



LE Process Data AOI Guide, v4

September 25th, 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 cyclic IO-Link Process Data In from a Banner LE sensor via an IO-Link Master to an Allen-Bradley PLC. The AOI covers parsing and display of the LE sensor Process Data In. The AOI has one User Defined Tag data type.

Components

Banner_LE_PD_v4_AOI.L5X

UDT Packaged with the AOI

Banner_LE_PDI_v4

Other AOIs Available Separately

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

Contents

1. Installation Process 1

2. Configuring the IO-Link Master 3

3. Configuring the AOI..... 4

4. Using the AOI..... 7

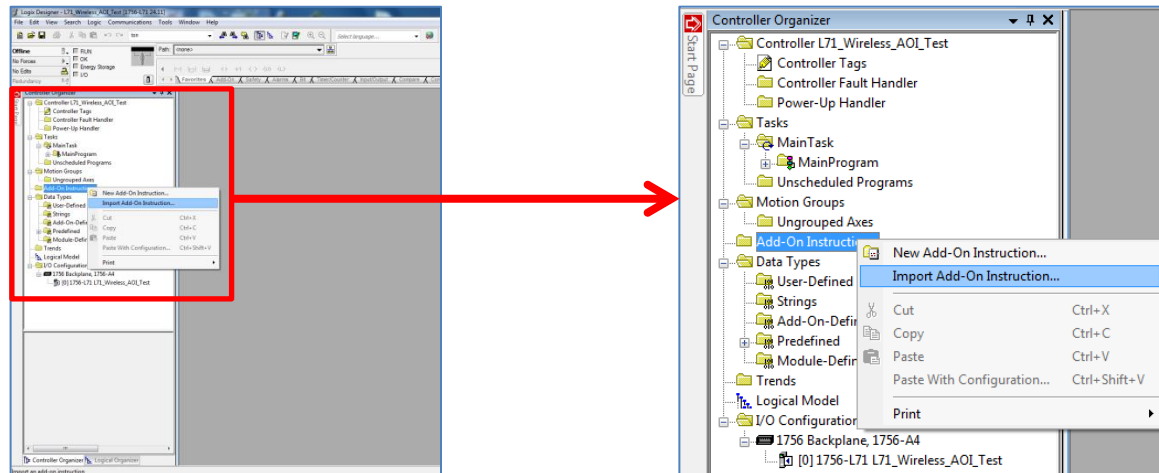
Appendix A LE Process Data 8

Appendix B IO-Link Master Cheat Sheet 9

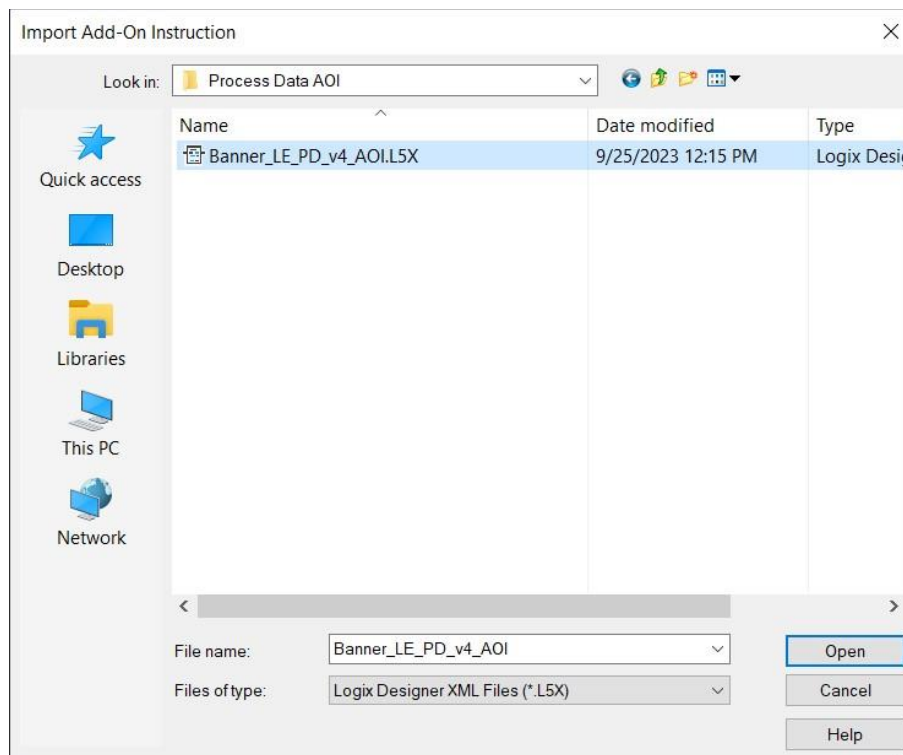
1. Installation Process

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

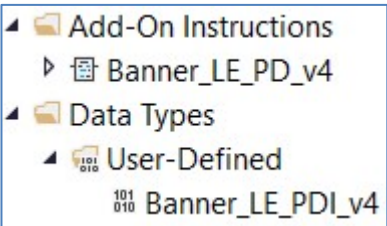
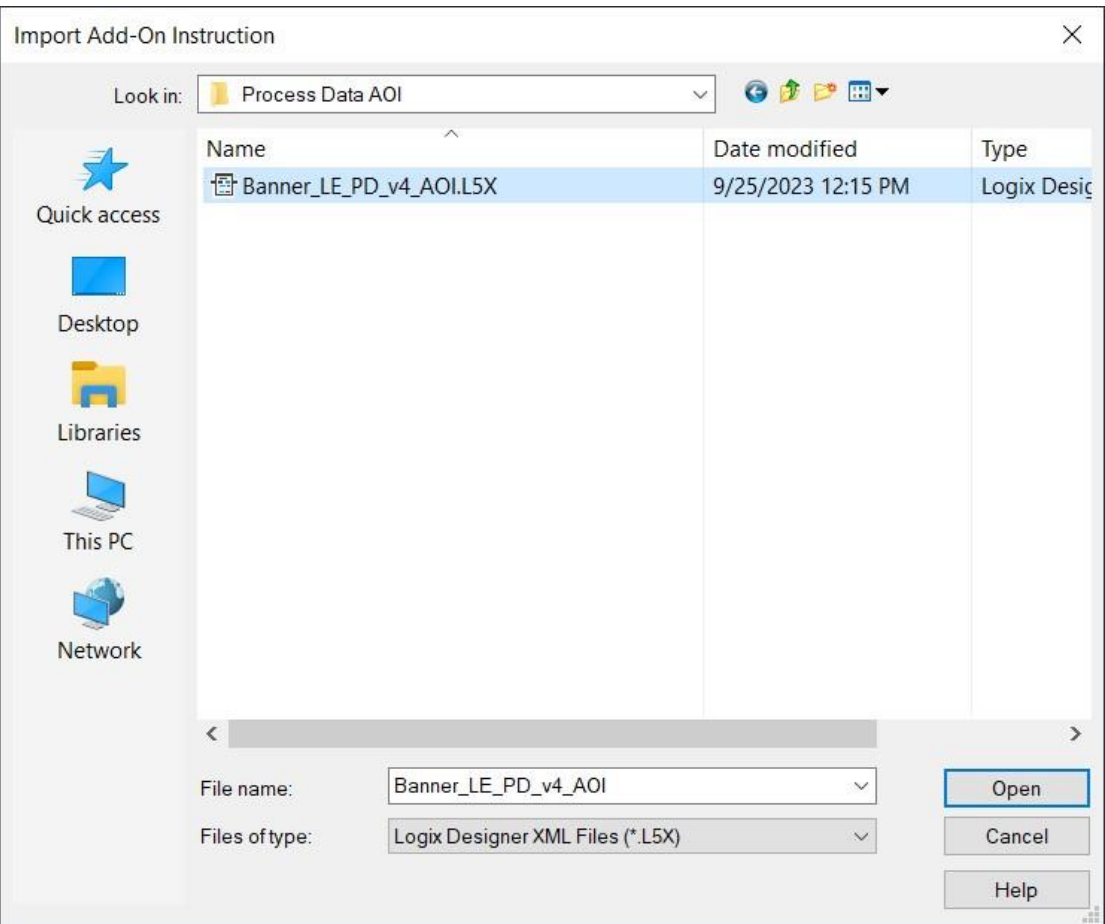
1. Open a project.
2. In the Controller Organizer window, right-click on the Add-On Instruction folder. Select the Import Add-On Instruction option.



3. Navigate to the correct file location and select the AOI to be installed. In this example the "Banner_LE_PDI_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 similar to the picture at left.
6. AOI installation into the Logix Designer software complete.

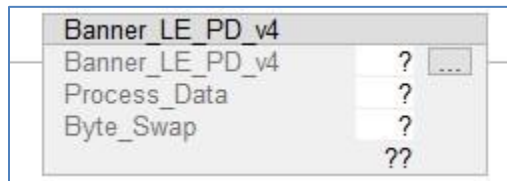
2. Configuring the IO-Link Master

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

Create an Ethernet communications module for the IO-Link Master device. The controller tags generated 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 device Process Data. Each port on the IO-Link Master is given a dedicated group of I and O registers. See the relevant IO-Link Master User's Guide for more information.

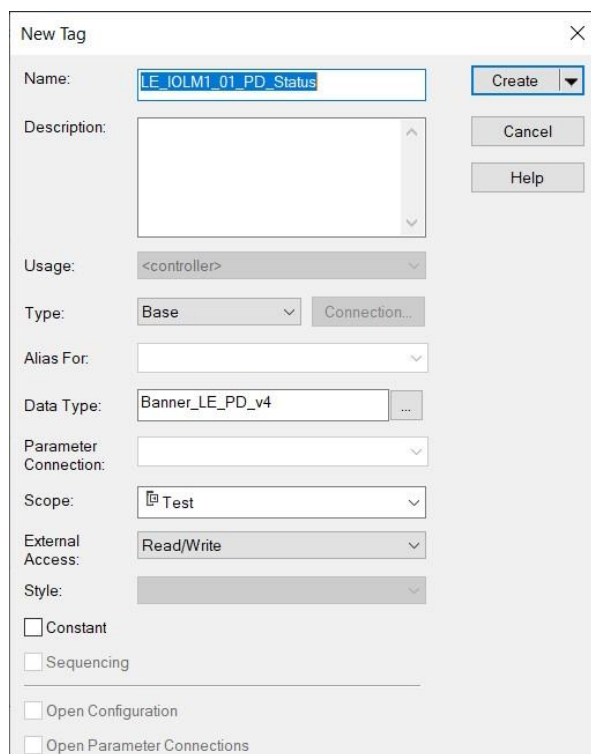
3. Configuring the AOI

1. Add the “Banner_LE_PD_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 Tags (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_LE_PD_v4”. Click New Tag. Name the new tag. This example uses the name “LE_IOLM1_01_PD_Status”. The example naming convention accounts for this being an LE sensor 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.

Note that the Data Type is the User-Defined Data Type (UDT) entitled “Banner_LE_PD_v4”. This custom-made array of registers is specially built to handle the memory needs of this AOI. Click Create to make the tag array.



New Tag

Name: Create

Description:

Usage:

Type: Connection...

Alias For:

Data Type:

Parameter Connection:

Scope:

External Access:

Style:

☐ Constant

☐ Sequencing

☐ Open Configuration

☐ Open Parameter Connections

Cancel Help

- Now we will right-click on the question mark on the line labeled "Process_Data" in the AOI. Click on "New Tag". Give the tag a name. This example uses the name "LE_IOLM1_01_PD". Notice that the Data Type is "Banner_LE_PDI_v4". Click Create.

New Tag

Name: LE_IOLM1_01_PD

Description:

Usage: <controller>

Type: Base Connection...

Alias For:

Data Type: Banner_LE_PDI_v4

Parameter Connection:

Scope: Test

External Access: Read/Write

Style:

☐ Constant

☐ Sequencing

☐ Open Configuration

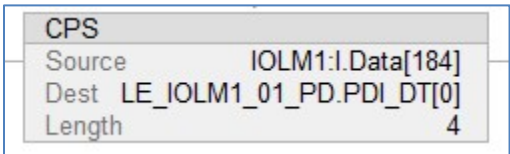
☐ Open Parameter Connections

Create Cancel Help

- The last line in the AOI is a setting to account for byte swapping. In the case of the LE, the Process Data is four bytes long. IO-Link Masters may read each pair of bytes in either order, so this AOI has to be ready to perform a byte swap. Enter a "0" or a "1" to toggle this setting. See Appendix B for more information.

- 5. The final step required before we download and run the LE Process Data AOI involves a File Synchronous Copy (CPS) instruction. This instruction allows the AOI to read from the raw Process Data values found in the register tags of the IO-Link Master.

Add a CPS instruction before the AOI on the ladder rung that looks like the one seen below. Refer to Appendix B for which byte to start with in the “Source” area. In this case, the IO-Link Master in question has the raw Process Data In values for a device connected to port 1 starting at byte 184. For the “Destination”, we will enter the “PDI_DT[0]” location, as seen below. Finally, the length will be 4 bytes, as that is the size of the LE Process Data In.



Here is what the entire rung looks like when completed.



- 6. The “Banner_LE_PD_v4” AOI is now ready for use.

4. Using the AOI

The “Banner_LE_Process_Data” Add-On Instruction has created a group of tags representing the LE Process Data, broken out into its component parts.

Look in the Controller Tags to find the name you used in Step 4 above. This example used the name “LE_IOLM_01_PD”. The tag array, seen below, has individual pieces of information instead of 32 unlabeled bits. The first three items are the on/off status of both discrete output channels and the stability indicator, the fourth item is the LE Measurement_Value is shown in mm.

| | |
|---|---------|
| ▲ LE_IOLM1_01_PD | {...} |
| ▶ LE_IOLM1_01_PD.Channel_1_Output_State | 1 |
| ▶ LE_IOLM1_01_PD.Channel_2_Output_State | 1 |
| ▶ LE_IOLM1_01_PD.Sensor_Stability | 1 |
| LE_IOLM1_01_PD.Measurement_Value | 146.717 |

Appendix A LE Process Data

The LE has 4 bytes of Process Data In, as shown below.

| ProcessDataIn "Process Data" id=PD_ProcessDataIn | | | | | | | | | |
|--|------------|-----------------|--|---------------|-------------|-----------------|---------------|------------------------|---|
| bit length: 32 data type: 32-bit Record (subindex access not supported) | | | | | | | | | |
| subindex | bit offset | data type | allowed values | default value | acc. restr. | mod. other var. | excl. from DS | name | description |
| 1 | 0 | Boolean | false = Inactive, true = Active | | | | | Channel 1 Output State | Channel 1 Output State |
| 2 | 1 | Boolean | false = Inactive, true = Active | | | | | Channel 2 Output State | Channel 2 Output State |
| 3 | 2 | Boolean | false = No target or Marginal, true = Stable | | | | | Stability | Stability state |
| 4 | 3 | 29-bit UInteger | | | | | | Measurement Value | The current measured distance in micrometers. |

This Process Data is mapped to a specific group of EtherNet/IP registers. The 32-bits of Process Data actually encode four separate pieces of information. Bit 0 is the state of BDC1 (Binary Data Channel 1, also known simply as Output Channel 1). Bit 1 is BDC2 (Channel 2). Bit 2 is the stability indicator. The remaining 29 bits are used to communicate the LE measurement value (in 0.001mm increments).

This AOI intelligently parses this Process Data into its component pieces.

Appendix B IO-Link Master Cheat Sheet

Different IO-Link Masters behave differently in several ways. For one, the register locations where Process Data is stored varies. For another, some IO-Link Masters require byte-swapping and/or word-swapping. The tables below aim to define some of these differences. Note that these numbers are when using all default settings. IO-Link Masters can change the register locations to which Process Data is mapped in response to non-default, optional settings. See relevant IO-Link Master documentation for more information.

PDI (Process Data In) is found in the IO-Link Master's T->O (PLC "Input") Assembly Instance.

PDO (Process Data Out) is found in the IO-Link Master's O->T (PLC "Output") Assembly Instance.

Table 1. First Register of Process Data "SINT0"

| Port | Allen-Bradley* | | Comtrol | | Balluff | | Turck | | ifm | | Banner | |
|------|----------------|--------------|---------|-----|---------|-----|-------|-----|-----|-----|--------|-----|
| | PDI | PDO | PDI | PDO | PDI | PDO | PDI | PDO | PDI | PDO | PDI | PDO |
| 1 | I.Ch0Data[0] | O.Ch0Data[0] | 4 | 0 | 8 | 6 | 6 | 4 | 190 | 46 | 184 | 182 |
| 2 | I.Ch1Data[0] | O.Ch1Data[0] | 40 | 32 | 56 | 38 | 38 | 36 | 222 | 78 | 218 | 216 |
| 3 | I.Ch2Data[0] | O.Ch2Data[0] | 76 | 64 | 104 | 70 | 70 | 68 | 254 | 110 | 252 | 250 |
| 4 | I.Ch3Data[0] | O.Ch3Data[0] | 112 | 96 | 152 | 102 | 102 | 100 | 286 | 142 | 286 | 284 |
| 5 | I.Ch4Data[0] | O.Ch4Data[0] | 148 | 128 | 200 | 134 | 134 | 132 | 318 | 174 | 320 | 318 |
| 6 | I.Ch5Data[0] | O.Ch5Data[0] | 184 | 160 | 248 | 166 | 166 | 164 | 350 | 206 | 354 | 352 |
| 7 | I.Ch6Data[0] | O.Ch6Data[0] | 220 | 192 | 296 | 198 | 198 | 196 | 382 | 238 | 388 | 386 |
| 8 | I.Ch7Data[0] | O.Ch7Data[0] | 256 | 224 | 344 | 230 | 230 | 228 | 414 | 270 | 422 | 420 |

*see relevant Banner Allen-Bradley IO-Link Master AOI Guide and Allen-Bradley User Guides for more information on using device IODD files to aid in integration.

Note: Murr IO-Link Masters have configurable process data. Refer to the Murr IO-Link Master Instruction Manual for Process Data mappings.

Table 2. Byte-Swap

| IO-Link Master | Byte Swap |
|----------------|-----------|
| Allen-Bradley | 0 |
| Comtrol | 1 |
| Balluff | 0 |
| Turck | 1 |
| ifm | 1 |
| Murr | 0 |
| Banner | 0 |

Specific hardware used in both tables (all default settings):

- Allen-Bradley Armor Block I/O IO-Link Master (1732E-8IOLM12R)
- Comtrol 8-EIP IO-Link Master (99608-8)
- Balluff BNI006A (BNI EIP-508-105-Z015)
- Turck TBEN-L5-8IOL
- ifm AL1122
- Murr Impact67 E DIO 12 DIO4/IOL4 4P (Art.-No. 55144)

Banner IO-Link Masters (DXMR90-4K) have a port status register. The register gives the status of the port. It gives information on if the port has an IO-Link device connected and if Process Data is valid. This is optional information but is useful for troubleshooting. The data comes into the PLC as bytes while the literature shows the value as a word. The table below gives the upper- and lower-byte data location in the PLC. The upper byte includes bits 15 through 8, while the lower byte has bits 7 through 0.

| IO-Link Master Port | Upper Bits 15 - 8 | Lower Bits 7 - 0 |
|---------------------|----------------------|---------------------|
| 1 | 182 | 183 |
| 2 | 216 | 217 |
| 3 | 250 | 251 |
| 4 | 284 | 285 |
| 5 | 318 | 319 |
| 6 | 352 | 353 |
| 7 | 386 | 387 |
| 8 | 420 | 421 |

Port Status:

Bit0 = Connected?

Bit1 = Process Data Valid?

Bit2 = Event Pending?

Bit3 = Ready for ISDU?

Bit4 = Pin4 SIO State

Bit5 = Pin2 SIO State

Bit6-7 = Pin4 Mode:

SDCI Mode = 0

SIO Input Mode = 1

SIO Output Mode = 2

Bit8-10 = Pin2 Mode:

Disabled = 0

Input Normal = 1

Output = 2

Diagnostic Input = 3

Inverted Input = 4