

Schuler AG uses PC-based motion control with TwinCAT

Quick axes under pressure

Transfer presses from Schuler are used in the production of ready-to-fit serial parts in the automotive industry, at suppliers for the automotive industry, in the electrical and domestic appliances industry, in equipment manufacturing, and in further specialized industries. Transfer presses are the alternative to individual presses operated in series. Depending on the load distribution and part size, single or multi-slide presses are used. Various transfer systems provide fast and reliable parts transport between the metal forming stations in the transfer presses.

With ProfiLine, Schuler has created a modular concept for press systems and their automation that is tailored to manufacturers from the automotive suppliers sector, who have to respond quickly to orders. ProfiLine offers standardized basic units that can be expanded with optional modules and configured individually.

The standardization of the components reduces the effort for engineering, production, assembly and commissioning and makes the systems available for the customer significantly more quickly. The core of ProfiLine comprises individual presses or press lines (with press forces from 2,000 to 20,000 kN) and transfer presses (with press forces of 2,000 to 20,000 kN). For ProfiLine transfer presses, modular 3-axis transfer systems are used as a link concept.

→ The globally active Schuler AG sees itself as “pacemaker” for metal forming. The new, fast transfer system for modular ProfiLine press systems, which was developed specially for the requirements of the automotive suppliers sector, is based on the TwinCAT PLC and motion control system from Beckhoff.

Schuler AG

As a system partner for the metal processing industry, Schuler offers comprehensive market-oriented solutions and consulting services for a range of sectors, including the automotive and supply industry, the electrical and domestic appliances industry and mint facilities. The Schuler AG offers a powerful combination of state of the art production facilities, efficient tools and comprehensive process know-how. With production locations in Germany, France, Brazil, the USA and the People's Republic of China, Schuler comprises an international production association. Worldwide, around 4,000 employees ensure the success of the Schuler Group.

→ www.schulergroup.com





Clement Peters, control technology group leader at Schuler Automation in Heßdorf and Frank Saueressig, manager of the Beckhoff branch in Balingen (left to right).

Completion and development of a transfer system

Schuler is renowned as manufacturer and supplier of complete metal forming systems of different complexity. Until now, Schuler had used 2- or 3-axis transfer devices from various manufacturers for automating the modular ProfilLine press systems. With the in-house development of a 3-axis transfer system, customers can now obtain all components optimally coordinated from one supplier. "We concentrated this development particularly on the automotive suppliers sector, which requires powerful and cost-effective systems", said Dipl.-Ing. Clement Peters, control technology group leader at Schuler Automation in Heßdorf/Germany and manager of the team responsible for the motion control of the transfer system. A further aim is the integration into the overall automation concept of the Schuler Group. To this end, interdisciplinary consultation and co-operation discussions about the selection and application of hardware and software systems are taking place with the other companies of the Schuler Group, beyond the Heßdorf location. "Important aspects are software standards, engineering, local data management, symbolic addressing and similar aspects", said Peters, noting that Schuler is committed to implementing a unified strategy across the group.

Automation becomes a must

Transfer devices are used for automating the workpiece flow in presses. 3-axis transfer systems are used primarily for mechanical presses with crank or hinged drives and for hydraulic presses. The range of parts to be transported includes chassis parts such as sill covers, exhaust parts, wheel rims, parts for clutches, brakes etc.

Over the last few years, there is an apparent change in the supply industry's transfer devices. Mechanical transfer devices are increasingly being replaced with electrical/NC transfer devices. The benefits are:

- | Short change-over times,
- | High product flexibility through freely programmable axes,
- | High number of strokes through optimized movement processes,
- | Economic production of small batch sizes.

Structured approach to design and production

Apart from the mechanics, a process-oriented control and drive structure is required for ensuring high output and operational reliability. For the team around Mr. Peters, the motion control concept aim is to develop a cost-effective, powerful and modular/hierarchic structure that enables short engineering and commissioning times, simple operation and a fast service for the customer. Customer-specific requirements can be incorporated in the concept without significant additional effort, and existing presses can be upgraded with this transfer device at any time and without excessive expense.

At its Heßdorf location, the control group has been working on the development of a hierarchic and modular software system structure for more than two years. In view of the control platforms to be used, the program structure and the philosophy, significant differences between the systems should be avoided, since the same staff has to operate different control systems. "Compliance with international standards, such as the IEC 61131-3 directive and the specifications of the PLCopen organization, through the control manufacturers is a basic prerequisite for the realization of an object-oriented software structure across the group", commented Peters.

These basic considerations have been accounted for in the development of the transfer application, with the requirements for the motion control concept being defined significantly more widely. An example for in-house co-operation is the development of the motion control library for applications within the Schuler Group. "We can use the same functions in a roller feed device, a blankloader, a modular



TwinCAT NC PTP – point-to-point axis positioning

Schuler decided to use a PC-based motion control concept, i.e. position control of the 3-axis transfer system via a PC solution. This consists of a hardware platform and the TwinCAT NC PTP software control system.

One of the reasons why Schuler decided to use TwinCAT was the embedding of the axis function within the IEC 61131-3 PLC system via function block libraries. Within the TwinCAT NC PTP system structure, axes are structured into channels for PTP motion and interpolating motion. The axes are controlled via variables for encoder, drive and controller. The axis can be linked to I/O interfaces, and parameters can

be set. Positioning is executed with a powerful, modern positioning algorithm, in which profiles are generated with jerk limitation and with pre-control of speed and acceleration to minimize the following error.

The TwinCAT Cam Design Tool is available for the development of electronic cam plates. It is fully integrated into the System Manager. Cam plates represent the relationship between the positions of different axes. The independent axis is referred to as the master axis, while the dependent axis is called slave axis. The position of the slave axis is uniquely functional dependent on the position of the master axis.



transfer device for large body presses or even in a 3-axis transfer system for ProfiLine”, said Peters about the benefits. Schuler Automation decided to use the TwinCAT software systems from Beckhoff as a control platform. “In our experience, TwinCAT is currently one of the most flexible and powerful systems”, said Peters, substantiating the company’s decision. “We see TwinCAT as a continuation of our approach to modular system concepts. Current product developments within the group are undertaken on this basis, and the system has now become the standard for our ProfiLine product sector.”

From selection to co-operation

A company like Schuler is difficult to serve for a control system supplier, since the tasks and requirements are multi-faceted. For this kind of co-operation, Schuler therefore requires a partner with a certain technological and entrepreneurial edge. “In addition to technological aspects, our internal discussions also considered local and global presence”, explained Peters. “This was a significant decision criterion during our selection process. Beckhoff has the width and the potential to meet Schuler’s requirements profile.”

“This is a declared aim of Beckhoff”, underlined Dipl.-Ing. Frank Saueressig, who is responsible for the Schuler Group at Beckhoff. Moreover, for the motion control expert there can be no doubt that the Beckhoff orientation towards widely accepted practices and international standards has had a positive influence. “Unlike some of our competitors, Beckhoff has relied on standards and therefore on mainstreams from a very early stage. We were thus able to save a lot of time and costs in development and market introduction”, said Saueressig, explaining the company philosophy.

For Schuler, an important prerequisite for the application of an automation solution is the availability of adequate performance for motion tasks, due to fast

axis movements. For Saueressig, this is one of the Beckhoff core competencies: “We are not just a software PLC supplier – our origins are in fast axis controls. Beckhoff also serves many more areas of application with high demands on axis performance, such as woodworking, press applications and packaging technology, among others. The Beckhoff forte is quick and precise movement. Real-time capability is therefore an important feature for all Beckhoff products. This applies not only to TwinCAT, but also for IPC systems, fieldbus concepts and bus terminals.”

Connections for the operator

ProfiLine automation solutions include Schuler Basic View, which was developed in-house. This visualization concept emerged in co-operation with the Faculty for Production Automation (PAK) at Kaiserslautern University, which carried out customer surveys and studies on man/machine interaction for Schuler. The result is a user interface tailored to this product sector.

Standard TwinCAT interfaces are used for visualization connections. A cost-effective advantage is therefore the option to run the control and visualization systems on the same PC platform. Peters describes the approach as follows: “This aspect demonstrates the Beckhoff openness. Beckhoff carried out studies to establish to what extent the executability of TwinCAT is ensured, if our preferred visualization system is installed in parallel on the PC platform.”

In this case, the visualization was integrated via TwinCAT OPC. “From the Beckhoff point of view, OPC has proved fully reliable, despite the fact that it is not based on institutionalized standards, but on standardization from within the industry”, said Saueressig. “This shows that product developers (not only Beckhoff) are no longer forced to develop solutions for their own proprietary environment, but are operating OPC-compliant, thus enabling the use of alternatives.



Dr. Pögel, Director of Product Development at Schuler Automation, commented on customer expectations for a press with NC transfer devices and the significance of simulation systems

“Even before they make their investments, customers have very concrete expectations. On the one hand they expect information about the productivity in order to know when the investment will have paid for itself. Other customer requirements are high flexibility, short set-up times, simple operation and high cost effectiveness even for the production of small batch sizes. Simulations carried out in advance can make an important contribution.

Simulations are used for optimizing the movement processes and therefore for determining the number of strokes (output), and they supply the clearance curve which is the basis for tool construction.”

Dr. Pögel commented on the harmonic synergy of the individual components within the overall system:

“It is not the individual components of a transfer system, e.g. a powerful controller, a highly dynamic drive system or sophisticated mechanics, that make for successful and highly productive metal forming systems, but their optimized and harmonic synergy. The associated requirements are high flexibility, short set-up times and economic production, even for small quantities. Such systems are not commissioned by the automotive industry, but by its suppliers, who are subject to very high price pressures. For this clientele the only significant factor is the productivity of their ProfiLine system, because they have to deliver just in time, based on reliable production systems.”

Dr. Pögel said: “While transfer systems are already very reliable, the avoidance of an additional NC axis contributes to increasing operational reliability even further.”

Times have passed in which special drivers had to be developed, which invariably used to raise the question of who would pay for it.”

En route to successful application

Suppliers and users have to co-operate closely whenever new products have to be developed with new control systems. This was also the case during the development of the motion control for the transfer system, as Peters explained: “Apart from meeting the fundamental requirements, Beckhoff has emerged as a very powerful partner for our development activities. Additional requirements were taken on board swiftly and implemented in the TwinCAT system within a short space of time, so that the new functions could immediately be used for our application development.” The additional functionality required by Schuler essentially covered the following areas:

- | Handling of the motion functions, which enable very good connection to the visualization for the graphic representation of the motion functions and effective drive monitoring,
- | Implementation of additional motion rules and functions within the TwinCAT CAM design tool,
- | General functions of the program editors.

According to Peters, the motivation of the team from Heßdorf regarding the functional expansion was not so much the development of Schuler-specific functions. It was more the integration of in-house know-how into a clever and effective engineering approach, rather than the independent extension of the tools used. Schuler Automation's team of six therefore works flat out and confidently on the completion of the development, because the date for the premiere is getting closer and closer.