



S15C-MUL Process Data AOI Guide, v4
October 30th, 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 and Process Data Out to and from a Banner S15C-MUL device via an IO-Link Master to an Allen-Bradley PLC. The AOI covers parsing and display of the S15C-MUL Process Data In and Process Data Out. The AOI has one User Defined Tag data types.

Components

Banner_S15C_MUL_PD_v4_AOI.L5X

UDT Packaged with the AOI

Banner_S15C_MUL_PDIO_v4

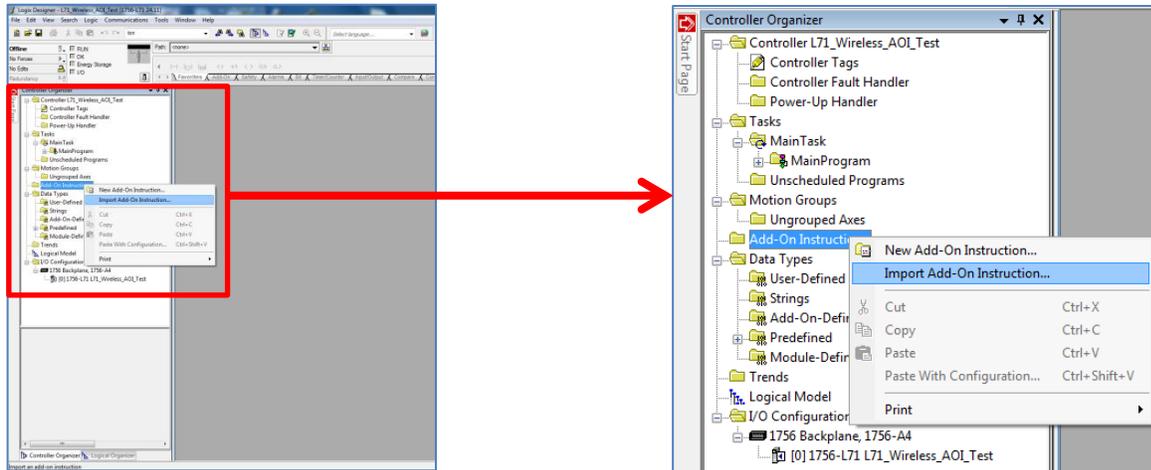
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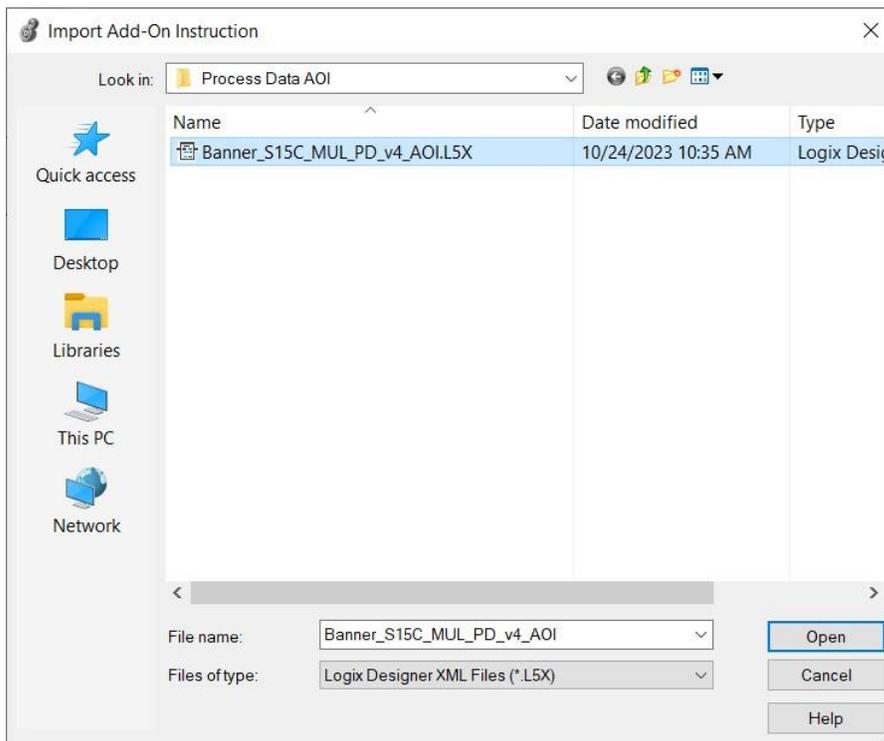
1. Installation Process

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

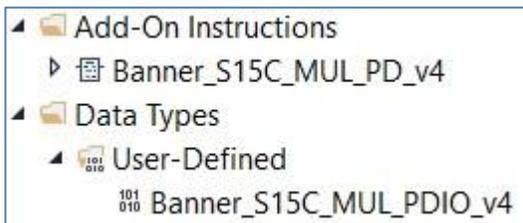
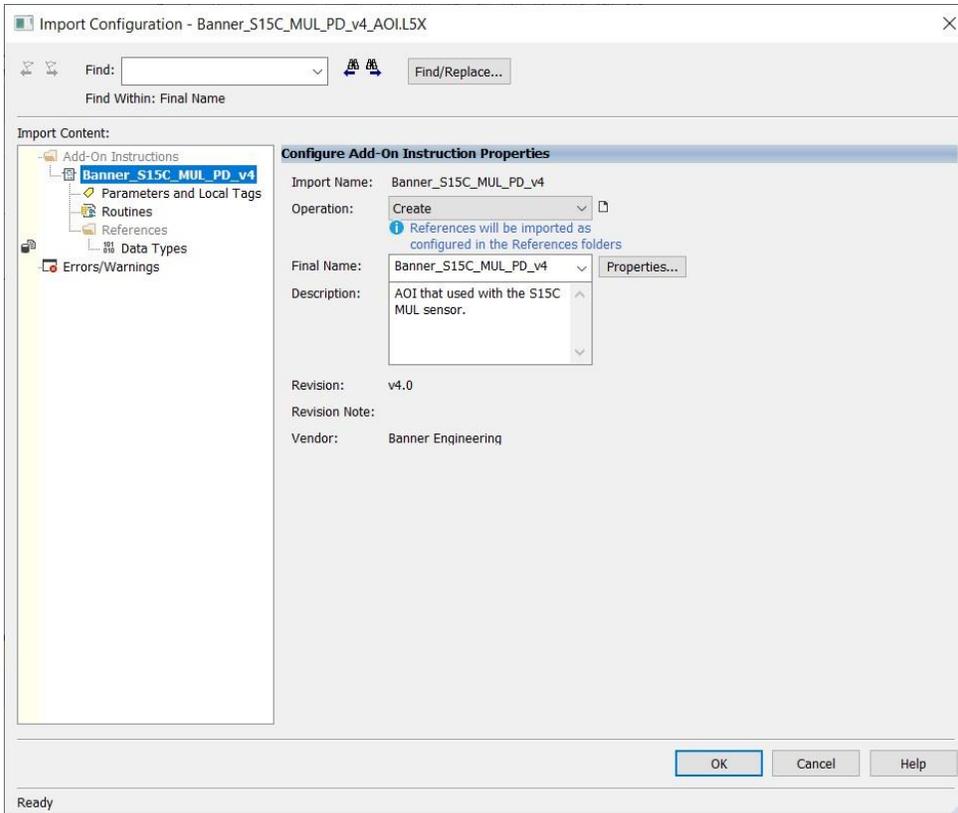
1. Open a project.
2. In the Controller Organizer window, right-click on the Add-On Instruction folder. Select the Import Add-On Instruction option.



3. Navigate to the correct file location and select the AOI to be installed. In this example the "Banner_S15C_MUL_PD_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 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 like the picture at left.
6. AOI installation into the Logix Designer software complete.

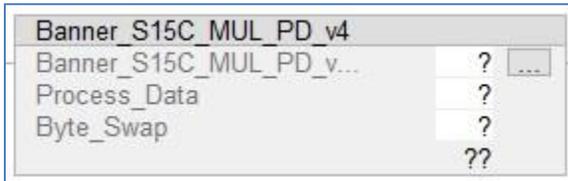
2. **Configuring the IO-Link Master**

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.

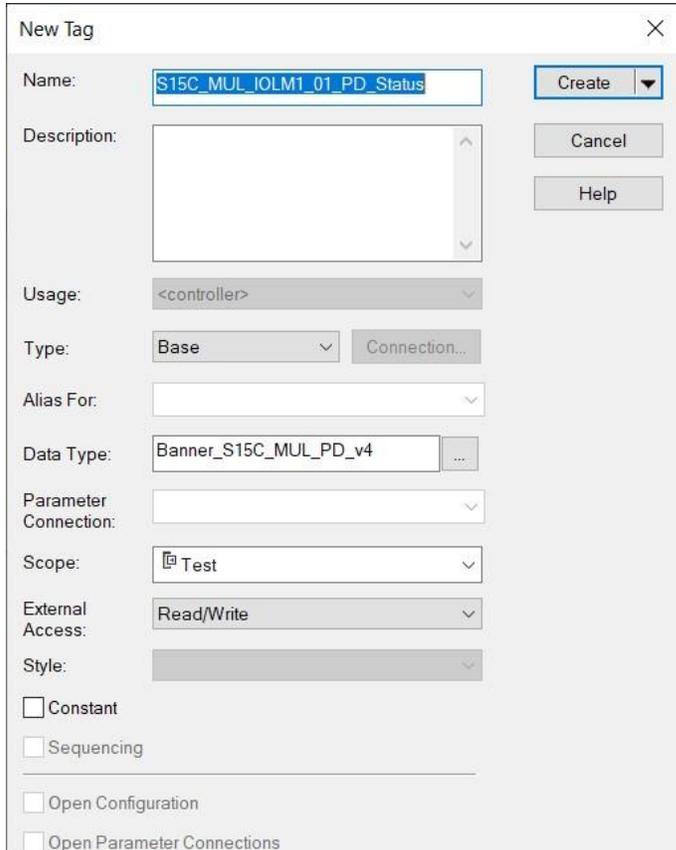
3. Configuring the AOI

1. Add the “Banner_S15C_MUL_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.



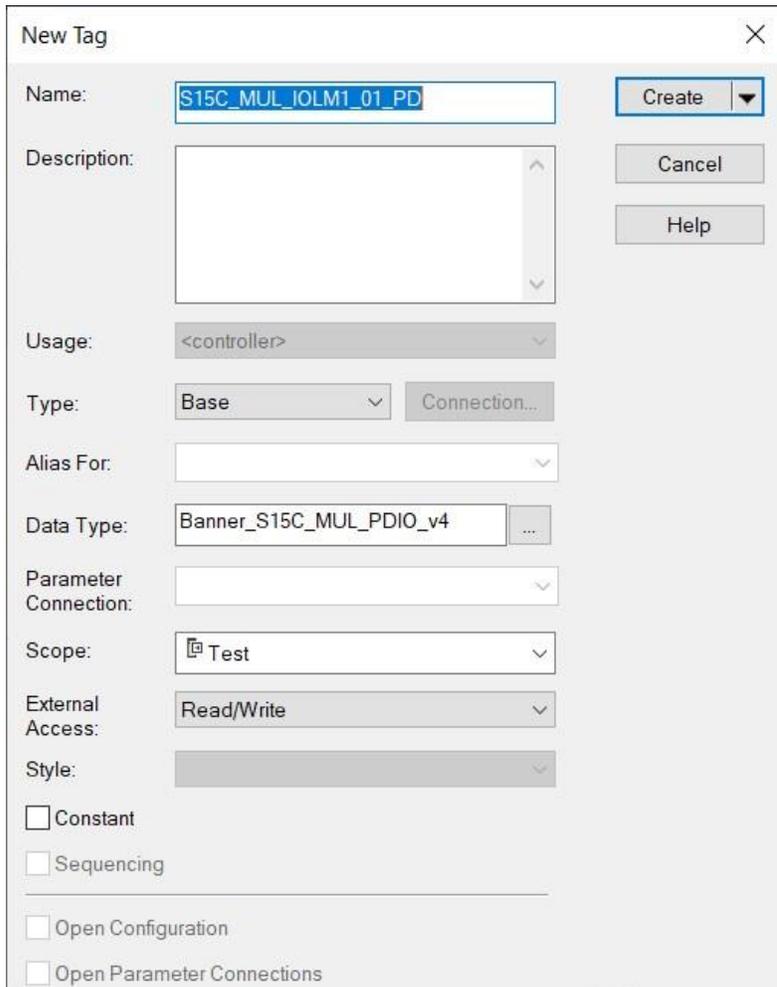
2. In the AOI, right-click on the question mark on the line labeled “Banner_S15C_MUL_PD_v4”. Click New Tag. Name the new tag. This example uses the name “S15C_MUL_IOLM1_01_PD_Status”. The example naming convention accounts for this being a S15C-MUL device connected to IO-Link Master #1, port #1, in our program. More masters could be named IOLM2, IOLM3, and different sensors could be connected at other port numbers, etc.

Note that the Data Type is the User-Defined Data Type (UDT) entitled “Banner_S15C_MUL_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.



3. 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 “S15C_MUL_IOLM1_01_PD”. Notice that the Data Type is “Banner_S15C_MUL_PDIO_v4”. Click Create.

This array will handle the displaying of the parsed Process Data In and Process Data Out for the S15C-MUL.

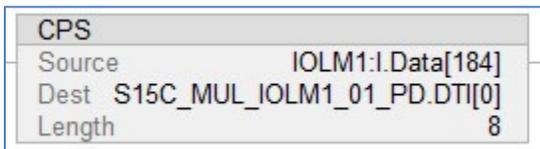


4. The next line in the AOI is a setting to account for byte swapping. In the case of the S15C-MUL, the Process Data In is 8 bytes long. IO-Link Masters may read each pair of bytes in either order, so this AOI must be ready to perform a byte swap. Enter a “0” or a “1” to toggle this setting. See Appendix B for more information.

NOTE: If the IO-Link Master you are using requires byte swapping be set to “1”, the single byte of Process Data Out the S15C-MUL uses will show up in one register higher than that listed on table 1 in Appendix B.

- 5. The final two steps required before we download and run the S15C-MUL Process Data AOI involve a pair of File Synchronous Copy (CPS) instructions. These instructions allow the AOI to read from and write to 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 8 bytes, as that is the size of the S15C-MUL Process Data In.



Here is what the entire rung looks like when completed.



The “Banner_S15C_MUL_PD_v4” AOI is now ready for use.

4. Using the AOI

The “Banner_S15C_MUL_PD_v4” Add-On Instruction has created a group of tags representing the S15C-MUL Process Data In and Process Data Out, 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 “S15C_MUL_IOLM1_01_PD”. The tag array, seen below, has individual pieces of information instead of a group of unlabeled bits. The parameter “Write_Data_Set” controls which of the three data sets that is currently being read. In the example below, the value is set to 0. This means Data Set 0 is read. The valid options are 0,1, and 2. There are three sets of Modbus Registers that could be mapped into the IO-Link Process Data In: Set_0, Set_1, and Set_2. The reading of the data set is working when the “Read_Status” has a value of 1. If it has a value of 0 than the data is not valid. The parameter “Read_Data_Set” should also come back with the same number as the “Write_Data_Set”. This is just confirming the data set.

The Process Data Out is shown near the bottom of the image and represents the choice of Modbus registers to use for the Process Data In (labeled Data_Set).

| | |
|------------------------------------|-------|
| ▲ S15C_MUL_IOLM1_01_PD | {...} |
| S15C_MUL_IOLM1_01_PD.Distance_mm | 381.0 |
| S15C_MUL_IOLM1_01_PD.Distance_in | 15.0 |
| S15C_MUL_IOLM1_01_PD.Temperature_C | 23.89 |
| S15C_MUL_IOLM1_01_PD.Temperature_F | 75.0 |

Appendix A S15C-MUL Process Data

The S15C-MUL has 8 bytes of Process Data In, as shown below. There are three modes for this Process Data, called Register Sets to Read. The Process Data Out controls which of the Registers Sets defines the Process Data In (0, 1, or 2).

| ProcessDataIn "Process Data In" id=V_Pd_InData | | | | | | | | | |
|--|------------|-----------------|----------------|---------------|-------------|-----------------|---------------|-----------------|--|
| bit length: 64 | | | | | | | | | |
| data type: 64-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 | 16-bit UInteger | 0..65535 | | | | | Distance (mm) | Distance in millimeters or inches. The distance = (value) / 100. |
| 2 | 16 | 16-bit UInteger | 0..65535 | | | | | Distance (in) | Distance in millimeters or inches. The distance = (value) / 100. |
| 3 | 32 | 16-bit UInteger | 0..65535 | | | | | Temperature (F) | Temperature in Celcius or Farenhits. The temperature = (value) / 20. |
| 4 | 48 | 16-bit UInteger | 0..65535 | | | | | Temperature (C) | Temperature in Celcius or Farenhits. The temperature = (value) / 20. |
| octet | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| bit offset | 63 - 56 | 55 - 48 | 47 - 40 | 39 - 32 | 31 - 24 | 23 - 16 | 15 - 8 | 7 - 0 | |
| subindex | 4 | 4 | 3 | 3 | 2 | 2 | 1 | 1 | |
| element bit | 15 - 8 | 7 - 0 | 15 - 8 | 7 - 0 | 15 - 8 | 7 - 0 | 15 - 8 | 7 - 0 | |

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