

BECKHOFF New Automation Technology

High performance built-in:
PC-based control for sheet metal working





Highly integrated, from panels to drives: the Beckhoff solution ...

As a specialist in PC-based control technology, Beckhoff provides proven, high-performance automation solutions for sheet metal working. High-performance PCs with industrial motherboards, a wide range of multi-touch panels, fast I/O components, EtherCAT as an open and ultra-fast fieldbus system, versatile and dynamic servo drive technology, and TwinCAT engineering and control software all combine as an integrated platform for sequential control, visualisation, motion control, robotics, safety and measurement technology, as well as condition monitoring. In TwinCAT, full utilisation of the multi- and many-core capabilities from cutting-edge processors enables the calculation of complex algorithms without affecting PLC performance.

Pressing



Punching and nibbling



Cutting and welding



Bending



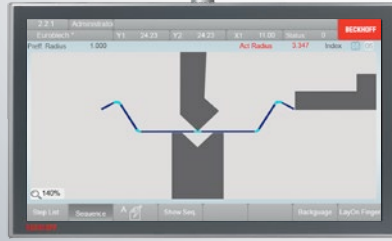
... for all control and drive applications in sheet metal working

The high degree of integration, the speed and performance-related scalability of the Beckhoff control solution consistently lead to process optimisations and cost benefits. In addition, there are specific benefits for the different areas of sheet metal processing: In addition to high-performance control technology, EtherCAT and EtherCAT P provide a competitive advantage for press lines. Beckhoff offers an extensive range of CNC functions and a quickly usable turnkey solution for cutting and welding machines. In addition, interpolations and adaptations provided by the customer can be integrated. Special punching and nibbling applications are supported through fast signal processing based on EtherCAT. Practice-proven algorithms are available in the technology blocks for bending processes, such as the calculation of the insertion depth.



Control Panels: multi-touch displays and Control Panels

► www.beckhoff.com/Multitouch



Technology blocks for bending processes

► www.beckhoff.com/forming



Embedded PCs: Industrial PCs with directly integrated I/O level

► www.beckhoff.com/Embedded-PC



EtherCAT I/Os: broad I/O spectrum in IP 20 and IP 67 protection ratings

► www.beckhoff.com/EtherCAT

Scalable and modular: the Beckhoff hardware and software platform ...

The comprehensive Beckhoff product range is characterised by scalable performance and modular design. The Industrial PC spectrum ranges from compact Embedded PCs to high-end IPCs with multi-core processors – complemented by multi-touch panels for advanced operator efficiency. More than 400 signal types are supported by the Beckhoff I/O system, covering the entire range of sensors and actuators and TwinSAFE as the integrated safety solution for I/O and motion control. The drive technology portfolio ranges from compact servo terminals to high-performance EtherCAT drives and highly dynamic servo-motors with One Cable Technology (OCT) as well as space-saving AMP8000 servomotors with integrated servo amplifier. The automation software TwinCAT integrates an engineering environment and full control system within a single software platform.



Highly dynamic servo drive technology

► www.beckhoff.com/motion



Servo terminals: compact drive technology

► www.beckhoff.com/compact-drive-technology



EtherCAT P: ultra-fast one cable solution

► www.beckhoff.com/EtherCATP



4 TwinCAT: software for engineering and runtime

► www.beckhoff.com/TwinCAT3



TwinSAFE integrated safety solution

► www.beckhoff.com/TwinSAFE



Industrial PC: control cabinet and Panel PCs

► www.beckhoff.com/IPC



DIEFFENBACHER

... and deep industry expertise combine for optimised and customisable control solutions

The automation toolkit from Beckhoff is complemented by extensive industry expertise and specific process knowledge in all areas of sheet metal working: This results in control solutions that offer high investment security, which can also be tailored exactly to individual requirements. Whether complex CNC applications, the technology blocks for bending processes or the implementation of EtherCAT P: As a pioneer of PC-based control and the inventor of EtherCAT, Beckhoff offers a high level of industry expertise backed by more than 20 years of experience in sheet metal working applications.



TwinCAT: One control platform covers all functionalities ...

PC-based control integrates all engineering and runtime processes on a centralised TwinCAT software platform. This applies to programming, configuration, the real-time environment and all runtime modules: multi PLC, motion and CNC, visualisation, safety technology, robotics, measurement technology, condition monitoring and image processing. Open interfaces support integration into existing visualisation, control and database systems. An extensive toolkit of function blocks and software libraries facilitates the creation of all applications, from simple to complex. Support for IEC 61131-3, including object-oriented extensions, C/C++ or MATLAB®/Simulink® makes common programming languages available for real-time applications.

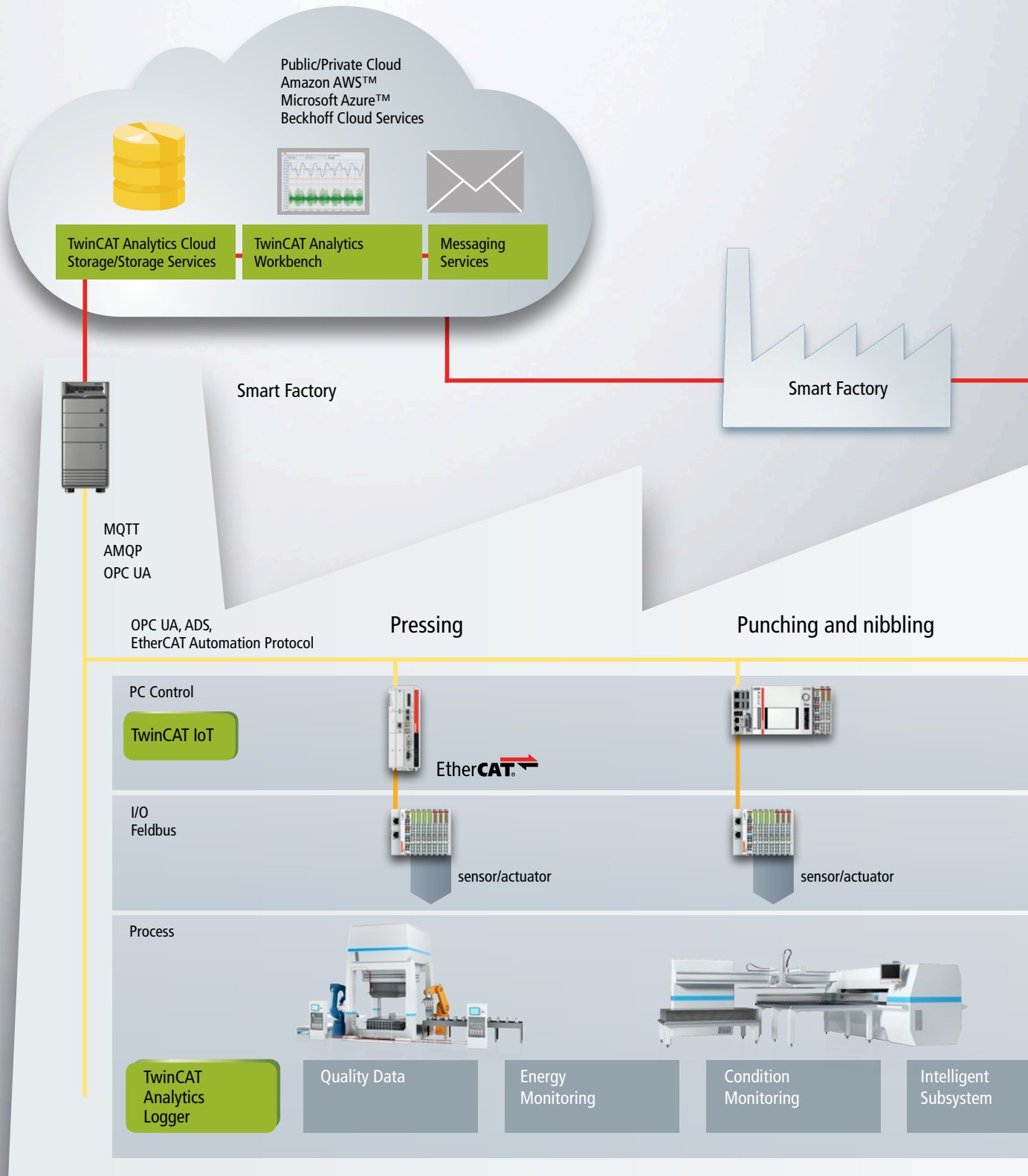


... providing efficiency advantages right from the engineering stage

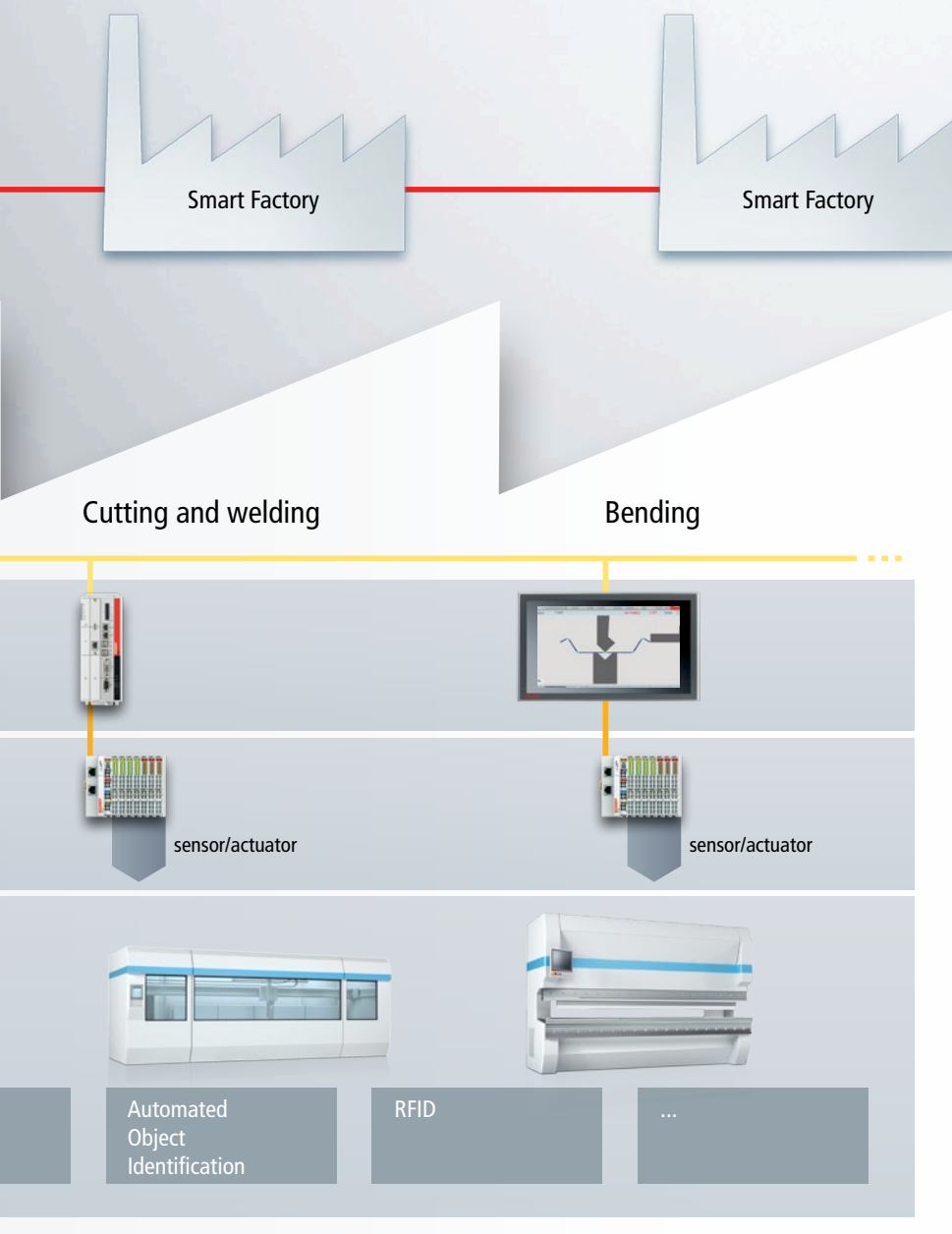
Comprehensive TwinCAT libraries for motion control simplify engineering processes. In addition, TwinCAT includes industry-specific functions such as complex interpolations, fast cam control and flexible hydraulics control. A comprehensive range of mechanisms for coupling and synchronisation enables the implementation of the most diverse applications. TwinCAT integration in Microsoft Visual Studio® offers developers an ideal infrastructure to generate reusable software modules. Moreover, additional control hardware can be replaced with software thanks to TwinCAT multi-core support. This significantly reduces hardware costs, development and commissioning time, as well as training effort.



Industrie 4.0 for sheet metal working with TwinCAT Analytics and TwinCAT IoT



PC-based control from Beckhoff provides the technological foundation for Industrie 4.0 and Internet of Things communication. In addition to conventional control tasks, TwinCAT also enables applications such as Big Data, pattern recognition and condition or power monitoring – consistently increasing the production efficiency of machines as a result. TwinCAT offers specific modules for simplified cloud communication and for analytics functions: TwinCAT IoT supports all common protocols for cloud communication and push notifications to smart devices. TwinCAT IoT is quick and easy to configure and, together with an Industrial or Embedded PC as the IoT controller, establishes a seamless connection between the Internet of Things and the Internet of Services. TwinCAT Analytics saves process data locally, on a server or in a cloud system in sync with the process cycle. Seamless data acquisition provides a basis for comprehensive analysis and enables innovative approaches, such as predictive maintenance.



Highly scalable and highly efficient: the Beckhoff CNC solution



Control Panels for sheet metal working with innovative multi-touch operating technology

Display sizes from 7 to 24 inches are available. With a wide range of display formats, connection technologies and processor performance the multi-touch panel portfolio offers users maximum versatility and flexibility to meet their individual requirements.

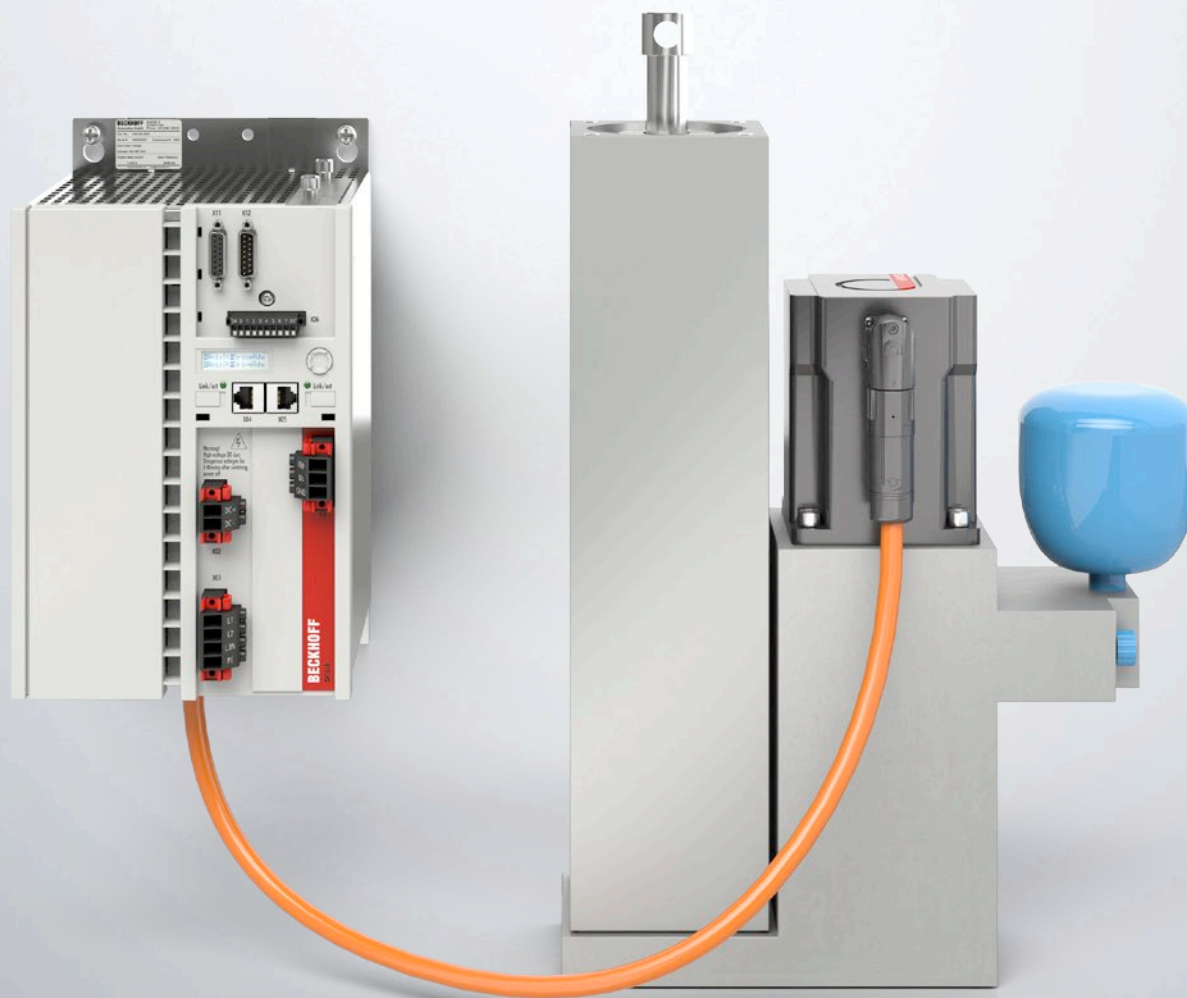
CNC push-button extension

A push-button extension that is optimised for CNC applications is available for simple and convenient machine operation.

As a comprehensive software solution, TwinCAT NC I/CNC covers the entire range of traditional CNC path controllers, up to high-end systems for complex motion and kinematics requirements. With support for multi-core and 64-bit operating systems, TwinCAT 3 opens up hardware performance reserves that can be utilised for highly precise control of high-speed laser cutting machines, for example. A wide range of multi-touch panels with varied display sizes and formats meets all HMI requirements. The standard .NET-based CNC user interface covers all required functions, such as online language changeover, setup functions, global message systems and user management. Application-specific parameter adaptation and expansion

options enable the flexible and fast implementation of customer requirements. The scalable Beckhoff CNC solution is available in all performance classes: from compact Embedded PCs with integrated I/O interface to Industrial PCs with multi-core processors. Users can choose between optional functions and scalable hardware platforms to configure a performance-based, efficient and cost-effective CNC control system. All controllers are universally configured and programmed using TwinCAT automation software. Through cyclic data transfer of control and status information, the embedding of CNC functions into a standard control system ensures very fast communication and the highest level of efficiency.

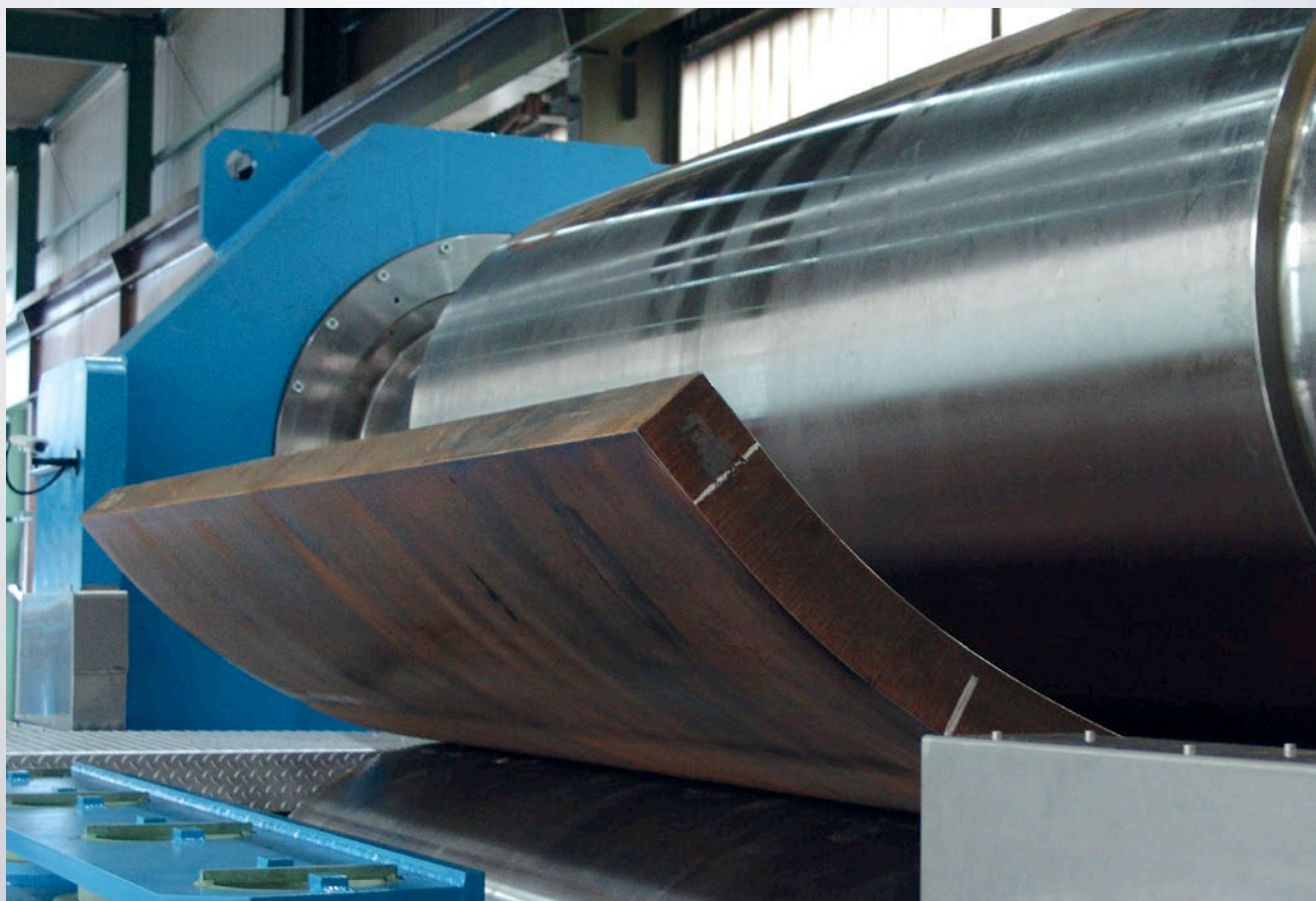
Highly dynamic servo drives for hybrid axes



The strengths of hydraulic drive technology such as a fast motion cycle and low mounting requirements are offset by higher maintenance costs and poor efficiency. Low-maintenance and energy-efficient solutions for sheet metal processing are now available with servo-hydraulic hybrid axes. Beckhoff Drive Technology is the ideal complement to these innovative concepts. The highly dynamic servo drive technology enables short machine cycles with low energy consumption. The software library TwinCAT PLC Hydraulic Positioning is ideally suited for the use of hybrid axes in different machine concepts. Design-related irregularities of the oil flow in pumps are minimised through optimised algorithms. The adaptive parameter

switching during the motion enables the switchover from position to pressure control with perfectly adapted parameters in each case. With the TwinCAT Hydraulic library the user thus achieves short machine cycle times with minimum deviations from the setpoint. Condition monitoring for pump wear and energy consumption is also available as an option.

Beckhoff hydraulic expertise ...



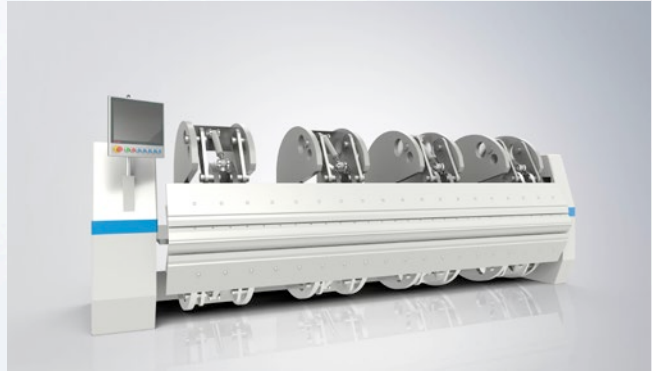
The TwinCAT Hydraulic Positioning software library (TF5810) provides all the software functions required for valve- and pump-controlled axes or servo pumps. As a rule, the solution is vendor-independent, so machine manufacturers are free to choose their preferred hydraulics equipment providers. The integration of motion control technology into the PLC makes separate hardware controllers unnecessary and eliminates additional communication effort. At the same time, the software-based architecture offers maximum flexibility for peak motion control performance. The Hydraulics library uses standardised PLCopen interfaces, which reduces engineering effort. Any hydraulic axes can be optimally operated through

adapted set value generators, automatic characteristic curve identification, segmented movements and freely programmable switching between force, pressure and position control. The Hydraulic Positioning library concept enables advanced motion control for any number of axes with matching CPU performance. Hydraulic axes can be operated in interpolating mode when TwinCAT NC I or TwinCAT CNC is used. Hydraulic drive systems need different interfaces for sensors and hydraulic components. Therefore, the TwinCAT Hydraulic Positioning library supports all common interfaces in conjunction with Beckhoff I/O systems.

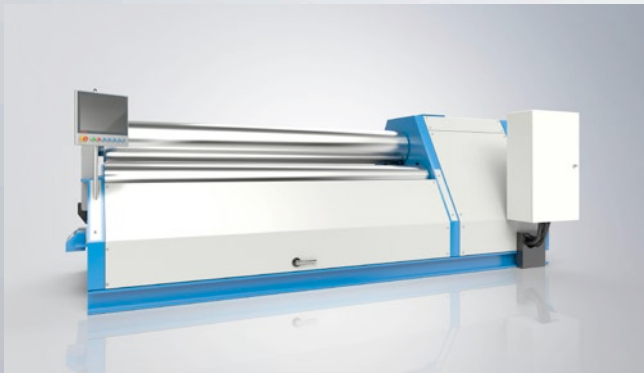
... optimises processing



Deep-drawing presses



Folding machines



Roller bending machines



Tube bending machines

Within the TwinCAT Hydraulic Positioning library, Beckhoff provides ready-to-use software function blocks for various sheet metal working processes. The function blocks can be used completely or individually by the customer.

Special optimised gear couplings and pressure controllers with feed forward are available for the deep drawing process. In combination with PC-based control technology and cycle times of less than 250 μ s, extremely short synchronisation distances can be achieved, even with very high upper die speeds.

In the case of folding, the balancing of mechanically coupled axes with micron accuracy is indispensable. These requirements can easily be met via the ready-made gantry axis coupling function blocks. The usual nonlinear transmissions can be represented by closed equations or in the form of look-up tables. An optional ready-implemented

state model of the valve can be used for a condition monitoring of the spool position.

In roller bending machines, the drums constantly have to follow new setpoints during pipe production. Any pipe geometry can be manufactured using the high-resolution CAM tables in conjunction with external setpoint generator. As an option setpoints from a master motion system like NC I may be used.

The high positioning accuracy when bending pipes places particularly high demands on the control technology. These positioning requirements can easily be met through multi-variable controllers with condition-feedback and subsequent valve linearisation. The automatic characteristic curve identification is a great help, especially during commissioning and service.

EtherCAT[®] P



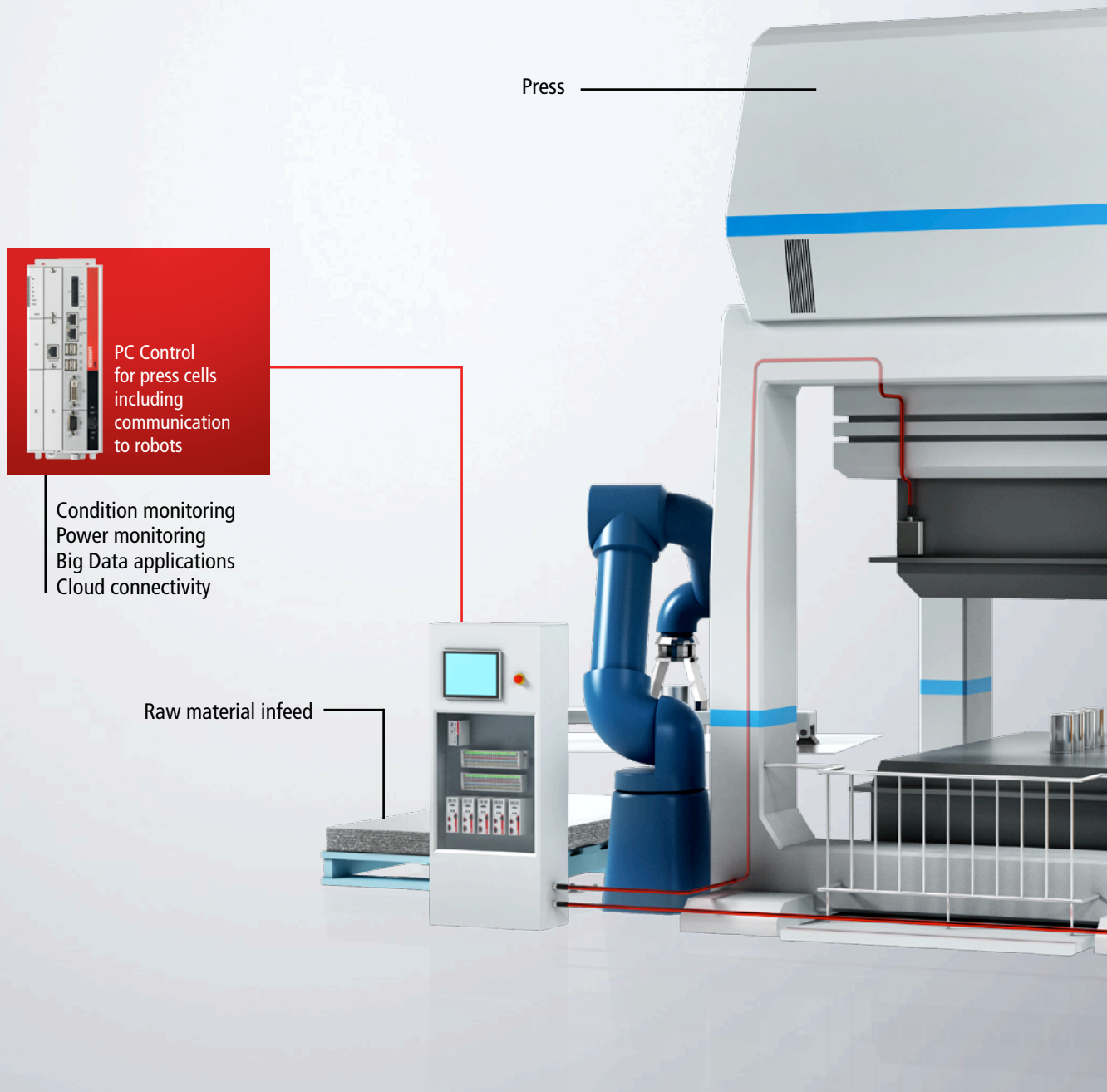
The ultra-fast One Cable Automation solution EtherCAT P ...

For complete systems and modular machine concepts, Beckhoff offers EtherCAT P, an innovative one-cable solution for the field level. EtherCAT P integrates EtherCAT communication with system and peripheral voltage all in one cable. In addition, EtherCAT P enables direct forwarding of power supply via connected devices. All benefits of EtherCAT are retained, including free choice of topology, high speed, optimum bandwidth utilisation, dynamic processing of telegrams, high-precision synchronisation, extensive diagnostics and more. That makes EtherCAT P the ideal bus system for sensors, actuators and measurement technology in sheet metal working. One Cable Automation simplifies system wiring in machine design since components, terminal boxes and machine modules only have to be linked via a single cable.



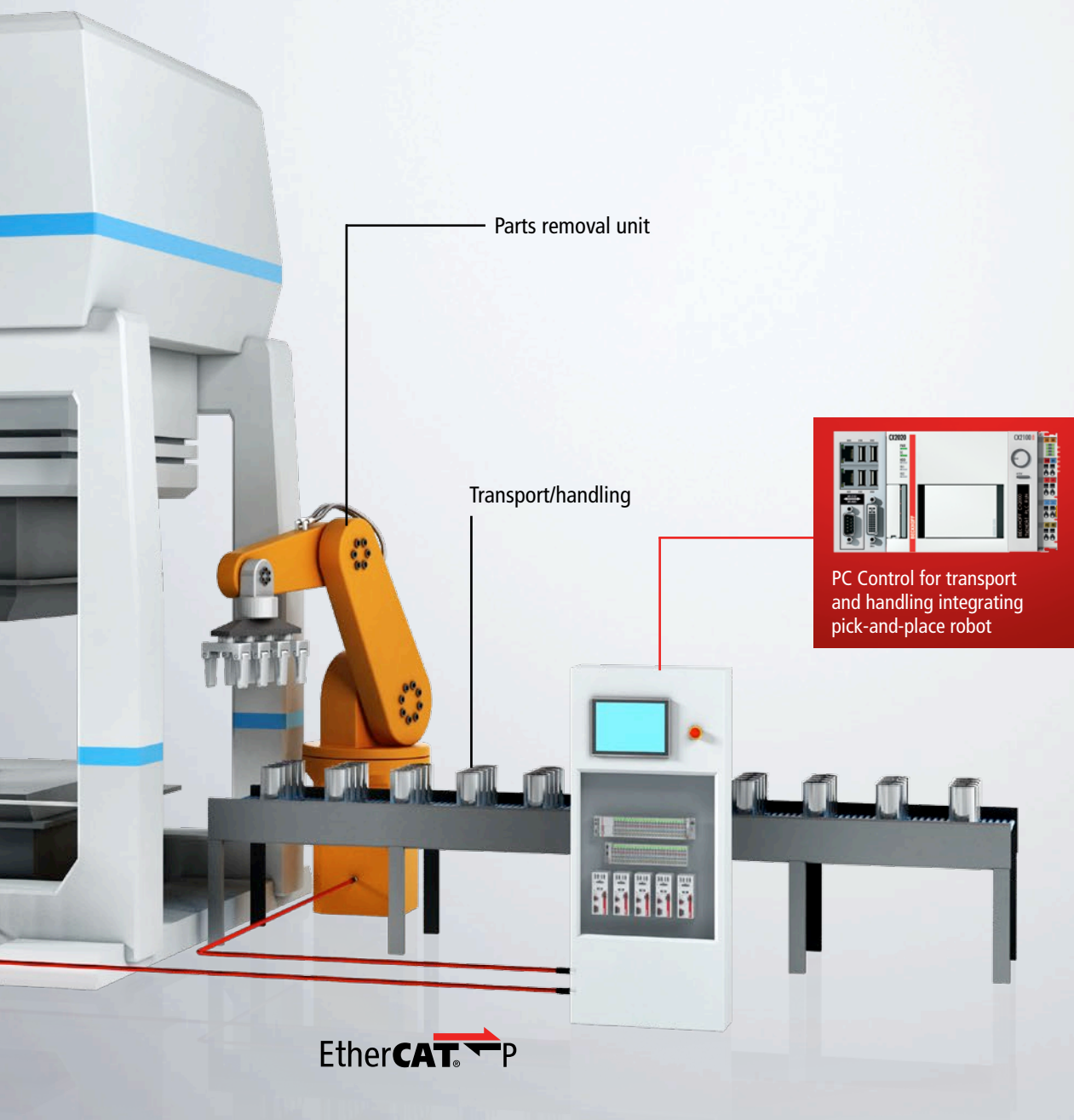
... offers all the proven EtherCAT benefits with reduced connection costs

In One Cable Automation, local terminal boxes and individual machine modules are supplied with control data and power via a single cable. Large control cabinets of the past can be replaced and plant footprints can be dramatically reduced. With EtherCAT P, modular machines and system design can be implemented with high flexibility and considerably decreased installation and commissioning requirements. Material costs, installation effort and time are saved, and the risk of errors during installation is reduced. Since a separate power feed is not required, the size of sensors and actuators can be reduced, and the space required in drag chains, control cabinets and in the machine itself is minimised. In other words, EtherCAT P enables peak performance and low connection costs at the same time.



Presses: PC-based control improves the entire press line ...

Centralised PC-based control for all processes in a complete press line: With cutting-edge PC Control technology and EtherCAT, the high-speed industrial Ethernet system, high-performance Beckhoff control solutions significantly increase control quality and ultimately the speed and precision of presses. The open, standards-based control architecture offers a wide range of interfaces and a high degree of flexibility for implementing customer requirements simply and cost-effectively. The scalability and modularity of all hardware and software components enables exact adaptation to the application, taking into account individual performance and cost requirements. TwinCAT Analytics can increase system productivity: Comprehensive condition monitoring enables predictive maintenance best practices and reduces machine downtime.



... and integrates all functionalities ranging from cloud connectivity to comprehensive data acquisition

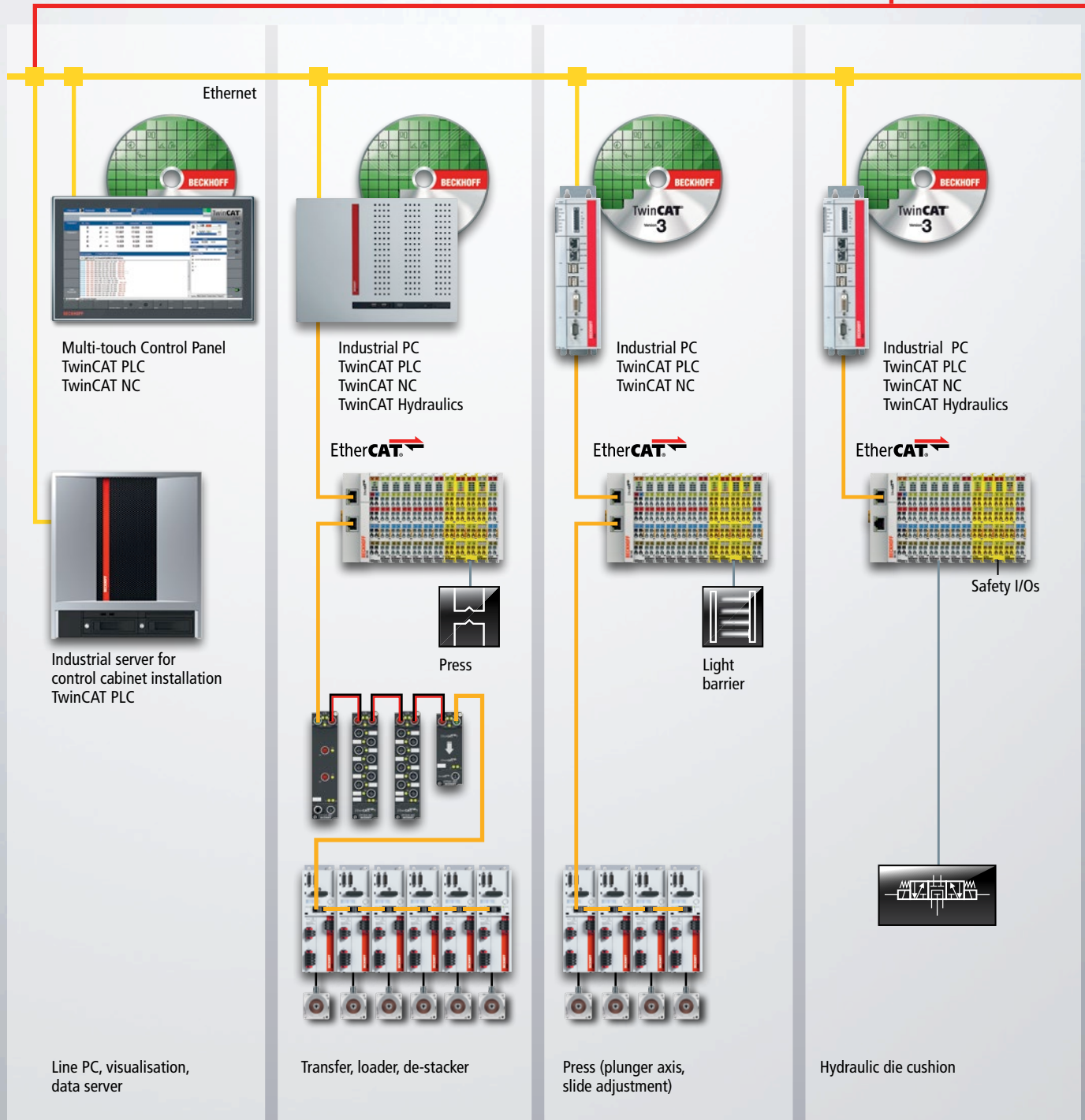
In combination with direct cloud connectivity, it is possible not only to realise Industrie 4.0 solutions, but also to optimise all process steps. Improved deep drawing with tolerance minimisation, increased workpiece quality, reduced rejects, maximum synchronisation precision and increased output all ensure a competitive edge. The integration of the control solution guarantees efficient interaction of all components and ensures maximum transparency. This helps avoid data incompatibility and latencies, such as those that occur in communication between different systems. The user benefits not only from enhanced synchronisation and process optimisation, but also from cost advantages gained by reduced hardware and engineering requirements.

Presses

The modular and scalable Beckhoff control technology is ideal for all press types, including hydraulic deep drawing and punch presses, sintering or transfer presses. Industrial PCs are available in a wide range of designs and performance categories, equipped with the latest processor technology. Product offerings include I/O systems for all common fieldbuses, TwinCAT automation software for PLC and motion control, EtherCAT-enabled servo drive technology and the integrated safety solution TwinSAFE. These technologies all help ensure complete coverage for all control requirements in a press line.

Cloud Services

Microsoft Azure™
Amazon AWS™
TwinCAT Services

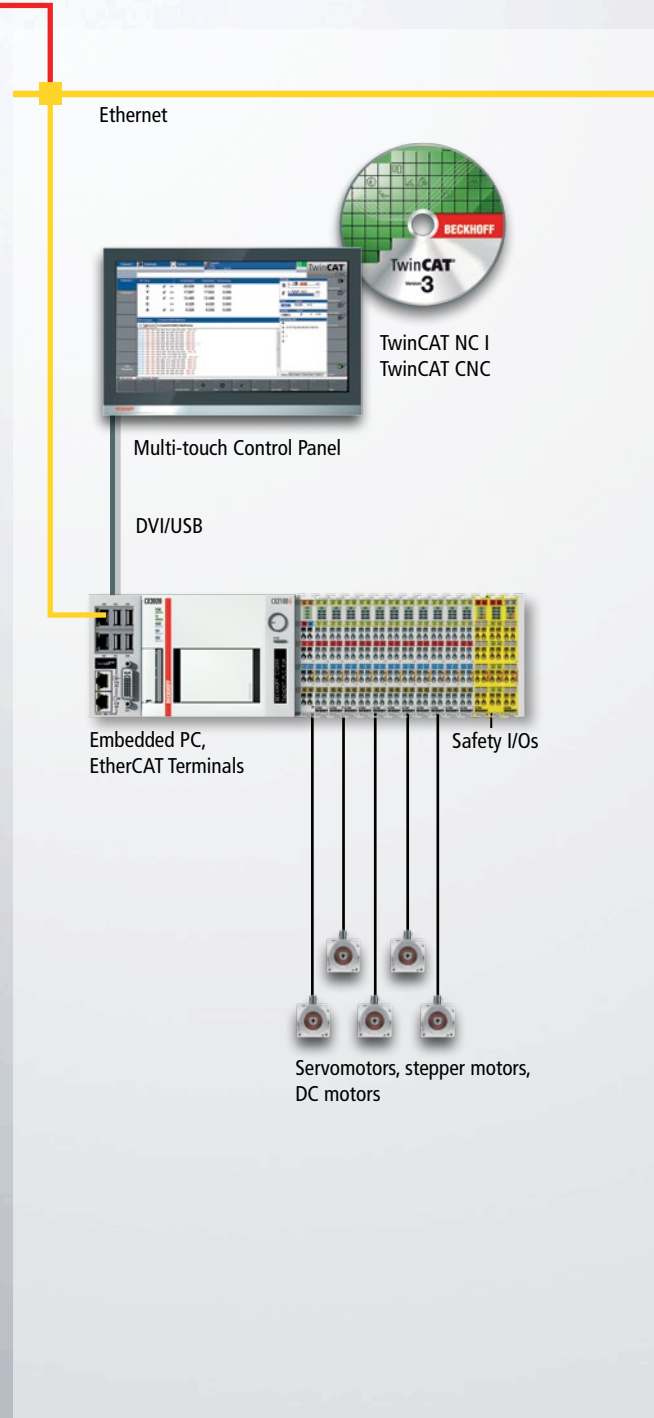
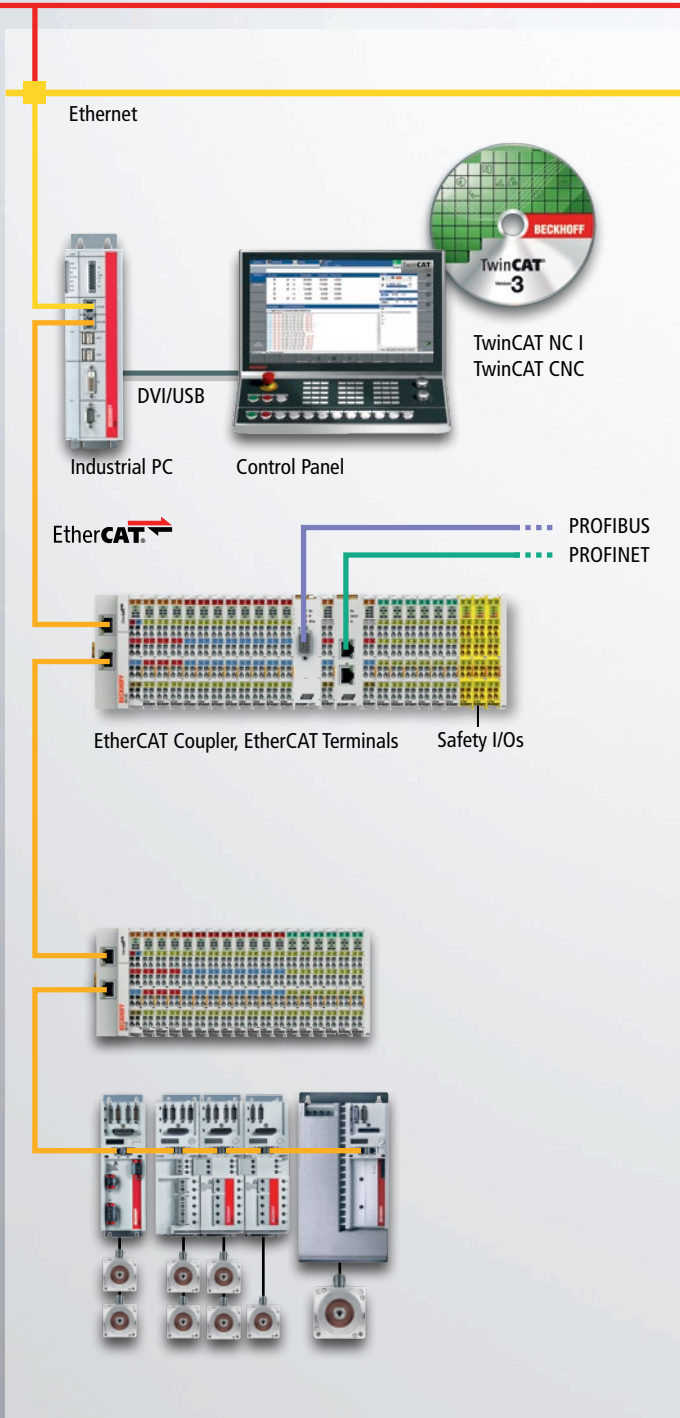


Cutting and welding machines

Beckhoff CNC controllers are used in autogenous, plasma, laser and water jet machining for cutting and welding. The TwinCAT NC I/CNC automation software is ideally suited for application-specific functions, including adaptive jet control, reverse travel or path resetting. EtherCAT and eXtreme Fast Control (XFC) technology enable fast switching functions at high processing speeds.

Punching and nibbling machines

The CNC solution from Beckhoff enables the realisation of highly-dynamic axis movements and fast control functionality for punching and nibbling machines used in sheet metal working. Precisely programmable strokes, automatic tool changes and the option to modify program code and machine settings during operation all lead to significant increases in productivity.



Software solutions for CNC press brakes ...

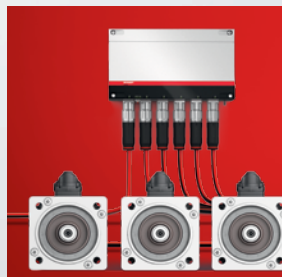
With open PC-based control technology and the technology blocks for press brakes, the user can automate his bending machines effectively and quickly. The Beckhoff Panel PCs such as the CP2715 offer the necessary high system performance for precise motion control as well as variable screen sizes for ergonomic operation. The Panel PC is connected to the standard Beckhoff I/O modules via EtherCAT. The integrated network interface handles remote service and cloud communication. Practicable safety solutions are available for press brakes with the fail-safe Bus Terminals and the TwinSafe Engineering, for example for the integration of special fail-safe sensors in a press.

For cost-sensitive applications Beckhoff offers a special HMI for press brakes that is tailored to the technology blocks and runs on Windows Embedded Compact. The design of the ergonomic user interface follows industry-standard operating concepts, thereby minimising the familiarisation period for operators. A 2D graphic input with the exact illustration of radii and sheet metal thicknesses is available for shortening setup times and simplifying the entry of product and tool geometries. This ensures the precise display of possible collision points. The user interface can be modified by the machine manufacturer with a look and feel of its own.



Panel PC

Extremely robust multi-touch Panel PCs in high-quality design meet all requirements with regard to ergonomic operation and as an elegant front end of the machine.



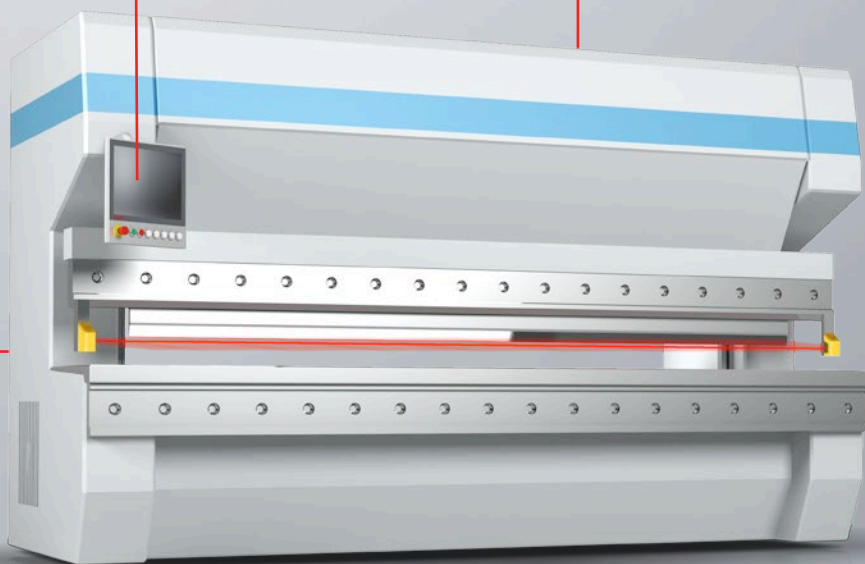
AMP8000


The distributed, highly dynamic and compact drive system is ideally suited for the backgauge in press brakes and reduces space requirements in the control cabinet.



Safety

TwinSAFE from Beckhoff integrates safety technology directly into the automation platform, simplifying system communication and reducing hardware consumption.





... open up new degrees of freedom for machine manufacturers

The technology software contains the motion control for the press beam and the back gauges. The bending process additionally requires the calculation of the bending order – with recognition of possible collisions. Insertion depth and stop positions are calculated automatically; this takes the load off the operator and enables shorter setup times. In order to achieve optimum motion control, the technology software is adapted to the specific machine hydraulics. The software is designed with open interfaces so that the user can simply integrate individual adaptations and extensions and add his own algorithms. In addition, machine manufacturers have access to the whole Beckhoff I/O range for integrating additional functions such as safety technology, acquisition of energy data, condition monitoring or optional peripherals.

Beckhoff – New Automation Technology

Beckhoff implements open automation systems based on PC Control technology. The product range covers Industrial PCs, I/O and Fieldbus Components, Drive Technology and automation software. Products that can be used as separate components or integrated into a complete and seamless control system are available for all industries. The Beckhoff "New Automation Technology" philosophy represents universal and open control and automation solutions that are used worldwide in a wide variety of different applications, ranging from CNC-controlled machine tools to intelligent building automation.

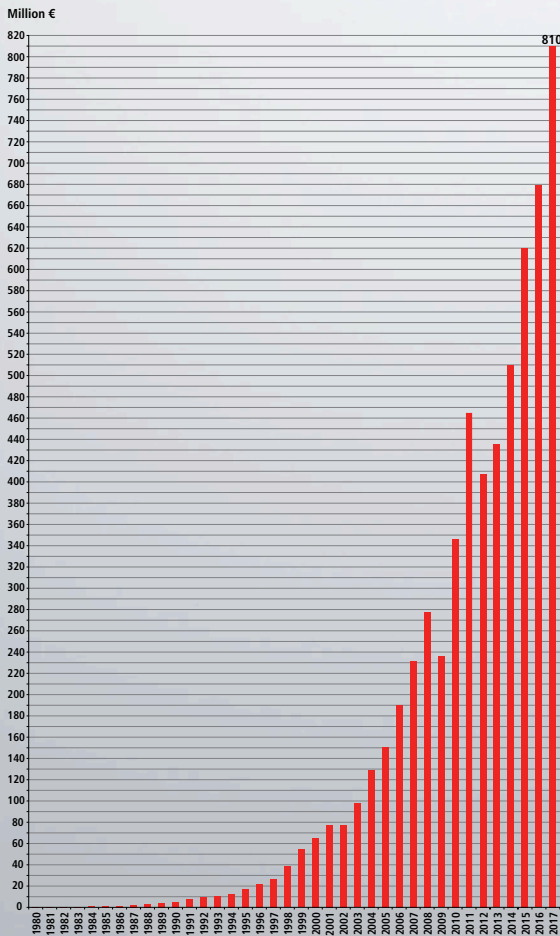
► www.beckhoff.com

Beckhoff at a glance

- Headquarters Verl, Germany
- Turnover 2017: 810 million euros (+19 %)
- Staff worldwide: over 3,900
- Branch offices Germany: 22
- Subsidiaries/branch offices worldwide: 37
- Representation worldwide: in 75 countries

(as of 04/2018)

Turnover development



Worldwide presence on all continents

The worldwide presence of Beckhoff in more than 75 countries ensures fast service and support for globally operating customers in their local language. Moreover, geographical proximity helps us develop an in-depth understanding of the technical challenges our customers are faced with around the world.

Further information

The web pages "PC-based control for sheet metal working" offer further information

► www.beckhoff.com/sheetmetalworking

The Beckhoff catalogs and flyers are available for download on the Internet.

► www.beckhoff.com/media

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Which sheet metal working application
will you optimise with PC-based control?

Get in touch with us at:

► www.beckhoff.com/sheetmetalworking