Robotics, Integration, and Automation

INTEGRATING SMART DEVICES: PART 1

Name	Class/Period	Date

1. Overview

In this lab activity, you will integrate IO-Link smart devices into your PLC project.

2. Performance Objectives

After completing this lab activity, you will be able to:

- Install an EDS file.
- Configure the IO-Link master for use with the PLC.
- Identify the PLC tags that exchange data with the IO-Link master and slave devices.
- Test data exchange between the PLC and IO-Link devices.

3. Required Materials

You need the following materials to complete the lab activity:

- SmartCart 4.0
- Computer
- Ethernet cables

4. Required Software

Logix Designer and View Designer are required for this lab activity. They are included in the Studio 5000 suite. Ensure that Studio 5000 is installed on your PC and has a valid license. If you are having problems installing or licensing the software, contact your instructor or IT manager.

5. Inventory and Safety

Before beginning the lab activity, review this checklist and mark off each item as you complete it.

- ☐ All hardware components are available for this lab activity.
- ☐ Hands, hair, and clothing are securely away from the work area.
- ☐ The work area is clean and devoid of food or drink.
- ☐ Review the SmartCart safety guidelines.
- ☐ Read through the entirety of this lab activity to familiarize yourself with the requirements.

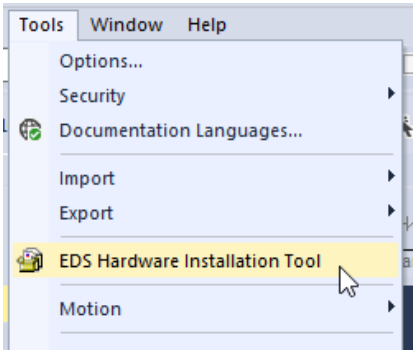
6. Lab Activity

6.1. Installing the EDS Files

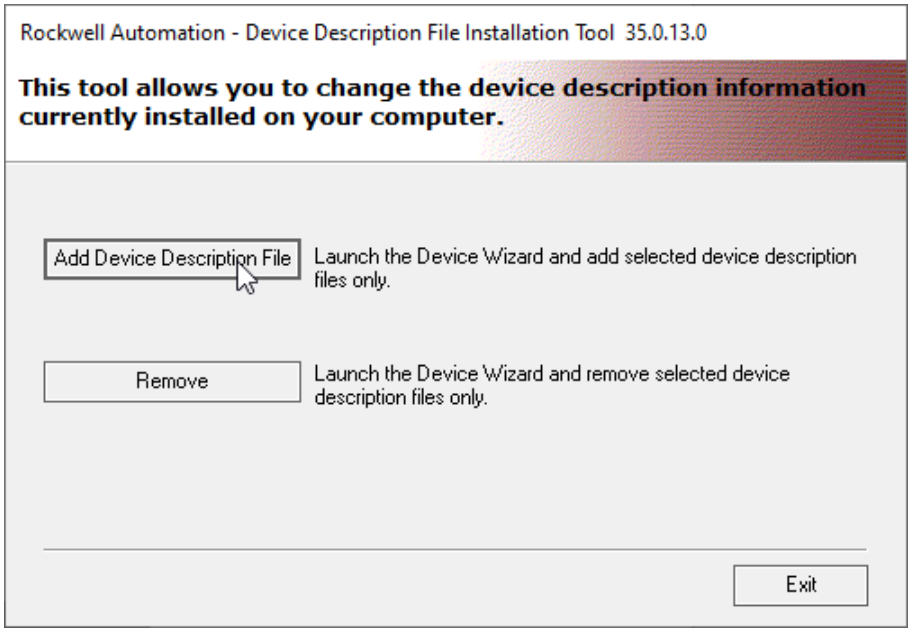
In this task, you will install the device description files for the IO-Link master so that your PLC can exchange data with it.

1. Download the IO-Link master EDS files. These can be found on the course page in this section's Resources area.
2. Extract all of the files in the zip folder.
3. From the Window's Start/Search area, open the **EDS Hardware Installation Tool** application.

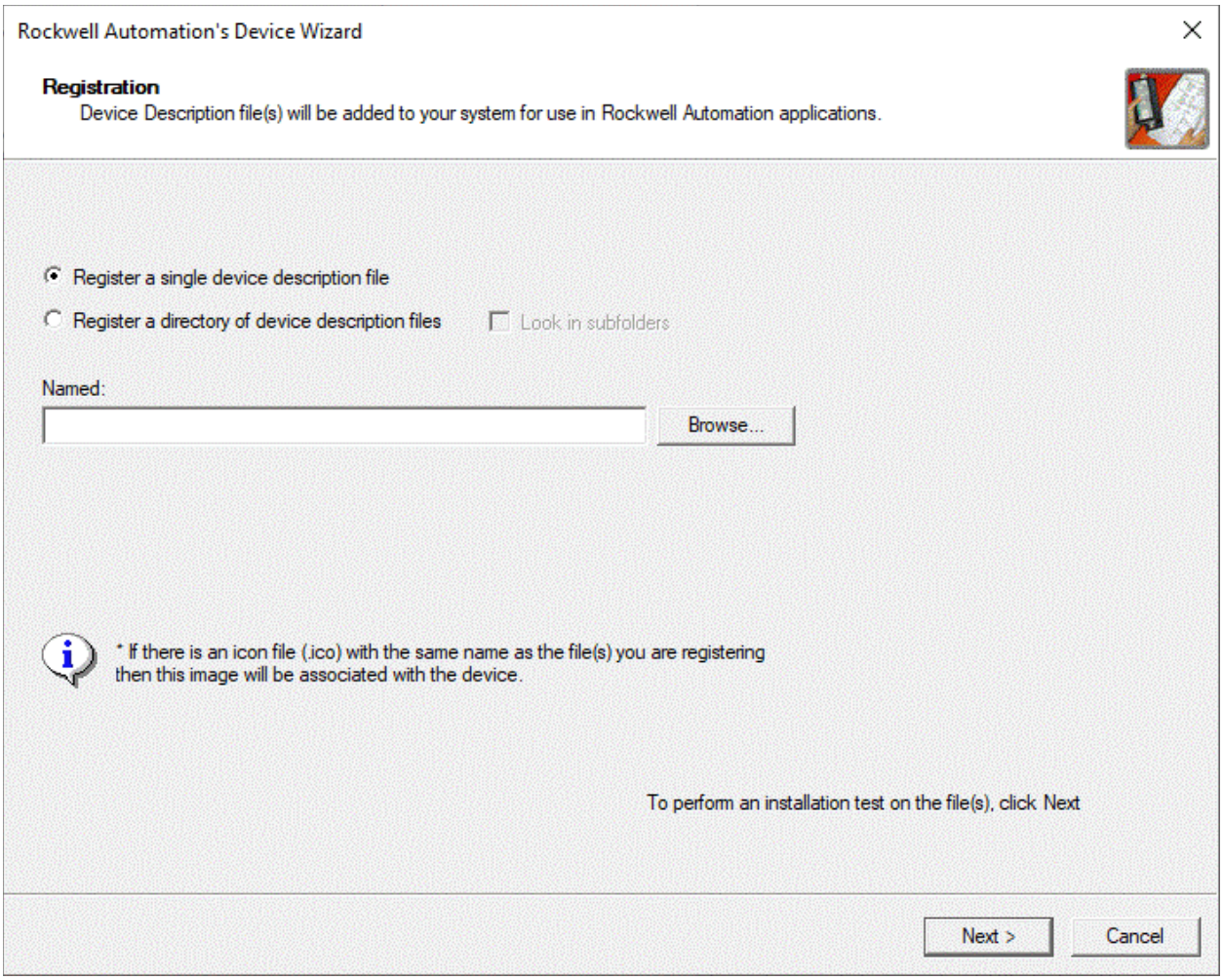
ⓘ ***Note:*** *This application is also accessible via Logix Designer. It is located in the Tools menu.*



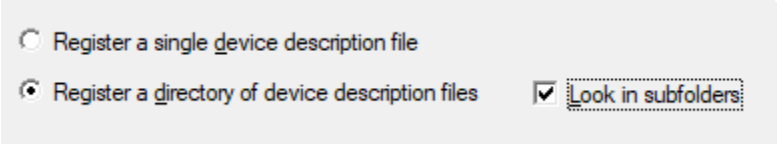
4. The application opens. Click the **Add Device Description File** button.



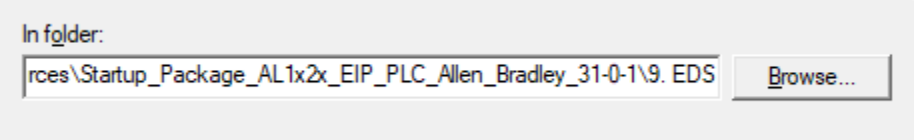
Rockwell Automation's Device Wizard is displayed.



5. Select **Register a directory of device description files**. Check the **Look in subfolders** option.

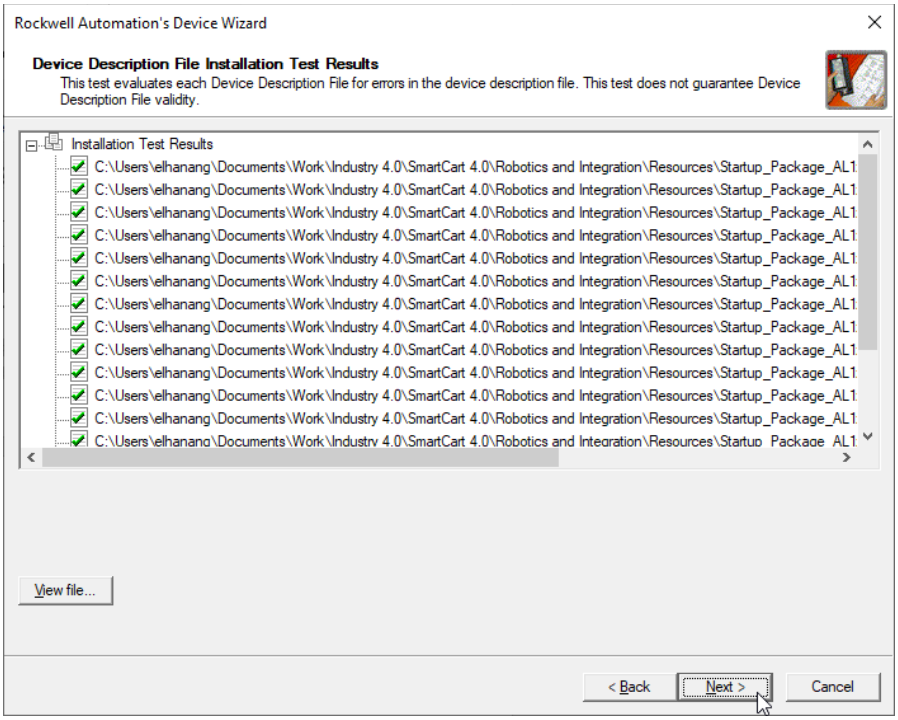


6. Browse to the folder where the EDS files are located.

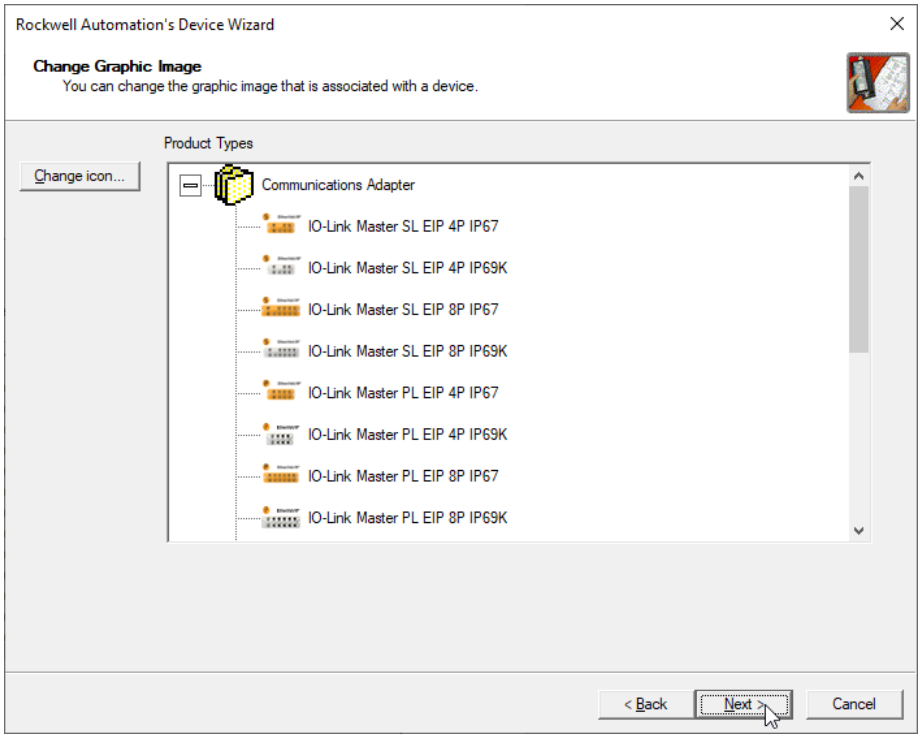


7. Click **Next**.

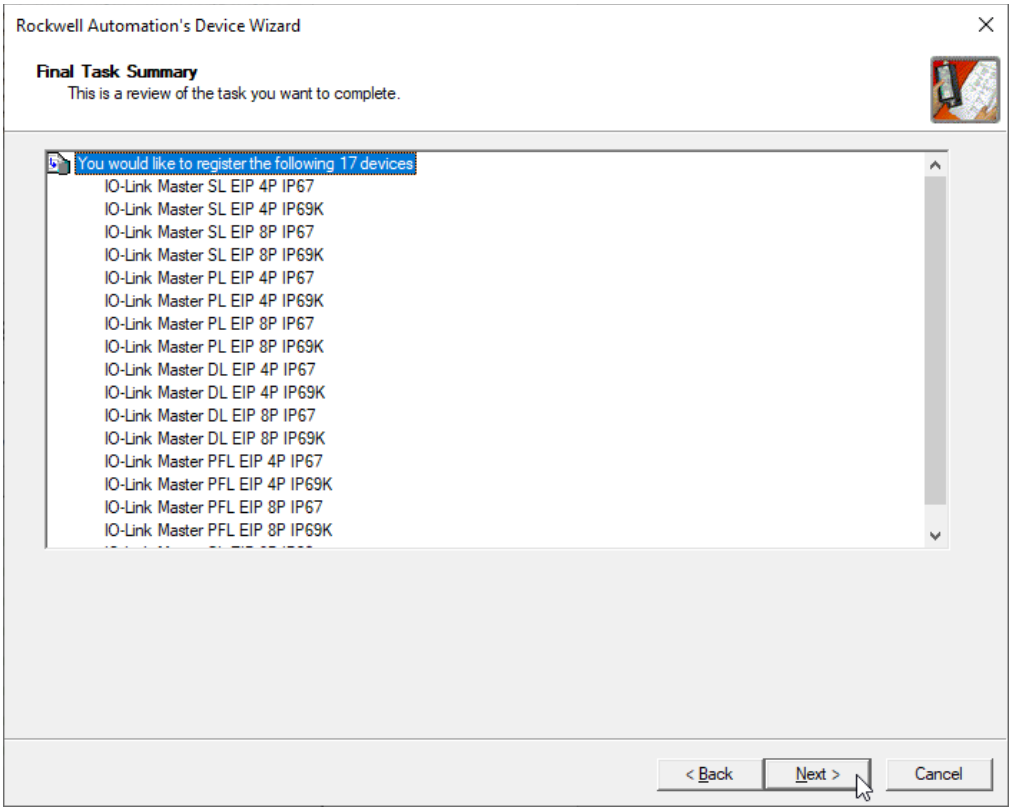
8. The installation test results are displayed. Click **Next**.



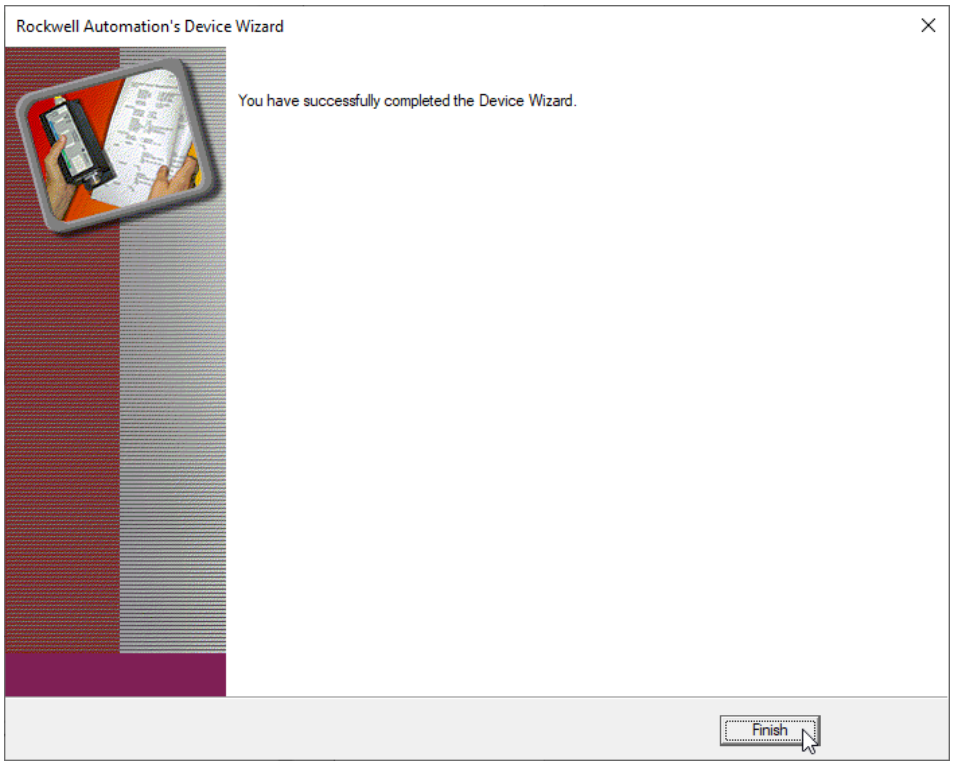
9. The files' graphic images are displayed. Click **Next**.



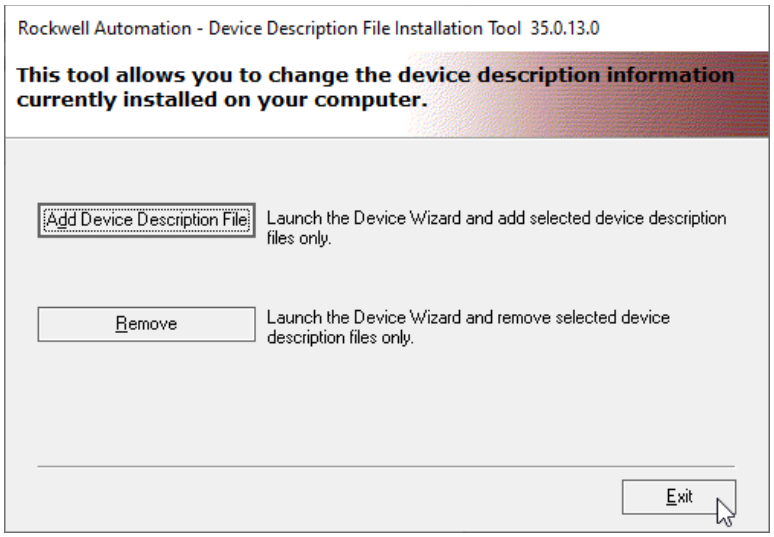
10. A review page is displayed. Click **Next**.



11. The files are installed. Click **Finish**.



12. Exit the EDS Installation Tool application.



The EDS files are now installed. They will be available in Logix Designer to add to your project.

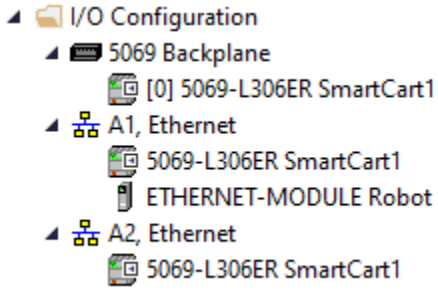
6.2. Adding the IO-Link Master Module to the PLC Project

In this task, you will add the master to your project's controller organizer.

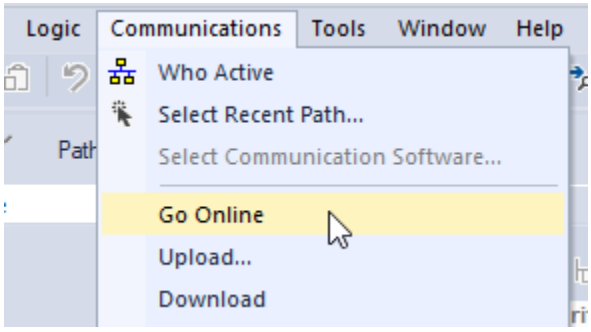
Perform these steps:

1. Turn on the I/O box. Wait for the PLC and the IO-Link smart devices to power up.
2. Open the Windows Command Prompt. Ping the PLC and the 8-port IO-Link master to confirm that they and your workstation are on the SmartCart LAN. Change the static IP addresses of the devices if necessary.
3. Run Studio 5000 and open the Logix Designer project that you have been working with up until now.

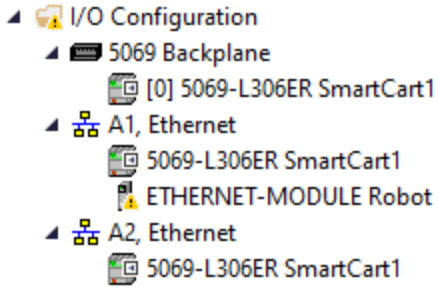
   Currently, your project's I/O Configuration folder has the PLC and the Robot module (ETHERNET-MODULE).



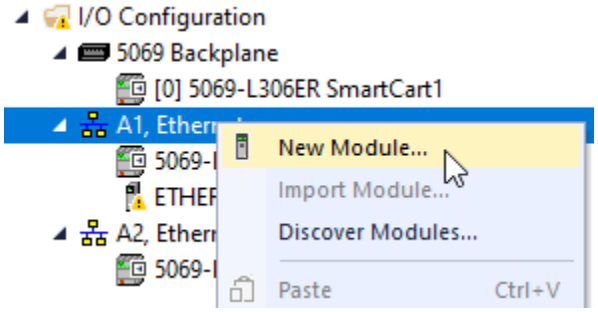
4. Go online with the controller in Rem Run mode.



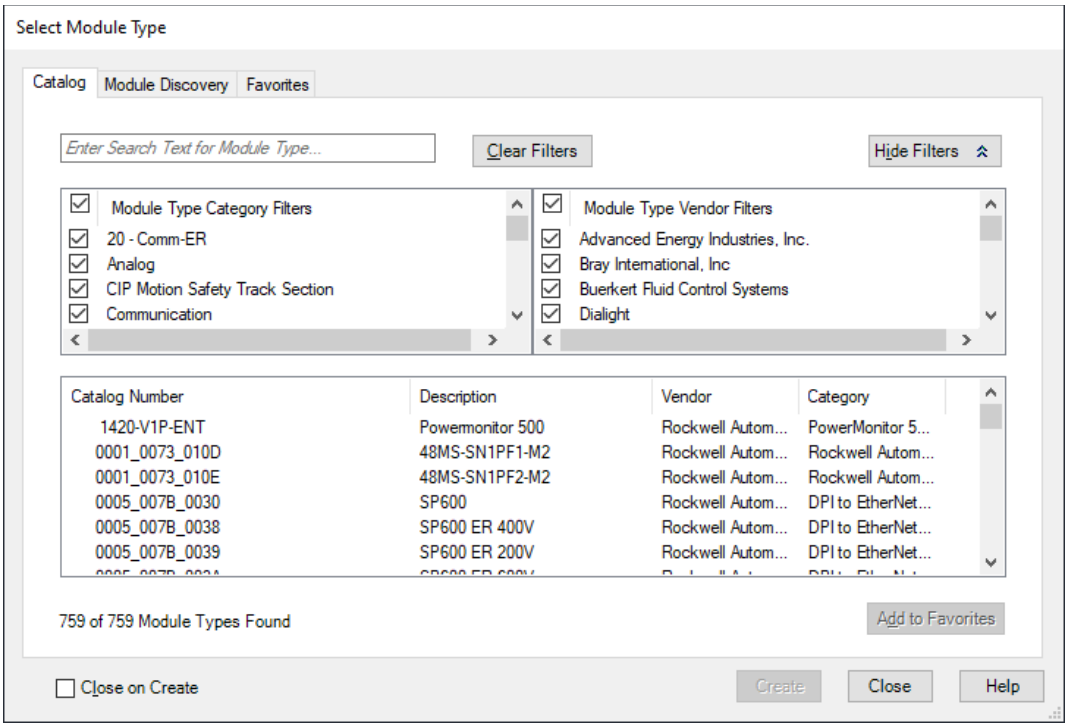
The robot is off, so you should have an I/O not responding error and yellow warning icons next to the robot module. No need to worry, the robot isn't required for this lab activity.



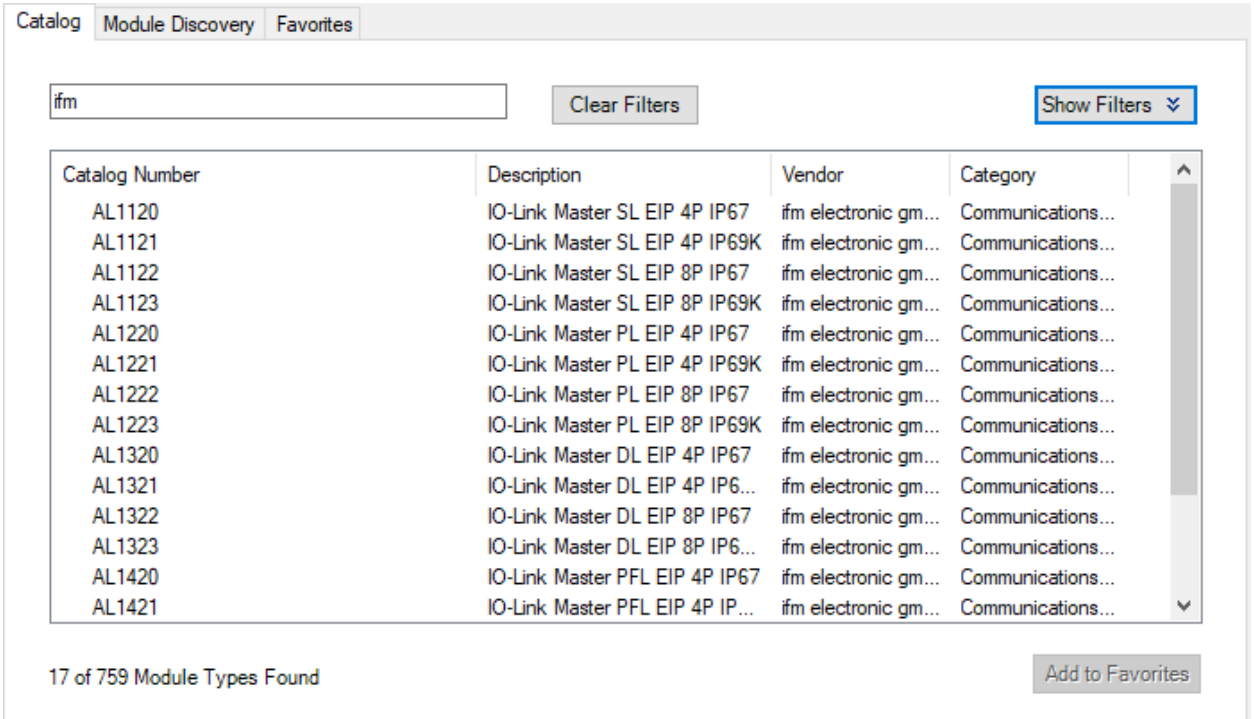
5. In the I/O Configuration folder, right-click **A1, Ethernet** and select **New Module**.



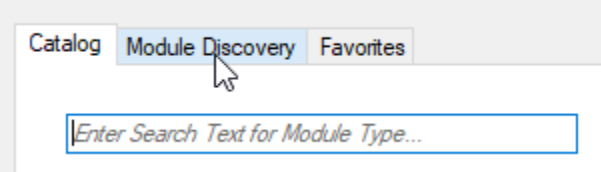
The hardware catalog is displayed.



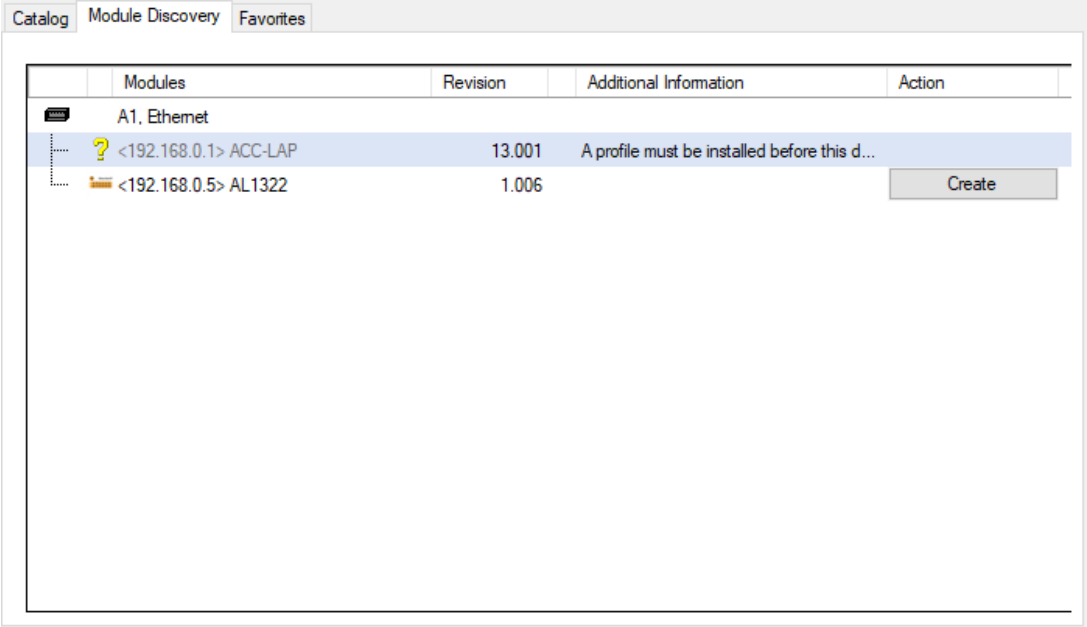
6. Scroll down or search for the IO-Link masters. They appear in the catalog because their device description files have been installed.



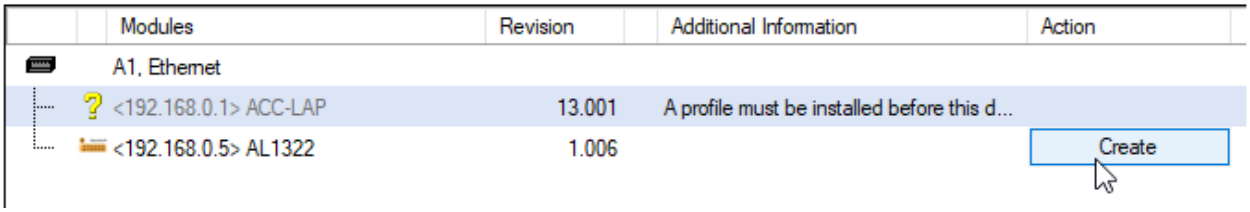
7. Your IO-Link master should be available using the module discovery feature. At the top of the window, click the **Module Discovery** tab.



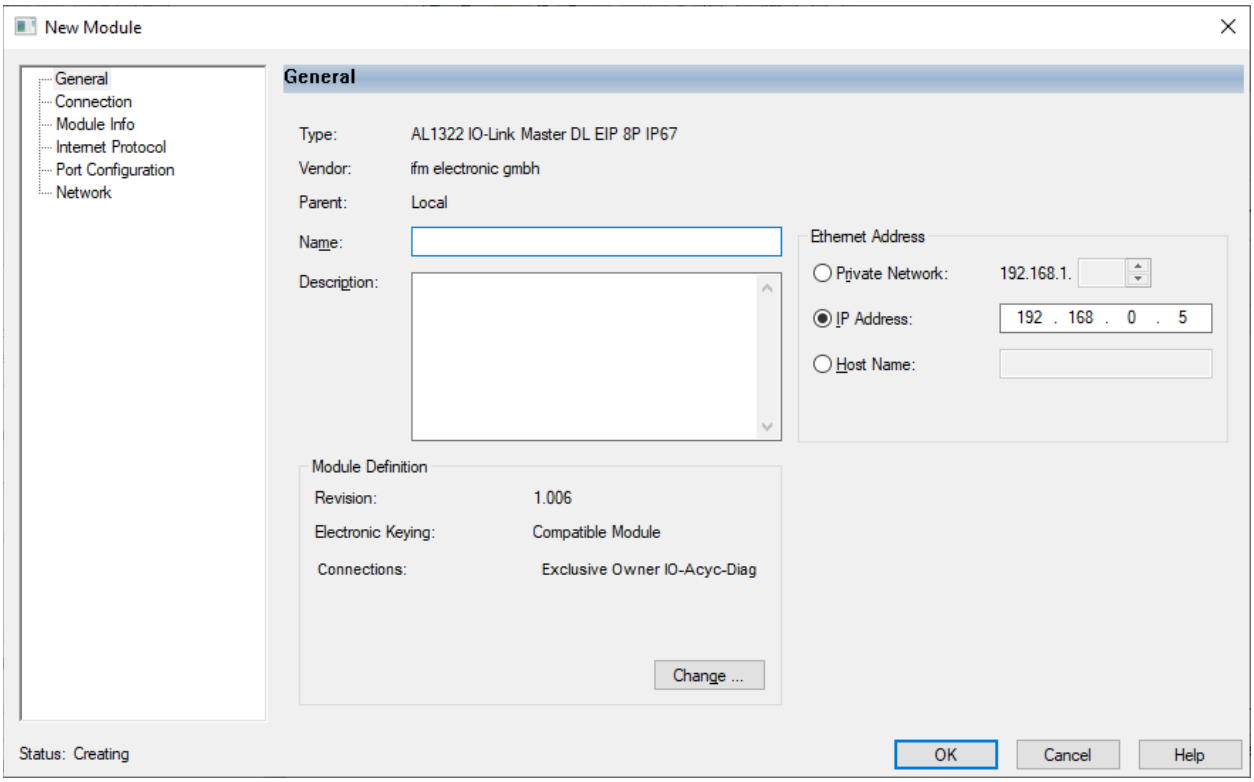
8. Wait several seconds for the devices to appear in the Module Discovery window. Note that other devices may be discovered if they are turned on and connected to the network.



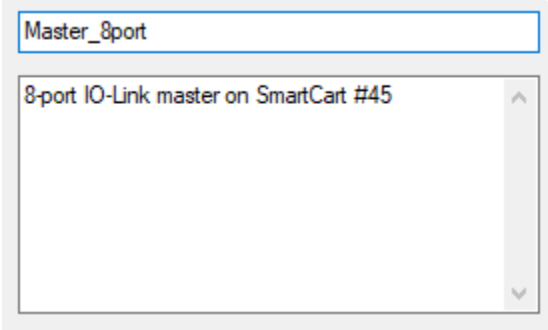
9. Find your 8-port master and click the **Create** button next to it.



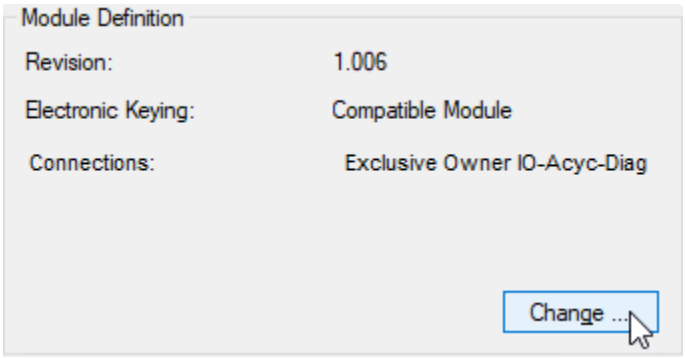
The New Module window is displayed. Note that the module type, the module's revision number, and its IP address are already filled in.



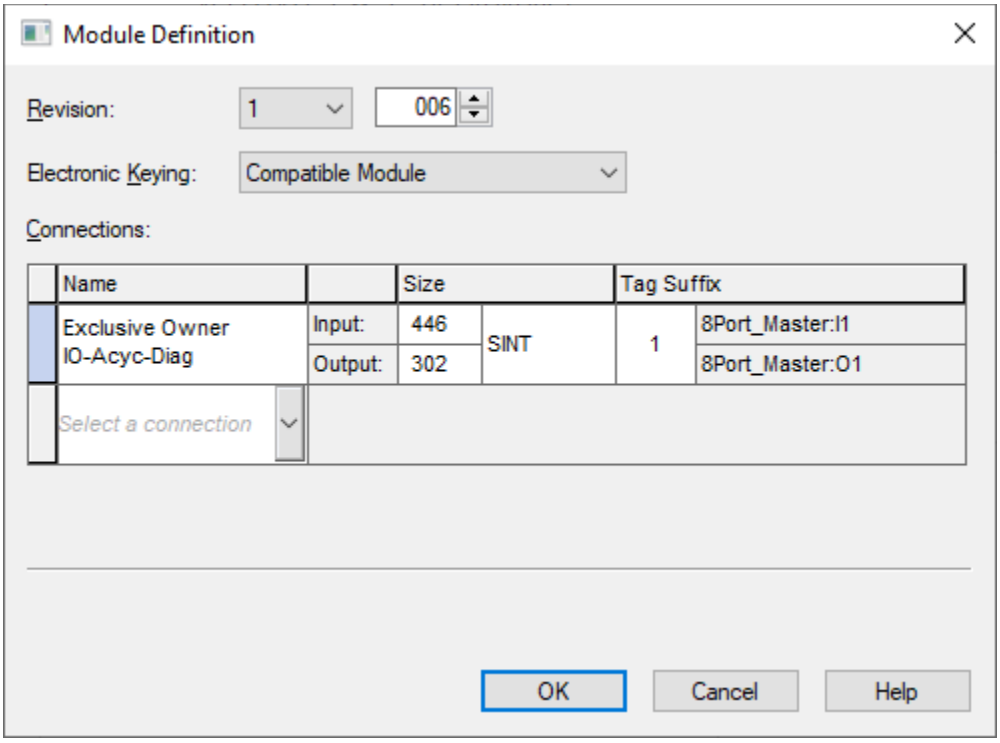
10. Give the module an appropriate name and description. An example is shown here.



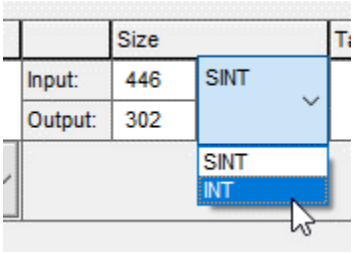
11. In the Module Definition area, click **Change**.



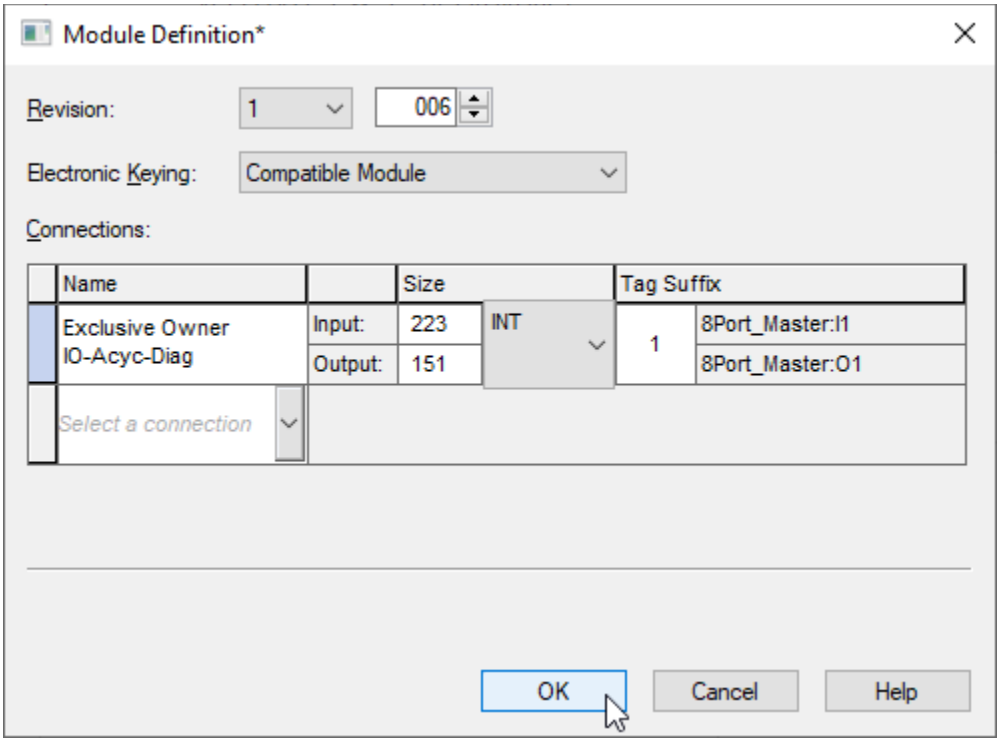
The Module Definition window is displayed.



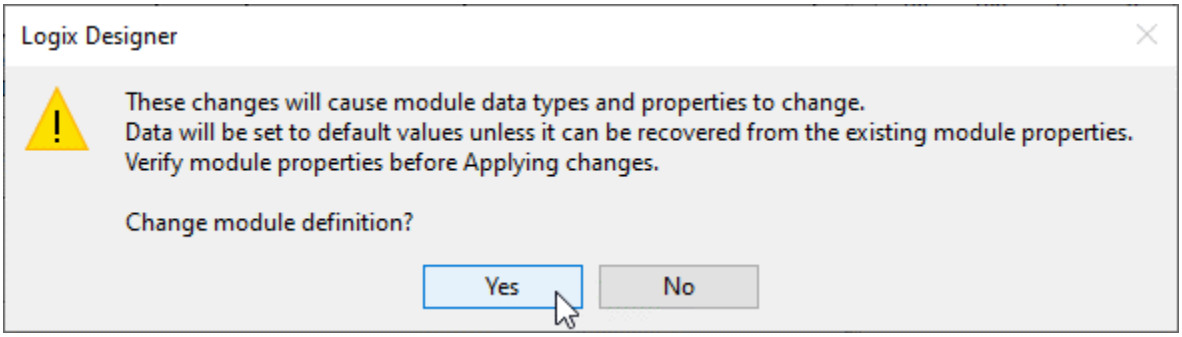
12. In the size area, select **INT**. INTs (words or 16 bytes of data) are more appropriate for the proximity sensors. This is because the memory size dedicated to the distance measurement (as described in the IODDs) is one word long.



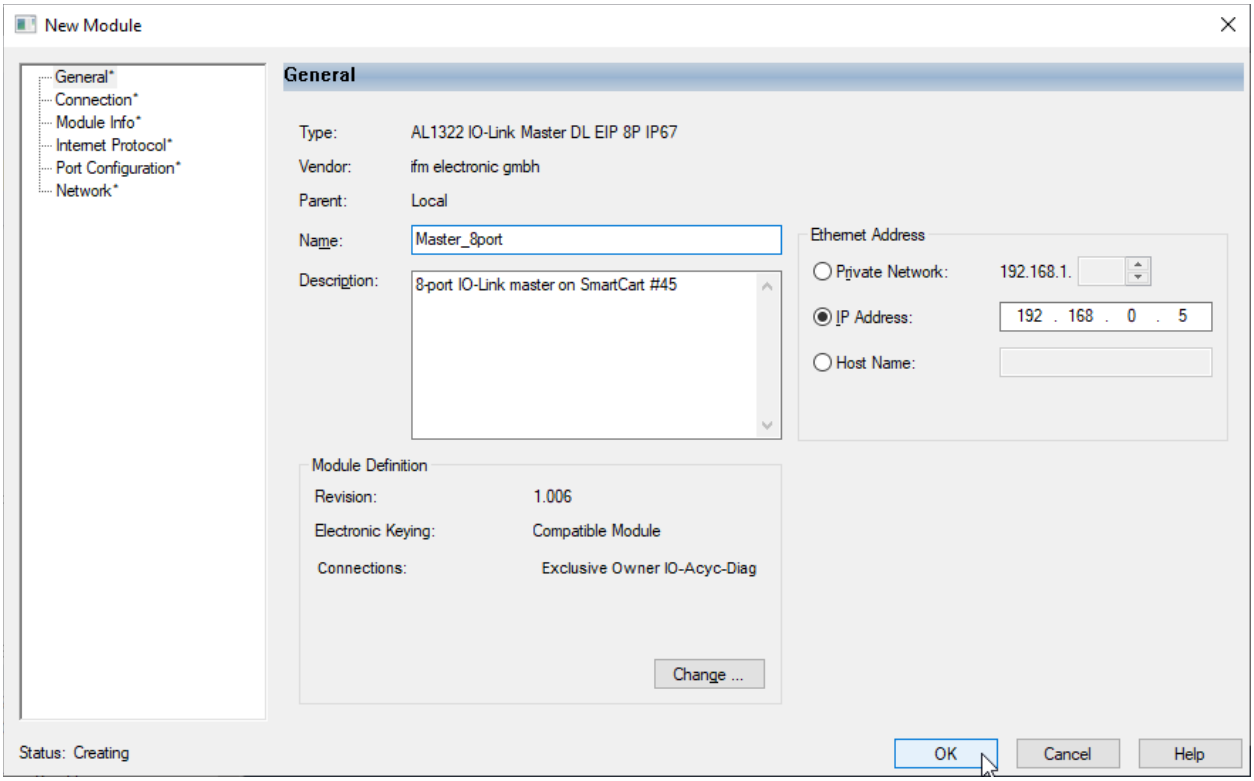
13. Click **OK**.



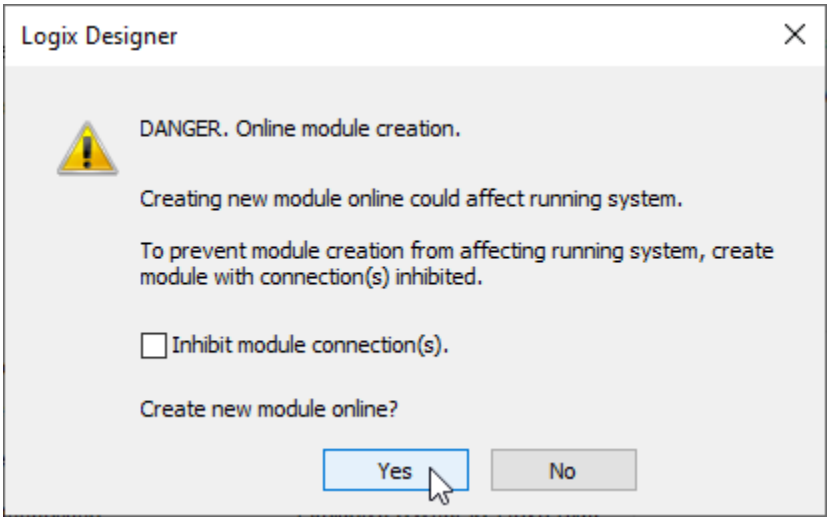
14. In the warning window, click **Yes**.



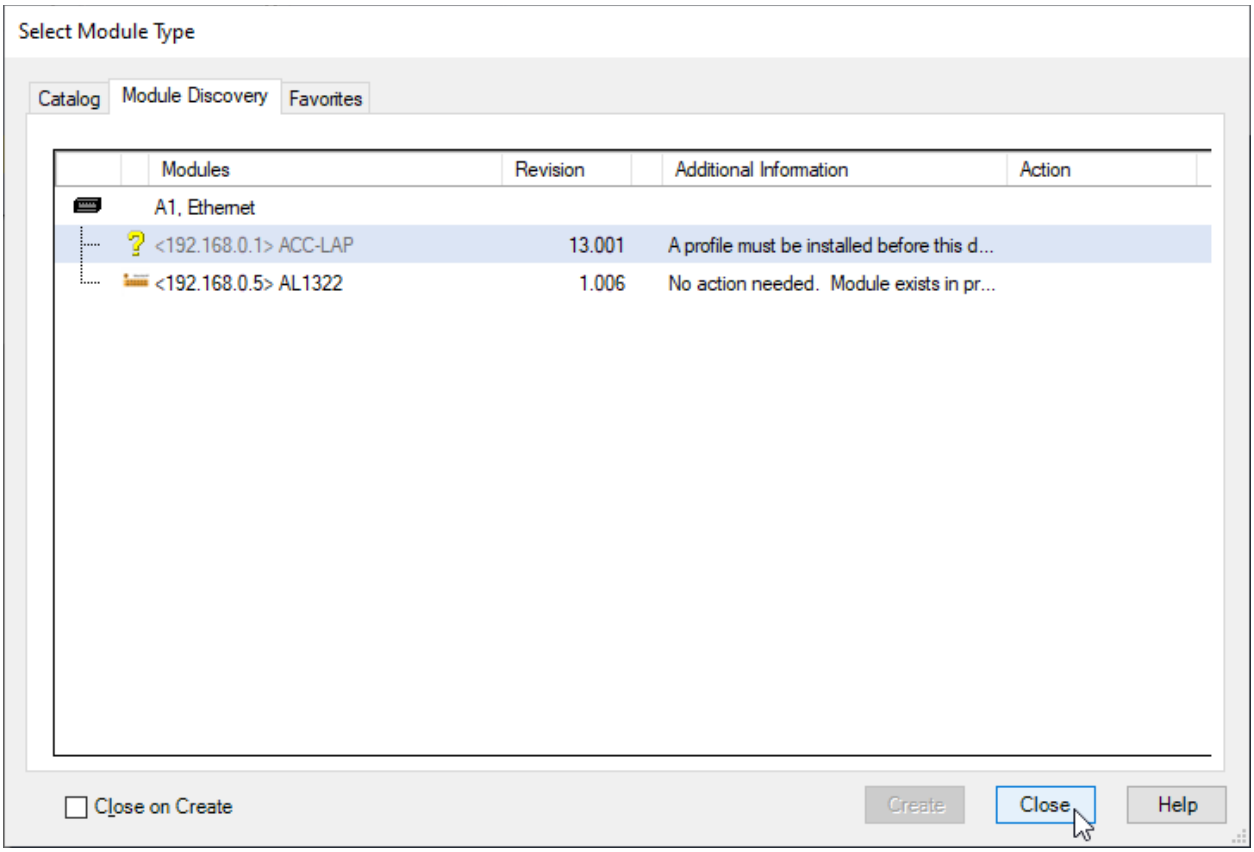
15. The Module Definition window closes. In the Create Module window, click **OK**.



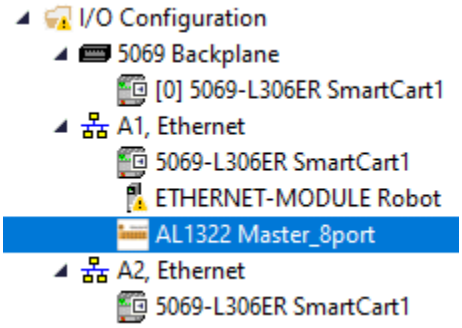
16. In the warning window, click **Yes**.



17. Close the Select Module Type window.



18. The IO-Link master's module is displayed in the I/O Configuration area.



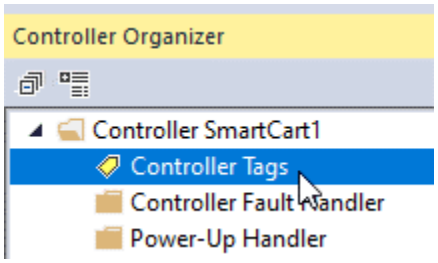
6.3. Testing Data Exchange with the Smart Sensors and RFID Head

In this task, you will identify the module tags that exchange data with the field devices. For the task, at least three devices must be connected to the IO-Link master: a proximity sensor (e.g., inductive, ultrasonic, photoelectric), an RFID head, and a signal lamp.

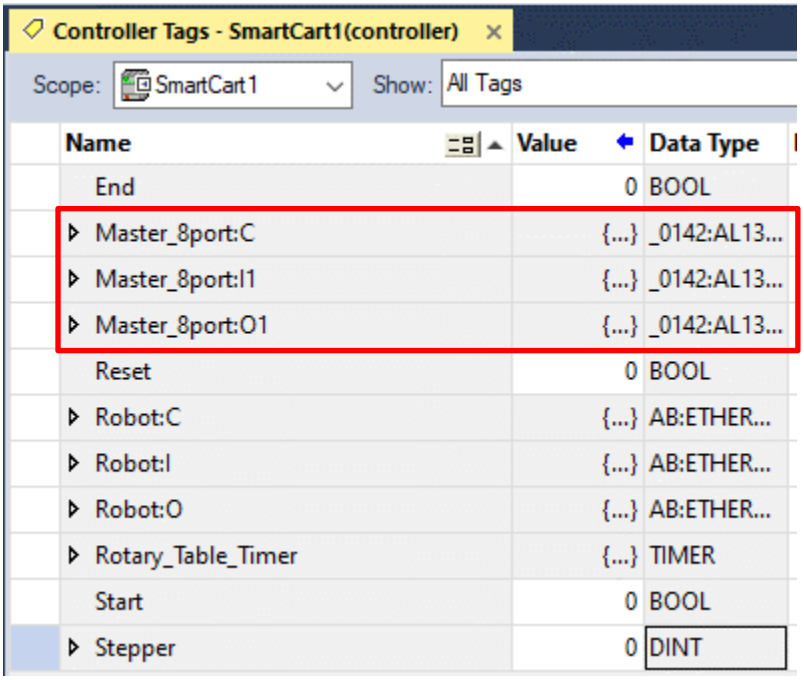
> ***Note:*** *Your SmartCart may not be equipped with an inductive proximity sensor.*

Perform these steps:

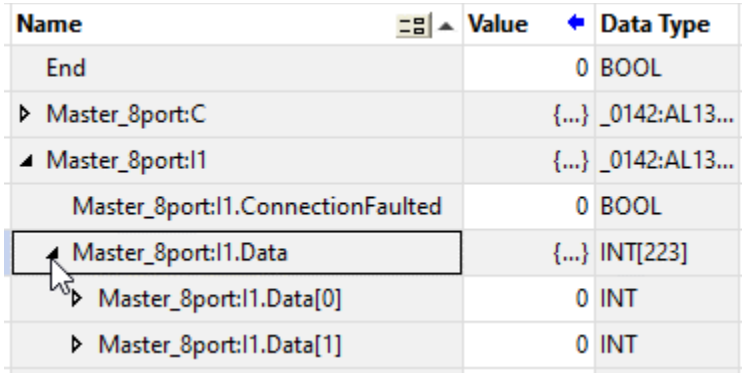
1. In the Controller Organizer, double-click **Controller Tags**.



The Tag Monitor opens. Note that the IO-Link master's module tags were added automatically when you created the module.



2. Expand the input data tags.



Name	Value	Data Type
End	0	BOOL
▷ Master_8port:C	{...}	_0142:AL13...
◢ Master_8port:I1	{...}	_0142:AL13...
Master_8port:I1.ConnectionFaulted	0	BOOL
◢ Master_8port:I1.Data	{...}	INT[223]
▷ Master_8port:I1.Data[0]	0	INT
▷ Master_8port:I1.Data[1]	0	INT

3. Ensure that there are no objects in range of the proximity sensors.

4. Scroll down the list of INT tags until you find the INT tags with a value greater than 30,000. These values are the distance values of the sensor when the switching signals are off (i.e., when nothing is detected). Your sensors' specific tag names will depend on which IO-Link master port they are connected to. Examples are shown in this table:

Sensor	INT Tag(s)
Inductive	Name / Value / Data Type ▷ Master_8port:I1.Data[95] 32736 INT
Photoelectric	▷ Master_8port:I1.Data[111] 32764 INT ▷ Master_8port:I1.Data[112] -256 INT
Ultrasonic	▷ Master_8port:I1.Data[127] 32760 INT ▷ Master_8port:I1.Data[128] -768 INT

ⓘ ***Note:*** *Only one word (INT tag) is allocated to the inductive sensor, while two words each are allocated to the photoelectric and ultrasonic sensors.*

ⓘ ***Note:*** *You may require the help of a partner for the next step.*

5. Place an object in range of each of the proximity sensors. For the inductive sensor, ensure that it is an object that the sensor can detect. Monitor the values of the tags and ensure that you can identify which tags apply to which sensors. Examples for each proximity sensor are shown below.

Sensor	INT Tag(s)
Inductive	▷ Master_8port:I1.Data[95] 163 INT
Photoelectric	▷ Master_8port:I1.Data[111] 48 INT ◢ Master_8port:I1.Data[112] -255 INT
Ultrasonic	▷ Master_8port:I1.Data[127] 103 INT ▷ Master_8port:I1.Data[128] -765 INT

6. Add descriptions for the tags of the proximity sensors, including any relevant BOOL tags such as the switching signal (SSC) bits.

Name	Value	Data Type	Description
▷ Master_8port:I1.Data[127]	45	INT	Ultrasonic distance
◢ Master_8port:I1.Data[128]	-765	INT	
Master_8port:I1.Data[128].0	1	BOOL	Ultrasonic SSC1
Master_8port:I1.Data[128].1	1	BOOL	Ultrasonic SSC2

7. Place an RFID tag within range of the RFID read/write head.

8. Since the RFID head's device parameters are the default parameters, the RFID head should be in read UID (unique ID) mode. Therefore, scroll up and down the module input data tags and search for five consecutive INT tags with values.

Name	Value	Data Type
▷ Master_8port:I1.Data[142]	0	INT
▷ Master_8port:I1.Data[143]	4	INT
▷ Master_8port:I1.Data[144]	-8188	INT
▷ Master_8port:I1.Data[145]	264	INT
▷ Master_8port:I1.Data[146]	10437	INT
▷ Master_8port:I1.Data[147]	-13883	INT
▷ Master_8port:I1.Data[148]	0	INT

9. The first (lowest) of these INT tags has the command value and status bytes of the RFID head. Give this tag a description.

Name	Value	Data Type	Description
Master_8port:I1.Data[143]	4	INT	RFID Command / Status
Master_8port:I1.Data[144]	-8188	INT	
Master_8port:I1.Data[145]	264	INT	
Master_8port:I1.Data[146]	10437	INT	
Master_8port:I1.Data[147]	-13883	INT	
Master_8port:I1.Data[148]	0	INT	

10. The next 15 words are RFID input words. For this project application, however, there is no need to write to the RFID tags, as we will simply use their UIDs. Give descriptions to INT tags that contain the RFID tag's UID.

Name	Value	Data Type	Description
Master_8port:I1.Data[143]	4	INT	RFID Command / Status
Master_8port:I1.Data[144]	-8188	INT	UID 1/4
Master_8port:I1.Data[145]	264	INT	UID 2/4
Master_8port:I1.Data[146]	10437	INT	UID 3/4
Master_8port:I1.Data[147]	-13883	INT	UID 4/4

11. One of the status BOOL tags is also important for programming the logic, something that you will do later in the section. Expand the lowest of the INT tags (143 in this example), and label the BOOL that has the value of 1 (Master_8port:I1.Data[143].2) with the description **RFID tag present**.

Name	Value	Data Type	Description
Master_8port:I1.Data[143]	4	INT	RFID Command / Status
Master_8port:I1.Data[143].0	0	BOOL	RFID Command / Status
Master_8port:I1.Data[143].1	0	BOOL	RFID Command / Status
Master_8port:I1.Data[143].2	1	BOOL	RFID tag present
Master_8port:I1.Data[143].3	0	BOOL	RFID Command / Status
Master_8port:I1.Data[143].4	0	BOOL	RFID Command / Status

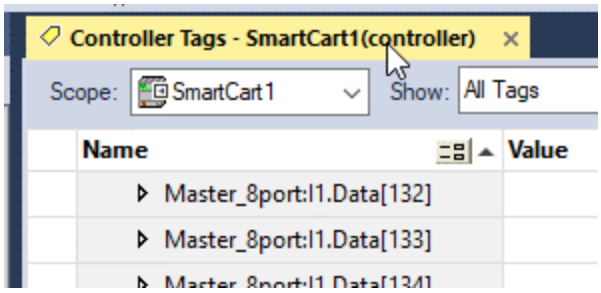
12. Remove the RFID tag from range of the RFID head. Place other RFID tags in range of the RFID head and observe their UIDs.

6.4. Testing the Signal Lamp

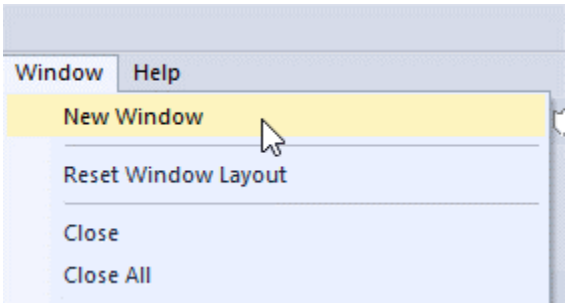
In the previous section, you saw how easy it is to identify a sensor's corresponding module tags: simply place objects in range of the sensors. However, it is more difficult when it comes to output devices such as the signal lamp, because in order to identify the correct module tags, you have to turn them on and off one by one.

In this task, you will test data exchange between the PLC and the signal lamp.

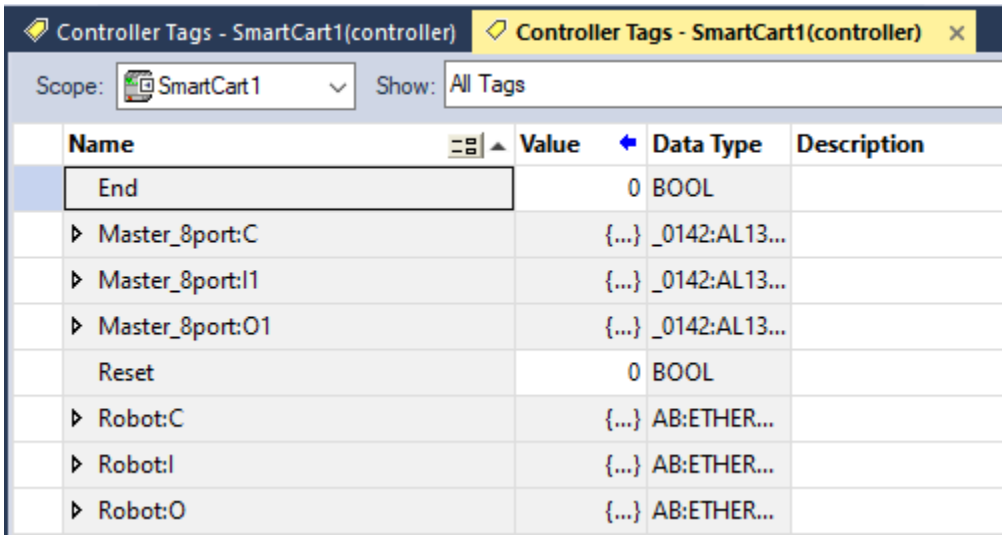
1. Ensure that the Controller Tags window is active.



2. In the menu at the top, select **Window > New Window**.



A new Controller Tag window opens.



3. Expand the module output tags.

Name	Value	Data Type
Master_8port:C	{...}	_0142:AL13...
Master_8port:I1	{...}	_0142:AL13...
Master_8port:O1	{...}	_0142:AL13...
Master_8port:O1.Data	{...}	INT[151]
Master_8port:O1.Data[0]	0	INT
Master_8port:O1.Data[1]	0	INT
Master_8port:O1.Data[2]	0	INT
Master_8port:O1.Data[3]	0	INT
Master_8port:O1.Data[4]	0	INT

4. While keeping your eye on the signal lamp, give the output INT tags any value between 1 and 8 until the signal lamp turns on (values 1-8 turn the signal lamp's LED on with constant light). In the example shown, the value 2 is used to turn the lamp on with green light. All of the INT tags are given a value of 2 until the lamp turns on when Master_8port:O1.Data[87] is given that value.

Name	Value	Data Type
Master_8port:O1.Data[84]	2	INT
Master_8port:O1.Data[85]	2	INT
Master_8port:O1.Data[86]	2	INT
Master_8port:O1.Data[87]	2	INT

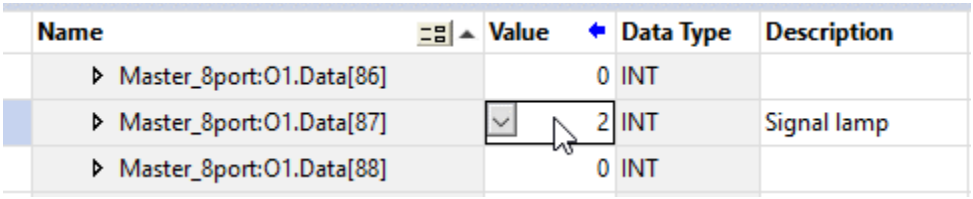
5. Label the tag responsible for the signal lamp output by entering a description.

Name	Value	Data Type	Description
Master_8port:O1.Data[84]	2	INT	
Master_8port:O1.Data[85]	2	INT	
Master_8port:O1.Data[86]	2	INT	
Master_8port:O1.Data[87]	2	INT	Signal lamp
Master_8port:O1.Data[88]	0	INT	

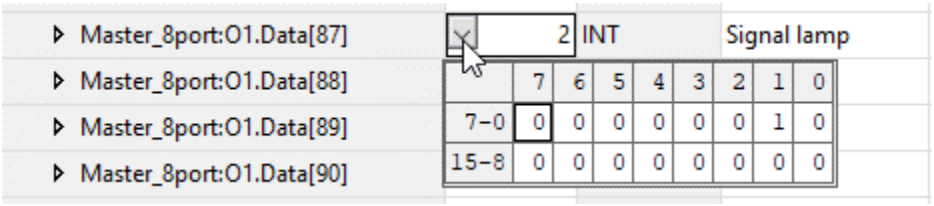
6. Return all other output values to 0 and confirm that the labeled tag is the correct one.

Name	Value	Data Type	Description
Master_8port:O1.Data[84]	0	INT	
Master_8port:O1.Data[85]	0	INT	
Master_8port:O1.Data[86]	0	INT	
Master_8port:O1.Data[87]	2	INT	Signal lamp
Master_8port:O1.Data[88]	0	INT	

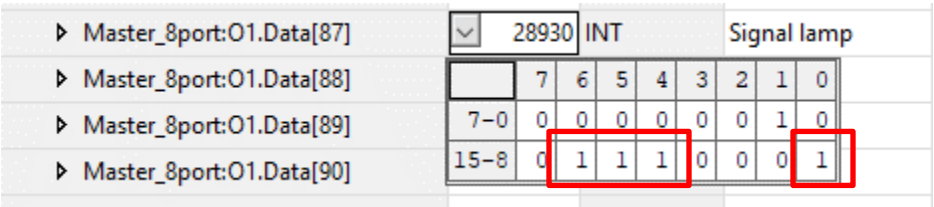
7. Click the tag's value box to reveal an arrow button.



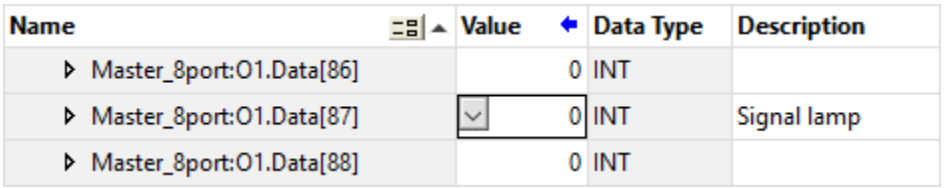
8. Click the button to reveal a table of bits.



9. Change the values of the bits in the high byte (bits 8 to 15) to test the buzzer. Bit 0 of that byte turns the buzzer on, while bits 4, 5, and 6 control the buzzer style. Test out several styles.



10. Change the value of the INT tag to **0.** This turns off the buzzer and lamp.



11. Go offline.

12. Save your Logix Designer project. In the next lab activity, you will integrate these tags into the PLC logic and bind them to new graphic elements on the HMI.

7. Authentic Skill Assessment

Have your instructor verify that your work meets the requirements in the performance objectives and sign below. Keep this lab activity sheet for future reference.

Instructor Signature	Date

8. Reset Steps

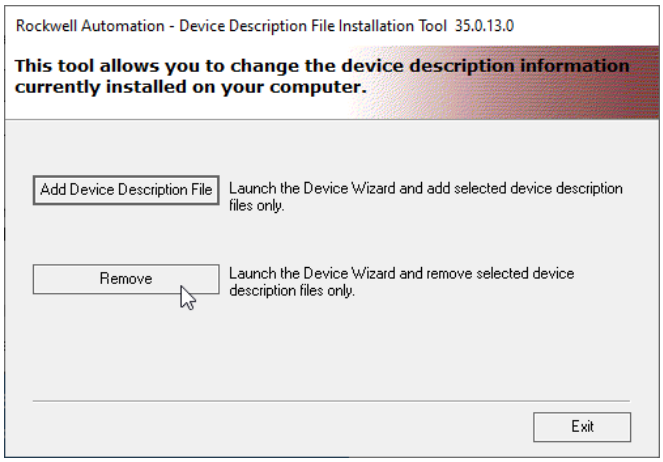
If someone else is going to be performing this lab activity after you, perform the reset steps below. Consult with your instructor before doing so.

8.1. Uninstalling EDS Files

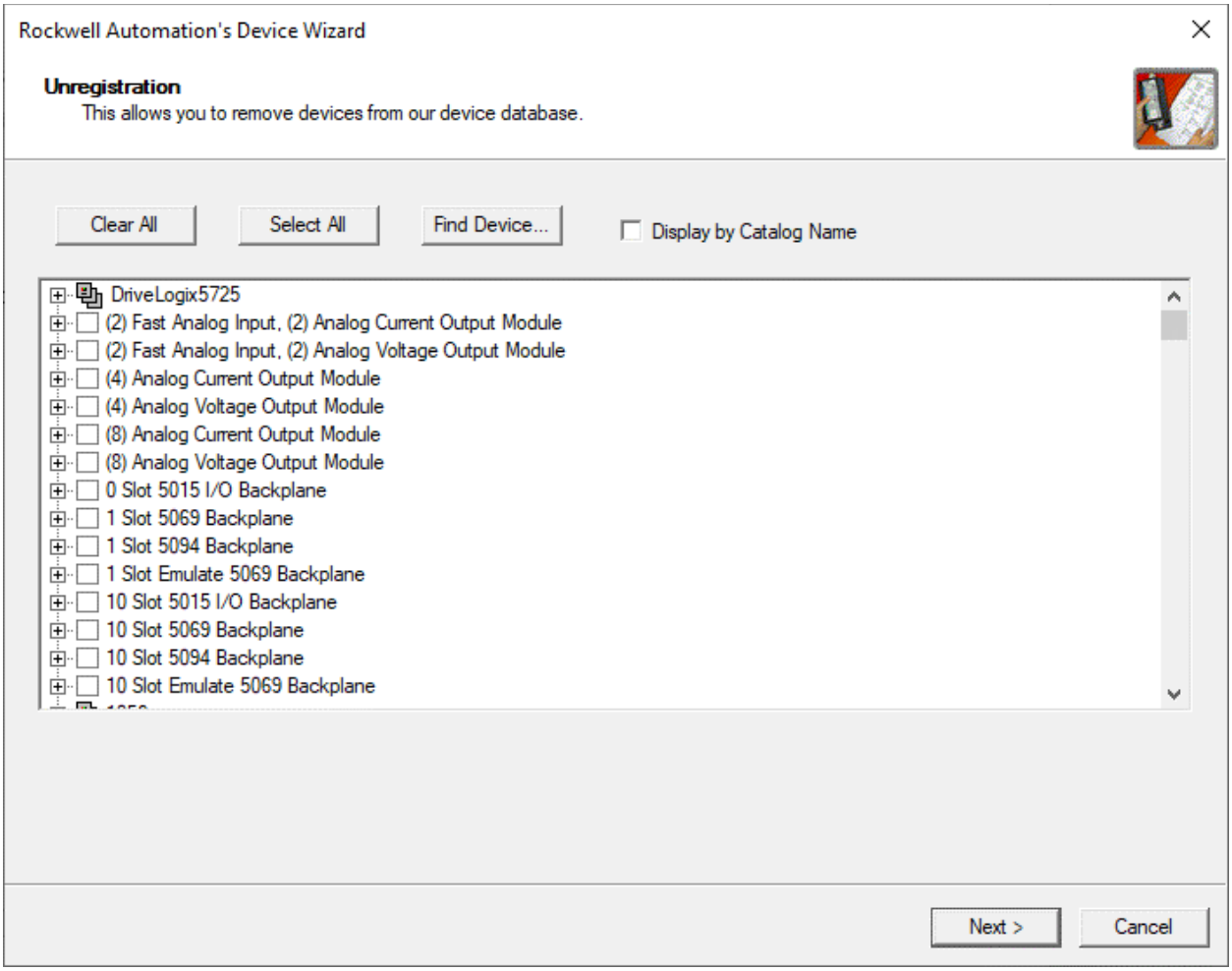
Perform these steps to uninstall the IO-Link master device description files:

1. From the Window's Start/Search area, open the **EDS Hardware Installation Tool** application.

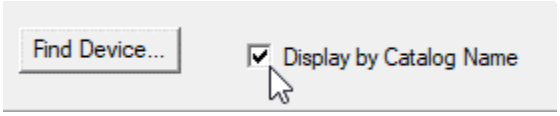
2. The application opens. Click **Remove**.



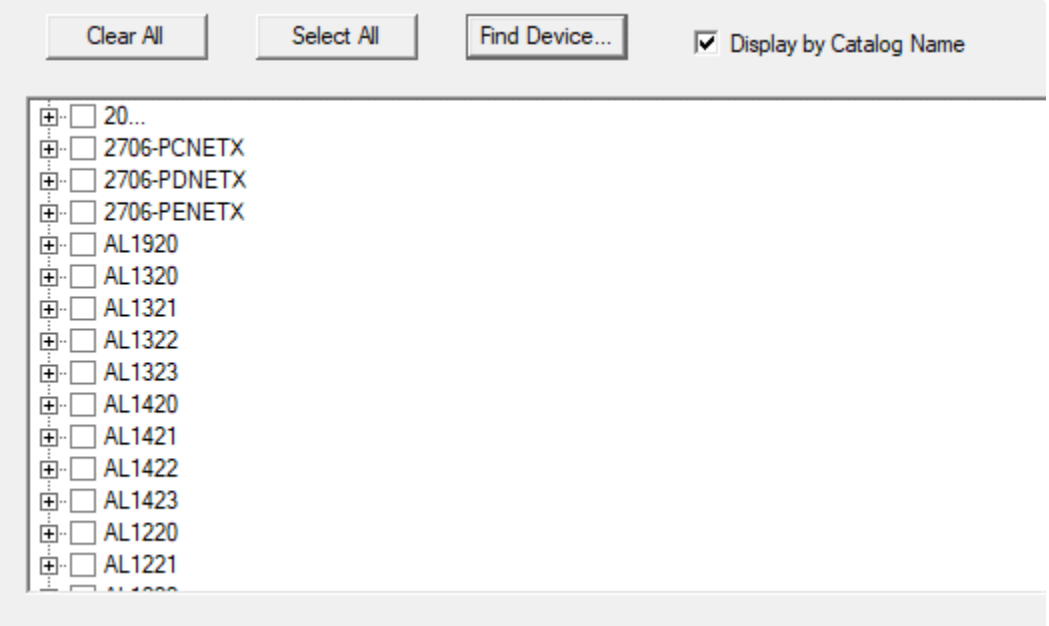
The Unregistration window is displayed.



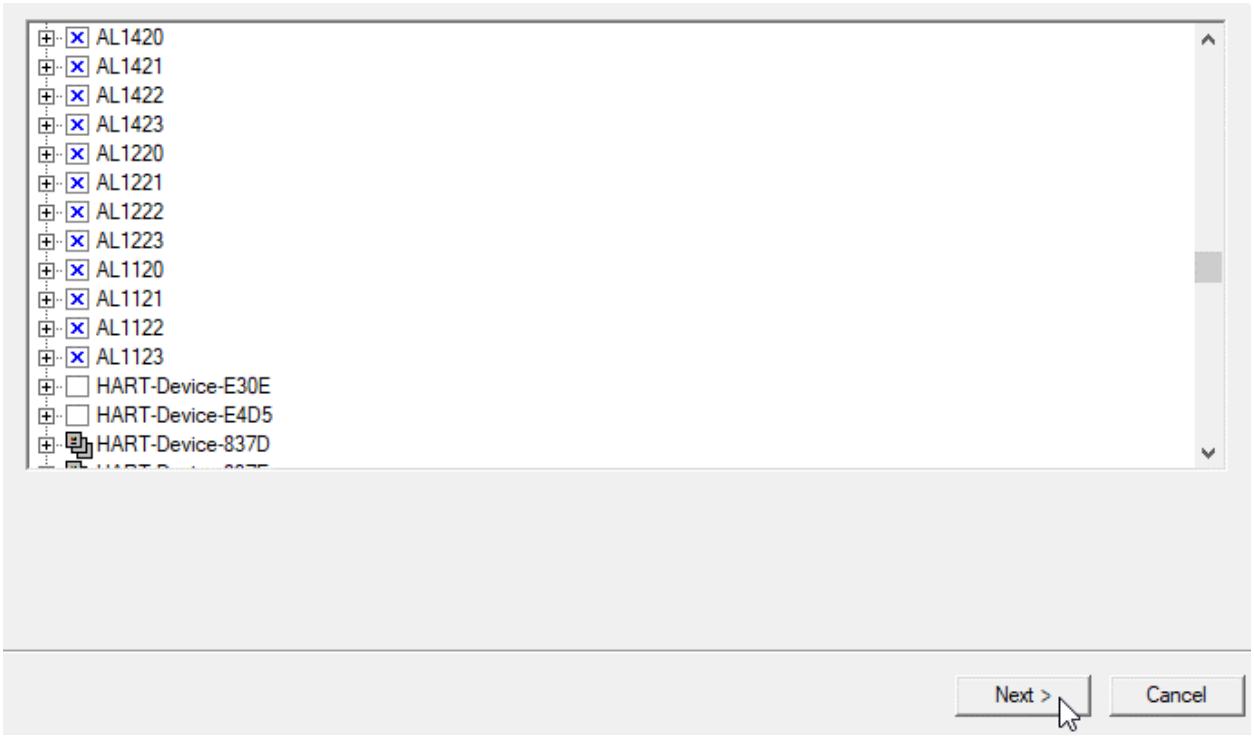
3. Check the **Display by Catalog Name** option.



4. The search option (Find Device) works poorly, and the devices shown on the list do not appear in any particular order. Therefore, scroll down the list until you find the IO-Link master IFM catalog numbers, which begin with AL.



5. Select all of the AL devices and then click **Next**.



6. Follow the rest of the steps of the Wizard to unregister the devices.

7. Exit the EDS Hardware Installation Tool.

9. Shutdown

Unless instructed otherwise by your instructor, review and complete each of the items on the checklist below.

- ☐ Close Logix Designer.
- ☐ Power down the I/O box.