



QCM50-K3 QCM50-K5 Process Data AOI Guide, v4

October 31st, 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 QCM50-K3 or QCM50-K5 sensor via an IO-Link Master to an Allen-Bradley PLC. The AOI covers parsing and display of the QCM50-K3/K5 sensor Process Data In. The AOI has one User Defined Tag data type.

Components

Banner_QCM50_K3_K5_PD_v4_AOI.L5X

UDT Packaged with the AOI

Banner_QCM50_K3_K5_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.

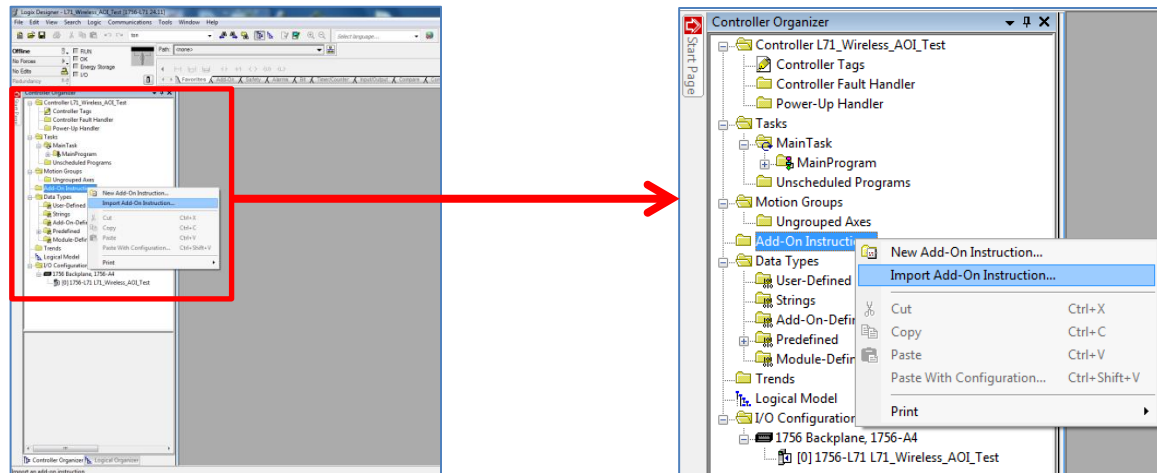
Contents

- 1. Installation Process 1
- 2. Configuring the IO-Link Master 3
- 3. Configuring the AOI..... 4
- 4. Using the AOI..... 8
- Appendix A QCM50-K3/K5 Process Data..... 9
- Appendix B IO-Link Master Cheat Sheet 11

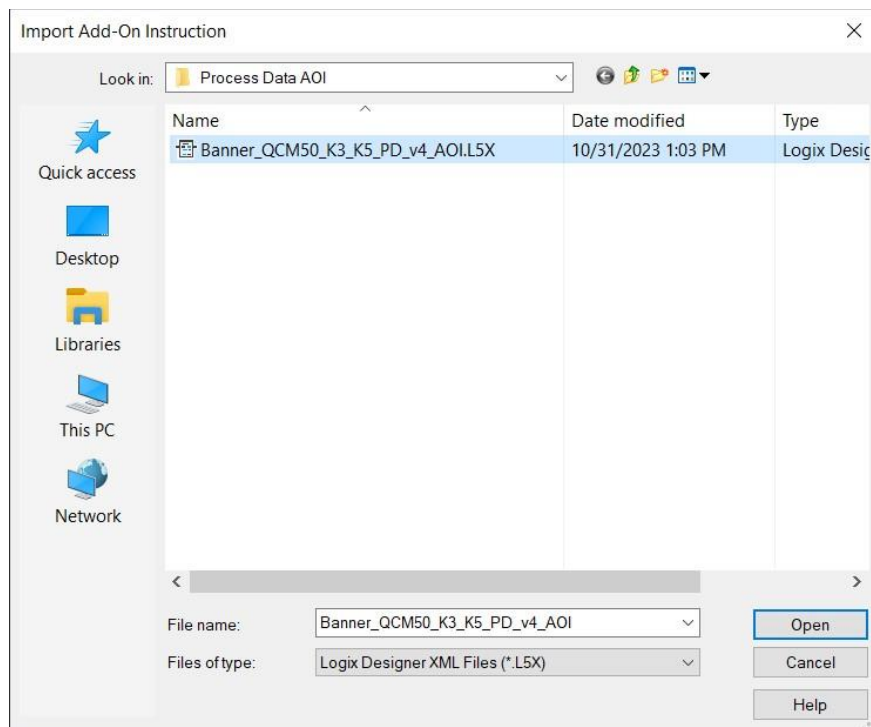
1. Installation Process

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

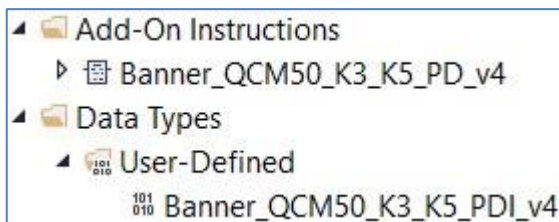
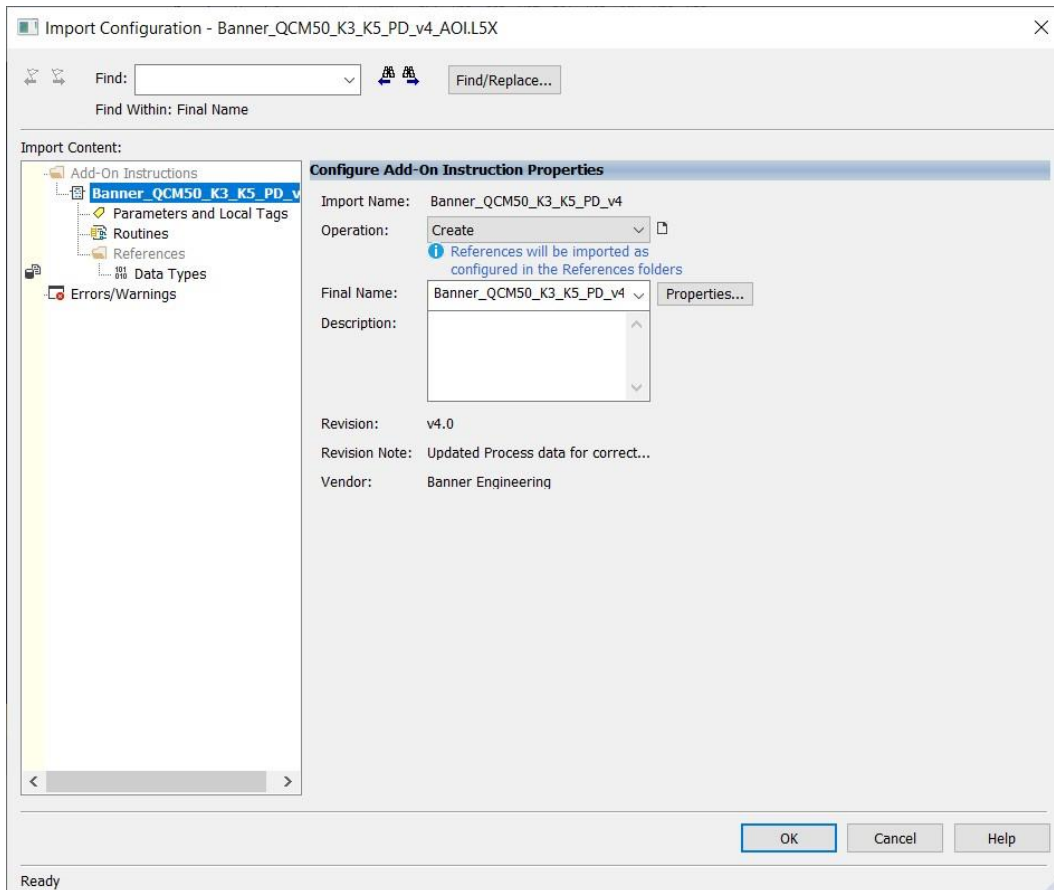
1. Open a project.
2. In the Controller Organizer window, right-click on the Add-On Instruction folder. Select the Import Add-On Instruction option.



3. Navigate to the correct file location and select the AOI to be installed. In this example the "Banner_QCM50_K3_K5_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.

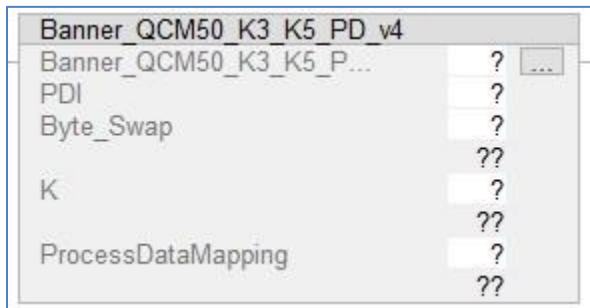
2. Configuring the IO-Link Master

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.

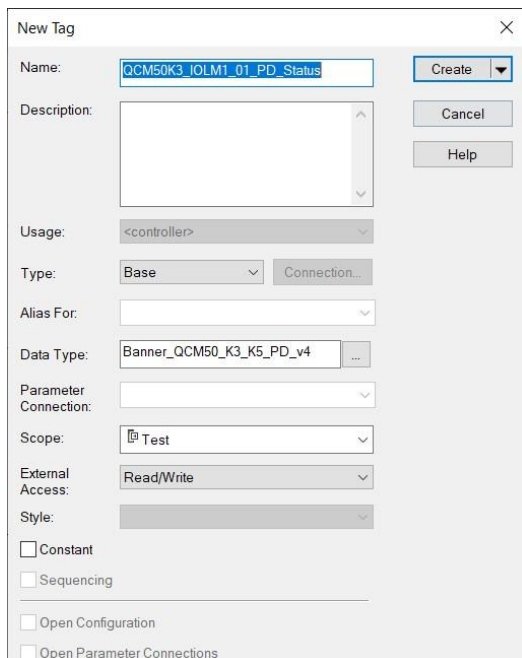
3. Configuring the AOI

1. Add the “Banner_QCM50_K3_K5_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_QCM50_K3_K5_PD_v4”. Click New Tag. Name the new tag. This example uses the name “QCM50K3_IOLM1_01_PD_Status”. The example naming convention accounts for this being a QCM50 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_QCM50_K3_K5_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.



- Now we will right-click on the question mark on the line labeled “PDI” in the AOI. Click on “New Tag”. Give the tag a name. This example uses the name “QCM50K3_IOLM1_01_PD”. Notice that the Data Type is “Banner_QCM50_K3_K5_PDI_v4”. Click Create.

New Tag

Name: QCM50K3_IOLM1_01_PD Create

Description:

Usage: <controller>

Type: Base Connection...

Alias For:

Data Type: Banner_QCM50_K3_K5_PDI_v4 ...

Parameter Connection:

Scope: Test

External Access: Read/Write

Style:

☐ Constant

☐ Sequencing

☐ Open Configuration

☐ Open Parameter Connections

Cancel Help

- The “Byte_Swap” line in the AOI is a setting to account for byte swapping. In the case of the QCM50-K3/K5, the Process Data is 6 bytes long. IO-Link Masters may read each pair of those 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.
- For the line labeled “K”, enter either 3 or 5, depending on the specific sensor model used.

6. The line labeled “ProcessDataMapping” allows the AOI to know which of two possible Process Data In definitions is currently in use. The choices for this setting are “0” (Switching Channel) and “1” (Color Values). 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 QCM50 Process Data AOI to the QCM50 Parameter Data AOI. See Appendix A for more information about QCM50 Process Data.

Banner_QCM50_K3_K5_PD_v4	
Banner_QCM50_K3_K5_P...	QCM50K3_IOLM1_01_PD_Status ...
PDI	QCM50K3_IOLM1_01_PD
Byte_Swap	0
K	3
ProcessDataMapping	0

Banner_QCM50_K3_K5_PD_v4	
Banner_QCM50_K3_K5_P...	QCM50K3_IOLM1_01_PD_Status ...
PDI	QCM50K3_IOLM1_01_PD
Byte_Swap	0
K	3
ProcessDataMapping	QCM50K3_IOLM1_01.Write_Data.Process_Data_Mapping 0

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 In information.

- 7. The final step required before we download and run the QCM50 Process Data AOI involves a File Synchronous Copy (CPS) instruction. A CPS instruction is added to the AOI rung, before the AOI. This CPS instruction is used to copy Process Data In into the AOI from the raw Process Data registers used by the IO-Link Master. See Appendix B for more information. In this example, we will connect the starting byte location for port 1 in the Process Data In to the AOI’s “PDI_DT[0]” array. Specifically, we are copying from the IO-Link Master Input Assembly Instance, starting at byte 184. The size to be copied is 6 bytes.

CPS	
Source	IOLM1:I.Data[184]
Dest	QCM50K3_IOLM1_01_PD.PDI_DT[0]
Length	6

Here is what the entire rung looks like when completed.

CPS	Banner_QCM50_K3_K5_PD_v4
Source	Banner_QCM50_K3_K5_P... QCM50K3_IOLM1_01_PD_Status
Dest	PDI QCM50K3_IOLM1_01_PD
Length	Byte_Swap 0
	K 3
	ProcessDataMapping QCM50K3_IOLM1_01.Write_Data.Process_Data_Mapping 0

The “Banner_QCM50_K3_K5_PD_v4” AOI is now ready for use.

4. Using the AOI

The “Banner_QCM50_K3_K5_PD_v4” Add-On Instruction has created a group of tags representing the QCM50 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 “QCM50K3_IOLM1_01_PD”. The tag array, seen below, has individual pieces of information instead of 48 unlabeled bits.

▲ QCM50K3_IOLM1_01_PD	{...}
▶ QCM50K3_IOLM1_01_PD.Signal_Quality	0
▶ QCM50K3_IOLM1_01_PD.Switching_Quality	0
▶ QCM50K3_IOLM1_01_PD.Q1	0
▶ QCM50K3_IOLM1_01_PD.Q2	0
▶ QCM50K3_IOLM1_01_PD.Q3	0
▶ QCM50K3_IOLM1_01_PD.Q4	0
▶ QCM50K3_IOLM1_01_PD.Q5	0
▶ QCM50K3_IOLM1_01_PD.Q6	0
▶ QCM50K3_IOLM1_01_PD.Q7	0
▶ QCM50K3_IOLM1_01_PD.Q8	0
▶ QCM50K3_IOLM1_01_PD.Q9	0
▶ QCM50K3_IOLM1_01_PD.Q10	0
▶ QCM50K3_IOLM1_01_PD.Q11	0
▶ QCM50K3_IOLM1_01_PD.Q12	0
▶ QCM50K3_IOLM1_01_PD.PDI_DT	{...}
▶ QCM50K3_IOLM1_01_PD.Ratio_Red	1155
▶ QCM50K3_IOLM1_01_PD.Ratio_Green	1348
▶ QCM50K3_IOLM1_01_PD.Ratio_Blue	1590
▶ QCM50K3_IOLM1_01_PD.Energy	313

Appendix A QCM50-K3/K5 Process Data

The QCM50-K3/K5 has 6 bytes of Process Data In, as shown below. The specific information included in the Process Data In varies by mode. These devices do not have Process Data Out.

First is Mode = 0, also called Switching Channel. This mode varies slightly between the K3 and K5 models, as shown below.

ProcessDataIn "Switching channel" id=PDIN_SwitchingOutput									
bit length: 48 data type: 48-bit Record									
subindex	bit offset	data type	allowed values	default value	acc. restr.	mod. other var.	excl. from DS	name	description
1	24	8-bit UInteger	0 = no signal, 1 = overflow, 2..100		ro			Signal quality	
2	16	Boolean			ro			Switching quality	
3	6	Boolean			ro			Q7	
4	5	Boolean			ro			Q6	
5	4	Boolean			ro			Q5	
6	3	Boolean			ro			Q4	
7	2	Boolean			ro			Q3	
8	1	Boolean			ro			Q2	
9	0	Boolean			ro			Q1	

Figure 1: Mode 0 Process Data In definition for the K3 models

ProcessDataIn "Switching channel" id=PDIN_SwitchingOutput									
bit length: 48 data type: 48-bit Record									
subindex	bit offset	data type	allowed values	default value	acc. restr.	mod. other var.	excl. from DS	name	description
1	24	8-bit UInteger	0 = no signal, 1 = overflow, 2..100		ro			Signal quality	
2	16	Boolean			ro			Switching quality	
3	11	Boolean			ro			Q12	
4	10	Boolean			ro			Q11	
5	9	Boolean			ro			Q10	
6	8	Boolean			ro			Q9	
7	7	Boolean			ro			Q8	
8	6	Boolean			ro			Q7	
9	5	Boolean			ro			Q6	
10	4	Boolean			ro			Q5	
11	3	Boolean			ro			Q4	
12	2	Boolean			ro			Q3	
13	1	Boolean			ro			Q2	
14	0	Boolean			ro			Q1	

Figure 2: Mode 0 Process Data In definition for the K5 models

Mode = 1 is called Color Values.

ProcessDataIn "Color values" id=PDIN_Color									
bit length: 48 data type: 48-bit Record									
subindex	bit offset	data type	allowed values	default value	acc. restr.	mod. other var.	excl. from DS	name	description
1	0	12-bit UInteger	0 = no signal, 1 = overflow, 10..4095		ro			Ratio red	
2	12	12-bit UInteger	0 = no signal, 1 = overflow, 10..4095		ro			Ratio green	
3	24	12-bit UInteger	0 = no signal, 1 = overflow, 10..4095		ro			Ratio blue	
4	36	12-bit UInteger	0 = no signal, 1 = overflow, 10..4095		ro			Energy	

Figure 3: Mode 1 Process Data In definition for the K3 and K5 models

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

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