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XTS – revolutionary Drive Technology enabled by EtherCAT

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Editor-in-Chief: Frank Metzner
Editors: Gabriele Kerkhoff Martin Fallmann Phone: +49 (0) 52 46 9 63 - 1 40 Fax: +49 (0) 52 46 9 63 - 1 99 editorial@pc-control.net www.pc-control.net

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The new XTS drive system (eXtended Transport System) combines the benefits of tried and tested rotational and linear drive systems. This results in a drive system that is an evolution of existing linear motor principles: XTS is a linear motor that moves in a circle. The motor is fully integrated in a unit, together with power electronics and displacement measurement. One or more wireless movers can be moved highly dynamically at up to 4 m/s on an almost arbitrary, modular and flexible path. The compact XTS revolutionizes drive technology by enabling totally new, space-saving machine concepts and new freedom for mechanical engineering.

The control and communication challenge of the XTS technology is that the drive control loops cannot be closed locally in the distributed drive modules, since the movers are moved with the aid of sequential solenoid coils. The drive amplifiers in the modules control several solenoid coils and have to deal with a continuously changing number of movers. Since the dynamic properties of the movers are to be carried beyond the module boundary, the control has to take place centrally. After all, the aim is to move the movers smoothly and seamlessly from one module to the next.

High process data communication: 80 Mbit/s per 3-meter distance
The challenge is not made any easier by the large number of position sensors and coils. Every 30 mm there is a position sensor, which has to be queried in a precise 250 µs cycle. The distributed coils are also controlled based on this cycle. This results in tremendous demands on the communication system: for every 3 meters of XTS distance, around 80 Mbit/s of process data must be transported to and from the distributed modules! Since XTS is an extremely precise drive system, the process data naturally must be sampled and output largely jitter-free. High-precision synchronization of the devices is therefore necessary – for longer distances over several EtherCAT segments. And it goes without saying that the whole system should be robust, simple to wire, and last but not least, cost-effective.

Dynamic data processing
EtherCAT meets these XTS requirements thanks to its special operating principle of processing on the fly. Each network device picks the data intended for it from the common data frames or writes its data into these frames – without first receiving, processing and dispatching the frames again, as it is usually the case. The frames are processed in the EtherCAT slave controllers during the transfer, practically without delay. Almost all advantageous features of EtherCAT are derived from this unique principle of operation developed by Beckhoff:

- The net usable data rate of EtherCAT reaches more than 95 % of the bit rate, since the Ethernet frame overhead does not occur per device and direction, but only once per approx. 1500 bytes of process data, which may be distributed to any number of devices. The required 80 Mbit/s are therefore exceeded, even with 100 Mbit/s Ethernet.

“EtherCAT helps deliver the processing power of advanced PC technology”

**XTS – revolutionary Drive Technology enabled by EtherCAT**

It is a widely accepted fact that EtherCAT is the fastest Industrial Ethernet technology currently available. EtherCAT acts as an Ethernet fieldbus, i.e. it offers the benefits of Ethernet with the simplicity of a conventional fieldbus. This too is widely known by now. But what does this mean for automation technology? Using the EtherCAT-based XTS system as an example, we demonstrate that the use of EtherCAT not only means “higher, faster, further,” but also enables totally novel solution approaches: Without EtherCAT, XTS would be unthinkable.
Since the same frame is used for input and output data, the bandwidth is available in full duplex mode. In other words, a bandwidth of 100 Mbit/s gross will essentially become 200 Mbit/s.

The EtherCAT slave controllers process the frames in hardware and therefore make the process data available to the local application immediately after the frames have passed through: Protocol stack cycle times are irrelevant for EtherCAT.

The high-precision clocks in the slave controllers are synchronized precisely and generate a common system clock, whose accuracy is independent of the frame sending jitter of the master. This not only enables EtherCAT to achieve synchronization accuracy on the distributed devices in the two-digit nanosecond range (!), it also means that no special hardware is required in the master.

Since the frames are transferred without software influence in the chip, EtherCAT offers minimum (and constant) pass-through delay. This means that the delay can quite easily be computationally eliminated during synchronization of the distributed clocks in the devices: The simultaneity of the sampling matches the synchronization accuracy.

Physically, EtherCAT is always a point-to-point connection. Any EMC influences therefore disappear after the next device, i.e. unlike in conventional fieldbuses where they are distributed across the whole system. Notwithstanding the high data rate, EtherCAT is therefore unusually robust.

In the unlikely event that a fault leads to a bit error, it can be reliably detected and localized thanks to CRC checks. Each frame is always checked by all devices, regardless if they participate in the current communication or not.

The EtherCAT slave controllers provide up to 4 EtherCAT ports. This means that every topology combination is supported, without the need for active infrastructure components such as switches or hubs. With the XTS system it makes sense to simply daisy-chain the modules.

Notwithstanding its exceptional performance and the ultra-precise synchronization, EtherCAT only has minimum hardware requirements in the master: a standard Ethernet port is sufficient. Unlike in conventional fieldbuses or other Industrial Ethernet systems, no special bus master chips or communication coprocessors are required. This not only reduces costs, but makes EtherCAT a natural partner for PC-based control technology. EtherCAT helps deliver the processing power of advanced PC technology, without being resource-intensive. High processing power certainly comes in handy for the XTS system – after all, many demanding control tasks must be handled in a 250 μs cycle. Thanks to EtherCAT and optimum utilization of the CPU performance on the part of TwinCAT software, usually only a single control computer is required, even for longer XTS distances. Several synchronized EtherCAT segments can be connected, if required.

**EtherCAT – The basis for high-speed Drive Technology**

Three technologies were basic prerequisites for the development of the XTS system: the high-performance PC architecture to make the required processing power available in a cost-effective manner, TwinCAT to implement this processing power in an easily configurable control system and of course EtherCAT to manage the demanding communication requirements in a robust way.

XTS is a clear example of an EtherCAT-based system approach that would have been unthinkable with conventional bus systems. In this case the crucial factor was performance; there are other examples for which the virtually unlimited number of nodes per system, the flexible topology features or simply the low system costs were crucial. It goes without saying that the EtherCAT features are also advantageous for all applications that would have been solvable with conventional bus systems. After all, EtherCAT has established itself as the Industrial Ethernet solution with the largest number of device vendors.
Production facilities are frequently plants that consist of several process steps, which are each performed by separate machine modules. The local safety functions of the machine modules are usually solved within that module. In addition, safety information must be exchanged plant-wide between the machine modules in order, for example, to implement comprehensive emergency stop functions or to inform upstream and downstream modules about the activation of the stop functions. The TwinSAFE product range from Beckhoff offers intelligent solutions on the basis of the Safety over EtherCAT protocol, both within a module and for plant-wide networking.
Modern safety architectures use safe networks

Even today the safety-relevant coupling of the devices still takes place in many machine concepts via an I/O connection: Safety sensors such as light curtains, protective door monitors or two-hand operating devices are monitored by a large number of evaluation devices, which in turn act on the safe outputs via relatively inflexible relay logic.

However, a clear trend can be discerned toward the use of communication systems with safety-relevant transmission. Intelligent safety sensors, such as laser scanners or camera-based monitoring systems as well as drives with integrated safe monitoring and shutdown functions, can be connected via a safety bus to safe logic. The use of such a safety bus results in benefits for the safety architecture like those that are already familiar from the introduction of standard fieldbus systems:

- short reaction times and thus increased machine safety
- very good (channel-specific) diagnostic options
- flexible expansion options
- clear machine architecture

If all safeguards for the detection of transmission errors are encapsulated in a "safety container," then the use of a safety protocol is possible irrespective of the standard communication system employed. Any data security measures used for the communication layer are not taken into account for the safe transmission: this is known as the "Black Channel principle." The advantage of this is that safety-relevant and standard process data can be transmitted in the same communication system. IEC 61784-3 defines the requirements for safety communication based on the Black Channel principle and describes various safety protocols.

Safety over EtherCAT is one such safety protocol as standardized in IEC 61784-3. The TwinSAFE product range from Beckhoff uses this protocol for safety data transmission. Additional benefits arise for the user, including:

- uniform communication system for standard and safety-relevant data
- routing of the safety protocol via standard gateways, backbone buses, other fieldbus systems or even wireless
- use of decentralized safety logic and retention of the standard PLC for machine control
- additional use of the safe process data in the standard controller
- greater variety of devices due to the use of a widespread and standardized protocol

The TwinSAFE terminals available in the EtherCAT I/O system exploit EtherCAT’s high performance to the maximum: as a result, up to 128 safety-related bus devices up to SIL 3, according to EN IEC 61508, and DIN EN ISO 13849-1 PLe can be connected to the EL6900 Safety PLC in the compact housing of an electronic terminal block with a width of just 12 mm. The safety PLC features 256 integrated function blocks that can be configured or programmed depending on the application. 24 V DC digital input terminals (EL1904) and 24 V DC digital output terminals (EL2902 – 2.3 A and EL2904 – 0.5 A) are available for connecting the safety sensors or actuators respectively. The EL6900 Safety PLC can also be used as a safety controller for the Beckhoff AX5000 Servo Drives with the safety drive option card AX58xx, which are linked via EtherCAT.

Plant structures

A plant for the production of cabinet walls is an example of a typical modular structure: a module for feeding the plant with new particle boards, a strip saw and a flying saw for cutting to length, various drilling and milling machines as well as an edge machining unit. These modules are mechanically connected, for example, by roller conveyors that lead to a stacking or packaging unit at the end. The interaction of the machine modules – guided by a master controller, which specifies which cabinet part must be produced – is realized via a plant-wide network. If the machine modules use the same communication system, then this is referred to as a homogenous communication structure. If, however, the plant is made up of modules from different manufacturers, then different communication systems may be used internally under certain circumstances. We call this a heterogeneous plant structure.

Safety functions within machine modules

The safety functions of the machine modules are usually solved within the module. For example, if a stop function must be initiated when a protection cover is opened, then the hazardous movements inside the module are stopped safely (e.g. by stopping the saw blade). The safety controller processes the input information from the sensors and determines the safe reactions at the outputs or actuators.

Detailed information about the status and the functional capability of the components involved is necessary within the machine module for this. Depending on the triggering input signal, different reactions must be triggered at the actuators.
In addition, channel-specific diagnostic information is important for the user in order to react as fast as possible to a detected error. If a defective sensor is discovered, for instance via cross-circuit detection, then a specific safe function is activated for this sensor and the user’s attention can be drawn specifically to the faulty device.

**Factory-wide safety architecture**

Safety information must also be exchanged plant-wide between the machine modules in order, for example, to implement comprehensive emergency stop functions or to inform upstream and downstream modules about the activation of stop functions. Ideally all areas that are visible from an emergency stop button are stopped by activating this button. In a dangerous situation it is irrelevant whether or not the emergency stop button is mounted on the machine module in which the danger is recognized – what is important is a fast reaction.

For the loading and unloading of a station it is additionally necessary to exchange safety-relevant information about the upstream or downstream module. For example, the exchange of material may only be enabled if no user is in the shared danger zone.

At the plant-wide machine communication level, therefore, it is not important to exchange channel-specific information for the individual sensors and actuators; much more important are the safety-relevant overall status of a machine module and the central activation of safety functions. The interface to each machine module is thus usually effected via pre-processed, filtered information; this means it is lean and can be standardized via an open interface profile.

**Heterogeneous communication structure**

Communication at field level increasingly uses Ethernet-based real-time communication systems for the exchange of I/O data to and from the actuators and sensors. Various technologies for this have established themselves on the market: EtherCAT, PROFINET, EtherNet/IP and others. At the master computer or the machine network level, individual machine modules are combined to form a production plant. The machine parts are usually coupled via higher-level master-to-master communication; the machine controller acts as a gateway between the internal communication system and the higher-level control system.

The safety-relevant coupling of the machine parts is governed by similar boundary conditions. Taking into account the different native safety protocols of the established bus systems within the machine modules, a safe gateway function is required for the plant-wide networking of the modules.

In connection with this the approach of implementing plant-wide safety functions by a generic, bus-independent safety protocol is frequently the subject of discussion. However, the implementation of a bus-independent safety protocol is technically difficult and entails several significant restrictions:

- The certification of a device with a safe communication interface is complex, since the device manufacturers require proofs of conformity and suitable tools for each communication system in order to implement a safety protocol. These are provided by the fieldbus organizations for the native safety protocols. For a generic protocol, however, proofs of conformity would be required from several non-cooperating organizations.
Device manufacturers will preferentially implement the native safety protocol for the supported bus interface in order to successfully place the device in the market for this communication interface.

The costs of each safety device would increase if a second safety protocol had to be supported in addition to the native safety protocol.

Since not all device manufacturers would support several safety protocols, the choice of devices would be reduced for the user and the overall costs would worsen.

The Beckhoff TwinSAFE system therefore offers a solution that allows different safety protocols to be used at precisely one place inside the machine module: in the safety controller, which is present in each machine module anyhow.

The safety controller monitors many connections to safe communication partners within the machine module. If this controller supports a further safety protocol for one or more of these connections, it can act as a safe gateway.

To this end the EL69xx Safety PLC is supplemented with the ability to create the connection to another device using not only Safety over EtherCAT, but also another safety protocol, e.g. PROFIsafe (EL6930).

Standardized interface profile

A profile specification is currently being elaborated within the EtherCAT Technology Group (ETG) that defines an application profile for the exchange of data between the modules and the command level above the safety protocols. The data concerned here are the compressed and pre-processed safe process data that a machine module delivers to the outside or receives from the outside.

When two machines “converse” with one another, it is not important to the neighbor whether this or that drive is in a safe state or whether an emergency stop button has been pushed. What is actually of interest, however, is – to put it simply – the information as to whether the neighboring plant has a safety problem and, if that is actually the case, whether the plant equipment can continue to produce parts. This means that the actual scope of safety information that needs to be represented outside a plant module is quite manageable.

The contents of the interface profile are, for example, the general safety-relevant machine state of a module, the information about whether the module was safely stopped, or perhaps also a higher-level emergency stop request. If this information is reflected in the form of a control or status word in a fixed place at the interface, then considerable advantages arise through pre-defined function blocks and reusable diagnostic options.

As opposed to a generic safety protocol that would additionally have to be integrated into all devices, the gateway function need only be realized once in a machine module, and with the EL69xx the safety gateway does not even have to be a self-contained device, but can be implemented as a sub-function of the safety controller.

Further Information:
www.beckhoff.com/Safety
www.beckhoff.com/FSoE
Highly flexible special-purpose machine construction with PC-based Control
Ottemeier Werkzeug- und Maschinentechnik GmbH based in Verl, Germany, specializes in custom solutions for machine construction and tool engineering. From initial design to final handover, the company deals with all aspects of projects that are tailored to the individual requirements of its customers. During 25 years of cooperation with Beckhoff, Ottemeier has always been able to respond flexibly and creatively to meet customer needs with the help of PC-based control technology. These characteristics were particularly useful during a recent steel frame processing line project for the company Hörmann KG based in Werne, Germany.

**Flexibility right from the start**

Ottemeier customers come from the construction, automotive, furniture and sanitary industries. These customers expect project management based on quality, expertise, pragmatic creativity and flexibility. The Ottemeier management team consisting of Managing Partner Marion Ottemeier-Esken, Proxy Holder Heike Ottemeier and Technical Director Christian Wölki meets these challenges on the basis of a strong 50-year company tradition. Christian Wölki said: “Each customer requirement results in individualized development and production processes, which means that each machine we build is different. We basically do what other machine builders don’t do – in a sense, we start where others finish.”

Based on an ERP order, all cutting and clamping parameters for the frame are calculated from the geometric dimensions at the saw inlet, so that the saw feed control is optimized at all times.
As the second generation of leadership, Marion Ottemeier-Esk, Heike Ottemeier and Christian Wölki (left to right) successfully manage the Ottmeier Werkzeug- und Maschinen technik company.
A door frame consists of two side jambs and a header. All three elements are made from beveled sheet metal and are mitered. The steel frame processing line for Hörmann consists of four saws, two gantries for material loading and several roller tracks for material handling. In addition to the saw unit the line also includes a laser cell with a special material supply concept and was extended with a complex punching machine during the course of the project.

Frank Kampschnieder, Engineering and Project Development Manager at Ottemeier, explains the complexity of the project: “At first glance the production process seems quite clear, and the material processing also appears quite straightforward. However, the realization of a job-specific, automated processing line for special door frames with more than 250 product variations in batch size 1 with an interface to the ERP system and integration with a semi-automatic welding line was a clear case for our special-purpose machine engineering.”

**Demanding tasks for Beckhoff Servo Drive technology**

In order to enable clamping of the different geometries and lengths on a single production line, Ottemeier developed a highly flexible servo clamping system. The widths of the frame sections vary between 60 and 560 mm and the heights vary between 15 and 115 mm. Two different material thicknesses are used. Instead of traditional clamping systems based on mechanical, pneumatic or hydraulic components, servo-driven clamps and grippers are used, in order to produce each product variation in an optimum manner. Ottemeier stores a clamping profile for each frame in a database, since not only the position but also the contact pressure of each clamping unit is crucial for a first-class sawing result. Ottemeier uses AX5000 EtherCAT Servo Drives in conjunction with TwinCAT NC PTP automation software. Optimization for multi-axis applications and fast control technology make EtherCAT Servo Drives ideally suited for such applications.

Hörmann benefits from the versatility of the system in several respects. All three frame elements (left side jamb, header, right side jamb) can now be produced on a single line. New product variants no longer necessitate mechanical adjustments to the clamping system: A new clamping profile can simply be “taught” in software.

**The scalable automation toolkit**

Ottemeier has been using the hardware and software options in the Beckhoff automation toolkit for special-purpose machine construction for many years. The 40 m long and 9 m wide sawing unit is equipped with Beckhoff components throughout, since the scalable product portfolio enables the automation of each function for any dimension. The central controller is a C6640 Industrial PC with TwinCAT NC PTP software. Two 15” Control Panels from the CP7932 series are used for the operator interface. The real-time characteristics of TwinCAT and the performance of the EtherCAT components, which include the drive system as well as the I/O modules in IP 20 and IP 67 ratings, also contribute to efficient system design and transparent communication.

The open platform of the PC-based control technology in combination with TwinCAT makes ERP interfacing straightforward. The manufacturing orders are called up from the ERP via Ethernet, tracked through the line with TwinCAT and fed back into the ERP system together with all production data. The cutting parameters and clamp settings are calculated individually for each frame and each manufacturing order. The intelligent feed control of the saw enables optimum machining of the door frame at all times and therefore extends the service life of the saw blade.

**Flexibly extended without system limitations**

With EtherCAT and PC-based control technology there are virtually no limits that would restrict expansion of a system. For example, it was relatively straightforward for Ottemeier to extend the line with a punching machine as an additional machining station and to integrate it in the program sequence of the central controller. By combining the three core processes (sawing, laser cutting, punching) in a single system it was possible to improve the production process and optimize the lead time.

For Ottemeier the integration of the laser cell was new territory – not in terms of the technical implementation, but due to the required cycle time: Laser production is only cost-effective if the waiting times during communication and material handling approach zero. TwinCAT, in conjunction with a postprocessor, enabled optimum data exchange with the laser cutting system. Thanks to the sophisticated material feed concept for the laser cell developed by Ottemeier, the components are prepared in parallel with the machining process: While one part is machined in the cell, the next part is prepared in a second working area within the cell.

**Safety assured with TwinSAFE**

For safety screening of the system, particularly the laser, Ottemeier uses the flexible TwinSAFE I/O solution for safety functions from Beckhoff. It can cope with the dynamic changes in a custom machine: Operations are easier and less expensive to modify in software than in copper.

**Mutual trust built through 25 years of cooperation**

Ottemeier and Beckhoff started working together 25 years ago. According to Frank Kampschnieder, this long-standing cooperation makes Ottemeier fairly relaxed when it comes to new developments: “Technical progress and increasing competitive pressure result in ever more complex customer requirements. At the same time, demands regarding the economic efficiency of the production processes are also increasing. As a general contractor we are ultimately responsible to our customers. For projects of this size it certainly makes a difference to have a trusted automation partner.”

Further Information:
www.ottemeier.com
Innovative machine design provides maximum flexibility

Optimized with EtherCAT: horizontal conveyor is the innovative choice for food packaging

High production output, flexibility and efficiency while fending off high cost pressures are the guidelines for mechanical engineering in the food packaging business. Innovative and flexibly designed processing and packaging systems are called for in order to keep pace with current trends in the food industry. While developing its new tna roflo® HM 3 horizontal conveyor, tna Australia, a manufacturer of food packaging systems, chose to use a Beckhoff controller to boost system power while streamlining the architecture. The feeding and distribution system can be integrated seamlessly into a packaging line for food products and impresses end users with its high flexibility and speed of operation.
tna Australia Pty Ltd., based in Silverwater, Australia, is one of the world’s leading manufacturers of turnkey, integrated packaging and processing solutions for the food industry. The tna horizontal and vibrating conveyors distribute and transport products such as snacks, confections, nuts, pasta, fresh produce or pet foods and feed them to the packaging system. The most recently developed horizontal conveyor system, the tna roflo® HM 3, is an innovative solution for the transport and distribution of food products. “It was specially developed with a view toward simple integration in upstream or downstream seasoning, weighing and packaging modules and enables the development of customer-specific solutions. With the tna roflo® HM 3, different products can be conveyed at the same time on a single line and moved in different directions,” explains Kerryn Ball of tna Packaging Systems.

**Perfect control using EtherCAT communication**

The tna roflo® HM 3 horizontal conveyor gives the operator complete control over the speed and direction of movement of the conveyed food products by implementing control commands virtually in real-time.

With a view to performance optimization, tna’s aim in developing the tna roflo® HM 3 was to implement a distributed control system with real-time Ethernet as the basis for communication. “Prior to the start tna had considered a range of communication options. Ultimately EtherCAT was the only system that is proven to work efficiently on standard hardware without having to install a processor board especially for the communication,” Kerryn Ball stresses.

tna Packaging and Processing Solutions is a globally active manufacturer of integrated food packaging solutions. More than 6,000 systems from tna are in operation in over 120 countries. The company offers a comprehensive product range, from the vertical form, fill and seal systems (VFFS) to product delivery and distribution systems to spraying systems, seasoning systems, weighing solutions, check weighers, metal detectors, case packers, etc.

The advantages of EtherCAT for the tna roflo®HM 3 system at a glance:

- EtherCAT offers the foundation for real-time communication in the machine modules.
- The openness of EtherCAT enables the development of a tna-designed, proprietary EtherCAT master that is perfectly tailored to the systems, equipment and philosophy of tna.
- Shortening of the necessary installation period thanks to reduced cabling work
- Simple network structure
The product is moved carefully in the pans. Once the desired position is reached the pan opens and the product is discharged.
“Since EtherCAT is an open standard protocol, we were able to develop our own EtherCAT master for real-time communication with the horizontal distribution system. The openness of the EtherCAT platform also gives us the option to use devices from different vendors. That offers both us and our customer’s valuable flexibility,” says Kerryn Ball.

Simplified cabling, lean control structure

tna has now installed EtherCAT into all non-stand-alone tna roflo® HM 3 systems worldwide. Currently, the most extensive system of this type is located in France: 21 servo axes for three production lines are controlled by just one computer.

There are further large-scale installations in Korea, with 18 axes, and in Mexico, with 19 axes. A single communication network can be used for several tna roflo® HM 3 systems.

The connection to the field level takes place via the EK1100 EtherCAT Coupler. Digital inputs such as level sensors and all universal inputs are connected via standard input terminals. Air-operated doors, warning lamps etc. are connected to the digital output terminals. The EK1122 branch terminals increase the topology options of the EtherCAT network in the case of larger systems for which a star topology is suitable.

Highlights of the EtherCAT solution

In the example of the system installed in France, 21 tna roflo® HM modules make up a distribution system that is perfectly tailored to the needs of the customer’s application. A single tna “switcheroo” or “lifteroo” feed line – a mechanism that separates, tilts and turns the tna roflo® HM pans – is able to distribute three different products from the processing line to the waiting packaging machines. This innovative function changes the way in which processing lines are interconnected and enables the simultaneous movement of products in several directions on a single packaging line. “Previously we needed three conventional feed lines for this – with the corresponding costs and space requirements. With the EtherCAT-based controller, the 21 servo axes distributed throughout the entire factory are controlled by just one powerful computer,” says Kerryn Ball outlining the advantages.

“Thanks to EtherCAT we can build and test the tna roflo® HM modules at our production site. All cables are located in the roflo® HM modules; in addition, information is exchanged over the network so that no ‘spaghetti cabling’ is created and the system can be designed very simply,” explains Kerryn Ball.

Further Information:
www.tnasolutions.com
www.beckhoff.com.au
The individual robots can perform different functions in the game, such as the position of defender, striker or goalkeeper.

EtherCAT “Turtles” from “Tech United” win RoboCup 2012 world championship

Dutch RoboCup team wins world championship

At the 16th RoboCup world championship, which took place from June 18 – 24, 2012 in Mexico City, the footballing robots from the Dutch team “Tech United Eindhoven” won the title in the Middle Size League. After four second places finishes in recent years, Tech United became world champions for the first time at the annual technology championship.

The goal keeper is a specially designed robot that is equipped with special software – and EtherCAT-capable.

The football robots contain a Beckhoff Embedded PC from the CX series, which controls the drives and all other functions via EtherCAT.
The RoboCup world championship takes place annually at different locations. The meetings, at which teams compete with each other, are attended by around 2000 scientists and students from around the world. In parallel with the contests a congress takes place, at which new scientific findings on artificial intelligence and robotics are exchanged.

At the final of the RoboCup world championship, the Dutch Tech United team met the Iranian MRL team. The robots from Tech United, equipped with EtherCAT, led 2-1 at the break. In the second half Tech United extended their lead to 4:1 for a comfortable victory.

Six players make up a team in the Middle Size League, the largest and fastest class in the RoboCup competition: the maximum speed is around 4 m/s. Each of the three-wheel robots weighs about 35 kg and operates completely autonomously and without remote control.

"Tech United“ from the Netherlands
wins world champion title

The team "Tech United“ from the university of Eindhoven, who were already European champions several times, made it to the final of the RoboCup world championship for the fifth year running: "Tech United“ played in the final every year since 2008 but was ultimately beaten every time by the teams from Portugal, Germany and China. All the more reason to celebrate when the team won the world champion title in Mexico: The numerous night shifts, with tests of the "Turtles“ in hotel rooms and last-minute firmware updates, paid off.

The EtherCAT "Turtles“ have mastered the new rule which stipulates that the robots must not dribble the ball across the center line, but cross the line with a pass. It has now paid off that "Tech United“ was the first robot football team to introduce direct passing of the ball during the German Open in 2010. The passes were placed precisely and exactly, with many scoring opportunities during the match. Another rule change was typically Mexican: the sombrero, a flat plate on the head of the "Turtles", with impedes lob-balling. Precise passes based on clear communication between the robots were the key factor that ultimately led to victory.

Motion control and data acquisition with EtherCAT

In the league of medium-sized robots two teams of up to five robots play on a 18 x 12 metre indoor playing field. Each robot has sensors and an on-board computer for analysing the current match situation and possible opportunities. The "Turtles“ use EtherCAT for data acquisition and motion control: Sensors, actuators and motion control loops use ultra-fast Industrial Ethernet.

The robots cooperate with each other and receive the referee’s instructions wirelessly via radio signals. Human interventions are only allowed to substitute players. The robots play fully autonomously, i.e. they develop their own tactics and cannot be coached during the match.

Still a long way off:
robots compete with national football teams

Over recent years research in the football robot league has made remarkable progress. Only a few years ago the main sections of the playing field were still colour-coded, in order to facilitate orientation. Today only the ball is coloured, goals only count if they are scored from the opponents’ half of the field, and the ball must cross the center line with a pass.

Such modifications of the competition rules, which lead to new challenges, ultimately serve to realize the big RoboCup goal: By 2050 the intention is to assemble a team of fully autonomous, humanoid robots that can win against a human football world cup team.

The automation components of the Tech United robot are sponsored by Beckhoff and IAL, the Dutch Beckhoff distributor: EtherCAT is used as the interface for the drives, sensors and actuators. A compact control cabinet Industrial PC from the Beckhoff C6920 series forms the hardware platform.

Further Information:
www.techunited.nl
www.robocup.org
www.ial.nl

The Tech-United team celebrates its first world championship title at RoboCup 2012 in Mexico City.
TwinCAT Hydraulic Library masters complex drive control

Deep drawing press convinces with speed and energy efficiency

The Danish press manufacturer Kiermar Technology has developed a revolutionary deep drawing press that challenges traditional concepts of size, speed and energy efficiency: although it has a pressing force of 1200 t, the press itself weighs just 26 tons; its overall height, including the crane for tool handling, is only four meters. The press also impresses with extremely fast cycle times, based on fast tool and integrated material handling: as a result, the press cycle for the production of a sink takes less than 15 seconds. The electrical and hydraulic Servo Drives are controlled by a Beckhoff C6920 Industrial PC with TwinCAT automation software and the EtherCAT communication system.

Martin Hansen, Managing Director of Kiermar Technology, presents the sink, which is pressed with the deep drawing press.
With its Advanced Deep Drawing Press (ADP), the Skanderborg, Denmark-based Kiermar Technology A/S has introduced a deep drawing press to the market that is characterized by the horizontal movement of the upper tools. Only the actual pressing procedure takes place from bottom to top. The upper tool only has to move freely five millimeters in a vertical direction before it drives horizontally out of the press and the finished product is placed on the conveyor belt by means of an ejector. “A complete pressing cycle takes less than 15 seconds and is thus around 30 % faster than other hydraulic deep drawing presses,” explains Martin Hansen, Managing Director of Kiermar Technology.

Up to 60 % energy savings
The extremely small movement of the upper tool means that only minimum vertical movements are required in the subsequent process in order to develop the sheet metal holding force. Therefore, the ADP press requires hydraulic pumps with a power rating of only 118 kW compared to the usual 300 kW. “In conventional presses all movements take place vertically, which means that the tool must be raised in accordance with the height of the finished product in order to remove the product from the press. Raising the tool requires considerable expenditure of force and, correspondingly, large amounts of hydraulic oil. Our deep drawing press concept runs with two hydraulic pumps: A large one for the actual pressing procedure and a small one for opening and closing the pressing tool. The pressure and flow rate of the hydraulic axes are precisely dosed during operation in order to save energy,” explains application engineer Hans Christian Pallesen from Beckhoff Denmark.

Universal Industrial PC platform for PLC and Motion Control
Just one Beckhoff C6920 Industrial PC is required to handle the PLC and Motion Control. PC-based control ensures that both the pressing procedure and the horizontal tool movements operate precisely and smoothly. The press is equipped with three electrical and three hydraulic servo axes. “This is where the challenge lies, because electrical and hydraulic servo axes are controlled very differently,” explains Hans Christian Pallesen and he adds: “In the case of electrical axes, a certain operating profile can be created in advance on the basis of ramps, position and speed. That is not possible with hydraulically-controlled axes, since they change their profile during operation. In addition to that, the hydraulics behave very differently, depending on the valve type, oil flow, oil temperature, etc.”

The hydraulic axes are “path controlled;” i.e. the position controller is active only when at a standstill. The set value generator controls the cylinder according to ramp and speed, while its current position is constantly checked via the encoder signal. Once the set value position is reached, the position controller is activated again in order to maintain the current position.
TwinCAT Hydraulic Library controls hydraulic axes

While the electrical axes are controlled by TwinCAT NC PTP software, the hydraulic axes are controlled via the TwinCAT Hydraulic Library. “With the aid of this standard software library we were able to master the special challenges of the ADP deep drawing press, such as the movement of 2,000 kg horizontally by 2 meters for discharging the work piece – in less than two seconds and with an accuracy of ± 0.1 mm.”

Update 500 times per second

TwinCAT automation software forms the cornerstone for the execution of the PLC program. The PLC data performance enables extremely fast execution while at the same time handling the very demanding travel movements. The entire PLC program is updated every 2 ms, i.e. 500 times per second. To do this, EtherCAT is used for communication with Beckhoff servo drives and I/O components. The extremely fast update rate gives rise to an ultra fast control system, which contributes to the precise positioning.

“...The prototype of the ADP Press was completed in October 2011 and has generated great interest”, says Martin Hansen. “We now focus on the export market and are about to establish a worldwide sales network for our machinery.”

Further Information:
Kiermar Technology A/S: www.kiermar.com
www.beckhoff.dk
Due to the integrated fire extinguishing system the datacenter sensors are integrated in the watertight EP3184 EtherCAT Box modules.

PC-based Control: Mobile, energy-efficient and exceptionally compact computing center

From fault to successful countermeasure in 30 milliseconds, thanks to EtherCAT

The Correct Power Institute (CPI) for technical safety and efficient energy use, based in Marsberg, Germany, was founded in 2004 as a private and independent technical institute. CPI does not offer standard products, but instead acts as a service provider for all-encompassing development work based on customer requirements. CPI offers solutions and ideas for cost- and energy-savings, designs systems and implements computing centers with capacities between 100 kW and 24 MW. In addition, customers can benefit from an extensive solution portfolio for fail-safe design of computing centers based on the Zero Defect Datacenter Design (zD³) concept.
The Correct Power Institute believes strongly in using products “Made in Germany” designed with robust German engineering. Based on this company philosophy CPI also cooperates closely with the Beckhoff application division on projects requiring fail-safe converter technology and fieldbus redundancy.

Modular energy efficiency:

a fail-safe computing center in 1.2 m²

Electronic distribution channels such as Internet and telephone create new challenges for companies in the fast-paced retail business: Back rooms are no longer filled with ring binders and box files. Server racks have taken their place, and telephone systems are also IP-based. An advanced information and communication infrastructure forms the backbone of all business processes, with small computing centers at the core of every branch. For such clients CPI offers compact, energy-efficient computing centers based on the “datacenter-in-a-box” concept. High reliability of the computing center is ensured through the “Zero Defect Datacenter Design” (zD³) concept developed by CPI. ZD³ enables the “datacenter-in-a-box” to provide fail-safe and fault-tolerant cooling for mission-critical, high-density server racks with high specific heat loads.

The smallest version of the datacenter with one active and one passive rack takes up just 1.2 m² of space and is 2 m tall. In addition to the network connection it requires connections for the integrated water cooling and a power connection. The miniature computing center is not only energy-efficient, it is independent of building-specific cooling and fire extinguishing systems, can be installed in any room and ensures a consistent IT standard for customers worldwide. After a relocation, a branch can be back online again in no time. Leasing models are also suitable for these solutions.

Increasing profitability: reduction in electricity costs

At times of rising electricity prices the energy efficiency of the IT solution – determined by the “power usage effectiveness” – directly influences the overall productivity of the branch, just like rental and staff costs. Only 50 % of the supplied energy is used by the servers in the computing center, the other half is consumed by cooling, power distribution and other infrastructure. The data-center enables simple allocation and effective management of IT infrastructure with high availability, taking into account advanced energy efficiency standards based on ASHRAE specifications.

Consuming around 37 % of total power, the server cooling uses almost as much energy as the actual servers. Based on its analyses and experience CPI derived the IEP® system (patent pending) for computing centers, through which electricity costs can be reduced via efficient positioning of components and encapsulation of modules. Cooling demand was reduced by separating hot and cold aisles and through consistent sealing of the racks. Energy savings of more than 90 % associated with air movements can be achieved through efficient fan speed control. In a large computing center the savings realized in this way can amount to more than 1 million euros per year. CPI bundles these findings in intelligent algorithms for controlling computing centers with PC-based control technology. Combined with a portfolio of standard components for air-conditioning, IT infrastructure and control cabinet construction, customers have a modular system available based on which they can configure an energy-efficient and fail-safe computing center tailored to their requirements.

PC-based Control helps drive efficiencies

Complex algorithms developed by CPI engineers control the climatic conditions within the computing center. CPI utilizes PC-based control to implement this technology. The C6915 Industrial PC offers maximum computing power in a very compact design. For computing centers of any size TwinCAT automation software logs fault indication data on the C6915. Starting with the smallest size of the “datacenter-in-a-box,” the UPS, air-conditioning system, connected

Water and electricity only: the “datacenter-in-a-box,” a small computing center, enables a highly available IT infrastructure to be set up simply in any building or room. It is independent of building-specific cooling and fire extinguishing systems and the low-noise version can even be installed directly in the office.

More than 280 data points for fault indication are monitored and logged in the customized C6915 Industrial PC from Beckhoff. The customer can check the status of their datacenter at any time and from anywhere in the world via a smartphone app.

[1] “Power usage effectiveness” (PUE) provides a reference standard for computing centers. The ratio between consumed total energy and energy used for actual IT purposes can be between one and infinite.

[2] ASHRAE, the “American Society of Heating, Refrigerating and Air-Conditioning Engineers”, is an international professional association that sets building technology standards, among other activities.
IT systems, fused outlets, and the load shedding in case of overload – 280 data points in total – are all monitored. In a large computing center the number of logged data points can increase to more than 5,000. The downstream “business intelligence” developed by CPI analyzes and visualizes the data. The analysis algorithms demand maximum performance from the control hardware and require full compatibility with Microsoft business solutions such as Microsoft® SQL Server® 2012 and others.

The analog measurement signals from the humidity and temperature sensors are logged via customized EtherCAT Box I/O modules. The 4-channel EP3184 analog modules feature four single-ended inputs, which can be adjusted to the signal level of the sensors used, ranging from 0/4 to 20 mA or -10/0 to +10 V.

In the EP3184-1002 custom version, two channels at a time are consolidated in a M12 socket. Climate control is based on a predefined target profile. In the event of deviations, countermeasures such as load reduction or external alarms via SMS or e-mail are triggered.

**Building management as a bottleneck**

For computing center operators it is important that faults are detected and problems are pinpointed quickly. Before complete failure occurs a defined state must be reached, so that transaction data can be saved or virtual machines transferred. Dipl.-Ing. Bernd Steinkühler, managing director of CPI, explains the key aspects: “Based on experiments we found that a complete failure of the cooling system would shut down a computing center within two and a half minutes. Conventional building management systems with response times of around one minute are much too slow, and standard fieldbuses without a redundancy concept are unsuitable. It is not possible to initiate a suitable counter-strategy if a whole minute of precious time is taken up just for detecting that a fault has occurred. Using EtherCAT as the communication system enables significantly shorter response times,” said Bernd Steinkühler. “With a cycle time of ten milliseconds we can detect a fault in the first cycle, pinpoint it in the second cycle, and initiate a counter-strategy in the third cycle.” In this way faults can be detected before they actually occur and preventive maintenance measures can be used to further increase the reliability of computing centers.

**Analysis with TwinCAT**

TwinCAT not only handles the intelligent algorithms, it also logs faults and failures in a database that can be used to reconcile and correlate performance reductions and malfunctions. In view of rising electricity costs, operators of computing centers must utilize their servers with optimum effectiveness. Monitoring of all components enables thorough analyses, which CPI offers its customers as after-sales services based on cloud-power monitoring in its TÜV-certified computing center.

Further Information:  
[www.cp-institute.de](http://www.cp-institute.de)
Test stand for lithium-ion batteries

Since the early days of submarine construction, extending the possible dive time has been one of the main objectives of research and development engineers. Here, the energy supply is a key factor. For more than 100 years lead-acid batteries have been used for energy supply purposes in submarines. More recent battery technologies, such as lithium-ion (Li-ion), represent significant progress. They offer much higher energy density and therefore enable longer dive times. However, before the technology can be used on board, it obviously must be tested. To this end a test facility was built at the Howaldtswerke-Deutsche Werft in Kiel, Germany, which simulates the electrical operating conditions on board. A Beckhoff CX1020 Embedded PC deals with system control and data storage for subsequent analysis.
Howaldtswerke-Deutsche Werft GmbH (HDW) is a ThyssenKrupp Marine Systems company with more than 2,000 staff at its Kiel site, which uses sophisticated and advanced shipbuilding technologies and production methods. HDW is a center of excellence for the construction of the most advanced non-nuclear submarines in the world. The unique submarines of the 212A and 214 classes are equipped with air-independent drives based on fuel cells, which enable the submarines to stay underwater for much longer. HDW is the only company in the world that currently offers a fuel cell drive that is ready for production. Under the motto “faster, quieter, deeper” HDW submarines serve in 17 navies around the world.

Testing of lithium-ion battery charging and discharging processes
While lithium-ion technology has already been tried and tested in a range of civil applications, it has also been considered for military applications. “Initial investigations were positive, so HDW decided to build a larger test facility in order to simulate operation of a submarine as realistically as possible,” said Tim Sievers, Development Engineer at HDW. “The main focus is on the charging and discharging processes. Other aspects include heat generation and distribution within the battery system.”

A battery module consists of 23 cells and a battery string consists of up to eight modules. For each cell the current and voltage are sampled and monitored. For each module there are six temperature measuring points.

Integrated safety solution
The automation includes the CX1020 Embedded PC with two substations to which a converter and the data sampling unit are connected via CAN bus. A battery module consists of 23 cells and a battery string consists of up to eight modules. For each cell the current and voltage are sampled and monitored. There are six temperature measuring points for each module.

Operational safety was a key aspect, since voltages of up to 800 V can occur during charging and discharging of the batteries. “With the Beckhoff safety solution, TwinSAFE, we implemented an emergency stop function that monitors access doors, emergency stop buttons, the fieldbus systems (watchdog) and data sampling alarms independent of the automation. It also disconnects the battery system from the converter, if necessary,” said Jürgen Kuhn, Shipbuilding Business Manager for Beckhoff, who supervises the project. This means that the system can be operated safely over several days and nights.

Convenient operation
After starting the CX1020 the battery configuration is read and limit values are set automatically. This prevents overcharging and deep discharging of the battery. The operator can now manually specify values for charging and discharging, although the system is designed to run mainly in automatic mode. To this end a previously prepared profile file (CSV format) containing data for several charging and discharging cycles is read from a USB stick, for example. The file represents a submarine operating profile with cycles that are automatically executed once the automatic mode has been started. The converter receives the charging and discharging data via EtherCAT and the CAN bus. In this way the battery can be charged and discharged with constant current or power. This continues until a certain voltage has been reached or a defined time has elapsed. These values are also included in the profile file.

All data such as battery cell voltages, temperatures and converter values are stored at 5-second intervals, for example, and written to a further CSV file. This file is also stored on a USB stick and is therefore portable for subsequent analysis on any PC or laptop.

Clear visualization
The visualization shows the current condition of all battery cells and the peripheral systems. The header shows the main data such as minimum/maximum values, alarm, converter state, etc. In addition, a register programmed under Windows CE was included in the visualization, so that any faults or alarms can be traced. The CERHost tool enables the visualization to be called up from any workstation within a network. The hardware and programming support provided by Beckhoff meets all system requirements. “Following the great success of the test facility, which has been operating since the end of 2010, we are currently setting up four further test stations,” said Tim Sievers.
High-precision logging of laser markers with EtherCAT

Advanced PC-based Control upgrades foil stamping machine

Foil stamping is an important part of many printing processes and is used to accentuate packaging, greeting cards, magazine covers, labels, etc. Go-Well Electrical Technology Co. Ltd, based in Shanghai, China, has developed a fully automatic hologram foil stamping system that is controlled by a Beckhoff Embedded PC and EtherCAT Terminals, which is integrated seamlessly into a fully automatic punching and folding machine.
During hot foil stamping the coating, such as colored metallic foil, is separated from the applied foil through pressure and heat and is then pressed onto the paper or card. The process may involve simple foil stamping, hologram or laser foil stamping. From a control perspective, hologram foil stamping is the most demanding technique in this kind of application.

Feed rate adaptations done “on the fly”
At the core of the hologram foil stamping control solution from Go-Well is the ELS101 EtherCAT Terminal from Beckhoff. This incremental encoder interface terminal can quickly and exactly record the position of the laser marking on the aluminum foil, which is scanned by a light barrier with a linear speed of more than 2 meters per second. The position information is forwarded to the controller and used for precise control and online modification of the respective cam curve with the aid of the TwinCAT NC Camming software library from Beckhoff.

At the start of the feed process the cam controller moves the axes with a theoretically determined feed rate. After scanning the laser marking at the specified “window” position the feed rate is adjusted “on the fly” by calculating the difference between the actual and the theoretical laser marking position. The corrected data are processed based on certain statistical procedures, in order to detect and avoid incorrect sampling or excessive settings.

Integration of measurement technology reduces hardware costs
Common foil stamping control solutions regulate the temperature of the electrical heating plates via a separate temperature controller with a timer switch, which deals with 12 to 18 temperature zones. The costs for this system typically make up a significant part of the total control cabinet costs. However, instead of a special hardware solution, Go-Well uses space-saving Beckhoff temperature measuring terminals in its foil stamping machine, which integrate seamlessly into the control platform. “This leads to a significant reduction in the hardware costs and offers our customers a competitive solution,” said Lv Yi, Chief Engineer at Go-Well. In addition to the usual temperature control functions, the operating time-based preheating and heating functions were also automated, significantly reducing the time required for heating and cutting overall energy consumption as a result.

Precise control of raw material consumption
The high-performance of the CX1030 Embedded PC as a control platform enables Go-Well to utilize the full bandwidth of automatic calculation functions as well as managing a large number of recipes for the foil stamping process. “In addition, we also integrate a function for simulating the production process, thereby offering our end customers enhanced convenience,” said Lv Yi. Before the start of production the system is able to precisely calculate the required foil quantity. A warning system indicates when the foil material is running low, preventing machine stoppages. A dedicated program calculates the optimum foil consumption and the optimum foil utilization. As a positive result, the machine operator can therefore always manage and ultimately reduce raw material costs.

“The Beckhoff Embedded PC, with directly connected EtherCAT Terminals, has proven to be an ideal control platform for our foil stamping machine. Having demonstrated its reliability and stability over several years of operation, the machine is now manufactured in series production,” said Lv Yi. "Particularly in the development of the operator control elements we were able to let our imagination run free. The user interface combines perfect functionality with simple handling.”

Further Information:
www.beckhoff.com.cn
TwinCAT controls advanced CNC turret punch press

Machine efficiency increased by 20 %

The new DMT-200 CNC turret punch press with gantry drive is the result of the successful cooperation of Jiangsu Jinfangyuan CNC Machine with Beckhoff China. With this advanced machine, Jinfangyuan has for the first time settled on a purely software-based CNC control solution. Through the use of EtherCAT and TwinCAT CNC it was possible to increase the processing performance of the DMT punch by around 20 % compared to the previous solution.
In addition to turret punch presses, the extensive machinery portfolio of Jiangsu Jinfangyuan CNC also includes bending machines, laser cutting machines and complete sheet metal processing facilities. The Beckhoff CP6902 built-in Control Panel with touch screen provides convenient operation and monitoring of the turret punch press.

In addition to turret punch presses, Jiangsu Jinfangyuan CNC, based in Yangzhou City, China, also includes bending machines, laser cutting machines and complete sheet metal processing facilities in its extensive machinery portfolio. Among the turret punch presses, the ET, VT and DMT model ranges are available with different punching heads. The CNC axis control and positioning are implemented identically on all three types. The ET range is fitted with a pneumatic punch, the VT with a classic hydraulic punch and the DMT series with the most energy-efficient solution, a punch servomotor.

**Universal PC-based control platform**
All punch presses are equipped with a powerful Beckhoff C6640 Industrial-PC, a CP6902 operating panel with touch screen, TwinCAT automation software, EtherCAT I/Os and the AX5000 EtherCAT Servo Drive. “The DMT, in which we are using TwinCAT CNC, works faster than all the other CNC machines from Jinfangyuan,” says Li Qiang, DMT Project Manager at Jinfangyuan. The punching speed of the current DMT-200 is 500 cycles/minute in 25 mm steps, with a punching pressure of up to 50 tons.

Jinfangyuan has already employed Beckhoff PC-based control technology for years and with the DMT-200 CNC turret punch press has now implemented a CNC controller completely based on TwinCAT CNC for the first time. The entire processing procedure of the DMT has been programmed completely in NC code. TwinCAT CNC includes PLC, Motion Control and CNC control and is used in the combined punching and laser cutting line as well as in the equipment for loading and unloading material. Owing to the high-performance of the PC, all automation functions can be run on one computer. Thus, both the hardware and space requirements as well as the system costs are significantly reduced.

“The open nature of the PC-based controller enables our developers to incorporate their process know-how in the controller. Thus, we are in a position to develop customized software and equipment for our machine and consequently improve our competitiveness,” explains Project Manager Li Qiang.

**No limits placed on the operating functions**
With TwinCAT TcHmiPro, Beckhoff offers a .NET-based open platform for developing an impressive man-machine interface. The operator interface has been programmed in C# and permits the integration of the ADS communication, automation functions, manual operation, recipe management and monitoring of variables in a single platform. Jinfangyuan has also extended its HMI interface with graphical processing simulation, a tool database and a real-time display of the punching operation.

**EtherCAT increases machine efficiency**
“Beckhoff has won our confidence thanks to the openness and user-friendliness of its control system and because of the development of the CNC kernel according to our wishes,” explains Yang Huiyu, Software Engineer on the DMT project at Jinfangyuan: “As a result of using EtherCAT, TwinCAT CNC and the possibility of customer-specific customization of the kernel, the processing efficiency of the DMT punching machine will be increased by about 20 % compared to our previous solution.” The TwinCAT system supports all current bus protocols such as EtherCAT, SERCOS, CANopen, etc. “This openness facilitates the communication of the DMT with other machinery throughout the entire installation and provides us with convenient support when setting up a flexible production line,” continues Yang Huiyu.

Further Information:
www.jinfangyuan.com
www.beckhoff.com.cn
Automation technology plays a part in craft beer

Fully automated carbonation system enhances beer quality

The United States has experienced a craft brewing renaissance in recent years. An ever increasing number of Americans attach importance to unique and special types of beer, resulting in an increasingly varied beer market. A total of 1,989 US breweries were in operation in 2011, including many mid-sized private breweries. Saugatuck Brewing Company, based in Douglas, Michigan, is benefiting from this trend and boasts rapid growth. However, not even craft beers can do without technology if consistently high quality and continued sales growth are to be achieved: the fully automated carbonation process, with which the beer is given an optimum carbon dioxide content, is controlled by a Beckhoff automation platform.

Saugatuck beers are mixed and brewed using classic recipes from around the world with some modern inspiration. “We brew various types of beer in the classic styles, but we are now increasingly developing new recipes,” explains Ron Conklin, Brewmaster at Saugatuck Brewing. “While we still had a production capacity of around 500 barrels (approx. 60,000 liters) in 2009, we hit over 2,000 barrels (approx. 240,000 liters) in 2011. Our goal is to more than double our beer production again in 2012,” explains Ric Gillette, CEO of Saugatuck Brewing. “We can only achieve that with state-of-the-art production technology and control solutions.”

Automation guarantees ideal taste and quality of beers
The fermentation process, in which the malt sugar is converted to alcohol by the addition of yeast, takes approx. two weeks at Saugatuck. Once this process is finished, the proteins and yeast collect at the bottom of the fermentation tank and the beer can be racked off from the top of the tank. From there the beer is transferred into the bright tank, where carbon dioxide (CO₂) is added. This addition previously took place manually. “Managing these CO₂ levels requires a great deal of skill and experience,” explains Brewmaster, Ron Conklin. “It is crucial for the quality of the beer and for a stable head of foam.” If the beer was under-carbonated it had to remain in the tank longer to increase the carbonation to the proper level. Conversely, if the CO₂ content was too high, the expensive carbon dioxide had to be removed again and the surplus proteins were scrubbed out.

Now the PC- and EtherCAT-based control platform from Beckhoff ensures an ideal, constant carbonation level. A compact CP6607 Industrial Panel PC with the TwinCAT automation software platform and EtherCAT communication system functions as an integrated controller and HMI. The pressure is now controlled fully automatically on the 5.7-inch touch screen; the brewery staff need only set the appropriate parameters. “This has made the system much more efficient and throughput is greater than ever because we can intelligently pulse CO₂ for better carbonation,” says Ron Conklin, praising the benefits.

The Beckhoff control platform also controls the glycol valves, which are installed in the bright tanks for temperature control. The tanks can be set individually with different temperature, CO₂ quantity and pressure. Bottling previously entailed much back and forth in an effort to maintain the correct pressure level in the tank; now the tank is adjusted once and maintains the pressure with an accuracy of 0.0069 bar (1/10 psi).

The I/O signals are integrated via the Beckhoff EtherCAT Terminals and the EK1100 EtherCAT Coupler. Outside the control cabinet, Saugatuck also utilizes sturdy EtherCAT Box modules with IP 67 protection for connection to valves and sensors. They are ideal for use in the brewery environment as they resist the excessive moisture levels and airborne particles from the brewing process.

“The openness of TwinCAT and EtherCAT has proven to be very beneficial,” explains Jason Conklin, Application Engineer from Beckhoff Automation USA: “It only took three months to install the new PC-based carbonation system and..."
integrate five bright tanks. If Saugatuck Brewing continues to grow at this rate and adds tanks, the main job is to simply add I/O to the system. With TwinCAT software it’s simple to link the I/O and expand the system to quickly incorporate more tanks.”

**Cracking open new markets**

Moving beyond the fermentation and carbonation tanks, future plans for Saugatuck Brewing include the option for Beckhoff controllers on the expanded bottling lines and automated barrel washers. “When I give tours of the brewery I explain to our guests that small breweries like Saugatuck typically don’t have such automation systems,” explains Ric Gillette. “However, that is precisely what gives a microbrewery like ours a competitive advantage.”

**Further Information:**

www.saugatuckbrewing.com

www.beckhoffautomation.com

Saugatuck Brewing programmed its HMI using TwinCAT PLC software. In addition, the pressure is now controlled fully automatically. Brewmaster Ron Conklin need only set the appropriate parameters on the touch screen display.
The integrated Beckhoff approach: everything on a single platform

PC- and EtherCAT-based Control for wind turbines

Automation technology from Beckhoff has successfully proven itself in use worldwide in wind turbines up to a size of 5 MW. Beckhoff automated 7,000 wind turbines with a total output of 11.2 GW in 2011 alone. Worldwide, more than 20,000 wind turbines are equipped with Beckhoff control technology – both on- and offshore. A powerful controller is available in PC-based automation technology that unites all components of a wind turbine – such as operational management and control of pitch, generator, converter and brake, as well as Condition Monitoring and farm networking – on a single platform. Doing without special hardware lowers the costs of the basic electrical equipment of the wind turbine and the costs of maintenance, whilst at the same time increasing the availability of the wind turbine.
The open, scalable automation software TwinCAT forms the core of the PC-based control platform. TwinCAT offers the user a high degree of freedom in choosing his programming language: in addition to the object-oriented extensions of IEC 61131-3, C and C++ are now also available as programming languages for real-time applications. With the integration of Matlab®/Simulink®, TwinCAT can also be used for plant simulation, for example for load calculation.

Open control technology offers investment security and reduces hardware and engineering costs

PC- and EtherCAT-based control technology from Beckhoff is characterized by its variety of hardware and software interfaces. Openness is the basis of the system concept at Beckhoff and aims at the integration of functions such as visualization, safety technology and measuring technology, and of third-party software. In addition, the smooth interaction of the Beckhoff technology with industrial communication standards such as IEC 61400-25, Ethernet TCP/IP or OPC guarantees high investment security for the user.

The openness of the Beckhoff control architecture fits the requirement profile of the wind power industry perfectly: performance-related scalability, maximum flexibility in controller design and a high degree of integration. The functional range of the control platform, which, apart from sequence control, also encompasses visualization, safety chain and Condition Monitoring, ensures the efficient interaction of all system components and optimizes the performance of the wind turbine. Beyond that, dispensing with special hardware leads to a leaner control architecture and to lower engineering expenditure. This results in a significant reduction in costs and corresponding competitive advantages. Interfaces for all common fieldbus systems and the large signal variety of the Beckhoff I/O systems cover all types of signals and fieldbuses that are relevant to wind power.

High degree of integration optimizes the controller and lowers the operating costs of wind turbines

Based on PC and EtherCAT technology, Beckhoff supplies a universal platform for all control requirements in wind turbines: all procedures are automated on the Industrial PC with directly connected Beckhoff I/O system and the TwinCAT automation software: from the operational management and control of pitch, converter, gearbox and brakes to the visualization, and farm networking. EtherCAT offers full Ethernet compatibility and outstanding real-time characteristics. Beyond that, the fast communication system is characterized by flexible topology and simple handling. Lower-level fieldbuses such as CANopen,
PROFIBUS and Ethernet TCP/IP can be relocated to the field via fieldbus master or slave terminals for the control of subsystems. Software libraries and hardware components specially developed for the wind power industry round off the wide range of solutions from Beckhoff.

The Beckhoff standard controller for a wind turbine consists of an Embedded PC as the master computer, EtherCAT as the communication system, the Bus or EtherCAT Terminals and the TwinCAT automation software. The converter, the I/O system in the nacelle and the pitch controller in the hub are connected to the master controller via EtherCAT or another fieldbus system. Safety technology and Condition Monitoring are integrated into the terminal strand via corresponding I/O modules. A separate CPU can thus be dispensed with. Through the use of EtherCAT as the universal fieldbus system, communication becomes much faster and simpler and the project engineering, programming and cabling of the wind turbine are simplified. The central Embedded PC acquires and processes all data, checks the feed-in and communicates with the central control room via Ethernet.

**Ultra-fast wind farm networking**

Wind farm networking with EtherCAT is not only faster compared to conventional IP solutions, but also offers cost benefits by dispensing with switches or hubs. With the EL3773 EtherCAT power measurement terminal integrated in the automation system, momentary current and voltage values can be measured at up to 10,000 samples/s. Using the EtherCAT Distributed Clocks, the measured values of all wind turbines and the measurement at the point of common coupling can be synchronized to a timeframe smaller than 1 μs. The physical layer can be used for both Ethernet TCP/IP and for EtherCAT. The existing Ethernet infrastructure (fiber-optic technology) can be used over distances of up to 20 km without loss of speed. TwinCAT supports the standardized IEC 61400-25 communication protocol for wind turbines, which simplifies the monitoring and control of heterogeneous wind farms, including the connection to the electricity supplier.

Further Information:

www.beckhoff.com/Wind
Operational management (nacelle)

Operational management (tower base)

Wind farm networking
Real-time networks for wind farms feature a cycle time of less than 1 ms

The expansion of renewable energies is rapidly gathering pace worldwide. The need to reduce CO₂ emissions as well as the decreasing acceptance of nuclear power are major contributors to this development. Since the wind and sunlight are not constantly available, however, feeding the renewable energies into the grids can lead to problems that are not insignificant. The fast EtherCAT-based automation solution from Beckhoff enables reaction times of less than 1 ms. The early diagnosis of voltage drops increases grid compatibility. In addition to wind turbines, this technology is also suitable for use with solar farms.
Initial steps have already been taken in this direction: Many international grid connection regulations – the so-called Grid Codes – now prescribe LVRT capability (Low Voltage Ride Through) for every wind turbine. This means that, in the case of sudden changes of voltage in the grid, due to short circuits for example, the plant must remain connected to the grid for a defined period of time and must feed in defined reactive currents for fault-finding and to support the voltage. Subsequently, it must return within a few seconds to full active power feed-in. The demanded reactive currents depend on the depth of the voltage drop and must be applied, depending on the requirement, at the wind turbine or at the grid connection point.

On this basis, every modern wind turbine is today able to react appropriately to a voltage drop in the grid. Wind farms are becoming increasingly large and installations of up to 500 MW are no longer a rarity. In view of the size of the internal power networks in the wind farm, LVRT conditioning executed purely at turbine level at the grid connection point often does not produce the effect desired by the grid operator. Due to the impedances lying between them, the voltages differ between the turbines and the grid connection point. This means that each wind turbine reacts differently to the changes in the grid. Also, the reactive currents fed in at turbine level are not identical to the resulting reactive current at the grid connection point.

The Beckhoff solution is designed to deal with this problem and enable a coordinated reaction of the entire wind farm to a voltage drop in the grid. In this way, the solution achieves a defined behavior of the entire farm at the grid connection point.

So far the following values have been regulated for the feed-in of wind turbines or wind farms:

- **LVRT and local voltage limitation** (temporal requirement of the control time: < 10 ... 20 ms)
- **Active power as well as reactive power or voltage** (temporal requirement of the control time: 1 s - 60 s)

Due to the temporal requirements, the reaction in the LVRT case is presently realized at the turbine level in the converter. The delays in the control loop which occur due to centralized conditioning by a farm controller would hamper the attainment of the demanded dynamics.

The voltage/reactive power level is realized at the wind farm level; only in this way can a set point value specified for the grid connection point also be achieved there. In conjunction with a weak grid connection and a Q(U)-characteristic, the high dynamics (control time 1 s) sometimes demanded represent a challenge here.

**Wind farm networking with EtherCAT**

The 2011 lecture by Melanie Hau and Martin Shan on the subject of "Wind farm control for network integration" showed that the speed of the wind farm networking and that of the turbine automation fieldbus both exert a significant influence on the attainable dynamics in the control of the voltage or reactive power in a wind farm.

This is precisely the point of attack of the Beckhoff solution, which is based on wind farm networking using EtherCAT. Wind farm networking has so far been

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realized using Ethernet. Ethernet fiber optic cables are used for the connection of the individual wind turbines to the master computer. Since EtherCAT is based on Ethernet and thus fully compatible with it, the same physics can be applied when using EtherCAT. The subject of cable redundancy is also fully solved with EtherCAT. The fiber optic cable ring in the wind farm is closed at the farm master. The necessary TCP/IP communication can take place via switch port terminals within the EtherCAT I/O system. The highlight here is that not only a significantly higher transmission rate is achieved by using EtherCAT, but also that significant cost benefits result in comparison with the redundancy-capable switches that have been used so far.

**Power measurement at 10,000 samples/s**

EtherCAT significantly increases system speed: A fully occupied EtherCAT telegram containing 1500 bytes can be sent by the master and received again in an impressive 77 μs. Assuming a process image of 50 input bytes and 50 output bytes for each wind turbine, the process image of a wind farm with more than 150 wind turbines can be refreshed in less than one millisecond. If the speed requirements or the number of wind turbines should significantly increase, several EtherCAT rings can also be realized on one master.

In addition there are further new technologies realized with EtherCAT: for instance, oversampling functionality permits the measurement or the output of signals in the field with a frequency of up to 100 kHz. This oversampling technology is used, for example, for the measurement of the current and the voltage at the grid connection point with the aid of the EL3773 EtherCAT power measurement terminal. The sampling frequency here is 10 KHz.

The Distributed Clock function of an EtherCAT device, with a resolution of 1 ns and an accuracy of 10 ns, permits the temporal synchronization of measured and control values in a time window significantly smaller than 1 μs, since all Distributed Clocks in an EtherCAT topology are synchronized by propagation delay measurement. On the basis of this function the measured values in a wind farm can be synchronized extremely well. Even the synchronization of the IGBTs of converters within a wind farm can be achieved with this technology. To this end, both the turbine manufacturer and the converter supplier must be brought on board.

**Wide range of applications due to open control technology**

In summary, this means that, using available standard components, a wind farm controller can be realized that makes a defined reaction of the entire wind farm to a voltage drop in the grid possible at the grid connection point. Outside the fault case, too, highly dynamic voltage or reactive power controllers can be implemented in the wind farm for weak grid connections.

Due to the openness of the EtherCAT system, this solution is possible with controllers from third-party vendors as well: master and slave interfaces for all common fieldbus systems (such as PROFIBUS, PROFINET and CANopen) are available for the EtherCAT Terminal system. Serial protocols are available for most interfaces; communication can alternatively be accomplished with parallel wiring.

The EL3413 EtherCAT power measurement terminal, which is equipped with a direct 690 Volt connection, can be used on any wind turbine for checking the controller. Extra signals such as weather data can be collected simply and inexpensively via this topology.

Author: Dirk Kordtomeikel, Business Manager Wind Energy, Beckhoff
In comparison with conventional IP solutions, wind farm networking with EtherCAT is faster and offers substantial cost benefits. The faster the farm networking is, the more effective the energy provider can react to voltage drops or changing grid requirements. The EtherCAT power measurement terminal integrated in the automation system logs momentary current and voltage values at the feed-in point at up to 10,000 samples/s. Early diagnosis of voltage drops is thus guaranteed.

Unlike current alternative solutions, it is possible to generate a reaction of an entire wind farm to an LVRT case using EtherCAT. If a voltage drop is diagnosed at the feed-in point, this can be signaled to all turbines in the entire farm network within 1 ms. Via the EtherCAT Distributed Clocks, the measured values of all wind turbines and the measurement at the point of common coupling can be synchronized to a timeframe smaller than 1 µs. With these data, the current, voltage and frequency can be controlled accordingly and the grid can be supported. The existing fiber optic-based Ethernet infrastructure can be used.

Further Information:
www.beckhoff.com/EtherCAT
www.beckhoff.com/EL3773
www.beckhoff.com/EL3413
Scientific Automation in wind turbines

Condition Monitoring as an integrated component of TwinCAT 3
Scientific Automation from Beckhoff represents a combination of high-performance Industrial or Embedded PCs, the highly deterministic EtherCAT fieldbus system and intelligent software. These components are also required for automating modern wind turbines. Wind turbine manufacturers want to use the same system for control tasks, monitoring, grid synchronization and system-wide communication. Just thinking of the complex Condition Monitoring algorithms which are to be processed on the controller, it becomes clear that it makes sense to use multi-core CPUs. With the new CX2000 series from Beckhoff, such powerful CPUs are now available in the Embedded PC format preferred by wind turbine manufacturers. The CX2000 devices are equipped with Sandy Bridge processors from Intel. In addition to economical Sandy Bridge Celeron® types, Intel® Core™ i7 processors are available. Even the CX2030, which is equipped with a 1.5 GHz processor (dual-core), is fanless and therefore exceptionally stable because it has no rotating components.

The real-time environment of TwinCAT 3 is designed to enable almost any number of PLCs, safety PLCs and C++ tasks to be executed on the same or on different CPU cores.

The degree of automation in wind turbines is increasing continuously. In addition to the actual system control, monitoring and networking play increasingly important roles. Many control suppliers that offer conventional controllers are reaching their performance limits. The solution lies in an automation system that is essentially based on a scientific approach and integrates the required measuring equipment in a standard control architecture.

Suitable software must be used to take full advantage of this enhanced performance. This is where TwinCAT 3 control software from Beckhoff comes in. The real-time environment of TwinCAT 3 is designed to enable almost any number of PLCs, safety PLCs and C++ tasks to be executed on the same or on different CPU cores.

**Condition Monitoring library for TwinCAT 3**

The new TwinCAT 3 Condition Monitoring library facilitates the utilization of these options. Raw data can be logged with a fast task and processed further with a somewhat slower task. This permits measured data to be logged continuously and analyzed with algorithms such as power spectrum, kurtosis, crest factor and envelope spectrum. The user does not have to worry about task-spanning communication, which is automatically handled by the Condition Monitoring library. The results from the individual function blocks in the
library are stored in a global transfer tray, a kind of memory table. From there the results can be copied to variables or processed further with the aid of other algorithms. In this way users can configure their own individual measuring and analysis chains.

Particularly in the wind industry, such developments must be tested and simulated extensively because once a wind turbine has been commissioned, modifications and updates in the field would be rather time-consuming and expensive. In order to save time and development costs, a Matlab®/Simulink® simulation of the system can be tested against the original control program code in real-time, for example. In this way many problems can be detected and rectified before commissioning. No Beckhoff-specific components or other modifications of the original model are required for creating Matlab®/Simulink® modules for the TwinCAT 3 runtime environment. The Matlab® and Simulink® coders generate C++ code, which is then compiled into a TwinCAT 3 module. Modules can be re-used easily through instantiation. The block diagram from Simulink® can be visualized directly in TwinCAT for setting break points, for example.

In addition to TwinCAT 3 and the auxiliary Condition Monitoring and Matlab®/Simulink® integration packages, TwinCAT Scope enables visualization of all relevant signals of a scientific automation software. The TwinCAT Scope consists of two components. The View component is used for displaying signals in the form of charts. The Server component records the data on the target device. A TwinCAT 3 installation always includes a basic version of Scope. This is particularly suitable for commissioning of systems. The Scope provides the user a quick graphic overview of the machine state. Different cursors enable precise reading of the measured data, even in the μs range. For large value ranges it makes sense to switch to a logarithmic display. The Scope product level enables additional functions such as long-term recording or integrability in custom .NET visualizations. All Scope product levels permit visualization of oversampling values from EtherCAT measuring terminals.

EtherCAT: High-precision measuring technology
EtherCAT as a fast, real-time capable bus system rounds off the scientific automation solution from Beckhoff. EtherCAT has not only become established as a control fieldbus, but also as a measurement fieldbus. Only this Ethernet-based, highly deterministic and fast fieldbus protocol enables complex applications, such as the integration of Condition Monitoring, to be realized. The functional principle of EtherCAT delivers usable data rates far in excess of 90 percent with full-duplex fast Ethernet and bus cycle times of a few microseconds. In conjunction with the oversampling function mentioned above and buffering of values directly in the EtherCAT slave, the sampling rates can be increased far beyond the actual bus cycle: The EL1262 digital input terminals, for example, can scan signals with up to 1 million samples/second. The EL3702 EtherCAT Terminal
samples analog signals of ±10 V with 16 bit resolution and up to 100 kHz. Distributed clocks in EtherCAT slaves ensure time-synchronized data sampling across the network. The jitter is significantly less than 1 microsecond, usually even less than 100 nanoseconds.

The EL3632 is also an EtherCAT oversampling terminal. This terminal is suitable for Condition Monitoring applications, in which oscillations must be sampled via acceleration sensors or microphones. Piezo sensors with IEPE interface (Integrated Electronics Piezo-Electric) can be connected directly to the two-channel terminal without a pre-amplifier. Due to different hardware filter stages, signal sampling frequencies between 0.05 Hz and 50 kHz are possible. The same principle of operation as in the EL3632 is used in the EL3773. The EL3773 is a power monitoring terminal that samples raw grid data, as opposed to raw oscillation data. Current and voltage can be sampled with up to 10 kHz, which makes the terminal suitable for synchronization with other networks.

The main advantage of these 12 mm wide modules is their high degree of flexibility. EtherCAT bus systems offer virtually unlimited expansion capabilities. This means that measuring applications, such as gear unit monitoring, can be implemented in new systems or retrofitted in existing systems. Thanks to the compact size of the controller and the wide range of open TwinCAT interfaces, stand-alone systems are becoming increasingly popular. Such stand-alone systems are currently retrofitted in some onshore turbines for monitoring the main bearing and the gear unit based on a CX5020 Embedded PC. To this end a terminal box is equipped with five EL3632 oversampling terminals and an EL3413 power measurement terminal. UMTS modems and compact heaters can be integrated as additional options. Depending on the available interface, the monitoring system can be integrated with the existing controller.

In summary, Scientific Automation enables the integration of engineering findings in the automation of wind turbines beyond the scope of conventional controllers. The power of the PC Control philosophy offers sufficient capacity to integrate numerous advanced functions beyond standard control. High-performance CPUs, fast I/O terminals, EtherCAT communication and TwinCAT software provide the basic technologies required for this purpose.

Further Information:
www.beckhoff.com/Scientific-Automation
www.beckhoff.com/Condition-Monitoring
www.beckhoff.com/TwinCAT3
XTS: higher flexibility and lower engineering effort for handling and assembly

Beckhoff will present its PC- and EtherCAT-based automation solutions for assembly and handling technology at Motek 2012, which takes place from 8 to 11 October in Stuttgart, Germany. In addition to product innovations, including new multi-touch panels or the new AM8000 servomotor generation, the main focus at Motek will be on the new XTS drive system (eXtended Transport System) from Beckhoff. XTS integrates feeding, handling and assembly in a single system and enables totally new and customizable machine concepts.

XTS combines the advantages of two proven drive principles: rotary and linear systems. The motor is completely integrated together with power electronics and displacement measurement. One or more movers – wireless, mobile carrier modules – can be moved highly dynamically at up to 4 m/s on an almost arbitrary and flexible path configuration.

**Optimized material flow for assembly applications**

XTS can be used in many different ways in the most diverse industries. It is predestined for high-speed material handling: pushing products, adapting product spacing, reducing or increasing product speed, clamping and moving products, transporting and discharging products, or manipulating products. An irregular product flow is isolated and transferred at a constant interval and constant speed to the next workstation.

XTS enables more compact and efficient machine designs for handling, feeding and assembly. In applications such as conventional rotary transfer machines all machining stations are subject to the same basic cycle. In other words, the whole system has to operate based on the cycle of the slowest station. XTS enables the processing steps to be controlled individually and independent of each other. For example, a second station could be used for parallel handling of the slowest process. XTS optimizes feeding. The total machine output is no longer limited by the slowest working cycle. XTS can also be used as an alternative to a delta robot, in order to synchronize an irregular product stream and then push the product into packaging or transfer it to the next processing step.
Flexible product changeover: standardized machine – adaptation through programming

In assembly applications, machines are often used for a wide range of different tasks. In many cases, product changeovers involve significant intervention in the mechanical systems. XTS offers new opportunities and increased flexibility for the design and construction of automatic assembly and handling machines. XTS can be used as quasi-standard hardware, and new or additional handling and assembly options can be implemented based on software. This means that the machine manufacturer may only have to build a standard machine, which could then be used for processing a wide range of products with minimum need for mechanical adaptations. Complex processes are transferred into the software.

In this way, even special-purpose machine manufacturers can achieve larger production runs, since standard machines can be adapted to different applications through programming of software parameters. The time to market can be reduced significantly, and implementation of the solution requires less engineering effort: special-purpose machine manufacturers only need to modify their machines slightly and program the associated software, so that they can respond faster to customer orders. The same benefits apply to end customers: fewer machine types, fast product changeover and fast time to market.

XTS – the new linear motor principle

XTS is a modular mechatronic system that can be configured to match the required geometries. The machine volume is utilized to the maximum, since the outward and return path as well as the curves can be used for the active material transport. The movers can accelerate, brake, position and synchronize themselves. They can take up absolute positions and positions relative to each other; they can group themselves and accumulate; they can create clamping forces in motion, drive through curves and along straights, recover energy through regenerative braking and use both the return paths and the outward paths for transport purposes.

Further Information:
www.beckhoff.com/motek
www.beckhoff.com/XTS
Beckhoff is exhibiting from 25 to 28 September 2012 at the international European Photovoltaic Solar Energy Conference and Exhibition (EU PVSEC) in Frankfurt, Germany, and will present its range of solutions for photovoltaic industry. With PC-based Control, Beckhoff offers a universal and high performance control platform, with optimization potential for the entire process chain of photovoltaic production: from the production of the wafer to that of the cell and the module. The tradeshow presentation will focus on the new software generation, TwinCAT 3, as well as scalable drive solutions. Beckhoff will present a further highlight in the motors from the AM8000 series, which require only one motor connecting cable for feedback and power, thus significantly reducing material and installation costs.

Beckhoff will present its range of solutions for the packaging industry at FachPack in Hall 4A, Booth 417. PC- and EtherCAT-based control technology from Beckhoff enables the whole process chain for individual packaging machines and complete packaging lines to be controlled and monitored. The new XTS (eXtended Transport System) revolutionizes drive technology and makes completely new concepts for packaging machines possible. All processes, from filling, forming, sealing, labeling, collecting and re-packing to palletizing, can be realized throughout with Industrial PCs and TwinCAT automation software. New Beckhoff products on show at FachPack include the new multi-touch panel series and a complete control solution in stainless steel design for the food industry, for example.

At EuroBlech in Germany between 23 and 27 October Beckhoff will present its integrated solution for metal forming. PC- and EtherCAT-based control increases the control quality, enabling machines to runs faster and with higher precision. Since only a single Industrial PC is required for control, Motion and HMI, expensive special controllers are no longer required. A further highlight is TwinCAT 3 automation software, which enables efficient engineering and offers multi-core support.

Sheet metal components come in all shapes and sizes, requiring a wide range of machining processes including rolling, cutting, stamping, folding, drawing, joining, cleaning and finishing. Beckhoff controls presses, punches, transfer units, straightening machines, lubrication units and cutters. For these diverse requirements Beckhoff offers an integrated, scalable control platform in the form of PC- and EtherCAT-based control.

Further Information:
www.beckhoff.com/euroblech
EtherCAT-based automation offers redundancy and high data transmission security.

Beckhoff enables the acquisition of all process parameters in the chemical or process industry, such as the temperature and pressure in a system.

Beckhoff at Achema 2012

3,773 exhibitors, of whom 50% were from countries outside Germany, presented their solutions for the chemical industry, process engineering and biotechnology from June 18 to 22 at Achema 2012 in Frankfurt am Main, Germany. This year’s trade show, which was well-attended with 167,000 visitors, focused on the subjects of energy and bio-economics.

At this year’s Achema show, Beckhoff exhibited its open automation technology for the process industry as well as innovative drive solutions for packaging machines. Particular interest was shown in Bus Terminals and Embedded PCs designed according to the ATEX directive 94/9/EC for use in Zone 2 as well as the complete range of stainless-steel devices for areas of application with strict hygienic requirements: the Beckhoff Panel PCs, I/O modules and servomotors with “Hygienic Design” are ideally suited for use in the chemical and pharmaceutical industries.

The highlight at the Beckhoff booth was the new XTS drive system (eXtended Transport System), which replaces traditional mechanical systems with innovative mechatronics. The motor is completely integrated together with power electronics and displacement measurement. One or more movers – wireless, mobile carrier modules – can be moved highly dynamically at up to 4 m/s on an almost arbitrary path configuration. “The XTS presentation was a great success, because it is a highly innovative system with outstanding potential. Even now it is foreseeable that with XTS we will enable new applications in the field of packaging machines for the pharmaceutical industry,” says Frank Würthner, from Packaging Technology Branch Management at Beckhoff.

Impressions at:
www.beckhoff.com/achema
EtherCAT activities in China: exhibitions and seminars

At this year’s Industrial Automation Beijing Show, the successor event to FA/PA, which took place between June 20 and 22 in Beijing, ETG members from China and abroad exhibited in a joint booth. A total of 12 co-exhibitors had more than 40 different EtherCAT products on display. The booth was well attended, and the feedback was positive. EtherCAT is used in many applications in China, ranging from power generation to machine tool manufacturing.

Between September 11 and 14, an EtherCAT seminar series for system integrator and machine builder decision makers will take place in Beijing, Chengdu, Guangzhou and Shanghai. The event series, supported by several EtherCAT Technology Group (ETG) members, will be accompanied by a table-top exhibition.

ETG Semiconductor Working Group in the home stretch

Less than a year after the kick-off meeting at the end of October 2011, 12 comprehensive profile documents have already reached the review stage: The ETG Semiconductor Working Group is working at record-breaking speed. The working group meetings to-date alone correspond to a cumulative effort of around five person years. There is, of course, also the profile work “at home,” web meetings and telephone conferences. The working group meetings take place in California’s Silicon Valley in the US, usually at one of the large manufacturers of semiconductor manufacturing equipment, the end users of EtherCAT technology. The composition of the working groups is downright ideal: In addition to users, fieldbus experts from companies that often offer specialized devices for the semiconductor industry are represented. Participants come from North America, Europe and Asia, thus representing the worldwide market for semiconductor production.

The working group is headed by Daniel R. Judd of Arlington Laboratories, who already played a key role in shaping the previous fieldbus standard in the semiconductor industry. Technical and organizational support for these activities is provided by the EtherCAT experts from the ETG offices in the US and Germany, who ensure that the results seamlessly match the existing EtherCAT specification and tools.

The next three-day face-to-face meeting is scheduled for mid-October 2012 at Applied Materials in Santa Clara, California. In addition to final coordination of the profile documents, the meeting will also focus on conformance tests for devices developed based on the profiles.

Florian Häfele, who provides technical support for the working group from the ETG office in Germany, said: “The exceptionally strong commitment of the large number of participants indicates that the semiconductor industry means business with their decision to use EtherCAT. Everyone is keen to make a start with implementations, because customers are waiting to use EtherCAT not only for motion control, standard I/O and gateways, but also to integrate industry-specific devices such as mass flow controllers, vacuum gauges or turbo pumps directly into the EtherCAT system.”
ETG member meetings in Korea and Japan

At their regional meetings in Korea and Japan this June, the EtherCAT Technology Group provided current information on the latest technological developments and worldwide activities. In addition, local members presented impressive EtherCAT applications and explained the associated customer benefits.

The Japan member meeting in Yokohama on June 12 was attended by around 120 Japanese ETG members. The high number of participants demonstrates the continuing strong interest in EtherCAT technology by the Japanese automation industry. One of the highlights of the meeting was the presentation by rapid prototyping specialist ExOne Asia. The company presented an EtherCAT-controlled 3D printer, which produces sand-casting molds for precision metal parts. PC-based EtherCAT control cut the cycle time of the machine by an exceptional 50 % compared to a conventional solution, significantly increasing both the productivity and the precision as a result.

The Korea member meeting which took place in Seoul was attended by more than 80 Korean EtherCAT users and system providers. Daewoo Shipbuilding and Marine Engineering presented a new, EtherCAT-based welding robot for shipbuilding applications. The portable 6-axis robot is placed in a U-shaped cell in the hull, where sensors determine its precise position in order to locate the weld points. The operator chooses the weld schedule and starts the robot, which then moves through the cell. The robot can weld independently for up to half an hour before the operator has to intervene again. The controller for the EtherCAT drives in the robot is housed in a movable enclosure, which can be located up to 50 m away from the robot.

Techno Frontier Show in Japan

Large crowds gathered in the hall during the presentation on EtherCAT technology by Masanori Obata, the Japanese ETG representative, at the recent Techno Frontier Show, which took place between July 11 and 13 in Tokyo. The ETG booth was organized by the members of the Japanese regional ETG committee and the Japanese ETG office. It was supported by numerous co-exhibitors, who mainly presented Japanese EtherCAT products. In parallel to the exhibition, an EtherCAT introduction seminar took place, which was very popular and attracted 70 participants.

At the Techno Frontier Show in Tokyo, Masanori Obata impressed a large crowd with his EtherCAT presentation.
**Trade shows 2012**

**Europe**

**Germany**
FachPack  
September 25 – 27, 2012  
Nuremberg  
Hall A4, Booth 417  
www.fachpack.de  
EU PVSEC  
September 24 – 28, 2012  
Frankfurt  
Hall 3.1, Booth B18  
www.photovoltaic-exhibition.com  

Motek  
October 08 – 11, 2012  
Stuttgart  
Hall 9, Booth 9108  
www.motek-messe.de  

EUROBLECH  
October 23 – 27, 2012  
Hanover  
Hall 27, Booth C41  
www.euroblech.de  

Forum Maschinenbau  
November 07 – 09, 2012  
Bad Salzuflen  
Hall 20, Booth E14  
www.forum-maschinenbau.com

**Austria**
Vienna-Tec  
October 09 – 12, 2012  
Hall D, Booth D0417  
Vienna  
www.vienna-tec.at

**Belgium**
ECL  
September 20 – 21, 2012  
Brussels  
Hall 9, Booth D000  
www.easyfairs.com

**Denmark**
FoodTech  
November 13 – 15, 2012  
Hemning  
www.foodtech.dk

**Finland**
Tekniikka  
October 10 – 12, 2012  
Jyväskylä  
Booth C133  
www.jklpavijonki.fi/tekniikka2012

**Sweden**
Scanautomatic  
October 09 – 11, 2012  
Gothenburg  
Hall B, Booth B03:22  
www.scanautomatic.se

**Turkey**
TATEF  
October 02 – 07, 2012  
Istanbul  
www.ite-turkey.com/ver3/fairs/tatef_en

**Asia**
China  
China Wind Power  
October 16 – 18, 2012  
Peking  
www.chinawind.org.cn  

Industrial Automation Show  
November 06 – 10, 2012  
Shanghai  
www.industrial-automation-show.com  

EMAT  
November 29 – December 02, 2012  
Pune  
www.emat-int.com

**SPS IPC Drives**  
November 27 – 29, 2012  
Nuremberg  
Hall 7, Booth 406  
www.mesago.de/spd

**Norway**
Offshore Technology Days  
October 17 – 19, 2012  
Bergen  
Hall A, Booth 6202  
www.offshoredays.com

**Israel**
Hi-Tech Building  
October 30 – November 01, 2012  
Moscow  
Hall 1, Booth 1-200  
www.hitechbuilding.ru

**Russia**
Hi-Tech Building  
October 30 – November 01, 2012  
Moscow  
Hall 1, Booth 1-200  
www.hitechbuilding.ru
India
India Manufacturing Show
September 27 – 30, 2012
Bangalore
Hall 1, upper level, Booth UA02
www.indianmanufacturingshow.com
Industrial Automation India
November 21 – 24, 2012
New Delhi
www.ia-india.com
EMAT
November 29 – December 02, 2012
Pune
www.emat-int.com

Indonesia
Manufacturing Indonesia
December 05 – 08, 2012
Jakarta
www.manufacturingindonesia.com

Japan
Semicon Japan
December 05 – 07, 2012
Chiba
www.semiconjapan.org

North America
USA
Pack Expo
October 28 – 31, 2012
Chicago
Hall North, Booth 4715
www.packexpo.com/pei2012

South America
Brazil
Brazil Automation ISA
November 06 – 08, 2012
São Paulo
www.brazilautomation.com.br

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www.beckhoff.com/trade_shows