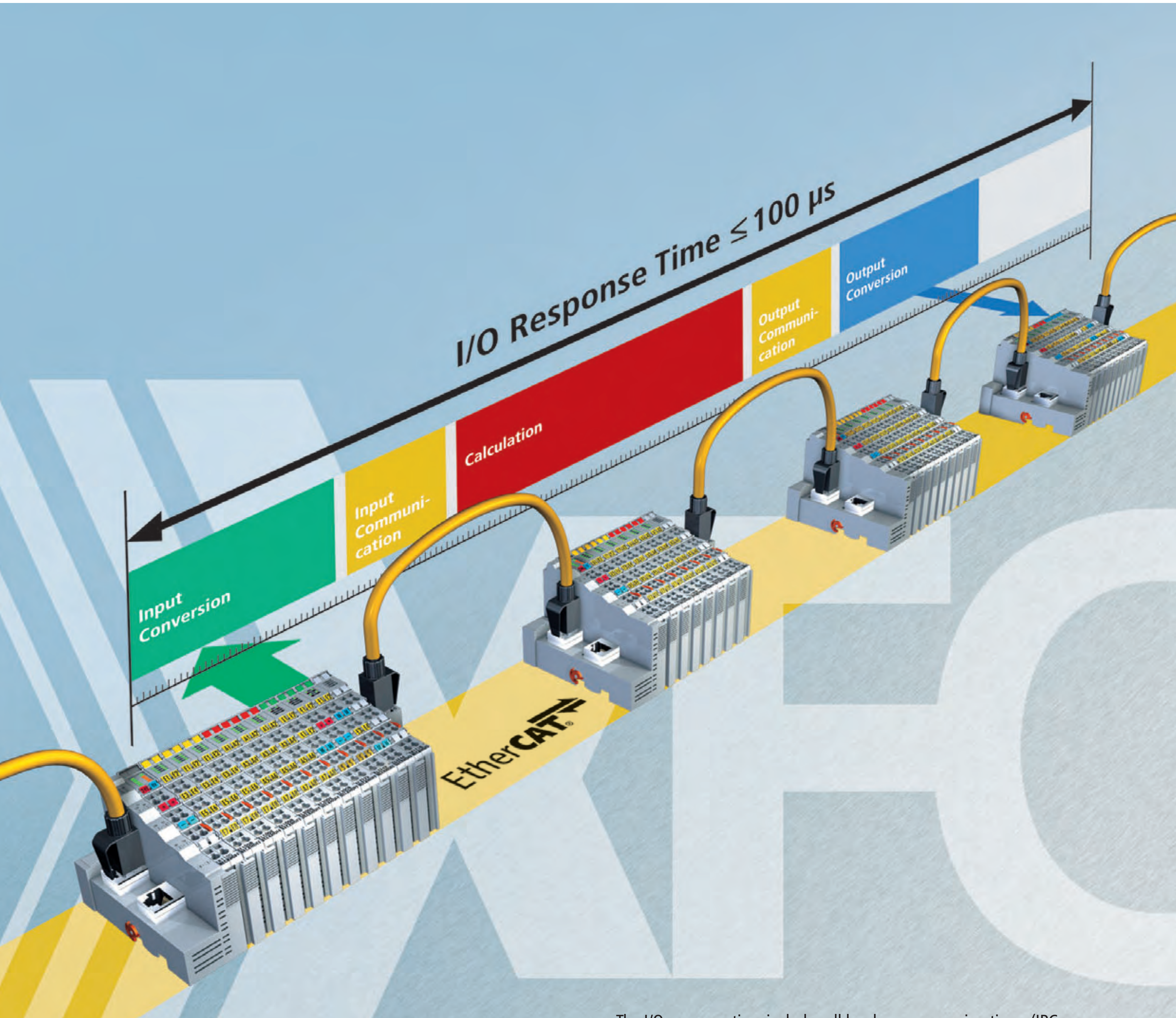
BECKHOFF New Automation Technology

XFC – eXtreme Fast Control Technology

XFC – The new class of Control Performance



The I/O response time includes all hardware processing times (IPC, EtherCAT and I/O system), ranging from physical input event to output response. With an I/O response time of ≤ 100 µs, PLC programmers have access to performance that in the past was only available in servo controllers with digital signal processors.

With XFC technology (eXtreme Fast Control Technology) Beckhoff presents a new, fast control solution: XFC is based on an optimised control and communication architecture comprising an advanced Industrial PC, ultra-fast I/O terminals with extended real-time characteristics, the EtherCAT high-speed Ethernet system, and the TwinCAT automation software. With XFC it is possible to realise I/O response times ≤ 100 µs. This technology opens up new process optimisation options for the user that were not possible in the past due to technical limitations.

XFC represents a control technology that enables very fast and highly deterministic responses. It includes all hardware and software components involved in control applications: optimised input and output components that can detect signals with high accuracy or initiate tasks; EtherCAT as very fast communication network; high-performance Industrial PCs; and TwinCAT, the automation software that links all system components.

Not long ago, control cycle times around 10–20 ms were normal. The communications interface was free-running, with corresponding inaccuracy of the determinism associated with responses to process signals. The increased availability of high-performance Industrial PC controllers enabled a reduction in cycle times down to 1–2 ms, i. e. by about a factor of 10. Many special control loops could thus be moved to the central machine controller, resulting in cost savings and greater flexibility in the application of intelligent algorithms.

XFC offers a further reduction of response times by a factor of 10, and enables cycle times of 100 µs, without having to give up central intelligence and associated high-performance algorithms. XFC also includes additional technologies that not only improve cycle times, but also temporal accuracy and resolution.

Users benefit from entirely new options for enhancing the quality of their machines and reducing response times. Measuring tasks such as preventive maintenance measures, monitoring of idle times or documentation of parts quality can simply be integrated in the machine control without additional, costly special devices.

In a practical automation solution, not everything has to be extremely fast and accurate – many tasks can still be handled with "normal" solutions. XFC technology is therefore fully compatible with existing solutions and can be used simultaneously with the same hardware and software.

www.beckhoff.com/XFC

www.beckhoff.com/EtherCAT

XFC: Optimised control and communication architecture for highest performance

TwinCAT – The extreme fast real-time control software

- real-time under Microsoft Windows down to 50 µs cycle time
- standard IEC 61131-3 programming in XFC real-time tasks
- Standard features of Windows and TwinCAT are XFC-compliant.

EtherCAT – The extreme fast control communication technology

- 1,000 distributed digital I/Os in 30 µs
- EtherCAT down to the individual I/O terminals, no sub bus required
- optimised use of standard Ethernet Controllers, e. g. Intel® PC chipset architecture
- advanced real-time feature based on distributed clocks
  - synchronisation
  - time stamping
  - oversampling

EtherCAT Terminals – The extreme fast I/O technology

- full range I/O line for all signal types
- high-speed digital and analog I/Os
- Time stamping and oversampling features allow extreme high timing resolution (down to 10 ns).

IPC – The extreme fast control CPU

- Industrial PC based on high performance real-time motherboards
- compact form factors optimised for control applications

XFC technologies

Distributed clocks – Shifting accuracy to the I/O level
In a normal, discrete control loop, actual value acquisition occurs at a certain time (input component), the result is transferred to the control system (communication component), the response is calculated (control component), the result is communicated to the set value output module (output component) and issued to the process (controlled system).

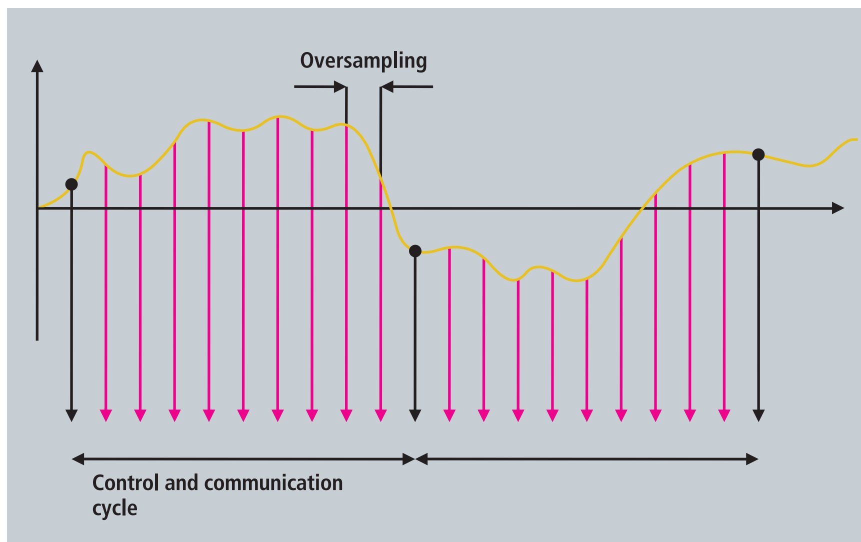
The crucial factors for the control process are: minimum response time, deterministic actual value acquisition (i. e. exact temporal calculation must be possible), and corresponding deterministic set value output. At what point in time the communication and calculation occurs in the meantime is irrelevant, as long as the results are available in the output unit in time for the next output, i. e. temporal precision is required in the I/O components, but not in the communication or the calculation unit.

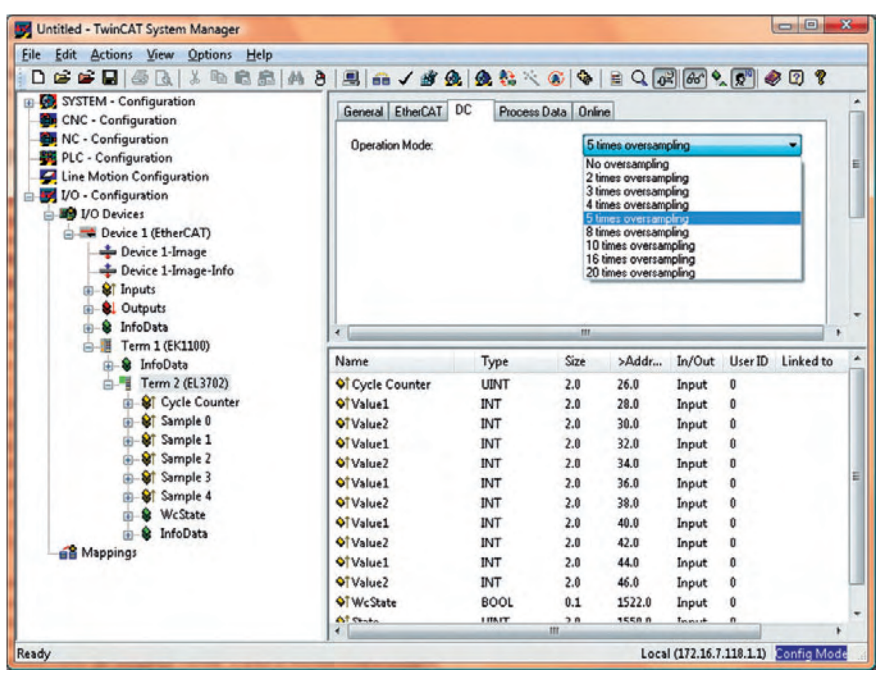
The distributed EtherCAT clocks therefore represent a basic XFC technology and are a general component of EtherCAT communication. All EtherCAT devices have their own local clocks, which are automatically and continuously synchronised with all other clocks via the EtherCAT communication. Different communication run-times are compensated, so that the maximum deviation between all clocks is generally less than 100 nanoseconds. The current time of the distributed clocks is therefore also referred to as system time, because it is always available across the whole system.

Time stamp data types
Process data is usually transferred in its respective data format (e. g. one bit for a digital value or one word for an analog value). The temporal relevance of the process record is therefore inherent in the communication cycle during which the record is transferred. However, this also means that the temporal resolution and accuracy is limited to the communication cycle.

Time stamped data types contain a time stamp in addition to their user data. This time stamp – naturally expressed in the ubiquitous system time – enables provision of temporal information with significantly higher precision for the process record. Time stamps can be used for inputs (e. g. to identify the time of an event occurred) and outputs (e.g. timing of a response).

Oversampling data types
Process data is usually transferred exactly once per communication cycle. Conversely, the temporal resolution of a process record





Oversampling settings in the TwinCAT System Manager directly depends on the communication cycle time. Higher temporal resolution is only possible through a reduction in cycle time – with associated practical limits.

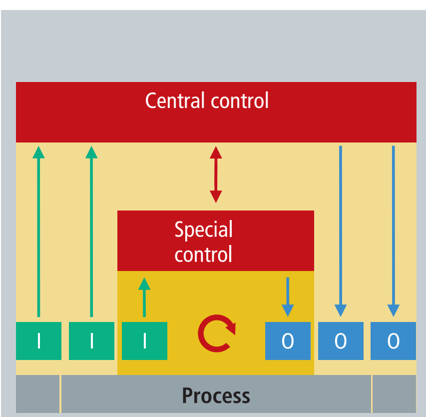
Oversampling data types enable multiple sampling of a process record within a communication cycle and subsequent (inputs) or prior (outputs) transfer of all data contained in an array. The oversampling factor describes the number of samples within a communication cycle and is therefore a multiple of one. Sampling rates of 200 kHz can easily be achieved, even with moderate communication cycle times.

Triggering of the sampling within the I/O components is controlled by the local clock (or the global system time), which enables associated temporal relationships between distributed signals across the whole network.

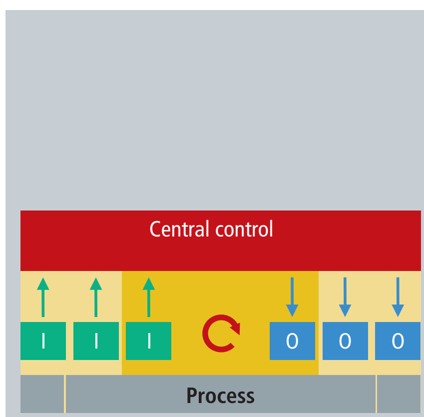
Very short cycle times – Optimised I/O communication

Very fast physical responses require suitably short control cycle times in the associated control system. A response can only take place once the control system has detected and processed an event.

The traditional approach for achieving cycle times in the 100 µs range relies on special separate controllers with their own, directly controlled I/Os. This approach has clear disadvantages, because the separate controller has only very limited information about the overall system and therefore cannot make higher-level decisions. Reparameterisation options (e. g. for new workpieces) are also limited. Another significant disadvantage is the fixed I/O configuration, which generally cannot be expanded.



Subordinate special control
(limited process image)



Fast central control
(complete process image)

XFC Performance data

Extreme short control cycle time
- 100 µs (min. 50 µs)
- new performance class for PLC application: control loops with 100 µs

Extreme fast I/O response time
- 85 µs (min. ~ 50 µs)
- Deterministic synchronised input and output signal conversion leads to low process timing jitter.
- Process timing jitter is independent of communication and CPU jitter.
- new performance class for PLC application: control loops with 100 µs

Signal oversampling
- multiple signal conversion in one control cycle
- hard time synchronisation through distributed clocks
- for digital input/output signals
- for analog input/output signals
- support of analog I/O EtherCAT Terminals
  - ► up to 200 kHz signal conversion
  - ► down to 5 µs resolution
- application
  - ► fast signal monitoring
  - ► fast function generator output
  - ► signal sampling independent of cycle time
  - ► fast loop control

Signal time stamping (10 ns resolution)
- extreme time measurement for digital single shot events: resolution: 10 ns, accuracy: < 100 ns
- exact time measurement of rising or falling edges of distributed digital inputs
  - ► exact timing of distributed output signals, independent of control cycle
  - ► time stamping data: resolution 10 ns, accuracy < 100 ns

Distributed-Clocks
- distributed absolute system synchronisation for CPU, I/O and drive devices
- resolution: 10 ns
- accuracy: < 100 ns

XFC components

Implementation of the XFC technologies described above requires full support for all hardware and software components involved in the control system, including fast, deterministic communication and I/O and control hardware. A significant part of XFC are the software components responsible for fast processing of the control algorithms and optimised configuration of the overall system.

Beckhoff offers a special XFC product range based primarily on four categories: EtherCAT as fieldbus, EtherCAT Terminals as I/O system, IPCs as hardware platform, and TwinCAT as higher-level software. All components are based on open standards, which means that any engineer or programmer can develop very fast control solutions with high performance based on standard components (i. e. without special hardware).

I/O component – EtherCAT Terminals with XFC technology

Standard EtherCAT Terminals already offer full support for XFC technology. Synchronisation of the I/O conversion with the communication or – more precisely – with the distributed clocks is already standard in EtherCAT and is therefore supported by all terminals.

Newly developed XFC terminals offer additional special features that make them particularly suitable for fast or high-precision applications:

- digital EtherCAT Terminals with very short T_{ON} /T_{OFF} times, or analog terminals with particularly short conversion times
- EtherCAT Terminals with time stamp latching at the exact system time at which digital or analog events occur. Output of digital or analog values can occur at exactly predefined times.
- Terminals with oversampling enable actual value acquisition or set value output with significantly higher resolution than the communication cycle time.

Communication component – EtherCAT fully utilised

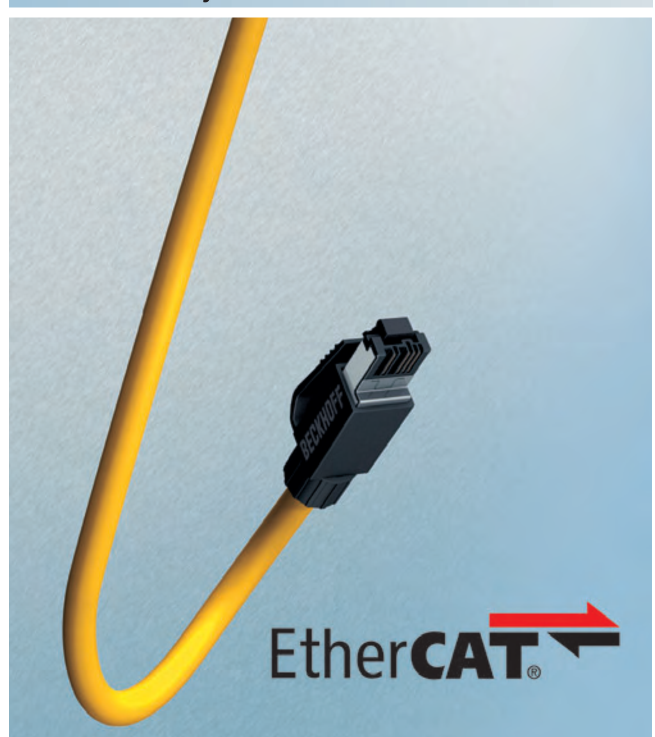
With high communication speed and usable data rates EtherCAT offers the basic prerequisites for XFC. However, speed is not everything. The option of using the bus to exchange several independent process images arranged according to the control application enables parallel application of XFC and standard control technology. The central control system is relieved of time-consuming copying and mapping tasks and can fully utilise the available computing power for the control algorithms.

The distributed EtherCAT clocks that form the temporal backbone of the XFC technologies are available in all communication devices without significant additional effort.

The crucial point of XFC is the option of integrating all I/O components directly in the EtherCAT communication, so that no subordinate communication systems (sub bus) are required. In many XFC terminals the AD or DA converter is connected directly to the EtherCAT chip, so that delays are avoided.

I/O component – EtherCAT Terminals with XFC technology

Communication component – EtherCAT fully utilised



Control component –
High-performance Industrial PCs

Central control technology can be particularly advantageous if it can run faster and more powerful control algorithms than would be the case with many distributed small controllers. Modern Industrial PCs offer significantly more processing power and memory at lower cost than the sum of a large number of small controllers.

The latest general PC technology innovations can also be used to good effect for control technology. Fast dual core processors are ideal for running the operator interface of the machine in parallel with the control tasks. Large caches available with modern CPUs are ideal for XPC technology, because fast algorithms run in the cache and can therefore be processed even faster.

An important factor for short XFC cycle times is the fact that the CPU is not burdened with complex process data copying tasks needed by traditional fieldbuses with their DPRAM-based central boards. EtherCAT process data communication can be handled entirely by the integrated Ethernet controller (NIC with bus master DMA).

Software component – TwinCAT automation suite

TwinCAT as high-performance automation suite fully supports the XFC technologies while retaining all the familiar features. The real-time implementation of TwinCAT supports different tasks with different cycle times. Modern Industrial PCs can achieve cycle times of 100 µs or less without problem. Several (different) fieldbuses can be mixed. The associated allocations and communication cycles are optimised according to the fieldbus capabilities. The EtherCAT implementation in TwinCAT makes full use of the communication system and enables application of several independent time levels. It uses distributed clocks. Different time levels enable coexistence of XFC and normal control tasks in the same system, without the XFC requirements becoming a "bottleneck".

A new option specially designed for XFC enables inputs to be read during independent communication calls and outputs to be sent directly after the calculation. Due to the speed offered by EtherCAT the inputs are read "just" before the start of the control tasks, followed by immediate distribution of the outputs. The resulting response times are faster than the fieldbus cycle time in some cases.

Special TwinCAT extensions facilitate handling of the new XFC data types (time stamp and oversampling). PLC blocks enable simple analysis and calculation of the time stamps. The TwinCAT scope can display the data picked up via oversampling according to the allocated oversampling factor and enables precise data analyses.

Control component – High-performance Industrial PCs

Software component – TwinCAT

EtherCAT Terminals: Ethernet in dynamic, electronic terminal blocks

- EtherCAT right up to the terminal
- protocol processing while passing
- 1,000 digital I/Os in 30 µs
- line, tree or star topology
- full range I/O line for all signal types
- digital and analog high-speed I/Os
- time stamping and oversampling features for high timing resolution

Full Ethernet compatibility, maximum utilization of the large bandwidth offered by Ethernet and remarkable real-time characteristics at low costs – these are the outstanding features of the EtherCAT I/O system from Beckhoff.

The EtherCAT Terminals are specially designed for the high performance and flexible topology of the EtherCAT protocol. On the hardware side, the modular EtherCAT I/O system with IP 20 protection is based on the housings of the reliable Bus Terminal system. In contrast to Bus Terminals, where the fieldbus signal is converted within the Bus Coupler to the internal, fieldbus-independent Terminal Bus (K-bus), the EtherCAT protocol is fully maintained right up to the individual terminals.

Each individual EtherCAT Terminal is equipped with an EtherCAT slave controller for protocol processing. To achieve high-speed processing beyond other Ethernet solutions, EtherCAT processing occurs directly during the pass. The Ethernet packet is no longer received and interpreted, followed by copying of process data to every connection. The EtherCAT slave devices read the data addressed to them while the frame passes through the node (chart below). Similarly, input data are inserted while the telegram passes through. The telegrams are only delayed by a few nanoseconds. Since an Ethernet frame comprises the data of many devices both in send and receive direction, the user data rate increases to over 90 %. The full-duplex features of 100BASE-TX are fully utilized, so that effective data rates of > 100 Mbit/s (> 90 % of 2 x 100 Mbit/s) can be achieved. The Ethernet protocol according to IEEE 802.3 is fully maintained right up to the individual terminals. Only the physical transfer behavior is converted from twisted pair to E-bus inside the coupler. E-bus technology is based on LVDS (low-voltage differential signaling) transfer, which satisfies the requirements of electronic terminal blocks. LVDS is a fast and cost-effective, alternative physical Ethernet layer that can also be used for 10 Gigabit Ethernet (IEEE802.3ae). At the end of the modular device, the system is simply switched back to 100BASE-TX.

The high speed of the communication system is also reflected in the EtherCAT I/O Terminals. For example, conversion times in the new 16 bit analog terminals have become 40 times faster so that the devices can be used in fast controllers. In digital terminals, the fast digital inputs/outputs with T_{ON}/T_{OFF} times of 1 µs offer response times of 100 µs.

Openness and flexibility inside

The EtherCAT protocol can transport other Ethernet-based services and protocols in the same physical network – usually with minimum loss of performance. Any Ethernet device can be connected within the EtherCAT segment via a switch port terminal without influencing the cycle time. Devices with a fieldbus interface are integrated via EtherCAT fieldbus master terminals. The UDP protocol variant can be implemented on each socket interface.

The EtherCAT function of Hot Connect/Disconnect of bus segments offers significant benefits in terms of system flexibility in practical applications because many systems – e. g. in processing centres with multiple, sensor-equipped tool systems – require a modification of the I/O configuration during operation. The EtherCAT protocol structure meets these requirements since Hot Connect enables parts of the network to be activated/deactivated or reconfigured during operation so that the system can respond flexibly to different configurations.

XFC EtherCAT Terminals

The EtherCAT I/O system provides a wide range with more than 200 different signal terminals. Standard EtherCAT Terminals already offer full support for XFC technology. Synchronisation of the I/O conversion with the communication or – more precisely – with the distributed clocks is already standard in EtherCAT and is therefore supported by all terminals. Further developed XFC terminals offer additional special features that make them particularly suitable for fast or high-precision applications:

XFC EtherCAT Terminals: Oversampling

EL1262:
- 2-channel digital input 24 V DC
- time synchronisation across the system through distributed clocks
- jitter < 1 µs
- conversion time up to 5 µs

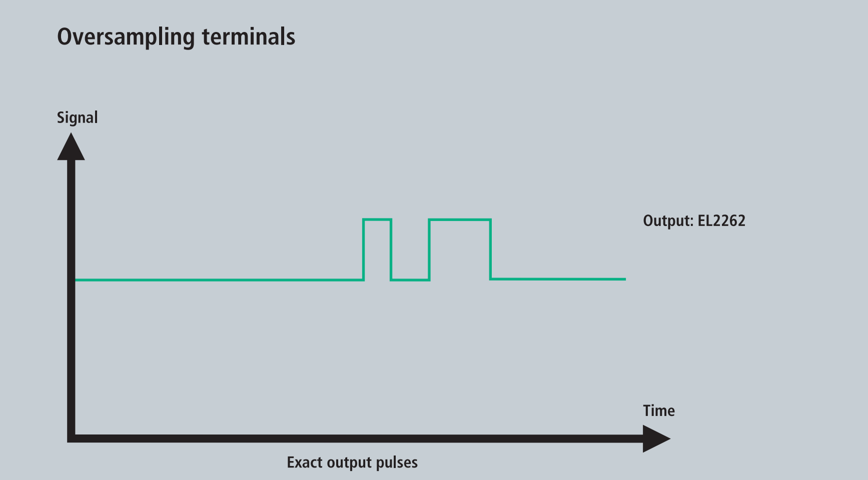
EL2262:
- 2-channel digital output 24 V DC
- time synchronisation across the system through distributed clocks
- jitter < 1 µs
- conversion time up to 5 µs

EL3742:
- 2-channel analog input 0…20 mA
- time synchronisation across the system through distributed clocks
- jitter < 1 µs
- conversion time up to 5 µs or 200 ksamples/s

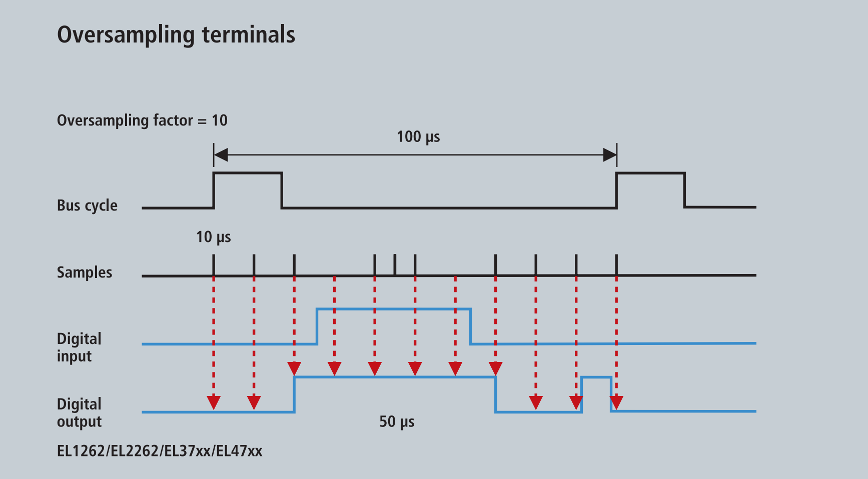
EL3702:
- 2-channel analog input -10 V…+10 V
- time synchronisation across the system through distributed clocks
- jitter < 1 µs
- conversion time up to 5 µs or 200 ksamples/s

EL4732:
- 2-channel analog output -10 V…+10 V
- time synchronisation across the system through distributed clocks
- jitter < 1 µs
- conversion time up to 5 µs or 200 ksamples/s

EL4712:
- 2-channel analog output 0…20 mA
- time synchronisation across the system through distributed clocks
- jitter < 1 µs
- conversion time up to 5 µs or 200 ksamples/s



With the digital EL2262 oversampling output terminal, outputs can be switched on and off within a 10 µs time frame, which is ideal for high-precision dosing applications, for example.



The digital EL1262 oversampling input terminal offers an input signal sampling rate that is better than the bus cycle time by a factor of 10 (configurable), enabling even short signals to be recorded, measured or counted exactly.

XFC EtherCAT Terminals: Time stamp

EL1252:
- 2-channel digital input 24 V DC
- exact signal acquisition for edge changes
- system accuracy 1 µs
- absolutely synchronised responses with EL2252

EL2252:
- 2-channel digital output 24 V DC
- exact signal acquisition for edge changes
- system accuracy 1 µs
- absolutely synchronised responses with EL1252

XFC EtherCAT Terminals: Fast I/Os

EL1202:
- 2-channel digital input 24 V DC
- input delay T_{ON}/T_{OFF} 1 µs
- minimum response times without appreciable delay

EL2202:
- 2-channel digital output 24 V DC
- input delay T_{ON}/T_{OFF} 1 µs
- minimum response times without appreciable delay

XFC performance data

Performance data for a typical 100 µs application

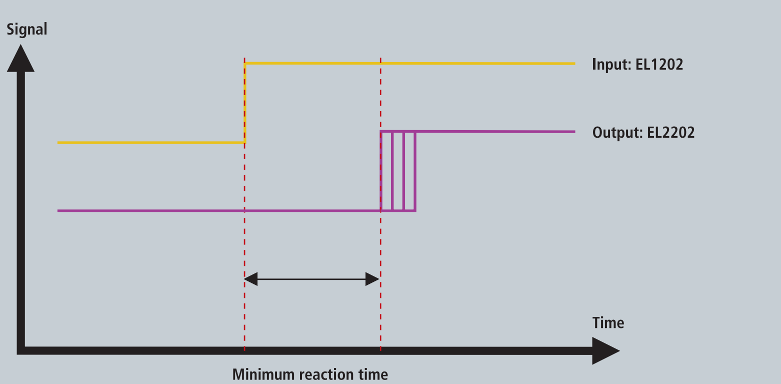
System performance
- ► cycle time: 100 µs (min. 50 µs)
- ► I/O response time: 85 µs (185 µs)

Distributed clocks
- ► resolution: 10 ns
- ► accuracy: < 100 ns

Signal oversampling
- ► sample rate: 200 kHz (500 kHz)
- ► time resolution: 5 µs (2 µs)
- ► accuracy: < 100 ns

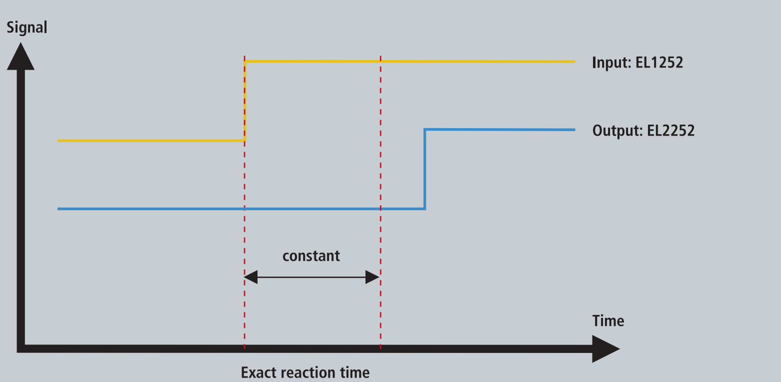
Time stamping resolution:
- ► resolution: 10 ns
- ► accuracy: < 100 ns

Fast I/O terminals 1 µs T_{ON}/T_{OFF}



With the EL1202 and EL2202 XFC terminals, delays in the terminal hardware are reduced down to < 1 µs and therefore become negligible. Input and output data are forwarded with maximum speed.

Time stamp terminals



Synchronised responses can be realised with time stamp input and output terminals; in the past, precision of < 1 µs was impossible with bus systems. The new XFC technology replaces hardware wiring.

XFC verified!

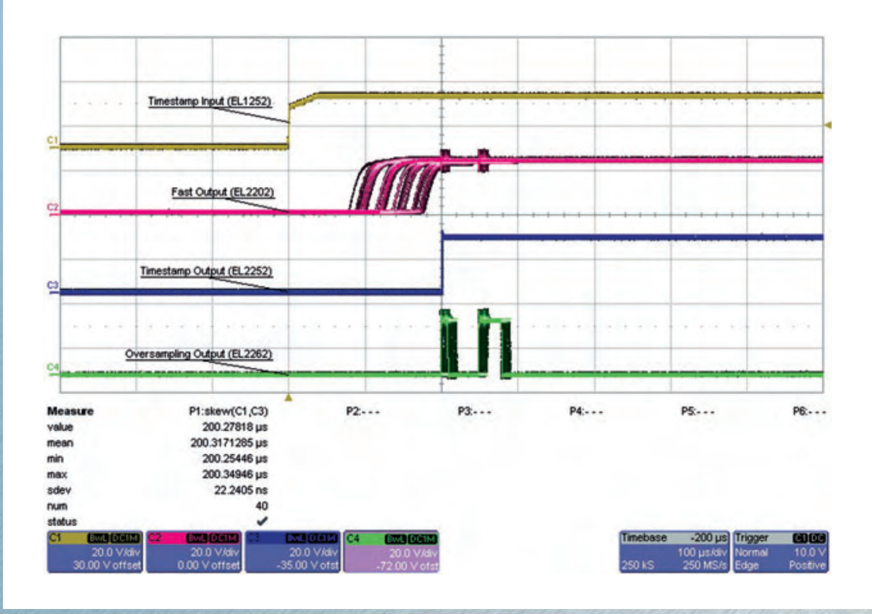
The following oscilloscope recording shows application results for different digital XFC terminals. The control and communi cation cycle time is 100 µs. Inputs and outputs are exchanged in separate EtherCAT telegrams in order to minimise the response time. (The horizontal scaling of the oscilloscope recording is 100 µs.)

An external, unsynchronised input signal is acquired via a digital input terminal with time stamp (EL1252, yellow curve). The oscilloscope is set to trigger based on this input signal. The recording is therefore synchronous with the external event, but asynchronous with the control cycle. Several recordings are superimposed.

A fast, digital output terminal (EL2202, red curve) is instructed by the control system to respond to the recorded input signal as quickly as possible. In the fastest case a control response is available at the output after approx. 85 µs. Since the input signal is unsynchronised, in the worst case an edge can be recorded with a delay of one cycle time, i.e. if the event occurs right after the cycle and is therefore not transferred until the next cycle. As a result, the output signal appears to jitter within a range of one cycle time, i. e. between 85 µs and 185 µs.

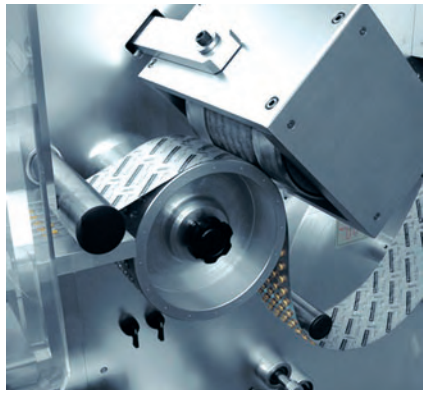
Since the input event is recorded with time stamp, the control system can issue an output response with a constant time offset, independent of the communication cycle. To this end, the PLC for a digital output terminal with time stamp (EL2252, blue curve) is associated with an output response that is offset by 200 µs. Despite the unsynchronised control cycle, the response can thus be exactly deterministic. In addition, the oscilloscope is set to measure and analyse the temporal difference between the input signal and the response of the EL2252 over several cycles (in this example 40 cycles). The result is a minimum value of 200.254 µs and a maximum value of 200.349 µs, i. e. the difference between minimum and maximum value is less than 100 ns. The fact that 200 µs is not adhered to exactly is due to the (small, but nevertheless present) T_{ON} and T_{OFF} times of the terminals, although these are constant and can therefore be accounted for.

The green curve shows a digital output terminal with oversampling (EL2262). With an oversampling factor set to 10 and with a cycle time of 100 µs output states can be issued every 10 µs. To illustrate this, in response to the input signal the PLC issued two pulses via the terminal, i. e. a short pulse followed by a slightly longer one. Here, too, a supposed jitter can be seen, although it is significantly lower (10 µs instead of 100 µs) – again caused by the unsynchronised input signal. When it comes to the response, the PLC can intervene much more precisely, according to the oversampling factor.



XFC in practice

Printer position control
The print marks are recorded via a digital EL1252 EtherCAT input terminal with a time stamp. The time stamp refers to system-wide, high-precision distributed clocks. In conjunction with an encoder terminal with distributed clocks, the exact position at the time of print mark recognition can thus be determined. No hardware wiring, e. g. on latch inputs at the encoder, is required, and all information is available in the control system.

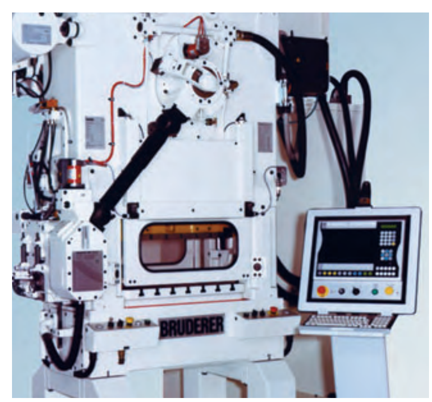


Glue application
Precise positioning and exact "drop by drop" volume can be ensured with the EL2212 EtherCAT Terminal. The timing of the glue nozzle opening can be specified with a resolution in the nanosecond range. Voltage overshoot ensures that the nozzle always opens safely and quickly. Closing is accelerated through a 24 V countervoltage. The timing for "opening", "length of voltage overshoot" and "closing" can be specified with an accuracy of significantly better than 1 µs.

Linear path control
Traditionally, linear path control is often realised in hardware in which the output response times are parameterised depending on the value of an encoder. Using XFC components with distributed clocks and time stamp, linear path control can be realised via EtherCAT and the PC. The fixed functionality of special hardware is replaced with flexible software. Inputs and outputs can be spatially distributed. The system-wide repeat accuracy of the switching times is < 1 µs.

Part tracking
Short response times and exact switching points increase the performance of material handling and sorting equipment. EtherCAT enables the distances between packets to be reduced, resulting in increased throughput with a system of the same size, while labour and costs for the whole control system are in fact lower. The typical size of a material handling system is supported through EtherCAT's flexible topology. System components can be connected and disconnected during operation without affecting the system function.

Closed-loop control
The control quality is determined by the temporal equidistance and the frequency of the sampling/output of the actual and set values, and the performance of the controller. With fast I/O components for high-frequency sampling, synchronised via distributed clocks, XFC technology offers the perfect basis. In conjunction with TwinCAT and a high-performance IPC as a platform for implementing the controller software, optimum conditions are available for realising high-performance and high-precision control systems.



Digital cam
Significantly reduced effort through EtherCAT in cam plate applications. Servo drives, position encoders and initiators simply connected via a bus cable. The control system receives all relevant data on a system-wide timebase and switches the actuators via distributed clocks. Cycle times of 2,000 strokes per minute are achieved with a high-speed press using standard Beckhoff system components. All data, parameters, and control program components are located at a central point and are easy to manage and archive.

XFC in practice

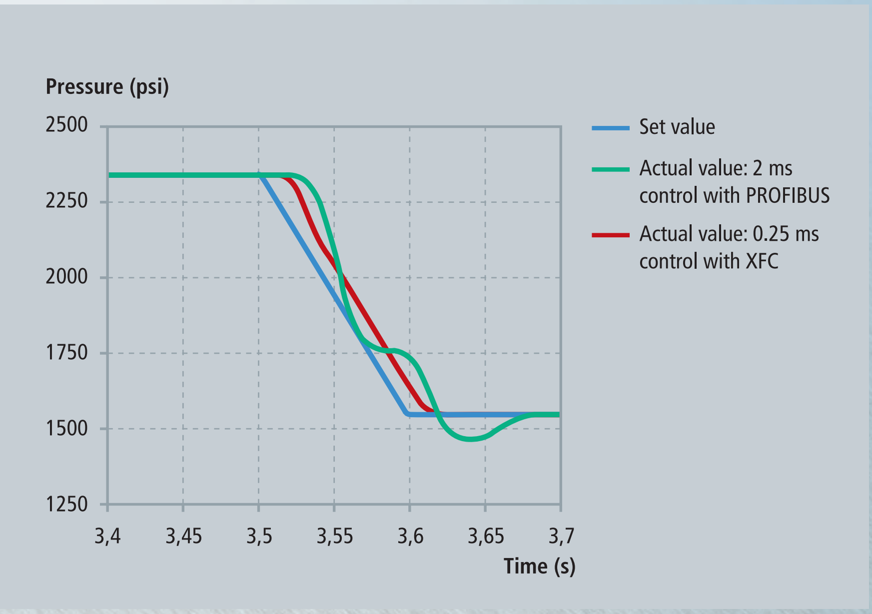
High-end injection moulding machines are very demanding in terms of control system performance. IO components, communication systems, IPCs and control software directly influence the quality and reproducibility of the control process and therefore offer an ideal area of application for XFC technology.

Husky Injection Molding, one of the largest manufacturers of injection moulding machines and tools worldwide, has recognised the potential of XFC and uses the technology for its machine control systems. The first control task in the production of injection-moulded parts relates to the speed with which the melted plastic is pressed into the mould. Mould filling generates a certain counterpressure, requiring fast switching over to pressure control at a certain well defined pressure value. Variation of pressure switchover must be minimised in order to ensure reproducible and uniform injection moulding results. To fill the mould completely the pressure has to be kept constant for a certain period and is then reduced, based on a configurable set value curve. The pressure must not be too high in order to prevent burr formation at the parts, while too low of pressure could cause holes or inadequate wall thickness.

The more precisely the injection moulding process is controlled, the lower the wall thicknesses of the produced parts can be, and a "material reserve" for preventing holes in systems with poor control is no longer required. Fluctuation of the part weight is a measure for the quality of the process: the smaller the variation, the better the control.

What benefits does XFC offer?
Control optimisation through minimisation of the response time and constant dead time is not an end in itself. In addition to enhanced quality, the aim is to save material through reduced wall thickness: In the specific application example a reduction in part weight by only 2 grams results in the following savings for the machine user:

Unit weight today (g):	22
Unit weight target (g):	20
Parts/year:	54,568,421
Annual material saving (kg):	125,507
Savings per year ($ US):	182,651

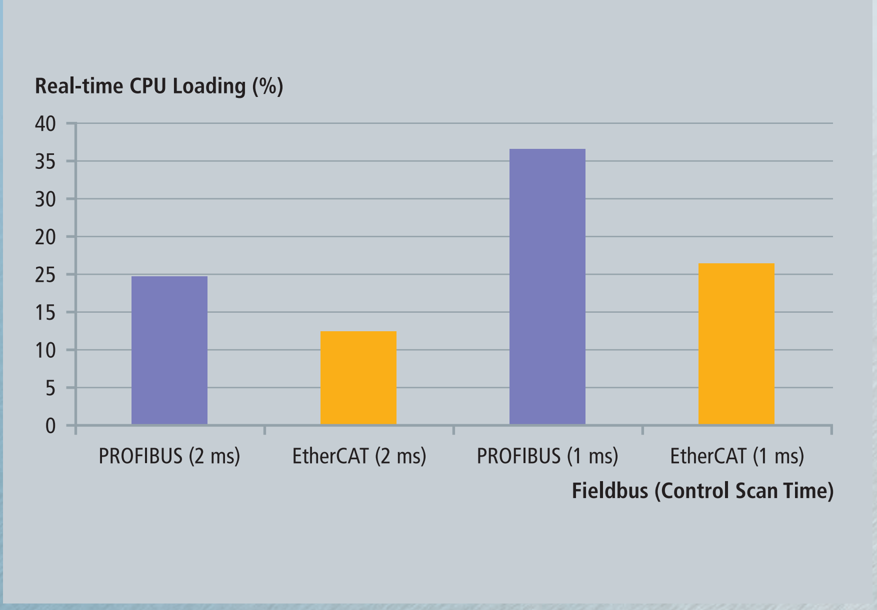


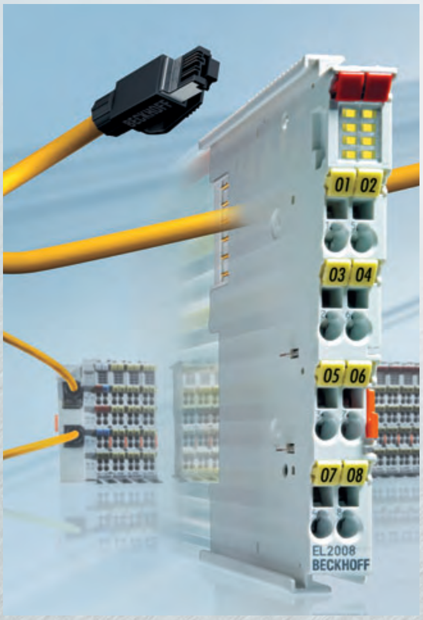
Improvement of the control with XFC technology

How is the control system optimised with XFC technology?

Before the optimisation, the existing machine control concept already included a high-performance C6140 IPC from Beckhoff and TwinCAT as control software. Only the signals relevant for the Motion Control were connected to fast EtherCAT Terminals and linked to the control computer via EtherCAT. With this controller configuration, cycle times of << 1 ms with very small jitter can be realised. In the specific example, the cycle time of 2 ms, which had been realised with a 12 Mbyte PROFIBUS system, was enhanced to 250 µs using XFC technology. In addition to improving the cycle time, XFC and EtherCAT also reduce the PC load. The process data mapping function, which in a PROFIBUS system has to be handled by the CPU of the PC, is already integrated in EtherCAT. The process image is made available to the control computer in pre-sorted form. The computing power previously required for the mapping is therefore available for control tasks. Conversely – because of improved cycle time – a more cost-effective PC with a smaller CPU can be used.

eXtreme Fast Control Technology offers an ideal basis for control applications. In addition to material savings and therefore cost reduction, the system also requires less maintenance. More exact control of the high-energy processes involved in injection moulding reduces vibrations and mechanical resonances and therefore the noise emission of the machine. Since the whole technology is based on standard XFC components, it offers a high degree of investment security. Further optimisation measures can be integrated seamlessly due to the hardware and software modularity of the Beckhoff control system. Based on this system Husky was able to improve its machines significantly and can offer its customers convincing benefits.





Measurement of the PC load (measured by Husky)

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