Smart Devices for Industry 4.0

LAB ACTIVITY 1: CONNECTING THE IO-LINK MASTER

Name	Class/Period	Date

1. Overview

In this lab activity, you will physically connect an IO-Link master to your computer and configure the connection for network communication between the two devices.

2. Performance Objectives

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

- Physically connect an IO-Link master to a computer using a connecting wire (M12-Ethernet).
- Enable communication between the computer and IO-Link master.
- Write information to the IO-Link master.

3. Background

3.1. IO-Link

What is IO-Link?

IO-Link is a communications protocol used primarily for connecting sensors and actuators in an industrial setting.

Characteristics of IO-Link

The following are characteristics of IO-Link:

- It is typically used for communications to simple three-wire sensors and actuators.
- IO-Link communication works **point-to-point**. A point-to-point communication connection is a connection between two nodes (end points).
- IO-Link communication is **bi-directional** (works in both directions) and works over short distances.
- IO-Link systems can communicate with PLCs via **fieldbus** or **Ethernet** communication, allowing the IO-Link systems to be placed in remote locations.

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The IO-Link System

A typical IO-Link system contains an **IO-Link master** with slave devices such as sensors and actuators attached to it. The IO-Link master acts as a hub for the slave devices, and communicates over a fieldbus connection (PROFINET or Ethernet/IP, for example) to a higher-level controller, which is usually a PLC.

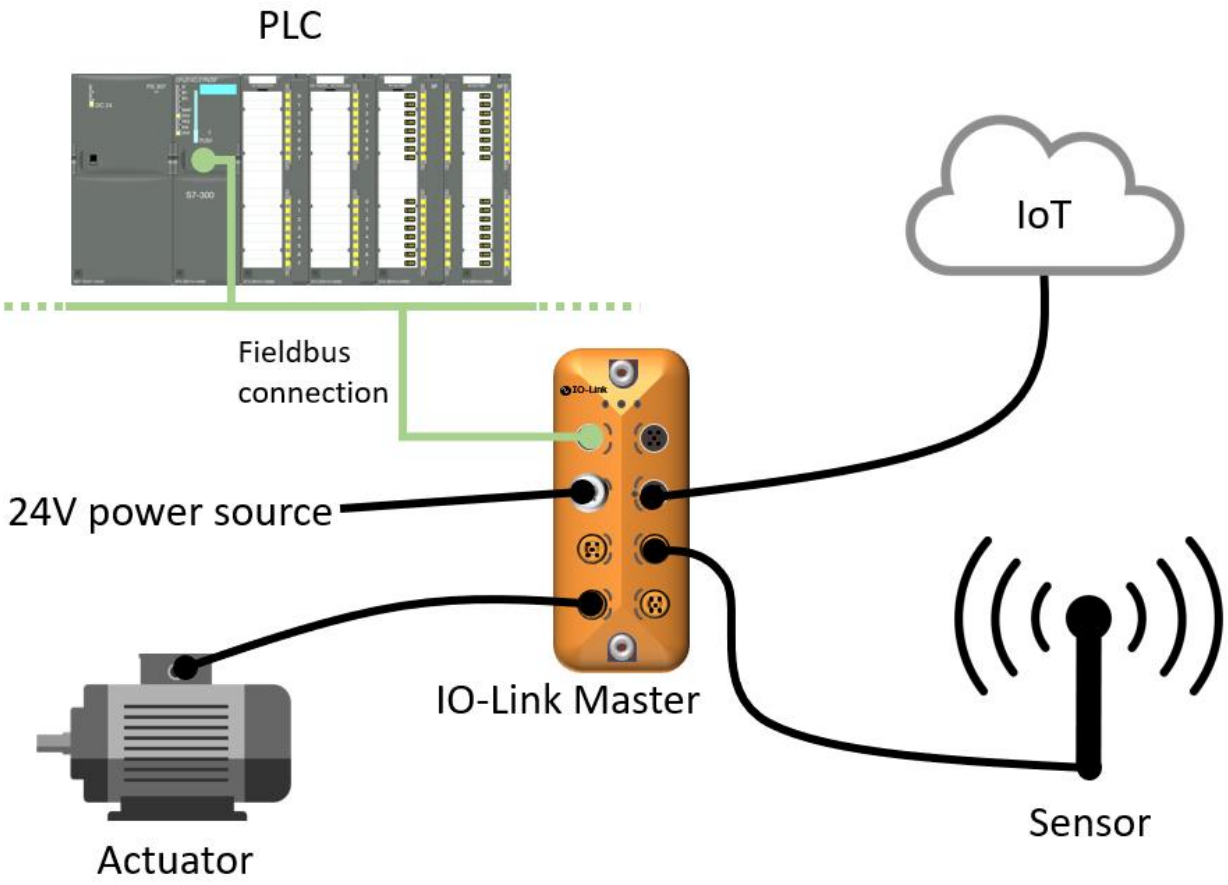


Figure 1. A sample IO-Link system with two IO-Link devices (a sensor and actuator).

The IO-Link Master

The IO-Link master establishes the connection between the automation system (usually a PLC) and controls the communication with connected **IO-Link devices** (field devices – sensors and actuators). It can be installed in the control cabinet or directly in the field.

Capable of processing both digital and analog data, the IO-Link master can integrate into existing systems and communicate using industry-recognized protocols such as PROFINET, PROFIBUS, or Ethernet/IP.

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Ports and Signal Types

An IO-Link master will have one or more IO-Link ports (also known as channels). Each port can connect to one IO-Link device, and this connection is point-to-point.

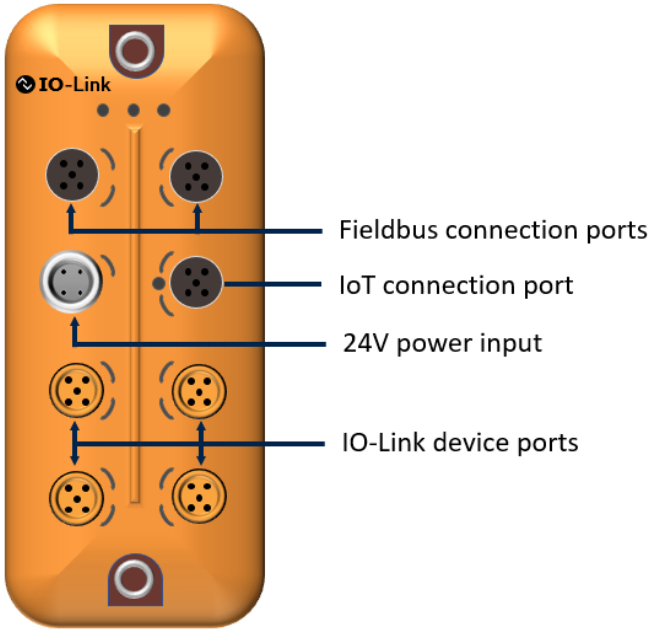


Figure 2. IO-Link master ports.

IO-Link device ports have four different signal types or operating modes:

- Deactivated (if the port is unused)
- Direct input (symbolized DI)
- Direct output (symbolized DQ)
- IO-Link communication

There are several types of **IO-Link communication**:

- Process data
- Value status
- Diagnostic data (such as diagnostics and events)

Process data and value status are transmitted at periodic intervals (cyclic transmission). Diagnostic data is only transmitted when it is required (acyclic transmission).

4. Required Materials

You need these materials to complete the lab activity:

- IO-Link master (“the master”)
- Computer
- Ethernet switch (optional)
- Up to 4 smart devices (optional)
- IO-Link master power cable
- IO-Link master Ethernet cable

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5. Required Software

The following software is required for this lab activity:

- Ethernet Configuration Tool (Hilscher)
- Moneo Configure Free v2.0.0 or later.

6. 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.
- ☐ All required software is installed in your computer.

7. Lab Activity

7.1. The Physical Connection

In this task, you will physically connect the IO-Link master to a 24V power source using the power cable. You will also connect the master to your computer or Ethernet switch using the provided Ethernet cable.

Perform these steps:

1. Connect the power cable to the master's 24 power input port. Ensure that the slit on the power cable aligns with the protrusion. Manually tighten the screw on the power cable to secure the connection.



Figure 3. Ensure that the protrusion on the Power IN port and the slit on the power cable are aligned.

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2. Connect the other end of the power cable to a power source such as a wall socket. After completing the connection, the Power IN LED is illuminated green. The IO-Link device port LEDs flash green.



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3. Connect the M12 end of the M12-Ethernet cable to the IoT port of the master. Connect the Ethernet end of the cable to your computer or Ethernet switch.

ⓘ ***Note:*** *When connecting the M12 end, ensure that the protrusion on the cable and the slit on the IoT port are aligned.*

ⓘ ***Note:*** *Connecting M12 ends of the cables to the ports on the master also requires a screwing action.*



Figure 4. IO-Link master connected to a computer via the IoT port. The green LED indicates a connection, while the yellow LED indicates that data is being transferred.

4. Optionally, connect smart devices to the master's four IO-Link ports.

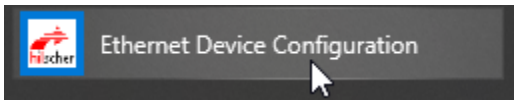
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7.2. Device Communication

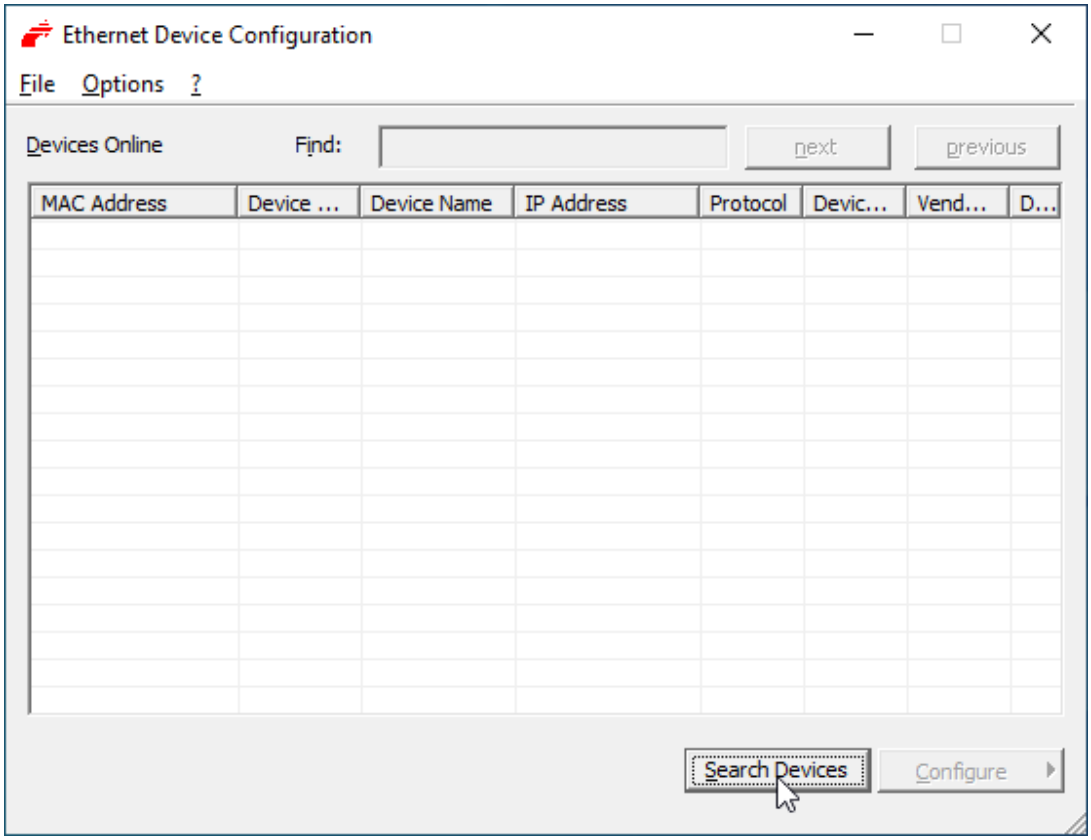
In this task, you will enable communication between your computer and the IO-Link master and either determine or define the master's IP address.

Perform these steps:

1. Open the Ethernet Device Configuration application.



2. Click **Search Devices**.



The configuration tool searches for and finds the IO-Link master.

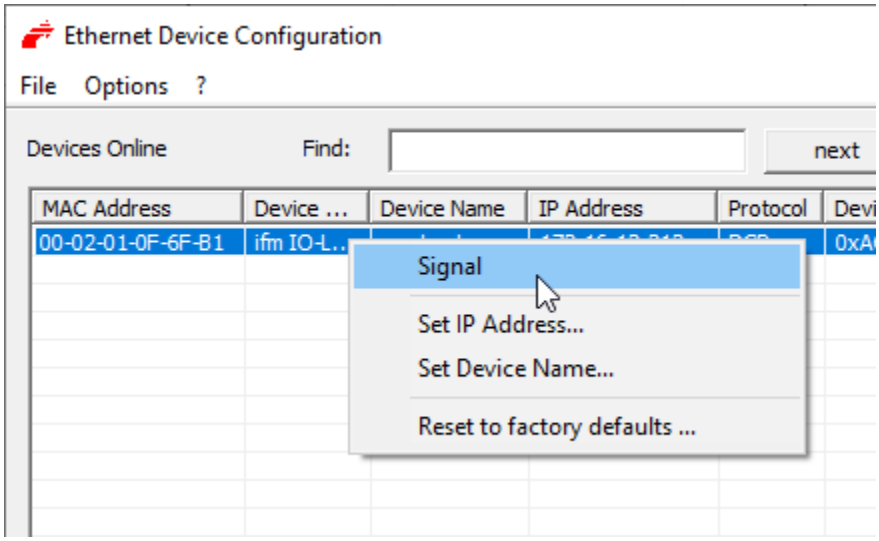
Right-clicking the row with the IO-Link device information brings up a pop-up menu. Alternatively, you can select the device from the list, and then select **Configure > Set IP Address**.

If the IP address for the IO-Link master has not been set, consult your institution's IT professional and set it now.

ⓘ ***Note:*** *The IP address of the computer must be in the same subnet as the IO-link master.*

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3. From the device list, right-click the device and select **Signal**.



The IoT LED next to the IOT port flashes green.

Figure 5. IoT port blinking green. Click or scan the above QR code to watch the video.

4. Open the Moneo Configure application.

5. Ensure that you are in the Device Management tab and then click the **+** button to add a new device.

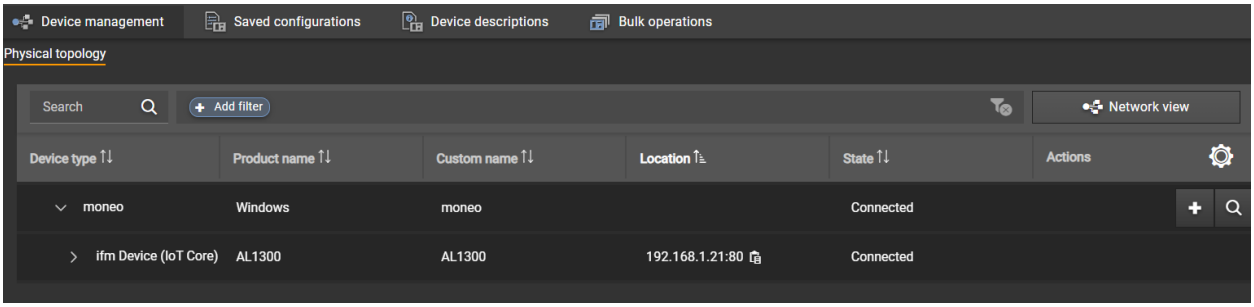
   a. For device type, select **ifm Device (IoT Core)**.

   b. For IP/Hostname, enter the device's IP address (that you may have configured in step 2 above).

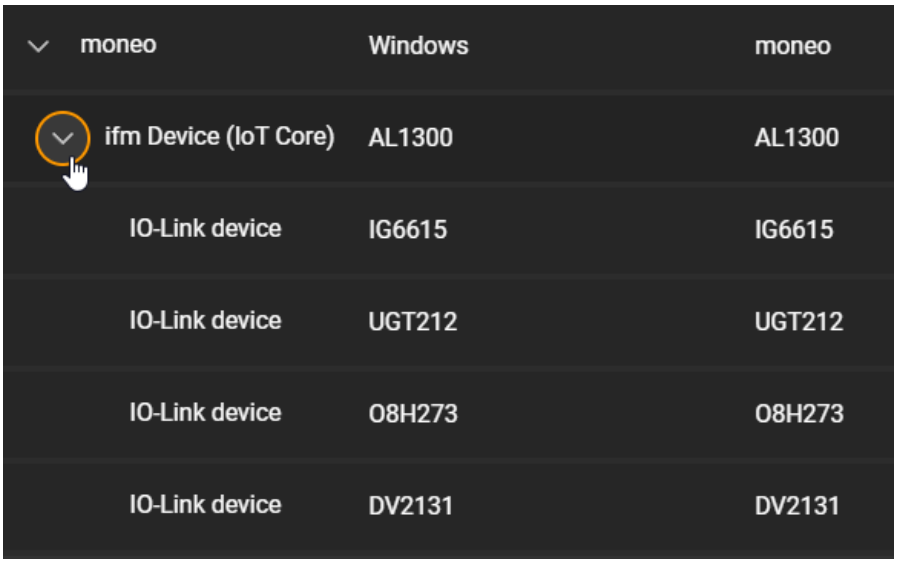
   c. Leave all other fields as default.

   d. Click **OK**. The IO-Link master is displayed on the list.

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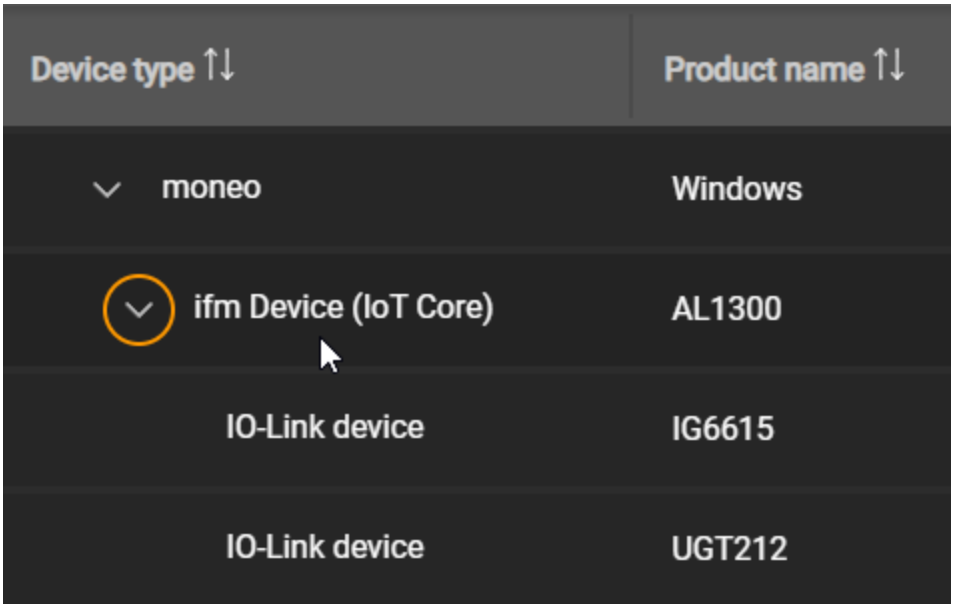


Clicking the arrow next to the master displays the master's ports and any connected devices. In this image, there are four connected smart sensors.



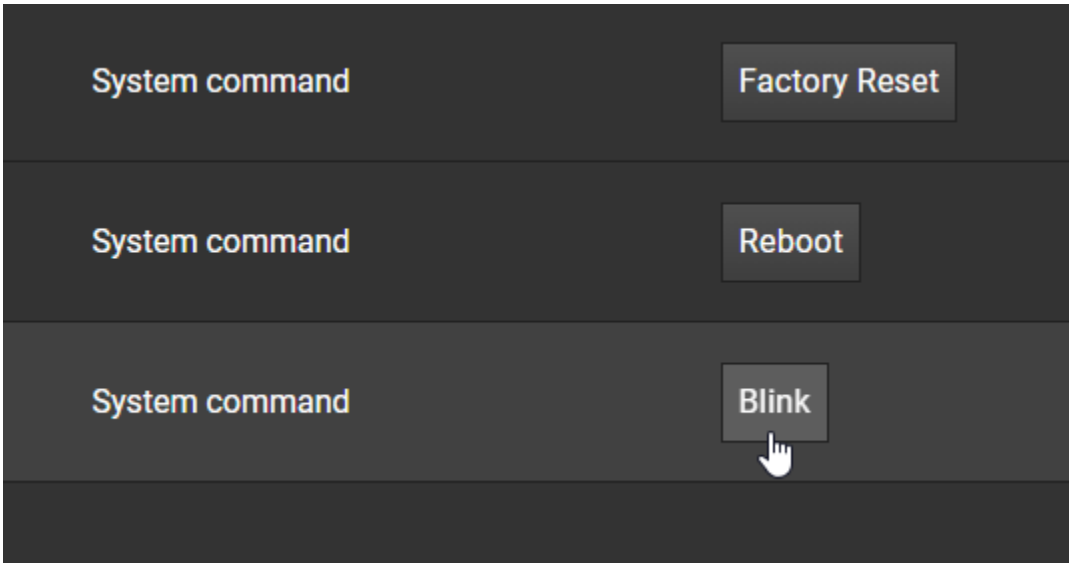
6. Click **Network view** to see the network, and them return to **List view**.

7. From the device list, click the IO-Link master.



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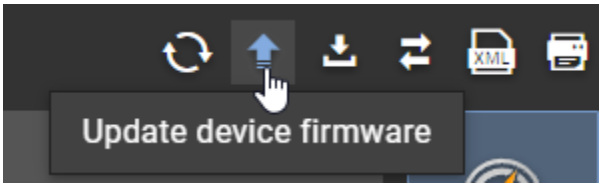
8. The master's configuration page is displayed. This page conains all of the configuration settings for the master. Scroll down to the bottom of the page and click **Blink**. This signals the master, causing the IoT LED to flash.



ⓘ ***Did you know?*** *Besides confirming that communication is enabled, signaling a device also helps identify it in the field or on the factory floor.*

9. Optionally, click **Factory Reset**. You may want to reset the device to its factory settings to overwrite the settings that were configured by any previous users.

   You may also want to update the device firmware. This is done using via the up-arrow button at the top of the screen.

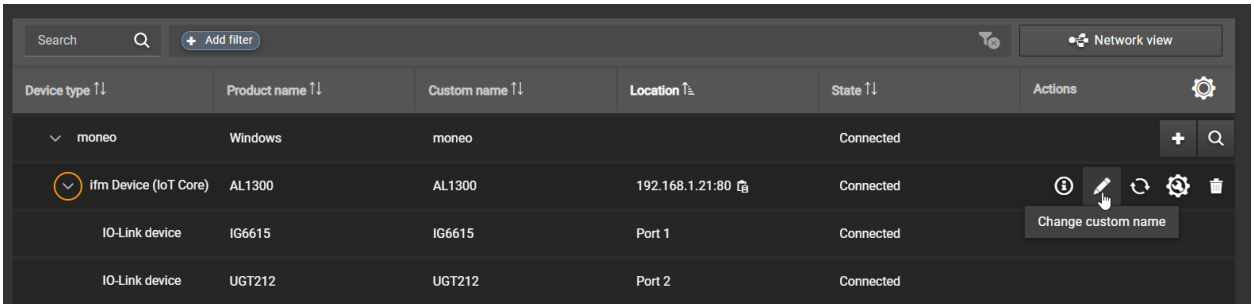


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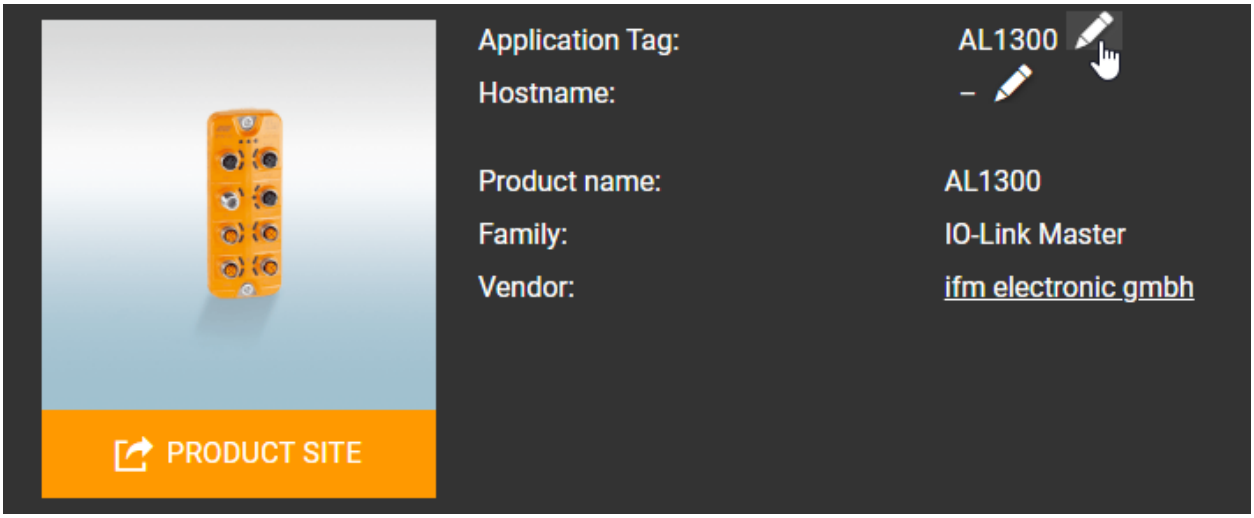
7.3. Writing to the IO-Link Master

In this next task, you will change the master's name and application tags. These items make the device more identifiable to engineers and technicians.

1. Click **Back** or the home button to return to the device list.
2. On the master's device row, click the **Change custom name** button.



3. In the Node name field, add a word or phrase such as "Station 1 IO-Link Master" that will make the IO-Link master more easily identifiable.
4. Click the master to return to the configuration settings.
5. Click the pencil icon next to the application tag.



6. The page scrolls down automatically to the application tag area. Change the application tag to "Station 1 master" or similar.
7. Note that this change is unsaved. It must be written to (ie, transferred to) the actual device. At the bottom of the screen, click **Write to Device**.

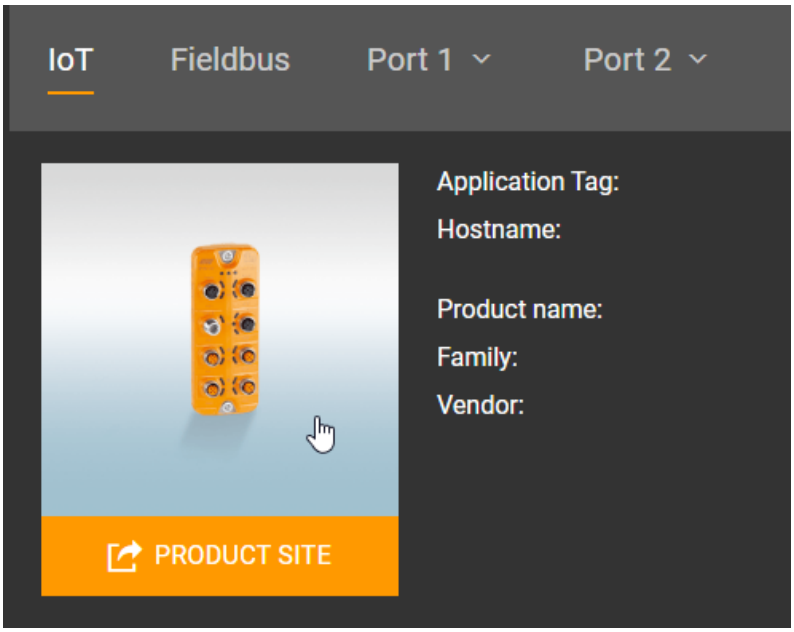
   A popup shows that the changes have been written to the master. The changes are saved.
8. Show the new application tag to your instructor.
9. Signal the IO-Link master to blink. Show the flashing IoT LED to your instructor.

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7.4. The Device Manual

All IO-Link devices that you will be working with in this course have their own device manuals. Those product manuals, as well as other useful related files, can be found on the device's product site.

- To access a product site, click the device's image at the top of its configuration page. An internet connection is required.



Take some time now to explore your IO-Link master's specifications and device menu on its webpage. When you are finished, close the browser, the Moneo Configuration application and the Ethernet Device Configuration application.

8. 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

9. Shutdown

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

- ☐ The IO-link master is disconnected and stowed away.
- ☐ The connecting cables are stowed away.

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