Customized Industrial PCs:
Ranging from industry solutions to customer-specific IT Terminals

24” TFT widescreen Display: Large industrial displays put automation and IT on “the big screen”

Vensys: Wind turbine manufacturer propels alternative energy using Beckhoff control technology

Tailor-made Industrial PCs
## contents

### 7 | products

- 24-inch TFT display: Large industrial displays put automation and IT on “the big screen”

### 18 | worldwide

- Microsoft, Germany: PC-based building control for The New World of Work

### 26 | Vensys, Germany: High-quality, proven control components for Vensys wind turbines

### 4 | news

- XFC Roadshow visits Beijing
- New forms of training at Beckhoff

### 5 | worldwide

- BARTEC Dispensing Technology GmbH, Germany: PC-based control platform blends dynamics and precision into one solution

### 6 | products

- Beckhoff Finland celebrates its 10th birthday

### 22 | worldwide

- HST Hydro-Systemtechnik, Germany: Wireless system ensures reliable plant communication at the Genkel Dam

### 7 | products

- TwinCAT 3: Connecting well-known simulation tools

### 24 | products

- PC Control for wind turbines

### 8 | products

- TwinCAT library optimize solar energy harvesting

### 26 | worldwide

- Vensys, Germany | Goldwind, China: High-quality, proven control components for Vensys wind turbines

### 12 | products

- PROFINET Bus Coupler – the cost-optimized alternative

### 30 | worldwide

- RAS Reinhardt Maschinenbau GmbH, Germany: Quantum leap in the production of small bent sheet metal parts

### 13 | products

- PC-based control technology streamlines blow molding machines

### 35 | products

- EuroBlech 2010: Open automation solutions for metal forming

### 14 | products

- 24-inch TFT display

### 36 | worldwide

- Breitenbach Software Engineering GmbH, Germany: Tailor-made Industrial PCs

### 50 | products

- Customized software solution integrates building services and care documentation

### 18 | worldwide

- Microsoft, Germany: PC-based building control for The New World of Work

### 52 | products

- Jiangsu Jinfangyuan CNC Machine Co. Ltd., China: Flexible, PC-controlled punching and bending system produces busbars
The wind power industry is booming

“When the winds of change blow, some build protective walls, while others build windmills”*

The wind power industry has recorded considerable growth this year worldwide – a development that has significant consequences for Beckhoff Automation as a supplier of controllers to the industry. True to the Chinese proverb quoted above, the wind energy business has also been pushed by Beckhoff: Beckhoff’s wind power division has been able to more than double its turnover for the fifth year running. Over 6,000 operational management systems and more than 6,000 pitch controllers have been supplied with Beckhoff technology this year alone. We owe this success in large part to the massive expansion of wind energy in China. One very good example of this is Goldwind, the highest profile licensee of Vensys wind turbines. Goldwind has developed into one of the most important Chinese wind turbine manufacturers and is still fully on course for growth (see article on page 26).

Looking back: about 10 years ago, the first customers from the wind power sector became aware of PC-based Control from Beckhoff and our Bus Terminal I/O system. The control architecture with open design, which supports all common fieldbus systems and a large number of signal types, fit the industry’s requirements like a glove. This was a very strong entry into the wind energy market. The introduction of our CX series Embedded PCs gave further lift to the development of the wind business. With the Ethernet-based fieldbus EtherCAT we have created a standard that more and more customers are using in their plants due to the flexible topology options. Today, nearly all major suppliers of pitch and converter systems are members of the EtherCAT Technology Group (ETG), the EtherCAT user’s organization. Additionally, the openness of the components permits the seamless integration of all control, measurement and safety-related tasks. The integration of safety functionality with TwinSAFE, power measurement, visualization and data storage as well as remote monitoring are further advantages of PC-based control architecture from Beckhoff.

We have achieved all of this using standard components that have been successfully proven over many years of employment in other branches of industry. Beyond that we have extended the product range specifically for wind energy applications: for example, the extended temperature range of our I/O components, the implementation of the new IEC 61850 and IEC 61400-25 telecontrol protocols for plant communication with wind farms or wind turbines and Condition Monitoring solutions. Together with the international Beckhoff subsidiaries, the ‘Wind Expertise Team’ introduced in 2005 in Lübeck, Germany, offers customer support for all areas of wind turbine control. The range of services extends from application-specific software libraries to control cabinet design and complete application software, i.e. operational management. The possibilities of Beckhoff’s PC-based solution are being significantly extended by new technologies, such as TwinCAT 3 (see article on page 12).

Dirk Kordtomeikel
Business Manager Wind Energy at Beckhoff Automation

*Chinese proverb
22 students start their working lives at Beckhoff

For the first time this year Beckhoff is offering practical places to students as part of practice-integrated studies at the Bielefeld University of Applied Sciences, annex Gütersloh. Hence, a total of 66 young people began their training or course of study including practical phase at Beckhoff in August 2010. Apart from his commitment to on-the-job training, the entrepreneur Hans Beckhoff is also one of the main proponents and patrons of practice-integrated study at the Gütersloh annex of the Bielefeld University of Applied Sciences. Bachelor study courses in mechatronics/automation as well as industrial engineering will be offered here from the winter term 2010/11 onwards. Beckhoff Automation and Elektro Beckhoff are making practical places available to a total of 22 students. “During the practical phases we will involve the students in development projects and train them in the latest technologies”, says Hans Beckhoff, describing the training concept. “We want to effectively counter the expected lack of professional staff and engineers with our commitment to on-the-job training and practice-integrated study.”

XFC Roadshow visits Beijing

An information event on eXtreme Fast Control Technology from Beckhoff took place under the title ‘XFC Red Storm’ on 13 May 2010 in the Xiyuan Hotel in Beijing. Following Guangzhou, Beijing was the second station of the Beckhoff information event series, to which Beckhoff China sent out invitations with the collaboration of the ‘China Association for Mechatronics Technology and Application’ (CAMETA) and the ‘International Industrial Automation News.’ More than 250 experts from the packaging, tobacco, plastics and printing industries of northern China took up the invitation. In lectures, high-ranking representatives of various associations and universities as well as experts from Beckhoff explained the technical advantages and gave concrete application examples of XFC technology and discussed the meaning of XFC for a new era in automation technology with the participants.

Beckhoff China www.beckhoff.cn
XFC www.beckhoff.com/XFC
At K 2010, the international trade show for plastic and rubber which will take place between 27 October and 3 November in Düsseldorf, Beckhoff will demonstrate its PC- and EtherCAT-based control solutions for plastic machines. Servo-electric as well as hybrid and hydraulic drive concepts are supported. Beckhoff introduces a new turnkey solution for injection molding machines whose basis is the "TwinCAT Injection Molding PLC Framework". Field-proven technology modules such as the controller for injection and holding pressure offer optimum solutions for the injection molding process. The openness of the Beckhoff control system enables the machine manufacturer to use in-house expertise or ready-made software components from Beckhoff. TwinCAT, the software PLC, helps to unlock the capabilities of modern PC architectures for increasing product quality and machine efficiency. A Windows CE or XP based visualization system is available for machine operation, which together with the "Injection Molding PLC Framework" forms an integrated solution for injection molding machines. In this way the development time is reduced without limiting options for in-house technology developments. To accompany the software solution Beckhoff offers a 12-inch Panel PC customized for injection molding applications. Beckhoff also developed a new compact and cost-effective control solution for blow molding machines based on Intel® Atom™ processors. It consists of a 6.5-inch Panel PC and a technology software for blow molding machines, including visualization.

**Universal high-speed Ethernet**

The application of EtherCAT, the fast real-time Ethernet fieldbus system, in plastics machines increases the machine efficiency and the quality of the end product. For logging temperatures directly at the injection cylinder or the tool, the tried and tested Beckhoff fieldbus modules of the FM series are now also available for EtherCAT.

To increase the energy efficiency of injection molding and blow molding machines there is a trend towards using servo-electric drives instead of hydraulic valves. This is the first time that Beckhoff will show the complete range of its EtherCAT servo drive series AXS100 to 170 A at a plastic industry fair. A pick-and-place robot with delta kinematics will be used to demonstrate the technology for handling systems. New extrusion control options complement the Beckhoff range for system solutions in the plastics industry.

*www.beckhoff.com/k2010*

*www.beckhoff.com/plastic*
Beckhoff Finland celebrates its 10th birthday

The Beckhoff subsidiary in Finland was established ten years ago with a single member of staff at TechVilla business park in Hyvinkää, approx. 50 km north of Helsinki. Today Managing Director Mikko Uuskoski has a team of 15. In addition to the head office in Hyvinkää, Beckhoff now has two further sales offices in Finland and is expecting this year a turnover of approx. 6 million euros. Beckhoff has established itself successfully in the Finnish automation market with its open, PC-based control philosophy and managed to gain customers from a wide range of sectors.

The expansion strategy, which Beckhoff has pursued for many years with the aim of penetrating deeper into the respective markets through establishment of branches, has paid off. Today Beckhoff is represented in more than 60 countries with 25 subsidiaries and distributors and sells its PC Control technology worldwide.

Since the establishment in the year 2000 the Finnish Beckhoff subsidiary has grown continuously. In 2006, Beckhoff opened two further sales offices in Seinäjoki and Tampere, in order to be able to offer Finnish customers a comprehensive network for distribution, application support and service. In 2008, Mikko Uuskoski oversaw the relocation into the “Technology Centre TechVilla” in Hyvinkää, once more with expansion in mind: larger offices enable training sessions so that Beckhoff Finland can offer its customers optimum all-round support.

Initially, Beckhoff Automation Oy mainly supplied components to the electronics, machine construction, wood and paper industries located in southern Finland, although more recently there has been a clear trend towards the systems business and expansion into new market segments. “Over recent years, we gained technically demanding customers and realized complex software solutions for different applications. In addition, building automation is becoming increasingly important, and we continue gaining new customers from the wind energy sector,” said Mikko Uuskoski. For the future, he and his team intend to strengthen their role as a reliable, competitive supplier of automation systems with comprehensive technical know-how and a high-quality product range in the Finnish market.

“Industry expertise and joint development of solutions together with our customers are top priorities for us,” said Mikko Uuskoski.

Beckhoff Finland www.beckhoff.fi
Beckhoff has extended its Control Panel and Panel PC series with a larger 24” display. The new widescreen display, with its high resolution of 1920 x 1200 pixels, is ideal for complex, graphical user interfaces and for information that must be visible from a distance. These visually-stunning new displays can be equipped with an optional touchscreen. The Panels can also be customized for maximum flexibility.

In many industrial IT and automation applications there is a developing trend towards large operating and display devices. The areas of application are varied and include data acquisition from production, computer-aided manufacturing and HMI. The robust, water- and dust-proof design of the aluminum Panels makes them suitable for application directly on machines or installed elsewhere on the plant floor.

The 24” Panels extend the already wide range of Beckhoff display sizes (5.7”, 6.5”, 12”, 15”, 19”). The 24” displays are currently available in Beckhoff Panel PC variants (CP6204, CP7204) with integrated CPUs for IPC, automation, PLC and motion control tasks and as “display-only” Control Panels (CP6904, CP7904). The Control Panel cases are made of high-quality, solid aluminum. The compact Panels from the CP7xxx series offer all-round IP 65 protection. The housings of the “built-in” CP6xxx Panel series have protection class IP 20 at the back and IP 65 at the front.

All Beckhoff Industrial PCs are compatible with these new panels and their resolution size of 1920 x 1200 pixels. A characteristic of Beckhoff’s entire Panel series, each 24-inch Panel can also be customized. Options include visual adaptations, application of customer logos, specific front laminates, special mechanical keys, emergency stop switches, or card scanners.

www.beckhoff.com/controlpanel
www.beckhoff.com/panel-pc

Compact 24” Control Panel with a resolution of 1920 x 1200 pixels for displaying complex display screens and graphics-intensive HMI software.
Due to globalization, requirements in the electrical engineering and machine construction industries have increased constantly in recent years. The result is that plant manufacturers are confronted with the task of implementing new technologies inexpensively and under considerable time pressures. The development and commissioning times of new plants thereby represent substantial cost factors. In order to reduce the severity of these demands, recourse is taken with a simulation tool, which is used from an early phase of the engineering process.

TwinCAT 3: Connecting well-known simulation tools

This method of design, also known in control technology as "Rapid Control Prototyping," consists of several steps:

| creation of a model of the system to be automated
| design of the controller
| simulation of the entire system
| implementation of the controller design on the target platform
| test of the implementation by coupling the target platform to the system model ("software in the loop" – SIL)
| test of the real system with the real controller

The engineering of complex plants mostly requires several iteration loops, meaning that these steps will be conducted several times. So that the design process can be configured universally, it is necessary for interfaces to exist between the simulation and the engineering tools that enable the data already created to be processed further. Based on these interfaces, a code generated in a simulation tool can be integrated automatically in a real-time system. This not only gives rise to significantly shorter cycle times of the individual iteration loops, but additionally allows control codes of significantly higher quality to be obtained.

The control system – TwinCAT 3

TwinCAT 3 is the new software generation from Beckhoff; with its assistance it is possible to extend almost any PC-based system by a real-time environment in which PLC, Safety PLC, NC, CNC, robotics and C/C++ modules can run. The number of modules that can be executed alongside one another is limited only by the performance capability of the hardware employed.

The software system consists of a runtime environment and an engineering tool. The former makes the simultaneous real-time execution of different modules possible due to its modular structure. Thanks to multi-core support, the execution of the individual modules can be distributed to various CPU cores, which enables optimum use of the computing power of modern processors for automation technology. The TwinCAT 3 engineering environment employs the Microsoft® Visual Studio® development environment, which is widely used in software development, as the framework. The TwinCAT System Manager for the configuration of the
entire system has been integrated into this development environment, as have the editors for the IEC 61131-3 programming languages, which permit the convenient implementation of PLC programs. Through integration into the Visual Studio® development environment, it is possible to use both the C and C++ programming languages for the creation of real-time modules and to implement complex visualizations in the same development environment using C#, C++ or Visual Basic. For the development of real-time modules in C/C++, the TwinCAT development environment has a real-time debugger, which makes the Visual Studio® debugging interface usable for real-time modules.

**The simulation system – Matlab®/Simulink®**

Matlab®/Simulink® by “The MathWorks™” is nowadays considered in research and development to be the standard tool for the digital simulation of technical systems. Complex, dynamic systems can be reproduced and simulated in a model even with just the basic Simulink® library. With the help of numerous additional toolboxes, the modeling effort for special areas of application can be reduced still further. The strengths of Matlab®/Simulink® can be used for automation technology in particular when designing and optimizing linear and non-linear control loops. However, the modeling of dynamic systems for the simulative test of associated control programs also facilitates the process of developing an automated machine.

The implementation of control or regulation algorithms in an automation system has so far taken place – in most cases manually – independent of the implementations already existing in Simulink®. Apart from the additional expenditure of time, this approach is very prone to errors, especially when algorithms are more complex. The implementation of subsequent changes in both software systems is not practicable with complex algorithms. There was a lack of universal programmability.

An approach to eliminating this drawback is offered by Real-Time Workshop®, which “The MathWorks™” offers as an extension to Simulink®. With its assistance, a C or a C++ code can be generated with a mouse click from a Simulink® model containing, for example, the implementation of a controller. The generated code forms the basis for the implementation of this controller in real-time, which in turn is the basic prerequisite for its employment in a real plant.

**Connection to TwinCAT 3**

The possibility of integrating C++ modules into the automation system results in a very flexible solution for the integration of the code generated by Real-Time Workshop®. In addition to the code for the implemented Simulink® model, Real-Time Workshop® automatically generates a suitable framework that forms the interface to the TwinCAT 3 system, if TwinCAT Target is employed. A Simulink® model thus becomes a Simulink® module for TwinCAT, which can be linked to I/Os or other modules in the TwinCAT 3 development environment. Modules can alternatively be nested in one another. This way, for example, a controller can be implemented in Simulink® and can be called within a PLC as a kind of function block.

**Prerequisites of the Simulink® model**

Unlike similar implementations of Simulink® in control systems, no special Simulink® blocks, e.g. input or output blocks, are required in order to generate a TwinCAT 3 module, if the TwinCAT Target is employed. Inputs and outputs are defined with the usual Simulink® blocks.

**Generation of the module from Simulink®**

The prerequisites for the generation of a TwinCAT module from Simulink® are Real-Time Workshop® by “The MathWorks™” and the TwinCAT Target. If both are installed on the system, there is an option to select TwinCAT as the Real-Time Workshop® target system in the settings window of a Simulink® model. Having selected the target system, the user is provided with additional configuration options, e.g. the activation or deactivation of “External Mode.” In principle, the standard settings are sufficient here in order to start the generation of the TwinCAT module. For experienced users there is an additional possibility to initially limit the generation process to the pure generation of code. This way, special adjustments can be made to the code if desired before it is compiled.
Integration in TwinCAT 3
When integrating the module into the TwinCAT 3 development environment, the user has various options:

- An instance of the compiled module can be inserted into the development environment via a selection dialog in the same way that TwinCAT users are familiar with from the integration of a compiled PLC project. The inserted instance then appears in a tree structure, which reflects the logical structure of the control system. The module can be opened in the tree in order to display its inputs and outputs. Digital and analog I/Os of arbitrary modules (PLC, Simulink®, C++ modules, etc.) can be linked to each other. The data transfer between the process images of the individual modules is configured in the TwinCAT development environment via these links. In order to ensure the cyclic processing of the inserted module, it is connected to a cyclic real-time task. This is created automatically when inserting the module and is preconfigured with the cycle time set in Simulink® or a "fixed step size."

As an alternative to the cyclic call by a task, an instantiated module can also be called inside another: in this case the input and output process data of the called module can be accessed inside the calling module.

- If the user wishes to make adjustments to the generated code, he can similarly integrate an automatically generated Visual Studio® project in the tree structure. The generated project file contains all source code files, compiler and linker settings necessary for the successful compilation of the module. After successful compilation, an instance of the generated module is inserted automatically into the tree structure and after that (naturally only if the source code is unchanged) has the same characteristics as the instance of a compiled module that was inserted into the tree.

Parameterization of the module in TwinCAT
Values that can be optimized during the simulation phase are assigned to the parameters of the employed Simulink® blocks as early as during the implementation in Simulink®. These parameter values are adopted into the module as the basic settings with the generation of the code. However, the user additionally has the possibility to adapt these parameters in the TwinCAT development environment. For example, after the exchange of controlled system components, the controller design can be adapted without the absolute necessity to use Matlab® or Simulink®. People who are commissioning a system and may not be familiar with Simulink®, or do not even have the software package installed on their computer, can nevertheless adjust parameters. The basic settings of the parameters can be restored at any time. The parameters can be found in a graphic interface inside the TwinCAT development environment. This graphic interface contains the blocks of arbitrarily nested Simulink® models in a tree structure, with whose assistance the user can navigate simply and clearly through model structures and purposefully adjust parameters.

External Mode
A connection can be made to the generated module from Simulink® with the aid of the "External Mode." Unlike "Normal Mode," with which the implemented model is calculated directly in Simulink®, the "External Mode" allows Simulink® to be used only as a graphic front end. From the Simulink® interface, the user can connect by mouse click to the generated module that is being executed in the TwinCAT system. The "External Mode" connection can be made to all controllers within a network. The user now has the possibility at runtime to adjust the settings within the module being executed in real-time by changing the parameters of the blocks inside the Simulink® environment. In addition, the actual values of the module being executed in real-time are displayed by blocks such as Simulink® scope, which serve to display states or progresses.

Connectivity via ADS
The ADS connection to the generated module is not only used for data transmission for the "External Mode." Data exchange with the Simulink® module can also take place from other applications, such as visualizations, master computers or remote control computers. A master computer can influence parameters or internal states; a visualization screen can display internal states or module output signals. In order to secure the system, the access possibilities can be limited to the parameters before the code generation.
can be generated from them. In TwinCAT these modules are used for the real-time simulation of the sub-systems. The real system is put gradually into operation, while individual system components are still integrated as simulation models.

Example 3: Test rig automation with “Hardware-in-the-Loop” simulation
A test rig for the examination of actuators, as sub-systems of a mechatronic system, is to be realized as a “Hardware-in-the-Loop” simulation. The dynamic model of the overall system was implemented in Simulink® and a TwinCAT module was generated from it.

The signals from and to the actuators to be examined were led out of the Simulink® model as inputs and outputs. Commercially available drive controllers as well as digital and analog input and output assemblies – which are linked with the appropriate module inputs and outputs – are used to control the drives and to acquire the measured data.

A PLC program, which is executed in parallel to the module generated from Simulink®, takes care of error monitoring and the higher level test rig control. Additional sensors for the monitoring of mechanical oscillations on the drives are evaluated exclusively by this controller. As a result, it is possible to limit the Simulink® model to the pure simulation of the mechatronic system and to outsource the monitoring of the real hardware.

The manual parameterization of the simulated system as well as the display of the momentary system status is optionally possible with the aid of the “External Mode” via the Simulink® interface.

The graphic display as well as the long-term acquisition of internal and external signal curves are realized via “TwinCAT ScopeView 2.” The data stored in this way is prepared for further evaluation in Matlab®, among other systems.

Summary
The TwinCAT Target facilitates the integration of modules implemented in the Matlab®/Simulink® simulation environment by “The MathWorks™” into the TwinCAT 3 control system. Unlike similar connections of this simulation environment to control systems, no additional blocks are needed for model inputs or outputs.

The selected type of integration therefore enables the so-called “Model Referencing” in the pure simulation in Simulink®. In the sense of “Rapid Control Prototyping,” individual sub-systems can thus be transferred to the target system without having to make adjustments to the simulation model.

Following the integration of the appropriate module in TwinCAT 3, the variables or parameter values used in Simulink® for simulation are displayed in the graphic interface of the System Manager, so that these can also still be changed here. These parameters can similarly be accessed from other modules or applications at runtime. The connection of Matlab®/Simulink® to the TwinCAT 3 software system created in this way stands out clearly from similar connections due to its possibilities.
The TwinCAT Solar Position Algorithm software function block enables high-precision calculation of the sun angles anywhere in the world at any time.

**High-precision PC-based solar tracking**

The TwinCAT Solar Position Algorithm software function block from Beckhoff enables exact calculation of sun angles anywhere in the world at any time, without the use of sensors. This flexible solution is ideal for parabolic mirror and photovoltaic systems as well as for other solar power plant designs that automatically track the sun’s position for optimum utilization of the sun’s rays. The control algorithm, which calculates sun angles with a precision of ±0.001°, can also be used for other applications such as in building automation or with wind turbines for shadow flicker calculations.

The TwinCAT Solar Position Algorithm software function block enables high-precision determination of sun angles and the times for sunrise, solar noon and sunset year-round. The calculation of the sun angles with the TwinCAT library simply requires the specification of the date, time and exact longitude and latitude of the location (e.g. through a GPS system). Depending on the required precision the algorithm can take into account additional parameters such as the time zone, the height above mean sea level, the slope of the ground or the orientation of the object, the air temperature and pressure, which influence atmospheric refraction. The algorithm can achieve an impressive precision of ±0.001°.

Areas of application include parabolic mirror systems with focusing mirrors of several meters diameter, which track the sun with great accuracy in order to focus the sun’s rays in an ideal focal point. This requires high-precision measurement of the sun angles. Photovoltaic installations that track the sun position also operate on this basis. Another area of application is building automation, where sensors alone are no longer sufficient to adequately deal with shading of large building facades. The Beckhoff software can also be used for exact calculation of shadow flicker from wind turbines, which is to be avoided in populated areas. The results allow individual turbines to be switched off if necessary.

www.beckhoff.com/TwinCATSolarPosition
Beckhoff Bus Terminals: Expansion of the automation kit

BK9053 PROFINET Bus Coupler – the cost-optimized alternative

The BK9053 Bus Coupler extends the Beckhoff Bus Terminal system by a PROFINET RT slave. The Bus Coupler from the “Compact” series is optimized for cost-sensitive applications and is manufactured in a slim housing design. Unlike the BK9103 PROFINET Bus Coupler with integrated 2-port Ethernet switch, the compact version has only one Ethernet port. The BK9053 makes the complete variety of approximately 400 different Bus Terminals available to PROFINET.

The BK9053 “Compact” PROFINET Bus Coupler connects PROFINET RT to the modularly extendable Beckhoff Bus Terminals. PROFINET cycle times down to 1 ms are possible with the BK9053. The coupler is configured and parameterized in the controller via the GSDML (basic device file).

Beckhoff supports all market-relevant fieldbus and Industrial Ethernet solutions. In addition to the IP 20 system, the IL230x-B903 Fieldbus Box in protection class IP 67 is also available for PROFINET applications. On the software side, the product range is rounded off by the TwinCAT software modules PROFINET RT Controller and PROFINET RT Device, which turn every Beckhoff PC controller into a PROFINET controller or device.

www.beckhoff.com/BK9053
Integrated control platform replaces special subassemblies

Traditional blow molding machine controllers are based on special hardware that is difficult to extend with new tools, for example. Turnkey software for blow molding applications plus a Panel PC with a 15-inch...
display and a high-performance Intel® Celeron® processor place all of the advantages of open PC-based automation technology at the user’s disposal: Instead of special modules, e.g. for controlling the wall thickness or the temperature, the Industrial PC constantly controls all machine functions. Thanks to the modular structure of the Blowmolding Framework software, different measuring systems such as analog encoders or SSI sensors can be more easily connected to a machine.

The electrical signals from the sensors, valves and motors are picked up and output with the aid of the Beckhoff Bus Terminal I/O system. Eliminating specialized “black box” modules increases the availability of the machine while at the same time reduces service expenditures and the required spare parts stock. In the case of large machines in particular, the placement of distributed I/O modules, e.g. on the extruder cylinder, saves costs and increases functional reliability. Beyond that, safety-oriented Bus Terminals permit the simple and fast implementation of safety functions. Compact Flash storage is used instead of a hard disk, which guarantees the user low failure rates.

**Short sampling times are decisive for the quality of the product**

Of course, optimum wall thickness control is crucial for the quality of the final product. Since this controlled system possesses a high natural frequency, short sampling times are decisive for quality. This requirement is fulfilled perfectly by the employment of a high performance Industrial PC and EtherCAT as a fast fieldbus system. Since, for example, sampling times of less than 1 ms can be achieved, the profile accuracy is increased to the maximum and plastic products with consistently high quality can be produced.

**Clear and convenient user interface**

The productivity of a machine depends, among other things, on how quickly the operator can intervene in the manufacturing process and that the information needed for this is available at a glance. Beckhoff’s industry-specific CP6202-1026 Blow Molding Panel PC is equipped with over 40 manual operating buttons, which are partly assigned to the right and left sides of the machine. The buttons are labeled using convenient push-in strips and can be adapted to each unique application. A 15-inch touchscreen displays all information in a clear format.

The user interface of a blow molding machine often supplies an abundance of unstructured information, making it difficult for the machine operator to distinguish between important and unimportant data. Therefore, particular importance was placed on a clear structure when designing the Beckhoff user interface. At the same time, ergonomic approaches were also utilized; i.e. the color design is “easy on the eyes” and the amount of visible data is intelligently condensed. The operator finds important data in the same place on each page. In addition, soft key functions support intuitive operation.

The machine and recipe data are stored in XML format, which has a hierarchical structure that ensures the safe processing of the parameter files, e.g. for language versions and axis parameterization using external editors. The data structure is imaged directly in the data model of the visualization software by the use of XML; this simplifies processing of the data and reduces the load on the system. The XML standard also facilitates automatic machine configuration using external configuration programs.

**Wall thickness editor guarantees ideal production results**

The user interface for the wall thickness control, for example, is characterized by a clear division into four equally large fields. The header field contains status information, such as language version, operator name and alarm messages. Access rights are specified and operator inputs registered with the aid of user management, so that the production process can be completely documented. The configurable status bar contains the most important process information, such as cycle time, extruder data or piece counters. This means that the operator specifies which data are to be permanently displayed, allowing them to ascertain the machine’s condition at a glance. The third field contains the soft keys, while the fourth field contains variable contents, such as wall thickness or temperature control.

The wall thickness editor contains all important functions for the fast, clear creation of the wall thickness curves. Support points and curve segments can be represented in an easily recognizable manner by means of cultured graduation. Up to 25 profiles can be illustrated and edited. Partial wall thick-
Drive concepts are supported, such as driving the main pump with a servo drive. Short cycle times are achieved by the optimum control of the transport movement and the clamping unit, among other things.

For this, the Blowmolding Framework uses the proven motion modules from the TwinCAT hydraulic library in order to obtain an optimum balance between fast movement and accurate positioning.

The operating page for the axis movement allows the parameterization of up to 25 motion axes. Up to five movement segments with optional holding points can be defined for each direction of movement. For the control of additional functions, a selection of 10 cams per axis is available that can be edited in relation to the direction and with variable hysteresis. As a result, the user is able to operate even complicated tools without intervention in the control program. The advantage of this is that the operator can define the individual movement segments independently and label them accordingly.

Tried and tested Beckhoff technology modules and customer-specific know-how complement each other for the ideal solution

The basis of the turnkey blow molding machine controller is the TwinCAT Blowmolding Framework. It consists of four separate program blocks, which can be supplemented or extended by customer-specific modules. The mechanical structure of the machine is defined by the configuration module; the type and number of axes and the sensor system of the machine are specified here.

These data are stored in XML format. The technological functions of the blow molding machine are located in the motion/temperature control module. The customer can supplement these with their own modules with their know-how – or replace the Beckhoff modules with their own software controllers. The organizational module represents the link between the sequential control and the technological functions. The customer-specific sequential control or the user interface can access process data such as positions or speeds in a simple manner.

Support for production cells

Modern production facilities frequently have special insertion units for placing prefabricated components into the mold, such as handles for drums or printed foils. Servo-electric handling systems increasingly perform article transport. Insertion units and handling systems are integrated either by

Precise, fast temperature control

Likewise, one of the main prerequisites for high product quality is precise and fast temperature control. The TwinCAT Blowmolding Framework integrates a software temperature controller with clear operating pages, which has been proven in many applications in the plastics industry. Special attention was paid during the development of an intelligent auto-tuning algorithm, which is optimized for the smallest possible overshoot when changing the set value. The retrofitting of additional heating zones can be easily achieved, since the software is prepared for a maximum number of zones and only further I/O terminals need to be installed to expand the system.

All important control zone parameters can be seen at a glance on the user interface; critical temperature deviations are indicated by a color change. The input of an entire group of temperature zones is especially simple, e.g. in the case of a cylinder. As a result, the operation – compared to single temperature controllers – is accelerated and simplified considerably.

Motion control for all hydraulic, hybrid and servo-electric axes

The TwinCAT Blowmolding Framework is suitable for blow molding machines with hydraulic, servo-electric or hybrid drive technology. Energy-efficient drive concepts are supported, such as driving the main pump with a servo drive. Short cycle times are achieved by the optimum control of the transport movement and the clamping unit, among other things.

All important control zone parameters can be seen at a glance on the user interface for the temperature control; critical temperature deviations are indicated by a color change.
fieldbus interface or integrated directly with the aid of the Blowmolding Framework.
For quality certification, an automated article check is performed, and its results are optionally displayed on the screen and stored in the production log. A free network interface is available as standard for the transmission of these data.

**Quality and efficiency requirements optimally fulfilled**
The high performance of Beckhoff’s PC-based controller platform makes short reaction times possible, guaranteeing the efficient production of high-quality plastic products. A large touchscreen display is available for ergonomic operator guidance and fast user intervention. The integration of the controller into company networks facilitates the complete documentation of the production process, the logging of operator interventions and the assignment of user rights. Beyond that, the high requirements of modern quality assurance systems are met. The analysis of machine errors is also supported by a sophisticated messaging system. All fault messages are stored and can contribute to the continuous improvement of the production process as well as to the minimization of downtime. If service should be necessary, there are extensive options for Internet-based remote diagnostics, so that the customer can quickly analyze and rectify malfunctions.

In the sense of a clear and convenient user interface, particular importance was placed on a clearly laid-out user interface in order to ensure straightforward operation.

The modular hardware and software architecture of the controller flexibly accommodates subsequent plant expansions or the integration of peripheral devices. This guarantees the user that their investment is secured over many years.
In its new subsidiary for North Rhine-Westphalia in Cologne, Germany’s waterfront quarter, Microsoft is combining cutting-edge IT and media technology with state-of-the-art building functions to realize its vision of the office of the future. Microsoft’s aim is to make communication and collaboration with its customers, partners and colleagues more efficient and more intuitive. The integration of Microsoft IT technologies into building automation was achieved using PC-based and Ethernet-based control technology from Beckhoff.

Supported by advanced IT technology, the world of work is undergoing radical change: new ways of working are evolving, which give employees greater freedom in terms of time and space and at the same time increase a company’s productivity and innovative power. Today Microsoft is already making this vision of a “New World of Work” a reality in its Cologne, Germany subsidiary. The building is one of the most advanced office buildings in Europe. The IT infrastructure is based on Microsoft products such as “Unified Communications” technology, which make employees in every area of the building accessible, regardless of their individual terminals. The events level of the office building contains state-of-the-art conference rooms and offices in which Microsoft customers and visitors can experience the latest trends in software and hardware. The events level also incorporates a state-of-the-art conference center, two lecture rooms, an equally spacious lounge with a bar, kitchen, catering area and rooftop terrace with an exclusive, panoramic view over the Rhine, Cologne Cathedral and the Old Town.

Superimposed operating functions
In order to integrate the IT and media technologies, the “Microsoft Technology Center” in Cologne was equipped with the most advanced building automation solutions from Beckhoff Automation. Accordingly, Elektro Beckhoff GmbH based in Verl was commissioned to plan and implement this integration. “The conference center is the first of its kind. Microsoft intends that it should serve as an example of just what can be
achieved in office buildings in terms of media and presentation technology now or in the very near future,” says Beckhoff Building Automation Manager, Georg Schemmann.

All the functions of a modern building were integrated into a holistic building automation solution. These functions include control of the HVAC systems, the lighting, control of Venetian blinds and awnings, flexible lighting scenarios adapted to suit a particular occupancy, etc. Control of the rooms and areas is multifunctional. All the functions can be accessed interactively and on the Web via the central point of information (POI), using a touch screen or “Mobile Devices” connected by WiFi to the Microsoft Cologne subsidiary corporate network. Not only can preset functions be activated, but set values or lighting scenarios can also be altered if necessary. This functionality is based on superimposing a building’s IT systems on its automation technology. Alternatively, the individual rooms and areas can of course be operated conventionally via actuators and other operating devices as well.

**POI – the information and control center**

The first object the visitor encounters at the entrance to the events floor is a kiosk, the central “Point-Of-Information” (POI). “You can find kiosks like this in many modern office complexes nowadays,” comments Georg Schemmann. Various items of information, e.g. TV news bulletins, current flight schedules at the Cologne/Bonn airport or traffic reports can be accessed easily via the touch screen. These services are transmitted to the

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The display wall at the lounge entrance consists of 16 46” displays arranged as a continuous series.

The “Point-of-Information” kiosk as an information and control center

View over Cologne’s waterfront and water meadows

The awning on the roof terrace is raised and lowered at both ends by a servomotor.

Touch panel with control options for accessing the room functions
POI via news channels. “You can operate and control the whole events level using these interfaces,” according to Frank Humann, the project manager from Elektro Beckhoff.

Moreover, all the room functions, including the heating, air-conditioning and ventilation systems can also be accessed at the POI via sub-menus. Beckhoff Automation equipment was “mounted on top of” the existing basic installations. A Beckhoff PC controller was also superimposed over the existing building technology on the fourth floor of the building in order to implement additional functions. “Moreover, we incorporated even more functions,” Frank Humann reports: “Energy efficiency is another important aspect in Microsoft’s view. So that the current energy consumption can be displayed at all times, we have installed energy measuring terminals into the system.”

**Embedded PC controls the events floor**

Shading by means of Venetian blinds is one of the standard fixtures in the building. Weather sensors located around the building record the temperature, precipitation, wind speed and brightness. The data are displayed via an RS485 interface and transmitted to the CX1010 Embedded PC from Beckhoff, which controls the entire building automation of the events floor. Data from the weather station sensors are integrated into the control of the Venetian blinds and HVAC systems which serve the whole building. Independently of this, Beckhoff building automation regulates and controls the indoor climate of the floors separately in terms of the individual areas or rooms. This is done via the volume flow regulator, which is in turn controlled by the CX1010 Embedded PC via MP Bus (Multi-Point Bus). Individual room control also makes it possible to regulate the volume flow according to the number of people occupying the conference rooms, for example. All of the room functions can also be controlled manually.

Moreover, it is possible to save certain preset scenarios which can then be retrieved or altered if necessary. Georg Schemmann observes: “Customers can go through the building and configure certain lighting scenarios themselves. They can do so either at an operating panel, via a light switch or the computer program because we have assigned certain values to a switch in our TwinCAT automation software via the ‘Building Automation Framework’.”

**Connecting the IT worlds**

Microsoft’s Silverlight Technology is then integrated into the POI and used to operate the entire floor. This enables the user to navigate the floor plan and zoom in on individual areas.

The BK9000 Bus Couplers from Beckhoff which are integrated into the sub-distributions are connected via Ethernet TCP/IP to the CX1010 Embedded PC which acts as the master. The Bus Terminals are then connected to the Bus Couplers: for example, the lighting is operated by 230 V AC by means of DALI (Digital Addressable Lighting Interface) Bus Terminals with dimmer functionality. All the sensors, actuators or other signalling devices, are connected via the 24 V DC Bus Terminals. In addition, room operating devices are used which are coupled in series to the Bus Terminals via RS485.
Superlative media technology

The absolute highlight of the events floor in the Microsoft subsidiary in Cologne is the wide range of media technologies available. Next to the “Point-Of-Information” kiosk at the entrance, which acts as an information and control center, is an impressive display wall comprising a continuous series of 16 46-inch LCD displays. All the current media content can be played back in 16:9 format on this large display wall.

Behind the display wall is the actual lounge landscape. The core of the fixtures and fittings are the Microsoft “Roundtable” video conferencing systems and Surface touch screen computers. The Round Table device with 360 degree camera has an all-round view, can focus on the speaker and films meetings. The contents of the “Surface” screen are filmed from above via a document camera integrated into the ceiling and projected onto one or both of the 65-inch plasma screens fixed to the wall.

Designed like a desktop, “Surface” comes without a mouse, keyboard or other conventional input devices. Everything is entered by one or more hands via multitouch on the 30-inch screen. This technology enables the computer to interact with either humans or other devices. Synchronizing “Surface” with other devices, e.g. mobile phones or digital cameras, is very straightforward. If these have WLAN, they must merely be placed on the screen. The touch screen computer will then recognize them and data can be exchanged, using drag and drop. The data are “dragged” into the devices by simple finger touch.

There are connections for Xbox, Media Center PC and various other multimedia devices in two media sideboards in the lounge. Signals from Xbox, a game console developed by Microsoft, can only be reproduced on the relevant plasma screen above the sideboard. Mounted above the two screens is an audio installation which is controlled by a touch panel integrated into the wall. Since it is connected to the CX1010 Embedded PC from Beckhoff, this touch panel can also control the functions of the lounge area.

At the front of the Microsoft Technology Center (MTC) is a large rear-projection wall made of safety glass and with a screen measuring 201” (5.11 m) diagonal. The MTC projects images via three HD projectors, each with a brightness of 10,000 ANSI lumens. The envisioning process is carried out by a PC installed with the equipment in the rear-projection wall, which displays the contextualized background images created by the user in full-screen format. This PC is operated wirelessly from the MTC by means of a keyboard and mouse. A VGA laptop source can be inserted from either moderator desk as a picture in picture display. The positions are specified by the user.

The rear-projection wall is touch sensitive, i.e. the touch function is available optionally on either one of the two laptops. Alternatively, the touch function can be used for both the background and the two laptops at the same time. However, this assumes that the laptops can be connected to the installed PC via Remote Desktop.

All the websites for controlling the building are stored on a central C5102 19-inch Industrial PC from Beckhoff. Equipped with two network cards, the Industrial PC can connect to the Microsoft Corporate Network from which it gets its IP address. The second network card connects it to the Beckhoff network via Ethernet TCP/IP.

The WiFi interfaces are also connected to the Microsoft Corporate Network and transmit the room functions retrieved from the mobile operating devices (PDA or handheld). In turn the Microsoft Corporate Network transmits the function calls to the CX1010 via Beckhoff’s Bus system. “Using a PDA or handheld device to operate room functions is becoming increasingly important,” according to Georg Schemmann. “In the end it also makes sense to use devices that can do more than just make a phone call.” The rooms can also be operated via “Windows Mobile Devices.” The user interfaces are based on a Web application which can be operated with very different “Windows Mobile” devices.

Straightforward configuration of the room functions

The room functions were programmed with the aid of the “TwinCAT Building Automation Framework.” Instead of following the conventional approach via PLC program functions, the functions are selected and configured,” explains Georg Schemmann. The Building Automation Framework simplifies building engineering and commissioning considerably. System integrators, building operators and users who have no programming skills themselves can implement new functions, change scenarios or assign different sensors and actuators easily by means of just a few clicks, following the motto of “Configuring instead of programming.”
HST Hydro-Systemtechnik relies on robust hardware components from Beckhoff

Wireless system ensures reliable plant communication at the Genkel Dam

The Genkel Dam, situated in the municipal area of Gummersbach and Meinerzhagen, Germany, supplies drinking water to the surrounding region. In order to automate the operation of the dam, HST Hydro-Systemtechnik GmbH was commissioned to plan, install and start up a new process control system. Robust automation components from Beckhoff ensure that the complex measuring and control tasks are performed reliably, despite long distances and a damp environment.

The Genkel Dam consists of a rock fill with a waterproof double asphalt concrete covering on the upstream face. The dam, which rises 41 metres from the bottom of the valley, is 200 meters long and almost 8 meters wide at the crown. The reservoir behind it holds approximately 8 million cubic meters of drinking water. In order to supervise the operation of the dam in accordance with state of the art technology, HST Hydro-Systemtechnik was commissioned from the Aggerverband, a regional water management association based in Gummersbach, with the installation of a modern process control system. This monitors parameters such as withdrawal of water, water level, water temperature, water evaporation and wind velocity. In addition, shifting of the dam in relation to the substrate is monitored constantly.

**PC-based control and monitoring system**
HST Hydro-Systemtechnik, with head office in Meschede, Germany, employs a total of 110 people and offers complete solutions for water management, which are used in both the municipal and the commercial sector. The applications include, for example, water works, dams, storm water tanks, sewer systems and wastewater treatment plants. The company’s core competencies include IT systems for automation and process control engineering. HST Hydro-Systemtechnik develops the software in-house. The hardware, conversely, is sourced externally. “Some years ago we decided to extend our HydroDat® V8 process control system using a PC-based TeleMatic system,” explains Frank Heutger, Product Manager for IT systems at HST Hydro-Systemtechnik. “To this end we looked for compatible hardware, which also had to be modular and durable. We ultimately decided to use Beckhoff components, because they are very reliable and their openness means they can be integrated simply into our process control system,” says the IT expert. HST Hydro-Systemtechnik has used Beckhoff hardware almost exclusively since then.

In water management it is frequently the case that several plants distributed over a wide area have to be integrated into a process control system. The particular challenge here is to ensure reliable operation despite these conditions. Frank Heutger comments: “Communication used to take place mostly via telephone lines. Today, however, radio data transmission is being used increasingly. In addition, online connections are established via Ethernet.”

**Successful integration of modern radio technology in proven Lightbus-based bus structures**
The new process control system for the Genkel Dam links together a total of 12 stations, of which one – the so-called measuring raft – is located on the reservoir. In addition, the system is directly connected to the central control room of the Aggerverband, from where several dams are monitored. “The association demanded high availability where the hardware is concerned. That means the components also have to work reliably
easily into the Bus Terminal system, use the 2.4 GHz band. A directional antenna ensures a stable radio link,” explains Frank Heutger. The same wireless technology also exists in station one, which acts as an interface between the two Bus Terminal systems.

Data transmission via ADS
The backbone of the process control system is formed by the 12 Bus Terminal Controllers which, via ADS (TwinCAT data transport protocol), either exchange the data among one another or transmit them to the control center, from which the entire dam is then monitored and controlled. The on-site operation and monitoring of the plant take place by means of a Beckhoff CP7102 Panel PC in protection class IP 65, which is connected to the Lightbus system with an integrated FC2001 PCI interface card. All information can be visualized and the corresponding commands entered on the 15-inch touchscreen panel.

Following a planning phase lasting several months, the new process control system for the Genkel Dam was realized in approximately six months in 2010. Since then it has worked without error. The radio link with the measuring raft has also passed the acid test. “This confirms once again the good experience that we have had with Beckhoff hardware for several years,” Frank Heutger declares, because in the meantime HST Hydro-Systemtechnik has installed well over 1000 CX Embedded PCs, which run reliably without exception.

Beckhoff Bus Terminal system integrates wireless communication
The 12 station, the so-called measuring raft, has almost the same hardware. However, since this raft is located out on the water 100 meters from the dam, a cable connection would have been risky. This is because a cable lying in the water body would be exposed to numerous lightning strikes during thunderstorms, since the body of water is struck by lightning much more frequently than the surrounding land. To solve this challenge, the experts from HST Hydro-Systemtechnik decided to use a solar power supply and initially a radio connection using the Beckhoff KM6551 Wireless Terminal. "These terminals, which can be integrated under difficult environmental conditions and have a long life span. The control system also has to guarantee secure data storage,” explains the IT expert from HST.

In order to transmit the data reliably within the process control system, the Aggerverband chose – for reasons of uniformity – the Lightbus system that has already been used successfully for several years at the Wiehl Dam, which likewise belongs to this association.

A total of 11 of the 12 stations of the Genkel Dam are connected via a 1.5-kilometer long Lightbus ring. Each station consists of a BC2000 Bus Terminal Controller with integrated PLC functionality. The process data are acquired by various analog and digital measuring terminals.

HST Hydro-Systemtechnik
Solutions for Water Treatment
www.systemtechnik.net
www.beckhoff.com/water
In the field of renewable energy, Beckhoff supplies manufacturers of wind turbines and their suppliers, among others, with PC and EtherCAT-based automation solutions. The integration of PLC, safety technology and condition monitoring as well as lower level bus systems on one control platform simplifies the engineering and reduces space requirements and costs. The plant manufacturer gains high investment security by the employment of open industrial communication standards, such as IEC 61400-25, Ethernet TCP/IP and OPC.

PC Control for wind turbines

Control technology by Beckhoff has successfully proven itself in use worldwide in wind turbines up to a size of 5 MW. Based on PC and EtherCAT technology, Beckhoff supplies universal control solutions for all areas of application in wind turbines, from pitch control and the operational management of tower and pod through to the farm networking and control room – both onshore and offshore. In modern wind turbines the EtherCAT real-time Ethernet system is the basis for fast communication in the wind turbine and for wind farm networking.

Through the integration of lower level fieldbuses, fieldbus masters can be relocated to the field for the control of subsystems without any additional CPUs being necessary. EtherCAT enables the seamless integration of condition monitoring into the EtherCAT terminal system. TwinSAFE, Beckhoff’s safety technology, merges the safety functions into the existing controller application and thus replaces the hard-wired safety chain.

The Beckhoff I/O systems are continuously being supplemented by new terminals or Embedded PCs. The latest developments, the Embedded PCs from the CX5000 and CX8000 series, are fanless, compact and energy-efficient PC-based controllers, which are ideally suited for control tasks in wind turbines.

The standard automation world is extended considerably by TwinCAT 3, the new software generation from Beckhoff. In addition to the object-oriented IEC 61131-3 extensions, the languages of the IT world are available in C and C++. Through the integration of Matlab®/Simulink® and Scada into the development environment, TwinCAT 3 offers a convenient tool for designing the control software. The modules are executable in the different languages in a common runtime under hard real-time conditions, using multi-core technology and with 32 or 64-bit operating systems.

The special issue contains user reports on worldwide wind turbine manufacturers and their suppliers of converters, pitch systems and brakes. You can obtain the Wind Special from the end of September through your Beckhoff Sales office or online at www.pc-control.net/wind.
PC- and EtherCAT-based control architecture for operational management, pitch control and wind farm networking

**Pitch control**
- EtherCAT

**Operational management (nacelle)**
- EtherCAT I/O system
- Condition Monitoring
- Ethernet TCP/IP
- CANopen (optional)
- PROFINET (optional)
- EtherCAT (fibre-optic)

**Wind farm networking**
- ADS SOAP, HTTP, IEC 61400-25, OPC-UA
- Ethernet TCP/IP

**Operational management (tower base)**
- TwinSAFE: direct integration of safety I/Os
- EtherCAT I/O system
- DVI/USB
- Embedded PC, EtherCAT Terminals
- Ethernet TCP/IP (optional)
- PROFINET (optional)
- CANopen (optional)
- EtherCAT (fibre-optic)
Chinese wind turbine manufacturer Goldwind uses Vensys plant design and PC-based control from Beckhoff

High-quality, proven control components for Vensys wind turbines
The gearless Vensys wind turbines are characterized by their simplicity and quality. The turbines are proof that a few high-quality and proven components are sufficient for building state of the art wind energy converters. With the 70, 77 and 82 series, Vensys offers advanced wind turbines in the 1.5 MW range with different hub heights and rotor diameters. New 2.5 MW plants will follow near the end of 2010. All Vensys wind turbines use PC-based control technology from Beckhoff. To date, more than 6,200 wind turbines based on the Vensys design with Beckhoff technology have been delivered worldwide.

Vensys Energy AG specializes in gearless wind turbines. In addition to manufacturing facilities at Neunkirchen (Saarland, Germany), the company has manufacturing capacities for more than 2000 wind energy converters through licensees around the world. At Diepholz, Lower Saxony in Germany, the subsidiary Vensys Elektrotechnik GmbH produces frequency converters, low-voltage distribution boards and pitch systems for the Vensys wind power units.

In addition to the development and manufacturing of wind turbines, Vensys sells expertise in the form of licenses. The licensees have the right to manufacture and sell wind turbines according to Vensys designs. Over recent years the companies Goldwind in China, Eozen in Spain, Regen Powertech in India and Enerwind/IMPSA Wind in Brazil have become the license partner of Vensys. Vensys wind turbines can be found in all major emerging markets around the world.

Vensys originated from the wind energy research team (FGW) at the University of Saarbrücken in Germany, which was established in 1990. The first Vensys 70/77 type 1.5 MW wind energy converters started operating in spring 2007. In September 2009 Vensys presented its newly developed 2.5 MW wind turbine generator. The design is based on established Vensys technology: At the core of the gearless wind energy converter is a synchronous generator with permanent magnet technology that is driven directly by the rotor. The direct drive avoids the need for gearboxes which are maintenance-intensive and susceptible to faults. The characteristic Vensys generator design achieves a high efficiency. The market introduction of the Vensys series 90 and 100 with 2.5 MW rated power is planned for the end of 2010.

Versatile and robust operations management permits application anywhere and under extreme environmental conditions

The control systems for all Vensys wind turbines are developed and manufactured in Diepholz by Vensys Elektrotechnik GmbH in close cooperation with Beckhoff. This is where the pilot production for the control cabinets and systems takes place before the licensees and/or their manufacturing partners commence series production. In order to be successful internationally, wind turbine manufacturers need high-performance and flexible control systems: Rapidly changing system states under different, and in some cases extreme climatic and environmental conditions result in complex demands for the control systems. Wind turbines must be suitable for the locational conditions found in Central European lowlands and climatically extreme conditions, as they occur in China, for example: Deserts naturally present different conditions than coastal locations or mountain regions. The control systems must withstand heat, cold, humidity, sand, extreme wind forces, turbulence and other demanding influences and respond reliably. The system must always face the right way relative to the wind; data must be collected and evaluated; state or error messages must be exact and meaningful; grid feed-in must be correct and grid-supportive. All this requires a high-performance and adaptable control system.

At the Diepholz, Germany facility Vensys Elektrotechnik GmbH builds the “pilot series” for the control cabinets before the licensees and/or their partners commence series production.
Lean control architecture integrates standard and safety I/O in a single system

The Vensys system design, which is based on just a few components, is matched by the “lean” Beckhoff control concept with a single PC (see topology diagram). The master computer is a Beckhoff CX1020 Embedded PC to which two Bus Terminal stations in the tower base, two stations in the nacelle and the pitch controllers in the hub are connected via PROFIBUS. The central Embedded PC collects and processes the operational management and pitch controller data, controls the grid feed-in and communicates with the control room via Ethernet.

Compared with conventional solutions the PC-based control system from Beckhoff has the advantage that only one PC is required for control purposes and data interfaces. The Bus Terminals are attached directly to the Embedded PC, so that PC technology and modular I/O level form a cohesive unit.

The safety functions are also directly integrated in the Bus Terminal system. TwinSAFE terminals are distributed to the different I/O stations. A central KL6904 TwinSAFE logic terminal serves as the link unit between the safe input and output terminals. The logic terminal integrates safety function blocks which are configured accordingly.

In the Vensys wind turbines, the overspeed relay, vibration sensor and the emergency off button are integrated in the safety circuit.

Robert Müller, wind power expert from the Beckhoff branch office in Lübeck, Germany explains the benefits of the integrated safety technology: “The merger of standard and safety I/O into a single streamlined system simplifies project planning, programming, cabling and diagnostics significantly. The TwinSAFE Bus Terminals permit the connection of all common safety sensors and actuators. The TwinSAFE protocol is used for secure communication. This enables safety-related data to be transferred via any media. In the case of Vensys systems, PROFIBUS is used for transferring the safe signals.” The use of TwinSAFE technology makes multi-wire copper cabling between the nacelle and the tower base, which is required for a conventional hard-wired safety chain, unnecessary. The safety chain is integrated in the optical fiber used for system automation.

Compact pitch controllers and flexible IEC-61131 programming

The pitch controllers are coupled with PROFIBUS via slip rings. Each rotor blade features a Beckhoff BX3100 Bus Terminal Controller with various Bus Terminals. The pitch box with integrated controller automatically collects and analyzes the ambient data, decides independently and communicates with the other pitch boxes in order to coordinate the initiated actions. At the same time the data are transferred to the Embedded PC in the nacelle. The rotor blades are pitched via external toothed belts – a solution developed in-house at Vensys that developers are quite proud of.

“Crucial factors for choosing the Beckhoff systems were the flexibility of the comprehensive Bus Terminal I/O kit, the small footprint of the controllers and I/O systems, the user-friendly programming via..."
TwinCAT, and ultimately the low system costs," said Frank Becker, director of control technology at Vensys.

Another argument in the decision for Beckhoff as control equipment supplier was the global positioning of the company in more than 60 countries. Beckhoff has wind power experts in its subsidiary branches in important wind power regions such as China.

**Goldwind relies on German technology**

The main licensee of Vensys wind energy converters is the company Goldwind Science and Technology Co Ltd., based in Urumqi in northwest China. Goldwind Windenergy GmbH, a German subsidiary of Goldwind, has been the main shareholder of Vensys Energy AG since April 2008 with 70% of the shares. Goldwind has become the industry leader among Chinese wind turbine manufacturers and is set for further growth.

Goldwind’s main activities include the development, manufacturing and sale of wind turbines. Goldwind also offers comprehensive technical and consulting services for the construction and operation of wind turbines for windfarm operators and investors. More than 6,000 Goldwind wind turbine generators are currently in operation in China. Goldwind supplied wind turbines for the Olympic Park near Beijing, which was built for the Summer Olympics in 2008. The company is also successful in the international wind energy market: The first networked 1.5 MW wind turbines at the UILK windfarm in Minnesota (United States) were commissioned in February 2010.

"Goldwind and Beckhoff have had a successful working relationship for many years," said Dr. Yuwen Bo, deputy director of the Goldwind wind energy technology center: "Beckhoff has extensive expertise in the wind energy industry and is able to supply complete system solutions. In addition, PC Control offers us a high degree of flexibility for programming and facilitates modifications of the control system according to application- or customer-specific requirements."

The increasing demands for efficiency and energy yield have resulted in strong growth for high-performance wind turbines: 1.5 MW systems are currently the standard in China. For the 2.5 MW systems, which will commence production towards the end of this year, Goldwind will use EtherCAT as communication system instead of PROFIBUS.

"The control algorithms for the systems are getting more and more complex," said Dr. Yuwen Bo: "In order to cope with difficult geographic and climatic conditions and varying requirements, the performance of the main controller – which represents the ‘brain’ of the wind turbine – must be able to ‘grow.’ The Embedded PCs from Beckhoff are able to process very complex algorithms, which means all wind turbine control tasks can run on an integrated platform.

Vensys Energy AG
www.vensys.de

Goldwind Science and Technology Co Ltd. www.goldwind.cn

Goldwind International www.goldwindglobal.com

The Guanting windfarm near Beijing is located at an elevation of approx. 460 to 479 m (1509 to 1572 ft) and is spread over an area of 6 x 14 km (3.7 x 8.7 mi). It has an installed wind power capacity of 155 MW. Guanting II, with a capacity of 50 MW, is currently under construction.
The MiniBendCenter from the mechanical engineering firm RAS produces sheet metal parts fully automatically with the highest precision and cost-effectiveness. So that the complex bending process, complete with workpiece and tool handling, can proceed in a coordinated fashion, RAS has equipped its machine with a PC- and EtherCAT-based automation platform from Beckhoff during a re-engineering of the system.

RAS Reinhardt Maschinenbau GmbH, based in Sindelfingen, southwest Germany, has developed advanced machines for forming, bending, stamping and cutting sheet metal for over 70 years and is able to impress end-users again and again with technically innovative solutions. With the MiniBendCenter, which was introduced by RAS in 2009, small sheet metal parts can be bent, such as those required for machines, the construction of housings, weighing scales, household appliances or for the inner workings of devices. Press brakes have been considered the standard in this field up to now, while the folding technique was reserved exclusively for bending large format sheet metal. The MiniBendCenter now proves the opposite and shows that the folding technique is also economical and highly productive for the manufacturing of small, complex bent parts as well.

The metal sheets are fed to the bending center, aligned and measured automatically; tooling likewise takes place automatically. Subsequently, the metal sheet is positioned on the bending line by a manipulator or a stop system and clamped by upper and lower cheeks. The bending cheek swivels upwards or downwards and bends the metal sheet to the desired angle. Since the clamped part of the metal sheet remains horizontal while the other bent part leaves the support level, this procedure is very easy to automate.

Automation at the highest level
The MiniBendCenter is designed for processing blanks up to a format of 600 x 600 mm (23.6-in x 23.6-in) and a thickness of up to 3 mm. The process runs fully automatically. The steel sheets are fed in, which are preferably laser-cut and contained in a magazine, are separated and aligned in the take-up section of the MiniBendCenter and taken up by a manipulator, which has them optically measured at a station. The blank is clearly identified with regard to its size and position and exists ‘logically’ in the MiniBendCenter. The manipulator subsequently transports the blank to the bending line and guides it through all bending steps, i.e. from tool to tool, without loss of precision. Since the machine determines the exact position of the sheet in the manipulator once and does not release the sheet again afterwards, it does not require stops. "This procedure leads to fast bending processes, high output, large leaps in productivity and low unit costs,” stresses Willy Stahl, Managing Partner of RAS Reinhardt Maschinenbau GmbH.

The required tools for the bending process are taken from the tool storage and installed in the bending cheek fully automatically. A CAM system developed by RAS supplies the machine controller with the data regarding the necessary tool lengths per station. A total of 14 axes, 11 of them servo axes, drive the upper and lower cheek, the bending cheek, the
The RAS MiniBendCenter is a fully automated, highly productive manufacturing center, which manufactures small, complex bent parts using the folding method.

A suction system grips the uppermost blank and brings it to the transfer table, where a manipulator takes over the part. This guides the sheet past an optical measuring station in the first step.

The steel sheets, measuring up to 600 x 600 mm (23.6-in x 23.6-in) with a thickness of up to 3 mm, are fed to the bending center, aligned and measured fully automatically. The tool change is likewise automatic.

Manipulator and the tool changer. So that the complex bending process, complete with workpiece and tool handling, can proceed in a coordinated fashion, RAS has installed the Beckhoff automation platform during the re-engineering of the machine. It consists of a Beckhoff C6925 Industrial PC with a separate CP6932 Control Panel as the HMI, TwinCAT PLC and NC I automation software, EtherCAT I/O terminals and EtherCAT, the ultra-fast communication system. The TwinSAFE solution from Beckhoff was also implemented for secure safety data transmission.

**Highest consistency and repeatability of the processes**

All axes of the machine are driven by servomotors with digital controllers. This guarantees automatic processes with the highest consistency.
The MiniBendCenter performs all movements via cam plates with different groups of movements, which are coordinated with one another via a virtual axis," explains Jochen Meier, the RAS developer responsible for the programming of the bending center: "We describe the entire bending process by means of so-called bending tables, which are tied to NC I channels. This way, we have defined individual NC I channels with the position tables for the associated servo axes for the tool changer, the manipulator, the upper cheek, etc."

RAS uses TwinCAT NC I for interpolating movements. "TwinCAT NC I offers the possibility of configuring a virtual axis as an interpolating axis. This is defined in turn as a master axis, to which several slave axes are coupled by means of cam plates. Besides that, the NC I channel is not fed in the classic way via an NC file, but rather via a table created in the PLC," explains Dieter Völkle, responsible sales representative from the Beckhoff branch office in Balingen, Germany. Jochen Meier is completely satisfied with what has been achieved: "With the MiniBendCenter we have taken our leave of the traditional point-to-point travel; on the basis of TwinCAT NC I and the fast EtherCAT bus system, the axes can now be driven interpolatively. This solution was not possible with our original CAN bus-based control concept."

**Simultaneously executed movements halve the cycle time**

The utilization of TwinCAT NC I automation software has not only allowed RAS to optimize the processes — since all axes now drive interpolatively with one another — but so-called risk drives are also possible. "We start a new movement here, because we know that the other motion axes, e.g. the 3 axes of the bending cheeks, have already been driven to the decisive point. As a result, we were able to cut the cycle time in half," stresses Jochen Meier. Dieter Völkle comments on the complexity of the motion control: "The heart of the automation is the control via two NC I channels, which are ‘fed’ via the TwinCAT PLC. One of the NC I channels has 3 main and 5 auxiliary axes; one of these auxiliary axes functions in turn as the master of 3 slave axes coupled via cam plates. Thus, up to 9 axes can be in motion simultaneously."

**The bending program is generated via 3D simulation on the computer**

At RAS, the automation of the sheet metal bending process begins with the design and work planning. "Since our customers deal increasingly with medium or small lot sizes nowadays, a powerful programming system is the basic prerequisite for economical production," explains Jochen Willmann, the RAS development manager responsible for the control technology.

"The CAM system, which is based on a 3D platform, permits the programming of complex bent parts in less than 30 minutes. The programmer determines the complete processing of the sheet metal part step by step from the 3D model. Once the bending program has been created on the computer, the MiniBendCenter has all the information it requires to generate the machine-specific operational sequence," adds Joachim Köhler, mechanical development manager at RAS. This way, the machine operator has virtually no programming tasks any more. The CAM software generates the complete machine program by transferring the 3D model back to the 2D level of the machine. The 2D model is applied offline on the machine as it were, wherein the measuring and orientation points are also specified. The processing program is then checked on the screen during work planning in the context of a virtual simulation, wherein the simulation program uses the real machine environment that exists as a 3D model in the system.

The processing program includes not only the handling of the blank through the respective production steps, from the measurement through all bending stations to the deposition of the finished sheet metal part; the preparatory process steps such as tool handling are also programmable via RAS-CAM. The tools for the different bending tasks stored in the MiniBendCenter’s tool magazine are each provided with a code. On basis
of this barcode, the tools are identified by the tool changer, removed from the magazine and installed in the correct order. After completion of the job, the tool changer automatically removes the tools from the machine and replaces them in the magazine.

**New dimensions in sheet metal processing**

The unusually high degree of automation of the MiniBendCenter can be used by all potential sheet metal processing plants. The processing center and the RAS programming tool can, but are not required to be networked with one another. The processing program can be loaded to the Beckhoff Industrial PC in other ways, e.g. via the USB interface or from a CD. "The concept of the system is that the virtual and real worlds are identical; that is to say, we image the designed workpiece in RAS-CAM the way it should be in reality. Therefore, the designed part must also contain the actual dimensions and radii, so that, if possible, no manipulations need to take place afterwards," explains Joachim Köhler. Jochen Willmann adds: "The workpieces intended for processing are sometimes so complex that they can no longer be programmed with traditional editing methods in any case. Our concept of obtaining good results by the upstream insertion of this programming tool has paid off. The consequence in the machine environment was that we needed a powerful and flexible automation platform that is able to implement the CAM specifications with high quality. We have solved that optimally with PC Control from Beckhoff."

RAS Reinhardt Maschinenbau GmbH  [www.ras-online.de](http://www.ras-online.de)
At the BlechExpo 2009 trade show in Germany, RAS demonstrated the MiniBendCenter, an outstanding, fully automated machine center for the production of small bent parts. The automation has been completely redesigned in the meantime and a control platform from Beckhoff has been integrated. What are the reasons and goals associated with that?

Willy Stahl: With the MiniBendCenter we want to perform very fast processing cycles, for which we need an open control platform that enables all machine functions and, on top of that, offers a comprehensive connection to the outside world — in other words, Internet capability. The latter in particular is of great importance to our service department. That’s why we decided to redesign the machine controller.

From the customer’s point of view, the coupling of the sheet metal bending center with job planning could gain in importance. How do you evaluate such possibilities?

Willy Stahl: These couplings are standard for us. With our bending centers for the processing of large parts it is possible to work through complete job lists. The customer can compile the daily requirement in the production planning, generate a job list from it and then work through it on the bending center.

How do you react as mechanical engineers to the development that more and more functionality is making inroads into software?

Willy Stahl: With the MiniBendCenter a total of 14 axes, 11 of them servo axes, are in use and so naturally the software increasingly gains in importance, because the necessary integration and networking are only possible by means of software. But beyond that our bending center represents a module within the customer’s process chain, and we can very well imagine additionally achieving the connection to the shelf systems or utilizing a robot for loading and unloading. However, this would mean additional axes. That is precisely why the integration capability of the Beckhoff controller and its openness and flexibility were important selection criteria for us.

What qualifications do your customers need to have for such a highly automated machine?

Willy Stahl: We as mechanical engineers have moved everything onto our side that could make the handling of the machine difficult, complex or complicated. Thus the introduction of the MiniBendCenter has become as simple as possible for the customer. Many functions that run internally and in an extremely complex manner in the background are ultimately simple to operate from the point of view of the customer — at the front end, on the touchscreen.

The interaction of the operator with the machine is extraordinarily well-designed in terms of graphics and the transparency of the processes is ensured. The user is normally more likely to have difficulties with situations in which there is a problem due to a malfunction. How can you help the customer in such cases?

Willy Stahl: Beckhoff has also provided for ideal conditions here, so that we can access all hardware components via the PC. We can connect to our customers’ bending centers via data networks using remote maintenance and query the status of the machine.

Will RAS be presenting the MiniBendCenter once again at the EuroBlech 2010 trade show?

Willy Stahl: We are certainly planning to. If we can manage it by the time of the trade show, our customers will also get to see a further ’tidbit. However, we cannot divulge any more details than that at present.
Beckhoff at EuroBlech 2010: Hall 27, Booth C31

Beckhoff is exhibiting its PC- and EtherCAT-based control solutions for metal forming at EuroBlech 2010, which takes place from 26 to 30 October in Hanover, Germany. The scalable automation solution from Beckhoff is used in almost all sectors of metal forming: from transfer presses and compact high-speed presses to pipe bending machines.

Open automation solutions for metal forming

PC-based control technology from Beckhoff can play fully to its strengths in the automation of press lines: all processes can be automated with a universal control platform, from the coil processing, the belt straightening machine, the cutting and punching plants and the actual press, to the transfer facilities and the feeding, loading and unloading station.

Beckhoff covers all control requirements in metal forming and sheet metal working with its extensive product range, which consists of a broad range of scalable Industrial PCs, I/O systems for all common fieldbuses, TwinCAT automation software for PLC and Motion Control, servo drive equipment, the TwinSAFE integrated safety solution and EtherCAT, the fast real-time Ethernet bus system.

EtherCAT for high-precision coordination of manufacturing processes

The Beckhoff Industrial PC and Embedded PC series are equipped with the latest processor technology, from the powerful Intel® Core™ 2 Quad to the energy-saving Intel® Atom™, and offer scalable performance for all machine functions. The controller, which is based on IT standards, additionally features all necessary interfaces such as Ethernet, WLAN or RFID for integrating the machine into higher-level processes.

A fast bus system with short reaction times for tough real-time requirements is available in EtherCAT. All necessary process signals can be integrated simply and inexpensively into the controller via the Beckhoff I/O systems in protection class IP 20 or IP 67: from the digital I/Os, high-precision measuring terminals and safety functions to Condition Monitoring. Gateway terminals enable the integration of PROFINET or CANopen components into the EtherCAT Terminal system.

TwinCAT software integrates all necessary functions for the automation of a press line: a development environment for all Beckhoff controllers, IEC 61131 PLC, Motion Control including ‘electronic cam plate’, cam controller and ‘flying saw’, and diagnostic options extending to the software oscilloscope. With TwinCAT the entire spectrum can be solved with one programming environment, from the smallest bus controller to the computer networks of complex manufacturing plants.

Die cushion control: from the black box into the PC

A press controller must precisely coordinate all of the mechanical components involved: in order to be able to start the pre-acceleration of the die cushion in precisely the correct reproducible moment, for example, the position and speed of the plunger must be detected precisely. All inputs and outputs at field level can be read and output synchronously with an accuracy of ~10 ns and provided with a time stamp by means of the distributed clocks of the EtherCAT system. This synchronization can even go beyond the individual PC and allows a whole production hall to cooperate synchronously.

Presses require control loops with a high quality. The sampling times of a hydraulic die cushion controller are, for example, around 250 µs, independent of how many axes the die cushion encompasses. The high demands on the availability of a press controller, for example in the press plant of a car manufacturer, are met by the RAID system integrated in the Industrial PC, among other things.

New items in the automation kit

In addition to industry solutions, trade visitors to the Beckhoff booth will find numerous new items: from the Industrial PC and Embedded PC families equipped with the latest processor technology to the HD Bus Terminals, which continue the trend towards compact designs with high packing density. At the center of attention is TwinCAT 3, the latest version of the Beckhoff automation suite, which opens up new possibilities in modern control technology thanks to its modular structure and multicore support.

www.beckhoff.com/euroblech
www.beckhoff.com/forming
The German-based company BARTEC Dispensing Technology, with its locations in Weikersheim and Garbsen, is specialized in customer-specific process solutions for the dispensing and processing of liquid and pasty reactive casting resins. BARTEC’s clientele includes the automotive industry, the electrical and electronic industry, medical technology firms and the filter industry. There are already more than 2,000 BARTEC machines installed in plants worldwide.

### High demands on dispensing accuracy and repeatability

“The treatment and processing of reactive casting resins is anything but trivial,” explains Steffen Dommerich, technical manager and proxy of BARTEC Dispensing Technology. “We process different materials, single- or multi-component epoxy resins, silicones and polyurethanes, from low to high viscosity, enriched now and again by abrasive fillers. The challenge in terms of process engineering consists of mixing the components homogeneously and then applying the mixture precisely.” Depending upon the constituents, the quantities and the viscosity, this procedure makes different demands on the dispensing technology. “That is precisely the trick: to obtain a homogeneous mixture in which the mixing ratio and the discharge quantity are correct over the entire duration of production,” says Steffen Dommerich.

### Customer-specific solutions – made to order

The complete solutions offered by BARTEC are combinations of dispensing technology, mechanical engineering, automation and information technology. Depending on the customer’s process and product requirements,
a universal solution is developed from standardized modules or standard solution concepts. Markus Schmitt, project manager in the engineering department, reports: “Before the start of the project, a detailed consultation with the customer takes place, in which the customer is advised about details of the core processes: dispensing, plasma pretreatment and the hot stamping procedure. In the subsequent step, preliminary tests are carried out in the company’s own pilot plant in accordance with the customer’s specific process task. Process parameters such as cycle times, type and processing of the materials etc. are determined together with the customer for this. Based on these results, a holistic concept is developed and the process solution is optimized.”

**Exact pumping, dispensing and mixing**
The objective is the production of homogeneous, free-flowing and bubble-free streams of material. This is ensured by the preparation of the dispensing material in the MPS material preparation system specially developed by BARTEC, which unites the following process steps: evacuation, tempering, homogenization, recirculation and pumping. These complex process tasks are accomplished by a standardized, configurable software solution on a CP6709 built-in Panel PC from Beckhoff Automation. The user interface specially developed by BARTEC offers the customer an optimal overview of its process parameters. In order to ensure a continuous, infinitely controllable flow of material without pressure fluctuations, the delivery rate of the feed pump is regulated by a PID block and the dispensing pump is therefore always optimally supplied.

The material is pumped into the mixing head by high precision BARTEC dispensing pumps and precisely controlled dispensing valves. The speed of the pump thereby determines the delivery amount. Conversely, the use of the different pump sizes and technologies is decided by the material properties and the dispensing rate. A continuous dispensing process is ensured by the constant monitoring of the pump speeds and the operating pressures.

BARTEC Dispensing Technology uses two different principles for material mixing: In the dynamic variant, a rotary mixer is used in a mixing chamber. In the static process, the two streams of material are mixed in disposable mixing tubes.

**High quality requirements as technology drivers**
The high degree of automation of the three or four-axis, servo-driven portal or gantry systems ensures that the high expectations for productivity, dispensing accuracy and repeatability, positioning, etc. are met. In dispensing technology it is frequently the case that axle loads of more than 15 kg (33 lb) need to be moved with a positioning accuracy of the order of 0.05 mm – and with relatively high dynamics at that. Movement speeds of up to 700 mm/s are also required, for example, when applying beads. “We use high performance drive technology from Beckhoff for this,” Markus Schmitt reports. But not only are the axis systems servo controlled; servo drives are also used in the dynamic mixing systems. “These consist of a chamber in which an agitator moves at up to 5,000 revolutions per minute, driven by a speed-controlled servo motor,” Steffen Dommerich remarks. “Process stability is ensured continuously by the employment of special monitoring systems,” Markus Schmitt adds. The integrated Beckhoff safety system TwinSAFE helps ensure safety throughout the workplace.
In many cases the customer’s databases must be connected to the BDT plant equipment; for example, documentation of the production chain is often called for in the automotive sector. Regarding this, Markus Schmitt explains: “We recently put a plant into operation that consisted of 10 stations. All processing stations were connected individually to the customer’s database so that the data from the processing step could be queried. To this end the product code is read in via a scanner. The specified target values and process data are retrieved from the customer database and the results of the processing are fed back.”

Open platform is ideal for the complexity of the application
A further technical challenge consists of the fact that the gantry systems with a 2D or 3D structure are not only path controlled, but are also driven interpolatively, fast and precisely by CNC functions. Furthermore, a great many sensor-assisted monitoring functions must be implemented. “A dispensing system with a dynamic mixing head can be considered to be a small chemical factory in itself,” comments Steffen Dommerich. Additionally, the BARTEC specialists need powerful communication and data interfaces, in order, on the one hand, to connect the self-developed control technology to the plant or cell controller and, on the other, not to endanger the variety of the individual control tasks through uncontrolled growth in a physical sense and in terms of data. Ultimately BARTEC Dispensing Technology relies on a function building kit with a uniform control concept for its solutions. “We found that at Beckhoff,” says Steffen Dommerich.

Several factors played a role in the decision in favor of Beckhoff’s open automation platform: “The prices for hardware and software were evaluated in the benchmark, but the development time for adaptations necessary for the platform as well as the running expenditure for individual subassemblies which we would incur later represented major criterion,” explains Markus Schmitt. Also of relevance to BARTEC’s decision was that TwinCAT control software is based on the globally-recognized IEC 61131-3 standard. “This was one of our specifications,” says Steffen Dommerich, “because if new employees are involved in the development, they should be familiar with the programming and not be confronted by obscure technology.”

Simplified migration assured into the future
Despite these great successes, the automation experts at BARTEC Dispensing Technology have no time to rest on their laurels. Beckhoff Bus Terminals have been used for the I/O so far; for new plants they are switching to EtherCAT I/O Terminals and the EtherCAT-based AX5000 servo drive. BARTEC has also developed a great interest in the upcoming TwinCAT version 3. “The integration of Visual Studio and, in particular, the possibility to program with C, C++ and C# is interesting to us,” explains Markus Schmitt: “There are customer requirements for which high-level language programming is needed, e.g. to connect our systems to the customers’ databases. In this case additional helpful interfaces will be available with the TwinCAT-3 release,” comments the project manager.

BARTEC Dispensing Technology GmbH www.bartec-dispensing.com
The software specialist Breitenbach, based in Möhnesee, Germany, has offered innovative, customized and integrated software solutions for time management, human resource planning and scheduling, production data acquisition, access control, payroll accounting, personnel management, etc. since 1980. In the past the company focused on software development and purchased hardware from third-party sup-

Breitenbach uses customized multi-functional terminals for industrial IT applications

Tailor-made Industrial PCs

With its multi-functional MF1065 terminal Breitenbach Software Engineering GmbH introduces a newly developed, innovative input and information system that offers an optimum solution for all processes in time and personnel management and operational data acquisition. The multi-functional terminal is based on a customized Beckhoff Panel PC.

The multi-functional MF1065 terminal is a newly developed, innovative input and information system. It offers users a versatile, cost-effective booking and information terminal with an intuitive touchscreen interface.

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“With the new multi-functional MF1065 terminal we wanted to take a different route, since an off-the-shelf hardware solution was no longer able to meet our specific needs. “With Beckhoff we have finally found a partner who developed a solution that was just right for us,” said managing director Wolfgang Breitenbach, describing the starting point of the cooperation.

For Breitenbach the key factors in the development of the MF1065 terminal were an attractive design, simple operation and a mechanically robust finish. “The specific requirements were: protection class IP 65, compact stainless steel housing, fanless cooling, touchscreen, RFID and fingerprint reader. In addition, Beckhoff could deal with maintenance of the terminals and guarantee long-term supply of spare parts. All these requirements were met,” said Wolfgang Breitenbach.

**In the business of customization**

“The development of customized Industrial PCs has been part of our product philosophy for years,” said Roland van Mark, product manager for Industrial PCs at Beckhoff. “Over 50 percent our IPCs and Control Panels are specially tailored to the requirements of our customers.” This includes functionality, shape, customer logos and color schemes. In some cases, such as the multi-functional terminal, Breitenbach embarks on completely new developments. “We can fall back on a wide range of components such as motherboards, displays, keyboards and power supply units developed and produced in-house at Beckhoff. This not only reduces the costs for our customers, it also means that we are able to supply identical or equivalent spare parts over many years,” said Roland van Mark.

**One terminal – many functions**

The multi-functional MF1065 terminal is a true all-in-one device. Applications include time recording, access control and management of applications for leave, duty schedules and time logs. The terminal can also be used to manage cafeteria operations. In addition it can be used to process operational data – for example, relating to orders, order backlog or overheads – and information from weather stations, which is important for printing. Finally, the MFT is also suitable for operation and status display of building functions such as lights, doors, roller blinds or ventilation components.

On the hardware side a compact Beckhoff Panel PC forms the basis of the multi-functional terminal. The device is equipped with cutting-edge Beckhoff motherboard technology, a high-performance Intel® Atom™ 1.60 GHz CPU and a 6.5-inch display with touchscreen and integrates all control and operating functions. Its stainless steel housing makes it suitable not only for office environments, but also for harsh industrial environments. Optional special seals between the touchscreen and the housing and the flush touchscreen meet the IP-65 standard and protect the interior of the multi-functional terminals from ingress of dust and spraywater, so that it can also be used in the food industry, for example.

Users can register via optional integrated RFID or fingerprint readers to gain secure access to operating functions and information. In this way, company staff can use the terminal to register their work and travel times and use the self-service-functions to submit applications for leave and retrieving their own time logs.
For example, directly next to a steel press, for example. “The wide range of applications for the terminal helps reduce the running costs for the users,” said Wolfgang Breitenbach. “If a company has to use different terminals for different ambient conditions, it is also needed to keep replacement devices for each type. This costs money, and in many cases the devices go out of date during storage,” said the Breitenbach director. With the new multi-functional MF 1065 terminal, such a scenario is less likely thanks to the state-of-the-art hardware from Beckhoff.

While the complete application software was developed by Breitenbach, the company uses Linux as the operating system. A client-server version is available for Windows. The dialog and menu interfaces developed by Breitenbach enable fast adaptation to specific customer requirements.

**Interface for the I/O level**

The multi-functional terminal features an Ethernet port (10/100 Mbit/s) for connection to the company network; a further port enables connection of an external Modbus module, which was also developed by Beckhoff. In this way, the terminal can also communicate with the I/O level. “This is a big step forward for us,” said Wolfgang Breitenbach, “because in the past we were unable to make our devices fit for the field level at a justifiable cost.” From Roland van Mark’s perspective the automation interface is the icing on the cake of this jointly developed project: “It enables a wide range of factory and building automation applications such as door operation via fingerprint or RFID readers.” This interface is currently configured for the Modbus protocol. In principle, all common fieldbuses can be connected without having to change the terminal hardware.

**Form and function combine in one flexible unit**

“With its compact dimensions of 210 x 170 mm (H x W), its slender design and its elegant stainless steel surface, the MF1065 terminal is suitable for the foyer of any corporate building,” said managing director Wolfgang Breitenbach. “On the other hand, the robust finish also makes the multi-functional terminal suitable for use directly next to a steel press, for example.”

Breitenbach Software Engineering GmbH was founded 1980 and is among the leading providers of software solutions for personnel management. It has 40 staff members at its head office at Möhnesee in North Rhine-Westphalia, Germany and its two branches at Erlangen and Tiefenbach (near Landshut), 10 of whom work in development. Around 80 percent of sales are generated in Germany, although the company is also active abroad with projects in England, the United States, Poland and China, for example.
One of the main requirements is to keep changes of speed as low as possible during the individual gear changes. Audi specified a maximum permitted drop in speed of 15 rpm on the engine side. In the past, a large gyrating mass was used for this test method. However, this has serious disadvantages, such as high weight and high space requirements. Not only that, the gyrating mass is potentially very dangerous and the concept does not allow dynamic tests to be performed.

One of the principal objectives of the development of the new test bench concept was to dispense with the gyrating mass while at the same time achieving the same or better test results. The new solution foresees the acceleration of the gearbox on the output side in second gear up to the nominal speed followed by energy-free shifting to first gear at t=0. As a result of the existing mass inertia, there is a drop in speed that needs to be compensated by the electric drive. The latter must also supply the energy required to accelerate the clutch disc when shifting from second to first gear. Purely mathematically, there would be a drop in speed of 140 rpm due to the acceleration of the existing mass inertia, or a necessary torque of 1166 Nm to compensate the drop in speed, which the drive would have to supply.

EtherCAT enables revolutionary new automotive test bench concept with no gyrating mass

**Synchromesh mechanism for gearboxes on test benches**

At its location in Recklinghausen, Germany, EDAG-Prüftechnik has offered comprehensive services in the conception, development, construction and assembly of test benches for over three decades. EDAG’s clientele includes renowned manufacturers from the automotive industry as well as customers from the general mechanical and electrical engineering industries. The company received an order from Audi to develop an endurance test bench for investigating the life span of the synchromesh mechanism of the gearbox of an Audi A4 2.0 TDI. It was possible to realize the new solution, which makes do without a gyrating mass, on the basis of the fast EtherCAT I/O system from Beckhoff.

EDAG GmbH’s range of services include the development of complete vehicles as well as the construction of model, prototype and special vehicles as well as the production of small series. Beyond the development service, EDAG offers the realization of complete production plants for body shells and vehicle assembly from one source. EDAG Prüftechnik specializes in the development and construction of the necessary test benches for quality assurance and the production of vehicle components. This way, for example, the mechanical and thermal load conditions of vehicle components are simulated realistically on endurance test benches. The series of measurements is executed using the time-lapse method; beginning damage is detected by the use of measuring sensors and the service life of the test specimen is determined as a result.

**Gearbox synchromesh mechanism from the Audi A4 in the endurance test**

Among the newest EDAG-Prüftechnik projects is an endurance test bench for the gearbox synchromesh mechanism of an Audi A4 2.0 TDI. While the gearbox is driven at a constant speed under no-load conditions, two gear changes are performed per minute and the important characteristics such as shifting force, speed of the drive motor, shifting stroke and noise development are recorded, archived and displayed.

The main motor drives the gearbox on the output side; the differential in the gearbox is disabled in order to allow single-sided driving. The inert mass of the vehicle is thus simulated, so that the driving speed is not reduced, for example when shifting from second to first gear, but instead the gearbox is brought up to a higher speed.

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**EtherCAT solves high control requirements**

Apart from the necessary technical control know-how, a fast, deterministic I/O system for the acquisition of the actual speed data and the transmission of the control setpoint values (max. cycle time 500 μs) as well as a correspondingly fast and deterministic control computer for the calculation of the setpoints (max. cycle time 500 μs) are necessary to solve this task. A very demanding task in terms of control technology — and the number of possible system suppliers was accordingly small.
As fig. 2 shows, impressive results were obtained. The maximum speed deviation was < 5 rpm. It is thus better by a factor of 3 than Audi’s requirement.

Dynamic testing assured with EtherCAT

“The first use of the Beckhoff technology proved for us to be surprisingly efficient and simple,” explains EDAG project manager Michael Hahn. “For example, the third party drive that we employed was put into operation on the EtherCAT bus within an hour. The realization of the test bench without a gyrating mass would not have been possible without the performance of EtherCAT. Therefore, we succeeded in realizing what is – as far as we know – the first synchromesh test in the world without a gyrating mass. On top of that, additional dynamic tests can be carried out, such as fast changes of speed or shifting through all gears in quick succession, which were not possible in this way before. In addition, the elegant integration into TwinCAT and the ADS communication with TwinCAT’s standard interfaces has facilitated our work very much.”

Well prepared for the future

EDAG considers itself to be well prepared for the future, too, with this control architecture. “In the future, we will be using the high performance of EtherCAT and the availability of a large number of devices with EtherCAT interfaces. We will also continue to rely on the open TwinCAT system architecture and the scalability of the hardware platform, with upwardly open computing power, to expand our range of tests, such as shifting force control, dynamic shifting profiles, mass simulation, etc.,” explains Michael Hahn. “The first project with Beckhoff will certainly not be the last.”

EDAG GmbH & Co. KGaA www.edag.de
Jentschmann AG, based in Hüntwangen, Switzerland, specializes in machines that manufacture awnings. Using the type 3796 combined automatic ultrasonic cutting and welding machine, awnings for motor homes and caravans are manufactured with a maximum length of 6 m (19.7 ft) and widths of between 2.5 m and 3.2 m (8.2 ft and 10.5 ft). Depending upon the necessary width, two thermoplastic-coated cloth webs and the piping seams are welded and cut precisely to size.

In order to ensure a continuous welding process, Jentschmann uses so-called “roll sonotrodes” with radial oscillation (amplitude), by means of which the PVC-based fabric is heated up and welded. The awning material runs continuously between the synchronously driven roll sonotrodes and the anvil rollers. The prerequisite for this dynamic process is the precise guidance of the fabric; the setting of the different welding parameters must be correspondingly precise and is automatically readjusted during the welding procedure.

Fully automated seaming, welding and cutting in a matter of seconds

The machine produces continuously from the roll; i.e. a roll of 180 m (590.5 ft) in length is processed in approximately 23 minutes at a speed of 8 m/min (26.2 ft/min). “The loading of the roll and the in-feeding of the cloth webs and the round piping profile, as well as the positioning of the ultrasonic welding head, take place manually,” explains Pierre Bartholdi of Jentschmann AG, who is responsible for the machine concept: “The order-dependent pull-off lengths and lot sizes are loaded via the operating panel from the product database and transferred to the controller.”

Upon starting the plant, the pulling carriage drives forward. “During transport both edges of the awning web are turned upwards first and then inwards by mechanical guides,” says Pierre Bartholdi, describing the intake of the awning web. “The round piping profile is bound into this fold synchronously. Ultrasonic welding heads with roll sonotrodes weld the assembly seam and the piping seams.”
After reaching the specified cloth length, the cross cutting gantry, which is programmed with the TwinCAT flying saw automation software, synchronizes itself to the pull-off speed, fixes the cloth by means of pneumatically actuated holders and cuts its transversely. “The precise cloth length is an important quality criterion for our machines,” explains Pierre Bartholdi. “We cut with an accuracy of ±1 to 2 mm. The intake of the cloth is regulated in width via an edge controller.” After the cross cut has been made, the pulling carriage drives at high speed with the finished awning cloth to the rear and sets it down on the delivery table, while the cross cutter continues to pull the welded cloth web until the pulling carriage takes over the pulling of the cloth again after having driven back. Upon that the cross cutting unit returns to the home position and waits for the next cross cut. The production of a finished cloth of 3.5 m (11.5-ft) in length takes approx. 26.25 seconds.

**Advanced drive technology as a core feature**

The production sequence runs fully automatically after the awning web is set up. Five Beckhoff EtherCAT Servo Drives from the AX5000 series plus servo motors from the AM3000 series — complete with attached two-stage planetary gear units and integrated single-turn Biss absolute encoder — drive the material web unwinder, the edge controller, the belt drive for the seam press, the cross cutting unit and the pulling carriage. The belt drive is the so-called “pilot drive,” with feed rate entered as a fixed value. The speed of the material web unwinder drive is controlled in relation to the feed rate and the
diameter of the material web roll. To this end, the diameter of the material web roll measured during setup is adopted into the control loops of the plant controller in the case of a known material thickness. Because the diameter of the cloth roll decreases as the awning web is unwound, the speed of the material web unwinder drive must be increased proportionally.

The diameter of the cloth roll is calculated precisely at the beginning via a dancer roll and incorporated in the dancer position control in order to avoid deviations. The control concept on which this is based was programmed with the TwinCAT Controller Toolbox. Pierre Bartholdi praises the clear sequence: “The dancer roll has an ultrasonic sensor with which the height is measured. The higher the roll rises, the more the unwinder drive must accelerate. This way, all parameters for control are known and, as a result, it is guaranteed that the unwinder will not oscillate during the production sequence.”

Customer-specific machine design requires open, scalable control technology

On questions of automation, Jentschmann AG consistently practices labor division in the case of complex plants: Indutron AG from Spreitenbach is brought in for the control technology and all electro-technical tasks. As a system partner, the company specializes in the process automation of machines and employs PC-based control technology from Beckhoff. As Indutron Managing Director, Harry A. Stirnemann states, the cooperation with Jentschmann AG has already proven its value in many common projects: “The automation of the Jentschmann 3796 automatic cutting and welding machine is a special project because the machine is conceptually designed so that it permits additional options.” In principle, each machine is unique rather than being a series product, which makes an open, scalable control solution necessary. As a Beckhoff Solution Provider, Indutron AG, which is responsible for the entire control technology from the project engineering to commissioning, has been familiar with the Beckhoff automation platform for years.

Project engineering and development time shortened

A CP6201 Panel PC with 12-inch touchscreen and TwinCAT software is employed as the controller for the Jentschmann 3796 automatic cutting and welding machine. TwinCAT NC PTP is used to control the drives. Furthermore, the TwinCAT Flying Saw software library is used for the cutting gantry and the TwinCAT PLC Controller Toolbox is utilized for the control of the dancer devices. "These function modules in TwinCAT software give us a big advantage," says Harry Stirnemann.
from Indutron: “We save a great deal of project engineering and development time because many control tasks cannot be solved with standard controllers. With the TwinCAT PLC Controller Toolbox, we were able to create the complex control of the drive coordination from basic software building blocks.”

The entire machine periphery is detected using Beckhoff EtherCAT Terminals. The EK1100 EtherCAT Coupler connects the periphery to the Panel PC via the EtherCAT bus system. The servo controllers and the integrated absolute value encoders of the servo motors are likewise networked via EtherCAT.

In addition, the Panel PC has a modem, via which the service specialists from Indutron can dial-in to the machine controller in the event of a malfunction. “This releases us from the necessity to carry out service on-site at the customer’s premises,” explains Harry Stirnemann.

**Convenient, self-explanatory operating concept**

Indutron paid particular attention to the self-developed, multilingual user interface, which allows intuitive operation. The operator can call up machine functions on the one hand and integrate special job-related characteristics on the other. The user interface displays messages and informs about malfunctions, and recipes can be selected or created, e.g. process or product-related data for all awning materials to be processed. These concern the welding speed, the cloth width or the temperature. Although all technologies are already stored in the machine controller, the machine operator must also be able to enter new programs. To do this, an existing program is copied and subsequently modified, so that the new awning cloth is welded cleanly and cut precisely to size. The openness of the user interface ends where the danger of an incorrect input exists. Harry Stirnemann remarks: “The operator cannot change anything on the machine controller; access to this level is protected by a password.”

**Interface to the customer’s IT system realized**

The HMI solution is also prepared for connections to the ERP or MES level. “In this way we have implemented connections to the IT systems, for example, of customers who operate cutting machines,” states Harry Stirnemann: “That is becoming increasingly important. The controller receives the cutting data from the customer’s IT system via the integrated interface. The interface between our user interface and the customer’s IT system is implemented via Visual Basic; communication between the TwinCAT system and the user interface takes place via TwinCAT ADS.”

**Potential for the future**

Beckhoff’s PC-based automation technology opens up further mechanical and technological possibilities for the latest generation of Jentschmann automated ultrasonic welding and cutting machines. These concern, for example, the automation of the cloth roll feed, the belt width control or the choice of an alternative joining process. With regard to machine safety, additional possibilities are also offered by Beckhoff’s safety technology. However, safety-relevant technology such as “Safe Stop” is already in use in the existing axis drives.

**Indutron AG**

The company Indutron AG, with head office in Spreitenbach, is a Beckhoff Solution Provider in Switzerland. Indutron AG was founded by Harry Stirnemann in 1983. Indutron develops control systems for the textile and wire production/processing industries as well as for handling and assembly machines and for special purpose machines.
Obel-P Automation A/S in Herning, Denmark, manufactures large-scale machine systems for the wood industry. For example, the company produces continuous press lines for non-stop gluing, pressing and cutting of glued boards for the furniture industry. The line is 41.2 m (135.2-ft) long and consists of a portal in-feeder, sorting line, gluing station, continuous high-frequency press, board-trimming saw and palletizing station. The control system is based on a Beckhoff Industrial PC with TwinCAT PLC, AX5000 EtherCAT Drives and EtherCAT I/O Terminals.

Founded in 1986 under the name of Uffe Sass A/S, Obel-P Automation has been a member of the Obel-P group since 2003. “We develop machines primarily for the wood industry and are known throughout the world as a major supplier of machines and production lines, for example for manufacturing doors, windows, glued boards and particle boards,” Morten Pipper, Managing Director of Obel-P Automation, explains. The company has extensive experience, above all in developing and applying high-frequency solutions for curing or hardening the glue faster. The high-frequency generators Obel-P Automation installs into its machines are made by the company itself.

Effective use of raw materials and energy
Producing glued boards at a speed of approx. seven meters per minute (23-ft/min) poses a particular challenge in the wood industry. To meet it, Obel-P has developed the specially-designed continuous press line for gluing, pressing and cutting glued boards non-stop. Feeding in wood bars
Moreover, by using the very fast EtherCAT network to communicate between the decentralized control cabinets and the central controller, we have been able to make the pressing line at least three times as fast compared to a conventional PLC solution,” Morten Pipper emphasizes.

By now Obel-P has invested in the Beckhoff automation platform including the Beckhoff servomotors and EtherCAT Servo Drives from the AX5000 series in all its machines and lines. “Customer response is extremely positive,” the Managing Director explains. “For us as manufacturers this is an advantage to work with just one platform which we can program ourselves and which our technicians know inside out,” Morten Pipper declares with satisfaction.

Sales engineer Søren Mark, Beckhoff Automation ApS, (left) and project manager Ivan Madsen, Obel-P Automation A/S, (right) in front of the pressing line during its construction.

Morten Pipper, Managing Director of Obel-P Automation A/S, at the control cabinet of the pressing line

Continuous press line for the non-stop gluing, pressing and cutting of the glued boards for the furniture industry. The machine is 41.2 m (135.2-ft) long and consists of a portal in-feeder, sorting line, gluing station, continuous high-frequency press, board-trimming saw and palletizing station.

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Obel-P Automation A/S www.obelp-automation.dk
Beckhoff Denmark www.beckhoff.dk

of different widths optimizes the use of the raw material and prevents cutting too close to the glued joint when cutting the finished boards to size. The pressing line is controlled centrally via a Beckhoff control cabinet Industrial PC C69xx with TwinCAT PLC. An EtherCAT network connects the PC to the control cabinets and the individual components throughout the process. “The modular structure of the control system simplifies the installation and operation of our lines,” Morten Pipper comments. “The decentralized control cabinets enable us to construct and check the components of the process individually before connecting them to the central TwinCAT PLC later on when we finally install them on-site. “Using TwinCAT PLC software gives us a great advantage over a conventional PLC since we do not need a separate PC for optimizing the thickness of the wood bars, for example,” says Morten Pipper. The PC control system is so powerful that it can display the optimization of the bar thickness for reducing waste in the cutting process and produce a 3D picture of the machine for ordering replacement parts on the control monitor at the same time.
Customized software solution integrates building services and care documentation

In mid-2008 the Belgium-based Armonea Group commissioned a software platform for its retirement homes that controls all building services as well as the care documentation system. The software package was developed by the IT company Myrtus. Beckhoff Automation supplied the intelligent operating panels and the infrastructure components.

Over recent years Armonea, a management group for retirement facilities based in Mechelen, Belgium, acquired around 50 retirement homes and apartments through mergers and acquisitions. Each of these facilities was equipped with different call, access control and phone systems. An integrated communication system was called for and Myrtus, a Belgian IT company, was commissioned to implement the system. “The development of a dedicated care documentation system that is integrated into the intelligent building control system was regarded as the optimum solution. The tailor-made Domoreg software package takes the burden of certain documentation requirements off the nursing staff and leaves more time for actual care of the residents. In view of our long-standing experience in the care sector this was a logical improvement,” said Kris Mues, managing director of Myrtus.

Integrated communication creates transparency
The software package, which seamlessly combines building services tasks with the care documentation system, is tailored to the specific requirements of the retirement facilities. Meanwhile Domoreg has been installed in 11 of the Armonea Group homes in conjunction with around 1,000 intelligent Beckhoff Ethernet Panels in 5.7-inch (CP6607) and...
6.5-inch (CP6619) screen sizes. The integrated building and care documentation system comprises three levels: The central server with database, the central controller in each Armonea retirement home, and the local room control in the residents’ accommodation, integrated via an Ethernet Panel that includes TwinCAT software from Beckhoff.

All data entered by the nursing staff, including the administration of medication or other care services, are automatically sent to the central PC controller (a Beckhoff C6925 control cabinet PC) and stored. The system keeps a precise record of the services received by each resident and records which staff member provided them. The controller sends all data to an SQL database on the central Armonea server. In this way all controllers in all facilities are connected to the central Armonea database. This enables precise comparisons between the individual retirement homes, so that the database ultimately also serves as a management tool.

**Customized Control Panel handles all control functions**

Via a display in each room residents can control the lighting, shading devices and nurse calls. Nurse calls are relayed to the switchboard via the central controller. “Beckhoff offers Control Panels with an integrated PLC,” said Patrick Gielis, managing director of Beckhoff Belgium, “so that we only need a compact control and operating device. For the Millenium retirement home in Ranst we adapted our standard panel to the requirements of the customer. It now has buttons to the left and right of the monitor and LEDs show the lighting status. The advantage of this control solution is that all ICT (information and communication technology) applications can run on the same device.”

**RFID badges for access control**

The software package developed by Myrtus also deals with access control. Residents and caregivers can register via RFID badges and the user name is displayed on the monitor. Residents and caregivers are granted or denied access to certain rooms or actions depending on the access rights stored in the PC.

The control software, which currently covers certain building services segments and the care services documentation, can easily be expanded in the future. For example, by installing a motion detector and a switch at the radiator valve, the temperature setpoint in a room could be reduced during the heating season when no movement was registered in the room for a certain period. New files and software versions can conveniently be installed via remote access.

*Armonea N.V. [www.armonea.be]*
*Myrtus N.V. [www.myrtus.be]*
*Beckhoff Belgium [www.beckhoff.be]*
Flexible, PC-controlled punching and bending system produces busbars

The company Jiangsu Jinfangyuan CNC Machine Co. Ltd., which is located in the high-tech area of Yangzhou City, China, manufactures and exports a wide range of hydraulic or servomotor-driven CNC machines for punching, bending and cutting sheet metal. Jiangsu Jinfangyuan developed a modular CNC punching and bending machine for producing busbars that can be operated individually or in tandem. The control system uses a PC-based automation solution from Beckhoff Automation.

With the utilization of new energy sources in China, particularly wind and solar energy, the optimization of transmission and distribution grid systems is becoming increasingly important. This applies to the conductance of busbars as well as their production conditions. Busbars are used to carry large currents in switchboards, substations and in other electrical equipment.

The fully automated plant developed by Jiangsu Jinfangyuan consists of two machine modules: a punching unit and a bending unit. As the name implies, the punching machine deals with punching, corrugating, shearing, embossing and stamping of the copper sheets, the bending press naturally deals with horizontal, vertical and U-bending. The two machines are controlled by separate hydraulic CNC systems, so that they can be used in tandem or as individual machines. With this high degree of flexibility the plant is able to meet a wide range of different customer requirements. Jiangsu Jinfangyuan chose a CP62xx "Economy" built-in Panel PC from Beckhoff as the control system for the punching machine and the bending press, EtherCAT as the bus system and EtherCAT Terminals for the I/O. The Servo Drive is integrated into the EtherCAT Terminal system via a CANopen master terminal.

Software replaces conventional positioning modules and NC controllers

The bending press uses TwinCAT NC PTP automation software. "TwinCAT NC PTP handles the axis movement and the position control of the bending unit. In addition, we utilize the functionalities of the NC PTP library by including two encoder axes in the system for indicating the movement positions of the hydraulic components,” said Jingchun Ye, director of the electric control department at Jinfangyuan.

The punching machine uses TwinCAT NC I. For Jingchun Ye, the openness of TwinCAT automation software yields another advantage: "TwinCAT offers us maximum independence when it comes to I/O and drive systems. This was an important selection criterion in our decision to use the software-based control platform.”

Openness of the software platform offers users a high degree of freedom

“The simple manageability of TwinCAT, based on the IEC-61131-3 programming standard, suits us very well and offers a high degree of flexibility for modifications,” said Shen Xiaoyuan, software engineer at Jinfangyuan: “We redesigned the PLC code structure to optimize the production flow of the busbar processing unit and we increased production capacity by 20% as a result.”

TwinCAT-ADS is also used for integrating the user interface. “Based on the Beckhoff .NET control library, our customers obtain extremely helpful references and functionality for developing their unique HMI. In conventional CNC systems, where only the existing functions and interfaces supported by the system are available, this is not possible. If a function doesn’t exist, there is nothing you can do about it,” said Chen Lin, also a software developer at Jinfangyuan.

"The advantages of the software-based control solution were the convincing factors for us and that it formed an excellent basis for subsequent CNC projects,” said Jingchun Ye. "We are currently in discussions with Beckhoff Shanghai regarding the use of Beckhoff NCI/CNC solutions for other machines.”

Jiangsu Jinfangyuan CNC Machine Co. Ltd www.jinfangyuan.com
Beckhoff China www.beckhoff.com.cn
The fully automatic punching machine MC-40 handles the punching, corrugating, shearing, embossing and stamping of the copper sheets from which the busbars are produced.

The CP62xx “Economy” built-in Panel PC from Beckhoff offers a compact unit for control and visualization on the punching unit MC-40.
Optimized parking space management based on a universal control platform

On average, a parking space is used by four cars per day. The effective utilization is just below 70 percent in the blue parking zones and around 30 percent in the underground garages (the latter mainly during the day). A team of three technicians is available for the integration and automation of the parking lot management system. A control center not only deals with the traffic searching for parking spaces via a telematics system, but also with monitoring and controlling the ticket machines and automatic cashiers, the logging of free and occupied spaces, automatic plate number recognition, video surveillance (CCTV), alarm and motion

Amersam is a municipal service company that deals with various infrastructure tasks, including management and operation of the six multi-story car parks, on behalf of the City of Reus. The city, with a population of 100,000 has around 2,000 parking spaces in multi-story car parks and additional short-term parking spaces in so-called blue parking zones. The size of the underground garages varies between 90 and 900 parking places. Amersam was faced with the task of making the operation of car parks with less than 250 places profitable. The company implemented a fully automated control and monitoring system based on a Beckhoff control platform, which enabled the integration of existing systems.

Integrated control system ensures trouble-free parking lot management

Optimizing utilization of available space in conjunction with minimizing traffic searching for parking spaces – including monitoring and operation – represents a complex control task. Municipal service provider Amersam has successfully solved the parking lot problem in the Catalan city of Reus in northern Spain. The parking lot management solution, which is based on an integrated system that coordinates all requirements such as acquisition of the available parking space, vehicle guidance to the parking area, billing, fault management and various building management functions, operates trouble-free and cost-effectively.
Beckhoff CP72xx series Control Panels, which are installed at the entrance to the multi-story car park, show drivers where to find the next available parking space, minimizing traffic in search of a parking space.

**DALI control system enables efficient energy use**

The DALI (Digital Addressable Lighting Interface) lighting control system saves up to 50 percent electricity in the multi-story car parks. The light intensity inside and outside is measured via a 0...10 V signal, and the lighting levels inside the multi-story car parks are adjusted accordingly. Each cark park is divi ed into independently illuminated zones. The required zones are illuminated based on the data from the motion detectors, so that dark areas are avoided and car park users feel safe.

**Integration of existing systems into the Beckhoff control platform**

Due to the openness of the Beckhoff control platform, the existing systems for the individual multi-story car parks could be integrated into...
the new control system. The existing devices came from different manufacturers and use various communication protocols and fieldbus systems such as PROFIBUS, Modbus, CANopen, etc.

Leonardo Blázquez, who is in charge of IT at Amersam, explained that TwinCAT automation software from Beckhoff and the function blocks in TwinCAT act as a kind of “middleware” for homogenizing the data from the different facilities for the main system. Amersam currently uses Ethernet as the fieldbus system for communication between the central controller and the peripherals. In the future, the company intends to switch to EtherCAT from Beckhoff.

**An investment that was well worthwhile**

The investment in the automation, which accounts for approx. 10 to 15 percent of the overall project costs, quickly paid for itself: “The efficient management of the multi-story car parks led to significant cost savings and therefore lower prices for the benefit of the citizens,” said Leonardo Blázquez.

**Future enhancements only require software adaptations**

The City of Reus intends to increase the number of its multi-story car parks to nine, which thanks to the automation can be achieved without additional staff. “Integrating a new car park into the system requires modifying approx. 20 percent of the software, which once again illustrates the advantage of software function blocks,” explained software developer Satyan Thomee.

As a socially-committed company, Amersam promotes employment of disabled staff, so that the systems have to be convenient to operate for people with a range of capabilities. A special periphery was established that supports staff through simple procedures or the option of visual adjustments without generating additional costs. “The decision to use the Beckhoff platform permits us to use open standards and a simple configuration for operating the applications. Over the four years since we started using the Beckhoff products they have proven their reliability,” said Leonardo Blázquez.
Dr. Guido Beckmann, who is in charge of the Safety over EtherCAT technology within the ETG. “Safety over EtherCAT is simple to implement, bus independent and open,” says Dr. Guido Beckmann, who is in charge of the Safety over EtherCAT technology within the ETG. “The acknowledgement of this well-proven safety protocol as an international standard is yet another logical step towards the proliferation of EtherCAT technology. It provides additional reassurance to both device manufacturers and end users who can depend on a stable and globally accepted technology.”

The publication of the international standard IEC 61784-3 Ed.2 is expected soon.

The protocol Safety-over-EtherCAT (FSoE) was specified for the transmission of safety relevant data. It is used to send input information of safety sensors (such as safety light curtains or emergency stop buttons) to a safety logic controller. Based on these inputs, this controller computes the commands for the safe outputs (such as contactors or safety relevant drives) and thus controls the safety functionality of the machine.

For further information please also see: www.ethercat.org
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FachPack
September 28–30, 2010
Nuremberg
Hall 9, Booth 242
www.fachpack.de

European Manufacturing Strategies Summit
October 18–20, 2010
Düsseldorf
www.ems-summit.com

EuroBLECH
October 26–30, 2010
Hanover
Hall 27, Booth C31
www.euroblech.de

K: Kunststoff + Kautschuk
October 27–November 3, 2010
Düsseldorf
Hall 11, Booth G21
www.k-online.de

FMB – Zuliefermesse Maschinenbau
November 3–5, 2010
Bad Salzuflen
Hall 23.2, Booth A11
www.forum-maschinenbau.com

SPS/IPC/Drives
November 23–25, 2010
Nuremberg
Hall 7, Booth 406
www.mesago.de/spc

Austria
Vienna-Tec
October 12–15, 2010
Vienna
Hall D, Booth D0409
www.vienna-tec.at

Belgium
easyFairs ECL
September 23–24, 2010
Brussels
Hall 9, Booth D019
www.easyfairs.com

easyFairs Factory & Process Automation
October 20–21, 2010
Brussels
Hall 6, Booth C011
www.easyfairs.com

Finland
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October 5–7, 2010
Jyväskylä
Booth C-418
www.jklpaviljonki.fi/tekniikka2010

FinnBuild
October 6–9, 2010
Helsinki
Booth 6E12
www.finnexpo.fi/finnbuild

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Intelligent Building System
September 21–22, 2010
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Booth C16
www.ibs-event.com

Emballage
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www.emballageweb.com

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www.mostreconvegno.it

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Lillestrøm
www.vvs-dagene.no

Poland
HAPExpo
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Sosnowiec
www.exposilesia.pl/hapexpo

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ITFM
September 28–October 1, 2010
Moscow
Booth 75A
www.itfm-expo.ru

PTA
October 5–7, 2010
Moscow
Hall 3, Booth C1
www.pta-expo.ru

Automation
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Saint-Petersburg
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www.chinawind.org.cn
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Shanghai
www.industrial-automation-show.com

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Abudhabi
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WEFTEC
October 4–6, 2010
New Orleans
Booth 1306
www.weftec.org
ISA Automation Week
October 4–7, 2010
Houston
Booth 124
www.isaautomationweek.org
Solar Power International
October 12–14, 2010
Los Angeles
www.solarpowerconference.com
Pack Expo
October 31—November 3, 2010
Chicago
Booth N-4613
www.packexpo.com

Fabtech
November 2–4, 2010
Atlanta
Booth 3350
www.fmfabtech.com

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