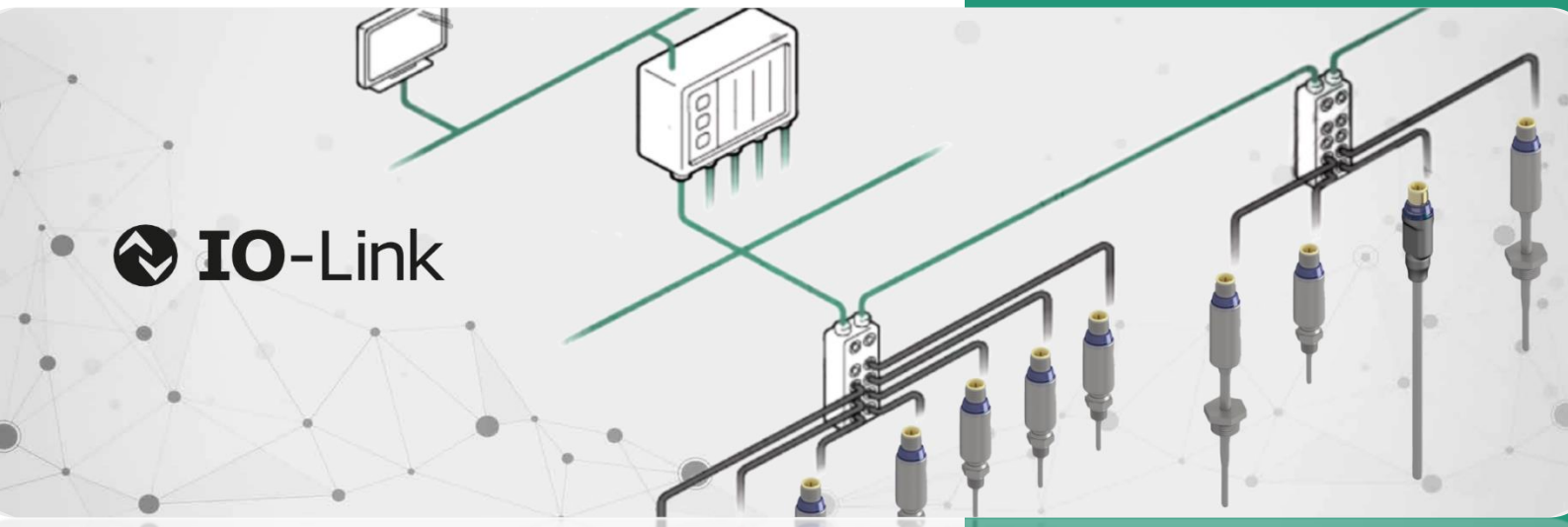
What is the IO-Link system?



White Paper

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Brief History

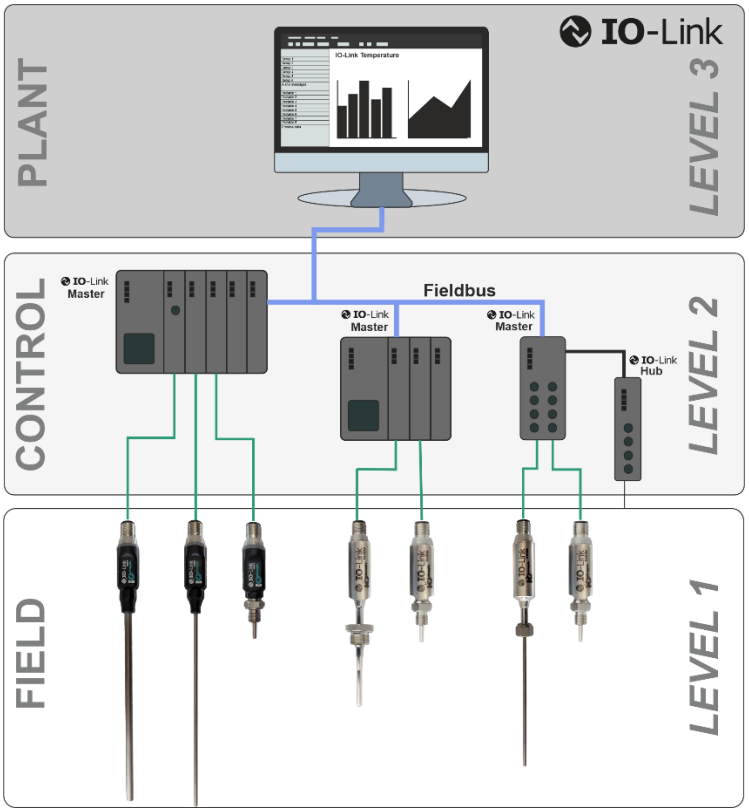
In 1982, the International Electrotechnical Commission (IEC) established conventions for programmable controllers and their software. This standard was later updated and renamed IEC 1131 in 1993; a further update and name change occurred in 1997, becoming IEC 61131. Part 9 of IEC 61131 (the standard for IO-Link) concerns "the single-drop digital communication interface for small-sized sensors and actuators" (SDCI).

IO-Link is a serial communication standard used in industrial automation to connect field devices, such as sensors and actuators, to programmable controllers and other automation devices. Communication is bidirectional and high-speed and can be briefly represented in three levels:

- **Level 1**: Sensors, transducers, and actuators
- **Level 2**: Master units that gather all information from Level 1
- **Level 3**: Higher-level data processing, where major decisions are made, such as operating times, efficiency, and error analysis.

A significant advantage of IO-Link devices is the ability to be configured simply, quickly, and without errors. The ease of commissioning and maintenance is evident, as during the replacement of a unit, the system can easily recognize it and apply the same configuration as the replaced unit.

Since all sensors/transducers follow the same standard, replacement can easily occur even among units from different manufacturers.



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IO-Link Software for Configuration

The configuration and commissioning of sensors/actuators occur simply and quickly through an IO-Link master unit (regardless of the brand or model), its included software, and a file named IODD provided by the manufacturer of the IO-Link device or downloadable from the IO-Link community website, IODDFinder.

The IODD file (IO Device Description) contains detailed descriptions of the functionalities, parameters, and characteristics of a specific IO-Link device. Simply put, it acts as a virtual manual for the device, providing the control system with all the necessary information to interact with it appropriately.

Types of Data in the IO-Link Protocol

Each IO-Link installation manages data through the master unit; such data can be cyclic (process data) and acyclic (device and event data).

- *Process Data*: These are basic operational information such as temperature, position, level, distance, and other parameters that the field units continuously measure and transmit to the IO-Link master.
- *Event Data*: This includes alarms, maintenance requests, as well as diagnostic information from error signals coming from the sensor or actuator.
- *Device Data*: These are the information about the unit and the operating parameter settings.

IO-Link 1.0 and 1.1: What are the Differences?

In 2013, the IO-Link consortium updated the IO-Link technical specifications from version 1.0 to 1.1 to provide greater flexibility and functionality.

One of the main improvements was the introduction of a third data transmission speed through a channel called COM3: this allowed for improved communication times between the IO-Link master and device.

The setting of the communication speed between the master and device occurs automatically upon first connection; this speed also determines the cycle time, which is the minimum time the master unit can request process data from the device, as indicated below:

- COM1: SDCI communication mode with transmission up to 4.8 kbit/s • Cycle times up to 18.0 ms
- COM2: SDCI communication mode with transmission up to 38.4 kbit/s • Cycle times up to 2.3 ms
- COM3: SDCI communication mode with transmission up to 230.4 kbit/s • Cycle times up to 0.4 ms

Furthermore, new additional parameters and functionalities have been defined, such as the locator or teach functions, for increased configuration flexibility.

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IO-Link Master

IO-Link masters are fundamental devices in IO-Link systems and perform several key functions in industrial automation processes. Some of the main functions that IO-Link masters perform include:

- *Interface with the Controller*: they act as a bridge between IO-Link devices, such as sensors and actuators, and the high-level control system, such as a PLC or industrial PC.
- *Communication Management*: they manage bidirectional communication between IO-Link devices and the control system. This includes forwarding commands from the control system to the devices and transferring data from the devices to the control system for processing and analysis.
- *Configuration and Parameterization*: they allow the configuration and parameterization of connected IO-Link devices. They can send commands to set device parameters, such as alarm thresholds, sensor resolution, operating modes, and other specific settings.
- *Diagnostics Management*: they provide diagnostic functionalities to monitor the status and performance of connected IO-Link devices. They can detect faults, anomalies, or malfunctions in the devices and report this information to the control system for analysis and troubleshooting.

In summary, IO-Link masters are components of industrial automation that facilitate communication, configuration, and control of IO-Link devices, contributing to improving the efficiency, flexibility, and reliability of industrial processes.

Cables and Connectors in the IO-Link Standard

The wiring used features a non-proprietary, unshielded three-wire construction with a maximum voltage of 24 V and 200 mA. In cases where field units require higher current, such as an actuator demanding more power, a five-wire version is employed.

Through a single cable that carries both power and data, each sensor or actuator is effectively and standardized connected to the automation network, ensuring highly reliable communications even in the most challenging industrial environments

The connectors used in the IO-Link system is compliant to a defined standard to ensure interoperability and compatibility among various components. The M12 connector with 4 or 5 poles is the most commonly used, but the IO-Link standard also includes M5 and M8 connector types. These connectors are classified as IP65/IP67.

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