K50 Pro Audible Process Data AOI Guide, v4
September 22nd, 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 K50 Pro Audible device via an IO-Link Master connected to an Allen-Bradley PLC. The AOI covers parsing and display of the K50 Pro Audible Process Data In and Process Data Out. The AOI has five User Defined Tag data types.

Components

Banner_K50Audible_PD_v2.L5X

UDT Packaged with the AOI

Banner_K50Audible_Advanced_v2
Banner_K50Audible_FourPD_v2
Banner_K50Audible_LED_v2
Banner_K50Audible_Multi_v2
Banner_K50Audible_PDIO_v2

Other AOIs Available Separately

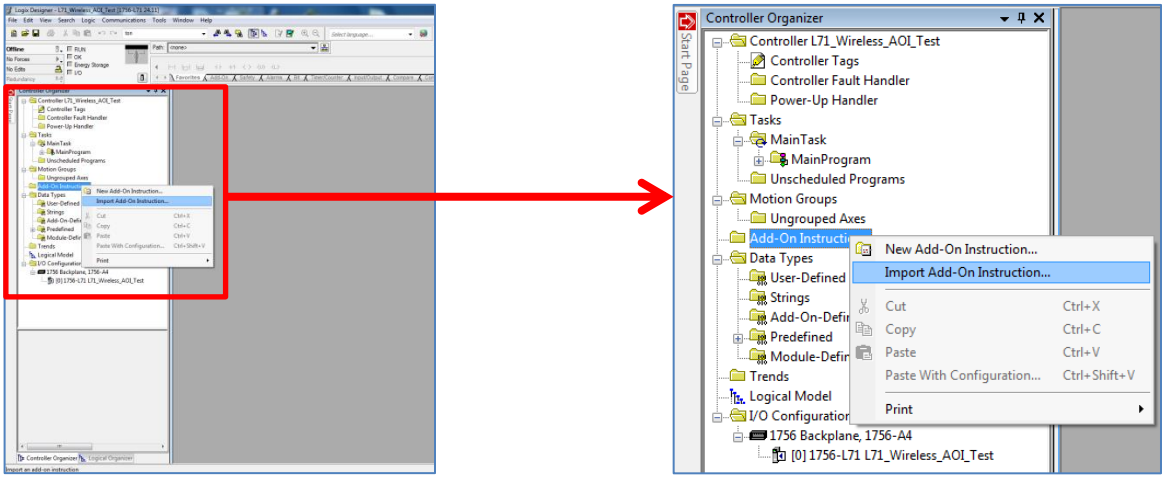
Banner has AOI files for controlling other Banner IO-Link devices and for a variety of IO-Link Masters. Banner also has AOI files for easily handling Banner device Parameter Data.

Contents

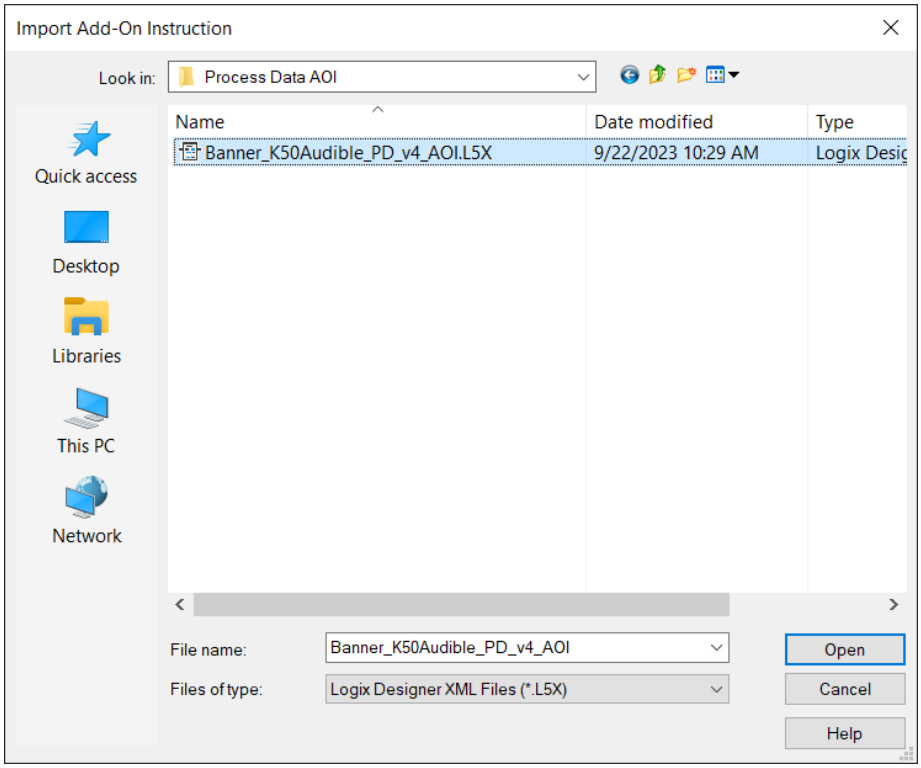
1. Installation Process

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

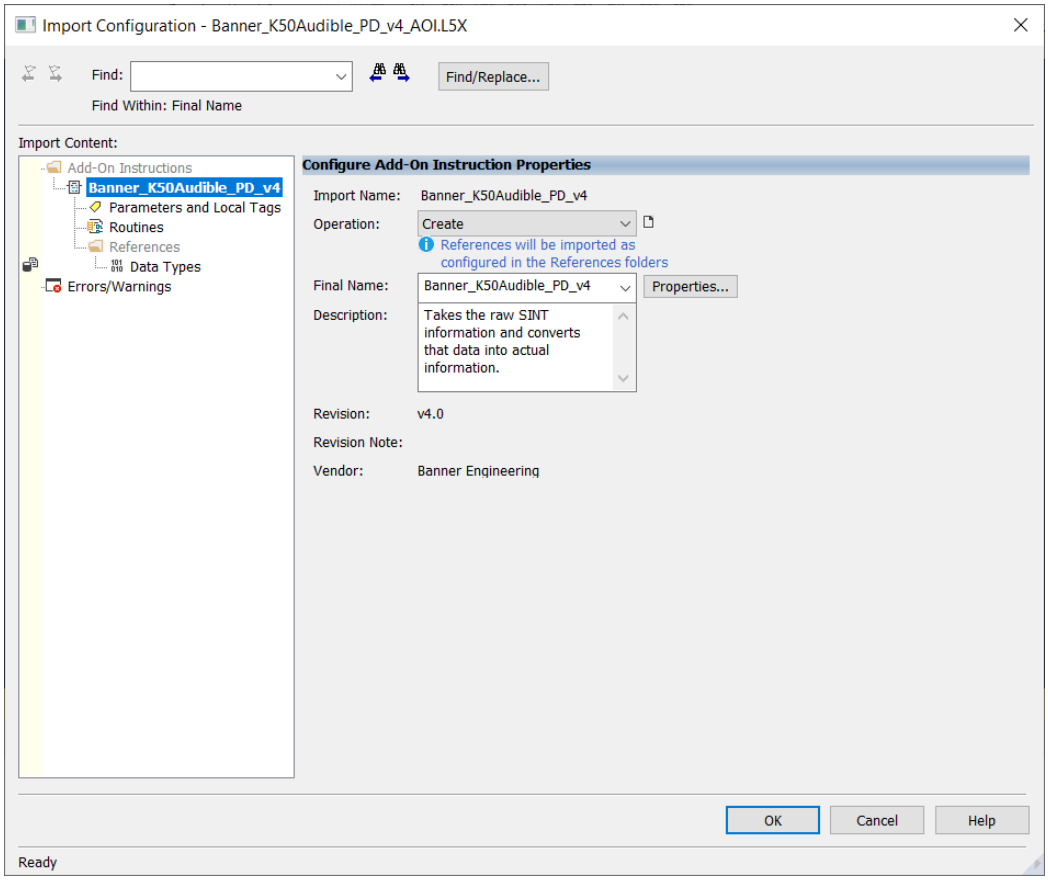
1. Open a project.
2. In the Controller Organizer window, right-click on the Add-On Instruction folder. Select the Import Add-On Instruction option.

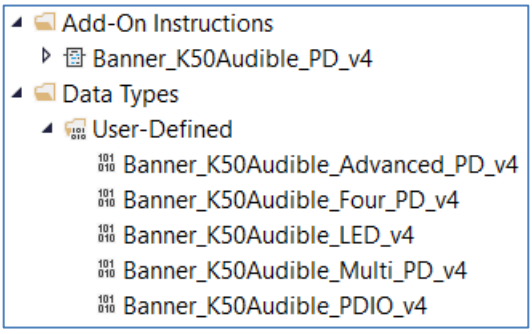


3. Navigate to the correct file location and select the AOI to be installed. In this example the "Banner_K50Audible_PD_v4.L5X" file will be selected. Click the Open button.



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 is complete.

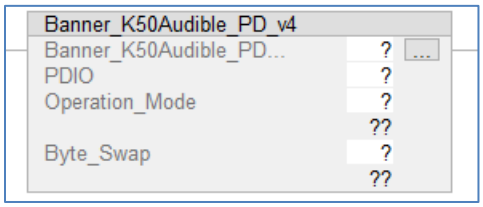
2. Configuring the IO-Link Master

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.

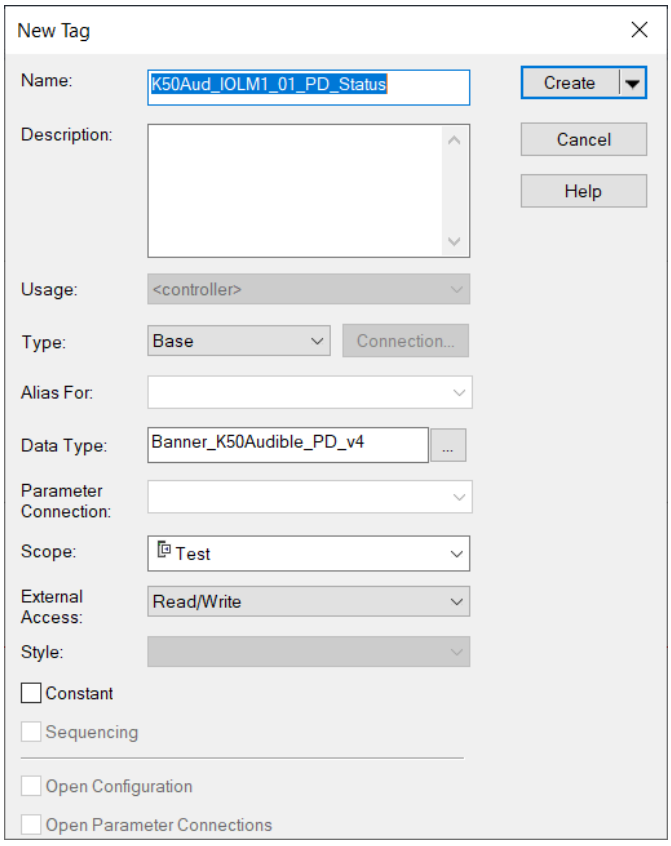
3. Configuring the AOI

1. Add the "Banner_K50Audible_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.



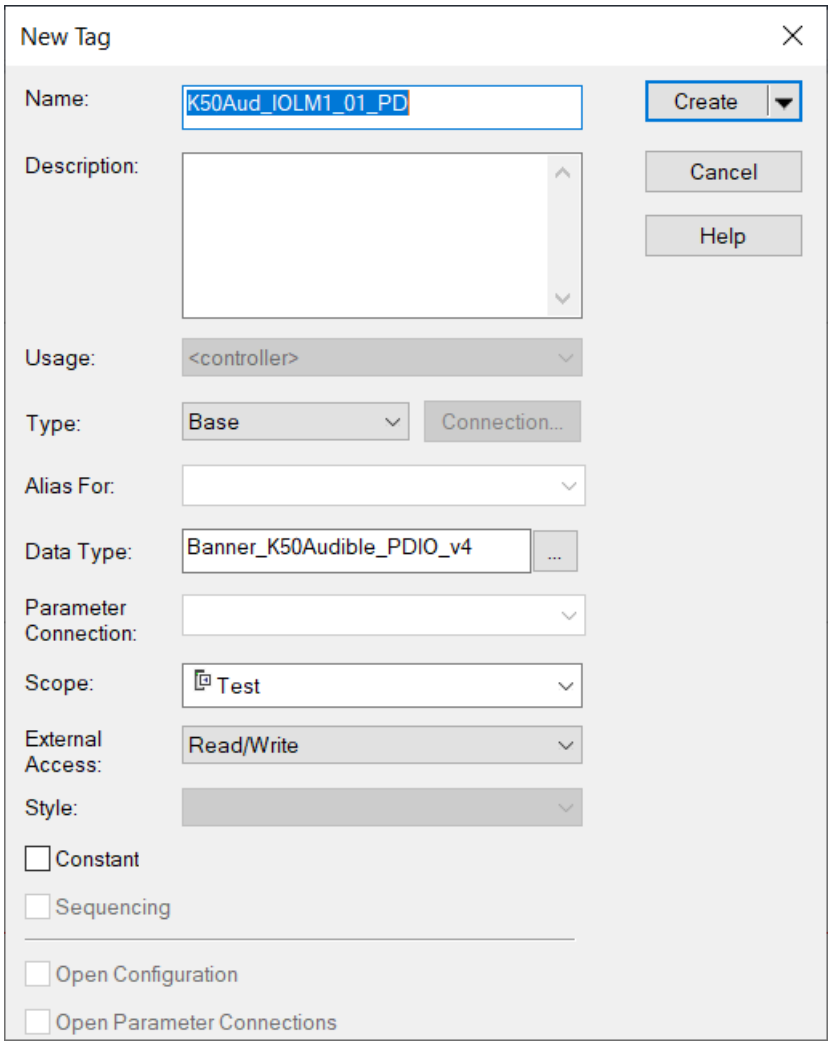
2. In the AOI, right-click on the question mark on the line labeled "Banner_K50ProAudible_PD_v4". Click New Tag. Name the new tag. This example uses the name "K50Aud_ IOLM1_01_PD_Status". The example naming convention accounts for this being an K50 Pro Audible device connected to IO-Link Master #1, port #0, 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_K50Audible_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.



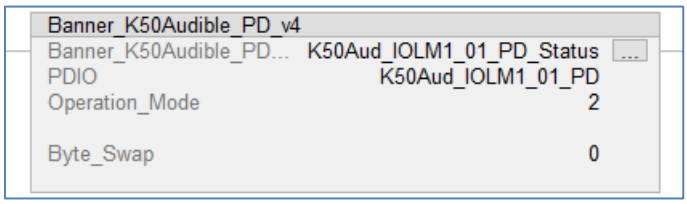
3. Now we will right-click on the question mark on the line labeled “Process_Data” in the AOI. Click on “New Tag”. Give the tag a name. This example uses the name “K50Aud_IOLM1_01_PD”. Notice that the Data Type is “Banner_K50Audible_PDIO_v4”. Click Create.

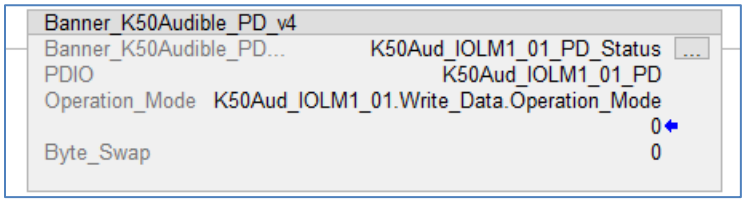
   This array will handle the displaying of the parsed Process Data In and Process Data Out for the K50 Pro Audible device.



4. The line labeled “Operation Mode” allows the AOI to know which of five possible Process Data Out definitions is currently in use. The choices for this setting are “0” (Multicolor mode), “1” (Four State Full Logic mode), “2” (Advanced mode), “3” (LED Control mode), and “4” (Demo mode). The default setting is “2”. This AOI needs to know which mode selection has been made in the device.

   There are two ways to achieve this goal. We can simply type in the correct number as a constant, or we can link this K50 Pro Audible Process Data AOI to the K50 Pro Audible Parameter Data AOI. See Appendix A for more information about K50 Pro Audible Process Data.



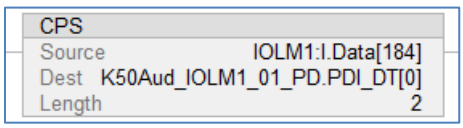


   NOTE: if you type in the incorrect number (i.e., it does not match the device’s current configuration) you will get incorrectly displayed Process Data Out information.

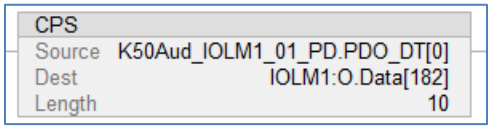
5. The last line in the AOI is a setting to account for byte swapping. In the case of the K50 Pro Audible, the Process Data Out is four bytes long. IO-Link Masters may read each pair of bytes in either order, so this AOI must be ready to perform a byte swap. Enter a “0” or a “1” to toggle this setting. See Appendix B for more information.

6. The final two steps required before we download and run the K50 Pro Audible 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.

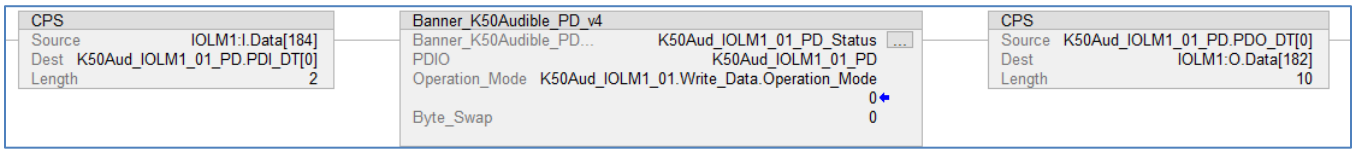
   Add a CPS instruction before the AOI on the ladder rung that looks like the one seen below. Refer to Appendix B for which byte to start with in the “Source” area. In this case, the IO-Link Master in question has the raw Process Data In values for a device connected to port 0 starting at byte 0. For the “Destination”, we will enter the “PDI_DT[0]” location, as seen below. Finally, the length will be 2 bytes, as that is the size of the K50 Pro Audible Process Data In.



Another CPS instruction is added to the AOI rung, this time after the AOI. This CPS instruction is used to copy Process Data Out from the AOI into the raw Process Data Out registers used by the IO-Link Master. See Appendix B for more information. In this example, we will connect the AOI's "PDO_DT[0]" to the starting byte location for port 0 in the Process Data Outside. In this example, that is byte 0. The size to be copied is 10 bytes.

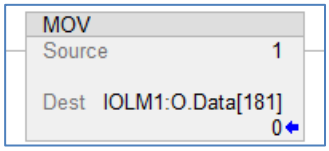


Here is what the entire rung looks like when completed.



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



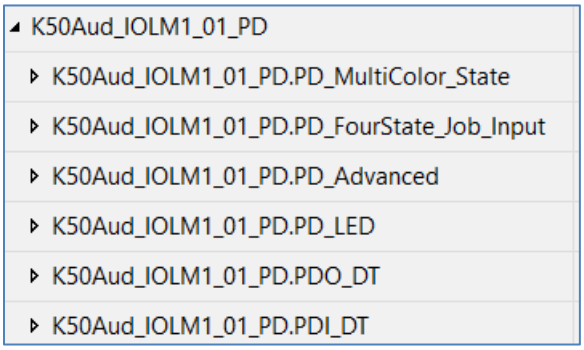
The "Banner_K50Audible_PD_v2" AOI is now ready for use.

4. Using the AOI

The “Banner_K50Audible_PD_v2” Add-On Instruction has created a group of tags representing the K50 Pro Audible Process Data, broken out into its component parts.

Look in the Controller Tags to find the name you used above. This example used the name “K50_IOLM1_0_PD”. The tag array, seen below, has individual pieces of information instead of unlabeled bits.

Each operating mode for the Process Data (except for Demo mode) has its own tag array. If the K50 Pro Audible device is in operating mode “0” (Multicolor mode), use the tags found under the “PD_MultiColor_State” array. If the operating mode is “2” (Advanced mode, as seen below), use the corresponding tags in the “PD_Advanced” array instead.



K50Aud_IOLM1_01_PD.PD_Advanced	{...}
K50Aud_IOLM1_01_PD.PD_Advanced.PDI_Output_State	0
K50Aud_IOLM1_01_PD.PD_Advanced.PDO_Animation	0
K50Aud_IOLM1_01_PD.PD_Advanced.PDO_Direction	0
K50Aud_IOLM1_01_PD.PD_Advanced.PDO_Pattern	0
K50Aud_IOLM1_01_PD.PD_Advanced.PDO_Speed	0
K50Aud_IOLM1_01_PD.PD_Advanced.PDO_Audio_Feedback	0
K50Aud_IOLM1_01_PD.PD_Advanced.PDO_Off_Delay_Type	0
K50Aud_IOLM1_01_PD.PD_Advanced.PDO_Off_Delay	0
K50Aud_IOLM1_01_PD.PD_Advanced.PDO_Static_Sequence	0
K50Aud_IOLM1_01_PD.PD_Advanced.PDO_Sequence_Start_Location	0
K50Aud_IOLM1_01_PD.PD_Advanced.PDO_Color_1	0
K50Aud_IOLM1_01_PD.PD_Advanced.PDO_Color_1_Intensity	0
K50Aud_IOLM1_01_PD.PD_Advanced.PDO_Color_2	0
K50Aud_IOLM1_01_PD.PD_Advanced.PDO_Color_2_Intensity	0
K50Aud_IOLM1_01_PD.PD_Advanced.PDO_Audio_Volume	0
K50Aud_IOLM1_01_PD.PD_Advanced.PDO_Audio_Type	0

Appendix A K50 Pro Audible Process Data

The K50 Pro Audible has 2 bytes of Process Data In and 9 bytes of Process Data Out. There are four modes for displaying this data, as shown below. This AOI intelligently parses this Process Data into its component pieces. The first is mode 0, “Multicolor”.

ProcessDataIn "Process Data In" id=V_Pd_InMulticolor

bit length: 16
data type: 16-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					Output State	Output State. Related parameters defined in output and touch settings parameter data.
2	8	2-bit UInteger	0 = State 1, 1 = State 2, 2 = State 3, 3 = State 4					State	Animation State. Related parameters defined in Four State Full Logic/Multicolor parameter data.

ProcessDataOut "Process Data Out" id=V_Pd_OutMulticolor

bit length: 80
data type: 80-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	2-bit UInteger	0 = State1, 1 = State2, 2 = State3, 3 = State4					State	Animation State. Related parameters defined in Four State Full Logic/Multicolor parameter data.

The next mode, “1”, is “Four State Full Logic”.

ProcessDataIn "Process Data In" id=V_Pd_InFourStateFullLogic

bit length: 16
data type: 16-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					Output State	Output State. Related parameters defined in output and touch settings parameter data.
2	8	2-bit UInteger	0 = State 1, 1 = State 2, 2 = State 3, 3 = State 4					State	Animation State. Related parameters defined in Four State Full Logic/Multicolor parameter data.

ProcessDataOut "Process Data Out" id=V_Pd_OutFourStateFullLogic

bit length: 80
data type: 80-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					Job Input	Job Input for Four State Full Logic mode.

Mode 2 is “Advanced”.

ProcessDataIn "Process Data In" id=V_Pd_InAdvanced

bit length: 16
data type: 16-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					Output State	Output State. Related parameters defined in output and touch settings parameter data.

ProcessDataOut "Process Data Out" id=V_Pd_OutAdvanced

bit length: 80
data type: 80-bit Record

subindex	bit offset	data type	allowed values	default value	acc. restr.	mod. other var.	excl. from DS	name	description
1	0	4-bit UInteger	0 = Off, 1 = Steady, 2 = Flash, 3 = Two Color Flash, 4 = 50/50, 5 = 50/50 Rotate, 6 = Chase, 7 = Intensity Sweep, 8 = Color Sweep, 9 = Sequence, 10 = Wave, 11 = Double Wave					Animation Type	The Animation type
2	4	Boolean	false = CCW, true = CW					Animation Direction	The Direction of Animation rotation
3	5	3-bit UInteger	0 = Flash, 1 = Strobe, 2 = Three Pulse, 3 = SOS, 4 = Random					Animation Pattern	The pattern of Animation/Audio Feedback
4	8	2-bit UInteger	0 = Slow, 1 = Medium, 2 = Fast, 3 = Custom					Animation Speed	The speed of the Animation/Audio Feedback
5	10	2-bit UInteger	0 = Off, 1 = On, 2 = Animation Pattern, 3 = Advanced Audible					Audio Feedback	Type of Audio Feedback
6	12	Boolean	false = Leading Edge, true = Trailing Edge					Off Delay Type	A leading edge delay is triggered on the rising edge of a touch input. A trailing edge delay is triggered on a the falling edge of a touch input.
7	16	16-bit UInteger	0..65535					Off Delay (ms)	Length of time before the device returns to 'touch inactive' state after button is released.
8	32	8-bit UInteger	0..255					Static Sequence Value (0-255)	Value describing the LED position of the device. LED state defined in parameter data.
9	40	3-bit UInteger	0 = LED1, 1 = LED2, 2 = LED3, 3 = LED4, 4 = LED5, 5 = LED6, 6 = LED7, 7 = LED8					Sequence Start Location	Defines the LED location that the sequence animation is initiated at.
10	48	5-bit UInteger	0 = Green, 1 = Red, 2 = Orange, 3 = Amber, 4 = Yellow, 5 = Lime Green, 6 = Spring Green, 7 = Cyan, 8 = Sky Blue, 9 = Blue, 10 = Violet, 11 = Magenta, 12 = Rose, 13 = White, 14 = Custom1, 15 = Custom2					Color 1	The main color of the Animation, Custom Colors are defined in Parameter data
11	53	3-bit UInteger	0 = High, 1 = Medium, 2 = Low, 3 = Off, 4 = Custom					Color 1 Intensity	The Intensity of Color 1, Custom Intensity defined in Parameter Data
12	56	5-bit UInteger	0 = Green, 1 = Red, 2 = Orange, 3 = Amber, 4 = Yellow, 5 = Lime Green, 6 = Spring Green, 7 = Cyan, 8 = Sky Blue, 9 = Blue, 10 = Violet, 11 = Magenta, 12 = Rose, 13 = White, 14 = Custom1, 15 = Custom2					Color 2	The secondary color of the Animation, Custom Colors are defined in Parameter data
13	61	3-bit UInteger	0 = High, 1 = Medium, 2 = Low, 3 = Off, 4 = Custom					Color 2 Intensity	The Intensity of Color 2, Custom Intensity defined in Parameter Data
14	64	2-bit UInteger	1 = Low, 3 = High					Audio Volume	The volume of the piezzo buzzer
15	66	6-bit UInteger	0 = Pulse, 1 = Wobble, 2 = Strobe, 3 = Whoop, 4 = Stacatto, 5 = Siren, 6 = Continuous 1, 7 = Continuous 2, 9 = Jingle, 10 = Melody 1, 11 = Melody 2, 12 = Melody 3, 13 = Custom					Audio Type	The type of audio sound being played

Mode 3 is “LED Control”.

ProcessDataIn "Process Data In" id=V_Pd_InLedControl

bit length: 16
data type: 16-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					Output State	Output State. Related parameters defined in output and touch settings parameter data.

ProcessDataOut "Process Data Out" id=V_Pd_OutLedControl

bit length: 80
data type: 80-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	4-bit UInteger	0 = Green, 1 = Red, 2 = Orange, 3 = Amber, 4 = Yellow, 5 = Lime Green, 6 = Spring Green, 7 = Cyan, 8 = Sky Blue, 9 = Blue, 10 = Violet, 11 = Magenta, 12 = Rose, 13 = White, 14 = Custom1, 15 = Custom2					LED 1 Color	Defines the color of the designated LED. LED 1 is oriented at the 12 O'clock position
2	4	4-bit UInteger	0..10					LED 1 Intensity (0-10)	Defines the intensity of the designated LED
3	8	4-bit UInteger	0 = Green, 1 = Red, 2 = Orange, 3 = Amber, 4 = Yellow, 5 = Lime Green, 6 = Spring Green, 7 = Cyan, 8 = Sky Blue, 9 = Blue, 10 = Violet, 11 = Magenta, 12 = Rose, 13 = White, 14 = Custom1, 15 = Custom2					LED 2 Color	Defines the color of the designated LED
4	12	4-bit UInteger	0..10					LED 2 Intensity (0-10)	Defines the intensity of the designated LED
5	16	4-bit UInteger	0 = Green, 1 = Red, 2 = Orange, 3 = Amber, 4 = Yellow, 5 = Lime Green, 6 = Spring Green, 7 = Cyan, 8 = Sky Blue, 9 = Blue, 10 = Violet, 11 = Magenta, 12 = Rose, 13 = White, 14 = Custom1, 15 = Custom2					LED 3 Color	Defines the color of the designated LED
6	20	4-bit UInteger	0..10					LED 3 Intensity (0-10)	Defines the intensity of the designated LED
7	24	4-bit UInteger	0 = Green, 1 = Red, 2 = Orange, 3 = Amber, 4 = Yellow, 5 = Lime Green, 6 = Spring Green, 7 = Cyan, 8 = Sky Blue, 9 = Blue, 10 = Violet, 11 = Magenta, 12 = Rose, 13 = White, 14 = Custom1, 15 = Custom2					LED 4 Color	Defines the color of the designated LED
8	28	4-bit UInteger	0..10					LED 4 Intensity (0-10)	Defines the intensity of the designated LED
9	32	4-bit UInteger	0 = Green, 1 = Red, 2 = Orange, 3 = Amber, 4 = Yellow, 5 = Lime Green, 6 = Spring Green, 7 = Cyan, 8 = Sky Blue, 9 = Blue, 10 = Violet, 11 = Magenta, 12 = Rose, 13 = White, 14 = Custom1, 15 = Custom2					LED 5 Color	Defines the color of the designated LED
10	36	4-bit UInteger	0..10					LED 5 Intensity (0-10)	Defines the intensity of the designated LED
11	40	4-bit UInteger	0 = Green, 1 = Red, 2 = Orange, 3 = Amber, 4 = Yellow, 5 = Lime Green, 6 = Spring Green, 7 = Cyan, 8 = Sky Blue, 9 = Blue, 10 = Violet, 11 = Magenta, 12 = Rose, 13 = White, 14 = Custom1, 15 = Custom2					LED 6 Color	Defines the color of the designated LED
12	44	4-bit UInteger	0..10					LED 6 Intensity (0-10)	Defines the intensity of the designated LED
13	48	4-bit UInteger	0 = Green, 1 = Red, 2 = Orange, 3 = Amber, 4 = Yellow, 5 = Lime Green, 6 = Spring Green, 7 = Cyan, 8 = Sky Blue, 9 = Blue, 10 = Violet, 11 = Magenta, 12 = Rose, 13 = White, 14 = Custom1, 15 = Custom2					LED 8 Color	Defines the color of the designated LED
14	52	4-bit UInteger	0..10					LED 7 Intensity (0-10)	Defines the intensity of the designated LED
15	56	4-bit UInteger	0 = Green, 1 = Red, 2 = Orange, 3 = Amber, 4 = Yellow, 5 = Lime Green, 6 = Spring Green, 7 = Cyan, 8 = Sky Blue, 9 = Blue, 10 = Violet, 11 = Magenta, 12 = Rose, 13 = White, 14 = Custom1, 15 = Custom2					LED 8 Color	Defines the color of the designated LED
16	60	4-bit UInteger	0..10					LED 8 Intensity (0-10)	Defines the intensity of the designated LED
17	64	2-bit UInteger	0 = Off, 1 = On, 2 = Animation Pattern, 3 = Advanced Audible					Audio Feedback	Type of Audio Feedback
18	66	2-bit UInteger	1 = Low, 3 = High					Audio Volume	The volume of the piezzo buzzer
19	72	6-bit UInteger	0 = Pulse, 1 = Wobble, 2 = Strobe, 3 = Whoop, 4 = Stacatto, 5 = Siren, 6 = Continuous 1, 7 = Continuous 2, 9 = Jingle, 10 = Melody 1, 11 = Melody 2, 12 = Melody 3, 13 = Custom					Audio Type	The type of audio sound being played

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