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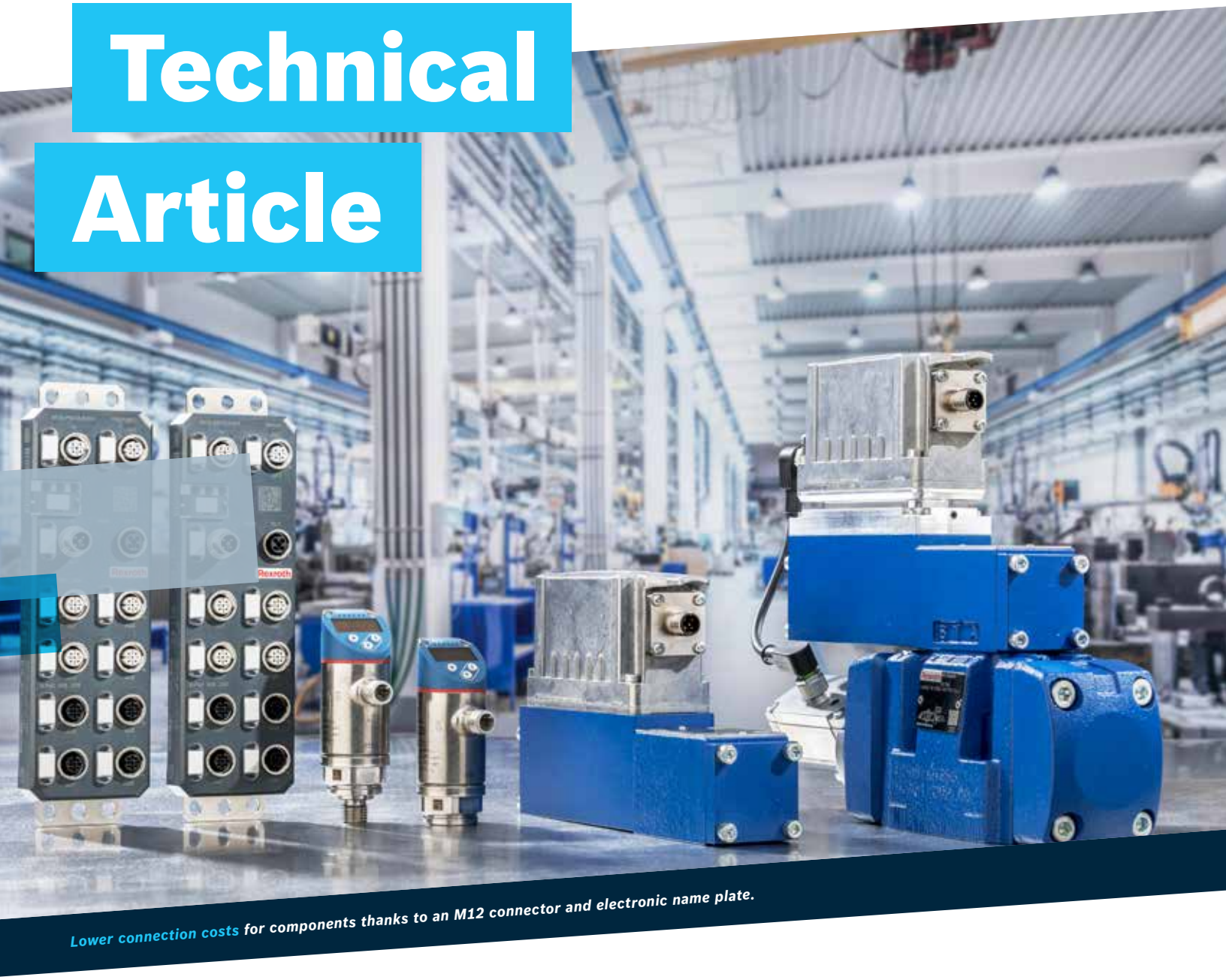
A Bosch Company

Technical Article



Lower connection costs for components thanks to an M12 connector and electronic name plate.

Hydraulics with IO-Link: Reduced effort, high value

Standardized wiring and electronic name place support commissioning and increase availability

Key Insights & Considerations

- **Open standard for bi-directional point-to-point connections in parallel to field bus**
- **Easy connection with standard cables and M12 connectors**
- **No additional engineering tool necessary, possible configuration via control system**

Summary

In almost all industries, machine user requirements of increased flexibility for production mean for small batches and continuous diagnostics of all actuators and sensors to increase availability. Additionally, there is quickly increasing horizontal and vertical connection of machinery and systems for Industry 4.0 applications. The open standard IEC 61131-9, IO-Link, fulfills these requirements at low connection costs and energy consumption. Flexibility of hydraulics is increased by transmission of parameter changes in running operation. Provision of diagnostics information offers numerous opportunities to extend the concepts of predictive maintenance for hydraulics to increase availability of systems and machinery. The manufacturer-independent IO-Link can be integrated easily and quickly in any industrial automation application.

Introduction: Limits of serial field bus communication

The introduction of field bus technology in the 1980s was the starting point for horizontal connection of decentralized actuators within machinery. Serial wiring led to a considerable reduction in cabling and opened new possibilities for modularization in mechanical engineering. Field buses as well as most current real-time Ethernet protocols are manufacturer-specific, proprietary systems. The protocols have been developed by control system manufacturers and focus on communication between owned electric control systems and selected peripherals. For actuators, sensors and other third-party equipment, either their manufacturers or system integrators are required to provide suitable interfaces in hardware and software for the respective field bus. This is very complex as device profiles and software have to be created in the respective PLC for every individual field bus and control system of each manufacturer.

Possibilities for hydraulic connection

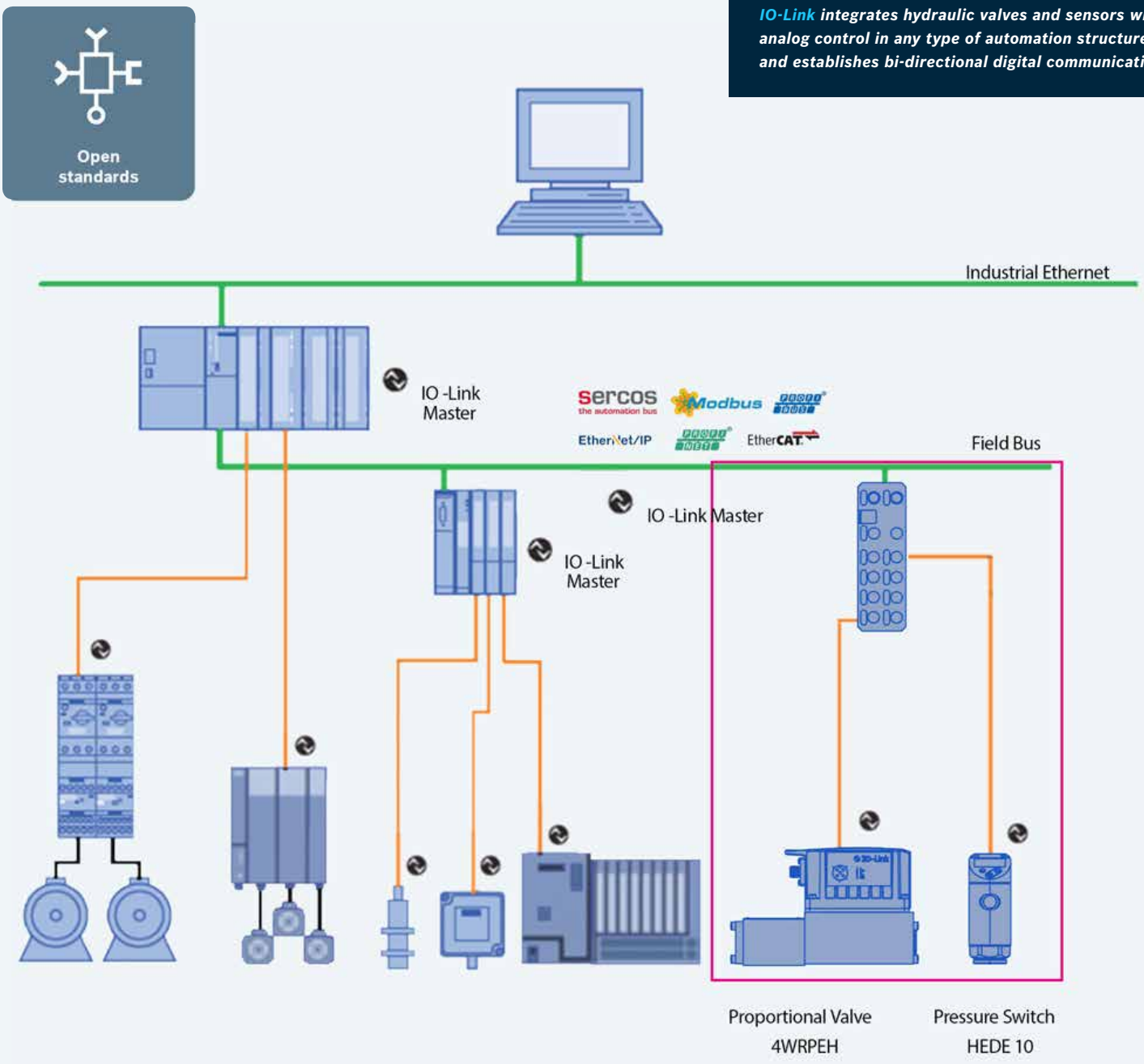
Integration of hydraulics in modern automation systems can be achieved in different ways. Numerous existing machine concepts apply on-board electronics for control of hydraulic valves. Exchange of digital information is restricted and only possible if the respective device is connected to a superior control system via individual wiring. This state-of-the-art technology increasingly no longer meets the requirements of end users.

The alternative are valves with integrated field bus connection. These, however, require extensive wiring, as well as, integration into the control system and the respective field bus protocol by means of dedicated software. Both require considerable effort that is too high, particularly for price-sensitive applications.

Thanks to IO-Link, machine manufacturers and system integrators are able to integrate, for example, proportional hydraulic series valves and sensors into digital communication structures with very little engineering effort. With its simple communication structure, IO-Link has low hardware requirements. Additionally, the standardized M12 connection technology enables simple and cost-efficient connection of hydraulic valves in the field. Products previously using analog signals and switches are transformed to an IO-Link format.

- **Data for predictive maintenance and quick device replacement**
- **Industry 4.0-compatible hydraulic components for vertical flow of information**

***IO-Link** integrates hydraulic valves and sensors with analog control in any type of automation structures and establishes bi-directional digital communication.*



IO-Link Masters ***are offered by approximately 50 manufacturers for connection of one IO device per port.***

IO-Link: Manufacturer-independent and compatible with all field bus protocols

The manufacturer-independent IO-Link, according to IEC 61131-9, standardizes connection technology for actuators, sensors and other equipment and provides a digital communication protocol for data exchange between control systems and devices regardless of the field bus. Field bus technology is not replaced but extended. Parallel communication enables machine manufacturers use of IO-Link with all protocols and integration of IO-Link-compatible devices into various concepts without additional effort.

IO-Link is currently already supported by approximately 130 device manufacturers and companies in the field of technology. IO-Link Masters are offered by approximately 40 manufacturers and the standard is supported by nine manufacturers of control systems with central Masters and respective engineering tools. IO-Link devices are in the product range of almost 60 manufacturers of sensors, actuators and other peripherals. Rexroth, for example, now also offers hydraulic proportional valves and pressure sensors with respective technology. Function and performance of these proportional valves are identical to series valves. However, they also offer all options for bi-directional communication via IO-Link. As a result, the hydraulics are integrated seamlessly into connected structures. Parameters can be changed and operating states changed by the control system during running operation.

IO-Link system set-up

A full IO-Link system consists of one centralized or decentralized IO-LINK Master, one or more IO-Link devices, as well as, unshielded 3- or 5-conductor standard cables with M12 connectors. Project planning and parameterization of the IO-Link Master can be

realized in the control system hardware or an optional engineering tool. The point-to-point connections between IO devices and the automation system are established by the IO-Link Master. It serves as the interface to the superior control system.

IO-Link Masters are offered by approximately 50 manufacturers for connection of one IO device per port. The selection includes options for the IP20 control cabinet as well as decentralized modules with protection class IP65/67 for installation at machinery or systems. Particularly in large-scale systems, cabling is considerably reduced.

For decentralized IO-Link Masters, the user organization of IO-Link has defined M12 plug-in connectors with three or five conductors. The 5-pole version “Class B” port is used for devices with increased current consumption like hydraulic valves. The 3-pole version “Class A” port provides an energy supply of up to 200 mA which is sufficient for most sensors. In contrast to analog controls, unshielded cables are sufficient for fault-free communication over a cable length of up to 20 meters. IO-Link standardizes connection technology for all actuators and sensors and eliminates numerous sources of errors during the installation of systems. Otherwise complicated and expensive cable dimensioning with individual wiring and shielding is no longer required. Additionally, the logistic effort is reduced thanks to application of uniform M12 cables for sensors and actuators.

Rapid commissioning per software

Every IO-Link device features an IO Device Description (IODD), that provides important information:

- Device data
- Text description
- Identification, process and diagnosis data
- Communication properties
- Device parameters with value range and default value
- Image of the device
- Logo of the manufacturer

The IODD set-up is identical for all devices of all manufacturers. The IODD enables automatic recognition of the device by the IO-Link Master for immediate parameterization. Device descriptions are also automatically included in the system documentation.

For project integration of the IO-Link Master in overall automation, commissioning personnel use the engineering tools of the respective PLC manufacturer. The IO-Link Master is selected from the device portfolio and added to overall automation. Depending on the control system manufacturer, all blocks for communication are available in a library for free.

Via IO-Link to Industry 4.0

IO-Link enables access to device data either directly from the control system or remotely via networks from any location. Particularly important for future-oriented concepts: IO-Link offers type and instance data of Industry 4.0 devices according to the definition of the German “Plattform Industrie 4.0” initiative.

In addition, hydraulic actuators meet all conditions for future requirements of Industry 4.0 applications. This approach is also well-suited for subsequent connection of existing machinery and systems with low effort. Users replace installed proportional valves and sensors with interchangeable options for IO-Link connection for direct communication with actuators and sensors.

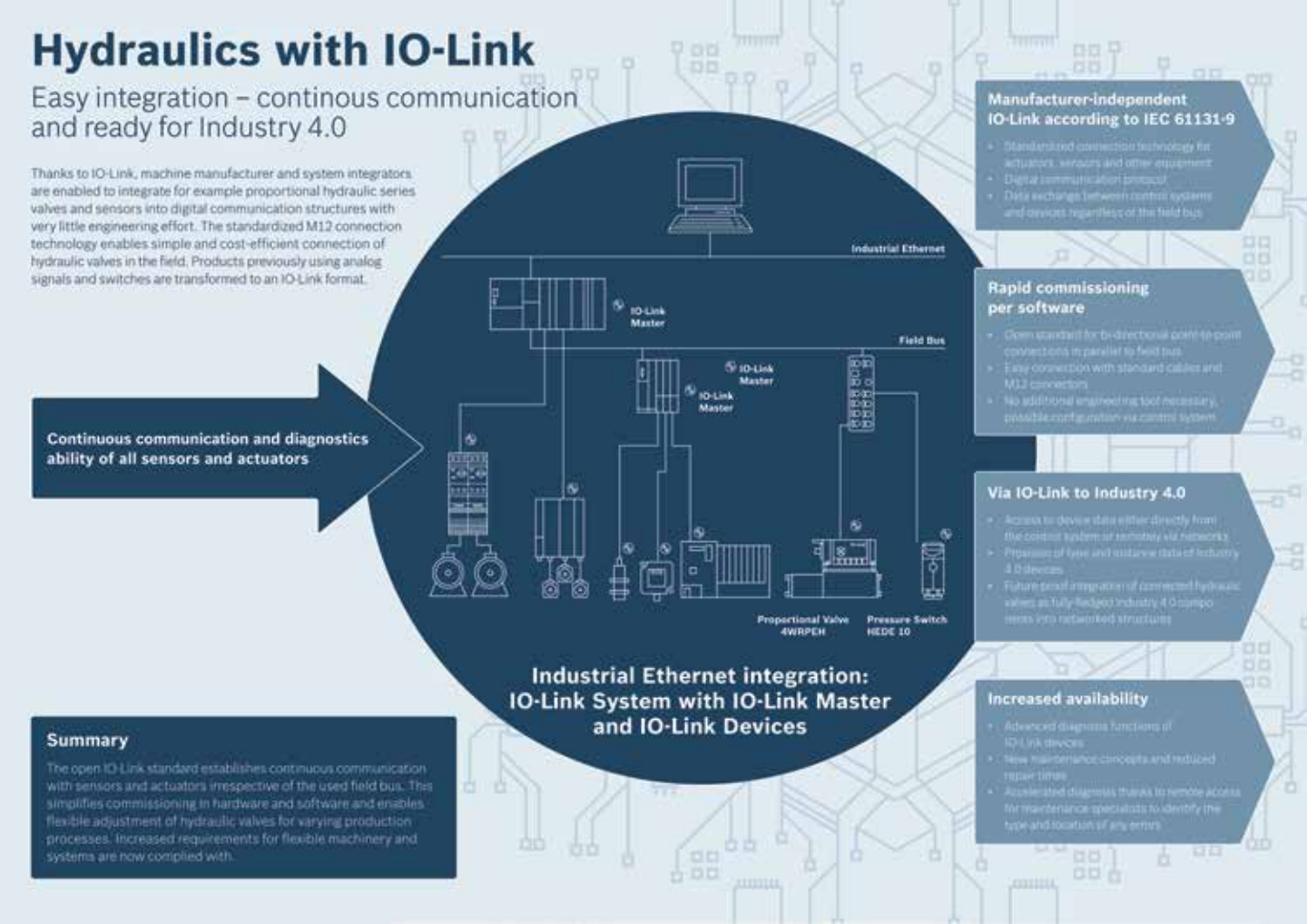
Diagnostic functions

Diagnostic functions of IO-Link devices enable new maintenance concepts and considerably reduce repair times. Respectively, proportional valves report whether they are functional, as well as any errors, such as under or over voltage, plus any electronic temperatures exceeding the admissible value. In addition, the valve and sensor status is displayed for transparent error analysis. An integrated operating hour indicator enables calculation of the residual life cycle for maintenance and decision-making on further use of the valve.

In case of faults, IO-Link accelerates diagnosis thanks to remote access for maintenance specialists to identify the type and location of any errors. Precise localization without personal presence at the system considerably reduces reaction times. If necessary, the maintenance technician opens the IODD file of the respective device in the control system.

Unlike before, components do not need to be disassembled to decipher hard to read labels, and manufacturers and types no longer need to be looked for in system documentations. Thanks to the electronic name plate, all this information can now be accessed with just one mouse click to initiate the respective order without delay.

IO-Link follows the plug & play principle. Replaced devices are recognized by the IO-Link Master according to their IODD file and the respective parameters are automatically transferred wthout any actions in the software. Less experienced technicians are enabled to replace components without problems to considerably reduce system downtimes.



Conclusion

The open IO-Link standard establishes continuous communication with sensors and actuators irrespective of the used field bus. Now, even hydraulic proportional valves can be intelligently, easily and cost-effectively integrated in bi-directional digital communication. This simplifies commissioning in hardware and software and enables flexible adjustment of hydraulic valves for varying production processes. Increased requirements for flexible machinery and systems are now complied with. Extended diagnosis information enables condition-oriented and predictive maintenance concepts, and standstill and maintenance times are reduced. This increases the availability of machinery. Additionally, IO-Link enables future-proof integration of hydraulic valves into connected structures as Industry 4.0 components with all their related features.

Do you have technical advice worthy of an article?
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