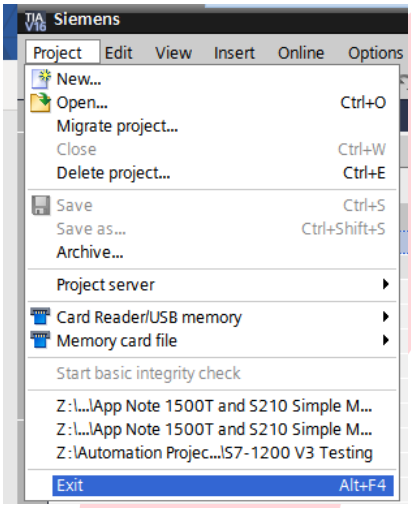
S210 Simple Motion S7-1500T using TIA Portal V16 and Startdrive

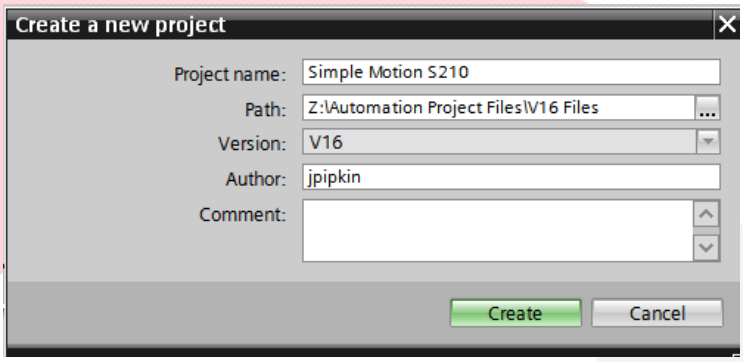
Revision Date: 4-6-2020

Launch TIA Portal V16 and open the Project View.

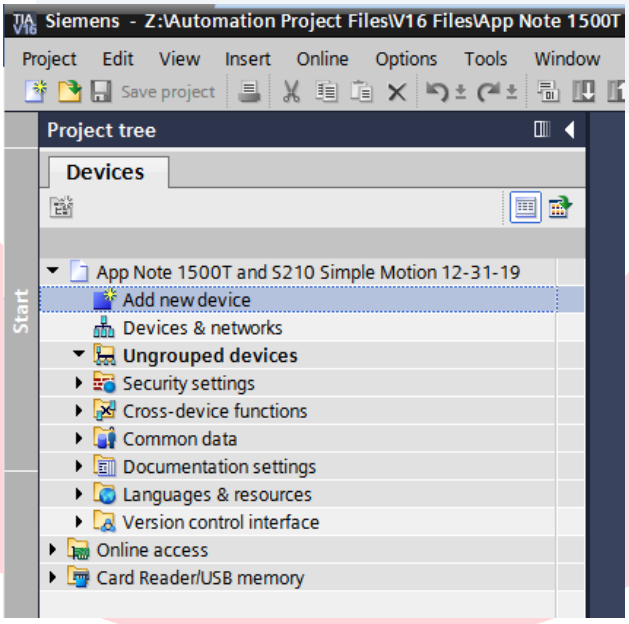
Begin by creating a new project by selecting New under the Project Menu or select the New Project Icon

Name the Project and select the path to save.

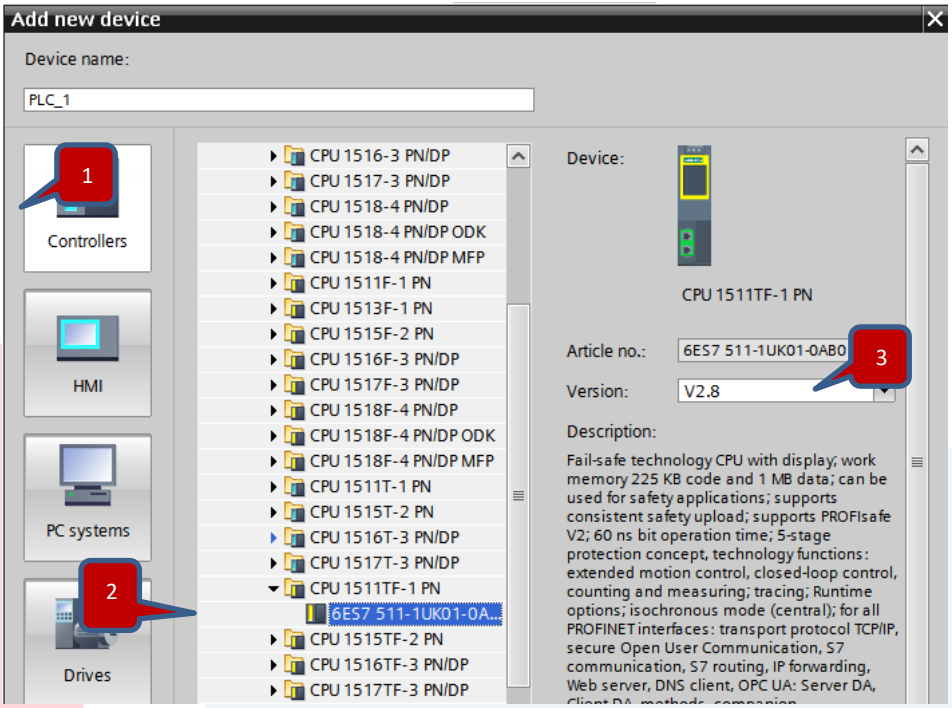




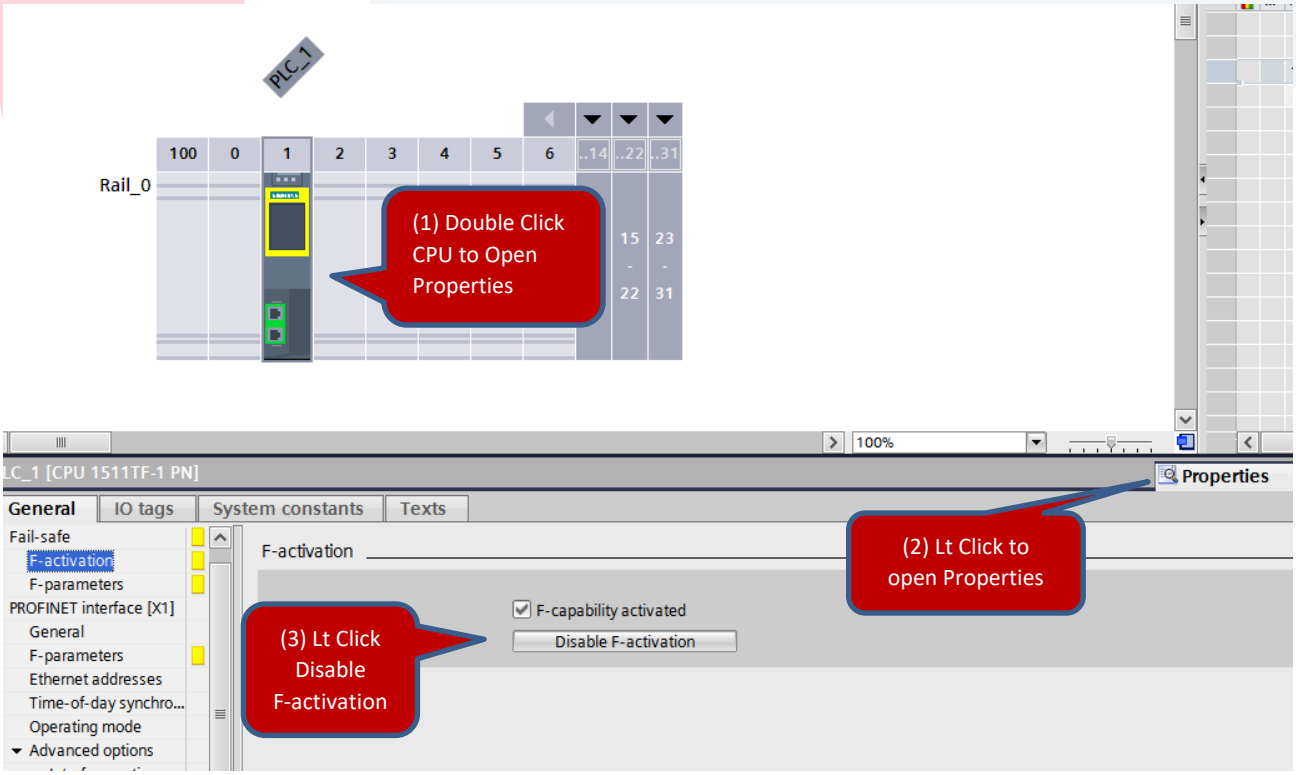
After the new project is created, select Add new device in the Project Tree.



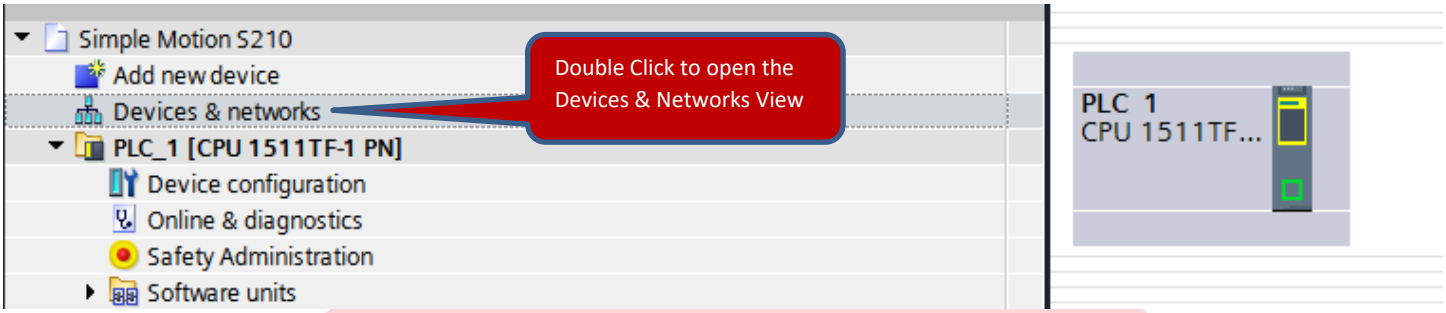
Selec Controllers then select your S7-1500 CPU from the list. Confirm the Version matches your CPU Firmware.



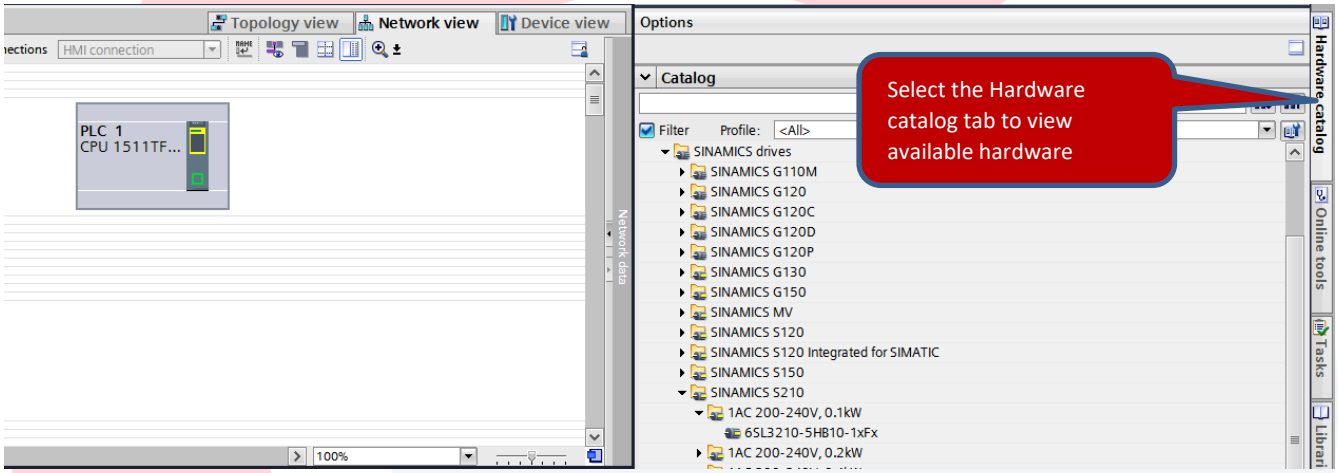
This CPU used for the document is a Failsafe CPU so for now Disable Safety in the PLC

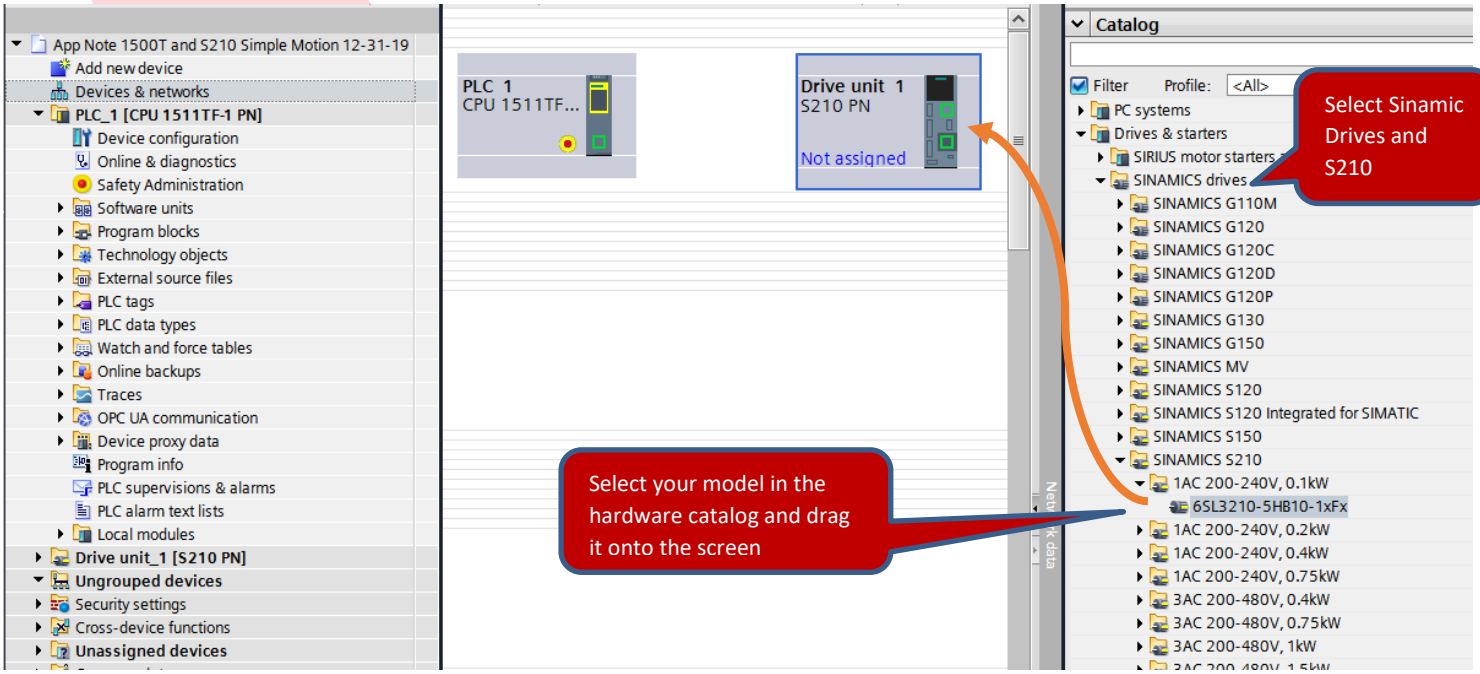


Open the Devices & Networks view to add the S210 Drive



In the Devices and Networks Window, Drag and Drop in your S210 Drive model from the hardware catalog.





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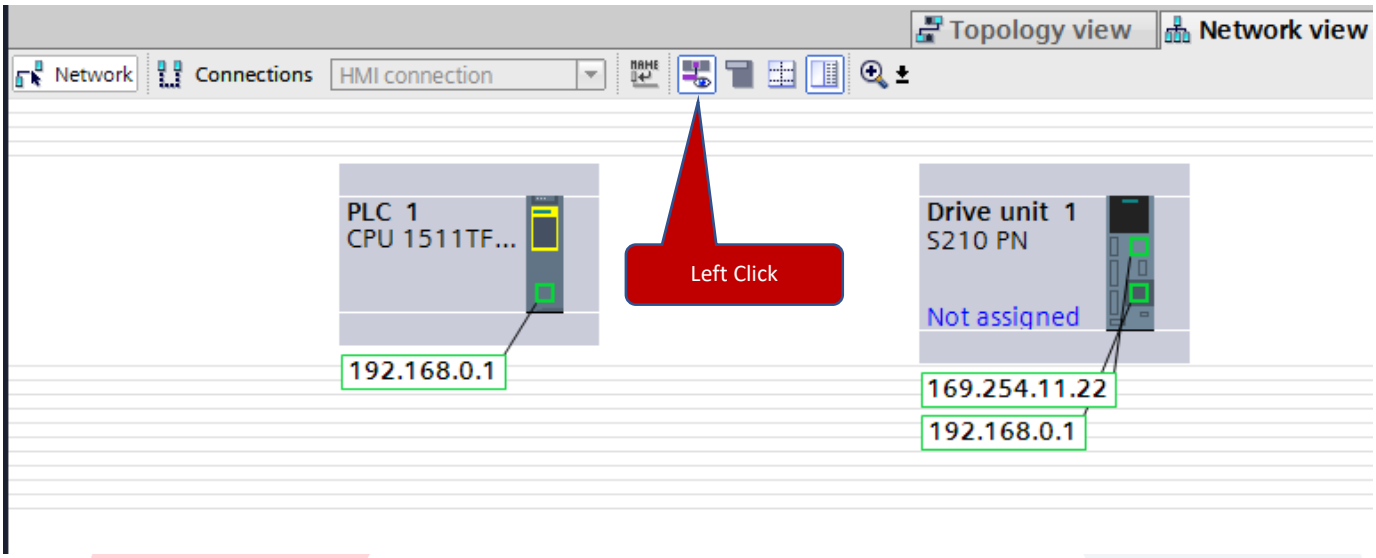
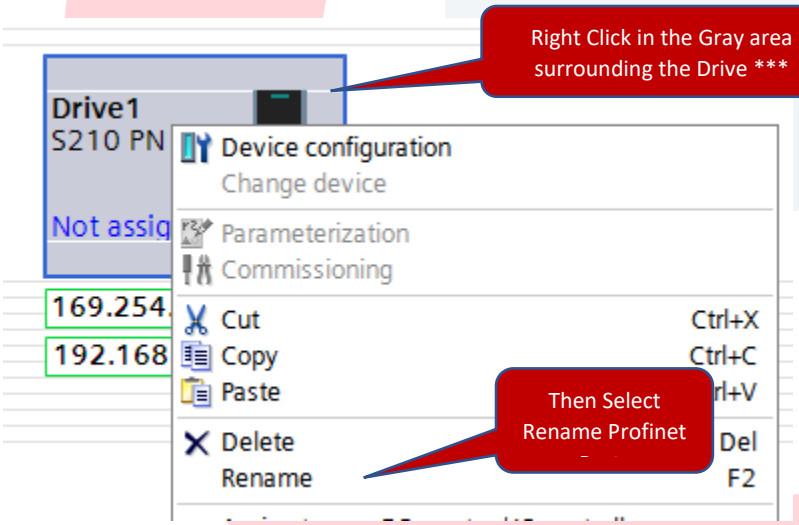
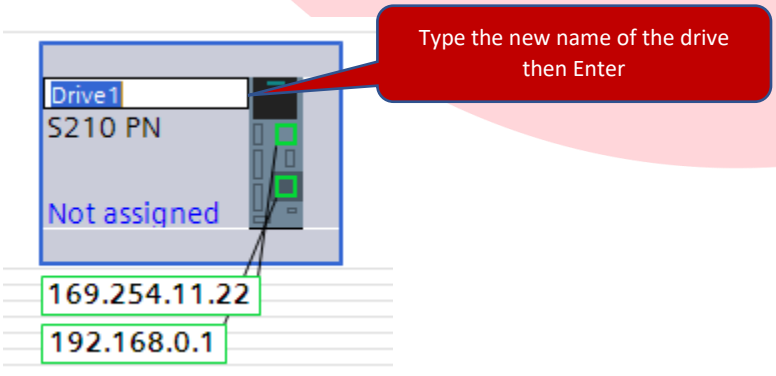
Click the “Show Address” icon to display the IP Addresses. At this point the Drive and the PLC are not connected on a network and have the same IP Address assigned.



Now rename the S210 Drive as Drive1.



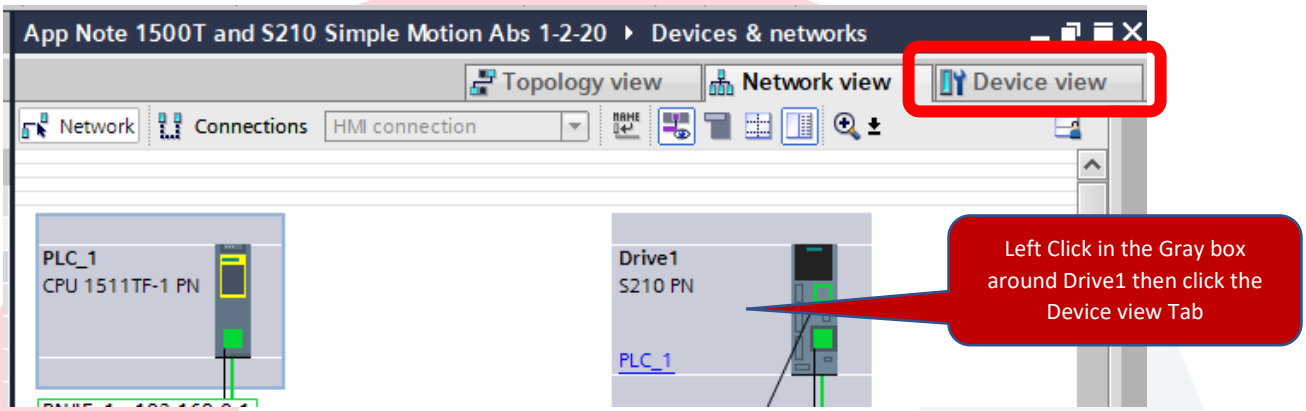
*** Note: If you click directly on the drive, the focus will change and rename will be grayed out



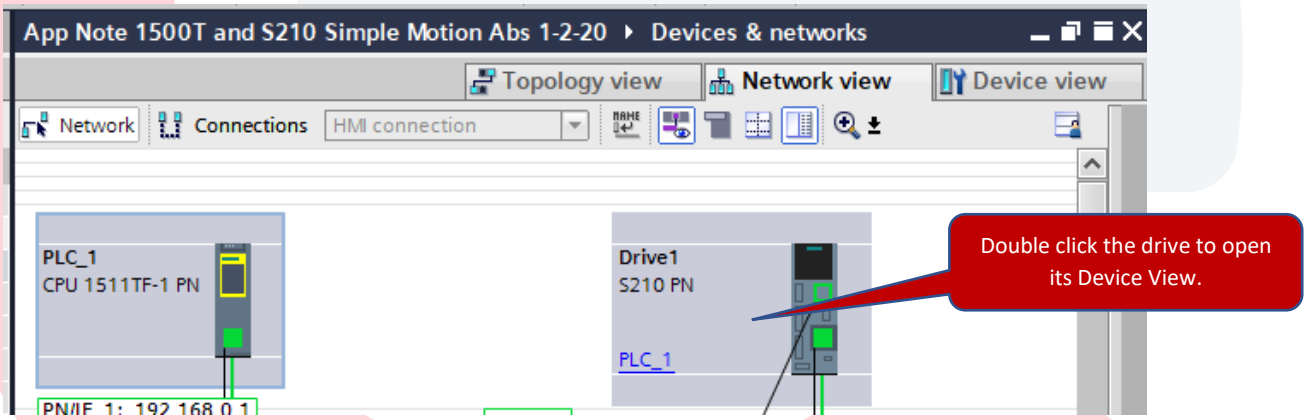
We now need to enter Drive1's device view.

Two options to open the Device View:

(1) Left Click on Drive1 then select the Device view Tab,

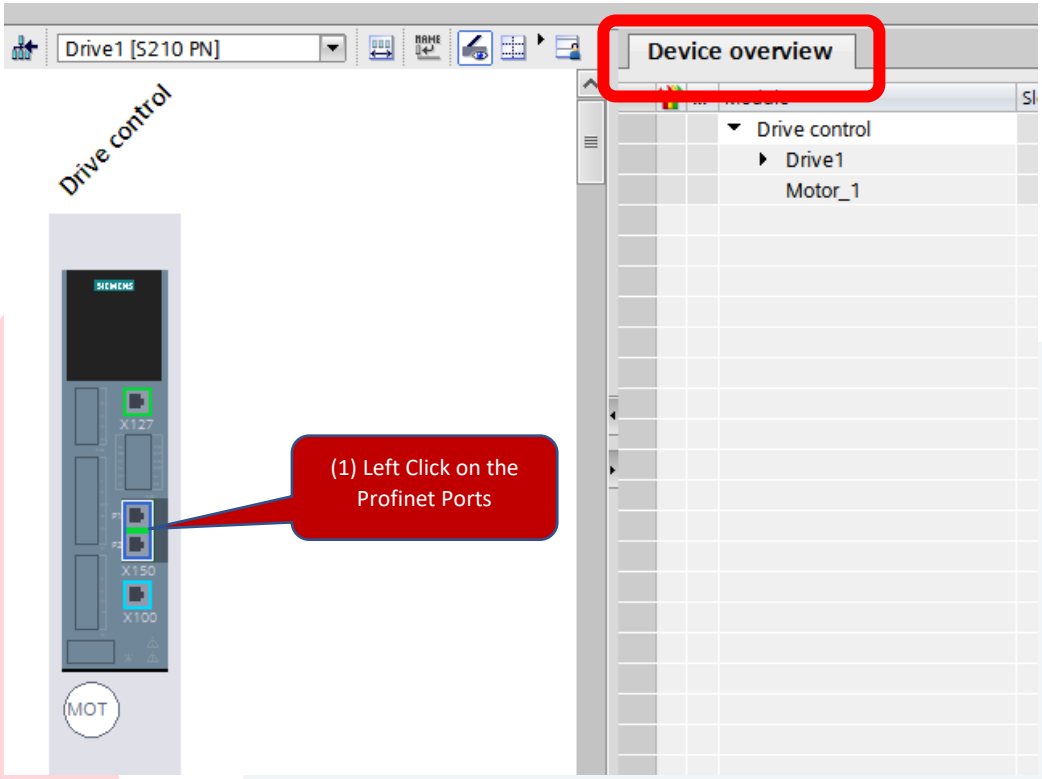


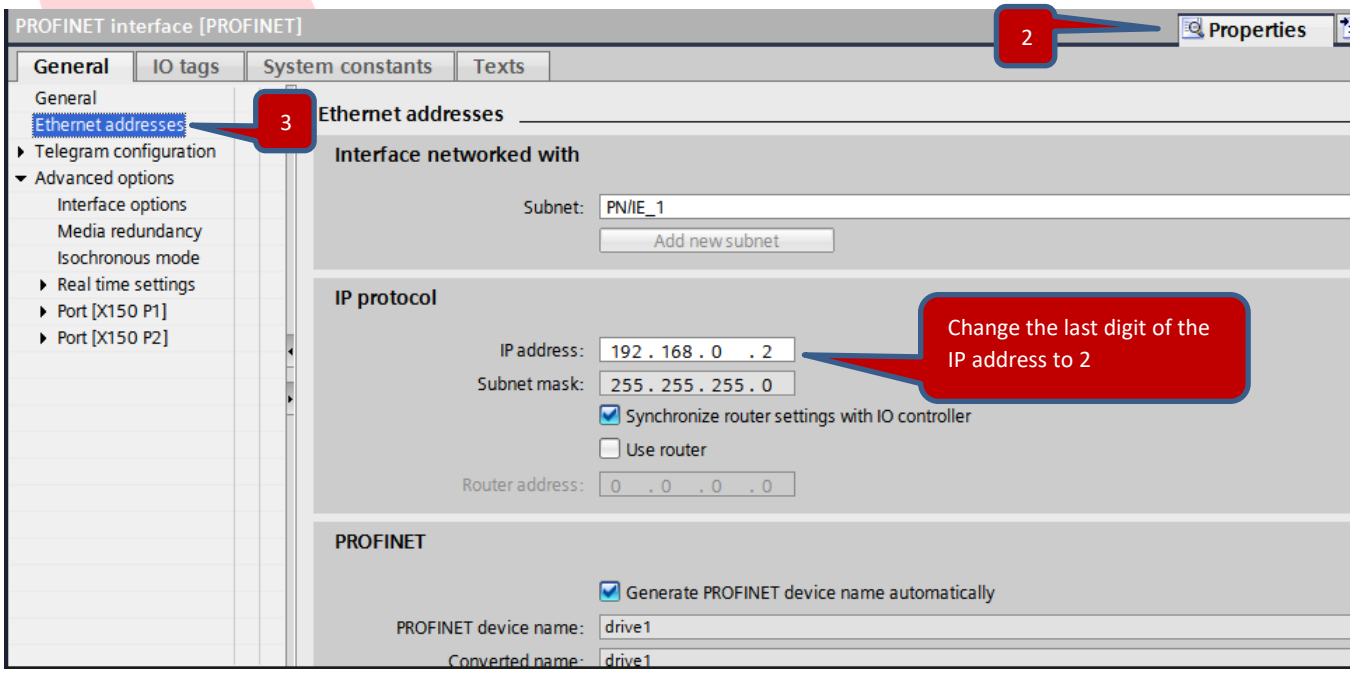
(2) Or you can Double Click on Drive1 to open Drive1 Device View.



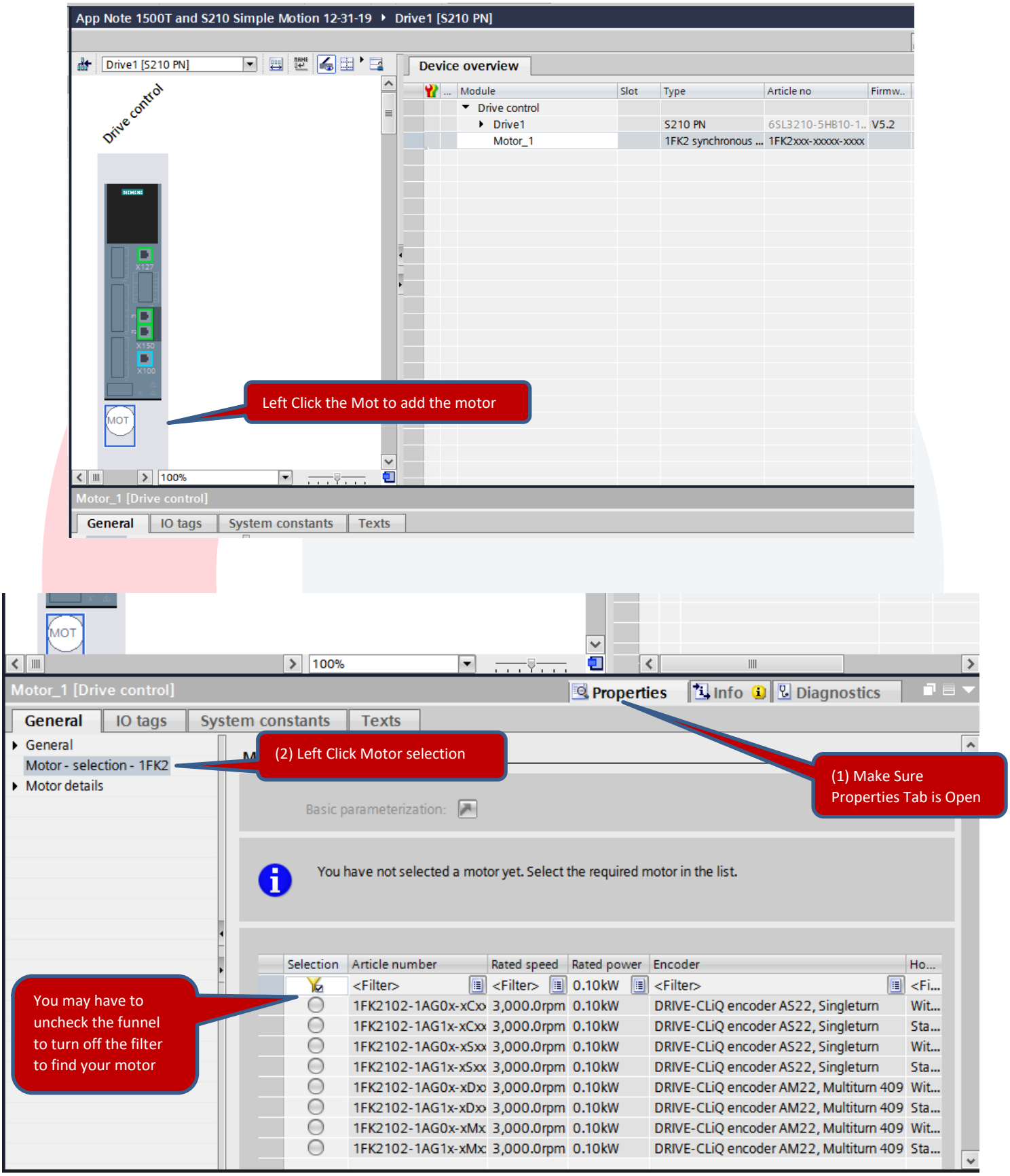
You should now be in the Device View of Drive1

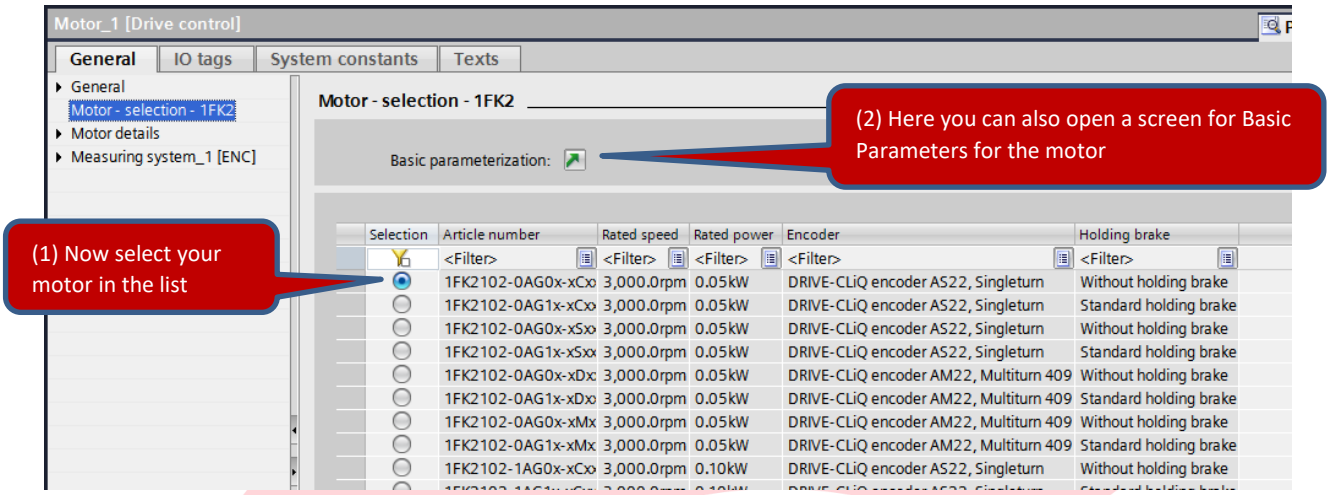
Check the auto assigned IP addresses and change the addresses.

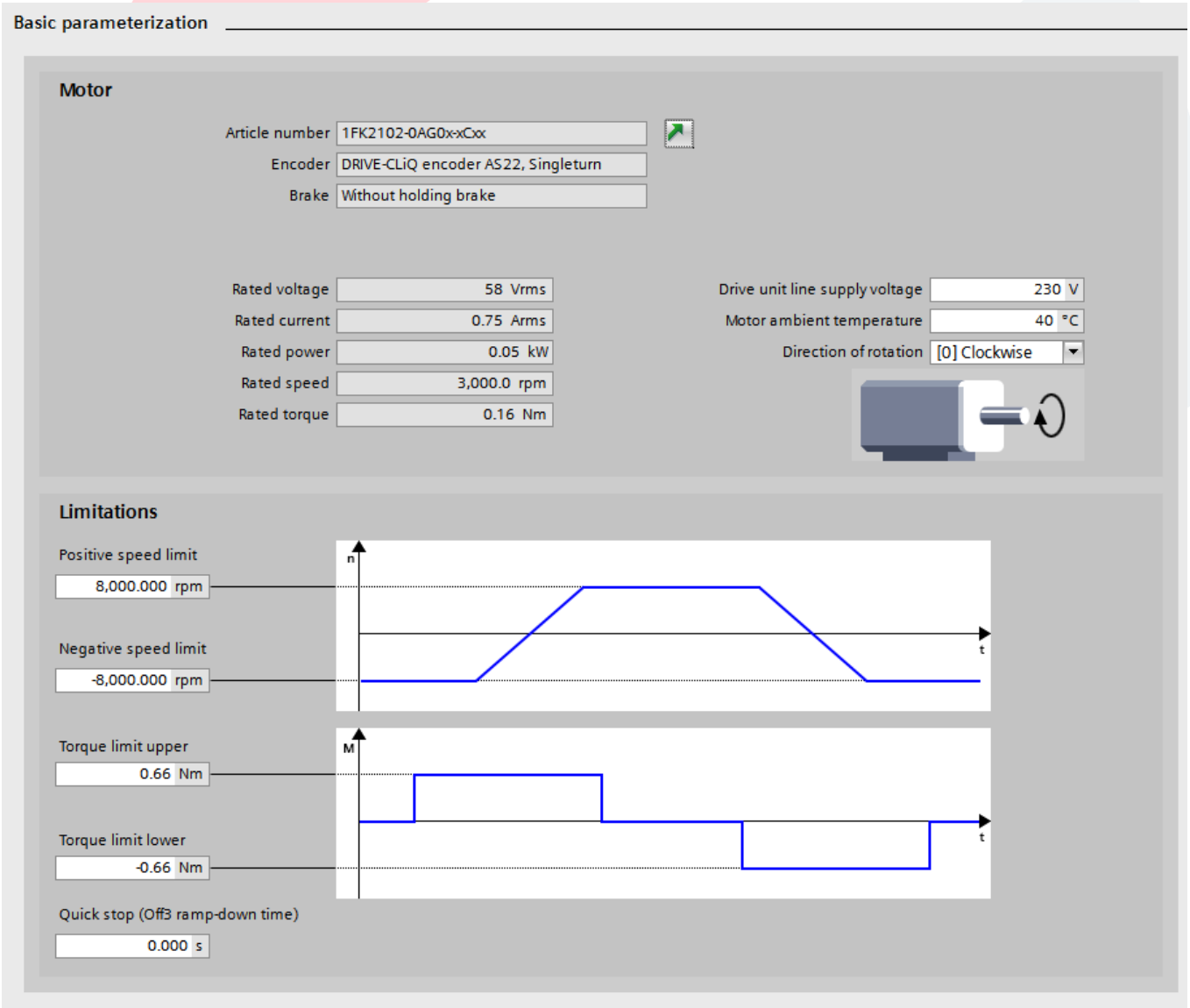




Next select the Motor attached to the S210 Drive

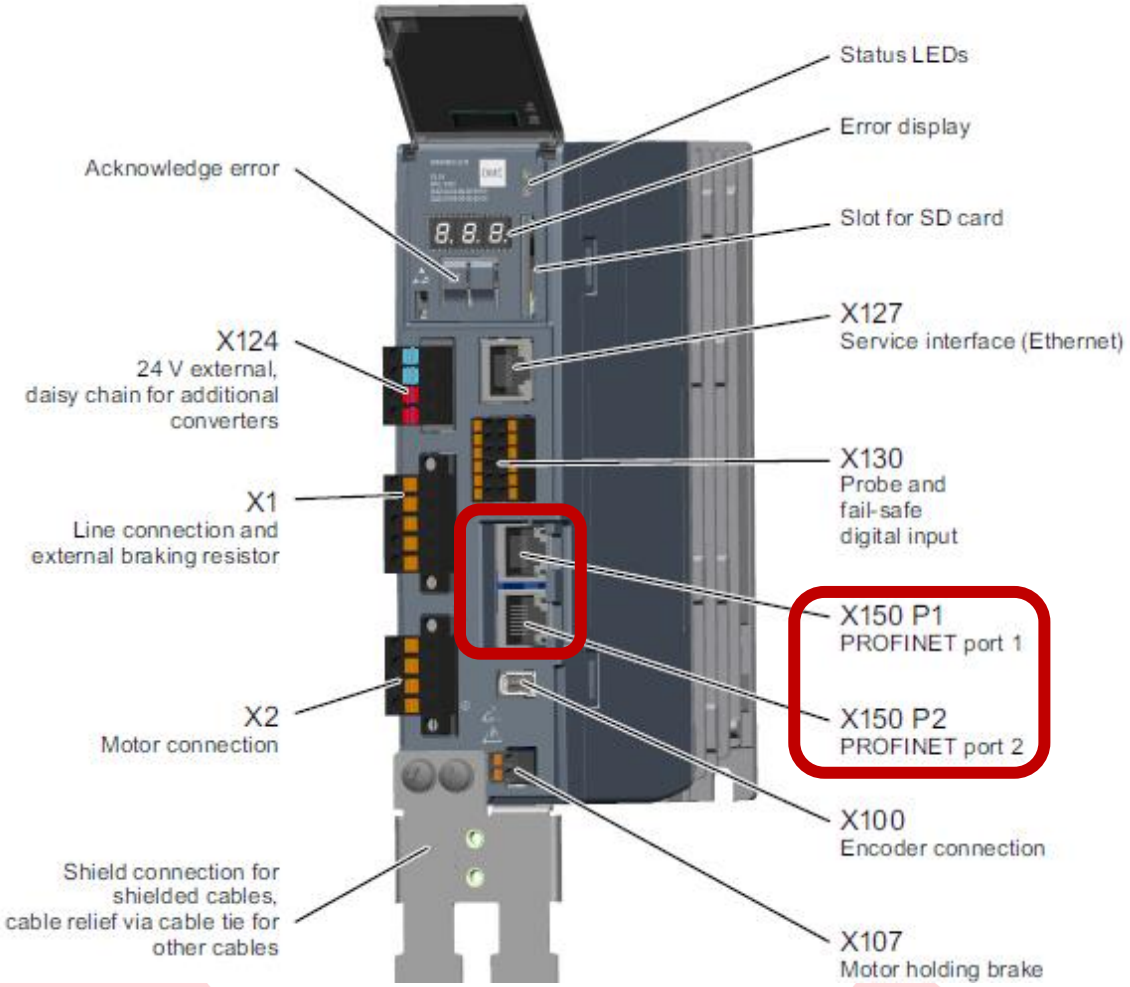



Motor_1 [Drive control]
General
IO tags
System constants
Texts
General
Motor - selection - 1FK2
Motor details
Measuring system_1 [ENC]
Motor - selection - 1FK2
Basic parameterization:
(2) Here you can also open a screen for Basic Parameters for the motor
(1) Now select your motor in the list
Selection
Article number
Rated speed
Rated power
Encoder
Holding brake
1FK2102-0AG0x-xCx 3,000.0rpm 0.05kW DRIVE-CLiQ encoder AS22, Singleturn Without holding brake
1FK2102-0AG1x-xCx 3,000.0rpm 0.05kW DRIVE-CLiQ encoder AS22, Singleturn Standard holding brake
1FK2102-0AG0x-xSx 3,000.0rpm 0.05kW DRIVE-CLiQ encoder AS22, Singleturn Without holding brake
1FK2102-0AG1x-xSx 3,000.0rpm 0.05kW DRIVE-CLiQ encoder AS22, Singleturn Standard holding brake
1FK2102-0AG0x-xDx 3,000.0rpm 0.05kW DRIVE-CLiQ encoder AM22, Multiturn 409 Without holding brake
1FK2102-0AG1x-xDx 3,000.0rpm 0.05kW DRIVE-CLiQ encoder AM22, Multiturn 409 Standard holding brake
1FK2102-0AG0x-xMx 3,000.0rpm 0.05kW DRIVE-CLiQ encoder AM22, Multiturn 409 Without holding brake
1FK2102-0AG1x-xMx 3,000.0rpm 0.05kW DRIVE-CLiQ encoder AM22, Multiturn 409 Standard holding brake
1FK2102-1AG0x-xCx 3,000.0rpm 0.10kW DRIVE-CLiQ encoder AS22, Singleturn Without holding brake


Basic parameterization
Motor
Article number 1FK2102-0AG0x-xCxx
Encoder DRIVE-CLiQ encoder AS22, Singleturn
Brake Without holding brake
Rated voltage 58 Vrms
Rated current 0.75 Arms
Rated power 0.05 kW
Rated speed 3,000.0 rpm
Rated torque 0.16 Nm
Drive unit line supply voltage 230 V
Motor ambient temperature 40 °C
Direction of rotation [0] Clockwise
Limitations
Positive speed limit
8,000.000 rpm
Negative speed limit
-8,000.000 rpm
n
t
Torque limit upper
0.66 Nm
Torque limit lower
-0.66 Nm
M
t
Quick stop (Off3 ramp-down time)
0.000 s

Next download to the Drive to install the basic parameters along with the assigned IP Address and the Profinet Name of the device.

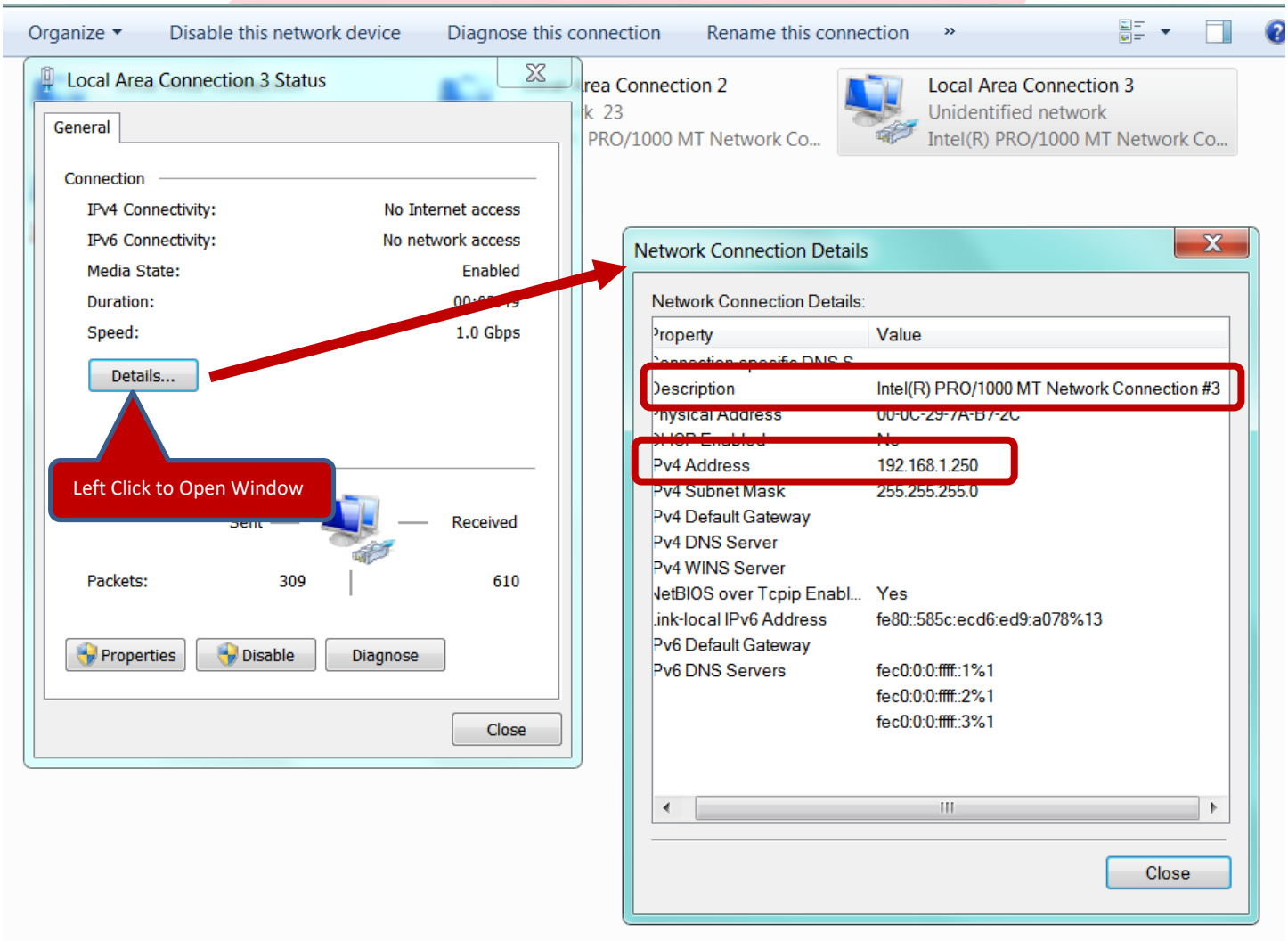
Make sure your Ethernet cable is plugged into one of the X150 ports on the Drive



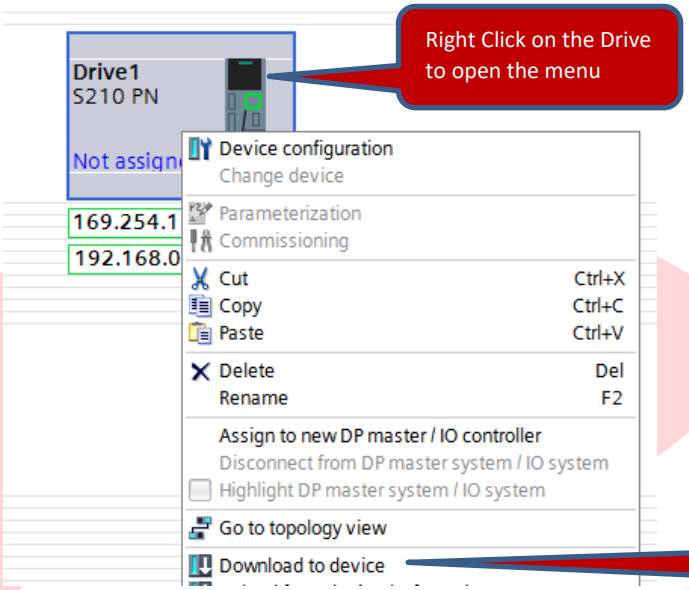
Note: For a successful first download, set the IP address of the wired port you plan to use to connect to the PLC and Drive Network into the same subnet as the PLC and Drive. The default IP addresses used in TIA Portal and the one we are using is 192.168.0.XXX. Set your PC IP Address to 192.168.0.250 and subnet mask to 255.255.255.0. Sometimes Wireless on a computer can also cause issues on first download, so disable wireless for the time being. Also, while in the Ethernet settings of the Computer note the Description name of the Ethernet connection. For my pc, I have extra Ethernet Ports defined. For the physical NIC RJ45 port, it is called Local Area Connection 3. The name in the Description in the Network Connections Details is the name to note. Also confirm the IPv4 Address is 192.168.0.250.

This is Windows 7, Windows 10 will look similar.

Windows Setup Information:



Now back in TIA Portal in the Network View:

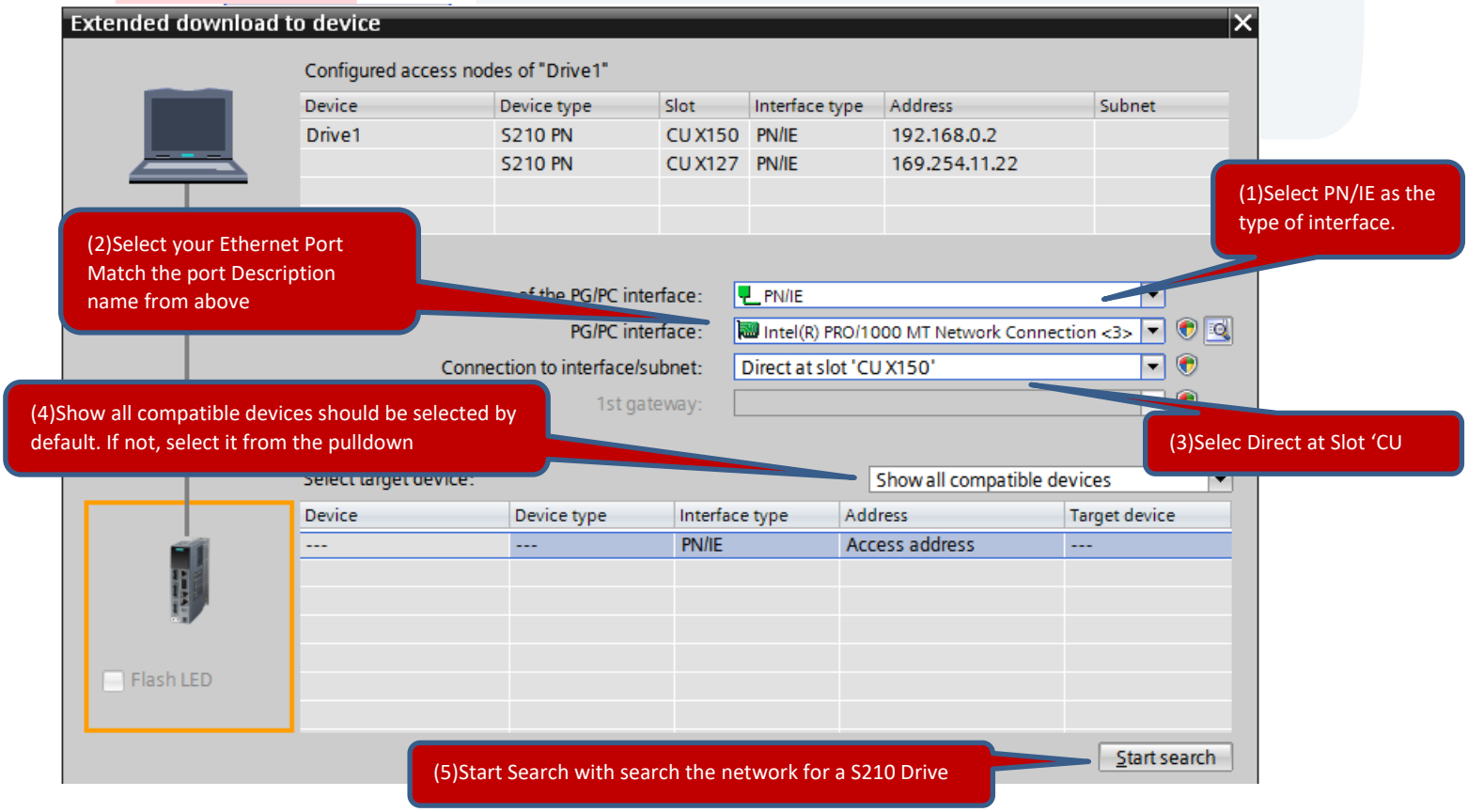


For the first download you will see the Extended download to device Window.

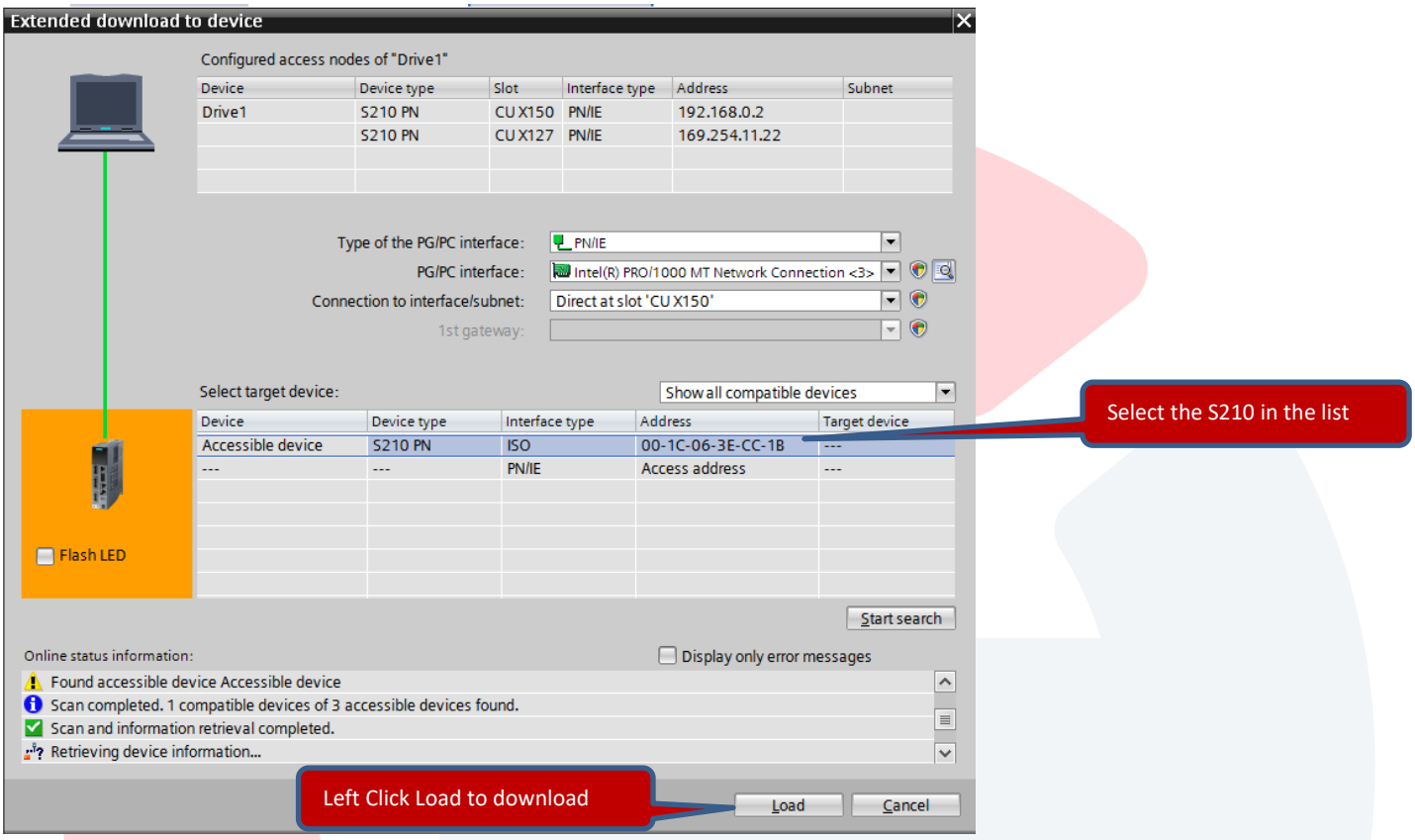
For PG/PC Interface select PN/IE – for Profinet Industrial Ethernet Download

Then Select PG/PC Interface as the physical NIC Card Name as shown above

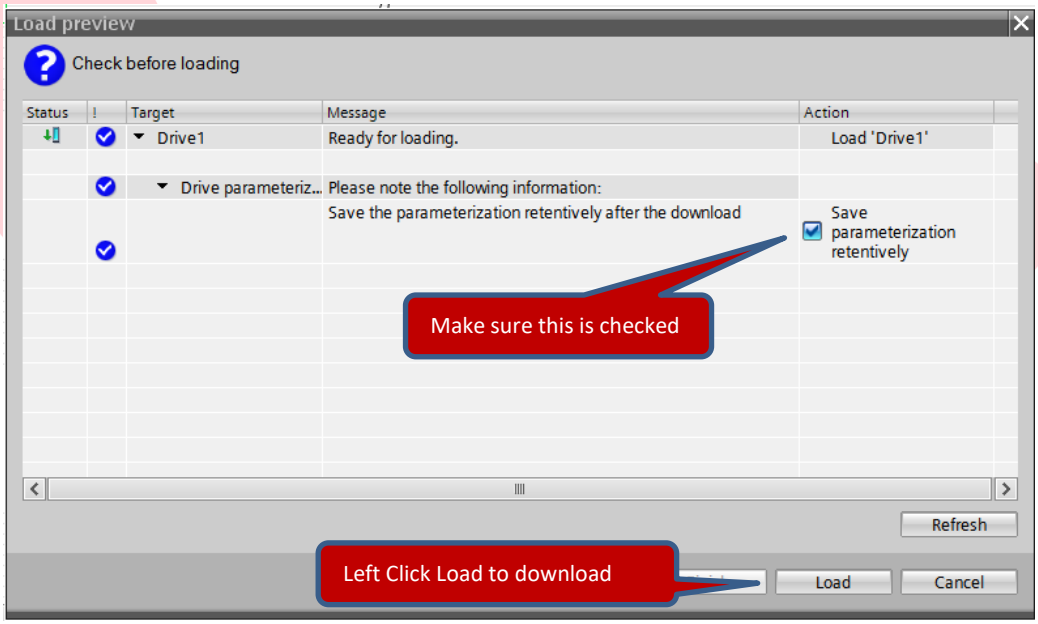
Also select Direct to Slot ‘CU X150’ for port on the S210 Drive.



After allowing a few seconds for TIA Portal to search the network, your drive should display on the Devices List. If you are connected directly to the Drive from your computer, then the drive will be all that is listed. Select the drive from the target device list and click Load.



Next you will see the Load preview window. Make sure the Save parameterization retentively is checked and click Load to begin the download.

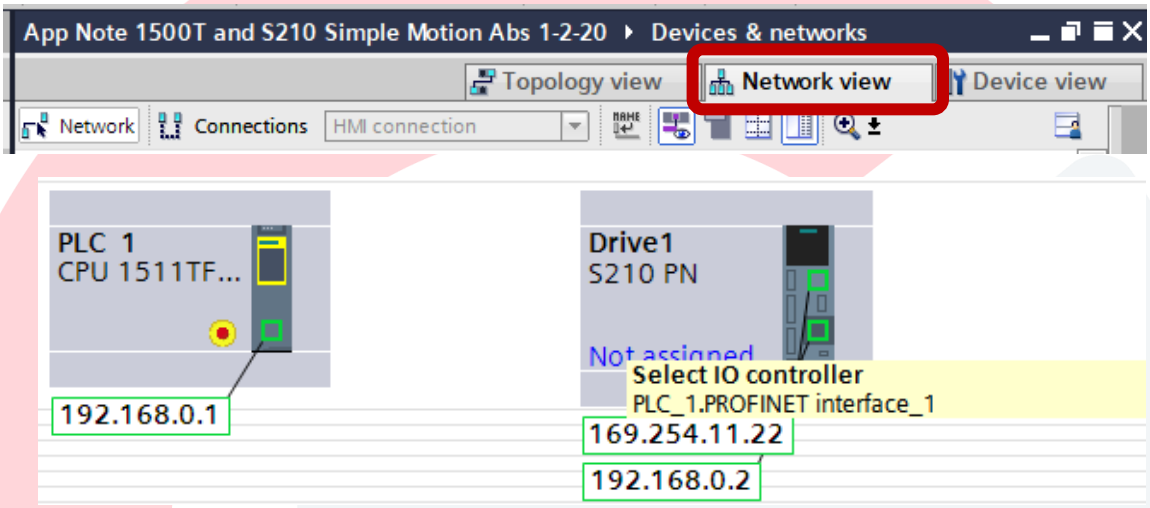


This will load the initial drive setup parameters motor data and the Profinet Name to Drive1

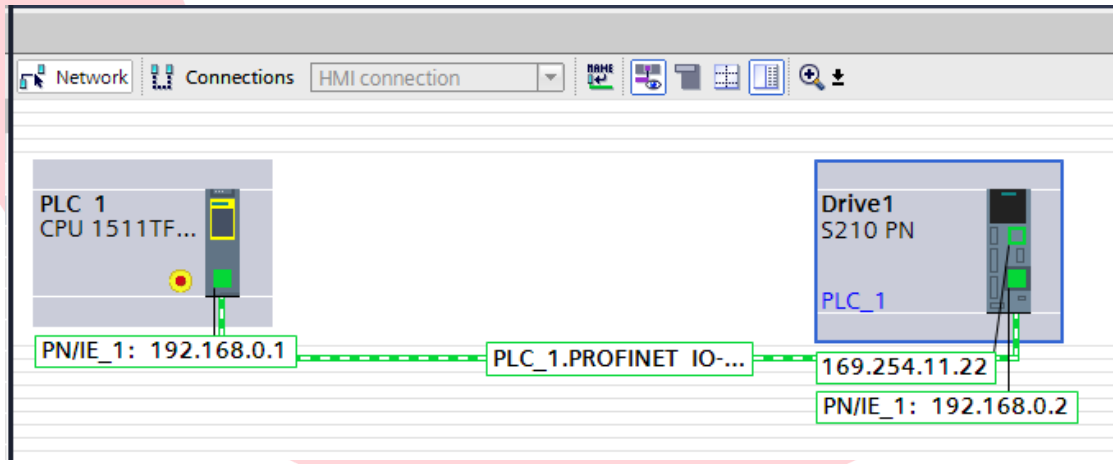
Note: Using Profinet Communications, the PLC assigns the IP address to each device by their Profinet Name, so you don't assign an IP address directly in the Drive, just the Profinet name.

Next, configure the Profinet Connection between Drive1 and PLC 1.

Open the Network View Tab. Left Click on Not Assigned on the Drive and select IO controller. Left Click PLC_1.PROFINET interface_1 to connect the two devices.



Now we see a Profinet Connection (Green Dashed Line) between the PLC and Drive

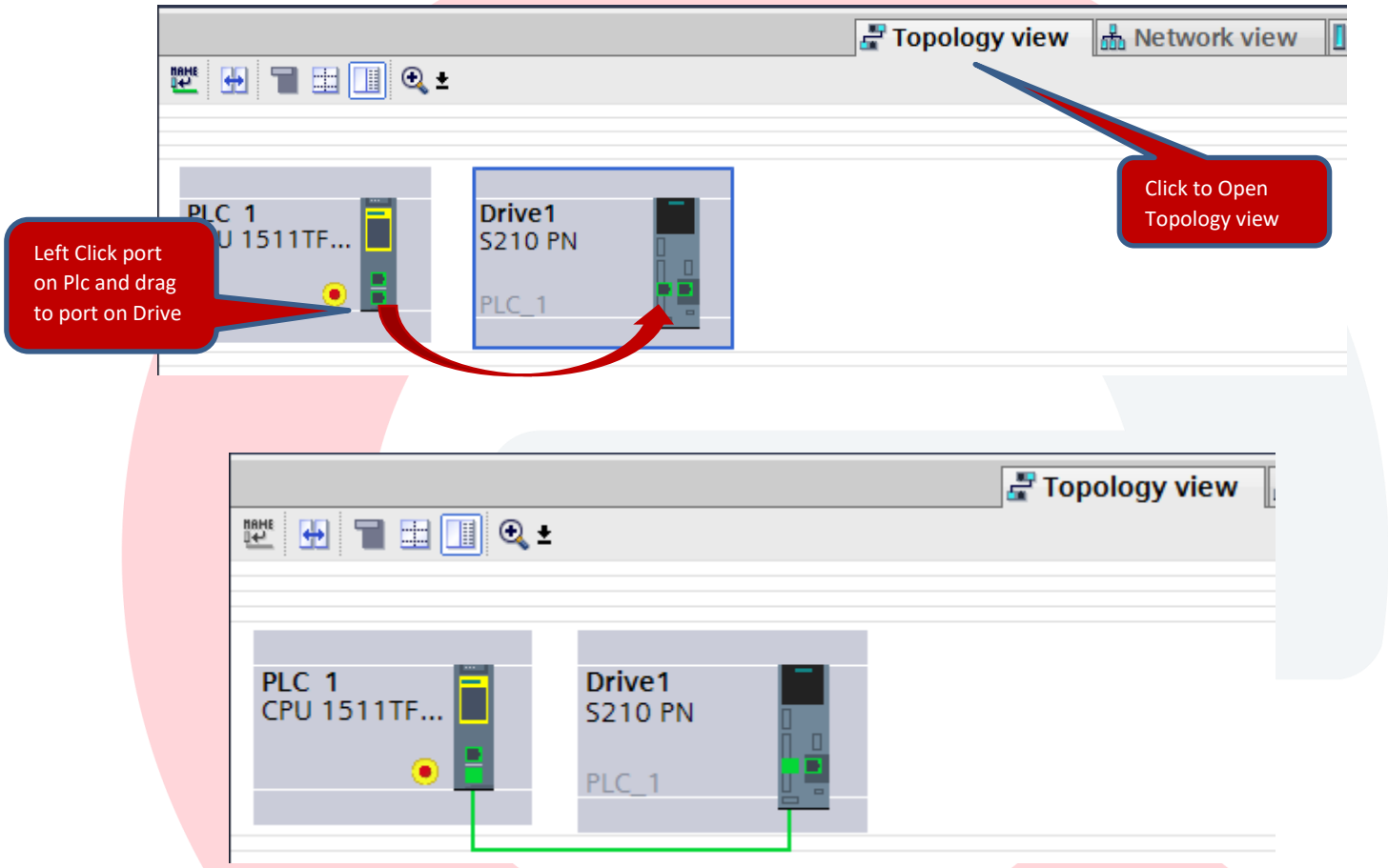


With Technology Objects and Motion, we also need to configure Topology View to be used the Profinet IRT (Isochronous Real-Time) communications

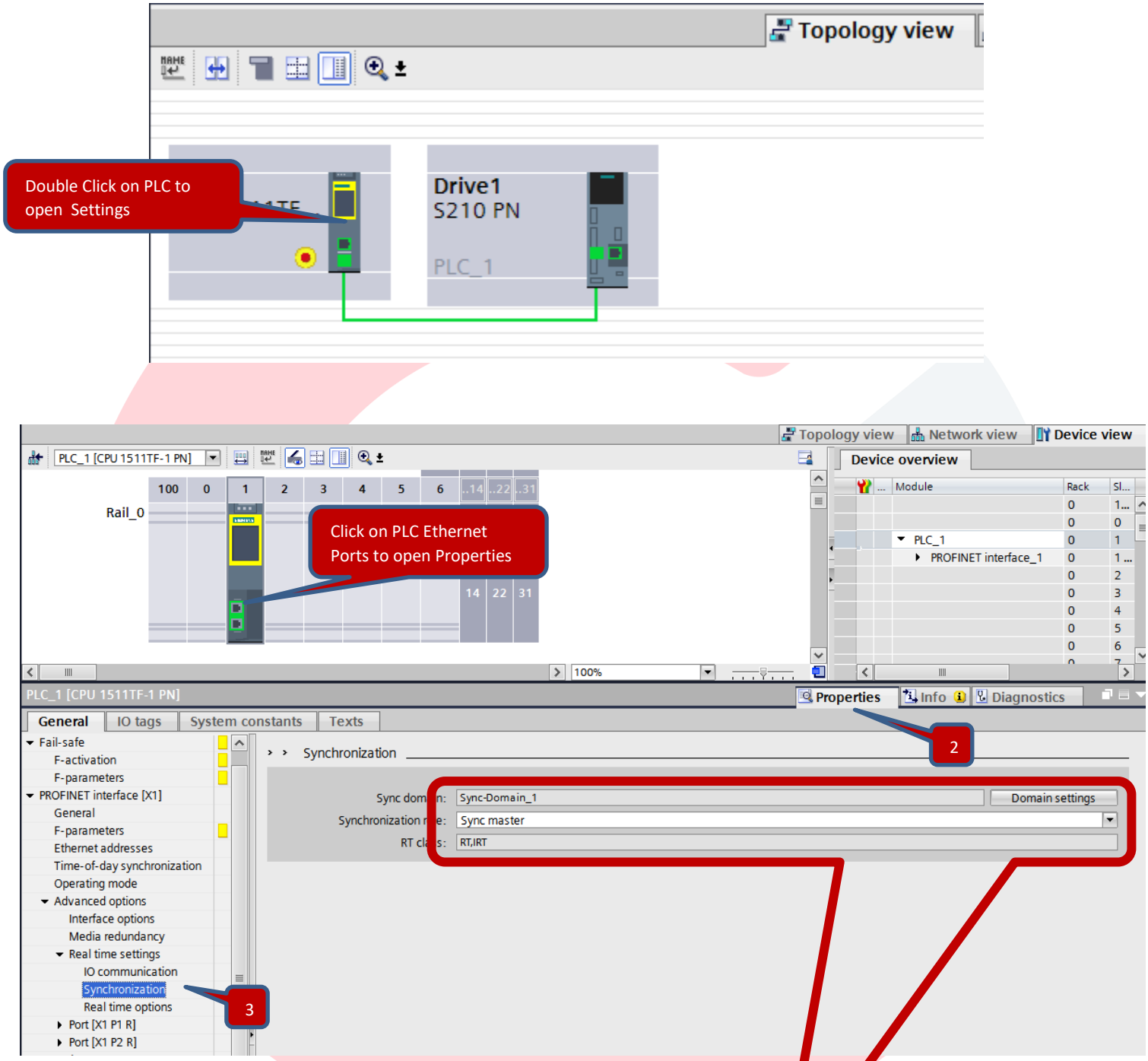
For Topology this needs to match the exact physical connections between the PLC and the Drive.

For my setup Port 2 on the PLC is connected directly to Port 1 on the drive.

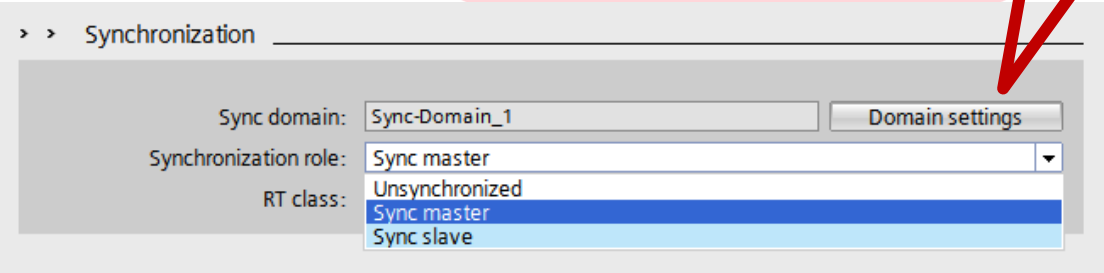
Left Click on Port 2 of the PLC and Drag to Port 1 on the Drive



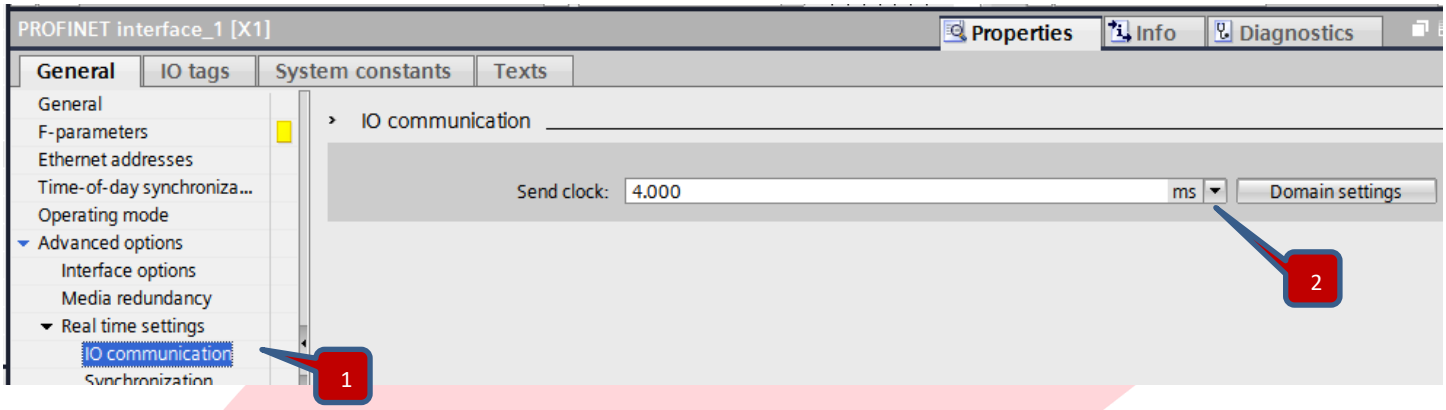
Next configure IRT communications for motion control over Profinet.



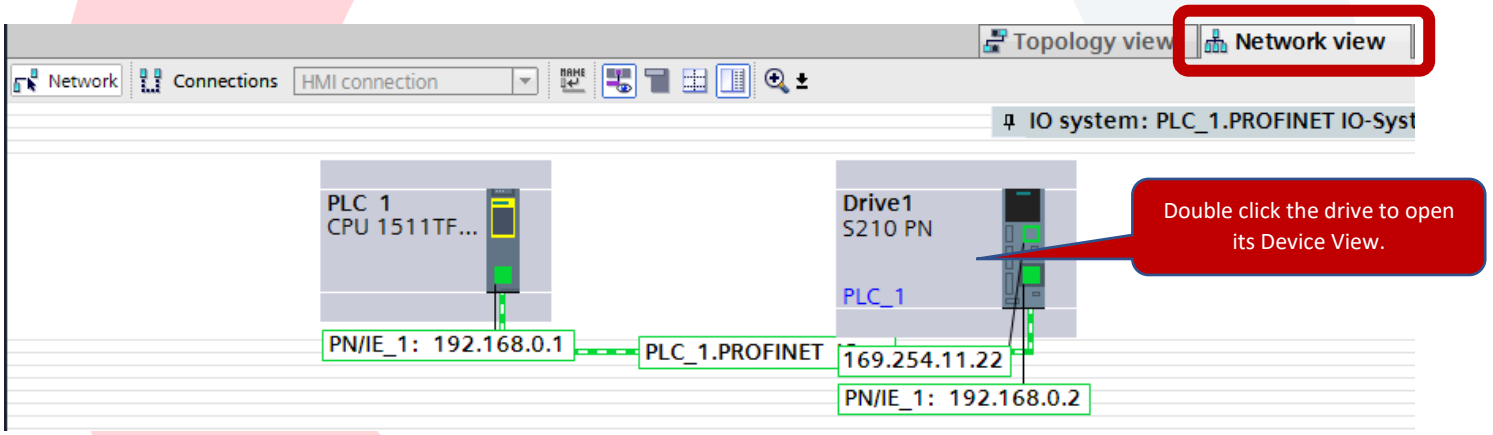
Set the PLC as Sync Master for the IRT Communications

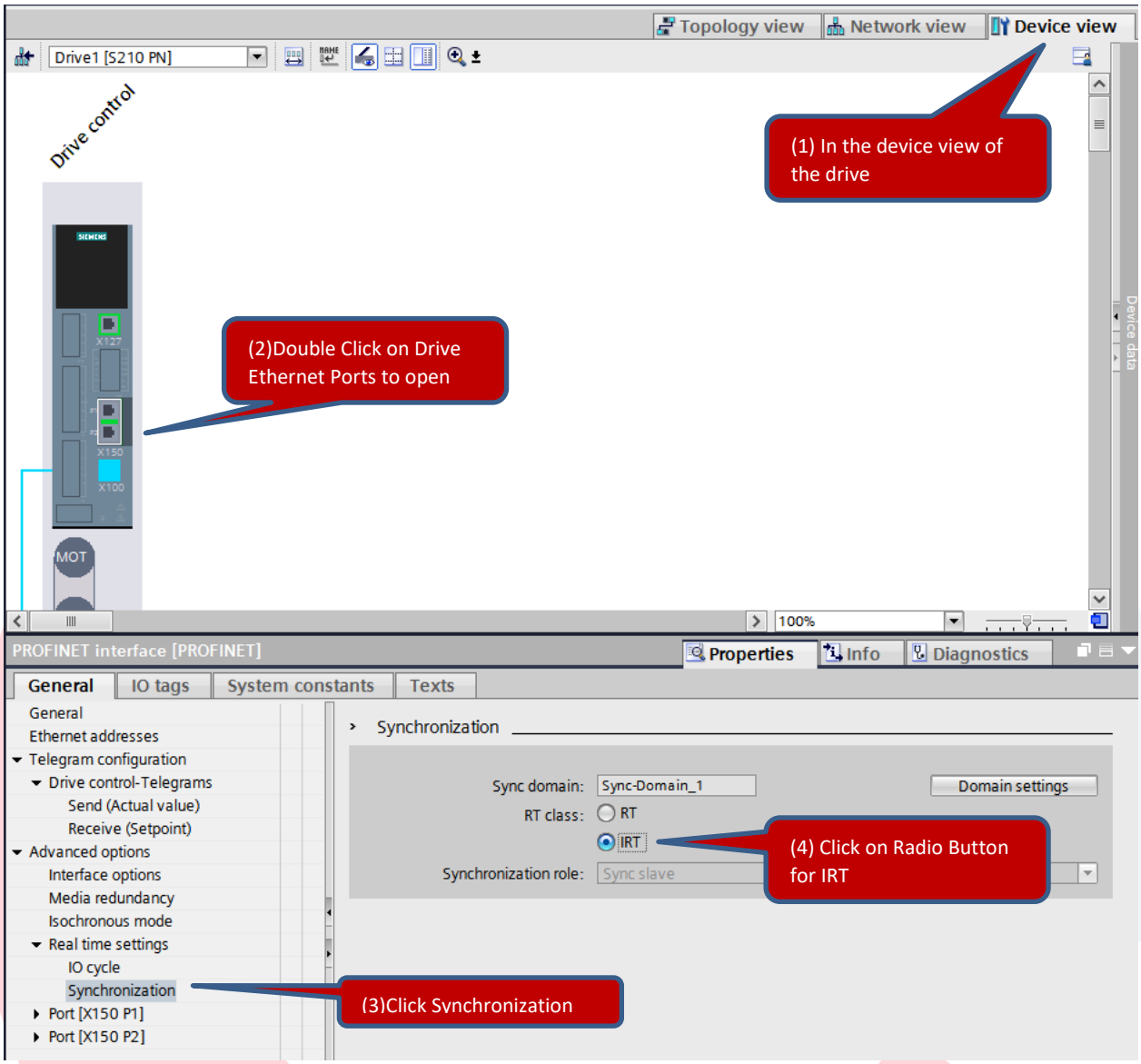


Double check IO Communications Send Clock and set to 4ms if not already set.



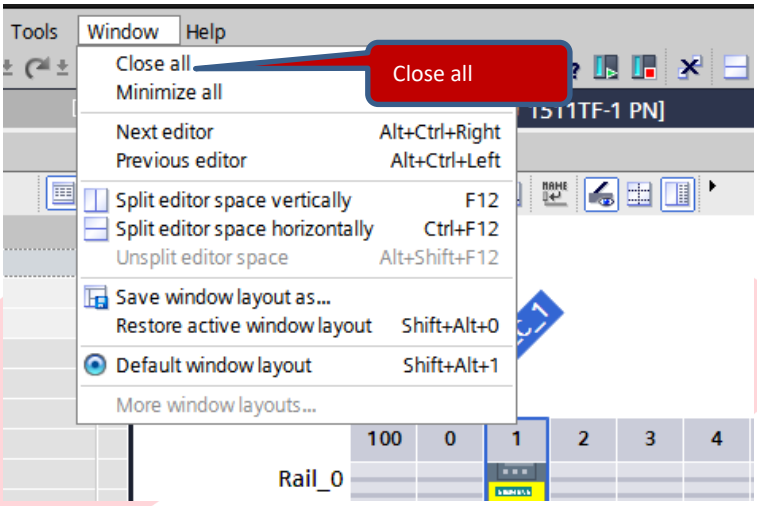
Now we will setup up the communications in the drive. Click the Network View tab, and double click on the drive to open its device view.





Save the Project.

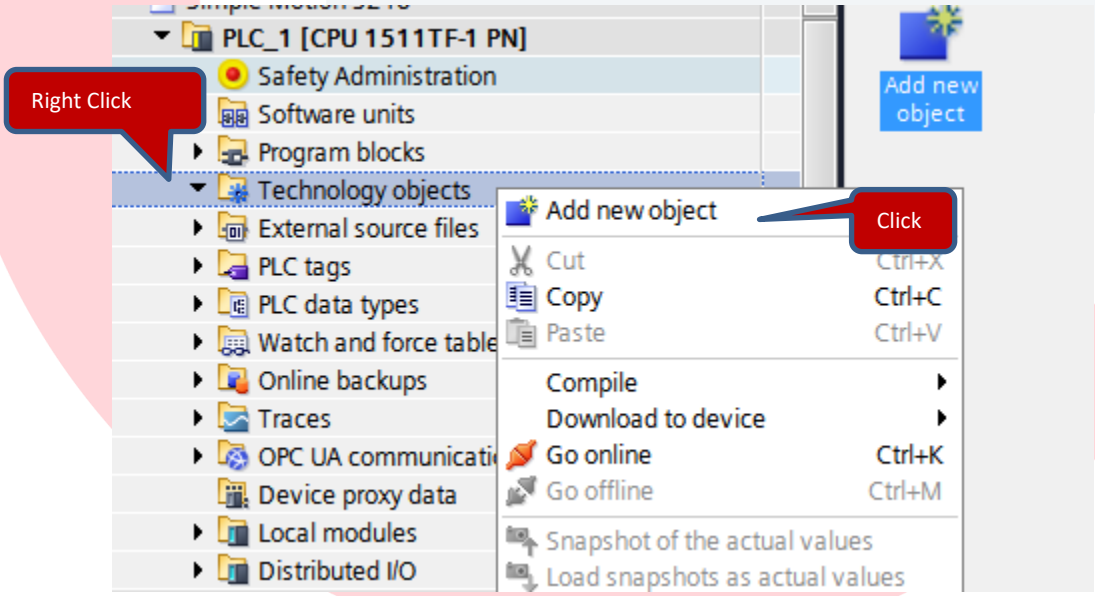
Select the Window menu and select Close all to close out all open windows.

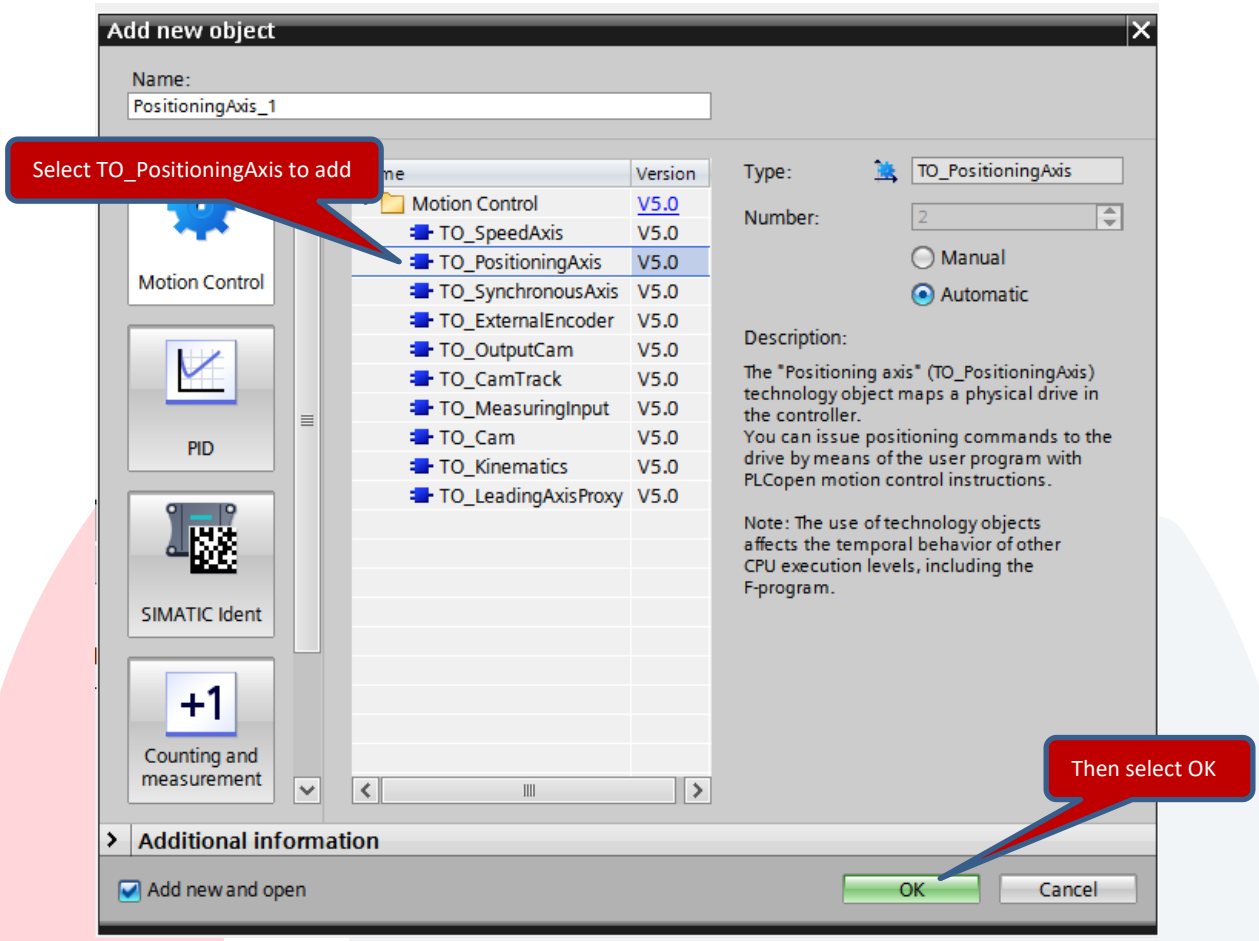


Now we begin Programming the Axis

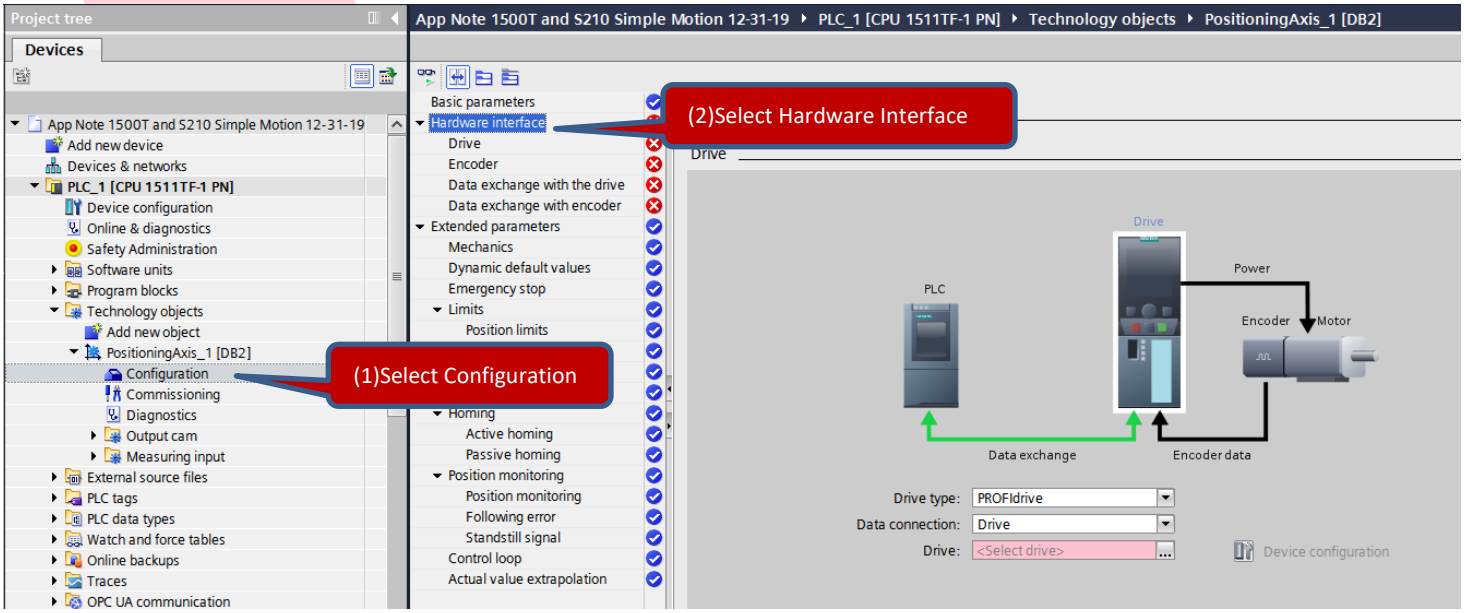
Right Click Technology Objects and Select Add new object

Then Select TO_PositioningAxis and keep the default name.

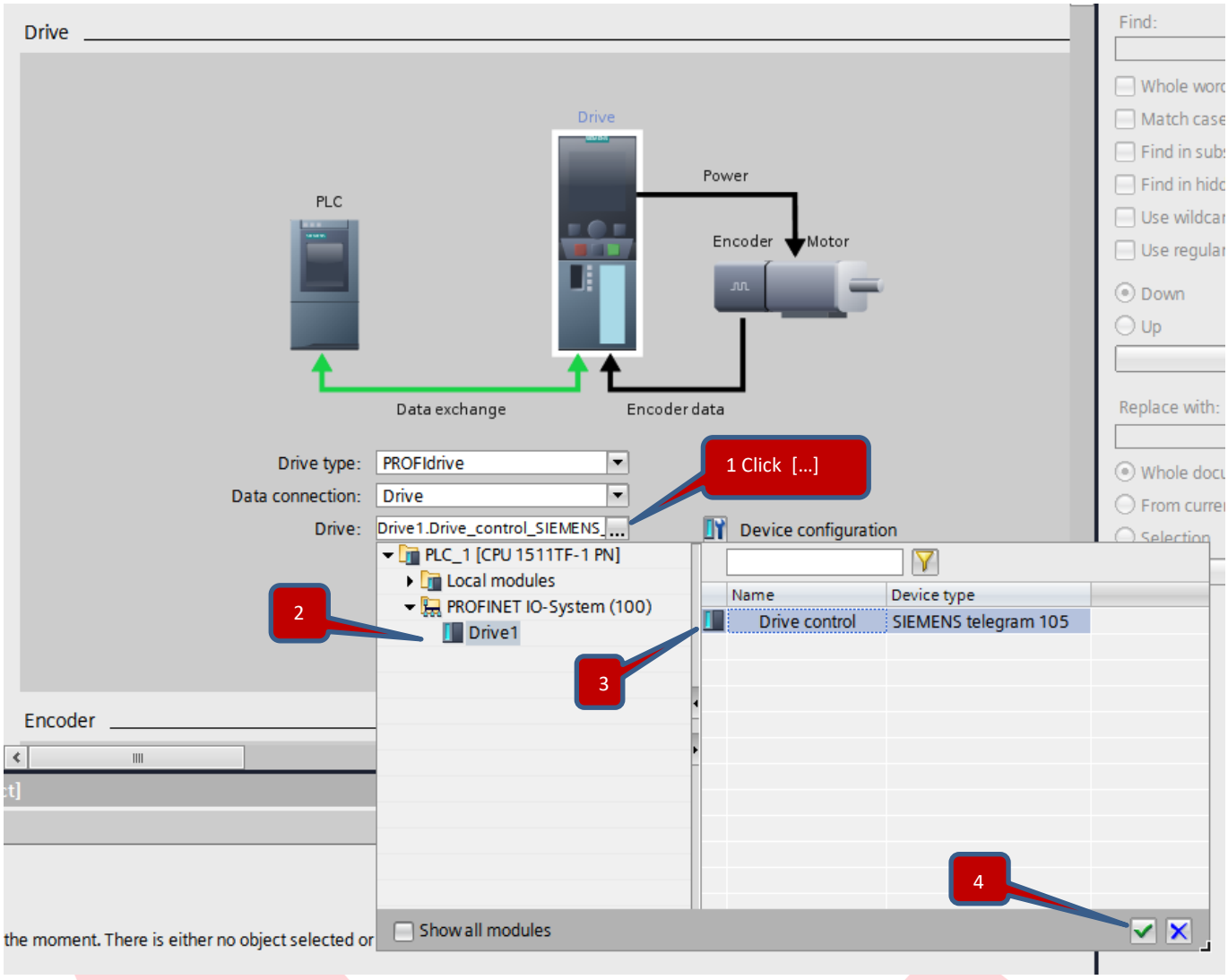




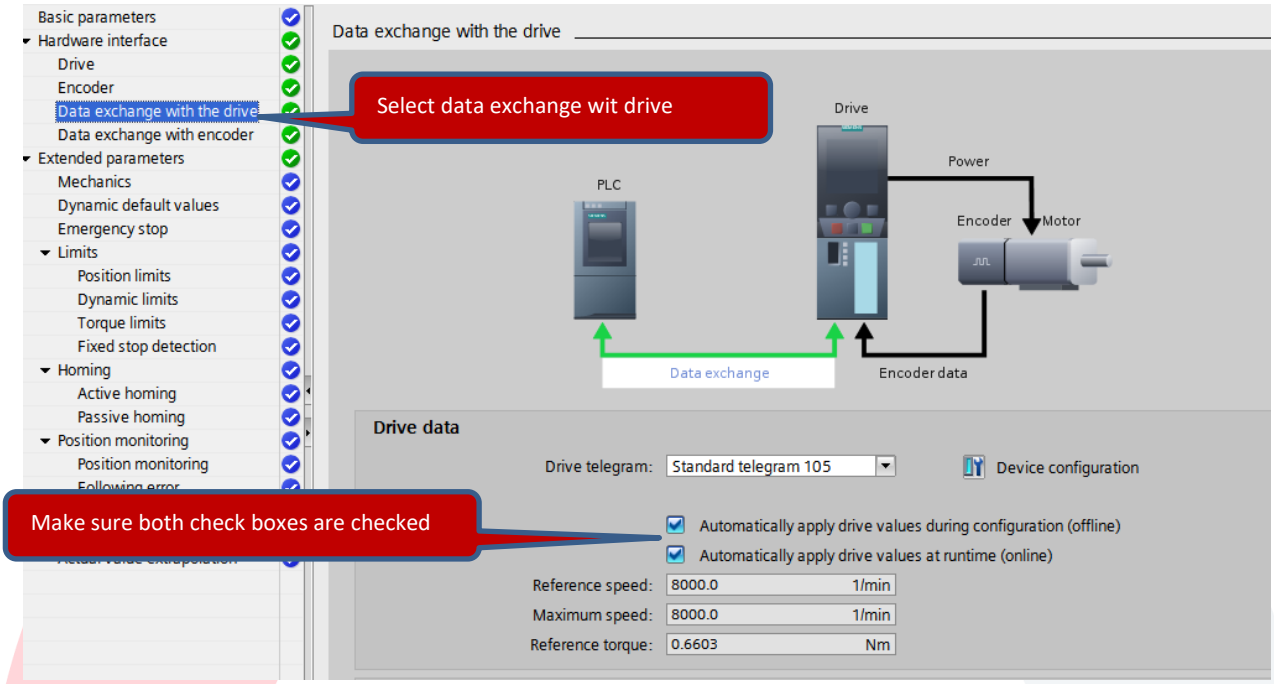
Under the new PositioningAxis_1 select Configuration



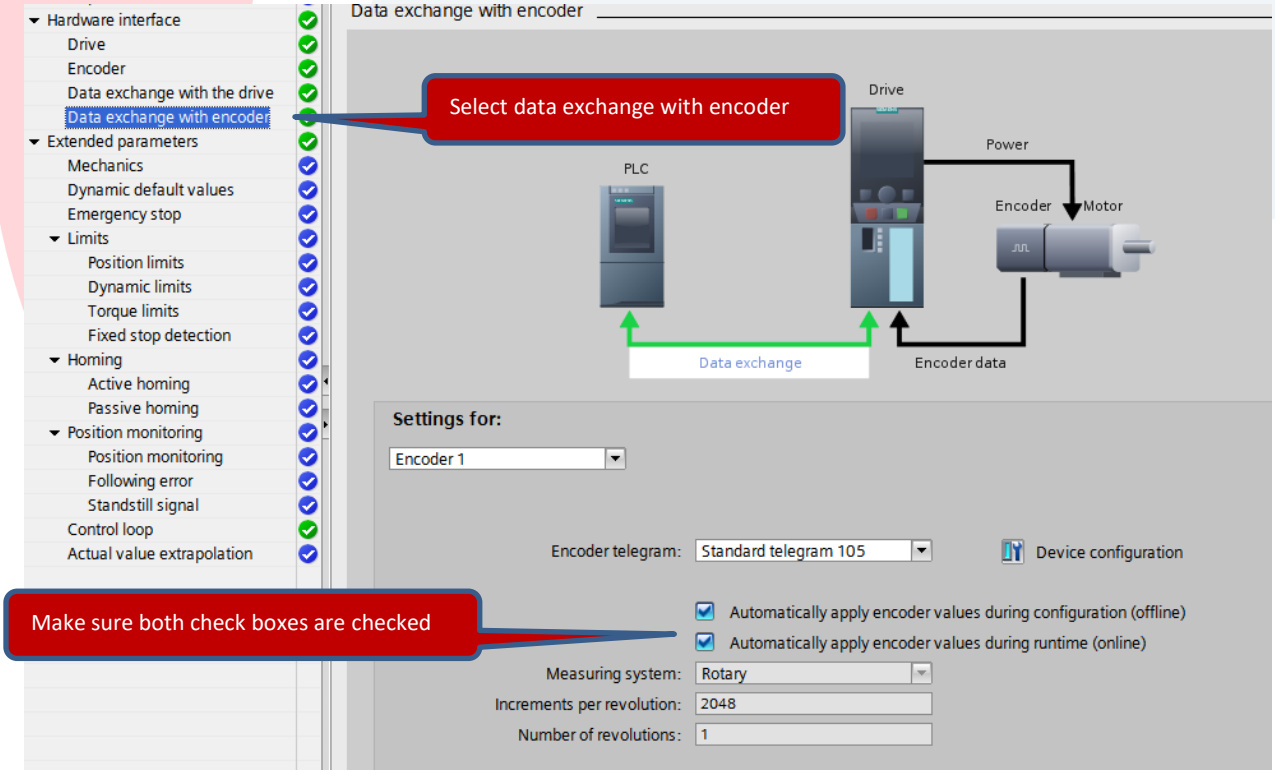
Select the Drive to attach to this Technology Object. Select the ellipsis (…) button and dive down under PROFINET IO-System, then Drive1, and select Drive Control for Drive1.



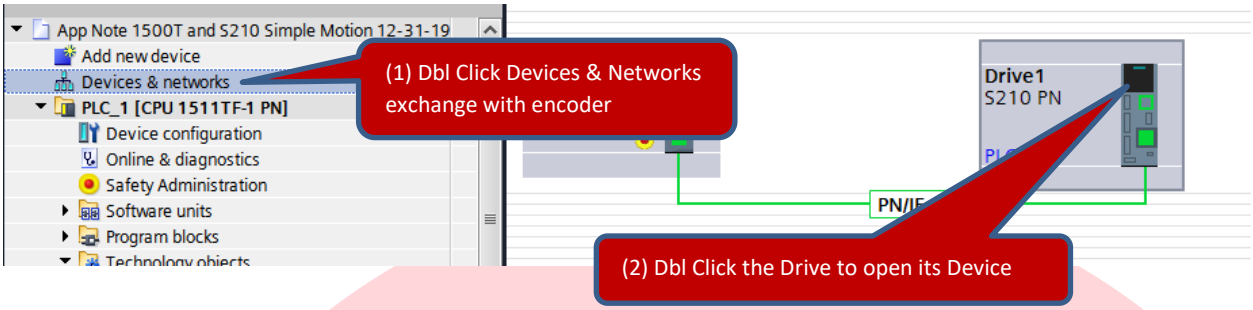
Check the Data exchange with the drive settings



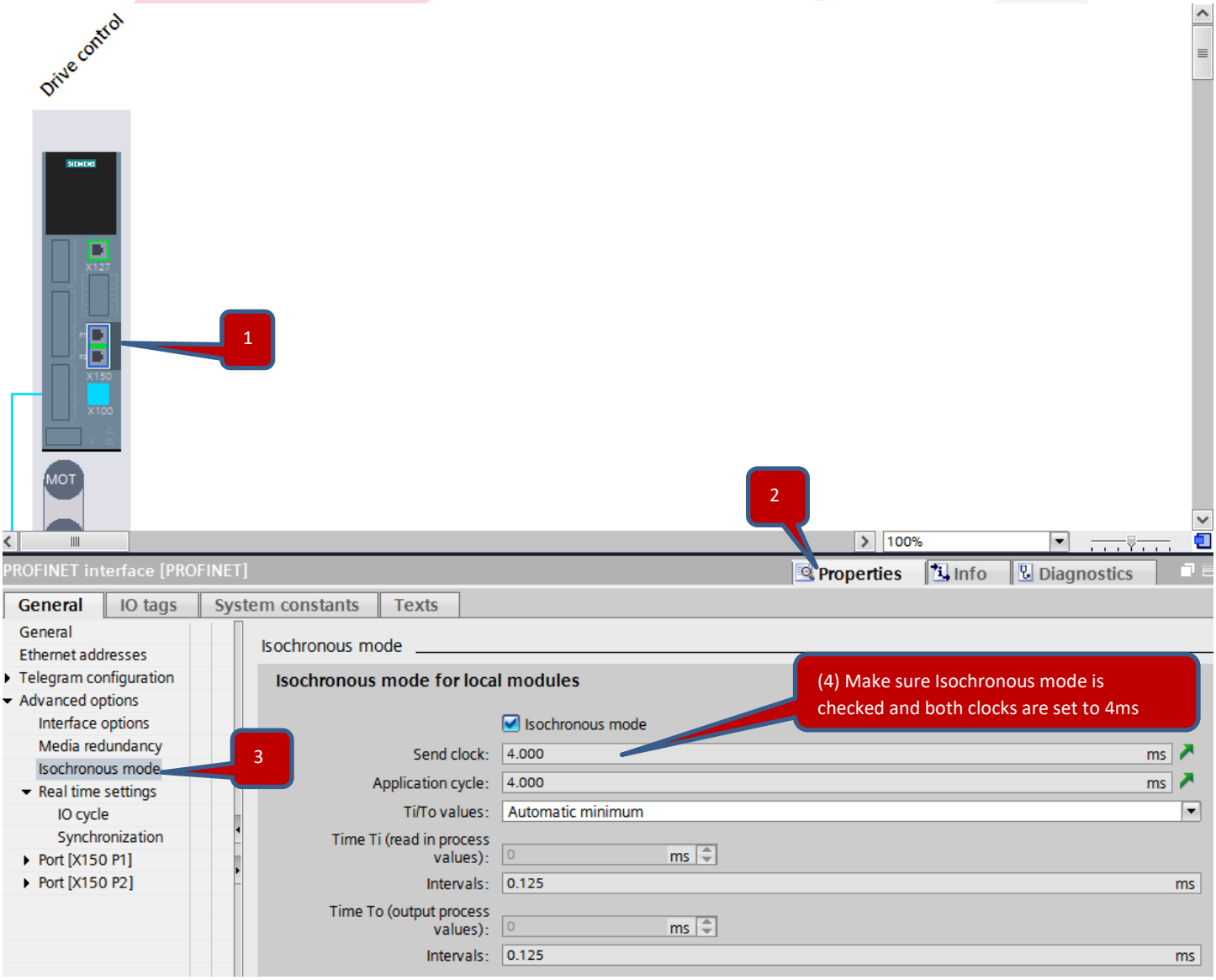
Then the Data exchange with encoder.



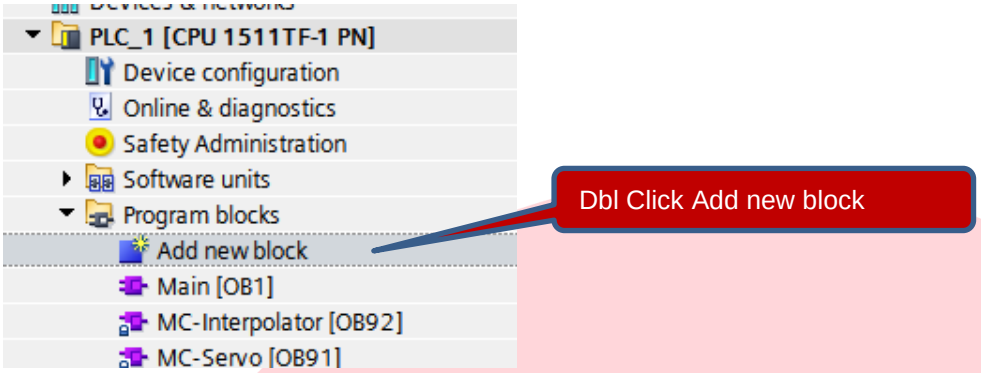
Now go back to the Devices & Networks Screen



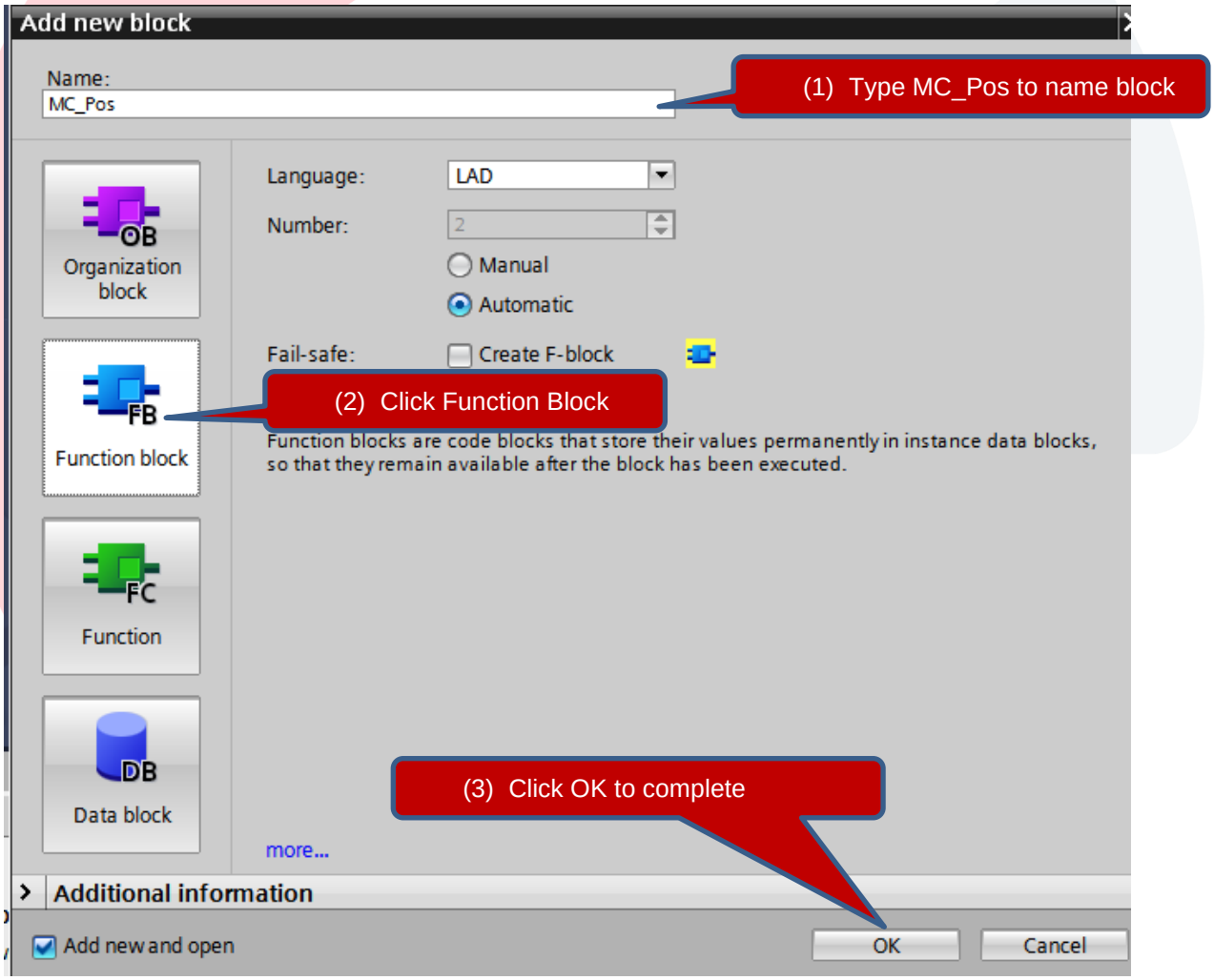
On the Device View click the Profinet Ports of the Drive, then click the Properties Tab at the bottom of the page, and check the Isochronous mode settings as shown.



Create the S7 Program



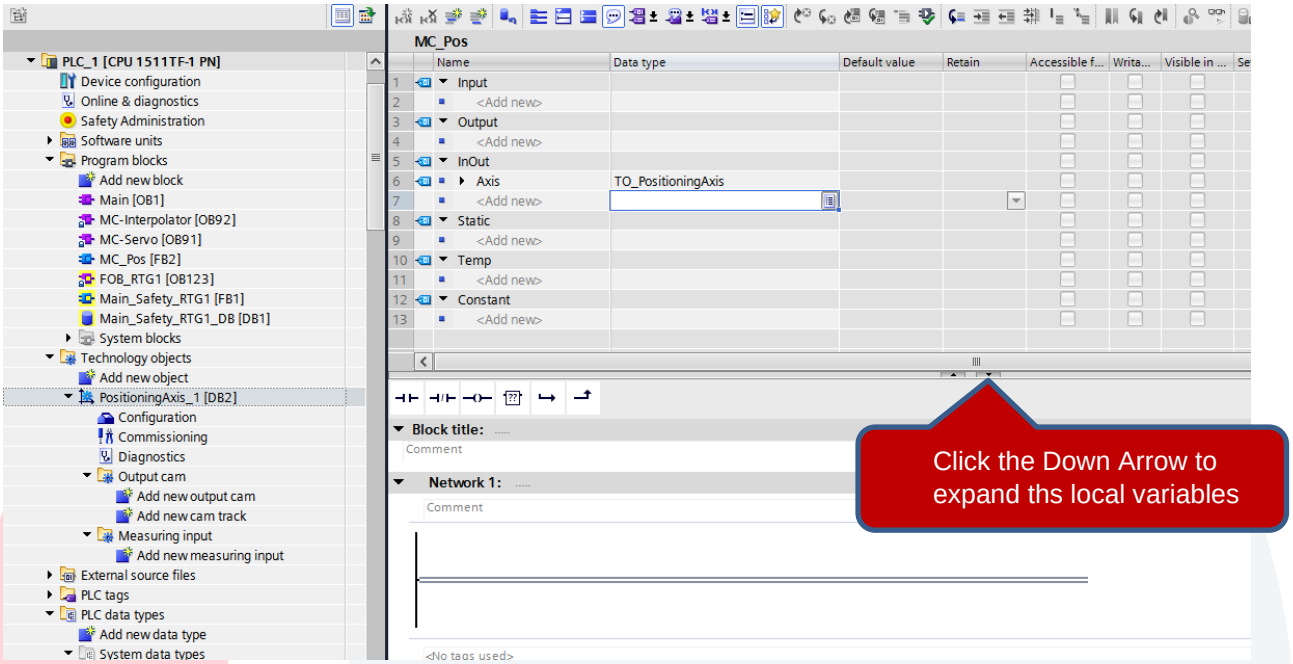
Create a new FB with the name MC_Pos.



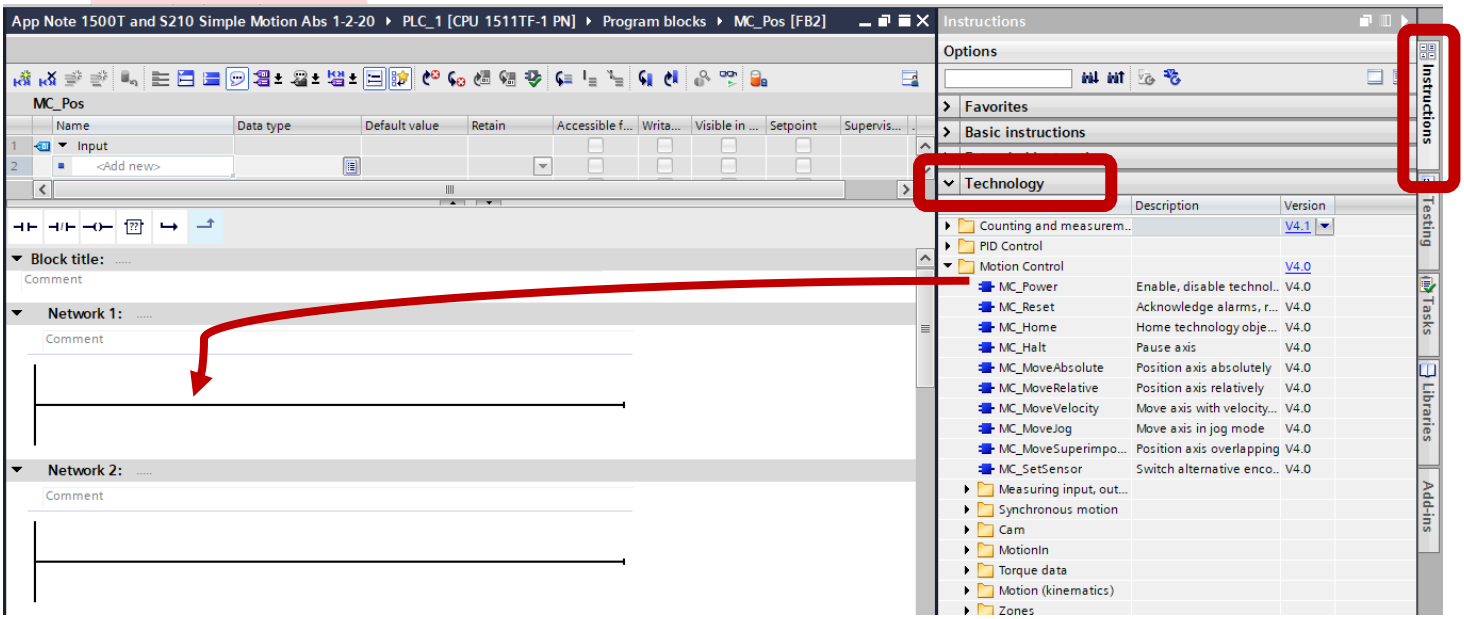
Add Local InOut Variable named Axis to MC_Pos as data type TO_PositionAxis.

You will need to Type TO_PositioningAxis as it can't be found by a search.

This InOut Axis Variable will be used to link the physical axis to these functions.

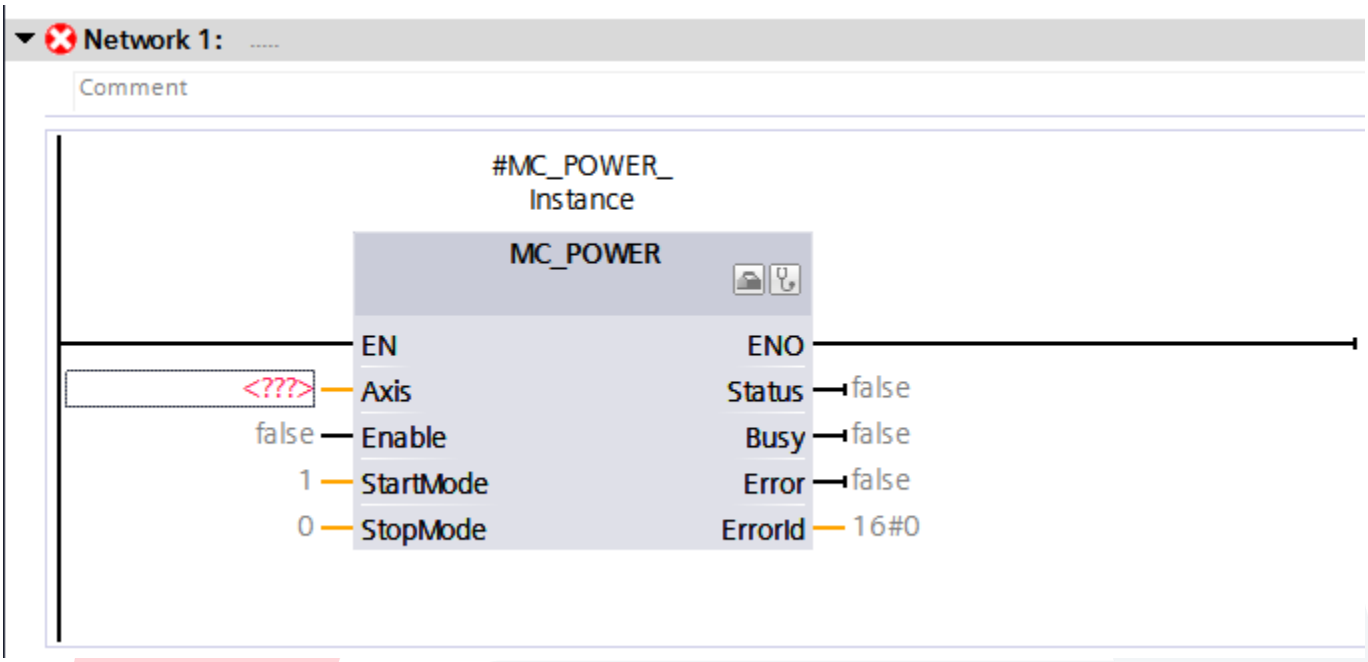


Here we will add logic for control of the Axis. We will be using functions from Motion Control under the Technology Library. Make sure to click on the Instructions Tab to open the Libraries the click on Technology to open the Technology Library. Left Click the Instruction and drag and drop onto the Ladder Network.

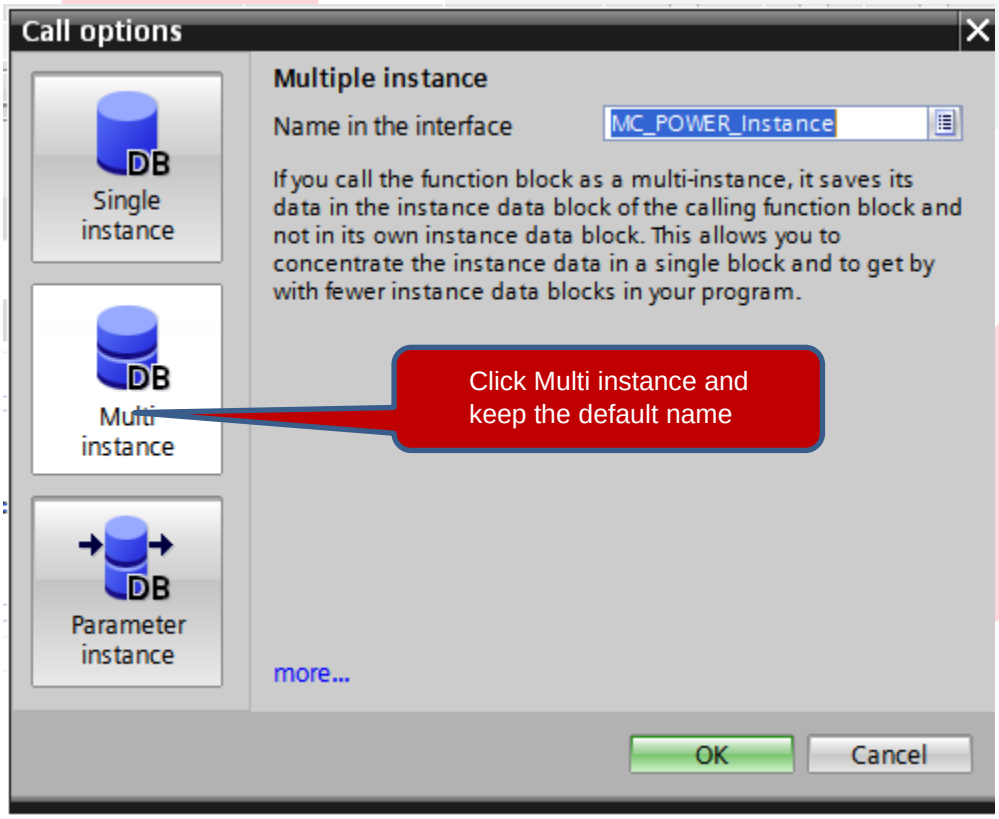


First, select MC_Power. MC_Power allows the drive to be enabled

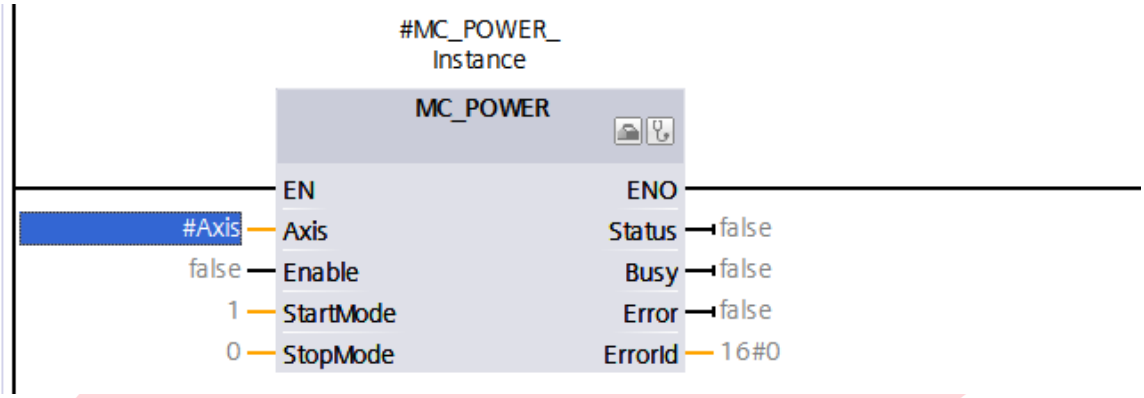
Left Click and hold on MC_Power in the Technology Instructions and drag and drop into the network.



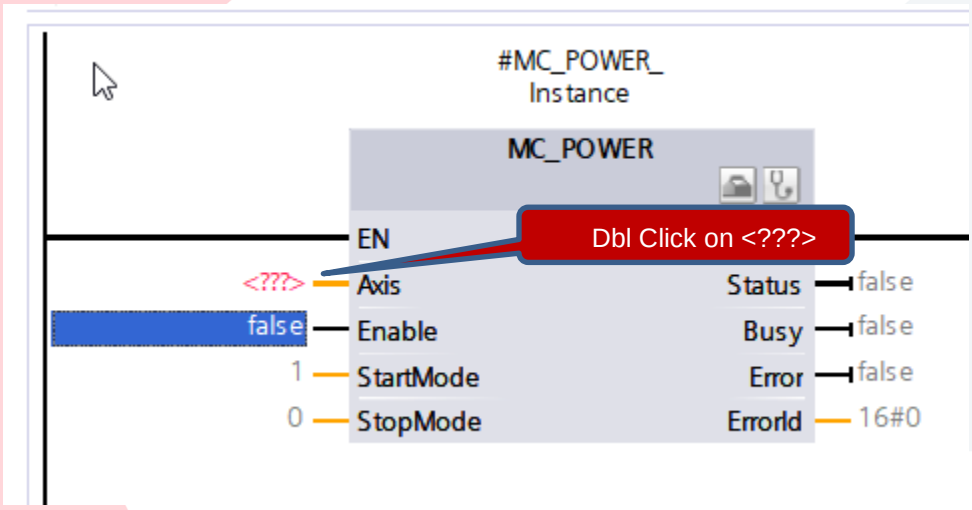
For all the MC block calls in this FB we will use Multi Instance for all these (MC) Motion Control Functions.

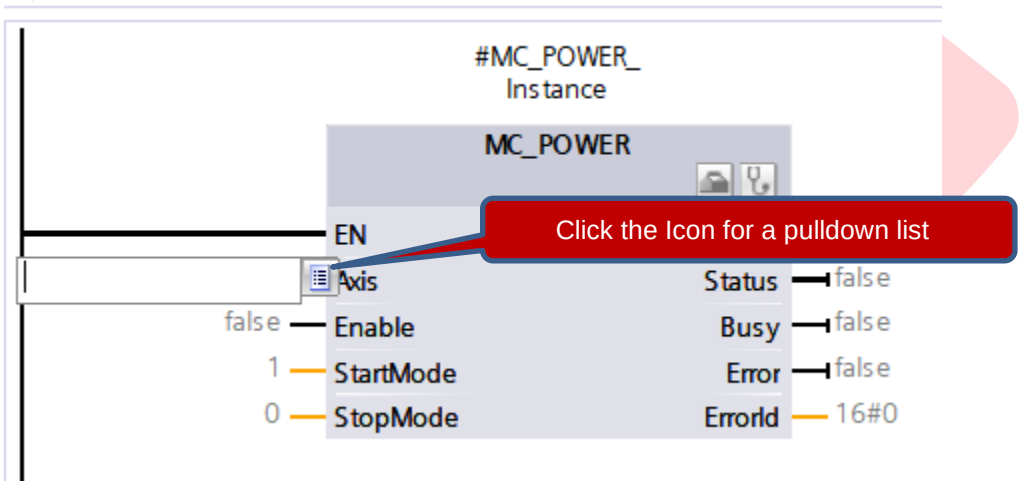


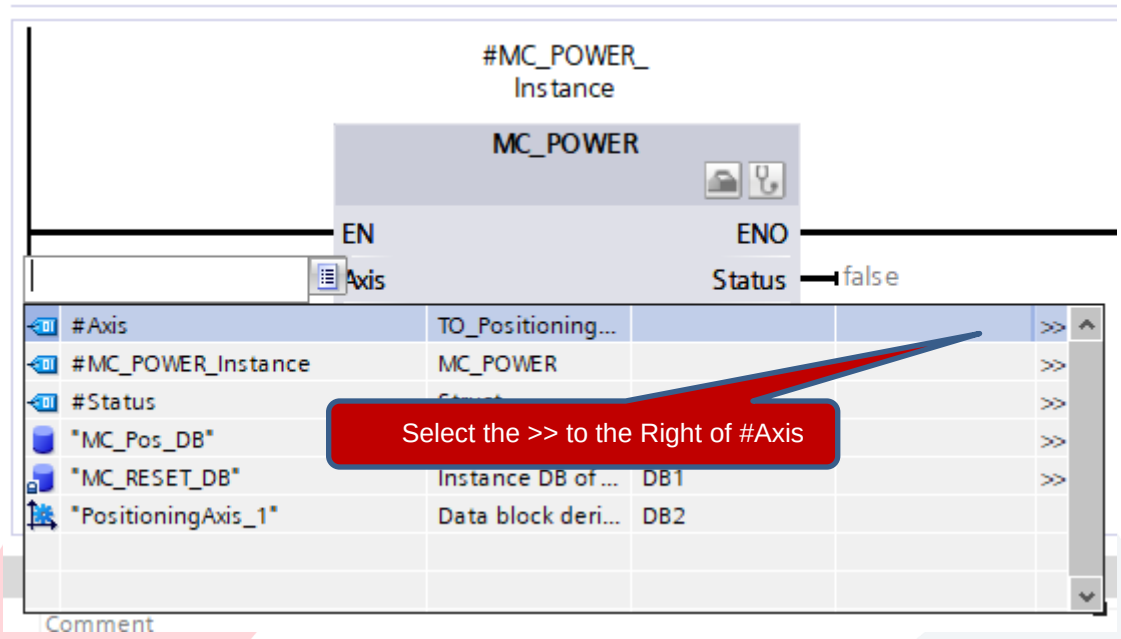
Next link our local InOut Variable #Axis to the Axis Pin on the MC_Power Block

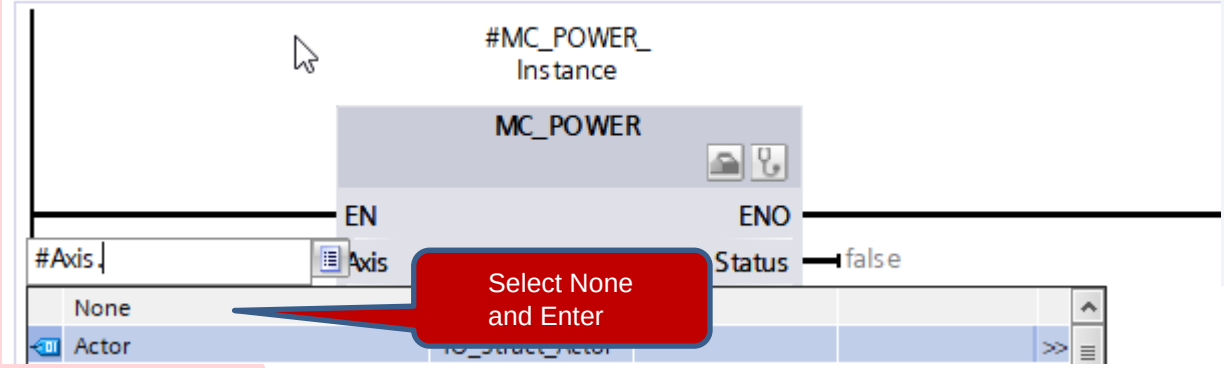


Selecting #Axis can be tricky. Follow these steps to simplify the exercise.






#MC_POWER_
Instance
MC_POWER
EN
ENO
Axis
Status
false
#Axis
TO_Positioning...
#MC_POWER_Instance
MC_POWER
#Status
"MC_Pos_DB"
"MC_RESET_DB"
Instance DB of ...
DB1
"PositioningAxis_1"
Data block deri...
DB2
Select the >> to the Right of #Axis
Comment

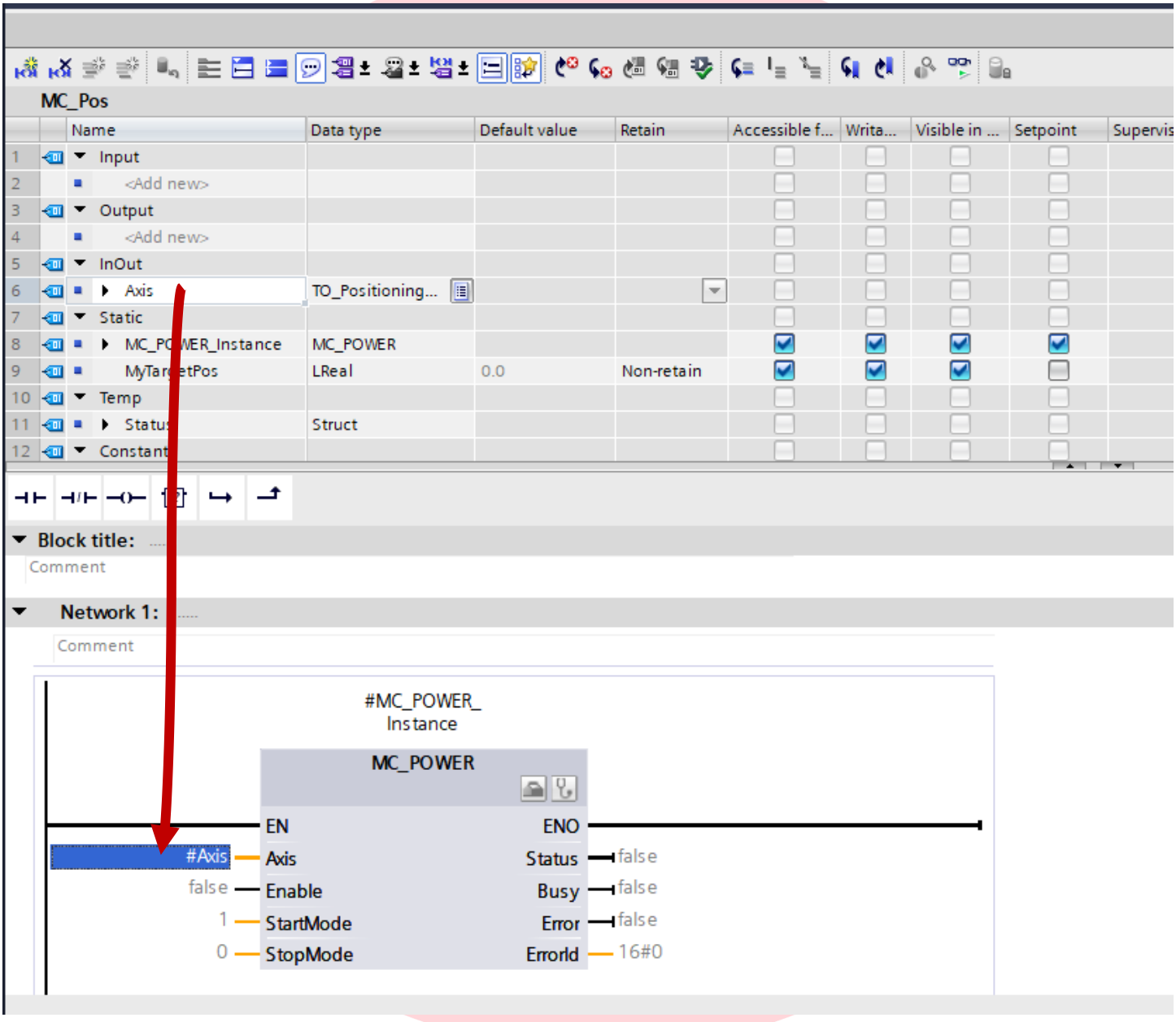

#MC_POWER_
Instance
MC_POWER
EN
ENO
#Axis
Axis
Status
false
None
Actor
Select None
and Enter

As another alternative, you can drag the variable directly from the Local FB variables table.

Click the down arrow below Block interface to open the table

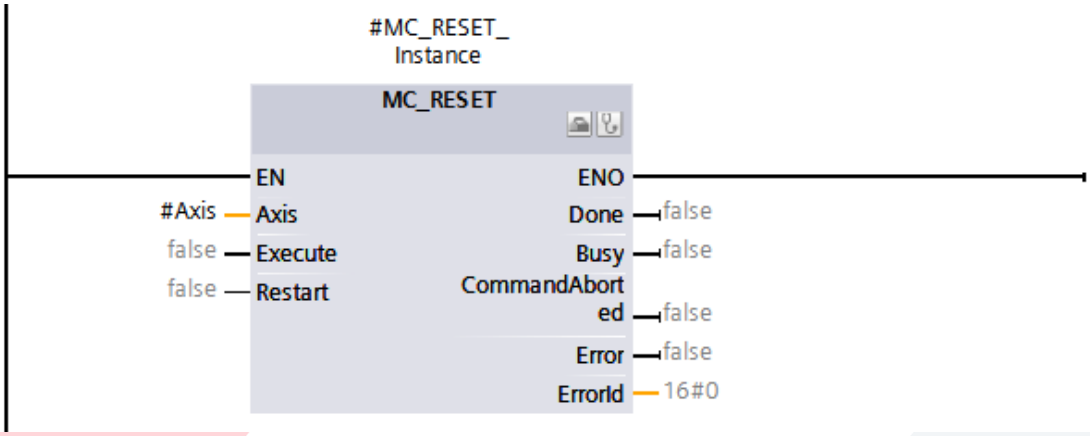
You can then single click the Axis variable from the Local Variables to select the variable.

Then Left Click it and drag and drop onto the MC_Power Axis input pin.

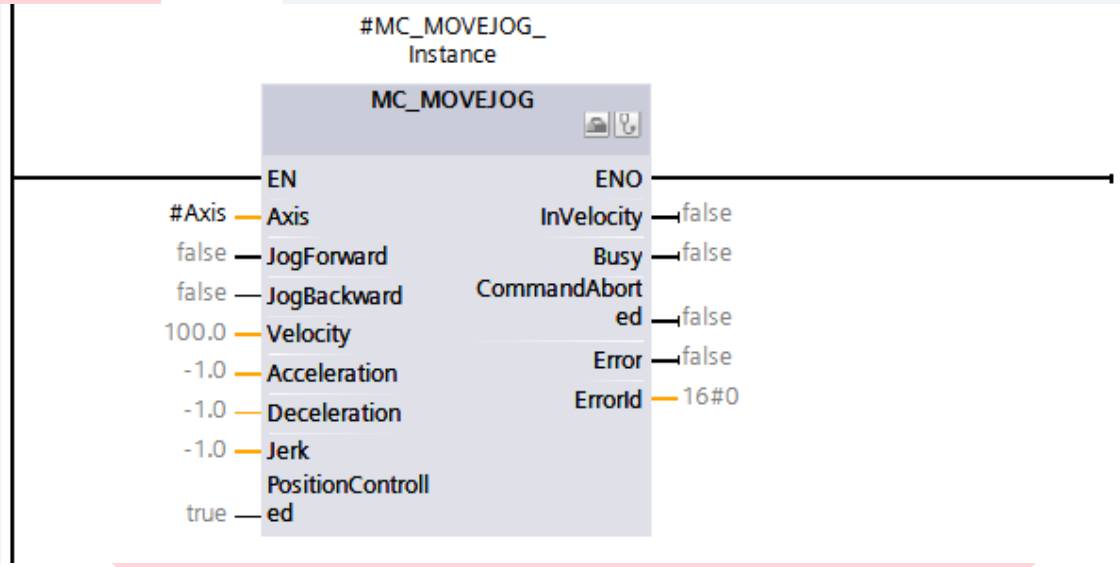


Add MC_Reset block to network 2. Again, select Multi Instance and connect #Axis

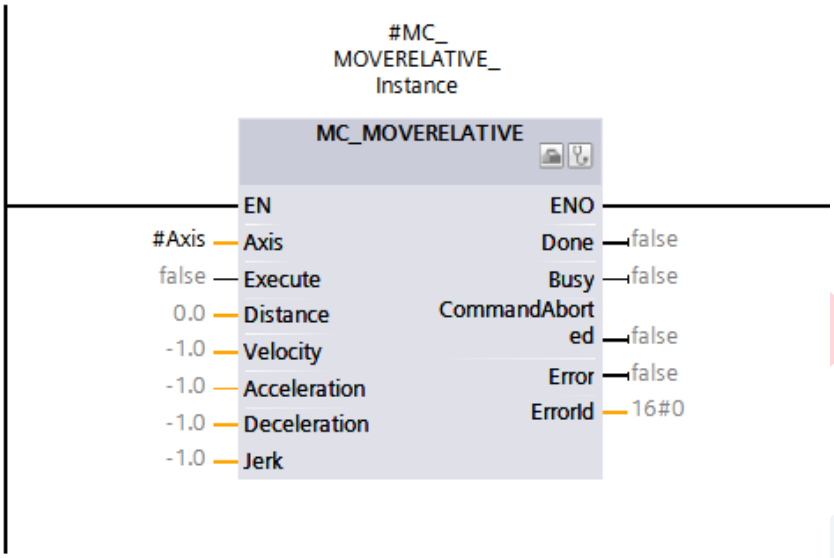
Note: It may help to enter all of the MC blocks below the go back and add the #Axis Variable. You can copy form the MC_Power Block by Rt Clicking and select Copy, then past on each block on the Axis pin.



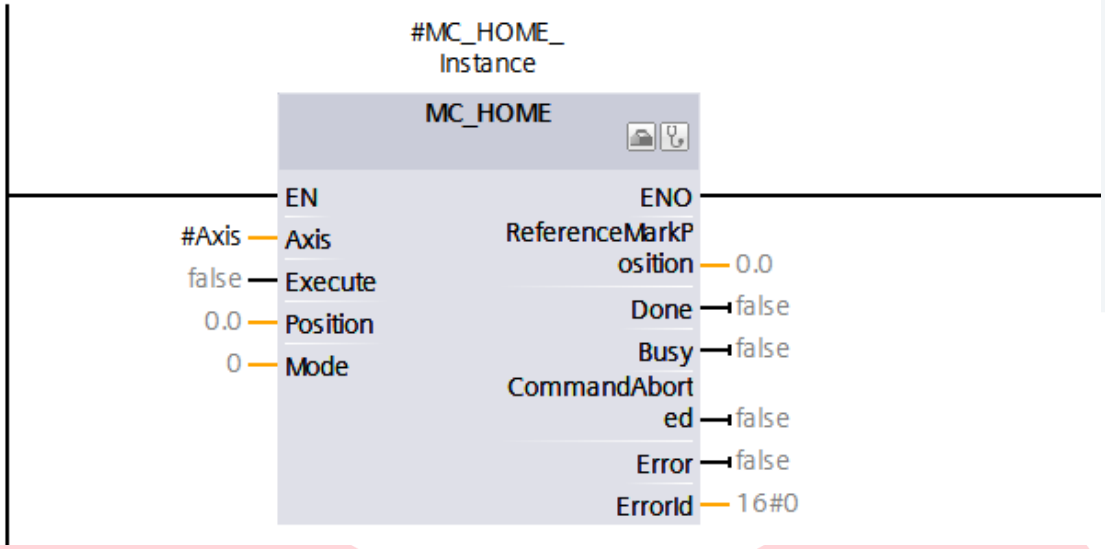
Add MC_MOVEJOG to network 3. Again, select Multi Instance and connect #Axis



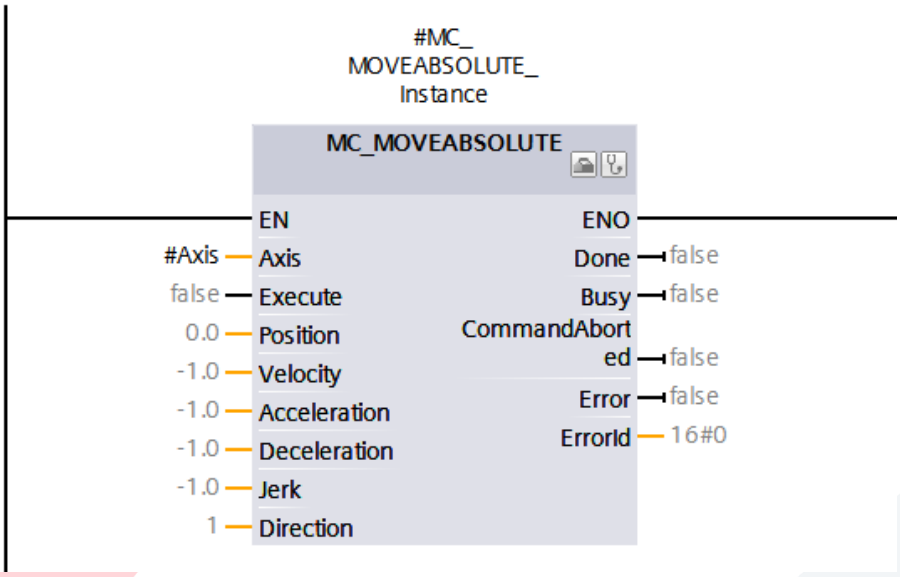
Add MC_MOVERELATIVE to network 4. Again, select Multi Instance and connect #Axis



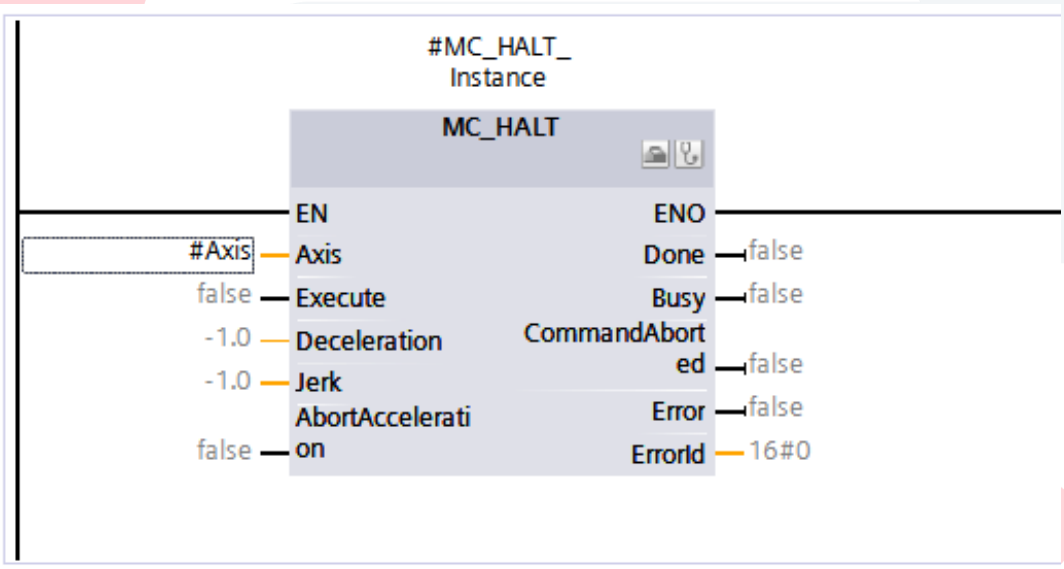
Add MC_HOME to network 5. Again, select Multi Instance and connect #Axis



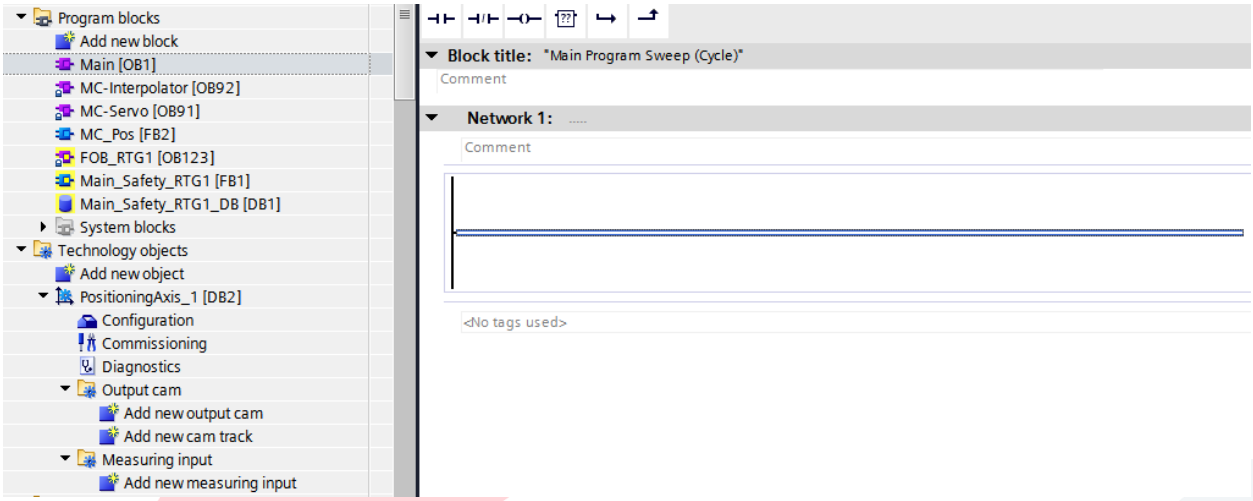
Add MC_MOVEABSOLUTE to network 6. Again, select Multi Instance and connect #Axis



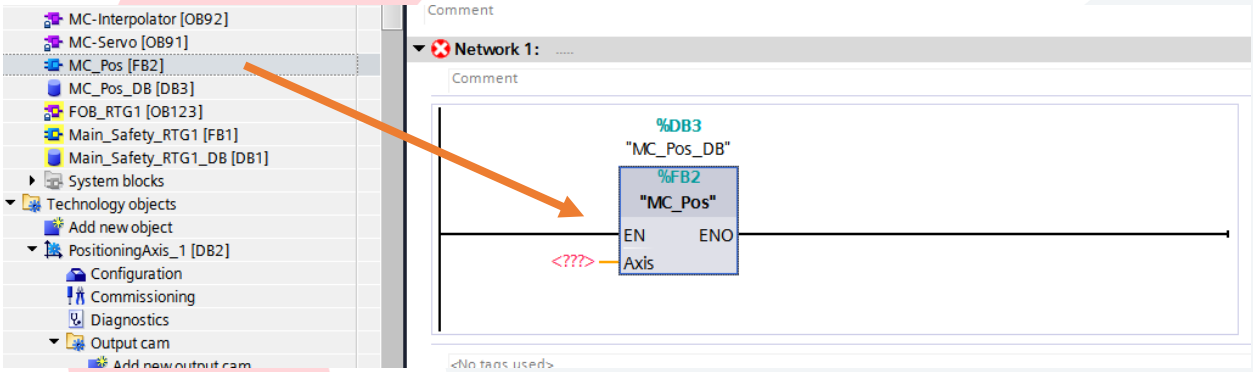
Finally add MC_Halt to network 7. Again, select Multi Instance and connect #Axis



Next open the Main [OB1]

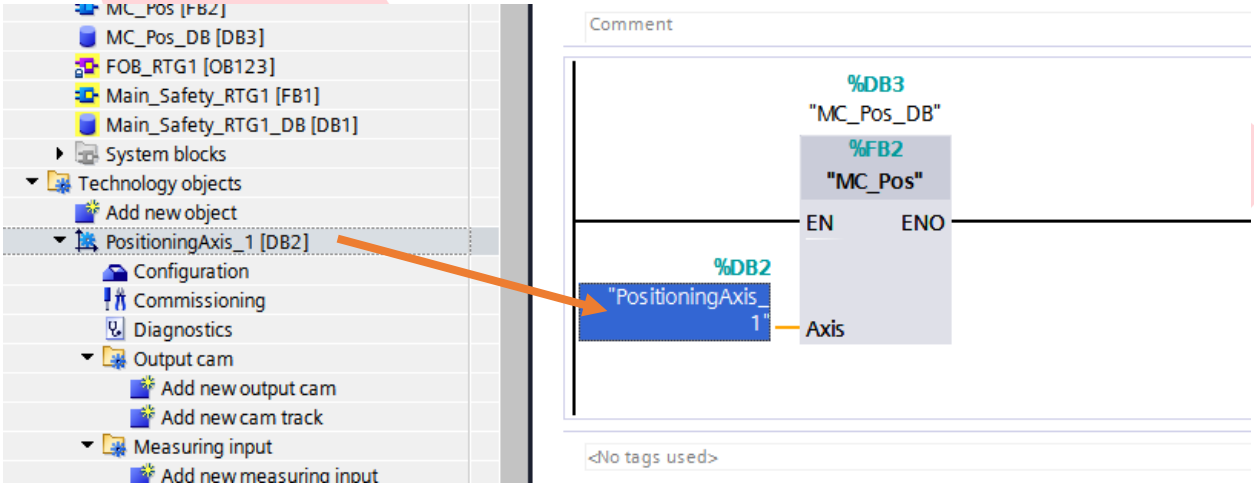


Left Click and drag and drop MC_Pos onto Network 1



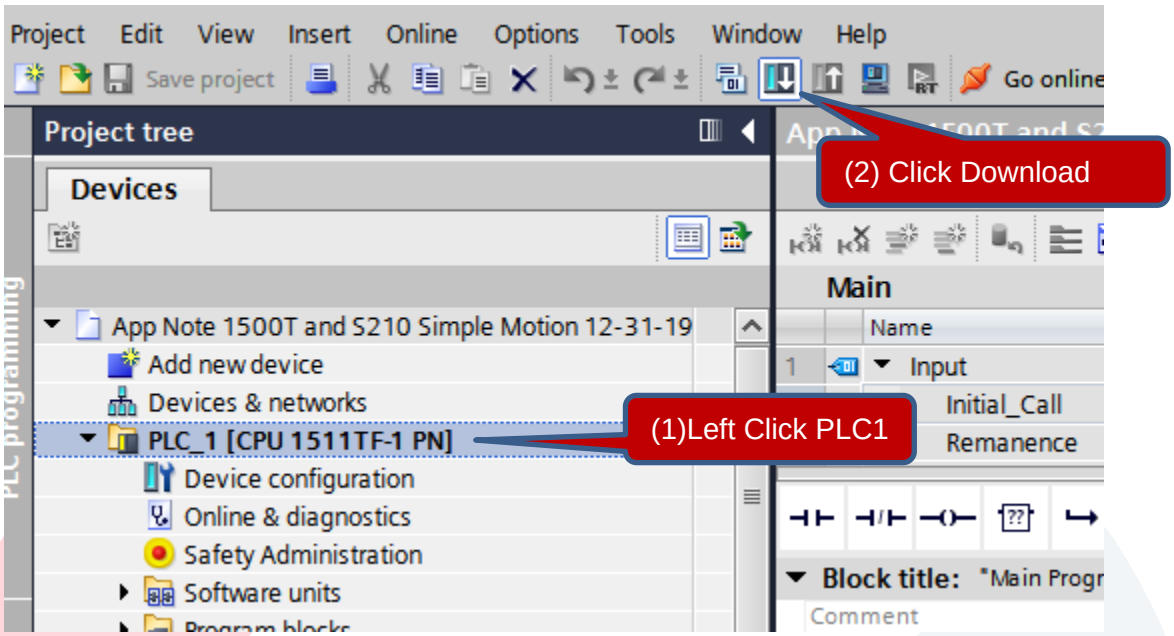
Left Click PositioningAxis_1 and drag and drop to the Axis pin on MC_Pos FB Call.

This links this call of MC_Pos to PositioningAxis_1.

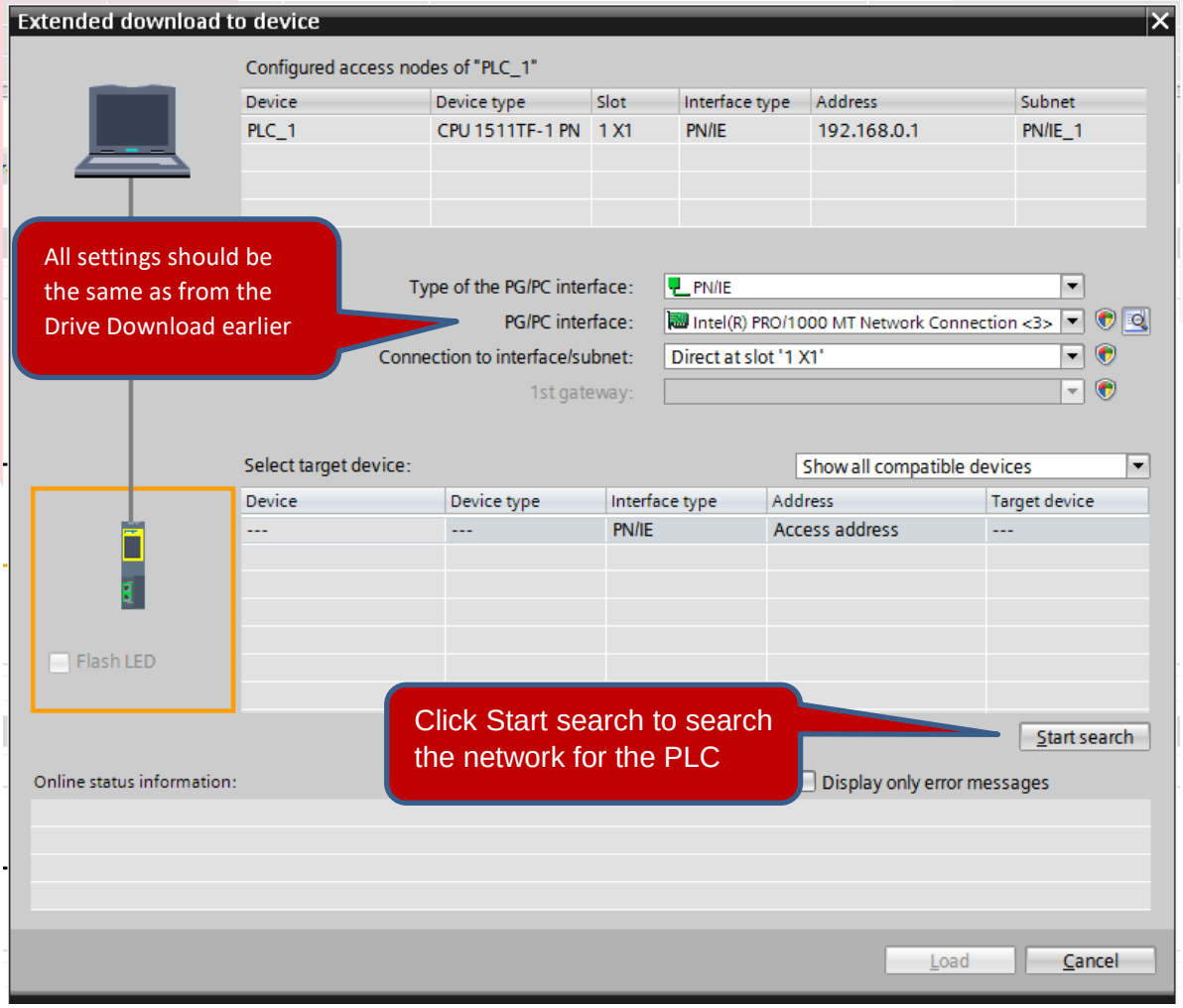


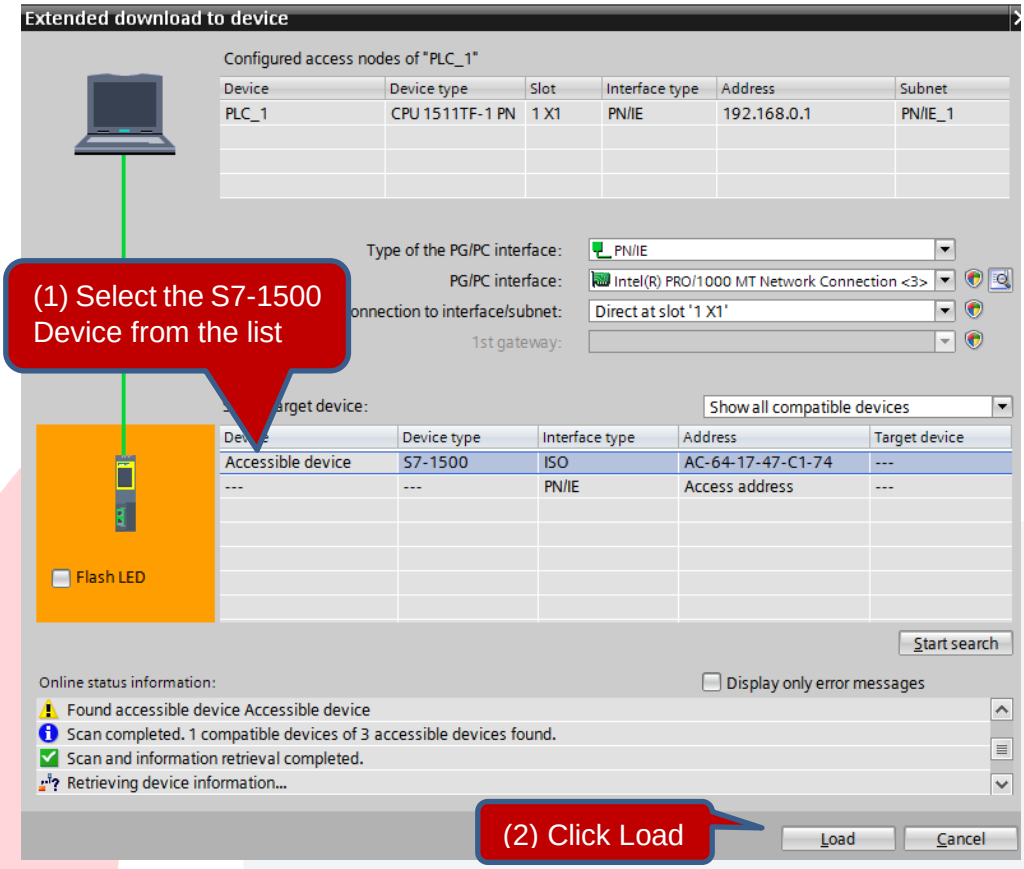
Save the Project

Now we will Download the program to the PLC.



Here again we will see the Extended download to device window.

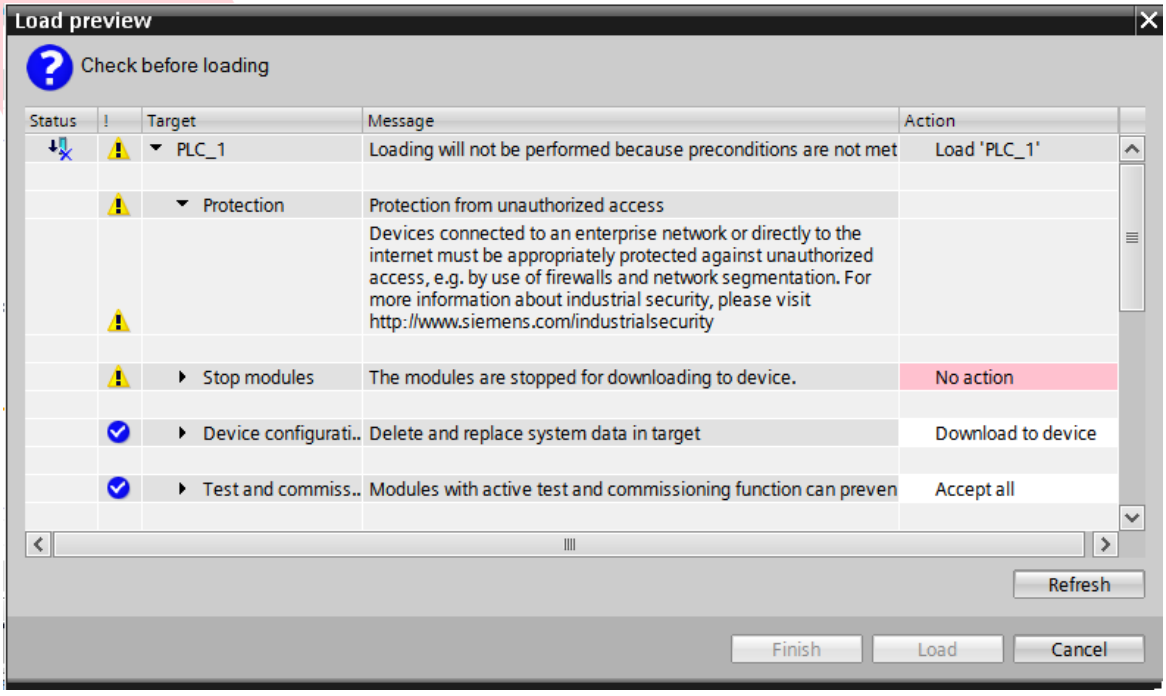


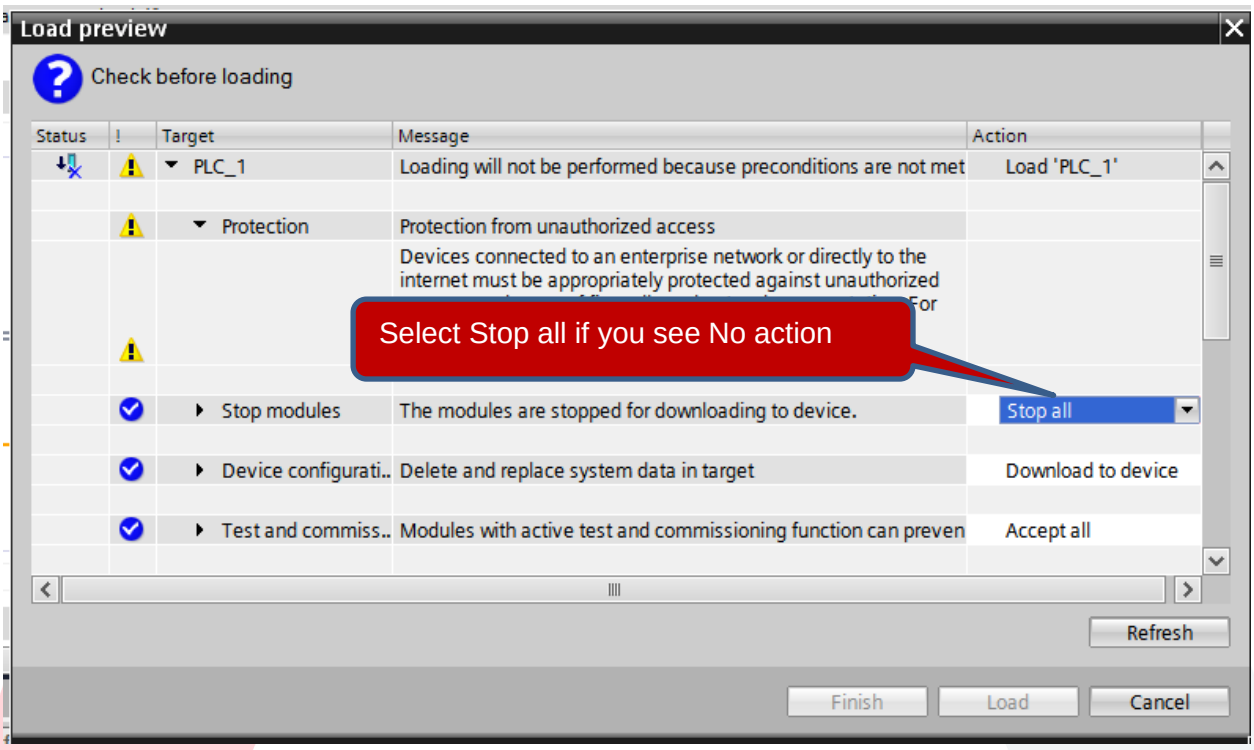


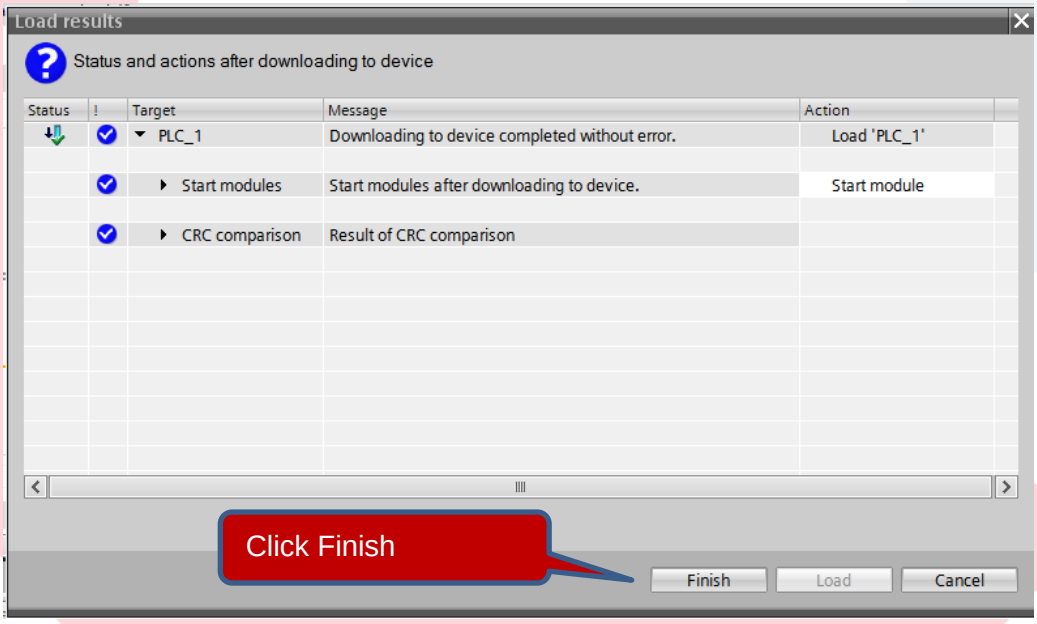
Next you will see the Load preview screen.

If the PLC had a previous program loaded, then you will see the No Action highlighted in Pink.

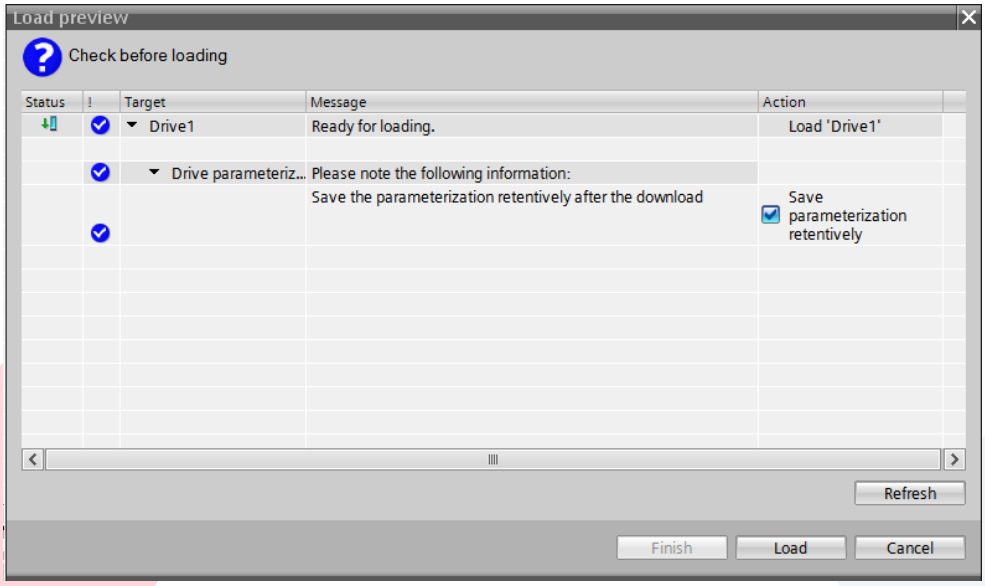
If this is the case change No action to Stop all. This will stop PLC processing so the new program can be loaded.



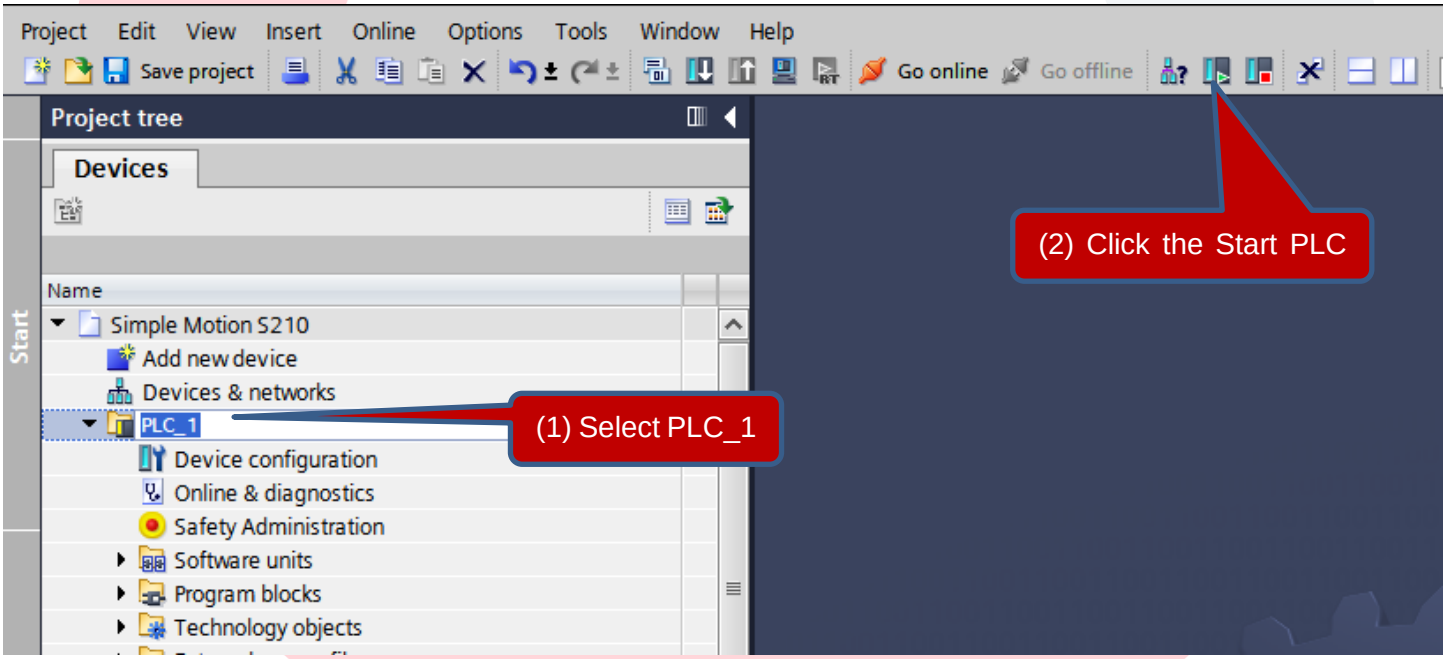

Load preview
Check before loading
Status
!
Target
Message
Action
PLC_1
Loading will not be performed because preconditions are not met
Load 'PLC_1'
Protection
Protection from unauthorized access
Devices connected to an enterprise network or directly to the internet must be appropriately protected against unauthorized
Select Stop all if you see No action
Stop modules
The modules are stopped for downloading to device.
Stop all
Device configurati..
Delete and replace system data in target
Download to device
Test and commiss..
Modules with active test and commissioning function can preven
Accept all
Refresh
Finish
Load
Cancel


Load results
Status and actions after downloading to device
Status
!
Target
Message
Action
PLC_1
Downloading to device completed without error.
Load 'PLC_1'
Start modules
Start modules after downloading to device.
Start module
CRC comparison
Result of CRC comparison
Click Finish
Finish
Load
Cancel

Also Download to the Drive again to get all network settings transferred to the drive. Again, make sure Save parameterization retentively is checked.



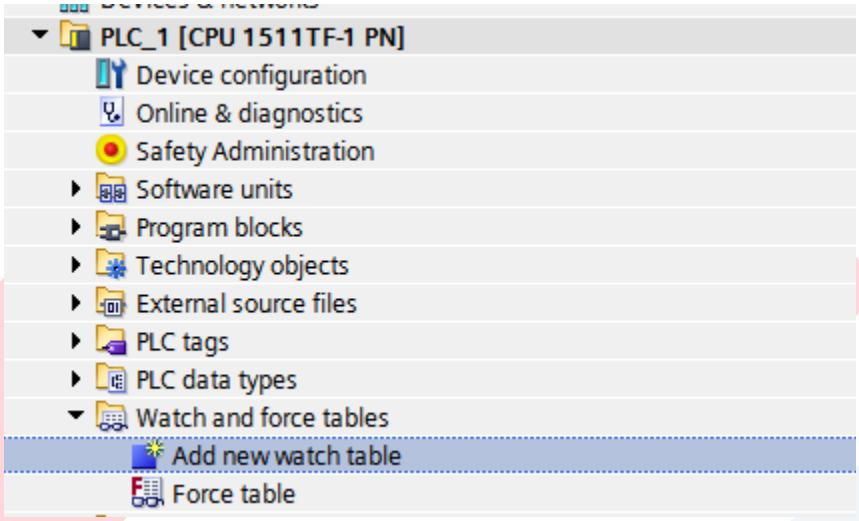
After the drive is loaded you will need to restart the PLC.



You should now see a Green Run Light on the PLC and two Green Led's on the Drive.

Drive Testing and Control:

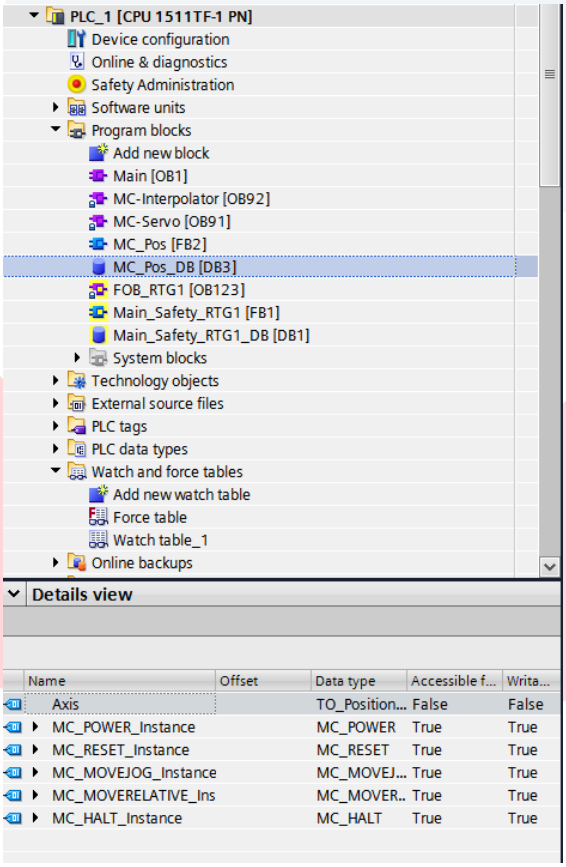
Add a Watch Table for easy access to the MC Blocks



Keep the Default Name of Watch table_1.

Next add variables to the Watch Table.

Left Click the MC_Pos_DB to list its variables in the Details View



From the Details view Select one or more pertinent variables and drag them to the Watch Table

Note: Multiple variables can be selected and brought over together.

	Name	Address	Display format	Monitor value
1	// MC_Power			
2	"MC_Pos_DB".MC_POWER_Instance.Enable		Bool	
3	"MC_Pos_DB".MC_POWER_Instance.Status		Bool	
4	"MC_Pos_DB".MC_POWER_Instance.Busy		Bool	
5	"MC_Pos_DB".MC_POWER_Instance.Error		Bool	
6	// MC_Reset			
7	"MC_Pos_DB".MC_RESET_Instance.Execute		Bool	
8	"MC_Pos_DB".MC_RESET_Instance.Done		Bool	
9	"MC_Pos_DB".MC_RESET_Instance.Busy		Bool	
10	"MC_Pos_DB".MC_RESET_Instance.Error		Bool	
11	// MC Move Jog			
12	"MC_Pos_DB".MC_MOVEJOG_Instance.JogForward		Bool	
13	"MC_Pos_DB".MC_MOVEJOG_Instance.JogBackward		Bool	
14	"MC_Pos_DB".MC_MOVEJOG_Instance.Velocity		Floating-point nu...	
15	"MC_Pos_DB".MC_MOVEJOG_Instance.Error		Bool	
16	// MC Move Relative			
17	"MC_Pos_DB".MC_MOVERELATIVE_Instance.Execute		Bool	
18	"MC_Pos_DB".MC_MOVERELATIVE_Instance.Distance		Floating-point nu...	
19	"MC_Pos_DB".MC_MOVERELATIVE_Instance.Velocity		Floating-point nu...	
20	"MC_Pos_DB".MC_MOVERELATIVE_Instance.Done		Bool	
21	"MC_Pos_DB".MC_MOVERELATIVE_Instance.Busy		Bool	
22	"MC_Pos_DB".MC_MOVERELATIVE_Instance.Error		Bool	
23	// MC Halt			
24	"MC_Pos_DB".MC_HALT_Instance.Execute		Bool	
25	"MC_Pos_DB".MC_HALT_Instance.Done		Bool	
26	// MC Home			
27	"MC_Pos_DB".MC_HOME_Instance.Execute		Bool	
28	"MC_Pos_DB".MC_HOME_Instance.Position		Floating-point nu...	
29	"MC_Pos_DB".MC_HOME_Instance.Mode		DEC+/-	
30	"MC_Pos_DB".MC_HOME_Instance.Busy		Bool	
31	"MC_Pos_DB".MC_HOME_Instance.Done		Bool	
32	"MC_Pos_DB".MC_HOME_Instance.Error		Bool	
33	// MC Move Absolute			
34	"MC_Pos_DB".MC_MOVEABSOLUTE_Instance.Execute		Bool	
35	"MC_Pos_DB".MC_MOVEABSOLUTE_Instance.Position		Floating-point nu...	
36	"MC_Pos_DB".MC_MOVEABSOLUTE_Instance.Velocity		Floating-point nu...	
37	"MC_Pos_DB".MC_MOVEABSOLUTE_Instance.Done		Bool	
38	"MC_Pos_DB".MC_MOVEABSOLUTE_Instance.Busy		Bool	
39	"MC_Pos_DB".MC_MOVEABSOLUTE_Instance.Error		Bool	
40				

Important Watch Table Icons

 Insert Row before current selected

 Add Row after current selected

 Insert Commend Line with //

 Monitor the variables in the Watch Table

 Wright Modified Values from Modify Value Column to the PLC

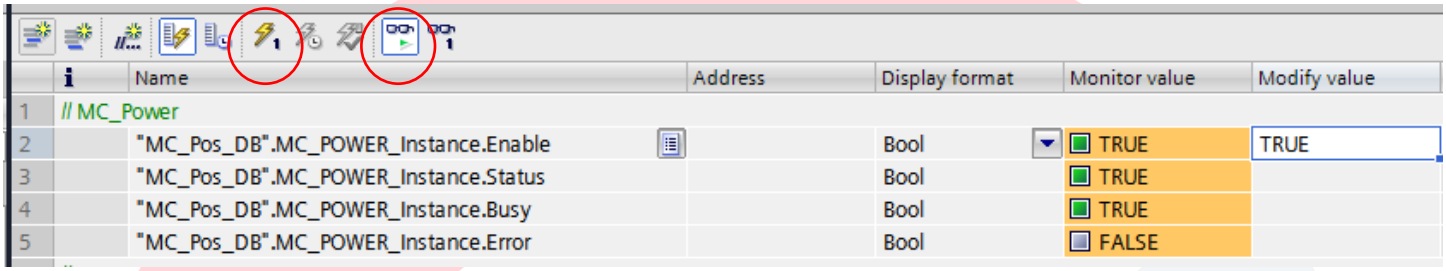
To run the drive from the Watch Table;

First Press the Monitor Button to go online with the Watch Table

 Monitor the variables in the Watch Table

First Enable the Drive with MC_Power.

Type 1 or TRUE in the Modify Value column next to MC_Power_Instance.Enable and



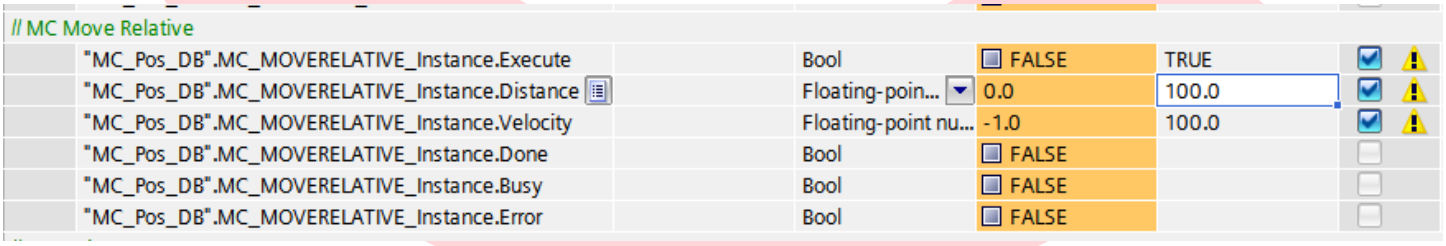
		Name	Address	Display format	Monitor value	Modify value
1		// MC_Power				
2		"MC_Pos_DB".MC_POWER_Instance.Enable		Bool	TRUE	TRUE
3		"MC_Pos_DB".MC_POWER_Instance.Status		Bool	TRUE	
4		"MC_Pos_DB".MC_POWER_Instance.Busy		Bool	TRUE	
5		"MC_Pos_DB".MC_POWER_Instance.Error		Bool	FALSE	

select Modify Values selected values. 

With MC_Power Enabled, now you can enter a 1 in JogForward or JogBackward and Modify Values to jog the motor. Return value to 0 and Modify All to stop the motion

// MC Move Jog					
	"MC_Pos_DB".MC_MOVEJOG_Instance.JogForward		Bool	TRUE	TRUE
	"MC_Pos_DB".MC_MOVEJOG_Instance.JogBackward		Bool	FALSE	FALSE
	"MC_Pos_DB".MC_MOVEJOG_Instance.Velocity		Floating-poin...	100.0	
	"MC_Pos_DB".MC_MOVEJOG_Instance.Error		Bool	FALSE	

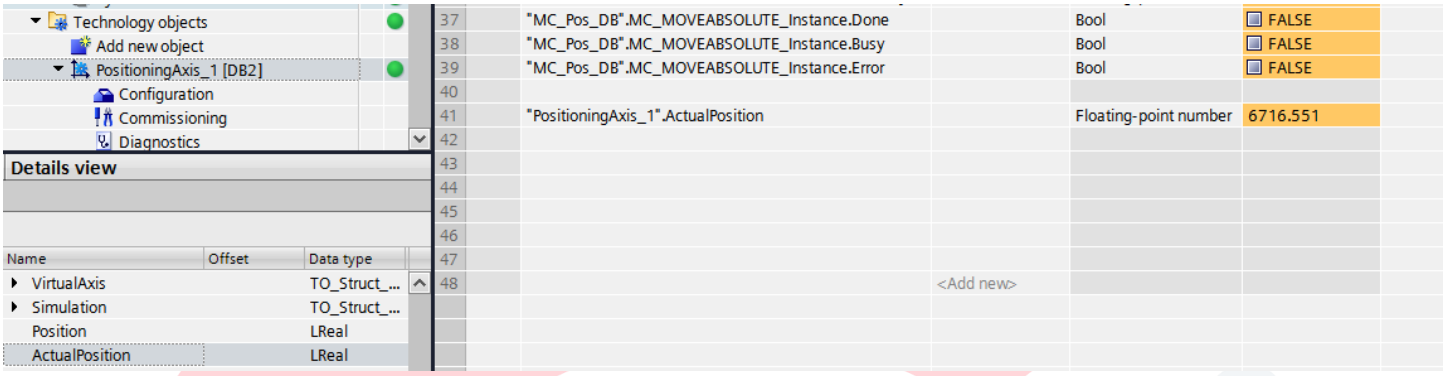
For a Relative Move enter a Distance in mm, a velocity in mm/sec and Modify All, then Enter a 1 in Execute and again Modify All. The motor will move 10 Revolutions or 100 mm (Default Scaling of the Technology Object that was created was a linear axis and is configured as a 10mm travel per 1 revolution of the motor). After the move you must toggle the Execute bit to OFF and Modify All then toggle back ON and Modify All again to move another 100mm. Most servo move commands trigger off of a rising edge of the input bit.



// MC Move Relative					
	"MC_Pos_DB".MC_MOVERELATIVE_Instance.Execute		Bool	FALSE	TRUE
	"MC_Pos_DB".MC_MOVERELATIVE_Instance.Distance		Floating-poin...	0.0	100.0
	"MC_Pos_DB".MC_MOVERELATIVE_Instance.Velocity		Floating-point nu...	-1.0	100.0
	"MC_Pos_DB".MC_MOVERELATIVE_Instance.Done		Bool	FALSE	
	"MC_Pos_DB".MC_MOVERELATIVE_Instance.Busy		Bool	FALSE	
	"MC_Pos_DB".MC_MOVERELATIVE_Instance.Error		Bool	FALSE	

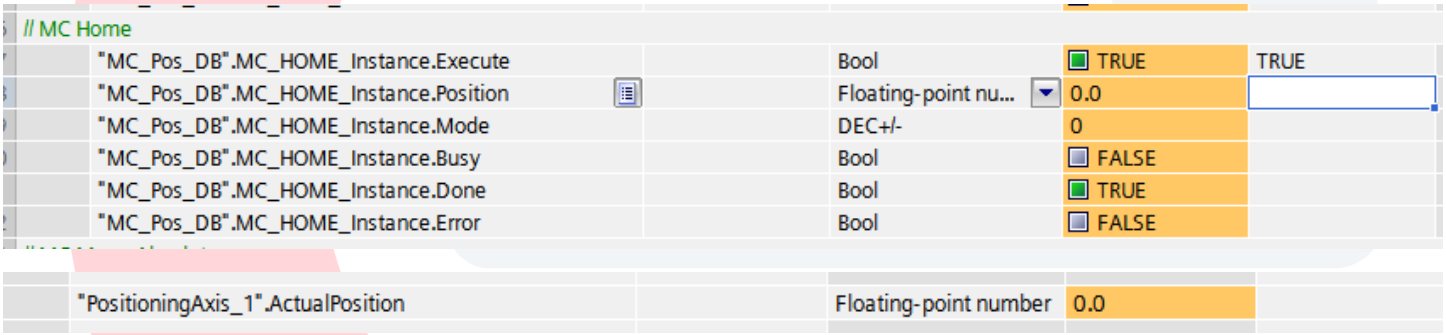
We will next Home the Motor. My Motor has an Absolute Encoder so homing is not required to do an Absloute move, but it will help to set the current position to 0 for a base reference

First add ActualPosition to the Watch Table from PositioningAxis_1.



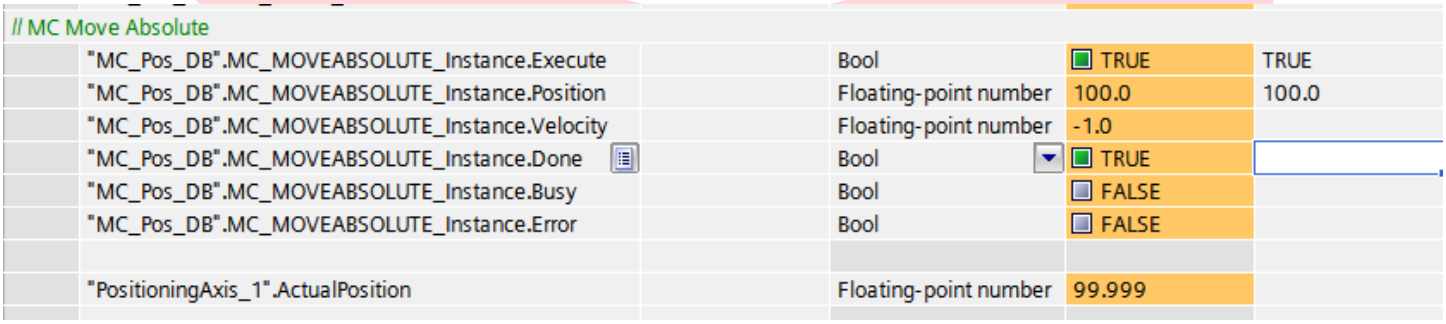
For the MC_Home block there are several options for homing mode. For this example we will just use mode 0, which will set the Actual Position Value to the value loaded in the MC_HOME_Instance.Position variable. We will use 0, so when the block is executed the ActualPosition will be set to 0.

Set Instance.Execute to 1 and modify all. The Done Bit should immediately turn on and Actual Position should be set to 0.



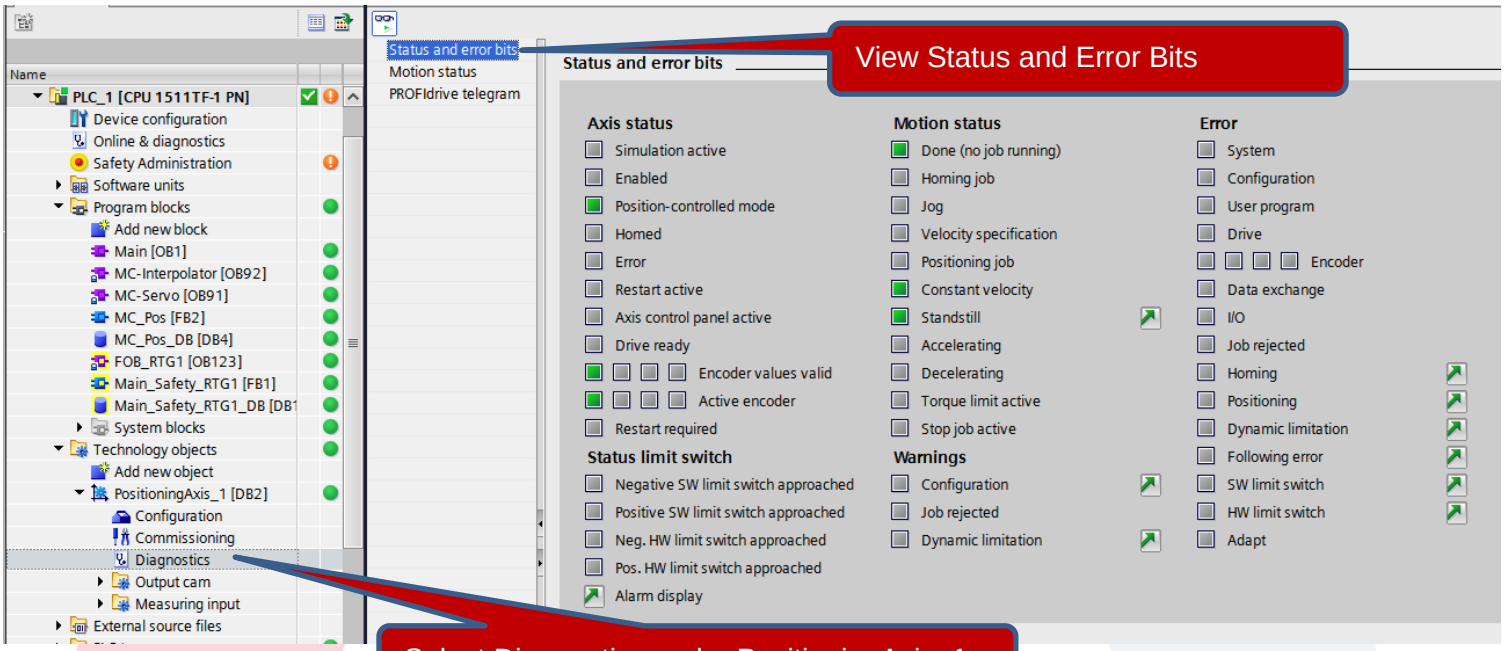
Now you can turn off the Execution Bit. Again type in 0 and Modify All.

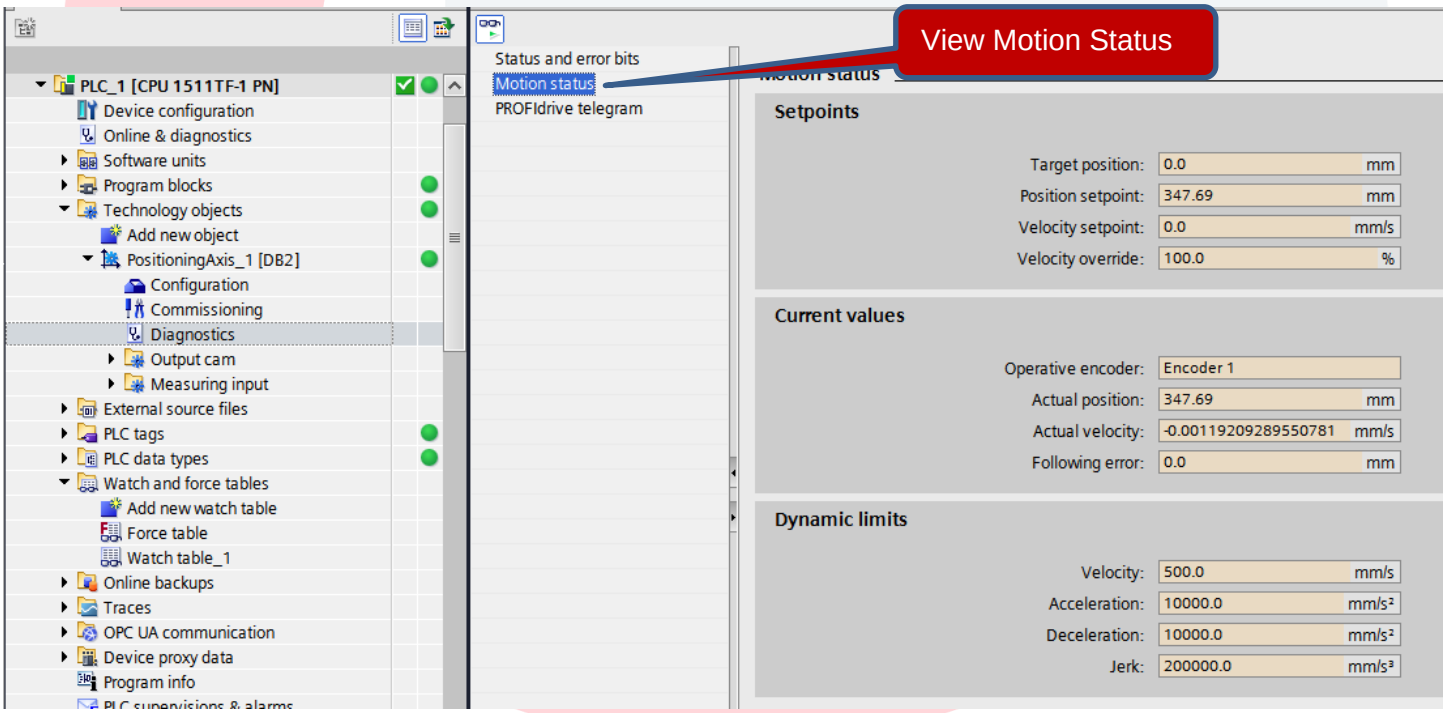
Now you can make an Absolute Move. Set the Instance Position to the Absolute Position you want the motor to move to and Modify All. Then Trigger the Execute bit to make the move. After the move is complete the Done Bit will turn on and you will see the Actual Position be very close to the target position.



Technology Object Monitoring Screens

There are also some other status screens for the drive built into the Technology Object





Save Project