QS18E Process Data Function

11/15/2022

This document covers the installation and use of a function for Siemen's TIA Portal software package. This function handles cyclic IO-Link Process Data In from a Banner QS18E sensor via an IO-Link Master to a Siemens PLC. The function covers parsing and display of the QS18E sensor Process Data In.

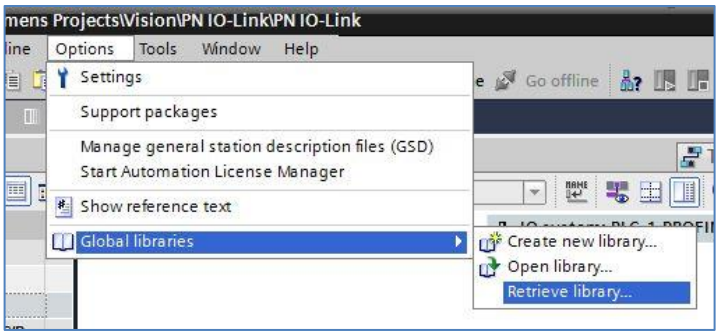
Components

Banner QS18 Library.zal14

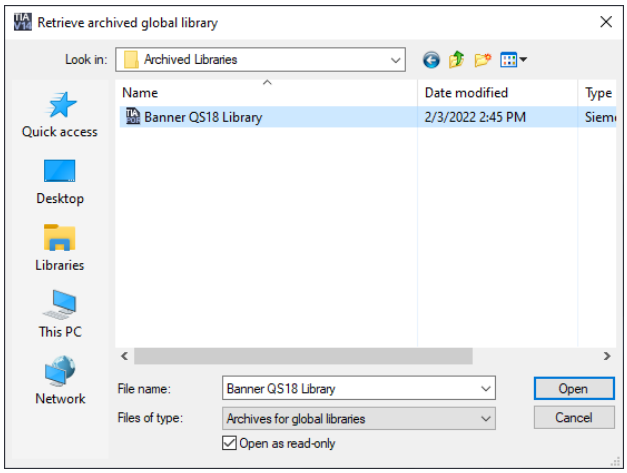
There are two methods for the process data. The first is used when creating a connection to Banner's IO-Link masters. The second set of instructions are for systems using other manufacturer's IO-Link masters.

Installation Instructions

1. Open a project.
2. Go to Options > Global Libraries > Retrieve Library.



3. Select the Banner QS18 Library. Click Open.



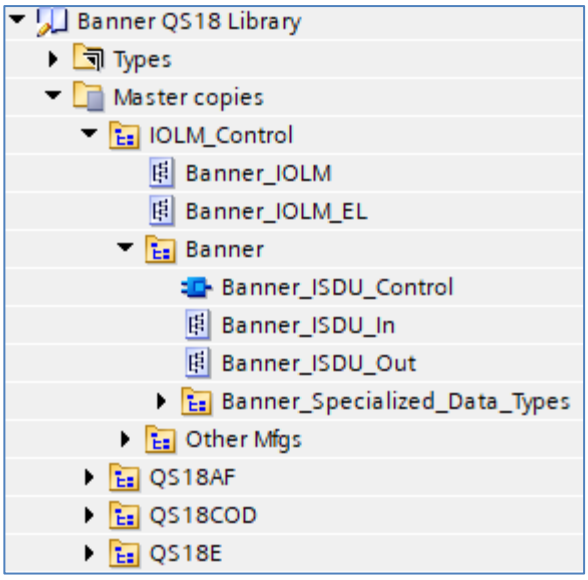
4. The library is now accessible in the Libraries tab.
5. Go to page 3 for Banner IO-Link Masters and to page 7 for all other IO-Link Masters.

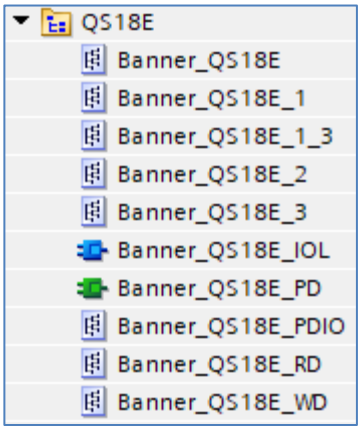
Setup of QS18E with a Banner DXMR90-4K

1. Go to Device and Networks to configure the DXMR90-4K. Add the DXMR90-4K if it has yet to be added to the system.
2. Add Banner IO-Link Master Info to Slot 1. This sets the DXMR90-4K for IO-Link mode.
3. Open the IO-Link Generic Devices and select the proper module. The 4/4 byte option has been selected for port 1. Make note of the I address for the Slot 2 which represents Port 1. Slot 2 starts are 10. The other number needed is I14. The data for the port start at that point (I14). The previous four bytes represents Port Status, Process Data In Size, and Process Data Out Size.

Module	Rack	Slot	I address	Q address	Type
dxm	0	0			1-port Device
Interface	0	0 X1			dxm
Banner IO-Link Master Info_1	0	1	1...9		Banner IO-Link Master Info
IO-Link In/Out 4/ 4 Byte + Status_1	0	2	10...17	1...18	IO-Link In/Out 4/ 4 Byte + Status

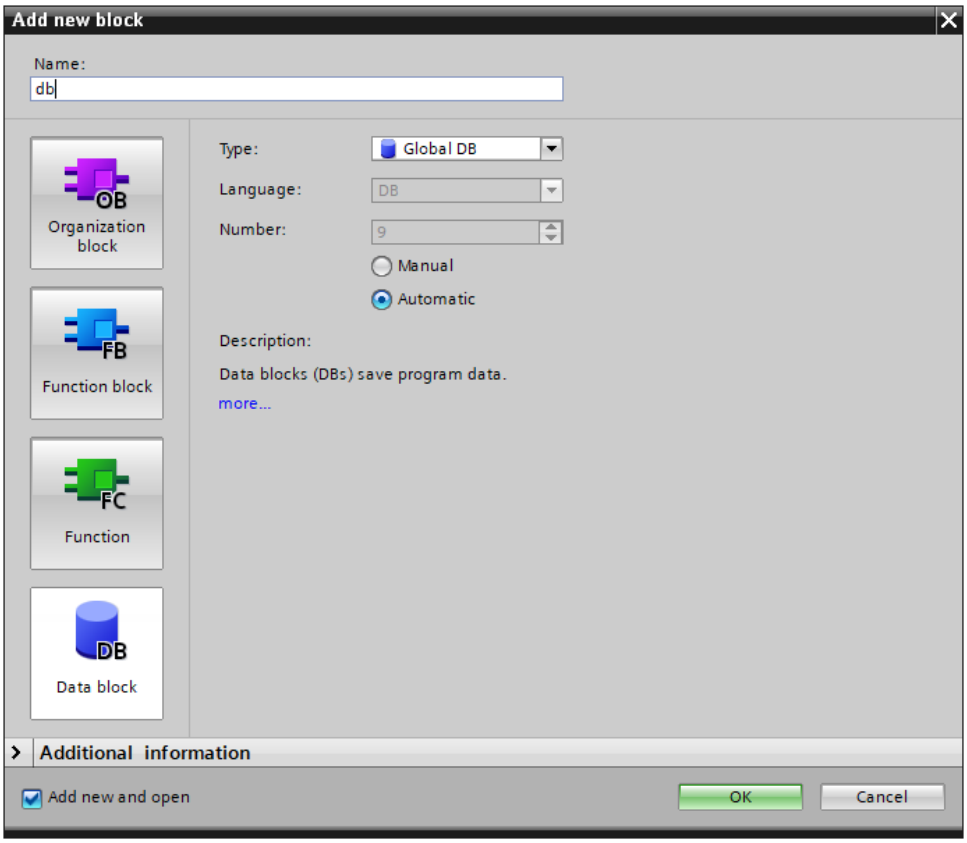
4. Drag the Banner_QS18E_PDIO to the PLC Data Types area under your PLC. Banner_ QS18E _PDI is found in the LM folder in the library. Drag the Banner_ QS18E _PD to the Program Blocks area.
5. Drag the necessary tags from IOLM_Control > Banner > Banner_Specialized_Data_Types. The tags used in this example is “Banner_4in” and “Banner_4out”. This tag represents the full raw process data along with port status information.
6. Go to PLC Tags. Create four tags. Two of the tags are for the full data structure while the second set represents the raw Process Data from the IO-Link Master. In this example, Tag table_1 was created, the tags “QS18E IOLM1 01 PDI” and “QS18E IOLM1 01 PDO” was created using a Data Type of “Banner_4In” and “Banner_4Out”. This naming convention calls out the type of sensor in question as well as the specific IO-Link Master and port number where the sensor is connected. A different IO-Link Master might be named IOLM2 or IOLM3, for instance, and other specific sensors may be connected to different port numbers. The “I” address found in step 2 is tied to this new tag. The second set of tags use “QS18E IOLM1 01 inRaw” and “QS18E IOLM1 01 outRaw”. These are the tags that will be used in the Function block.





Name	Data type	Address
QS18E IOLM1 01 PDI	"Banner_4In"	%I10.0
QS18E IOLM1 01 inRaw	UDInt	%ID14
QS18E IOLM1 01 PDO	"Banner_4Out"	%Q1.0
QS18E IOLM1 01 outRaw	USInt	%QB3

7. Go to Program blocks. Add a new Data block if necessary. In this example the new data block is named “db”.



8. In the new data block, create a new tag to represent the parsed Process Data In and Out for our LM. The tag name again calls out the type of sensor, the IO-Link Master, and the port number. Use the data type “Banner_QS18E_PDIO” for the new tag.

Name	Data type
Static	
QS18E IOLM1 01 PD	"Banner_QS18E_PDIO"
Output State	Bool
Health State	Bool
Marginal Light State	Bool
Marginal Dark State	Bool
Normalized Signal Strength	UInt
Signal	UInt
Count	UInt
Duration	UInt
Events per Minute	UInt
EmitterLED	Bool

9. Add the "Banner_QS18E_PD" function to an OB ladder. Link the "Process Data In" and the "Process Data Out" to the raw process data variable from step 5. The tag name again calls out the type of device, IO-Link Master, and the port number. The "QS18E Process Data" needs to be linked to the variable created in step 7. It was called "db"."QS18E IOLM1 01 PD" for this example.

   The last variable, "PDI Config", allow the function to correctly interpret the Process Data. In the case of the QS18E. This function needs to know what choice has been made in the QS18E for this Operational Mode variable.

   There are two ways to achieve this goal. We can simply type in the correct number for entries (see Fig. 1), or we can link this QS18E Function to the QS18E Data Function Block (see Fig. 2). See Appendix A for more information about QS18E Process Data.

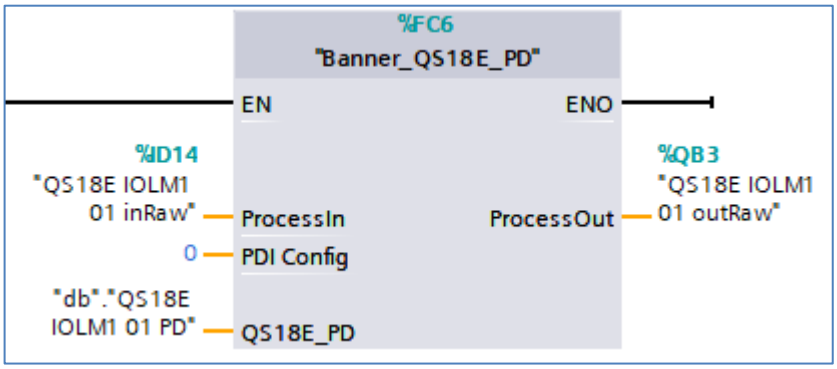


Figure 1: Hand typed correct numbers for PDI Config

NOTE: if you type in the incorrect number, you will get incorrectly displayed Process Data information.

PDI Config: the options here are "0" (Standard Five and Signal), "1" (Standard Five and Count), "2" (Standard Five and Duration), and "3" (Standard Five and Events Per Minute). The default is "0".

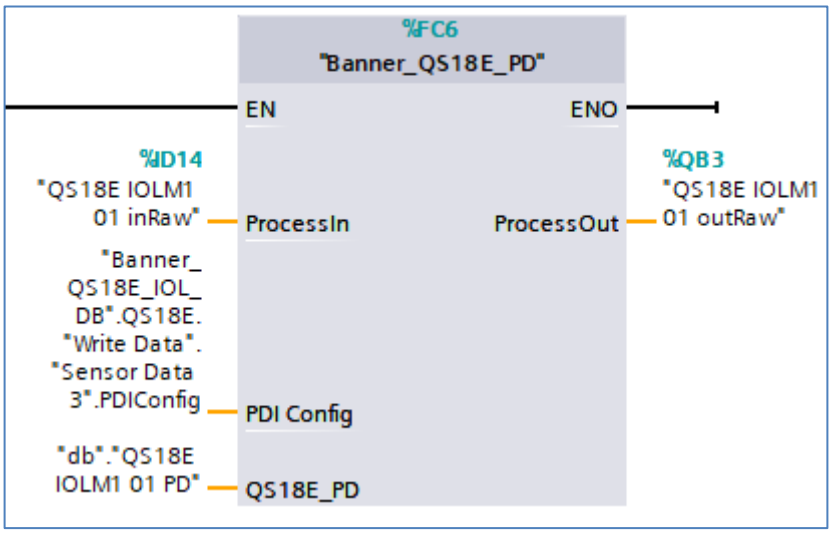
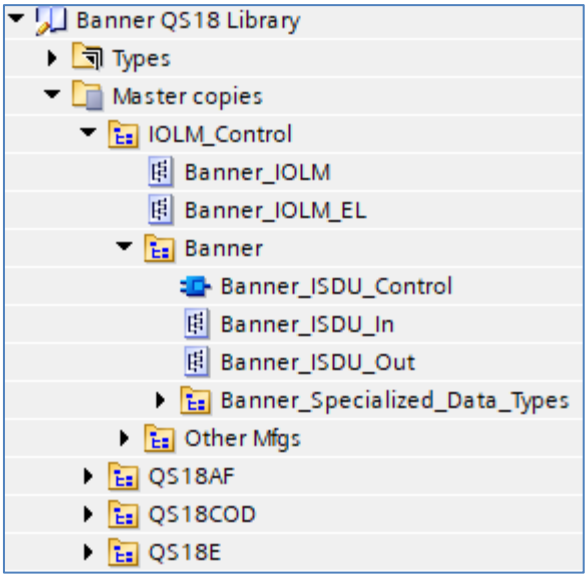


Figure 2: PDI Config variable to QS18E Parameter Data Function Block

10. Process Data setup is complete.
11. Compile and download the configuration to the PLC, then go online. Open the "db" data block and click Monitor all. You should see parsed QS18E Process Data In, like that shown below.

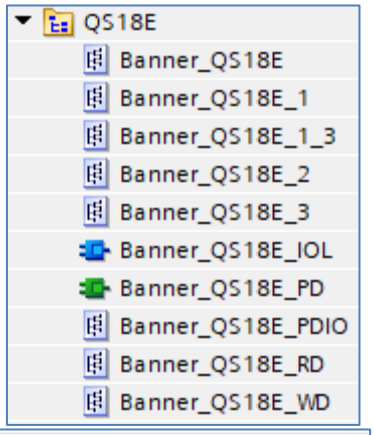
Setup of QS18E with other IO-Link Masters



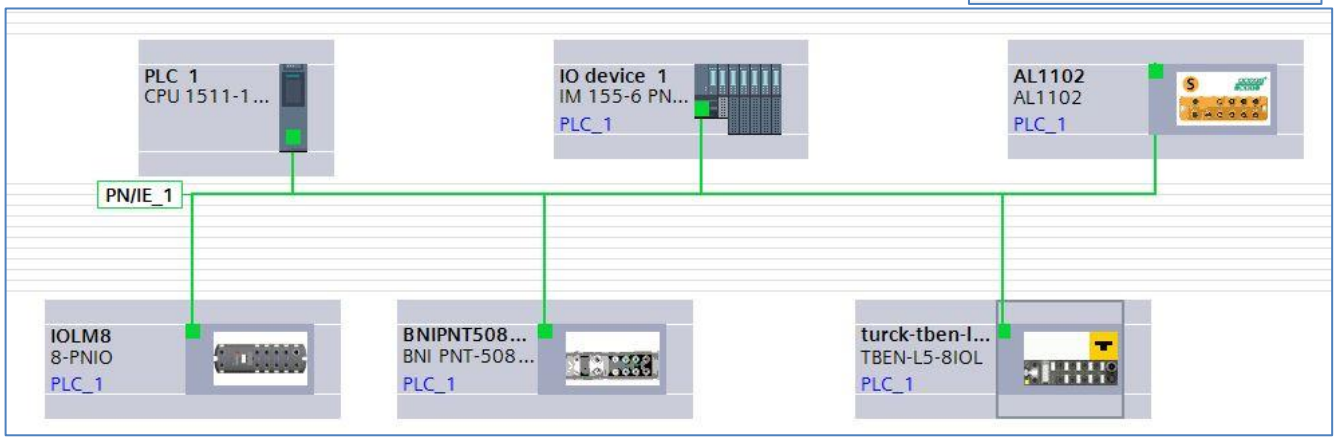
1. The Banner QS18 Library will now be in the Global Library List. Expand the Master copies section. The QS18E folder contains elements for both Process Data and Parameter Data connections to a QS18E sensor. As Process Data is the focus of this paper, we will concern ourselves with these two items: Banner_QS18E_PD and Banner_QS18E_PDIO.

2. Drag Banner_QS18E_PD to the Program Blocks area under your PLC.

3. Drag the Banner_QS18E_PDIO to the PLC Data Types area under your PLC.



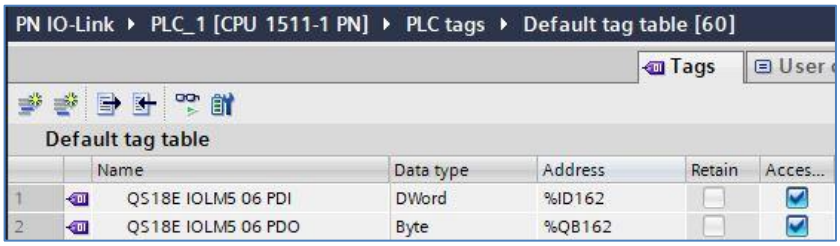
4. Go to Devices and networks to configure the system as necessary. Below is an example of what a configuration might look like. This example shows 5 different IO-Link Masters connected to the same PLC.



5. Click on the relevant device and configure the IO-Link Master as necessary. Refer to the documentation for the IO-Link Master. Recall that a QS18E requires 4 bytes of space for the

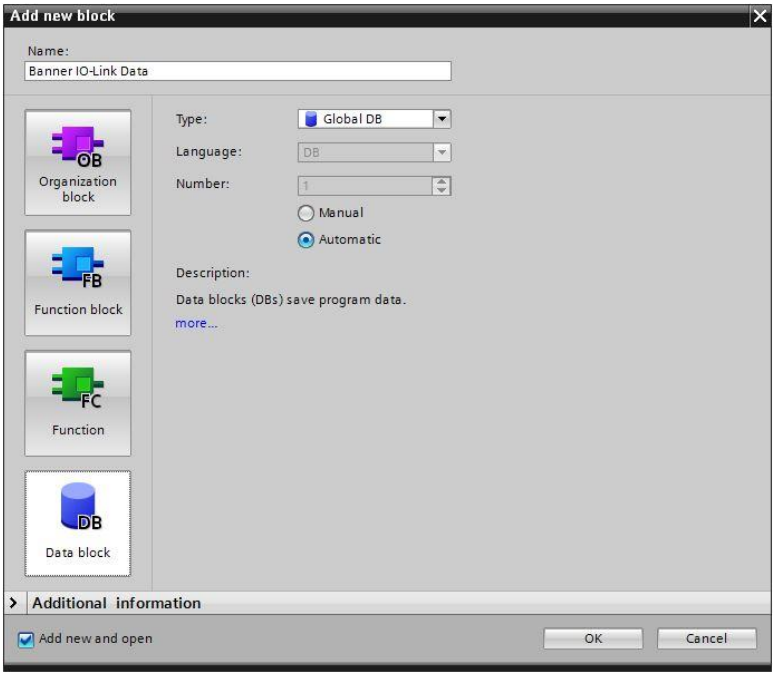
Process Data In and 1 byte of space for the Process Data Out.

6. Record the “I” and “Q” addresses where this QS18E Process Data In and Out are to be stored, as these addresses will be required in the next step. In this example, 4 bytes of Process Data In for port 6 on the IO-Link Master will be stored starting in I162. The 1 byte of Process Data Out will be stored at “Q162”. In the case of the opposed mode QS18E, the PDI is linked to the receiver while the PDO is linked to the emitter.
7. Go to PLC Tags. If desired, add a new tag table, then create a new tag to represent the raw Process Data from the IO-Link Master. The QS18E has both Process Data In and Process Data Out. In this example, the tag “QS18E IOLM5 06 PDI” was created using a Data Type of “DWord”. This naming convention calls out the type of sensor in question as well as the specific IO-Link Master and port number where the sensor is connected. A different IO-Link Master might be named IOLM1 or IOLM2, for instance, and other specific sensors may be connected to different port numbers. The “I” address found in step 9 is tied to this new tag. Similarly, a new tag is created for the raw Process Data Out. This one is just a single byte, and we used the name “QS18E IOLM5 01 PDO”. The “Q” address is from step 9.



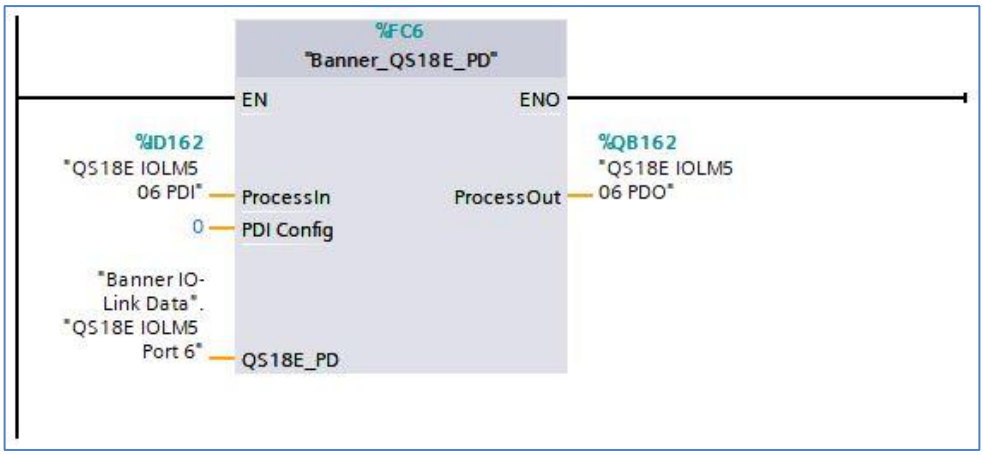
For the QS18E opposed mode setup, the PDI is linked to the receiver sensor and the PDO is linked to the emitter.

8. Go to Program blocks. Add a new Data block if necessary. In this example the new data block is named “Banner IO-Link Data”.

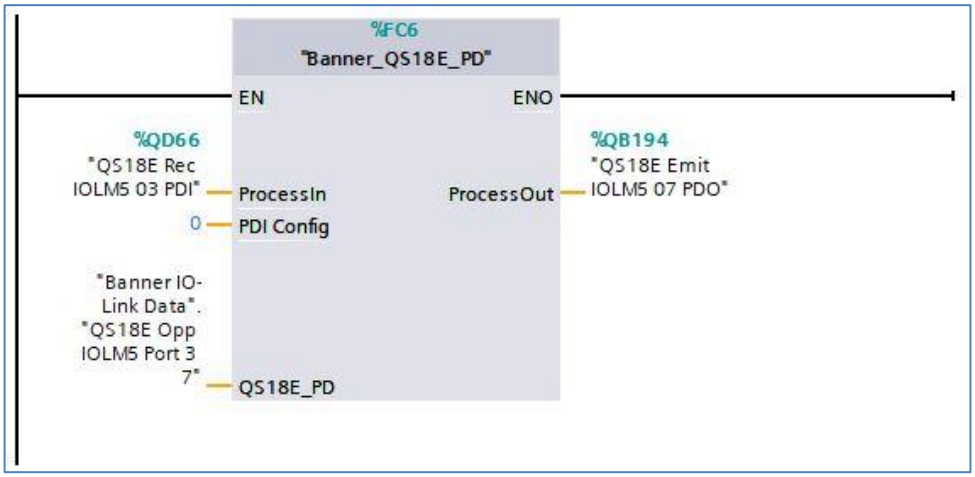


9. In the new data block, create a new tag to represent the parsed Process Data (In and Out) for our QS18E. The tag name again calls out the type of sensor, the IO-Link Master, and the port number. Use the data type “Banner_QS18E_PDIO” for the new tag.

10. Add the “Banner_QS18E_PD” function to an OB ladder. Link the “ProcessIn” to the raw Process Data In variable from step 10. PDI Config is set based on the Process Data Input selection. This can be a constant or a user-controlled variable. See Appendix A. Link the “ProcessOut” to the raw Process Data Out variable from step 10. Link “QS18E_PD” to the parsed Process Data variable from step 12. The first example below shows a single QS18E sensor.



The next example shows an opposed mode setup, wherein the QS18E Receiver device is in port 3 on the IO-Link Master (and is linked to the ProcessIn side of the Function). The QS18E Emitter device is connected to port 7 of the same IO-Link Master in this example (and is linked to the ProcessOut) side of the Function.



11. Process Data setup is complete.

12. Compile and download the configuration to the PLC, then go online. Open the “Banner IO-Link Data” data block and click Monitor all. You should see parsed QS18E Process Data In, like that shown below.

Banner IO-Link Data

	Name	Data type	Start value	Monito...	Comment
1	Static				
2	QS18E IOLM5 Port 6	"Banner_QS18E_PDIO"			
3	Output State	Bool	false	TRUE	0 = Off, 1 = On.
4	Health State	Bool	false	TRUE	1 = Sensor is Healthy.
5	Marginal Light State	Bool	false	FALSE	1 = Marginal Light
6	Marginal Dark State	Bool	false	FALSE	1 = Marginal Dark
7	Normalized Signal Strength	UInt	0	231	
8	Signal	UInt	0	11	Raw ADC signal value
9	Count	UInt	0	0	Output Event Count
10	Duration	UInt	0	0	The output duration
11	Events per Minute	UInt	0	0	
12	EmitterLED	Bool	false	FALSE	0 = On, 1 = Off.

Here is the same data from the two-sensor opposed mode alternate setup.

Banner IO-Link Data

	Name	Data type	Start value	Monito...	Comment
13	QS18E Opp IOLM5 Port 3 7	"Banner_QS18E_PDIO"			
14	Output State	Bool	false	TRUE	0 = Off, 1 = On.
15	Health State	Bool	false	TRUE	1 = Sensor is Healthy.
16	Marginal Light State	Bool	false	FALSE	1 = Marginal Light
17	Marginal Dark State	Bool	false	FALSE	1 = Marginal Dark
18	Normalized Signal Strength	UInt	0	0	
19	Signal	UInt	0	0	Raw ADC signal value
20	Count	UInt	0	0	Output Event Count
21	Duration	UInt	0	0	The output duration
22	Events per Minute	UInt	0	0	
23	EmitterLED	Bool	false	FALSE	0 = On, 1 = Off.

Appendix A QS18E Process Data

The QS18E has 4 bytes of Process Data In, and 1 byte of Process Data Out, as shown below. The specific information included in the Process Data In varies by mode. In the case of the opposed mode method of operation, two QS18E sensors are used and the Process Data In is linked to the receiver sensor while the Process Data Out is linked to the emitter sensor.

First is Mode = 0, also called Process Data with Signal.

ProcessDataIn "Process Data Input" id=PD_ProcessDataInWithSignal

bit length: 32
data type: 32-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 = False, true = True					Output State	true (1) = C/Q Output Active
2	1	Boolean	false = False, true = True					Health State	true (1) = Sensor is Healthy
3	2	Boolean	false = False, true = True					Marginal Light State	true (1) = Sensor is Marginal Light
4	3	Boolean	false = False, true = True					Marginal Dark State	true (1) = Sensor is Marginal Dark
5	4	10-bit UInteger						Normalized Signal Strength Value	Normalized Signal Strength value.
6	16	16-bit UInteger						Signal	The raw ADC signal.

Octet 0

bit offset	31	30	29	28	27	26	25	24
subindex	6							
element bit	15	14	13	12	11	10	9	8

Octet 1

bit offset	23	22	21	20	19	18	17	16
subindex	6							
element bit	7	6	5	4	3	2	1	0

Octet 2

bit offset	15	14	13	12	11	10	9	8
subindex	//////	//////	5					
element bit			9	8	7	6	5	4

Octet 3

bit offset	7	6	5	4	3	2	1	0
subindex	5				4	3	2	1
element bit	3	2	1	0				

ProcessDataOut "Process Data Output" id=PD_ProcessDataOutWithSignal

bit length: 8
data type: 8-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 = On, true = Off					Emitter LED	

Octet 0

bit offset	7	6	5	4	3	2	1	0
subindex	//////	//////	//////	//////	//////	//////	//////	1

Mode = 1 is called Process Data with Count.

ProcessDataIn "Process Data Input" id=PD_ProcessDataInWithCount

bit length: 32
data type: 32-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 = False, true = True					Output State	true (1) = C/Q Output Active
2	1	Boolean	false = False, true = True					Health State	true (1) = Sensor is Healthy
3	2	Boolean	false = False, true = True					Marginal Light State	true (1) = Sensor is Marginal Light
4	3	Boolean	false = False, true = True					Marginal Dark State	true (1) = Sensor is Marginal Dark
5	4	10-bit UInteger						Normalized Signal Strength Value	Normalized Signal Strength value.
6	16	16-bit UInteger						Count	The output event count.

Octet 0

bit offset	31	30	29	28	27	26	25	24
subindex	6							
element bit	15	14	13	12	11	10	9	8

Octet 1

bit offset	23	22	21	20	19	18	17	16
subindex	6							
element bit	7	6	5	4	3	2	1	0

Octet 2

bit offset	15	14	13	12	11	10	9	8
subindex	///////	///////	5					
element bit			9	8	7	6	5	4

Octet 3

bit offset	7	6	5	4	3	2	1	0
subindex	5				4	3	2	1
element bit	3	2	1	0				

ProcessDataOut "Process Data Output" id=PD_ProcessDataOutWithCount

bit length: 8
data type: 8-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 = On, true = Off					Emitter LED	

Octet 0

bit offset	7	6	5	4	3	2	1	0
subindex	///////	///////	///////	///////	///////	///////	///////	1

Mode = 2 is called Process Data with Duration.

ProcessDataIn "Process Data Input" id=PD_ProcessDataInWithDuration

bit length: 32
data type: 32-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 = False, true = True					Output State	true (1) = C/Q Output Active
2	1	Boolean	false = False, true = True					Health State	true (1) = Sensor is Healthy
3	2	Boolean	false = False, true = True					Marginal Light State	true (1) = Sensor is Marginal Light
4	3	Boolean	false = False, true = True					Marginal Dark State	true (1) = Sensor is Marginal Dark
5	4	10-bit UInteger						Normalized Signal Strength Value	Normalized Signal Strength value.
6	16	16-bit UInteger						Duration	The output event duration.

Octet 0

bit offset	31	30	29	28	27	26	25	24
subindex	6							
element bit	15	14	13	12	11	10	9	8

Octet 1

bit offset	23	22	21	20	19	18	17	16
subindex	6							
element bit	7	6	5	4	3	2	1	0

Octet 2

bit offset	15	14	13	12	11	10	9	8
subindex	//////	//////	5					
element bit			9	8	7	6	5	4

Octet 3

bit offset	7	6	5	4	3	2	1	0
subindex	5				4	3	2	1
element bit	3	2	1	0				

ProcessDataOut "Process Data Output" id=PD_ProcessDataOutWithDuration

bit length: 8
data type: 8-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 = On, true = Off					Emitter LED	

Octet 0

bit offset	7	6	5	4	3	2	1	0
subindex	//////	//////	//////	//////	//////	//////	//////	1

Mode = 3 is called Process Data with Events per Minute.

ProcessDataIn "Process Data Input" id=PD_ProcessDataInWithEventsPerMinute

bit length: 32
data type: 32-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 = False, true = True					Output State	true (1) = C/Q Output Active
2	1	Boolean	false = False, true = True					Health State	true (1) = Sensor is Healthy
3	2	Boolean	false = False, true = True					Marginal Light State	true (1) = Sensor is Marginal Light
4	3	Boolean	false = False, true = True					Marginal Dark State	true (1) = Sensor is Marginal Dark
5	4	10-bit UInteger						Normalized Signal Strength Value	Normalized Signal Strength value.
6	16	16-bit UInteger						Events Per Minute	The events per minute.

Octet 0

bit offset	31	30	29	28	27	26	25	24
subindex	6							
element bit	15	14	13	12	11	10	9	8

Octet 1

bit offset	23	22	21	20	19	18	17	16
subindex	6							
element bit	7	6	5	4	3	2	1	0

Octet 2

bit offset	15	14	13	12	11	10	9	8
subindex	///////	///////	5					
element bit			9	8	7	6	5	4

Octet 3

bit offset	7	6	5	4	3	2	1	0
subindex	5				4	3	2	1
element bit	3	2	1	0				

ProcessDataOut "Process Data Output" id=PD_ProcessDataOutWithEventPerMinute

bit length: 8
data type: 8-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 = On, true = Off					Emitter LED	

Octet 0

bit offset	7	6	5	4	3	2	1	0
subindex	///////	///////	///////	///////	///////	///////	///////	1

This Process Data is mapped to a specific group of PROFINET addresses. The 32-bits of Process Data In encode size separate pieces of information. The 8-bits of Process Data Out are used to enable or disable the sensor's LED.

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