Multi-functional miniature panel
The new CP6608 Ethernet Control Panel is equipped with a 5.7-inch display and an integrated PC.

Future-proof PC controllers
For their new generation of punching machines Bruderer AG uses advanced PC controllers and XFC technology.

XFC: eXtreme Fast Control Technology
Optimized control and communication architecture for maximum performance with I/O response times of ≤ 100 µs
**eXtreme Fast Control Technology**
– Looking for the problem to the existing solution

If the automation requirements of current production machines are examined, they can be solved in most cases with established control technology. In conjunction with modular fieldbus technology, PC-based systems in particular offer more than enough reserves of power to satisfy the requirements made of them. However, traditional fieldbus technology could not keep pace with increasing CPU power in the past. Therefore, it became increasingly necessary to use several instances of a system or to use different systems that were specialized for respective tasks. That alone was reason enough for the development of EtherCAT, a new high-bandwidth fieldbus suitable for essentially all requirements.

These considerations are now a couple of years old. EtherCAT has been on the market since 2003 and enjoys global distribution — in particular, thanks to the support of the EtherCAT Technology Group (ETG). In developing EtherCAT, great importance was placed on the optimum utilization of the bandwidth available: simple, 2 bit digital terminals should be supported just as well as complex participants requiring acyclic communication in addition to a great deal of process data. Naturally, the participants should be synchronized with one another. After all, Motion Control applications represent a significant proportion of manufacturing automation.

The upshot is that a single EtherCAT bus is entirely sufficient for the automation of the machines. Even in more elaborate plants, considerably less than 10 percent of the bandwidth is exhausted. All EtherCAT participants are synchronized with one another much more precisely than would be required for normal Motion Control applications. Even if one assumes that part of the free bandwidth and accuracy will be consumed in the next few years by the constant progress in automation technology, there will still be enough capacity in reserve for completely new tasks. What, then, are the additional challenges that we can approach with this solution?

For some tasks, higher speed and improved accuracy help in classic control loops — and this is precisely where Beckhoff XFC (eXtreme Fast Control Technology) is applied.

Automation tasks that would otherwise be reserved for expensive special devices can now be accomplished in passing by a ‘normal’ controller. However, there is more to XFC than just a fast fieldbus system. The backbone of XFC is formed by the entire chain of precise I/O components with extremely short conversion times, fast communication via EtherCAT, powerful Industrial PCs and TwinCAT automation software.

Other tasks that go beyond pure automation, such as the monitoring of machines and tools or the documentation of work piece quality, can similarly be assumed by XFC. Techniques such as distributed clocks and oversampling, which combine the accuracy of the system with the available bandwidth, enable sampling rates which were previously only possible with oscilloscopes. The modern TwinCAT PLC, in accordance with IEC 61131, has no problem with the amount of incoming data — high-level language programming, huge data buffers, access to databases and the hardware resources of Industrial PCs make virtually any application possible.

However, there are many more tasks waiting for the appropriate solutions. The great tradition here at Beckhoff is that we, as a developer, also maintain contact to our customers at trade shows, which provides us not only with valuable feedback, but also with the impetus for new concepts and products. It is enjoyable and also makes us a little bit proud when we can present techniques that inspire our customers to ideas and comments such as “With this technique I can solve my … problems very easily” or “I can save … with that!” or even better: “This way, the quality of the parts produced by my machines can be improved without a great deal of additional expense.”

Long-standing automation technology problems can be solved in a simple way today using XFC and EtherCAT. But besides that, there are a great many other technical measurement tasks and industry-, customer- or application-specific tasks. – We would like to inspire you to make use of the new techniques in solving your specific problems. – At the same time, of course, time does not stand still and Beckhoff will continue to develop the most useful products possible.

Dr. Dirk Janssen is Software Development Manager at Beckhoff and was instrumental in the development of EtherCAT and XFC.
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eXtreme Fast Control Technology – The new class of control performance
EMO – World’s foremost trade fair for metalworking

CNC control concept with EtherCAT and XFC

Beckhoff will present a new generation of more powerful and price-optimized CNC systems with PC and EtherCAT-based control technology at the EMO 2007. The EtherCAT real-time Ethernet system enables high speed communication between the PC controller and the digital drives. Additional process optimization is offered by the XFC technology, which allows extremely fast, deterministic reactions. In this way, the user is presented with completely new possibilities to improve the quality of his machine and to shorten reaction times.

The world’s most important metalworking trade fair, the EMO Hanover, takes place from 17th to 22nd September 2007. Manufacturers from all over the world will present a wide range of machine tools and production systems for cutting and forming processes, as well as precision tools and controllers for the entire production technology.

At the EMO 2007, Beckhoff will present its range of products from the fields of IPC, I/O, Motion and Drives. In the field of metalworking, PC-based PLC, Motion Control and CNC solutions are used, for example, in processing centers and lathes, and in sheet metal processing, grinding, sawing and cutting machines.

In principle, the Beckhoff solution comprises:
- a modern Industrial PC as an open control platform,
- software NC/CNC for Motion Control and interpolating path movements,
- an open, flexible and configurable .NET-based HMI solution,
- EtherCAT as a fast communication medium for I/Os and drives,
- EtherCAT I/Os for high precision control of actuators and fast sensor signal recording, to integrated measurement technology and condition monitoring,
- EtherCAT Servo Drives from the AX5000 series with a corresponding range of motors.

A new generation of Industrial PCs is available for the EtherCAT-based control concept. Instead of additional, expensive fieldbus cards, these IPCs contain two Ethernet interfaces for automation and IT applications. While the 100 Mbit Ethernet port offers optimum performance for all EtherCAT control tasks, a Gigabit port is available for connecting the higher-level network.

The C69xx control cabinet PC series offers a slimline, modern controller platform. The Industrial PCs in robust, ultra-compact aluminum housings are equipped with the latest generation of processors and are optionally available without cooling fans or mechanically moved parts.

Software replaces hardware-oriented controller systems

Besides high-end PCs, the Beckhoff scalable control system with Embedded PCs also offers powerful solutions in the lower price range. One example of this is the combination of a CX1020, Windows CE-based operating system and TwinCAT NC I for interpolating path movements in up to 3 axes. The DIN rail mountable Embedded PCs additionally offer the advantage that the Beckhoff Bus Terminals and EtherCAT Terminals can be mounted directly side by side.

On the software side, Beckhoff offers two solutions for interpolating path movements in the TwinCAT NC I and TwinCAT CNC: TwinCAT NC I is the modular CNC solution for up to 31 channels, each with up to three main and five auxiliary axes. TwinCAT CNC is the classic, powerful CNC application for up to 64 path axes/spindles in up to twelve channels. In addition, this package offers spline and transformation functionality (5-axis functionality) as an option. The basis of both CNC systems is the fast TwinCAT PLC system.

Optimized control and communication architecture

Beckhoff will present an innovation for the metalworking industry at the EMO in XFC technology (eXtreme Fast Control Technology), an extremely fast control solution. XFC is based on an optimized control and communication architecture comprising an advanced Industrial PC, ultra-fast I/O terminals, the EtherCAT high-speed Ethernet system, and the TwinCAT automation software. In addition to optimized cycle time, XFC also offers improved temporal accuracy and enhanced resolution. In this way, the user is presented with completely new possibilities to improve the quality of his machine and to shorten reaction times. Measuring tasks or documentation of parts quality can simply be integrated in the machine control without additional, costly special devices. In the field of machine tools, XFC technology offers the widest variety of applications for process optimization, such as:
- oversampling for structure-borne sound analysis for integrated tool monitoring
- high precision recording of measuring probes
- high mutual synchronicity of axes (important for the precision of interpolating movements)

The main information at a glance:
- EMO Hanover 2007, Germany
- September 17 – 22, 2007
- Opening hours: Monday–Saturday, 9 am – 6 pm
- Beckhoff: Hall 25, Booth G33

www.emo-hannover.com
www.beckhoff.com/EMO2007
Beckhoff at K 2007 in Düsseldorf, Germany

PC Control for plastics injection molding, blow molding and extrusion machines

Beckhoff exhibits its automation and industry solutions for the plastics manufacturing industry at K 2007 for the first time. The K show is the largest trade fair in the world for the plastics and rubber industry and takes place in Düsseldorf, Germany, every three years. More than 2,900 exhibitors from 57 countries will be presenting their latest developments for the plastics industry at the top trade fair. The main focus of the exhibition is on mechanical and plant engineering, for which Beckhoff offers a universal and innovative control technology.

Universal system solutions for plastics machines
Beckhoff has been established in the plastics industry as a supplier of automation solutions and control components for many years. Being a pioneer in the area of open PC-based automation technology, Beckhoff has anticipated the current trend towards open control architectures in plastics engineering. Due to many years of experience and the implementation of different applications in the field of plastics machines, Beckhoff is very familiar with the specific requirements of the industry. Knowledge of the industry is integrated in various software application modules, e.g. for Motion Control, temperature control and sequencing. In addition to standard solutions, Beckhoff also provides support for customized application developments. The customer therefore has access to the broad experience of Beckhoff in the field of electrical and hydraulic control technology and can incorporate his own knowledge without difficulty.

Open automation technology from IPC to drives
The Beckhoff open automation technology consists of a comprehensive portfolio of innovative products. The compact top performance PCs, the wide range of electronic I/O terminals, the high-speed fieldbus EtherCAT, the TwinCAT automation software and the Drive Technology are highly suited for application engineering in plastics applications. The Beckhoff software framework for plastic machinery provides a universal Motion Control solution for fully electronic, hydraulic and hybrid Motion Control concepts. The standard unified control architecture for every drive version minimizes engineering costs and contributes to efficiency.

The Beckhoff safety technology TwinSAFE enables the combination of safety related inputs and integrated drive safety functions according to safety category 3. This technology gives the mechanical engineer flexibility and reduces the costs for engineering and electrical equipment at the same time. In addition, the global presence of Beckhoff enables it to provide optimal worldwide support and service for its customers’ expansion into future markets.

XFC – Highest precision for plastics processing
High process stability and productivity require a maximum system performance, especially for electrically driven machines: Demands for rapid reaction times with deterministic system response and high sampling rates are adequately fulfilled with XFC (eXtreme Fast Control Technology) down to the nano second range. XFC is based on an optimized control and communication architecture comprising an advanced Industrial PC, ultra-fast I/O terminals with extended real-time characteristics, the EtherCAT high-speed Ethernet fieldbus and the TwinCAT automation software.

Customized solutions for the industry
Beckhoff presents its solution for the PC-based control technology at K 2007 in Düsseldorf, Germany: The main focus is on EtherCAT-based automation, XFC and the Beckhoff Drive Technology. In addition, examples of customized Control Panels give an overview of Beckhoff’s scaleable PC hardware.

The main information at a glance:
- K 2007 (plastics and rubber), Düsseldorf, Germany
- October 24–31, 2007
- Opening hours: Wednesday–Wednesday, 10 am – 6.30 pm
- Beckhoff: Hall 11, Booth G21

www.k-online.de
Sales increase through strengthening of distribution network and new technologies

The Beckhoff strategy of "openness for new markets and new technologies" has once again led to strong growth rates of 26 % over the past financial year. During 2006, worldwide turnover of Beckhoff Automation was 190 million euros. The basis for the continuing success is continuous realization of innovative products and introduction of new product ranges and basic technologies, combined with consistent expansion of the international distribution network.

In 2006, Beckhoff Automation GmbH established five new subsidiaries in Spain, Belgium, Brazil, South Africa and Australia. "We were already represented through distributors in these countries", said managing director Hans Beckhoff, "but we intend to expand our position in these markets." The sales increases confirm the success of this strategy: Exports made up 43 % of the total turnover in 2006. "While currently our growth is achieved roughly equally in Germany and in export markets, our medium- and long-term growth prospects are more global", said Hans Beckhoff.

Overall, Beckhoff is now represented in more than 60 countries worldwide through now 20 subsidiaries, agencies or distribution partners.

"In 2007, we have further continued to intensify the expansion of our global distribution network. In addition to the new subsidiaries in India and the United Arab Emirates, a branch office in Turkey is in a start-up phase", said Hans Beckhoff. The number of Beckhoff Automation employees has also grown: At the end of 2006, Beckhoff had 800 employees worldwide, an increase of 20 % compared with the previous year.

Hans Beckhoff is pleased with the business development over recent years: "With annual growth rates of 26 % (2006), 17 % (2005), 31 % (2004) and 27 % (2003), our company continues to be on a very good course."

This is based on worldwide growth in the automation market, especially above-average development in Beckhoff’s specialist areas of PC Control, distributed I/O, software PLC/NC and Drive Technology.

"In 2006, we set further performance and price milestones with the introduction of EtherCAT Terminals, the TwinSAFE safety solution, the new AX5000 drive range and the new compact IPCs", said Hans Beckhoff. In 2007, continuous development of new products and technologies will again form one of the columns of the sales development. At this year’s Hanover Fair the focus was on the innovative XFC technology.

In July 2006, in order to strengthen the position as technology leader, Beckhoff took over Embedded Logic Design & More GmbH and BeDeHa GmbH. Both specialist companies for customized motherboards and BIOS software are based in Münster, Germany.

"We bought technology for an emerging market, thereby strengthening our own development capacities", said Hans Beckhoff.

Hans Beckhoff is optimistic about the future: "The positive development of previous years continued during the first and second quarter of 2007. Provided the main parameters remain stable, I am confident that the positive economic situation will continue".
On 21st June 2007 a QS welding workshop took place at Harms & Wende Schweißtechnik in Hamburg, Germany, which was very well attended by automotive manufacturers and suppliers. At the workshop, the new modular and flexible monitoring system from the PQS family was presented, which includes the components 'Quadrigo', 'Quadrigo Master' and 'QuadrigoVisu'. Beckhoff supplied the latest Industrial PC technology for the monitoring construction kit with a customer-specific version: control cabinet PCs from the C69xx series and the new CP72xx Panel PC.

The name Harms & Wende Schweißtechnik has been synonymous with welding equipment for over 60 years in Europe. The company offers a dynamic system for every welding task, such as resistance, friction and friction spot welding. HWH Qualitätssicherungs-Technologie GmbH is a 100 % subsidiary of Harms & Wende, which specializes in the economic and reliable assurance of the process and product quality of welding methods and joining technologies such as arc welding, stud welding or clinching.

The Quadrigo Master is based on a C69xx-series IPC, which is tasked with inputting all relevant welding process data from the connected Quadrigo measurement module to a MySQL database. That portion runs as a background client.

The Quadrigo Visu modules are responsible for the rapid and reliable operation and visualization of the entire system. These also include adapted functional and informational tools for unclear or complex production plants – not all functions should or may be possible everywhere, all the time. Despite that, information must be made available, quickly and securely. The CP72xx Panel PC, also in a customer-specific version, is used for this purpose.

The Quadrigo PC components were completely developed to series production maturity, from design phase to printed catalog item, in just three months. The majority of customer-specific requirements are effectively covered by just three versions. The large degree of acceptance on the part of participants rounded off the successful presentation of Quadrigo monitoring technology at the QS workshop.

Sample configuration using 16 welding robots with 16 measuring points:
- one Quadrigo Master, database server
- three Quadrigo Visu CP7202, 15-inch touch panel
- one Quadrigo Visu Plus CP7203, 19-inch operating panel

Harms & Wende GmbH & Co KG www.harms-wende.de
HWH Qualitätssicherungstechnologie GmbH www.hwh-qst.de
The readers of the North American edition of Control Engineering magazine nominated three Beckhoff products for the annual ‘Engineers’ Choice Awards’. In the 2006 competition for industrial products, Beckhoff won awards in three different categories. More than 700 Control Engineering readers voted online in various product categories. The industrial products were assessed with regard to innovation, usefulness and market relevance. Announced in April 2007, the winners were the C69xx Industrial PC, the CX1020 Embedded PC and the BK9105 EtherNet/IP Bus Coupler.

“I am both honored and delighted that the Control Engineering readers have recognized so many Beckhoff products as innovative and significant to their branch of industry,” said Graham Harris, President of Beckhoff North America.

The ‘Engineers’ Choice Awards’ for Beckhoff Technology (from left to right): C69xx Industrial PC (‘Industrial PCs’ category), CX1020 Embedded PC (‘Controllers’ category) and the BK9105 EtherNet/IP Bus Coupler (‘I/O products’ category).

SkillsGermany is an initiative intended to foster national and international vocational competitions. The winner of the national competition qualifies to take part in the EuroSkills European Vocational Championship and, if successful there, to enter in the WorldSkills World Vocational Championship. The objective of this international competition is to be able to compare the vocational qualifications of apprentices from all over the world.

In Germany, the vocational competition was integrated in the Hanover Exhibition Centre’s TectoYou initiative and the project “Germany - land of ideas”. TectoYou’s objective is to inspire young people to take up technical professions and to bring to life the attractive fields of activity and occupational images. At present, Beckhoff Automation has 56 apprentices of a total of 860 employees.
As a pioneer in PC-based control technology, Beckhoff has many years of experience in the development of industrial motherboards. Thanks to the company’s in-house development of motherboards and also BIOS, Beckhoff can react very quickly to new technologies in the PC market. The results of this consistent in-house development are high-quality and innovative technical solutions, in which the new CB4051 PCI-104 motherboard in single board design now takes its place.

The main features of the new Industrial Motherboard are a powerful chipset with modern Intel® processors, large RAM and numerous high-speed interfaces. The CB4051 is equipped with the Intel® 945GM(E) chipset and can be built with current Intel® processors from the Celeron® M, Core™ Duo and Core™ 2 Duo series. These are specified for operation at enclosure temperatures of between 0 and 85 °C (32 °F and 185 °F), ensuring the greatest possible safety even in harsh environments. The processors have a second-level cache of up to 4 Mbyte currently. SoDIMM200 RAM modules (DDR2-667), as commonly used in notebooks, are installed on the CB4051 PCI-104 board. A memory extension up to 2 Gbyte is possible using currently available SoDIMM modules.

Thanks to its numerous interfaces, the CB4051 Industrial Motherboard is prepared for a large number of applications. It has two Ethernet ports (one of which is a gigabit port) and eight fast USB 2.0 interfaces. In addition, the CB4051 is equipped with two serial interfaces, COM1 and COM2, an IDE interface, two SATA connections with a data transfer rate of up to 3 Gbit per second, a PS2 interface for keyboard and mouse and an LPT interface. Sound input and output as well as CRT and TFT connectors are similarly provided.

The PCI bus is made available in the form of a PC/104-Plus socket for expansion cards such as SCSI, IEEE1394, etc. A maximum of four PCI slots can be controlled. Although the relevant sections of the PCI-104 standard have not yet been approved, the CB4051 already provides the user with the opportunity to use a PCI-Express interface in an Industrial Motherboard. For this purpose, the CB4051 can optionally be fitted with a PCIe socket, through which three PCIe lanes can be fed.

At just 96 x 90 (115) mm, the dimensions of the CB4051 motherboard are very compact. Compliance with the PC/104 form factor enables variable expansion using additional plug-in modules. This makes the CB4051 a universally usable, extremely powerful computing unit in the embedded sector. In addition to general industrial applications, the board is also suitable for applications requiring greater CPU power such as image processing or the fast processing of measured data. Thanks to the presence of the Ethernet ports, the CB4051 is also innately suited for use in ultra high performance EtherCAT-based applications.
Ultra compact Ethernet Control Panel with 5.7-inch display

The new CP6608 “Economy” Control Panel takes its place in the CP66xx series of Ethernet panels as yet another inexpensive display alternative. With its ultra compact 5.7-inch display, which can be optionally equipped with a touch screen, the CP6608 extends the existing CP66xx series. The user can now choose from “Economy” Ethernet Panels with 5.7-, 6.5-, 12-, 15- and 19-inch display size versions. A newly developed Beckhoff Motherboard forms the core of the CP6608. The “Economy” panels from the CP66xx series are based on the design of the previous Ethernet Control Panels from the CP67xx series and are equipped with an Intel® IXP420 processor with XScale® technology and 266 MHz. The CP6608 has 32 Mbyte on-board flash and 128 Mbyte on-board RAM included as standard. The panel’s features are completed by the SM501 on-board graphic adapter. The CP6608 has the following series-standard external interfaces: two Ethernet ports with 10/100BASE-T, two fast USB 2.0 connectors and a serial RS232 connector. This means that the CP6608 can be put to outstanding use in many in-
Small controller with touch screen

The new CP6608 Ethernet Panel is optionally available with an interface package which is specially trimmed to the requirements of building automation. In this way, the CP6608 can become the central control and operating unit of a building. The building automation kit for the panel contains the following additional interfaces:

| 2 digital inputs and outputs |
| 1 microphone input |
| 1 stereo out |
| 1 freely assignable interface (e.g. for PT100 temperature sensor or I²C interface) |

The additional connections are attached to the device via a 16-pin plug. The two standard Ethernet ports and two USB 2.0 connectors are also included in the building automation version.

The optionally available Mini PCI cards with NOVRAM memory for fail-safe data storage are a useful supplement, particularly for building automation applications. In this version, important basic settings such as the control of lights, blinds and building access can be stored permanently in the CP6608.

Individual front versions

Besides the standard color, the front laminate of the new CP6608 “Economy” Control Panel can be supplied in all standard RAL colors. In this way, it is possible to supply the Ethernet Panel with a white front laminate in order for it to blend harmoniously into a white wall, for example, to be used as a control and operating unit for building automation. The elegant, narrow aluminum frame ensures a stylish, high quality appearance. Further laminate patterns are available for particular tastes. The CP6608 Ethernet Panels can even be given a wood grain or marble look.

Due to its intelligently designed features, the CP6608 is suited to a great number of possible applications. The integrated PC, the numerous interfaces and the typical high quality Beckhoff workmanship, coupled with the long-term availability of all components, make the CP6608 an attractive alternative for machine and plant construction. At the same time, the Ethernet Panel is well suited for use as a building or room controller in industrial buildings and hotels. The CP6608 can also be used in residential and commercial buildings due to its abundance of standard interfaces, which are well-suited to building automation.

In addition, the numerous options for individualizing the front panel can help blend with almost any building environment.
XFC – eXtreme Fast Control Technology

XFC represents a control technology that enables very fast and highly deterministic responses. It includes all hardware and software components involved in control applications: optimized input and output components that can detect signals with high accuracy or initiate tasks; EtherCAT as very fast communication network; high-performance Industrial PCs; and TwinCAT, the automation software that links all system components. Not long ago, control cycle times around 10–20 ms were normal. The communications interface was free-running, with corresponding inaccuracy of the determinism associated with responses to process signals.

The increased availability of high-performance Industrial PC controllers enabled a reduction in cycle times down to 1–2 ms, i.e. by about a factor of 10. Many special control loops could...
The I/O response time includes all hardware processing times (IPC, EtherCAT and I/O system), ranging from physical input event to output response. With an I/O response time of < 100 µs, PLC programmers have access to performance that in the past was only available in servo controllers with digital signal processors.

### XFC performance data

<table>
<thead>
<tr>
<th>Extreme short control cycle time</th>
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<tbody>
<tr>
<td>100 µs (min. 50 µs)</td>
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<tr>
<td>new performance class for PLC application: control loops with 100 µs</td>
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<table>
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<tr>
<th>Extreme fast I/O response time</th>
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<tbody>
<tr>
<td>85 µs (min. – 50 µs)</td>
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<tr>
<td>Deterministic synchronized input and output signal conversion leads to low process timing jitter.</td>
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<tr>
<td>Process timing jitter is independent of communication and CPU jitter.</td>
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<th>Signal oversampling</th>
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<tr>
<td>multiple signal conversion in one control cycle</td>
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<tr>
<td>hard time synchronization through distributed clocks</td>
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<tr>
<td>for digital input/output signals</td>
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<tr>
<td>for analog input/output signals</td>
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<tr>
<td>support of analog I/O EtherCAT Terminals</td>
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<tr>
<td>– up to 200 kHz signal conversion</td>
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<tr>
<td>– down to 5 µs resolution</td>
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<tr>
<td>application</td>
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<tr>
<td>– fast signal monitoring</td>
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<tr>
<td>– fast function generator output</td>
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<tr>
<td>– signal sampling independent of cycle time</td>
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<tr>
<td>– fast loop control</td>
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<tr>
<th>Signal time stamping (10 ns resolution)</th>
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<tbody>
<tr>
<td>extreme time measurement for digital single shot events: resolution: 10 ns, accuracy: &lt; 100 ns</td>
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<tr>
<td>exact time measurement of rising or falling edges of distributed digital inputs</td>
</tr>
<tr>
<td>– exact timing of distributed output signals, independent of control cycle</td>
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<tr>
<td>– time stamping data: resolution 10 ns, accuracy &lt; 100 ns</td>
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<tr>
<th>Distributed-Clocks</th>
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<tr>
<td>distributed absolute system synchronization for CPU, I/O and drive devices</td>
</tr>
<tr>
<td>resolution: 10 ns</td>
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<tr>
<td>accuracy: &lt; 100 ns</td>
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XFC technologies

Distributed clocks – Shifting accuracy to the I/O level
In a normal, discrete control loop, actual value acquisition occurs at a certain time (input component), the result is transferred to the control system (communication component), the response is calculated (control component), the result is communicated to the set value output module (output component) and issued to the process (controlled system).

The crucial factors for the control process are: minimum response time, deterministic actual value acquisition (i.e. exact temporal calculation must be possible), and corresponding deterministic set value output. At what point in time the communication and calculation occurs in the meantime is irrelevant, as long as the results are available in the output unit in time for the next output, i.e. temporal precision is required in the I/O components, but not in the communication or the calculation unit.

The distributed EtherCAT clocks therefore represent a basic XFC technology and are a general component of EtherCAT communication. All EtherCAT devices have their own local clocks, which are automatically and continuously synchronized with all other clocks via the EtherCAT communication. Different communication run-times are compensated, so that the maximum deviation between all clocks is generally less than 100 nanoseconds. The current time of the distributed clocks is therefore also referred to as system time, because it is always available across the whole system.

Time stamp data types
Process data is usually transferred in its respective data format (e.g. one bit for a digital value or one word for an analog value). The temporal relevance of the process record is therefore inherent in the communication cycle during which the record is transferred. However, this also means that the temporal resolution and accuracy is limited to the communication cycle.

Time stamped data types contain a time stamp in addition to their user data. This time stamp – naturally expressed in the ubiquitous system time – enables provision of temporal information with significantly higher precision for the process record. Time stamps can be used for inputs (e.g. to identify the time of an event occurred) and outputs (e.g. timing of a response).

Oversampling data types
Process data is usually transferred exactly once per communication cycle. Conversely, the temporal resolution of a process record directly depends on the communication cycle time. Higher temporal resolution is only possible through a reduction in cycle time – with associated practical limits.

Oversampling data types enable multiple sampling of a process record within a communication cycle and subsequent (inputs) or prior (outputs) transfer of all data contained in an array. The oversampling factor describes the number of samples within a communication cycle and is therefore a multiple of one. Sampling rates of 200 kHz can easily be achieved, even with moderate communication cycle times. Triggering of the sampling within the I/O components is controlled by the local clock (or the global system time), which enables associated temporal relationships between distributed signals across the whole network.

Very short cycle times – Optimized I/O communication
Very fast physical responses require suitably short control cycle times in the associated control system. A response can only take place once the control system has detected and processed an event.

The traditional approach for achieving cycle times in the 100 μs range relies on special separate controllers with their own, directly controlled I/Os. This approach has clear disadvantages, because the separate controller has only very limited information about the overall system and therefore cannot make higher-level decisions. Reparameterization options (e.g. for new workpieces) are also limited. Another significant disadvantage is the fixed I/O configuration, which generally cannot be expanded.
**XFC components**

Implementation of the XFC technologies described above requires full support for all hardware and software components involved in the control system, including fast, deterministic communication and I/O and control hardware. A significant part of XFC are the software components responsible for fast processing of the control algorithms and optimized configuration of the overall system.

Beckhoff offers a special XFC product range based primarily on four categories: EtherCAT as fieldbus, EtherCAT Terminals as I/O system, IPCs as hardware platform, and TwinCAT as higher-level software. All components are based on open standards, which means that any engineer or programmer can develop very fast control solutions with high performance based on standard components (i.e. without special hardware).

**I/O component – EtherCAT Terminals with XFC technology**

Standard EtherCAT Terminals already offer full support for XFC technology. Synchronization of the I/O conversion with the communication or – more precisely – with the distributed clocks is already standard in EtherCAT and is therefore supported by all terminals. Newly developed XFC terminals offer additional special features that make them particularly suitable for fast or high-precision applications:

- digital EtherCAT Terminals with very short Ton/Toff times, or analog terminals with particularly short conversion times
- EtherCAT Terminals with time stamp latching at the exact system time at which digital or analog events occur. Output of digital or analog values can occur at exactly predefined times.
- Terminals with oversampling enable actual value acquisition or set value output with significantly higher resolution than the communication cycle time.
Communication component – EtherCAT fully utilized

With high communication speed and usable data rates EtherCAT offers the basic prerequisites for XFC. However, speed is not everything. The option of using the bus to exchange several independent process images arranged according to the control application enables parallel application of XFC and standard control technology. The central control system is relieved of time-consuming copying and mapping tasks and can fully utilize the available computing power for the control algorithms.

The distributed EtherCAT clocks that form the temporal backbone of the XFC technologies are available in all communication devices without significant additional effort. The crucial point of XFC is the option of integrating all I/O components directly in the EtherCAT communication, so that no subordinate communication systems (sub bus) are required. In many XFC terminals the AD or DA converter is connected directly to the EtherCAT chip, so that delays are avoided.

Control component – High-performance Industrial PCs

Central control technology can be particularly advantageous if it can run faster and more powerful control algorithms than would be the case with many distributed small controllers. Modern Industrial PCs offer significantly more processing power and memory at lower cost than the sum of a large number of small controllers.

The latest general PC technology innovations can also be used to good effect for control technology. Fast dual core processors are ideal for running the operator interface of the machine in parallel with the control tasks. Large caches available with modern CPUs are ideal for XFC technology, because fast algorithms run in the cache and can therefore be processed even faster.

An important factor for short XFC cycle times is the fact that the CPU is not burdened with complex process data copying tasks needed by traditional fieldbuses with their DPRAM-based central boards. EtherCAT process data communication can be handled entirely by the integrated Ethernet controller (NIC with bus master DMA).

XFC EtherCAT Terminals

The EtherCAT I/O system provides a wide range with different signal terminals. Standard EtherCAT Terminals already offer full support for XFC technology. Synchronization of the I/O conversion with the communication or – more precisely – with the distributed clocks is already standard in EtherCAT and is therefore supported by all terminals. Further developed XFC terminals offer additional special features that make them particularly suitable for fast or high-precision applications.

With the digital EL2262 oversampling output terminal, outputs can be switched on and off within a 10 µs time frame, which is ideal for high-precision dosing applications, for example.

The digital EL1262 oversampling input terminal offers an input signal sampling rate that is better than the bus cycle time by a factor of 10 (configurable), enabling even short signals to be recorded, measured or counted exactly.

With the EL1202 and EL2202 XFC terminals, delays in the terminal hardware are reduced down to < 1 µs and therefore become negligible. Input and output data are forwarded with maximum speed.

Synchronized responses can be realized with time stamp input and output terminals; in the past, precision of < 1 µs was impossible with bus systems. The new XFC technology replaces hardware wiring.
Software component – TwinCAT automation suite

TwinCAT as high-performance automation suite fully supports the XFC technologies while retaining all the familiar features. The real-time implementation of TwinCAT supports different tasks with different cycle times. Modern Industrial PCs can achieve cycle times of 100 µs or less without problem. Several (different) fieldbuses can be mixed. The associated allocations and communication cycles are optimized according to the fieldbus capabilities. The EtherCAT implementation in TwinCAT makes full use of the communication system and enables application of several independent time levels. It uses distributed clocks. Different time levels enable coexistence of XFC and normal control tasks in the same system, without the XFC requirements becoming a “bottleneck”.

A new option specially designed for XFC enables inputs to be read during independent communication calls and outputs to be sent directly after the calculation. Due to the speed offered by EtherCAT the inputs are read “just” before the start of the control tasks, followed by immediate distribution of the outputs. The resulting response times are faster than the fieldbus cycle time in some cases. Special TwinCAT extensions facilitate handling of the new XFC data types (time stamp and oversampling). PLC blocks enable simple analysis and calculation of the time stamps. The TwinCAT scope can display the data picked up via oversampling according to the allocated oversampling factor and enables precise data analyses.

www.beckhoff.com/XFC

XFC verified!

The oscilloscope recording shows application results for different digital XFC terminals. The control and communication cycle time is 100 µs. Inputs and outputs are exchanged in separate EtherCAT telegrams in order to minimize the response time. (The horizontal scaling of the oscilloscope recording is 100 µs.)

An external, unsynchronized input signal is acquired via a digital input terminal with time stamp (EL1252, yellow curve). The oscilloscope is set to trigger based on this input signal. The recording is therefore synchronous with the external event, but asynchronous with the control cycle. Several recordings are superimposed.

A fast, digital output terminal (EL2202, red curve) is instructed by the control system to respond to the recorded input signal as quickly as possible. In the fastest case a control response is available at the output after approx. 85 µs. Since the input signal is unsynchronized, in the worst case an edge can be recorded with a delay of one cycle time, i.e. if the event occurs right after the cycle and is therefore not transferred until the next cycle. As a result, the output signal appears to jitter within a range of one cycle time, i.e. between 85 µs and 185 µs.

Since the input event is recorded with time stamp, the control system can issue an output response with a constant time offset, independent of the communication cycle. To this end, the PLC for a digital output terminal with time stamp (EL2252, blue curve) is associated with an output response that is offset by 200 µs. Despite the unsynchronized control cycle, the response can thus be exactly deterministic. In addition, the oscilloscope is set to measure and analyze the temporal difference between the input signal and the response of the EL2252 over several cycles (in this example 40 cycles). The result is a minimum value of 200.254 µs and a maximum value of 200.349 µs, i.e. the difference between minimum and maximum value is less than 100 ns. The fact that 200 µs is not adhered to exactly is due to the (small, but nevertheless present) TON and TOFF times of the terminals, although these are constant and can therefore be accounted for. The green curve shows a digital output terminal with oversampling (EL2262). With an oversampling factor set to 10 and with a cycle time of 100 µs, output states can be issued every 10 µs. To illustrate this, in response to the input signal the PLC issued two pulses via the terminal, i.e. a short pulse followed by a slightly longer one. Here, too, a supposed jitter can be seen, although it is significantly lower (10 µs instead of 100 µs) – again caused by the unsynchronized input signal. When it comes to the response, the PLC can intervene much more precisely, according to the oversampling factor.
Design and construction of window production machines requires flexibility down to the last detail. Due to the wide variety of different window profiles and individual customer requirements, machine adaptation to modified and optimized processes should be as straightforward as possible. The company BJM uses TwinCAT NC Interpolation, the software-based motion control solution from Beckhoff for its complex profile machining systems in order to offer its customers maximum flexibility.

Machine construction that is made-to-measure

BJM Ingenieurbüro & Maschinenbau GmbH is based in Verl, Germany. The company develops and builds made-to-measure window production machines. "Our machines are used for processing plastic and aluminum profiles for windows and doors", said Dietmar Kay, who is responsible for distribution and marketing at BJM. Due to the variety of different window profiles that have to be processed, almost all BJM machines are custom-built. "We can’t take a standard machine catalog to our customers", said Dietmar Kay, "instead we have to determine their exact requirements and then design and build a tailor-made machine for the respective application.” This not only requires flexibility on the part of the machine manufacturer, but also on the part of the control equipment supplier. BJM has been cooperating with Beckhoff right from the start. "Beckhoff is BJM’s main supplier of control components. To date, we have equipped
around 250 individual machines and around 200 production facilities of different sizes, including fully automatic profile processing systems with PC controllers from Beckhoff”, said Wolfgang Brunnert, one of BJM’s managing directors. “Meanwhile Beckhoff specialists are familiar with the requirements for our custom machines and can respond accordingly”, said Dietmar Kay.

Almost all machines are different

When designing a fully automatic profile processing center, a wide range of factors must be taken into account: Profiles and processing steps have to be specified. Traditional processing steps include sawing and drilling or milling of oblong holes and recesses. Steel reinforcement, including cutting, is either introduced manually or automatically. Locking pieces may have to be supplied and attached fully automatically based on customer specifications. The wide variety of profiles that have to be machined represents a further challenge. For example, a well-known profile manufacturer from Germany alone offers around 12,000 different aluminum profiles. Occasionally, special architect-designed profiles are used for individual projects. The processing machine must be able to handle the whole range of parts.

All these factors, including profile variety, functional requirements, productivity, and customer-specific spatial conditions are taken into account in customized machine concepts and implemented by BJM. BJM deals with all machine construction tasks in-house. Beckhoff is a partner for machine control technology that not only supplies hardware and software components, but also offers engineering services.
Technology briefing as the starting point

"The project phase follows well-rehearsed steps based on years of cooperation, i.e. BJM specifies the functionality and Beckhoff offers matching system solutions", said Dietmar Kay. "We also discuss innovative control strategies and scope for integration in the current project", said Frank Maasmeier, window industry expert at Beckhoff.

The control concept is entirely based on Beckhoff components. At the field level, the inputs and outputs are connected in local terminal boxes in the machine via Bus Terminals and Couplers. Exchange with the IPC takes place via the interference-proof Lightbus. The intelligent, compact positioning drives for profile format adjustments are controlled via CANopen. The drive components, including servo drives and servo motors, are connected via the high-speed EtherCAT fieldbus. "Systems with many servo axes requiring fast signal acquisition and processing need a very fast fieldbus system. We therefore use EtherCAT in our profile processing systems", said Frank Maasmeier.

The BJM machines are controlled by Industrial PCs from Beckhoff, equipped with Ethernet ports for data interfacing with the process planning EDP system of the customer. TwinCAT PLC and NC I are used as software PLC and NC. "For achieving the sometimes very complex processing cycles, we use subroutines written in DIN code, which are developed and optimized in cooperation with our customers. The speed of the software NC combined with anticipatory, optimizing sorting logics for handling tasks ensures maximum processing speed with consistently high machining accuracy", said Thorsten Knapp, systems engineering project manager at Beckhoff. "A further advantage is the integrated approach of our system solution that covers hardware and software", said the systems specialist. "Beckhoff offers fully integrated, advanced control solutions with adaptable software modules for production data acquisition and analysis." "In addition, Beckhoff offers a wide and scalable range of Industrial PCs and Embedded PCs”, said Dietmar Kay. "On the one hand we are able to guarantee optimum functionality and on the other, we can use a cost- and performance-optimized system solution."
The window manufacturing industry also has special requirements in terms of IT interfacing: IT-Basis is design software that offers enterprise resource planning and production modules covering all sector-specific EDP aspects, including CAM modules. An automatic profile machining system has very different IT interfacing requirements than other production systems. Frank Maasmeier points out another special characteristic: "The design programs used in the window manufacturing industry generate production datasets in Beckhoff XML production data format that are transferred to the machine computer via the corporate network. In this way, all specific and relevant production data are imported directly into the Beckhoff IPC for processing by the control system."

"In view of the high technical demands for our machines, only capable control systems and cooperation with knowledgeable partners can lead to success", said managing director Wolfgang Brunnert, reflecting on 12 years of fruitful cooperation with Beckhoff.

**Precision and flexibility down to the last detail**

All processing options are reflected in the programming – the associated machine program is already stored in the control system for each profile to be processed. Only the production data have to be updated and allocated specifically for each order. In this way programming errors can be avoided and the machine can be commissioned and put into use very quickly.

"The flexibility of our control software offers tremendous benefits", said Frank Maasmieer. After all, parts with lengths between 300 and 7,000 mm have to be transported, cut and machined fully automatically based on specified production data. All profiles are different. The various national requirements for window, doors and façade construction not only determine the profile contours, but also the machining process. This implies continuous variation of the requirements for the control task. Considerable diversity and versatility is also required when taking into account profile and tool positioning – including tool and profile data management."

A high degree of flexibility is also needed for assembly of steel reinforcement components, which are required to provide the necessary rigidity for PVC profiles. In order to prevent inserted steel bars from moving inside the PVC profile during transport, the system reduces tongs acceleration and speed, screws in the first screw, and checks the result. The tongs speed is then increased again, so that the remaining screws can be processed more quickly.

Profile length registration is also a detailed task and involves two steps: The length is initially determined roughly via light barriers installed at certain intervals. Tongs then move the profile to a light spot where the length is measured exactly via a linear incremental measuring system. This measuring technique is fast and precise and enables high-performance residue processing, leading to significant cost optimization of the profile machining process.

"The company BJM Ingenieurbüro & Maschinenbau GmbH, based in Verl, Germany, has been designing and building machines and fully automatic profile processing centers for the window manufacturing industry for 12 years. It was established in 1995 by engineers Wolfgang Brunnert, Dirk Jacobebbinghaus and Jürgen Messow, who still lead the company today. Over the years, BJM has become an established manufacturer of window production machines with distribution throughout Europe. In 2006, the company generated sales of 12 million euros."
The cut components are placed on a trolley with special compartments for subsequent processing in the welding machine.

Maximum quality through precise profile measurement

Certain plastic production machines — and in particular aluminum applications — require profile height measurements due to fluctuating profile dimensions. The measured value is compared with the specified value and a tool positioning correction is applied. This algorithm is integrated into the Beckhoff control system. The procedure for width measurements is similar. This is required for counterbore holes, for example, to prevent countersunk bolt heads from protruding and to ensure that the counterbore holes do not exceed the specified depth.

The different profiles must be fixed in an optimum position for processing. In the past, this involved time-consuming machine changeover procedures. BJM developed a patented, profile-independent and fully automatic adaptive clamping system for their machines based on motor-driven adjustment functionality.

Since BJM sells its profile machining systems throughout Europe, the machines and their automation components must be suitable for all operating conditions found across Europe, including different menu languages, different temperature and humidity requirements and different voltage and supply conditions. “We haven’t had a single failure so far”, said Dietmar Kay. “Just in case, PC-based control technology offers simple and fast access to individual machines via Internet or remote service for troubleshooting purposes”, said Thorsten Knapp and continued: “The focus is on reliability, which is why the measures required for integrating the control computers into the corporate network and the Internet are fully coordinated with the end customer.”

BJM www.bjm-gmbh.com
PC Control 02 | 2007

spidercam GmbH, with headquarters in Villach, Austria, has developed an innovative camera carrier system. Attached to four cable winches, the system, which has been named SpiderCam®, allows the camera to move three-dimensionally through space. The company is relying on PC-based control technology from Beckhoff in order to control and drive the winch system.

The development of the SpiderCam® was to achieve camera movement freely through space without worrying about obstacles on the ground, without getting in the way of the audience’s view of the scene and without creating a hazard. To deliver its spectacular pictures, the camera has to move quickly, both close to the ground and at dizzying height, taking pictures from perspectives that a conventional camera cannot achieve.

In the SpiderCam®, the company of the same name has developed a camera robot that moves the camera freely in every direction, like a remote-controlled...
A cable winch system can be attached to four masts, to the ceiling or to other available fixed points to hold the camera in the desired position. Cable winches that shorten and lengthen the cables and coordinated controls drive the system, making it fast and agile. Speeds of up to 9 m/s (32 km/h) are possible. The specially manufactured cables are made of plastic. A glass fiber cable is woven into them that transmits the image data (SDI or HD-SDI) to the ground without loss of quality. A light sag of at most 10° in the cables means that they only support the weight of the camera head or dolly. There is no pre-stressed support cable. The desired straight flight-path is created by simultaneously winding and unwinding the four motor-operated cable winches.

Embedded PC with Windows CE operating system

In order to control this complex process, spidercam GmbH is using a CX1000 Embedded PC running Windows CE as an operating system for the central controller. Special algorithms are used to calculate the cable lengths. This data is read into the TwinCAT NC PTP automation software through external specification of set values.

Online display provides accurate information about the exact position of the camera at all times. The SpiderCam® is controlled by two joystick units.

Different cameras can be fitted to the camera head, or dolly, according to need. The image signals are transmitted to the director’s booth or the transmitter van along the glass fiber that is embedded in the plastic cables.

Ing. Jens C. Peters, General Manager of spidercam GmbH, explains the reasons for the cooperation with Beckhoff: “It was important for us to construct a modular control system that is easy to operate and works with open standards, so it can be integrated effectively into our overall scheme. We received a solution from Beckhoff that matches our needs exactly. Beckhoff’s engineering experience also gave us valuable assistance that contributed to the development of the SpiderCam®.

Safety is of particular importance, particularly at public events. For the sake of exciting pictures, the SpiderCam® must often fly immediately above the head of the audience. If one of the cables were to fail, the load would be picked up by the other three cables – the two opposing cables would take up the load, while the third cable prevents or minimizes oscillation; the system would then shut down quite automatically. To prepare for a power failure and the consequent possibility that the cables could freely unwind from the winches, each winch has two entirely independent automatic brakes. The braking force is applied by steel springs, so that even if the power fails, the brakes will automatically be applied without the need for any external power.
The cable winches are driven by Beckhoff AX2000 Servo Drives with Ethernet interfaces and Synchronous Servomotors. “After reliability and speed, low noise was very important to us”, added Peters. “There should, after all, not be any interference to the TV production.”

Each winching station includes a cable winch weighing 200 kg, driven by an AX2000 Digital Compact Servo Drive and Synchronous Servomotors. A CX9000 Embedded PC with integrated TwinSAFE terminals performs the distributed control of the extremely compact winch stations.

SpiderCam® technology is particularly valuable at large events like soccer games. The unusual camera perspectives give the television viewer the feeling of being right in the thick of things.

The cable winches are driven by Beckhoff AX2000 Servo Drives with Ethernet interfaces and Synchronous Servomotors. “After reliability and speed, low noise was very important to us”, added Peters. “There should, after all, not be any interference to the TV production.”

Each winch station incorporates a CX9000 Embedded PC with TwinCAT software that communicates through network variables with the CX1000 in the central control unit. Integrated TwinSAFE I/O terminals ensure maximum safety, particularly at critical times such as commissioning or when under manual control. In spite of the complex technology, it is relatively easy to use the SpiderCam®. Only two people are needed to operate the camera system. While one flies the SpiderCam® through space with the aid of a joystick, the second operates the camera itself. A control monitor with online display provides accurate information about the exact position of the camera at all times.

Flexible: from soccer to casting shows

The SpiderCam® can be used in studios and indoor halls as well as at outdoor events. The cable system permits a maximum activity area of 250 x 250 m over which the camera robot can travel to any position, including vertically. The camera moves can be controlled live or can be programmed in advance and worked through at variable speeds.

A SpiderCam® can be hired in Germany through PMT in Hamburg. Viewers were able to enjoy the exciting pictures already taken by the SpiderCam® in recent months at television broadcaster RTL: The competitions for this year’s series of “Deutschland sucht den Superstar” (Germany in search of the superstar), which is similar to the American Idol and Pop Idol series, was filmed with the SpiderCam®, as was the Echo Awards ceremony in Berlin. The fact that the Echo ceremony was held between two “German Superstar” shows did not cause the operators much trouble: the entire camera system can be dismantled within a few hours and – depending on circumstances – be reassembled again at a new site within 1–2 days.

spidercam GmbH www.spidercam.tv
PMT www.spidercam.de
Beckhoff Austria www.beckhoff.at
Bruderer AG: XFC for punching machines

Future-proof PC controllers

The automatic punching machine built by Bruderer performs up to 2,000 strokes per minute producing plug contacts, rotor plates or screening for mobile phones — 24 hours a day, 365 days a year, for up to 25 years. The controller monitors and controls system operation in order to ensure high manufacturing quality. With a long standing reputation in automation, Bruderer from Frasnacht, Switzerland, has been using electronic controllers since 1985 and PC-based controllers from Beckhoff since 1998.

Increasing the lifetime of the control system

Many of the electronic parts in the first CNC controller from 1985 are today no longer available, even as a “legacy product” charged at several times the original price. The fact that electronic components have become shorter and shorter lived intensifies this problem. This is a heavy burden for control system manufacturers because they generally guarantee system availability for 10 years. After the decision to launch a new control system, it takes around four years of development before a new punching machine featuring the new system appears in the market. The fact that Bruderer offers support for its machines for ten years results in a potential gap of four years of electronic component uncertainty.

Several options are available for bridging this gap. One solution would be to purchase and store sufficient spare parts in a timely manner. Of course, this option is expensive, requires plenty of storage space and is uncertain because it is impossible to predict exactly how many components of each type will be required. The second option, which is used by the punching machine specialist, uses PC-based controllers. It enables the service life of the machine to be extended based on the same technology, but perhaps with different, yet still compatible components.
Continuity in a highly dynamic market

Machine lifecycle management is becoming increasingly important for machine builders to succeed. Many manufacturers seem to forget that new products can create future problems that have to be solved in 10 years’ time or less. Bruderer, therefore aims to offer robust long-term control hardware solutions. All punching machines, dating back to 1999, can be controlled and operated with the current, Windows-based PC controllers. This platform should be possible for several years to come. With a PC-based methodology, life cycles far beyond the standard 10 years for electronic components can be achieved.

Servicing of machines also plays a significant role in life cycle considerations. PC-based Bruderer systems have been used for eight years in conjunction with associated user training. Worldwide service could be difficult to organize if the system changed continuously. In addition, a lot of know-how could be lost if a new system with a new programming language or hardware were introduced too soon.

Bruderer’s strategy involves strong vertical integration in order to achieve maximum independence and availability of spare parts. The punching machine manufacturer produces all main components in-house. This means that 95 % of all components ever produced are available as spare parts. Development and production of Beckhoff Motherboards is based at Beckhoff facilities in Germany. If, for example, a processor is discontinued, Beckhoff can either store an adequate quantity of this component or design a replacement processor within a relatively short amount of time.

Small controller – high performance

The latest product from Bruderer demonstrates the impressive scalability and software compatibility of Beckhoff PC controllers – seamlessly from compact Embedded PCs to large Industrial PCs. The new punching machine, which is equipped with a CX1020 Embedded PC from Beckhoff, uses the same TwinCAT control software that Beckhoff developed for Industrial PCs. All Bruderer punching machines use the same software, regardless of which Beckhoff control system is used. TwinCAT software is always backwards compatible, i.e. the latest version also runs on older machines. The same software can be used even if the industrial PCs use different operating systems such as Windows NT, Windows 2000, or Windows XP. This means that all machines are operated in the same way, even if a customer uses different generations of punching machines. The only possible constraint for TwinCAT updates is that the PC processor has to have adequate performance.

The new Embedded PC-based control system also indicates how quickly computing performance is increasing (and shrinking in size). Despite the fact that it is significantly more compact than the previous device, the IPC-based “B controller” offers the same performance with a 1 GHz Intel® Celeron® M ULV processor. In addition, it requires no rotating components such as hard disk or fan, which improves stability and reliability.

Just as the compact Embedded PCs are becoming faster, the performance of the Industrial PCs from Beckhoff also continually increases. The new dual core-based motherboards double the computing power at a stroke. The two computation kernels enable parallel processing of complex visualizations with sophisticated graphics and control processes.

Market edge through XFC

Thanks to EtherCAT – the real-time Ethernet fieldbus – the dimensions of the controller have been reduced to a minimum. Up to now, almost all slots of the punching machine control system were occupied by fieldbus cards: one for I/O, one for the cam group, plus a modem card. These functions can now be combined as I/O terminals linked via EtherCAT and connected directly to the control system, which saves valuable space.

So far Beckhoff has implemented the control software for the cam group of the punching machines based on Bruderer know-how. The control system for the cam group currently runs in a special run-time system with a cycle time of 80 µs because before EtherCAT was used, the fieldbus limited the cycle time of the software PLC to 2 ms. Now with EtherCAT and PC-based control, Beckhoff’s new XFC control solution (eXtreme Fast Control Technology) breaks through previous control limitations with a cycle time of 50 µs, even in the software PLC. As a result, Bruderer can implement the cam group directly in the PLC. The convenient IEC 61131 development tools of the TwinCAT automation software ensure short development times and offer excellent diagnostic functions so that the Bruderer cam group can be extended flexibly.

Bruderer AG www.bruderer-presses.com
Beckhoff Switzerland www.beckhoff.ch
"Economy" Control Panels from Beckhoff

Economy 1: CP66xx
Ethernet Control Panel
➔ Intel® IXP420, 266 MHz
➔ 128 MB on-board RAM
➔ 32 MB on-board flash, optional CF card
➔ 2 x Ethernet, 2 x USB 2.0, 1 x RS232

Economy 2: CP69xx
DVI/USB Control Panel
➔ Integrated DVI/USB extension
➔ Distance between PC and panel can be up to 50 m.

Economy 3: CP62xx
Built-in Panel PC
➔ Intel® Pentium® M, 1.8 GHz
➔ 256 MB up to 2 GB DDR RAM
➔ CF card and/or hard disk
➔ 2 x Ethernet, 4 x USB 2.0, 1 x RS232

“Economy” built-in Control Panels
The new generation of Panel PCs and Control Panels:
➔ Installation in control cabinet, operator panels or building wall
➔ Slimline housing with small mounting depth
➔ Aluminium front IP 65, back IP 20
➔ TFT display, optionally with touch screen, touch pad, membrane keyboard or full keyboard with special PLC keys
➔ 6.5-, 12-, 15- or 19-inch TFT display
➔ Beckhoff Motherboards inside
➔ Custom design optional

For further information and international sales contacts see:
www.beckhoff.com
One of the central challenges for the mail order clothing industry is the logistics involved with the extraordinary number of clothing items in various sizes. In the past, shipping orders have been assembled from static warehouses that contained items sorted according to item type and size. Klingel, however, has modernized the logistics of hanging garments through the introduction of fully automated storage. The Pick-Rotor system, made by Dürkopp Fördertechnik in Bielefeld, Germany, rises to the challenge effectively and economically.

Clothing in movement
The dynamic storage for hanging garments consists of 21 “Pick-Rotors” together with the sorting equipment and around 60 independent transport systems. The stock is held in any convenient sequence, and, at the latest, is available to the dispatch department one hour after the pick order has been placed. The dynamic store regularly contains about 120,000 items supplied to it from static stores and from returns. “Our job was to handle the large number of returns that have to be reintroduced into the logistical flow” explained Dipl.-Wirt.-Ing. Dirk Sieksmeier, Development Manager at Dürkopp Fördertechnik, who was responsi-
Central, PC-based control concept
Dirk Sieksmeier explained the fundamental control concept: “We rejected our first idea, which was to control the entire system non-centrally, because of all the cross-connections between the 21 storage units and the conveying sections. Although the installation is quite extensive, we decided in favor of central intelligence, which also has the advantage of being easy to service in the event of a fault.” The store extends over an area of 200 x 50 meters, and is controlled by a single Industrial PC with a TwinCAT PLC. Dürkopp’s development engineer made the decision because “due to the large number of interlinked conveying systems, we did not feel able to manage the complex communication between the distributed controllers without the task becoming unreasonably complex.”
An Industrial PC C5102 Pentium 4, 2.8 GHz running Windows XP, a RAID controller and exchangeable disk are used. It is fitted with four fieldbus cards (FC310x) for about 140 PROFIBUS slaves. The I/O stations are implemented as IP 20 Bus Terminals in distributed control cabinets or as IP 67 Fieldbus Box modules, close to the working machines. According to Sieksmeier, the use of PROFIBUS has historical reasons amongst conveying technology specialists: “Just like PROFIBUS, our equipment is also in use in many parts of the world and this means that our staff has the necessary know-how.” Around 2,500 digital inputs, 2,500 digital outputs, some 40 absolute rotary encoders and 60 serial interfaces for the RFID readers are fitted in the installation. In addition, 40 asynchronous motors are supplied with complex data words and are cyclically read over the PROFIBUS.

Real-time position acquisition
Because the store regularly contains more than 100,000 items and because the conveying orders must be executed by means of a variety of intermediate stations, the software PLC must know the position of every roller adapter in real-time. Although the conveying system consists of nearly 60 independent sections, each 100 meters long, the computer is able to calculate the position of every single adapter to an accuracy of 15 mm within about 10 ms. In order to keep this quantity of data safe from a power supply failure, the IPC needs about 30 MB of non-volatile PLC memory.

The customer’s own system, based on Visual Basic, is used for visual display and can be called up at any authorized workplace within the mail order company. As far as communication with other tools within the company is concerned, Sieksmeier adds that “to communicate with the visual display system we use the TwinCAT TCP/IP Server, which adds server functionality to the PLC”. Communication with the supervisory material flow system is also implemented through TCP/IP. Commissioning the complex control system is made significantly easier by the option of recording all the events – to any desired precision – on the hard disk in the PC, as well as by TwinCAT’s internal visual display system.

TwinSAFE: Smart safety for the entire system
Secure Bus Terminals have also been integrated into the I/O system. They connect the emergency stop switches and perform secure shutdown of the drives. This is the first time that Dürkopp Fördertechnik has used TwinSAFE Bus Terminals from Beckhoff. To handle the secure I/Os, each control cabinet contains five or six secure Bus Terminals, to which more than 100 secure I/O components are connected. Sensors and actuators of both standard and safety types can be freely mixed in the Bus Terminal system. It is not necessary to install an additional bus and I/O system. It is therefore possible to extend the safety-relevant functions in the I/O system at a later stage.

According to Sieksmeier, there are two particular arguments in favor of wiring the emergency stop circuits by means of secure Bus Terminals: “Changes are an everyday occurrence during the planning phase and while the electronic equipment is being constructed, the customer’s requirements can change at any stage up to the commissioning. In the past, we regularly had to reconnect hard-wired emergency off circuits, and install new wiring.” Sieksmeier also sees the interface to the existing belt conveyors and the conveyor belts for folded garments as a further important feature. The Development Manager added: “While TwinSAFE allows the structure of the system to remain flexible to the end, the technology also offers significant cost advantages.” Beckhoff TwinSAFE Bus Terminals allow all the safety circuit wiring to be moved into the existing fieldbus, and for the secure signals to be freely mixed together with standard signals. This saves design effort, installation and material. Maintenance is simplified significantly through faster diagnosis and simple replacement of only a few components.

In addition to the KL19xx digital input terminal and the KL29xx digital output

The items of clothing are given a 125 kHz RFID chip for identification. This chip contains a unique 40 bit code, while stored in a database together with the code of the hanger, identifies the item of clothing being transported. A total of 60 RFID readers with serial interfaces are working in the system, connected via communication Bus Terminals.
terminal, the KL6904 TwinSAFE Logic Bus Terminal creates the necessary logical connection between the inputs and outputs. The secure Bus Terminals allow any common safety sensors to be connected, and are operated, stand-alone, with the TwinSAFE Logic Bus Terminal. The TwinSAFE protocol makes it possible to transmit safety-relevant data in a genuine “black-box” channel over any desired media, as the transmission medium does not contribute to safety. Fieldbus systems such as PROFIBUS, CANopen and Interbus or Ethernet systems such as EtherCAT can be used in conjunction with TwinSAFE. All these systems can also be mixed without restriction.

“We have also checked the use of specific secure fieldbuses”, explains Dirk Sieksmeier. “But with the TwinCAT System Manager we don’t need any other engineering tool for the safety functions. The System Manager saves the configuration and linking matrix of the inputs and outputs in the secure terminals. If there is a fault, this information simply has to be read back.”

Leading edge EtherCAT replaces PROFIBUS

The advantages of using an Industrial PC instead of a hardware PLC is more than just a question of cost. Sieksmeier has found that working with libraries is also effective: “We have standardized much of the functionality of our equipment and saved it in libraries, which can be reused in new projects and, on occasion, modified centrally. The support service also benefits from this.” Sieksmeier also points to the increasing significance of remote servicing: “Our service team can easily access the customer’s controller over ISDN and a router with the aid of the Remote Desktop function, allowing faults to be rectified quickly.” Dürkopp Fördertechnik’s designers also expect a further performance boost from the introduction of EtherCAT. “The data from 5,000 I/O points, including the TwinSAFE communication between the fieldbus cards, has to be transferred over the PCI bus every 15 ms. This makes a significant contribution to the workload of the IPC.” There are already plans for an installation being designed in England to at least be partly based on EtherCAT.

Dirk Sieksmeier, Development Manager at Dürkopp Fördertechnik: “In the past we had to rewire the emergency stop circuits again and again, whereas with TwinSAFE, the structure of the system can remain flexible right until the end.”
The newly established Beckhoff Automation Pvt. Ltd. has started operations in India on 1 August 2007. India has a broad range of industries from electronics manufacture through automotive engineering to textile production. The branch headquarters is in Pune, a metropolis with a population of 3 million in western India. The site chosen is the Muttha Towers technology park close to the airport. “Pune is the industrial heart of India”, explained Jitendrakumar Kataria, managing director of Beckhoff Automation Pvt. Ltd. “In addition to the automotive industry, numerous chemical and pharmaceutical companies as well the iron and steel industries are located in Pune. Moreover, in the past, numerous foreign companies have become established around the city and in the Mumbai region. Besides the market for industrial automation solutions, the demand for intelligent building automation is currently booming.” Beckhoff is entering familiar territory with the newly established branch office. Since 2001 the company has been represented throughout the Indian market via its distribution partner Inteltek Automation Pvt. Ltd., which also has its headquarters in Pune and branch offices with trained engineers in major cities.
India is located between the Himalayas and the Indian Ocean. With its 1.1 billion inhabitants it is the largest democracy in the world, measured in terms of population. The highly developed tradition-based culture has led to more than 100 languages including 21 official national languages. For this reason, in addition to Hindi, English has also developed into the universal economic and official language of India.

Having previously been focused on the domestic market, the Indian economy has been developing foreign trade since the beginning of the 1990s, primarily due to the lifting of trade barriers.

The successful collaboration will continue in the future. "Our customers and prospective buyers receive comprehensive support – from the first enquiry to subsequent maintenance or expansion of their automation solutions" explained Kai Ristau, Beckhoff international sales manager. "We are pleased to be increasing our commitment in this interesting and fast-growing market with a branch office. The development of our own resources in India is a challenge which we are looking forward to. We expect this to lead to a further growth process which we shall be promoting jointly with our distribution partner Inteltek.

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IWM Automation is globally active as a system integrator in special machine construction. The company has four specific competence fields in which it also works as a general contractor to implement equipment designs. In addition to system services such as engineering, plant construction and assembly, commissioning and after-sales services (teleservice), the company’s activities also include assembly and welding technology as well as glue and proportioning technology. Test engineering effectively developed as an intersection of these various competence fields.

IWM Automation most recently achieved sales of about 20 million EUR. It has 95 employees, of whom more than half work in engineering, project management and similar areas.
A PC-based automation solution, with the Embedded PC CX1020 at its heart, controls 15 NC axes in a complex machine for tube-end forming at IWM Automation. With the innovative control concept that integrates PLC and Motion Control at the software level, IWM Automation offers its customers significant advantages over traditional PLC approaches.

The tube-end forming machines are used by suppliers to the automotive industry for machining and shaping the ends of tubes. This includes, for instance, tube stamping as a preliminary process, as well as swaging and pressing for the fabrication of assemblies. The tube ends are cold formed in up to four steps in which they are hydraulically swaged on both sides and, in some cases, calibrated. The end product is a subassembly incorporated in a unit for the motor vehicle industry. The machine that IWM Automation has developed implements the machining process through thirteen motor-driven and two hydraulic NC servo axes.

Optimum automation for highly complex Motion Control

IWM Automation, based in Porta Westfalica, Germany, was awarded the “tube end forming” project in mid-2006. The job involved the implementation of a type of hydraulic press that, in a simplified form, was already being used by the customer. The customer has greatly tightened the requirements profile in respect of cycle time and machine output. A requirements profile of this kind was entirely new for IWM Automation. “In our initial approach to the design, we looked for ways in which the complex machine process could be implemented efficiently and economically,” explains Olaf Klink, Marketing and Project Development Manager at IWM Automation. “Instead of taking the approach of adding supplementary hydraulic control to a conventional PLC, we decided in favor of PC-based control from Beckhoff.”

The tube-end forming machine has a modular structure with three main and two auxiliary stations. The nature of the product requires the machining process to be sequential; a specific working sequence must be followed. From the point of view of the machine, however, all the machining stations are continuously in operation. Altogether, up to two swaging movements and up to four forming movements are executed, which means that four tools can be used in the main station. Loading and discharge actions, as well as adjustment movements, must also be carried out. The parts are advanced through the machining stations by a servo motor-driven handling device. The cycle time for an assembly needing three swaging processes amounts to about 8.5 seconds per assembly.
Compact control solution

An Embedded-PC CX1020 is used for controlling the equipment and machines. A classic CNC controller was originally planned in the performance specification. However, an additional, special controller would also have been necessary in order to control the servo-hydraulic axes. Olaf Klink comments: "We would have needed two controllers, and these would have had to be coupled together. For this reason, Beckhoff’s software modules, which handle both motor-driven and hydraulic NC axes, are the better alternative."

Windows XP Embedded provided the operating system for the CX1020, while TwinCAT PLC was used as the run-time system. All the peripheral devices, including all sensors, command units, displays and actuators – except for a small part handled via PROFIBUS – are connected to the Embedded PC via the EtherCAT fieldbus system. The PROFIBUS coupling is made through a modular master module plugged onto the CX1020.

Visual display is provided by the Zenon software system; a 15-inch touch screen panel from Beckhoff displays the progress of the machine. The visual display program runs on the Embedded PC – the HMI unit is used to display and parameterize the equipment. TwinCAT interacts with the visual display program through TwinCAT ADS, which as an open interface, permits well-organized exchange of data with other Windows programs.

Software-based Motion Control solution

A total of 15 NC axes are used for machining, of which 13 axes use AX2000 Servo Drives and appropriate servomotors from Beckhoff; 2 NC axes are driven by servo hydraulic units. All the axes are simple point-to-point (PTP) single axes. In other words, none of the axes have continuous-path control.

The TwinCAT PLC Hydraulic Positioning library is used to program the positioning processes. This library is one of several Motion Control libraries standardized in accordance with PLCopen. "This software tool allows the programming of both hydraulic servo axes and servo motor axes," explains Stefan Sieber from the marketing department at Beckhoff’s headquarters. Although a hydraulic axis behaves, in terms of control engineering, quite differently from a motor-driven axis, all the axes can be programmed with this software tool, without the need for special NC control components. Olaf Klink adds: "We drive the hydraulic axes following a defined speed profile that is specified by the end customer. This is an important component in the total cycle time." The highly dynamic axes achieve a speed of 2,000 mm/s. The hydraulic axes – used to swage the pipe ends – have a total of up to 45 tons of feed force.

Sensors detect the actual progress of the positioning. The analog resistance displacement transducers (0…10 V DC) on the hydraulic axes are directly coupled via EtherCAT Terminals. In the case of the electrical axes, the encoder signals are directly connected to the AX2000 axis amplifiers. These, in turn, are connected to the Embedded PC CX1020 via EtherCAT. The CX1020 generates the profiles for all the axes and carries out their control. The set values for the proportional valves in the servo hydraulic system are output as an analog signal (0…10 V DC) through an EtherCAT Terminal.

Pressure measuring cells are another type of sensor; they are used to acquire the pressure generated by the equipment. The maximum operating pressure of the production equipment is 310 bar; the operating pressure in use at present is
230 bar. Olaf Klink points out: “It is particularly important to monitor the hydraulic temperature. A complete temperature module is coupled to the Embedded PC via EtherCAT for this purpose.”

**EtherCAT: a faster bus for faster cycles… even for hydraulics**

Generally speaking, hydraulic systems are significantly slower than actuators driven by electric motors. This naturally raises the question of why EtherCAT, a high-speed fieldbus, is being used. For Olaf Klink the pre-conceived notion regarding hydraulics does not hold water: “Hydraulic equipment can be just as fast as electrical drive equipment. Use of a fast Ethernet fieldbus system like EtherCAT is necessary for the sake of the total process control, as we are not controlling the movements by autonomous, distributed regulators, but centrally, in one controller. This can only be done if data is exchanged at high speed. This means that the hydraulics can be operated not only quickly, but with a positional accuracy that is better than 0.01 mm.” Stefan Sieber supports the argument: “The extremely short cycle time demands that signals are also quickly available. EtherCAT’s high transmission speed is therefore necessary.”

The EtherCAT wiring is based on CAT5 copper cables. They are, however, laid with great care, as the machine, after all, is a production machine involving hydraulics and additional applied oil; as Olaf Klink says, an additional oil mist is sprayed on to the tube ends during the forming process, both in order to reduce tool wear and to support the forming.

**A convincing solution**

IWM Automation is a very experienced company in the field of control technology. Olaf Klink has this to say about the company’s experience to date with the PC-based automation solution from Beckhoff: “We were able to convince the machine operator that he will work more effectively with a PC-based automation solution, and will also have more potential available. And we are confident that we are on the right path with the Embedded PC solution from Beckhoff, as we were not only able to meet the customer’s production engineering requirements, but were even able to offer cycle times that are shorter than specified. There is no doubt that we will continue in this way.”

IWM Automation has set itself high targets for precision and quality, customer service and efficiency, a highly professional approach and the maximum possible success for both sides – for the manufacturer as well as the operator of production equipment. Olaf Klink is convinced that solutions such as the production plant realized for tube-end forming will contribute to reaching those targets and even going beyond them. His summary is that “the solution gave the customer better performance than was asked for. This generates trust and satisfaction!”
The new Beckhoff Automation FZE branch is located in the Dubai Silicon Oasis, a modern technology park near Dubai International Airport. Due to the easily accessible location along Dubai’s Emirates Road, other business centers such as Dubai Investment Park, Techno Park, Jebel Ali Ports and Dubai Industrial City are within easy reach.

“Chandran Velayudhan was appointed as managing director of Beckhoff Automation FZE”, said Kai Ristau, International Sales Manager of Beckhoff Automation GmbH in Germany. “In addition to distribution of our products and system solutions, our Dubai branch also offers comprehensive service and support. Sales activities will focus on industrial automation and building automation.” Due to its geographical location, the Dubai branch will act as central contact for the Middle East including the United Arab Emirates, Oman, Qatar, Bahrain, Kuwait, Saudi Arabia, Jordan and Lebanon.

Dubai is currently experiencing an unprecedented building boom. Each project changes the appearance of the city, which is becoming increasingly independent of oil production. Investment capital is flowing into the emirate from around the world.

Infrastructure expansion plays a central role in Dubai. Investments focus on energy supply and expansion of the transport infrastructure. In addition, numerous building projects, ranging from office and apartment blocks to recreational facilities and luxury hotel complexes, shape the appearance of the city. The application of state-of-the-art technologies and the desire for exceptional comfort features lead to increasing demand for intelligent automation solutions.

This is where Chandran Velayudhan sees significant potential for the versatile control technology from Beckhoff: “PC- and Ethernet-based control technology from Beckhoff is used in a wide range of industrial and infrastructure applications as well as industrial building automation and home automation. The fine scalability of the components enables implementation of customized automation concepts. Through the application of innovative technologies and open standards we are able to meet individual customer requirements.”

With the establishment of a subsidiary in the United Arab Emirates (UAE), Beckhoff opens up the Middle East as a sales region. The Dubai-based Beckhoff company has been operating since 1 August 2007. Extensive oil resources and a liberal economic policy have turned the Emirate of Dubai into a boomtown attracting both companies and tourists.
Chandran Velayudhan, managing director of Beckhoff Automation FZE, has extensive industry knowledge accumulated in the United Arab Emirates and India. He is an experienced application engineer, project manager for system integration, and product manager for PLC systems.
SAB is a leading manufacturer and supplier of extrusion and injection blow molding machines for the plastics industry worldwide. Previously, the machines had a special control system: Three CPUs were used for sequence programming, motion and temperature control; a different fieldbus technology was used for the controller and the I/Os. The hydraulic control system was a black box that SAB was unable to adapt or develop further.

SAB Plastmach Co. Ltd, Thailand, developed a new range of high-performance extrusion blow molding machines based on TwinCAT PLC and Motion Control from Beckhoff. Particularly the material handling system was improved thanks to EtherCAT.

**EtherCAT improves hydraulic Motion Control systems**

EtherCAT for blow molding

Boonlue Rungsawang, leader of the electrical systems and control technology section at SAB, initially decided to use a central PLC controller and a single fieldbus for the whole machine. Initial trials with a standard PLC were unsatisfactory due to long cycle times and slow fieldbus communication. Particularly control of the hydraulic axis could not be realized with the required precision.
Thus, SAB came to the conclusion that a PC-based system with fast, real-time Ethernet was the optimum solution. The technology offers adequate performance reserves and has the advantage that the complete control system know-how, including hydraulic control, can be mapped in a software PLC according to IEC standard.

TwinCAT handles HMI, sequence programming and Motion Control in a single system. Data exchange between the system components is quick and easy to implement. PC-based technology and fast EtherCAT I/Os shorten the sampling time of the digital controllers substantially.

**Industrial PC as all-rounder**

SAB replaced all existing hardware components for sequence programming, hydraulics and temperature with a single Pentium® 4 Industrial PC running TwinCAT NC and the TwinCAT PLC Hydraulic Positioning und TwinCAT PLC Temperature Control libraries. The control unit is a customized Beckhoff Control Panel with 15” TFT touch screen, PLC keys, membrane keyboard, and floppy drive. The fully integrated software platform is based on the languages defined in the IEC 61131-3 standard. TwinCAT function blocks for hydraulic axes are used for controlling ten machine axes based on the standard. The Beckhoff system solution does away with black box programming, which means that SAB can modify or extend all program components in the common IEC-61131-3 languages. Motion control for a hydraulically operated positioning axis is not a trivial task, because the controlled system is non-linear and must meet specific process engineering requirements. For example, the system must enable highly dynamic movements of the transport axis weighing several tons and hold the axis in the target position with high precision. The computing power of an Industrial PC enables cycle times of 1 to 2 ms with simultaneous handling of ten or more axes as well as HMI, temperature control, and sequential control. Direct communication between the individual program components largely eliminates non-productive times caused by conventional control systems.

**TwinCAT as the backbone**

Replacing special control hardware with a software-based open control concept using EtherCAT reduces system costs considerably. The Industrial PC offers the system performance required for handling all control functions plus adequate reserves for future expansion. With support from Beckhoff, SAB was able to handle all machine programming tasks in-house, thereby gaining comprehensive machine and process know-how. TwinCAT provides a constantly available programming and diagnostics environment for service engineers that can be used on site – or remotely via modem – directly at the machine.

In future SAB will develop modular machines and “zero engineering” tools for simple programming. TwinCAT is the backbone of this new concept that enables flexible responses to customer and market requirements.
Control solution for high-precision weighing applications

Due to the complexity and versatility of the material weighing and dosing process, Sonner had been faced with the problem of meeting different customer requirements as quickly as possible, while at the same time addressing the demand for customized solutions. The customized Beckhoff control solution fully meets Sonner’s requirements in terms of product size, function and design. With support from the Beckhoff technical team, Sonner developed their own fieldbus control system, Flex-Control-LW, based on a BC7300 Bus Terminal Controller with Modbus interface. The controller monitors and controls the process parameters such as weighing and dosing and ensures general monitoring of limit values.

“Our weighing apparatus is very compact. The reasons why we chose Beckhoff products are their outstanding performance and compact housing design. Last, but not least, the Beckhoff I/O system includes the high-precision KL3356 Bus Terminal for precise resistance bridge analysis”, said Pai Peng, general manager of Sonner. “Before we started using Beckhoff products, we used a PLC system with a weighing transmitter. However, this combination was unsatisfactory in applications requiring high precision. In addition, the Beckhoff control system not only saved costs, but we were also able to reduce the control cabinet size.”

Sonner Machinery Co., Ltd., located in Shanghai, China, specializes in dosing and blending products. In long-term cooperation with Beckhoff, the company provides system solutions for the plastics, fiber, food and chemical industries.

The KL3356 analog Bus Terminal permits direct connection of a resistance bridge. The ratio between the bridge voltage UD and the supply voltage UREF is determined in the input circuit. In order to achieve good long-term stability, the complete circuit is re-calibrated at least every 3 minutes. This procedure can be synchronized by the control in order to prevent the calibration leading to a delay in the production process.
TwinSAFE: Extending the modular I/O system safely

- Compact safety solution
- Standard and safety I/Os in a single system
- Fieldbus-neutral communication
- Fail-safe PLC in the Bus Terminal
- Integrated blocks, e.g. for emergency stop, safety door, etc.

www.beckhoff.com/twinsafe

Safety and I/O technology in one system
The integrated safety-system from I/Os to drives:
- Certified solution according to IEC 61508 (SIL 3)/EN 954 (Cat. 4), NRTL, UL, CSA
- Cost-effective secure and standard communication via a single fieldbus system
- Fieldbus-neutral application of EtherCAT, Ethernet, PROFIBUS, CANopen, etc.
- Modular secure and standard signals in a single I/O system
- Universal a single safety solution, covering individual machines and groups of machines
- Available comprehensive diagnostic options
- Convenient secure signals automatically also in standard control system

For further information and international sales contacts see: www.beckhoff.com

BECKHOFF New Automation Technology
Located in Germantown, Wisconsin, shrink wrapping machine builder, Conflex Inc., has been undergoing what Joe Morrissey, Product Manager at the company, refers to as a renaissance. In 2005 Conflex began the “rebirth” by substantially redesigning each machine in the product line and will continue redesigning machines until the end of 2007. The company’s Modular CW and ServoFlex™ lines have had a complete mechanical and electrical redesign.

Conflex wrapping machines are tailored to the food, consumer goods, electronic media and printing industries, among others. Typical applications for the company’s machines include wrapping for frozen foods, CD and DVD packaging and the packaging of household products and toys. With the Conflex motto in mind – “Flexible People Make Flexible Systems” – Conflex sought a controls system that could fully deliver true application flexibility to customers in these diverse industries. All of Conflex’s customers demand user-friendly machines with intuitive interfaces.

New technology implemented in practice

In particular, the ServoFlex™ film seal wrapper saw dramatic changes from its previous incarnation. The old ServoFlex design utilized numerous intelligent drives that handled the automation and motion control aspects of the machine. The required programming time for multiple drive controllers irritated Conflex.

“This was a three servo system – each axis had its own controller that had to be individually programmed,” said Mark Lorenz, Conflex Electrical Applications Engineer.

For restructuring the machines, Conflex decided to use the CX1020 Embedded PCs with TwinCAT as control platform. From January 2006 onward, Conflex began the design and construction of the revamped ServoFlex machines. “Using the CX1020 with TwinCAT, we handle all PLC functions and motion control on a single device,” Larry Koenigs, Electrical Engineer at Conflex, said. The new ServoFlex machine is a four axis system – one master axis with three slave axes. This horizontal form, fill and seal wrapper delivers continuous motion at up to 100 ft of film per minute with an advanced reciprocating hot knife seal system. ServoFlex machines feature cradle-style powered film feed, which is easy to load and allows for fast change-overs.

Software libraries save engineering costs

Conflex found that several of the programming libraries in TwinCAT were particularly helpful. “The Flying Saw code library saved us time and effort by providing pre-written software functions to achieve a great deal of our motion program-
“Lorenz said. On the ServoFlex, a vacuum conveyor holds the wrapper film and leads it to the sealing area that features reciprocating motion. “We have to hit a very specific mark on the film, so the Flying Saw program handles the sealing motion of the knife moving back and forth on the machine,” Lorenz said. “Also, built-in libraries for PID temperature control for the machine’s film heaters and superimposed move for print registration are huge time savers in our area of packaging.”

**EtherCAT boosts control speed**

Any controller Conflex uses must provide very fast control of the film cutting knife to exactly match the speed of the incoming wrapper film. “The Industrial Ethernet fieldbus, EtherCAT helped immensely in terms of ramping up our control speed on the ServoFlex machines,” Morrissey said. “Beyond top performance, Conflex had to choose a fieldbus that will be supported well into the future (like EtherCAT) and won’t go obsolete in a few years.” Conflex customers also enjoy remote diagnostic capabilities for troubleshooting via standard Ethernet connectivity with the EtherCAT-equipped machines.

Some EtherCAT I/O terminals are used on the ServoFlex to develop built-in special latching functions for hardware interrupt. The significance of the latch input is to allow the machine cutting and sealing operations to be synchronized to the printed film. This allows for a very professional looking finished product for the machine’s end user. The EL5101 EtherCAT Terminal is an interface for the direct connection of incremental encoders with differential inputs (RS485). A 16 bit counter with a quadrature decoder and a 16 bit latch for the zero pulse can be read, set or enabled. Incremental encoders with alarm outputs can be connected at the interface’s status input. Interval measurement is possible.

“With the low-cost Beckhoff EtherCAT I/O system, we have the best solution available for our previous I/O board challenge,” Koenigs said. “The simple, direct I/O connection to the CX1020 made this decision that much easier.”

**User-friendly machines**

The main objectives of the Conflex machinery renaissance were to not only make the machines perform better, but also to make them more flexible and even easier for end users to operate. “ServoFlex machines feature pre-loaded training videos that can literally train end-users on how to quickly learn how to operate our machines,” Morrissey said. “This feature allows us to further differentiate with other machine manufacturers. It’s something that couldn’t be easily done using conventional controls platforms.”

“Because we run Windows CE on the CX1020 Embedded PCs, creating the human-machine interface (HMI) was quite straightforward for us,” Koenigs said. “Another added bonus from the use of Embedded PCs is that all the software resides on a Compact Flash (CF) card so changes can be made very easily in the field if needed.”

**Seamless integration into production line**

The new control platform has proved very positive in all respects: Conflex machines are now better suited to integrate more seamlessly into lines with machines from a variety of manufacturers and extract data from the entire line. “The Ethernet capability is a huge benefit for our customers and helps us deliver the most flexible machines possible,” Morrissey said.

The controls replacement cost on Conflex machines has been highly optimized. “The old drive system with integrated intelligence cost about triple what we’re paying for a Beckhoff system that does more work,” Morrissey said. “With the kind of success we experienced on the ServoFlex line, Conflex will be expanding the use of Beckhoff controls into other machine lines to fully apply our expanded PC-based control expertise.”

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**Conflex, Inc. [www.conflex.com]**

**Beckhoff USA [www.beckhoffautomation.com]**
Commonly, tube forming machines size tubes specific to either their outside diameter or inside diameter. To achieve the best rounded form, the tubes are expanded beyond the intended final diameter by an inner machine tool and subsequently forced back to the exact specified diameter by an outer machine tool. If the tube is formed only once, i.e. immediately to its final shape, variations in material properties (welded seams), spring-back, etc., can create an undesirable oval shape. Exactly how much a machine must over-expand a tube is determined by a manual trial and error process; i.e. several parts are produced until the specified dimensional accuracy is achieved. Modern CNC tube forming machines have the advantage that they can simulate forming variations without wasting valuable materials and setup time.

**Dynamic machines – inconceivable without high-end CNC**

“Using traditional controls, bending tubes that are 3 inches long at the end of the process often wastes up to 6 inches of material,” explains Cliff Bailey, Electrical Engineering Manager at GWS. “GWS machines are specially designed to produce very short tubular parts efficiently, with much less waste.” By means of a unique forming and cutting process, the machines can reduce the amount of wasted material to a ¼ inch. In order to maintain this advantage, GWS needed a PC platform with the maximum available processing power.

In early 2006, GWS had to design two completely new, complex CNC machines for one of their largest customers. Cliff Bailey saw this as an opportunity to move towards a more reliable and higher performance PC control platform. “We had used PC-based control for a few years, but we were looking for an alternative that was free of rotating parts.” Bailey says. Besides stable, vibration-resistant hardware, GWS sought to provide their customers with more process and production data and online diagnostics from the machine tools.

**Robust industrial PCs – successors to outdated controllers**

In order to fulfill the requirements of the automotive industry, GWS use the latest Industrial PC technology for the CNC control in their machines. After a thorough analysis of all major industrial PC suppliers, Bailey ultimately selected CX1000 and CX1020 Embedded PCs running TwinCAT NC PTP automation software for PLC and Motion Control functions.
GWS relies on optical fiber technology for networking: a SERCOS interface as fieldbus and IP-Link for the cabling of the IP 67 Fieldbus Box I/Os. “Fiber optic cabling is ideal for our machines because it is highly immune to electrical interference,” explains Bailey.

“With the help of PC-based controls, we can easily do the work of two traditional tube-end forming machines with just one GWS machine,” he says. “For example, typical production of an exhaust part where one end of the exhaust tube is opened up and the other end is formed with a much smaller diameter, would normally require two machines to manufacture. GWS offers an ‘all-in-one’ solution for this type of application.” Not only does this save the purchase price of a second machine, but, perhaps more importantly, it saves extremely valuable automotive factory floor space. It also reduces the amount of time operators spend walking back and forth to different machines during the manufacturing process.

“The compact size of the CX controller and the use of remote Bus Terminals reduced the size of the control cabinets by almost 50 percent. We only use as many I/O terminals as we really need, 2-, 4-, or 8-channel, exactly matching the respective requirement,” Bailey explained. “We have also cut our required wiring time in half via the use of IP-Link fiber optic cabling and the ability to wire our sensors directly into the Beckhoff Bus Terminal blocks. The whole process of converting to Beckhoff equipment was extremely fast. The design process took less than three months from start to finish,” Bailey emphasizes. Today, GWS machines equipped with CX series Embedded PCs are widely used in factories. With high processing power, hardware reliability, small controller size and improved wiring efficiency, Bailey believes he’s found the optimum control platform for tube forming machines: “GWS is converting all standard controls on CNC machines to a Beckhoff automation platform. We will only retain a traditional PLC platform for machines at the low end of the performance range.”
The ‘Tornado’ is an ingenious automated warehousing solution because it uses a very fast and quiet lifting technique that operates like a lift. When the correct product code is entered into the system either manually, using a barcode reader or automatically, the lift fetches the ordered pallet and brings it to the picker at the right collection height. If necessary, the entire pallet can be transferred to another working location.

“The Tornado is a secure and closed warehouse system for valuable and fragile goods. We’ve calculated that it saves a good 70 % of the floor space needed by a conventional warehousing system and speeds up picking by around 60 %,” says Constructor Finland Oy’s R&D Manager Stefan Lindh. The Tornado can easily be adapted to the dimensions of the customer’s product and can be built up to 15 meters high. That makes it ideal for customer-oriented applications such as in cash & carry stores.

New generation of automated warehousing systems
Development of the new Tornado started in early 2006. One objective was to make it so operationally reliable and easy to use that it could be marketed for use in consumer outlets. Another aim was to build an operating system from components that are readily available on the commercial market.

“First of all, we set about modernizing the PC-based control and operating system. The chipset and the servo board had been the Achilles heel of the old Tornado so we wanted to eliminate the multiple control cards needed inside the PC. Beckhoff’s PC-based control system was the optimal solution for this,” explains Lindh.

“One of Beckhoff’s strengths is that they offer open automation systems, which are compatible with components made by other suppliers. The PC-based controller also allows the use of different sizes of monitor screens. Besides that, all of the functions of a Windows environment can be used,” Lindh continues. The Tornado’s automation system is based on a C5102 Industrial PC running a Windows operating system and TwinCAT automation software. The fast EtherCAT real-time Ethernet system was chosen as the fieldbus and EtherCAT Terminals with the EL6752 DeviceNet master terminal as the I/O system. Communication between TwinCAT and the Tornado’s interface is via TwinCAT ADS.

“The Industrial PC as a control platform guarantees a trouble-free interface with all higher-level systems. The important thing here is the connection compatibility to a wide range of ERP systems,” emphasizes Vilho Heinonen, Key Account Manager at Beckhoff Finland.

“Beckhoff was fully involved in the project from the outset and was able to provide excellent support, not just in Finland, but also in the countries where our warehousing systems are delivered,” explains Lindh.
will enhance service and considerably improve product availability – while also saving costs by way of higher efficiency. A total of 110 Tornados were sold in 2006. This year, the target is well over 200 units. The main market areas to date have been Scandinavia and England, but there is now worldwide demand. Existing customers include, for example, Aker, Scania and SAS.

Kasten-Tornado www.kastentornado.fi
Constructor Finland Oy www.kasten.fi
Beckhoff Finland www.beckhoff.fi

More user-friendly
Thanks to its simple design, the Tornado is very reliable and requires little maintenance, which means that it will in future make an appearance in consumer outlets as well. Although stores are increasingly run on a self-service basis, the problem remains that the consumers themselves can only pick goods from the lower shelves. The lower shelves then empty quickly and cannot be replenished from the higher shelving during the store’s opening hours. The Tornado brings the goods directly to the consumers from a height of several meters at the touch of a button. Automated warehousing that consumers can use

Picking times are very short thanks to the Tornado’s fast vertical and horizontal speeds. Picking locations can be on many levels.

Product development manager Stefan Lindh believes that the cooperation with Beckhoff will in future extend to other products as well.

Technical specifications:

- Pallet width (internal dimension): 1,250–4,000 mm (4 – 13 ft)
- Pallet depth (internal dimension): 520, 620, 720, 820 and 1,220 mm
- Pallet weight, max.: 500 kg (1,102 lbs)
- Load height, max.: 850 mm (2.8 ft)
- Vertical speed, max.: 2.2 m/s (7.2 ft/s)
- Horizontal speed, max.: 1.2 m/s (3.9 ft/s)
- Pallet exchange time: 15 s
- Payload, max.: 40,000 kg (88,000 lbs)
- System height, max.: 15 m (49.2 ft)
- Power supply: 3 x 400 V AC
- Motor rating: 5.5 kW
Energy data acquisition with Internet connection for buildings

The main reason for the poor exploitation of energy potentials is the lack of an accepted database for the users’ consumption behavior. Recording devices for electricity, fuel, heating or water are almost always present nowadays, above all due to legal stipulations, but even when these devices have an electrical interface, they work almost exclusively as stand-alone solutions with proprietary hardware and software. This hinders further continuous processing and sometimes even the comparability of recorded data with regard to the lasting management of consumption costs. Simple examples of this are the identification of hidden “electricity hogs” within a house installation or the determination of leaks in the water supply. However, complex optimization work too, such as the hydraulic balancing of heating circuits, can only be accurately and economically assessed by means of the long-term analysis of comparable consumption data.

The Ingenieurbüro Dr. Lauzi has stepped up to fill this gap with a new, modern concept for the acquisition of consumption data – especially for smaller and medium-sized buildings. The controller design is based on the BC9000 Ethernet controller from Beckhoff, which, besides being suitable for use in the widest variety of industrial applications, is also ideal for the requirements of industrial building automation and home automation.

“We decided to use a Beckhoff controller because we needed a product that could be integrated in the overall design together with the widest variety of components and at the same time satisfy our requirements with respect to equipment and loading capacity,” explains Dr.-Ing. Markus Lauzi. “System-related limitations, in particular the size of the non-volatile memory, can be easily overcome by selecting the next-largest product family such as the new CX1010 Embedded PC.”

The BC9000 is connected to the building’s technical network systems via Ethernet. Using DynDNS (dynamic DNS entry) and a VPN-capable router, a direct Internet connection can be established at no extra cost.

With this system, the user is able to:

- read out and record consumption data from individual measurement points in accordance with a preset program or at any time if need be, whereby the acquisition time interval can be anywhere within a range of minutes to years,
- carry out password-protected actions, such as correcting or resetting the display values of meters that track consumption and
- read out collected data along with a local display from anywhere in the world with the aid of proven Internet technology and process it with the aid of a spreadsheet program.

The software, which was developed by the Ingenieurbüro Dr. Lauzi from the requirements of a building administration, is modularly constructed as a “consumption data acquisition” technological function block in the form of an IEC 61131 library.

Simple scaling of the application is always possible. Long-term experience has been gained with several successfully installed systems. Currently, analyses are taking place with, among others, electricity and gas meters connected via a simple pulse interface with digital input terminals. The timebase is provided by an operating device with a two-line display, which is connected via Modbus RTU to the KL6021 serial communication Bus Terminal I/O module.

The core of the energy data acquisition system is a BC9000 Bus Terminal Controller. Due to the high scalability of Beckhoff control technology, CX1010 to CX1030 Embedded PCs or a high end Industrial PC can also be used as the central intelligence for larger applications.
The test rig software from Birke can be used for testing and setting up hydraulic or electric steering systems and the associated control valves and sensors. It can be used for toothed rack or recirculating ball steering systems. Realistic driving conditions are simulated on a test rig. One of Birke's long-standing customers is Mercedes Benz Lenkungen GmbH, which in 2005 was taken over by ThyssenKrupp Technologies. Birke initially supplied a DOS-based test rig software to the company. Since 1999 the software has been Windows-based and features its own real-time system.

The parameterizable software can be adapted to the respective test task in terms of procedure and function without programming effort. Comprehensive diagnostic options offer support for exposing technical faults. In addition, Birke offers its own solutions for PDA and CAQ applications. The test rig software is suitable for laboratory rigs (and for very precise and time-consuming measurements) and for production rigs with cycle times of 30 seconds. The following parameters can be analyzed and controlled:

- Steering angle, accuracy 65,000 increments/90°
- Toothed rack distance, accuracy 1/10 µm (correct)
- Toothed rack speed between 10 µm/s and 100 mm/s, max. following error ±10 µm at ±10 kN load
- Volume flows with an accuracy of ±0.05 l/min up to a delivery rate of 20 l/min via proportional valves or directly via pump control lines
- Torque values

**EtherCAT – convincing speed and flexibility**

Commercially available hydraulic control systems are too slow, too inaccurate and too inflexible for controlling and analyzing these processes. What’s more, these controls represent an additional system that has to be programmed, parameterized and integrated into the terminal computer via a defined interface, which leads to additional overhead and potentially significant costs for the required hardware and its integration into the terminal computer. Birke Systemtechnik therefore decided to use a software-based solution from Beckhoff: TwinCAT PLC with a cycle time of 500 µs. Also, EtherCAT periphery ensures very fast sampling of the actual values and enables high-quality control.

The control system is integrated in the terminal computer, which makes it highly flexible. The digital and analog I/Os for the test rig control system are connected to the EtherCAT terminal system. The customer benefits from a high degree of flexibility with regard to system expansion (hardware and software). The fast, high-resolution analog inputs required for the tests are monitored via EL3102 input terminals (-10...+10 V) and via EL5101 incremental encoder interfaces.

The test software accesses the PLC via TwinCAT ADS. The real-time system from Beckhoff and the 500 µs cycle causes less than 5 % load on the PC.

"Overall we have achieved a very homogeneous, compact and cost-effective solution", said Christian Birke, managing director of Birke Systemtechnik. "We have already built several test rigs for EPAS (Electric Power Assisted Steering), the steering system of the future. While car manufacturers expect production benefits from electric servo steering in the form of reduced model variety, drivers should experience lower fuel consumption and increased comfort."
ETG News

ETG offices in North America and China

In order to serve its global membership even better, the EtherCAT Technology Group has opened offices in China and North America. In close cooperation with the Headquarters in Germany and the Japanese office, the new offices are now available for all kinds of requests regarding the EtherCAT technology.

The North American office is based near Austin, Texas, and is overseen by ETG North American representative, Joey Stubbs. Joey joins the EtherCAT Technology Group with several years of experience with the next generation Ethernet-based fieldbus as well as numerous other major industrial protocols. Prior to joining the ETG, he worked as a Sales and Applications Engineer with Beckhoff Automation where he strengthened his expertise in the areas of Industrial Ethernet, fieldbuses, automation, PC-based control, PLCs and Motion Control. Joey Stubbs holds a B.S. in Electrical Engineering from the University of South Carolina, as well as several technical degrees. He is also a registered Professional Engineer. With his years of technical experience working with EtherCAT industrial applications, ETG is convinced that he is an ideal fit for the organization and will have an immediate impact serving the ETG member companies in North America.

The Chinese office is located in Beijing, and is managed by the ETG China Representative Beryl Fan. Beryl has a technology marketing background and has been involved in the promotion of EtherCAT in China since mid-2006. She is supported by YanQiang Liu, from Beihang University. YanQiang holds a PhD in engineering and is an acknowledged EtherCAT expert. He just finished a six month training period in Germany, where he studied EtherCAT in detail and developed software tools for analyzing network traffic. Thus the Beijing Team combines marketing and technical expertise in an ideal way to further accelerate the EtherCAT adoption in China.

The world’s first Java-powered Industrial Robot is EtherCAT-based!

Developed by Dr. Klas Nilsson and his team at Lund University, Sweden, and supported by Sun Microsystems, the robot FlexPicker from ABB was presented at the JavaOne Conference in San Francisco, California.

The robot is controlled with EtherCAT drives from a standard PC.

EtherCAT was chosen primarily for two reasons: outstanding performance, which is crucial for demanding applications such as robot control, and the possibility to implement the master entirely in software, without any dedicated master hardware. This ensures maximum flexibility and independence from hardware manufacturers.

Dr. Klas Nilsson explains: “We used EtherCAT directly from real-time Java via the Solaris Streams/Data Link Provider Interface. This means that the entire EtherCAT master can be implemented in standard real-time Java, which provides maximum portability. Since the technology is well documented, we developed the stack within just two months.” Lund University intends to use the system with other robot types as well and furthermore to make the EtherCAT Java master available as open source.

“EtherCAT is on its way to become the de-facto standard for demanding motion applications in general, and for robotics in particular. This impressive project clearly demonstrates both the openness of the technology as well as technical benefits,” comments Martin Rostan, Executive Director of the EtherCAT Technology Group. “We also welcome the plan to make the Java master stack available as open source. It will be a valuable enhancement of the EtherCAT open source software portfolio, which already contains implementations for several operating systems.”
ETG: more than 500 members

The 500th member of the ETG is Salvagnini Italia s.p.a., the Italian company known for sheet metal manufacturing solutions. Roberto Capolupo, CEO of the company, received the membership certificate at a small ceremony at their Vicenza plant, close to Verona in northern Italy.

“Salvagnini considers itself to be the driving force in sheet metal fabrication. Joining the EtherCAT Technology Group and adopting this superior communication technology is hence in line with our philosophy: to continue to be the worldwide reference for applying intelligence to sheet metal working,” said Capolupo.

Martin Rostan, Executive Director of the ETG, added: “To exceed 500 member companies from 35 different countries just 3 1/2 years after founding the EtherCAT Technology Group shows the tremendous worldwide interest in our technology. Companies like Salvagnini benefit notably from EtherCAT, since they not only have demanding applications, but also develop their own control technology. Thus, high performance paired with simple implementation and low costs are crucial features where EtherCAT provides a unique combination of advantages. We welcome Salvagnini as our 500th member and look forward to support their EtherCAT application as successfully as we have done with so many members in the past.”

At this year’s Hannover Fair, ETG was represented with a large number of exhibitors. At the ETG booth in Hall 9, 46 manufacturers presented more than 90 different components and devices based on EtherCAT technology. The range of products included controllers, drives, I/O components, hydraulic and pneumatic valves, sensors and operating devices, as well as Safety over EtherCAT solutions.

Roberto Capolupo, CEO of Salvagnini Italia s.p.a., presents the membership certificate in the presence of Martin Rostan (Executive Director, ETG, on the left).
Trade shows 2007

Europe

Germany

EMO
September 17 – 22, 2007
Hanover
www.emo-hannover.com

HusumWind
September 18 – 22, 2007
Husum
Hall 3, Booth 3B17
www.husumwind.com

Motek
September 24 – 27, 2007
Stuttgart
www.motek-messe.com

K Kunststoff
October 24 – 31, 2007
Düsseldorf
Hall 11
www.k-online.de

Forum Maschinenbau
November 08 – 09, 2007
Bad Salzuflen
www.forum-maschinenbau.com

SPS|IPC|DRIVES
November 27 – 29, 2007
Nürnberg
Hall 7, Booth 406
www.mesago.de/sps

Austria

Smart
October 03 – 05, 2007
Linz
www.smart-automation.at

Belgium

Mocon-Hydromech
October 17 – 18, 2007
Brussels
www.easyfairs.com/shows/

France

SCS AUTOMATION
November 13 – 16, 2007
Lyon
www.scs-automation.com

Italy

C2 Control & Communication
September 20, 2007
Milan
c2.vnu.it/c2

C2 Control & Communication
September 25, 2007
Bari
c2.vnu.it/c2

Austria

Smart
October 03 – 05, 2007
Linz
www.smart-automation.at

Belgium

Mocon-Hydromech
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For additional information on our worldwide subsidiaries’ and partner companies’ trade show schedules please check:

**Russia**

HI-TECH HOUSE & Building
November 07 – 10, 2007
Moscow
Booth 103
www.hitechhouse.ru

Automation
November 20 – 23, 2007
Saint-Petersburg
Booth A5
www.farexpo.ru

PTA Ural
December 04 – 07, 2007
Ekaterinburg
Booth D21
www.pta-expo.ru/ural

**Spain**

TECNIEXPO
October 03 – 05, 2007
Barcelona
www.tecniexpo.com

**Sweden**

Scanautomatic
October 09 – 12, 2007
Göteborg
Hall B
www.scanautomatic.se

**North America**

USA

National Manufacturing Week
September 25 – 27, 2007
Rosemont (Chicago), Illinois
Booth 1000
www.manufacturingweek.com

Pack Expo
October 15 – 17, 2007
Las Vegas, Nevada
Booth 5352
www.packexpo.com

**Asia**

**China**

Industrial Automation Show
November 06–10, 2007
Shanghai
www.industrial-automation-show.com

For additional information on our worldwide subsidiaries’ and partner companies’ trade show schedules please check:

www.beckhoff.com
The world of wood was the new lead theme for the 11th Ligna+ trade fair, which ran in Hanover, Germany, from 14 to 18 May 2007. In hall 19, Beckhoff presented its open automation solutions for the wood industry.

The range of furniture available in the market today is more diverse than ever: The furniture industry caters for all conceivable requirements and preferences with regard to style and design, comfort, functionality and price. This market leaves nothing to be desired and responds to trends and fashions in a target group-specific manner. The fast pace of changing living styles and not least the competitive environment oblige furniture manufacturers to offer highly flexible product ranges. Individual production has thus become a common requirement for the furniture industry and its suppliers – naturally with maximum throughput.

Meeting these requirements represents a challenge for the machine construction and system engineering sector, because furniture manufacturers keep asking for more powerful, more flexible and more automated systems that enable them to supply top-quality products at prices in line with market requirements. The furniture production process involves a wide range of machines with different functions and stringent requirements in terms of performance and flexibility. Data management is an increasingly important factor in industrial manufacturing, both vertically (from order processing to the machine) and horizontally (between the individual machines in a production line). Machine builders have to find the right balance between top performance, low costs, optimum integration into the respective production structure and machine type, and ease of use.

There is basically only one platform that can meet all these requirements, i.e. PC-based control, which combines PLC, NC/CNC, line and camming functionality in a single hardware or maps it through software modules. The PC can easily handle tracking of parts, user interfaces, CAD/CAM user interfaces, drill optimization, configuration tools, production data collection and local databases. Porting all functions to PC hardware also simplifies data transfer – generally via Ethernet – to the production databases and ERP systems.
Further information about Beckhoff products and technologies or contact addresses for our worldwide subsidiaries and partner companies can be found on the Beckhoff website. All PC Control articles are available online at www.pc-control.net.
EtherCAT Terminals: The I/O system for EtherCAT

- Real-time Ethernet down to the I/O level
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- Easy configuration
- Maximum performance
- Outstanding diagnostics
- Low system costs

www.beckhoff.com/ethercat-terminal

Extremely fast I/O technology
- Flexible I/O system for the EtherCAT real-time Ethernet fieldbus
- The EtherCAT protocol is maintained right down to each device.
- Line, tree or star topologies can be freely selected and combined.
- Cost-effective wiring via standard Ethernet cables
- Almost unlimited network size: up to 65,535 devices
- Integration of traditional fieldbus devices through master/slave terminals
- Decentralised connection of Ethernet devices via switch ports
- Breaking point detection, exact location of faults
- Integrated safety: TwinSAFE terminals for Safety over EtherCAT

For further information and international sales contacts see: www.beckhoff.com

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