User Manual

Allen-Bradley

45LMS Laser Measurement Sensor with IO-Link Interface 45LMS-D8LGC*-D4 and 45LMS-U8LGC3-D4

IO-Link CE

Allen-Bradley • Rockwell Software

Rockwell Automation

Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts, sample programs and layout examples shown in the guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Rockwell Automation does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Rockwell Automation publication SGI-1.1, Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control (available from your local Rockwell Automation sales office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

Throughout this manual we use notes to make you aware of safety considerations:

WARNING	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
ATTENTION	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequences.
SHOCK HAZARD	Labels may be on or inside the equipment (for example, drive or motor) to alert people that dangerous voltage may be present.
BURN HAZARD	Labels may be on or inside the equipment (for example, drive or motor) to alert people that surfaces may reach dangerous temperatures.

It is recommended that you save this user manual for future use.

Product Overview

Product Description

The 45LMS family of long-distance laser sensors is available in various measuring ranges. The 8 m (26.2 ft) diffuse and 50 m (164 ft) retroreflective models use a Class 1 visible red laser and the 15 m (49.2 ft) diffuse models use a Class 2 visible red laser. The discrete and analog outputs can be easily set using the five-step rotary switch and the push button. Potential applications include object position (analog output) and object detection (background suppression with discrete output).

This sensor uses the Time of Flight (ToF) principle and has a relatively small beam spot even at 15 m (49.2 ft) away. The sensor is completely self-contained and does not require any external control devices, which add cost and, require additional mounting space.

The 45LMS is easily set up by mounting the sensor such that the target is within the operating range of the sensor and teaching in the appropriate set-points that are required for the application. All sensors in this family have one discrete output with one analog output. The discrete output can be wired for either light operate (L.O.) or dark operate (D.O.) and the analog output is automatically scaled between the selected set-points with either a positive or negative slope.

The 45LMS is an excellent solution for long-range detection and measurement applications including: distance measurement, verifying material position, stack level, thickness measurement, roll diameter, positioning fixtures, error proofing inspection, long standoff distance, level monitoring, crane crash protection, and other difficult applications that exceed the capabilities of standard diffuse or background-suppression photoelectric sensors.

The 45LMS Laser Measurement Sensor offers an IO-Link interface. The IO-Link interface enables consistent communication for diagnosing and parameterizing through to the sensor level and makes the intelligence that is already integrated in every 45LMS sensor fully available to the user. This provides advantages in the service area (fault elimination, maintenance, and device replacement), during commissioning (cloning, identification, configuration, and localization) and during operation (job changeover, continuous parameter monitoring, and online diagnosis).

Operating Modes

The sensor can operate in two modes:

Standard IO (SIO) Mode: The sensor-default operation mode. The sensor outputs and user interface behave as described in the installation instructions included with the product. This mode of operation is active when the sensor is connected to digital input devices such as a PLC inputs modules, distribution boxes, and input terminal connections.

IO-Link Mode: This mode is automatically activated when the sensor is connected to an IO-Link enabled master device. Upon entering this mode, the green LED on the sensor starts blinking at a rate of one hertz to indicate that IO-Link communication has been successfully established with the master. The sensor transmits more parameter and diagnostic information that can be accessed via the PLC process data. No user intervention is required to enable this functionality within the sensor.

When operating with IO-Link, other options become available, such as evaluation of the detected mark and background, display of measured values, and sensor diagnosis.

Features

- Eye Safe Class 1 or Class 2 laser
- 8 m (26 ft), 15 m (49 ft), or 50 m (164 ft) sensing range
- One discrete output (1 x NPN/PNP) and one analog output (1 x 4…20 mA)
- Easy setup of switch points or analog scaling using programming buttons
- IP65 enclosure
- Self-contained sensor
- 10 ms response time
- Adjustable-position micro (M12) quick disconnect (QD)
- IO-Link communication protocol helps minimize downtime and increase productivity
- IO-Link sensors are forward/backward compatible with standard sensors: the same sensors and same cables that are used in IO-Link and non-IO-Link applications
- IO-Link provides
  - Remote detection of the health of the sensor,
  - Unique description/name of the sensor,
  - Storage of multiple profiles/recipes, and
  - Ability to lock the sensor to minimize the settings being changed.

Specifications

Certifications	cULus Listed and CE Marked for all applicable directives
Environmental	
Operating Environment	IP65
Vibration	10…55 Hz, 0.5 mm amplitude, three planes; meets or exceeds IEC 60068-2-6
Shock	30 g with 11 ms; three planes; meets or exceeds IEC 60068-2-27
Operating Temperature [C (F)]	-30…50° (-22…122°)
Storage Temperature [C (F)]	-30…70° (-22…158°)
Optical	
Light Source	Class 1 laser, visible red 660 nm (for 8 m and 50 m models) Class 2 laser, visible red 660 nm (for 15 m model)
Spot Size	< 10 mm (0.39 in.) at a distance of 8 m (26 ft) at 20°C (68°F) < 15 mm (0.59 in.) at a distance of 15 m (49 ft) at 20°C (68°F) < 50 mm (2 in.) at a distance of 50 m (164 ft) at 20°C (68°F)
Sensing Distance	0.2…8 m (0.66…26.25 ft) diffuse0.2…15 m (0.66…49.21 ft) diffuse 0.2…50 m (0.66…164.04 ft) retroreflective
Absolute Accuracy	± 25 mm (± 0.98 in.)
Repeatability	< 5 mm (0.20 in.)
Angle Deviation	± 2° maximum
Reference Target	Kodak white (90%)
Temperature Influence	≤ 0.25 mm/K typical
Electrical	
Operating Voltage	10…30V DC (18…30V DC when operating in IO-Link mode)
Current Consumption	≤70 mA at 24V DC
Discrete Output Type	1 NPN/PNP output, short-circuit protection, reverse polarity protection
Discrete Output Rating	30V DC maximum/100 mA maximum
Analog Output Type	One analog output 4…20 mA, short-circuit/overload protection
Switching Frequency	50 Hz
IO-Link	
Protocol	IO-Link V1.0
Interface Type	IO-Link
Mode	COM 2 (38.4 kBaud)
Cycle Time [1]	2.3 ms
SIO (standard I/O)	Supported (pin 2 for standard; pin 4 for IO-Link)
Mechanical	
Housing Material	Plastic ABS
Optical Face Material	Plastic pane
Control Inputs	5-step rotary switch for operating modes selection Push button for set-point teach
Connection Type	4-pin DC micro (M12)

Chapter 2

Installation

Displays and Controls

The operating indicator (green LED) provides information about the state of the sensor interface. The following states are indicated:

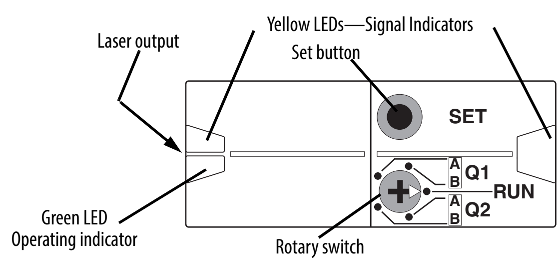
- Power supply in order (standard IO mode)—static on
- IO-Link communication—brief interruption in rhythm of one second
- Fault states: Undervoltage and short circuit at the outputs

The signal indicators show the detection status of the sensor.

The following states are indicated:

- Signal indicator—yellow LED on
- Operating indicator—green LED off

Controls and Indicators



User Interface

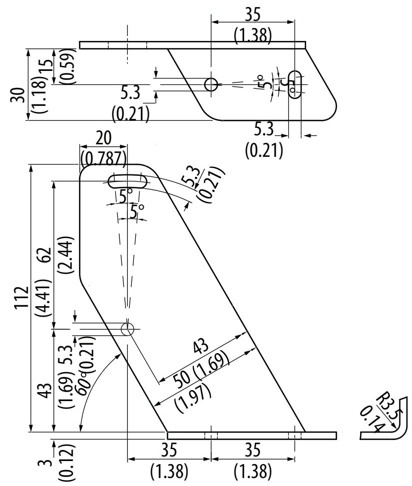
LED Status

Mounting

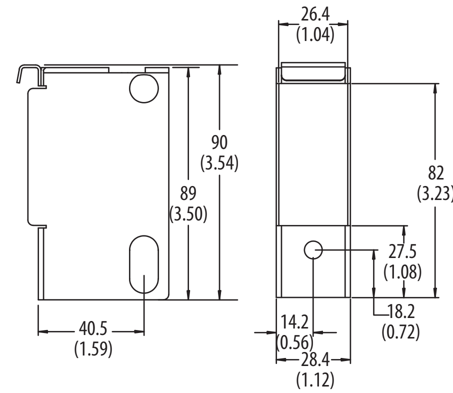
Securely mount the sensor on a firm, stable surface, or support for excellent reliability operation. A mounting subject to excessive vibration or shifting could cause intermittent operation. The 45LMS-BKT1 mounting bracket is available for installation convenience. Once securely mounted, the sensor can be wired per the wiring instructions in the next section.

Mounting Bracket [mm (in.)]

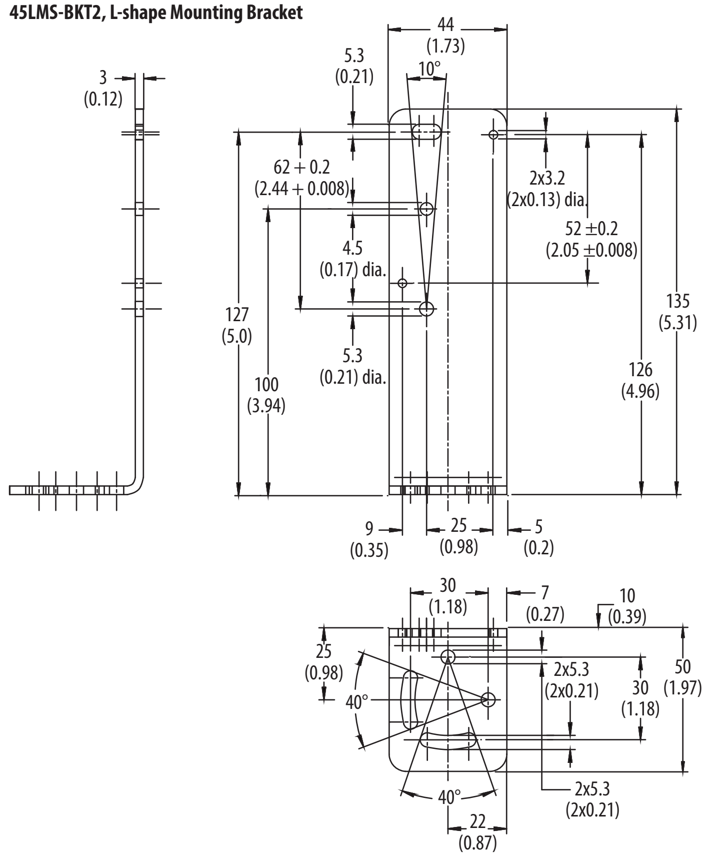
45LMS-BKT1



45LMS-BKT3, Weld Slag Cover

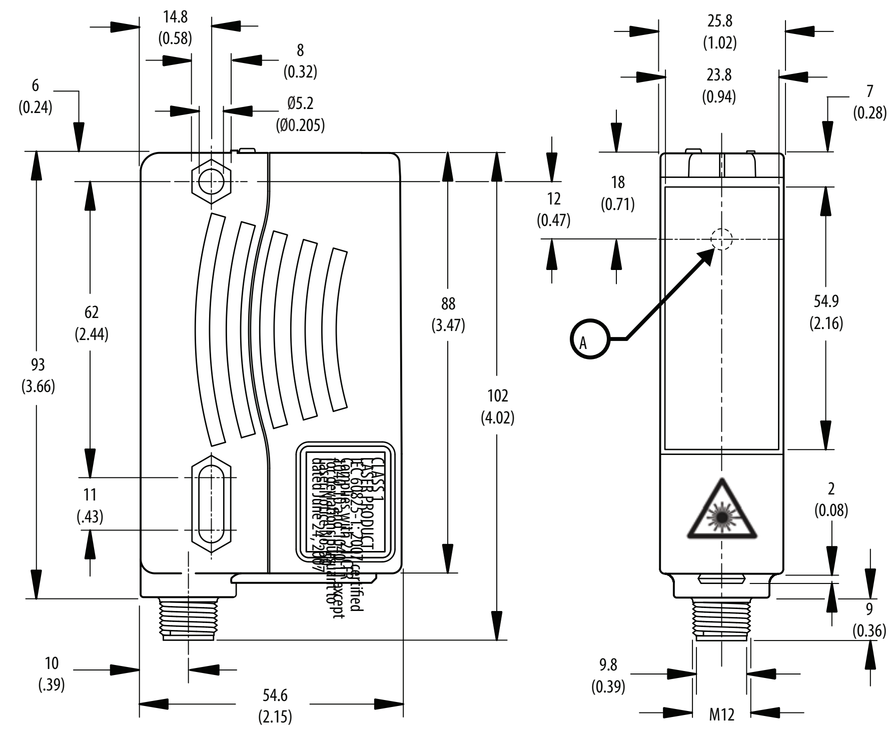


45LMS-BKT2, L-shape Mounting Bracket



Dimensions [mm (in.)]

The following illustration shows the relevant device dimensions:



Wiring

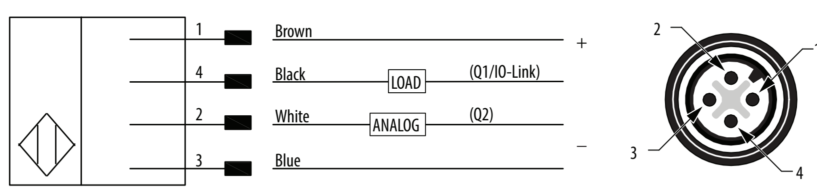
Output Wiring

The 45LMS photoelectric sensor is available with a micro quick disconnect for ease of installation and maintenance.

Rockwell Automation® recommends the use of the 889 Series of cordsets and patchcords for quick-disconnect model sensors. All external wiring must conform to the National Electric Code and all applicable local codes.

The 45LMS features complementary push-pull discrete output, which means the outputs always drive either 24V or 0V and can, therefore, be wired like either an NPN or a PNP sensor.

In SIO mode, Q1 is a discrete output and Q2 is an Analog output. In IO-Link mode, Q1 is a discrete output and Q2 can be a discrete or analog output.

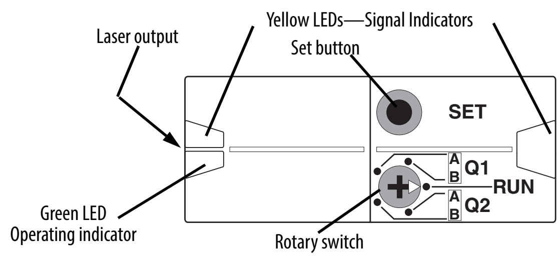


Chapter **3**

Teaching the 45LMS in Standard IO (SIO) Mode

Teach Overview

The sensor is set up in standard IO mode using the rotary switch and the SET button, and it displays feedback via the Yellow and Green LED indicators on the top of the sensor.



Teach Modes

There are two outputs teach methods for the 45LMS in SIO mode. The first method is discrete and the second is analog.

The 45LMS is set-up using the rotary switch and the SET button, and it displays feedback via the yellow and green LED indicators on the top of the sensor.

Upon completion of any set-point Teach, both LEDs flash simultaneously, followed by an alternating flash of the LEDs.

- A slower alternating flash (2.5 Hz) indicates a successful Teach.
- A faster alternating flash (8 Hz) indicates an unsuccessful Teach. After an unsuccessful Teach, the sensor continues to operate with the previous valid setting.

Set-points can be independently taught. For example, set-point Q1-B can be set/re-taught without changing set-point Q1-A.

By pressing the SET button for >5 s (when Q1-A, Q1-B, or Q2-A is selected with the rotary switch), the taught value for that set-point is deleted, leaving the sensor with no value for the set-point that was selected. When you delete Q2-A, the analog output changes to Zero Point mode (see "Zero Point (Positive Slope) on page 14 for details). The value for Q2-B cannot be deleted, it can only be overwritten.

When switching between discrete sensing modes, it is necessary to delete or teach the set-points for both Q1-A and Q1-B.

IMPORTANT	The remainder of these instructions refers to the 24V state as ON and the 0V state as OFF (PNP). If wired as NPN, the logic is inverted.

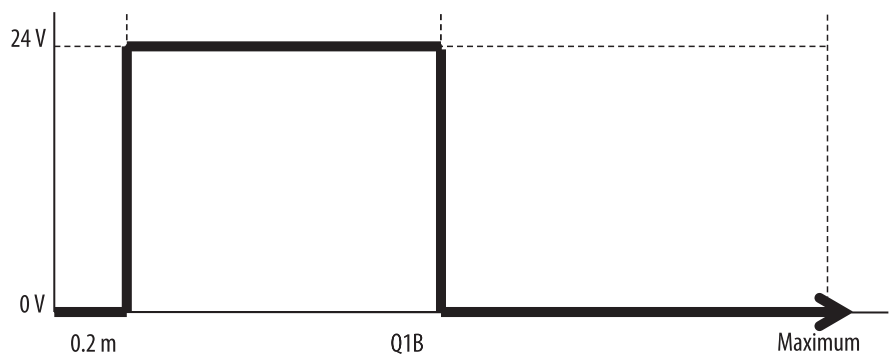
Setting the Discrete Output: Q1

The discrete NPN/PNP output can be set as a switch point *or* switching window as described below.

These instructions were made with the assumption that the sensor is being used for light operate and that PNP output is desired. If the required output is NPN, then refer to the rotary positions listed in the parentheses () throughout the Discrete Output instructions.

IMPORTANT	When you use the sensor for an NPN output, the Yellow LED behaves opposite to the sensor output. For example, when the NPN output is ON, the Yellow LED is OFF.

Switch-point and Closer



This is the most commonly used mode for object detection with background suppression. If using the sensor for this type of application, set the Teach-point at the farthest distance from the sensor that the target passes.

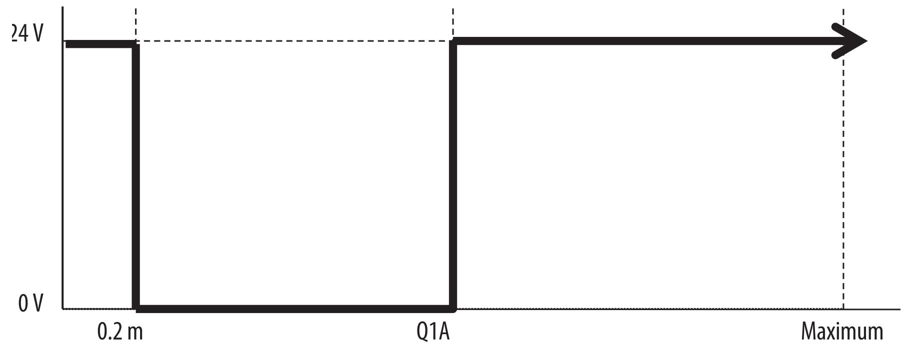
When using this mode, the sensor output turns on if it detects an object 200 mm (8 in.) from the sensor face and up to the Teach-point. For example, if the Teach-point is set at 2 m (6.6 ft), the output would turn on if the sensor detects an object anywhere between 200 mm and 2 m.

1. Place a target at the desired Teach-point, move the rotary switch to position Q1-B (Q1-A for NPN).

2. Press and hold the SET button until the green and yellow LEDs flash simultaneously. [1]

3. If the Teach is successful, move the rotary switch to RUN.

Switch-point and Farther



In this mode, the sensor output turns on if it detects an object at the Teach-point or at any distance farther than the Teach-point up to the maximum range of the sensor. For example, if the Teach-point is at 2 m (6.56 ft), the output turns on if the sensor detects an object anywhere from 2 m to the maximum range.

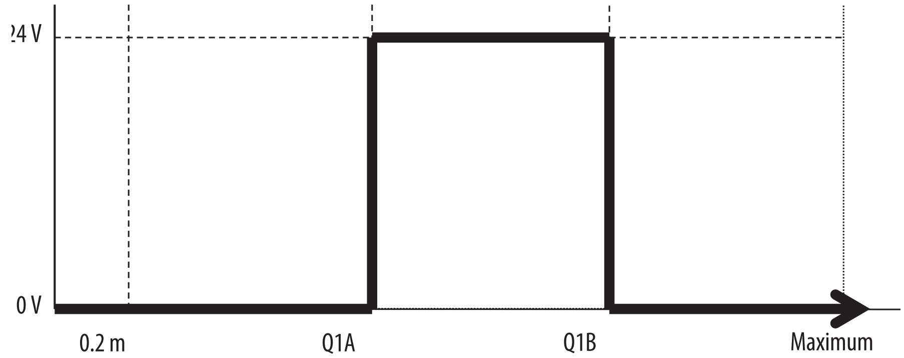
1. Place a target at the desired Teach-point, move the rotary switch to position Q1-A (Q1-B for NPN).

2. Press and hold the SET button until the green and yellow LEDs flash simultaneously. [1]

3. If the Teach is successful, move the rotary switch to RUN.

1 After the LEDs flash simultaneously, they flash alternately to indicate whether the Teach was successful (slower alternating flashing at 2.5 Hz) or unsuccessful (faster alternating flashing at 8 Hz).

Switching Window

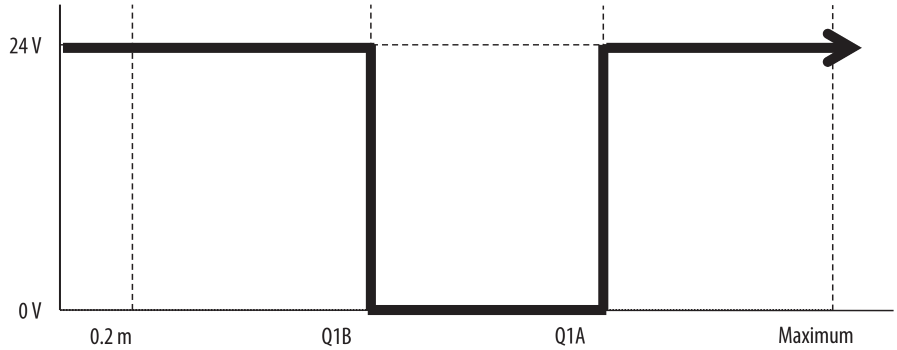


When setting the sensor in this way, the output turns on when it detects an object within a window that is created between two Teach-points. For example, if the Teach-point for Q1-A is set at 2 m, and the Teach-point for Q1-B is set at 3 m, the sensor turns on the output if it detects an object at 2…3 m (6.56…9.84 ft).

1. Place a target at the closer (relative to the sensor) desired Teach-point, move the rotary switch to position Q1-A (Q1-B for NPN).
2. Press and hold the SET button until the green and yellow LEDs flash simultaneously.[1]
3. Place a target at the farther (relative to the sensor) desired Teach-point, move the rotary switch to position Q1-B (Q1-A for NPN).
4. Press and hold the SET button until the green and yellow LEDs flash simultaneously.[1]
5. If the Teach is successful, move the Rotary Switch to RUN.

1 After the LEDs flash simultaneously, they flash alternately to indicate whether the Teach was successful (slower alternating flashing at 2.5 Hz) or unsuccessful (faster alternating flashing at 8 Hz).

Switching Window (inverted)



When setting the sensor in this way, the output turns on when there is no object that is detected within the defined window that is created between two Teach-points. For example, if the Teach-point for Q1-B is set at 2 m, and the Teach-point for Q1-A is set at 3 m, the sensor remains on as long as there is no object that is detected in 2…3 m.

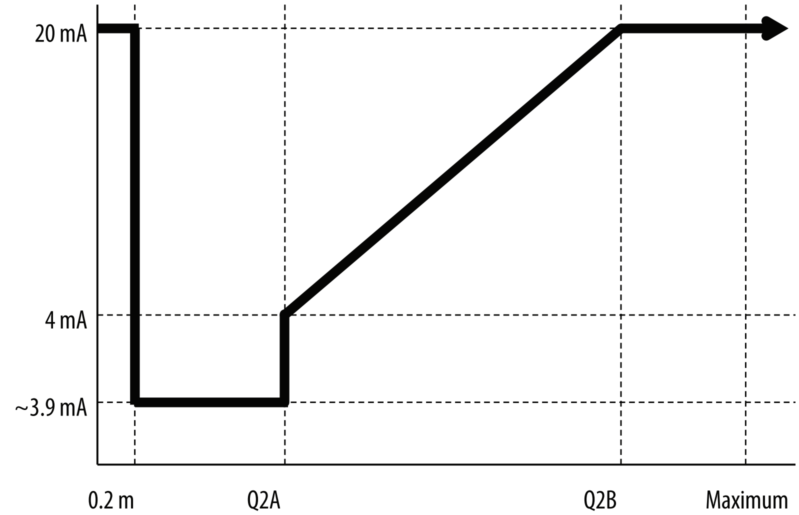
1. Place a target at the closer (relative to the sensor) desired Teach-point, and move the rotary switch to position Q1-B (Q1-A for NPN).
2. Press and hold the SET button until the green and yellow LEDs flash simultaneously.[1]
3. Place a target at the farther (relative to the sensor) desired Teach-point, move the rotary switch to position Q1-A (Q1-B for NPN).
4. Press and hold the SET button until the green and yellow LEDs flash simultaneously.[1]
5. If the Teach is successful, move the rotary switch to RUN.

Setting the Analog Output: Q2

The 4…20 mA output can be defined as any range within 200 mm to the maximum range of the sensor, as either a rising or falling slope, as described below. The default analog-output setting for Q2 is A = 200 mm (8 in.) and B = 5,000 mm (16 ft) for all sensor models. Minimum window for setting the analog span is 21 mm (0.83 in.)

1 After the LEDs flash simultaneously, they flash alternately to indicate whether the Teach was successful (slower alternating flashing at 2.5 Hz) or unsuccessful (faster alternating flashing at 8 Hz).

Positive Slope

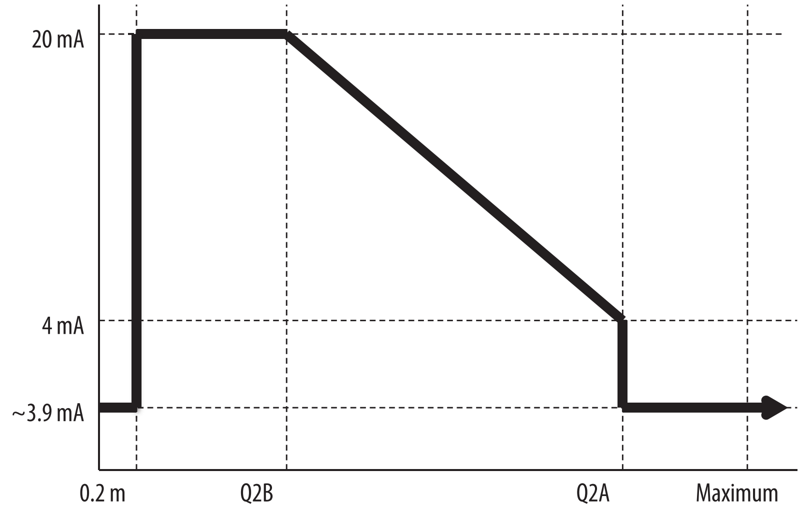


In the Positive Slope mode (also called Rising Slope) a target that is positioned at the closer set-point results in an analog output of 4 mA. And a target at the farther set-point results in an output of 20 mA, with the analog output scaled linearly in between. In this mode, the sensor outputs 20 mA when the target is outside of the operating range, which is 0…200 mm (0…8 in.) and anything greater than the maximum sensing range.

1. Place a target at the minimum Teach-point.
2. Move the Rotary Switch to position Q2-A.
3. Press and hold the SET button until the Green and Yellow LEDs flash simultaneously[1].
4. Place a target at the maximum Teach-point.
5. Move the Rotary Switch to position Q2-B.
6. Press and hold the SET button until the Green and Yellow LEDs flash simultaneously.[1]
7. If the Teach is successful, move the Rotary Switch to RUN.

1 After the LEDs flash simultaneously, they flash alternately to indicate whether the Teach was successful (slower alternating flashing at 2.5 Hz) or unsuccessful (faster alternating flashing at 8 Hz).

Negative Slope



In the Negative Slope mode (also called Falling Slope) a target that is positioned at the farther set-point results in an analog output of 4 mA. And a target at the closer set-point results in an output of 20 mA, with the analog output scaled linearly in between. In this mode, the sensor outputs 3.9 mA when the target is outside of the operating range, which is 0…200 mm (0…8 in.) and anything greater than the maximum sensing range.

1. Place a target at the maximum Teach-point, and move the rotary switch to position Q2-A.

2. Press and hold the SET button until the green and yellow LEDs flash simultaneously.[1]

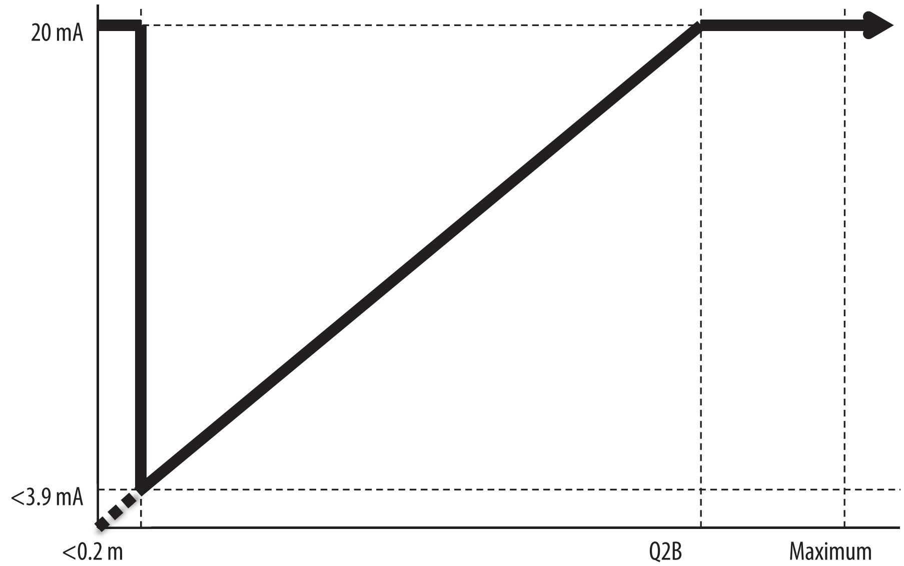
3. Place a target at the minimum Teach-point, move the Rotary Switch to position Q2-B.

4. Press and hold the SET button until the Green and Yellow LEDs flash simultaneously.[1]

5. If the Teach is successful, move the Rotary Switch to RUN.

1 After the LEDs flash simultaneously, they flash alternately to indicate whether the Teach was successful (slower alternating flashing at 2.5 Hz) or unsuccessful (faster alternating flashing at 8 Hz).

Zero Point (Positive Slope)



In the Zero Point (Positive Slope) mode a target that is positioned at the farther set-point Q2-B results in an analog output of 20 mA. And the analog signal is scaled linearly between 0.0 mm and Q2-B. This is useful for simplifying the scaling within the PLC or control device. For example, the following equation can be used:

$D = (D_{Max} / I_{Max}) * I_i$

Where

D = Current distance of target

D_{Max} = set-point distance

I_{Max} = analog range (which is always 20 for the 45LMS)

I_i = current analog output from sensor.

However, even though the analog signal is scaled linearly from 0.0 mm to Q2-B it still provides an analog output of 20 mA when the target is outside of the operating range, which is 0…200 mm (0…8 in.) and anything greater than the maximum sensing range. (This is because the 45LMS cannot detect objects between 0…200 mm.)

1. Place a target at the maximum Teach-point.
2. Move the rotary switch to position Q2-B.
3. Press and hold the SET button until the green and yellow LEDs flash simultaneously[1].

4. Move the rotary switch to position Q2-A, and delete the set-point [factory default is 200 mm (8 in.)] by pressing and holding the SET button for >5 s. Both LEDs turned off indicates successful completion.

5. If the Teach is successful, move the Rotary Switch to RUN.

Alarm Feature

The 45LMS also has an alarm feature that alerts the user via LEDs that the teach process was successful.

After the LEDs flash simultaneously, they flash alternately to indicate whether the Teach was:

Successful: slower alternating flash (2.5 Hz)
Unsuccessful: faster alternating flash (8 Hz)

1 After the LEDs flash simultaneously, they flash alternately to indicate whether the Teach was successful (slower alternating flashing at 2.5 Hz) or unsuccessful (faster alternating flashing at 8 Hz).

Chapter 4

Laser Measurement Sensor with IO-Link Overview

What Is IO-Link?

The IO-Link technology is an open point-to-point communication standard and was launched as (IS) IEC 61131-9. IO-Link is now the first globally standardized technology for sensor and actuator communication with a field bus system. This technology provides benefits to both OEMs and End Users.

IO-Link provides communications-capable sensors to the control level by a cost-effective point-to-point connection. IO-Link provides a point-to-point link between the I/O module and sensor that is used for transferring detailed diagnostics, device identity information, process data, and parameterization.

IO-Link communication is based on a master-slave structure in which the master controls the interface access to the sensor. The option of using the intelligence that is integrated into the sensor provides the user with new commissioning methods. Benefits range from reduced installation time during startup to increased diagnostics over the lifetime of the machine. Benefits of IO-Link technology include:

- Reduced inventory and operating costs
- Increased uptime/productivity
- Simplified design, installation, set-up, and maintenance
- Enhanced flexibility and scalability
- Detailed diagnostic information for preventative maintenance

Why IO-Link?

IO-Link Offers a Full Range of Advanced Features and Functions

Seamless Integration

- Forward and backward compatible, sensor catalog numbers remain the same
- No special cables required
- Connectivity options remain the same
- Access IO-Link functionality by simply connecting an IO-Link enabled device to an IO-Link master
- Analog devices no longer require a dedicated input card

Real-time Diagnostics and Trending

- Real-time monitoring of the entire machine down to the sensor level
- Optimized preventative maintenance—identify and correct issues before failures can occur
- Detect sensor malfunctions/failure

Sensor Health Status

- Real-time monitoring helps ensure that sensors are operating correctly
- Detect damaged sensors and pinpoint their exact location for quick troubleshooting through Application-Specific Name parameter

Device Profiles and Automatic Device Configuration

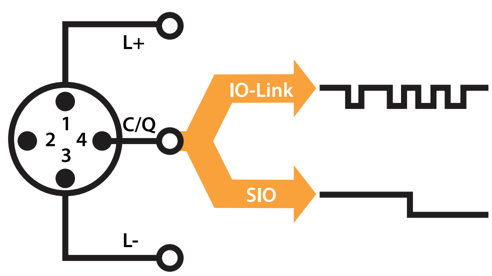
- "Golden" device configurations are stored in the IO-Link master module
- Multiple configurations can be stored in controller to support changes in machine production, for example tool changes
- Within minutes instead of hours, modify sensor parameters to produce different finished goods

Descriptive tags

- Faster programming during initial setup
- More efficient troubleshooting-process data tags are named based on the information they provide
- Easily monitor sensor data though intuitive tag names

How Does IO-Link Work?

IO-Link delivers data over the same standard field cabling used today. By connecting an IO-Link sensor to an IO-Link master, the field-device data and diagnostics are accessible. So go beyond detecting products on the machine—now the health of the machine can be MONITORED as it runs.



Pin	Signal	Remark
1	L+	24V
2	Out	Depends on sensor
3	L-	Ground
4	C/Q	Communication/ switching signal

IMPORTANT The response time of an IO-Link system is not fast enough for high-speed applications. In this case, it is possible to monitor/configure the sensor through IO-Link on pin 4 of the sensor while connecting pin 2 (if the sensor offers a second output) of the sensor to a standard input card.

Transmission Rates

Three baud rates are specified for the IO-Link device:

- COM 1 = 4.8 kbaud
- COM 2 = 38.4 kbaud
- COM 3 = 230.4 kbaud

An IO-Link device typically supports only one of the specified transmissions rates, while the IO-Link V1.1 specifications requires an IO-Link master to support all three baud rates. (See Product Specifications for product baud rate.)

Transmission Quality

The IO-Link communication system operates at a 24V level. If a transmission fails, the frame is repeated two more times. If the transmission fails on the second try, the IO-Link master recognizes a communication failure and signals it to the controller.

Response Time of the I-O Link System

The device description file (IODD) of the device contains a value for the minimum cycle time of the device. This value indicates the time intervals at which the master addresses the device. The value has a large influence on the response time. In addition, the master has an internal processing time that is included in the calculation of the system response time.

Devices with different minimum cycle times can be configured on one master. The response time differs accordingly for these devices. When configuring the master, you can specify a fixed cycle time and the device-specific minimum cycle time that is stored in the IODD. The master then addresses the device that is based on this specification. The typical response time for a device therefore results from the effective cycle time of the device and the typical internal-processing time of the master. (See Product Specifications for minimum product cycle-time.)

IO-Link Data Types

There are four data types available through IO-Link:

Process data	?	Cyclic data
Value status	?	Cyclic data
Device data	?	Acyclic data
Events	?	Acyclic data

Process Data

The process data of the devices are transmitted cyclically in a data frame in which the size of the process data is specified by the device. Depending on the device, 0…32 bytes of process data are possible (for each input and output). The consistency width of the transmission is not fixed and is thus dependent on the master.

Some devices can support multiple process data "modes," which allow the user to select different cyclic process data themes.

Value Status

The value status indicates whether the process data is valid or invalid. The value status can be transmitted cyclically with the process data.

Device Data

Device data supports device-specific configurable parameters, identification data, and diagnostic information. They are exchanged acyclically and at the request of the IO-Link master. Device data can be written to the device (Write) and also read from the device (Read).

Events

When an event occurs, the device signals the presence of the event to the master. The master then reads out the event. Events can be error messages and warnings/ maintenance data. Error messages are transmitted from the device to the controller via the IO-Link master. The transmission of device parameters or events occurs independently from the cyclic transmission of process data.

Accessing IO-Link Data

Cyclic Data

To exchange the cyclic process data between an IO-Link device and a controller, the IO-Link data from the IO-Link master is placed on the address ranges assigned beforehand. The user program on the controller accesses the process values using these addresses and processes them. The cyclic data exchange from the controller to the IO-Link device (that is, IO-Link sensor) is performed in reverse.

Acyclic Data

Acyclic data, such as device parameters or events, are exchanged using a specified index and subindex range. The controller accesses these using Explicit Messaging. The use of the index and subindex ranges allows targeted access to the device data (that is, for reassigning the device or master parameters during operation).

Start-up of the I/O System

If the port of the master is set to IO-Link mode, the IO-Link master attempts to communicate with the connected IO-Link device. To do so, the IO-Link master sends a defined signal (wake up pulse) and waits for the IO-Link device to reply.

The IO-Link master initially attempts to communicate at the highest defined data transmission rate. If unsuccessful, the IO-Link master then attempts to communicate at the next lower data transmission rate.

If the master receives a reply, the communication begins. Next, it exchanges the communication parameters. If necessary, parameters that are saved in the system are transmitted to the device. Then, the cyclic exchange of the process data and value status begins.

Assigning Device Parameters

Installing a device for a specific application requires changes to parameter settings. The device parameters and setting values are contained in the IODD of the device.

IO Device Description (IODD) files contain information about the device identity, parameters, process data, diagnostic data, and communication properties. These files are required to establish communication with the sensors via IO-Link.

The IODD consists of multiple data files; the main file and several optional language-files are in XML-format and graphic files are in PNG format (portable network graphics). These files adhere to the IO-Link open standard, which means that they can be used with any IO-Link masters.

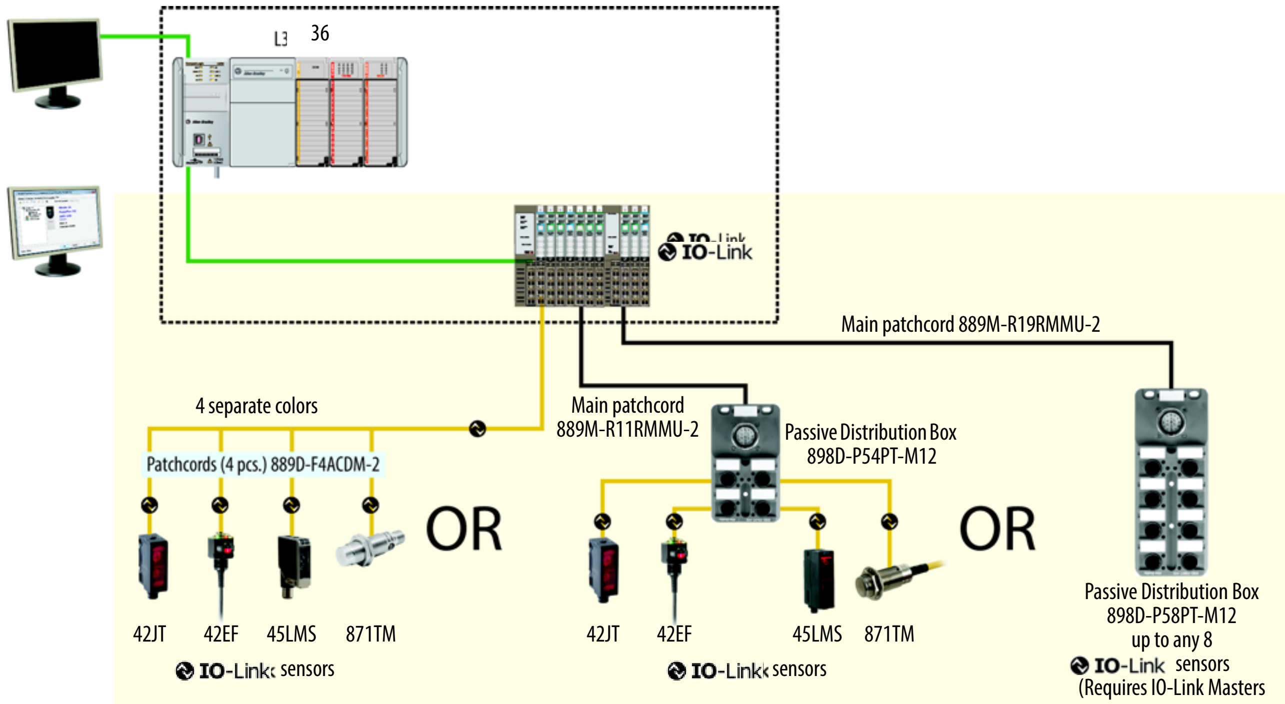
IODD files are assigned using Studio 5000® and the 1734-4IOL Add-on Profile (when using the 1734-4IOL IO-Link master module).

Rockwell Automation Solution

Overview and Benefits

Rockwell Automation is the only supplier who provides every piece of the Connected Enterprise solution from top to bottom. Plus, exclusive features, and Premier Integration between Allen-Bradley® components and an Integrated Architecture® system allow for a seamless connection and commission of control components. Empowering the ability to reap the benefits of an IO-Link solution

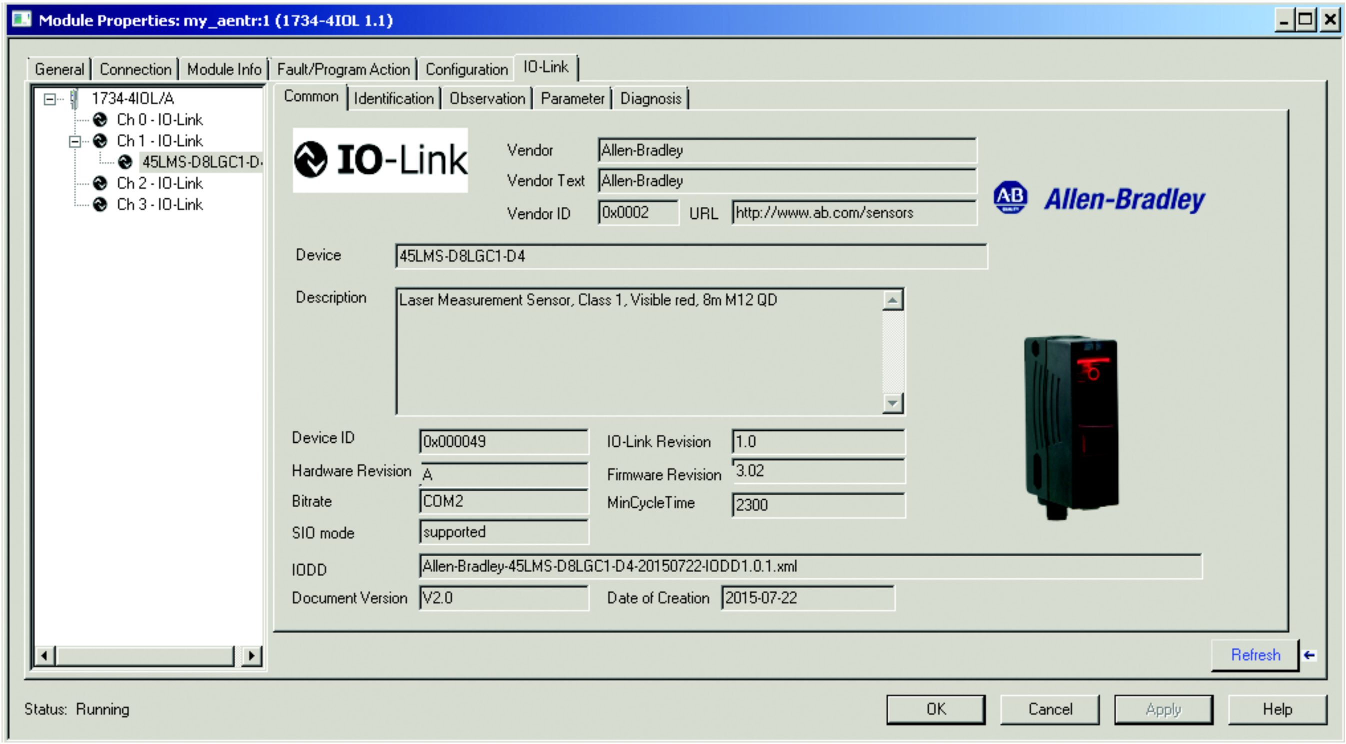
With access to more detailed and customized plant-floor information than other solutions can offer.



Premier Integration

The Studio 5000 Logix Designer® environment combines design and engineering elements in one interface, enabling users to access IO and configuration data across the Integrated Architecture system. Using a Rockwell Automation solution, provides a smooth, consistent integration of Allen-Bradley IO-Link enabled devices into the system.

To simplify the integration of the Rockwell Automation IO-Link devices to the Rockwell Automation architecture, there is an IO-Link Add-on Profile (AOP) available for the 1734-4IOL master module. The use of an AOP simplifies the setup of devices by providing the necessary fields in an organized manner that allows users to build and configure their systems in a quick and efficient manner.



45LMS IO-Link Features

These features are available in the 45LMS:

Triggered: Is the process data bit that communicates the change in state of the 45LMS upon the detection of a registration mark. The status of the triggered bit can be viewed in a Studio 5000 controller tag.

Polarity: Changes the operation of the triggered parameter. It performs the same function as teaching the light and dark operate in standard I/O (SIO) mode.

Local Operation: Disables the push button interface helps prevent unauthorized users from changing sensor settings.

Teach Operation: The 45LMS has three teach methods:

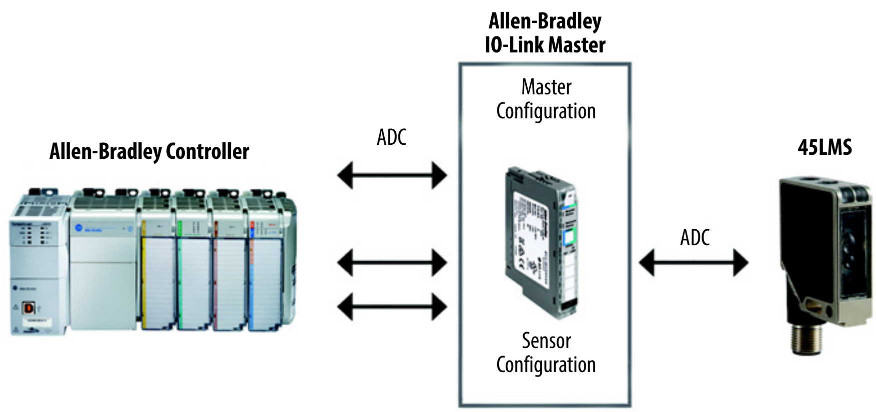
> **Static Teach:** Consists of a two steps: teach the registration (first condition) and teach the background (second condition). This method is recommended for most applications.
>
> **Dynamic Teach:** Is ideal for teaching the sensor while the application is running. The sensor automatically detects the registration mark and background to help ensure reliable detection and operation.
>
> **Local Teach:** When the local teach is enabled in IO-Link, the teach process follows the standard IO (SIO) teach method using the rotary switch on the sensor.

Multiple Profiles: The sensor setup can be stored in Studio 5000 by using Explicit Messaging to support multiple machine configurations. Therefore, the sensor can be taught and programmed to detect multiple products/packages. Multiple profiling enables designing the sensor one time and having the capabilities to change products instantly without manual intervention.

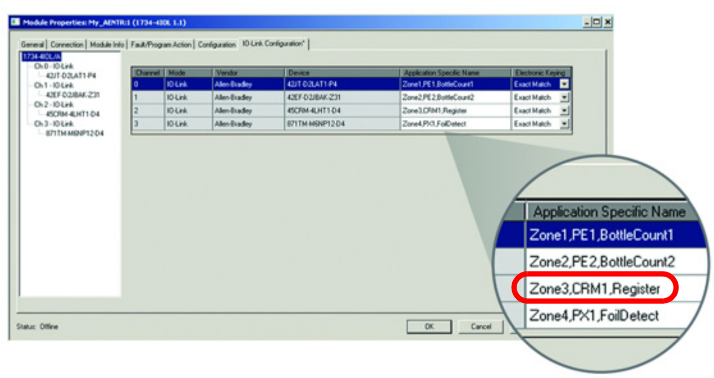
Multiple profiling must be done through Explicit Messaging. For more information, reference the Explicit Messaging in Appendix C.

Location Indication: Helps the user to identify the location of a specific sensor on a machine by temporarily increasing the LEDs to flash in a specific rhythm.

Automatic Device Configuration (ADC): Replacing damaged sensors is easy. Simply remove the old Allen-Bradley sensor and connect the new one—the controller automatically sends the configuration to the new sensor.



Application Specific Name (ASN): With numerous sensors on a machine with the same catalog number, the ASN parameter within each sensor makes it easy to identify the sensor during commissioning and the lifetime of the machine when collecting data. Name resides in the project and the sensor itself.



Tag Naming for I/O Data: Rockwell Automation system solutions provide tag names that are based on the Allen-Bradley sensor connected. I/O data is converted, formatted, and named based on the Allen-Bradley sensor applied. Reduces commissioning time by the OEM and reduces troubleshooting time by the end user when searching for sensor data. Consistent naming techniques used.

42JT	My_1734_4IOL:1:I.Ch0.Triggered
	My_1734_4IOL:1:I.Ch0.MarginLowAlarm
42EF	My_1734_4IOL:1:I.Ch1.Triggered
	My_1734_4IOL:1:I.Ch1.MarginLowAlarm
42CRM	My_1734_4IOL:1:I.Ch2.Triggered
871TM	My_1734_4IOL:1:I.Ch3.Triggered
	My_1734_4IOL:1:I.Ch1.MarginStatus
45LMS	My_1734_4IOL:2:I.Ch0.Distance
	My_1734_4IOL:2:I.Ch0.Triggered1
	My_1734_4IOL:2:I.Ch0.Triggered2
	My_1734_4IOL:2:I.Ch0.MarginLowAlarm

Chapter 5

Setting up the 45LMS for IO-Link Mode

This chapter shows the physical hardware and software that is required to configure the 45LMS through IO-Link and provides a simple guide to installing the hardware.

Products required:

Hardware

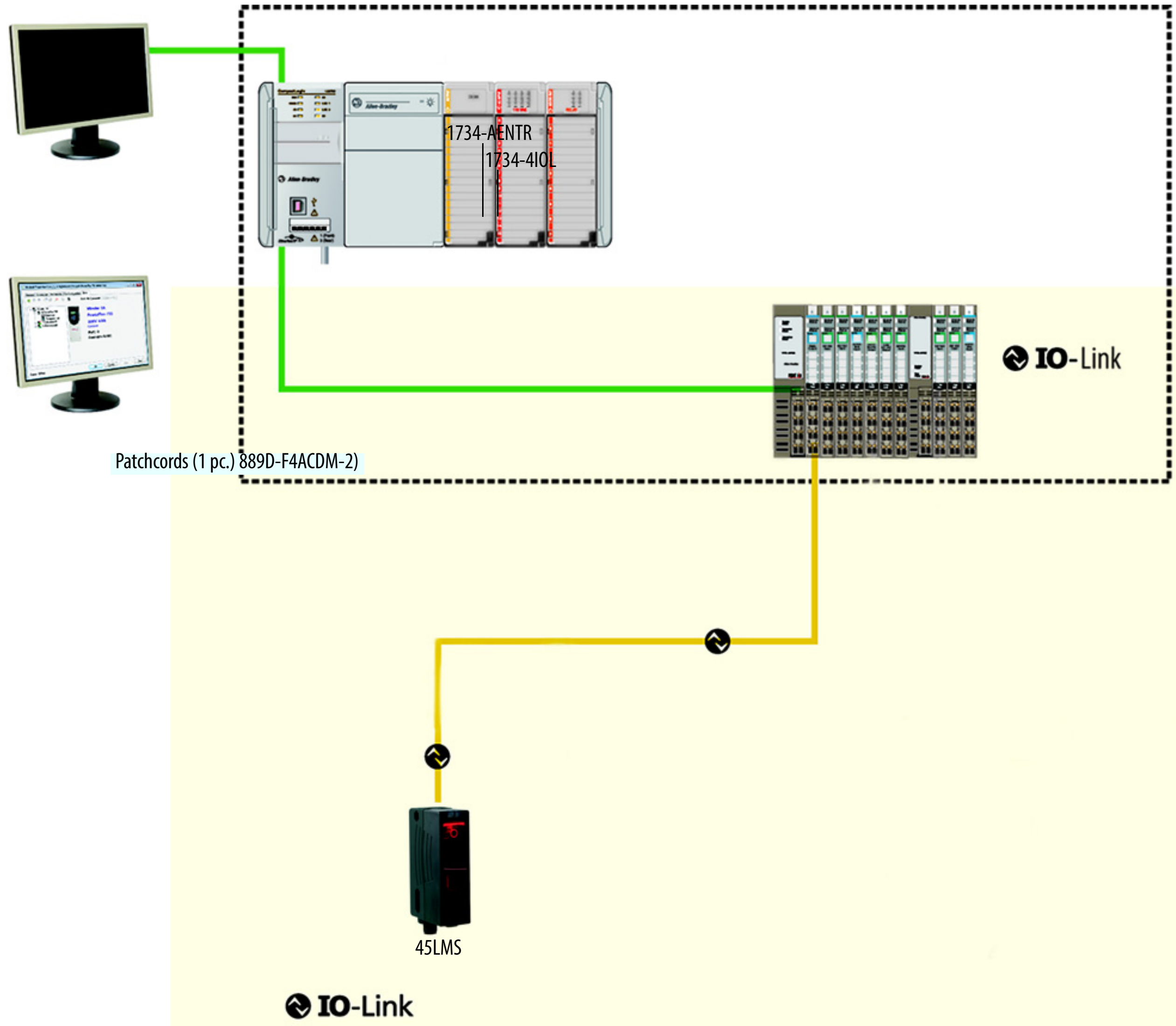
- 45LMS-D8LGC1-D4, 45LMS-D8LGC2-D4, 45LMS-D8LGC1-D4
- CompactLogix or ControlLogix PLC Platform
- POINT I/O Communications Interface: 1734-AENTR
- POINT I/O IO-Link Master Module: 1734-4IOL
- POINT I/O Terminal Base: 1734-TB
- RJ45 network cable for EtherNet/IP connectivity: 1585J-M8TBJM-1M9*
- 889D cordsets (optional): 889D-F4AC-5** (IO-Link maximum acceptable cable length is 20 m (65.6 ft))

Software:

- Studio 5000 environments, version 21 and higher
- Sensor specific IODD
- 1734-4IOL IO-Link Add-on Profile (AOP)

Example: Setting Up the Hardware

In this example, we are showing an Allen-Bradley POINT I/O chassis with a 1734-AENTR adapter and a 1734-4IOL IO-Link master module in the first slot. The 1734-AENTR is communicating with a CompactLogix controller via EtherNet/IP.



When adding a 45LMS to the 1734-4IOL master module, complete the following steps:

1. Provide power to the 1734-AENTR adapter.
2. Set the node address on 1734-AENTR adapter.
3. Connect the 1734-AENTR to the Allen-Bradley controller with the recommended RJ45 Ethernet cable.
4. Wire the sensor cable to the desired location on the IO-Link master (in this example, we are showing the sensor that is wired to the channel 0).

5. Connect the 45LMS to the other end of the sensor cable.

6. After connecting the sensor, you will need to create/open a project in Studio 5000 to establish communication with the Allen-Bradley controller that is being used and to add the 1734-AENTR adapter and 1734-4IOL IO-Link master module to Controller Organizer Tree (see Chapters 6 and 7 for detailed instructions).

IMPORTANT	Once the sensor adapter and the master module have been configured in the Controller Organizer Tree and the 45LMS has been wired to the master module, the green LED indicator on the sensor should flash at a 1 Hz rate indicating that it is operating in IO-Link mode. The green indicator that is associated with the channel that the sensor is wired into on the right-hand side of the master module should also pulse at a 1 Hz rate.

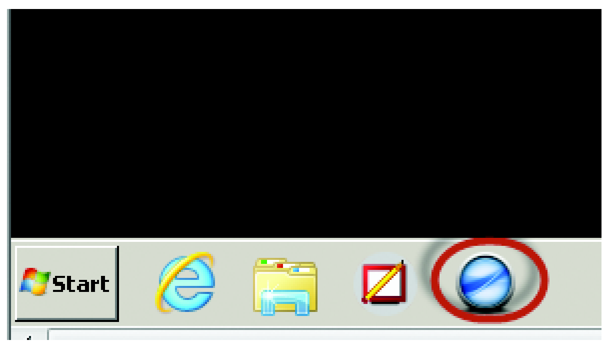
Chapter 6

Creating a Project

To begin a new project in Studio 5000, follow these steps.

If there's an existing project within Studio 5000 with CompactLogix or ControlLogix hardware that is installed and communicating online, go directly to Chapter 7 "Configuring the IO-Link Master."

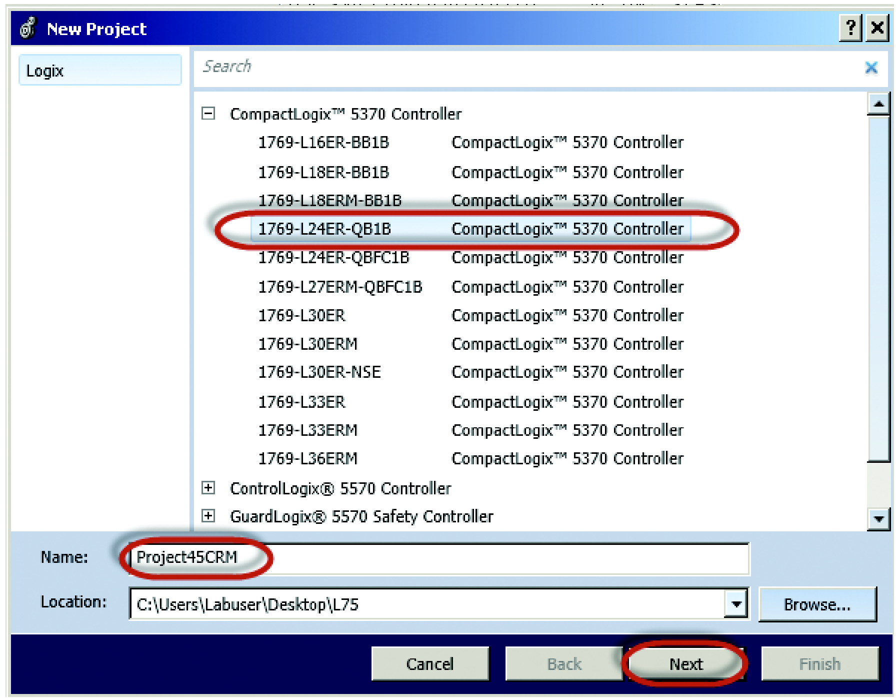
1. Double-click the Studio 5000 icon.



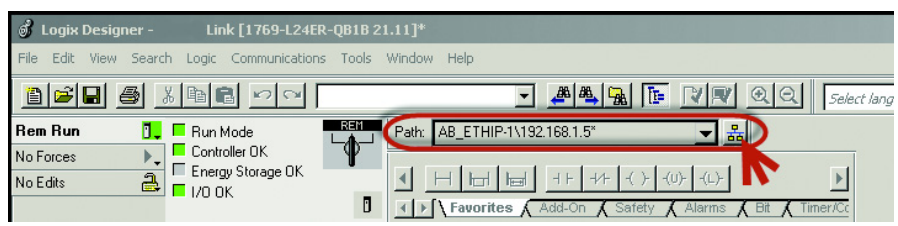
2. Click New Project.

3. To program the controller, select the controller that is used. In this example, it is the "1769 L24ER" CompactLogix.

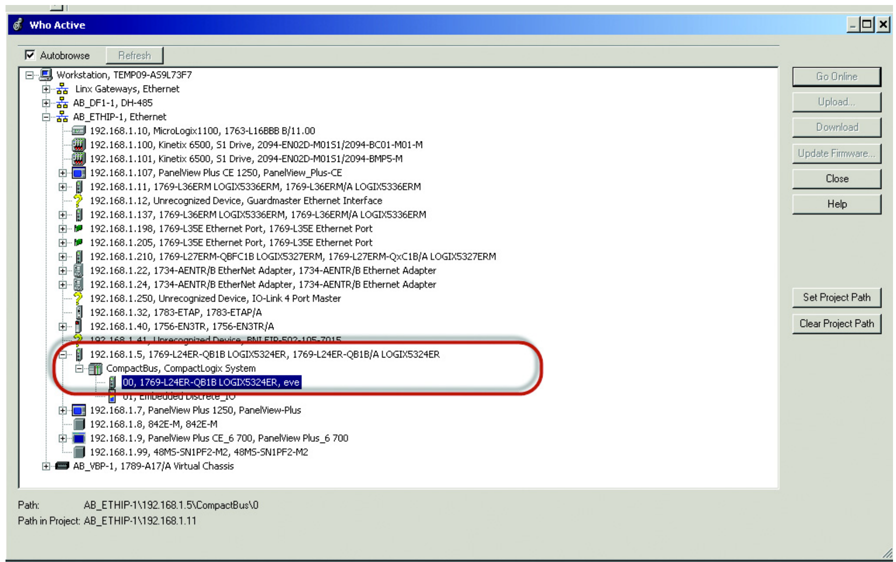
4. After selecting the controller, name the project and click "Next." In this example, the project name is "Project45LMS."



5. Once the project opens up, setup the IP address of the controller to help ensure communication. To set the IP address, click the browsing icon.



6. Select the controller that is being used for the project. In this example, we are using a 1769-L24ER-QB1B CompactLogix.



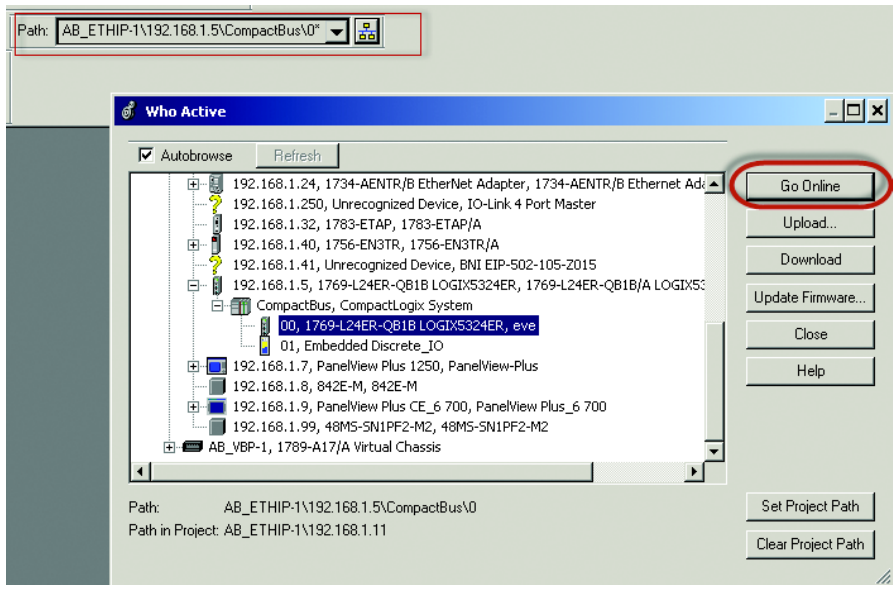
7. Click “Go Online” to start communicating.

The next step is to configure the IO-Link Master.

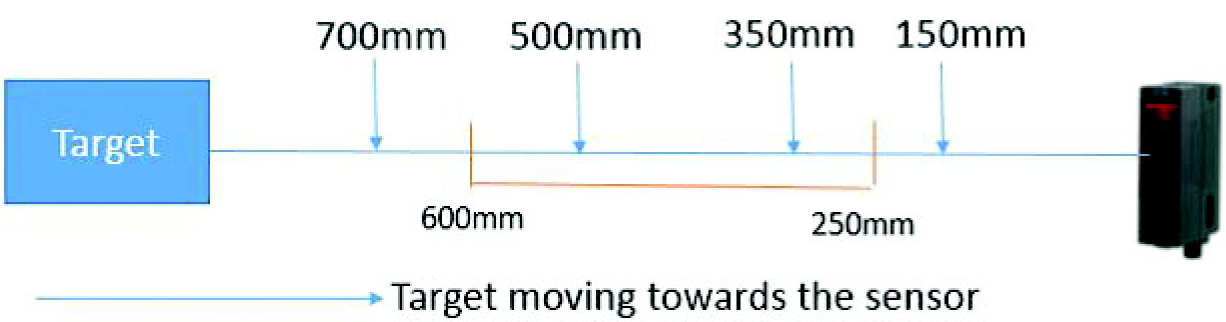
Chapter 7

Configuring the IO-Link Master

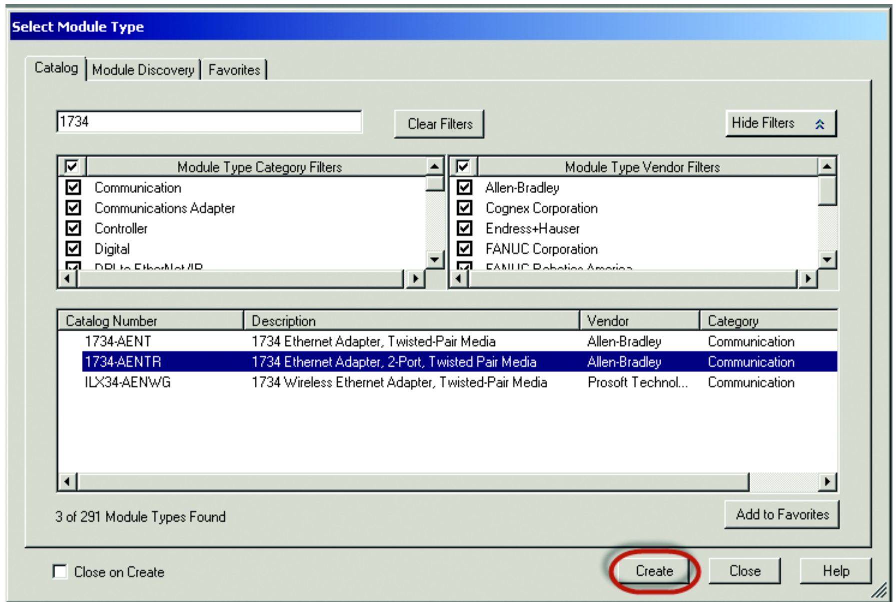
1. Make sure that the controller is offline to configure the IO-Link Master.



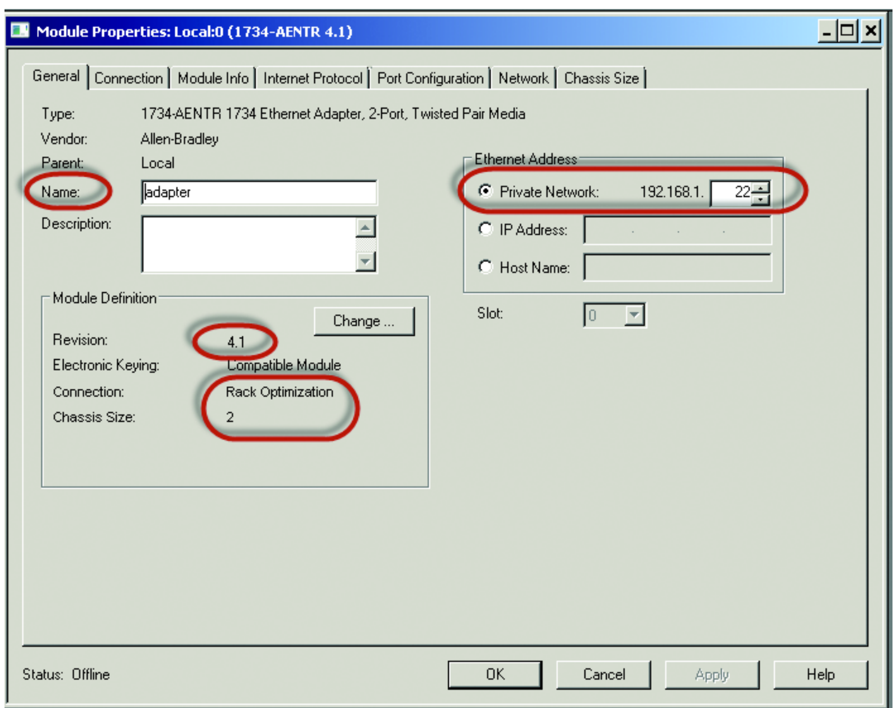
2. In the controller organizer tree, find Ethernet under I/O Configuration and right-click to "add new module."



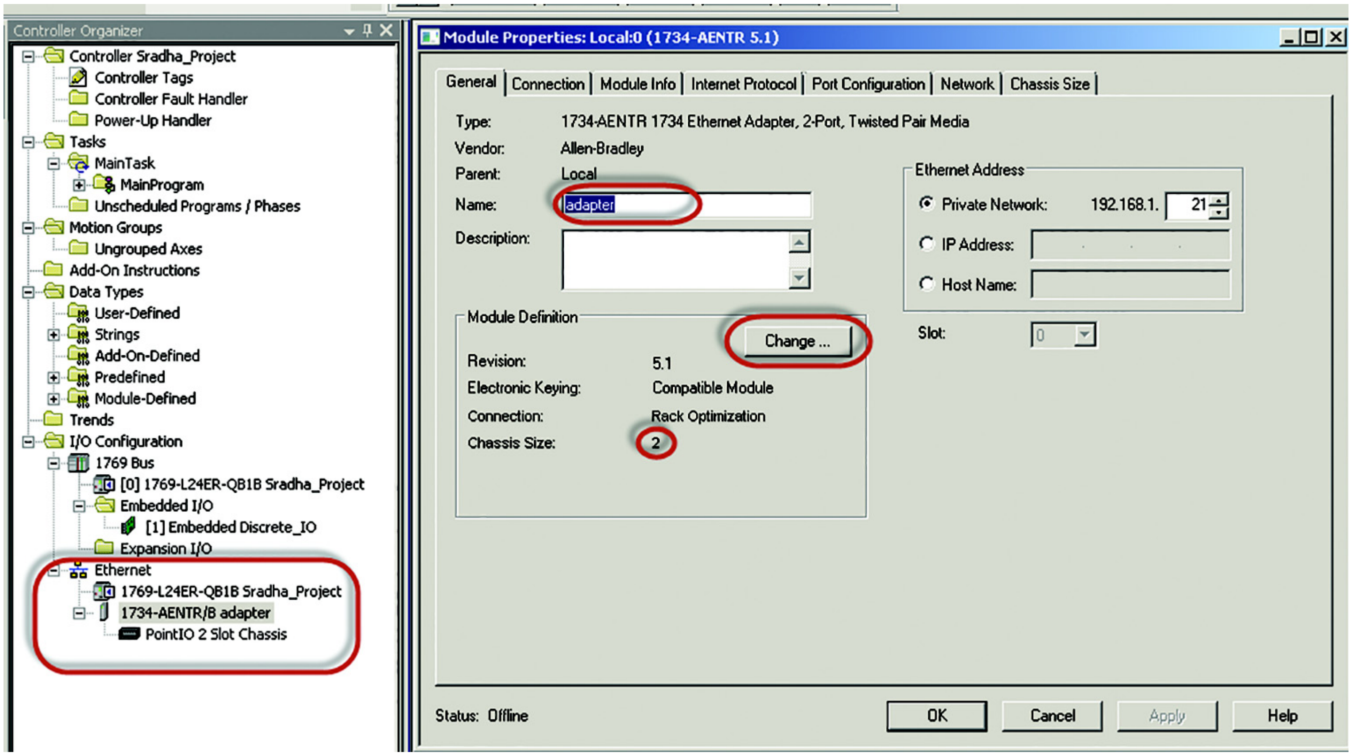
3. The module window pops up and show the available modules. Select the "1734-AENTR, 1734 Ethernet adapter, two-port, twisted-pair media" and click Create.



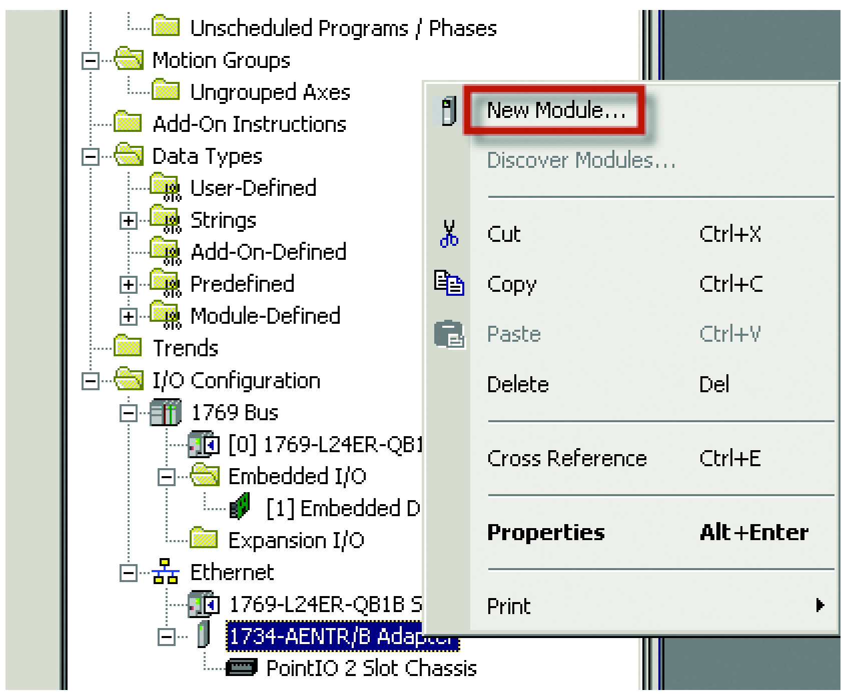
4. Name the Ethernet adapter (in this example our adapter name is "adapter"), set the chassis size, check the module revision and set-up the adapter IP address. Click OK and then Close.



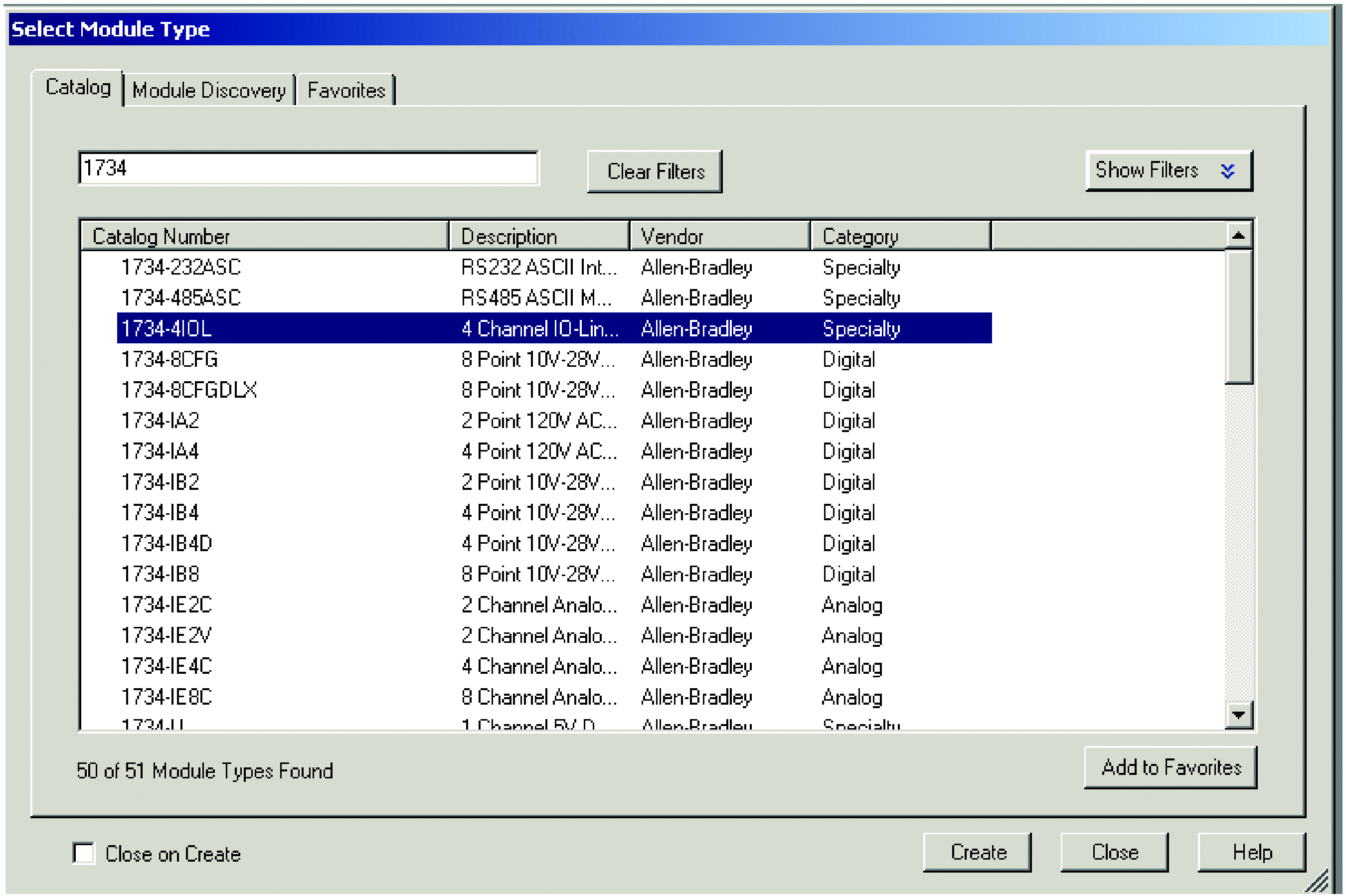
5. The 1734 AENTR now appears in the Controller Organizer tree.



6. Right-click on 1734-AENTR adapter, and then select “New Module.”

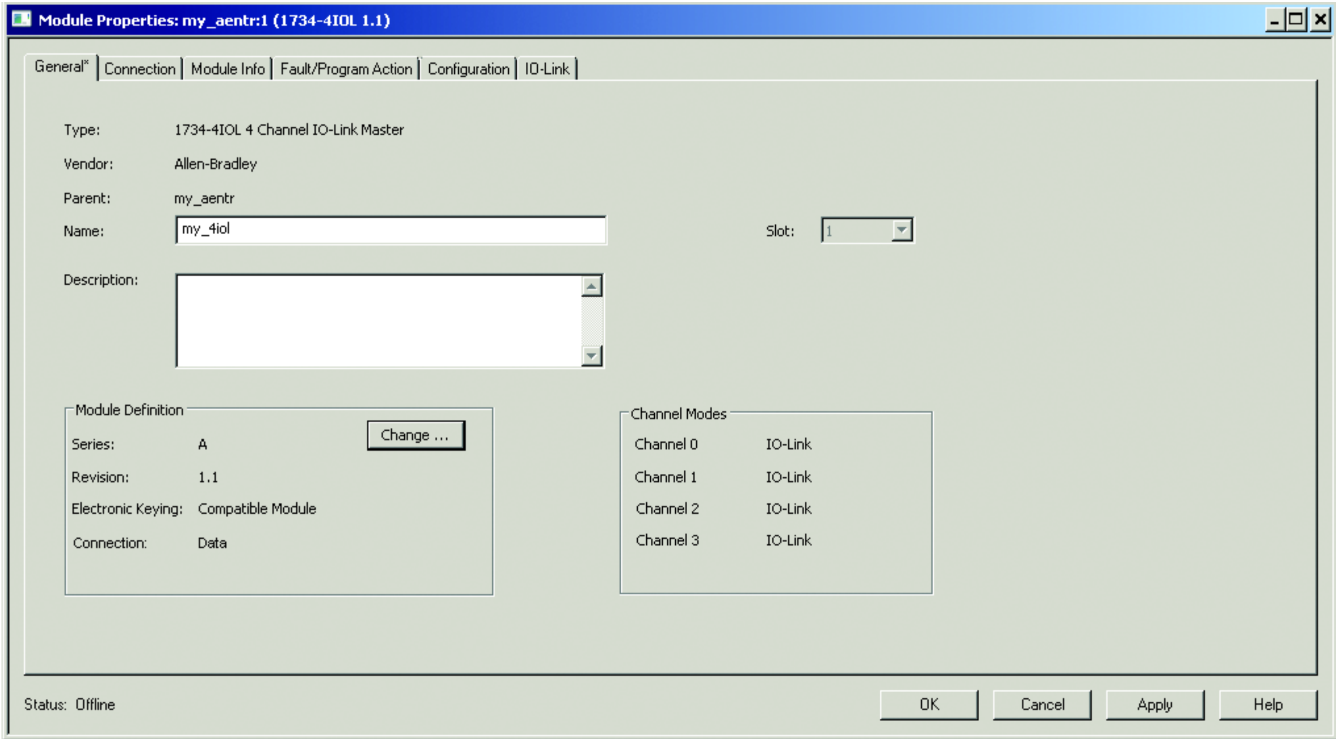


7. Select "1734-4IOL" and click Create.



8. Another screen appears showing the IO-Link Configuration screen.

9. Name the IO-Link Master and click OK.



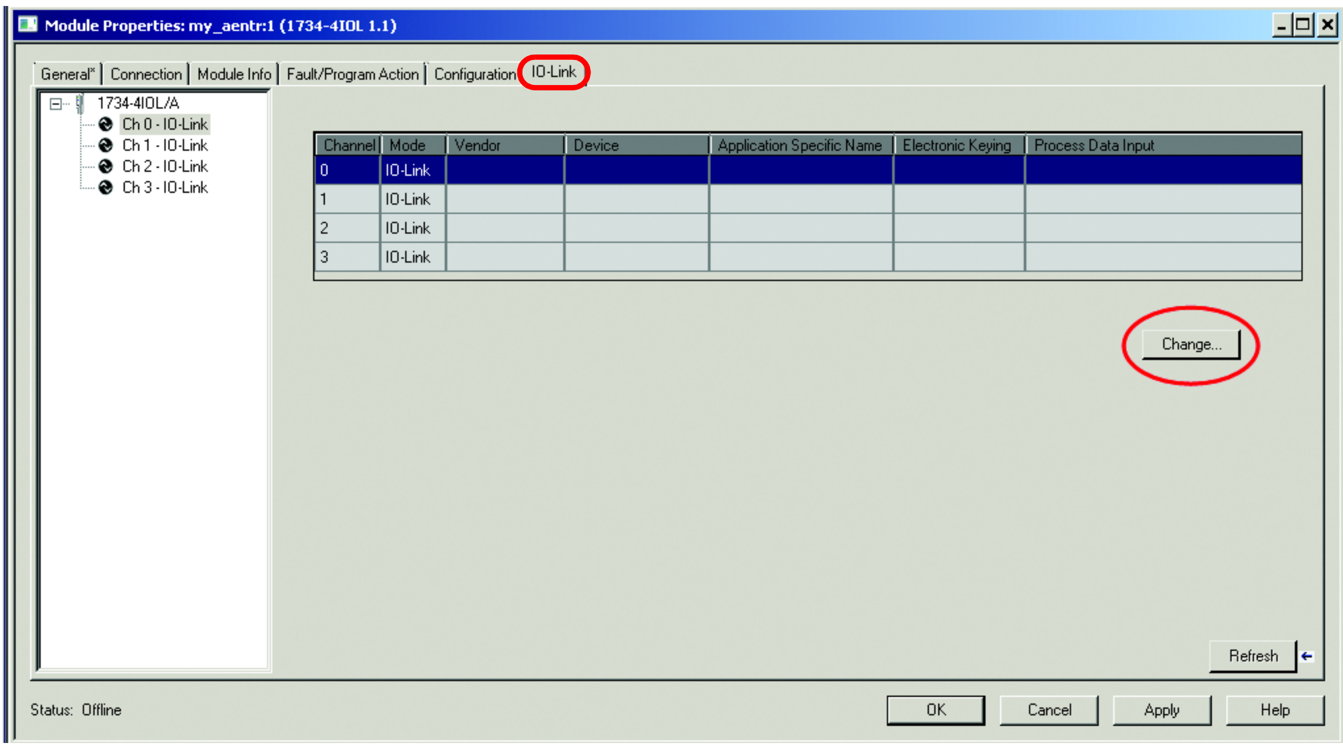
The 45LMS can now be configured. To configure the sensor, a sensor specific IODD (IO Device Description) file is required. The next steps will show how to register the IODD file.

Chapter 8

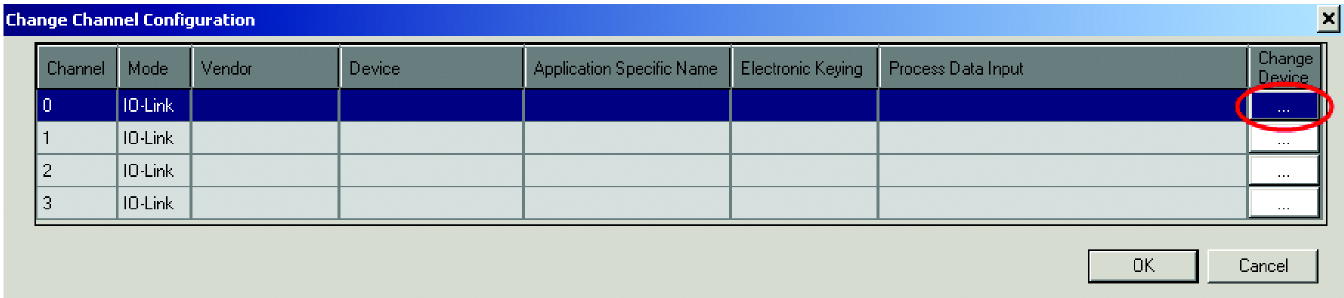
Connecting the 45LMS to the IO-Link Master

Once the IO-Link master is configured, connected the sensor to the IO-Link master. Take the controller off-line to add a device to the IO-Link master.

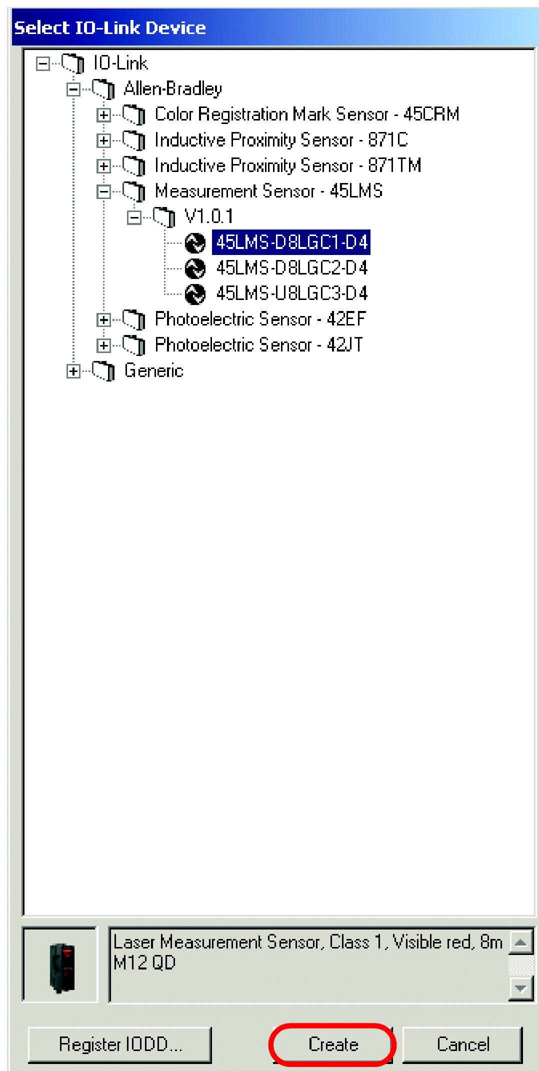
1. Go to the IO-Link tab and click “Change.”



2. Next click in the "Change Device" column for the IO-Link channel number the sensor will be added to.



3. A window containing a library of all the sensors that are currently registered in the IO-Link Device Library appears. Select the appropriate sensor and click "Create." (If the sensor does not appear in the library, go to Chapter 9 to learn how to Register the IODD.)



4. The sensor is now in the channel configuration window.

You can change the Application Specific Name, Electronic Keying, and Process Data Input configuration while the project is in the offline mode.

Modify the information:

Application Specific Name (ASN): The purpose of the Application Specific Name is to add theme naming to distinguish the sensors within a machine and the associated project profile in the Add-on Profile. The ASN allows for easier maintenance and operation since the device is further identified by how it is used on the machine/project.

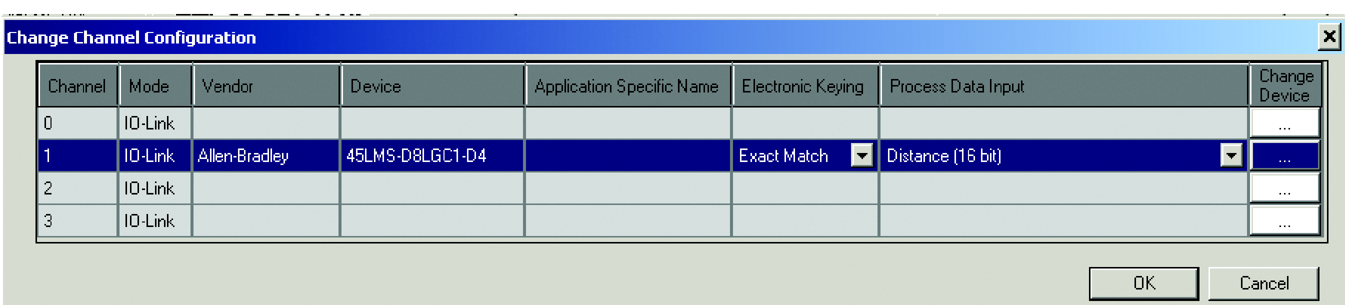
Electronic Keying Information: Select Exact Match or Disabled from the pull-down menu. The Exact Match and Disabled keying options in this dialog correspond to the Compatible and No Check keying options in IO-Link terminology, respectively.

When Exact Match is selected, the connected IO-Link device must have the same Vendor ID, Device ID, and Revision information that has been configured for that channel. If they do not match, IO-Link communications are not established and a Keying Fault status bit is set. When Disabled is selected, key check is not performed.

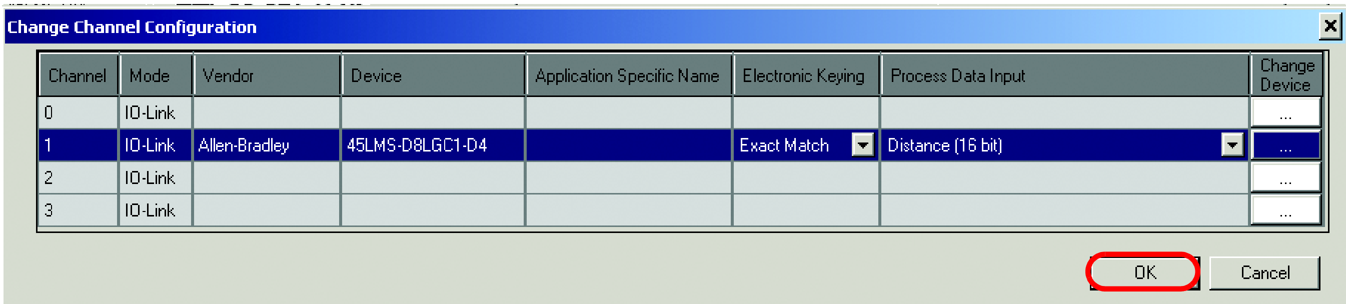
Process Data Input: Select the input data from the pull-down menu (for devices that support multiple layouts of input data).

There are four options to select for the process data. This selection will affect the IO-Link parameters and controller tags, which are available in IO-Link mode and online with the controller.

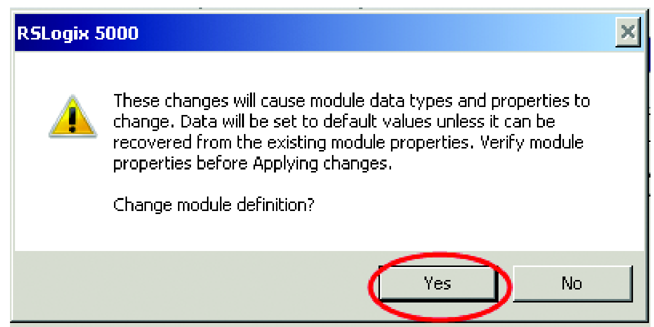
- 16 bit distance,
- 14 bit for distance, 1 bit for triggered 1 and 1 bit for triggered 2,
- 14 bit for distance and 2 bit for margin level,
- 12 bit for distance, 2 bit for margin level, 1 bit for triggered 1, and 1 bit for triggered 2



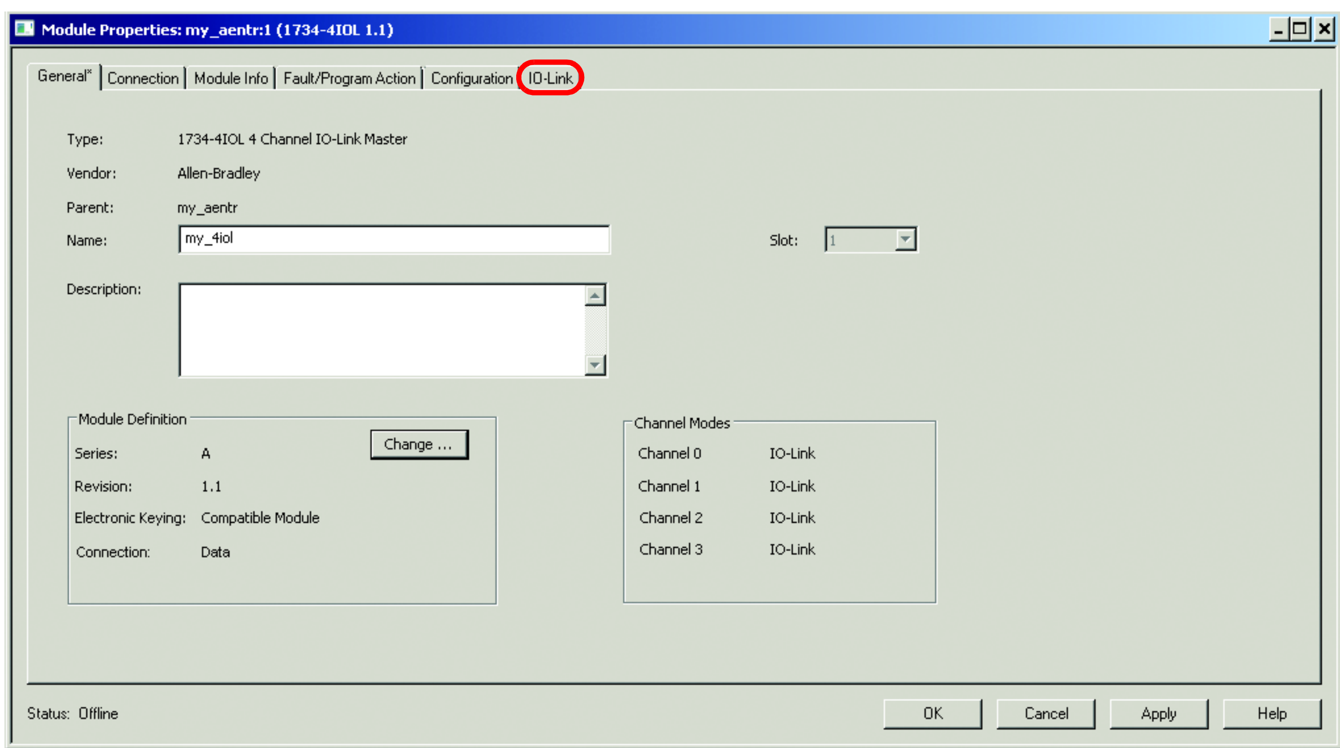
Click “OK.”



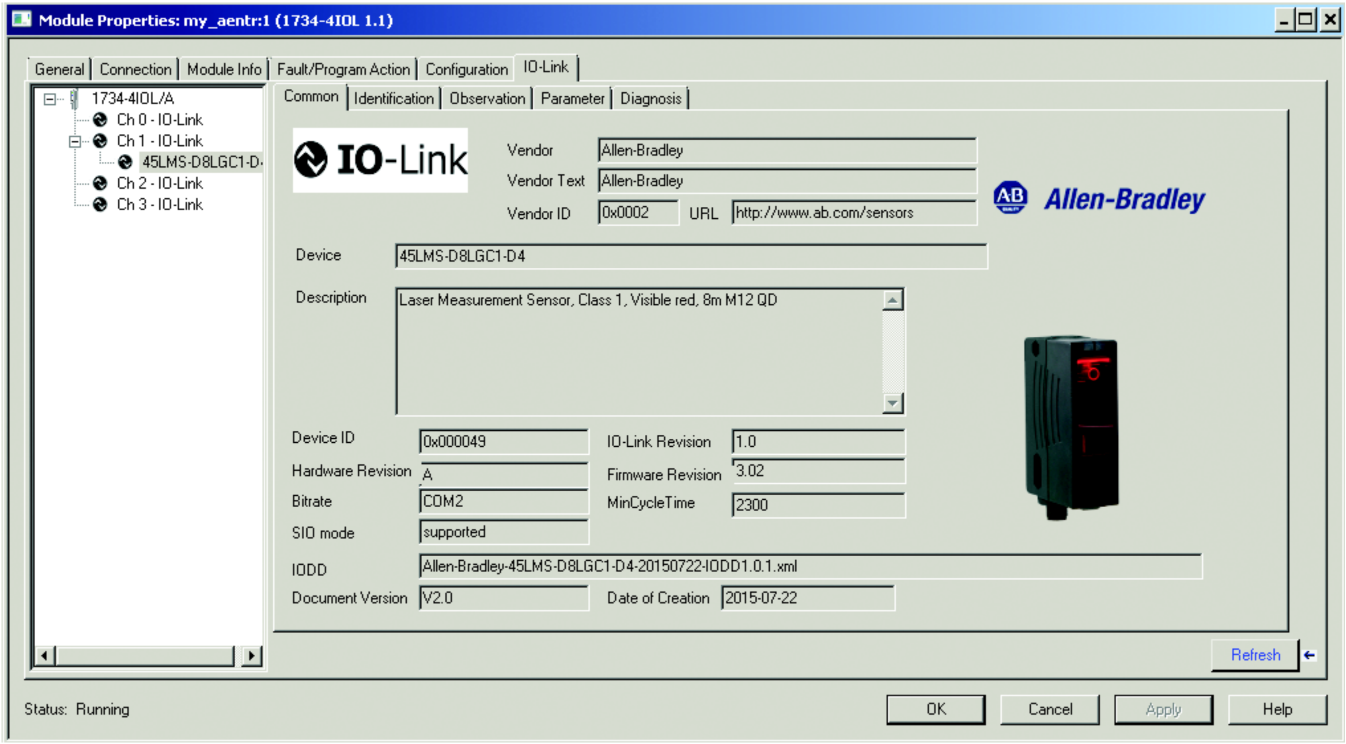
5. Next click “Yes” to confirm the sensor changes.



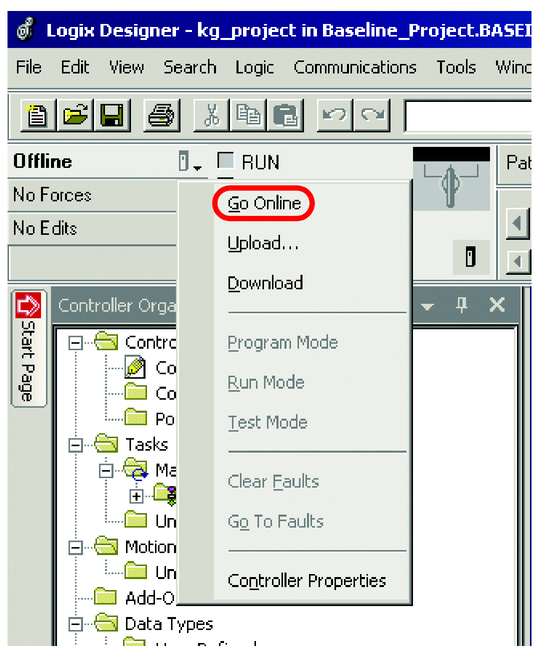
6. The module properties screen appears on the General Tab. Click the “IO-Link” tab.



7. Locate the sensor that you added in the organization tree and click it.



8. The sensor can now be configured through the Add-on Profile. Go online to communicate with the controller and sensor.



Proceed to Chapter 10 for a description of each tab that is associated with the 1734 AOP and a description of how the AOP can be used to configure the sensor.

Chapter 9

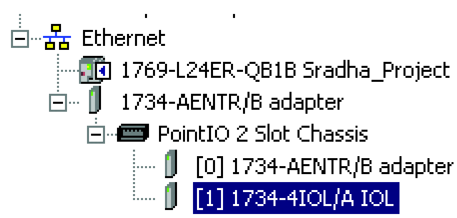
Registering the 45LMS IODD

If you are not able to locate the 45LMS in the IO-Link Sensor Library (as shown in the previous chapter), then you need to register the IODD of the sensor. By default, the IODDs are already located in the AOP, but as new products are released it is necessary to add products to the library.

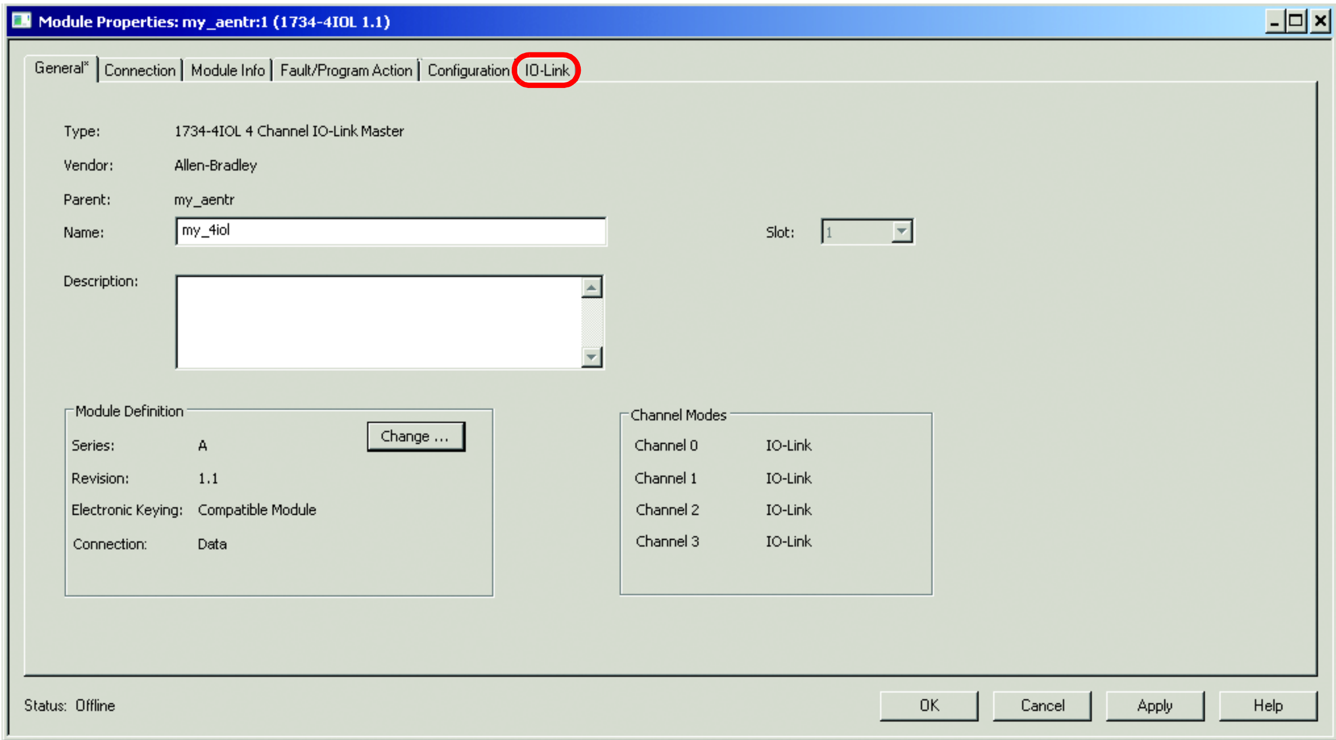
The IO Device Description (IODD) files contain the information that is related to the sensor, integrated into the system environment. To initialize a sensor on an IO-Link Master, registering the IODD of the sensor is required.

If the IODD file for the sensor cannot be located in the library, it can be downloaded from *http://ab.rockwellautomation.com*. Once the IODD is registered, there's no need to register the IODD again unless it is manually deleted from the Master Tree.

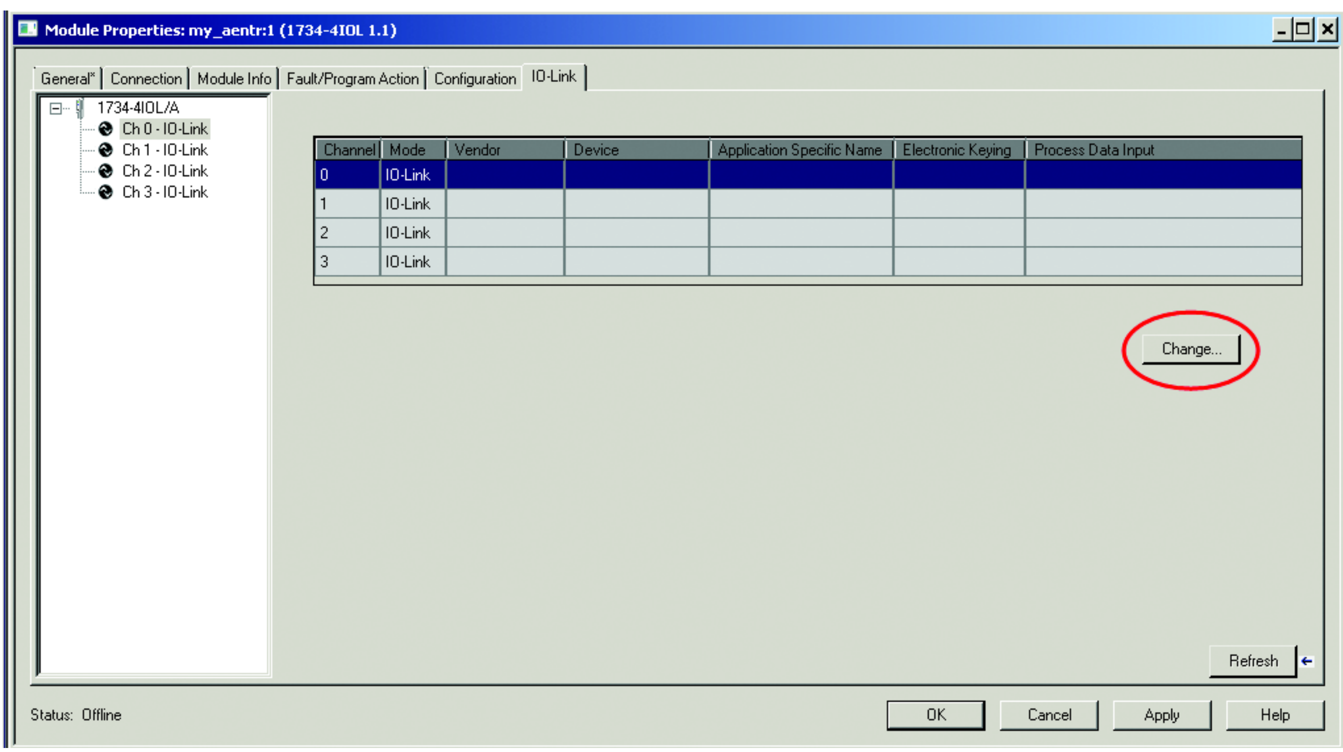
1. Double-click the "1734-4IOL" in the Controller Organizer Tree.



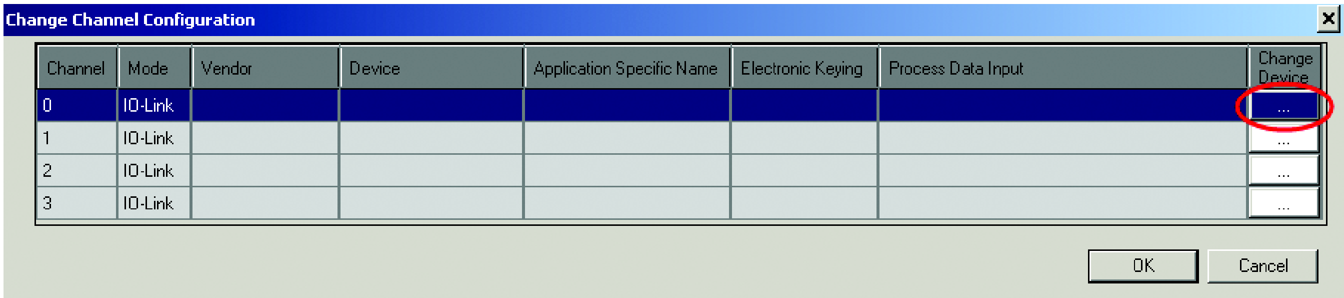
2. Select the IO-Link tab.



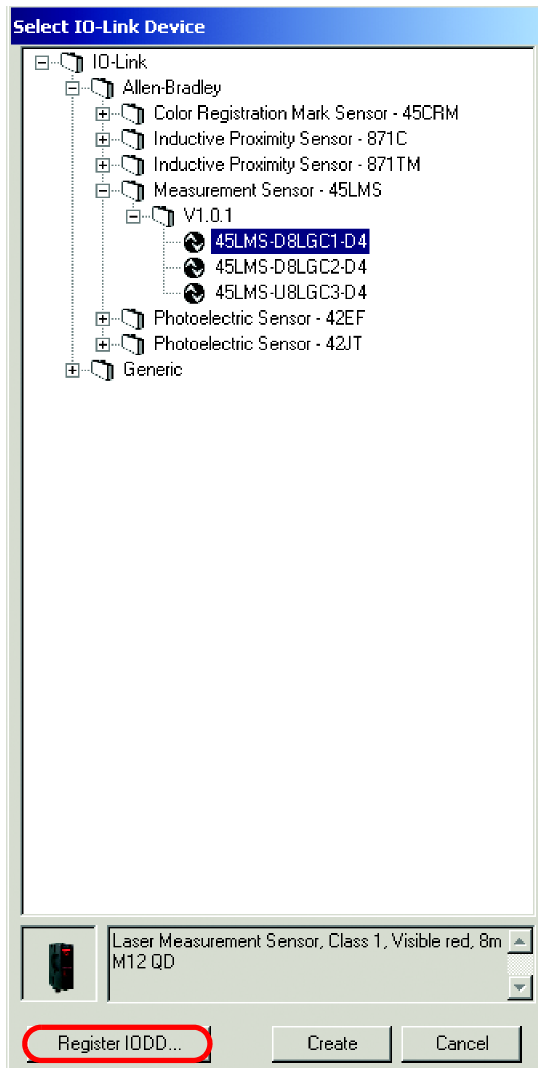
3. The IO-Link screen appears, click "Change."



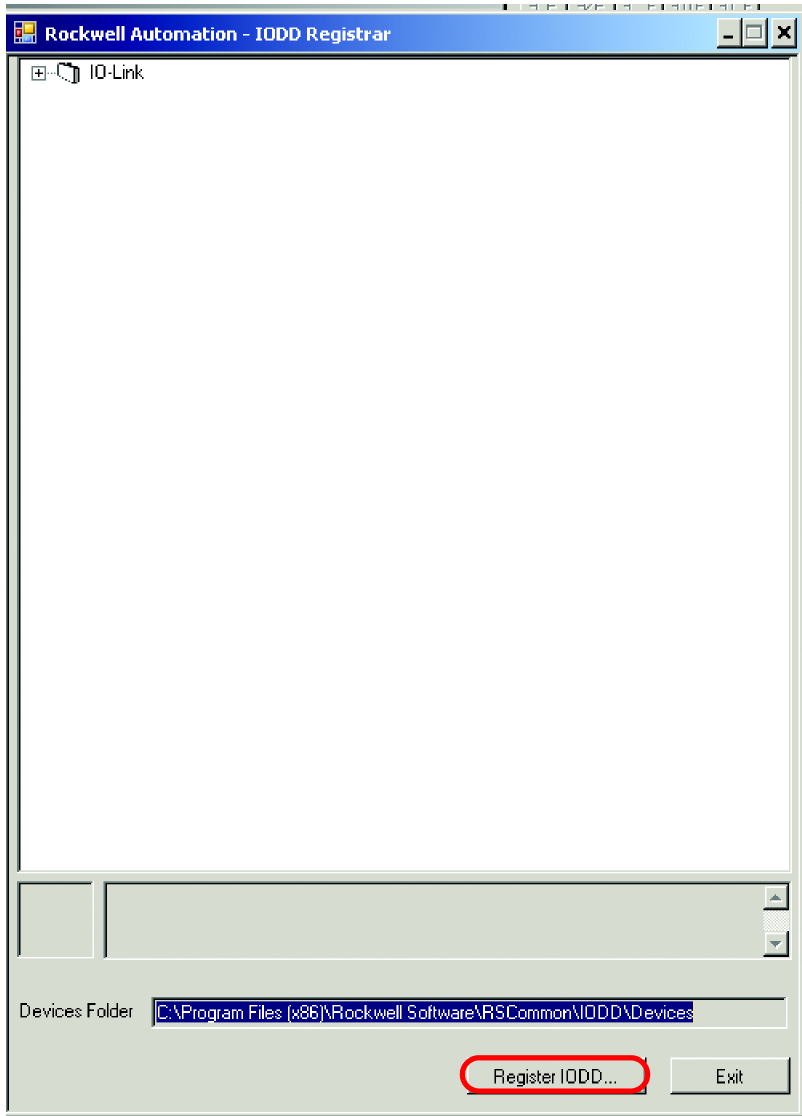
4. Next click in the “Change Device” column for the IO-Link channel number that the sensor is added to.



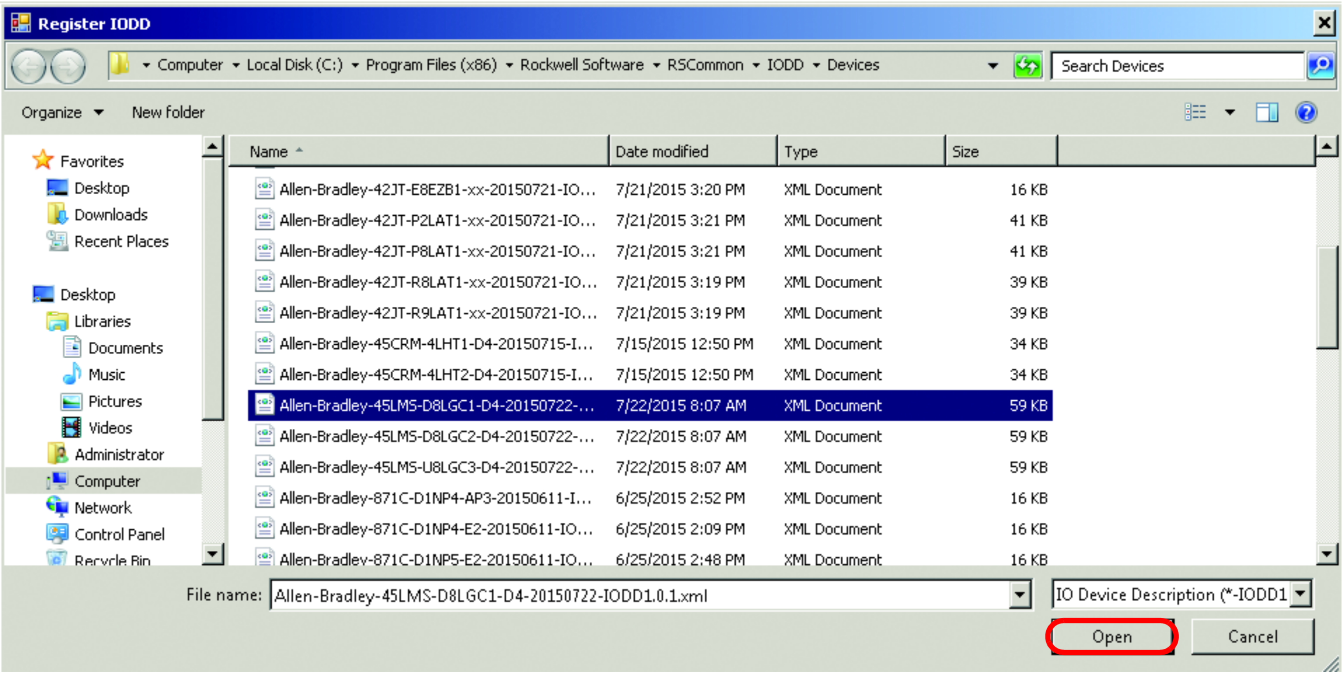
5. In the IO-Link Device Library window, select “Register IODD.”



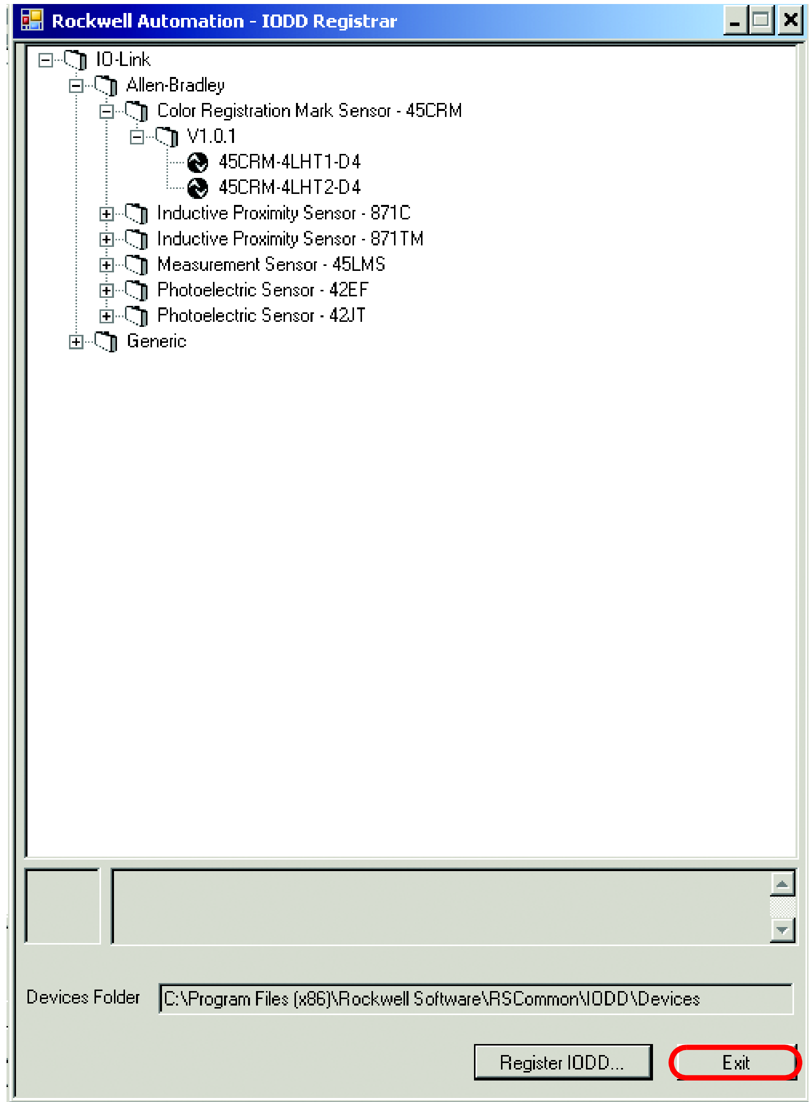
6. Click “Register IODD” in the following dialog box.



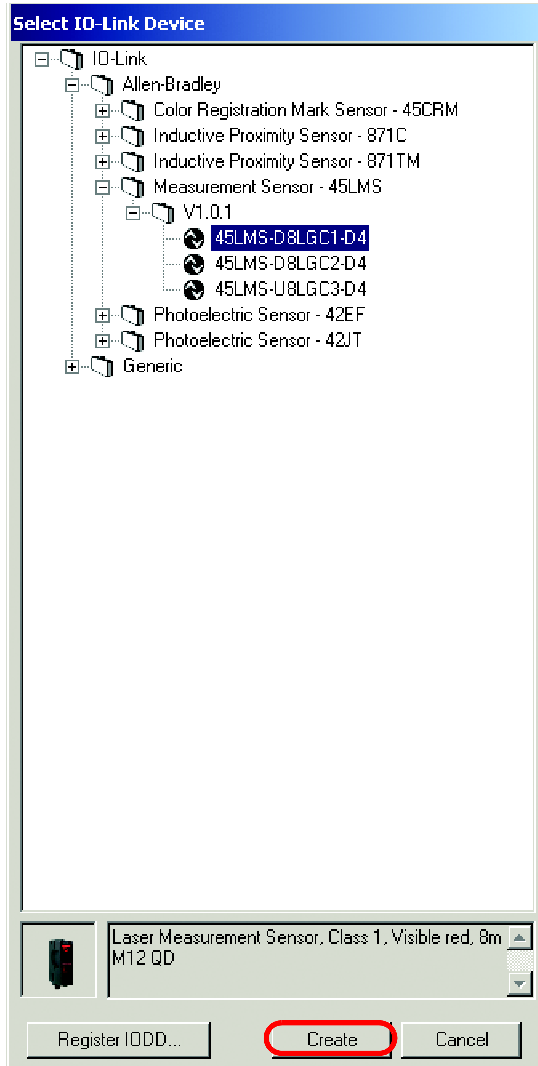
7. Locate the IODD XML file and double-click it. Then click "Open."



8. Then click “Exit.”



9. The 45LMS is now visible in the IO-Link Device Library. Select the appropriate sensor and click “Create.”



10. The sensor appears in the channel configuration window.

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Process Data Input: Select the input data from the pull-down menu (for devices that support multiple layouts of input data).

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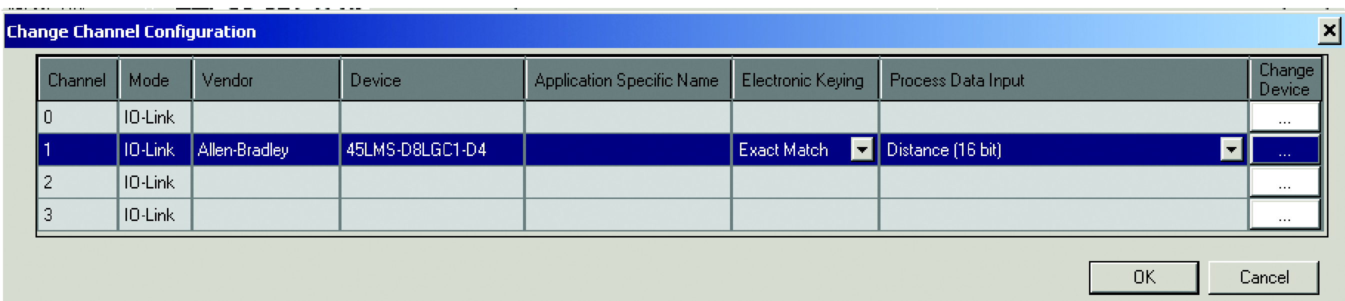
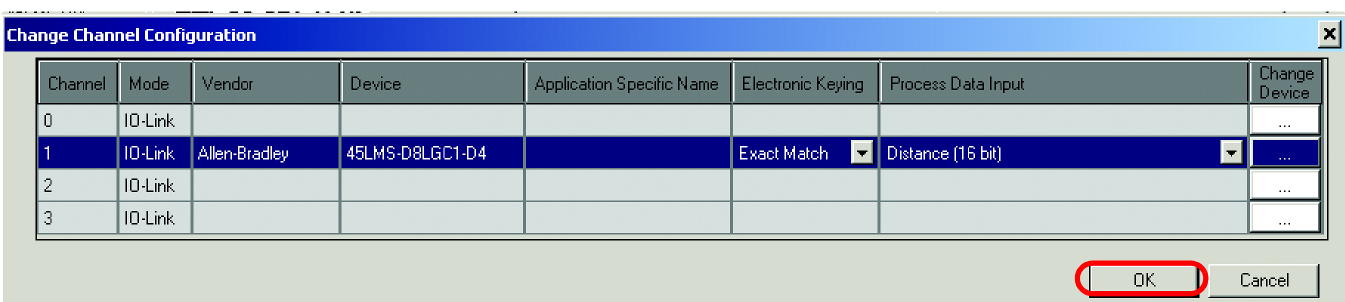
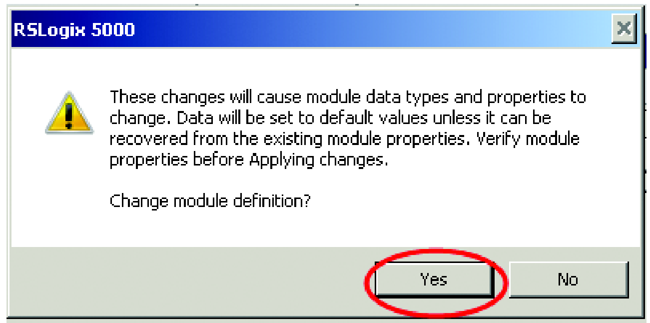
- 12 bit for distance, 2 bit for margin level, 1 bit for triggered 1, and 1 bit for triggered 2



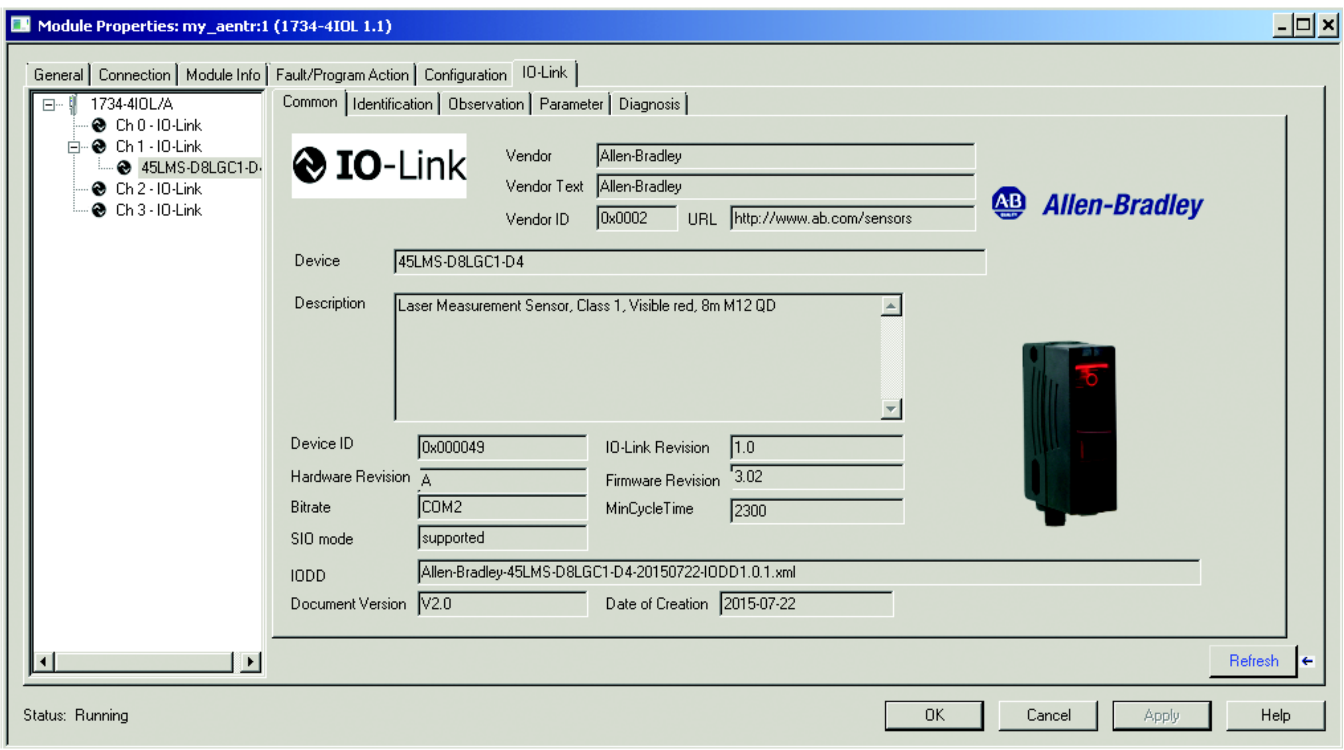
Click "OK."



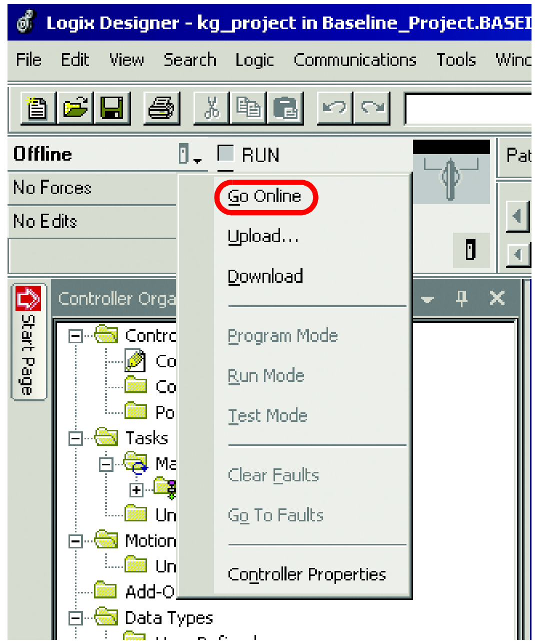
11. Next click “Yes” to confirm the sensor changes.



12. The module properties screen appears on the General Tab. Click the “IO-Link” tab and navigate to the sensor that was added. The sensor can now be programmed through the Add-on Profile.



13. Go online to communicate with the controller and sensor.



The IODD registration and connecting to the IO-Link master is complete.

Proceed to Chapter 10 for a description of each tab that is associated with the 1734 AOP and a description of how the AOP is used to configure the sensor.

Chapter 10

Reviewing the 1734-4IOL IO-Link AOP

Overview

Device Parameter Behavior

IO-Link parameters are shown in the Add-on Profile only for IO-Link devices with IODD Advanced integration. Each parameter can have an attribute of read-only (ro), read-write (rw), or write only (wo). The behavior of parameters and the source for their values differ whether the user is offline or online.

See Table 1 for more information:

Table 1 - IO-Link Device Parameter Behavior

Attribute	Offline	Online
Read-only (ro)	Parameters are blank.	Parameter values are read from the connected IO-Link device. Parameters show "??" when communication breaks.
Read-write (rw)	Parameter values are read from the IODD file when the IO-Link device is added. changes made to the parameters are applied when the "OK" and "Apply" buttons are clicked.	Parameter values can be edited and changes made to the parameters are applied when the "OK" and "Apply" buttons are clicked. Changes are sent to the Master Module, which then writes the changes to the connected IO-Link device.
Write only (wo)	Parameter buttons are disabled.	Parameter buttons that could potentially alter the Process Data are disabled. Other parameter buttons that are enabled, result in commands being sent to the connected IO-Link device.

A complete list of all the 45LMS parameters can be found in Appendix B on page 88.

The 1734-4IOL AOP offers five different tabs to describe the sensor functionality and operation. These tabs are:

Common Tab: Provides general product information about the sensor specifications and IO-link IODD information.

Identification Tab: Provides the sensor catalog number, series letter, general product description including the current product firmware, and hardware revisions.

Observation Tab: Provides the sensors setting for viewing.

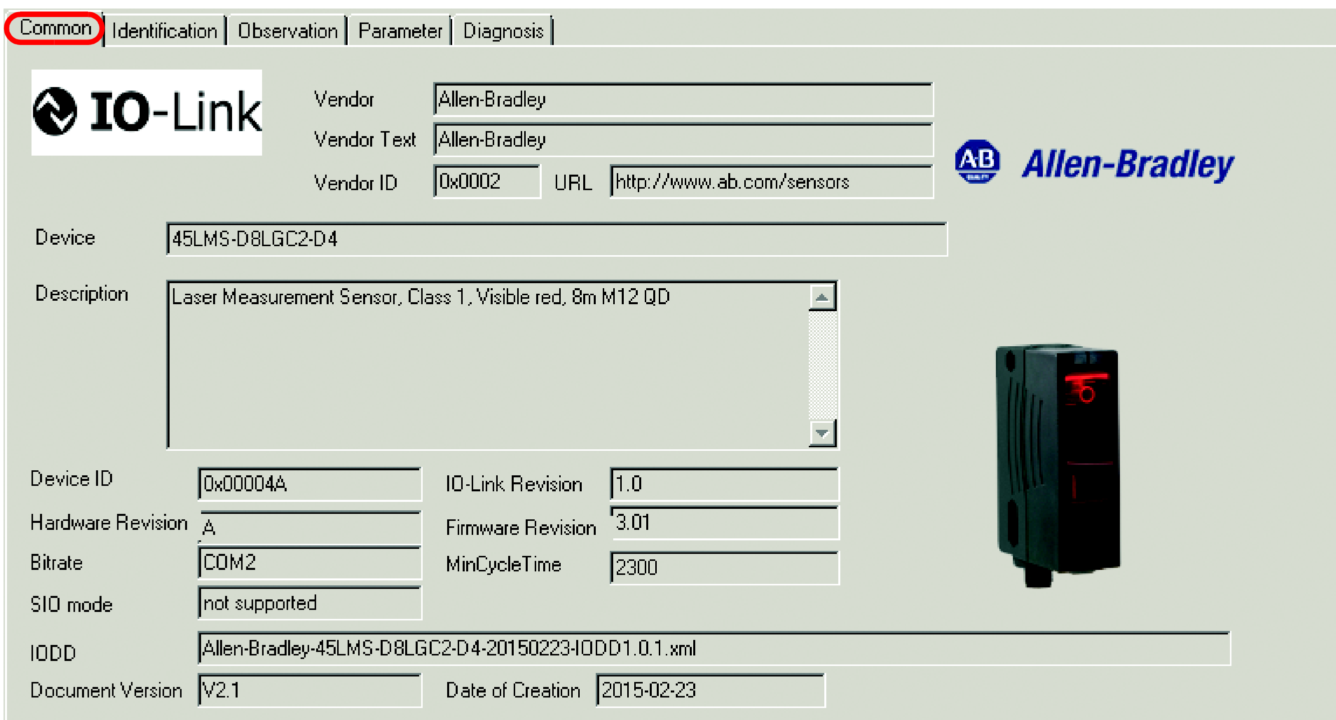
Parameter Tab: Offers the different teach functions available in the 45LMS.

Diagnosis Tab: Provides the ability to test the basic features of the sensor, locate the sensor on the machine, lock/unlock the local sensor settings, and restore the sensor to its original factory settings.

Common Tab

The common tab is automatically generated to provide general information about the sensor. The tab contains:

- Vendor
- Vendor Text
- Vendor ID
- URL
- Device and Description
- Device ID
- IO-Link Revision
- Hardware and Firmware Revision
- Bitrate
- MinCycle Time
- IODD
- Document Version
- Date of creation



Identification Tab

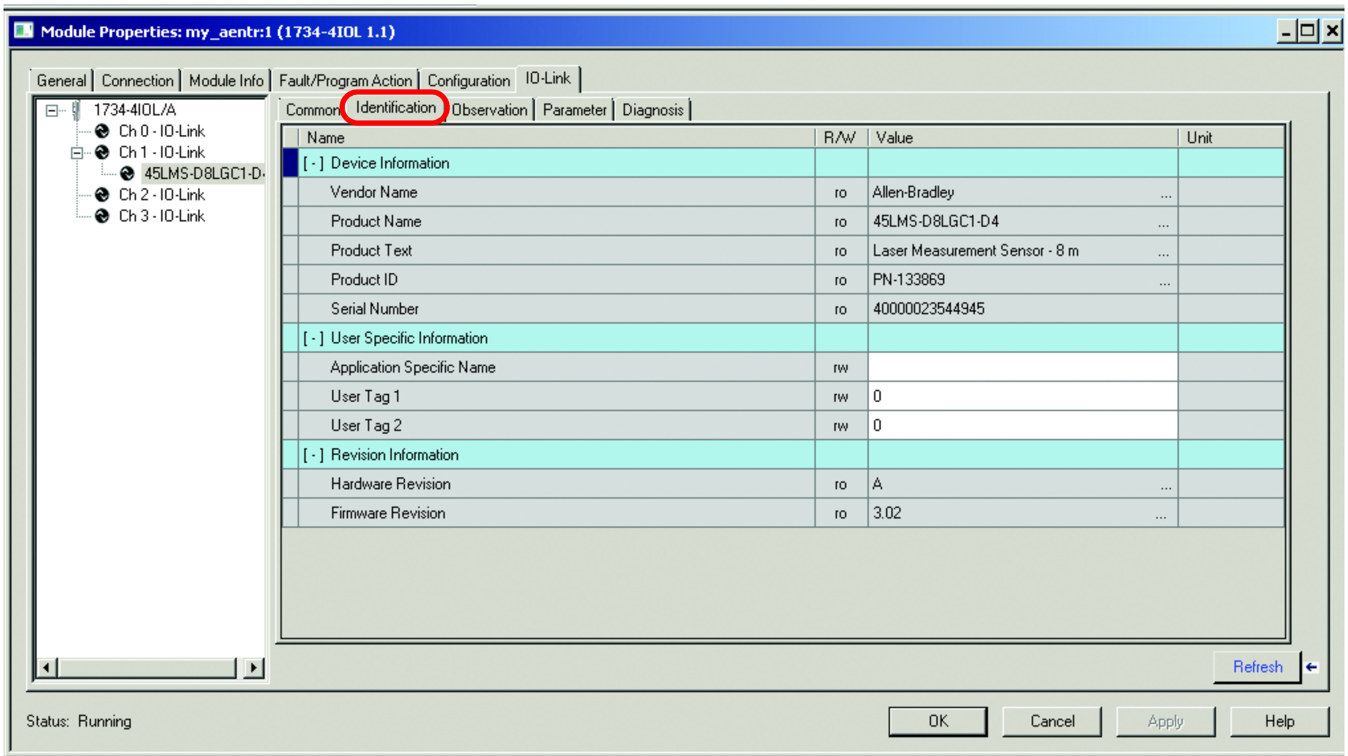
The Identification Tab is divided into three sections: Device Information, User Specific Information, and Revision Information:

The **Device Information** shows us the Vendor Name, Product Name, Product Text, and Product ID of the exact sensor that is configured. These fields are automatically populated according to the sensor information. These fields are Read Only (RO).

The **User Specific Information** contains the Application Specific Name (ASN) where the sensor can be named with a unique text string for identification. The ASN allows unique identity of each sensor. These fields can be custom that is populated and is Read/Write (rw).

User tag 1 and User tag 2 provides the ability to add more descriptions in the AOP for each sensor.

Revision Information gives the hardware and firmware revision of the sensor. Display of the firmware and hardware version helps in troubleshooting. If there are problems with the sensor and it's necessary to contact the Tech Support/ Service Center, be sure to have the exact revision number for troubleshooting. These fields are automatically populated according to the sensor information.



Observation Tab

The Observation Tab displays the sensor settings. This section is read only and allows the information from the sensor setting to be displayed. The values are updated when right-clicking and selecting "Refresh Channel."

.Distance — provides the distance of the laser measurement sensor. The range is 0…4294967294 and 4294967294 is defined as no target detected. This value is dependent on the .Mapped Data configuration in the Parameter tab.

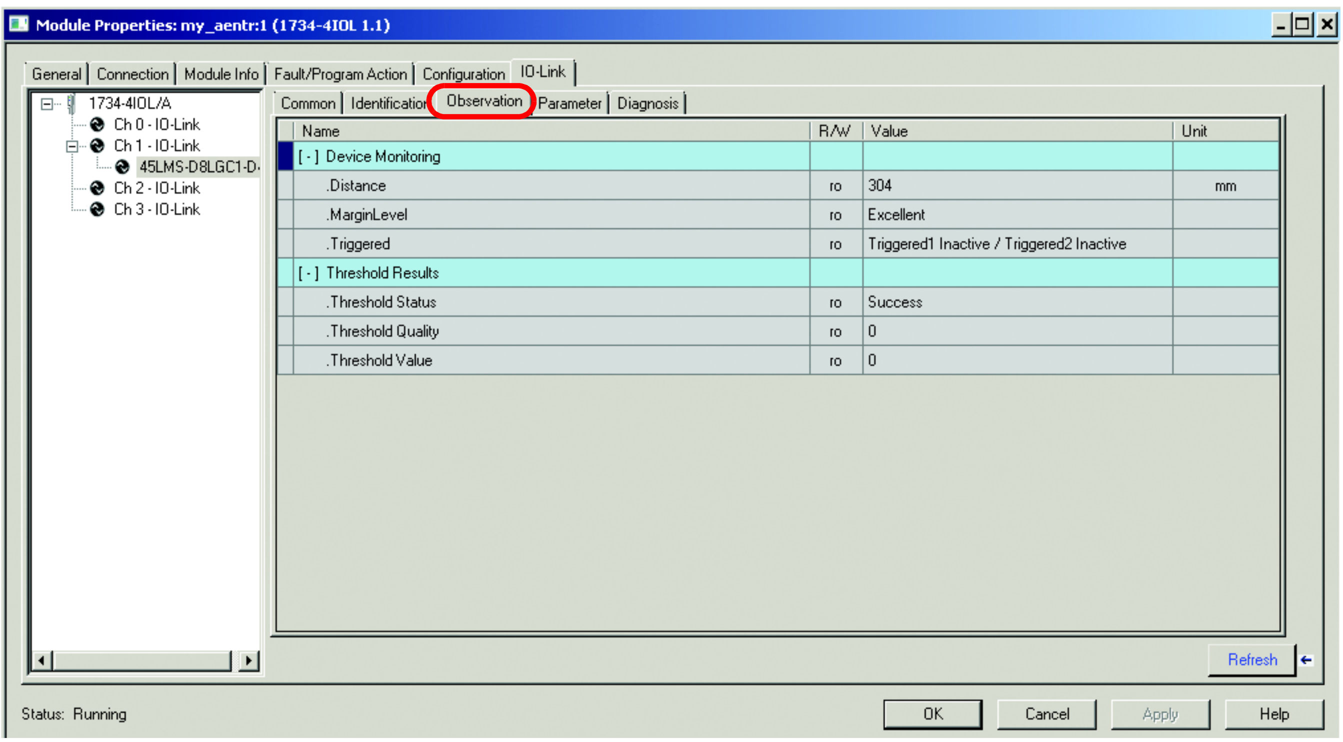
.Margin Level — provides margin indication of what the sensor is detecting. There are four categories: 0 = Insufficient, 1 = Acceptable, 2 = Good, 3 = Excellent.

.Triggered — is the process data bit that communicates the change in state of the 45LMS upon the detection of a target.

The following provides information on the configuration that is selected.

Distance, MarginLevel, Triggered.Distance
Distance, MarginLevel, Triggered. MarginLevel
Distance, MarginLevel, Triggered.Triggered1
Distance, MarginLevel, Triggered.Triggered2

.Threshold Status: 0 = Success; 1 = In progress; 255 = Failure
.Threshold Quality: 0 to 100
.Threshold Value: Blank



Parameter Tab

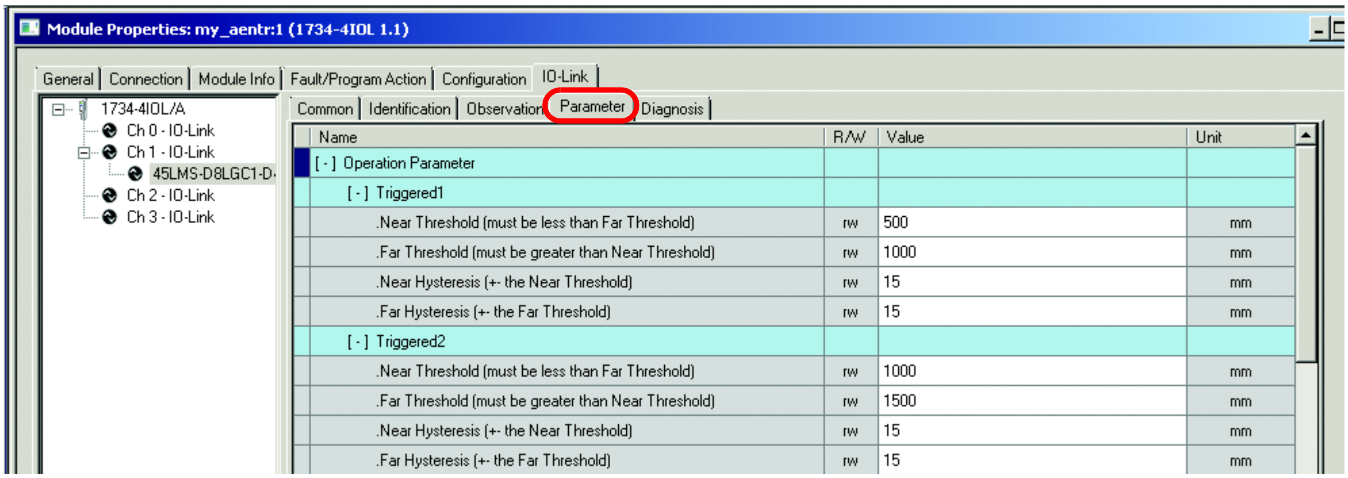
The Parameter Tab displays the sensor parameter settings, and enabling the user to read data from the sensor or teach the sensor by writing new values.

The 45LMS has several parameters, which are important to understand when programming the sensor. The 45LMS provides one discrete output (Q1/Triggered 1) and one discrete or analog output (Q2/Triggered 2). Each output is independent of the other and allows for the option of using one output or both outputs.

Operation Parameter

Both outputs (Triggered 1 and Triggered 2) have these adjustable parameters. These parameters are Read/Write (rw).

.Near Threshold – The low set point must be less than the Far Threshold.
.Far Threshold – The high set point must be greater than the Near Threshold.
.Near Hysteresis – Plus or minus the Near Threshold.
.Far Hysteresis – Plus or minus the Far Threshold.



Operation Configuration

The discrete and analog output for the 45LMS can be managed in the Operation Configuration section of the Parameter Tab. For the two discrete outputs and one analog output the following parameters must be configured:

.Mode: This parameter is Read/Write (rw). There are four operation modes available.

1. **Inactive Mode:** Indicates that the output is "Inactive," therefore the sensor does not turn on or off in any condition.

2. **Window Mode:** Is selected when you are able to set the switching mode ranges by setting the near threshold range and a far threshold range.

3. **Threshold Mode:** Is selected when far threshold and far hysteresis values are critical to the application. The Near Threshold and Near Hysteresis values are negligible and do not impact the installation of the sensor.

4. **Hysteresis Mode:** Is when the range is limited by the Near and Far threshold values. These two values create a hysteresis window. The Near and Far Hysteresis values are negligible and does not impact the installation of the sensor.

.Polarity: This parameter is Read/Write (rw).

For light operate, the polarity selection must show “not inverted.” Therefore, when the status of the Triggered process data value is “1,” a target is present and the status of the Triggered process data value is “0,” a target is not present.

For dark operate, the polarity selection must show “inverted.” Therefore, when the status of the Triggered process data value is “0,” a target is present and the status of the Triggered process value is “1,” a target is not present

.Timing — This parameter is Read/Write (rw). There is the option of: No Delay, 50 ms Delay, or 100 ms Delay.

.Triggered1 — This parameter is Read/Write (rw). The options are push pull.

.Triggered2 — This parameter is Read/Write (rw). The options are push pull, Low Side, High Side, High Impedance, and Analog Signal.

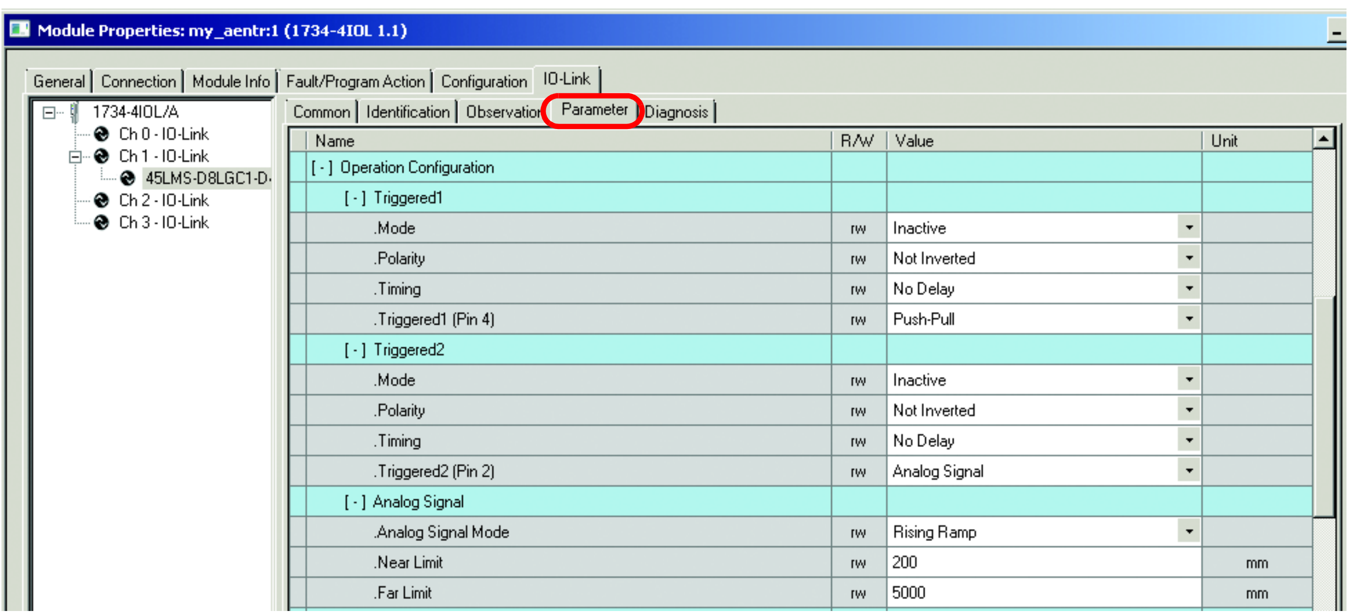
Analog Signal

Triggered 2 is able to be an analog signal. These parameters are Read/Write (rw).

.Analog Signal Mode — The options are rising, failing, or linear ramp; riser, failing, linear ramp with substitution values.

.Near Limit — The low set point (closer to the sensor)

.Far Limit — The high set point (farther from the sensor)



Data Mapping Configuration

.Mapped Data — These parameters are Read/Write (rw). There are four options to select.

The maximum data is 16 bit. Depending on the option that is selected, the values vary.

1. For distance the value is16bit. The distance tag error value is 65535. The distance value in the observation tab maintains the actual millimeter distance.

2. For distance, Triggered 1, Triggered 2, the values are distance at 14 bit and margin level at 2 bit. The distance tag error value is 4095. The distance value in the observation tab maintains the actual millimeter distance.

3. For Distance and Margin level, the values are Distance at 14 bit and Margin level at 2 bit.

4. For Distance, Margin Level, Triggered 1, Triggered 2, the values are Distance at 12 bit, Margin Level at 2 bit, Triggered 1 at 1 bit, and Triggered 2 at 1 bit.

.Distance Resolution — The distance resolution setting affects the distance value displayed. These parameters are Read/Write (rw). There are four options to select.

Example: Selecting Distance (16 bit) as the Mapped Data and target is at 1000 mm distance.

Distance resolution at 1 mm/bit, Distance tag value is 1000 (high resolution)

Distance resolution at 2 mm/bit, Distance tag value is 500 (actual distance that is divided by 2)

Distance resolution at 5 mm/bit, Distance tag value is 200 (actual distance that is divided by 5)

Distance resolution at 10 mm/bit, Distance tag value is 100 (actual distance that is divided by 10)

The .Distance value in the observation tab always remains at 1000 mm (39.37 in.) and the value reading is independent of the .Mapped Data configuration.

.Distance Mode: These parameters are Read/Write (rw). There are two options to select: Relative and Normalized. When setting the mode to relative, the distance tag is displayed as a multiple of the actual distance (depending on the distance resolution selection). When setting the mode to distance normalization, the distance tag is displayed in bytes and is not a multiple of the actual value. The normalized value that is entered indicates the maximum distance that the sensor will error to.

.Distance Normalization: When setting a value for distance normalization, this value indicates the maximum distance that the sensor will error. Therefore, the output turns on/off between the far and near thresholds, however error out when it reaches the distance normalization value.

[-] Data Mapping Configuration			
.Mapped Data	rw	Distance (12 bit), MarginLevel, Triggered...	
.Distance Resolution	rw	10 mm / Bit	
.Distance Mode	rw	Relative	
Distance Normalization	rw	5000	mm

Sensor Configuration

Evaluation Mode: Is the sampling time, which is the frequency at which the sensor distance is refreshed. Default is 10 ms. Other options are 20 ms, 50 ms, and 100 ms.

Offset Distance: Is an option to provide a correction factor to the sensing distance. This value can be positive or negative. For example, if the sensor distance is reading 1098 mm and reality the distance is 2000 mm, then the offset distance is set at 2 mm.

[-] Sensor Configuration			
Evaluation Mode	rw	Averaging 10ms	
Offset Distance	rw	0	mm

Event Configuration

.Lost Target: The default value is disabled. There is an option to enable. If disabled, no error codes are being generated.

.Lost Target (2): The default value is disabled. There is an option to enable. If disabled, no error codes are being generated.

[-] Event Configuration			
.Lost Target	rw	Disabled	
.Lost Target (2)	rw	Disabled	

Operation Configuration: Polarity is the only parameter that can be configured in this section of the Parameter Tab. This parameter is Read/Write (rw).

For light operate, the polarity selection must show “not inverted.” Therefore, when the status of the Triggered process data value is “1,” a target is present and the status of the Triggered process data value is “0,” a target is not present.

For dark operate, the polarity selection must show “inverted.” Therefore, when the status of the Triggered process data value is “0,” a target is present and the status of the Triggered process value is “1,” a target is not present.

Operation Parameters: In this section of the Parameter Tab, the user can see Teach-In Results, Mark Values, Background Values, and Contrast Values.

Teach-In-Results parameters are all Read Only (ro). The parameters in this section include the following parameters:

Status — Indicates the state of the Teach-In process (0 = No Update, 1 = Updated Target TM, 2 = Updated Background TB, 3 = Updated Mark/Background). This parameter can only be updated during the teach process.

Quality Factor — This parameter defines the quality of signal contrast between the taught mark and the background.

Error — Indicates whether an error occurred during the teach-in process (True = Teach-In Failure, False = Teach-In Ok).

Mark Value and **Background Value** parameters provide signal level values for the red, blue, and green components of the Mark and Background taught. These values are Read/Write (rw).

IMPORTANT	The ability to Read/Write these values allows the user to set up multiple product profiles. Specific Mark/Background values can be stored in the PLC for multiple targets and downloaded to the sensor, by using message instructions, when the user changes targets.

Contrast parameters include the following (ro) parameters:

Contrast On: Indicates the signal level the sensor receives when the output is on.

Contrast Off: Indicates the signal level the sensor receives when the output is off.

Contrast Value: When this parameter value is “0”, it indicates that the taught mark is darker than the taught background. When this parameter value is “1”, it indicates that the taught mark is brighter than the taught background.

IMPORTANT	To see updated values for any of the Operational Parameters, right-click on the sensor catalog number on the left-hand side of the AOP screen. Select “Refresh Channel Data.”

Diagnosis Tab

The Diagnosis Tab allows the user to test some of the basic features of the sensor, locate the sensor on the machine, lock/unlock the local sensor settings, and restore the sensor to its original factory settings. This tab is broken into two sections: Service Function and Communication Characteristics.

Service Function: In this section of the Parameter Tab, the user can see Teach-In Results, Mark Values, Background Values, and Contrast Values.

Sensor Test Operation: The (rw) parameter allows the user to individually test laser output on the unit.

Locator Indicator: By changing the (rw) value of this parameter to "Locator Indication," the LEDs on the sensor begin to flash at a 5 Hz rate. This feature allows the user to locate a specific sensor in a system or application where multiple sensors are present.

Local Operation Status: When the (rw) parameter is selected as "Lock" the sensor is no longer locally teachable. The sensor cannot be taught locally in IO-Link mode or in standard IO mode. To locally teach the sensor this parameter, must be selected as "Unlock."

LED (Yellow) Indications: ????

Local Teach Button: The (ro) parameter follows the Local Operation parameter. When the Local Operation Status parameter value is "Lock," this parameter is "Active."

Local Teach-In: This parameter follows the Local Teach parameter. When the sensor is being taught using the Local Teach parameter then this parameter value = "True" (False = Inactive, True = Active).

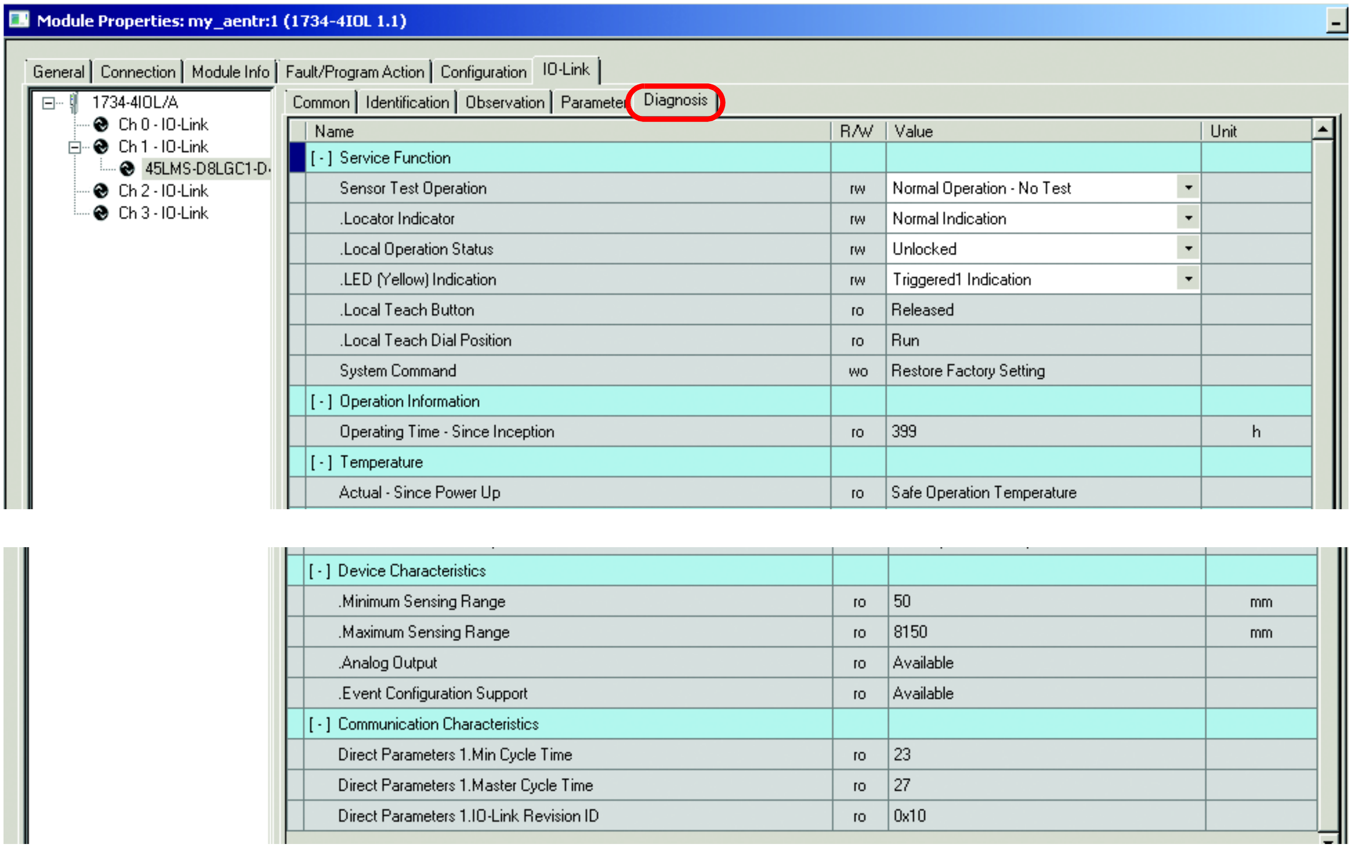
Local Teach Dial Position: Is a (ro) parameter that shows the current position of the teach dial on the sensor.

System Command: Allows the user to Restore Factory Settings on the sensor. Click "Restore Factory Settings" and click "Yes" when prompted.

Operation Information: In this section of the Diagnosis Tab, the user can see the (ro) values for the Operating Time since Inception and the actual temperature since power up.

Device Characteristics: In this section of the Diagnosis Tag the user can see the (ro) values for the Minimum and Maximum sensing range, Analog output, and Event Configuration support

Communication Characteristics: In this section of the Diagnosis Tab the user can see (ro) values for the Minimum Cycle Time (response time of the sensor) and Master Cycle Time (time used by the master to address the sensor) while in IO-Link mode. The user can obtain the IO-Link Revision of the sensor in this section.



Manage Parameter Differences Between IO-Link Devices and Controllers

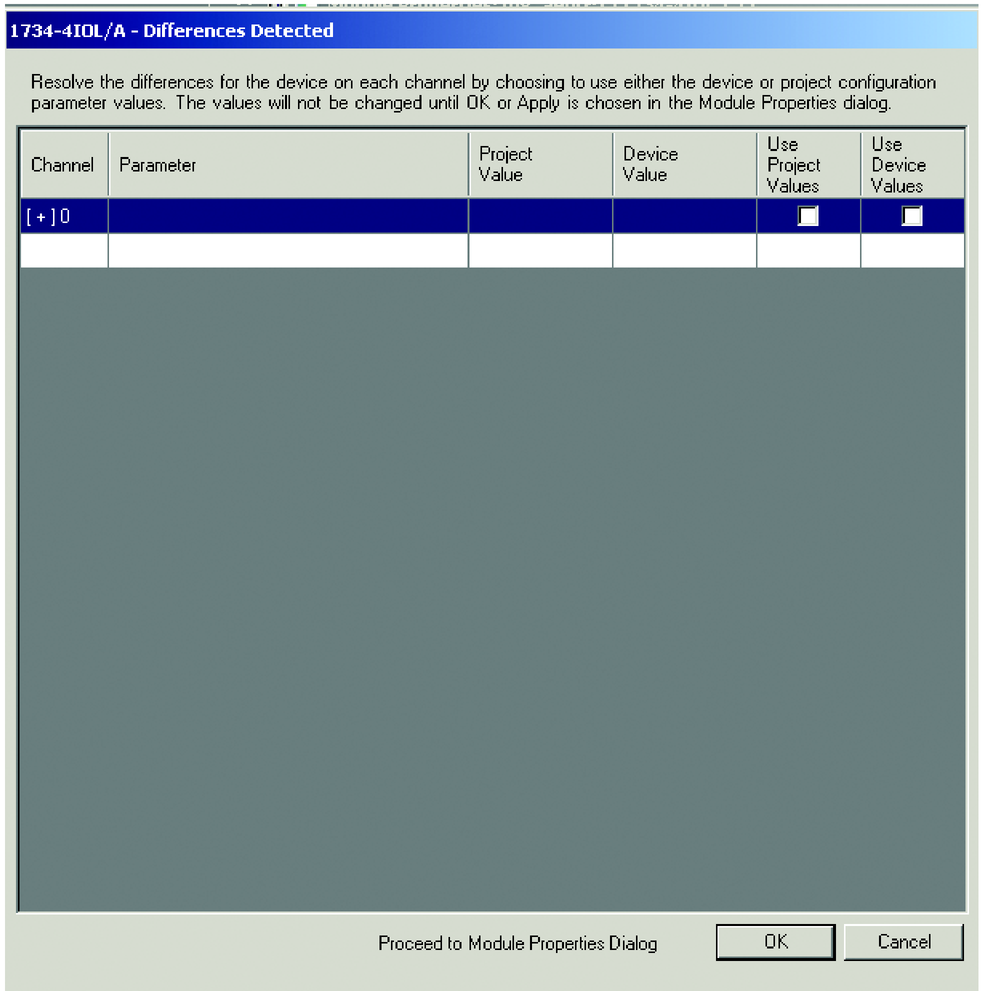
The Add-on Profile has a Refresh button that updates the read-only parameters for all channels with IO-Link devices. It also performs a Correlation check of the read-write parameters in all connected IO-Link devices and in the controller.

Differences in parameter values can happen when the device configuration is changed externally, such as through a device console during operation. If there are differences after running a Correlation check, you can choose to use the parameters that are currently in the connected IO-Link device or to use the parameters that are stored in the controller. The changes can be done on a per channel basis.

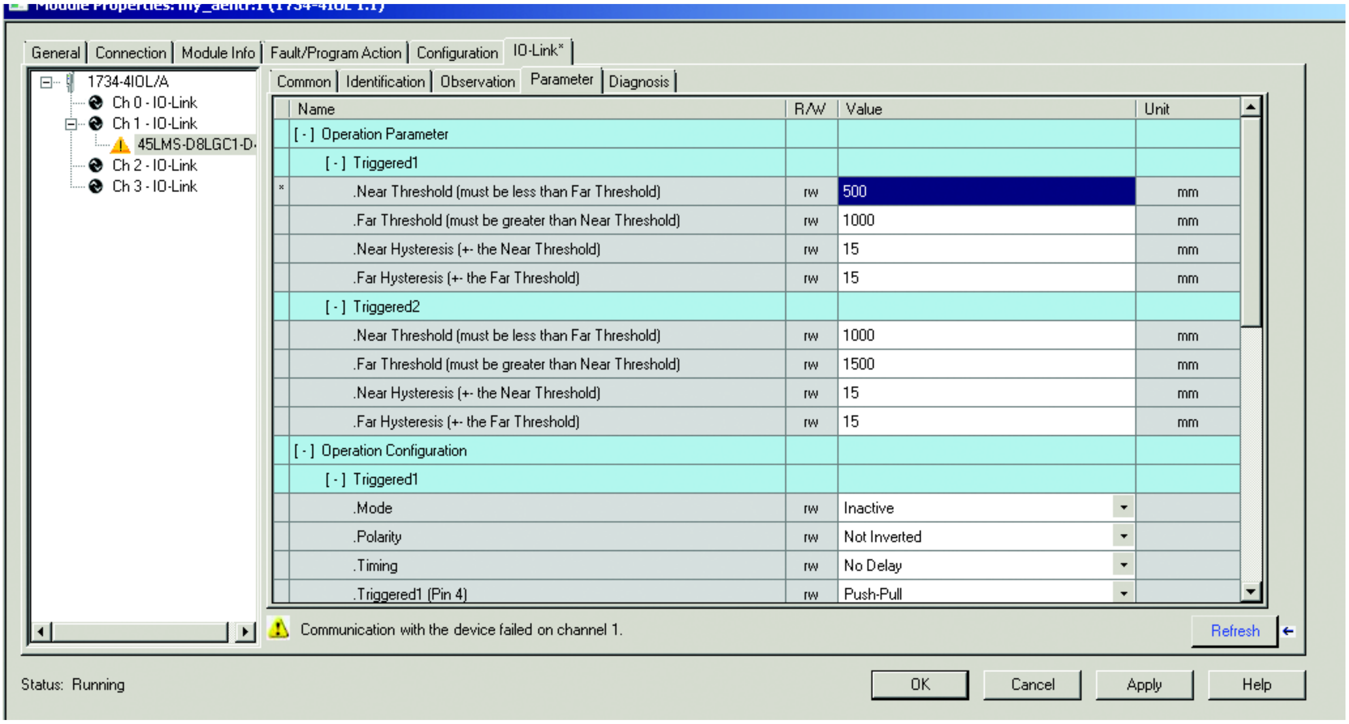
Before you proceed with this task, take note that the Refresh function:

- Is only enabled in Online mode.
- Is performed initially when the Add-on Profile is launched in Online mode.

1. From the IO-Link tab on the working pane, click the Refresh button. If differences are detected in the RW values, a dialog box appears. The dialog box displays mismatched information per channel, including the parameters and the values present in the device and in the controller.

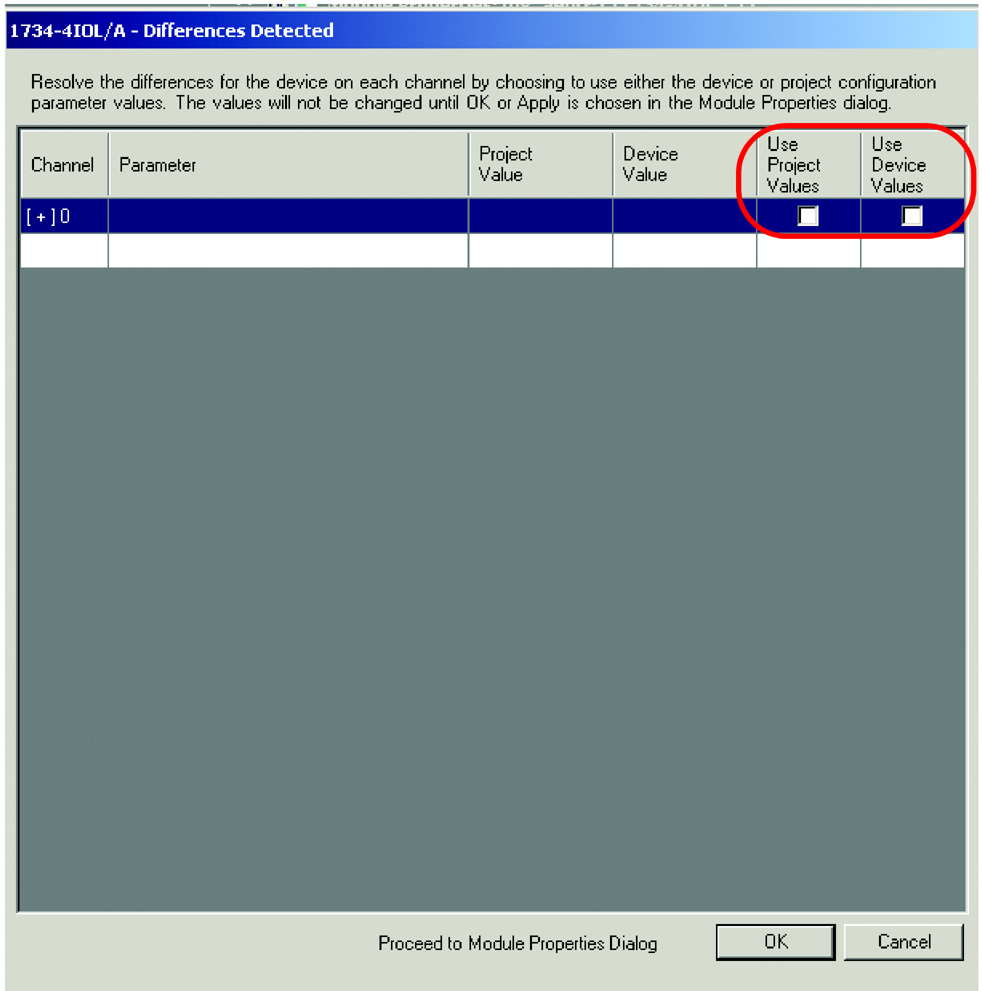


Communication errors (if applicable) are indicated in the dialog for each channel. A link becomes available for you to click to retry communication.



2. For each channel, select the checkbox for the corrective action:
   - Use Device Values: Uploads the parameter values that are read from the connected IO-Link device to the project.
   - Use Project Values: Downloads the parameter values from the project to the connected IO-Link device.

3. Click "OK." If you click the "OK" button without fixing the errors, the read-write parameters of the affected channels are displayed.


1734-4IOL/A - Differences Detected
Resolve the differences for the device on each channel by choosing to use either the device or project configuration parameter values. The values will not be changed until OK or Apply is chosen in the Module Properties dialog.
Channel
Parameter
Project Value
Device Value
Use Project Values
Use Device Values
[+] 0
Proceed to Module Properties Dialog
OK
Cancel

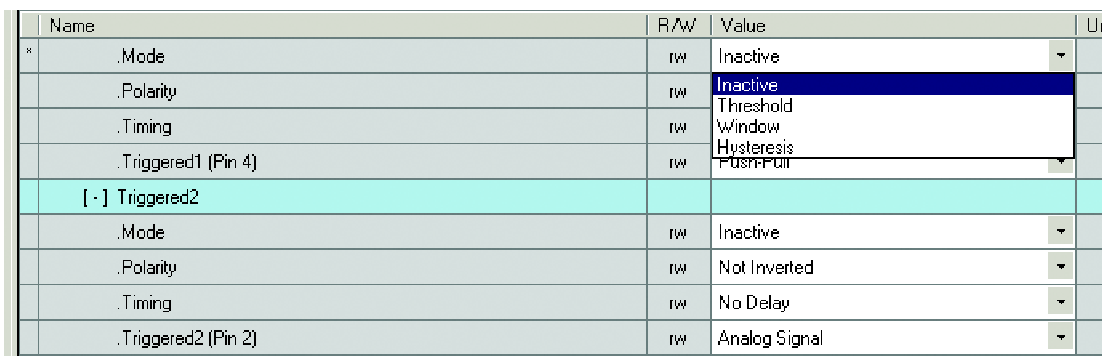
Chapter 11

Teaching the 45LMS on IO-Link

Operation Configuration

The 45LMS has several parameters which are important to understand when programming the sensor. The 45LMS provides two discrete outputs (Q1/Triggered 1) and one discrete or analog output (Q2/Triggered 2). Each output is independent of the other and you have the option to use one output or both.

1. Select the Operating Mode for Triggered1 and Triggered2 (if two outputs are required):



The four operation modes for the output are:

a. **Inactive Mode** – This selection indicates that the output is "Inactive," therefore the sensor will not turn on or off in any condition. The Triggered Parameter will state "Inactive" and the correlated controller tag will stay at 0 (or 1 if the polarity is inverted).

b. **Window Mode** – When window mode is selected, you have the ability to set your switching mode ranges by setting the Far Threshold range and a Near Threshold range.

The Far Threshold value is limited to the sensor maximum sensing range according to the sensor catalog number. The Near Threshold value must be 50 mm (1.97 in.) or higher.

There is also the ability to add a hysteresis to the Far and Near Threshold ranges. The Default values are 15 mm (0.59 in.) for Far Hysteresis and 15 mm for Near Hysteresis. The Hysteresis value can be set to zero if no Hysteresis is required. **Note: The Hysteresis value is always half of the actual value which you see. Therefore 15 mm Hysteresis is actually 7.5 mm (0.29 in.) or 200 mm (7.87 in.) Hysteresis is actually 100 mm (3.94 in.).**

The configuration is:
Mapped Data: Distance at 12 bit
Distance Resolution: 10mm/bit
Distance mode: Relative

Window Mode Example 1 (no Hysteresis):

The configuration is:
Mapped Data: Distance at 12 bit
Distance Resolution: 10mm/bit
Distance mode: Relative

	[-] Operation Parameter			
	[-] Triggered1			
	.Near Threshold (must be less than Far Threshold)	rw	250	mm
	.Far Threshold (must be greater than Near Threshold)	rw	600	mm
*	.Near Hysteresis (+- the Near Threshold)	rw	0	mm
*	.Far Hysteresis (+- the Far Threshold)	rw	0	mm

The output will turn on when target is in the range of 250…600 mm (9.84…23.62 in.). The output will turn off when the target is below 250 mm or above 600 mm. The sensor will error when it is below 50 mm (1.97 in.). (The output will be reversed if the polarity is changed to non-inverted.)

Window Mode Example 2 (with Hysteresis):

	Name	R/W	Value	Unit
	[-] Operation Parameter			
	[-] Triggered1			
	.Near Threshold (must be less than Far Threshold)	rw	250	mm
	.Far Threshold (must be greater than Near Threshold)	rw	600	mm
*	.Near Hysteresis (+- the Near Threshold)	rw	200	mm
*	.Far Hysteresis (+- the Far Threshold)	rw	200	mm

Result:

As the target moves towards the sensor, the output will turn on at 500 mm (19.68 in.) and off at 150 mm (5.90 in.) (the lower hysteresis value for the Far and Near Thresholds).

As the target moves away from the sensor, the output will turn on at 350 mm (13.78 in.) and off at 700 mm (27.56 in.) (the higher hysteresis value for the Far and Near Thresholds).

c. **Threshold Mode** –

Far Threshold and Far Hysteresis values are required to set up the sensor in Threshold mode. The Near Threshold and Near Hysteresis values are not valid and make no impact on the set up of the sensor.

Note: If Far Hysteresis value is entered, the range of the sensor will be plus and minus of the Far Threshold value.

The configuration is:
Mapped Data: Distance at 12 bit
Distance Resolution: 10 mm/bit
Distance mode: Relative

Threshold Mode Example 1 (no Hysteresis)

	[-] Operation Parameter			
	[-] Triggered1			
	.Near Threshold (must be less than Far Threshold)	rw	250	mm
	.Far Threshold (must be greater than Near Threshold)	rw	600	mm
*	.Near Hysteresis (+- the Near Threshold)	rw	0	mm
*	.Far Hysteresis (+- the Far Threshold)	rw	0	mm

Result:

Sensor output will be on only from 50…600 mm (1.97…23.62 in.).

Threshold Mode Example 2 (with Hysteresis)

	Name	R/W	Value	Unit
	[-] Operation Parameter			
	[-] Triggered1			
	.Near Threshold (must be less than Far Threshold)	rw	250	mm
	.Far Threshold (must be greater than Near Threshold)	rw	600	mm
*	.Near Hysteresis (+- the Near Threshold)	rw	200	mm
*	.Far Hysteresis (+- the Far Threshold)	rw	200	mm

Result:

If the target is moving towards the sensor, the output will turn on at 500 mm and stay on until 50 mm.

If the target is moving away from the sensor, the output will be on from 50…700 mm (1.97…27.56 in.) and turn off after 700 mm.

d. **Hysteresis Mode** – The range is limited by the Near and Far threshold values. These two values create a hysteresis window. The Near and Far Hysteresis values are negligible and will not make any impact on the sensor set up.

The configuration is:
Mapped Data: Distance at 12 bit
Distance Resolution: 10mm/bit
Distance mode: Relative

Hysteresis Mode Example 1

	[-] Operation Parameter			
	[-] Triggered1			
	.Near Threshold (must be less than Far Threshold)	rw	250	mm
	.Far Threshold (must be greater than Near Threshold)	rw	600	mm
*	.Near Hysteresis (+- the Near Threshold)	rw	0	mm
*	.Far Hysteresis (+- the Far Threshold)	rw	0	mm

Result:

As the target approaches the sensor, the sensor output turns on at 250 mm (9.84 in.), and then off at 600 mm (23.62 in.). If the target moves away from the sensor, then the sensor output will stay on from 5…600 mm (0.20…23.62 in.) and turn off after 600 mm.

Example of the various configurations are shown below:

Relative Mode
Near Threshold = 500; Threshold = 1000

16bit, 10mm/bit, relative	14bit, 10mm/bit, relative	12bit, 10mm/bit, relative
Distance (observation tab): 2035	Distance (observation tab): 2035	Distance (observation tab): 2035
Distance tag: 203	Distance tag: 203	Distance tag: 203
Error, distance tag 65535	Error, distance tag 16383	Error, distance tag 4095
16bit, 5mm/bit, relative	**14bit, 5mm/bit, relative**	**12bit, 5mm/bit, relative**
Distance (observation tab): 2035	Distance (observation tab): 2035	Distance (observation tab): 2035
Distance tag: 406	Distance tag: 406	Distance tag: 406
Error, distance tag 65535	Error, distance tag 16383	Error, distance tag 4095
16bit, 2mm/bit, relative	**14bit, 2mm/bit, relative**	**12bit, 2mm/bit, relative**
Distance (observation tab): 2035	Distance (observation tab): 2035	Distance (observation tab): 2035
Distance tag: 1016	Distance tag: 1016	Distance tag: 1016
Error, distance tag 65535	Error, distance tag 16383	Error, distance tag 4095
16bit, 1mm/bit, relative	**14bit, 1mm/bit, relative**	**12bit, 1mm/bit, relative**
Distance (observation tab): 2035	Distance (observation tab): 2035	Distance (observation tab): 2035
Distance tag: 2035	Distance tag: 2035	Distance tag: 2035
Error, distance tag 65535	Error, distance tag 16383	Error, distance tag 4095

Normalized Mode = 5000
Distance Resolution is negligible
Near Threshold = 500; Threshold = 1000

16bit, normalized	14bit, normalized	12bit, normalized
Distance (observation tab): 2035	Distance (observation tab): 2035	Distance (observation tab): 2035
Distance tag: 26750	Distance tag: 6680	Distance tag: 1670
Error, distance tag 65535	Error, distance tag 16383	Error, distance tag 4095

In normalized mode, the distance tag is displayed in bits. For the 15 m (49.2 ft) 45LMS sensor the mapped distance must be at 2 mm (0.08 in.)/bit or higher to get the full sensing distance. For the 50 m (164 ft) 45LMS sensor, the mapped distance must be at 10 mm (0.39 in.)/bit to get the full sensing distance.

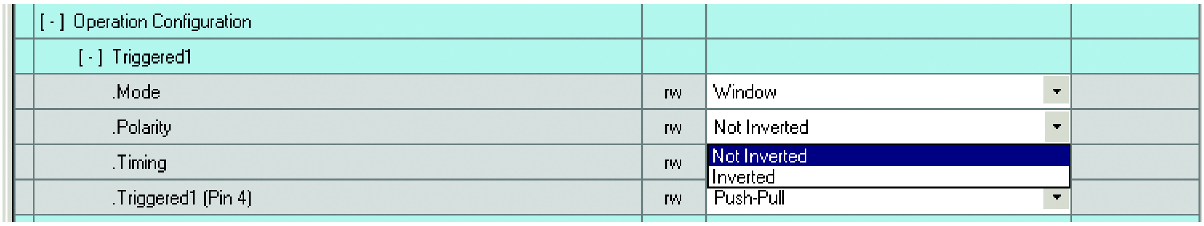
Example: If the sensor is in relative mode, 16 Bit, at 1 mm (0.04 in.)/bit using the 8 m (26.2 ft) 45LMS sensor. The distance in observation tab states 3000, then the distance controller tag will display 24,575 (3000/8000 * 65535).

2. Set the Polarity:

   Polarity is write only (rw), therefore selectable.

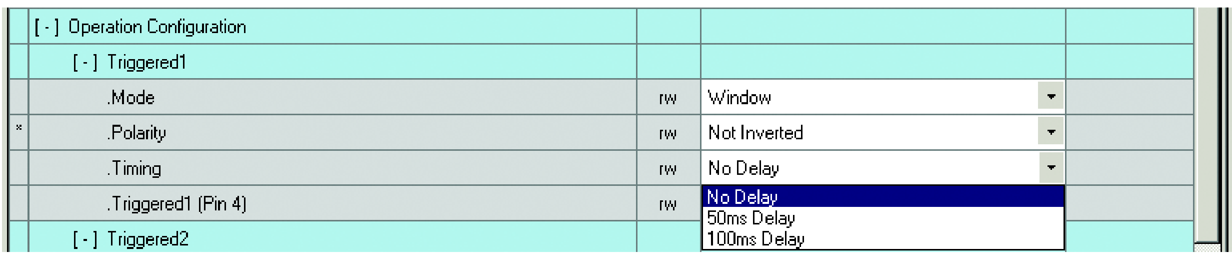
For Light Operate – the Polarity selection should show “Not Inverted” Therefore when the status of the trigger is “1,” a target is present and the status of the trigger is “0,” a target is not present.

For Dark Operate, the Polarity selection should show “Inverted” Therefore when the status of the trigger is “0,” a target is present and the status of the trigger is “1,” a target is not present.



3. Set the Timing:

   There is the option of: No Delay, 50 ms Delay or 100 ms Delay.



4. In Analog mode, only the relative mode is applicable and the near and far threshold values are of importance. The hysteresis values and modes are negligible and make no impact to analog mode. The 4…20 mA applies as the near and far limits, therefore if the near limit will act as the 4 mA output and the far limit will act as the 20 mA output.

Chapter 12

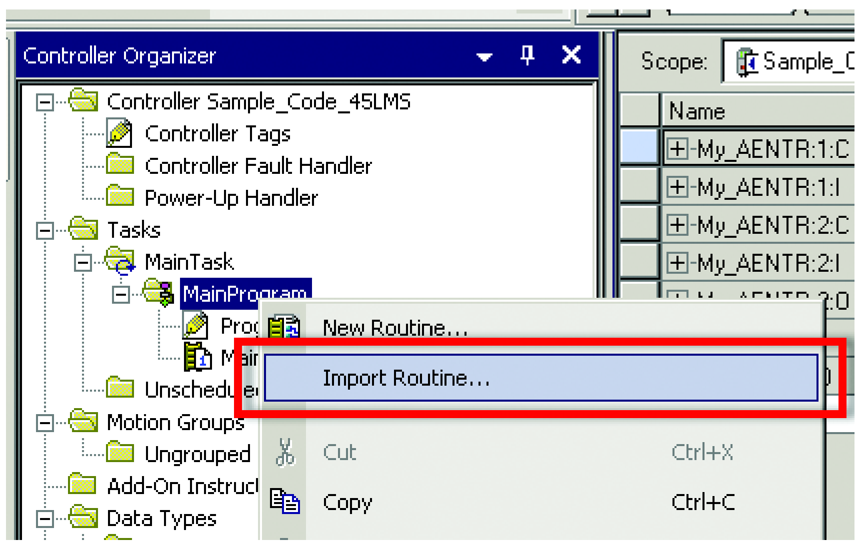
Setting up the Sensor with Studio 5000

Sample Code

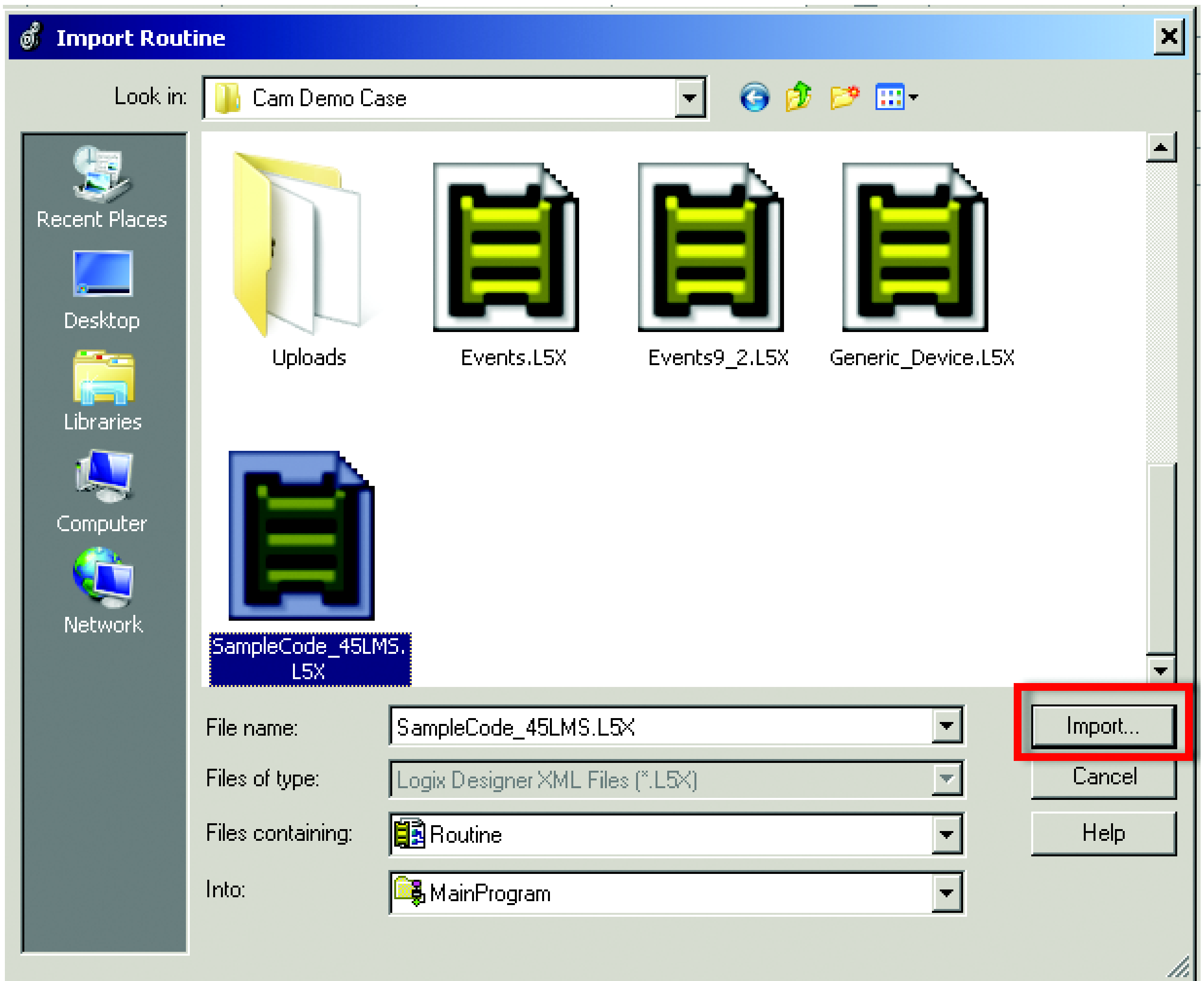
To download the sample code that is shown in this chapter go to www.ab.com and follow these steps:

1. Save and Extract Crm_Control.L5X to a folder of your choice.

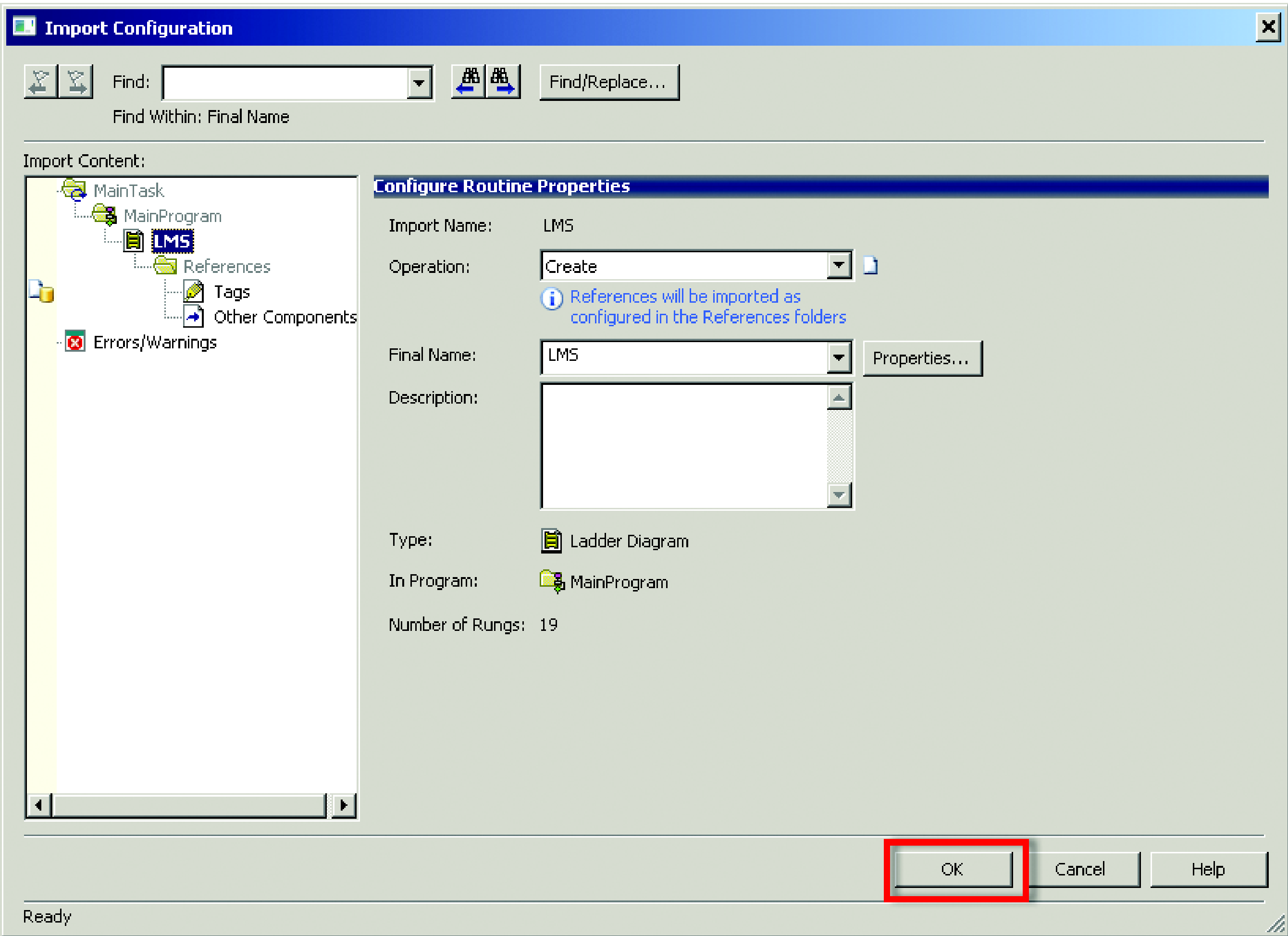
2. Within your Logix Studio program, right-click Main program and select import routine.



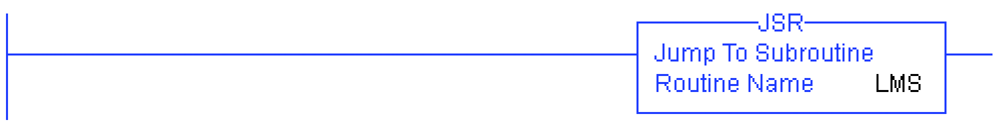
3. Browse to the folder containing the routine extracted in step 1. Select and click “Import.”



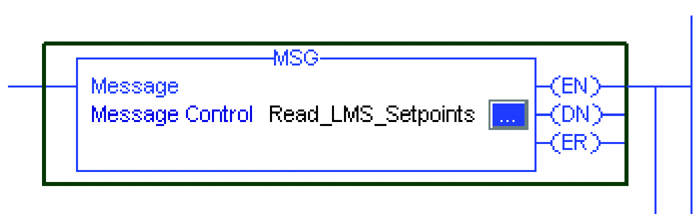
4. The “Import Configuration” box displays, accept the default settings, and click “OK.”



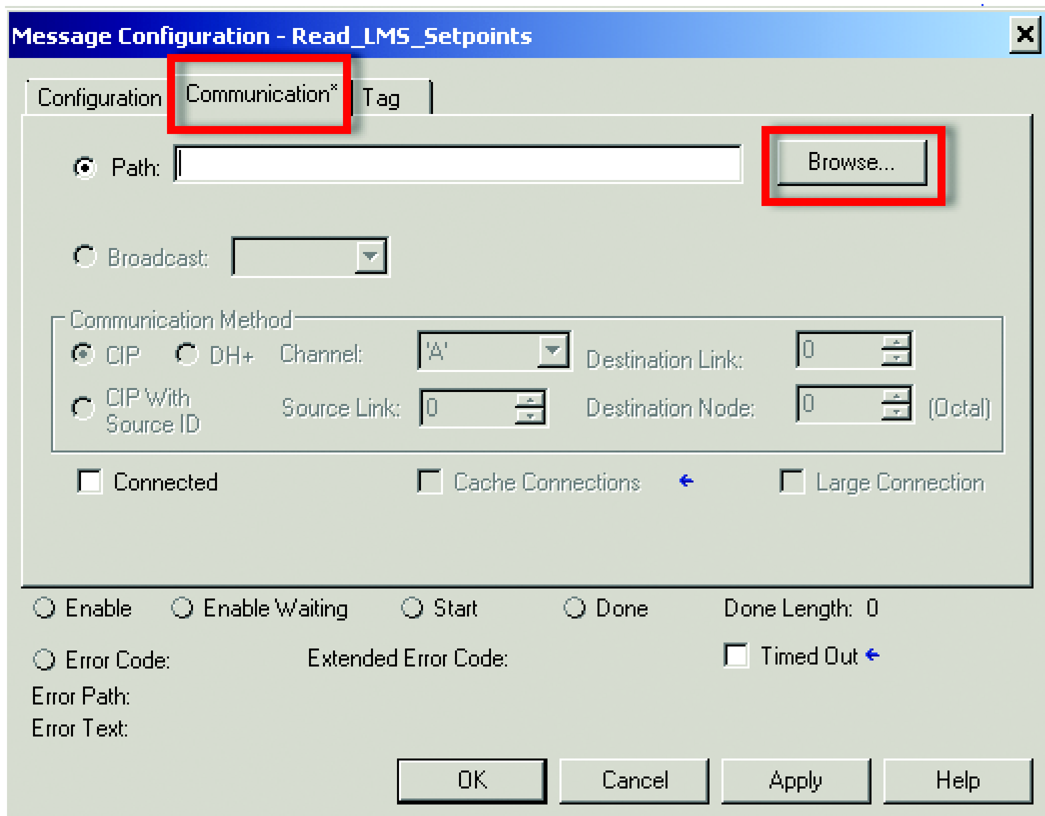
5. From the MainRoutine create a rung of code that runs the subroutine LMS.



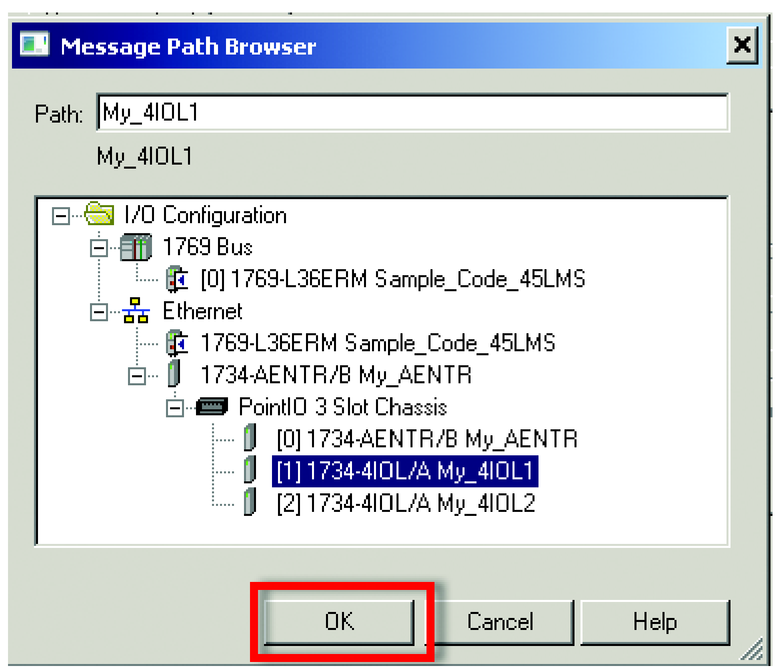
6. Open the LMS subroutine. On Rung 0 within the MSG Instruction, click the square button to open the message configuration.



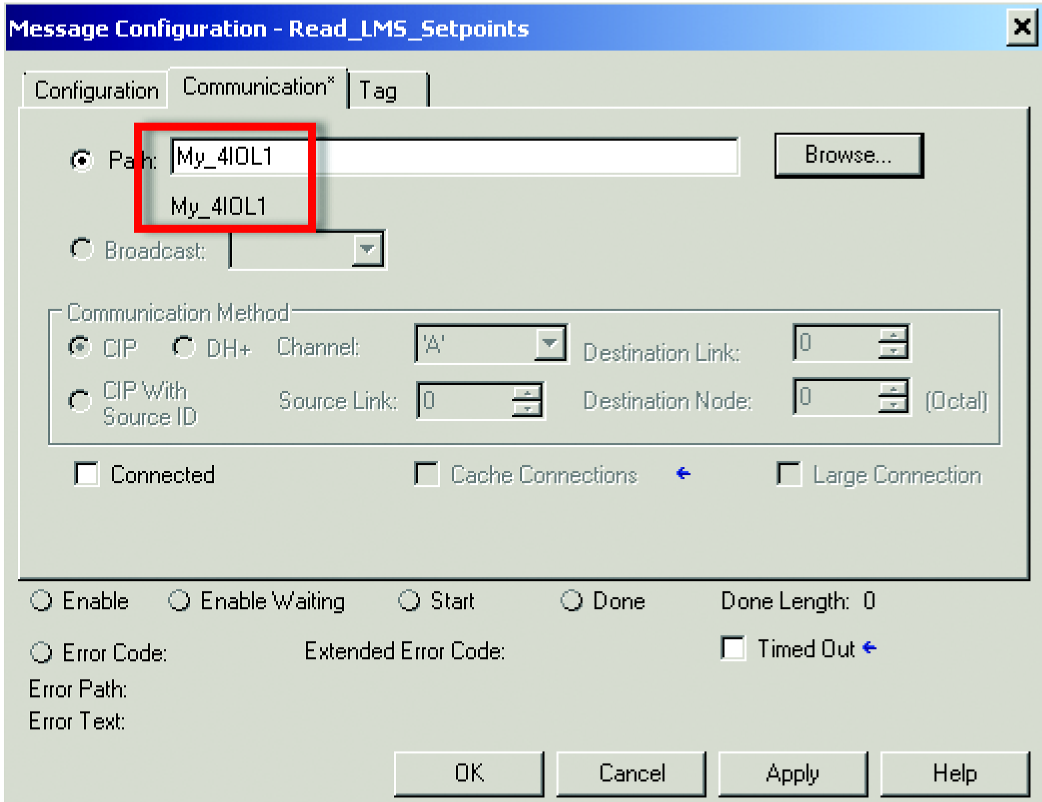
7. The Message configuration pop-up box is displayed. Click the "Communication" tab. Select the "Browse" button.



8. Browse the Ethernet Network to the 1734-AENTR and select the 1734-4IOL Master. Click "OK."

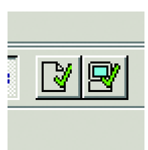


Notice that the path is now set to Master_1 in the communication path. Click "Apply" then "OK."

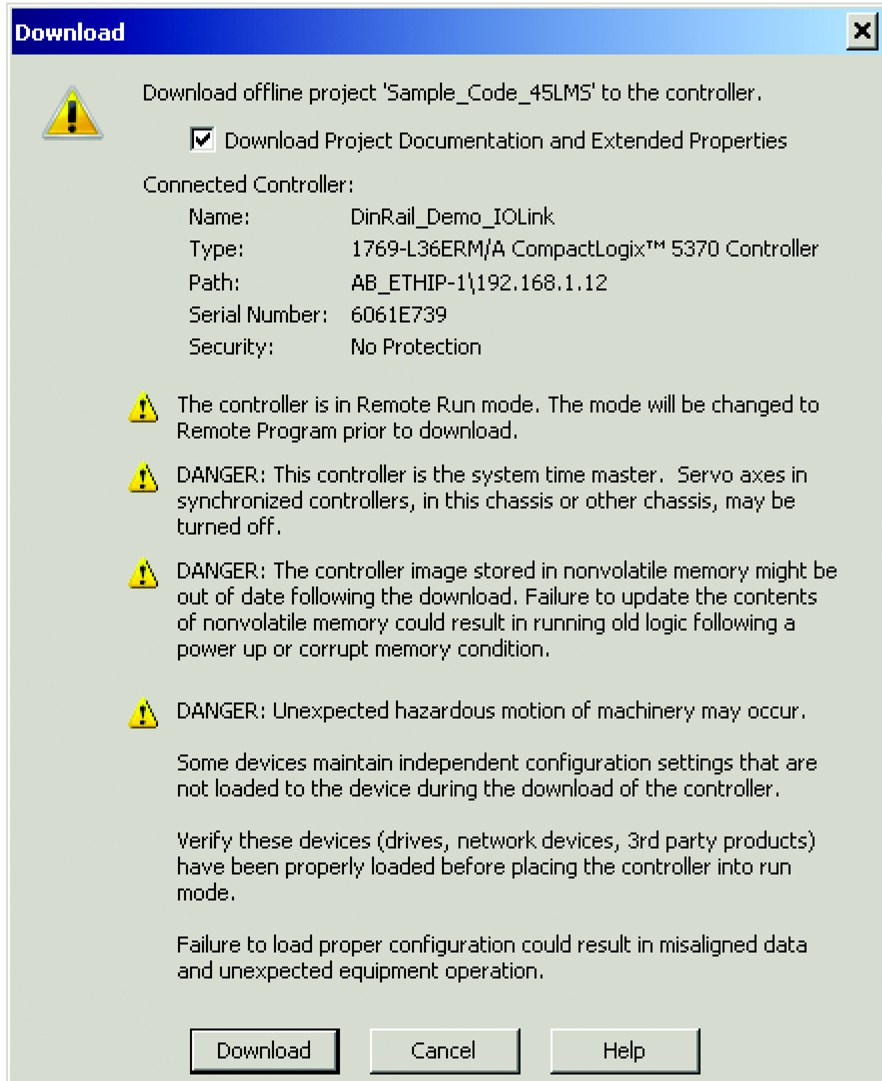


9. Repeat Step 8. For the remaining message instructions.

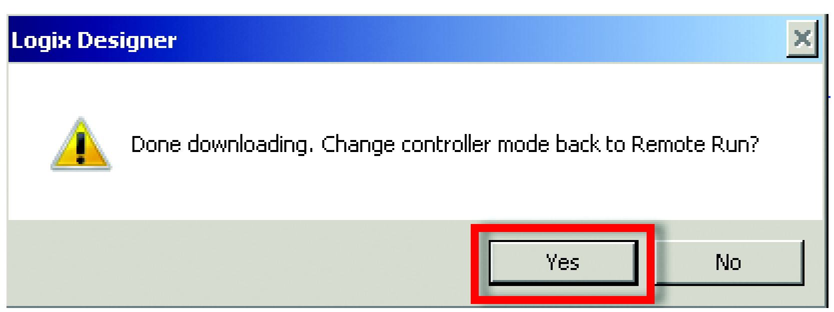
10. Verify that the routine is free of errors.



11. Download the program to the controller.



12. Put the controller in “Run” mode.

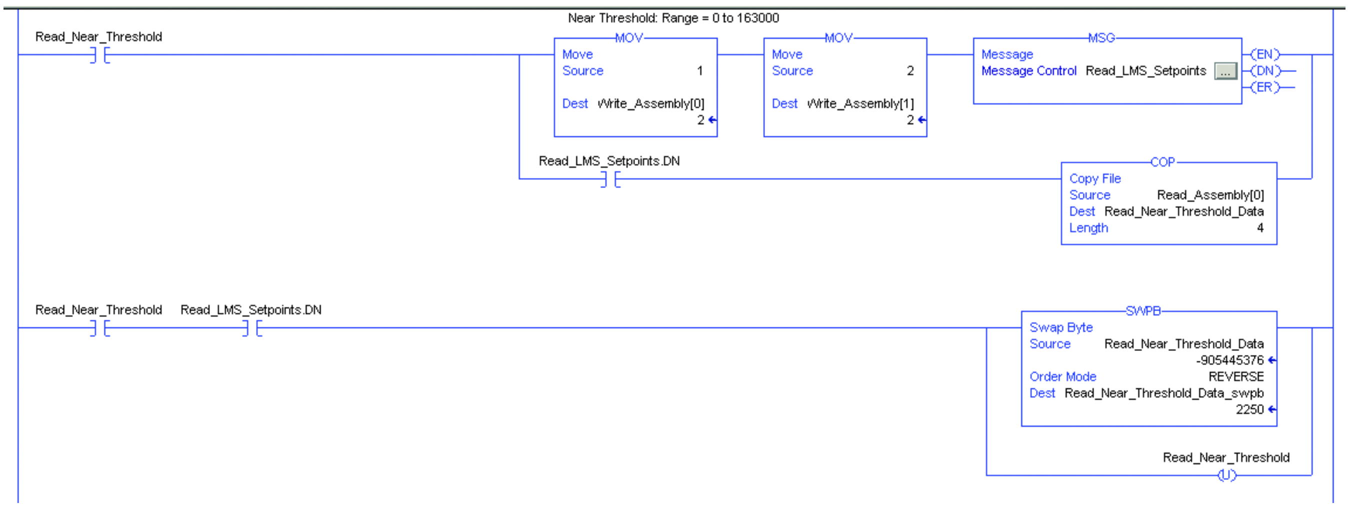


The following code has be compiled to read and write parameters of a 45LMS sensor connected to channel 2 of the 1734-4IOL module.

Operation

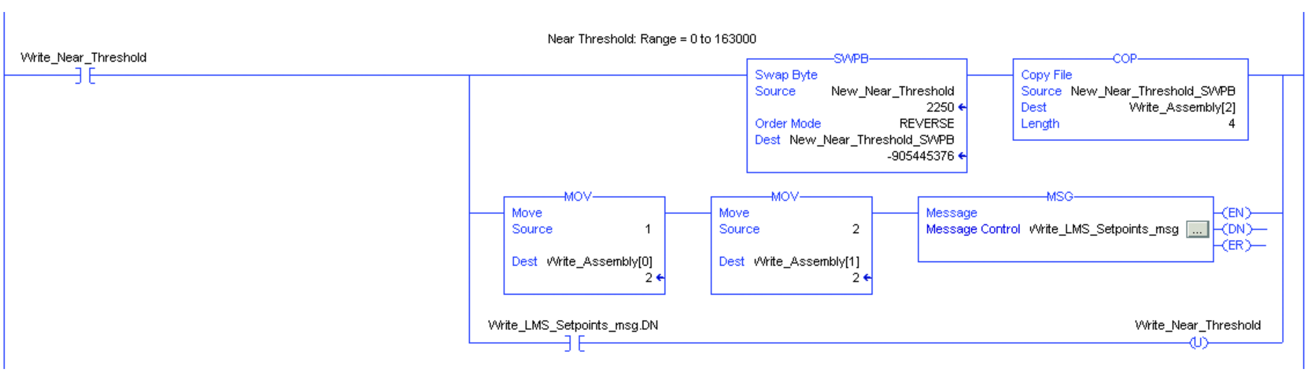
Thresholds (reading)

Toggle the “Read_Near_Threshold” contact (CTRL +T), initiates a explicit message which read Index 64, Sub Index 1. The four bytes of data are read and retrieved into ‘Read_Near_Threshold_Data’ array. This data is then transposed using the SWPB instruction. The configured value is the displayed in DINT tag named ‘Read_Near_Threshold_Data_SWPB’.



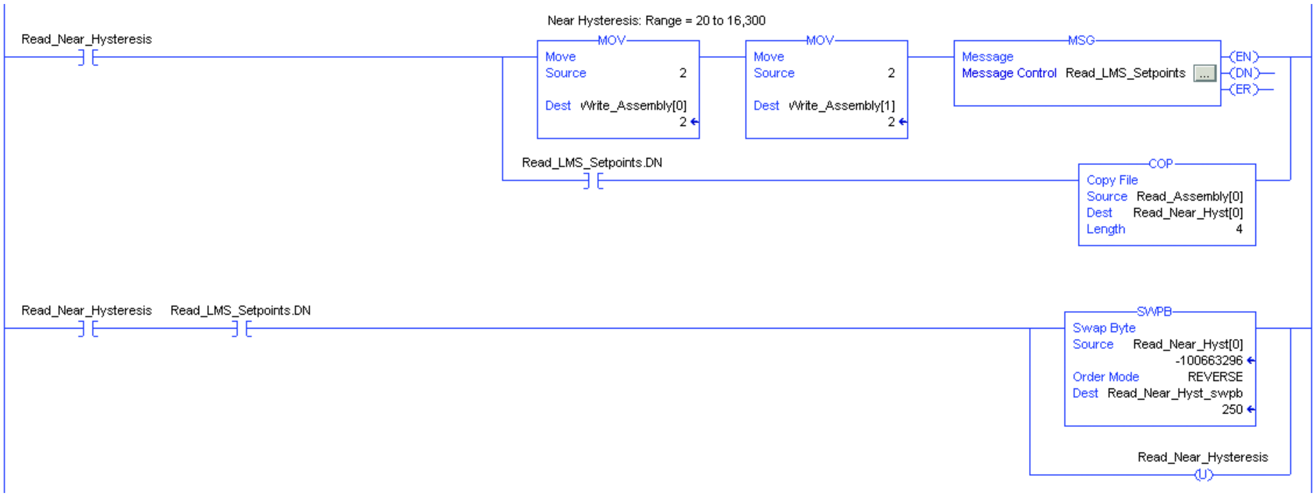
Thresholds (writing)

Enter the New value to be written into the ‘New_Near_Threshold’ tag. Toggle the “Write_Near_Threshold” contact (CTRL +T), initiates a reverse SWPB instruction converting the value and then initiates an explicit message which writes Index 64, SubIndex 1.



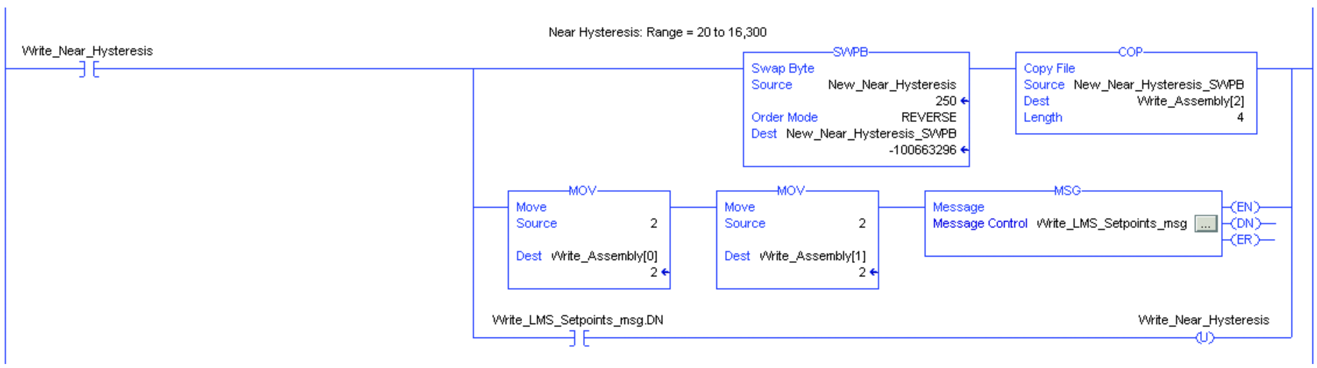
Hysteresis (reading)

Toggle the "Read_Near_Hysteresis" contact (CTRL +T), initiates a explicit message which read Index 64, Sub Index 2. The four bytes of data are read and retrieved into 'Read_Near_ Hysteresis_Data' array. This data is then transposed using the SWPB instruction. The configured value is the displayed in DINT tag named 'Read_Near_ Hysteresis _Data_SWPB'



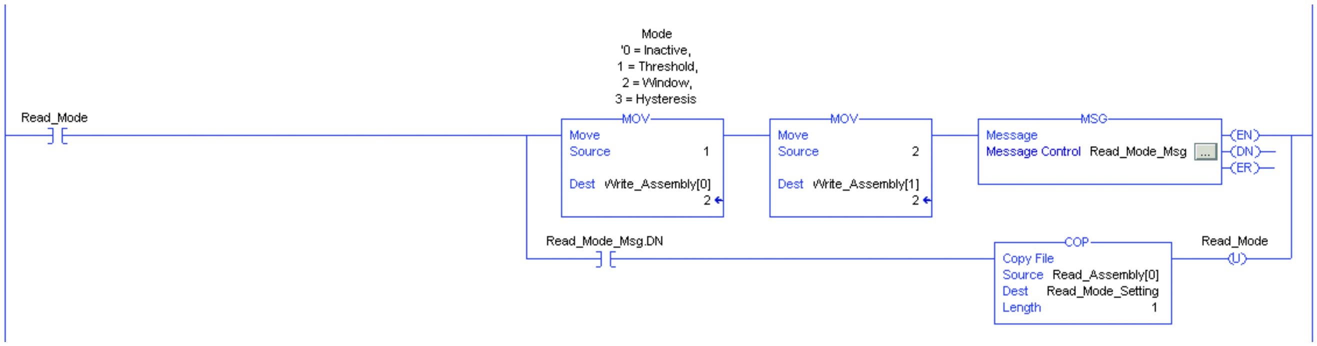
Hysteresis (writing)

Enter the New value to be written into the 'New_Near_Hysteresis' tag. Toggle the "Write_Near_Hysteresis" contact (CTRL +T), initiates a reverse SWPB instruction converting the value and then initiates an explicit message which writes Index 64, SubIndex 2.



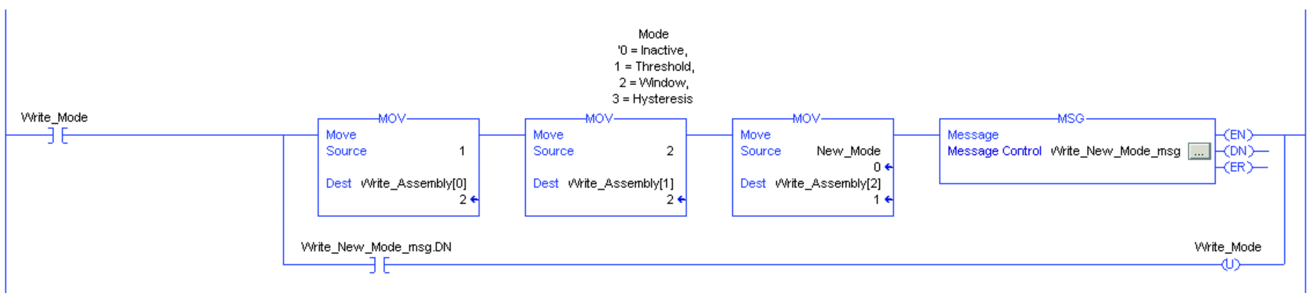
Mode (reading)

Toggle the "Read_Mode" contact (CTRL +T), initiates a explicit message which read Index 96, Sub Index 1. One Byte of data is then retrieved and stored into SINT 'Read_Mode_Setting'.



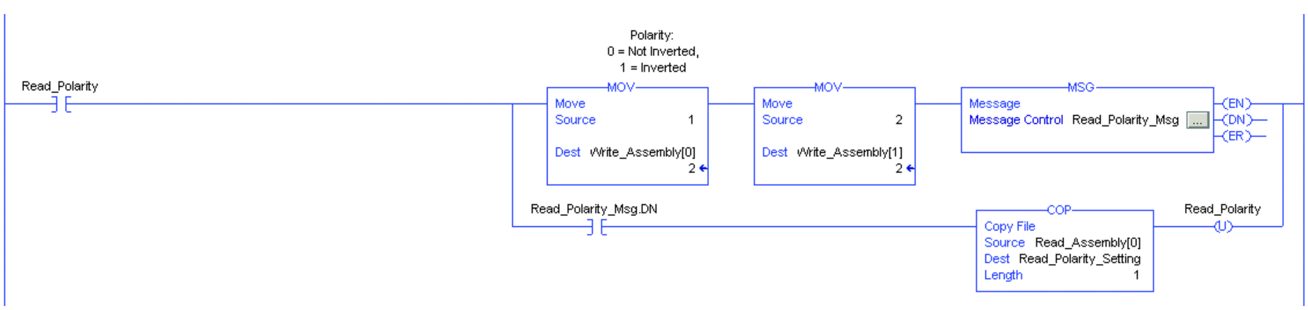
Mode (writing)

Enter the New value to be written into the 'New_Mode' tag. Toggle the "Write_Mode" contact (CTRL +T). Three bytes of data (Sub Index, Channel # and New_Mode) are then written to the sensor, Index 96 Subindex 1.



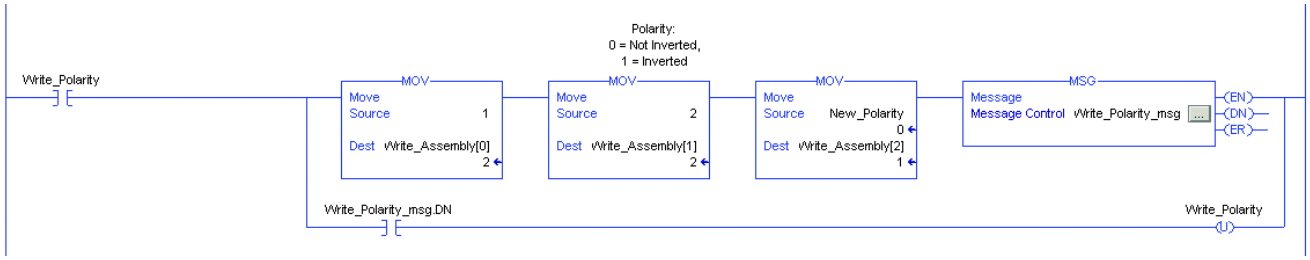
Polarity (reading)

Toggle the "Read_Polarity" contact (CTRL +T), initiates a explicit message which read Index 112, Sub Index 1. One Byte of data is then retrieved and stored into SINT 'Read_Polarity_Setting'.



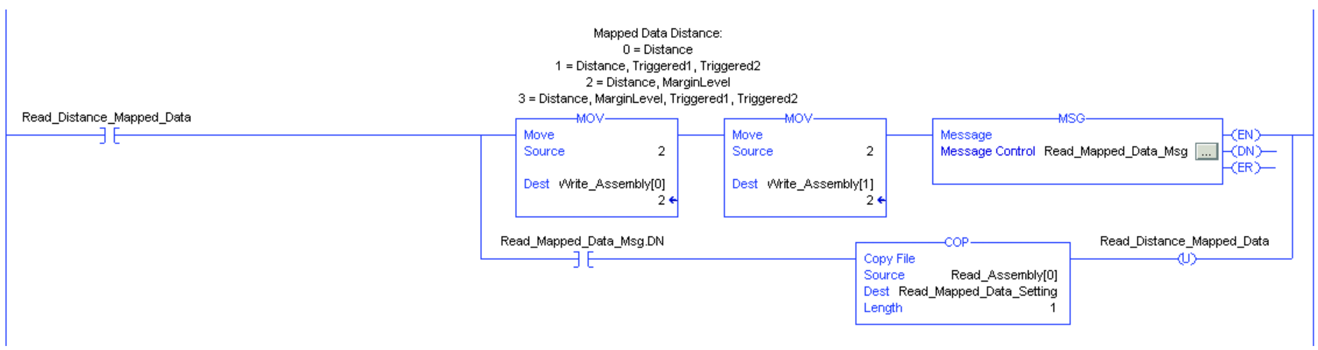
Polarity (writing)

Enter the New value to be written into the ‘New_Polarity’ tag. Toggle the “Write_Polarity” contact (CTRL +T). 3 bytes of data (Sub Index, Channel # and New_Polarity) are then written to the sensor, Index 112 Subindex 1.



Sensor Configuration (reading)

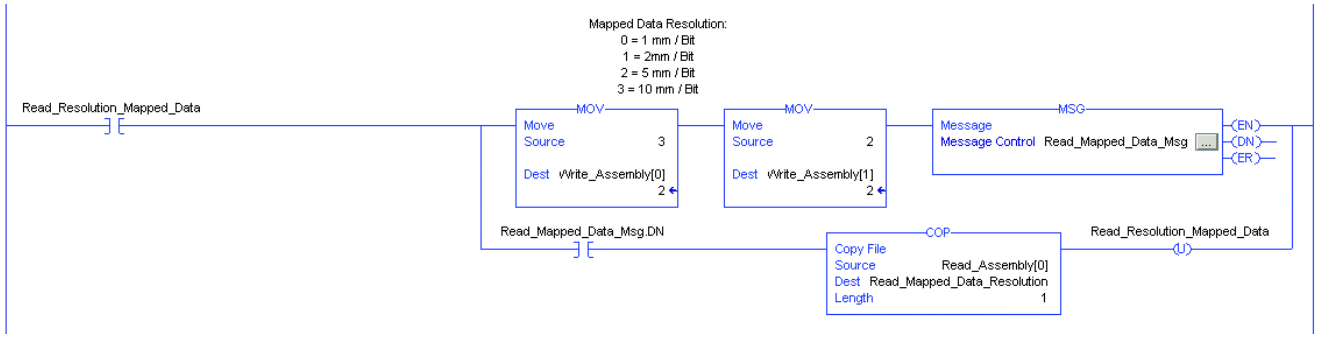
Toggle the “Read_Distance_Mapped_Data” contact (CTRL +T), initiates a explicit message which read Index 99, SubIndex 2. One Byte of data is then retrieved and stored into SINT ‘Read_Mapped_Data_Setting.



ATTENTION: The Sensor Distance Configuration can not be written from an Explicit Message.

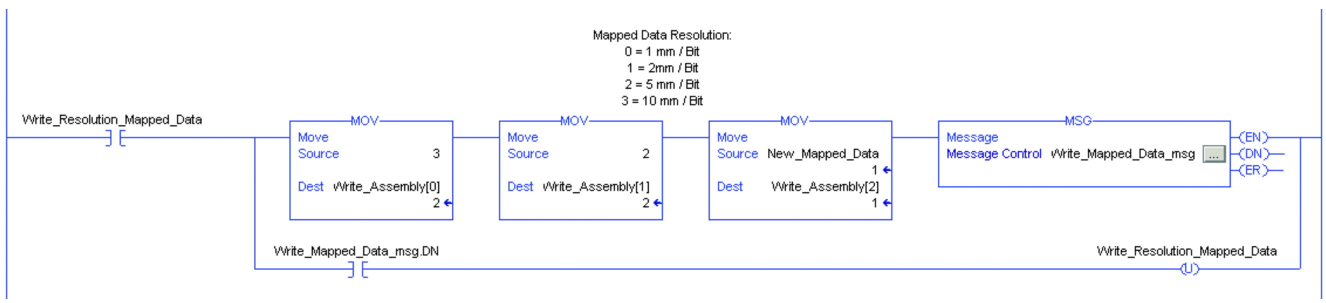
Sensor Resolution (reading)

Toggle the “Read_Resolution_Mapped_Data” contact (CTRL +T), initiates a explicit message which read Index 99, SubIndex 3. One Byte of data is then retrieved and stored into SINT ‘Read_Mapped_Data_Resolution’.



Sensor Resolution (writing)

Enter the New value to be written into the 'New_Mapped_Data' tag. Toggle the "Write_Resolution_Mapped_Data" contact (CTRL +T). Three bytes of data (Sub Index, Channel # and Write_Resolution_Mapped_Data) are then written to the sensor, Index 99 Subindex 3.



Chapter 13

Troubleshooting

Checklist

Error	Cause	Remedy
“Operator Indicator” LED does not light up	The power supply is switched off.	Check to see if there’s a reason for it to be switched off (installation or maintenance work, etc.). Switch on the power supply if appropriate.
“Operating Indicator” LED does not light up	The 4-pin M12 plug is not connected to the connector on the sensor	Connect the 4-pin M12 plug to the sensor and tighten the cap nut by hand.
“Operating Indicator” LED does not light up	Wiring fault in the splitter or control cabinet.	Check the wiring carefully and repair any wiring faults.
“Operating Indicator” LED does not light up	Supply cable to the sensor is damaged.	Replace the damaged cable.
No IO-Link connection to the device	The C/Q communication port on the sensor is not connected to the IO-Link master	Make sure that the C/Q communication port is connected to the IO-Link master.
No IO-Link connection to the device	No power supply	See error “Operating Indicator” LED does not light up.
Manual adjustment option not available on the device	Local operation has been de-activated using the software.	Activate local operation using the software.
Print marks and/or background are not detected cleanly	Sensor is too close or too far from the reading point. Incorrect print marks and/or background taught in.	Check the mounting and teach in the print marks and/or background again.

Installing the Add-on Profile

Introduction

This appendix shows how to install the IO-Link Add-on Profile (AOP) with the RSLogix™ 5000 program. Add-on Profiles are files that users add to their Rockwell Automation® library. These files contain the pertinent information for configuring a device that is added to the Rockwell Automation network.

The Add-on Profile simplifies the setup of devices because it presents the necessary fields in an organized fashion. The Add-on Profile allows for set up and configuration of systems in a quick and efficient manner.

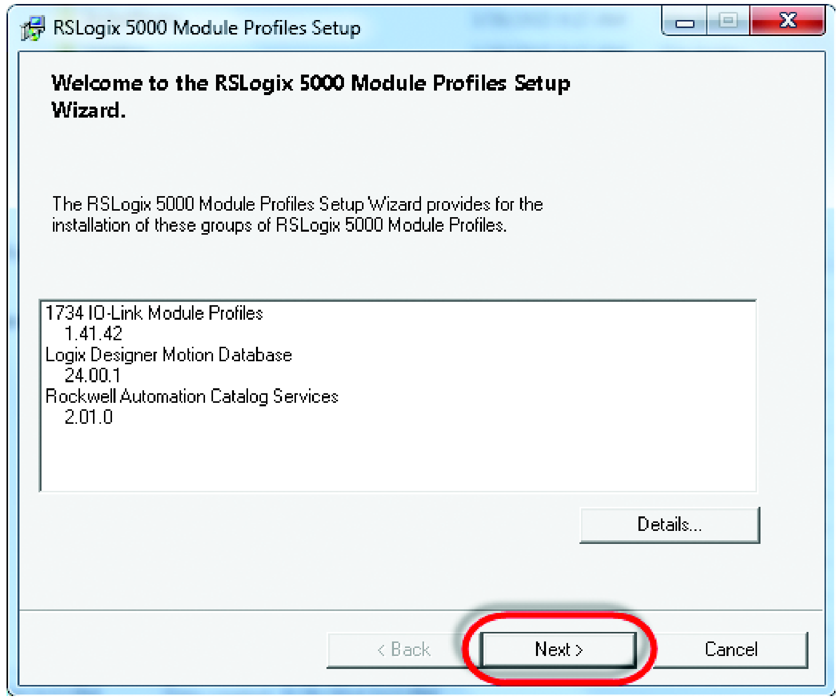
The Add-on Profile is a folder that contains numerous files for the device. It comes as an installation package.

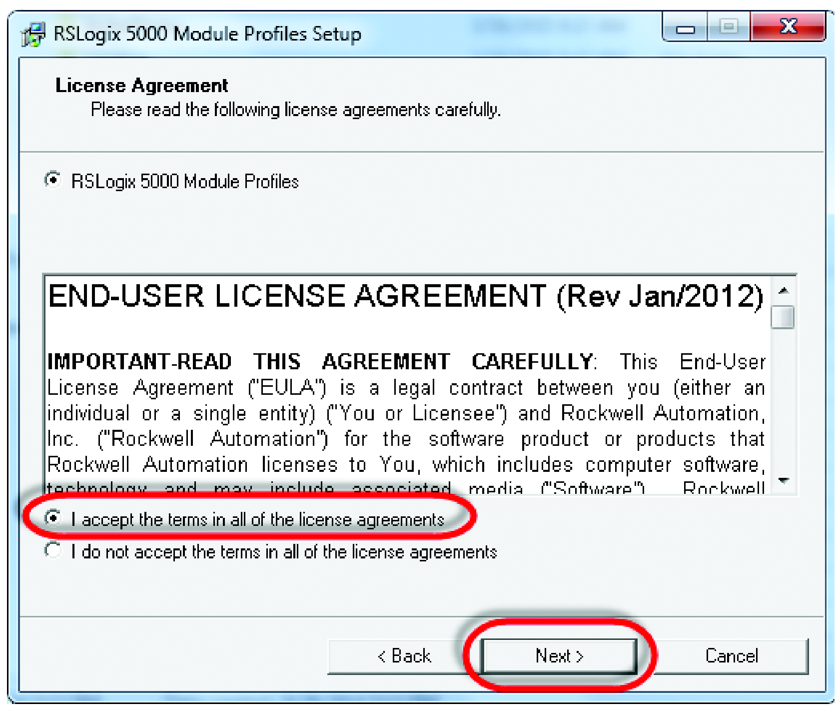
Performing the Installation

1. Download the latest IO-Link AOP file from the Add-on Profiles website. https://download.rockwellautomation.com/esd/download.aspx?downloadid=addonprofiles

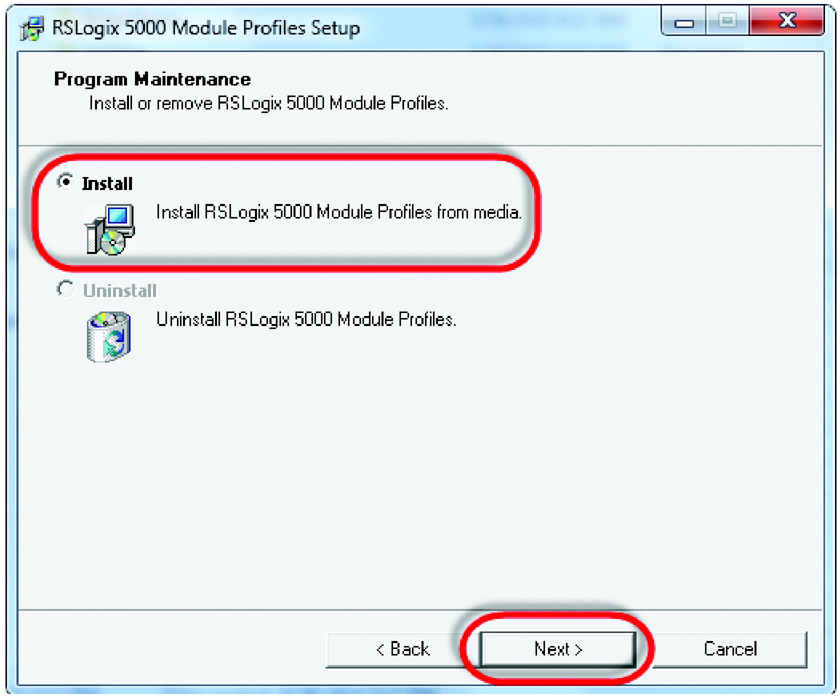
2. Extract the AOP zip file, open the folder, and execute the "MPSetup" application file.

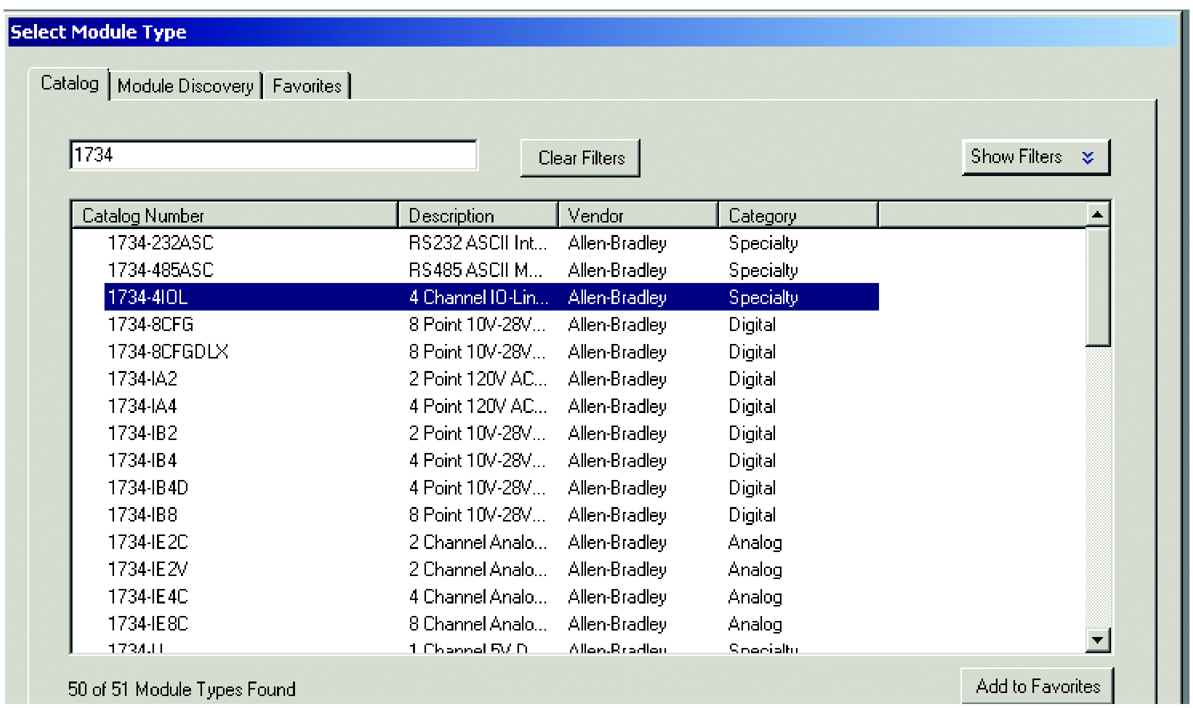
3. Select "Next" in order to install the IO-Link module profiles, accept the license agreements, select "Next" and follow the module-profiles installation wizard.



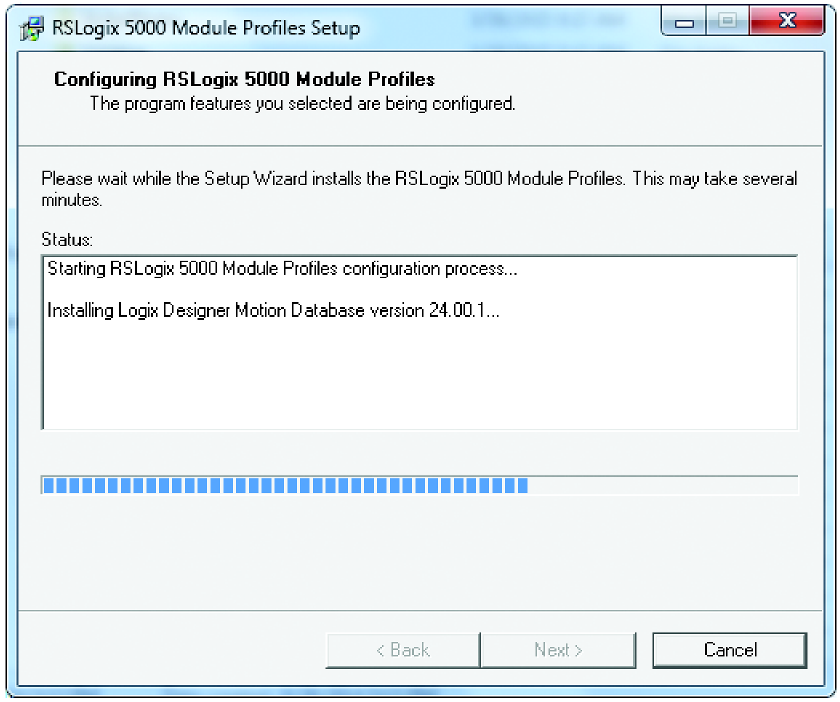


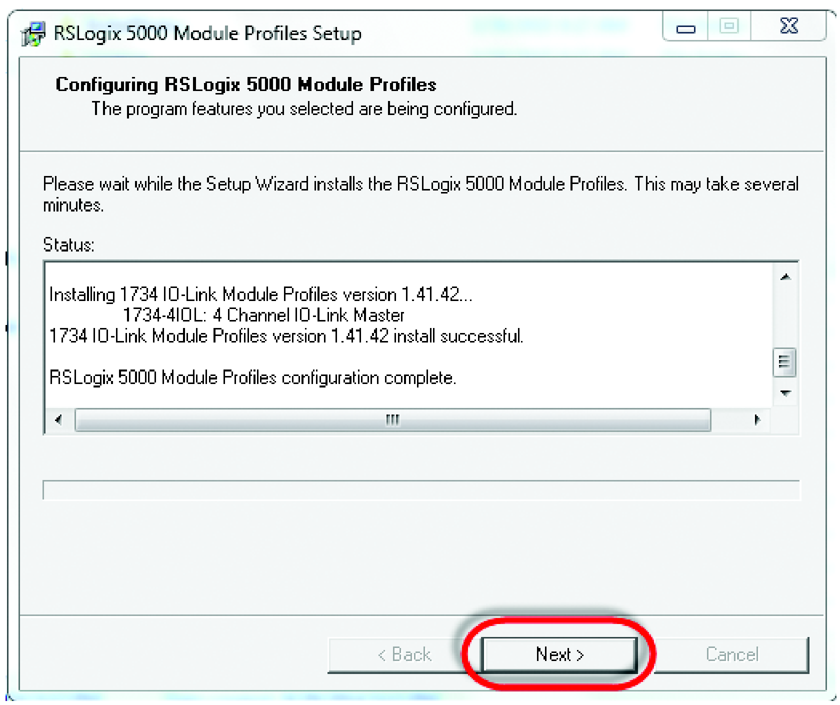
4. Be sure the “Install” option is selected, select “Next,” review the install details and select “Install.”



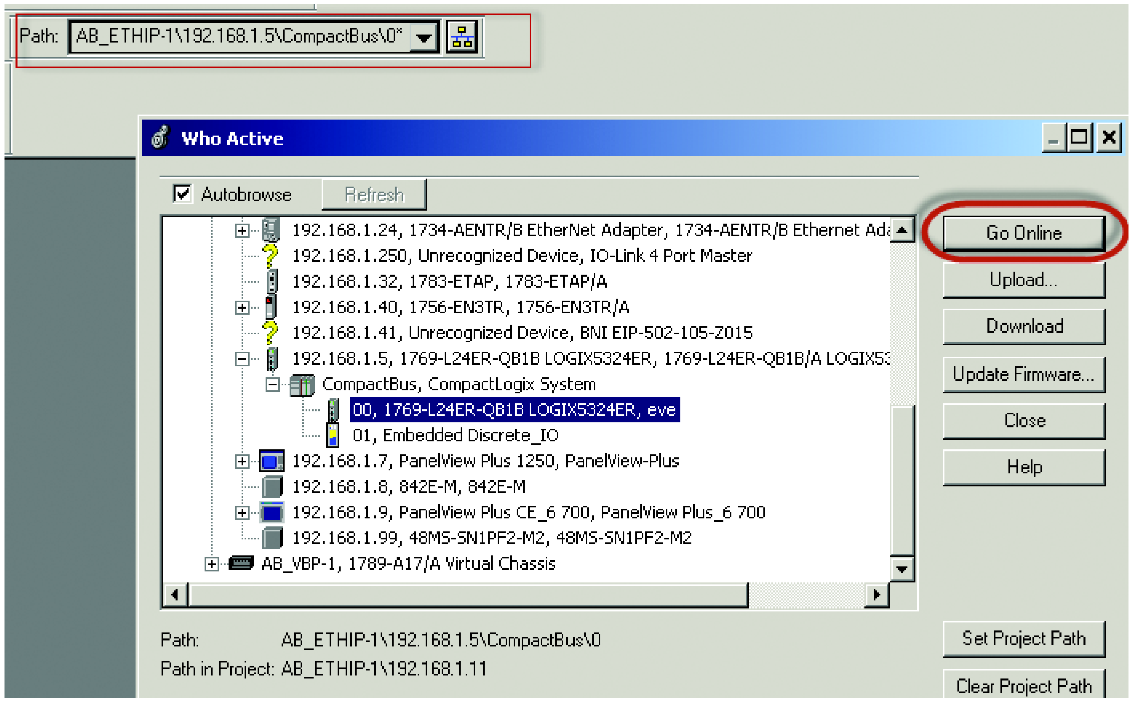


5. The installation process begins. This may take several minutes. Once completed the "Next" button is available, select "Next."





6. Select "Finish" and review the release notes for any additional information. The IO-Link AOP installation is completed.



Device Parameters

Identification

Parameter Name	Index Hex (Dec)	Sub-Index Hex (Dec)	Access	Default	Value	Data Type (Length)	Allowed Values
Device Information							
Vendor Name	0x10 (16)	0x00 (0)	RO	Allen-Bradley	Allen-Bradley	STRING (64)	Allen-Bradley
Product Name	0x12 (18)	0x00 (0)	RO	Product Cat. No.: 45LMS-D8LGC1-D4 45LMS-D8LGC2-D4 45LMS-U8LGC3-D4	Product Cat. No.: 45LMS-D8LGC1-D4 45LMS-D8LGC2-D4 45LMS-U8LGC3-D4	STRING (64)	Product Cat. No. is displayed
Product Text	0x14 (20)	0x00 (0)	RO	Laser Measurement Sensor	Laser Measurement Sensor	STRING (64)	Product Description is displayed
Product ID	0x13 (19)	0x00 (0)	RO	For: 45LMS-D8LGC1-D4, it is PN-133869 45LMS-D8LGC2-D4, it is PN-133870 45LMS-U8LGC3-D4, it is PN-133871	For: 45LMS-D8LGC1-D4, it is PN-133869 45LMS-D8LGC2-D4, it is PN-133870 45LMS-U8LGC3-D4, it is PN-133871	STRING (64)	Product SAP Material Master is displayed
Serial Number	0x15 (21)	0x00 (0)	RO			STRING (16)	Blank
User Specific Information							
Application Specific Name	0x18 (24)	0x00 (0)	RW			STRING (32)	Custom sensor descriptions
User Tag 1	0xC0 (192)	0x01 (1)	RW	0		UINT (UIntegerT) 32-bit (BitLength)	Custom sensor descriptions
User Tag 2	0xC1 (193)	0x00 (0)	RW	0		UINT (UIntegerT) 16-bit (BitLength)	Custom sensor descriptions
Revision Information							
Hardware Revision	0x16 (22)	0x00 (0)	RO	A	A	STRING (64)	
Firmware Revision	0x17 (23)	0x00 (0)	RO	3.01/3.02	3.01/3.02	STRING (64)	

Observation

Parameter Name	Index Hex (Dec)	Sub-Index Hex (Dec)	Access	Default	Value	Data Type (Length)	Allowed Values
Device Monitoring							
.Distance	0x48(72)	0x01(1)	RO	10.8	Range = 0 to 4294967294 4294967294 = No Target Detected	UIntegerT (RecordT) 32-bit (BitLength) 16 (bitOffset)	mm
.MarginLevel	0x48(72)	0x02(2)	RO	3 = Excellent	0 = Insufficient, 1 = Acceptable, 2 = Good 3 = Excellent	UIntegerT (RecordT) 8-bit (BitLength) 8 (bitOffset)	0 = Insufficient, 1 = Acceptable, 2 = Good 3 = Excellent
.Triggered	0x48(72)	0x3(3)	RO	0 = Triggered1 Inactive / Triggered2 Inactive,	0 = Triggered1 Inactive / Triggered2 Inactive, 1 = Triggered1 Active / 2 Inactive 2 = Triggered1 Inactive / Triggered2 Active 3 = Triggered1 Active / Triggered2 Active	UIntegerT (RecordT) 8-bit (BitLength) 0 (bitOffset)	0 = Triggered1 Inactive / Triggered2 Inactive, 1 = Triggered1 Active / 2 Inactive 2 = Triggered1 Inactive / Triggered2 Active 3 = Triggered1 Active / Triggered2 Active
.Distance	0x28(40)	0x00(0)	RO	0	Distance is displayed		Distance from sensor to target is displayed
.Threshold Status	0x49(73)	0x01(1)	RO	0 = Success	0 = Success, 1 = In Progress, 255 = Failure	UIntegerT (RecordT) 8-bit (BitLength) 40 (bitOffset)	0 = Success, 1 = In Progress, 255 = Failure
.Threshold Quality	0x49(73)	0x02(2)	RO	0	Range = 0 to 100	UIntegerT (RecordT) 8-bit (BitLength) 32 (bitOffset)	Range = 0 to 100
.Threshold Value	0x49(73)	0x03(3)	RO	0		UIntegerT (RecordT) 32-bit (BitLength) 0 (bitOffset)	

Operation Parameter

Parameter Name	Index Hex (Dec)	Sub-Index Hex (Dec)	Access	Default	Value	Data Type (Length)	Allowed Values
Trigger 1 (Trigger)							
Far Threshold	0x40(64)	0x03(3)	RW	10000	Range = 0 to 163.000	UIntegerT (RecordT) 128-bit (BitLength) 32 (bitOffset)	mm
Far Hysteresis	0x40(64)	0x04(4)	RW	150	Range = 20 to 16,300	UIntegerT (RecordT) 128-bit (BitLength) 0 (bitOffset)	mm
Near Threshold	0x40(64)	0x01(1)	RW	5000	Range = 0 to 163.000	UIntegerT (RecordT) 128-bit (BitLength) 96 (bitOffset)	mm
Near Hysteresis	0x40(64)	0x02(2)	RW	150	Range = 20 to 16,300	UIntegerT (RecordT) 128-bit (BitLength) 64 (bitOffset)	mm
Trigger2							
Far Threshold	0x41(65)	0x03(3)	RW	15000	Range = 0 to 163.000	UIntegerT (RecordT) 128-bit (BitLength) 32 (bitOffset)	mm
Far Hysteresis	0x41(65)	0x04(4)	RW	150	Range = 20 to 16,300	UIntegerT (RecordT) 128-bit (BitLength) 0 (bitOffset)	mm
Near Threshold	0x41(65)	0x01(1)	RW	10000	Range = 0 to 163.000	UIntegerT (RecordT) 128-bit (BitLength) 96 (bitOffset)	mm
Near Hysteresis	0x41(65)	0x02(2)	RW	150	Range = 20 to 16,300	UIntegerT (RecordT) 128-bit (BitLength) 64 (bitOffset)	mm
Analog Signal							
Analog Signal Mode	0x60(96)	0x03(3)	RW	0 = Rising Ramp	0 = Rising Ramp, 1 = Falling Ramp, 2 = Linear Ramp, 16 = Rising Ramp w. Substitution Values, 17 = Falling Ramp w. Substitution Values, 18 = Linear Ramp w. Substitution Values	8-bit UINT	
Near Limit	0x42(66)	0x01(1)	RW	2,000	Range = 0 to 163.000	UIntegerT (RecordT) 64-bit (BitLength) 32 (bitOffset)	mm
Far Limit	0x42(66)	0x02(2)	RW	50,000	Range = 0 to 163.000	UIntegerT (RecordT) 64-bit (BitLength) 0 (bitOffset)	mm

Operation Parameter

Parameter Name	Index Hex (Dec)	Sub-Index Hex (Dec)	Access	Default	Value	Data Type (Length)	Allowed Values
Trigger1 (Trigger)							
Mode	0x60(96)	0x01(1)	RW	0 = Inactive	0 = Inactive, 1 = Threshold, 2 = Window, 3 = Hysteresis	8-bit UINT	
.Polarity	0x70(112)	0x01(1)	RW	0 = Not inverted	0 = Not Inverted, 1 = Inverted	45LMS Boolean (RecordT) 8-bit (BitLength) 0 (bitOffset) 45LMS Boolean (RecordT) 48-bit (bitLength) 40 (bitOffset)	0 = Not Inverted, 1 = Inverted
Timing	0x70(112)	0x05(5)	RW	0 = No Delay	0 = No Delay, 1 = 50ms Delay, 2 = 100ms Delay	8-bit UINT	
TargetPresent1 (Pin 4)	0x70(112)	0x03(3)	RW	0 = Push-Pull	0 = Push-Pull	8-bit UINT	
Trigger2							
Mode	0x60(96)	0x03(3)	RW	0 = Inactive	0 = Inactive, 1 = Threshold, 2 = Window, 3 = Hysteresis	8-bit UINT	
Polarity	0x70(112)	0x02(2)	RW	0 = Not Inverted	0 = Not Inverted, 1 = Inverted	Boolean (RecordT) 48-bit (bitLength) 32 (bitOffset)	
Timing	0x70(112)	0x06(6)	RW	0 = No Delay	0 = No Delay, 1 = 50 ms Delay, 2 = 100 ms Delay	8-bit UINT	
TargetPresent2 (Pin 2)	0x70(112)	0x04(4)	RW	0 = Push-Pull	0 = Push-Pull 1 = Low-Side 2 = High Side 3 = High Impedance 4 = Analog Signal	8-bit UINT	

Operation Parameter

Parameter Name	Index Hex (Dec)	Sub-Index Hex (Dec)	Access	Default	Value	Data Type (Length)	Allowed Values
Data Mapping Configuration							
Mapped Data	0x63(99)	0x02(2)	RW	0 = Distance	0 = Distance 1 = Distance, TargetPresent1, TargetPresent2 2 = Distance, MarginLevel 3 = Distance, MarginLevel, TargetPresent1, TargetPresent2 Originally was: Distance Distance, Switching Signals Distance, Signal Quality Distance, Signal Quality, Switching Signals	8-bit UINT	
Distance Resolution	0x63(99)	0x03(3)	RW	3 = 10 mm/bit	0 = 1 mm / Bit 1 = 2mm / Bit 2 = 5 mm / Bit 3 = 10 mm / Bit	8-bit UINT	
Distance Mode	0x63(99)	0x02(2)	RW	0 = Relative	0 = Relative, 1 = Normalized	32-bit UINT	mm
Distance Normalization	0x44(68)	0x00(0)	RW	5000	0 to 303,000	32-bit UINT	mm
Sensor Configuration							
Evaluation Mode	0x62(98)	0x00(0)	RW	0 = Averaging 10 ms	0 = Averaging 10 ms 1 = Averaging 20 ms 2 = Averaging 50 ms 3 = Averaging 100 ms	8-bit UINT	
Offset Distance	0x42(67)	0x00(0)	RW	0	-81,500 to 81,500	32-bit UINT	mm
Event Configuration							
.Lost Target	0x74(116)	0x01(1)	RW	False = Disabled	False = Disabled, True = Enabled	Boolean	
.Lost Target (2)	0x74(116)	0x02(2)	RW	False = Disabled	False = Disabled, True = Enabled	Boolean	

Diagnosis

Parameter Name	Index Hex (Dec)	Sub-Index Hex (Dec)	Access	Default	Value	Data Type (Length)	Allowed Values
Service Function							
Sensor Test Operation	0x72(114)	0x00(0)	RW	0 = Normal Operation - Not Test	CRM 0 = Normal Operation - No Test 1 = Test - Red On 2 = Test - Green On 3 = Test - Blue On 4 = Test - Red, Green, Blue Off LMS 0 - Normal Operation - No Test 1 - Test - Emitter Off	UINT (UIntegerT) 8-bit (BitLength)	CRM 0 = Normal Operation - No Test 1 = Test - Red On 2 = Test - Green On 3 = Test - Blue On 4 = Test - Red, Green, Blue Off LMS 0 - Normal Operation - No Test 1 - Test - Emitter Off
.Locator Indicator	0x7F(127)	0x01(1)	RW	0 = Normal Indication	0 = Normal Indication 1 = Locator Indication	Boolean (RecordT) 8-bit (BitLength)	0 = Normal Indication 1 = Locator Indication
Local Operation	0x71(113)	0x01(1)	RW	0 = Unlock	0 = Unlock, 1 = Lock	UINT (UIntegerT) 8-bit (BitLength)	0 = Unlock, 1 = Lock
LED (Yellow) Indication	0x7E(126)	0x01(1)	RW	0 = TargetPresent1 Indication	0 = TargetPresent1 Indication, 1 = TargetPresent2 Indication	Boolean	
Local Operation Status	0x73(115)	0x02(2)	RO	0 = Unlocked	0 = Unlocked, 1 = Locked	Boolean 4 (bitOffset)	0 = Unlocked, 1 = Locked
Local Teach Dial Position	0x73(115)	0x01(1)	RO	CRM 0 = Standard Operate (S) 'LMS 0 = Run	CRM 0 = Standard Operate (S) 1 = Static Teach - Target (M) 2 = Static Teach - Background (TB) 3 = Dynamic Teach (TD)' 'LMS '0 = Run, 1 = Discrete Set Point 1 (AQ1) 2 = Discrete Set Point 2 (BQ1), 3 = Analog Set Point 1 (AQ2) 4 = Analog Set Point 2 (BQ2)	UINT (UIntegerT) 4-bit (BitLength) 0 (BitOffset)	CRM 0 = Standard Operate (S) 1 = Static Teach - Target (M) 2 = Static Teach - Background (TB) 3 = Dynamic Teach (TD)' 'LMS '0 = Run, 1 = Discrete Set Point 1 (AQ1) 2 = Discrete Set Point 2 (BQ1), 3 = Analog Set Point 1 (AQ2) 4 = Analog Set Point 2 (BQ2)
System Command	0x02(2)	0x00(0)	WO	Button = "Device Reset"	Button = "Device Reset"		

Diagnosis

Parameter Name	Index Hex (Dec)	Sub-Index Hex (Dec)	Access	Default	Value	Data Type (Length)	Allowed Values
Operation Information							
Operating Time - Since Inception	0xE0(224)	0x00(0)	RO	104		UINT (UIntegerT) 32-bit (BitLength)	hr
Temperature							
Actual -Since Power Up	0xE1(225)	0x00(0)	RO	0 = Safe Operation Temperature	0 = Safe Operation Temperature 1 = Critical High Temperature 2 = Overtemperature 3 = Critical Low Temperature 4 = Undertemperature	UINT (UIntegerT) 8-bit (BitLength)	0 = Safe Operation Temperature 1 = Critical High Temperature 2 = Overtemperature 3 = Critical Low Temperature 4 = Undertemperature
Device Characteristics							
.Minimum Sensing Range	0xEF(232)	0x01(1)	RO	50		UINT (UIntegerT) 64-bit (BitLength) 32 (BitOffset)	mm
.Maximum Sensing Range	0xEF(232)	0x02(2)	RO	8150		UINT (UIntegerT) 64-bit (BitLength) 32 (BitOffset)	mm
.Analog Output	0xEF(239)	0x01(1)	RO	True = Available	True = Available, False = Not Available	Boolean (RecordT) 16-bit (bitLength) 0 (bitOffset)	
.Event Configuration Support	0xEF(239)	0x02(2)	RO	True = Available	True = Available, False = Not Available	Boolean (RecordT) 16-bit (bitLength) 1 (bitOffset)	
Communication Characteristics							
Direct Parameters Min Cycle time	0x00(0)	0x03(3)	RO	74		UIntegerT bitLength = 8 bitOffset = 104	ms
Direct Parameters Master Cycle time	0x00(0)	0x02(2)	RO	74		UIntegerT bitLength = 8 bitOffset = 112	ms
Direct Parameters 1.IO-Link Revision ID	0x00(0)	0x05(5)	RO	0x10		UIntegerT bitLength = 8 bitOffset = 88	

Process Data (Controller Tag Section of AOP)

Parameter Name	Index Hex (Dec)	Sub-Index Hex (Dec)	Access	Default	Value	Data Type (Length)	Allowed Values
Process Data (Controller Tag Section of AOP)							
Trigger1							
Trigger2							
Distance							
Mode			RW	0 = Mode 0	0 = Mode 0 1 = Mode 1 2 = Mode 2 3 = Mode 3 4 = Mode 4 5 = Mode 5		

Error Codes and Events

Event Codes

When an event occurs, the device signals the presence of the event to the master. The master then reads out the event. Events can be error messages and warnings/ maintenance data. Error messages are transmitted from the device to the controller via the IO-Link master. The transmission of device parameters or events occurs independently from the cyclic transmission of process data.

Name	Event Description	Mitigation Description	Event Code (HEX)	Event Code (DEC)	Event Qualifier (HEX)	Event Qualifier (DEC)	Instance	Type
Notification - Target Lost	The device can no longer detect the target as it was originally set-up.	The Operator should either 1) position the target within the detection range as it was previously set up in the project, 2) assure the device light beam is directly in the target path, and/or 3) clean the sensor surface to assure optimal performance.	8CA0	36000	E4	228	1 - Physical Layer (PL)	1 - Notification

Abbreviations

ADC	Automatic Device Configuration
AOI	Add-on Instruction
AOP	Add-on Profile
ASN	Application Specific Name
IEC	International Electrotechnical Commission
IODD	I/O Device Description
NEC	National Electric Code
QD	Quick Disconnect
SIO	Standard I/O

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Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products.
At http://www.rockwellautomation.com/support you can find technical and application notes, sample code, and links to software service packs. You can also visit our Support Center at https://rockwellautomation.custhelp.com/ for software updates, support chats and forums, technical information, FAQs, and to sign up for product notification updates.

In addition, we offer multiple support programs for installation, configuration, and troubleshooting. For more information, contact your local distributor or Rockwell Automation representative, or visit
http://www.rockwellautomation.com/services/online-phone.

Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/rockwellautomation/support/overview.page, or contact your local Rockwell Automation representative.

New Product Satisfaction Return

Rockwell Automation tests all of its products to help ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

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