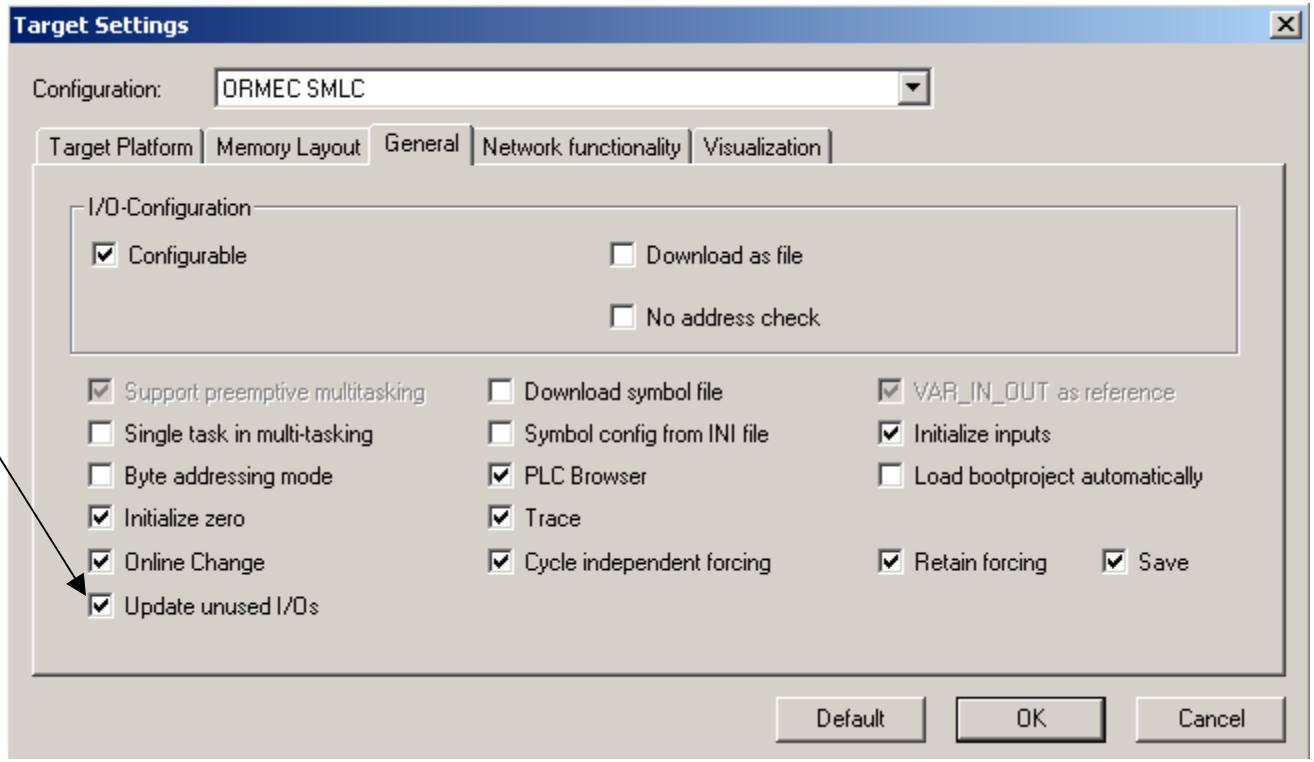
SMLC PROFIBUS DP Master Tutorial

- PROFIBUS is the world's most popular fieldbus with over 13,000,000 nodes in use world wide.
- There are over 2500 products available from over 400 vendors
- PROFIBUS DP is designed for fast data exchange with devices at the field level
- PROFIBUS DP-V0 provides the basic functionality of DP, including cyclic data exchange, station, module and channel-specific diagnostics.
- PROFIBUS DP-V1 contains enhancements geared toward process automation, in particular acyclic communication for parameter assignment, operation and visualization.
- PROFIBUS supports up to 126 nodes
- Network length can be between 100m and 1200m depending on data rate
- Data rates from 9.6kBits/sec to 12 Mbits/sec.
- PROFIBUS is a Master/Slave network
- A PM option in the SMLC part number indicate that the SMLC is capable of being a PROFIBUS DP Master :
- e.g. SMLC-30-PM-0
- e.g. SMLC-80-PM-0
- e.g. SMLC-160-PM-0

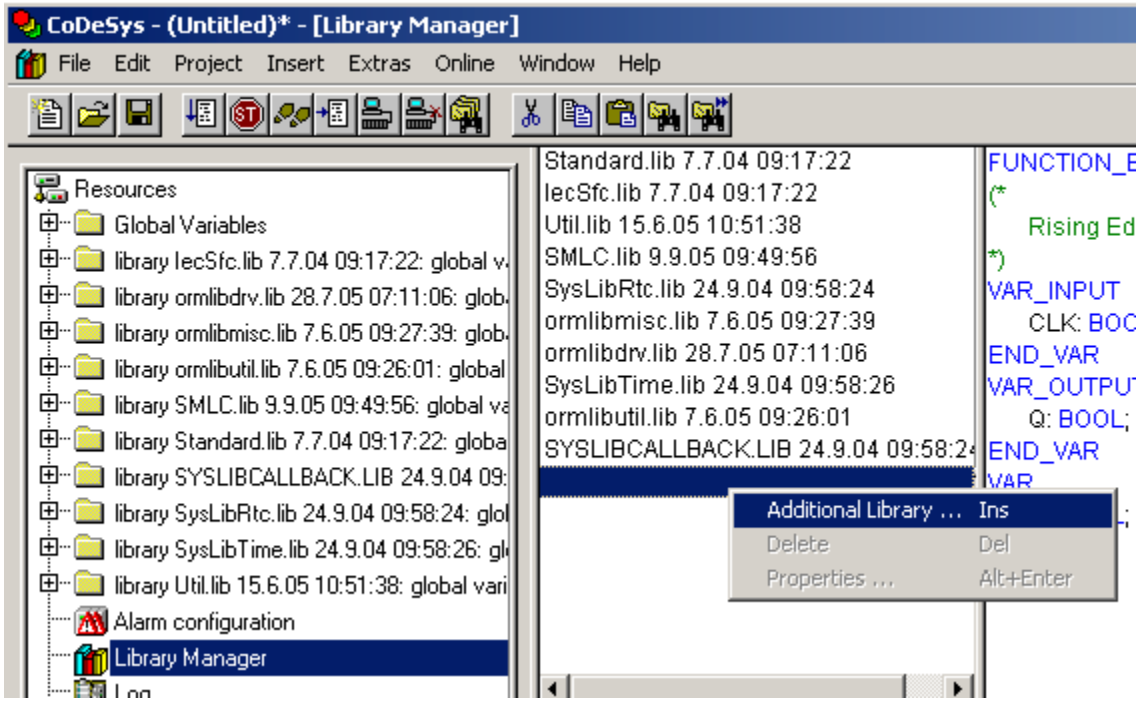
“Update unused I/Os” target setting

- Create a new project for an SMLC target
- **TIP**: Go to the General page of the target settings and check the “Update unused I/Os” checkbox. This will enable you to view/change the state of I/O even if they are not used in your program.
- **Note: You must have SMLC firmware v2.0.2 or later installed to use the PROFIBUS capabilities.**



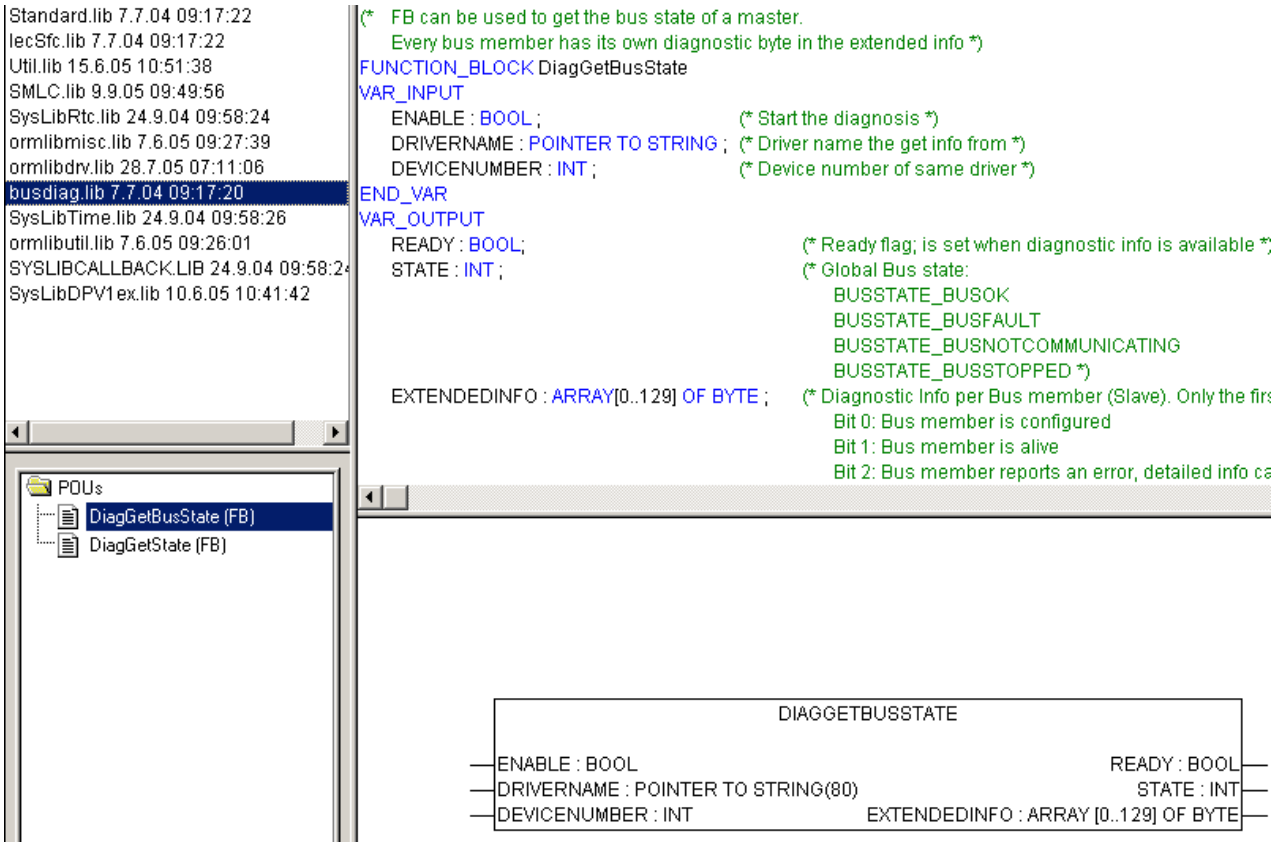
Adding the optional libraries

- Go the Library Manager and right click to add additional libraries.
- Select BusDiag.lib to access PROFIBUS diagnostic bytes
- Select either SysLibDPV1.lib or SysLibDPV1ex.lib if you want to use DPV1 Read/write function blocks.
- SysLibDPV1ex adds the capability of returning error status from DPV1 reads and writes.
- Adding the BusDiag library is completely optional but may be useful in diagnosing problems.
- The DPV1 libraries are only required if you intend to do DPV1 communications to a slave device.



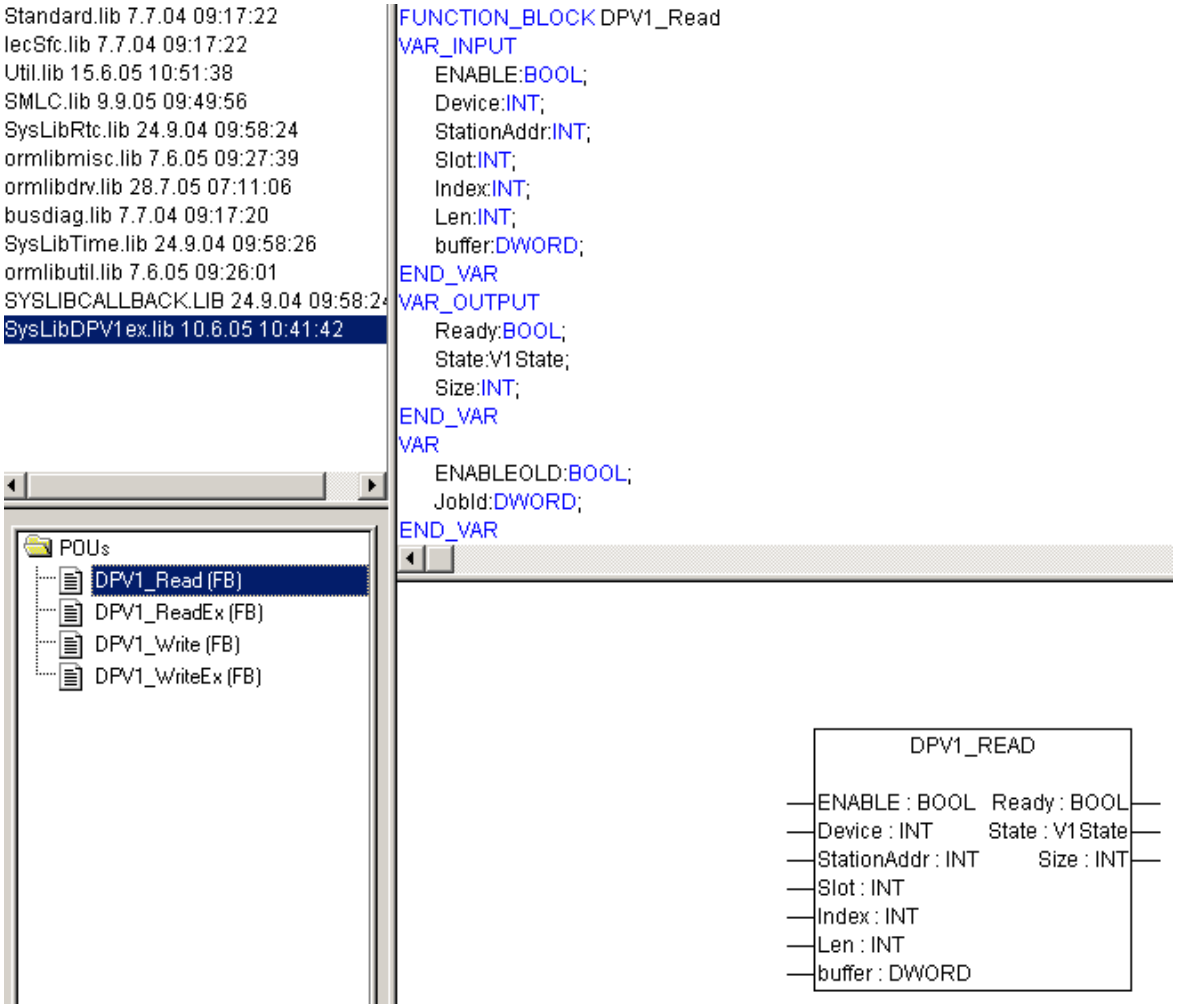
BusDiag library

- The BusDiag library allows you to read the diagnostic status bytes of the master as well as from each of the slave devices.
- DiagGetBusState is for reading the Master's diagnostic status bytes
- DiagGetState is for reading the individual slave's diagnostic status bytes.



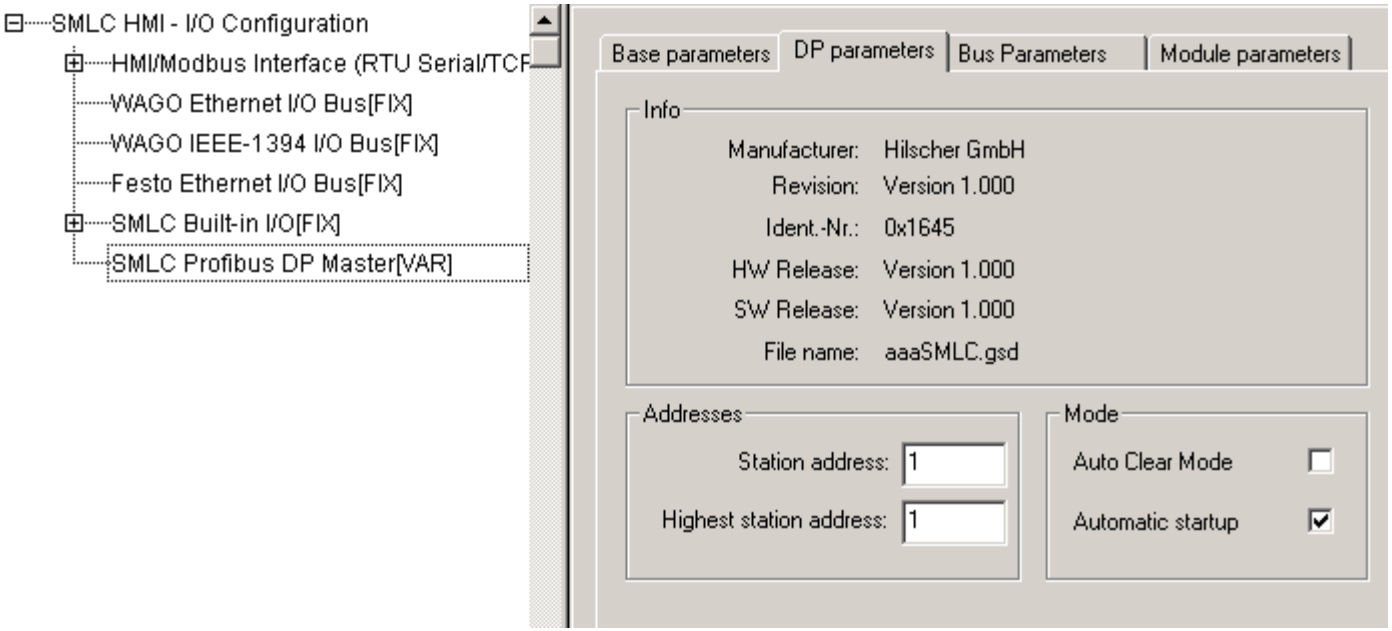
DPV1 Libraries

- There are two libraries for DPV1 communications: SysLibDPV1.lib and SysLibDPV1ex.lib.
- SysLibDPV1 contains only the DPV1_Read and DPV1_Write function blocks
- SysLibDPV1ex adds the DPV1_ReadEx and DPV1_WriteEx function blocks
- The “Ex” function blocks add the capability of reading the error status of a DPV1 transaction.
- Only add one of these libraries to prevent compilation errors for duplicate function blocks
- **TIP:** use the SysLibDPV1ex.lib even if you don’t intend to read the error status codes.



PLC Configuration - DP Parameters

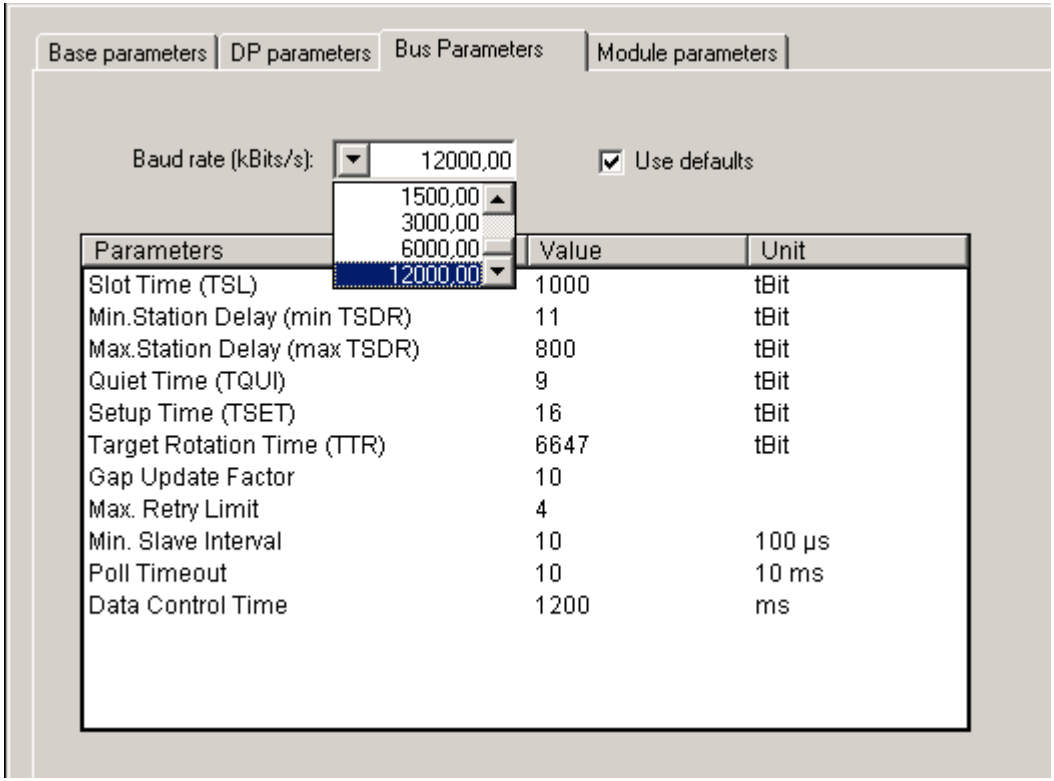
- Go to the PLC Configuration on the Resources tab
- Select SMLC PROFIBUS DP Master.
- Select the DP Parameters tab
- Set the station address for the master.
- Masters must be station 0, 1 or 2
- The default master station address is 1



- The SMLC uses a Hilscher PROFIBUS DP Master card. The .gsd file is completely identical to the Hilscher CIF50-PB and CIF104-PB with the exception of the network node name (SMLC PROFIBUS DP Master)
- Its not necessary to set the Highest station address at this point. CoDeSys will automatically adjust it as you add your slave devices.

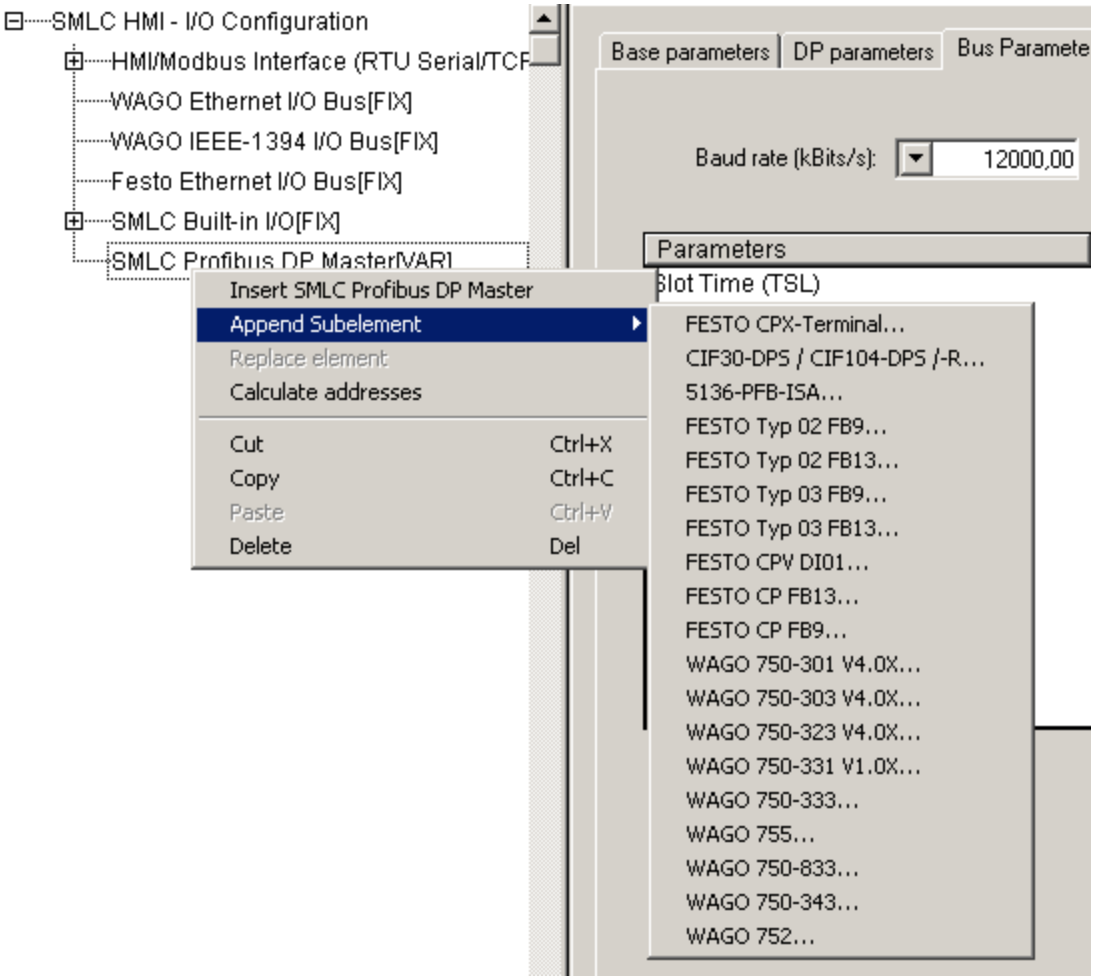
PLC Configuration - Bus Parameters

- Go to the Bus Parameters tab and set the Baud rate
- The most typical baud rate selections are 1500 or 12000
- **TIP:** leave the Use defaults option checked for optimal bus parameter values.



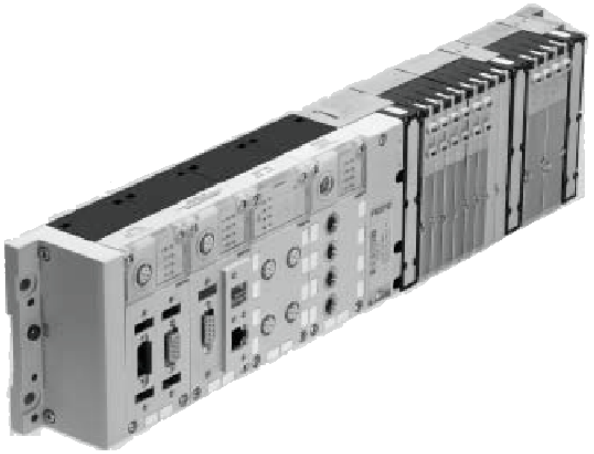
PLC Configuration - Adding a slave device

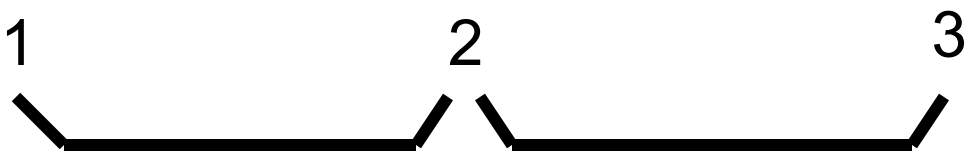
- Right click on the SMLC PROFIBUS DP Master and select Append Subelement
- Pick your slave device from the list.
- If you don't see the device you wish to use need to copy the device's .gsd file to the SMLC target directory.
- A .gsd file is the file provided by the I/O manufacturer that contains all of the data regarding the capabilities of the I/O module.
- The SMLC target directory is located in the ORMEC_SMLC subdirectory of the CoDeSys v2.3\Targets folder. (Typically c:\program files\3s Software\CodeSys v2.3\Targets\ORMEC_SMLC)
- If you add a new .gsd file you need to quit and restart CoDeSys for it to show up in the list.



Our tutorial network

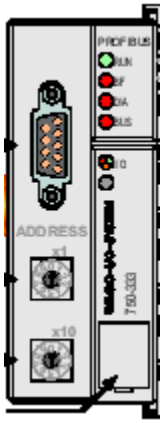
- For the purposes of this tutorial we will create the following network
- SMLC PROFIBUS DP Master, station address 1
- Wago 750-333 bus coupler, station address 2
- FESTO CPX-Terminal, station address 3

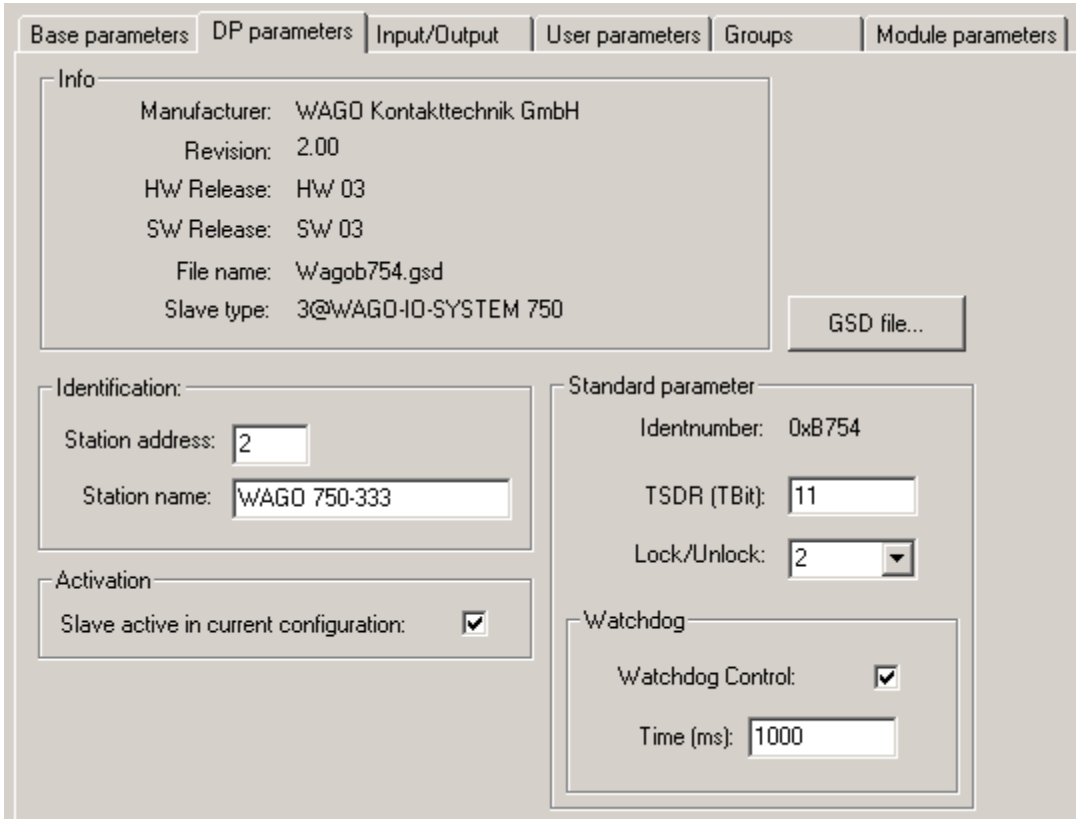




PLC Configuration - Configuring the Wago 750-333

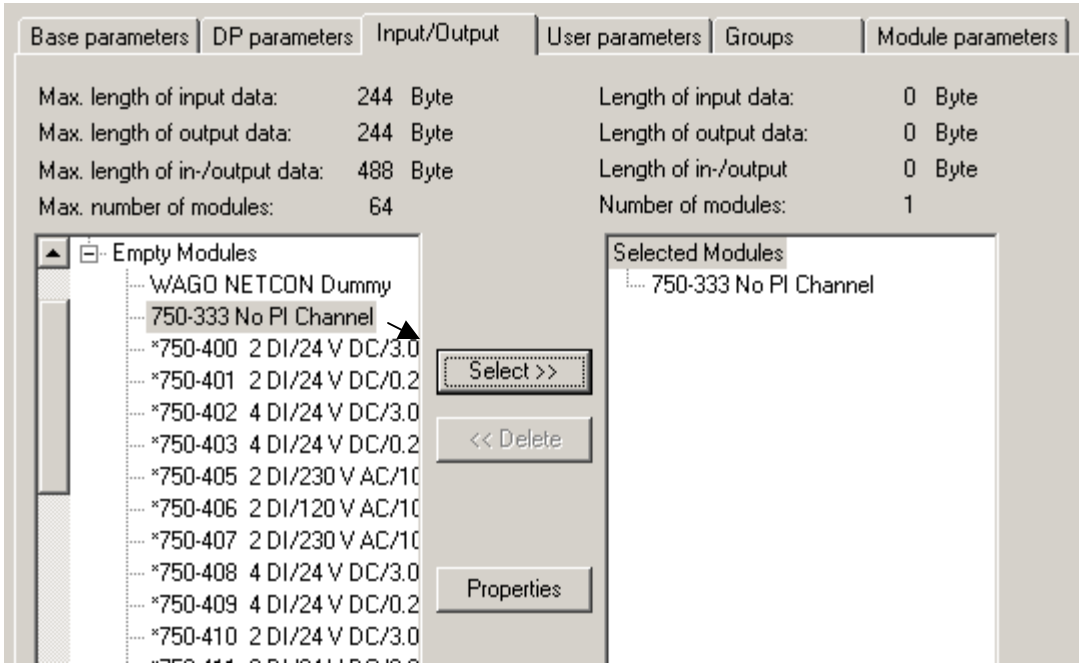
- Select a Wago 750-333 and go to the DP parameters tab
- Set the Station address to 2
- Our Wago bus coupler has the following I/O modules installed
- 750-430 8 DC inputs
- 750-530 8 DC outputs
- The rotary switches on the Wago bus coupler are set for a station address of 2





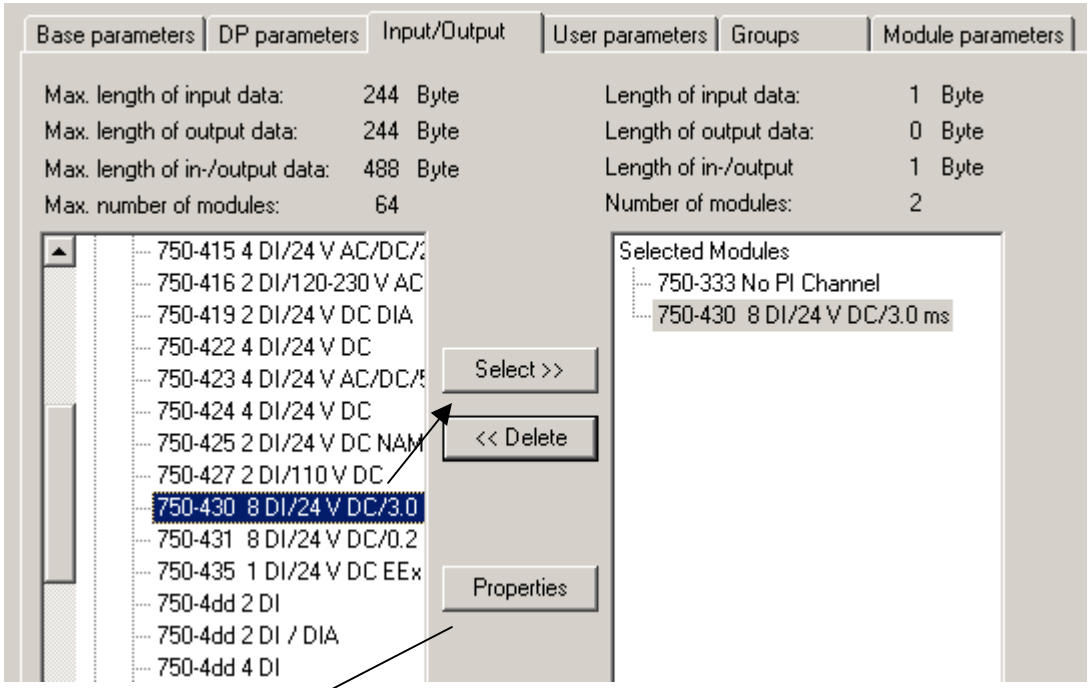
PLC Configuration - Configuring the Wago 750-333

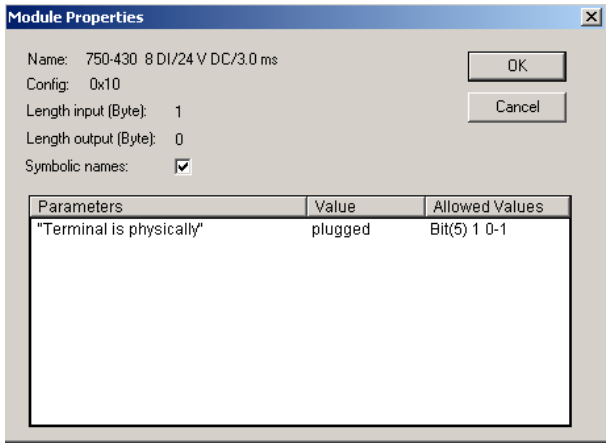
- Select the Input/Output tab
- Here is where we select the modules that are installed on our bus coupler.
- Now is a good time to read the documentation that came with your slave device. If the configuration doesn't match exactly the slave will not go online.
- The Wago documentation tells us that we need to insert an Empty Module - "No PI channel" as the first module on our slave. If we don't do this we will get a configuration error!



PLC Configuration - Adding the input module

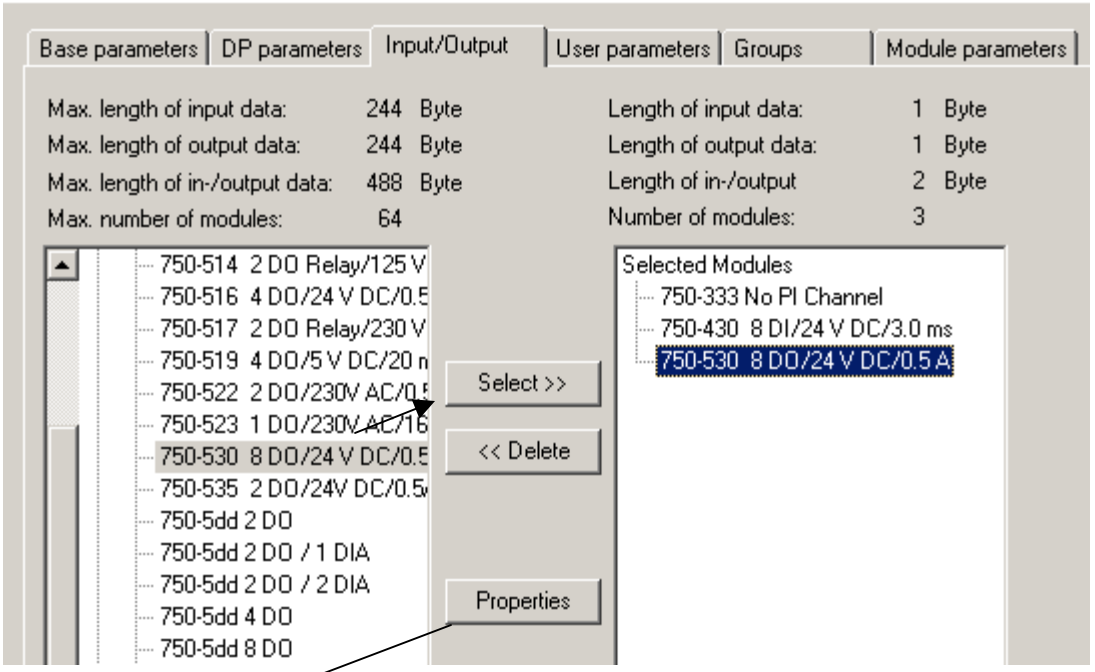
- Go to the input modules section of the tree
- Click on the 750-430 and hit the Select button
- If you then click on the 750-430 module in the right hand pane and click on the Properties button you can set the individual properties for the module. For this module the only option is whether it is physically plugged (present) or not.

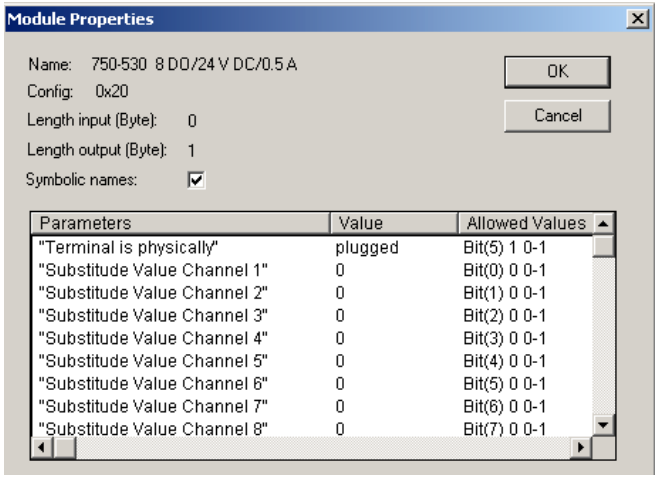




PLC Configuration - Adding the output module

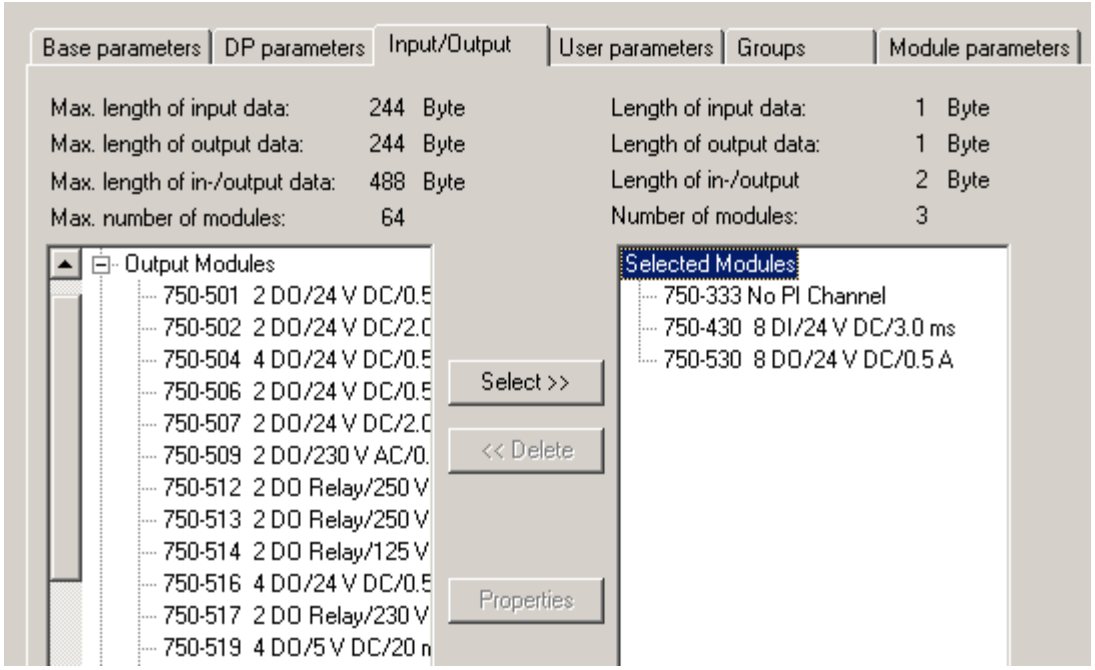
- Go to the Output Modules section of the tree and select a 750-530 module.
- For this module we can see that there are many properties that can be set, including the state for each output should the PROFIBUS network fail. Refer to the Wago documentation for more information.





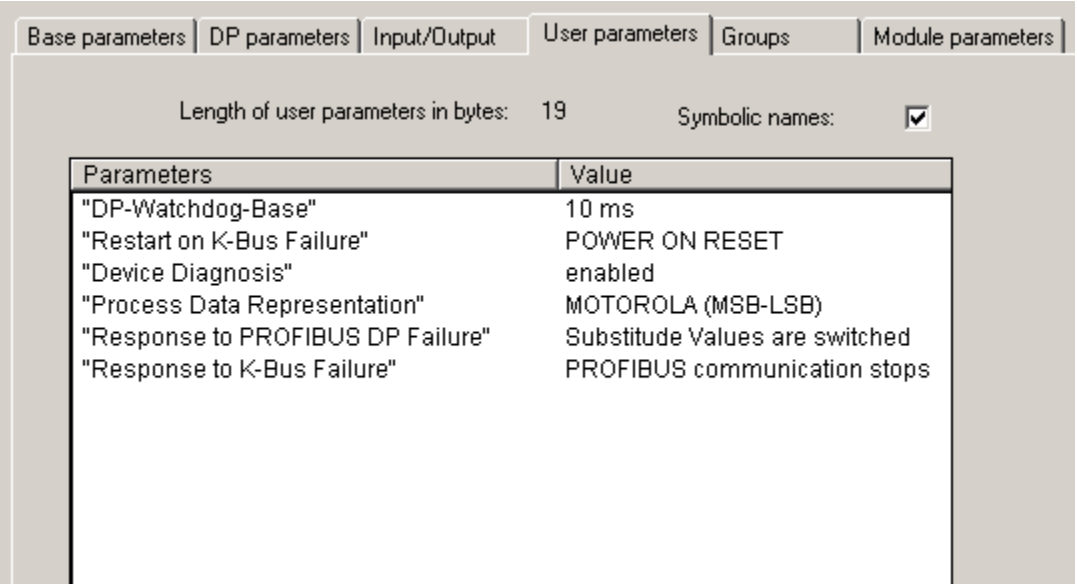
PLC Configuration - Verify Wago configuration

- At this point your configuration should look like this.
- If the order of the modules does not match exactly the physical configuration then you need to fix it before proceeding. If necessary delete and re-select modules to get them into the proper position.
- **TIP** - If you want to append a module click on “Selected Modules” before clicking the Select button. If you want to insert a module click on the module you want to insert before and then click on Select.



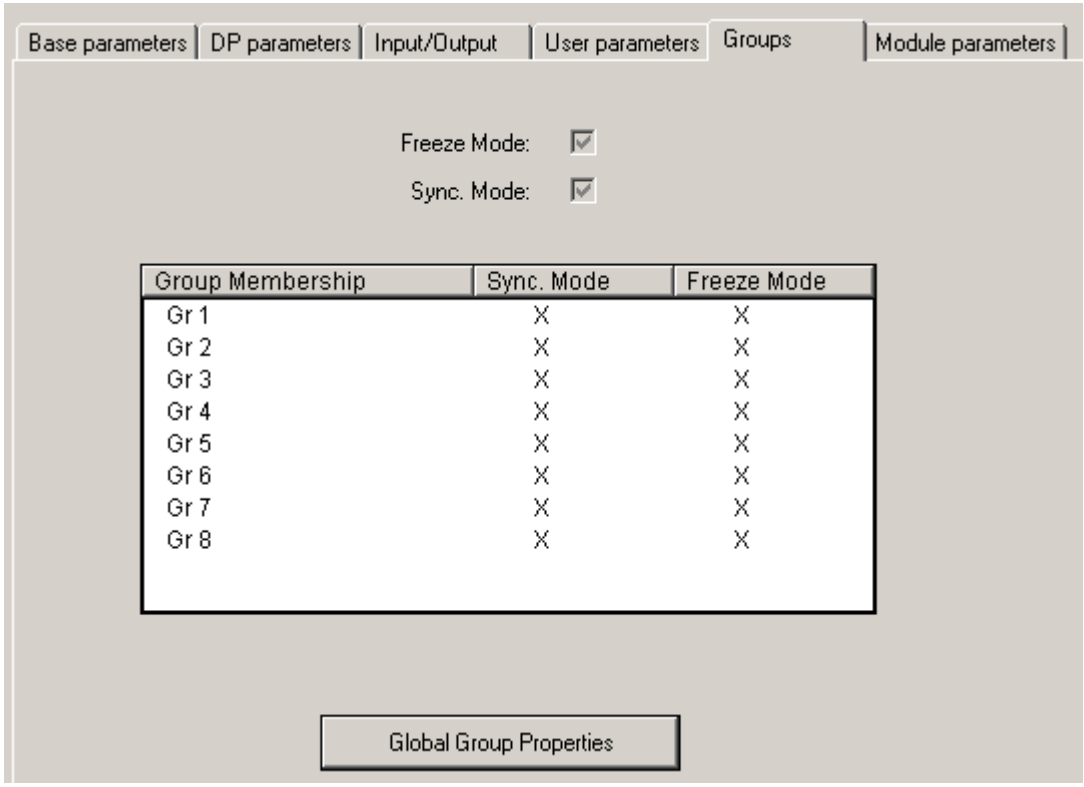
PLC Configuration - User parameters for the Wago node

- Go to the User parameters tab
- Here was see the settings for the bus coupler itself.
- To change a value double click on it. The values will toggle through all of their possible settings.



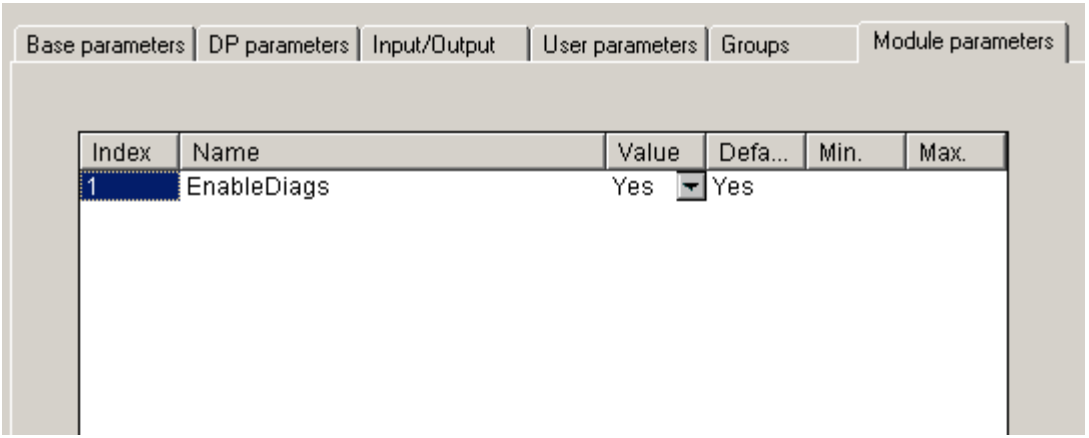
PLC Configuration - Group parameters for the Wago node

- Go to the Groups tab
- Here you can set the group membership and Sync/Freeze modes for this node.
- This topic is beyond the scope of this tutorial.



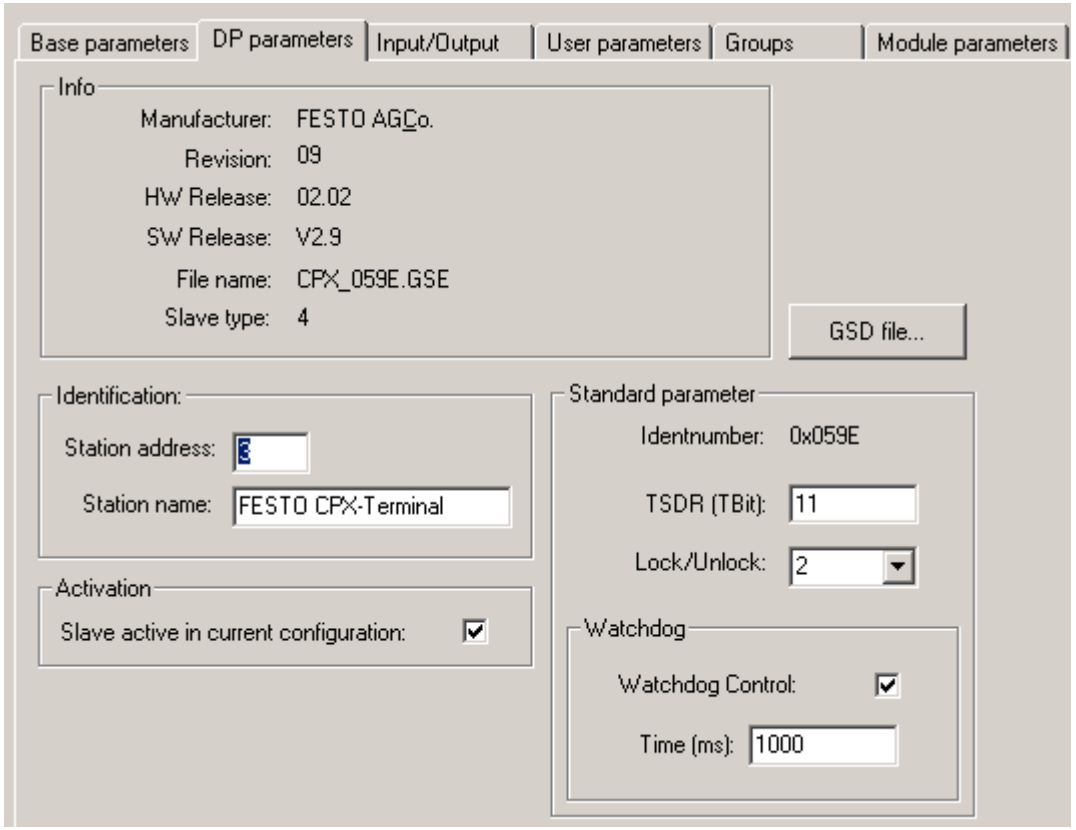
PLC Configuration - Module parameters for the Wago node

- Go to the Module parameters tab
- Here we can set the Module parameters for this node.
- **TIP:** Leave the default setting EnableDiags = Yes. This allows you to retrieve diagnostic information from this module.



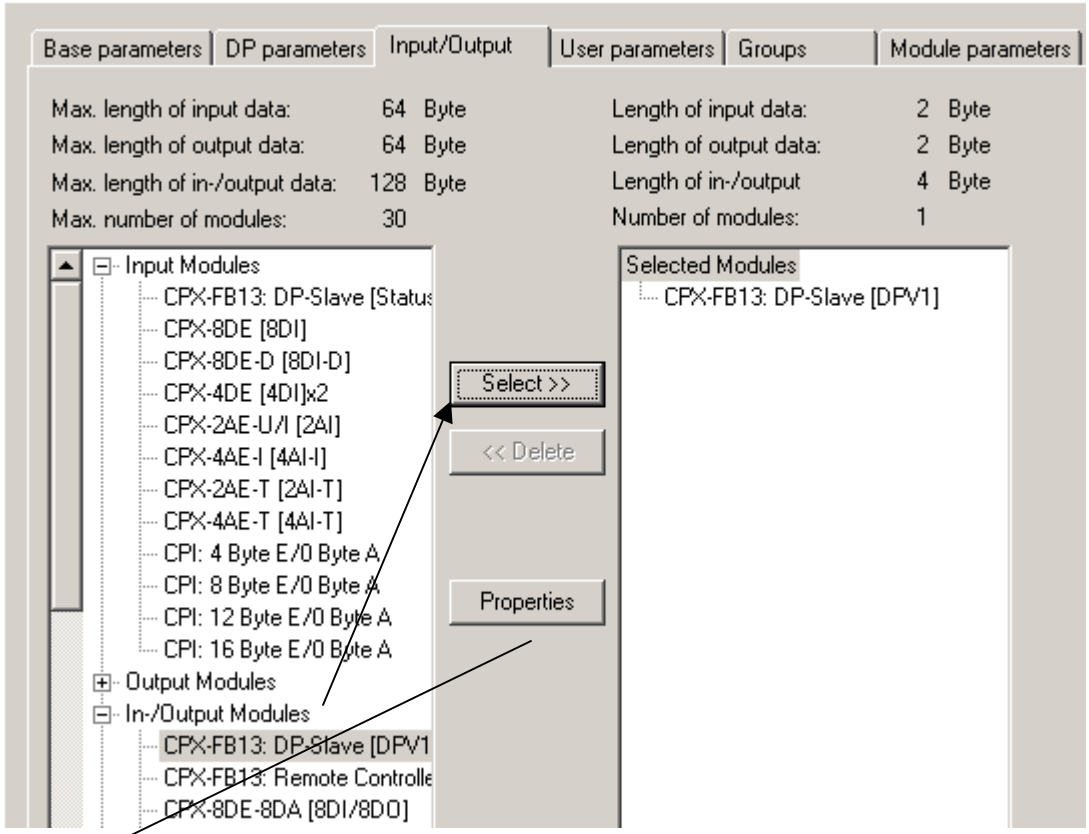
PLC Configuration - Configuring the FESTO CPX-Terminal

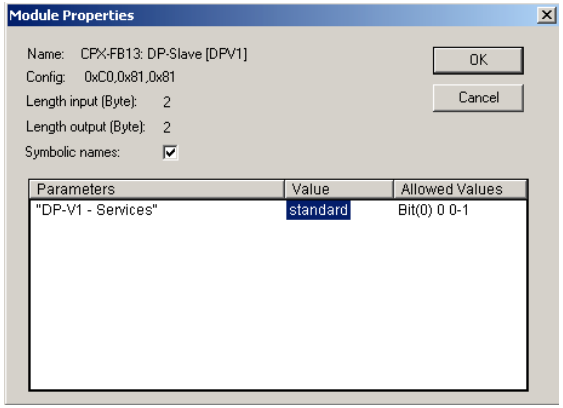
- Select a FESTO CPX Terminal and go to the DP parameters tab.
- Set the Station address to 3
- In our setup the CPX has the following modules:
- CPX-8DE-8DA (8DI/8DO)
- CPX-2AE-U/I (2 analog inputs)
- CPX-2AA-U/I (2 analog outputs)
- MPA1S (valve bank w/ 4 valves)



PLC Configuration - Configuring the FESTO CPX-Terminal

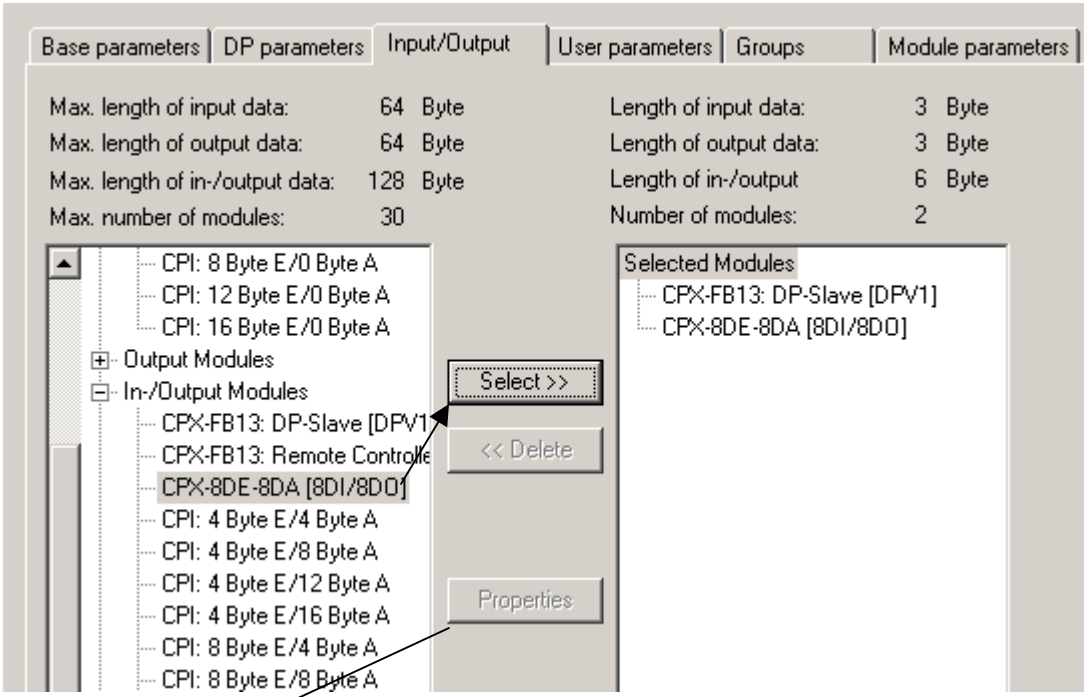
- Go to the Input/Output tab
- From reading the documentation for the FESTO CPX we know that we can operation this device in one of three ways:
- DP Slave (no status), DP Slave (status), DP Slave (DPV1 enabled)
- For this example we want to use the DPV1 functions so under the In/Output Modules tree select CPX-FB13: DP-Slave [DPV1]
- Select the Properties and verify the value Standard.

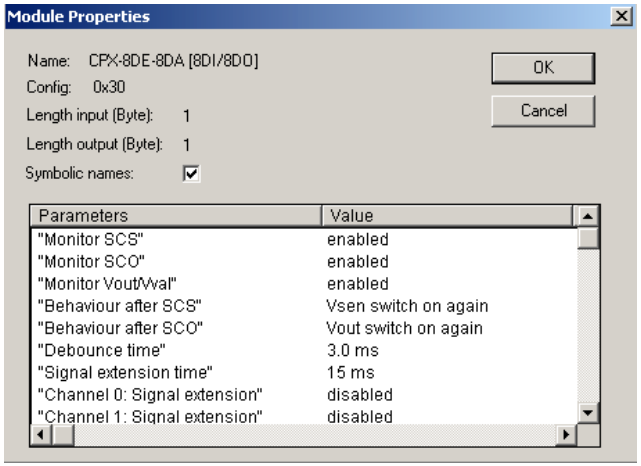




PLC Configuration - Adding the 8DI/8DO module

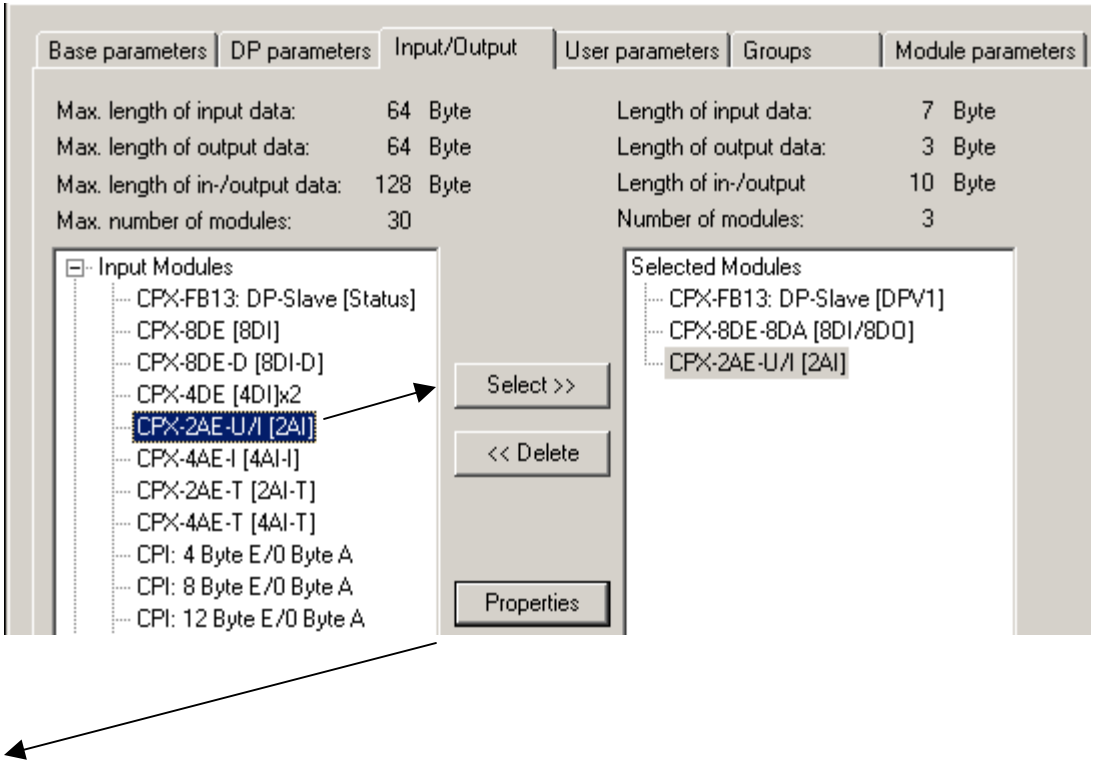
- Next add the 8DI/8DO module
- Click on the module in right pane after insertion and then click on the Properties button to see all of the options for this module
- **TIP** - after viewing the properties click on Selected Modules before inserting the next module or the new module may be inserted rather than appended.

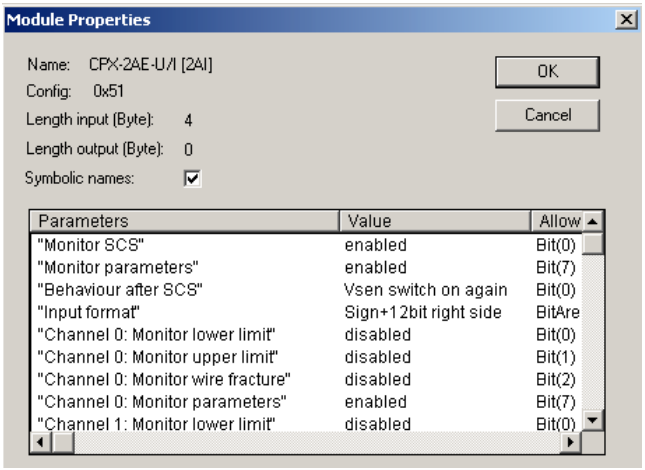




PLC Configuration - Adding the Analog input module

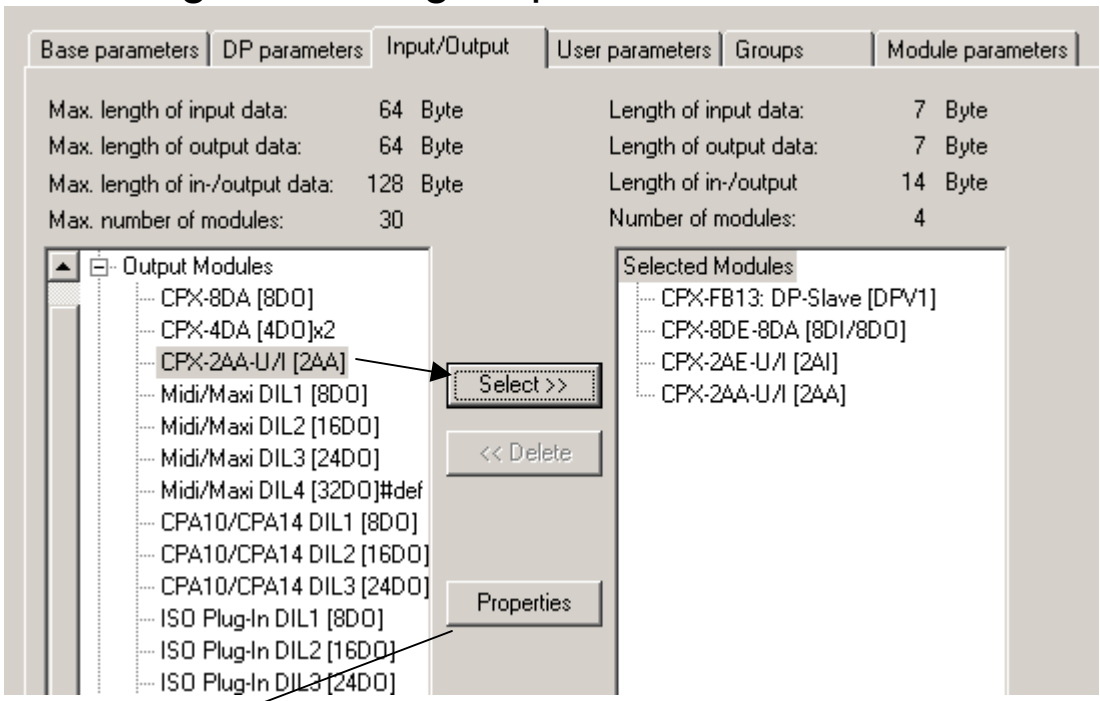
- Next add the 2AI module
- Click on the module in right pane after insertion and then click on the Properties button to see all of the options for this module

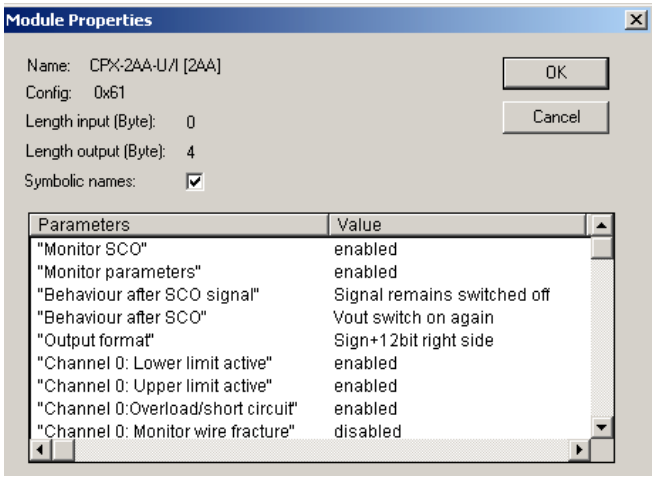




PLC Configuration - Adding the Analog output module

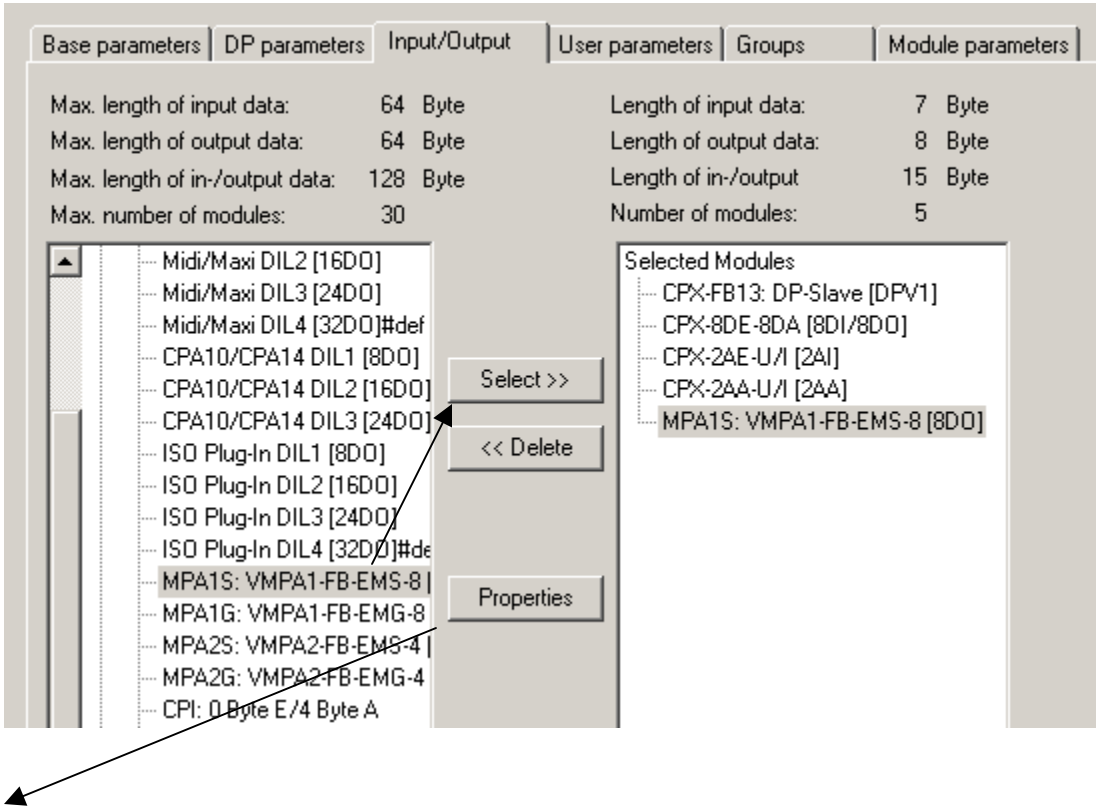
- Next add the 2AO module
- Click on the module in right pane after insertion and then click on the Properties button to see all of the options for this module

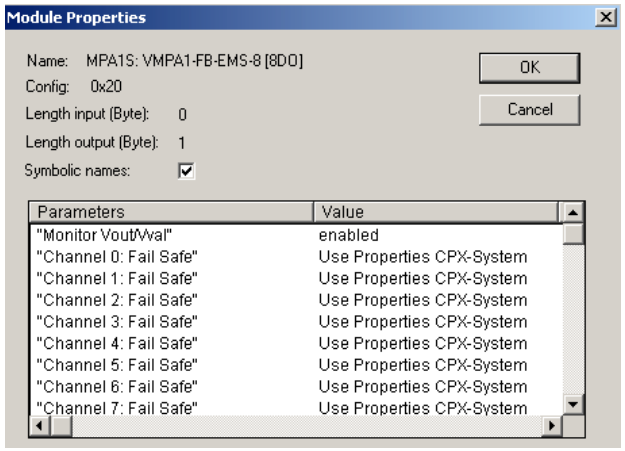




PLC Configuration - Adding the valve bank

- Next add the MPA1S module
- Click on the module in right pane after insertion and then click on the Properties button to see all of the options for this module





PLC Configuration - Verify the FESTO configuration

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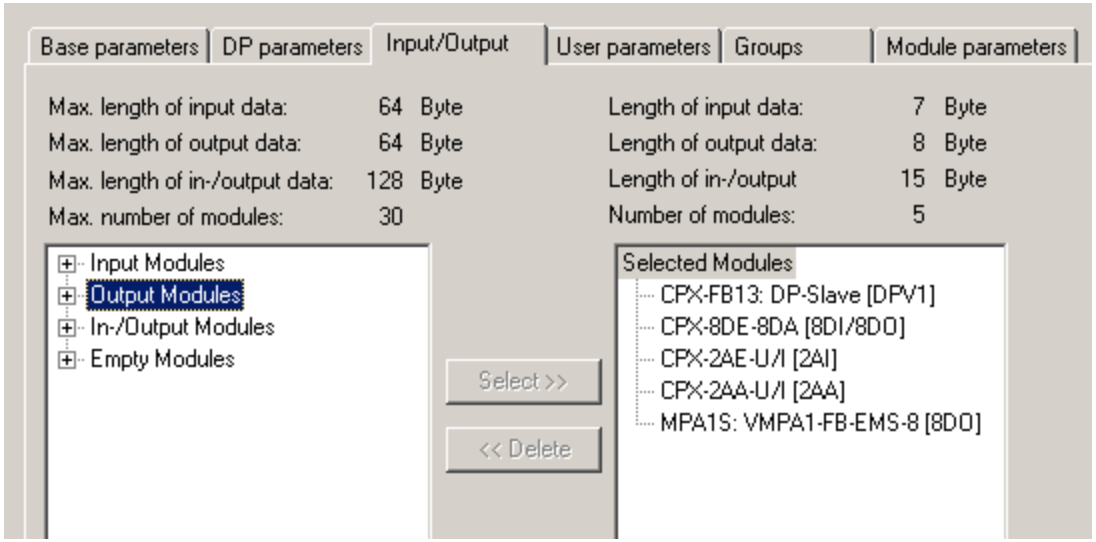

PLC Configuration - User parameters for the FESTO node

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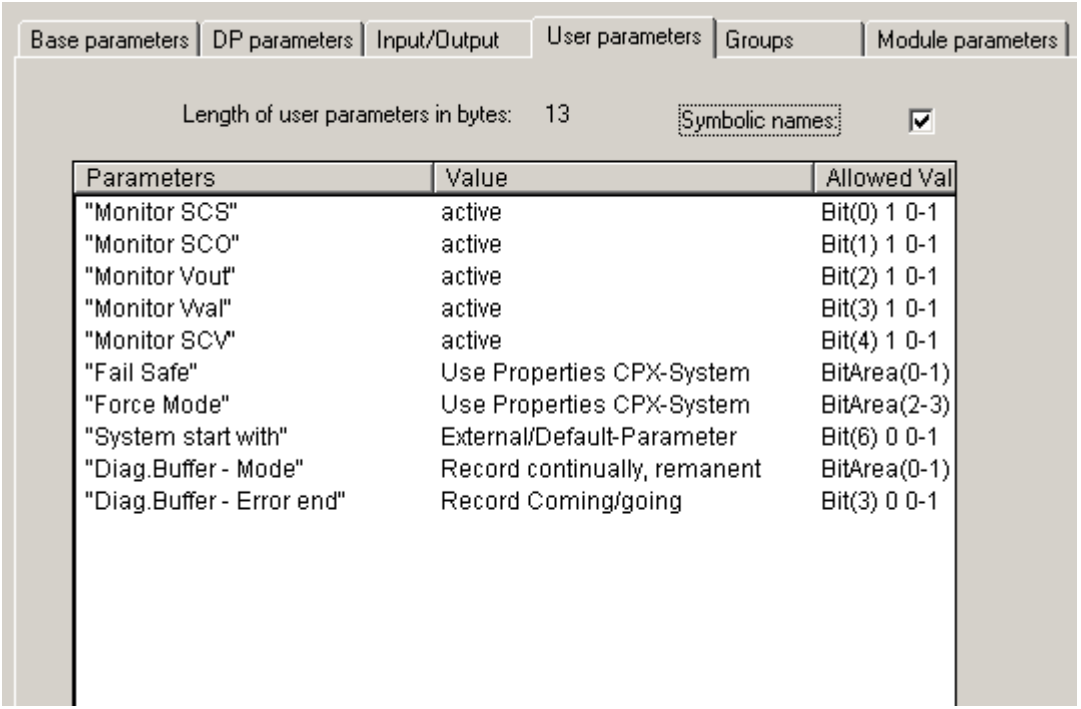

PLC Configuration - Group parameters for the FESTO node

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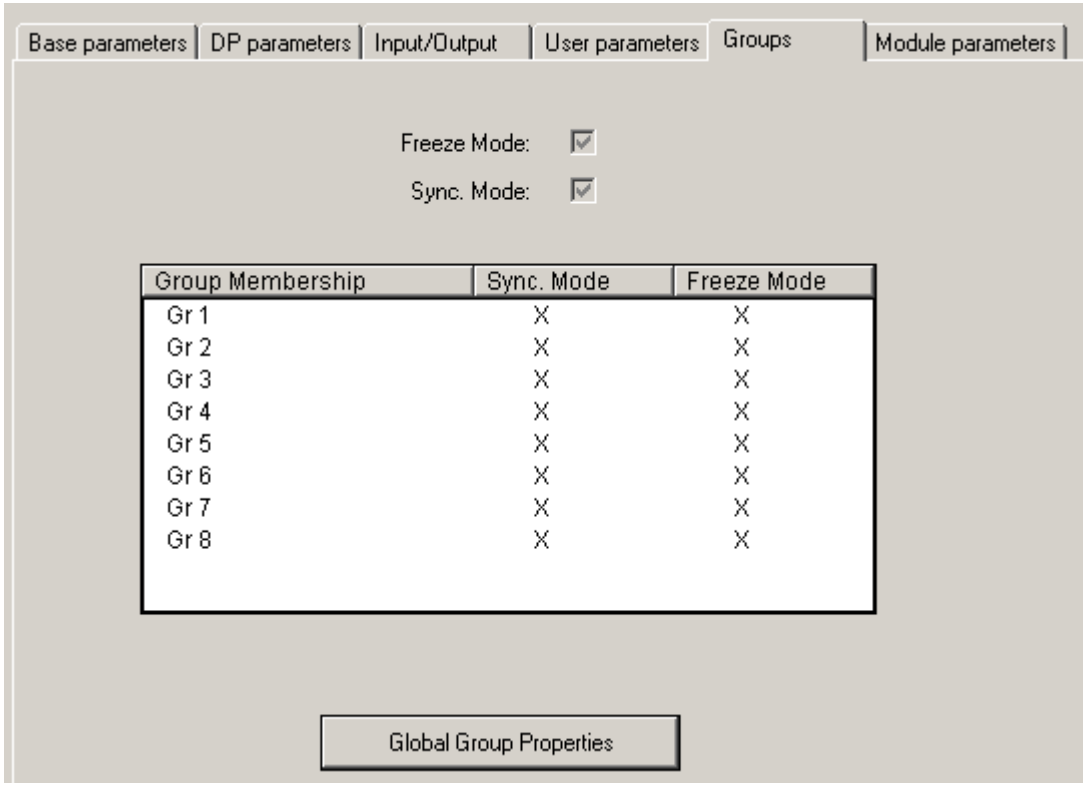
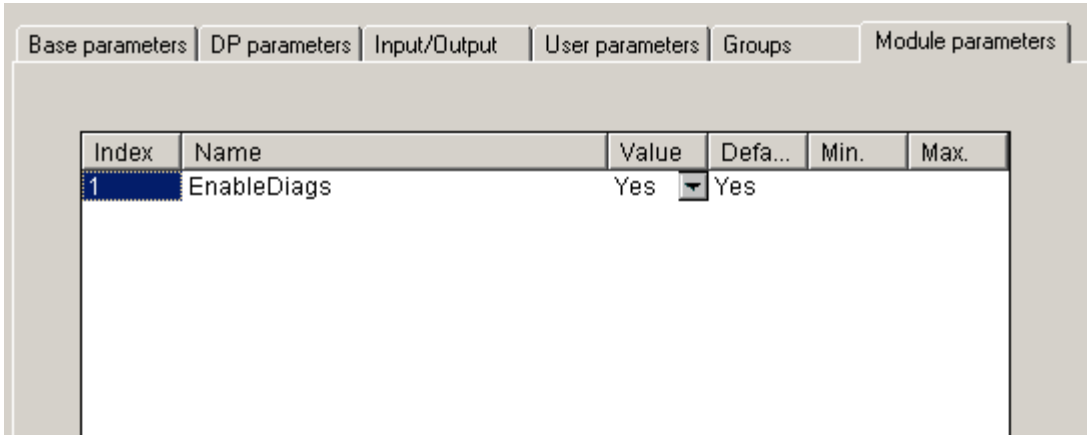


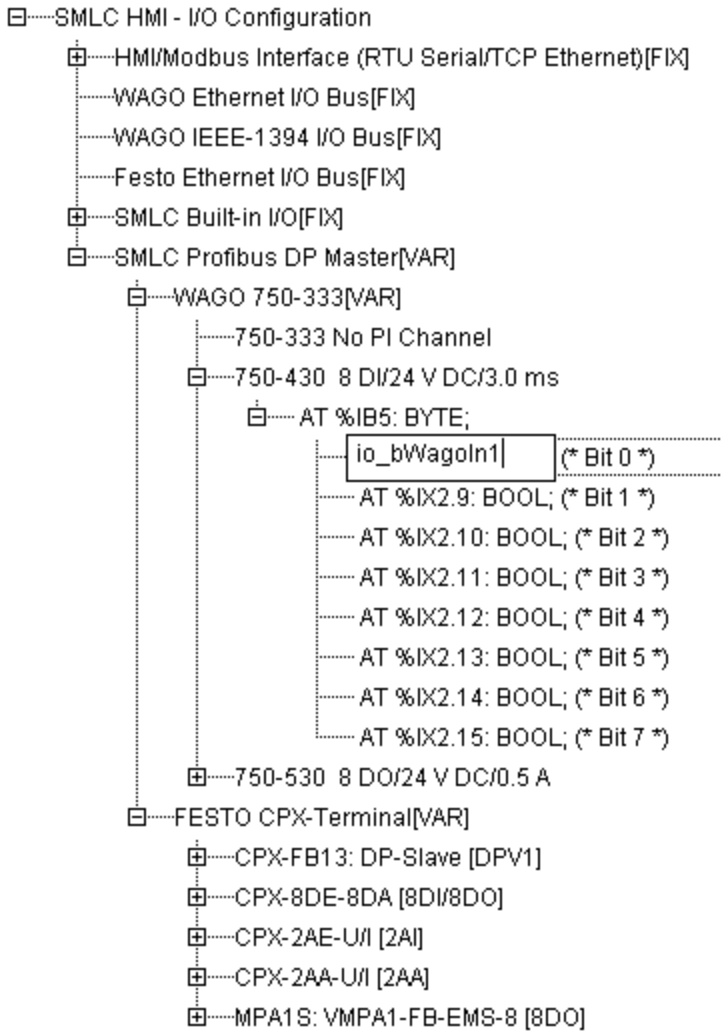
PLC Configuration - Module parameters for the FESTO node

- Go to the Module parameters tab
- Here we can set the Module parameters for this node.
- **TIP:** Leave the default setting EnableDiags = Yes. This allows you to retrieve diagnostic information from this module.



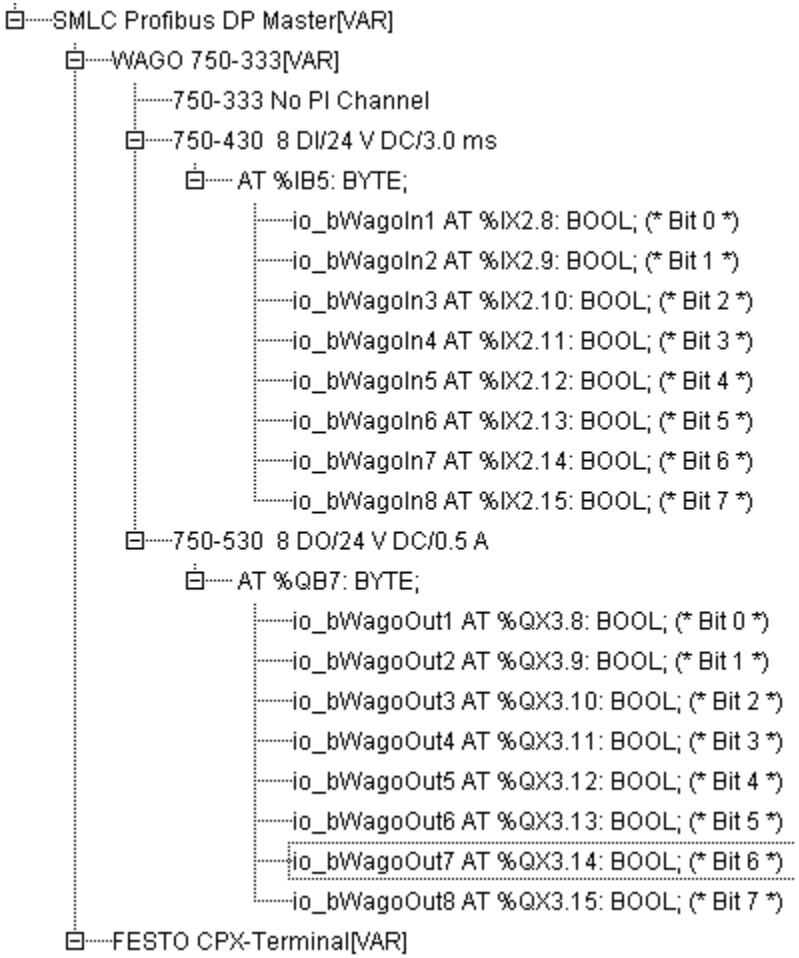
PLC Configuration - Assigning the I/O variable names

- In the PLC Configuration tree expand the Wago 750-430 module. We see that there is one byte of data. Expand the byte and we can see the individual I/O bits on this module.
- Double click on that AT for Bit 0 and enter the I/O point's name.
- This automatically creates a global variable in your program, allowing you to access this input.
- **TIP** - use a naming convention to help you identify physical I/O point amongst your program variables. We like to use the io_ prefix to indicate that it is a physical I/O point. The b indicates that it is a boolean (or bit) value. The rest of the name should provide a meaningful description of the device connected to this point. E.g. io_bJogFwdPB.



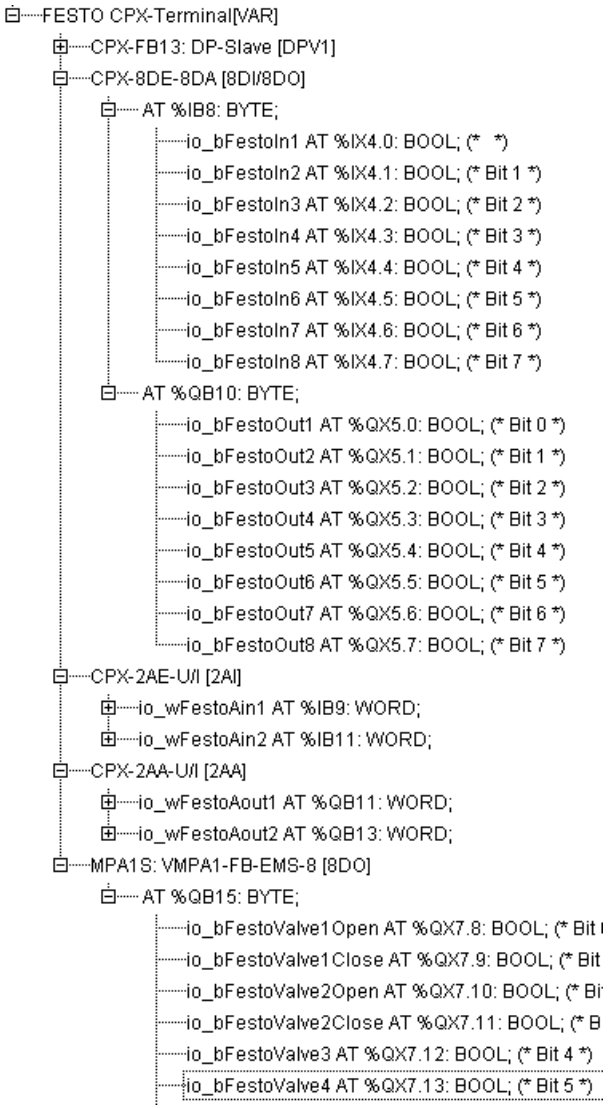
PLC Configuration - Assigning the I/O variable names

- Fill in the rest of the Wago I/O point names.



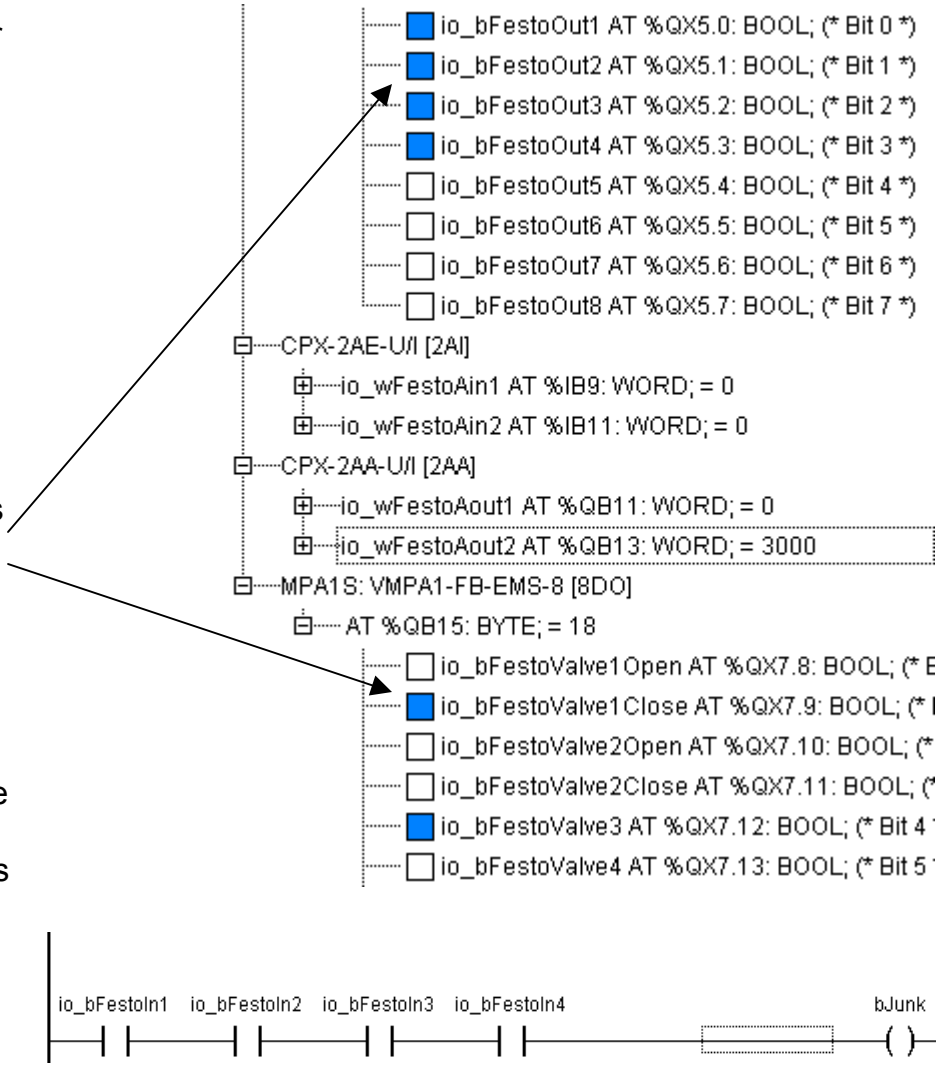
PLC Configuration - Assigning the I/O variable names

- Fill in the Festo I/O point names.
- Note that the analog inputs and outputs are Words
- Note that our valve bank has two two-way valves and two single way valves. The two way valves use one output to open the valve and one output to close the valve. The single way valves are open when on, closed when off.
- Always refer to the vendor's documentation to understand how the bits, bytes and words are mapped to a particular device.



PLC Configuration - Testing the Configuration

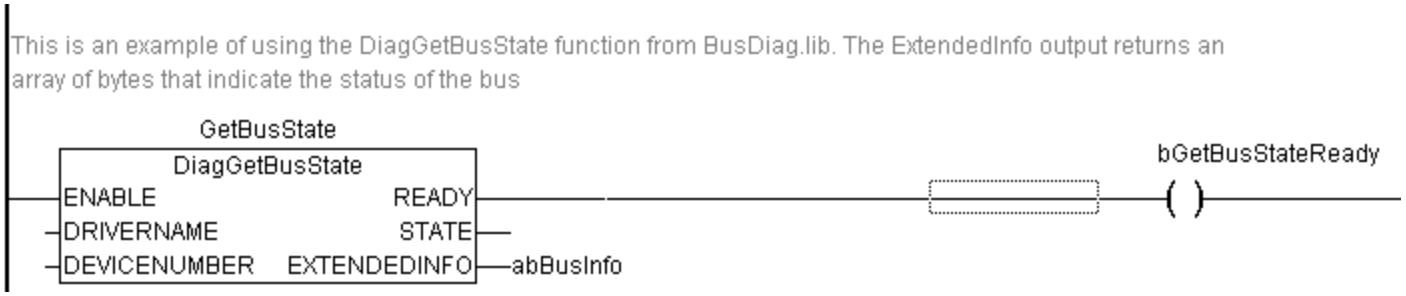
- At this point you should be able to log in to your SMLC and download this I/O configuration.
- If the bus couplers have been powered up you should see Bus Fault indications before you have downloaded the program. If you have configured everything correctly the Bus Fault indicators should go out after the program has been downloaded. If the Bus Fault indicator do not go out then proceed to the troubleshooting section of this tutorial.
- If the Bus Fault indicators did go out then you can proceed to test your I/O. Go to the PLC Configuration tree and toggle the Output points by clicking in the square before each point (or click to enter an analog value).
- **Note:** the inputs will not be updated unless you are actually using them in your program or you have checked the "Update unused I/Os" option on the General tab of the Target Settings.
- **Note**: in version 2.0.2 of the SMLC firmware the unused inputs may not update correctly even if you have checked the box on the target settings if you have more than one PROFIBUS node. If this is the case, uncheck the check box and "use" the inputs in your program, even in "junk" logic. This will allow the inputs to update correctly on the PLC Configuration screen.



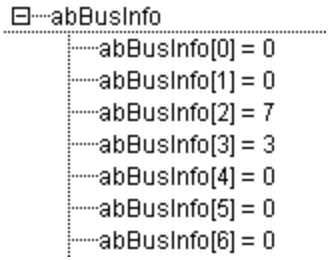
Troubleshooting the network

- The first steps in troubleshooting a PROFIBUS network are to check the obvious things
- Are all nodes powered up? Plugged into the network?
- Is the network properly terminated (terminator turned on only at the ends of the network)?
- Are the station IDs properly assigned to match the nodes?
- Have you created the configuration properly? Do all of the modules match the configuration perfectly? Did you include the correct modules for the node itself (the No PI Channel for Wago, the Status/No Status/DPV1 for the FESTO CPX).
- Try powering down all of the nodes and doing a clean all | rebuild all in CoDeSys. Download this and power all of the nodes back up.
- The I/O modules may provide status information that can direct you to the problem. For example, Wago bus couplers will flash an error code (blink code) that can pinpoint specific problems. Refer to the Diagnosis section of the Wago Profibus Bus Coupler manual (provided on the CDS-SDK CD in the Wago documentation folder).

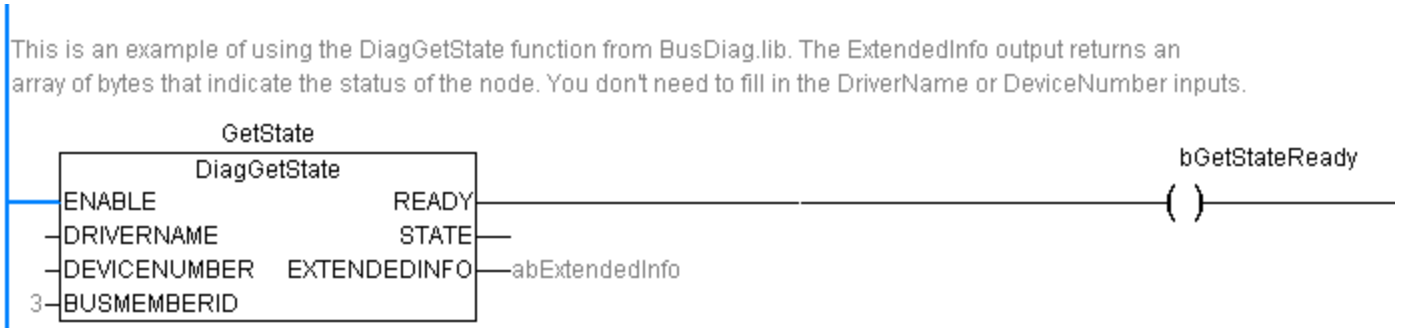
Troubleshooting the network using the BusDiag library



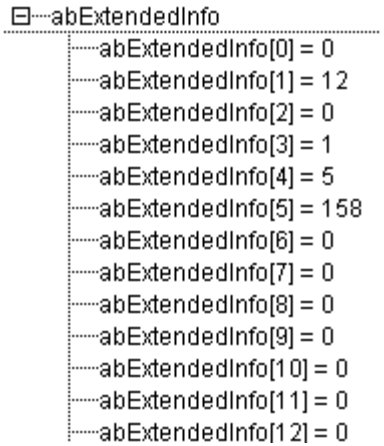
- If none of the previous trouble shooting tips worked its time to use the BusDiag function blocks.
- Insert the DiagGetBusState function block.
- It is not necessary to fill in the DRIVERNAME or DEVICENUMBER inputs
- The EXTENDEDINFO output is an array of 130 bytes declared like this:
  abBusInfo: ARRAY [0..129] OF BYTE;
- Run the program and look at the contents of the abBusInfo array.
- abBusInfo is a map of the network showing the status of each slave device. The slave's network ID is the offset into the array. In this example device 2 is the Wago 750-333 and its status is 7. The FESTO CPX is node 3 and its status is 3.



Troubleshooting the network using the BusDiag library

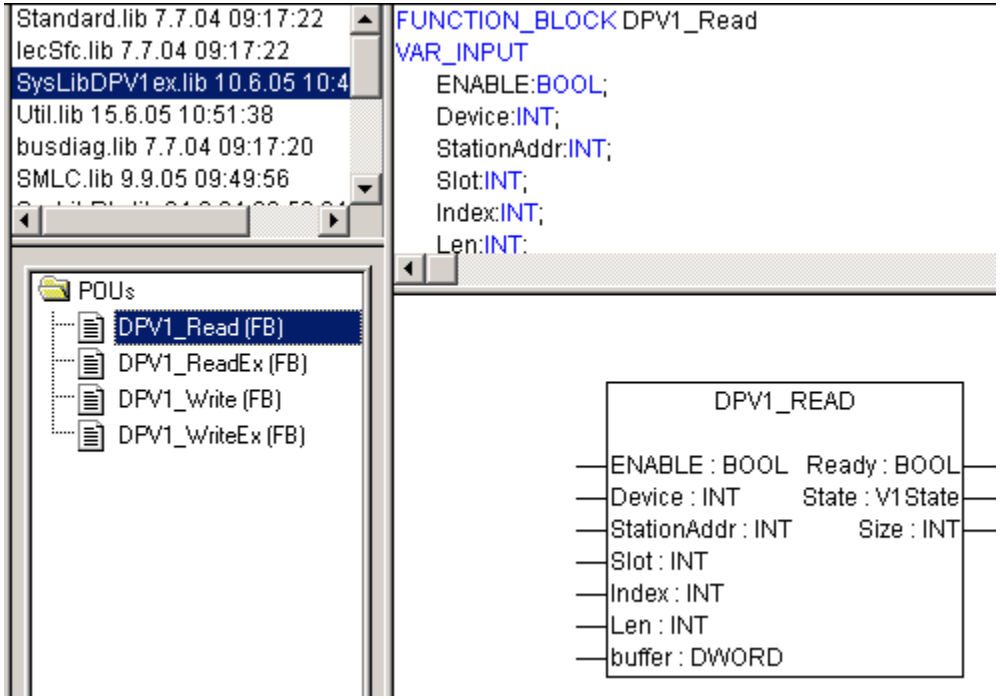


- Insert the DiagGetState function block.
- It is not necessary to fill in the DRIVERNAME or DEVICENUMBER inputs
- The BUSMEMBERID is the station address of the slave whose status we wish to read.
- The EXTENDEDINFO output is an array of 100 bytes declared like this: abBusInfo: ARRAY [0..99] OF BYTE;
- Run the program and look at the contents of the abExtenededInfo array.
- Refer to the vendors documentation to determine the meaning of the status bytes.



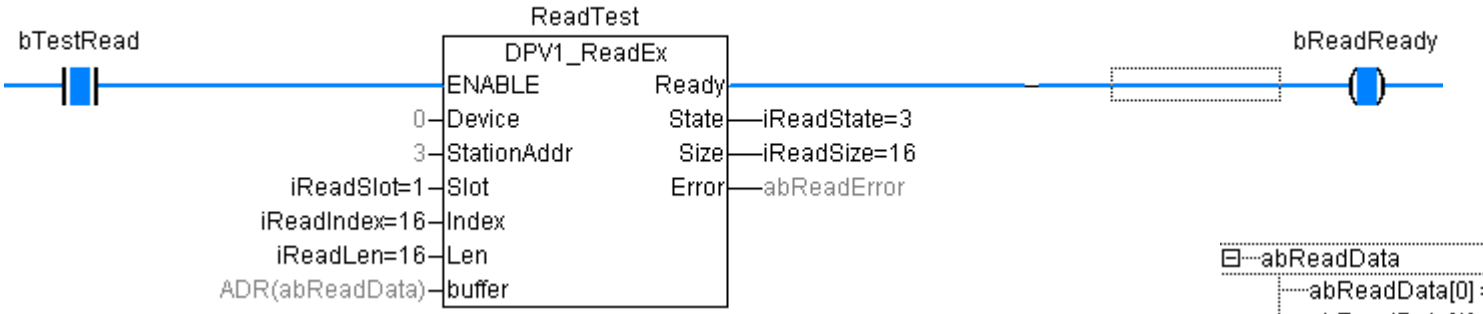
DPV1 Communications

- Recall that we inserted the SysLibDPV1ex.lib earlier (if you didn't do this then now is the time).
- This library provides the DPV1_Read and DPV1_Write function blocks
- The Ex versions add error status
- DPV1 provides asynchronous read/write capability between devices that support it.
- Not all PROFIBUS slaves support DPV1 communications. Refer to the vendors documentation be sure.
- DPV1 uses the concept of slots. These slots may correspond to physical modules/slots or virtual.
- Each slot contains data, accessible by an index



- DPV1 supports 0-255 slots per device with 0-255 indices per slot. Each index may contain up to 240 bytes of data. Refer to the vendor documentation for the device to determine what it supports.
- In our example we will communicate with a FESTO CPX-FB13 which supports slots 1,2,3 and 100-147. Slots 1 contains system parameters, Slot 2 contains Channel-specific module parameters and Slot 3 contains indexed addressing of objects. Slots 100-147 contain Module data and module parameters.

DPV1 Read

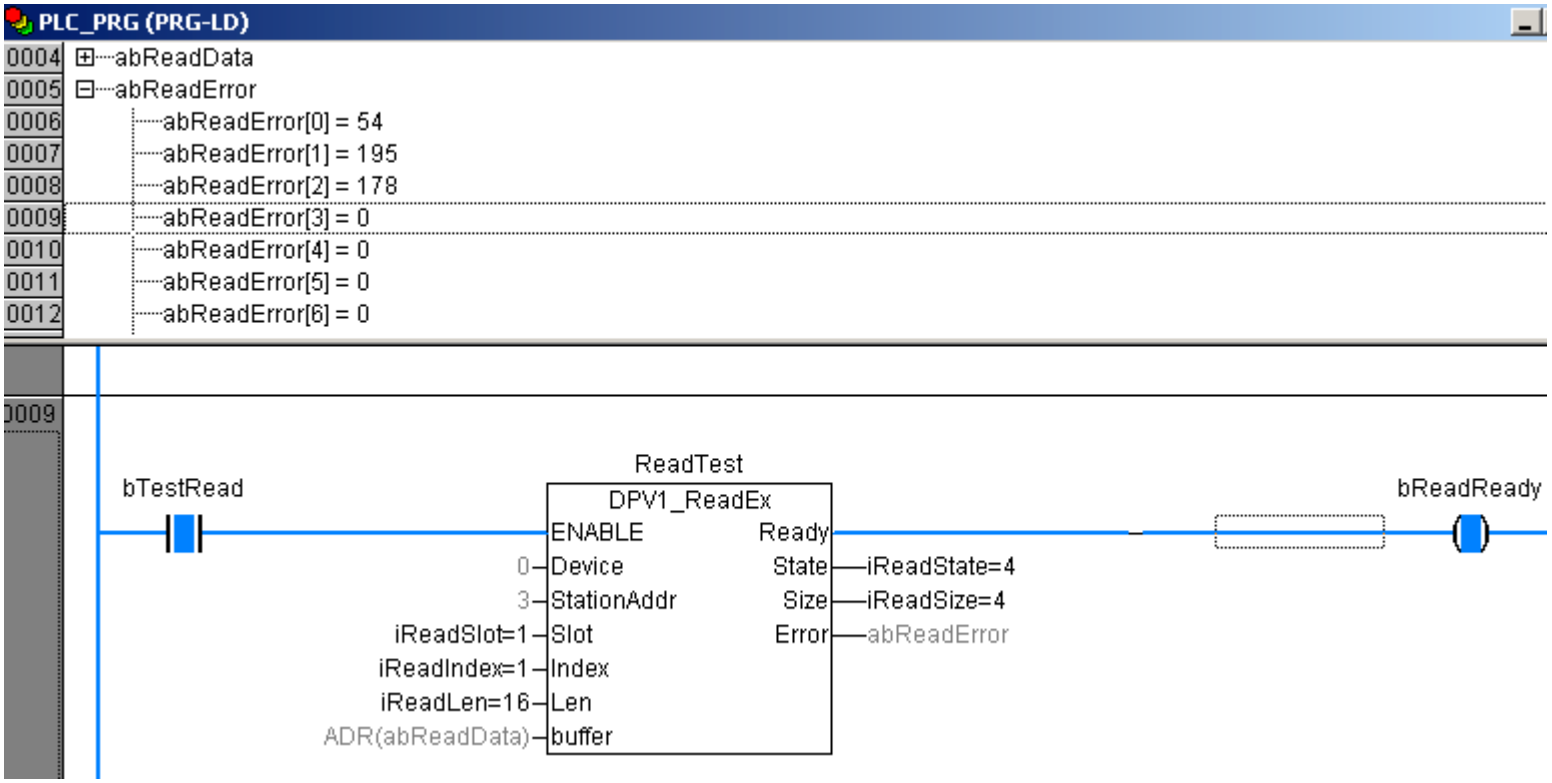


- abReadData
  - abReadData[0] = 1
  - abReadData[1] = 0
  - abReadData[2] = 31
  - abReadData[3] = 34
  - abReadData[4] = 0
  - abReadData[5] = 0
  - abReadData[6] = 0
  - abReadData[7] = 14
  - abReadData[8] = 0
  - abReadData[9] = 0
  - abReadData[10] = 0

- Insert the DPV1_ReadEx function block.
- Enter 0 for the Device input (or leave blank)
- The StationAddr is the station address of our node (3)
- In this example we will read from Slot 1 - System Data, Index 16 which contains 16 bytes worth of data.
- We can see that executing the function block returns a state 3 which indicates Done, without error. A state of 4 indicates Done, with error.
- The function block tells us that it was able to read 16 bytes.
- The read data is placed into the input buffer that we passed the address of to the function block. abReadData is defined as ARRAY[0..239] OF BYTE
- If an error had occurred (state = 4) then the error status would have been placed into abReadError which is defined as ARRAY[0..7] OF BYTE.

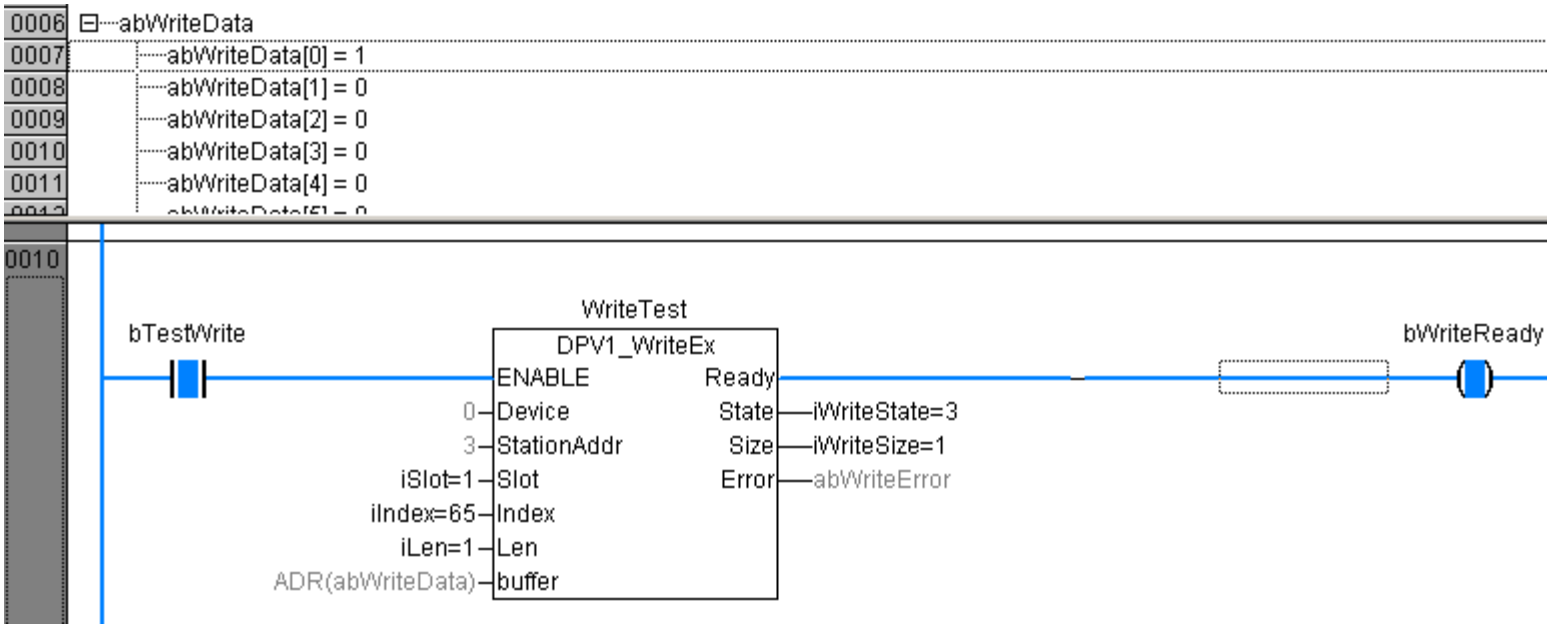
- abReadError
  - abReadError[0] = 0
  - abReadError[1] = 0
  - abReadError[2] = 0
  - abReadError[3] = 0
  - abReadError[4] = 0
  - abReadError[5] = 0
  - abReadError[6] = 0
  - abReadError[7] = 0

DPV1 Read w/Error



- In this example we try to read an invalid Index (1) for Slot 1. The function block returns State 4 (Done, with Error) and we can see the error codes in the abReadError byte array.
- Refer to the vendor documentation for the meaning of the error codes.

DPV1 Write



- For our DPV1_Write example we will clear the diagnostic memory of the CPX-FB13 by writing to Slot 1, Index 65.
- Insert the DPV1_WriteEx function block. The Device input is 0 (or blank), the station address is 3, the slot number is 1, the Index is 65 and the length is 1
- Enter the value you wish to write into the abWriteData array which is defined as ARRAY[0..239] OF BYTE
- Send the message. In this example we can see that the State is 3 which is Done, No error
- Always refer to the vendor documentation for the details on which slots and indexes are available to write to.

Conclusion

- This concludes the SMLC/PROFIBUS DP Master tutorial
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