



## **Turck IO-Link 2.0 Master Add-On Instruction Guide, v4**

### **September 18<sup>th</sup>, 2023**

This document covers the installation and use of 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 Turck IO-Link Master. This covers the new acyclic option that Turck introduced with **firmware 3.3.1**. This AOI has three User Defined 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 Turck TBEN-L5-8IOL IO-Link Master. Other Turck IO-Link Master's may work as well.

#### **Components**

Banner\_IOLM\_T2\_v4.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.

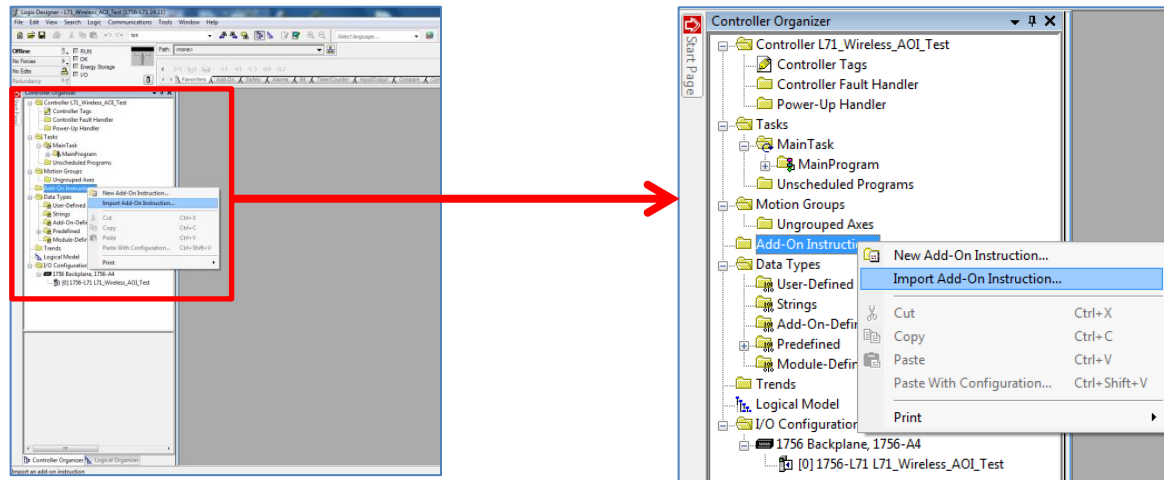
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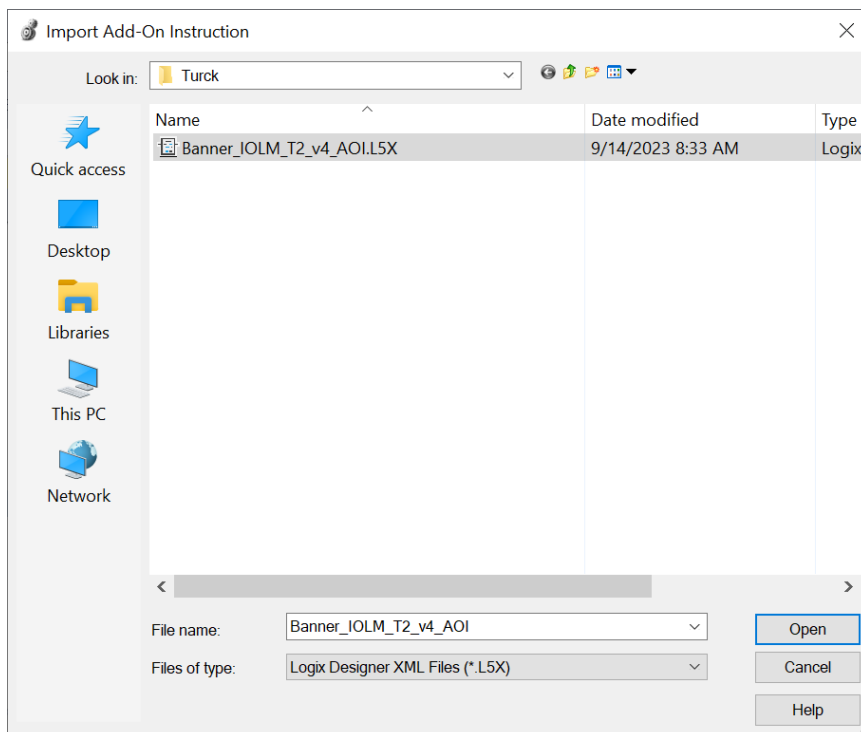
## 1. Installation Process

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

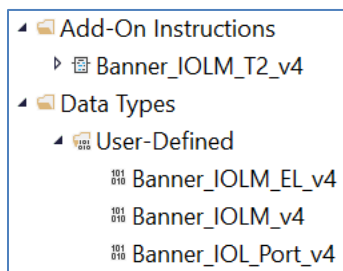
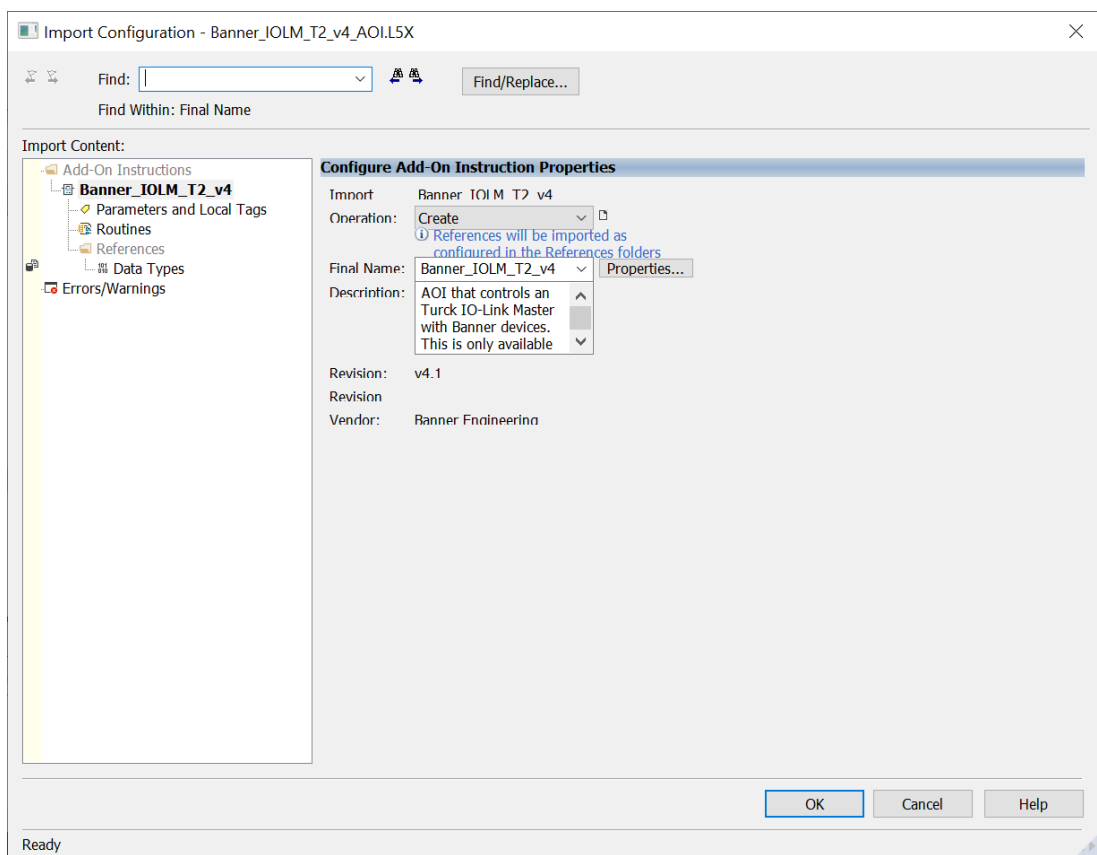
1. Open a project.
2. In the Controller Organizer window, right-click on the Add-On Instruction folder. Select the Import Add-On Instruction option.



3. Navigate to the correct file location and select the AOI to be installed. In this example the "Banner\_IOLM\_T2\_v4.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 picture at left.
6. AOI installation into the Logix Designer software complete.

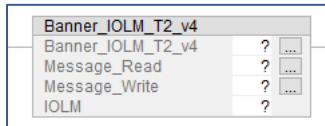
## 2. Configuring the Turck IO-Link Master

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

Create an Ethernet communications module for the Turck 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 Turck 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\_T2\_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\_T2\_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 image displays two side-by-side screenshots of the "New Tag" dialog box, illustrating the configuration for two different tags: "IOLM1\_Read" and "IOLM1\_Write".

**Left Dialog (IOLM1\_Read):**

- Name: IOLM1\_Read
- Description: (Empty text area)
- Usage: <controller>
- Type: Base
- Alias For: (Empty dropdown)
- Data Type: MESSAGE
- Parameter Connection: (Empty dropdown)
- Scope: Test
- External Access: Read/Write
- Style: (Empty dropdown)
- Constant: ☐
- Sequencing: ☐
- Open MESSAGE Configuration: ☐
- Open Parameter Connections: ☐

**Right Dialog (IOLM1\_Write):**

- Name: IOLM1\_Write
- Description: (Empty text area)
- Usage: <controller>
- Type: Base
- Alias For: (Empty dropdown)
- Data Type: MESSAGE
- Parameter Connection: (Empty dropdown)
- Scope: Test
- External Access: Read/Write
- Style: (Empty dropdown)
- Constant: ☐
- Sequencing: ☐
- Open MESSAGE Configuration: ☐
- Open Parameter Connections: ☐

4. 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 this 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.

New Tag

Name:

IOLM1

Create

Description:

Cancel

Usage:

<controller>

Help

Type:

Base

Connection...

Alias For:

Data Type:

Banner\_IOLM\_v4

...

Parameter Connection:

Scope:

Test

External Access:

Read/Write

Style:

☐ Constant

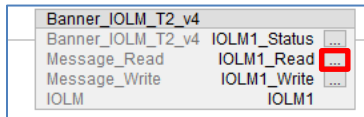
☐ Sequencing

☐ Open Configuration

☐ Open Parameter Connections

◀ IOLM1	{...}
▶ IOLM1.Message_Source_Data	{...}
▶ IOLM1.Message_Destination_Data	{...}
▶ IOLM1.Error_Log	{...}
IOLM1.Error_Write_Retry	0
▶ IOLM1.Num_Error_MSGS	0
IOLM1.IO_Link_Master_Busy	0
IOLM1.AOI_Reset	0
▶ IOLM1.Port_Data	{...}
IOLM1.Halt_Operation	0
IOLM1.AOI_Halted	0

- 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 a Service Code of 4b. Enter a Service Code of 4b.

Message Configuration - IOLM1\_Read

Configuration\* Communication Tag

Message Type: CIP Generic

Service Type: Custom Source Element:

Service Code: 4b (Hex) Class: 0 (Hex) Source Length: 1 (Bytes)

Instance: 0 Attribute: 0 (Hex) 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

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 Element: IOLM1.Message\_Sour

Enter Name Filter... Show: All Tags

Name	Data Type	Description
IOLM1	Banner_IOLM_v4	UDT to control IO-Link Masters.
IOLM1.Message_Source_Data	SINT[190]	UDT to control IO-Link Masters.
IOLM1.Message_Destination_Data	SINT[190]	UDT to control IO-Link Masters.

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

Message Configuration - IOLM1\_Read

Configuration\* Communication Tag

Message Type: CIP Generic

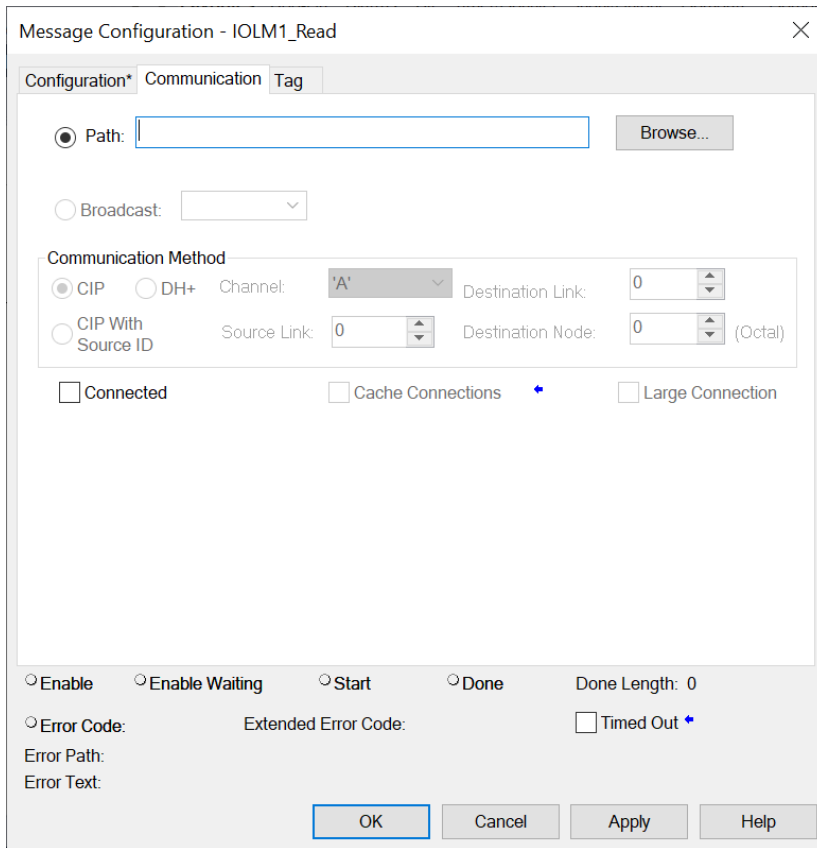
Service Type: Custom Source Element: essage\_Source\_Data

Service Code: 4b (Hex) Class: 0 (Hex) Source Length: 1 (Bytes) Destination Element: IOLM1.Message\_Dest

Enter Name Filter... Show: All Tags

Name	Data Type	Description
IOLM1	Banner_IOLM_v4	UDT to control IO-Link Masters.
IOLM1.Message_Source_Data	SINT[190]	UDT to control IO-Link Masters.
IOLM1.Message_Destination_Data	SINT[190]	UDT to control IO-Link Masters.
IOLM1.Error_Log	Banner_IOLM_EL_v4[10]	UDT to control IO-Link Masters.

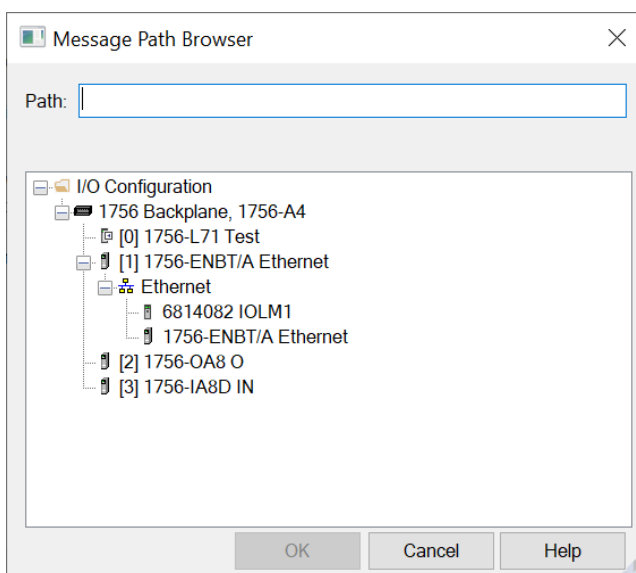
9. Now click on the Communication tab, then click the Browse button.



The dialog box is titled "Message Configuration - IOLM1\_Read". It has three tabs: "Configuration\*", "Communication", and "Tag". The "Communication" tab is selected. It contains the following fields and controls:

- Path:** A text input field with a "Browse..." button to its right.
- Broadcast:** A radio button followed by a dropdown menu.
- Communication Method:**
  - CIP:** A selected radio button.
  - DH+:** An unselected radio button.
  - Channel:** A dropdown menu showing "A".
  - Destination Link:** A numeric input field showing "0".
  - CIP With Source ID:** An unselected radio button.
  - Source Link:** A numeric input field showing "0".
  - Destination Node:** A numeric input field showing "0" with "(Octal)" to its right.
- Connected:** An unchecked checkbox.
- Cache Connections:** An unchecked checkbox with a blue star icon.
- Large Connection:** An unchecked checkbox.
- Buttons:** "Enable", "Enable Waiting", "Start", "Done", "Done Length: 0", "Error Code:", "Extended Error Code:", "Timed Out" (with a blue star icon), "Error Path:", and "Error Text:".
- Bottom Buttons:** "OK", "Cancel", "Apply", and "Help".

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.

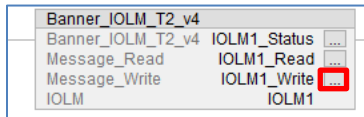


The dialog box is titled "Message Path Browser". It has a "Path:" text input field at the top. Below it is a tree view showing the following structure:

- I/O Configuration
  - 1756 Backplane, 1756-A4
    - [0] 1756-L71 Test
      - [1] 1756-ENBT/A Ethernet
        - Ethernet
          - 6814082 IOLM1
          - 1756-ENBT/A Ethernet
      - [2] 1756-OA8 O
      - [3] 1756-IA8D IN

At the bottom are "OK", "Cancel", and "Help" buttons.

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.



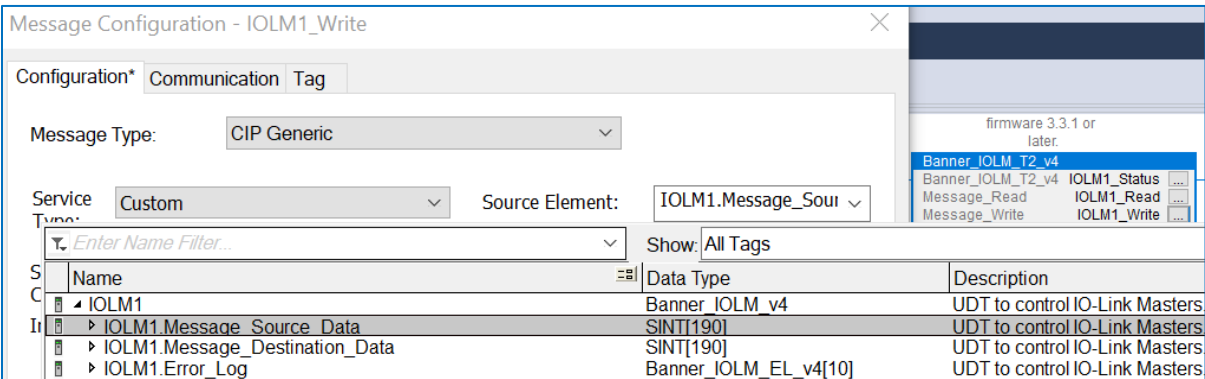
12. In the Message Configuration window, keep the Message Type “CIP Generic” and the Service Type “Custom”. Enter a Service Code of 4c. Enter a Service Code of 4c.

A screenshot of a dialog box titled "Message Configuration - IOLM1\_Write". It has three tabs: "Configuration\*", "Communication", and "Tag". The "Configuration" tab is active. It contains the following fields and controls:

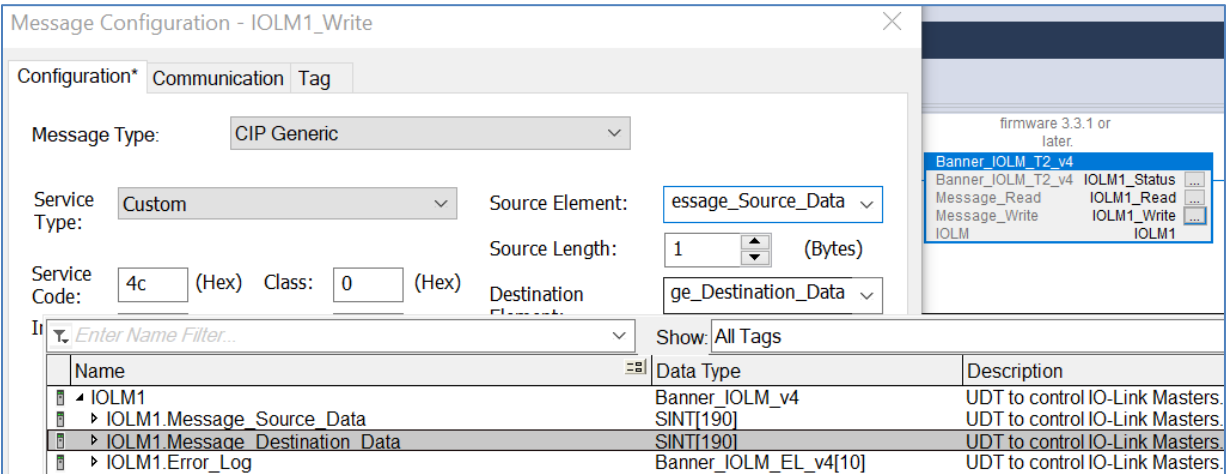
- Message Type:** A dropdown menu set to "CIP Generic".
- Service Type:** A dropdown menu set to "Custom".
- Source Element:** A dropdown menu.
- Source Length:** A numeric input set to "1" with a "(Bytes)" label.
- Service Code:** A numeric input set to "4c" with a "(Hex)" label.
- Class:** A numeric input set to "0" with a "(Hex)" label.
- Destination Element:** A dropdown menu.
- Instance:** A numeric input set to "0".
- Attribute:** A numeric input set to "0" with a "(Hex)" label.
- New Tag...** A button.

At the bottom, there are radio buttons for "Enable", "Enable Waiting", "Start", and "Done". To the right of "Done" is "Done Length: 0". Below these are "Error Code:" and "Extended Error Code:" labels, followed by a "Timed Out" checkbox with a blue asterisk. At the bottom are "Error Path:" and "Error Text:" labels. At the very bottom are four buttons: "OK", "Cancel", "Apply", and "Help".

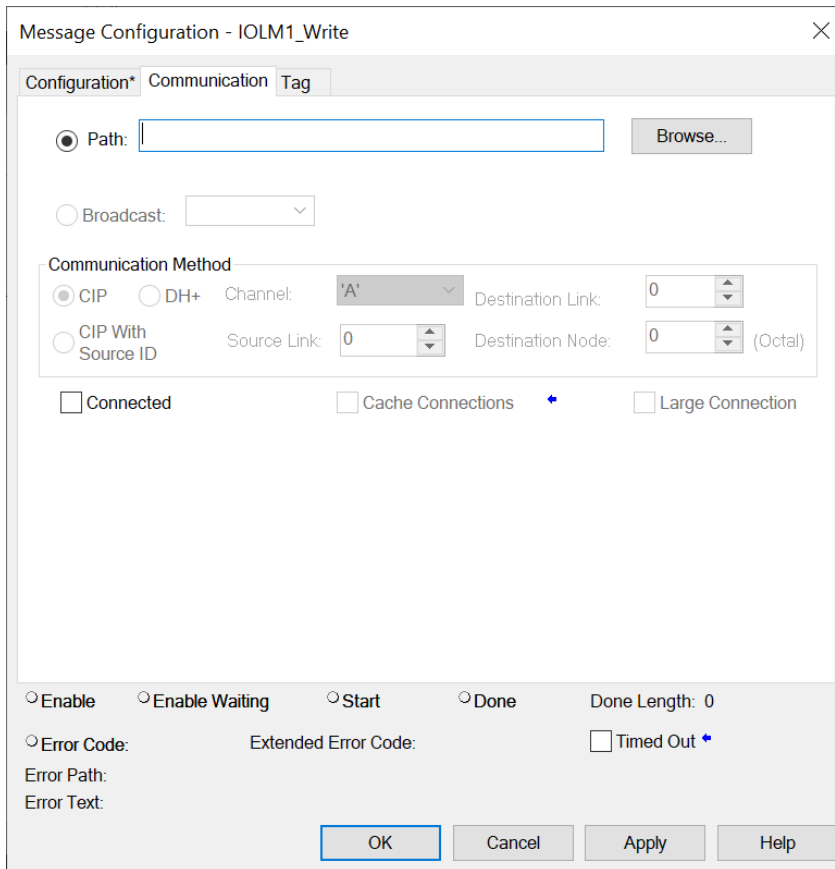
13. For the Source Element field, select “IOLM2.Message\_Source\_Data”.



14. For Destination Element, select “IOLM2.Message\_Destination\_Data”.

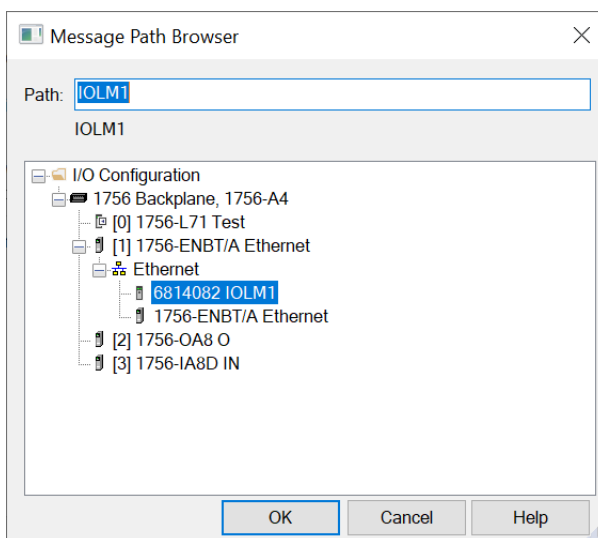


15. Now click on the Communication tab, then click the Browse button.



The image shows the 'Message Configuration - IOLM1\_Write' dialog box. It has three tabs: 'Configuration\*', 'Communication', and 'Tag'. The 'Communication' tab is selected. In this tab, there is a 'Path:' label with a text input field and a 'Browse...' button. Below this is a 'Broadcast:' label with a dropdown menu. The 'Communication Method' section contains two radio buttons: 'CIP' (selected) and 'DH+'. The 'CIP' method has a 'Channel:' dropdown set to 'A', a 'Destination Link:' spinner set to '0', a 'CIP With Source ID' radio button, a 'Source Link:' spinner set to '0', and a 'Destination Node:' spinner set to '0' (labeled '(Octal)'). There are three checkboxes: 'Connected', 'Cache Connections' (with a blue plus icon), and 'Large Connection'. At the bottom, there are radio buttons for 'Enable', 'Enable Waiting', 'Start', and 'Done'. The 'Done' button is selected, and 'Done Length:' is set to '0'. There are also fields for 'Error Code:', 'Extended Error Code:', and a 'Timed Out' checkbox (with a blue plus icon). At the very bottom are 'Error Path:' and 'Error Text:' labels. The bottom of the dialog has 'OK', 'Cancel', 'Apply', and 'Help' buttons.

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.



The image shows the 'Message Path Browser' dialog box. It has a 'Path:' label with a text input field containing 'IOLM1'. Below the input field is a tree view titled 'IOLM1'. The tree view shows a hierarchy: 'I/O Configuration' (expanded) -> '1756 Backplane, 1756-A4' -> '[0] 1756-L71 Test' -> '[1] 1756-ENBT/A Ethernet' -> 'Ethernet' -> '6814082 IOLM1' (highlighted with a blue selection box). Below the tree view are 'OK', 'Cancel', and 'Help' buttons.

#### 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 “IOLM2.Port\_Data.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. In the example below, a single Banner device is connected to port 1. The specific bit used here matches the port’s label on the IO-Link Master. Some masters start with port 0, some start with port 1, depending on manufacturer. Save the program to store these changes in the database.

◀ 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.

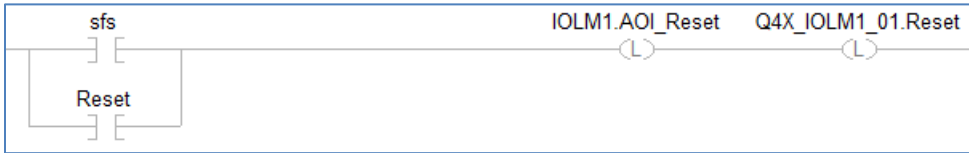
The specific error information will be stored in the “Error\_Log” array. This array includes space for 10 errors. Each entry records whether the error occurred on a read (0) or write (1) attempt and which port on the IO-Link Master and Index on the IO-Link Device were involved. Once the error is logged,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

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 Q4X 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	{...}
▶ IOLM1.Message_Source_Data	{...}
▶ IOLM1.Message_Destination_Data	{...}
▶ IOLM1.Error_Log	{...}
IOLM1.Error_Write_Retry	0
▶ IOLM1.Num_Error_MSGS	0
IOLM1.IO_Link_Master_Busy	0
IOLM1.AOI_Reset	0
▶ IOLM1.Port_Data	{...}
IOLM1.Halt_Operation	0
IOLM1.AOI_Halted	0