Phoenix Contact's Axiocontroller(AXC) 1050

& Axioline(AXL) F BK PN Manual v0.0.3 Alpha

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OBS: This manual was developed using PC Worx version 6.30 and AXC(version 3) and AXL(version 2)

Introduction:

Axiocontrollers and Axioline are a line of PLC's produced by Phoenix Contact. It is an Industrial Grade PLC, so it is extremely resistant to impacts but let's not try to break it, ok?

How does the AXC differs from the other PLC's already donated to the College, like the NanoPLC? The answer is that as the Arduino is less reliable or resistant to damage than the NanoPLC, The NanoPLC is less reliable or resistant to damage than the AXC line. In an Industrial environment, errors need to be close to 0, and having a device that can answer to a signal in milliseconds is extremely important.

Security:

If you already played around with a NanoPLC you know that you should use a USB cable to upload a project from NanoNavigator and instantly you get an answer from the device. The AXC line will not work that way. Multiple AXL machines can be connected to a single AXC, but for that to work, it uses Ethernet cables to do this communication. So lets start with the main topic: making the AXC and AXL work together.

PS: This setup requires "expertise" in networking and if you don't know what you are doing, that is totally fine. Just Contact your TA or ITS.

First steps:

1- Connect the power cord to the AXC Trainer 1050 PN (locate as shown below), and turn the switch to the ON (|) mode.

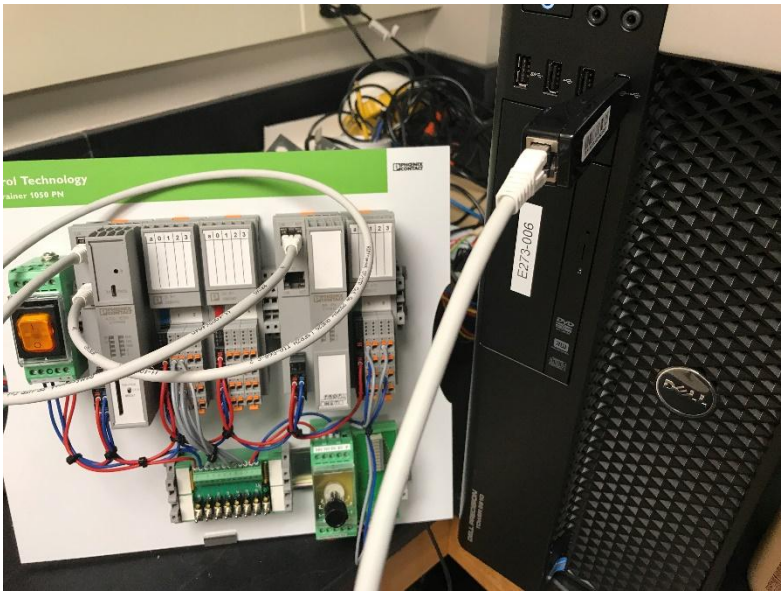
2- Take a second to see the lights blinking and understand the connection between the modules. Check appendix A to see the legend.

Now we have a functioning PLC, but without any code inside. To upload code, we will have to setup a connection between the AXC and your computer, and that's when things get hard. If you have problems, contact the TA or ITS!

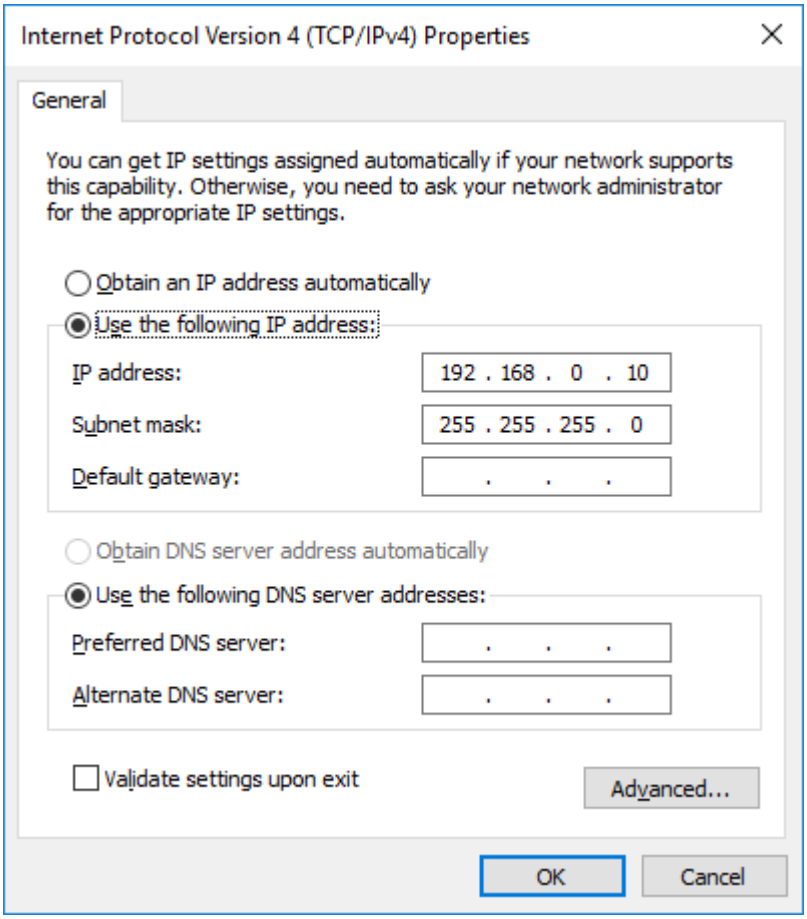
On your computer:

1- Connect a USB-to-Ethernet adapter to the front of your computer.

2- Connect an Ethernet cable from the USB adapter to the X1 port of the AXC.



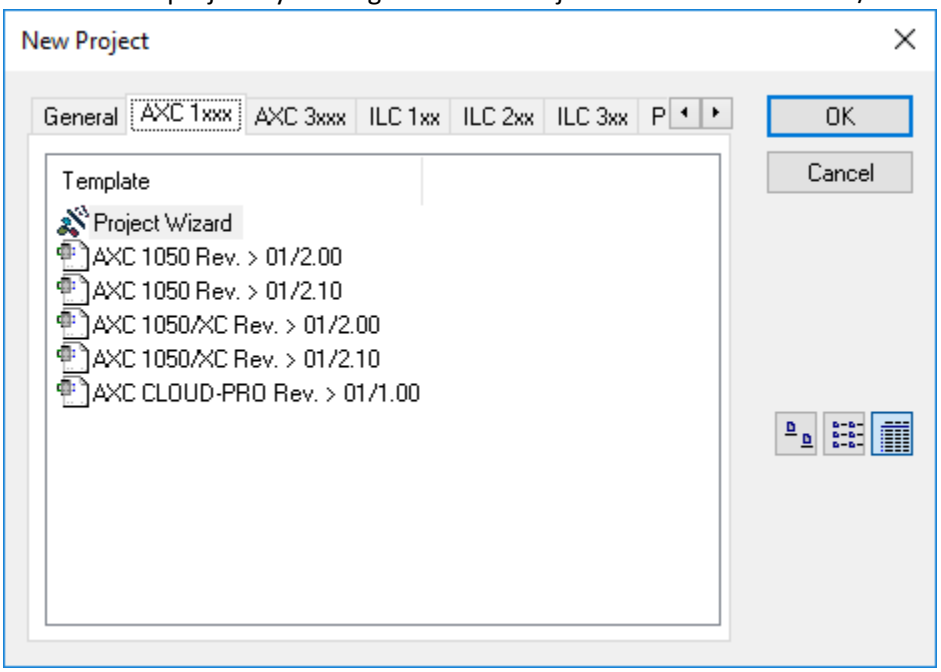
3- Go on the ***Control Panel***, click on ***Network and Internet*** and click on ***Network and Sharing Center*** and check the network adapters. One of them should be Ethernet 2 or something like that. Double-click on it and click on Properties. Click on Internet Protocol Version 4 (TCP/IPv4). After selecting it, click in properties, select "Use the following IP address" and enter the value for IP address of 192.168.0.10, for subnet mask 255.255.255.0 and click ok and you can close the other windows.



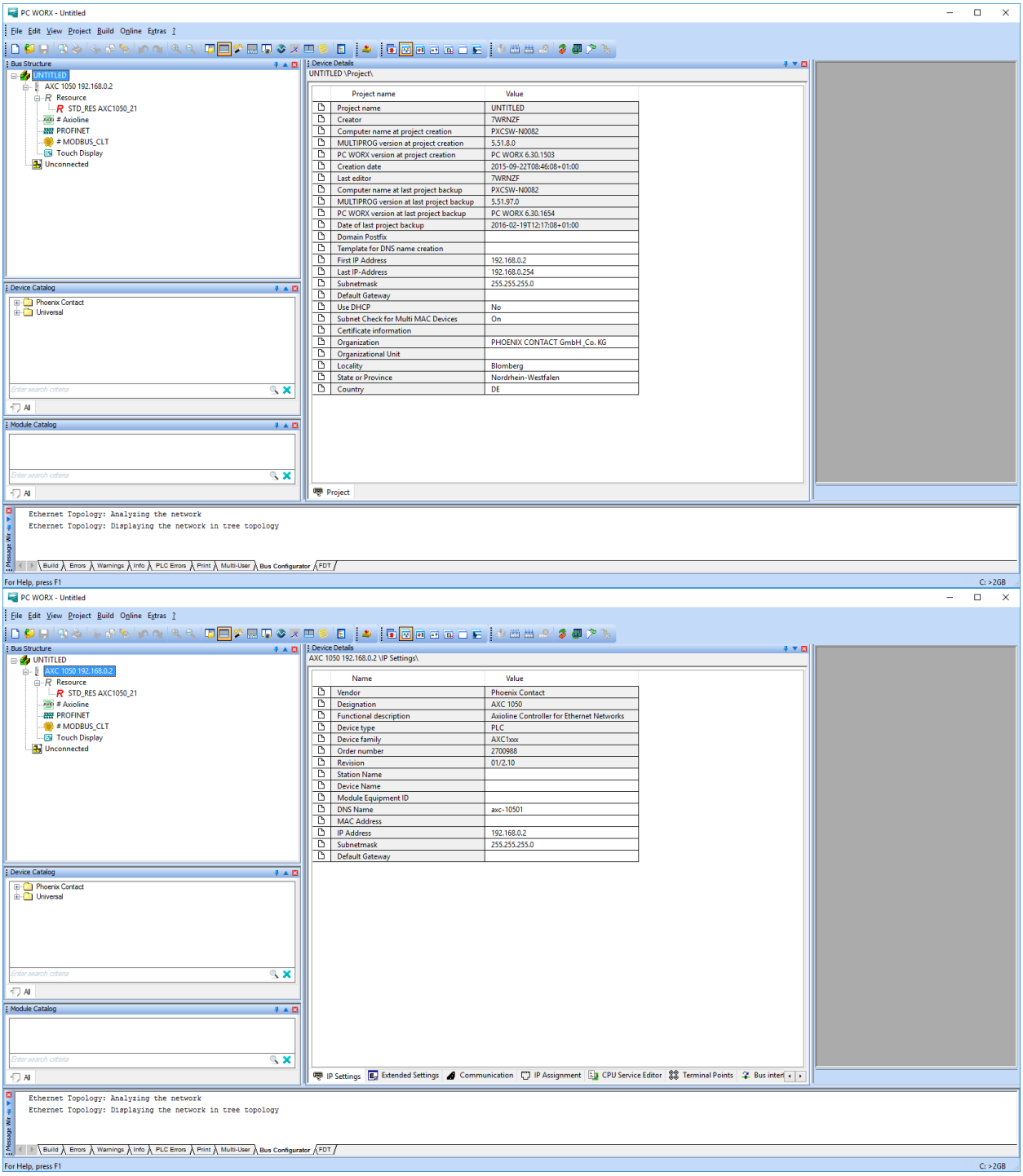
Now we have the Adapter and the computer configured to the common range of devices that is the 192.168.0.XXX range. Be mindful that every device to be configured on this manual needs to be in the IP range between 192.168.0.2 and 192.168.0.254.

PC Worx:

1- Open PC Worx on your computer. You can click the search box on the bottom of the screen and search for PC WORX and PC Worx 6.30.1668 should show up on the search. If it doesn't, contact your TA.
2- Create a new project by clicking file→New Project→AXC 1050 Rev. > 01/2.10



3- To configure the Bus, click on Bus Configuration Workspace, on the Toolbar, click on the AXC 1050 192.168.0.2 that is inside the Bus Structure and click on IP Settings on the Device Details page.



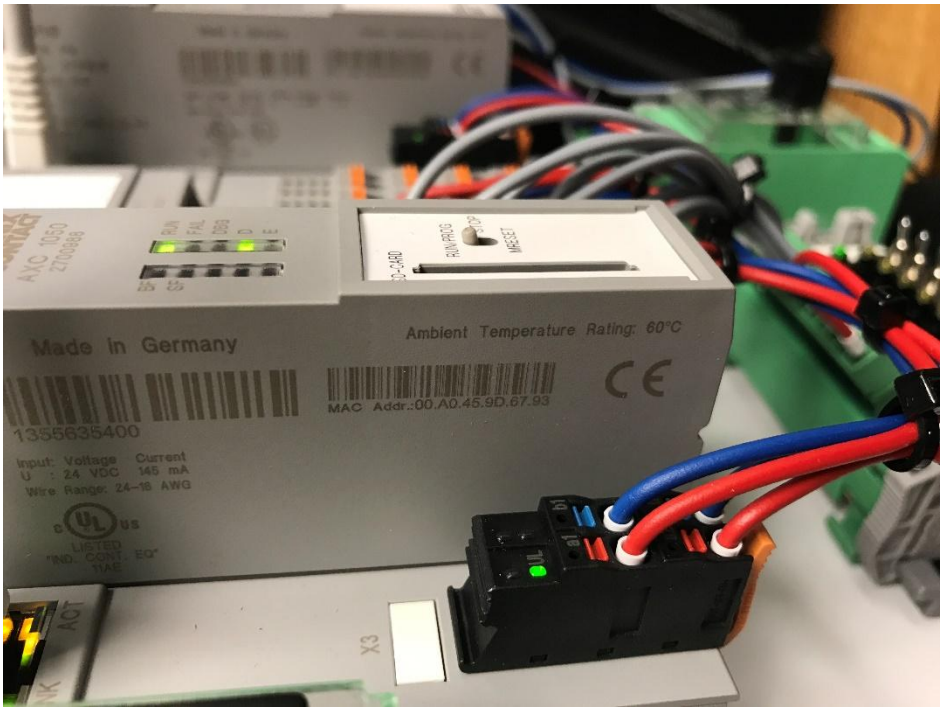
4- Check the IP Address defined to the AXC and the Subnet mask value and see how they reside inside the range of 192.168.0.XXX.

Device Details

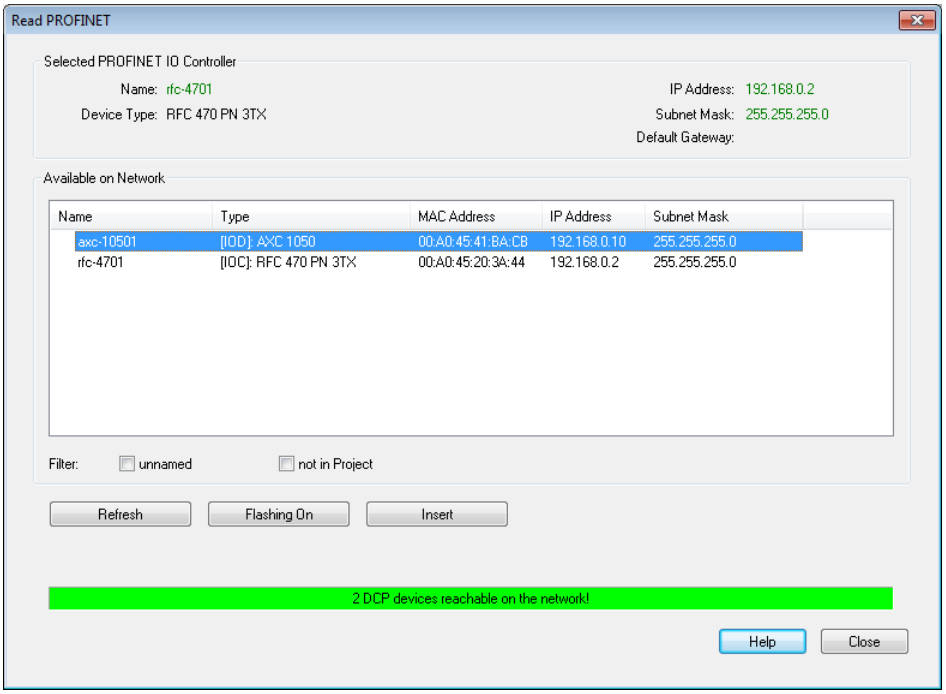
AXC 1050 192.168.0.2 \IP Settings\

Name	Value
Vendor	Phoenix Contact
Designation	AXC 1050
Functional description	Axioline Controller for Ethernet Networks
Device type	PLC
Device family	AXC1xxx
Order number	2700988
Revision	01/2.10
Station Name	
Device Name	
Module Equipment ID	
DNS Name	axc-10501
MAC Address	
IP Address	192.168.0.2
Subnetmask	255.255.255.0
Default Gateway	

5- VERY IMPORTANT: check the side of your AXC and it should have a MAC address under a barcode. Enter on the defined area (above IP Address) this number on the device.



6- Now go to the IP Assignment Tab and it should display 2 devices: AXC and AXL. Click on the one that starts with AXC and click on Assign IP and click refresh to see if the IP Address has changed.

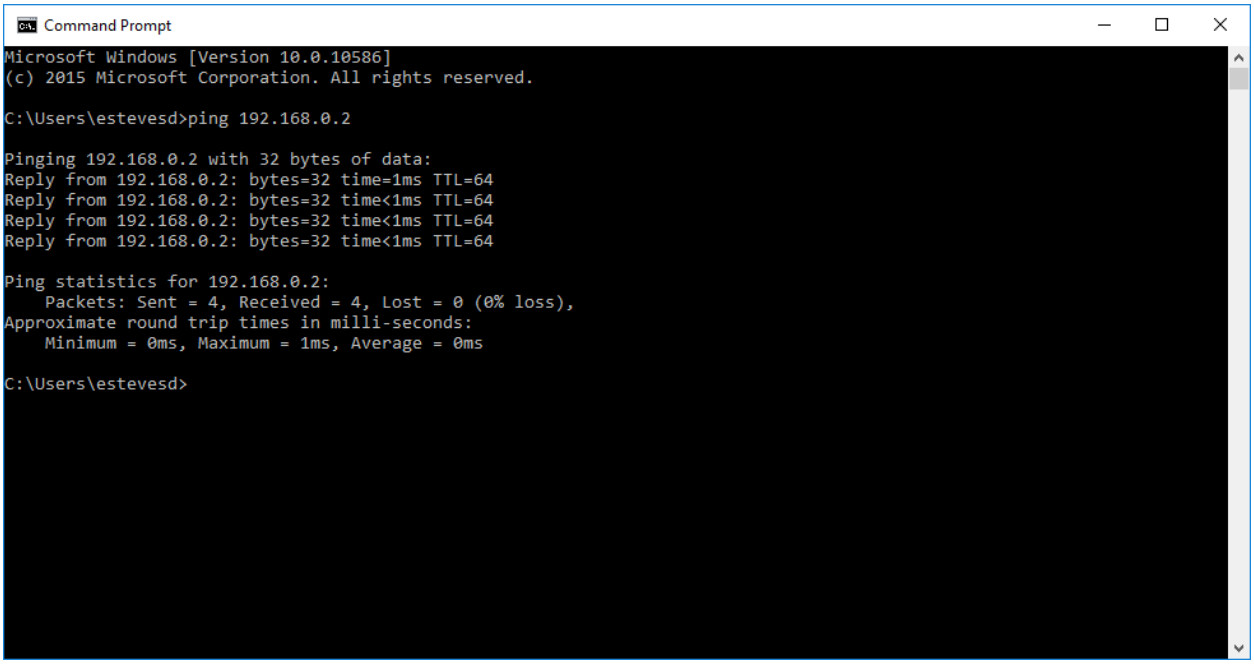


7- Restart your AXC!!!!

8- If the IP was successfully changed, let's go to the next step and we are going to take a break from PCWorx just for a second.

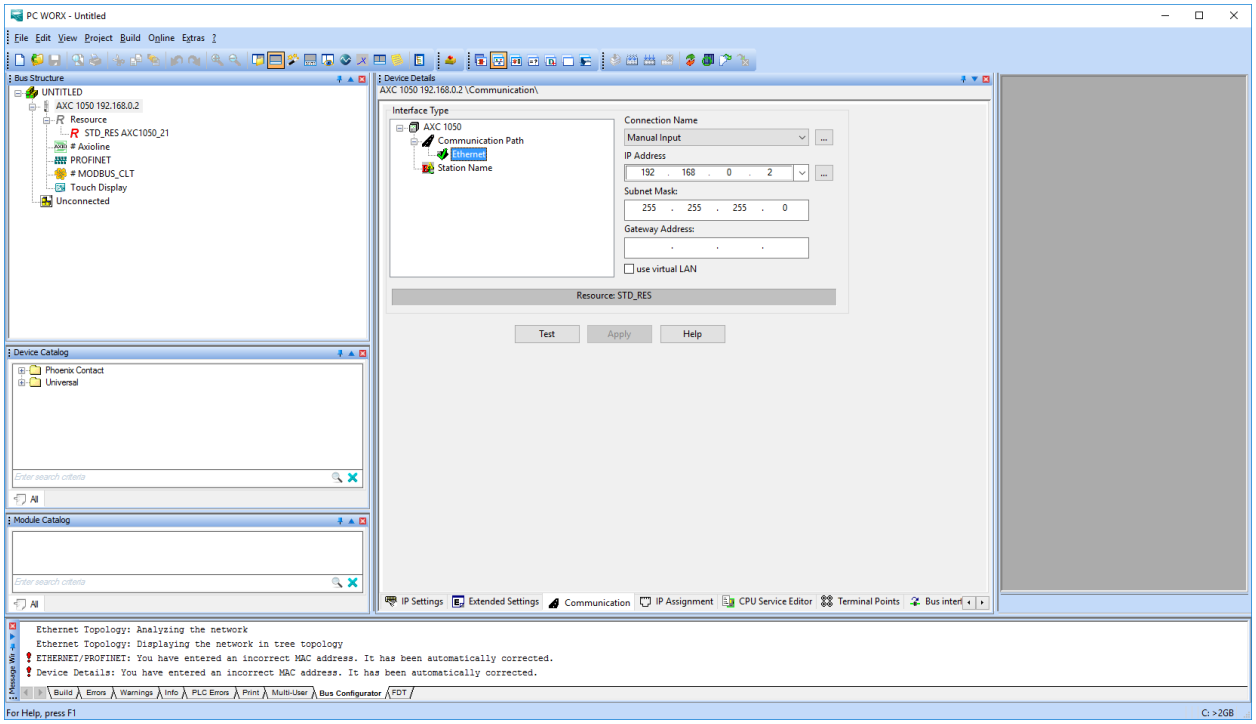
On your computer:

1- Press the Windows button on your keyboard and type “cmd” and click on Command Prompt.
2- Type without the quotes ”ping 192.168.0.xxx”. Substitute the xxx by the last digit of the IP address of the AXC. If it gives the following code, you can go to the next step. If not, try rebooting the machine and redoing the steps inside PC Worx.

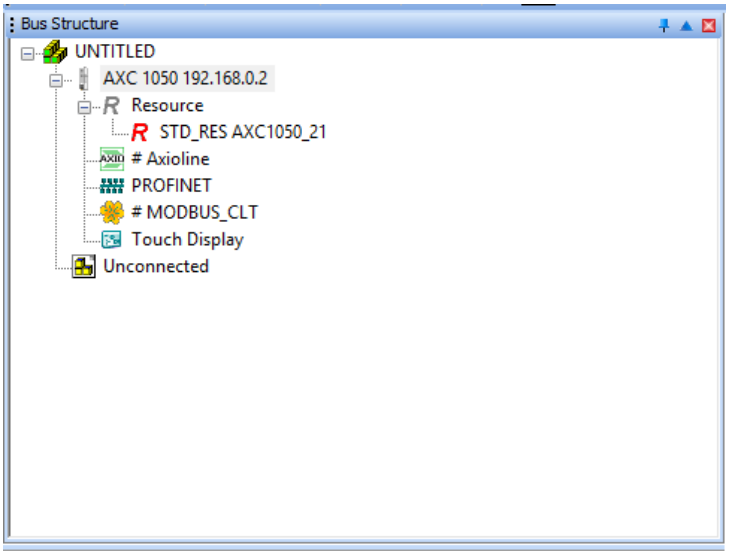


Back to PCWorx:

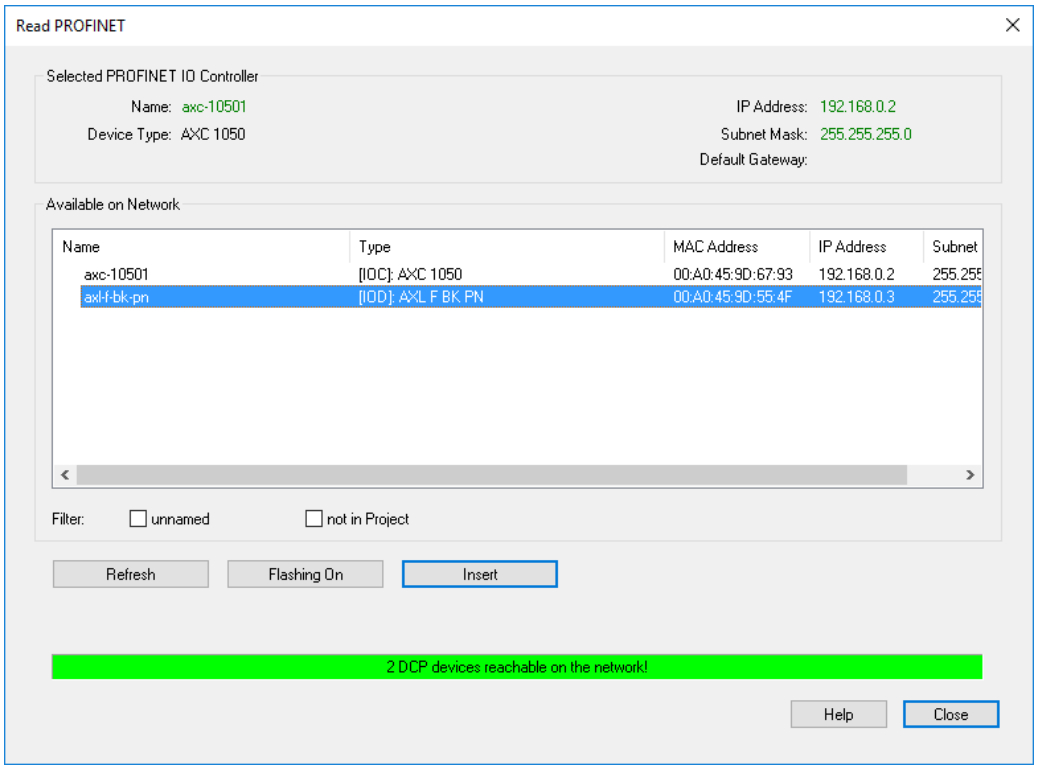
1- Go to the Communication Tab inside Bus Configuration Workspace.
2- Check that the Interface Type is Ethernet, the Connection name is Manual Input, the IP address is the same you used with the ping command above, the subnet mask is 255.255.255.0 and the gateway address is empty and unchecked use virtual LAN.

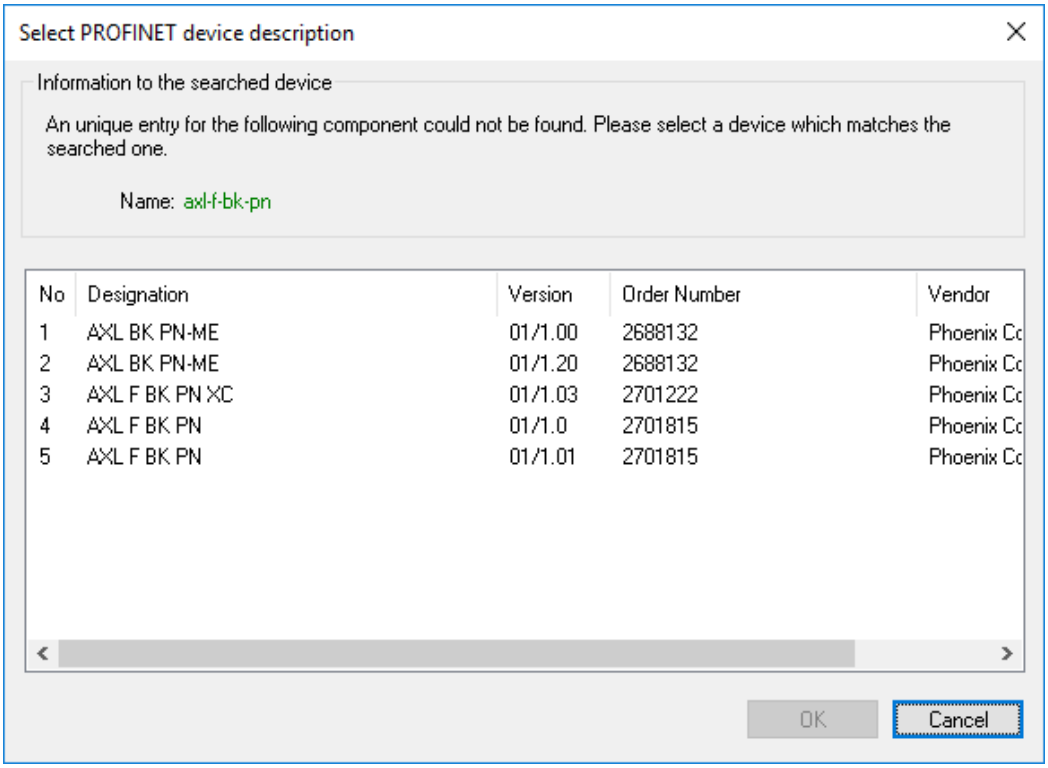


3- Click Test and it should display a text inside a green box saying" Host Type: AXC 1050".
4- If the above happened, kudos to you!! You did a good job! But it is not over yet…
5- Go on the Bus Structure (the top-left box) and right click on Axioline, Read Axioline, OK and you should see the Axioline expanded with #1 and #2.

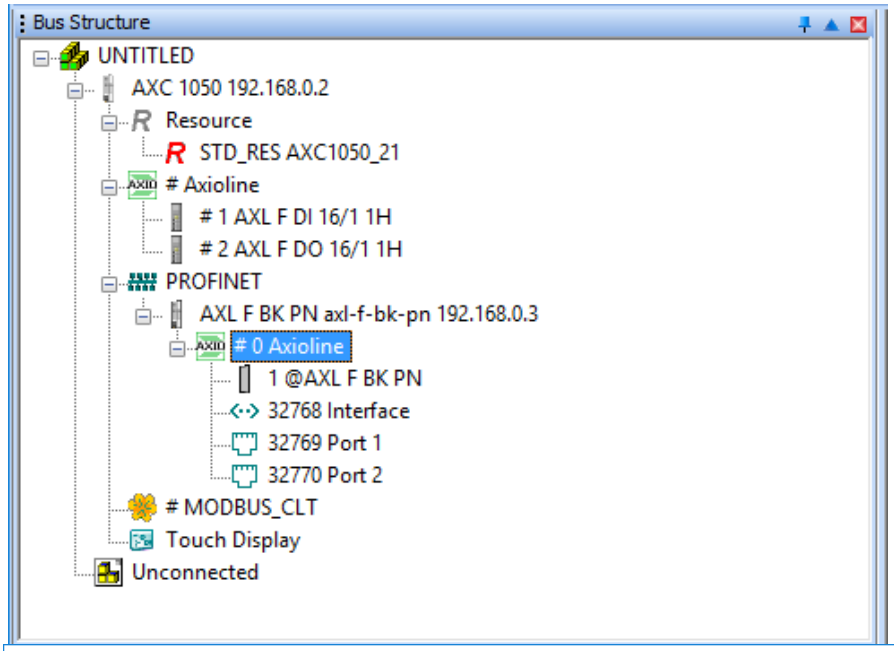


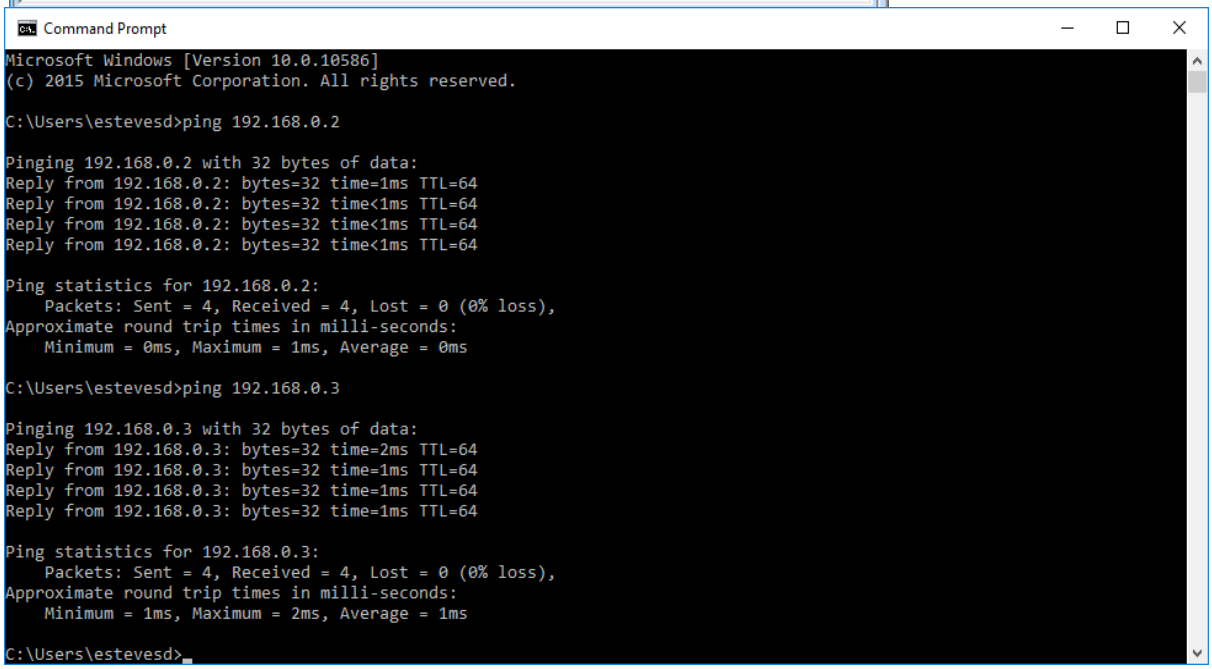
6- Now right-click on PROFINET, Read PROFINET, click on the AXL, click insert, AXL F BK PN 01/1.01, click ok and close the window.





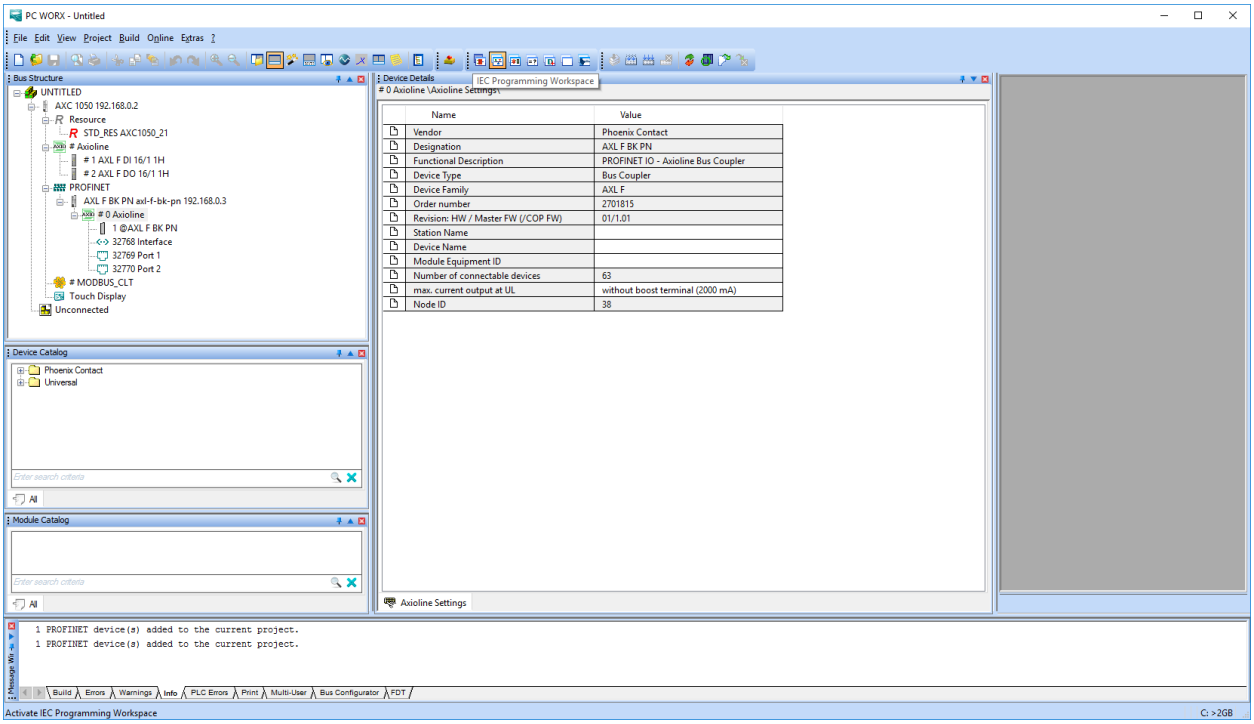
7- You should have everything connected. To make sure, click on the AXL under PROFINET, find its IP address and repeat the ping process that you did with the AXC IP address test.



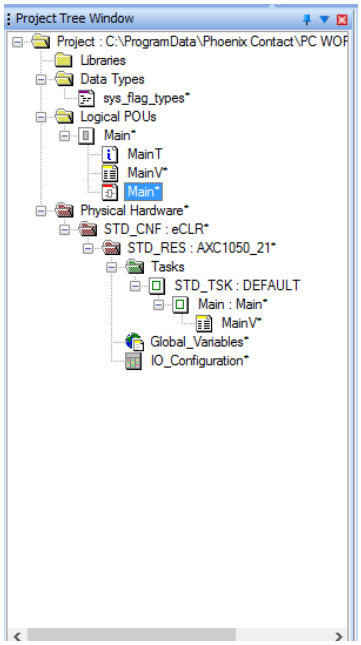


Finally, Lets Code!!

1- Right next to the Bus Configuration Workspace button there is a button called IEC Programming Workspace. Click on it.



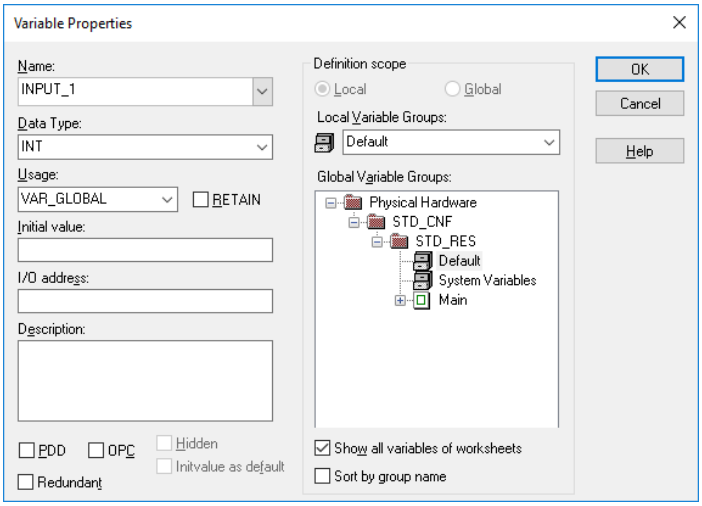
2- On Project Tree Window, expand Logical POU's to find Main. Expand Main to find 3 Main. Double-click on the plain Main (without T or V).



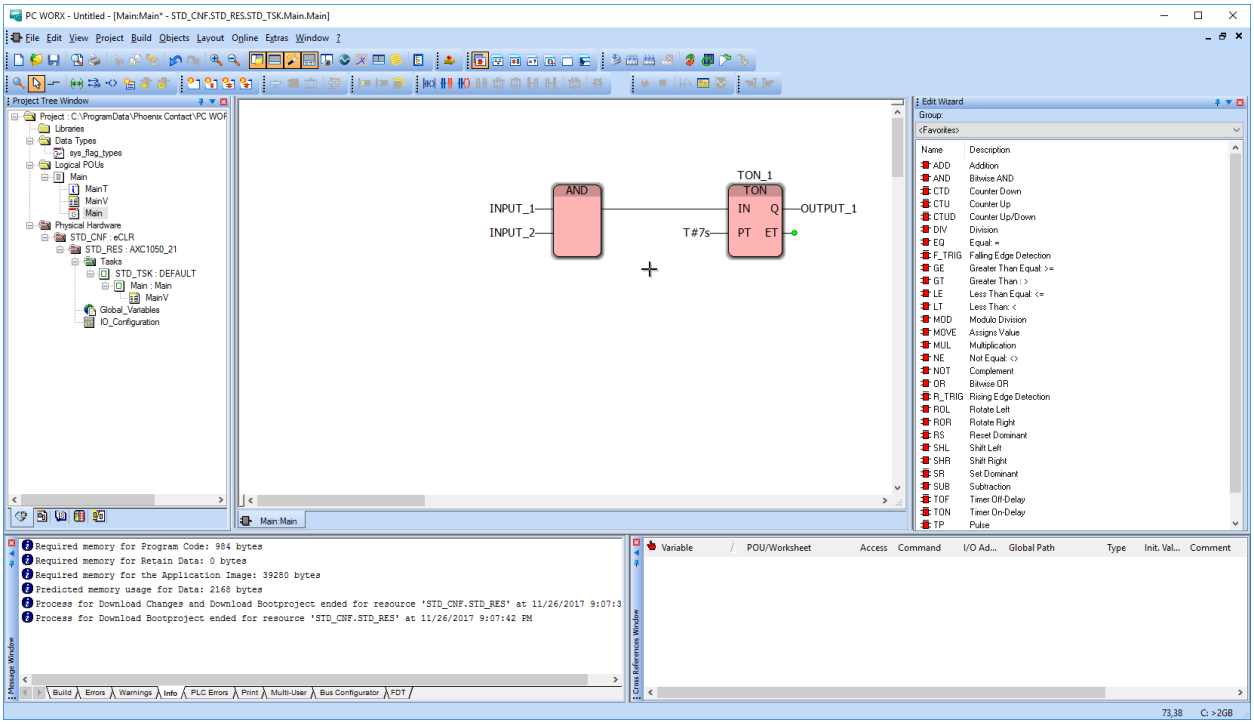
3- As an example we will set up a circuit that will turn an Output HIGH after the 2 Inputs remain HIGH for 7 seconds.

4- On the right part of the window you will find multiple kinds of logic gates. We will use two for this example: 1 AND + 1 TON.

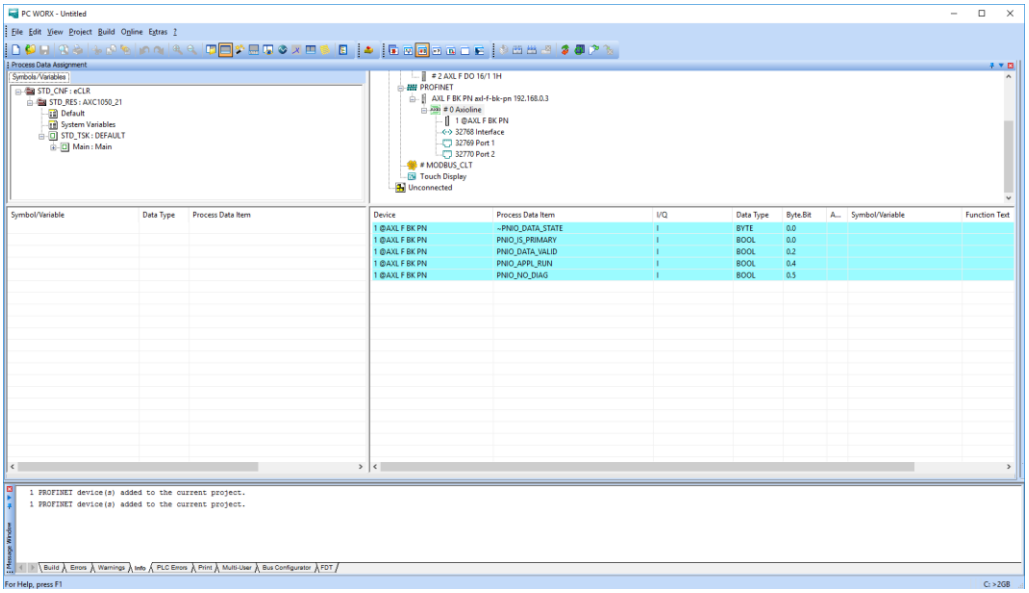
5- Drag the AND gate and drop anywhere you want. Double-click one of the blue terminals. Rename it as “INPUT_1” or something you like. Make sure the Usage is set to VAR_GLOBAL and the data type to BOOL. Repeat that to the second blue terminal but change the name of it.

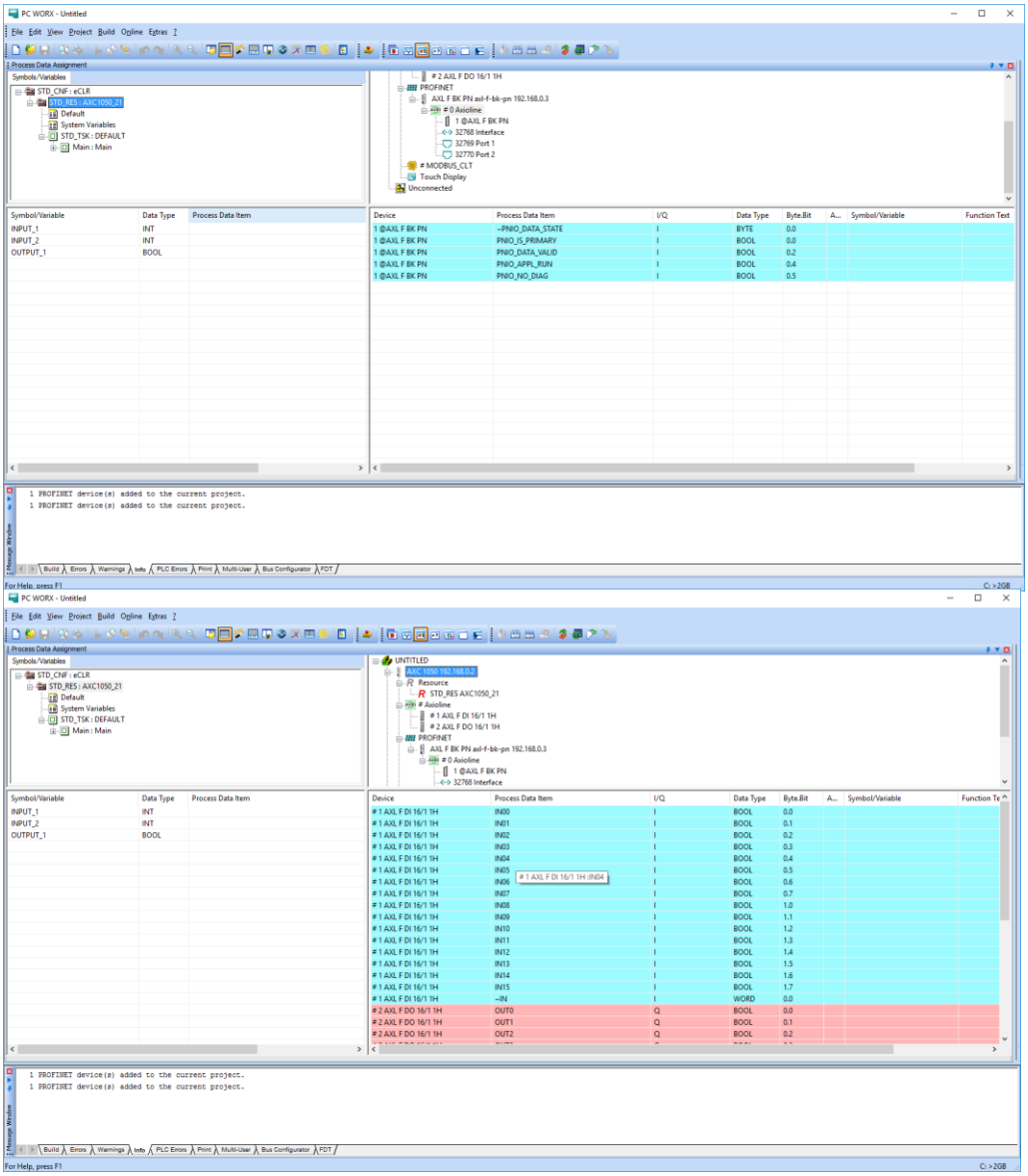


6- Now drag the TON gate to the right of the AND gate. Do not change anything on it, just click ok. Connect the output of the AND gate to the IN input of the TON gate. Double-click the blue terminal next to PT and name it T#7s. Double click the terminal next to ET and enter the name Actual_Time (Data type: TIME). Double click Q and put the name of the variable you want. MAKE SURE ALL THE VARIABLES ARE IN USAGE MODE VAR_GLOBAL!!!



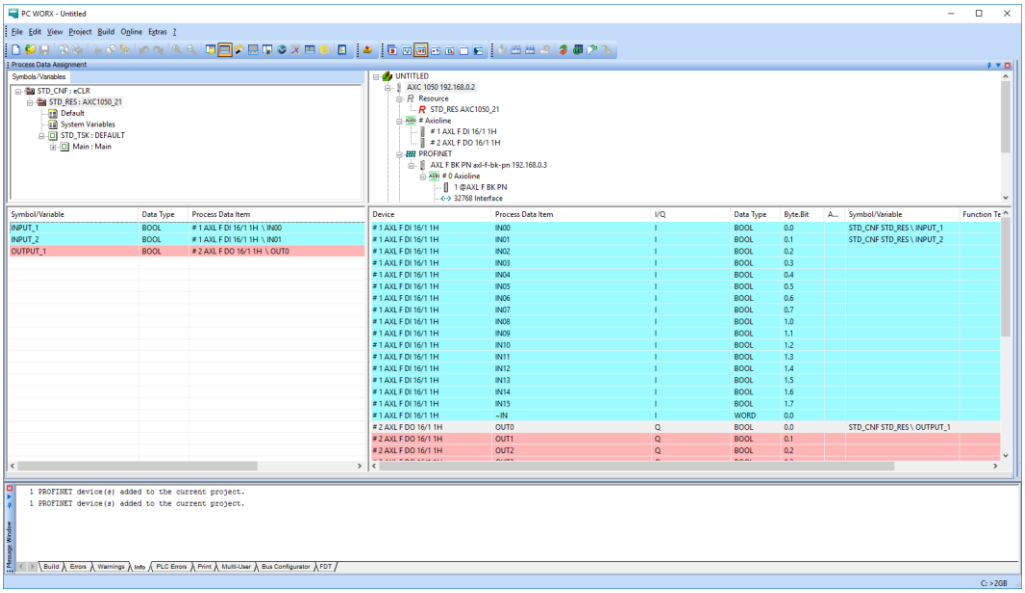
7- Let's link the variables to the PLC controller lights and switches. Press Process Data Workspace and a 4-window page is going to show up. On the top-left one click on STD_RES:AXC1050_21. This should display some variables on the bottom-left. On the Top-right one Click on the AXC 1050 192.168.0.xxx and some items should be displayed on the bottom-left window.



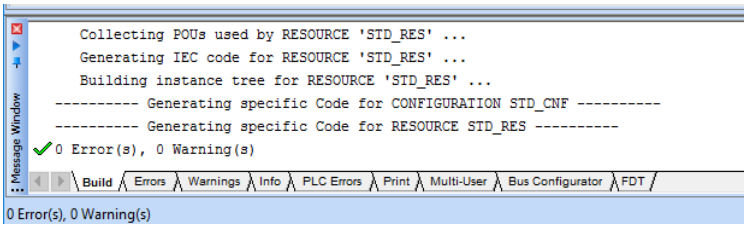

PC WORX - Untitled
File Edit View Project Build Online Extras ?
Process Data Assignment
Symbols/Variables
STD_CNF : eCLR
STD_RES : AXC1050_21
Default
System Variables
STD_TSK : DEFAULT
Main : Main
2 AXL F DO 16/1 1H
PROFINET
AXL F BK PN axl-f-bk-pn 192.168.0.3
0 Axioline
1 @AXL F BK PN
32768 Interface
32769 Port 1
32770 Port 2
MODBUS_CLT
Touch Display
Unconnected
Symbol/Variable
Data Type
Process Data Item
INPUT_1
INT
INPUT_2
INT
OUTPUT_1
BOOL
Device
Process Data Item
I/Q
Data Type
Byte.Bit
A...
Symbol/Variable
Function Text
1 @AXL F BK PN
-PNIO_DATA_STATE
PNIO_IS_PRIMARY
PNIO_DATA_VALID
PNIO_APPL_RUN
PNIO_NO_DIAG
1 PROFINET device(s) added to the current project.
1 PROFINET device(s) added to the current project.
Message Window
Build Errors Warnings Info PLC Errors Print Multi-User Bus Configurator FDT
For Help, press F1
C: >2GB

PC WORX - Untitled
File Edit View Project Build Online Extras ?
Process Data Assignment
Symbols/Variables
STD_CNF : eCLR
STD_RES : AXC1050_21
Default
System Variables
STD_TSK : DEFAULT
Main : Main
UNTITLED
AXC 1050 192.168.0.2
Resource
STD_RES AXC1050_21
Axioline
1 AXL F DI 16/1 1H
2 AXL F DO 16/1 1H
PROFINET
AXL F BK PN axl-f-bk-pn 192.168.0.3
0 Axioline
1 @AXL F BK PN
32768 Interface
Symbol/Variable
Data Type
Process Data Item
INPUT_1
INT
INPUT_2
INT
OUTPUT_1
BOOL
Device
Process Data Item
I/Q
Data Type
Byte.Bit
A...
Symbol/Variable
Function Te
1 AXL F DI 16/1 1H
IN00
IN01
IN02
IN03
IN04
IN05
IN06
IN07
IN08
IN09
IN10
IN11
IN12
IN13
IN14
IN15
--IN
2 AXL F DO 16/1 1H
OUT0
OUT1
OUT2
1 AXL F DI 16/1 1H :IN04
1 PROFINET device(s) added to the current project.
1 PROFINET device(s) added to the current project.
Message Window
Build Errors Warnings Info PLC Errors Print Multi-User Bus Configurator FDT
For Help, press F1
C: >2GB

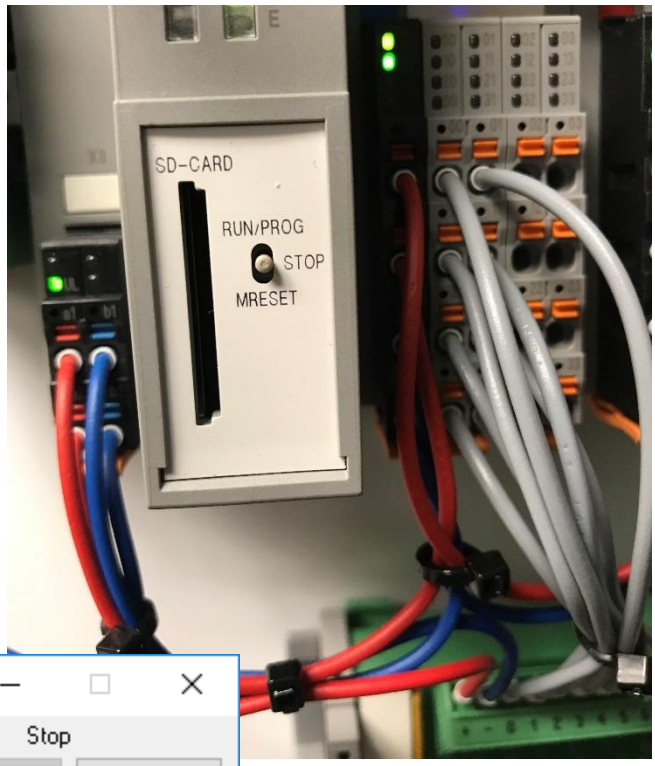
8- Take a look at how the Device separates the matrixes into I(inputs) Q(Outputs). The tables correspond to the same notation on the device. So grab the input you want and drag and drop into the variable. That simple! Repeat that to the second input and for the output but don't use an Input as an output variable, of course.

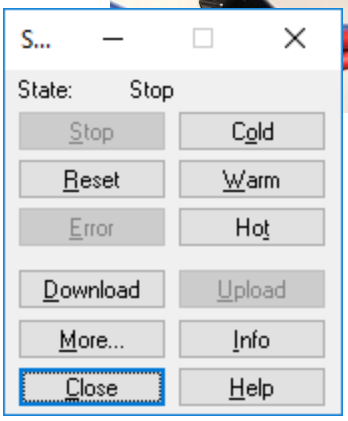


9- That should be it! Go on Build→Rebuild Project and some comments should show up on the bottom of the page. If you forgot something about the Data Types or Variables that you didn't initialize, it will yell at you.

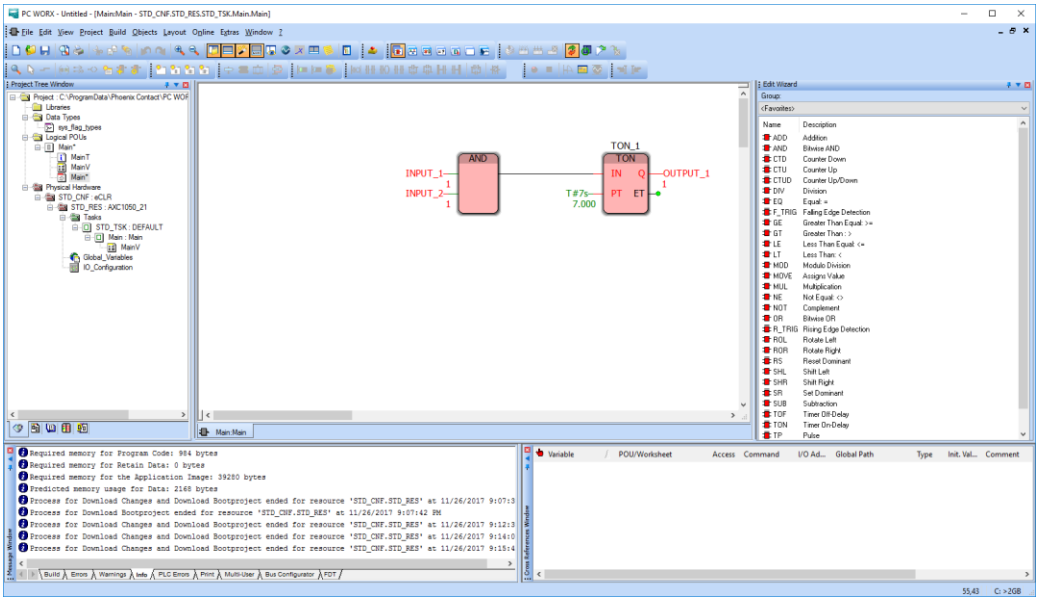


10- Make sure the device is in the STOP mode by switching it to STOP physically and click Project Control Dialog and click on Download. Just click ok is any problems come up. Allow the PLC to run for a minute.





11- Now switch the device to RUN/PROG and flip the switches that you indicated in the previous steps as input. You can turn on the Debug on/off button and watch everything happening virtually including time counters.



You just finished programming for an Industrial-Grade PLC.

Appendix:

A) Lights legend

3.5 Diagnostics and status indicators

The diagnostics and status indicators are used for quick local error diagnostics.

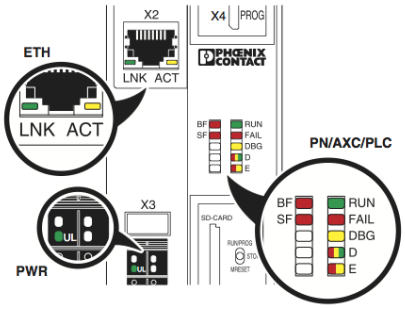


Figure 3-7 Diagnostics and status indicators

Table 3-1 Diagnostics and status indicators of the controller

Desig-nation	Color	Meaning	State	Description
PN: PROFINET controller/device function				
BF	Red	Status of PROFINET com-munication/com-munication errors	**AXC 1050 (XC) as a PROFINET controller**	
			Off	The AXC 1050 (XC) has established an active communication connection to each configured PROFINET device.
			On	No link status at the Ethernet interfaces and/or no 100-Mbit transmission and/or no full-duplex operation.
			Flashing (1 Hz)	Link status present, at least one configured PROFINET device has no communication connection.
			AXC 1050 (XC) as a PROFINET device	
			Off	A PROFINET controller has established an active communica-tion connection to the AXC 1050 (XC) (PROFINET device) or the function of the PROFINET device is switched off.
			On	No PROFINET communication (no link status at the Ethernet in-terfaces).
			Flashing (1 Hz)	Link status present, no communication connection to the PROFINET controller.

Table 3-1 Diagnostics and status indicators of the controller

Designation	Color	Meaning	State	Description
BF	Red	Status of PROFINET communication/communication errors	**AXC 1050 (XC) concurrently operates as a PROFINET controller and device**	
			Off	The AXC 1050 (XC) (PROFINET controller) has established an active communication connection to each configured PROFINET device **and** a PROFINET controller has established an active communication connection to the AXC 1050 (XC) (PROFINET device).
			On	No link status at the Ethernet interfaces and/or no 100-Mbit transmission and/or no full-duplex operation.
			Flashing (1 Hz)	Link status present, at least one configured PROFINET device has no communication connection or the PROFINET controller has no communication connection.
SF	Red	Group error (PROFINET)	Off	PROFINET diagnostics not present.
			On	PROFINET diagnostics present.
PLC: controller diagnostics				
RUN	Green	RUN status of the controller	Off	IEC 61131 runtime system not ready to operate.
			Flashing (0.5 Hz)	IEC 61131 runtime system successfully initialized. Control function is in the READY/STOP state, program not processed.
			Flashing (2 Hz)	Controller reset to default state (see Section "Reset button (concealed)" on page 30).
			On	IEC 61131 runtime system successfully initialized and a program is running. Control function is in the RUN state.
FAIL	Red	Failure	On	A runtime error has occurred in the IEC 61131 runtime system program.
			Off	No runtime error has occurred in the IEC 61131 runtime system program.
			Flashing (0.5 Hz)	The hardware watchdog of the controller has been triggered.
DBG	Yellow	Debug mode (troubleshooting)	On	The IEC 61131 runtime system/controller is in debug mode, i.e., debug mode has been activated in PC Worx (breakpoint(s) set and/or variable(s) forced). The state of the RUN LED is not affected.
			Flashing (2 Hz)	Boot phase of the controller (from sending the BootP request to assigning the IP address settings) if the MAC address of the controller has been entered in the PC Worx software. Otherwise, flashing stops after three failed boot requests.

Table 3-1 Diagnostics and status indicators of the controller

Desig-nation	Color	Meaning	State	Description
AXC: Axioline F diagnostics				
D	Red/yel-low/green	Axioline F: diag-nostics for local bus communica-tion	Green on	Run: The Axioline F station is ready for operation; communication within the Axioline F station is OK. All data is valid. There is no error.
			Flashing green	Active: The Axioline F station is ready for operation; communication within the Axioline F station is OK. The data is **not** valid. Valid data from the controller is not available. There is no malfunction in the device.
			Yellow on	Ready: The Axioline F station is ready for operation; no data is being exchanged.
			Flashing yellow	Access from Startup+ in I/O check mode
			Flashing yellow/red	Local bus error during active I/O check
			Flashing red	Local bus error during startup Possible causes: – Configuration cannot be generated, information is missing from a device – Chip version of a device is < V 1.1 – Deviation between actual and required configuration – No local bus device connected – The maximum number of local bus devices has been exceeded
			Red on	Bus error in RUN state The Axioline F station is ready for operation but has lost connection to at least one device. Possible causes: – Communication error – A local bus device has been removed or a configured device is missing – Reset from a local bus device – Serious device error at a local bus device (local bus device can no longer be reached)
			Off	Power down: Device is in (power) reset.
E	Yel-low/red	Error/warning	Yellow on	I/O warning at an Axioline F device
			Red on	Peripheral fault at an Axioline F device

Table 3-1 Diagnostics and status indicators of the controller

Desig-nation	Color	Meaning	State	Description
PWR: supply voltage (communications power U_L)				
UL	Green	U_{Logic}	Off	24 V communications power feed-in not present or too low.
			On	24 V communications power feed-in present.
ETH: Ethernet interfaces				
LNK	Green	Link status	Off	Connection not established successfully
			On	Connection established successfully (link): the controller is able to contact another network device.
			Flashing (0.5 Hz)	PROFINET device identification "flashing"
ACT	Yellow	Activity status	Off	Data transmission inactive
			On/flashing	Data transmission active (activity): the Ethernet interface is sending or receiving data

Exception: updates

During an update using FTP or an SD card, the RUN and DBG LEDs flash in alternation.

For information about performing updates, please refer to Section "Performing updates" on page 150.

Exception: update using an SD card

Once an update using an SD card is successfully completed, the BF, SF, RUN und FAIL LEDs all flash concurrently at a frequency of 1 Hz.

For information about performing updates using an SD card, please refer to Section "Performing updates via an SD card" on page 150.

B)