T30R KD Discrete Process Data AOI Guide, v3
11/10/2020

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 T30R KD Discrete sensor via an IO-Link Master to an Allen-Bradley PLC. The AOI covers parsing and display of the T30R KD sensor Process Data In. The AOI has four User Defined Tag data types.

Components

Banner_T30RKD_PD_v3.L5X

UDT Packaged with the AOI

Banner_T30RKD_PD0_v3
Banner_T30RKD_PD1_v3
Banner_T30RKD_PD2_v3
Banner_T30RKD_PDI_v3

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.

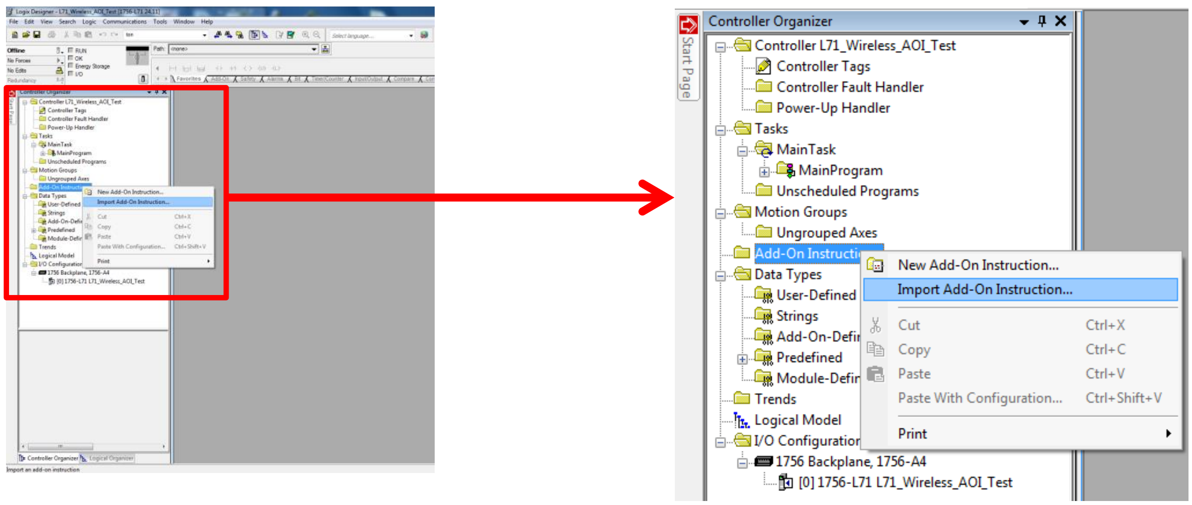
Contents

1. Installation Process

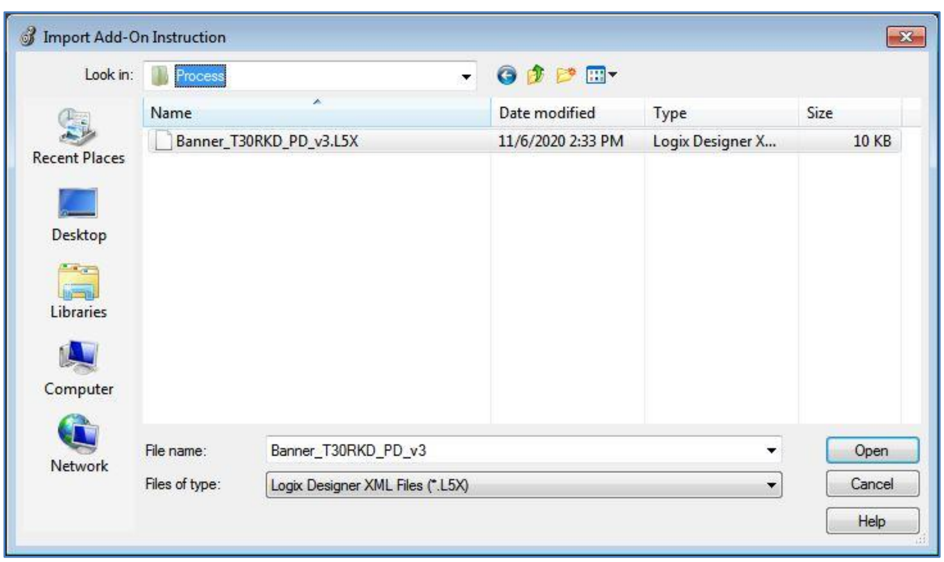
This section describes how to install the AOI in Logix Designer software.

1. Open up a project.

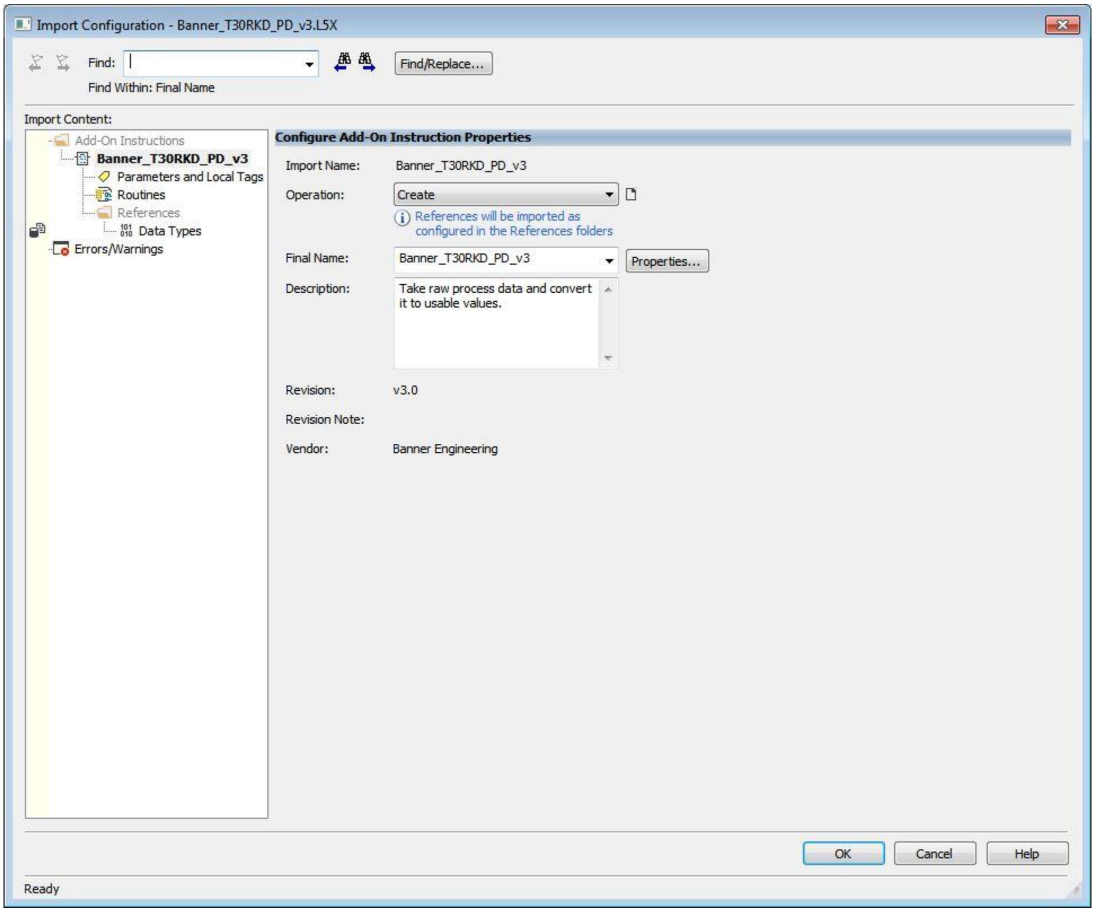
2. In the Controller Organizer window, right-click on the Add-On Instruction folder. Select the Import Add-On Instruction option.

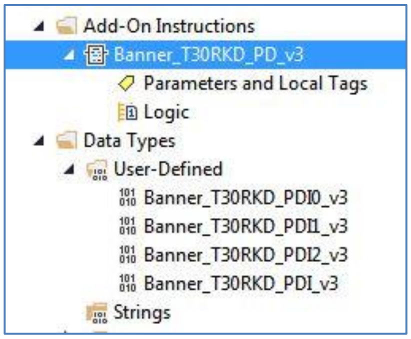


3. Navigate to the correct file location and select the AOI to be installed. In this example the “Banner_T30RKD_PD_v3.L5X” file will be selected. Click the Open button.



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.

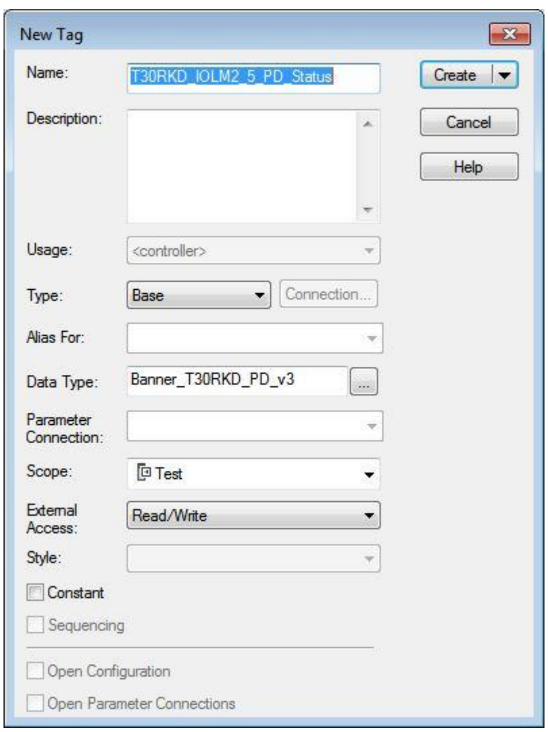
Create an Ethernet communications module for the IO-Link Master device. The controller tags generated include Input (I) and Output (O) Assembly Instances. Each Assembly has a corresponding tag array. Creating this Class 1 EtherNet/IP implicit IO connection will provide the PLC access to the IO-Link device 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_T30RKD_PD_v3” 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.

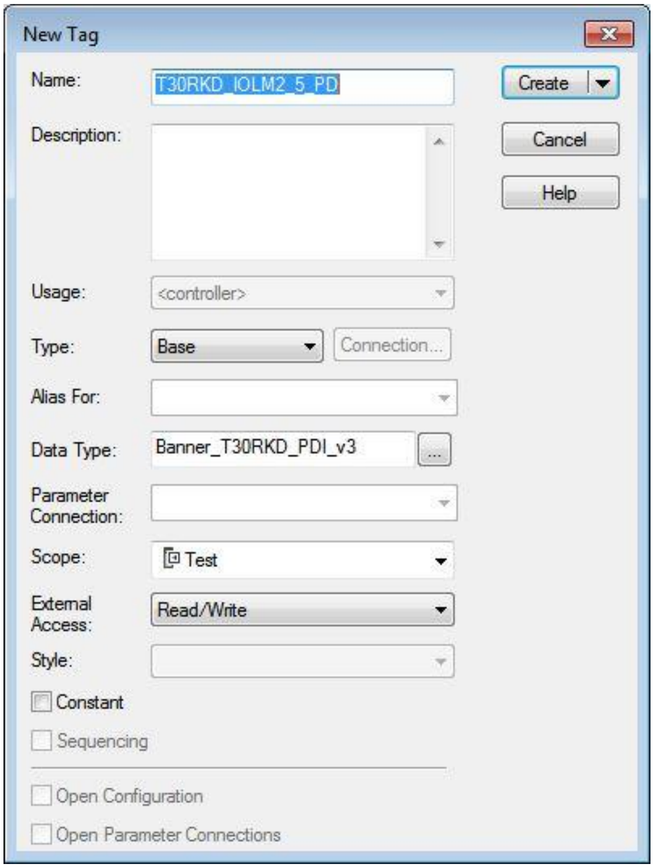
2. In the AOI, right-click on the question mark on the line labeled “Banner_T30RKD_PD_v3”. Click New Tag. Name the new tag. This example uses the name “T30RKD_IOLM2_5_PD_Status”. The example naming convention accounts for this being a T30RKD sensor connected to IO-Link Master #2, port #5, in our program. More masters could be named IOLM1, 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_T30RKD_PD_v3”. This custom-made array of registers is specially built to handle the memory needs of this AOI. Click Create to make the tag array.



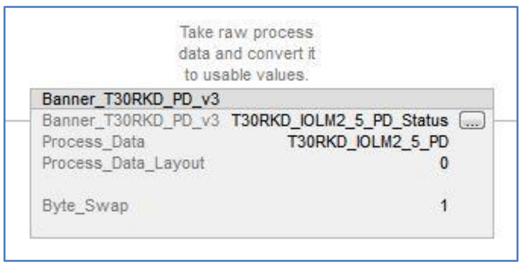
3. Now we will right-click on the question mark on the line labeled “Process_Data” in the AOI. Click on “New Tag”. Give the tag a name. This example uses the name “T30RKD_IOLM2_5_PD”. Notice that the Data Type is “Banner_T30RKD_PDIO_v3”. Click Create.

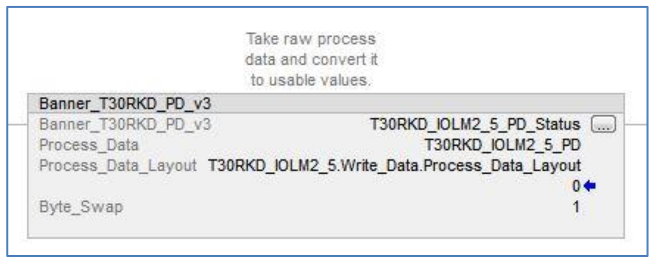
   This array will handle the displaying of the parsed Process Data In for the T30RKU sensor.



4. The next line, "Process_Data_Layout", allows the AOI to correctly interpret the Process Data In. In the case of the T30RKD, there are three modes for the sensor Process Data In: Digital Measurement Sensor (mode 0, the default), Distance and Excess Gain (mode 1), and Distance and Excess Gain with Binary Data (mode 2). This AOI needs to know which of those three modes the sensor is currently in, in order to make sense of the raw Process Data.

   There are two ways to achieve this goal. We can simply type in the correct number for this selection, or we can link this T30RKD Process Data AOI to the T30RKD Parameter Data AOI. See Appendix A for more information about T30RKD Process Data In.





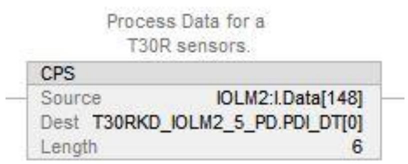
   NOTE: if you type in the incorrect number (i.e. it does not match the sensor's current configuration) you will get incorrectly displayed Process Data In information.

   Configuration: the options here are 0, 1, or 2, depending on the sensor's configuration (setting found in Index 64, Subindex 6).

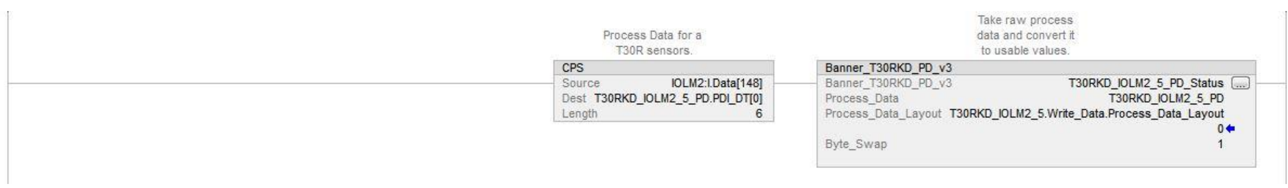
5. The last line in the AOI is a setting to account for byte swapping. In the case of the T30RKD, the Process Data In is six bytes long. IO-Link Masters may read each pair of bytes in either order, so this AOI has to be ready to perform a byte swap. Enter a "0" or a "1" to toggle this setting. See Appendix B for more information.

6. The final step required before we download and run the T30RKD Process Data AOI involves a File Synchronous Copy (CPS) instruction. This instruction allows the AOI to read 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 5 starting at byte 148. For the “Destination”, we will enter the “PDI_DT[0]” location, as seen below. Finally, the length will be 6 bytes, as that is the size of the T30RKD Process Data In.



   Here is what the entire rung looks like when completed.



   The “Banner_T30RKD_PD_v3” AOI is now ready for use.

4. Using the AOI

The “Banner_T30RKD_PD_v3” Add-On Instruction has created a group of tags representing the T30RKD 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 “T30RKD_IOLM2_5_PD”. The tag array, seen below, has individual pieces of information instead of a group of unlabeled bits. There are three modes the Process Data In could be in, labeled here as: Set_0, Set_1, and Set_2. Depending on the mode setting of the sensor, only one of these arrays will be correctly populated with parsed Process Data In. In this example, the sensor is in mode 0. The Set_0 array is expanded below. The five items of Process Data In are the T30RKD measurement value, the measurement scale, the stability indicator, and the states of discrete output 1 and 2.

◢ T30RKD_IOLM2_5_PD	{...}	{...}		Banner_T30RKD_PDI_v3
◢ T30RKD_IOLM2_5_PD.Set_0	{...}	{...}		Banner_T30RKD_PDI0_v3
▷ T30RKD_IOLM2_5_PD.Set_0.Measurement	975		Decimal	DINT
▷ T30RKD_IOLM2_5_PD.Set_0.Scale	253		Decimal	DINT
▷ T30RKD_IOLM2_5_PD.Set_0.Stability	1		Decimal	SINT
▷ T30RKD_IOLM2_5_PD.Set_0.BDC1_State	1		Decimal	SINT
▷ T30RKD_IOLM2_5_PD.Set_0.BDC2_State	1		Decimal	INT
▷ T30RKD_IOLM2_5_PD.Set_1	{...}	{...}		Banner_T30RKD_PDI1_v3
▷ T30RKD_IOLM2_5_PD.Set_2	{...}	{...}		Banner_T30RKD_PDI2_v3
▷ T30RKD_IOLM2_5_PD.PDI_DT	{...}	{...}	Decimal	SINT[6]

Appendix A T30RKD Process Data

The T30RKD Analog has 6 bytes of Process Data In, as shown below. There are three modes for this Process Data In, called: Digital Measurement Sensor (mode 0, the default), Distance and Excess Gain (mode 1), and Distance and Excess Gain with Binary Data (mode 2). The default mode, Digital Measurement Sensor, is shown first. In this mode, the Process Data In includes the distance measurement value, the measurement scale, the stability indicator, and the states of discrete outputs 1 and 2.

ProcessDataIn "Process Data Input" id=PD_ProcessDataInMeasurement

bit length: 48
data type: 48-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	16	32-bit Integer						Distance Measurement Value	Process Data Distance Measurement
2	8	8-bit Integer						Measurement Scale	The measurement device scale
3	2	Boolean	false = No Target or Marginal, true = Valid					Stability	Stability State
4	1	Boolean	false = Inactive, true = Active					BDC2 State	BDC2 State
5	0	Boolean	false = Inactive, true = Active					BDC1 State	BDC1 State

Figure 1: PDI Mode 0, " Digital Measurement Sensor "

This Process Data In is mapped to a specific group of EtherNet/IP registers. The 48-bits of Process Data In actually encode five separate pieces of information.

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

The “Distance and Excess Gain” mode for the T30RKD Process Data In is shown below.

ProcessDataIn "Process Data Input" id=PD_ProcessDataInDistanceAmplitude

bit length: 48
data type: 48-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	16	32-bit Integer						Distance Measurement Value	Process Data Distance Measurement
2	0	16-bit UInteger						Excess Gain Measurement Value	Process Data Excess Gain Measurement

Figure 2: PDI Mode 1, " Distance and Excess Gain "

The “Distance and Excess Gain with Binary Data” mode for the T30RKD Process Data In is shown below.

ProcessDataIn "Process Data Input" id=PD_ProcessDataInDistanceScaledAmplitude

bit length: 48
data type: 48-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	16	32-bit Integer						Distance Measurement Value	Process Data Distance Measurement
2	8	8-bit UInteger						Excess Gain Measurement Value	Process Data Excess Gain Measurement (restricted to 0-255x)
3	2	Boolean	false = No Target or Marginal, true = Valid					Stability	Stability State
4	1	Boolean	false = Inactive, true = Active					BDC2 State	BDC2 State
5	0	Boolean	false = Inactive, true = Active					BDC1 State	BDC1 State

Figure 3: PDI Mode 2, "Distance and Excess Gain with Binary Data"

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