

# PControl

The New Automation Technology Magazine

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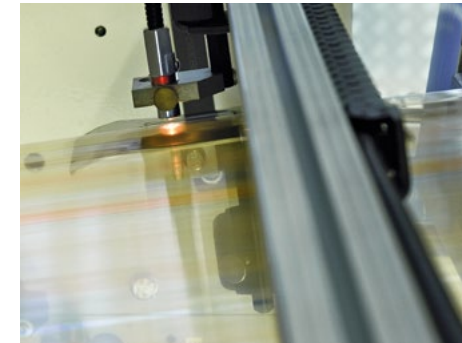
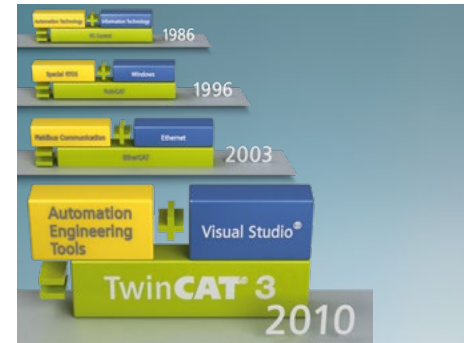
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33415 Verl/Germany  
Phone: +49 (0) 52 46 / 9 63-0  
Fax: +49 (0) 52 46 / 9 63 -1 98  
info@beckhoff.com  
www.beckhoff.com

Editor-in-Chief:  
Frank Metzner

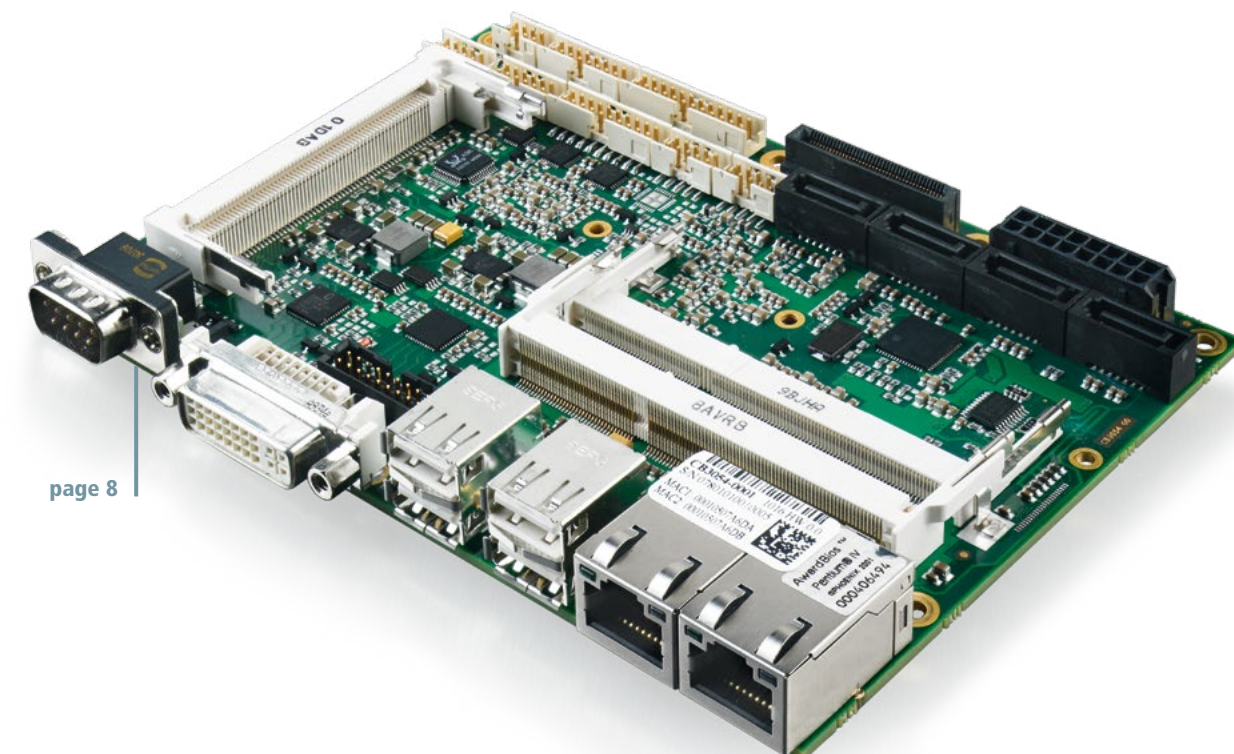
Editors:  
Gabriele Kerkhoff  
Martina Fallmann  
Phone: +49 (0) 52 46 / 9 63 - 1 40  
Fax: +49 (0) 52 46 / 9 63 - 1 99  
editorial@pc-control.net  
www.pc-control.net

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## Beckhoff technology controls the movement of the energy center in the German pavilion at EXPO 2010 in Shanghai

The Expo 2010 in Shanghai closed its gates on October 31, 2010 after welcoming over 72,000,000 visitors. This astonishing number of attendees beat all previous world exhibition attendance records. The highlight of the German pavilion was the so-called 'energy center,' with an interactive pendulum, which could be made to swing by calls from the visitors and projected pictures on the subject of 'balancity – city in balance.' Developed by the University of Stuttgart in cooperation with Milla und Partner Agentur & Ateliers, Beckhoff technology works in the background as part of the complex drive equipment in the pendulum.

The Federal Republic of Germany presented itself at the Expo 2010 as a country that draws its particular quality of life from the cultural versatility and contrariness of the German cities. Under the motto 'balancity,' the aim, in connection with the guiding theme of the Expo – 'Better City, Better Life', was to show how cities can gain quality of life and versatility from the harmonic interaction of all elements and forces. Visitors to the German pavilion were accordingly guided by a future vision of urban life, which was borne by the balance between renewal and preservation, innovation and tradition, urbanity

and nature, community and individual, work and leisure, and globalization and national identity. The highlight of the German pavilion was the interactive show in the energy center: A ball with a diameter of three meters, fitted with almost 400,000 LEDs, was suspended on a thin rod. The ball, weighing around 1.2 tons, was made to swing by the calls and hand claps of the visitors via a drive integrated into the ceiling of the pavilion. Even the direction of swing of the pendulum could be influenced by the acoustic signals. Pictures and films from Germany were created on the ball. The



energy from the interaction of the different forces was reflected by the intensification of the colors and the acceleration of the circular movement. The concept and development of the interactive pendulum arose out of a joint project of the Institute of Technical and Numeric Mechanics (ITM), the Institute of Control Engineering of Machine Tools and Manufacturing Units (ISW) and the Institute for Machine Elements (IMA) at the University of Stuttgart, together with the Stuttgart-based exhibition design company Milla und Partner. The control and drive concept, the design and calculation of the lifetime of the pendulum rod as well as the sensors were planned and developed by the University of Stuttgart. The drive concept ensures that the pendulum is reliably set in motion as desired and safely decelerated again. The basis for this

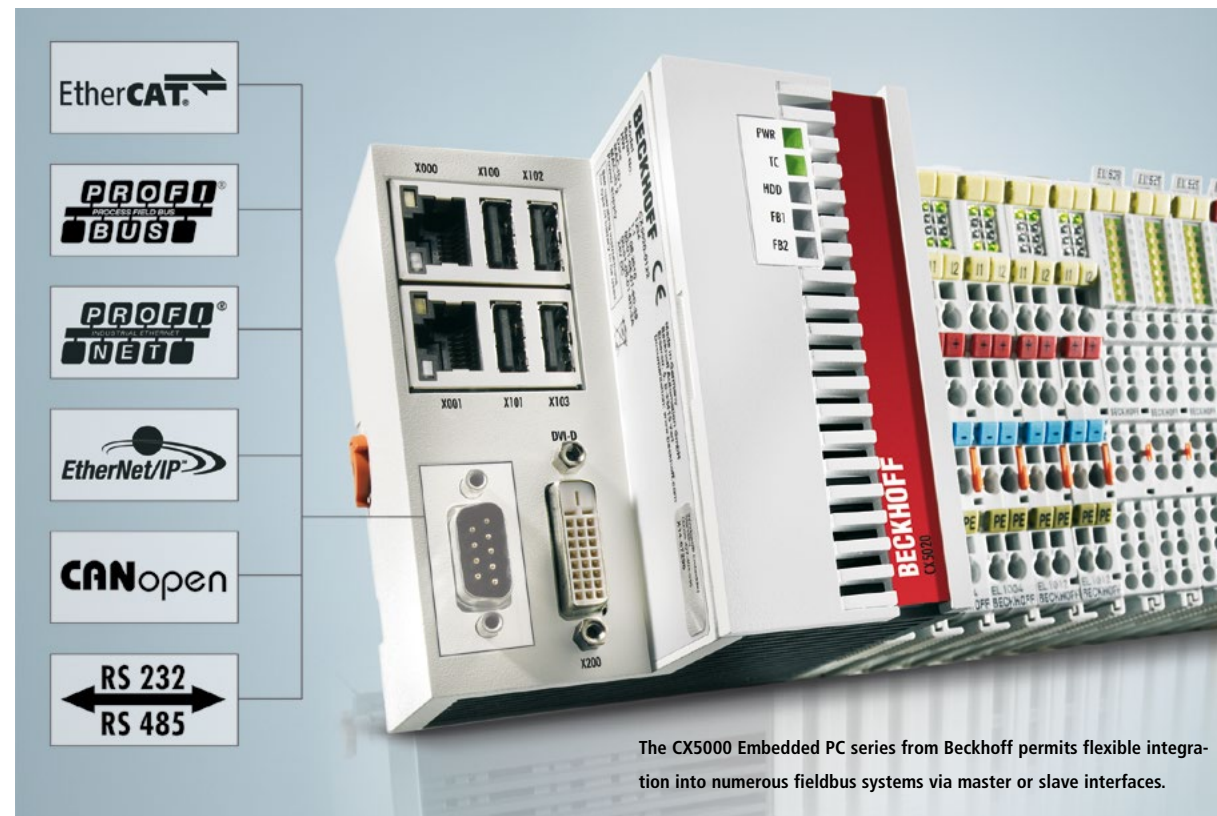
is a servomotor-driven cross table with a universal joint. Metron GmbH was entrusted with the design and construction of the drive equipment. The movement of the ball is controlled by a Beckhoff C6140 Control Cabinet Industrial PC and a CP7902 Control Panel. The basic functions of the controller were programmed using the Beckhoff TwinCAT PLC automation software and TwinCAT HMI is used for the visualization. The safety functions of the machine are guaranteed by the TwinSAFE software-based safety solution from Beckhoff. Commissioning was performed jointly by the University of Stuttgart, Metron GmbH and Beckhoff.

[www.expo2010-deutschland.de/en](http://www.expo2010-deutschland.de/en)

The owner of the pavilion is the Federal Ministry of Economics and Technology. It commissioned Koelnmesse International with the coordination of the preparations for and running of the German pavilion. The German Pavilion EXPO 2010 Shanghai Consortium (ARGE) was responsible as the general contractor for the planning and construction of balancity. Schmidhuber + Kaindl from Munich designed the architecture of the pavilion and were responsible for its general planning. Milla und Partner from Stuttgart were responsible for the exhibition and media design. NÜSSL (Germany) from Roth near Nuremberg took care of the project management and the building work.



Enhancing connectivity: New interfaces for the CX5000 Embedded PC from Beckhoff with Intel® Atom™ processor



The CX5000 Embedded PC series from Beckhoff permits flexible integration into numerous fieldbus systems via master or slave interfaces.

The CX5000 Embedded PC series with its robust and compact magnesium housing offers a wide range of communication options through integrated I/O and system interfaces. Optional master/slave fieldbus and communication interfaces enable flexible integration in subordinate or higher-level systems. The dynamic control system can be operated within an extended temperature range between -25 and +60 °C (-13 and 140 °F).

## Wide selection of fieldbus interfaces designed for open control technology

The CX5000 Embedded PC from Beckhoff offers the user an exceptional assortment of connectivity solutions. It features a variety of system interfaces (2 x Gigabit-Ethernet, 4 x USB, 1 x DVI-D) and a direct I/O interface for Beckhoff Bus Terminals and EtherCAT Terminals. The EtherCAT I/O system enables simple integration of countless fieldbus devices via communication terminals that range from PROFINET to IO link. Alternatively, fieldbus integration is also possible via the CX5000 Embedded PC. The system can be optionally extended through master or slave fieldbus connections (EtherCAT, PROFIBUS, PROFINET RT, EtherNet/IP, CANopen) or communication interfaces (RS232, RS422/RS485). Even with these expansion options, the overall dimensions of the CX5000 remain unchanged. Particularly noteworthy is the EtherCAT slave application as a programmable, local device in an EtherCAT installation.

The flexible Beckhoff CX5000 Embedded PC series for DIN rail mounting is ideal for application as a compact Industrial PC for PLC, Motion Control and visualization. The device series CX5010, equipped with Intel® Atom™ Z510, 1.1 GHz, and CX5020 with Intel® Atom™ Z530, 1.6 GHz, are characterized by very low power dissipation. The extended operating temperature range between -25 and +60 °C (-13 and 140 °F) enables application in climatically demanding environments. The CX5000 series Embedded PCs are also fanless and have no rotating components, providing optimum stability.

Embedded PC CX5000 [www.beckhoff.com/CX5000](http://www.beckhoff.com/CX5000)

Space-saving C5210 Industrial PC with just one height unit for 19-inch rack installation



The space-saving C5210 19-inch slide-in Industrial PC measures only one height unit. This new IPC has an Intel® Core™2 Duo on a 3½-inch motherboard with on-board RAID controller and two SATA 3½-inch hard drive caddies. The combination of industrially-capable performance and functionality with an extremely flat design makes the C5210 particularly well-suited for space-saving applications.

With the new C5210 Industrial PC, Beckhoff is extending its series of 19-inch slide-in Industrial PCs with a device with only one height unit and thus satisfies the growing demand for control devices with a flat design. The C5210 has an Intel® Core™2 Duo processor on a 3½-inch motherboard and is equipped with an on-board RAID controller and two SATA 3½-inch hard drive caddies. The Industrial PC can be extended with PCIe modules, a mini-PCI card or a DVD drive.

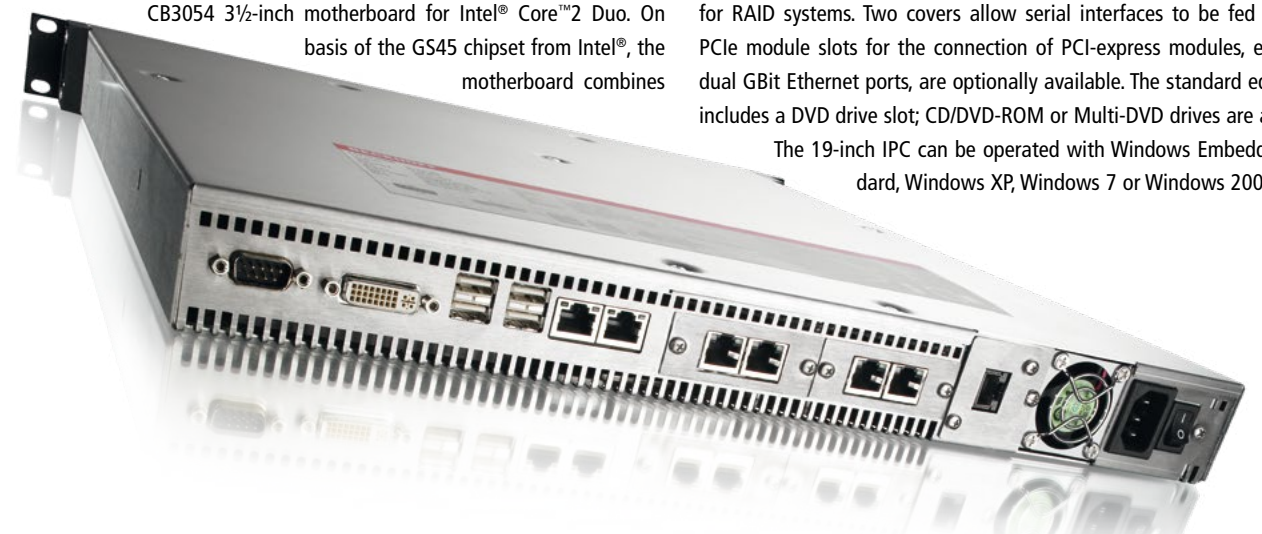
## Slide-in Industrial PC features extremely flat design

With just one height unit (1 HU = 44.45 mm), the C5210 Industrial PC (IPC) represents a space-saving control alternative without losses to performance or function. With its compact dimensions of 482 x 44.45 x 494 mm (W x H x D), the flexible 19-inch Slide-in IPC is suitable, for example, for areas of use where installation space is tight, such as in building services, for measurement technology, in control rooms or in laboratories, etc. The low installation height is made possible with the new Beckhoff CB3054 3½-inch motherboard for Intel® Core™2 Duo. On basis of the GS45 chipset from Intel®, the motherboard combines

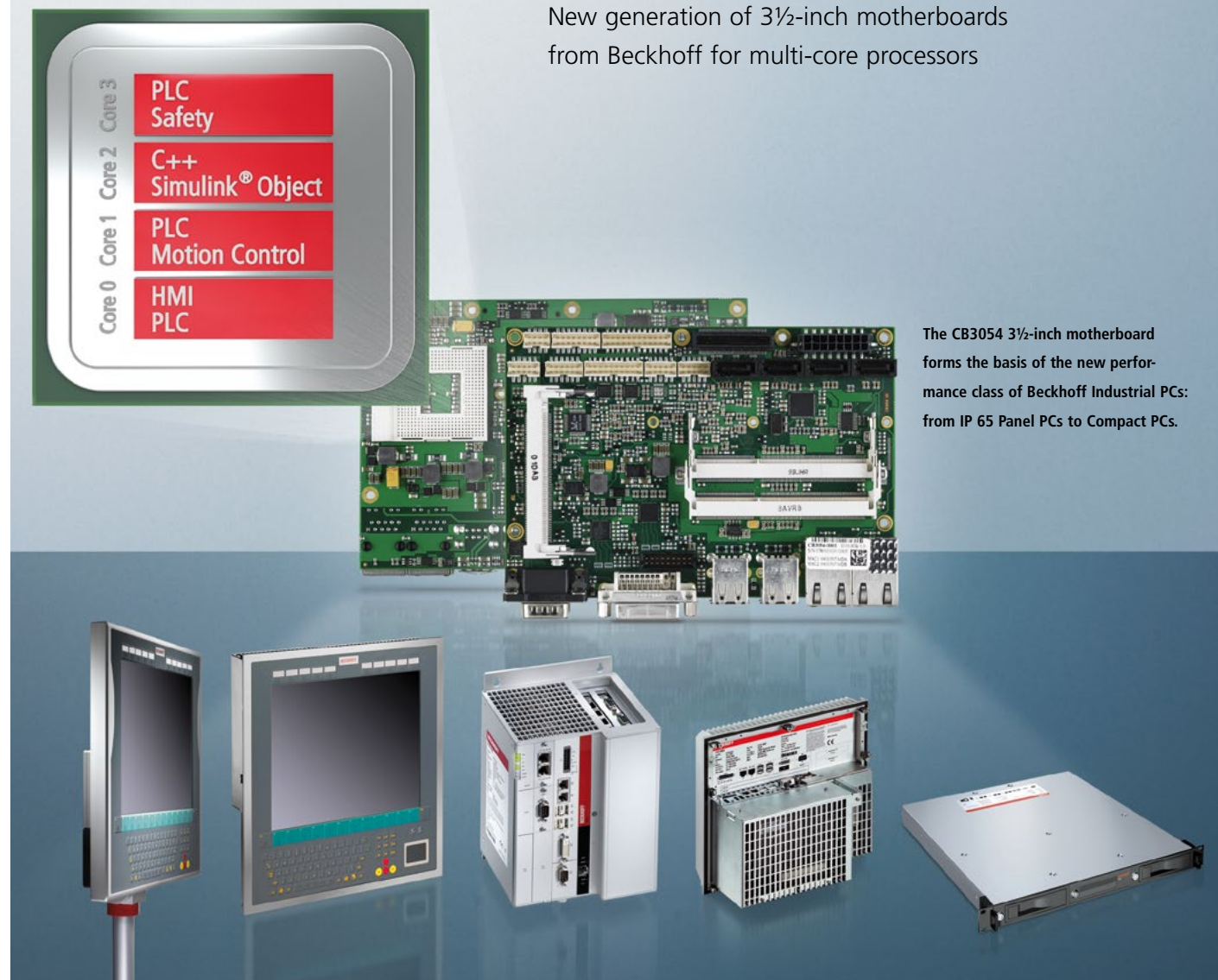
multi-core technology with a socket in the 3½-inch form factor and is equipped with a multitude of on-board interfaces, such as SATA, COM or USB ports. A free mini-PCI card slot enables the integration of further fieldbus interfaces. An additional DVI interface located on the motherboard permits the user to connect two separate displays and to create extensive visualization solutions.

The C5210 is equipped with two hard drive caddies for 3½-inch hard disks for RAID systems. Two covers allow serial interfaces to be fed out. Two PCIe module slots for the connection of PCI-express modules, each with dual GBit Ethernet ports, are optionally available. The standard equipment includes a DVD drive slot; CD/DVD-ROM or Multi-DVD drives are available.

The 19-inch IPC can be operated with Windows Embedded Standard, Windows XP, Windows 7 or Windows 2008 Server.



New generation of 3½-inch motherboards from Beckhoff for multi-core processors



The CB3054 3½-inch motherboard forms the basis of the new performance class of Beckhoff Industrial PCs: from IP 65 Panel PCs to Compact PCs.

## PC-based Control: The new performance class of Beckhoff Industrial PCs

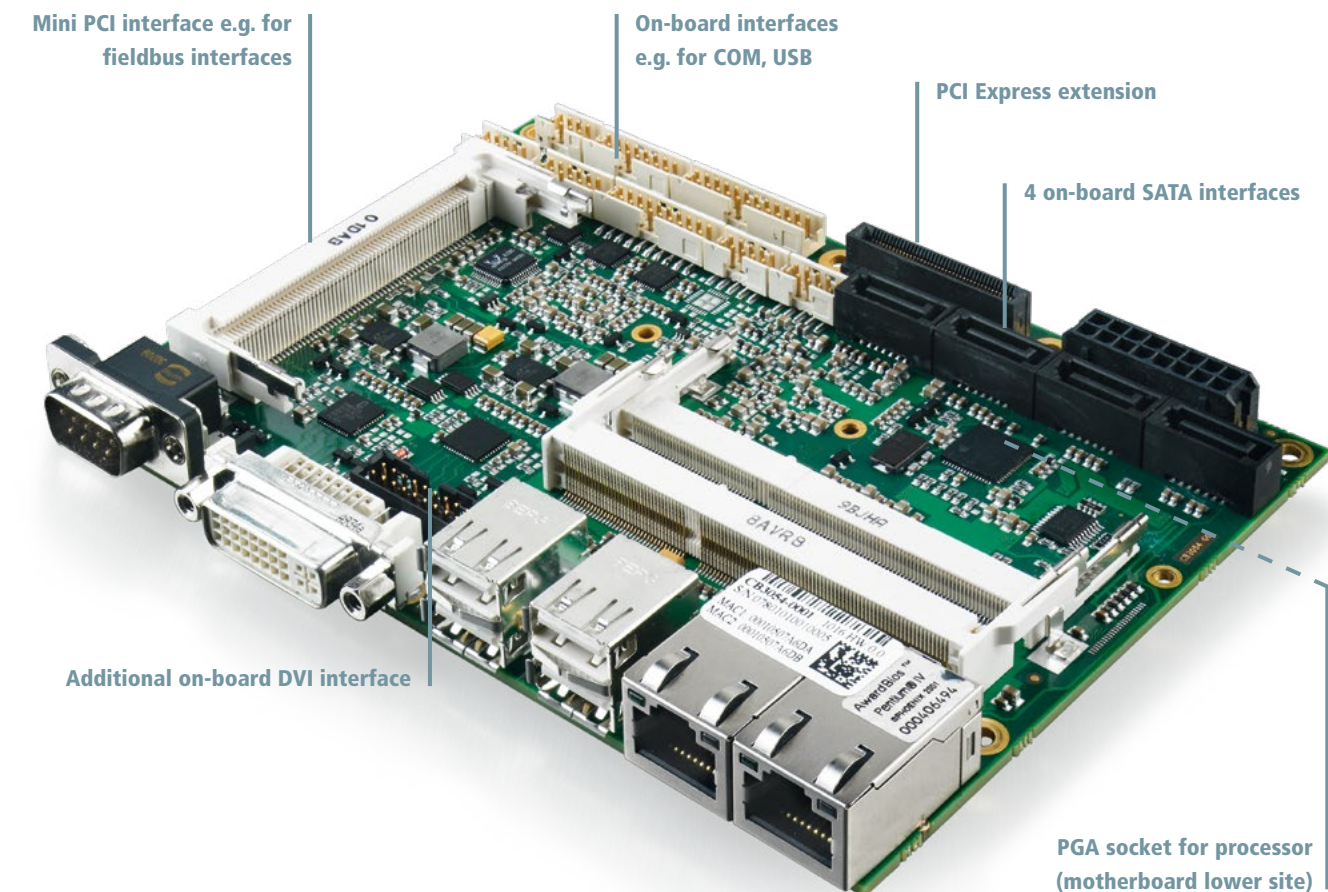
Multi-core processors offer decisive advantages for PC-based control technology: with them, software-based automation solutions are able to distribute tasks, depending upon the number of available CPU cores. As a result, various functions such as PLC, NC, robotics, measurement technology or HMI can be distributed to dedicated cores with little effort. Beckhoff provides ideal solutions for multi-core technology on the software side with TwinCAT 3 and on the hardware side with a wide range of Industrial PCs.

The increased use of Ethernet-based fieldbus systems has been a clear developing trend in the automation industry for several years. Industrial Ethernet solutions such as EtherCAT enable hard real-time control to be realized as a pure software solution. EtherCAT combines top performance with low infrastructure costs and complete freedom of choice with regard to network topology.

PC- and Ethernet-based automation offers the user many mechanical advantages, since modern PCs feature Ethernet ports and Ethernet cables are simple and reliable to install. This has led to many PC manufacturers offering extremely compact devices that are tailored to use in Ethernet-based automation, but offer no additional flexibility. However, apparently contradictory requirements such as compact design and flexibility are by all means achievable at the same time with the appropriate choice of components. One example of this is the consistent development of the C69xx Industrial PC series from Beckhoff.

### Utilization of state-of-the-art motherboard characteristics

The heart of a new Industrial PC generation is the new CB3054 motherboard. On the basis of the Intel® GS45 chipset, the board combines multi-core technology with a socket in the 3½-inch form factor. This allows the user to select freely between different processors. Thanks to this flexibility, Industrial PCs can be equipped both with various multi-core processors, such as the Intel® Core™2 Duo or Core™2 Quad, and with inexpensive Celeron®, 2 cores, processors. The latter allow high performance PCs to be used even in price-sensitive applications. The board developed by Beckhoff has a large number of on-board interfaces, such as SATA, COM ports or USB ports. A free mini PCI slot allows the integration of further fieldbus interfaces, such as PROFIBUS, CANopen or SERCOS. An additional DVI interface located on the motherboard permits the user to connect two separate displays and thus to develop extensive visualization solutions.



The new CB3054 3½-inch motherboard was developed exclusively for multi-core processors.

It has a large number of on-board interfaces, such as SATA, COM or USB ports. A free mini-PCI card slot permits the integration of further fieldbus interfaces. An additional DVI interface enables the connection of two separate displays in order to realize extensive visualization solutions.



The PCI Express extension increases the flexibility of the Industrial PC thanks to additional on-board interfaces. It enables the use of a slotbox with additional PCI and PCI Express card slots, which can be located up to seven meters (23-ft) away.

**PCI Express extension technology offers flexibility using minimum space**

On top of that, there is a PCI Express extension on the CB3054 motherboard. The PCI Express Bus can be used both within and outside the Industrial PC for further interfaces. The advantages of this technology can be shown simply, taking the C6930 Industrial PC as an example: thanks to the PCI Express extension technology, additional interfaces can be offered within the IPCs for Ethernet-based automation. For an Industrial PC such as the C6930, this means that the user has up to seven independent Ethernet ports at their disposal in an exceptionally compact device. As a result, complex Ethernet networks can also be implemented. The second on-board DVI port can also be fed out via a simple front bracket. The user can additionally select from different plug-in card slots, with which a further customer request – the greatest possible flexibility – is fulfilled: By means of the PCI or PCI Express slots, existing interface cards, special measuring cards or even modems can be integrated simply. In addition, the PCI Express extension permits the use of a slotbox. This makes PCI Express and PCI slots available outside the IPC as well. The PCI Express bus is fed via a plug connector and cable to a slotbox located up to seven meters (23-ft) away. Users can use the installation space in the control cabinet flexibly and locate further plug-in cards locally. Both PCI and PCI Express card slots are available by using different versions of the slotbox. The slotbox is made of sturdy aluminum and protects the plug-in cards against vibration and shocks and is ideal for use in industrial environments.

**Highly available storage media for faster access time and maximum data security**

Apart from high flexibility, modern Industrial PCs offer a number of further advantages: New, highly available storage media are available in the CFast and SSD memory cards. CFast cards, the successors to the well-known Compact Flash cards, offer significantly faster access times, while maintaining the mechanical characteristics of the CF cards. SSD memory in the 2½-inch form factor and SLC technology (Single Level Cell)

**Overview of Industrial PCs with CB3054 motherboard**

The following PCs from Beckhoff contain the CB3054 3½-inch motherboard for Intel® Core™2 Duo, Core™2 Quad or Celeron®, 2 cores:

|                                |                            |
|--------------------------------|----------------------------|
| Built-in Panel PC              | CP62xx                     |
| Built-in Panel PC              | CP62xx with PCI/PCIe slots |
| Built-in Panel PC              | CP62xx with PCIe modules   |
| Panel PC IP 65                 | CP72xx                     |
| Built-in Industrial PC         | C6515                      |
| Built-in Industrial PC         | C6515 with PCIe modules    |
| Built-in Industrial PC         | C6525                      |
| Built-in Industrial PC         | C6525 with PCI/PCIe slots  |
| Built-in Industrial PC         | C6525 with PCIe modules    |
| Control cabinet IPC            | C6920                      |
| Control cabinet IPC            | C6920 with PCI/PCIe slots  |
| Control cabinet IPC            | C6930 with PCIe modules    |
| Control cabinet IPC            | C6930 with PCI/PCIe slots  |
| 19 inch slide-in Industrial PC | C5210                      |

additionally fulfill the highest requirements for data security. Beyond that, availability is increased with further features such as an integrated UPS and an on-board RAID controller, with which Industrial PCs such as the C6930 are equipped. Today, the prudent integration of the latest processor and chipset technologies into the Industrial PC make a compact design possible without losses in flexibility. This provides users with the opportunity to equip existing applications with state-of-the-art PC technology and to harness all of its advantages. On the other hand, a large number of interfaces can be made available thanks to integrated PCI Express extension technology. The new PC generation with the Beckhoff CB3054 motherboard exclusively supports multi-core processors. Multi-core support is one of the major new elements in TwinCAT 3, the new software generation from Beckhoff for PC-based control technology. TwinCAT 3 facilitates the utilization of multi-core systems through corresponding configuration and diagnostics tools. (For details regarding multi-core support by TwinCAT 3, see PC-Control issue 01/2010, page 18 ff "Optimal utilization of the multi-core technology"). Windows Embedded Compact 7 will be launched in the 1<sup>st</sup> quarter of 2011; as a result, universal multi-core support will be available for PC control on the operating system side.

Beckhoff Industrial PC [www.beckhoff.com/ipc](http://www.beckhoff.com/ipc)  
TwinCAT 3 [www.beckhoff.com/TwinCAT3](http://www.beckhoff.com/TwinCAT3)

Flexibility increases for the versatile Beckhoff C69xx Industrial PC series

Compact Industrial PCs with new PCI and PCIe card extensions



The Beckhoff C6920 (left) and C6930 (right) control cabinet PCs with PCI and PCIe card extension. The combinations of two PCI and two PCI Express slots or one PCI and one PCI Express slot can be ordered as options.

The Beckhoff C69xx series control cabinet PCs are extremely small with a robust aluminum housing. The C69xx IPC features up to three independent Ethernet interfaces, making it ideal for use as a compact central processing unit in EtherCAT control systems. For applications that additionally require PCI or PCIe cards, the C6920 and C6930 control cabinet PCs are now available with plug-in card extensions. This makes the PC housing only 70 mm (2.76-in) wider, but increases the device's flexibility.

The Beckhoff C6920 and C6930 control cabinet PCs are optionally extendable using two plug-in card slots and can accept conventional PC plug-in cards of up to 190 mm (7.5-in) in length. The 70 mm (2.76-in) wider PC housing includes a backplane that provides a choice of two PCI slots, two PCI Express slots or one PCI and one PCI Express slot. The plug-in card connections are located on the top side of the PC. An aluminum cover on the front of the slot expansion permits easy installation of the plug-in cards without having to open the housing of the computer core. As a result, all Beckhoff PCI fieldbus cards can now be used in the C69xx series. The plug-in card extension can be ordered as an option. The C69xx

Industrial PC series is equipped with 3½-inch Beckhoff Motherboards. The C6920/C6930 variants have powerful Intel® Core™2 Duo processors. The C6930 additionally has a SATA RAID controller for mirroring two hard disks. Extensions via additional PCI or PCIe plug-in card slots are also possible for the Beckhoff Panel PCs from the CP62xx series and for the C6525 "built-in" Industrial PC.

[www.beckhoff.com/C6920](http://www.beckhoff.com/C6920)  
[www.beckhoff.com/C6930](http://www.beckhoff.com/C6930)

30 Years of Beckhoff Automation –  
Interview with Hans Beckhoff

## A synonym for automation technology

It has been thirty years since Beckhoff Automation began PC-based control technology. In an interview with Ronald Heinze, chief editor of Open Automation, company founder Hans Beckhoff reviews the past and announces the next milestones in automation technology: for example, the systematic modularization of functionalities for TwinCAT 3.

Over the past 30 years Beckhoff Automation has grown from a staff of one to 1400. From an annual turnover of 50,000 Deutschmarks (DM) in the first year, Beckhoff has recorded a sales increase of over 45 % in the current year so far. A target of 340 million euros is set for 2010 which could be exceeded depending on the end of year performance. "We have recorded a high growth in sales in all areas, both geographically and across sectors. Worldwide machine construction is recovering its previous strength," according to director Hans Beckhoff. "The Chinese market is one main growth area. But we are currently growing at 45 % in the United States and Germany as well." Beckhoff is also optimistic for 2011 and anticipates a two-figure increase in sales. Current growth generators include alternative energies according to Hans Beckhoff, these contributing 15 % to total sales. The strong growth requires an expansion in production with new production facilities and manufacturing machines as well as ongoing recruitment of new staff. "We are currently taking on new staff every week," the director remarked.

### Rapid development

"This rapid development means we are in a constant state of flux," Hans Beckhoff stated. Despite this, the company displays a high level of stability in terms of staff, customers and products. Thirty years ago Beckhoff started with only a few engineering customers in and around Westphalia/Germany: today the company has a global distribution network with 27 subsidiaries. This year new sales offices were established in Israel, Singapore, Malaysia and Japan.

"Automation is an innovative but also very stable sector," according to Hans Beckhoff. "It is controlled by technical progress on the one hand and by long-term stability of the products and their delivery reliability on the other." Beckhoff is still supplying the same Lightbus I/O modules which came onto the market at the beginning of the 1990s.

The last 30 years in automation technology have been marked by technological milestones which have had a crucial effect on automation products. Among these Hans Beckhoff includes on his list microprocessor technology as the technological basis for controls design and PC technology with the subsequent linking of IT and automation technology – the key words here being Windows and real-time. Beckhoff sees fieldbus technology as having an important influence on control architectures. "The development of the Bus Terminal enabled automation to be decentralized. The integration of different functions, such as sequential control, motion control, robotics, CNC, control and communication technology on a single platform had an equally marked effect on automation technology and will continue to do so in the years to come." A further important point mentioned by Beckhoff is the digitization of functional safety technology.

### Getting the right balance

"Some important decisions have been crucial for the company's development," Hans Beckhoff stressed. One of the first decisive questions was whether to establish an engineering office or a factory. He decided in favor of a factory and, as

"Automation is an innovative but also very stable sector. It is controlled by technical progress on the one hand and by long-term stability of the products and their delivery reliability on the other."

early as 1983, defined his own product range. Of equal importance was the decision to establish a sales department and the associated marketing in addition to product development and manufacturing. "A close relationship to the customer is very important," as Hans Beckhoff knows. These days a similar amount is spent on sales and marketing as is on product development. The third important business decision relates to the business model where the focus is on general automation technology instead of application niches.

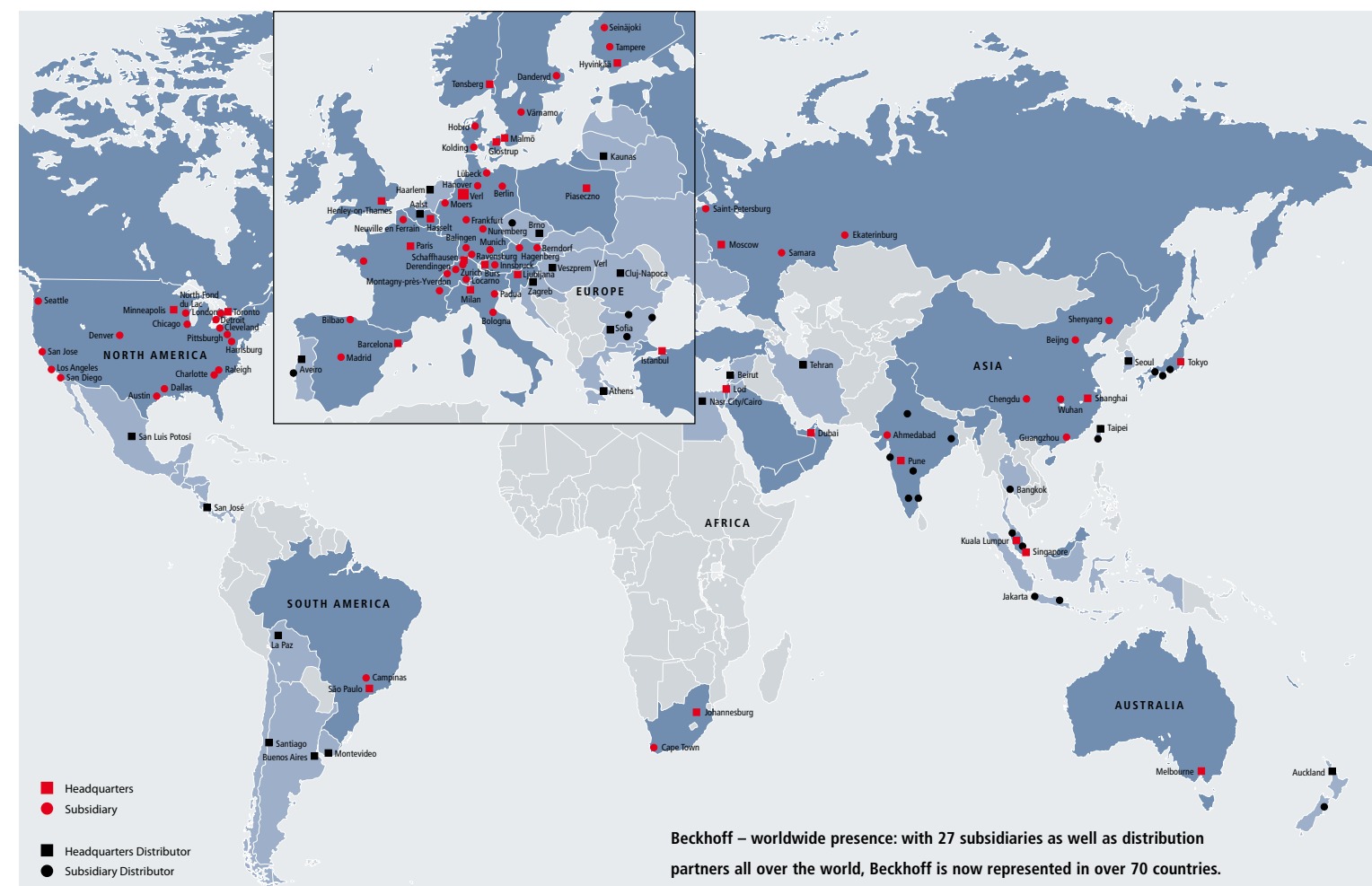
Beckhoff describes itself as a technology company. "The important aspects have not changed," according to Hans Beckhoff, "which are having fun while you work and truly enjoying advanced technology." This is also reflected in the high employee loyalty which Beckhoff describes as "a great asset for us and our customers." Customer loyalty is equally impressive. "We are gaining new customers and only very rarely lose some. The long-term collaboration often develops into close relationships almost akin to friendships with our customers. We rely on each other, not only at home but abroad." A further characteristic of Beckhoff automation technology is its longevity. As technology itself may become complex, it is of vital assistance to the customer when the technological contacts stay the same

over the years as is frequently the case at Beckhoff. Hans Beckhoff stresses the importance of getting the right balance among customers, staff, suppliers, the geographic location, its community and the business sector. These are some of the most fundamental considerations for any successful business.

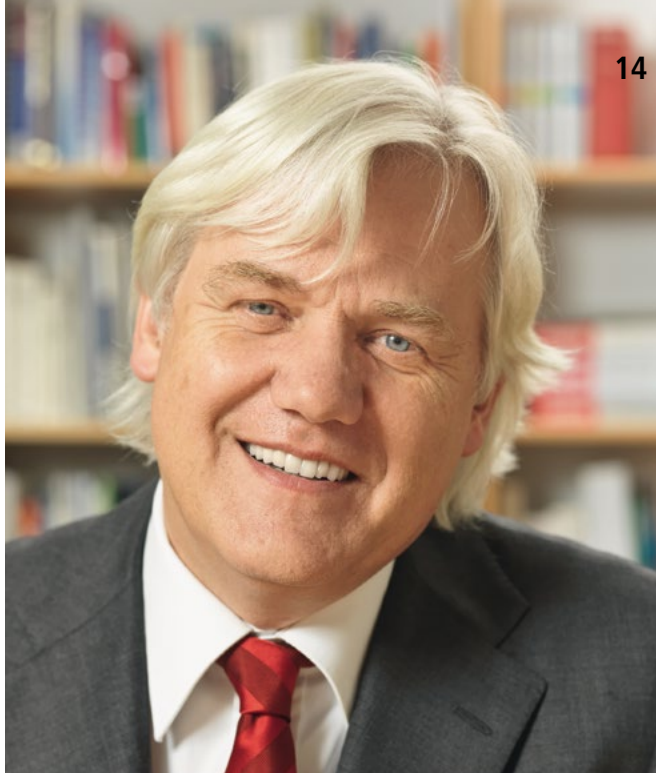
### The technology highlights: EtherCAT and Scientific Automation

Does the pioneer of PC-based control technology see any future for the traditional PLC? "Hardware PLCs have a future – despite the increased growth of PC-based systems," Hans Beckhoff believes. "The traditional suppliers such as Siemens, Omron, Mitsubishi and Rockwell continue to focus predominantly on this technology." These suppliers are only just beginning to push PC-based control technology. So PC-based control technology will not generally replace PLCs in the foreseeable future – at least not in terms of market volume.

This has benefits for a company like Beckhoff. For example, up until now the Japanese market has been completely dominated by the large Japanese hardware PLC manufacturers. "There has, in effect, been no PC-based control technology up until now," according to Hans Beckhoff. "This means that this market segment has not yet been filled." Beckhoff Automation is now beginning to work on the conservative Japanese market and is convinced of finding supporters for its own control philosophy there – as an alternative to traditional control systems. "This market may be small by comparison, but for us as a medium-sized company, it still achieves a respectable volume," remarked Beckhoff. There is also a certain sporting ambition underlying this because, Hans Beckhoff believes, "anyone who succeeds in the difficult Japanese market can do so anywhere." This project is helped along by EtherCAT which "has been well received in Japan," according



Beckhoff – worldwide presence: with 27 subsidiaries as well as distribution partners all over the world, Beckhoff is now represented in over 70 countries.



“We have had success all over the world with our EtherCAT protocol. Both from a technology angle as well as commercially. We are proud to have established a standard technology which is used across the globe.”

to Beckhoff. The EtherCAT Technology Group (ETG) already has 120 members in Japan alone. For example, Omron has made a clear commitment to EtherCAT.

“We have had success all over the world with our EtherCAT protocol,” stated Hans Beckhoff, “both from a technology angle as well as commercially. We are proud to have established a standard technology which is used across the globe. Not least because I believe it has enabled us to contribute to the progress of mankind a little.” Today EtherCAT is used worldwide. There are countless examples of EtherCAT applications, both with and without Beckhoff components.

“By opening the EtherCAT protocol we were able to establish a platform on the market with an open system architecture for users and suppliers of automation technology” Hans Beckhoff says with satisfaction.

Beckhoff also wants to promote automation technology in terms of functionality. “Today, machine-oriented measurement technology belongs in the control system as does motion control which has become a normal component of the control system in the last 10 years,” Beckhoff continued. It is therefore only logical that the Bus Terminal range is continuously and systematically expanded with fast, precise modules which can capture signals with a higher resolution. The associated extension of the software can be taken care of by, for example, libraries for the analysis of the measurement values. “Our new TwinCAT version 3 enables a close link to standard peripherals based on Matlab or Labview,” Beckhoff added. The integration of measurement technology into the automation environment is an important step in the direction of Scientific Automation.

#### The technology highlights: TwinCAT 3 and XFC

TwinCAT in the new version 3 sets standards when it comes to incorporating tools. “We have discussed this topic in depth with almost all our customers and have received extensive feedback,” Beckhoff continued. One significant benefit

of the measurement technology integrated in the control system is that internal variables and external measurement values do not need to be synchronized because they are all in one memory. The integrated control and measurement technology simplifies central handling, thus opening up great optimization potential for machine builders.

TwinCAT 3 forms the focus of the presentation at the SPS/IPC/DRIVES 2010 in Nuremberg, Germany. Completion of the software is on schedule. The beta version will be ready for customers to test at the start of 2011. “The software will then be released in mid 2011,” Hans Beckhoff announced. The new software version also provides the technological requirements for a further planned development stage: the systematic modularization of software functionalities. “In the future we want to assemble software modules in a similar way to our I/O terminal modular systems,” said Beckhoff, looking to the future. In addition to own modules from Beckhoff, software modules from third party suppliers can be used with TwinCAT 3. The aim of this is to get TwinCAT 3 quickly ready for special applications. For example, users or specialized engineering companies can provide algorithms for special applications.

The fast control technology XFC (eXtreme Fast Control) is already on the path to success. “The ability to achieve 100 microseconds response time has gained us many customers,” reported Beckhoff adding, “XFC provides an important contribution to increasing the efficiency of machines and conserving resources. This delivers high benefits at a low cost.” Fast control technology therefore also helps to save energy and to increase the efficiency of machinery and systems. “Our control technology promotes environmental and economic objectives alike,” Hans Beckhoff says with satisfaction. He sees the latter – from the angle of equalizing the living conditions of emerging countries such as China – as very important. “Automation technology therefore bears a high social responsibility,” he stated.

#### Growth in all markets

Hans Beckhoff believes that automation technology performance still has a long way to go. True to the statement coined years ago – that the function-related price decreases by 30 to 50 percent every ten years – he sees further potential for improvement in nearly all product areas. “This opens up even more new application areas for our products,” he stressed. “But the sectors already occupied such as machine construction, building control, process technology and embedded solution devices are still capable of expansion.” With machine construction the main objective is to gain a further share of the overall project. Hans Beckhoff sees openings for this in measurement technology, electrical drive engineering and also CNC applications.

In addition, the company's product range is being extended in the technology area of drive engineering. Currently, servomotor development and production is being established in collaboration with Erwin Fertig, the founder of Elau, in Marktheidenfeld/Germany. Fertig Motors, who are involved with the Beckhoff Group in a joint venture, will focus production on highly dynamic servomotors. The first production series devices are expected at the end of 2011. “This is a big step for Beckhoff. We have always been specialists in hardware and software and naturally we had a high level of drive expertise. But the development of our own motor series will markedly expand and deepen this expertise. We are delighted about this development and are convinced that we will be able to offer our users even more efficient system solutions,” Hans Beckhoff added.

#### Further sales development

Beckhoff will continue to invest in the development of its sales network. Hans Beckhoff is convinced that general automation technology must be

“Our control technology promotes environmental and economic objectives alike. Automation technology therefore bears a high social responsibility,”

marketed everywhere. “It makes sense to have a dense geographical presence,” according to Beckhoff. “So we will continue to expand our sales network. This applies to Germany and the rest of the world alike.” The number of sales staff is thus growing constantly.

In addition to this, vertical market-related sales will be developed. Over the next decade Hans Beckhoff plans to establish centers of competence within the company where technology experts with extensive knowledge of the vertical market will develop the best solutions jointly with their customers.

Between 1990 and 2000 the company grew by a factor of ten. Due to two financial crises, a growth factor of six was recorded between 2000 and 2010. For the next ten years Hans Beckhoff makes a more cautious estimate, dependent on the development of the world economy: a target growth factor of 4. Beckhoff Automation will then be able to show a turnover of 1.2 billion euros. This requires a corresponding development in the number of employees which is planned to triple by 2020. There will then be 3000 staff employed at the company headquarters in Verl alone. A company initiative involving universities aims to find the best and brightest employees. “For example, this year we have started giving 20 future young engineers the opportunity to practice-integrated studies,” Hans Beckhoff explained.

#### The vision for the next 10 years

In 10 years Beckhoff Automation will have reached a new order of magnitude: above all it will have an even greater international presence. “However, staff and customers should continue to find themselves in friendly, human-scale surroundings which we wish to ensure through a well-organized company structure,” Beckhoff continued. “External turnover will then be around 70 %” according to his forecasts.

Beckhoff Automation will be working hard to become a global technology address for automation technology, combining expertise in many sectors. The expectation is that an ever growing number of customers will turn to the company for all areas of automation technology: Beckhoff – a synonym for automation technology.



Ronald Heinze, editor-in-chief of openautomation

Published in openautomation 06/2010, VDE-Verlag, www.openautomation.de



#### Beckhoff milestones – standards for automation

Since the company was established on July 1<sup>st</sup> 1980, consistent development of innovative products and solutions using PC-based control technology has been the basis of our continuing successes. Many automation technology standards that are taken for granted today were recognized by Beckhoff at an early stage and successfully marketed as innovations.

- 1982:** P1000 – single-board motion controller
- 1986:** PC Control – first PC-based machine control
- 1988:** S1000 – Software PLC/NC on PC (DOS)
- 1989:** Lightbus – fast fieldbus based on optical fiber
- 1990:** All-in-one PC motherboard
- 1995:** Bus Terminals – fieldbus technology in compact terminal block format
- 1996:** TwinCAT – real-time software solution under Windows with PLC and Motion Control functions
- 1998:** Control Panel – detached IPC Control Panel
- 1999:** Fieldbus Box – the I/O system in IP 67
- 2002:** CX1000 – modular Embedded PC for DIN rail installation
- 2003:** EtherCAT – real-time Ethernet system
- 2005:** TwinSAFE – safety solution for the Bus Terminal system
- 2005:** AX5000 – EtherCAT servo drive
- 2007:** Industrial motherboards – Made in Westphalia, Germany
- 2008:** XFC – eXtreme Fast Control
- 2009:** HD Bus Terminals – 16-channel terminals in 12 mm
- 2010:** TwinCAT 3 – eXtended Automation (XA)

EtherCAT Box takes on harsh environments with EtherCAT I/O technology



## High performance for the IP 67 world

In an interview with Stefan Ziegler, editor-in-chief of Elektro Automation, Dirk Bechtel, Product Manager for fieldbus systems at Beckhoff, describes the technical highlights and practical advantages of the EtherCAT Box, with which the high performance of EtherCAT can also be used in environments that require IP 67 devices. Along with numerous new items at the SPS/IPC/DRIVES trade show, this system is an ideal supplement to the EtherCAT I/O portfolio.

**With the EtherCAT Box, Beckhoff has “transferred” the EtherCAT Terminals from the IP 20 to the IP 67 world. What are the special features and unique selling points of the system and which applications lend themselves to its use?**

**Dirk Bechtel:** The EtherCAT Box integrates the well-known and the proven: the IP 67 technology familiar from the original Beckhoff Fieldbus Box, our know-how with all major signal types and the fast and flexible EtherCAT system. Put simply, we have placed our IP 20 EtherCAT terminals in a waterproof and dustproof package. The user, for example the machine manufacturer, does not have to give any consideration to lower-level subsystems, data consistencies, transmission bandwidths, topologies, etc. when designing. In an ideal case, only the absolute necessities remain in the control cabinet; the complete I/O infrastructure can be built directly

into the machine. Of course, this is particularly advantageous where space in the control cabinet is at a premium – the classic case for the use of IP 67 I/Os – or where mechanical machine units are to be docked or undocked. This is made possible by the Hot Connect modules. Example applications are packaging plants, assembly machines or conveyor systems. From a purely practical point of view, it has proven to be the case so far that mainly digital and analog inputs and outputs are used in the field. However, more complex technologies such as the EP7041 Stepper Motor Box or serial interface modules such as the EP6002 are being increasingly used. Also, infrastructure modules such as the EP1122 Junction Box allow a much more flexible machine structure. All things considered, IP 20 solution from Beckhoff is optimally supplemented with an IP 67 counterpart.

**What are the technical highlights of the EtherCAT Box and in particular the current new solutions at the SPS/IPC/DRIVES show in November 2010?**

The main highlight is the consistent integration of EtherCAT into each individual box in a small housing size. The complete integration of EtherCAT technology, including Distributed Clocks, Hot Connect, Time Stamp and so on enables the seamless use of this technology outside the control cabinet. Alongside an incremental encoder box and an analog input/output box, we will also present new IP 67 safety variants at SPS/IPC/DRIVES in Germany. In order to also use the EtherCAT Box in other environments, which has been requested by many users, we have extended the operating temperature range to well below zero (Celsius).

**With regard to engineering and installation, are there any special advantages associated with the predefined cable sets or plug connectors, and why is Beckhoff using M8 plug connectors as the connection method?**

The use of prefabricated cable sets essentially gives you the following advantages: time savings when cabling, avoidance of wiring errors and

savings on maintenance efforts. The M8 plug connector is increasingly being used in newer installations, by the way: one plug – one signal, while the M12 is standardized in certain industries. We didn’t want to “rock the boat,” which is why we support both variants. The available space was the decisive factor for the EtherCAT cabling. Two M12 plug connectors would simply not have fit into the given basic format of the boxes (126 x 30 mm). Thanks to the screened plugs of the M8 EtherCAT connections in conjunction with suitable Ethernet cables, we can also guarantee a distance of 100 m between two EtherCAT Box Modules. The same applies here: of course the users themselves can manufacture the cables as required using cable sold by the meter and plugs that can be assembled in the field, but the majority of customers use our wide range of prefabricated cables in the widest variety of lengths and cable materials.

EtherCAT Box [www.beckhoff.com/EtherCAT-Box](http://www.beckhoff.com/EtherCAT-Box)

Stefan Ziegler  
Editor-in-chief, Elektro Automation, Germany



**Dirk Bechtel, Product Manager Fieldbus Systems:** “Thanks to the integrated EtherCAT interface, the modules can be connected directly to an EtherCAT network without an additional coupler box; the high performance of EtherCAT is retained into each IP 67 box. Each box is an autonomous EtherCAT slave that is connected directly to an EtherCAT controller via an Ethernet cable with 100Base-TX.”





The EP1908 EtherCAT Box for the TwinSAFE system facilitates the acquisition of eight safety sensor signals directly on the machine or plant.

Safety technology: EP1908 EtherCAT Box with eight fail-safe inputs

# TwinSAFE, machine safety simplified in harsh industrial environments

The TwinSAFE open safety technology is now available to the IP 67 world with the new EP1908 EtherCAT Box. The EtherCAT Box has eight 24 V DC inputs and enables the acquisition of safety sensor signals directly on the machine or plant. The EP1908 conforms to the requirements of IEC 61508 SIL 3 and DIN EN ISO 13849 PL<sub>e</sub>.

The TwinSAFE safety solution is already integrated into the Beckhoff IP 20 systems – the Bus Terminals and EtherCAT Terminals. That is now extended to the IP 67 system with the moisture- and dust-resistant EP1908 EtherCAT Box. Up to eight safety sensors can be connected to a module via M12 plug connectors. The necessary logical links of the acquired signals are carried out by the IP 20 TwinSAFE logic terminal, which is the core of the system. The safety application is configured or programmed in TwinCAT automation software. It is subsequently loaded via the bus system to a TwinSAFE logic terminal of type KL6904 (Bus Terminal) or EL6900 (EtherCAT Terminal). All safety devices in the plant communicate with this logic terminal. The certified safety function blocks of the TwinSAFE logic terminals allow the simple and inexpensive implementation of all safety tasks.

EtherCAT Box EP1908 [www.beckhoff.com/EP1908](http://www.beckhoff.com/EP1908)  
TwinSAFE system [www.beckhoff.com/TwinSAFE](http://www.beckhoff.com/TwinSAFE)

**i** Product announcement estimated market release 1<sup>st</sup> quarter 2011

# Serial interfaces in compact IP 67 box



The new EP6002 2-channel EtherCAT Box module in protection class IP 67 enables the integration of external devices with an RS232 or RS422/RS485 serial interface into an EtherCAT network.

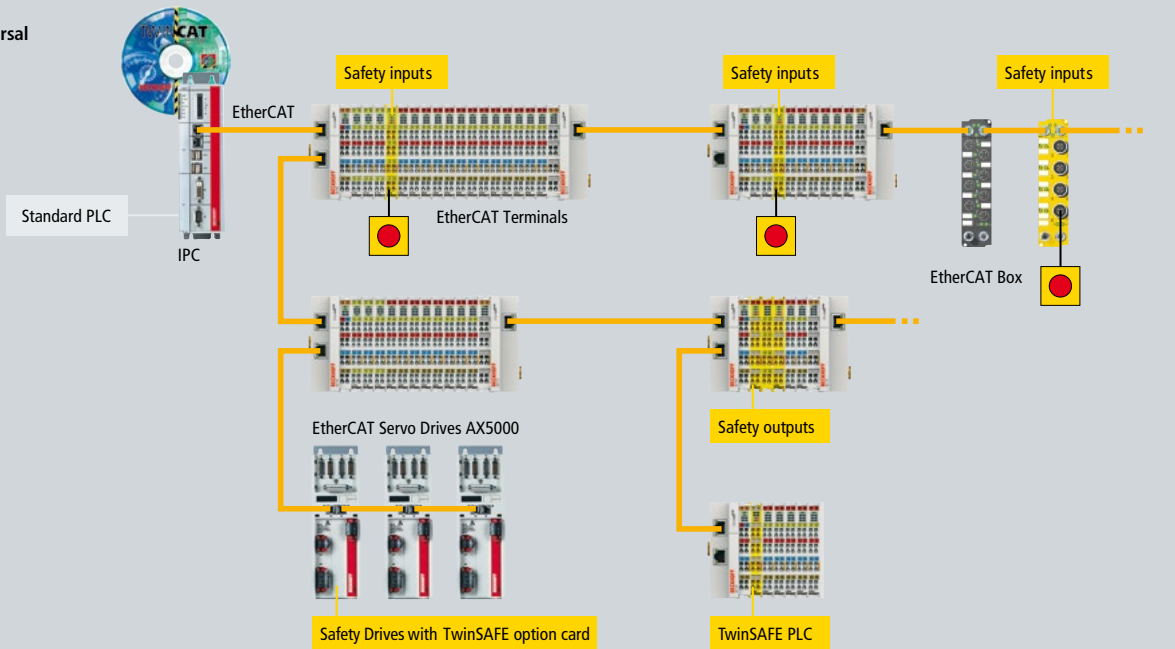
The new EP6002 EtherCAT Box Module permits the direct integration of external devices with a serial interface, such as barcode or RFID readers, in the field without a control cabinet. Using selectable RS232 or RS422/RS485 interfaces, the compact IP 67 module with two channels offers high flexibility for the integration of serial devices into an EtherCAT network.

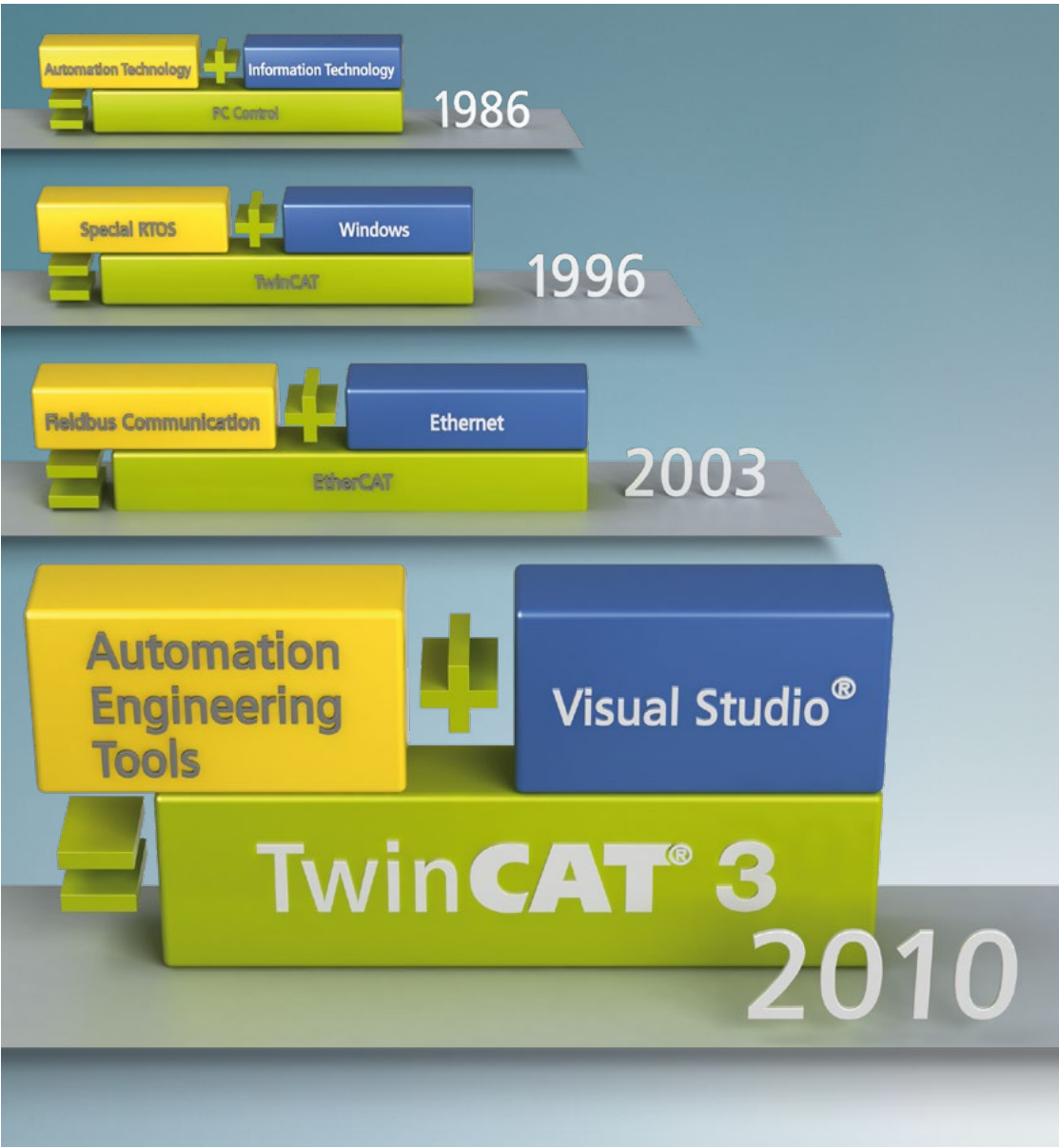
The EtherCAT Box's small dimensions of only 126 x 30 x 26.5 mm (H x W x D) make it ideal for applications in confined spaces. The IP 67 box EP6002 enables the simple connection of devices with an RS232 or an RS422/RS485 interface. The module transmits the data in a fully transparent way to the higher level EtherCAT controller. The active serial

communication channels operate in full duplex mode at up to 115,200 baud, wherein an 864-byte receive buffer and a 128-byte transmit buffer are available for the temporary storage of the data in the EtherCAT Box. The serial devices are connected via rugged M12 plug connectors. With the "TwinCAT Virtual Serial COM Driver" software, the EP6002 EtherCAT Box can also be used without a controller as a COM interface in Windows operating systems.

EP6002 EtherCAT Box [www.beckhoff.com/EP6002](http://www.beckhoff.com/EP6002)

TwinSAFE from Beckhoff: the universal safety system from I/Os to drives.





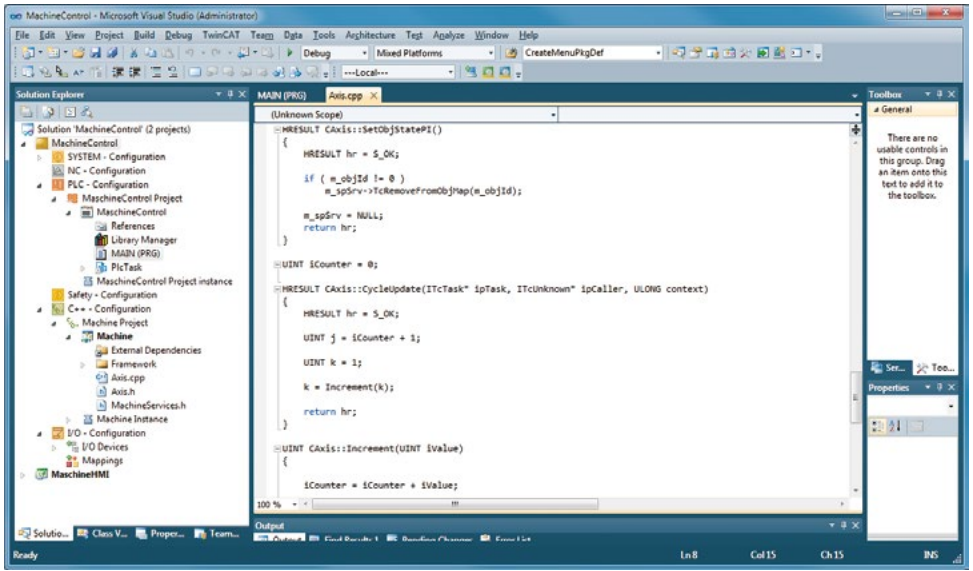
eXtended Automation Engineering (XAE):  
Visual Studio® 2010 – enhanced for automation

# TwinCAT 3 – convergence of technologies

Beckhoff has adapted useful mainstream technologies from the IT industry for automation with the new software generation, TwinCAT 3. As a result, Microsoft Visual Studio® 2010, the world-famous IT tool, can now also be optionally used for automation and application programming. All main programming languages such as C/C++, Matlab®/ Simulink® or the object-oriented IEC 61131-3 extensions are integrated in a single development environment.

Real-time

- System Manager
- LD editor
- FBD editor
- SFC editor
- IL editor
- ST editor
- CFC editor
- Visual C/ C++ editor



Non-real-time

- C#
- .NET
- Visual Basic
- C++
- Silverlight

Visual Studio® integration: Automation devices and application programming in one environment

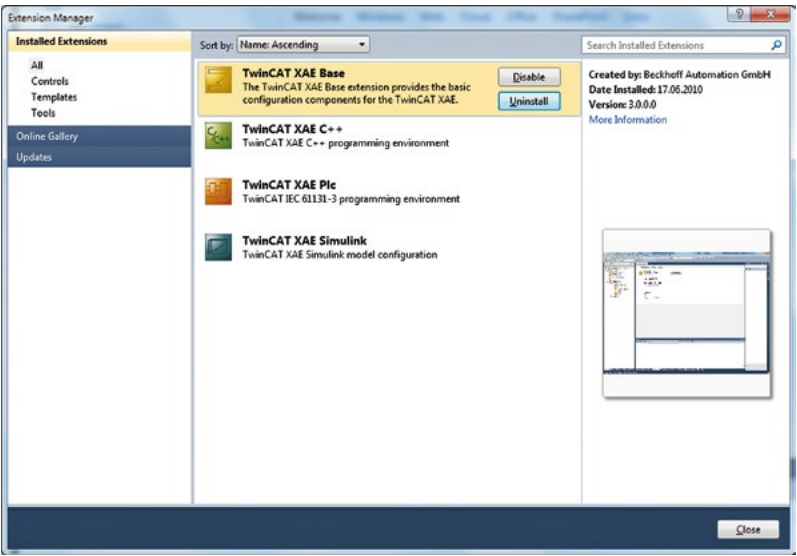
TwinCAT 3 is the result of the consistent technological development of the familiar TwinCAT 2 automation software, which has been tried and tested in numerous applications around the world. In addition to the object-oriented IEC 61131-3 extensions, the languages C and C++ of the IT world are now also available to TwinCAT users. The integration of Matlab®/ Simulink® also opens the way for scientific applications. The modules written in different languages run in a common eXtended Automation Runtime (XAR). This provides an answer to harsh real-time conditions with the use of multi-core technology and the support of 64-bit operating systems. The implementation of TwinCAT 3 modules and the configuration of the overall system take place in the eXtended Automation Engineering environment (XAE), which is based on Microsoft Visual Studio.

## eXtended Automation Engineering (XAE)

The engineering environment used by TwinCAT 3 is the Microsoft Visual Studio 2010 development environment, which is commonly used in IT software development. The two modes, "TwinCAT 3 Standard" and "TwinCAT 3 Integrated," use the "Visual Studio Shell" version, which is accessible via the Microsoft program "Visual Studio Industry Partner" (VSIP). The earlier Visual Studio 2008 version had already provided a business model in VSIP that makes it possible to use and to easily customize the Visual Studio development environment. The free basic version of "Visual Studio Shell" additionally offers all of the functions required by a modern development environment in order to support modular software development: Besides the interfaces for inserting proprietary editors into the project engineering tree or into the menus, all other services can be used, from the compiler to the help system. With expandability via plug-ins – the so-called "VS-Extensions" – the framework can grow and be adapted and updated rapidly and modularly with proprietary technological know-how.

## TwinCAT 3 in "Standard" mode

There are two possibilities to install TwinCAT 3 on a target system: If no Visual Studio 2010 version currently exists on the target system, then a free basic version of the VS Shell with the TwinCAT extensions is installed with TwinCAT 3. This use of the shell is called the "Isolated Mode": several hundred companies use the VSIP program and can load their extensions into their own instance of the VS Shell. As a result, many "Isolated Mode"-based applications can be operated in parallel without disruptions. The TwinCAT mode "TwinCAT 3 Standard" is intended for all users who only wish to configure and to use IEC 61131 exclusively as a programming language set. The System Manager dialogues familiar from the TwinCAT Version 2 environment have been adopted, so that the user

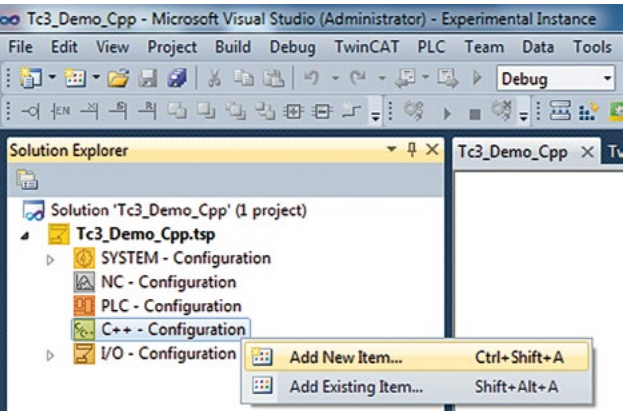


TwinCAT 3 modules integrate themselves as "Visual Studio Extensions" into the Microsoft Visual Studio 2010 environment.

immediately finds himself on familiar ground. The use of TwinCAT C or Matlab®-Simulink® modules at runtime is possible, but the appropriate VS environment for changing or debugging C/C++ code is not available.

“TwinCAT 3 Integrated” offers access to the C/C++ world

If one of the Visual Studio 2010 versions “Professional,” “Premium” or “Ultimate” is available on the target system, then there are two options: Here too, TwinCAT 3 can be installed in parallel in a “VS Shell in Isolated Mode.” It makes more sense, however, to use the operating mode “TwinCAT Integrated,” which integrates itself into the VS2010 existing on the computer. The C/C++ programming language is thus additionally available for real-time tasks. The modular Visual Studio environment can also be extended by components from the “Visual Studio Gallery”: In addition, information on the VS extensions available in the Internet marketplace can be displayed in the “Extension Manager” menu. Products can be bought, graded and commented on in the Microsoft marketplace. Currently more than 1286 extensions from various suppliers are available for direct download and for integration in the VS Shell for the Visual Studio 2010 platform alone. Some of the extensions on the marketplace are free. The variety of the VS

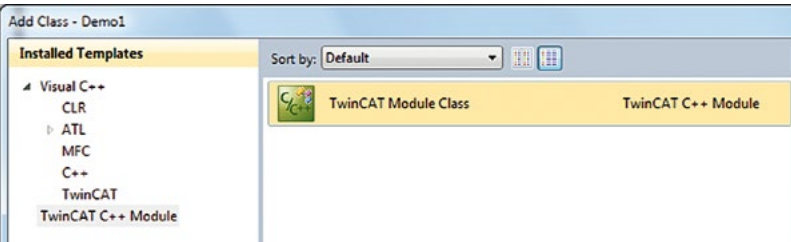


extensions is virtually unlimited: From .NET or Silverlight components for the creation of operating interfaces, or tools for generating setups or for the modeling of software packages, to team development tools, such as SVN SubVersion as an alternative to the existing Team Foundation Server (TFS). All marketplace components promise to facilitate engineering.

Enhanced for use in automation technology

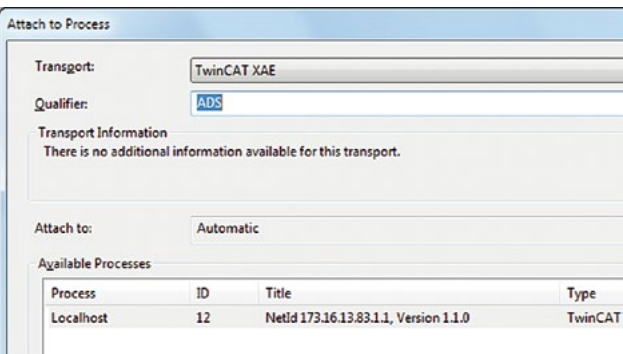
In addition to the C/C++ languages, Beckhoff has also integrated the IEC 61131 programming options and the TwinCAT System Manager – the configuration tool for system, modules, I/O and motion – into this modular VS development environment. This means that two tools with mutual export/import steps are no longer necessary for the exchange of configurations during engineering: Integration into a uniform environment simplifies handling, dispenses with administrative detours, accomplishes tasks automatically in the background – thereby eliminating possible sources of error – and in this way makes more efficient engineering possible. An exciting observation is how the implementation possibilities in the two worlds of the conventional PLC and C-coding are growing toward

one another: Using TwinCAT 3, PLC programmers can use additional object-oriented functions that the PLC world had previously been denied: TwinCAT 3 already offers the features of the new IEC 61131-3 3rd Edition. With respect to the object-oriented programming structures, the advantages of the extension and modernization of the standard can already be used in all languages within IEC 61131. The possibilities include single inheritance as well as the possibility to use interfaces, methods and attributes. The implementation in C/C++ code is beneficial above all to users from the image processing, measuring technology and robotics industries: Axis transformations can be created more efficiently; a C-code basis is frequently already available and can now be easily integrated into the powerful TwinCAT 3 substructure. Talented young programmers do not learn PLC sequential function charts at university, but modern high-level languages instead. However, C/C++ programmers will also have to get used to a different procedure. Whereas most developers have so far mostly created event-controlled applications, the C-code is now executed cyclically in the real-time context. If actions are to be started in the C-code that require a longer processing time than the cycle time allows, then these tasks must be decoupled.



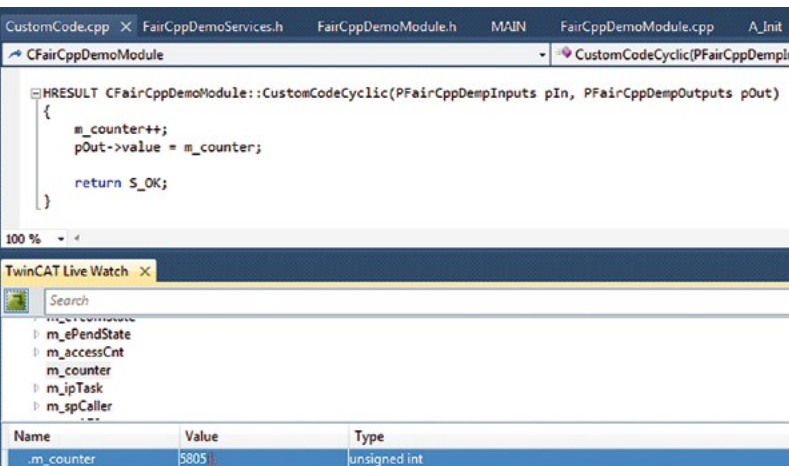
In addition to I/O configuration and PLC programming, C/C++ code can also be created in the TwinCAT 3 project. Wizards for the creation of basic projects, classes and I/O variables make efficient engineering possible.

Beckhoff provides a “Software Development Kit” (SDK) for this, in order to start actions from the deterministic real-time process and to monitor the processing status: the reading/writing of files, the starting of threads, the allocation of memory and communication with databases takes place via functions from the SDK and corresponds to the mechanism of the use of PLC libraries familiar to the PLC programmer. The C compiler contained in Microsoft Visual® Studio 2010 is used for the generation of C-code. After the compilation the object code is loaded into the real-time runtime system in the form of dynamically loadable libraries (DLL). The user is thus able to extend the TwinCAT system with program modules. Diagnostic options, such as the monitoring and changing of process variables during a running PLC cycle, are matters of course for PLC programmers. A C developer doesn’t get very far with the available on-board mechanism and must initially stop the execution of the code with a breakpoint in order to modify the status of the symbols in the watch window. Here, too, Beckhoff has extended the Visual Studio® options and created ideal diagnostic options for the use of C/C++ in automation technology: A custom debug transport channel was created with the aid of the



TwinCAT 3 offers significantly improved online and debugging options for C/C++ applications: The custom transport channel allows the selection of local and remote TwinCAT C/C++ modules.

“Custom Debugger Interface.” The online data are subsequently available in a “TwinCAT watch” window for monitoring and changing, without having to stop the machine sequence with a breakpoint. This diagnosis of the real-time application is available both locally and via remote access. Visual Studio® offers further languages for designers: Silverlight-Designer or .NET-based languages, such as C#, can be used for the programming of non-real-time parts of the application, e.g. the user interface. In the “Visual Studio® Shell,” Microsoft supplies a platform with the necessary interfaces for extensions. Its combination with the Beckhoff extensions for automation technology results in the powerful, modular platform called “eXtended Automation Engineering” (XAE): All components, from the I/O configuration, the PLC and/or C-code, up to the GUI or database linking, can easily be managed in the same project for team use as well. Beckhoff has once again remained true to its philosophy:

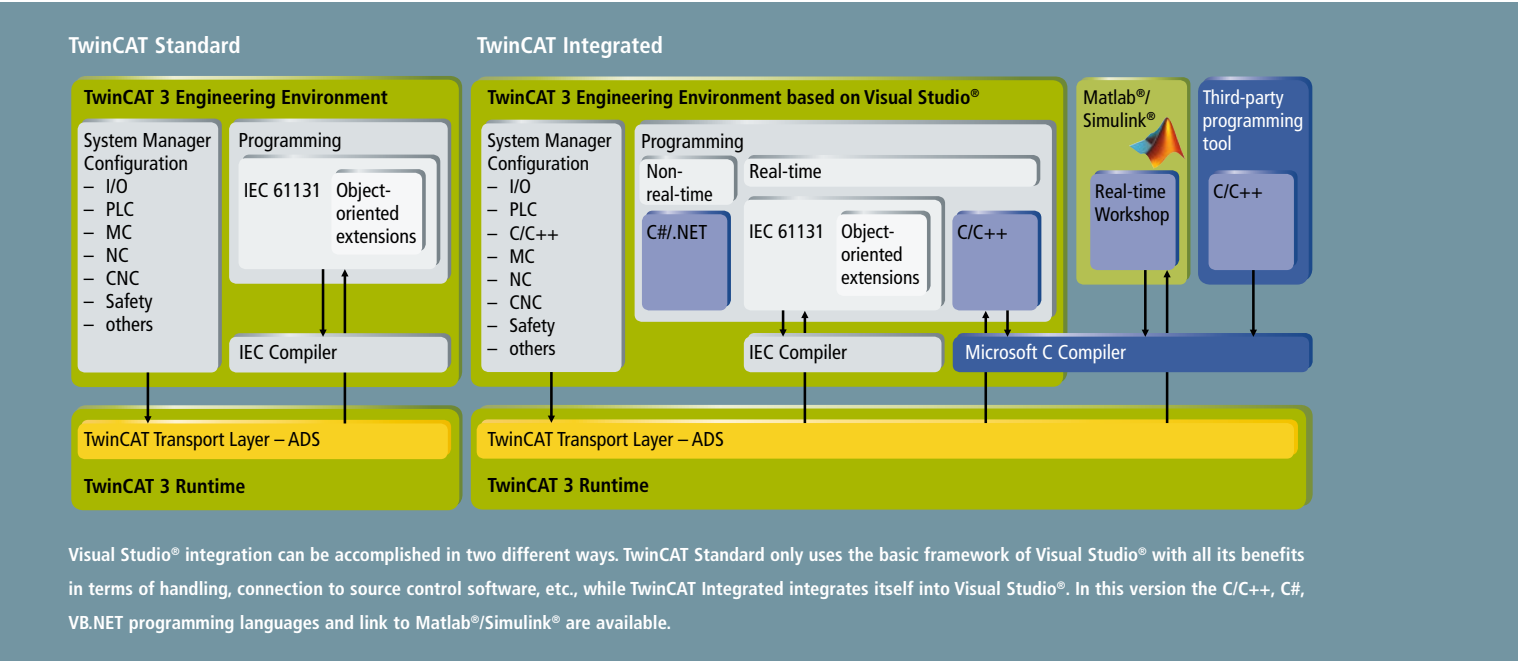


The routine “CyclicUpdate” is cyclically processed. The internal variables are available for monitoring in the TwinCAT online watch window even without having to set a breakpoint.

beneficial and commonly used solutions from the IT world are accepted and used for automation technology.

[www.beckhoff.com/TwinCAT3](http://www.beckhoff.com/TwinCAT3)

 estimated market release 2<sup>nd</sup> quarter 2011



EtherCAT and high-speed automation for register control

## Exceptional precision and flexibility

How do you modernize a register controller for web printing machines that has been setting standards in terms of performance for nearly 20 years already? eltromat GmbH, a global market leader in high-quality optical quality measuring and monitoring systems for inline processes, was faced with this difficult question. New requirements now need to be fulfilled due to the changing production and automation environment in the printing industry. It quickly became clear that only a change from the proprietary solution to an open one – implemented with PC control, EtherCAT and XFC technology from Beckhoff – would make the desired precision, flexibility and communication capability possible.

Electronic register controllers are indispensable in web printing for the permanent and program-controlled monitoring of the register. This is in order to synchronize the fields of the printing machine and to print the colors of the individual printing units precisely on top of one another. The corresponding eltromat controllers from the “register” product range are the result of many years of development and intensive optimizations based on the needs of the printer. They were developed consistently for the requirements of the most diverse areas of application in web printing – for gravure, flexo, offset and screen printers for inline or offline processes.

The latest generation of register controllers – the regi\_star 20 – is equipped for the detection of print marks with fiber-optic sensor heads or CCD matrix cameras. They ensure the complete detection and measurement of highly complex printing marks even at speeds of up to 1000 m/min. Standardized or individually created printing marks are detected precisely, automatically and with positioning of the measuring window – independent of their parameters such as arrangement, geometry, contrast or order at the edge of the printing web within defined zones or at freely-selectable positions in the print images. The entire operation is menu-guided; all status messages are displayed in plain text. In the event of fluctuations of the web tension and the resulting register deviations, the patented accelerator permanently ensures optimal controller behavior. Even register errors, such as those that can result from roll changes, splices or incompletely printed register marks, are automatically registered and accounted for in the controller behavior.

### Impressively precise and failure-proof...

From the complexity of the tasks described, one can already imagine the height of the demands placed on the register controller. This is made clear by the following performance characteristics, as explained by Dipl.-Ing. Volker Reinholdt, Project Manager at eltromat: “The local acquisition of the measured values with a precision in the range of 5 µm places high demands in particular on the accuracy and synchronization of the distributed clocks. This must lie in the region of 100 ns and is therefore in the high-end area. The cycle time is around 1 ms and does not fully exhaust the performance capability of the TwinCAT PLC.” The number of networked EtherCAT devices is around 150 to 200 I/O terminals and up to forty optical sensors (register mark sensors developed by eltromat).

The replacement of the previous proprietary and completely in-house developed register controller generation had less to do with the efficiency or measurement accuracy, because this was also achieved before, albeit via individually wired devices instead of by bus communication. Only the cycle time of the controller was around 8 ms slower than the new version. In addition to this, the old system was developed at the beginning of the 1990s and

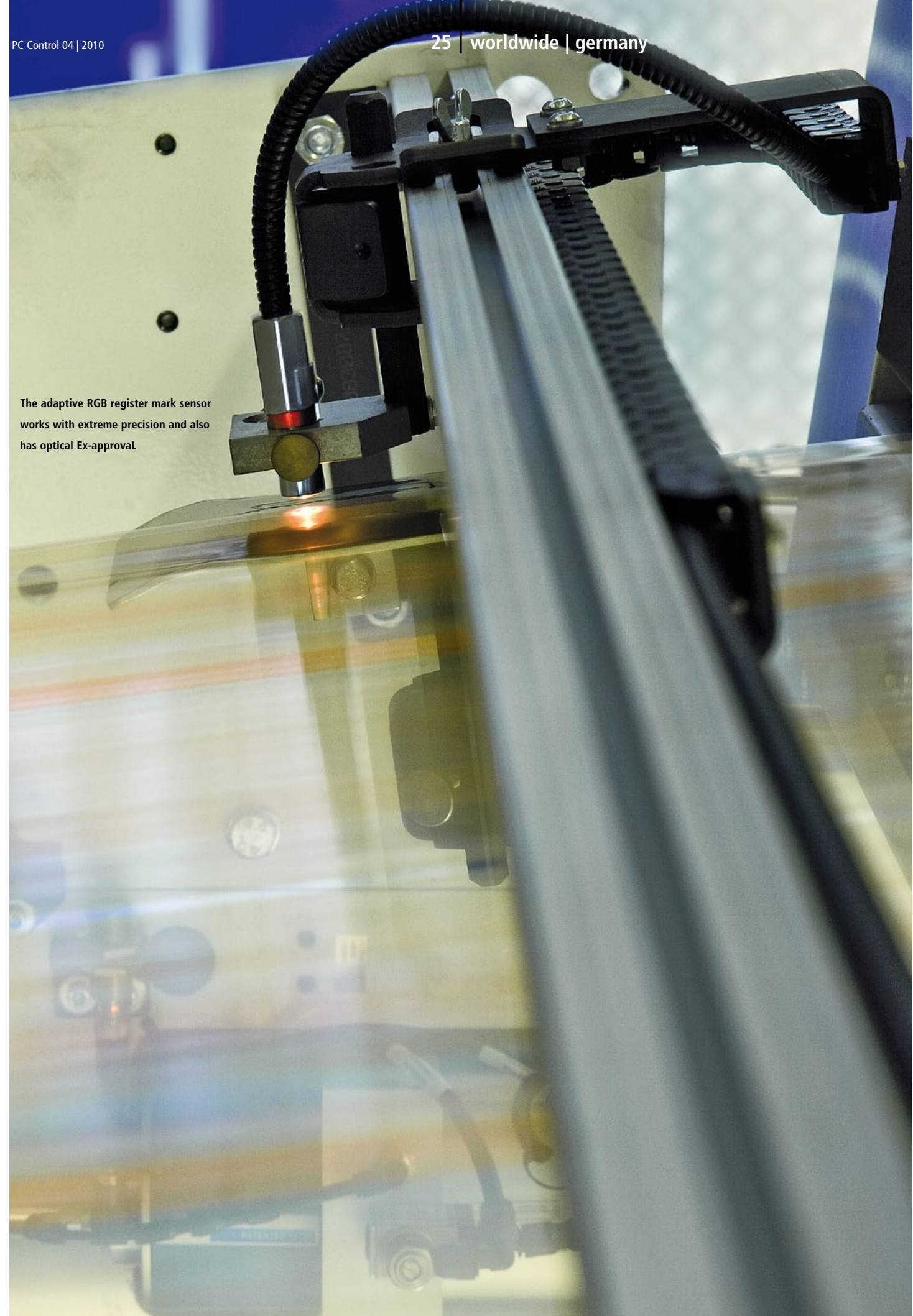
had thus been on the market for a very long time and was above all extremely failure-proof. eltromat Managing Director Dr.-Ing. Johann-Carsten Kipp also considers this reliability to be a very important success factor, which also had to be achieved by the successor model regi\_star 20: “The reliability of the old system was really exorbitant, and in two ways at that: not only stochastic failures, but also lifetime. Our register controller is famous for never failing.” So why redevelop it and change to an open control technology at all? Volker Reinholdt says: The architecture was very much tailored to the special task and was still 20 years old; that is to say, it no longer fit into the modern automation environment. At the end of the day, we are suppliers to printing machine manufacturers who are naturally also using bus systems to an increasing extent. Their integration would have required a great deal of development expenditure.”

Dr. Johann-Carsten Kipp adds: “Apart from the improved communication options, we profit from significantly increased flexibility; that is to say, applications can be changed today very much faster and with less expenditure. In addition to that, more and more of the old components were being discontinued and support expenditure had thus risen enormously. However, our customers expect the long-term guarantees from us that they are used to.”

### ...and now also open...

Due to the changing requirements, eltromat was faced with the decision of whether to develop a proprietary solution entirely in-house, or to employ open standards. According to Volker Reinholdt this decision became clear relatively quickly: “We no longer wanted to develop all of the computer cards ourselves, but rather to concentrate on our core competencies; in other words, the actual ‘register control’ application. At the end of the day, PC technology is advancing continuously and rapidly. Proprietary developments would therefore have been too complex and not profitable for small series.” eltromat had more difficulty with the decision regarding the operating system to be used on the Industrial PC – a Linux derivative with real-time extension or a Windows platform with appropriate software automation components.

Ultimately the expenditure to be expected with a change of technology proved to be decisive: The use of Linux would have entailed the proprietary development of a complete framework. The goal was therefore to base the development on a stable and open platform and in this way to profit without great expenditure from the simple integration of arbitrary I/O hardware or of fieldbuses without additional drivers and to be extremely flexible in the integration of new functions. Dr. Johann-Carsten Kipp sees another advantage of the Windows-based software PLC: “A further argument was the short time to market. With Linux you are dependent on someone getting around to devel-



The adaptive RGB register mark sensor works with extreme precision and also has optical Ex-approval.



Dr.-Ing. Johann-Carsten Kipp, Managing Director at eltromat GmbH



Dipl.-Ing. Volker Reinholdt, Project Manager Product Development at eltromat



The print marks are detected quickly and precisely thanks to XFC technology from Beckhoff.

oping a driver for your hardware at sometime or another. There is usually no such uncertainty in terms of time with Windows operating systems.” Volker Reinholdt also confirms that the decision made at that time was absolutely correct: “So far we have had no disadvantages from the use of Windows and the TwinCAT PLC software running on it. And even the original wish to program according to completely object-oriented principles in C/C++ in addition to the classic IEC 61131-3 PLC programming languages will shortly be possible to realize with TwinCAT 3 automation software from Beckhoff – if our developers still want to do so at all following the good experiences we have had with the PLC programming.”

On the other hand, the decision in favor of EtherCAT as the bus system was an easy one to make for the eltromat experts: at the end of 2006/beginning of 2007, the few Ethernet-based bus systems available at that time were evaluated, with the result that only EtherCAT could provide the necessary performance. Dr. Johann-Carsten Kipp summarizes: “Back then, many were talking about ‘real-time Ethernet,’ but only Beckhoff could actually offer what we wanted – namely the synchronization of the distributed clocks in the 100 ns range.” The mode of operation of the ‘Distributed Clocks’ – a component of the extremely fast XFC technology (eXtreme Fast Control) – is described by Beckhoff sales employee Stefan Sieber: “If we consider a normal, discrete control loop, then the measurement of an actual value is performed at a certain time, the result is delivered to the controller, the reaction is calculated and its result is communicated to the set value output unit and output to the process. For many control processes a strict determinism of this sequence is sufficient. The controlled system determines the necessary speed of the control process. Usually, dead times occurring in controllers, the controlled system, actuating and measuring units are taken into account accordingly in the design of the controller or they can perhaps be

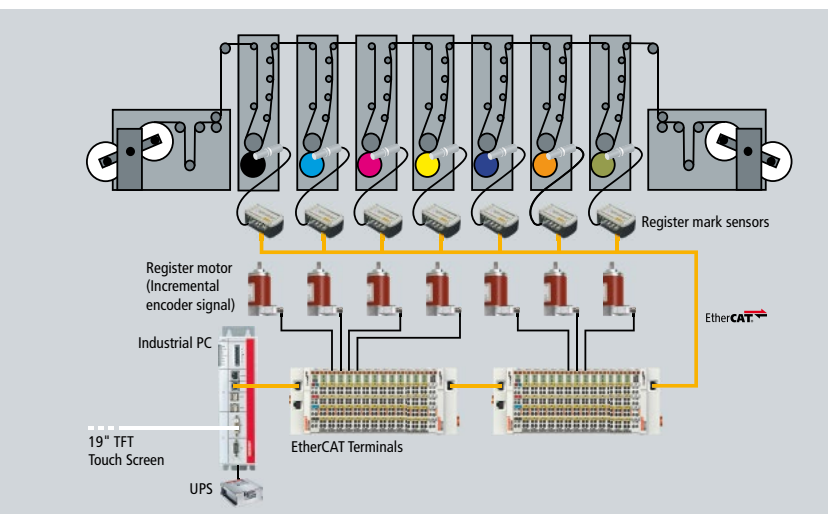
compensated. These procedures are basic principles of control technology and have, of course, been standard for many years under TwinCAT. Additionally for the register control, the print marks detected by the print mark sensors must be matched to the high-precision angular positions of the printing units in order to then determine the differences between the positions of the print marks. The necessary temporal exactness for the print marks and detection of the positions of the printing units is supported by high-precision clocks in the I/O components. The EtherCAT devices each have their own local clocks, which are constantly synchronized with one another via EtherCAT. Differences in the absolute time of the EtherCAT devices concerned are compensated, so that the maximum deviation of all distributed clocks in the system is always less than 100 ns.”

After the decision had been taken for an open, Windows-based solution, this had to be physically implemented at eltromat. For the developers in particular, who were used to working in an embedded controller world, the step to a PLC was first of all strange and by all means subject to some preconceptions. However, the initial skepticism has quickly dissolved thanks to the considerable advantages, i.e. a stable environment or framework, easily integrable peripheral hardware and extensive diagnostic tools. The corresponding know-how had to be acquired very quickly within the running time of the project, however, which is why eltromat pursued a two-pronged strategy: first of all a one-week in-house training course was held, and subsequently a Beckhoff technician was integrated into the development team for four weeks – a very

### High-speed with XFC

XFC (eXtreme Fast Control) is based on an optimized control and communication architecture consisting of an Industrial PC, I/O terminals with advanced real-time properties, the EtherCAT high-speed Ethernet system and the TwinCAT automation software. I/O response times < 100 µs can be realized with XFC. This technology opens up new process optimization options for the user. The EtherCAT Distributed Clocks thereby represent a core XFC technology.

[www.beckhoff.com/XFC](http://www.beckhoff.com/XFC)



The structural principle of the register controller

short time, but an indication of the simple-to-handle automation technology on the one hand and of the efficient support by Beckhoff on the other. In this manner it was possible to develop the new register controller from the preliminary investigations to the first system running on a production machine in just one year. Dr. Johann-Carsten Kipp comments on this achievement as follows: “Taking the approximately halved time to market as a basis, one can assume that the development costs were around 50 % lower. For a proprietary system we would have spent twice as long developing it or we would have had to invest in additional personnel.” He also describes the controllable development progress as a further very important advantage: “This is only possible with the open system. If you develop a proprietary system, which means you are forced to develop the hardware and software separately from one another, then the two can only be tested together at the end. This nearly always leads to redesigns and/or changes of code. On the basis of PC technology, however, the software code can always be verified with the existing hardware. That was an essential element for development security.”

### ...flexibly and easily integrable

The following Beckhoff components form the basis for the flexibility and the capability of communication to the automation environment achieved by standard technology:

- | C69xx Industrial PC with TwinCAT software for register control or print mark control,
- | C62xx IPC for the eltromat image processing,
- | IEC 61131-3-compatible TwinCAT PLC (software PLC),
- | EtherCAT Terminals with standard and XFC technology and
- | CU20xx Ethernet switches.

The decisive success factor for the project was the fast integration of the EtherCAT interface into the optical sensor solution developed by eltromat. Stefan Sieber explains: “The optical sensor from eltromat has an EtherCAT communication ASIC, which uses the function of the Distributed Clocks. This is supplemented from our side by the EL5101 Incremental Encoder Terminal, into whose standard functions we have incorporated special requirements from eltromat.”

Thanks to this powerful standard technology, the eltromat developers were able to concentrate all the more on their core competency, e.g. the realization of the optical, adaptive register mark sensor. This was completely developed from the optics through to the integration of the EtherCAT chip and detects both lateral and longitudinal register deviations, wherein it can also detect extremely low-contrast and metallized colors as well as transparent lacquers. The sensor – with optical Ex-approval – analyzes the chromatic spectrum of the light reflected by the web in order to enable the reliable detection of all register marks automatically. Thanks to the large depth of focus of the fiber optics, the user need change neither the signal amplification nor the scanning angle – the reliable detection of the marks is therefore an absolutely intervention-free procedure. With its fully automatic sampling technology, the sensor designed for the regi\_star supports the single-head measurement process patented by eltromat. This technology enables both sequential control for a fast production start and standard color control for the best possible production quality. A maximum reduction in waste and costs is achieved by the process-dependent automatic changeover between sequential and standard color control or by the use of the different measurement and control procedures in any combination.

Apart from the technological advantages of the color sensor – according to Volker Reinholdt – the higher system flexibility also has a considerable effect: “What we still very much appreciate with Beckhoff is the fact that you can reach all major fieldbuses available on the market via a gateway terminal. There is a great advantage in this for us, since our customers use the most diverse automation technologies and are thus constantly requesting us to provide special interfaces. The system is also flexible with regard to the structure of its hardware; that is to say, some customers wish to accommodate the I/O terminals directly in the associated printing unit, while others want to house all terminals together in a separate control cabinet. We couldn’t have provided that previously.” Dr. Johann-Carsten Kipp adds: “In addition to that, we can now adapt the register controller much better to OEM applications thanks to the scalable automation system; in other words, the customer only needs to buy what is really necessary and besides that they have better options to modularize and standardize the printing machine.”

In the meantime eltromat has sold over 100 regi\_star 20 units, the majority of which are already in operation. The system has worked stably in many different forms from the prototype onwards. Due in particular to its good integration in the automation environment and its modularity, eltromat has been able to reduce manufacturing costs compared to the predecessor system and has passed this advantage on to its customers. This is surely not just a short-term success, since the flexible hardware architecture of the regi\_star 20 allows the integration of further functions at any time, and a unique intelligent link between register control and web monitoring has been created.

Eltromat [www.eltromat.de](http://www.eltromat.de)





Scientific Automation: High-precision temperature measurement and signal acquisition in climatic chambers

# PC-based measurement technology for Miele quality assurance

Quality, strength of innovation, tradition – these are values to which Miele & Cie. KG has been committed to since the business was founded in 1899. True to the guiding principle of “Forever better,” the name Miele stands for the development and production of domestic appliances and commercial equipment that meet the highest quality standards. The quality assurance system and the feedback of test and measurement data in all relevant processes are among the key factors in the success of the Miele brand. “Scientific Automation” from Beckhoff has been a part of these sub-processes for about two years now.

For several generations, the family-owned Miele company, with headquarters in Gütersloh, Germany, has produced premium household appliances and first-class commercial equipment that are designed for high quality, long service life and sustainable resource conservation. Each year, more than 7 % of the company’s sales is invested in research and development. Miele has production facilities in eight plants in Germany and one plant each in Austria, the Czech Republic, Romania and China. The extensive product range includes washing machines, clothes dryers, built-in cookers and ovens, dishwashers, fridges and freezers, fully automatic coffee

machines, microwave ovens and much more. The entire product range undergoes constant, intensive quality tests and checks.

### Automated test and measurement

The central division in Miele’s Gütersloh plant is also responsible for basic research for the “Cooling & Coffee International” (CCI) business unit. “The CCI Test and Development Center includes 11 climatic chambers with a total of 14 stand-alone measuring systems, in which fridges and freezers, fully automatic coffee machines,

A climatic chamber usually contains a measuring system with four measuring stations; some climatic chambers were equipped as dual chambers that incorporate eight measuring stations. CCI’s Basic Research has a total of 56 measuring stations at its disposal for testing fridges and freezers, fully automatic coffee machines, and microwave ovens.

Testing a built-in fully automatic coffee machine:  
For each measuring system, 80 channels for high-precision temperature measurement with PT100 sensors are available.



In a total of 11 climatic chambers, fridges and freezers, fully automatic coffee machines, and microwave ovens are put through a rigorous testing program to meet Miele’s exacting quality standards.

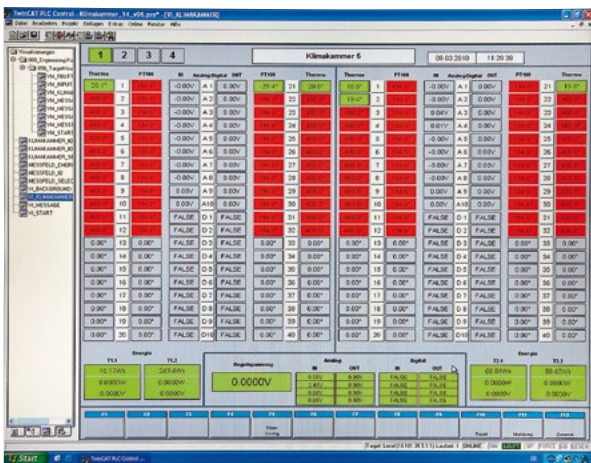


and microwave ovens are put through a rigorous testing program,” reports Benjamin Held, Development Engineer in CCI Basic Research. A climatic chamber usually contains a measuring system with four measuring stations. Some climatic chambers were equipped with double the number, however, so that a total of 56 measuring stations are available for CCI’s basic research. All measuring stations are equipped with automation and measurement technology from Beckhoff. For each measuring system, 80 measuring channels for high-precision temperature measurement with PT100 sensors are therefore available. There are also connections for 80 thermocouples, 20 analog inputs and outputs, and 20 digital inputs and outputs. All connection points take the form of Beckhoff EtherCAT terminals. Each climatic chamber is equipped with a C6650 industrial PC from Beckhoff that provides the central control functions for the chamber. A Beckhoff CP6903 Control Panel is built into the control panel door and facilitates visualization of the application and the dialog with the PLC.

The software-PLC used in the application is TwinCAT PLC. For programming, Miele focuses on IEC 61131-3. On this subject, Benjamin Held commented that: “The test applications are programmed in the Structured Text programming language.”

### High-precision temperature measurement through certified accuracy

Climatic tests are accorded a very high priority at Miele, because refrigeration technology is extremely sensitive to climatic conditions. Since the refrigerators are used worldwide and have to run 24/7, year after year without interruption, all operation conditions must be evaluated. As Benjamin Held continued: “Our fridges and freezers are not just used in European households. Depending on the location, and considering countries in Asia or the Middle East as examples, temperatures up to 43 °C (109 °F) and air humidity up to 90 % RH can exist. We have therefore defined ‘climate categories,’ and we test in conformance with standards that category conditions are maintained. Other factors such as transportation condi-



Michael Jost, Product Manager for EtherCAT and Beckhoff I/O systems: “The EL3201-0020 high-accuracy temperature terminals are metrology modules that undergo a special setup procedure by Beckhoff during manufacturing. If climate categories are to be tested very accurately, the control technology must always be one step better to ensure that the tolerances will be maintained.”

Benjamin Held, Development Engineer in the Basic Research department of Miele’s “Cooling & Coffee International” (CCI) business unit: “Painstaking environmental tests to evaluate all operating conditions guarantee that Miele refrigeration units can also be used in extremes of climates and will run around the clock, year after year, and without interruption.”

tions are also simulated, where appliances are exposed to a temperature range of -20 °C (-4 °F) to +60 °C (140 °F).”

As well as the adaptable test and measurement capabilities, precise temperature measurement is particularly important for Miele. The stated aims are highly accurate temperature measurement in the appliances and precise control of temperature in the climatic chambers. Fundamentally, temperature is a critical process variable that is continuously acquired and evaluated throughout the one- to three-week testing periods.

Based on the “Scientific Automation” solution, the integration of automation technology with measuring tasks, Beckhoff has developed special fieldbus terminals for highly accurate temperature measurement. The usual accuracy of PT100 terminals in industrial applications is around  $\pm 1$  °C. The Beckhoff EtherCAT temperature measuring terminals used by Miele deliver an accuracy of  $\pm 0.1$  °C, which is an impressive improvement by a factor of 10. Michael Jost, Product Manager for EtherCAT and Beckhoff I/O systems, describes the interrelationship as follows: “The EL3201-0020 high-accuracy temperature terminals are measuring modules that undergo a special setup procedure during manufacturing. The factory calibration is recorded in an individual certificate, as required for high-precision measuring equipment. Such dedicated measurement technology is the basis for the integration of high-performance and high-precision measurement technology without special components. If climate categories are to be tested very accurately, then the tolerances must be maintained as well. To ensure this, the control technology must always be one step better. In our view, the measuring device must be better by a factor of 10 than the equipment that it will be used with.”

**High-accuracy signal acquisition with scalable precision**

The second climatic parameter that is acquired in Miele’s application is air humidity. “We use external measuring equipment for this purpose i.e. we use humidity sensors that likewise operate in the high-precision range. Their analog output signals are connected to analog input terminals,” says Benjamin Held. For this application,

**Automated test level**

It is generally known that the sensor level is just one part of a test and control task; the control of actuators or controllers is another part. “The actuators are not standardized. This means that simple actuators, such as fans, can be directly controlled. Other actuators, such as amplifiers or controllers, are controlled via analog output terminals,” says Benjamin Held, while pointing out that today’s refrigerators

The stated aim is the highly accurate measurement and control of the temperature in the appliances and climatic chambers during the entire test period.

Fridge/freezer undergoing testing in the climatic chamber. To ensure that the appliances can be used worldwide, they are specified by ‘climate categories,’ and Miele checks in conformance with standards that category conditions are maintained.



are equipped not just with one compressor cycle or a chiller or compressor, but sometimes have two combined compressors. Moreover, Miele also uses variable-speed compressors, which create extensive opportunities for work and research. In addition - and depending on the climate category and appliance - arrangements known as ‘winter circuits’ may also be implemented. Fans can also be incorporated in an appliance to enable dynamic cooling with a precise temperature distribution. Benjamin Held assesses this interrelationship as follows: “We have a great many parameters at our disposal for controlling the test and measurement tasks. It is important to us that the automated test and measurement technology makes us as flexible as possible, so that we can vary the control variables quickly and accurately. The Beckhoff platform we have implemented means that we can

incorporate these requirements in programming and thus quasi-automate the measurement procedures. This is particularly significant in the area of quality checks, because the program procedures enable us to achieve a high throughput of tested appliances.”

The sensor data from the test and measurement functions of the climatic chambers are transmitted from TwinCAT via the standardized OPC interface to Miele’s parent test-data acquisition system. “This way, we can connect other, external instruments, such as our portable energy meters without any problems,” says Benjamin Held.

Miele & Cie. KG      [www.miele.com](http://www.miele.com)  
Scientific Automation      [www.beckhoff.com/scientific-automation](http://www.beckhoff.com/scientific-automation)

Reproducible measurements through certified precision

Thanks to the high fundamental accuracy of the EL3201-0020 temperature measurement terminal, the measuring error is reduced to  $\pm 0.1$  K of the temperature measurement range. The EtherCAT Terminal enables direct connection of a resistance sensor (PT100) using 4-wire technology. The characteristic curves of the sensors are implemented over their complete measuring range and are made available to the higher-level control system in a suitably linearized form.

Reliable reproducibility of results is becoming increasingly important in a wide range of automation applications, in order to optimize parameters and ensure verifiability, for example for online quality monitoring in running processes. Beckhoff meets these requirements with a calibration certificate that authenticates the measuring accuracy of the terminal and the exact measuring error. Online download of the certificate based on the serial number and terminal handling similar to common analog terminals make the application of high-precision measurement technology very convenient.

[www.beckhoff.com/EL3201](http://www.beckhoff.com/EL3201)

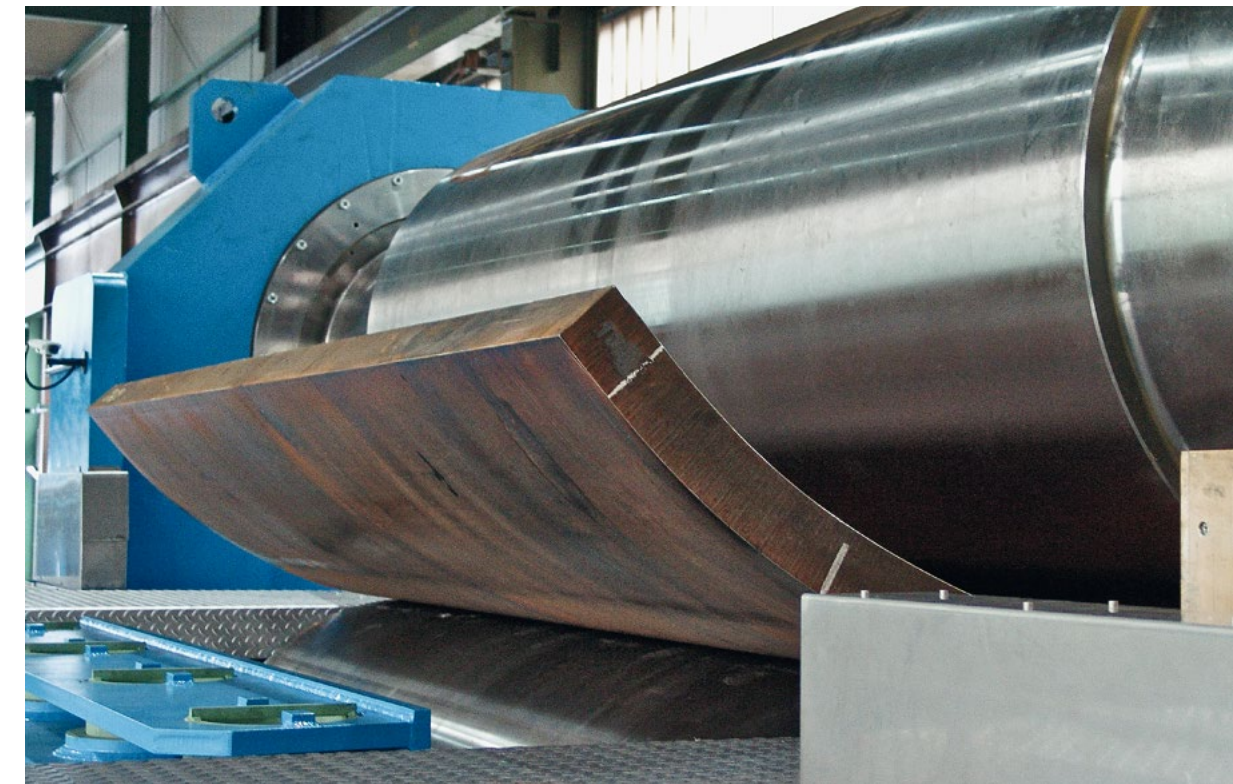
Haeusler AG: new control concept for advanced plate bending machines

## Clever giants bend 320 mm plates in a cold forming process



RMS large pipe plate bending machine for the manufacture of longitudinally welded large pipes.

Haeusler AG has firmly established itself in the plate bending technology market on account of numerous technological innovations. With the new 'BEND-IT Swiss Technology' controller, the Swiss company has developed a new software concept for the control of its plate bending machines. The 'virtual' NC controller combines with automation technology from Beckhoff to form a future-proof and comprehensive control platform. Haeusler has applied this automation concept universally in all of its machines since August 2009.



Maschinenfabrik Haeusler was founded in 1936 in Dornach, Switzerland. The company specializes in plate bending on roller plate and section bending machines and manufactures at two facilities (in Duggingen, Switzerland and Rheinfelden-Herten, Germany). The large-format machines process plate thicknesses of up to 320 mm. "Bending diameters from 16 to 64 inches and lengths of well over 12 m are among the usual formats for us in pipe manufacturing plants," says Michael Fabianek, manager of automation technology, IT and hydraulics at Haeusler. The machines are used, for example, to bend plates for shipbuilding, for the automotive and aerospace industries as well as container construction, for the manufacture of pipes for pipelines and wind farms, for the manufacture of heat exchangers in heating systems, or as section bending machines for steel construction. Haeusler currently manufactures a total of 20 different types of machines.

### Relaunch of the controller aims at process optimization and sustainability

"Control of the forming process is one of the main quality features of our machine concept," stresses Michael Fabianek, manager of automation technology, IT and hydraulics at Haeusler AG. Therefore, the company decided to replace its previous control concept, which consisted of a separate CNC and PLC controller that communicated with one another at the I/O level. Michael Fabianek's expectation was that "the new control solution should integrate CNC and process control on one control platform. Our goal was to reduce maintenance costs and the complexity

of the control architecture and at the same time to optimize the process speed and the dimensional accuracy of the machine. The openness of the Beckhoff technology, the fast EtherCAT fieldbus system and also industrial know-how from Beckhoff in forming technology and the company's worldwide presence were crucial factors in our decision in favor of Beckhoff."

### Full utilization of multi-core processors

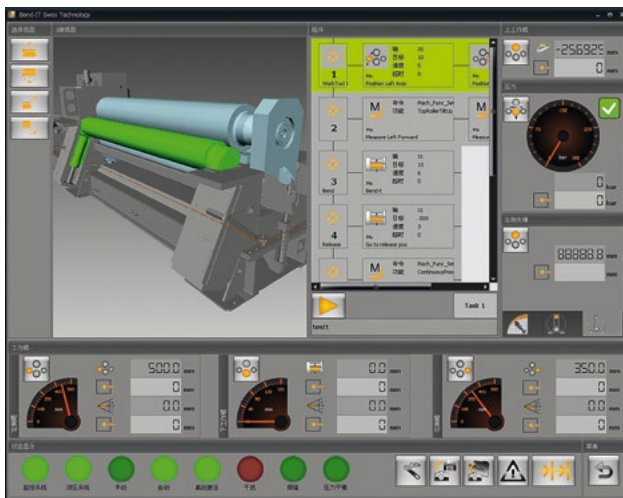
The control platform for the 'BEND-IT Swiss Technology' developed by Haeusler consists of a 19-inch Beckhoff Panel PC from the CP62xx series with Windows XP Embedded operating system, TwinCAT PLC automation software and EtherCAT as the fieldbus system. Haeusler uses a proprietary developed solution for the NC controller. Its core is a modern HMI based on .Net technology and programmed in C# with an integrated 3D visualization. "The so-called 'virtual' machine offers both NC and CNC functionality and covers all axes," explains the automation expert. "We use one processor core of the dual core CPU for the user interface (HMI) and the data management, and the other core for PLC and Motion Control (NC or CNC). The Haeusler CNC is coupled with the TwinCAT Motion Control blocks. The connection of the axes to these functions is programmed with the 'TwinCAT Hydraulic Library' software library." Furthermore, the multi-core technology enables a three-dimensional animated representation of the machine, which displays all movements and allows the operator to work intuitively, thus significantly reducing the training period for new machine operators.



Michael Fabianek, manager of automation technology, IT and hydraulics



Pipe Mill large pipe making works



The 3D operator interface of the plate bending machines allows intuitive and convenient operation of the machine.

Haeusler's decision to use Compact Flash as the storage medium was also far-sighted considering operational reliability. As Peter Reinstadler, Area Sales Manager of Beckhoff Switzerland, says: "That means there are no moving parts in the data storage system. As a result, Haeusler can guarantee its customers high security and availability, in particular with respect to the vibrations and shocks that are unavoidable in the harsh machine environment. In addition, the memory is remanent and buffered via a UPS, so that the data are always protected."

#### EtherCAT delivers fast communication

The hydraulically moved bending axes of the Haeusler machines are embedded in a multitude of digital and analog sensors and actuators. These are distributed in the large machine units and their signals are coupled to the Beckhoff Bus Terminal station. Connection to the central Panel PC takes place via EtherCAT. "The variety within the EtherCAT terminal system is impressive," says Michael Fabianek: "In the pipe bending presses currently being manufactured in our facility, for example, we use a new rotary encoder with a hall sensor that senses the teeth on the axial piston unit. This function used to be fulfilled with an absolute encoder, which measured the rotation in a very complex manner by conversion with disks. This functionality is now performed by the Beckhoff EL5151 and EL5152 EtherCAT terminals."

The PC and EtherCAT controlled hydraulic pipe bending press from Haeusler works with a pressing force of 6,000 tons. It enables the bending of pipes from 16 to 64 inches in diameter. The machine can be converted to a different pipe diameter within just two hours.

EtherCAT is one of the incisive features of the new controller, to which Haeusler attached particular importance. In this respect, the Beckhoff automation platform scores in several ways: On the one hand, the Industrial PC features the classic Ethernet interfaces without additional fieldbus cards, and on the other, EtherCAT offers high performance for I/Os and drive technology. In addition to that, there are gateways to other bus systems in the EtherCAT terminal system. "The extremely short cycle time of 1,000 I/O signals in only 50 µs fits perfectly with our concept," says Michael Fabianek contentedly: "The quicker the positional data is available to us, the more precisely we can control the machine."

#### Condition Monitoring for increased machine availability

Machine safety is ensured by Condition Monitoring, which is implemented in the controller. "The monitoring of critical moments, such as the temperature of the motherboard, the CPU and RAM or the charge level of the UPS, can be implemented via standard software function blocks. The exact monitoring of the operating resource systems, including the oil temperature and the hydraulic oil level as well as the oil quality, are essential for the machine availability," comments Michael Fabianek. "The automatically generated and predicted maintenance scheduling on the basis of the digital operating resource inspection is a further highlight of the controller. The implementation was very much assisted by the open control platform as well as the real-time communication between the HMI and Motion Control via ADS," says Michael Fabianek.

#### Universal automation platform for all types of machines

Following a six month evaluation phase, Haeusler chose Beckhoff as its future control supplier. "A short while after that, in December 2008, we started the first project, which was already implemented five months later," recalls Michael Fabianek: "Then in August 2009 we began with the complete changeover of our control technology to the Beckhoff platform." The scalable automation platform can be used for the company's entire range of machines. "Not only do we gain as machine manufacturers, our customers gain too," says Michael Fabianek says, "because they get a modern and powerful production system with optimal availability. Our customers also very much welcome the proprietary developed remote maintenance concept based on Ethernet technology and VPN." Currently, the first pipe manufacturing plants are being implemented entirely with Beckhoff control technology. "In plant manufacturing in particular, the openness of the Beckhoff system to the Windows world, with the acquisition of operating data via RFID, networking, the implementation of control centers, etc. is a great advantage," explains the automation specialist Fabianek.

If the customer should need support from the machine manufacturer, despite the extensive error and information messages that have been



implemented, the manufacturer can dial into the machine controller via the Ethernet interface and remotely analyze the cause of the fault. Thanks to EtherCAT, XFC (eXtreme Fast Control) technology and TwinCAT 3, and with Beckhoff as system partner, Haeusler considers itself to be equipped in the best possible way for future and current developments, which are aimed toward adaptive controllers, artificial intelligence or Condition Monitoring.

Haeusler AG [www.haeusler.com](http://www.haeusler.com)  
Beckhoff Switzerland [www.beckhoff.ch](http://www.beckhoff.ch)

Volkswagen Motorsport uses PC- and EtherCAT-based engine test bench technology

# Optimized engine technology leads to VW victory at 2010 Dakar Rally



At Volkswagen, commitment to motor sports has a long tradition. The latest example is the triple success for the racing version of the VW Touareg at the 2010 Dakar Rally. At the VW test center in Hanover, Germany the engines are prepared for extreme stress: State-of-the-art measuring and control systems, designed and installed by the company RTW B. Nossol, controls the medium conditioning systems of the two engine test benches and the air-conditioning of the test chambers. Beckhoff supplied the PC- and EtherCAT-based automation platform.

Nearly all Volkswagen racing engines are tested at the in-house test center in Hanover, which has around 130 staff. The high-performance diesel, gas and petrol engines are used in a range of competitions: the Dakar Rally, Formula 3, the 24-hour race at Nürburgring in Germany, the STCC (Swedish Touring Car Championship), the Scirocco Cup, Formula ADAC, the Jetta Cup USA, etc. Extensive test procedures are required for these high-performance engines. "Our work starts with the basic development of the combustion techniques and includes numerous steps up to the final simulation of driving profiles, which we use to optimally adapt the engines to each individual race," said Johannes Brandt von Fackh, who is responsible for the engine test benches at Volkswagen motor sport. The units are

subjected to extreme stresses. "A test run can occasionally last up to 150 hours," said the engine expert.

**Relaunch of the measuring and control systems**

When Volkswagen Motorsport made the decision last year to modernize its engine test benches, the measuring and control systems for the building services and media conditioning were also going to be included in the update. Their main purpose is conditioning of the cooling systems for water, oil, charge air and the combustion air for the engines on the test benches. In addition they control the air-conditioning system for the test rooms and the control station. "In the past these functions ran via a relatively complex interface consisting of many analog signal cables



The engine experts from Volkswagen used TwinCAT HMI CE visualization software from Beckhoff to keep an eye on the processes.

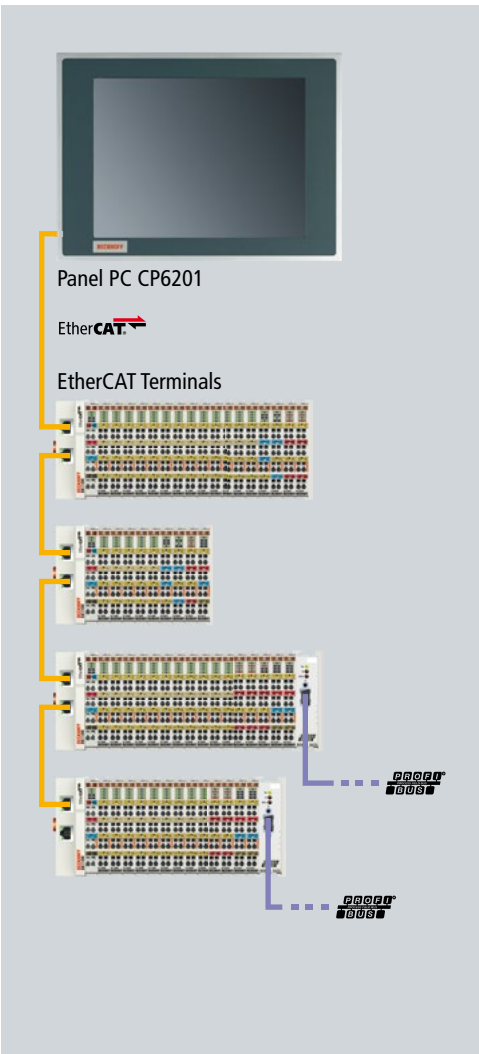
and a hardly used PROFIBUS, with different configurations for each test chamber," said Johannes Brandt von Fackh.

**Communication via EtherCAT**

Volkswagen Motorsport commissioned the company RTW B. Nossol GmbH, based in Neuenkirchen near Soltau, Germany, to modernize the measuring and control systems. This system integration company, which specializes in switchgear, automation and building management, has 20 years of experience in this field. "Our cutting-edge switchgear and controlgear production facilities enabled us to achieve the proposed alterations of the test bench within the specified time frame," said Timor Rickert, project manager at RTW-B. Nossol. "When it came to designing

the new IT infrastructure, we decided to use Beckhoff automation components with EtherCAT as the data bus. Key advantages of EtherCAT are its flexibility and capacity reserves for integration with other fieldbuses, and the comparatively low system costs."

The centerpiece of the new IT infrastructure for the media conditioning of the engine test benches and the air-conditioning of the test chambers is a Beckhoff CP6201 Panel PC with 1.8 GHz Intel® Pentium® processor and TwinCAT automation software. Four EtherCAT I/O stations with a total of 61 EtherCAT Terminals, which are housed in a control cabinet, are used for controlling the 360 I/Os. The EtherCAT network communicates with the higher-level test bench system via PROFIBUS terminals that are integrated in the EtherCAT Terminal system.



A Beckhoff CP6201 Panel PC with TwinCAT automation software is used for the media conditioning of the engine test benches and the air-conditioning of the test chambers. Four EtherCAT I/O stations with a total of 61 EtherCAT Terminals control a total of 360 I/Os.



Four decades of motor sport tradition

Volkswagen has been setting standards in motor sport for more than 40 years. It all started in 1966 with Formula V (the "V" stood for Volkswagen), which boasted 58 PS and robust beetle technology and offered new recruits a cost-effective route into Formula racing. No fewer than four subsequent Formula 1 World Champions, Jochen Rindt, Keke Rosberg, Nelson Piquet and Niki Lauda, emerged from this racing class. Between 1979 and 1994 Volkswagen won 55 international competitions as manufacturer of Formula 3 motors, with Michael Schumacher, Bernd Schneider and Joachim Winkelhock, among others. In addition, Volkswagen has shaped touring car racing for more than three decades with brand cups such as Scirocco, Golf and Polo. Moreover, Volkswagen was also successful in endurance races for touring cars, starting in 1997 with the 24-hours race at the Nürburgring. Since 2003 Volkswagen has been focusing on marathon rally sports. The first big success came with the victory at the 1980 Dakar Rally, followed by further victories in this classic offroad race, and culminating in the triple success in 2010.

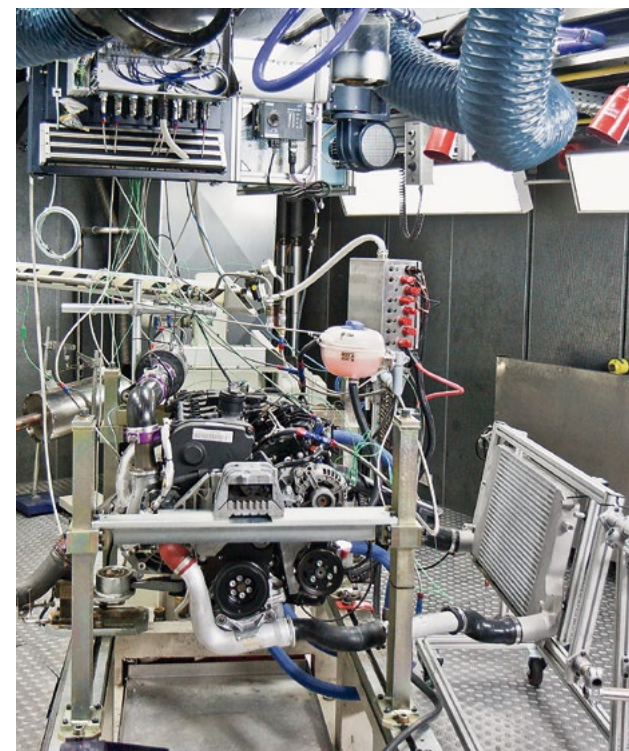
#### Standard TwinCAT libraries and function blocks simplify design and installation

During the test runs the motor data are logged and analyzed by the test bench system provided by AVL, a company that specializes in engine measurement technology. At the same time both the ambient temperature and the oil and cooling water temperature can be controlled via the EtherCAT network. The TwinCAT PLC HVAC library from Beckhoff permitted complex measuring and control systems for the media conditioning of the engine test benches and the air-conditioning of the test chambers. It also allowed the control station to be mapped in ready-made macros and function blocks. "This was very helpful for the engineering process and made the installation straightforward. All we had to do on-site was to connect the I/Os with the actuators and sensors," said Timor Rickert, summarizing the benefits of the TwinCAT PLC library.

The engine experts from Volkswagen used the TwinCAT HMI CE visualization software from Beckhoff to keep an eye on the processes. The software can also be used to change certain parameters such as the



The heating and cooling circuits with pumps for the media conditioning



operating state of the fans. "The PC- and EtherCAT-based systems from Beckhoff enabled us to implement all the requirements for the new measuring and control systems," said Johannes Brandt von Fackh. To-date the complete installation has been very reliable, just like the racing engines in the VW Touaregs at this year's Dakar Rally.

Volkswagen Motorsport [www.volkswagen-motorsport.com](http://www.volkswagen-motorsport.com)  
 RTW-B. Nossol GmbH [www.rtw-nossol.de](http://www.rtw-nossol.de)  
 AVL Deutschland GmbH [www.avl.com](http://www.avl.com)

EtherCAT facilitates ultra-fast application of handles for packaging



## Getting a better handle on multi-container packaging

PakTech makes handles to unite two to twelve containers.

PakTech is manufacturer of sturdy plastic handles, which turn single packages into a kind of bundle that can be comfortably stored and transported. In addition, the company also builds the machines that attach the handles to a wide variety of container types. A switch to a Beckhoff PC- and EtherCAT-based control platform has helped bring PakTech an enormous increase in production speed while reducing space requirements in the control cabinet by an impressive 20 %.



The MPA60 features the rugged CP6201 Control Panel for HMI hardware that's well-suited for demanding plant environments.

Bundling plastic containers or PET bottles with small handles is simple, effective and saves materials and represents an environmentally-friendly solution for consumers. Jim Borg, founder of the Eugene, Oregon, USA-based PakTech and Oregon Precision Industries, Inc., developed a company from this idea. PakTech produces the most diverse carrying solutions for all kinds of containers for food, beverages, cleaning agents, body care products and more. The company's services range from the design and manufacture of the handles (using an injection molding process), and the optional attachment of barcode labels, to the design, manufacture and service of in-line application equipment. In addition to that, the company develops and builds the handle applicator machines with which the handles are pulled with a precise fit over the closures of the containers, where they are applied. Up to 12 containers or PET bottles can be bundled with such a handle, so that further packaging can be eliminated.



Paktech uses the two-channel, space-saving AX5000 EtherCAT drive.



Today PakTech has an extra 20 % of free control cabinet space to accommodate additional hardware requests from customers.

**Performance increased and costs lowered using PC-based control**  
The packaging market is constantly under pricing pressures. Therefore, in order to remain competitive, PakTech sought a control solution for its handle application machinery that was not only elegant and powerful, but also inexpensive. “We needed to expand our control ability while reducing our costs – which we couldn’t do with a separate servo platform and PLC platform such as those we had used in the past,” explains Dan Shook, Director



PakTech handle applicator for applying multi-pack handles on various bottles and packages

of Operations at PakTech. “What we envisaged on one hand was greater openness of the controller. We also sought a user interface that was specific to our type of equipment so that the look and feel would be the same across different PakTech platforms.” Since PakTech has used a Husky injection molding machine with Beckhoff PC control to manufacture the plastic handles for several years, the decision was made quickly: “Through Husky, we see that the brand of PC-based control technology from Beckhoff is well-thought out, tested in the field for several years and is trouble-free,” says Dan Shook. He also considers the possibility of remote maintenance to be a big advantage of PC-based control: “This way we can ideally support our customers and lower maintenance costs.”

**PC unites PLC and data management on one platform**

The PakTech systems usually integrate with a conveyor. After the machine has detected the product on the conveyor, the plastic handles are applied to two or more plastic containers by means of a pick-and-place robot, so that they are firmly connected with one another. The correct application of the handles is subsequently checked and the products then move downstream for further packaging steps. The machine also communicates line speed to other systems in the plant. “The PC-based controller also allows us to provide machine information to our customers’ ERP systems,” says Dan Shook.

**All-in-one control platform: compact, powerful and flexible**

For the MPA60 multi-purpose applicator, which fits handles to 60 cases per minute, PakTech uses a CX1020 Embedded PC with the TwinCAT NC PTP



The versatile MPA60 from PakTech is a “Multi-Purpose Applicator” that can apply TwinPak® handles at 60 cases per minute.

automation software for PLC and Motion Control as the control platform. Visualization is accomplished using the Beckhoff CP6201 Control Panel and TwinCAT PLC HMI. Alternatively, PakTech also uses the C6920 Compact Industrial PC with Intel® Core™ Duo depending on the application. EtherCAT is used as the high speed communication bus. Whereas the EtherCAT I/O Terminals in IP 20 protection are accommodated in the control cabinet, the robust IP 67 EtherCAT Box modules are used directly on the machine and around the robot arm. For the motion system, PakTech uses the AX5000 series EtherCAT drives and servomotors from the AM3052 series. “The CX1020 Embedded PC was selected because it’s a flexible DIN Rail mounted controller and with its 1 GHz processor, it’s a very powerful device for automation,” Shook noted. “The CX1020 also provides a direct backplane connection to EtherCAT I/O terminals.”

**EtherCAT throughout**

Systems from PakTech include one-touch operation, easy to set up controls and tool-less changeovers. “It cut our required training time in half for our customers because time previously had to be spent in the plant training the maintenance technician on how to navigate through the previous system. Now, the navigation is essentially as simple as pushing a button on the machine,” says Dan Shook. “That’s one more argument with which to convince our customers about this new control concept.” The machine-mountable EtherCAT Box I/O solution enabled PakTech to meet the requirements for high performance networking and data acquisition in the field to various areas of the machines. “In the past, all our I/O was central-

ized and we had a great deal of wiring back and forth to the field – EtherCAT Box I/O has eliminated this and the related costs and time required,” says Dan Shook, and he explains: “With EtherCAT and PC-based control we can implement the motion and logic in the same controller. This was a technological leap forward for PakTech and, naturally, it helped us reduce required electrical panel space to a considerable degree.”

**Affordable, high performance packaging machine control is within reach**

PakTech expects an additional gain in efficiency as a result of using the PC-based control system. “We’re confident we’ll maintain 99 % efficiency with installed machines and we’re expecting a 20 % improvement in reliability over our previous design,” summarizes the Director of Operations. “Today we have 20 % more control cabinet space to accommodate additional hardware requests from customers.”

Paktech [www.paktech-opi.com](http://www.paktech-opi.com)  
Beckhoff USA [www.beckhoffautomation.com](http://www.beckhoffautomation.com)

Processing of more than 30,000 I/Os with BC9100 Ethernet controllers



If everything goes according to plan, the Russian Soyuz carrier rocket will blast off from the Kourou spaceport in French Guiana in early 2011. For its mission, Soyuz is to place satellites for the European navigation network Galileo into orbit. On behalf of ESA and CNES, the European and French space agencies, the Spanish company GTD is supplying the control and monitoring systems for the Soyuz launching pad. GTD relies on Beckhoff I/O components for the real-time control of more than 30,000 input and output data.

## When 'Soyuz' lifts off, Beckhoff Bus Terminals are there for the countdown

The Barcelona-based company GTD has already been involved in several European space projects and is specialized in the development of control and ground control systems for spaceships as well as flight software and operational systems for the Europe Space Port. GTD's scope of performance also includes technical support for the preparation and launch of the Ariane, Vega and Soyuz rockets.

The European Kourou Space Port, in the South American country of French Guiana, is one of the most efficient launching bases in the world and is of great importance to ensure Europe's independent access to space. All launches have taken place according to schedule and under optimum conditions here for years. In 2002 the European aerospace authority decided to build a launch pad for the Russian Soyuz rocket; assembly work began in Kourou two years later. In the future, the world's most successful carrier rocket, with 1,750 launches, will place payloads of around three tons into orbit around the earth. It will mainly be used to establish the European navigation system, Galileo, and for launching larger earth observation satellites.

### Control and monitoring of the Soyuz launching pad in Kourou

GTD was awarded the contract to develop various sub-projects for the control and monitoring of the launching pad. As project manager Josep Fontova explains, the services that GTD has to provide are very complex: "Our task is to adapt the operational and monitoring systems that are responsible for the trajectory tracking and the reception and evaluation of the telemetry data from the rocket, starting with the lift-off of the rocket and ending with placing the payload into orbit." Under the supervision of Arianespace, the European operator of the launch systems, GTD is also responsible for the operation and maintenance of the infrastructures of the new launch pad.

The CCSS control, command and service system developed by GTD is responsible for the monitoring and control of all process steps involved in the preparation, assembly and launch of the rocket. This allows the monitoring and steering of all take off base facilities by means of control terminals in the control center, which is housed in a protected building. All preparations connected with the Soyuz launch up until the launch itself are coordinated from here.

Overall view of the launch pad for the Soyuz carrier rocket. The European space agency ESA has built a launch pad for the Soyuz in Kourou, in the middle of the South American tropical jungle. The Russian carrier rocket is scheduled to takeoff from here for the first time in early 2011 and to place a satellite for the European navigation network Galileo into orbit.

Founded in 1987, GTD now has branch offices in Barcelona, Madrid, Logroño and French Guiana and is specialized in the development and integration of highly critical and highly complex scientific computer systems.



The Soyuz mobile gantry at the spaceport in French Guiana under construction. The mobile gantry is 52 meters (171-ft) high and can approach the already built rocket on rails. The payload is installed in the nose of the rocket from the mobile gantry at a height of 36 meters (118-ft).



Josep Fontova, GTD project manager (left) and Ricardo Bennassar, commercial manager responsible for the CCSS project, with a model of the Soyuz carrier rocket

### Maximum requirements with regard to reliability and availability

The CCSS system developed by GTD must fulfill the highest demands in terms of reliability and operational readiness; availability must be ensured around the clock, 365 days a year. More than 30,000 signals and data – from the facilities surrounding the takeoff preparations and from the actual launch – must be managed in real-time. The control system is based on two redundant servers. They manage the flow of data between the control consoles and all devices at control level: the PLCs, the local I/Os, the power supplies, fire alarms, etc. The four PLCs and the local I/O modules are connected to one another via an optical fiber TCP/IP network with a ring topology which, with a length of 10 km (6.2 mi), traverses the entire facility.

### Ethernet Bus Terminal Controllers enable the secure transmission of data over long distances

"In order to manage the total of 1650 terminals, we have constructed a network of 50 local I/O stations with BC9100 Intelligent Ethernet Bus Terminal Controllers," explains Josep Fontova, CCSS Interfaces project manager at GTD. The Bus Terminal Controllers are used independently of one another in different physical places: in the control center, the fuel store, the general power supply, the power supply for the air conditioning systems, the launch

ramp (in the bunker) 20 meters below ground, the mobile gantry, the carrier system and pumping stations, etc. The I/O stations communicate with one another and with the monitoring system via Modbus/TCP. The BC9100 Bus Terminal Controllers manage systems in the launch pad and in the launcher assembly and testing building, the ventilation (of the satellite and the final stage of the rocket), the safety and fluid systems, the compressed air generation (for the process control on the rocket pad), the water pumps (on the base), the optical and video systems and, finally, the high-speed cameras that supply photos of the rocket at liftoff.

### Cabling work reduced – reliability increased

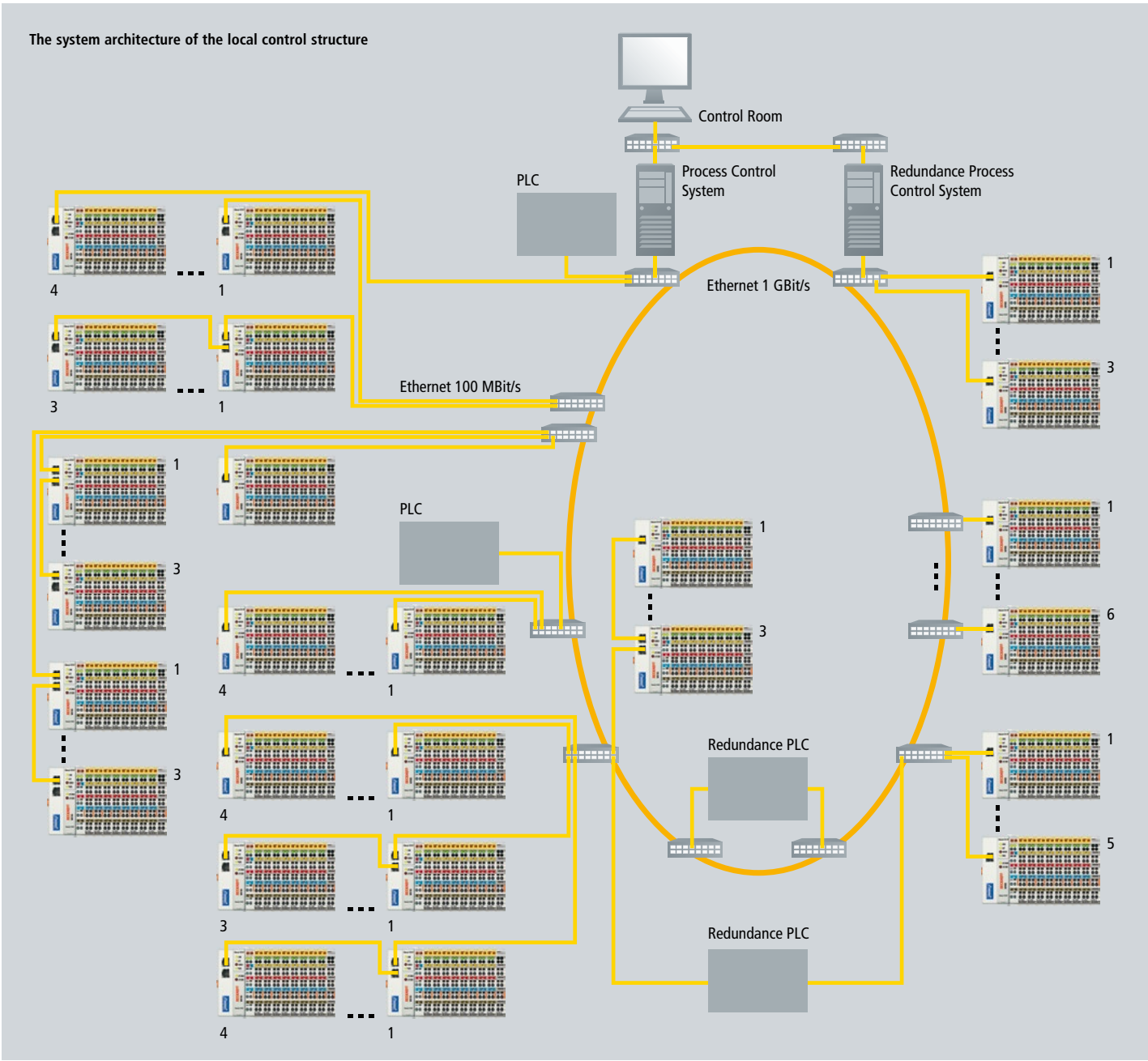
According to Ricardo Bennassar, commercial manager at GTD with responsibility for the CCSS project, one of the biggest challenges was to implement the acquisition of data from the various sensors and actuators, taking into account the large geographical distances involved (several thousand meters on the site): "The modular Beckhoff Bus Terminal system allows the construction of a flexible architecture that connects widely scattered components with one another and conducts the data stream centrally to a building. The considerable amount of cabling that this saved was very important. A further advantage of the BC9100 Bus Terminal Controller is that it is equipped with two RJ-45 ports, which makes a linear topology possible without distributors.

Thanks to the controller, which is programmable in IEC-61131-3, the user has the option to dock to the inputs and outputs of local information systems.”

Outlook

GTD will also be involved with the further development of the ‘Ariane 5,’ the objective of which is to produce a new version of the carrier rocket by around 2016. At the same time, the intention is to significantly increase the flexibility and capacity of the rocket (11.2 tons of freight for geostationary orbits). In the long-run, GTD will also play an important role in the realization of a new generation of European Launch systems (Ariane 6), which is planned for 2025. There will additionally be involvement in other satellite projects, such as GMES (Global for Monitoring Environment and Security) or SSA (Space Situational Awareness).

GTD Sistemas de información [www.gtd.es](http://www.gtd.es)  
Beckhoff Spain [www.beckhoff.es](http://www.beckhoff.es)



Beckhoff is among the winners of the prestigious “Ringier Technology Innovation Award for Plastic Industries” 2010

Peng Jie, Beckhoff China’s marketing manager, received the prize in the name of his company and expressed his gratitude for the honor in his speech. Beckhoff has now won the “Ringier Award” twice.

Innovative technologies and solutions for the plastics industry are honored each year with the prestigious “Ringier Technology Innovation Award,” presented by Ringier Trade Publishing. About 120 representatives and experts from the plastics industry met on August 10<sup>th</sup> in the Renaissance Shanghai Pudong Hotel in Shanghai, to attend the high profile awards ceremony. Beckhoff was among the 31 winners in 2010, receiving honors in the categories of software, control and automation.

With the industry-specific Blow Molding Panel PC, EtherCAT as a high speed fieldbus and the “TwinCAT Blow Molding Framework” software library, Beckhoff offers a turnkey control solution for blow molding machines with hydraulic, servo-electric or hybrid drive technology. Using standard hardware and software components and innovative technologies such as EtherCAT and TwinSAFE, the integrated control solution from Beckhoff replaces traditional hardware concepts with a separate PLC, wall thickness controller and temperature controller. Beckhoff’s Ringier Award-winning “all-in-one solution” leads to considerable improvements in the manufacturing of plastics in relation to both manufacturing efficiency and product quality, as well as with regard to energy savings and environmentally-friendly production.

The “Ringier Technology Innovation Award,” which is organized by a leading industrial business-to-business media enterprise, Ringier Trade Publishing Ltd., has been presented in China since 2005. The prize covers four areas: the food and beverage industry, the packaging industry, the plastics processing industry and the metalworking industry. The honor is intended to distinguish innovative products and top-performing technologies that make a contribution to technological progress in these industries. On account of Ringier Trade Publishing’s expertise, independence and vision toward the future, the prize generates much attention and recognition by industry.

Ringier Trade Media Ltd. [www.industrysourcing.com](http://www.industrysourcing.com)  
Beckhoff China [www.beckhoff.cn](http://www.beckhoff.cn)



31 companies were honored for their innovative technologies and solutions in the field of plastics processing at the awards ceremony for the “Ringier Technology Innovation Award for Plastic Industries” on August 10<sup>th</sup>, 2010 in Shanghai.



Together with Dmitry Dzilno, the Director of Engineering, Controls Group, Applied Materials, the ETG had written a congress article and published it as a white paper at SEMICON: “EtherCAT – enabled Advanced Control Architecture.” The statement from the world’s largest supplier of semiconductor manufacturing equipment caused quite a stir at the trade show.



With 54 participants, the 10th European EtherCAT Plug Festival also met with great interest. Further interested parties had to be turned down, even though the host – Lenze in Braunschweig – had booked an extra-large venue. The wide range of slave devices from 21 manufacturers was operated with 10 different master implementations and interoperability was proven or improved respectively. The EtherCAT Conformance Test Tool was also put to use.

The second North American Plug Festival was also well attended. 7 master implementations and slaves from 10 manufacturers were in action at the event, which was hosted by Yaskawa Electric America in Waukegan, IL.



The second meeting of Korean ETG members took place at the beginning of July in Seoul: over 60 representatives of Korean ETG members assembled to get information on the further development of the EtherCAT technology, worldwide ETG activities and EtherCAT applications in Korea. The photo shows Prof. Yong Seon Moon, the ETG representative for Korea, during his lecture on EtherCAT in robot applications in Korea. According to him, EtherCAT has established itself as the de-facto standard for all new robot projects in Korea.



The EtherCAT Technology Group was represented for the first time with its own booth at the Techno-Frontier Trade Fair in Tokyo. The joint booth of 14 Japanese EtherCAT suppliers was prepared by the ETG Task Force Japan and was very well attended. With 80 participants, the EtherCAT introduction seminars accompanying the exhibition also met with great interest.



The annual members’ meeting in Japan is already a tradition: the Japanese ETG members met in July in Tokyo for what was already the fourth time. Over 130 participants demonstrate the great acceptance of the EtherCAT technology in one of the world’s largest markets for automation technology, which is also considered to be one of the most difficult for foreign technologies. Apart from the unique combination of technical advantages, it is the openness of EtherCAT in particular that plays an important role in Japan.

# Trade shows 2010 / 2011

Europe

**Germany**  
Tire Technology Expo  
February 15 – 17, 2011  
Cologne  
Booth 8025  
[www.tiretechnology-expo.com](http://www.tiretechnology-expo.com)

Intec  
March 1 – 4, 2011  
Leipzig  
Hall 1, D28  
[www.messe-intec.de](http://www.messe-intec.de)

Hannover Messe  
April 4 – 8, 2011  
Hanover  
Hall 9, Booth F06  
[www.hannovermesse.de](http://www.hannovermesse.de)

Interpack  
May 15 – 18, 2011  
Düsseldorf  
Hall 15, Booth D25/E26  
[www.interpack.com](http://www.interpack.com)

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

Sensor+Test  
June 7 – 9, 2011  
Nuremberg  
Hall 11, Booth 11 – 127  
[www.sensor-test.de](http://www.sensor-test.de)

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

Motek  
October 10 – 13, 2011  
Stuttgart  
[www.motek-messe.de](http://www.motek-messe.de)

SPS/IPC/DRIVES 2011  
November 22 – 24, 2011  
Nuremberg  
[www.mesago.de/SPS](http://www.mesago.de/SPS)

Austria

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

Belgium

EWEA  
March 14 – 17, 2011  
Brussels  
Booth 11921  
[www.ewec.info](http://www.ewec.info)

Indumation  
May 18 – 20, 2011  
Kortrijk  
Booth 5C20  
[www.indumation.com](http://www.indumation.com)

Czech Republic

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

Italy

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

Netherlands

European Food Manufacturing and Safety Summit  
January 31 – February 1, 2011  
Amsterdam  
[www.foodmanufacturingevent.com](http://www.foodmanufacturingevent.com)

Russia

Hi-Tech Building  
December 7 – 9, 2010  
Moscow  
Booth 1-102  
[www.hitechhouse.ru](http://www.hitechhouse.ru)

Spain

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



Switzerland

Ineltec  
September 13 – 16, 2011  
Basel  
[www.ineltec.ch](http://www.ineltec.ch)

Turkey

WIN World of Industry Part II  
March 17 – 20, 2011  
Istanbul  
[www.win-fair.com](http://www.win-fair.com)

Asia

China

CIMT  
April 11 – 16, 2011  
Peking  
[www.cimtshow.com](http://www.cimtshow.com)

India

The Big 5 Show  
November 21 – 24, 2010  
Dubai  
[www.thebig5exhibition.com](http://www.thebig5exhibition.com)

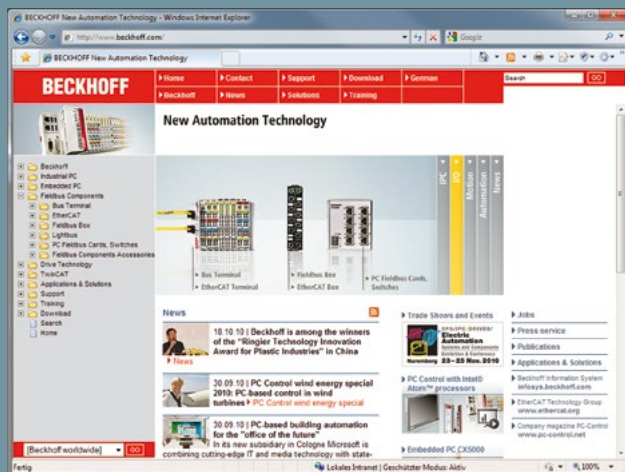
Malaysia

Industrial Automation  
July 20 – 23, 2011  
Kuala Lumpur  
[www.asean-ia.com](http://www.asean-ia.com)

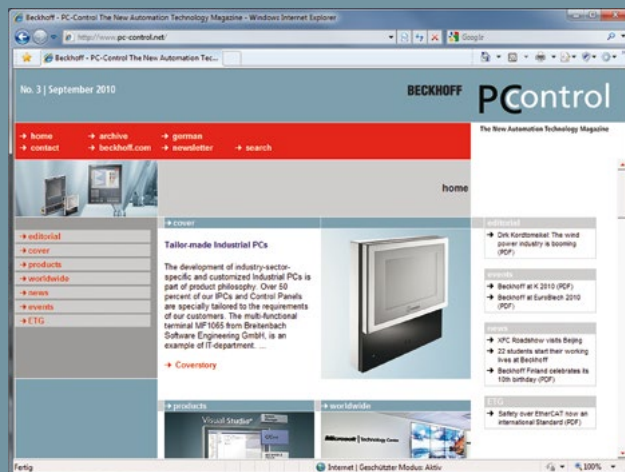
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