XU IO-Link Diffuse

Programming Guide

Original version

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Safety Information

Important Information

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER
DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

WARNING
WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

CAUTION
CAUTION indicates a hazardous situation which, if not avoided, **could result** in minor or moderate injury.

NOTICE
NOTICE is used to address practices not related to physical injury.

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A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

About the Book

Document Scope

This manual describes the features, installation, wiring, usage, and troubleshooting of the XU IO-Link and the communication system IO-Link.

Validity Note

The technical characteristics of the device(s) described in this manual also appear online.

To access this information online:

Step	Action
1	Go to www.telemecaniquesensors.com.
2	In the **Search** box, type the model number of a product or the name of a product range. Do not include blank spaces in the model number/product range.
3	If more than one model number appears in the **Products** search results, click on the model number that interests you.
4	To save or print a data sheet as a .pdf file, click **Download product datasheet**.

The characteristics that are described in the present document should be the same as those characteristics that appear online. In line with our policy of constant improvement, we may revise content over time to improve clarity and accuracy. If you see a difference between the document and online information, use the online information as your reference.

Related Documents

Title of documentation	Reference number
IO-Link master EtherNet IP - User Guide	TESEUG000067EN (ENG) TESEUG000067FR (FRA) TESEUG000067ES (ESP) TESEUG000067IT (ITA) TESEUG000067DE (DEU) TESEUG000067ZH (CHS)
IO-Link master Profinet - User Guide	TESEUG000064EN (ENG) TESEUG000064FR (FRA) TESEUG000064ES (ESP) TESEUG000064IT (ITA) TESEUG000064DE (DEU) TESEUG000064ZH (CHS)

IO-Link Diffuse:

Title of documentation	Reference number
XUB Diffuse - Instruction Sheet	PKR6253500
XUN Diffuse - Instruction Sheet	BQT5549600
XUB-XUN Diffuse - IO-Link Table Parameters	BQT5550100

IO-Link Thru-Beam & Reflex:

Title of documentation	Reference number
XUB Thru-Beam - Instruction Sheet	PKR6253700
XUB Reflex - Instruction Sheet	PKR6253600
XUN Thru-Beam - Instruction Sheet	BQT5549500
XUN Reflex - Instruction Sheet	BQT5549700
XUB-XUN Thru-Beam & Reflex - IO-Link Table Parameters	BQT5550200

You can download these technical publications and other technical information from our website at www.telemecaniquesensors.com.

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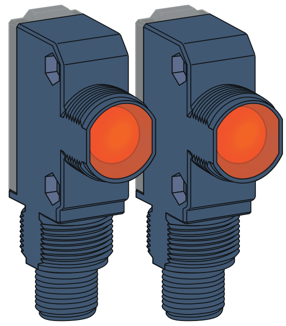
Product Description

Principle

Range

XU IO-Link photoelectric sensors are contactless object detectors from the XUB, XUM, and XUN ranges supporting the communication protocol digital IO-Link.

These three ranges are similar by the functionalities or characteristics of their sensors but by their format:

XUB	XUM	XUN
M18 cylinder body	Miniature rectangular body	Combinaison body
		

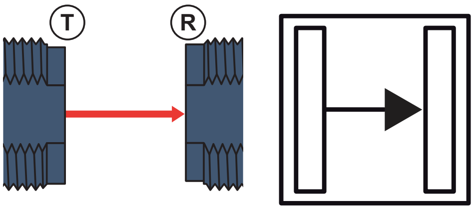
This standardized input/output technology allows these sensors to dialogue with the control system (commonly called “IO-Link master module”) in order to transmit measurement data, diagnostics or even to receive parameter data. The IO-Link standard therefore facilitates the configuration of your sensors and their maintenance operations.

To discover our complete IO-Link offer:

http://qr.tesensors.com/XU0022

Main Sensors Detection Modes

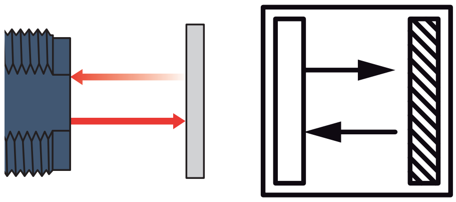
XU IO-Link sensors support the following detection modes:



- **Thru-beam** (XU•2 range):

  One sensor emits a light beam and a second receives it. Detection occurs as soon as the receiver no longer receives the beam. The sensor provides precise detection with long-range capabilities and immunity to false triggers. It is suitable for applications requiring high accuracy and clear line-of-sight detection.

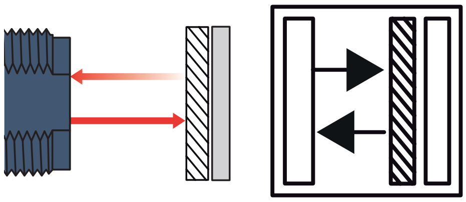
  Advantages: high accuracy, long sensing range, less susceptible to false triggers, offers precise detection within a specific line of sight.



- **Diffuse** (XU•4/5/6 ranges):

  The sensor emits a light beam and detection occurs when an object passes in front of it and reflects it in the direction of the receiver built into the sensor. It offers simplicity and versatility, making it suitable for various object detection tasks without the need for precise alignment.

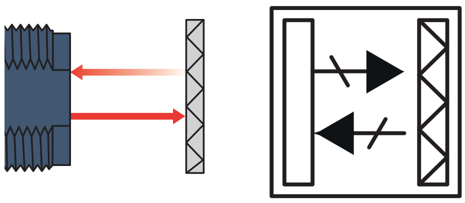
  Advantages: easy to install, can detect objects at various distances and positions, requires less space.



- **BGS (Background Suppression)** (XU•8 range):

  The principle of operation is the same as Diffuse mode but it is equipped with a background suppression functionality which allows the sensor not to confuse background activity with the passage of an object. Selectively detects objects within a defined range, making it useful for applications where background objects need to be ignored. It strikes a balance between simplicity and selective detection.

  Advantages: ideal for applications where you want to detect objects, requires less space, offers good immunity to background interference.



- **Reflex** (XU•9 range):

  The sensor emits a light beam in the direction of a reflector which reflects this beam towards the receiver built into the sensor. Detection occurs as soon as an object interrupts the transmission of the light beam from the reflector to the receiver. Combines the simplicity of diffuse mode with distance independence, often using a reflector for detection, making it versatile and suitable for irregularly shaped objects.

  Advantages: easy to install, the position of the object can vary without affecting detection, reflex mode sensors can provide better immunity to false triggers.

Applications

Overview

An Original Equipment Manufacturer (OEM) specializing in packaging machinery designs and produces high-speed bottling lines for beverage companies. These bottling lines are responsible for filling and capping bottles at a rapid pace. To allow smooth operation and quality control, the OEM has integrated IO-Link sensors with background suppression into their machines to detect the presence and positioning of bottles on the production line.

Detection and Positioning with IO-Link Sensors

Sensor Selection: The OEM chooses IO-Link sensors with background suppression because they offer precise detection capabilities even in challenging environments with various background colors or lighting conditions. These sensors can detect bottles of different shapes, sizes, and colors efficiently.

Configuration Ease: IO-Link enables easily the configuration of the sensors. Using a central controller or Human-Machine Interface (HMI), the OEM can remotely configure sensor parameters such as detection range, sensitivity, and response time. This simplifies the setup process, saving time during machine assembly and maintenance.

Data Monitoring and Quality Control

Real-time Data: IO-Link sensors provide real-time feedback to the control system. This data includes information about the presence, position, and even the orientation of bottles on the production line. This real-time data is essential for quality control and ensuring that bottles are properly positioned for filling and capping.

Integration with PLC: The OEM integrates the IO-Link sensor data easily into the Programmable Logic Controller (PLC) system of the machine through an IO-Link master. This allows for immediate response to any anomalies or issues detected during the production process. For example, if a bottle is misplaced, the PLC can trigger an alert or adjust the operation of the machine to rectify the problem automatically.

Sensor Replacement and Maintenance

Easy Diagnostics: IO-Link offers enhanced diagnostic capabilities. When a sensor experiences a misuse or reaches the end of its lifespan, the OEM can quickly identify the issue through the IO-Link communication. This reduces downtime and allows for proactive maintenance.

Plug-and-Play Replacement: Replacing a sensor is made easy due to IO-Link. The new sensor can be configured with the same parameters as the previous one, either manually or through automated configurations stored in the IO-Link Master. This plug-and-play capability minimizes the need for specialized technicians, reducing maintenance costs and downtime.

Benefits for the OEM

Enhanced Efficiency: IO-Link sensors improve the efficiency of the bottling line by ensuring precise bottle detection and positioning, reducing the likelihood of bottlenecks or quality issues.

Remote Monitoring: The ability to monitor sensor data remotely allows the OEM to offer ongoing support and diagnostics to their clients, improving customer satisfaction.

Cost Savings: Reduced downtime, easy sensor replacement, and efficient troubleshooting result in cost savingsfor the OEM and their customers.

In summary, an OEM in the packaging segment benefits from using IO-Link sensors with background suppression for bottle detection by allowing accurate and efficient production, real-time data monitoring, and simplified sensor maintenance and replacement. This technology enhances the performance of their packaging machinery, leading to increased customer satisfaction and cost savings.

IO-Link Generalities

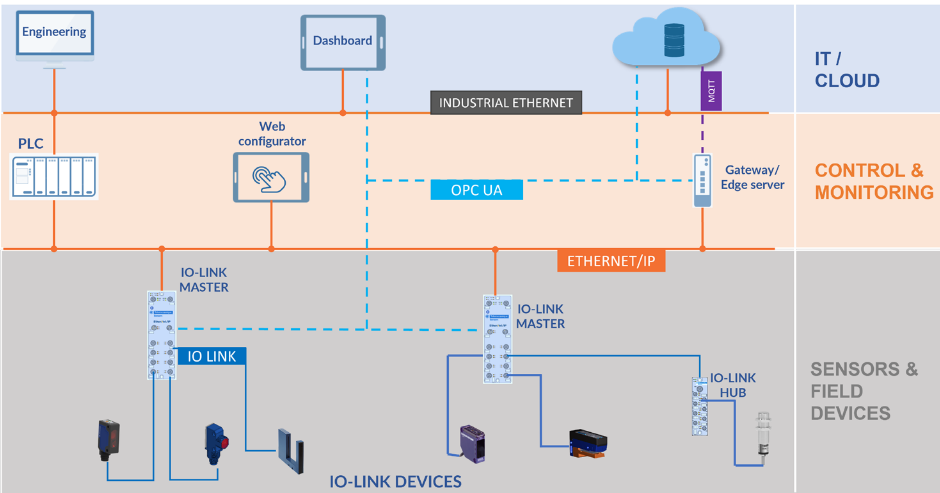
System Description

IO-Link is a point-to-point communication protocol which acts as an interface between standard controllers (PLC, industrial PC or HMI) and field devices (sensors and actuators). It communicates by the master IO-Link using industry protocols. This very robust communication system operates using 24 volts. It is a standardized input/output technology according to IEC 61131-9.

The IO-Link system is based on an IO-Link master which has devices (such as photoelectric sensors) connected to it. The connexion between this IO-Link master and its devices is established via a 3 wires cable (the maximum cable length is 20 meters or 65,61 feet).

The IO-Link master is an I/O box which is capable of processing digital signals and analog values. It contains several IO-Link ports or channels. It could therefore be integrated to the PLC or used as remote I/O in the field.

Overview of IO-Link system:



Advantages

IO-Link is a versatile industrial communication protocol that offers several advantages in various automation and manufacturing applications. Here are themain advantages of using IO-Link:

- **Parameterization and Configuration**: IO-Link allows for the remote configuration and parameterization of sensors, actuators, and other devices, simplifying setup and reducing manual adjustments.
- **Real-Time Data:** It provides real-time data exchange, enabling precise monitoring and control of devices, leading to improved process efficiency and quality.
- **Increased Diagnostics**: IO-Link devices offer enhanced diagnostics, providing detailed information about device status, teach errors, and performance issues, which aids in troubleshooting and predictive maintenance.
- **Simplified Replacement**: When a device needs replacement, the settings of the sensor to be replaced can be saved and restored identically in the memory of the replaced sensor, IO-Link makes it easy to swap devices without the need for complex reconfiguration, reducing downtime and maintenance costs.
- **Interoperability**: IO-Link is a standardized protocol, ensuring compatibility between devices from different manufacturers, allowing for flexibility in system design and device selection.
- **Easy maintenance thanks to status and diagnostic data returned by the sensors**: you can quickly identify from your desk the cause of a problem as soon as it arises in order to know exactly which sensor to change (or to fix) and where to get it.
- **Remote Device Identification**: It allows for automatic device identification and parameter loading when a new device is connected, reducing human mistake and setup time.
- **Full overview of all devices connected to the IO-Link master:** The inventory of your equipment becomes very fast.
- **Energy Efficiency**: IO-Link devices can be powered down or placed into standby mode when not in use, reducing energy consumption and extending device life.
- **Reduced Wiring**: IO-Link uses a simple point-to-point wiring scheme, minimizing the amount of cabling required, which can lead to cost savings and a cleaner installation.
- **Increased Flexibility**: IO-Link supports hot-swapping, enabling devices to be added or removed from a network without disrupting operation of the entire system.
- **Enhanced Traceability**: In applications such as traceability and serialization, IO-Link can provide detailed data about each product and allowing for improved quality control.
- **Use of standard cables**: Switching to IO-Link does not require you to purchase expensive and hard-to-find cables.

Overall, IO-Link offers flexibility, intelligence, and efficiency in industrial automation systems, making it a valuable tool for optimizing processes, reducing downtime, and increasing productivity in manufacturing and control applications.

Communication

IO-Link Master

An IO-Link master is a key component in an IO-Link network, acting as a bridge between IO-Link devices and the higher-level control system (for example, a PLC or controller).

Here is a brief overview of how an IO-Link master **works:**

Communication Hub: The IO-Link master serves as a communication hub in an industrial automation system. It connects to multiple IO-Link devices, such as sensors, actuators, or smart devices, through standardized IO-Link ports.

Device Connection: IO-Link devices are connected to the IO-Link master via standard M12 connectors and cables. These connections are typically point-to-point, meaning each device has its dedicated connection to the master.

Data Exchange: IO-Link devices communicate with the IO-Link master by exchanging digital and analog data. This data includes sensor readings, actuator commands, diagnostic information, and configuration parameters.

Parameterization: The IO-Link master provides a means for configuring and parameterizing connected IO-Link devices. It can remotely configure device settings, such as detection thresholds for sensors or actuation parameters for actuators. This simplifies device setup and maintenance.

Real-Time Data: In Process Data Mode, the IO-Link master collects real-time data from IO-Link devices. This data is transmitted to the higher-level control system (PLC or controller) for monitoring, control, and decision-making.

Diagnostics: The IO-Link master continuously monitors the health and status of connected devices. It can detect setting errors or changes in device behavior and provides detailed diagnostic information. This aids in predictive maintenance and troubleshooting.

Service Mode: For maintenance and setup purposes, the IO-Link master offers a Service Mode. Technicians can connect a laptop or handheld device directly to the master to access device parameters, perform firmware updates, and diagnose issues easily.

Integration: The IO-Link master integrates seamlessly with the higher-level control system, making device data available for process control and automation. It can communicate with the control system using various fieldbus or Ethernet protocols.

Flexibility: IO-Link masters are designed to be flexible and interoperable. They can work with IO-Link devices from different manufacturers, allowing users to mix and match devices while maintaining compatibility.

In essence, an IO-Link master simplifies the integration and management of IO-Link devices in an industrial setting. It enables real-time data exchange, remote configuration, diagnostics, and service capabilities, making it a critical component for efficient and flexible industrial automation systems.

The IO-Link master allow the transmission between the sensors or actuators and the controllers. It is generally composed of 8 ports that can be configured as digital I/O or IO-Link I/O.

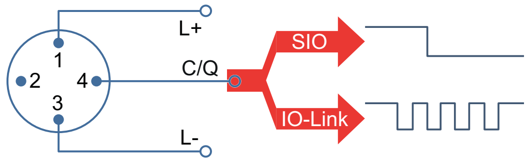
In a IO-Link master, the IO-Link protocol allows an IO-Link port to be operated in one of four different operating modes, these modes can be set on the IO-Link Master:

- **IO-Link mode**: the port is used for IO-Link communication.
- **DI mode**: the port acts in the same way as a digital input device.
- **DQ mode:** the port acts in the same way as a digital output device.
- **Deactivated mode:** this mode is used when the port is unused.

For more informations about the IO-Link master see the IO-Link master guide, page 6.

Interface of IO-Link Device

Here is the **connector of the IO-Link devices:**



- Pin 1: 24 V.
- Pin 3: 0 V.
- Pin 4: Switching and communication line (C/Q).

SIO (Q): The device communicates as standard digital devices.

IO-Link (C): The device communicates using IO-Link.

Process of Communication

When the master port is set in IO-Link mode, the master starts the “wake up” process to initiate the IO-Link communication with the IO-Link device. The routine communication is established by a request from the master to the connected device. If the device responds, the IO-Link communication starts.

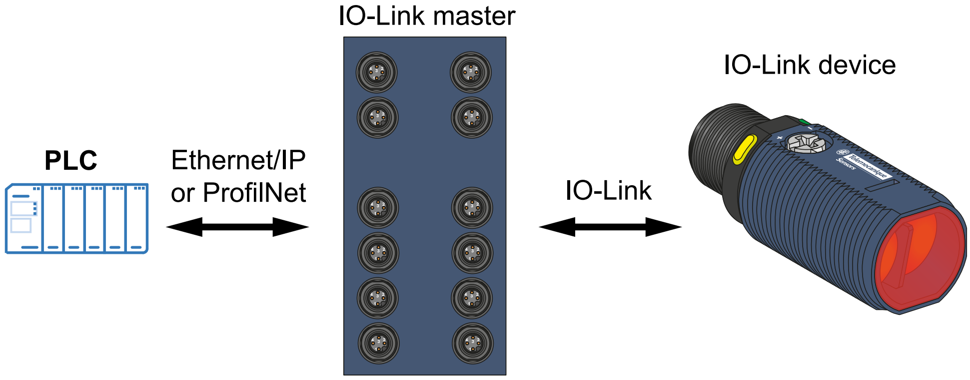
When the master is set in DI or DQ mode, the device connected remains the SIO communication.

It is via the master that it is possible to define whether the device uses the SIO or IO-Link communication mode.

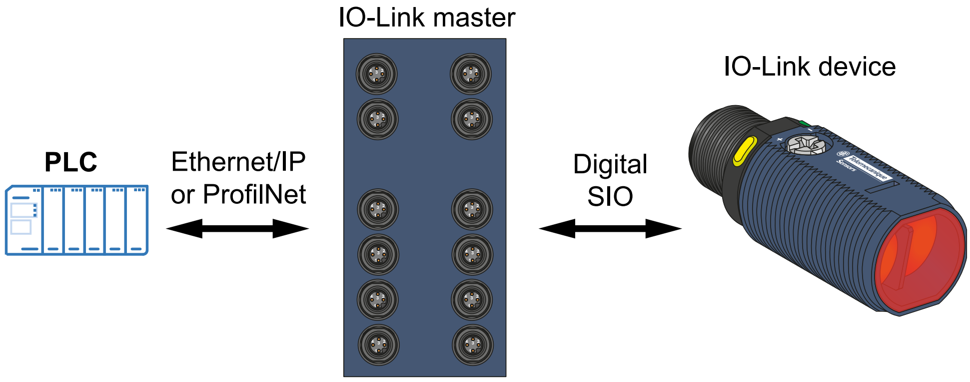
Possible Configurations

There are 3 main configurations:

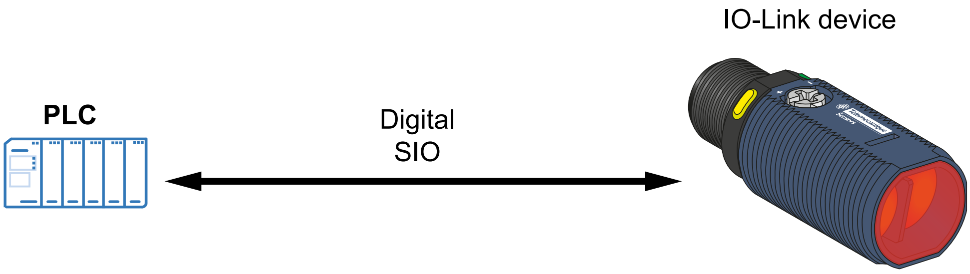
When the IO-Link master port is set to IO-Link mode, the connected IO-Link device communicates in IO-Link.



When the IO-Link master port is set to DI or DQ mode, the connected IO-Link device communicates in SIO.



When the IO-Link deviceis connected to a PLC or another monitor, the device communicates in SIO.



Transferred Data

The device communicates 3 types of data to the masters:

Process data	Value status	Device data
The process data of the devices are transmitted in a data frame. The size of this data frame is specified by the device.	It indicates if the process data are valid or invalid.	These data are exchanged at the request of the IO-Link master. They can be parameters, identification data, and diagnostic information. The device can send data to the master to notify specific conditions or events.
Cyclically	*Acyclically*	*Acyclically*

Cyclic data: Data transmitted by the device automatically and at regular intervals. It is the fastest rate available and is used for process control in the automation system to send the real-time informations of the device.

Acyclic data: Data initiated by the master or the sensor in response to specific events or requests. Through this data, devices can be configured. This data stream can also allow to transmit data for identification and analysis.

Communication between the IO-Link master and the device is only possible if you load the appropriate IODD file into the memory of the IO-Link master. For more details, refer to Requested Definition Files (IODD, DFB, and DTM), page 19.

Transmission

The response time of the IO-Link system provides information about the frequency and speed of the data transmission between the sensor and the master. The IODD file contains a value for the minimum cycle time of the sensor. During the master configuration, you can specify a fixed cycle time in addition to the sensor specific minimum cycle time stored in the IODD. The master then addresses the sensor based on this specification. Devices with different minimum cycle times can be configured on one master.

Characteristics

Here is communication specifications.

Baud rate:
IO-Link supports configurable baud rates to accommodate various communication requirements. The baud rate determines the rate at which data bits are transmitted over the communication link. Commonly used baud rates in IO-Link communication include 4.8 kbps (kilobits per second) in COM1, 38.4 kbps in COM2, and 230.4 kbps in COM3, among others.
The choice of baud rate depends on factors such as the specific IO-Link device, cable length, and environmental conditions. Higher baud rates can provide faster data transmission but may require shorter cable lengths and can be more susceptible to signal electromagnetic interference.
IO-Link devices and the IO-Link master must be configured with the same baud rate for successful communication.

Data length:
IO-Link communication uses a flexible data length, which allows for the exchange of various types of data, including cyclic process data, parameter data, and diagnostic data.
The maximum data length supported by IO-Link depends on the specific version of the IO-Link specification. For example, IO-Link version 1.0 supports a maximum data length of 32 bytes per message, while IO-Link version 1.1 increases this to 64 bytes per message. This expanded data length in version 1.1 allows for more comprehensive data exchange and can be advantageous for devices with advanced features.

Configuration

Overview

You can modify some of the settings parameters via the IO-Link configuration software or the embedded web server. You have to connect your PC to the IO-Link master on which your sensor is connected. To know how to connect, see Wiring IO-Link for Configuration, page 26.

Configuration of Replaced Sensor

On some IO-Link masters, there is a feature that allows the sensor parameters to be saved and automatically integrated into a replacement sensor that has the same characteristics (manual settings and calibration excluded). To find out if your master has this feature or how to use it, please refer to your IO-Link master guide, page 6.

Manual Configuration

Some configuration settings can be done manually directly on the IO-Link sensor.

For example: some sensors allow you to configure the output mode (NO or NC) by wiring the "in" input pin in a specific way.

For more details, refer to the instruction sheet of your sensor, page 6.

Configuration with Software or Embedded Web Server

To configure features of the IO-Link sensor, there are two possibilities: the IO-Link Control Tool software or the embedded web-server.

The IO-Link Control Tool software allows access to the object (or index) to the function implemented on your sensor.

Wiring IO-Link for configuration between an IO-Link sensor and an IO-Link master involves making the necessary electrical connections to establish communication and configure the sensor. Here are the steps to wire an IO-Link sensor for configuration:

NOTE: Before you begin, make sure you have the appropriate cables, connectors, and tools required for the wiring. Verify that the sensor and the IO-Link master are compatible with each other and that you have access to the documentation of the manufacturer for both devices.

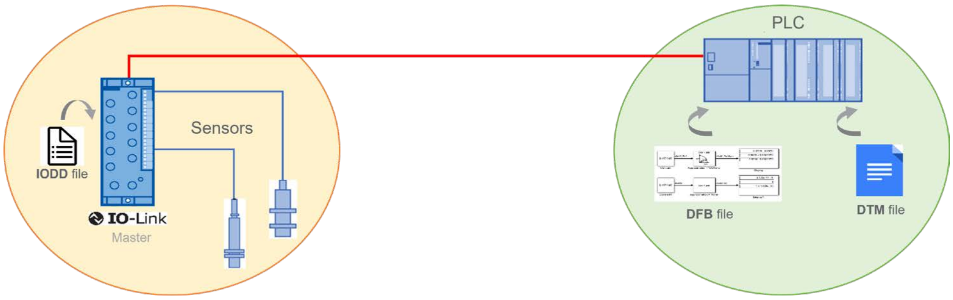
Step	Action
1	Gather the Required Components : • IO-Link Sensor or Actuator • IO-Link Master • IO-Link Cable • Configuration Software or Configuration Tool
2	Connect one end of the IO-Link cable to the IO-Link port on the IO-Link sensor. Typically, the IO-Link port is labeled as "C/Q" (for communication and configuration). Connect the other end of the IO-Link cable to the IO-Link port of the IO-Link master. The port of the master IO-Link may also be labeled "C/Q". The power supply of the sensor is delivered by the master.

Step	Action
3	Connect your computer or configuration tool to the IO-Link master using the appropriate interface (For example, USB, Ethernet, or serial connection) provided by the master. This connection allows you to access and configure the IO-Link sensor.
4	Turn on the power supply to the IO-Link sensor (if required) and verify that the IO-Link master is powered.
5	Launch the configuration software or tool on your computer and identify and select the IO-Link sensor within the configuration software. This may involve searching for the sensor by name or serial number. Configure the parameters of the sensor as needed using the configuration software.You can adjust sensing ranges, thresholds, communication settings, and other parameters according to your application requirements.
6	After configuring the sensor, save the settings within the configuration software. This indicates that the sensor operates with the desired parameters.
7	Test the functionality of the sensor and validate that it operates as expected with the newly configured settings. Verify that the sensor provides accurate readings or detections.
8	Continuously monitor the performance of the sensor , especially during initial operation after configuration. Use diagnostic data provided by the sensor for fault detection and troubleshooting.

For more information, see IO-Link Control Tool software guide, page 6.

Requested Definition Files (IODD, DFB, and DTM)

Overview



IODD

The IO-Link communication protocol uses a file named IODD (IO-Link Device Description) to establish a connection between your sensor and your IO-Link master device.

An IODD (IO Device Description) is a standardized electronic data file used in the field of industrial automation and process control. IODDs follow a standardized format defined by the IO-Link Consortium, ensuring consistency and compatibility across different manufacturers and devices. It serves as a digital description and identity of an IO-Link device, providing essential information about the characteristics, parameters, and communication capabilities of the device. IODDs are primarily used to simplify the integration and configuration of IO-Link devices into automation systems.

This IODD file can be downloaded from the official IO-Link website and loaded into the memory of the IO-Link master module via the Telemecanique Sensors web server or the IO-Link community web server.

⚠ CAUTION
INOPERABLE EQUIPMENT DUE TO CYBER ATTACK ON IO-LINK • Apply external cybersecurity protection on IO-Link master device. • Download IO-Link device description files only from these web servers: IO-Link support page of the Telemecanique Sensors website or IODDfinder page of the official IO-Link website. **Failure to follow these instructions can result in injury, or equipment damage.**

IO-Link support page of the Telemecanique Sensors website:

https://tesensors.com/global/en/support/iolink

When integrating an IO-Link device into an automation system, the user typically configures the device to suit the specific application. IODDs simplify this process by providing a standardized and human-readable description of the parameters of the device. To use an IODD, we can use configuration tools provided by the IO-Link master manufacturer or third-party software that supports IO-Link. These tools allow to import the IODD file and interact with the device. For more details, see the IO-Link software user guide, page 6.

IODDs help identify IO-Link devices accurately by providing details such as device type, manufacturer, and model.

It is possible to access and configure the parameters of the device, such as sensing ranges, detection thresholds, and operating modes, through the configuration tool. These parameters are defined within the IODD.

The IODD can include information about potential error codes and diagnostic messages, helping in troubleshooting and maintenance.

When a new IO-Link device is connected to an IO-Link master, the master can automatically identify the device by referencing its IODD. This simplifies device integration and reduces setup time.

IODDs can include information about firmware versions and compatibility, ensuring that the correct device parameters are used.

To use an IODD, follow these general steps:

Step	Action
1	Download or obtain the IODD file for the specific IO-Link device you are working with.
2	Open the configuration software.
3	Import the IODD file into the configuration tool.
4	Connect the IO-Link device to the IO-Link master.
5	Use the configuration tool to access and set device parameters as needed for your application.
6	Save and apply the configuration to the device.

For more details, see the IO-Link software user guide, page 6.

DFB

A DFB (Data Function Block) file is a software component used in industrial automation systems to facilitate the integration of IO-Link devices with a PLC or control system.

DFB Basics:
DFBs provide a structured, user-friendly way to interact with IO-Link devices by encapsulating communication protocols, device parameters, and data processing tasks.

Role in Device Integration:
When an IO-Link master is connected to a PLC in an automation system, DFBs are used to simplify the configuration and communication between the PLC and the IO-Link devices.

Benefits of Using DFBs:
DFBs simplify the programming and configuration of IO-Link devices, making it easier to incorporate these devices into automation systems. They provide a consistent and structured approach to handling different types of IO-Link devices within the PLC programming environment. DFBs encapsulate the complexity of communication protocols and data processing, reducing programming effort and minimizing the risk of programming errors.

NOTE: DFB files are available on the Telemecanique Sensors website. You can find them on the page dedicated to each sensor.

DTM

The next step is to allow your programmable logic controller (PLC) to communicate with your IO-Link master. To do this, it is necessary to load a file called DTM (Device Type Manager) into the memory of your PLC via a computer. A DTM is a software component used in industrial automation systems to configure, monitor, and manage field devices connected to an IO-Link master and integrate them with a PLC or control system. DTMs are typically used in systems that adhere to the FDT (Field Device Tool) technology standard. This DTM file provides to the PLC a unified structure of the master module. By this, the PLC can access the master module to configure and troubleshoot it when needed.

DTM Basics:
A DTM is essentially a software driver or plug-in specifically designed to communicate with and manage a particular type of field device, such as an IO-Link sensor or actuator. Each type of IO-Link device typically has its own corresponding DTM.

Role in Device Integration:
When an IO-Link device is connected to an IO-Link master in an automation system, the DTM associated with that type of the device is loaded into a configuration and diagnostic tool (known as a Frame Application or FDT Frame) on a PC or engineering station. The DTM serves as the bridge between the IO-Link master and the user interface of the FDT Frame. It provides a standardized way to configure and monitor the IO-Link device.

Configuration and Monitoring:
Using the DTM,it is possible to perform the following tasks:
Configuration: DTMs allow users to configure various parameters of the IO-Link device, such as sensing ranges, detection thresholds, and communication settings. This configuration is done through a user-friendly interface provided by the DTM.
Monitoring: The DTM provides real-time data from the IO-Link device, including sensor readings, status information, diagnostic messages, and event notifications. Users can monitor the performance of the device and quickly identify any issues.
Diagnostics: DTMs offer detailed diagnostic information, enabling users to troubleshoot problems, identify error codes, and perform maintenance tasks effectively.

Integration with PLC:
After configuring and monitoring the IO-Link device using the DTM, it is possible to apply the settings to the device. The IO-Link master then communicates with the device based on the configured parameters.
The PLC or control system can communicate with the IO-Link master, retrieving data from the connected devices through the DTM. This data is used for process control, decision-making, and automation tasks.

Benefits of Using DTMs:
DTMs streamline the integration of IO-Link devices with PLCs and control systems by providing a standardized interface for configuration, monitoring, and diagnostics. They simplify the setup and maintenance of field devices, reducing engineering and commissioning time.

DTMs enhance the flexibility of IO-Link systems, as different IO-Link devices can be easily integrated and managed within a single framework.

In summary, a DTM is a crucial software component when integrating IO-Link devices with a PLC or control system. It enables the configuration, monitoring, and management of IO-Link devices, streamlining the setup and maintenance processes in industrial automation systems.

NOTE: DTM are available on the Telemecanique Sensors website. You can find them on the page dedicated to each sensor.

Detected Transmission Failure

If detected transmission failure occurs, the frame is repeated two more times. If the IO-Link master recognize a detected transmission failure of the second retry, it signals this to the higher-level controller.

A detected transmission failure in the context of an IO-Link communication system refers to a situation where there is a detected failure or interruption in the data transmission between the IO-Link master and an IO-Link sensor. This can occur for various reasons and is an important aspect of IO-Link communication, as it provides insights into the health and status of the communication link.

There can be several reasons for a detected transmission failure, including but not limited to:

- **Cable Disconnect:** Physical disconnection or damage to the communication cable between the master and sensor.

- **Power Supply Issues:** Interruption in the power supply to either the master or the sensor.

- **Environmental Factors:** Interference from external factors such as electrical noise, electromagnetic interference (EMI), or harsh environmental conditions.

Maintenance and Troubleshooting: Detected transmission failures are essential for maintenance and troubleshooting purposes. They help identify and pinpoint communication issues quickly, allowing maintenance personnel to take corrective action, such as checking connections, replacing cables, or addressing sensor or master faults.

Preventive Maintenance: Regular monitoring of detected transmission faults can also contribute to preventive maintenance. By dealing with communication problems quickly, potential downtime can be minimized and the reliability of the IOLink system improved

Compatibility

IO-Link version numbers are important when connecting an IO-Link sensor and an IO-Link master because they signify the compatibility and feature set of the IO-Link protocol. These version numbers help to ensure that the sensor and master can communicate effectively and that the desired functionality is supported.

Different versions of the IO-Link protocol may introduce changes or enhancements to the communication standard. Check compatibility between sensor and master in terms of IO-Link versions helps prevent communication errors or incompatibilities. IO-Link versions may include new features, capabilities, or improvements. By knowing the IO-Link version of both the sensor and the master, you can determine whether specific features you require are supported. For example, later versions may offer enhanced diagnostics, faster data rates, or additional configuration options. IO-Link versions can affect the parameters and configuration options available for the sensor. Knowing the version numbers helps ensure that the sensor can be properly configured through the master, and that the master can interpret and apply the configuration of the sensor settings. IO-Link is designed to be an interoperable standard, meaning sensors and masters from different manufacturers should work together. However, knowing the IO-Link versions of both components can help confirm that they adhere to the same standard and can interoperate seamlessly.

All manufacturers may release firmware updates to improve the performance or add features to IO-Link devices. Understanding the IO-Link version is essential for identifying whether a device is running the latest firmware or if updates are needed for optimal operation. As technology evolves, new IO-Link versions may be introduced to support emerging industrial automation requirements. By considering the IO-Link version numbers, you can make informed decisions about device compatibility and that your automation system is ready for future advancements.

XU Range IO-Link Specificities

Characteristics

Baud rate:

Here is the baud rate available:

- COM1: 4.8 kbps (Not supported)
- COM2: 38.4 kbps
- COM3: 230.4 kbps (Not supported)

Minimum cycle time: 2.3 ms for COM2

Data length:

- PD (Process Data) size: 1 byte
- OD (On-request Data) size: 1 byte (M-sequence type: TYPE_2_1)

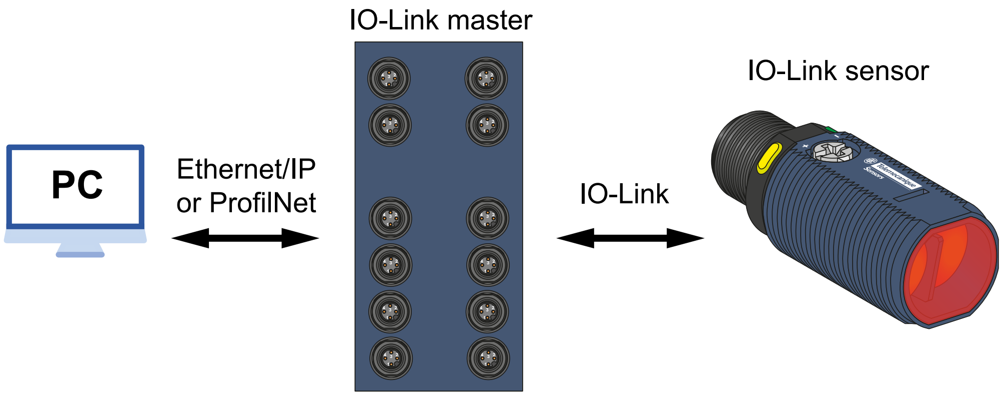
Compatibility

All devices of Telemecanique Sensors are in IO-Link version 1.1.2 or higher. By this, the devices are compatible with all IO-Link master versions.

Installation

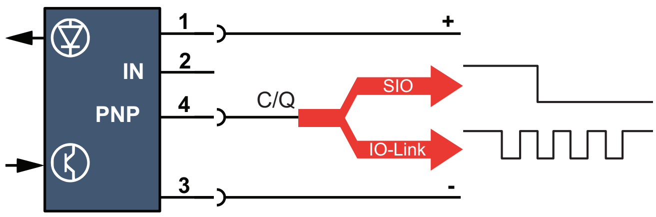
Wiring IO-Link for Configuration

Step	Action
1	Connect the sensor to the IO-Link master. For more details about cables, see Accessories, page 27.
2	Establish a connection with the master and a computer.



Wiring

IO-Link sensor connections:



The pins assignment is specified as follows:

Pin	Signal	Details
1	+	+ 24 Vdc
2	IN (Output logic configuration)	+ = NO - = NC Open = NO
3	-	0 Vdc
4	Q / Switching signal (SIO)	The sensor communicates as standard digital device.
	C / Communication IO-Link	The sensor communicates using IO-Link.

Installation Precautions

Mechanical Installation Precautions

When installing your sensors, follow the recommendations listed in the instruction sheet (see Related Documents, page 6).

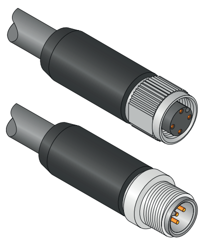
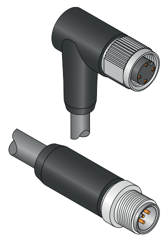
IO-Link Installation Precautions

The cable between the IO-Link master and the device should not exceed 20 meters *(65.61 ft)*. For more details on the cables, refer to Accessories, page 27.

Accessories

IO-Link Cables

The following cables can be used with XU photoelectric sensors:

M12 – M12, 4 pins				
Jumper length	**PVC**	**PUR**	**PVC**	**PUR**
1 m *3.28 ft.*	XZCRV15110-41C1	XZCR15110-41C1	XZCRV15120-41C1	XZCR15120-41C1
2 m *6.56 ft.*	XZCRV15110-41C2	XZCR15110-41C2	XZCRV15120-41C2	XZCR15120-41C1
5 m *16.4 ft.*	XZCRV15110-41C5	–	XZCRV15120-41C5	–
PVC cable are designed for general use and PUR cable for severe industrial environments				

IO-Link Features

Overview

There are features offered by IO-Link technology, categorized in two sections, configuration functions and diagnosis functions.

Some IO-Link device features are still configurable and usable as the standard device. IO-Link features are described hereafter. Standard features are described in the related Instruction Sheet.

Configuration

Here are the configuration functions:

Function	IO-Link product	Standard product
Reset to Factory Settings, page 29	x	
Configure the Lock of Settings, page 29	x	
Set Tags, page 30	x	
Set Sensitivity Level, page 31	x	x
Configure NO/NC Function, page 33	x	x
Configure the NPN/PNP Output Function Type, page 34	x	x(1)
Configure the Timer Function, page 35	x	

(1): NPN or PNP depending on chosen device.

Diagnosis

Here are the diagnosis functions:

Function	IO-Link product	Standard product
Read the Identification Values, page 39	x	
Read Operating Hours, page 40	x	
Read the Live Output State / Detection State, page 40	x	x
Read the Target Position, page 42	x	
Access to the Number of Change State, page 43	x	
Read the Excess Gain, page 44	x	

Configuration Function

Reset to Factory Settings

Description

Factory settings, also known as default settings, refer to the predefined configuration and parameters that a device or system has when it leaves the production line of the manufacturer.

The reset to factory settings can be use for different situation, as when you encounter issues, want to start fresh, or need to return a device to its original state. This action restores all settings to the factory defaults, essentially erasing any user-customized configurations.

Process

To reset to the factory settings:

Step	Action	Index
1	Set the object : **System command = Restore factory settings** (index 2 = 130).	2

Configure the Lock of Settings

Description

Configuring a lock for device settings, often referred to as "settings lock" or "parameter lock," is a security feature that prevents unauthorized access to, modification of, or tampering with the configuration of the device. This lock is commonly used in various applications, especially in industrial where secure and consistent device operation is essential.

This function permits to lock settings that can be configured in externally (such as NO/NC Function, page 33 or Sensitivity Level, page 31), whatever the "NO/NC selection" and the "gain/sensitivity/distance selection".

This lock is applied only when the selection is configured as external.

Process

To set the lock of settings:

Step	Action	Index
1	Set the object : **Product settings lock = Lock** (index 80 = 0). **NOTE**: By default the value is set to "255 = Unlock".	80

Set Tags

Description

This function allows to set a tag to a device.

Setting a specific tag to a sensor is a common practice in industrial and automation systems for identification and organization. You can use the Specific Tag to number devices with the same location and function. Tags help users and control systems to quickly identify and manage individual sensors.

Process to Set Specific Tag

To set a specific tag:

Step	Action	Index
1	Write your text in the object **Application Specific Tag** (index 24).	24

Set Sensitivity Level

Description

Setting the sensitivity level of a sensor is a crucial step to ensure that it accurately detects and responds to specific conditions or objects in an industrial or automation system. The sensitivity level determines the responsiveness of the sensor to changes in its environment.

Here are the different possibilities to set the sensitivity level distance in the sensors:

- Set Sensitivity Level by the Potentiometer, page 31
- Set Sensitivity Level by IO-Link, page 31
- Teach the Sensitivity Level, page 32

Set Sensitivity Level by the Potentiometer

To set sensitivity level with potentiometer:

Step	Action	Index
1	Set the object : **BDC1 Setpoint setting: IO-Link/External Selection = External** (index 81 = 0).	81
2	To set the potentiometer, refer to the Instruction Sheet, page 6.	-

Set Sensitivity Level by IO-Link

Electronic adjustment, through IO-Link using the dedicated software configuration tool, provides precise control over the sensitivity of the sensor.

To find the sensitivity level to be set with a test obstacle, refer to Read the Target Position, page 42.

To set sensitivity level by IO-Link:

Step	Action	Index
1	Set the object : **BDC1 Setpoint setting: IO-Link/External Selection = IO-Link** (index 81 = 255).	81
2	**Set the object:** **Switchpoint mode = Single point mode** (index 61 / subindex 2 = 1).	61 / sub 2
3	Set the value in the object **Setpoint 1** (index 60, subindex 1). The value in the object **Read Target Position** (index 83) can be used here (only if the value has been read under the same conditions as Setpoint 1 will be used) . **NOTE**: For the same distance, the value can be different because the detection depends on the color and the material of the object as illustrated in Read the Target Position, page 42.	60 / sub 1 83

Teach the Sensitivity Level

Setting the sensitivity level of a sensor by teaching it involves a process where the sensor learns the characteristics of the objects or conditions it needs to detect. Teaching a sensor is particularly useful when the objects or conditions to be detected are variable or complex. It allows the sensor to adapt and learn, making it a valuable tool in industrial and automation applications.

To teach the sensitivity level:

Step	Action	Index
1	Place your object in front of your sensor. Do not move theobject during the teaching procedure.	-
2	Set the object : **System command = SP1 Single Value Teach** (index 2 = 65).	2
3	Wait 3 seconds to save the value.	-
4	If the teaching process is successful: **SP1 TP1 = true** (index 59, subindex 4 = 1). **Teach State = SP1 Success** (index 59, subindex 5 = 1). The Value is saved in the object **Setpoint 1** (index 60, subindex 1).	59 / sub 4 59 / sub 5 60 / sub 1
5	If the teaching process is unsuccessful: **SP1 TP1 = false** (index 59, subindex 4 = 0). **Teach State = Error** (index 59, subindex 5 = 7).	59 / sub 4 59 / sub 5

Configure NO/NC Function

Description

Configuring the NO (Normally Open) or NC (Normally Closed) function of a sensor or switch is recommended to determine how the sensor responds to the presence or absence of a target. The choice between NO and NC configuration can affect how the sensor interacts with other components in the system, such as controllers, alarms, actuators,... .

The BDC1 (Binary Digital Configuration 1) Switchpoint Logic Setting in IO-Link is a configurable feature that allows you to define the behavior of a switching output of the IO-Link sensor based on specific conditions or logic rules.

The BDC1 Switchpoint logic setting allows to configure the way in which the NO/NC (Normally Open/Normally Closed) function is **defined:**

The object **BDC1 Switchpoint logic setting** permits to set the way to configure the NO/NC function:

- **BDC1 Switchpoint logic setting = External** (index 71 = 0): configuration through the IN (Input) wire.
- **BDC1 Switchpoint logic setting = IO-Link** (index 71 = 255): configuration by IO-Link.

Configure NO/NC Function Through the IN Wire

To configure NO/NC function through the IN wire, refer to the Instruction Sheet, page 6.

Configure NO/NC Function by IO-Link

To set the NO/NC function by IO-Link:

Step	Action	Index
1	Set the object: **BDC1 Switchpoint logic setting = IO-Link** (index 71 = 255). **NOTE**: By default the value is set to «0 = External».	71
2	Set the object **Switchpoint logic** (index 61 / subindex 1) to: • 0 = Not inverted (NO) or, • 1 = Inverted (NC). **NOTE** : By default the value is set to «0 = Not inverted (NO)».	61 / sub 1

Configure the NPN/PNP Output Function Type

Description

Configuring the NPN/PNP Output Function Type involves specifying the electrical behavior of the output of the sensor. NPN and PNP are two common transistor-based output types configured to ensure that the output of the sensor is compatible with the rest of your electrical system. The choice between NPN and PNP configurations depends on your specific application and the electrical requirements of your devices.

Configure NPN/PNP Output Function Type for Standard Sensors

For standard sensors, the output function type depends of the sensor and its wiring. Refer to the Instruction Sheet, page 6.

Configure NPN/PNP Output Function Type by IO-Link

To set the NPN/PNP output function type by IO-Link:

Step	Action	Index
1	Set the object **Output function type** (index 70) to: • 0 = NPN, • 128 = AUTODETECT. When “AUTODETECT” is selected, each time the sensor is powered on, the connection polarity of the output thru the load (to +V or to 0 V) is detected and the output is set NPN or PNP on this basis. • 255 = PNP. **NOTE**: The PNP/NPN configuration is only effective in SIO mode.	70

Configure the Timer Function

Description

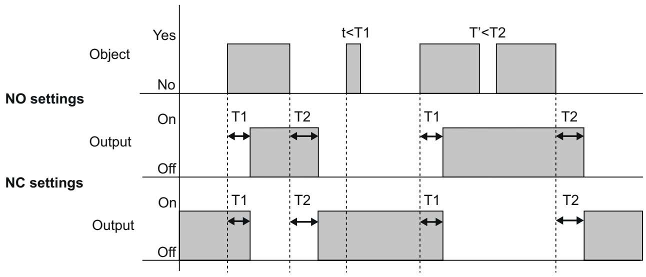
Configuring the timer function involves setting up a sensor or device to activate or deactivate its output or perform specific actions based on a predefined time delay or timer settings. Configuring the timer function adds a time-based dimension to the operation of the sensor, allowing it to perform actions or switch its output based on specific time delays or intervals. This functionality is valuable in applications where precise timing is needed, such as in industrial automation, process control, and monitoring systems.

Configure the Timer Function

To set the timer function by IO-Link:

Step	Action	Index
1	Set the object **Timer Selection** (index 90) to: • 0 = No timer, • 1 = On/Off Delay, page 35 • 2 = Rising edge delayed one, page 35 • 3 = Falling edge delayed one, page 35 .	90
2	Set the object **T1** value (index 91) among those available: 0 ms, 5 ms, 10 ms, 25 ms, 50 ms, 100 ms, 250 ms, 500 ms, 1 000 ms 2 500 ms, 5 000 ms, 10 000 ms, 25 000 ms.	91
3	Set the object **T2** value (index 92) among those available: 0 ms, 5 ms, 10 ms, 25 ms, 50 ms, 100 ms, 250 ms, 500 ms, 1 000 ms, 2 500 ms, 5 000 ms, 10 000 ms, 25 000 ms.	92

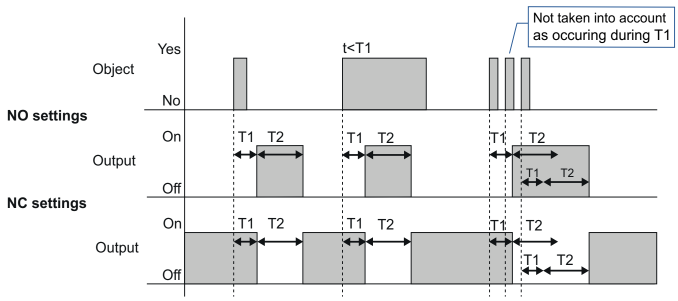
On/Off Delay

On/Off delay		
	Delay T1	**Delay T2**
Function	Delays output activation/ deactivation after target detection if target detection duration > T1.	Delays output activation/ deactivation after target end of detection if target end of detection duration > T2.
Application	As only longer signals are extracted, this function is useful to detect if a line is clogged, or to sense only objects taking a long time to travel.	This function is useful if the output signal is so short that the connected device cannot respond.
Diagram	Timers T1 and T2 are retriggerable. **Rising edge delay (T1) / Falling edge delay (T2):**  **NOTE**: Timers are reset when power is turned-on in both modes. Then, the triggering of the timers will necessarily be made by a change of state in the detection.	

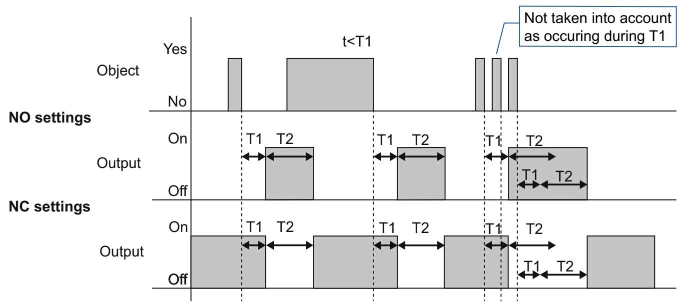
Delayed One Shot

<table>
<tr><th colspan="3">Delayed one shot</th></tr>
<tr><th></th><th>T1</th><th>T2</th></tr>
<tr><td>Function</td><td>Output delay to change the status, after target detection.</td><td>T2 corresponds to the output state hold time.</td></tr>
<tr><td>Application</td><td colspan="2">As soon as a package is detected, the sensor triggers the one shot delay. It generates a brief, predefined pulse signal, after detected the package (T1) and typically a few milliseconds in duration (T2), to stick a label.</td></tr>
<tr><td>Diagram</td><td colspan="2">The T1 timer is not retriggerable and T2 is retriggerable (the pulse may be retriggered if T1 < T2).

Rising edge delayed one shot:



Falling edge delayed one shot:



NOTE: Timers are reset when power is turned-on in both modes. Then, the triggering of the timers will necessarily be made by a change of state in the detection.</td></tr>
</table>

Use Case of On-Delay Timer

Scenario:
An OEM specializes in manufacturing conveyor systems for material handling in warehouses and factories. These conveyor systems are equipped with sensors and On-Delay Timers for detecting and responding to jams or blockages.

Use Case Description:
Normal Conveyor Operation: During normal operation, the conveyor transports materials smoothly along the belt.
Blockage Detection: If an object or material causes a blockage or jam on the conveyor, a sensor detects the issue and initiates the On-Delay Timer.
Delay for Initial Assessment: The timer introduces a delay before taking action. During this delay, the system assesses whether the blockage is temporary or requires intervention.
Action Initiation: After the delay, if the blockage persists, the timer signals the conveyor system to stop or reverse the belt to clear the jam. If the blockage clears on its own, the timer resets without taking further action.
Preventing Damage: The On-Delay Timer delay period helps prevent abrupt stops or reversals that could potentially damage the conveyor system or the materials being transported.

Benefits:
Minimized Downtime: The On-Delay Timer allows that the conveyor system does not immediately halt upon detecting a potential jam. This reduces downtime and improves productivity.
Reduced Maintenance Costs: By avoiding sudden stops and reducing stress on the system, the OEM can lower maintenance and repair costs.
Enhanced Efficiency: The system responds effectively to jams, allowing that the conveyor operates efficiently, even in situations with occasional blockages.

Use Case of Off-Delay Timer

Scenario:
An OEM designs conveyor systems for a variety of industries. They have integrated proximity sensors along the conveyor belt to detect the presence of packages or products. These sensors are equipped with Off-Delay Timers.

Use Case Description:
Packing Station Monitoring: The conveyor system leads to packing stations where workers place items into boxes.
Off-Delay Timer Purpose: When a package moves away from the detection area of the sensor, it initiates the timer. The Off-Delay Timer allows that the conveyor does not stop immediately when a package moves out of the range of the sensor (for example, due to worker activity). Instead, it keeps the conveyor running for a short period after the sensor no longer detects the package.
Worker Efficiency: This Off-Delay Timer function optimizes worker efficiency by avoiding frequent conveyor starts and stops. It provides a brief window for workers to prepare the next package for processing, reducing downtime.

Benefits:
Worker Efficiency: One of the primary benefits is the improvement of worker efficiency. Off-Delay timers allow the conveyor to continue running for a brief period after a package has moved out of the detection of the sensor area. This extra time gives workers a window to prepare the next package for processing without having to restart the conveyor repeatedly.
Reduced Downtime: By avoiding frequent starts and stops of the conveyor, the Off-Delay timer reduces downtime. Conveyor systems are most efficient when they run continuously or in longer cycles. Frequent stops and starts can lead to inefficiencies and wear and tear on the equipment.
Optimized Throughput: Off-Delay timers contribute to optimizing throughput in the conveyor system. Packages can continue to move along the conveyor smoothly during the delay period of the timer, allowing a steady flow of goods and reducing the likelihood of bottlenecks.

Use Case of Pulse Timer

Scenario: The OEM designs conveyor systems used in e-commerce warehouses for sorting and labeling packages. These systems utilize photoelectric sensors equipped with Pulse Timers.

Use Case Description:
Labeling Station: The conveyor system includes a labeling station where packages need to be labeled before reaching their final destination.
Sensor Placement: Photoelectric sensors are strategically placed along the conveyor just before the labeling station to detect the presence of packages.
Pulse Timer Configuration: The sensors are configured with Pulse Timers. When a package is detected by the sensor, the Pulse Timer is initiated.
Labeling Process: The labeling process involves applying a label to the package, which takes a brief moment.
Pulse Trigger: As soon as a package is detected, the sensor triggers the Pulse Timer. It generates a brief, predefined pulse signal, typically a few milliseconds in duration.
Labeling Activation: This pulse signal activates the labeling machine for a very short period, precisely when the package is in the ideal position for labeling.

Benefits:

Optimized Labeling: The Pulse Timer allows that the labeling machine applies the label with precision, exactly when the package is aligned correctly. It avoids labeling misplacing that might occur if the machine were activated too early or too late.

Efficiency and Accuracy: By utilizing Pulse Timers, the conveyor system of the OEM enhances efficiency and accuracy in the labeling process. Labels are applied precisely, reducing the risk of mislabeling or wasted labels.

Minimized Label Waste: Because labels are applied only when needed, there is a reduction in label waste. Labels are not applied to packages that pass by without stopping at the labeling station.

High Throughput: The conveyor system can maintain a high throughput rate while allowing accurate labeling, making it ideal for e-commerce facilities with a high volume of packages to process.

Diagnosis Function

Read the Identification Values

Description

The identification values of an IO-Link sensor typically include key information that uniquely identifies and provides details about the sensor. These values are used for tracking, configuration, and troubleshooting purposes in industrial and automation systems. These identification values are accessible through the IO-Link communication protocol and can be read and configured using an IO-Link master device and associated software tools. They play a crucial role in allowing that sensors are properly integrated into automation systems, correctly configured, and maintained effectively.

Process

To read the identification values:

Step	Action	Index
1	The different readable object values are: • **Vendor Name** (index 16): manufacturer name. • **Vendor Text** (index 17): manufacturer website. • **Product Name** (index 18): commercial reference ID. • **Product ID** (index 19): product ID. • **Product Text** (index 20): product range description. • **Hardware Revision** (index 22): current hardware revision. • **Firmware Revision** (index 23): current firmware revision.	• 16 • 17 • 18 • 19 • 20 • 22 • 23

Read Operating Hours

Description

The Operating Hours for a sensor refer to the total amount of time that the sensor has been actively in operation or has been powered on and functioning. It measures the cumulative duration during which the sensor has been performing its sensing or monitoring tasks.

The value is updated every hour. The last operating hour before the sensor power off is lost. The data can only be read, no reset possible.

Process

To read the operating hours:

Step	Action	Index
1	Read the object **Operation hours** (index 103)	103

Application Example

Operating hours are an useful metric for various purposes, including:

Maintenance Scheduling: Knowing the operating hours helps in planning maintenance and calibration activities. Sensors often require regular maintenance or replacement after a certain number of operating hours to allow their continued accuracy and reliability.

Asset Management: Tracking operating hours is crucial for asset management. It allows organizations to monitor the usage of equipment and sensors, which can be valuable for budgeting, resource allocation, and asset lifespan analysis.

Energy Efficiency: For sensors that consume power, monitoring operating hours can be part of energy efficiency initiatives. It helps in identifying sensors that may be consuming energy unnecessarily when not needed.

Read the Live Output State / Detection State

Description

Reading the Live Output State or Detection State for a sensor involves checking the real-time status or condition of the output of the sensor based on its current sensing or detection operation. This reading provides information about whether the sensor is actively detecting or sensing a target or a specific condition at a given moment.

The data type and structure is identical to the process data transferred in the process communication channel.

Here is how it works:

Live Output State: This typically refers to the immediate status of the output signal sensor. For example, if the sensor is designed to detect the presence of an object and provide a digital output signal (for example, "1" for object detected, "0" for no object detected), the live output state would be the current value of this signal at any given time.

Monitoring and Control: Reading the live output state or detection state is used for monitoring and controlling automated processes. It allows systems to respond in real-time to the presence or absence of objects or specific conditions, triggering actions or alerts as needed.

Applications: This functionality is used in a wide range of applications, including industrial automation, robotics, security systems, and quality control. For instance, in a manufacturing setting, a live output state of the sensor may determine when a robotic arm should pick up an item from a conveyor belt based on the presence or absence of the item.

Integration: Sensor data, including live output or detection state, can be integrated into control systems, PLCs (Programmable Logic Controllers), or SCADA (Supervisory Control and Data Acquisition) systems for centralized monitoring and decision-making.

In essence, reading the live output state or detection state of a sensor provides real-time information about the activity of the sensor and the conditions it is detecting, allowing for timely responses and automation in various industrial and control applications.

This feature furnishes the most recent valid input data from the sensor application, mirroring the data type and structure of the information exchanged within the process communication channel. More importantly, this data is automatically transmitted by the sensor alongside the process data, reducing the need for explicit requests.

Although, it is possible to request it, it is automatically send by the sensor with the process data.

Process

To read the live outpout/detection state:

Step	Action	Index
1	Read the object **ProcessDataInput** (index 40) • 0 = OFF • 1 = ON	40

Read the Target Position

Process

To read the target position:

Step	Action	Index
1	Read the object **Read Target Position** (index 83). The value is the minimum potentiometer position to be set (in percentage) to detect the target seen when reading the object. For example: If the value indicate 50, the potentiometer should be set on 50%. **NOTE**: The value is only updated when the “read” request is made from IO-Link.	83

This value can be used:

- to set the real potentiometer on the sensor
- or set in the object “**Setpoint 1**” (index 60, subindex 1). For more details, refer to Set Sensitivity Level by IO-Link, page 31.

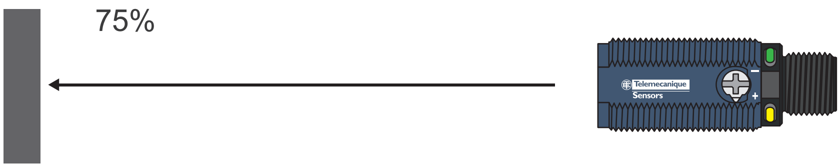
Details On Target Position

For the same distance, the Target Position value can change depending to the color and the material of the detected object, the surrounding dust, and so on.

Here is an example of reading a target position with different objects at the same distance:

Example 1: with a grey object, the value indicate 50.

Example 2: with a black object, the value indicate 75.



Access to the Number of Change State

Description

The number of change state of a sensor refers to the count or quantity of times that an output signal of the sensor changes from one state to another within a specific period of time or under certain conditions. This parameter is often used in various industrial and automation applications to monitor and analyze the behavior of sensors and the objects or processes they are sensing. For example, in the context of a sensor detecting the presence or absence of objects on a conveyor belt, the number of change state could refer to how many times the output of the sensor switches from "object detected" to "no object detected" and vice versa as objects pass by the sensor.

The value is reset to zero when the product is restarted. The count of changes states is updated each time the output status changes.

Process

To read the number of change states:

Step	Action	Index
1	Read the object **Change state number** (index 102)	102

To reset the number of change states:

Step	Action	Index
1	Read the object **Reset change of state counter = Reset** (index 107 = 255)	107

Application Example

This information can be valuable for tasks such as:

Counting objects: Keeping track of the number of objects passing a sensor.

Monitoring machine operations: Detecting changes in the status of moving machine parts.

Quality control: Identifying variations in product characteristics during manufacturing.

Fault detection: Noticing anomalies or unexpected changes in a process.

Maintenance scheduling: Determining when sensors might need maintenance or replacement based on their usage patterns.

Read the Excess Gain

Description

The term "excess gain" in the context of a photoelectric sensor refers to the additional amplification or sensitivity beyond what is strictly necessary for the sensor to perform its function. In simpler terms, it represents the degree to which the sensor is more sensitive than required for a given application.
The Excess Gain is the amount of energy received compared to the amount energy needed to detect the target. The value can change depending to the color of the detected object, the surrounding dust, and so on.
The value of this ratio is expressed by a value between 0.1 and 100. The value is equal to 1 when the sensor barely detects the target.

Processes

To read the excess gain:

Step	Action	Index
1	Read the object **Read energy quantity** (index 100).	100

It is possible to see a feedback on the energy quantity received by levels, such as: “acceptable”, “limit”, or “excellent”.

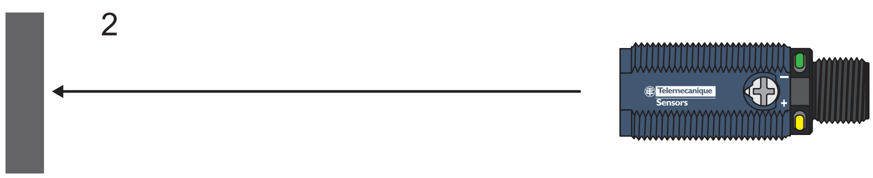
To read the excess gain by levels:

Step	Action	Index
1	Read the object **Energy quantity result** (index 101): • 0 = Not Enough (corresponds to a value between 0.0 and 1.5), • 1 = Limit (corresponds to a value between 1.5 and 2.5), • 2 = Acceptable (corresponds to a value between 2.5 and 5.0), • 3 = Excellent (corresponds to a value between 5.0 and 100).	101

Details On Excess Gain Value

For the same distance, the excess gain value can change depending to the color and the material of the detected object, the surrounding dust, and so on.
Here is an example of reading an excess gain with different objects at the same distance and with a diffuse sensor:
Example 1: with a grey object, the value given by the diffuse sensor is 10. On the feedback, that correspond to “Excellent”.

Example 2: with a black object, the value given by the diffuse sensor is 2. On the feedback, that correspond to “Limit”.



Summary Table

GENERAL INFORMATION	
Communication mode IO-Link	COM 2
Minimum cycle time	2.3 ms
SIO mode	Supported
Length process data	8 Bit
Vendor ID	297 / 0x0129
Device ID	102
Data storage	Supported
Specification IO-Link	1.1.2

PROCESS DATA							
SENSOR PROFILE							
Byte 0							
7	6	5	4	3	2	1	0
x	x	x	x	x	x	x	Switching output Q

IDENTIFICATION DATA								
Indec (dec/hex)	Access (1)	Data type	Length	Sub-index	Default value	Value range	Object name	Description
16 / 0x10	R	StringT	64 Bytes	0	Schneider Electric	-	Vendor Name	Manufacturer name
17 / 0x11				0	https://www.tesensors.com/	-	Vendor Text	Manufacturer website
18 / 0x12				0	XUB5APYNM12 XUB5BPYNM12 XUB6APYNM12 XUB6APYWM12 XUB6BPYNM12 XUB6BPYWM12 XUN5APYNM12 XUN6APYNM12		Product Name	The parameter Product Name contains the complete product name (Commercial Reference).
19 /0x13				0			Product ID	The parameter Product ID contains the vendor specific product or type identification of the device.
20 / 0x14				0	Proximity Sensor	-	Product Text	The parameter Product Text contains additional product information for the device.
22 / 0x16				0	-	-	Hardware Revision	The parameter Hardware Revision contains a vendor specific coding for the hardware revision of the device (For example: HW-V1.0).
23 / 0x17				0	-	-	Firmware Revision	The parameter Firmware Revision contains a vendor specific coding for the firmware revision of the device (For example: FW-V1.0).
14 / 0x18	R / W	StringT	32 Bytes	0	***	-	Application Specific Tag	The parameter Application Specific Tag is dedicated for the user application. It can be used as a «tag function» (role of the Device) or a «tag location» (location of the Device).
(1): R = Read, W = Write								

SYSTEM COMMAND								
Indec (dec/hex)	Access (1)	Data type	Length	Sub-index	Default value	Value range	Object name	Description
2 / 0x02	W	UIntegerT	1 byte	0	-	65 130	System Command	65 = Launch the teach process (see feedback in index 59) 130 = Restore factory settings
(1): R = Read, W = Write								

DETECTION PARAMETERS								
Indec (dec/hex)	Access (1)	Data type	Length	Sub-index	Default value	Value range	Object name	Description
Teach in Status								
59 / 0x3B	R	RecordT	1 byte	0	-	-	Tech-in status	The parameter «Teach-in Status» provides feed-back on the status and the results of the teach-in process (SP1 Single Value Teach / index 2). This status information is split into «Teach State» and «Teach Flags».
		Boolean	1 Bit	1	0	false = Teachpoint x not taught or not successful true = Teachpoint x successfully taught	SP2 TP2	Teach flag for SP2 TP2 (Only for XU•8 BGS)
		Boolean	1 Bit	2	0		SP2 TP1	Teach flag for SP2 TP1 (Only for XU•8 BGS)
		Boolean	1 Bit	3	0		SP1 TP2	Teach flag for SP1 TP2 (Only for XU•8 BGS)
		Boolean	1 Bit	4	0		SP1 TP1	Teach flag for SP1 TP1
		UIntegerT	4 Bits	5	0	0 = IDLE 1 = SP1 SUCCESS 2 = SP2 SUCCESS 3 = SP12 SUCCESS 4 = WAIT FOR COMMAND 5 = BUSY 6 = RESERVED 7 = ERROR	Teach State	Teach State result: 0 = IDLE, teach not yet done 1 = SP1 SUCCESS, the teach process for the detection point 1 is succeeded 2 = SP2 SUCCESS, the teach process for the detection point 2 is succeeded (Only for XU•8 BGS) 3 = SP12 SUCCESS, the teach process for the detection point 1 + 2 is succeeded (Only for XU•8 BGS) 4 = WAIT FOR COMMAND (Only for XU•8 BGS) 5 = BUSY (Only for XU•8 BGS) 6 = RESERVED (Only for XU•8 BGS) 7 = ERROR, If no object in front of the sensor / out of the sensing range / Object too close
Detection point								
81 / 0x51	R / W	UIntegerT	1 Byte	0	0	0 = External 255 = IO-Link	BDC1 setpoints setting: IO-Link/ External Selection	Define the way to configure the BDC1 setpoint (by IO-Link or externally).
60 / 0x3C	R / W	RecordT	2 Bytes	0	-	-	Setpoints of BDC1	The following parameters define the detection point for BDC1.
		UIntegerT	1 byte	1	0	0...100	Setpoint 1	BDC1 Setpoint 1 (set in IO-Link first in Index 81)
		UIntegerT	1 byte	2	0	-	Setpoint 2	BDC1 Setpoint 2 (Only for XU•8 BGS)
Detection signal								
100 / 0x64	R	Float32T	4 Bytes	0	-	0.1...100	Read energy quantity	Read the energy quantity received to ensure a reliable detection.
101 / 0x65	R	StringT	1 byte	0	-	0 = Not Enough 1 = Limit 2 = Acceptable 3 = Excellent	Energy quantity result	Provides a feedback on the energy quantity received by levels: • 0 = Not Enough (energy quantity between 0.0 and 1.5) • 1 = Limit (energy quantity between 1.5 and 2.5) • 2 = Acceptable (energy quantity between 2.5 and 5.0) • 3 = Excellent (energy quantity between 5.0 and 100)
Potentiometer setting								
80 / 0x50	R / W	UIntegerT	1 Byte	0	255 (Unlock)	0 =Lock 255 = Unlock	Product settings lock	Lock all the settings of the product (potentiometer value and the input wires value).
83 / 0x53	R	UIntegerT	1 Byte	0	-	0...100	Read target position	Return the potentiometer minimum value in % (0% means minimum position and 100% means maximum position) to detect the target. The va-lue depends on the color & material of the object. For Read the Target Position, page 42. If it is less than 1% the teaching will be in error 7. After a teach success, the value read from this index should correspond to “BDC1 Setpoint 1”, index 60 sub-index 1.
(1): R = Read, W = Write								

DATA PARAMETERS								
Indec (dec/hex)	Access (1)	Data type	Length	Sub-index	Default value	Value range	Object name	Description
Read operating data								
103 / 0x67	R	UIntegerT	4 Bytes	0	-	0...2^{32}-1	Operating Hours	Number of operating hours. The data can only be read; no reset possible.
102 / 0x66	R	UIntgerT	4 Bytes	0	-	0...2^{32}-1	Change State Number	Number of output change status (On & Off). Passing a target increases the object value twice.
107 / 0x6B	W	UIntegerT	1 Byte	0	-	255 = Reset	Reset Change of States Counter	Reset the change of states counter to 0.
(1): R = Read, W = Write								

FUNCTION PARAMETERS								
Indec (dec/hex)	Access (1)	Data type	Length	Sub-index	Default value	Value range	Object name	Description
Timer configuration								
90 / 0x5A	R / W	UIntegerT	1 Byte	0	0	0 = No Timer 1 = On/Off Delay 2 = Rising Edge Delayed One Shot 3 = Falling Edge Delayed One Shot	Timer Selection	Defines which Timer Function should be applied on the output.
91 / 0x5B	R / W	UIntgerT	2 Bytes	0	0	0ms, 5ms, 10ms, 25ms, 50ms,100ms, 250ms, 500ms, 1000ms, 2500ms, 5000ms, 10000ms, 25000ms	T1	Defines the value of T1 for Timer Function.
92 / 0x5C	R / W	UIntegerT	2 Bytes	0	0		T2	Defines the value of T2 for Timer Function.
Other function								
14 / 0x0E	R	Array of bytes StringT	Variable	0	0x01, 0x01, 0x00	-	PDInput-Descriptor	Mandatory for Common Profile, not implemented in Diffuse sensor.
(1): R = Read, W = Write								

OUTPUT PARAMETERS								
Indec (dec/hex)	Access (1)	Data type	Length	Sub-index	Default value	Value range	Object name	Description
Output behaviour								
71 / 0x47	R / W	UIntegerT	1 Byte	0	0	0 = External 255 = OI-Link	BDC1 Switchpoint logic setting: IOLink / External Selection	Define the way to configure NO/NC function (by IOLink or through IN wire).
61 / 0x3D	R / W	RecordT	4 Bytes	0	-	-	Switch Parameters of BDC1	The following 3 parameters define the switching behavior of a BDC1 (output 1)
		UIntegerT	1 Byte	1	0	0 = Not inverted (NO) 1 = Inverted (NC)	Switchpoint logic	The parameter «Switchpoint logic» defines whether the switching information is transmitted in inverted or not inverted manner. Select the output function between NO (Normally Open) and NC (Normally Closed). Select first Index 71=IO-link.
		UIntegerT	1 Byte	2	1	0 = Deactivated 1 = Single point mode 2 = Window mode 3 = Two points mode	Switchpoint mode	Select the detection mode: 1= Single point mode is selected when one point of detection is needed 2 = Window mode is selected when detection is needed between two detection points called near point and far point (Only for XU•8 BGS). 3 = Two points mode (Only for XU•8 BGS)
		UIntegerT	2 Bytes	3	0	0	Switchpoint hysteresis	The parameter «Switchpoint hysteresis» defines whether a hysteresis is associated with the Setpoints SP1 and SP2. The layout of the hys-teresis in respect to SP1 and SP2, for example symmetrical, right-aligned, or left-aligned, etc. is manufacturer/vendor specific. It cannot be defined in the FunctionClass. The interpretation of the hysteresis values (relative or absolute) is also manufacturer/vendor specific.(Only for XU•8 BGS)
Output configuration								
70 / 0x46	R / W	UIntegerT	1 Byte	0	128	0 = NPN 128 = AUTODETECT 255 = PNP	Output function type	Define the output function type of the sensor (NPN / AUTODETECT / PNP)
40 / 0x28	R	UIntegerT	1 Byte	0	-	0 = OFF 1 = ON	PD Input	Last valid process input data of the device.
58 / 0x3A	R / W	UIntegerT	1 Byte	0	0	0	Teach-in channel	The parameter «Teach-in Channel» allows addressing the particular BDC or a set of BDCs for which the teach-in commands apply. A maximum of 128 BDCs can be addressed. (Only for XU•8 BGS)
(1): R = Read, W = Write								

Frequently Asked Questions

What are the advantages of using photoelectric sensors with IO-Link?
Photoelectric sensors with IO-Link offer improved flexibility, remote configuration, real-time diagnostics, and enhanced data exchange with the controller.

Can I use standard cables for IO-Link connections, or do I need special cables?
It is recommended to use shielded, twisted-pair cables specifically designed for IO-Link to enable good communication and minimize interference. To see our cables available, see Accessories, page 27.

What types of photoelectric sensors are available with IO-Link compatibility?
Various types are available, including diffuse, retro-reflective, through-beam, and color sensors, among others. They are recognized by the logo IO-Link and can be found following this link: http://qr.tesensors.com/XU0022.

How can I configure and set up photoelectric sensors with IO-Link?
You can configure them using the IO-Link master device or a compatible software tool provided by the sensor manufacturer. For more details, see IO-Link master User Guide, page 6.

What is the maximum cable length for IO-Link connections?
IO-Link typically supports cable lengths of up to 20 meters, but this can vary depending on the sensor and IO-Link master used.

Can I use multiple photoelectric sensors on the same IO-Link network?
Yes, IO-Link supports multiple sensors and devices on the same network, allowing for efficient data exchange.

Do photoelectric sensors with IO-Link support industry-standard communication protocols like Modbus or Ethernet/IP?
Many IO-Link devices can interface with these protocols through the IO-Link master device. Please refer to this link to select the appropriate IO-Link master: IO-Link master User Guide, page 6.

How can I troubleshoot communication issues with IO-Link sensors?
Check the cable connections, power supply, and the configuration settings on the IO-Link master and sensors to diagnose communication problems.

Can I use IO-Link sensors in harsh environments, such as those with extreme temperatures or exposure to chemicals?
Some IO-Link sensors are designed for harsh environments, but it is recommended to choose sensors rated for the specific conditions you need. Please refer to our website to select the right sensor: https://www.telemecaniquesensors.com/global/en.

Are there any limitations to the number of sensors I can connect to a single IO-Link master?
The number of sensors you can connect depends on the capabilities of the IO-Link master and the overall network design. Consult your IO-Link master User Guide, page 6.

What is the response time of photoelectric sensors with IO-Link compared to traditional sensors?
IO-Link sensors generally have a response time similar to traditional sensors when it is used to configure the sensor only. If the data are exchanged in real time, the response time of the sensor will depend on the quantity of information needed between the sensor and the master device. For more details, see Transmission, page 16.

Can I update the firmware of IO-Link sensors remotely?

This sensor versions don’t allow the firmware and keep the cybersecurity at the highest level.

What are some typical applications for photoelectric sensorswith IO-Link?
These sensors are used in applications such as object detection, part counting, level sensing, and quality control, among others. Some application examples are described in Applications, page 9.

Do IO-Link sensors require a separate power source, or can they be powered through the IO-Link cable?
They can often be powered through the IO-Link cable but check the IO-Link master specifications for power requirements in your IO-Link master User Guide, page 6.

Can IO-Link sensors be integrated with other industrial automation systems, such as SCADA or MES systems?
Yes, IO-Link sensors can be integrated with higher-level systems to provide real-time data for process monitoring and control. Consult your system's compatibility and requirements.

Glossary

B

Baud rate

Data transmission speed specified in the form of a number of bits transferred per second (baud rate = data rate).

BOOL

A *Boolean* type is the basic data type in computing. A `BOOL` variable can have one of these values: 0 (`FALSE`), 1 (`TRUE`). A bit that is extracted from a word is of type `BOOL`, for example: `%MW10.4` is the fifth bit of a memory word number 10.

BYTE

When 8 bits are grouped together, they are called a `BYTE`. You can enter a `BYTE` either in binary mode or in base 8. The `BYTE` type is encoded in an 8-bit format that ranges from `16#00` to `16#FF` (in hexadecimal format).

C

CIP

(Common Industrial Protocol) CIP is an industrial protocol for industrial automation applications. It encompasses a comprehensive suite of messages and services for the collection of manufacturing automation applications-control, safety , synchronization, motion, configuration and information.

Cycle time

Time to transmit an M-sequence between a master and its device including the following idle time.

D

DHCP

dynamic host configuration protocol. A TCP/IP protocol that allows a server to assign an IP address based on a device name (host name) to a network node.

DI

(Digital input)

DO

(Digital output)

DSCP

(Differentiated Services Code Point) DSCP is a computer networking architecture that specifies a mechanism for classifying and managing network traffic and providing quality of service on modern IP networks.

E

EMI

(Electromagnetic Interference) It is unwanted noise or interference in an electrical path or circuit caused by an outside source. It is also called radio frequency interference.

Ethernet

A physical and data link layer technology for LANs, also known as IEE 802.3. Ethernet uses a bus or a star topology to connect different nodes on a network.

H

HMI

(Human Machine Interface) An operator interface, usually graphical, for industrial equipment.

I

IEC 61131-9

International standard that deals with the basics of programmable controllers. Part 9 describes IO-Link under the designation Singledrop digital communication interface for small sensors and actuators (IO-Link).

IODD

(IO Device Description) IODD serves as a digital description and identity of an IO-Link device, providing information about the characteristics, parameters, and communication capabilities of the device.

N

NTP

(Network Time Protocol) NTP is a networking protocol for clock synchronization between computer systems over packet-switched, variable-latency data networks.

O

OEM

(Original Equipment Manufacturer) It refers to any company that manufactures products or parts intended to be incorporated into a final product of another company.

OPC UA

(Open Platform Communications Unified Architecture) It is an omni-platform communication protocol for industrial automation. Regardless of their age, OPC-UA enables industrial robots, machine tools and PLCs to communicate with each other.

P

PELV

(Protective Extra Low Voltage) PELV describes a voltage that is set so low that in the event of indirect contact and small area direct contact there is no risk of electric shock. In the event of an insulation failure adequate protection must still be provided.

PLC

(Programmable Logic Controller) The PLC is the brain of an industrial manufacturing process. It automates a process as opposed to relay control systems. PLCs are computers suited to survive the harsh conditions of the industrial environment.

Port

Communication medium interface of the Master to one Device.

S

SCADA

(supervisory control and data acquisition) A system that monitors, manages, and controls industrial applications or processes, usually for entire sites or complexes of systems spread over large areas.

SELV

(safety extra low voltage) A system that follows IEC 61140 guidelines for power supplies is protected in such a way that voltage between any 2 accessible parts (or between 1 accessible part and the PE terminal for class 1 equipment) does not exceed a specified value under normal conditions or under inoperable conditions.

SIO

(Standard Input Output) Port operation mode in accordance with digital input and output defined in IEC 61131-2 that is established after power-up or fallback or unsuccessful communication attempts.

W

Wake-up

IO link procedure for causing a device to change its mode from SIO to IO-Link mode.

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