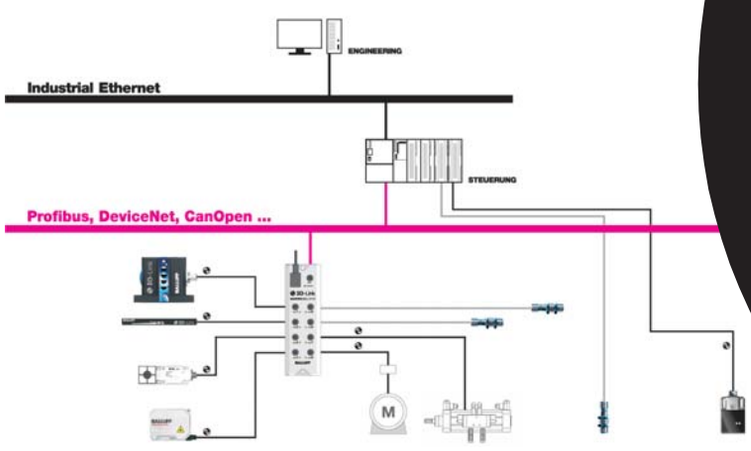
BALLUFF

IO-Link

Breakthrough in communication



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The performance capability of modern machines and systems in factory and process automation has increased remarkably in recent years and decades. The machines are not only faster, smaller and more reliable, they have at the same time become safer and above all more flexible. Economic forces lead to high demands on availability of the equipment. Here also enormous improvements have been made.

This kind of progress has been triggered and made possible to no small degree by innovation in automation technology. All the levels of automation technology, from control technology to fieldbus or the sensor/actuator level, have been involved. The demands for more and more functions, parameterization and especially diagnostics follows the increasingly common integration of microcontrollers in sensors and actuators which enables them to meet these demands. The general term for this is "intelligent" sensors or actuators. But there is one area where progress has not so far kept pace: The interface connecting the sensors/actuators to the automation systems is still today mainly a purely binary one.

The problem of the "last meter"
This interface always represents a bottleneck when it comes to adding diagnostics information or parameter data to the actual process signal. A specific example of this is a photoelectric sensor (diffuse type) which in addition to a contamination indicator also offers adjustable background suppression. Transmission of the contamination information to the controller using today's technology requires additional wiring complexity plus an additional input point on the controller. This scares many designers off (after all, it involves added cost), and many a practical function remains unused.

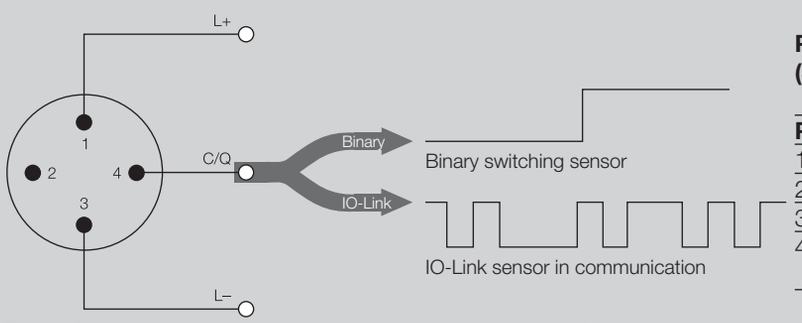
Automatic setting or reducing of the maximum detection range (background suppression) by the controller is for example not possible; this can be done only on the sensor itself using a teach-in process or potentiometer, which takes time and costs money if it requires manual intervention during startup, after replacing the sensor or when retrofitting.

How to eliminate the bottleneck? IO-Link!
In response to the difficulties described above, leading manufacturers from the automation field got together to create the breakthrough in communication, i. e. consistent communication all the way up to the sensor or actuator.

IO-Link was defined as a point-to-point connection between sensor/actuator and the I/O module. IO-Link eliminates the bottleneck between the sensor and fieldbus level by making today's binary standard sensor interface capable of communication.

Compatibility with the standard
When defining IO-Link, for reasons of investment security particular emphasis was placed from the very beginning on maintaining as much compatability as possible with the existing technology. Thus IO-Link sensors and actuators can be connected to existing I/O modules at any time. Likewise, a sensor which doesn't "speak" IO-Link can still be connected to an IO-Link I/O module. The IO-LInk I/O module recognizes communication-capable sensors/actuators after power-up and establishes IO-Link communication, or if appropriate reverts to standard switching mode.

Especially notable is the 100 % mechanical compatibility in terms of cabling. This means the familiar, inexpensive and unshielded standard industrial cable can be used for all IO-Link slaves – regardless of their complexity. The advantage becomes especially apparent when you compare this with shielded or multi-conductor cables, not to mention their assembly and installation problems.



Pin configuration for (3-wire interface)

PIN	Signal	Remarks
1	L+	24 V
2		
3	L–	Ground
4	C/Q	Communication/ Switchingsignal

Fig. 1: IO-Link is defined as an "add-on" to the standard sensor/actuator interface

Process data and service data

Whereas today's binary connection of sensors and actuators is designed to sent process data as a single bit, namely the switching state information, this bottleneck is permanently eliminated with IO-Link. With IO-Link there is a process data channel and a service data channel, over which 2 bytes each can be sent in a typical 2 ms cycle. This not only increases the amount of process data significantly, but also satisfies current demands with respect to diagnostics and parameter data transmission thanks to the additional service data channel.

Integration of analog sensors

Analog sensors are used whenever a simple binary signal is no longer sufficient, such as when a motion controller needs to know the exact position of a moving part. The integration of analog sensors is still associated with great effort in today's automation topologies. The fact that analog input and output channels are more expensive than binary I/O points is the least of the problem. The required signal-to-noise ratios often require greater effort and expense. To achieve true 12-bit resolution, the noise component in a 10 V data signal needs to remain under 1...2 mV! The use of shielded cable is usually unavoidable. But these are not easy to handle and are also significantly more costly than standard sensor cable. As a consequence, the required signal quality is often not achieved in spite of the measures just outlined.

With IO-Link it is possible to send an already digitized value over cost-effective, unshielded cable. Without fear of noise interference. Aside from the IO-Link box, no additional components are required for the analog in- or outputs. Unplanned empty spaces are eliminated. In addition to optimal utilization, which in most cases results in a reduction in the number of boxes, the variety is reduced to just one type. This is a dream come true for systems operators and maintenance personnel! The savings potential is enormous. In contrast it is easy to show what is involved in the A/D conversion in the sensor, not to mention the fact that digital values are already present in many sensors.

Key technical data for the IO-Link interface

- Serial point-to-point connection
- 3/2-wire interface based on IEC 60947-5-2 oriented
- Cable length 20 m, unshielded standard sensor cable
- Current draw per sensor/actuator 200 mA
- Communication takes place using pulse modulation 24 V as serial UART protocol

Communication modes

- Process data (cyclical):
  Typ. 2 bytes in- and 2 bytes output data, max. 32 bites input and 32 bytes output data
- Deterministic time response:
  Typ. 2 ms cycle time for 16 bits of process data
- Service data (diagnostics, parameters)
  and no mutual interference with switching signal

Alternative switching mode

- Switching signals in realtime
- Parameterization through communication is possible

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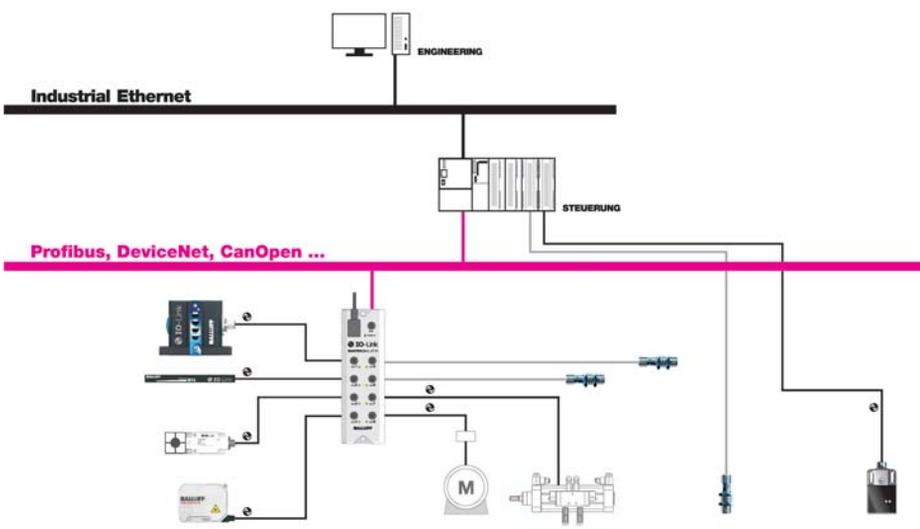

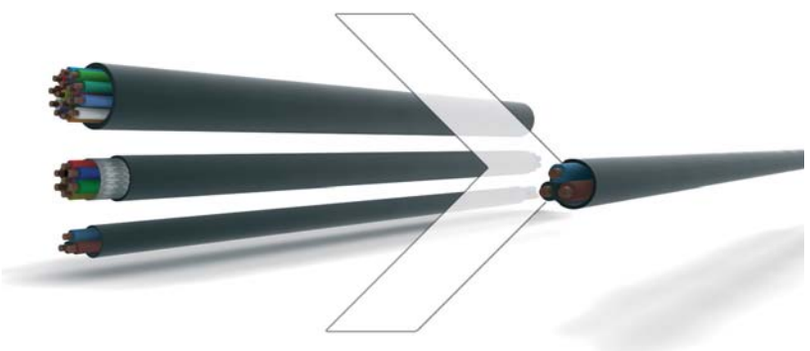

IO-Link reduces cabling and terminating costs while at the same time eliminating mistakes when wiring a multi-conductor cable.

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