# R95C-4B4UI Process Data AOI Guide, v4
## January 8th, 2025

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 from a Banner R95C-4B4UI device via an IO-Link Master to an Allen-Bradley PLC.

**<u>Components</u>**
Banner_R95C_4B4UI_PD_v4_AOI.L5X

**<u>UDTs Packaged with the AOI</u>**
Banner_R95C_4B4UI_PDI0_v4
Banner_R95C_4B4UI_PDI1_v4
Banner_R95C_4B4UI_PDIO_v4
Banner_R95C_4B4UI_PD_Discrete_v4

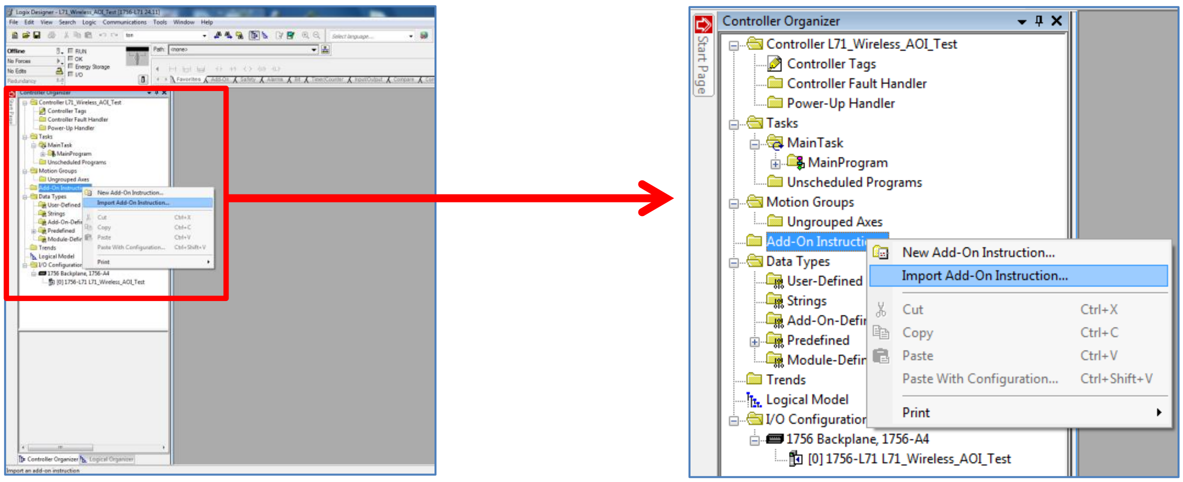
***<u>Other AOIs Available Separately</u>***
Banner has AOI files for controlling other Banner IO-Link devices and for a variety of IO-Link Masters. Banner also has AOI files for easily handling Banner device Parameter Data.

## Contents

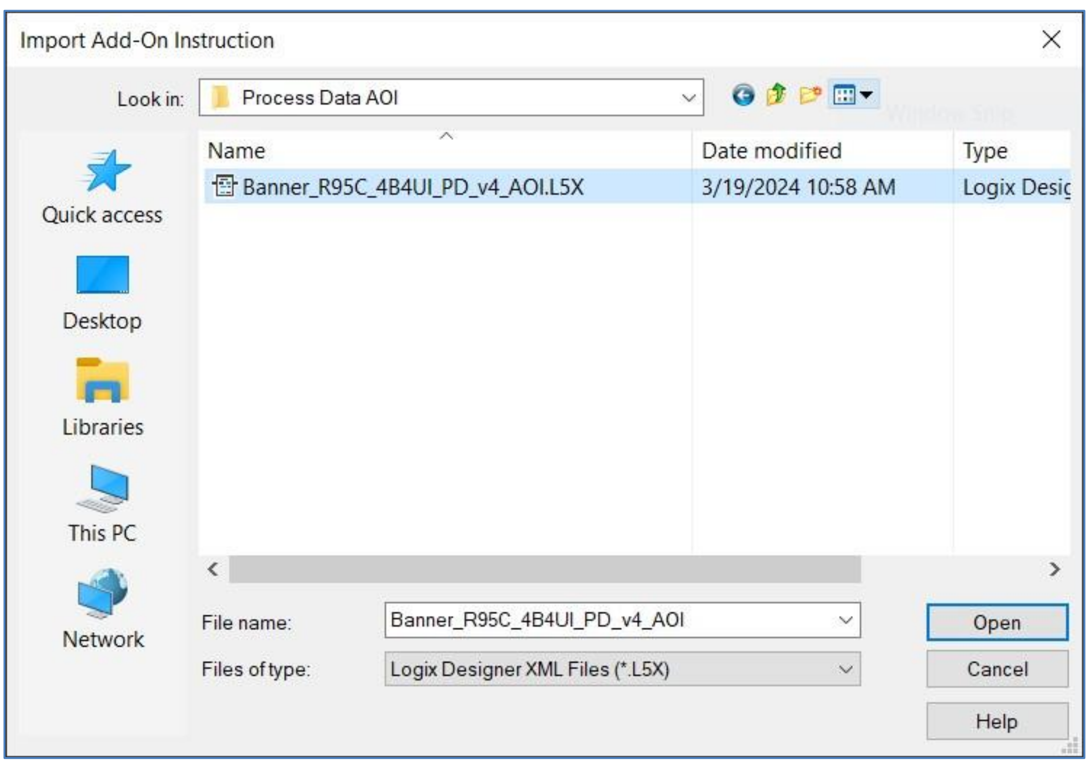
# 1. Installation Process

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

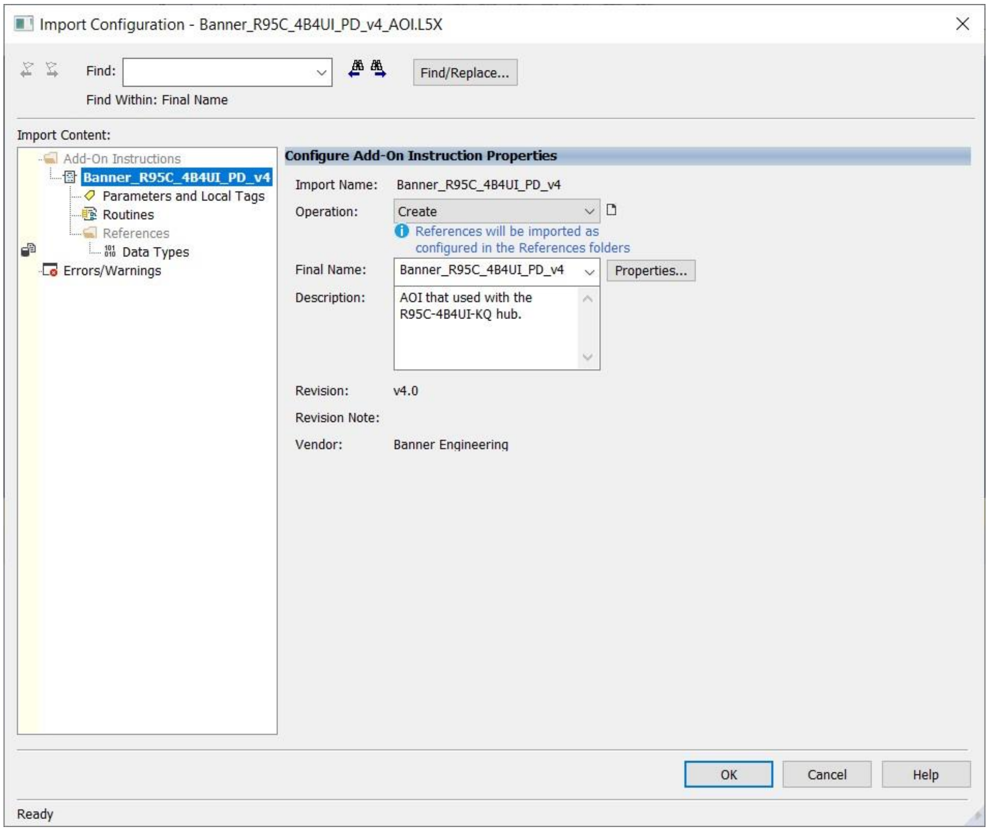
1. Open a project.
2. In the Controller Organizer window, right-click on the Add-On Instruction folder. Select the Import Add-On Instruction option.

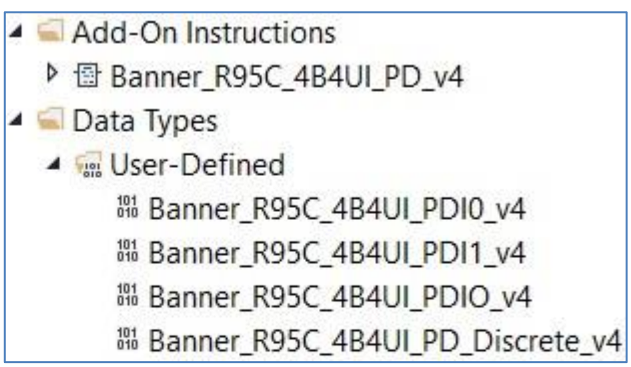



3. Navigate to the correct file location and select the AOI to be installed. In this example the "Banner_R95_4B4UI_PD_v4_AOI.L5X" file will be selected. Click the Open button.



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 like the picture at left.
6. AOI installation into the Logix Designer software complete.

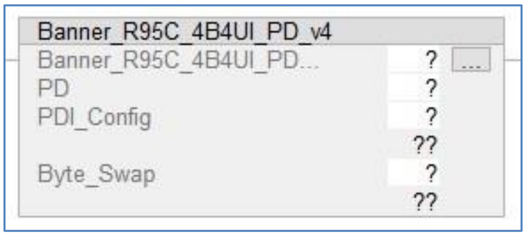
## 2. Configuring the IO-Link Master

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.

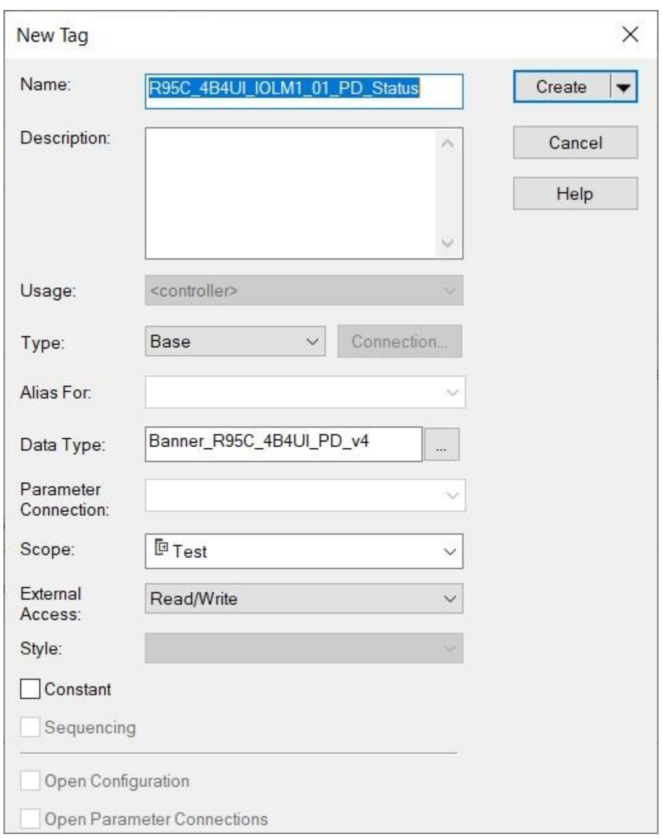
## 3. Configuring the AOI

1. Add the "Banner_R95C_4B4UI_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.



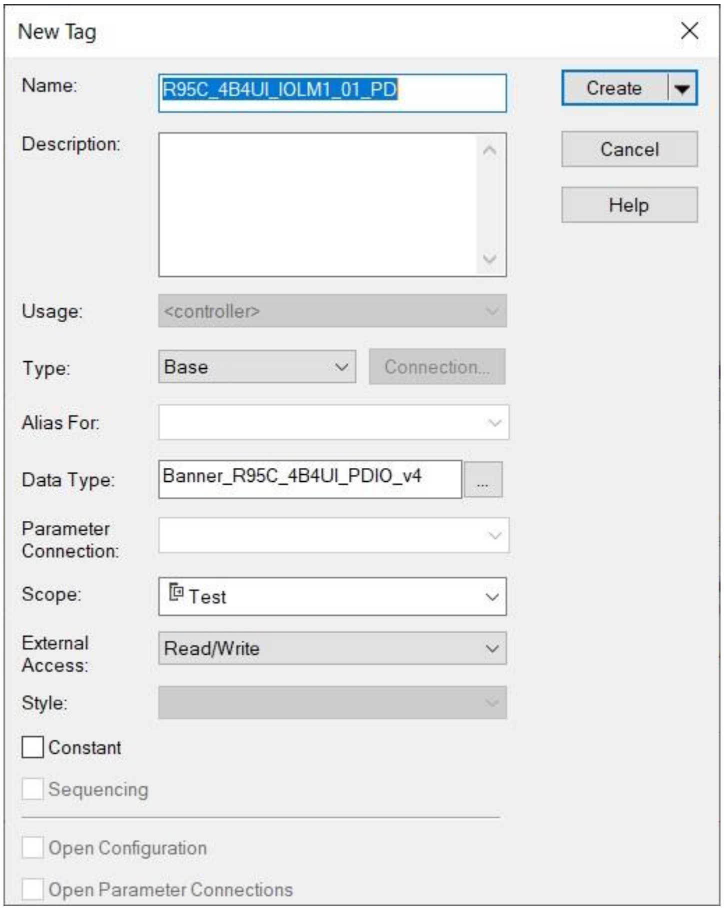

2. In the AOI, right-click on the question mark on the line labeled "Banner_R95C_4B4UI_PD_v4". Click New Tag. Name the new tag. This example uses the name "R95C_4B4UI_IOLM1_01_PD_Status". The example naming convention accounts for this being a R95C-4B4UI device connected to IO-Link Master #1, port #1, 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_R95C_4B4UI_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 "PD" in the AOI. Click on "New Tag". Give the tag a name. This example uses the name "R95C_4B4UI_IOLM1_01_PD". Notice that the Data Type is "Banner_R95C_4B4UI_PD_v4". Click Create.

   This array will handle the displaying of the parsed Process Data for the R95C-4B4UI.




4. The line labeled "PDI_Config" allows the AOI to know which of two possible Process Data Formats the unit is currently in use. The choices for these settings are "0" (Analog Value) and "1" (Digital Measuring Sensor). The default setting is "0" (Analog Value).

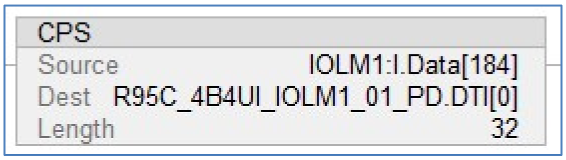
   There are two ways to achieve this goal. We can simply type in the correct number as a constant, or we can link this Process Data AOI to the ISDU Parameter Data AOI. The Parameter AOI has the tag Process Data Input Configuration that would be linked. Normally using the constant is the easier approach.

5. The next line in the AOI is a setting to account for byte swapping. In the case of the R95C-4B4UI, the Process Data In is 29 bytes long and the Process Data Out is 9 bytes. 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.

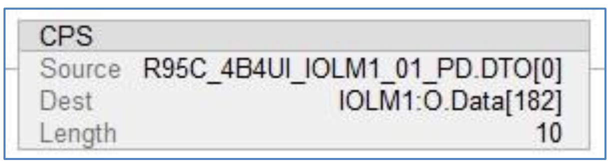
   **NOTE:** If the IO-Link Master you are using requires byte swapping be set to "1".

6. The final step required before we download and run the R95C-4B4UI Process Data AOI involves adding two 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.

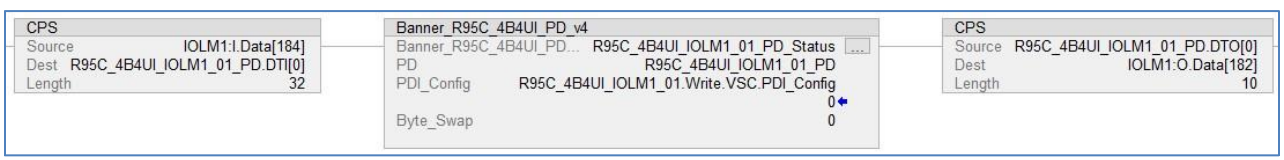
   Add a CPS instruction before the AOI on the ladder rung that looks like the one seen below. Refer to Appendix B for which byte to start with in the “Source” area. In this case, the IO-Link Master in question has the raw Process Data In values for a device connected to port 1 starting at byte 184. For the “Destination”, we will enter the “DTI[0]” location, as seen below. Finally, the length will be 32 bytes.




   The second CPS instruction sends the Process Data Output to the correct location for the IO-Link Master. It requires a size of 10 bytes. The Source will be the DTO[0] and is linked to the output location as shown in Appendix B.

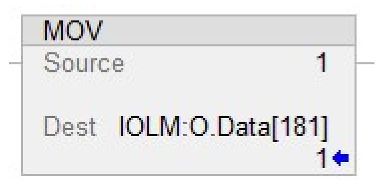



   Here is what the entire rung looks like when completed.




   If a Banner IO-Link Master is being used, setup a Move block. Send a 1 to the Activate Outputs array value (see table for each port’s value). As an example, if port 1 needs the process data outputs active then send a 1 to 181.

| IO-Link Master Port | Activate Outputs |
|---|---|
| 1 | 181 |
| 2 | 215 |
| 3 | 249 |
| 4 | 283 |
| 5 | 317 |
| 6 | 351 |
| 7 | 385 |
| 8 | 419 |




The “Banner_R95C_4B4UI_PD_v4” AOI is now ready for use.

## 4. Using the AOI

The “Banner_R95C_4B4UI_PD_v4” Add-On Instruction has created a group of tags representing the Process Data In, 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 “R95C_4B4UI_IOLM1_01_PD”. The tag array, seen below, shows what data the UDT has. The “Port_Data” tag stores all the information for all eight ports of the device. Expand the “Port_Data” tag.

| |
|---|
| ◢ R95C_4B4UI_IOLM1_01_PD |
| ▷ R95C_4B4UI_IOLM1_01_PD.Set0 |
| ▷ R95C_4B4UI_IOLM1_01_PD.Set1 |
| ▷ R95C_4B4UI_IOLM1_01_PD.DTI |
| ▷ R95C_4B4UI_IOLM1_01_PD.DTO |

“Port_Data” is broken out into the tags for the data set being looked at. Here data set 0 is being shown. Each item has the necessary tags stored in it.

| |
|---|
| ◢ R95C_4B4UI_IOLM1_01_PD.Set0 |
| ▷ R95C_4B4UI_IOLM1_01_PD.Set0.Analog_In |
| ▷ R95C_4B4UI_IOLM1_01_PD.Set0.PDI_Measurement |
| ▷ R95C_4B4UI_IOLM1_01_PD.Set0.Discrete |
| ▷ R95C_4B4UI_IOLM1_01_PD.Set0.Analog_Out |

The Discrete info is given for Ports 1 through 4. It gives the current On/OFF state of the discrete inputs/outputs 1 or 2. Reference the setup for the Port to know what data is used for the port. Only one of the Discrete_1_In or Discrete_1_Out can be configured.

| | |
|---|---|
| ◢ R95C_4B4UI_IOLM1_01_PD.Set0.Discrete | {...} |
| ▷ R95C_4B4UI_IOLM1_01_PD.Set0.Discrete.P1_DI1 | 1 |
| ▷ R95C_4B4UI_IOLM1_01_PD.Set0.Discrete.P1_DI2 | 0 |
| ▷ R95C_4B4UI_IOLM1_01_PD.Set0.Discrete.P2_DI1 | 0 |
| ▷ R95C_4B4UI_IOLM1_01_PD.Set0.Discrete.P2_DI2 | 0 |

The output tags allow the user to turn the discrete output on or off. This can only be done if discrete 1 or 2 is configured as an output via parameter data.

# Appendix A R95C 4B4UI Process Data

The R95C-4B4UI has 29 bytes of Process Data In and 9 bytes of Process Data Out.

## ProcessDataIn "Process Data Input" id=PD_ProcessDataIn

bit length: 232
data type: 232-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 | | | | | Port1 Discrete1 Input State | true (1) = Discrete1 Input Active. Note - even if Discrete1 is configured as an output, the active state will be reflected at the input |
| 2 | 1 | Boolean | false = Inactive, true = Active | | | | | Port1 Discrete2 Input State | true (1) = Discrete2 Input Active. Note - even if Discrete2 is configured as an output, the active state will be reflected at the input |
| 3 | 2 | Boolean | false = Inactive, true = Active | | | | | Port2 Discrete1 Input State | true (1) = Discrete1 Input Active. Note - even if Discrete1 is configured as an output, the active state will be reflected at the input |
| 4 | 3 | Boolean | false = Inactive, true = Active | | | | | Port2 Discrete2 Input State | true (1) = Discrete2 Input Active. Note - even if Discrete2 is configured as an output, the active state will be reflected at the input |
| 5 | 4 | Boolean | false = Inactive, true = Active | | | | | Port3 Discrete1 Input State | true (1) = Discrete1 Input Active. Note - even if Discrete1 is configured as an output, the active state will be reflected at the input |
| 6 | 5 | Boolean | false = Inactive, true = Active | | | | | Port3 Discrete2 Input State | true (1) = Discrete2 Input Active. Note - even if Discrete2 is configured as an output, the active state will be reflected at the input |
| 7 | 6 | Boolean | false = Inactive, true = Active | | | | | Port4 Discrete1 Input State | true (1) = Discrete1 Input Active. Note - even if Discrete1 is configured as an output, the active state will be reflected at the input |
| 8 | 7 | Boolean | false = Inactive, true = Active | | | | | Port4 Discrete2 Input State | true (1) = Discrete2 Input Active. Note - even if Discrete2 is configured as an output, the active state will be reflected at the input |
| 9 | 8 | 32-bit Integer | | | | | | Process Data Measurement 1 | Process Data Measurement 1 Value |
| 10 | 40 | 32-bit Integer | | | | | | Process Data Measurement 2 | Process Data Measurement 2 Value |
| 11 | 72 | 32-bit Integer | | | | | | Process Data Measurement 3 | Process Data Measurement 3 Value |
| 12 | 104 | 32-bit Integer | | | | | | Process Data Measurement 4 | Process Data Measurement 4 Value |
| 13 | 136 | 24-bit Integer | | | | | | Measurement Value - Analog in 1 | If The Mode of Analog In = Voltage, Process Data Input = value*0.001V, If The Mode of Analog In = Current, Process Data Input = value*0.000001A |
| 14 | 160 | 24-bit Integer | | | | | | Measurement Value - Analog in 2 | If The Mode of Analog In = Voltage, Process Data Input = value*0.001V, If The Mode of Analog In = Current, Process Data Input = value*0.000001A |
| 15 | 184 | 24-bit Integer | | | | | | Measurement Value - Analog in 3 | If The Mode of Analog In = Voltage, Process Data Input = value*0.001V, If The Mode of Analog In = Current, Process Data Input = value*0.000001A |
| 16 | 208 | 24-bit Integer | | | | | | Measurement Value - Analog in 4 | If The Mode of Analog In = Voltage, Process Data Input = value*0.001V, If The Mode of Analog In = Current, Process Data Input = value*0.000001A |

## ProcessDataIn "Process Data Input" id=PD_ProcessDataInDMS

bit length: 232
data type: 232-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 | | | | | Port1 Discrete1 Input State | true (1) = Discrete1 Input Active. Note - even if Discrete1 is configured as an output, the active state will be reflected at the input |
| 2 | 1 | Boolean | false = Inactive, true = Active | | | | | Port1 Discrete2 Input State | true (1) = Discrete2 Input Active. Note - even if Discrete2 is configured as an output, the active state will be reflected at the input |
| 3 | 2 | Boolean | false = Inactive, true = Active | | | | | Port2 Discrete1 Input State | true (1) = Discrete1 Input Active. Note - even if Discrete1 is configured as an output, the active state will be reflected at the input |
| 4 | 3 | Boolean | false = Inactive, true = Active | | | | | Port2 Discrete2 Input State | true (1) = Discrete2 Input Active. Note - even if Discrete2 is configured as an output, the active state will be reflected at the input |
| 5 | 4 | Boolean | false = Inactive, true = Active | | | | | Port3 Discrete1 Input State | true (1) = Discrete1 Input Active. Note - even if Discrete1 is configured as an output, the active state will be reflected at the input |
| 6 | 5 | Boolean | false = Inactive, true = Active | | | | | Port3 Discrete2 Input State | true (1) = Discrete2 Input Active. Note - even if Discrete2 is configured as an output, the active state will be reflected at the input |
| 7 | 6 | Boolean | false = Inactive, true = Active | | | | | Port4 Discrete1 Input State | true (1) = Discrete1 Input Active. Note - even if Discrete1 is configured as an output, the active state will be reflected at the input |
| 8 | 7 | Boolean | false = Inactive, true = Active | | | | | Port4 Discrete2 Input State | true (1) = Discrete2 Input Active. Note - even if Discrete2 is configured as an output, the active state will be reflected at the input |
| 9 | 8 | 32-bit Integer | | | | | | Process Data Measurement 1 | Process Data Measurement 1 Value |
| 10 | 40 | 32-bit Integer | | | | | | Process Data Measurement 2 | Process Data Measurement 2 Value |
| 11 | 72 | 32-bit Integer | | | | | | Process Data Measurement 3 | Process Data Measurement 3 Value |
| 12 | 104 | 32-bit Integer | | | | | | Process Data Measurement 4 | Process Data Measurement 4 Value |
| 13 | 136 | 16-bit Integer | | | | | | Measurement Value 5 | The channel 5 measurement device value |
| 14 | 152 | 7-bit Integer | | | | | | Measurement Scale 5 | The channel 5 measurement device scale |
| 15 | 159 | Boolean | | | | | | SSC5.1 - Switching Signal | Indicates the detection status of an object or measurement value within a window. |
| 16 | 160 | 16-bit Integer | | | | | | Measurement Value 6 | The channel 6 measurement device value |
| 17 | 176 | 7-bit Integer | | | | | | Measurement Scale 6 | The channel 6 measurement device scale |

## ProcessDataOut "Process Data Output" id=PD_ProcessDataOut

bit length: 72
data type: 72-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 = Off, true = On | | | | | Port1 Discrete1 Output State | true (1) = Discrete1 Output Active |
| 2 | 1 | Boolean | false = Off, true = On | | | | | Port1 Discrete2 Output State | true (1) = Discrete2 Output Active |
| 3 | 2 | Boolean | false = Off, true = On | | | | | Port2 Discrete1 Output State | true (1) = Discrete1 Output Active |
| 4 | 3 | Boolean | false = Off, true = On | | | | | Port2 Discrete2 Output State | true (1) = Discrete2 Output Active |
| 5 | 4 | Boolean | false = Off, true = On | | | | | Port3 Discrete1 Output State | true (1) = Discrete1 Output Active |
| 6 | 5 | Boolean | false = Off, true = On | | | | | Port3 Discrete2 Output State | true (1) = Discrete2 Output Active |
| 7 | 6 | Boolean | false = Off, true = On | | | | | Port4 Discrete1 Output State | true (1) = Discrete1 Output Active |
| 8 | 7 | Boolean | false = Off, true = On | | | | | Port4 Discrete2 Output State | true (1) = Discrete2 Output Active |
| 9 | 8 | 16-bit Integer | | | | | | Analog Out Value 1 | If Voltage = Enter mV value, If Current = Enter uA value |
| 10 | 24 | 16-bit Integer | | | | | | Analog Out Value 2 | If Voltage = Enter mV value, If Current = Enter uA value |
| 11 | 40 | 16-bit Integer | | | | | | Analog Out Value 3 | If Voltage = Enter mV value, If Current = Enter uA value |
| 12 | 56 | 16-bit Integer | | | | | | Analog Out Value 4 | If Voltage = Enter mV value, If Current = Enter uA value |

## 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"**

| | Allen-Bradley* | | Comtrol | | Balluff | | Turck | | ifm | | Banner | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Port** | **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