IO-Link transceiver improves efficiency in industrial automation

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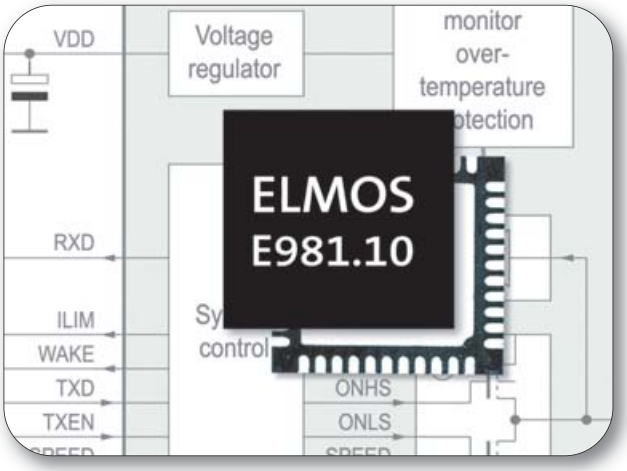
To balance cost reduction against the need for higher equipment availability, industrial automation depends on effective diagnostic concepts and efficient handling of parameter data. Modern sensors and actuators enable this but have not been efficiently connectable to the whole automation system. The IO-Link transceiver offers new possibilities.



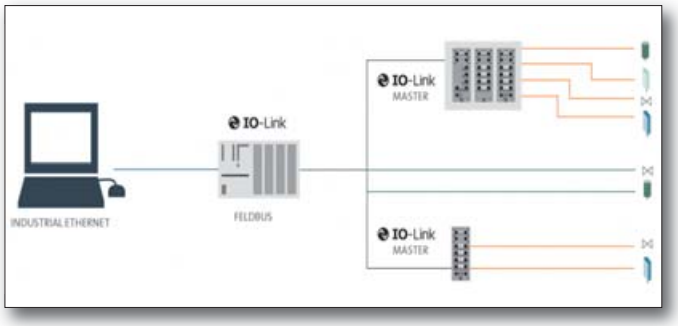
In industrial automation technology, sensors and actuators are still mostly connected to the control via switching 24V or standard analog signals. This is a laborious and unnecessarily expensive procedure, considering that there are now significantly more efficient and space-saving solutions such as, for example, the IO-Link transceiver E981.10 from Elmos. With the help of this highly integrated IC, process, parameter and diagnostic data can be securely transmitted digitally coded via a single 3-wire connection, with a transmission speed up to 230.4 kbps. What is more, the innovative communications component enables bi-directional communication with I/O field devices. It is therefore time for a technology change.

Today, the on-going balancing act between cost reduction on the one side and higher equipment availability on the other depends in automation technology on effective diagnostic concepts and efficient handling of parameter data. Modern sensors and actuators establish the necessary conditions for this. However it has not so far been possible to efficiently implement their connection to the whole automation system. But now IO-Link, as an innovative interface, offers completely new possibilities. In contrast to typical fieldbus systems, IO-Link uses parallel wiring, enabling data rates of up to 230.4 kbps to be transmitted over a maximum cable length of 20m. The signal transmission takes place by means of 24V pulse modulation and a standard UART protocol. IO-Link uses the standardized unshielded 3-wire connection cable (M12, M8, M5), which is also used for connection of conventional standard IO (SIO) sensors/actuators. This not only reduces the additional wiring effort to the absolute minimum, but also protects investments already made, since proven topologies can continue to be used and need not be changed.

A further advantage of IO-Link is that expensive shielded cable can be dispensed with, due to the elimination of analog measurement value transmission. The bidirectional IO-Link communication puts the overriding automation system in a position both to write parameter and configuration data to the sensor/actuator, and to read process and diagnostics data from the sensor/actuator. However, IO-Link can also handle communication via binary switching states as used by conventional SIO sensors. The new communications standard is thus backwards compatible, almost without restrictions, and can be applied combined freely, including with non-IO-Link-capable devices. Due to the open standard, IO-Link can be integrated in all popular automation and fieldbus systems so that a high level of flexibility with regard to supplier selection continues to be maintained. Integrations for Profibus, Profinet, Interbus, ASi and EtherCAT are already available and IO-Link integration in the ODVA is being pursued.

In order to ensure the requirements for, for example, over-current and over-voltage protection, defined in the IO-Link specification, a large number of individual components, transistors, diodes and other passive components, are used in the majority of the IO-Link devices so far available. For the first IO-Link field devices, this was the only way to map the interface to the wire and to fulfil the IO-Link specification. Especially problematic here has been the required interoperability with the control side, since the corresponding electrical circuits can only orient themselves to the IO-Link specification.

A remedy for this is the IO-Link transceiver E981.10, which now offers developers of IO-Link-capable sensors/actuators a highly integrated, space-saving solution for the wire interface. The driver component, which is backwards compatible to standard IO applications, fulfils the requirements of all relevant standards, and its features include a wide input voltage range from 8 V to 36 V, a high driver capability up to 200mA, integrated wake-up detection and a data transmission speed of up to 230.4 kbps.



Schematic overview: IO-Link in industrial automation

The driver stage can optionally be used as low-side, high-side or push-pull. Short-circuit, over-current and over-temperature protection functions ensure a high operating safety and also simplify application design.

Thanks to an internal 5V voltage regulator and a 3.3/5V compatible digital interface, the E981.10 can be combined with a variety of popular microcontrollers e.g. with a NEC 78K0R MCU, which in this case takes over protocol implementation. The component is useable with a chip temperature up to +150°C and is provided in a small 4x4mm QFN package, thus making it ideally suited for use in compact sensors and actuators. How useful the diverse functions of the E981.10 prove to be in practice is shown in examples including the integrated wake-up detection. In most cases, an IO-Link system consists of an IO-Link master and one or more IO-Link devices i.e. sensors and actuators. The IO-Link master provides the interface to the programmable logic controller (PLC) and controls communication with the IO-Link devices connected.

As a result of the backwards compatibility of IO-Link devices to standard IO (SIO) ports of the higher level control, IO-Link sensors and actuators initially behave like SIO devices. However, it is possible for the IO-Link master to identify IO-Link-capable devices in the network and switch over to IO-Link communication mode. This takes place by a so-named wake-up signal. During wake-up, the signal applied to the sensor in SIO mode is overwritten by the master with a typically 80µs impulse. The signal state can be high or low level, according to the sensor output signal. The information about a wake-up event exists for the software of two bits; from the level to be driven (TXD) and the level to be received (RXD). A combinatorial linkage of two IO ports for generation of an interrupt is generally not available with the microcontroller used. Support of the wake-up procedure by the E981.10 reduces the demands on the software, which otherwise would have to monitor the communication path by comparing the send and receive signal in high resolution. The binary wake-up signal provided by the transmitter can trigger an interrupt, which in turn results in relieving the microcontroller.

The signalling of an over-current error condition (ILIM signal), caused by a short circuit or other incidents, is a further example of the high flexibility of the IO-Link transceiver. This feature contributes to a significant increase in the long-term reliability of the product. By recognizing these errors, the software can react intelligently and deactivate the driver stage. In addition, the power dissipation can be reduced by examining the line for over-current in long intervals.

With the qualification and final EMC tests at the renowned test and certification body of the FTZ in Zwickau, Germany, development work on the IO-Link transceiver has now been completed according to plan. The official test report of the FTZ Zwickau, which proves compliance with the EMC limit values at transmission rates of up to 230.4 kbps, is available upon request. ■