Smart Devices for Industry 4.0

LAB ACTIVITY 3: ULTRASONIC SENSOR

Name	Class/Period	Date

1. Overview

In this lab activity, you will physically connect an ultrasonic sensor to the IO-Link master and explore the sensor's capabilities.

2. Performance Objectives

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

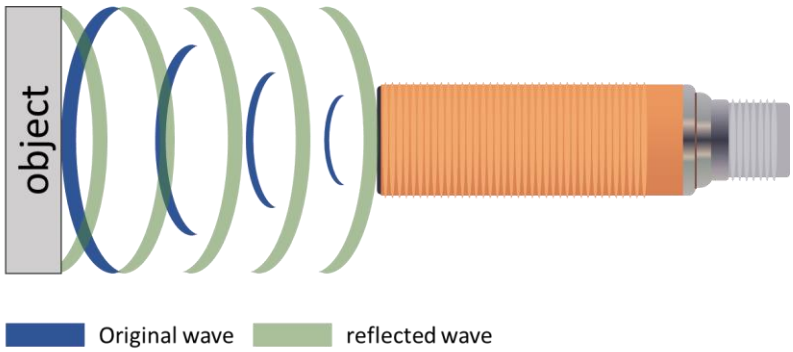
- Physically connect an ultrasonic sensor to the IO-Link master using the M12-to-M12 IO-Link connection cable.
- Enable communication between the computer, the IO-Link master, and the ultrasonic sensor.
- Explore the different outputs of the ultrasonic sensor.
- Determine the best size and shape for an object that can be detected by the ultrasonic sensor.
- Adjust ultrasonic sensor settings.

3. Background

3.1. Ultrasonic Sensor with IO-Link

What is an Ultrasonic Sensor?

Ultrasonic sensor is a proximity sensor that uses high frequency sound waves - typically 25 to 50 kHz - which are higher than the audible limit of human hearing. The sensor has a transmitter and a receiver. It transmits an ultrasonic wave. The wave hits the object and bounces back (echo). The sensor then measures the delay between the transmitted signal and the received signal in order to calculate the distance between itself and the object.



© 2026 Intelitek Inc. All rights reserved | IO-Link_Conf_A3_Ultrasonic_Sensor_v1.0

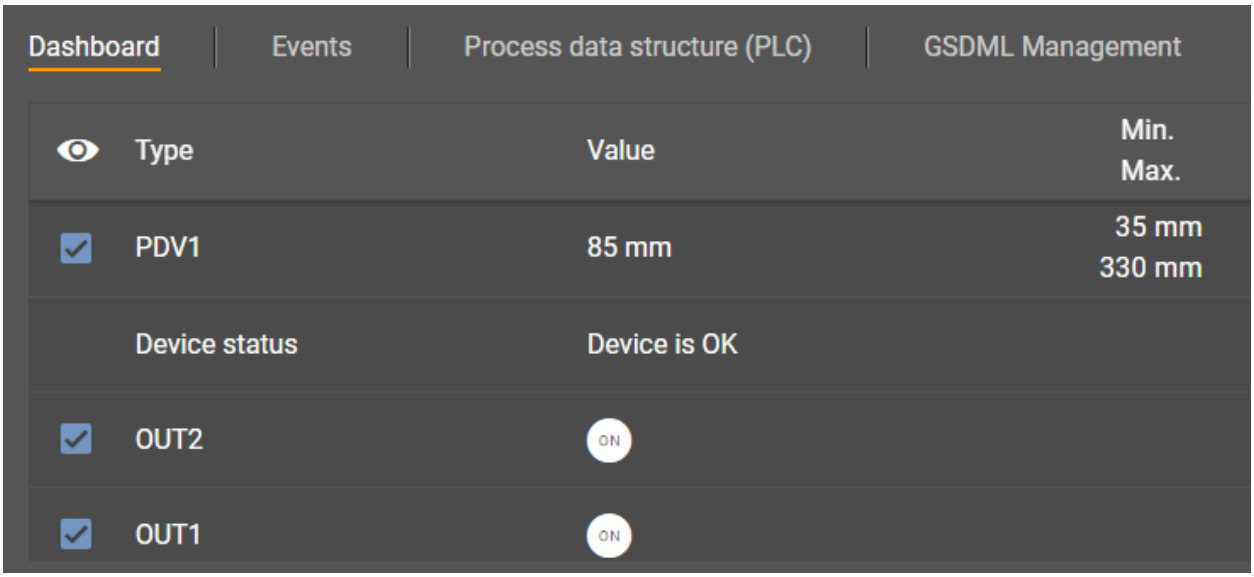
Characteristics of the IO-Link Ultrasonic Sensor

The following are characteristics of your ultrasonic sensor:

- It connects to the IO-Link master via an M12-to-M12 IO-Link cable.
- It sends the master one type of analog and two types of digital data.
- The analog data is the **P**rocess **D**ata **V**ariable (PDV) that holds the actual proximity value of the object as detected by the sensor.
- The digital data are the two switching signal channels (SSC). See the Inductive Sensor lab activity to review what these channels are.
- The sensor has a yellow status LED that is activated when the selected switching output is ON.
- The sensor has a green LED that is activated when a reflected signal is detected.

The Dashboard

When the ultrasonic sensor is connected to the master and selected in the Device catalogue the components of the Dashboard indicators look like this:



PDV1 (Process Data Variable) shows the actual distance of the object from the sensor (in micrometers).

- When the distance exceeds the upper limit, PDV1 displays **OL (Over Limit)**.
- When the distance is below the lower limit, PDV1 displays **UL (Under Limit)**.

The Device status area displays the device status.

OUT1 and OUT2 are the digital switching channels (SSC1 and SSC2) that change according to the setup.

© 2026 Intelitek Inc. All rights reserved | IO-Link_Conf_A3_Ultrasonic_Sensor_v1.0

4. Required Materials

You need these materials to complete the lab activity:

- IO-Link master (“the master”)
- Computer connected to the Internet
- Ethernet switch (optional)
- Ultrasonic sensor with IO-Link
- IO-Link master power cable
- IO-Link master Ethernet cable
- M12-to-M12 IO-Link connection cable
- A ruler
- Brass piece
- Marked aluminum cylinder
- Round steel bar
- Blue prism
- Plexiglass block
- Magnet

5. Required Software

The following software is required for this lab activity:

- Moneo Configure software
- Ethernet Configuration Tool (Hilscher)

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. Connections

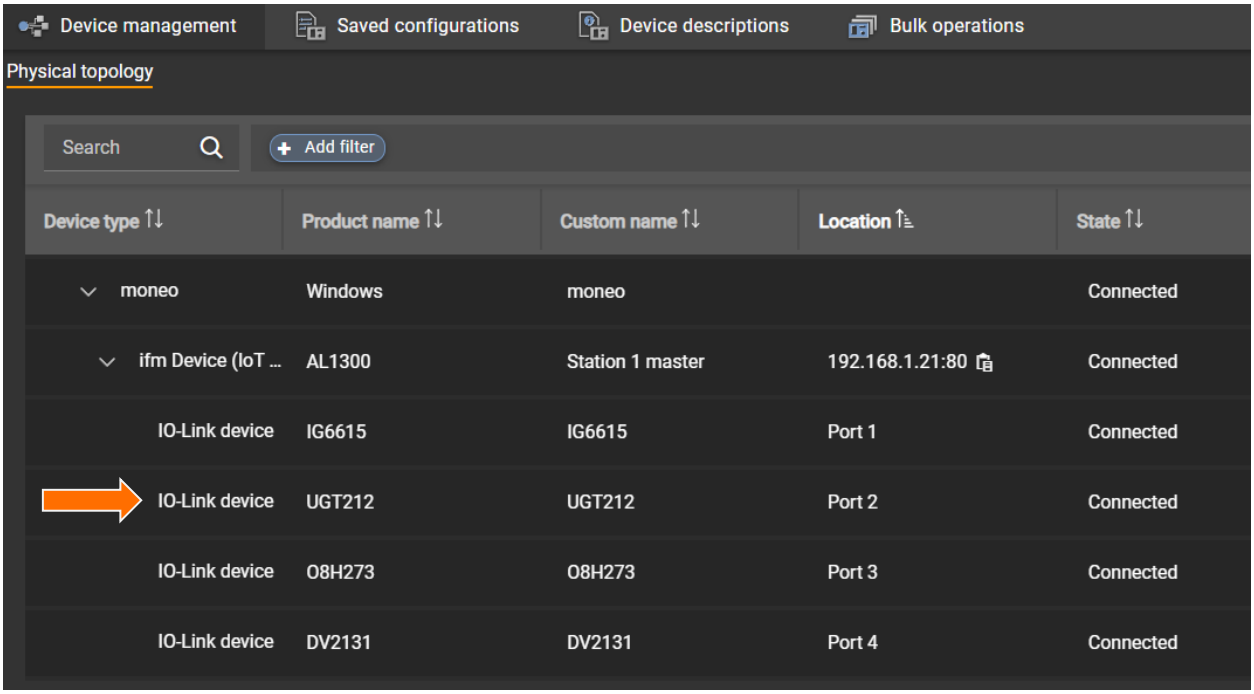
In this task, you will physically connect the ultrasonic sensor to the master using an M12-to-M12 connection cable. You will also connect the master to the Moneo application. Perform these steps:

1. Connect the power cable to the master’s 24 power input port. Connect the other end to a power source.
2. 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. Observe the LEDs to ensure that a connection has been made.

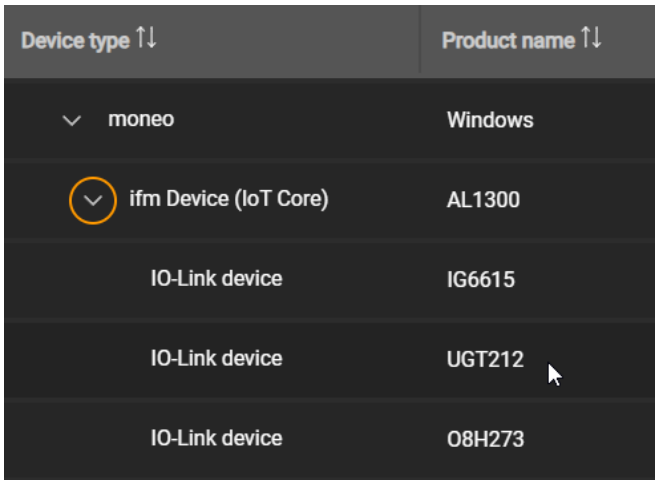
© 2026 Intelitek Inc. All rights reserved | IO-Link_Conf_A3_Ultrasonic_Sensor_v1.0

3. Connect one end of the IO-Link connection cable to the sensor. Ensure that the slit on the connection cable aligns with the protrusion. Manually tighten the screw on the power cable to secure the connection.
4. Connect the other end of the IO-Link cable to one of the master's free IO-Link input ports.
5. Enable communication between the master and your computer using the Moneo Configure application and, if necessary, the Ethernet Configuration Tool.

Once connected, the master's parameters are displayed in Moneo Configure. The ultrasonic sensor, connected to Port 2, is indicated in the image below.

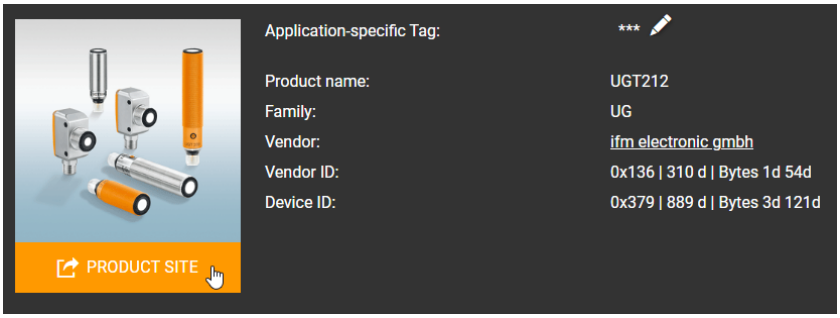


6. Click the sensor to view its settings.



© 2026 Intelitek Inc. All rights reserved | IO-Link_Conf_A3_Ultrasonic_Sensor_v1.0

7. If you have an internet connection, take some time to review the device on the product site.



7.2. Writing to the IO-Link Master

In this next task, you will change the sensor's **application-specific tag**. The application-specific tag is a name given to the sensor to make it more identifiable in the field or factory floor where many of these devices may be present.

1. In the **Application-specific Tag** field, add a word or phrase such as "Ultrasonic Sensor Station 1" that will make the sensor more easily identifiable. If such a tag already exists, make a small change to the text.
2. In the menu at the bottom right, click **Write Changes to device**. The application tag is written to the master, and the *Unsaved changes* indicator is no longer present.
3. Show the new application tag to your instructor.

7.3. Using Objects of Different Shapes and Sizes

In this next task, you will explore the ultrasonic sensor's readings when exposing the sensor to objects of different size and shape.

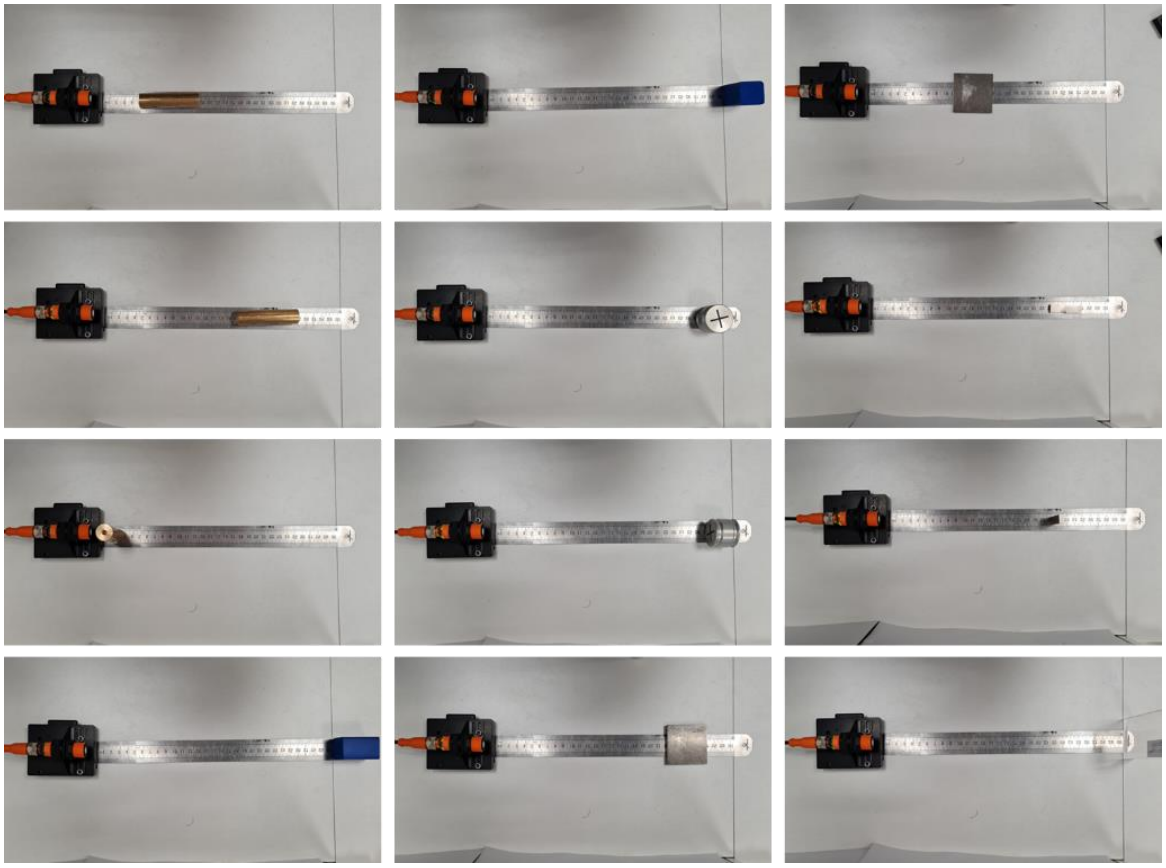
1. Place a ruler on a flat surface (close enough to the sensor) and place the ultrasonic sensor at the 0 mark of the ruler.



2. Open the **Dashboard** screen (gauge button on the top-right).

© 2026 Intelitek Inc. All rights reserved | IO-Link_Conf_A3_Ultrasonic_Sensor_v1.0

3. Explore the ultrasonic sensor output when using the different objects. Place each object at multiple distances and in various positions. Share your findings with your classmates and instructor.



Top view of the ultrasonic sensor, the ruler, and the different objects.

This task shows us that the ultrasonic sensor is not affected by the material of the object, but by the shape and size of the object.

You may have noticed that the sensor has a “blind spot”. When the object is too close to the sensor, the sensor cannot detect the distance. This is because the delay between the transmission and reflection of the wave is too small to calculate.

© 2026 Intelitek Inc. All rights reserved | IO-Link_Conf_A3_Ultrasonic_Sensor_v1.0

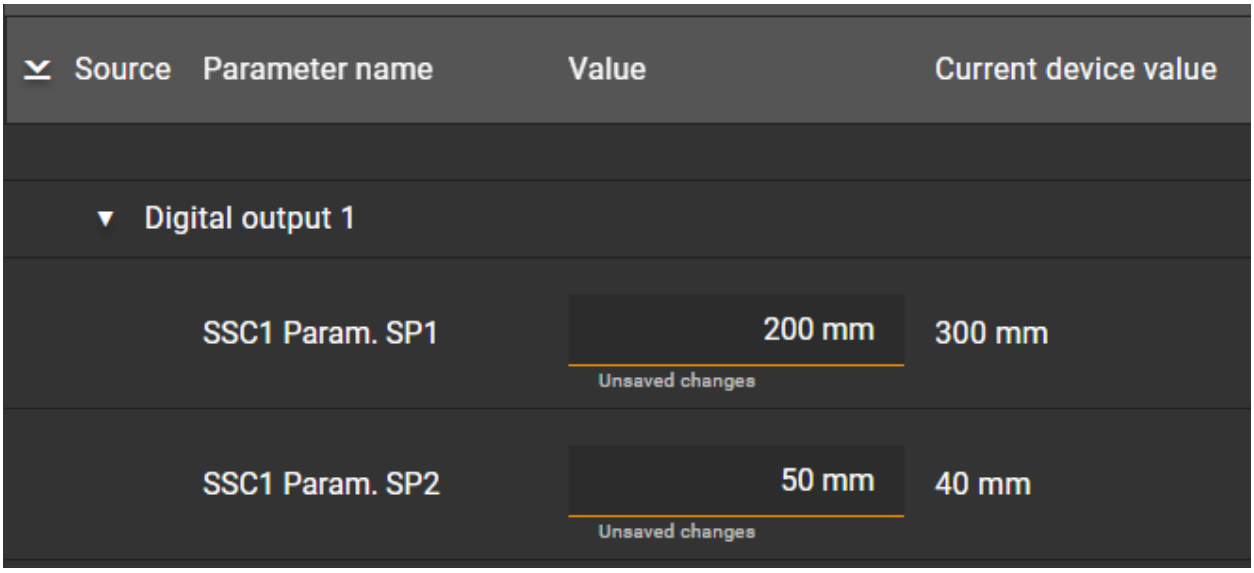
7.4. Changing the Default Settings

In this next task, you will learn how to change some of the setting parameters of the ultrasonic sensor SSC indicator and see how the changes affect the reading on the Dashboard display. Some of the settings similar to those of the previous lab activity.

ⓘ ***Note:*** *In this task, you will change the SSC1 indicator settings. The same changes can be done for the SSC2 indicator settings.*

Setpoint 1 and Setpoint 2

1. Scroll down to the Digital output 1 area. In the **SSC1 Param. SP1** field, change the value to **200**.
2. In the **SSC1 Param. SP2** field, change the value to **50**.



ⓘ ***Note:*** *Once you change the value the pencil icon appears to the left of the value text box. That means that the change hasn't been written to the master yet.*

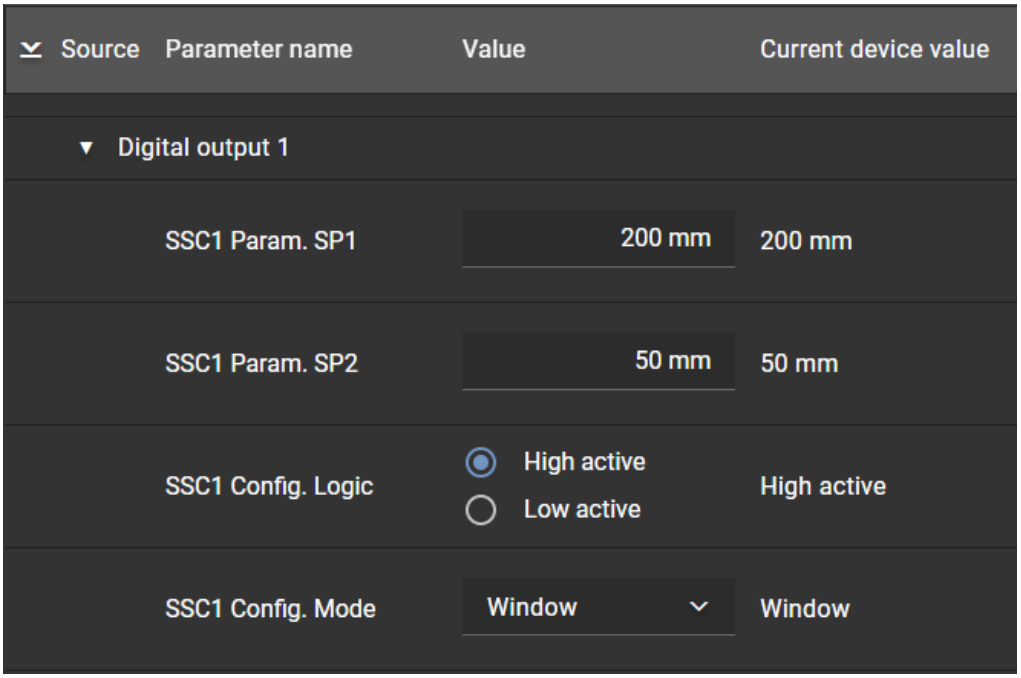
3. In the menu at the bottom-right, click the **Write Changes to device** button. You got an error! The reason is that the default setting of the "SSC1 Config. Mode" is *single point* (review the previous lab activity to see what this means) and it requires SP2 to be 40 mm. Click **OK** to close the error message box.
4. Change the value of SP2 to **40** and save the changes by clicking the **Write Changes to device** button.
5. Open the **Dashboard** screen. Take one of the objects and place it near the ultrasonic sensor. Observe the value on the Dashboard. Note that OUT1 is ON only when the value of PDV1 is less than 200 mm (SP1). This is because the SSC mode is single point by default.

© 2026 Intelitek Inc. All rights reserved | IO-Link_Conf_A3_Ultrasonic_Sensor_v1.0

Mode

In this task you will change the mode of the sensor and observe the changes in readings.

1. In the Digital output 1 **SSC1 Config. Mode** dropdown menu, select **Window**.
2. In the Digital output 1 **SSC1 Param. SP2** field, enter **50**.



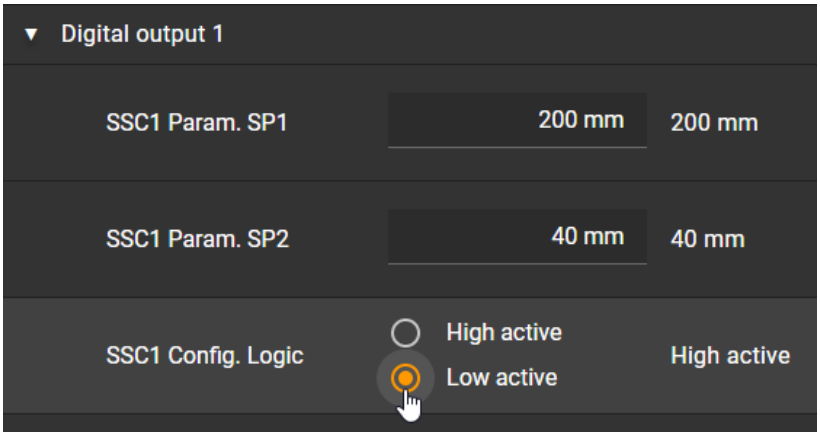
3. Write the changes to the device.
4. Go to the Dashboard screen.
5. Take the object and place it near the ultrasonic sensor. Observe the value and note when the OUT1 indicator changes to ON.
6. In the SSC1 Config. Mode dropdown menu, select **2Point**.
7. Write the changes to the device.
8. Observe the Dashboard screen. Take the object and place it near the ultrasonic sensor. Observe the value and note when the OUT1 indicator changes to ON.
9. Return to the Setup window. In the SSC1 Config. Mode dropdown menu, select **1Point**.
10. In the SSC1 Param. SP2 field, enter **40**.
11. Write the changes to the device.

© 2026 Intelitek Inc. All rights reserved | IO-Link_Conf_A3_Ultrasonic_Sensor_v1.0

Normally ON/Normally OFF

In this task, you will experiment with the default on/off settings of the sensor.

1. In the SSC1 Config. Logic row, select **Low active**.



2. Write the changes to the device.
3. Observe the **Dashboard** screen. Note that the OUT1 indicator is ON by default.
4. Take the object and place it near the ultrasonic sensor. Observe the value on the Dashboard and note when the OUT1 indicator changes to OFF.
5. In the **SSC1 Config. Logic** row, select **High active**.
6. Write the changes to the device.

Switch-On Delay and Switch-Off Delay

In this task, you will experiment with the sensor delay settings.

1. For the digital output 1 **SSC1 Switch-On delay**, change the value to **1000** ms (1 second).

ⓘ ***Note:*** *the maximum delay that you can set is 2000 ms (2 seconds), this is true for the switch-on and the switch-off delay.*

2. Click the **Write changes to device** icon to save the changes.
3. Observe the **Dashboard** screen. Take the object and place it near the ultrasonic sensor. Observe the Dashboard values and note that the OUT1 indicator changes to ON *one second* after the value on PDV1 becomes less than 200 mm.
4. In the **SSC1 Switch-Off delay** field, change the value to **2000** ms (2 seconds). Write the changes to the device.
5. Observe the **Dashboard** screen. Place the object near the ultrasonic sensor. Look at the values on the Dashboard and note that the OUT1 indicator changes to OFF *two seconds* after the value of PDV1 exceeds 200 mm.

© 2026 Intelitek Inc. All rights reserved | IO-Link_Conf_A3_Ultrasonic_Sensor_v1.0

6. For both the **SSC1 Switch-On delay** and **SSC1 Switch-Off delay** fields, change the value to 0 ms. Write the changes to the device.

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.

- ☐ Restore the sensor's factory settings. To do so navigate to **Setup > Restore Factory Settings > Execute command**.
- ☐ Close the Moneo Configure application and, if necessary, the Ethernet Device Configuration application.
- ☐ Disconnect and stow away the master, sensor and connecting cables.

© 2026 Intelitek Inc. All rights reserved | IO-Link_Conf_A3_Ultrasonic_Sensor_v1.0