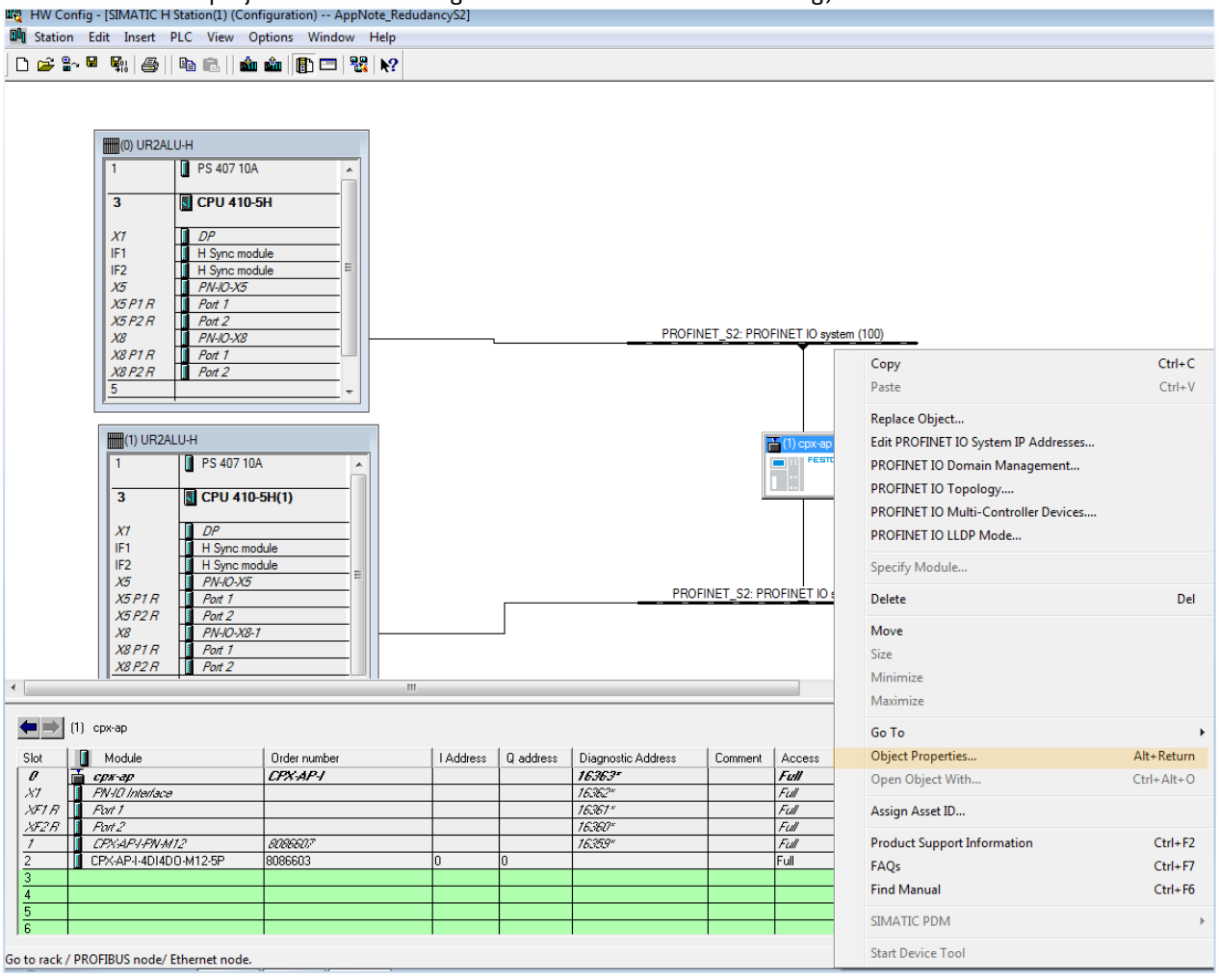


5.6 PROFINET network name assignment

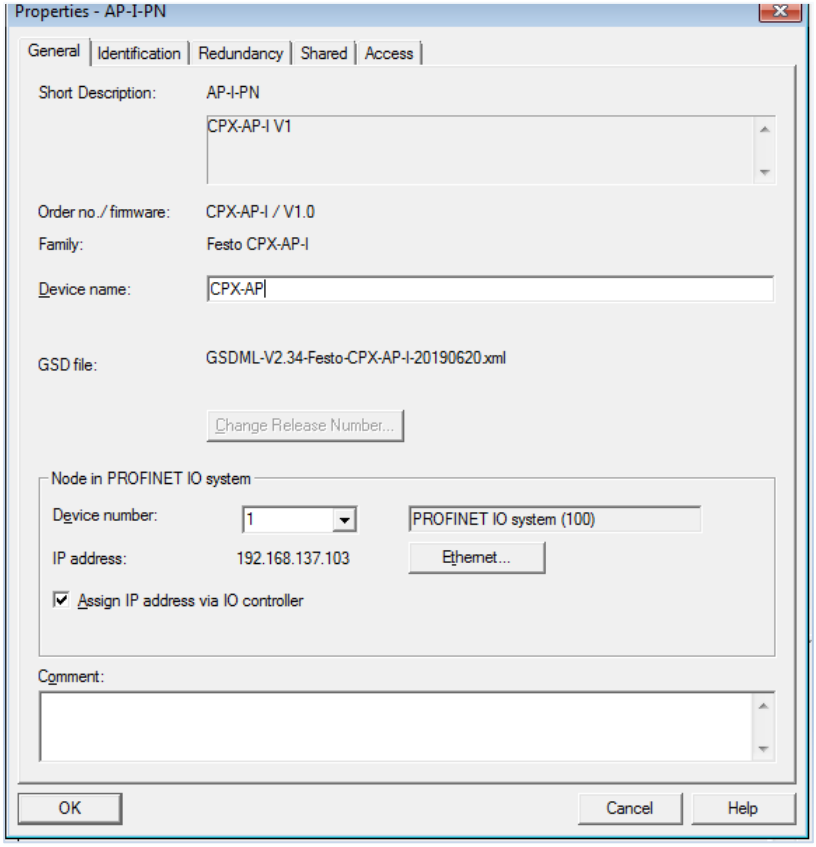
- To assign /check the name , you can use a PRONETA from Siemens



- The name from the project and “HW config” at Simatic should be a matching;

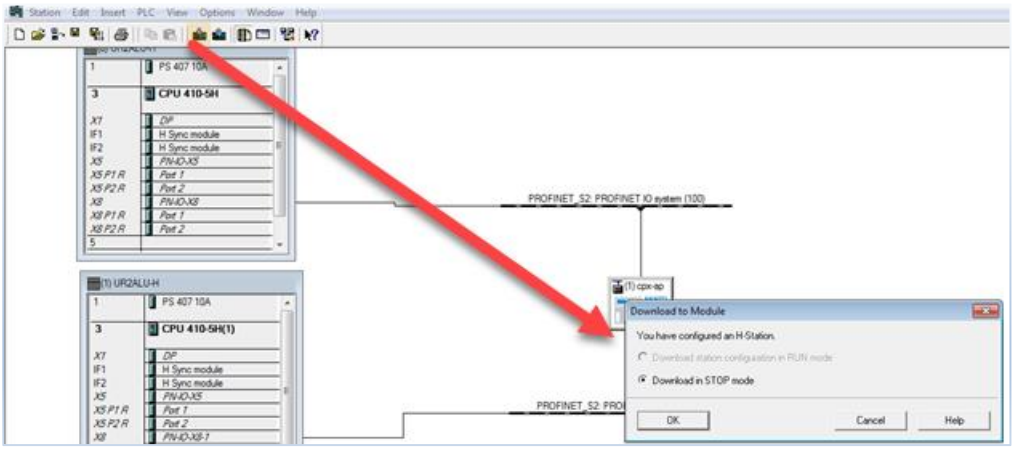


- Check/Modify the name at “Device Name”;

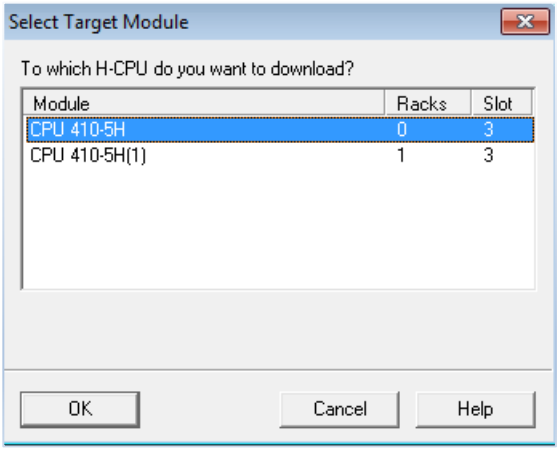


5.7 Downloading the HW Configuration

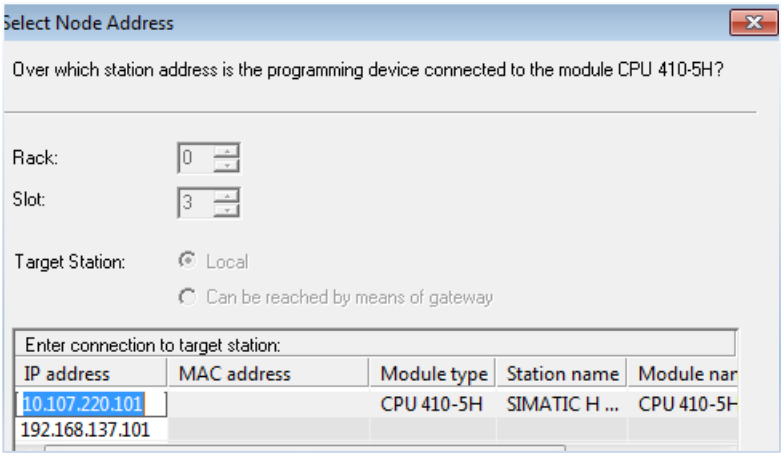
- Click at the Download Icon ;



- Please check the CPU from H-System that you are connected



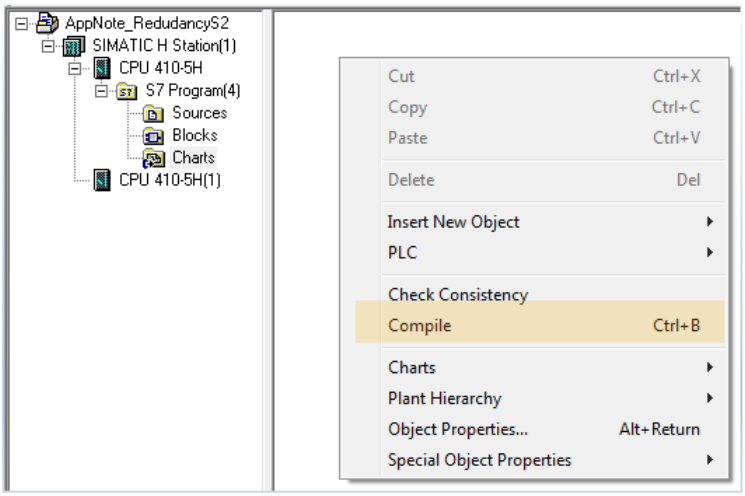
- Select the IP according with the interface that it has been used;



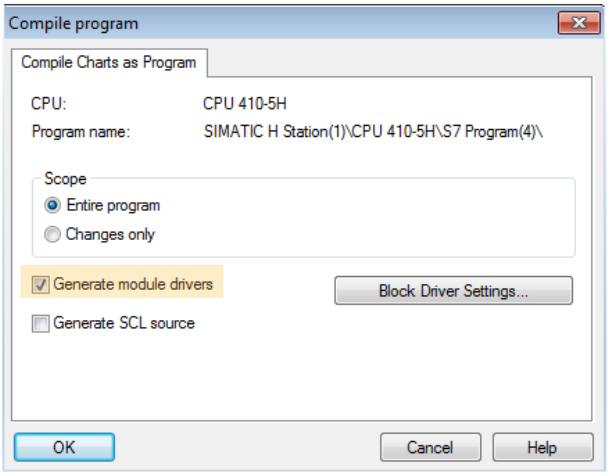
5.8 Creating the CFC @PA_CPU

The S7-400 CPU´s as any Siemens controller, uses predefined Object blocks (OB) for the tasks that should be executed.
If the OB´s are not configured correctly, any new error that arises , can STOP the CPU from work and for a H-systems this can be not desirable.
This part in the document stands for how we can configure the CPU and which OB´s should be in the execution task in order to avoid that the CPU stops in case of an error arises.

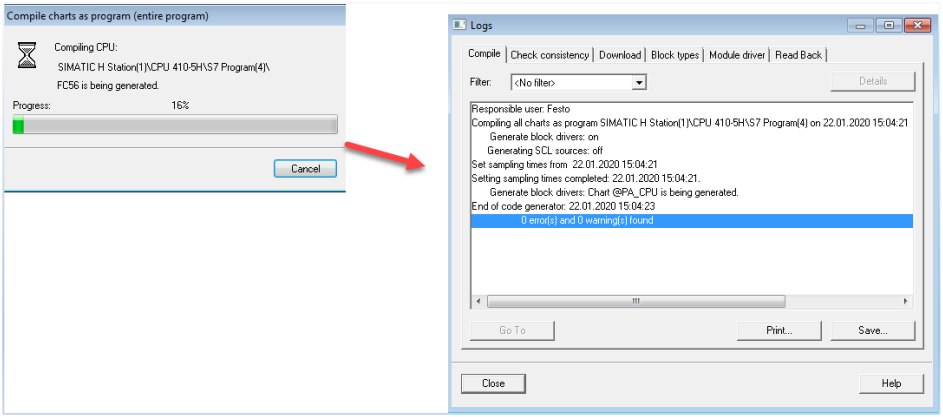
- Open S7 Program -› Charts -› Right Click -› Compile;



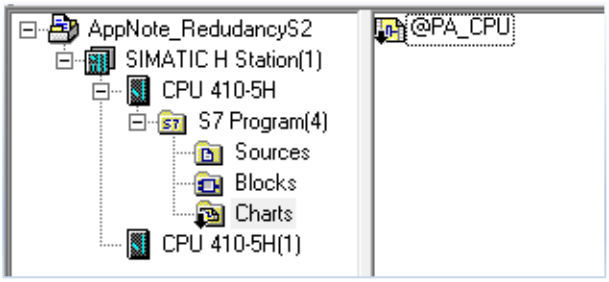
- Check the box “ Generate Module Drivers”



- The prompt below should appear;

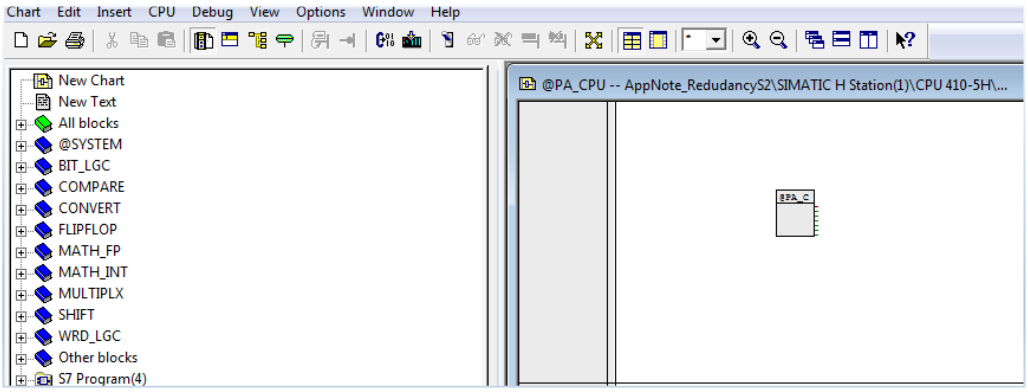


- And at the Charts tab, a new CFC called “@PA_CPU” should appear, This CFC is generate automatically by the compilation for CPU Diagnosis Purposes;

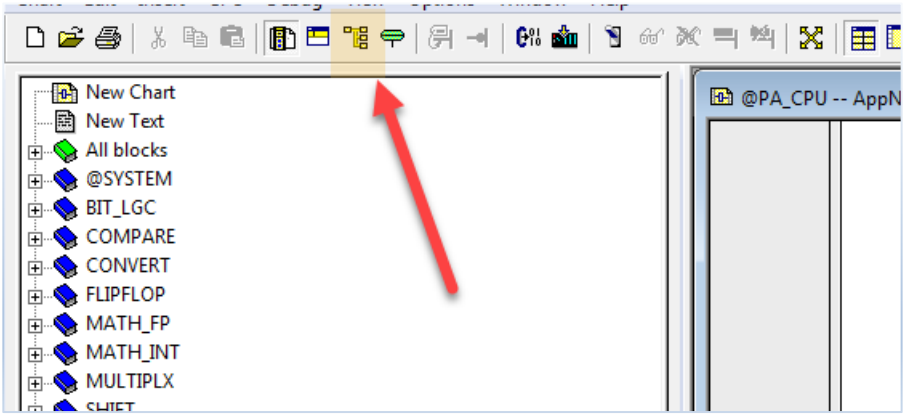


5.9 Configuring and Optimizing the OB Call

- Double click at the CFC that has been Created;

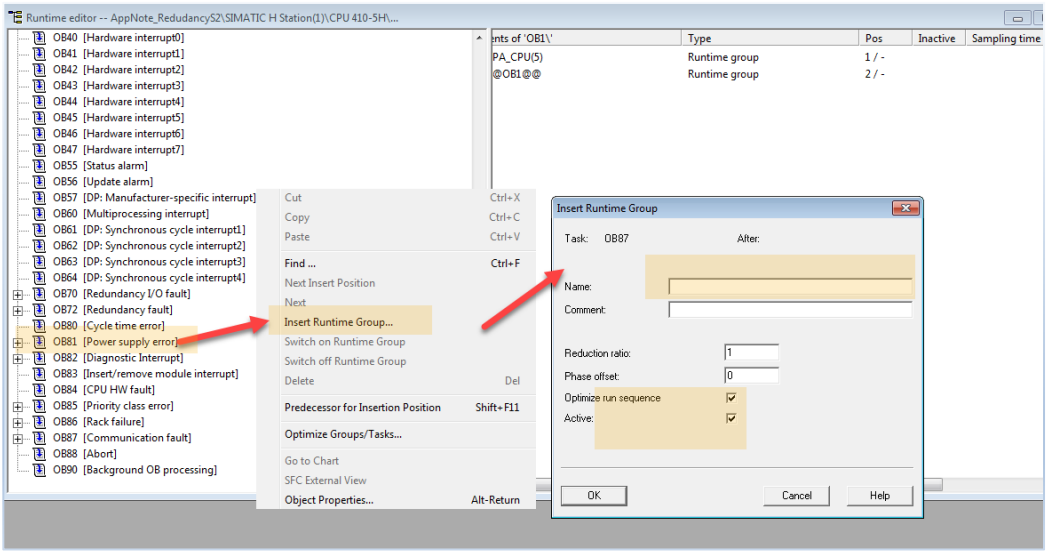


- Click at “Run Sequence” Button;

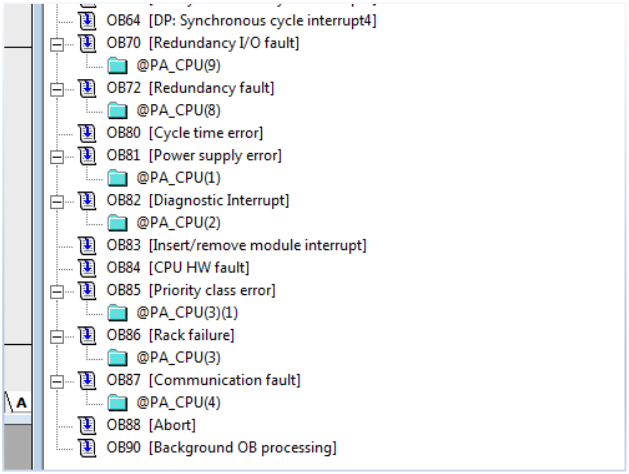


- To Avoid that the CPU Stop when there is any error , we call the CFC into other OB´s , avoiding the CPU to freeze;

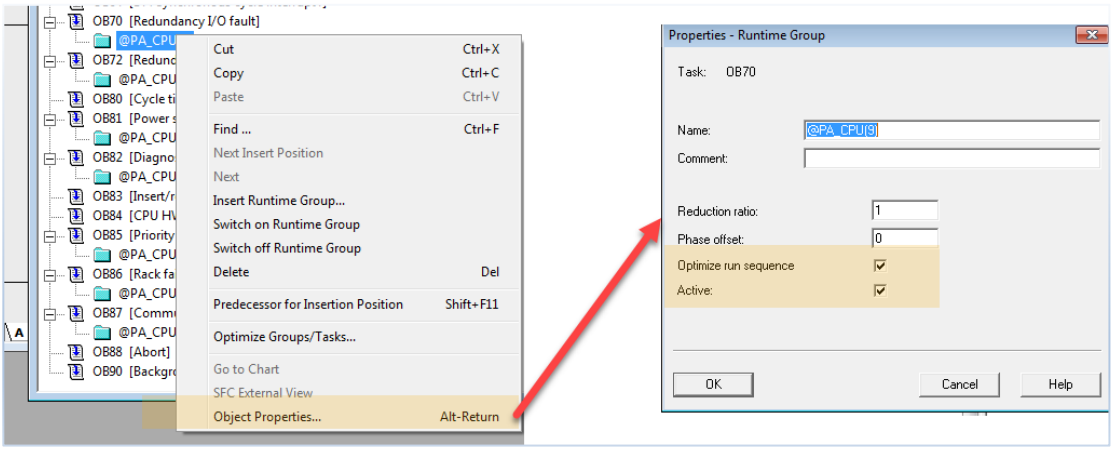
- If is not generated automatically, you can click with the right button at the OB and create a runtime group, even if it is empty;



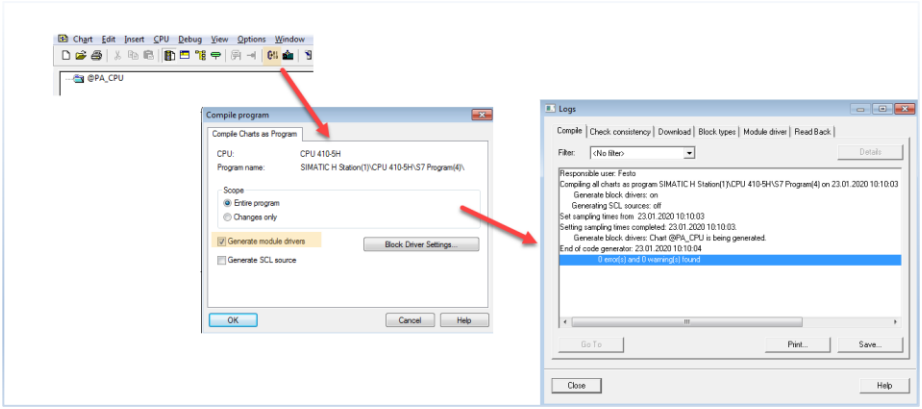
- The OB should be called are : OB 70; OB 72; OB 82; OB 84; OB 86; OB 87.



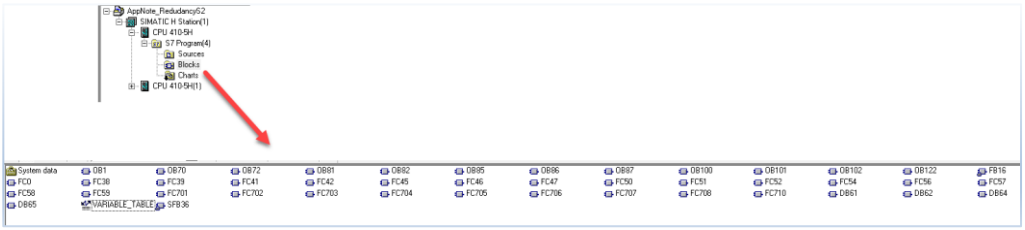
- Check if all the Runtime are checked with the “Active” and “Optimize run Sequence “ Flags ;



- Return to the CFC overview and Click at “ Compile” and check “generate module Drivers”;

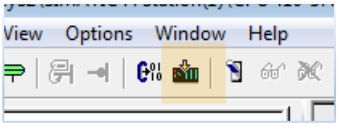


- When you check the overview from blocks, we can see that the OB has been generated automatically at the “S7 Program” -› “Blocks”;

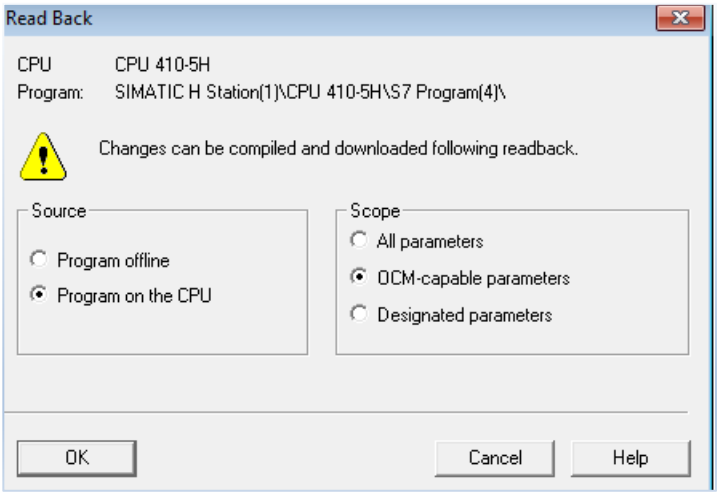


5.10 Download CFC Program

- At the CFC Editor, click at “ Download”



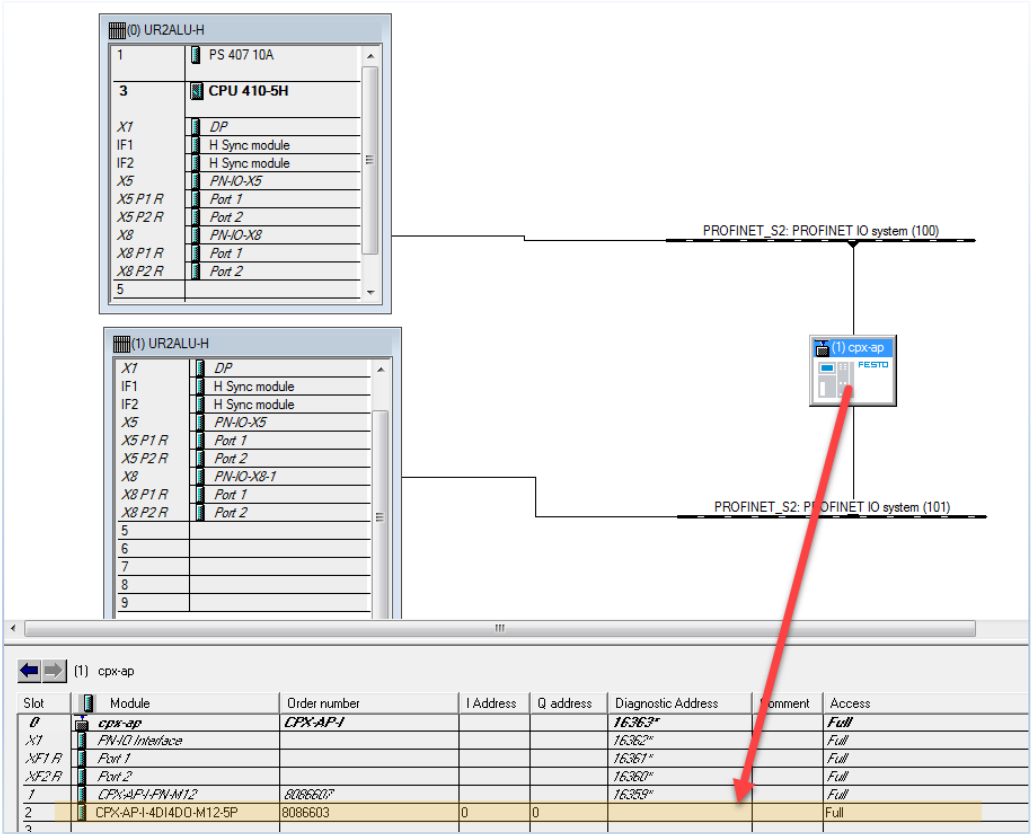
- A Prompt will show up as follow, select “OCM-capable parameters” and “ Program to CPU”



6 Operation

6.1 Checking address allocation from CPX-AP

You can check the address allocation into your CPX using “Device View”.



6.2 Process Image and addressing from CPX-AP

This application uses the Processing Image for CPX-AP-I-4DI4DO-M12-5P as follow:

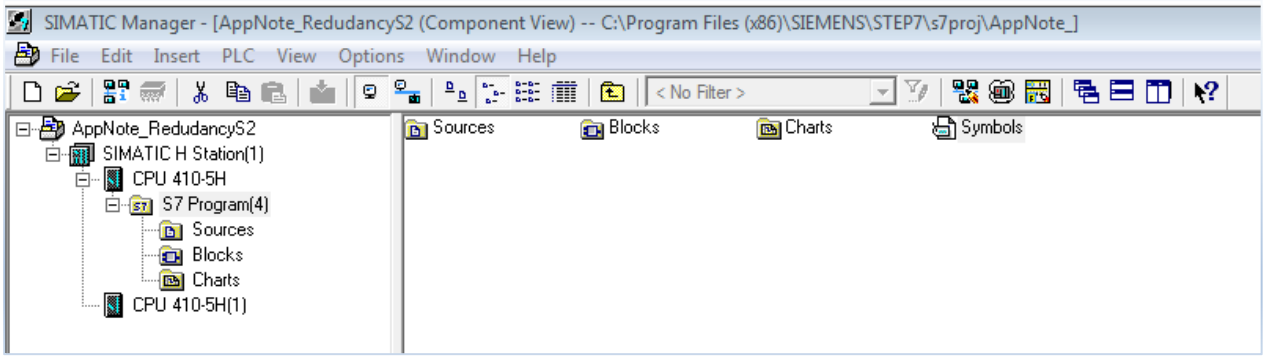
CPX-AP	Byte content							
	7	6	5	4	3	2	1	0
Input					DI 3	DI 2	DI 1	DI 1
Output					DO 3	DO 2	DO 1	DO 0

Table 6.1: CPX-AP-I-4DI4DO-M12-5P Process Image

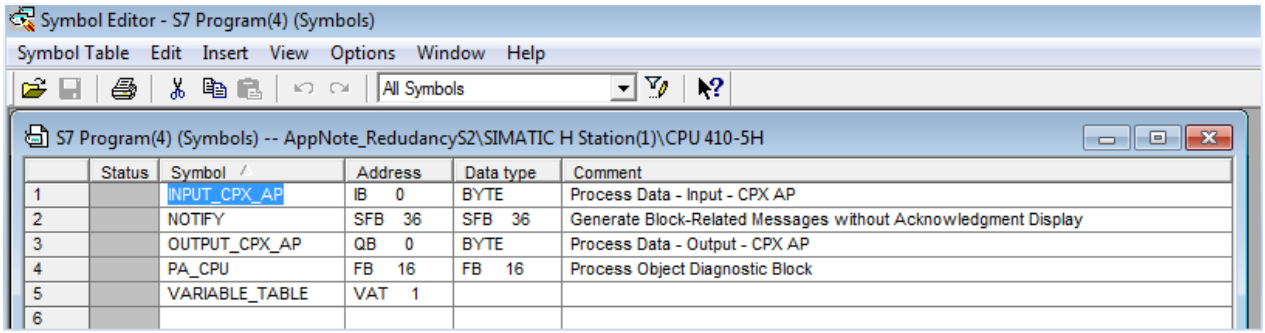
6.3 Adding Symbol Addressing

You can assign addressing according with the need from your project. This made your project commissioning easier and organized.

- Click At “Symbol”;



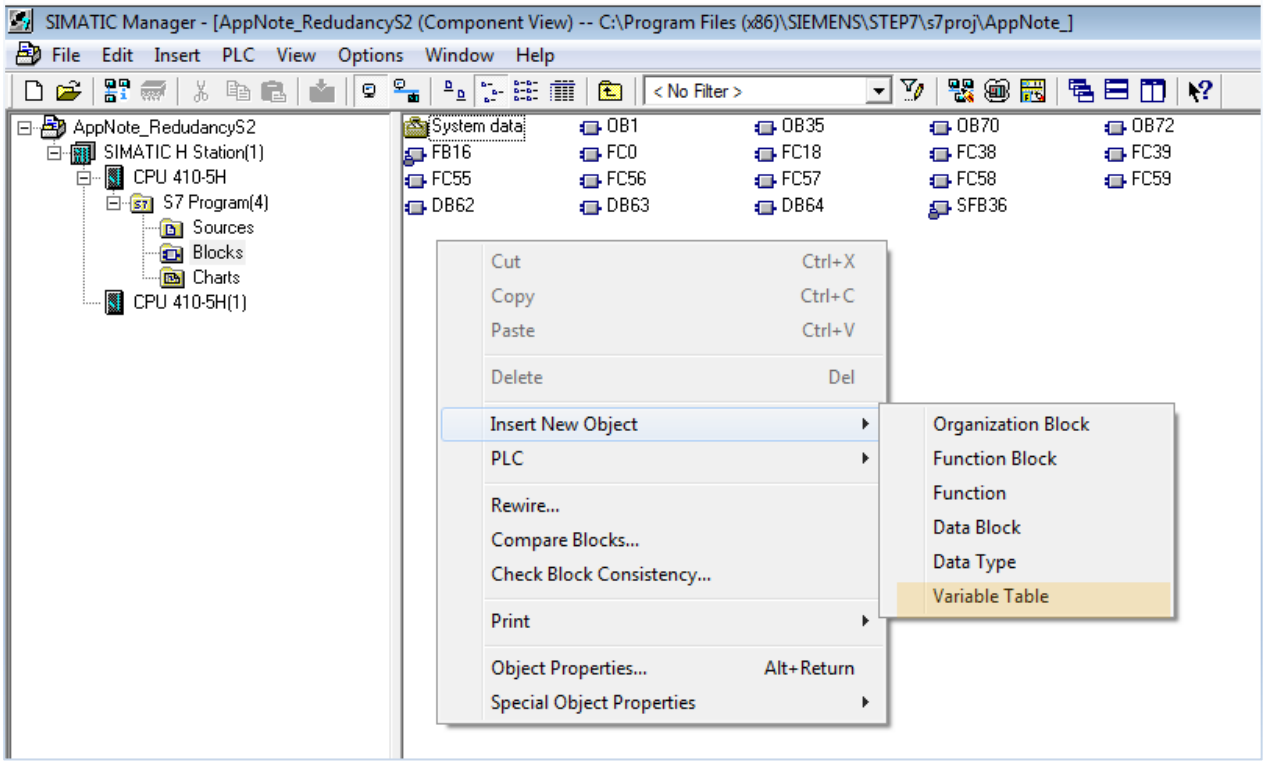
- Create at the table, the following values for the CPX-AP , according with the symbols that would like to call;



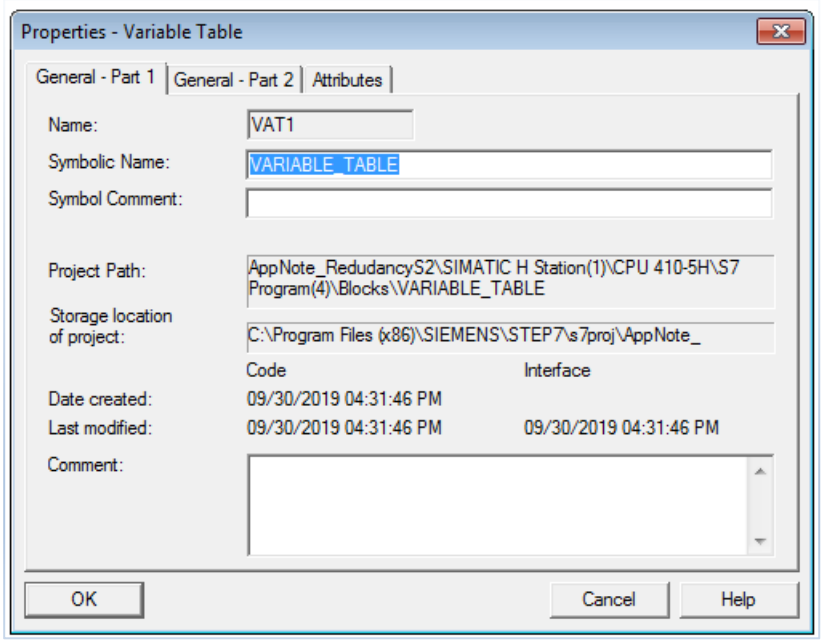
	Status	Symbol	Address	Data type	Comment
1		INPUT_CPX_AP	IB 0	BYTE	Process Data - Input - CPX AP
2		NOTIFY	SFB 36	SFB 36	Generate Block-Related Messages without Acknowledgment Display
3		OUTPUT_CPX_AP	QB 0	BYTE	Process Data - Output - CPX AP
4		PA_CPU	FB 16	FB 16	Process Object Diagnostic Block
5		VARIABLE_TABLE	VAT 1		
6					

6.4 Add Variables using Variable table in SIMATIC

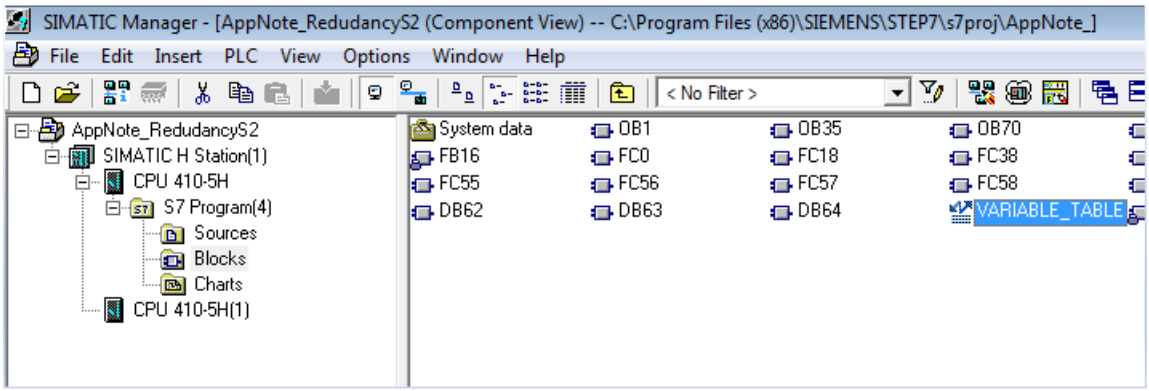
- Click at the “S7 program” - › right click at the window -› “Insert new object” -› “Variable Table” ;



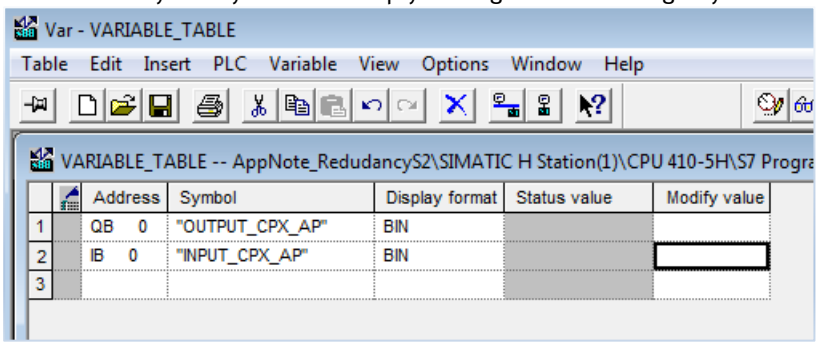
- Click “OK”;



- Double click at the “Variable_Table”;



- You can call by the Symbols or simply adding the addressing at your table;

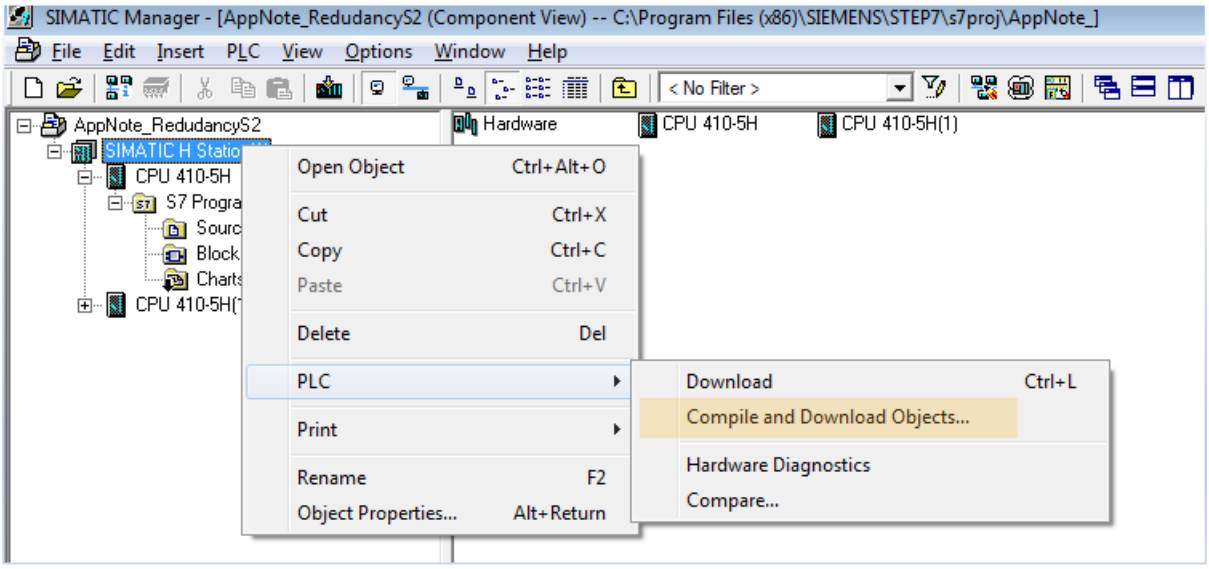


6.5 Downloading Full Project at H-Systems

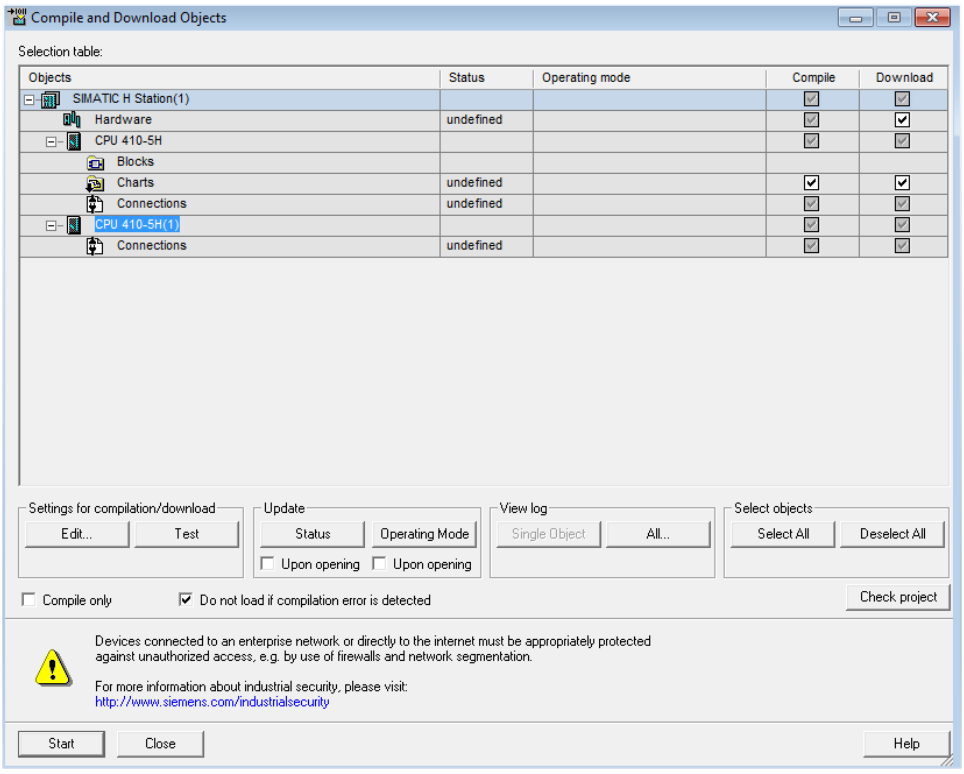
This is how to do a full download from your project , once that you can have partial downloads from HW configuration , parameter and programs.

For H-Systems is important to take in consideration that you application will run at least with one of the CPUs . In order to do the download for new project, there is no problem to STOP both CPU´s for download. But in a real application or program modification, consider that your system should keep running in case of download from a new project.

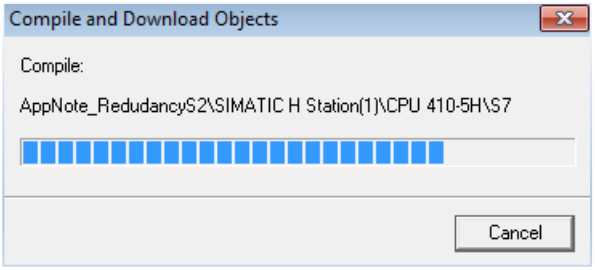
- At the Project Tree, right click at “Simatic H Station” and select “PLC” -› ”Compile and Download Objects”;



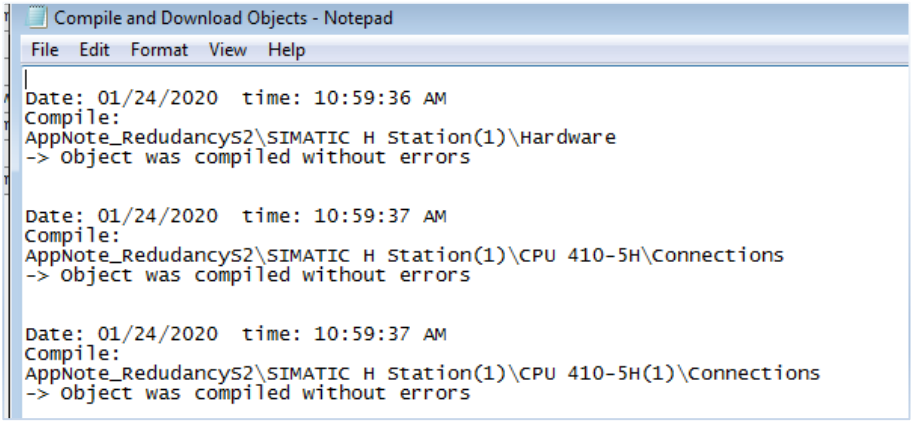
- Click at “select All” and “start”;



- A prompt will be shown ;

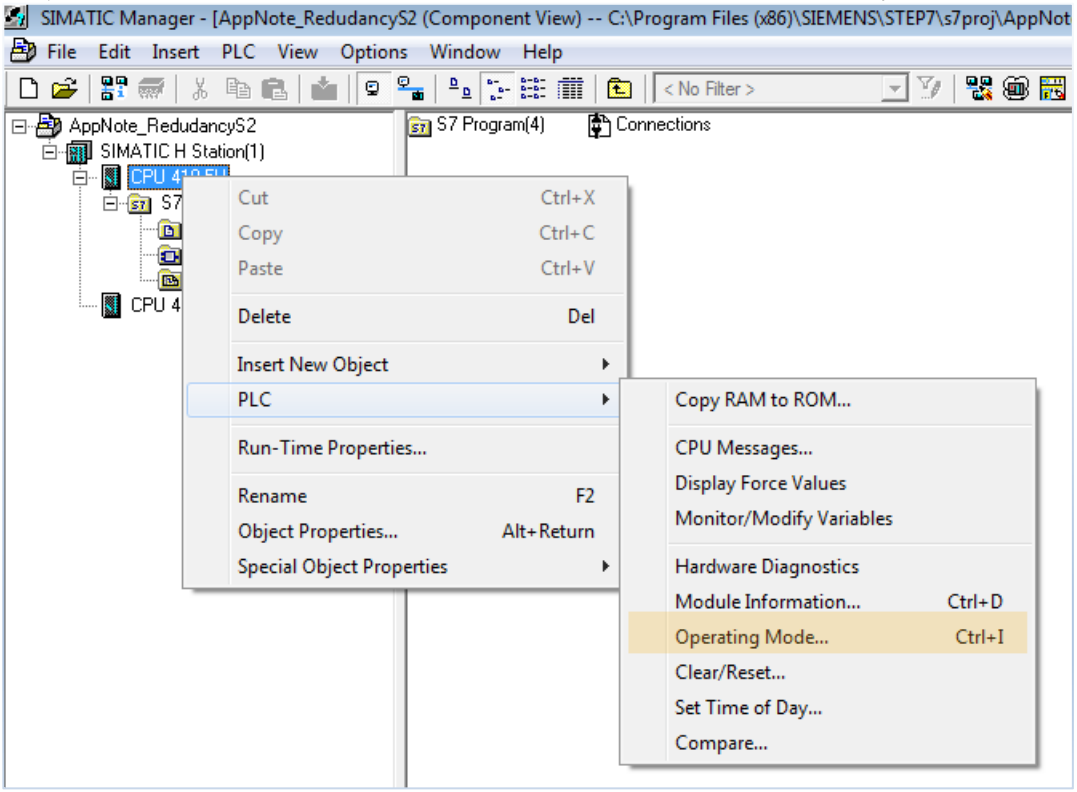


- After a report will be shown with all the operations that has been made;

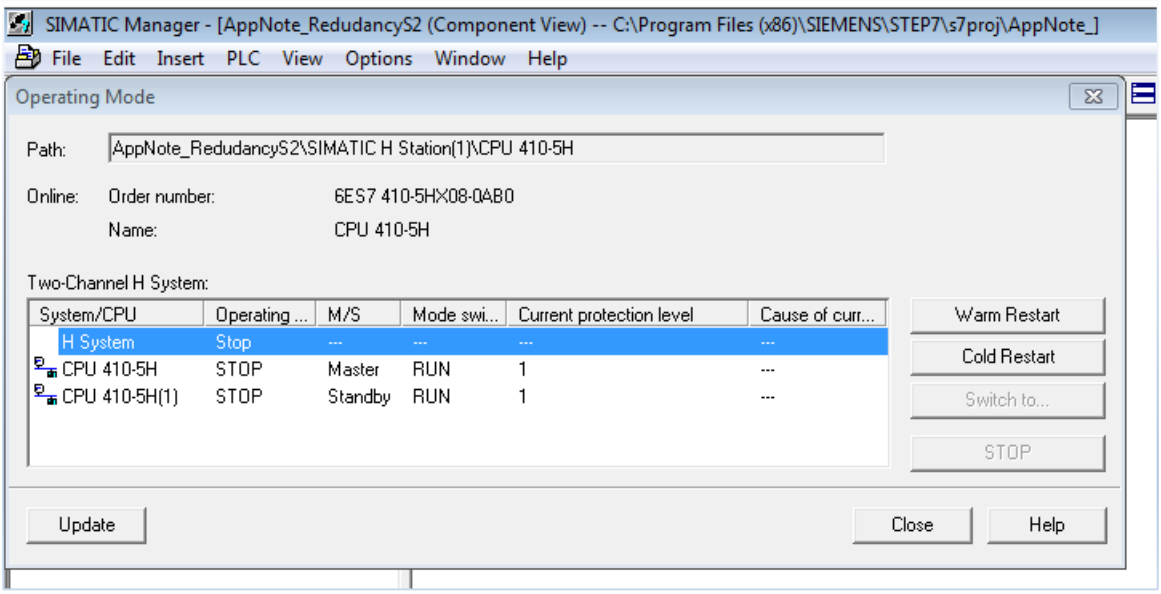


6.6 Warm Restart, Running H-System and Master CPU Selection

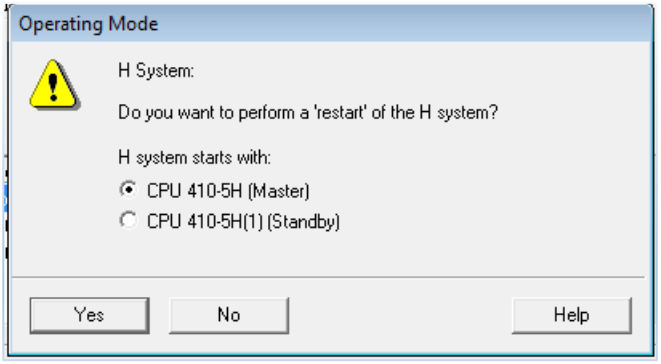
- At Project tree , click with the right button in one of the CPU´s. Select “PLC” -› “Operating Mode”;



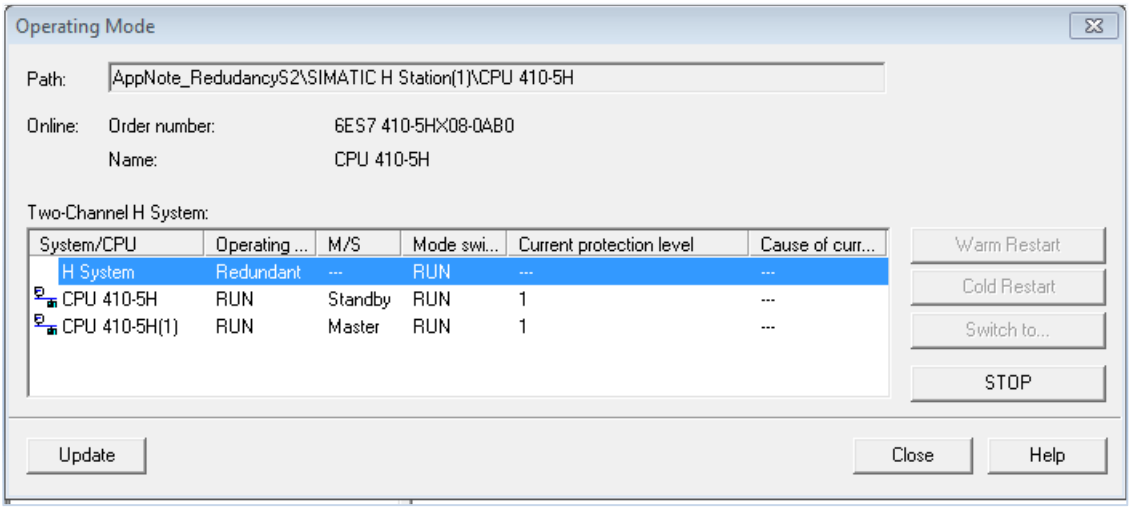
- If the connection has been stablished before, the following prompt should appear.
  Click at “H System” and select “Warm Restart”;



- Select which CPU will be your master CPU ;

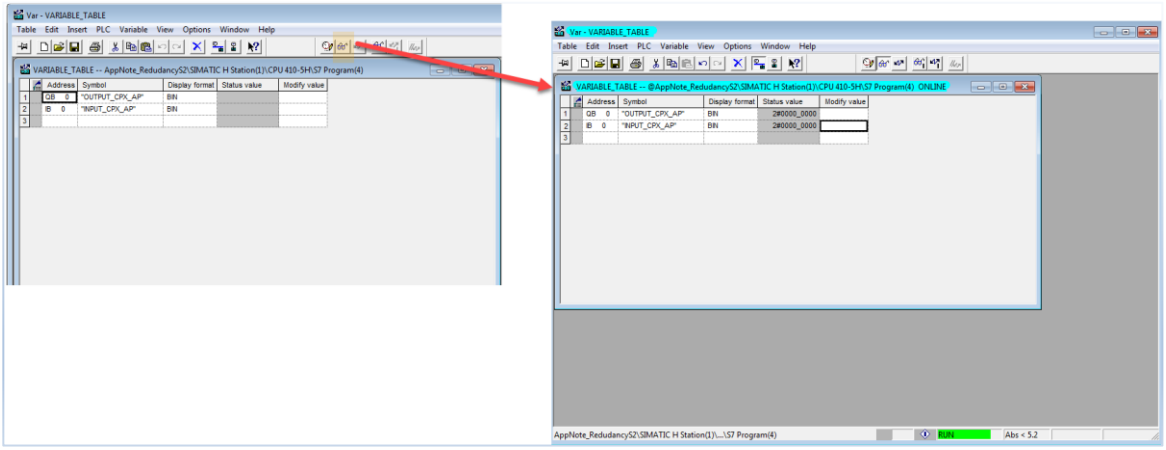


- The H-system should appear operation as bellow ;



6.7 Forcing variables and Online

- Go to “Variable Table” and click at “monitor variables”- Once that you have the connection established, the window will appear as below.



- To change the values from variable, write it at the “modify value” column and press “modify values” or CTRL+F9;