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TwinCAT Core Boost for greater computing performance in real time

Leap in performance and cost efficiency through processor cores in turbo mode

TwinCAT 3 from Beckhoff consistently supports modern multi-core processor technology. The multi-thread capability makes it possible to distribute the application across several cores. Supplemented by TwinCAT Core Boost, the computing performance of individual real-time cores can now also be increased by up to 50% to maximize system performance and optimize it for specific requirements.

With TwinCAT Core Boost, the clock frequency of the processor cores can be configured individually and as required, so they no longer all have to be clocked at the same rate. The clock rate can be set for each real-time core. It is also possible to operate individual cores continuously and in real time in what is known as turbo mode.

The permissible current consumption and temperature of each processor core (and of the overall system) is monitored by TwinCAT Core Boost, ensuring reliable operation even when the turbo mode is used. TwinCAT Core Boost will gradually be introduced for all Beckhoff Industrial PCs with Intel® Core™ i processors from the 11th generation, initially for the:
– C6030 and C6032 ultra-compact Industrial PCs
and then for:
– C6025, C6027, C6030, C6032, C6040, and C6043 ultra-compact Industrial PCs
– CP62xx and CP72xx or CP22xx and CP32xx single and multi-touch Panel PCs
– C6515 and C6525 built-in Industrial PCs without fans
– C6920 and C6930 compact Industrial PCs
– C6640, C6650 and C6675 control cabinet Industrial PCs
– C5210 and C5240 19-inch slide-in Industrial PCs
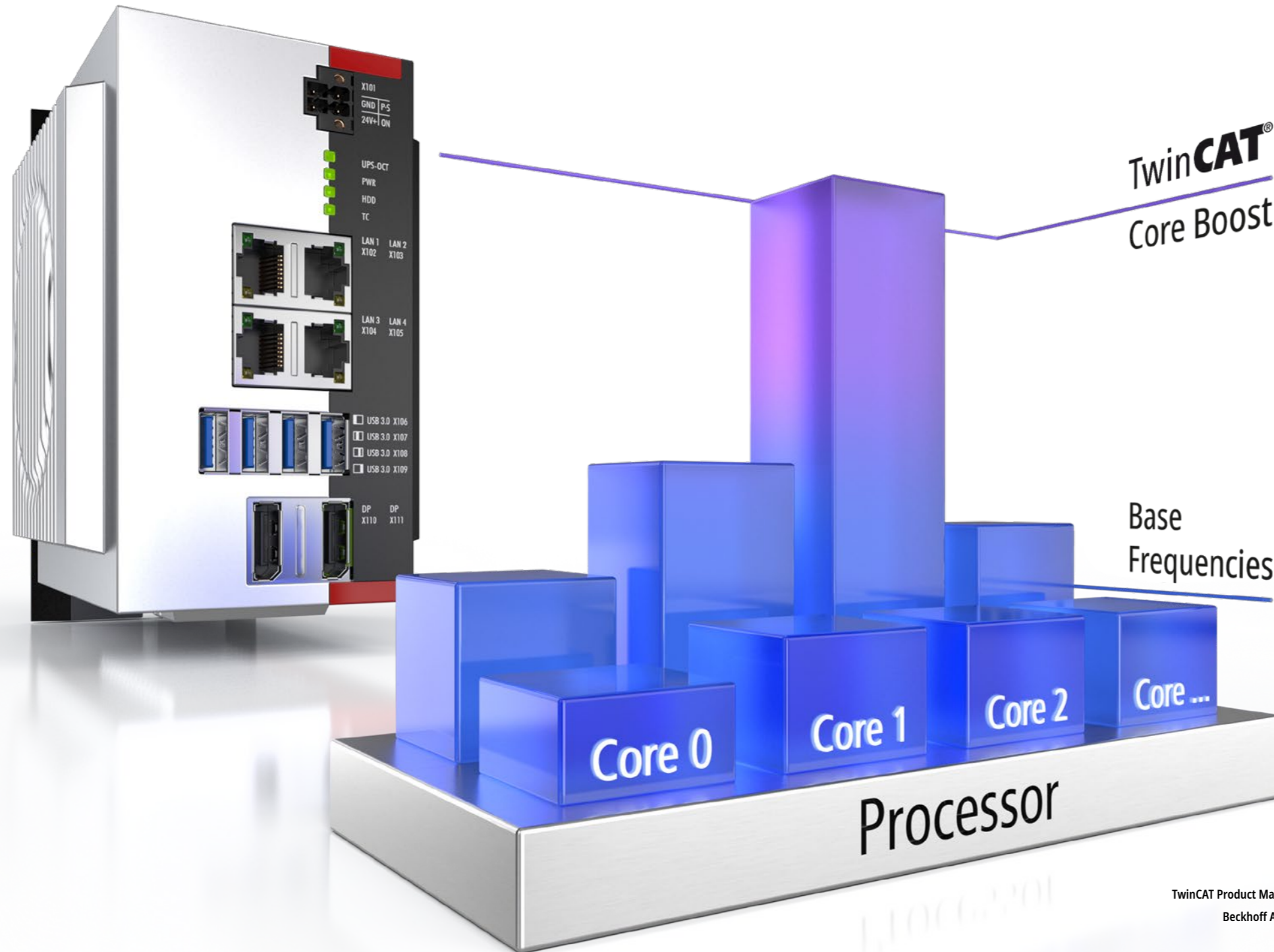
With TwinCAT Core Boost, individual processor cores can be operated as required and also in turbo mode.

" The deep and seamless integration of the Core Boost function extends from configuration in engineering to diagnostics in the PLC code and from the HMI to automatic monitoring by the TwinCAT system itself."

Béla Höfig,
TwinCAT Product Management,
Beckhoff Automation

Felix Wildemann, Industrial PC Product Management, Beckhoff Automation

" With TwinCAT Core Boost, a more cost-effective Intel® Core™ i3 may be sufficient in an application instead of an Intel® Core™ i7."

Increased control performance and cost efficiency

In combined benchmarks for the Beckhoff Performance Portal, the single-core performance of an Intel® Core™ i7 11850HE with base frequency was compared with the same CPU with TwinCAT Core Boost on a single core: With TwinCAT Core Boost, it was possible to increase the clock frequency from 2.6 GHz to 4.2 GHz. This meant the Beckhoff Performance Index of the CPU could be increased by over 50%. The benchmark is an example of how TwinCAT Core Boost can increase clock frequencies and thus shorten computing times. This makes it possible to minimize project cycle times and operate machines and systems even more efficiently. TwinCAT Core Boost can also be used to elevate smaller processors to meet the performance standards required for the application, which they might otherwise struggle to achieve. Therefore, the user saves costs for both the required hardware and for processor-dependent software licenses.

In concrete terms, TwinCAT Core Boost enables users to boost the clock rate of individual cores using simple parameterization. This allows them to respond flexibly to the application requirements and efficiently execute application parts with particularly high performance requirements – such as for motion control, a vision solution, or a machine learning model – on the corresponding processor core. The core clock is permanently increased to guarantee real-time capability and deterministic control within TwinCAT. This was made possible by the corresponding features of the new Intel® processors, which now enable users to access, influence and constantly increase the clock frequency directly from the application. It also counteracts the current technological trend toward an increasing number of processor cores that are, however, running at a comparatively low clock frequency.

This further development in processor technology corresponds exactly to the concept of PC-based control technology from Beckhoff which seamlessly integrates all advantages of the IT world into automation technology. As a central control system, the IPC is continually opening up new possibilities and an increased range of functions, including through machine learning or the new TwinCAT MC3 motion control generation. This is because, for example, previously used control code can be executed more quickly on the same platform. What's more, the IPC can also be used cost-effectively in existing applications, for example by reducing the required processor from an Intel® Core™ i7 to an Intel® Core™ i3. The same code can be executed on a smaller platform at the previous speed, which means users get the same functions at lower costs for hardware, operating system license and TwinCAT performance level.
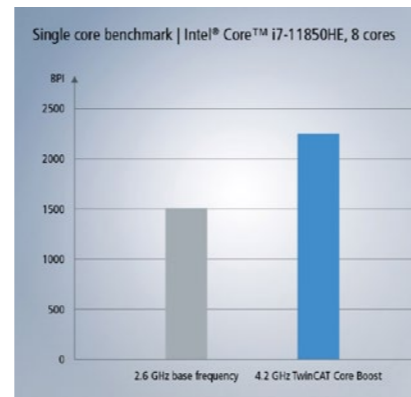
Integrated in the new TwinCAT Build

The Core Boost function is available as a feature directly integrated in the new TwinCAT Build 4026. On the engineering side, there are the necessary extensions within the existing processor core configuration. Detailed and easy-to-use diagnostic options are also available within the runtime. All the important values can be tracked and questions answered both in the PLC and via the HMI: Does the operating system have sole use of the core or does it share it with TwinCAT? Does TwinCAT run isolated on a core? How high is the overall power consumption of the processor and how warm are the individual cores? All this information is captured in TwinCAT and is accessible for monitoring. TwinCAT responds independently to certain limit specifications. For example, when the maximum permissible processor power consumption is reached, the clock frequency of the non-real-time cores is automatically throttled as a first measure to ensure that the overall system can continue to run stably.

Single core benchmark | Intel® Core™ i7-11850HE, 8 cores

CPU comparison with and without TwinCAT Core Boost: The clock frequency of 2.6 GHz can be increased to 4.2 GHz.

More information:
www.beckhoff.com/twincat-core-boost
www.beckhoff.com/ipc

Interview with I/O and smart grid expert Dr. Fabian Assion

The energy transition requires grids with comprehensive measurement technology

The proportion of renewable energies – solar, hydropower, and wind – has increased significantly in recent years and had already accounted for more than half of Germany's electricity feed in 2023. Dr. Fabian Assion, Product Manager I/O at Beckhoff, explains what this high share of highly fluctuating energy means for grid operation as well as for the required smart grids from a control technology perspective.

© DeWind Inc

The measurement data of renewable energies, such as those generated by DeWind's wind turbine for Argentina's Veladero gold mine at an altitude of 4,300 m, needs to be recorded in as much detail as possible.

> " The increasing proportion of renewable energies requires more as well as control-integrated measurement technology at all grid levels."

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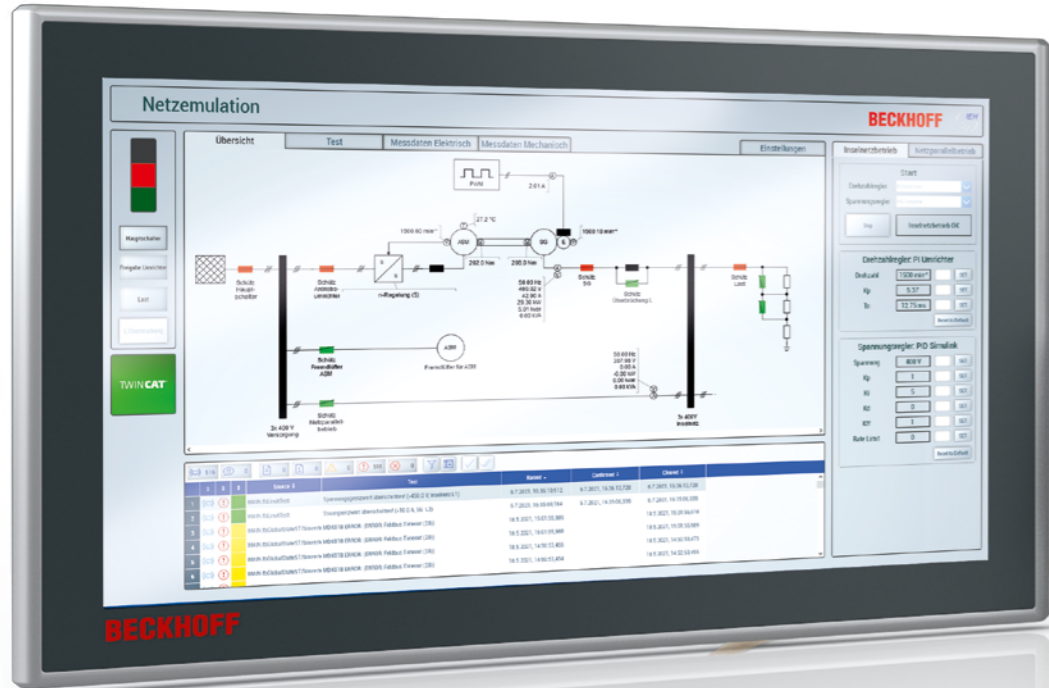
Operation and monitoring of the grid simulation of the Institute of Electrical Energy Systems and High Voltage Technology (IEH) at the Karlsruhe Institute of Technology (KIT) created with TwinCAT HMI

Dr. Fabian Assion,
Product Manager I/O
at Beckhoff Automation

With the distributed clocks of EtherCAT, only one EL3443 measurement terminal is sufficient to achieve detailed and high-quality power measurements in distributed power measurement together with any number of EL3446 measurement terminals distributed in the grid.

What role do smart grids play in the energy transition and what does this mean for grid management?

Dr. Fabian Assion: The increased proportion of renewable energies is making the supply grids more unstable for two reasons. The first reason is that this energy is generated in a much more distributed manner. It is no longer distributed as centrally as was previously the case with large power plants. This means that the existing physical grid structure is not as suitable as it used to be: The change in current flow sometimes leads to grid instabilities and overloads. The second reason is that traditional power plants are usually operated by synchronous generators. This is ideal for grid operation, e.g., by providing optimal grid support in the event of a ground fault. Renewable energies, however, are controlled by power inverters. Therefore, they can only provide the very high currents required in such cases to a limited extent, which also leads to grid instabilities. Today's energy supply grids are therefore more complicated to control overall. And this is exactly what smart grids are used for: They have significantly more information on the current grid status and are therefore much easier to control.

What are the technical requirements of smart grids in terms of extended measurement technology, for example?
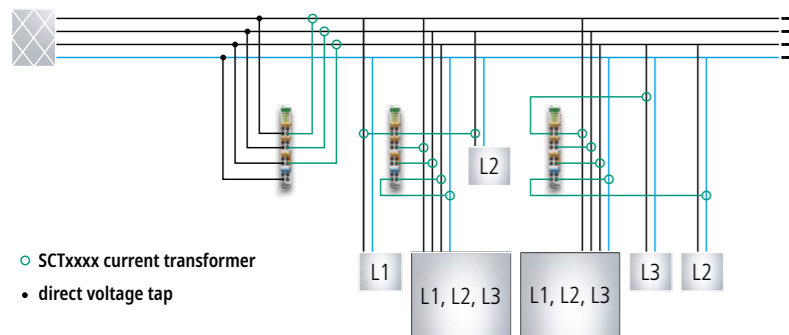
Dr. Fabian Assion: Additional measurement technology has to be installed at all grid levels. To date, this has primarily been implemented in the ultra-high and high-voltage sectors, but hardly – if at all – in the medium and low-voltage sectors. The fact that the lower grid levels in particular need to be upgraded is of great importance from an investment perspective. This is because these levels are much, much more extensive than the upper sectors and therefore, accordingly, require many more measuring points. Hundreds of thousands of measuring points are needed even for a reasonably comprehensive approach. This is illustrated by the example of the local substation as the lowest link in the supply grid. This is where the medium voltage is transformed into low voltage, usually using a transformer with eight or more low-voltage outputs. These voltage outputs should all be equipped with measurement technology for a wide range of measured variables. And that's the case for some 100,000 local substations in Germany.

And which metrics are relevant?

Dr. Fabian Assion: The current is of course the most important single value, but it doesn't go far on its own. If possible, all types of power – reactive, apparent, and active power – should also be recorded at each outgoing feeder to make statements about the grid status. This is particularly important as the majority of loads now use a power supply unit and therefore generate undesirable harmonics. In other words, it is now almost essential for the grid operators responsible for grid quality to collect detailed data on harmonics and even on the level of each individual harmonic from each voltage output in order to take targeted measures if necessary.

What advantages does the PC and EtherCAT-based control technology from Beckhoff offer with its system-integrated measurement technology?

Dr. Fabian Assion: With PC-based control from Beckhoff, measurements can be performed using comparatively little technical effort and financial expense. What's more, the measurement technology is high quality and easy to use. It is based on EtherCAT with its distributed clocks and is therefore sufficiently fast and precise to respond appropriately to short-term events in the grid. We would like to point out that due to our concept of distributed power measurement, high-quality measurement data can be generated particularly cost-effectively.

○ SCTxxxx current transformer
● direct voltage tap

The Beckhoff concept of distributed power measurement minimizes the material and installation costs for comprehensive energy data acquisition.

**What exactly is behind the concept of distributed power measurement?**

Dr. Fabian Assion: A key feature here is that all relevant electrical data from the supply grid, including real measured values for power – without local voltage measurement – can be determined with the EL3446 EtherCAT Terminal as a mere current measurement terminal. However, the EL3446 terminals distributed in the system as required receive the voltage values required for calculating the power data via EtherCAT from a separate EL3443 power measurement terminal, which only needs to be installed once and is precisely synchronized in time by the distributed clocks function in EtherCAT. This minimizes the hardware and installation costs required to reliably monitor the grid quality with a high-quality harmonic measurement at each outgoing voltage feed and the resulting power quality factor.

Solutions with PC-based control have already proven their worth many times over in areas such as the wind energy sector. What are the main advantages here?

Dr. Fabian Assion: More than 100,000 wind turbines up to a size of 16 MW have already been automated worldwide with our PC-based control technology. Once again, EtherCAT demonstrates its advantages here, as it enables very fast and precisely synchronizable control processes, allowing operation and energy yield to be optimized. This applies to individual wind turbines, even on a larger scale, but also to networking within a complete wind farm. In the case of offshore turbines, high-voltage direct current (HVDC) transmission is also one of the most sophisticated elements in a supply grid. PC-based control from Beckhoff has also been successfully implemented in this sector. This is illustrated by the Siemens Energy solution described in issue 02/2024 of our customer magazine PC Control.

Beckhoff technology not only demonstrates its advantages in the field of power generation, but also when it comes to distributing energy via regional supply grids. What efficiency potential can be tapped into?

Dr. Fabian Assion: In addition to the system-integrated measurement technology, users benefit greatly from the exceptionally broad range of Beckhoff I/O solutions for all application areas and environmental conditions. This means that all necessary data can be recorded and merged in the control system – for power measurement, but also for integrating telecontrol protocols, switch positions, signal messages, and transformer and ambient temperatures. The example of Romande Energie, an energy supplier in western Switzerland, shows just how much this can contribute to secure grid management (see PC Control, issue 04/2020).
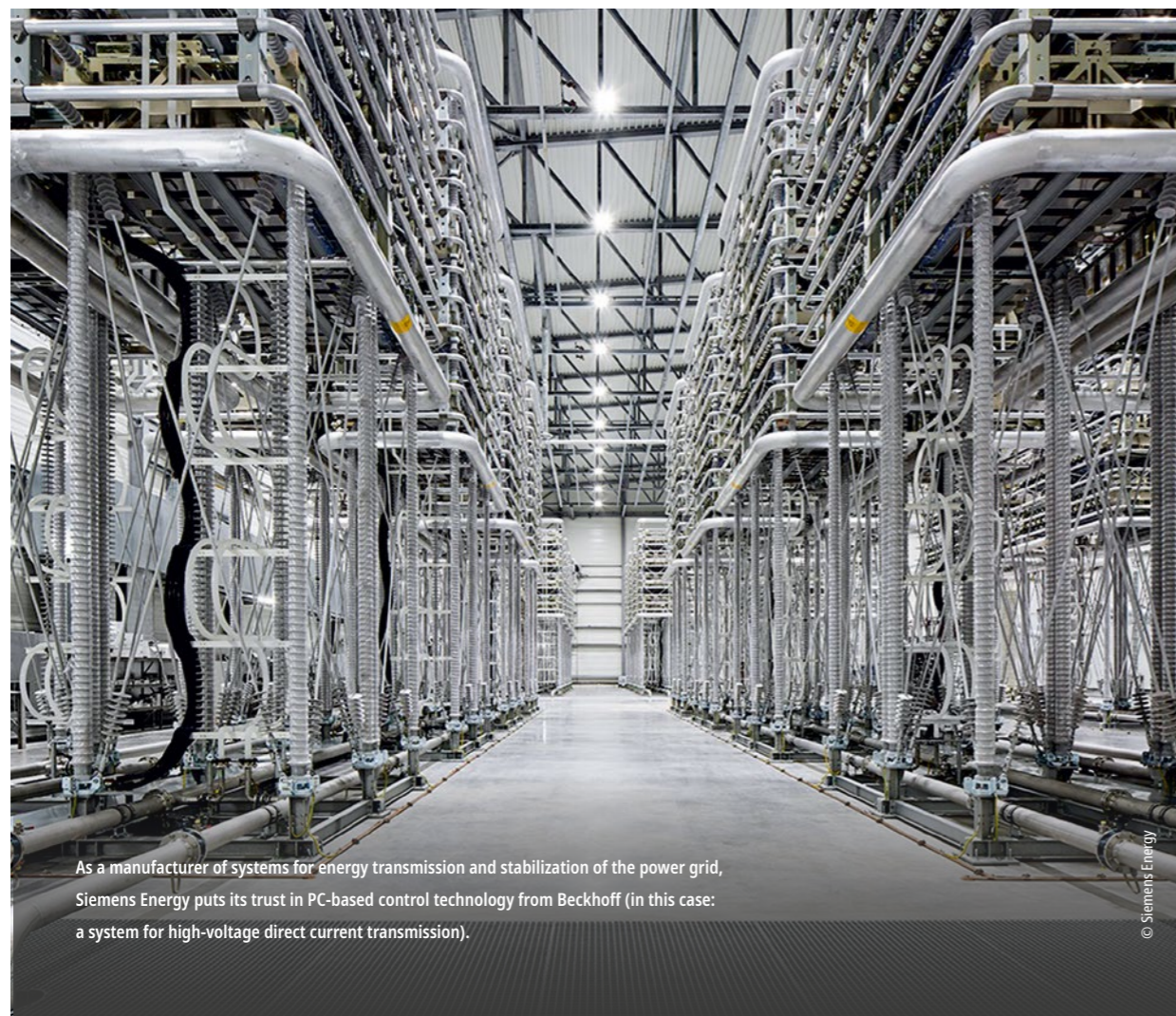
As a manufacturer of systems for energy transmission and stabilization of the power grid, Siemens Energy puts its trust in PC-based control technology from Beckhoff (in this case: a system for high-voltage direct current transmission).

© Siemens Energy

Romande Energie SA, one of the five biggest energy suppliers in Switzerland, is using system-integrated measurement technology from Beckhoff in its substations. It implements the EL3453 power measurement terminals and other EtherCAT Terminals to assure grid availability (in this case: a high-voltage installation).

© Beckhoff

Recording performance data is one aspect, stabilizing it is another. What solutions does PC-based control offer in terms of frequency control and stabilization?

Dr. Fabian Assion: Frequency control and stabilization in the energy supply grid is a very elaborate and complicated task. This requires not only comprehensive grid data, but also an extremely fast system response – in the millisecond and, at times, even in the microsecond range. The Korean company Power 21 successfully implemented this in 2015 for energy supplier KEPCO with a high-precision frequency measurement using our EL3773 grid monitoring terminal with oversampling function (see PC Control, issue 01/20216). Another example is how the Institute of Electrical Energy Systems and High Voltage Technology (IEH) at the Karlsruhe Institute of Technology (KIT) is researching ways to ensure system stability in the transmission grids that are changing as a result of the energy transition. In addition to investigative simulations, the behavior of power plants and inverter-based generation systems in an island grid is being simulated in a dedicated test environment. For this purpose, innovative new control methods are being carried out on Beckhoff Embedded PCs with TwinCAT, thereby validating their application in realistic scenarios (see PC Control, issue 03/2021).

What power consumption savings potential can regional consumers – especially larger industrial plants with their own supply grids – tap into?

Dr. Fabian Assion: Our own energy management system enables us to track loads and minimize costs by avoiding peak loads. This is of particular importance when establishing an in-house energy supply grid. And this applies not only to large industrial groups, but also to SMEs. As soon as a company has installed its own generation system, e.g., in the form of photovoltaics, it should consider energy management as a next step. If storage systems and controllable loads are also in the mix – for example together as a bidirectional charging point – energy flows can be controlled in a targeted manner.

How important is integrated control technology such as PC-based control when it comes to controlling both the building and production operations, and coordinating them in terms of energy?

Dr. Fabian Assion: An integrated Beckhoff solution makes it very easy to determine comprehensive energy data. Together with a corresponding energy management system, these form the basis for considering possible process optimizations from an energy perspective and for enabling a response to increasingly dynamic electricity prices. Both offer considerable potential for reducing energy costs. Excellent examples are the process and building automation from a single source at pharmaceuticals manufacturer Engelhard Arzneimittel and the building and production automation connected via PC-based control at Austrian mechatronics manufacturer Pollmann International GmbH (see PC Control, issue 03/2022).

The growing proportion of renewable energies also requires the expansion of decentralized storage capacities. What control options does PC-based control offer for battery-powered storage systems, biogas power plants, or hydrogen storage systems?

Dr. Fabian Assion: The application areas for our control and measurement technology are as diverse as the storage systems themselves. In the battery-powered sector, an example with huge future potential is the use of electric vehicles as energy storage systems in parking garages. With TwinCAT 3 IoT OCPP (Open Charge Point Protocol) and the EL6761 EtherCAT Terminal, Beckhoff offers a complete solution for ISO 15118 communication between charging stations and electric vehicles, between existing charging points, and between charging points and/or the associated central management systems. Reverion's biogas power plants in a compact container design (see PC Control, issue 01/2024) and GKN Hydrogen's low-pressure, metal hydride hydrogen storage systems (see cover story of this PC Control issue) demonstrate how PC-based control can be used to implement flexible process control and seamless data monitoring for other storage technologies.

Is there anything else you would like to add as a final point?

Dr. Fabian Assion: We are all facing a variety of major challenges and one of them is the restructuring of our energy supply. Beckhoff is doing all it can to stay true to our owner and company founder's motto which is "Engineers must save the world!". But it's fair to say that we can't do this all on our own. So I would like to offer all our existing and future customers the opportunity to help us tackle this task together!

The interview was conducted by Stefan Ziegler, Editorial Management PR, Beckhoff Automation

More information:
www.beckhoff.com/smart-grids
www.beckhoff.com/energy

Located in Vitis, this plant for Pollmann, an Austrian supplier of sunroof kinematics and electromechanical door locks, was voted the best factory in Austria by Fraunhofer Austria in 2022 on account of its highly efficient energy system and its smart and efficient production methods – automated with PC-based control.

© Pollmann

Due to PC-based control, the Reverion biogas power plants are housed in a single highly compact container, achieve a high efficiency of 80 %, and allow reversible operation.

© Reverion

PC-based control for advanced hydrogen storage technology

Consistent use of renewable energies with flexible metal hydride storage systems

The proportion of renewable energies from solar, wind and water is rising continuously. However, sufficient storage options are of the essence to use these energies as efficiently as possible – in the event of surplus supplies, for example. GKN Hydrogen offers a particularly compact and safe option: low-pressure metal hydride hydrogen storage systems which are controlled by PC-based control from Beckhoff.

Hydrogen storage systems (here: HY2MEGA)
in a container design from GKN Hydrogen

"The energy transition will be very difficult to achieve without sustainable energy that can be stored in the long term," says Gottfried Rier, CTO of GKN Hydrogen in Pfalzen, Italy. He adds that this is particularly true given that the global energy demand will continue to rise in the future. To consistently rely on renewable energies, sufficient storage options are therefore essential for balancing out non-continuous power generation from sources such as photovoltaics and wind. As Gottfried Rier goes on to explain, hydrogen storage technology is very well suited as a buffer process: "Hydrogen produced from renewable energy sources is completely carbon-neutral and can be used at various levels – directly as a fuel or as electricity via fuel cells. Particularly with the low-pressure process we use, hydrogen is also easy to transport and can therefore be consumed in a decentralized manner. What's more, hydrogen has 2.7 times the energy content of fossil fuels and, in connection with metal hydride, it can be stored in a both very compact and safe way."

Metal hydride storage offers multiple uses

GKN Hydrogen has developed technology which can charge and discharge specially prepared metal hydride several thousand times with hydrogen without losing any storage capacity. Another advantage (particularly when compared to battery-based systems) is the long storage time: Hydrogen can be stored for years without loss. In concrete terms, GKN Hydrogen has developed three storage systems: HY2MINI (up to 25 kg of hydrogen, 420 kWh of electrical storage capacity), H2YMEDI (up to 120 kg, 2 MWh), and HY2MEGA (cascadable up to 250 kg, over 8.3 MWh).

The metal hydride only needs to be heated to approx. 20 to 30 °C for optimum absorption of the hydrogen; a temperature of 60 to 90 °C is required to release the hydrogen. Daniel Schwingshackl, Advanced Engineering at GKN Hydrogen, adds: "Our process offers another major advantage: It requires very little pressure. Our solutions work in the low-pressure range up to a maximum of 40 bar. In contrast to a gas tank, they require 15 times less volume and are significantly less dangerous compared to the tanks of hydrogen vehicles with pressures up to 700 bar." Another safety aspect is that around 96% of the hydrogen forms a connection with the metal hydride – only 4% of it is volatile. In addition, recycled material can be used to sustainably produce the systems, and the low pressure does not limit the permitted material usage time.

Changing controls for greater flexibility

The sophisticated process sequences and the evaluation of approx. 150 sensors calls for a powerful yet extremely flexible and easily scalable control technology. In 2021, these requirements ultimately led to the company switching from the previous conventional PLC control technology to PC-based control from Beckhoff. Roland Hilber, Electrical & Software Engineering at GKN Hydrogen, explains: "The Beckhoff control technology offered decisive advantages in terms of excellent scalability toward higher computing power and overall handling. The system is also both open and modular. The wide range of I/O terminals enables us to integrate a wide variety of components, ranging from a wide range of sensor technology and other essential third-party devices to the system components for connection, such as fuel cells and electrolyzers. And let's not forget all the advantages we gained from Beckhoff Austria's fast and highly competent support. This is a particularly important aspect when we're considering future projects."

At first glance, the high precision and speed of PC and EtherCAT-based control technology from Beckhoff does not always appear to be necessary

© Harald Wisthaler/GKN Hydrogen

The sophisticated inner workings and associated diverse process sequences
require flexible, scalable, and reliable control technology.

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Daniel Schwingshackl, Advanced Engineering, Roland Hilber, Electrical & Software Engineering, and CTO Gottfried Rier (all GKN Hydrogen) as
well as Andres Oetken, Business Management Process Industry (Beckhoff Automation), and George Hampel, head of the Innsbruck sales office
(Beckhoff Austria), in front of the compact HY2MEGA hydrogen storage system (from left to right)

in the process technology environment. For Daniel Schwingshackl, however, it is very important: "Highly precise control will be of great importance in the future when our customers have to supply energy to the exchange and this has to be implemented precisely in terms of time." Roland Hilber adds: "For this to happen, the energy acquisition and evaluation process needs to be as precise as possible – and we can achieve this using the EL3443 and EL3446 energy measurement terminals and the distributed power measurement concept from Beckhoff." Additional data included into system control includes, for example, the temperature and pressure of the fuel cell or the load status, which is determined indirectly using the temperature and pressure. All this information is used to efficiently manage the entire energy flow.

The control system's core is the C6015 ultra-compact Industrial PC, which for Roland Hilber offers the advantage of energy efficiency packed into a compact design: "Especially when our storage systems are operating in isolated mode, every watt that is required for system operation counts because it is then not available for actual use." A CP2916 multi-touch Control Panel is used for operation. According to Roland Hilber, it was chosen for its appealing design and the excellent value for money it offers. In addition, GKN Hydrogen is also implementing TwinCAT HMI for visualization, which easily enables operators to use their own controls.

Efficient use of I/Os and software
In addition to the diversity and modularity of the Beckhoff I/O system – which extends to the ELX terminals and the corresponding explosion protection expertise – GKN Hydrogen focuses primarily on the underlying EtherCAT communication. As the most important advantages, Roland Hilber cites the plug-and-play nature of the EtherCAT components, the automatic device detection during network expansions, and the overall extremely stable network operation.

GKN Hydrogen also benefits from the measurement technology integrated into the PC-based control system. This starts with the SCT series current transformers, which easily replaced the previous transformers and were just as straightforward to put into operation. The EtherCAT energy measurement terminals are used to record the power consumption of the entire system in detail – to detect anomalies or harmonics, for example. Data on the internal performance of individual devices or loads helps to optimize the process and when designing new developments by identifying sub-optimal operating points or oversizing. This is also where the concept of distributed power measurement with the EL3443 and EL3446 energy measurement terminals shows its true strength – it offers a particularly efficient and inexpensive way of obtaining exact power measurement data, even in more sophisticated systems. A key feature here is that all relevant electrical data from the supply

grid, including real measured values for power, can be determined with the EL3446 as a mere current measurement terminal. However, the EL3446 terminals distributed in the system receive the voltage values required for calculating the power data via EtherCAT from a separate EL3443 power measurement terminal, which only needs to be installed once per network and is precisely synchronized in time by the distributed clocks function in EtherCAT. This minimizes hardware and installation costs.

According to Roland Hilber, the system's efficiency has also been demonstrated in the use of TwinCAT: "The integration of TwinCAT in Visual Studio is greatly beneficial because many of our experts stem from this area and are used to high-level languages. The logical structure of both the software and the control projects makes it very easy to find your way around TwinCAT." In addition, the company also opted for TwinCAT Scope View, which enables simple evaluation of the relevant data – even over several days if required. In other words, all paths are open to GKN Hydrogen due to the connectivity provided by TwinCAT – primarily OPC UA and MQTT for IoT data transfer.

Versatile application options
The wide range of applications for GKN Hydrogen's hydrogen storage systems extends from wind turbines and systemically relevant infrastructure to industrial plants, hospitals, and apartment buildings. A prime example is the

sustainable energy supply for the Müllerhütte cabin in South Tyrol which lies at an altitude of 3,145 m and is only open in summer. The operators were looking for an alternative solution to a defective wind turbine and an outdated diesel generator. The company was able to implement the HY2MEDI hydrogen storage system (for 60 kg of hydrogen), a self-sufficient energy supply, in this remote mountain region with its extreme climatic conditions. The hydrogen required for the system is produced on site by electrolysis using the solar power and hydropower provided by the surrounding environment.

More information:
www.gknhydrogen.com
www.beckhoff.com/hydrogen

PC-based control automates the chamfering and deburring of gears

Precise gear machining every second

Many innovations have their roots in the Black Forest, including radial chamfering, which Tec for Gears (TfG) from Furtwangen are using to automate a previously predominantly manual production step with TwinCAT PLC/NC PTP and EtherCAT oversampling terminals from Beckhoff, among other things. The gear chamfering and deburring process becomes precise, reliable, and so fast that it can be integrated directly into production.

Radial chamfering places high demands on the synchronization of the drive axes – synchronization which was implemented with an EL3742 EtherCAT Terminal with oversampling and TwinCAT 3 Motion Control XFC.

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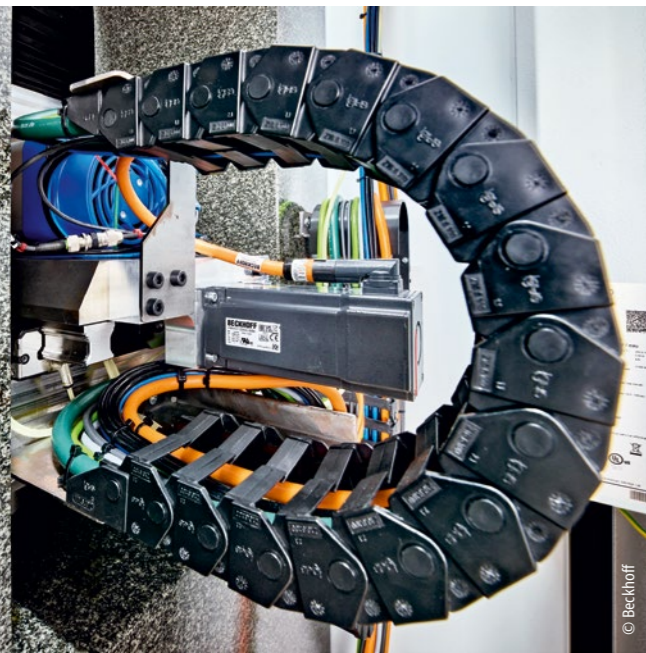
AM8000 servomotors position the tool spindle
dynamically in relation to the rotating workpiece.
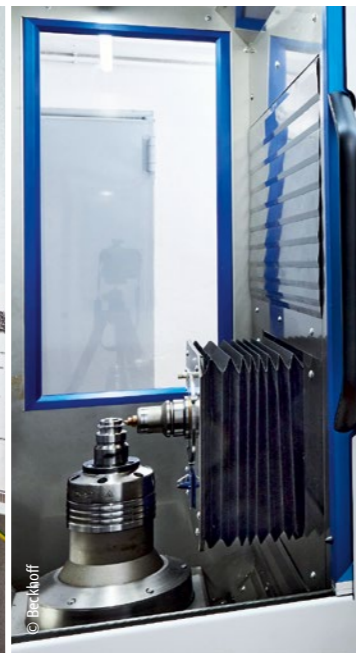
The tools and jobs are selected via a CP2916 multi-touch Control Panel,
which is connected to the CX5140 Embedded PC in the control cabinet.

The control center: AX5000 servo drive (bottom) and
CX5140 Embedded PC with EtherCAT Terminals (top).

Niklas Müller (left), Managing Director of Tec for Gears, and Dieter Völkle (right), Beckhoff Sales at the Balingen branch,
with gears that are chamfered in a manner true to contours in seconds on the RGC350 (Radial Gear Chamfering).

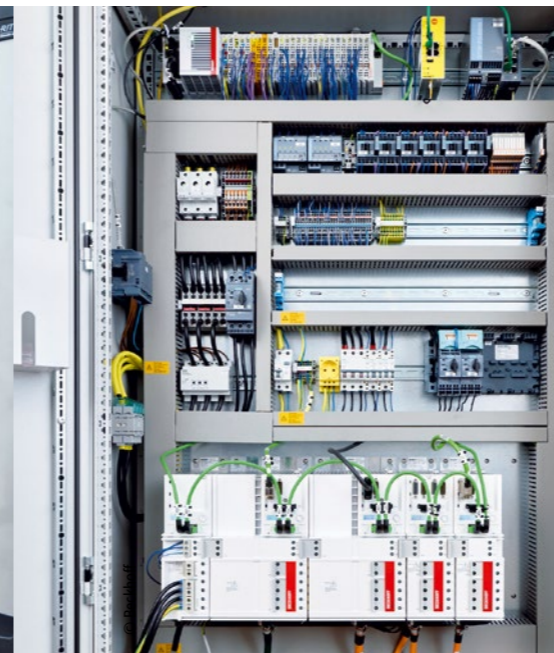During chamfering, a rotating cutting tool moves radially into a rotating gear, removing burrs on the gear contours. The aim is to create a precise chamfer on the tooth front edges. "The tool moves along the front of a gear, removing material in the process," explains Niklas Müller, founder and Managing Director of Tec for Gears in Furtwangen. This results in the continuous processing of components. This may not sound like a high requirement at first, but the process is demanding in terms of control technology. "Synchronizing the two axes – which are rotating at different speeds – with each other in a defined rotation ratio alone is a challenge," says Deter Völkle, member of the sales team at the Beckhoff branch in Balingen. This is because the spindle rotates at up to 17,000 revolutions per minute and the workpiece in the chuck rotates at up to 1,000 revolutions per minute. The rotation ratio of the two spindles is determined by the respective boundary conditions of the workpieces and tools.

CNC or cam plate?
Initially, it was not clear whether a CNC was required, whether cam plates were sufficient, and how quickly the tooth gaps had to be detected. In the end, the special requirements of the chamfering machine were achieved with TwinCAT 3 PLC/NC PTP, TwinCAT 3 NC Camming, and TwinCAT 3 Motion Control XFC, which run together with the TwinCAT HMI Server on a CX5140 Embedded PC with an Intel Atom® quad-core processor. "Dieter Völkle supported us with his expertise in designing the system right from the start," explains Niklas Müller.

Given that the gears are clamped in an unaligned position, the cutting tool and tooth gap must be precisely aligned with each other before machining. However, this should not significantly increase process times. The tooth gaps are therefore detected at a high speed. Depending on the number of teeth – the proximity switch used delivers two pulses per tooth – this results in a very fast signal sequence. To record these signals, TfG uses EL1258 EtherCAT Terminals

with a multi-timestamping function to achieve a sampling rate of up to 100 kHz and to transmit the sensor pulses to the controller using several timestamps. The exact position of the teeth are determined and the clamped product is verified at the same time.

In addition to the encoder signals of the rotation axes, the values of a linear measuring system for compensating thermal expansion are also incorporated into the synchronization and positioning of the tool. The synchronization between the tool spindle and the workpiece axis must be correspondingly stable – even when the machining forces are added during chamfering and at spindle speeds of up to 17,000 revolutions per minute. Volker Eschle, Sales at Tec for Gears, comments: "The continuous and fast rotation of the component and cutting edge enables our RGC350 chamfering machine to achieve very short cycle times while maintaining a high and, above all, consistent machining quality." TfG achieves the high repeatability with precise motion control from Beckhoff, AX5000 compact servo drives and AM8000 servomotors. "No other control manufacturer would have been able to automate our machine with such performance and precision with their technology," says Niklas Müller.

OEMs are demanding "clear-cut edges"
More and more OEMs and their suppliers are now demanding precise, defined chamfers on the tooth fronts and are writing "chamfering that is true to contours" in their design drawings. This is no longer possible using conventional deburring in the gear cutting machine, which produces a burr-free but sharp edge. This is why the industry needs radial chamfering technology. With automatic loading and unloading, the RGC350 can chamfer up to one million parts per year. As a rule, the machining time per gear is eight to ten seconds for the complete process which involves clamping the workpiece, detecting tooth gaps, axis synchronization, chamfering, unclamping.

The machine can be used to process virtually all types of gears ranging between 10 and 300 mm in diameter – even those with double or multiple teeth and interfering contours. Components with helical gearing can also be machined. A further spatial axis and coupling is then taken into account when calculating the curves to compensate for the helix angle.

HMI masks complicated technology
Niklas Müller states that, despite this variability, machine operators need no more than 10 min to retool the machine to fit a new gear. "All data for automatic chamfering is imported into the controls via XML," adds Dieter Völkle. The operator only has to call up the data set associated with the job in the visualization implemented with TwinCAT HMI and clamp the corresponding tool. This uncomplicated retooling process makes the RGC350 interesting not only for large quantities, but also for contract manufacturers with changing orders and small batches. "One of our customers was able to replace four manual workstations requiring two-shift operation with one machine and then instate the employees elsewhere," says Volker Eschle.

In order to convert processing speed into added value, most customers integrate the chamfering machine into their production processes with an automatic material feed and removal system. The flexible and open nature of PC-based control is demonstrated in such projects, which allows for the implementation of customer-specific adaptations. Extensions such as additional drive controllers and motors are easily and quickly implemented and integrated into the control program. "This flexibility helps us to implement our customers' ideas as well as our own, of course, without having to modify the basic concept," enthuses Niklas Müller. Another reason to rely on Beckhoff as a control partner is that they are always ready with advice in case of questions or problems and provide competent and solution-oriented support.

Efficient tool management
One development project concerns tool management. This is because each gear variant requires the right tool for chamfering, which TfG has manufactured in Germany based on the component dimensions. Depending on the variation of components, a customer has to manage a large number of tools and take their service life into account when planning orders. This helps them to make optimum use of the tools and to avoid producing faulty parts due to excessively worn tools.

Currently, there are tool life counters that can be created for each individual tool in the HMI. As long as each tool has been created with its serial number in the visualization, the machine setter can then choose a tool with a sufficient tool life to match the order size. "The component is often changed, but not the tool," says Volker Eschle. This results in a crash that causes unnecessary trouble for the customer. "We want to eliminate such mix-ups and avoidable errors in the future and optimize tool management," says Niklas Müller. "We'll definitely succeed with Beckhoff as our system partner."
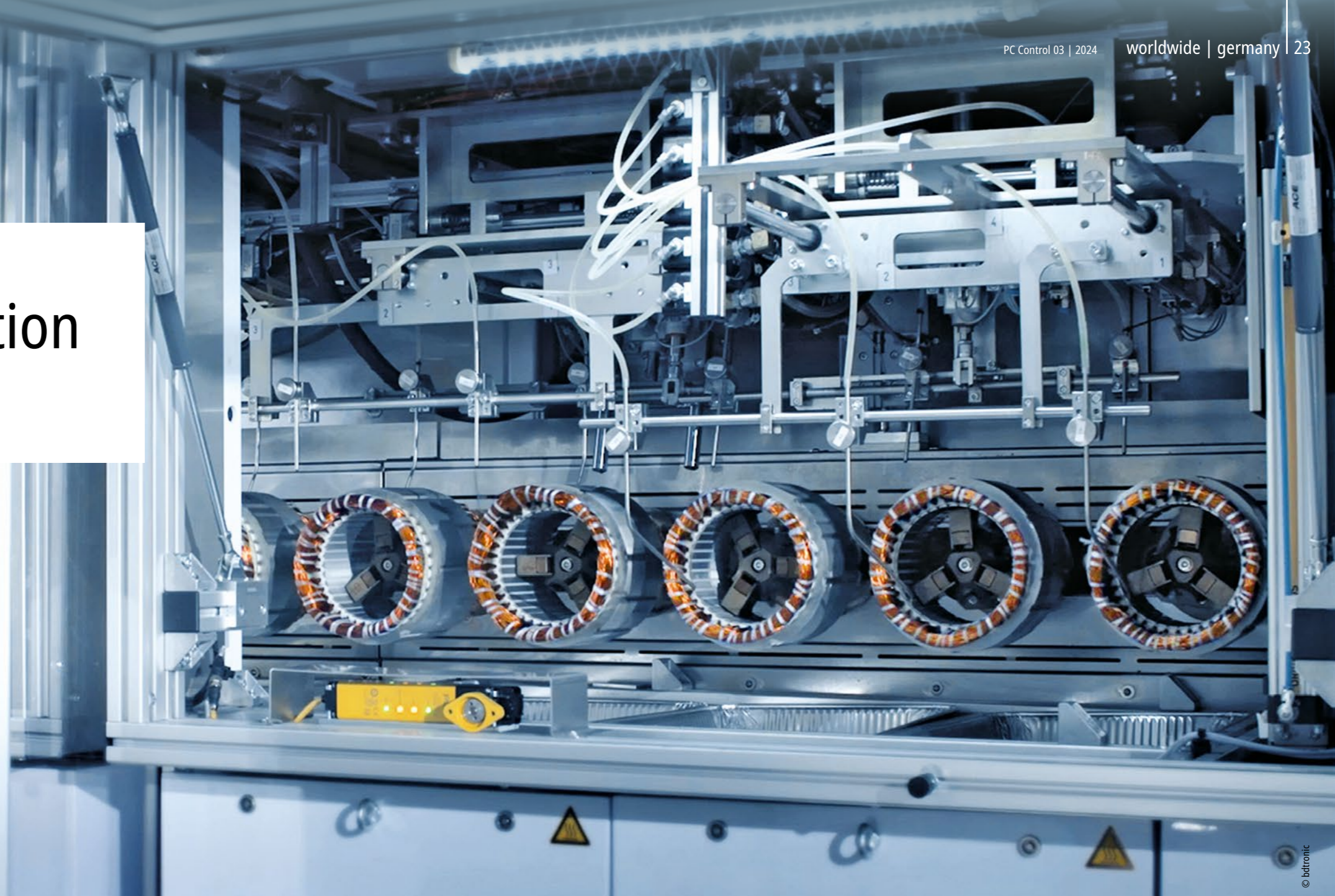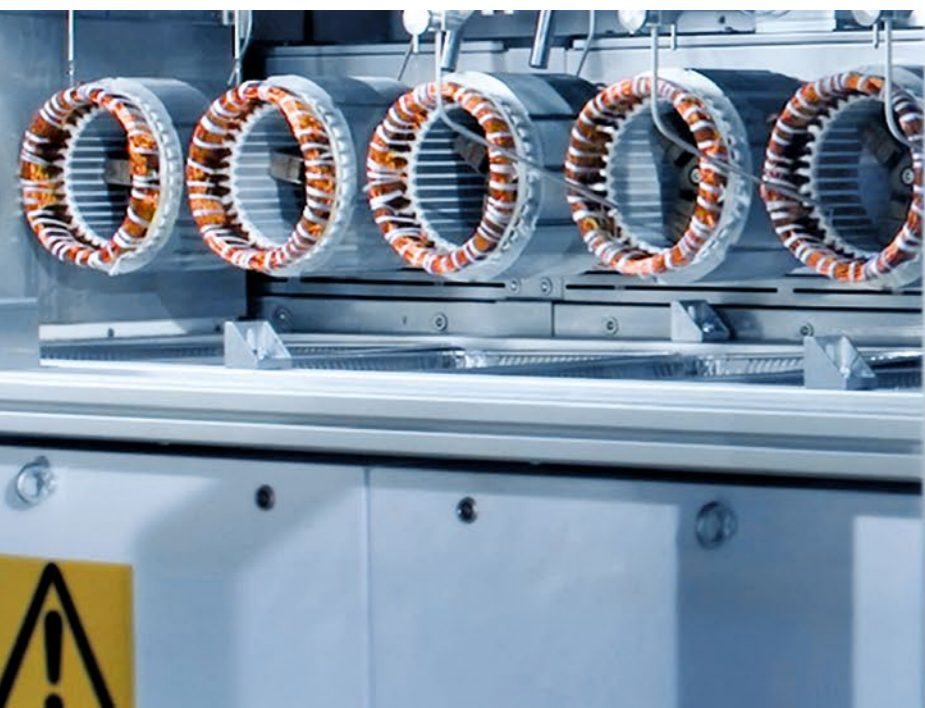
More information:
www.tecforgears.de
www.beckhoff.com/machine-tools

PC-based control for trickle impregnation systems in electric motor production

The perfect process solution for e-mobility

© bdtronic

Potting the windings is crucial for the performance and durability of electric motors. This is why many car manufacturers rely on impregnation systems from bdtronic. The process solution provider from Weikersheim combines its comprehensive process expertise in the dispensing, plasma, impregnation and heat staking technology into individual, cycle time-optimized systems with the help of PC-based control from Beckhoff.

The trickle systems for impregnating electric motors place high demands on the precise synchronization and positioning of many drive axles.

The higher the degree of filling of the impregnating resin in the slots of a stator/rotor, the better the thermal dissipation and mechanical stability of the motor winding, which, in turn can improve the performance of the electric drive. Therefore, to develop high-performance impregnation systems, system providers must possess in-depth process expertise about material preparation, dispensing and curing of resins. Manufacturing dispensing and impregnation systems since the seventies, bdtronic now boasts eight service and sales branches worldwide. More than 580 employees dedicate their time

to developing and producing machines and systems for the electronics industry, for the production of batteries for electric vehicles, and sensor technology for autonomous driving. The process solutions are used for single-component and two-component dispensing, prior plasma treatment, heat staking and impregnation for electric drives. "Nearly all of the world's leading OEMs produce their motors using trickle technology from bdtronic," explains Markus Rieger, Director of Indirect Sales and Marketing at bdtronic.

From dipping to efficient trickling

When dipping, the stators/rotors of electric motors are immersed in an open basin with resin until all cavities are filled. This is followed by an elaborate process of removing the resin from the bundle of laminations of the electric motors. "This is both cost-intensive and unsustainable in terms of material consumption and environmental and operator protection," explains Florian Schütz, Regional Sales Manager DACH at bdtronic.

In contrast, trickling is an impregnation process: The systems apply the impregnation material precisely and in the required quantity at pre-determined positions. The resin flows between the stator housing and the winding and hardens under defined process conditions. "We have developed and refined the trickling process as a sustainable and cost-effective alternative to the usual dipping process," emphasizes Andreas Olkus, Managing Director of bdtronic.

To further reduce the wiring effort required for impregnation systems, bdtronic will continue decentralizing with the help of EtherCAT Box modules in the future – similar to the systems from the Dispensing Technology Business Unit.

Picture below: Based on the modular system design, the AX8000 multi-axis servo system is installed in the control cabinets in question.

© Beckhoff

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The experts on site (from left to right): Antonia Anetzberger (Product Manager Dispensing Systems, bdtronic), Jörg Rottkord (Beckhoff Automotive Industry Manager) as well as Markus Rieger (Director of Indirect Sales and Marketing), Karsten Bauer (Head of Software and Electrical Design), and Andreas Olkus (Technical Managing Director, all bdtronic), Mirko Ammersbach (head of Beckhoff sales office Marktheidenfeld), Florian Schütz (Regional Sales Manager DACH) and André Hellinger (global head of development, both bdtronic).

The XTS linear transport system from Beckhoff is used in a production cell for heat staking electronic housings.

© Beckhoff

The main advantage for customer applications? The precise interaction of automation and dispensing technology. bdtronic's very own Technology Center is responsible for developing the process for large-scale production. The parameters determined by the center are transferred to large-scale production to build suitable system. "Our expertise helps to automate the process so that it works perfectly and is reproducible under a wide range of production conditions," says Global Head of Development André Hellinger.
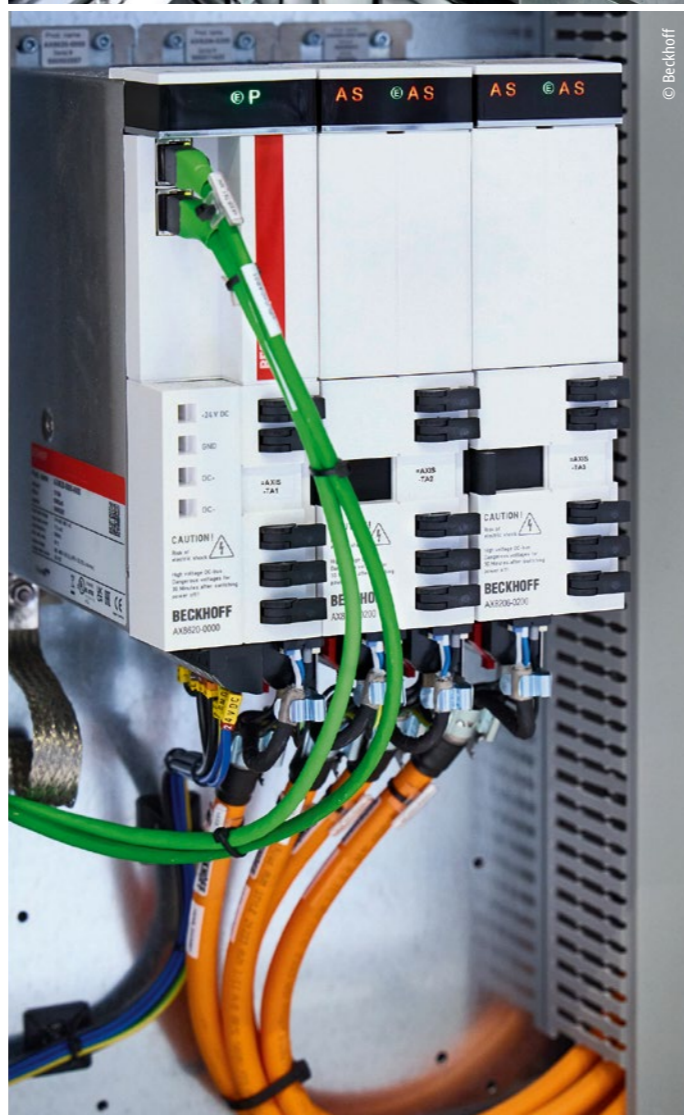
Sophisticated motion control

At the beginning of the overall process, a robot picks up three stators/rotors and fixes them onto tool holders. These holders are then guided via a transport chain through the roughly 13-m long system. In a first step, the stators/rotors are preheated to around 100 °C , before trickling begins at around 50 servo-controlled trickling stations. This is followed by gelling and curing zones with temperatures of up to 180 °C as well as final cooling zones. At the end of the system, another robot removes the stators/rotors and prepares them for the next processing steps.

To ensure that all grooves are completely filled and the resin does not drip, the stators/rotors must rotate continuously as they pass through the system. The sheer number of dispensing pumps and rotating tool holders on the chain alone are an indication of the sophisticated motion sequences that are implemented using the TwinCAT 3 software from Beckhoff. A challenging factor is that the chain expansion varies constantly in the different temperature zones. The dispensing needles are positioned with an accuracy of ±0.1 mm to the rotating stators/rotors.

In addition, the trickling station servo pumps must be controlled synchronously with the movements. Even the rotation of the stators/rotors is precisely controlled to maintain a constant rotation speed in the transport chain curves. "We have invested a lot of time and energy into the software and the motion profile in terms of positioning and component rotation in relation to the chain," emphasizes Karsten Bauer, Head of Software and Electrical Design.
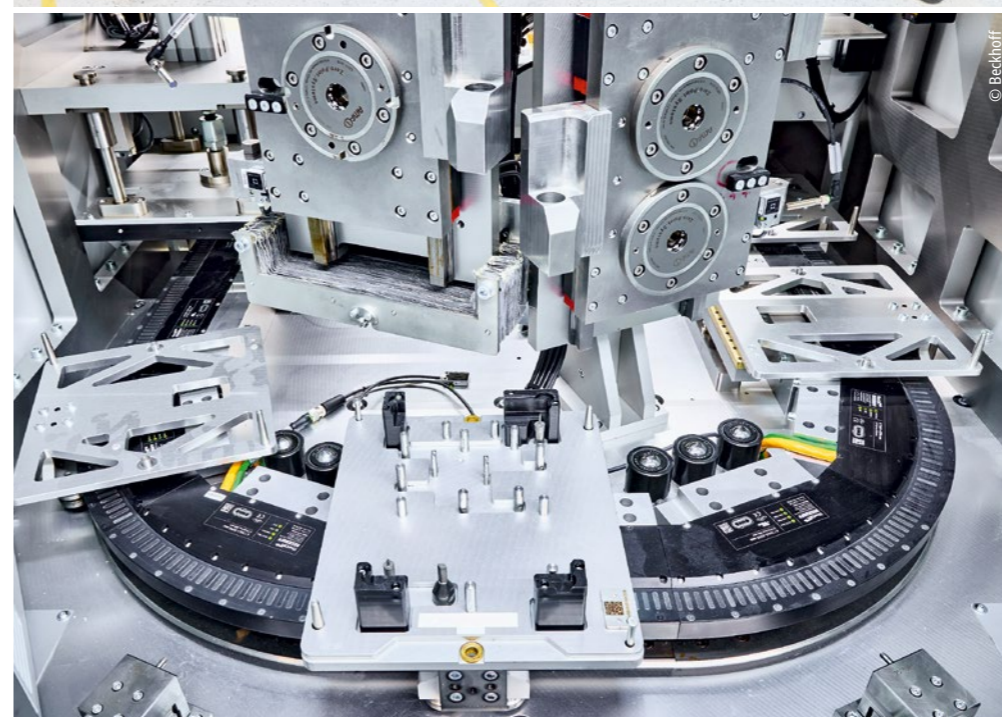
Keywords: tracking and tracing

"Temperature and dispensing quantity are very important factors for the perfect dispensing and trickling process," highlights Antonia Anetzberger, Product Manager for Dispensing Systems. bdtronic sets great store in being able to trace the complete process chain and offers maximum process reliability. This means that users know at all times where each stator/rotor is currently positioned in the system and the conditions under which it was impregnated. In addition, each stator/rotor is weighed before and after impregnation to document the amount of resin absorbed as a further quality criterion.

Customers can access such production data using a wide variety of interfaces or can directly connect the database to their own QM systems. "This is where the openness and the flexibility of PC-based control present an enormous advantage," says Mirko Ammersbach, head of the Beckhoff sales office in Marktheidenfeld.

Scalable in terms of hardware and software

Machine builder bdtronic relies on almost the entire range of Beckhoff components in its various systems and scales the computer hardware according to the performance requirements. Components such as CX2033 Embedded PCs, C6930 control cabinet Industrial PCs, and C6040 ultra-compact Industrial PCs are integrated into the dispensing, plasma, heat staking and impregnation systems. To minimize the systems' footprint, EtherCAT Box modules are used in addition to EtherCAT Terminals. "At the moment, system wiring and cabling still require a relatively large amount of space and time," says Andreas Olkus. Beckhoff supports decentralization with the MX-System, the pluggable system

solution for control cabinet-free automation as well as the AMP8000 distributed servo drive system, the AMI8100 integrated servo drives and the EP series EtherCAT Box modules.

Of equal interest are the XPlanar planar motor system for implementing new machine concepts, as well as Beckhoff Vision and ATRO (Automation Technology for Robotics). "If required, we can easily integrate these components into our control environment and adapt the performance of the industrial PCs to our liking," says Karsten Bauer, highlighting the advantages of PC-based control.

More information:
www.bdtronic.com
www.beckhoff.com/automotive

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Building automation enables autonomous operation of an airport terminal

Flying into the future of building management

Is a fully autonomous building mere science fiction? No, it is already a reality, as the Belgian ASL Group in Liège is proving with a state-of-the-art, 24/7 terminal for private flight operations. Beckhoff Solution Provider Boolean BV supported the implementation of this with end-to-end building automation.

The C6030 ultra-compact Industrial PC forms the core of the building automation.

© Philippe van Gelooven

The ASL Group's new airport terminal autonomously powers up the building technology as soon as an employee enters the building.

Raf Weerts, facility manager at the ASL Group, explains: "We only have one permanent employee here. The other staff are freelancers who only work when an aircraft arrives or departs. To ensure that they don't have to spend a lot of time powering up all the technology, the building starts everything automatically when an employee enters. As soon as no more movement is detected in the building, all systems – ventilation, lighting, heating, etc. – automatically switch back to sleep mode. This enables us to work in a very energy-efficient manner. In our energy-intensive industry in particular, we try to prioritize sustainability wherever possible."

Seamless integration for autonomous operation

The state-of-the-art building is the result of a tender by Liège Airport itself. The latter was looking for a partner to build and operate a new general aviation terminal. "And we were looking for an operations base in this region, so it was a perfect match," recalls Weerts. With 900 m² of office space and a 2,250 m² aircraft hangar, the building also offers state-of-the-art architecture. Inside, a large lounge can accommodate groups of up to 35 people, while a small, intimate lounge has space for three to four people. "It definitely has a certain charm," laughs Weerts, "but the real power lies within. The autonomous operation that we have achieved through the seamless integration of all technologies is amazing."

The ASL Group was not alone in this project. Through previous professional collaborations, Raf Weerts already knew owner Chris Briers and partner Thomas Nagels from Beckhoff Solution Provider Boolean and was aware of their extensive experience in implementing such a demanding project. "We were on the same wavelength right from the start. Beckhoff technology had to be the backbone of this entire system. Ultimately, open control technology is essential in order to bring together all the different signals and protocols." The KL4408 and KL6821 (DALI-2) Bus Terminals and the EL2809 EtherCAT Terminals as well as the TwinCAT Modbus TCP, Modbus RTU, and SMS/SMTP functions are used for this purpose.

The TwinCAT 3 controller coordinates the entire HVAC technology – from lighting, electricity, and charging stations through to the audio system. "Only access control remains in the hands of the airport. With any other automation platform, this would have required many more interfaces and much more integration effort. With PC-based control from Beckhoff, however, the openness and connectivity we need are already integrated into the system," explains Chris Briers.

The biggest challenge for the Boolean team was to implement the high level of usability required by the ASL Group. "Raf Weerts had a very clear idea of what a technical installation should look like; a vision of how the building should function. Turning this into a flowchart gave us a guideline that we could work

with and use to program the software accordingly," says Thomas Nagels. According to him, it was also crucial that sufficient flexibility was provided: "We also wanted to incorporate feedback from end users and be able to integrate new technologies or try out new things in the future – a living laboratory, so to speak." For Raf Weerts, the powerful monitoring visualized with TwinCAT 3 HMI is also important: "If something isn't going quite according to plan, I can easily log in, identify the problem, and solve it myself from my keyboard or explain what needs to be done to the people on site."

Proprietary platform with IPC and TwinCAT core
Boolytics, Boolean's proprietary platform, was vital in this project, as Thomas Nagels explains: "We can record and log real-time data on this platform. The use of a web dashboard visualizes the process very well with TwinCAT 3 HMI and provides the information on all data points in a clear overview. This tool also offers enough flexibility to strike the right balance between a high level of usability for the customer and the ability to go deep enough into the analysis." Raf Weerts clarifies his specifications as follows: "Everything is monitored in such a way that I have usually already called before the employees on site even detect there is a problem. For example, if the heating isn't working properly, I can take immediate action before the building cools down."

The heart of the entire control system is the C6030 ultra-compact Industrial PC from Beckhoff. It receives most of the data via bus systems or IP communication, collects it in the TwinCAT software, and transfers it to Boolytics. "Transparency on both sides is what makes Beckhoff the right technology partner," summarizes Chris Briers. And that doesn't just mean in Liège – because the

responsible facility manager, Raf Weerts is pushing to equip all buildings with Beckhoff technology: "Not every building has the same technology, but you can still standardize operations and always use the same structure. This is much more convenient for the end user and means that more options are available for sharing energy, for example. By having the PLCs for the different locations communicate with each other, it's easy to see when it's the best time to switch on the large energy consumers."

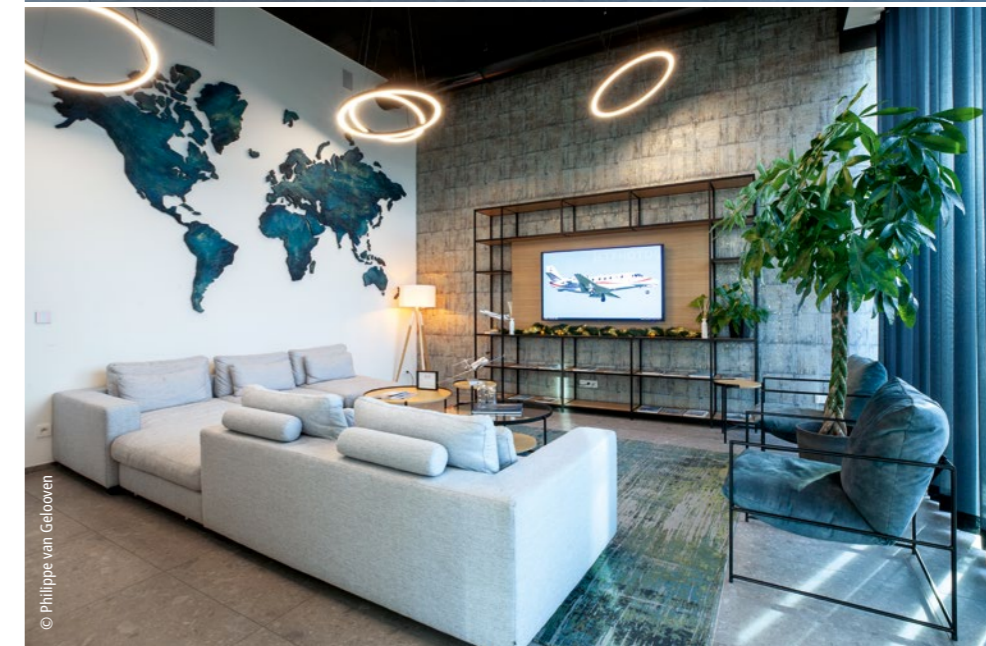**2030 building standards already implemented today**
In terms of its overall energy performance, the building is ahead of its time. Raf Weerts explains: "In terms of insulation, glazing, etc., we have followed the 2030 standards. After all, you can only insulate once. So you have to do it right. A VRF (Variable Refrigerant Flow) heat pump with an output of 32 kW can now keep the entire office building at the right temperature. We also don't need a room temperature of 23 °C. Guests who come here only have to spend five to ten minutes in the building and can keep their coats on, for example. Yet consideration has been given to ensure that employees also make themselves comfortable – if necessary, the room temperature can be quickly increased using a boost button."

Boolean's programming work has paid off, particularly in terms of energy efficiency, as Chris Briers explains: "We have really immersed ourselves in this subject. The manufacturers' conventional configurations have all been revised. Everything has been set and parameterized internally." Thomas Nagels adds: "With this building, we have clear proof that our operation is more economical, because we carry out very extensive monitoring – including via

Beckhoff Control Panels. We even keep an eye on the intermediate steps in the arrangements. This allows us to see exactly where the process can be optimized further." Experiments have already been carried out on the heating curve settings to see what effects adjusting the parameters has, how the end result is affected, and whether the effort involved in making the changes is worthwhile.

As a Beckhoff Solution Provider, Boolean required very little support. Nevertheless, Chris Briers makes special mention of the support provided by the automation specialist. "The experts from Beckhoff Belgium are very responsive and are always easy to reach if necessary. The longer you work with PC-based control, the less support you need. However, the support team is on hand if required and also suggests new technologies and products. In our view, it is particularly important that Beckhoff technology also offers a high level of stability despite all the innovations. Spare parts are still available for solutions that were installed more than a decade ago. This is robust, industrial-grade technology – I could use the same IPC that controls the building management here to also control a sophisticated production process. So there is no shortage of computing power and therefore no limit to what we can achieve with this building in the long term."

The experts on site (from left to right): Philip Neyens (support engineer from Beckhoff Belgium), Thomas Nagels (partner at Boolean), Bert Cuypers (account manager from Beckhoff Belgium), Chris Briers (owner of Boolean), and Raf Weerts (facility manager at the ASL Group)

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Above: The large lounge offers a clear view of the airfield.

Center: A small, more intimate lounge offers space for up to four people.

Bottom: A web dashboard implemented with TwinCAT 3 HMI illustrates the process particularly well and simplifies access to requested data points.

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More information:
www.aslgroup.eu
www.booleanbv.be
www.beckhoff.com/building

PC-based control enables innovative separation of recyclable materials

Small EtherCAT Terminal with great benefits

There is still plenty of scope to achieve more automation, efficiency and quality in recycling, the circular economy and sustainability. This is demonstrated in a plant realized by Belgian specialist machine builder Absolem Engineering which features an innovative process for separating recyclable materials. Using PC-based control and, in particular, the EL5131 EtherCAT Terminal from Beckhoff, a major problem has been elegantly solved: the generation of different signal sequences for the exact synchronization of different camera systems.

Absolem Engineering has been pooling the expertise in special-purpose machine building and laser technologies of the former Philips production facility in Turnhout, Belgium, since 2016. The company's activities include process research in the field of laser technologies and the construction of machines in which lasers create added value. Customers include ASML, a leading company in semiconductor technology. "We believe that we can make a difference with our expertise," emphasizes Herman Van Dijck, technical operations manager.

The company has put this into practice this in a project for VITO, an independent Flemish research organization in the area of cleantech and sustainable development. "VITO has developed a fascinating technology

The battery sorting plant automated with PC-based control is the first to use a process based on three camera systems to analyze the flow of recyclable materials.

The CX2033 Embedded PC (top, with attached EtherCAT Terminals and alongside the CU8110-0120 UPS and the PS2000 power supply) serves as the control computer; extensive safety monitoring is implemented with an EK1960 TwinSAFE compact controller (bottom) and additional TwinSAFE Terminals.

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From right to left: Herman Van Dijck, business unit manager at Absolem Engineering, in front of the innovative sorting machine with his colleagues Luc Vermeylen (automation systems architect), Steph Collart and Dirk Debacker (both from the mechanical design team) as well as Dimitri De Keyser (Beckhoff system integrator at AASYS) and Enzio Cominotto (account manager at Beckhoff Belgium).

© Beckhoff

The sorting plant can be conveniently operated via the customer-specific multi-touch control panel from Beckhoff.

EL5131 as a precise pulse divider

Absolem Engineering's project involved the challenge of precisely synchronizing several cameras, each with different pulse counter inputs, with the speed of the conveyor belt. The belt speed is captured via an incremental encoder (5 V DC A/B), whose pulse sequence varies between 0 Hz and 65 kHz. The problem, however, is that the counter inputs of the camera systems can only process lower frequencies. A solution therefore had to be found to divide the original pulse sequence of the encoder – in a ratio of 1:4, 1:5, and 1:7, depending on the camera type. Yet the duty factor of 50 % was not allowed to change. The maximum delay between the pulse sequence of the encoder and the pulses forwarded to the cameras had to stay within 10 µs in order to ensure precise synchronization.

The EL5131 EtherCAT Terminal therefore takes on a central task in the sorting plant. It records encoder signals at up to 5 MHz (RS422), 1 MHz (TTL), and 100 kHz (open collector), and has two fast digital outputs (T_{on}: 3 µs, T_{off}: 4 µs). Eight threshold values and corresponding output states can be configured for each output and saved in the terminal. If the counter reaches one of these threshold values, the output issues the corresponding value – regardless of the PLC cycle time and EtherCAT frame rate. The outputs switch extremely quickly and can therefore generate the different pulse sequences for the camera systems.

More information:
www.beckhoff.com/el5131

for classifying waste streams," says Van Dijck. The idea behind this is simple: The better able you are to identify each individual element, the easier it is to separate and recycle the components.

VITO records and categorizes the components of a material flow on conveyor belts using a color camera, a 3D laser scanner, and an X-ray machine. Machine learning is used to identify individual particles in a material flow and assign various parameters, such as material class, shape, or texture. This creates a digital twin of each particle.

Battery sorting with a digital twin

To test the theory in practice, VITO and a battery sorting company considered how this concept could be implemented in an industrial, automated process for sorting batteries. A tender was issued to find a machine builder who could put the algorithms developed by VITO into practice. This is where Absolem Engineering and AASYS come into play. Together with Luc Vermeylen from Absolem Engineering, who developed the automation concept for the machine, Dimitri De Keyser from AASYS was responsible for implementation and programming. As an official Beckhoff Solution Provider and long-standing partner of Absolem Engineering, this partnership was built on solid foundations.

The plant was designed to distinguish and sort a total of seven different battery types based on their chemical composition. Herman Van Dijck explains: "Our preparation process included several workshops with all those involved, in which we identified possible solutions and evaluated those that were most

effective and efficient." 18 months later, the first functional prototype of the sorting plant was delivered to the battery sorting company. The process is as follows: A conveyor belt transports the batteries to the sorting plant. To prevent X-rays from getting out into the external environment, the batteries are routed in a tunnel via a bend to the detection and sorting area. The length of the area and the speed of the belt were dimensioned so that there was enough space and time for the 3D camera, X-ray system, and color camera to capture the batteries. In a first run, the batteries are roughly separated into the categories "good" and "bad." In a second sorting process using more detailed algorithms, they are then sorted into the seven categories.

Precisely synchronized through PC-based control

As Absolem's laser technology is based on Windows and VITO also uses a separate Windows PC to characterize the material flows, both could be easily integrated with PC-based control to create a high-performance automation solution based on TwinCAT 3. "We rely on Beckhoff for the automation of our machines, not only because of the products and technologies they offer, but also because of their employees," says Van Dijck, as he explains the project's biggest challenge – the timing of the three different camera systems. The reason this was so tricky was that each camera required different frequencies and cycle times for synchronization. The first idea was to synchronize the three systems via the software in the PLC. However, the timings were so critical that this could not be implemented even with the PLC's shortest cycle time. "Absolem therefore needed a hardware solution," says Philippe Henin, support engineer and product specialist I/O at Beckhoff Belgium.

"Philippe Henin suggested using an EtherCAT Terminal that had not yet been officially released when the project started, but which met the requirements perfectly," recalls Van Dijck: the EL5131 EtherCAT Terminal for incremental encoders with differential or single-ended signals. "What makes the EL5131 so special is the two fast digital outputs," states Henin. The outputs can be configured so that the levels change depending on the position values of the encoder and also several times between two PLC cycles. This results in only a minimal phase shift between the encoder position and the output signal generated for the camera. With this solution, Absolem is able to generate and output the different clock signals for each camera – at a belt speed of up to 500 mm/s. Van Dijck adds: "We received a lot of support from Philippe Henin and Product Management I/O in Germany to set all the parameters of the EtherCAT Terminals correctly." This enabled Absolem to build a sorting plant for VITO and the battery sorting company that is ideally suited to the application of the new process. However, the success story does not end there: the company wants to learn from its experiences "on the job" and further optimize the system: "Recycling, the circular economy, and sustainability are important values for us. We are pleased that we can make a contribution to a better society," says Van Dijck.

More information:
www.aasys.eu
www.absolem.be
www.vito.be
www.beckhoff.com/ethercat

EtherCAT and PC-based control elevate next-generation laser cutting machine

Scalable for the future with fully integrated, open control technology
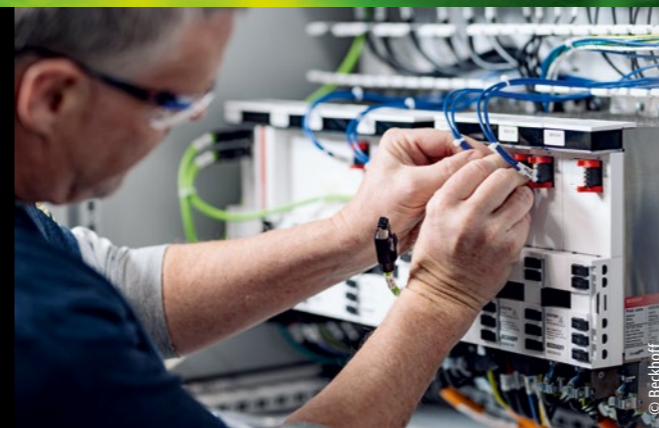
The AX8000 multi-axis servo system delivers high-end motion control, cuts space requirements and simplifies installation.

© Beckhoff

Cincinnati Incorporated (CI) has been building sheet metal processing equipment for 125 years and continues to support its durable machines for decades. The company is able to do this because it develops everything in-house, from the hardware to the software. However, the further development of proprietary control technology became too costly and challenging to support. Since the switch to PC-based control, the only limits to development have been physical, according to the engineers at CI.

The CLX laser cutting machine delivers reliable, high-precision and high-throughput CNC metalworking, which is critical for keeping contract manufacturers up and running at maximum capacity.

© Beckhoff

Cincinnati Inc. from Harrison, Ohio, has remained at the forefront of metal-working. The reliable, high-performance equipment for bending, shearing, laser cutting and more has made the company an iconic American machine builder brand. At Cincinnati Inc., the "Own It" philosophy guides every aspect from product development and sales to long-term service and support, according to Matt Garbarino, Business Unit Leader – New Machinery Sales. "Machines that we shipped decades ago are still in service and, in many cases, supported," Garbarino says. "We still make spare parts for equipment from the 1940s. Of course, supporting both new and old equipment presents challenges."

Growing pressure for innovation
With the CLX Fiber Laser System, CI needed to design more than its next generation of a laser cutting machine. Most importantly for its customer base – about one-third OEMs, two-thirds job shops – the CLX needed to be fast, intuitive and dependable. Downtime is unacceptable for laser cutting systems as it creates a domino effect across an entire manufacturing facility. "If the lasers go down, you also have to send press brake operators home, and then in a number of hours, you have to send welders home," says Troy Wilson, Product Manager at Cincinnati Inc.

"In the '80s and '90s, we led the market as one of the first U.S. laser cutting machine builders. But back then, the pace at which we had to add features, remove features or change how we did things typically took about three years. Today, it's 6 to 18 months," Wilson says.

Today, machines are increasing in complexity, for instance by adding handling systems between metalworking processes to feed material and remove completed parts. However, CI's legacy motion control system from a previous vendor lacked scalability and used programming languages outside of IEC 61131-3 standards. This slowed development and shrank the talent pool for recruiting new engineers.

In addition, CI's customers regularly wanted to adapt machines – for higher wattage lasers or other features. While competitors would require customers to buy a new machine, CI faced excessive, labor-intensive efforts to accommodate such requests. So a future platform would need to be flexible to connect and disconnect devices and easily change parameters in software.

Always cutting-edge technology
The CLX Fiber Laser System leverages a C6030 ultra-compact Industrial PC (IPC) to control the entire CNC machine. The scalable machine controller offers ample processing power combined with flexible interface options. Above all, it eliminates the previous obsolescence struggles. Beckhoff designs its PC-based controllers and software to be backwards compatible and accommodate future technology developments as well.

"A major advantage that drew us to Beckhoff was the promise that we'd no longer have to worry about controls obsolescence. Beckhoff takes care of it for customers," Matt Garbarino says. "With Beckhoff, IPC upgrades are just a natural progression in product development. When we built our own CPUs, it was paralyzing when chips and other components expired. To have a vendor deal with all that for us is a game changer."

A choice of modern programming standards
As a universal engineering and runtime platform, TwinCAT 3 automation software also ensures future-proof scalability. From IEC 61131-3-compliant PLC languages with their object-oriented extensions to custom and predefined function blocks to computer science standards, TwinCAT's integration into Microsoft Visual Studio® empowers engineers to program in the languages that best fit the application. This was a major step ahead from the previous vendor's proprietary script.

TwinCAT Scope, the software-based oscilloscope, has helped with debugging. Another advantage is TwinCAT's no-cost engineering environment, with

a license required only at runtime. "It doesn't cost me anything to create prototype systems in TwinCAT," says Zackary Bischoff, Electrical Engineering Manager at Cincinnati Inc. "And with the coding flexibility, I regularly copy and paste software modules from one program to another."

Access to the controls during machine operation has become even more intuitive via the user interface on the CLX. Operators and maintenance personnel don't have to dig through outdated Ladder Logic to troubleshoot or make adjustments to the machine. A dual-screen 24-inch CP3924 Control Panel installed on a mounting arm offers a generously sized, sleek interface customized with Cincinnati Inc. branding.

Flexible automation with EtherCAT
The EtherCAT industrial Ethernet system and servo drive technologies from Beckhoff further enhanced performance and scalability. Beyond fast real-time communication, EtherCAT delivers free selection of network topology, and handles up to 65,535 nodes in a single network. As an open protocol, it simplifies connection to other industrial communication protocols. CI also uses TwinSAFE to add functional safety in the same I/O segment as non-safety equipment.

"We use a wide range of EtherCAT I/O modules from Beckhoff," Zackery Bischoff says. "The hot connect capability – to plug and unplug EtherCAT equipment in ongoing operation – has been very powerful, especially with our automatic nozzle changer (ANC). That flexibility will be even more important as we integrate robots and possibly even a press break in a comprehensive manufacturing line."

The AX8000 multi-axis servo system delivers a powerful motion control solution in a space-saving form factor. The dual-channel drives can power two AM8000 series servomotors each, and One Cable Technology (OCT) means a single cable can provide power and feedback signals to the motors. Beyond that, the Beckhoff servo solutions provide high dynamics and precision.

"With our previous machines, the limitations were with control hardware and networking. That is no longer the limit," Troy Wilson says. "Now, our limit is physics."

Own it – for generations to come
The CLX Fiber Laser System has achieved incredible results, but the engineering team isn't stopping there. The second-generation machine will launch in late 2024.

The inherent ability to transmit machine data to the cloud using PC-based control feeds directly into Industry 4.0 initiatives at Cincinnati Inc. The company's software solutions, including those for cloud-based machine monitoring, can pull performance and diagnostic information directly from a connected CLX, according to Paul Frederick, Associate Director of Engineering at Cincinnati Inc. Engineers can log in remotely, see what's happening via three machine vision cameras inside the cutting cell or use TwinCAT Scope for further analytics.

"In the design process and performance evaluations, managing data access from the Beckhoff controls was an order of magnitude easier for us, so we could optimize performance," Frederick says. "We could graph any parameters from the machine in real time."

The engineering team expects to simplify programming and support by standardizing on Beckhoff going forward. As manufacturing equipment begins to work together, rather than operating as islands of automation, Les Rogers, Director of Engineering at CI, sees modularity as key. "Rather than relying on dedicated boards that we've built in-house with a vertical manufacturing strategy, we now have a modular platform that could deploy across all facets of our business," he says. "Modularity also supports how we give upgrade paths for existing equipment. We have a great foundation to support all our customers far into the future."

© Beckhoff

A custom, dual-screen CP3924 Control Panel from Beckhoff offers an intuitive and modern operator interface.

View into the CLX Faber Laser System with several EtherCAT Terminals installed in a decentral switch box

The CLX Fiber Laser System is a next-generation CNC solution from Cincinnati Inc. and combines 125 years of mechanical engineering tradition with ongoing technological development that's geared toward the future of metalworking.

More information:
www.e-ci.com
www.beckhoff.com/sheetmetalworking

Ready for series production in electrochemical machining with PC-based control

Creating complex components atom by atom

PECM (Pulsed Electrochemical Machining) is a fast corrosion process that can form complicated geometries atom by atom. It is therefore ideal for the precise manufacturing of metal parts for high-tech applications. To integrate the core process into a fully automated, high-throughput production line, Voxel Innovations and Palmetto Mechatronics relied on the open PC-based control technology from Beckhoff.

A gantry moves trays of product through
various baths before and after machining.

Daniel Herrington, CEO of Voxel Innovations, was working for the U.S. Department of Energy's Advanced Research Projects Agency–Energy (ARPA–E) when he had a realization. "Manufacturing underpins most major advances in technology, whether it's in the energy industry, medical device or aerospace. I realized I wanted to work in manufacturing, and I saw that electrochemical machining had significant untapped potential."

Founded in 2015 in Raleigh, North Carolina, Voxel is now an established provider of pulsed electrochemical machining (PECM). Using machinery developed in-house, the company offers contract manufacturing to support customers across the U.S. These are operating in aerospace, medical device, energy and other industries that need highly engineered, metallic components in large quantities.

© Beckhoff

A SCARA robot unloads trays of product
and routes pieces for inspection.

One of the first hires at Voxel seems unconventional at first glance. Previously electrochemist Dr. Omar Yepez worked to protect offshore equipment against rust for as long as possible. Now, Daniel Herrington wanted him to do the opposite for Voxel. That's what PECM is, after all: very fast, highly targeted corrosion that shapes intricate, high-quality geometries atom by atom. "The PECM process is non-contact and non-thermal, so it can create thin-wall geometries with intricate features without deforming the part. With it we can produce parts that traditional manufacturing processes can't handle as economically or, many times, couldn't make at all," Daniel Herrington says.

To continue its growth trajectory, Voxel needed to implement a more sophisticated automation platform for their system that would scale to support increasing production volumes. After extensive vendor research, they selected Beckhoff. This decision also led them to Robert Belk, Jr., Owner and Automation Consultant at Palmetto Mechatronics in Greenville, South Carolina. Working together, the teams at Voxel, Palmetto and Beckhoff developed an automated production line with integrated robotics and inspection capabilities.

Product handling and quality control built in
In the line, the parts are first separated, and then a SCARA robot loads them onto a tray. A gantry moves the tray through pretreatment baths. Next, an articulated robot grabs multiple workpieces and inserts them into the PECM cell. Inside, the tooling lowers into place, and an electrolyte solution fills the minute gap between the tool and the part. By applying the correct voltage potential, the system dissolves metal through electrolysis. Simultaneously, the electrolytic fluid also acts as a flushing agent that removes waste material and any residual heat. Afterward, the robot unloads the machined parts onto a separate tray. A second gantry then takes them through post-treatment baths and a drying chamber. Finally, another SCARA unloads the trays, while routing parts to an inspection station with Micro Epsilon optical gauges.

The sophisticated operation requires fast cycle times and exact synchronization between different processes. On top of that, interfacing with databases, connecting to web-based platforms to extract data and straightforward integration with third-party devices were all considerations.

Automation software solves tough challenges
Robert Belk worked with Voxel Controls Engineer Kevin Judd to program the machine using Beckhoff TwinCAT 3 automation software. TwinCAT enables engineers to program in whichever language best suits their skillsets and the needs of the application. Belk relied on Structured Text, along with C# for HMI customization.

Beyond standard PLC functionality and running PID loops for process sensors, several other TwinCAT functions proved crucial, including:
– ADS communication between the machine logic and a custom Windows .Net application for interfacing with the optical measurement device and HMI
– PTP motion control library, for instance, to drive ball screw actuators with 13 Beckhoff AM8100 servomotors, which raise and lower the PECM tooling

– database connectivity with TwinCAT 3 Database Server for high-speed connection to a custom database for Work-In-Progress (WIP) control and determination of key performance indicators

"This system requires real-time interaction with an MS-SQL database. Each part is assigned a virtual serial number when placed into the first tray, and that is updated throughout each step of the process," Robert Belk says. "The part data is very important for determining machine tool wear or damage and optimizing the machining process. The Beckhoff database client software enables very fast execution of stored procedures from within the TwinCAT control software."

Precision control for precision machining
The PECM production line at Voxel uses a CX2042 Embedded PC running TwinCAT as the central machine controller. The CX2042 with directly connected EtherCAT Terminals communicates with the three robots, optical gauges, MS-SQL database and hosts the HMI program. Equipped with Intel® Xeon® multi-core processors, it provides the necessary computing power for short cycle times.

On the networking side, EtherCAT provides fast real-time communication and a flexible topology. EtherCAT Terminals installed on the articulated robot control the end-of-arm tooling with valves and sensors for 24 sets of grippers. Also, EL7211 servomotor terminals provided space-saving 48 V DC servo amplifiers for the AM8100 servomotors. TwinSAFE hardware as well as capabilities built into the robots enable the implemention of functional safety over the EtherCAT network.

Innovative automation for high volume production
After a year of development time, the automated PECM production line went live in June 2023, and is producing roughly four million parts a year. Voxel has hit the performance benchmarks set in the design phase. The system offers complete visibility into quality control data, pH levels, etc., providing traceability to comply with standards like AS9100 in aerospace and ISO 13485 in medical device manufacturing. In addition, it can pause production and alert the operator if anything falls out of tolerance.

"Whether it's a part for a jet engine, an implantable medical device or a heat exchanger for an energy application, our vision is to offer customers differentiated technologies that help them optimize performance and cost metrics," Daniel Herrington says. "Then we want to support them all the way through that process and throughout the product life cycle. Our model is to be that trusted engineering development and volume manufacturing partner." And the demand proves him right: The company continues to run production around the clock in three shifts to keep up with orders.

At Voxel Innovations' facility in Raleigh, North Carolina: (from left) Jack Plyler, Application Engineer, and Chuck Padvorac, Sales Engineer (both Beckhoff USA) as well as Daniel Herrington (CEO at Voxel); Robert Belk (Owner of Palmetto Mechatronics) and Kevin Judd (Controls Engineer at Voxel)

Beckhoff AM8100 servomotors with ball screw actuators to raise and lower the PECM tooling with maximum precision.
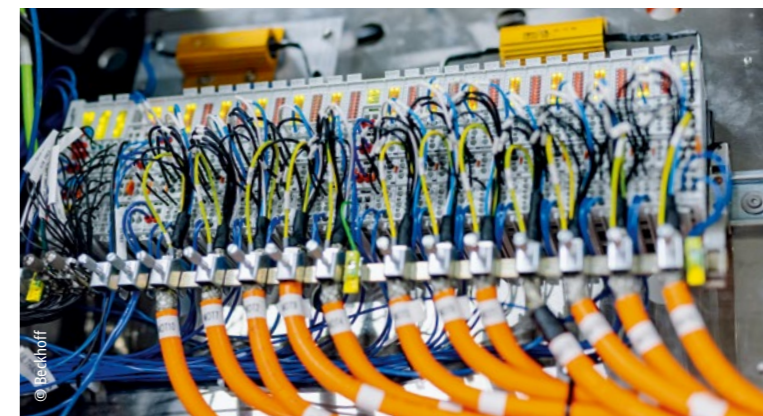
Within the EtherCAT I/O system, EL7211 servomotor terminals from Beckhoff provide space-saving 48 V DC amplifiers for the AM8100 servomotors.

More information:
www.voxelinnovations.com
www.palmettomechatronics.com
www.beckhoff.com/twincat

PC-based control for the installation of wind turbines in any weather

Fast control technology reliably compensates for rotor blade movements caused by wind load

According to Danish company Seasight Solutions, the entire industry is talking about a real game changer in the field of wind-turbine installation. This innovative new approach uses human-sized propellers to compensate for wind loads and keep the rotor blades precisely in position in relation to the hub, allowing the huge components to be assembled safely and quickly without hauling ropes – even on stormy days. However, a sophisticated control concept and real-time-capable automation technology are needed to make this possible, which is precisely where PC-based control from Beckhoff comes into play.

© Seasight Solutions

The autonomous positioning system (APS) from Seasight Solutions reduces the number of forced breaks caused by adverse weather conditions during the installation of wind turbines.

A high-performance automation platform is needed to keep the positions of the rotor blades precisely in place – even in strong winds. Seasights Solutions have found the ideal control solution for this in the form of PC-based control and TwinCAT.

Mads Susgaard, Head of Automation Technology at Hvide Sande Shipyard A/S: „The C6015 ultra-compact Industrial PC, together with the EtherCAT and TwinSAFE Terminals, facilitates short cycle times of under 1 ms.

Wind turbines are getting taller, rotor blades are getting longer, and the number of turbines being installed is increasing. With this in mind, it goes without saying that fast and safe installation is essential, no matter from which direction or how strong the wind blows, or whether the wind turbines are to be installed near a lake or in the middle of a forest. "Today's rotor blades are mainly still stabilized with the taglines used to lift them up perpendicular to the ground," explains Mads Susgaard, Head of Automation Technology at Hvide Sande Shipyard A/S in Denmark. The problem is that traditional installation aids are difficult to use at sites like this, plus the potential for bad weather often wreaks havoc with scheduling.

Seasight Solutions A/S, a spin-off of Hvide Sande Shipyard, has now resolved these problems with its autonomous positioning system (APS), which was developed together with the wind turbine manufacturer Vestas Wind System A/S. "We use propellers to stabilize the momentum of the blades, ensuring safe lifting and stable positioning," emphasizes Mads Susgaard.

Maximum positioning precision for rotor blades
No matter how cold or hot it is, whether a storm is raging, or what the terrain is like where the rotor blades are to be raised to the nacelle, the APS stabilizes them virtually on autopilot and with defined switch-on and switch-off points. "You would normally expect to use custom electronics for this task," notes the automation expert, "but with TwinCAT and PC-based control, we have flexibility and can change the software at lightning speed as required." The control continuously logs all data, which the control system then uses for navigation. The result is impressive: even at wind speeds of up to 14 m/s (wind force 6), the rotor blade is stable and precise in the wind. This makes the crane the limiting factor; the crane safety limit is usually 12 m/s. This also increases the number of possible working days by up to 50 percent, since poor visibility and excessive wind no longer present obstacles. "This means huge time and cost savings for wind energy companies," enthuses Mads Susgaard, pointing out the enormous benefits of the APS.

The patented system has been tested with 85-meter-long rotor blades, but it can also be scaled to blades measuring just over 100 meters. The solution has also been tested in tough terrain in northern Norway and northern Finland, where the cold conditions and topology of the terrain present real installation challenges. In the meantime, well over 1,000 components have been hoisted into place at their locations and assembled using the APS.

Flexible and high-performance with PC-based control
From the propeller to the software, Seasight Solutions manufactures everything in-house and counts on Beckhoff Automation Technology. Powerful industrial PCs and TwinCAT software are at the heart of this solution, ensuring crucial accuracy and stability. This is because a high level of computing and processing power are required to calculate the position of the rotor blades at lightning speed and to take corrective action via the propellers or their motor speed. "The impressive thing about the control system is that the PLC estimates the position of the APS in real time," explains Mads Susgaard. At a frequency of over 1 kHz, to be precise. The speeds of the propellers are controlled on the basis of these scans. According to Mads Susgaard: "When we made the first prototypes, we were set no limits in terms of performance in order to obtain the short cycle times needed for position control." Ultra-compact industrial PCs, such as the C6015, have emerged as optimal computers.

For current and future automation tasks, standardized, user-friendly software is vital for Seasight Solutions. "TwinCAT is our software of choice for programming and real-time control. When our customers order a customized, high-tech solution from us, this also includes our commitment to monitor performance and continuously optimize it continuously within the framework of multi-year cooperation agreements," declares the automation expert. This requires 24/7 support via regional service partners and reliable remote maintenance. After all, wind turbines are often installed in locations which are far from the nearest service base. "To ensure that the APS not only works, but also helps operators meet their tight schedules and avoid costly delays, robust diagnostic software and connectivity to both the support center in Denmark and the various service teams are needed," says Mads Susgaard.

To date, the company has 25 APSs in operation worldwide – in Europe, the USA, Australia, Africa, and Vietnam. The goal is to sell 50 units per year. Plenty of other industries stand to benefit from this solution, too, as the APS can also hold lifting containers, construction elements, and precast concrete parts precisely in position. "We have huge expectations for the APS – both locally and globally, and both within the wind industry and beyond," concludes Mads Susgaard.

More information:
www.seasightsolutions.com
www.beckhoff.com/wind

For every online retailer, warehouse logistics is part of the critical infrastructure: If the conveyor lines come to a standstill, it generally won't be possible for any more packages to get out. To prevent this, an Australian office equipment supplier has retrofitted the warehouse logistics installation of its central warehouse. In its role as project manager, Layer Seven Automation replaced the proprietary decentralized controllers of the conveyor lines with PC-based control from Beckhoff, based on powerful EtherCAT communication.

Retrofit of the conveyor technology control system in central dispatch

Open control system reduces maintenance costs and boosts future-proofing

The end user is one of Australia's leading office equipment suppliers, with a broad portfolio ranging from office supplies and computers to office furniture. The company operates more than 100 stores across Australia as well as an online store with more than 40,000 products. At main distribution center, the stored goods are removed from shelves and packed into boxes, then transported along various conveyor lines – with a total length of 700 m and 28 distribution stations – and prepared for dispatch.

The conveyor lines had operated reliably for many years but it had become apparent that the systems were reaching the end of their service life. Malfunctions were occurring more and more frequently, and the required spare parts had become increasingly difficult to obtain and more expensive due to the age of the system. As a result, the management of the office equipment supplier commissioned Layer Seven Automation from Bella Vista (in the Sydney metropolitan area), which specializes in warehousing and logistics projects, to develop a concept that would modernize the warehousing system.

The evaluation revealed that the mechanics of the main conveyor belt were still in a usable state, but that the control system needed to be replaced. Lucky Thommadura, co-founder and chief engineer at Layer Seven Automation, says: "One of the disadvantages of the conveyor system was its proprietary structure. Every part had to be purchased from the manufacturer, which would have made it even more difficult to expand the system." As a result, the decision was made to configure an open system based on off-the-shelf products. "This would offer a future-proof solution and reduce maintenance costs," states Thommadura.
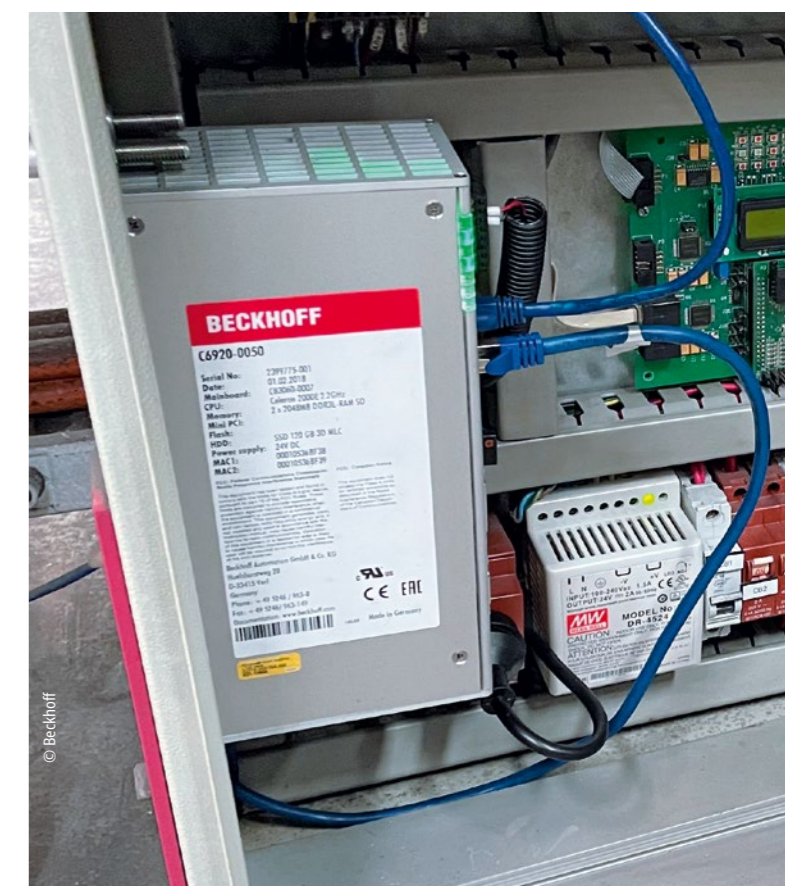
In the extensive central warehouse of Australian office equipment supplier Officeworks, Layer Seven Automation has replaced the proprietary, outdated warehouse logistics control technology with PC-based control.

© Beckhoff

The decentralized control technology of the 28 stations in total was replaced by a single C6920 control cabinet Industrial PC (left), which controls all the stations in the extensive logistics system via EtherCAT.

© Beckhoff

Barcode scanners with an EtherCAT interface detect incoming packages via integrated I/Os and receive the positioning commands for controlling the switches from the central control computer.

Lucky Thommadura, co-founder and chief engineer at Layer Seven Automation, says: "A major advantage of TwinCAT is how easy it is to integrate your own software and incorporate it into existing IT infrastructures."

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One industrial PC replaces 28 controllers

The original system configuration was based on one controller and one barcode scanner for each distribution station. Layer Seven Automation's aim was to create a centralized control architecture that would increase the efficiency of the system and reduce costs.

The barcode scanners at each station are essential for recording the contents of the boxes. Here, Layer Seven Automation opted for scanners that can be configured via an EtherCAT interface and have integrated I/Os for simple control functions. The inputs are used to detect the boxes via opto sensors, for example, while the outputs are used to switch the switches or pushers according to the destination station.

First, a single distribution station was converted and its scanner was connected to a C6920 control cabinet Industrial PC from Beckhoff via EtherCAT. Following successful tests, all 28 stations were migrated in stages and net-

worked with the C6920 in a linear structure (daisy chain). Lucky Thommadura comments: "The technicians of the logistics company and I were surprised by the compactness of the solution, the fast update rates of the EtherCAT network, and the overall speed of the controller." After all, the barcode on the box has to be scanned and forwarded to the industrial PC via EtherCAT. There, the application determines whether the switch of the corresponding station needs to be switched and sends this information back to the barcode scanner via EtherCAT. "The Beckhoff Industrial PC manages the extensive calculations in around 100 μs, which is phenomenally fast," says Thommadura enthusiastically, "and yet we still have reserves."

Even though there has not yet been a network failure, carelessness can quickly cause a cable break and thus a failure of the entire system. A shutdown of this kind would have a significant impact on productivity, especially in such a large-scale logistics installation. There are therefore concrete plans to implement cable redundancy, which is easy to retrofit with EtherCAT.

Engineering with IT methods

The engineering team at Layer Seven Automation has extensive experience in the general software and computing sector – for example, in setting up databases or creating web servers. Until the project, however, Lucky Thommadura and his team had not yet come into contact with the automation environment: "We knew that all of this would be new to us. But when I discovered how

EtherCAT works, what an industrial PC is, and how easily we can combine Windows with a virtual PLC, it all made sense. The virtual machine in particular enabled me to test the program via a laptop from home, at work, or on site." The fact that TwinCAT is integrated in Visual Studio was another reason for the chief engineer to invest in Beckhoff and EtherCAT. "I really believe that this is the way automation technology needs to go – away from closed systems with Ladder Diagram programming and outdated signal processing. We need to take established software design and architecture practices and combine them with automated testing so that we can deliver our solutions more effectively," Thommadura adds.

PC-based control: Secure, open, and flexible

According to Layer Seven Automation, a major advantage of PC-based control is that the control architecture is easy to integrate into existing IT systems. This was another pleasant surprise for Lucky Thommadura: "Many IT departments have very strict security requirements, but Windows is always easy to integrate. The firewall, security settings, and global user administration have made our work here much easier." The option to use Windows has also enabled Layer Seven Automation to combine its own programs with TwinCAT: For example, an SQL database was integrated via TwinCAT 3 Database Server (TF6420), which archives the details of a box every time it is scanned. This action is permanently recorded and logged in the TwinCAT 3 EventLogger. In addition, a dedicated message queue system was created, which uses the ADS

protocol to extract data and ultimately link it to the RabbitMQ message broker software. "ADS technology from Beckhoff offers almost unlimited possibilities. We use ADS to collect the recorded volumes of data and distribute them both horizontally and vertically. It can also be used to easily integrate almost any MES or ERP system," adds Thommadura.

More information:
www.layerseven.com.au
www.beckhoff.com/intralogistics

PC-based control technology for DNA tests in livestock farming

Meeting the requirements of modern agriculture with modern technology

According to RML Machinery, New Zealand has been at the forefront of technological development in agriculture for years, ensuring efficiency and modernization in livestock farming. A recent example involves the use of SNPshot™ DNA tests, which harness the latest technology – including from Beckhoff – to meet the needs of two end user groups: farmers who take samples in the field and DNA laboratories that process the resulting samples.

Cartridges for the SNPshot™ system, which stands out from existing DNA sampling systems with its simple "on the farm" sampling unit.
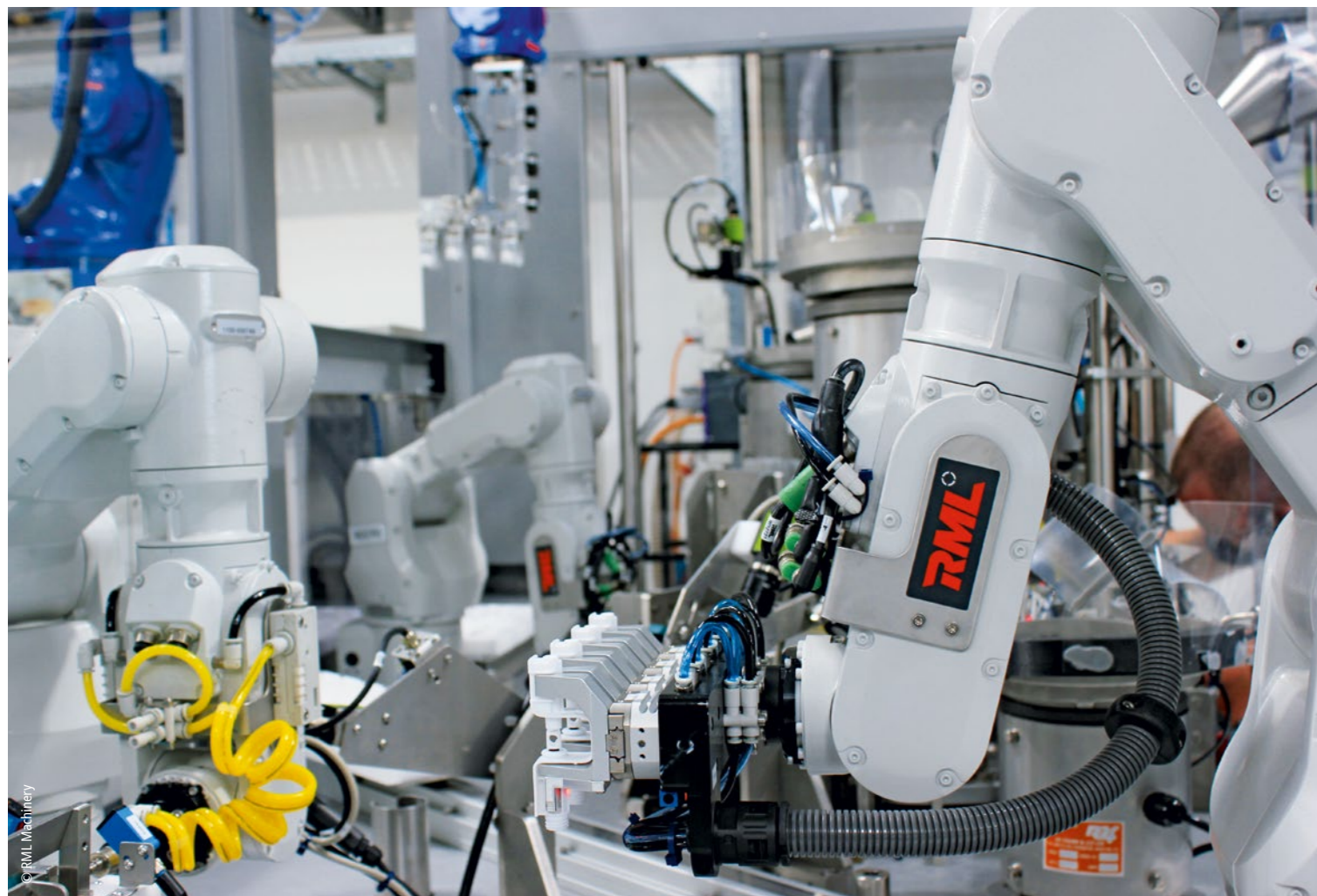
© RML Machinery

View of the machine for assembling the cartridge injection molded parts

New Zealand-based automation and robotics company, RML Machinery, has been working closely with Beckhoff on control system integration for the last decade. RML provides comprehensive solutions for many of Australia's leading fast-moving consumer goods (FMCG) brands, implementing the flexible "challenge accepted" approach to automation technology. The progressive, flexible, and reliable approach of Beckhoff makes it the ideal partner for RML, which is always thinking one step ahead in terms of increasingly sophisticated solutions.

High-precision DNA sampling on the farm in no time
SNPshot™ DNA tests have a wide range of applications, with around 15 million samples taken worldwide every year to identify stud horses, sheep, farmed salmon, and more besides. The SNPshot™ DNA sampler is equipped with both RFID and barcode readers, capable of reading a wide variety of animal ID tags. What's more, at the time of sampling, the GPS coordinates of the sampling site are recorded to be used as a practical verification and risk management tool.

To illustrate, the sampler reads an animal's ear tag and links it to a QR code on the corresponding cartridge while the tissue sample is being taken. Once a farmer has finished sampling for the day, they can transfer the sampling data – i.e., the cartridge QR code and the linked animal ID – to the SNPshot™

mobile app on a smartphone via Bluetooth and even synchronize it with the cloud-based SNPshot™ hub if required. Once the sampling process is complete, the test tubes are removed from the cartridges and sent by courier to a DNA lab. These test tubes contain a buffer solution so that they do not need to be cooled during shipping. Both the cartridges and their recyclable sleeves are quick and easy to load into the sampler. Most users wear a simple two-piece tool belt during this process, with fresh cartridges on one side and used cartridges on the other.

As a new cartridge is used for each animal, the risk of contamination of the samples is minimal. The beauty of the SNPshot™ cartridge is that it is compatible with standard laboratory test tubes. This in turn offers the advantage that the test tubes are sure to be the right size for use with normal laboratory equipment when sent to the DNA lab. The seamless digitalization of the entire process also serves to minimize any previous challenges with regard to animal identification.

Sophisticated cartridge production
The sampling cartridges consist of nine components, one of which is filled with a saline solution. Manufacturing these cartridges was incredibly labor-intensive in the past and even identified as a source of production bottlenecks. SNPShot™ therefore needed a system that would automate the process and

produce finished cartridges at a rate of 20 units per minute. RML proposed an A101 injection molding assembly machine as a solution, which takes the cartridge bodies directly from an injection molding machine. The other eight components are loaded into separate tray conveyors, where they can be separated and made available for loading as separate units.

The assembly machine consists of three robots, three Beckhoff servo axes for precision positioning, eight cameras for part identification, a dispenser unit for saline solution, a QR barcode printer, and database integration for complete traceability of all components. Each cap in the cartridge is provided with a pre-printed miniature data matrix code. During the assembly process, this code is read and sent to a cloud database via a RestAPI interface. The code is then validated and a secondary QR code is returned via the same interface. It is this secondary QR code that is ultimately printed on the outside of the cartridge body.

High-performance industrial PC and convenient visualization
An C6030 ultra-compact Industrial PC from Beckhoff with a quad-core Intel® Core™ i7 processor with a clock frequency of 3.6 GHz was selected as the controller. This high-performance processor offers all the computing power required for the demanding application. According to Jon Marden from RML, the system reliably handles sophisticated motion tasks, image processing control for a total of eight cameras, cloud-based data exchange, interface control for three robots, and the sophisticated human-machine interface that combines all of these modules in a user-friendly operator interface. He goes on to assert, "The fact that this outstanding computing power is available in an extremely compact design also makes for a smaller control cabinet compared to other products on the market."

Exceptional ease of use is afforded by the two touch-screen monitors connected to the Beckhoff Industrial PC: one with TwinCAT HMI for convenient visualization and machine control, and another for a live feed from each camera in the image processing application. This gives the operator a clear insight into the entire process sequence.

The precision axes are managed by a Beckhoff AX5103 servo drive, which communicates with the industrial PC via EtherCAT. In addition to the TwinCAT 3 HMI Server for visualization, the system also uses TwinCAT 3 PLC and TwinCAT 3 NC PTP, as well as TwinCAT 3 Database Server, TwinCAT 3 TCP/IP, and TwinCAT 3 IoT HTTPS/REST for efficient data communication. According to Jon Marden, the openness of the PC- and EtherCAT-based control technology from Beckhoff allowed RML to provide a high-precision positioning system without being limited to a single hardware supplier.

Jon Marden from RML Machinery (left) and Neil Pearce from
Beckhoff New Zealand (right) pictured in front of the machine

The EK1960 TwinSAFE Compact Controller
ensures functional safety.

An AX5103 servo drive with AX5805 TwinSAFE option card
provides precise and reliable movements.

More information:
www.rmlnz.com
www.snpshot.com
www.beckhoff.com/c6030
www.beckhoff.com/ek1960

Semiconductor working group of the ETG met for the 25th time

Recently, the Semiconductor Technical Working Group of the ETG met for the 25th time. More than 70 people attended the anniversary meeting both in person and online. In addition to the regular work on profiles for the semiconductor industry, this time the group also took time to look back on the working group's successes since it was founded in 2011.

Semiconductor working group of the ETG met for the 25th time.

And the results are impressive: Over 3,000 person-days have gone into participating in the 25 multi-day meetings to date. The result is over 75 profiles and draft profiles for the semiconductor industry. The so-called task groups within the working group play a key role here, focusing specifically on individual topics or profiles and thus efficiently driving forward development and implementation.

The Semi TWG, as the working group is known for short, is primarily made up of equipment suppliers and manufacturers of equipment ("tools") for semiconductor production, although more and more of their end customers are now also taking part in the meetings. This enriches the group's work in that it provides valuable insights into practical applications, such as how the data from certain actuators and sensors is used by chip manufacturers and what the exact system requirements are. In addition, feedback from end customers can be used to determine the success of the working group and to identify potential future requirements.

Florian Essler, who plays a leading role in the working group on behalf of the ETG, explains: "We founded the Semi TWG in 2011 with the aim of supporting all system and tool manufacturers and suppliers of semiconductor production components that use EtherCAT or offer products with EtherCAT. The focus of our work is on the development of semiconductor-specific device profiles, installation guidelines and device tests to meet the special requirements of the semiconductor industry. I attribute our success in this to the constructive atmosphere in the group: the efforts of each individual to use all their experience and expertise to draft a specification that is of benefit to everyone involved."

The meetings of the Semi TWG take place alternately online and in person, and participation is open to all ETG members. Detailed information about the working group itself and past meetings can be found on the EtherCAT Technology Group website.

Fully booked: 2024 European EtherCAT Plug Fest

In June, the ETG once again held one of its popular developer meetings, this time the 2024 European EtherCAT Plug Fest. All providers of EtherCAT MainDevices, SubDevices, codes and tools were invited.

The event took place in Hattersheim at the premises of ETG member company Hilscher Gesellschaft für Systemautomation mbH. With more than 65 participants from 29 different manufacturers, the EtherCAT Plug Fest was fully booked. The EtherCAT experts on site were impressed by the unbroken interest in EtherCAT and the high demand for this type of developer meeting.

The EtherCAT Plug Fests focus on the implementation of interoperability tests. Vendors of EtherCAT Main and SubDevices meet to improve the interoperability of their products, but also to share information about implementation and clarify questions about the technology. The ETG's EtherCAT experts will be on site to pass on their know-how directly and personally and thus support the development process of the individual participants.

Florian Hammel, part of ETG's technical team and on-site contact person in Hattersheim, explains: "The more devices that can be tested for interoperability at an EtherCAT Plug Fest, the better. We therefore regard the event here in Hattersheim as a complete success. The advantage of the personal exchange between the participants and us is also beyond question."

The EtherCAT Plug Fests take place at regular intervals in Europe, Japan, Korea and North America. All information on future dates can be found online at www.ethercat.org/events.

Large attendance at the ETG's 2024 European EtherCAT Plug Fest

More than 200 participants at the ETG Member Meetings in Japan and Korea

The ETG Member Meetings in Japan and Korea have been an integral part of the EtherCAT Technology Group's calendar for many years. Once again, numerous ETG members accepted the invitation and attended the meetings, which took place in Yokohama and Seoul.

Similar to the General Assembly, which takes place annually during the SPS trade fair in Nuremberg, visitors to the Member Meetings in Japan and Korea receive a comprehensive update on the latest developments within the organization and its diverse activities both locally and worldwide. The program will be rounded off by technical EtherCAT presentations from some member companies as well as various live product demonstrations on site.

Of course, the presentations also included a look back at 20 years of the ETG (here by Martin Rostan, Executive Director of the ETG, in Korea).

Full house at the ETG Member Meetings (here in Japan)

More information:
www.ethercat.org

PCControl

The New Automation Technology Magazine