

# LE Parameter Data Function Block

2/8/2022

This document covers the installation and use of a function block for Siemens's TIA Portal software package. This function block handles acyclic IO-Link commands to and from a Banner LE and allows the user to easily change LE Parameter Data.

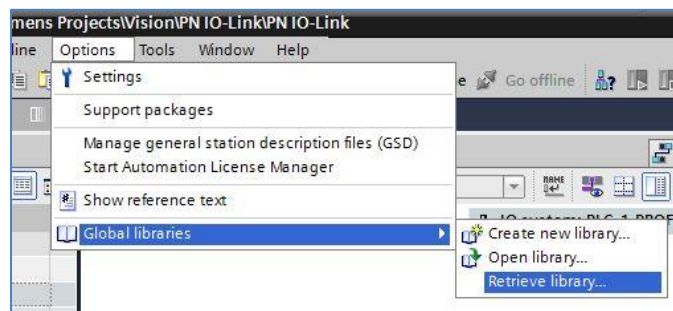
Each Banner IO-Link Device Parameter Data function block is meant to be used alongside a Banner IO-Link Device Master Control function block. This paper describes how to set up both of these blocks.

## Components

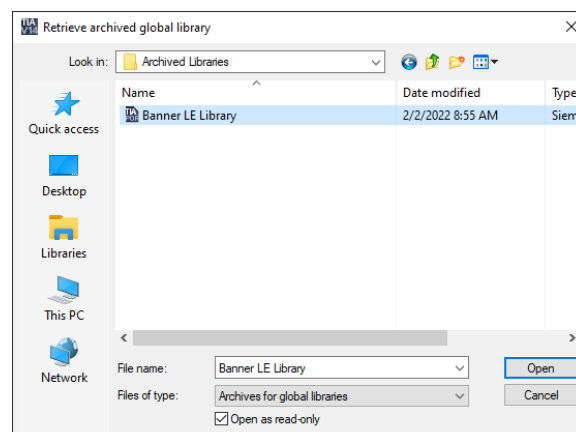
Banner LE Library.zal14  
*also requires Siemens IO\_LINK\_DEVICE function block*

## Installation Instructions

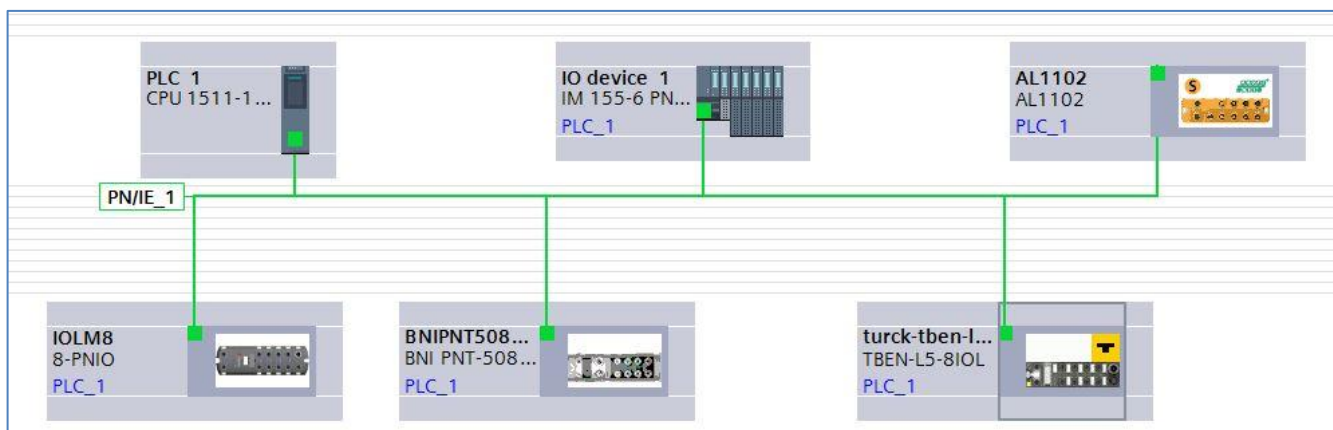
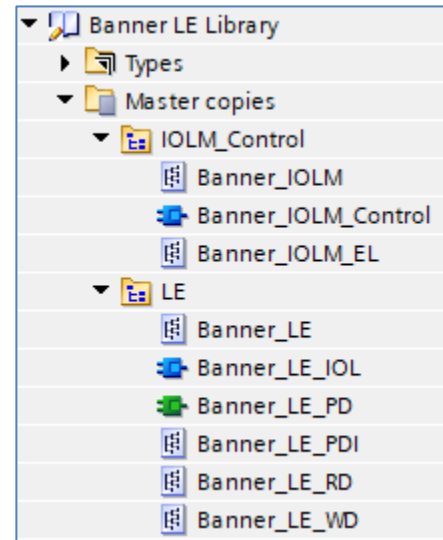
1. Open a project.
2. Go to Options > Global Libraries > Retrieve Library.



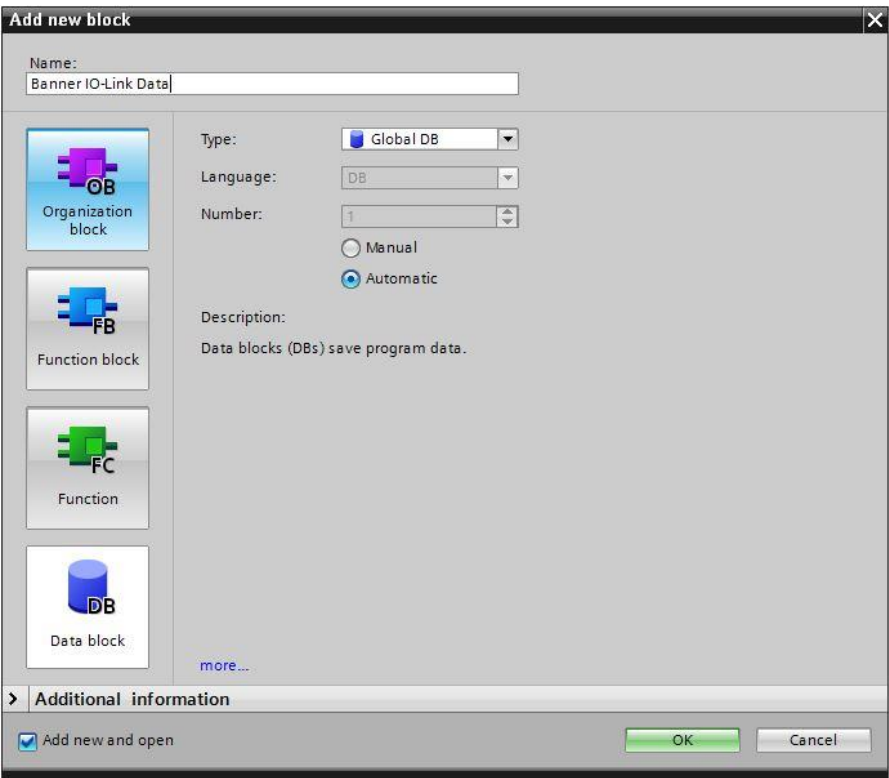
3. Select the Banner LE Library. Click Open.



4. The Banner LE Library will now be in the Global Library List. Expand the Master copies section. The LE folder contains elements for both Process Data and Parameter Data connections to an LE sensor. As Parameter Data is the focus of this paper, we will concern ourselves with these four items: Banner\_LE, Banner\_LE\_IOL, Banner\_LE\_RD, and Banner\_LE\_WD.
5. Drag Banner\_LE\_IOL to the Program Blocks area under your PLC.
6. Drag the Banner\_LE, Banner\_LE\_RD, and Banner\_LE\_WD to the PLC Data Types area under your PLC.
7. We also must prepare for setting up the IO-Link Master. Go to the IOLM\_Control section of the Banner IO-Link Library List.
8. Drag Banner\_IOLM and Banner\_IOLM\_EL to the PLC Data Types area under your PLC.
9. Drag the Banner\_IOLM\_Control to the Program Blocks area under your PLC.
10. Finally, we must bring the Siemens-made IO\_LINK\_DEVICE function block specific to your PLC into our project. This can be found in a Siemens IO-Link Library. See their website for more details. Once that library is retrieved and opened, drag IO\_LINK\_DEVICE to the Program Blocks area under your PLC.
11. 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.
























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



13. In the new data block, create a new tag to represent the IO-Link Master, using the data type “Banner\_IOLM”. This example uses the tag name “IOLM2”. A different IO-Link Master might be called IOLM1 or IOLM3, for instance.

Banner IO-Link Data			
	Name	Data type	Start value
1	Static		
2	IOLM2	*Banner_IOLM*	

14. Expand the IOLM2 tag, then expand the Port Controlled section. The Port Controlled tag array determines which of the ports has a function block-controlled Banner IO-Link device plugged into it. Each Port Controlled array tag with **true** as the start value is considered to have such a device connected. Correctly setting this array allows the Device and IO-Link Master function blocks to control the device on that port. Errors will occur if a port without an IO-Link device is set to true.

Banner IO-Link Data				
	Name	Data type	Start value	Retain
4	 IOLM2	"Banner_IOLM"		<input type="checkbox"/>
5	 Port Controlled	Array[1..8] of Bool		<input type="checkbox"/>
6	 Port Controlled[1]	Bool	false	<input type="checkbox"/>
7	 Port Controlled[2]	Bool	false	<input type="checkbox"/>
8	 Port Controlled[3]	Bool	false	<input type="checkbox"/>
9	 Port Controlled[4]	Bool	true	<input type="checkbox"/>
10	 Port Controlled[5]	Bool	false	<input type="checkbox"/>
11	 Port Controlled[6]	Bool	false	<input type="checkbox"/>
12	 Port Controlled[7]	Bool	false	<input type="checkbox"/>
13	 Port Controlled[8]	Bool	false	<input type="checkbox"/>
14	 Port Activate	Array[1..8] of Bool		<input type="checkbox"/>
15	 Port Read Request	Array[1..8] of Bool		<input type="checkbox"/>
16	 Port Write Request	Array[1..8] of Bool		<input type="checkbox"/>
17	 Port RW Complete	Array[1..8] of Bool		<input type="checkbox"/>
18	 Port Device Read	Array[1..8] of Bool		<input type="checkbox"/>
19	 Transfer Data	Array[0..231] of Byte		<input type="checkbox"/>
20	 Wr_Length	Int	0	<input type="checkbox"/>
21	 Rd_Length	Int	0	<input type="checkbox"/>
22	 IO-Index	Int	0	<input type="checkbox"/>
23	 Reset	Bool	false	<input type="checkbox"/>
24	 ForceReset	Bool	false	<input type="checkbox"/>

15. Next add the “Banner\_IOLM\_Control” function block to an OB ladder. You will be prompted to make a new data block. You now must define three input variables for this function block: CAP, ID Control state, and IOLM.

Defining an input variable for the fourth input, Communications Error, is optional.

The Client Access Point (CAP) varies, depending on the specific IO-Link Master used.

IO-Link Master	CAP
Balluff (BNI PNT-508-105-Z015)	255
Control (IOLMPN8P)	255
ifm (AL1102)	46080
Siemens (CM 4xIO-Link)	227
Turck (TBEN-L5-8IOL)	251

The ID Control state variable should be “true” if using an IO-Link Master from ifm; otherwise it should be set to “false”.

Link the “IOLM” input variable to the tag created in step 13.

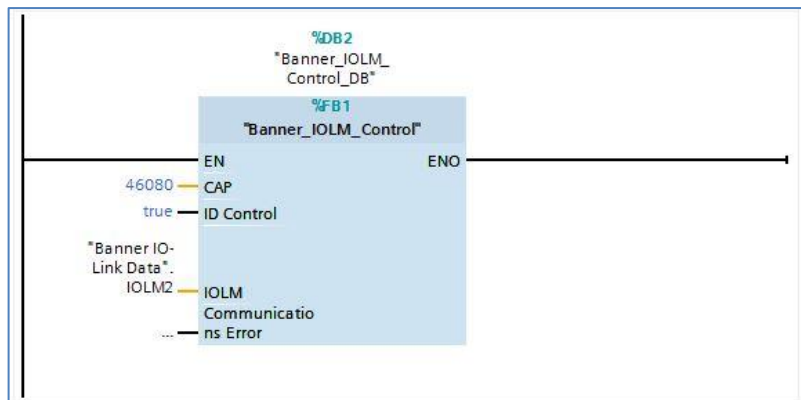


Figure 1: An example using an ifm IO-Link Master

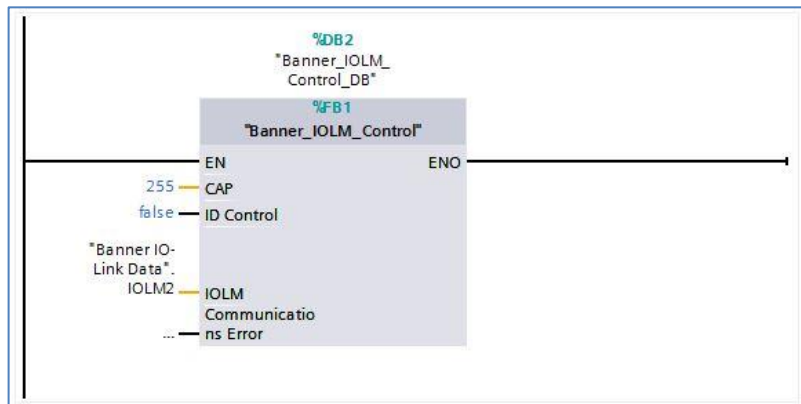


Figure 2: An example using a Balluff IO-Link Master

16. The ID Control true/false state is linked to an array called "ID\_Array", found in "Banner\_IOLM\_Control\_DB". This array contains the Hardware ID property of the PROFINET configuration.

See Appendix A for more information on how to find the correct value for your specific IO-Link Master.

In the case of an IO-Link Master from ifm, each port has a different Hardware ID and each number must be entered into the correct place. The example shown in Figure 3 is of an IO-Link device connected to port 6 of an ifm IO-Link Master. The ifm IO-Link Master's port 6 Hardware ID is entered into the "ID\_Array[6]" slot. This full array of different Hardware IDs, based on port used, is used when the "ID Control" variable is set to true (i.e. only when the IO-Link Master is from ifm).

IO-Link Masters from other vendors use a single Hardware ID value for all ports. In this case, the Hardware ID is entered into the "ID\_Array[1]" slot of the array, regardless of the port to which the device is connected. This array is ignored (but the [1] slot is still important) when the "ID Control" variable is set to false.

▼ ID_Array	Array[1..8] of HW_IO	
■ ID_Array[1]	HW_IO	0
■ ID_Array[2]	HW_IO	0
■ ID_Array[3]	HW_IO	0
■ ID_Array[4]	HW_IO	0
■ ID_Array[5]	HW_IO	0
■ ID_Array[6]	HW_IO	279
■ ID_Array[7]	HW_IO	0
■ ID_Array[8]	HW_IO	0

Figure 3: The ID\_Array when using an ifm IO-Link Master; device attached to port 6

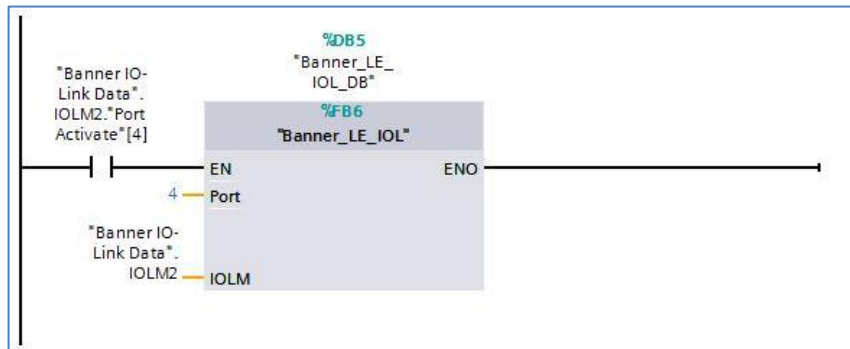
▼ ID_Array	Array[1..8] of HW_IO	
■ ID_Array[1]	HW_IO	309
■ ID_Array[2]	HW_IO	0
■ ID_Array[3]	HW_IO	0
■ ID_Array[4]	HW_IO	0
■ ID_Array[5]	HW_IO	0
■ ID_Array[6]	HW_IO	0
■ ID_Array[7]	HW_IO	0
■ ID_Array[8]	HW_IO	0

Figure 4: The ID\_Array when using a Balluff IO-Link Master; device attached to any port (only ID\_Array[1] is used)



17. Now add the “Banner\_LE\_IOL” function block to an OB ladder. You will be prompted to make a new data block. Type in the port number for the device, then link the “IOLM” variable to the IO-Link master variable created in step 13.

As a final step, the Port Activate bit is added on the same rung as the LE function block to ensure orderly behavior. The IO-Link Master function block will cycle through all ports, giving each connected device function block a time to shine.


























18. The LE Parameter Data function block is now set up. Compile the project and download it to the PLC. Go online, then open the LE data block. When the function block starts out, it does an initial global read of all LE information. The Read Data section of the data block shows this information.

Banner_LE_IOL_DB				
	Name	Data type	Start value	Monitor value
7	LE Data	"Banner_LE"		
8	Initial Global Read	Bool	false	TRUE
9	Command	Int	0	0
10	Read Data	"Banner_LE_RD"		
11	Master Cycle Time	USInt	0	40
12	Min Cycle Time	USInt	0	23
13	M-Sequence Ca...	USInt	0	9
14	IO-Link Version...	USInt	0	17
15	Process Data In...	USInt	0	195
16	Process Data O...	USInt	0	0
17	Vendor ID Com...	UDInt	0	451
18	Vendor ID 1	USInt	0	1
19	Vendor ID 2	USInt	0	195
20	Device ID Com...	UDInt	0	327681
21	Device ID 1	USInt	0	5
22	Device ID 2	USInt	0	0
23	Device ID 3	USInt	0	1
24	Serial Number	String	"	'LE201710021705.
25	Teach State	USInt	0	0
26	SP1 TP1	USInt	0	0
27	SP2 TP2	USInt	0	0
28	Measurement ...	DInt	0	0
29	Excess Gain Per...	UDInt	0	512

19. The Write Data section of the data block shows all of the writeable parameter data for the LE. Simply change a value here and it will be automatically written to the sensor via a one-time acyclic write through the IO-Link Master.

It is almost like the LE is a PROFINET-speaking device!

Banner_LE_IOL_DB					
		Name	Data type	Start value	Monitor value
7		LE Data	"Banner_LE"		
8		Initial Global Read	Bool	false	TRUE
9		Command	Int	0	0
10		Read Data	"Banner_LE_RD"		
11		Write Data	"Banner_LE_WD"		
12		System Comm...	USInt	0	0
13		Parameter Acc...	Bool	false	FALSE
14		Data Storage L...	Bool	false	FALSE
15		Local Paramete..	Bool	false	FALSE
16		Local User Inter..	Bool	false	FALSE
17		Teach Channel	USInt	0	0
18		BDC1 Setpoint ...	UDInt	0	1600
19		BDC1 Setpoint ...	UDInt	0	10000
20		BDC1 Switchpo...	USInt	0	0
21		BDC1 BDC Mode	USInt	0	2
22		BDC1 Hysteresis	UInt	0	0
23		BDC2 Setpoint ...	UDInt	0	1050
24		BDC2 Setpoint ...	UDInt	0	10000
25		BDC2 Switchpo...	USInt	0	0
26		BDC2 BDC Mode	USInt	0	2
27		BDC2 Hysteresis	UInt	0	0
28		Response Speed	USInt	0	1
29		Zero Reference ...	USInt	0	0



## Appendix A

### IO-Link Master Hardware ID Numbers

The Hardware ID number used in “ID\_Array” in the “Banner\_IOLM\_Control\_DB” function block is not trivial to find. Each manufacturer uses the Hardware Identifier of a slightly different subcomponent as the value required for our purposes. Furthermore, the particular Hardware Identifier numbers will change based on the number of devices in your configuration. These pictures show which subcomponent’s Hardware ID is relevant to the function block.

In each case, click on the hardware device from the “Devices & Networks” view. Click on “Properties”, then click on “System Constants” to see the screen shots below.

#### Balluff

Use the Hardware Identifier from the “BNI\_PNT-508-105-Z015\_1” Hw\_SubModule. Type this number into the [1] slot of the ID\_Array found in the “Banner\_IOLM\_Control\_DB” data block.

The screenshot displays the Siemens SIMATIC Manager hardware configuration window for a Balluff BNI\_PNT-508-105-Z015 device. The 'Device overview' table on the right lists the modules and their addresses. The 'System constants' table at the bottom lists the hardware identifiers for various components. The identifier 309 for the 'BNI\_PNT-508-105-Z015\_1' submodule is highlighted with a red box.

Module	Rack	Slot	I address	Q address
BNI_PNT-508-105-Z015	0	0		
PN-IO	0	0 X1		
BNI_PNT-508-105-Z015_1	0	1		
IOL_I/O_32/32 byte_1	0	2	324...355	320...351

Name	Type	Hardware identi.	Used by	Comment
BNI_PNT-508-105-Z015-PN-IO-port_1_-M12	Hw_Interface	306	PLC_1	
BNI_PNT-508-105-Z015-PN-IO-port_2_-M12	Hw_Interface	307	PLC_1	
BNI_PNT-508-105-Z015-PN-IO	Hw_Interface	305	PLC_1	
BNI_PNT-508-105-Z015-Proxy	Hw_SubModule	304	PLC_1	
BNI_PNT-508-105-Z015-Head	Hw_SubModule	308	PLC_1	
BNI_PNT-508-105-Z015-BNI_PNT-508-105-Z015_1	Hw_SubModule	309	PLC_1	

Figure 5: Balluff BNI005H. Type this value into the “ID\_Array[1]” location.

Control

Use the Hardware Identifier from the “Head” Hw\_SubModule. Type this number into the [1] slot of the ID\_Array found in the “Banner\_IOLM\_Control\_DB” data block.

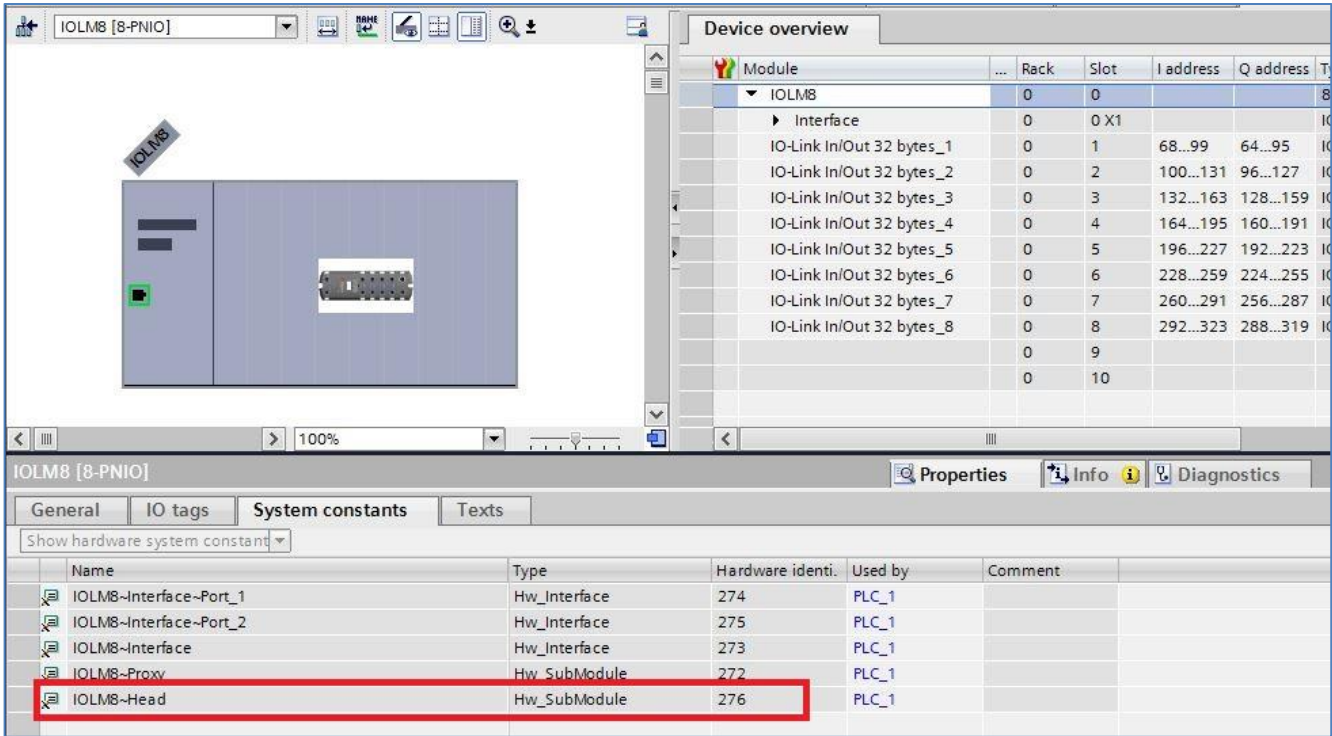


Figure 6: Control IOLM8 PNIO. Type this value into the “ID\_Array[1]” location.

Turck

Use the Hardware Identifier from the “Basic\_1” Hw\_SubModule. Type this number into the [1] slot of the ID\_Array found in the “Banner\_IOLM\_Control\_DB” data block.

The screenshot displays the Siemens STEP 7 HW Config interface. The main window shows a rack configuration with a Turck TBEN-L5-8IOL module. The 'Device overview' table on the right lists the modules and their addresses. The 'System constants' table at the bottom lists the hardware identifiers for each module, with 'tben-Basic\_1' highlighted in red.

Module	Rack	Slot	I address	Q address
tben	0	0		
PN-HO	0	0 X1		
Basic_1	0	Basic	33...36	33...34
	0	IO-Lin...		
	0	IO-Lin...		
	0	IO-Lin...		
	0	IO-Lin...		
	0	IO-Lin...		
IN 32 BYTE/OUT 32 BYTE_1	0	IO-Lin...	356...387	352...383
	0	IO-Lin...		
	0	Diagn...		
	0	IO-Lin...		

Name	Type	Hardware identi.	Used by	Comment
tben-PN-HO-Port_1	Hw_Interface	298	PLC_1	
tben-PN-HO-Port_2	Hw_Interface	299	PLC_1	
tben-PN-HO	Hw_Interface	297	PLC_1	
tben-Proxy	Hw_SubModule	296	PLC_1	
tben-Head	Hw_SubModule	300	PLC_1	
tben-Basic_1	Hw_SubModule	301	PLC_1	

Figure 3: Turck TBEN-L5-8IOL. Type this value into the “ID\_Array[1]” location.

Siemens

Use the Hardware Identifier from the “CM\_4xIO-Link\_1” Hw\_SubModule. Type this number into the [1] slot of the ID\_Array ID\_Array found in the “Banner\_IOLM\_Control\_DB” data block.

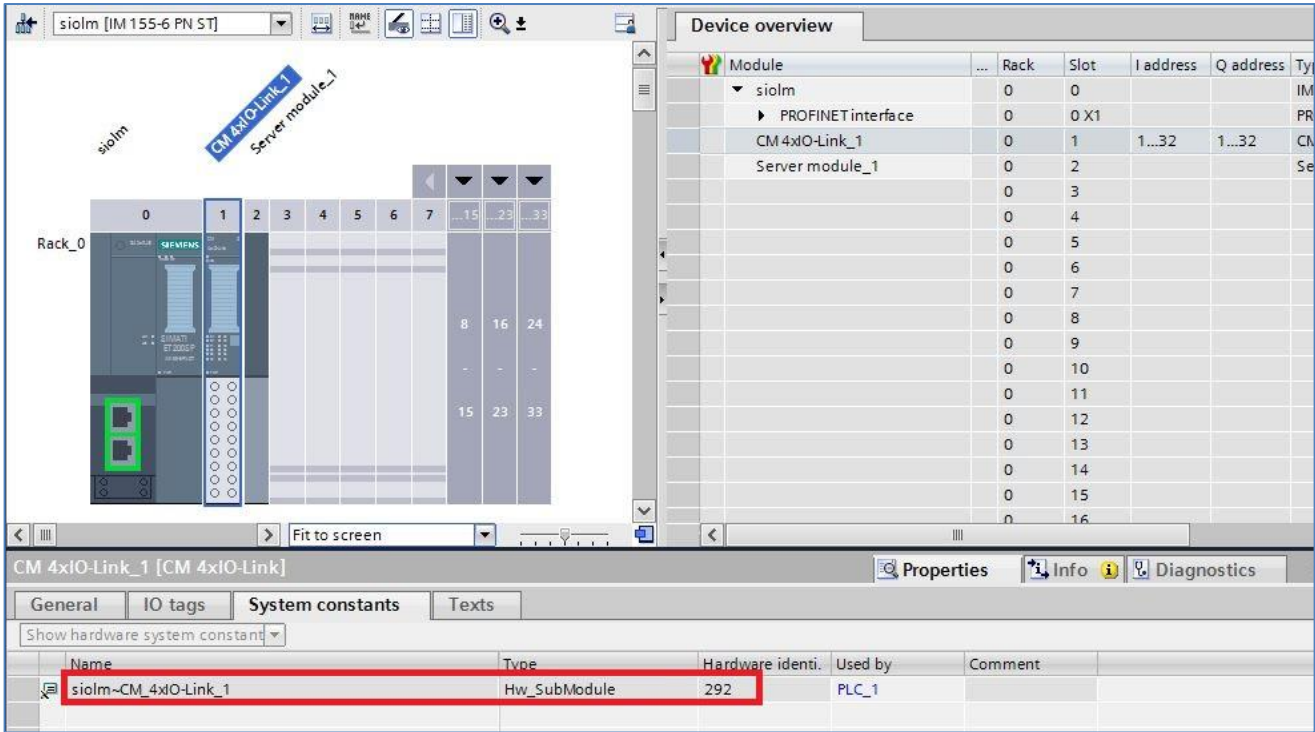


Figure 4: Siemens CM 4xIO-Link Master on ET-200SP. Type this value into the “ID\_Array[1]” location.

**ifm**

Use the Hardware Identifier from the port to which the IO-Link Device you wish to control is connected Hw\_SubModule. Each port is a different Hardware identifier. You will need to populate the ID\_Array, found in the “Banner\_IOLM\_Control\_DB” data block, with the correct values. In the example below, port 6 on the master has a Hardware ID of “279”. Thus, the [6] entry in the ID\_Array variable should be set to “279”.

The screenshot displays the SIMATIC Manager HW Config interface. On the left, a rack diagram shows the AL1102 module. On the right, the 'Device overview' table lists the modules and their addresses.

Module	Rack	Slot	I address	Q addr...
AL1102	0	0		
X1	0	0 X1		
8 Ports_1	0	1		
IO-Link Master	0	1 1		
	0	1 2		
	0	1 3		
	0	1 4		
	0	1 5		
	0	1 6		
IO-Link In 2 Byte + PQI	0	1 7	68...70	
	0	1 8		
	0	1 9		

Below the device overview, the 'Properties' window for 'IO-Link In 2 Byte + PQI' is open, showing the 'System constants' tab. A table lists the hardware identifiers for each port, with the entry for port 8 highlighted in red.

Name	Type	Hardware identi.	Used by	Comment
AL1102-8_Ports_1~IO-Link_In__2_Byte_+_PQI	Hw_SubModule	279	LC_1	

Figure 5: ifm AL1102: each port on the ifm IO-Link Master has its own Hardware ID. Type these values into the correct “ID\_Array[x]” location, where ‘x’ is the port number in question ([6] here, as the ports are labeled 2 through 9).