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Beckhoff Automation was established in 1980 and the first PC-based machine controller was delivered by Beckhoff just six years later. It was a ‘simple’ controller for a double miter saw, which encompassed single-axis positioning control with a few machine sequence functions. The saw was a well-known standard machine, which became a direct sales success for the machine manufacturer due to the innovative PC Control technology. The combination of IT functions and automation technology (AT) in a controller was and is still a revolution. The benefits resulting from this revolution were recognized even at the beginning and received enthusiastically by machine manufacturers and users. For example, data could be read directly into the machine controller using standard IT media (floppy disks). In 1986, this represented significant progress in productivity.

Beckhoff expanded the company’s PC Control concept consistently and quickly in the years that followed: Multi-axis NC functions and a complete, integrated software PLC enabled the PC-based Control of highly complex machines and plants. It should be mentioned here that Beckhoff has advanced this technology in close cooperation with many mid-sized customers, who were open to the new technology concepts and certainly benefited from them. These ambitious companies have made an important historical contribution to the development of PC Control.

In 1990, PC Control technology had matured to the extent that Beckhoff presented the concept to the wider public for the first time at Hanover Fair. The professional world was surprised, skeptical and impressed. The high performance and value for a low cost quickly convinced many customers, however. Starting with this Hanover Fair, PC Control has become generally accepted worldwide as a standard technology in automation and has enabled the Beckhoff workforce to grow from 40 employees at that time to 1650 people worldwide today.

There have been no fundamental changes to this successful concept since then: the abstraction of the control function from the device hardware and the consistent use of ‘mainstream’ IT technologies converging with the principles of automation technology lead, on the one hand, to continuously improving performance and functionality and, on the other, to cost reductions. The PC Control principle is very simple: a powerful Industrial PC, an equally high-performance fieldbus to which peripheral devices for sensor and actuator systems are connected and control software with real-time capability for motion and logic – nothing more is required.

Of course, Beckhoff has developed further important products over the last 25 years that could be considered milestones, since they each represent a smaller or larger revolution and have contributed in no small way to the current state of PC-based automation. I would like to mention here:

- 1989: Lightbus – fibre optic fieldbus for fast I/O coupling
- 1995: Bus Terminals – fine granular I/Os
- 1996: TwinCAT – standard real-time automation software running on Windows
- 2003: EtherCAT – real-time Ethernet for automation
- 2005: TwinSAFE – functional safety in non-safe environments
- 2006: Scientific Automation – measuring technology and engineering science as a control component
- 2008: XFC – eXtreme Fast Control for efficient machines and plants
- 2010: TwinCAT 3 – engineering tool for object-oriented and modular automation
- 2011: CCAT – C for Control Automation Technology – automation based on high-level languages

When we at Beckhoff want to describe the variety of demands placed on automation, we say: “The world is big and colorful” – and we are proud of the fact that our PC Control technology has found the widest use in this big, colorful and also beautiful world: in machine construction and plant engineering, in measurement and testing technology, in wind turbines and photovoltaic manufacturing, in office buildings and private houses, in stage technology and on luxury yachts, in medical technology and in particle accelerators … PC Control from Beckhoff is the basis for intelligent, powerful and reliable control technology in all fields.

And the revolution continues, driven by hardware and software advances in IT and AT. Multi-core technologies permit the provision of virtually unlimited computing power and new software tools are improving engineering. All automation engineers are called on to use these increases in performance, for example, to control machines, plants and buildings with greater efficiency while using less resources, and in particular to give free rein to their imaginations and to contribute to the future revolutions of the next 25 years.

Automation remains exciting!

Hans Beckhoff
Beckhoff elevates Motion division

With a major new development agreement, Beckhoff has invested in the future development and production of its own Drive Technology. Fertig Motors GmbH, which is cooperating in a joint venture with the Beckhoff Group, will co-develop and produce highly dynamic Beckhoff servomotors. The first of these products will be presented at the end of 2011.

The Motion division is being strategically expanded with new product lines in the category of Servo Drives, servo terminals and servomotors. Production capacities for Beckhoff Drive Technology have already been expanded. The target is to grow the Motion division in the medium term to 25% of total turnover.

In cooperation with Fertig Motors GmbH, whose headquarters are in Marktheidenfeld, Germany, Beckhoff is developing new product series of servomotors that are specially designed for PC- and EtherCAT-based control technology from Beckhoff. Fertig Motors was established in March 2010 as a joint venture between Beckhoff and Erwin Fertig, the former CEO and founder of Elau. Fertig currently has a team of 15 experienced motor and Drive Technology developers. The production facility is currently under construction and will begin series production at the end of 2011. “Our goal is to develop the next generation of servomotors: more dynamic, more energy-efficient and available at a low cost. Our team of highly motivated specialists is looking forward to this new challenge and is going about its work with enthusiasm. In order to ensure maximum quality standards and to guarantee high availability, all motors should be ‘Made in Germany’,” states Erwin Fertig.

With the new standard product lines as a basis, the intent is to also develop and manufacture application-specific motors in the future. In this way, Beckhoff and Fertig Motors strive to provide their customers and their customers’ applications with ideally suited motion products. The existing standard servomotor series from Beckhoff – the AM2000, AM3000 and AM3500 – will, of course, continue to be expanded even further, so that the widest possible range of drive solutions will be available.

Hans Beckhoff, Managing Director of Beckhoff, regards the cooperation with Fertig Motors as a big step in the company’s development: “We have always specialized in hardware and software, and naturally we have extensive know-how in Drive Technology. However, our knowledge will now be decisively deepened with the development of our own motor series, especially in the area of highly dynamic magnetic mechanics and the associated control algorithms. We are delighted with this new partnership and we are convinced that we will be able to offer our customers even more powerful system solutions as a result.”
Prof. Dr.-Ing. Frank Schiller strengthens the Beckhoff “Safety and Security” team of excellence

Prof. Dr.-Ing. Frank Schiller took over the position of Scientific Project Manager in the Safety and Security Division of Beckhoff with effect from 1st March 2011.

Prof. Dr. Frank Schiller lectures at the Technical University of Munich, Germany, and works in the field of safety and security in automation technology. With his research and developments, Prof. Dr. Schiller has contributed substantially to the modern concepts for safety-related communication and software-based safety logic. Prof. Dr. Schiller studied electrical engineering at the Technical University of Dresden, Germany, from 1987 to 1992 and subsequently attained a doctorate in the field of control technology at the Technical University of Hamburg-Harburg, Germany. Following his doctorate, he moved to industry and worked on different topics of diagnostics, safety technology and software development. During this period he was heavily involved in the development and certification of the PROFIsafe safety protocol and of the fail-safe control technology. In November 2004 he accepted a professorship for automation technology at the Faculty of Mechanical Engineering at the Technical University of Munich, Germany. Beckhoff and Prof. Dr. Schiller are looking forward to their future cooperation, which is intended to be a synthesis of science and industrial development. “Safety is an integral component of automation technology and we have already set an extremely efficient standard in this field with Safety over EtherCAT,” says managing director Hans Beckhoff. “Together with Prof. Dr. Schiller we will realize further extremely innovative concepts, which in our view can likewise become technological milestones.”

Beckhoff India establishes a new branch office in the Gujarat region

Beckhoff has extended its sales network with the establishment of a new branch office in Ahmedabad, in Western India. The office in Ahmedabad is managed by the Regional Sales Director, Mitesh Gajjar. Apart from sales and marketing, the Ahmedabad branch office also accommodates the training center, which is specially tuned to the automation needs of Beckhoff customers in the Gujarat region. Gujarat is the center for numerous machine manufacturers from the most diverse industrial markets. These include textiles, plastics, packaging, pharmaceuticals and machine tools.

Beckhoff India www.beckhoff.co.in
Beckhoff is presenting its control technology for packaging machines at Interpack 2011. The highlight of the live presentations is a highly dynamic handling solution for products and packaging from the foodstuffs industry. The H 130 handling module combines high-tech mechanical engineering from MULTIVAC with state-of-the-art control technology from Beckhoff. The pick-and-place robot is based on TwinCAT automation software and EtherCAT as the fast communication system. The FDA-compliant Beckhoff stainless steel operating panel and servomotors are specially designed for the stringent hygiene requirements in the food industry. MULTIVAC, specialists for packaging machines based in Wolfertschwenden, Germany, use PC-based control technology from Beckhoff in all of their fully automatic machines. The H 130 handling module functions either as an autonomous pick-and-place robot, or it can be fully integrated into MULTIVAC’s automated packaging lines. It automates a wide range of handling tasks in packaging processes and is characterized by high speed and precision, fast convertibility and a consistent hygienic design.

The PC controller in the H 130 consists of a compact CX1020 Embedded PC with integrated I/O terminals for the coupling of sensors and actuators as well as TwinSAFE terminals for the safety equipment. MULTIVAC uses Beckhoff type AX5000 Servo Drives for accurate positioning tasks. The basis for the fast process communication and highly dynamic regulation of the drive axes is EtherCAT, the Industrial Ethernet system. The four axes of the MULTIVAC handling module allow exact spatial positioning as well as orientation in the vertical axis. This allows products weighing up to 1000 g to be picked up and orientated as desired.

At Interpack in Düsseldorf, Germany, 12 – 18 May 2011, Beckhoff will present its automation and industry solutions for the packaging industry. PC Control from Beckhoff enables the automation of the complete process chain for a packaging line. Beckhoff Industrial PCs and TwinCAT automation software can be used to integrate a wide range of packaging tasks such as filling, forming, sealing, labelling, collecting, re-packing and palletizing. At the Beckhoff booth in Hall 15, Booth D25/E26 the focus is on Industrial PCs, Automation and Motion as well as on the new software generation TwinCAT 3.

**All in one: Robotics and Motion Control on one platform**

The PC-based control system from Beckhoff combines PLC, Motion Control and Robotics on one hardware and software platform. The “TwinCAT Kinematic Transformation” software integrates itself transparently into the existing Motion Control world, allowing Robotics and Motion Control functions to be optimally synchronized. For example, the 3-D Delta kinematics can be coupled simply with the “flying saw” function in order to synchronize to conveyors and to pick up or set down packaging (Conveyor Tracking).
The FDA-compliant and hygienic stainless steel design of the handling solution enables the wet cleaning of the entire unit. MULTIVAC chose the Beckhoff Control Panel in a high-quality stainless steel finish for this. The control units and operating devices comply with the stringent hygiene requirements in food technology. The stainless steel panels with IP 65 protection feature virtually gapless housing design with flush-mounted touch panels. The servomotors for the pick-and-place unit are also designed for the food industry. The AM3000 servomotor series with a white surface coating is FDA-compliant. The coating is suitable for use with foodstuffs and is resistant to aggressive cleaning agents.

Beckhoff at Interpack
MULTIVAC H 130 handling module
www.beckhoff.com/interpack
www.multivac.com

Industry prize for Nils Johannsen, a Beckhoff engineer

On February 15th, 2011, the industry prize of the Westcoast University of Applied Sciences (Fachhochschule Westküste, FHW - Germany) was awarded for the ninth time in Heide (in the district of Dithmarschen) in the context of the Automation Forum. The decision for this award was made by a committee consisting of one representative each from the FHW supporters’ association, business and the university. Nils Johannsen, 24 years old and working in wind turbine applications software at Beckhoff accepted the prize for his bachelor dissertation on “The development of a fuzzy controller for the blade angle of a wind turbine.”

In his speech, Dr. Sven Wanser, business area manager of E.ON Hanse AG, described Nils Johannsen’s thesis as ground-breaking. It showed that fuzzy logic is more suitable than conventional technologies for controlling wind turbines. Nils Johannsen succeeded in considerably simplifying the design of the controller, improving the quality of the control and, as a by-product, also significantly reducing the required engineering effort. “In contrast to the PID controllers currently employed for most wind turbines, fuzzy controllers are intrinsically non-linear state controllers and said to have very robust characteristics,” explains Robert Müller, a wind energy business manager at Beckhoff, who supervised Nils Johannsen’s dissertation work.

After his practical semester in Beckhoff’s Lübeck branch office, Nils Johannsen worked at Beckhoff as a student trainee in software programming during his study of electrical engineering and information technology. He has been employed in the Lübeck branch since the start of 2011, working in the applications software area. At the same time, he is working toward his master’s degree via long distance learning.
The BK1150 “Compact” Bus Coupler connects EtherCAT to the modular extendable Bus Terminals (K-bus). A unit consists of a Bus Coupler, any number of terminals from 1 to 64 (with K-bus extension: 255) and a bus end terminal. The “Compact” Bus Coupler offers a cost-optimized alternative to the BK1120 EtherCAT Bus Coupler.

www.beckhoff.com/BK1150

Stainless steel Control Panel and Panel PC series combines control and operating units that meet the strict hygiene regulations for the food, packaging and medical industries as well as for cleanrooms. The range is completed by a stainless steel mounting arm adapter for adaptation to steel pipes, which can be ordered as an option. The range is rounded off by customer-specific modifications, such as additional display sizes or the integration of emergency off and electromechanical buttons, short-stroke keys and RFID readers under the front laminate as well as USB ports.

www.beckhoff.com/stainless-steel-panel

CX8000 Embedded PC with automatic E-Bus / K-Bus recognition

With the new CX8000 series Embedded PCs, a special option no longer needs to be selected to communicate with different I/O systems (E-Bus or K-Bus). The basis for this solution is a direct I/O interface that is designed for the connection of both Bus Terminals and EtherCAT Terminals. The CX8000 Embedded PC automatically recognizes the type of I/O system connected during the start-up phase. This increases flexibility and reduces storage costs for those users who implement both Beckhoff I/O systems.

The Embedded PCs from the CX8000 series with 400 MHz ARM CPU and microSD card as the storage medium are suited primarily for use as decentralized intelligence. Connection to the master controller takes place via an integrated fieldbus slave. To this end, the CX8000 series features six versions with fieldbus interfaces for EtherCAT (CX8010), PROFIBUS (CX8031), CANopen (CX8051), PROFINET (CX8093), EtherNet/IP (CX8095) and Ethernet (CX8090).

www.beckhoff.com/CX8000

The flexible CX8000 series Embedded PCs automatically recognize the type of I/O system connected to the device: Bus Terminals (K-Bus) or EtherCAT Terminals (E-Bus).

www.beckhoff.com/CX8000
Industrial Ethernet: “Compact” Bus Coupler for Bus Terminal system

Cost-effective EtherNet/IP Bus Coupler in a compact design

“Compact” series Bus Couplers from Beckhoff have been supplemented with the new BK9055 for EtherNet/IP. The BK9055 couples EtherNet/IP with the modular Beckhoff Bus Terminal system, which offers over 400 different signal types. The “Compact” Bus Coupler series is characterized by slim housings and cost-optimized design.

The BK9055 “Compact” Bus Coupler allows the inexpensive connection of the Beckhoff I/O system to EtherNet/IP networks. The BK9055 is software-compatible to the BK9105 EtherNet/IP Bus Coupler from Beckhoff, which unlike the “Compact” version has a second RJ 45 port (2-channel switch). Therefore, the I/O stations can be configured with a line topology, instead of the classic star topology. For use in industrial Ethernet systems, the “Compact” Bus Couplers are also available for PROFINET (BK9053) and Ethernet (BK9050).

In addition to Ethernet TCP/IP, the BK9050 also supports Modbus TCP as well as cyclic data exchange in accordance with the EtherCAT Automation Protocol (EAP).

Beckhoff ET Bus Terminals for extreme climates

New extended temperature range increases I/O application flexibility

With the extension of the operating temperature range for selected standard Bus Terminals and Couplers to between -20 and +60 °C (-4 and 140 °F) Beckhoff supports applications in extreme climatic zones. The storage temperature of the ET Bus Terminals (Extended Temperature) is specified as an impressive -40 to +85 °C (-40 and 185 °F).

The Beckhoff Bus Terminal system has stood the test of time in machine and building automation applications where a temperature range of 0 to 55 °C (32 and 140 °F) is sufficient. Beckhoff has extended the operating temperature range for selected standard Bus Terminals and Couplers to between -20 and +60 °C (-4 and 140 °F) making them ideal for applications in the “outdoor segment.” Typical fields of application are alternative energy systems such as a wind, solar or tidal power plants, which in some cases have to operate under extreme climatic conditions.

The I/O terminals selected for the extended temperature range cover the most common are as of application and a wide range of signal types. As an added benefit to users, the components for the extended temperature range are available at the same price as the standard Bus Terminals.

The ET Bus Terminals may even enable users to save additional costs for reducing or eliminating the heating and air-conditioning requirements in the control platform. The CX5000 series Embedded PCs with direct I/O connection are also designed for this extended temperature range.

This represents a complete controller and I/O solution for extreme environments.

ET Bus Terminals
www.beckhoff.com/ET-Terminals

Selected Bus Terminals and Bus Couplers are now available as ET (Extended Temperature) components for the extended temperature range between -20 and +60 °C (-4 and 140 °F) and are specified for application in extreme climates.

The new BK9055 for EtherNet/IP extends the “Compact” Bus Coupler series for the Beckhoff Bus Terminal system. For use in Ethernet-based fieldbus systems, “Compact” Bus Couplers are also available for PROFINET and EtherCAT TCP/IP.

BK9055 Bus Coupler www.beckhoff.com/BK9055
Bus Terminals www.beckhoff.com/Busterminal
Beckhoff EtherCAT Box system – the solution for all standard analog signals

Combination I/O box enhances plant design flexibility

Beckhoff has extended its range of IP 67 I/O modules with the new EP4374 EtherCAT Box, which combines two analog inputs and two analog outputs in one device. The versatile combination I/O box offers a finely scalable solution that empowers machine manufacturers to plan ahead based on demand and, therefore, plan more cost-effectively. The input and output channels can be parameterised independent of each other for the standard signals 0…10 V, ±10 V, 0…20 mA and 4…20 mA.

With the combination of parameterisable inputs and outputs in a single housing, users benefit from increased flexibility and can utilise the existing signals in an optimal manner. The EtherCAT Box features two input channels and two output channels. Each channel is configurable individually for current or voltage measurement or output. The resolution for the current and voltage signals is 16 bit (signed).

The EP4374-0002 module has a direct EtherCAT connection, so that the high EtherCAT performance of 100 Mbit/s is retained right down to each IP 67 box. The compact dimensions of the EtherCAT Box of only 126 x 30 x 26.5 mm (H x W x D) make it ideal for applications in confined spaces.

Robust and compact: The Embedded PC with Intel® Atom™ for PC-based control.

The flexible CX5000 series from Beckhoff.

www.beckhoff.com/CX5000

The CX5000 Embedded PC series from Beckhoff for DIN rail mounting:
for flexible application as a compact Industrial PC or as a PC-based controller
for PLC, Motion Control and visualisation:
- Intel® Atom™ Z530 CPU, 1.1 GHz (CX5010) or 1.6 GHz (CX5020)
- Durable and compact magnesium housing
- High operating temperature range between -25 and 60 °C (-13 and 140 °F)
- Fanless, without rotating components (Compact Flash as storage medium)
- I/O interface for EtherCAT Terminals and Bus Terminals
- Optional space for serial or fieldbus interface
- Integrated 1-second UPS

### Technical Specifications

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<tr>
<th>Model</th>
<th>Description</th>
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<tr>
<td>CX1020/CX1030</td>
<td>Embedded PC with Intel® Pentium® M CPU, 1.8 GHz or Intel® Celeron® M CPU, 1.0 GHz</td>
</tr>
<tr>
<td>CX1010</td>
<td>Embedded PC with Pentium® MMX-compatible CPU, 500 MHz</td>
</tr>
<tr>
<td>CX9000/CX9010</td>
<td>Ethernet controller with Intel® XScale® technology, 266 MHz or 533 MHz</td>
</tr>
<tr>
<td>CX8000</td>
<td>Fieldbus controller with ARM9 CPU, 400 MHz, e.g. for PROFIBUS, PROFINET, EtherCAT and Ethernet</td>
</tr>
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Directly connect servomotor and resolver to a 12 mm Bus Terminal

Complete Servo Drive in a compact EtherCAT Terminal

The new EL7201 servo terminal for the Beckhoff EtherCAT Terminal system integrates a complete Servo Drive for motors up to 200 W into a standard 12 mm terminal housing. Efficient integration into the EtherCAT I/O system simplifies cabling and commissioning considerably while reducing space requirements and costs.
A servomotor is overloadable and therefore has much higher dynamics than a stepper motor.

- The high torque is independent of the load up to a high rotation rate.
- Using a servomotor reduces maintenance to a minimum.

All these benefits are available to the user of the new Beckhoff EL7201 servo terminal. Integration into the controls and the low space requirement of the terminal has various advantages. Firstly, the terminal makes an additional communications interface to the controller unnecessary and secondly, it leads to a considerable reduction in space requirements.

With the EtherCAT servomotor terminal the user can build compact and economical systems without foregoing the benefits of a servomotor.

### The Beckhoff servo terminal

The EL7201 is a fully capable Servo Drive for direct connection to servomotors in the lower performance range. There is no need for further modules or wiring to make a connection to the control system. This results in a very compact control system solution. The E-Bus connection of the EL7201 makes the full functionality of EtherCAT available to the user. This includes in particular the short cycle time, low jitter, simultaneity and easy diagnostics provided by EtherCAT. With this level of performance, the dynamics a servomotor can achieve is being used optimally. With a rated voltage up to 50 V DC and a rated current of up to 4 A, the EL7201 enables the user to operate a servomotor with a power of up to 200 W. Permanent magnet synchronous motors

<table>
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<th>Technical data in summary</th>
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<td>Number of channels</td>
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<td>Speed controller frequency</td>
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<tr>
<td>Motor brake output voltage</td>
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<tr>
<td>Motor brake output current</td>
</tr>
</tbody>
</table>

In the past, an applications engineer may have asked for many projects, “Do I really need servomotors for this machine segment or are stepper motors a possible solution?” In these cases, some of the advantages of servomotors were often passed up. Decisive for this was that using servomotors in an application was always a very expensive consideration. The reasons for that are clear. For the operation of a servomotor, a large amount of electronics is usually required. Accurate positioning is only achievable with a feedback system. Both of these aspects have a big effect on the price. From this viewpoint, the use of stepper motors was the more attractive variant for many applications. By internally counting their steps they can reach a specified position, avoiding the need for a feedback system. A further cost advantage is the simpler means of controlling the stepper motor. A servomotor requires a considerably more comprehensive and complicated drive circuit than a stepper motor. This usually requires large efforts in wiring and parameterization. In addition, present-day Servo Drives take up a lot of space. They need to be located in the control cabinet, separate from the controllers and connected to the controllers by means of a suitable bus system. This leads to increased requirements for space, wiring and costs.

"But why use a servomotor at all, if the stepping motor can position itself without a feedback system?" asks the application engineer. This legitimate question can be answered with a look at the details. The positioning of a stepper motor with internal step counting is of limited accuracy because, with a changing load, the motor’s position can vary within one step. A further drawback is the reduction of torque with increasing speed. This can also lead to positioning errors. The reduced torque when the load is too high can result in steps being lost, so the internal counter “gets the count wrong.” A suitable feedback system can prevent this. In the end, the cost advantage of the stepper motor over the servomotor dwindles.

The servomotor provides many advantages that can lead to a more efficient and capable application.

- Servomotors have a significantly higher efficiency.
- The Servo Drive achieves very high accuracy for high-precision requirements.
The various advantages of the servomotor make the EL7201 servo terminal particularly compelling for a large range of applications. The excellent dynamics are very suitable, for example, in industrial robotics. With the EL7201, very compact, but very powerful mini-industrial robots can be made for Pick & Place, welding and various other applications.

A servomotor is also well suited for other applications such as in machine tools and packaging machines. The high positioning accuracy available with a Servo Drive makes it possible to achieve exceptional coordination and synchronization on several axes. The advantages of the Servo Drive combined with the EL7201 enable the creation of very dynamic, accurate and compact applications.

Technical Information/video www.beckhoff.com/EL7201
Advantages of Windows Embedded Compact 7 in automation technology

Microsoft launched Windows Embedded Compact 7 (WEC7 for short) at Embedded World 2011. A public WEC7 CTP version (‘Community Technical Preview’) had already been available since June 2010. Compact 7 is the latest version of Windows Embedded CE and offers a complete update of the kernel as well as the IP stack, new developer tools and additional features. Stefan Hoppe, Beckhoff Product Manager for TwinCAT and Microsoft eMVP, provides an overview of the advantages of Windows Embedded Compact 7 for automation technology.

The Windows Embedded versions are generally scalable, i.e. OEMs can scale the included features of the operating system to the needs of their devices. Compared with Windows Embedded Standard 7 (the componentized version of Windows 7 with additional Embedded features), Embedded Compact generates a significantly smaller footprint (between 3 MB and 70 MB) and is thus also optimized for the smallest Embedded hardware. The source code for the operating system is not available to end users, but it is to OEMs and already offers hard, deterministic real-time capabilities. The kernel offers the most important changes: Compact 7 is the first version to support SMP (Symmetric Multiprocessing). The kernel can use several CPU cores simultaneously and distribute the execution of different processes and threads to them. The number of available cores can be determined by API from the application – the processing and assignment of a thread to a specially selected core is possible. For solutions this allows to execute the hard real-time application on one core while a User interface app or other solutions can be scaled unimpared on another core. In addition to the distribution of processes and threads, however, the cores themselves can be managed: With the exception of the main core, all other cores can be switched on or off dynamically by API at runtime.

A further kernel change concerns the available RAM: Although the preceding version ‘Windows Embedded CE 6.0’ offered 2 GB of virtual memory, a physical 512 MB RAM limit was historically imposed, dating from the old CE origins with support for MIPS and SH3 CPUs. It was possible to access the additional RAM oneself from an application with the aid of ‘tricks,’ but the operating system itself recognized only 512 MB of RAM. This limit has now been lifted and 3 GB of physical RAM are now available.

The Compact 7 operating system runs in a Windows Virtual PC environment with 2 GB of available memory.

The Compact 7 operating system is now also available for the latest ARM-v7 architectures and still for the ARMv5 and ARMv6 platforms – but no longer for the ARMv4 architecture of the old StrongARM processors. There have also been many innovations in the area of networks and connectivity: the operating system provides not only a new, higher-performance Internet Explorer version, but also Internet Protocol Security (IPSec), WinSocket2 and a new NDIS 6.1 stack, which is also used in Windows 7 and Windows Server 2008. Apart from general updates for Wi-Fi, Bluetooth...
and safety. 'Windows Device Stage' is a visible innovation: on connecting Embedded consumer devices to a PC, the user can now be presented with a dialog tailored to the device function instead of a default dialog. This will be noticeable in the future, for example, when connecting a digital camera by USB to a PC by the automatic starting of dialogs specially tailored to the camera model.

The 'Windows Filtering Platform' (WFP), which replaces various previous technologies for filtering IP packets, could be of interest for some automation applications: the incoming data stream can be analyzed and also modified first by API before it is passed on to the actual IP stack or completely rejected.

For the creation of user interfaces, 'Silverlight for Windows Embedded' (SLWE for short) was integrated with Windows Embedded CE 6.0 R3 which, from a technological point of view, means the separation of the actual design of the interface and the implementation of the logic. As a result, the layout of the user interface can be delivered in a different design style without having to adapt or specially test the source code of the logic. Compact 7 now integrates the more powerful Silverlight 3 engine here as an update. Expression Blend 3 is now supported as a design tool and, as a result, delivers with XAML a description of the user interface based on XML.

The BAML data format as a binary version of XAML is new: BAML enables the compression of large XAML files for sophisticated user interfaces into a more efficient binary format. This can be interpreted with higher performance using a parser at the GUI runtime. The GUI logic is coded in the Compact 7 version exclusively using C++ in Visual Studio 2008.

Various ‘remote tools’ have been available to the experienced CE developer for a long time in the engineering area. For example, it was possible to edit the registry of the target system via the network using the ‘Remote Registry Editor.’ Together with further tools such as the Performance Monitor, the Profiler or the Resource Leak Detection, these tools are now bundled in a new ‘Remote Tools Framework.’

Silverlight for Windows Embedded separates the design of the user interfaces from the creation of the logic.

The Remote Tools Framework offers a useful collection of analysis tools – the tools themselves have been thoroughly revised.

At first sight the remote tools themselves have also been revised in terms of content and can be used more efficiently: As a result, the 'Remote Registry Editor' can now also log changes to the registry at the runtime of the Embedded device.
The Resource Leak Detector Tool offers clearer and better diagnostics when compared to the previous ‘Application Verifier’. If necessary, snapshots of the system condition can be generated and analyzed according to type, time or size and other criteria.

Conclusions
In conclusion, it can be said that the new Windows Embedded Compact 7 version offers considerable advantages over the previous Windows Embedded CE version for the field of automation: only with Compact 7 can the characteristics of multi-core CPUs be fully utilized. However, single core devices also benefit from the support for 3 GB physical RAM where memory-hogging applications are involved. Multi-touch functions for dynamic touch screens permit new control concepts on the smallest Embedded devices. These tidied and extended tools help create a modern approach and facilitate advancements in engineering.

At Embedded World 2011, which took place from March 1 – 3, 2011 in Nuremberg, Germany, Beckhoff provided proof of concept of the new Embedded operating system Compact 7 in the form of an application example for print mark detection. The “Print Mark Demo” from Beckhoff illustrated implementation in an actual industrial application for the purpose of evaluating the new functions offered by Windows Embedded Compact 7. The most interesting innovation for industrial automation is the kernel with multi-core CPU support and higher RAM limits, in line with industry trends.

Advanced printing technology operates with high web speeds of more than 10 m/s. Despite this, the print quality must meet stringent requirements, and the print pixels must be set with a precision of less than 1/10 mm. This requires fast technology for controlling the print quality during production.

To identify the position of print colors, special patterns referred to as print marks are printed on the paper and generally cut off after completion. Since the fast-moving print marks cannot be detected by the human eye, they are often illuminated by stroboscopes for visual checking. This produces a recognizable, stationary image for the observer. Such an application was reproduced at Embedded World 2011 with realistic high speeds.

An "all-in-one" Beckhoff CP6201 Panel PC controlled the entire demo. It is equipped with an Intel® Core™ Duo 2.0 GHz and 2 GB of RAM and takes full advantage of the new Compact 7. In addition to offering an intuitive HMI, it meets the requirements of high-precision, real-time tasks. The machine ultimately works safely and highly deterministically.
Beckhoff now uses Microsoft Visual Studio® with the new software generation TwinCAT 3. All major programming languages, such as C/C++, a Matlab®/Simulink® connection and the IEC 61131-3 languages, including the object-oriented IEC 61131-3 extensions, are integrated into a single development environment. These enable, among other things, the use of object-oriented techniques such as single inheritance, interfaces, methods and attributes, which significantly increase both the reusability and the quality of the control code.

eXtended Automation Engineering (XAE): Modular engineering using the object-oriented IEC 61131-3 extensions

TwinCAT 3 – enhanced flexibility through object-oriented extensions
New methods and tools are required in order to master the constantly increasing requirements for the productivity, flexibility and availability of a plant, while at the same time reducing the costs for the engineering process, commissioning and maintenance of the plant. One way to achieve this is to use a mechatronic approach. The plant is thereby divided into mechatronic modules (objects), which map individual functions of the total process of a plant. If these modules are not only functionally encapsulated, but the interfaces between the modules are also defined, then a kind of building kit is available from which one can utilize for the project engineering of new plants.

The individual modules of the building kit thereby completely map their respective subfunctions. In other words: they cover all facets of a module, from the mechanical, to the electrical, to the control functions, which do not necessarily run on their own controller.

In order to do justice to these object-oriented concepts in control technology, the language used must be extended by these possibilities. However, the goal in doing so cannot be to introduce a new object-oriented language, but rather to make these object-oriented extensions available in the standard languages of control technology. This is where TwinCAT 3 comes into play.

TwinCAT 3 software is the result of consistent development of TwinCAT 2 automation software, which has been well-known for many years through a wide range of applications worldwide. The goal of this further development, besides other important points such as the integration of the Beckhoff PLC Control and System Manager engineering tools into one environment and the use of the globally-recognized Microsoft Visual Studio® 2010 software environment as a framework, was also the adaptation of the TwinCAT software environment to the constantly increasing requirements in the field of machine and plant engineering. In order to, at the same time, do justice to the new module and object-oriented ways of thinking, the IEC 61131-3 language was extended by ten new keywords, whose meaning and application are described below.

**New keywords in TwinCAT 3**

| EXTENDS |
| Using the keyword EXTENDS, function blocks can be derived from other function blocks. The derived function blocks have the same methods and properties as the basic function block, but these operate on the data of the derived function block. |

| INTERFACE |
| Interfaces are virtual classes that define methods that must instance objects derived from them, so that they can be compiled without error. They can thus be used in order to define the structure or interfaces of object types. Beyond that, however, they make it possible, by means of pointers to the interface, to directly "address" all function blocks derived from them with precisely these interface pointers. |

**IMPLEMENTS**
The keyword IMPLEMENTS implements an interface in a function block.

**METHOD**
Methods are kinds of functions that are assigned to a function block. In other words, they are not self-contained POUs (Program Organization Units), but rather a component of the function block and operate on the data of the function block instance that contains them.

**PROPERTY**
Properties are characteristics that can be assigned to a function block or a program. These properties can each contain a Get and a Set method and they serve as a type of read or write protection.
for internal variables. In addition to the actual assignment, it is also possible to implement further instructions in these Get or Set methods in order to make the necessary value available or to pre-process the assigned value.

**THIS**
With the aid of the This pointer, it is possible to point to the instance of the function block itself.

**SUPER**
The Super pointer can be used to point to methods of the function block from which inheritance takes place.

**FB_init/FB_reinit/FB_exit**
Based on constructors and destructors, these methods are called when initializing, copying and exiting the function block instance. These new keywords are available in all IEC 61131-3 languages. The application of the new keywords will now be presented on the basis of a small example.

A plant in which several kinds of cylinders are used serves as the basis for this example. The task is now to make the control code for this plant so flexible that the actual set sequence of the plant is independent of the type of cylinder used. What all of these cylinder types have in common is that they have two positions (left and right) that can be detected by means of limit switches.

As a solution for this example, it is now defined that, in accordance with the object-oriented concept, the function of each of these cylinders is mapped entirely in a function block. Beyond that, it is defined that all cylinders possess a state machine, which should be supplied with the required position of the cylinder or should return the current position of the cylinder by means of inputs or outputs respectively.

![Figure 2: Example cylinder with state machine](image)

Since, according to the task, the respective type of cylinder used in the plant should be flexible, the interface via which the cylinders are addressed must be the same. From this, the first thing to be defined is an interface, iCylinder, which must be implemented by all cylinder function blocks. This interface possesses a method, mStateMachine, which maps the state machine of the cylinders. This method has the inputs bPosLeftReq and bPosRightReq as well as the outputs bActPosLeft and bActPosRight, which represent the signals of the limit position switches. These inputs and outputs are all of the type BOOL (see Figure 3).

![Figure 3: Interface iCylinder with the method mStateMachine](image)

Based on this interface, a basic function block, fbBaseCylinder, can now be created in which the state machine of the cylinder is implemented. If, at the time of creating the function block, one selects that
the interface iCylinder is to be implemented, the method mStateMachine will be created automatically along with all of its inputs and outputs and then only needs to be programmed. The interfaces that a function block implements are defined with the help of the keyword IMPLEMENTS (see Figure 4). The derivation of a function block from several interfaces is thereby possible.

Once the basic function block has been programmed, the function blocks of the different cylinder types can be derived from it. This is done using the keyword EXTENDS.

The derived function blocks now inherit all methods and properties of the basic block. In our example, this means that the function blocks of the derived cylinders inherit the methods of the mStateMachine from the basic function block. The advantage here is that extensions in the method mStateMachine, which apply to all cylinder function blocks, only have to be updated in the basic function block and are then immediately available in all derived function blocks. If the state machine of a derived cylinder exhibits a different behavior to those of the basic function block, it is possible to overwrite this method. This takes place by means of the derived function block implementing a method with the same name as that of the function block of the basic class.

The task in this example was to find a solution in which the set sequence of the plant is independent of the cylinder type that is actually installed in the plant. In order to show that the task is fulfilled by this solution, two function block types, Cylinder_TypA and Cylinder_TypB, are now derived from the basic function block and programmed accordingly. In doing so, additional, partly differing inputs and outputs are added to other types of function blocks. One instance of each type is created in the program main (see Figure 5). Since access to these function blocks is to take place via the interface, an interface pointer is also created that points to the interface iCylinder.

As can be seen in the illustration, our state machine is actually called via the call of the method mStateMachine of the interface pointer. By assigning a function block instance to the interface pointer, it can now be decided at runtime which method mStateMachine is actually called. This is called ‘late linking.’

An additional nice possibility for the use of interfaces is, for example, switching the mode of operation of the modules in a plant. If it is ensured that all modules in a plant (e.g. also our cylinder) implement an interface containing the basic interface for switching the mode of operation, then the switching of the mode of operation of all plant components can be accomplished by means of just one loop via an array of this interface type.

Conclusions

If we now summarize once more what has been shown in this example, it can be seen that the introduction of these new keywords gives rise to new possibilities not only to functionally encapsulate control code, but also to structure it. The goal is therefore to increase not only the reusability of the control code, which leads to considerable savings in time and costs, but also its readability and extendibility. This results in control code of a considerably higher quality.

www.beckhoff.com/TwinCAT3
f l glass GmbH manufactures high-quality flat glass. The company operates a state-of-the-art production plant at its site in Osterwedding, Germany, producing 700 tons of flat glass a day round the clock. Besides basic glass, the company also produces specialized products such as safety glass or coated glass for thermal insulation and solar control for the window manufacturing and photovoltaic industries. iSATT GmbH was given the task of automating the glass coating unit on the basis of Beckhoff control technology.
Innovative concept fulfills complex requirements

Having worked for Interpane for years and by now thoroughly familiar with the process control of coating systems, iSATT was commissioned to develop a new control concept to fulfill the following requirements:

| Large expanse of the plant as a whole, meaning that the fieldbus I/Os would be distributed over a considerable area |
| Large number of fieldbus I/Os as well as PROFIBUS and CANopen devices |
| Integration of the safe I/Os via a common fieldbus |
| Integration of complete drive cabinets with Servo Drives for glass transport |
| Modular occupation of the sputtering chambers with independent units at controller runtime without reconfiguration |
| Automatic recognition of the occupation status of the sputtering chambers |
| Communication link to the loading and unloading mechanisms via PROFIBUS |
| Connection to the process control system |

iSATT’s innovative concept was to replace the existing control system which used several external CPUs with a central control platform. The high performance of the Beckhoff C5102 Industrial PC with Intel® Core™2 Duo CPU, the Beckhoff PLC and Motion Control software TwinCAT PTP and the EtherCAT fieldbus system serving as backbone of the control system was ideal for the job. Jörg Mönnekes, Coating Director at f | glass, adds: “The flexibility and modularity of TwinCAT fulfills the complex requirements of our processes perfectly.”

“The following considerations prompted us to opt for this centralized concept,” commented iSATT Managing Director, Peter Hennes: “On the one hand, cross communication between the controllers at different locations was no longer necessary. Another advantage is the centralized data management. The operator/maintenance engineer can see all data at a glance at any one time. This means signal tracking, program modifications and system maintenance can all be done in one place. Also, only one central remote access point is required. Furthermore, only one EtherCAT master is necessary to fulfill all the requirements of the fieldbus topology in terms of the distribution and number of I/Os.”

The EtherCAT network comprises 20 servo controllers with EtherCAT slave connections, 22 EtherCAT Terminal stations with a total of 1,000 digital and 60 analog I/Os and 57 safety channels, 30 Hot Connect groups with 830 digital I/Os, 41 PROFIBUS and 21 CAN master connections in total. Another 30 Hot Connect groups with similar equipment will be added by the time the expansion of the plant is complete.

State-of-the-art coating technology

The coating technology which Interpane has used for years is known as sputtering, whereby a coating is continuously applied in a vacuum. The glass is transported through a system of chambers from the intake sluice via the transfer chamber into the actual coating area, the sputtering chamber. The pressure in the sputtering chamber is reduced to 10⁻³ mbar, virtually creating a vacuum. To achieve an even coating, the glass is guided under the tools at a constant speed.

During sputtering, high voltage is applied between a cathode and anode under vacuum, which ignites a plasma. This is produced when atoms of the noble gas argon introduced into the chamber collide with the electrons already there and become heavy, positively charged argon ions. The high voltage causes the argon ions to accelerate towards the cathode on which the target is mounted, consisting of the actual coating material (e.g. silver). Encountering the higher voltage, the ions hit the target with high energy and dislocate material from it, which is then deposited on the glass in a thin layer. To create a chemical bond between the sputtered target materials, the reactive gas oxygen is also introduced into the chamber.

Various types of coating can be applied, using this process. Coated in this way, the glass sheets are further processed, for example into insulating glass with excellent thermal insulating properties for windows in buildings.

The total length of the production line is 180 meters (590-ft).
are inserted from above, depending on the type of process. The sputtering chambers are configured to hold 60 ‘compartments’ in total. Every type of cathode requires different processing technology and, in terms of control technology, forms a Hot Connect group comprising a number of I/Os and PROFIBUS/CAN masters, depending on the type of unit. The cathodes communicate with the controller via a centralized plug connection. The advantage lies in the fact that the Hot Connect groups can be coupled and uncoupled within an EtherCAT network at any position during controller runtime.

Master and slaves move closer together
A further advantageous point of the EtherCAT Terminal system, which proves to be beneficial within the Hot Connect group, is the integrated fieldbus master or -slave functionality. The high speed and considerable bandwidth of EtherCAT make it possible to move required bus masters out of the PC into the field level via PROFIBUS or CANopen and insert them at any EtherCAT bus station. This means the data from and to one of these fieldbus master-slave terminals is inserted into the EtherCAT protocol transparently – and only logically and physically converted into the relevant fieldbus protocol in the terminal itself. Consequently, almost any number of fieldbus masters distributed within an EtherCAT network can perform their tasks. Another positive spin-off is the shorter cable lengths of the fieldbus devices. Thus the master is brought closer to the slaves as demonstrated in the example of a cathode unit.

The fact that an ID switch allocates the address in the EK1101 EtherCAT Coupler means not only that operations can be performed at almost any point inside the sputtering chamber, but also that the type of cathode is identified. An address range is allocated to every type of cathode, which is imported into the PLC program and integrated into the control technology as required.

Motion Control ensures uniform glass transport
Glass transport in and out of the sputtering chambers is enabled by Servo Drives. The centrally calculated set values are transmitted cyclically to the Servo Drives via EtherCAT. First, the glass sheets produced on site are fed onto the roller conveyors in the line by material handling robots. The sheets pass through a washing unit which removes the separator ap-
applied to the sheets when they are stored to prevent them from adhering. They are then conveyed through three chambers in which the necessary vacuum is gradually increased. Positioned at an interval of 10 cm (4-in) for example, the glass sheets enter the sputtering chamber where the coating process described above takes place. To ensure the material is applied evenly, it is extremely important that the glass transport does not fluctuate.

Once the glass is out in the atmosphere of the shop floor again, the coating is checked. Optical sensors measure the reflections and transmission of the glass panes and their electric resistance is measured, which is also an indication of coating quality. The final step is done by a material handling robot which takes the finished panes off the line and places them on transport racks. During a normal shift, one finished glass sheet is removed from the line every minute.

Centralized control concept
Despite the complexity of the system, f | glass opted for a centralized control system. "We feel this has obvious advantages," explained Alexander Kick, automation expert at f | glass: "On the one hand, there is no need for cross communication between controllers as with a decentralized control system; on the other, central data management gives the operator or developer all the information at a glance. Moreover, the administrative costs for signal tracking, program modifications, system management and archiving as well as for centralized remote access are far less.

Easy to operate despite complex control technology
The visualization and master control of the coating line is coupled to TwinCAT via Beckhoff’s ADS interface. Over 5,000 variables are exchanged between the control PC and the master computer via Ethernet. Ethernet TCP/IP forms the physical interface between the control system and controller.

Integrated safety technology
All the safety devices in the line, together with all the emergency stop buttons along the transfer route, are operated via the integrated Beckhoff TwinSAFE system. If an emergency stop button is activated, all the drives, valves and power units for generating the plasma switch off. Four KL6904 TwinSAFE logic terminals evaluate the safe inputs and shut down the outputs. Communication between the TwinSAFE terminals, together with the exchange of the process data at controller and I/O level is done via EtherCAT.
The stage has a total area of 20 m x 35 m, wherein the main area, the four movable podiums, takes up a total area of 10.5 x 12 m.

View of the overstage machinery with the cable winches: following the complete rebuild of the stage, the Schauspielhaus in Nuremberg now has 47 machine hoists for the backdrop, panorama, portal, gallery lighting, overhead lighting, rear stage and forestage hoists, ten point hoists and four lowering devices for the stage podiums, which can be moved independently of one another.
New control solution for Schauspielhaus renovation in Nuremberg

Complex stage and theatre technology with PC- and EtherCAT-based control

Flawless performances in opera houses and theatres require ultramodern and complex stage systems and technology. To meet these demands, the Schauspielhaus in Nuremberg, Germany has been completely renovated over a two-year construction period. The contract for the renovation of the entire stage equipment was awarded to TTS Theatertechnische Systeme, who, for the first time ever, relied entirely on PC-based control technology from Beckhoff with EtherCAT connectivity throughout for this complex project.

Up to 14 different performances take place each week in the Schauspielhaus of the State Theatre in Nuremberg. This is possible only with ultramodern stage technology, with lifting podiums, computer-controlled flies and turntable, as well as state-of-the-art lighting technology. For this reason the decision was made in favor of a general overhaul of the theatre: apart from the reception area, the renovation covered the seating and auditorium as well as the entire understage/overstage machinery. TTS GmbH was commissioned to carry out the entire renovation, from the steelwork through to the electrical and control installations. Specializing in technical theatre systems, TTS GmbH is based in Syke in north Germany and has been active in theatre and stage technology for 20 years and has used Beckhoff components since 2002.

EtherCAT – high-speed Ethernet as the higher-level bus system

The stage control is subdivided into different task areas and functional areas, for which various Beckhoff Industrial PCs and the EtherCAT bus system are used throughout. (see page. 31) The main controller is a TTS computer, which is implemented as a cable-redundant EtherCAT master. Safety functions are controlled via software specially developed for theatres. The back-up master computer is a Beckhoff C6340-0020 control cabinet Industrial PC running TwinCAT I/O software, which takes control of the cable-redundant EtherCAT network in the event of failure of the main computer. Three Beckhoff C6920 control cabinet Industrial PCs with customized operating panels are in use on the main and auxiliary control consoles; four more Industrial PCs control the understage/overstage machinery.
TTS has been using Beckhoff components since 2002. “The use of local I/O peripherals from Beckhoff enables us to tailor our systems precisely to the needs of our customers. The successful introduction of the Bus Terminals was followed by a switch to Beckhoff Panel PCs and TwinCAT automation software,” explains Frank Kremer. “In the last step, which was the search for a bus system to suit our purposes, we decided on EtherCAT, which encompasses the most important characteristics for us: real-time capability, high bandwidth, cable redundancy and impressive diagnostic properties.”
Three CP6202 and CP6207 Panel PCs are responsible for the control of the stage manager's console, the main stage and the forestage. The lowering of the platform is controlled by two C6340 control cabinet PCs with detached 15-inch panels. More than 5000 I/O points are distributed around the stage area; these are monitored and controlled via 700 EtherCAT Terminals which are divided into four individual EtherCAT I/O stands or rings:

- Ring 1: TTS controller (C6340 Backup PC), cable redundancy: 82 devices
- Ring 2: TTS controller (C6340 Backup PC), cable redundancy: 153 devices
- Ring 3: Beckhoff C6340 IPC with TwinCAT master, cable redundancy: 404 devices
- Ring 4: Beckhoff C6920 IPC with TwinCAT master: 67 devices

The entire system can be controlled wirelessly from different control consoles, which are stationary, mobile or portable, depending upon the version. Eight customized control panels with touchscreen functionality are used, some with an integrated or a detached Industrial PC and display sizes ranging from 5.7 to 24 inches.

Scenery changes with the curtain open
Following the complete rebuild of the stage, the Schauspielhaus in Nuremberg now has 47 machine hoists, ten point hoists and four lowering devices (podsiums), which can be moved independently of each other. The stage has a total area of 20 m x 35 m, wherein the main area, the four movable podiums, takes up a total area of 10.5 x 12 m. Each podium is equipped with a so-called tilting cover, which serves to tilt the entire podium surface by up to 10 degrees. In each tilting cover there are seven trap doors with electric drives, which enable the opening of the stage floor. Two lowering platforms can be placed on the lug subpodium of the podium under the trap doors. In addition, there is a foldable stage wagon with an integrated turntable of 10 m in diameter and a weight of 20 tons. If the turntable wagon is not in use, it is folded up at the rear of the stage and pulled upwards into a parking position. The lifting/folding movement is performed by a hydraulic cylinder that can pull up to 60 tons.

The technical functions of the stage offer a wide range of new possibilities for performances. One example of this is the open transformation of the stage, i.e. the scenery can be changed with the curtain open. To this end, the stage technician selects previously created movement sequences (so-called transformations) on the operator interface and subsequently executes them. Thus complex movements on the stage can be carried out at the push of a button. All driving modes are synchronized, so that synchronous movements between the understage and overstage machinery are easily possible. "Theatre operators place great importance on safety and very high availability of the controller. Redundant EtherCAT bus masters and EtherCAT with cable redundancy have been used in order to guarantee compliance with the SIL 3 safety requirements," explains TTS project manager Frank Kremer.

EtherCAT provides precisely synchronized movement sequences
There is an axis computer for each of the drives that need to be controlled, regardless of whether it is a backdrop hoist or a point hoist; a total of 70 EtherCAT drives were installed for this. The central computer from TTS controls the entire drive equipment. Each axis computer is responsible for the positioning and monitoring of the drive axis assigned to it, wherein it receives its drive commands and setpoint values from the master computer via a bus system. "With this latest controller generation we have used EtherCAT throughout as the bus system. EtherCAT combines the advantages of high bandwidth with real-time capability for the synchronization of the drives and with higher availability due to the cable redundancy characteristics," comments Frank Kremer.

The dual-channel master computer evaluates the input data from the various control consoles and the drive commands from the individual drive levers. It also relays the data to the axis computers and controls the entire data communication of the controller, adherence to specified movement sequences and the positioning of the axes. The axes of the overstage and understage machinery can be controlled simultaneously from the master computer so that, for example, a podium and a backdrop hoist resting on it can be driven synchronously.

Everything available at a glance
"In conclusion, it can be said that our requirements and functions have been entirely fulfilled by the new installation," confirms Florian Steimann, stage inspector at the Schauspielhaus in Nuremberg: "Due to the elaborate decorations and the increasingly complex and numerous transformations of the stage area, we are well equipped for the future, too, with the new stage machinery. The 24-inch displays provide an overview of the entire stage without scrolling the screen. The operation and monitoring of the complex system has become much simpler and is more user-friendly as a result."

TTS Theatertechnische Systeme
www.ttssyke.de
Schauspielhaus Nürnberg
www.staatstheater-nuernberg.de
High-end solution for high-precision PCB placement

Beckhoff automation platform controls EasyMounter

The Belgian company IPTE FA (Factory Automation) specializes in developing production and test systems in the electronics industry. With the EasyMounter, IPTE FA has created a machine for the placement of PCBs with odd-form printed circuits. A new Motion Control system and user-friendly HMI ensure a faster, more flexible and accurate production process.

Production process based on the utmost precision

The placement process must not only be fast and flexible, it must also be highly accurate. For this reason the EasyMounter uses a Double Vision system and application-dependent grippers equipped with a force control mechanism. First, a PCB which has been assigned a bar code in the system is inserted from the side; then the placement area on the PCB is marked out via two or three reference markers and the precise placement position (mount position) identified. This is a standard marking procedure, which determines the zero point of the group. The placement position is recorded by the top camera and transmitted to the Motion Control system. Then the correct component is picked up by the gripper from one of the six placement heads on the rear of the machine. The precise position of the printed circuit in the gripper is recorded beforehand by the bottom camera. This requires a visual check on a reference pin. There is yet another quality control and visual inspection, in case pins have broken off, before the component is placed in position. Finally, the built-in force sensor and programmed force control ensure that nothing is damaged during placement. Although some force is required to press the pins into the openings on the PCB, a need for excessive force indicates that the positioning is not properly aligned with the pattern of the openings. Force measurement is therefore another control measure which guarantees a top-quality end product and a pristine machine. After placement, either the next component is placed or the PCB is fed towards the next process step, depending on the customer’s order.

One control platform for PLC and Motion Control

So that all the axes of the gantry robot and mounter, the individual grippers, vision systems and sensors work totally in sync, they need a control system that guarantees fast, and at the same time, precise positioning. An end-to-end Beckhoff control solution comprising an Industrial PC (IPC) with TwinCAT NC 1 automation software, various EtherCAT I/Os and Servo Drives was chosen. Evidently, its flexibility was not the only...
Complete solution from a single source

The PC-based control platform offers IPTE FA several advantages at once as IPTE FA Managing Director, Phil Frederix, emphasizes: “The improved compatibility of the hardware components means their replacement, for example for maintenance reasons, requires only a brief intervention. Moreover a modular design is possible. This has advantages with regards to standardization, which no longer requires us to make compromises in the customer-specific versions of new generations of machines.” The main reason for choosing Beckhoff to supply the control system was that the company offered a complete solution based on the ‘building block’ principle, which was able to guarantee an excellent price-to-performance ratio. “Another crucial factor was the commitment of the application engineers on-site to rise to the challenges posed by the specification in terms of speed and precision,” explains Frederix.

Universal machine operating concept

IPTE FA is no less proud of its user interface than of the high-end Motion Control solution which the company itself developed and has been seamlessly integrated into the new control system. Named Platform 3, the HMI includes an article manager, tool manager, calibration assistant and an order-processing module. “The modules programmed into C# include everything that the operator needs for precision PCB placement,” Frederix stresses. New articles can be created or old ones adjusted in the article manager, whereby specifications such as gripper type, force settings and type of camera program can be applied and additional parameters coupled to the article concerned. The specific gripper settings are adjusted in the tool manager of a database in which all the devices (placers, grippers and cameras) are generated and managed. By setting the vision system, the calibration assistant helps identify a new product if necessary. Moreover, the system can be coupled to a customer’s ERP system. In the words of the Managing Director, The uniformity of the user interface represents a huge gain for our customers who no longer have to familiarize themselves with another operating system for each individual production line in their plant.”

advantage of having the IPC control all the movements. The TwinCAT NC Interpolation system also eliminates the need to program the speed and torque in the drive itself. Using the SERCOS Drive profile, the positions are read via EtherCAT in each 125 microsecond cycle and the new speed curves of all the axes are automatically interpolated on the basis of three points.
High throughput figures in series production
The process becomes particularly interesting, however, when throughput in series production is considered. Specifically, it is a question of how many riveted joints can be manufactured in a certain time. "I would claim that we manufacture the fastest orbital riveters in Europe," declares Marc Heiter. "We can accomplish an orbital riveted joint in 0.6 to 0.7 seconds. In the application area of the manufacturing of fittings, we have proven that our machines can manufacture an orbital riveted joint with solid steel rivets of 4 mm in diameter in only 0.8 s. It is in any case interesting that hollow rivets can also be riveted cleanly and permanently using the orbital riveting process."

If several riveted joints must be achieved in a short space of time for reasons connected with the production cycle, e.g. in the case of workpieces that are fed in multiple-up production, KMT offers a so-called multi-spindle orbital riveting head.

Beckhoff automation technology guarantees fast process cycles
The orbital riveting process is a recognized and established joining process all over the world and has proven itself in a wide range of applications. It is used to connect not only metals with one another, but also differing and sometimes sensitive materials, such as ceramics, leather or plastics. Users also include leading car manufacturers and their suppliers, electrical appliance manufacturers, companies that make fittings, sensor manufacturers and many others.

Technology proven in a wide range of applications
The term ‘orbital riveting’ comes from the ‘orbital’ movement of the riveting die (peen), which is moved in a circular path over the rivet head: due to the fixed inclination of the riveting spindle axis, the peen rotates during the riveting procedure with a metered vertical pressure on a circular path around its own axis. At the points where the rivet is touched, a deformation is produced, which continues along the line of contact between the riveting die and the rivet. "The advantage of the orbital riveting process is that only one tenth to one fifth of the force required in press riveting needs to be applied to achieve the same deformation or material joint," says Marc Heiter, managing director of KMT. "We need about 100 kg of compressive force per millimeter diameter for the material deformation. For 5 mm it would then be 500 kg." Marc Heiter also describes the gentle treatment of the surfaces as a particular advantage of the orbital riveting process. "Metallic coatings and coatings applied by electroplating are simply formed with the material," he explains. "In the orbital riveting process, the riveting die runs completely on the rivet head, so that there is only very slight impairment of the surface.”

High throughput figures in series production
The process becomes particularly interesting, however, when throughput in series production is considered. Specifically, it is a question of how many riveted joints can be manufactured in a certain time. "I would claim that we manufacture the fastest orbital riveters in Europe,” declares Marc Heiter. "We can accomplish an orbital riveted joint in 0.6 to 0.7 seconds. In the application area of the manufacturing of fittings, we have proven that our machines can manufacture an orbital riveted joint with solid steel rivets of 4 mm in diameter in only 0.8 s. It is in any case interesting that hollow rivets can also be riveted cleanly and permanently using the orbital riveting process."

If several riveted joints must be achieved in a short space of time for reasons connected with the production cycle, e.g. in the case of workpieces that are fed in multiple-up production, KMT offers a so-called multi-spindle orbital riveting head.

PC-based automation as the basis for a standardized, scalable machine concept
With their CNC orbital riveter cell, KMT has developed a modular machine concept that allows the customer to assemble its plant as if from a building kit, according to requirements. The basis for this is the flexible PC-based control concept, which is expandable depending on the scope of the plant. The control platform consists of a Beckhoff CX1020 Embedded PC with 12-inch Control Panel, EtherCAT Terminals along with Beckhoff Servo Drives and servomotors. "The orbital riveter is selected from the standard KMT range according to the respec-
online programming using the teach-in method. The riveting travel or stroke can be provided with a positive and negative tolerance. Furthermore, two riveting pressure steps can be defined.

**High speed requirements fulfilled**

With regard to procedural scalability, the individual processes are monitored and documented by sensors. "The Beckhoff EtherCAT Terminal system offers a wide range of possibilities for sensor integration. However, speed was much more important to us," says Marc Heiter, and he goes on: "The Beckhoff controller was the first control solution to fulfil our high speed requirements. In earlier machines and in stand-alone concepts we always had to combat speed problems. From the process point of view, the following must be considered: driving to the rivet and the concluding upward drive take place in just 0.26 seconds in the case of a 10 mm stroke. During this time slot the force/distance measurement system must determine whether the raw rivet is too long or too short. This simply cannot be achieved with conventional control systems."

Marc Heiter, Managing Director of KMT Produktions- und Montagetechnik GmbH from Villingen Schwenningen

The control cabinet accommodated at the side of the machine bed contains the Beckhoff CX1010-0112 Embedded PC, EtherCAT I/O terminals and the Beckhoff AX5203 Servo Drive for two motor outputs. The Servo Drive and PC communicate over EtherCAT.

The new CNC orbital riveter cell from KMT is based on a modular machine concept that allows a customized solution on basis of standard components.

The CNC orbital riveting cell offers three modes of operation: base position drive, setup and automatic operation. The associated operational sequences are displayed on the touch panel, which is installed on a mounting arm. A total of 100 riveting programs, each with up to 100 positions are stored in the controller. The riveting positions can be input with an accuracy of 0.01 mm. The adjustment value for the raw rivet length can also be specified. These parameters and the rivet positions can be entered by the user as absolute values or specified during operation and monitoring via touch panel

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Strengthening the market presence in Southeast Asia

Beckhoff opens subsidiary in Singapore

Beckhoff is continuing the export offensive in Southeast Asia with the opening of a new branch office in Singapore. The Beckhoff office at the Nordic European Centre in the International Business Park in Singapore was opened in January 2011. Beckhoff has been represented in this Southeast Asian city-state by TDS Technology (S) Pte Ltd. since 2000. David Chia, Managing Director of Beckhoff Singapore, and his team strive to build on the current business successes and high-quality customer relations in order to tap new markets for the PC-based control philosophy.

“Singapore is by no means new territory for Beckhoff, since we have already been cooperating with TDS for quite some time and will continue to partner with them in the future,” explains Kai Ristau, Beckhoff’s Head of International Sales. The positive business development in recent years, together with the economic growth of the country, has prompted Beckhoff to strengthen their business commitment in Singapore and to expand into new market segments.

“In David Chia we have gained a skilled managing director who also has experience as an automation engineer,” comments Joshua Alexander Rusdy, Area Sales Manager at the Beckhoff Head Office in Germany. Singapore’s industry is characterized by the manufacturing of highly industrialized products. The key industries include electronics, petrochemicals, biotechnology, environmental technology and nano-technology.

Germany is traditionally one of Singapore’s most important foreign trade partners - and the foreign trade volume continues to increase. “‘Made in Germany’ continues to enjoy a high status in Singapore,” says David Chia and he goes on: “We see great potential for New Automation Technology from Beckhoff in the local market. Our customers come from all branches of light and heavy industry. However, we are already operative as a component...
Export offensive in Southeast Asia: Kai Ristau, Head of International Sales, David Chia, Managing Director of Beckhoff Singapore, Hans Beckhoff, Managing Director of Beckhoff Automation and Joshua Alexander Rusdy, Area Sales Manager, International Sales (f.l.t.r.)

The head office of Beckhoff Singapore is located in the prominent Nordic European Centre in the International Business Park of Singapore. Customers in Singapore, Indonesia, Vietnam and the Philippines are supported from here.
High-speed image processing ensures satisfied passengers and reduces airline costs

Automated scanning system for ultra efficient baggage sorting

Lost or damaged luggage items are not only annoying for the affected passengers, they also represent a significant expense for airlines. A solution to this chronic problem is offered by the innovative BAGCHECK baggage handling system, which scans the outlines of luggage in a matter of seconds, enabling reliable separation of items that require special attention. In this way undesirable baggage jams and blockages on the conveyor belts can be reduced by 40%. The fast screening technology is controlled using PC Control from Beckhoff.

The BAGCHECK solution was jointly developed by the Dutch company Quintech Engineering Innovations, who are based in Delft, Netherlands and are experts in innovative automation solutions for airport logistics, and Vanderlande Industries, a global market leader for complete baggage and package handling systems. The BAGCHECK prototype is installed as a pilot system at London Heathrow Airport.

In modern airports, the baggage handling system play an essential role in dealing with huge quantities of luggage quickly and correctly. Scans and manual sorting of luggage represent a significant source of error. Staff have to judge at a glance whether a piece of luggage can pass along the conveyor belt without problem or has to be separated out as a special item. This applies to all bulky objects that may jam, round luggage items that may roll off the conveyor belt, as well as bags and rucksacks with loose handles or straps that may become trapped in the conveyor belt and lead to blockages. Although the majority of non-standard luggage items are separated out during passenger check-in, they frequently end up back in the general baggage stream in cases where passengers change planes.

High-resolution images ensure reliable baggage sorting

This is where the BAGCHECK solution developed by Quintech and Vanderlande Industries comes in. After the luggage has been weighed and fitted with a bar code label, a conveyor belt takes it to the BAGCHECK station for scanning. Unlike in a security check, the system scans the baggage outlines, not the content. Jorick Naber, co-founder and technical director of Quintech, describes the procedure: “Based on a contour scan camera and a light curtain, BAGCHECK generates a high-resolution 3-D image of the outlines of the luggage item from above. The light curtain generates the side views, so that we know how tall the luggage item is and whether it has a round shape, for example. In contrast to a volume scanner, which only calculates the volume and the rough dimensions of a luggage item, this provides exact information about the outlines to be derived. Based on this information we can filter out luggage items that are not suitable for the standard conveyor within one or two seconds.” The camera scans 4,000 contours per second when a luggage item passes it (1 contour corresponds to 1 mm).
Data transmission in real-time
A Beckhoff CP6502 Panel PC with 19-inch TFT display and Intel® Core™ Duo processor is used for synchronization of the camera, the lighting and the conveyor belts (via encoders). Alternatively Quintech may use a C66xx control cabinet Industrial PC with the CP690x “Economy” Control Panel as control platform. “The camera is linked with the PC via a 1-Gigabit Ethernet connection. “Key elements in our decision to use EtherCAT were the speed and accuracy of the data communication,” said Jorick Naber. “To achieve accurate results, the images that are acquired need to be high resolution. For this we use line scan cameras and powerful LED line lights that need to be synchronized very accurately with the conveyor velocity and position through high resolution encoders. To achieve line rates of up to 4000 Hz, the control cycle has to be as short as 125 microseconds (μs). We found that other PLC and soft PLC systems failed to deliver the short cycle times that were needed, but Beckhoff’s EtherCAT fieldbus components combined with TwinCAT NC PTP software did the job. Another advantage of TwinCAT was the straightforward integration with our image analysis and classification software by utilizing the ADS layer to link variables. And during development the Scope View feature proved invaluable for tracing areas in the software that needed to be adjusted.” For the analysis and image processing software Quintech uses a C# application that is coupled with the TwinCAT control software via ADS. “With our software it is possible to analyze two luggage items that are on top of each other or side by side, by separating them ‘virtually,’ so to speak,” Jorick Naber added. “Existing systems are unable to do this and a situation like this would cause the conveyor to stop or direct both luggage items to the same aircraft.”

Vastly improved tracking of lost luggage items
Quintech’s decision to use a Beckhoff Panel PC was not only based on speed, but also on data capacity. “The PC platform integrates the controller and the database. All image data for the scanned luggage items are stored in an SQL database,” said Jorick Naber. In this way even items without a label can easily be identified: BAGCHECK matches the photographs of the scanned luggage items with the item without a label and is able to trace back to which passenger it belongs.

Jorick Naber is satisfied with the development of the prototype and the performance of the Beckhoff automation components: “Through simple programming we can easily control all I/O interfaces. Due to its flexibility the open control system also lends itself to extensions and the development of new solutions.” Naber is optimistic for the future: “We are currently building four more BAGCHECK systems that will be integrated in Vanderlande’s baggage handling system at London Heathrow.”

Quintech Engineering Innovations
Vanderlande Industries
Industrial Automation Link
www.quintech.nl
www.vanderlande.com
www.ial.nl

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When it comes to the application of networks and automation technology onboard superyachts, the Royal Huisman yard based in Vollenhove in the Netherlands can point to considerable successes. In 1998 the yard built the luxury yacht Hyperion for Jim Clark, the owner of Netscape Communications Corporation, a sailing yacht exclusively equipped with the most advanced computer technology. Since then all the yachts leaving the Vollenhove yard are equipped with a modern network into which all the technical functions are integrated, including the cabin automation and media control systems. With Twizzle, the latest yacht to be completed, Royal Huisman takes a step further towards technical perfection: control components from Beckhoff operate every single one of the 3,500 sensors and actuators on the 57 m (187-ft) boat.

All requirements for reliability, flexibility and transparency fulfilled

Sjoerd Schrichte, Manager of the Systems Integration Department at Royal Huisman, was directly involved in developing Twizzle’s automation system and gives the following reasons for choosing Beckhoff as the control system supplier: “We have been automating our yachts since 1995. In the early days of the yard we used Beckhoff control systems increasingly alongside PLC hardware. Twizzle is the first project in which we have used only Beckhoff components for the entire control system. One of the reasons for our decision was the flexibility of these components. For example, the modular design of the existing Bus Terminal stations makes them easy for us to extend if necessary. Moreover, the fine granularity and compact structure of the Bus Terminals, with up to 16 channels in a 12 mm housing, make them extremely flexible and reduce the amount of space they require in the control cabinet. Another advantage is that our engineers find them extraordinarily easy to program using TwinCAT software. All the Embedded PCs can be accessed via Ethernet. Also the transparency of the Beckhoff platform allows us to couple EIB modules, for example, and it even has an interface to the Crestron automation system for yachts, which includes the lighting, air-conditioning and multimedia control systems.”

Meeting the highest environmental standards

Sustainability and a minimum carbon footprint are a top priority with regards to Twizzle’s construction and operation. Accordingly, wastewater is not discharged into the sea, a prerequisite for her certification by the Yacht Carbon Offset committee. Exhaust gases from the generators are cleaned by filters developed by Royal Huisman. The remaining CO₂ emissions are offset by what are known as Green Energy Projects all over the world. The same standards apply to the other building materials used such as aluminum and steel. Yacht Carbon Offset monitors whether this offsetting is actually effective. This certification means Twizzle meets the very highest environmental standards and can sail all the world’s oceans, including the Arctic Ocean.
The finest technology for seafaring automation

Beckhoff technology automates nearly all the systems associated with sailing the yacht and life on board. This applies both to cruising under engine power or with sails. “For example, we have an automated engine management system for the diesel engine and its fuel and coolant pumps,” explains Sjoerd Schrichte. In addition, Twizzle has a comprehensive hydraulic system that controls the drive for the winches, setting the sails, adjusting the masts, raising the keel, and the swimming platform.

In addition, there is of course a power management system onboard which ensures a constant supply of 24 V, 230 V and 400 V. Then there is the yacht itself, which has its own system for producing drinking water, a wastewater treatment system, ventilation system, and naturally a heating and air-conditioning system for all the cabins on board. An extensive lighting system is also integrated into the automation system.

“Another special feature is the feedback of the rudder pressure,” adds Sjoerd Schrichte. “Because the rudder is powered by the hydraulic system, you do not feel any resistance when you turn the wheel. However, so that the helmsman can experience the genuine feel of a rudder, we have fitted strain sensors to the rudder shaft which measure the pressure exerted on the rudder. The measurements are fed into the EPC (Electronic Power Control); this operates a servo-assisted wheel which then puts pressure on the wheel. These are just some of the technical features of this yacht, but the list is still far from complete.”

“The most extensive network we have ever installed on a ship”

A total of 24 Beckhoff CX9000 Embedded PCs are connected to a redundant Ethernet ring structure in order to ensure all the functions can be monitored and reliably controlled. The Bus Terminals control 3,500 I/Os, of which 2,900 are digital and 600 analog. Connections to a higher network level are operated via switches. “This is the most extensive network we have ever installed on a ship,” declares Sjoerd Schrichte. The network on Twizzle is connected via standard Ethernet to which the Beckhoff PC and all the other network components are coupled. The PCs communicate via the real-time Ethernet protocol.

Royal Huisman  
www.royalhuisman.com  
www.twizzle.org

Industrial Automation Link  www.ial.nl
Fully automatic textile folding, according to packaging designs specified by customers, needs to be very fast and highly accurate. In view of the large number of packaging designs and textile types, this is a complex task. The up and coming Swiss company espriTex GmbH builds and manufactures modern, versatile textile folding machines which can easily adapt to suit the very different requirements of their international customers. It is PC-based control technology from Beckhoff that guarantees the precision and speed of the folding machines.

The Swiss company espriTex GmbH, which is based in Wiler near Seedorf, sells a wide range of machines for folding textiles. “Our clients are mainly manufacturers of household textiles,” founder and CEO of espriTex, Samuel Gerber, explains. “These include bed linen, bath linen and table linen, as well as blankets, curtains and other products.” Given the large variety of sizes, textile qualities, packaging designs and folding measurements, this is a process which is anything but easy to automate. Samuel Gerber explains: “The folding machines ‘reduce’ the parts to the format and folding design specified by the customer. The resulting folding corresponds exactly to the presentation design of the packaging in which a product is displayed on the shelf. Depending on the type of machine, up to 1,500 flat textiles can be folded per hour, with one or two cardboard inserts according to customer’s request.”

The large number of folding programs and processes means that any packaging design required by a customer can be fulfilled.

“The modular design of the machines and the many available folding programs enable us to create almost any presentation design required,” emphasizes Gerber. “We build our machines exactly according to the requirements of our customers and their applications, and ideally customized solutions are the result.”
The technical folding process in a machine begins when the material is fed in. This is done either manually or directly by a fully automatic sewing system. The subsequent complex folding process is fully automatic. Gerber illustrates this as follows: "We have to deal with very different materials. Silk and satin for example are very smooth, slippery materials which behave differently compared to a heavy cotton or a blended fabric when folded. The second requirement arises out of the formats to be processed. For example, the widths and lengths for bed linen differ all over the world. The sizes on the highly standardized US market alone range from twin, full, queen, king to California king size. This requires changing the types of folding again and again in order to achieve packaging of the same size."

Depending on the field of application, it is possible to select from various folding processes, e.g. reverse, cascade, blow tube, slider, sword, rocker arm, box or template folding. The processes most used are based on mechanical folding sliders (the textiles are stretched to the specified width over templates), sword or blow tube folding (the product is pressed between two rollers by means of a folding sword or blast of air), rocker arm combined with a template (the textiles are laid over a template by a rocker bar) and reverse folding (a combination of reversing conveyor belts and blow-tube and sword folding). "We convey, move and work a great deal with compressed air, pneumatics as well as electronics and electric drives, in other words, with mechatronics," is how Gerber describes the processes.

**PC-based control technology from Beckhoff enables exceptionally precise, fast folding.**

The espriTex machines are extremely accurate. Theoretically, the maximum deviation in the folding is ± 0.5 mm at conveyor speeds of 60 m/min, which, at first glance, seems unnecessarily accurate for folding textiles. However, further deviations are caused by factors which cannot be directly influenced: e.g. environmental effects such as air humidity and temperature fluctuations, varying electrostatic load, a build-up of dust during production, vibrations, as well as current and voltage fluctuations determined by the mains supply or differences in materials from the same production lot. For this reason, the repeatability of the machine is very important.

The control system used is crucial to the precision and speed of the folding processes. espriTex uses a Beckhoff C6350 Industrial PC (IPC) with TwinCAT NC PTP automation software as the central control system. This is installed in the control cabinet and operated via a remote touchscreen. The individual machine modules have decentralized I/Os, connected via the EtherCAT bus system. "There are different reasons why Beckhoff PC control technology is the ideal automation platform for our machines," explains Marcel Stebler who is responsible for software engineering: "The modular control system makes it very easy for us to connect our wide range of system and drive elements, the Beckhoff AX2006 Servo Drive, 17 frequency converters and diverse sensors. In addition, in EtherCAT we have chosen a fast and reliable system bus. Thanks to the switch to faster PC and EtherCAT technology, we have been able to make our machines 2-3 times more accurate than before."
Modular espriTex folding machine with a Beckhoff touch screen Control Panel as the operating unit in a customer-specific configuration

**Integrated safety technology ensures the control system has a compact design**

Furthermore, safety I/O terminals are also integrated at the fieldbus nodes. "The Beckhoff TwinSAFE safety system provides another advantage with regards to our concept of a compact control architecture," according to Stebler. "The fact that most impressed us was that although the EtherCAT safety terminals can be easily integrated into the existing terminal strand, they represent an independent safety system in programming terms. Moreover, if necessary, detailed diagnostics can be carried out and made available to the operator at no great cost. This would be almost impossible with a conventional safety system."

**3D simulation of the folding process makes programming easier.**

espriTex uses a CAD system to build and develop its machines as far as both the mechanics and electronics are concerned. "The 3D design allows us to implement our concepts very quickly," explains Gerber. Regarding the electronic design, the installation and wiring diagrams and the manuals can be made available as PDF files. "We store these documents on the Industrial PC," adds Gerber. "This is convenient for customers, since they no longer have to store thick manuals in order to stay up to date." Likewise, all of the drive data are stored securely on the PC. These data and documents can be used for servicing via the PC which has internet connectivity.

The HMI operating concept of the folding machines developed by espriTex is based on VB6 and is currently being revised with .Net. As Stebler illustrates, the operator masks and all the input masks for parameterizing the folding schemes were programmed by espriTex. "The basic programs for the formulae are stored in a database. Using visualization, these can be adjusted before they are loaded since the characteristics of the textiles must always be taken into account. We use the IEC languages, Structured Text and Function Block Diagram for the PLC programs."

**Service and maintenance available all over the world via Remote Desktop**

The espriTex folding machines are both stand-alone machines and parts of larger system solutions, and can be coupled to a fully automatic sewing system by real-time Ethernet, for example. With the sewing system the feed is fully automatic. Stand-alone machines are often used as downstream folding machines for hand-sewing stations or to fold and assemble different textiles with various packaging sizes for designs of bed linen sets or similar items if necessary.

espriTex delivers its folding machines all over the world, mainly to the emergent countries where textiles are produced and processed today. "We install the systems directly at the textile manufacturer’s premises," says Gerber. "Remote servicing and maintenance, and resident troubleshooting are therefore vitally important to espriTex. PC-based automation has definite advantages for us: if customers have a problem, we do not usually have to visit them since we can simply dial into the IPC. The entire machine control system is then available to us and the excellent diagnostic facilities of Beckhoff control technology nearly always enable us to locate the fault."

espriTex GmbH  www.espritex.biz
Beckhoff Switzerland  www.beckhoff.ch
Beckhoff consolidates its sales network in the Middle East

New subsidiary opens in Israel

At the beginning of 2011, Beckhoff established a new subsidiary in Airport City near Tel Aviv. Intensive market observation and several years of customer support from the German head office preceded this decision. The Israeli market presence is to be strengthened by local sales in addition to technical service and support. Managing director Assaf Berger is aiming to tap new markets for PC- and EtherCAT-based control technology from Beckhoff in Israel’s aspiring economy through intensive marketing.

The Israeli economy is dominated by high-tech companies, wherein the semiconductor industry plays a leading role. A number of “global players” from the high-tech industry maintain research centers in Israel for the development of future technologies, for example the development of electric car concepts, are contributing to the country’s economic growth. Managing director Assaf Berger sees an expandable market here for PC control technology from Beckhoff: “Our EtherCAT technology represents a ‘door opener’ in discussions with customers. We have gained several important new customers here and swung project decisions in our favor. In order to strengthen this position further, we need to facilitate rapid and responsive local service and technical support.”

“The 200 sq. meter office is situated in an easily accessible location in the new Airport City technology park near Tel Aviv. There is excellent access to Ben-Gurion Airport and to Israel’s major roads,” says Assaf Berger.

In the past four years the Israeli market has been supported directly by the Beckhoff head office in Germany. “We have been recording considerable growth in turnover since 2006,” explains Jens-Olaf Brede, Area Sales Manager for Beckhoff in Verl. “PC-based control technology is as yet not so well-known in Israel. Therefore, we want to gain a greater share of the local automation market through intensive marketing activities, such as trade show presentations and product training. We are aiming for turnover of around 2 million Euros for the next two years.” “Our goal,” adds Assaf Berger, “is to create a new standard in the high-tech industry based upon PC Control philosophy and EtherCAT.”
New trends in automated stoneworking

Controller relaunch for CNC processing centers

The French machine manufacturer Thibaut manufactures machines for processing stone and hard mineral building materials. In order to keep pace with changing market requirements, the company has decided on a new control concept for its machines on the basis of PC-based control from Beckhoff.

Thibaut, founded in 1952 in Vire, Normandy, is specialized in stone working machines. The machines are particularly suitable for processing hard stone, such as marble and granite, as well as for slate, concrete, glass and chamotte. The company’s core competencies include grinding and polishing technology as well as shaping by means of milling. Thibaut produces approx. 200 machines per year. “The industry has changed a great deal over the years,” explains Vincent Ernoult, buyer at Thibaut. Whereas the main sales market used to be gravestone production, the trend is now toward decorative elements for homes: This includes worktops for kitchens, wall and floor coverings for bathrooms, stairs and spa areas as well as statues and stone façade elements. Thibaut recognized this trend quickly and, in the T818 and T812 machine series, developed versatile CNC processing centers for the manufacturing of inner and outer contours, for the profiling and chamfer milling of curved or straight edges, and for surface grinding, drilling, thinning, sizing and groove milling.

PC-based control provides more flexibility in manufacturing

In order to meet the demand for made-to-order products in lot sizes as small as one, Thibaut needed a flexible control system for its machines. “The interior decorating market demands the development of made-to-order parts with high precision, often in limited series or even unique pieces, as in the case of kitchen worktops,” explains Vincent Ernoult. “We were only able to meet this requirement on the basis of a new machine concept or a more flexible, PC-based control solution,” says Guillaume Pasquier, manager of the Thibaut automation design office. “The controller we used up to that point could not satisfy the new manufacturing requirements for parts with a complex geometry, particularly in the case of frequent production changes.”

Today nearly all Thibaut machines are delivered with a PC-based controller from Beckhoff. The decision was made in favor of Beckhoff mainly due to the impressive price-performance ratio and the openness of the control platform, which also allows the integration of components from third-party manufacturers.

There are no limits to the decorative surface design of the stone.
The decisive thing for us is that we have a long-term solution in the Beckhoff platform. In the past the design of a new machine was frequently a reason to reconsider the automation concept and to look for an optimal solution. This often resulted in a change of the controller supplier. Our considerations are now running in a different direction. The Beckhoff solution offers us the possibility to adapt to the respective requirements: whether the machine has one or five axes, whether it encompasses one or two PCs and whether it has 20 or 200 inputs/outputs is irrelevant and has no effect whatsoever on the software,” argues Guillaume Pasquier.

The Beckhoff control platform employed is based on a CP6202 ‘Economy’ built-in Panel PC with a 15-inch display and touchscreen, EtherCAT I/Os and – depending on the type of machine – between three and four AX5000 Servo Drives. Since the Thibaut processing centers have relatively small dimensions (length of less than 10 m), the I/Os, which are connected via EtherCAT, are accommodated in a central control cabinet.

Thibaut S.A.S  
Beckhoff France  
www.thibaut.fr  
www.beckhoff.fr

“The T818 CNC processing center is available in different versions, for installation as a stand-alone machine or integrated into a production line. The machine optionally has a 3- or 4-axis controller and is designed for the manufacture of kitchen worktops with draining surfaces, washbasin covers, etc. from granite or marble. The machine includes a linear tool change magazine with two rows for 45 tools.
Randek AB, a company based in Falkenberg in Sweden, creates high-performance machines and production lines that manufacture components for prefabricated wooden houses. The company history of Randek stretches back into the 1940s and is closely connected to the concept and development of prefabricated houses.

The roof truss, i.e. the supporting structure for a roof frame, consists of compression and tension members which are joined at the nodes using plates and nails according to an exact nailing pattern. This is why it is also known as a “nailed truss.” Nailed trusses are usually made from several layers of wood. Since the 1970s the traditional nailed truss has largely been replaced by the much more economical nail plate truss. In this method the timber components are joined by industrially manufactured nail plates which are pressed into the wood on both sides using special presses.

### Fully automated process replaces time-consuming manual work

Traditional roof truss manufacturing methods are both labor-intensive and costly because most of the processes such as positioning the clamping devices, laying out the timbers, positioning the nail plates, fixing the plates using the truss press and stacking the finished roof trusses are done by hand.

The new AutoEyeTruss system SF022 from Randek provides a fully automated production unit to manufacture traditional or scissor-shaped roof trusses. Manual handling is only required at the beginning of the process when two operators lay out the building timber on the machine. Everything else runs automatically: the timber is placed and positioned against stop pucks on what is known as the puck table. The joints are automatically fixed with corrugated nails using the nailing bridge and the timbers are marked with production data by an ink-jet printer. In the next stage the roof truss is transported to the press which picks the appropriate nail plates from the correct container and feeds them to the press. The press visually identifies the butt joints in the roof truss design in order to position the nail plate exactly. The pressing force adapts automatically to the size of the nail plate and the thickness of the timber, making the result perfect.

The butt joints that are fixed with nail plates to the roof truss are then transported to quality control. This is followed by automatic stacking and loading onto a truck for shipping.

“The annual production capacity in a three-shift operation is around 187,000 roof trusses,” explained the Randek Sales Manager Johan Larsson. “One of the great benefits of the production unit is its high degree of automation. Work that was previously carried out by 15-20 employees now only requires three.”

### Convenient operation and short machine set-up times

The AutoEyeTruss system controls all processes automatically using a CAD system selected by the operator on the 19” screen of the Beckhoff CP7203 Panel PC. The CAD files which contain all the data for the roof truss being produced are processed directly in the system. There is almost unlimited flexibility with regards to different designs and the set-up time is very short. “With manual production it takes almost an hour to change from one roof truss design to another when resetting the various clamping devices,” Johan Larsson explained. The new production unit requires about 30 seconds to adjust the clamping table as the stop pucks move into position automatically.

### PC-based control solution handles PLC and NC functionality

An important component of the automation concept is EtherCAT, the ultra-fast communication system for connection to EtherCAT I/O terminals and the drive system. A total of 16 AX5000 EtherCAT Servo Drives plus the AM3000 and AM3500 servomotors are responsible for the various movements in the produc-
The new AutoEyeTruss system SF022 from Randek provides a fully automated production unit to manufacture traditional or scissor-shaped roof trusses.

Well-established cooperation yields results
Randek and Beckhoff Sweden are also cooperating on the automation of other production lines. “The benefit lies in the fact that we have an integrated system with which we are familiar. Our partner Beckhoff has given us expert advice for developing the AutoEyeTruss system as well as for implementing the Servo Drives. The result is a machine which is unrivalled worldwide,” stated Åke Svensson, development manager for Randek.

Norway creates European record
The new AutoEyeTruss roof truss production unit combines high production capacity with industrial quality conforming to building standards and will be marketed throughout the world, according to Randek’s plans for the future. The standard production line can process roof trusses up to 4.5 m (14.7-ft) high and 12 m (39-ft) wide. The system can also be adapted for longer roof trusses, should this be necessary.

“The first client to implement the new roof truss production line is Pretre AS, Norway’s largest manufacturer of roof trusses whose production plant is in Gausdal,” explained Johan Larsson. “The new production unit was officially opened in autumn 2010 and is the most efficient and progressive in Europe. Production capacity is 126,000 roof trusses per year in a two-shift operation. Each roof truss requires 81 seconds to manufacture – a European record.

Randek House Production Technologies
www.randek.com

Beckhoff Sweden
www.beckhoff.se
tunnels, a fundamental reassessment of the safety concepts took place in 2000. The tunnel ventilation requirements also had to be reworked after the introduction of catalytic converters and the reduction in exhaust emissions that occurred as a result. The ventilation concept, originally only conceived for normal operations, has been designed for event mode (operations in the event of incidents), and in the event of fire, in particular.

The "General Technical Specification" (GTS) prepared by the Basel Federal Highways Civil Engineering Office includes guidance documents for planning and execution of information flow, signaling concepts, and control of the Nordtangente. It explicitly describes the requirements on the hierarchically-ordered operations, process, group management and field levels. In particular, these contain the process computers (master computers and group computers), including the linking of processes to the supervisory management system (node computers). Furthermore, the GTS controls the connection of the actuators and sensors at the field level to the group management level. The concept differs from that of other tunnel facilities.
in terms of consistent implementation and integration into a complete system with functions and components that are clearly aligned with one another. For the safety of road users and the optimal flow of traffic, all electromechanical equipment and traffic management technology for both the Basel Nordtangente and Osttangente (tunnels and above-ground sections) have been brought together and integrated into the supervisory management system.

**Complex network concept**

The process management system is structured in a strictly hierarchical manner. The reason for this hierarchical structure lies in the desire to establish autonomy for the individual levels, i.e., each level must functionally and technically form an independent unit and cannot be dependent on the fundamental functions of the level above. This ensures that in the event of failure at one level, the functionality of the level below is not affected. If normal operation of a system fails, a contingency level immediately takes over the functions. If, for example, the communications network fails, the most important signals are transmitted via exchanges between hardware. In addition to the supervisory operations management system, individual systems for lighting, ventilation, safety, traffic management, energy supply/miscellaneous, and contingency level have been specified for the project in six electrical plants. Related individual systems are brought together in supervisory systems, but operate autonomously as much as possible.

Three different networks constitute the infrastructure for all of the Nordtangente systems:

- an Ethernet ring with a data transfer rate of 10 Gb/s
- a 100 Mb/s Ethernet ring for the contingency level (a second redundant communications route with its own optical fiber links)
- a 100 Mb/s Ethernet ring for each of the six system controls with its own optical fiber links

On the basis of the specifications established by the Basel Federal Highways Civil Engineering Office, all computers coupled to the 10 Gb Ethernet network have been linked via TCP/IP with a virtual local area network (V-LAN) for each system. Each system has access to its own network; the electrical plants are electrically isolated from one another. Communications on the operations management level take place via Ethernet using the Process Visualization and Control System (PVSSII). Communications between the systems level and the operations management level, and also within a level, take place via TCP/IP Ethernet/Fast Ethernet using OPC and the Beckhoff TwinCAT ADS software. From the systems level to the group management level communications similarly take place via Fast Ethernet and TwinCAT ADS.

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Master PC

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<tr>
<th>Control Panel CP6903</th>
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<tbody>
<tr>
<td>OPC Client</td>
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<td>OPC DA/DCOM</td>
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<td>OPC Server</td>
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<td>ADS</td>
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<td>TwinCAT</td>
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Group PC

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<th>IPC C6925</th>
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<tr>
<td>ADS</td>
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Communication architecture of the master and group computers
Hardware and software redundancy guarantees reliability

In terms of software, the communication links are all structured in accordance with the client-server principle. This means that the communications client (an IS server) links with the communications server (a master computer for each system and electrical plant). The server is able to manage a number of links to several clients simultaneously. The use of automatic supervisory circuits has been avoided as far as possible; supervisory functions have been implemented at the process level in order to minimize the number of special cases.

The redundancy principle as implemented is not based purely on hardware redundancy, but incorporates software redundancy as well. A second server collects the relevant data, independently of the first, and executes the corresponding functions. The redundant system stops short of activating the components that are already active. A sophisticated monitoring procedure detects any failure of the computer that is in control; in this event the second computer takes over the functions of the first. The first computer changes its status to that of a redundant server and no longer executes any active commands or switching procedures. Should, for whatever reason, the first server not alter its status, it is locked out by the second, i.e. two servers never execute automatic switching commands at the same time. The operations stations recognize the status of each server and communicate exclusively with the active server.

Robust and reliable control platform

The Basel Federal Highways Civil Engineering Office specified Beckhoff automation components after a fundamental evaluation of the market. "The decision to comprehensively utilize Beckhoff hardware components was made on the basis of their robustness and proven deployment in industry," explains Eugen Fuchs, the Civil Engineering Office manager responsible for the project. "Further positive points include the many opportunities for software coupling using Microsoft’s Windows XP Embedded and Windows CE operating systems, the IEC 61131-3-based software PLC TwinCAT, and OPC or OLE for process control (Object Linking Embedded)."

Ticos AG, based in Feuerthalen, Switzerland, was contracted to create the complete software system; the company has experience with large control packages for tunnel facilities operating across plant systems. Ticos’ managing director Kurt Salvisberg stresses: "We received very good specifications from our client. In the implementation of the control package for the total system, we were likewise able to specify very clear structures."

Eugen Fuchs, Project Manager, Basel Civil Engineering Office: "The decision to comprehensively utilize Beckhoff hardware components was made on the basis of their robustness and proven deployment in industry."
After a history of some 50 years of planning and building, the main section of the Basel Nordtangente became operational in mid-2007. With the opening of the Luzerner-Ring junction, the historic Basel Nordtangente project is complete. Of the 3.18 km length of the urban expressway, a total of 2.79 km take the form of tunnels or bridges. The Nordtangente starts from France with a 240 m long above-ground section and then moves into the Großbasel Tunnel (1432 m). On the east side of the St. Johann rail station, the section proceeds under the very busy Voltastrasse to the Rhine. In this section the 600 m long St. Johann link also branches off underground. At the Rhine, the expressway emerges from the tunnel and proceeds via the two-level 266 m long Dreirosen Bridge into the 1092 m long Kleinbasel Tunnel. The last section guides the expressway onto the existing ramp of the Osttangente. Thanks to its five junctions, the Nordtangente can not only accommodate the through traffic to and from France, but also a large proportion of the urban traffic and can thereby alleviate the levels of noise and traffic suffered by some residential areas.

-graphical elements for status displays and interventions, instigated by sensor signals from the field level. The systems, while acting autonomously, also work together with the control technology in an optimal manner: important alarms and faults are forwarded via remote alarm systems. For example, all relevant information, including the air speed measurements that are necessary for ventilation system operation, are available for the ventilation plant process images.

Tunnel control package includes a wealth of functions
One of the central elements for safety is the control of the tunnel ventilation. The safety of the tunnel user and the sequence of events that occur in the event of a fire are massively affected by ensuring the best possible flow conditions. The measuring units in the tunnel provide information to the control system at all times concerning the current flow and pressure conditions. From this data the control system calculates the necessary switching procedures for the 82 jet fans (with a total of more than 2 MW of power) in order to achieve the optimal pressure conditions. In this manner the escape routes are maintained to be free of smoke in the event of a fire, and any migration of smoke into the adjacent service tunnels can be prevented. The safety system records all information relevant to safety for forwarding to the police; the latter are, e.g., immediately informed if an emergency exit door is activated, if a vehicle is stationary in the tunnel, or if a fire extinguisher is taken out of its cradle. Similarly, the control system for the lighting plant makes available all the relevant information that is necessary for operating the various lighting systems: e.g. manual or automatic activation of various modes of operation, such as emergency operation or fire/accident. Light sensors measure the external level of brightness and regulate the adaptation level of the lighting so that the human eye can become accustomed to the reduced light levels when entering the tunnel. Light sensors in the tunnel measure the effective level of illumination and by this means permit corrections for any contamination and aging of the lighting equipment.

A complex traffic management system undertakes the control of the traffic, so that all operating states that occur can be dealt with without causing any difficulties for the user. The signaling system serves in the first place to close the tunnel, i.e. the tunnel’s entries and exits, to warn the road users of a variety of hazardous situations, to close individual lanes, to transfer people or vehicles to the adjacent service tunnels, etc.

The “Energy Supply/Miscellaneous” system monitors all infrastructure systems of the electrical plants, such as building fire alarm systems, system safeguards, energy inputs, transformers, measuring units for the central building and infrastructure systems.

Integration of existing sub-systems optimizes monitoring and reduces costs
During project implementation, the existing Osttangente sub-systems put together in the years 1970 to 2003 have been linked onto the IS. By virtue of this comprehensive integration, all information and intervention options are available on a common platform to the operators. All current and future data points are recorded in a consistent and cost-effective manner by the flexible Beckhoff group computers using the extensive selection of terminals. Roland Gysin of “North-West Switzerland Federal Highways AG” (NSNW), who is responsible for the operation and maintenance of the urban expressway, comments on the experience to date: “The system runs very stably, and we very seldom have any malfunctions. Previously we paid more for maintenance of just the management system than maintenance costs us for all the systems today.”

The investment for all the operations and safety systems is running at about 124 million euros. A large part of this investment has in fact been for the safety of the tunnel user. The many measurement, control and regulation tasks could be fulfilled along with a level of future-proofing using Beckhoff technology. The complex status of the expressway monitoring system enables rapid and targeted intervention in the event of a malfunction and thus offers the maximum possible level of safety.

Basel-City City Development Basel North  www.baselnord.bs.ch
Ticos AG  www.ticos.ch
Beckhoff Switzerland  www.beckhoff.ch
The Swiss company Bobst was welcomed as ETG member number 1,500 at the end of last year. The Bobst group is a leading supplier of machines and services to the packaging industry. Marc Nicole, Controller and Electronic Manager at Bobst SA, says: "The decisive factors in choosing EtherCAT as the future fieldbus for our self-developed control system were in particular the exceptionally high performance of EtherCAT, its simple integration into our own control hardware and the openness of the system."

The growth of the ETG in Europe and America is impressive; the number of Asian members is experiencing above-average growth: there are already 400 member companies in this region.

However, not only the number of members, but in particular the unusually wide variety of devices with EtherCAT interfaces are proof of the worldwide acceptance, openness and success of the technology. Over 100 master suppliers, more than 80 drive manufacturers and over 50 manufacturers of I/O components with an EtherCAT interface are known.

"EtherCAT is accepted all over the world. A great many leading suppliers support EtherCAT or are about to implement the technology. As far as the others are concerned, the question is no longer 'whether,' to implement EtherCAT, but 'when,' and great demand on the part of the users means that the answer to this question is 'soon,'” says Martin Rostan, Executive Director of the EtherCAT Technology Group.

EtherCAT Technology Group
now the world’s largest fieldbus organization

The EtherCAT Technology (ETG) has been the largest Industrial Ethernet Organization for a long time, now it is also the world’s largest fieldbus organization: the association now has over 1,570 member companies from 52 countries and growth continues unabated.

ETG at SEMICON Japan

EtherCAT is developing into the de facto standard in the semiconductor industry. The ETG and Applied Materials already caused a stir at SEMICON West in San Francisco with a White Paper entitled "EtherCAT-enabled Advanced Control Architecture." In Japan too, many large suppliers to the semiconductor industry have also selected EtherCAT as their "Next Generation" network.

The participation of the ETG at SEMICON Japan in Chiba reflected this great interest. Organized by the Task Force Japan, 20 exhibitors displayed their components at the joint booth and were rewarded with great demand. Additionally, numerous visitors gathered information in a daily introductory seminar about the outstanding characteristics of EtherCAT.

EtherCAT was also a popular subject of discussion at the companies’ own booths and the trade show was used as a welcome opportunity to present new EtherCAT products.
Safety over EtherCAT in a carefree package

Integrated functional safety is becoming an indispensable component of every control architecture. Nevertheless, many manufacturers shrink from the increased expenditure of implementation and linking to a secure communication system. Therefore, extensive support is available for the implementation of the Safety over EtherCAT technology in addition to a particularly lean specification.

Beckhoff offers certification support including test cases and tools for the implementation of the safe protocol. Parameterization software for the EL6900 Decentralized Safety Controller is a component of the Beckhoff ET9000 EtherCAT Configurator, which also harmonizes with EtherCAT masters from other manufacturers because of the open interfaces.

Further suppliers supplement the “totally carefree package” of Safety over EtherCAT with their own services and tools: 3S-Smart Software Solutions GmbH offers the linking of the CoDeSys safety editor to the EL6900 Decentralized Safety Controller. CoDeSys customers can thus add functional safety to their control systems without having to develop and certify a safety controller of their own.

Safety over EtherCAT protocol stacks for master and slave devices are offered by the company IXXAT; in addition, IXXAT supports its customers in the implementation and certification of its Safety over EtherCAT devices.

The Safety over EtherCAT technology is in great demand and is being implemented by well-known companies in the fields of control and Drive Technology, robotics and sensor systems in Europe, the United States and Asia.

Dr. Guido Beckmann, chairman of the ETG Technical Committee and a safety expert at Beckhoff, underlines the leaness and openness of the safe protocol: “Experience shows that the extent of the code and stack runtimes are significantly lower than those of comparable protocols. The safety container of a minimum 6 bytes also facilitates use on traditional fieldbus systems without problem, and owing to the wide variety of suppliers offering support, it will now be even simpler to integrate Safety over EtherCAT into the product range: ‘Make or Buy’ - with Safety over EtherCAT, you have the choice.”

ETG seminar series in India

Following two successful seminar series in 2009, the ETG returned to India in February 2011: this time it was the turn of New Delhi, Bangalore, Coimbatore and Mumbai.

In all-day seminars, the participants gathered information about the technology and the user benefits associated with the use of EtherCAT. Particularly in Bangalore, where many companies have R&D centers and many development service providers are based, the event series met with great interest on the part of implementers, who integrate the EtherCAT interfaces in their own devices and in those of customers.
Trade shows 2011

**Europe**

**Germany**

- **Interpack**
  - May 12–18, 2011, Düsseldorf
  - [www.interpack.com](http://www.interpack.com)

- **Ligna**
  - May 30 – June 3, 2011, Hanover
  - [www.ligna.de](http://www.ligna.de)

- **Sensor+Test**
  - June 7–9, 2011, Nuremberg
  - [www.sensor-test.de](http://www.sensor-test.de)

- **EU PVSEC**
  - September 5–8, 2011, Hamburg
  - [www.photovoltaic-conference.com](http://www.photovoltaic-conference.com)

- **EMO**
  - September 19–24, 2011, Hanover
  - [www.emo-hannover.de](http://www.emo-hannover.de)

**Austria**

- **Smart Automation**
  - October 4–6, 2011, Linz
  - [www.smart-automation.at](http://www.smart-automation.at)

**Belgium**

- **Indumation**
  - May 18–20, 2011, Kortrijk
  - [www.indumation.com](http://www.indumation.com)

- **easyFairs ECL**
  - September 22–23, 2011, Brussels
  - [www.easyfairs.com](http://www.easyfairs.com)

**Czech Republic**

- **Tabexpo**
  - November 15–18, 2011, Prague
  - [www.tabexpo.org](http://www.tabexpo.org)

**Finland**

- **Automatia**
  - October 4–6, 2011, Helsinki
  - [www.automatiamessut.fi](http://www.automatiamessut.fi)

**France**

- **Intelligent Building System**
  - September 20–21, 2011, Paris
  - [www.ibs-event.com](http://www.ibs-event.com)

- **Measure Expo**
  - October 4–6, 2011, Paris
  - [http://en.mesurexpo.com](http://en.mesurexpo.com)

**Italy**

- **SPS/IPC/Drives Italia**
  - May 24–26, 2011, Parma
  - [www.sps-italia.net](http://www.sps-italia.net)

**Norway**

- **Nor-Shipping**
  - May 24–27, 2011, Oslo
  - [www.nor-shipping.no](http://www.nor-shipping.no)

- **PEA**
  - September 27–29, 2011, Oslo
  - [www.pea-messen.no](http://www.pea-messen.no)

**Russia**

- **Hi-Tech Building**
  - November 8–12, 2011, Moscow
  - [www.hthb.ru](http://www.hthb.ru)

**Spain**

- **ITMA**
  - September 22–29, 2011, Barcelona
  - [www.itma.com](http://www.itma.com)

**Switzerland**

- **EPHJ-EPMT**
  - May 24–27, 2011, Lausanne
  - [www.epmt.ch](http://www.epmt.ch)

- **swissT.fair**
  - June 16–17, 2011, Zurich
  - [www.swisstfair.ch](http://www.swisstfair.ch)

- **Ineltec**
  - September 13–16, 2011, Basel
  - [www.ineltec.ch](http://www.ineltec.ch)
easyFairs Industrie- & Zweckbau
October 12–13, 2011, Bern
www.easyfairs.com

Asia
China
China Glass
May 11–14, 2011, Shanghai
www.chinaglass-expo.com

ChiNaplas
May 17–20, 2011, Shanghai
www.chinaplasonline.com

FAPA
May 18–20, 2011, Peking
www.fa-pa.com.cn

Electrical Building Technology
June 9–12, 2011, Guangzhou
www.lighting-building.com

Offshore Wind China
June 15–17, 2011, Shanghai
www.offshorewindchina.com

Wind Power Asia
June 22–24, 2011, Peking
www.windpowerasia.com

Propak China
July 13–15, 2011, Shanghai
www.propakchina.com

China Wind Power
October 19–21, 2011, Peking
www.chinawind.org.cn

Industrial Automation Show
November 1–5, 2011, Shanghai
www.industrial-automation-show.com

Marintec
November 29 – December 2, 2011, Shanghai
www.marintecchina.com

India
Engimach
November 23–27, 2011, Ahmedabad
www.engimach.com

Malaysia
Industrial Automation
July 20–23, 2011, Kuala Lumpur
www.asean-ia.com

Africa
South Africa
Process Expo
May 17–19, 2011, Johannesburg
www.process-expo.co.za

North America
Canada
PackEx
June 21–23, 2011, Toronto
www.packextoronto.com

Canadian Manufacturing
and Technology Show
October 17–20, 2011, Toronto
www.cmts.ca

USA
Windpower
May 22–25, 2011, Anaheim
www.windpowerexpo.com

ATX East
June 7–9, 2011, New York City
www.canontradeshows.com/expo/atxe10

InterSolar North America
July 12–14, 2011, San Francisco
www.intersolar.us

Pack Expo West
September 26–28, 2011, Las Vegas
www.packexpo.com

Solar Power International
October 12–14, 2011, Los Angeles
www.solarpowerinternational.com

Process Expo
November 1–4, 2011, Chicago
www.myprocessexpo.com

Fabtech
November 13–16, 2011, Chicago
www.fabtechexpo.com

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www.beckhoff.com/trade_shows