# IO-Link CTL50 Master Add-On Instruction Guide, v5
# June 8th, 2026

This document covers the installation and use of **optional** Add-On Instructions (AOIs) for the Logix Designer software package from Rockwell Automation. This AOI handles acyclic (Parameter Data) IO-Link commands from various IO-Link Masters.

**All the IO-Link Master AOIs are meant to be used in conjunction with the Banner_IOL_CTL50_Parmaeter_AOI.**

**Download files on BannerEngineering.com under the CTL50 IO-Link Device Page**

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# 1. DXMR IO-Link Setup

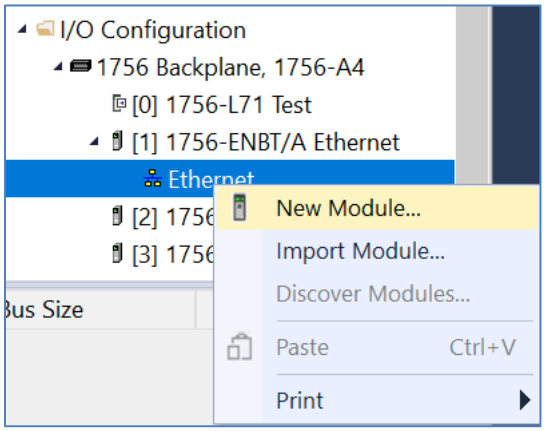
This section describes how to install the DXMR into Studio 5000 and configure the AOI used Studio 5000.

**Create DXMR Connection**

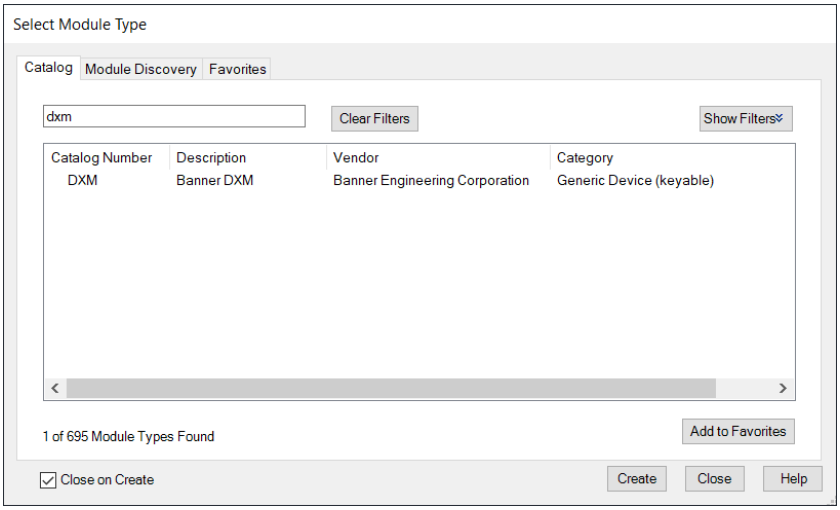
Make an EtherNet/IP connection to the Banner IO-Link Master.

1. There are two ways to create a connection to the DXMR.
    a. If an EDS will be used go to Step 2.
    b. If a generic connection will be used go to Step 3.

2. EDS setup instructions.
    a. Create an Ethernet communications module for the Banner DXMR IO-Link Master device.

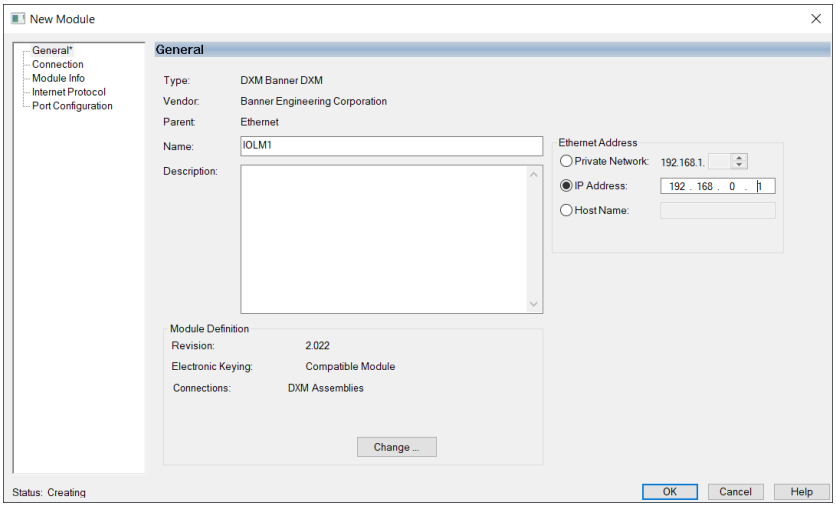



    b. The “Select Module Type” window will pop-up.
        i. Search DXM.



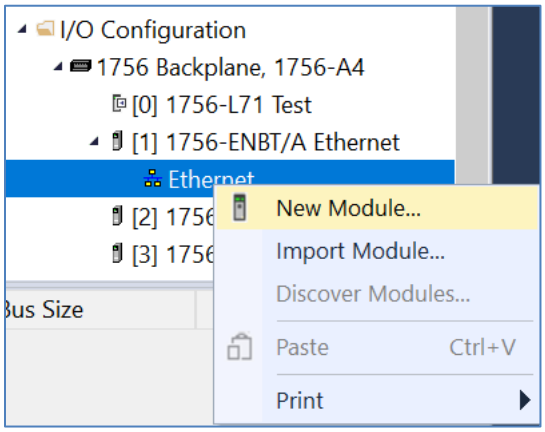

    c. Select “DXM” option.

d. The “New Module” window will open.

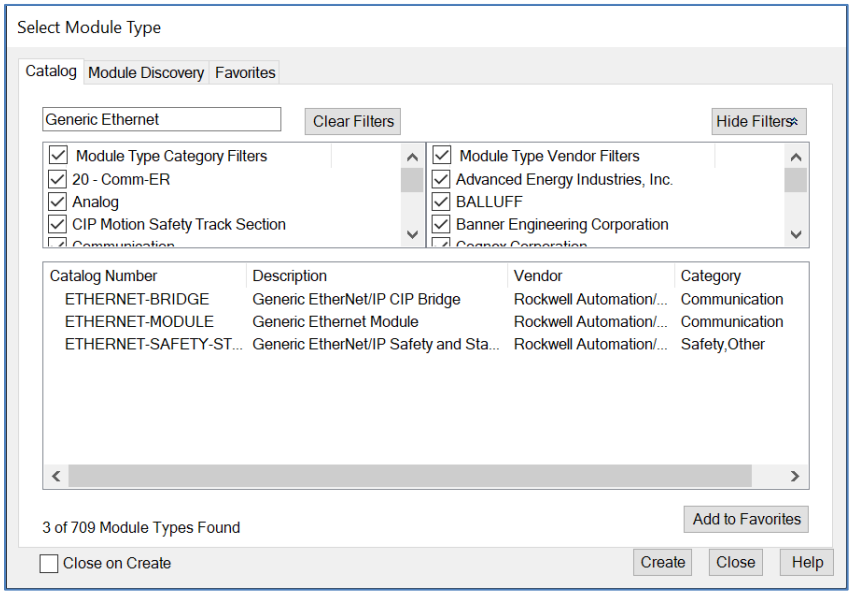



e. Enter the Name of the unit and an IP Address.
f. The data is defaulted as SINT. This is the data type that is used for a DXMR IO-Link models.
g. EDS setup is complete.

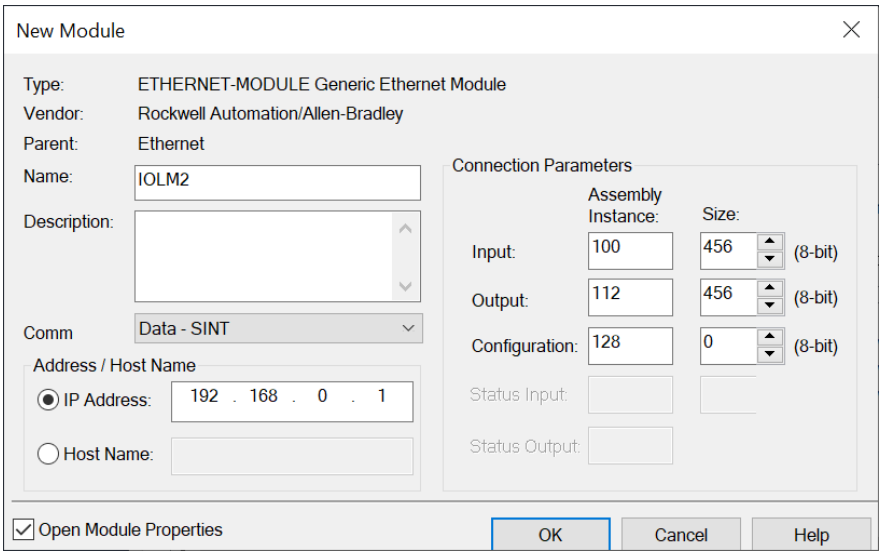
3. Generic Ethernet Module Setup.
   a. Create an Ethernet communications module for the Banner DXMR90 IO-Link Master.



b. The “Select Module Type” window will pop-up. Search for Generic Ethernet.

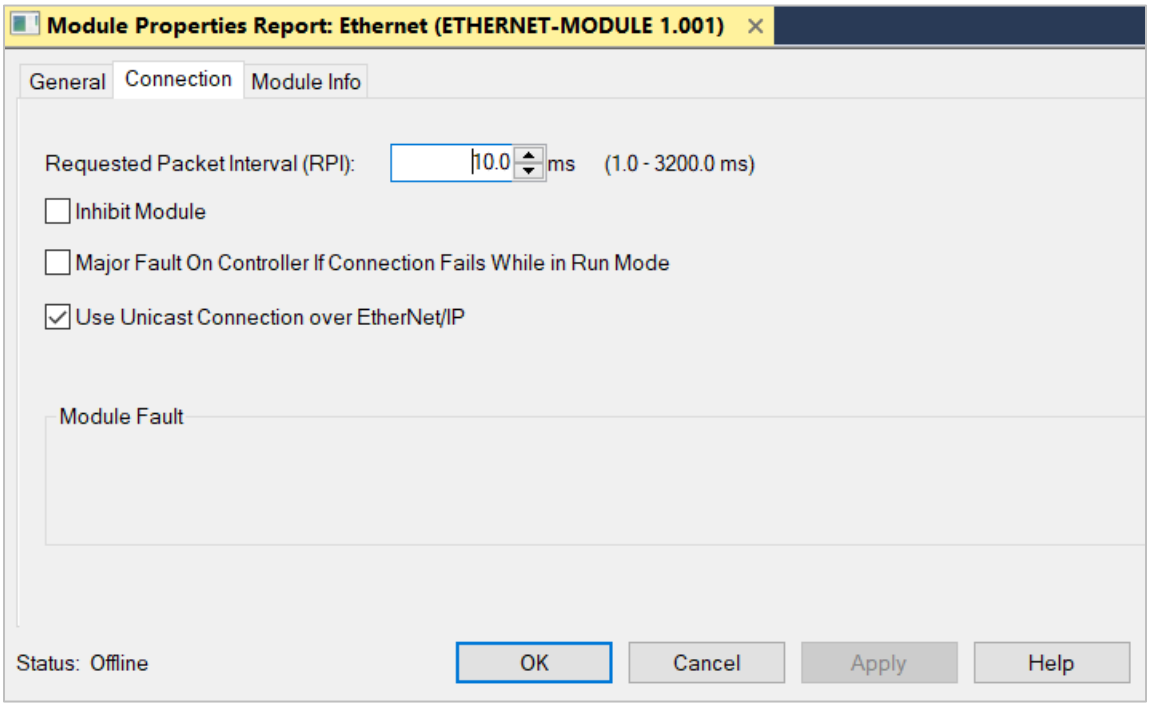



c. Select the “Ethernet-Module” option.
d. The “New Module” window will open.
e. Make the following changes.
   i. Change the Comm type from Data – DINT to Data – SINT.
   ii. Name the unit. (The example uses IOLM2).
   iii. Connection Parameters are Input 100 and Size 456, Output 112 and Size of 456, and Configuration 128 and Size 0.
   iv. Enter the IP Address of the DXMR90-4K (192.168.0.1 was used in this example).
   v. Press the OK button to finalize the changes.



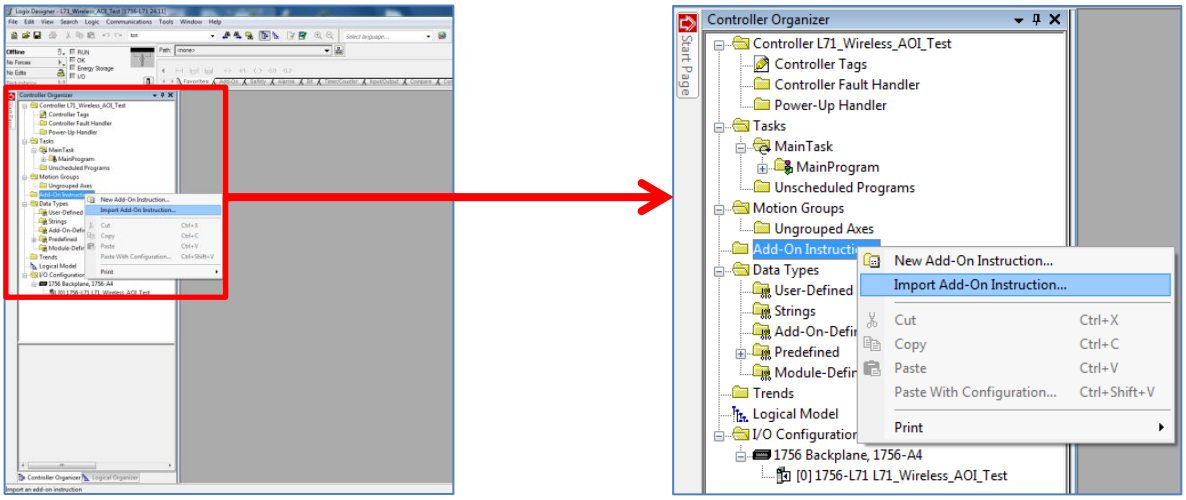

f. The “Module Properties Report” window will pop-up.
g. If the Connection tab is not active, press it to activate it.

h. The RPI (Requested Packet Interval) should be set to 20. This number may need to be increased depending on the unit's operation in the system.
i. Press OK to finalize the settings.

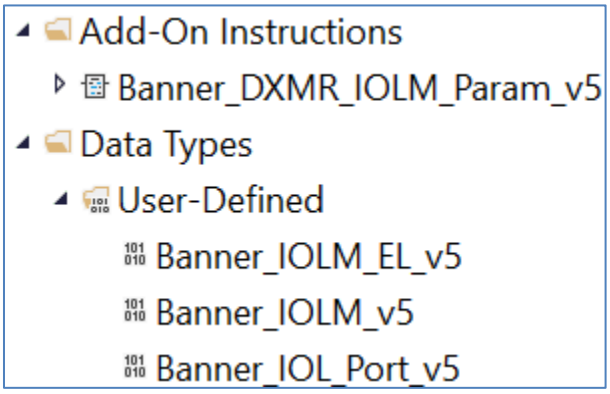


## DXMR AOI Installation

1. Open a project.
2. In the Controller Organizer window, right-click on the Add-On Instruction folder. Select the Import Add-On Instruction option.

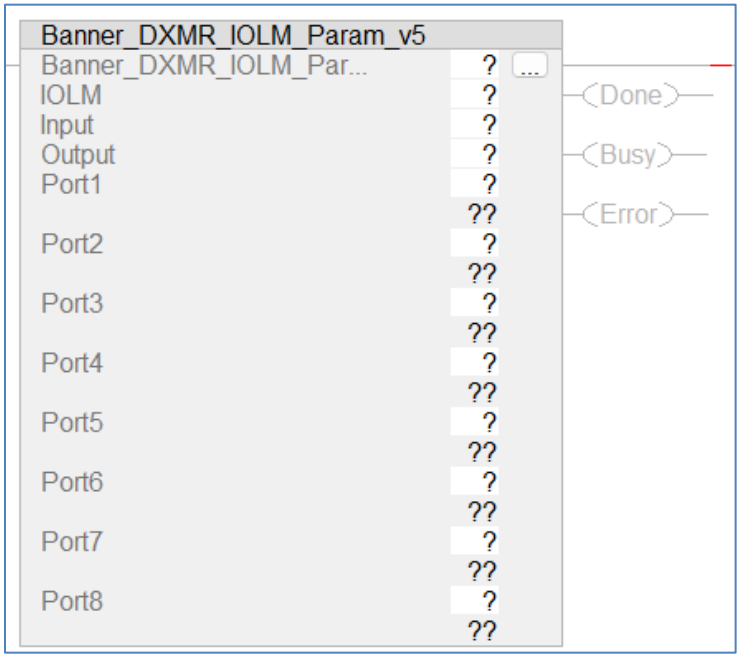



3. Navigate to the correct file location and select the AOI to be installed. In this example the "Banner_DXMR_IOLM_v5_AOI.L5X" file will be selected. Click the Open button.
4. The Import Configuration window will pop up. The default selection will create all the necessary items for the AOI. Click the OK button to complete the import process.
5. The AOI is added to the Controller Organizer window and should look like the image shown.
6. AOI installation into the Logix Designer software complete.



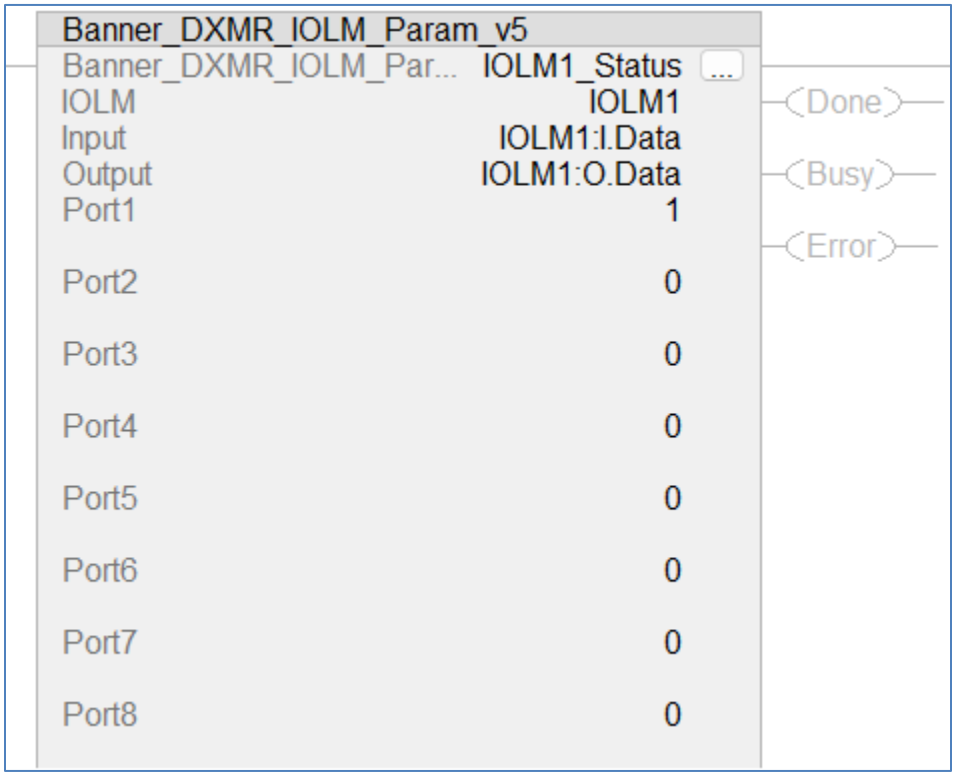
**DXMR AOI Configuration**

1. Add the "Banner_DXMR_IOLM_Param_v5" AOI to your ladder logic program. For each of the question marks shown in the instruction we need to create and link a new tag array. The AOI includes a new type of User Defined Tag (UDT): a custom array of tags meant specifically for this AOI.




2. In the AOI, right-click on the question mark on the line labeled "Banner_DXMR_IOLM_Param_v5". Click New Tag. In this example, we'll use the name "IOLM1_Status". The example naming convention accounts for this being the #1 IO-Link Master in our program. More masters could be named IOLM2, IOLM3, etc.
3. Now create a new tag array for the "IOLM" line in the AOI. Here we used the name "IOLM1". The tags created here will serve as linkages between the IO-Link Master AOI and the connected Banner device AOI(s). This group of tags also controls the flow of information to and from the master, ensuring that all sensors get a chance to read and write in an orderly fashion.
4. Link the Input line to the Input data from DXMR. Here the DXMR was called IOLM1, so the tag needed is IOLM1:I.Data.
5. Link the Output line to the Output data from DXMR. The tag needed is IOLM1:O.Data.
6. Port 1 Through 8 tells the AOI which ports are controlled. Set the Port value to 1 if controlled and 0 if not controlled.

7. The completed AOI should look like the below image.



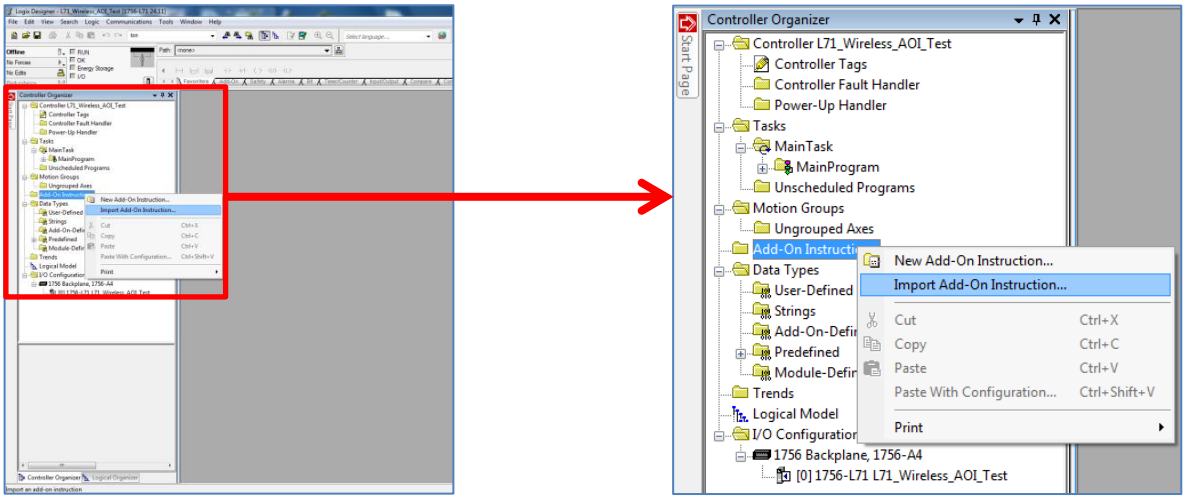

8. AOI configuration complete.
9. Go to the Import Device Data and Rule Set for Banner IOL Parameter AOI section to complete setup.

# 2. Allen Bradley 1732 & 1734 IO-Link Master Setup

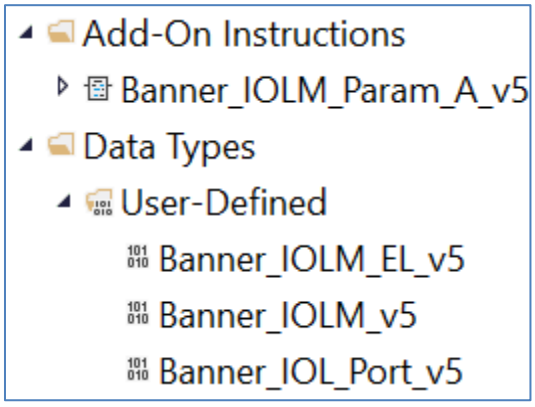
Ensure that the Allen Bradley IO-Link Master connection has been created in Studio 5000 before proceeding.

**AB AOI Installation**

1. Open a project.
2. In the Controller Organizer window, right-click on the Add-On Instruction folder. Select the Import Add-On Instruction option.

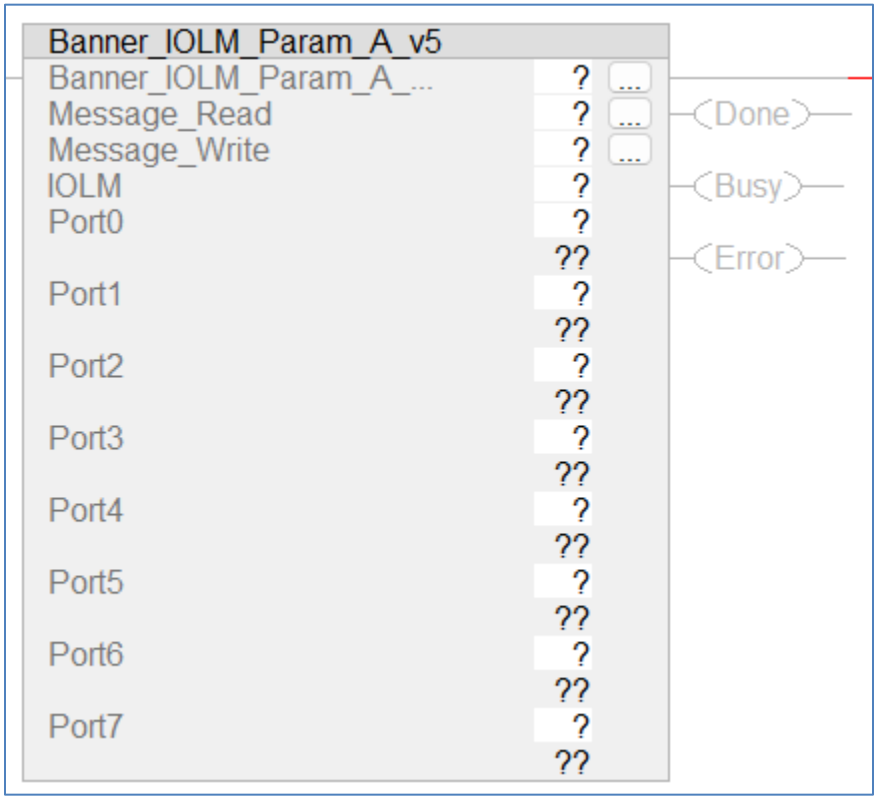



3. Navigate to the correct file location and select the AOI to be installed. In this example the "Banner_IOLM_Param_A_v5_AOI.L5X" file will be selected. Click the Open button.
4. The Import Configuration window will pop-up. The default selection will create all the necessary items for the AOI. Click the OK button to complete the import process.
5. The AOI is added to the Controller Organizer window and should look like the image shown.
6. AOI installation into the Logix Designer software complete.



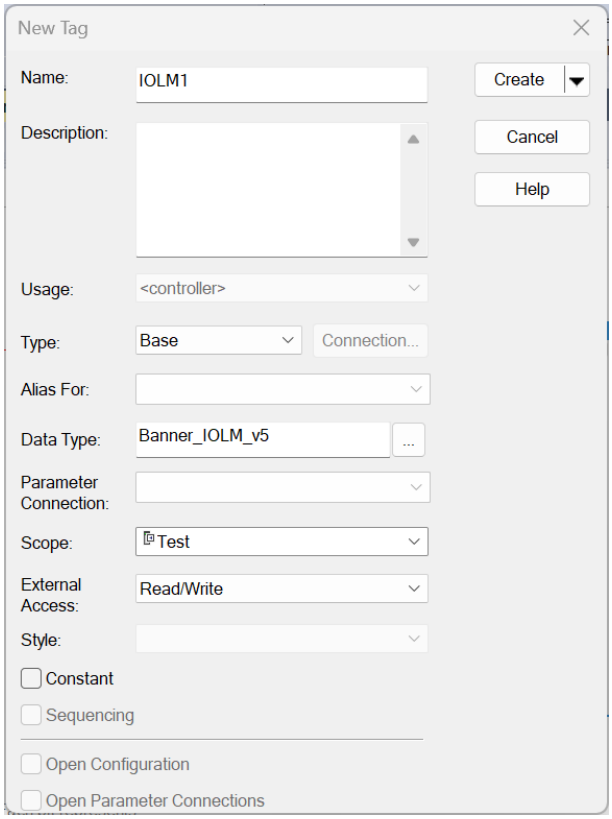
**AB AOI Configuration**

1. Add the "Banner_IOLM_Param_A_v5" AOI to your ladder logic program. For each of the question marks shown in the instruction we need to create and link a new tag array. The AOI includes a new type of User Defined Tag (UDT): a custom array of tags meant specifically for this AOI.



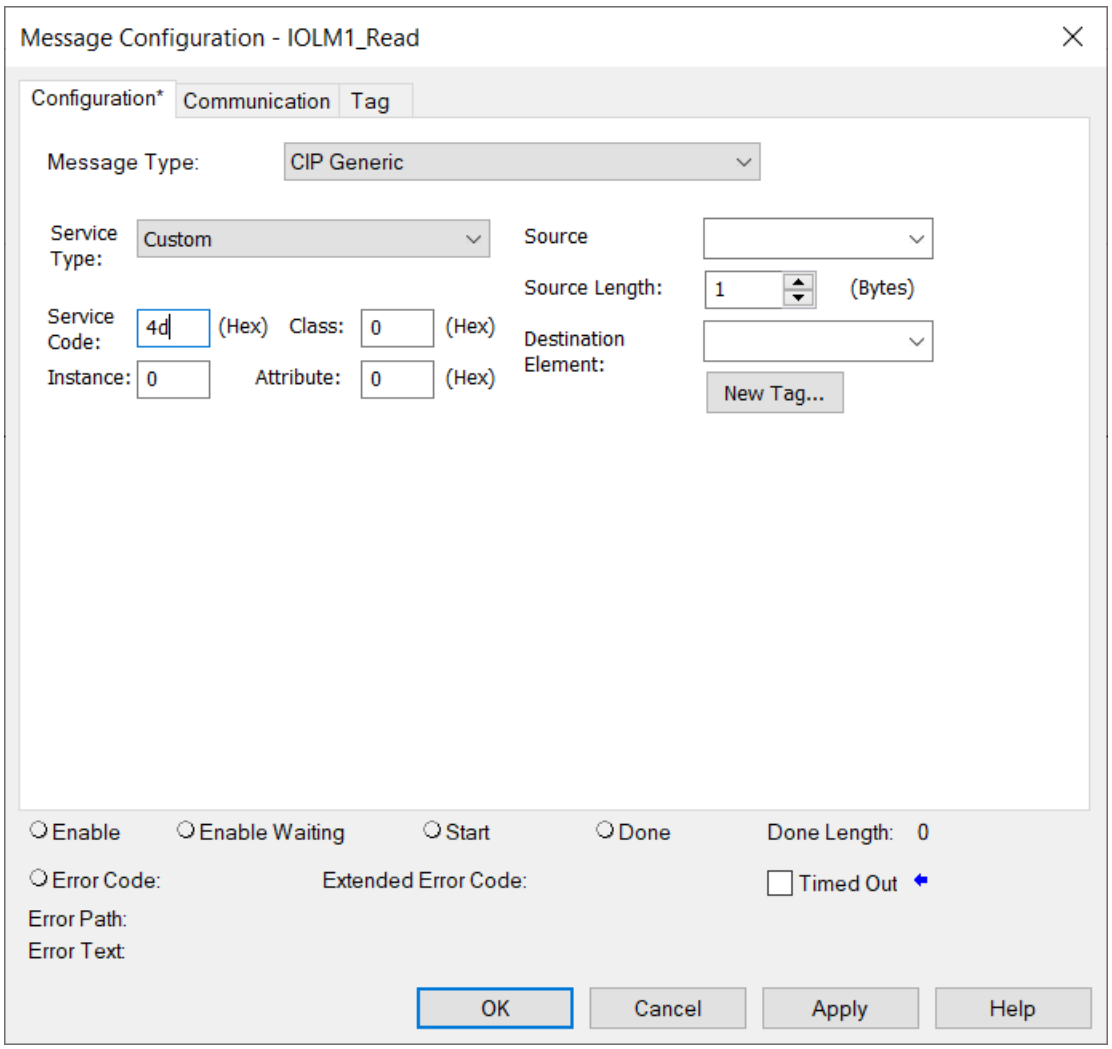

2. In the AOI, right-click on the question mark on the line labeled "Banner_IOLM_Param_A_v5". Click New Tag. In this example, we'll use the name "IOLM1_Status". The example naming convention accounts for this being the #1 IO-Link Master in our program. More masters could be named IOLM2, IOLM3, etc.
3. Now set up the Messages used to read and write to devices connected to this IO-Link Master. Right-click on the question mark for Message_Read line in the AOI and choose New Tag. In this example we'll use the tag name IOLM1_Read. Click Create.
4. Do the same for the Message_Write line in the AOI.

5. Now create a new tag array for the “IOLM” line in the AOI. Here we used the name “IOLM1”. The tags created here will serve as linkages between the IO-Link Master AOI and the connected Banner device AOI(s). This group of tags also controls the flow of information to and from the master, ensuring that all sensors get a chance to read and write in an orderly fashion.

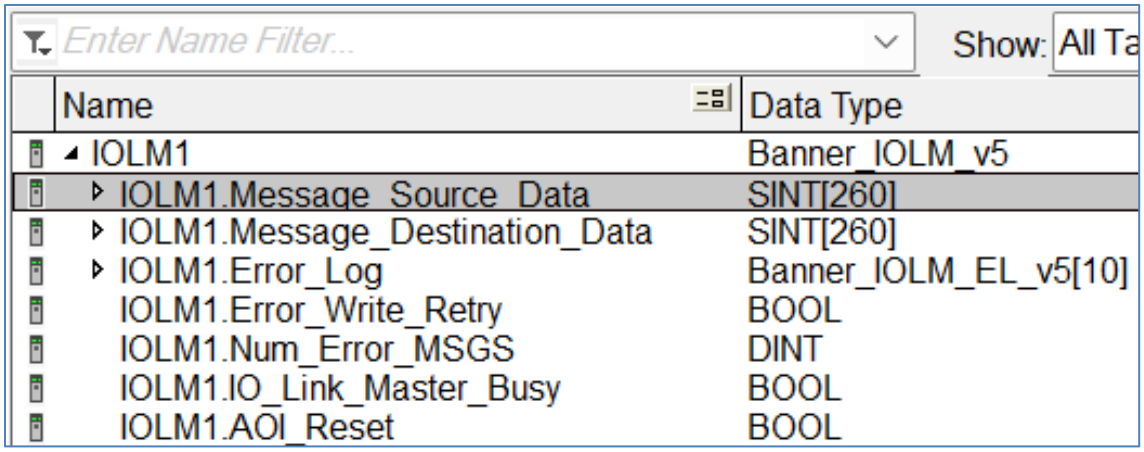



6. Now configure “Message_Read”, setting up the Explicit Message that will handle half of the communications between the PLC and the IO-Link Master. Click on the “…” button at the far right of the “Message_Read” line.

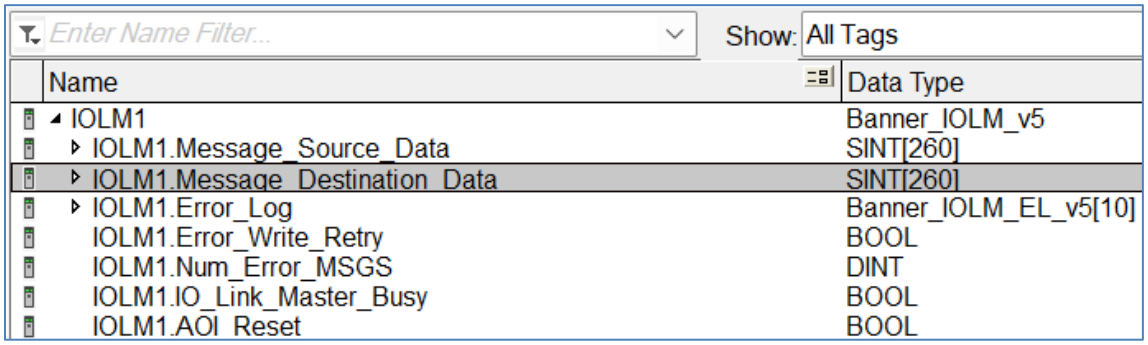
7. In the Message Configuration window, keep the Message Type “CIP Generic” and the Service Type “Custom”. Enter a Service Code of 4d.



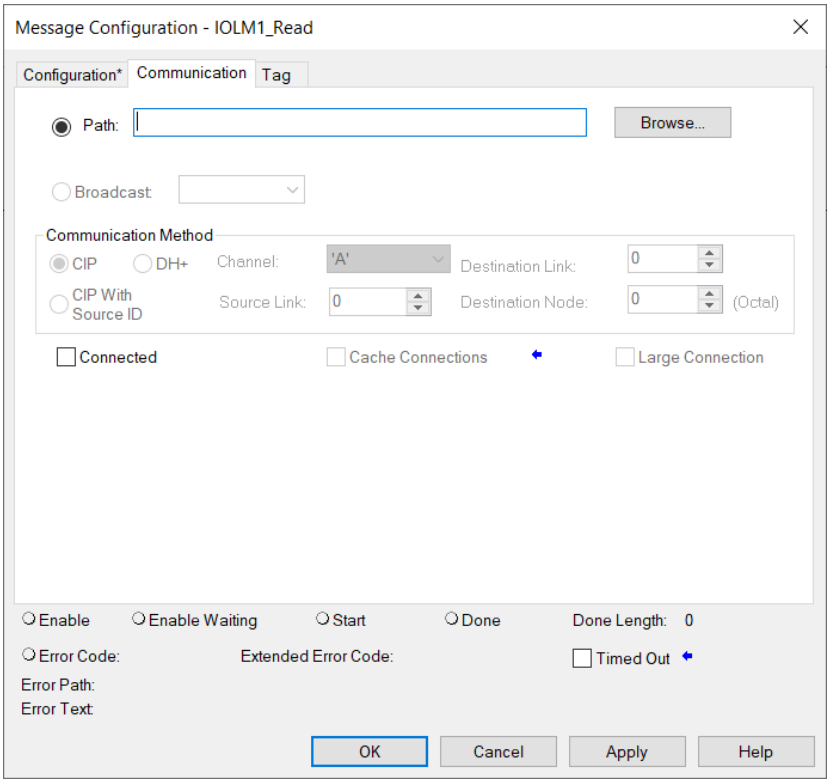
8. For the Source Element field, select “IOLM1.Message_Source_Data”.



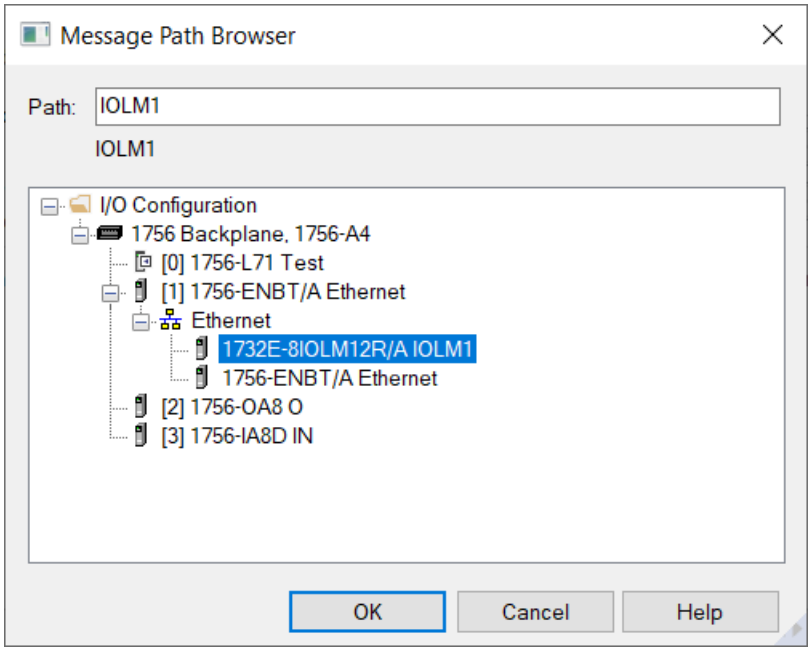

9. For Destination Element, select “IOLM1.Message_Destination_Data”.



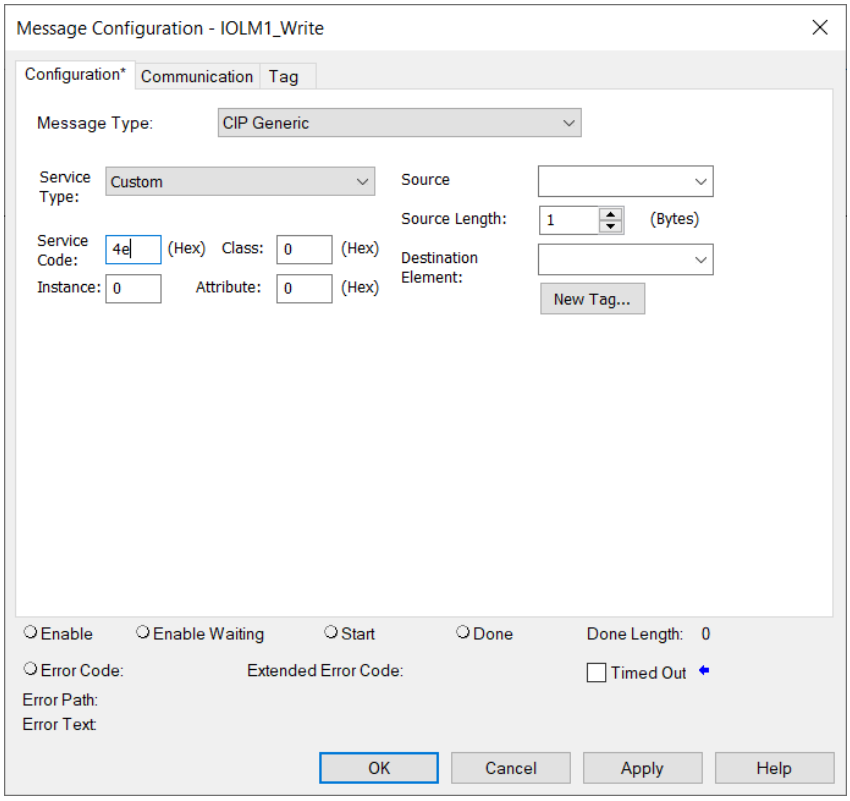
10. Now click on the Communication tab, then click the Browse button.



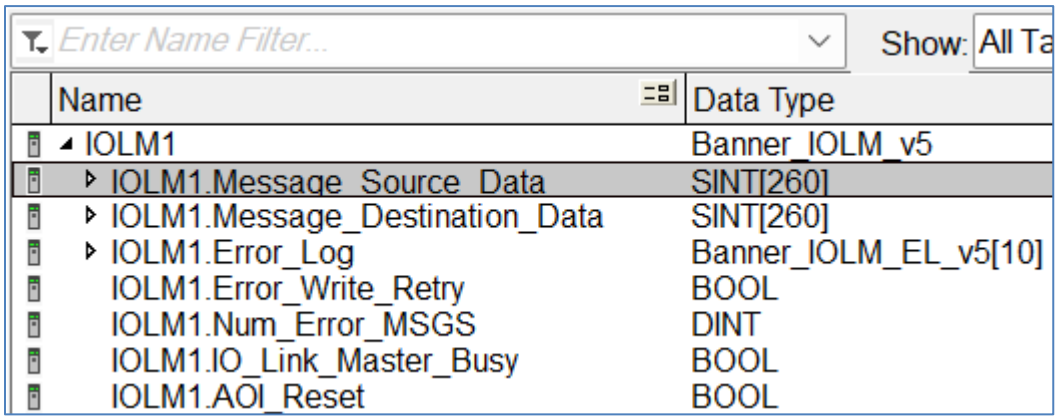

11. Select the IO-Link Master, then click OK to close the Message Path Browser window, then click OK again to close the Message Configuration window.



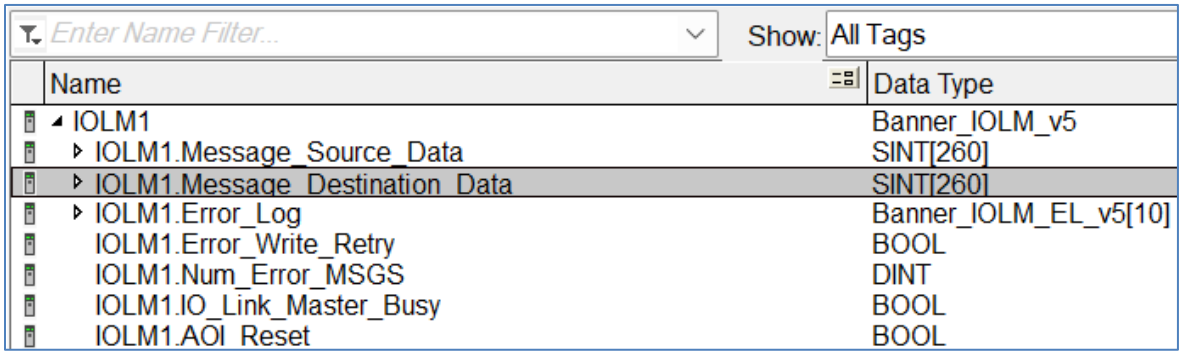
12. Now configure “Message_Write”, setting up the Explicit Message that will handle the other half of the communications between the PLC and the IO-Link Master. Click on the “…” button at the far right of the “Message_Write” line.
13. In the Message Configuration window, keep the Message Type “CIP Generic” and the Service Type “Custom”. Enter a Service Code of 4e.



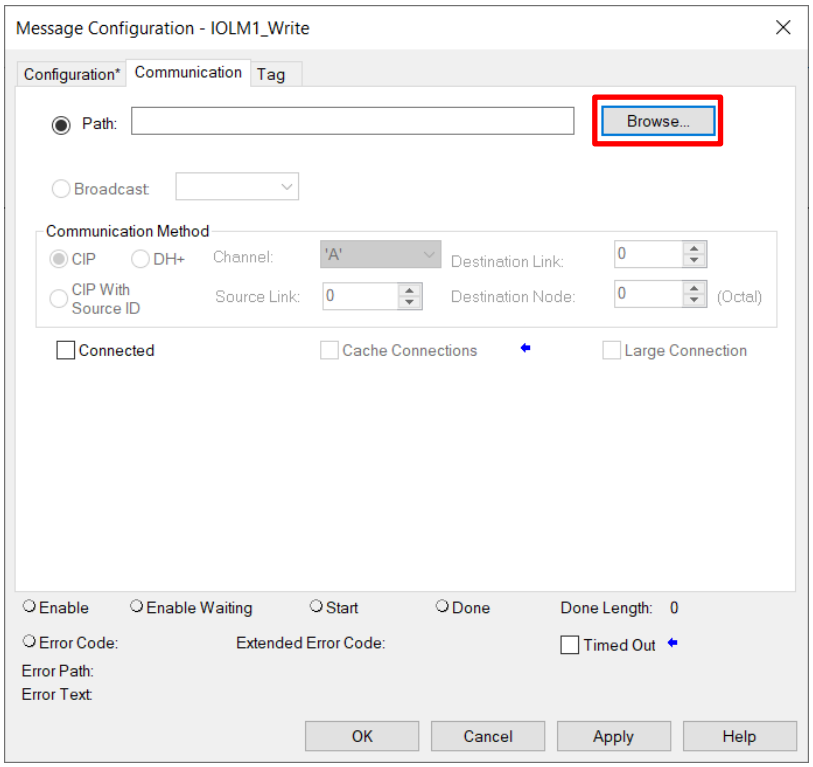

14. For the Source Element field, select “IOLM1.Message_Source_Data”.



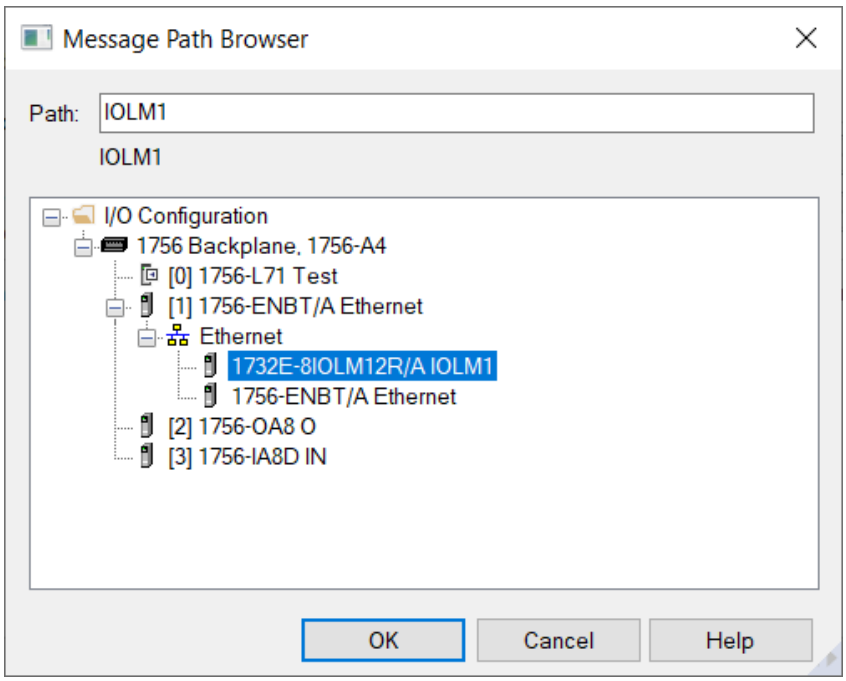
15. For Destination Element, select “IOLM1.Message_Destination_Data”.




16. Now click on the Communication tab, then click the Browse button.

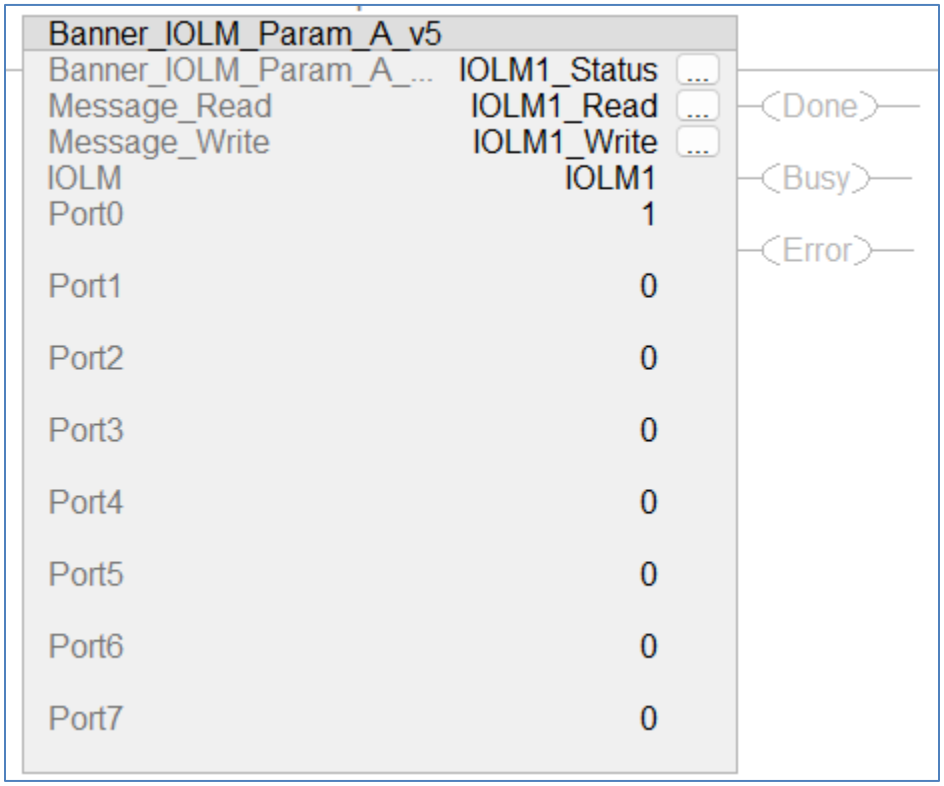


17. Select the IO-Link Master, then click OK to close the Message Path Browser window, then click OK again to close the Message Configuration window.




18. Port 1 Through 8 tells the AOI which ports are controlled. Set the Port value to 1 if controlled and 0 if not controlled. In this example, port 1 will be the only port controlled.

19. The completed AOI should look like the below image.



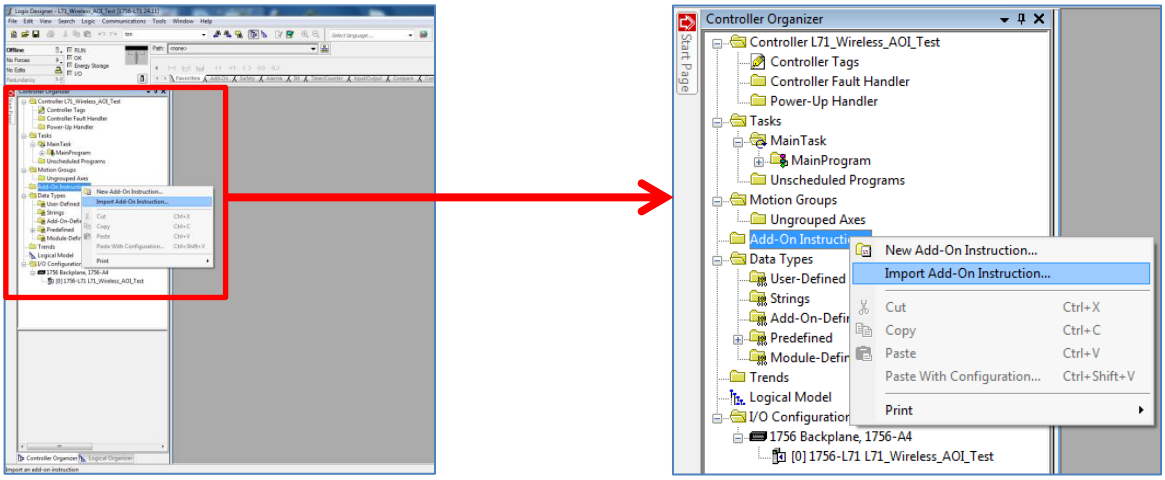

20. AOI configuration complete.
21. Go to the Import Device Data and Rule Set for Banner IOL Parameter AOI section to complete setup.

# 3. Allen Bradley 5032 IO-Link Master Setup

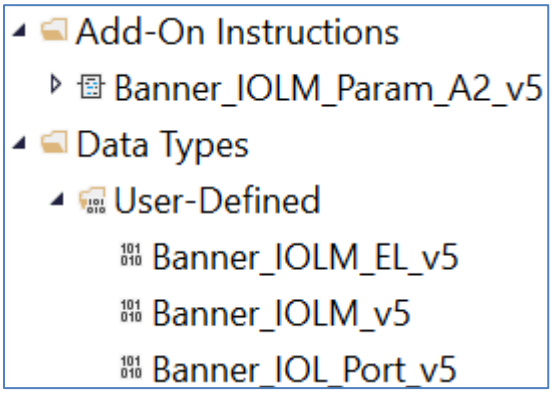
Ensure that the AB 5032 IO-Link Master connection has been created in Studio 5000 before proceeding.

**5032 AOI Installation**

1. Open a project.
2. In the Controller Organizer window, right-click on the Add-On Instruction folder. Select the Import Add-On Instruction option.

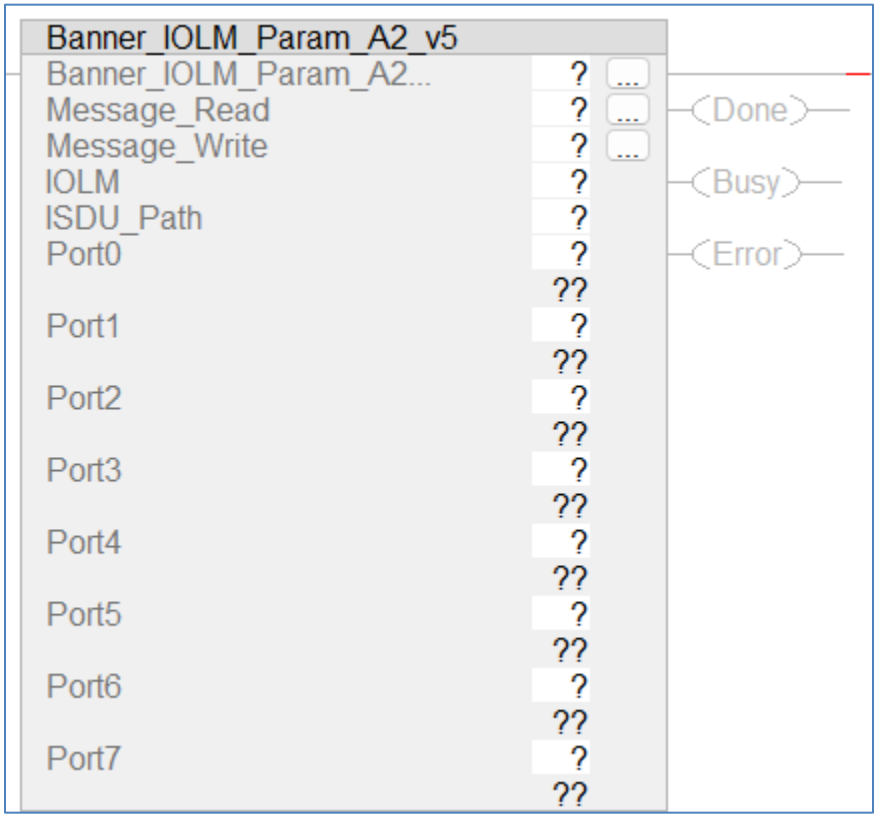



3. Navigate to the correct file location and select the AOI to be installed. In this example the "Banner_ IOLM_Param_A2_v5_AOI.L5X" file will be selected. Click the Open button.
4. The Import Configuration window will pop up. The default selection will create all the necessary items for the AOI. Click the OK button to complete the import process.
5. The AOI is added to the Controller Organizer window and should look like the image to the right.
6. AOI Installation into the Logix Designer software complete.



**5032 AOI Configuration**

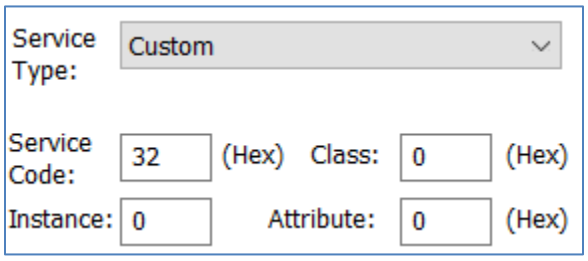
1. Add the "Banner_IOLM_Param_A2_v5" AOI to your ladder logic program. For each of the question marks shown in the instructions we need to create and link a new tag. The AOI includes a new type of User Defined Tag (UDT): a custom array of tags meant specifically for this AOI.



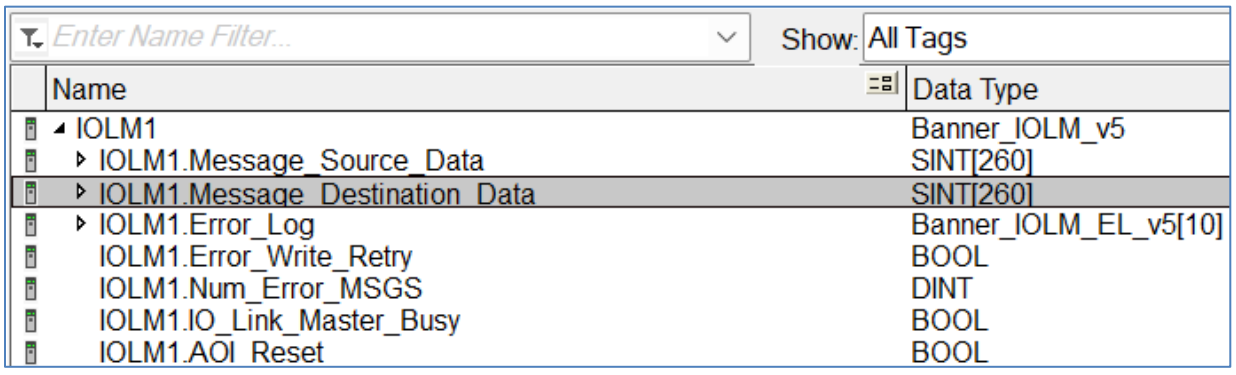

2. In the AOI, right-click on the question mark on the line labeled "Banner_IOLM_Param_A2_v5". Click New Tag. In this example, we'll use the name "IOLM1_Status". The example naming convention accounts for this being the #1 IO-Link Master in our program. More masters could be named IOLM2, IOLM3, etc.
3. Now we set up the Messages used to read and write to devices connected to this IO-Link Master. Right click on the question mark for the "Message_Read" line in the AOI and choose New Tag. In this example we'll use the tag name "IOLM1_Read". Click Create.

   Do the same for the "Message_Write" line in the AOI. In this example "IOLM1_Write" is used.

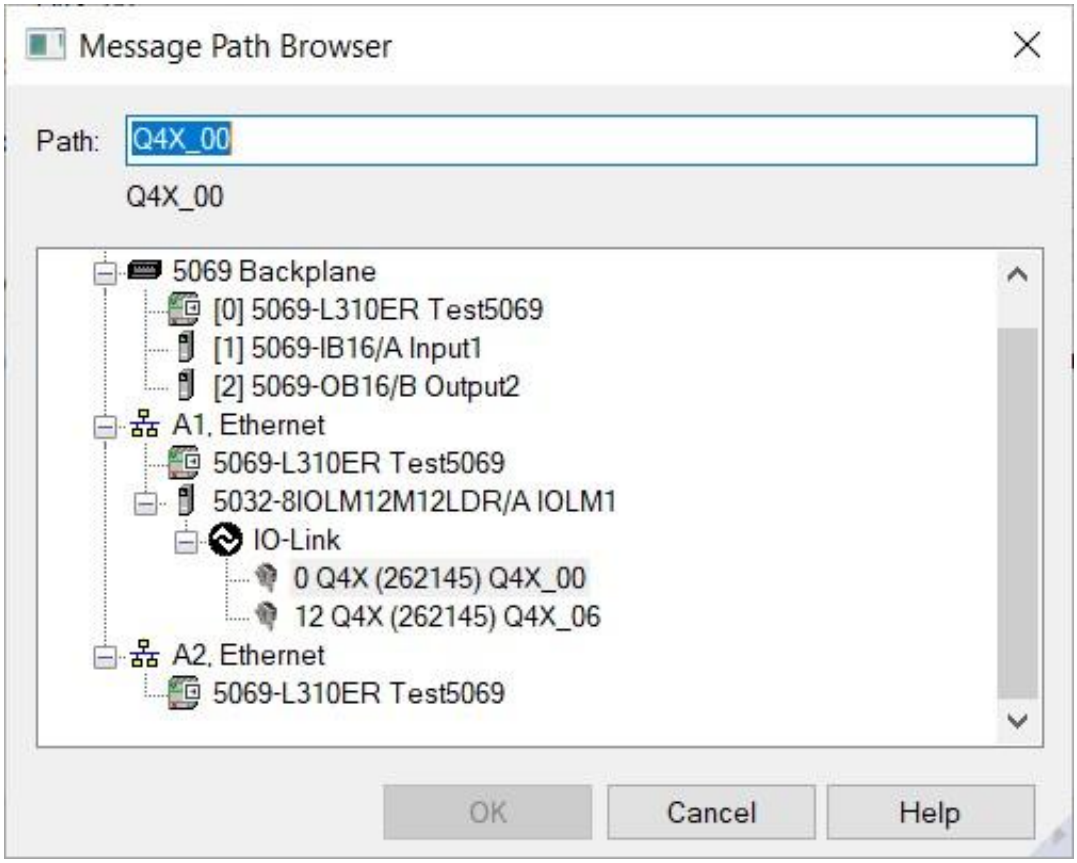
4. Now create a new tag array for the “IOLink” line in the AOI. Here we used the name “IOLM1”. The tags created here will serve as linkages between the IO-Link Master AOI and the connected Banner device AOI(s). This group of tags also controls the flow of information to and from the master, ensuring that all sensors get a chance to read and write in an orderly fashion.
5. Create a new tag for the “ISDU_Path” line. This creates an array which stores the path for the controller to take to access the ISDU operation for the 5032 IO-Link Master. Can also import the tag via a rung import.
6. Enter either a 0 or 1 into Port0 to Port7. If the port has a Banner IO-Link Device connected to the Port then use a 1; otherwise, set it to a 0.
7. Now configure “Message_Read”, setting up the Explicit Message that will handle half of the communications between the PLC and the IO-Link Master. Click on the “…” button at the far right of the “Message_Read” line.
8. In the Message Configuration window, keep the Message Type “CIP Generic” and the Service Type “Custom”. Enter a Service Code of 32.




9. Set the Source Length to 0.
10. For Destination Element, select “IOLM1.Message_Destination_Data”.

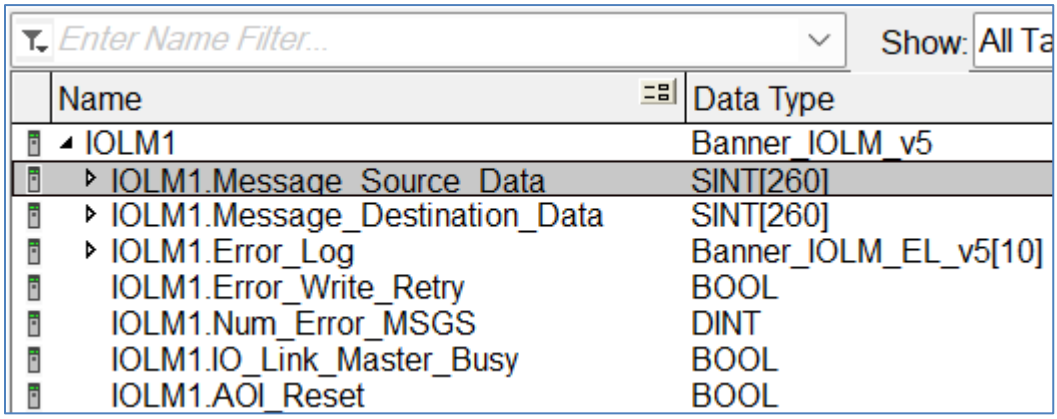


11. Now click on the Communication tab, then click the Browse button.
12. Select the IO-Link Master and then one of the IO-Link Devices attached to the unit, then click OK again to close the Message Configuration window.

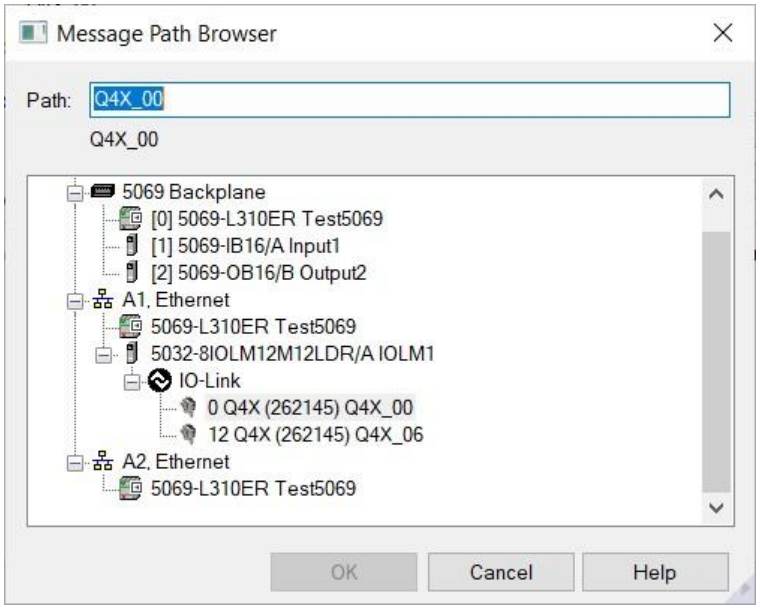



13. Now configure “Message_Write”, setting up the Explicit Message that will handle the other half of the communications between the PLC and the IO-Link Master. Click on the “…” button at the far right of the “Message_Write” line.

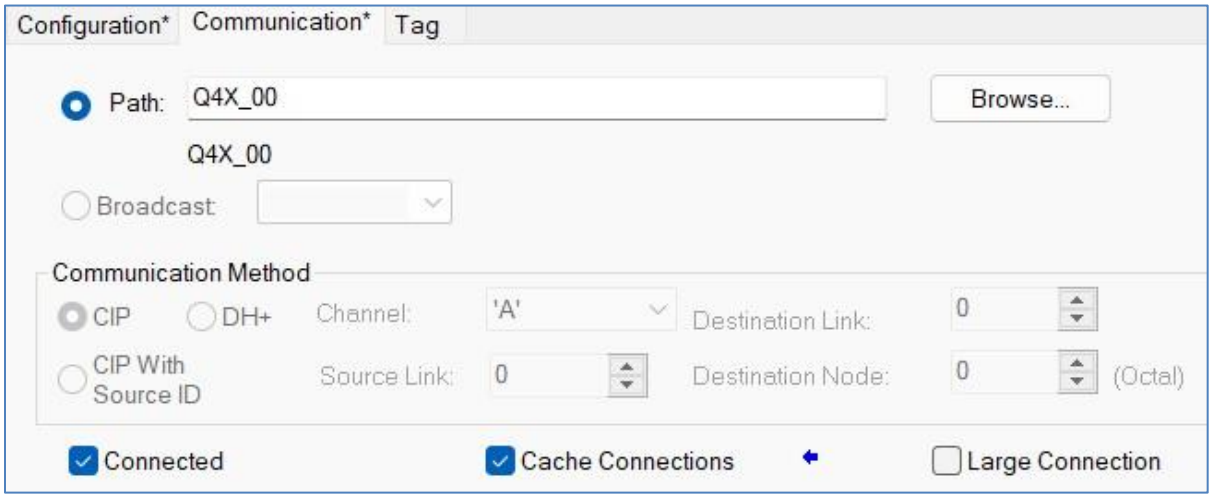
14. In the Message Configuration window, keep the Message Type “CIP Generic” and the Service Type “Custom”. Enter a Service Code of 33.
15. For the Source Element field, select “IOLM1.Message_Source_Data”.



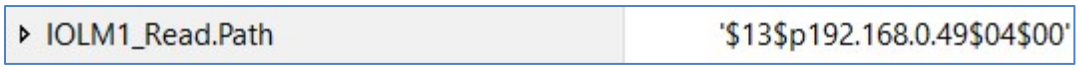

16. Now click on the Communication tab, then click the Browse button.
17. Select the IO-Link Master and then a device attached to the master. Then click OK again to close the Message Configuration window.



18. The last step is to select the Connected option. A check mark will appear for both Connected and Cache Connections. These are necessary to ensure the write commands work correctly to the 5032. If these are not selected if a Write operation is done an error will occur.




19. Press OK to finalize the changes.
20. Now it is necessary to generate the ISDU IP Paths the PLC needs for the read and write commands. The 5032 requires this information to correctly navigate to the various ports on the 5032. When the communication path was selected in step 17 that was to link to one port of the IO-Link. Since accessing all the ports is important for most applications these paths need to be figured out.
21. Got to the Controller Tags and look for the IOLM1_Read tags (or the tag you created for Step 6).
22. Expand the tag and look for the Path tag. The path shown here is the path that the PLC needs to use to access the port and channel on the IO-Link Master. In this example a 5069 PLC was being used. The 192.168.0.49 is the ip address for the IO-Link Master. The $00 at the end is the channel address (Port 0 Channel 0 in this case) to be accessed. Everything else is based on the PLC being used. It is best to copy this string.

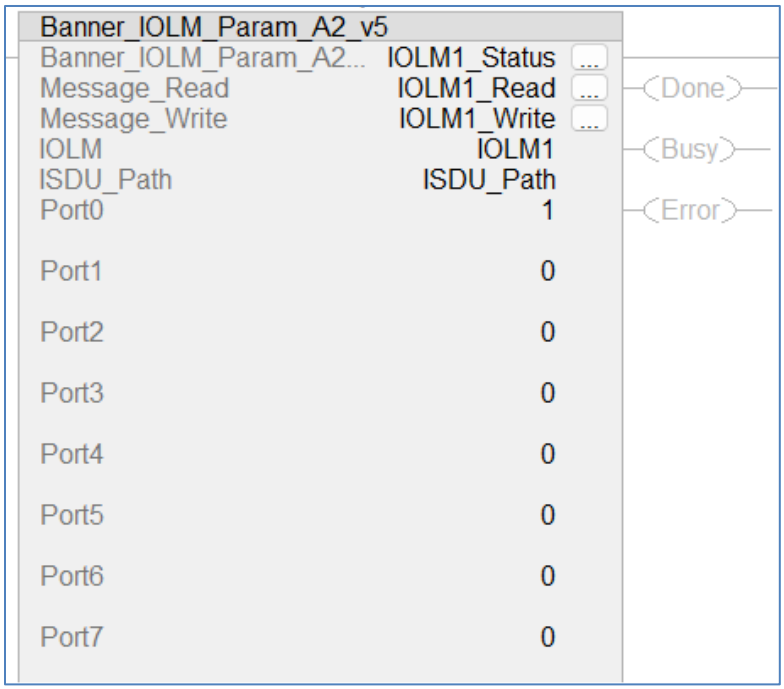



23. After copying the string go to the ISDU_Path tag created in Step 5.
24. If more than 1 port is going to be used copy that string into the required sections of the array. Then modify the array numbers that represent the port/channel that has an IO-Link Device plug into it. The example will show all 8 ports being used.
    a. Port 0 Channel 0 uses $00
    b. Port 1 Channel 2 uses $02
    c. Port 2 Channel 4 uses $04
    d. Port 3 Channel 6 uses $06
    e. Port 4 Channel 8 uses $08
    f. Port 5 Channel 10 uses $l (lower case L).
    g. Port 6 Channel 12 uses $p
    h. Port 7 Channel 14 uses $0E

25. The completed array should look like the image below. Remember only the ports that have IO-Link devices plugged into them need the path.

| Path1 | {...} |
|---|---|
| Path1[0] | '$13$p192.168.0.49$04$00' |
| Path1[1] | '$13$p192.168.0.49$04$02' |
| Path1[2] | '$13$p192.168.0.49$04$04' |
| Path1[3] | '$13$p192.168.0.49$04$06' |
| Path1[4] | '$13$p192.168.0.49$04$08' |
| Path1[5] | '$13$p192.168.0.49$04$I' |
| Path1[6] | '$13$p192.168.0.49$04$p' |
| Path1[7] | '$13$p192.168.0.49$04$0E' |

26. Setup of the IO-Link 5032 AOI is complete at this point. It will need a Banner IO-Link Device AOI to work properly, however.



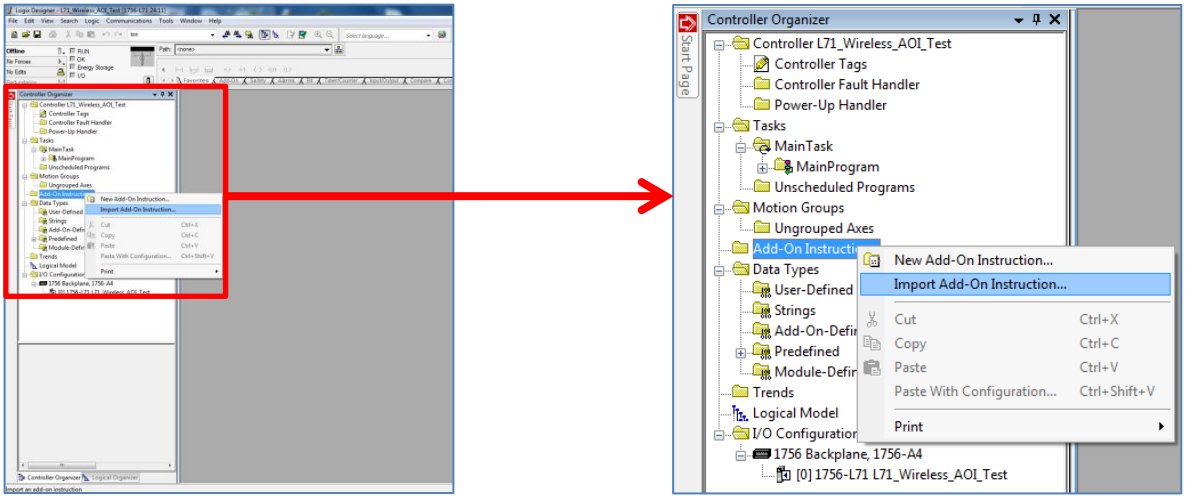

27. AOI configuration complete.
28. Go to the Import Device Data and Rule Set for Banner IOL Parameter AOI section to complete setup.

# 4. Balluff IO-Link Master Setup

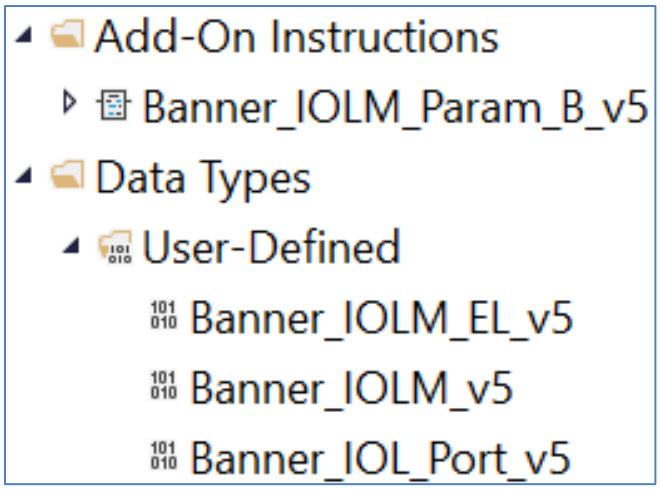
Ensure that the Balluff IO-Link Master connection has been created in Studio 5000 before proceeding.

**Balluff AOI Installation**

1. Open a project.
2. In the Controller Organizer window, right-click on the Add-On Instruction folder. Select the Import Add-On Instruction option.

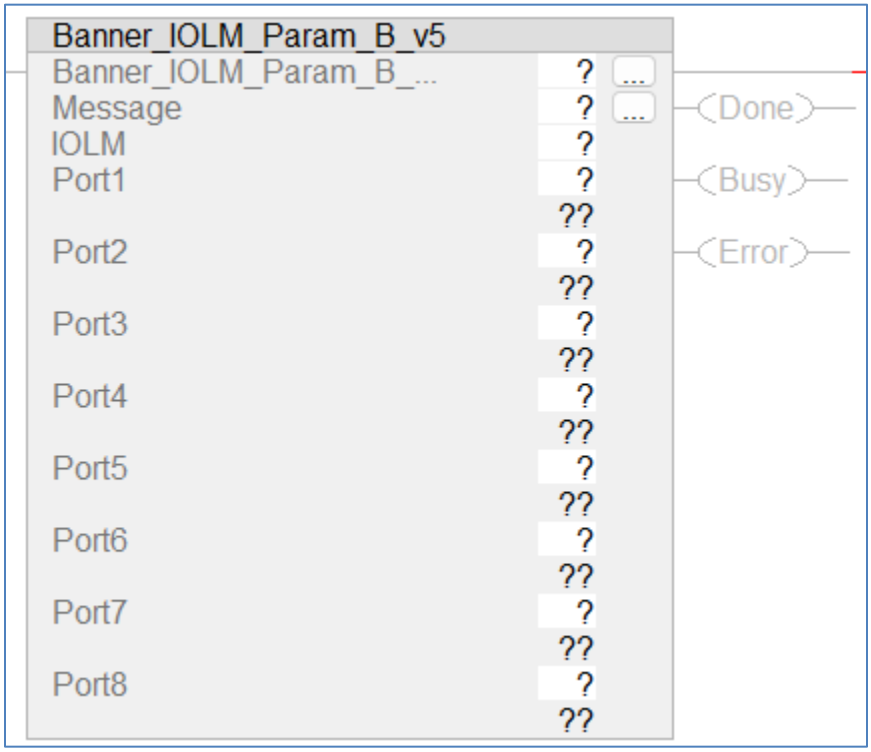



3. Navigate to the correct file location and select the AOI to be installed. In this example the "Banner_IOLM_Param_B_v5_AOI.L5X" file will be selected. Click the Open button.
4. The Import Configuration window will pop up. The default selection will create all the necessary items for the AOI. Click the OK button to complete the import process.
5. The AOI is added to the Controller Organizer window and should look like the image shown.
6. AOI installation into the Logix Designer software complete.



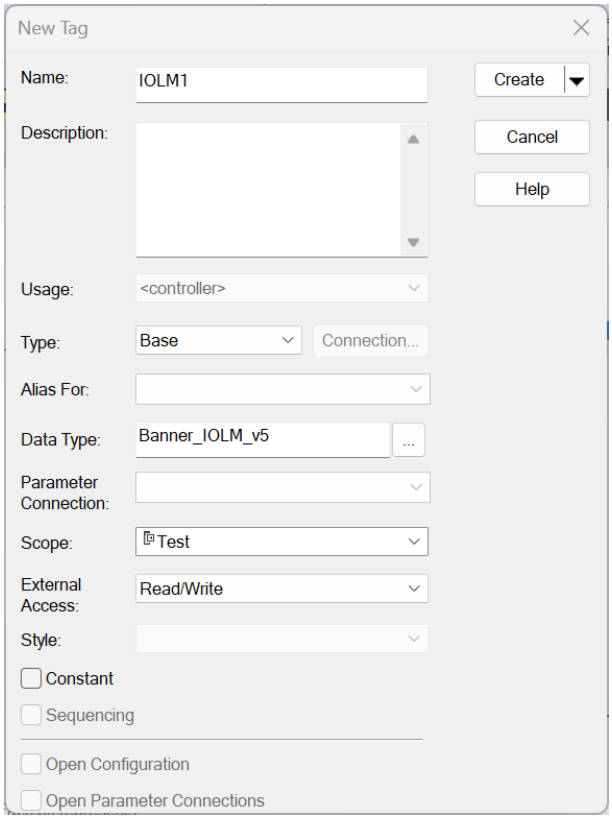
**Balluff AOI Configuration**

29. Add the "Banner_IOLM_Param_B_v5" AOI to your ladder logic program. For each of the question marks shown in the instruction we need to create and link a new tag array. The AOI includes a new type of User Defined Tag (UDT): a custom array of tags meant specifically for this AOI.



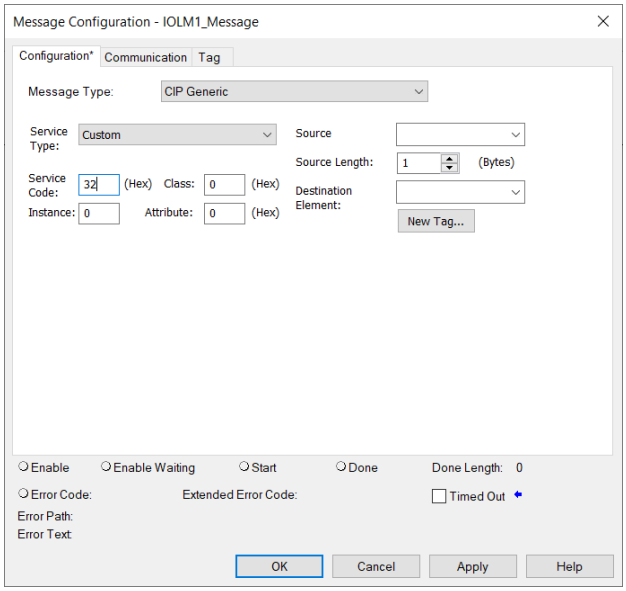

30. In the AOI, right-click on the question mark on the line labeled "Banner_IOLM_Param_B_v5". Click New Tag. In this example, we'll use the name "IOLM1_Status". The example naming convention accounts for this being the #1 IO-Link Master in our program. More masters could be named IOLM2, IOLM3, etc.
31. Now set up the Message command used to read and write to devices connected to this IO-Link Master. Right click on the question mark for Message line in the AOI and choose New Tag. In this example we'll use the tag name IOLM1_Message. Click Create.

32. Now create a new tag array for the “IOLM” line in the AOI. Here we used the name “IOLM1”. The tags created here will serve as linkages between the IO-Link Master AOI and the connected Banner device AOI(s). This group of tags also controls the flow of information to and from the master, ensuring that all sensors get a chance to read and write in an orderly fashion.

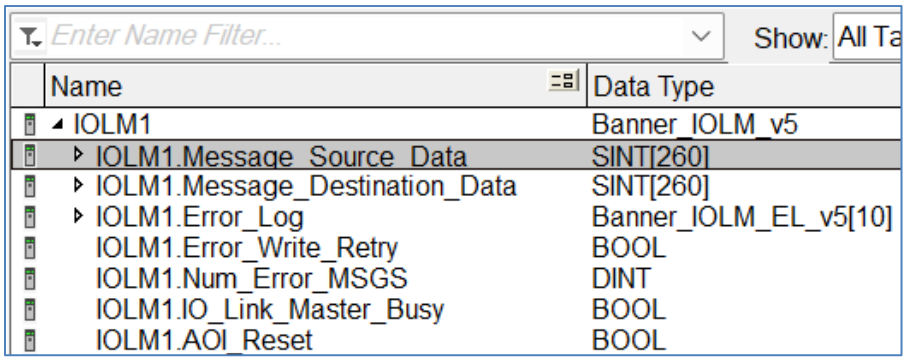



33. Now configure “IOLM1_Message”, setting up the Explicit Message that will handle half of the communications between the PLC and the IO-Link Master. Click on the “…” button at the far right of the “Message” line.

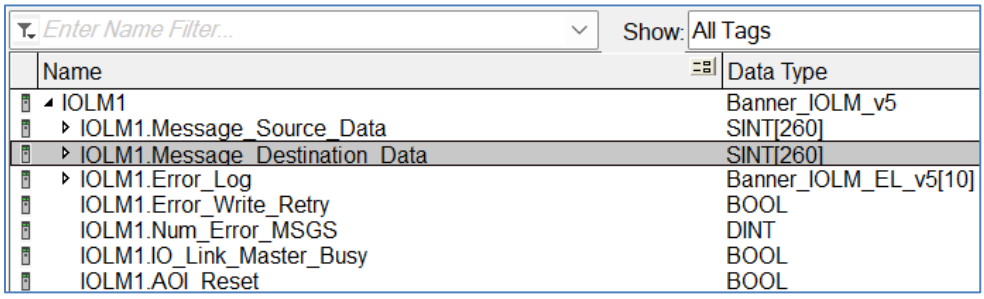
34. In the Message Configuration window, keep the Message Type “CIP Generic” and the Service Type “Custom”. Enter Service Code 32.



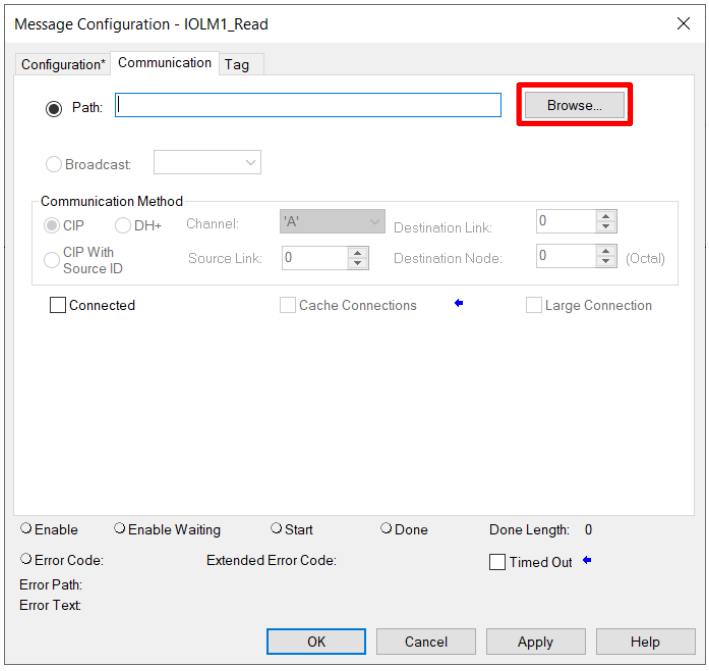

35. For the Source Element field, select “IOLM1.Message_Source_Data”.



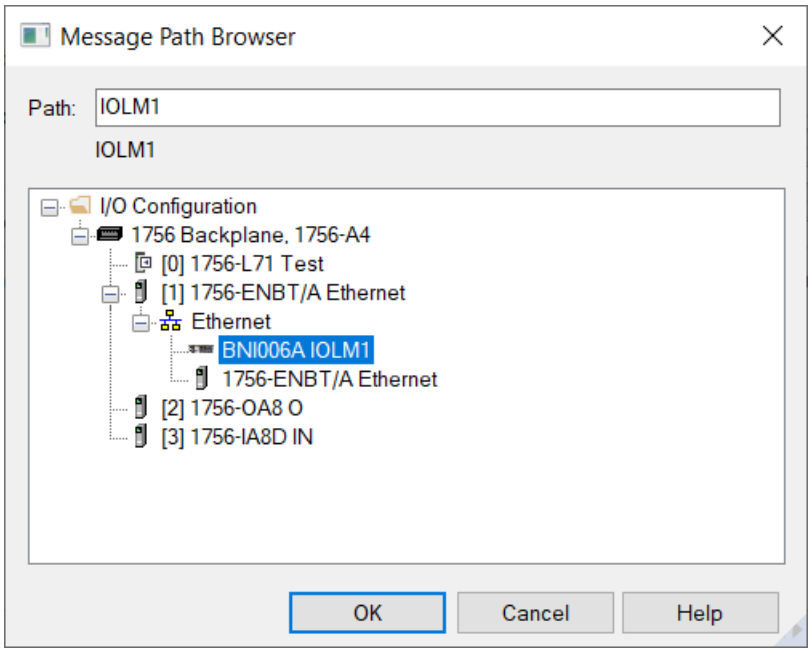

36. For Destination Element, select “IOLM1.Message_Destination_Data”.



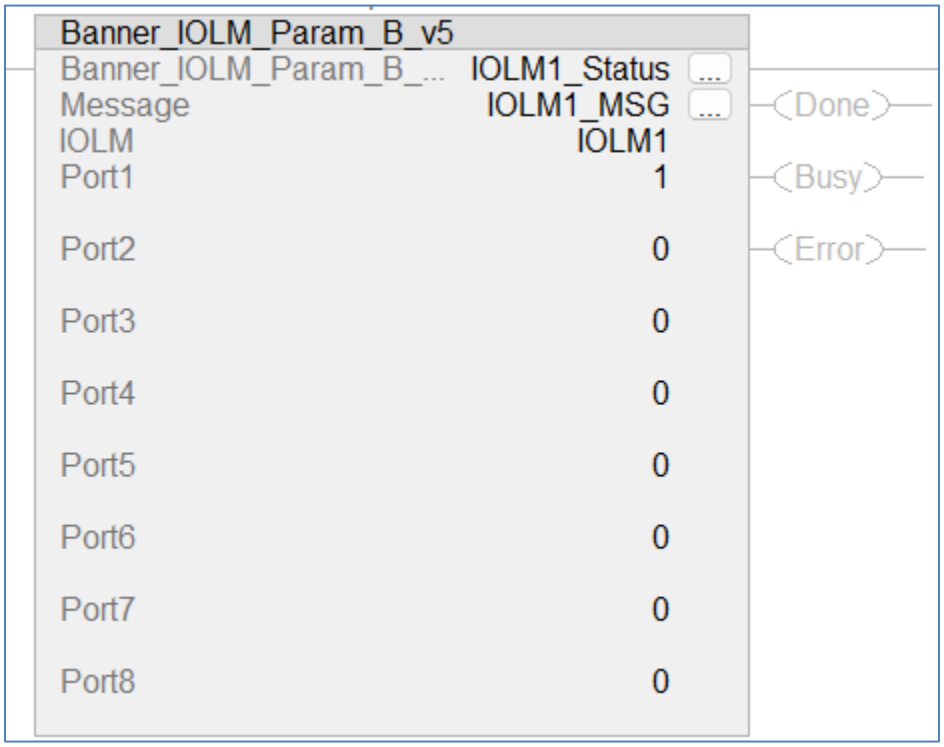
37. Now click on the Communication tab, then click the Browse button.




38. Select the IO-Link Master, then click OK to close the Message Path Browser window, then click OK again to close the Message Configuration window.



39. Port 1 Through 8 tells the AOI which ports are controlled. Set the Port value to 1 if controlled and 0 if not controlled. In this example, port 1 will be the only port controlled.
40. The completed AOI should look like the below image.



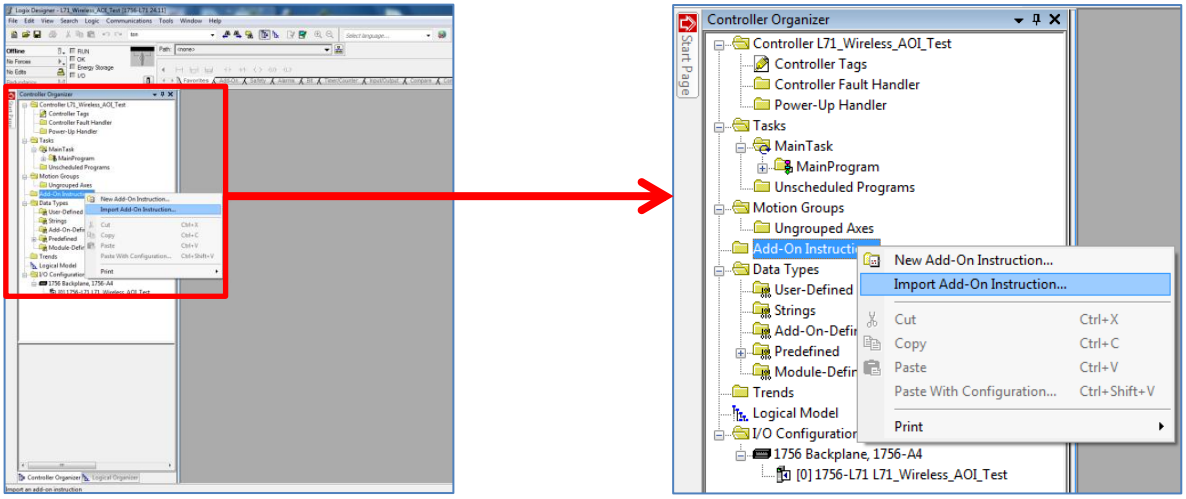

41. AOI configuration complete.
42. Go to the Import Device Data and Rule Set for Banner IOL Parameter AOI section to complete setup.

# 5. IFM IO-Link Master Setup

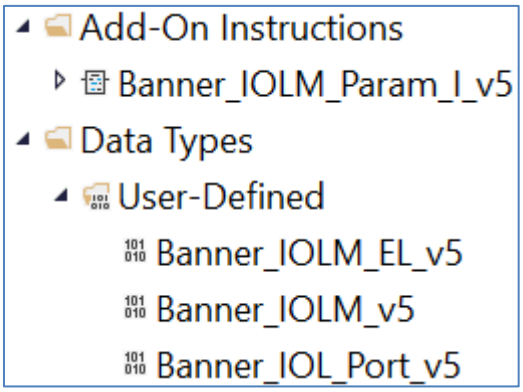
Ensure that the IFM IO-Link Master connection has been created in Studio 5000 before proceeding.

**IFM AOI Installation**

1. Open a project.
2. In the Controller Organizer window, right-click on the Add-On Instruction folder. Select the Import Add-On Instruction option.

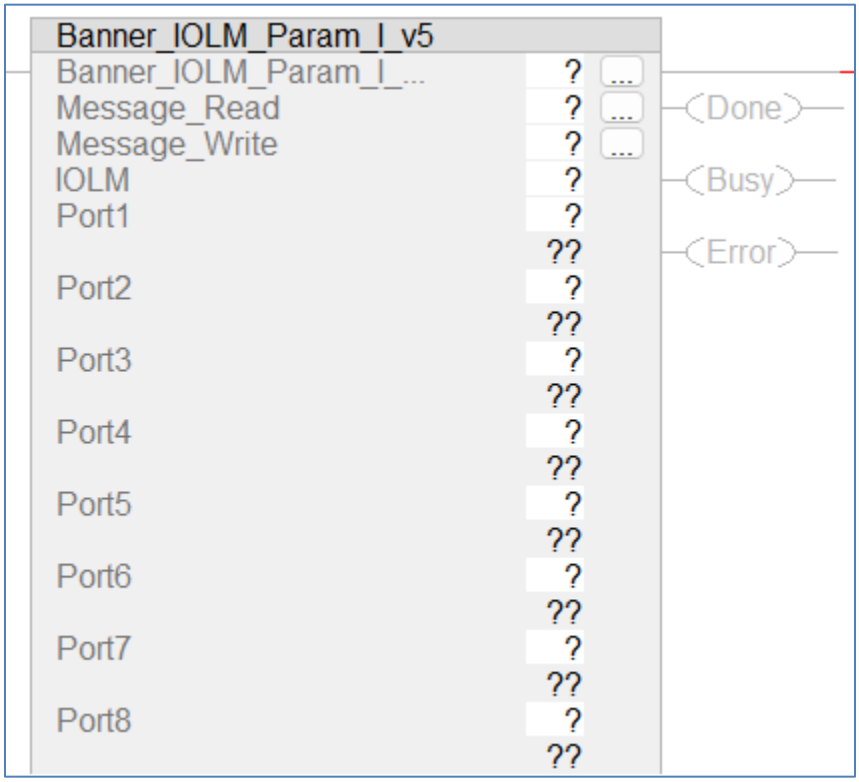



3. Navigate to the correct file location and select the AOI to be installed. In this example the "Banner_IOLM_Param_I_v5_AOI.L5X" file will be selected. Click the Open button.
4. The Import Configuration window will pop up. The default selection will create all the necessary items for the AOI. Click the OK button to complete the import process.
5. The AOI is added to the Controller Organizer window and should look like the image shown.
6. AOI installation into the Logix Designer software complete.



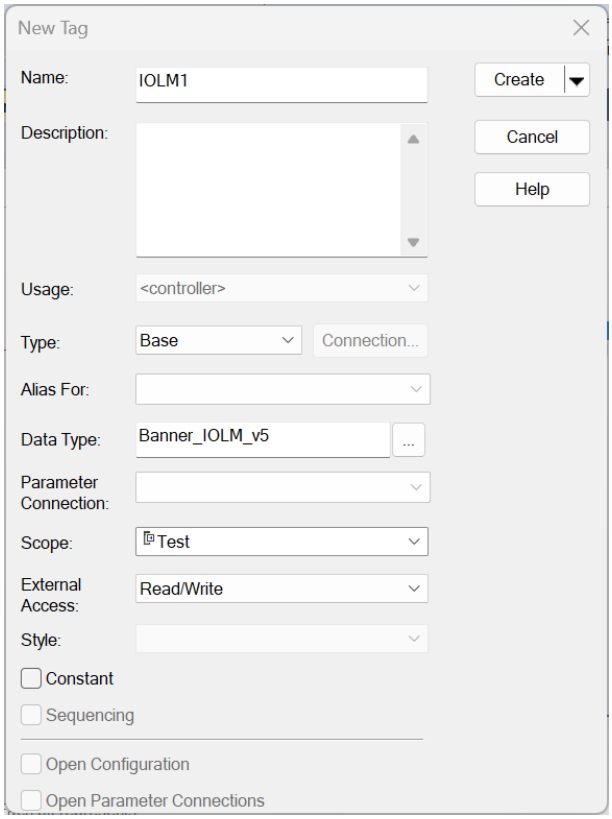
**IFM AOI Configuration**

1. Add the "Banner_IOLM_Param_I_v5" AOI to your ladder logic program. For each of the question marks shown in the instruction we need to create and link a new tag array. The AOI includes a new type of User Defined Tag (UDT): a custom array of tags meant specifically for this AOI.



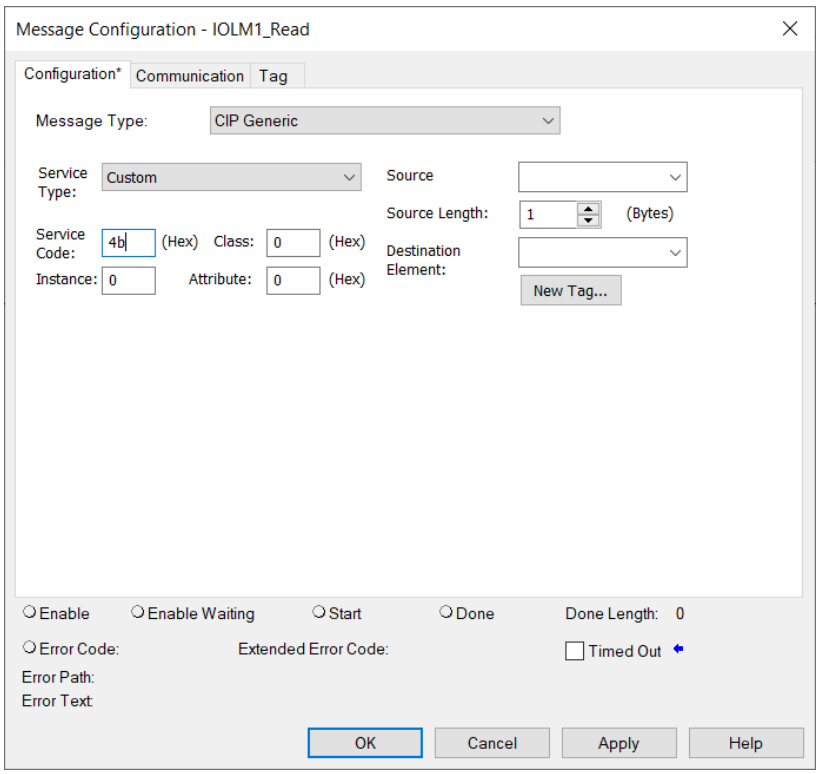

2. In the AOI, right-click on the question mark on the line labeled "Banner_IOLM_Param_I_v5". Click New Tag. In this example, we'll use the name "IOLM1_Status". The example naming convention accounts for this being the #1 IO-Link Master in our program. More masters could be named IOLM2, IOLM3, etc.
3. Now set up the Messages used to read and write to devices connected to this IO-Link Master. Right click on the question mark for Message_Read line in the AOI and choose New Tag. In this example we'll use the tag name IOLM1_Read. Click Create.
4. Do the same for the Message_Write line in the AOI.

5. Now create a new tag array for the “IOLM” line in the AOI. Here we used the name “IOLM1”. The tags created here will serve as linkages between the IO-Link Master AOI and the connected Banner device AOI(s). This group of tags also controls the flow of information to and from the master, ensuring that all sensors get a chance to read and write in an orderly fashion.

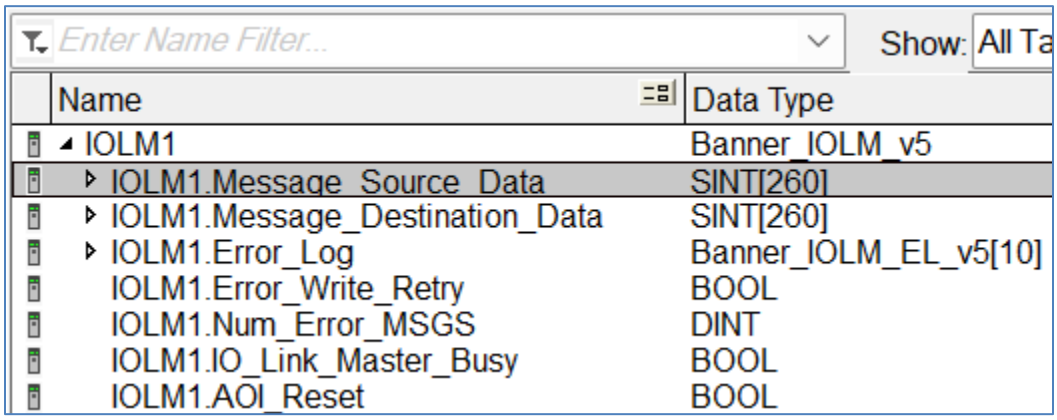



6. Now configure “IOLM1_Read”, setting up the Explicit Message that will handle half of the communications between the PLC and the IO-Link Master. Click on the “…” button at the far right of the “Message_Read” line.

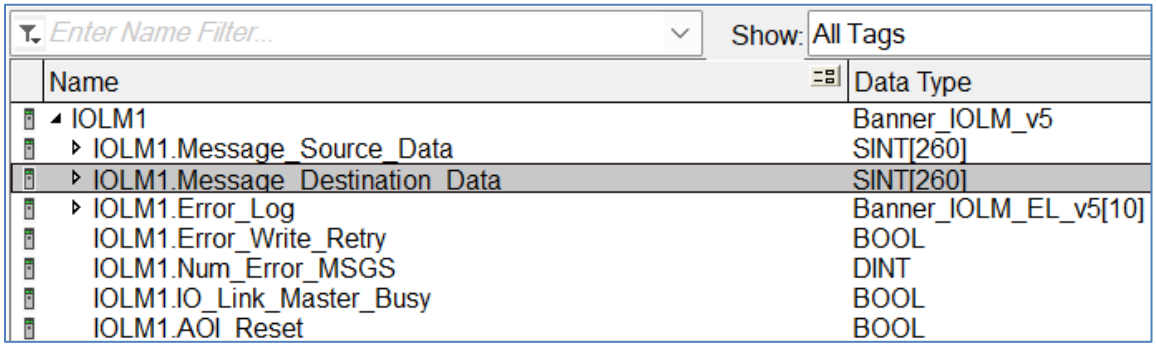
7. In the Message Configuration window, keep the Message Type “CIP Generic” and the Service Type “Custom”. Enter Service Code 4b.



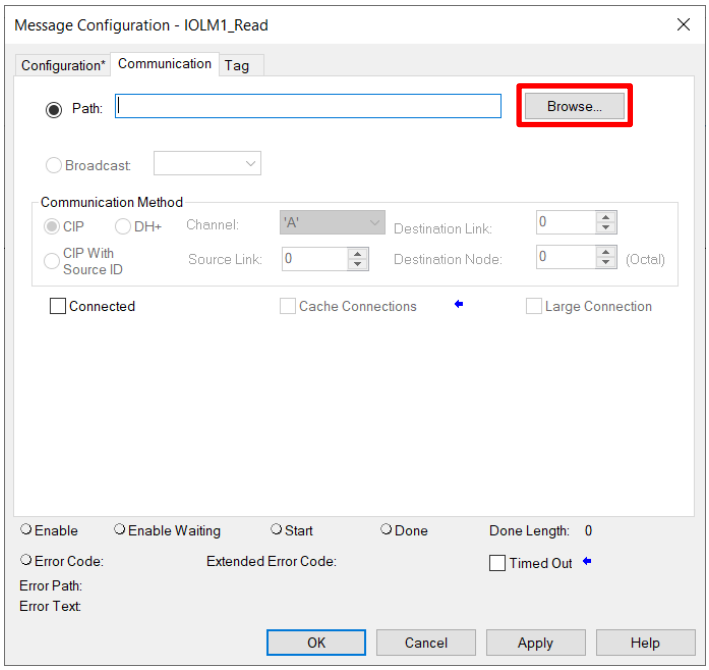

8. For the Source Element field, select “IOLM1.Message_Source_Data”.



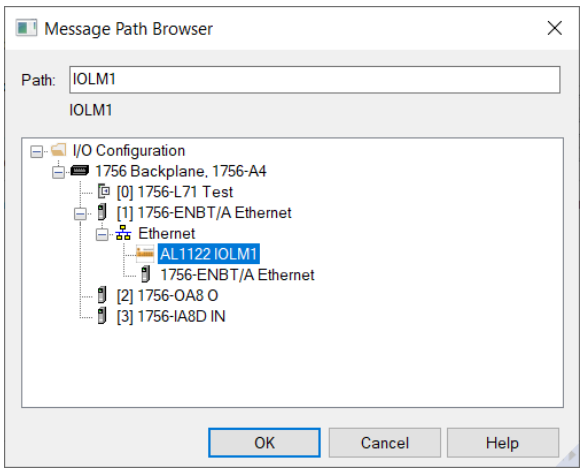
9. For Destination Element, select “IOLM1.Message_Destination_Data”.



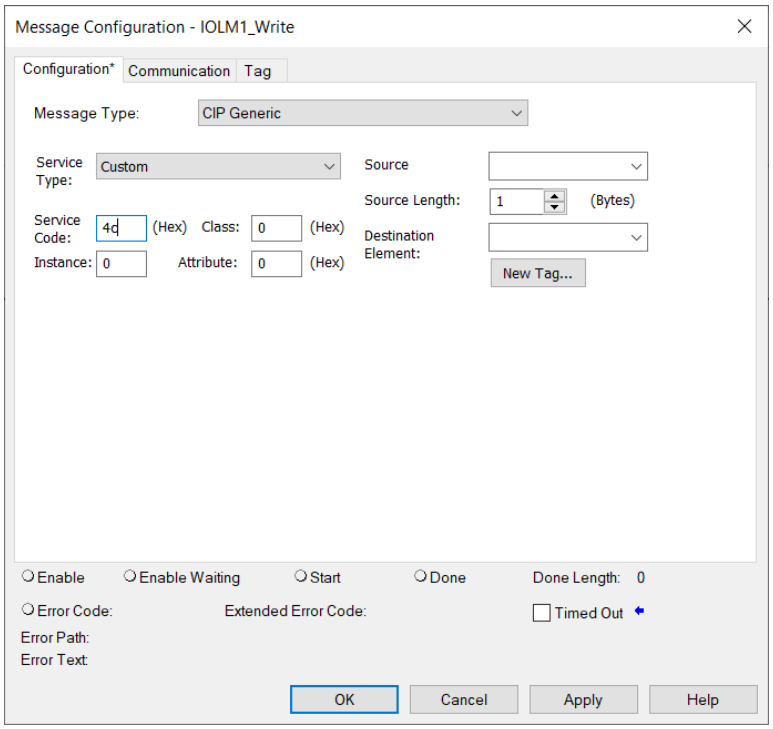

10. Now click on the Communication tab, then click the Browse button.



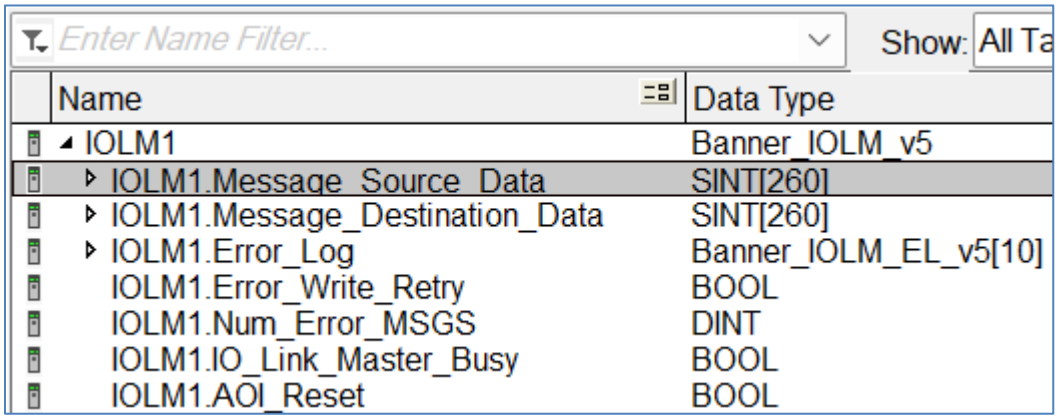
11. Select the IO-Link Master, then click OK to close the Message Path Browser window, then click OK again to close the Message Configuration window.



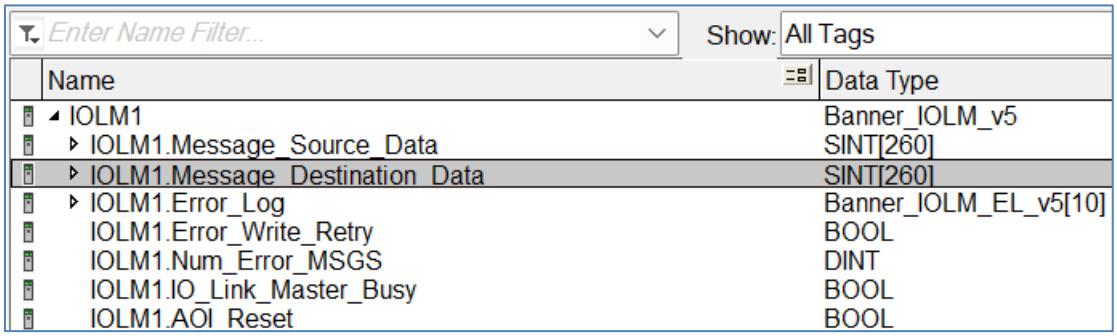

12. Now configure “Message_Write”, setting up the Explicit Message that will handle the other half of the communications between the PLC and the IO-Link Master. Click on the “…” button at the far right of the “Message_Write” line.
13. In the Message Configuration window, keep the Message Type “CIP Generic” and the Service Type “Custom”. Enter a Service Code of 4c.



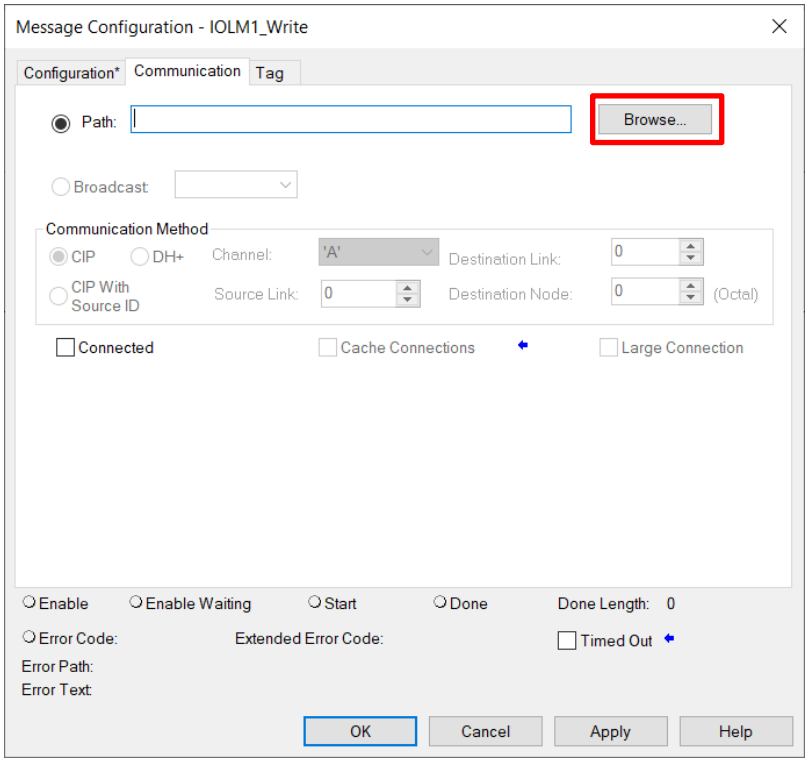
14. For the Source Element field, select “IOLM1.Message_Source_Data”.



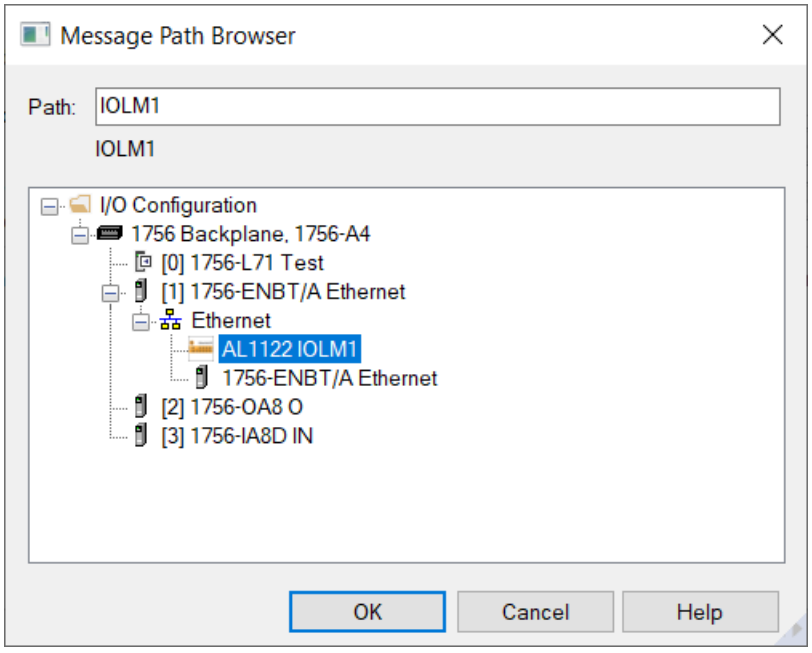

15. For Destination Element, select “IOLM1.Message_Destination_Data”.



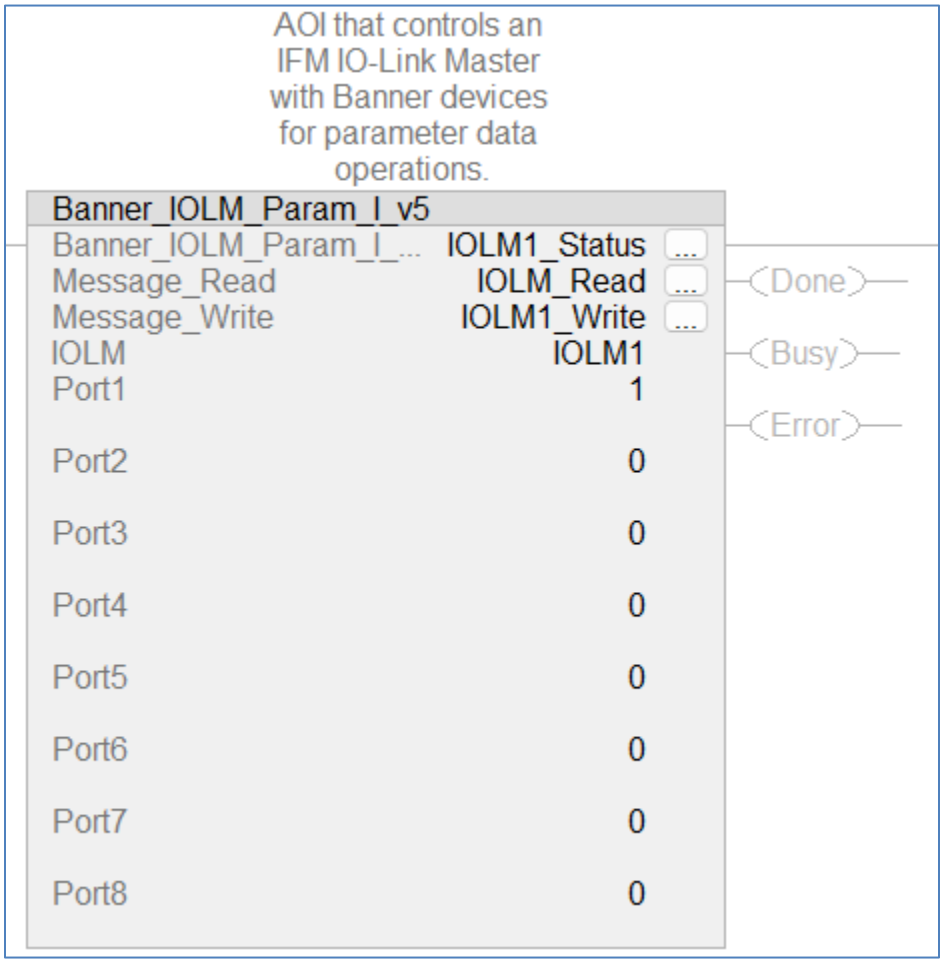
16. Now click on the Communication tab, then click the Browse button.




17. Select the IO-Link Master, then click OK to close the Message Path Browser window, then click OK again to close the Message Configuration window.



18. Port 1 Through 8 tells the AOI which ports are controlled. Set the Port value to 1 if controlled and 0 if not controlled. In this example, port 1 will be the only port controlled.
19. The completed AOI should look like the below image.



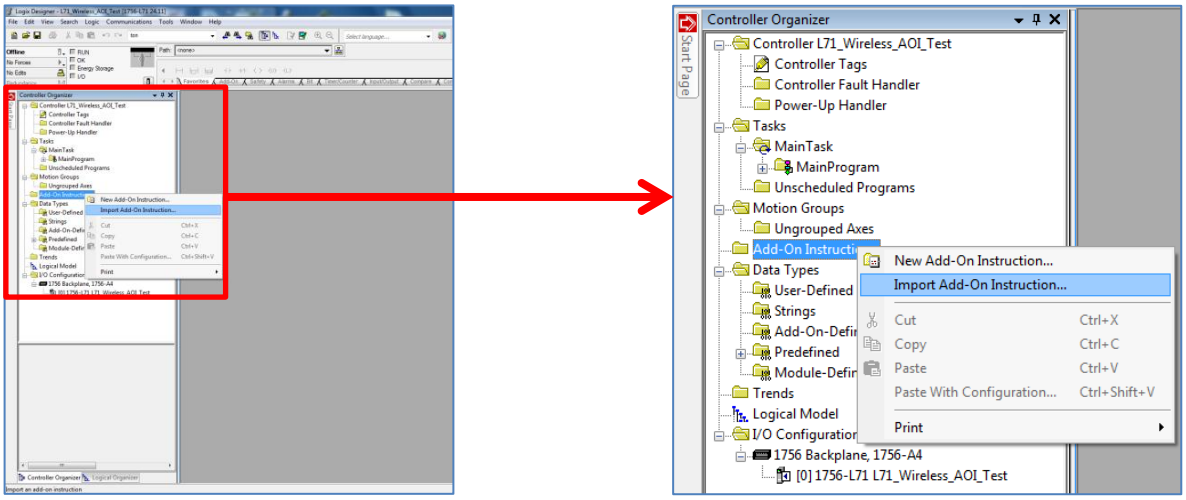

20. AOI configuration complete.
21. Go to the Import Device Data and Rule Set for Banner IOL Parameter AOI section to complete setup.

# 6. Lumberg LioN-X IO-Link Master Setup

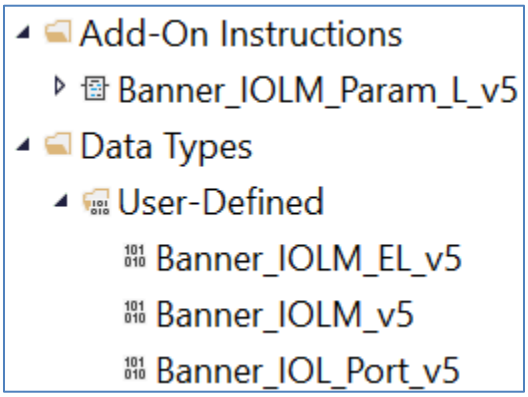
Ensure that the Lumberg LioN-X IO-Link Master (0980 XSL 3912-121-007D-00F was used for this setup) connection has been created in Studio 5000 before proceeding.

**Lumber Lion-X AOI Installation**

1. Open a project.
2. In the Controller Organizer window, right-click on the Add-On Instruction folder. Select the Import Add-On Instruction option.

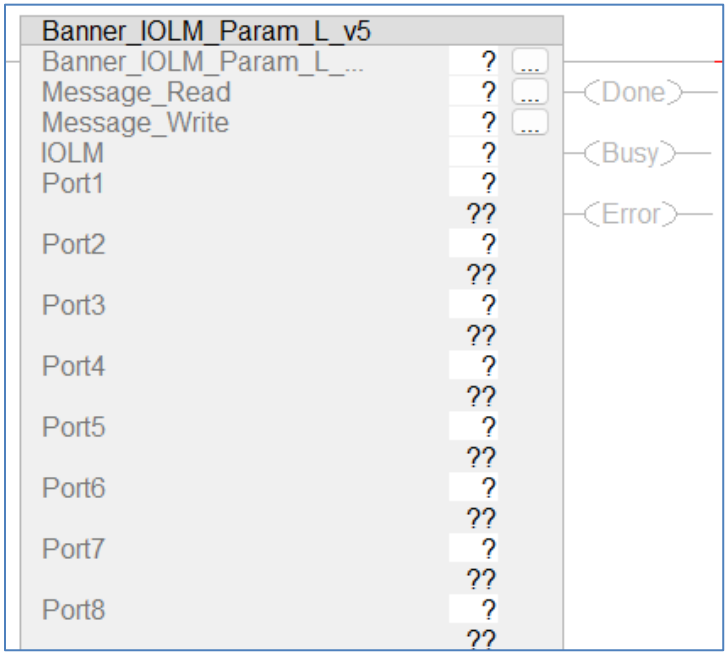



3. Navigate to the correct file location and select the AOI to be installed. In this example the "Banner_IOLM_Param_L_v5_AOI.L5X" file will be selected. Click the Open button.
4. The Import Configuration window will pop up. The default selection will create all the necessary items for the AOI. Click the OK button to complete the import process.
5. The AOI is added to the Controller Organizer window and should look like the image shown.
6. AOI installation into the Logix Designer software complete.



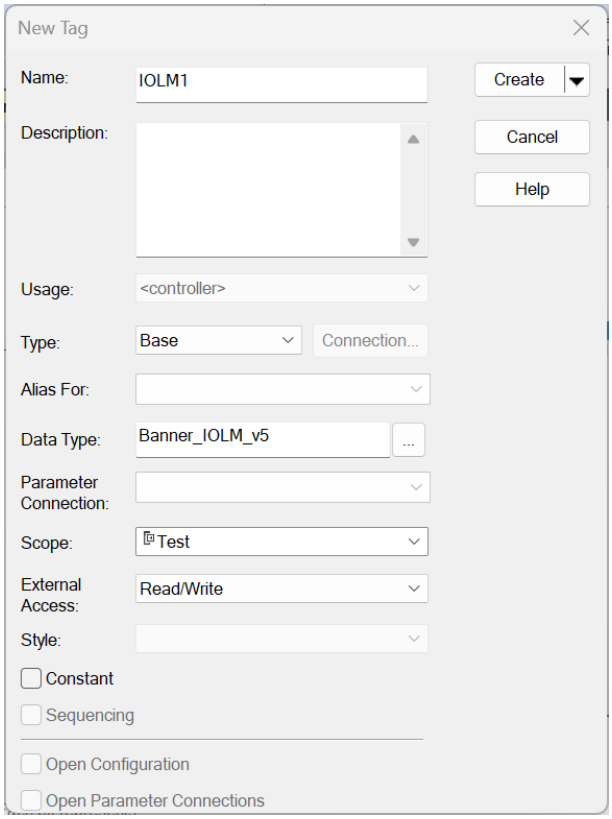
**Lumberg LioN-X AOI Configuration**

1. Add the "Banner_IOLM_Param_L_v5" AOI to your ladder logic program. For each of the question marks shown in the instruction we need to create and link a new tag array. The AOI includes a new type of User Defined Tag (UDT): a custom array of tags meant specifically for this AOI.



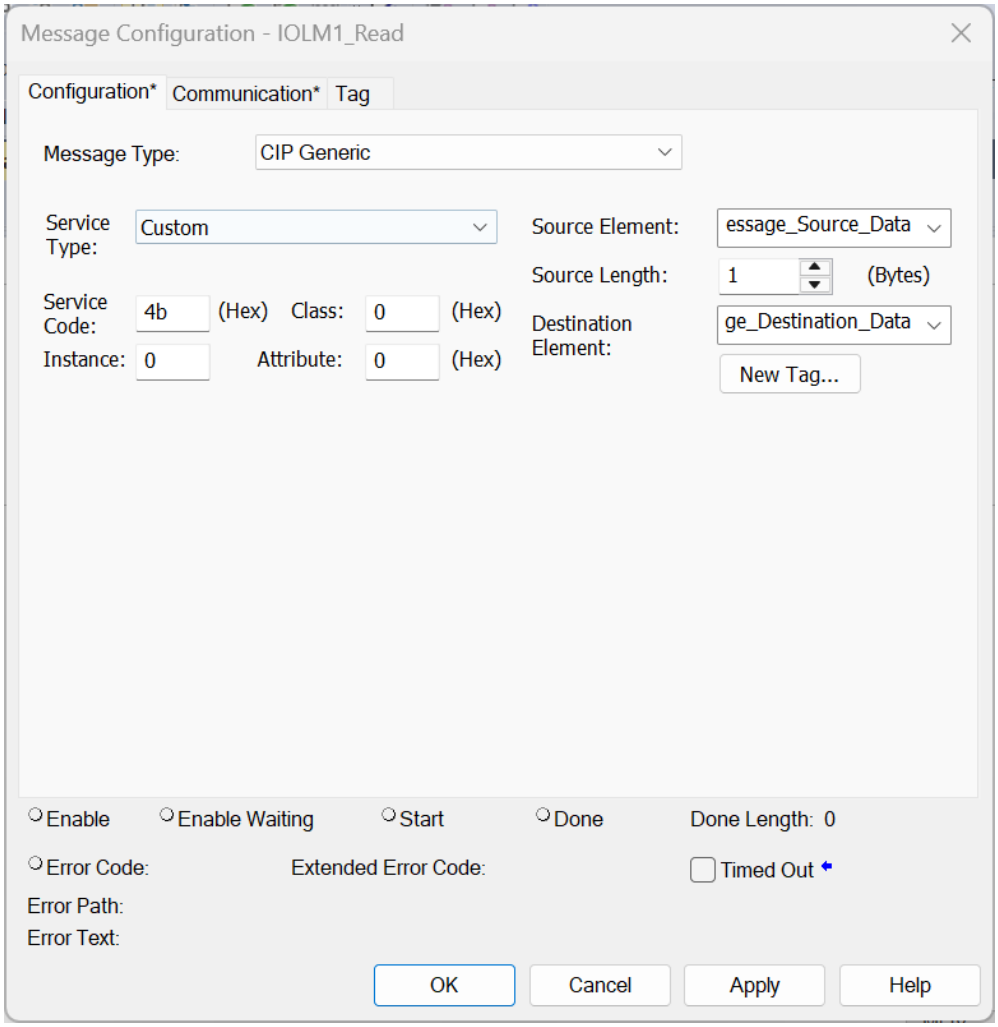

2. In the AOI, right-click on the question mark on the line labeled "Banner_IOLM_Param_L_v5". Click New Tag. In this example, we'll use the name "IOLM1_Status". The example naming convention accounts for this being the #1 IO-Link Master in our program. More masters could be named IOLM2, IOLM3, etc.
3. Now set up the Messages used to read and write to devices connected to this IO-Link Master. Right click on the question mark for Message_Read line in the AOI and choose New Tag. In this example we'll use the tag name IOLM1_Read. Click Create.
4. Do the same for the Message_Write line in the AOI.

5. Now create a new tag array for the “IOLM” line in the AOI. Here we used the name “IOLM1”. The tags created here will serve as linkages between the IO-Link Master AOI and the connected Banner device AOI(s). This group of tags also controls the flow of information to and from the master, ensuring that all sensors get a chance to read and write in an orderly fashion.

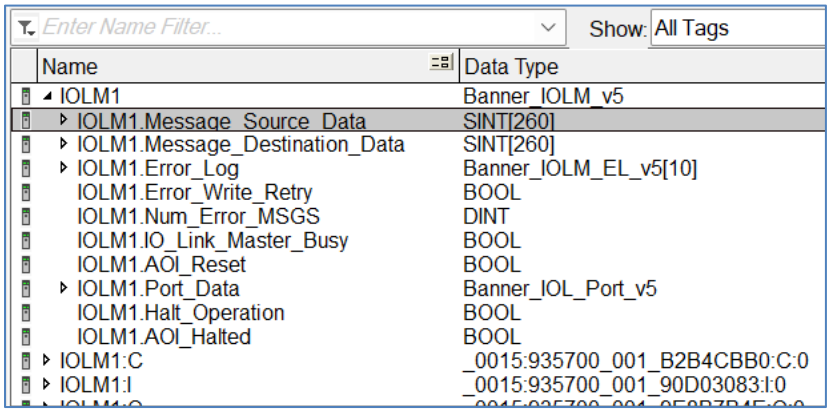



6. Now configure “IOLM1_Read”, setting up the Explicit Message that will handle half of the communications between the PLC and the IO-Link Master. Click on the “…” button at the far right of the “Message_Read” line.

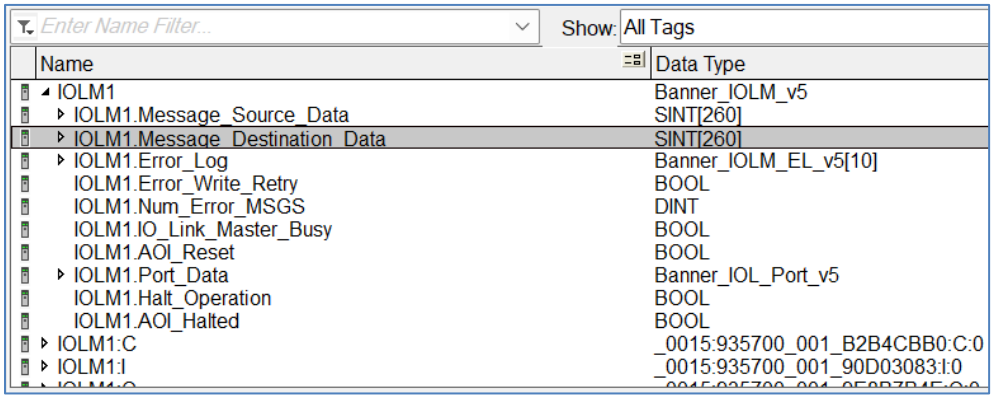
7. In the Message Configuration window, keep the Message Type “CIP Generic” and the Service Type “Custom”. Enter Service Code 4b. Class, Instance, and Attribute are handled by the AOI.



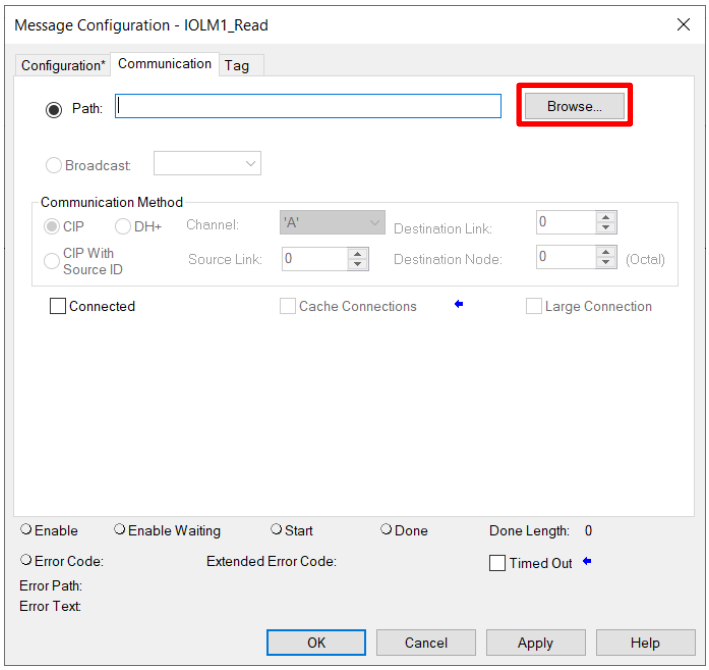

8. For the Source Element field, select “IOLM1.Message_Source_Data”.



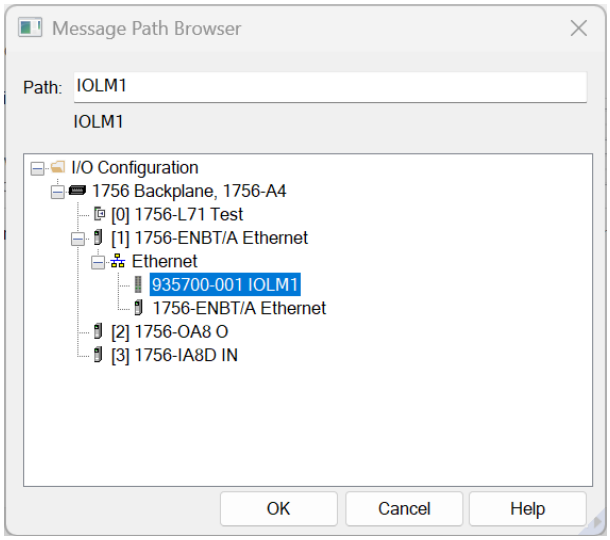
9. For Destination Element, select “IOLM1.Message_Destination_Data”.



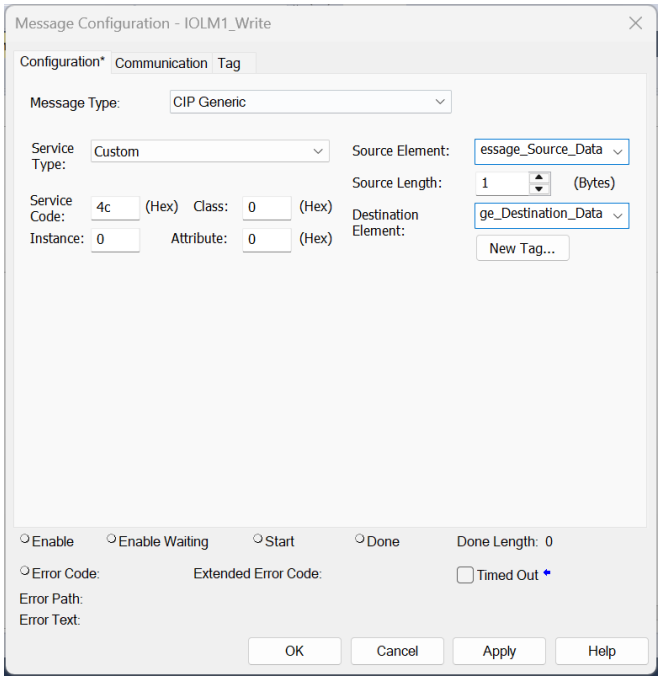

10. Now click on the Communication tab, then click the Browse button.



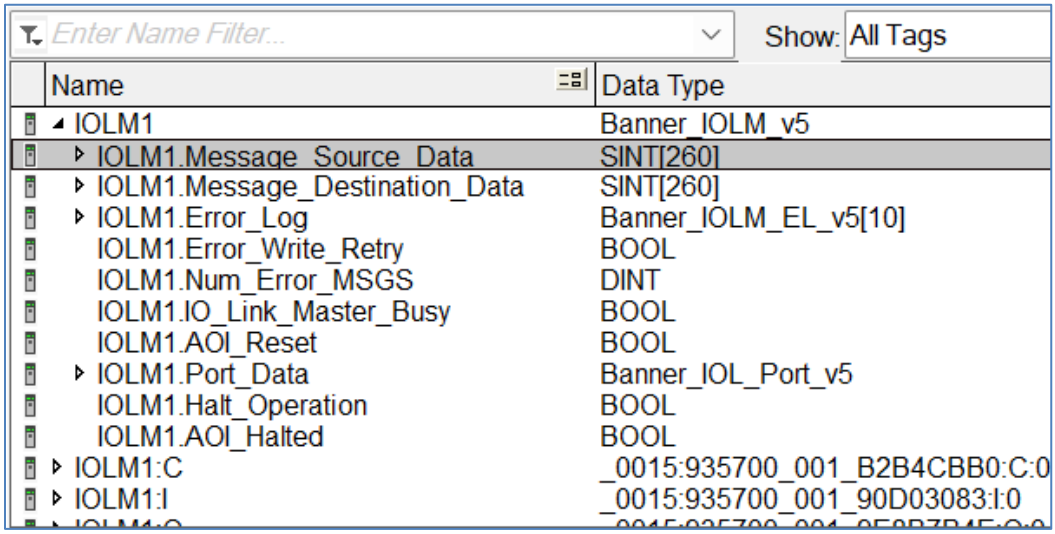
11. Select the IO-Link Master, then click OK to close the Message Path Browser window, then click OK again to close the Message Configuration window.



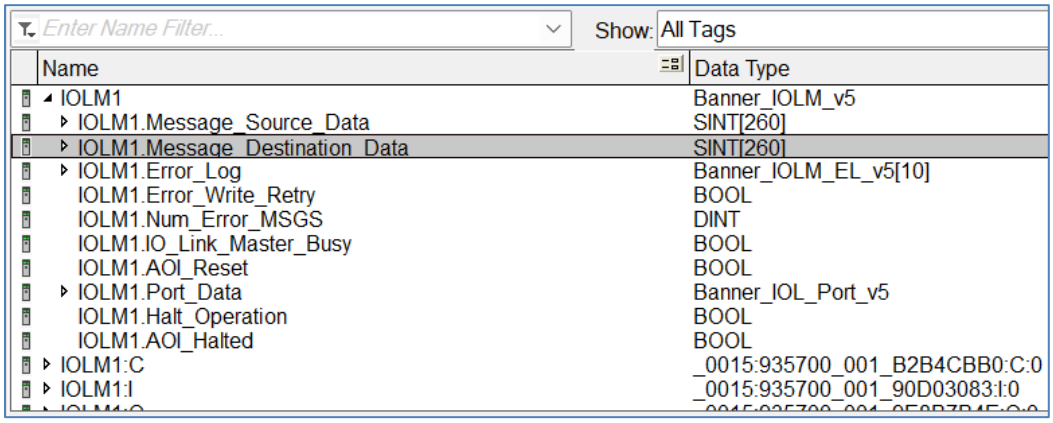

12. Now configure “Message_Write”, setting up the Explicit Message that will handle the other half of the communications between the PLC and the IO-Link Master. Click on the “…” button at the far right of the “Message_Write” line.
13. In the Message Configuration window, keep the Message Type “CIP Generic” and the Service Type “Custom”. Enter a Service Code of 4c. Class, Instance, and Attribute are handled by the AOI.



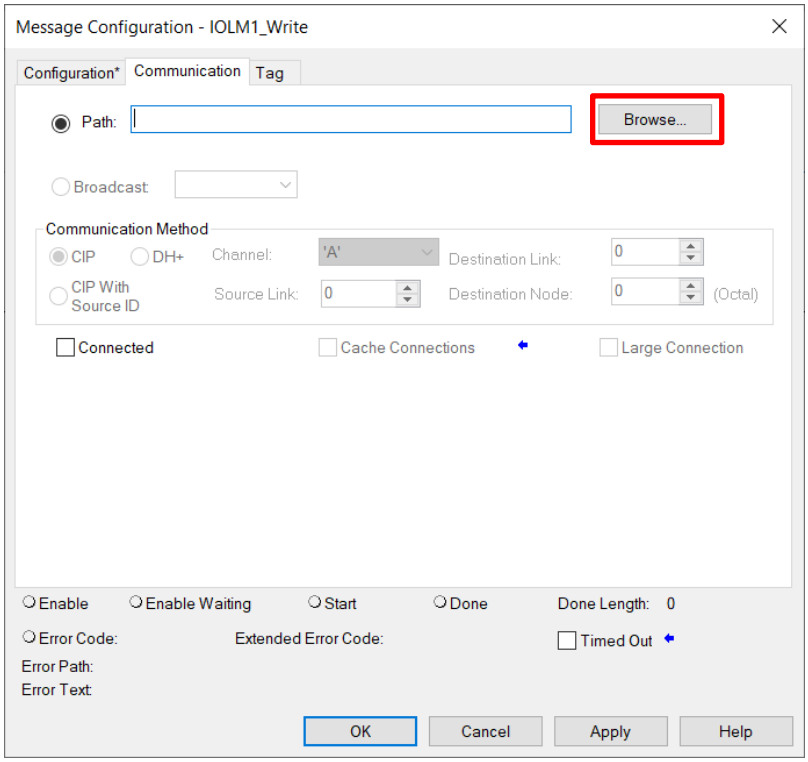
14. For the Source Element field, select “IOLM1.Message_Source_Data”.



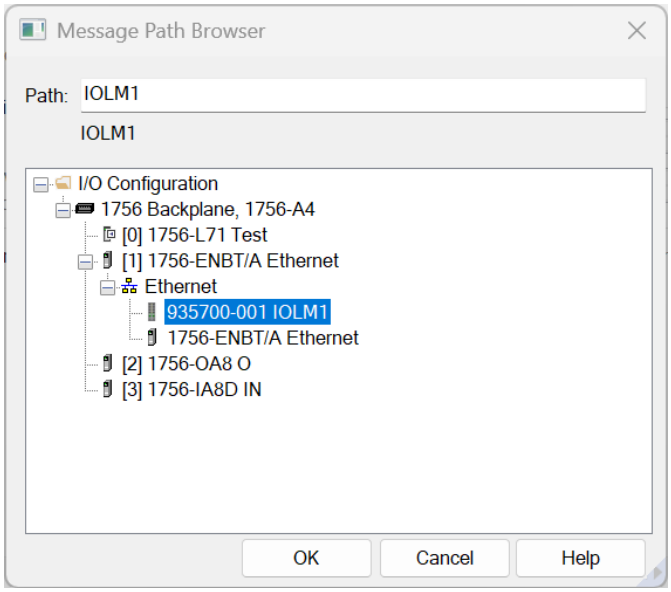

15. For Destination Element, select “IOLM1.Message_Destination_Data”.



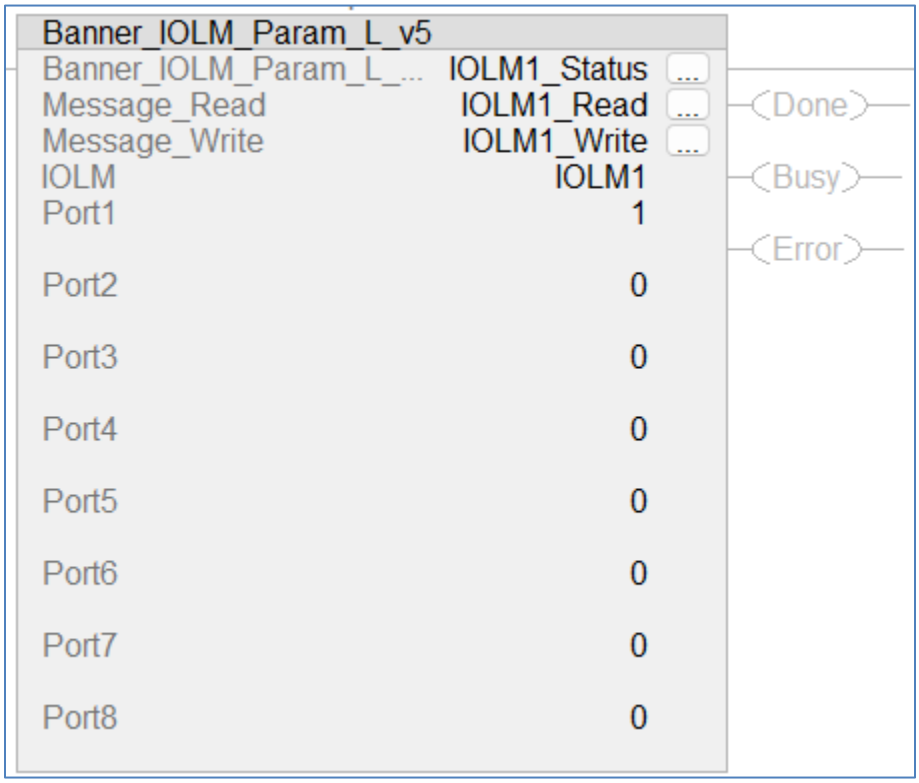
16. Now click on the Communication tab, then click the Browse button.




17. Select the IO-Link Master, then click OK to close the Message Path Browser window, then click OK again to close the Message Configuration window.



18. Port 1 Through 8 tells the AOI which ports are controlled. Set the Port value to 1 if controlled and 0 if not controlled. In this example, port 1 will be the only port controlled.
19. The completed AOI should look like the below image.



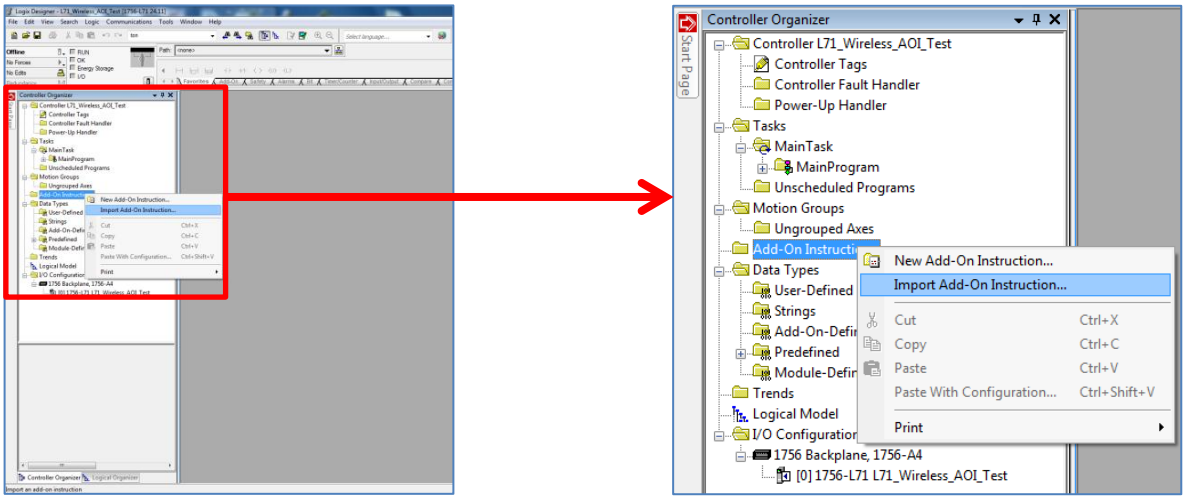

20. AOI configuration complete.
21. Go to the Import Device Data and Rule Set for Banner IOL Parameter AOI section to complete setup.

# 7. Murr IO-Link Master Setup

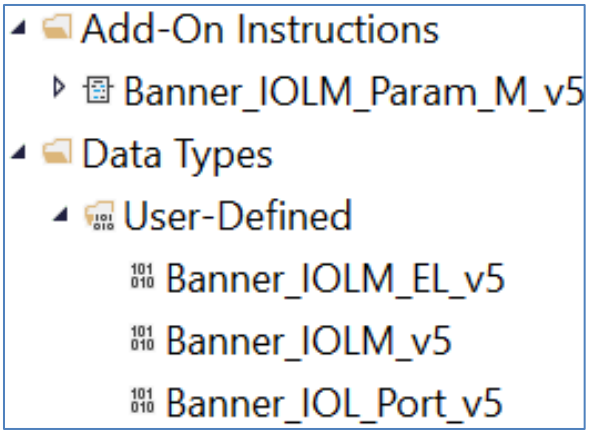
Ensure that the Murr IO-Link Master connection has been created in Studio 5000 before proceeding.

**Murr AOI Installation**

1. Open a project.
2. In the Controller Organizer window, right-click on the Add-On Instruction folder. Select the Import Add-On Instruction option.

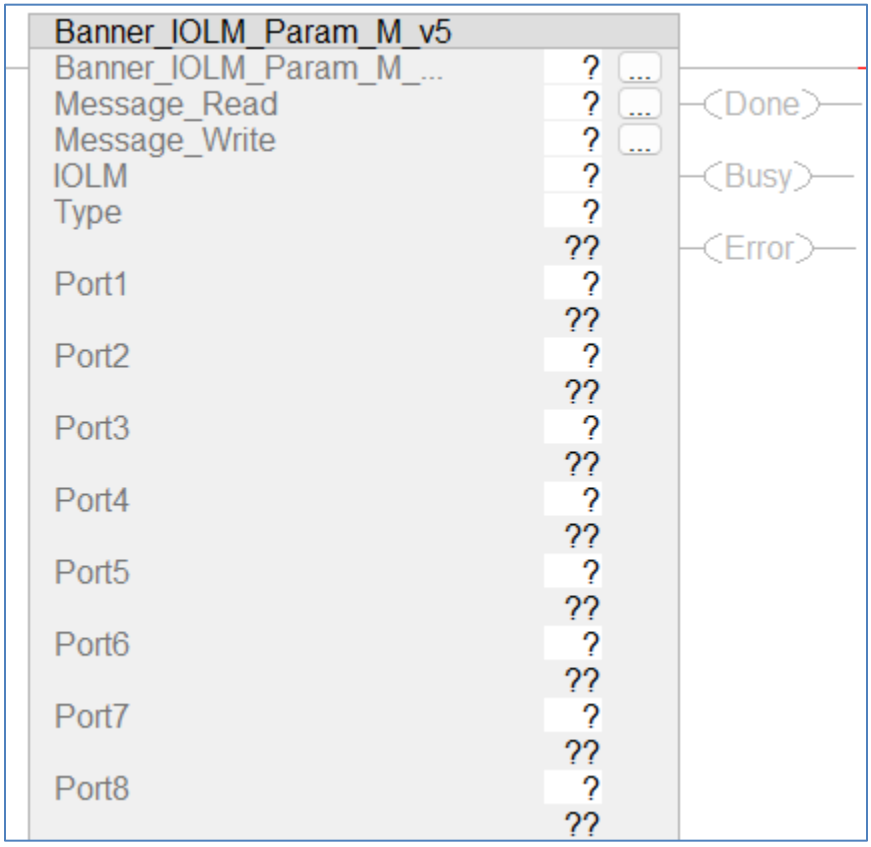



3. Navigate to the correct file location and select the AOI to be installed. In this example the "Banner_IOLM_Param_M_v5_AOI.L5X" file will be selected. Click the Open button.
4. The Import Configuration window will pop up. The default selection will create all the necessary items for the AOI. Click the OK button to complete the import process.
5. The AOI is added to the Controller Organizer window and should look like the image shown.
6. AOI installation into the Logix Designer software complete.



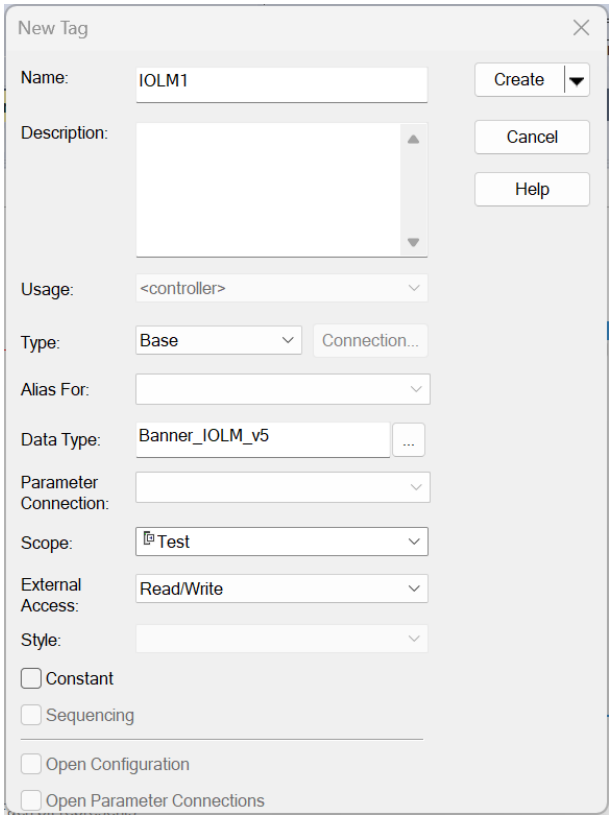
**Murr AOI Configuration**

1. Add the "Banner_IOLM_Param_M_v5" AOI to your ladder logic program. For each of the question marks shown in the instruction we need to create and link a new tag array. The AOI includes a new type of User Defined Tag (UDT): a custom array of tags meant specifically for this AOI.



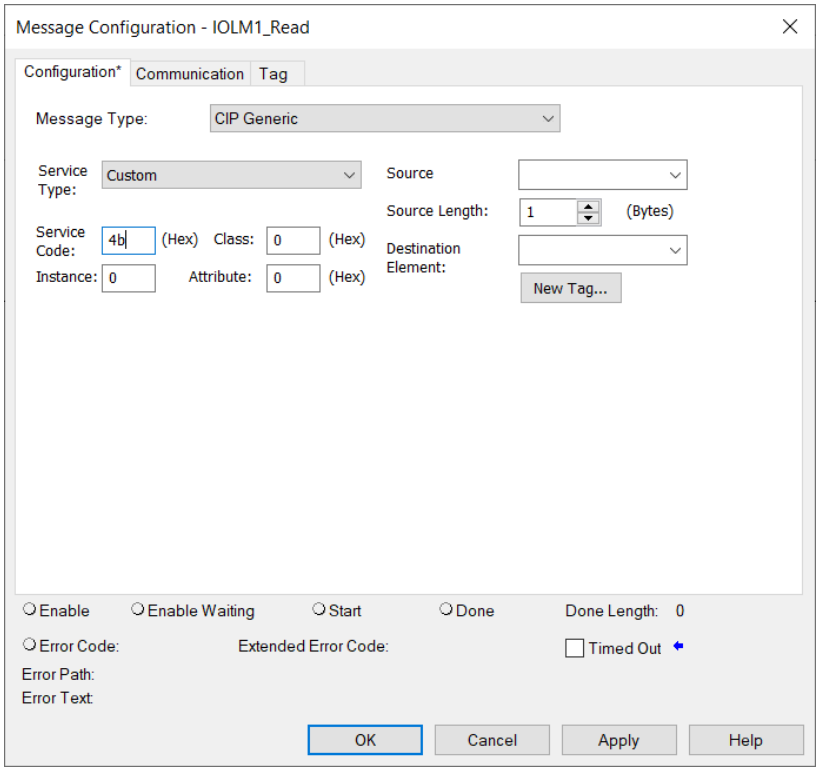

2. In the AOI, right-click on the question mark on the line labeled "Banner_IOLM_Param_M_v5". Click New Tag. In this example, we'll use the name "IOLM1_Status". The example naming convention accounts for this being the #1 IO-Link Master in our program. More masters could be named IOLM2, IOLM3, etc.
3. Now set up the Messages used to read and write to devices connected to this IO-Link Master. Right click on the question mark for Message_Read line in the AOI and choose New Tag. In this example we'll use the tag name IOLM1_Read. Click Create.
4. Do the same for the Message_Write line in the AOI.

5. Now create a new tag array for the “IOLM” line in the AOI. Here we used the name “IOLM1”. The tags created here will serve as linkages between the IO-Link Master AOI and the connected Banner device AOI(s). This group of tags also controls the flow of information to and from the master, ensuring that all sensors get a chance to read and write in an orderly fashion.

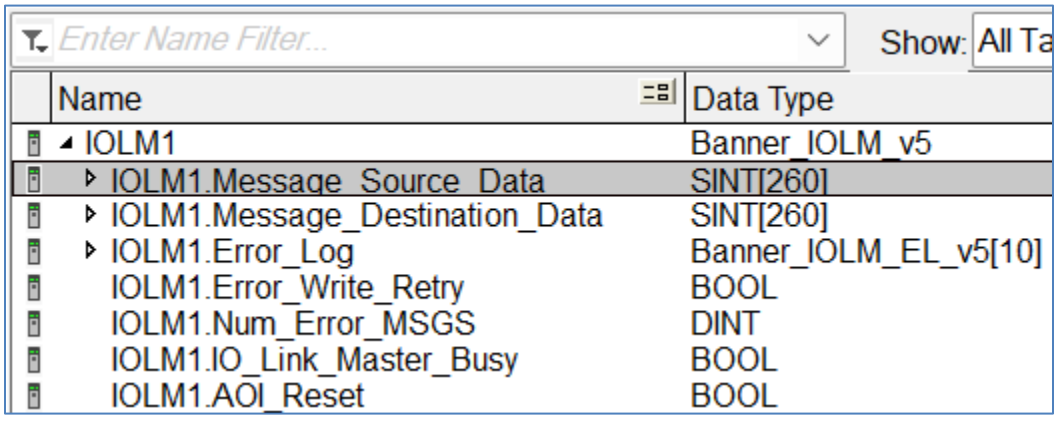



6. The Murr IO-Link Masters follow two separate IO-Link ISUD formats.
    a. Murr Impact67 E DIO 12 DIO4/IOL4 4P (Art.-No. 55144) uses 16#80 for CIP_Class, a value of 1 for CIP_Instance, and port number for the CIP_Attribute. A value of 0 in the Type parameter for the AOI configures the AOI for this data format.
    b. Murr Impact67 Pro E DIO8 IOL8 M12L 5P (Art.-No. 54631) uses 16#83 for CIP_Class and port number for the CIP_Instance. A value of 1 in the Type parameter for the AOI configures the AOI for this data format.

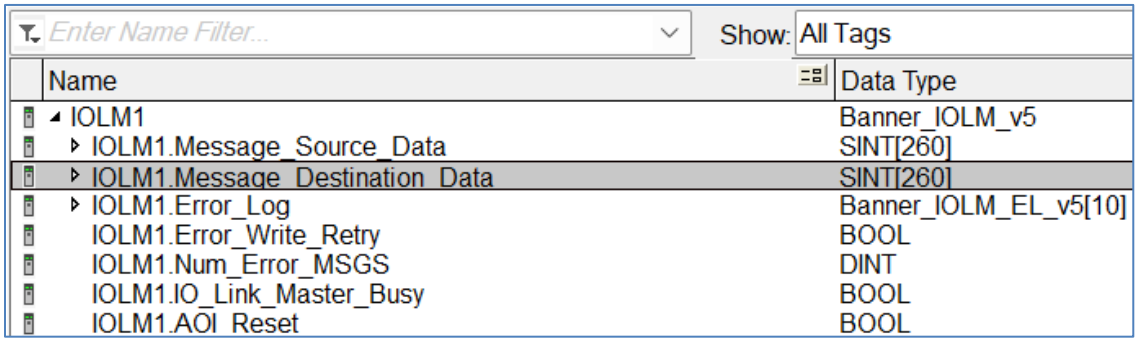
7. Now configure “IOLM1_Read”, setting up the Explicit Message that will handle half of the communications between the PLC and the IO-Link Master. Click on the “…” button at the far right of the “Message_Read” line.
8. In the Message Configuration window, keep the Message Type “CIP Generic” and the Service Type “Custom”. Enter Service Code 4b.



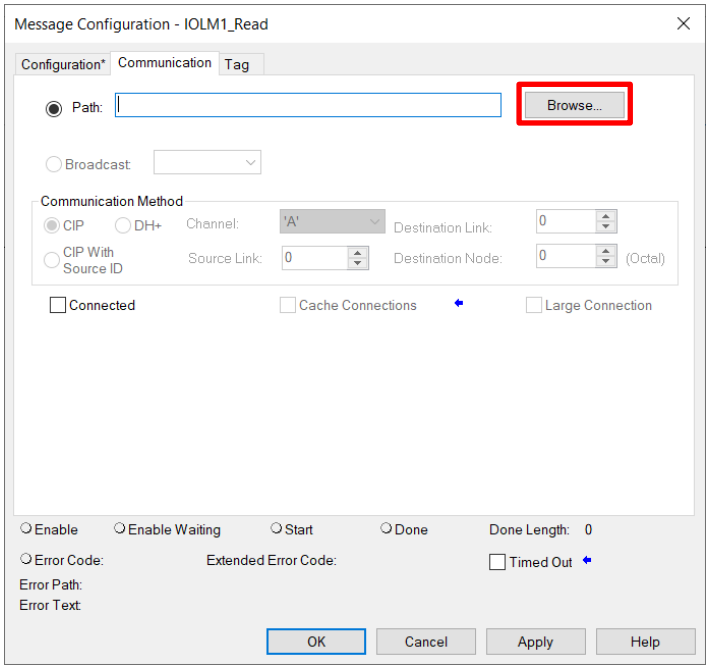

9. For the Source Element field, select “IOLM1.Message_Source_Data”.



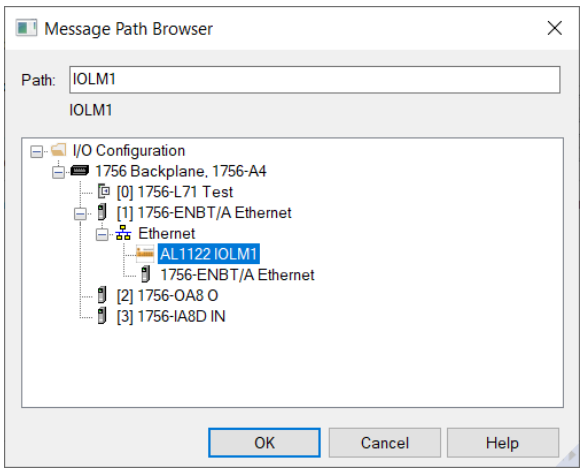
10. For Destination Element, select “IOLM1.Message_Destination_Data”.



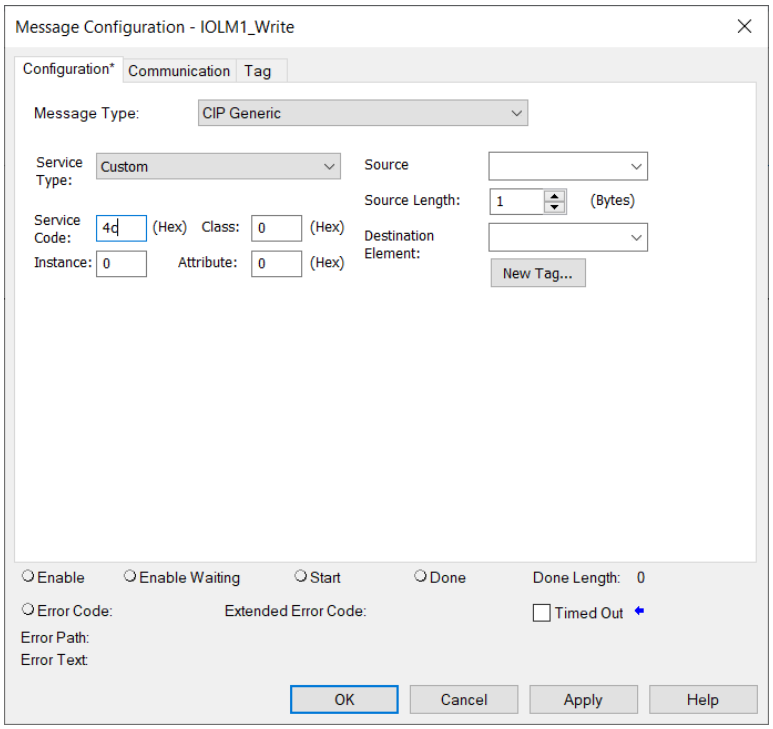

11. Now click on the Communication tab, then click the Browse button.



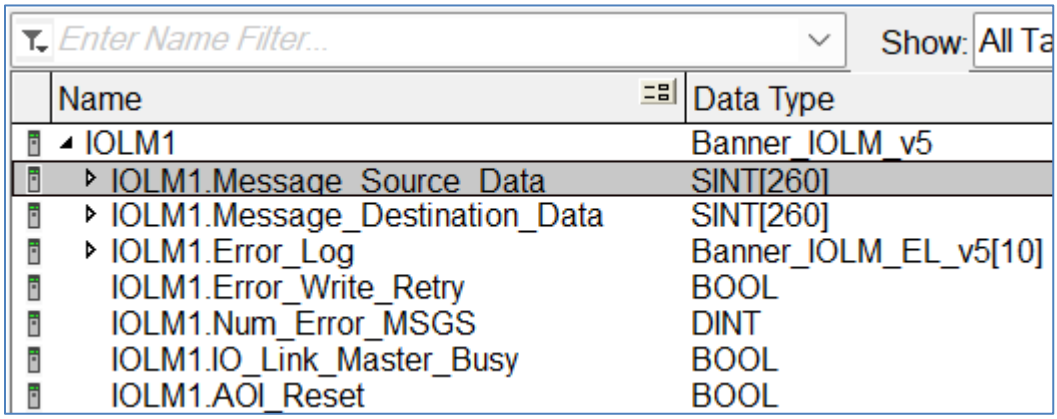
12. Select the IO-Link Master, then click OK to close the Message Path Browser window, then click OK again to close the Message Configuration window.



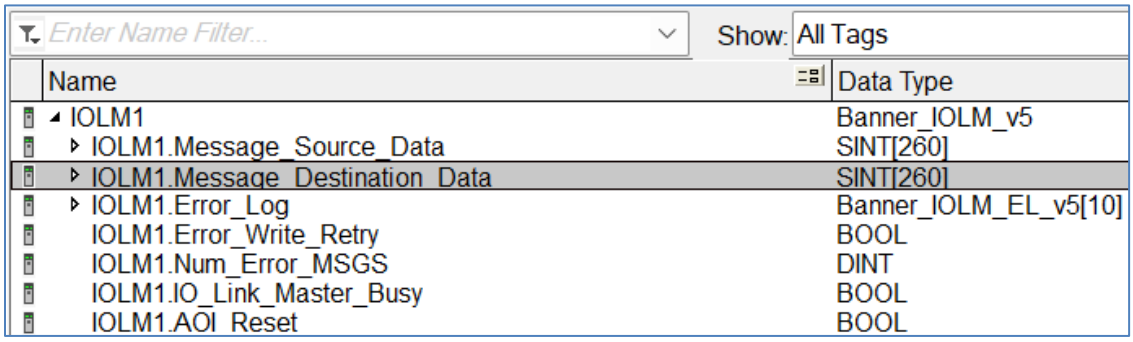

13. Now configure “Message_Write”, setting up the Explicit Message that will handle the other half of the communications between the PLC and the IO-Link Master. Click on the “…” button at the far right of the “Message_Write” line.
14. In the Message Configuration window, keep the Message Type “CIP Generic” and the Service Type “Custom”. Enter a Service Code of 4c.



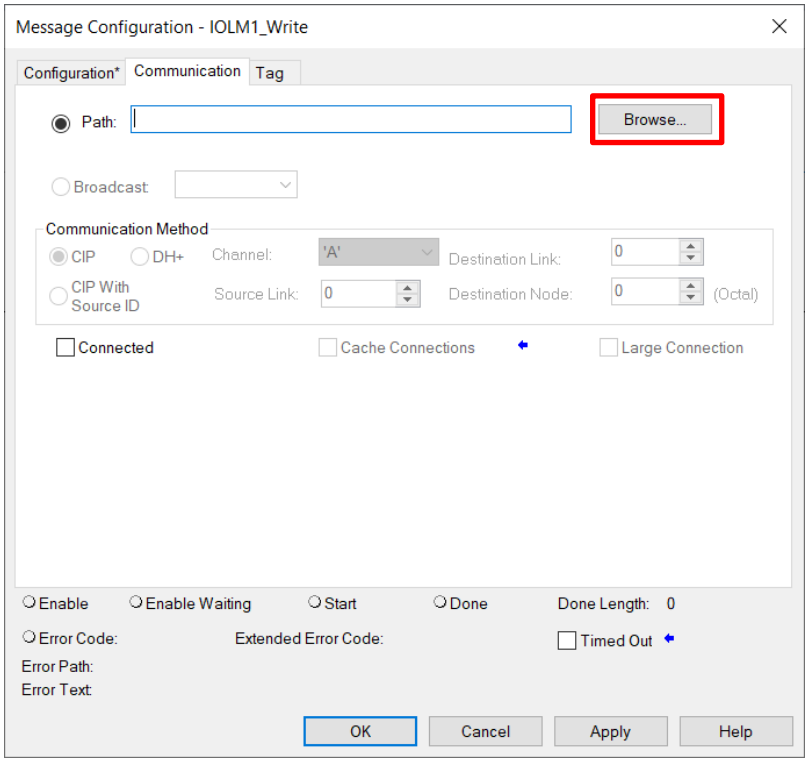
15. For the Source Element field, select “IOLM1.Message_Source_Data”.



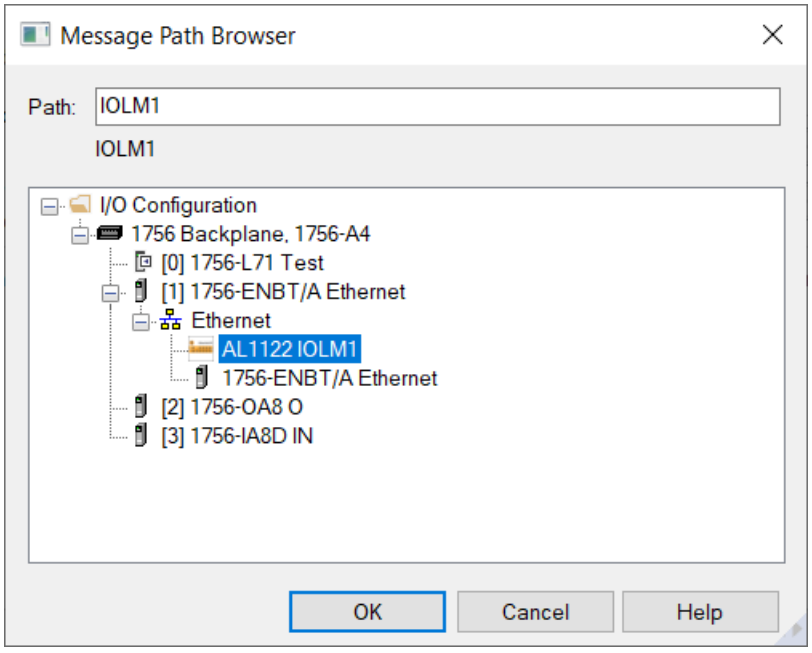

16. For Destination Element, select “IOLM1.Message_Destination_Data”.



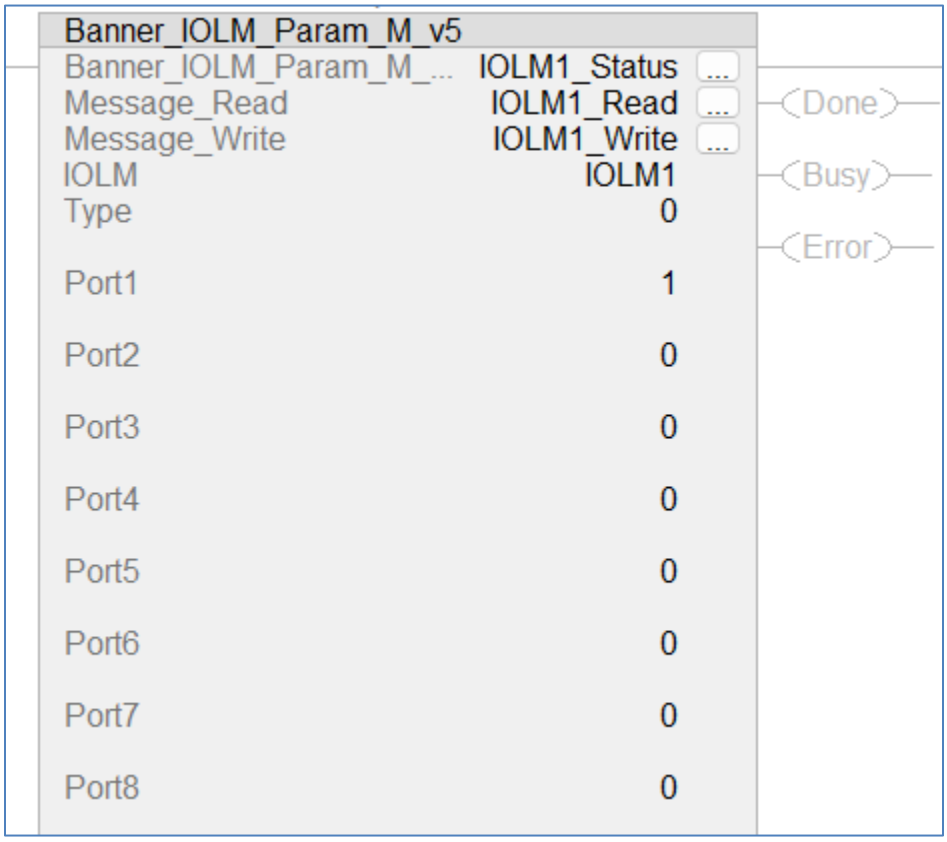
17. Now click on the Communication tab, then click the Browse button.




18. Select the IO-Link Master, then click OK to close the Message Path Browser window, then click OK again to close the Message Configuration window.



19. Port 1 Through 8 tells the AOI which ports are controlled. Set the Port value to 1 if controlled and 0 if not controlled. In this example, port 1 will be the only port controlled.
20. The completed AOI should look like the below image.



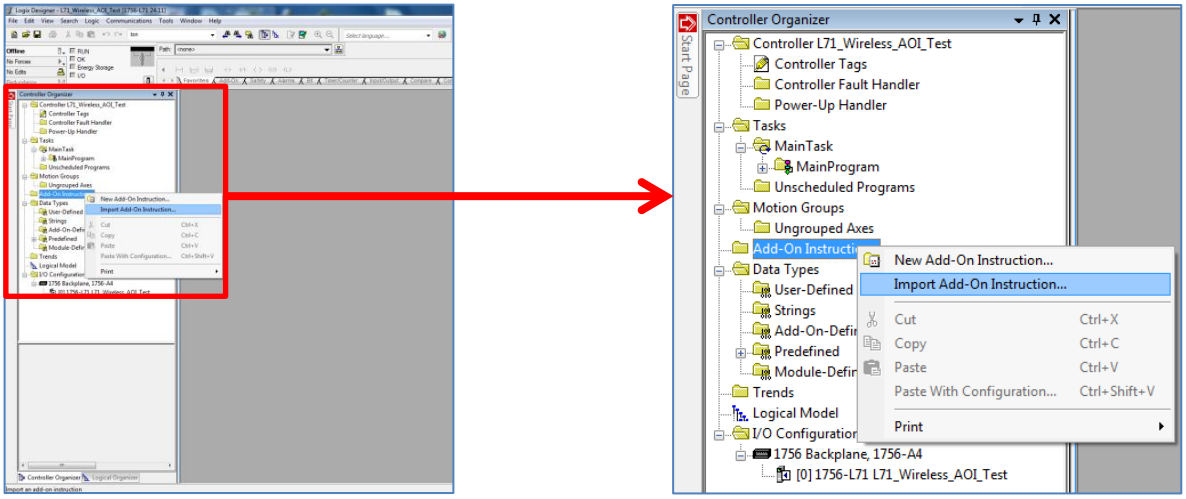

21. AOI configuration complete.
22. Go to the Import Device Data and Rule Set for Banner IOL Parameter AOI section to complete setup.

# 8. Turck IO-Link Master Setup

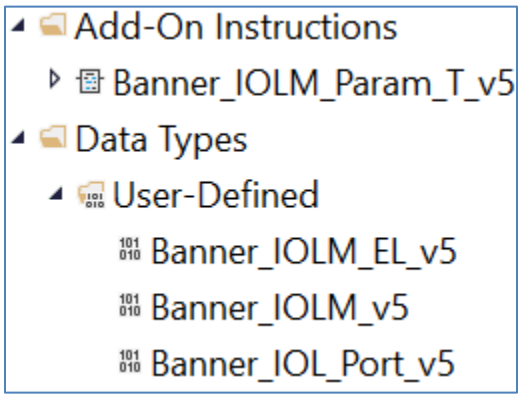
Ensure that the Turck IO-Link Master connection has been created in Studio 5000 before proceeding.

**Turck AOI Installation**

1. Open a project.
2. In the Controller Organizer window, right-click on the Add-On Instruction folder. Select the Import Add-On Instruction option.

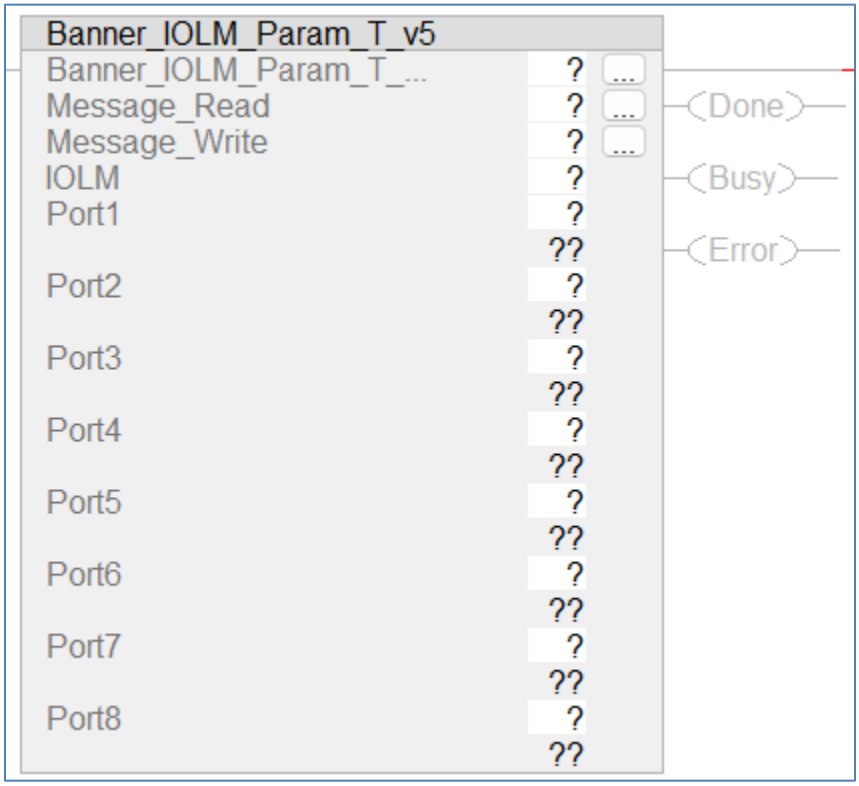



3. Navigate to the correct file location and select the AOI to be installed. In this example the "Banner_IOLM_Param_T_v5_AOI.L5X" file will be selected. Click the Open button.
4. The Import Configuration window will pop up. The default selection will create all the necessary items for the AOI. Click the OK button to complete the import process.
5. The AOI is added to the Controller Organizer window and should look like the image shown.
6. AOI installation into the Logix Designer software complete.



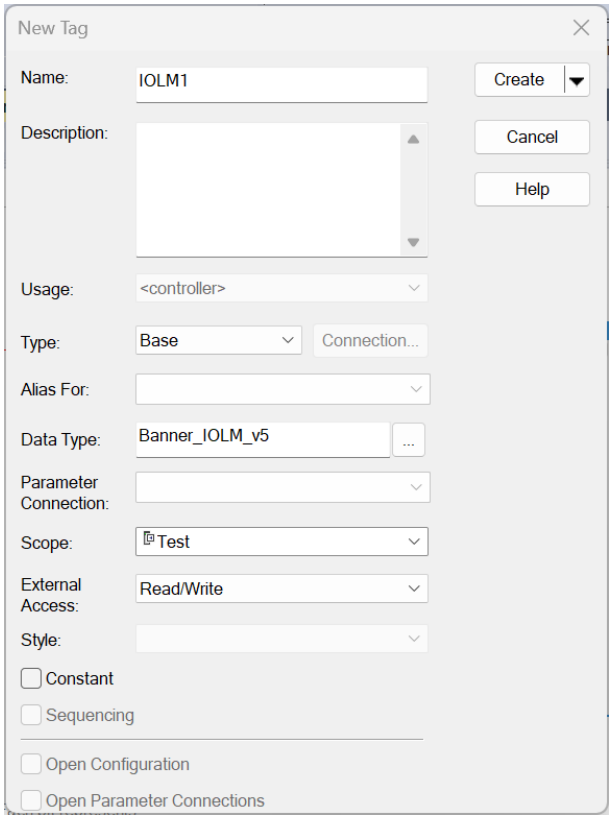
**Turck AOI Configuration**

1. Add the "Banner_IOLM_Param_T_v5" AOI to your ladder logic program. For each of the question marks shown in the instruction we need to create and link a new tag array. The AOI includes a new type of User Defined Tag (UDT): a custom array of tags meant specifically for this AOI.



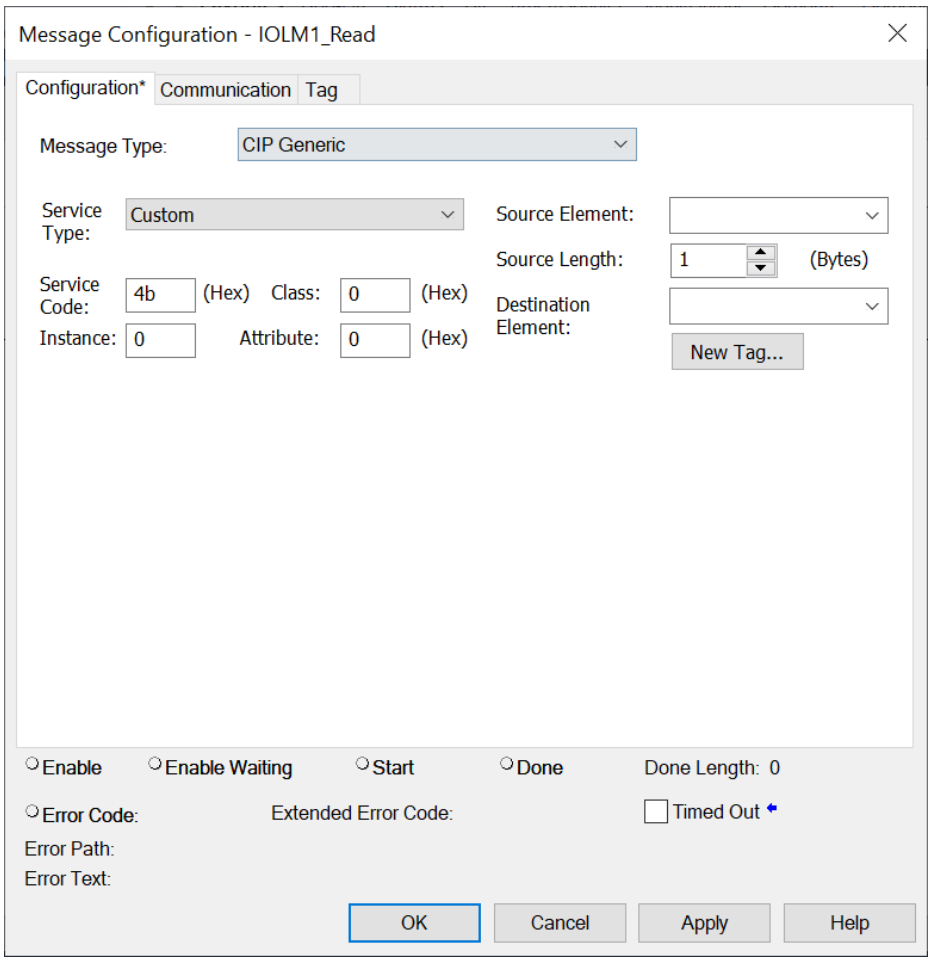

2. In the AOI, right-click on the question mark on the line labeled "Banner_IOLM_Param_T_v5". Click New Tag. In this example, we'll use the name "IOLM1_Status". The example naming convention accounts for this being the #1 IO-Link Master in our program. More masters could be named IOLM2, IOLM3, etc.
3. Now set up the Messages used to read and write to devices connected to this IO-Link Master. Right click on the question mark for Message_Read line in the AOI and choose New Tag. In this example we'll use the tag name IOLM1_Read. Click Create.
4. Do the same for the Message_Write line in the AOI.

5. Now create a new tag array for the “IOLM” line in the AOI. Here we used the name “IOLM1”. The tags created here will serve as linkages between the IO-Link Master AOI and the connected Banner device AOI(s). This group of tags also controls the flow of information to and from the master, ensuring that all sensors get a chance to read and write in an orderly fashion.

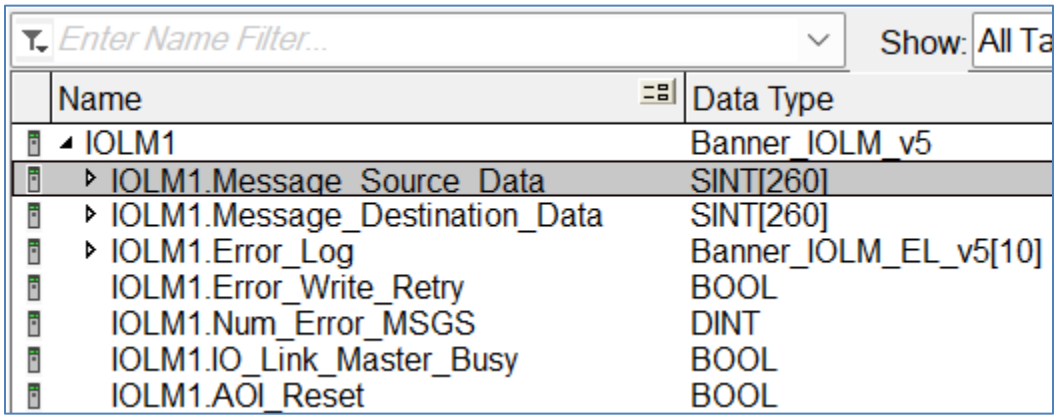



6. Now configure “Message_Read”, setting up the Explicit Message that will handle half of the communications between the PLC and the IO-Link Master. Click on the “…” button at the far right of the “Message_Read” line.

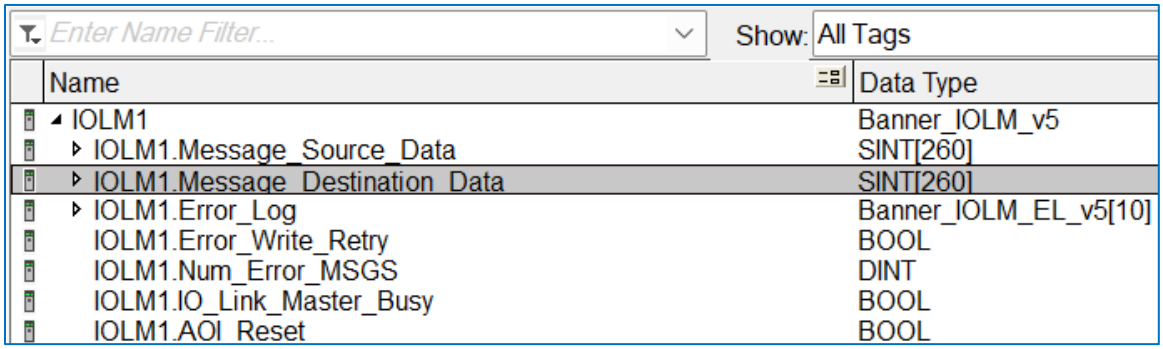
7. In the Message Configuration window, keep the Message Type “CIP Generic” and the Service Type “Custom”. Enter a Service Code of 4b.



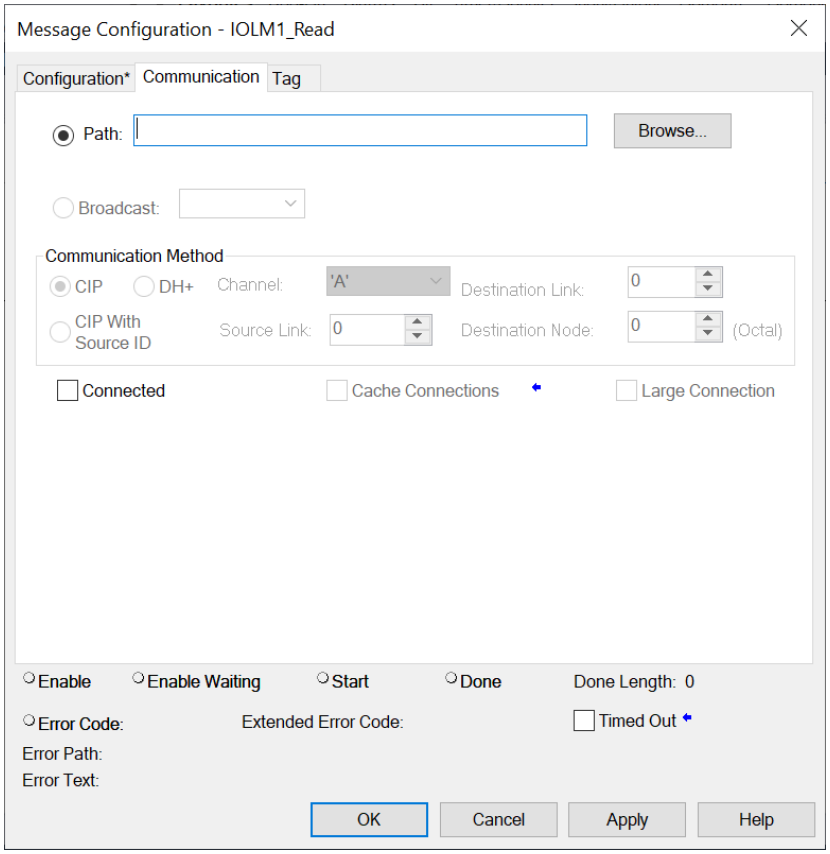

8. For the Source Element field, select “IOLM1.Message_Source_Data”.



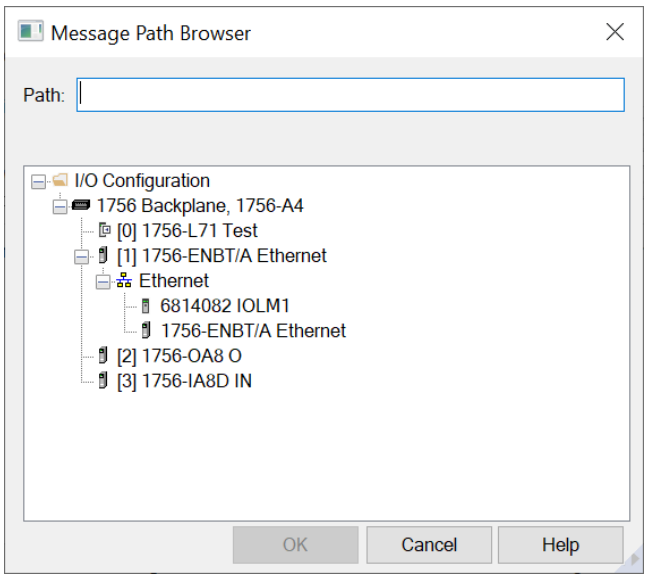
9. For Destination Element, select “IOLM1.Message_Destination_Data”.




10. Now click on the Communication tab, then click the Browse button.

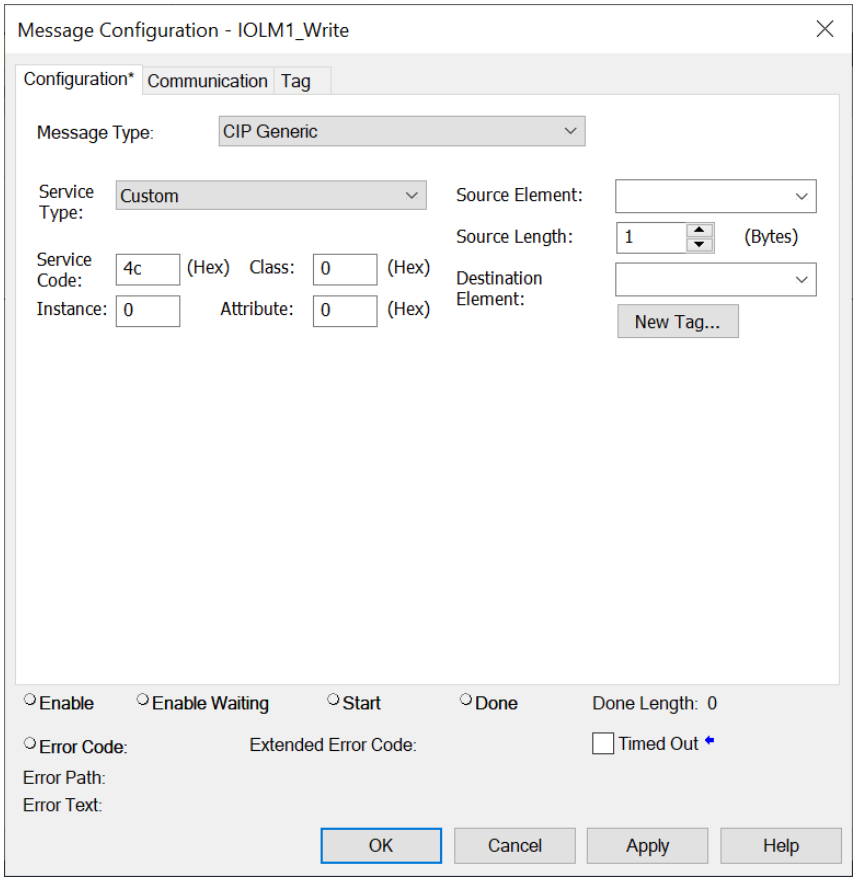


11. Select the IO-Link Master, then click OK to close the Message Path Browser window, then click OK again to close the Message Configuration window.

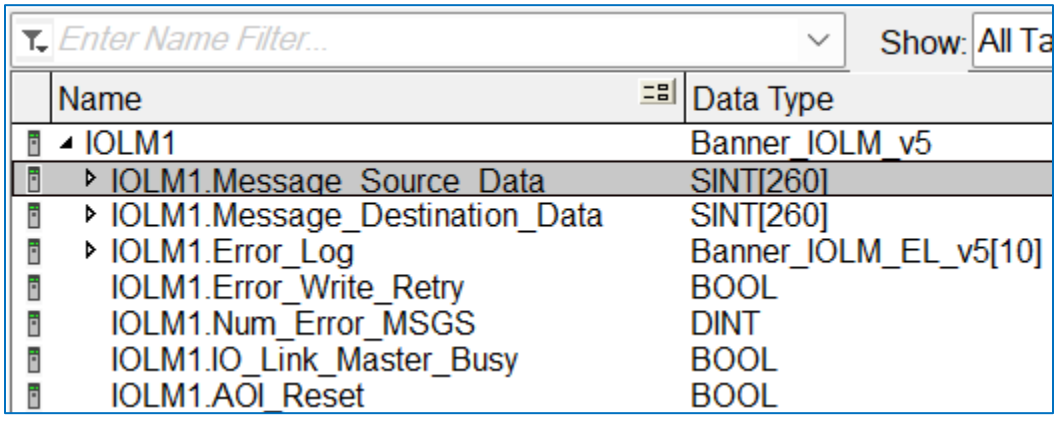



12. Now configure “Message_Write”, setting up the Explicit Message that will handle the other half of the communications between the PLC and the IO-Link Master. Click on the “…” button at the far right of the “Message_Write” line.

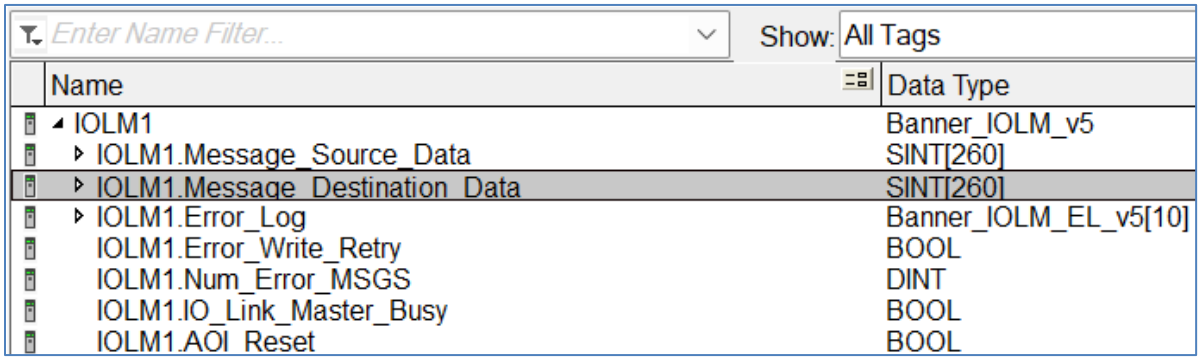
13. In the Message Configuration window, keep the Message Type “CIP Generic” and the Service Type “Custom”. Enter a Service Code of 4c.



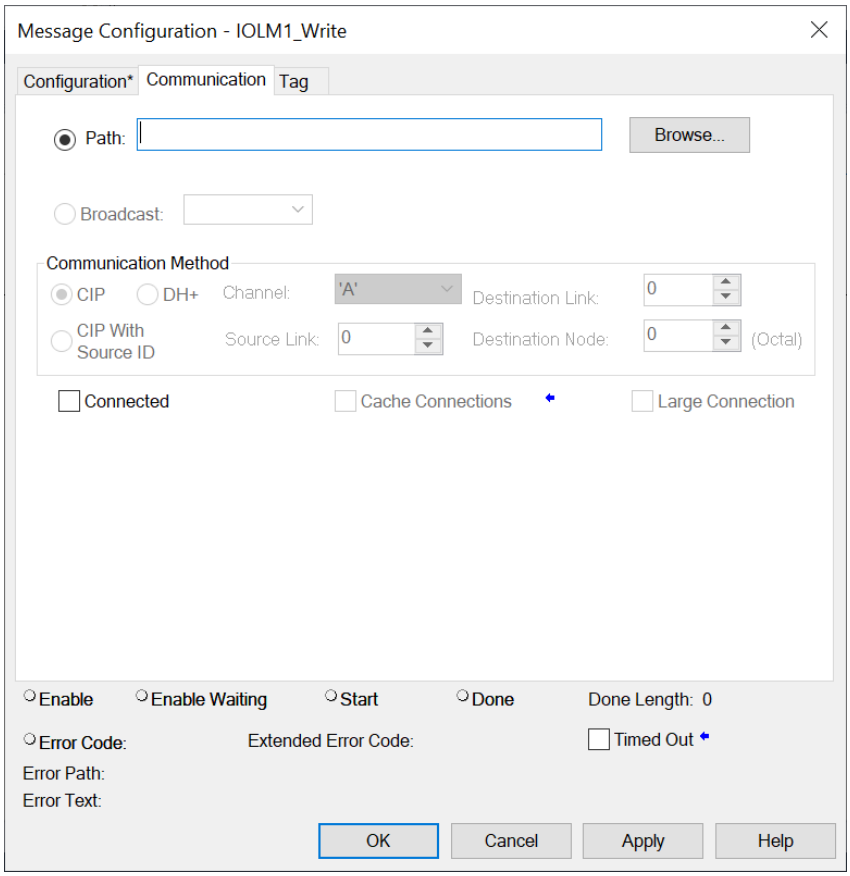

14. For the Source Element field, select “IOLM2.Message_Source_Data”.



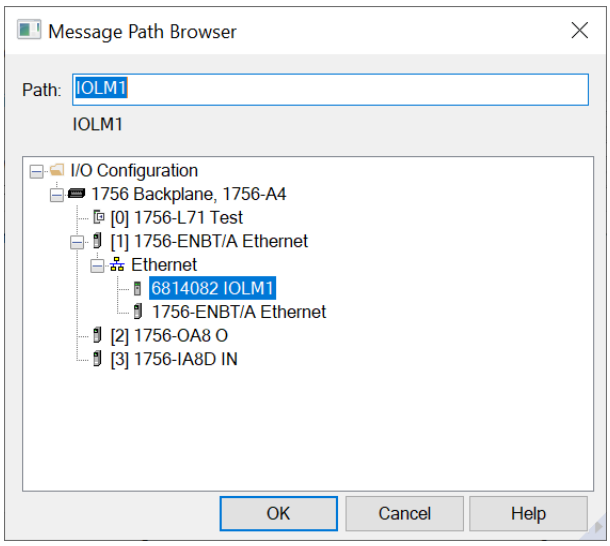
15. For Destination Element, select “IOLM2.Message_Destination_Data”.



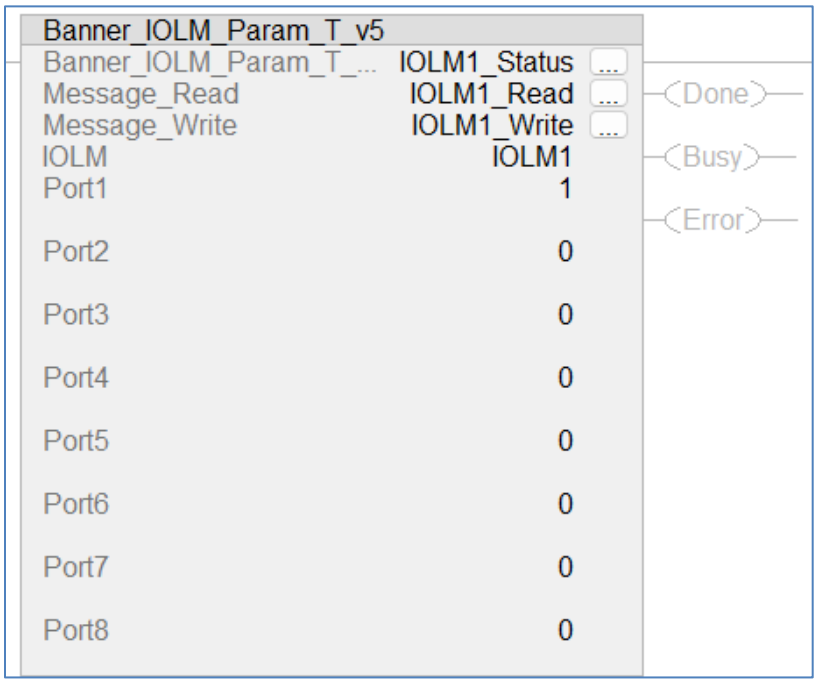

16. Now click on the Communication tab, then click the Browse button.



17. Select the IO-Link Master, then click OK to close the Message Path Browser window, then click OK again to close the Message Configuration window.




18. Port 1 Through 8 tells the AOI which ports are controlled. Set the Port value to 1 if controlled and 0 if not controlled. In this example, port 1 will be the only port controlled.
19. The completed AOI should look like the below image.

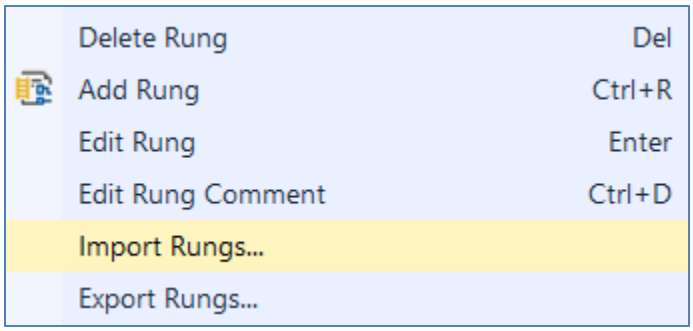



20. AOI configuration complete.
21. Go to the Import Device Data and Rule Set for Banner IOL Parameter AOI section to complete setup.

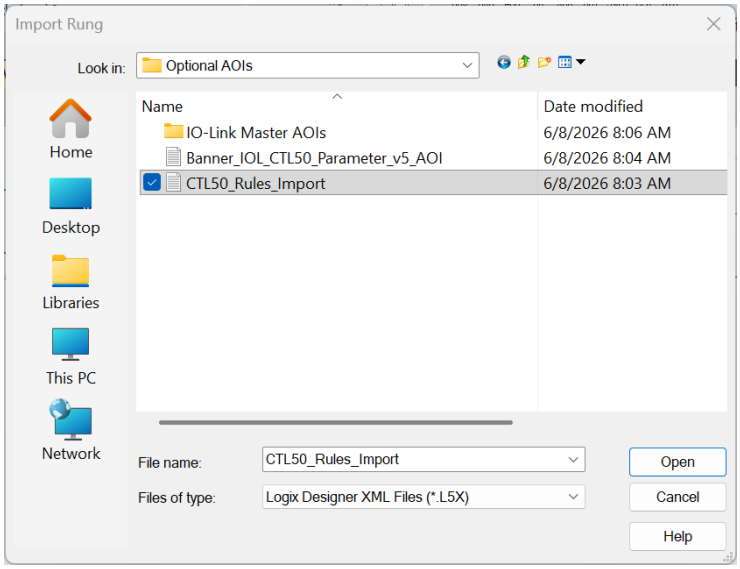
# 9. Import Device Data and Rule Set for Banner IOL CTL50 Parameter AOI

This section describes how to import the User Defined Data Types in Logix Designer software.

1. Go to an open ladder rung. Right click and select “Import Rungs…”. The Import rung window will appear.

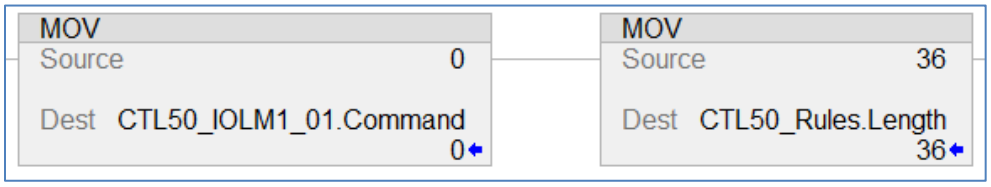



2. Navigate to the correct file location and select the IO-Link Rules to be installed. Select the Banner device required for your system. In this example the “CTL50_Rules_Import_v5.L5X” file will be selected. Click the Open button.

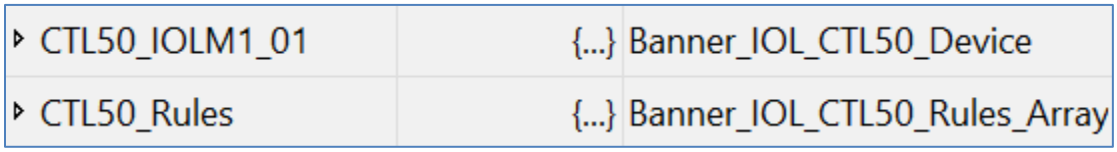



3. The Import Configuration window will pop up. The default selection will create all the necessary items for the AOI. Click the OK button to complete the import process.

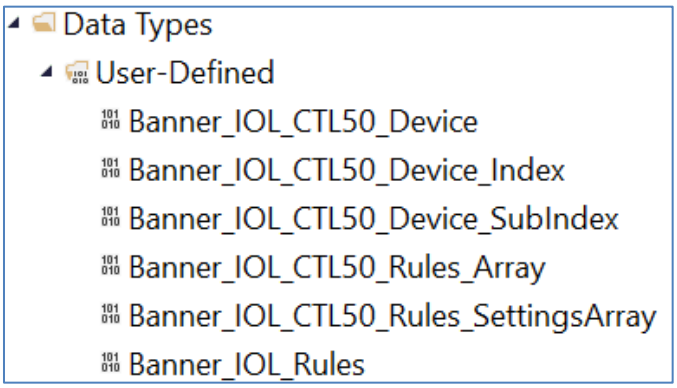
4. Two Move blocks will now be added to the rung. This step imports the proper data for gathering the CTL50 Parameter data. Delete these two blocks. The import is only done to get the tags populated into the system.




5. Controller Tags will now have two new entries. These tags will be required after the AOI has been imported. Rename the tags for the system as needed. If there are multiple CTL50 sensors in the system copy the CTL50_IOLM1_01 tag and rename the copied version for another entry. Repeat this process as needed. Feel free to change the name for CTL50_IOLM1_01, so it follows any naming convention used.



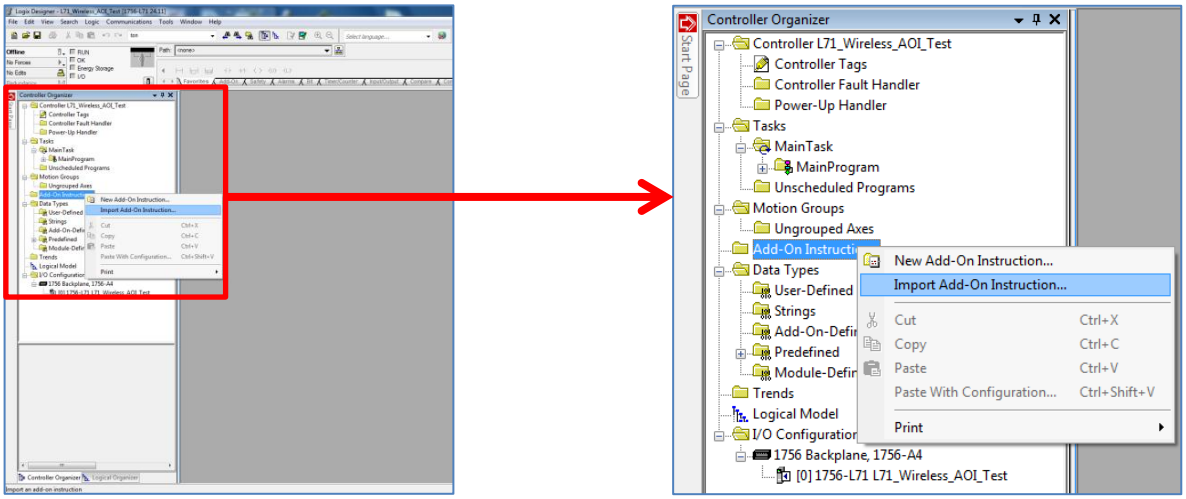

6. The import added several User-Defined Data Types to the System.
7. Import operation into the Logix Designer software complete.



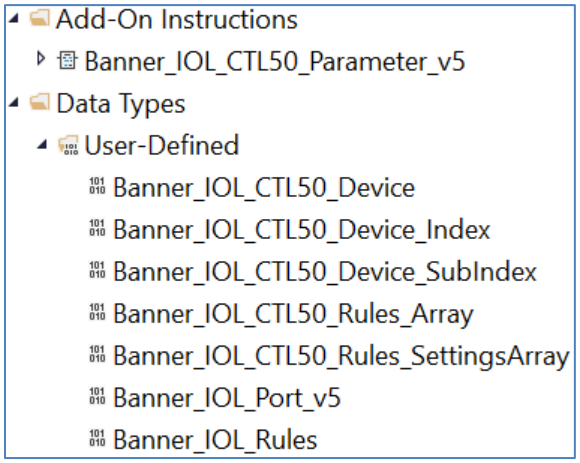
## 10. Install Banner IOL CTL50 Parameter AOI

This section describes how to install the AOI in Logix Designer software.

1. In the Controller Organizer window, right-click on the Add-On Instruction folder. Select the Import Add-On Instruction option.



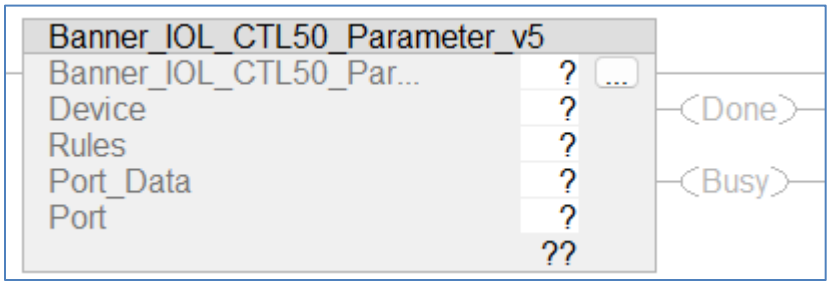

2. Navigate to the correct file location and select the AOI to be installed. In this example the "Banner_IOL_CTL50_Parameter_v5_AOI.L5X" file will be selected. Click the Open button.
3. The Import Configuration window will pop up. The default selection will create all the necessary items for the AOI. Click the OK button to complete the import process.
4. The AOI is added to the Controller Organizer window and should look like the shown image.
5. AOI Installation into the Logix Designer software complete.



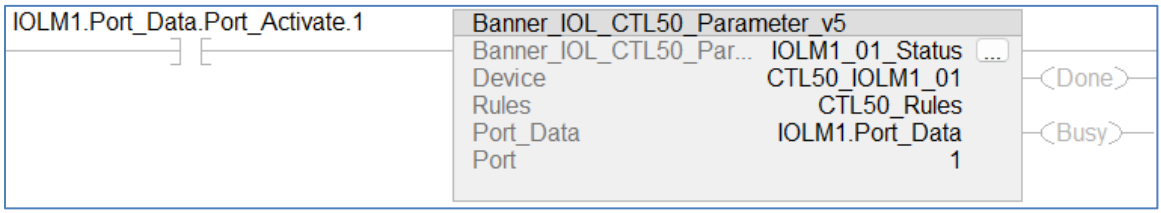
# 11. Configuring the Banner IO-Link CTL50 Parameter AOI

Make sure to add and configure a Banner IO-Link Master AOI to your program before adding a Banner IO-Link Device AOI. There will be an instance of "Banner_IOL_CTL50_Parameter_v5" for each Banner IO-Link device in the system.

1. Add the "Banner_IOL_CTL50_Parameter_v5" AOI to your ladder logic program. For each of the question marks shown in the instruction we need to create and link a new tag array. The AOI includes new types of User Defined Tag (UDT): custom arrays of tags meant specifically for this AOI.

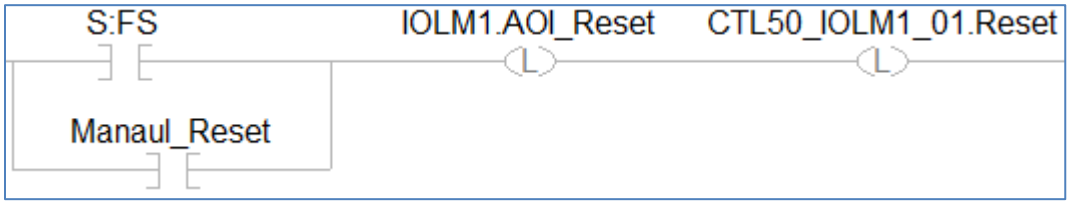



2. In the AOI, right-click on the question mark on the line labeled "Banner_IOL_CTL50_Parameter_v5". Click New Tag. In this example, we'll use the name "CTL50_IOLM1_01_Status". The example naming convention accounts for this being an IO-Link device connected to IO-Link Master #1, port #1, in our program. More masters could be named IOLM2, IOLM3, and different sensors could be connected at other port numbers, etc.
3. Now link the tag imported in the previous section called "CTL50_IOLM1_01" to the Device line. This array of tags includes the Read and Write data blocks, made up of the information from the CTL50 IO-Link Index and Subindex values.
4. Now link the tag imported in the previous section called "CTL50_IOL_Rules" to the Rules line. This tag array tells the Banner_IOL_Parameter AOI how to communicate with a CTL50 device through the Banner DXMR IO-Link Master.
5. For the "Port_Data" line, choose the relevant IO-Link Master AOI's "Port_Data" variable. In this example, we choose "IOLM1.Port_Data".
6. The last line of the CTL50 AOI, "Port", type in a number equal to the IO-Link Master port number to which the CTL50 is connected. In this example, the CTL50 is on port 1.




7. Finally add an Examine On in front of the AOI. Link this to a IOLM1.Port_Data.Port_Activate.1. Change the 1 to the correct port number for the device.
8. Configuration of AOI complete.
9. There is one final piece that needs to be created.

10. Best practices suggest adding a rung to your ladder logic program that resets all IO-Link Master and Device Parameter AOIs on the first scan. The example below shows one IO-Link Master, called IOLM1, and one connected CTL50 having their respective AOIs being reset in this way. The S:FS represents the System First Scan variable. The “Manual_Reset” is a user created tag. This allows the user a way to manually activate the reset. Turn “Manual_Reset” On for a couple of seconds and then turn it Off.



## 12. Using the Paired IO-Link Master and Device Parameter Data AOIs

The Banner IOL CTL50 Parameter AOI will automatically gather data for all IO-Link devices in the system when first powered on. Parameter data is an acyclic process and can take some time to complete. The initial read is complete when the “Initial_Global_Read” tag is set to 1. This flag can be set to false to request another full global read of all parameter data for an IO-Link device. There should be one tag of “Banner_IOL_Device” for each device in the system. If you have 3 CTL50 sensor then copy the “CTL50_IOLM1_01” until you have three copies of it. One for each device. Rename them as needed for the system.

| | |
|---|---|
| ▾ CTL50_IOLM1_01 | {...} |
| CTL50_IOLM1_01.Initial_Global_Read | 0 |
| ▸ CTL50_IOLM1_01.Command | 0 |
| ▸ CTL50_IOLM1_01.Data | {...} |
| CTL50_IOLM1_01.Reset | 0 |

The Data section in “Banner_IOL_CTL50_Device” should be expanded. Now the Index should also be expanded. Now the Index array is fully visible. Start at Index[2] each line is labeled. These labels represent the IO-Link indices in the device. Read only indices will have a “ro” in the description. Write only has a “wo”. Everything with neither a “ro” or a “wo” is Read Write capable. See the image below for an example of this.

| | | | |
|---|---|---|---|
| ▾ CTL50_IOLM1_01 | {...} | Banner_IOL_CTL50_Device | |
| CTL50_IOLM1_01.Initial_Global_Read | 0 | BOOL | |
| ▸ CTL50_IOLM1_01.Command | 0 | SINT | |
| ▾ CTL50_IOLM1_01.Data | {...} | Banner_IOL_CTL50_Device_Index | |
| ▾ CTL50_IOLM1_01.Data.Index | {...} | Banner_IOL_CTL50_Device_SubIndex[... | |
| ▸ CTL50_IOLM1_01.Data.Index[0] | {...} | Banner_IOL_CTL50_Device_SubIndex | |
| ▸ CTL50_IOLM1_01.Data.Index[1] | {...} | Banner_IOL_CTL50_Device_SubIndex | |
| ▸ CTL50_IOLM1_01.Data.Index[2] | {...} | Banner_IOL_CTL50_Device_SubIndex | Direct Parameters 1 (ro) |
| ▸ CTL50_IOLM1_01.Data.Index[3] | {...} | Banner_IOL_CTL50_Device_SubIndex | Standard Command (wo) |
| ▸ CTL50_IOLM1_01.Data.Index[4] | {...} | Banner_IOL_CTL50_Device_SubIndex | Device Locks |
| ▸ CTL50_IOLM1_01.Data.Index[5] | {...} | Banner_IOL_CTL50_Device_SubIndex | Serial Number (ro) |
| ▸ CTL50_IOLM1_01.Data.Index[6] | {...} | Banner_IOL_CTL50_Device_SubIndex | Operating Mode |
| ▸ CTL50_IOLM1_01.Data.Index[7] | {...} | Banner_IOL_CTL50_Device_SubIndex | Segment Configuration |
| ▸ CTL50_IOLM1_01.Data.Index[8] | {...} | Banner_IOL_CTL50_Device_SubIndex | Segment 1 Configuration |
| ▸ CTL50_IOLM1_01.Data.Index[9] | {...} | Banner_IOL_CTL50_Device_SubIndex | Segment 2 Configuration |
| ▸ CTL50_IOLM1_01.Data.Index[10] | {...} | Banner_IOL_CTL50_Device_SubIndex | Segment 3 Configuration |

A Global Read can be started by either entering a 1 into Command or setting the “Initial_Global_Read” to 0. A singular Index Read is started by entering the index number in the command. As an example, if “Segment 1 Configuration” should be updated then entering an 8 into the Command does the Read operation for that Index. The Data in the index is now updated. Expand the index to see the data.

The Write operation requires a few steps to complete. Start by expanding the Index that will be updated. For this example, “Segment 1 Configuration” will be used.

| | | | |
|---|---|---|---|
| CTL50_IOLM1_01.Data.Index[8] | {...} | Banner_IOL_CTL50_Device_SubIndex | Segment 1 Configuration |
| CTL50_IOLM1_01.Data.Index[8].Sub | {...} | DINT[20] | Segment 1 Configuration |
| CTL50_IOLM1_01.Data.Index[8].Sub[0] | 0 | DINT | Segment 1 Configuration |
| CTL50_IOLM1_01.Data.Index[8].Sub[1] | 1 | DINT | Basic Color: 0=Green, 1=Red, 2=Orange, 3=Amber, 4=Yellow, 5=Lime |
| CTL50_IOLM1_01.Data.Index[8].Sub[2] | 0 | DINT | Basic Flash Rate: 0=Medium, 1=Fast, 2=Slow, 3=Custom Flash Rate |
| CTL50_IOLM1_01.Data.Index[8].Sub[3] | 0 | DINT | Animation: 0=Off, 1=Steady, 2=Falsh, 3=2 Color Flash, 4=2 Color Shif |
| CTL50_IOLM1_01.Data.Index[8].Sub[4] | 0 | DINT | Color 1: 0=Green, 1=Red, 2=Orange, 3=Amber, 4=Yellow, 5=Lime Gre |
| CTL50_IOLM1_01.Data.Index[8].Sub[5] | 0 | DINT | Color 1 Intensity: 0=High, 1=Low, 2=Medium, 3=Off, 4=Custom |
| CTL50_IOLM1_01.Data.Index[8].Sub[6] | 0 | DINT | Speed: 0=Medium, 1=Fast, 2=Slow, 3=Custom Rate |

Change all the “Sub” values that need to be updated. This example changes Animation from 0 to 1 and Color 1 from 0 to 10.

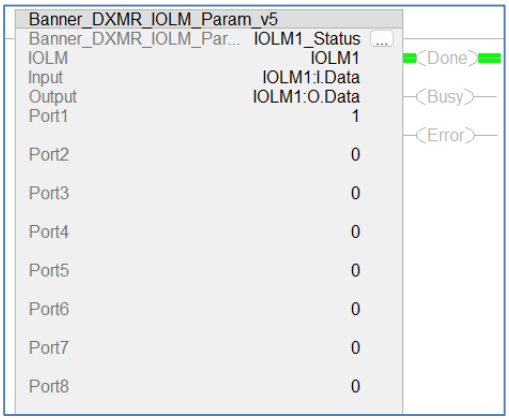
| | | |
|---|---|---|
| CTL50_IOLM1_01.Data.Index[8].Sub | {...} | Segment 1 |
| CTL50_IOLM1_01.Data.Index[8].Sub[0] | 0 | Segment 1 |
| CTL50_IOLM1_01.Data.Index[8].Sub[1] | 1 | Basic Color |
| CTL50_IOLM1_01.Data.Index[8].Sub[2] | 0 | Basic Flash |
| CTL50_IOLM1_01.Data.Index[8].Sub[3] | 1 | Animation: |
| CTL50_IOLM1_01.Data.Index[8].Sub[4] | 10 | Color 1: 0= |

Command needs to be set for the Write command to be updated. Take the index number and add 40 to it. This is the value that needs to be entered into the Command value. Here the value 48 (40 + 8) is entered and the device is updated.

| | |
|---|---|
| CTL50_IOLM1_01 | {...} |
| CTL50_IOLM1_01.Initial_Global_Read | 1 |
| CTL50_IOLM1_01.Command | 48 |

The Command value will be set back to 0 after the operation is completed. When the Command is set back to 0 check to see if the error bit was set to on from “IOLM1_Status” or the AOI.

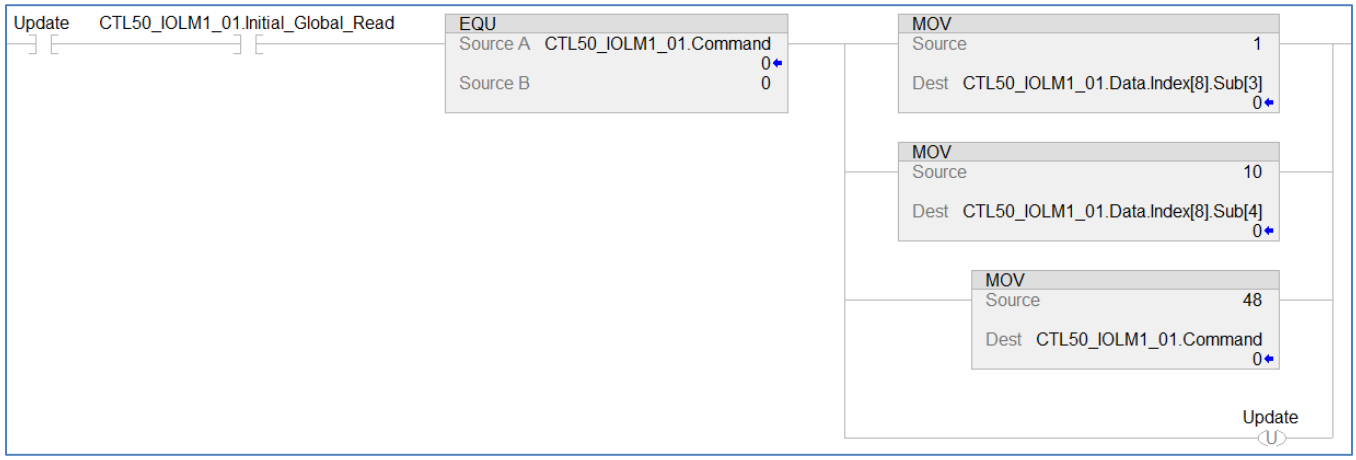
| | |
|---|---|
| CTL50_IOLM1_01 | {...} |
| CTL50_IOLM1_01.Initial_Global_Read | 1 |
| CTL50_IOLM1_01.Command | 0 |



The previous section went through the steps of how to manually read and write the data. This section will show an example of how the update could happen when programmed. The user will need to come up with some logic that determines when the update should occur. This logic should not be able to be continuously activated.

*NOTE: Parameter data is meant to be updated infrequently. The data is stored in EEPROM that has limited number of writings available. Exceeding this limit can cause the IO-Link device to error out. Each Index data element has a separate counter for this. If the application requires very quick Index writes, contact Banner Engineering to discuss. Never need to worry about Reads, however.

Example Logic for IO-Link Parameter Update




In this example, the update tag represents the logic that triggers the parameter data update. Here it is just a simple Boolean value; however, it will likely be more complex in the actual system. Next is a normally open contact that is checking that the “Initial_Global_Read” has been set to 1. This ensures that the system has read all the parameter data correctly. If the parameter data has yet to be read, then the data cannot be updated yet. Next is an Equal comparison check. This looks at the Command variable for the AOI. If Command is already processing a command/operation wait until that is completed before trying to do another command/operation. Finally, all the data for one Parameter Data Index can be adjusted as needed. In this example Sub[3] (Animation) and Sub[4] (Color 1) are updated to the necessary values for the system. Command has a 48 sent to it which represents Index 8 (remember writes are activated by adding 40 to the Index number). The Boolean used to activate the routine is turned off. It may be necessary to handle this in another way depending on the logic used to activate this process. The “Banner_IOL_CTL50_Parameter_v5” will update the IO-Link device to the new parameters.

# Appendix A Error Handling & AOI Resets

Whenever an error related to the read or write Message Commands buried inside the AOI occurs, the "Num_Error_MSGS" variable will increment by 1.

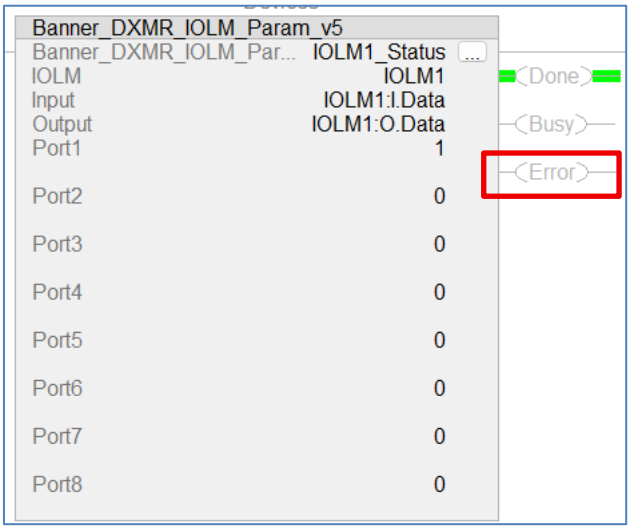
The specific error information will be stored in the "Error_Log" array. This array includes space for 10 errors. Each entry records whether the error occurred on a read (0) or write (1) attempt and which port on the IO-Link Master and Index on the IO-Link Device were involved. Once the error is logged, the AOI moves on to the next task. An example of an Error_Log entry is shown below, where an IO-Link Master AOI failed to write to Index 60 on the IO-Link device connected to port 1.

| | |
|---|---|
| IOLM1.Error_Log | {...} |
| IOLM1.Error_Log[0] | {...} |
| IOLM1.Error_Log[0].RW | 1 |
| IOLM1.Error_Log[0].Port | 1 |
| IOLM1.Error_Log[0].Index | 60 |

Potential causes for errors include incorrect setup of the Device or Master AOI (wrong port number for device, wrong Port_Controlled array for master, or incorrect settings for the Master message commands), having the sensor physically connected to the incorrect port on the Master, or having no power to the IO-Link Master.

The "AOI_Reset" variable is used to restart the AOI from scratch. To initiate this reset, write a "1" to this register. The reset will occur, then turn the variable back to "0" automatically.

The IOLM AOI also shows when an error occurs. The Error line on the AOI itself will be green/active when an error occurs.



# Appendix B Halt AOI Operation

At times it may be desirable to halt the IO-Link Master AOI. This is especially true if you are using AOIs made by other manufacturers, particularly those made by the manufacturer of the IO-Link Master itself. The "Halt_Operation" variable can be used to stop the action of the Banner IO-Link Master AOI, allowing other AOIs to function correctly. When the other AOIs are done, the Banner IO-Link Master AOI can be reactivated.

