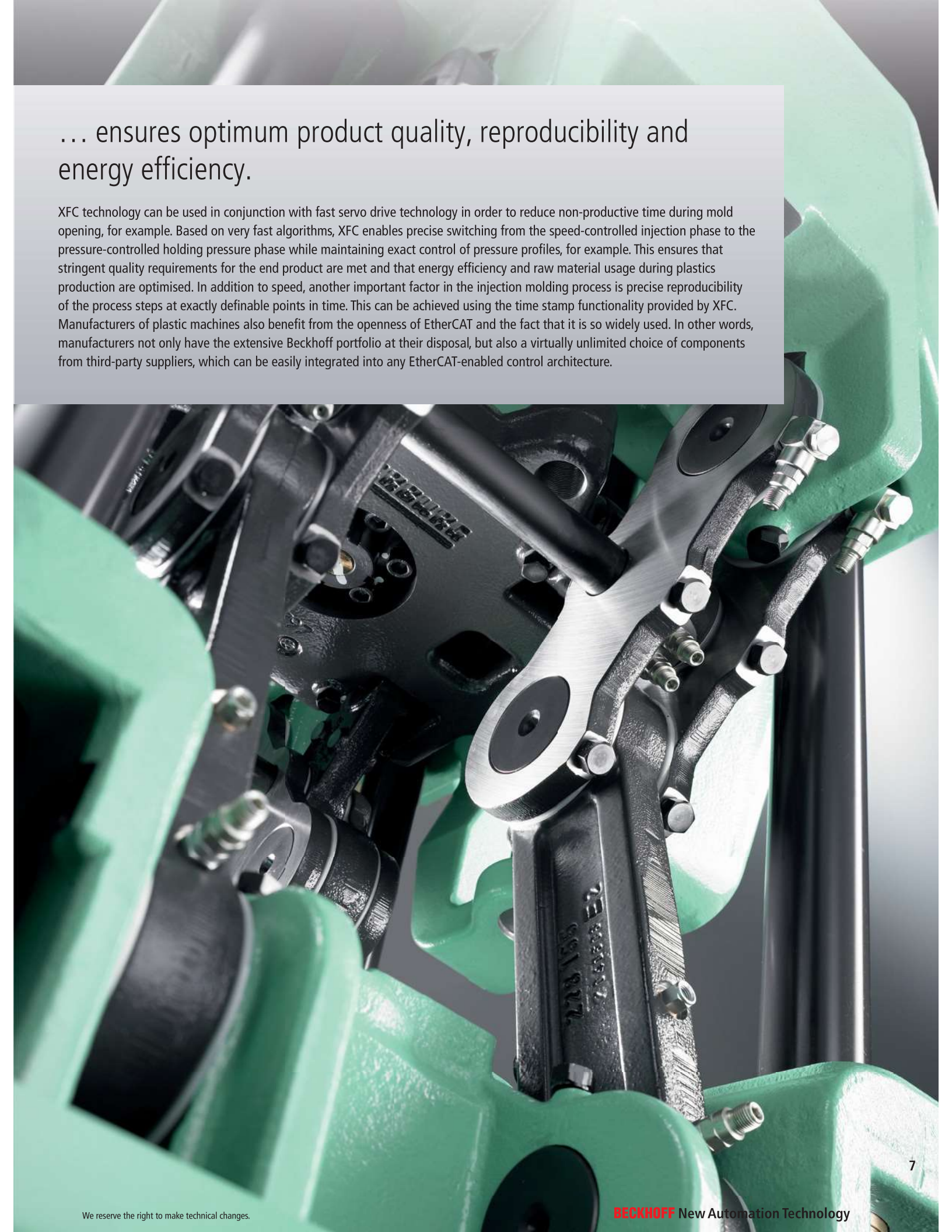# EtherCAT, the global standard for injection molding machines …

EtherCAT, the high-speed-communication system and servo-electric drive technology provide the basis for mastering demanding injection molding machine concepts. Leveraging AX5000 Servo Drives and EtherCAT-based eXtreme Fast Control Technology (XFC), Beckhoff offers maximum precision and energy efficiency, particularly for servo-electric machines. The TwinCAT Injection Molding PLC Framework technology software is based on proven TwinCAT automation software and includes standard functionality needed for injection molding machines. This saves users development time, without limiting their own technological developments. XMold and eMold offer complete solutions for injection molding machines, which are suitable for automating complex systems for the production of high-tech products (XMold) and for simpler machines designed for mass production (eMold).

We reserve the right to make technical changes.

… ensures optimum product quality, reproducibility and energy efficiency.

XFC technology can be used in conjunction with fast servo drive technology in order to reduce non-productive time during mold opening, for example. Based on very fast algorithms, XFC enables precise switching from the speed-controlled injection phase to the pressure-controlled holding pressure phase while maintaining exact control of pressure profiles, for example. This ensures that stringent quality requirements for the end product are met and that energy efficiency and raw material usage during plastics production are optimised. In addition to speed, another important factor in the injection molding process is precise reproducibility of the process steps at exactly definable points in time. This can be achieved using the time stamp functionality provided by XFC. Manufacturers of plastic machines also benefit from the openness of EtherCAT and the fact that it is so widely used. In other words, manufacturers not only have the extensive Beckhoff portfolio at their disposal, but also a virtually unlimited choice of components from third-party suppliers, which can be easily integrated into any EtherCAT-enabled control architecture.

- 15.6" TFT display in portrait mode
- touch function
- LED backlight
- keypad for injection molding applications, 72 membrane keys

- language selection
- different user levels
- permanent display of important process data
- Icon Editor for on-screen parameterisation/programming

- Ethernet interface for remote service via Internet
- host computer connection
- USB interface for recipe storage

- EtherCAT interface
- Euromap-67 interface
- Euromap-75 interface (optional)
- CANopen interface (optional)

- suitable for all common drive concepts (hydraulic, servo-electric and hybrid)
- supports injection control via the central pump or servo-valves
- supports toggle levers and linear injection units
- comprehensive core pulling functions
- linearisation of pumps and valves

XMold: the system solution for complex applications

The XMold solution is suitable for complex applications involving hydraulic, servo-electric or hybrid injection molding machines. It includes a CP6216-1004 Panel PC with a 2nd generation Intel® Celeron® processor, a 15.6" widescreen display in portrait format, Beckhoff I/Os, industry-specific software and drive components. The XMold Panel features a key arrangement that is optimised for injection molding processes and is designed to suit most applications. The technology software includes standard functions, such as the switch-over to holding pressure, which reduces engineering complexity for users. With the Icon Editor Beckhoff has created a simple graphic programming interface that requires no special programming knowledge and therefore minimises the effort for adapting certain machine sequences. In conjunction with XFC technology, XMold offers ultra-fast system responses and is ideally suited for precision manufacturing.

- 9" TFT display
- LED backlight
- keypad for injection molding applications, 72 membrane keys

- Ethernet interface for remote service via Internet
- host computer connection
- USB interface for recipe storage

- language selection
- different user levels
- permanent display of important process data
- storage of quality data
- eight hot runners (optional)

- suitable for all hydraulic injection molding machines
- supports injection control via the central pump or servo-valves
- supports toggle levers and linear injection units
- suitable for servo pumps
- four core pullers included as standard
- linearisation of pumps and valves

eMold: the compact solution for cost-sensitive applications

eMold is an integrated solution for cost-sensitive injection molding applications. A 9-inch CP6616-1004 Panel PC with Intel® Atom™ processor is used as an integrated control and operating solution. It features a special I/O board for injection molding machines that is linked via EtherCAT and corresponding technology software. The key arrangement of the eMold Panel is optimised for injection molding processes and is designed to suit most applications. Clearly, an important factor for the acceptance of a machine by operators is ergonomic, intuitive operation. The dynamic user interfaces of the XMold and eMold solutions are based on Microsoft Silverlight Embedded. Thanks to the distinction between the attractive, ergonomic design and programming of the actual operating logic, machine manufacturers are able to customise their user interfaces very quickly and flexibly.

BECKHOFF New Automation Technology

Servo-electric machine with integrated handling
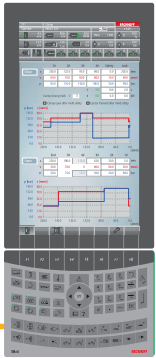
Panel PC CP6216

EtherCAT

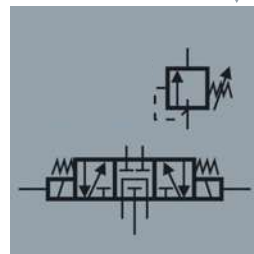Emergency
stop

Emergency
stop

IP 67
EtherCAT Box

| Injection axis | Clamping unit | Plastifi-cation | Nozzle | Ejector | x-, y-axis, z-axis |
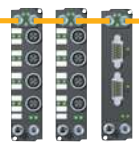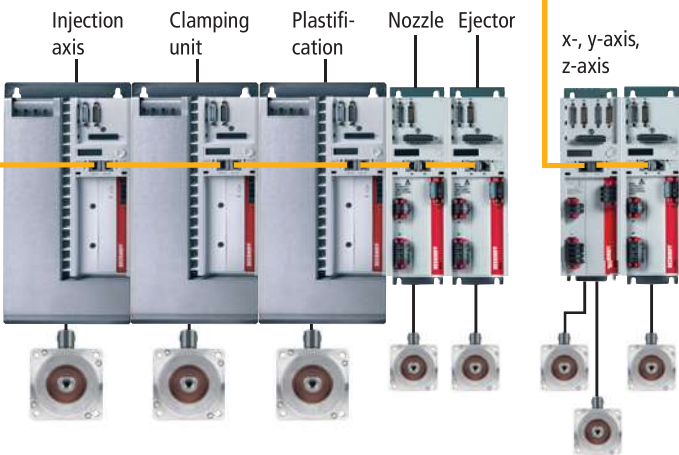
Hydraulic machines with options

Panel PC CP6216

EtherCAT

I/O Board
EM8908

Alternative: Hydraulics
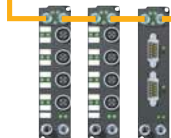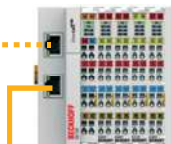
IP 67
EtherCAT Box

Fieldbus
Module:
multi-thermo-
couple
connection
(12 or
32 channels)

Servo Drive
for central
hydraulic pumps

# XMold user interface for injection molding machines

The XMold user interface can be used for controlling standard applications as well as complex processes. The XMold control system is ideally suited to large machines, multi-component machines and high-speed applications. Complex tools with comprehensive core pulling functions or servo-driven turning tools are supported. The large screen area with touch function enables clear visualisation of the process. Permane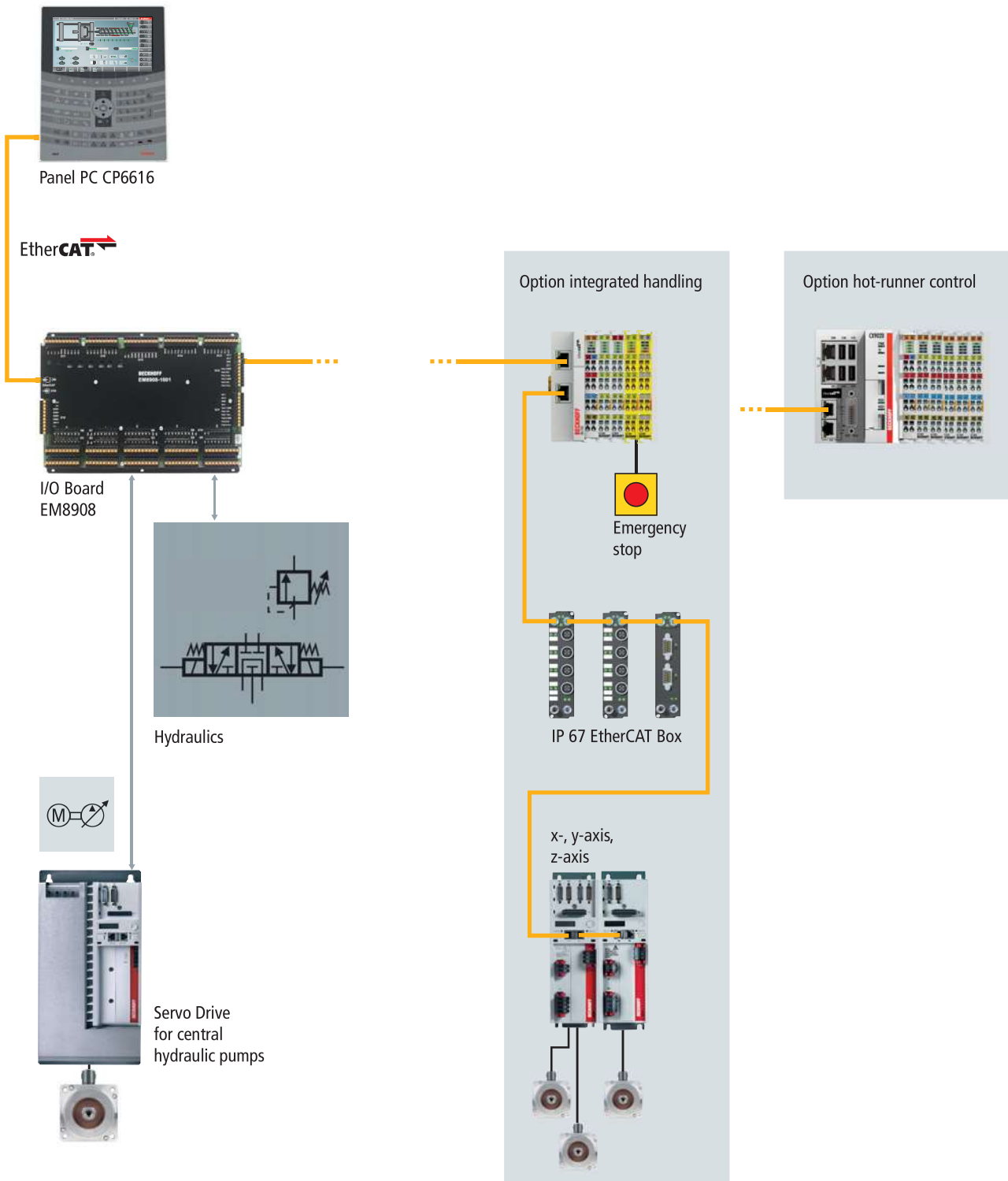nt status displays and active operating screens provide a quick overview. Graphic profile input with a variable number of support points and clear display of core pulling movements facilitate mold validation. Process analysis tools include the quality table and clear cycle display. Standard functions include user administration, input log, language and unit switching. An icon editor enables fast and convenient programming of complex process steps.

Overview screen
- permanent display of the main process data in the header
- optional display of cycle monitor and time diagram or quality table
- display of production data
- cycle time monitor with sequence display
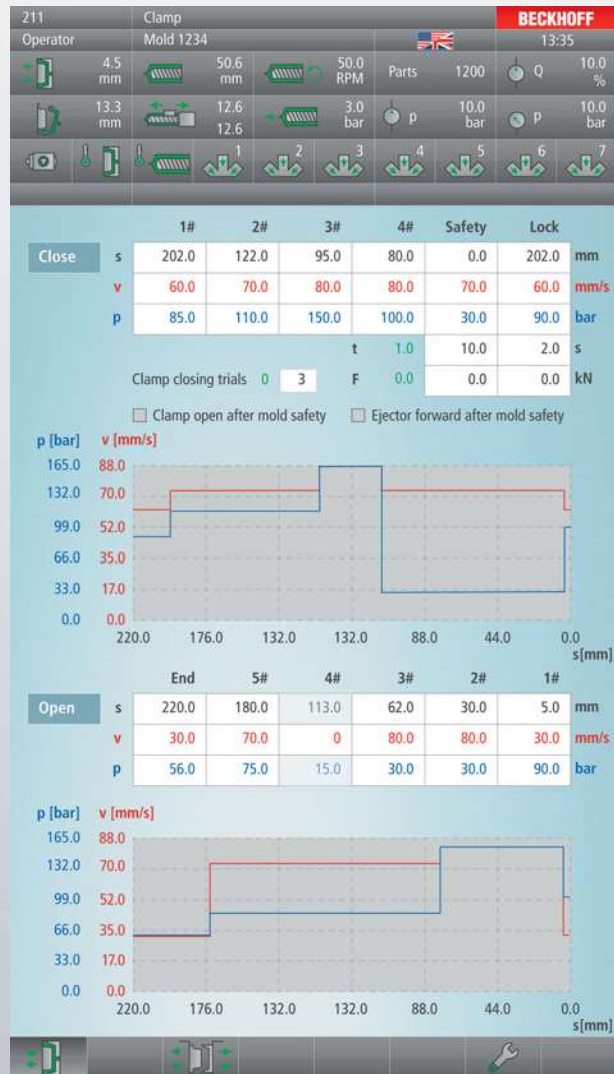
Clamping unit
- flexible number of support points, depending on the complexity of the process
- path input for tool protection and locking
- input of clamping force monitoring
- display of actual values in the graphic

BECKHOFF New Automation Technology

Hydraulic machine with options

Panel PC CP6616

EtherCAT.

I/O Board
EM8908

Hydraulics

Servo Drive
for central
hydraulic pumps

Option integrated handling

Emergency
stop

IP 67 EtherCAT Box

x-, y-axis,
z-axis

Option hot-runner control

We reserve the right to make technical changes.
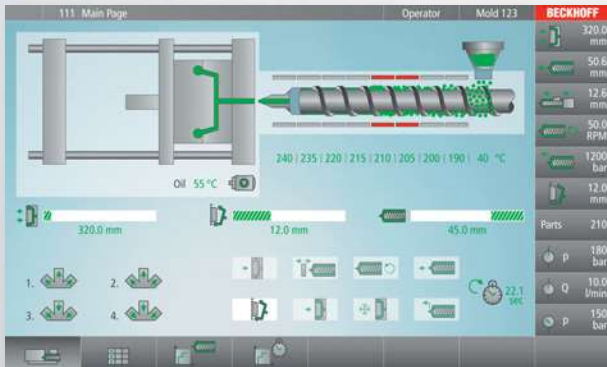
eMold user interface for injection molding machines

The user interface of the eMold control system is clearly arranged and easy to manage. Important process parameters are permanently displayed in a status bar. Units and language switching as well as quality documentation are included as standard.

- All key process values are shown on the right in the status field.
- Axis movements are shown in the bar chart display.

- customisable number of interpolation points
- display of switching criterion

- 4 core pullers included as standard
- 12 standard core pulling sequences with priority control

- customisable number of interpolation points
- graphic profile input
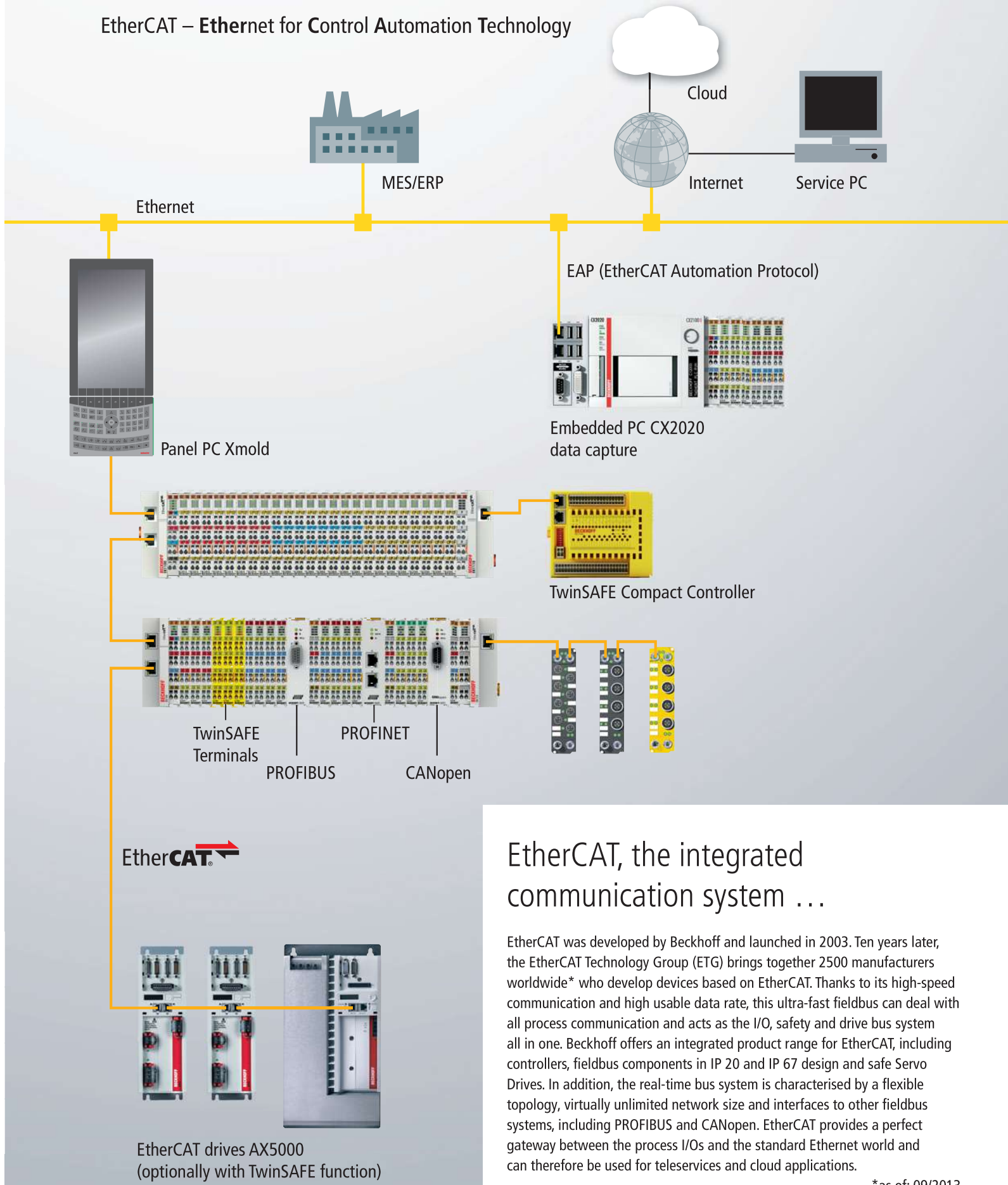- mold safety stroke input

- display of quality data for the last eight parts on one page
- configurable buffer capacity
- choice of 12 process parameters

- user management
- units and language switching

BECKHOFF New Automation Technology

EtherCAT – **Ether**net for **C**ontrol **A**utomation **T**echnology

Cloud

MES/ERP

Internet   Service PC

Ethernet

EAP (EtherCAT Automation Protocol)

Panel PC Xmold

Embedded PC CX2020
data capture

TwinSAFE Compact Controller

TwinSAFE
Terminals

PROFIBUS   PROFINET

CANopen

EtherCAT®

EtherCAT, the integrated communication system …

EtherCAT was developed by Beckhoff and launched in 2003. Ten years later, the EtherCAT Technology Group (ETG) brings together 2500 manufacturers worldwide* who develop devices based on EtherCAT. Thanks to its high-speed communication and high usable data rate, this ultra-fast fieldbus can deal with all process communication and acts as the I/O, safety and drive bus system all in one. Beckhoff offers an integrated product range for EtherCAT, including controllers, fieldbus components in IP 20 and IP 67 design and safe Servo Drives. In addition, the real-time bus system is characterised by a flexible topology, virtually unlimited network size and interfaces to other fieldbus systems, including PROFIBUS and CANopen. EtherCAT provides a perfect gateway between the process I/Os and the standard Ethernet world and can therefore be used for teleservices and cloud applications.

*as of: 09/2013

EtherCAT drives AX5000
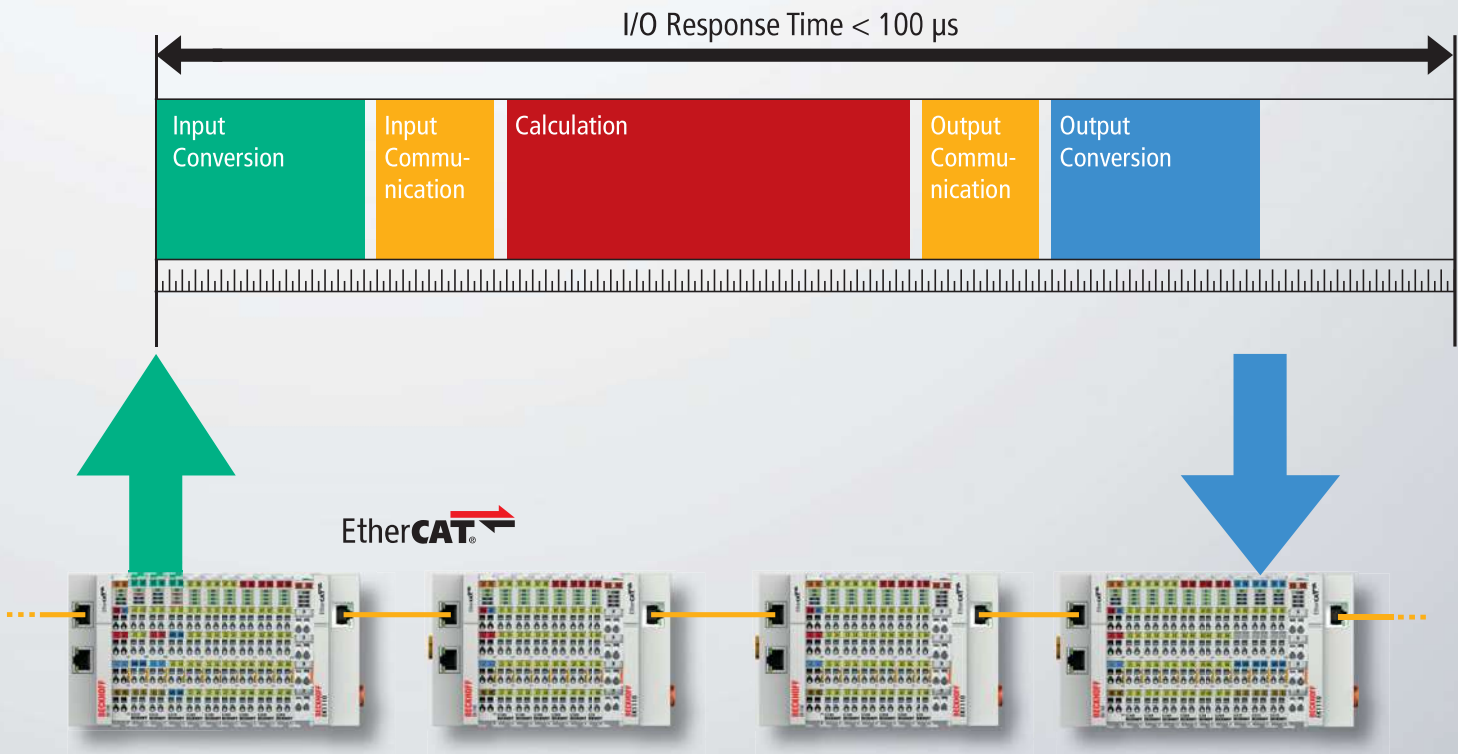(optionally with TwinSAFE function)

Safety integrated

Occupational health and safety plays an increasingly important role in machine design. With TwinSAFE, Beckhoff offers an advanced safety solution that is integrated into the primary control system. It is based on safety Bus Terminals and the TwinCAT Safety Editor and enables safe operation of axes and integration of machine safety devices without the need for additional wiring. In extrusion systems, for example, downstream equipment such as take-offs and saws can be connected with an EtherCAT fieldbus cable without separate emergency-stop cabling. Due to the modularity of the Beckhoff safety solution, system retrofits are quite straightforward, and subsequent modifications or extensions can be implemented with ease through software adaptations.

… enables perfect integration of plastic machines in the production environment.

Due to its excellent real-time characteristics and high bandwidth, EtherCAT is ideally suited for controlling the complex processes encountered in plastic machines and serves as a backbone for linking production equipment. The openness of EtherCAT in terms of connecting to other fieldbus interfaces facilitates integration of peripheral systems such as cooling devices, hot runner controllers or handling systems. The CANopen-based Euromap standard, which is used in the plastics industry worldwide, can be implemented simply via gateways. In this way EtherCAT enables exceptional integration of plastic machines into the production environment – be it towards the master computer or towards the peripheral equipment. Because EtherCAT is a worldwide standard today, machine manufacturers can choose from a wide range of drive solutions available on the market and are able to integrate components into their control architecture that are best suited for their respective applications. Compatibility with other EtherCAT-based devices is guaranteed.

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I/O Response Time < 100 µs

| Input Conversion | Input Commu- nication | Calculation | Output Commu- nication | Output Conversion |

EtherCAT.
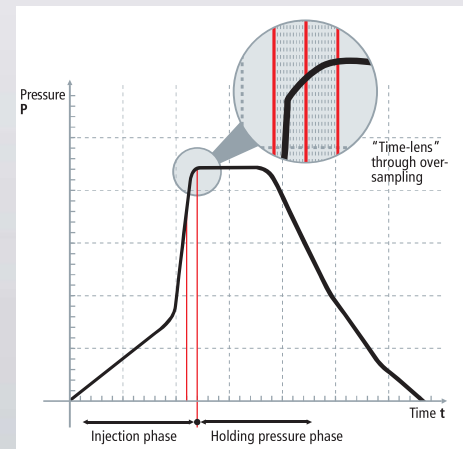
Very precise and fast: eXtreme Fast Control …

eXtreme Fast Control (XFC), the fast, high-precision control solution is based on: high-performance Industrial PCs; EtherCAT, the high-speed communication network; optimised I/O components (which can sample signals and trigger actions with high precision); and TwinCAT, the integrated software platform. This unified system enables I/O response times of less than 100 µs, so that very fast and highly deterministic responses become possible. Accordingly, XFC opens up new opportunities for process optimisations. Oversampling technology enables exact determination of the signal characteristics. In combination with the time stamp function of EtherCAT, which links each event with a precise point in time, the reproducibility of procedures is significantly increased compared with conventional solutions. Drives can be perfectly synchronised based on the distributed clocks function of EtherCAT.

We reserve the right to make technical changes.

Oversampling

XFC enables high-resolution analysis of the corresponding pressure curve. Oversampling enables resolutions even below the minimum I/O response time. The distributed synchronised clocks, combined with the time stamp functionality of EtherCAT, facilitate sampling at precisely defined times.

Reduction of material consumption

Logging of highly variable input signals with high temporal resolution enables precise control of the injection molding process. As a result, the working window becomes narrower, and part weight fluctuations and material consumption are reduced.

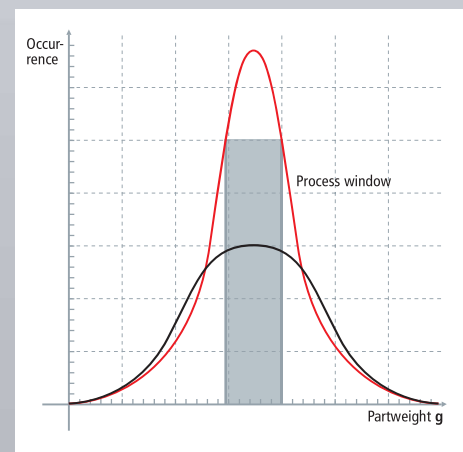# … reduces raw material consumption and increases parts quality.

Logging of highly variable input signals with high temporal resolution enables precise control of the injection molding process. Fast algorithms enable the magnitude and trend of the control value to be precisely calculated as a function of the switching event time. The working window becomes narrower, while part weight fluctuations and raw material consumption are reduced. High-precision servo drive technology, in conjunction with XFC, increases the reproducibility of the injection molding process even further. XFC also enables the integration of measurement technology into the machine control system, eliminating the need for special hardware. In this way it is possible to implement a cost-effective solution for Condition Monitoring, for example, which can extend the service life of machines and minimise downtime through preventive maintenance.

BECKHOFF New Automation Technology

Electrical servo technology replaces hydraulic systems …

The TwinCAT technology modules for plastic machines support hydraulic drive technology and servo-electric drives, therefore offering a wide selection of drive technology components. The integrated, fast control technology of the AX5000 EtherCAT Servo Drive series enables the realisation of fast and highly dynamic motion processes. The flexible drive design, with 1- and 2-channel units as well as the variable distribution of motor output allocation, allows cost-optimised solutions, in particular for handling systems. The comprehensive range of Beckhoff Servomotors is optimised for the AX5000 Servo Drives. One Cable Technology, which combines the power and feedback cables into one standard motor cable, reduces cable runs, mounting space and commissioning costs. Thanks to the integrated TwinSAFE technology the Servo Drives meet the stringent safety requirements for plastic machines and simplify the configuration of production cells.

… and increases the energy efficiency of plastic machines.

PC-based control technology in combination with EtherCAT Servo Drives is ideally suited for replacing hydraulic axes with electrical drive solutions, which helps reduce the energy consumption of machines. When it comes to energy-efficient machines, a distinction is made between all-electric machines, where each axis is equipped with an electric motor and a spindle, and so-called servo hydraulics, where the hydraulic pump is operated with a servomotor. For both drive concepts solutions exist that include the AX5000 and TwinCAT technology software modules. In this way it is possible to effectively trigger crucial mold protection procedures that quickly stop the machine movement if a plastic part is detected in the mold. For the development of new machines Beckhoff can offer support for the configuration of motors and gear units.

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