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## IO-Link Retrofit Delivers Rapid ROI

Smart, networked switching devices improve furnace functionality, saving money for end-users and OEMs

In today's tight economy, manufacturers are seeking every possible way to cut expenses and enhance performance. One original equipment manufacturer (OEM) of industrial heat-treatment equipment used IO-Link-enabled switching devices from Siemens to upgrade three furnaces that it was building for its customer. The result: a significant increase in the equipment's functionality and uptime with no increase to the price.

This OEM has been making heat treatment equipment for more than three decades. They produce furnaces with multiple chambers, each of which is divided into several zones that must be monitored separately. The design requires an approach that makes it easy to track temperatures and quickly make adjustments. The OEM's design team chose to apply IO-Link with the intent of improving performance and reducing wiring overhead so that the change did not adversely affect the overall cost of the machine. According to their electrical engineering manager, the

effort was a success. "We succeeded in doing this almost one hundred percent," he says. "[IO-Link] saves us significant wiring overhead and at the same time enables us to offer our customer valuable diagnostics options in addition to optimized process engineering."

### Cutting hardware costs

As well as huge savings in wiring costs, the redesign also led to a substantial reduction of the number of ammeters in the switchboard doors and current transformers in the cables for each system. Each of the zones in each of the furnace chambers is monitored with the help of the IO-Link-enabled current-monitoring relay from Siemens. The devices are directly plugged into the power contactor from below, saving corresponding space and wiring.

Their previous design used signaling contacts to indicate faults. The current version is based on three-phase current measurement, which offers a great advantage; that each phase failure is detected as soon as it happens. This is

because with the star connection they selected, a phase failure would result in a drastic current increase in the remaining phases. "We now register [phase failures] immediately with the new monitoring relays, and we can influence this right away by controlling current flow," says the engineering manager. The approach delivers other benefits, as well. "It requires fewer openings in the switchboard doors. This means a higher protection class assessment according to the UL criteria."

For best results, the furnaces need to bring the workpieces up to their processing temperature as quickly as possible. For this purpose, the three-phase power contactors are switched via IO-Link capable SIRIUS 3RA27 function modules. Like the other IO-Link-enabled devices, these are connected directly to IO-Link master modules mounted in Simatic ET 200 distributed I/O systems from Siemens. The distributed I/O communicates with the controller via PROFINET.

### Monitoring heat, with redundancy

The furnace system switchboard includes multiple Siemens IO-Link masters, each of which features four channels. Each channel offers up to 2 bytes of input and output data for cyclic data transfer for monitoring the switching and monitoring devices. One group of up to four individual contactors can be connected per channel, and even though four contactors are connected via one IO-Link channel, they can still be switched separately. This works via the corresponding function modules that have been plugged into each starter and which are connected via flat cable. "Here, too, the saved wiring overhead is clearly apparent," notes the engineering manager.

The actual temperature control in the zones is performed by semiconductor relays. These are wear-free and can be precisely regulated via the controller. For accurate measurement and to prevent uncontrolled temperature fluctuations, IO-Link capable SIRIUS 3RS1 temperature-monitoring relays from Siemens monitor each individual chamber in addition to the controller. Once again, IO-Link handles communications between the monitoring relay and the controller. The engineering manager explains, "Thanks to the systematic use of digital measuring devices with IO-Link connection, we create redundancy at important points. This is extremely valuable, both from a process view and from the safety perspective."



Figure 1 The monitoring and control scheme for these heat-treatment furnaces feature multiple IO-Link masters per furnace, located on the ET 200S distributed I/O from Siemens and connected with the controller via PROFINET.



### Keeping it safe

In addition to process safety, personnel safety also plays a leading role in systems with a high installed-power rating. For this reason, the OEM design team lavished as much attention on the safety engineering as on the standard automation. Here, too, a new approach came to the forefront that avoids the disadvantages of previous solutions. In the past, connecting several devices together side-by-side required the use of extra contacts and extra wiring, all requiring more space. The new Sirius 3SK1 safety relay allows each basic unit to host up to five expansion modules, connected via the backplane bus, with input on the left and output on the right. It's an approach that reduces footprint, components, wiring and cost while expanding functionality. As the engineering manager puts it, "This is really practical."

The system monitors the status of the emergency-stop pushbuttons in all parts of the system, as well as the protective doors of the enclosure. In addition, each individual zone door is monitored to determine whether it is open or closed. Another engineering advantage is the ability to adapt the devices individually to each protection situation via DIP switches on the front of the device. Above all, the engineering manager finds that having a choice between direct switching and time delay simplifies the development of custom safety and shut down systems, important for both product differentiation and convenience. "The safety relay is ideally suited to our safety concept," he sums up.



### Improving the process

If sensors and actuators are to be integrated into the control level, communication via IO-Link offers the best solution. For this OEM, the platform upgrade led to significant reductions in wiring, which almost entirely offset the added cost of a more modern solution. This was because it was possible to equip the contactors for the heaters with the relevant IO-Link function modules, and the current monitoring relays also have IO-Link capability. These simply mount to the contactors via connectors from below, saving space and wiring overhead.

The system also includes relays to monitor the temperatures in the furnace zones for safety reasons. The direct IO-Link connection simplified integration into the controller architecture. In addition to the reduction in wiring, the engineering manager sees the detailed diagnostics provided via IO-Link to be a significant technical advance in the manufacture and maintenance of heat-treatment equipment. IO-Link's condition monitoring capability is central to the overall process engineering effort. It lays the foundation for simplified service, as well as condition-related and preventive maintenance.

Overall, the upgrade yielded better-controlled process equipment at nearly the same cost. The additional hardware expense is offset by reductions in wiring and commissioning expenses, and additional cost benefits will result from advanced diagnostics and reduced downtime. The result is a platform that delivers enhanced performance and improved levels of safety in a smaller footprint and for a lower cost. "As a result of the modernization measure with IO-Link devices, we have achieved substantial process improvements for almost identical cost," the engineering manager summarizes.

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