

First EtherCAT application
in Schuler Profiline presses

Ethernet puts on the pressure

→ In a pilot project involving EtherCAT in their new Profiline press generation, Schuler is pioneering the use of an Ethernet-based fieldbus system for the communication between the system periphery and the PC-based control system.





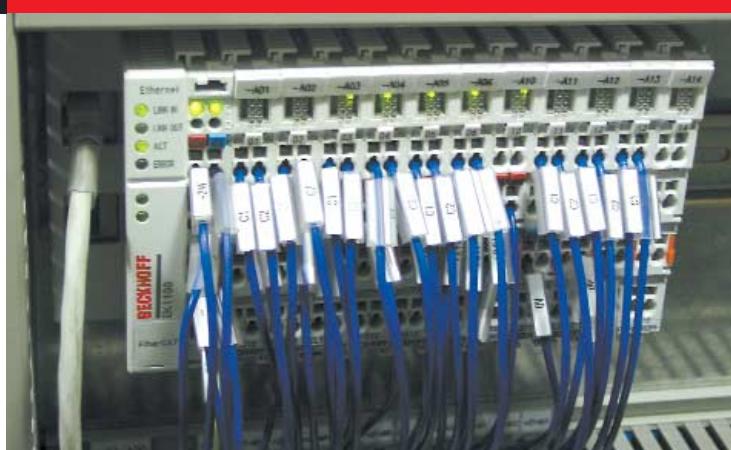
The "fathers" of the new control solution: Clement Peters (left), group representative for the development of control and drive technology at Schuler, and Ralf Sohr, chief designer for electric systems at Schuler Hydrap.

Schuler Hydrap with head office in Plüderhausen, Germany, is part of the Schuler Group and specializes in the Profiline hydraulic press range, which is aimed at users in the electrical and domestic appliances sector and at suppliers for the automotive industry. When the development of a new press generation in the 160 and 1600 ton range became an issue 18 months ago, Schuler decided to revamp their control technology.

Before, Schuler Hydrap had used conventional PLCs, e.g. Simatic S7, and a variety of additional special hardware components for controlling the hydraulic system over Profibus. However, because hydraulic control is one of the core competencies in press construction, manufacturers are quite reluctant to let it out of their control. According to Clement Peters, group representative for control and drive technology development, Schuler was keen to move away from this special solution. "It is no good to us if a manufacturer of a hydraulic control module provides his know-how in a black box to which we have no access."

With the move to high-performance PC-based control technology, Schuler wanted to integrate the hydraulic control directly into the Soft PLC. In other words: The aim was to provide the control know-how in the form of PLC software, in order to be able to influence it directly in future. Another decision criterion was the intention to use a uniform IEC-based control concept that covers all control requirements of the Schuler Group and moreover provides an opportunity to become more platform-independent. Mr. Peters said: "A system with absolute addressing without local data management just doesn't fit the bill."

After a thorough examination of the market, Schuler finally chose the TwinCAT automation software from Beckhoff as their preferred system for the Profiline range. PLC, hydraulic and drive control tasks can thus be realized on one platform. In addition, this solution enables the visualization of all machine and tool parameters to be operated via the Schuler in-house Basic-View system in parallel on the control PC. Ralf Sohr, chief designer for electric systems at Schuler Hydrap, looks back to the early days of the new control solution: "The integration of the hydraulic control technology into the PLC software alone already enabled us to improve our process and therefore to increase the quality of the produced components".



However, the process interface – i.e. the bus system – remained the critical issue. Clement Peters explains why: "Through appropriate NC tasks in the TwinCAT software, we are able to map transfer applications with high quality of motion on the control side, for example, we use cycle times of 1 to 2 ms. The basic prerequisite for being able to use an integrated platform – i.e. TwinCAT – for hydraulic systems is a bus system that meets the requirements of the hydraulic control technology. This means that quick recording, processing and output of analog signals, and also path registration by the system, in significantly less than 1 ms is essential."

Using the previous technology, i.e. conventional PLC plus special hydraulic controller module and Profibus as the bus system, Schuler was unable to achieve cycle times of less than 5 ms for their presses. According to Ralf Sohr, this was due to the relatively high overhead of the communication system. This changed with the move to PC technology, because the PC processors had enough CPU power for achieving the required cycle times. However, according to Ralf Sohr, the solution was not perfect: "As long as Profibus was used as the communication medium, the TwinCAT system only used approximately 10 % of the total cycle time. For the remaining 90 % of the time, the controller had to wait for the operation of the Profibus communications. The reserves of this system were therefore very



Managing Director Hans Beckhoff and Wilfried Jakob, member of the Schuler AG Board of Directors, presented the new PC-based control technology for the 3-axis transfer system from the ProfiLine range at an in-house exhibition in the German Heßdorf in July 2003.

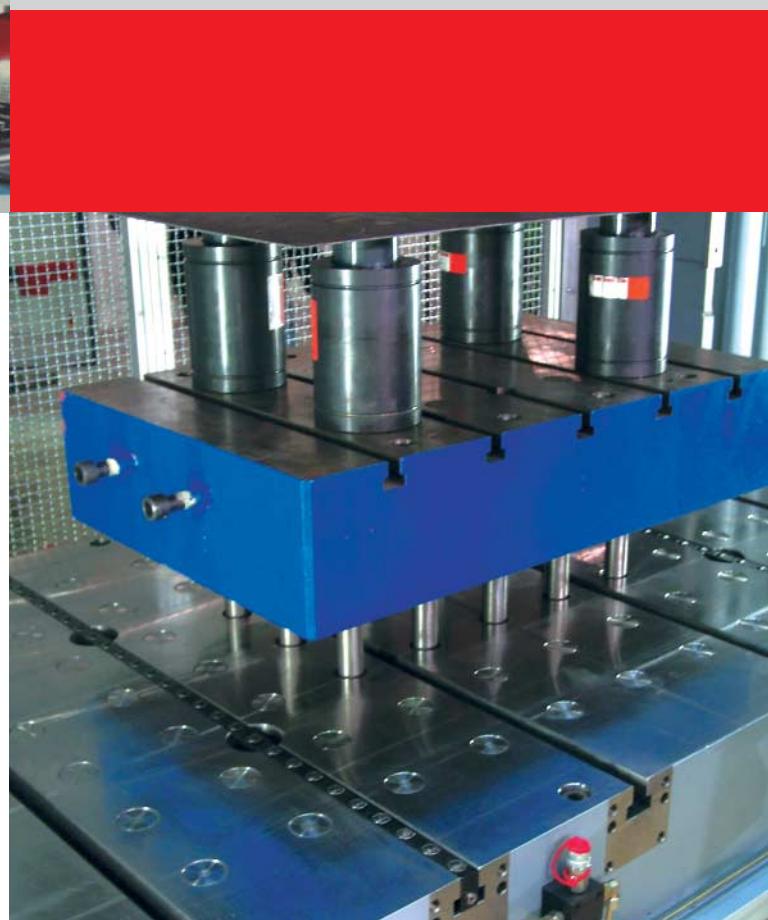
limited, particularly in terms of future developments. With EtherCAT we now have a communication system that opens up the full capacity of TwinCAT, thereby offering new perspectives."

Drastically reduced overhead

The situation changed fundamentally after the 2003 Hanover Fair, where Beckhoff had presented their Ethernet-based EtherCAT concept. Impressed with the options offered by this new bus system, Schuler decided to integrate EtherCAT into the Profiline control concept as part of a pilot project. Ralf Sohr commented: "EtherCAT's speed and its low overhead offer significant speed benefits. This means that this system enables us to realize fast drive and hydraulic controls for all applications currently used in the Schuler Group. Another crucial factor is that, due to EtherCAT's performance, we still have enough potential for solving complex control tasks in future without speed problems."

However, EtherCAT's performance data alone would not have been sufficient to motivate Schuler to make the switch. According to Ralf Sohr, a crucial argument in favor of EtherCAT was "that we can map the components on the machine with the same high granularity we were used to from the existing bus systems." The chief designer commented further: "During the implementation we realized that there is also a cost difference between the Ethernet and the Profibus solution. The list price for a Profibus master card is between 400 and 500 euros. An Ethernet card, on the other hand, is either already installed in the PC or can be bought for between 50 and 60 euros. And in terms of the slave connections, the ratio is approximately 1:3 in favor of the Ethernet solution."

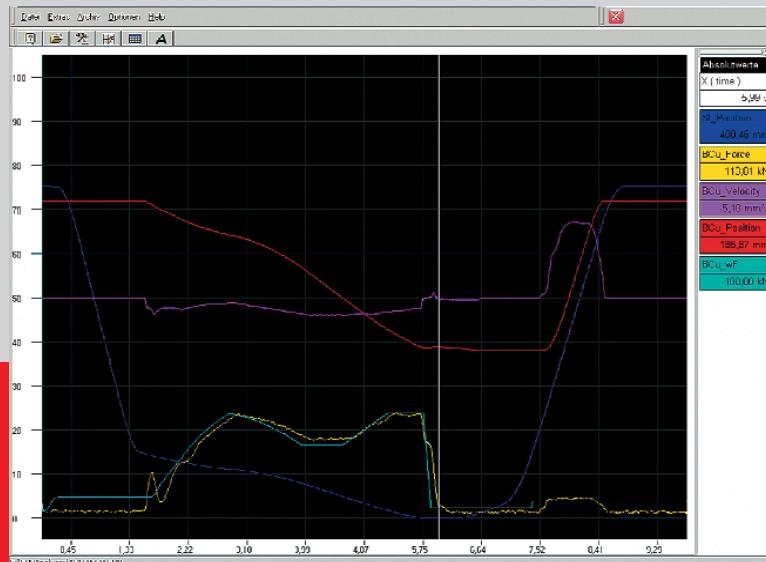
Notwithstanding the technology and cost benefits of EtherCAT, Ralf Sohr sees clear potential for improvement of the Ethernet connection technology. The industrial suitability of an RJ45 plug connector, for example, is still far from comparable with that of a bus system that requires no screen at all and can usually be connected with a simple tool, such as a screwdriver. The manufacturers still have quite a bit of work to do in that respect.



The next steps

While the emphasis for the application of EtherCAT at Schuler is currently clearly on hydraulic applications, Clement Peters is already planning an expansion of Ethernet communication to others areas: "One potential application area is linking of presses. EtherCAT should enable us to specify a central master set-point for a complete system and to use it as a basis for the synchronization of sub-components such as electric transfers, belt feeds or removal and stacking devices. This would mean that we move away from systems that have to wait on each other, thereby also achieving higher plant output."

Because the Profiline control concept currently still requires additional bus systems in addition to EtherCAT, Schuler aims to successively replace these systems with Ethernet. The reason is clear: Irrespective of the different components, different bus systems invariably also mean different project design, configuration and commissioning. However, according to Clement Peters, a basic prerequisite for being able to use Ethernet as the sole communication system for standard control technology is "that our key suppliers are able to supply EtherCAT-capable components". The current situation is that Schuler's drive supplier has not yet

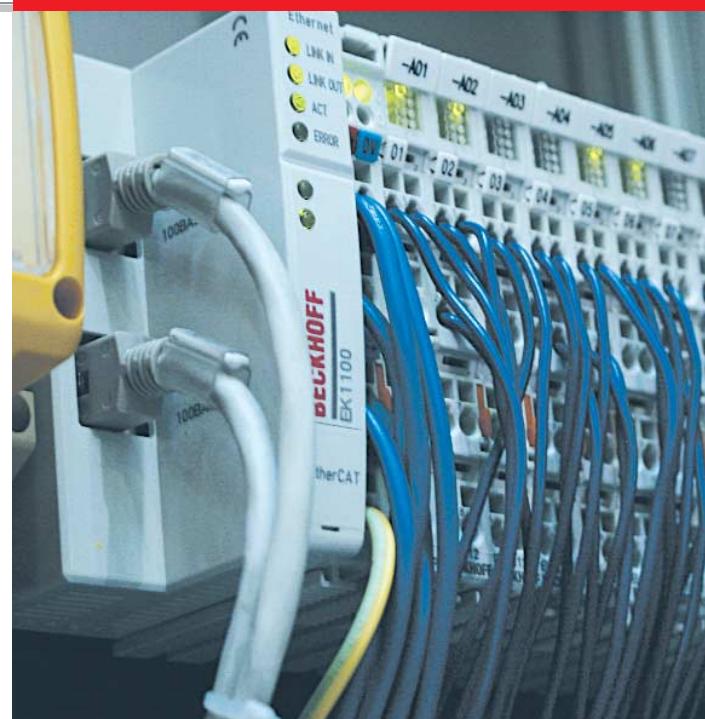


integrated an EtherCAT interface. For this reason, the Sercos interface still forms the connecting link between the axes and TwinCAT. When it comes to coupling the TwinCAT controller with the safety controller of the press, the situation is similar. Here, Profibus is still used as the interface. These shortcomings were one of the reasons why Schuler joined the EtherCAT Technology Group (ETG), which was recently founded by Beckhoff. Mr. Peters said: "Through ETG, we are hoping to achieve a certain announcement effect with our suppliers and motivate them to support EtherCAT."

The aim: Uniform concepts across the group

Support by the component suppliers is only half the story. Another issue is acceptance of Ethernet-based control technology by the customers, i.e. the press users. The control expert from Schuler is optimistic: "Within our Group, the Beckhoff control system is used primarily in the ProfiLine range, i.e. aimed at suppliers. Because we have defined this solution as our standard platform, less customer-specific adaptation is required. For the customers, this has a positive price effect."

However Mr. Peters admits that in the automotive industry, where usually very strict manufacturer specifications and regulations have to be met, the move to new concepts is more difficult. Our automotive range is therefore based on Siemens for the European and Asian markets, and Rockwell for the American market. Nevertheless, according to Mr. Peters, the chances for the new control technology are not bad with automotive customers either: "With TwinCAT in combination with EtherCAT we can show that we are able to produce systems at a higher technological level and, moreover, more cost-effectively compared with conventional control solutions." As a system provider for the metal forming industry, Schuler's clear aim is for the individual companies to operate with standardized control technology. Last year already saw the successful realization of motion control applications, common programming guidelines for the main control platforms, unified components and a common visualization concept, i.e.



Schuler Basic-View. A uniform "look & feel" for machines and systems from the Schuler Group was thus created at the crucial interface with the system operator. In the same way as Schuler-wide function block libraries for PLC and motion control applications are currently continuously being expanded, a control library for hydraulic control technology is in preparation. In practice this means: A bed cushion from Schuler for a mechanical crossbar transfer press will then be based on the same blocks as a hydraulic press at Schuler SMG or Schuler Hydrap.

→ Schuler AG www.schulergroup.com

