

PC Control for high-performance punching presses



→ A processing machine is nowadays usually a link in a production chain. Terms like networking capability, data exchange, remote servicing, customized user interfaces, etc., are no longer unfamiliar to the machine maker. They must offer these facilities to their customers. The Swiss company of Bruderer AG have followed this strategy with their high performance punching presses for worldwide use.

At Bruderer, the term "high-performance" refers to a whole range of properties such as speed, precision, long life, reliability, flexibility, easy operation and the possibility of integration. "Fast" nowadays means up to 2000 strokes/min, a number that could rise even further in the future. But fast also means reaching the customer quickly, and providing him with a version of the machine that satisfies his requirements as perfectly as possible. For Bruderer, "precise" means, for instance, that the ram can be maintained by a closed control loop at a prescribed height ($\pm 5 \mu\text{m}$), depending on the mechanical cycle rate (from 100 to

2000 strokes). It is, of course, important to the operator that a constant precision is achieved for the stamped parts over a "long time". One of a number of techniques contributing to this goal is to compensate for alterations in the ram's lower dead point resulting from temperature change without needing to uncouple the machine. This can only be possible with a fast and reliable control system, such as TwinCAT. Also, the Windows NT operating system was chosen to ensure maximum reliability for the controller. The data is transferred at high speed over the Beckhoff Lightbus, therefore protecting it from electromagnetic interference. The measurement of stamping force and tool supervision can also be integrated into the controller.

Hardware PLC development phase bypassed

If the benchmark (theoretical) performance figures just mentioned are to be achieved in practice, it is of course necessary to use a well-developed drive construction, such as offered by Bruderer. Even the cleverest mechanical system, however, will not help very much if the peripheral components such as the sensors, actuators, interfaces, controller, displays, operating elements and software do not live up to the same high standard of performance.

In 1996, the responsible engineers at Bruderer evaluated the next generation of the older, inflexible CNC controllers, and in the process came across Beckhoff's PC-based solutions. "Beckhoff were able to present a convincing concept based on the world's leading standards, those of Microsoft. As system suppliers, they were also able to act as a single source for everything from the I/O components, the Industrial PCs through to the control software" was how Herbert Högger, Software Development Manager at Bruderer, explained his choice of the controller supplier. The PC controller allowed the complex and inflexible "PLC development phase" to be bypassed.

The prototype for the new generation of stamping machines was first presented in 1998. It was greeted with excitement and interest, because the use of a machine controlled by a PC not only improves the ergonomics, is also brings a huge leap forward in both profitability and process reliability.

Fast camshaft controller implemented in TwinCAT

The entire camshaft controller is based on software, and is implemented with the TwinCAT Cam Server. Amongst other features, this includes automatic tracking of the upper dead-point stop angle when stationary, positioning of the flywheel to a precision of 0.1°, a programmable braking angle, and so forth. The camshaft controller for tool supervision includes 32 freely programmable angle-angle or angle-time camshafts, with counting functions from 1 to 65,000. The tool supervision requires 16 cams, and the same number are reserved for internal use by Bruderer. Each cam can be displayed graphically in connection with the tool supervision input. Because the Bruderer cams are not available for external tool supervision, additional inputs, outputs and displays are provided for these signals. If Lightbus is used as the bus system, the TwinCAT CAM Server can achieve a minimum cycle time of 66 µs.

Five parameterizable, eight-digit counters can be used to set conditions such as the following: enable, preselection, forwards/reverse, clearing, calculation, numbers of inputs and cams. A wide variety of counters are integrated into the software, including piece, total and operating hours counters, 3-shift operation or the inspection counter for the tools (re-grinding).

Even this incomplete list indicates the versatile possibilities and the flexibility of the software PLC/NC TwinCAT. The special tasks, displays, intervention facilities and safety functions for any applications can be integrated into the basic software.

Numbered, are the days of the control cabinet and its limited capabilities

Any manufacturer of semi-finished and finished goods is subject to enormous price and time pressure. Efforts are therefore made to keep production times as short as possible, so that capital is not tied up unnecessarily. This has been achieved with the TwinCAT PC control software, a reliable data acquisition system with electronic Bus Terminals, a powerful Industrial PC, and with the full professional support of Beckhoff's Swiss branch and of the company's headquarters in Germany. The synergy of Bruderer's process expertise and Beckhoff's control know-how is what makes a high-performance machine possible.

Bruderer's customers do not just need a fast machine – they are looking for a complete solution for the manufacturing process. This could not and cannot be achieved without early, close co-operation. A "manufacturing island" was developed, one that can be networked, enabling data exchange both with other devices (winding and unwinding drums, further processing, administration and so on) and with a supervisory system, and it even permitted remote servicing and maintenance. These are exactly the requirements that can be ideally satisfied by a PC controller from Beckhoff. And, quite unlike CNC or PLC controllers, a PC controller is always easily expanded. After all, the user can define and customize "his" user interface in a special mask. He can even modify the machine programming to suit himself. For international application, the Bruderer engineers are implementing 2 of 11 languages (constantly being extended), and these can be changed at the press of a button. Setting up the machine requires, of course, a skilled operator, but a specialized programmer is not needed. Once it has been set up; the clear, customer-friendly interface allows operation of the machine to



The B-controller from Bruderer

With this future-oriented controller, Bruderer are ushering in a new epoch for the punching presses controller sector. The hardware and software used are setting new standards. The B-controller offers the operator a clear display on the 12.1" flat screens, and easy operation through operating mode selectors and through soft keys. 500 tool data sets can be stored in the controller, guaranteeing fast, fault-free changeover from one tool to another, because the axes are automatically started up. Refitting time is also reduced, helping to lower costs. A further benefit is the integration of a variety of Bruderer options in the B-controller, such as stamping force measurement, tool supervision, data exchange with peripheral devices and so on.

Bruderer – the world language for top technology in stamping

As far as "top technology in stamping" is concerned, the same language is now spoken on all five of the world's continents. The Bruderer BSTA high-performance punching press has been recognized around the world for its maximum precision, extraordinary performance, unexcelled reliability, and outstanding profitability. The continuously growing demand for Bruderer quality has led to expansion that has nevertheless been appropriate and responsible in the light of the company's size. Subsidiary factories have been founded, and the Far Eastern market covered at an early stage through the issue of licences. Expressing the worldwide Bruderer presence in terms of figures, across Switzerland, Germany, Great Britain, Spain, the USA, Australia, Singapore and Japan there are now 800 employees in the Bruderer group. 34,000 sqm of floor-space in Frasnacht are complemented by 8,800 sqm in the production plant at Huntsville, Alabama.



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be handed over to any employee. TwinCAT also makes it possible for the entire machine to be configured by software, because it contains modular, scalable software program units with open interfaces to programmers, controllers and visualization systems. This means that all the functions associated with the stamping and the material flow are handled.

In addition to operation using the 12.1 inch TFT flat screen, it is also possible to connect an external keyboard, and the operating panel can be located a full 65 m from the machine. The customer has a great deal of freedom to choose the mounting and position of the operating panel, because the unit's dimensions are so convenient.

The operating and programming interface is implemented in Visual Basic 6.0, and is linked to the controller via standard interfaces. Beckhoff's TwinCAT control software includes an IEC 61131-3-Multi-PLC. In this application each has 120 inputs and outputs, and a program size of approximately 120,000 program lines. The C6140 model Industrial PC with a 700 MHz Pentium III processor has allowed a cycle time of 40 ms for the PLC functions and 4 ms for implementation of the axis control.

I/O system for flexible wiring

The demand for wiring flexibly is yet another being made with increasing frequency. The Beckhoff Bus Terminals have the advantage here that the field devices are wired locally, at the machine. The required Bus Terminal is inserted and then a straight forward data exchange is established with the controller. If it is necessary to use a variety of fieldbusses, it is only necessary to insert another Bus Coupler, and the installation is up and running. Therefore, it is not necessary to duplicate various connection techniques, and the wiring becomes clear and comprehensible. All common analog and digital interfaces can be connected to the Bus Terminals.

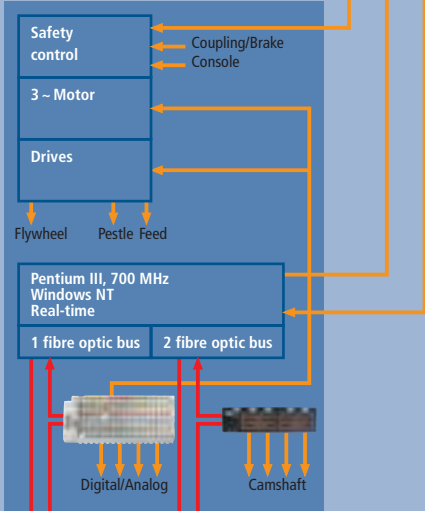
Thanks to the PC control system, Bruderer can offer its customers a much better machine at a price that is acceptable to the market, where success has confirmed this claim. More than 150 punching machines with the "B-controller" have been sold to date, and the forward trend is rising.



Control Panel

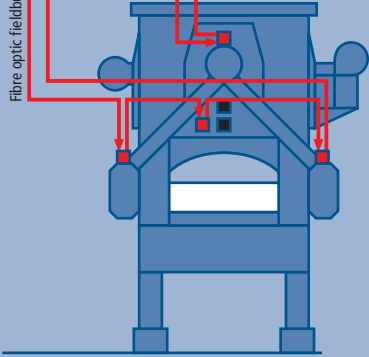


Control cabinet



max. 65 m

BSTA



Fibre optic fieldbus