



## ifm IO-Link Master Add-On Instruction Guide, v4 September 15<sup>th</sup>, 2023

This document covers the installation and use of an Add-On Instruction (AOI) for the Logix Designer software package from Rockwell Automation. This AOI handles acyclic IO-Link commands from an Allen-Bradley PLC through an ifm IO-Link Master. This AOI has two User Defined Tag data types.

**This IO-Link Master AOI is meant to be used alongside one or more v4 Banner IO-Link Device Parameter Data AOIs.**

This document was written using an ifm AL1122 IO-Link Master (SL EIP 8P IP67). Other ifm IO-Link Masters may work as well.

### **Components**

Banner\_IOLM\_I\_v4\_AOI.L5X

### **UDT's Packaged with the AOI**

Banner\_IOLM\_v4

Banner\_IOLM\_EL\_v4

Banner\_IOL\_Port\_v4

### **NOTE:**

This Banner IO-Link Master AOI is useless on its own.

It is intended to be linked to one or more v4 Banner Device Parameter AOIs to function.

### **Other AOIs Available Separately**

Banner has AOI files for other brands of IO-Link Master and for controlling a variety of Banner IO-Link devices. Banner also has AOI files for easily handling Banner device Process Data.

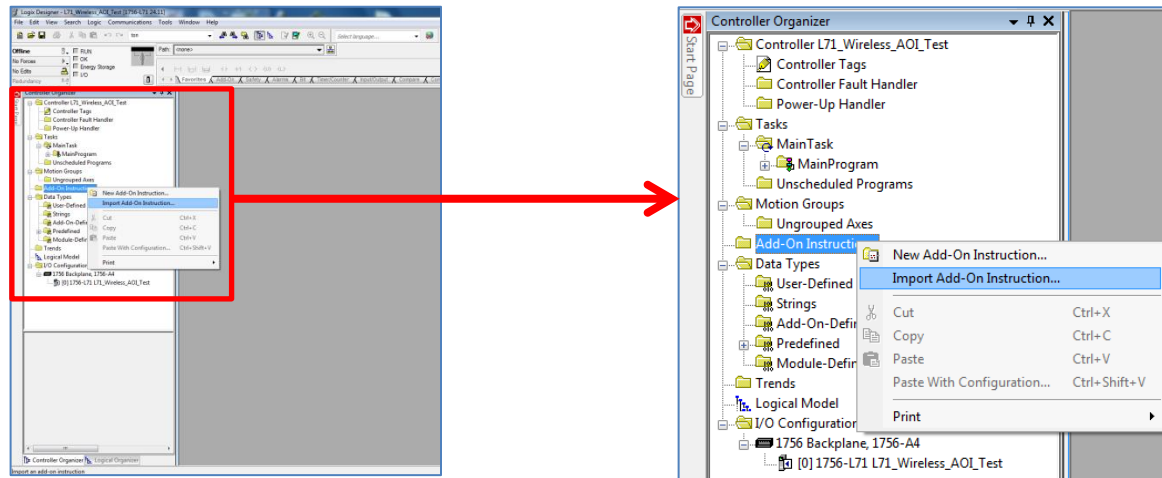
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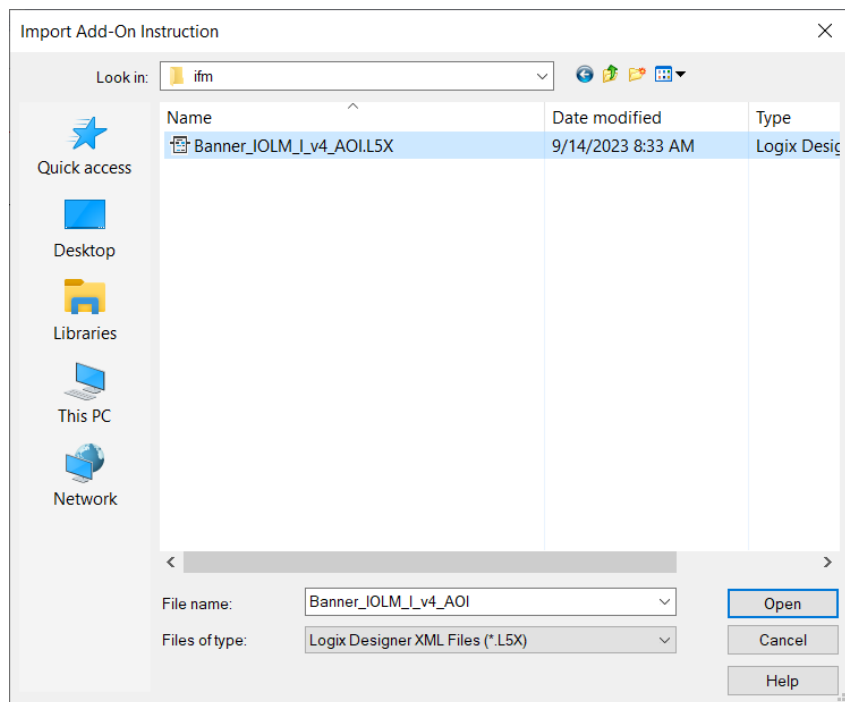
## 1. Installation Process

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

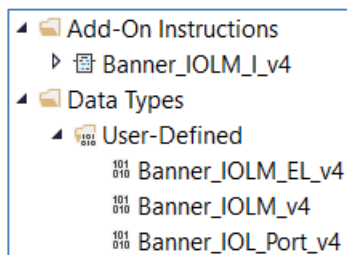
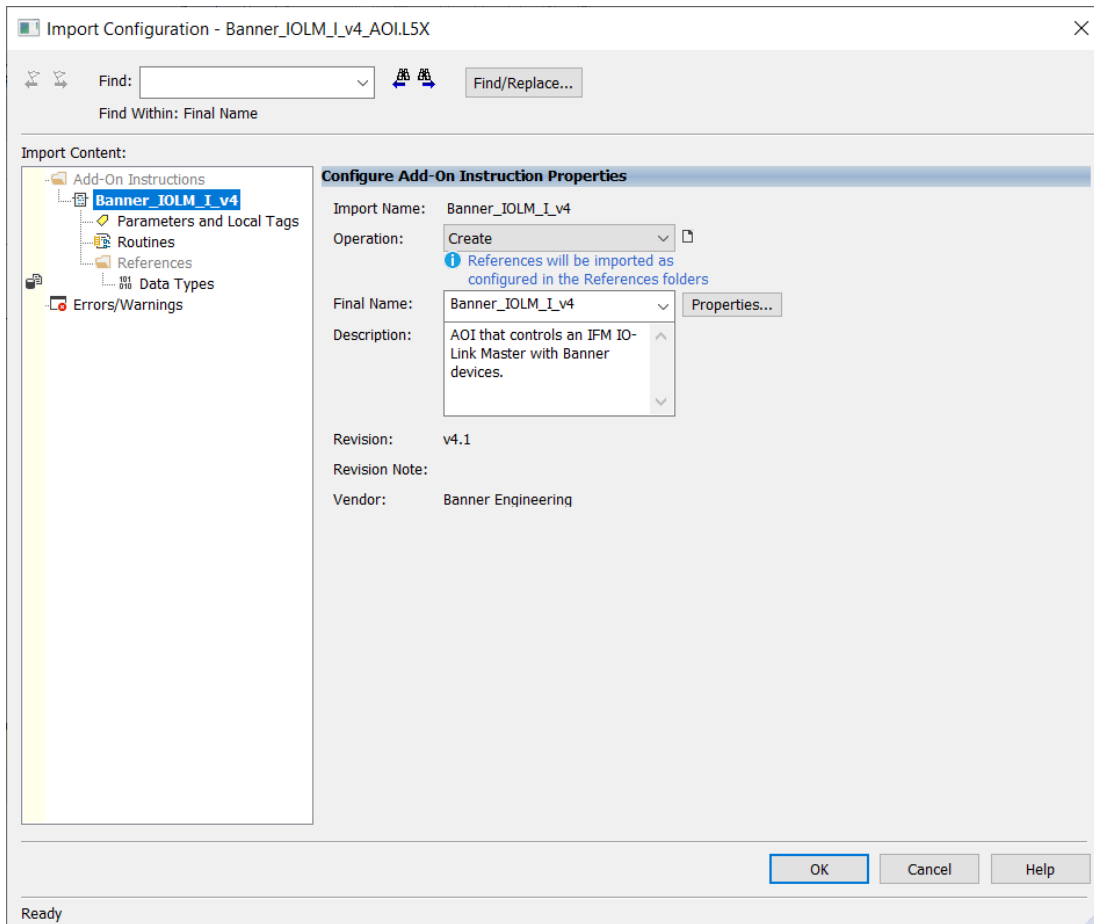
1. Open a project.
2. In the Controller Organizer window, right-click on the Add-On Instruction folder. Select the Import Add-On Instruction option.



3. Navigate to the correct file location and select the AOI to be installed. In this example the "Banner\_IOLM\_I\_v4\_AOI.L5X" file will be selected. Click the Open button.



4. The Import Configuration window will pop up. The default selection will create all of 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 picture at left.
6. AOI installation into the Logix Designer software complete.

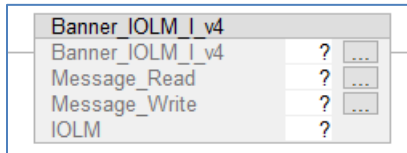
## 2. Configuring the ifm IO-Link Master

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

Create an Ethernet communications module for the ifm IO-Link Master device. In this example the EDS file was used, and the connection was named “IOLM1”. The controller tags include Input (I) and Output (O) Assembly Instances. Each Assembly has a corresponding tag array. Creating this Class 1 EtherNet/IP implicit IO connection will provide the PLC access to the IO-Link sensor Process Data. Each port on the IO-Link Master is given a dedicated group of I and O registers. See the relevant ifm User’s Guide for more information. This connection will also provide a communications pathway for the explicit messages used by the AOI to send IO-Link information to and from the Banner devices.

### 3. Configuring the Banner IO-Link Master AOI

1. Add the “Banner\_IOLM\_I\_v4” 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\_I\_v4”. 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.

The “EnableIn” and “EnableOut” variables are ladder logic rung status bits automatically added to all AOIs.

- 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.

The 'New Tag' dialog box for 'IOLM1\_Read' is shown. The 'Name' field contains 'IOLM1\_Read'. The 'Description' field is empty. The 'Usage' dropdown is set to '<controller>'. The 'Type' dropdown is set to 'Base'. The 'Alias For' field is empty. The 'Data Type' dropdown is set to 'MESSAGE'. The 'Parameter Connection' dropdown is empty. The 'Scope' dropdown is set to 'Test'. The 'External Access' dropdown is set to 'Read/Write'. The 'Style' dropdown is empty. The 'Constant' checkbox is unchecked. The 'Sequencing' checkbox is unchecked. The 'Open MESSAGE Configuration' checkbox is unchecked. The 'Open Parameter Connections' checkbox is unchecked. The 'Create' button is highlighted in blue.

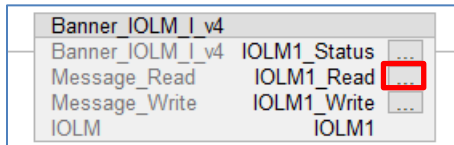
The 'New Tag' dialog box for 'IOLM1\_Write' is shown. The 'Name' field contains 'IOLM1\_Write'. The 'Description' field is empty. The 'Usage' dropdown is set to '<controller>'. The 'Type' dropdown is set to 'Base'. The 'Alias For' field is empty. The 'Data Type' dropdown is set to 'MESSAGE'. The 'Parameter Connection' dropdown is empty. The 'Scope' dropdown is set to 'Test'. The 'External Access' dropdown is set to 'Read/Write'. The 'Style' dropdown is empty. The 'Constant' checkbox is unchecked. The 'Sequencing' checkbox is unchecked. The 'Open MESSAGE Configuration' checkbox is unchecked. The 'Open Parameter Connections' checkbox is unchecked. The 'Create' button is highlighted in blue.

- 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.

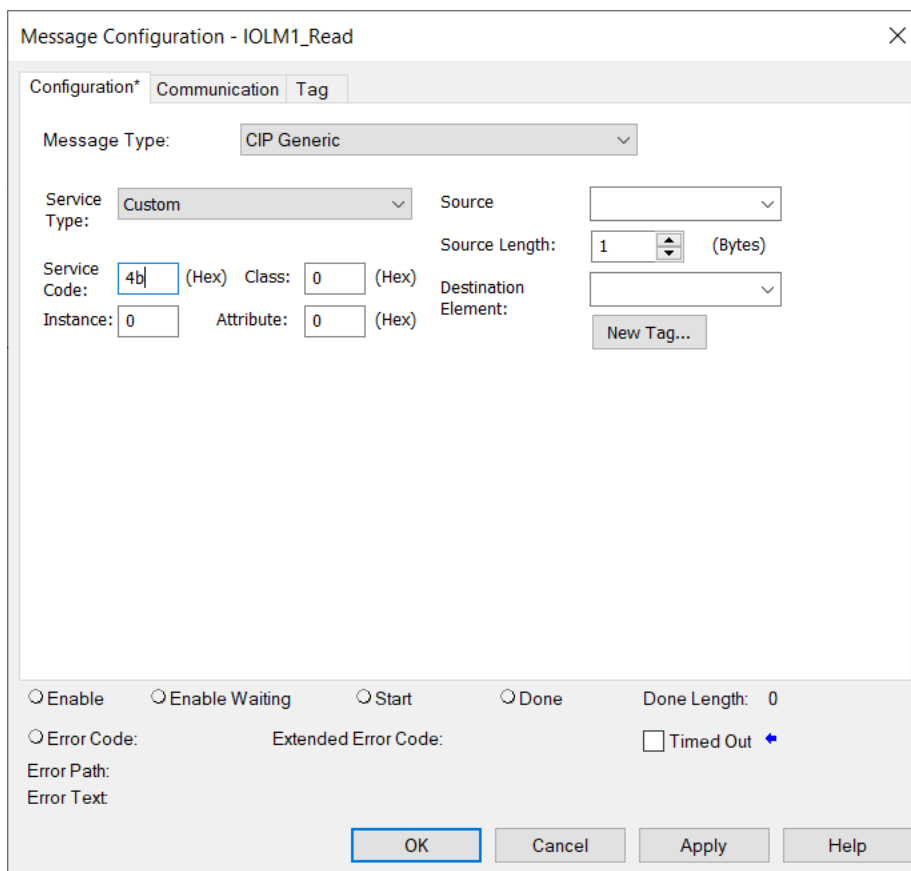
▲ IOLM1	{...}		Banner_IOLM_v4
▶ IOLM1.Message_Source_Data	{...}	Decimal	SINT[190]
▶ IOLM1.Message_Destination_Data	{...}	Decimal	SINT[190]
▶ IOLM1.Error_Log	{...}		Banner_IOLM_EL_v4[10]
IOLM1.Error_Write_Retry	0	Decimal	BOOL
▶ IOLM1.Num_Error_MSGS	0	Decimal	DINT
IOLM1.IO_Link_Master_Busy	0	Decimal	BOOL
IOLM1.AOI_Reset	0	Decimal	BOOL
▶ IOLM1.Port_Data	{...}		Banner_IOL_Port_v4
IOLM1.Halt_Operation	0	Decimal	BOOL
IOLM1.AOI_Halted	0	Decimal	BOOL



- 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.



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

A screenshot of a "Message Configuration - IOLM1\_Read" dialog box. It has three tabs: "Configuration\*", "Communication", and "Tag". The "Configuration\*" tab is selected. Inside, "Message Type" is a dropdown menu set to "CIP Generic". Below it, "Service Type" is a dropdown menu set to "Custom". To the right of "Service Type" is a "Source" dropdown menu. Below "Service Type" are four input fields: "Service Code" (containing "4b" with "(Hex)" next to it), "Class" (containing "0" with "(Hex)" next to it), "Instance" (containing "0"), and "Attribute" (containing "0" with "(Hex)" next to it). To the right of these is a "Source Length" spinner set to "1" with "(Bytes)" next to it. Below "Source Length" is a "Destination Element" dropdown menu. At the bottom right of the configuration area is a "New Tag..." button. At the bottom of the dialog are several radio buttons: "Enable", "Enable Waiting", "Start", and "Done". To the right of these is "Done Length: 0". Below the radio buttons are "Error Code:" and "Extended Error Code:" labels. To the right of these is a "Timed Out" checkbox with a blue plus icon next to it. At the bottom of the dialog are four buttons: "OK", "Cancel", "Apply", and "Help".

## 7. For the Source Element field, select “IOLM1.Message\_Source\_Data”.

Message Configuration - IOLM1\_Read

Configuration\* Communication Tag

Message Type: CIP Generic

Service Type: Custom Source: IOLM1.Message\_So...

Service Code: 4b (Hex) Class: 0

Instance: 0 Attribute: 0

Enter Name Filter...

Show: All Tags

Name	Data Type
▶ IOLM1	Banner_IOLM_v4
▶ IOLM1.Message_Source_Data	SINT[190]
▶ IOLM1.Message_Destination_Data	SINT[190]
▶ IOLM1.Error_Log	Banner_IOLM_EL_v4[10]
▶ IOLM1.Error_Write_Retry	BOOL
▶ IOLM1.Num_Error_MSGS	DINT
▶ IOLM1.IO_Link_Master_Busy	BOOL
▶ IOLM1.AOI_Reset	BOOL
▶ IOLM1.Port_Data	Banner_IOL_Port_v4
▶ IOLM1.Halt_Operation	BOOL

AOI that controls an IFM IO-Link Master with Banner devices.

Banner\_IOLM\_v4 IOLM1\_Status  
Banner\_IOLM\_v4 IOLM1\_Read  
Message\_Read IOLM1\_Write  
Message\_Write IOLM1

## 8. For Destination Element, select “IOLM1.Message\_Destination\_Data”.

Message Configuration - IOLM1\_Read

Configuration\* Communication Tag

Message Type: CIP Generic

Service Type: Custom Source: ssage\_Source\_Data

Service Code: 4b (Hex) Class: 0

Instance: 0 Attribute: 0

Source Length: 1 (Bytes)

Destination: IOLM1.Message\_Des...

Enter Name Filter...

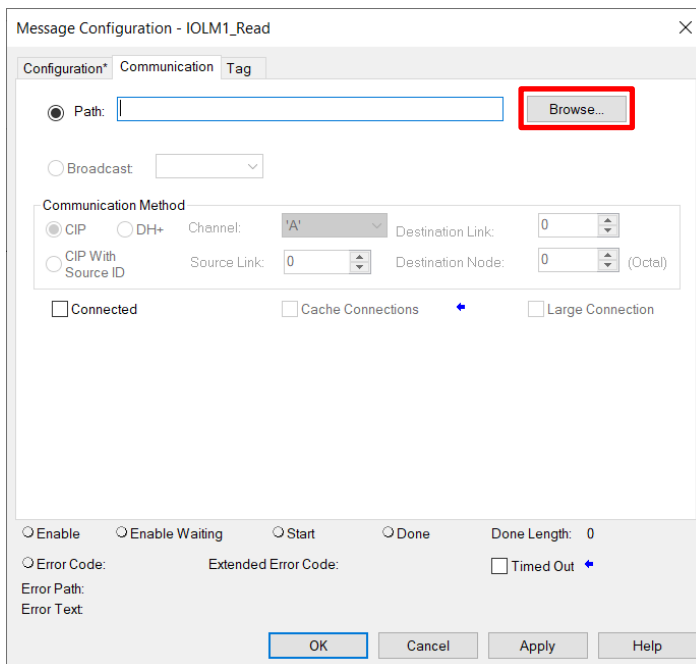
Show: All Tags

Name	Data Type
▶ IOLM1	Banner_IOLM_v4
▶ IOLM1.Message_Source_Data	SINT[190]
▶ IOLM1.Message_Destination_Data	SINT[190]
▶ IOLM1.Error_Log	Banner_IOLM_EL_v4[10]
▶ IOLM1.Error_Write_Retry	BOOL
▶ IOLM1.Num_Error_MSGS	DINT
▶ IOLM1.IO_Link_Master_Busy	BOOL
▶ IOLM1.AOI_Reset	BOOL
▶ IOLM1.Port_Data	Banner_IOL_Port_v4
▶ IOLM1.Halt_Operation	BOOL

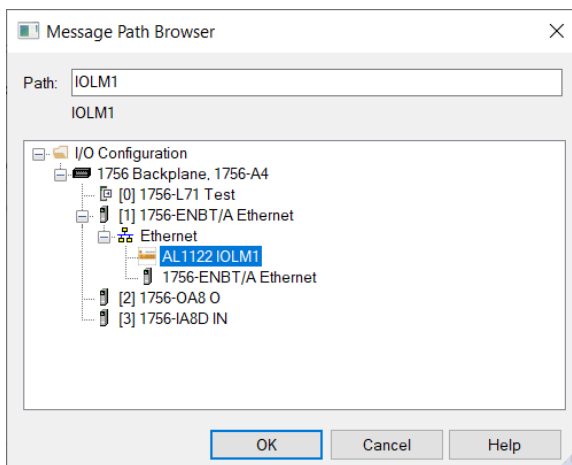
AOI that controls an IFM IO-Link Master with Banner devices.

Banner\_IOLM\_v4 IOLM1\_Status  
Banner\_IOLM\_v4 IOLM1\_Read  
Message\_Read IOLM1\_Write  
Message\_Write IOLM1

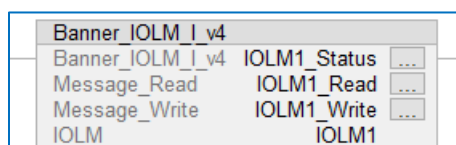
9. Now click on the Communication tab, then click the Browse button.



10. 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.



11. 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.



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

Message Configuration - IOLM1\_Write

Configuration\* Communication Tag

Message Type: CIP Generic

Service Type: Custom

Service Code: 4c (Hex) Class: 0 (Hex) Instance: 0 Attribute: 0 (Hex)

Source: Source Length: 1 (Bytes) Destination Element:

New Tag...

☐ Enable ☐ Enable Waiting ☐ Start ☐ Done Done Length: 0

☐ Error Code: Extended Error Code: ☐ Timed Out

Error Path: Error Text:

OK Cancel Apply Help

13. For the Source Element field, select “IOLM1.Message\_Source\_Data”.

Message Configuration - IOLM1\_Write

Configuration\* Communication Tag

Message Type: CIP Generic

Service Type: Custom

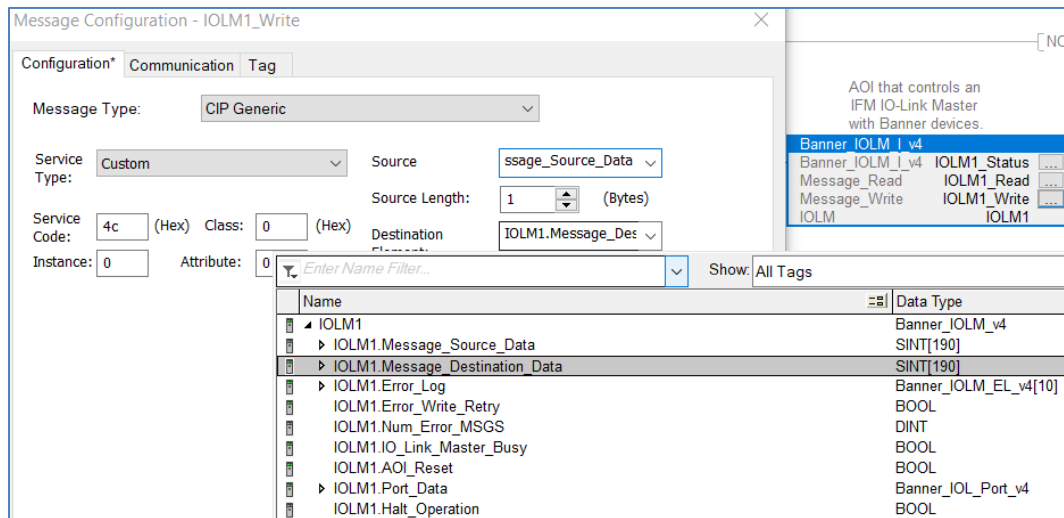
Service Code: 4c (Hex) Class: 0 Instance: 0 Attribute: 0

Source: IOLM1.Message\_Source\_Data

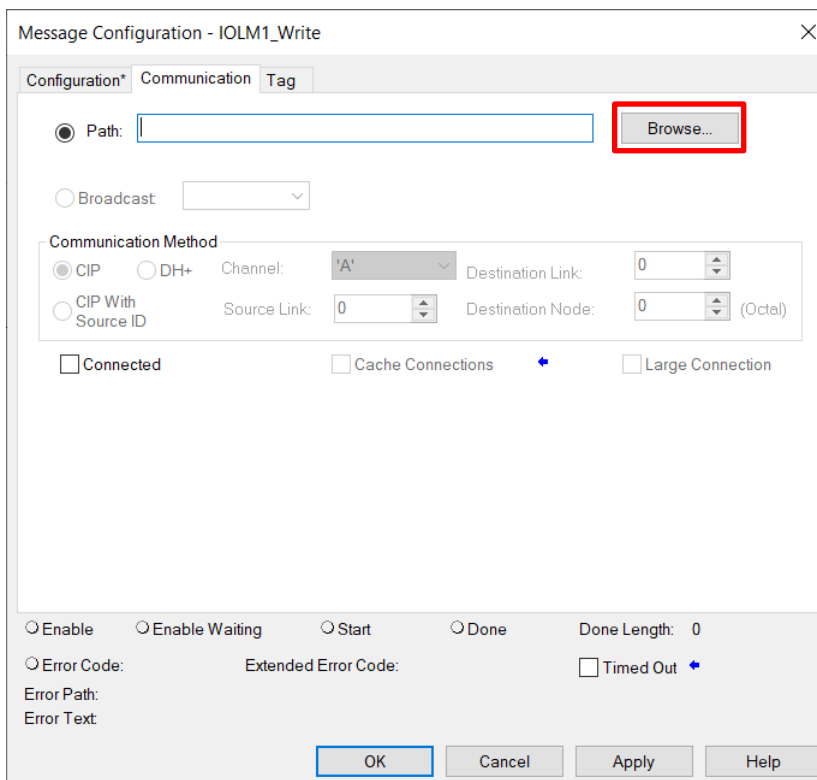
Enter Name Filter... Show: All Tags

Name	Data Type
IOLM1	Banner_IOLM_v4
IOLM1.Message_Source_Data	SINT[190]
IOLM1.Message_Destination_Data	SINT[190]
IOLM1.Error_Log	Banner_IOLM_EL_v4[10]
IOLM1.Error_Write_Retry	BOOL
IOLM1.Num_Error_MSGS	DINT
IOLM1.IO_Link_Master_Busy	BOOL
IOLM1.AOI_Reset	BOOL
IOLM1.Port_Data	Banner_IOL_Port_v4
IOLM1.Halt_Operation	BOOL

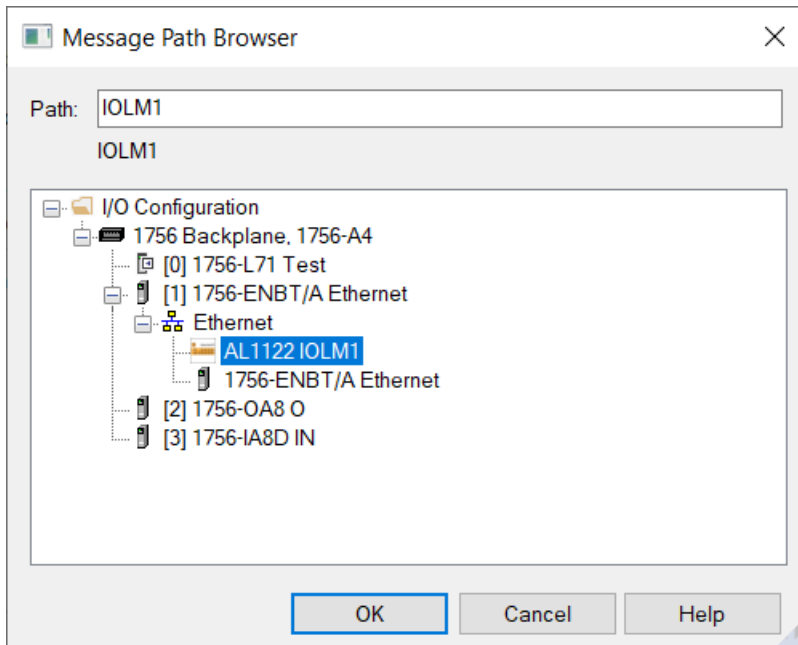
## 14. For Destination Element, select "IOLM1.Message\_Destination\_Data".



## 15. Now click on the Communication tab, then click the Browse button.



16. 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.



#### 4. Linking the Master AOI to Device AOIs

Select and install one or more Banner device AOIs. The device AOIs then need to be linked to this IO-Link Master AOI to provide control over IO-Link settings. See the relevant Banner IO-Link device AOI documents for more information.

Set "IOLM1.Port\_Controlled" bits to 1 for every port on the IO-Link Master with a connected Banner device and its corresponding Device Parameter Data AOI. Some masters start with port 0, some start with port 1, depending on manufacturer. Save the program to store these changes in the database. In this example, a Banner device is connected to port 1.

▸ IOLM1.Port_Data	{...}
▸ IOLM1.Port_Data.Port_Controlled	2
IOLM1.Port_Data.Port_Controlled.0	0
IOLM1.Port_Data.Port_Controlled.1	1
IOLM1.Port_Data.Port_Controlled.2	0
IOLM1.Port_Data.Port_Controlled.3	0
IOLM1.Port_Data.Port_Controlled.4	0
IOLM1.Port_Data.Port_Controlled.5	0
IOLM1.Port_Data.Port_Controlled.6	0
IOLM1.Port_Data.Port_Controlled.7	0
IOLM1.Port_Data.Port_Controlled.8	0

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

The goal is to make the Banner device's IO-Link Index and Subindex values appear in PLC tag arrays as if it were an EtherNet/IP-speaking device. Reading from and writing to the Banner IO-Link device becomes as easy as changing tag values in the PLC. All the complicated work of translating from EtherNet/IP to IO-Link is handled automatically, behind the scenes.

When the program is downloaded to the PLC and the PLC goes into run mode, the IO-Link Master AOI performs a global read for each connected Banner device AOI. The Banner device AOI then creates an archive copy of all writeable parameters for that device. This archive is used to determine whether one of the writeable data tags has been changed. If so, the AOI automatically triggers the process of acyclic writing, using correctly-formatted CIP generic message commands.

There are two methods for acyclic reading of Banner device Index and Subindex values.

1. The initial global read, as requested by the IO-Link Master AOI after the PLC program is downloaded and run.
2. Manually via the "Command" variable found in every Device Parameter Data AOI. The "Command" register can be used to force one-time read or write actions, as described in Appendix A of any Banner Device Parameter AOI guide.

Acyclic writes to the IO-Link device are handled by simply changing the relevant tag values in the device's "Write\_Data" tag array.



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.

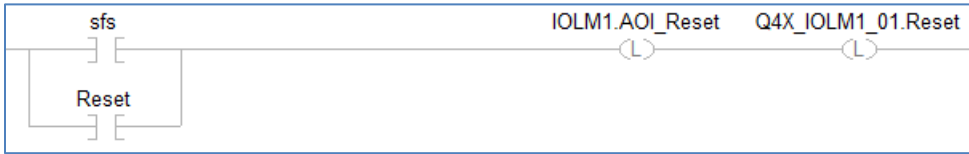
The specific error information will be stored in the “Error\_Log” array. This array includes space for 10 errors. Each entry records whether the error occurred on a read (0) or write (1) attempt and which port on the IO-Link Master and Index on the IO-Link Device were involved. Once the error is logged, 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 6.

▲ 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.

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 Q5X having their respective AOIs being reset in this way.



## 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.

▲ IOLM1	{...}		Banner_IOLM_v4
▶ IOLM1.Message_Source_Data	{...}	Decimal	SINT[190]
▶ IOLM1.Message_Destination_Data	{...}	Decimal	SINT[190]
▶ IOLM1.Error_Log	{...}		Banner_IOLM_EL_v4[10]
IOLM1.Error_Write_Retry	0	Decimal	BOOL
▶ IOLM1.Num_Error_MSGS	0	Decimal	DINT
IOLM1.IO_Link_Master_Busy	0	Decimal	BOOL
IOLM1.AOI_Reset	0	Decimal	BOOL
▶ IOLM1.Port_Data	{...}		Banner_IOL_Port_v4
IOLM1.Halt_Operation	0	Decimal	BOOL
IOLM1.AOI_Halted	0	Decimal	BOOL